PONTIAC

Service Manual

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1988
PONTIAC
FIERO
SERVICE MANUAL

This manual applies to the 1988 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 1988 Pontiac Models. In all cases, an equivalent may be used.

PONTIAC MOTOR DIVISION
GENERAL MOTORS CORPORATION
PONTIAC, MICHIGAN 48053

S-8810-P

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CAUTION

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

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

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

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

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

SECTION 0A

GENERAL INFORMATION

CONTENTS

GENERAL DESCRIPTION

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

BODY NUMBER PLATE

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

VEHICLE IDENTIFICATION NUMBER

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

METRIC FASTENERS

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

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

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

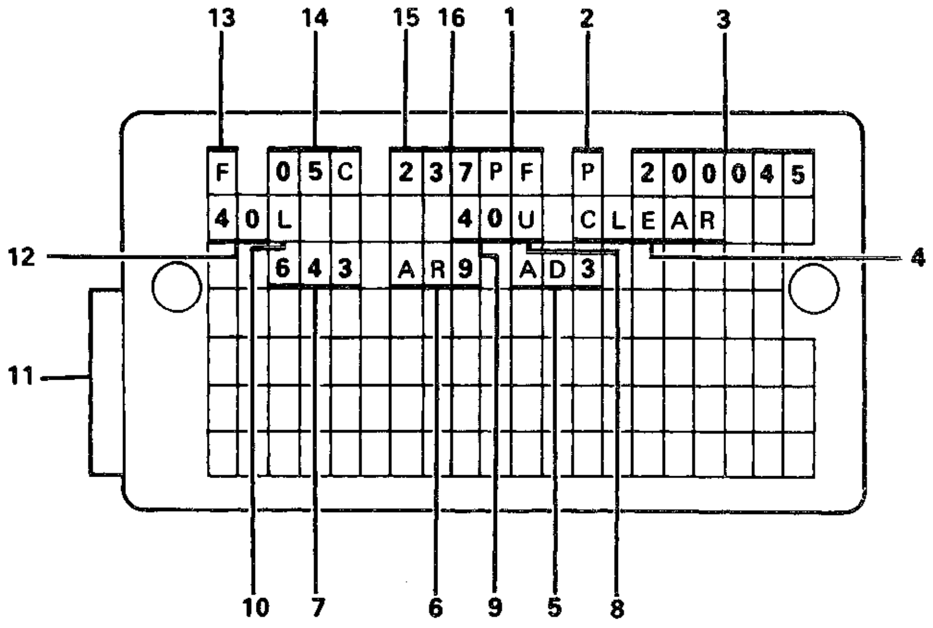

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Fig. 1 Body Number Plate

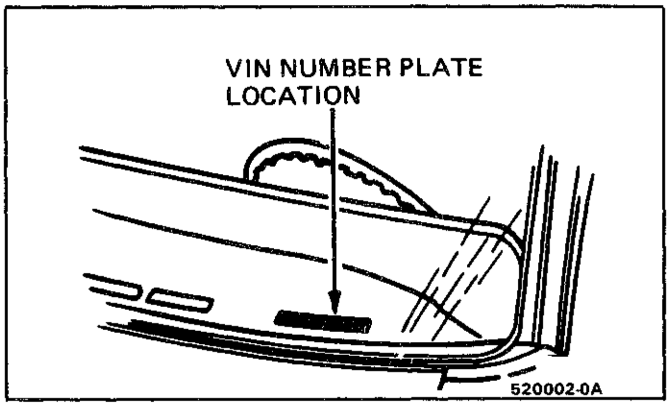


Fig. 2 Vehicle Identification Number Plate Location

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 6. 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 10 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. 9).

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. 9).

RECOMMENDATIONS FOR FASTENER REUSE:

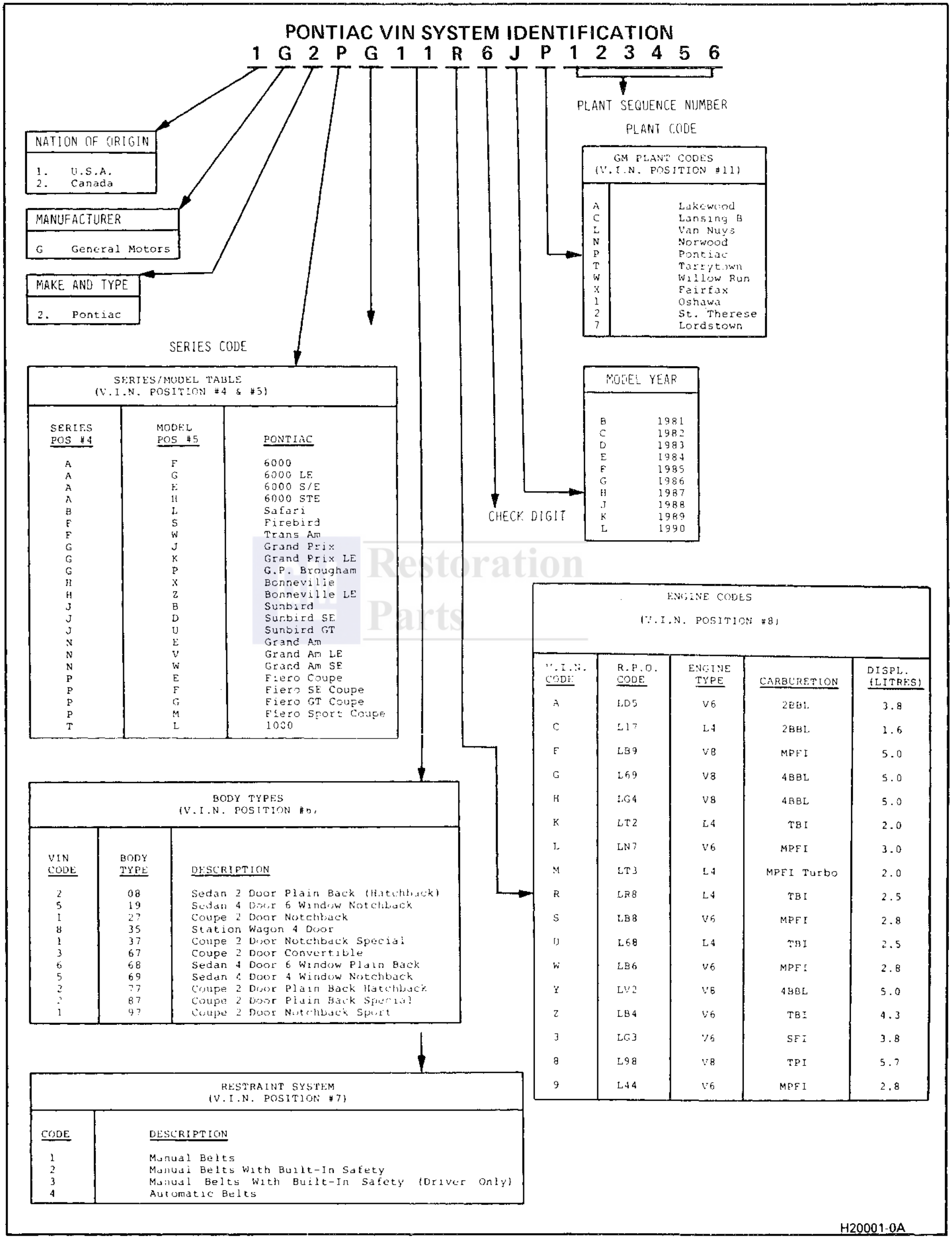
1. Clean, unrusted prevailing torque nuts and bolts may be reused as follows:
    a. Clean dirt and other foreign material off nut or bolt.
    b. Inspect nut or bolt to insure there are no cracks, elongation, or other signs of abuse or overtightening. (If there is any doubt, replace with a new prevailing 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 15 thru 17 indicate the recommended areas for hoist contact.

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 P G 1 1 R 6 J P 1 2 3 4 5 6

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
C	Lansing B
L	Van Nuys
N	Norwood
P	Pontiac
T	Tarrytown
W	Willow Run
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

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

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

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

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

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

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

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

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

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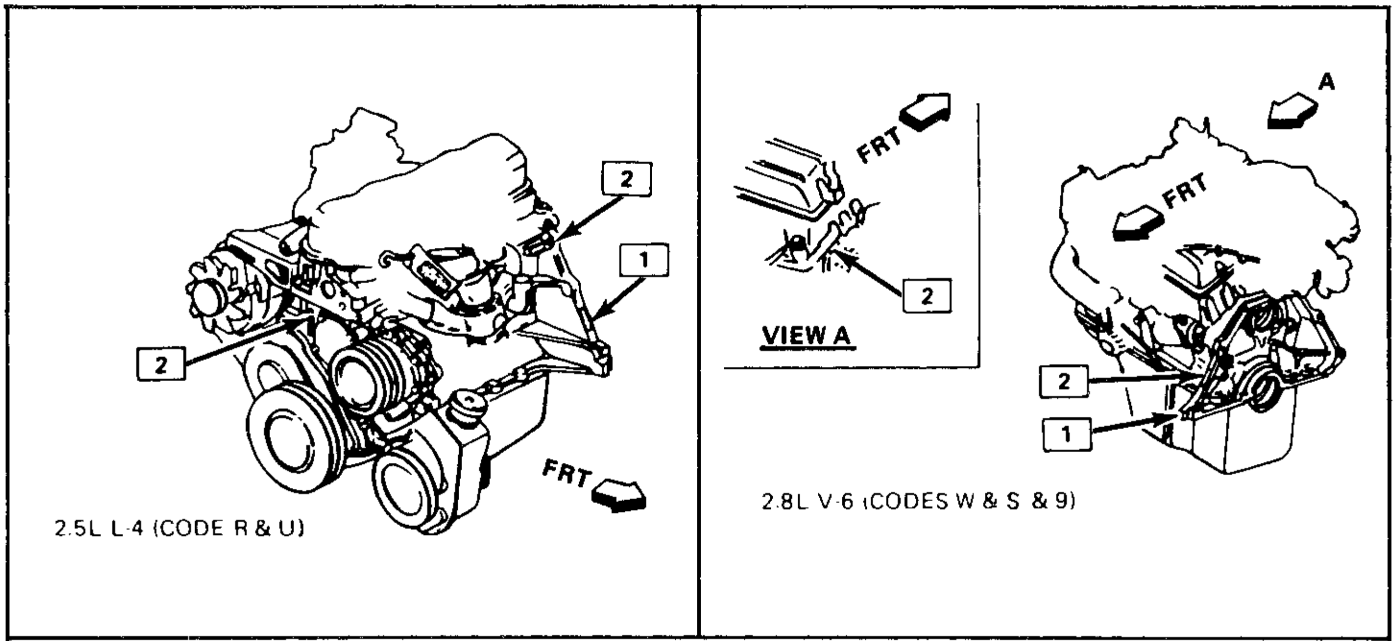
Fig. 3 Vehicle Identification Number Data



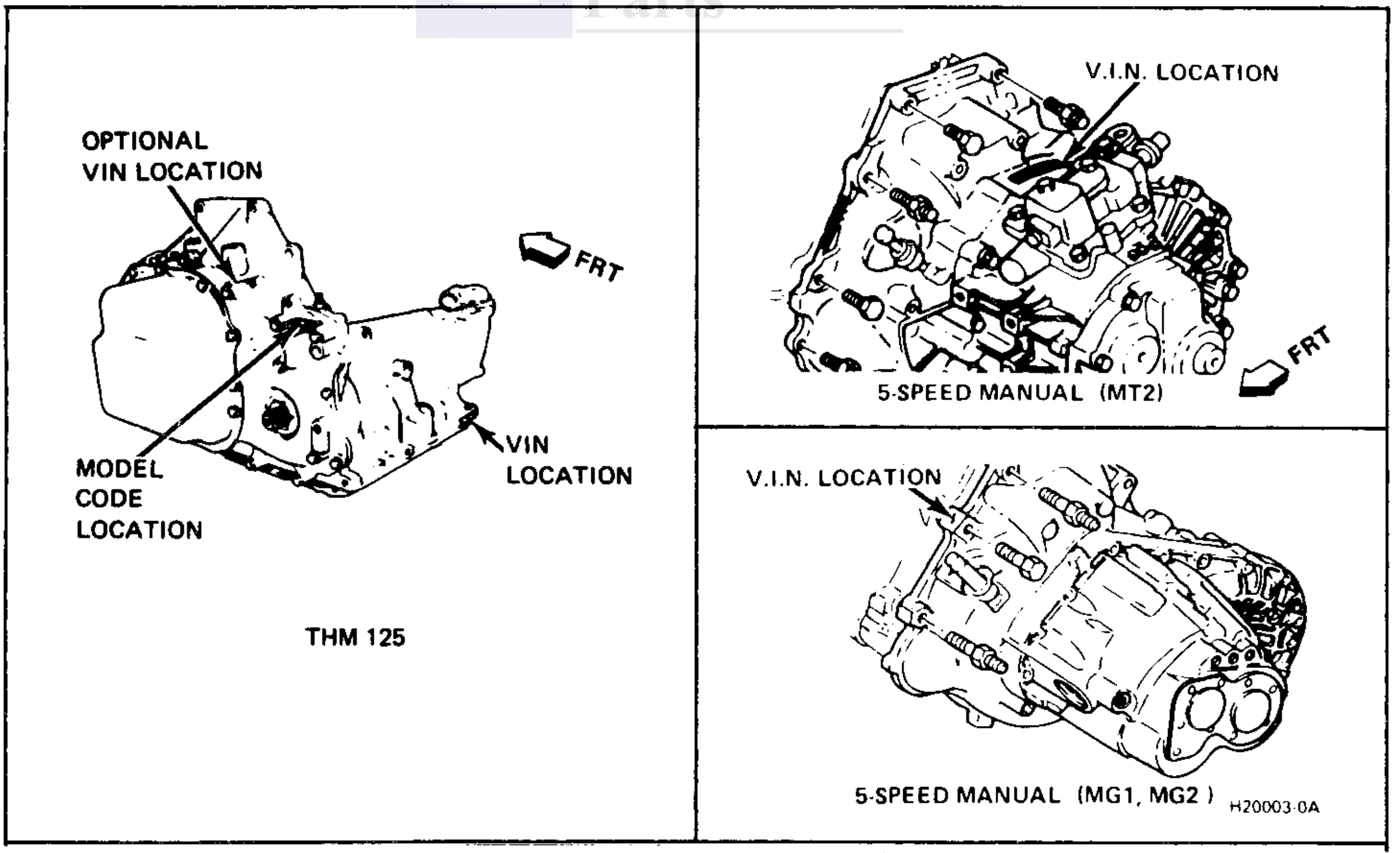
2.5L L-4 (CODE R & U)

2.8L V-6 (CODES W & S & 9)

1–V.I.N. NUMBER LOCATION

2–OPTIONAL V.I.N. NUMBER LOCATION

Fig. 4 Engine V.I.N. Identification Location



THM 125

5-SPEED MANUAL (MT2)

5-SPEED MANUAL (MG1, MG2)

Fig. 5 Transaxle Identification Location

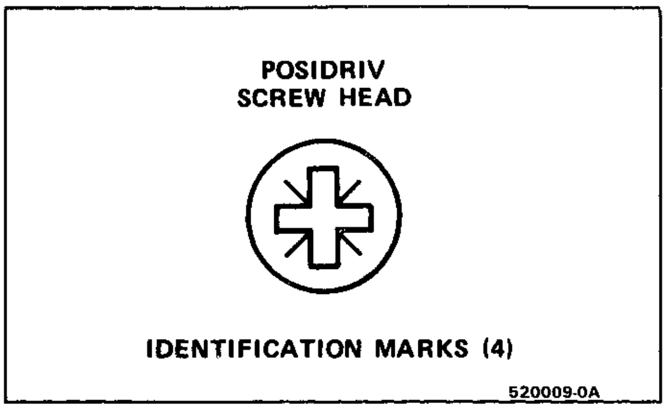


Fig. 6 Cross Recess Screw

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 ALL METAL BOLTS	N•m	0.4	0.8	1.4	2.2	3.0	4.2	7.0
	IN. LBS.	4.0	7.0	12	18	25	35	57
ADHESIVE OR NYLON COATED BOLTS	N•m	0.4	0.6	1.2	1.6	2.4	3.4	5.6
	IN. LBS.	4.0	5.0	10	14	20	28	46

INCH SIZES

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

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Fig. 8 Torque Chart

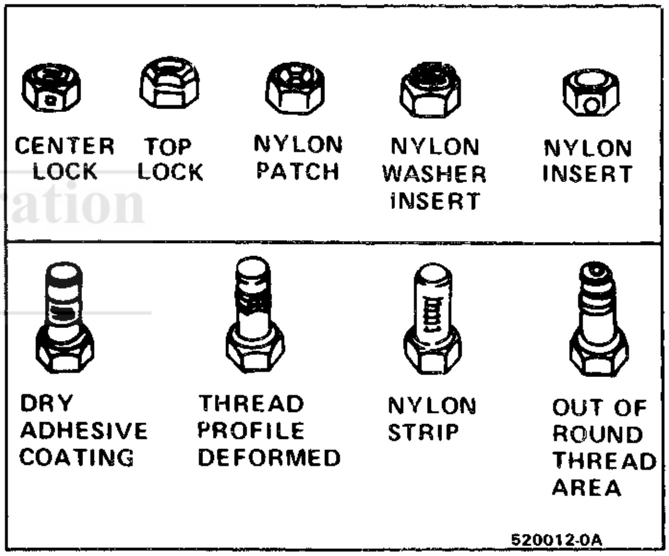


Fig. 9 Prevailing Torque Fasteners

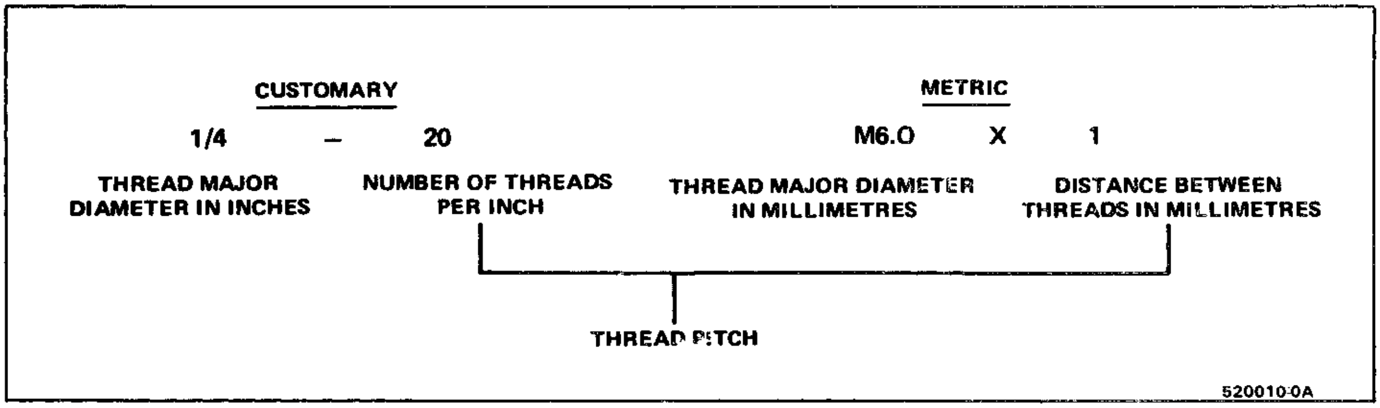
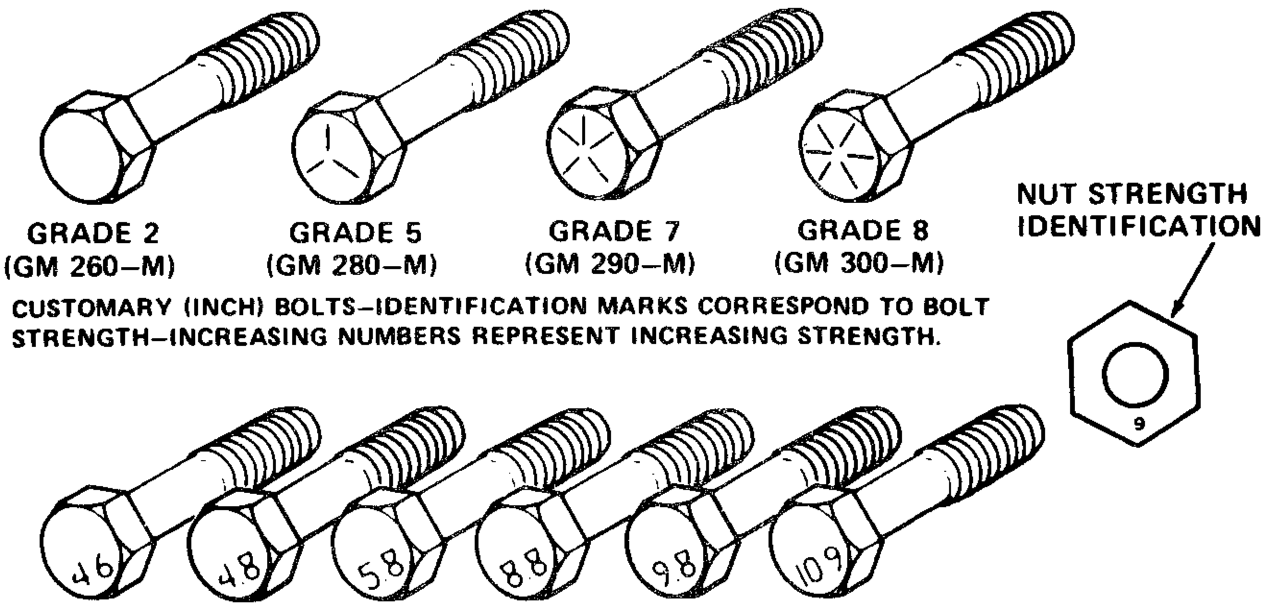


Fig. 7 Thread Notation



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.

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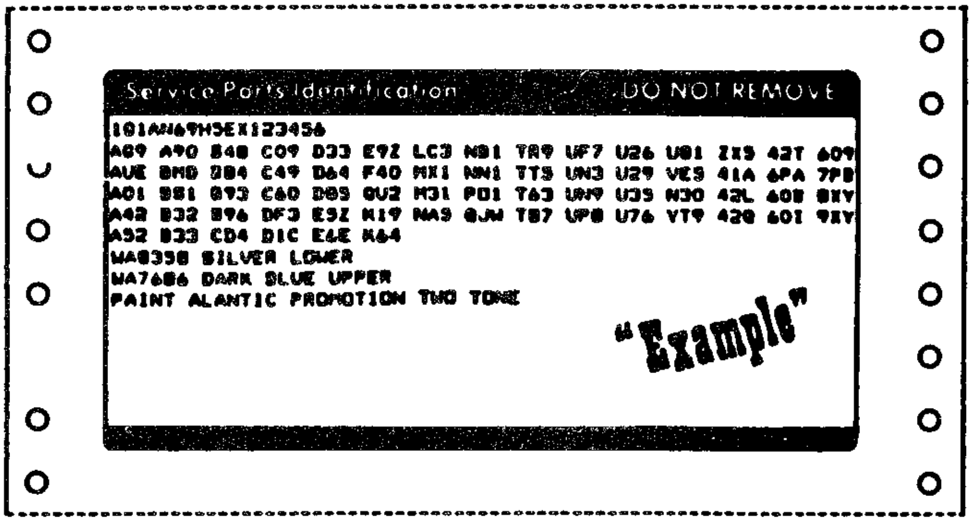
Fig. 10 Bolt Strength Markings

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

```
1G1AN69H3EX123456
A69 A90 B48 C09 D33 E92 LC3 N81 TR9 UF7 U26 U81 ZX5 42T 609
AU3 BMD B84 C49 D64 F40 MX1 NN1 TT5 UN3 U29 VE5 41A 6PA 7PB
A01 B51 B93 C60 D85 GU2 M31 P01 T63 UN9 U35 N30 42L 60B 8XY
A42 B32 B96 DF3 E52 K19 MA5 QJW T87 UP8 U76 VT9 420 601 9XY
A52 B33 CD4 D1C E4E K64
WA8358 SILVER LOWER
WA7686 DARK BLUE UPPER
PAINT ALANTIC PROMOTION TWO TONE
```

"Example"

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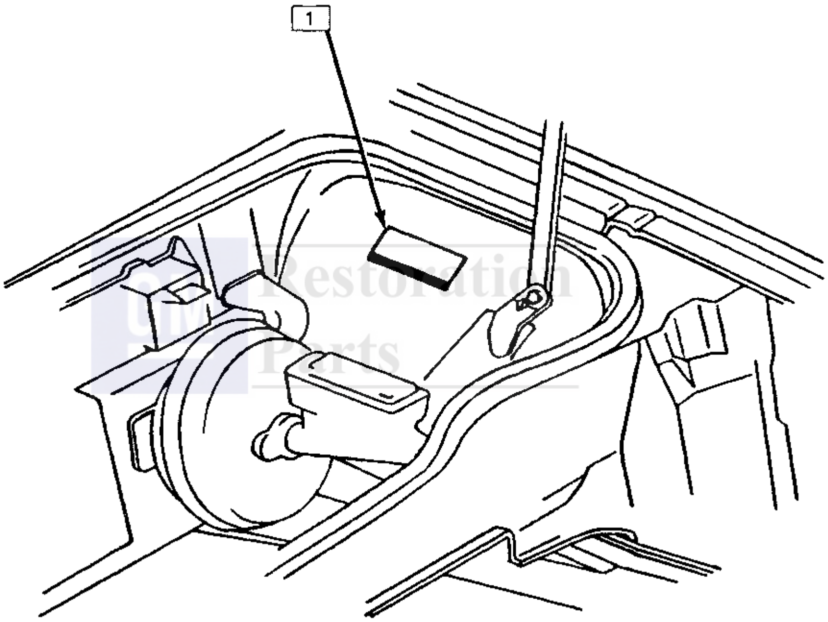
Fig. 11 Service Parts Identification



1 LABEL LOCATION

Fig. 12 Service Parts Label Location

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

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

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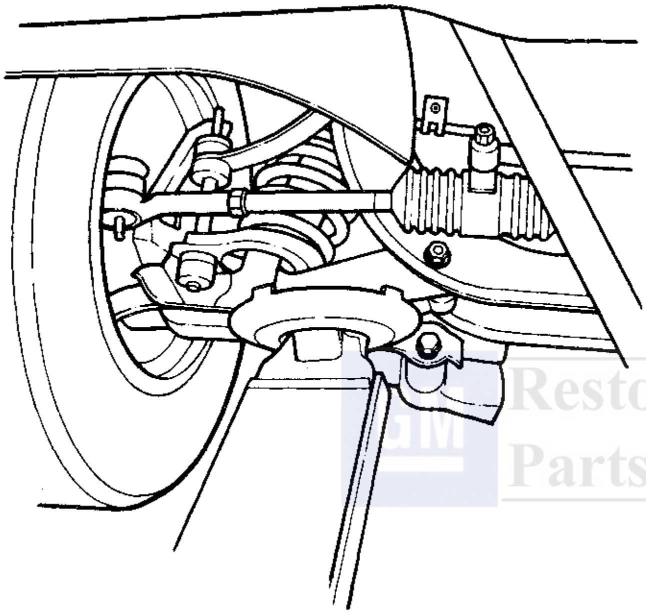
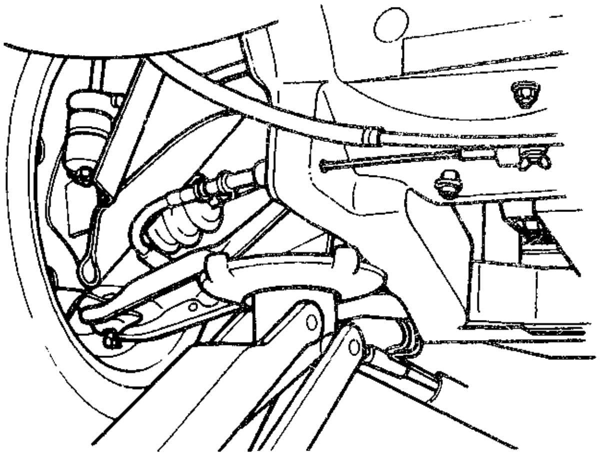
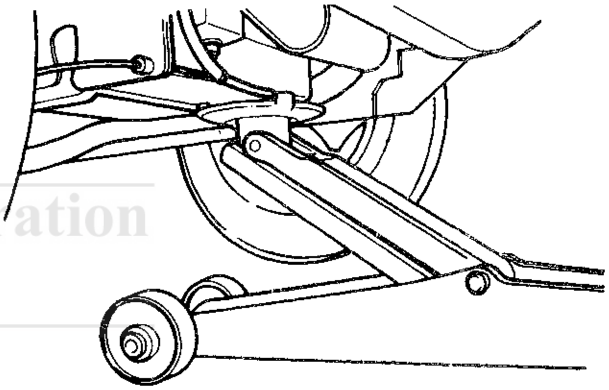
Fig. 14 Automotive Abbreviations



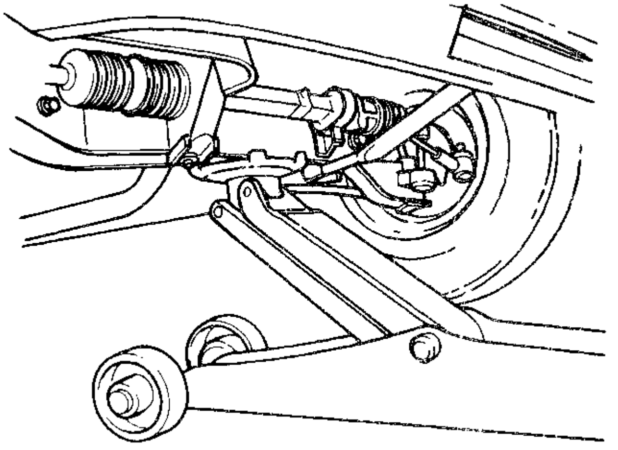
WHEN USING A FLOOR
JACK, LIFT ON THE
CENTER OF THE FRONT LOWER
CONTROL ARM



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)

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Fig. 15 Vehicle Lifting Points "P" Model

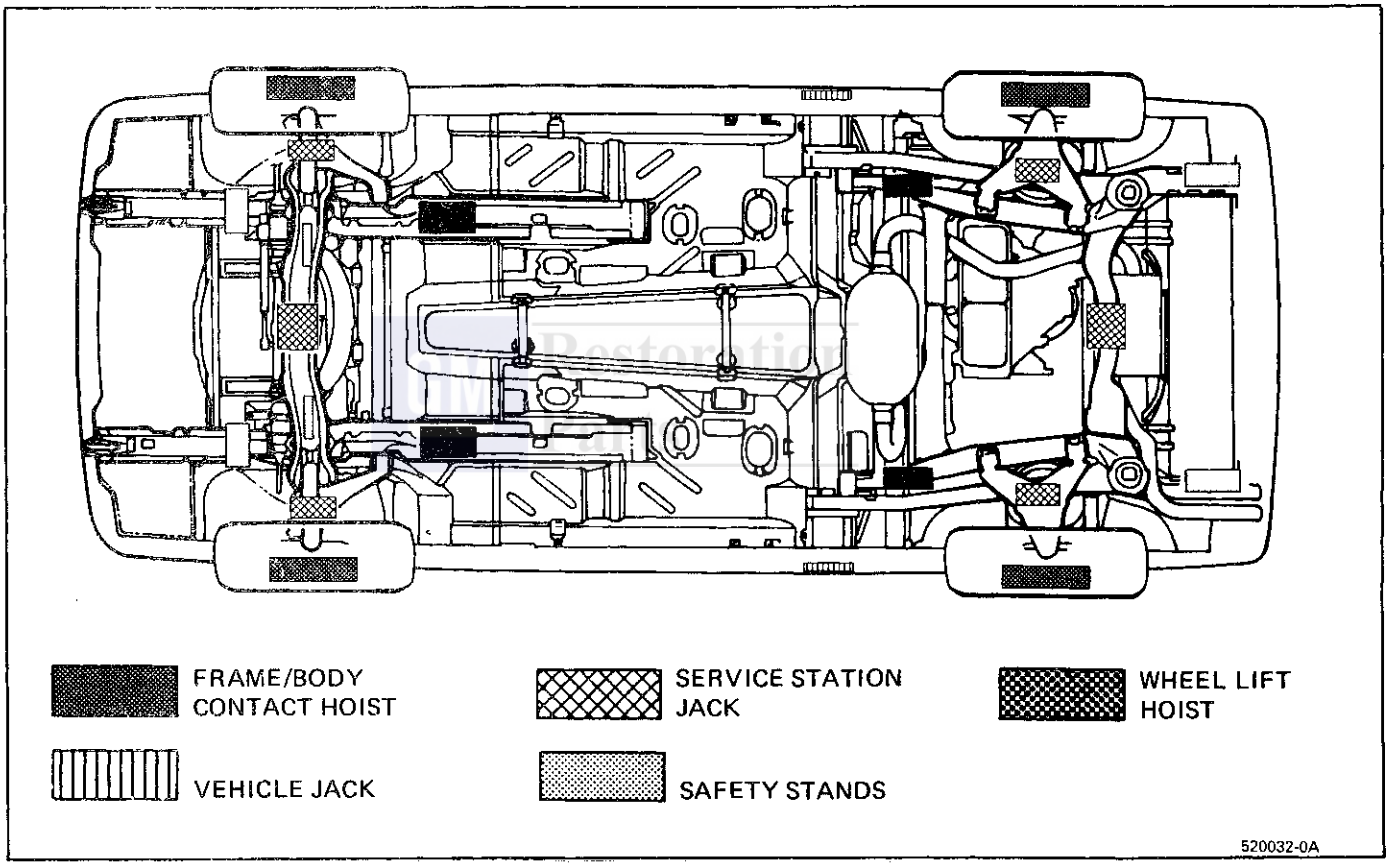
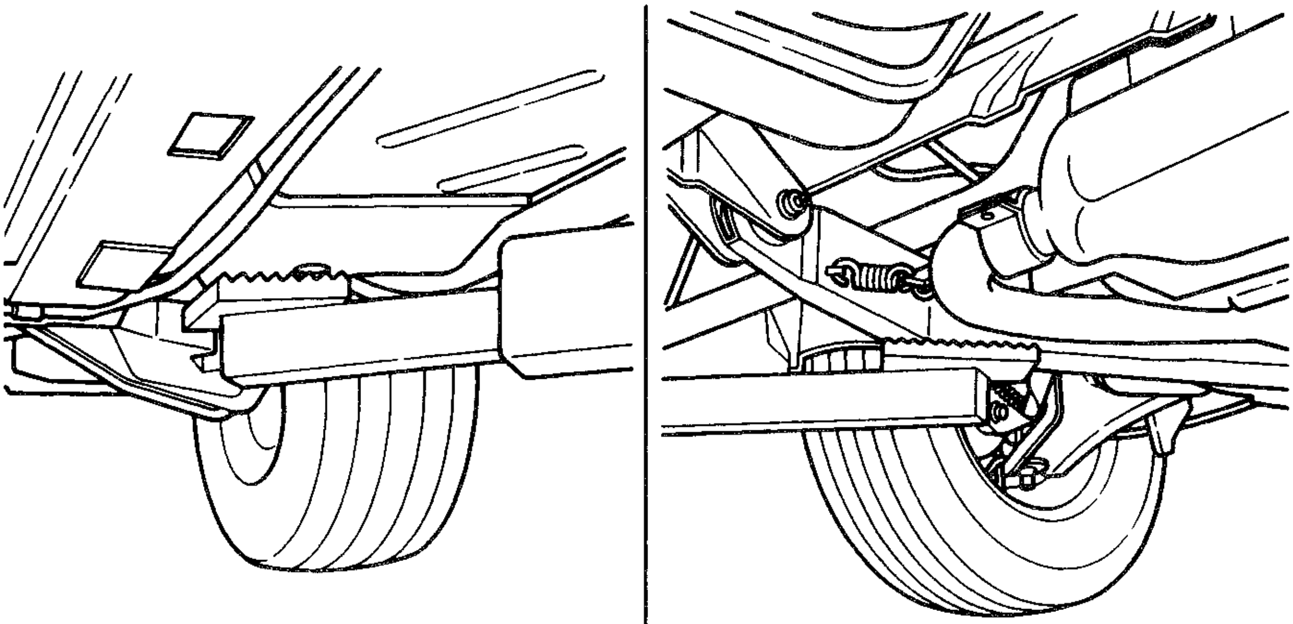
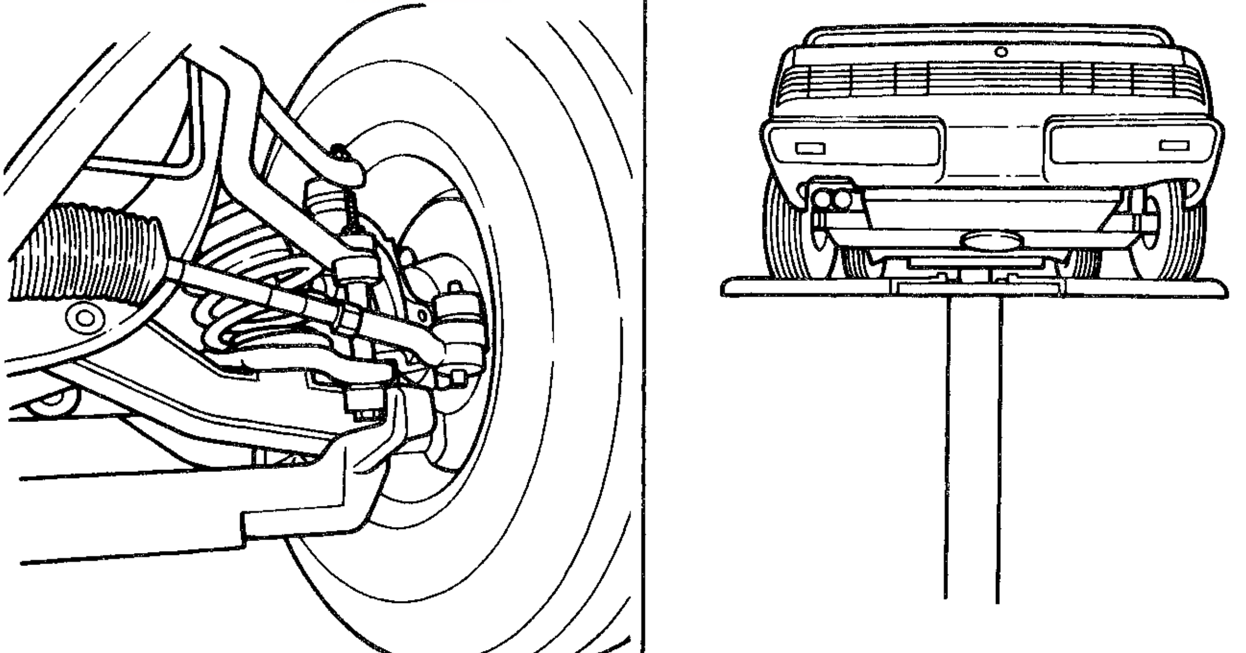


Fig. 16 Vehicle Lifting Points "P" Model



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-

520034-0A

Fig. 17 Vehicle Lifting Points "P" Model

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 transaxle shift linkage, clutch pedal pivot point and actuator rod, parking brake cable guides, underbody contact points and linkage.

ITEM 3

TBI Mounting Bolt Torque

Check torque of mounting bolts and/or nuts.

ITEM 4

Cooling System Service

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

ITEM 5

Transaxle Service

The manual transaxle fluid does not require changing.

ITEM NO.	TO BE SERVICED	**WHEN TO PERFORM** Miles (kilometers) or Months. Whichever Occurs First	The services shown in this Schedule up to 48,000 miles (80,000 km) are to be performed after 48,000 miles at the same intervals															
		MILES (000)	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48
		KILOMETERS (000)	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80
1	Engine Oil & Oil Filter Change*	Every 3,000 mi. (5 000 km) or 3 mos.	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
2	Chassis Lubrication	Every other oil change		●		●		●		●		●		●		●		●
3	TBI Mounting Bolt Torque*	At 6,000 mi. (10 000 km) only		●														
4	Cooling System Service*	Every 30,000 mi. (50 000 km) or 24 mos.										●						
5	Transaxle Service	See explanation for service interval in Section B.																
6	Spark Plug Service*	Every 30,000 mi. (50 000 km)										●						
7	Spark Plug Wire Inspection* ø	Every 30,000 mi. (50 000 km)										●						
8	PCV Valve Inspection* ø	Every 15,000 mi. (25 000 km) 24 mos.					●					●					●	
9	EGR System Inspection* ø	Every 30,000 mi. (50 000 km) 36 mos.					●					●						
10	Air Cleaner Element Replacement*	Every 15,000 mi. (25 000 km) 24 mos. †										●						
11	Engine Timing Check*	Every 30,000 mi. (50 000 km)										●						
12	Fuel Tank, Cap & Lines Inspection* ø	Every 30,000 mi. (50 000 km)										●						
13	Thermostatically Controlled Air Cleaner Inspection*	Every 30,000 mi. (50 000 km)										●						
14	Tire & Wheel Inspection & Rotation	Every 6,000 mi. (10 000 km)		●		●		●		●		●		●		●		●

FOOTNOTES:

**An Emission Control Service*

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

†Change air filter every 9,000 miles (15 000 km) or every 12 months when frequently operating in dusty areas.

Fig. 1 Maintenance Schedule 1

For automatic 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 of 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 6

Spark Plug and Wire Service

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

ITEM 7

Spark Plug Wire Inspection

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

ITEM 8

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 9

EGR System Service

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

ITEM 10

Air Cleaner Element Replacement

Replace every 24 months or 15,000 miles (25 000 km). Replace more often under dusty conditions. Ask your dealer for the proper replacement interval for your driving conditions.

ITEM 11

Engine Timing Check

Adjust timing to underhood label specifications.

ITEM 12

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 13

Thermostatically Controlled Air Cleaner Inspection

Inspect all hoses and ducts for proper hook-up. Make sure valve works properly.

ITEM 14

Tire and Wheel Rotation

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

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: Some rear wheel drive cars equipped with limited slip differential should have fluid drained and refilled at 7,500 miles (12 500 km). Some also use a limited slip additive. See the 1987 GM Maintenance Schedule for specific information.

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 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 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.

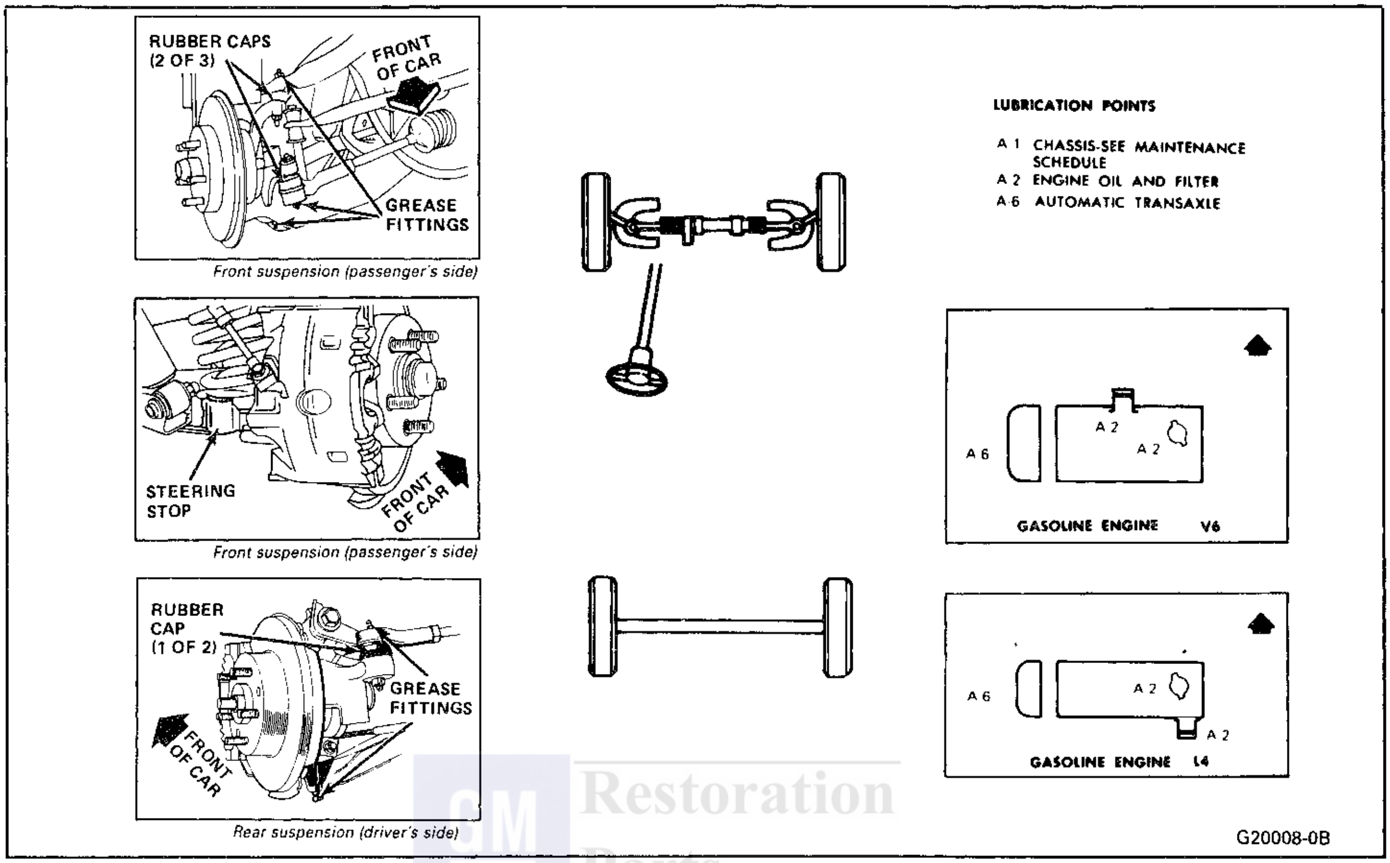
Engine cooling system service –Inspect coolant and freeze protection. If dirty or rusty, drain, flush and refill with new coolant. Keep coolant at the proper mixture as specified in your Owner's Manual. This provides proper freeze protection, corrosion inhibitor level and engine operating temperature. 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 N. 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 (RPO MK7/MT2)	DEXRON® -II Automatic Transmission Fluid (GM Part No. 1051855)
Manual Transaxle	**GM Part No. 12345349**
Manual Transmission (rear-wheeldrive) 3 and 4 speed	Corvette overdrive unit and Pontiac Firebird 4 speed manual—DEXRON® -II. 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
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 N. 1050109 b) Chassis grease meeting requirements of GM-6031M (GM Part No. 1052497)
Front Wheel Bearings (rear-wheeldrive)	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.

Fig. 2 Recommended Fluids and Lubricants



Front suspension (passenger's side)

Front suspension (passenger's side)

Rear suspension (driver's side)

Fig. 801 Typical Lubrication Points

				EXCEPTION(S)		
		TIRE INFLATION PRESS. (PSI)			TIRE INFLATION PRESS. (PSI)	
MODEL	TIRE SIZE	FRONT	REAR	TIRE SIZE	FRONT	REAR
6000	---	35	35	P195/70R14	30	30
Safari	---	30	35	---	--	--
Firebird	---	30	30	---	--	--
Grand Prix	---	35	35	P215/65R15	30	30
Bonneville	P205/75R14	35	35	---	--	--
	P215/65R15	30	30	---	--	--
Sunbird	---	35	35	P215/60R14	30	30
Grand Am	---	30	30	P185/80R13	35	35
Fiero	---	30	30	P185/75R14	35	35
1000	---	30	35	---	--	--

Please refer to this listing during Pre-delivery Inspection and otherwise.

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Fig. 802 Tire Pressure Specifications

FLUID CAPACITIES

FUEL TANK CAPACITIES

MODELS	IDENTIFIER	METRIC	U.S.
"P"	L4	45.0 Liters	11.9 Gal.

ENGINE OIL CAPACITIES (CRANKCASE)

Engine	VIN Code(s)	W/O Filter	W Filter
2.5L (Gas)	R	3.8 Liters (4 qts.)	3.8 Liters (4 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)
5-Speed	MG2	Muncie	1.9L (4.1 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.)

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.

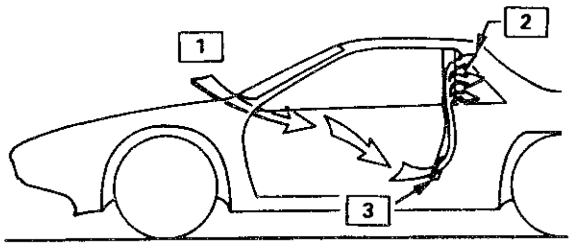
Air distribution is through a heater outlet, defroster duct, and power-vent duct work and outlets.

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.



1—FRONT INLET GRILLE
2—OUTLET
3—BODY LOCK PILLAR EXHAUST

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Figure 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.

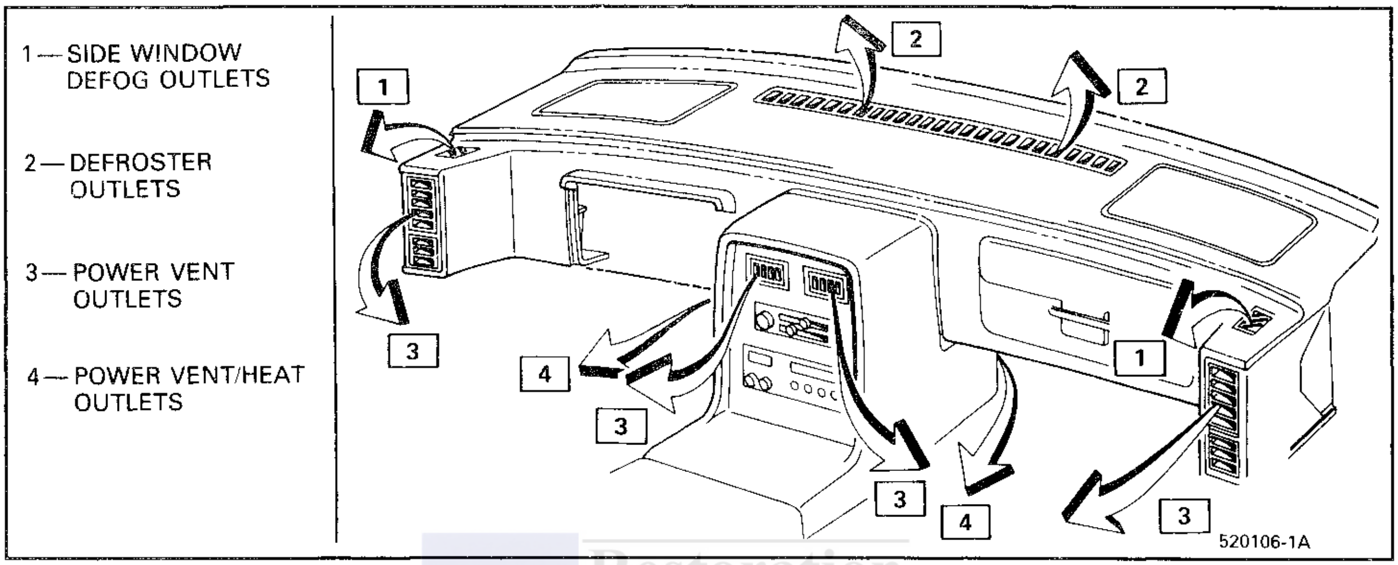


Figure 2 Ventilation System

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 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.

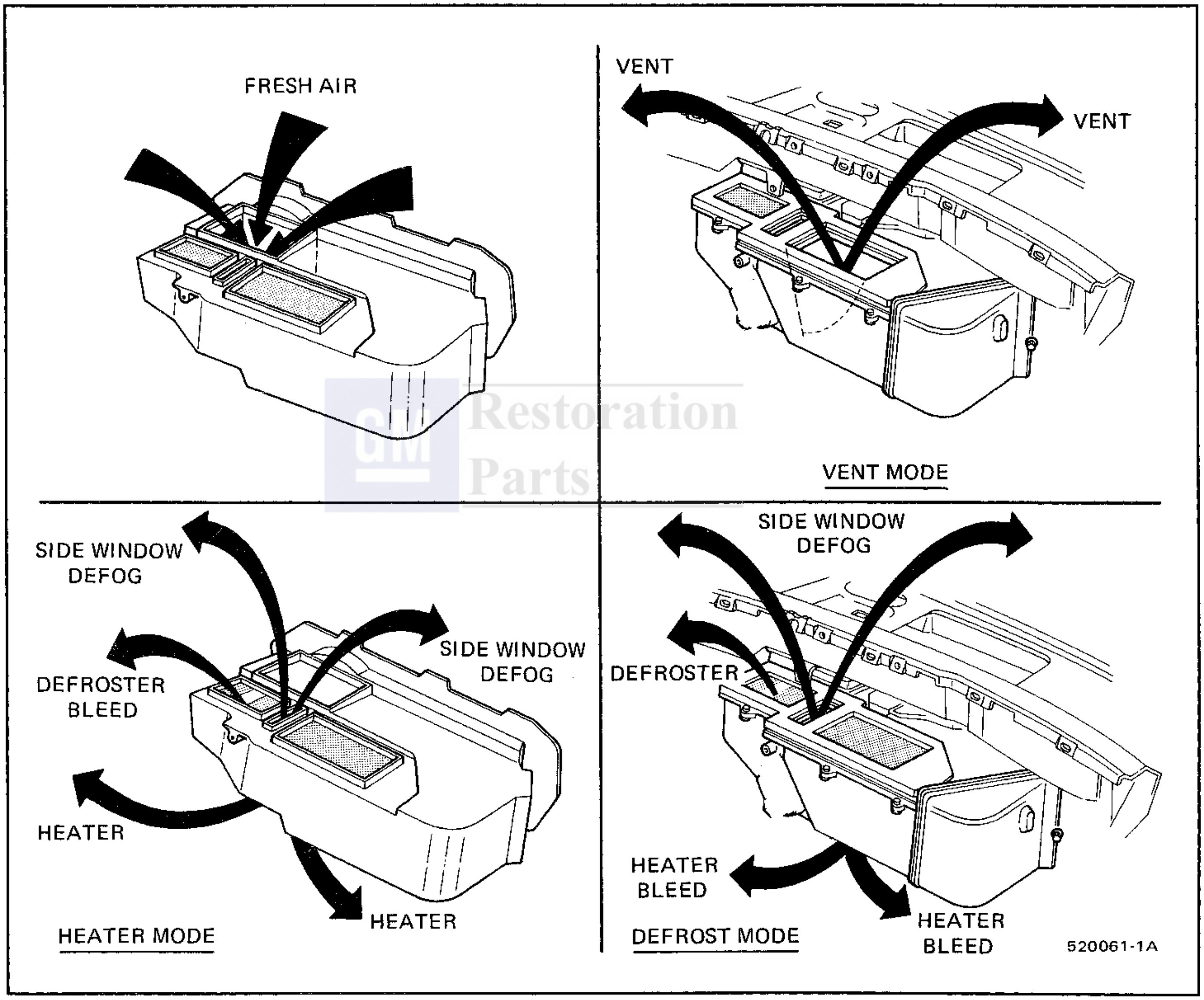
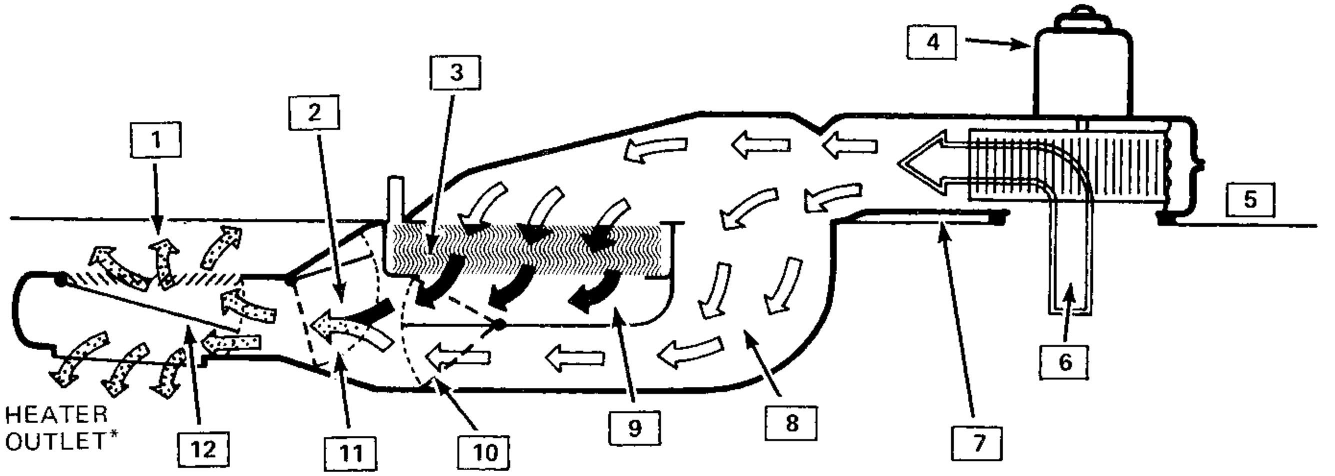


Figure 3 Module Air Flow



1—DEFROSTER OUTLET

2—BLENDED AIR

3—HEATER CORE

4—BLOWER

5—DASH PANEL

6—OUTSIDE AIR FROM COWL PLENUM CHAMBER

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

8—UNTEMPERED AIR

9—WARMED AIR

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

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

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

*ON SOME MODELS ALSO SUPPLIES SIDE WINDOW DEFOGGING DUCTS.

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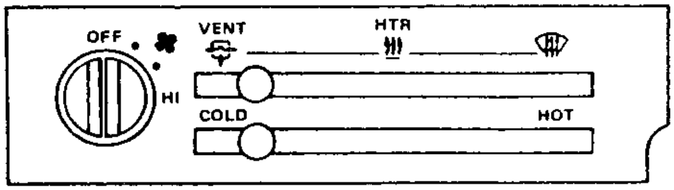
Figure 4 Typical Heater System Air Flow

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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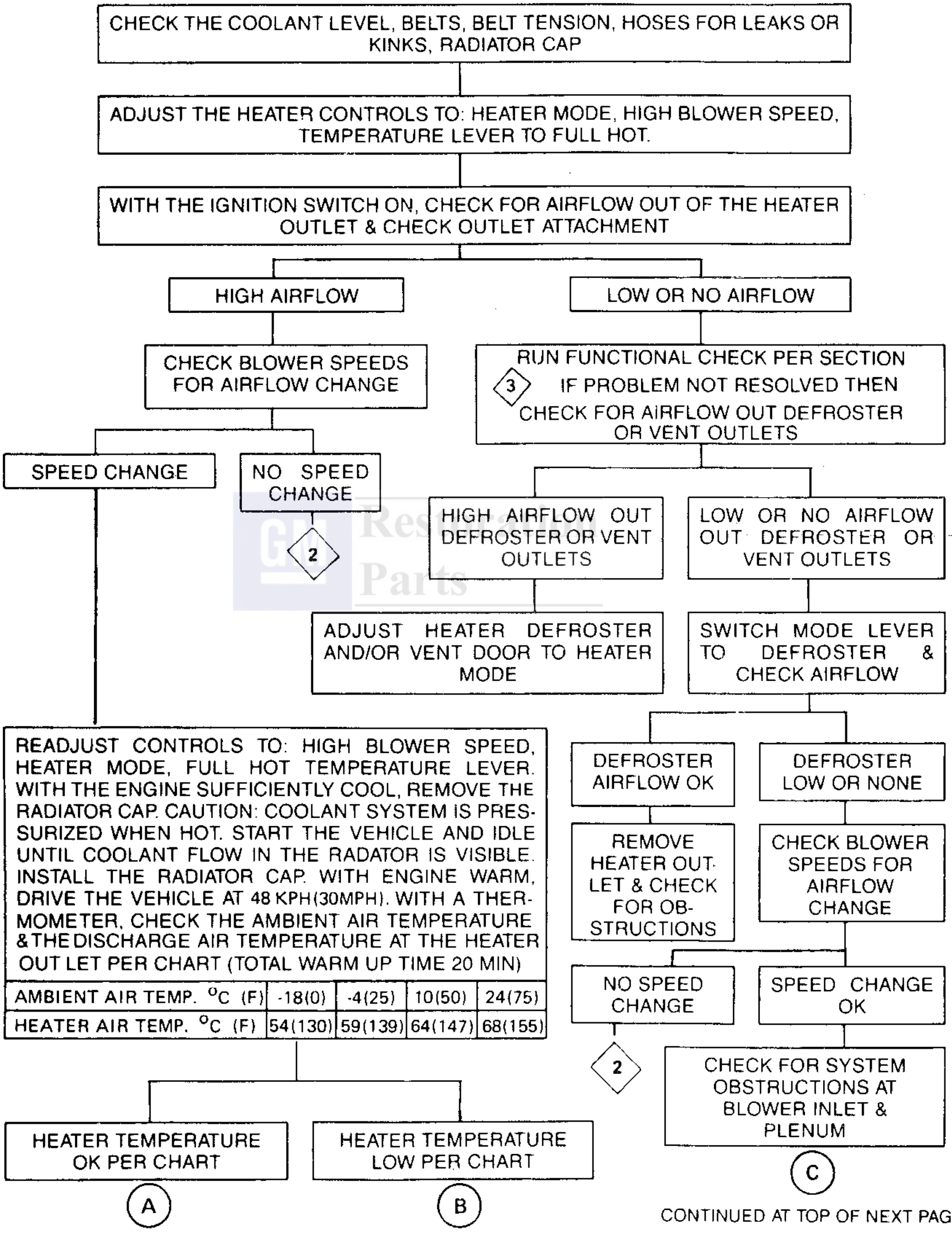
Figure 5 Heater Functional Test

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

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

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

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

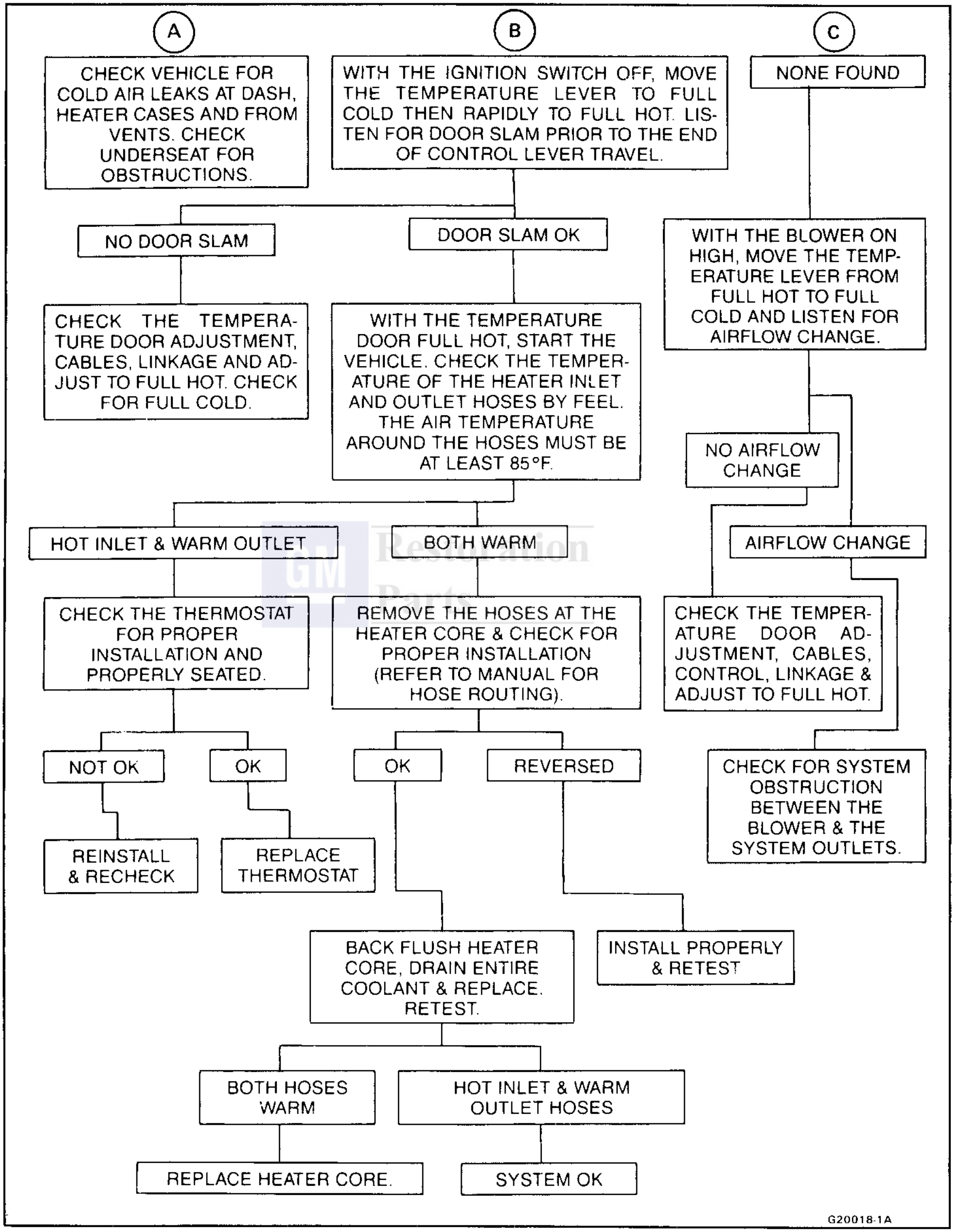

Figure 7 Insufficient Heating or Defrosting Diagnosis Procedure (2 of 2)

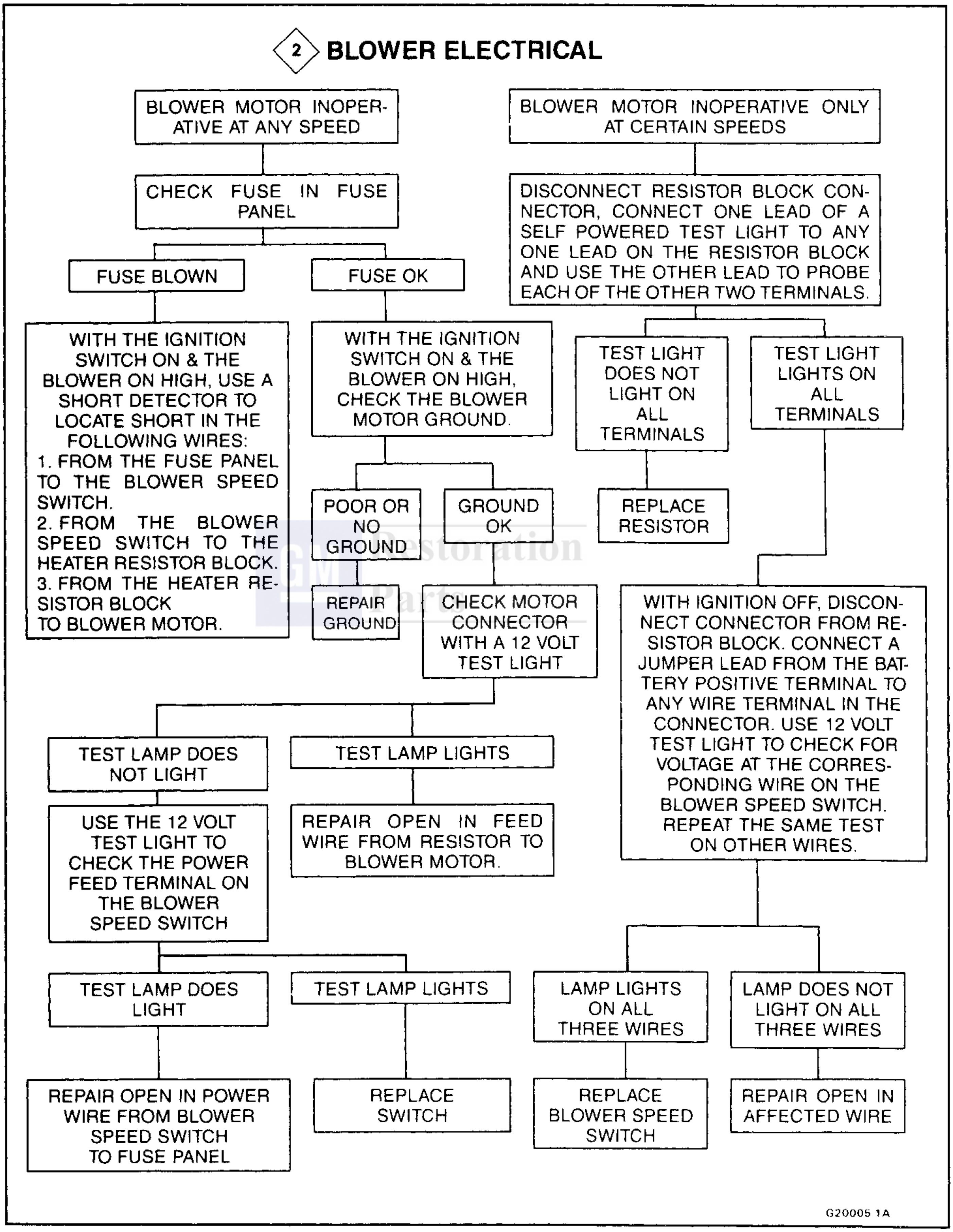

Figure 8 Blower Electrical Diagnosis

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

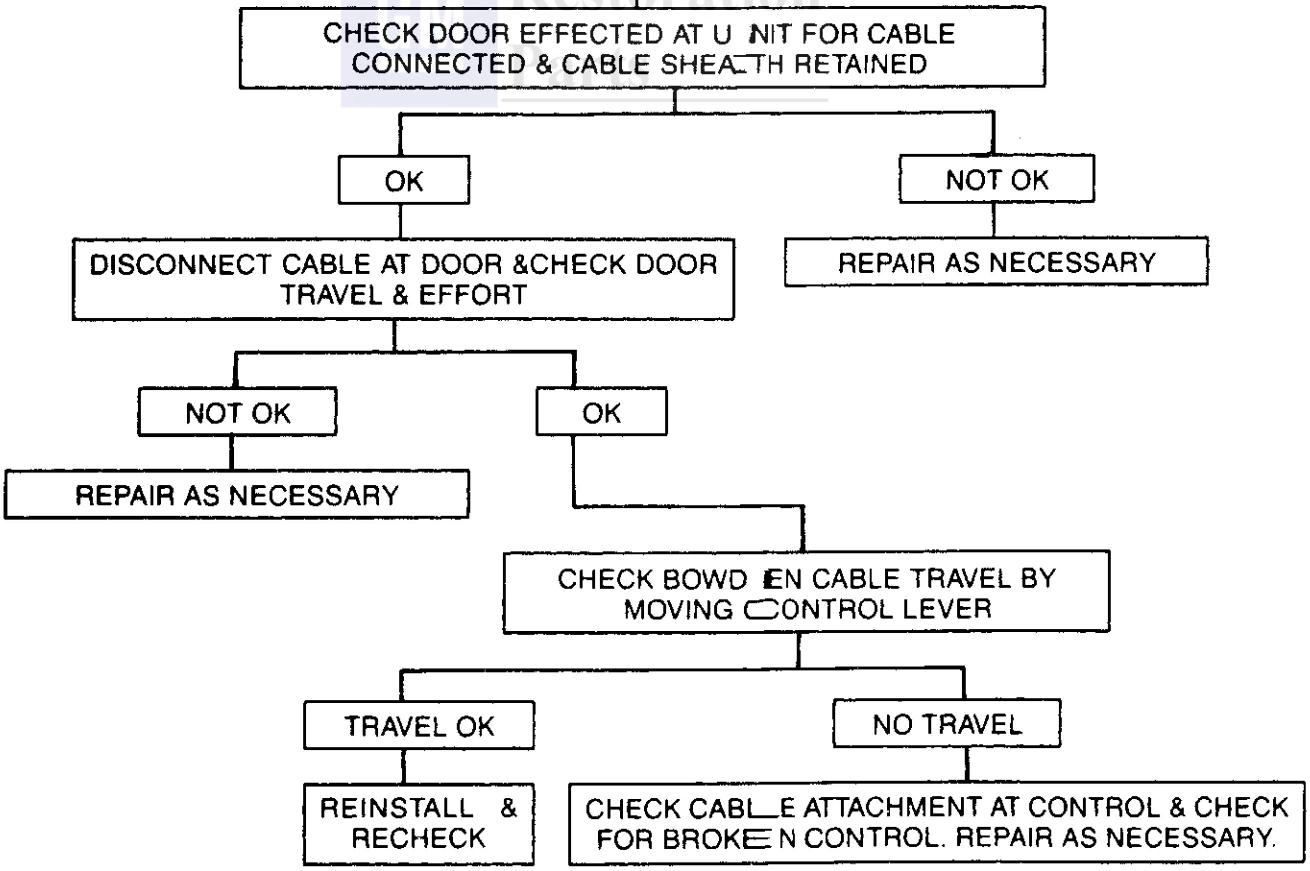

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Figure 9 Improper Air Delivery Or Mode Shift Diagnosis

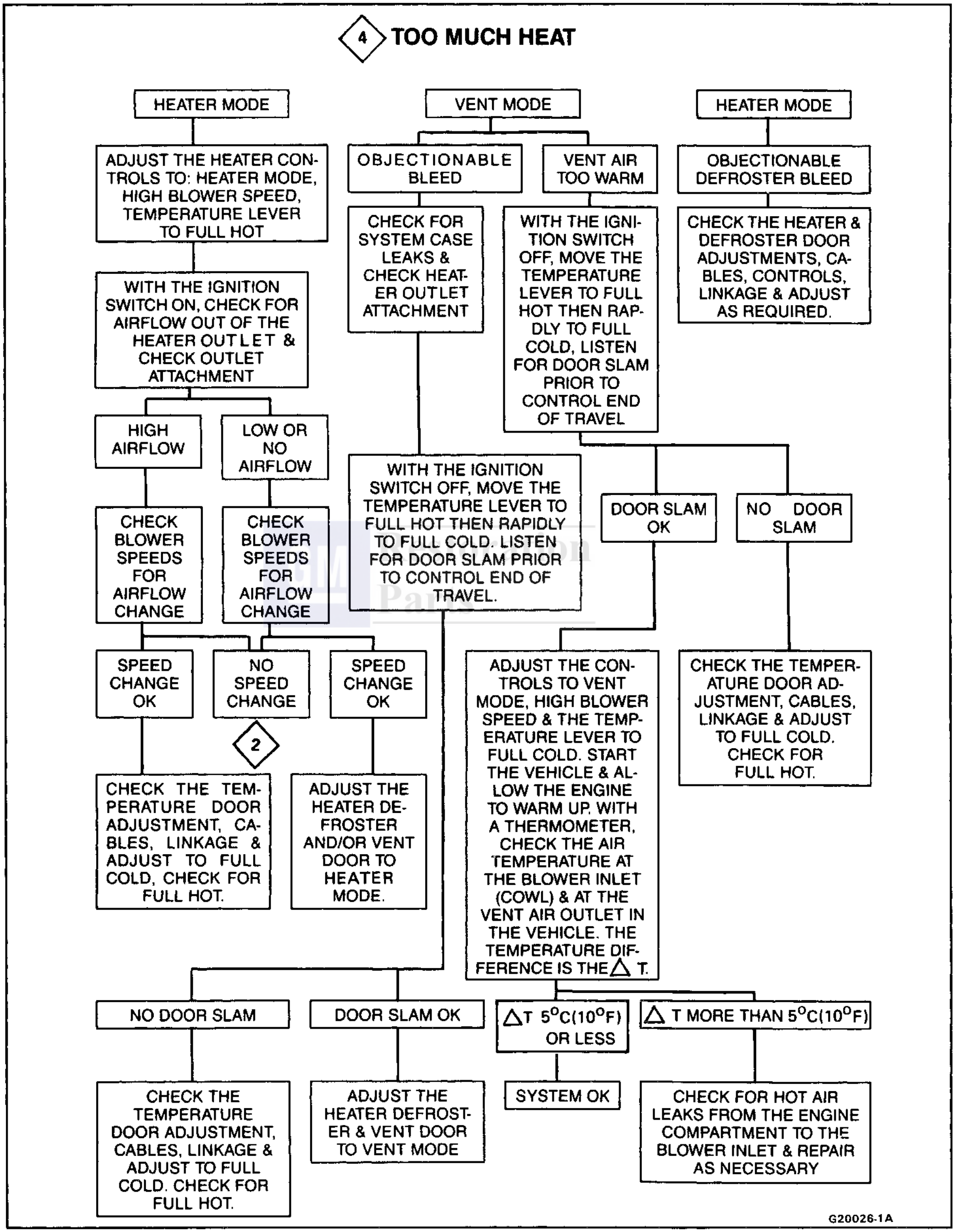

Figure 10 Too Much Heat Diagnosis

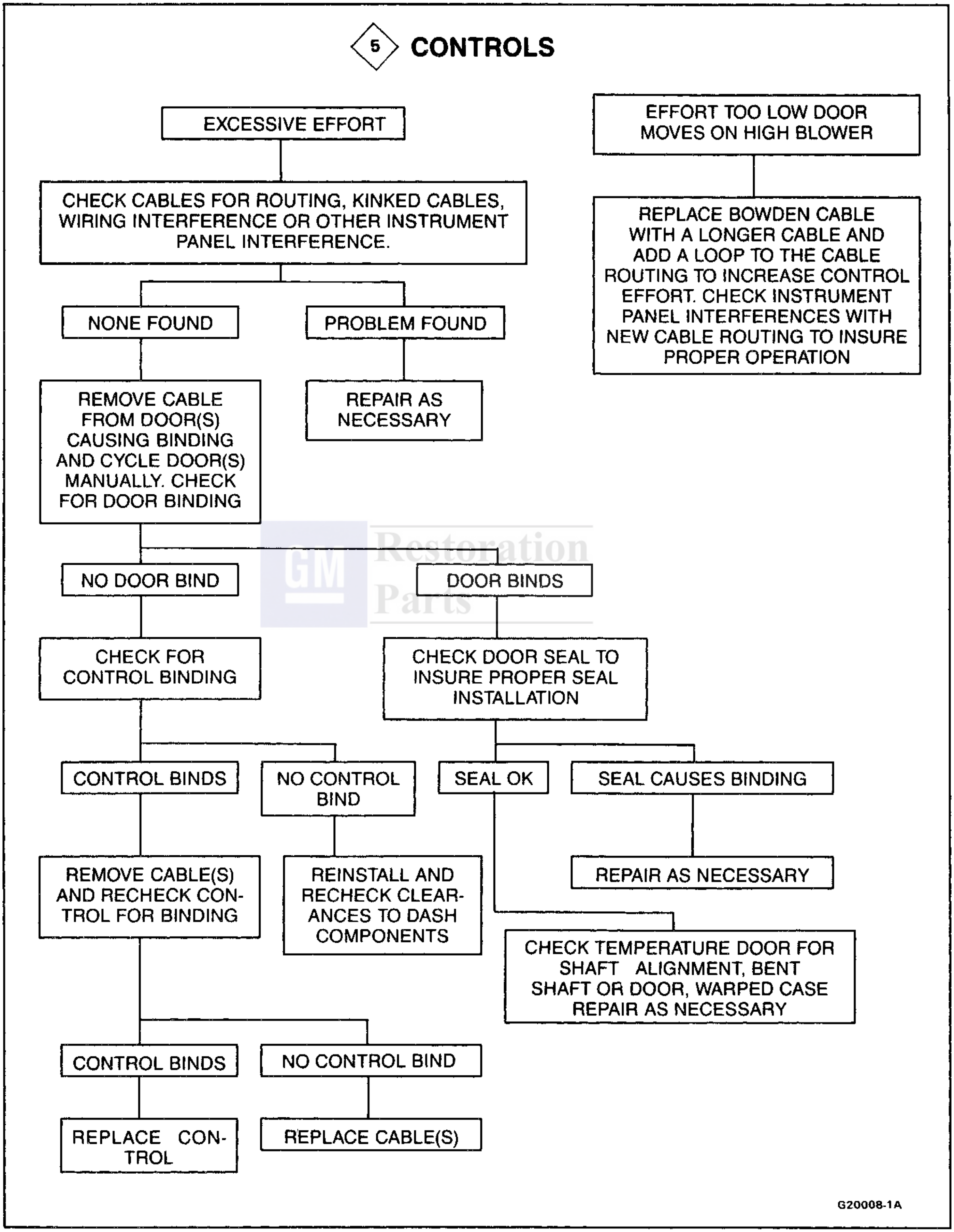

Figure 11 Heater Controls Diagnosis

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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Figure 12 Blower Noise Diagnosis (1 of 2)

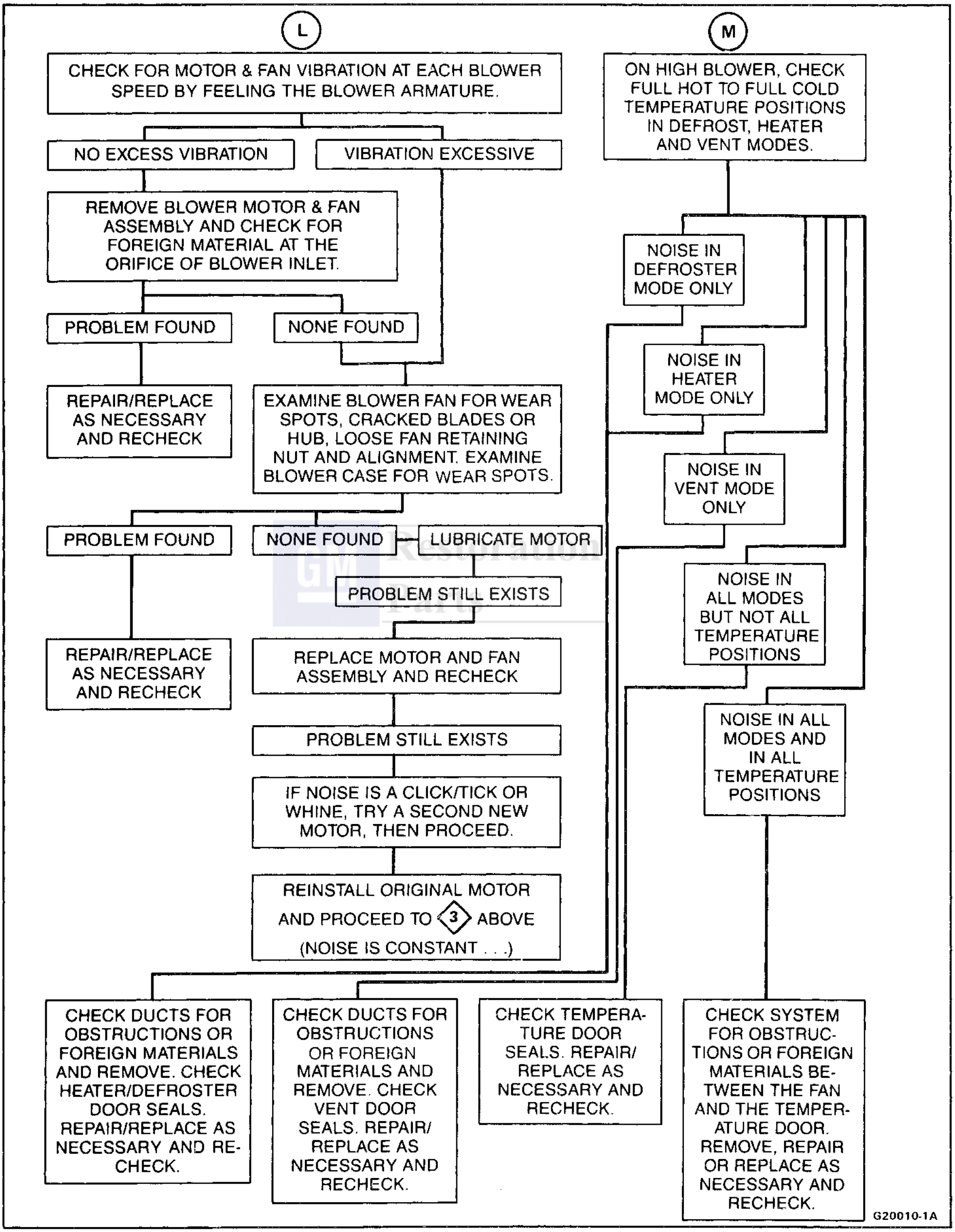
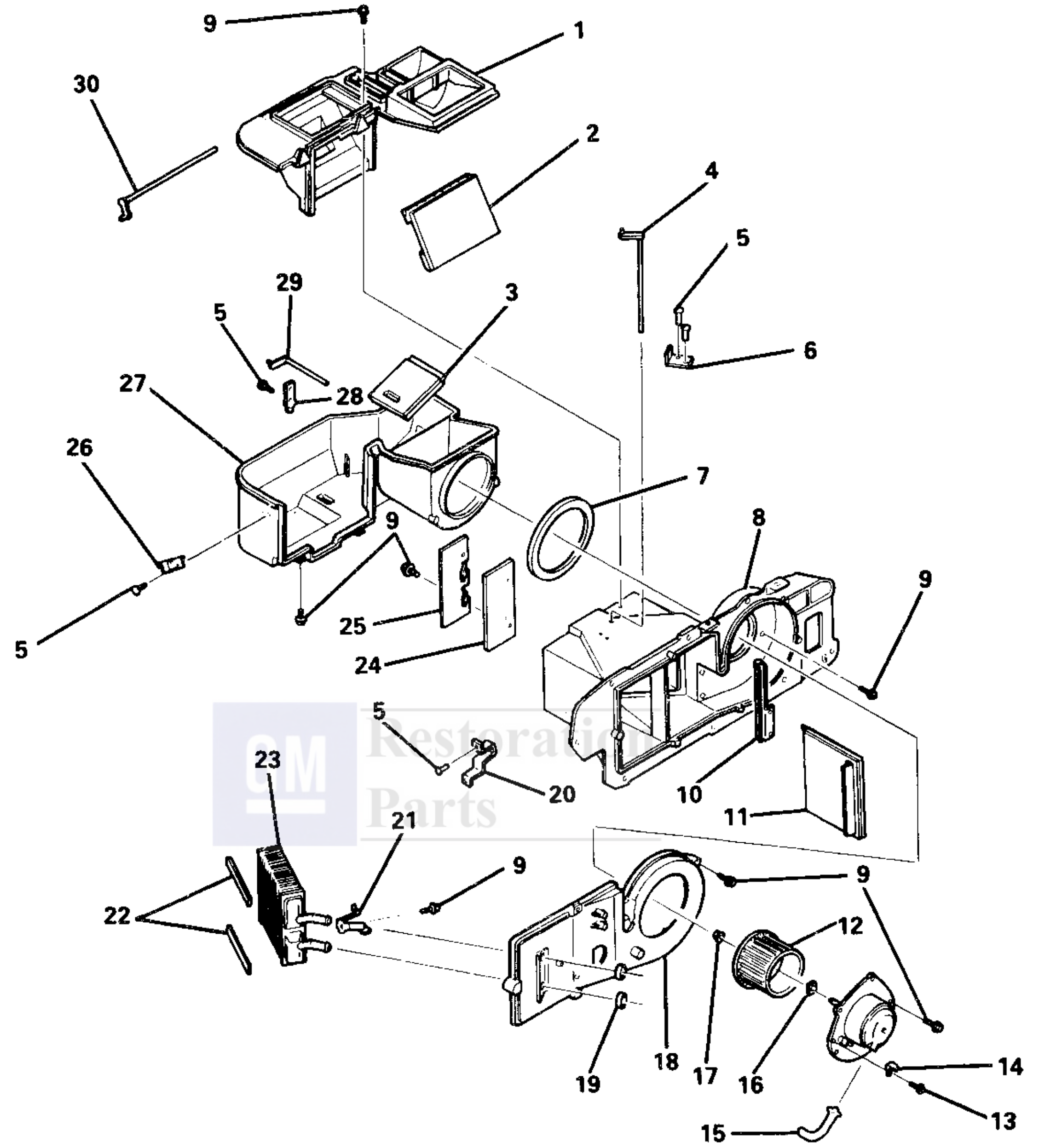


Figure 13 Blower Noise Diagnosis (2 of 2)



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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Figure 14 Heater Module Disassembled View

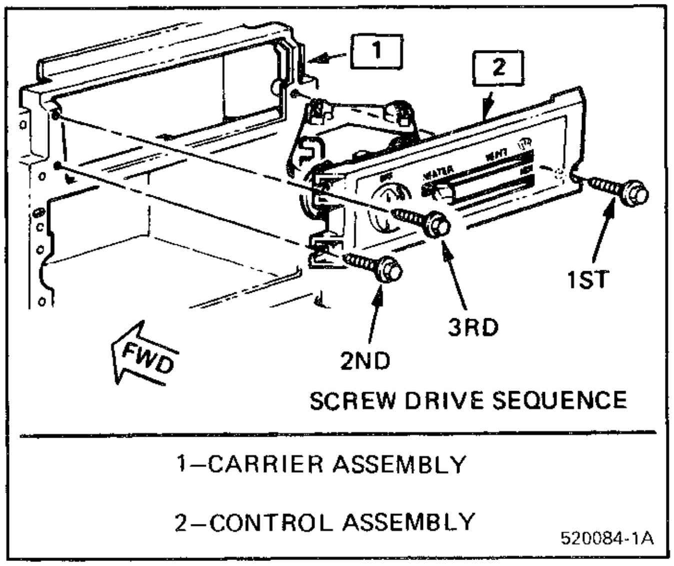


Figure 15 Heater Control Mounting

ON-VEHICLE 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.

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.

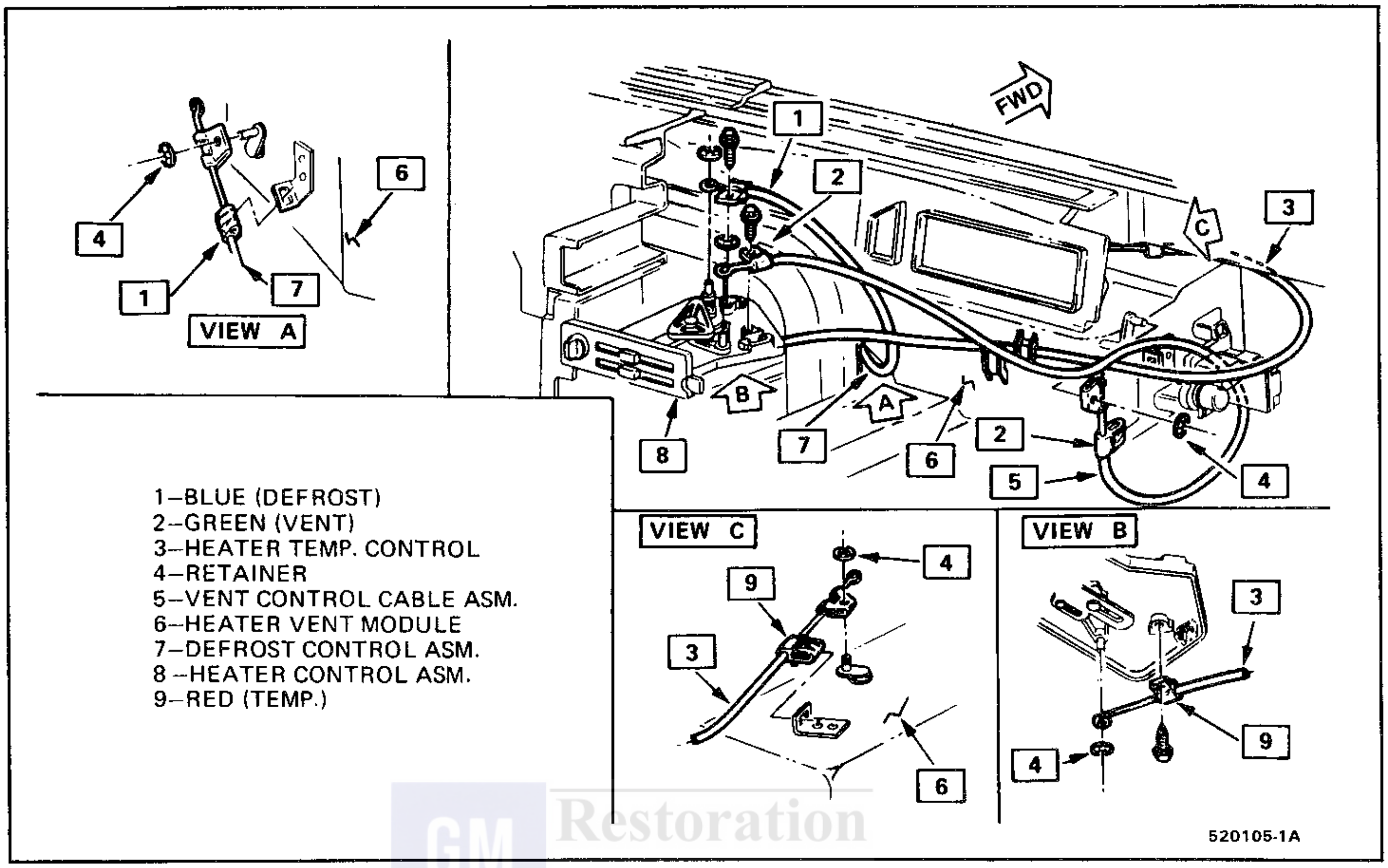
Adjust

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

HEATER CORE

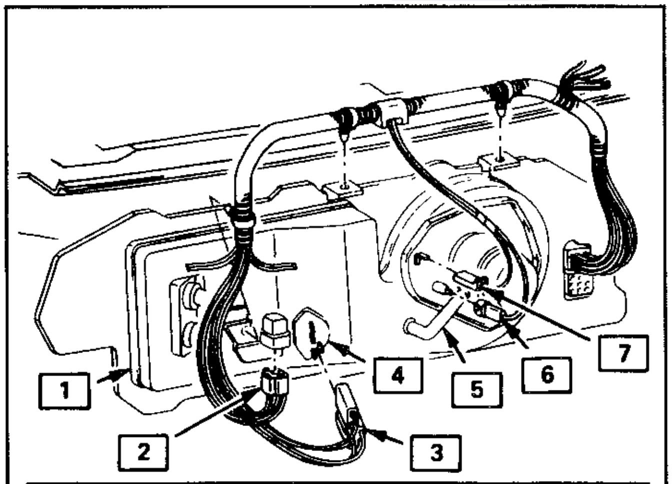
Remove or Disconnect

1. Negative Battery 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.



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.)

Figure 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

Figure 17 Heater Module Wiring

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)
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. Negative battery cable.

HEATER CONTROL WIRING

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

See Section 8C for duct removal.

LOWER (FLOOR) HEATER OUTLET

Remove or Disconnect

1. Screw.
2. Outlet.

Install or Connect

1. Outlet.
2. Screw.

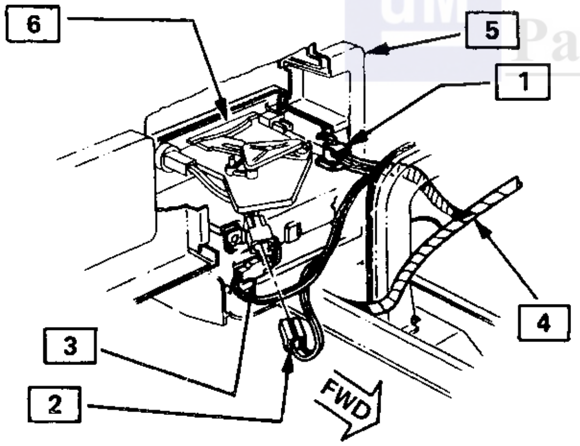
ELECTRIC ACTUATOR

Remove or Disconnect

1. Negative battery cable.
2. Bezel and screws at radio.
3. Wires and radio assembly.
4. Lower heater outlet.
5. Electrical connector at actuator.
6. Retainer clip from left hand rod.
7. Retainer clip from actuator shaft
8. Linkages to actuator.
9. Actuator.

Install or Connect

1. Actuator.
2. Linkages to actuator.
3. Retaining clip from actuator shaft.
4. Retaining clip form left hand rod.
5. Electrical connection at actuator.
6. Lower heater outlet.
7. Wires and radio assembly.
8. Screws and bezel at radio.
9. Negative battery cable.



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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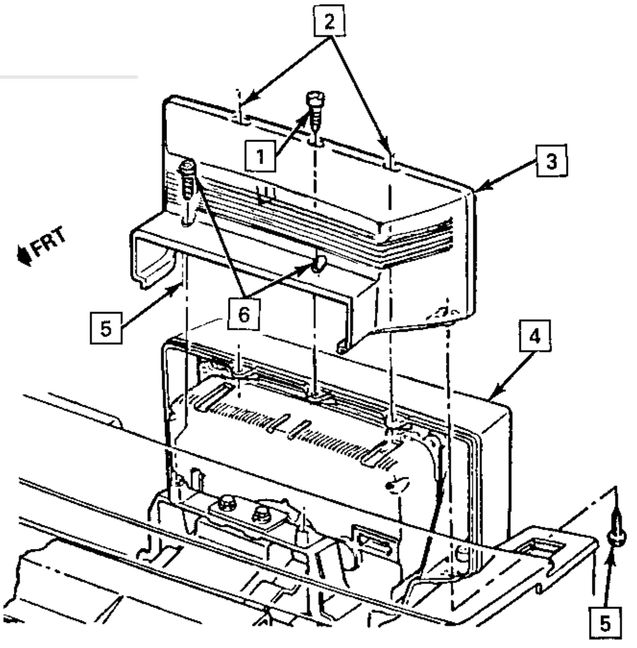
Figure 18 Heater Control Wiring Harness



1. INSTALL FIRST AT 1.5 N·m (13 LB. IN.)
2. INSTALL SECOND AT 1.5 N·m (13 LB. IN.)
3. COVER ASM.
4. HOUSING ASM.
5. INSTALL THIRD 1.5 N·m (13 LB. IN.)
6. INSTALL FOURTH 1.5 N·m (13 LB. IN.)

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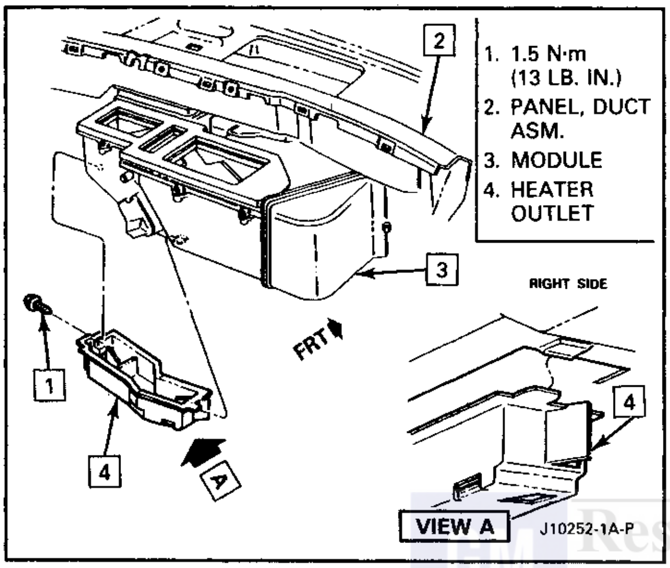
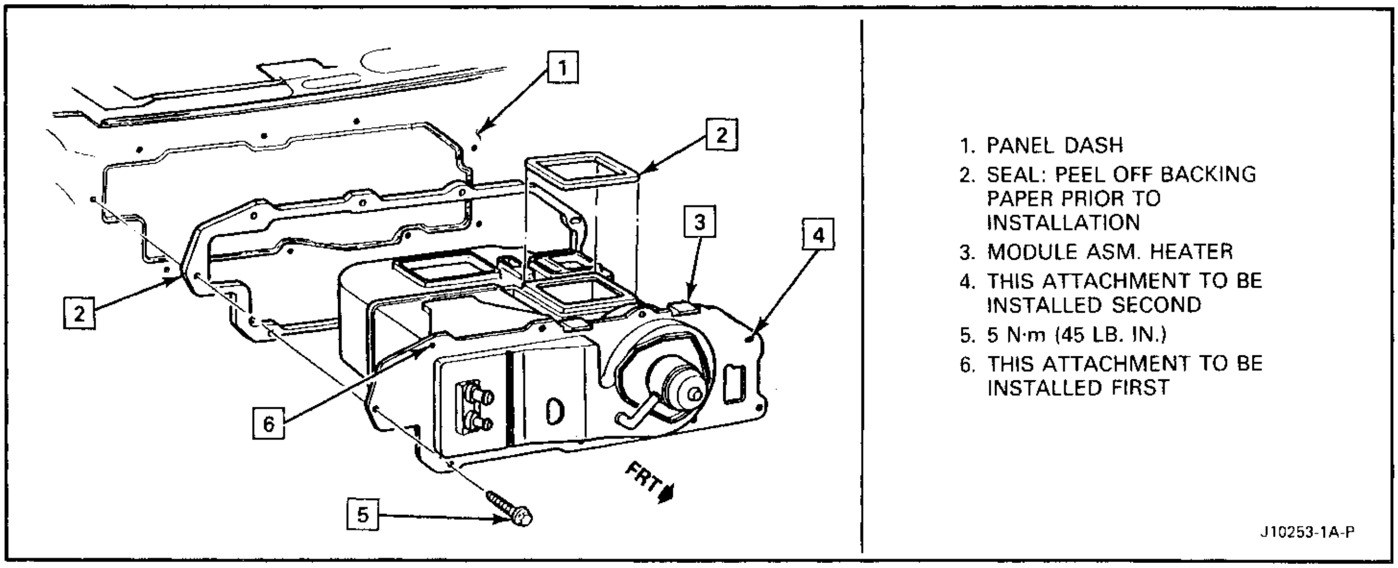
Figure 19 I.P. Service Cover



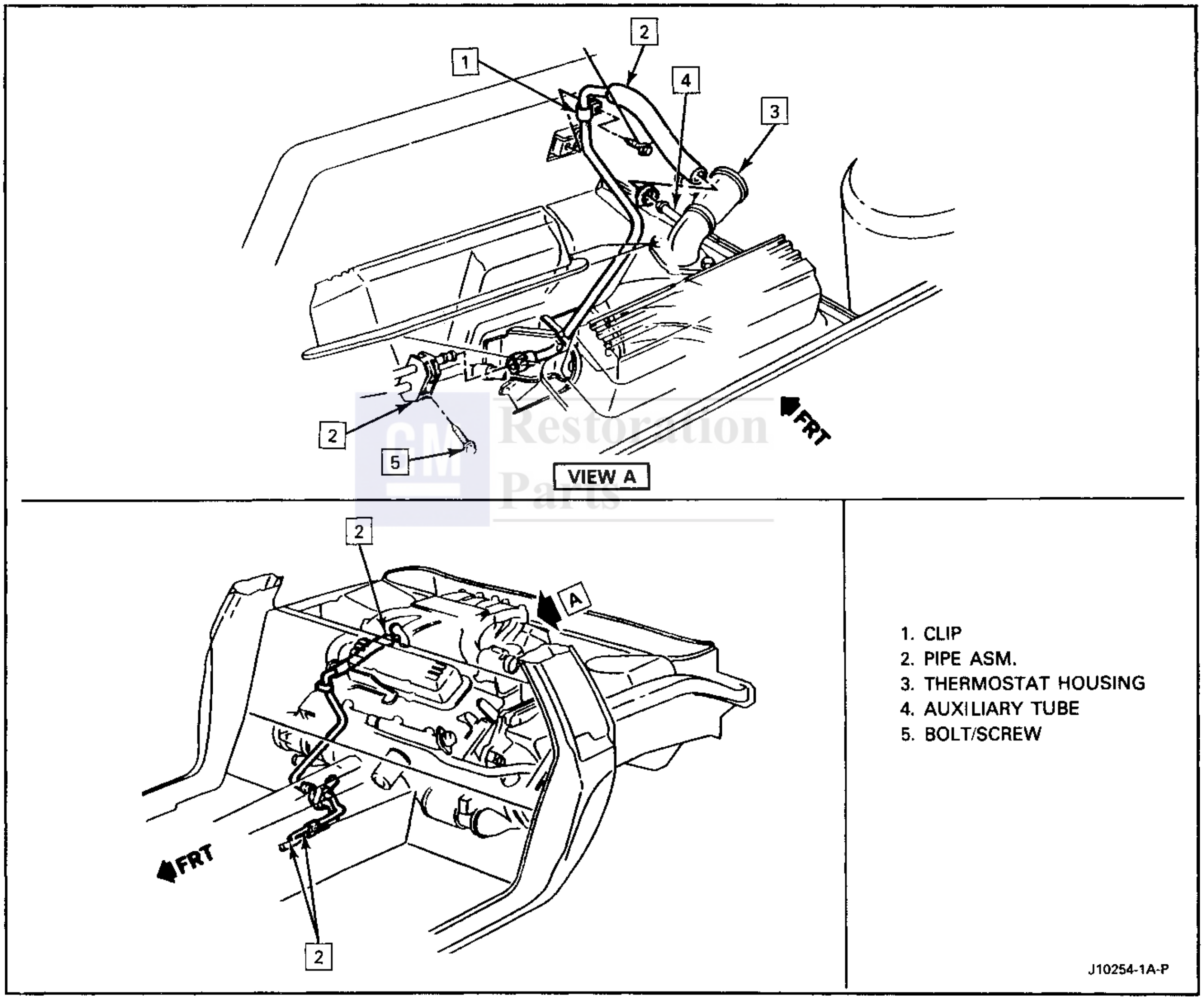
1. 1.5 N·m (13 LB. IN.)
2. PANEL, DUCT ASM.
3. MODULE
4. HEATER OUTLET

Figure 20 Lower (Floor) Heater Outlet



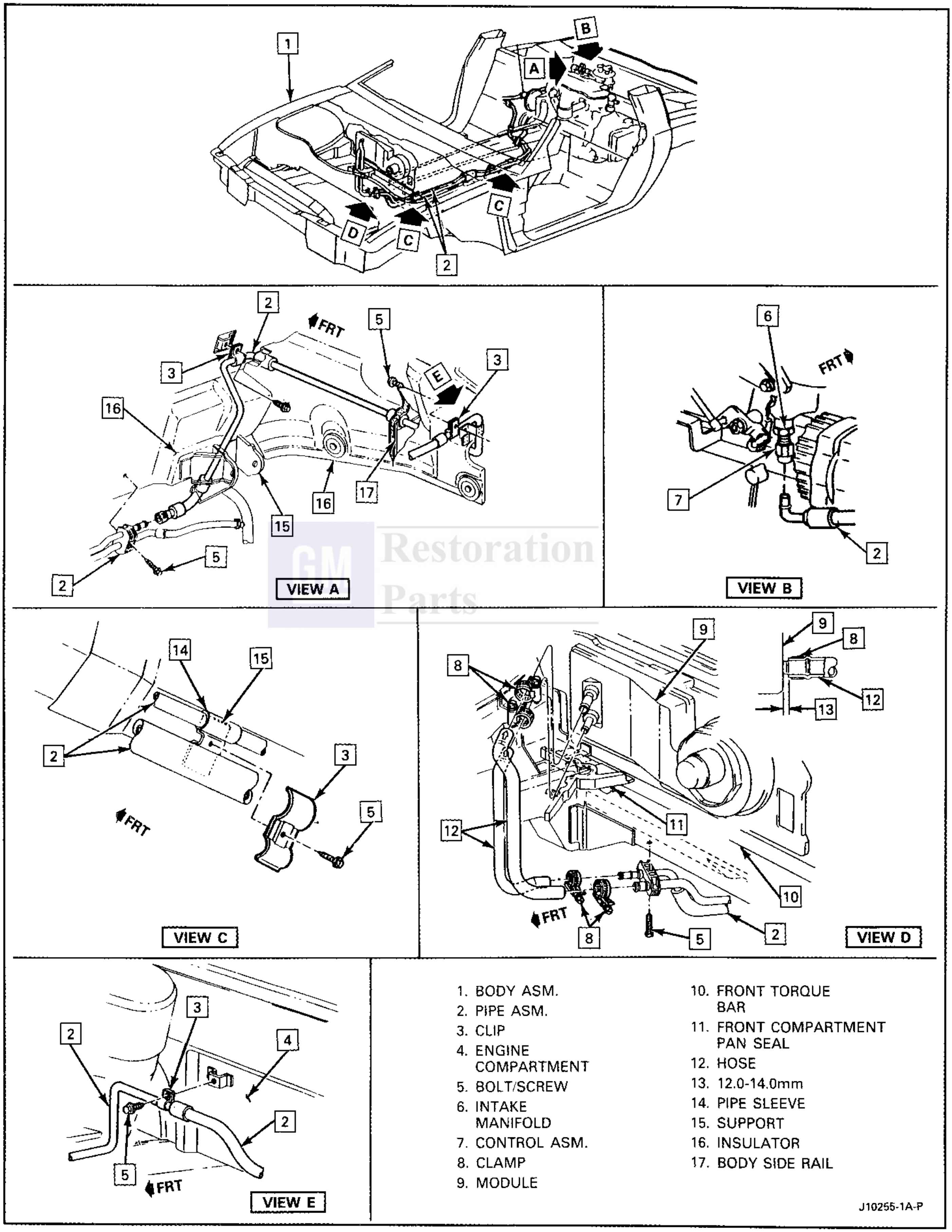
1. PANEL DASH
2. SEAL: PEEL OFF BACKING PAPER PRIOR TO INSTALLATION
3. MODULE ASM. HEATER
4. THIS ATTACHMENT TO BE INSTALLED SECOND
5. 5 N·m (45 LB. IN.)
6. THIS ATTACHMENT TO BE INSTALLED FIRST

Figure 21 Heater Module



1. CLIP
2. PIPE ASM.
3. THERMOSTAT HOUSING
4. AUXILIARY TUBE
5. BOLT/SCREW

Figure 22 Heater Hoses and Pipes, Engine Code 9



1. BODY ASM.
2. PIPE ASM.
3. CLIP
4. ENGINE COMPARTMENT
5. BOLT/SCREW
6. INTAKE MANIFOLD
7. CONTROL ASM.
8. CLAMP
9. MODULE
10. FRONT TORQUE BAR
11. FRONT COMPARTMENT PAN SEAL
12. HOSE
13. 12.0-14.0mm
14. PIPE SLEEVE
15. SUPPORT
16. INSULATOR
17. BODY SIDE RAIL

Figure 23 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

Currently there are two different air conditioning systems are available:

1. 4-Cylinder (2.5 Liter, LR8, V.I.N. Code R) V-5
2. 6-Cylinder (2.8 Liter, L44, V.I.N. Code 9) HR-6

All air conditioning systems that use the fixed displacement R-4 or HR-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 referenced to as V-5 type systems. 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 — CONTROL).

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 — CONTROL).

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 HR-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 to cooling fins to provide rapid transfer of heat. The air passing through the condenser cools the high-pressure refrigerant vapor causing it to condense to a liquid.

Expansion (Orifice) Tube

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

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

Evaporator Core

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

Accumulator

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

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

A low-side pressure Schrader valve service fitting is located near the top of the accumulator. A similar Schrader fitting 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.

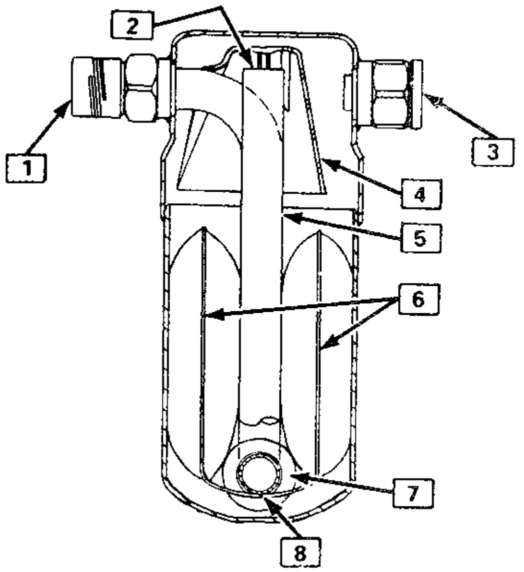


Figure 1 Accumulator — Interior Parts

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.

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

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Figure 2 A/C Performance Test

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 HR-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.

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"

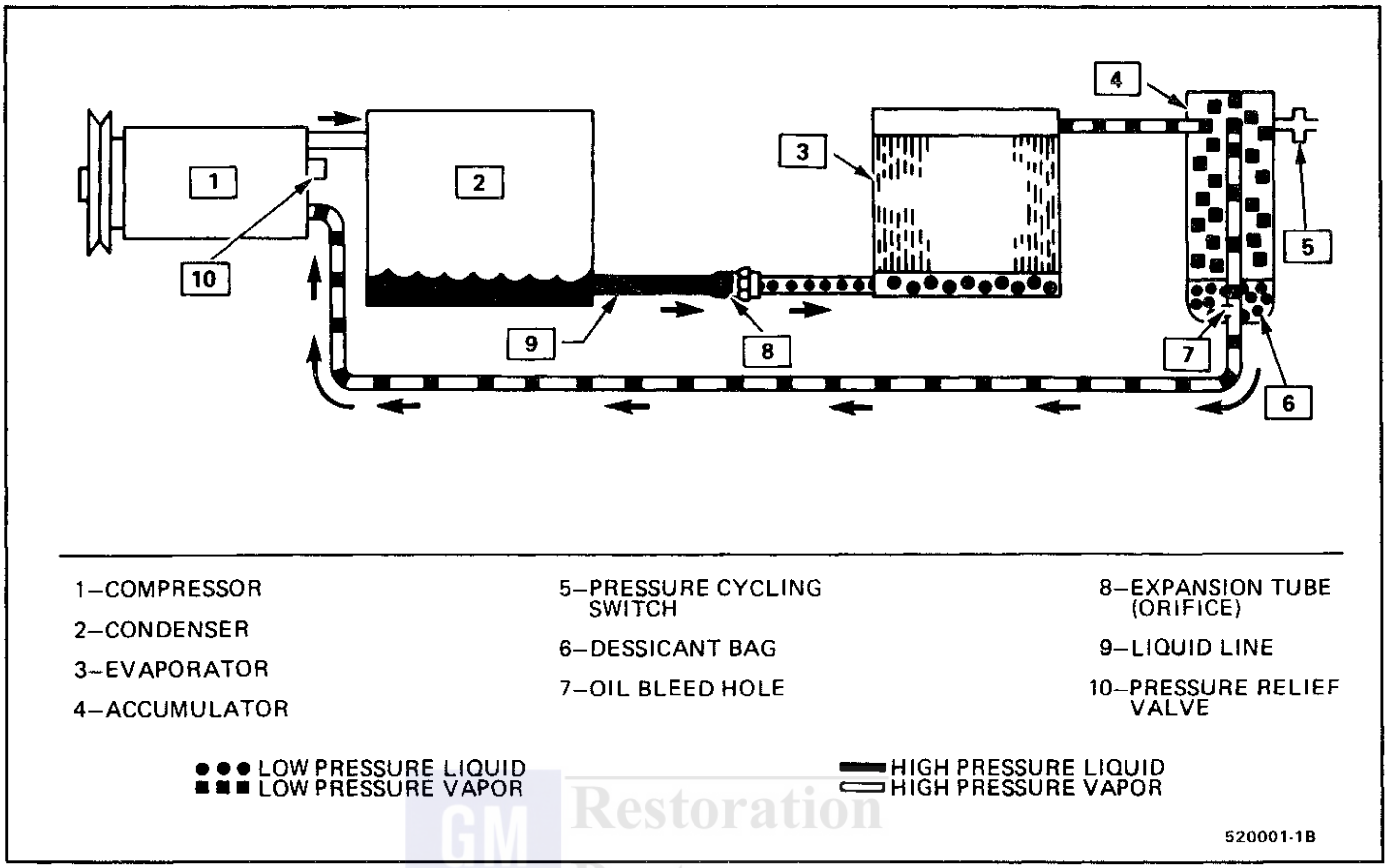


Figure 3 A/C System — Typical

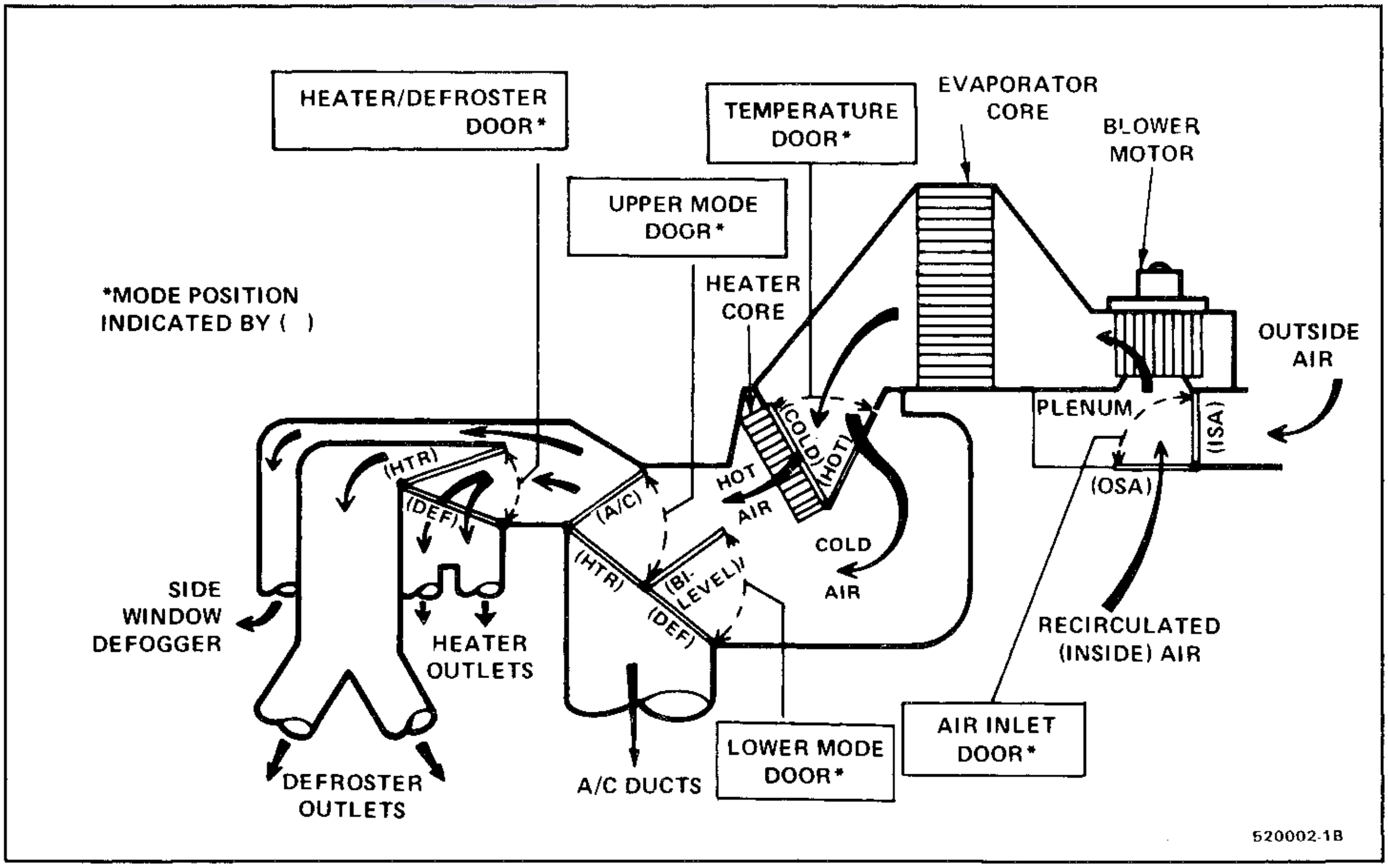
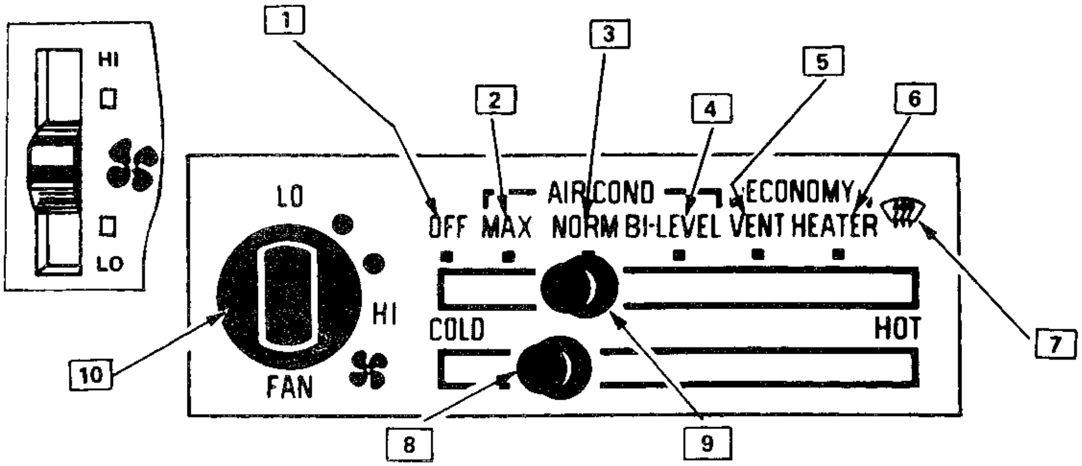


Figure 4 A/C Air Flow — Typical



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

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Figure 5 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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Figure 6 Pressure-Temperature Relationship of R-12

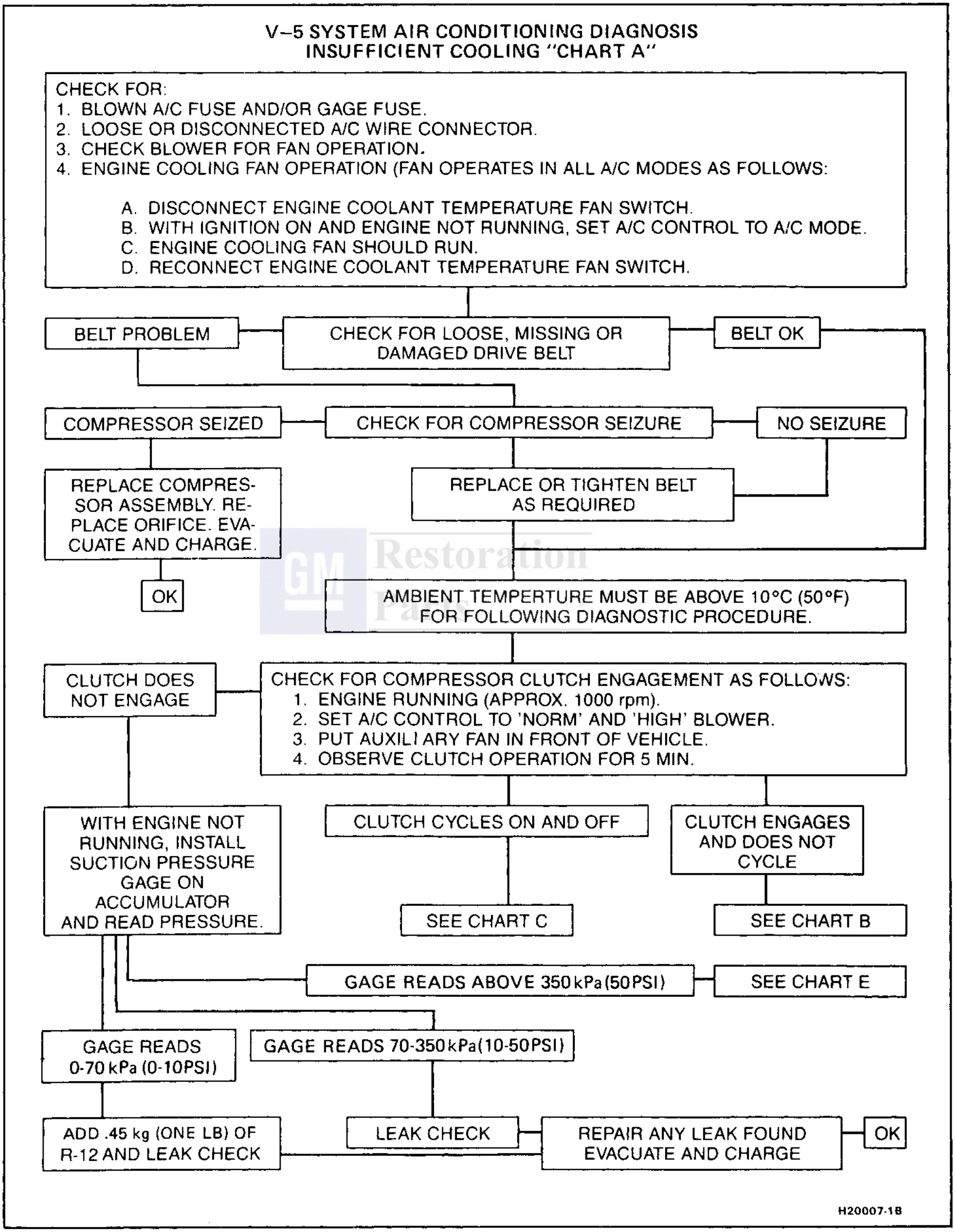

Figure 7 V-5 A/C System Insufficient Cooling Diagnostic Procedure (1 of 4)

V–5 SYSTEM AIR CONDITIONING DIAGNOSIS
INSUFFICIENT COOLING "CHART B"

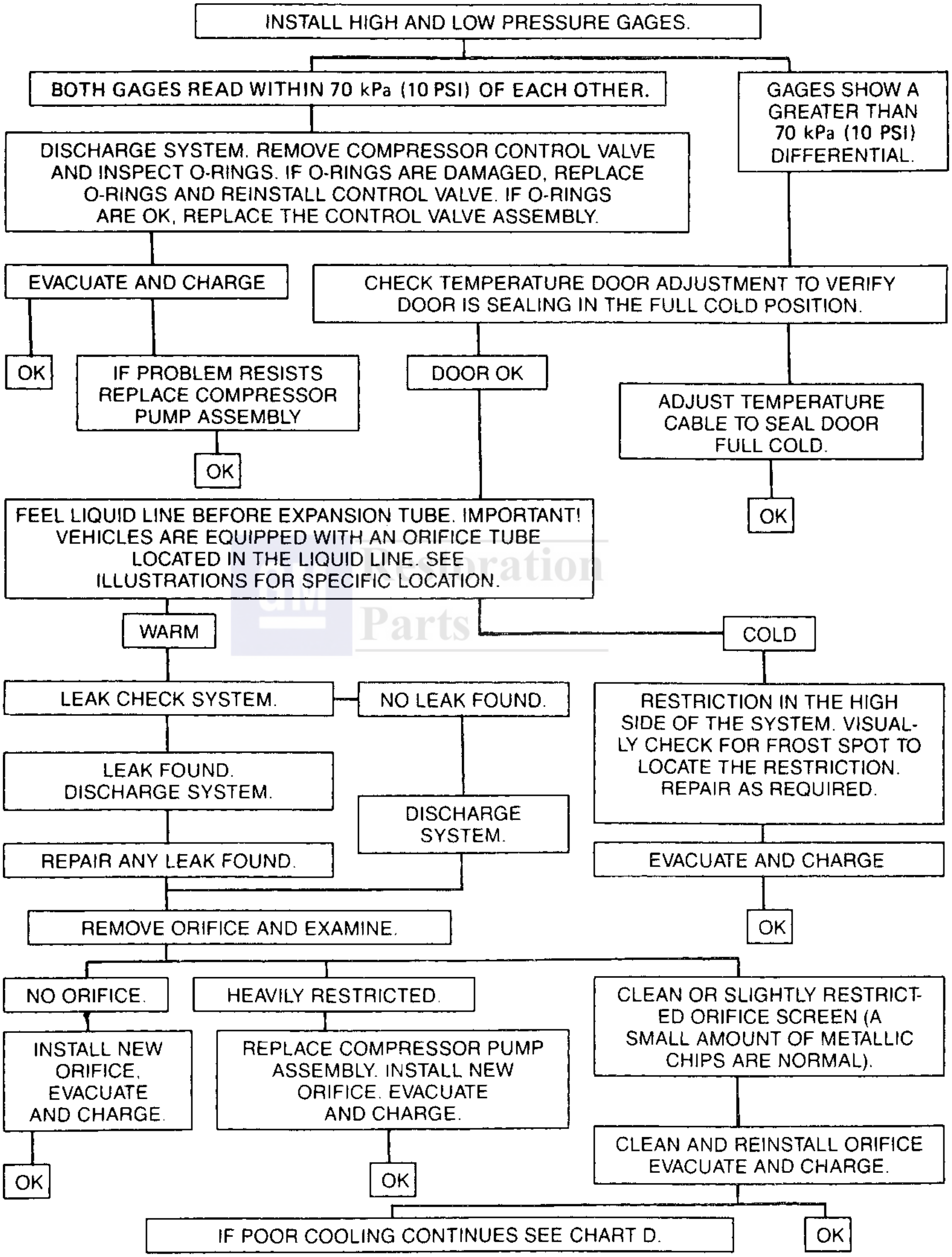

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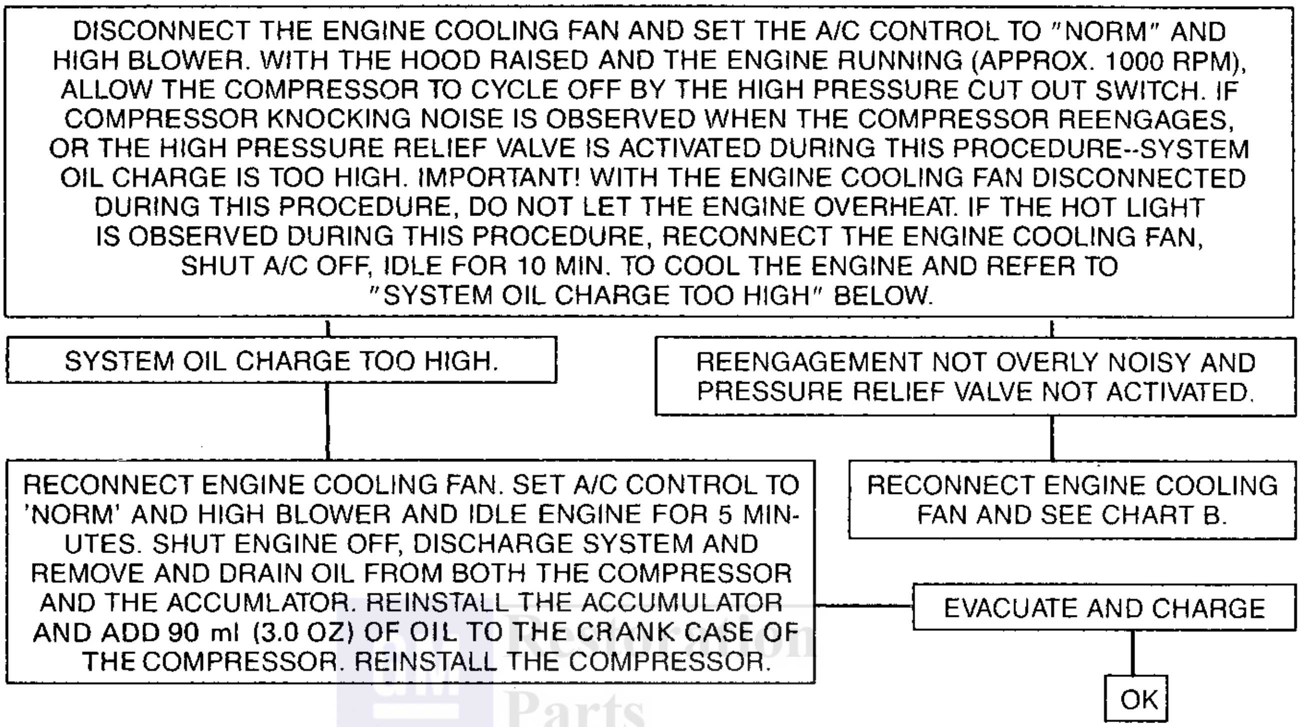
Figure 8 V-5 A/C System Insufficient Cooling Diagnostic Procedure (2 of 4)

V-5 SYSTEM AIR CONDITIONING DIAGNOSIS
INSUFFICIENT COOLING "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.

REENGAGEMENT NOT OVERLY NOISY AND PRESSURE RELIEF VALVE NOT ACTIVATED.

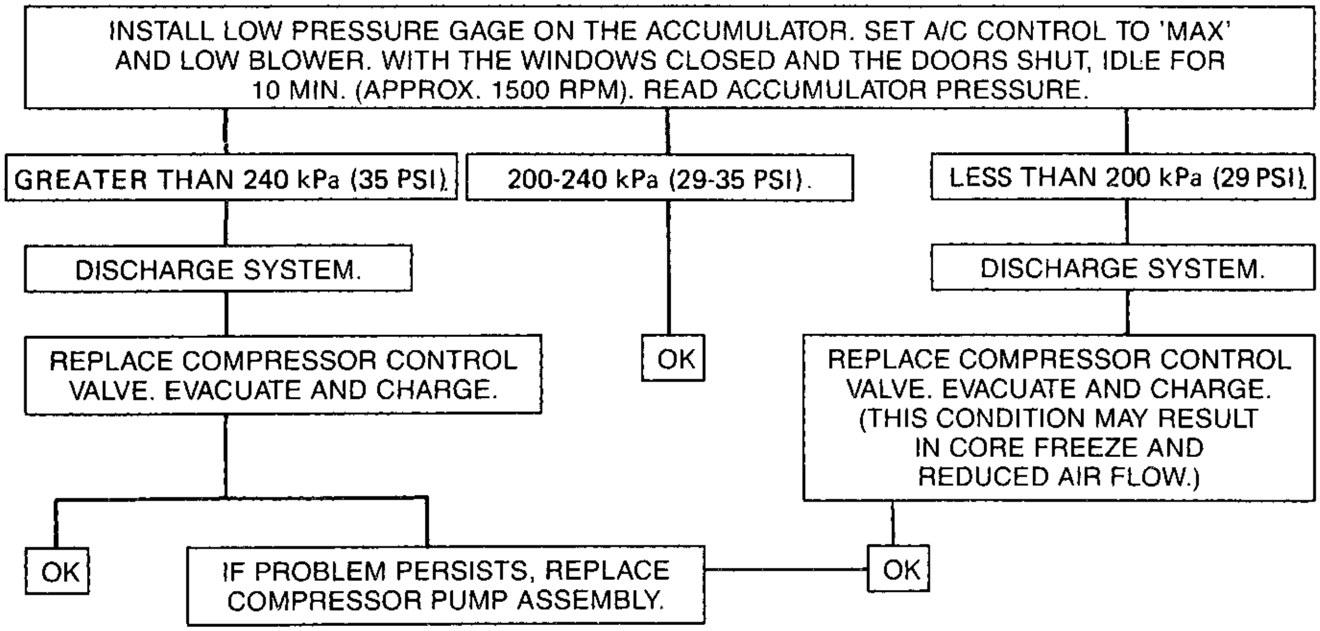
RECONNECT ENGINE COOLING FAN. SET A/C CONTROL TO 'NORM' AND HIGH BLOWER AND IDLE ENGINE FOR 5 MINUTES. SHUT ENGINE OFF, DISCHARGE SYSTEM AND REMOVE AND DRAIN OIL FROM BOTH THE COMPRESSOR AND THE ACCUMLATOR. REINSTALL THE ACCUMULATOR AND ADD 90 ml (3.0 OZ) OF OIL TO THE CRANK CASE OF THE COMPRESSOR. REINSTALL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

RECONNECT ENGINE COOLING FAN AND SEE CHART B.

EVACUATE AND CHARGE

OK

V–5 SYSTEM AIR CONDITIONING DIAGNOSIS
INSUFFICIENT COOLING "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).

200-240 kPa (29-35 PSI).

LESS THAN 200 kPa (29 PSI).

DISCHARGE SYSTEM.

REPLACE COMPRESSOR CONTROL VALVE. EVACUATE AND CHARGE.

OK

IF PROBLEM PERSISTS, REPLACE COMPRESSOR PUMP ASSEMBLY.

OK

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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Figure 9 V-5 A/C System Insufficient Cooling Diagnostic Procedure (3 of 4)

V–5 SYSTEM AIR CONDITIONING DIAGNOSIS
INSUFFICIENT COOLING "CHART E"

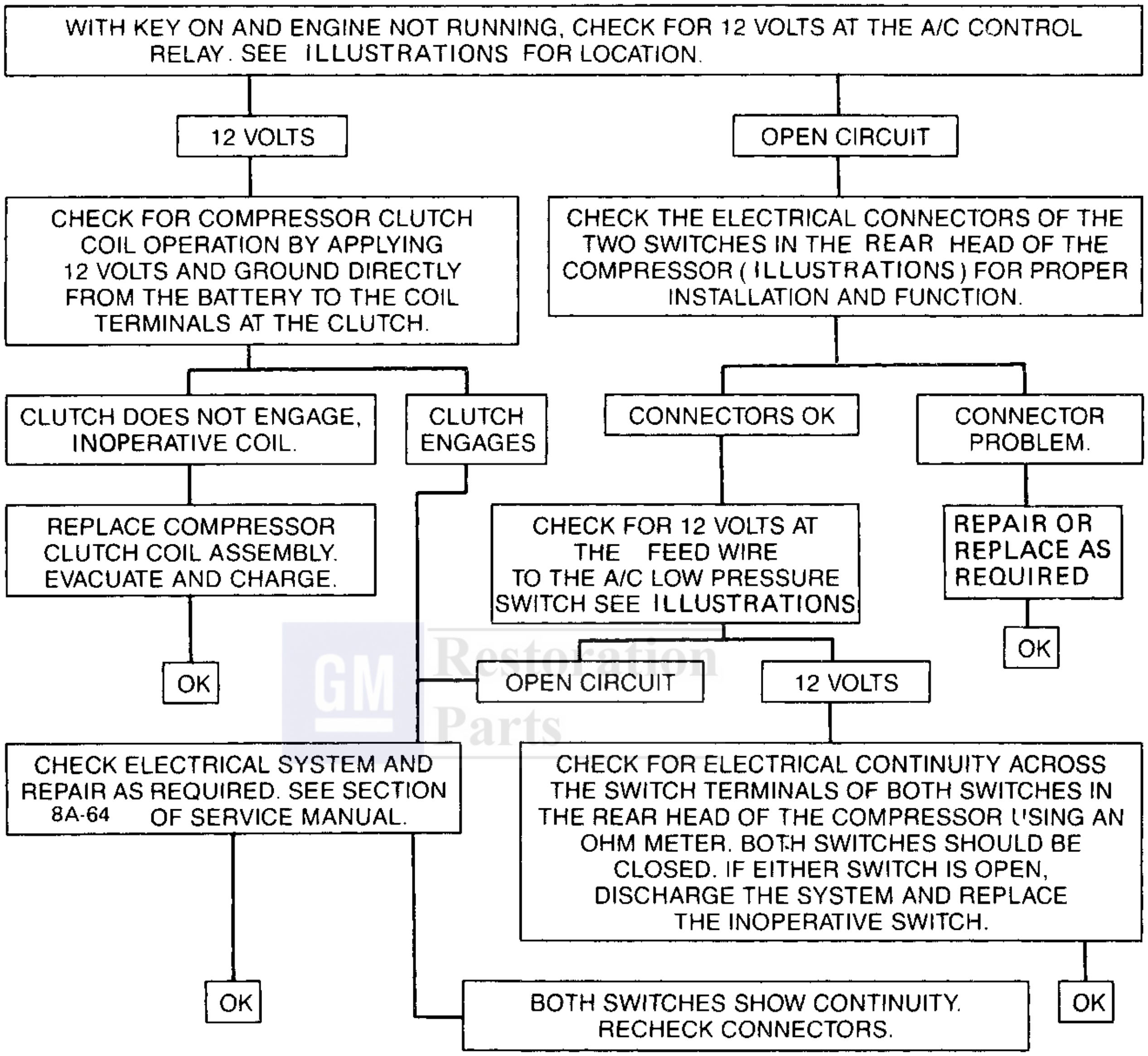

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Figure 10 V-5 A/C System Insufficient Cooling Diagnostic Procedure (4 of 4)

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

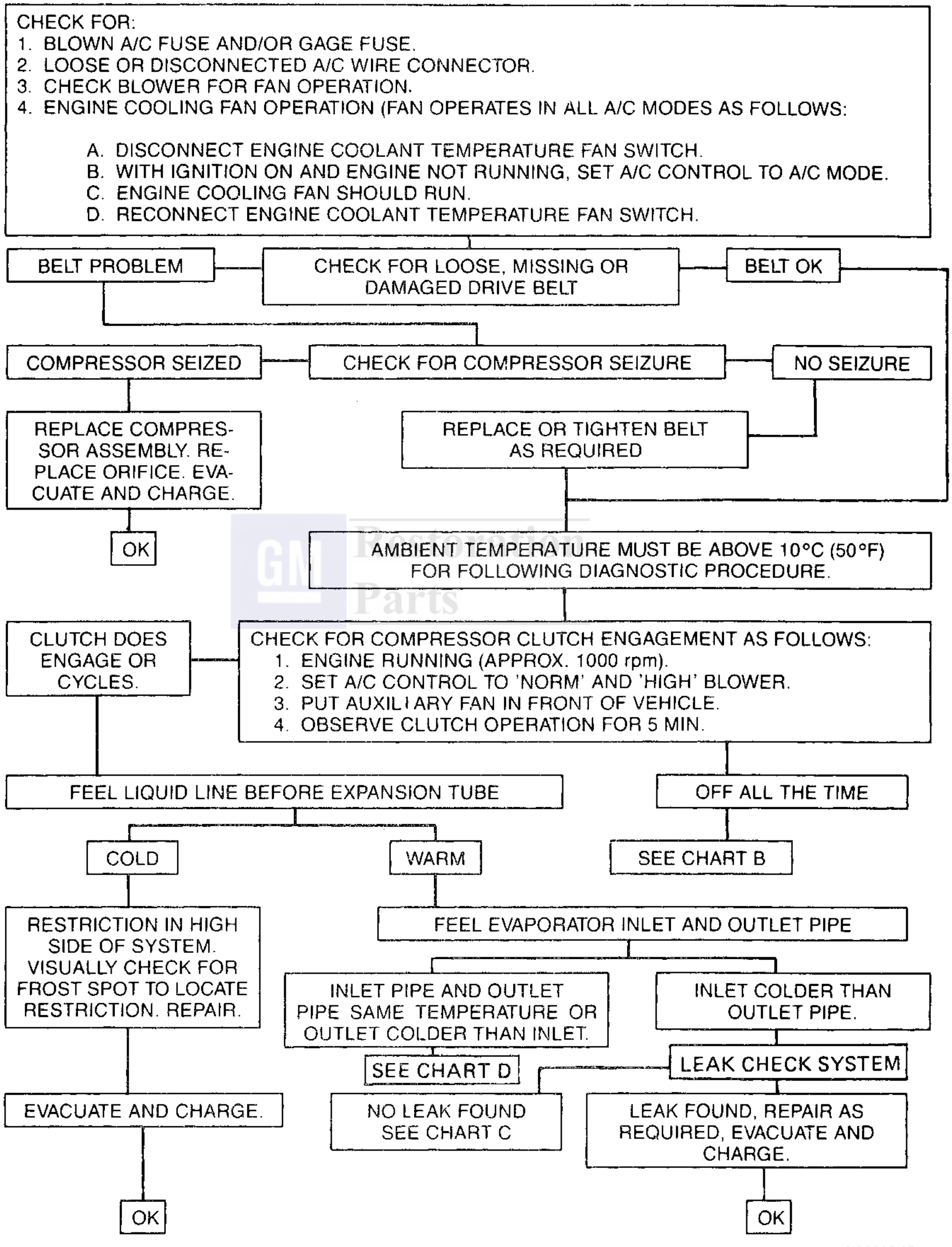

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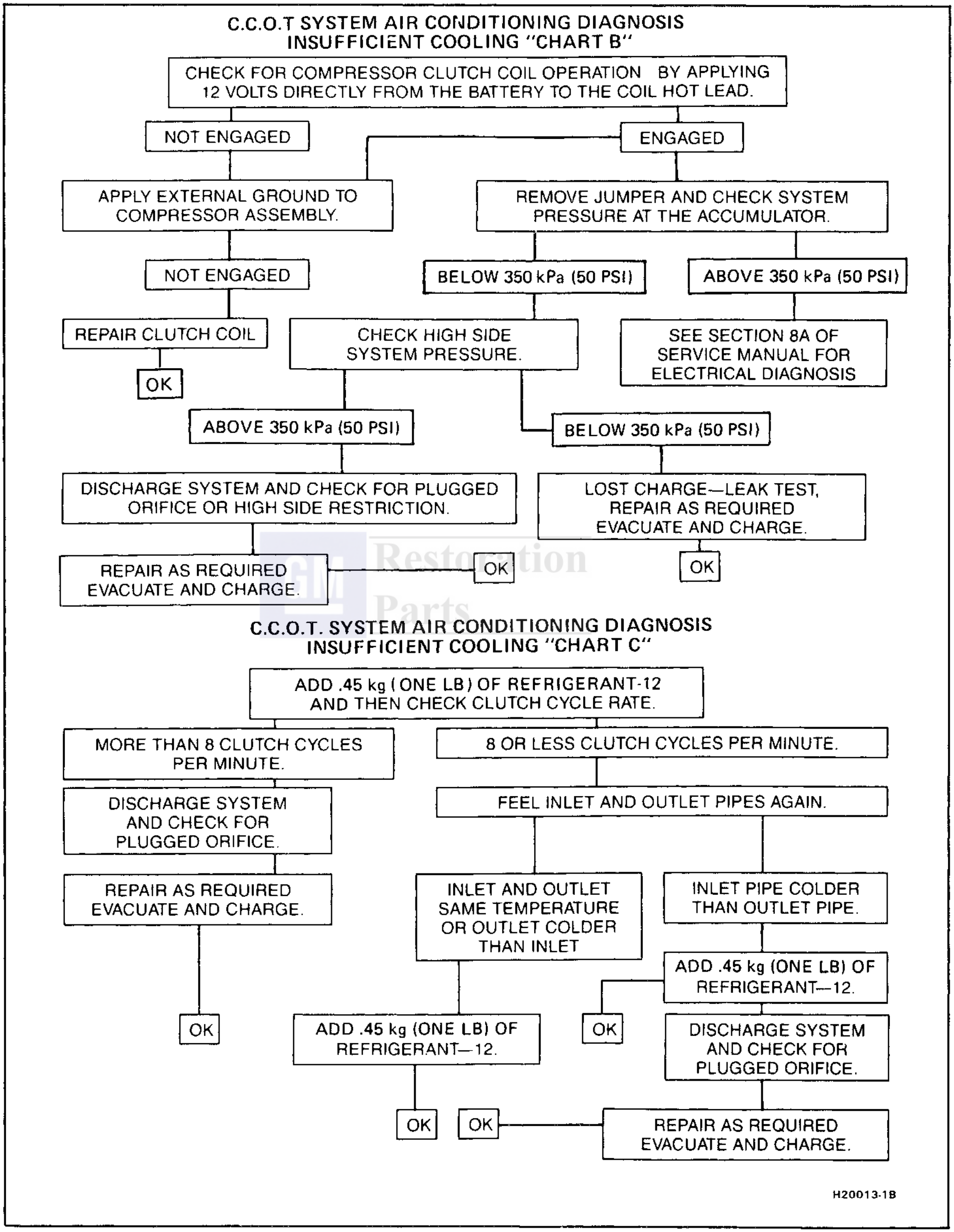
Figure 11 C.C.O.T. A/C System Insufficient Cooling Diagnostic Procedure (1 of 4)

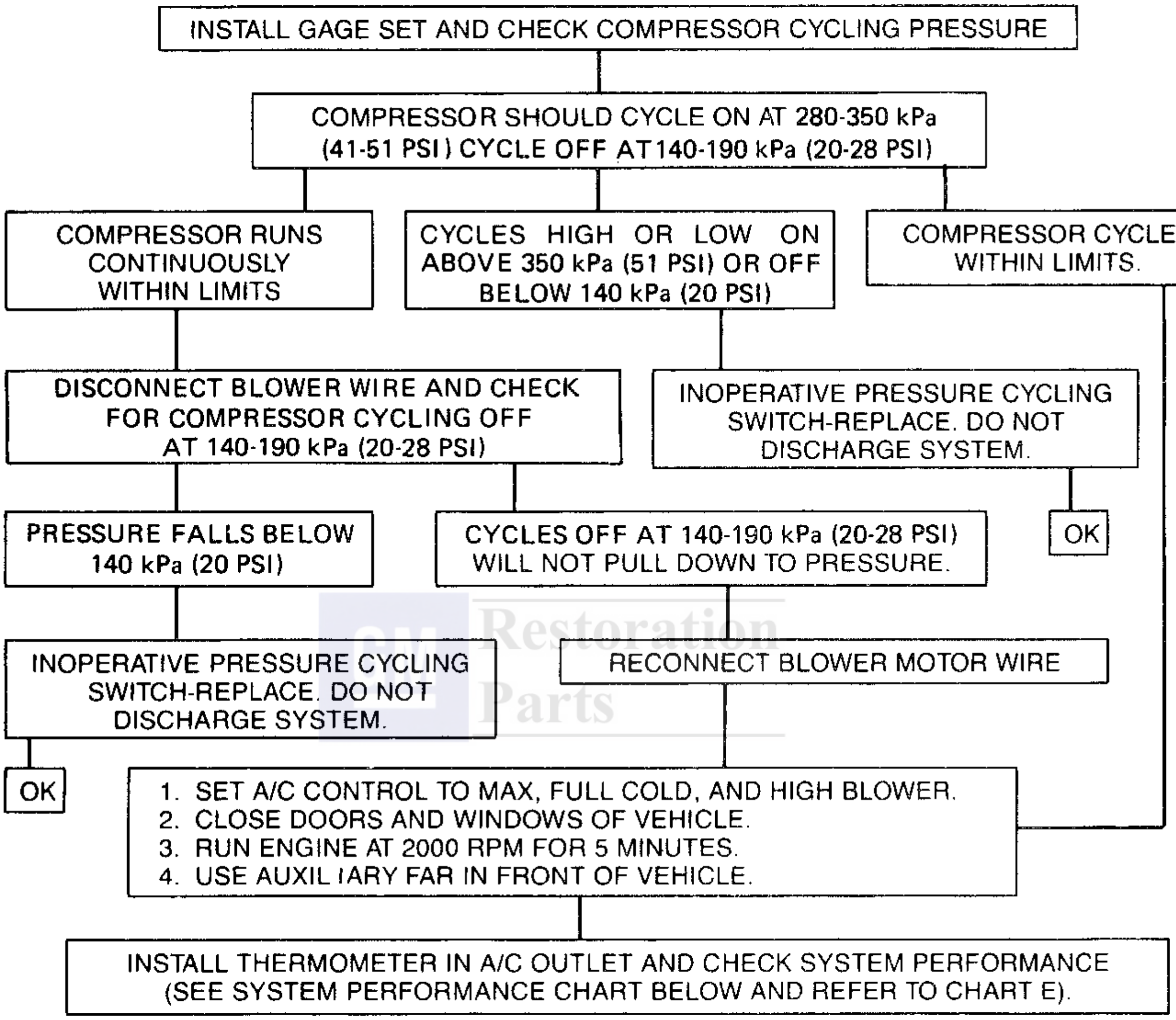


C.C.O.T SYSTEM AIR CONDITIONING DIAGNOSIS
INSUFFICIENT COOLING "CHART B"

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

Figure 12 C.C.O.T. A/C System Insufficient Cooling Diagnostic Procedure (2 of 4)

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



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

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

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Figure 13 C.C.O.T. A/C System Insufficient Cooling Diagnostic Procedure (3 of 4)

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

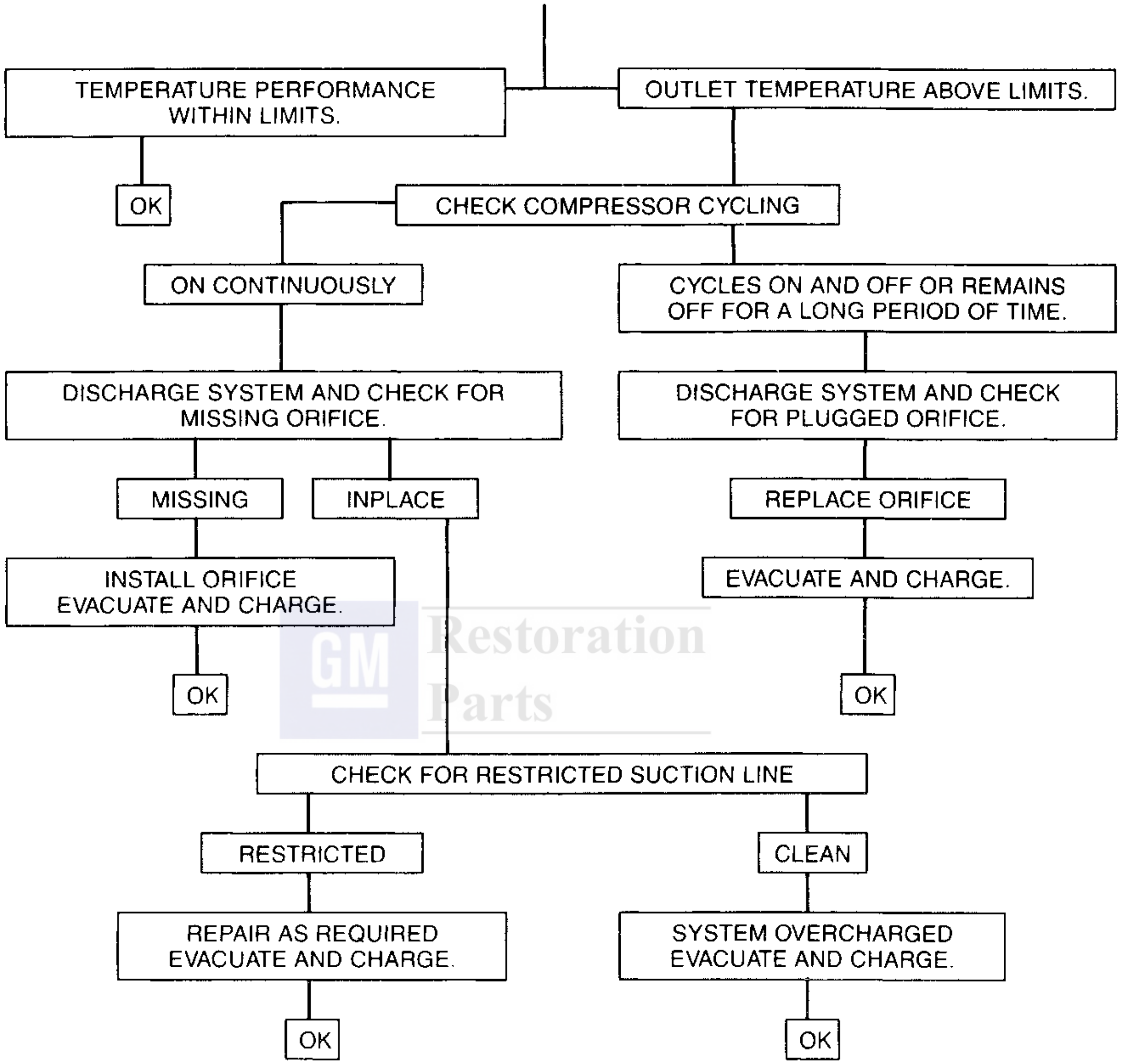


Figure 14 C.C.O.T. A/C System Insufficient Cooling Diagnostic Procedure (4 of 4)

ELECTRICAL/VACUUM SYSTEM DIAGNOSIS

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

LEAK TESTING THE REFRIGERANT SYSTEM

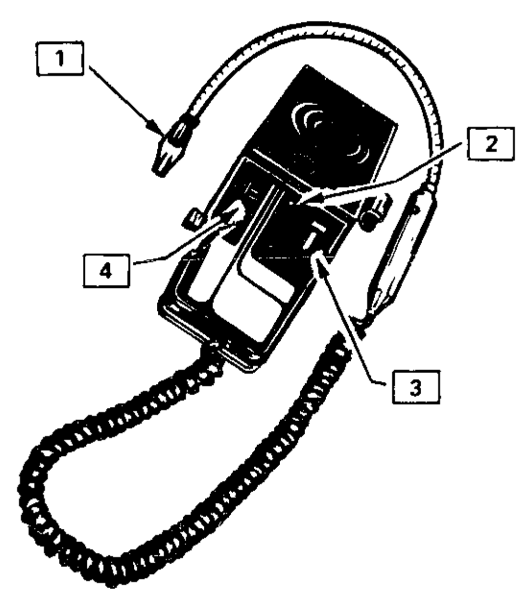
Whenever a refrigerant leak is suspected in the system or a service operation performed which results in disturbing lines or connections, it is advisable to test for leaks.

Liquid Leak Detectors

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

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

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



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

Figure 15 Electronic Leak Detector J-29547

ELECTRONIC LEAK TESTERS

(Figure 15)

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

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

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

SERVICE PROCEDURES

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

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

Tighten all tubing connections as shown in torque chart (Figure 16). Insufficient or excessive torque when tightening can result in loose joints or deformed joint parts. Either condition can result in refrigerant leakage.

Important

O-RING REPLACEMENT

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

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

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Figure 16 Pipe & Hose Connection Torque Chart

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

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

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

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

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

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

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

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

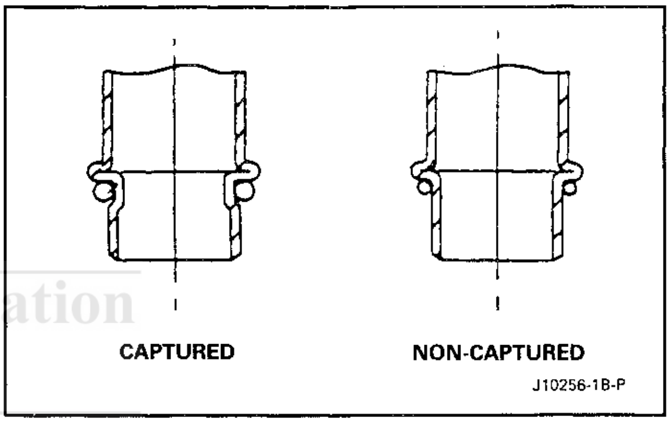


Figure 17 O-Ring Designs

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 with air conditioning lines or components.

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

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

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

HANDLING OF REFRIGERANT LINES AND FITTINGS

Tighten all tubing connections as shown in torque chart (Figure 16). 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 (Figure 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 Refrigerant-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.

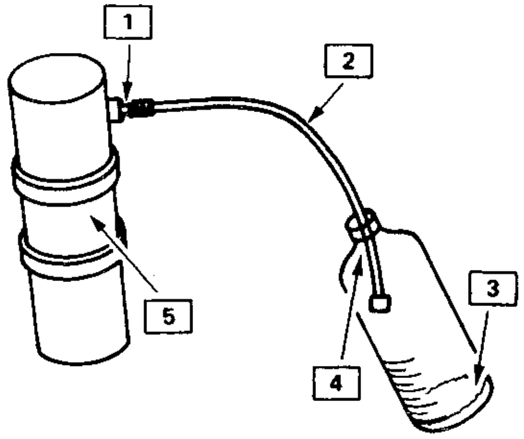
CAUTION: Never remove a gage line from its adapter when line is connected to A/C system. Always remove the line adapter from the service fitting to disconnect a line. Do not remove charging hose at gage set while attached to service low-side fitting. This will result in complete discharge of system due 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 (Figure 18). 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.)



1–USING J 5420 ADAPTER

2–GAGE HOSE

3–OIL

4–REFRIGERANT OIL BOTTLE UNCAPPED TO ALLOW GAS TO ESCAPE

5–ACCUMULATOR

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Figure 18 Discharging the A/C System Without Charging Station

4. When the system is completely discharged (no vapor escaping with hose fully tightened down), measure, record amount, and discard the collected refrigerant oil. If the measured quantity is 15ml (1/2 fl. oz.) or more, this amount of new 525 viscosity refrigerant oil must be added to system, plus any quantity in removed parts before system evacuation and charging with Refrigerant-12 (see REFRIGERANT OIL DISTRIBUTION for specific quantity of oil normally retained in removed parts).

Adding Oil to the Air Conditioning Refrigerant System

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

Refrigerant Oil Distribution

- V-5 COMPRESSOR SYSTEM — Requires 240ml (8 fluid ounces) of 525 viscosity refrigerant oil.

Total System Capacity	Residual Quantity	Add Quantity
V-5 -- 240ml (8 fl. oz.)	= 45ml (1.5 fl. oz.)	+ 195ml (6.5 fl. oz.)
HR6 -- 240ml (8 fl. oz.)	= 45ml (1.5 fl. oz.)	+ 195ml (6.5 fl. oz.)

J10251-1B-P

Figure 19 Refrigerant Oil Quanitities

- HR-6 COMPRESSOR SYSTEM — Requires 240ml (8 fluid ounces) of 525 viscosity refrigerant oil.

- R-4 COMPRESSOR SYSTEM — Requires 180ml (6 fluid ounces) of 525 viscosity refrigerant oil.

- New 525 viscosity refrigerant oil must be added to the system when components are replaced, as follows:
  a. All Compressors
  - If less than 1 oz. is drained - add 2 oz.
  - If more than 1 oz. is drained - add same amount.

  b. Accumulator Dehydrator
  - Add 3.5 oz. to new accumulator.

  c. Evaporator
  - Add 3 oz. oil.

  d. Condenser
  - Add 1 oz. oil.

- Refrigerant oil loss due to a large leak
  a. If the refrigerant charge is abruptly lost due to a large refrigerant leak, approximately 3 oz. of refrigerant oil will be carried out of the system suspended in the refrigerant. Any failure that causes an abrupt refrigerant discharge will experience this oil loss. Failures that allow the refrigerant to seep or bleed off over time do not experience this oil loss.
  b. Upon replacement of a component which caused a large refrigerant leak, add 3 oz. of new 525 viscosity refrigerant oil plus the required amount of oil for the particular component (as outlined above).
  c. Add the oil directly to the replaced component if possible. If the oil cannot easily be added to the replaced part, add the oil to the accumulator.

Evacuating and Charging the A/C System

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

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 "0". 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 "0" 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 Figure 20.
   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 Figure 20, 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.

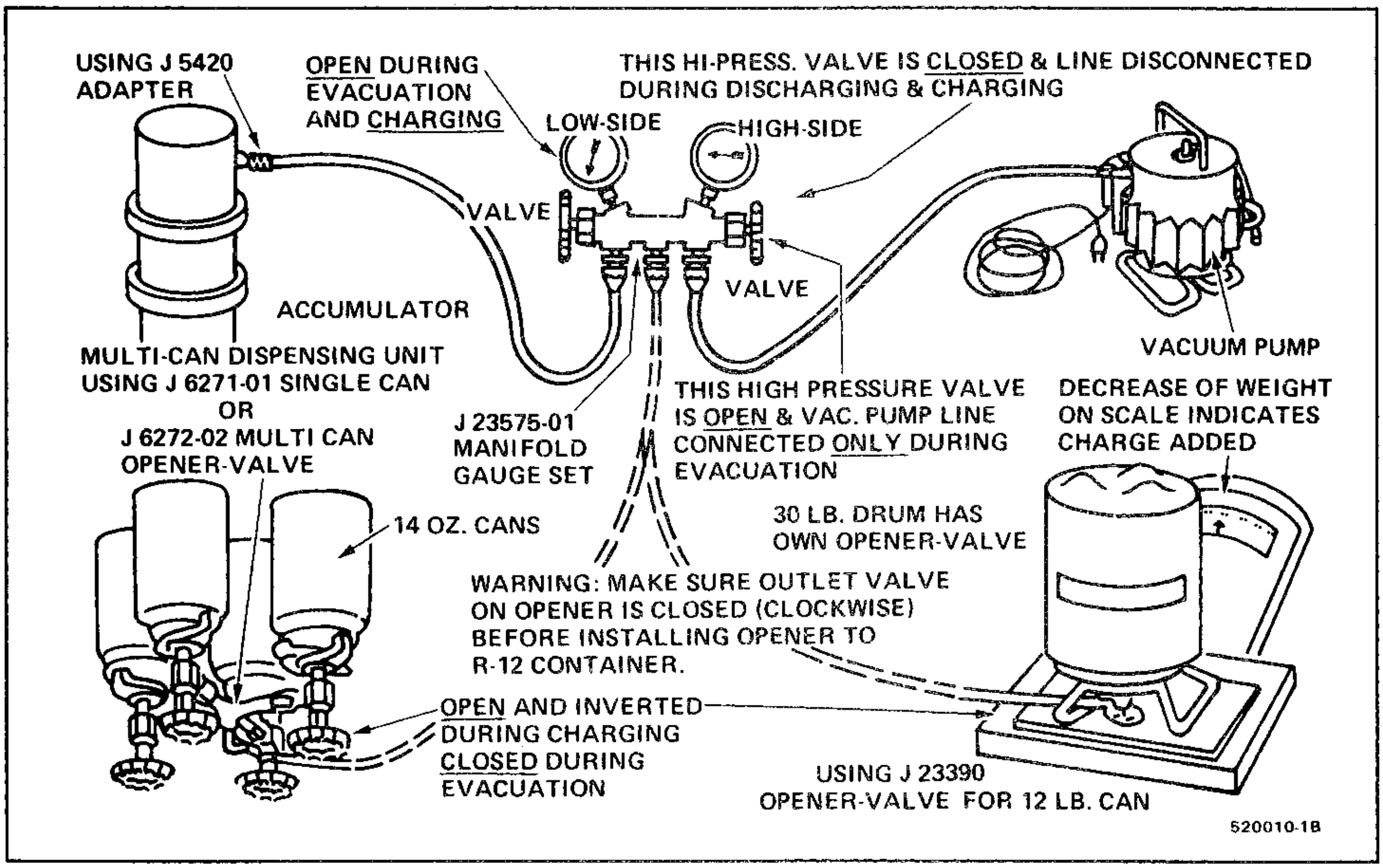


Figure 20 Charging the System With Disposable Can or Drum

5. If vacuum does not hold for five (5) minutes, charge system with 420ml (1/2 pound) Refrigerant-12 and leak check. Discharge system again and repair leak as necessary. Repeat evacuation procedure.

To Begin Charging of the A/C System

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

   The charging operation can be sped up by using a large volume fan to pass air over the condenser. If condenser temperature is maintained below charging cylinder temperature, Refrigerant-12 will enter the system more rapidly.
4. Turn off R-12 source valve and run engine for 30 seconds to clear lines and 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.

IN-LINE AIR CONDITIONING FILTER INSTALLATION

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

Aluminum Line Installation

(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 sufficient amount 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 21). 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, torque fitting nut while holding the can with a second open-end wrench. (Figure 21)
6. Repeat assembly procedure for opposite end of can.
7. Evacuate/recharge system per recommended procedure (see Service Manual). If system has been severely contaminated, examine the orifice tube to determine if replacement will be necessary.

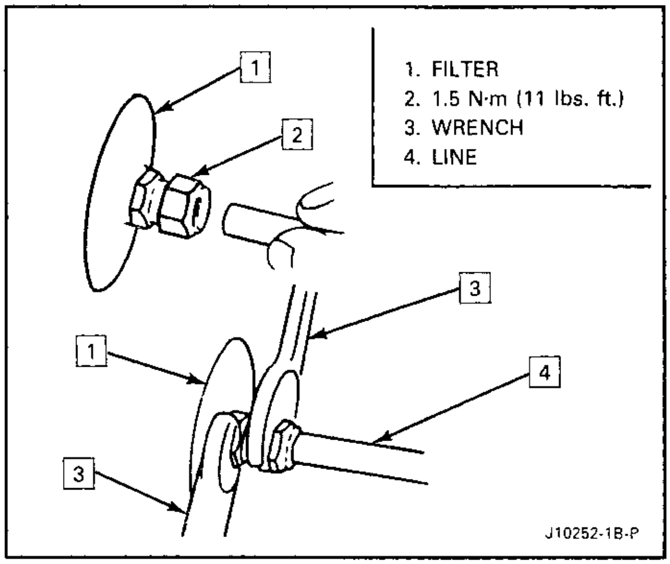
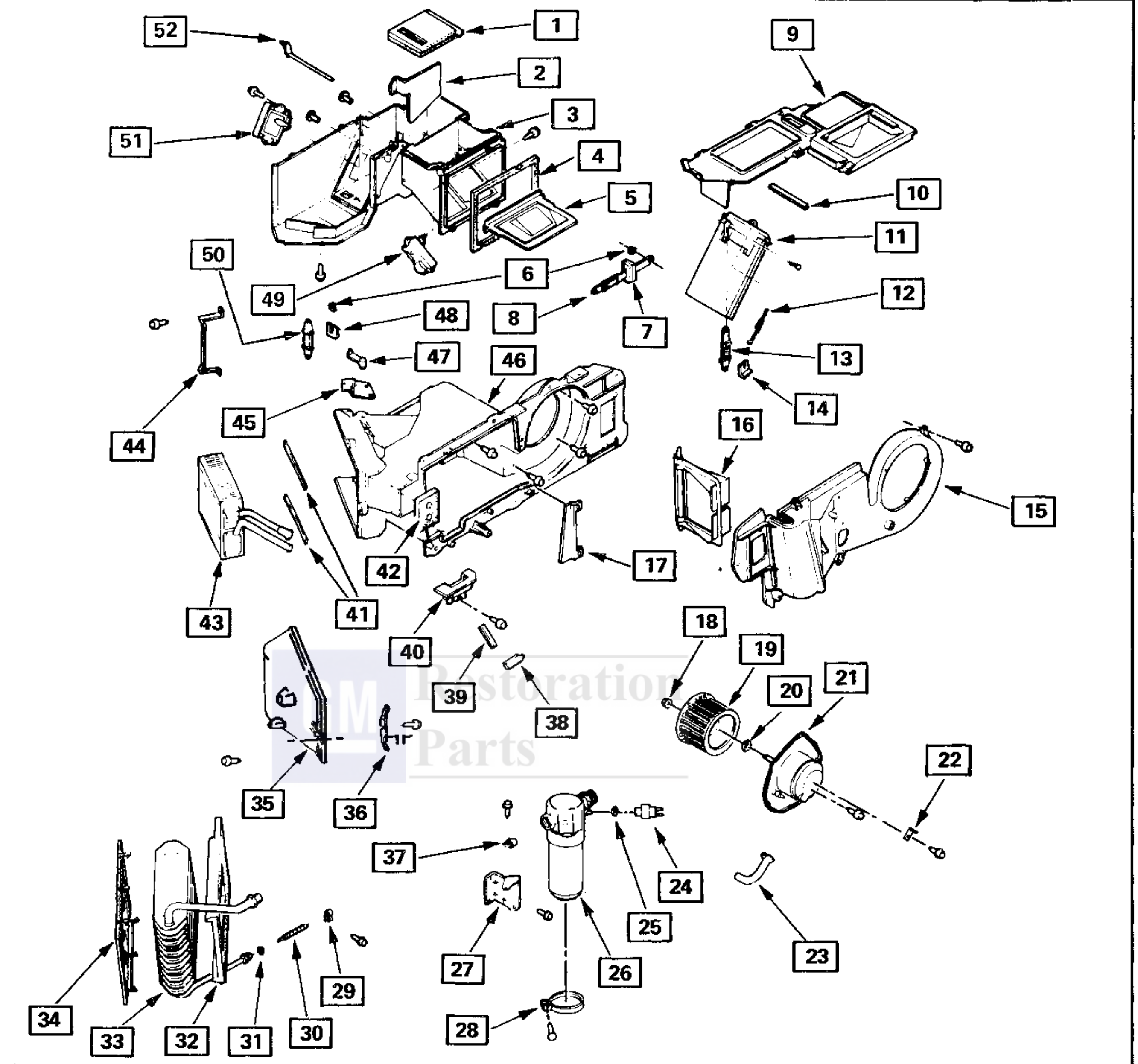


Figure 21 Aluminum Line Filter Installation

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.



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.

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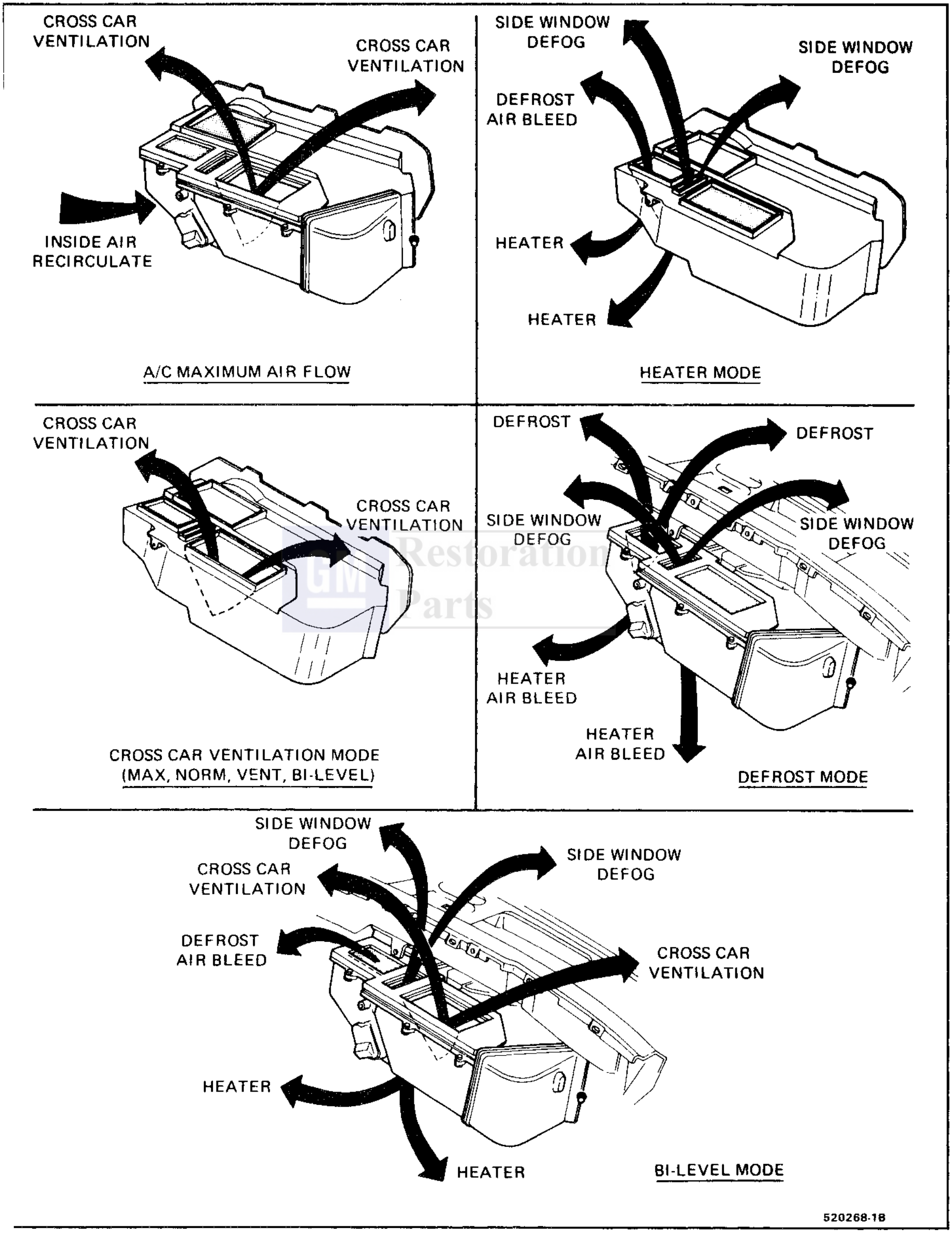
Figure 22 A/C Module Disassembled View



A/C MAXIMUM AIR FLOW

HEATER MODE

CROSS CAR VENTILATION MODE (MAX, NORM, VENT, BI-LEVEL)

DEFROST MODE

BI-LEVEL MODE

Figure 23 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

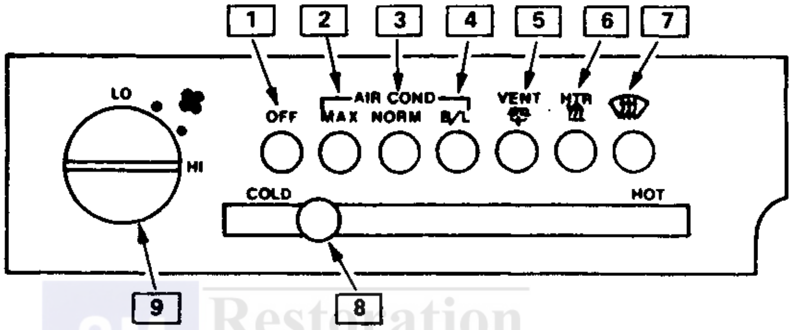


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Figure 24 A/C Controller

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.

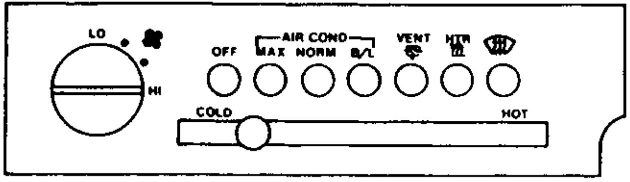

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Figure 25 A/C Controller Functional Check

Install or Connect

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

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

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

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

ACCUMULATOR ASSEMBLY SERVICE

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

The accumulator assembly should only be replaced when:

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

DO NOT Replace the accumulator assembly when:

- merely a dent is found in the outer shell of the accumulator.
- the 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.

NOTICE: Tighten all tubing connections as shown in torque chart (Figure 16). Insufficient or excessive torque when tightening can result in loose joints or deformed joint parts. Either condition can result in refrigerant leakage.

ON-VEHICLE 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.).
7. Evacuate and charge system.

BLOWER MOTOR AND 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.

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.

Install or Connect

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

BLOWER RESISTOR

Remove or Disconnect

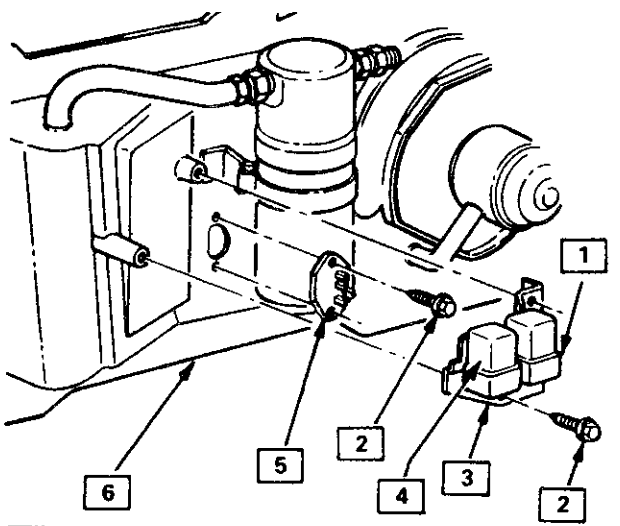
1. Negative (−) battery cable.
2. Electrical connection.
3. Two screws.
4. Blower resistor.

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.



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.

Figure 26 A/C Power Switching — High Blower Relay and Resistor

PRESSURE CYCLING SWITCH (VIN 9 Only)

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 OR 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.

LOW PRESSURE CUT OFF 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.).

4. 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. 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.).

5. 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.

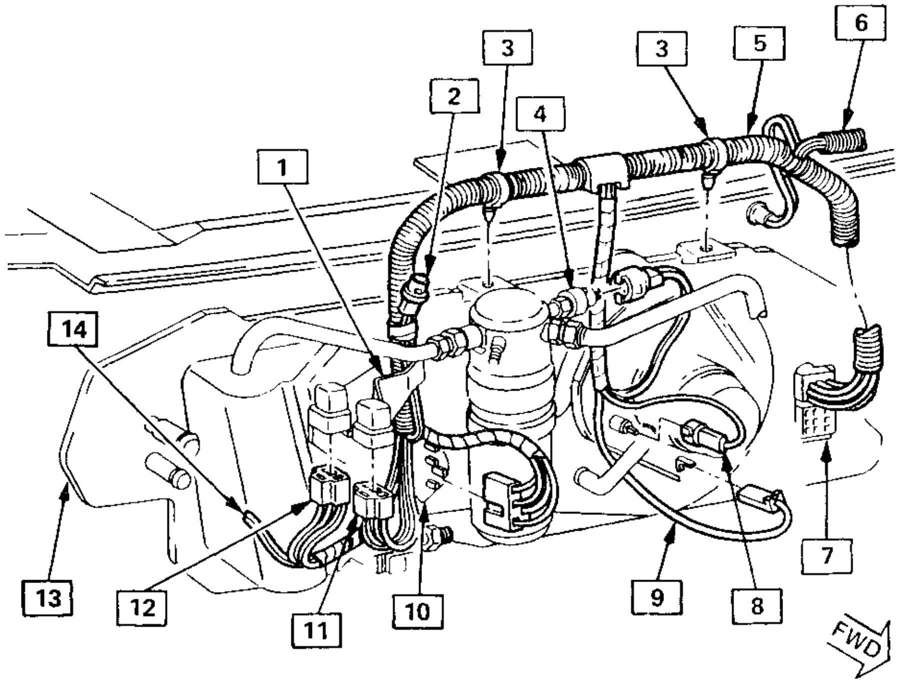
Install or Connect

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.



1 — ROUTE HARN. & LEADS BEHIND BRACKET & RELAY ASM. AS SHOWN
2 — TO FORWARD COURTESY LAMP
3 — CLIP
4 — PRESSURE CYCLING SWITCH (L44 ONLY)
5 — WIRE ASM.
6 — TO W/SHIELD WIPER MTR.
7 — MAIN BODY WIRING HARNESS BULKHEAD
8 — BLOWER MOTOR
9 — BLOWER MOTOR GROUND
10 — A/C RESISTOR
11 — A/C HI BLOWER RELAY
12 — A/C POWER SWITCHING RELAY
13 — A/C MODULE
14 — TO W/S WASHER PUMP

H20076-1B

Figure 27 A/C Module Wiring

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.

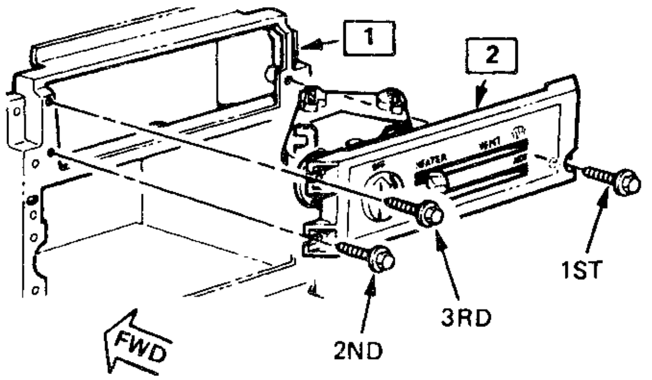
Inspect

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.



1–CARRIER ASSEMBLY

2–CONTROL ASSEMBLY

520084-1A

Figure 28 A/C Controller Installation (Heater Control Shown)

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

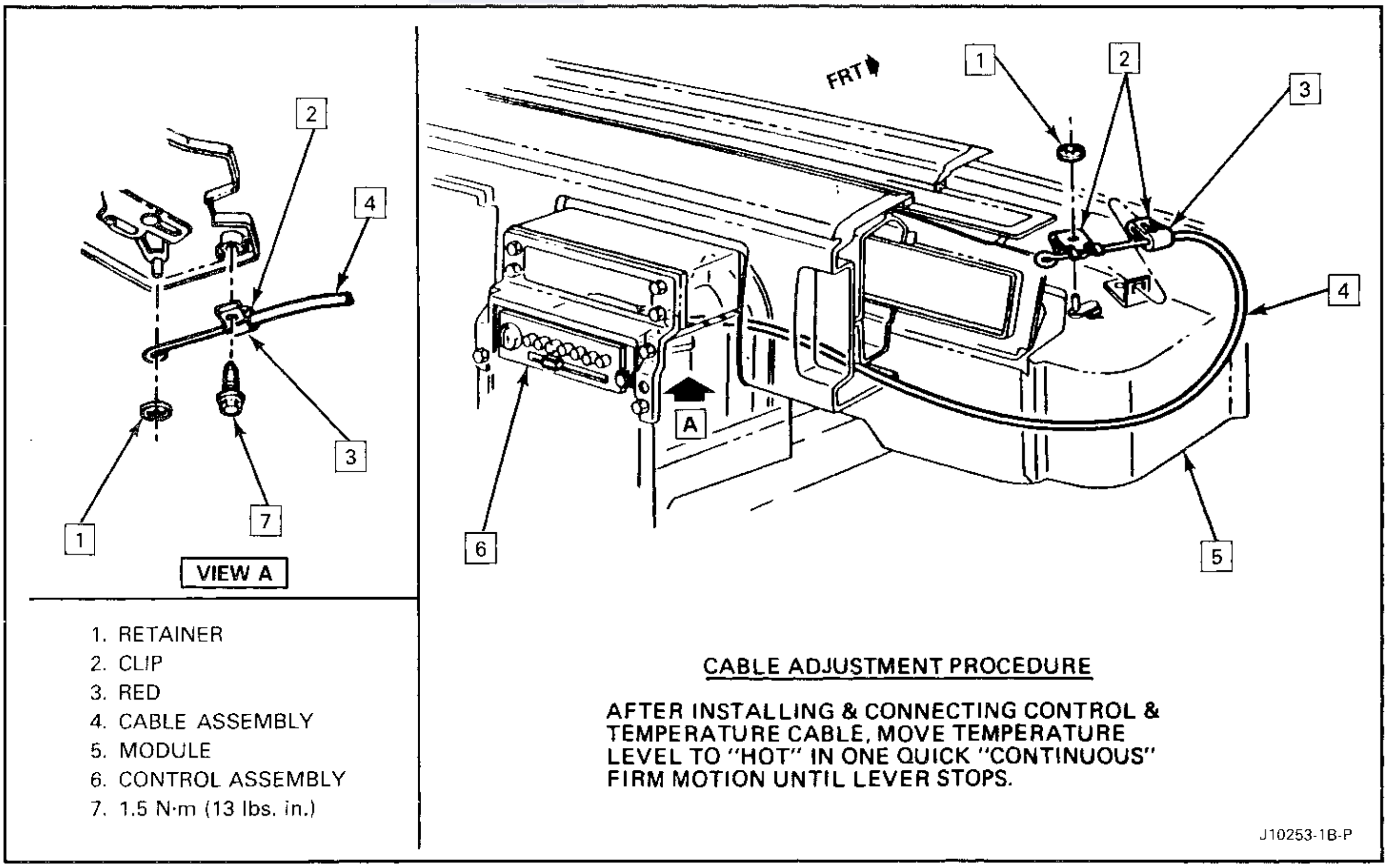
1. Four bolts at trim plate assembly.
2. Trim plate.
3. Three bolts at controller.
4. Controller.
5. Temperature cable at controller.
6. Right speaker grill.
7. Four bolts at speaker.
8. Electrical connection at speaker.
9. Speaker.
10. Temperature control cable at heater A/C module.

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

See Section 8C for removal.

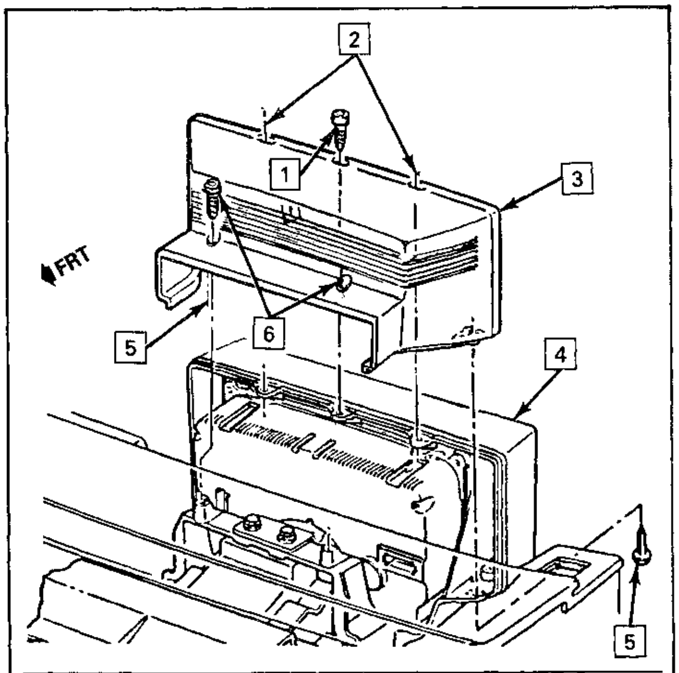


1. RETAINER
2. CLIP
3. RED
4. CABLE ASSEMBLY
5. MODULE
6. CONTROL ASSEMBLY
7. 1.5 N·m (13 lbs. in.)

CABLE ADJUSTMENT PROCEDURE

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

Figure 29 Temperature Control Cable Routing



1. INSTALL FIRST AT 1.5 N·m (13 LB. IN.)
2. INSTALL SECOND AT 1.5 N·m (13 LB. IN.)
3. COVER ASM.
4. HOUSING ASM.
5. INSTALL THIRD 1.5 N·m (13 LB. IN.)
6. INSTALL FOURTH 1.5 N·m (13 LB. IN.)

J10251-1A-P

Figure 30 I.P. Cluster Cover Mounting

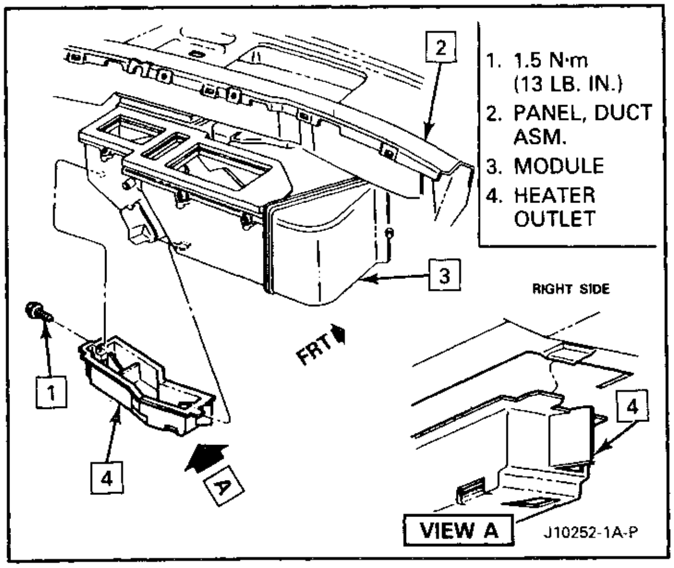
LOWER (FLOOR) HEATER OUTLET

Remove or Disconnect

1. Screw.
2. Outlet.

Install or Connect

1. Outlet.
2. Screw.



1. 1.5 N·m (13 LB. IN.)
2. PANEL, DUCT ASM.
3. MODULE
4. HEATER OUTLET

J10252-1A-P

Figure 31 Floor Heat Outlet

COMPRESSOR CLUTCH CONTROL RELAY

Remove or Disconnect

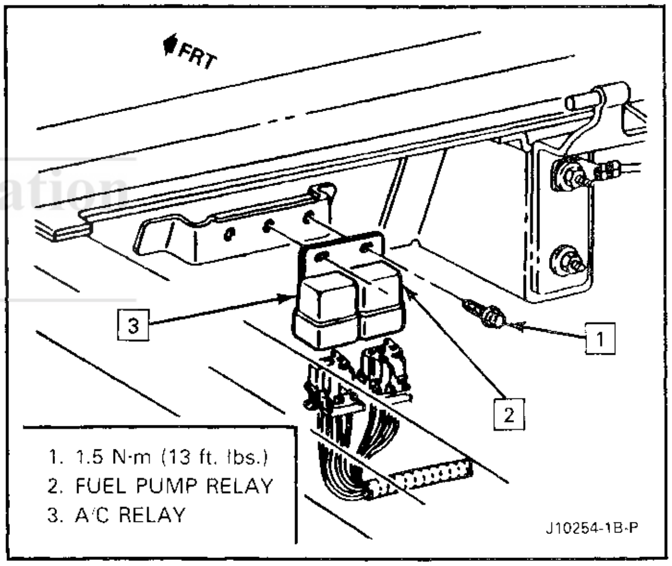
1. Open deck lid.
2. Negative (−) battery cable.
3. Electrical connector.
4. One bolt.
5. Clutch relay assembly.

Install or Connect

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

Inspect

A/C clutch for proper engagement.



1. 1.5 N·m (13 ft. lbs.)
2. FUEL PUMP RELAY
3. A/C RELAY

J10254-1B-P

Figure 32 Compressor Relay

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.

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.

ELECTRIC ACTUATOR

Remove or Disconnect

1. Negative battery cable.
2. Bezel and screws at radio.
3. Wires and radio.
4. Lower heater outlet.
5. Electrical connector at actuator.
6. Retainer clip form left hand rod.
7. Retainer clip from actuator shaft.
8. Linkages to actuator.
9. Actuator.

Install or Connect

1. Actuator.
2. Linkages to actuator.
3. Retaining clip from actuator shaft.
4. Retaining clip from left hand rod.
5. Electrical connection at actuator.
6. Lower heater outlet.
7. Wires and radio assembly.
8. Screws and bezel at radio.
9. 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:

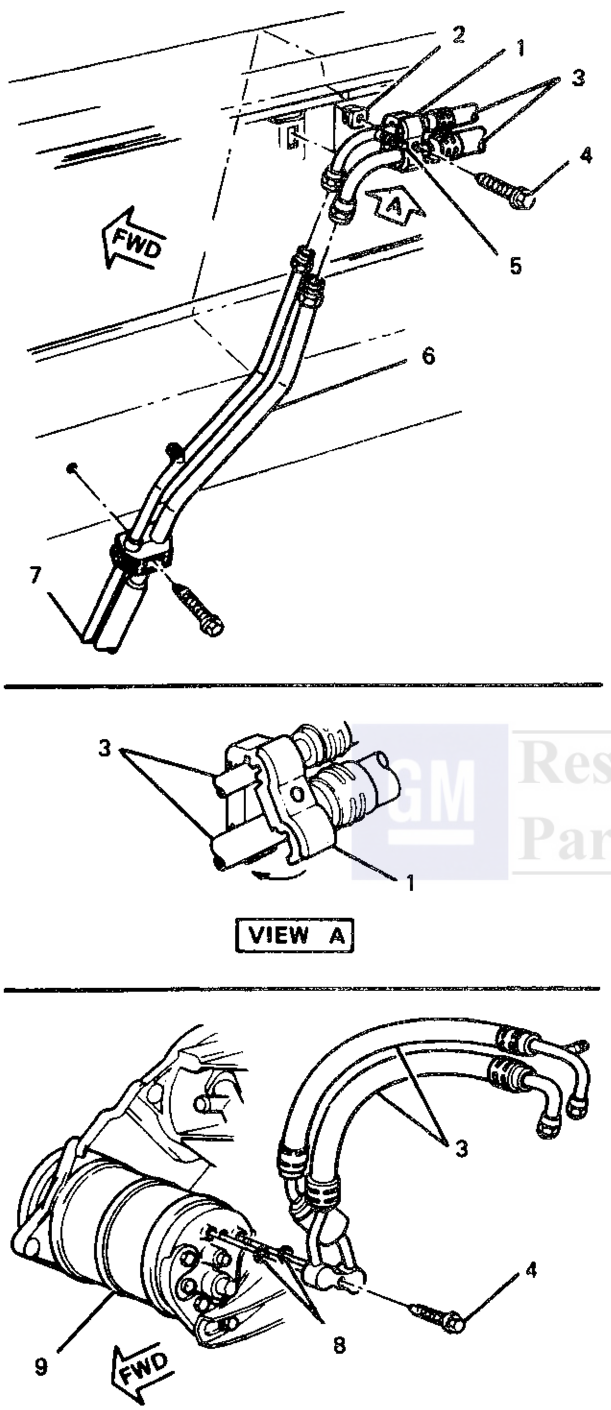
- Hose assembly to compressor 4 N•m (3 ft. lbs.).
- Hose assembly to outlet tube 24 N•m (17 ft. lbs.).
- Hose assembly to inlet tube 41 N•m (30 ft. lbs.).

6. 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.



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

Figure 33 A/C Coupled Hose Assembly — Typical

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.).

7. Front compartment panel seal.
8. Spare tire storage panel.
9. Jack assembly.
10. Spare tire assembly.
11. Inlet tube at accumulator.

    Tighten

    Torque to 41 N•m (30 ft. lbs.).

12. Negative (–) battery cable.
13. Evacuate and charge system.

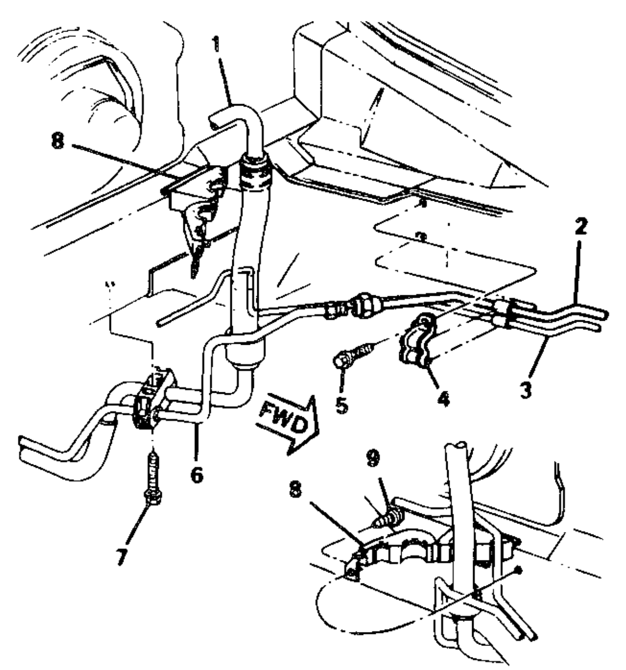
A/C OUTLET TUBE ASSEMBLY

Remove or Disconnect

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



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

520237-1B

Figure 34 A/C Tube Assembly At Front Compartment

Tighten

Torque to 24 N•m (17 ft. lbs.).

7. Compressor outlet tube at compressor hose assembly.

Tighten

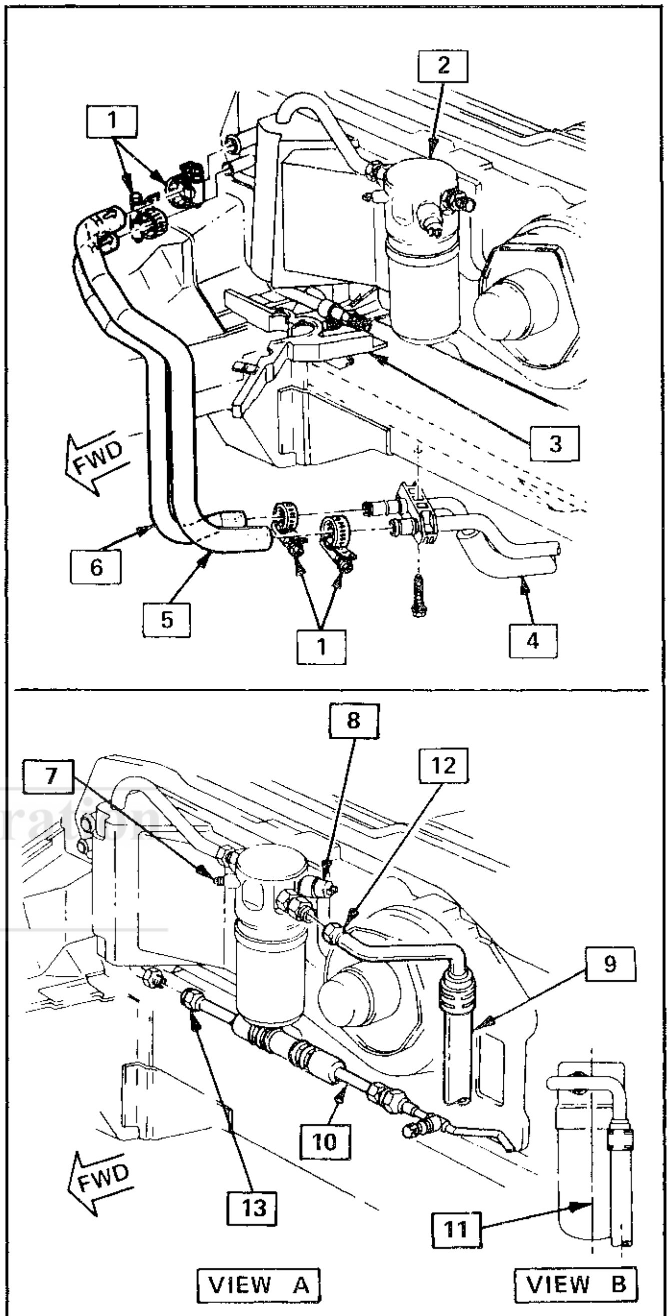
Torque to 24 N•m (17 ft. lbs.).

8. Spare tire storage panel.
9. Jack assembly.
10. Spare tire assembly.
11. Negative (−) battery cable.
12. Evacuate and charge system.

EVAPORATOR CORE

Remove or Disconnect

1. Discharge system.



1 — CLAMPS
2 — ACCUMULATOR ASM.
3 — FRONT COMPARTMENT PANEL SEAL
4 — PIPE ASM. (HEATER)
5 — HOSE — OUTLET (HEATER)
6 — HOSE — INLET (HEATER)
7 — LOW SIDE FITTING
8 — CYCLING PRESSURE SWITCH
9 — TUBE & HOSE ASM. (INLET)
10 — TUBE ASM. — A/C EVAPORATOR (INLET)
11 — INSTALLED ANGLE 14° — 15°
12 — 41 N·m (30 LBS. FT.)
13 — 17 N·m (13 LBS. FT.)

H20075-1B

Figure 35 A/C Tube and Heater Hose Assemblies at Module

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.).

4. Blower housing assembly.
5. Bolts at blower housing assembly.
6. Heater hoses at heater core.
7. Evaporator core tube to accumulator.

Tighten

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

8. Relay bracket.
9. All electrical wiring at module.
10. Negative (−) battery cable.
11. Evacuate and charge system.
12. 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. Grille.
5. Both condenser lines.
6. Lower condenser attaching bolts.
7. Condenser assembly.

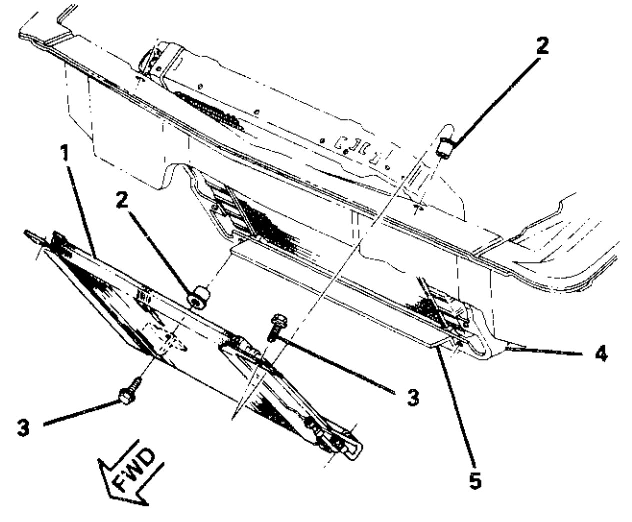


Figure 36 Condenser Installation

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.).

4. Grille.
5. Lower vehicle.
6. Upper condenser attaching bolts.
7. 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.).

4. Lower vehicle.
5. Negative (−) battery cable.
6. Evacuate and charge system.

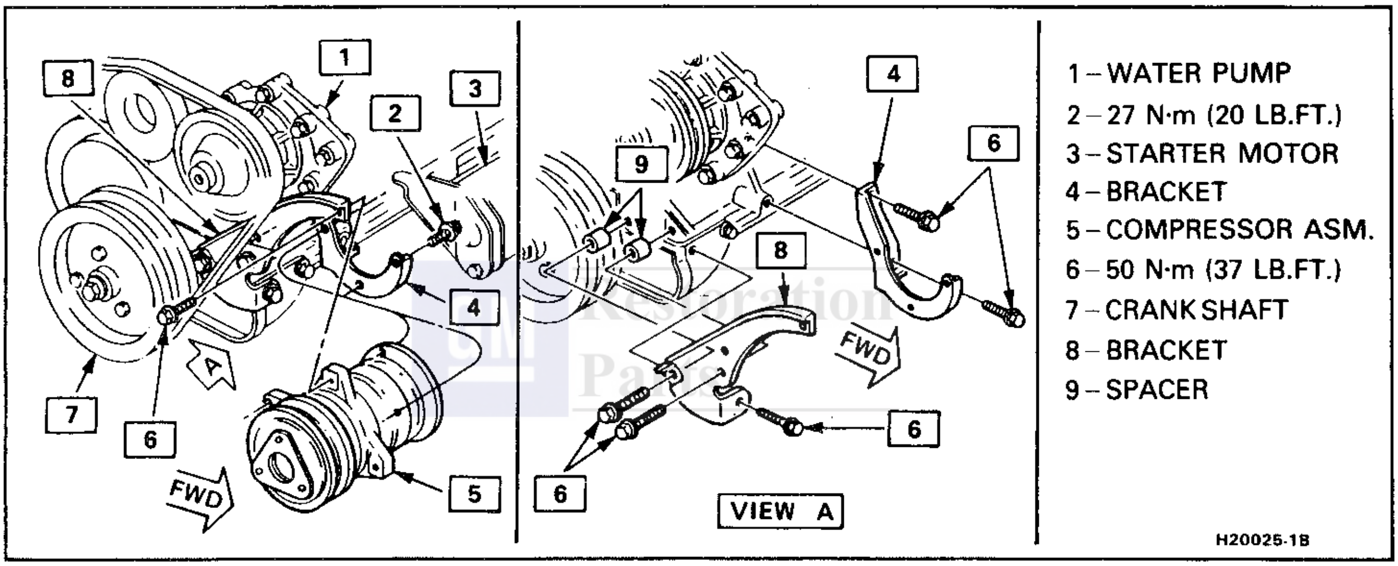


Figure 37 A/C Compressor Mounting — VIN Code R

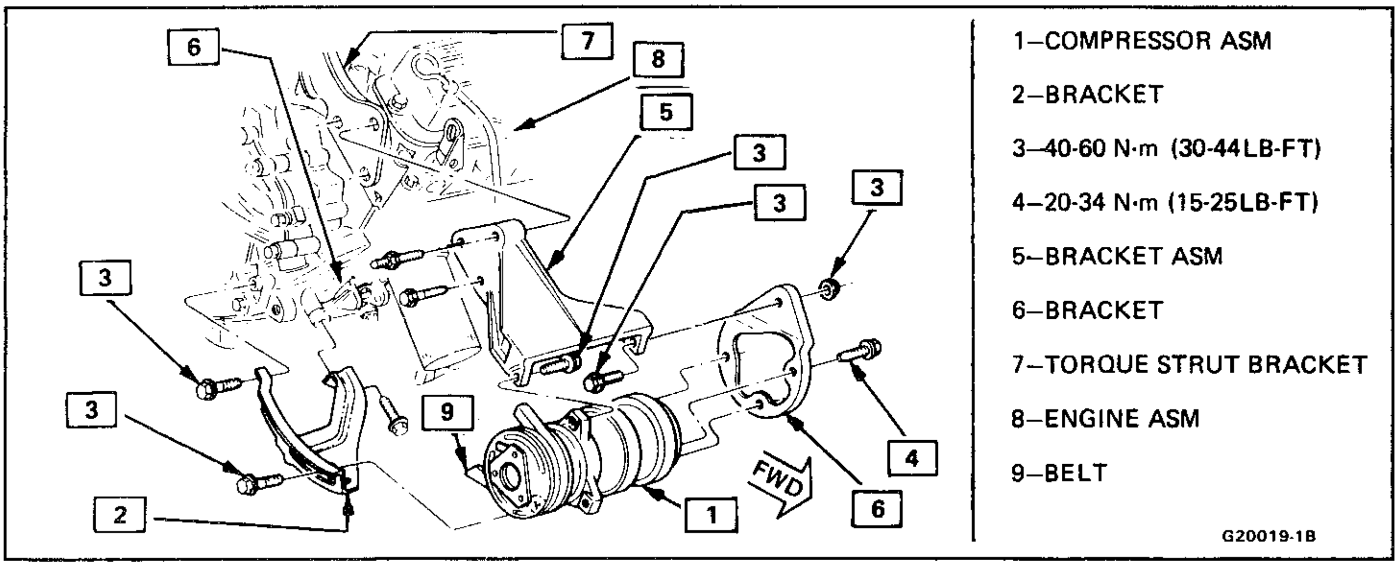
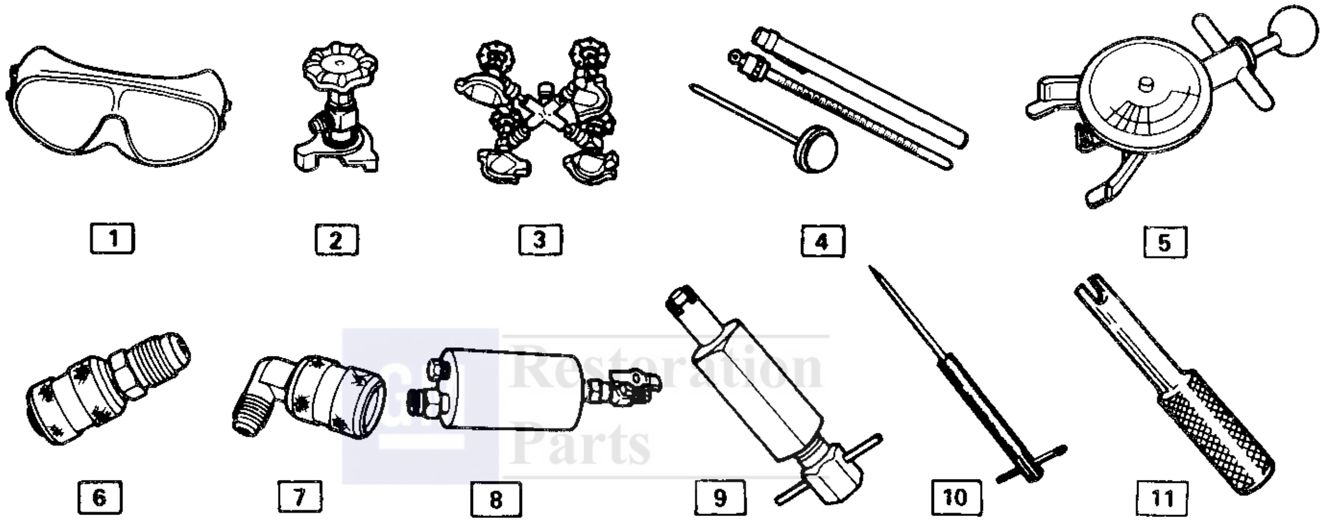


Figure 38 A/C Compressor Mounting — VIN Code 9

SPECIFICATIONS

- R-12 Capacity is 1183ml (40 fl. oz.), 1.134kg, (2.5 lbs.)
- The 420ml (14 fl. oz.) disposable can of Refrigerant-12 is equivalent to .399 kg, (.88 lb.)



1—J-5453 GOGGLES

2—J-6271-01 REFRIGERANT CAN ADAPTER

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

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

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

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

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

5—J-23600-B BELT TENSION GAUGE

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

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

8—J-7605-03 COMPRESSOR OIL INJECTOR

9—J-26549-C ORIFICE TUBE REMOVER

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

11—J-34611 A/C VALVE CORE TOOL

520277-1B

Figure 39 A/C Special Tools

HR-6 AIR CONDITIONING COMPRESSOR OVERHAUL

CONTENTS

GENERAL INFORMATION

The HR-6 Automotive Conditioning Compressor and Clutch Assembly is a lightweight, six cylinder axial design consisting of three double ended pistons and weights 5.8 kg (12.7 lbs.).

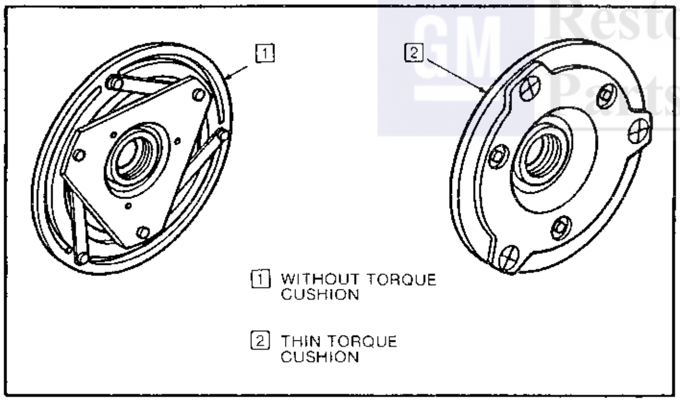


Fig. 1 HR-6 Clutch Driver Designs

Although the HR-6 compressor is the same for all vehicle applications, there are differences in installations, mounting brackets, pulleys, torque cushions and switches, none of which will affect the following overhaul procedures.

There are two (2) clutch driver designs for the HR-6 compressor. The clutch driver without a torque cushion and the clutch driver having a thin torque cushion (Fig. 1).

Note: When servicing clutch drivers with a torque cushion, the clutch hub holding tool J-25030 is used in place of J-33027.

Service compressors are supplied with either the control switches assembled in the rear head or a plug may be found where a control switch is required. If the service compressor requires control switches, the plug may be removed from the appropriate rear head switch cavity of the replaced compressor and assembled as prescribed in this manual.

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 R-11, Trichloroethane, Naphtha, stoddard solvent, kerosene or equivalent and dried with dry air. When necessary to use a cloth on any part, it should be of a non-lint producing type.

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, measured and recorded. This oil should then be discarded and an equal amount of new 525 viscosity refrigerant oil added to the compressor.

Note: The service compressor is shipped with 8 oz. of 525 viscosity refrigerant oil. This oil should be drained and retained for replacement oil when service procedures require addition of new oil to compressor.

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.

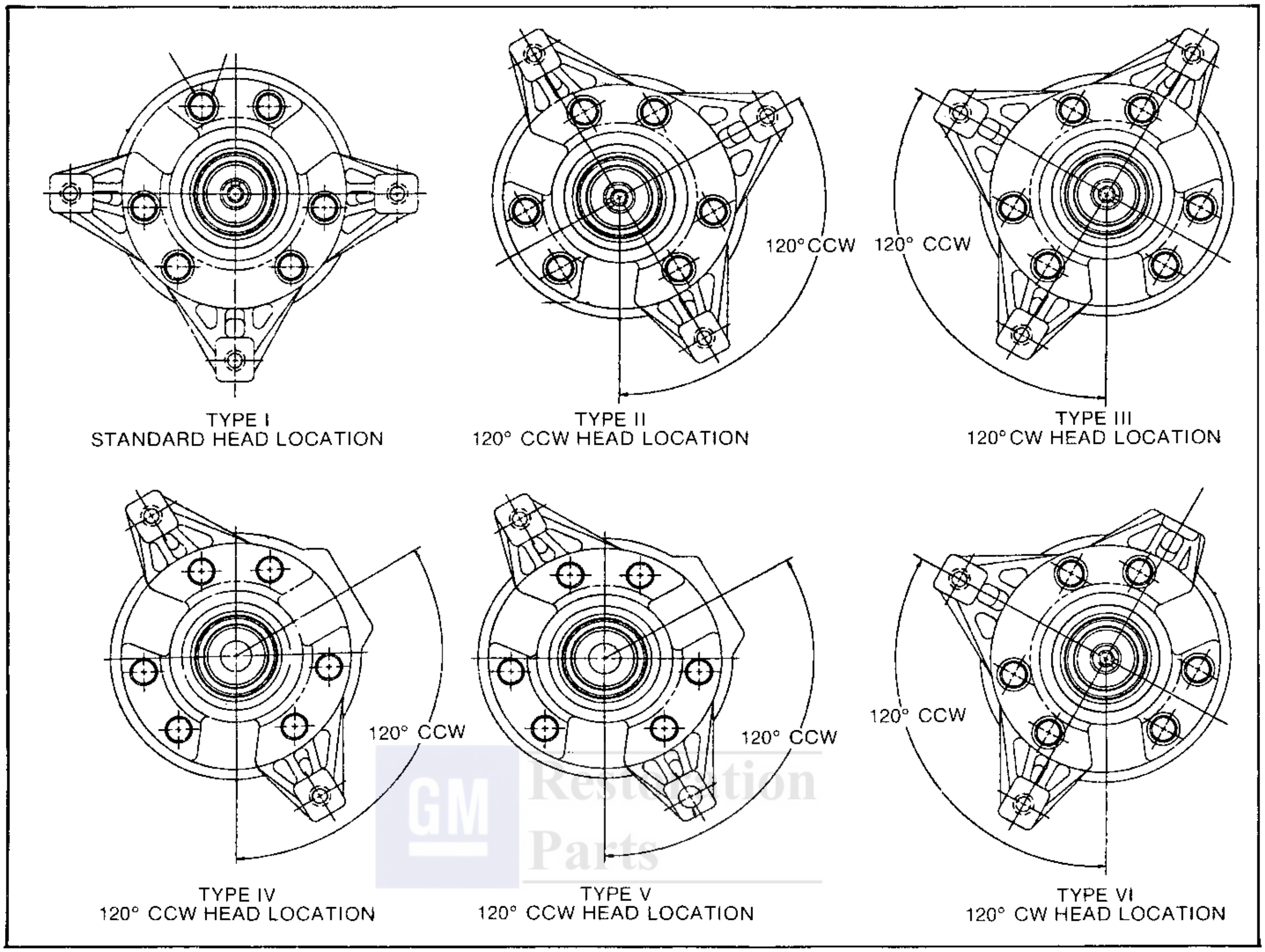
METRIC THREAD SIZE INFORMATION

1. Compressor to mounting bracket bolts.
   Front M10x1.5 - 6H
   Rear M8x1.25 - 6H

2. Suction-discharge port screw.
   M10x1.5 - 6H

3. Compressor shaft.
   M9x1.25 - 6H

4. Internal hub-clutch drive assembly.
   M22x1.5 - 6H



TYPE I
STANDARD HEAD LOCATION

TYPE II
120° CCW HEAD LOCATION

TYPE III
120°CW HEAD LOCATION

TYPE IV
120° CCW HEAD LOCATION

TYPE V
120° CCW HEAD LOCATION

TYPE VI
120° CW HEAD LOCATION

Fig. 2 HR-6 Compressor Front Head Orientation

SERVICE PROCEDURES

MINOR REPAIR PROCEDURES, HR-6 COMPRESSOR

THE FOLLOWING OPERATIONS TO THE HR-6 COMPRESSOR CLUTCH PLATE AND HUB, ROTOR AND BEARING, AND COIL ARE COVERED AS "MINOR" BECAUSE THEY MAY BE PERFORMED WITHOUT FIRST DISCHARGING THE SYSTEM OR REMOVING THE COMPRESSOR FROM THE VEHICLE.

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

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

When servicing the compressor, remove only the parts that preliminary diagnosis shows are in need of service. Refer to Figures 4 and 5 for information relative to part names and location.

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

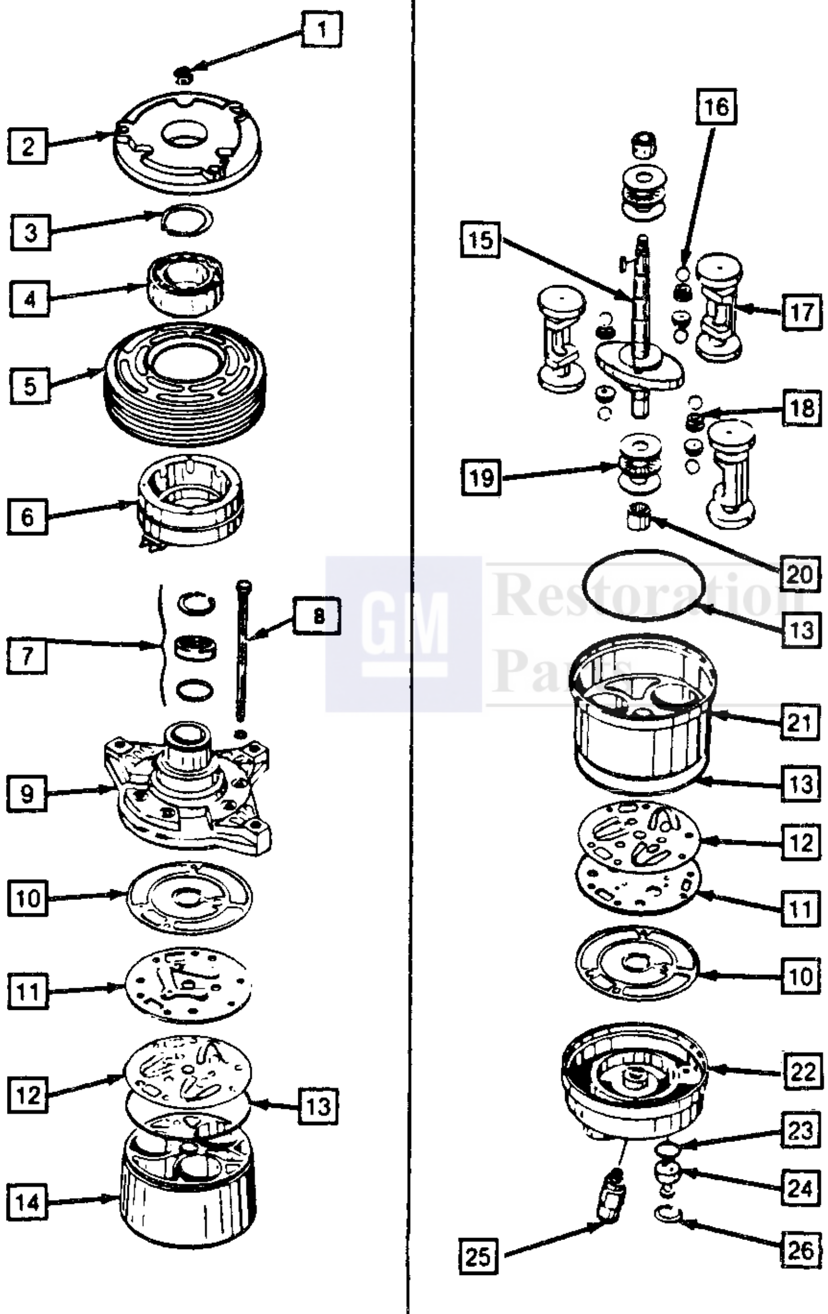
1. Clamp the holding fixture J-33026 in a vise and attach compressor to holding fixture with thumb screws J-33026-1 (Fig. 6).
2. Keep the clutch hub and drive plate assembly from turning by using the clutch hub holding tool J-25030. Remove the shaft nut using shaft nut socket J-33022 (Fig. 6).
3. With center screw forcing tip in place to thrust against the end of the shaft, thread the Clutch Plate and Hub Assembly Installer-Remover J-33013-B, into the hub. Hold the body of the remover with a wrench and turn the center screw into the remover body to remove the clutch plate and hub assembly (Fig. 7).

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

4. Remove the shaft key and retain for reassembly.

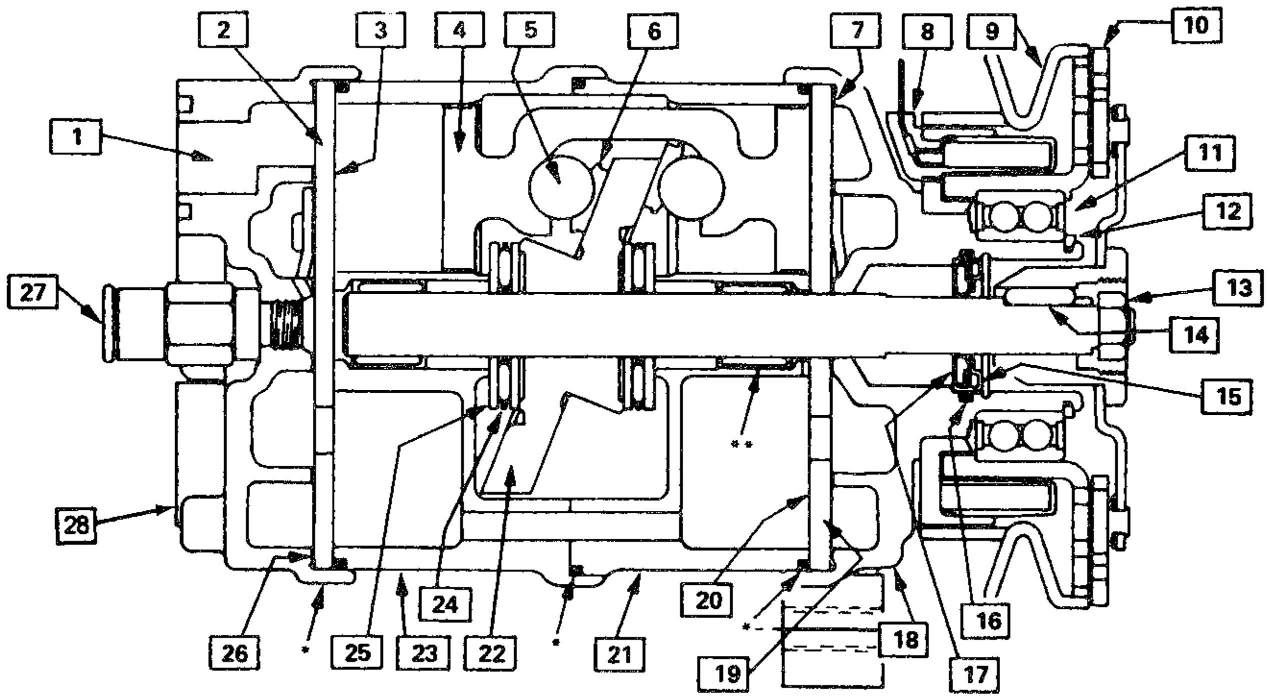
→← Install or Connect

1. Install the shaft key into the hub key groove (Fig. 8). Allow the key to project approximately 3.2mm (1/8")



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 BOLTS (6)
9	FRONT HEAD
10	HEAD GASKET
11	VALVE PLATE
12	SUCTION REED
13	CYLINDER O-RING
14	FRONT CYLINDER
15	SHAFT AND AXIAL PLATE
16	PISTON BALL (6)
17	PISTON (3)
18	SHOE (6)
19	THRUST BEARING AND RACES
20	MAIN BEARING REAR CYLINDER
21	REAR CYLINDER
22	REAR HEAD
23	SWITCH O-RING
24	SYSTEM CONTROL SWITCH
25	HIGH PRESSURE RELIEF VALVE
26	RETAINER RING-SWITCH

Fig. 4 HR-6 Compressor Components — Exploded 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 PLATE 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

G60050-1D2-EK

Fig. 5 HR-6 Compressor — Cross Section

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.

4. Remove the forcing tip on J-33013-B clutch plate and hub assembly installer-remover center screw and reverse the body direction on the center screw, as shown in Figure 9.

   NOTICE: The forcing tip on J-33013-B remover-installer center screw must be flat or the end of the shaft/axial plate assembly will be damaged.

5. Install the clutch plate and hub installer-remover J-33013-B with bearing as shown in Figure 9.

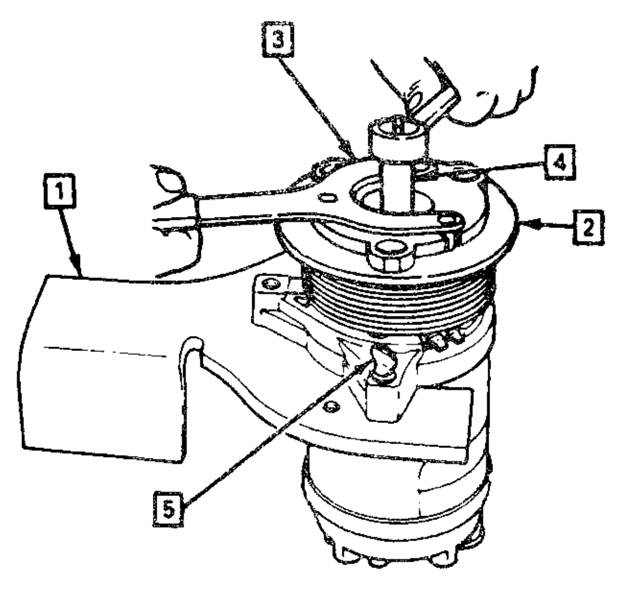
   The body of the J-33013-B installer-remover should be backed off sufficiently to allow the center screw to be threaded onto the end of the compressor shaft.

6. Hold the center screw with a wrench. Tighten the hex portion of the installer-remover J-33013-B 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 wedge and will break the clutch hub.

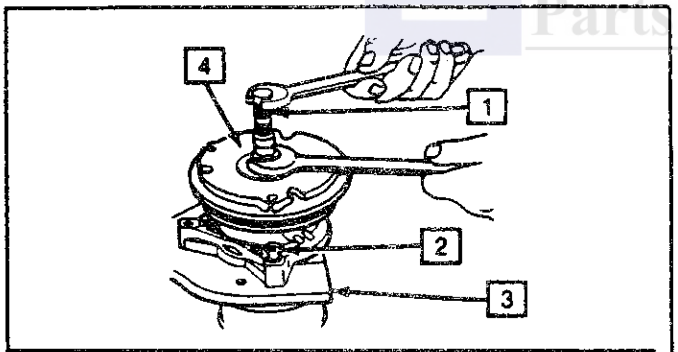
7. Remove installer J-33013-B, check for proper positioning of the shaft key (even or slightly above the clutch hub). Install the shaft nut. Hold the clutch plate and hub assembly with clutch hub holding tool J-25030 and using shaft nut socket J-33022, tighten the nut against the compressor shaft shoulder 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.



1 J 33026 HOLDING FIXTURE
2 CLUTCH PLATE AND HUB ASSEMBLY
3 J 25030 CLUTCH HUB HOLDING TOOL
4 J 33022 NUT SOCKET
5 J 33026-1 THUMB SCREW

Fig. 6 Removing Shaft Nut



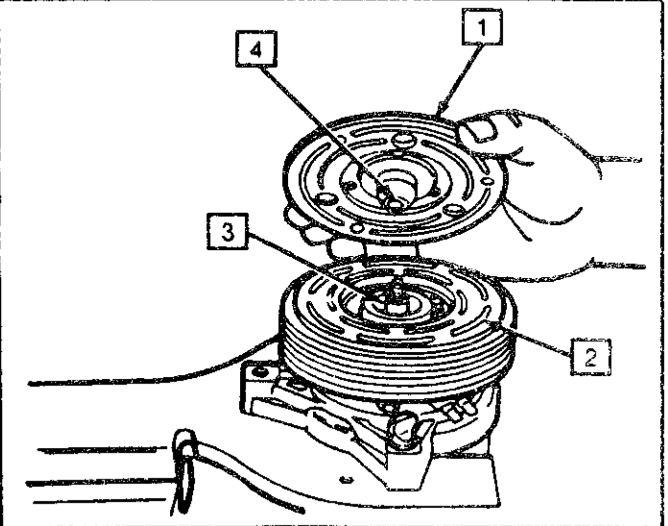
1 J-33013-B HUB AND CLUTCH DRIVE PLATE ASM. REMOVER
2 J-33026-1 THUMB SCREW
3 J-33026 HOLDING FIXTURE
4 CLUTCH PLATE AND HUB ASM.

Fig. 7 Clutch Plate and Hub Assembly Removal

COMPRESSOR CLUTCH ROTOR AND/OR BEARING

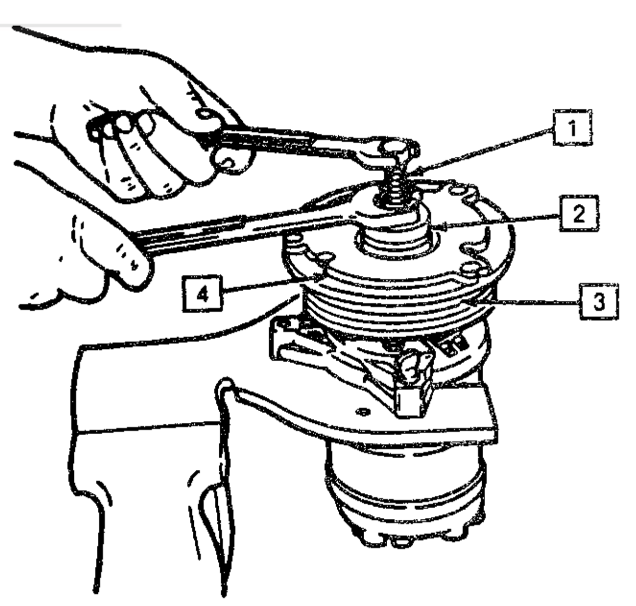
↔ Remove or Disconnect

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-A 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 CLUTCH PLATE AND HUB ASSY.
2 CLUTCH PULLEY ROTOR
3 SHAFT KEYWAY
4 SHAFT KEY

Fig. 8 Shaft Key, Clutch Plate/Hub Installation



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

Fig. 9 Installing Clutch Plate & Hub Assembly

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. 13.

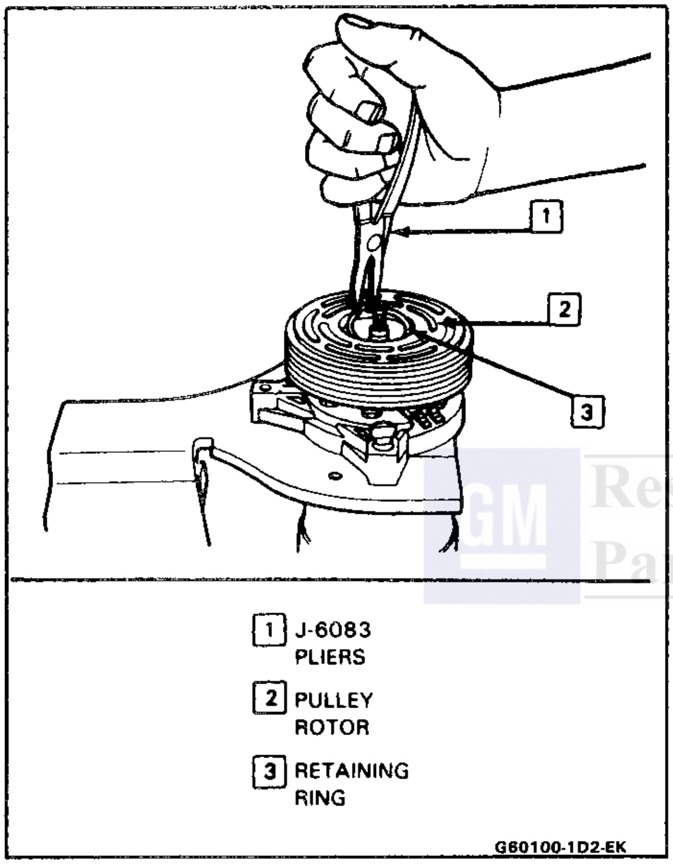


Fig. 10 Installing-Removing Pulley Rotor & Bearing Assembly Retaining Ring

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.

→← 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.

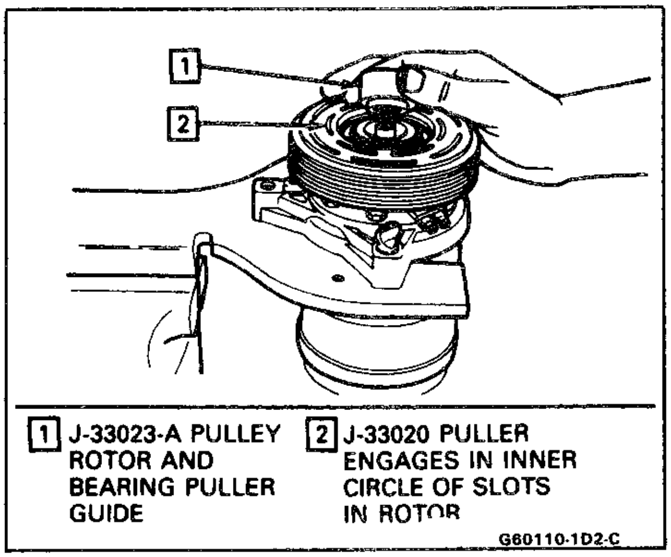


Fig. 11 Installing Pulley Rotor/Bearing Puller Guide

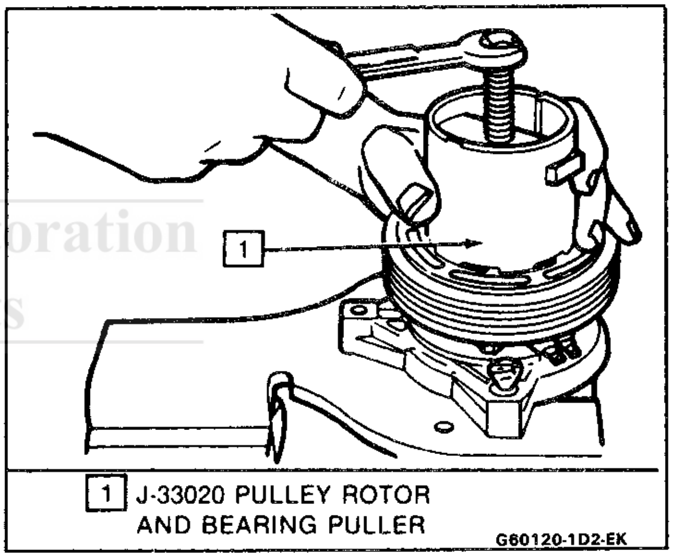
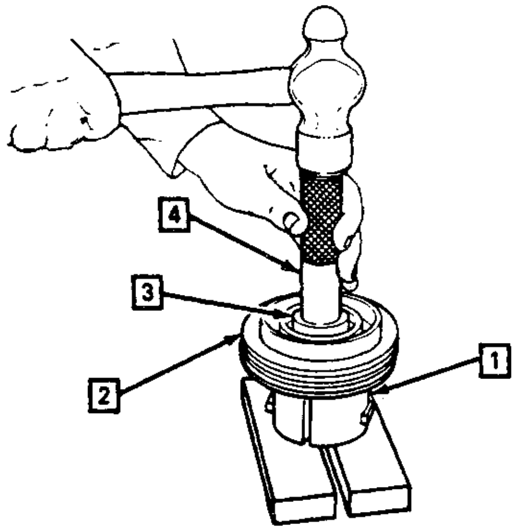


Fig. 12 Removing Pulley Rotor and Bearing Assembly

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 Figure 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**.

   Noisy bearing operation and reduced bearing life may result if outer bearing race is deformed while staking. The stake metal should not contact the outer race of the bearing. Stake three (3) places 120° apart as shown in Figure 16.

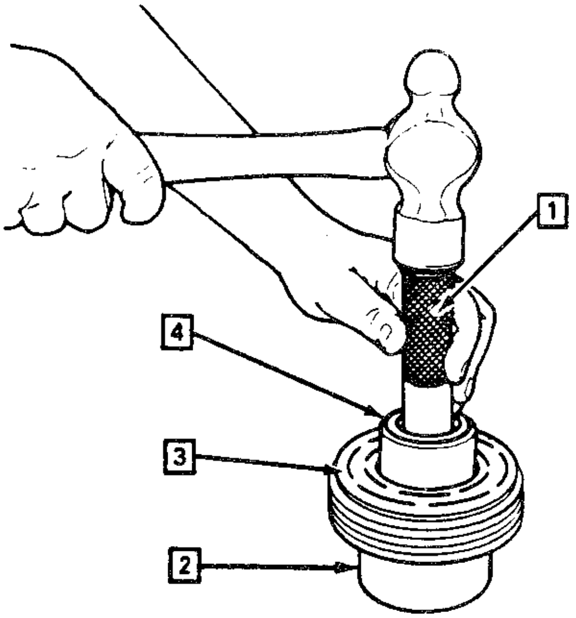


1	J-33020 (LESS FORCING SCREW) INVERTED AND USED TO SUPPORT HUB OF ROTOR FOR BEARING REMOVAL. PULLER TANGS ENGAGED IN ROTOR SLOTS.	2	PULLEY ROTOR "FACE DOWN"
		3	J-9398-A BEARING REMOVER
		4	J-29886 DRIVER HANDLE

G60130-1D2-C

Fig. 13 Pulley Rotor Bearing Removal

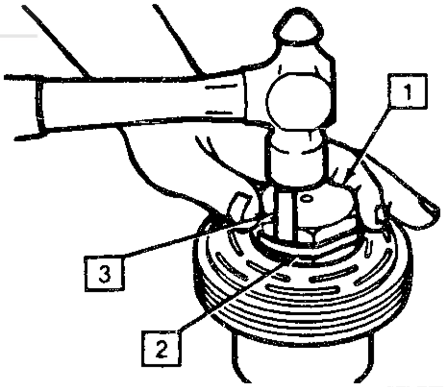
5. With the compressor mounted to the J-33026 holding fixture, position the rotor and bearing assembly on the front head (Fig. 17).
6. Position the J-33017 pulley rotor and bearing installer and J-33023-A puller pilot directly over the inner race of the bearing (Fig. 17).
7. Position puller crossbar J-8433-1 on the puller pilot J-33023-A 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.



1	J-29886 DRIVER HANDLE	3	PULLEY ROTOR
2	J-21352-A SUPPORT BLOCK	4	J-9481-A BEARING INSTALLER

G60140-1D2-C

Fig. 14 Installing Pulley Rotor Bearing



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

G60150-1D2-EK

Fig. 15 Staking Bearing In Rotor Hub Bore

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-A puller pilot on front head of compressor (Fig. 18). Also install J-8433-1 puller crossbar with J-33025 puller legs as shown in Figure 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.

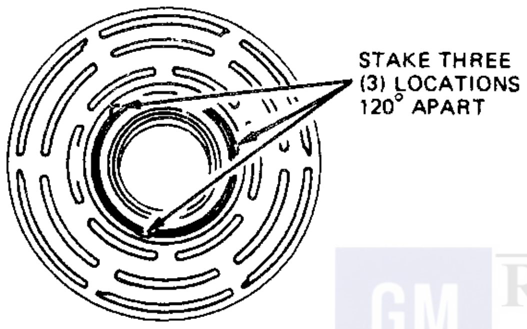
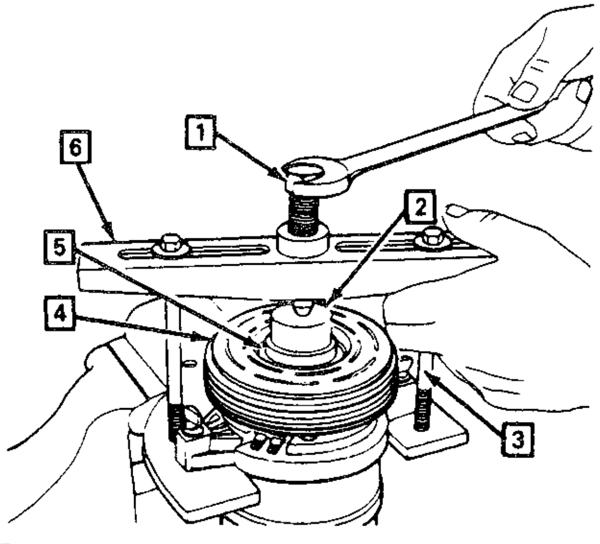
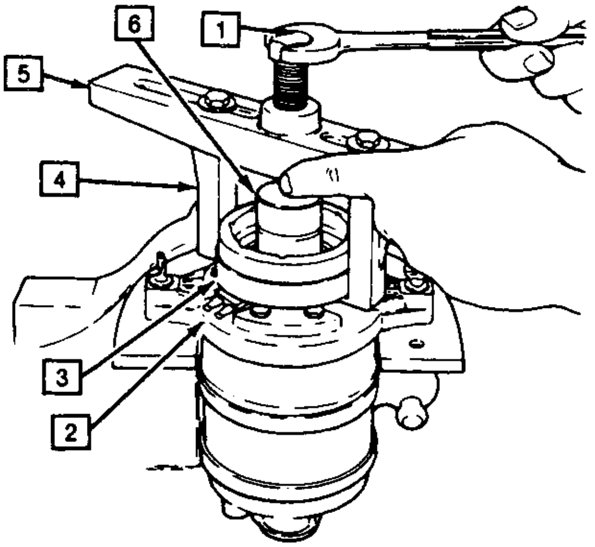


Fig. 16 Bearing Staked in Place



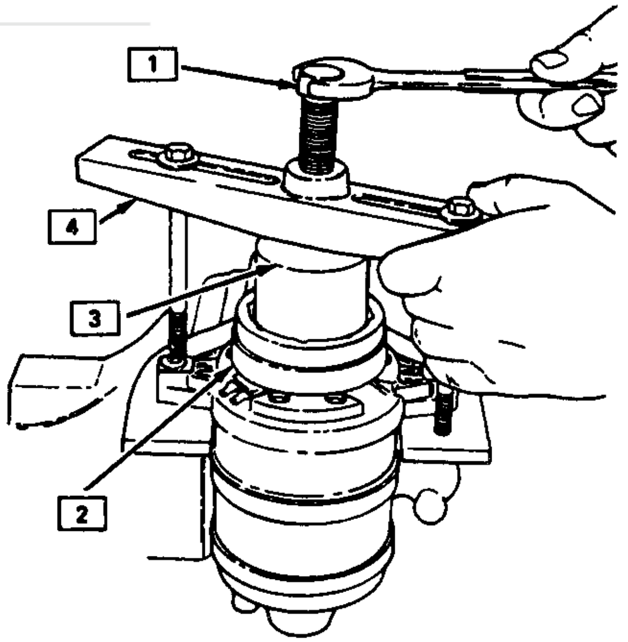
1 J-8433-3 SCREW
2 J-33023-A PULLER PILOT
3 J-33026-2 THRU BOLTS
4 PULLEY ROTOR
5 J-33017 PULLEY ROTOR AND BEARING INSTALLER
6 J-8433-1 CROSS BAR

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-A PULLER PILOT

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

Fig. 19 Installing Clutch Coil Assembly

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 remains in position.
   - Stake size should be only one-half the area of the punch tip and be only approximately 0.28-0.35mm (.010-.015") deep (Fig. 21).
6. Install rotor and bearing assembly and the clutch plate and hub assembly as described previously.

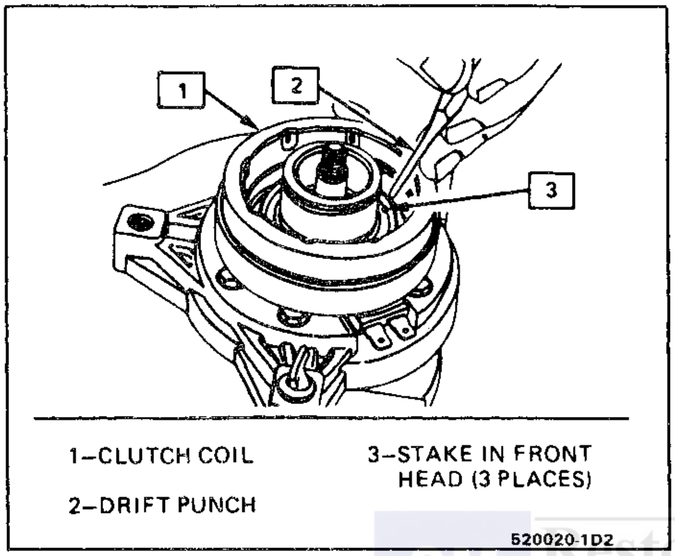


Fig. 20 Staking Clutch Coil to Front Head

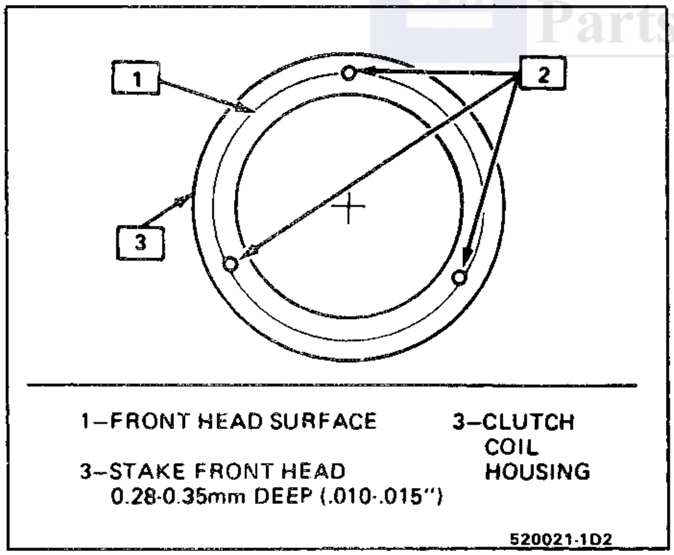


Fig. 21 Details of Stakes in Front Head for Clutch Coil

MAJOR HR-6 COMPRESSOR REPAIR PROCEDURES

When replacing the shaft seal assembly (Fig. 22), pressure relief valve or control switches, (Fig. 23), it will be necessary to discharge the system of refrigerant. 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, recorded and replaced.

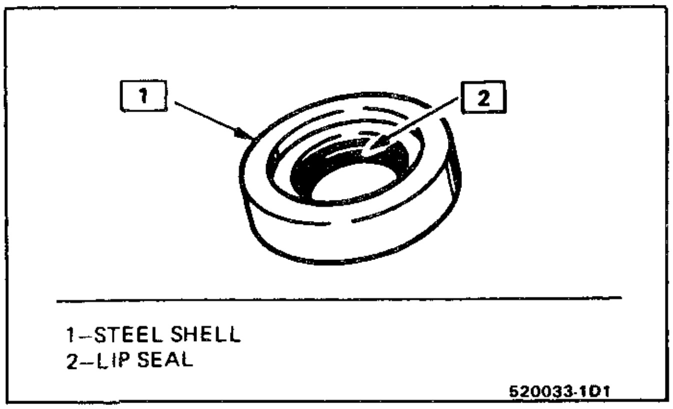


Fig. 22 Compressor Shaft Seal

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 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. **Seals and protective packaging should be left intact until just prior to installation.**

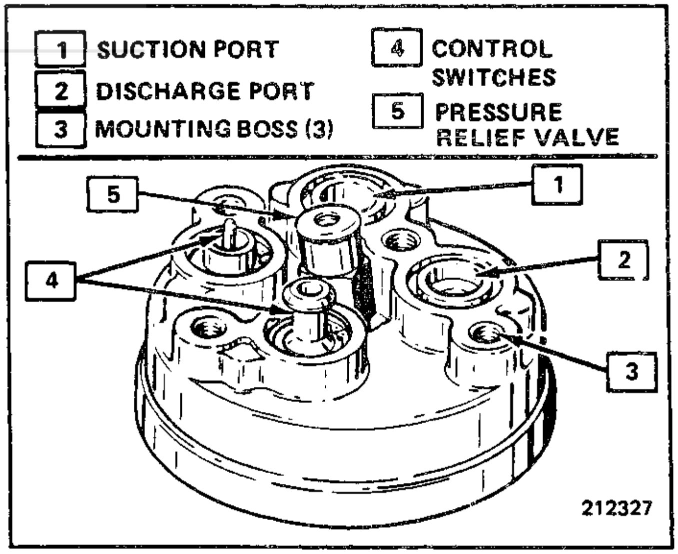


Fig. 23 Compressor — Rear Head

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 but only after actual refrigerant leakage is found using an approved leak detector, J-29547, or equivalent.

Remove or Disconnect

1. Discharge the refrigerant system.
2. Loosen and reposition compressor in mounting brackets, if necessary.
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 retainer ring groove and the shaft itself. 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 must be hand-tightened securely. Do not use a wrench or pliers.
7. Remove and discard the seal seat O-ring from the compressor neck using O-ring remover J-9553-01, Figure 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.

Clean

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

Important

Seals should not be re-used. Always use a new specification service seal 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 seat and seal are free of lint and dirt that could damage the seal surface or prevent sealing.

Install or Connect

1. Dip the new seal seat O-ring in clean 525 viscosity refrigerant oil and assemble onto O-ring installer J-33011, Figure 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. Dip the new seal in clean 525 viscosity refrigerant oil and assemble seal to Seal Installer J-23128-A, by turning handle clockwise. The stamped steel case side of the lip seal must be engaged with knurled tangs of installer so that flared-out side of lip seal is facing and installed towards the compressor. Install seal protector J-34614, in the seal lip and place over the compressor shaft, Figure 26, and push the seal in place with a rotary motion or place the seal protector J-34614 over end of compressor shaft, Figure 25, and slide the new seal onto the shaft with a rotary motion until it stops. Take care not to dislodge the O-ring. Be sure the seal makes good contact with the O-ring. Disengage the installer from the seal and remove the installer J-23128-A and the seal protector J-34614.

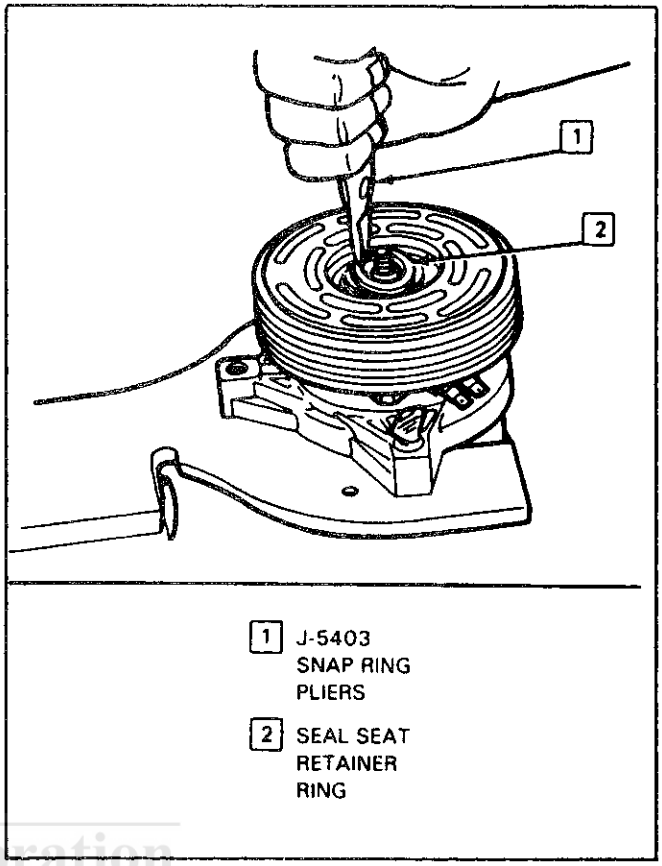


Fig. 24 Removing or Installing Shaft Seal Retaining Ring

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

4. Install the new seal retainer ring with its flat side against the Seal, using Snap-Ring Pliers J-5403. See Figure 24. Use the sleeve from O-ring installer J-33011 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.

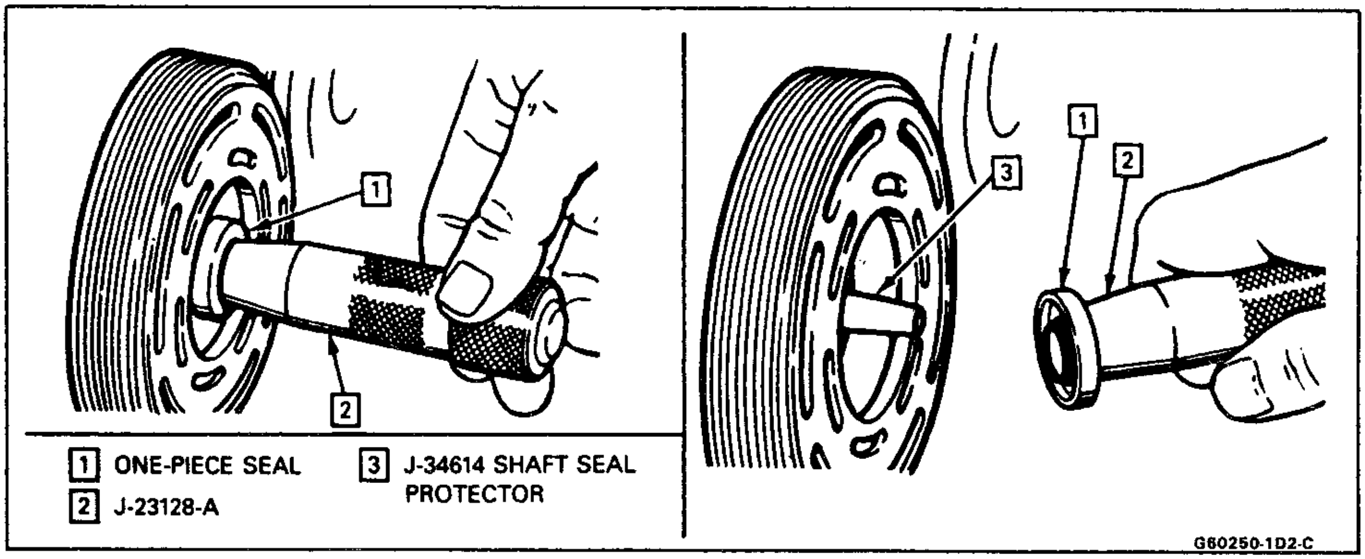


Fig. 25 Removing or Installing Shaft Seal

COMPRESSOR PRESSURE RELIEF VALVE

Remove or Disconnect

1. Discharge the Refrigerant System.
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 Nm (5.5-7.7 lbs. ft.)
2. Evacuate and recharge the system.
3. Leak test system.

CONTROL SWITCHES (See Fig. 23)

Remove or Disconnect

1. Discharge Refrigerant System.
2. Disconnect the electrical connector from the switch in the rear head of compressor.
3. Remove the switch retaining ring using J-5403 internal snap ring pliers.
4. Remove the switch from the compressor.
5. Remove old O-ring seal from the switch cavity using J-9553-01 O-ring removal tool.

Note: If existing control switch is reinstalled in the compressor, a new O-ring seal must be used and preferably a new retainer ring should also be used. A new switch kit has the O-ring and retainer ring included.

Install or Connect

1. Check switch cavity and O-ring groove in the rear head for dirt or foreign material and clean as necessary. Install a new O-ring coated with clean refrigerant oil into groove in switch cavity.
2. Lubricate the control switch housing with clean refrigerant oil and carefully insert switch into switch cavity until switch bottoms in cavity.
3. Using J-9533-1 snap ring pliers install switch retaining ring with high point of curved sides adjacent to switch housing. Be sure retaining ring is properly seated in switch cavity retaining groove. Leak test according to bench test 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 and remove the compressor from the car. Drain the oil from the compressor into a container, measure, record the amount 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 (Figs. 2 and 27).
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. 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.
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 th J-33026 holding fixture as shown in Figure 29. Usin masking tape or similar tape, tape across the througl bolt holes in the front head at the 12 o'clock an

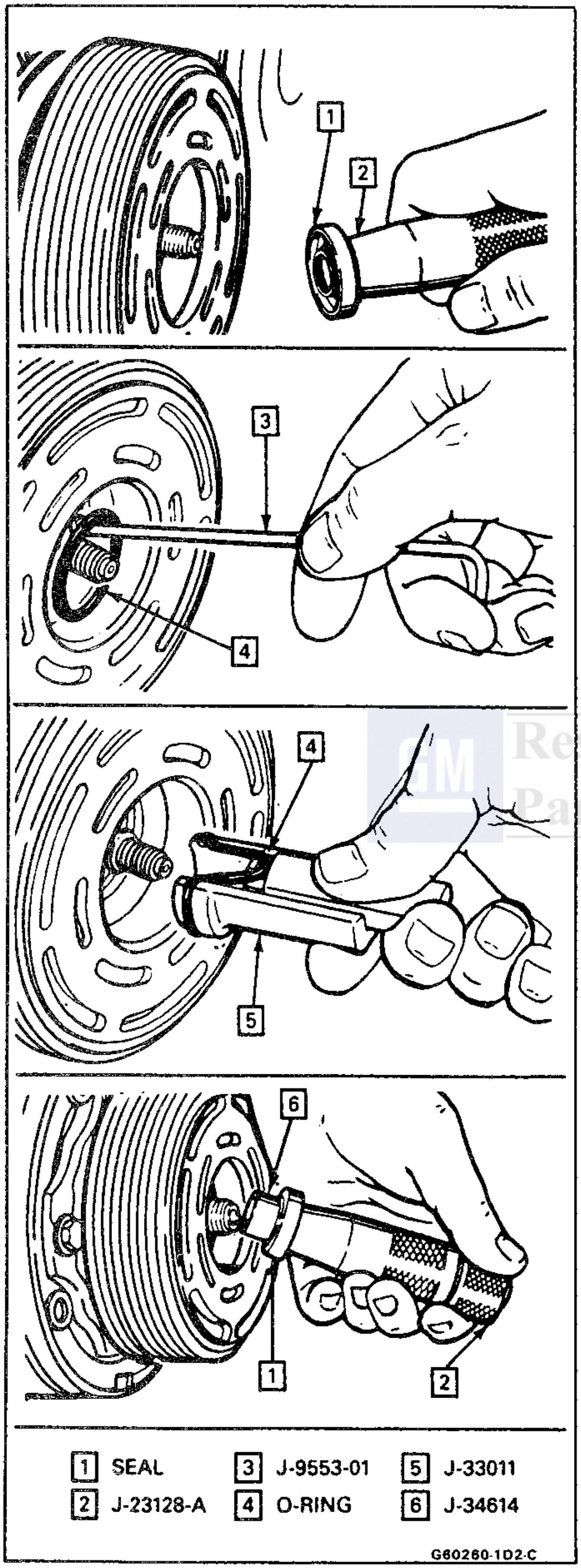


Fig. 26 Removing and Installing Shaft Seal and O-Ring

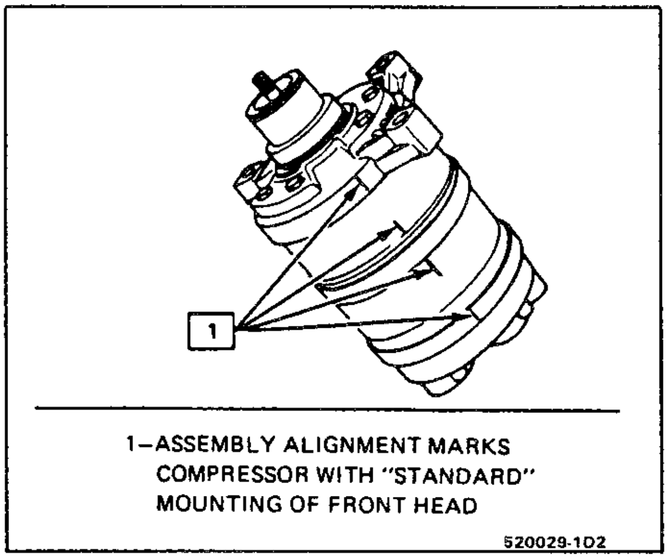


Fig. 27 Compressor Cylinder and Head Alignment

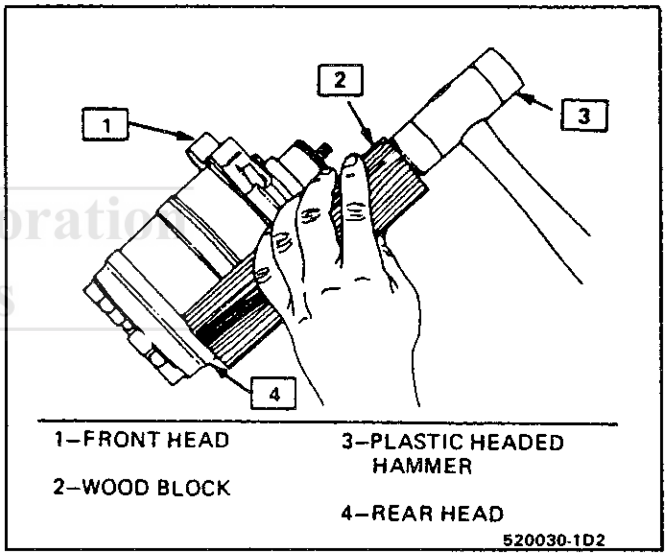


Fig. 28 Tapping Front or Rear Head Free of Cylinder

6 o'clock positions to support the J-33016 assembly guide pins in the through bolt holes shown in Figure 30. 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 Figure 29 and then rolled into the O-ring groove but cylinder surface must be clean. (Preferably cleaned with recommended solvent and blown dry with air).
3. Install suction reed plate over the J-33016 and guide pins as shown in Figure 32.
4. Install rear valve plate over the J-33016 guide pins as shown (Fig. 33).
5. Install head gasket over guide pins as shown (Fig. 34).
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. 35). If guide pins are properly engaged in the through bolt holes in the rear head, the head will not

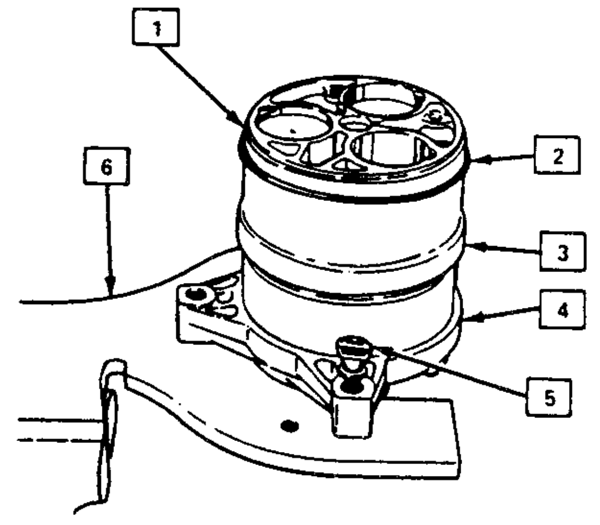


Fig. 29 O-Ring Installation on Rear Cylinder O-Ring Seat Recess

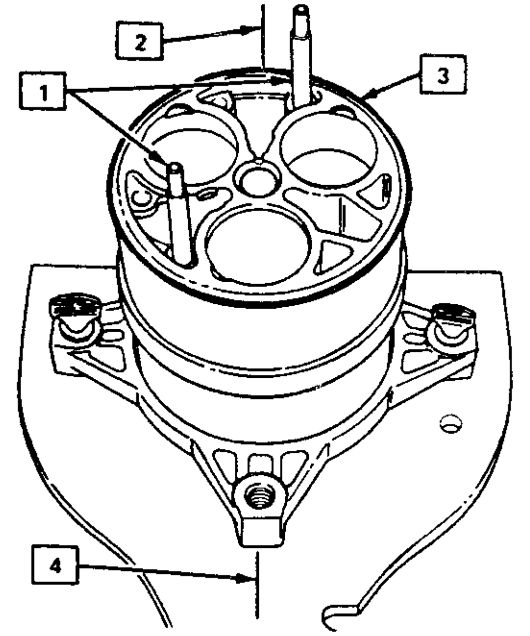


Fig. 30 Assembly Guide Pins in Cylinder Assembly (Standard Head Position)

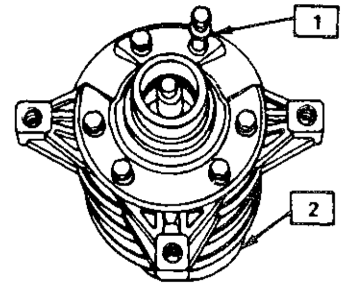


Fig. 31 Front Head Installed: Thru Bolts and Gaskets in Place

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. 36).

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. 31). 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.

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 and remove th compressor from the car. Drain the oil from th compressor into a container, measure, record th amount and discard the oil.
2. Remove the clutch drive and hub assembly, pulle rotor and bearing assembly and the clutch coil pe previous procedure.
3. Remove the shaft seal parts per previous procedur and discard the old seal parts.
4. Mark the location and note the alignment of the fror head to the alignment marks on the cylinder. This important for reassembly. Depending on applicatic mounting, the front head may be rotated 12

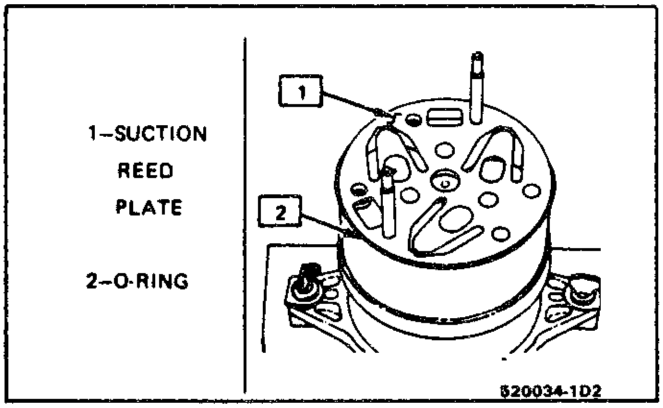


Fig. 32 Suction Reed Plate Assembled to Cylinder Assembly

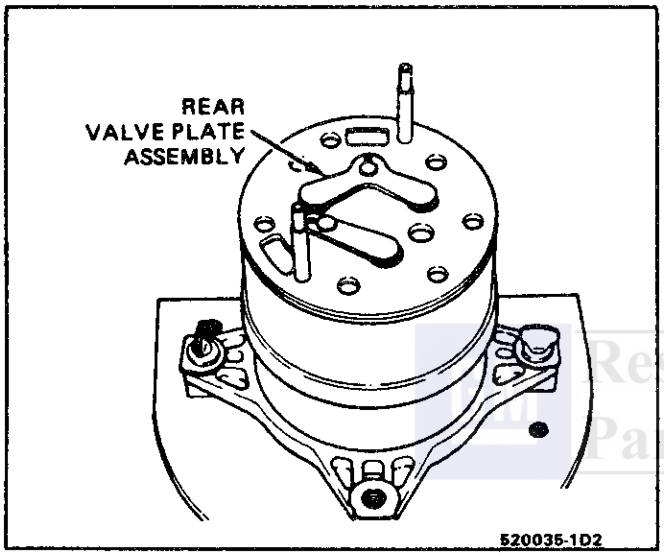


Fig. 33 Rear Valve Plate Assembled to Cylinder Assembly

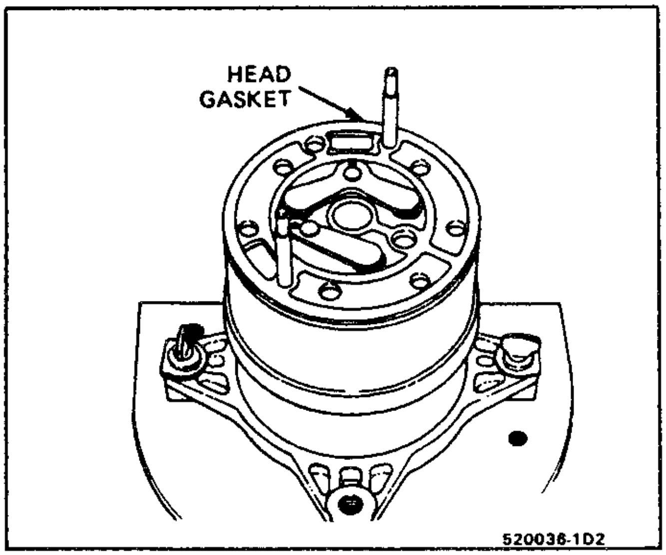


Fig. 34 Head Gasket Assembled Over Rear Valve Plate

clockwise or 120° counterclockwise from the "standard" position (Figs. 2 and 27).

5. Remove the six (6) compressor through bolts and gaskets. Discard the gaskets.

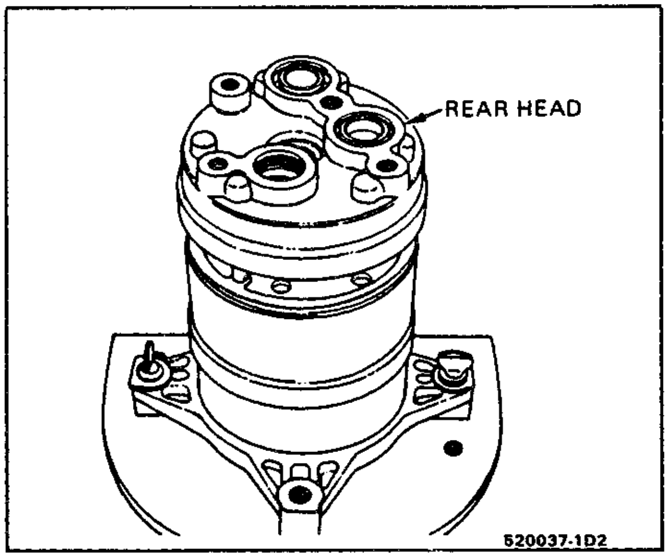


Fig. 35 Rear Head Assembled Onto Assembly Guide Pins

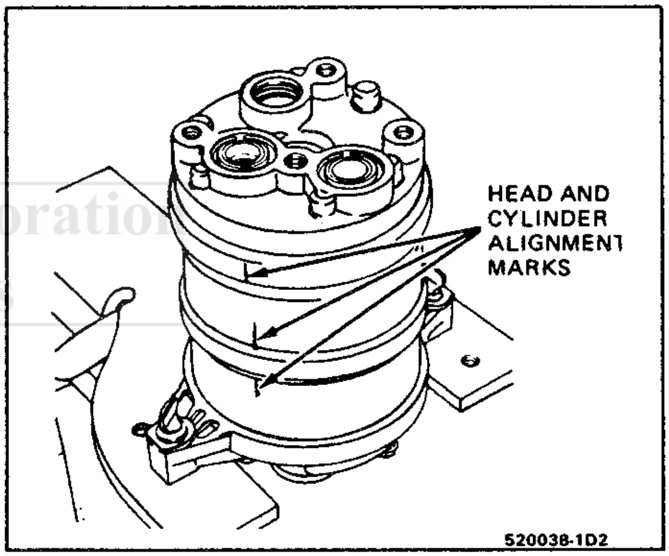


Fig. 36 Rear Head Installed in Aligned Position

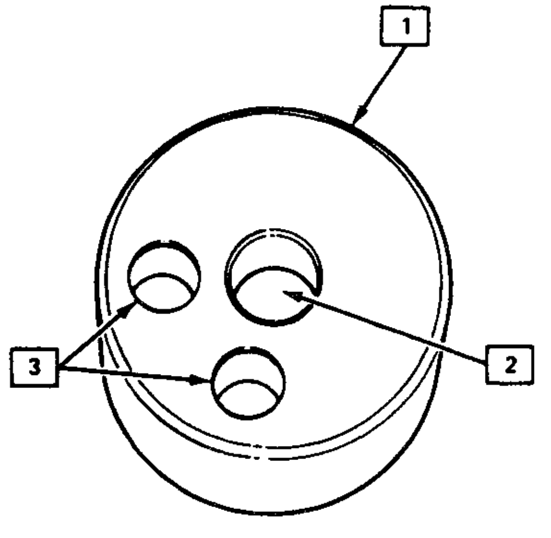
6. Using a plastic-headed hammer, tap the front head at the mounting locations to disengage the head from the compressor cylinder.

   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-A support block (Fig. 37), and install the two (2) J-33016 assembly guide pins in the through bolt holes indicated (Fig. 38).
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 (Fig. 39).
3. Install suction reed plate over the J-33016 guide pins as shown (Fig. 39).



1–J-21352-A SUPPORT BLOCK
2–POSITION HIGH RELIEF VALVE IN OPENING
3–POSITION REAR HEAD SWITCH(ES) IN OPENING(S)

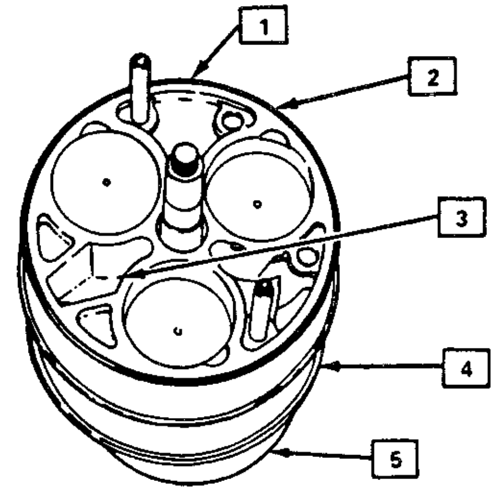
520039-1D2

Fig. 37 Support Block for the HR-6 Compressor

4. Install front valve plate over the J-33016 guide pins as shown (Fig. 40).
5. Install head gasket over guide pins as shown (Fig. 41).
6. Line up mark on front head (step 4 of Remove) with the alignment marks on the comprssor cylinder and assemble head over guide pins (Fig. 27).

   The front head in Figure 42 is assembled in the "standard" position and may differ 120° in 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.

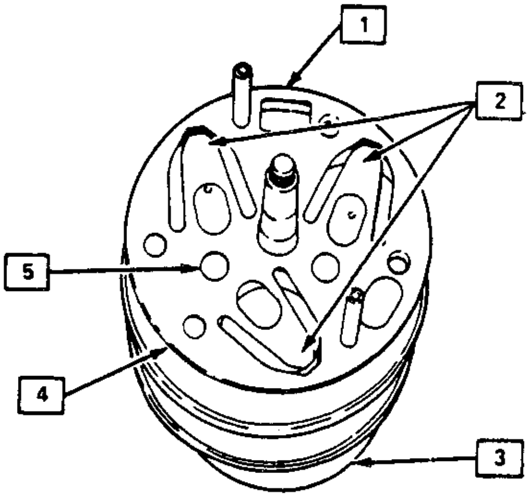
   Alternately tighten the through bolts in progressive torque until a torque of 8-10 N·m (72-84 in. lbs.) is achieved on all six (6) bolts.
9. Install new shaft seal kit per previous procedure.
10. Add amount of new 525 viscosity refrigerant oil as determined in step 1 of Remove. Install test plate J-9625-A. 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.



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

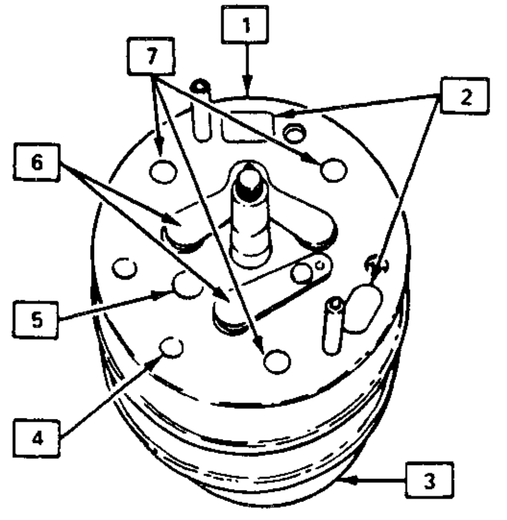
Fig. 38 Cylinder and Shaft Assembly Installed Over Guide Pins into Rear Head



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. 39 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)

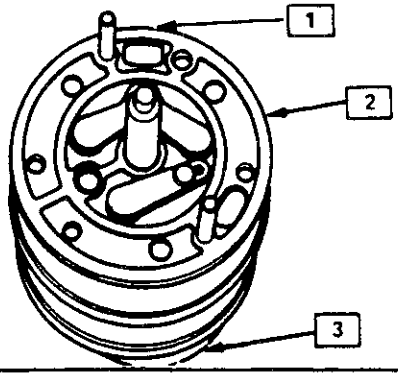
5–DISCHARGE CROSS-OVER OPENING

6–DISCHARGE VALVE REED RETAINERS

7–SUCTION INTAKE OPENINGS

520042-1D2

Fig. 40 Front Valve Plate Installed and Detail Description



1–12 O'CLOCK REFERENCE

2–HEAD GASKET

3–J-21342-A SUPPORT BLOCK

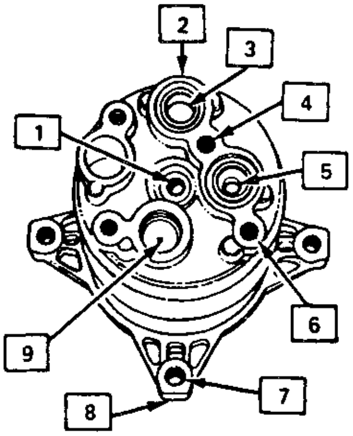
520043-1D2

Fig. 41 Head Gasket Assembled on Front Valve Plate

COMPRESSOR CYLINDER AND SHAFT

Remove or Disconnect

1. Discharge the refrigerant system and remove the compressor from the car. Drain the oil from the compressor into a container, measure, record the amount and discard the oil.
2. Remove the clutch drive and hub assembly, pulley rotor and bearing assembly and the clutch coil per previous procedure.



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. 42 Installation of Compressor Front Head

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. 27). 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.
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. 37) 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 Figure 43. Install the two (2) J-33016 assembly guide pins into the mounting holes indicated.
3. Assemble the head gasket (Fig. 44) 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. 45).
5. Assemble the suction reed plate over the guide pins and position as shown (Fig. 46). Be sure all three (3) suction reed tips cover the suction ports in the rear valve plate, if not, the reed plate is improperly assembled. Note the recess provisions in rear of cylinder for suction reed tip movement (Fig. 47).
6. 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 Figure 29 and then rolled into the O-ring groove but cylinder surface must be clean. (Preferably 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.
7. With the O-ring in place on the rear of the cylinder, carefully lower the assembly over the guide pins to the rear head using the hole locations shown in Figure 38.
8. Using both hands, press the cylinder and shaft assembly down into the rear head.
9. 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. 38).
10. Assemble the suction reed plate over the guide pins and position as shown (Fig. 39). Be sure tips of all three suction reeds locate above a recess at top of cylinders or the reed plate is improperly assembled.
11. Assemble the front valve plate over the guide pins and lower plate into position (Fig. 40).
12. Assemble the head gasket over the guide pins (Fig. 41).

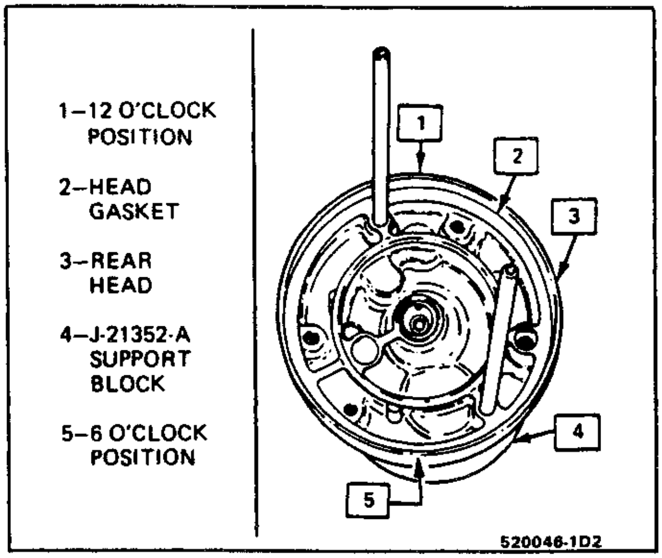


Fig. 44 Head Gasket Installed in Rear Head

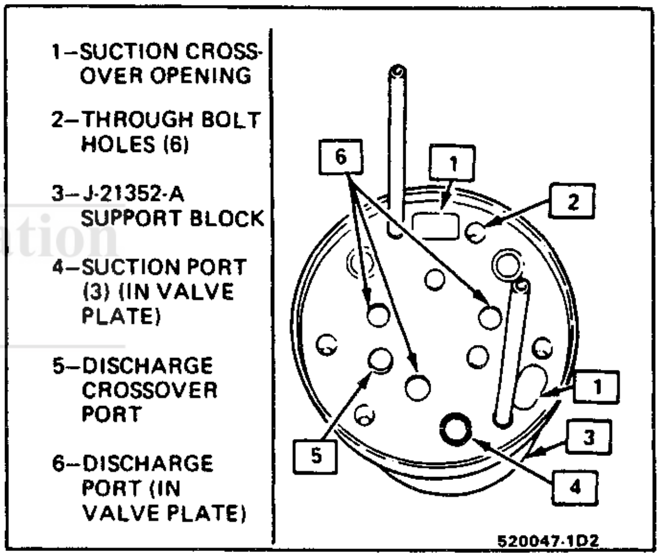


Fig. 45 Rear Valve Plate Installed in Rear Head

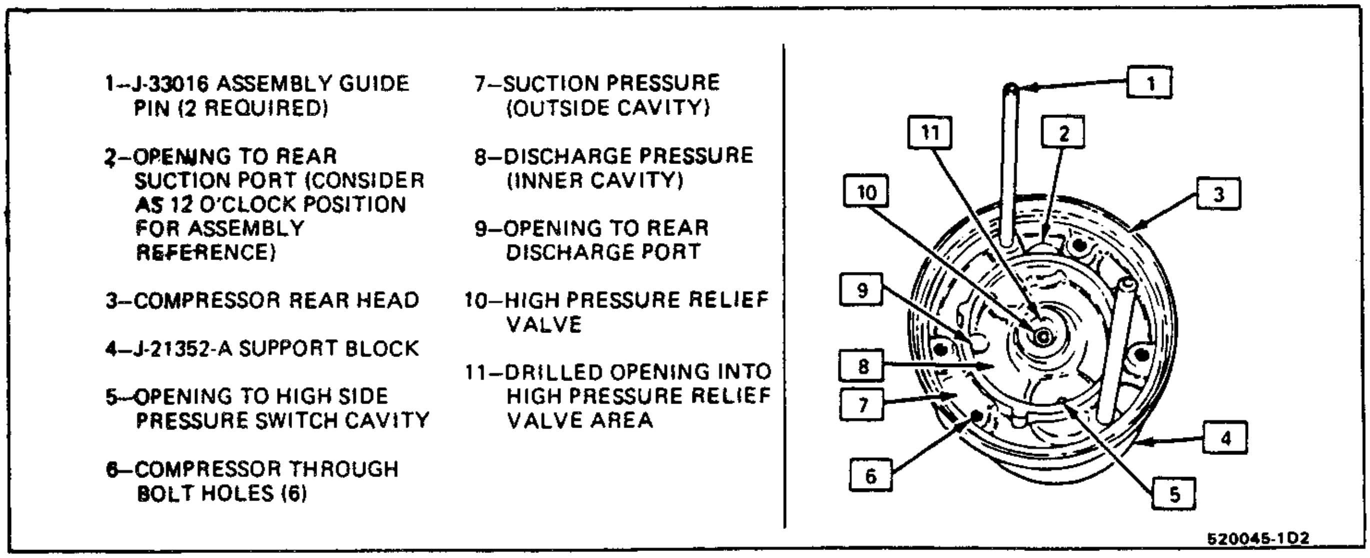


Fig. 43 Detail of Compressor Rear Head-Assembly Guide Pins Installed

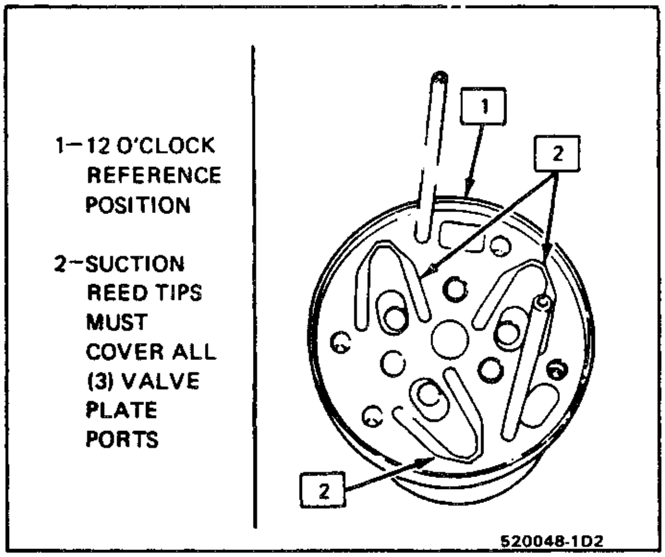


Fig. 46 Suction Reed Plate Properly Installed

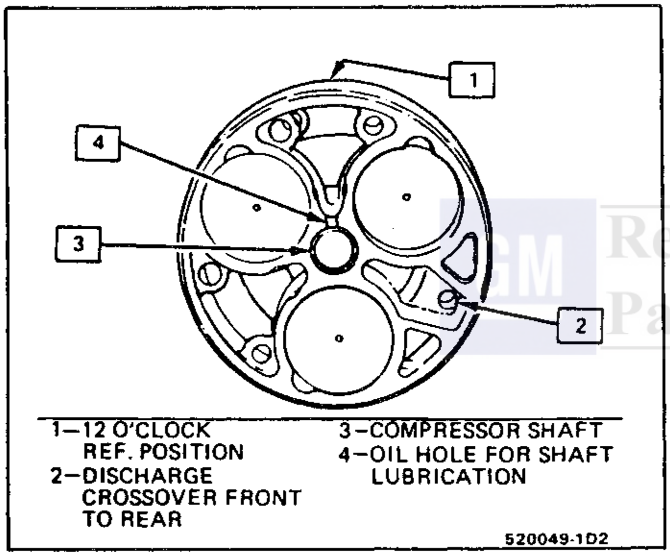


Fig. 47 Rear View and Detail of HR-6 Cylinder and Shaft Assembly

13. Line up mark on front head (step 4 of Remove) with the alignment marks on the compressor cylinder and assemble head over guide pins.

14. Using both hands, press down on the front head to force it over the O-ring at the front of the cylinder.

15. Add new through bolt gaskets to the through bolts and install the bolts into the compressor assembly (Fig. 31). 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.

16. Install new shaft seal kit per previous procedure.

17. Add amount of new 525 viscosity refrigerant oil as determined in step 1 of remove. Install test plate J-9625-A. Place shaft nut on shaft and rotate compressor shaft several times.

18. Leak test complete compressor assembly according to (Bench-Check) Leak Testing procedure.

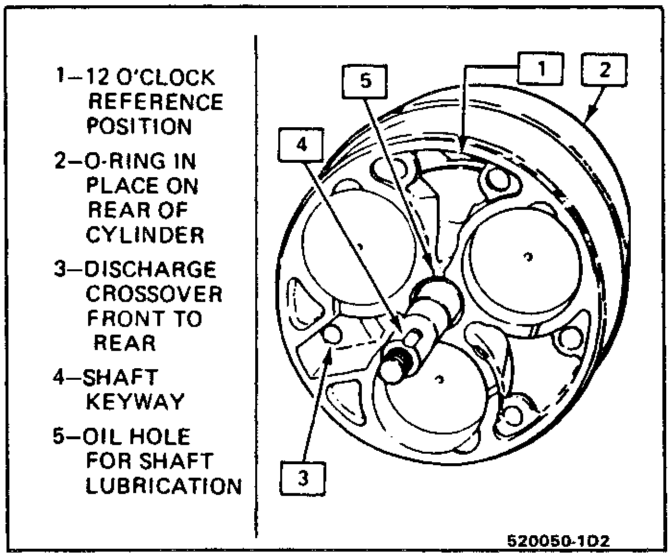


Fig. 48 Front View and Detail of HR-6 Cylinder and Shaft Assembly

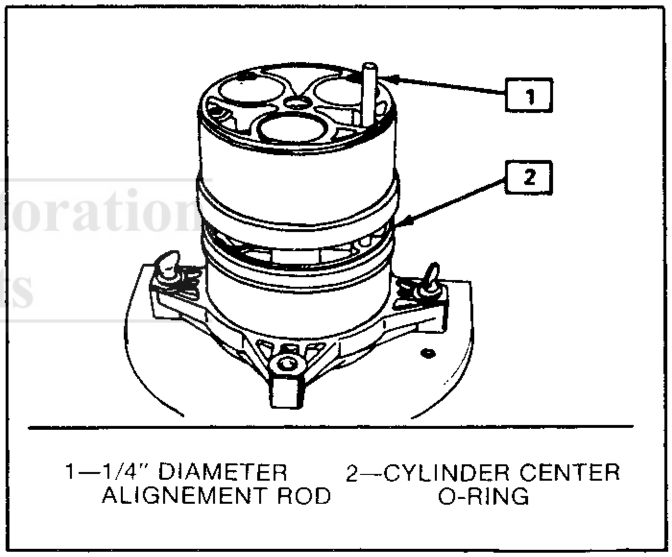


Fig. 49 Cylinder Alignment Rod Through Cylinder Halves

19. Remove shaft nut and install clutch parts on compressor according to previous procedure.

20. Install compressor assembly on car.

21. Evacuate and charge the refrigerant system.

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. Fasten the front head in the J-33026, holding fixture (Fig. 29) and insert the cylinder and shaft assembly into the front head, shaft end down.
4. 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.
5. Insert a piece of 1/4" diameter drill rod or smooth 1/4" 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.
6. 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.

7. Assemble the compressor per previous Cylinder and Shaft Replace procedure.

COMPRESSOR LEAK TESTING (EXTERNAL AND INTERNAL)

BENCH-CHECK PROCEDURE

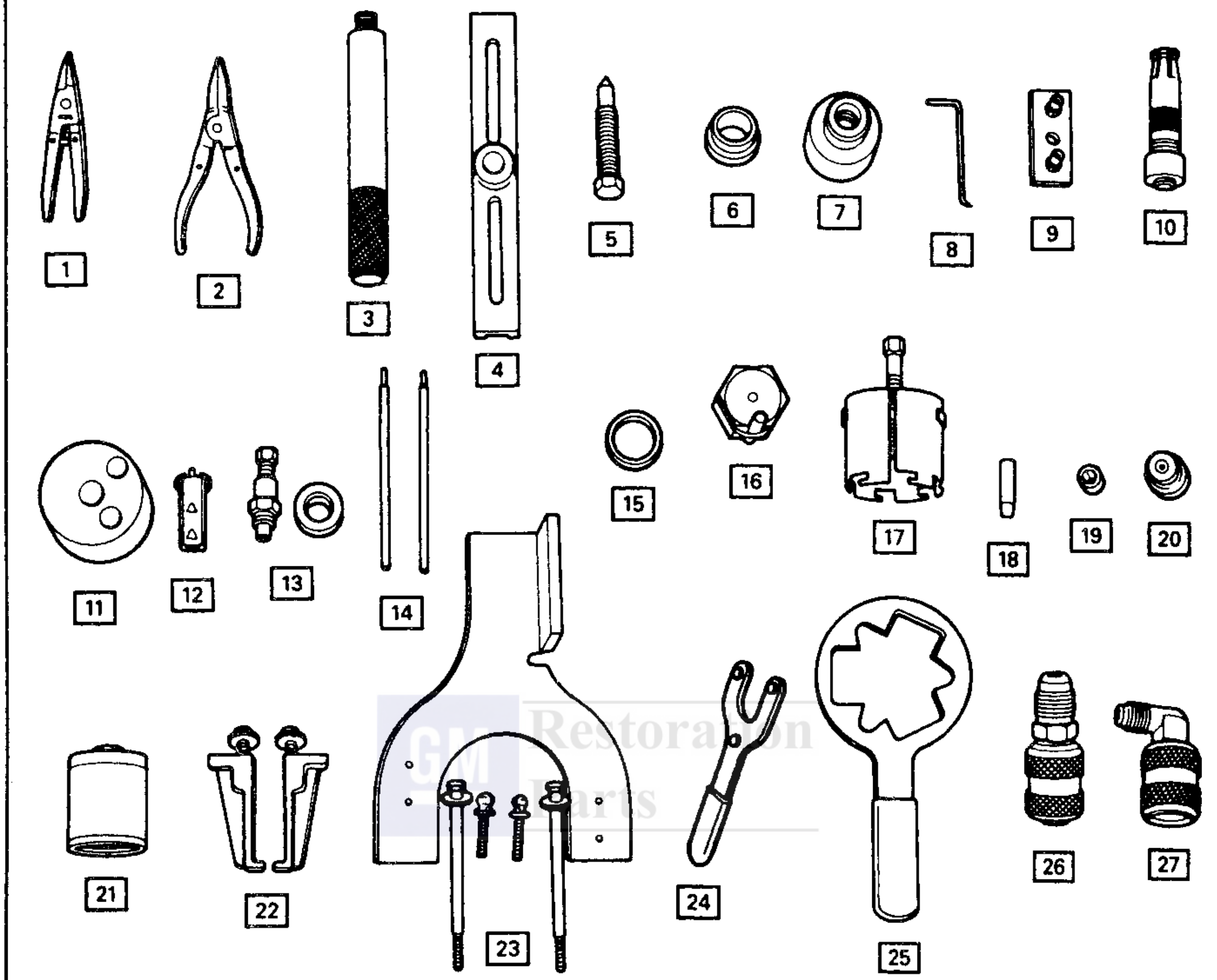
1. Install test plate J-9625-A on rear head of compressor.
2. Attach center hose of manifold gage set on charging station to a refrigerant drum standing in an upright position and open valve on drum.
3. Connect charging station high and low pressure lines to corresponding fittings on test plate J-9625-A, 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. 42).
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.
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.

18\. 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\. 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 refill with the proper amount of oil. The oil may be poured into the suction port. If further assembly o 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 29886	DRIVER HANDLE
4	J 8433-1	PULLER BAR
5	J 8433-3	FORCING SCREW
6	J 9398-A	BEARING REMOVER
7	J 9481-A	BEARING INSTALLER
8	J 9553-01	"O" RING REMOVER
9	J 9625-A	PRESSURE TESTING CONNECTOR
10	J 23128-A	SEAL SEAT REMOVER & INSTALLER
11	J 21352-A	SUPPORT BLOCK
12	J 33011	"O" RING INSTALLER
13	J 33013-B	HUB & DRIVE PLATE REMOVER & INSTALLER
14	J 33016	CYLINDER ALIGNMENT RODS
15	J 33017	PULLEY & BEARING ASSEMBLY INSTALLER
16	J 33019	BEARING STAKING TOOL
17	J 33020	PULLEY PULLER
18	J 34614	SHAFT SEAL PROTECTOR
19	J 33022	SHAFT NUT SOCKET
20	J 33023-A	PULLER PILOT
21	J 33024	CLUTCH COIL INSTALLER ADAPTER
22	J 33025	CLUTCH COIL PULLER LEGS
23	J 33026	COMPRESSOR HOLDING FIXTURE
24	J 25030	CLUTCH HUB HOLDING TOOL
25	J 33027	CLUTCH HUB HOLDING TOOL
26	J 5420 J 25498	7/16"-20 STRAIGHT ADAPTER 7/16"-20 x 3/8"-24 STRAIGHT ADAPTER
27	J 9459 J 25499	7/16"-20 90° ELBOW ADAPTER 7/16"-20 x 3/8"-24 90° ELBOW ADAPTER

Fig. 50 HR-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.

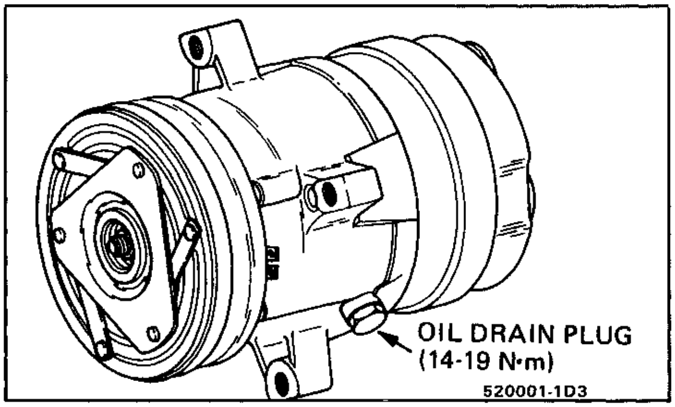


Fig. 1 V5 Compressor, V-Groove Pulley & Standard Mounting

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, naphtha, 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, measured and recorded. This oil should then be discarded and new 525 viscosity refrigerant oil added to the compressor (see "Refrigerant Oil" Distribution in Section 1B).

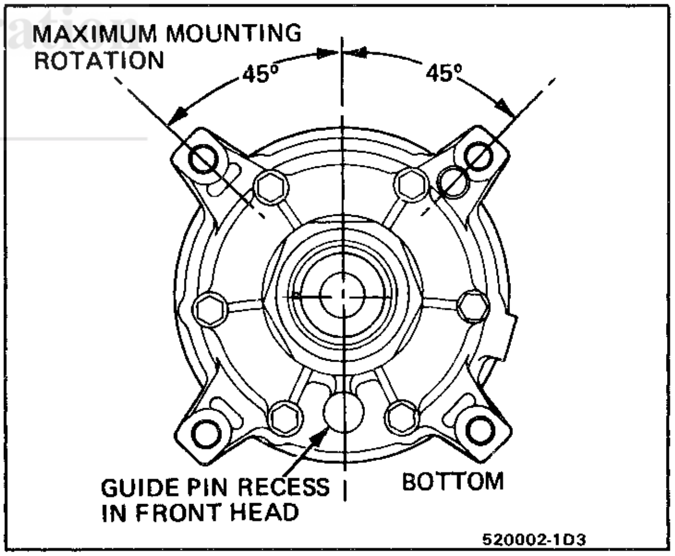


Fig. 2 V5 Compressor Front Head Orientation

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.

Vehicles using the V5 compressor may have one of two different rear heads. One rear head contains no pressure switches. They are located in the refrigerant lines. The other rear head is the same as past models, except that some models have replaced the low pressure cut-out switch with a coolant fan switch. The low pressure cut-out switch on these models will also be located in a refrigerant line. See Section 1B for specific locations.

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 rotating 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.

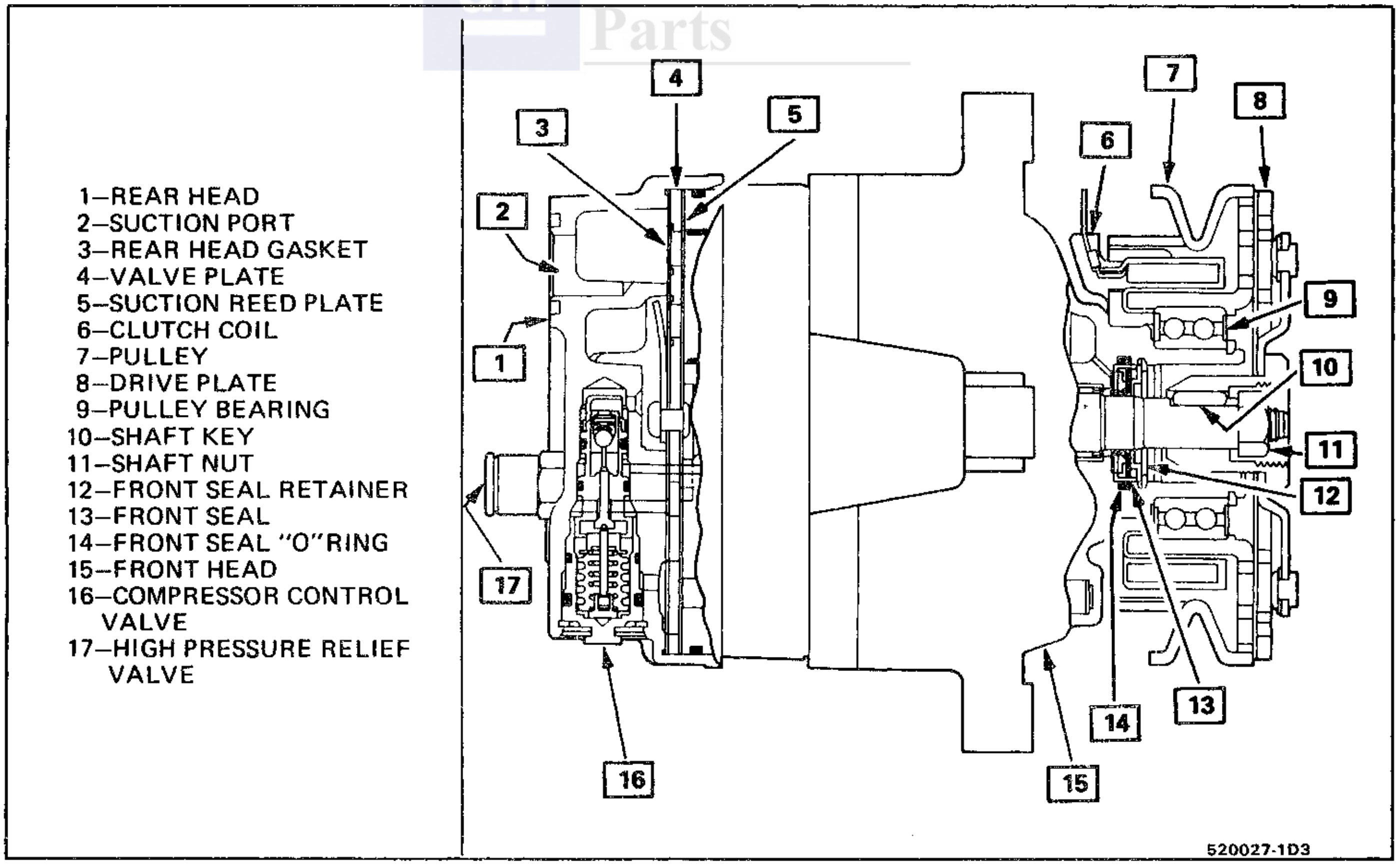


Fig. 3 V5 Compressor - Cross Section

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

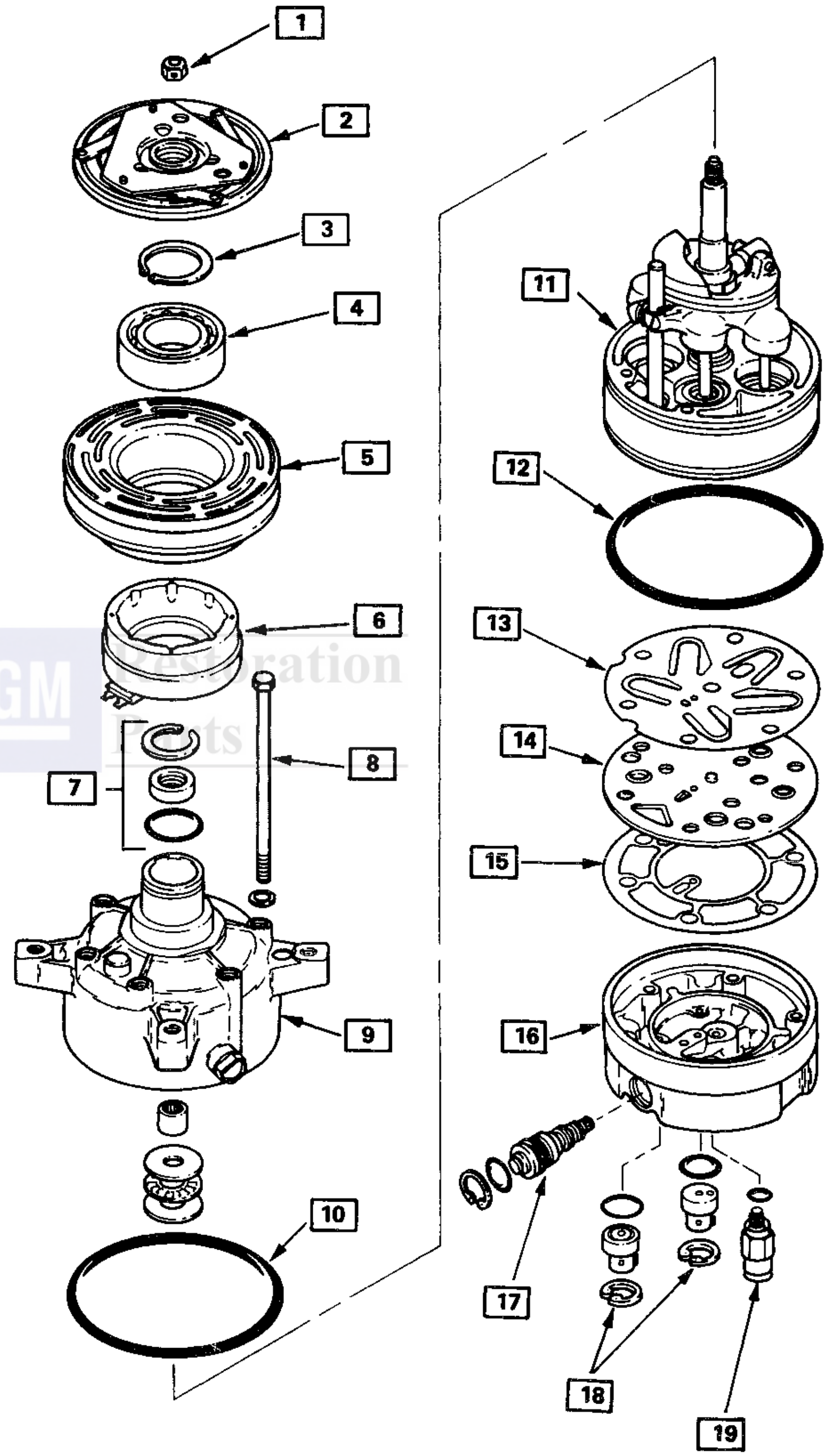


Fig. 4 V5 Compressor Components - Disassembled View

SERVICE PROCEDURES

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.

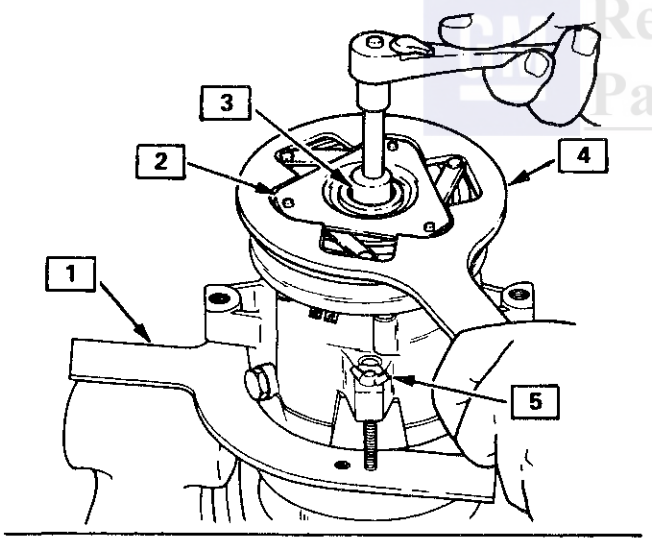
Removal and installation of external compressor parts, and disassembly and assembly of internal parts, must be performed on a clean workbench. The work area, tools and parts must be kept clean at all times.

CLUTCH PLATE AND HUB ASSEMBLY

Fig. 5 thru 8

↔ 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.
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.



1–J-34992 COMPRESSOR HOLDING FIXTURE

2–CLUTCH PLATE AND HUB ASM.

3–J-33022 NUT SOCKET

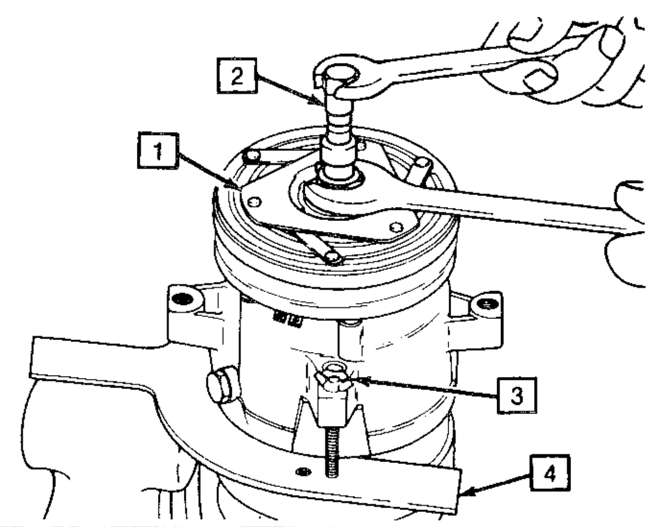
4–J-33027 CLUTCH HUB HOLDING TOOL

5–J-34992-1 THUMB SCREW

520006-1D3

Fig. 5 Removing Shaft Nut

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.
4. Remove the shaft key and retain for reassembly.



1 CLUTCH PLATE AND HUB ASSEMBLY

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

3 J-34992-1 THUMB SCREW

4 J-34992 HOLDING FIXTURE

G60070-1D3-J

Fig. 6 Clutch Plate and Hub Assembly Removal

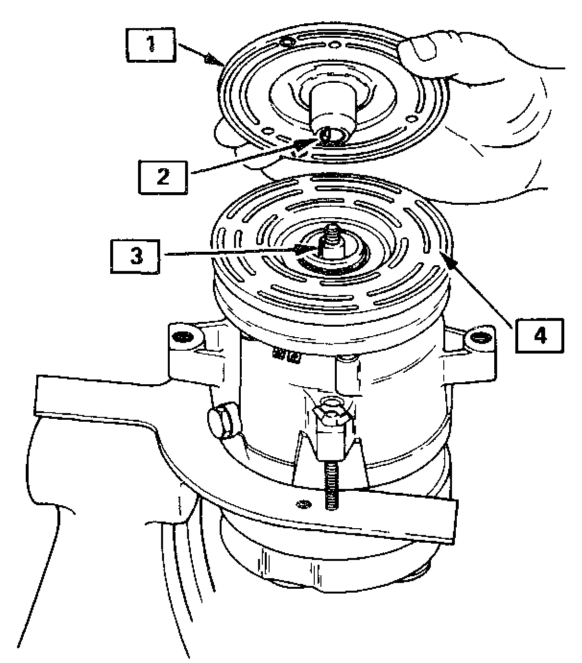
→← Install or Connect

1. Install the shaft key into the hub key groove. 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 J-33013 remover - installer center screw and reverse the body direction on the center screw.
5. Clutch plate and hub installer J-33013 with bearing.

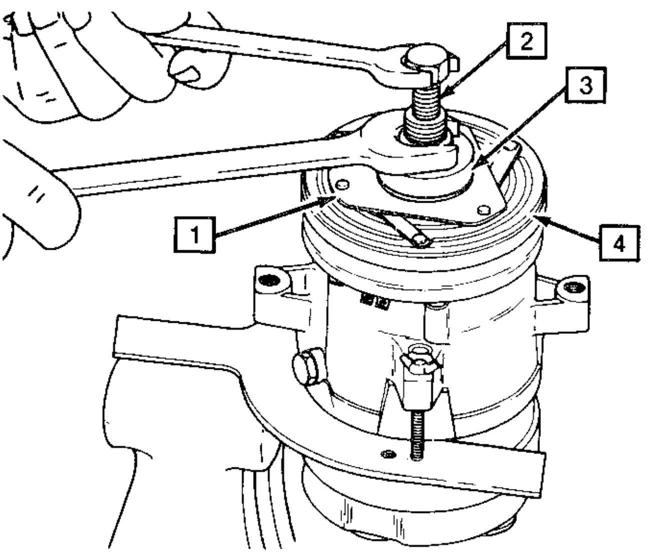
   The body of the J-33013 installer should be backed off sufficiently to allow the center screw to be threaded onto the end of the compressor shaft.
6. Hold the center screw with a wrench. Tighten the hex portion of the Installer J-33013 body to press



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

520008-1D3

Fig. 7 Shaft Key, Clutch Plate/Hub Installation



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

G60090-1D3-J

Fig. 8 Installing Clutch Plate & Hub Assembly

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 wedge and break the clutch hub.

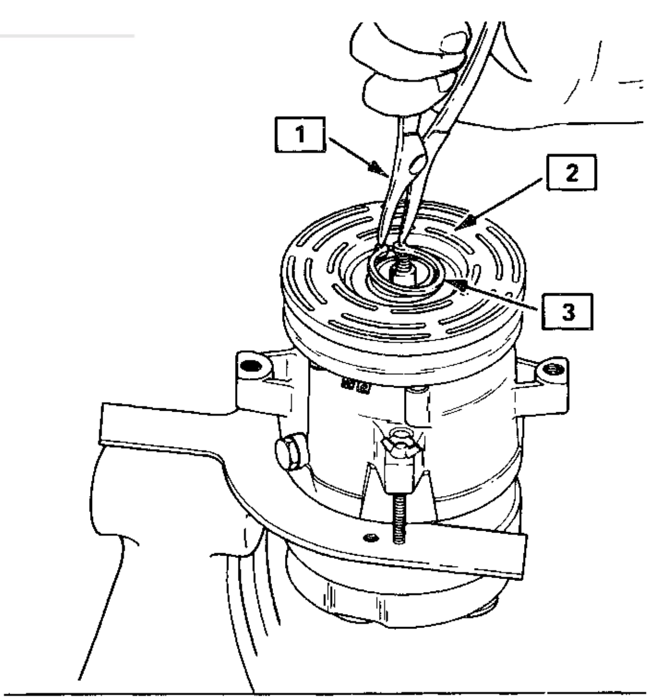
7. Remove installer J-33013, check for proper positioning of the shaft key (even or slightly above the clutch hub). Install the shaft nut. Hold the clutch plate and hub assembly with clutch hub holding tool J-33027 and using shaft nut socket J-33022, tighten the nut against the crankshaft shoulder to 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.

CLUTCH ROTOR AND BEARING

Fig. 9 thru 16

↔ **Remove or Disconnect**

1. Clutch plate and hub assembly.
2. Rotor and bearing assembly retaining ring, using snap ring pliers J-6083.

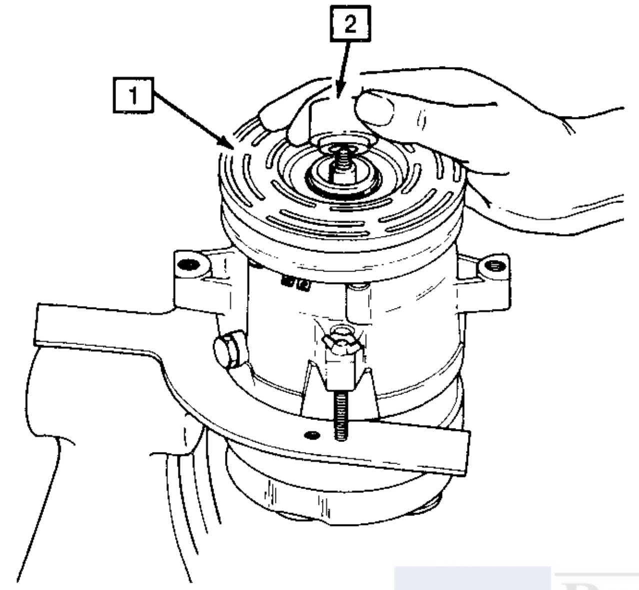


1–J-6083 PLIERS
2–PULLEY ROTOR
3–RETAINING RING

520010-1D3

Fig. 9 Removing Pulley Rotor & Bearing Assembly Retaining Ring

3. Install pulley rotor and bearing puller guide J-33023 to the front head and install J-33020 pulley rotor and bearing puller down into the inner circle of slots in the rotor. Turn the J-33020 puller clockwise in the slots to engage the puller tangs with the segments between the slots in the rotor.



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

2 J-33023-A PULLEY ROTOR AND BEARING PULLER GUIDE

Fig. 10 Installing Pulley Rotor/Bearing Puller Guide

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.
6. Drive the bearing out of the rotor hub with rotor bearing remover J-9398-A and J-29886 universal handle.

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

→← Install or Connect

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

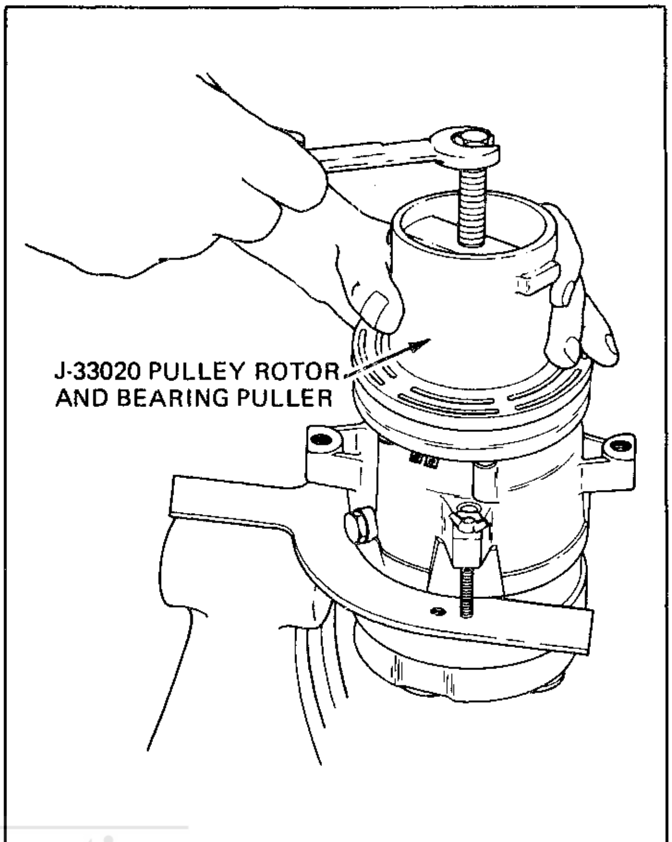
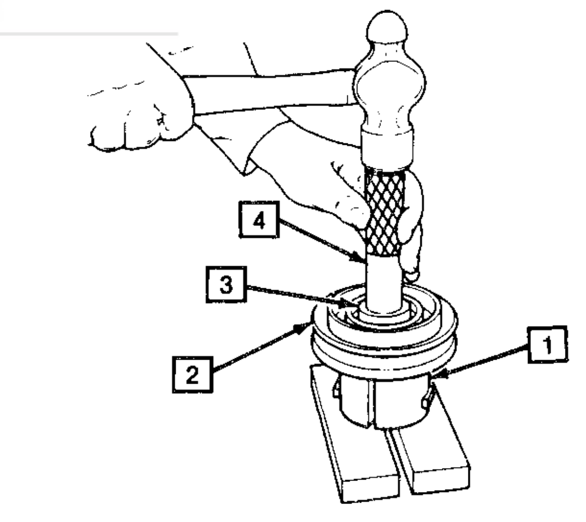


Fig. 11 Removing Pulley Rotor and Bearing Assembly



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"

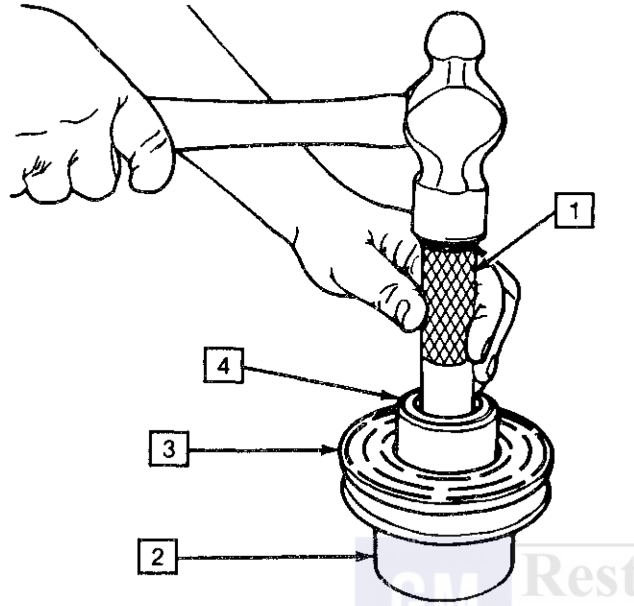
3 J-9398-A BEARING REMOVER

4 J-29886 DRIVER HANDLE

Fig. 12 Pulley Rotor Bearing Removal

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.



1 J-29886 DRIVER HANDLE

2 J-21352-A PULLEY ROTOR SUPPORT BLOCK

3 PULLEY ROTOR

4 J-9481-A BEARING INSTALLER

G60140-1D3-J

Fig. 13 Installing Pulley Rotor Bearing

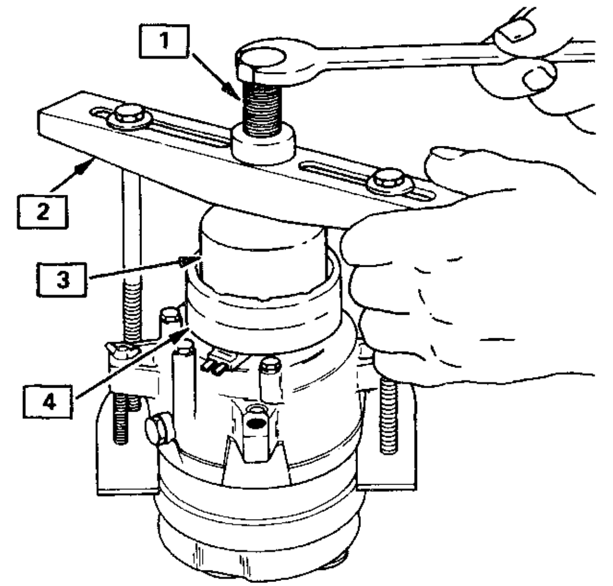
3. Place bearing staking guide J-33019-1 and bearing staking pin J-33019-2 in the hub bore. Shift the rotor and bearing assembly on the J-35372 support block to give full support of the hub under the staking pin location. A heavy-duty rubber band may be used to hold the stake pin in the guide, and the 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.

5. With the compressor mounted to the J-34992 holding fixture, position the rotor and bearing assembly on the front head.

6. Position the J-33017 pulley rotor and bearing installer and J-33023 puller pilot directly over the inner race of the bearing.



1—J-8433-3 SCREW

2—J-8433-1 PULLER CROSS BAR

3—J-33024 CLUTCH COIL ASSEMBLY

4—CLUTCH COIL ASSEMBLY

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Fig. 14 Installing Clutch Coil Assembly

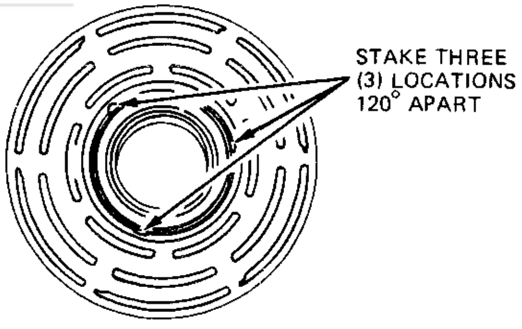

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Fig. 15 Bearing Staked In Place

7. Position puller crossbar J-8433-1 on the puller pilot J-33023-A 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. 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. 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.

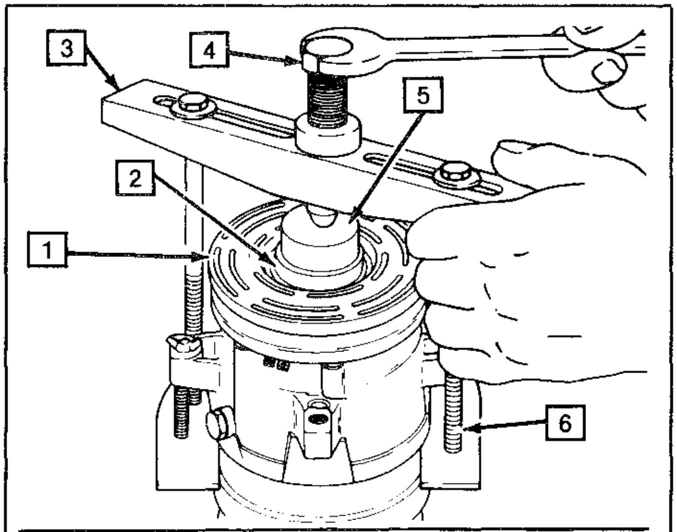


Fig. 16 Installing Pulley Rotor and Bearing Assembly

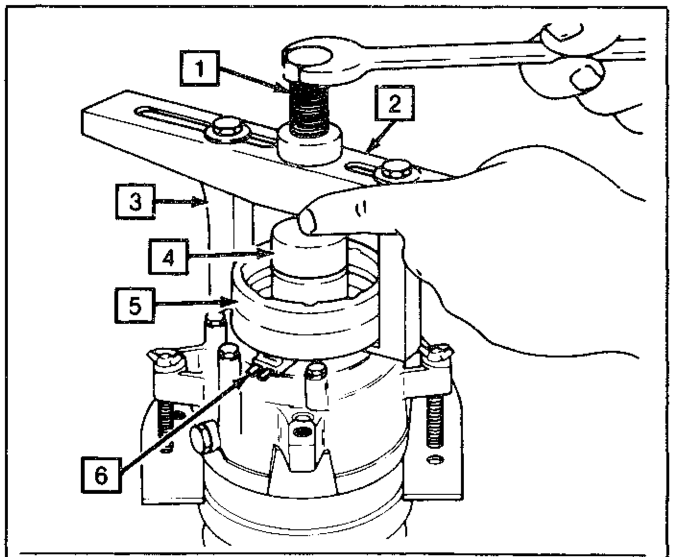


Fig. 17 Clutch Coil Assembly Removal

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

CLUTCH COIL

Fig. 17 thru 20

↔ Remove or Disconnect

1. Perform Steps 1 through 4 of "Clutch Rotor and Bearing" removal procedure. Mark clutch coil terminal location on compressor front head.
2. Install J-33023 puller pilot on front head of compressor. Also install J-8433-1 puller crossbar with J-33025 puller legs.
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.
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.

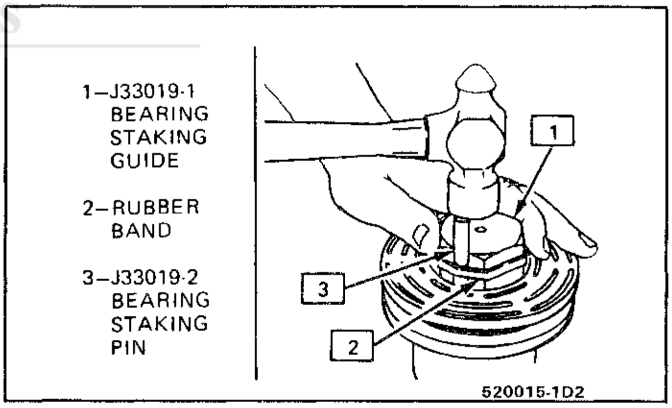


Fig. 18 Staking Bearing In Rotor Hub Bore

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, 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.
6. Install rotor and bearing assembly and the clutch plate and hub assembly according as described previously.

MAJOR V5 COMPRESSOR REPAIR PROCEDURES

When replacing the shaft seal assembly, pressure relief valve or rear head mounted pressure switches,

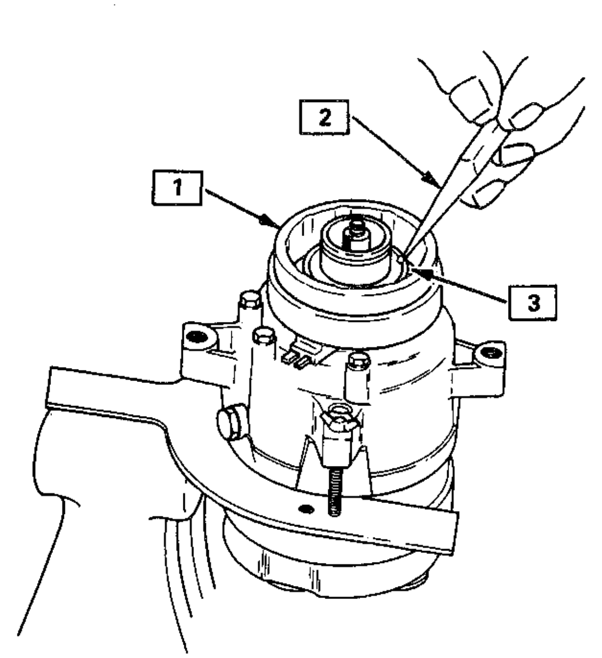


Fig. 19 Staking Clutch Coil To Front Head

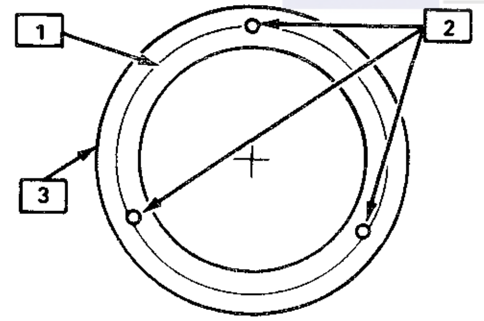


Fig. 20 Details of Stakes In Front Head for Clutch Coil

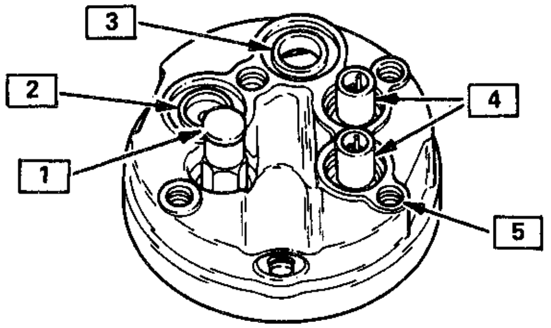


Fig. 21 Compressor and Clutch Assembly - Rear View

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, recorded 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.

Fig. 22 Compressor Shaft Seal

SHAFT SEAL REPLACEMENT

Seal Leak Detection

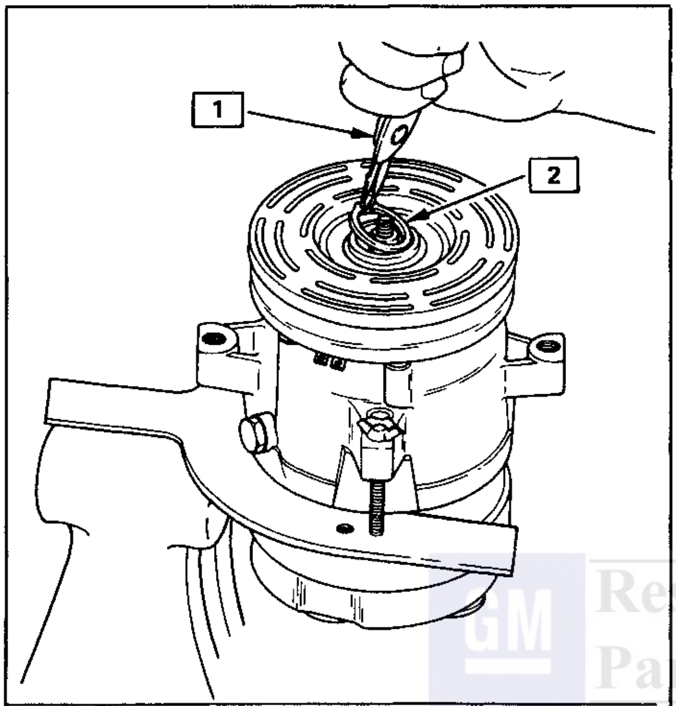
Fig. 23 thru 27

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 A/C system.
2. Loosen and reposition compressor in mounting brackets.
3. Clutch plate and hub assembly from compressor.
4. Shaft seal retainer ring, using snap ring pliers J-5403.



1–J-5403 SNAP RING PLIERS

2–SEAL SEAT RETAINER RING

520018-1D3

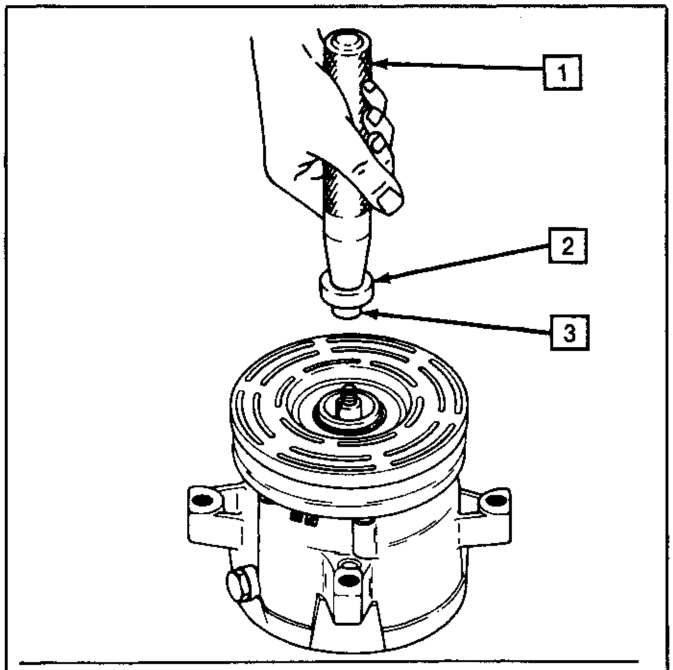
Fig. 23 Removing or Installing Shaft Seal Seat Retaining Ring

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. 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-9553-01.

   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.



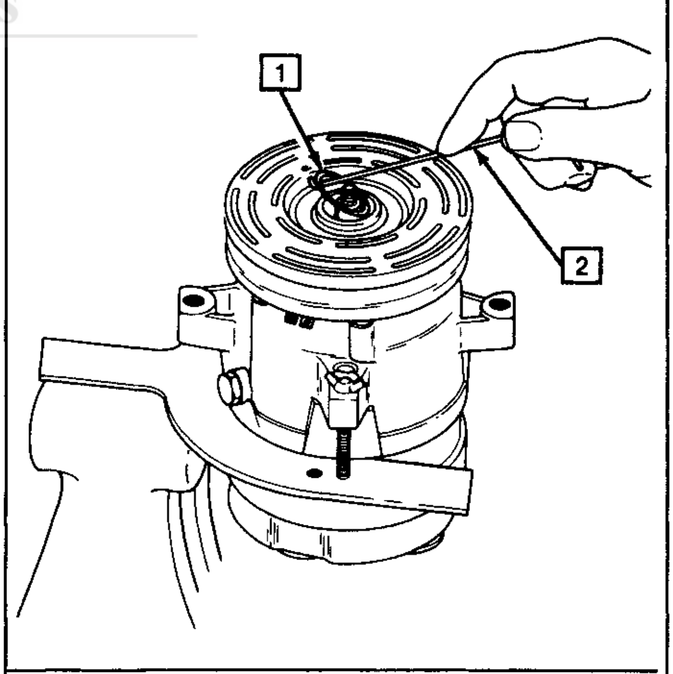
1 J-23128-A SEAL SEAT REMOVER AND INSTALLER

2 SEAL SEAT

3 J-34614 SHAFT SEAL PROTECTOR

G60250-1D3-J

Fig. 24 Removing or Installing Shaft Seal



1 SHAFT SEAL SEAT O-RING

2 J-9553-01 "O" RING REMOVER

G60260-1D3-J

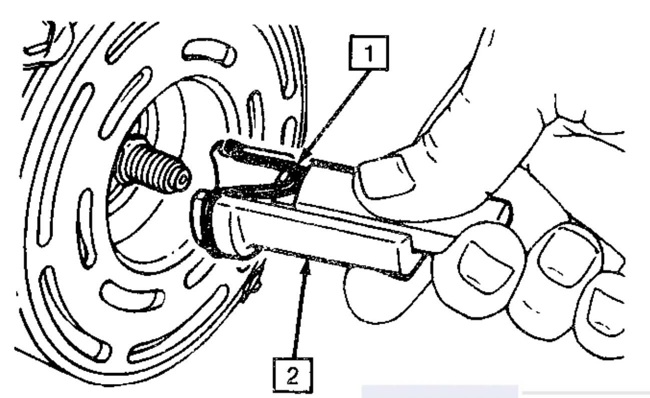
Fig. 25 Removing Shaft Seal Seat O-Ring

Important

Seals should not be re-used . Always use a new specification service seal kit on rebuild. 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.

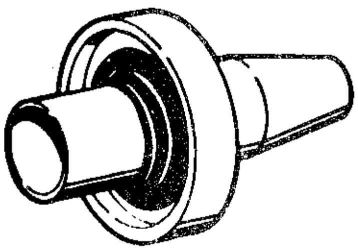


1 O-RING
2 J-33011

G60270-1D3-J

Fig. 26 Installing Shaft Seal Seat O-Ring

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.



J-34614 SEAL PROTECTOR

520025-1D3

Fig. 27 Lip Seal Installed on Seal Protector

4. Install the new seal retainer ring with its flat side against the seal, using snap-ring pliers J-5403. Use the sleeve from seal 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 A/C system.

PRESSURE RELIEF VALVE

Fig. 21

Remove or Disconnect

1. Discharge A/C System.
2. Pressure relief valve.

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).

HIGH PRESSURE CUT-OFF AND LOW PRESSURE CUT-OUT SWITCHES

Fig. 21

Remove or Disconnect

1. Discharge A/C System.
2. Electrical connector from switch.
3. Switch retaining ring, using J-5403 internal snap ring pliers.
4. Switch from compressor.
5. O-ring seal from switch cavity using J-9553-01 O-ring removal tool or equivalent.
   If existing 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 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.

CONTROL VALVE ASSEMBLY

Fig. 4

Remove or Disconnect

1. Discharge A/C System.
2. Control valve retaining ring using J-5403 internal snap ring pliers.
3. 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.

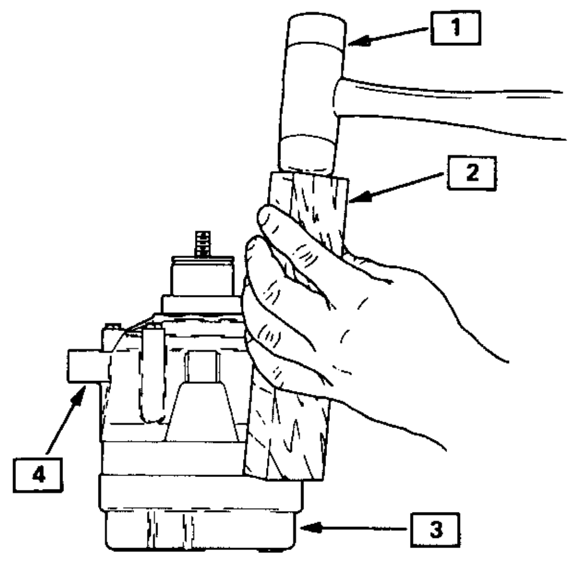
REAR HEAD, HEAD GASKET, REAR VALVE PLATE, SUCTION REED PLATE AND CYLINDER TO REAR HEAD O-RING

Remove or Disconnect

1. Discharge A/C system and remove compressor from car. Drain oil from compressor into a container, measure, record and discard oil.
2. Clutch drive and hub assembly, pulley rotor and bearing assembly and clutch coil.
3. Six (6) compressor through bolts and gaskets. Discard 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. 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. Guide pins in mounting holes at 11 and 5 o'clock positions.
3. Head gasket over guide pins, with elongated hole at upper left pin (11 o'clock).
4. Rear valve plate over guide pins with elongated hole at upper left pin. Lower into place.
5. Suction reed plate over guide pins. Remove guide pin at 5 o'clock position.
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.



1–PLASTIC HEADED HAMMER

2–WOOD BLOCK

3–REAR HEAD

4–FRONT HEAD

Fig. 28 Tapping Front or Rear Head Free of Cylinder

7. With O-ring in place on rear of cylinder assembly locate relief boss for compressor guide pin at 6 o'clock position, 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 through bolts and install into 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.
10. New shaft seal kit.
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.
13. Remove shaft nut and install clutch parts on compressor.
14. Install compressor assembly on car.
15. Evacuate and charge A/C system.

CYLINDER TO FRONT HEAD O-RING

Remove or Disconnect

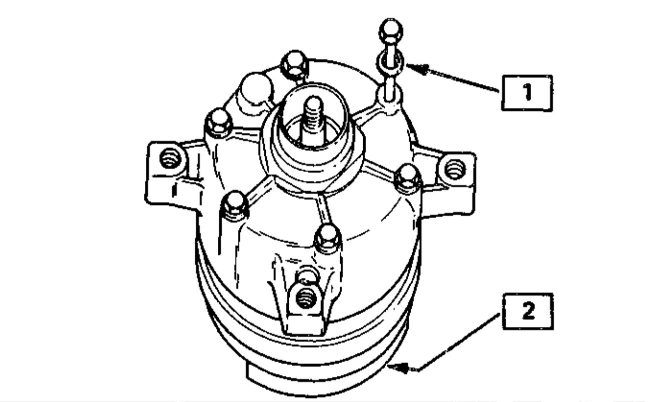
1. Discharge A/C system remove compressor from car. Drain oil from compressor into a container, measure, record and discard oil.
2. Clutch drive and hub assembly, pulley rotor and bearing assembly and clutch coil.
3. Shaft seal parts and discard.
4. Six (6) compressor through bolts and gaskets. Discard gaskets.
5. Using a plastic headed hammer, tap the front head at the mounting locations to disengage the head from the compressor cylinder.
6. Front head, and cylinder to front head O-ring. Discard O-ring.

   Note assembly sequence of thrust washer and bearing for reassembly.

Install or Connect

1. Rest the rear head on support block J-35372. Install one (1) assembly guide pin J-34993 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. 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. New shaft seal kit.
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.
9. Remove shaft nut and install clutch parts on compressor.
10. Install compressor assembly on car.
11. Evacuate and charge A/C system.



1—THROUGH BOLT GASKET (6) REQUIRED

2—J-35372

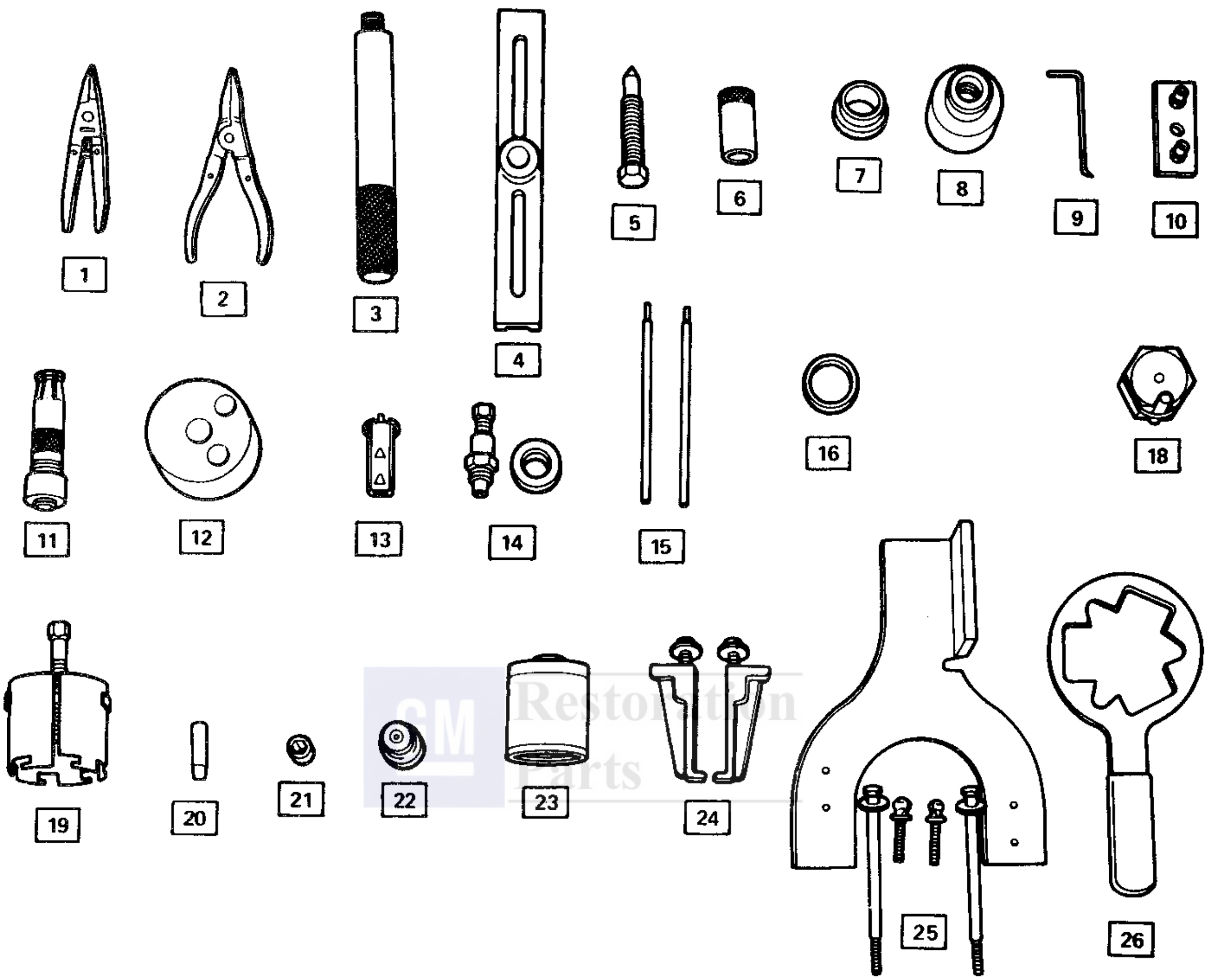
520023-1D3

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

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 J-29547, 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	15–J 34993	CYLINDER ALIGNMENT RODS
2–J 6083	SNAP RING PLIERS	16–J 33017	PULLEY & BEARING ASSEMBLY INSTALLER
3–J 8092	DRIVER HANDLE		
4–J 8433-1	PULLER BAR		
5–J 8433-3	FORCING SCREW		
6–J 9393	SEAL SEAT INSTALLER	18–J 33019	BEARING STAKING TOOL
7–J 9398-A	BEARING REMOVER	19–J 33020	PULLEY PULLER
8–J 9481	BEARING INSTALLER	20–J 34614	SHAFT SEAL PROTECTOR
9–J 9553-01	"O" RING REMOVER	21–J 33022	SHAFT NUT SOCKET
10–J 9625	PRESSURE TESTING CONNECTOR	22–J 33023	PULLER PILOT
11–J 23128-A	SEAL SEAT REMOVER & INSTALLER	23–J 33024	CLUTCH COIL INSTALLER ADAPTER
12–J 35372	SUPPORT BLOCK	24–J 33025	CLUTCH COIL PULLER LEGS
13–J 33011	"O" RING INSTALLER	25–J 34992	COMPRESSOR HOLDING FIXTURE
14–J 33013	HUB & DRIVE PLATE REMOVER AND INSTALLER	26–J 33027	CLUTCH HUB HOLDING TOOL

520024-1D3

Fig. 30 V5 Compressor Overhaul - Special Tools

SECTION 2A

FRAME (CRADLE) AND MOUNTS

CONTENTS

GENERAL DESCRIPTION

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 thoroughly 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 2). The body mounts eliminate the motion of the cradle in relation to the body.

ON-VEHICLE 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 1

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

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 safety stands in the front and two in the rear at the points shown in Section 0A.

Tools Required

- J28467-A
- J35563 (2.8L only)

Install or Connect

1. Engine support fixture.
   - Raise engine enough to take tension off cradle mounts.
2. Hoist vehicle.

Remove or Disconnect

1. Exhaust pipe bolts at manifold.
2. Rear wheels and tire assemblies.
3. Both rear lateral control arms at knuckle.

4. Both fixed adjusting links at knuckle.
5. Both trailing arms at knuckle.
6. Stabalizer brackets at cradle. (GT only)
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 at first.
3. Engine and transmission mounting bolts.
4. Emergency brake cable at cradle.
5. Stabalizer brackets at cradle. (GT only)
6. Both trailing arms at knuckle.
7. Both fixed adjustable links at knuckle.
8. Both rear lateral control arms at knuckle.
9. Exhaust pipe bolts at manifold.
10. Rear wheel and tire assemblies.

Tighten

- Torque the following as indicated.
    1. Front cradle bolts 90 N•m (67 lbs. ft.)
    2. Rear cradle nut 103 N•m (76 lbs. ft.)
    3. Engine mount assembly 54 N•m (38 lbs. ft.)
    4. Rear Mount assembly 48 N•m (36 lbs. ft.)
    5. Front mount assembly 48 N•m (36 lbs. ft.)
    6. Rear lateral control arm at knuckle 50 N•m (37 lbs. ft.) + 90°
    7. Rear lateral control arm at cradle 55 N•m (41 lbs. ft.) + 105°
    8. Fixed adjusting link at knuckle 50 N•m (37 lbs. ft.) + 90°
    9. Fixed adjusting link at cradle 55 N•m (41 lbs. ft.) + 105°
    10. Trailing arm to cradle 51 N•m (37 lbs. ft.) + 80°
    11. Trailing arm to knuckle 60 N•m (44 lbs. ft.) + 90°
    12. Stabalizer bar bracket mounting bolts 25 N•m (18 lbs. ft.)
    13. Exhaust pipe bolts at manifold 25 N•m (18 lbs. ft.)

Remove or Disconnect

1. Lower vehicle
2. Support Fixture

Adjust

Toe-in, and parking brake assembly.

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

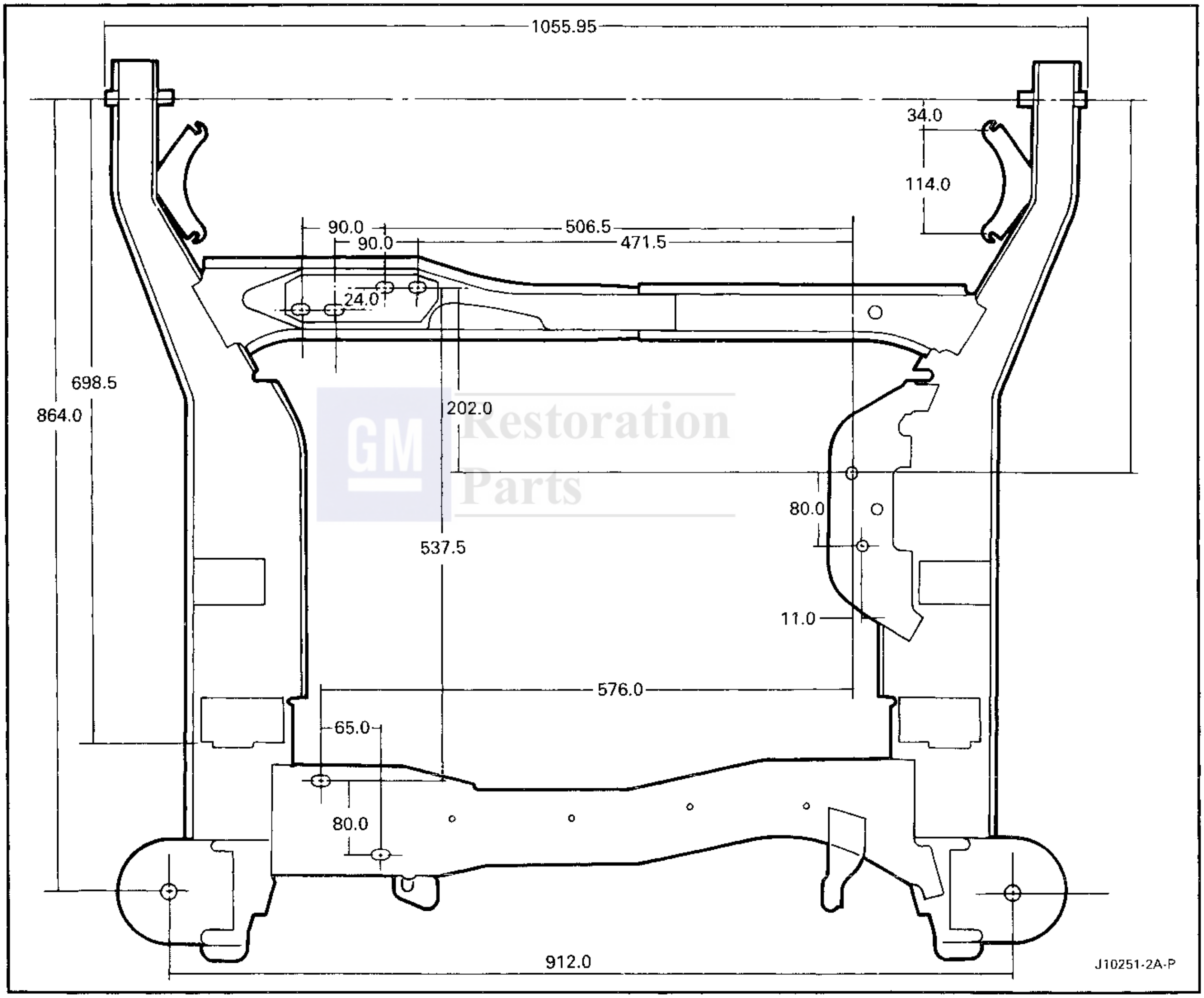
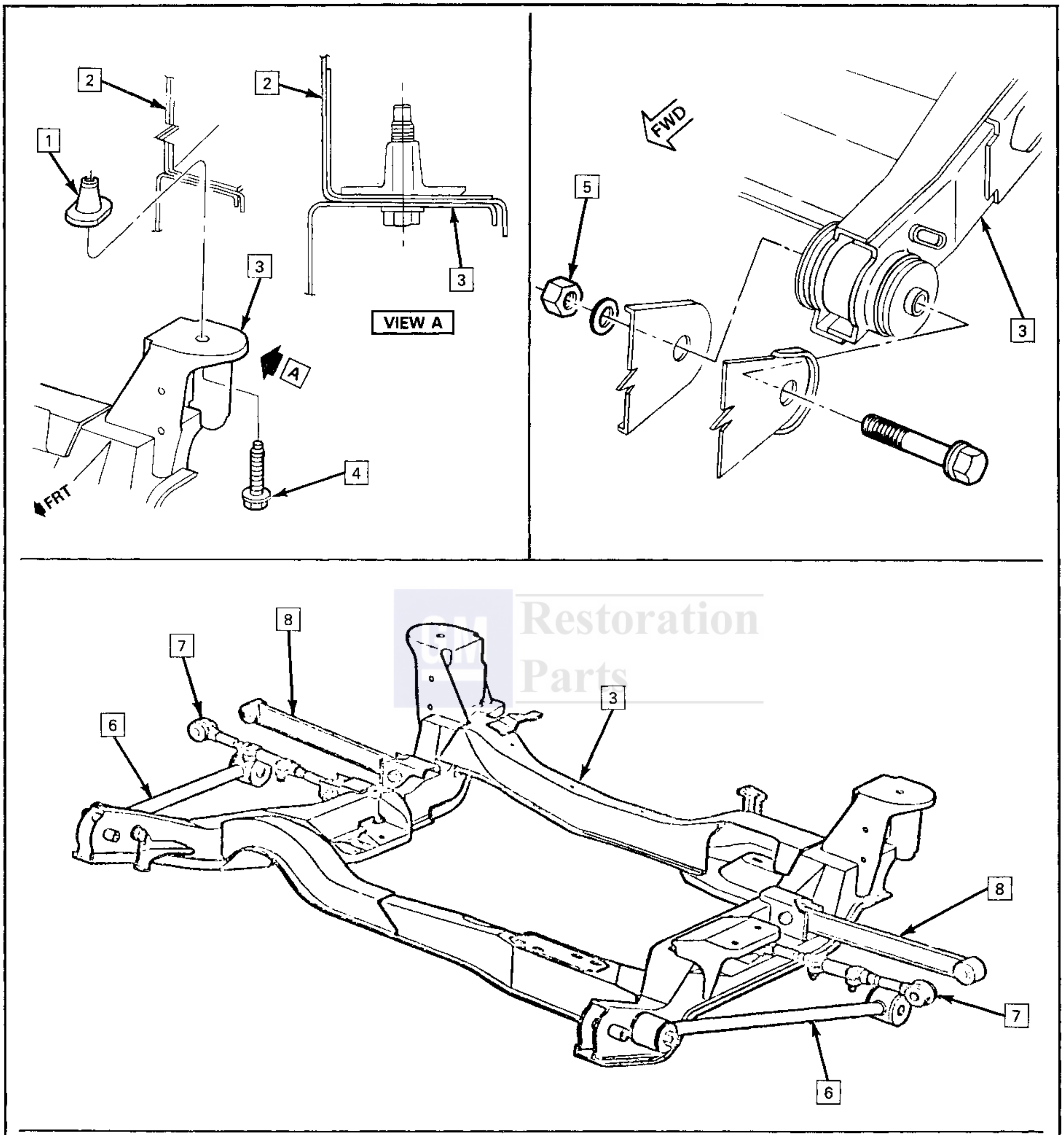


Figure 1 Cradle Alignment Specifications



1. CAGE NUT
2. RAIL
3. FRAME ASM.
4. 103 N·m (76 LB. FT.)
5. 90 N·m (66 LB. FT.)
6. TRAILING ARM
7. FIXED ADJUSTABLE LINK
8. LATERAL CONTROL ARM

J10252-2A-P

Figure 2 Cradle Mountings

1. BATTERY
2. ENGINE
3. ENGINE SUPPORT FIXTURE J28467-A
4. LEFT STRUT MOUNTING

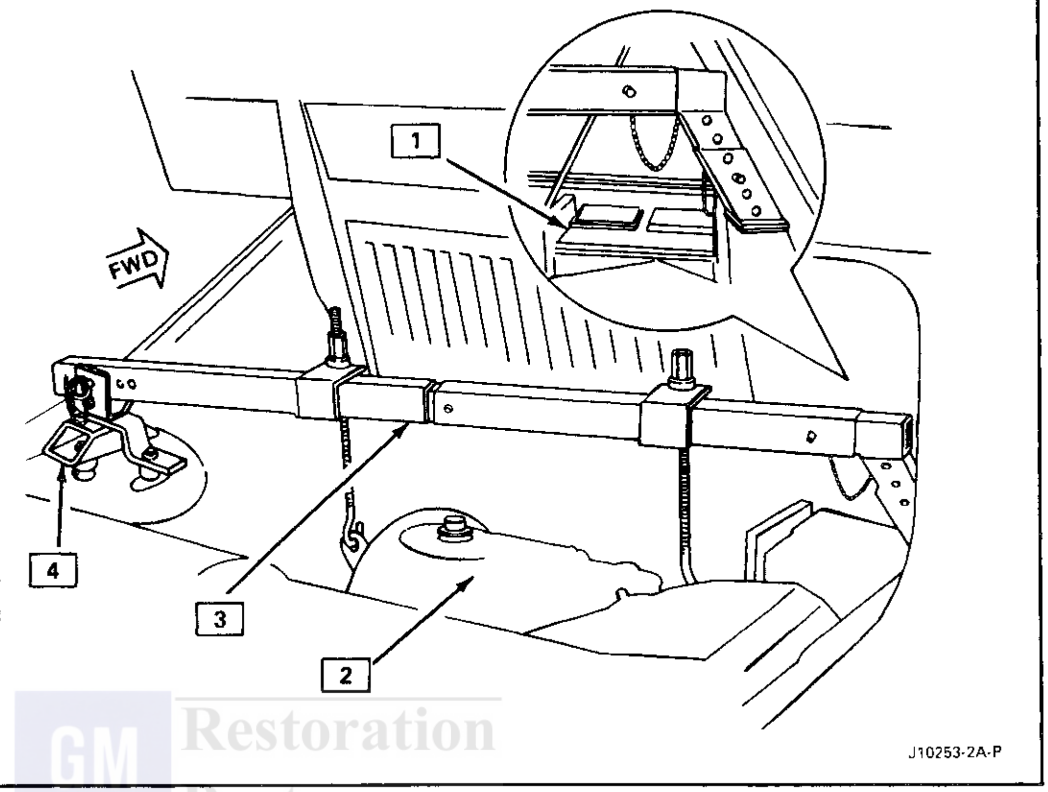
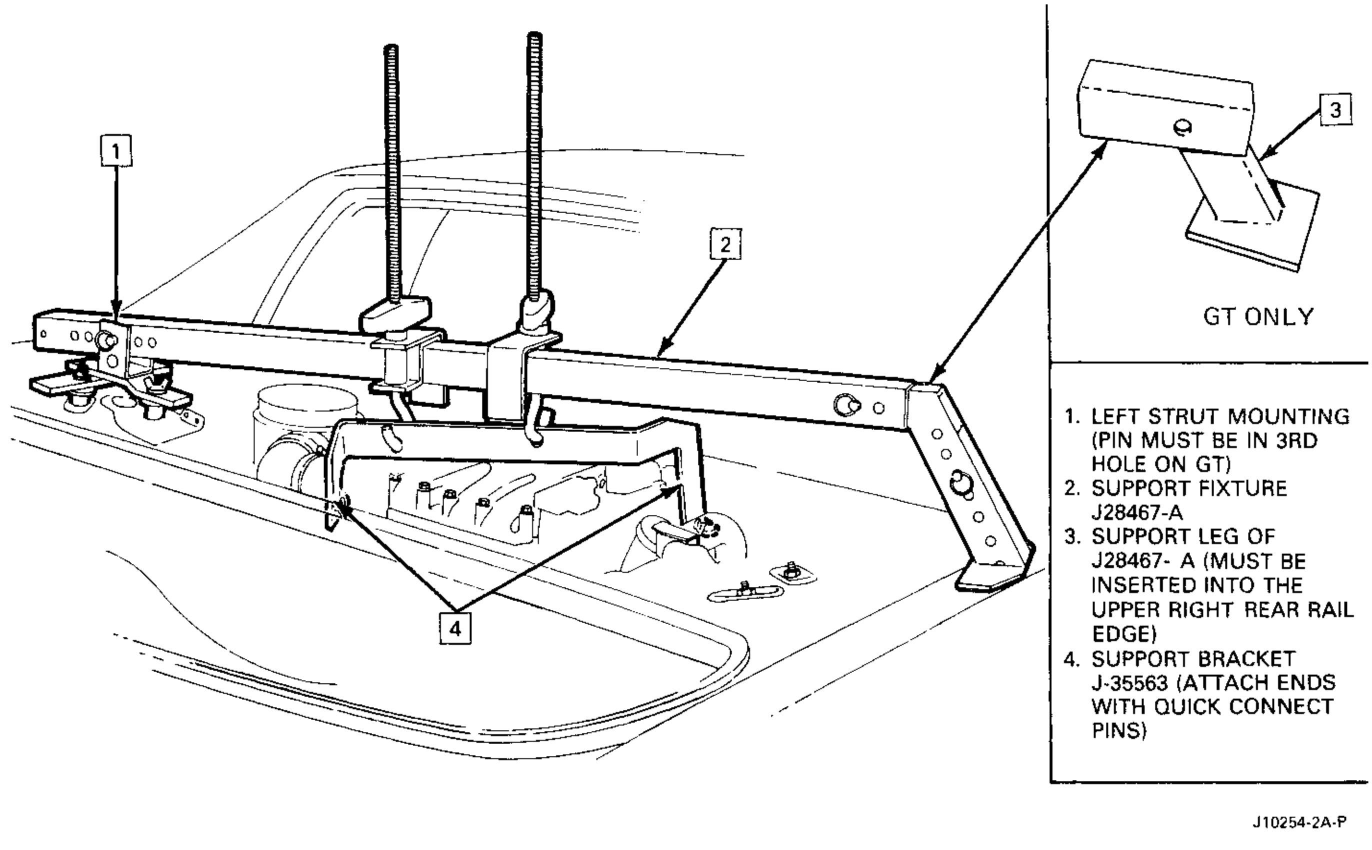


Figure 3 Engine Support Fixture Mounting



1. LEFT STRUT MOUNTING (PIN MUST BE IN 3RD HOLE ON GT)
2. SUPPORT FIXTURE J28467-A
3. SUPPORT LEG OF J28467- A (MUST BE INSERTED INTO THE UPPER RIGHT REAR RAIL EDGE)
4. SUPPORT BRACKET J-35563 (ATTACH ENDS WITH QUICK CONNECT PINS)

Figure 4 Engine Support Fixture Mounting (2.8L and GT)

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 assure proper retention of all parts. There is to be no welding as it may result in extensive damage and weakening of the metal.

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

CONTENTS

GENERAL DESCRIPTION

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.

BUMPER ENERGY ABSORBING UNITS

The absorbing capability for both front and rear bumper systems is achieved through honeycombed 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 old retainers 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.
   - If energy absorber is to be replaced, drill out old retainers and install new retainers.

Install or Connect

1. Reverse removal procedure.

FEDERAL VEHICLE THEFT PREVENTION STANDARD

(Anti-Theft Labeling)

Federal law requires General Motors to label certain parts, on selected cars, with the VIN. The purpose of the standard is to reduce the cases of motor vehicle thefts by helping in the tracing and recovery of parts from stolen vehicles.

The label will be permanently affixed to an interior surface of the part and will contain the complete VIN. The label on replacement parts will contain the letter R, the manufacturers logo, and the symbol "DOT".

Important

THESE LABELS ARE NOT TO BE DEFACED, REMOVED, OR COVERED OVER. The labels must be shielded from paint, rust proofing, and undercoating (Dealer preparation included).

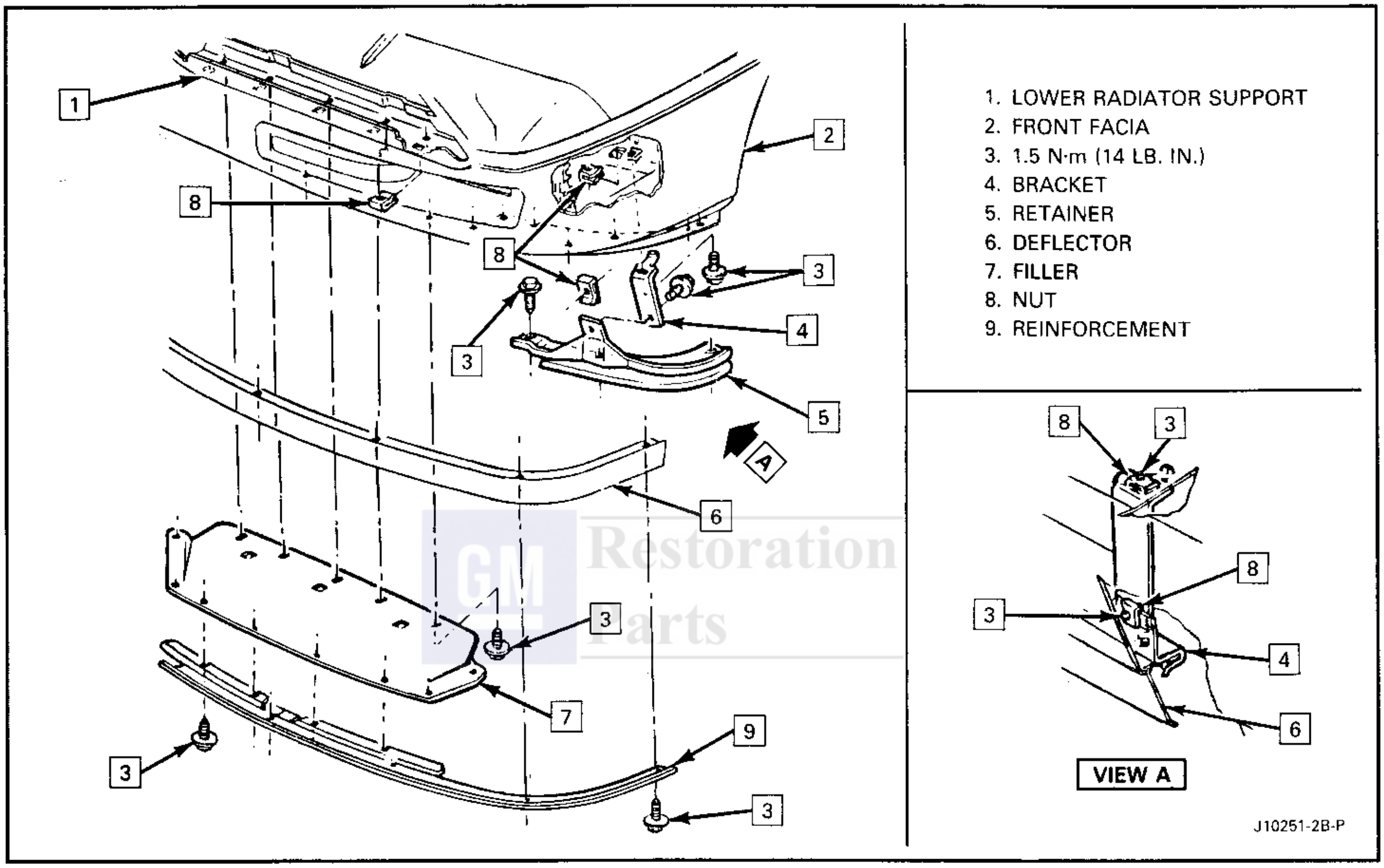


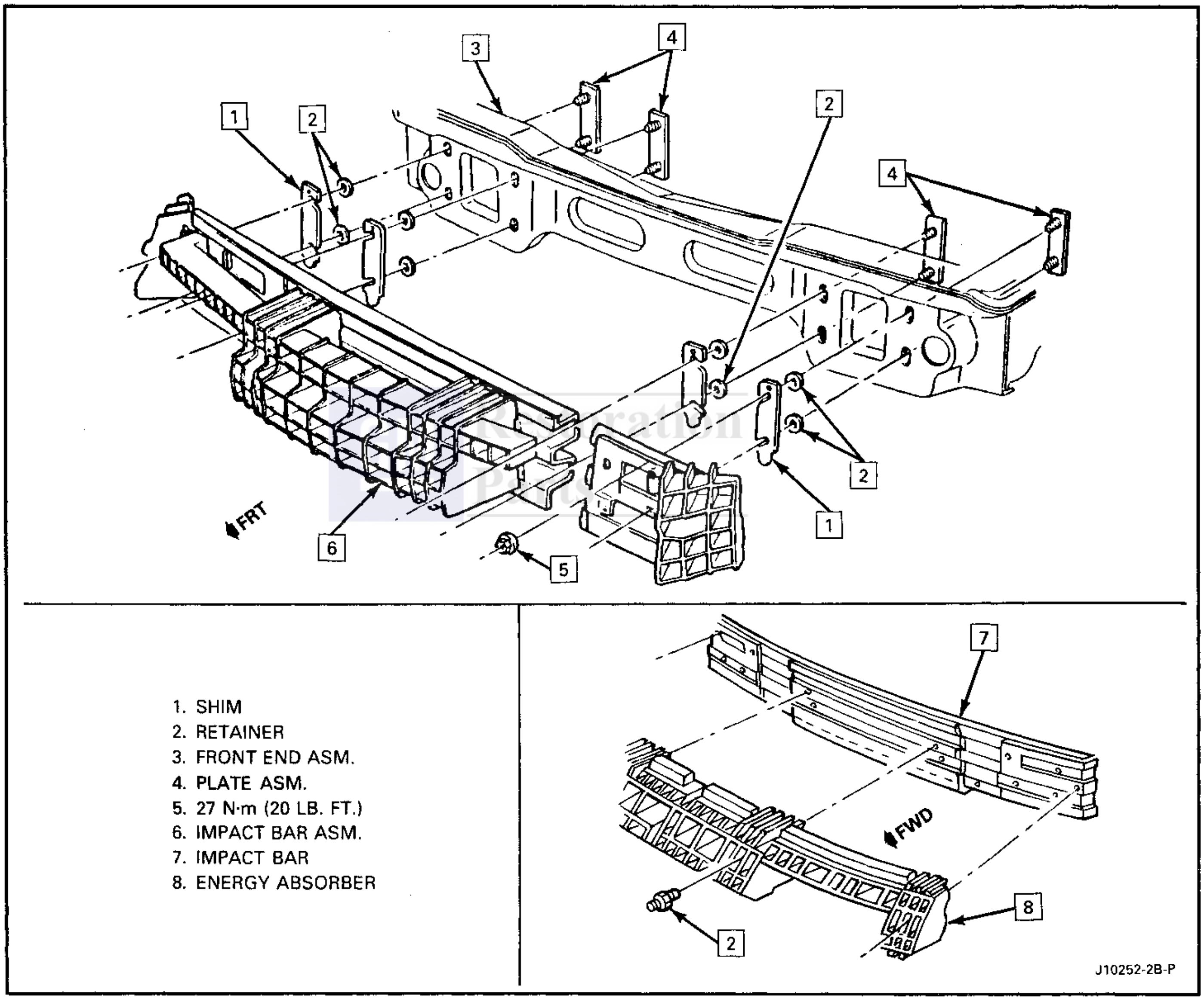
Figure 1 Front Filler and Air Deflector

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

The parts involved:

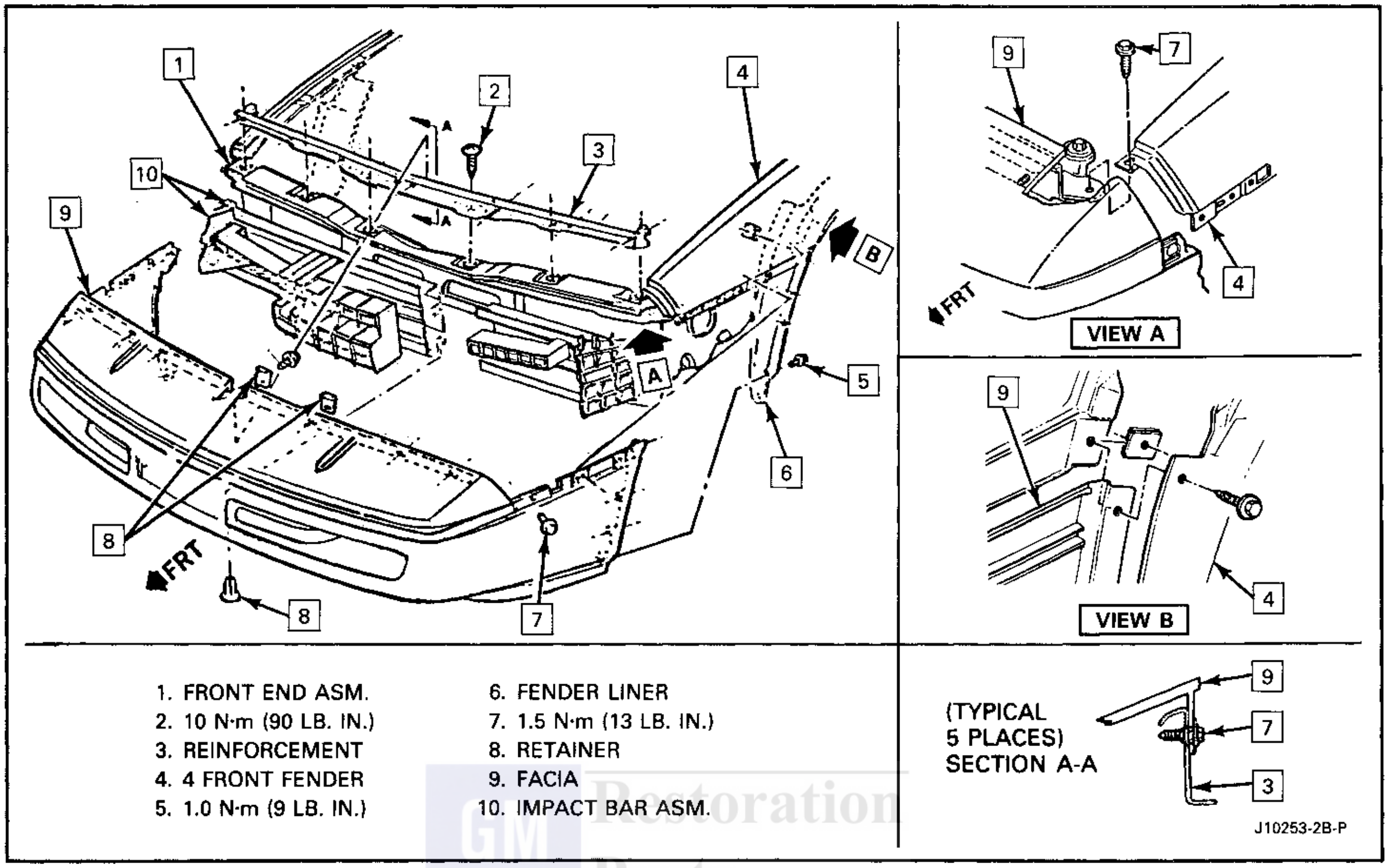
- Front and rear bumper assemblies
- Hood
- Right and left front doors*
- Right and left rear doors
- Right and left quarter panel assemblies
- Rear compartment lid/hatch
- Right and left front fenders

*Certification label on drivers door qualifies as a theft prevention label.



1. SHIM
2. RETAINER
3. FRONT END ASM.
4. PLATE ASM.
5. 27 N·m (20 LB. FT.)
6. IMPACT BAR ASM.
7. IMPACT BAR
8. ENERGY ABSORBER

Figure 2 Front Impact Bar Asm. To Frame



1. FRONT END ASM.
2. 10 N·m (90 LB. IN.)
3. REINFORCEMENT
4. 4 FRONT FENDER
5. 1.0 N·m (9 LB. IN.)
6. FENDER LINER
7. 1.5 N·m (13 LB. IN.)
8. RETAINER
9. FACIA
10. IMPACT BAR ASM.

Figure 3 Front Bumper Asm. (Non GT)

1–RETAINER CLIP

2–RETAINER

3–BOLT/SCREW

4–FASCIA

5–RETAINER

6–REINFORCEMENT

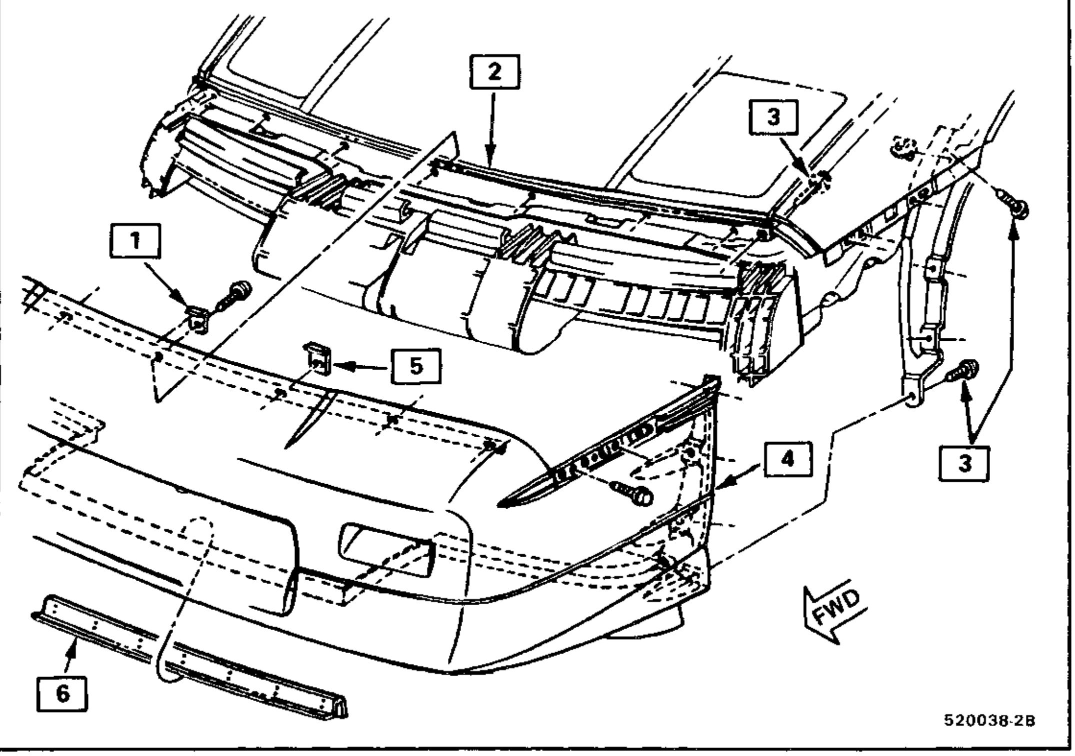
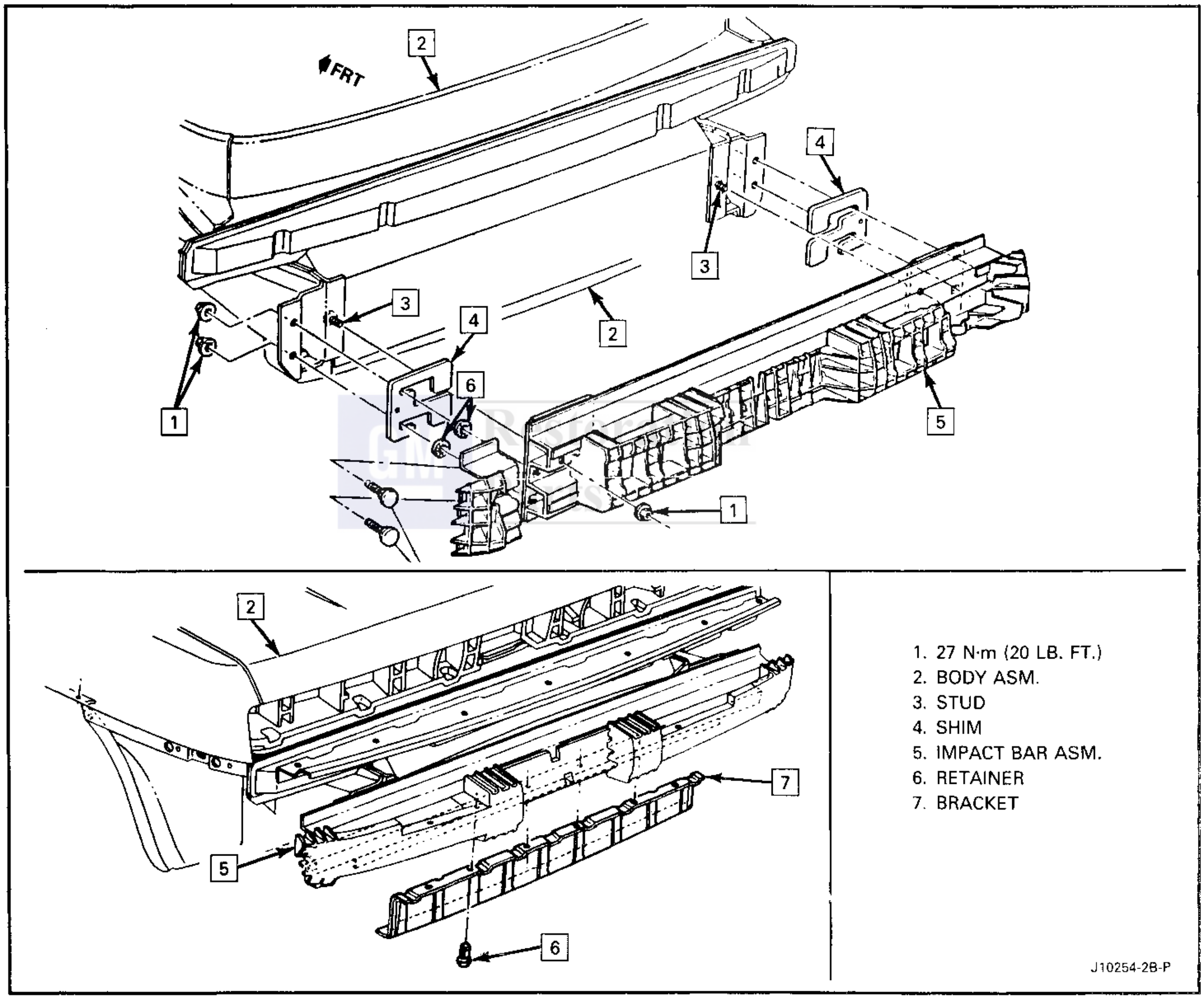


Figure 4 Front Facia Mounting (GT)



1. 27 N·m (20 LB. FT.)
2. BODY ASM.
3. STUD
4. SHIM
5. IMPACT BAR ASM.
6. RETAINER
7. BRACKET

Figure 5 Rear Fascia Bracket/Impact Bar Asm to Frame

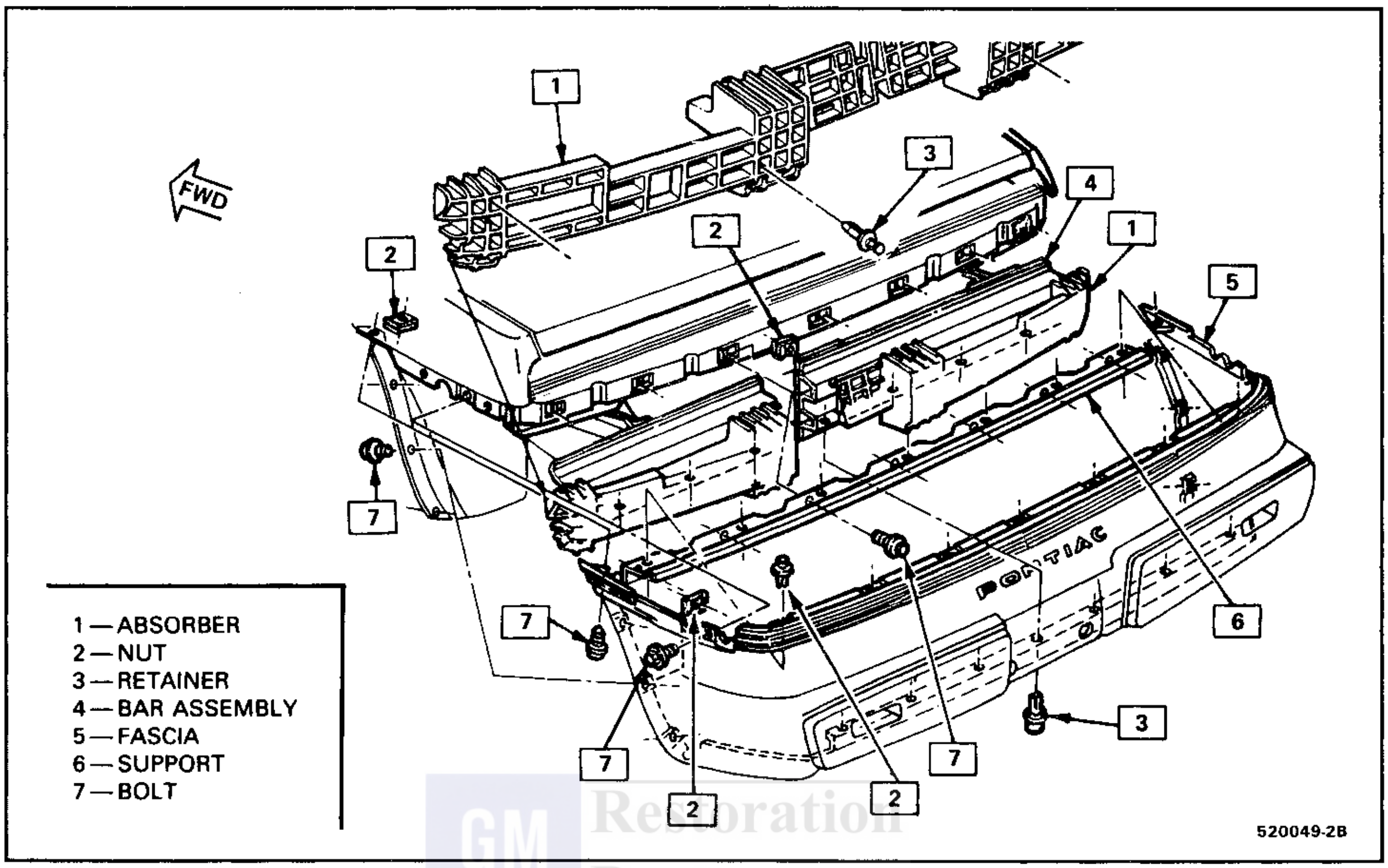


Figure 6 Rear Fascia/Bumper/Impact Bar Asm. to Body (Non GT)

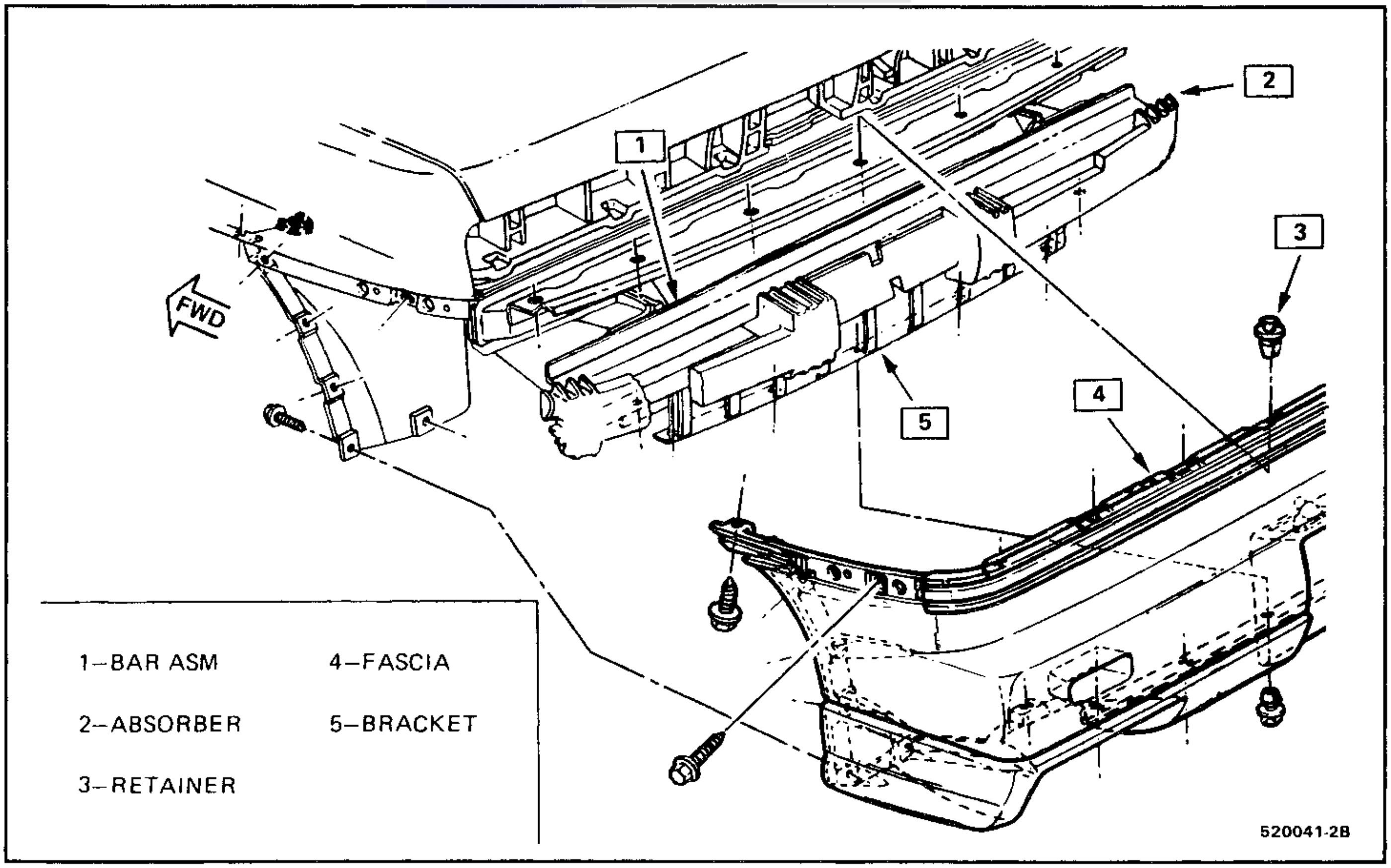


Figure 7 Rear Fascia Mounting (GT)

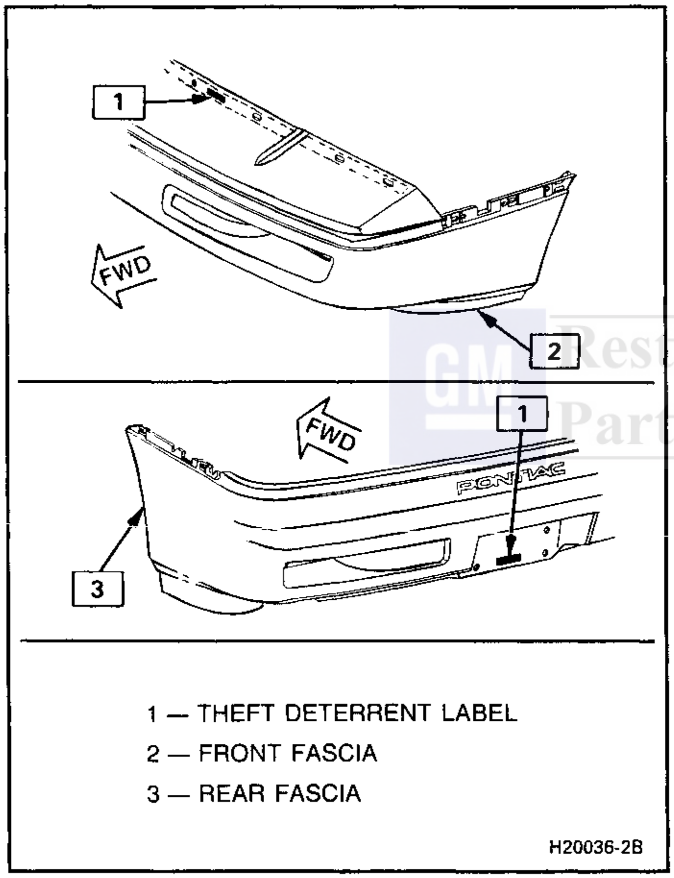


Figure 8 Theft Deterent Label Placement

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 contour 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 (FIGURE 1)

Basecoat

1. Wash with a mild detergent and water to remove any water soluble contaminants, 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 thoroughly. 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.

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

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 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 (FIGURE 2)

Basecoat

1. Wash with a mild detergent and water to remove any water soluble contaminants, 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 featheredge 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 coats 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.

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

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.

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

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.

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 substrate 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 possibility of mixture "pot life" exists; therefore, spray equipment should be emptied and flushed immediately after use.

Body Color and Flexible Additive System

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 additives 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.

FEDERAL VEHICLE THEFT PREVENTION STANDARD

(Anti-Theft Labeling)

Federal law requires General Motors to label certain parts, on selected cars, with the VIN.

The purpose of the standard is to reduce the cases of motor vehicle thefts by helping in the tracing and recovery of parts from stolen vehicles.

The label will be permanently affixed to an interior surface of the part and will contain the complete VIN. The label on replacement parts will contain the letter R, the manufacturers logo, and the symbol "DOT".

Important

THESE LABELS ARE NOT TO BE DEFACED, REMOVED, OR COVERED OVER. The labels must be shielded from paint, rust proofing, and undercoating (Dealer preparation included).

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

The parts involved:

- Front and rear bumper assemblies
- Hood
- Right and left front doors*
- Right and left rear doors
- Right and left quarter panel assemblies
- Rear compartment lid/hatch
- Right and left front fenders

*Certification label on drivers door qualifies as a theft prevention label.

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.

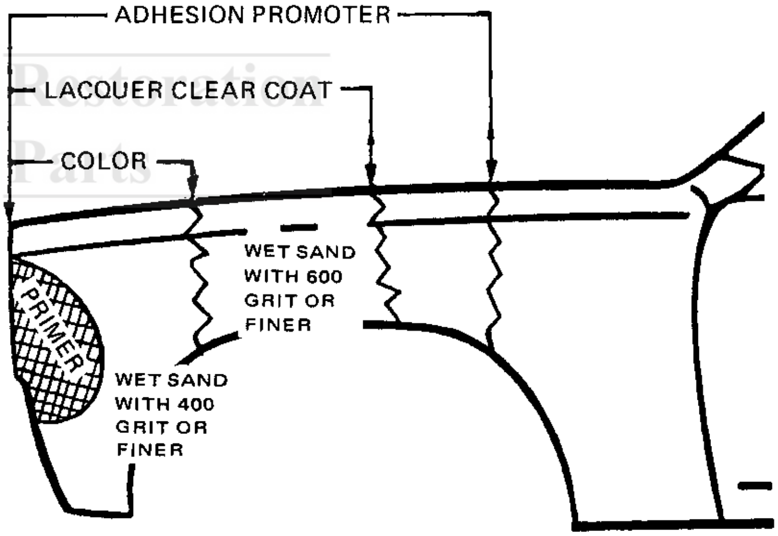


Figure 1 Spot Repair With Lacquer Clear Coat

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.

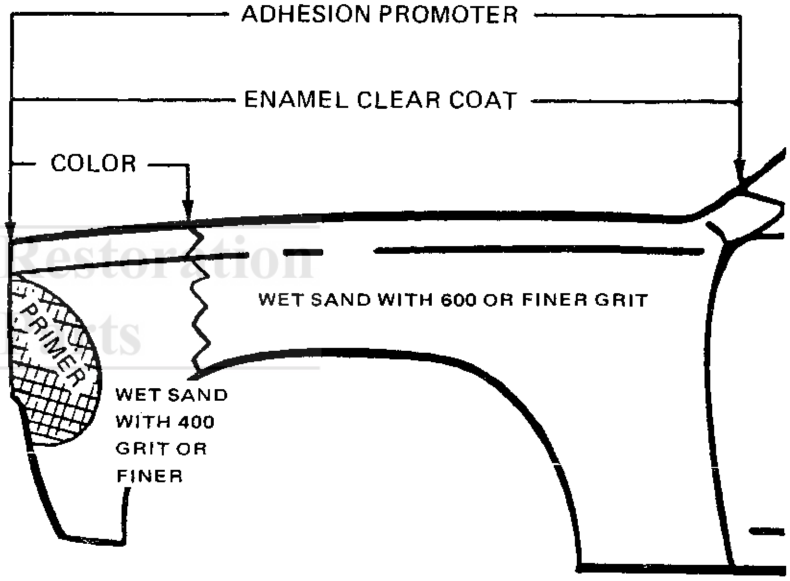
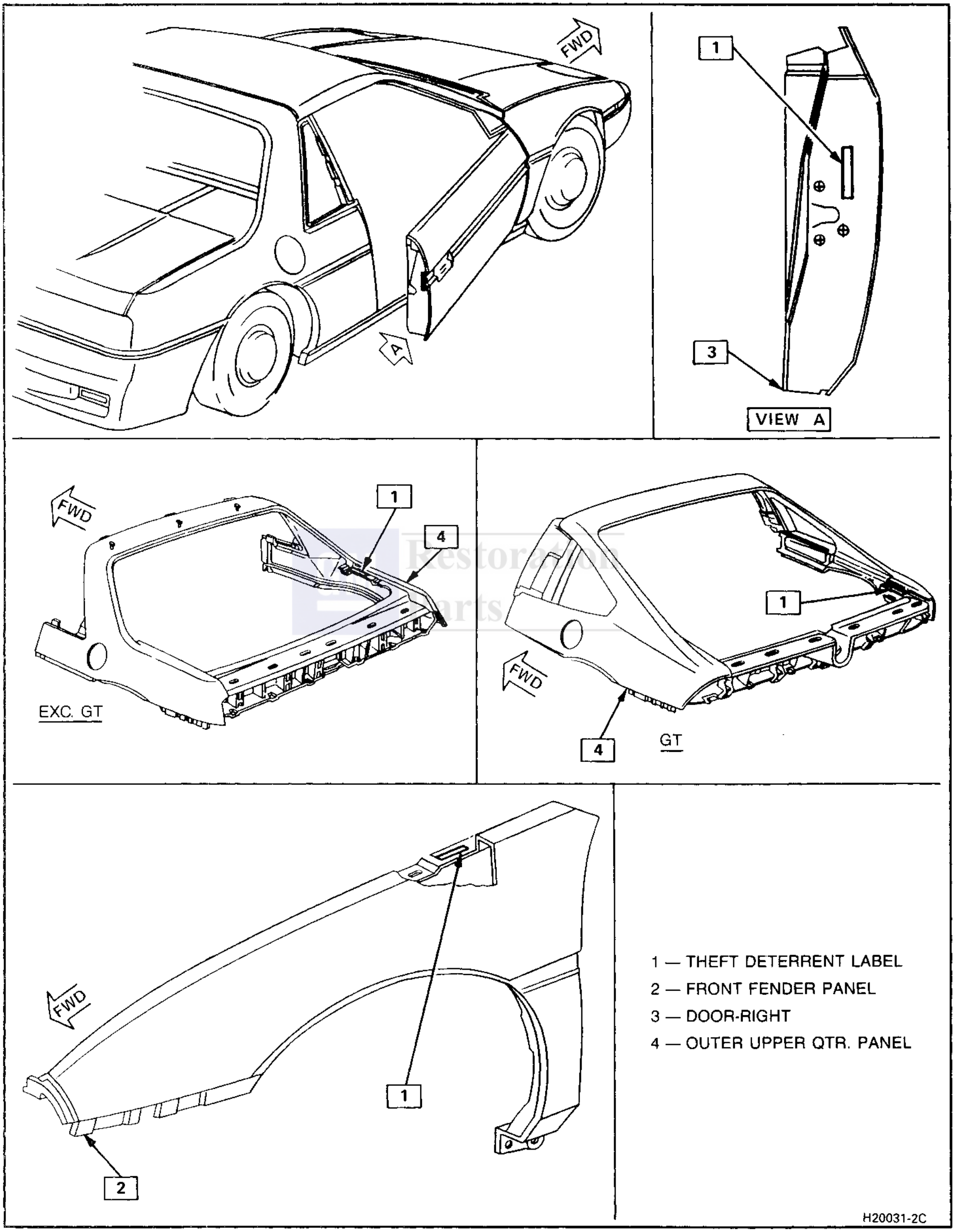


Figure 2 Panel Repair With Enamel Clear Coat



1 — THEFT DETERRENT LABEL
2 — FRONT FENDER PANEL
3 — DOOR-RIGHT
4 — OUTER UPPER QTR. PANEL

Figure 3 Theft Deterent Labels (Body Panels and Doors)

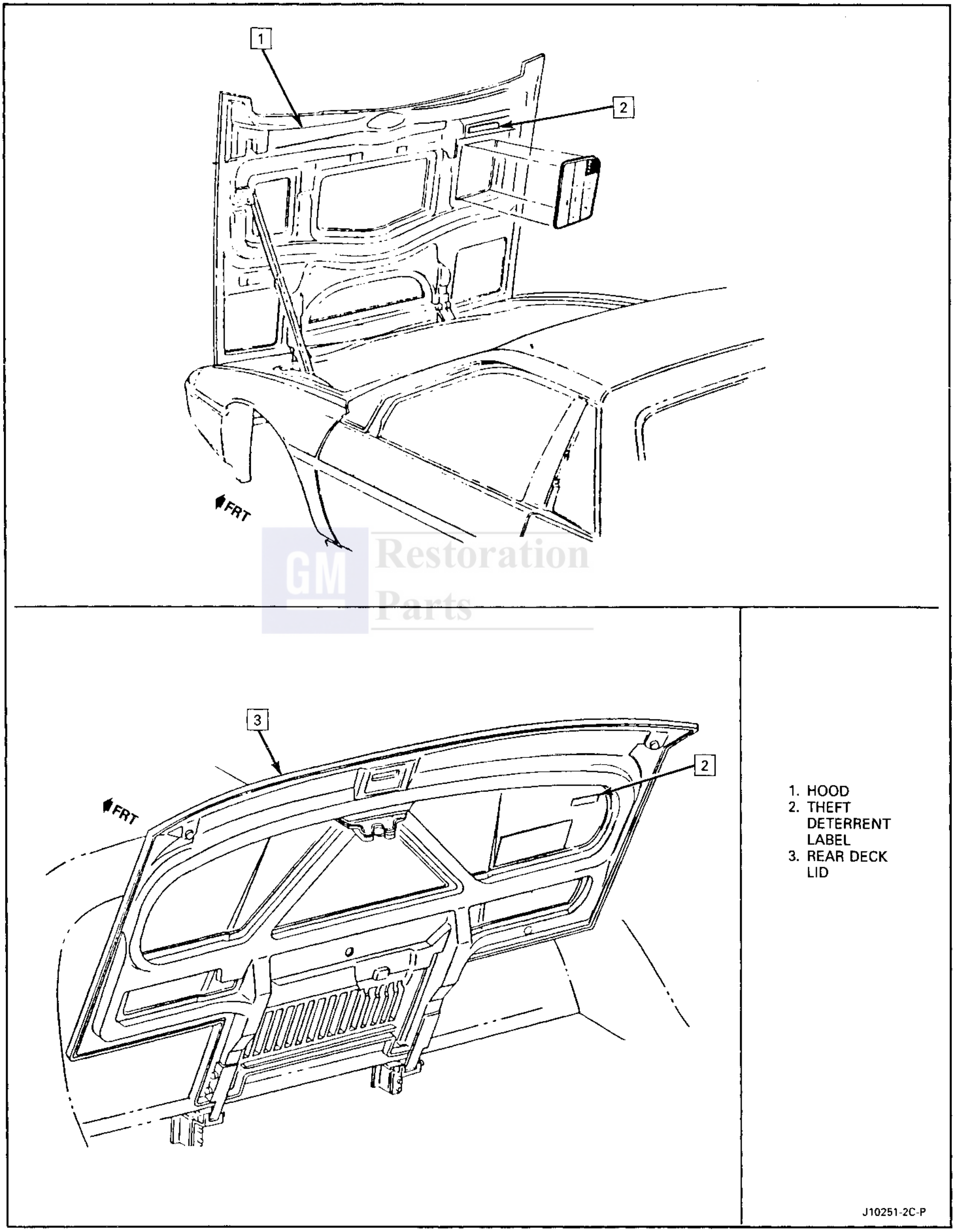


Figure 4 Theft Deterent Labels (Hood and Deck Lid)

SECTION 3

STEERING, SUSPENSION, TIRES AND WHEELS

DIAGNOSIS

CONTENTS

GENERAL INFORMATION

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

Inspect

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

GENERAL DIAGNOSIS

Car Pulls (Leads)

Inspect

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

Abnormal or Excessive Tire Wear

Inspect

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

Scuffed Tires

Inspect

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

Wheel Tramp

Inspect

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

Shimmy, Shake or Vibration

Inspect

- Tire or wheel out of balance
- Worn wheel bearings
- Worn tie rod ends
- Worn lower ball joints
- Excessive wheel runout
- Blister or bump on tire
- Excessive loaded radial runout of tire and wheel assembly

Hard Steering (Manual)

Inspect

- Lack of lubrication – ball joints, tie rod ends and steering gear
- Front-wheel alignment
- Steering gear adjustment

Too Much Play In Steering

Inspect

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

Poor Returnability (Manual)

Inspect

- Lack of lubrication – ball joints and tie rod ends
- Bind in ball joints
- Bind in steering column
- Lack of lubricant in steering gear
- Front-wheel alignment
- Steering gear adjustment

Abnormal Noise, Front End

Inspect

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

Wander or Poor Steering Stability

Inspect

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

Erratic Steering When Braking

Inspect

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

Low Or Uneven Trim Height

Inspect

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

Ride Too Soft

Inspect

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

Ride Too Harsh

Inspect

- Incorrect strut dampeners or shock absorbers
- Incorrect springs

Body Leans Or Sways In Corners

Inspect

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

Suspension Bottoms

Inspect

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

"Dog" Tracking

Inspect

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

MANUAL RACK AND PINION STEERING GEAR DIAGNOSIS

Excessive Play or Looseness in Steering System

Inspect

- Steering gear adjustment
- Wheel bearings worn
- Tie rod end loose
- Loose steering gear mounting

Rattle or Chucking Noise in Steering Gear

Inspect

- Insufficient or improper lubricant in steering gear
- Loose steering gear mounting
- 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
- Improper shift linkage adjustment
- Damaged rack
- Interference between bowl and rack coupling
- Ignition switch stuck
- Actuator rod restricted
- Sector installed incorrectly
- Park lock cable damaged

High Lock Effort

Inspect

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

Will Stick In "Start"

Inspect

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

Key Cannot Be Removed in "Off-Lock"

Inspect

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

Lock Cylinder Can Be Removed

Inspect

- Lock cylinder retaining screw missing

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

Inspect

- Distorted rack

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

Inspect

- Ignition switch is not set correctly

COLUMN

Noise In Column

Inspect

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

High Steering Shaft Effort

Inspect

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

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 page 8A-111-0 for turn signal switch electrical diagnosis.

Turn Signal Will Not Stay In Turn Position

Inspect

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

Turn Signal Will Not Cancel

Inspect

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

Turn Signal Difficult To Operate

Inspect

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

Turn Signal Will Not Indicate Lane Change

Inspect

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

Hazard Switch Cannot Be Turned Off

Inspect

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

Hazard Switch Will Not Stay On or Difficult To Turn Off

Inspect

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

No Turn Signal Lights

Inspect

- Electrical failure in chassis harness
- Inoperative turn signal flasher
- Loose chassis-to-column connector. Disconnect column-to-chassis connector and connect new turn signal switch to chassis and operate switch by hand.
  - A. If car lights now operate normally, turn signal switch is inoperative.
  - B. If car lights do not operate, refer to page 8A-111-0 for electrical diagnosis.

Turn Indicator Lights On, But Not Flashing

Inspect

- Inoperative turn signal flasher
- Loose chassis-to-column connection
- Inoperative turn signal switch
- To determine if turn signal switch is inoperative, substitute new turn signal switch into circuit and operate switch by hand. If the car's lights operate normally, turn signal switch is inoperative.

Front Or Rear Turn Signal Lights Not Flashing

Inspect

- Burned-out or damaged turn signal bulb
- High resistance 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 page 8A-111-0 for electrical diagnosis.

Turn Indicator Panel Lights

Inspect

Burned out bulbs or opens, grounds in the wiring harness from the front turn signal bulb socket to the indicator lights. Refer to page 8A-110-0 for electrical diagnosis.

Stop Light Not On When Turn Indicated

Inspect

- Loose column-to-chassis connection
- Disconnect the column-to-chassis connector and connect the new turn signal switch into the system and operate the switch by hand.
  - A. If the brake lights work when the switch is in the turn position, the turn signal switch is inoperative.
  - B. If the brake lights do not work, refer to page 8A-111-0 for electrical diagnosis.

Turn Signal Lights Flash Very Slowly

Inspect

- Loose chassis-to-column connection
- Disconnect the column-to-chassis connector and connect a new turn signal switch into the system and operate the switch by hand.
  - A. If the lights flash at a normal rate, the turn signal switch is inoperative.
  - B. If the lights still flash very slowly, refer to page 8A-111-0 for electrical diagnosis.

Hazard Signal Lights Will Not Flash – Turn Signal Functions Normally

Inspect

- Blown fuse
- Inoperative hazard warning flasher
- Loose chassis-to-column connection
- Disconnect the column-to-chassis connector and connect a new turn signal switch into the system, then press in the hazard warning button and watch the hazard warning lights.
  - A. If the lights now work normally, the turn signal switch is inoperative.
  - B. If the lights do not flash, check the wiring harness. Refer to page 8A-111-0 for electrical diagnosis.

IGNITION SWITCH

Electrical System Will Not Function

Inspect

- Damaged ignition switch
- Ignition switch not adjusted properly
- Loose connector at the ignition switch

Switch Will Not Turn

Inspect

- Damaged ignition switch

Switch Cannot Be Set Correctly

Inspect

- Switch actuator rod deformed
- Sector to rack engaged in wrong tooth

KEY REMINDER

Figs. 1 through 11

Reminder Continues To Operate With Key Out, But Stops When Driver's Door Is Closed

Inspect

- Chips, foreign material in lock cylinder bore
- Sticky lock cylinder actuator tip
- Damaged or broken reminder switch

Reminder Does Not Sound With Key Fully Inserted In Lock Cylinder And The Driver's Door Open

Inspect

1. Power not available to reminder. Refer to page 8A-75-0 through 8A-77-0 for electrical diagnosis.
2. Open in chassis wiring. Check by separating chassis-to-column connector. Connect terminals "E" and "F" female contacts on the chassis connector (a bent paper clip will work). If the reminder sounds, repair chassis wiring. If the reminder does not sound, go to Step A.
   A. Connect a continuity meter (light) to the male "E" and "F" column connector contacts. Push the key all the way into the lock cylinder. If the light is on when the key is in, and off when the key is out, the function is normal. If the light is not on, the fault is in the column. Go to Step B.
   B. Disassemble the upper end of the column until the turn signal switch mounting screws have been removed. Lift the turn signal switch and check the probes of the reminder switch to ensure good contact with the pads on the signal switch. Bend the probes, if needed, then replace the turn signal switch and tighten the three screws. Check the function as in Step A.
3. Short or fault in the turn signal switch wiring. Connect male "E" and "F" contacts of column connector with jumper. Check key reminder switch pads on turn signal switch with continuity meter. If there is continuity, the function is normal. If not, replace the turn signal switch.
4. If the problem has not been found, connect a continuity meter (light) to the reminder switch probes on the switch. Fully insert and remove the key from the lock cylinder. If the light is on when the key is in the lock cylinder, and off when the key is out, the function is normal. Retrace the diagnostic steps starting at Step A. If the light is not on, the fault is in the lock cylinder or reminder switch.

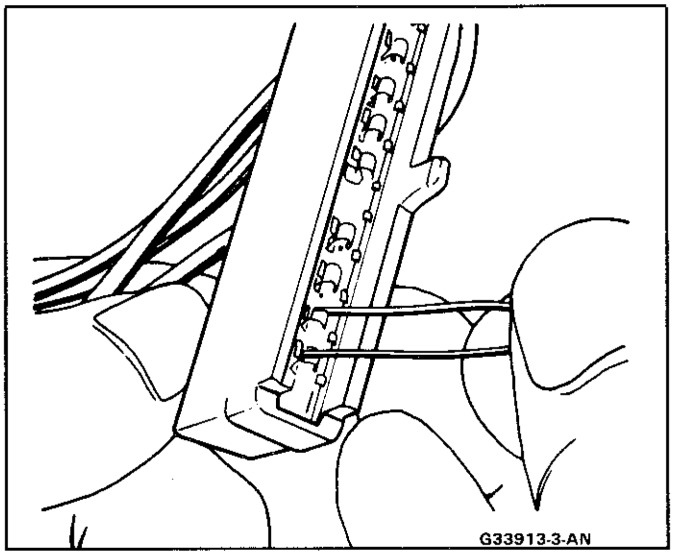


Fig. 1 Checking Reminder at Chassis Connector

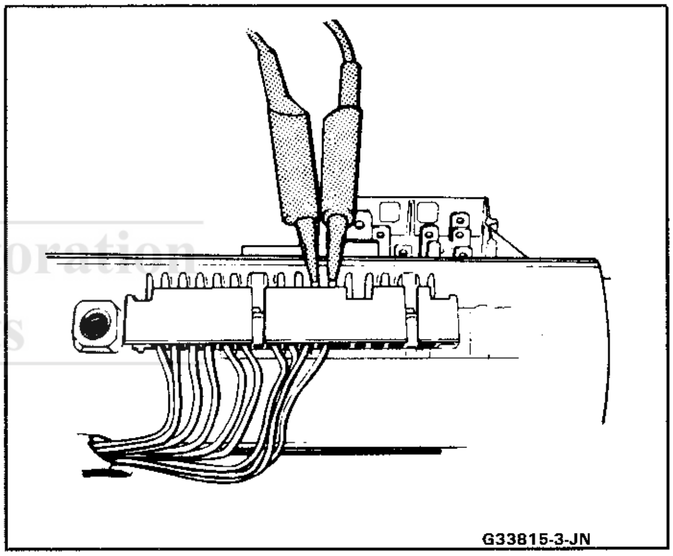


Fig. 2 Checking Reminder at Column Connector

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.
6. Damaged lock cylinder. With the lock cylinder removed, push the key all the way in, then remove it. The lock cylinder actuator tip should extend and retract smoothly. Total extension of tip should be 1.27 mm (.050"). If not, replace the lock cylinder. Remove and clean as required. Reassemble and recheck per Step 4.
7. Switch appears good but will not operate. Connect continuity meter leads to the reminder switch probes on the switch. Press on the actuator

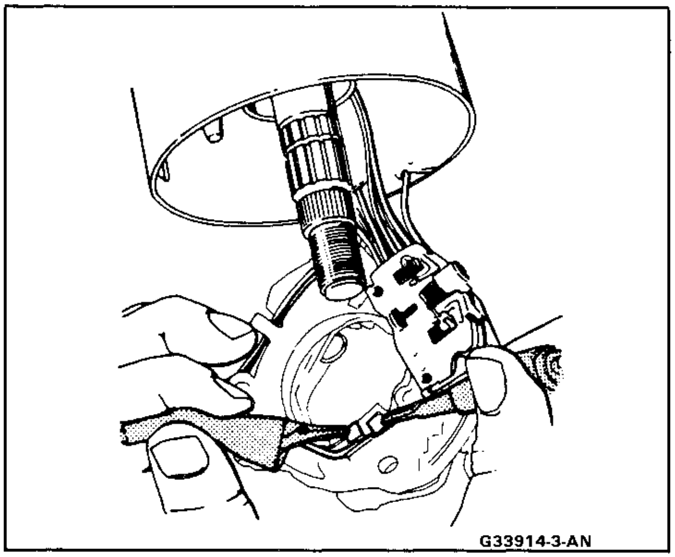


Fig. 3 Checking Reminder Switch Pads

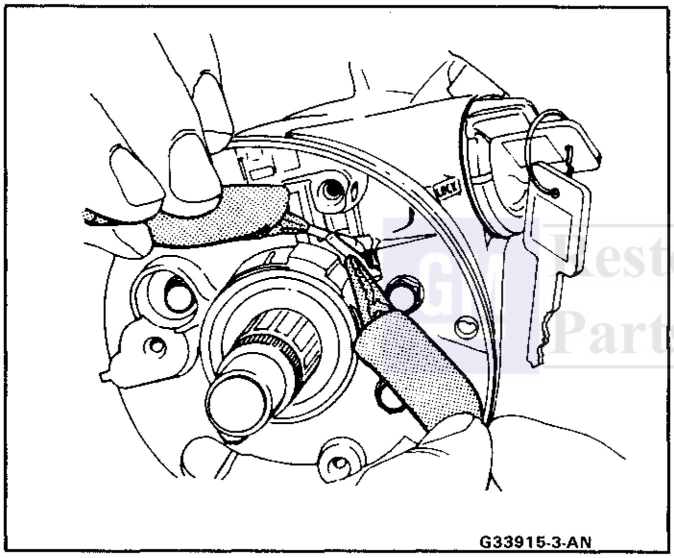


Fig. 4 Checking Reminder Switch

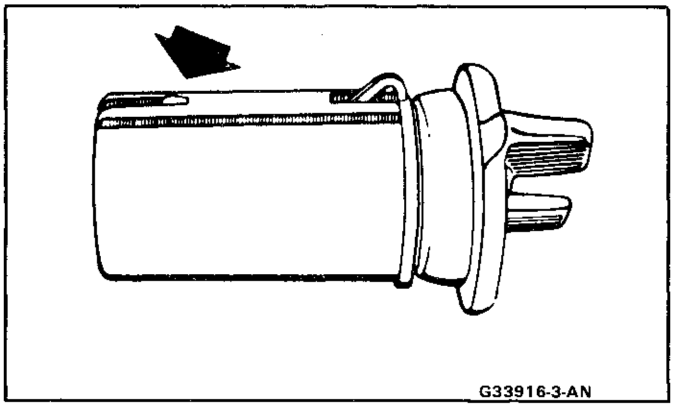


Fig. 5 Lock Cylinder Actuator – Key Removed

pad until the switch points contact. If contact is not made, replace reminder switch.

8. Check the switch contact gap by pressing a 0.8 mm (.030″) wire-type plug gage with a flat piece of stock onto the actuator pad. If contact is not made, decrease the switch contact gap until positive contact is made. Use a continuity meter (light).

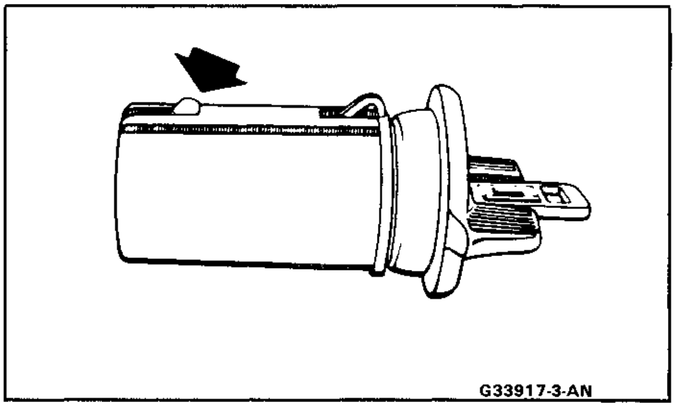


Fig. 6 Lock Cylinder Actuator – Key in Place

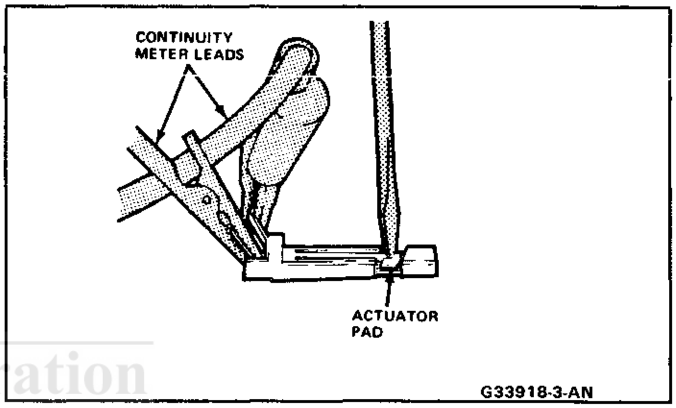


Fig. 7 Checking Key Reminder Switch Continuity

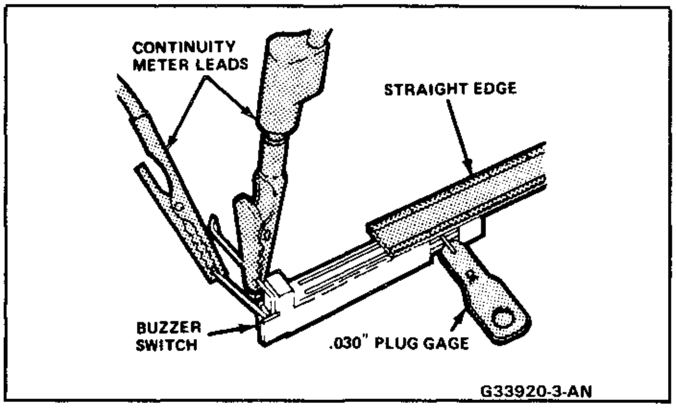


Fig. 8 Checking Contact Gap

9. With positive contact at 0.8 mm (.030″), use a 0.6 mm (.025″) plug gap wire beneath the flat stock. No contact should occur. If contact is made, increase the switch contact gap. When the switch will make contact with the 0.8 mm (.030″) wire but not with the 0.6 mm (.025″) wire, the switch is set properly.

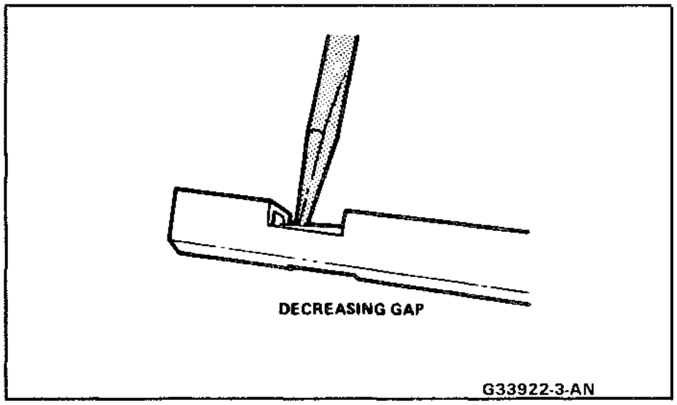


Fig. 9 Decreasing Switch Contact Gap

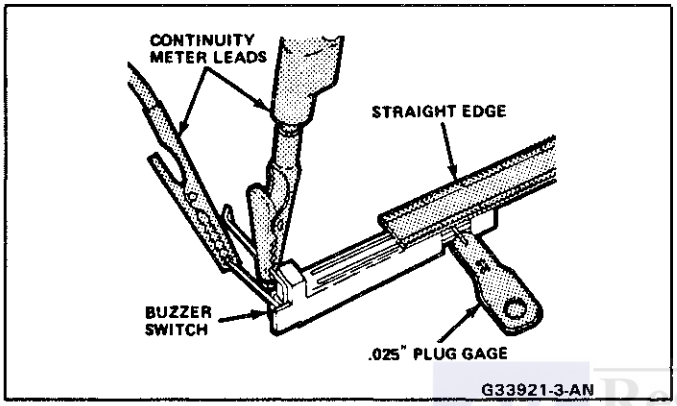


Fig. 10 Checking Contact Gap

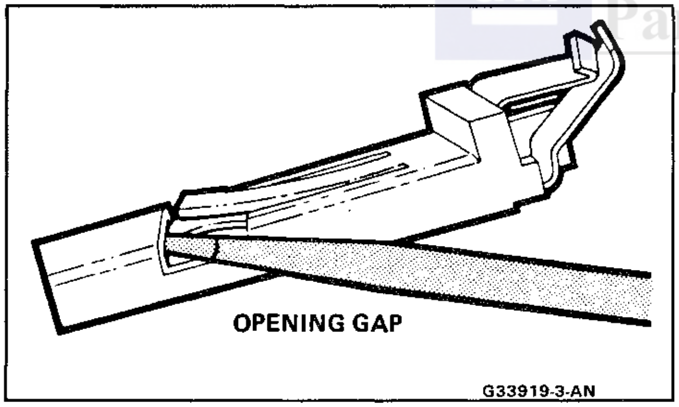


Fig. 11 Increasing Switch Contact Gap

Reminder Keeps Operating With Key In Lock Cylinder, Driver's Door Open Or Closed; Ceases When Key Is Removed

Inspect

- Door jamb switch on driver's side misadjusted or inoperative.

- Wire from signal switch to door jamb switch shorted.

  A. This condition indicates the lock cylinder or the reminder switch is at fault. To verify, check for continuity at the "E" and "F" male column connector contacts, with the key removed from the lock cylinder. If continuity exists, the fault is in the column.

  B. Insert the key into the lock, then turn the lock toward the "Start" position. If the reminder stops when the key is in the "Run" position or when it is turned past "Run" toward "Start," the problem is a sticky lock cylinder actuator.

COLUMN-MOUNTED DIMMER SWITCH

No "Low" or "High" Beam

Inspect

- Loose connector at dimmer switch
- Improper adjustment
- Internally damaged or worn switch. Check the continuity on the switch at the lt. green and at the tan switch terminals by pushing in the plunger all the way. A click should be heard. If there is no continuity, replace the dimmer switch. If there is continuity, refer to page 8A-100-0 or 8A-101-0 for electrical diagnosis.

PIVOT AND SWITCH ASSEMBLY

Switch Inoperative: No "Low," "High" and/or "Wash"

Inspect

- Loose body-to-switch connector
- Broken or damaged switch
- Internally damaged or worn switch. Connect a new switch without removing the old one. If the system functions, replace the switch. If the system doesn't function, refer to page 8A-90-0 or 8A-91-0 for electrical diagnosis.

STRUT DAMPENER AND SHOCK ABSORBER DIAGNOSIS

The strut dampener is basically a shock absorber. Strut dampeners are easier to extend and retract by hand than are shock absorbers.

The following procedure includes both on-car and bench checks to be done when evaluating the performance of strut dampeners and shock absorbers.

ON-CAR CHECKS

Weak

For struts, follow Steps 1 through 4.

1. Check and adjust tire pressures to the pressures shown on the Tire Placard.
2. Note the load conditions under which the car is normally driven.
3. If practical, ride with the owner to be sure you understand the complaint before proceeding to next step.
4. Test each strut dampener/shock in turn by quickly pushing down, then lifting up, the corner of the bumper nearest the strut dampener/shock being checked. Use the same amount of effort on each test and note the resistance on compression and rebound. Compare this with a similar car

having acceptable ride quality. Both strut dampeners/shocks should provide the same feeling of resistance.

If there is much difference between the right and left rear shocks, go to the next step.

5. Support the rear axle at least enough to unload the shock mounts.
6. Disconnect the lower shock mountings. Stroke the shocks at various rates of speed, through maximum travel in both directions. Compare the two sides for rebound and compression resistance. Rebound resistance is normally stronger than compression (about 2 to 1). The right and left shocks must feel comparable. Differences between front and rear are normal. If in doubt about the condition, compare with a shock known to be good.

Noisy

For struts, follow Steps 1 through 3.

1. Check all mountings for proper torque. A loose mounting will cause a noise.
2. If all mountings are intact, bounce the car as in Step 4 (weak) to isolate the suspected unit.
3. If practical, ride with the owner to be sure you understand the complaint, before proceeding to next step.

Leaks

1. Fully extend the strut/shocks (wheels unsupported) to expose the seal cover area for inspection.
2. Look for signs of leaks in the seal cover area.
3. A slight trace of fluid is NOT cause for replacement; the seal permits some seepage to lubricate the piston rod. There is a built in fluid reserve to allow for seepage.
4. A leaking strut dampener/shock can easily be found because there will be fluid around the seal cover and an excessive amount of fluid on the strut dampener/shock. A leaking strut dampener/shock must be replaced.

BENCH CHECKS

Strut Dampeners and Regular Shock Absorbers (Standard and Firm Ride)

Regular strut dampeners/rear shocks use a gas-filled cell in the fluid reservoir. Aeration or foaming of the fluid is eliminated, as the gas and the fluid cannot mix.

Proceed with the actual bench check as follows:

1. Clamp the strut dampener/shock UPSIDE DOWN in the vise. Do not clamp on the reservoir tube or the mounting threads. If a lag is noticed when it is stroked, it means the gas-filled cell has ruptured and replacement is necessary.
2. Pump strut dampener/shock by hand at various rates of speed and note the resistance.
3. Rebound resistance normally is stronger than compression resistance by about 2 to 1. However, the resistance should be smooth and constant for each stroking rate.
4. Compare with a strut dampener/ shock known to be good.
5. It is normal to hear a hissing noise. The following symptoms are abnormal and are reason for replacement.
    A. A skip or lag at reversal near mid-stroke.
    B. A seize (except at either extreme end of travel).
    C. A noise (such as a grunt or squeal) after completing one full stroke in both directions.
    D. A clicking noise at fast reversal.
    E. Fluid leakage.

TIRE DIAGNOSIS

Irregular and Premature Wear

Fig. 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.

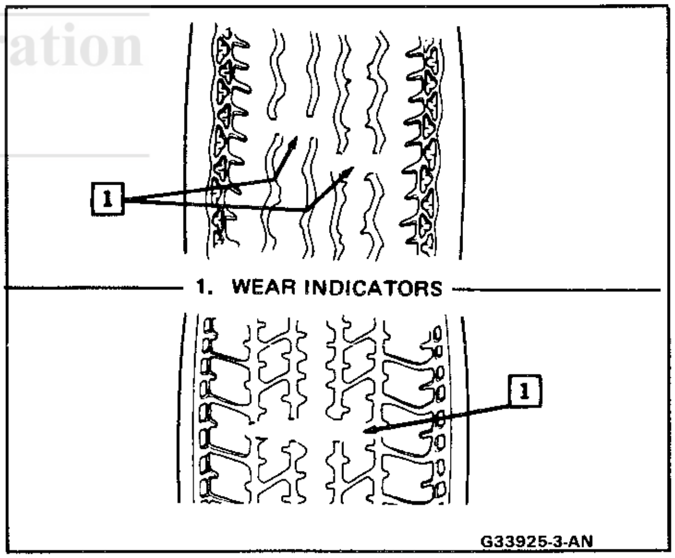


Fig. 12 Tire Wear Indicator

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.

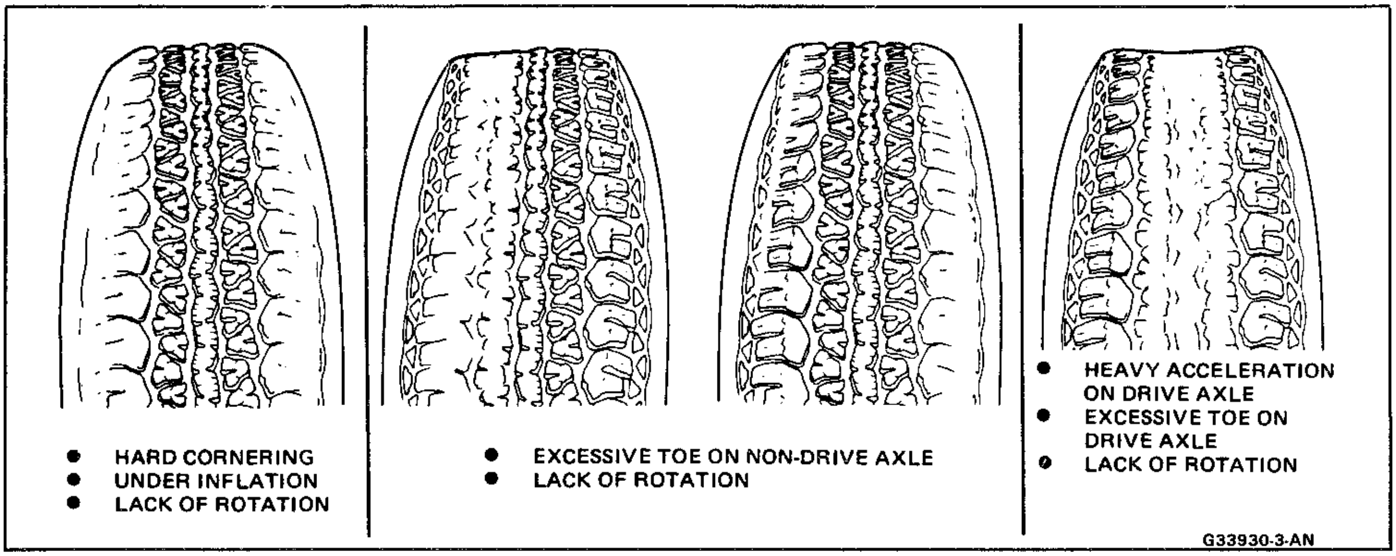


Fig. 13 Tire Wear Diagnosis

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, or by excessive lateral runout of the tire or wheel. It is most noticeable at low speed, about 8 to 48 km/h (5 to 30 mph). It may also appear as a ride roughness at 80 to 113 km/h (50 to 70 mph).

The car can be road tested to see which end of the car has the faulty tire. If the tire causing the waddle is on the rear, the rear end of the car will "waddle." From the driver's seat, it feels as if someone is pushing on the side of the car.

If the faulty tire is on the front, the waddle is more easily seen. The front sheet metal appears to be moving back and forth. It feels as if the driver's seat is the pivot point in the car.

Another more time-consuming method of determining the faulty tire is substituting tire and wheel assemblies that are known to be good. Follow these steps:

1. Drive the car to determine if the waddle is coming from the front or rear.
2. Install tire and wheel assemblies known to be good (from a similar car) in place of those on the end of the car which is waddling. If the waddle cannot be isolated to front or rear, start with the rear tires.
3. Road test again. If improvement is noted, install the original tire and wheel assemblies one at a time until the faulty tire is found. If no improvement is noted, install tires known to be good in place of all four. Then, install the originals one at a time until the faulty tire is found.

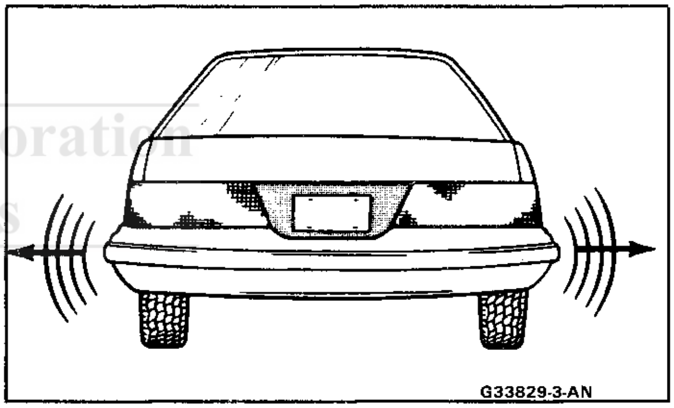


Fig. 14 Tire Waddle

Radial Tire Lead/Pull

Fig. 15

"Lead/Pull" 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. Tire construction.
2. Uneven brake adjustment.
3. Wheel alignment.

The way in which a tire is built can produce lead in a car. An example of this is placement of the belt. Off-center belts on radial tires can cause the tire to develop a side force while rolling straight down the road. The tire will tend to roll like a cone.

The Radial Tire Lead/Pull Correction Chart should be used to make sure that front wheel alignment is not mistaken for tire lead.

Rear tires will not cause lead.

VIBRATION DIAGNOSIS

See Figs. 16 through 18 for vibration diagnosis.

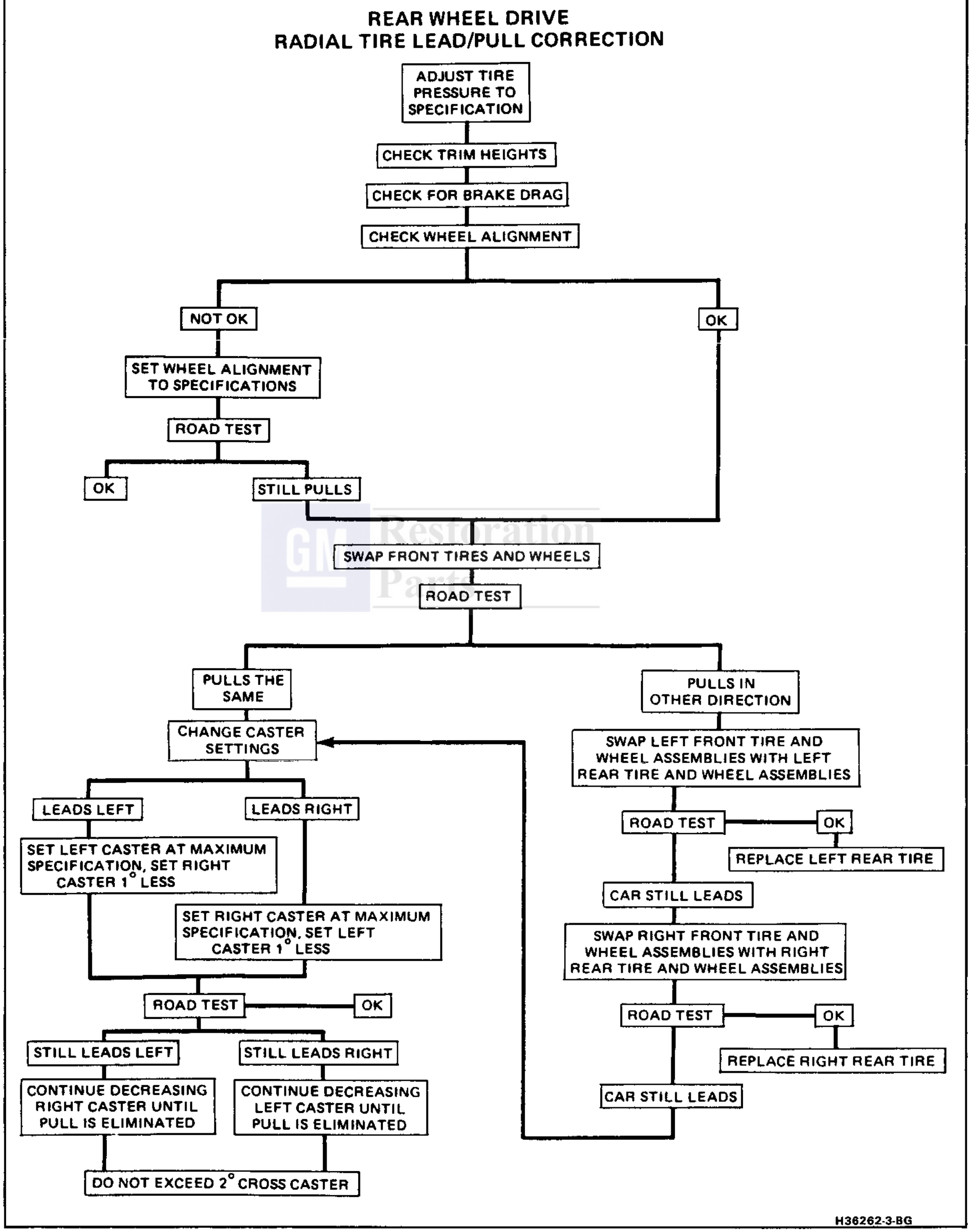


Fig. 15 Radial Tire Lead/Pull Diagnosis – Rear-Wheel Drive

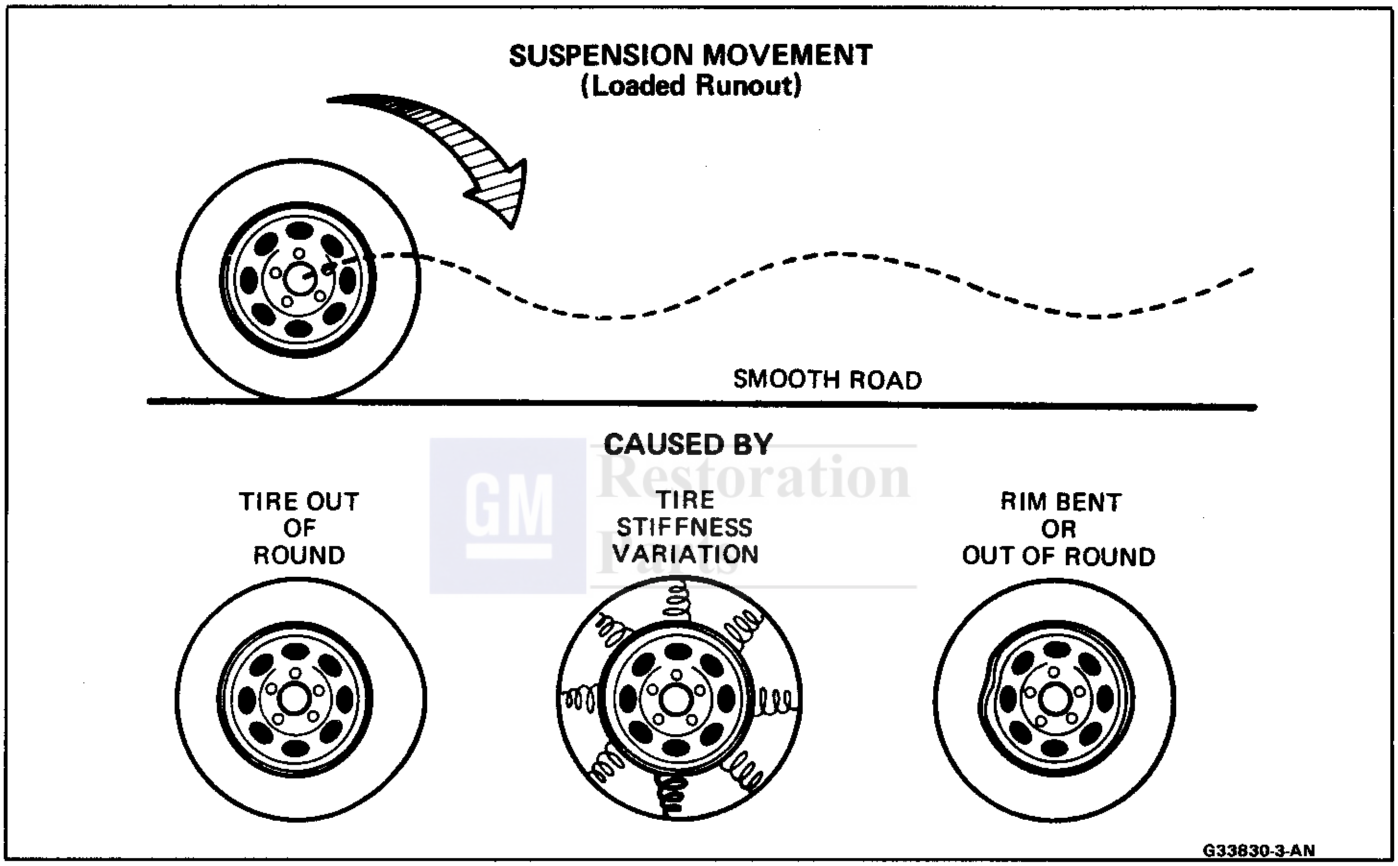


Fig. 16 Causes of Vibrations

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.

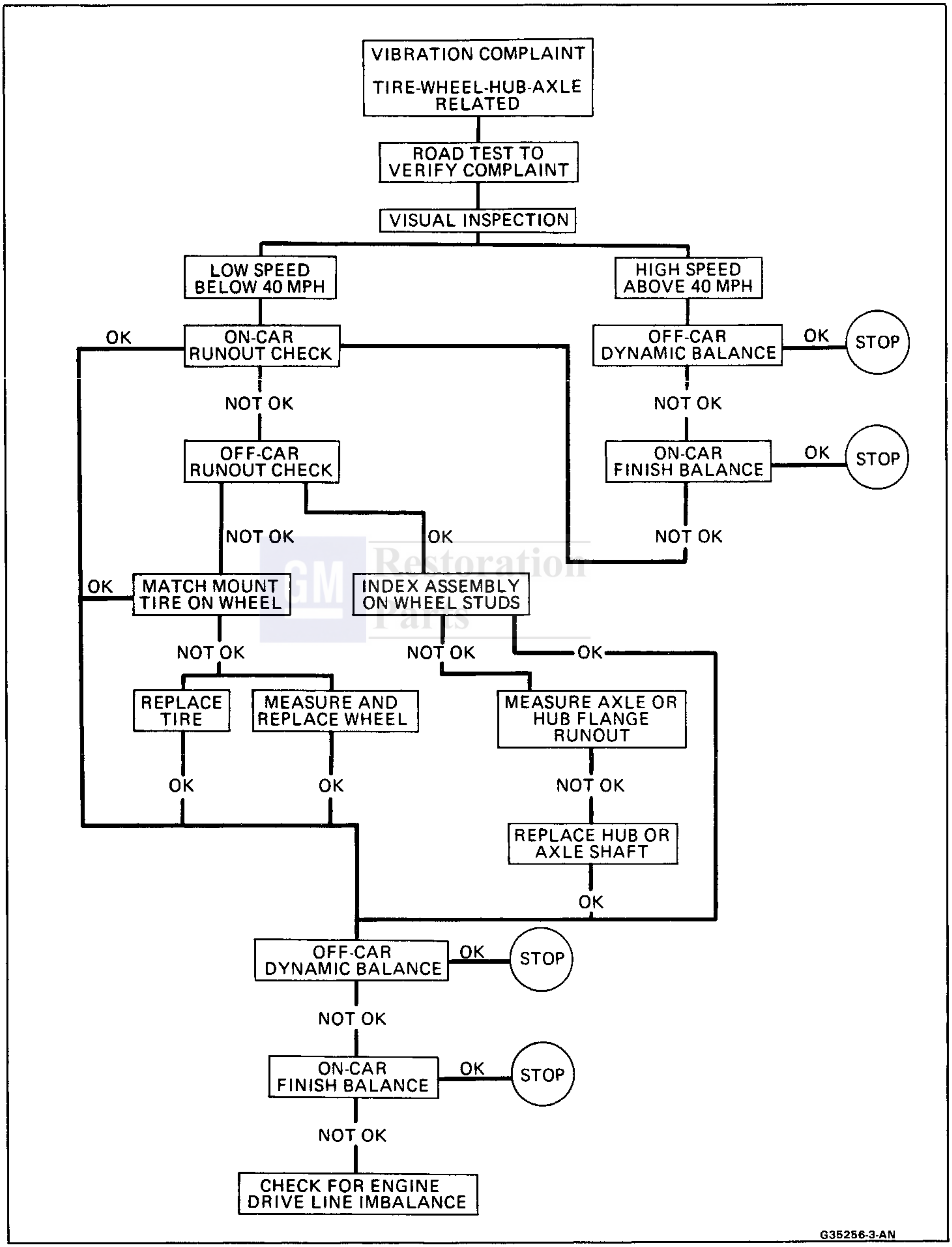


Fig. 17 Vibration Complaint Chart (1 of 2)

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

Prior to performing any work, always road test the car and perform a careful visual inspection for:

- Obvious tire and wheel runout.
- Obvious drive axle or propeller shaft runout.
- Proper inflation pressure.
- Wrong trim height.
- Bent wheels.
- Debris build-up on the tire or wheel.
- Loose or missing wheel weights or wheel nuts.
- Irregular or excessive tire wear.
- Proper tire bead seating on rim.
- Damaged tires, such as tread distortions, separations, or bulges from impact damage. Slight sidewall indentations are normal and will not affect ride quality.

Balance is the easiest procedure to perform and should, therefore, be done first if the vibration occurs at highway speeds. An off-car two-plane dynamic balance should first be performed. This will correct any imbalance in the tire and wheel assembly.

An on-car finish balance may also be required. This will correct any brake drum, rotor, or wheel cover imbalance. Follow the balancing procedures outlined in Section 3E.

If balance does not correct the highway speed vibration, or if the vibration is at low speeds, runout is the probable cause. Runout can be caused by the tire, wheel, or the way the wheel attaches to the car. The following procedure should be used:

A. If runout is suspected, the free runout of the tire and wheel assembly should first be measured on the car. A dial indicator with a roller wheel is preferable, but a dial indicator with button end may be used. Lateral runout (side to side) should be measured on the tire's sidewall as close to the tread shoulder as possible. Radial runout (up and down) should be measured on the center tread rib. Some tread designs may require tightly wrapping a piece of tape around the center tread circumference for better dial indicator contact. For measuring wheel runout follow the "Measuring Wheel Runout" procedure in Section 3E. Whether measuring radial or lateral runout, disregard any instantaneous indicator needle jumps due to sidewall depressions, tread blocks, etc. Record the total indicator reading, and the location of the high point of runout. The total tire and wheel on-car runout should be less than .060", if either measurement exceeds .060", proceed to Step B.

B. If the on-car radial or lateral runout measured in Step A exceeds .060", mount the tire and wheel assembly on a dynamic balance machine and again measure the amount of runout. Locate on the machine by the wheel's inside center pilot hole. Using the same procedure as in Step A, record the amount of tire and wheel runout and its high point location. Next, measure wheel runout, see Section 3E. If the wheel exceeds specifications replace the wheel. If the tire and wheel radial or lateral runout exceeds .050" at the tire tread, proceed to Step C.

C. If the off-car tire and wheel radial or lateral runout measured in Step B exceeds .050", match mount the high radial runout point of tire to low radial runout point of wheel. Reinflate, mount on the dynamic balance machine, and again measure and record the radial and lateral runout and its location, as done in Step B. In many cases, match mounting the tire on the wheel will bring the assembly's runout into the acceptable range of less than .050".

D. If the runout of the tire and wheel assembly is within limits when measured off the car, yet exceeds the limits when measured on the car, the attachment of the tire and wheel assembly to the hub is the probable cause. Rotate the assembly two wheel studs and recheck the runout. Several positions may have to be tried to find the best location.

E. If the assembly runout cannot be reduced to an acceptable level, remove the tire and wheel assembly and measure wheel stud runout with a dial indicator. Zero the dial indicator button on one stud. Lift button gently off stud and rotate flange to position next stud against dial indicator button. Record the runout on all studs. Dial indicator should read zero when repositioned on first stud that was checked. If runout exceeds .030", the hub or axle shaft should be replaced.

Whenever a tire is rotated on the wheel, or a tire or wheel is replaced, the assembly must be rebalanced.

In addition to balance and tire and wheel free runout, tire stiffness variation (loaded radial runout) can also cause a vibration. However, this is impossible to measure without a TPD (Tire Problem Detector) or a loaded radial runout buffer.

The TPD is a roller drum that slowly rotates the tire while under load and mounted on the car. Tire stiffness variation causes wheel spindle movement which can be measured.

The loaded radial runout buffer is a more automated machine that slowly rotates the tire and wheel off the car under load with a roller drum and measures the tire's stiffness variation. It will then "match" the tire to the wheel by buffing off small amounts of rubber from the outer tread rows at the stiff spot. This procedure is usually effective, especially when used as a measuring device and for fine buffing only.

The TPD and loaded radial runout buffer are two methods that will measure or correct tire stiffness variation, tire runout, and wheel runout at the same time. However, because such equipment is not always available, and both have their disadvantages, the more basic procedure of measuring free runout with a dial indicator, as previously detailed, is usually more practical. The free runout of the tire will usually correspond with the tire's stiff spot.

The substitution method of vibration diagnosis can also be used. Install a known good set of tire and wheel assemblies. If these correct the vibration, the original assemblies should be reinstalled one at a time until the vibration returns. This will point out the tire with excess stiffness variation.

Tire stiffness variation will be higher or lower depending on the direction of tire rotation.

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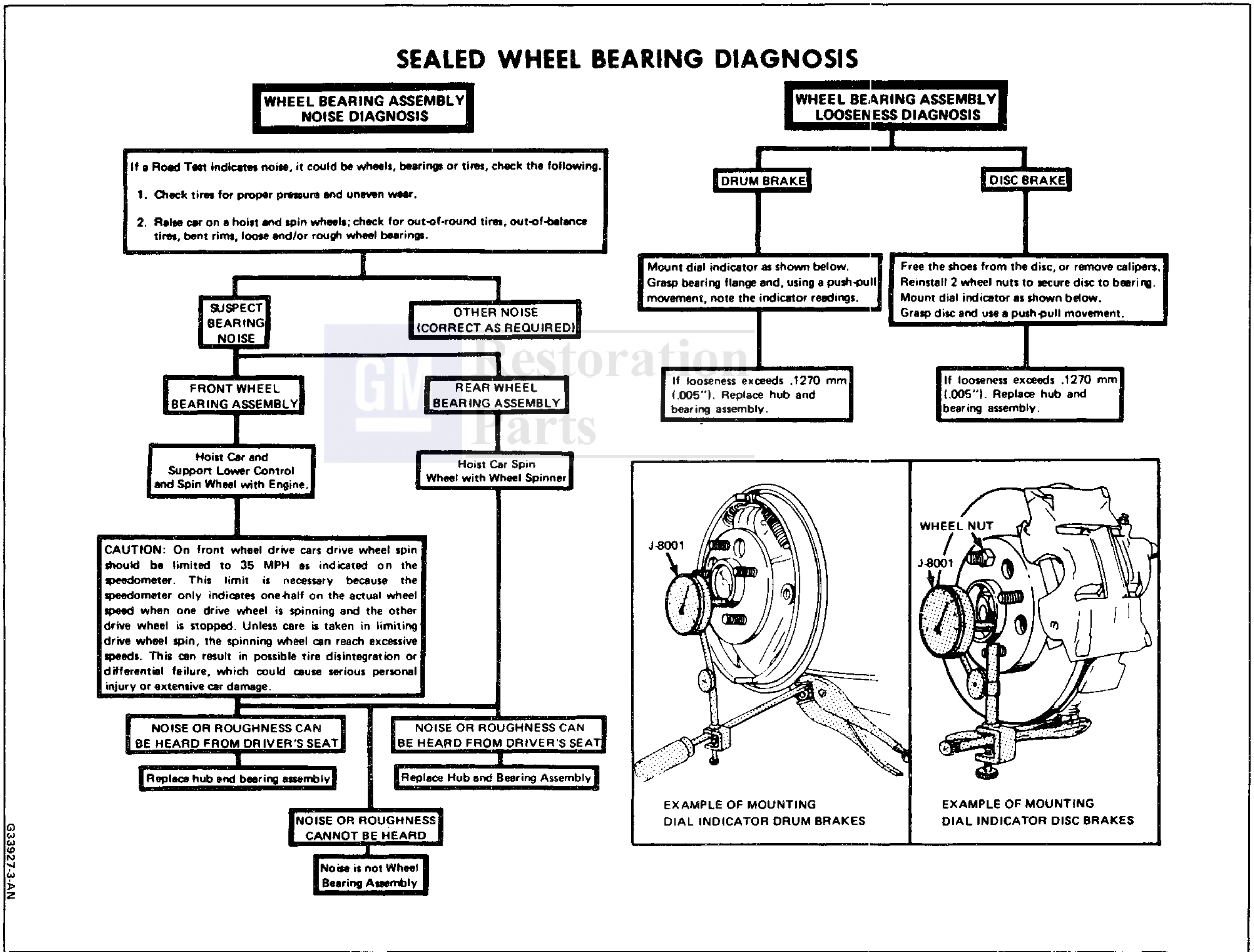
Fig. 18 Vibration Complaint Chart (2 of 2)



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.

SUSPECT BEARING NOISE

OTHER NOISE (CORRECT AS REQUIRED)

FRONT WHEEL BEARING ASSEMBLY

Hoist Car and Support Lower Control and Spin Wheel with Engine.

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.

NOISE OR ROUGHNESS CAN BE HEARD FROM DRIVER'S SEAT

Replace hub and bearing assembly

REAR WHEEL BEARING ASSEMBLY

Hoist Car Spin Wheel with Wheel Spinner

NOISE OR ROUGHNESS CAN BE HEARD FROM DRIVER'S SEAT

Replace Hub and Bearing Assembly

NOISE OR ROUGHNESS CANNOT BE HEARD

Noise is not Wheel Bearing Assembly

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.

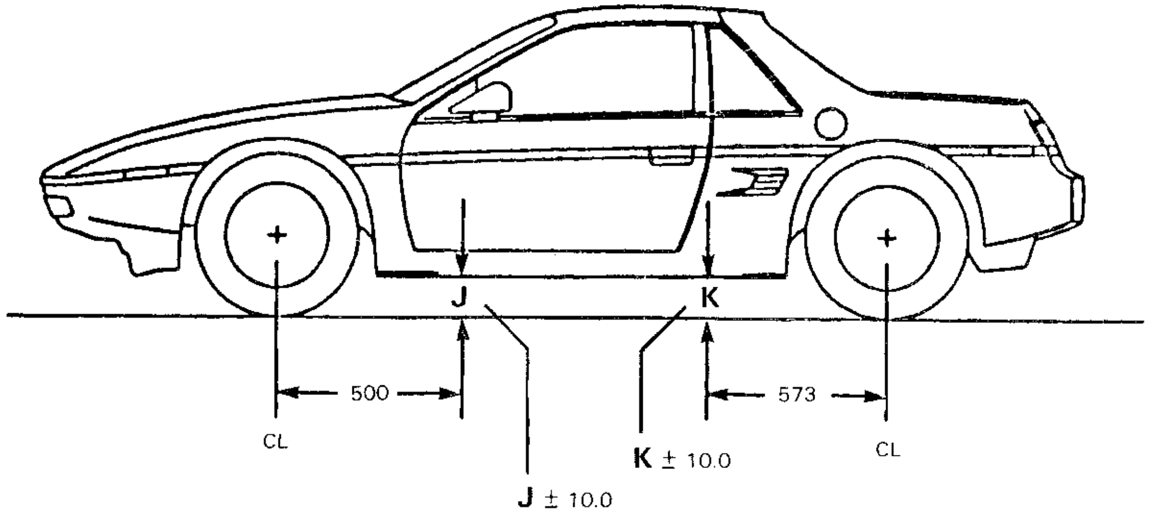
EXAMPLE OF MOUNTING DIAL INDICATOR DRUM BRAKES

EXAMPLE OF MOUNTING DIAL INDICATOR DISC BRAKES

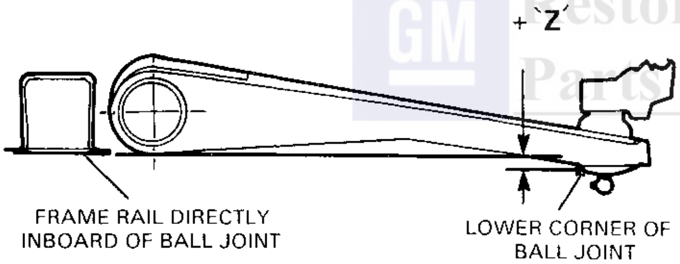
Fig. 19 Sealed Wheel Bearing Diagnosis

TRIM HEIGHT SPECIFICATIONS

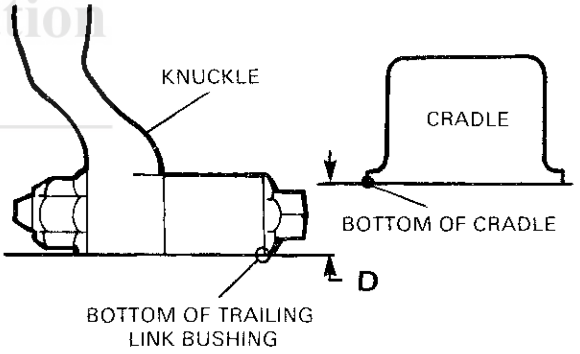
Trim heights checked with correct tire pressures, fuel tank full or equivalent weight in the trunk. No passengers or added weight in car. Trunk must be empty except for spare tire and jack or simulated fuel load. Measure from known level floor to rocker panel with steering wheel in the center position.



FRONT



REAR



ALL MODELS	Z	D	J	K
TIRE SIZE				
P195/70R 14	6.9	25	189	186
P185/75R 14	6.9	22	189	186
FP 05/RP215 60R 15	6.9	13	189	186

"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 APPROXIATELY 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 APPROXIAMTELY 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.

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

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. Worn 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 and aft and transversely.

CAMBER ANGLE

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.

CASTER ANGLE

Figure 1

Caster is the forward or rearward tilting of the wheel axis (at the top) from vertical. A rearward tilt (at the top) is a positive angle, and a forward tilt is a negative angle.

Weak springs or overloading of a vehicle will affect caster. because the steering axis changes when normal body "trim height" is altered.

Caster angle influences directional stability and steering effort, but does not affect tire wear.

TOE ANGLE

Figure 1

Toe is the dimension which allows parallel rolling of all four (4) wheels. As the vehicle is directed down the highway, the components which make up the steering and suspensions are subjected to dynamic forces. Manufacturing tolerances exist in each complementary component, which when compounded, requires pre-compensation (toe-in/toe-out). Precise toe-in or toe-out will provide minimal tire wear and optimum economy.

ON-CAR SERVICE

Front Camber/Caster Angle Adjustment

Figure 2

Before adjusting caster and camber angles, both the front and rear bumpers should be raised and released (jounced) three times each. See "Trim Heights" in Section 3. Caster and Camber adjustments are performed by loosening the upper control arm shaft bolts to tilt the wheel from the vertical to change Camber Angle, and forward or rearward to change Caster Angle. Toe Angle must be adjusted after caster/camber adjustments are performed.

If U.C.A. Shaft bolts are removed for any reason, the paddle nut assembly must be replaced. See Section 3C.

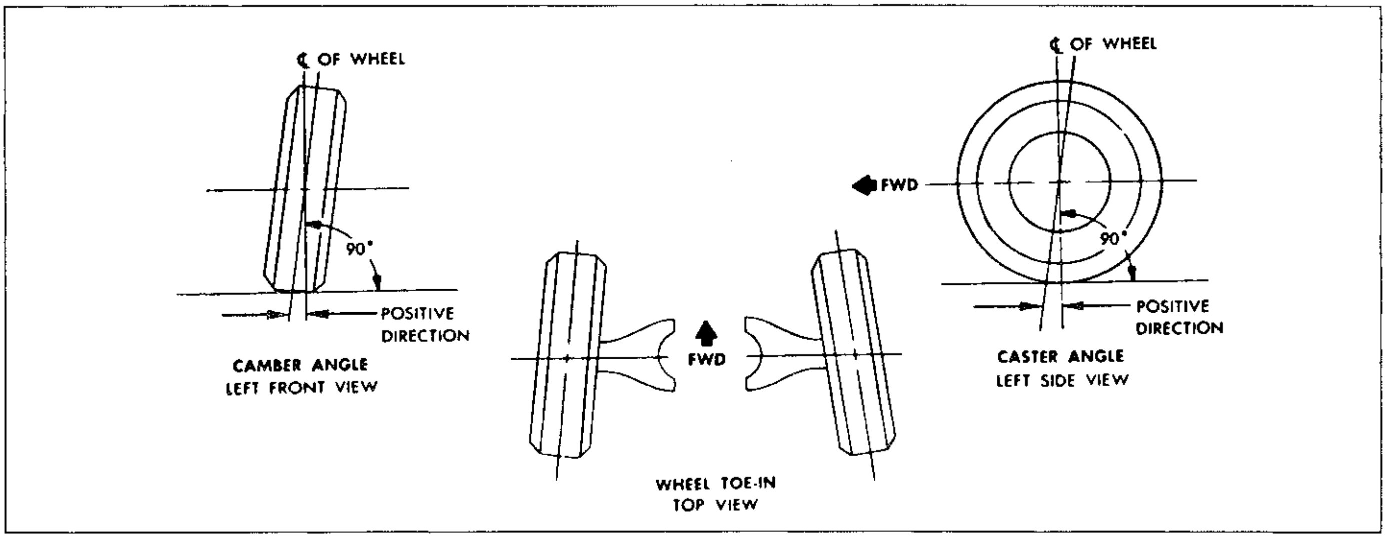
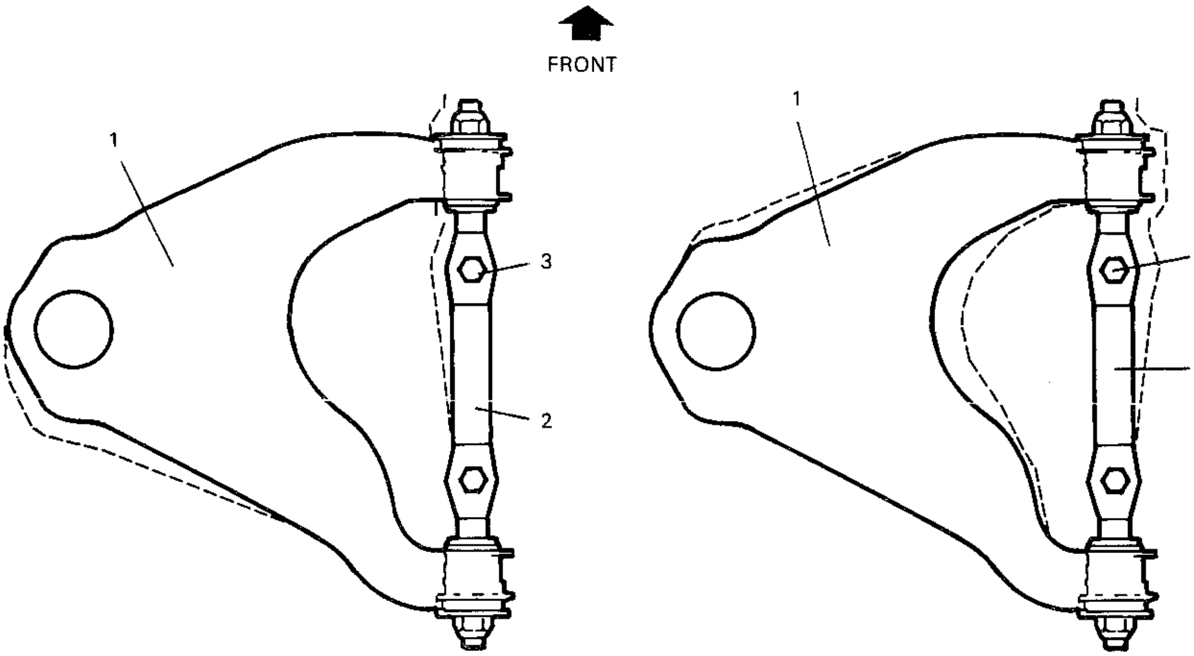
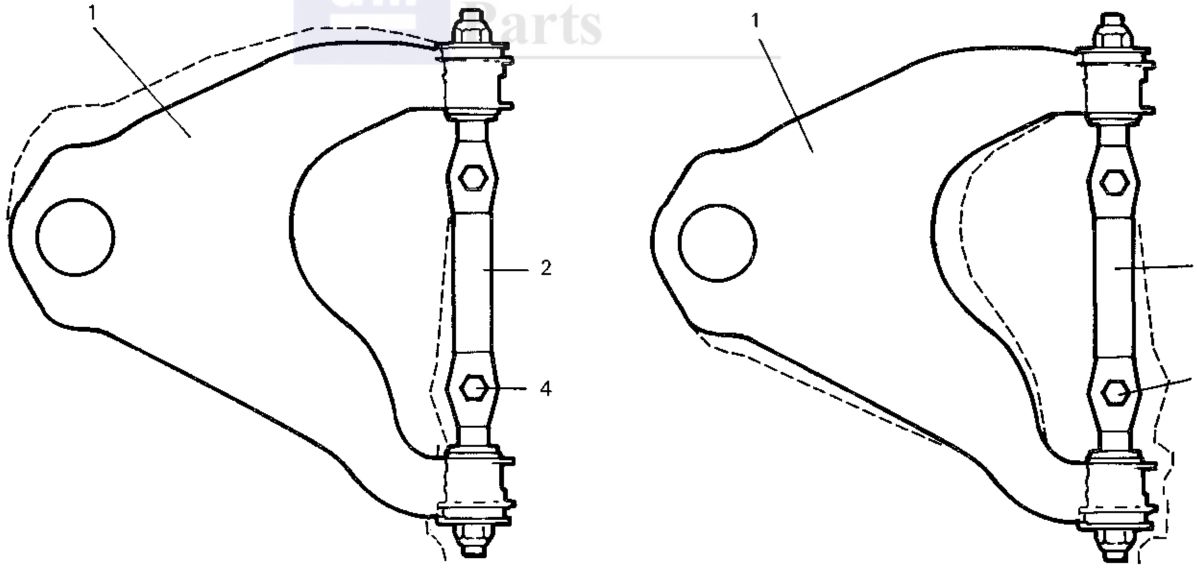


Figure 1 Caster, Camber and Toe-In



TO INCREASE CASTER AND CAMBER.

TO DECREASE CASTER AND CAMBER.



TO DECREASE CASTER AND INCREASE CAMBER.

TO INCREASE CASTER AND DECREASE CAMBER.

1 UPPER CONTROL ARM
2 U.C.A. SHAFT
3 FRONT BOLT
4 REAR BOLT

Figure 2 Adjusting Front Caster and Camber

Final torque to U.C.A. Shaft bolts is 70 N•m (52 lb. ft.) + 1/4 turn (90°)

Front Toe-In Adjustment

Figure 3

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

Rear Camber Adjustment

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 enough 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.

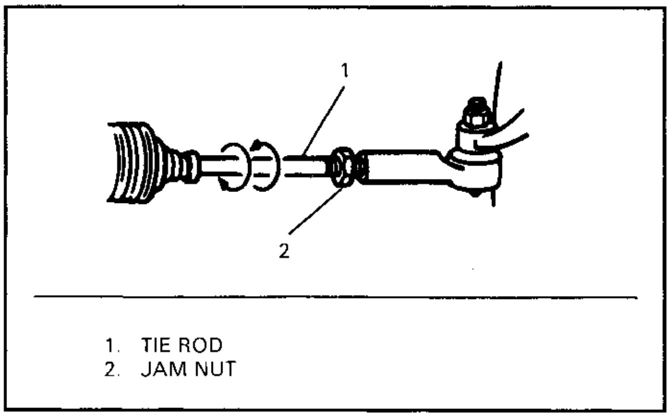


Figure 3 Adjusting Toe-In (Front) Typical

Rear Toe-In Adjustment

Figure 4

1. Position the car on your alignment equipment, and follow the manufacturer's instructions to obtain a toe-in reading.
2. Loosen the adjuster tube clamps.
3. Rotate the adjuster tube to change toe-in angle.
4. Tighten the clamps torque to 64 N•m (47 lb. ft.).

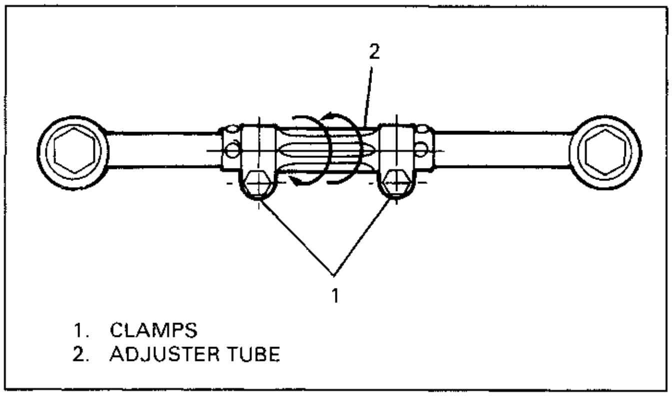


Figure 4 Adjusting Toe-In (Rear)

	SPECIFICATIONS FOR DIAGNOSIS FOR WARRANTY REPAIRS OR CUSTOMER PAID SERVICE (SERVICE CHECKING)	SERVICE SETTING
TOE FRONT DEG (PER WHEEL)	0.3° ± 2° TOTAL	0.3° TOTAL
CAMBER FRONT	0° ± .5°	0°
CASTER FRONT (MANUAL STRNG)	3.0° ± .5°	3.0°
CASTER FRONT (GT & FORMULA)	5.0° ± .5°	5.0°
CAMBER REAR	-1.0° ± .5°	-10° ± .5°
TOE REAR DEG (PER WHEEL)	.15° ± .1°	.15° ± .1°

- Vehicle must be jounced three times before checking alignment, to eliminate false geometry readings
- Front toe adjustment to be set separately per wheel, with steering wheel held in "straight-ahead" position within ± 5.0°.
- Front & rear cross car camber must be within 0.75°.
- Front cross car caster must be within 0.75°.
- Tie rod boot must not be twisted and must be seated in tie rod groove.

Figure 5 Wheel Alignment Specifications

SECTION 3B2

MANUAL RACK AND PINION

CAUTION: To help avoid personal injury when a vehicle is on a hoist, provide additional support for the vehicle at the end opposite from which components are being removed. This will reduce the possibility of the vehicle falling off the hoist.

NOTICE: All steering gear fasteners are important attaching parts that 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 INFORMATION

The manual rack and pinion steering system consists of two main components, the rack and the pinion. The motion of the pinion is transferred through the pinion teeth which mesh with teeth on the rack, which moves the rack. The force is then transmitted through the steering knuckles on the control arms which turn the wheels.

ON-CAR SERVICE

RACK AND PINION ASSEMBLY

Figure 1

←→ Remove or Disconnect

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

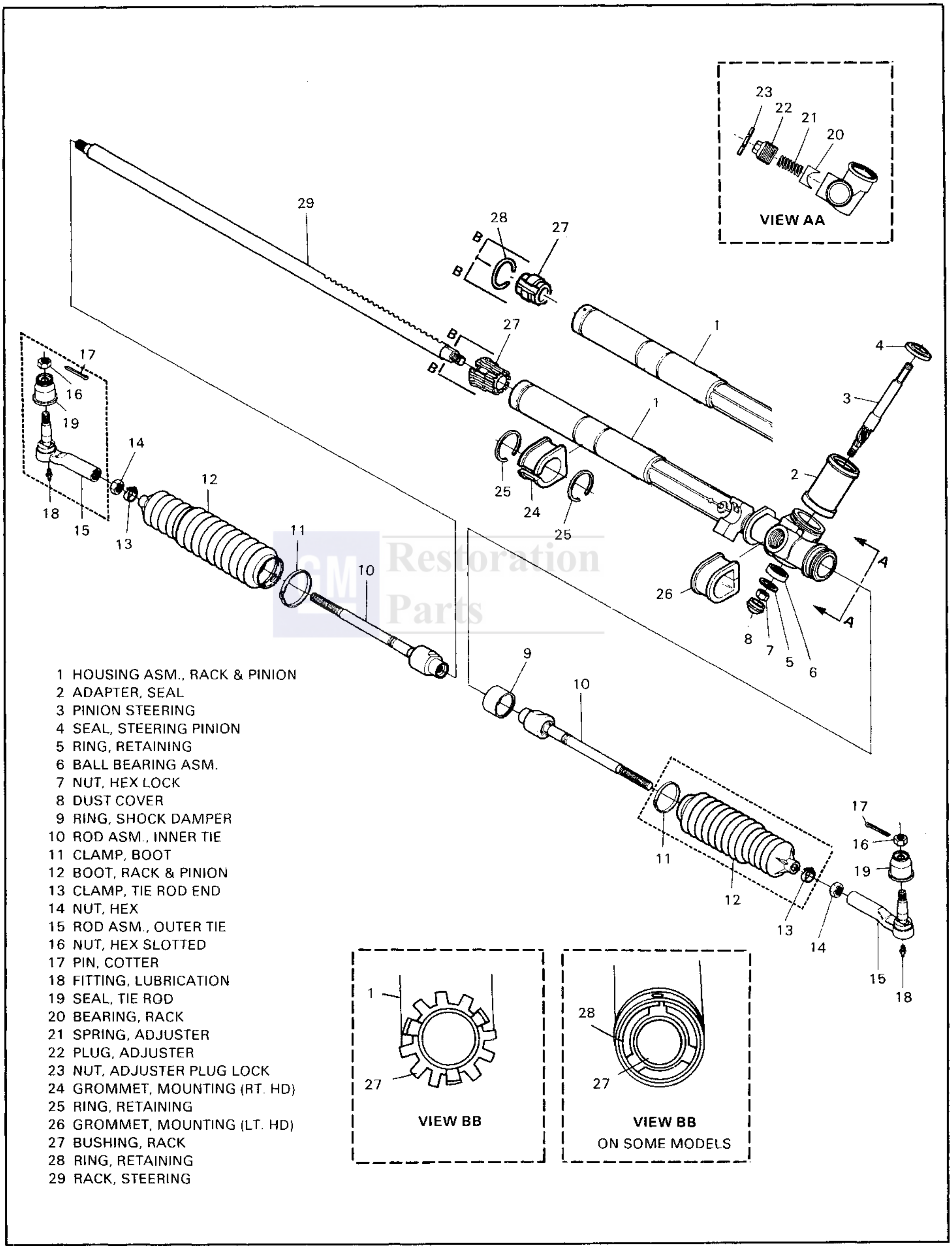
→← Install or Connect

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.
4. Tie rod nut on each knuckle assembly.

Tighten

- Flexible coupling bolt to 62 N•m (46 lbs. ft.).
- Four steering assembly bolts to 27 N•m (20 lbs. ft.).
- Tie rod nut at each knuckle to 20 N•m (15 lbs. ft.) plus 1/2 turn (180°). It is permissible to torque up to 54 N•m (39 lbs. ft.), approximately 1/6 turn of the nut, for cotter pin alignment.

5. Lower vehicle.
6. Check/adjust front wheel alignment. See Section 3A.



1 HOUSING ASM., RACK & PINION
2 ADAPTER, SEAL
3 PINION STEERING
4 SEAL, STEERING PINION
5 RING, RETAINING
6 BALL BEARING ASM.
7 NUT, HEX LOCK
8 DUST COVER
9 RING, SHOCK DAMPER
10 ROD ASM., INNER TIE
11 CLAMP, BOOT
12 BOOT, RACK & PINION
13 CLAMP, TIE ROD END
14 NUT, HEX
15 ROD ASM., OUTER TIE
16 NUT, HEX SLOTTED
17 PIN, COTTER
18 FITTING, LUBRICATION
19 SEAL, TIE ROD
20 BEARING, RACK
21 SPRING, ADJUSTER
22 PLUG, ADJUSTER
23 NUT, ADJUSTER PLUG LOCK
24 GROMMET, MOUNTING (RT. HD)
25 RING, RETAINING
26 GROMMET, MOUNTING (LT. HD)
27 BUSHING, RACK
28 RING, RETAINING
29 RACK, STEERING

Fig. 1 Rack and Pinion Steering Assembly

1. REMOVE AND INSTALL OUTER TIE ROD

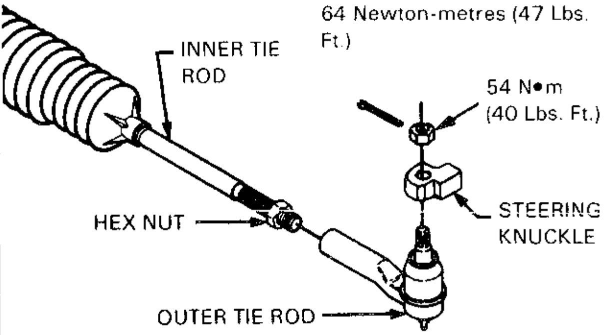
REMOVE

1. Loosen jam nut.
2. Remove tie rod from steering knuckle, using Tool J-6627A.
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 64 Newton-metres (47 Lbs. Ft.)



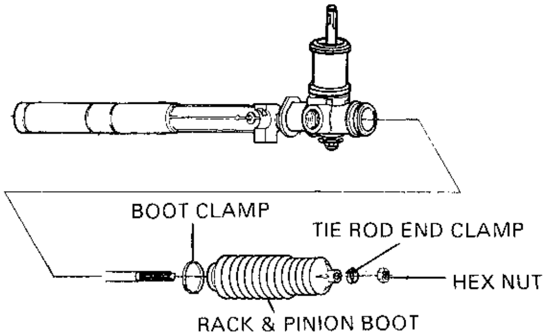
2. REMOVE AND INSTALL BOOT SEAL

REMOVE

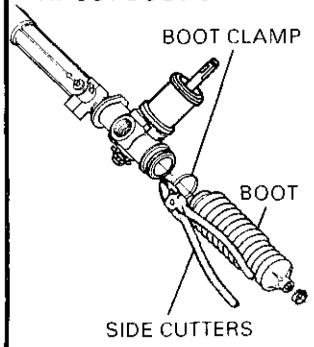
1. Remove jam nut.
2. Remove tie rod end clamp.
3. Cut boot clamp and discard.
4. See insert for proper boot seal removal.

INSTALL

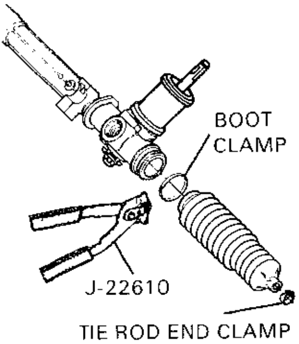
1. Place new clamp on boot before installing boot.
2. See insert for proper installation of boot seal.
3. Engage boot onto housing.
4. Secure boot clamp.
5. Secure the tie rod end clamp.

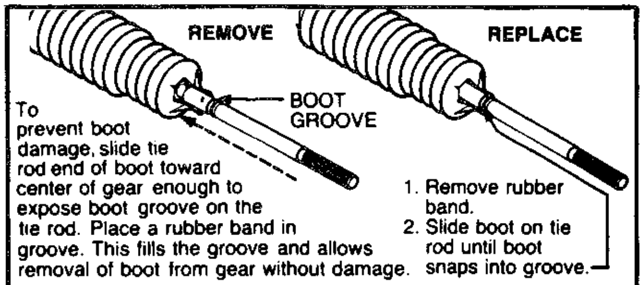


A. CUT BOOT CLAMP



B. SECURE BOOT CLAMP





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.

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

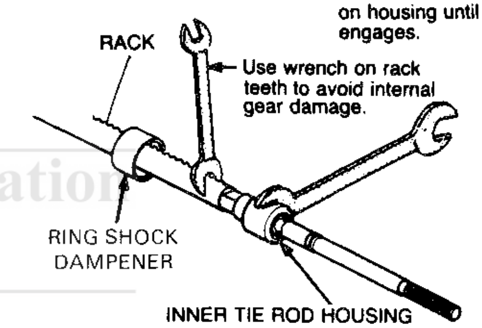
3. REMOVE AND INSTALL INNER TIE ROD

REMOVE

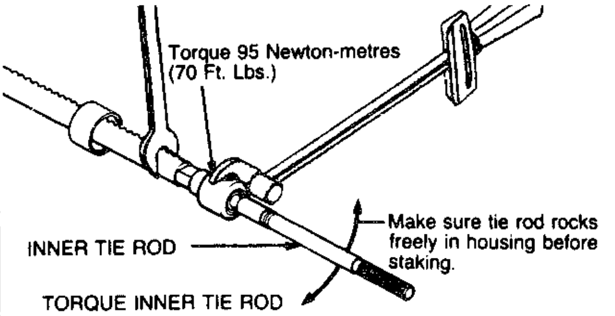
1. Remove parts as shown.
2. Use wrench on rack when either left or right hand tie rods are removed.

INSTALL

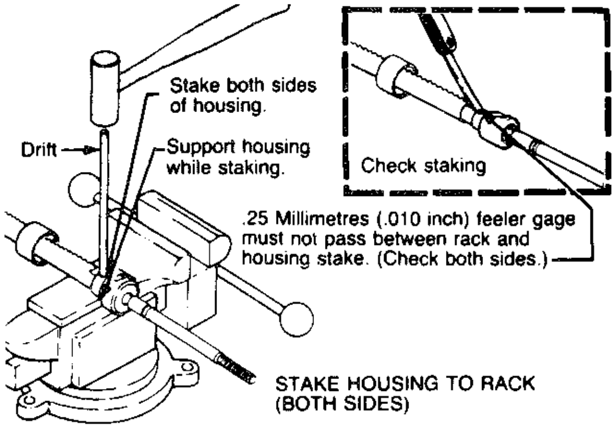
1. Install parts as shown.
2. Torque housing. (Use wrench on rack when tightening right or left tie rod to avoid internal gear damage.)
3. Slide shock dampener on housing until it engages.



Use wrench on rack teeth to avoid internal gear damage.



Make sure tie rod rocks freely in housing before staking.



Stake both sides of housing.

Support housing while staking.

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

STAKE HOUSING TO RACK (BOTH SIDES)

Fig. 2 Rack and Pinion Assembly Service - Chart A

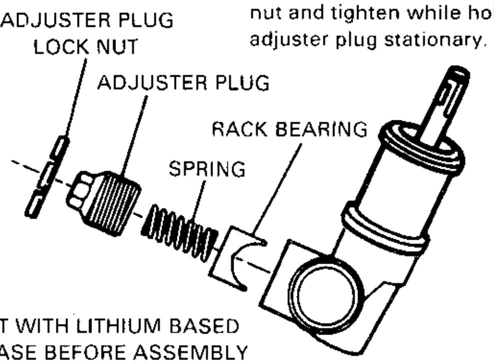
4. REMOVE AND INSTALL RACK BEARING

REMOVE

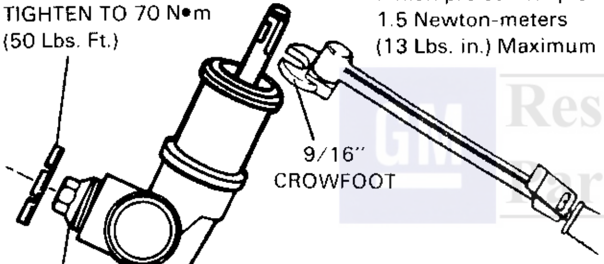
1. Remove parts as shown.

INSTALL

1. Install parts as shown.
2. Turn adjuster plug clockwise until it bottoms, then back off 70° to 90°. Check torque on pinion.
3. Assemble adjustor plug lock nut and tighten while holding adjuster plug stationary.



COAT WITH LITHIUM BASED GREASE BEFORE ASSEMBLY



ADJUSTER PLUG LOCK NUT - TIGHTEN TO 70 N•m (50 Lbs. Ft.)

Pinion preload torque 1.5 Newton-meters (13 Lbs. in.) Maximum

CHECK PINION TORQUE

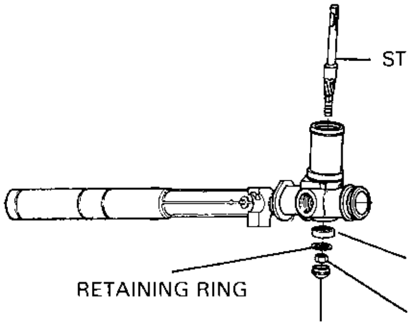
5. REMOVE AND INSTALL PINION SHAFT ASSEMBLY AND RACK

REMOVE

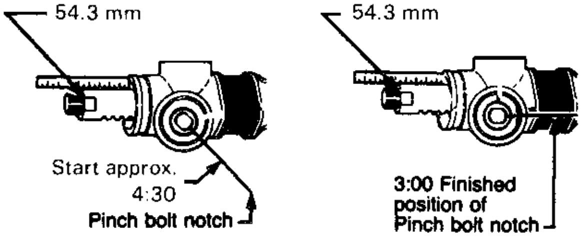
1. Remove parts as shown.

INSTALL

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



CAUTION: WITH STEERING PINION REMOVED STEERING RACK CAN SLIDE FROM HOUSING AND BE DAMAGED.



INSTALL RACK & PINION

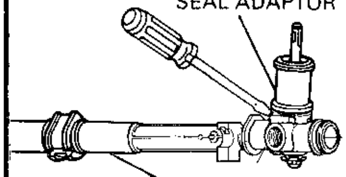
6. REMOVE AND INSTALL PINION SEAL

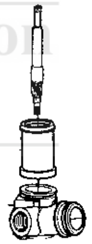
REMOVE

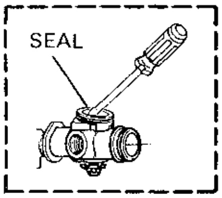
1. Remove seal as shown.

INSTALL

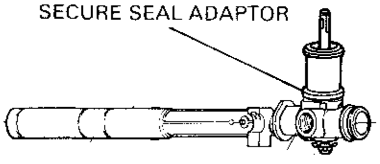
1. Install parts as shown.
2. Thoroughly coat pinion shaft and seal where they contact with anhydrous grease.
3. Seat the seal adaptor onto the housing



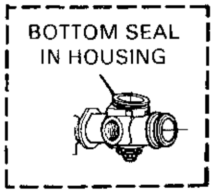




VIEW OF SEAL REMOVAL



INSTALL PINION SEAL



BOTTOM SEAL IN HOUSING

7. REMOVE AND INSTALL ROLLER BEARING ASSEMBLY

REMOVE

1. Remove parts as shown.

INSTALL

1. Install bearing assembly as shown.

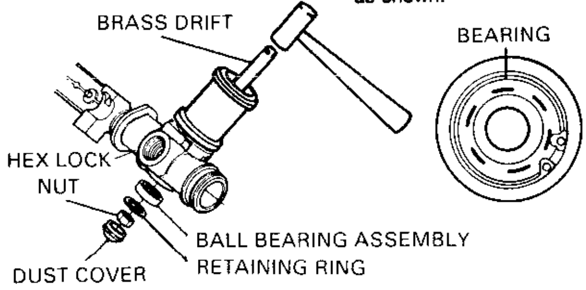
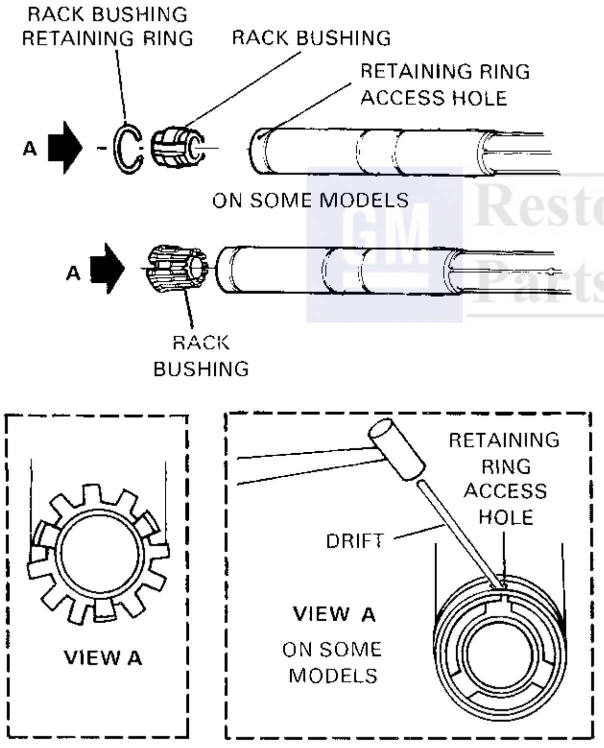


Fig. 3 Rack and Pinion Assembly Service - Chart B

8. REMOVE AND INSTALL RACK BUSHING.

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



9. REMOVE AND INSTALL GROMMET.

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

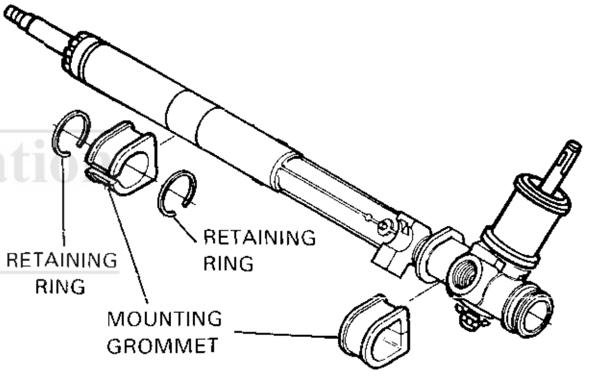


Fig. 4 Rack and Pinion Assembly Service - Chart C

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

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.

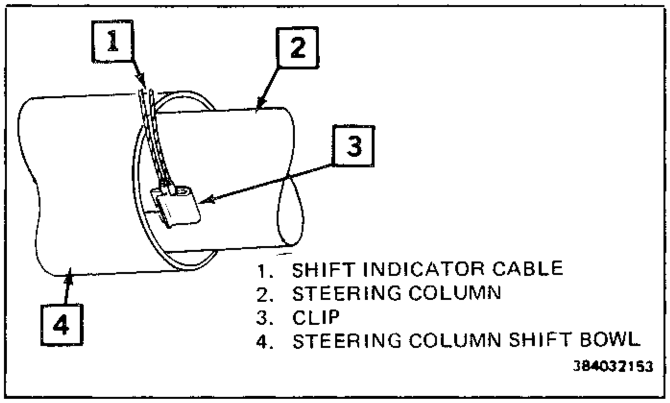


Fig. 1 Shift Indicator Adjustment

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.

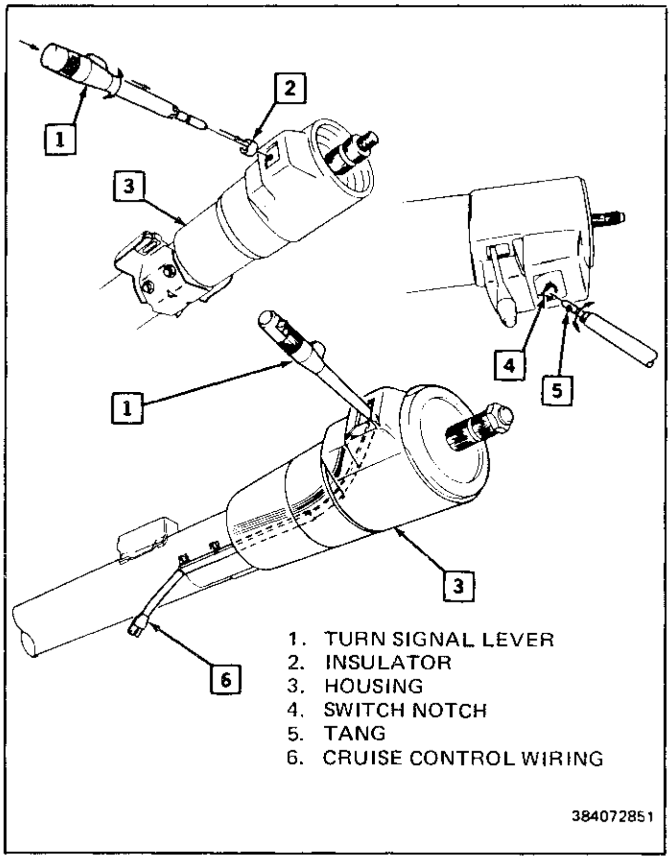


Fig. 2 Multifunction Turn Signal Lever

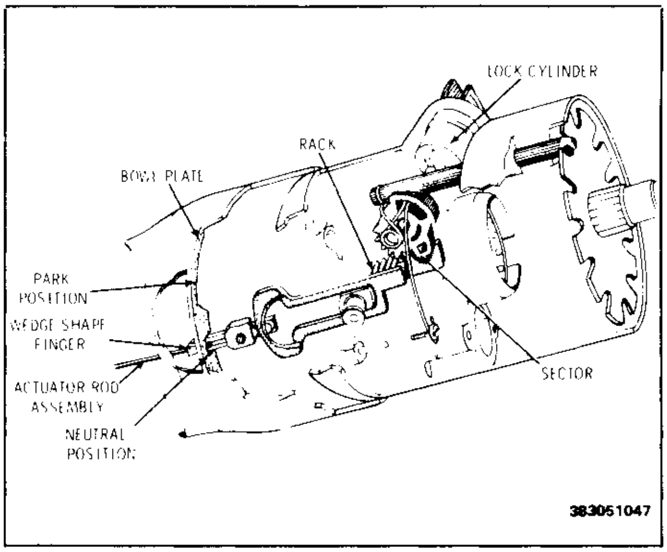


Fig. 3 Mechanical Neutral Start System

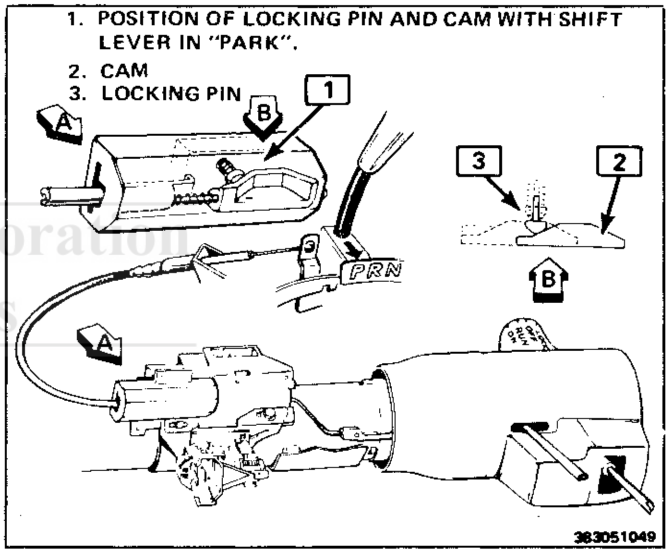


Fig. 4 Park Lock System

STEERING WHEEL

Standard

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

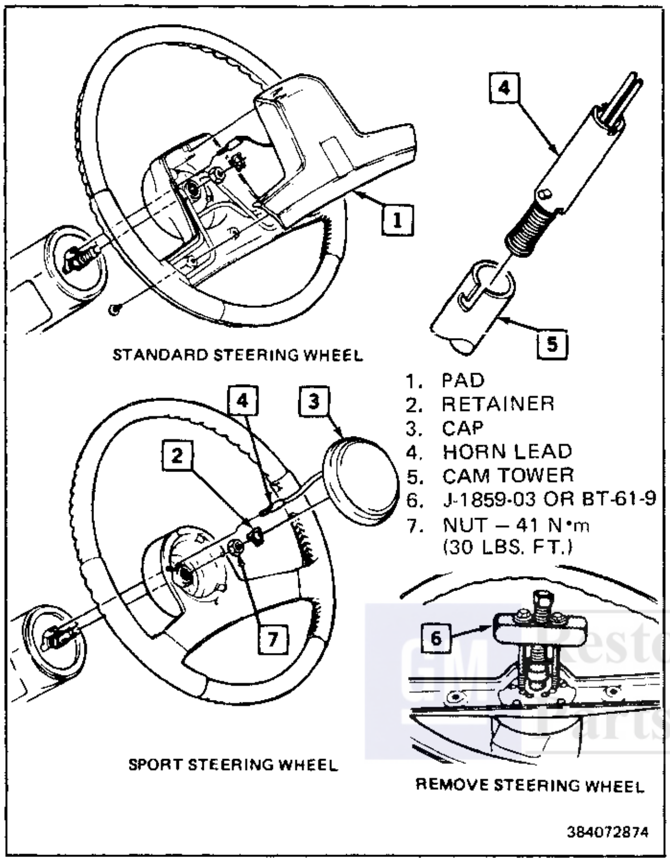


Fig. 5 Steering Wheel

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

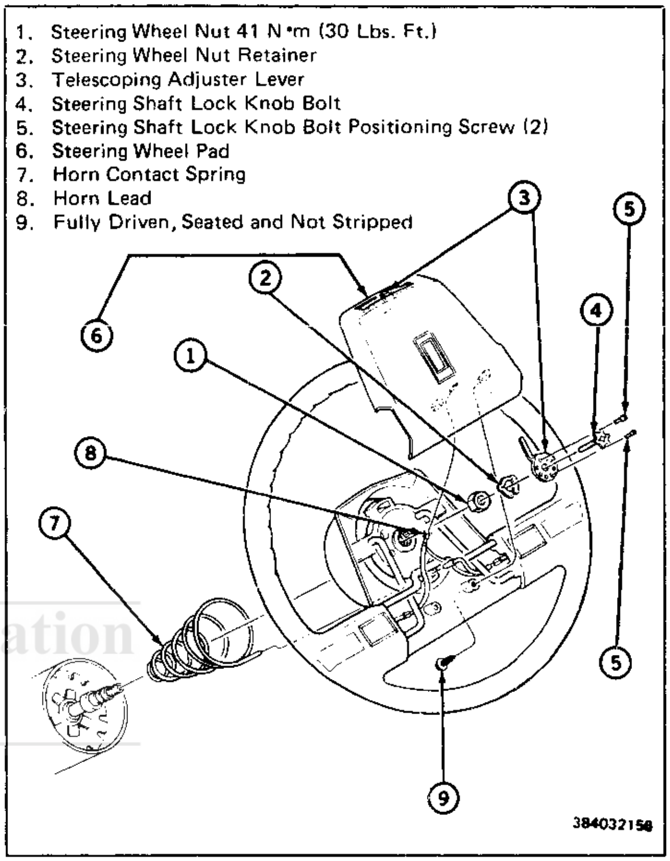


Fig. 6 Tilt Wheel

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

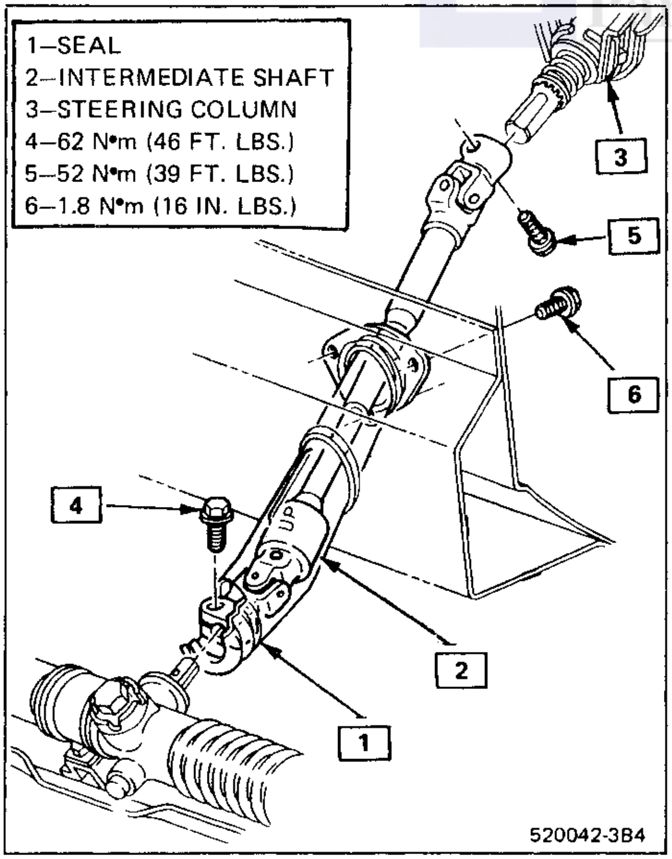


Fig. 7 Steering Column Mounting

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

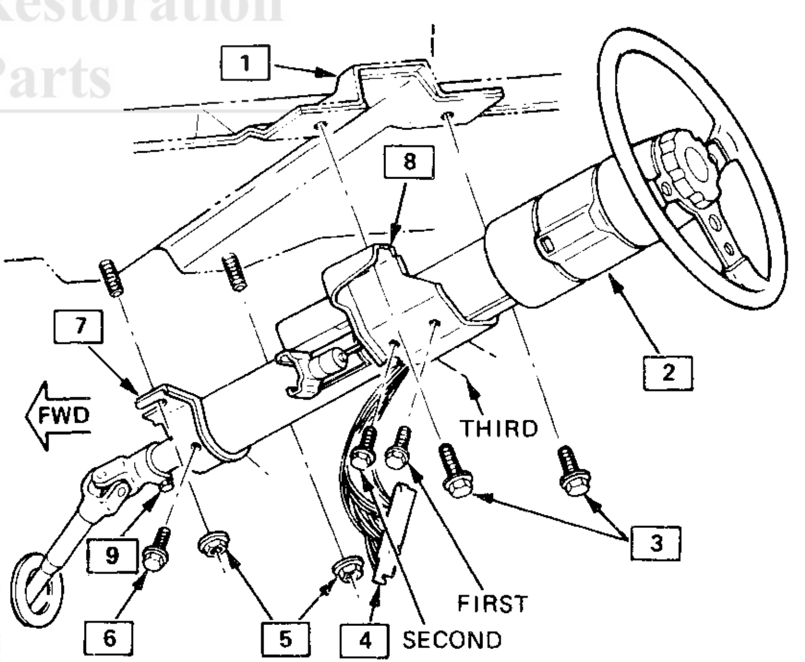
5–NUT 34 N•m (25 FT. LBS.)

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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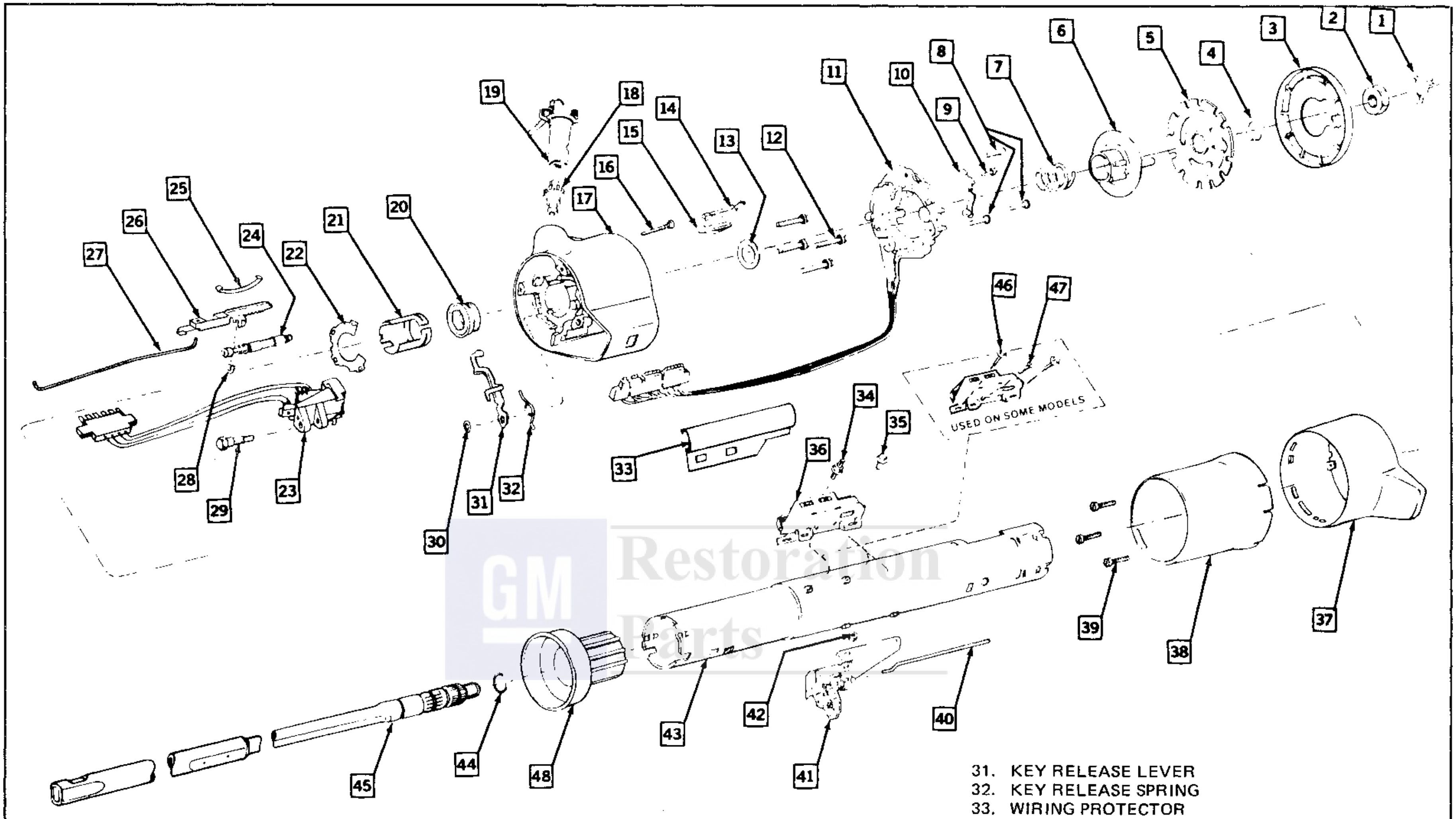
Fig. 8 Intermediate Shaft



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

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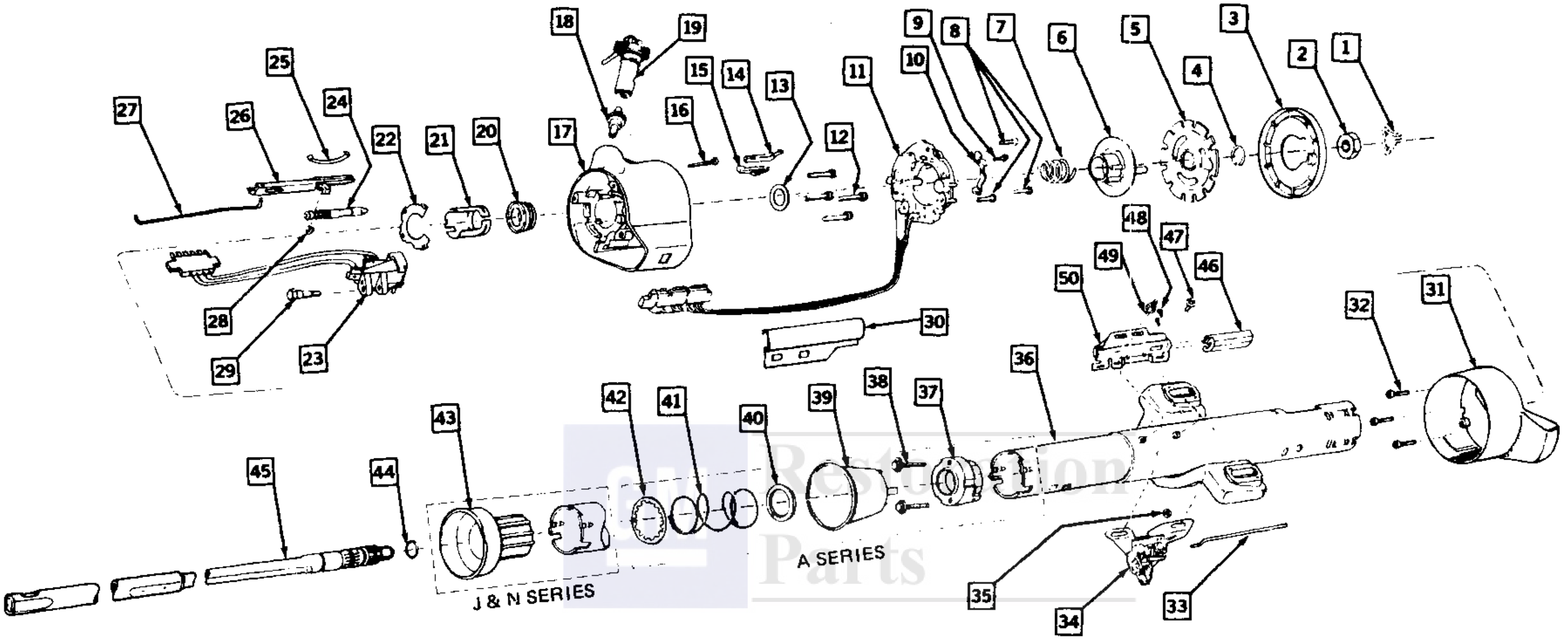
Fig. 9 Key Release Standard Steering Column



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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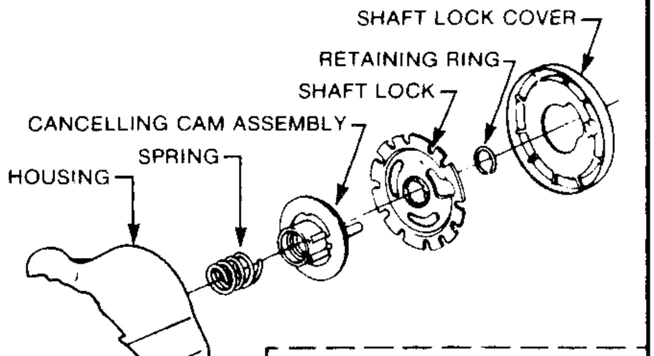
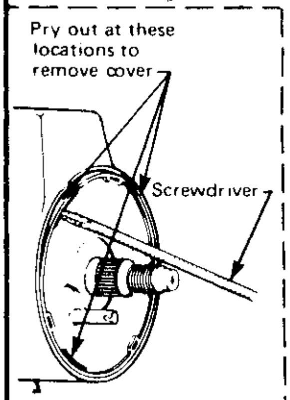
Fig. 10 Park Lock Standard Steering Column

ALL STANDARD STEERING COLUMNS

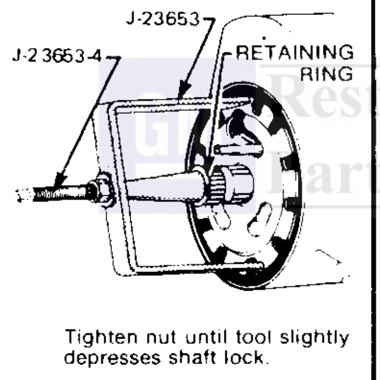
1. REMOVE AND INSTALL LOCK PLATE AND/OR CANCELLING CAM

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




Pry out at these locations to remove cover

REMOVE SHAFT LOCK COVER

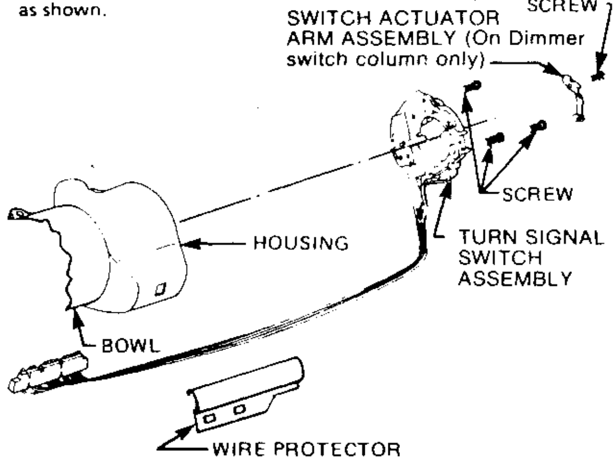


Tighten nut until tool slightly depresses shaft lock.

REMOVE AND INSTALL RETAINING RING

2. REMOVE AND INSTALL TURN SIGNAL SWITCH

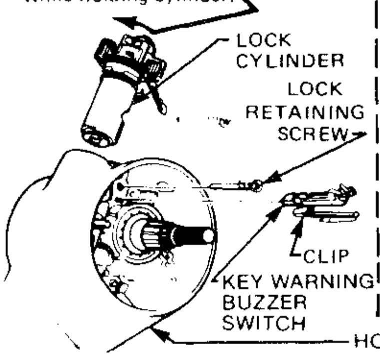
REMOVE	INSTALL
1. Remove parts as shown.	1. Install parts as shown.

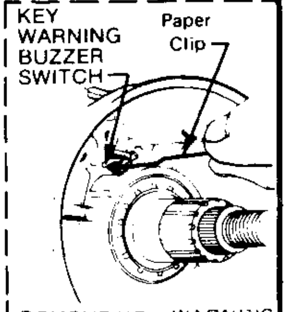


3. REMOVE AND INSTALL IGNITION LOCK AND KEY WARNING BUZZER

REMOVE	INSTALL
1. Turn lock to "RUN" position and remove key warning buzzer switch.	1. Install lock cylinder.
2. Remove parts as shown.	2. Turn lock to "RUN" position and install key warning buzzer switch.

To assemble, rotate to stop while holding cylinder.

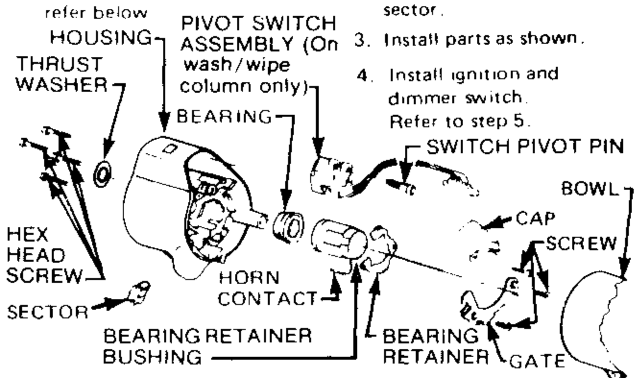




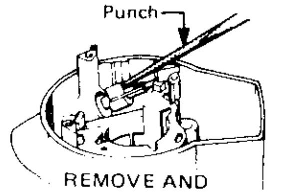
REMOVE KEY WARNING BUZZER SWITCH

4. REMOVE AND INSTALL HOUSING AND WIPER SWITCH

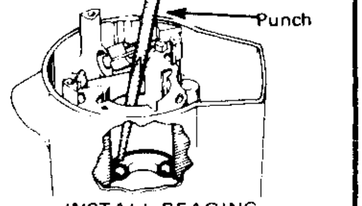
REMOVE	INSTALL
1. Remove ignition and dimmer switch. Refer to step 5.	1. For KEY RELEASE refer below.
2. Remove parts as shown.	2. Assemble rack so that first rack tooth engages between first and second tooth of sector.
3. For KEY RELEASE refer below	3. Install parts as shown.
	4. Install ignition and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



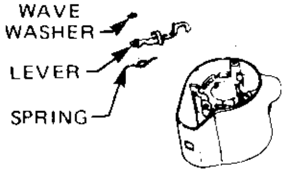
NOTE: Housing without bearing retainer and bushing has spun-in bearing. If repair is necessary, complete housing assembly replacement is necessary.



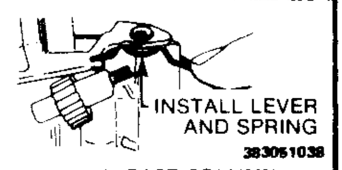
REMOVE AND INSTALL SECTOR



INSTALL BEARING



KEY RELEASE COLUMN



KEY RELEASE COLUMN

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

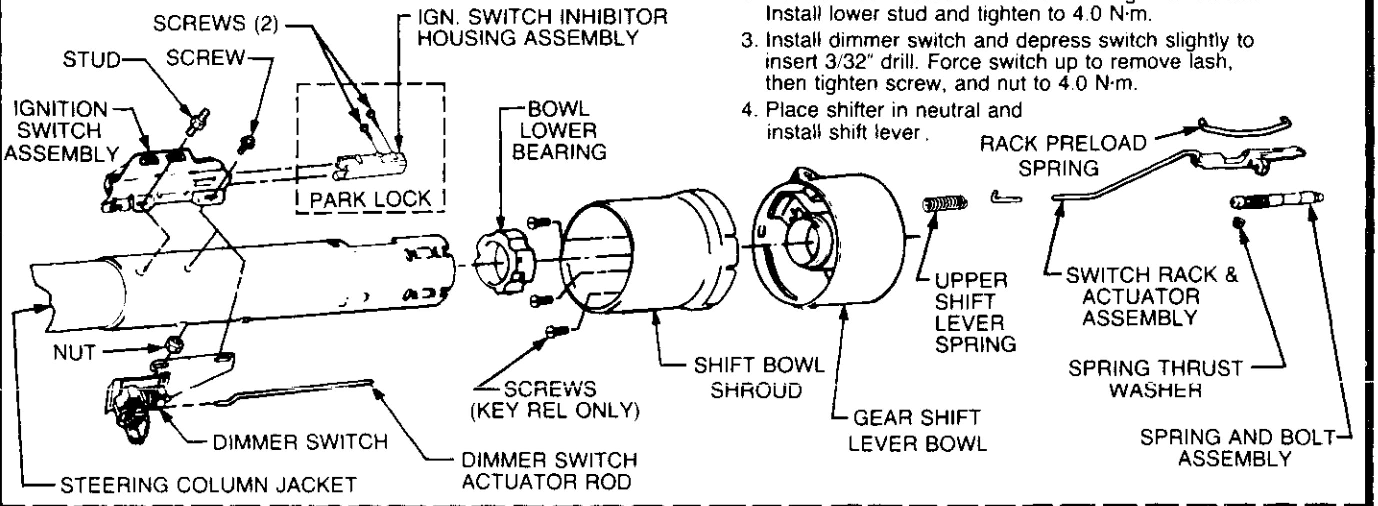
5. REMOVE AND INSTALL IGNITION AND DIMMER SWITCH

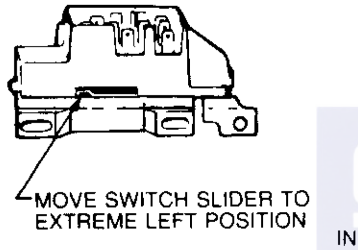
REMOVE

1. Remove parts as shown.

INSTALL

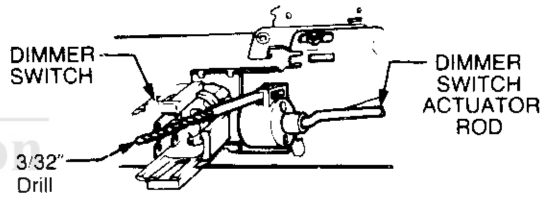
1. Install parts as shown
2. Position rod in slider hole and install ignition switch. Install lower stud and tighten to 4.0 N·m.
3. Install dimmer switch and depress switch slightly to insert 3/32" drill. Force switch up to remove lash, then tighten screw, and nut to 4.0 N·m.
4. Place shifter in neutral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

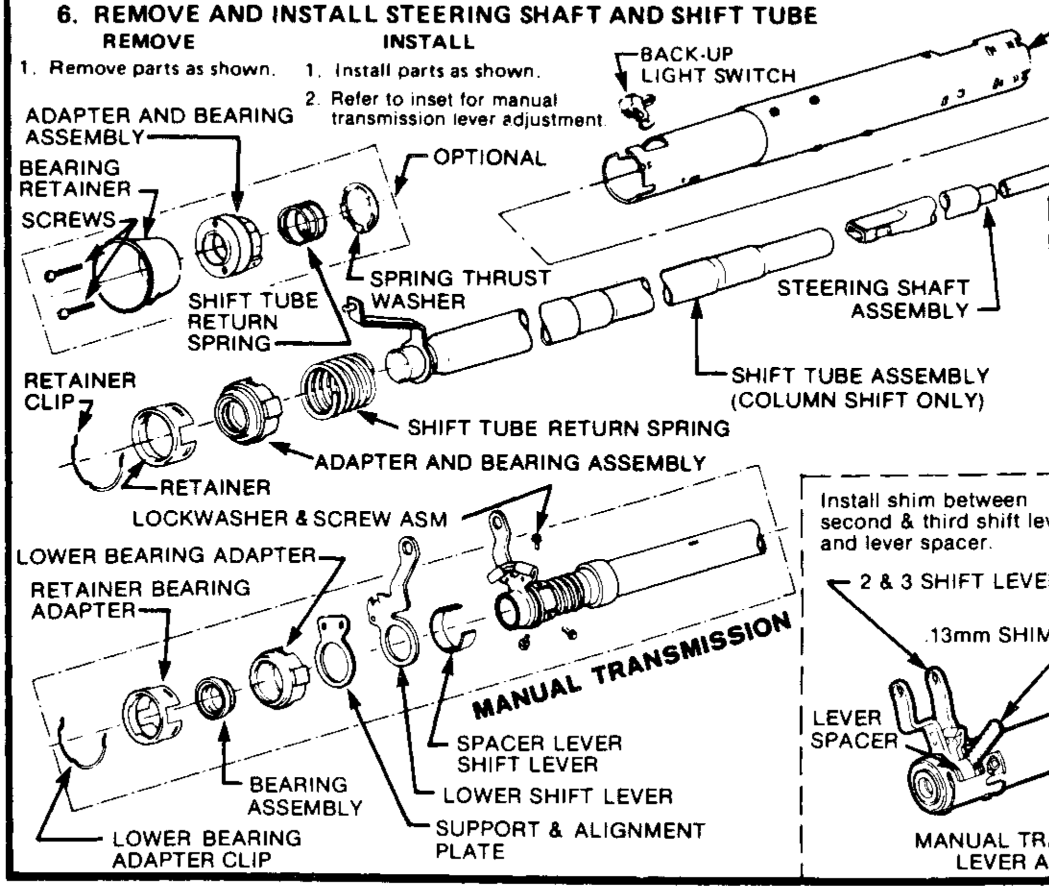
6. REMOVE AND INSTALL STEERING SHAFT AND SHIFT TUBE

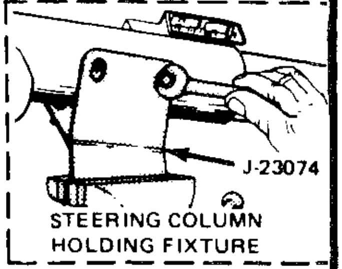
REMOVE

1. Remove parts as shown.

INSTALL

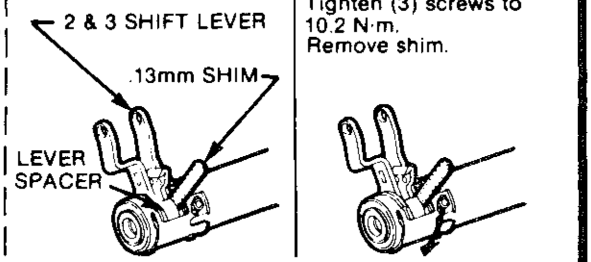
1. Install parts as shown.
2. Refer to inset for manual transmission lever adjustment.





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

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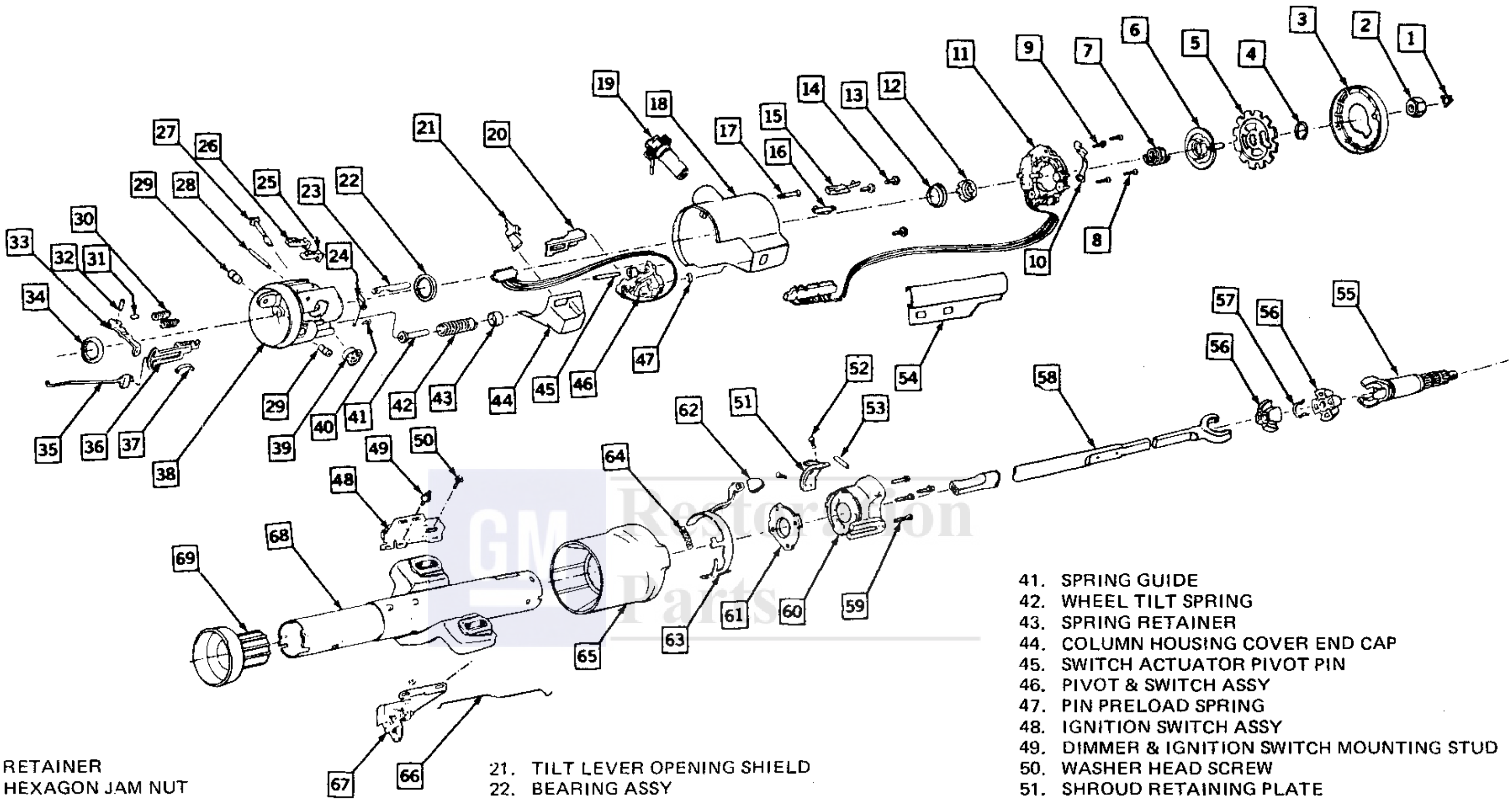
Fig. 12 Standard Steering Column Service (2 of 2)



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

3B4082971

Fig. 13 Key Release Tilt Wheel Steering Column

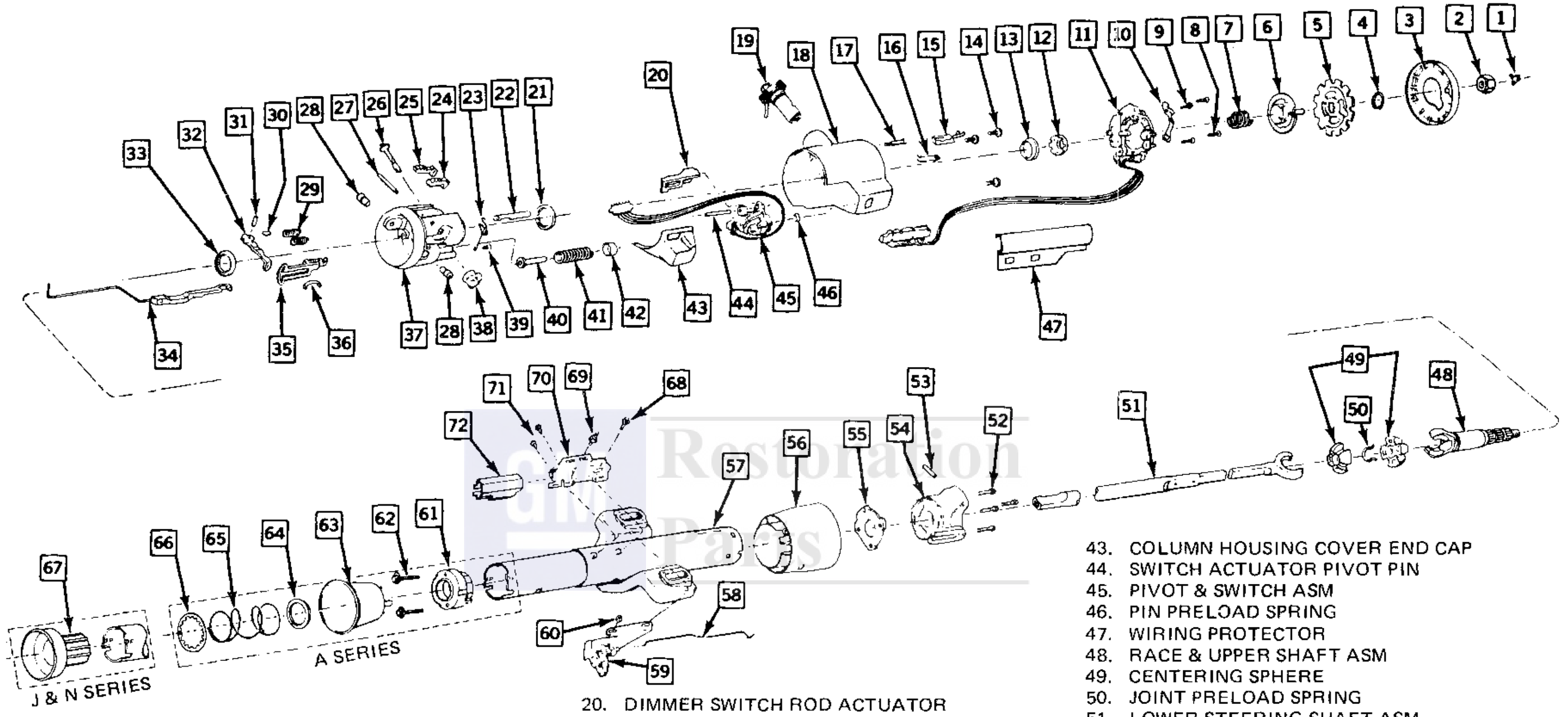


Fig. 14 Park Lock Tilt Wheel Steering Column

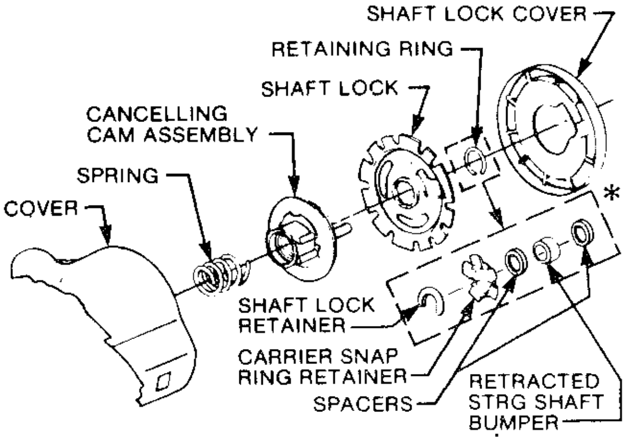
1. RETAINER
2. HEXAGON JAM NUT
3. SHAFT LOCK COVER
4. RETAINING RING
5. STEERING SHAFT LOCK
6. TURN SIGNAL CANCELLING CAM ASM
7. UPPER BEARING SPRING
8. BINDING HEAD CROSS RECESS SCREW
9. ROUND WASHER HEAD SCREW
10. SIGNAL SWITCH ARM ASM
11. TURN SIGNAL SWITCH ASM
12. UPPER BEARING INNER RACE SEAT
13. 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

3B4082972

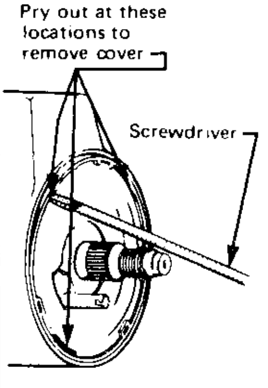
ALL ADJUSTABLE STEERING COLUMNS

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

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

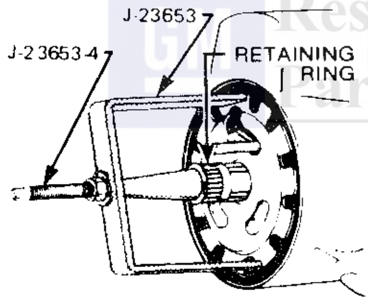


*ON TELESCOPE STEERING ONLY



Pry out at these locations to remove cover

REMOVE SHAFT LOCK COVER

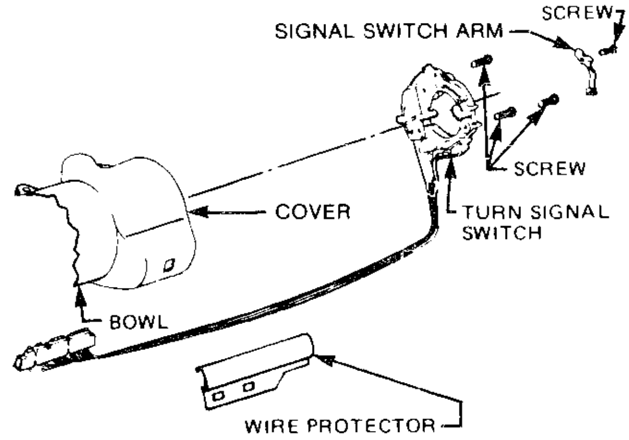


Tighten nut until tool slightly depresses shaft lock

REMOVE AND INSTALL RETAINING RING

2. REMOVE AND INSTALL TURN SIGNAL SWITCH

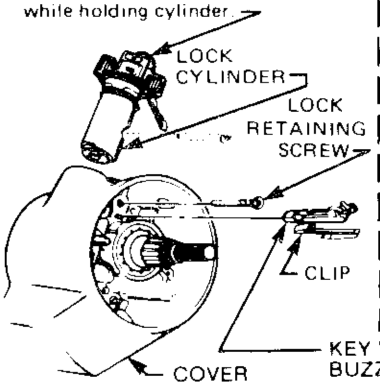
REMOVE	INSTALL
1. Remove parts as shown.	1. Install parts as shown.

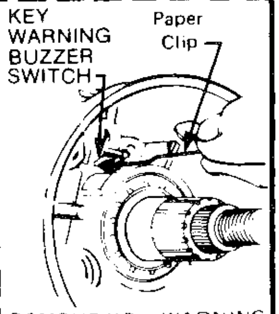


3. REMOVE AND INSTALL IGNITION LOCK AND KEY WARNING BUZZER

REMOVE	INSTALL
1. Turn lock to "RUN" position and remove key warning buzzer.	1. Install lock cylinder.
2. Remove parts as shown.	2. Turn lock to "RUN" position and install key warning buzzer switch.

To assemble, rotate to stop while holding cylinder.

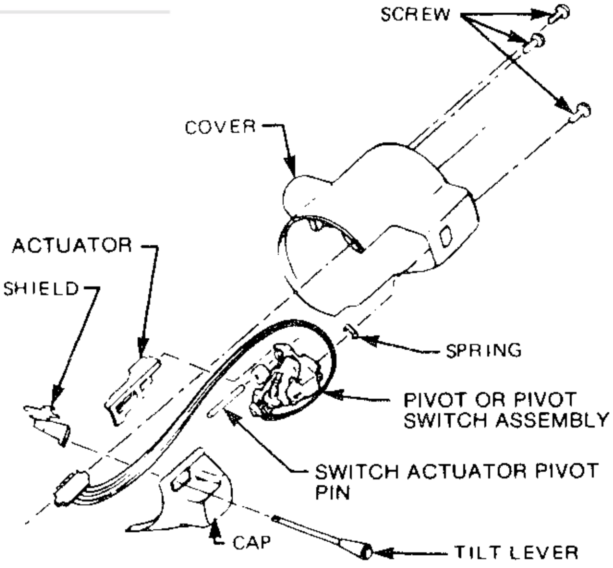


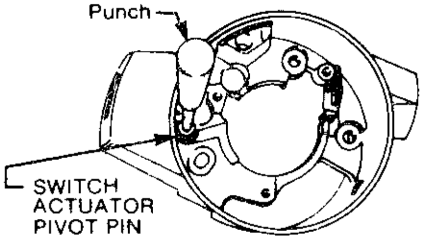


REMOVE KEY WARNING BUZZER SWITCH

4. REMOVE AND INSTALL COVER AND WIPER SWITCH

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





REMOVE AND INSTALL PIVOT AND SWITCH ASSEMBLY

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

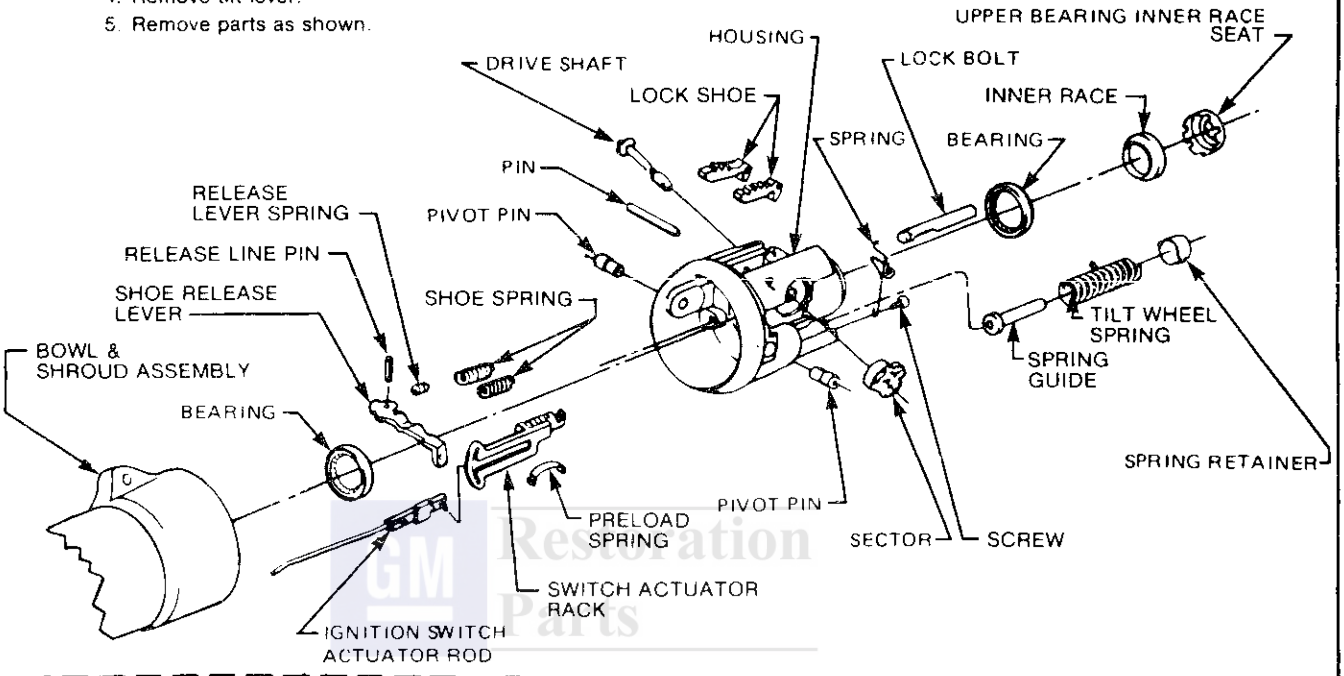
5. REMOVE AND INSTALL HOUSING

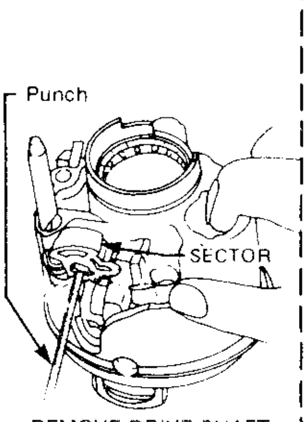
REMOVE

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.

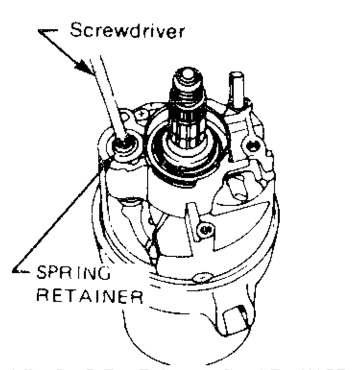
INSTALL

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.

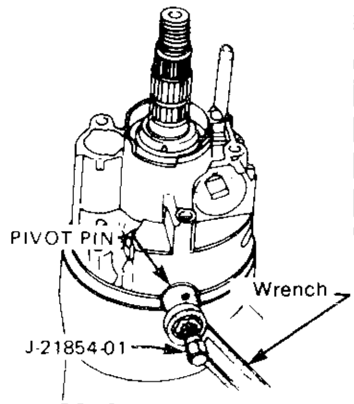




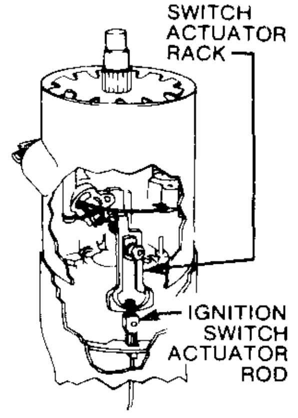
REMOVE DRIVE SHAFT AND SECTOR



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.

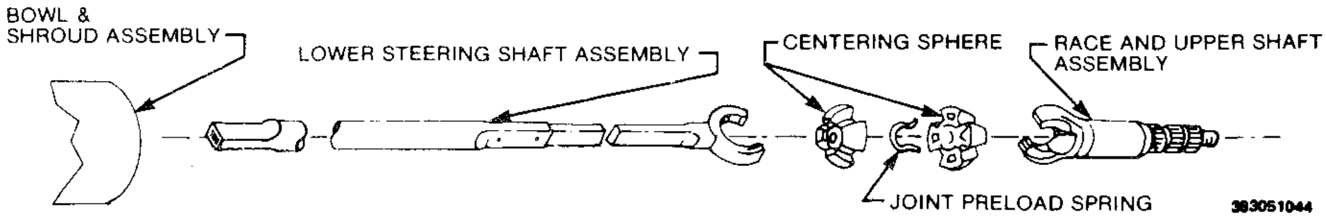


Fig. 16 Adjustable Steering Column Service (2 of 3)

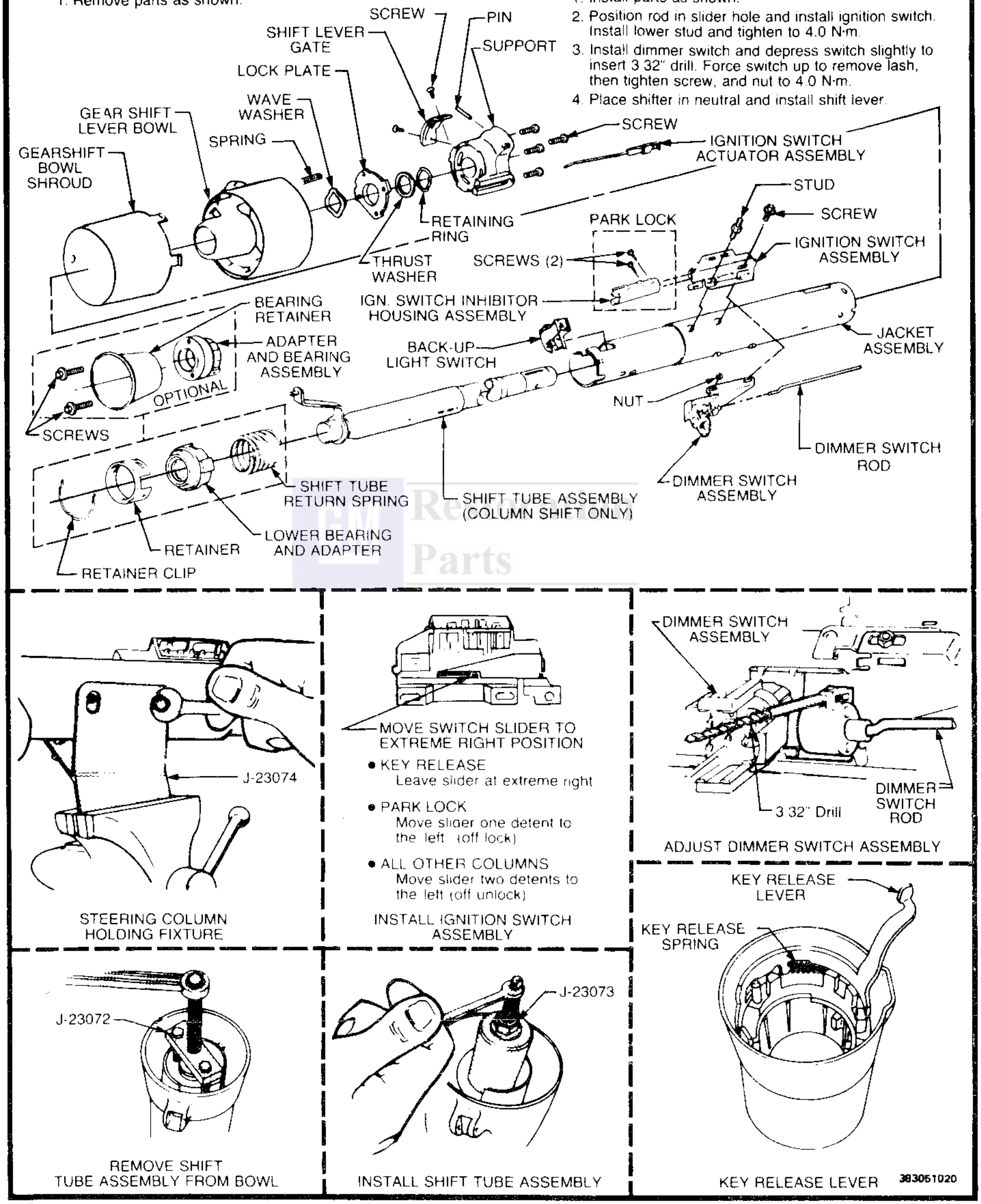
7. REMOVE AND INSTALL SHIFT TUBE, IGNITION AND DIMMER SWITCH ASSEMBLIES

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)

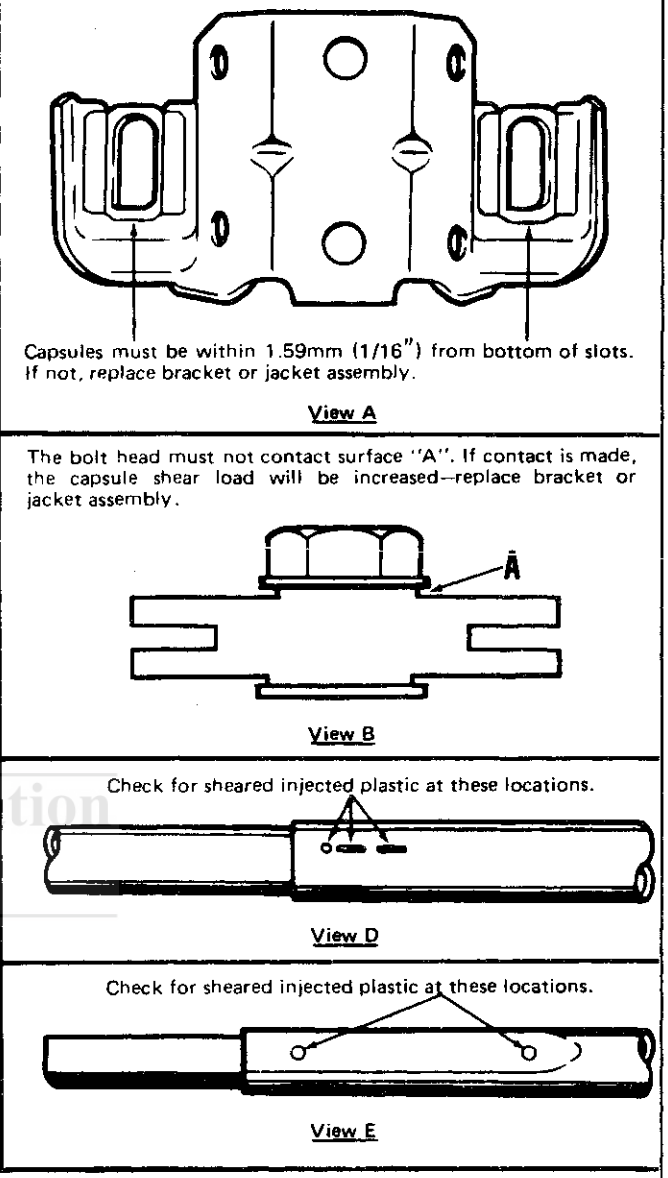
CHECKING STEERING COLUMN FOR ACCIDENT DAMAGE

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.

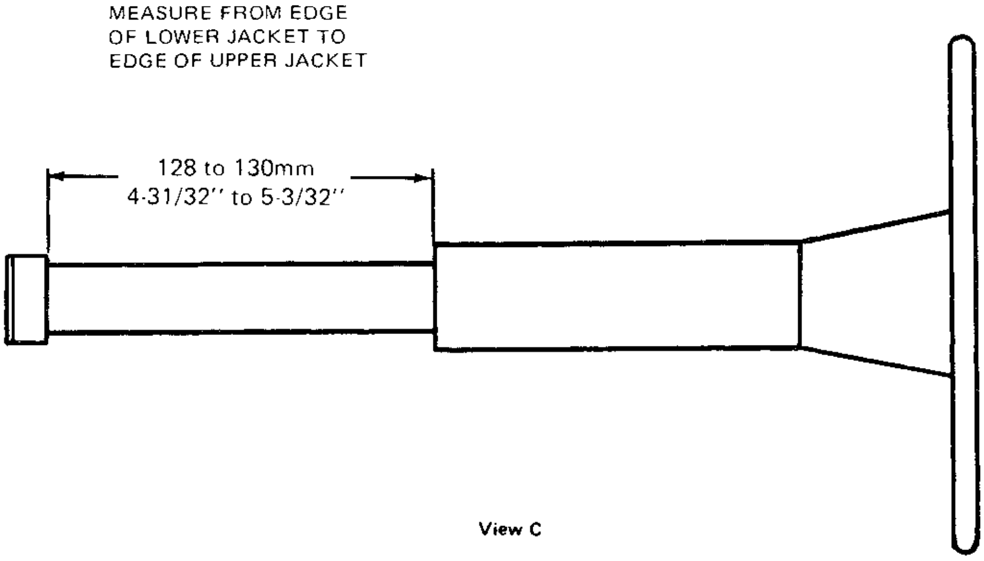
View B

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

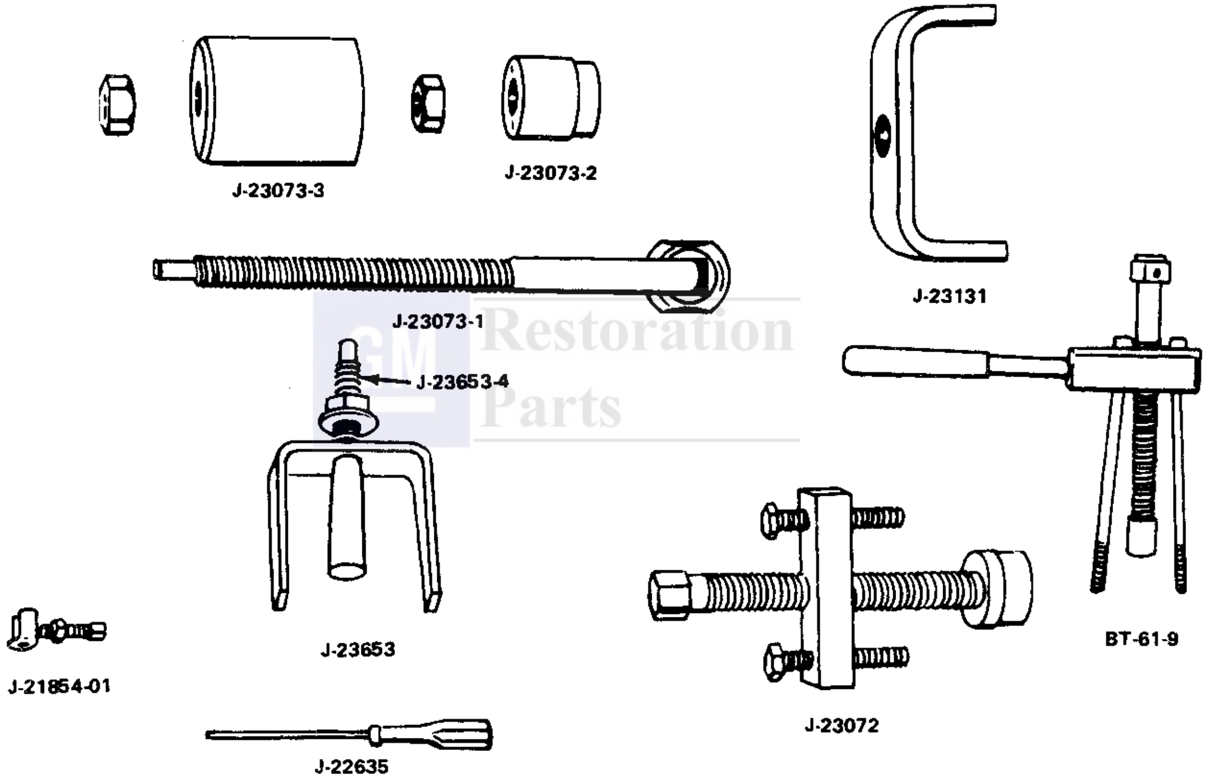
View C

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

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

FRONT SUSPENSION ASSEMBLY

Figure 1

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/hub and bearing assembly at the outer pivot points. Lower ball joints use the "wear indicator" feature.

FRONT WHEEL BEARINGS

NOTICE: Sealed hub and bearing assemblies are used on all series vehicles.

INSPECT

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, see "Sealed Wheel Bearing Diagnosis" in this section.

MAINTENANCE INTERVALS

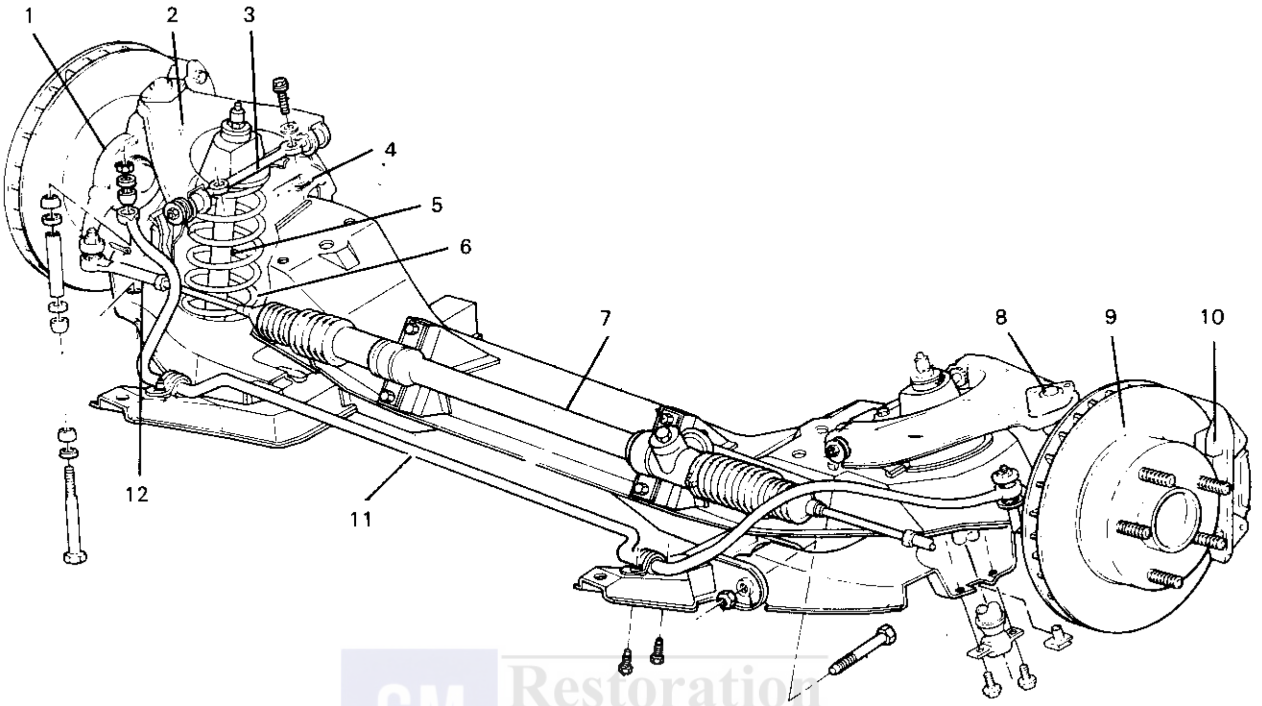
Recommended intervals for maintenance of front suspension items are covered in Section OB of this manual.

ON-CAR SERVICE

HUB AND BEARING ASSEMBLY

Remove or Disconnect

1. Raise vehicle on a hoist.
2. Wheel and tire assembly.
3. Bolt attaching brake line clip to upper control arm.
4. Caliper and suspend with a wire.
5. Rotor.
6. Three bolts attaching hub and bearing assembly to steering knuckle.



1. STEERING KNUCKLE
2. UPPER CONTROL ARM
3. PIVOT ARM
4. PADDLE NUT ASM.
5. SHOCK ABSORBER
6. SPRING
7. RACK AND PINION ASM.
8. UPPER BALL JOINT
9. ROTOR
10. BRAKE CALIPER
11. STABILIZER BAR
12. TIE ROD END

Figure 1 Front Suspension Assembly

Install or Connect

Important

- See **NOTICE** on page 3C-1 of this section regarding the fasteners referred to in this section.

1. Hub and bearing assembly to steering knuckle. Torque bolts to 260 N•m (220 lb. ft.).

Inspect

Whenever the brake rotor has been separated from the wheel bearing, remove any rust or other foreign material from the mating surfaces of the wheel bearing flange and rotor. Failure to do so may result in lateral runout of the rotor, causing brake pedal pulsation.

2. Rotor and caliper, refer to Section 5 for torque specifications.
3. Bolt attaching brake line clip to upper control arm.
4. Wheel and tire assembly.
5. Lower vehicle to the ground.

SHOCK ABSORBERS

Figure 2

Remove or Disconnect

1. Raise vehicle on a hoist.
2. Upper retaining nut, washer, and shock insulator.
3. Two bolts from the lower end of the shock absorber.
4. Shock absorber through lower control arm.

Install or Connect

1. Extend shock and insert through lower control arm with shock insulator and washer in place.
2. Upper shock insulator, washer, and retaining nut. Torque nut to 11 N•m (8 lb. ft.).
3. Bolts to lower control arm. Torque bolts to 27 N•m (20 lb. ft.).
4. Lower vehicle to the ground.

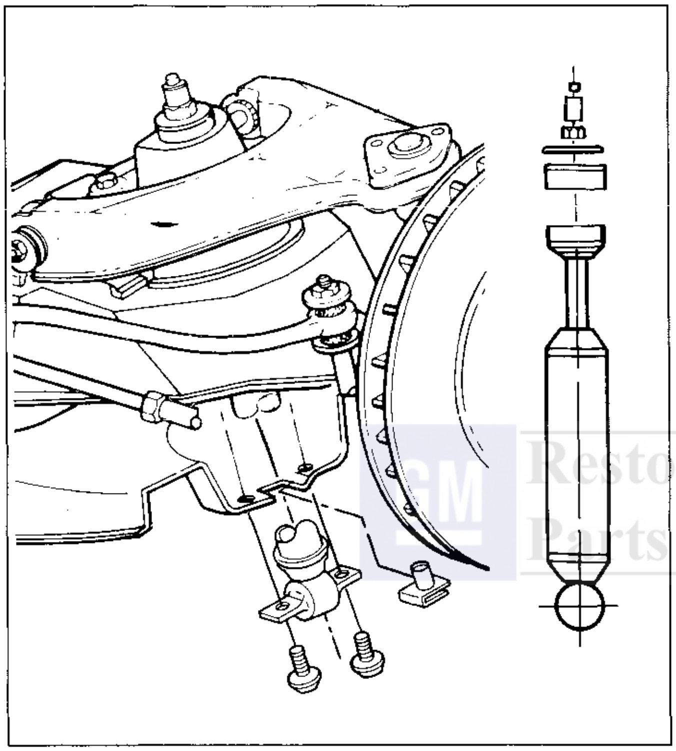


Figure 2 Shock Absorber

WHEEL STUD BOLT

Figure 3

Tool Required
J-6627-A
4 Washers

Remove or Disconnect

1. Raise vehicle on a hoist.
2. Tire and wheel assembly.
3. Bolt attaching brake line clip to upper control arm.
4. Caliper and suspend with a wire.
5. Rotor.
6. Splash shield.
7. Position stud to be removed at 4 o'clock or 8 o'clock.
8. Stud using tool J-6627-A

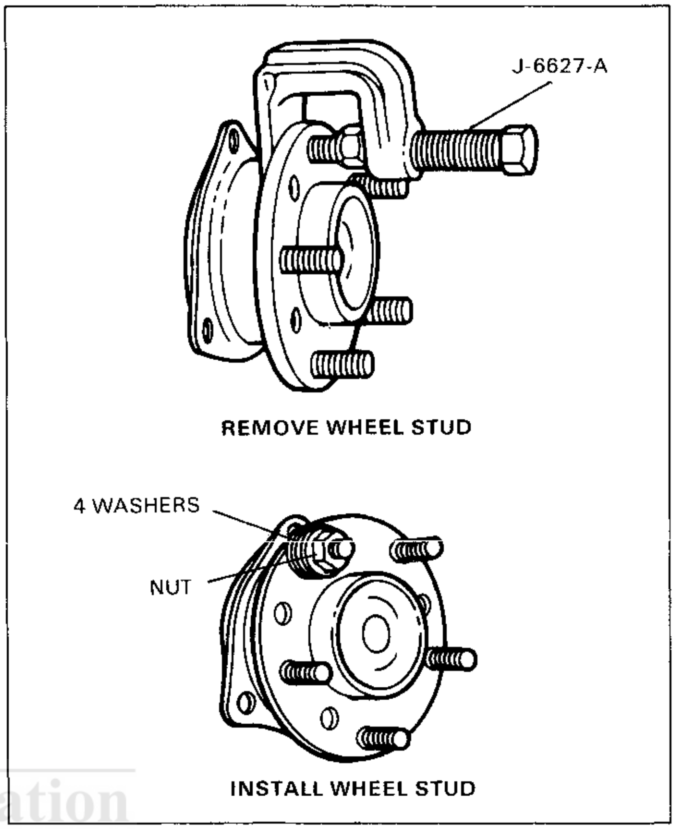


Figure 3 Wheel Stud Remove/Install

Install or Connect

1. Insert stud in wheel hub.
2. Install four washers and a nut on the stud and tighten until stud is fully seated.
3. Rotor and caliper. Refer to Section 5 for torque specifications.
4. Bolt attaching brake line clip to upper control arm.
5. Splash shield.
6. Tire and wheel assembly.
7. Lower vehicle to the ground.

STABILIZER BAR

Figure 4

Remove or Disconnect

NOTICE: Tape or mark the stabilizer bar on the right end prior to removal. This will insure proper orientation of the part during installation.

1. Raise vehicle on a hoist.
2. Both front wheel and tire assemblies.
3. Both tie rods from the steering knuckles.
4. Bolt attaching brake line clip to upper control arm.

5. Left side caliper, rotor, and splash shield.
6. Caliper and suspend with wire.
7. Stabilizer bar to lower control arm links.
8. Two bolts at each stabilizer bar clamp and bushing assemblies.
9. Stabilizer bar from the underside of the vehicle by moving bar to the left side of the vehicle until the right side clears the frame rail.

Install or Connect

1. Stabilizer bar from the underside of the vehicle.

Important

- The slit in the stabilizer bushing must be installed toward the front of the vehicle.

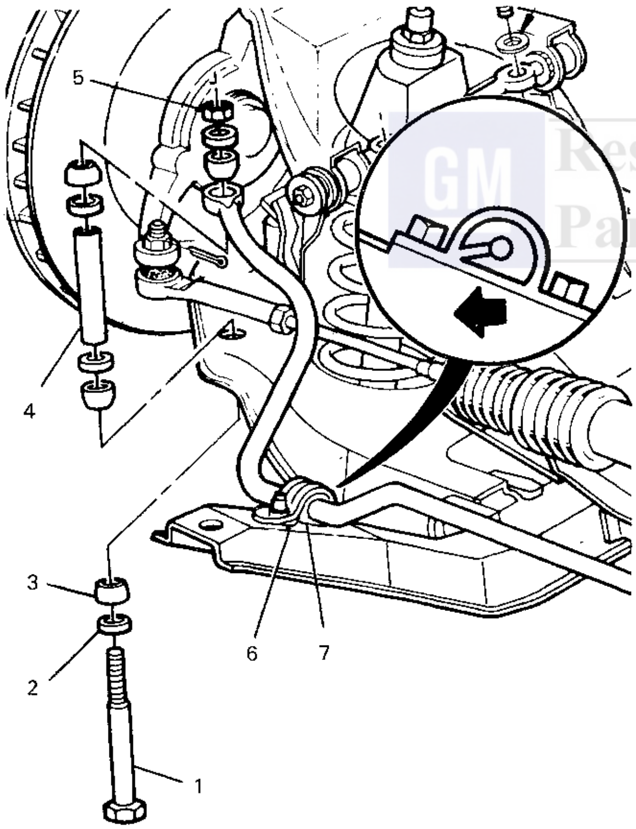


Figure 4 Stabilizer Bar Assembly

2. Clamps and bushings. Hand tighten bolts to hold the stabilizer in place.
3. The link assemblies from stabilizer bar to lower control arms. Torque the bolts to 17 N•m (12 lb. ft.).
4. Torque bushing clamps to 27 N•m (20 lb. ft.).
5. Tie rod ends to steering knuckle.

Tighten

- Torque 20 N•m (15 lb. ft.) + 1/2 turn (180°) Maximum 1/6 turn to align cotter pin.

6. Left side rotor, caliper, and splash shield Refer to section 5 for torque specs.
7. Bolt attaching brake line clip to upper control arm.
8. Wheel and tire assemblies.
9. Lower vehicle to the ground.

STEERING KNUCKLE

Figure 5

Tools Required
J-6627-A
J-26407

Remove or Disconnect

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

CAUTION: This keeps the coil spring compressed. Use care to support adequately, or personal injury could result.

2. Tire and wheel assembly.
3. Brake caliper and rotor. Suspend the caliper with a wire. Do not allow the caliper to hang by the brake hose.
4. Three bolts attaching the splash shield.
5. Three bolts attaching the hub and bearing assembly to the steering knuckle.
6. Tie rod end from steering knuckle using tool J-6627-A.
7. Cotter pins and loosen stud nuts attaching upper and lower ball joints to the steering knuckle.
8. Upper ball joint using tool J-26407 to press ball stud from the steering knuckle.
9. Lower ball joint by reversing tool J-26407 to press ball stud from the steering knuckle.
10. Ball stud nuts and steering knuckle.

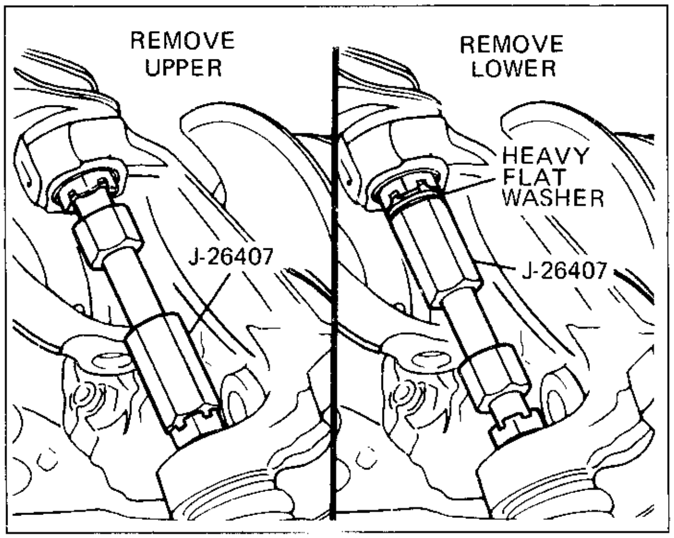


Figure 5 Removal of Ball Joints From Knuckle

Install or Connect

Important

- See **NOTICE** on page 3C-1 of this section regarding the fasteners referred to in the following steps.

Inspect

- The tapered hole in the steering knuckle and remove any dirt. If any out-of-roundness, deformation, or damage is noted, the knuckle MUST be replaced.

1. Place steering knuckle in position and insert the upper and lower ball studs into knuckle bosses.
2. Ball stud nuts and tighten to specifications.

Tighten

- U.C.A. ball joint 40-55 N•m (30-40 lb. ft.). Maximum 1/6 turn to align cotter pin (not to exceed 75 N•m, 55 lb. ft.).
- L.C.A. ball joint 35 N•m (26 lb. ft.) + 1/2 turn (180°), Maximum 1/6 turn to align cotter pin.

3. Three bolts attaching splash shield to steering knuckle.
4. Tie rod end to steering knuckle.

Tighten

- 20 N•m (15 lb. ft.) + 1/2 turn (180°) Maximum 1/6 turn to align cotter pin.

5. Three bolts attaching hub and bearing assembly. Torque to 260 N•m (220 lb. ft.).
6. Rotor and brake caliper, refer to Section 5 for torque specifications.
7. Tire and wheel assembly.
8. Remove jack under lower control arm and lower vehicle to the ground.

UPPER BALL JOINT

Figures 5 and 6

Tools Required
J-26407
Drill & bits
Center punch

Remove or Disconnect

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

CAUTION: This keeps the coil spring compressed. Use care to support adequately, or personal injury could result.

2. Tire and wheel assembly.
3. Bolt attaching brake line clip to upper control arm.
4. Tie rod end from steering knuckle and swing knuckle outboard.
5. Upper ball joint from steering knuckle using tool J-26407.
6. Upper ball joint from control arm by drilling out three attaching rivets as shown in Figure 6.

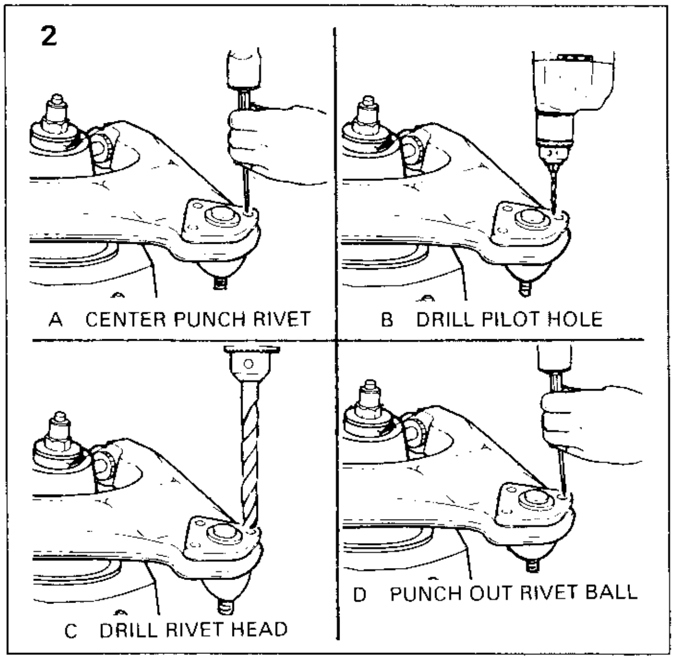


Figure 6 Upper Ball Joint Removal

Install or Connect

1. Upper ball joint to control arm with nuts and bolts. Torque to specifications provided in service repair package.

Inspect

- The tapered hole in the steering knuckle and remove any dirt . If any out-of-roundness, deformation, or damage is noted, the knuckle MUST be replaced.

2. Install upper ball joint to steering knuckle.

Tighten

- Torque 40-55 N•m (30-40 lb. ft.) 1/6 turn to align cotter pin, not to exceed 75 N•m (55 lb. ft.). Install a new cotter pin.

3. Brake line clip to control arm.
4. Tire and wheel assembly.
5. Remove jack under lower control arm and lower vehicle to the ground.

UPPER CONTROL ARM

Figures 5 and 7

Tools Required
J-26407

Remove or Disconnect

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

CAUTION: This keeps the coil spring compressed. Use care to support adequately, or personal injury could result.

2. Tire and wheel assembly.
3. Bolt attaching brake line clip to upper control arm.
4. Tie rod end from steering knuckle and swing knuckle outboard.
5. Upper ball joint from steering knuckle using tool J-26407.
6. Two bolts and paddle nut assembly attaching U.C.A. shaft to crossmember and remove control arm from vehicle.

Install or Connect

1. U.C.A. shaft bolts to crossmember with a new paddle nut assembly. Do not apply final torque until alignment is performed.

Inspect

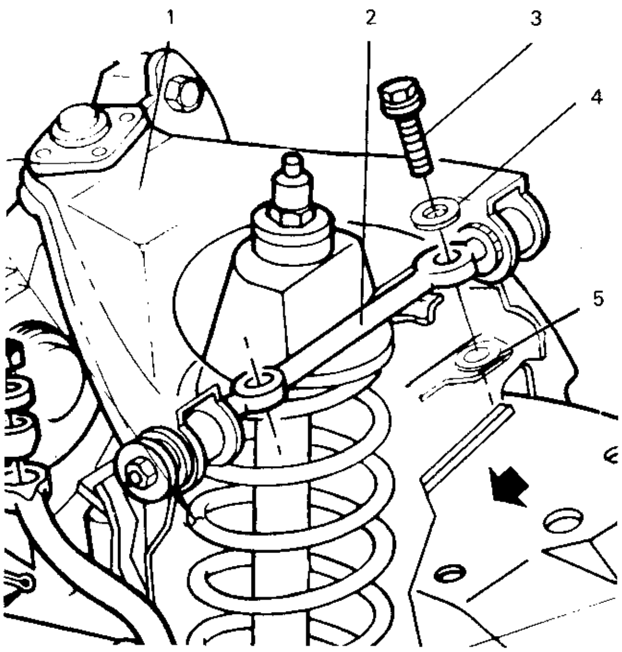
- The tapered hole in the steering knuckle, remove any dirt. If any out-of-roundness, deformation, or damage is noted, the knuckle MUST be replaced.

2. Upper ball joint to steering knuckle.

Tighten

- Torque 40-55 N•m (30-40 lb. ft.) 1/6 turn to align cotter pin, not to exceed 75 N•m (55 lb. ft.). Install a new cotter pin.

3. Bolt attaching brake line clip to upper control arm.
4. Wheel and tire assembly.
5. Remove jack supporting lower control arm and lower vehicle to the ground.
6. Check and set alignment as necessary. See Section 3A for specifications.



1. UPPER CONTROL ARM
2. PIVOT ARM
3. BOLTS (2)
4. HARDENED WASHER
5. PADDLE NUT ASM.

Figure 7 Upper Control Arm

LOWER BALL JOINT

Figure 8

Tools Required
J-26407
J-6627-A
J-9519-10
J-9519-18
J-37161-1
J-37161-2
J-37161-3
J-37161-4

Remove or Disconnect

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

CAUTION: This keeps the coil spring compressed. Use care to support adequately, or personal injury could result.

2. Tire and wheel assembly.
3. Tie rod end from steering knuckle.
4. Lower ball joint from steering knuckle using tool J-26407 and swing knuckle with rotor, caliper, and bearing out of the way.

Inspect

- The tapered hole in the steering knuckle and remove any dirt. If any out-of-roundness, deformation, or damage is noted, the knuckle MUST be replaced.

Assemble

- Clamp J-9519-10 and bolt J-9519-18 with removal adapters J-37161-1 and J-37161-3 on lower control arm as shown in Figure 8.

5. Press ball joint out of lower control arm.

Install or Connect

Assemble

- Clamp J-9519-10 and bolt J-9519-18 with installation adapters J-37161-2 and J-37161-4 on lower control arm as shown in Figure 8.

1. Press ball joint into lower control arm.
2. Position ball stud into steering knuckle boss and install ball stud nut.

Tighten

- Torque 35 N•m (26 lb. ft.) + 1/2 turn (180°). Maximum 1/6 turn to align and install a new cotter pin.

3. Tie rod end to steering knuckle.

Tighten

- Torque 20 N•m (15 lb. ft.) + 1/2 turn (180°). Maximum 1/6 turn to align and install cotter pin.

4. Tire and wheel assembly.
5. Remove jack supporting lower control arm and lower vehicle to the ground.
6. Check and align as necessary. See Section 3A for specifications.

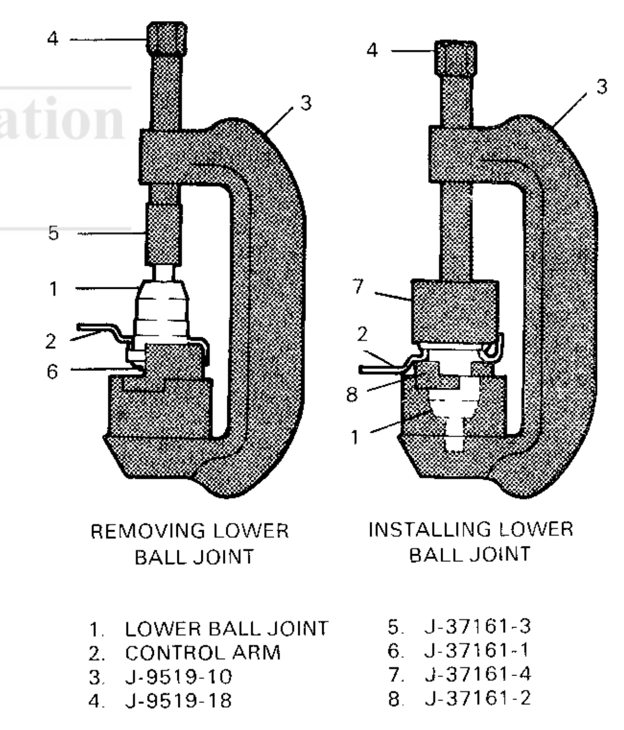


Figure 8 Lower Ball Joint Remove/Install

FRONT SPRING

Figure 9

Remove or Disconnect

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

CAUTION: This keeps the coil spring compressed. Use care to support adequately, or personal injury could result.

2. Wheel and tire assembly.
3. Shock absorber.
4. Stabilizer bar from lower control arm.

CAUTION: The coil spring is under load, if released too quickly personal injury could result.

5. Install a chain through the spring as a safety precaution.
6. Lower control arm pivot bolts.

CAUTION: Any handling of springs must not cause any damage to the corrosion protection coating on the springs. Hard steel contact MUST be avoided. Springs with a damaged corrosion protection coating should not be used until repaired.

7. Slowly lower the jack and remove the safety chain when the spring is no longer under load. Remove spring and spring insulator.

Install or Connect

1. Position the spring and spring insulator into the upper spring seat. Align bottom of spring with the lower control arm seat and install.
2. A safety chain through the spring as a safety precaution.
3. Use a jack to slowly raise the lower control arm and compress the spring.
4. Align the control arm bushings to the crossmember and install pivot bolts. Tighten slightly, but do not apply final torque.
5. Remove the safety chain.
6. Shock absorber.
7. Stabilizer bar. Torque bolt to 17 N•m (12 lb. ft.).
8. Remove jack supporting lower control arm and lower vehicle to the ground. With suspension system at its normal standing height, torque lower control arm pivot bolts.

Tighten

- Torque to 50 N•m (37 lb. ft.) + 3/4 turn (270°).

LOWER CONTROL ARM

Figure 9

Tools Required
J-26407

Remove or Disconnect

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

CAUTION: This keeps the coil spring compressed. Use care to support adequately, or personal injury could result.

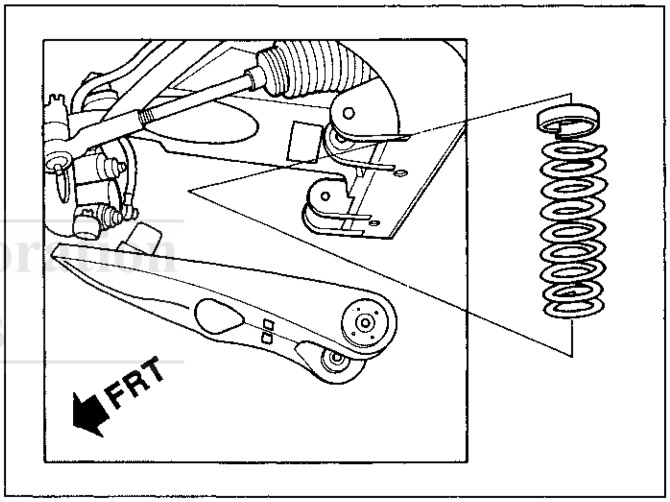


Figure 9 Front Spring

2. Tire and wheel assembly.
3. Front spring using procedures described in front spring removal.
4. Remove cotter pin from lower ball joint stud and loosen ball stud nut one full turn.
5. Using ball joint remover Tool J-26407, loosen lower ball joint from the steering knuckle.
6. Lower ball stud nut and lower control arm.

Inspect

- The tapered hole in the steering knuckle and remove any dirt. If any out-of-roundness, deformation, or damage is noted, the knuckle MUST be replaced.

Install or Connect

1. Place lower control arm with ball joint in position and insert lower ball stud into knuckle boss. Install ball stud nut.

Tighten

- Torque 35 N•m (26 lb. ft.) + 1/2 turn (180°). Maximum 1/6 turn to align and install new cotter pin.

2. Spring and spring insulator following spring installation procedures.
3. Tire and wheel assembly.
4. Remove jack supporting lower control arm and lower vehicle to ground.
5. Check and align as necessary. See Section 3A for alignment specifications.

LOWER CONTROL ARM BUSHINGS

Figure 10

Tools Required
- J-21474-5
- J-21474-18
- J-21474-19
- J-21474-23
- J-37162-1
- J-37162-2

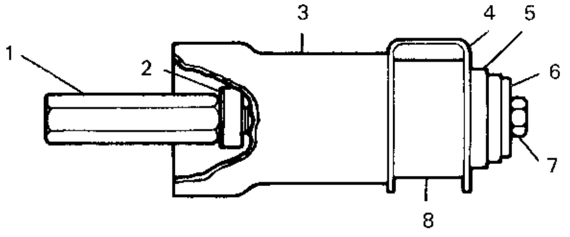
Remove or Disconnect

1. Lower control arm. See front spring and L.C.A. removal procedures in this section.

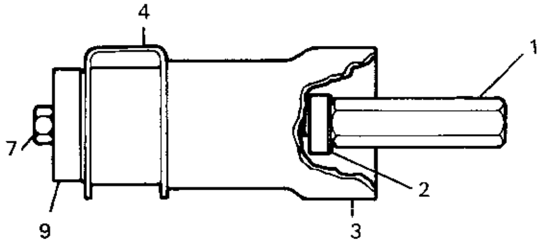
Assemble

- Bushing tool on lower control arm bushing as follows:
  a. Bolt J-21474-19 and bushing driver J-21474-23 through lower control arm. Bushing and bushing receiver J-21474-5 with small end toward L.C.A.
  b. Install bearing and J-21474-18 on bolt.
  c. Place spacer J-37162-2 over L.C.A. bushing.

2. Tighten the bolt until bushing is driven out of lower control arm.
3. Remove bushing tool assembly.



REMOVE LOWER CONTROL ARM BUSHING



INSTALL LOWER CONTROL ARM BUSHING

1. J-21474
2. BEARING
3. J-21474-5
4. LOWER CONTROL ARM
5. L.C.A. BUSHING
6. J-21474-23
7. J-21474-19
8. J-37162-2
9. J-37162-1

Figure 10 Lower Control Arm Bushing Remove/Install

Install or Connect

1. Bushing and bushing driver tool in lower control arm as described below.

Assemble

- Bushing tool and new bushing as follows:
  a. Bolt J-21474-19 with J-37162-1 and new L.C.A. bushing through lower control arm.
  b. Bushing receiver J-21474-5 and J-21474-18 with bearing on bolt.
  c. Install spacer in lower control arm.

2. Tighten bolt until bushing is fully seated.
3. Remove bushing driver tool.
4. Replace lower control arm. See front spring and L.C.A. installation procedures in this section.

SPECIFICATIONS

TORQUE SPECIFICATIONS

Bolt:	
U.C.A. Shaft To Crossmember	70 N•m (52 lb. ft.) + 1/4 turn (90°)
Nut:	
L.C.A. To Crossmember	50 N•m (37 lb. ft.) + 3/4 turn (270°)
Nut:	
U.C.A. Ball Joint To Knuckle	40-55 N•m (30-40 lb. ft.)
Note: (1/6 turn to align cotter pin) not to exceed 75 N•m (55 lb. ft.)	
Nut:	
L.C.A. Ball Joint To Knuckle	35 N•m (26 lb. ft.) + 1/2 turn (180°)
Note: Maximum 1/6 turn to align cotter pin	
Bolt:	
Steering Gear To Crossmember	27 N•m (20 lb. ft.)
Nut:	
Tie Rod At Knuckle	20 N•m (15 lb. ft.) + 1/2 turn (180°)
Note: Maximum 1/6 turn to align cotter pin	
Bolt:	
Hub and Bearing To Knuckle	260 N•m (220 lb. ft.)
Nut:	
Upper Shock	11 N•m (8 lb. ft.)
Bolt:	
Shock to L.C.A.	27 N•m (20 lb. ft.)
Bolt:	
Stabilizer Bar Bushing Clamp	27 N•m (20 lb. ft.)
Nut:	
Stabilizer Bar Link	17 N•m (12 lb. ft.)

SPECIAL TOOLS

J-6627-A	– Wheel Stud and Tie Rod End Remover
J-26407	– Ball Joint Remover
J-21474-5 J-21474-18 J-21474-19 J-21474-23 J-37162-1 J-37162-2	– Control Arm Bushing Remove/Install Assembly
J-9519-10 J-9519-18 J-37161-1 J-37161-2 J-37161-3 J-37161-4	– Lower Ball Joint Remove/Install Assembly

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 MacPherson 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.

ON-VEHICLE SERVICE

REMOVE AND INSTALL REAR STRUT DAMPER ASSEMBLY

Remove or Disconnect (Figure 1,4,5)

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 suspension links.
6. Wheel and tire.
7. Brake line clip.

Important

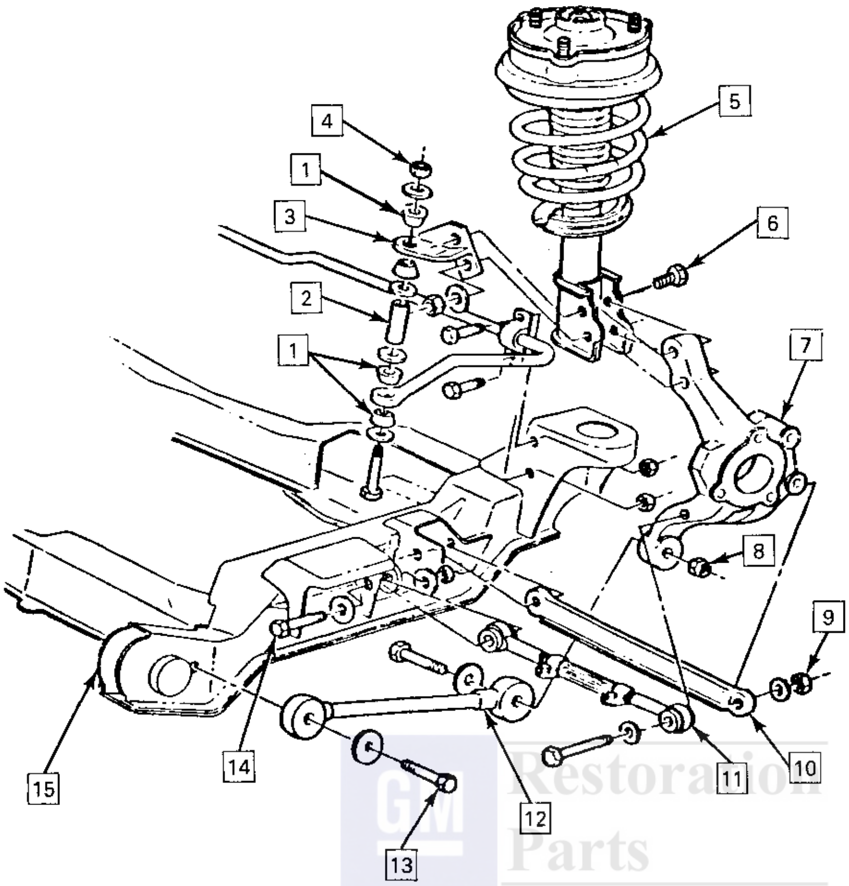
Scribe strut and knuckle as shown in Figure 1.

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.



1. INSULATOR
2. SPACER
3. BRACKET
4. 17 N·m (13 LBS. FT.)
5. STRUT ASSEMBLY
6. INSTALL IN DIRECTION SHOWN
7. KNUCKLE
8. 60 N·m (44 LBS. FT.) + 90°
9. 50 N·m (37 LBS. FT.) + 90°
10. LATERAL CONTROL ARM
11. FIXED ADJUSTING LINK
12. TRAILING ARM
13. 51 N·m (37 LBS. FT.)
14. 55 N·m (41 LBS. FT.)
15. FRAME

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.

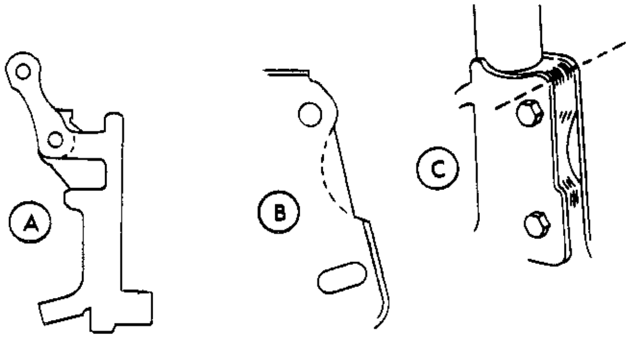


Figure 1 Rear Suspension

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.).

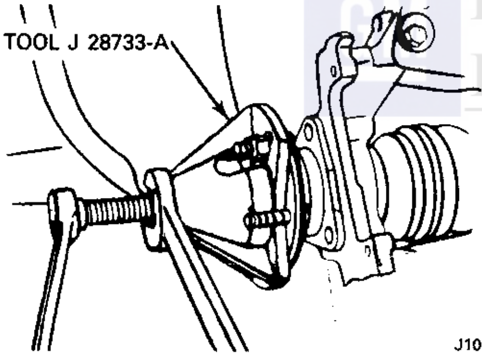
Install or Connect

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.



REMOVING HUB-AND-BEARING ASM

Figure 2 Removing Hub & Bearing

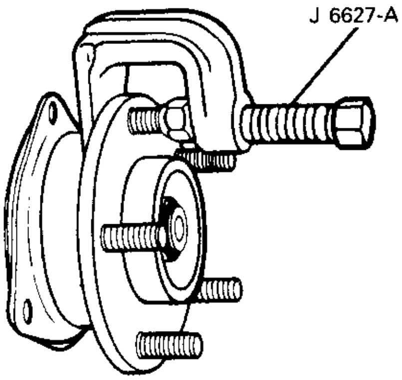
WHEEL STUDS

Remove or Disconnect (Figure 3)

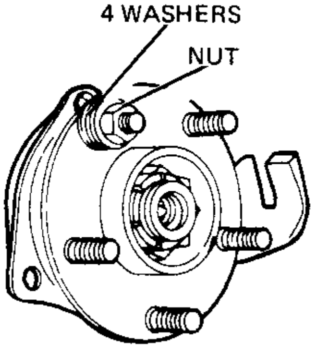
Tools Required:

- J 6627-A wheel stud remover
- J 28733-A 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-A and remove hub and bearing assembly.



REMOVE WHEEL STUD



INSTALL WHEEL STUD

Figure 3 Removing & Installing Wheel Stud

8. Install Tool J 6627-A 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.

WHEEL CALIPER REMOVAL AND INSTALLATION

Remove or Disconnect

1. Hoist vehicle
2. Tire and wheel.
3. Allen head mounting bolts.
4. Caliper from rotor.
5. Suspend caliper from frame with wire hook.
6. Rotor.

Install or Connect

1. See notice on page 1 of this section.
2. Rotor.
3. Caliper.
4. Allen head mounting bolts.
5. Tire and wheel.
6. Lower vehicle.

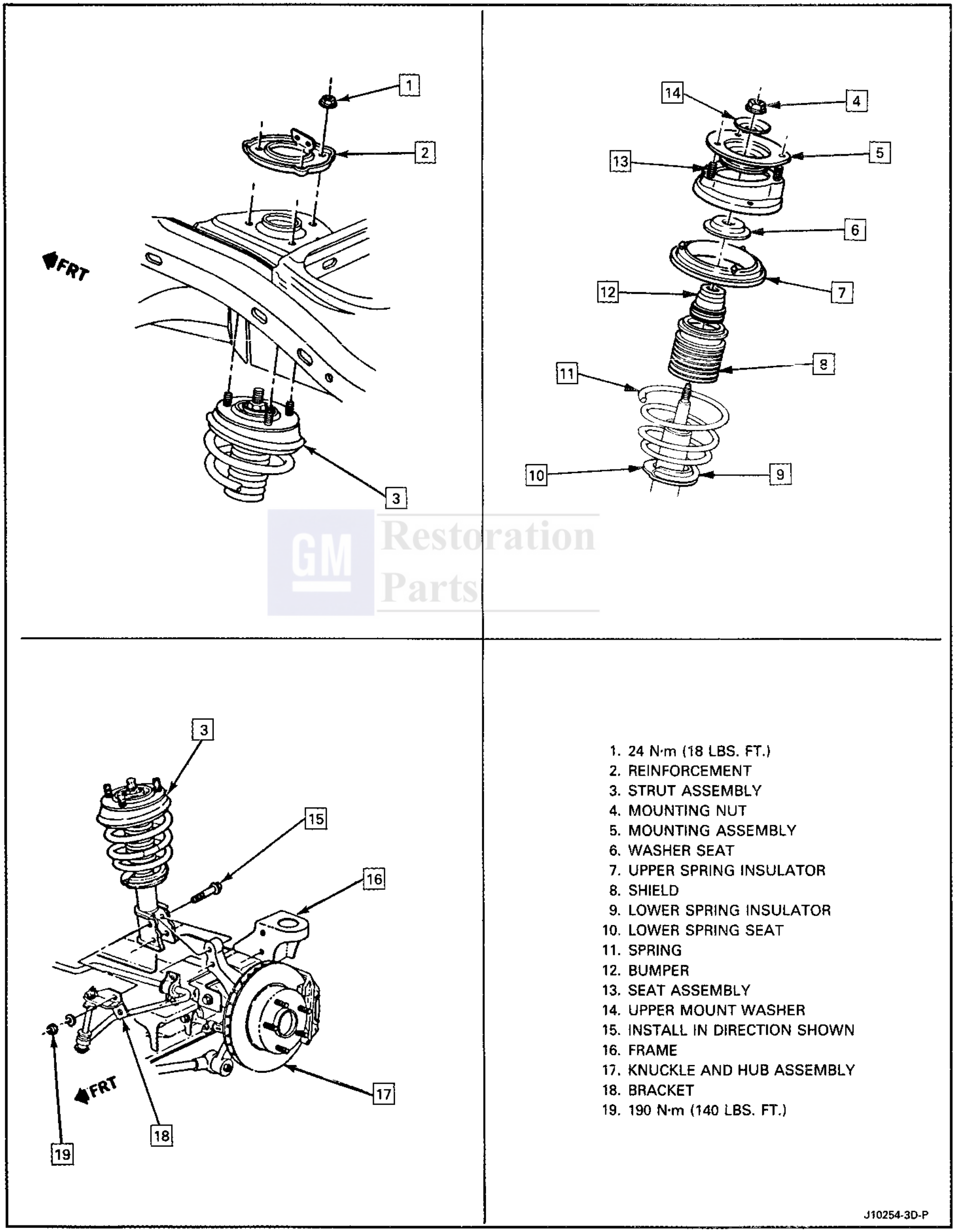
REAR KNUCKLE

Remove or Disconnect

1. Raise vehicle.
2. Support front of vehicle with suitable jack stands.
3. Install drive axle boot protector.
4. Wheel and tire.
5. Hub nut (discard).
6. Caliper and rotor.
7. Trailing arm at knuckle.
8. Fixed adjusting link/lateral control arm through bolt.
9. Strut mounting bolts.
10. Hub/knuckle assembly from drive axle.

Install or Connect

1. Hub/knuckle assembly to drive axle.
2. Loosely install strut mounting bolts with bolt head to rear.
3. Fixed adjusting link/lateral control arm through bolt.
4. Trailing arm at knuckle with bolt head inboard.
5. Strut mounting bolts at knuckle.
6. Rotor and caliper
7. PARTIALLY torque **New** hub nut and washer to 100 N•m (74 lbs. ft.).
8. Remove drive axle seal boot protector.
9. Tire and wheel.
10. Remove jack stands.
11. Lower vehicle
12. Apply FINAL torque to hub nut and washer to 270 N•m (200 lbs. ft.).
13. Set camber and toe as necessary.



1. 24 N·m (18 LBS. FT.)
2. REINFORCEMENT
3. STRUT ASSEMBLY
4. MOUNTING NUT
5. MOUNTING ASSEMBLY
6. WASHER SEAT
7. UPPER SPRING INSULATOR
8. SHIELD
9. LOWER SPRING INSULATOR
10. LOWER SPRING SEAT
11. SPRING
12. BUMPER
13. SEAT ASSEMBLY
14. UPPER MOUNT WASHER
15. INSTALL IN DIRECTION SHOWN
16. FRAME
17. KNUCKLE AND HUB ASSEMBLY
18. BRACKET
19. 190 N·m (140 LBS. FT.)

Figure 4 Remove And Install Strut Damper

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

STRUT DISASSEMBLY PROCEDURE

NOTICE: Special tool J 34013-A 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 34013-A in holding fixture J 3289-20
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 26584-450 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 26584-450 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.

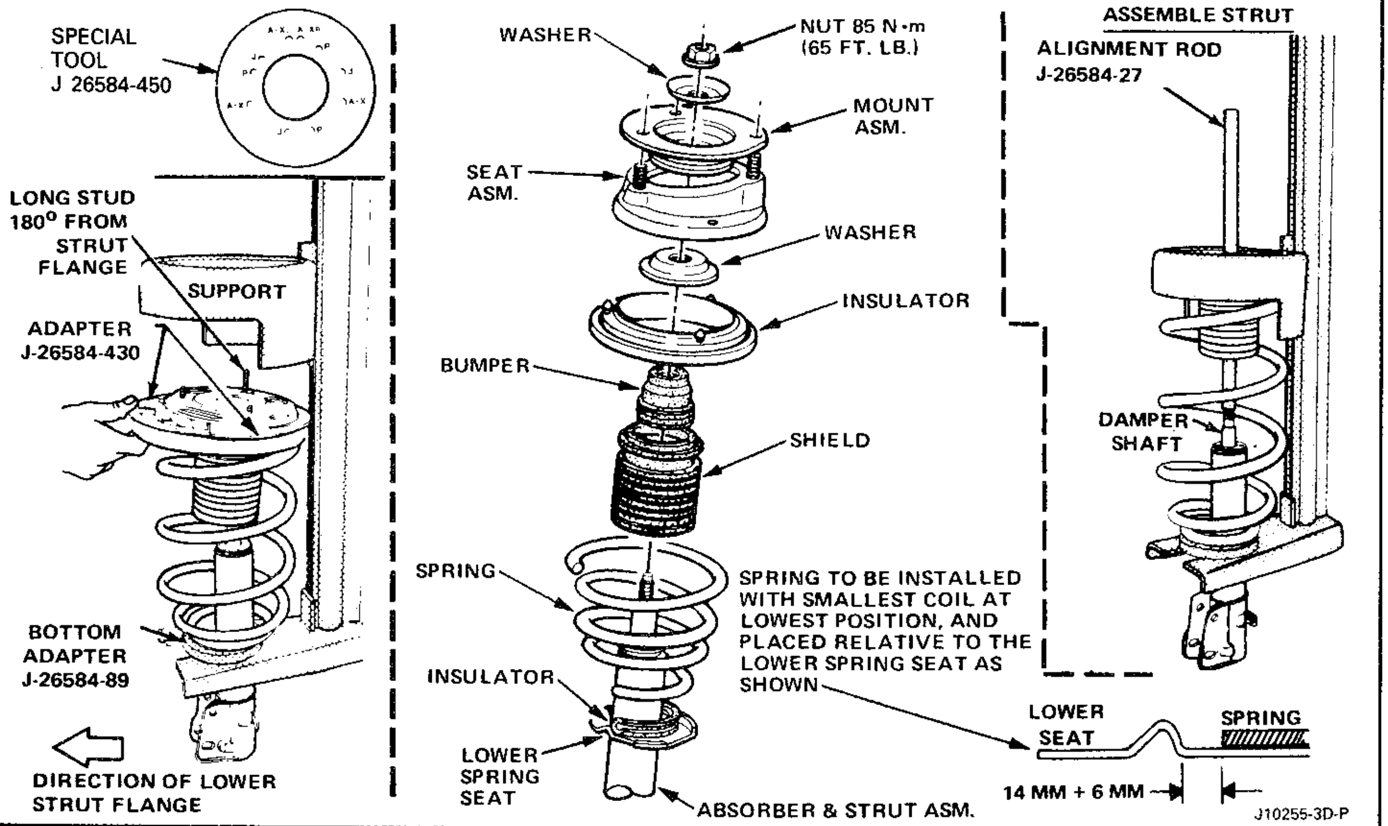


Figure 5 Disassemble/Reassemble Strut Assembly

REMOVE AND INSTALL REAR WHEEL BEARING.

REMOVE

Steel Wheel

1. Remove hub cap.
2. Loosen hub 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.

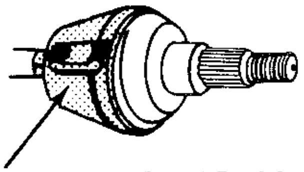
   If bearing assembly is being reused, mark attaching bolt and corresponding holes for installation.
8. Install J 28733-A and remove hub-and-bearing assembly.

   If excessive corrosion is present make sure hub-and-bearing is loose in knuckle before using tool J 28733-A.
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.



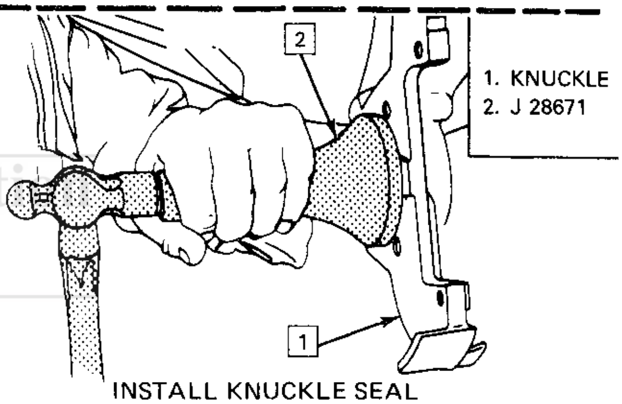
USE J-33162 FOR TRI-POT JOINT

INSTALL DRIVE AXLE BOOT PROTECTOR

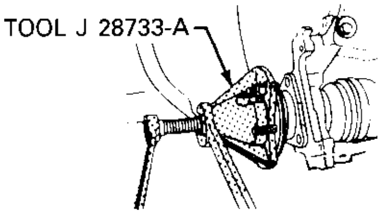
INSTALL

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.).



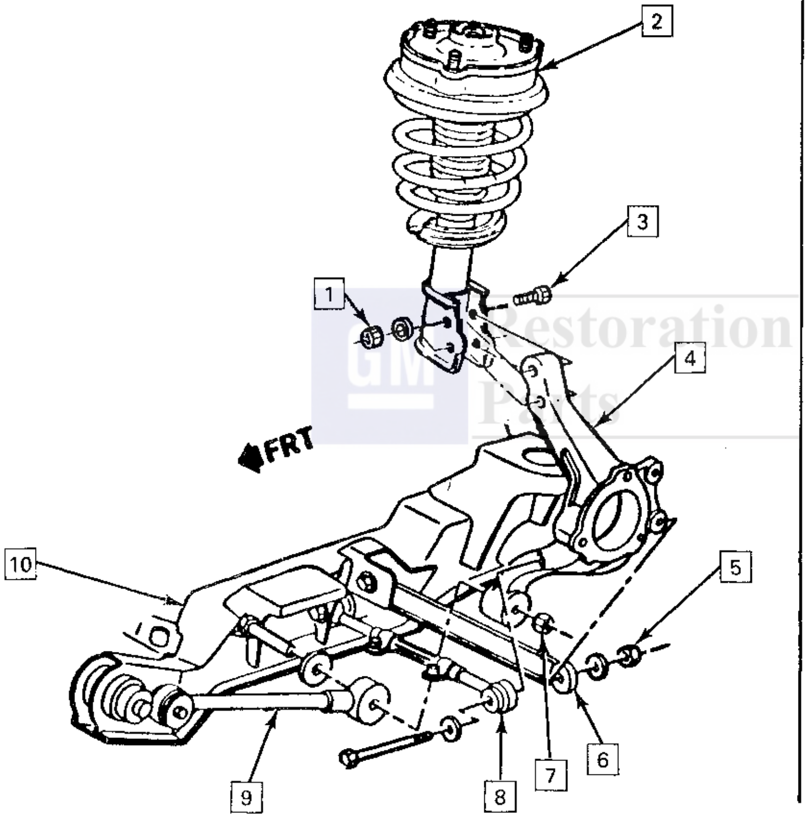
INSTALL KNUCKLE SEAL



REMOVING HUB-AND-BEARING ASM

J10256-3D-P

Figure 6 Remove/Install Rear Wheel Bearing



1. 190 N·m (140 LBS. FT.)
2. STRUT ASSEMBLY
3. INSTALL IN DIRECTION SHOWN
4. KNUCKLE
5. 50 N·m (37 LBS. FT.) + 90°
6. LATERAL CONTROL ARM
7. 60 N·m (44 LBS. FT.)
8. FIXED ADJUSTING LINK
9. TRAILING ARM
10. FRAME

J10257-3D-P

Figure 7 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, wheel alignment and driving techniques have an important influence on tire life. Heavy cornering, excessive rapid acceleration, and heavy braking will increase tire wear.

REPLACEMENT TIRES

Fig. 1

A Tire Performance Criteria (TPC) specification number is molded in the sidewall near the tire size of all original equipment tires. This specification number assures that the tire meets GM's performance standards for traction, endurance, dimensions, noise, handling, rolling resistance, and others. Usually, a specific TPC number is assigned to each tire size.

When replacing tires, only the size, load range, and construction as originally on the car are recommended. This can best be accomplished by replacing with tires of the same TPC specification number. Use of any other tire size or construction type may seriously affect ride, handling, speedometer/odometer calibration, car ground clearance and tire clearance to the body and chassis. This does not apply to the spare furnished with the car.

It is recommended that new tires be installed in pairs on the same axle. If it is necessary to replace only one tire, it should be paired with the tire having the most tread, to equalize braking traction.

Although they may appear different in tread design, tires built by different manufacturers with identical TPC specification numbers, can be intermixed on the same car.

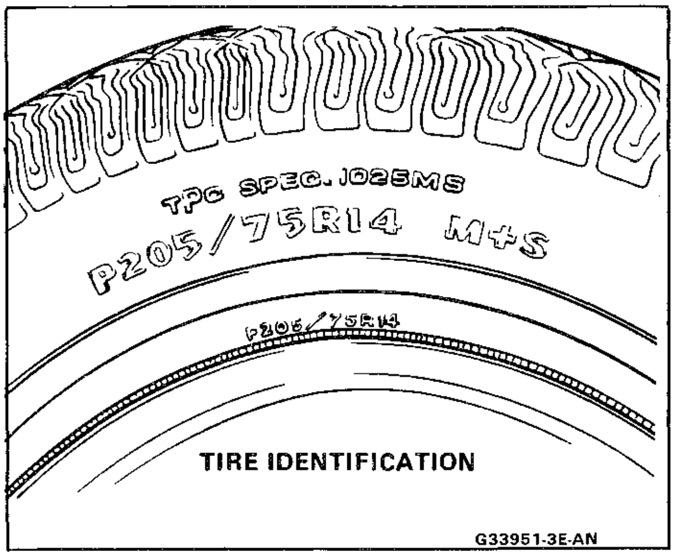


Fig. 1 Tire Identification

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.

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.

TIRE PLACARD

Fig. 4

The tire placard is permanently located on the rear face of the driver's door, and should be referred to for tire information. The placard lists the maximum car load, tire size (including spare), and cold inflation pressure (including spare).

WHEELS

Wheels must be replaced if they are bent, dented, have excessive lateral or radial runout, leak air through welds, have elongated bolt holes, if wheel nuts won't stay tight, or if they are heavily rusted. Wheels with excessive runout may cause objectional vibrations.

Replacement wheels must be equivalent to the original equipment wheels in load capacity, diameter, rim width, offset, and mounting configuration. A wheel of improper size or type may affect wheel and bearing life, brake cooling, speedometer/odometer calibration, car ground clearance, and tire clearance to the body and chassis.

Steel wheels can be identified by a two or three-letter code stamped into the rim near the valve stem. Aluminum wheels have the code, part number, and manufacturer ID cast into their back side.

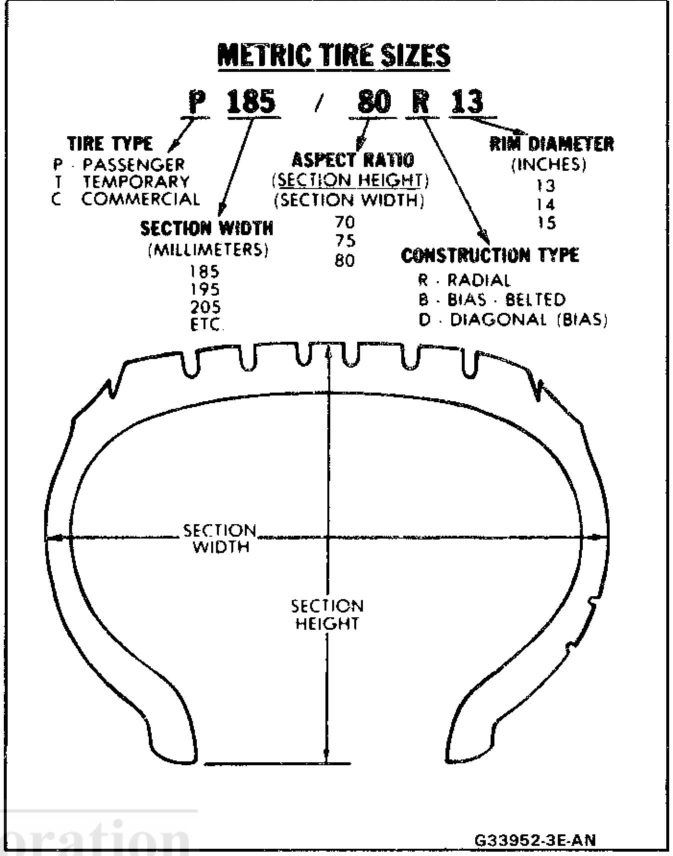


Fig. 2 Metric Tire Size Format

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

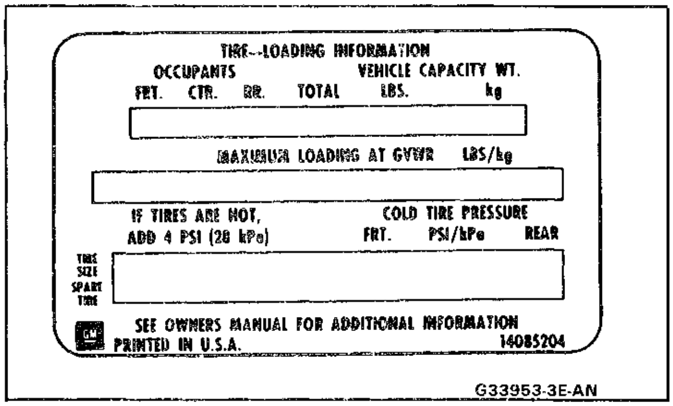
G33987-3E-AN

Fig. 3 Inflation Pressure Conversion

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.



TIRE--LOADING INFORMATION

OCCUPANTS VEHICLE CAPACITY WT.

FRT. CTR. RR. TOTAL LBS. kg

MAXIMUM LOADING AT GVWR LBS/kg

IF TIRES ARE HOT, ADD 4 PSI (28 kPa)

COLD TIRE PRESSURE FRT. PSI/kPa REAR

TIRE SIZE SPARE TIRE

SEE OWNERS MANUAL FOR ADDITIONAL INFORMATION

PRINTED IN U.S.A. 14085204

Fig. 4 Tire Placard

METRIC WHEEL NUTS AND STUDS

Some models use metric wheel nuts and wheel studs. The nut will have the word "metric" stamped on its face and the stud will have the letter "M" stamped into the threaded end. The word "metric" is stamped on its head.

The thread size of the metric wheel nuts and wheel studs are "M12 x 1.5". These stand for:

M = Metric
12 = Diameter in millimeters
1.5 = Millimeters per thread

If a broken stud is found, see Section 3C (Front Suspension) or Section 3D (Rear Suspension) for replacement procedure.

INFLATION OF TIRES

The pressure recommended for any model is carefully calculated to give a satisfactory ride, handling, tread life and load carrying capacity.

Tire pressure, with tires cold, (after car has set for three hours or more, or driven less than one mile) should be checked monthly or before any extended trip and set to the specifications on the tire placard located on rear face of driver's door. Tire inflation pressure is also given in Section 0B.

Valve caps or extensions should be on the valves to keep dust and water out.

1. **For sustained driving at speeds up to 85 mph (140 km/h),** in countries where such speeds are allowed by law, your tires should be set at the pressures recommended on your tire placard. **Sustained driving at speeds faster than 85 mph (140 km/h), where permitted by law, is not advised** unless your car has special high speed tires available from many tire dealers.
2. Tire pressures may increase as much as 6 psi when hot.
3. Higher than recommended pressure can cause:
   - Hard ride
   - Tire bruising or carcass damage
   - Rapid tread wear at center of tire
4. Lower than recommended pressure can cause:
   - Tire squeal on turns
   - Hard steering
   - Rapid and uneven wear on the edges of the tread
   - Tire rim bruises and rupture
   - Tire cord breakage
   - High tire temperatures
   - Reduced handling
   - High fuel consumption
5. Unequal pressure on same axle can cause:
   - Uneven braking
   - Steering lead
   - Reduced handling
   - Swerve on acceleration

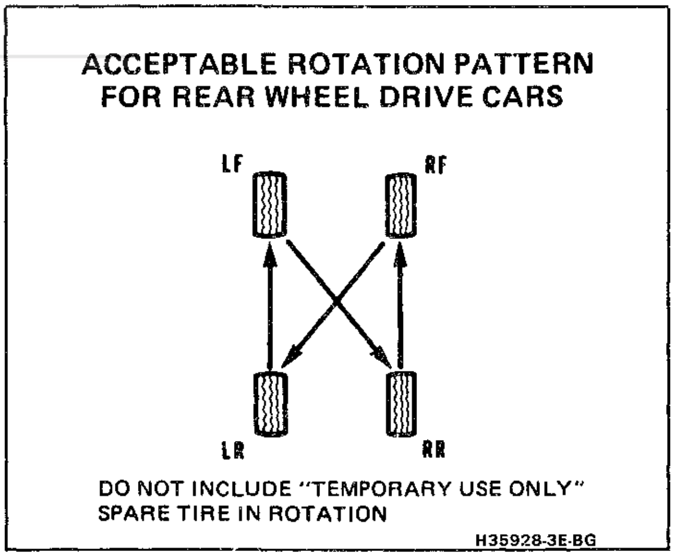
TIRE ROTATION

Figs. 5 and 6

To equalize wear, rotate tire and wheel assemblies at intervals specified in Section 0B. In addition to scheduled rotation, the tire and wheel assemblies should also be rotated whenever uneven tire wear is noticed.

Due to their design, radial tires tend to wear faster in the shoulder area particularly in front positions. Radial tires in non-drive locations may develop an irregular wear pattern that can increase tire noise if not rotated. This makes regular rotation especially necessary.

After rotation, be sure to check wheel nuts for specified torque.



ACCEPTABLE ROTATION PATTERN 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. 7

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

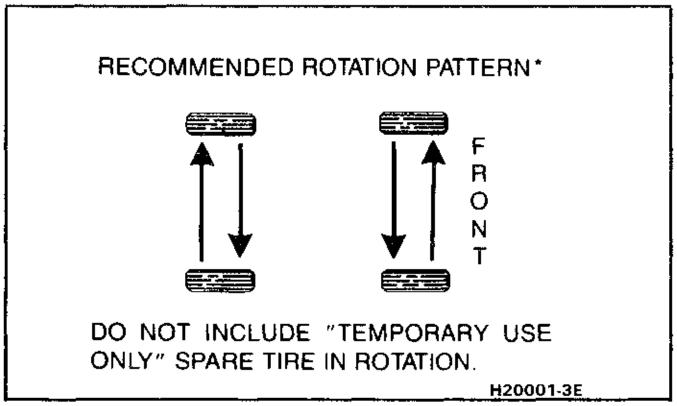


Fig. 6 Tire Rotation - GT Only

installed. Therefore, be sure to purchase the correct chains for the tires on which they are to be used. Rubber adjusters should not be used to take up slack or clearance in chains which are loose due to incorrect size. Always follow the chain manufacturers installation instructions.

Use of chains may adversely affect car handling. When using chains:

- Adjust speed to road conditions
- Avoid sharp turns
- Avoid locked-wheel braking

In general, to help prevent chain damage to your car:

- Install the chains on the drive tires as tightly as possible, then tighten them again after driving 1/4 to 1/2 mile (0.4 to 0.8 kilometer). The use of chains on the non-drive tires is not recommended; the chains may contact and possibly damage the car. If you intend to use chains on the non-drive tires, be sure there is enough clearance.
- Do not exceed 45 mph (70 km/h), or the chain manufacturer's speed limit, if lower.
- Drive in a restrained manner and avoid large bumps, potholes, severe turns and other maneuvers which could cause the tires to bounce up and down.
- Follow any other instructions of the chain manufacturer which do not disagree with the above.

Additional specific information is published in the Owner's Manual.

SERVICE OPERATIONS

WHEEL REMOVAL

Fig. 8

Sometimes wheels can be difficult to remove from the car due to foreign material or a tight fit between the wheel center hole and the hub or rotor. These wheels can be removed without damage as follows:

1. Tighten all wheel nuts on the affected wheel, then loosen each wheel nut two turns.
2. Lower car onto floor.
3. Rock the car from side to side as hard as possible using one or more person's body weight to loosen the wheel, and/or rock the car from "Drive" to "Reverse" allowing car to move several feet in each direction. Apply quick, hard jabs on the brake pedal to loosen the wheel.
4. Raise the car. Remove the wheel nuts and the wheel.

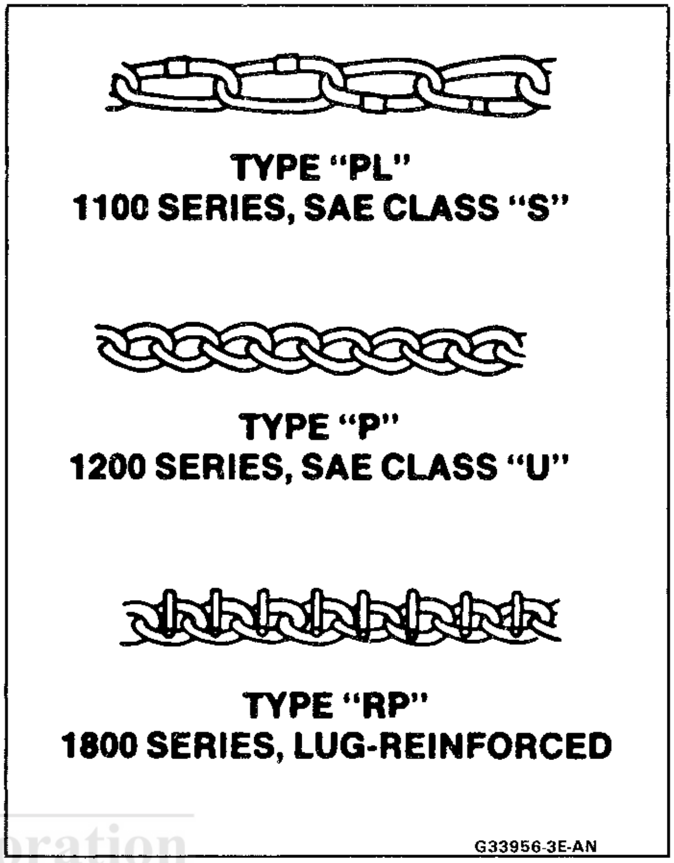


Fig. 7 Examples of Passenger Car Tire Chains

Penetrating oil has not been found to be effective in removing tight wheels, however, if it is used, it should be applied sparingly to the wheels center hole area only. **Do not** allow the penetrating oil to get on the vertical surfaces between the wheel and the drum (or rotor) because penetrating oil in this area could cause the wheel to work loose as the car is driven causing loss of control.

NEVER use heat to loosen a tight wheel because the application of heat to the wheel can shorten the life of the wheel, wheel bolts and/or wheel bearings.

Excessive force such as hammering the wheel or tire can also cause damage and is not recommended. Slight tapping of the tire side wall, such as with one's hand or a rubber mallet, is normally acceptable.

Before installing wheels, remove any build up of corrosion on the wheel mounting surface and brake drum or rotor mounting surface by scraping and wire brushing. Installing wheels without good metal-to-metal contact at the mounting surfaces can cause wheel nuts to loosen, which can later allow the wheel to come off causing loss of control.

Wheel nuts must be tightened in sequence and to proper torque to avoid bending wheel or brake drum or rotor.

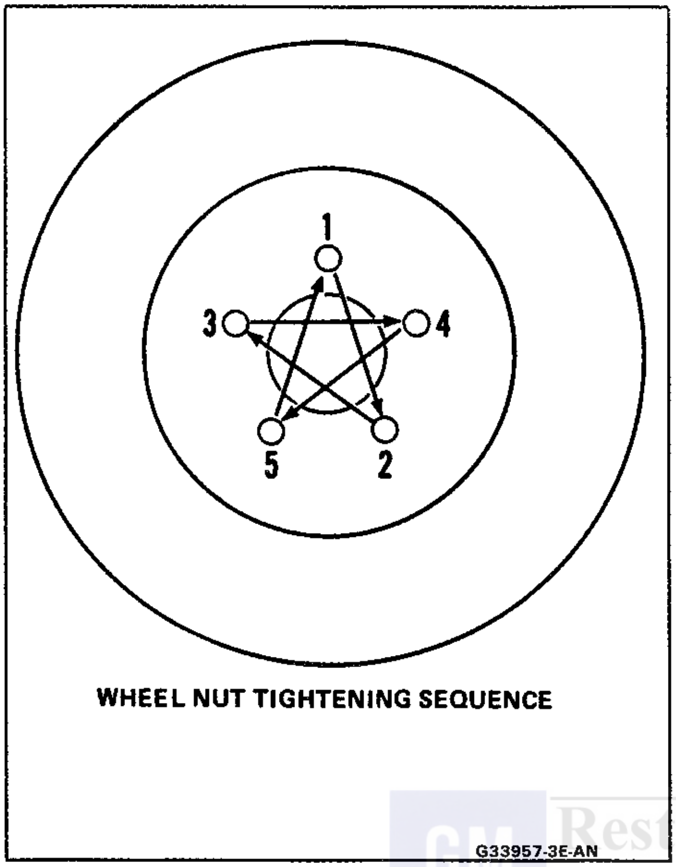


Fig. 8 5 Hole Wheel Nut Tightening Sequence

TIRE MOUNTING AND DISMOUNTING

Fig. 9

Use a tire changing machine to mount or dismount tires. Follow the equipment manufacturer's instructions. Do not use hand tools or tire irons to change tires as they may damage the tires bead or wheel rim.

Rim bead seats should be cleaned with a wire brush or coarse steel wool to remove lubricants, old rubber, and light rust. Before mounting or dismounting a tire, the bead area should be well lubricated with an approved tire lubricant.

After mounting, inflate until beads are seated, but never exceed 275 kPa (40 psi) to seat the beads.

> **CAUTION: To avoid serious personal injury, do not stand over tire when inflating. Bead may break when bead snaps over safety hump. Do not exceed 275 kPa (40 psi) pressure when inflating any tire if beads are not seated. If 275 kPa (40 psi) pressure will not seat beads, deflate, relubricate the beads and reinflate. Overinflation may cause the bead to break and cause serious personal injury.**

Install valve core and inflate to proper pressure. Check the locating ring of the tire to be sure it shows

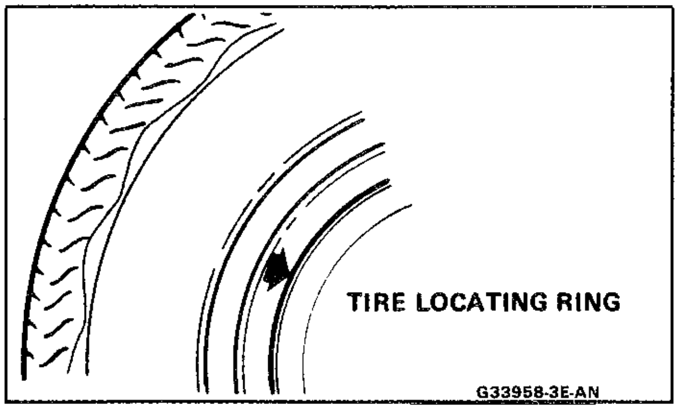


Fig. 9 Tire Locating Ring

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.

Due to the thin 3.2 mm (4/32″) tread depth on temporary spare tires, tire repair is not recommended.

WADDLE

Waddle is side-to-side movement at the front and/or rear of the car. It can be caused by the steel belt not being straight within the tire, or by excessive lateral runout of the tire or wheel. Use a dial indicator on the tire's sidewall and on the rim's flange to determine if there is excessive lateral runout.

MEASURING WHEEL RUNOUT

Fig. 10

Wheel runout should be measured with an accurate dial indicator. Measurements may be taken with the wheel installed on the car or off the car using an accurate mounting surface such as on a wheel balancer. Measurements may also be taken with or without the tire mounted on the wheel.

Radial runout and lateral runout should be measured on both the inboard and outboard rim flanges. With the dial indicator firmly in position, slowly rotate the wheel one revolution and record the total indicator reading. If any measurement exceeds specifications, and there is a vibration that wheel balancing will not correct, the wheel should be replaced. Disregard any indicator readings due to welds, paint runs, scratches, etc.

- STEEL WHEELS

  Radial runout .040″

  Lateral runout .045″

- ALUMINUM WHEELS

  Radial runout .030″

  Lateral runout .030″

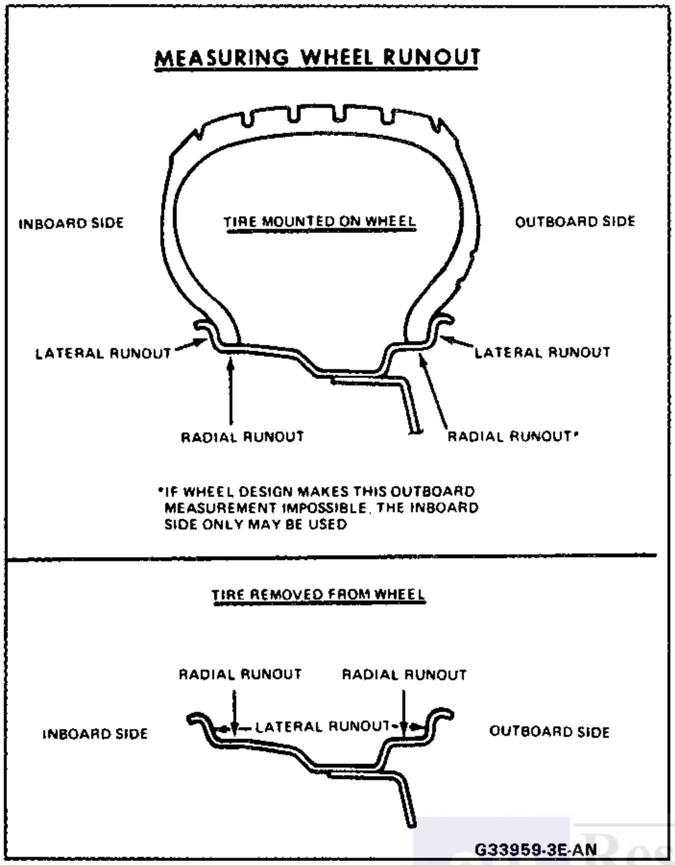


Fig. 10 Wheel Runout

SPARE TIRE

Compact Spare

Fig. 11

Some models will be equipped with a high pressure compact spare. The compact spare uses a narrow 4-inch wide rim, although the wheel diameter is usually one inch larger than the road wheels.

The compact spare wheel should not be used with standard tires, snow tires, wheel covers or trim rings. If such use is attempted, damage to these items or other parts of the car may occur. The compact spare should be used only on cars which offered it as original equipment.

Inflation pressure of the compact spare must be periodically checked and maintained at 415 kPa (60 psi). It can be mounted and dismounted from its wheel using present tire changing equipment and procedures. As with other tires, the beads should completely seat at 275 kPa (40 psi). The tire may then be safely inflated to 415 kPa (60 psi).

CAUTION: To avoid serious personal injury, do not stand over tire when inflating. Bead may break when bead snaps over safety hump. Do not exceed 275 kPa (40 psi) pressure when inflating any tire if beads are not seated. If 275 kPa (40 psi) pressure will not seat beads, deflate, relubricate the beads and reinflate. Overinflation may cause the bead to break and cause serious personal injury.

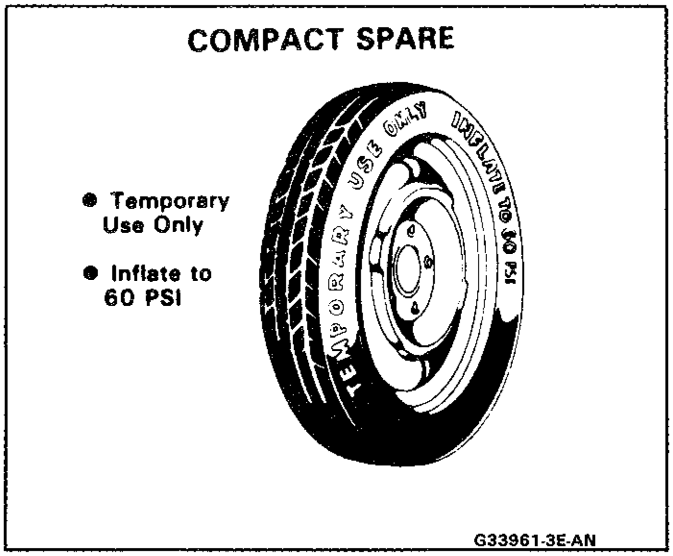


Fig. 11 Compact Spare

MATCH MOUNTING

Fig. 12

Tires and wheels are "match-mounted" at the assembly plant. This means that the radially stiffest part of the tire, or "high spot", is matched to the smallest radius or "low spot" of the wheel.

The "high spot" of the tire is originally marked by a yellow paint mark or adhesive label on the outboard sidewall.

The "low spot" of the wheel will be at the location of the valve stem.

Before dismounting a tire from its wheel, a line should be scribed on the tire at the valve stem to assure that it is remounted in the same position.

Replacement tires and wheels that are of original equipment quality will have their "high and low spot" marked in the same manner.

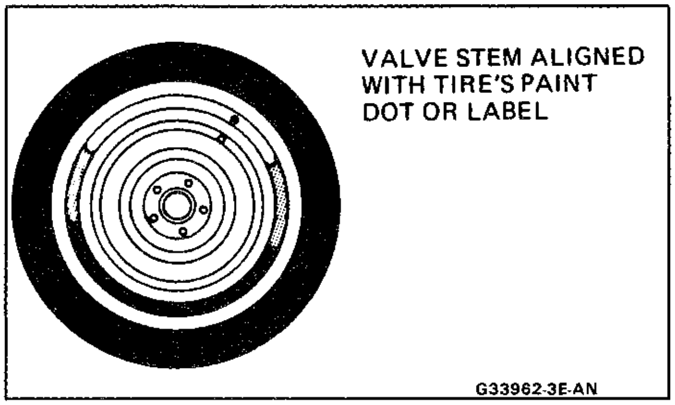


Fig. 12 Matched Tires and Wheels

BALANCING TIRE AND WHEEL

Figs. 13 and 14

There are two types of tire and wheel balancing, static and dynamic. Static balance is the equal distribution of weight around the wheel. Assemblies that are statically unbalanced cause a bouncing action called wheel tramp. This condition will eventually cause uneven tire

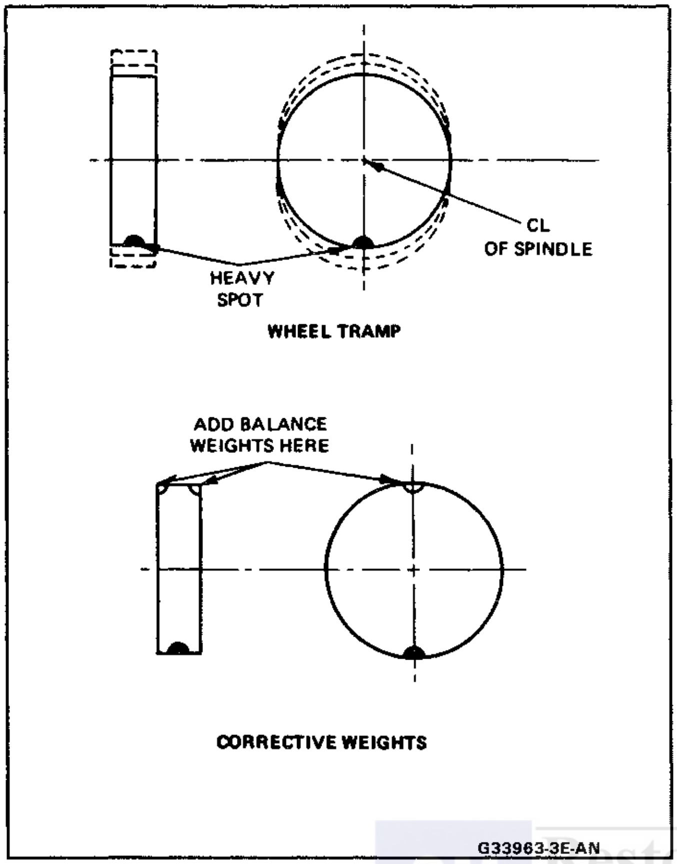


Fig. 13 Static Unbalance Correction

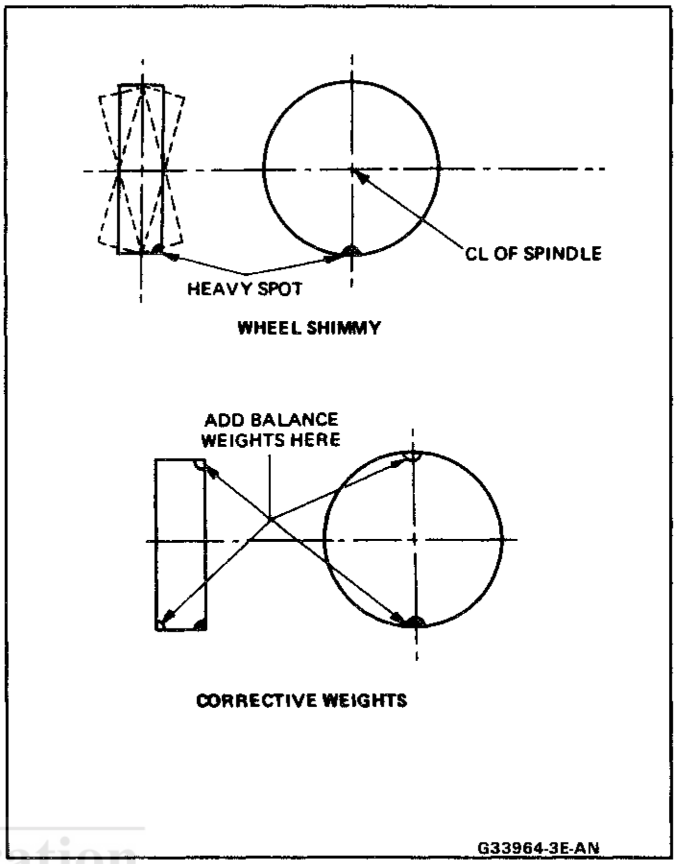


Fig. 14 Dynamic Unbalance Correction

Dynamic balance is the equal distribution of weight on each side of the centerline so that when the assembly spins there is no tendency for it to move from side to side. Assemblies that are dynamically unbalanced may cause wheel shimmy.

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.

The rear 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

Fig. 15

If more than 85 grams (3.0 oz.) are needed, the wheel weights should be split as equal as possible between the inboard and outboard flanges.

Balancing of assemblies with factory aluminum wheels requires the use of special nylon coated clip-on type wheel weights. These weights are designed to fit over the thicker rim flange of the aluminum wheel and should be installed with a plastic tipped hammer.

Adhesive wheel weights are also available. Use the following procedure to install adhesive wheel weights.

Adhesive Wheel Weight Installation

1. Clean wheel by sanding to bare aluminum where wheel weight is to be located.
2. Wipe wheel weight attachment area with a mixture of half Isopropyl alcohol and half water. A clean cloth or paper towel must be used for this operation.
3. Dry the attachment area with hot air. Surface of wheel should be warm to the touch.
4. The adhesive backing on wheel weights must be warmed to room temperature.
5. Remove tape from back of weights. Do not touch the adhesive surface.
6. Apply wheel weight and press on with hand pressure.
7. Secure wheel weight with a 70-110 N (16-25 lb) force applied with a roller.

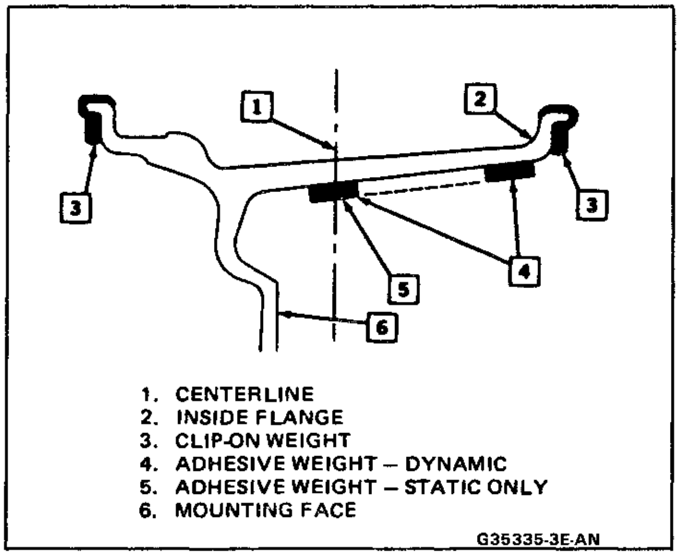


Fig. 15 Aluminum Wheel Weight Placement

CORRECTING NON-UNIFORM TIRES

There are two ways to correct tires which cause a vibration even though they are properly balanced. One method uses an automatic machine which loads the tire and buffs small amounts of rubber from high spots on the outer two tread rows. Correction by this method is usually permanent and, if done properly, does not significantly affect the appearance or tire tread life. Tire truing with a blade-type machine is not recommended as this reduces the tread life substantially and often does not permanently correct the problem.

Another method is to dismount the tire and rotate it 180 degrees on the rim. It is important that this be done on tire and wheel assemblies which are known to be causing a vibration as it is just as likely to cause good assemblies to vibrate.

Refer to Section 3, "Vibration Diagnosis" for more details.

ALUMINUM WHEEL CLEANING

Aluminum wheels should be cleaned and waxed regularly. Do not use abrasive cleaners, as they could damage the protective coating.

ALUMINUM WHEEL HUB CAP

←→ Remove or Disconnect

1. Tire and wheel assembly
2. Place a block of wood approximately 2″ in diameter with a squared off end against the back surface of the cap. A sharp hammer blow on the block of wood will remove the cap.

→← Install or Connect

1. Place cap into position at wheel opening and place a block of wood at least three inches in diameter against cap face. Install cap by striking block of wood with hammer.
2. Tire and wheel assembly

NOTICE: Failure to hit cap squarely without the load distributed evenly could result in permanent damage to the cap.

ALUMINUM WHEEL POROSITY REPAIR

1. Remove tire and wheel assembly.
2. Locate leaking areas by inflating tire to 345 kPa (50 psi) and dipping tire and wheel assembly into a water bath.
3. Mark leak areas and remove tire from wheel.
4. Scuff inside surface at leak area with 80 grit sandpaper and clean area with general purpose cleaner such as 3M #08984 or equivalent.
5. Apply 1/8″ thick layer of adhesive/sealant P/N 1052366 or equivalent to leak area and allow twelve hours of drying time.
6. Mount tire on wheel, pressurize to 345 kPa (50 psi) and check for leaks.

CAUTION: To avoid serious personal injury, do not stand over tire when inflating. Bead may break when bead snaps over safety hump. Do not exceed 275 kPa (40 psi) pressure when inflating any tire if beads are

not seated. If 275 kPa (40 psi) pressure will not seat beads, deflate, relubricate the beads and reinflate. Overinflation may cause the bead to break and cause serious personal injury.

7. Adjust tire pressure to meet specifications.
8. Balance tire and wheel assembly.
9. Install tire and wheel assembly.

ALUMINUM WHEEL REFINISHING

A protective clear or color coating is applied to the surface of original equipment cast aluminum wheels. A surface degradation condition can begin to develop if frequent, repeated automatic car wash cleaning abrades or wears off the factory applied protective coating. This can happen at some automatic car wash facilities using aggressive silicon carbide tipped tire brushes to clean white walls and tires. Once the protective coating is damaged, exposure to caustic cleaners and/or road salt further causes surface degradation. The following procedure details how to strip, clean and recoat aluminum wheels that are affected by these conditions.

Required Materials:

Amchem Alumi Prep #33 – stock #DX533 or equivalent – cleaning and conditioning chemical for aluminum.

Amchem Alodine #1001 – stock #DX50T or equivalent – coating chemical for aluminum.

Ditzler Delclear Acrylic Urethane Clear – stock #DAU-75 or equivalent.

Ditzler Delthane Ultra-Urethane Additive – stock DXR-80 or equivalent.

Service Procedure:

1. Mark wheel and wheel stud for position on car.
2. Remove tire and wheel assembly from car.
3. Mark location of outboard weights and remove.
4. Wash wheel inside and out with water base all purpose cleaner. Remove grease and oil with solvent cleaner.
5. Mask off tire prior to painting.
6. Select and follow the correct procedure, "Aluminum Damage on Wheel Surface" or "Clear Coat Damage on Unpainted Wheels".
7. Replace wheel weights with nylon coated weights.
8. Install tire and wheel assembly on car and tighten wheel nuts to proper torque.

Accent Color Preparation

1. Sand over painted areas that will not require recoloring with 400 grit (wet or dry) to promote adhesion of clear coat.

Aluminum Damage on Wheel Surface

1. Mount tire and wheel on brake lathe and spin slowly.
2. Sand wheel with backing block or pad by holding abrasive flat to surface of wheel and moving slowly back and forth from center to outer edge to remove damage. Use the following sandpaper grits in the order listed.
   A. Sand with 80 grit
   B. Sand with 150 grit
   C. Sand with 240 grit
3. Continue with "Recoating Procedure."

Clear Coat Damage on Unpainted Wheels

1. Apply chemical stripper. Use small 1/4″ detail brush dipped in stripper to apply material around perimeter and spoke-like areas.
2. Remove stripper following manufacturers recommendations.
3. Sand wheel with 240 grit while rotating wheel on a slow spinning brake lathe or by mounting on car and spinning by hand. This will restore the machined appearance and promote adhesion.

   CAUTION: Do not use engine power to rotate wheel while sanding to avoid serious personal injury.
4. Continue with "Recoating Procedure."

Recoating Procedure

1. Clean surface of contaminants.
2. Soak wheel with Amchem #33 or equivalent from 1 to 3 minutes, then rinse with water and blow dry.
3. Soak wheel with Amchem #1001 or equivalent for 1 to 3 minutes, then rinse with water and blow dry.
4. Finish with Ditzler Delclear Acrylic Urethane and Ditzler Ultra-Urethane Additive or equivalent using three coats.

   1st Coat – Light mist coat, let flash
   2nd Coat – Light, let flash
   3rd Coat – Heavy double wet coat

   CAUTION: To avoid serious personal injury when applying any two part component paint system, follow the specific precautions provided by the paint manufacturer. Failure to follow these precautions may cause lung irritation and allergic respiratory reaction.
5. Let dry for 24 hours – (or flash for 30 minutes, force dry at 140° for 30 minutes, and allow to cool for 30 minutes before mounting.

WHEEL NUT TORQUE

M12X1.5 .... 140 N·m (100 lbs. ft.)

				EXCEPTION (S)		
		TIRE INFLATION			TIRE INFLATION	
MODEL	TIRE SIZE	(PSI) FRONT	(PSI) REAR	TIRE SIZE	(PSI) FRONT	(PSI) REAR
Fiero	—	30	30	FP205/RP215/60R15	30	35

Please refer to this listing during Pre-delivery Inspection and otherwise.

Fig. 16 Tire Pressure Specifications

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

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

Figures 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-A 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. Support front end of vehicle with suitable jack stands.
4. Install drift punch through rotor and remove hub nut and washer (discard nut).
5. Caliper and rotor.
6. Trailing arm at knuckle.

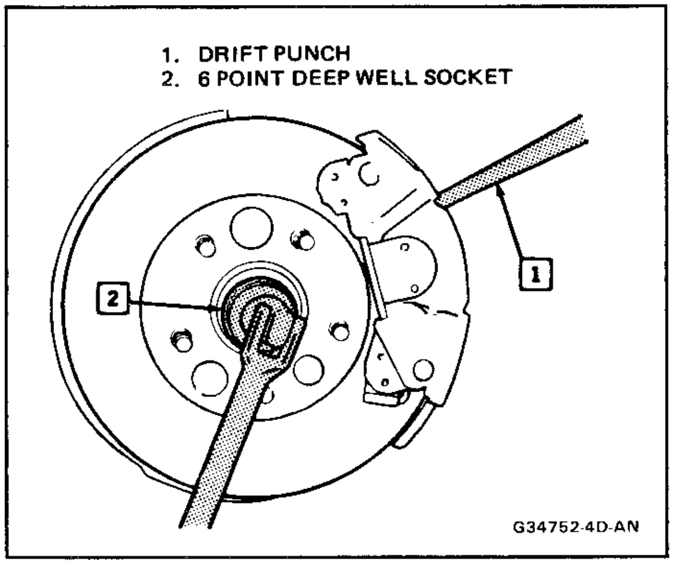


Figure 1 Removing & Installing Hub Nut

7. Fixed adjusting link, lateral control arm through bolt.
8. Scribe strut and knuckle assembly as outlined in section 3D.
9. Strut mounting bolts.
10. Hub from drive axle.
11. 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.

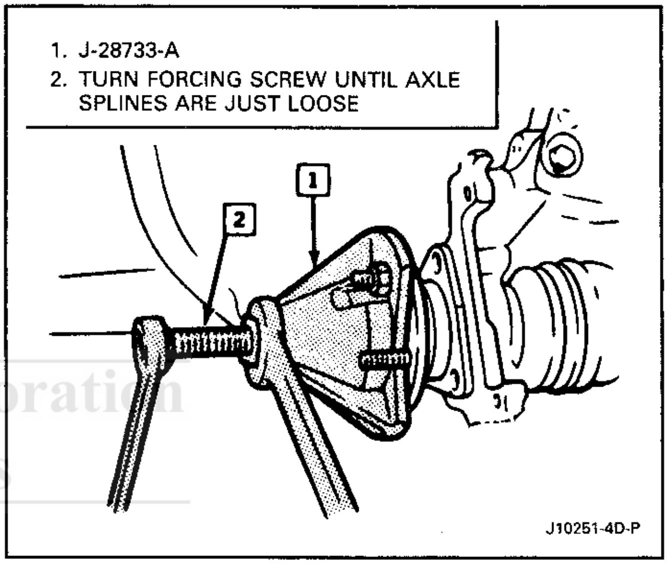


Figure 2 Loosening Splines Between Drive Axle and Hub

2. Start splines of drive axle into transaxle and push drive axle until it "snaps" into place.
3. Align hub assembly with drive axle.
4. Hub on drive axle.
5. Loosley install strut mounting bolts with bolt head to rear of vehicle.
6. Fixed adjusting link, lateral control arm through bolt with bolt head to front of vehicle and torque to 50 N•m (37 lbs. ft.). + 90°
7. Trailing arm at knuckle with bolt head inboard and torqued to 60 N•m (44 lbs. ft.) + 90°
8. Strut mounting bolts at knuckle and torque to 190 N•m (140 lbs. ft.) while observing scribe marks.
9. Caliper and rotor.
10. Insert drift punch through rotor and install washer and new hub nut and torque to 250-285 N•m (183-208 lb. ft.).
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.

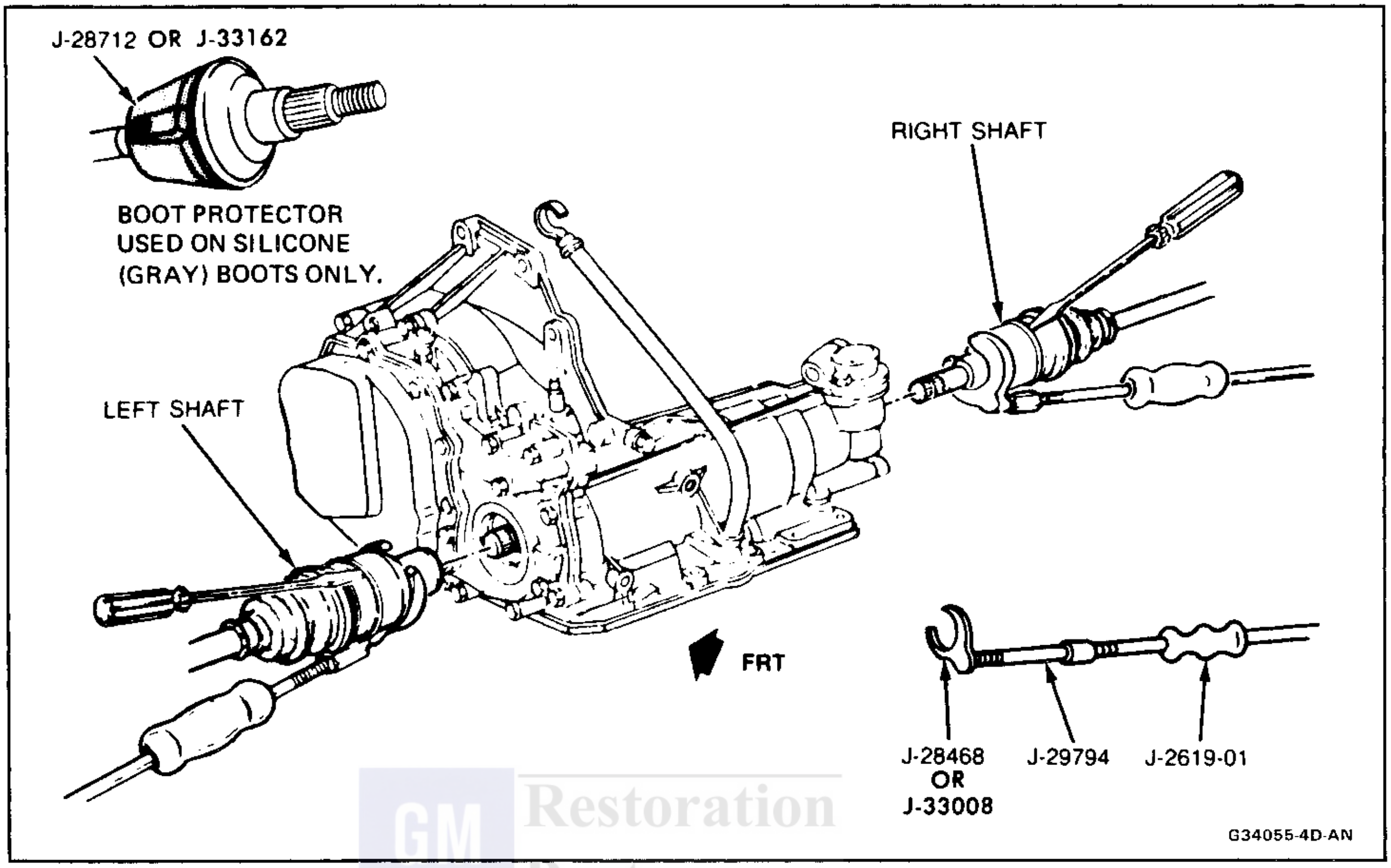


Figure 3 Drive Axle Removal

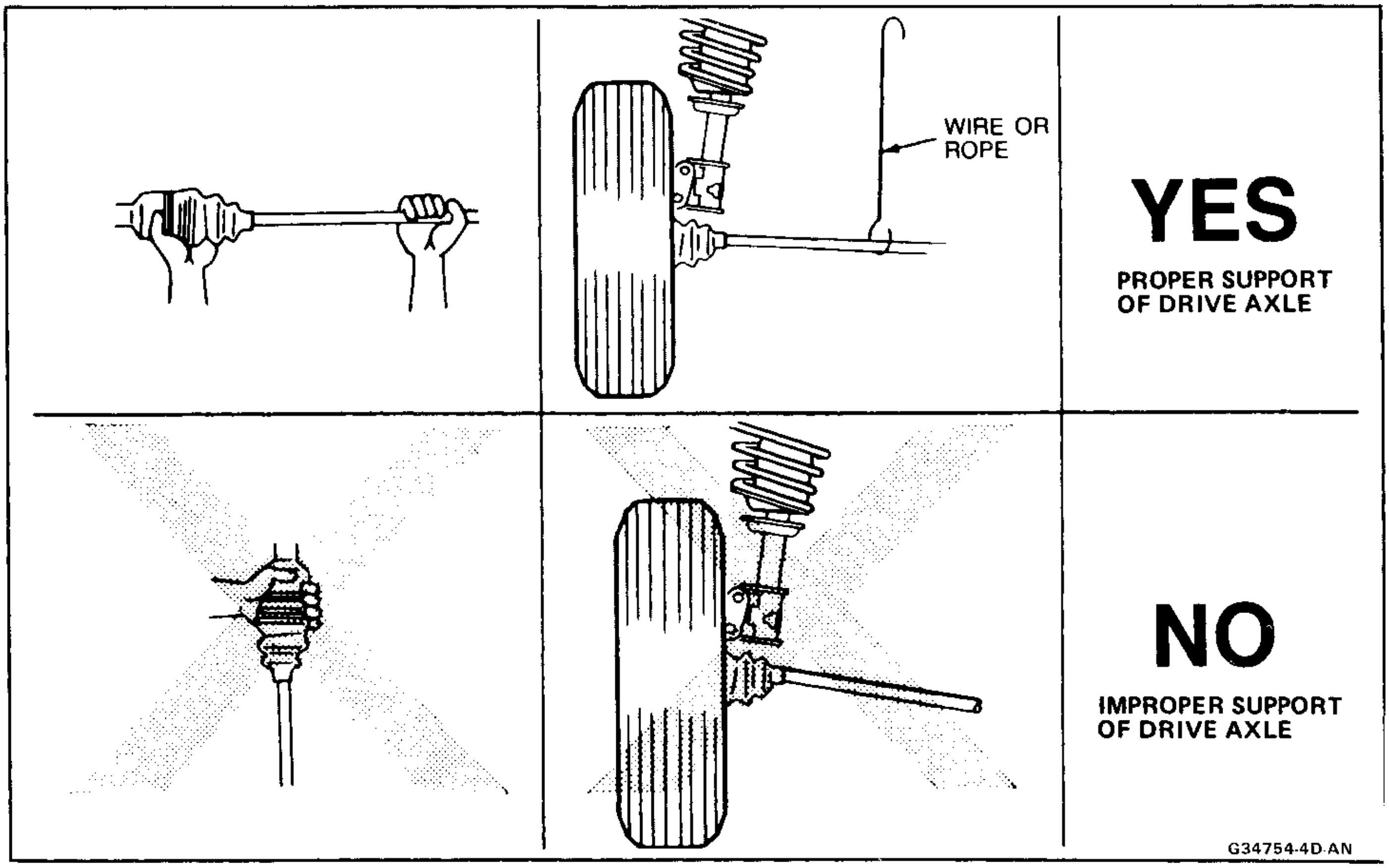


Figure 4 Tri-Pot Joint Handling Precaution

INBOARD THERMOPLASTIC SEAL

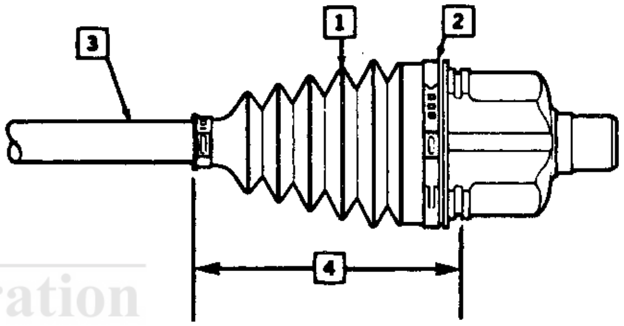
Figure 5

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.

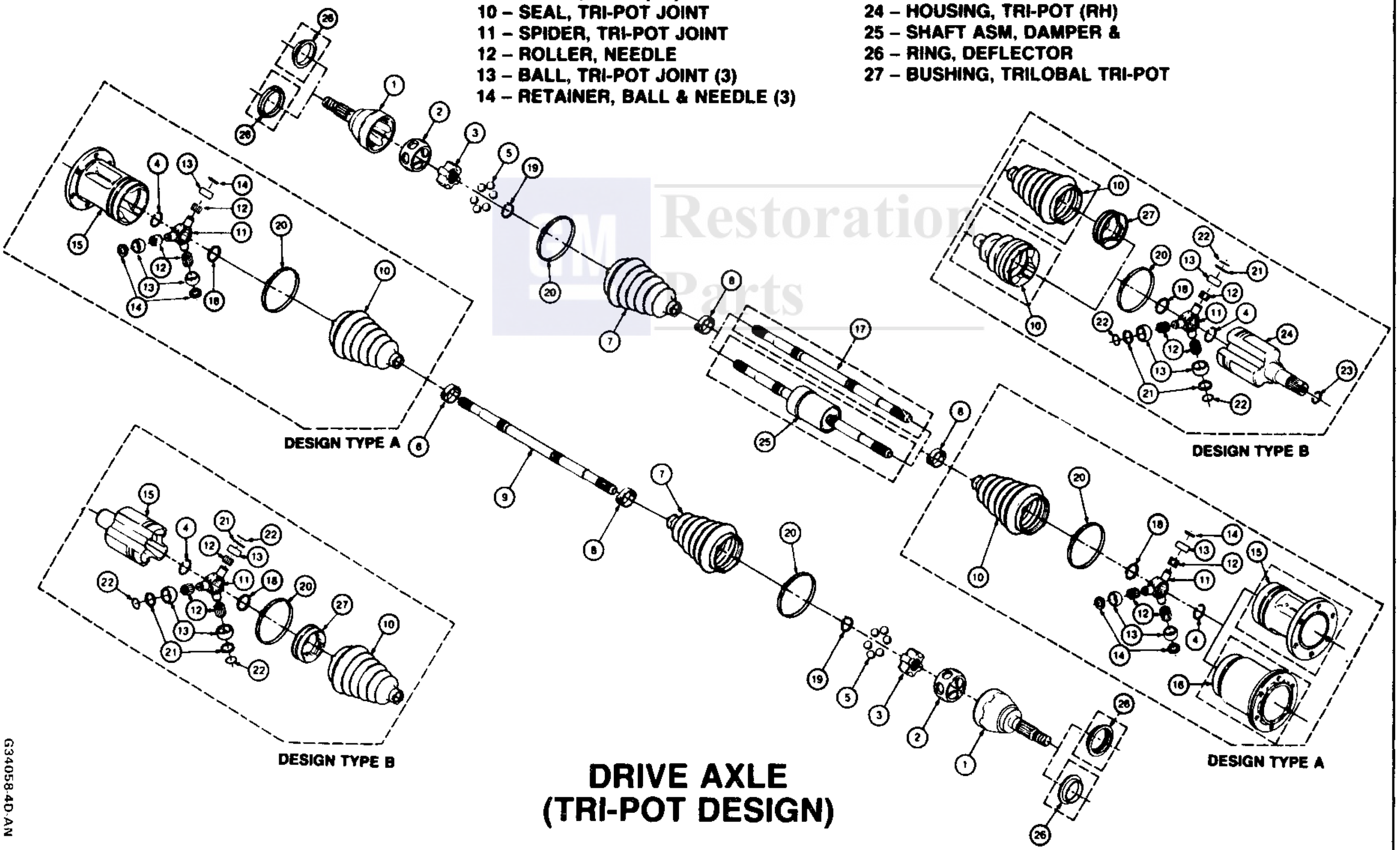


1. INBOARD THERMOPLASTIC SEAL
2. TRILOBAL TRIPOT JOINT
3. AXLE SHAFT
4. 130 MM (5 1/16") – JOINT AND SEAL ARE TO BE COMPRESSED TO THIS DIMENSION BEFORE CRIMPING CLAMPS.

G34642-4D-AN

Figure 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



DRIVE AXLE
(TRI-POT DESIGN)

Figure 6 Tri-Pot Axle

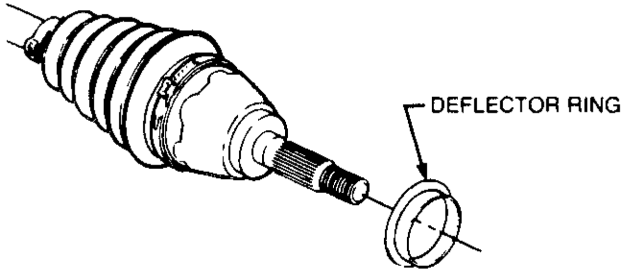
1. REMOVE AND INSTALL DEFLECTOR RING

REMOVE

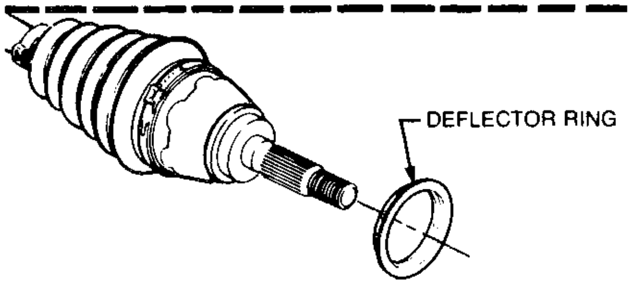
1. For damaged deflector ring, remove parts as shown.

INSTALL

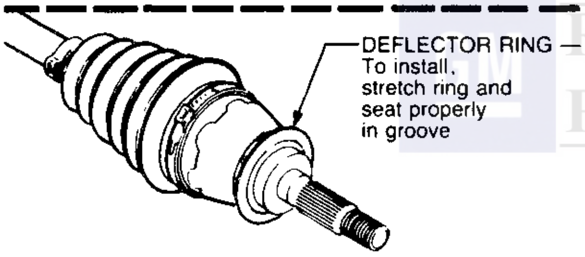
1. Install part as shown.



AXLE ASSEMBLY WITH STEEL DEFLECTOR RING

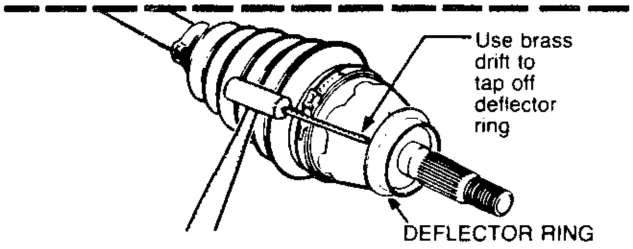


AXLE ASSEMBLY WITH RUBBER DEFLECTOR RING

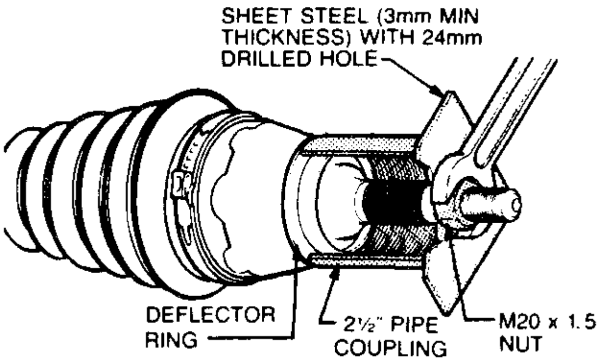


To install, stretch ring and seat properly in groove

REMOVE AND INSTALL DEFLECTOR RING (RUBBER)


Use brass drift to tap off deflector ring

REMOVE DEFLECTOR RING (STEEL)



INSTALL DEFLECTOR RING (STEEL)

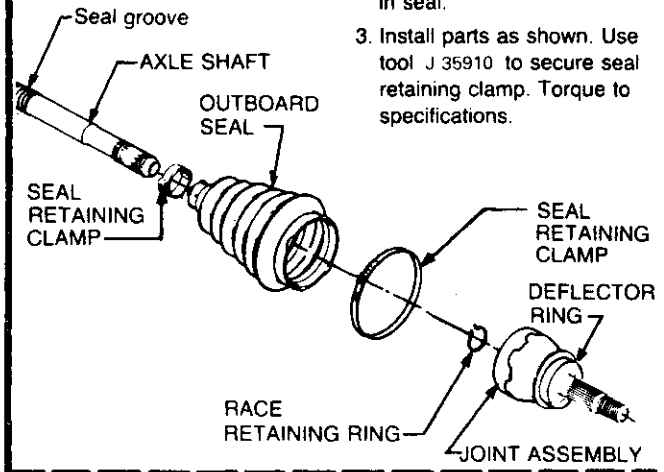
2. REMOVE AND INSTALL OUTER JOINT SEAL

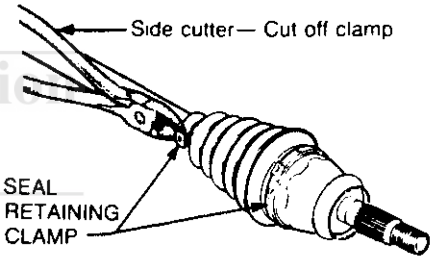
REMOVE

1. Cut seal retaining clamps.
2. Remove parts as shown.

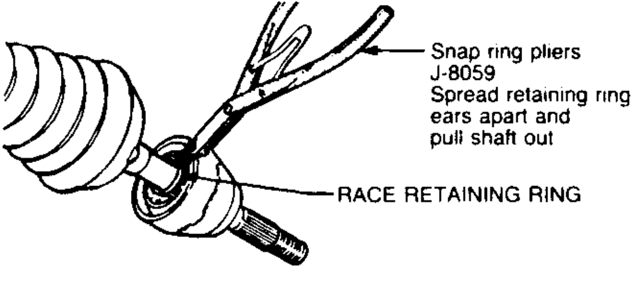
INSTALL

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 35910 to secure seal retaining clamp. Torque to specifications.



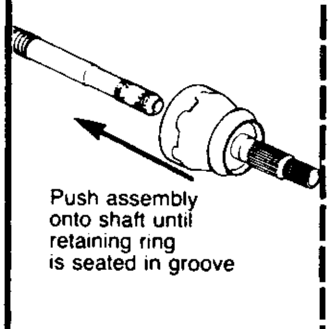


REMOVE CLAMP AND RETAINER

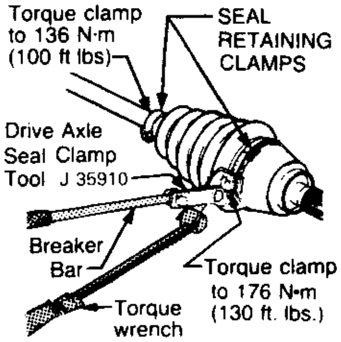


Spread retaining ring ears apart and pull shaft out

REMOVE JOINT ASSEMBLY


Push assembly onto shaft until retaining ring is seated in groove

INSTALL JOINT ASSEMBLY


Torque clamp to 136 N·m (100 ft lbs)

Torque clamp to 176 N•m (130 ft. lbs.)

INSTALL SEAL RETAINING CLAMP

J10252-4D-P

Figure 7 Unit Repair

3. DISASSEMBLE AND ASSEMBLE OUTER JOINT ASSEMBLY

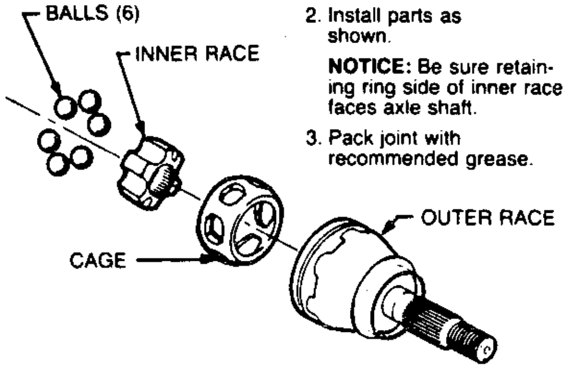
REMOVE

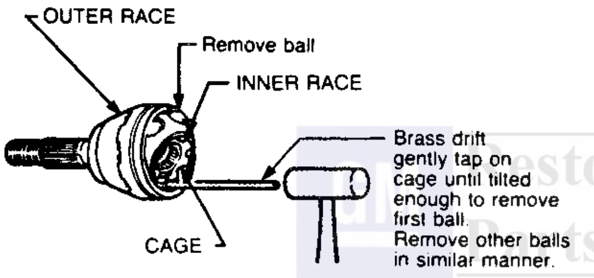
1. Remove parts as shown.

INSTALL

1. Put a light coat of recommended grease on ball grooves of inner and outer races.
2. Install parts as shown.

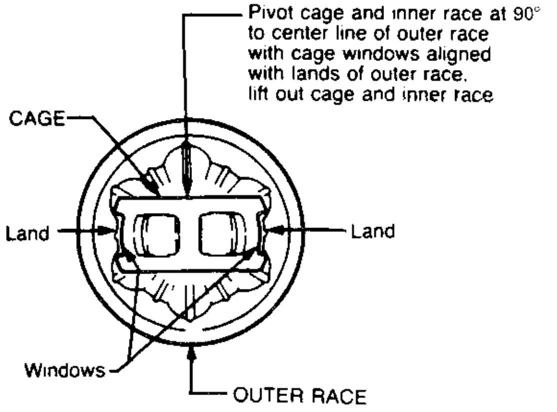
   NOTICE: Be sure retaining ring side of inner race faces axle shaft.
3. Pack joint with recommended grease.





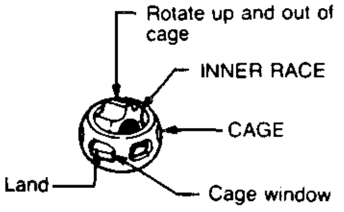
Brass drift gently tap on cage until tilted enough to remove first ball. Remove other balls in similar manner.

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



Rotate up and out of cage

DISASSEMBLE AND ASSEMBLE INNER RACE AND CAGE

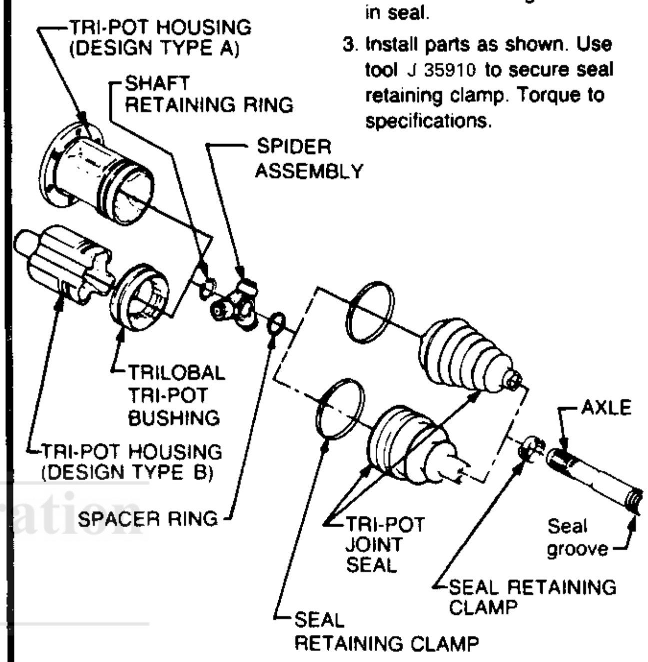
4. REMOVE AND INSTALL INNER TRI-POT SEAL

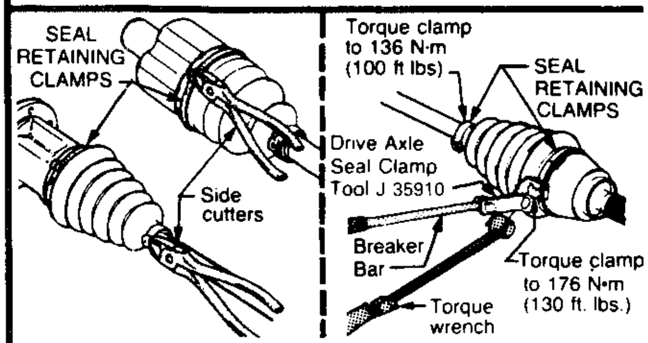
REMOVE

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 35910 to secure seal retaining clamp. Torque to specifications.

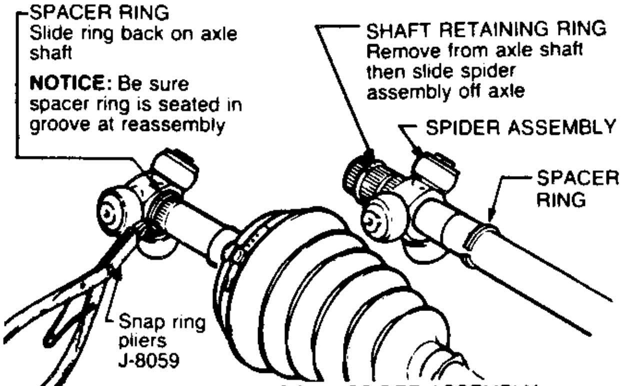




Torque clamp to 136 N·m (100 ft lbs)

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

J10253-4D-P

Figure 8 Unit Repair

SPECIAL TOOLS

J 35910	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-A	Front Hub Spindle Remover
J 28712 or J33162	Drive Joint Boot Protector

J10264-4D-P

Figure 9 Special Tools

SECTION 5

BRAKES

NOTICE: All brake attaching fasteners are important attaching parts in that they could affect the performance of vital parts and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of parts.

CAUTION: When servicing brake parts, do not create dust by grinding, sanding brake linings, or by cleaning brake parts with a dry brush or with compressed air. Many brake parts contain asbestos fibers which can become airborne if dust is created during servicing. Breathing dust containing asbestos fibers may cause serious bodily harm. A water dampened cloth or water based solution should be used to remove any dust on brake parts. Equipment is commercially available to perform this washing function. These wet methods will prevent asbestos fibers from becoming airborne.

CONTENTS

GENERAL DESCRIPTION

COMPOSITE MASTER CYLINDER

This vehicle uses a composite master cylinder which has an aluminum body and a clear nylon reservoir with fluid level indicators.

The master cylinder uses a "quick take-up" feature in the rear chamber to reduce excess pedal travel which may result from increased fluid displacement required to move the caliper piston. The quick take-up master cylinder includes a spring loaded ball check valve which holds pressure in the large-diameter rear chamber. When the brake is first applied, the movement of the rear piston causes fluid to be displaced forward, past the primary piston primary seal and into the primary high pressure chamber, which feeds the rear brakes. At a predetermined pressure, 480-690 kPa (70-100 psi), the ball unseats and fluid from the large rear bore is displaced past the ball and into the reservoir. The primary and secondary high pressure chambers supply pressure to the rear and front brakes, respectively, in the conventional manner. When the pedal is released, the large-bore chamber is filled with fluid by drawing fluid from the reservoir around the quick take-up lip seal, and also through a small orifice in the ball seat.

BRAKE FLUID LEVEL INDICATOR (Figure 1)

The nylon master cylinder reservoir has two windows which allow the brake fluid level to be checked without removal of the reservoir cover.

OPERATION OF DISC BRAKES

When the brakes are applied, fluid pressure behind the caliper piston increases. Pressure is exerted equally against the bottom of the piston and also against the bottom of the piston bore. The pressure applied to the piston is transmitted to the inner shoe and lining, forcing the lining against the inner rotor surface. The pressure applied to the bottom of the piston bore forces the caliper to slide on the mounting bolts toward the center of the car. This movement 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, the shoe and lining assemblies are pressed against the rotor surfaces with increased force, bringing the car to a stop.

Outward movement of the piston and inward movement of the caliper automatically compensate for lining wear. As the linings wear, the increased area behind the piston is filled with brake fluid from the master cylinder reservoir.

OPERATION OF COMBINATION VALVE

To prevent early rear wheel lock-up under heavy braking loads, the proportioning section of the combination valve proportions outlet pressure to the rear brakes after a predetermined rear input pressure has been reached.

The valve has a by-pass feature which insures full system pressure to the rear brakes in the event of a front brake system failure. Similarly, full front pressure is retained in the event of a rear brake pressure failure.

BRAKE PRESSURE DIFFERENTIAL WARNING SWITCH

The brake pressure differential warning switch constantly compares brake pressure in both parts of the system. The switch will activate the "BRAKE" warning lamp on the instrument panel in case of a failure in either part. The combination valve is designed so the switch will stay in the warning position once a failure has occurred. The lamp can only be turned off by repairing the failure and applying a pedal force as required to develop up to 3100 kPa (450 psi) line pressure.

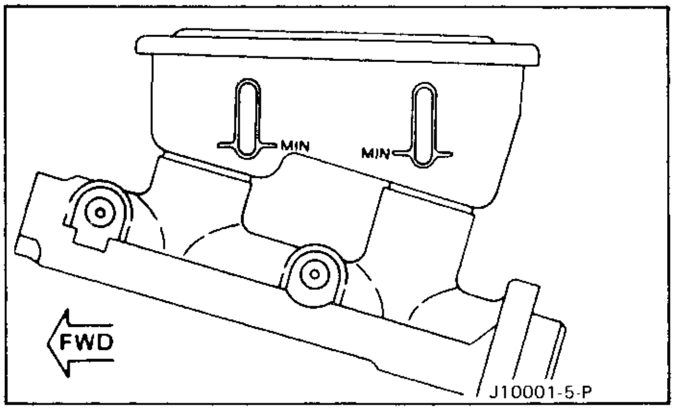


Figure 1 Master Cylinder Reservoir Window (Typical)

DIAGNOSIS AND INSPECTION

BRAKE SYSTEM TESTING (Figures 2 and 3)

Brakes should be tested on a dry, clean, reasonably smooth and level roadway. A true test of brake performance cannot be made if the roadway is wet, greasy or covered with loose dirt so that all tires do not grip the road equally. Testing will also be affected if the roadway is crowned which would throw the weight of the car toward the wheels on one side. If the roadway is too rough, the wheels will tend to bounce.

Test brakes at different car speeds with both light and heavy pedal pressure, avoid locking the brakes and sliding the tires. Locked brakes and sliding tires do not indicate brake efficiency, because heavily braked, but turning

BRAKE DIAGNOSIS CHART — 4 WHEEL DISC SYSTEMS

CAUSE / SYMPTOM	Excessive Brake Pedal Travel	Brake Pedal Travel Gradually Increases	Excessive Brake Pedal Effort	Excessive Braking Action	Brakes Slow To Respond	Brakes Slow To Release	Brakes Drag	Uneven Braking Action (Side To Side)	Uneven Braking Action (Front To Rear)	Scraping Noise From Brakes	Brakes Squeak During Application	Brakes Squeak During Stop	Brakes Chatter (Roughness)	Brakes Groan At End Of Stop	"BRAKE" Warning Lamp Glows
Leaking Brake Line or Connection	X	XX	X						X						XX
Leaking Piston Seal	X	XX	X	X				X	X						X
Leaking Master Cylinder	X	XX	X						X						X
Air in Brake System	XX		X						X						XX
Contaminated or Improper Brake Fluid	X				X	X	X	X	X						X
Leaking Vacuum System			XX		X										
Restricted Air Passage in Power Head		X	X		XX	X									
Damaged Power Head		X	X	X	X	XX									
Worn Out Brake Lining			X	X				X	X	X	X	X		X	
Uneven Brake Lining Wear-Replace	X			X				X	X	X	X	XX		X	X
Glazed Brake Lining			XX		X			X	X		X	X			
Incorrect Lining Material-Replace			X	X		X		X	X			X		X	
Contaminated Brake Lining-Replace				XX		X		XX	XX	X	X	X		X	
Linings Damaged by Abusive Use-Replace			X	XX				X	X	X	X	X		X	
Heat Spotted or Scored Discs				X				X	X		X	X	XX	X	
Improper Thickness Variation	X												XX		
Excessive Lateral Run-out	X												X		
Automatic Adjuster Problem	X						X	X	X						X
Brake Assembly Attachments-Missing or Loose	X						X	X	X	X		X	X	X	
Restricted Brake Fluid Passage		X	X		X	X	X	X	X						X
Improperly Adjusted Stoplamp Switch Or Cruise Control Vacuum Dump							X								
Brake Pedal Linkage Interference or Binding			X		X	XX	XX								
Improperly Adjusted Parking Brake							X		X						
Improper Length Booster Pushrod	X			X		X	XX		X						
Incorrect Front End Alignment								XX							
Incorrect Tire Pressure								X	X						
Incorrect Wheel Bearing Adjustment	X									X			X		
Loose Front Suspension Attachments							X	X		XX			X	X	
Out-of-Balance Wheel Assemblies													XX		
Operator Riding Brake Pedal			X				X		X					X	
Sticking Caliper or Caliper 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

J10002-5-P

Figure 2 Brake Diagnosis (Chart)

BRAKE DIAGNOSIS CHART — POWER BRAKE UNIT TROUBLE DIAGNOSIS

The same types of brake troubles are encountered with power brakes as with standard brakes. Before checking power brake system for source of trouble, see "BRAKE DIAGNOSIS CHART — 4 WHEEL DISC SYSTEMS." After these possible causes have been eliminated, check for cause as outlined below:

HARD PEDAL

CAUSE	CORRECTION
Broken or damaged hydraulic brake lines.	Inspect and replace as necessary.
Vacuum failure.	Check for: Faulty vacuum check valve or grommet. Replace. Collapsed or damaged vacuum hose. Replace. Plugged or loose vacuum fitting. Repair. Faulty air valve seal or support plate seal. Replace. Damaged floating control valve. Replace. Bad stud welds on front or rear housing or power head. Replace unless easily repaired.
Faulty diaphragm.	Replace.
Restricted air filter element.	Replace.
Worn or distorted reaction plate or levers.	Replace plate or levers.
Cracked or broken power pistons or retainer.	Replace power pistons and piston rod retainer.

GRABBY BRAKES
(Apparent Off-On Condition)

CAUSE	CORRECTION
Broken or damaged hydraulic brake lines.	Inspect and replace as necessary.
Insufficient fluid in master cylinder.	Fill reservoirs with approved brake fluid. Check for leaks.
Faulty master cylinder seals.	Repair or replace as necessary.
Cracked master cylinder casting.	Replace.
Leaks at disc brake calipers or in pipes or connections.	Inspect and repair as necessary.
Air in hydraulic system.	Bleed system.

BRAKES FAIL TO RELEASE

CAUSE	CORRECTION
Blocked passage in power piston.	Inspect and repair or replace as necessary.
Air valve sticking shut.	Check for proper lubrication of air valve "O" ring.
Broken piston return spring.	Replace.
Broken air valve spring.	Replace.
Tight pedal linkage.	Repair or replace as necessary.

J10003-5-P

Figure 3 Vacuum Booster Diagnosis (Chart) wheels will stop car in less distance than locked brakes. More tire-to-road friction is present with a heavily braked turning tire than with a sliding tire.

The brake system is designed and balanced to avoid locking the wheels, except at very high deceleration levels. The shortest stopping distance and best control is achieved without brake lock-up.

Because of high deceleration capability, a firmer pedal may be felt at higher deceleration levels.

External Conditions That Affect Brake Performance

1. **Tires.** Tires having unequal contact and grip on road will cause unequal braking. Tires must be equally inflated, and the tread pattern of right and left tires must be approximately equal.
2. **Car Loading.** A heavily loaded car requires more braking effort. When a car has unequal loading, the most heavily loaded wheels require more braking power than others.
3. **Wheel Alignment.** Misalignment of the wheels, particularly excessive camber and caster, will cause the brakes to pull to one side.
4. **Front Wheel Bearings.** A loose front wheel bearing permits the front wheel to tilt and have spotty contact with the brake shoe linings causing erratic brake operation.

WARNING LAMP OPERATION

The brake system uses a single red "BRAKE" warning lamp located in the instrument panel cluster. When the ignition switch is in the "START" position, the "BRAKE" warning lamp should come on. It should go off when the ignition switch returns to the "RUN" position.

The following conditions will activate the "BRAKE" warning lamp:

1. Parking brake applied. The lamp should be on when the parking brake is applied and the ignition switch is "ON."
2. Pressure differential switch detects a failure. See "Brake Pressure Differential Warning Switch" in this section.

BRAKE FLUID LEAKS

With engine running at idle and the transaxle in neutral, depress the brake pedal and hold a constant foot pressure. If the pedal gradually falls away with the constant pressure, the hydraulic system may be leaking. Perform a visual check to confirm any suspected leak.

Check the master cylinder fluid levels. While a slight drop in reservoir level does result from normal lining wear, an abnormally low level in either reservoir indicates a leak in the system. The hydraulic system may be leaking either internally or externally. See "Master Cylinder Check." Also, the system may appear to pass this test but still have slight leakage.

If fluid levels are normal, check the vacuum booster pushrod length. If an incorrect length pushrod is found, adjust or replace the pushrod. Check the service brake pedal travel and the parking brake adjustment.

When checking the fluid levels, the master cylinder reservoir may be as low as one inch from the top if the linings are worn. This is not abnormal.

MASTER CYLINDER CHECK

These checks will help locate some master cylinder malfunctions. Use the brake Diagnosis Charts to help isolate the problem if it is not found by using these tests.

1. Check for a cracked master cylinder casting or brake fluid around the master cylinder. Leaks are indicated only if there is at least a drop of fluid. A damp condition is not abnormal.
2. Check for a binding pedal linkage.
3. Disassemble the master cylinder and check for swollen or stretched piston seal(s). If swollen seals are found, substandard or contaminated brake fluid should be suspected. If contaminated, all components should be disassembled and cleaned. All rubber components should be replaced and all the pipes should be flushed.

SUBSTANDARD OR CONTAMINATED BRAKE FLUID

Improper brake fluid, mineral oil or water in the fluid may cause the brake fluid to boil or the rubber components to deteriorate.

If primary piston cups are swollen, the rubber parts have deteriorated. This deterioration may also be seen by a swollen master cylinder cover diaphragm.

If rubber deterioration is evident, disassemble all hydraulic parts and wash with alcohol. Dry parts with compressed air before assembly to keep alcohol out of the system. Replace all rubber parts in the system, including hoses. Check for fluid on the linings. If excessive fluid is found, replace the linings.

If master cylinder piston seals are satisfactory, check for leakage or excessive heat conditions. If condition is not found, drain fluid, flush with brake fluid, fill and bleed the system.

ON-CAR SERVICE

PEDAL TRAVEL

Most low pedal problems are caused by air in the hydraulic system. Bleed the system until all air is purged. See "Bleeding Brake Hydraulic System". Other less frequent causes of excessive pedal travel are incorrect pushrod length, improperly adjusted parking brake, linings excessively worn, and hydraulic system leakage.

Measure

Tools Required:
J 28662 Brake Pedal Effort Gage

1. With engine off and key off, pump brake pedal until all reserve is exhausted from the brake booster. (A definite change in pedal feel will occur.)

2. Install J 28662 onto brake pedal.
3. Hook end of tape measure over top edge of brake pedal and measure the distance to the rim of the steering wheel.
4. Apply brake pedal with 445N (100 lbs.) force and remeasure. The difference between both readings is the actual pedal travel and should not exceed specifications. See Section 5F for Brake Pedal Travel specifications.

STOPLAMP SWITCH ADJUSTMENT (Figure 5)

Adjust

With brake pedal in fully released position, the stop lamp switch plunger should be fully depressed against the brake pedal shank. Adjust switch by moving in or out as necessary.

1. Make certain that the tubular clip is in brake pedal mounting bracket.
2. With brake pedal depressed, insert switch into tubular clip until switch body seats on clip. Clicks can be heard as the threaded portion of the switch is pushed through the clip toward the brake pedal.
3. Pull brake pedal fully rearward against brake pedal stop until clicking sounds can no longer be heard. Switch will be moved in tubular clip providing adjustment.
4. Release brake pedal and then repeat step 3, to assure that no clicking sounds remain.

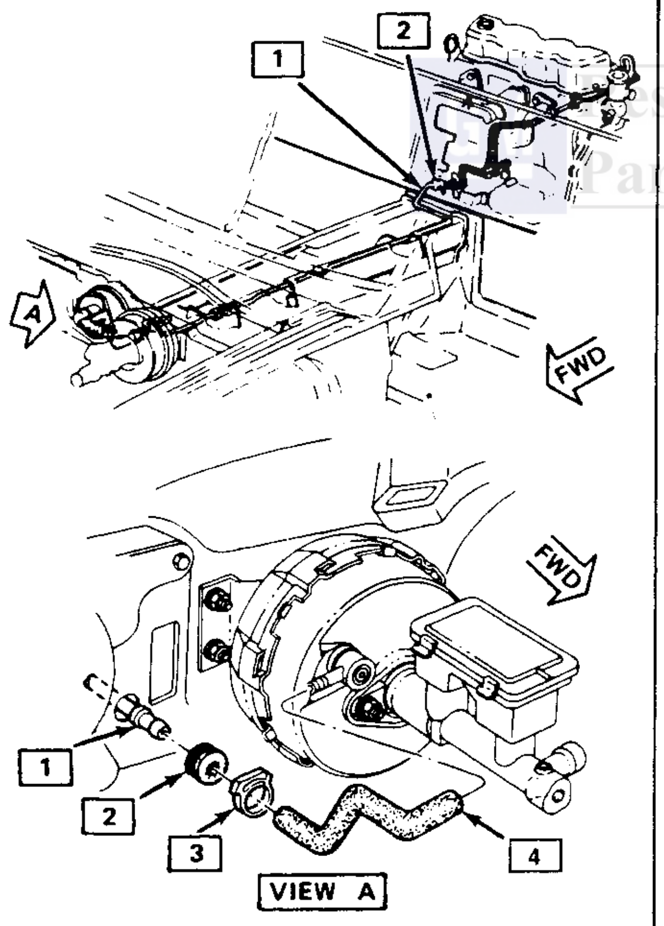
FILLING MASTER CYLINDER RESERVOIRS

The master cylinder must be kept properly filled to insure adequate reserve and to prevent air from entering the hydraulic system. However, because of expansion due to heat absorbed from brakes and from engine, master cylinder must not be overfilled.

The brake fluid reservoir is on the master cylinder which is located under the hood on the left side of the vehicle.

Thoroughly clean reservoir cover before removal to avoid getting dirt into reservoir. Remove cover and diaphragm.

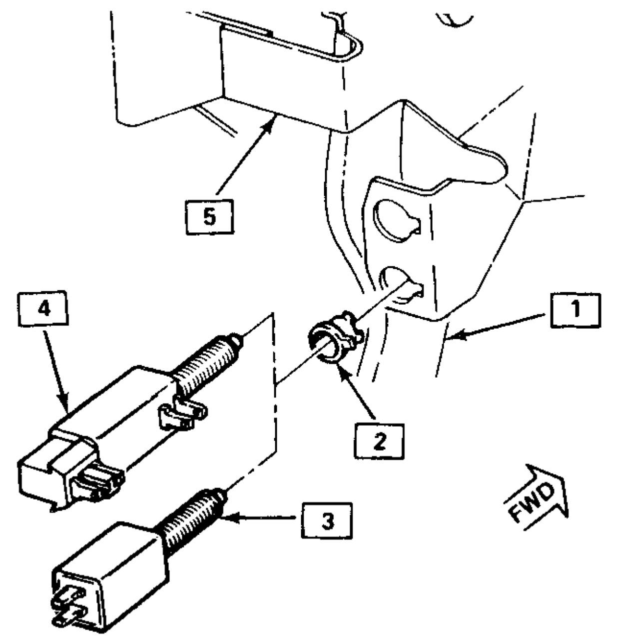
NOTICE: Do not use fluid which contains a petroleum base. Do not use a container which has been used for petroleum based fluids or a container which is wet with water. Petroleum based fluids will cause swelling and distortion of rubber parts in the hydraulic brake system and water will mix with brake fluid, lowering the fluid boiling point. Keep all fluid containers capped to prevent contamination.



1 – TUBE
2 – GROMMET
3 – CLAMP
4 – HOSE

J10004-5-P

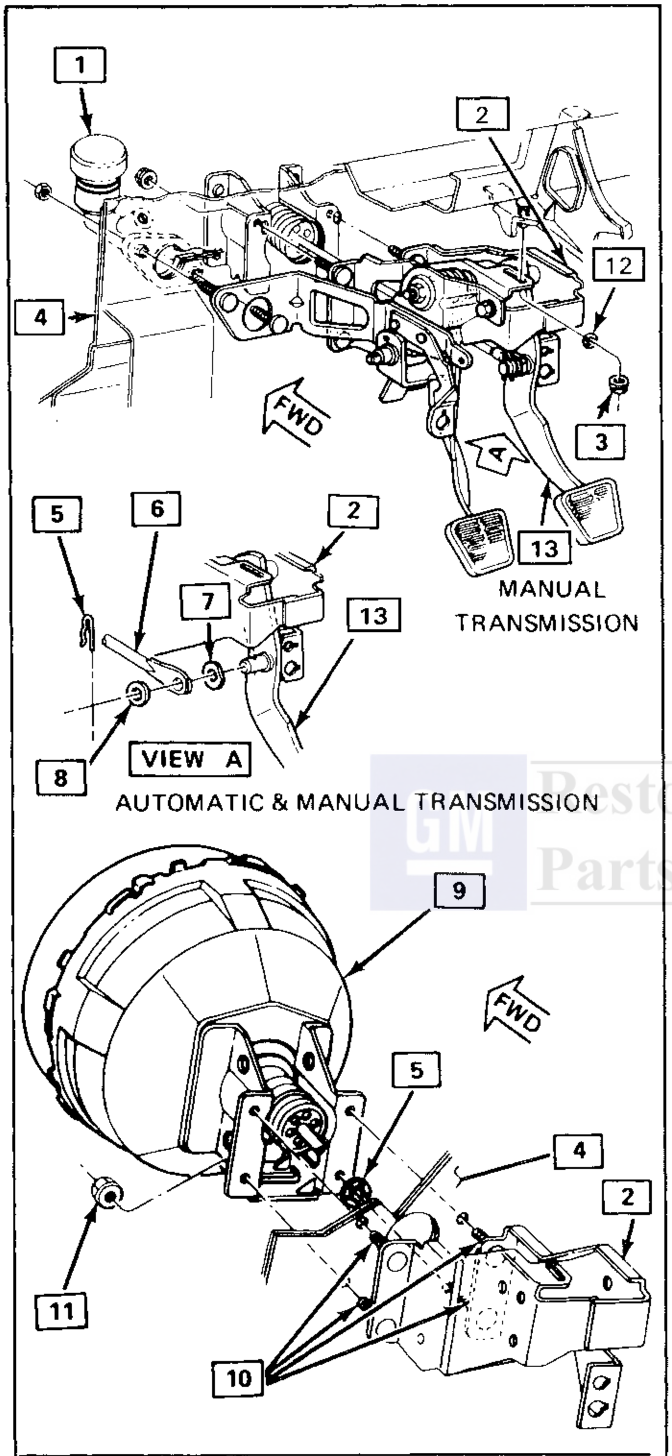
Figure 4 Power Brake Hoses and Tube



1 – PEDAL
2 – RETAINER
3 – SWITCH (W/O CRUISE CONTROL)
4 – SWITCH (WITH CRUISE CONTROL)
5 – PEDAL SUPPORT

J10005-5-P

Figure 5 Stoplamp Switch Adjustment



1 — CLUTCH MASTER CYLINDER
2 — BRAKE PEDAL SUPPORT
3 — NUT
4 — DASH PANEL
5 — RETAINER
6 — PUSHROD
7 — WASHER — INBOARD
8 — WASHER — OUTBOARD
9 — BOOSTER
10 — STUD
11 — NUT
12 — RETAINER
13 — BRAKE PEDAL

J10006-5-P

Figure 6 Brake Pedal Mounting

Add fluid as required to bring level to approximately 6mm (1/4 inch) from top of reservoir or within limits identified by steps on inboard front corner of reservoir. Use Delco Supreme No. 11 Hydraulic Brake Fluid or equivalent. Fluid must be "DOT 3."

BLEEDING BRAKE HYDRAULIC SYSTEM

A bleeding operation is necessary to remove air from the hydraulic brake system whenever it is introduced into the hydraulic system.

It may be necessary to bleed the hydraulic system at all four brakes if air has been introduced through a low fluid level or by disconnecting brake pipes at the master cylinder. If a brake pipe is disconnected at one wheel, only that wheel caliper needs to be bled. If pipes are disconnected at any fitting located between master cylinder and brakes, then the brake system served by the disconnected pipe must be bled.

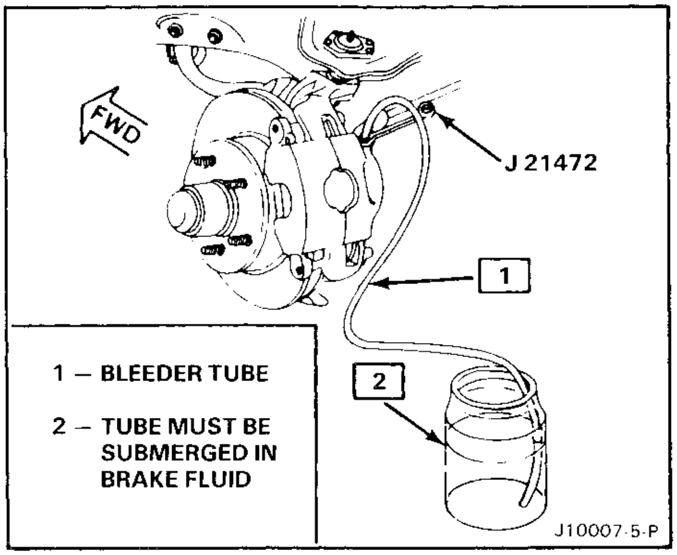
Manual Bleeding (Figure 7)

Tool Required:
J 21472 Bleeder Wrench

The time required to bleed the hydraulic system can be reduced if the master cylinder is filled with fluid and as much air as possible is expelled before the cylinder is installed on the vehicle.

Power brakes require removing the vacuum reserve by applying the brakes several times with the engine off. Care must be taken to prevent brake fluid from contacting any painted surface.

1. Fill the master cylinder reservoirs with brake fluid and keep at least half full of fluid during the bleeding operation.
2. If the master cylinder is known or suspected to have air in the bore, then it must be bled before any wheel cylinder or caliper in the following manner:
   a. Disconnect the forward (blind end) brake pipe connection at the master cylinder.
   b. Allow brake fluid to fill the master cylinder bore until it begins to flow from the forward pipe connector port.



1 — BLEEDER TUBE
2 — TUBE MUST BE SUBMERGED IN BRAKE FLUID

Figure 7 Bleeding Brakes (Typical)

   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, repeat step d and bleed the master cylinder at the rear (cowl) connection.
   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 or tool J 21472 over the bleeder valve. Attach a clear tube over bleeder valve and allow tube to hang submerged in a clear container partially filled with brake fluid. Depress the brake pedal **slowly one time and hold.** Loosen the bleeder valve to purge the air from the cylinder. Tighten bleeder screw and **slowly release pedal. Wait 15 seconds.** Repeat the sequence, including the 15 second wait until all air is removed. It may be necessary to repeat the sequence ten or more times to remove all the air. Rapid pumping of the brake pedal pushes the master cylinder secondary piston down the bore in a way that makes it difficult to bleed the rear side of the system.
4. If it is necessary to bleed all of the calipers, the following conventional sequence should be followed:
   a. right rear
   b. left rear
   c. right front
   d. left front
5. Check the brake pedal for "sponginess" and the "BRAKE" warning lamp for indication of unbalanced pressure. Repeat entire bleeding procedure to correct either of these two conditions.

Pressure Bleeding (Figures 7 and 8)

Tools Required:
J 29532 Bleeder
J 29567 Bleeder Adapter
J 21472 Bleeder Wrench

NOTICE: Pressure bleeding equipment must be the diaphragm type and must have a rubber diaphragm between the air supply and the brake fluid to prevent air, moisture, oil and other contaminants from entering the hydraulic system.

1. Install the bleeder adapter to the master cylinder.
2. Charge bleeder to 140-172 kPa (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. Raise car. See Section 0A.

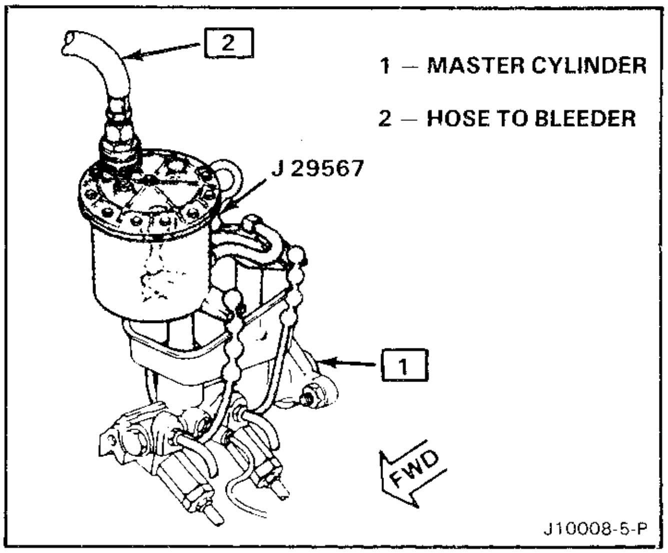


Figure 8 Plastic Reservoir Master Cylinder Pressure Bleeder Adapter (Typical)

5. Bleed the brakes in the following sequence:
   a. right rear
   b. left rear
   c. right front
   d. left front
6. Place a proper size box end wrench or J 21472 over the bleeder valve. Attach a clear tube over valve and allow tube to hang submerged in a clear container partially filled with brake fluid.
7. Open the bleeder valves at least 3/4 turn and allow flow to continue until no air is seen in the fluid.
8. Close the bleeder valves.
   - Be sure they seal.
9. Repeat steps 6 through 8 until all calipers have been bled.
10. Lower car. See Section 0A.
11. Check the brake pedal for "sponginess" and the "BRAKE" warning lamp for indication of unbalanced pressure.
    - Repeat entire bleeding procedure to correct either of these two conditions.
12. Remove brake bleeding equipment from master cylinder.

FLUSHING BRAKE HYDRAULIC SYSTEM

It is recommended that the complete hydraulic system be thoroughly flushed with clean brake fluid whenever new parts are installed in the hydraulic system.

The system must be flushed if there is any doubt about the grade of fluid in the system or if fluid has been used which contains the slightest trace of mineral oil.

All rubber parts that have been subjected to a contaminated fluid must be replaced.

Approximately one-quart of fluid is required to flush the hydraulic system.

BRAKE PIPE REPLACEMENT (Figures 9 and 10)

Tool Required:
J 29803 I.S.O. Flaring Tool

CAUTION: Never use copper tubing because copper is subject to fatigue cracking and corrosion which could result in brake failure. Use double walled steel tubing.

I.S.O. Flare (Figure 9)

1. Obtain the recommended tubing and steel fitting nuts of the correct size. (Outside diameter of tubing is used to specify size).
2. Cut tubing to length. Correct length may be determined by measuring old pipe using a string and adding 3mm (1/8-inch) for each I.S.O. flare.
3. Make sure fittings are installed before starting flare. Flare tubing ends using I.S.O. flaring tool, J 29803. Follow instructions included in tool set.
4. Bend pipe assembly to match old pipe using a tubing bender. Clearance of 19mm (.750-inch) must be maintained to all moving or vibrating parts.

BRAKE HOSE INSPECTION

Inspect

The flexible hydraulic brake hoses, which transmit hydraulic pressure from the steel brake lines 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 hoses should be checked for road hazard damage, for cracks and chafing of the outer cover and for leaks and blisters. A light and mirror may be needed for an adequate inspection. If any of the above conditions are observed on a brake hose it will be necessary to replace it.

BRAKE HOSE REPLACEMENT

Front Brake Hose

Remove or Disconnect (Figure 9)

1. Wheel and tire. See Section 3E.

Clean

- Dirt and foreign material from hoses and fittings.

2. Bolt attaching the brake hose clip to the upper control arm.
3. Brake pipe from hose.
    - Use a backup wrench on hose fitting.
    - Be careful not to bend bracket or pipe.
4. Spring clip from female fitting at bracket.
5. Hose from bracket.
6. Bolt, hose, and two copper gaskets from caliper.
    - Discard two copper gaskets.

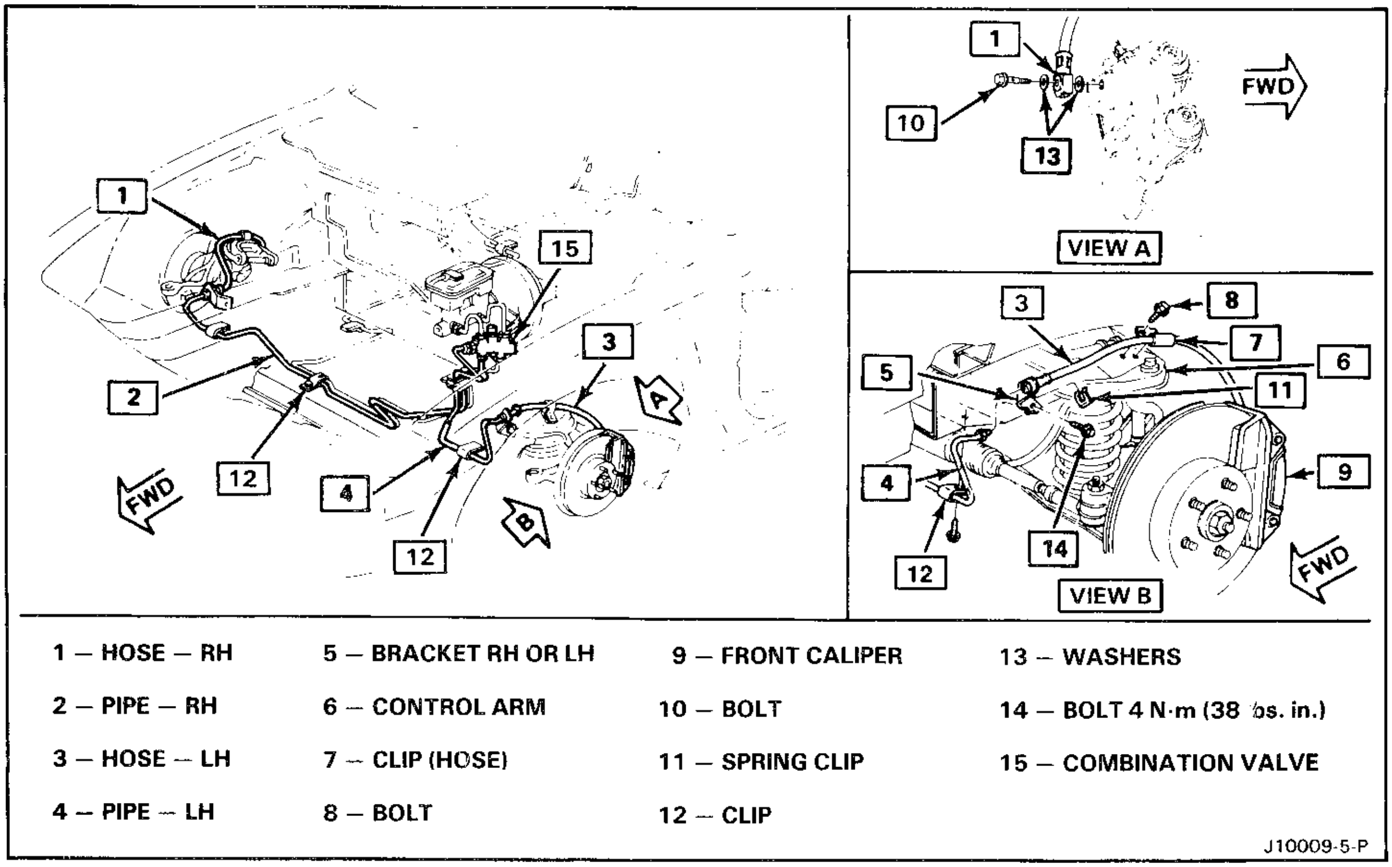
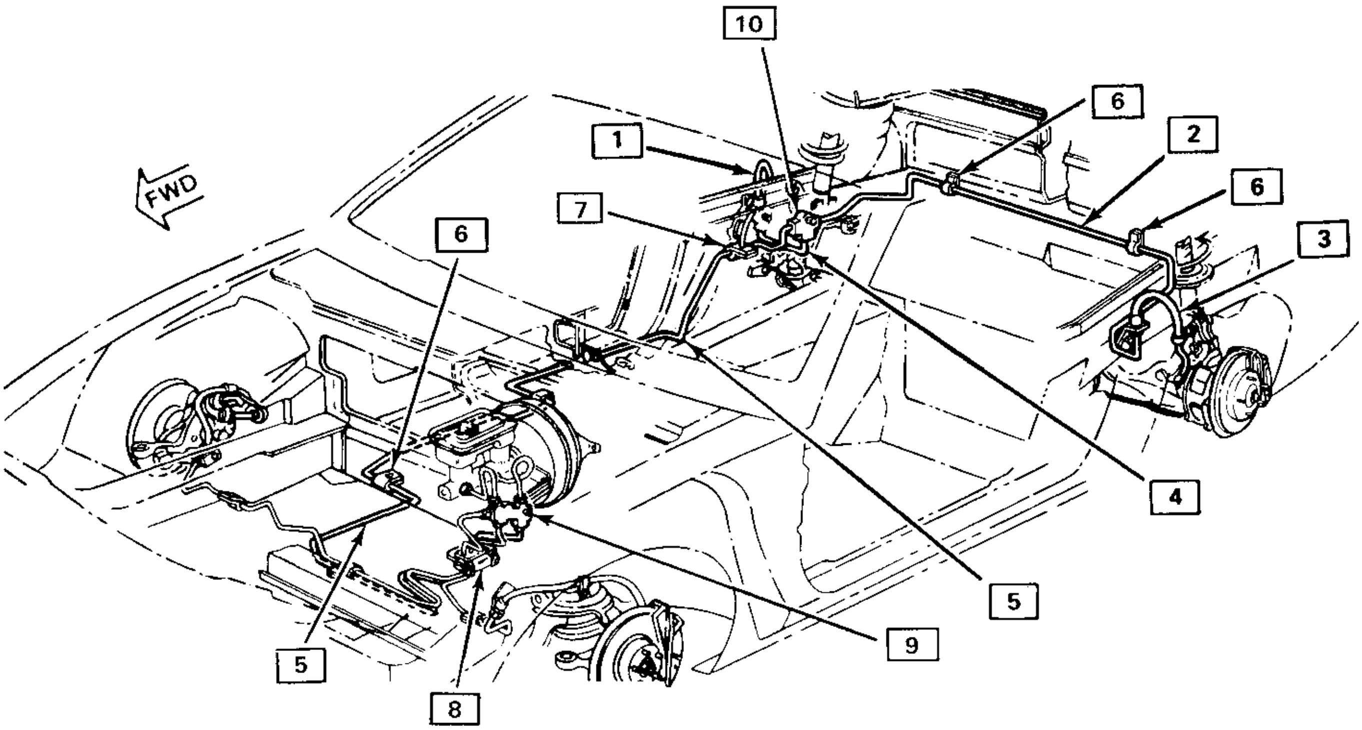


Figure 9 Front Brake Pipes and Hoses



1 — HOSE — REAR RH
2 — PIPE — REAR LH
3 — HOSE — REAR LH
4 — PIPE — REAR RH
5 — PIPE — REAR BRAKES
6 — CLIP
7 — FITTING
8 — BRACKET
9 — COMBINATION VALVE
10 — JUNCTION BLOCK

J10010-5-P

Figure 10 Center and Rear Brake Pipes

Install or Connect (Figure 9)

NOTICE: See "Notice" on page 5-1 for steps 1, 3 and 4.

1. Bolt, hose, and two copper gaskets to caliper.
    - Use new copper gaskets.
    - Lubricate bolt threads with brake fluid.
    - Fitting flange must engage caliper orientation ledge.

Tighten

- Bolt to 45 N·m (33 lbs. ft.).

2. Hose into bracket.
    - There should be no kinks in hose.
3. Bolt attaching hose clip to upper control arm.

Tighten

- Bolt to 6 N·m (54 lbs. in.).

4. Spring clip at hose mounting bracket.
5. Brake pipe to hose.
    - Use backup wrench on hose fitting.
    - Make sure that hose does not make contact with any part of suspension. Check in extreme right and extreme left turn conditions.

Tighten

- Fittings to 15 N·m (11 lbs. ft.).

6. Bleed brake system. See "Bleeding Brake Hydraulic System" in this section.
7. Wheel and tire. See Section 3E.

Rear Brake Hose

Remove or Disconnect (Figure 11)

1. Wheel and tire. See Section 3E.

Clean

- Dirt and foreign material from hoses and fittings.

2. Brake pipe from brake hose at hose mounting bracket.
   - Use a backup wrench on hose fitting.
   - Be careful not to bend bracket or pipe.
3. Spring clip at hose mounting bracket.
4. Bolt, hose and two copper gaskets from caliper.
   - Discard two copper gaskets.

Install or Connect (Figure 11)

NOTICE: See "Notice" on page 5-1 for steps 1 and 3.

1. Bolt, hose, and two copper gaskets to caliper.
   - Use new copper gaskets.
   - Lubricate bolt threads with brake fluid.

   Tighten

   - Bolt to 45 N·m (33 lbs. ft.)
2. Hose into bracket.
   - There should be no kinks in hose.
3. Spring clip at hose mounting bracket.
4. Brake pipe to brake hose.
   - Use backup wrench on hose fitting.
   - Be careful not to bend bracket or pipe.

   Tighten

   - Fittings to 15 N·m (11 lbs. ft.).
5. Bleed brake system. See "Bleeding Brake Hydraulic System" in this section.
6. Wheel and tire. See Section 3E.

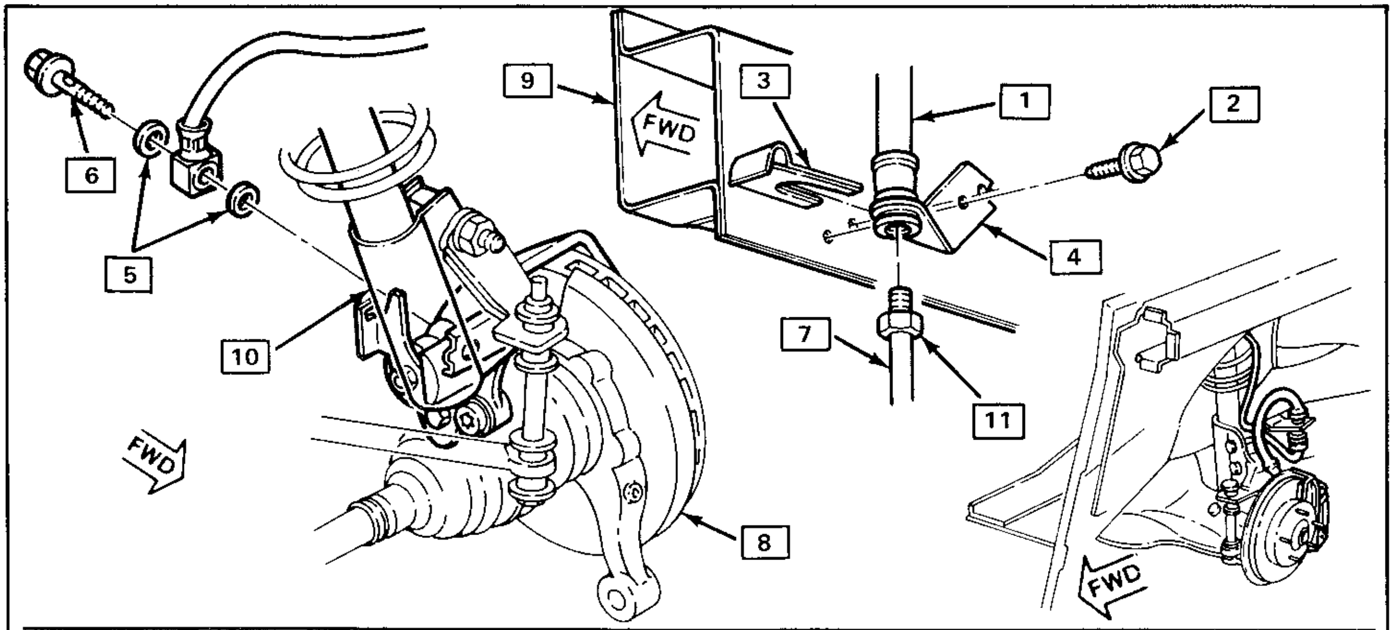
PARKING BRAKE

This vehicle is equipped with coated parking brake cable assemblies. The wire strand is coated with a clear plastic material which slides over plastic seals inside the conduit end fittings. This is for corrosion protection and reduced parking brake effort.

Handling of these cables during servicing of the parking brake system requires extra care. Damage to the plastic coating will reduce corrosion protection and if the damaged area passes through the seal, increase parking brake effort could result. Contact of the coating with sharp-edged tools, or with sharp surfaces of the vehicle underbody, should be avoided.

To prevent damage to the threaded parking brake adjusting rod when servicing the parking brake, the following is recommended:

- Before attempting to turn the adjusting nut, clean the exposed threads on each side of the nut.
- Lubricate the threads of the adjusting rod before turning the nut.



1 — HOSE — RR BRAKE LH OR RH
2 — BOLT/BRAKE HOSE BRACKET 4 N·m (36 lbs. in.)
3 — SPRING CLIP
4 — BRACKET — BRAKE HOSE LH OR RH
5 — WASHER
6 — BOLT/BRAKE HOSE
7 — PIPE LH OR RH
8 — CALIPER
9 — FRAME
10 — REAR STRUT
11 — NUT

J10011-5-P

Figure 11 Rear Brake Hoses

PARKING BRAKE CONTROL ASSEMBLY

Remove or Disconnect (Figure 12)

- Raise vehicle. See Section 0A.
- Loosen adjusting nut at equalizer enough to allow cable to be disconnected from parking brake control assembly.
- Lower vehicle. See Section 0A.

1. Carpet finish molding.
2. Parking brake lever boot.
   - Unsnap clip holding boot to lever.
3. Wiring from switch.
4. Cable and casing from control assembly.
   - Use a 1/2-inch box end wrench to free casing from control assembly.
5. Two bolts and control assembly from floor pan.

Install or Connect (Figure 12)

1. Two bolts and control assembly to floor pan.

   Tighten

   - Two bolts to 28 N·m (21 lbs. ft.).
2. Cable and casing to control assembly.
3. Wiring to switch.
4. Parking brake lever boot.
   - Snap clip holding boot to lever.
5. Carpet finish molding.

Adjust

- Parking brake. See Section 5B10.

PARKING BRAKE CABLES

Parking Brake Front Cable

Remove or Disconnect (Figure 12)

- Raise vehicle. See Section 0A.

1. Cable from equalizer and clip.
2. Cable and casing from cradle and pull out.

- Lower vehicle. See Section 0A.

3. Carpet finish molding.
4. Parking brake lever boot.
   - Unsnap clip holding boot to lever.
5. Seat belt anchor bolt.
6. Shoulder harness retaining bolt.
7. Quarter trim finishing molding.
8. Cable with grommet.
   - Pull back carpet.
   - Bend clamp away from cable.
   - Unseat grommet.
   - Pull cable through body, from inside car.

Install or Connect (Figure 12)

1. Cable with grommet.
   - Push cable through body, from inside car.
   - Bend clamp down over cable.
   - Seat grommet in floorpan.
   - Reposition carpet.
2. Quarter trim finishing molding.
3. Shoulder harness retaining bolt.
4. Seat belt anchor bolt.
5. Parking brake lever boot.
   - Snap clip holding boot to lever.
6. Carpet finish molding.

- Raise vehicle. See Section 0A.

7. Cable casing to cable.
   - Push through hole in cradle.
   - Seat clip on casing.
8. Cable to equalizer and clip.

- Lower vehicle. See Section 0A.

Adjust

- Parking brake. See Section 5B10.

Parking Brake Rear Cable

Remove or Disconnect (Figure 12)

- Raise vehicle. See Section 0A.

1. Cable from clip and equalizer.
2. Cable and casing from caliper.
3. Casing clip at cradle.
4. Cable and casing from cradle.

Install or Connect (Figure 12)

1. Cable and casing through cradle.
2. Casing clip at cradle.
3. Cable and casing to caliper.
4. Cable to clip and equalizer.

- Lower vehicle. See Section 0A.

Adjust

- Parking brake. See Section 5B10.

BRAKE LINING INSPECTION

Inspect the brake lining at least twice a year when the wheels are removed (tire rotation, etc.). Check both ends of the outer shoe by looking in the hole in the rear of the caliper. These are the points at which the highest rate of wear normally occurs. Also check the lining thickness on the inner shoe to make sure that it has not worn prematurely. Look through the hole in the rear of the caliper to view the inner shoe. Whenever the thickness of any lining is worn to within 0.76 mm (0.030-inch) of rivet or either end of the shoe, replace the disc brake shoe and lining assemblies in sets.

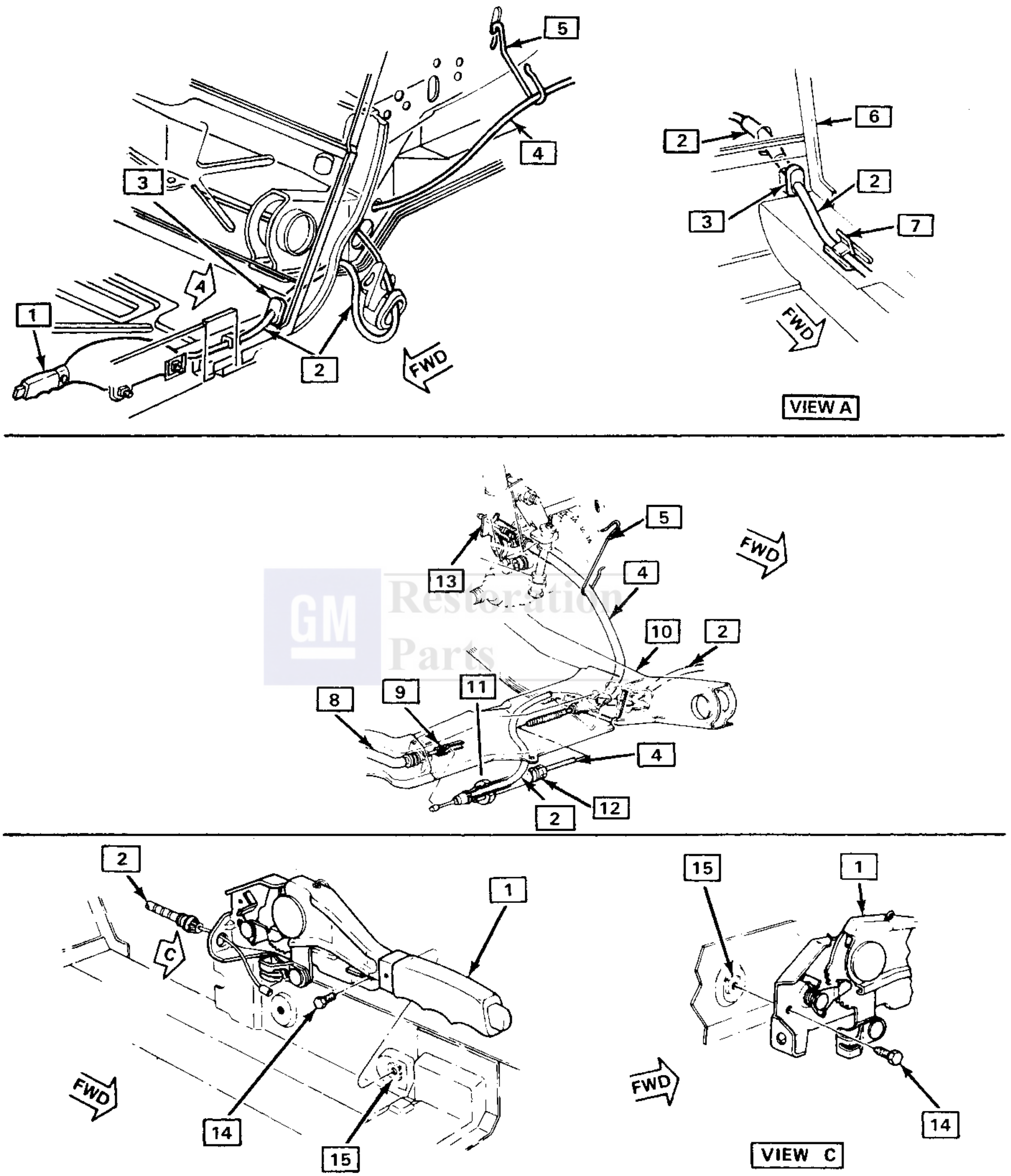
INSPECTING AND REFINISHING ROTORS

Thickness Variation Check

Thickness variation can be checked by measuring the thickness of the rotor at four or more points around the circumference of the rotor. All measurements must be made at the same distance in from the edge of the rotor. A rotor that varies by more than 0.013 mm (0.0005-inch) can cause pedal pulsation and/or front end vibration during brake applications. A rotor that does not meet these specifications should be refinished to specifications or replaced.

Lateral Runout Check

1. Remove caliper and install two inverted lug nuts to retain rotor.



1 — CONTROL ASSEMBLY
2 — FRONT CABLE
3 — GROMMET
4 — LEFT REAR CABLE
5 — CLIP
6 — FLOOR PAN
7 — CLIP
8 — RIGHT REAR CABLE
9 — CLIP
10 — FRAME
11 — INSULATOR
12 — EQUALIZER
13 — LEVER
14 — BOLT
15 — WELD NUT

J10012-5-P

Figure 12 Parking Brake Control Assembly and Cables

2. Fasten a dial indicator to the steering knuckle so that the indicator button contacts the rotor about 1 inch from the rotor edge.
3. Zero the dial indicator.
4. Move the rotor one complete revolution and observe total indicated runout (T.I.R.).

Excessive lateral runout of the rotor can often be improved by indexing the rotor on the hub one or two bolt positions from the original position. If the lateral runout cannot be corrected by indexing the rotor, check the hub and bearing assembly for excessive lateral runout. If the hub and bearing assembly lateral runout exceeds .040 mm (.0015-inch), replace the hub and bearing assembly. If lateral runout is within specifications, see "Rotor Tolerance and Surface Finish."

A rotor that does not meet the lateral runout specification should be resurfaced or replaced as necessary.

Rotor Tolerance and Surface Finish

In manufacturing the brake rotor, tolerances of the braking surfaces for flatness, thickness variation and lateral runout are held very close. The maintenance of close tolerances on the shape of the braking surfaces is necessary to prevent brake roughness.

In addition to these tolerances, the surface finish must be held to a specified range. The control of the braking surface finish is necessary to avoid pulls and erratic performance and to extend lining life.

Light scoring of the rotor surfaces not exceeding 0.38 mm (0.015-inch) in depth, which may result from normal use, will not affect brake operation.

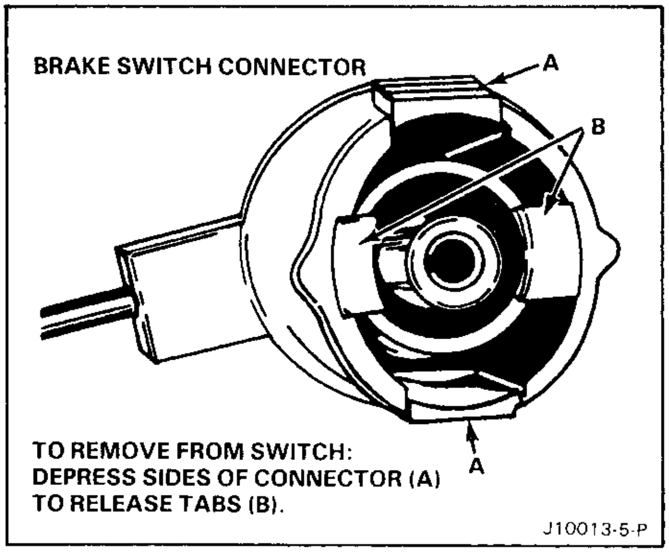
Refinishing Brake Rotors

All brake rotors have a minimum thickness dimension cast into them. This dimension is the minimum wear dimension and not a refinish dimension. Do not use a brake rotor that will not meet specifications. See Section 5F.

Since accurate control of the rotor tolerances is necessary for proper performance of the disc brakes, machining of the rotor should be done only with precision equipment.

When refinishing rotors, always use sharp cutting tools or bits. Dull or worn tools leave a poor surface finish which will affect initial braking performance. Vibration dampening attachments should always be used when refinishing braking surfaces. These attachments eliminate tool chatter and will result in better surface finish.

The optimum speed for refinishing braking surfaces is a spindle speed of 200 rpm. Crossfeed for rough cutting should range from 0.254-0.152 mm (0.010-0.006-inch) per revolution. Finish cuts should be made at crossfeeds no greater than 0.051 mm (0.002-inch) per revolution.



TO REMOVE FROM SWITCH:
DEPRESS SIDES OF CONNECTOR (A)
TO RELEASE TABS (B).

Figure 13 Removing Brake Switch Connector

COMBINATION VALVE

Testing Combination Valve Electrical Circuit (Figure 13)

When removing the electrical wire connector from the pressure differential switch, squeeze the eliptical shaped plastic locking ring and pull up. This will move the locking tangs away from the switch. Pliers can be used to help remove the connector.

1. Disconnect wire from switch terminal and use a jumper to connect wire to a good ground.
2. Turn ignition key to "ON." The warning lamp should light. If lamp does not light, bulb is burned out or electrical circuit is faulty. Replace bulb or repair electrical circuit as necessary.
3. When warning lamp lights, turn off ignition switch. Disconnect jumper and connect wire to switch terminal.

Testing Combination Valve Warning Lamp Switch

1. Attach a bleeder hose to a rear brake bleed screw and immerse the other end of the hose in a container partially filled with clean brake fluid. Be sure master cylinder reservoirs are full.
2. Turn ignition switch to "ON." Open bleeder screw while an assistant applies moderate pressure to the brake pedal. Warning lamp should light. Close bleeder screw before assistant releases brake pedal. Apply brake pedal with moderate-to-heavy pressure. Lamp should go out.
3. Attach the bleeder hose to a front brake bleeder screw and repeat steps 1 and 2. Warning lamp action should be the same as in step 2. Turn off ignition switch.
4. If warning lamp does not light during steps 2 and 3, but does light when a jumper is connected to ground, the warning lamp switch portion of the combination valve is faulty. Do not disassemble the combination valve. If any portion of the combination valve is faulty, it must be replaced with a new combination valve.

Combination Valve Replacement

↔ Remove or Disconnect (Figures 13 and 14)

- The combination valve is not repairable and must be serviced as a complete assembly.

1. Hydraulic pipes at combination valve.
    - Plug pipes to prevent loss of fluid and entrance of dirt.
2. Wiring harness from valve switch terminal.
3. Bolt attaching valve to bracket.
4. Combination valve.

Install or Connect (Figures 13 and 14)

NOTICE: See "Notice" on page 5-1.

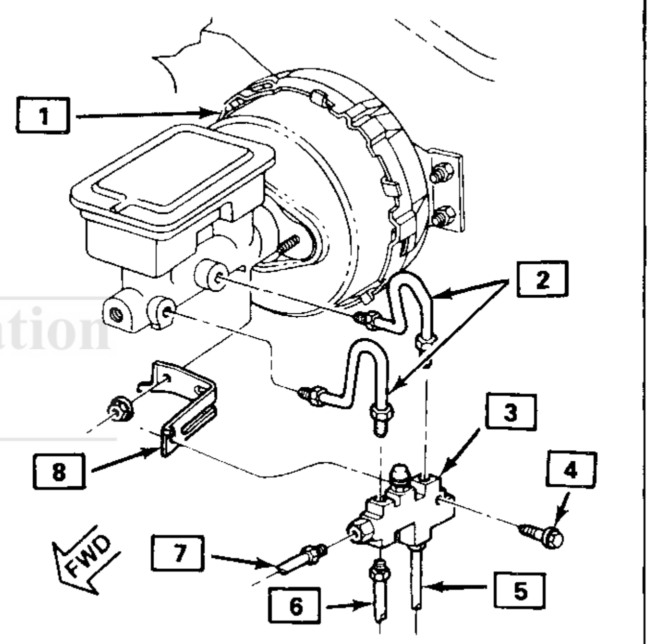
1. Combination valve.
2. Bolt attaching valve to bracket.

   Tighten

   - Bolt to 6 N·m (54 lbs. in.).
3. Wiring harness to valve switch terminal.
4. Hydraulic pipes at combination valve.

- Bleed brakes. See "Bleeding Brake Hydraulic System" in this section.

CAUTION: Do not move the car until a firm brake pedal is obtained. Air in the brake system can cause loss of brakes.



1 – BOOSTER
2 – PIPE
3 – VALVE
4 – BOLT
5 – BRAKE PIPE – RR
6 – PIPE – R H
7 – PIPE – L H
8 – BRACKET

J10014-5-P

Figure 14 Combination Valve to Master Cylinder Mounting

SECTION 5A3

COMPOSITE MASTER CYLINDER

CONTENTS

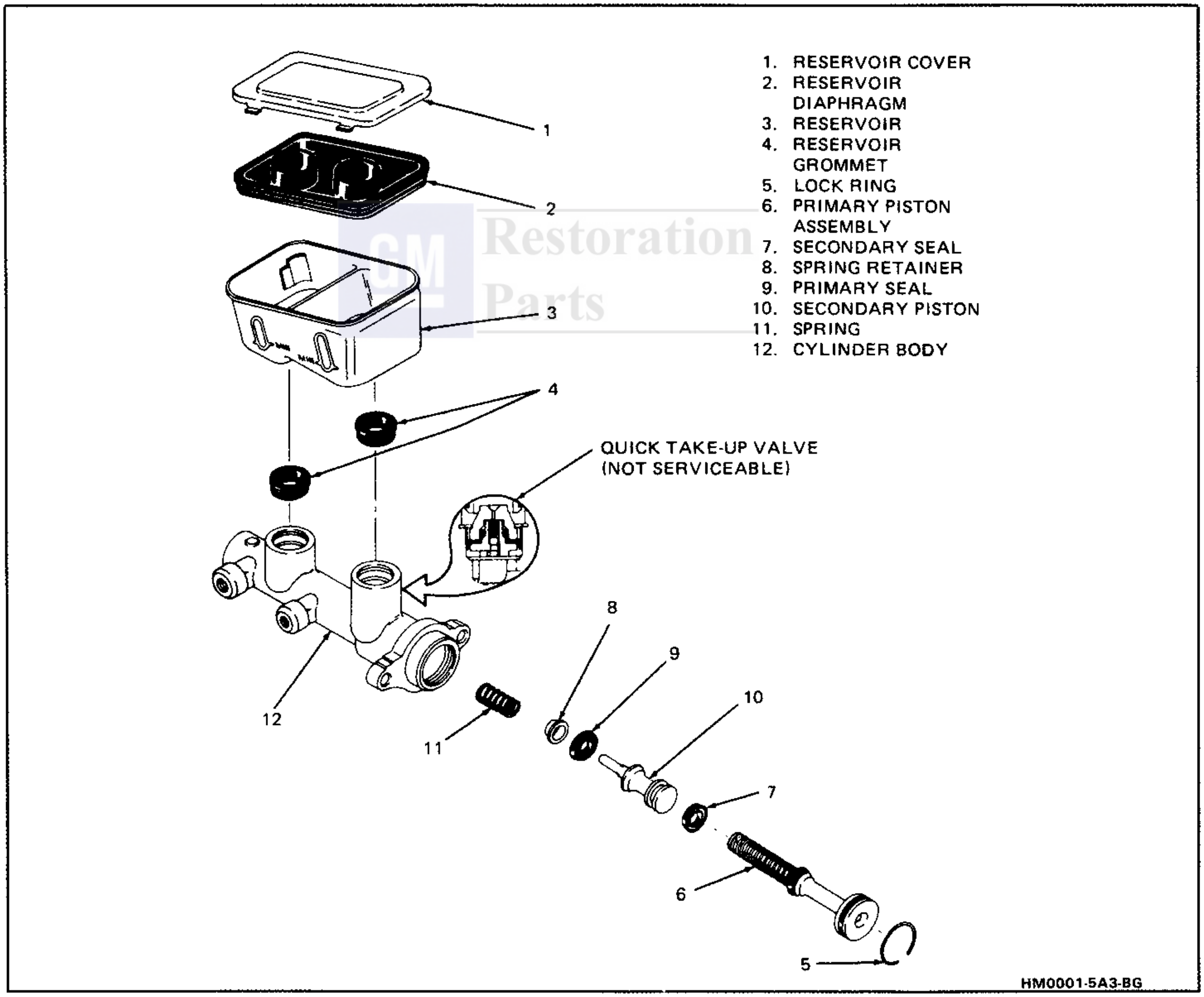


Figure 5A3-1 Composite Master Cylinder

GENERAL DESCRIPTION

This master cylinder is a composite design (plastic reservoir and aluminum bore) incorporating a conventional front to rear brake system split. The primary piston provides the fluid pressure to the front brakes, while the secondary piston provides the fluid pressure to the rear brakes. If pressure is lost from either system, the remaining system will function to stop the vehicle.

A quick take-up feature is incorporated which provides a large volume of fluid to the wheel brakes at low pressure with initial brake apply. The low pressure fluid quickly provides the displacement requirements created by the seal retraction of the pistons into the front calipers.

Important

- Replace all components included in repair kits used to service this master cylinder.
- Lubricate rubber parts with clean brake fluid to ease assembly.
- Do not use lubricated shop air on brake parts as damage to rubber components may result.
- If any hydraulic component is removed or disconnected, it may be necessary to bleed all or part of the brake system.
- The torque values specified are for dry, unlubricated fasteners.
- Perform service operations on a clean bench free from all mineral oil materials.

ON-CAR SERVICE

MASTER CYLINDER ASSEMBLY

Remove or Disconnect (Figure 5A3-2)

1. Tube nuts (14) and hydraulic lines.
   - Plug open lines to prevent fluid loss and contamination.
2. Two attaching nuts (15).
3. Master cylinder (13).

- See NOTICE on page 5-1.

Install or Connect (Figure 5A3-2)

1. Master cylinder (13) with attaching nuts (15) to 27 N·m (20 lb-ft).
2. Hydraulic lines and tube nuts (14) to 23 N·m (17 lb-ft).
3. Fill master cylinder to proper level with clean brake fluid.
   - Bleed hydraulic system.
   - Recheck fluid level.

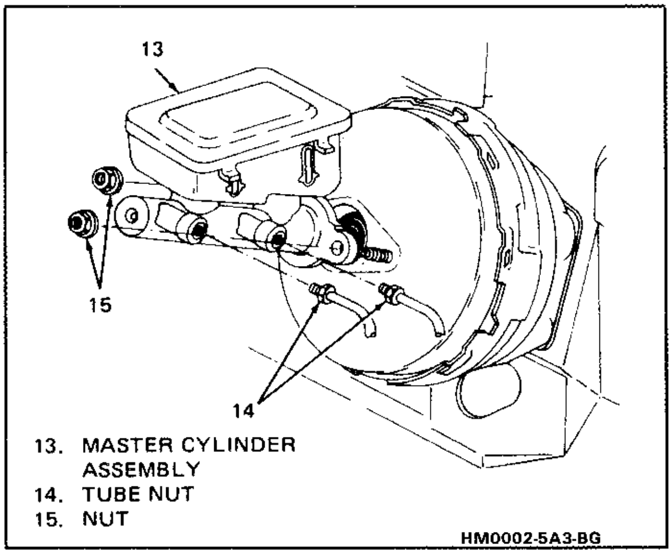


Figure 5A3-2 Removing Master Cylinder Assembly

UNIT REPAIR

MASTER CYLINDER OVERHAUL

Disassemble (Figure 5A3-1)

Important

Reservoir cover and diaphragm can be inspected and/or serviced without removing the master cylinder from the vehicle.

1. Master cylinder (13) completely from vehicle as previously described.
2. Reservoir cover (1) and diaphragm (2).
   - Wipe reservoir cover clean before removing.
   - Empty fluid from reservoir (only if master cylinder is to be completely removed and overhauled).

Inspect

- Reservoir cover (1) and diaphragm (2) for:
  - Cuts
  - Cracks
  - Nicks
  - Deformation
- Replace damaged parts.

3. Retainer (5) while depressing primary piston assembly (6).
   - Take care not to damage the piston, bore, or retainer groove.
4. Apply low pressure dry compressed air into outlet port at blind end of bore (other outlet port plugged) to remove:
   - Primary piston assembly (6).
   - Secondary piston (10).
   - Spring (11).
   - Spring retainer (8).
5. From secondary piston (10):
   - Seals (7 and 9).
   - Spring retainer (8).

Inspect

- Master cylinder bore for scoring or corrosion.
- If noted, replace master cylinder.
- No abrasives should be used in bore.

Clean

- All parts in clean, denatured alcohol.
- Dry with unlubricated compressed air.

Assemble (Figure 5A3-1)

- See NOTICE on page 5-1.

1. Lubricated seals (7 and 9) and spring retainer (8) onto secondary piston (10).
2. Spring (11), and secondary piston assembly (7 thru 10) into cylinder bore.
    - To ease reassembly, lubricate with clean brake fluid.
3. Lubricated primary piston assembly (6) into cylinder bore.
4. Retainer (5) while depressing primary piston assembly (6).
5. Diaphragm (2) into reservoir cover (1) and install on reservoir (3).
6. Master cylinder (13) as previously described.

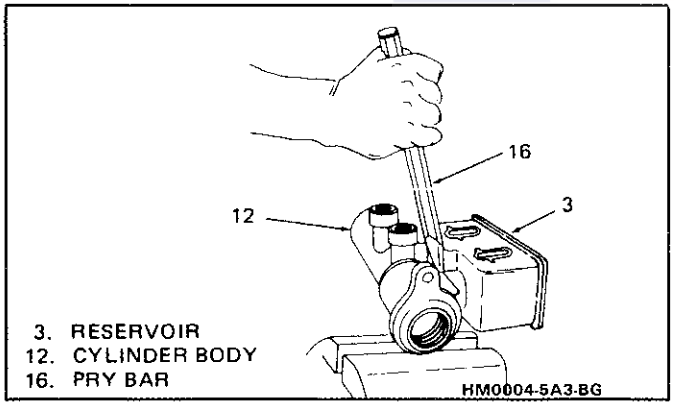


Figure 5A3-3 Removing Reservoir

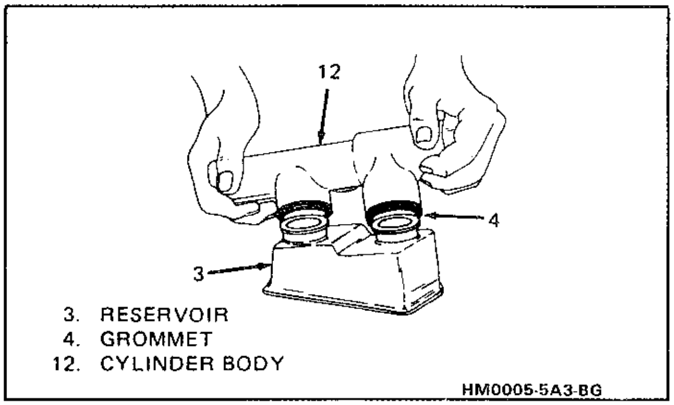


Figure 5A3-4 Installing Reservoir

MASTER CYLINDER RESERVOIR

Disassemble (Figures 5A3-3,5A3-4)

1. Remove and disassemble master cylinder as previously described.
2. Clamp flange of master cylinder body (12) in vise.

Important

- Do not clamp on master cylinder body (12).
- Do not remove quick take-up valve from body.
- Valve is not serviceable separately.

3. Reservoir (3) using a pry bar (16).
4. Reservoir grommets (4).

Inspect

- Reservoir for cracks or deformation.
- Replace if found.

Clean

- Reservoir with clean denatured alcohol.
- Dry with unlubricated compressed air.

Assemble (Figure 5A3-4)

- See NOTICE on page 5-1.
    - Lubricate new grommets (4) and reservoir bayonets with clean brake fluid.

1. Grommets (4) into master cylinder body (12).
    - Make sure grommets are properly seated.
2. Reservoir (3) into master cylinder body (12) using rocking motion.
3. Reassemble master cylinder and install as previously described.

SECTION 5B4

DISC BRAKE CALIPER ASSEMBLY 48H FRONT CALIPER

CONTENTS

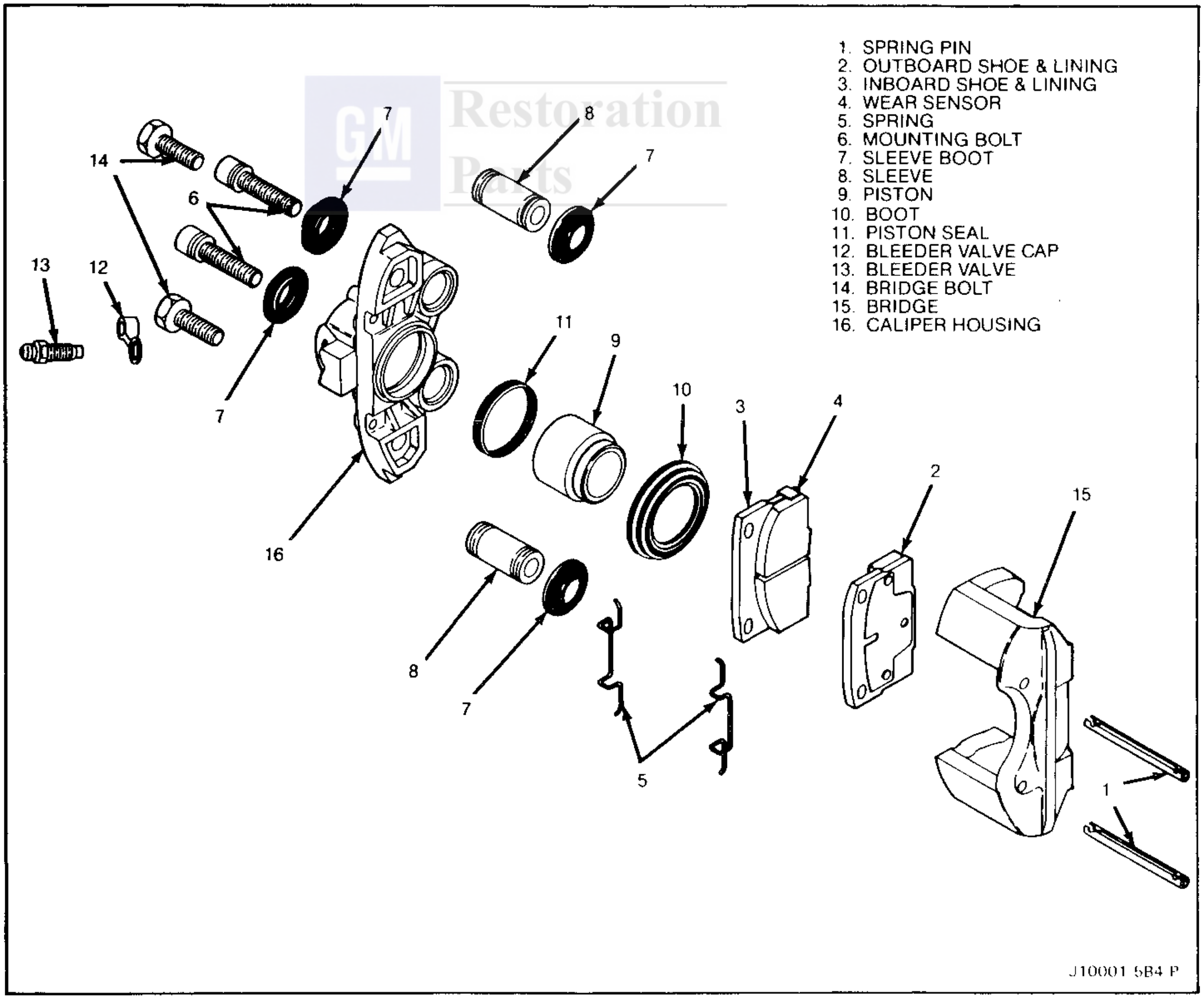


Figure 1 48H Front Caliper Assembly Components

GENERAL DESCRIPTION

This caliper has a single bore and is mounted to the support bracket with two mounting bolts. Hydraulic pressure, created by applying the brake pedal, is converted by the caliper to a stopping force. This force acts equally against the piston and the bottom of the caliper bore to move the piston outward and to 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: Do not use lubricated shop air on brake parts as damage to rubber components may result.

Important

- Replace all components included in repair kits used to service this caliper.
- Lubricate rubber parts with clean brake fluid to make assembly easier.
- If any hydraulic component is removed or disconnected, it may be necessary to bleed all or part of the brake system.
- Replace shoe and linings in axle sets only.
- The torque values specified are for dry, unlubricated fasteners.
- Perform service operations on a clean bench, free from all mineral oil materials.

ON-CAR SERVICE

SHOE AND LINING ASSEMBLIES

Remove or Disconnect (Figures 1 through 8)

Tools Required:
J 6125-1B Slide Hammer
J 36620 Spring Pin Remover

1. Two-thirds of brake fluid from master cylinder assembly.
- Raise car and suitably support. See Section 0A.
- Mark relationship of wheel to axle flange.
2. Wheel and tire. See Section 3E.
    - Install two inverted wheel nuts to retain rotor.
- Bottom piston into caliper bore to provide clearance between linings and rotor.
    - Position 12-inch adjustable pliers over caliper housing (16) and flange of the inboard brake shoe (3).
    - Squeeze pliers to compress piston back into caliper bore.

CAUTION: Be prepared to catch springs when removing spring pins. Springs may fly out causing injury to personnel.

3. Spring pins (1).
    - Connect J 36620 onto J 6125-1B.
    - Remove threaded tip from rod on J 36620. Insert rod completely through pin (1) and install threaded tip as far as it will go.
    - Thrust weight on J 6125-1B outward, against tool handle to drive out pin (1).
4. Springs (5) from inboard and outboard shoe flanges.
5. Outboard shoe and lining (2).
    - Lift through caliper opening.
6. Inboard shoe and lining (3).
    - Lift through caliper opening.
    - If necessary, push on bridge (15), moving caliper housing (16) inboard to provide clearance for removing inboard shoe and lining (3).

Install or Connect (Figures 1 through 8)

Important

- Piston (9) must be bottomed into caliper housing (16) bore before installing new shoe and linings (2 and 3).

1. Inboard shoe and lining (3) with wear sensor (4) at leading edge of shoe during forward wheel rotation.
2. Outboard shoe and lining (2).

NOTICE: See "Notice" on page 5-1.

NOTICE: In the following steps, do not use a steel drift to install pins. This will damage ends of pins and make later removal of pins difficult.

3. One spring pin (1) aligning holes in shoe and linings (2 and 3).
    - Tap in pin (1) using hammer and soft brass rod or drift until end of pin just emerges from inboard face of caliper housing (16).
4. Springs (5) and remaining pin (1).
    - Position pins (1) so that slots in pins face each other. This will ease assembly of springs (5).
    - Tap in pin (1) as in step 3 above, but stop when pin (1) is just through outboard section of caliper housing (16). Pin (1) can then be moved by hand.

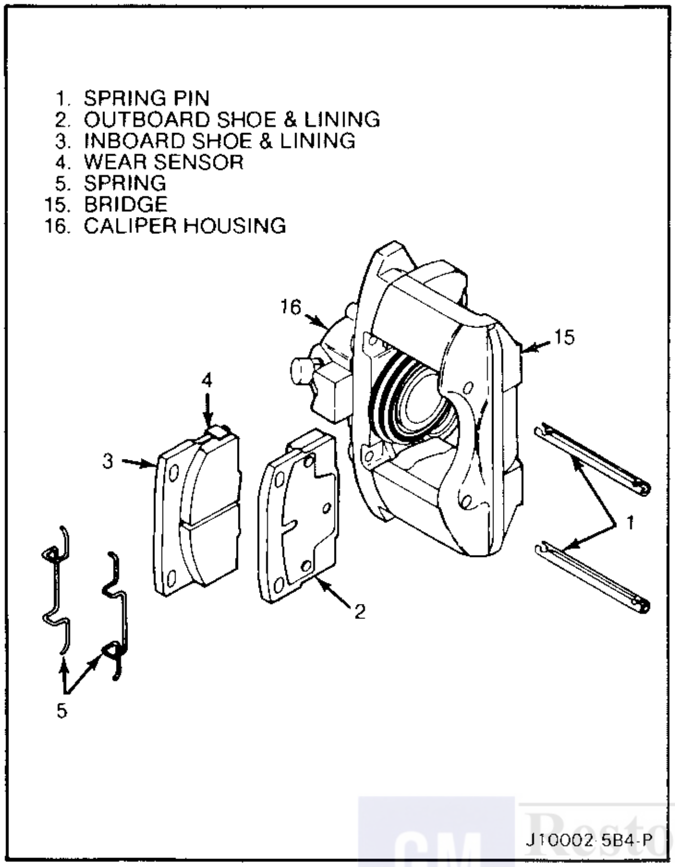


Figure 2 Shoe and Lining Assembly

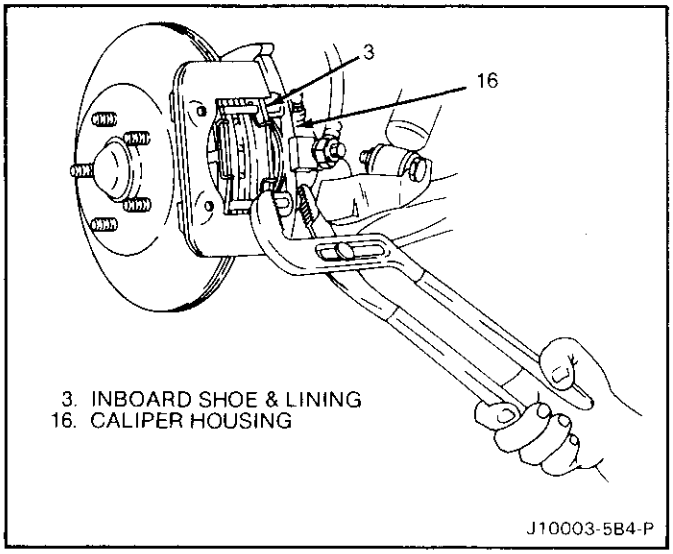


Figure 3 Compressing Piston

- Install springs (5) one at a time. Hook end of spring (5) under pin (1) installed in step 3, with midsection of spring (5) over shoe flange.
- Press down on other end of spring (5) with screwdriver as remaining pin (1) is slid inboard. Figure 8 shows outboard spring (5) installed and inboard spring (5) being installed.
- Complete pin installation by tapping as in step 3 above.

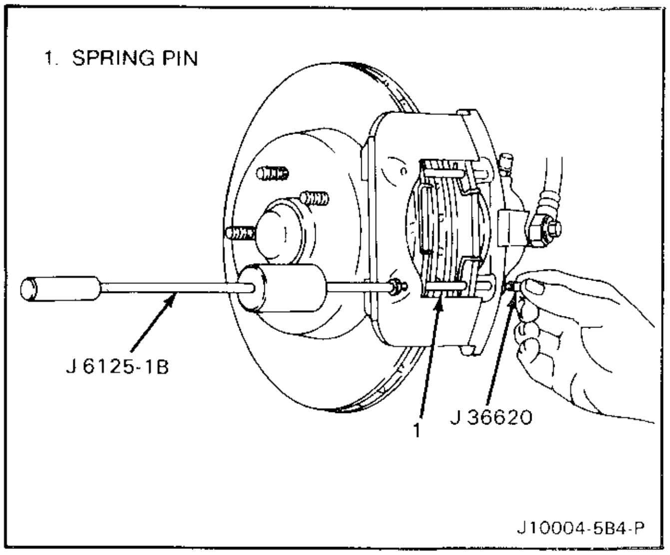


Figure 4 Attaching Impact Tool

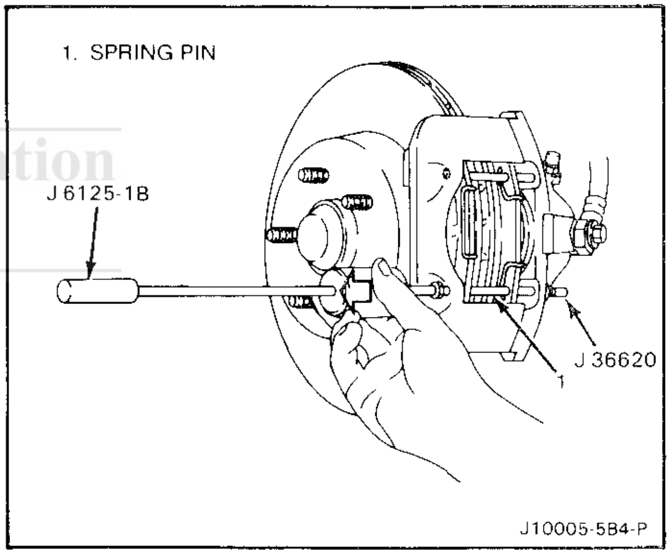


Figure 5 Removing Spring Pins

  - Make sure springs (5) are centered on shoe flanges with each spring end projecting under pins (1) an equal amount.
- Wheels and tires, aligning previous marks. See Section 3E.
  - Remove wheel nuts securing rotor to hub.
  - Lower car. See Section 0A.
  - Torque wheel nuts. See Section 3E.
- Fill master cylinder to proper level with clean brake fluid.
- Apply approximately 778 N (175 lb.) force to brake pedal three times to seat linings.

CALIPER ASSEMBLY

↔ **Remove or Disconnect (Figures 9 through 12)**

1. Shoes and linings as previously described.

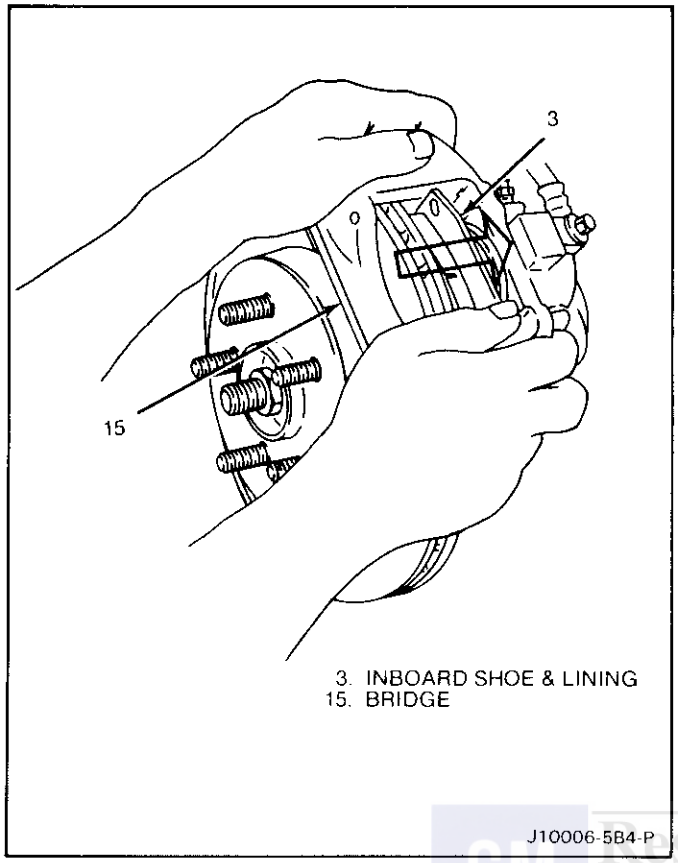


Figure 6 Moving Caliper Inboard

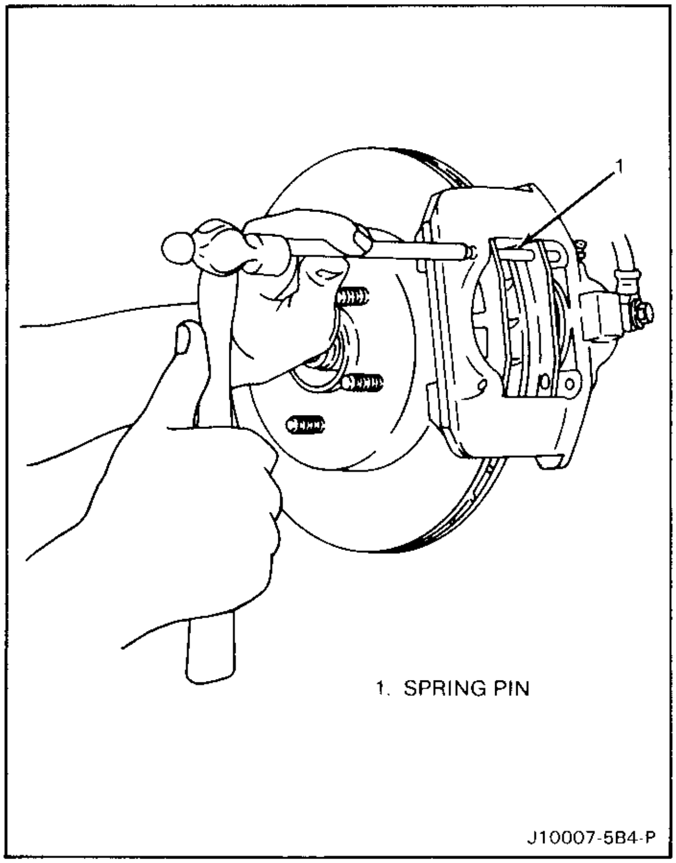


Figure 7 Installing Spring Pins

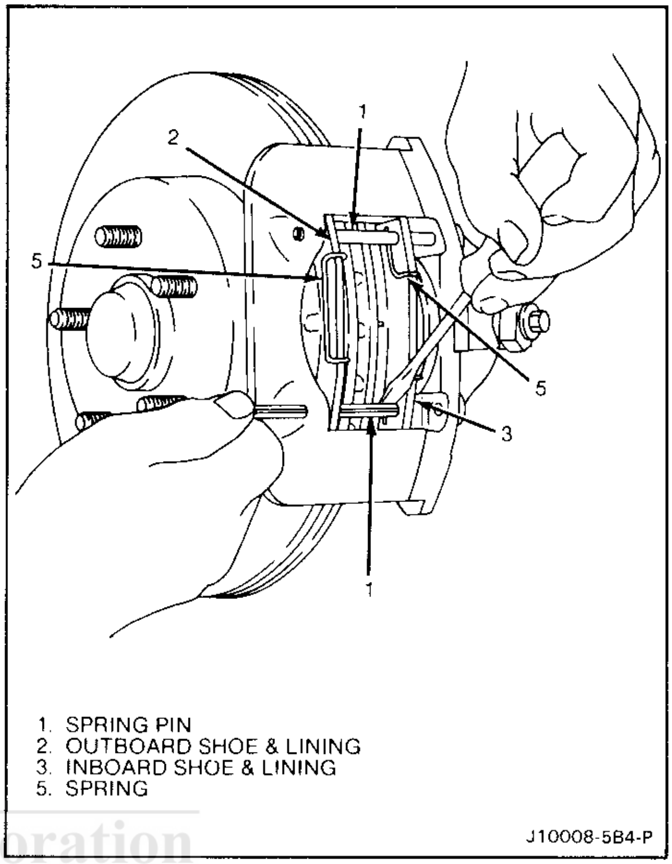


Figure 8 Installing Springs

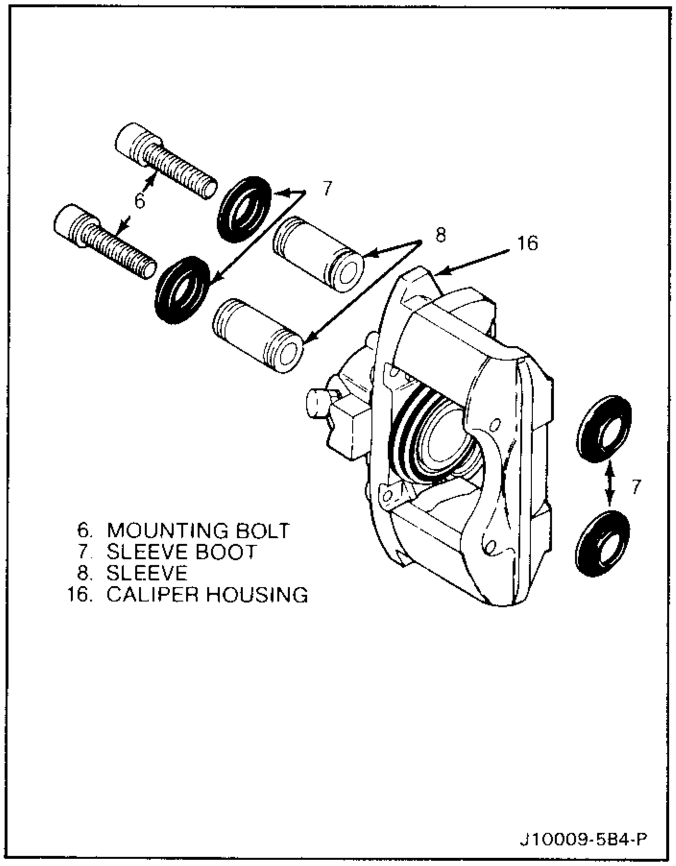


Figure 9 Front Caliper Assembly

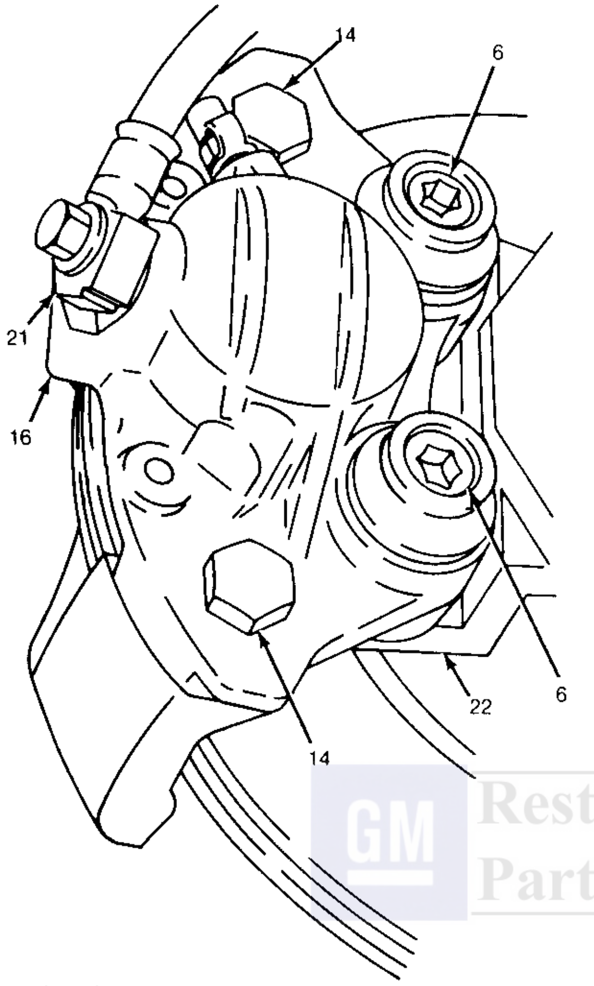


Figure 10 Front Caliper Installed

2. Bolt attaching inlet fitting (21), only if caliper housing (16) is to be removed from vehicle for overhaul.
   - Plug openings in caliper housing (16) and pipe to prevent fluid loss and contamination.
3. Mounting bolts (6) using No. 55 torx wrench.
   - Do not confuse mounting bolts (6) with bridge bolts (14).
4. Caliper housing (16) from mounting bracket (22) and rotor.
   - If caliper overhaul or replacement is not required, hang caliper housing (16) with a wire hook from the suspension to avoid damaging the brake hose.
5. Sleeves (8) and sleeve boots (7).

Inspect (Figure 9)

- Mounting bolts (6) and sleeves (8) for corrosion.
- Sleeve boots (7) for cuts, nicks, or deterioration.
  - If corrosion is found, use new parts, including sleeve boots (7) when installing caliper housing (16).
  - Do not attempt to polish away corrosion.

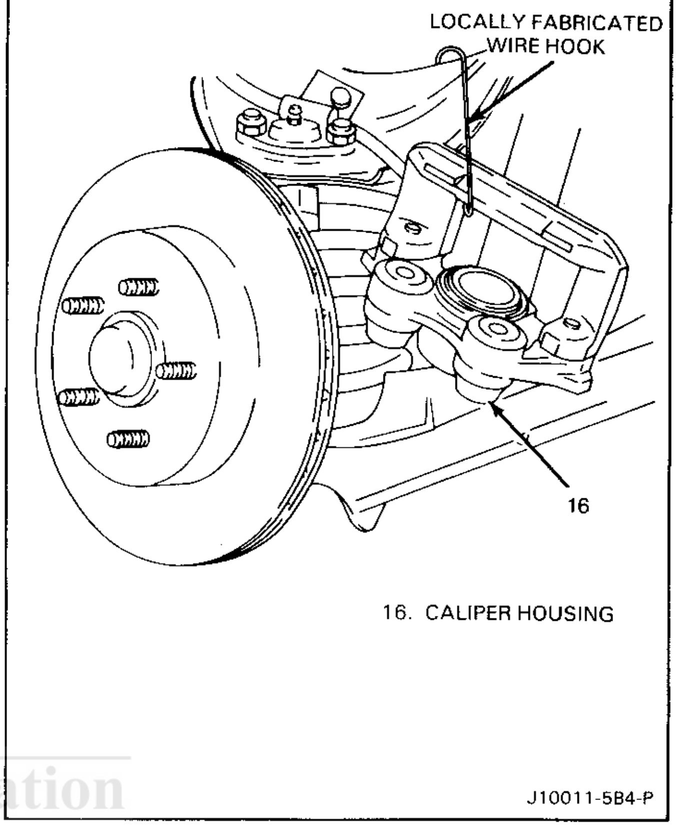


Figure 11 Suspending Front Caliper

Install or Connect (Figures 9 through 12)

NOTICE: Make sure sleeves are installed with large holes facing inboard. If sleeves are installed backwards, damage to threads in mounting bracket can result.

1. Sleeve (8) and sleeve boots (7) in caliper housing (16).
   - Lubricate sleeve (8) OD and mounting bolt hole ID in caliper housing (16) with silicone grease.
   - Lubricate both ID and OD sealing beads on sleeve boots (7) with silicone grease.
   - Install one sleeve boot (7) OD into groove in mounting bolt hole of caliper housing (16).
   - Push sleeve (8) into mounting bolt hole past ID of installed sleeve boot to approximate position shown in figure 12, view A.
   - Install second sleeve boot (7) OD in groove at other end of mounting bolt hole. See figure 12, view B.
   - Push sleeve (8) back the other way and seat the ID beads on both sleeve boots (7) into grooves of sleeve (8). See figure 12, view C.
   - Repeat procedure with remaining sleeve (8) and sleeve boots (7).

NOTICE: See "Notice" on page 5-1.

2. Caliper housing (16) over rotor to mounting bracket (22) with mounting bolts (6).

Tighten

- Bolts (6) to 100 N·m (74 lbs. ft.) using No. 55 torx wrench.

Important

- Make sure that caliper mounting bolts (6) are properly torqued.

3. Inlet fitting (21), if removed.
   - Use new copper gaskets.

Tighten

- Fitting (21) to 45 N·m (33 lbs. ft.).

4. Shoes and linings as previously described.

- If inlet fitting (21) was removed, bleed caliper. See Section 5.
- Check brake fluid and fill if necessary. See Section 5.

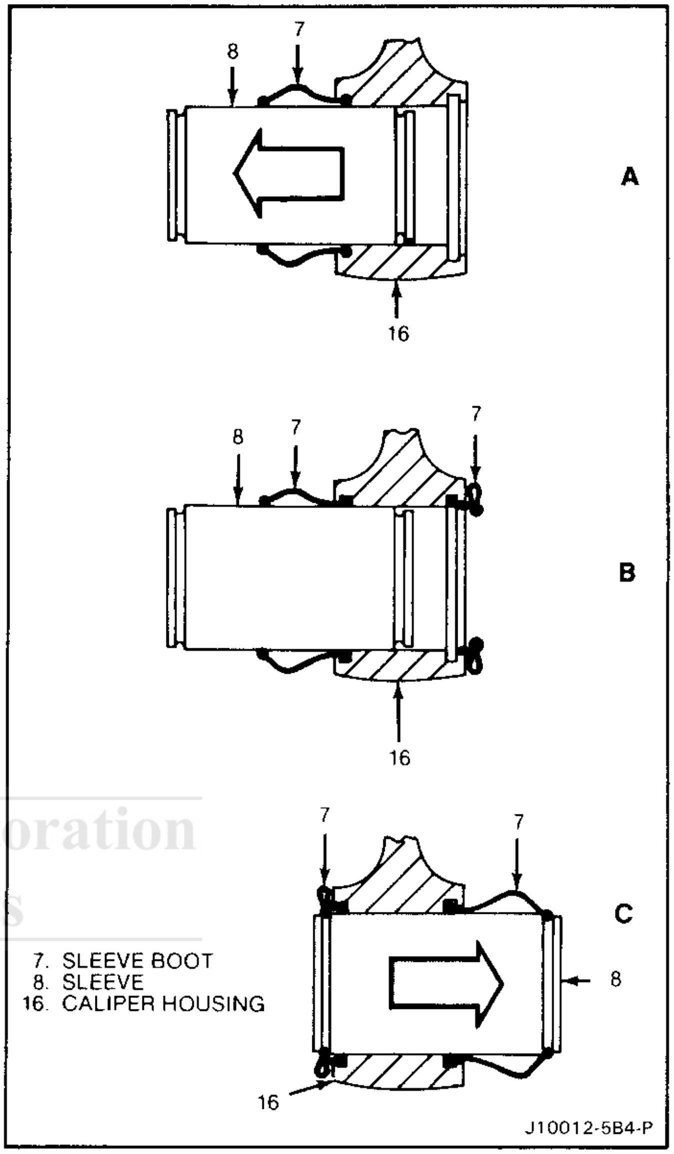


Figure 12 Installing Sleeves and Sleeve Boots

UNIT REPAIR

CALIPER OVERHAUL

Remove or Disconnect

- Caliper as previously described.

Inspect (Figure 13)

- Bridge (15) for cracks.

Disassemble (Figures 13 through 15)

1. Bridge bolts (14) and bridge (15) only if bridge (15) is suspected of being cracked or damaged.
   - Caliper housing (16) can be overhauled without removing bridge (15).

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.

2. Piston (9) using compressed air into the caliper housing inlet hole.

Important

- Use clean shop towels as a pad over bridge (15) during piston removal.

Inspect

- Piston (9) for scoring, nicks, corrosion and worn or damaged chrome plating.
  - Replace piston (9) if any of the above are found.

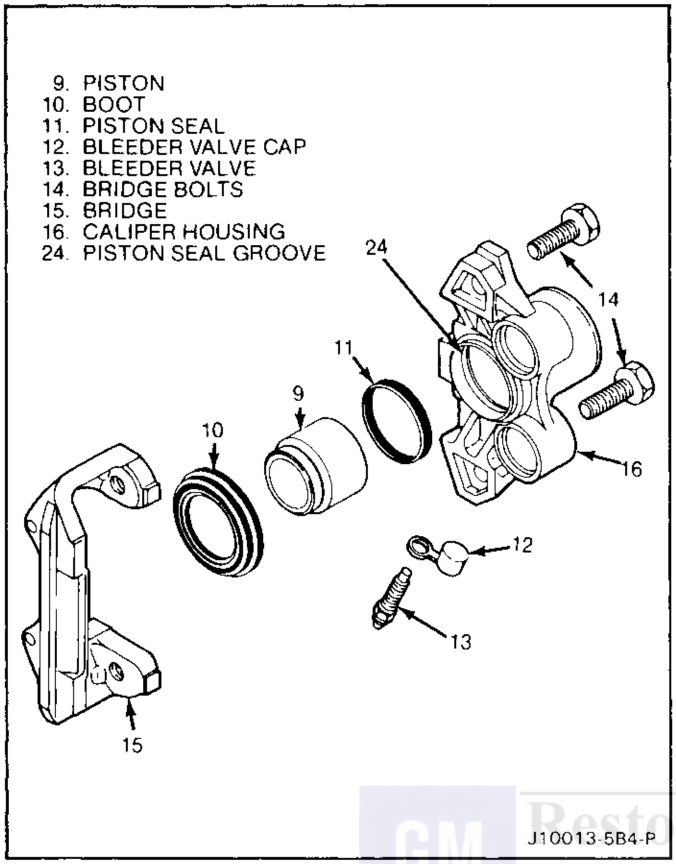


Figure 13 Front Caliper Assembly Components

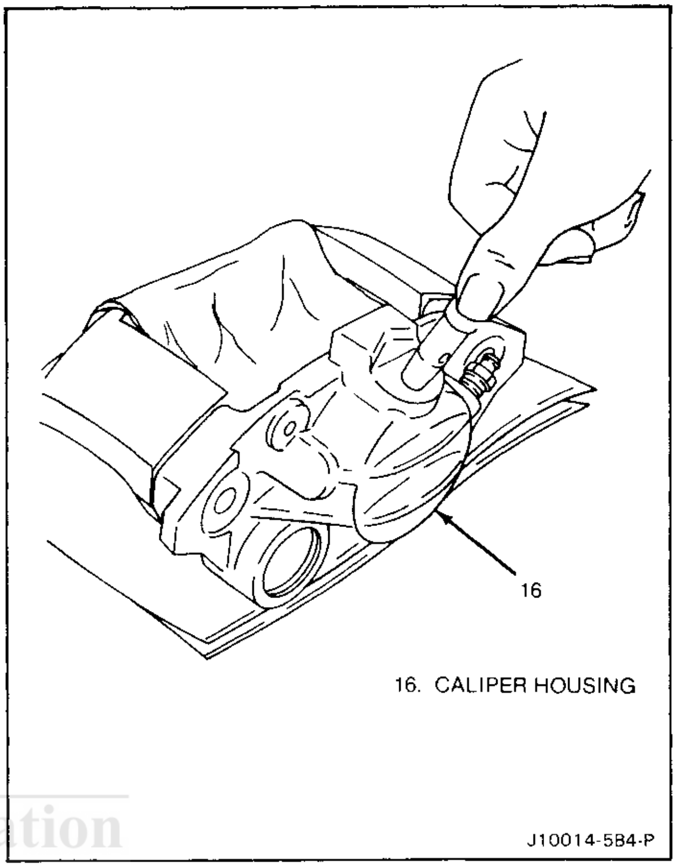


Figure 14 Removing Caliper Piston

3. Boot (10).
    - Be careful not to scratch housing (16).

NOTICE: Do not use a metal tool to remove piston seal. Metal tools may damage caliper bore or seal groove.

4. Piston seal (11) from groove (24) in caliper housing (16).
    - Use a small wood or plastic tool.

Inspect (Figure 13)

- Caliper bore and piston seal groove (24) for scoring, nicks, corrosion and wear.
    - Use crocus cloth to polish out light corrosion.
    - Replace caliper housing (16) if corrosion in and around seal groove (24) will not clean up with crocus cloth.

5. Bleeder valve cap (12) and bleeder valve (13) from caliper housing (16).

Clean (Figure 13)

- All parts in clean, denatured alcohol.
- Dry with unlubricated compressed air.
- Blow out all passages in housing (16) and bleeder valve (13).

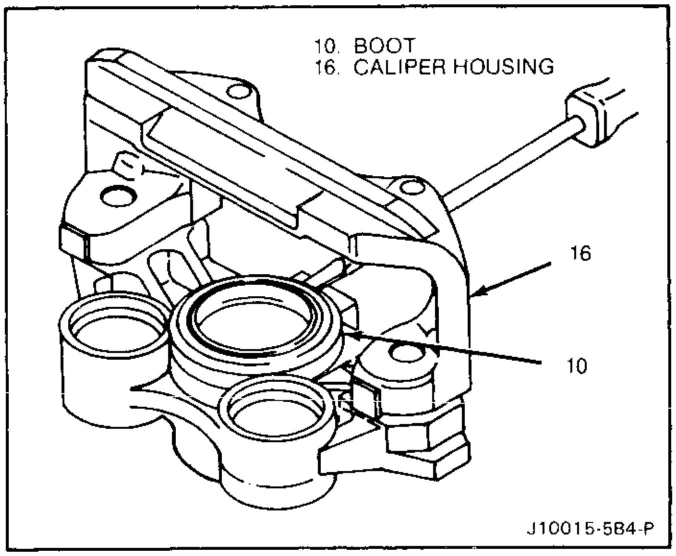


Figure 15 Removing Caliper Boot

Assemble (Figures 13 through 18)

Tools Required:
J 36622 Boot Seal Installer
J 36623 Piston Installer

NOTICE: See "NOTICE" on page 5-1.

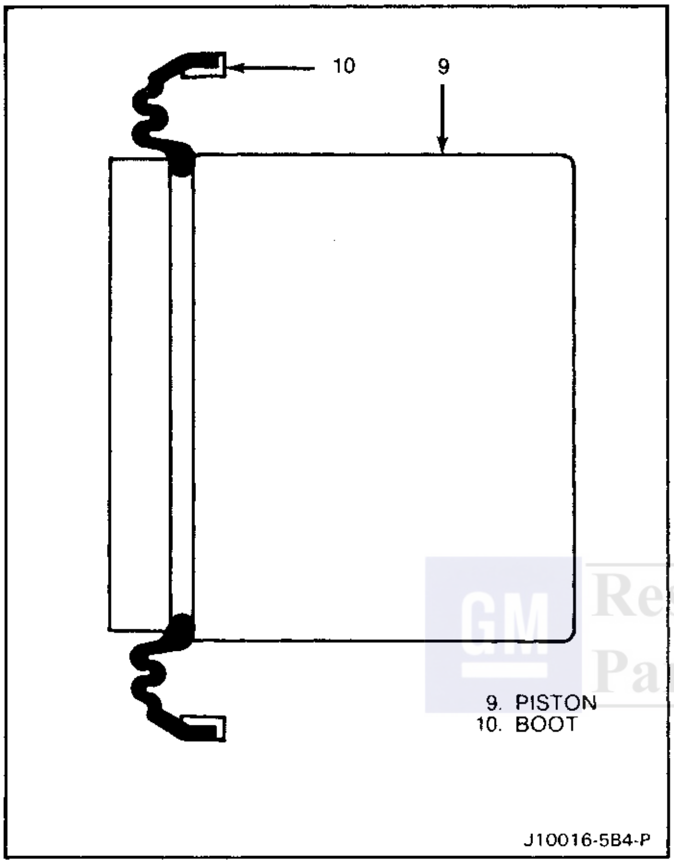


Figure 16 Installing Boot Onto Piston

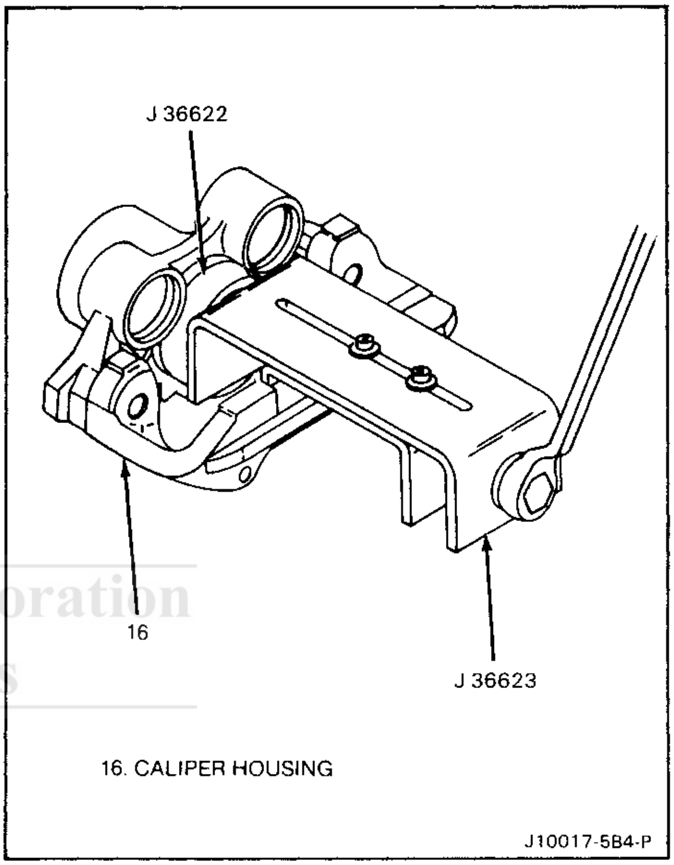


Figure 17 Seating Boot Into Caliper Housing

1. Bridge (15) and bridge bolts (14), if removed or replaced.

   Tighten

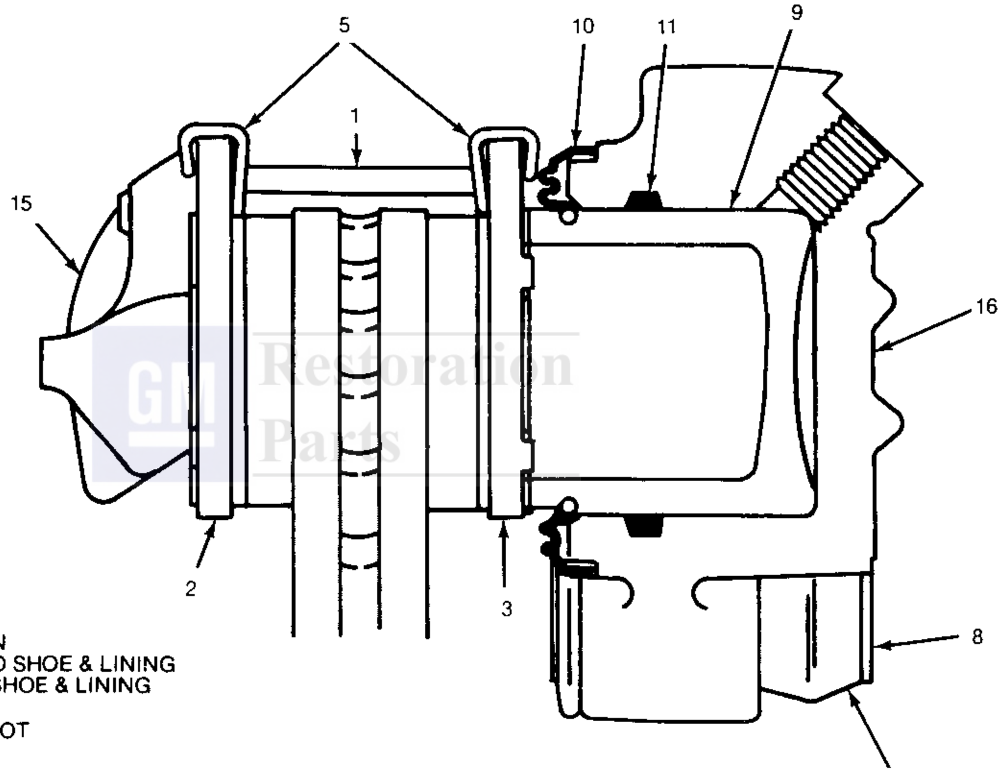
   - Bridge bolts (14) to 100 N·m (74 lbs. ft.).
2. Bleeder valve (13) and valve cap (12).

   Tighten

   - Bleeder valve (13) to 13 N·m (116 lbs. in.).
3. Lubricated new piston seal (11) into piston seal groove (24).
   — Make sure seal (11)is not twisted.
4. Lubricated boot (10) onto piston (9).
5. Piston (9) with boot (10) into bore of caliper housing (16) and push to bottom of bore.
   - Use J 36623 to bottom piston (9).
6. Boot (10) to counterbore in caliper housing (16) using J 36622 and J 36623.

Install or Connect

- Caliper as previously described.



1. SPRING PIN
2. OUTBOARD SHOE & LINING
3. INBOARD SHOE & LINING
5. SPRING
7. SLEEVE BOOT
8. SLEEVE
9. PISTON
10. BOOT
11. PISTON SEAL
15. BRIDGE
16. CALIPER HOUSING

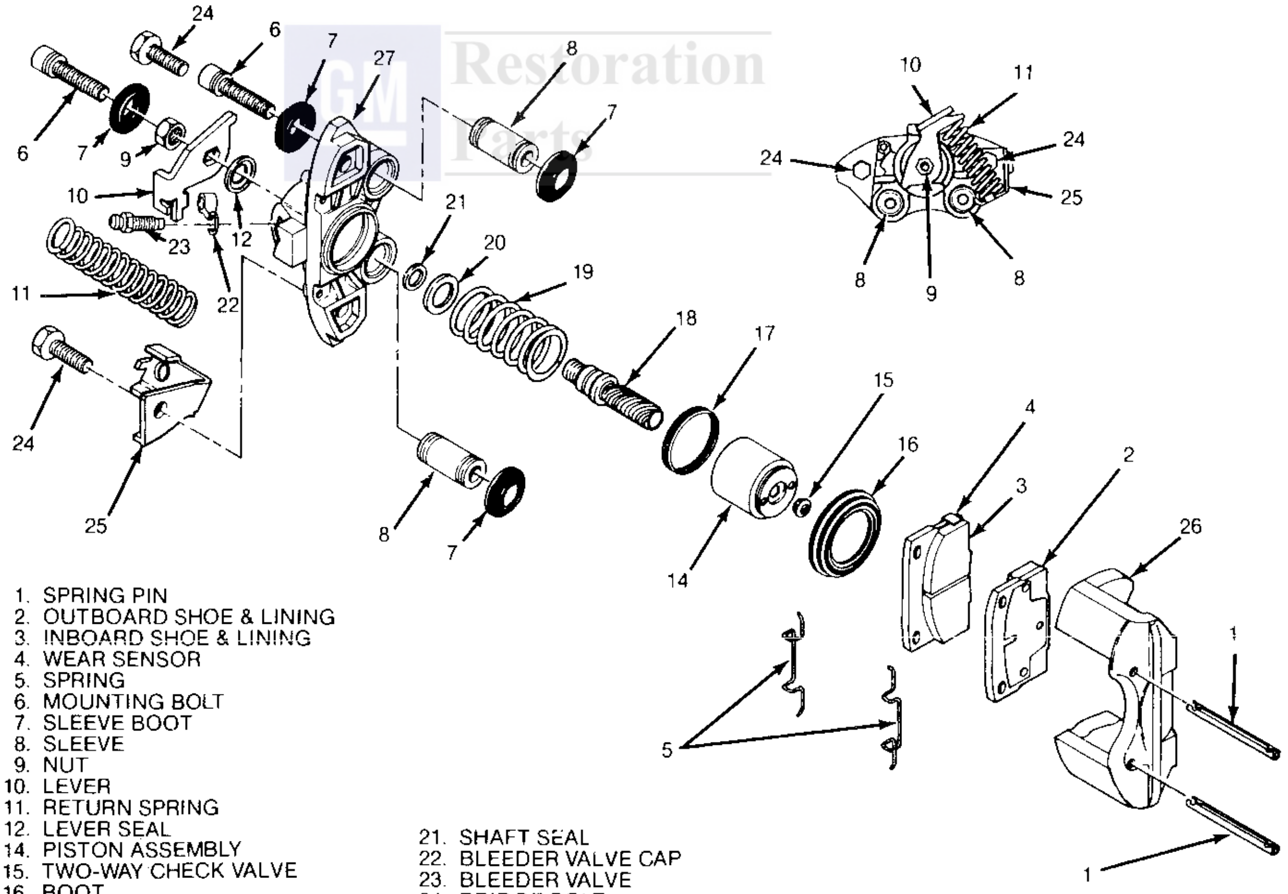
J10018-5B4-P

Figure 18 48H Front Caliper Assembly — Cutaway View

SECTION 5B10

DISC BRAKE CALIPER ASSEMBLY 48H REAR CALIPER

CONTENTS



1. SPRING PIN
2. OUTBOARD SHOE & LINING
3. INBOARD SHOE & LINING
4. WEAR SENSOR
5. SPRING
6. MOUNTING BOLT
7. SLEEVE BOOT
8. SLEEVE
9. NUT
10. LEVER
11. RETURN SPRING
12. LEVER SEAL
14. PISTON ASSEMBLY
15. TWO-WAY CHECK VALVE
16. BOOT
17. PISTON SEAL
18. ACTUATOR SCREW
19. BALANCE SPRING
20. THRUST WASHER
21. SHAFT SEAL
22. BLEEDER VALVE CAP
23. BLEEDER VALVE
24. BRIDGE BOLT
25. BRACKET
26. BRIDGE
27. CALIPER HOUSING

J10001-5B10-P

Figure 1 48H Rear Caliper Assembly Components

GENERAL DESCRIPTION

This caliper has a single bore and is mounted to the support bracket with two mounting bolts. Hydraulic pressure, created by applying force to the brake pedal, is converted by the caliper to a stopping force. This force acts equally against the piston and the bottom of the caliper bore to move the piston outward and to slide the caliper inward which results 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, into a nut in the piston assembly which 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: Do not use lubricated shop air on brake parts as damage to rubber components may result.

Important

- Replace all components included in repair kits used to service this caliper.
- Lubricate rubber parts with clean brake fluid to make assembly easier.
- If any hydraulic component is removed or disconnected, it may be necessary to bleed all or part of the brake system.
- Replace shoe and linings in axle sets only.
- The torque values specified are for dry, unlubricated fasteners.
- Perform service operations on a clean bench, free from all mineral oil materials.

ON-CAR SERVICE

SHOE AND LINING ASSEMBLIES

Remove or Disconnect (Figures 1 through 9)

Tools Required:
J 6125-1B Slide Hammer
J 36620 Spring Pin Remover
J 36621 Piston Rotator Wrench

1. Two-thirds of brake fluid from master cylinder assembly.
   - Release parking brake and raise car.
   - Mark relationship of wheel to axle flange.
2. Wheel and tire. See Section 3E.
   - Install two inverted wheel nuts to retain rotor.

CAUTION: Be prepared to catch springs when removing spring pins. Springs may fly out causing injury to personnel.

3. Spring pins (1).
   - Connect J 36620 onto J 6125-1B.
   - Remove threaded tip from rod on J 36620. Insert rod completely through pin (1) and install threaded tip as far as it will go.
   - Thrust weight on J 6125-1B outward, against tool handle to drive out pin (1).
4. Springs (5) from inboard and outboard shoe flanges.
5. Outboard shoe and lining (2).
   - Lift through caliper opening. Loosen parking brake cable adjustment, if necessary.
6. Inboard shoe and lining (3).
   - Lift through caliper opening.
   - If necessary, push on bridge (26), moving caliper inboard to provide clearance for removing inboard shoe and lining (3).
7. Two-way check valve (15) from end of piston assembly (14) using small screwdriver.

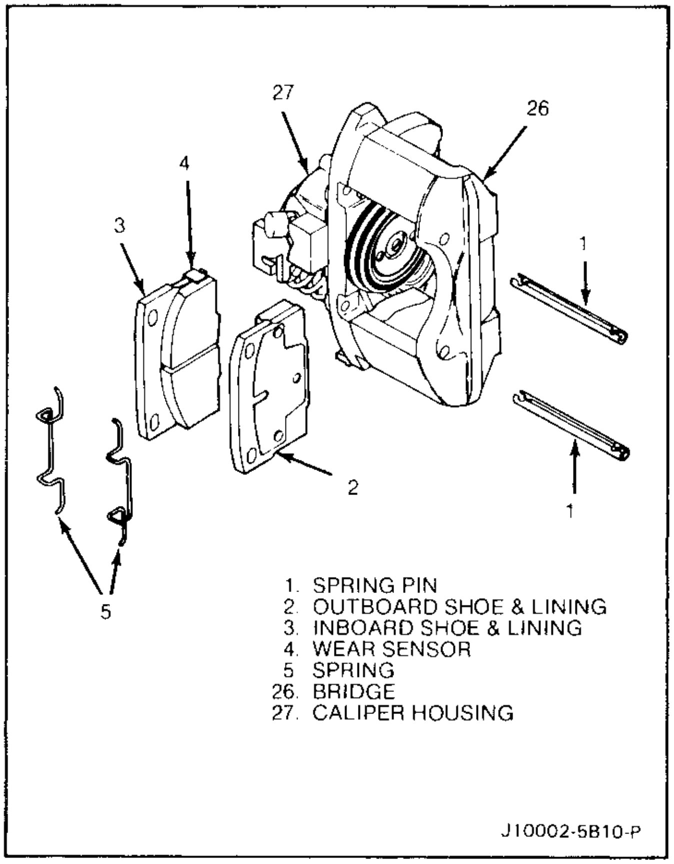


Figure 2 Shoe and Lining Assembly

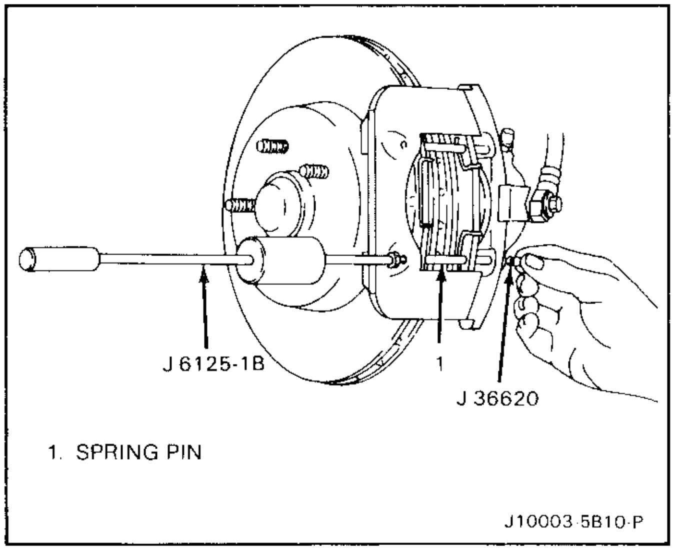


Figure 3 Attaching Impact Tool

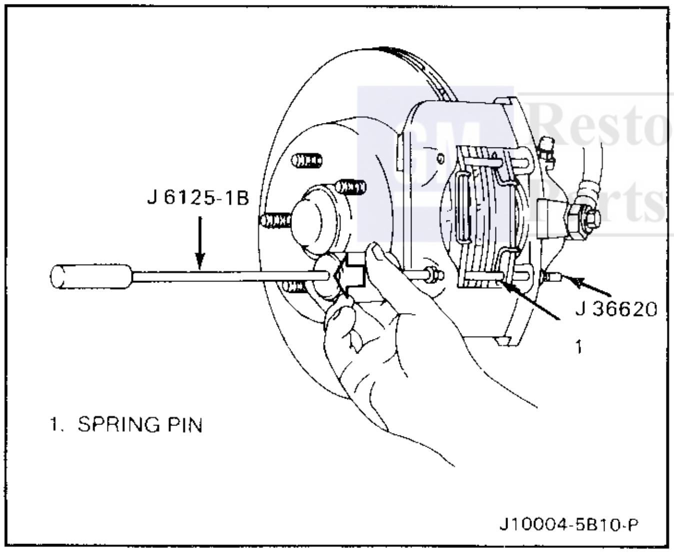


Figure 4 Removing Spring Pins

Important

  - If leakage is noted from piston hole after check valve (15) is removed, overhaul caliper as specified.

- Bottom piston assembly (14) in caliper (27) bore.
  - Use J 36621 to turn piston assembly.
  - J 36621 has pins to engage holes in piston assembly (14).
  - Turn left caliper piston assembly counterclockwise and turn right caliper piston assembly clockwise to move piston assembly (14) back into caliper bore.

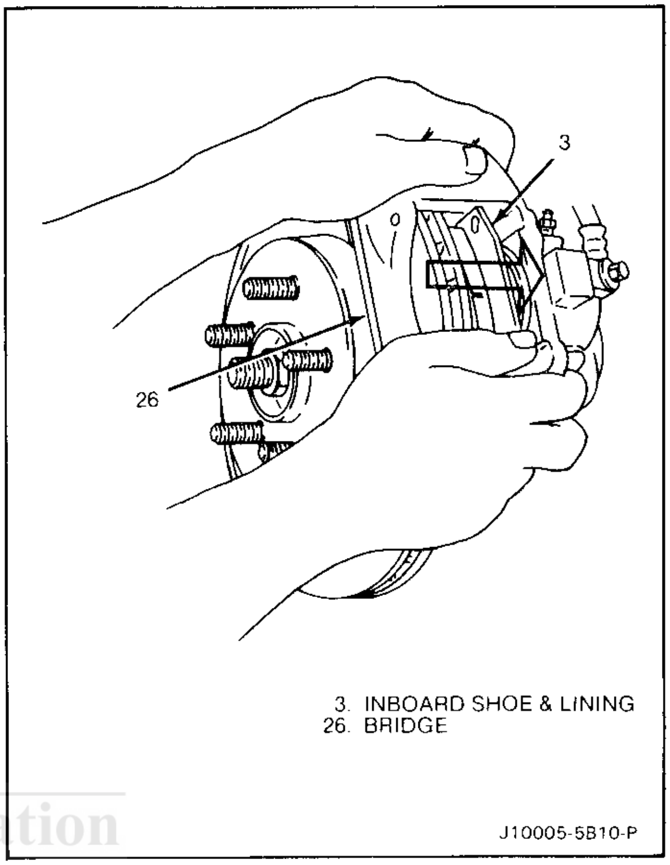


Figure 5 Moving Caliper Inboard

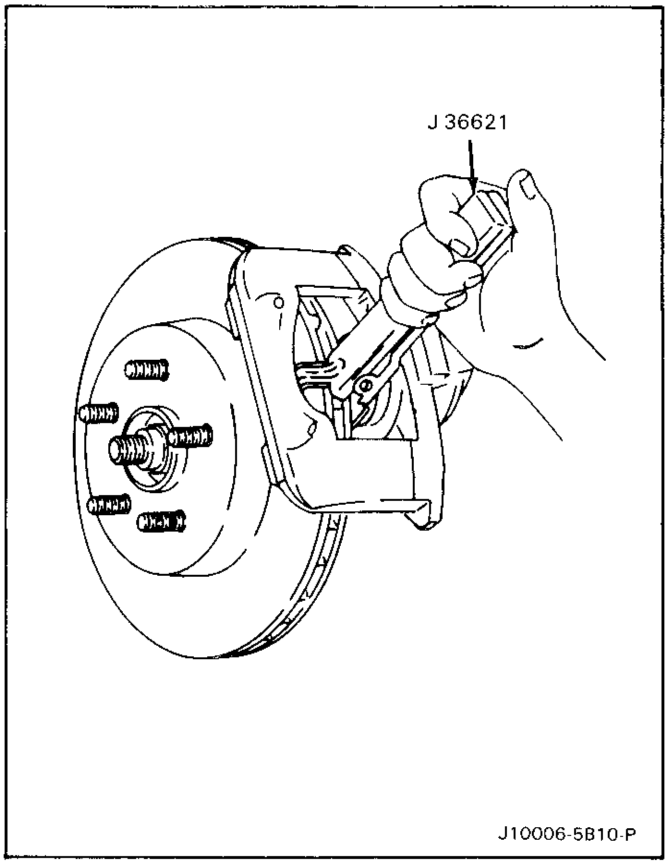


Figure 6 Bottoming Piston Assembly

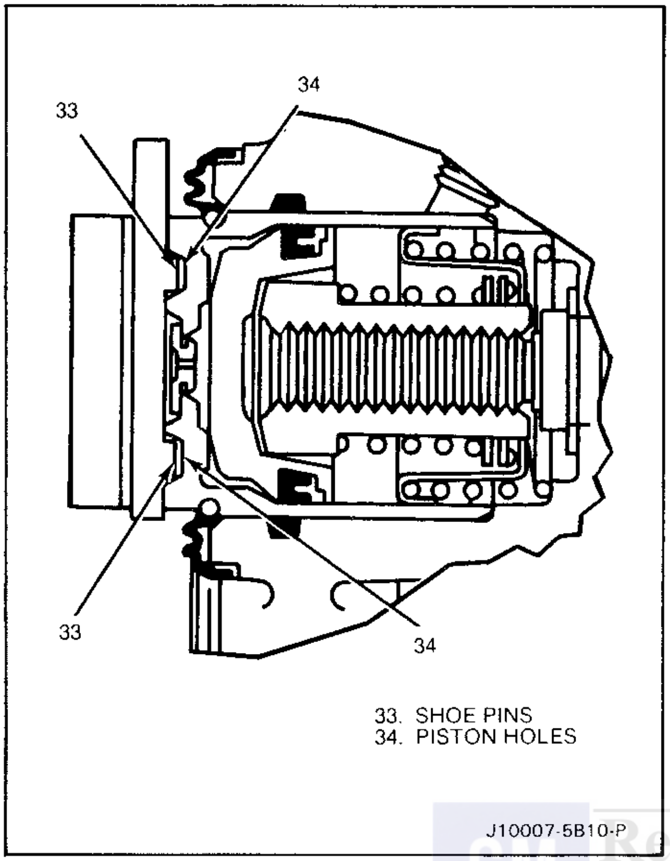


Figure 7 Aligning Piston Holes with Shoe Pins

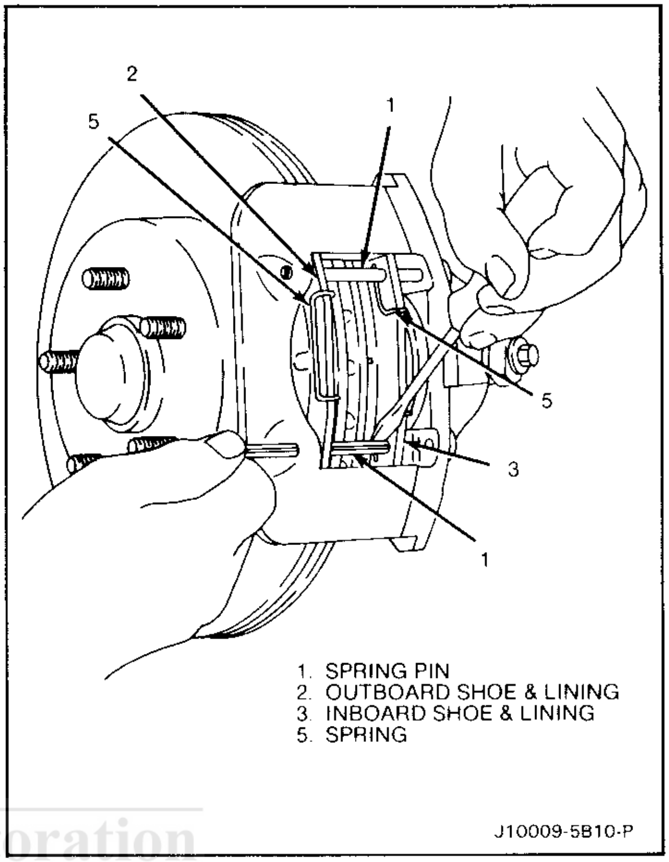


Figure 9 Installing Springs

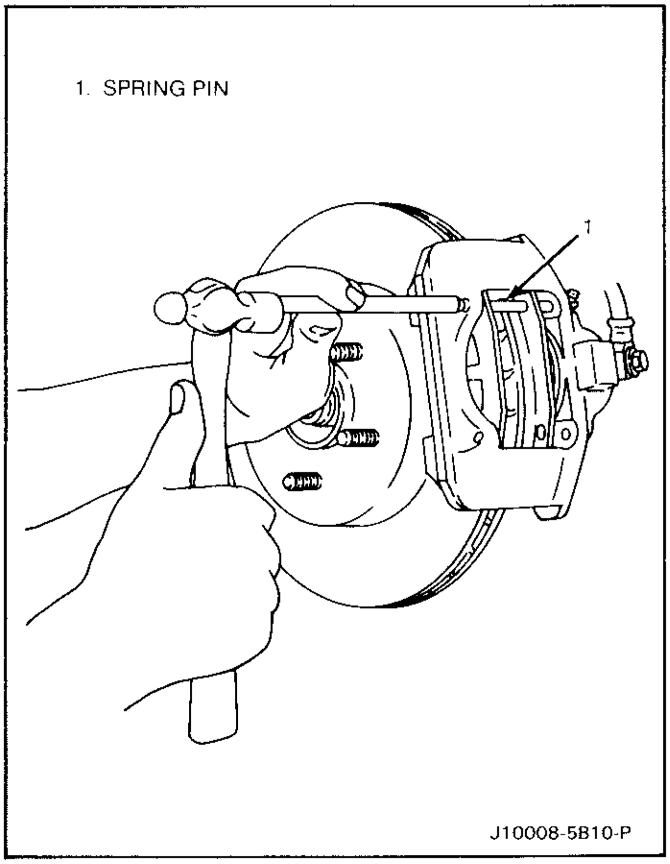


Figure 8 Installing Spring Pins

Install or Connect (Figures 1 through 9)

Important

- Piston assembly (14) must be bottomed into caliper housing (27) bore before installing new shoe and linings (2 and 3).

1. Lubricated new two-way check valve (15) into end of piston assembly (14).
2. Inboard shoe and lining (3) with wear sensor (4) at leading edge of shoe during forward wheel rotation.
   - Make sure shoe pins (33), on back of inboard shoe, engage holes (34) in end of piston assembly (14).
   - Use J 36621 to align piston holes if necessary.
3. Outboard shoe and lining (2).

NOTICE: See "Notice" on page 5-1.

NOTICE: In the following steps, do not use a steel drift to install pins. This will damage ends of pins and make later removal of pins difficult.

4. One spring pin (1) aligning holes in shoe and linings (2 and 3).
   - Tap in pin (1) using hammer and soft brass rod or drift until end of pin just emerges from inboard face of caliper housing (27).
5. Springs (5) and remaining pin (1).
   - Position pins (1) so that slots in pins face each other. This will ease assembly of springs (5).

- Tap in pin (1) as in step 4 above but stop when pin is just through outboard section of caliper housing (27). Pin (1) can then be moved by hand.
- Install springs (5) one at a time. Hook end of spring (5) under pin (1) previously installed in step 4 with midsection of spring (5) over shoe flange.
- Press down on other end of spring (5) with screwdriver as remaining pin (1) is slid inboard. Figure 9 shows outboard spring (5) installed and inboard spring (5) being installed.
- Complete pin installation by tapping as in preceding step 4.
- Make sure springs (5) are centered on shoe flanges with each spring end projecting an equal distance under the pins (1).

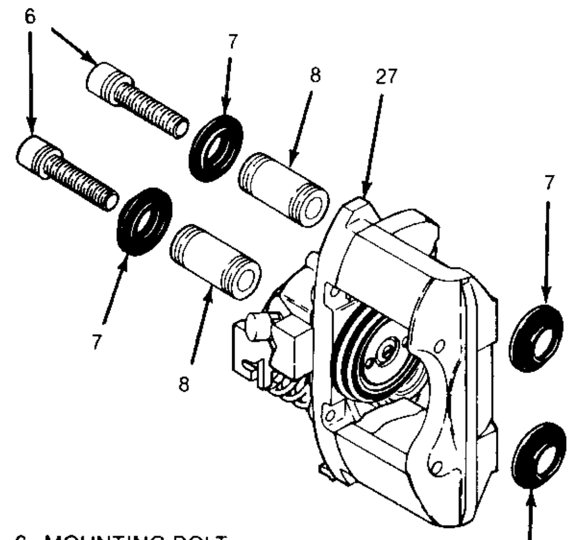
6. Wheels and tires, aligning previous marks. See Section 3E.
   - Remove wheel nuts securing rotor to hub.
   - Lower car. See Section 0A.
   - Torque wheel nuts. See Section 3E.

- Fill master cylinder to proper level with clean brake fluid. See Section 5.
- Apply approximately 778 N (175 lb.) force to brake pedal three times to seat linings.

CALIPER ASSEMBLY

Remove or Disconnect (Figures 10 through 14)

1. Shoes and linings as previously described.



6. MOUNTING BOLT
7. SLEEVE BOOT
8. SLEEVE
27. CALIPER HOUSING

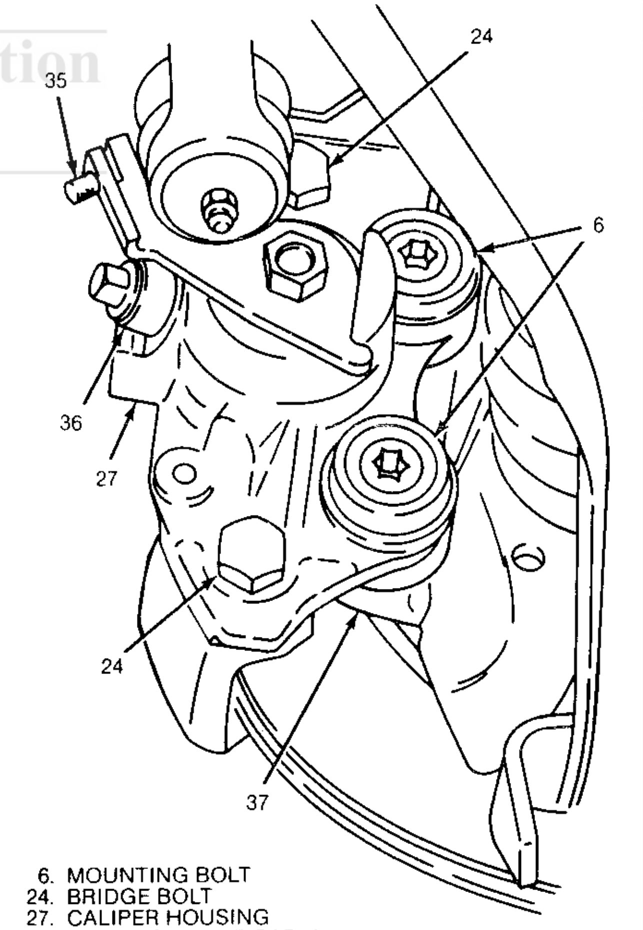
J10010-5B10-P

Figure 10 Rear Caliper Assembly

2. Parking brake cable (35) and return spring (11) from parking brake lever (10).
   - Loosen cable adjustment if necessary.
3. Bolt attaching inlet fitting (36), only if caliper is to be removed from vehicle for overhaul.
   - Plug openings in caliper housing (37) and pipe to prevent fluid loss and contamination.
4. Mounting bolts (6) using No. 55 torx wrench.
   - Do not confuse mounting bolts (6) with bridge bolts (24).
5. Caliper housing (27) from mounting bracket (37) and rotor.
   - If caliper overhaul or replacement is not required, hang caliper with a wire hook from the suspension to avoid damaging brake hose.
6. Sleeves (8) and sleeve boots (7).

Inspect (Figure 10)

— Mounting bolts (6) and sleeves (8) for corrosion.
   - If corrosion is found, use new parts, including sleeve boots (7) when installing caliper housing (37).



6. MOUNTING BOLT
24. BRIDGE BOLT
27. CALIPER HOUSING
35. PARKING BRAKE CABLE
36. INLET FITTING
37. MOUNTING BRACKET

J10011-5B10-P

Figure 11 Rear Caliper Installed

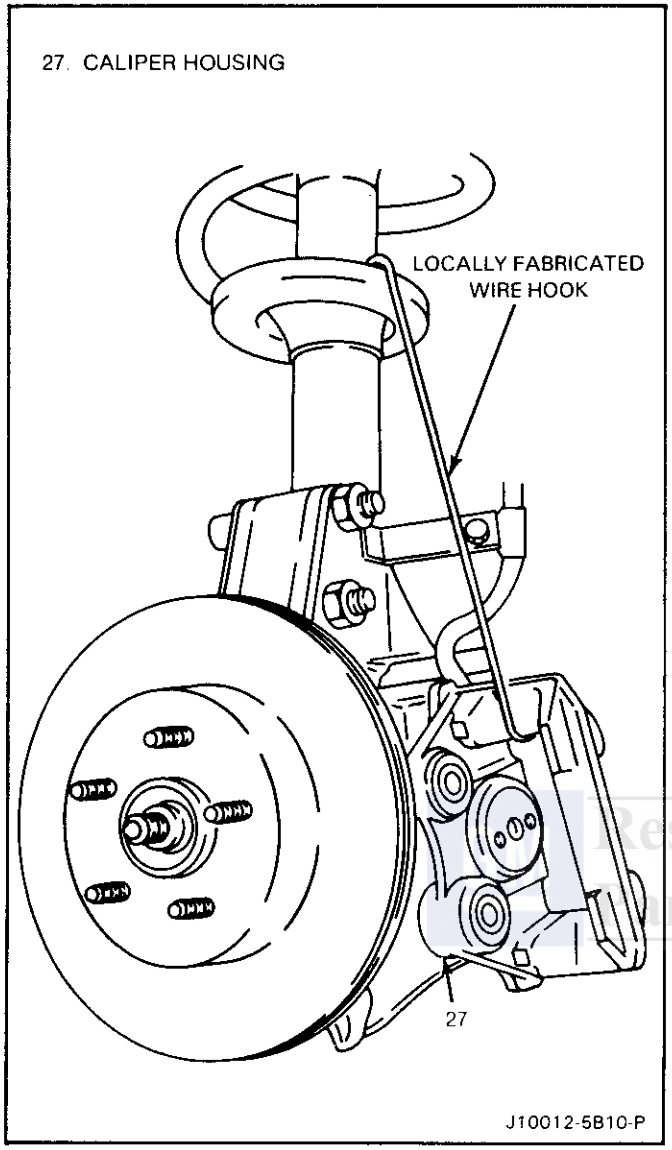


Figure 12 Suspending Rear Caliper

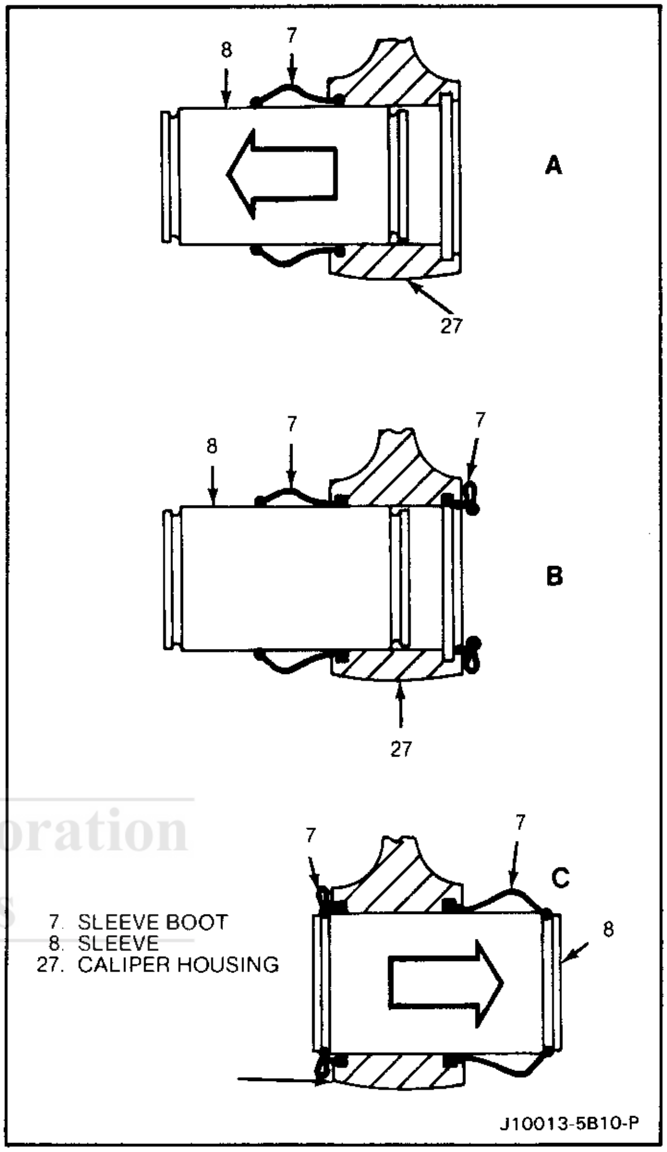


Figure 13 Installing Sleeves and Sleeve Boots

  - Do not attempt to polish away corrosion.

— Sleeve boots (7) for cuts, nicks, or deterioration.

Install or Connect (Figures 10 through 14)

NOTICE: Make sure sleeves are installed with large holes facing inboard. If sleeves are installed backwards, damage to threads in mounting bracket can result.

1. Sleeve (8) and sleeve boots (7) in caliper housing (27).
    - Lubricate sleeve (8) OD and mounting bolt hole ID in caliper housing (27) with silicone grease.
    - Lubricate both ID and OD sealing beads on sleeve boots (7) with silicone grease.
    - Install one sleeve boot (7) OD into groove in mounting bolt hole of caliper housing (27).
    - Push sleeve (8) into mounting bolt hole past ID of installed sleeve boot (7) to approximate position shown in figure 13, view A.
    - Install second sleeve boot (7) OD in groove at other end of mounting bolt hole. See figure 13, view B.
    - Push sleeve (8) back the other way and seat the ID beads on both sleeve boots (7) into grooves of sleeve (8). See figure 13, view C.
    - Repeat procedure with remaining sleeve (8) and sleeve boots (7).

NOTICE: See "Notice" on page 5-1.

2. Caliper housing (27) over rotor in mounting bracket (37) with mounting bolts (6).

Tighten

- Bolts (6) to 100 N·m (74 lbs. ft.) using No. 55 torx wrench.

Important

- Make sure that caliper mounting bolts (6) are properly torqued.

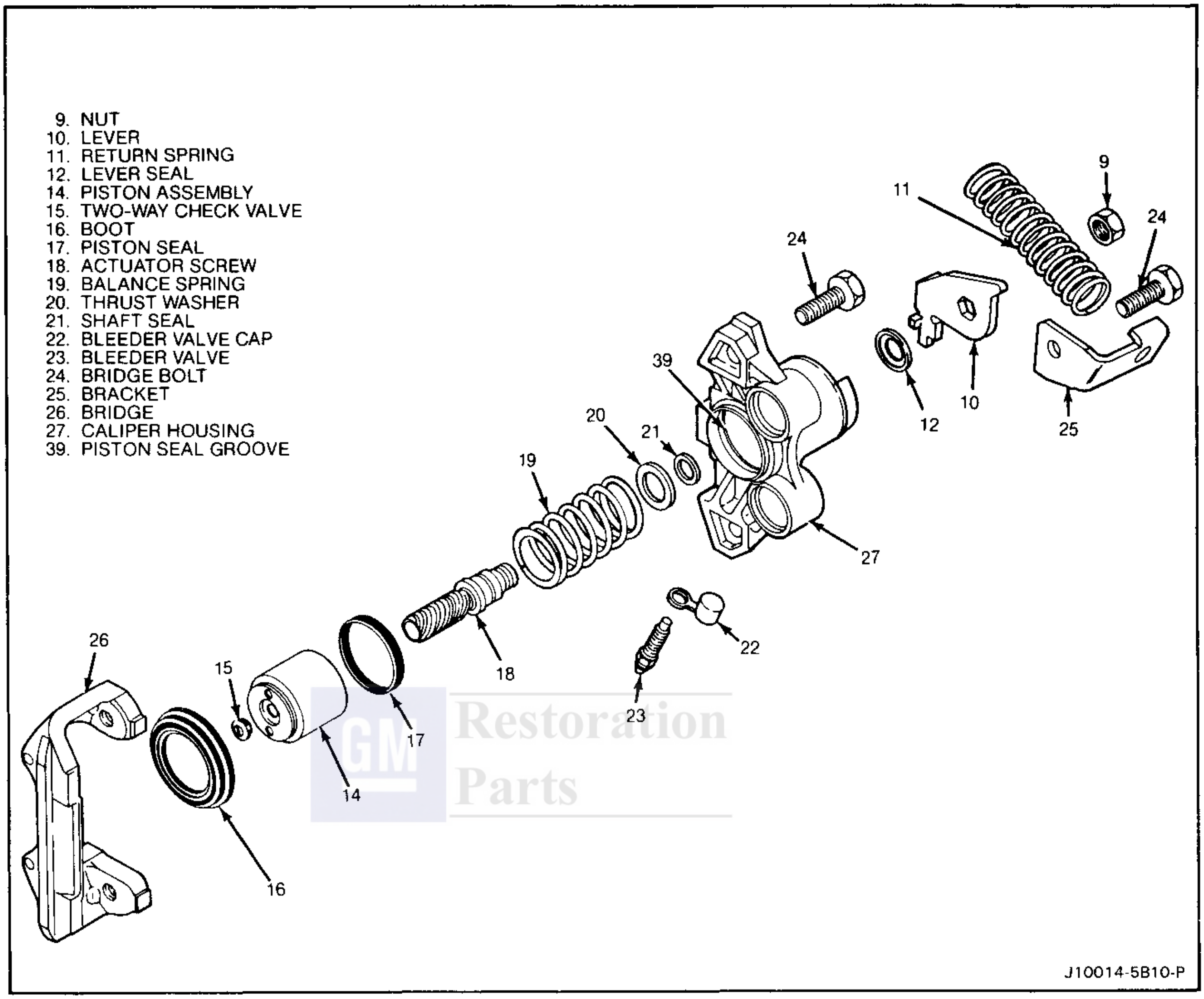


Figure 14 Rear Caliper Assembly Components

3. Inlet fitting (36), if removed.
   - Use new copper gaskets.

Tighten

   - Fitting (36) to 45 N·m (33 lbs. ft.).
4. Shoes and linings as previously described.
- If inlet fitting (36) was removed, bleed caliper. See Section 5.
- Check brake fluid level and add fluid as necessary. See Section 5.
5. Parking brake cable (35) and return spring (11) to parking brake lever (10).

Adjust

- Parking brake. See "Parking Brake Adjustment."

PARKING BRAKE ADJUSTMENT (Figure 14)

1. Apply service brake pedal three times with a pedal force of approximately 778 N (175 lbs.).
2. Apply and release parking brake three times.
3. Check parking brake lever for full release.
   - Turn ignition on.
   - "BRAKE" warning lamp should be off. If "BRAKE" warning lamp is still on, and the hand lever is completely released, pull downward on the front parking brake cable to remove slack from lever assembly.
4. Raise car and suitably support. See Section 0A.
5. Check that parking brake levers (10) on both calipers are against the lever stops on the caliper housings (27). If levers (10) are not against stops, check for binding in rear cables and/or loosen cables at adjuster until both left and right levers (10) are against their stops.
   - If cables are binding, replace as necessary. See Section 5.
6. Tighten parking brake cable at adjuster until either the left or right lever (10) begins to move off the stop then loosen adjustment until lever (10) moves back barely touching stop.

7. Lower car. See Section 0A.
8. Operate parking brake several times to check adjustments. After cable adjustment, the parking brake lever should not travel more than six ratchet clicks. Rear wheels should not rotate forward when lever is applied three to six ratchet clicks.

UNIT REPAIR

CALIPER OVERHAUL

Remove or Disconnect

- Caliper from vehicle as previously described.

Disassemble (Figures 14 through 16)

1. Nut (9), lever (10) and lever seal (12).

   Inspect

   - Bracket (25) and bridge (26) for cracks or distortion.
2. Bridge bolts (24) bracket (25) and bridge (26), only if bridge or bracket is suspected of being cracked or damaged.
   - Caliper housing (27) can be overhauled without removing bridge (26).
3. Piston assembly (14).
   - Use clean shop towels as a pad over bridge (26) and under caliper housing (27) during piston removal.
   - Use a wrench to turn actuator screw (18) in parking brake "apply" direction, to work piston assembly (14) out of caliper housing (27).

   Inspect

   - Piston assembly (14) for scoring, nicks, corrosion and worn or damaged chrome plating.
     - Replace piston assembly (14) if any of the above are found.
4. Actuator screw (18) by pressing on thread end.

   Inspect

   - Actuator screw (18) for cracks and thread damage.
5. Balance spring (19).
6. Shaft seal (21) and thrust washer (20) from actuator screw (18).
7. Boot (16).
   - Be careful not to scratch housing.

NOTICE: Do not use a metal tool to remove piston seal. Metal tools may damage caliper bore or seal groove.

8. Piston seal (17) from groove (39) in caliper housing (27).
   - Use a wooden or plastic tool.

   Inspect

   - Caliper bore and seal groove (39) for scoring, nicks, corrosion and wear.
     - Use crocus cloth to polish out light corrosion.
     - Replace caliper housing (27) if corrosion in and around seal groove (39) will not clean up with crocus cloth.
9. Bleeder valve cap (22) and bleeder valve (23) from caliper housing (27).

Clean (Figure 14)

- All parts in clean, denatured alcohol.

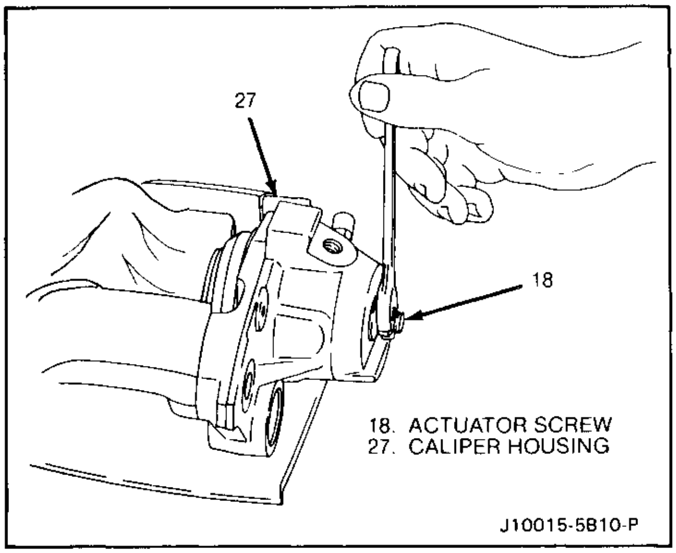


Figure 15 Removing Caliper Piston

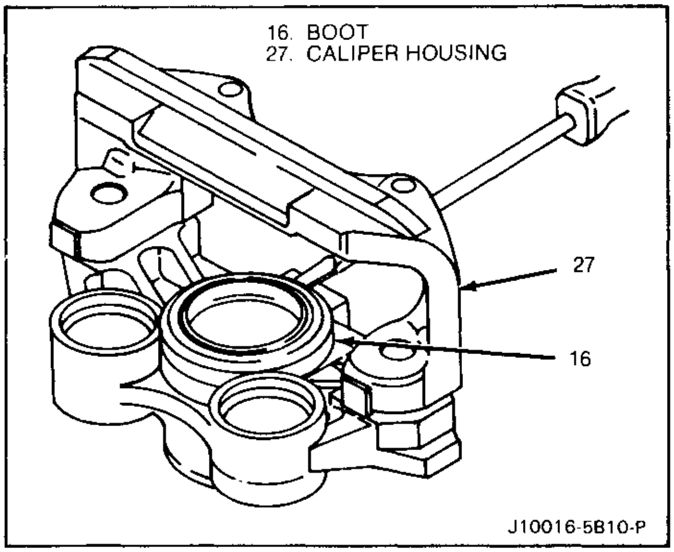


Figure 16 Removing Caliper Boot

- Dry with unlubricated compressed air.
- Blow out all passages in caliper housing (27) and bleeder valve (23).

Assemble (Figures 14 through 19)

Tool Required:
J 36622 Boot Seal Installer
J 36623 Piston Installer

NOTICE: See "Notice" on page 5-1.

1. If removed or replaced, bracket (25), bridge (26) and bridge bolts (24).

Tighten

- Bridge bolts (24) to 100 N·m (74 lbs. ft.).

2. Bleeder valve (23) and valve cap (22).

Tighten

- Bleeder valve (23) to 13 N·m (116 lbs. in.).

3. Lubricated new piston seal (17) into groove (39) in caliper housing (27).
   - Make sure seal (17) is not twisted.
4. Thrust washer (20) on actuator screw (18) with copper side of washer (20) towards the piston assembly (14) and the grayish surface towards caliper housing (27).
5. Lubricated shaft seal (21) on actuator screw (18).
6. Lubricated boot (16) onto piston assembly (14).
7. Lubricated actuator screw (18) along with shaft seal (21) and thrust washer (20) into caliper housing (27).
8. Balance spring (19) into caliper housing (27) bore, with end of spring (19) in recess at bottom of caliper bore.

Important

- Make sure outside diameter of piston assembly (14) is well lubricated before installation.

9. Lubricated piston assembly (14) and boot (15) into lubricated bore of caliper housing (27).
   - Push piston assembly (14) toward bottom of caliper bore using J 36623.
   - Turn actuator screw (18) as necessary to allow piston assembly (14) to move to bottom of caliper bore.
10. Lubricated lever seal (12) over end of actuator screw (18).
    - Rubber sealing bead on lever seal (12) should be against lever (10) and copper colored side against caliper housing (27).

Important

- In the next step, hold lever (10) back against stop on caliper housing (27) while tightening nut (9). This will prevent accidental application of the parking brake mechanism.

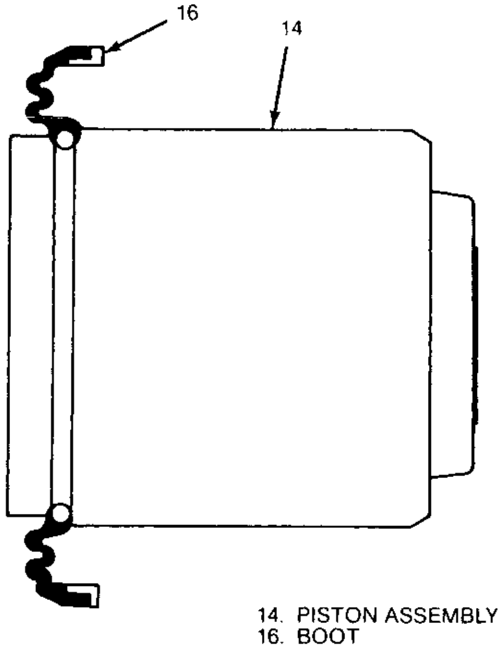


Figure 17 Installing Boot Onto Piston Assembly

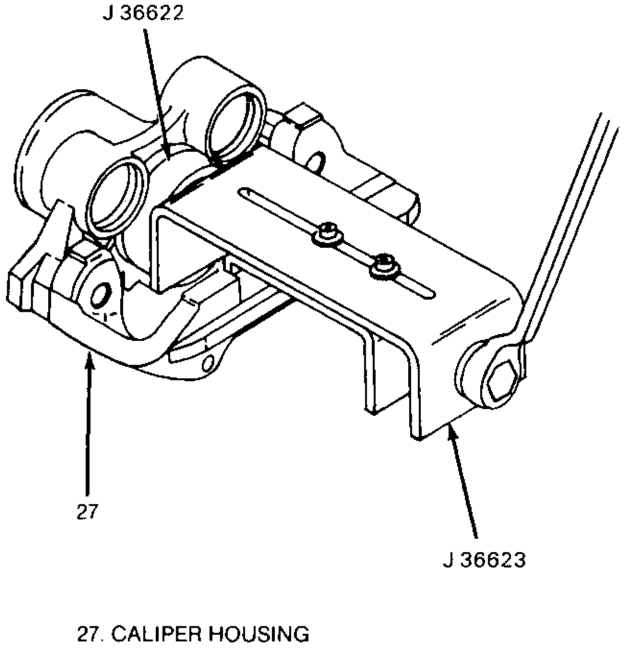


Figure 18 Seating Boot Into Caliper Housing

11. Lever (10) and nut (9).
    - Hex hole in lever (10) must engage hex on actuator screw (18).

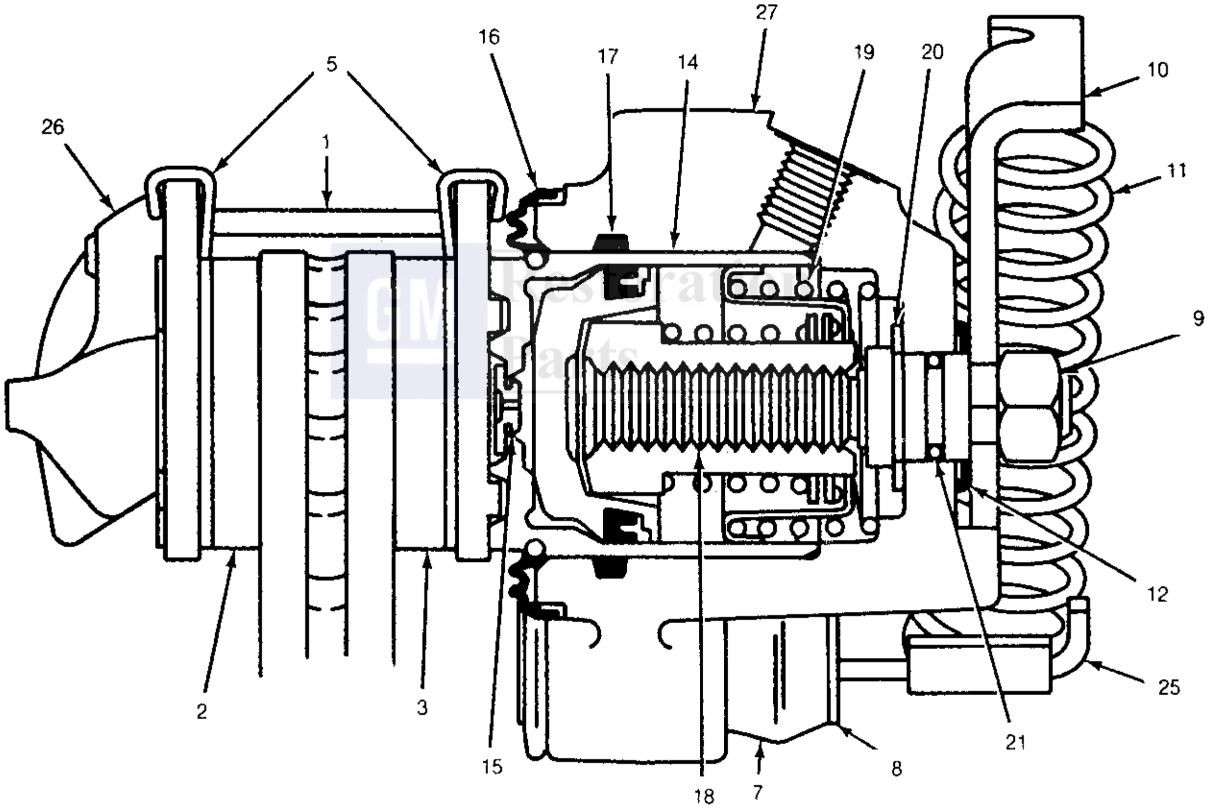
Tighten

- Nut (9) to 47 N·m (35 lbs. ft.).

12. Boot (16) to counterbore in caliper housing (27) using J 36622 and J 36623.

Install or Connect

- Caliper as previously described.



1. SPRING PIN
2. OUTBOARD SHOE & LINING
3. INBOARD SHOE & LINING
5. SPRING
7. SLEEVE BOOT
8. SLEEVE
9. NUT
10. LEVER
11. RETURN SPRING
12. LEVER SEAL
14. PISTON ASSEMBLY
15. TWO-WAY CHECK VALVE
16. BOOT
17. PISTON SEAL
18. ACTUATOR SCREW
19. BALANCE SPRING
20. THRUST WASHER
21. SHAFT SEAL
25. BRACKET
26. BRIDGE
27. CALIPER HOUSING

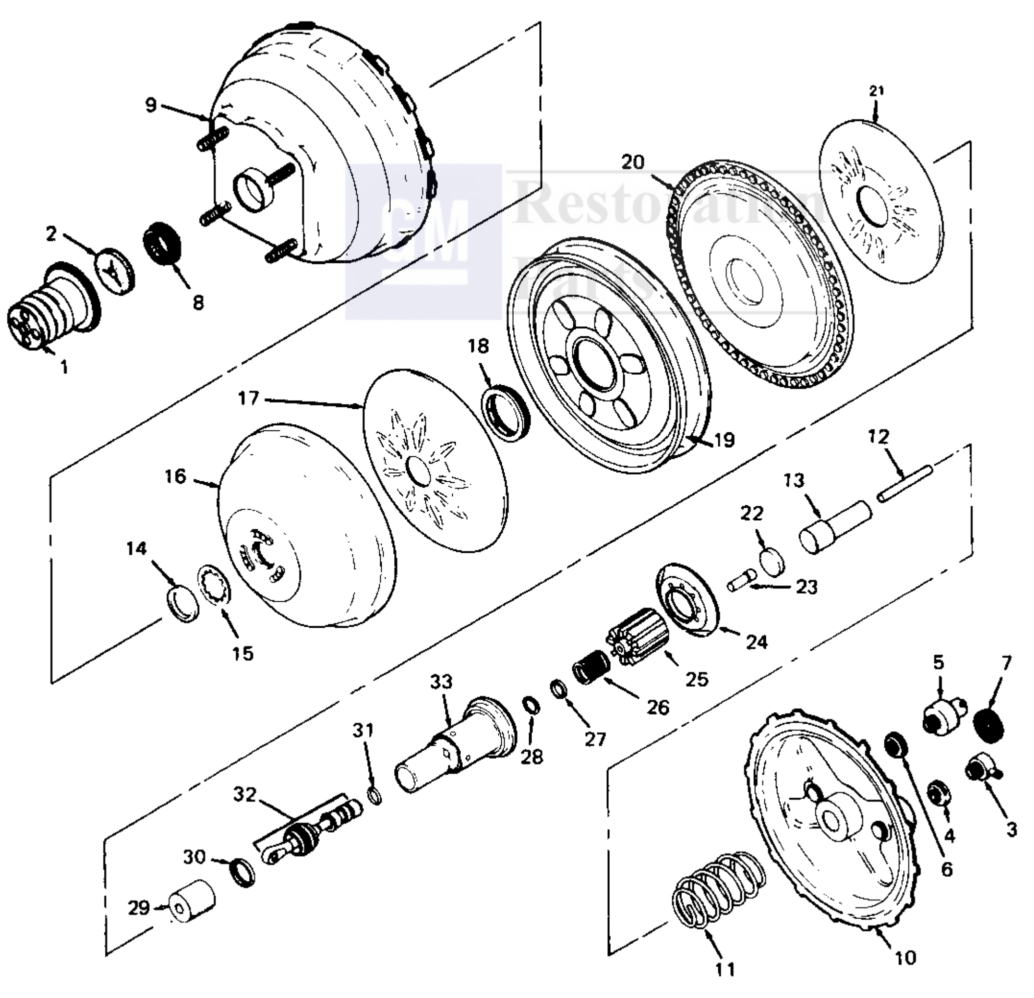
J10019-5B10-P

Figure 19 48H Rear Caliper Assembly — Cutaway View

SECTION 5D2

POWER HEAD ASSEMBLY - TANDEM DIAPHRAGM

CONTENTS



1. BOOT
2. SILENCER
3. VACUUM CHECK VALVE
4. GROMMET
5. VACUUM SWITCH (SOME MODELS)
6. GROMMET
7. FRONT HOUSING SEAL
8. PRIMARY PISTON BEARING
9. REAR HOUSING
10. FRONT HOUSING
11. RETURN SPRING
12. PISTON ROD (GAGED)
13. REACTION RETAINER
14. POWER HEAD SILENCER
15. DIAPHRAGM RETAINER
16. PRIMARY DIAPHRAGM
17. PRIMARY SUPPORT PLATE
18. SECONDARY PISTON BEARING
19. HOUSING DIVIDER
20. SECONDARY DIAPHRAGM
21. SECONDARY SUPPORT PLATE
22. REACTION DISC
23. REACTION PISTON
24. REACTION BODY RETAINER
25. REACTION BODY
26. AIR VALVE SPRING
27. REACTION BUMPER
28. RETAINING RING
29. FILTER
30. RETAINER
31. O-RING
32. AIR VALVE PUSH ROD ASSEMBLY
33. POWER PISTON

HM0001-5D2-AB

Figure 1 Booster Assembly

GENERAL DESCRIPTION

This booster is a tandem vacuum suspended unit. In a normal operating mode, with the service brakes in the released position, the tandem vacuum suspended booster operates with vacuum on both sides of its diaphragms. When the brakes are applied, air at atmospheric pressure is admitted to one side of each diaphragm to provide the power assist. When the service brake is released, the atmospheric air is shut off from the one side of each diaphragm. The air is then drawn from the booster through the vacuum check valve to the vacuum source.

Important

- Replace all components included in repair kits used to service this booster.
- Lubricate rubber parts with silicone grease, provided in kits, to ease assembly.
- Do not use lubricated shop air on brake parts as damage to rubber parts may result.
- If any hydraulic component is removed or disconnected, it may be necessary to bleed all or part of the brake system.
- The torque values specified are for dry, unlubricated fasteners.
- Perform service operations on a clean bench free from all mineral oil materials.

ON-CAR SERVICE

BOOSTER ASSEMBLY

(Figure 2)

Remove or Disconnect

1. Master cylinder attaching nuts (37).
2. Master cylinder (34) from booster (35).
3. Booster pushrod (32) from brake pedal.
4. Booster attaching nuts (36) and booster (35).

See NOTICE on page 5-1.

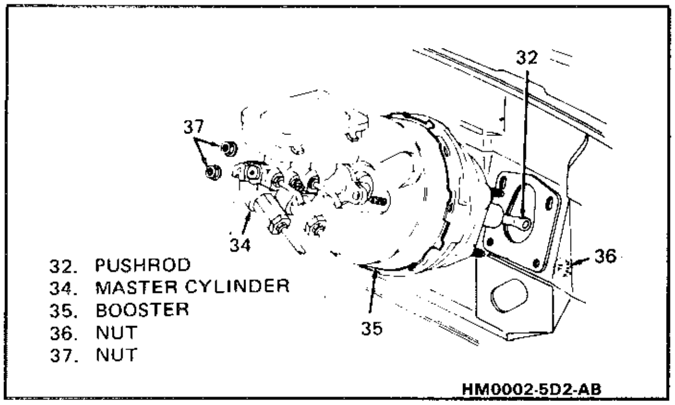


Figure 2 Removing Booster Assembly

Install or Connect

1. Booster (35) and attaching nuts (36) to 21 N·m (15 lb-ft).
2. Booster pushrod (32) to brake pedal.
3. Master cylinder (34) to booster (35) and attaching nuts (37) to 27 N·m (20 lb-ft).

EXTERIOR COMPONENTS

(Figure 3)

Important

The vacuum check valve, grommet and front housing seal can be inspected and/or serviced without removing the booster from the vehicle.

Remove or Disconnect

1. Booster (35) as previously described.
2. Boot (1) and silencer (2).
3. Vacuum check valve (3) and grommet (4).
4. Front housing seal (7).

Inspect

- Boot, front housing seal, and grommets for:
  - Cuts
  - Nicks
  - Excessive wear
- Replace part(s) if any of the above are found.

Clean

- Above parts in clean denatured alcohol.
- Dry with unlubricated compressed air.

See NOTICE on page 5-1.

Install or Connect

- Lubricate inside and outside diameters of grommet (4) and front housing seal (7) with a thin layer of silicone grease.

1. Grommet (4) and vacuum check valve (3).
2. Front housing seal (7).
3. Silencer (2) and boot (1).
4. Booster (35) as previously described.

UNIT REPAIR

BOOSTER

Tool Required:
J 23456 Power Brake Booster Disassembly and Reassembly Tool

(Figures 4 thru 6)

Disassemble

1. Booster (35) as previously described.
2. Scribe a mark on front and rear housings (10 and 9) to aid reassembly.
3. Using Tool J 23456 (39), apply force in a counter-clockwise direction to unlock housings (9 and 10).
4. Return spring (11) and power piston group (38).

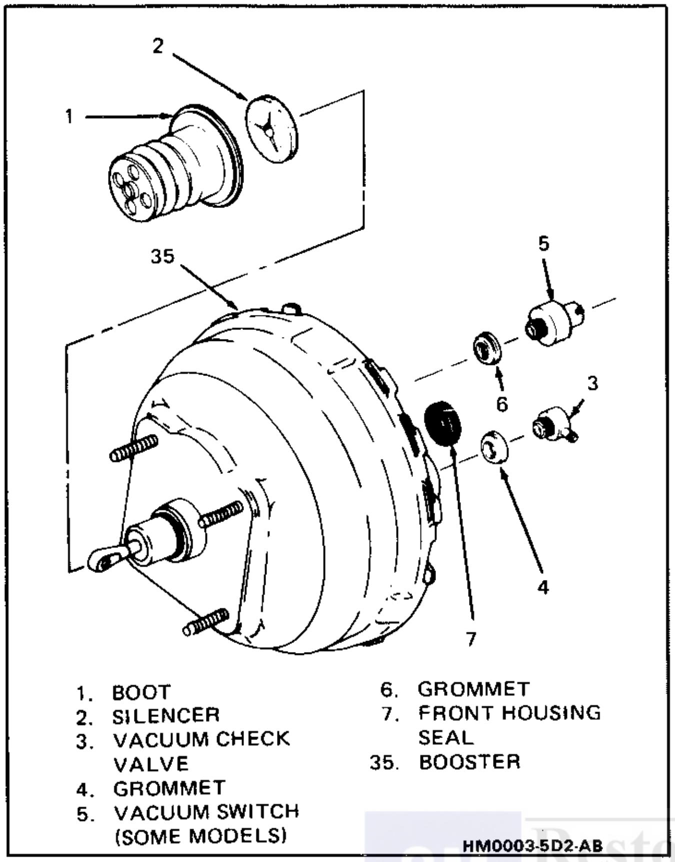


Figure 3 Exterior Components

5. Primary piston bearing (8) from rear housing (9).

Inspect

- Front and rear housings:
  - Corrosion
  - Cracks
  - Distortion
  - Excessive wear
- Use crocus cloth to polish away minor corrosion.
- Power piston bearing for:
  - Cuts
  - Nicks
- Replace if damaged.

Clean

- Above parts in clean denatured alcohol.
- Dry with unlubricated compressed air.

Assemble

1. Lubricate inside and outside diameters of primary piston bearing (8) with silicone grease, P/N 1052863 or equivalent.
2. Primary piston bearing (8) into rear housing (9).
3. Power piston group (38) into rear housing (9).
4. Return spring (11).
5. Align scribe marks on housings (9 and 10).
6. Using tool J 23456 (39), apply force in a clockwise direction to lock front and rear housings (10 and 9).

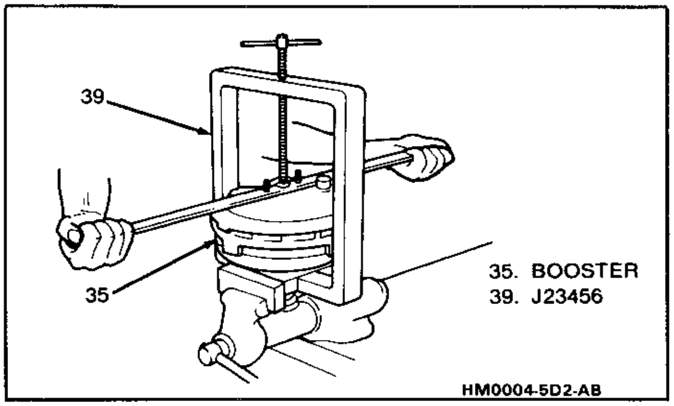


Figure 4 Unlocking and Locking Booster

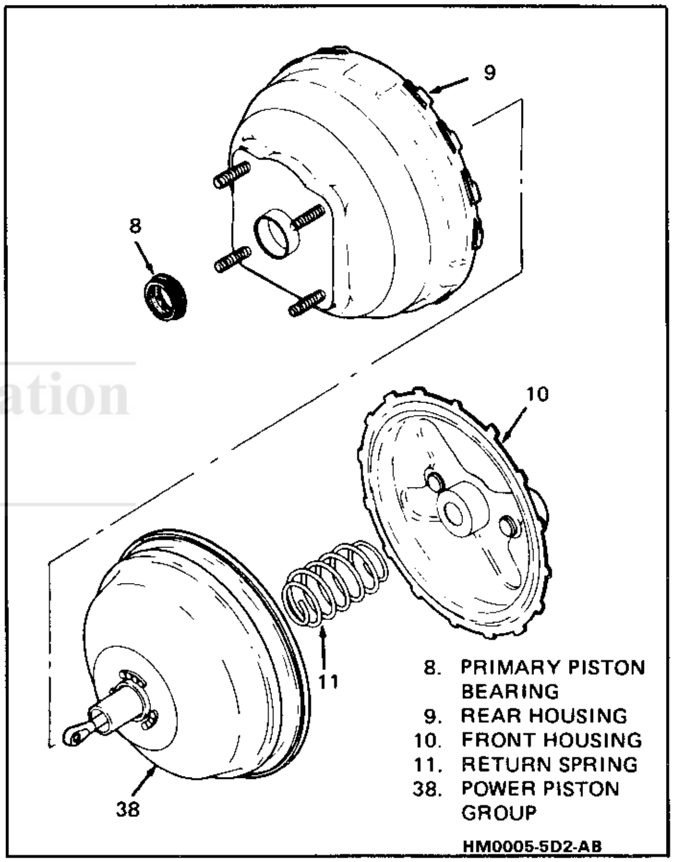


Figure 5 Booster Inner Components

- Stake housing after locking. Stake two tabs 180 degrees apart.
- Do not stake a tab that has been previously staked.
- Assembly can be aided by connecting a vacuum source to the booster.

7. Booster as previously described.

POWER PISTON GROUP

Tool Required:

J 28458 Retainer Installer (Power Piston Seal Protector)

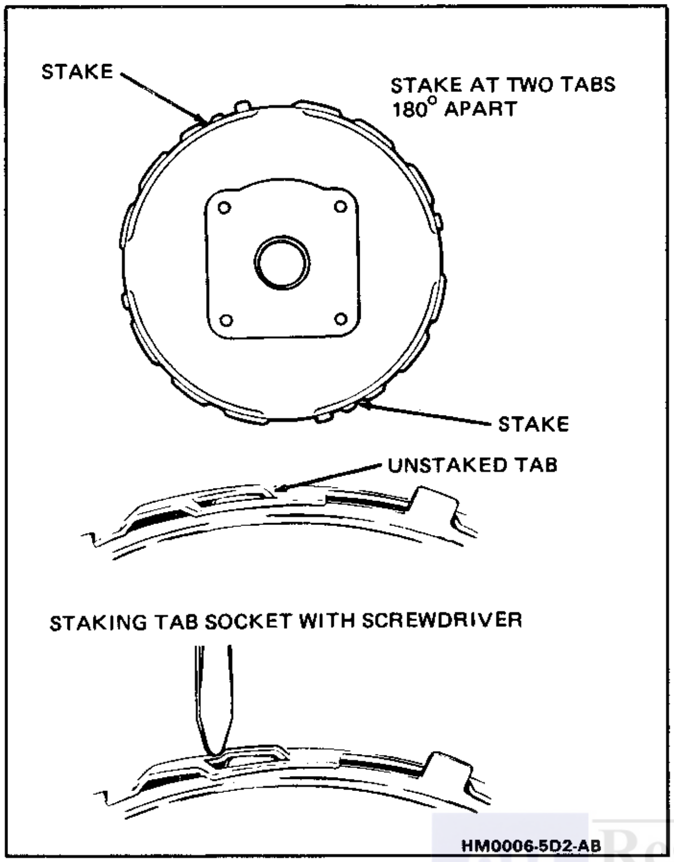


Figure 6 Staking Procedure

(Figures 7 thru 11)

Disassemble

1. Remove booster (35) and disconnect housings (9 and 10) as previously described.
2. Piston rod (12), reaction retainer (13) and power head silencer (14).
3. Power piston assembly (41) along with pushrod (32).
    - Grasp assemby at outside edge of housing divider (19) and diaphragms (16 and 20).
    - Hold with pushrod (32) down against a hard surface.
    - Use a slight force or impact to dislodge diaphragm retainer (15).
4. Primary diaphragm (16) and primary support plate (17) from housing divider (19).
5. Primary diaphragm (16) from primary support plate (17).
6. Secondary diaphragm (20) and secondary support plate (21) from housing divider (19).
7. Secondary piston bearing (18) from housing divider (19).
8. Secondary diaphragm (20) from secondary support plate (21).

Inspect

- Parts for:
    - Corrosion
    - Nicks
    - Cracks
    - Cuts
    - Scoring
    - Distortion
    - Excessive wear
- Use crocus cloth to polish away minor corrosion to diaphragm supports, or housing divider.

Clean

- All parts in clean denatured alcohol.
- Do not immerse power piston and pushrod assembly in alcohol, rather wipe clean with an alcohol dampened cloth.
- Dry with unlubricated compressed air.

Assemble

1. Lubricate inside diameter of secondary diaphragm (20) lip, inside diameter of primary diaphragm (16) lip and secondary piston bearing (18) with a thin layer of silicone grease.
2. Secondary diaphragm (20) into secondary support plate (21).
3. Secondary diaphragm (20) and support plate (21) over power piston assembly (41) and pushrod (32). Use J 28458 as a guide to protect the power piston.
4. Secondary piston bearing (18) into housing divider (19) with flat surface of bearing on same side as six raised lugs on divider.
5. Secondary piston bearing (18) and housing divider (19) over power piston assembly (41) and pushrod (32). Use J 28458 as a guide.
6. Primary diaphragm (16) into primary support plate (17).
7. Fold primary diaphragm (16) up, away from primary support plate (17).
8. Primary diaphragm (16) and support plate (17) over power piston assembly (41) and pushrod (32).
9. Fold primary diaphragm (16) back into position and pull diaphragm OD over formed flange of housing divider (19).
    - Check that beads on secondary diaphragm (20) are seated evenly around complete circumference.
10. New diaphragm retainer (15) and seat using J 28458 Retainer Installer.
11. Silencer (14), reaction retainer (13) and piston rod (12).
12. Reassemble booster as previously described.

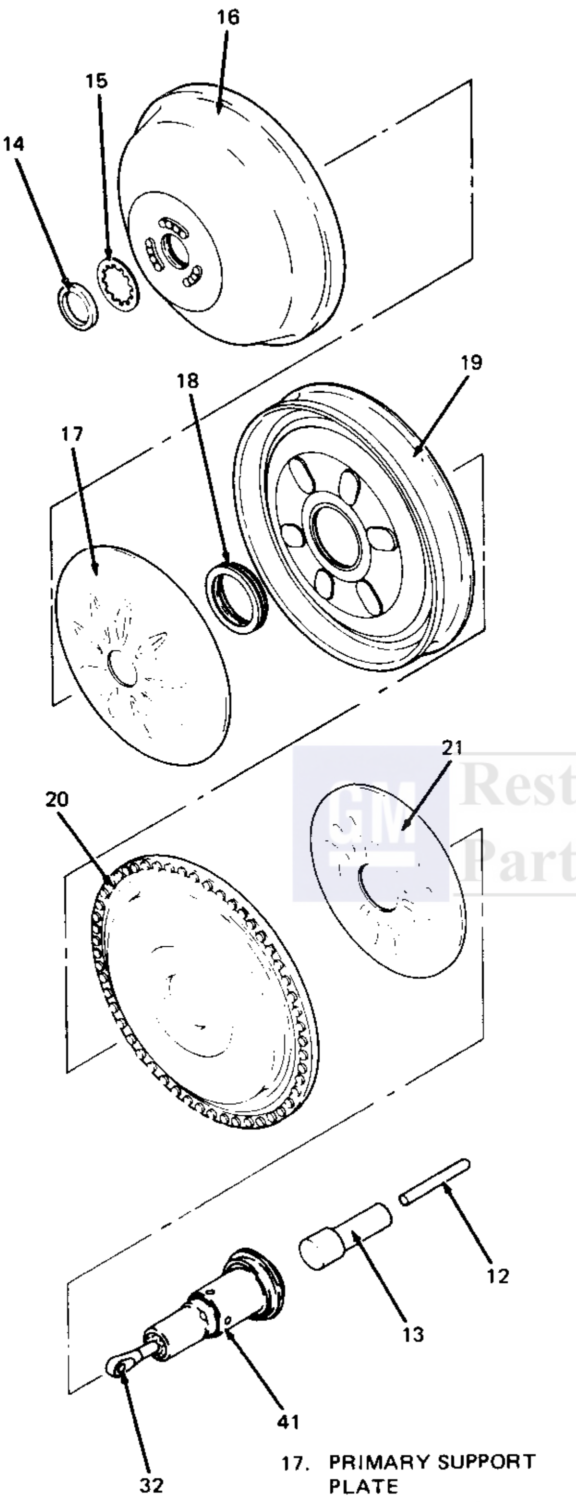
POWER PISTON OVERHAUL

Tools Required:
J 29282 Air Valve Push Rod Retainer Installer

(Figures 12 thru 14)

Disassemble

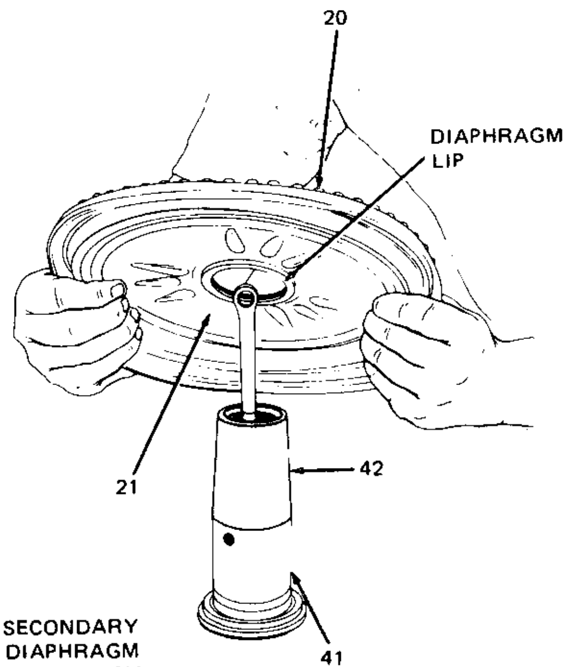
1. Reaction body retainer (24).
2. Reaction body (25).



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

HM0007-5D2-AB

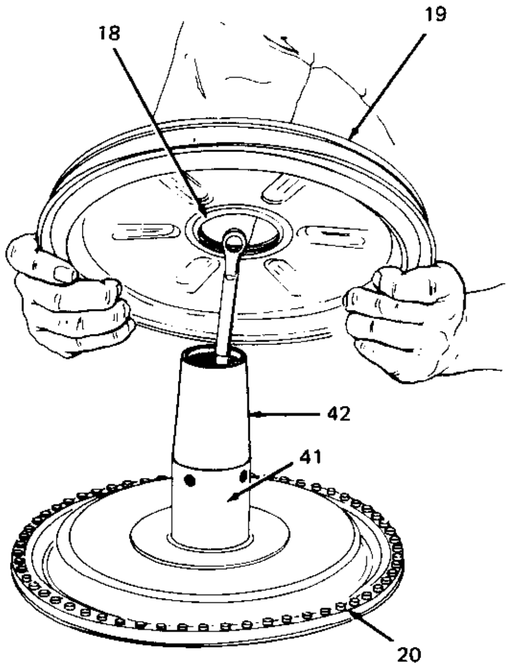
Figure 7 Power Piston Group



20. SECONDARY DIAPHRAGM
21. SECONDARY SUPPORT PLATE
41. POWER PISTON ASSEMBLY
42. TOOL J28458

HM0008-5D2-AB

Figure 8 Assembling Secondary Diaphram & Support



18. SECONDARY PISTON BEARING
19. HOUSING DIVIDER
20. SECONDARY DIAPHRAGM
41. POWER PISTON ASSEMBLY
42. TOOL J28458

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Figure 9 Assembling Housing Divider

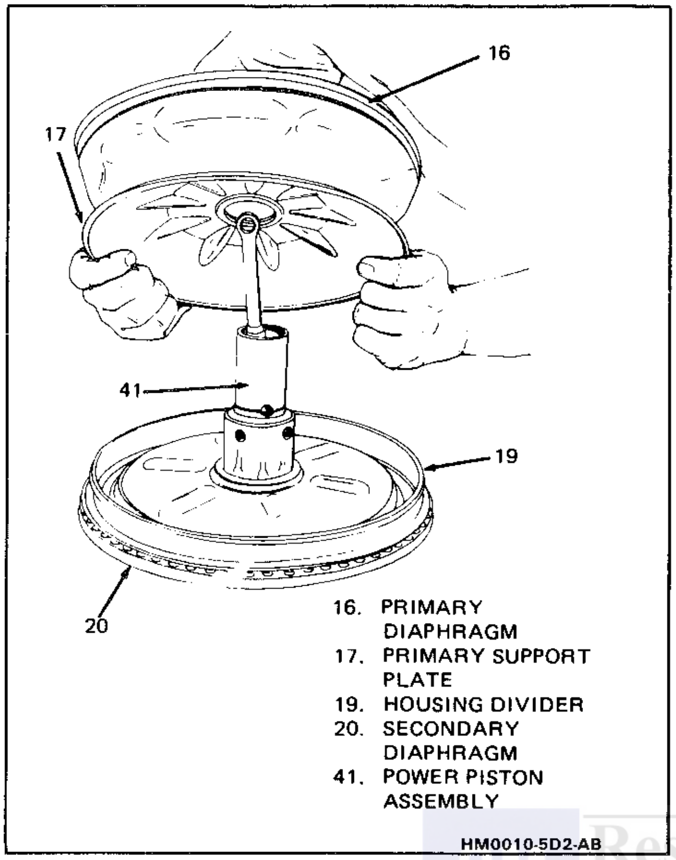


Figure 10 Assembling Primary Diaphram and Support

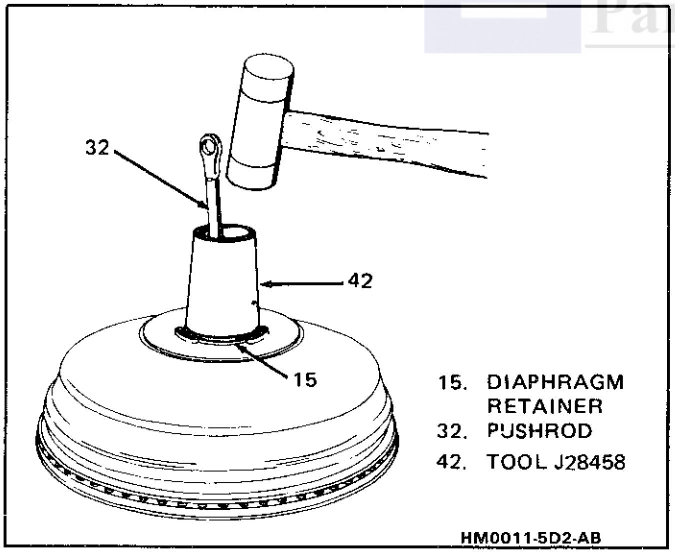


Figure 11 Sealing Diaphragm Retainer

3. Reaction disc (22) and reaction piston (23) from reaction body (25).
4. Air valve spring (26) and reaction bumper (27) from end of air valve pushrod (32).
5. Retaining ring (28) from air valve pushrod assembly (32) using No. 2 Truarc pliers or equivalent.
6. Air valve pushrod assembly (32) by inserting screwdriver through pushrod eyelet and pulling straight out.
   - Considerable force will be required.
7. Filter (29), retainer (30) and O-ring (31) from air valve pushrod assembly (32).

Inspect

- Power piston for cracks.
- Rubber parts for cuts or nicks.
- Air valve pushrod assembly for corrosion.
- Replace part(s) if any of the preceding are found.

Clean

- All parts in clean denatured alcohol.
- Dry with unlubricated compressed air.

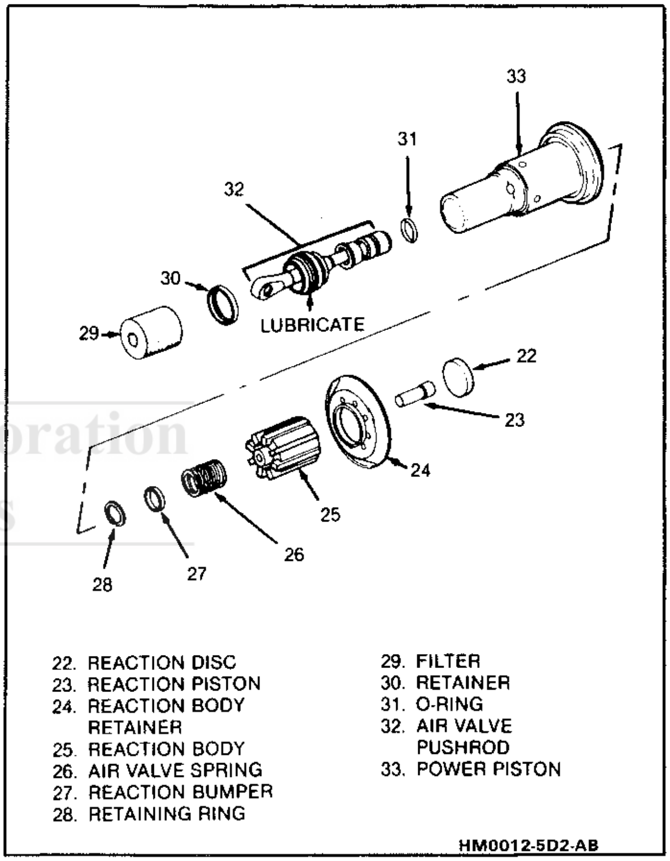


Figure 12 Power Piston Assembly

Assemble

1. Lubricated O-ring (31) onto air valve pushrod assembly (32).
2. Air valve pushrod assembly (32) into power piston (41).
3. Retainer (30) and seat using appropriate Retainer Installer (44).
4. Filter (29) over pushrod eyelet into power piston (41).
5. Retaining ring (28) onto air valve pushrod assembly (32) using No. 2 Truarc pliers or equivalent.
6. Reaction bumper (27), air valve spring (26).
7. Reaction piston (23) and reaction disc (22) into reaction body (25).
8. Reaction body (25).
9. Reaction body retainer (24).

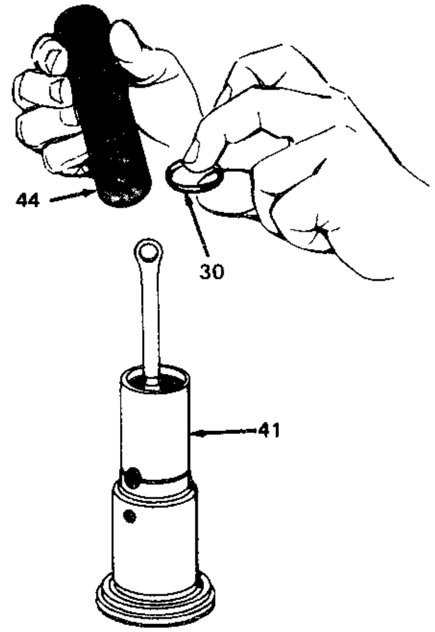


Figure 13 Retainer Assembly

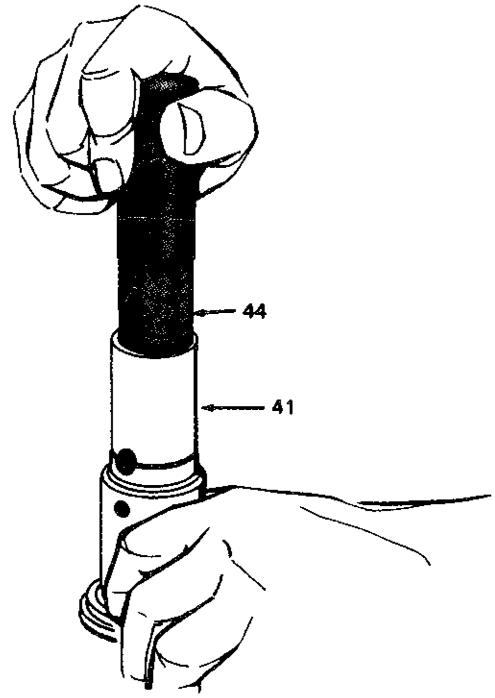


Figure 14 Installing Retainer Into Piston

GAGING PROCEDURE

Tool Required:
J 22647 Push Rod Height Gage

(Figure 15)

Measure

- After assembly of booster, position J 22647 Gage (43) over piston rod (12).
- If piston rod (12) height is not within GO-NO GO limits of gage (43), use a service-adjustable piston rod to obtain correct height.

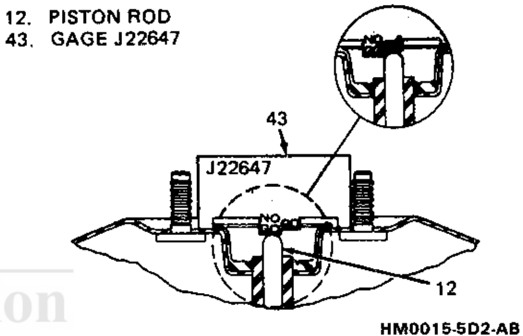


Figure 15 Gaging Piston Rod

SECTION 5F

SPECIFICATIONS AND SPECIAL TOOLS

GENERAL SPECIFICATIONS

Item	mm	In.
Brake Pedal Travel*	57.00	2.25
Brake Rotors (Front and Rear)		
Rotor Diameter	265.00	10.43
Lateral Runout	0.082	0.003
Thickness Variation	0.013	0.0005
Rotor Thickness (Max)	19.20	0.756
Minimum Thickness After Refinish	17.84	0.702
Discard Thickness**	17.30	0.681

*Brake pedal travel maximum with 445 N (100 lbs.) force applied to pedal with ignition "OFF" and vacuum or hydraulic assist depleted.

**All brake rotors have a discard dimension cast into them. This is a wear dimension and not a refinish dimension. Any rotor which does not meet the specification should be replaced.

TORQUE SPECIFICATIONS

Component	N·m	Lbs. Ft.	Lbs. In.
Booster to Pedal Bracket Nuts	27	20	—
Brake Hose Bracket Bolts	4	—	36
Brake Hose Clamp Screws	6	—	54
Brake Hose to Caliper	45	33	—
Brake Pedal Bracket to Dash Nut	27	20	—
Brake Pipes from Combination Valve to Brake Hoses	15	11	—
Brake Pipes from Master Cylinder to Combination Valve	23	17	—
Brake Pipe Clamp Nuts	6	—	54
Brake Pipe Clamp Screws	4	—	36
Caliper Bleeder Valve	13	—	116
Caliper Bridge to Housing Bolts	100	74	—
Caliper Mounting Bolts	100	74	—
Combination Valve to Bracket Bolts	6	—	54
Master Cylinder to Booster Nuts	27	20	—
Parking Brake Control Assembly to Floor Pan Bolts	27	20	—
Parking Brake Lever to Caliper Nuts	47	35	—
Splash Shields Bolts	12	—	107

SPECIAL TOOLS

Number	Name
J 6125-1B	Slide Hammer
J 21472	Brake Bleeder Wrench
J 22647	Pushrod Height Gage
J 23456	Power Brake Booster Disassembly and Assembly Tool
J 28458	Power Piston Seal Protector
J 28662	Brake Pedal Effort Gage
J 29282	Control Valve Installer
J 29532	Power Brake Bleeder
J 29567	Brake Bleeder Adapter
J 29803	I.S.O. Flaring Tool
J 36620	Spring Pin Remover
J 36621	Piston Rotator Wrench
J 36622	Boot Seal Installer
J 36623	Piston Installer

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

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.

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.

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

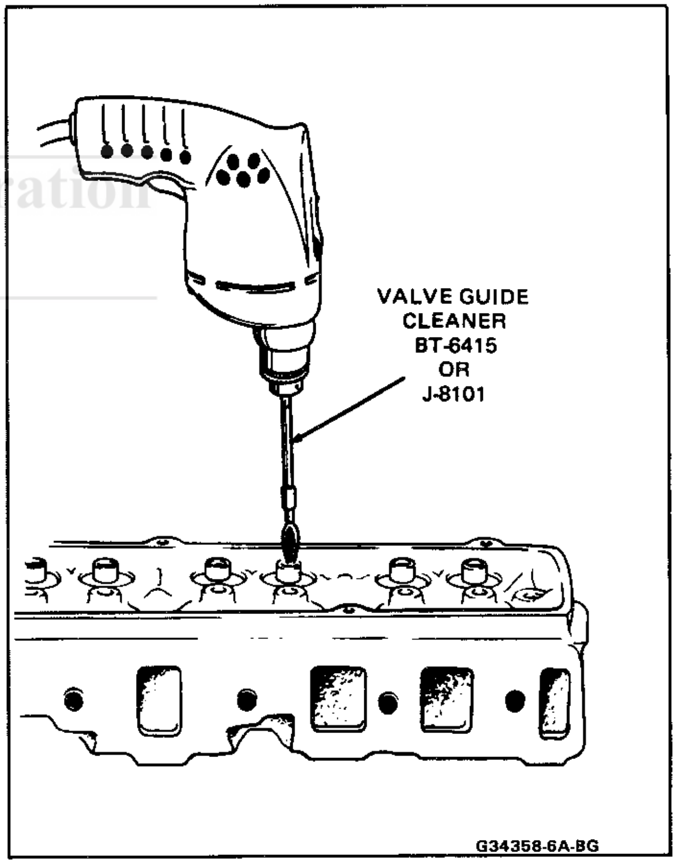


Figure 1 Cleaning Valve Guide

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.

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 reconditioned by parallel grinding. If more than .39 mm (.010") V6, or .152 mm (.006") V8 must be removed, replace the head.

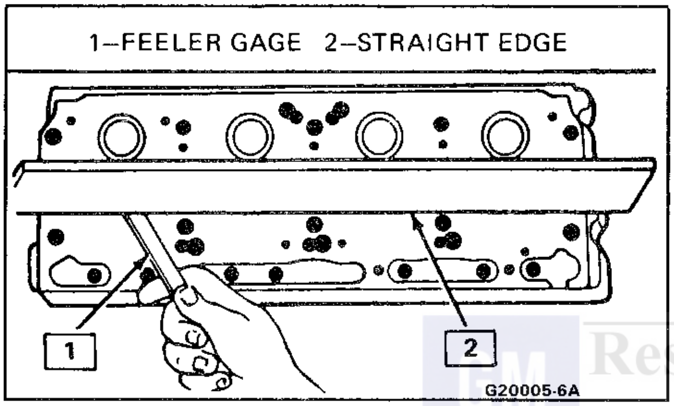


Figure 2 Checking Cylinder Head Flatness

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, the valve guide must be 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 has been reinstalled.

VALVE DISASSEMBLY

Disassemble

- Valve and spring mechanism (refer to Specific Engine Section)

Important

- Be sure that 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
  - 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 specific engine section for allowable clearances.
- The valve guides may be reamed oversize and an oversized valve installed (Figure 4).

Reaming Valve Guides

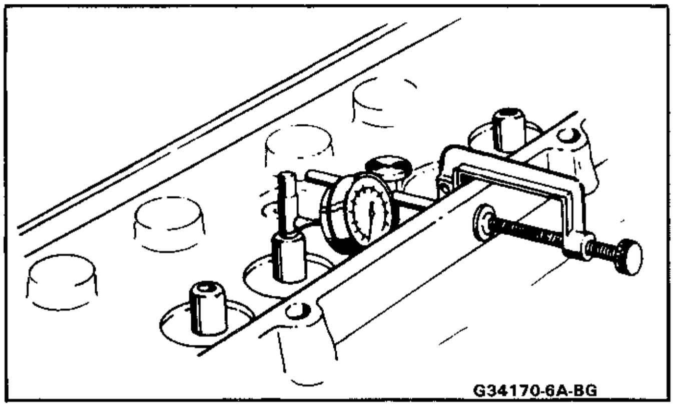


Figure 3 Measuring Valve Guide Clearance

Engine(s)	Nominal Size	Reamer (Oversize - OS)
1.6 & 2.0L	7mm	.19mm (.0075") OS
	7mm	.381mm (.015") OS
	7mm	.762mm (.030) OS
2.5L	11/32	.076mm (.003") OS
		.127mm (.005") OS
2.8L	11/32	.076mm (.003") OS
		.381mm (.015") OS
		.762mm (.030") OS
3.0 & 3.8L	11/32	.076mm (.003") OS
		.152mm (.006") OS
4.3L & 5.0L	11/32	.076mm (.003") OS
		.127mm (.005") OS

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.

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.

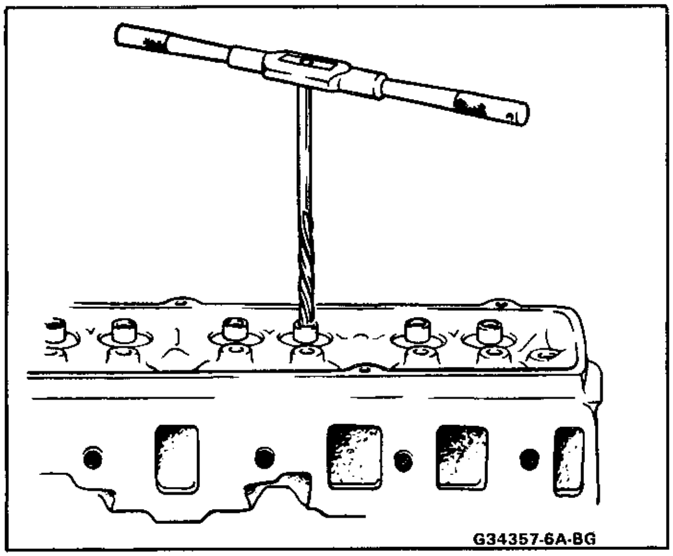


Figure 4 Reaming Valve Guide

Inspect

- Valve stem tip for wear. 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.

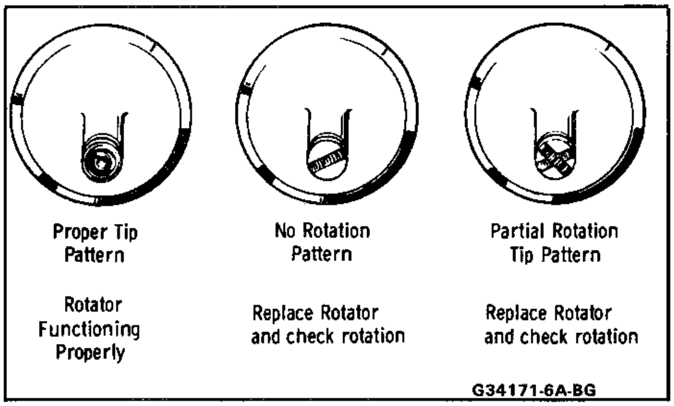


Figure 5 Valve Stem Tip Wear

- 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.
- 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 refacing 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. 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
  - Expanded height
  - Spring ends. If they are not parallel, the spring is bent and must be replaced.
  - Spring load. If below specification, replace.

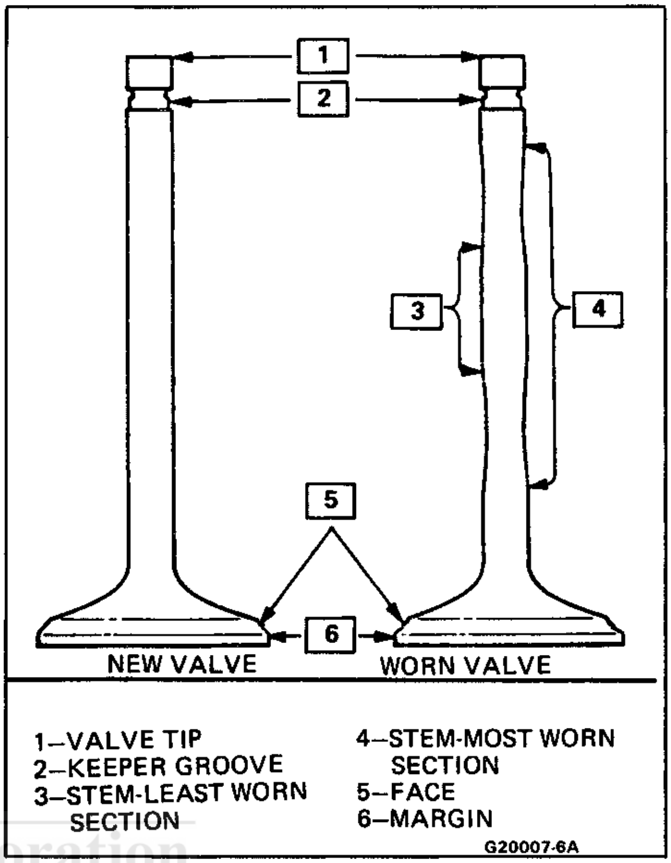


Figure 6 Valve Wear

- Valve spring seating surface of the valve rotators, or spring retainers, for wear or gouging. Replace as required.

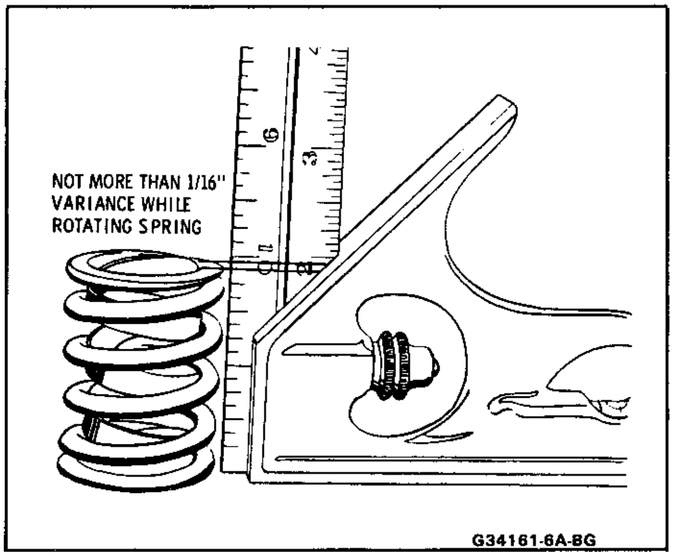


Figure 7 Checking Valve Springs

VALVE SEALS

Important

- If seals are the **Umbrella type,** push them down as far as they will go. If oversized valves have been installed, oversized valve stem seals must be used. Intake and exhaust valve stem seals may be different.

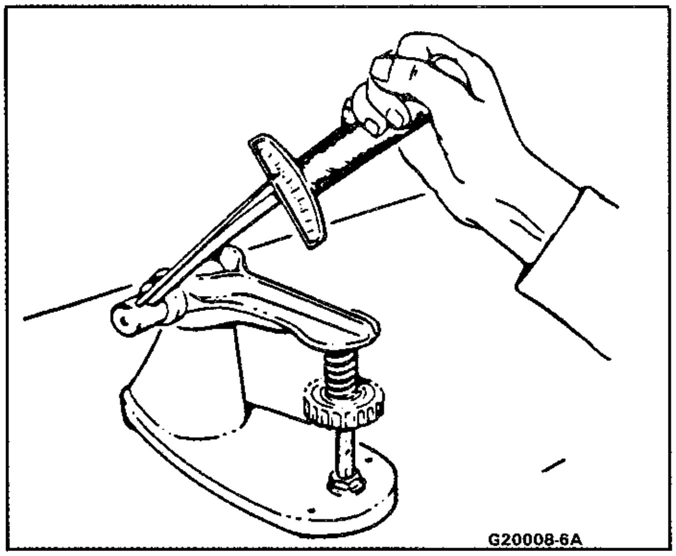
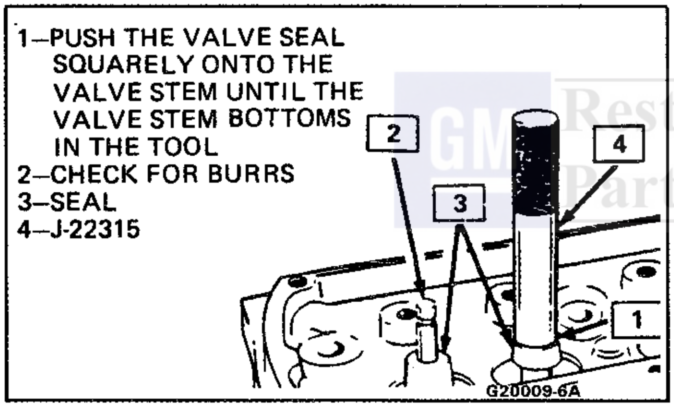


Figure 8 Checking Valve Spring Load

- If valve stem seals are the "**O**" **Ring type** be sure they are properly seated in the groove and not twisted.



1—PUSH THE VALVE SEAL SQUARELY ONTO THE VALVE STEM UNTIL THE VALVE STEM BOTTOMS IN THE TOOL
2—CHECK FOR BURRS
3—SEAL
4—J-22315

Figure 9 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.

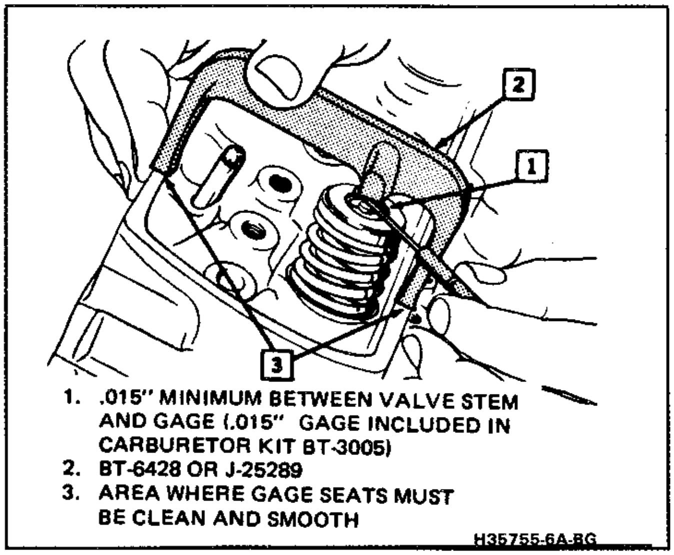
VALVE STEM HEIGHT (BRIDGE-TYPE TOOL)

Tool Required:

J 25289

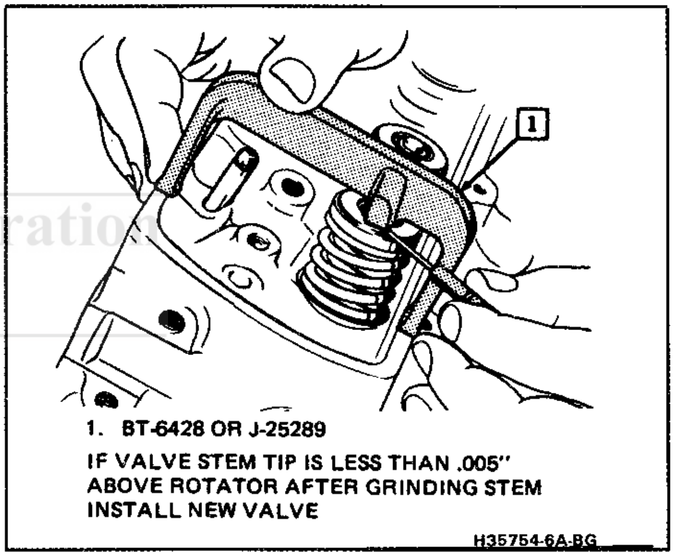
- Installed valve stem height (Figure 10). Excessive valve stem height is caused by lowering of the valve seat and excessive valve face grinding during reconditioning. To correct, remove the valve and shorten the valve stem by grinding. (Refer to Figure 11 for specifications.)
- Valve stem-to-rotator height (Figure 11)

NOTICE: If below specification (Figure 11), the valve must be replaced to avoid interference of the



1. .015" MINIMUM BETWEEN VALVE STEM AND GAGE (.015" GAGE INCLUDED IN CARBURETOR KIT BT-3005)
2. BT-6428 OR J-25289
3. AREA WHERE GAGE SEATS MUST BE CLEAN AND SMOOTH

Figure 10 Measuring Valve Stem Height (Bridge-type Tool)



1. BT-6428 OR J-25289

IF VALVE STEM TIP IS LESS THAN .005" ABOVE ROTATOR AFTER GRINDING STEM INSTALL NEW VALVE

Figure 11 Measuring Valve Rotator Height

VALVE STEM HEIGHT (STEEL RULE)

1. Place the valve in its guide and hold it in the closed position.
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 12). 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.

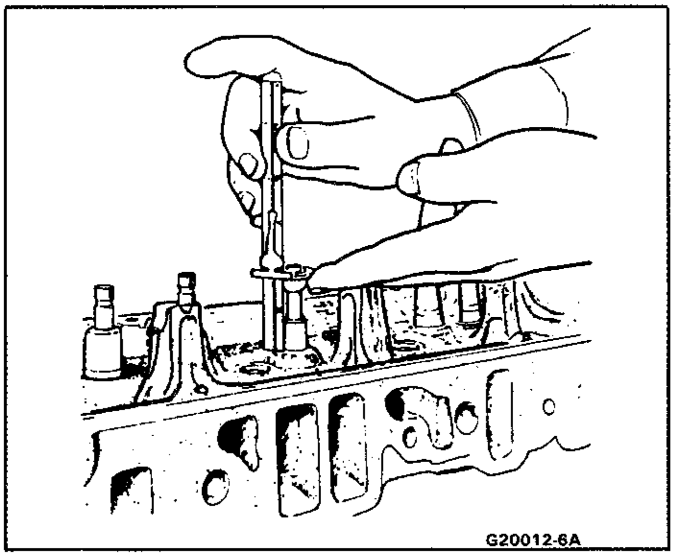
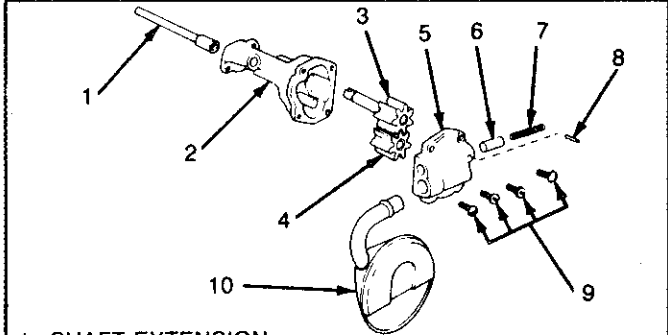


Figure 12 Measuring Valve Spring Installed Height

OIL PUMP

Three types of oil pumps are used. They are the engine oil pan (sump pump) (Figure 13), the front cover gear type (Figure 14), or the front cover Gerotor type (Figure 15).



1. SHAFT EXTENSION
2. PUMP BODY
3. DRIVE GEAR AND SHAFT
4. IDLER GEAR
5. PUMP COVER
6. PRESSURE REGULATOR VALVE
7. PRESSURE REGULATOR SPRING
8. RETAINING PIN
9. SCREWS
10. PICKUP SCREEN AND PIPE

34174-6A-BG

Figure 13 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.

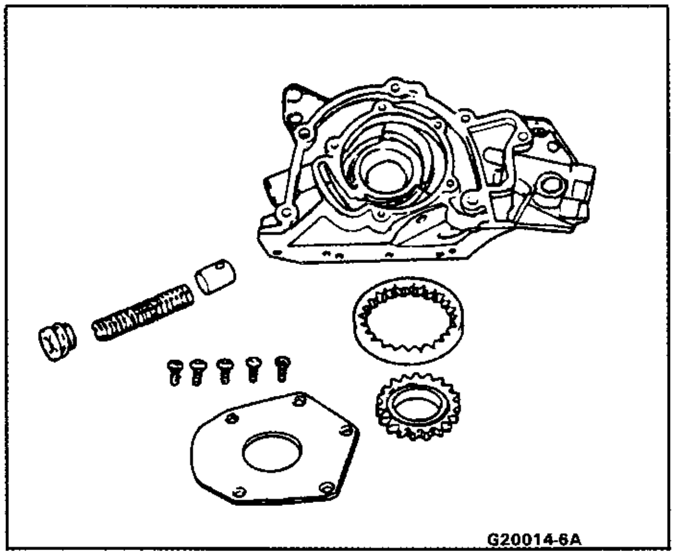
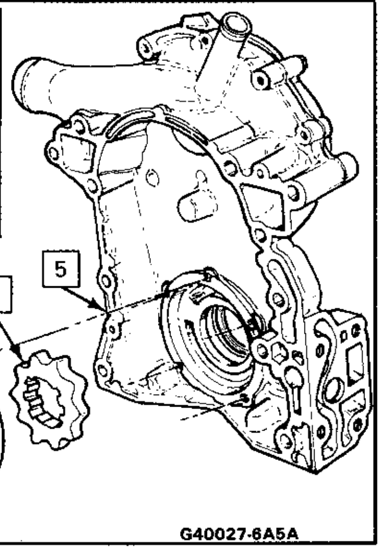


Figure 14 Oil Pump, Front Cover Gear Type



1	11 N·m (88 IN. LBS.)
2	OIL PUMP COVER
3	PUMP OUTER GEAR
4	PUMP INNER GEAR
5	FRONT COVER

Figure 15 Gerotor Oil Pump

5. Pump gears.
6. Pressure regulator valve.
   - Plug or cotter pin.
   - Spring.
   - 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

- 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 16)
- Gear lash. Install gears, marking toward the timing cover and measure in several places (Figure 17).
- Pump housing gear pocket (Figure 18)
- Gears (Figure 19)
- Gear side clearance, if applicable (Figure 20)
- Gear end clearance (Figure 21)

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, **all** pump cavities must be 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.

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 and 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

- 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.

DISPLACEMENT				2.0L	2.5L	2.8L	3.8L	3.0L	5.0L	4.3L,5.0L
ENGINE VIN CODE				K, M	R, U	9, 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	-

H20001-6A

Figure 16 Oil Pump Specification

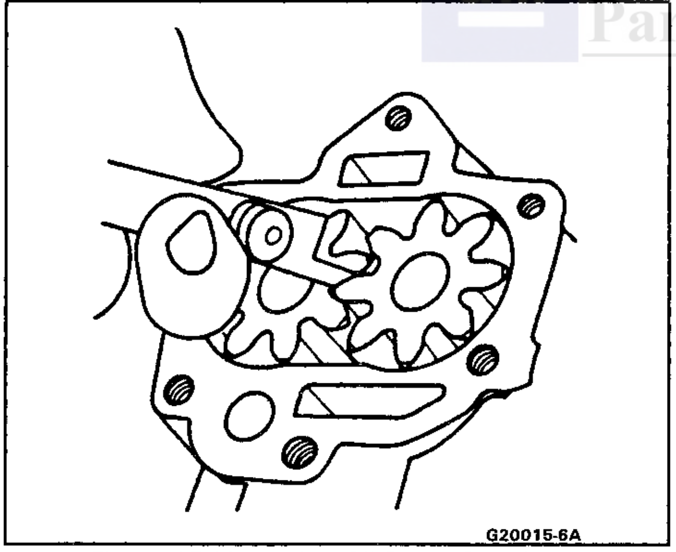


Figure 17 Measuring Oil Pump Gear Lash

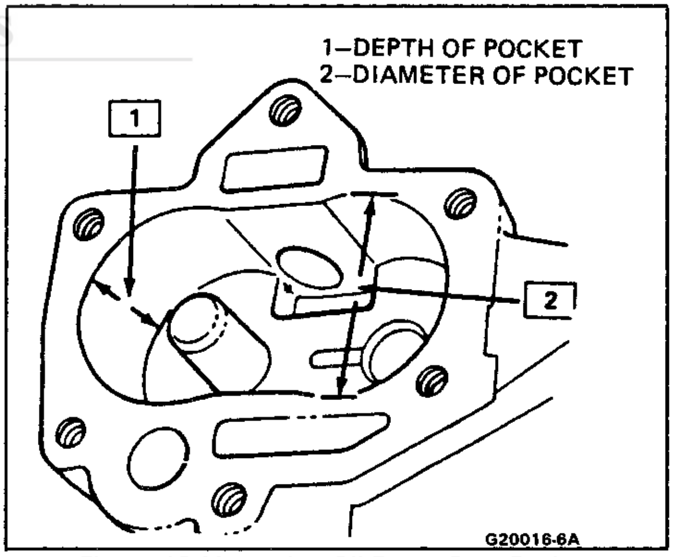


Figure 18 Measuring Oil Pump Gear Pocket

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:

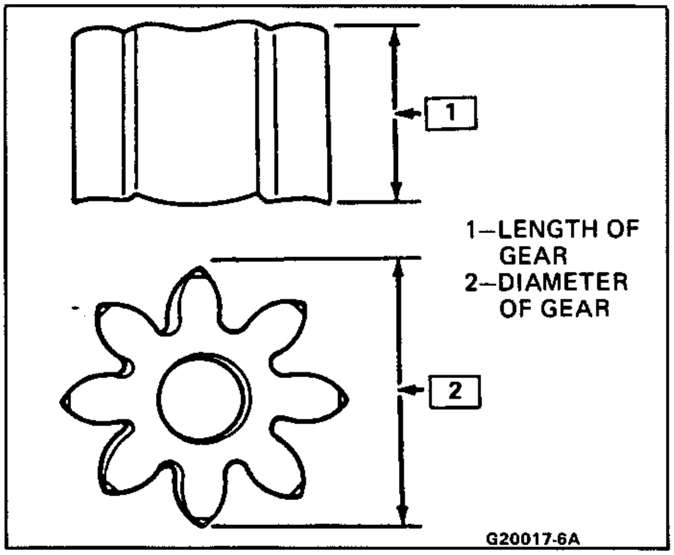


Figure 19 Measuring Oil Pump Gears

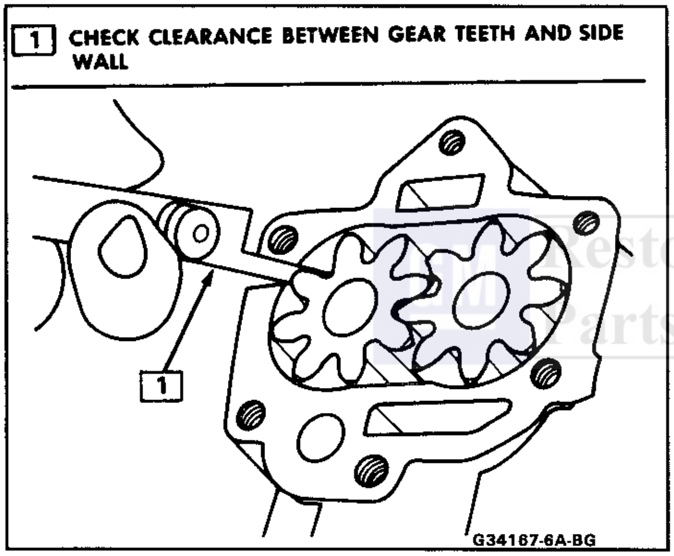


Figure 20 Measuring Gear Side Clearance

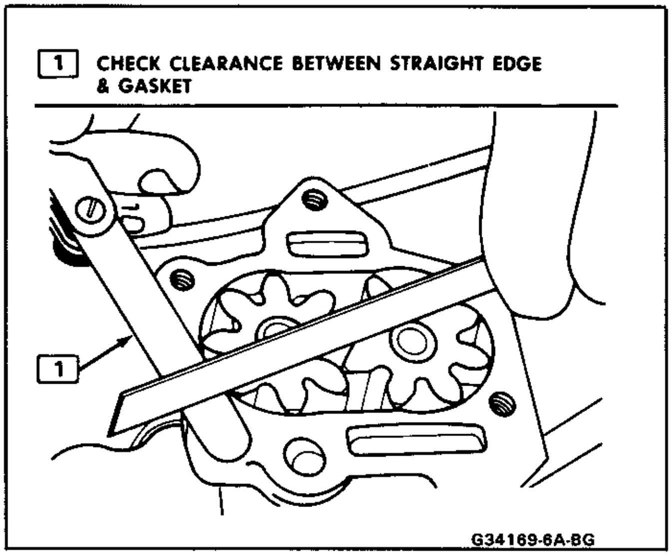


Figure 21 Measuring Oil Pump End Clearance

- Chipping
- Galling
- Excessive Wear

Measure

- Oil pump gears for:
  - Inner gear tip clearance. Max. .152 mm (.006"). See Figure 22.
  - Outer gear diameter clearance. .203 mm - .381 mm (.008" - .015"). See Figure 23.
  - Gear end clearance (gear drop in housing). .025 mm - .089 mm (.001" - .0035"). See Figure 24.

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.).

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 reassemble. 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.

CONNECTING ROD AND MAIN BEARINGS

Engine bearings are of the precision insert type. They are available for service use in standard and various undersizes (Figure 25).

Replacement

Depending upon crankshaft condition, bearings may be replaced in the car or the engine must be removed. If the engine must be removed, follow the

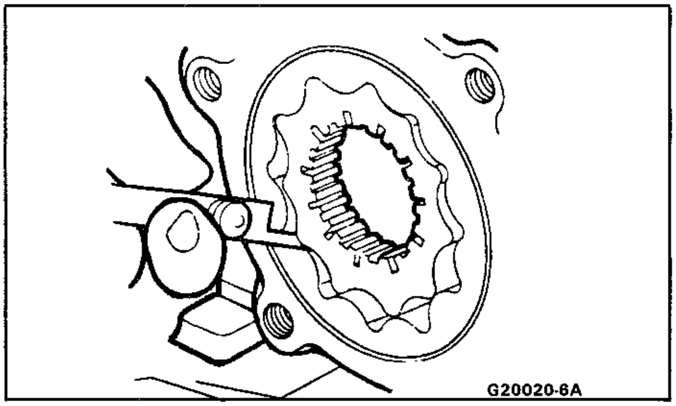


Figure 22 Inner Gear Tip Clearance-Gerotor

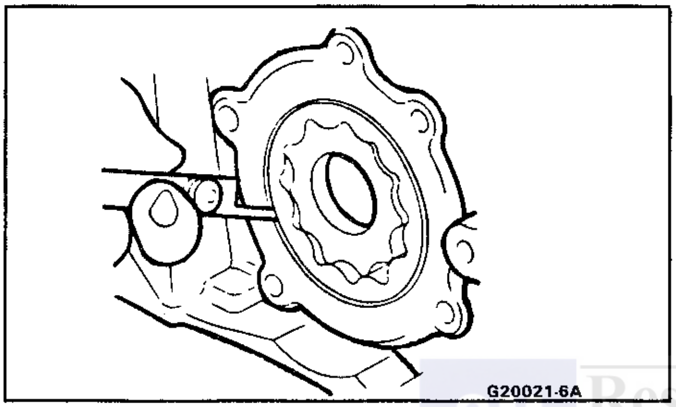


Figure 23 Outer Gear Diameter Clearance-Gerotor

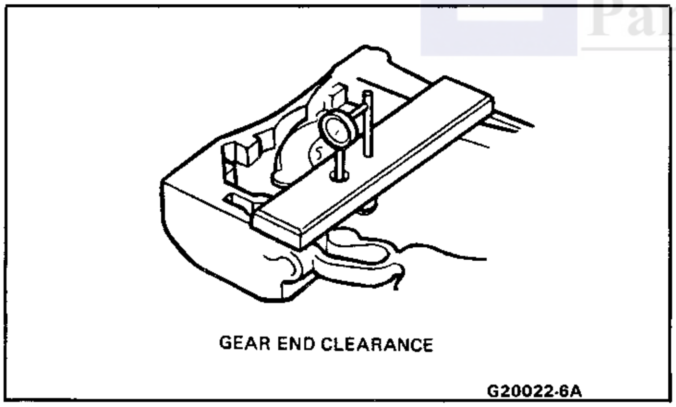


Figure 24 Gear End Clearance (Gear Drop In Housing) -Gerotor

crankshaft procedure in this section and the specific engine section. Evaluate bearings as specified in this section. If the engine is out of the vehicle and upside down, the crankshaft will rest on the upper bearings and the total clearance can be measured between the lower bearing and journal. If the engine is to remain in the vehicle, the crankshaft must be supported upward to remove any clearance from the upper bearing. The total clearance can then be measured between the lower bearing and journal.

With Crankshaft Removal

1. Remove and inspect the crankshaft.
2. Remove the main bearings from the cylinder block and main bearing caps.
3. Coat bearing surfaces of new, correct size, main bearings with oil and install in the cylinder block and main bearing caps.
4. Install the crankshaft.

Without Crankshaft Removal

1. With oil pan, oil pump and spark plugs removed, remove cap on main bearing requiring replacement and remove bearing from cap.
2. Install a main bearing moving and installing tool in oil hole in crankshaft journal. If such a tool is not available, a cotter pin may be bent as required to do the job.
3. Rotate the crankshaft clockwise, as viewed from the front of engine. This will roll upper bearing out of block.
4. Oil new selected size upper bearing and insert plain (unnotched) end between crankshaft and indented or notched side of block. Rotate the bearing into place and remove tool from oil hole in crankshaft journal.
5. Oil new lower bearing and install in bearing cap.
6. Install main bearing cap with arrows pointing toward front of engine.
7. Torque all main bearing caps, EXCEPT THE REAR MAIN CAP, to specifications. Torque rear main bearing cap to 10-12 lb. ft. (14-16 N·m) then pry end of crankshaft, first rearward then forward with a screwdriver or prybar. This will line up rear main bearing and crankshaft thrust surfaces. Retorque all main bearing caps to specifications.

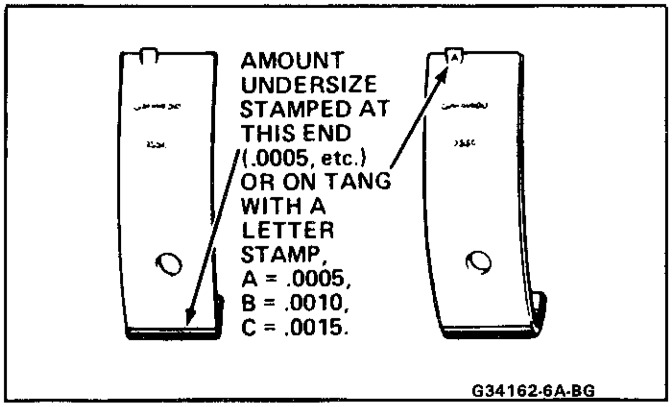


Figure 25 Bearing Insert Markings

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 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 runout. (Refer to basic engine section 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 reconditioned 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: To avoid 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 26).

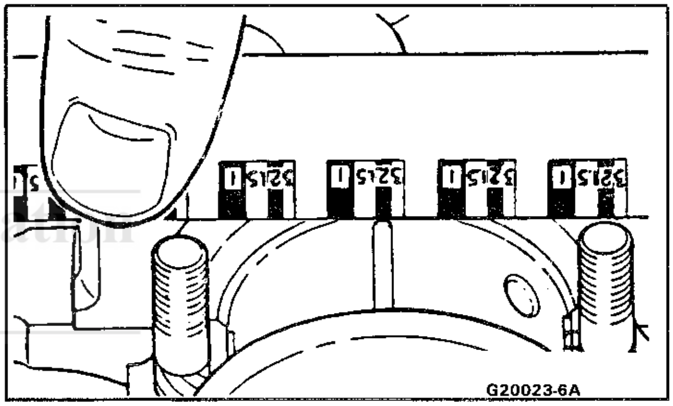


Figure 26 Measuring Bearing Clearance

7. Remove all traces of the gaging plastic after measuring.
8. Select a set of bearing inserts that will produce the desired clearance.

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.

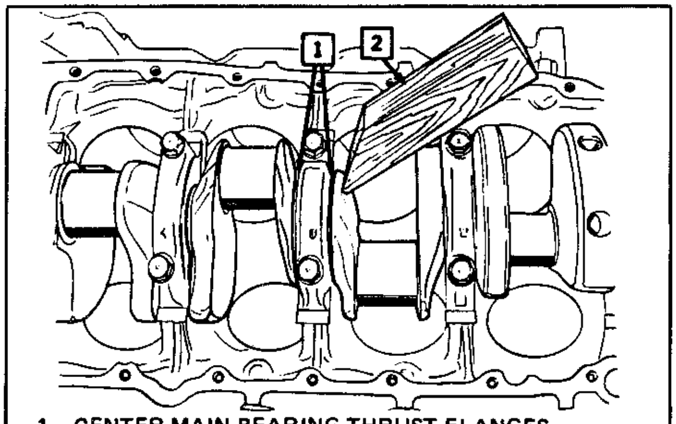
NOTICE: In order to prevent the possibility of cylinder block and/or main bearing cap damage, the main bearing caps are to be tapped into their cylinder block cavity using a brass, lead or leather mallet before attaching bolts are installed. Do not use attaching bolts to pull main bearing caps into their 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 27)



1. CENTER MAIN BEARING THRUST FLANGES
2. WOOD BLOCK

BUMP SHAFT IN EACH DIRECTION TO ALIGN THRUST FLANGES OF CENTER MAIN BEARING.

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Figure 27 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 28)
- Connecting rod side clearance (Figure 29, 30)

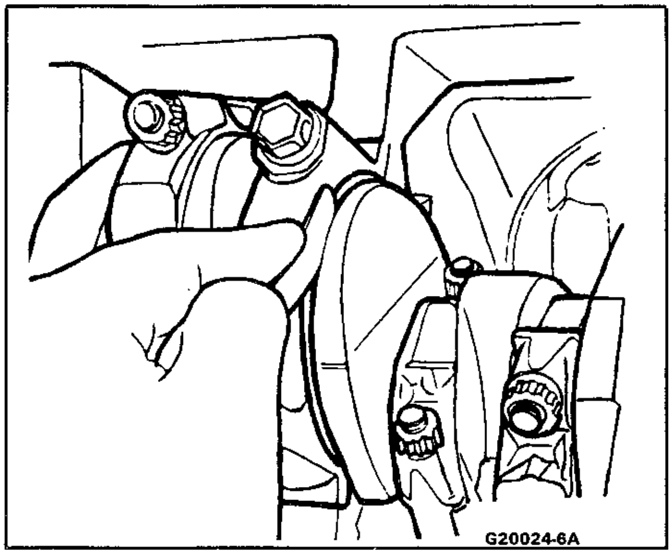


Figure 28 Measuring Crankshaft End Play

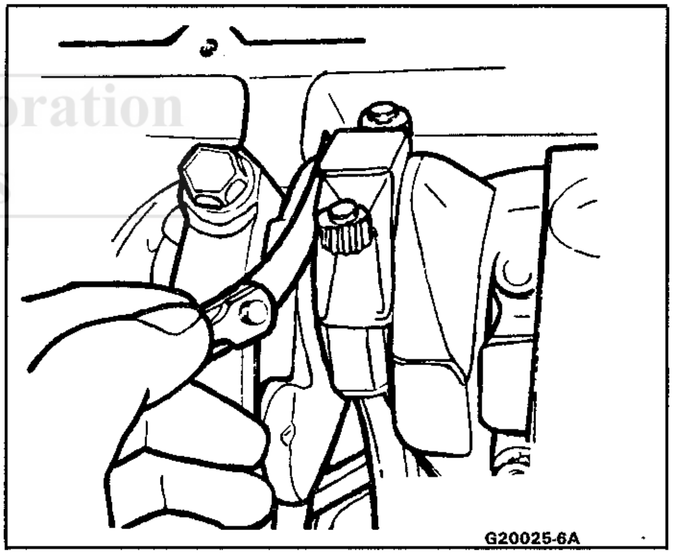


Figure 29 Measuring Connecting Rod Side Clearance (Single Rod Journal)

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)

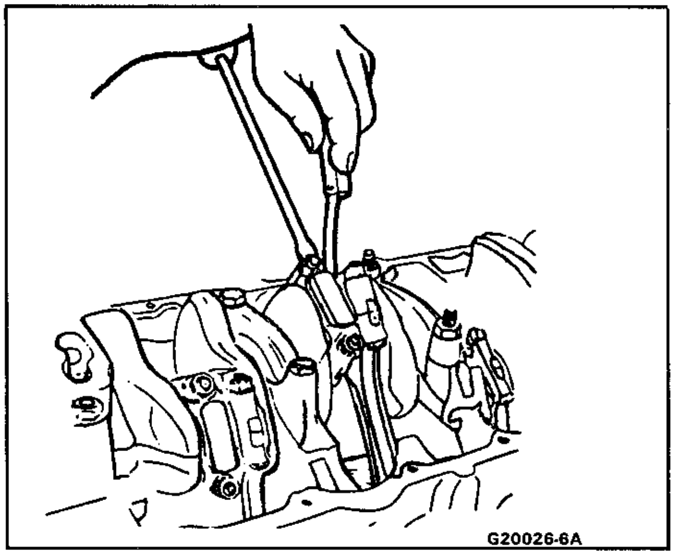


Figure 30 Measuring Connecting Rod Side Clearance (Double Rod Journal)

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. 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 31).

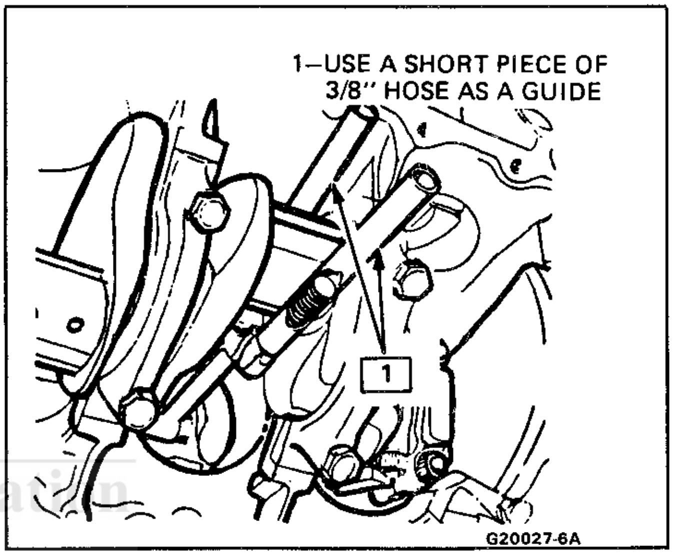


Figure 31 Connecting Rod Protectors (Typical)

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 32).

Clean

- Piston, piston pin and connecting rod
  - Sludge
  - Carbon
  - Piston ring grooves must be cleaned of carbon to the bare metal.
  - Varnish from the piston pin by soaking in carburetor cleaning solution.

CAUTION: Avoid inhaling fumes or exposure of the skin to carburetor cleaning fluid, as bodily injury may result.

  - Do not scrape the piston skirt.

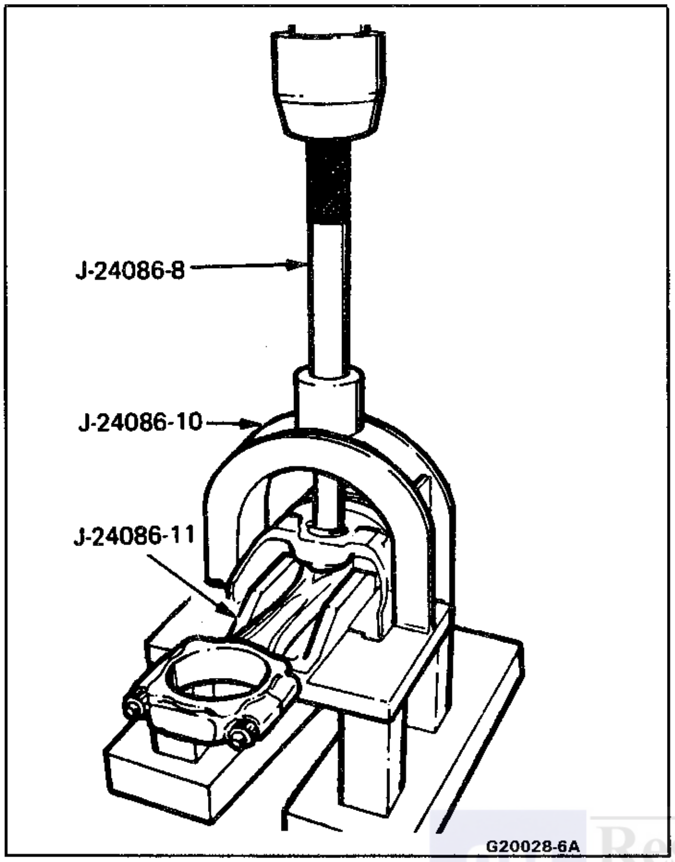


Figure 32 Removing Piston Pin Using Tool J 24086

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 33)
   - 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 33). If the gap is below specification, increase the gap by carefully filing off excess material.

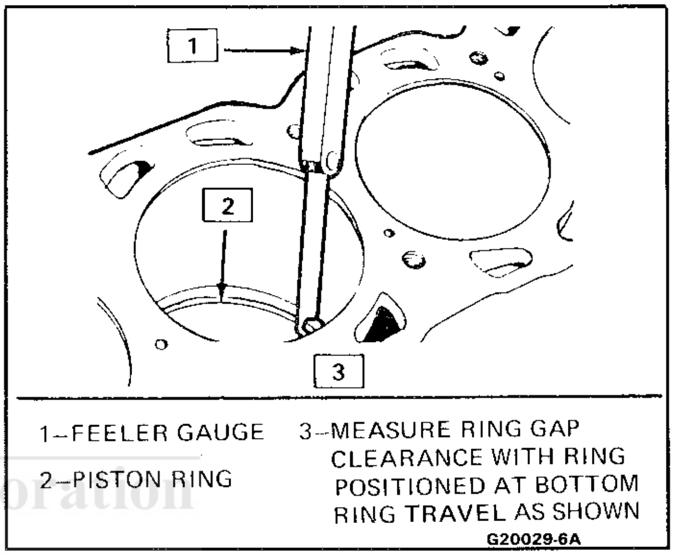


Figure 33 Measuring Piston Ring Gap

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 34). If the ring is too thick, try another ring. If no ring can be found that fits the specifications, 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 35) lines up with the side of the connecting rod that faces the front of the engine.

1. Place piston and connecting rod into Fixture J 24086 (Figure 36)
2. Adjust plunger of the fixture.

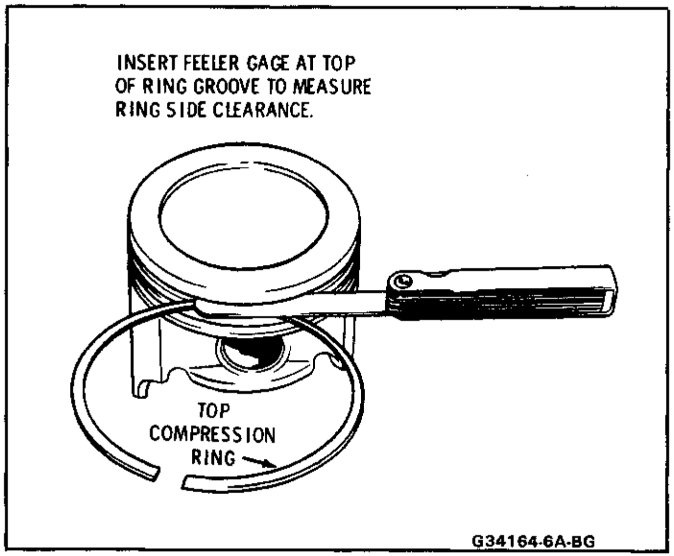


Figure 34 Measuring Piston Ring Side Clearance

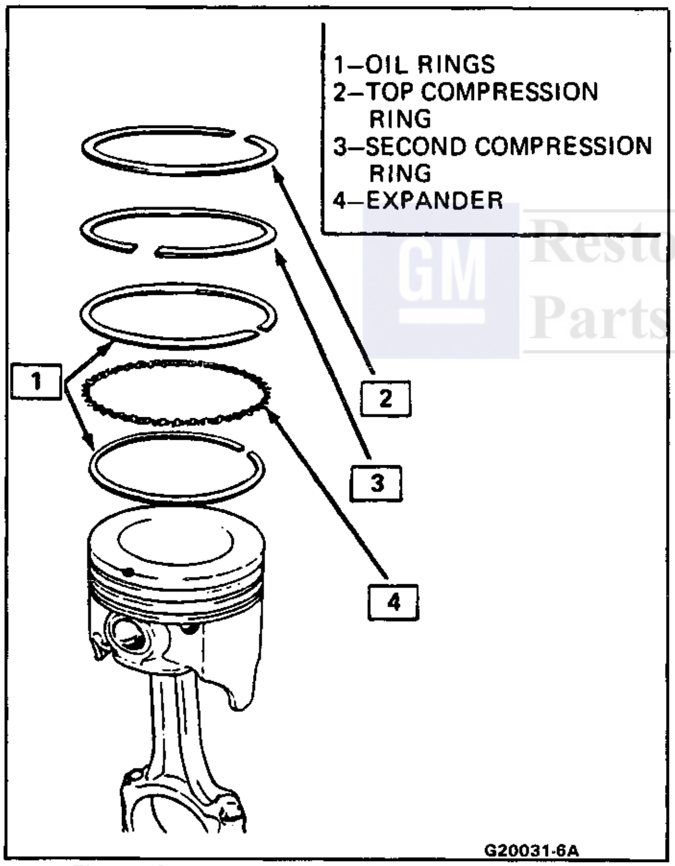


Figure 35 Piston and Rod Assembly (Typical)

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

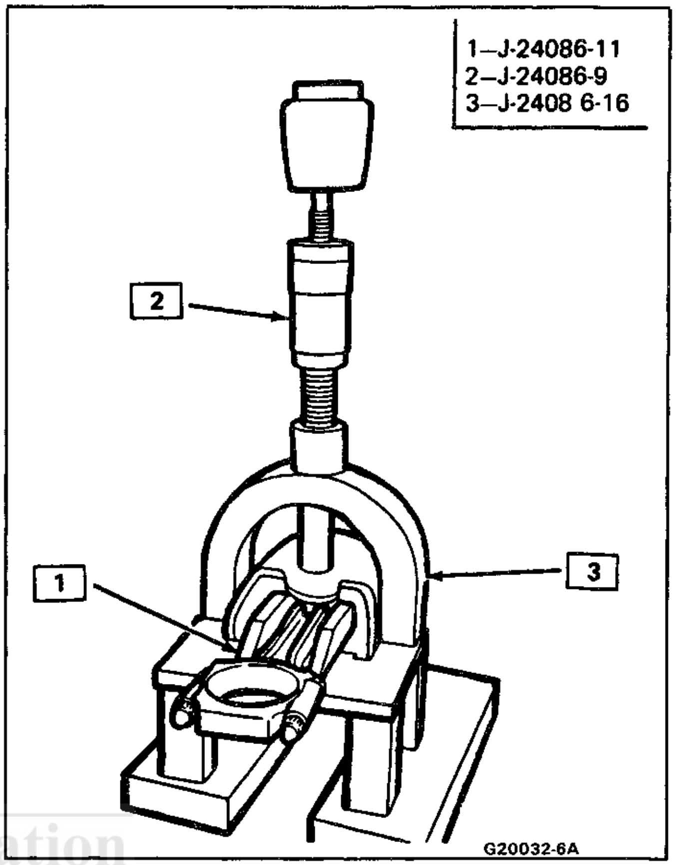


Figure 36 Installing Piston Pin Using Tool J 24086

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 37).

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 31)
4. Piston ring compressor (Figure 38)
5. Align piston and connecting rod assembly according to the mark on the piston (Figure 35) and insert in the cylinder.

NOTICE: Guide the lower connecting rod end carefully to avoid damaging the crankshaft journal.

6. Remove thread protectors.
7. Connecting rod bearing (refer to Connecting Rod and Main Bearing).
8. Bearing cap.

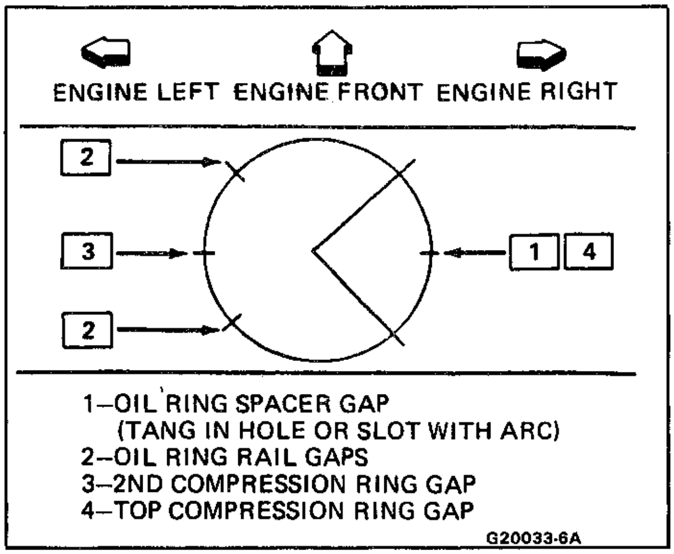


Figure 37 Piston Ring Gap Locations

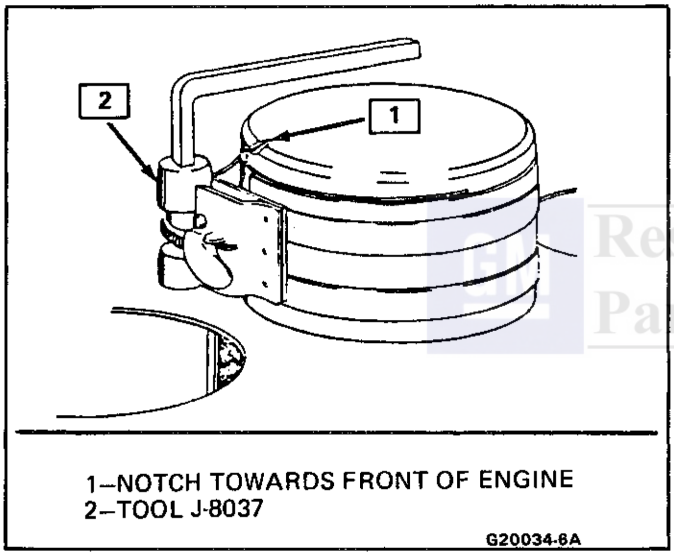


Figure 38 Installing A Piston Using A Piston Ring Compressor

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 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 39). If any one cam lobe lift is out of specification, replace the camshaft.

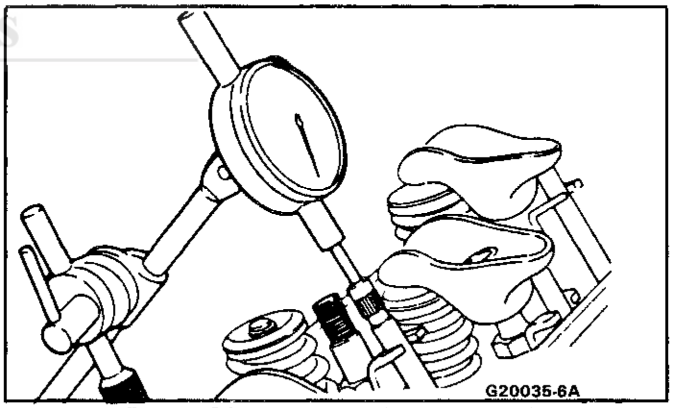


Figure 39 Measuring Cam Lobe Lift

- Bearing journals
  - With a micrometer, measure runout 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.

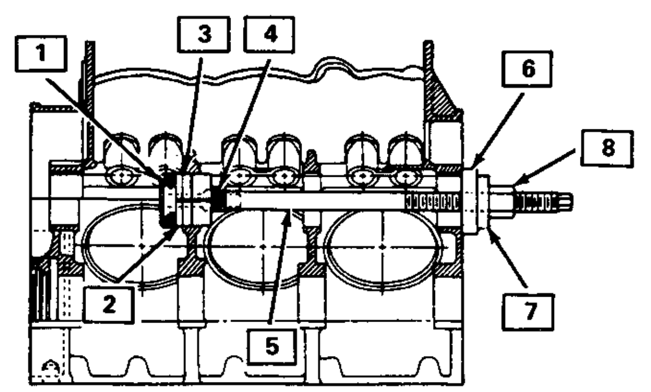
Camshaft Bearings

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 40). Make sure the puller nut engages a sufficient number of threads.
   - Pull out bearings



1—BACK-UP NUT
2—EXPANING COLLET
3—BEARING
4—EXPANDING MANDREL
5—2 PIECE PULLER SCREW
6—PULLING PLATE
7—THRUST BEARING
8—PULLING NUT

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Figure 40 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

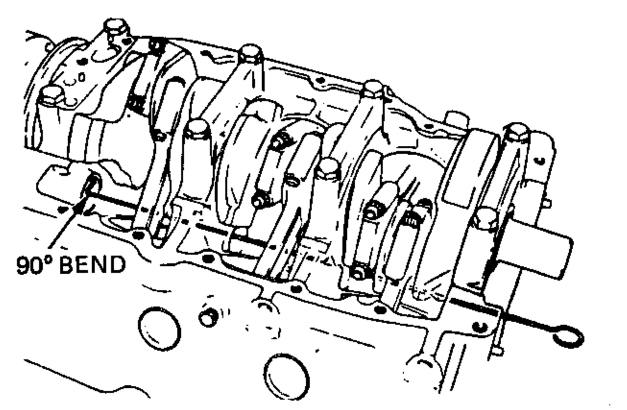
Install or Connect

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 40).

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 41).



CHECKING OIL HOLE ALIGNMENT WITH BRASS ROD. MAKE ROD AS SHOWN USING 3/32" ROD ABOUT 762mm (30") LONG

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Figure 41 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 42).

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:

   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

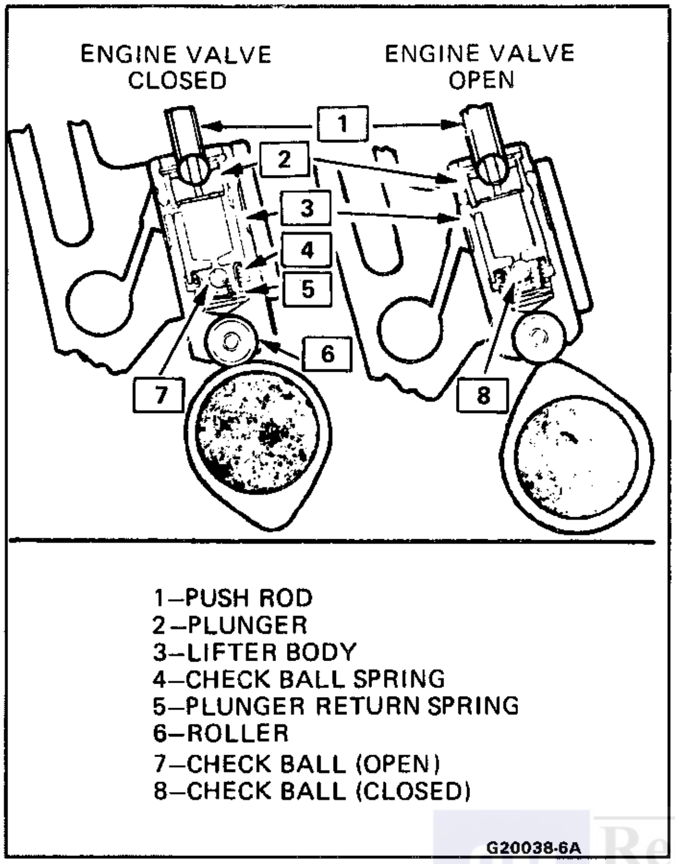


Figure 42 Valve Lifter Operation (Roller Shown)

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 7).
   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

Valve lash indicates one of the following:

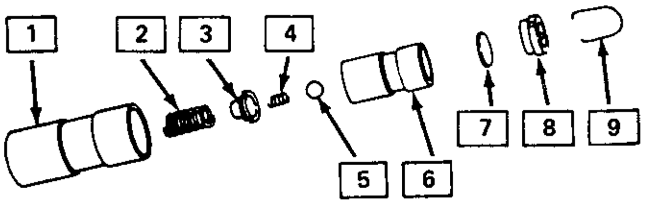
a. Worn push rod.
b. Worn rocker arm.
c. Lifter plunger stuck in down position, due to dirt or carbon.
d. Faulty lifter.

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 43) for most engines and a roller tappet type (Figure 44). They function in a similar manner.
- If the camshaft was replaced, the lifters must also be replaced (except roller lifters).



1—LIFTER BODY
2—PLUNGER SPRING
3—BALL CHECK RETAINER
4—BALL CHECK SPRING
5—BALL CHECK
6—PLUNGER
7—OIL METERING VALVE
8—PUSH ROD SEAT
9—RETAINER RING

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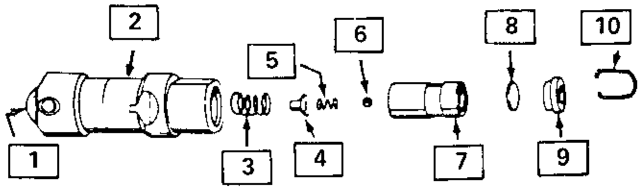
Figure 43 Valve Lifter - Flat Tappet



1—ROLLER
2—LIFTER BODY
3—PLUNGER SPRING
4—BALL CHECK RETAINER
5—BALL CHECK SPRING
6—BALL CHECK
7—PLUNGER
8—OIL METERING VALVE
9—PUSH ROD SEAT
10—RETAINER RING

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Figure 44 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 45)

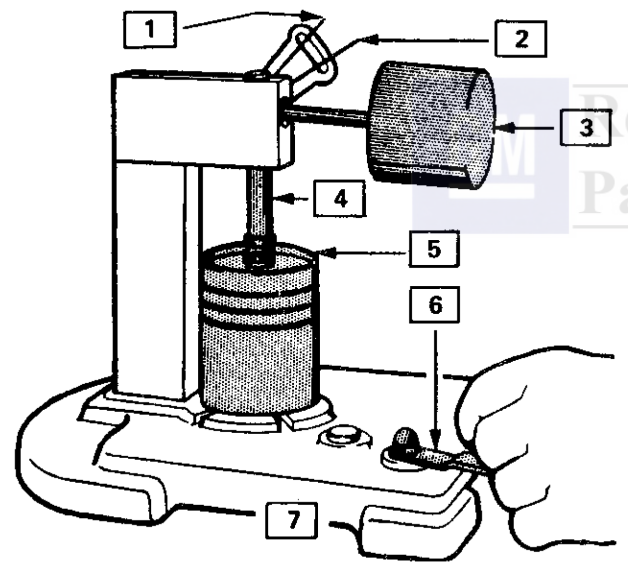


Figure 45 Measuring Valve Lifter Leak-Down Rate

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 46). Minor irregularities may be carefully machined. If more than .25 mm

(.010") (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

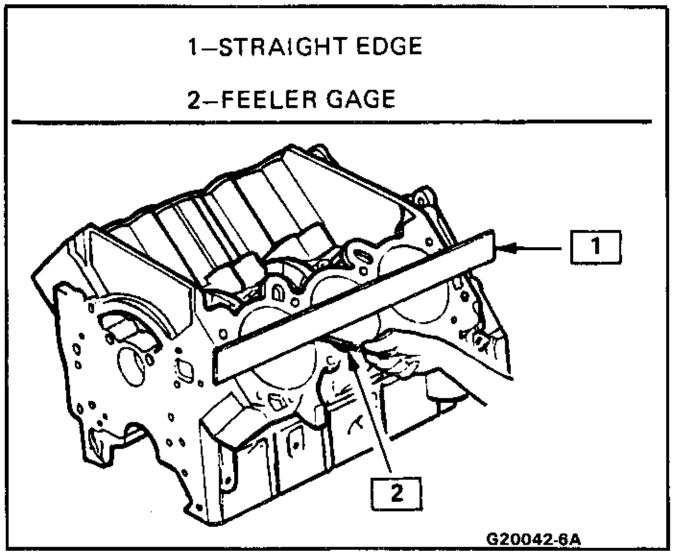


Figure 46 Checking Cylinder Block for Flatness

NOTICE: If this surface is not flat, a broken flexplate may result.

- Temporarily install the crankshaft. Measure crankshaft flange runout (refer to Crankshaft).

Measure

- Six mounting hole bosses (Figure 47)
  1. Hold gage plate flat against the crankshaft flange (Figure 47).
  2. Place dial indicator stem on the transmission mounting bolt hole boss (Item 1, Figure 47) 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.

- 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.

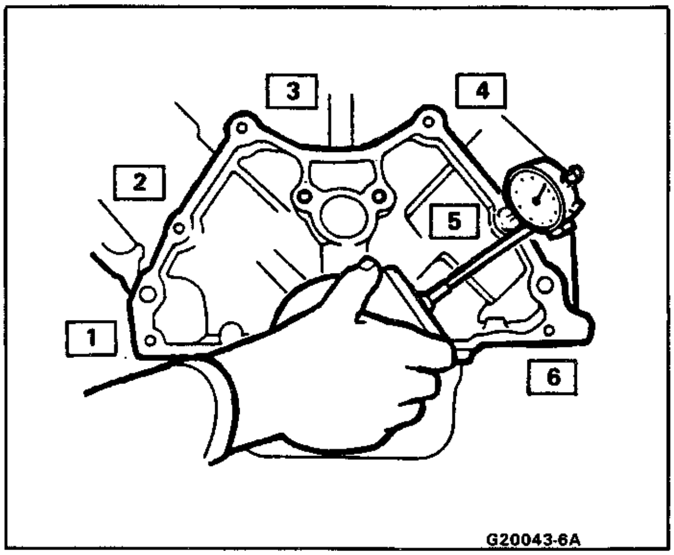


Figure 47 Measuring Transmission Mounting Surface Run Out

- Bearing bores. With a bore gage, measure concentricity and alignment (Figure 48)
  - 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.

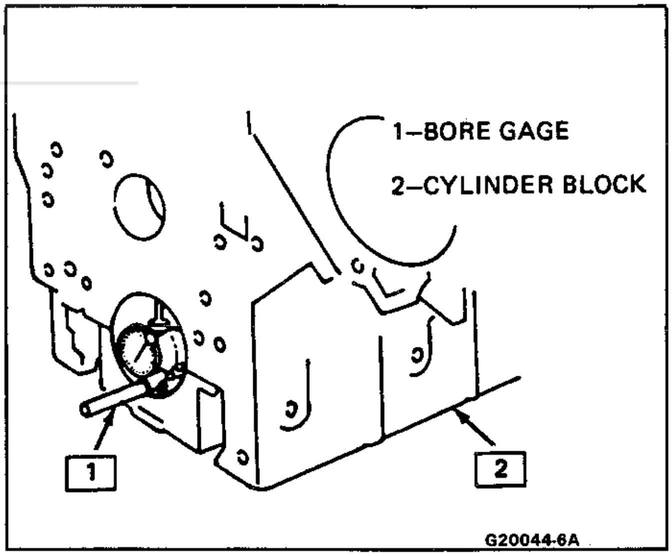


Figure 48 Measuring Bearing Bore

- Cylinder bore, with bore gage J 8087 measure for wear, taper, runout and ridging (Figure 49)

- If the bore is worn beyond limits (Figure 50), it may be rebored, honed and fitted with oversize pistons. The smallest available oversize should be selected (refer to Piston Fitting).

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.

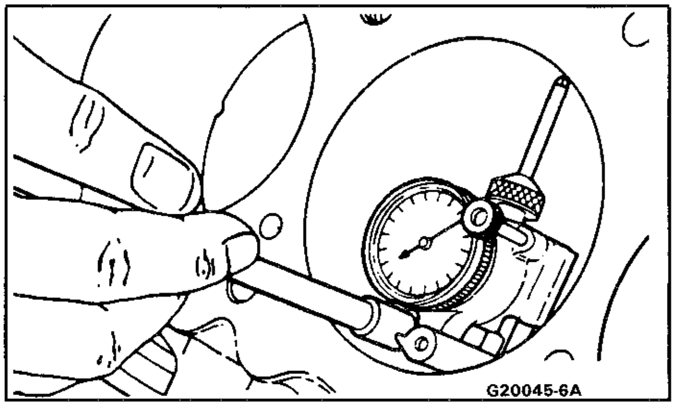


Figure 49 Measuring Cylinder Bore For Taper and Out of Round

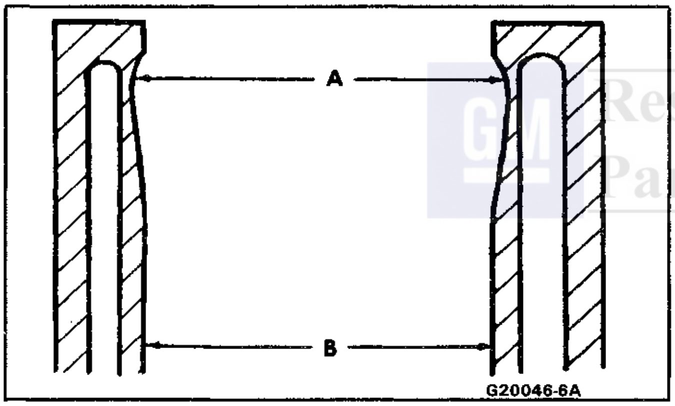


Figure 50 Cylinder Wear Pattern

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, if 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 51), refer to Cylinder Block. If worn beyond specifications, rebore and hone to size.

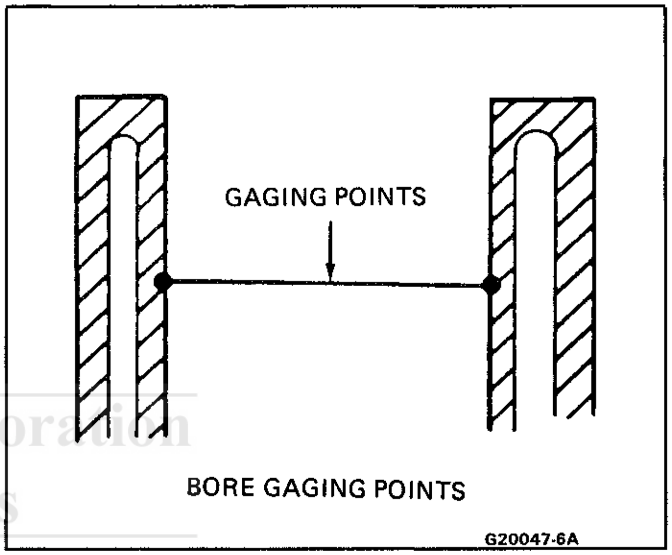


Figure 51 Cylinder Bore Gaging Point

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 52.
   c. Subtract piston diameter from cylinder bore diameter to determine piston to bore clearance.
   d. Compare piston to bore clearance obtained with that specified.

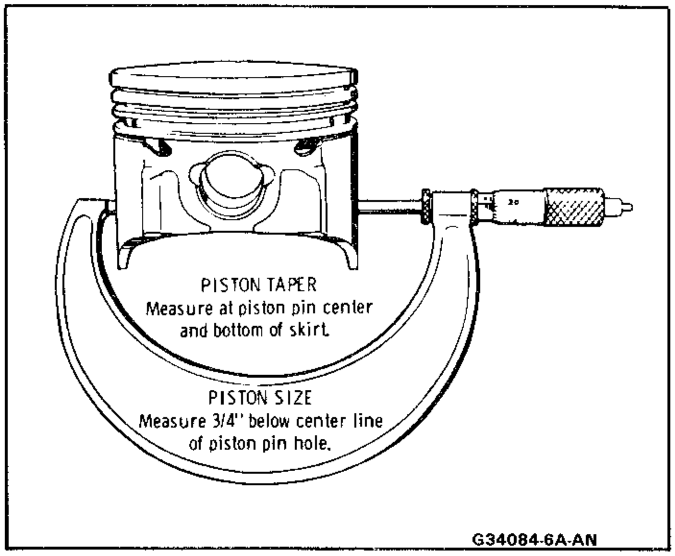


Figure 52 Measuring Piston

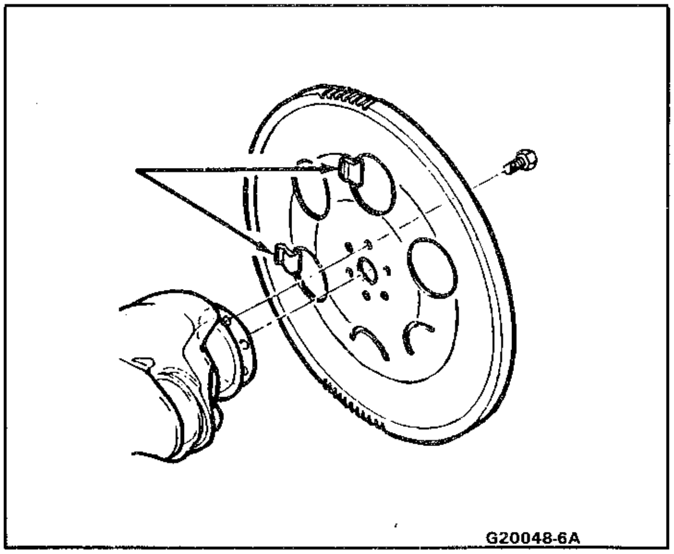


Figure 53 Flexplate Balance Clip Location (Typical)

   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 53).

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.

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 54). 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.

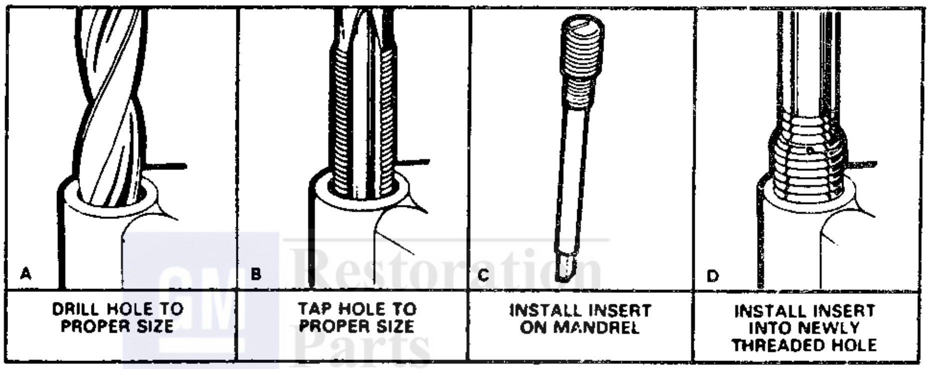


Figure 54 Repairing Threaded Holes

SECTION 6A1

2.5 LITER L4 ENGINE

CONTENTS

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 8.3:1. It is cast with individual intake and exhaust ports for each cylinder. 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. Face angles of both intake and exhaust valves are 45°. The cylinder head has straight valve guides, cast integrally. Positive valve stem seals are used on intake and exhaust valves to prevent excess oil from entering the valve guides.

Valve springs with external spring dampers control spring surge at high RPM.

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.

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.

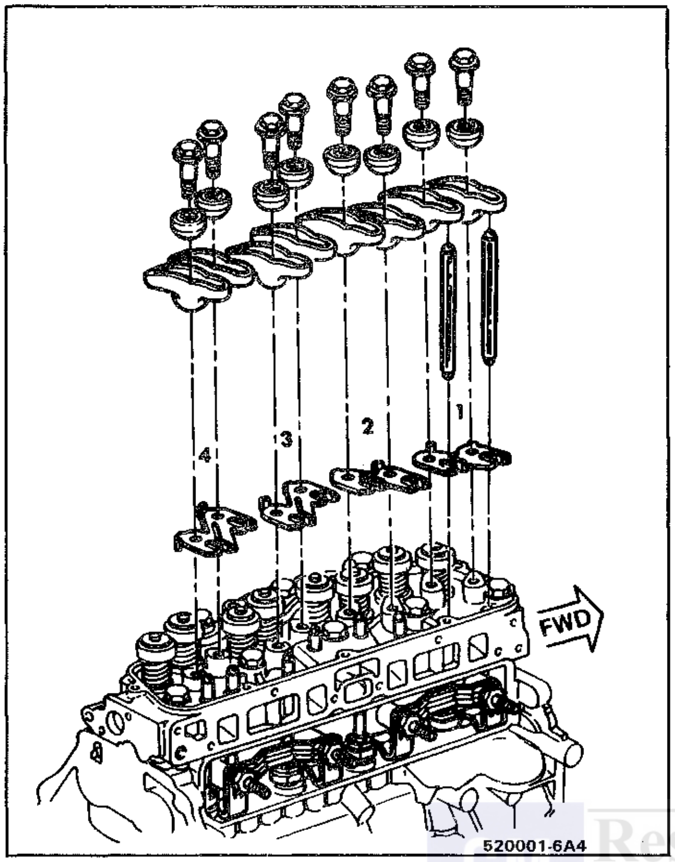


Fig. 1 Valve Train

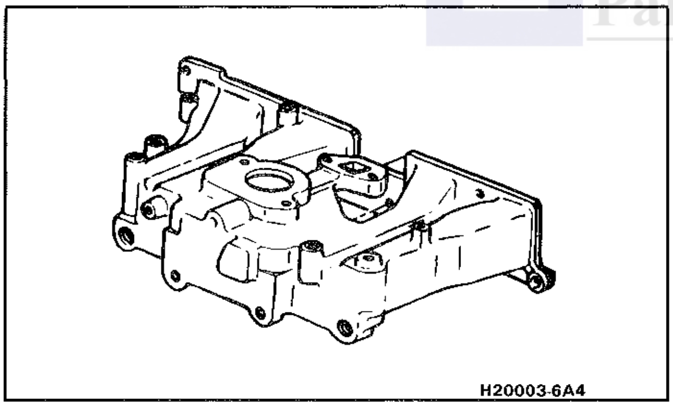


Fig. 2 Intake Manifold

EXHAUST MANIFOLD

The exhaust manifold is made of stainless steel and directs exhaust gases from the combustion chambers.

CAMSHAFT AND DRIVE

The modular iron camshaft is supported by three bearings and is gear driven. A powdered metal crankshaft gear drives the camshaft through a pheonolic fabric composition gear with a steel hub (Fig. 4).

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.

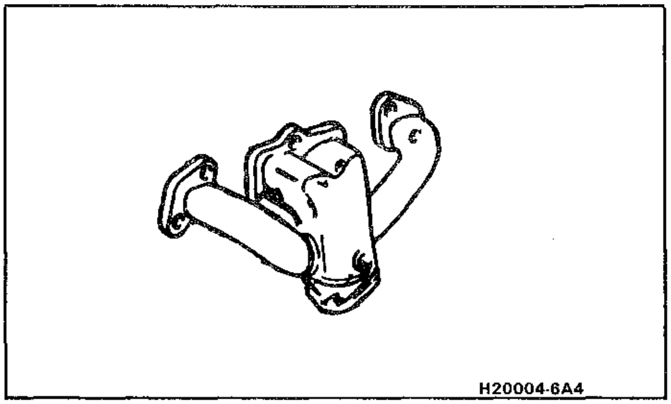


Fig. 3 Exhaust Manifold

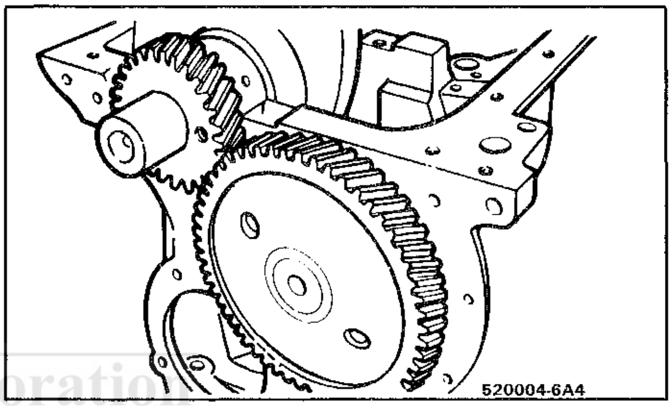


Fig. 4 Camshaft and Crankshaft Gears

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).

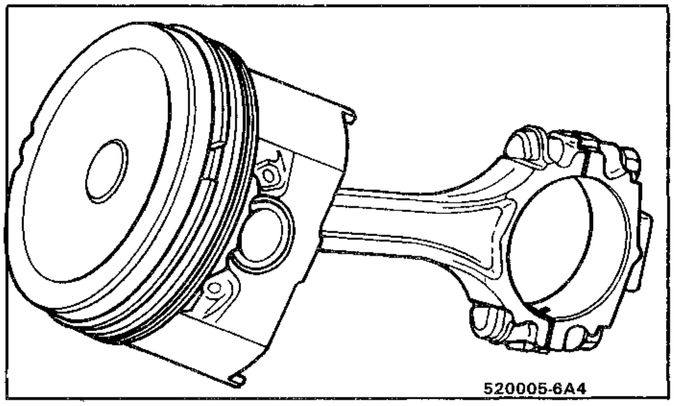


Fig. 5 Piston and Rod Assembly

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.

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.

FORCE BALANCER ASSEMBLY

A force balancer assembly is used on all cars. Two eccentrically weighted shafts and gears are counter rotated by a concentric gear on the crankshaft at twice crankshaft speed. This tends to dampen engine vibration. The balancer also includes a sump pick-up screen, a Gerotor-type oil pump and the oil filter. The oil filter is serviced through an opening in the bottom of the oil pan.

OIL PUMP

The Gerotor-type oil pump drives off the back side of one of the balance shafts. Operation is similar to Gerotor type pumps shown in Section 6A.

ENGINE LUBRICATION

The pump picks up engine oil from the oil pan sump and 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. Valves are incorporated into the oil system to insure proper flow of oil. A 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, or fed from the cam bearing. Engine lubrication diagram is shown in Fig. 6. A full flow oil filter is standard equipment on 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

Tool required:

J34144-A Rocker Arm Cover Remover

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 using tool J34144-A.

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. 8

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.

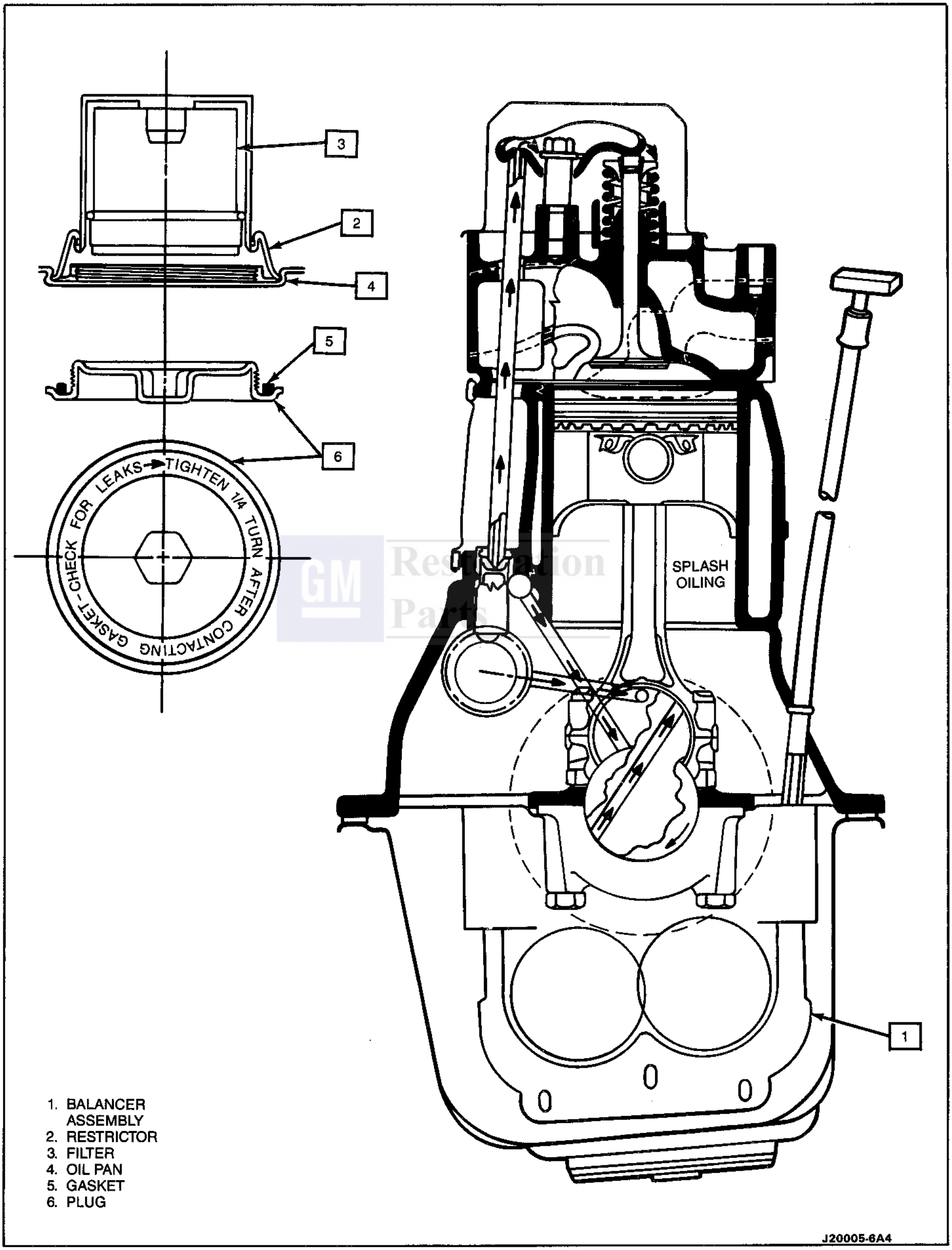
ROCKER ARMS, PUSH RODS AND GUIDES

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.
- Push rod guides are different and must be reassembled in previous location.



1. BALANCER ASSEMBLY
2. RESTRICTOR
3. FILTER
4. OIL PAN
5. GASKET
6. PLUG

Fig. 6 Engine Lubrication

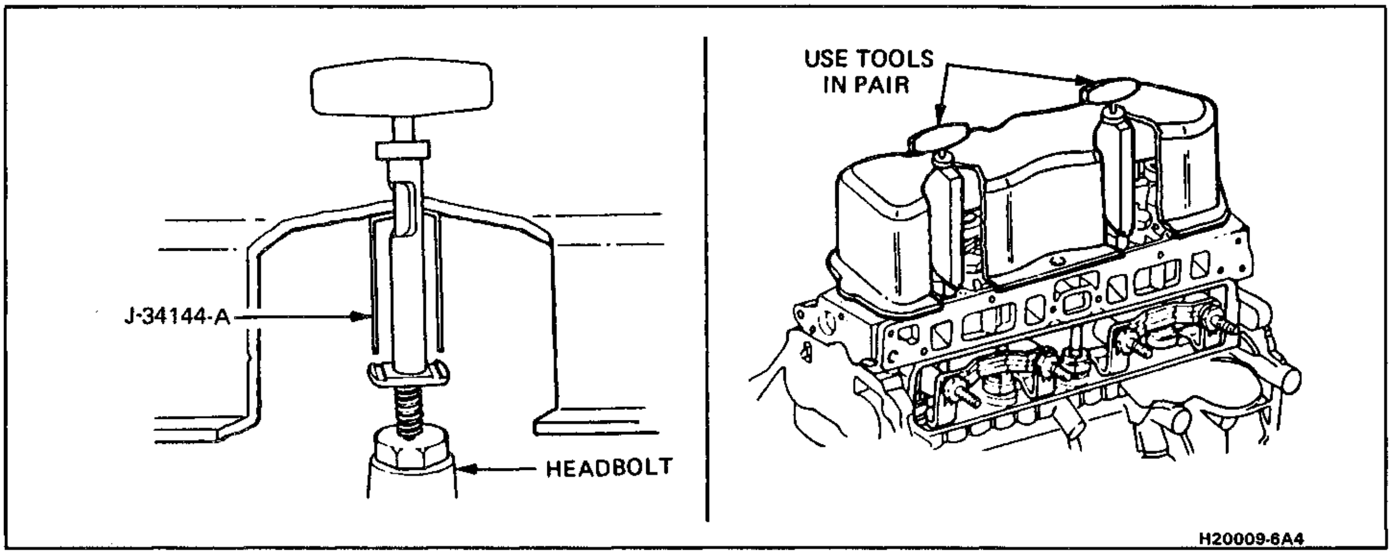


Fig. 7 Rocker Arm Cover Removal

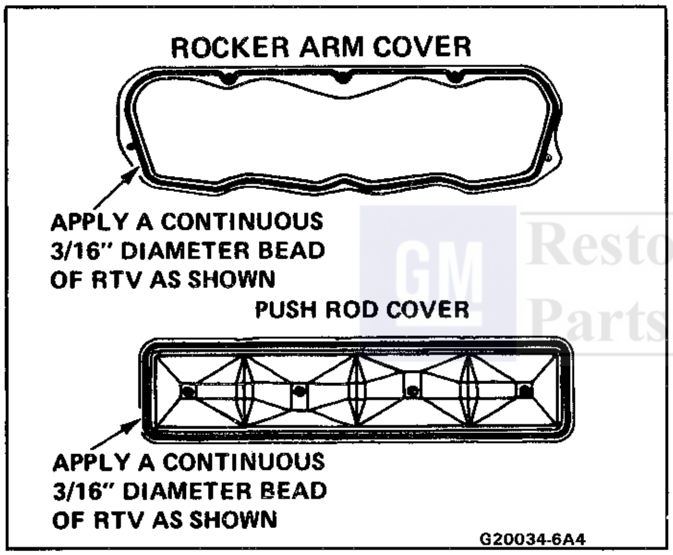


Fig. 8 Push Rod Cover and Rocker Arm Cover RTV Application

- 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.

Remove or Disconnect

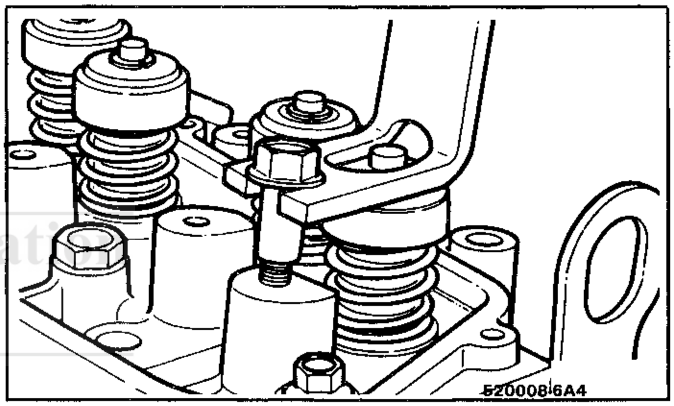


Fig. 9 Compressing Valve Springs

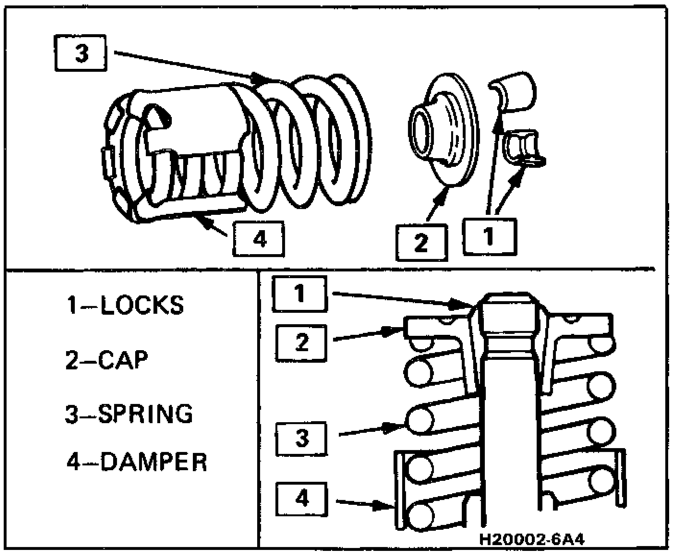


Fig. 10 Upper Valve Train Parts

Figs. 9 and 10

1. Rocker arm cover.
2. Rocker arm(s).
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 and spring.
   h. Valve stem seal.

Install or Connect

1. Valve stem components.
   a. Valve stem seal.
   b. Assemble spring and cap.
   c. Using tool J5892-A, or modified J5892-1, compress the valve spring.
   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.
2. Release air pressure, and remove J23590.
3. Spark plugs.
4. Rocker arms.
5. Rocker arm cover.

Inspect

- For oil leaks.
- For proper completion of repair.

INTAKE MANIFOLD

Remove or Disconnect

1. Negative battery cable.
2. Air cleaner.
3. PCV valve and hose at TBI.
4. Coolant.
5. Fuel lines (see Section 6C).
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. 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 to specification.
3. Heater hose.
4. Throttle linkage and bell crank.
5. Cruise control and linkage, if fitted.
6. Linkage - transaxle downshift.
7. To TBI assembly.
   - Wiring.
   - Throttle linkage.
8. Vacuum hoses.
9. Fuel lines.
10. Engine coolant.
11. PCV valve and hose at TBI.
12. Air cleaner.
13. Negative battery cable.

Inspect

- For fluid and vacuum leaks.

VALVE LIFTERS

Remove or Disconnect

1. Rocker arm cover.
2. Intake manifold.
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.

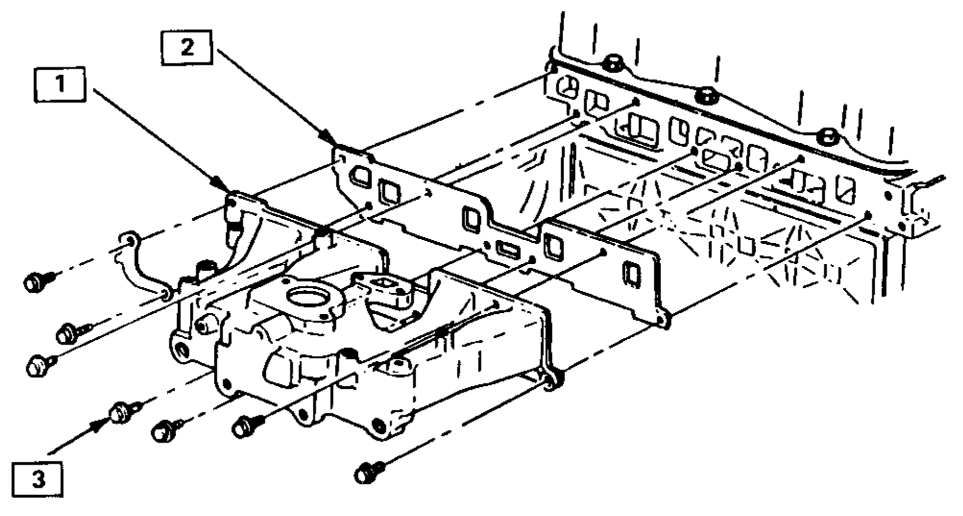
Install or Connect

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.



1–INTAKE MANIFOLD

2–GASKET

3–BOLTS (7) 43 N m
(25 LB. FT.)

Fig. 11 Intake Manifold Assembly

Inspect

- For oil leaks.
- For proper completion of repair.

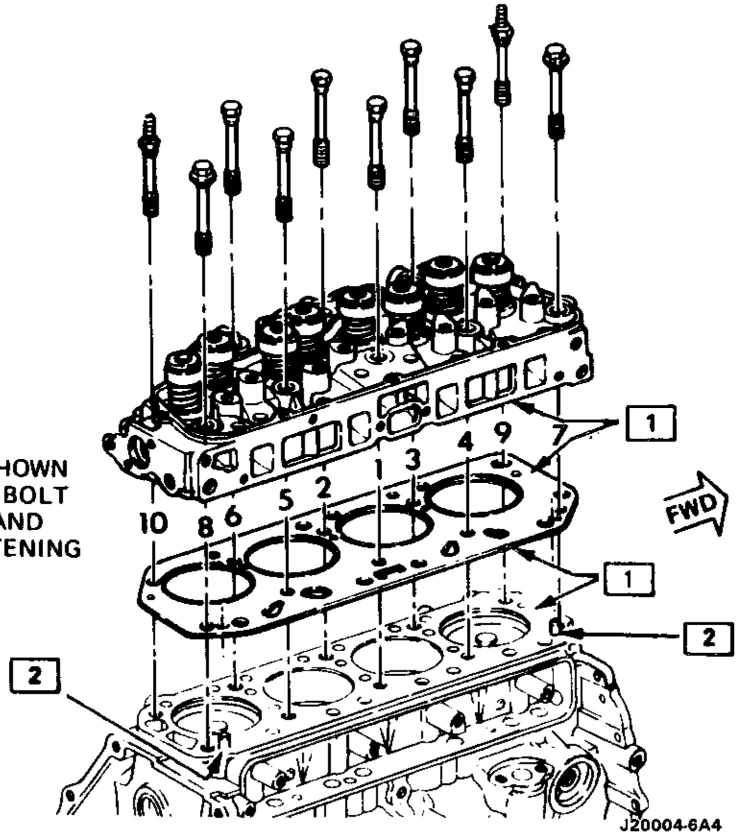
CYLINDER HEAD

Remove or Disconnect

1. Negative battery cable.
2. Engine coolant.
3. Raise car.
4. Exhaust pipe.
5. Oxygen sensor connector.
6. Lower car.
7. Battery ground cable.
8. Oil level indicator tube.
9. Air cleaner.
10. From TBI assembly.
    - Wiring.
    - Throttle linkage.

1–MOUNTING SURFACES OF BLOCK ASM., HEAD ASM. AND BOTH SIDES OF GASKET MUST BE FREE OF OIL AND FOREIGN MATERIAL.

2–LOCATING PINS



NUMBERS SHOWN DESIGNATE BOLT POSITIONS AND BOLT TIGHTENING SEQUENCE.

Fig. 12 Cylinder Head Tightening Sequence (Typical)

- Fuel lines.

11. Heater hose from intake manifold.
12. Wiring connections from intake manifold and cylinder head - all.
13. Vacuum hoses.
14. Engine strut rod bolt from upper support (A and P Carlines only).
15. A/C brackets, A/C compressor (swing aside) (if top mounted).
16. Generator brackets (swing aside).
17. Power steering pump bracket-upper (if top mounted).
18. Radiator hoses.
19. Rocker arm cover.
20. Rocker arms.
21. Push rods.
22. Cylinder head bolts.
23. 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 - fingertight.

Tighten

- Cylinder head bolts gradually with torque wrench to 25 N·m (18 lb. ft.) in sequence shown in Fig. 12.
- Repeat sequence, bringing torque to 35 N·m (26 lb. ft.) on all bolts except number 9. Retorque number 9 to 25 N·m (18 lb. ft.).
- Repeat sequence, turning all bolts 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. Heater hose to intake manifold.
15. To TBI assembly.
    - Wiring.
    - Throttle linkage.
    - Fuel lines.
16. Oil level indicator tube.
17. Air cleaner.
18. Coolant.
19. Raise car.
20. Exhaust pipe.
21. Oxygen sensor connector.
22. Lower car.
23. Negative battery cable.

Inspect

- For fluid leaks.
- For proper completion of repair.

FORCE BALANCER ASSEMBLY

Remove or Disconnect

1. Oil pan.
2. Balancer Assembly.

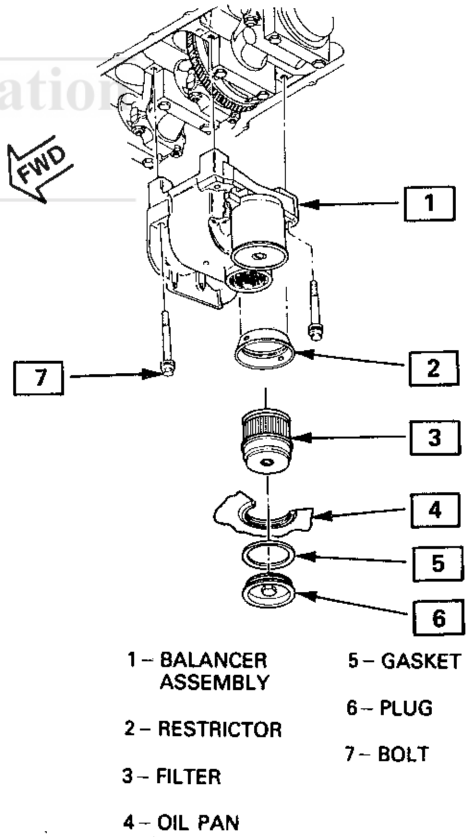


Fig. 13 Balancer Assembly

Install or Connect

1. Balancer assembly. Short bolts (88mm)-12 N·m (9 lb. ft.), plus a 75° turn. Long bolts (108mm)-12 N·m (9 lb. ft.), plus a 90° turn.

Important

- Rotate engine to T.D.C. on No. 1 and No. 4 cylinders.
- Measure from block to first cut of double notch on reluctor ring (see figure 14).
- Dimension should be 1-11/16 (42.8 mm).
- Mount balancer with counterweights parallel and pointing away from crankshaft (see figure 15). Do not move crankshaft.

2. Oil pan.

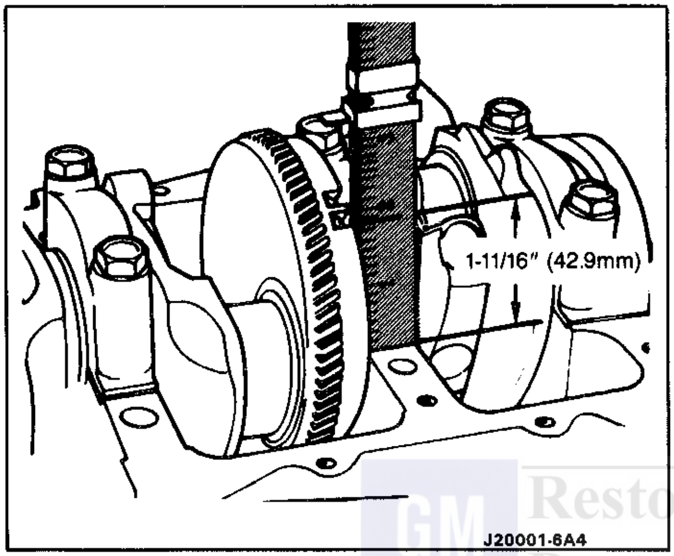


Fig. 14 Crankshaft Positioning

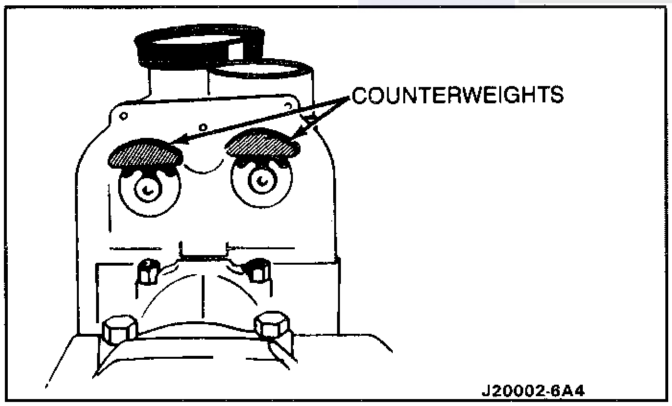


Fig. 15 Counterweights Correctly Positioned

OIL PUMP/PRESSURE REGULATOR VALVE

Remove or Disconnect

1. Oil pan.

Important

- It is not necessary to remove the balancer assembly to service the oil pump or pressure regulator valve.

Disassemble

1. Restrictor.
2. Filter.
3. Oil pump cover assembly.
4. Oil pump gears.
5. Pressure regulator valve.
    - Plug or pin.
    - Spring.
    - Valve. If the valve is stuck, clean the valve and pump housing with carburetor cleaning solvent.

CAUTION: The pressure regulator valve spring is under pressure. Exercise caution when unscrewing the plug, or removing the pin, as bodily injury may result.

Clean

- All parts of sludge, oil and varnish.
- Varnish on parts 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. When working overhead, wear eye protection.

Inspect

- For foreign material and determine its source.
- Pump housing and oil pump cover assembly for:
    - Cracks
    - Scoring
    - Casting imperfections
- 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.
- Screen assembly for:
    - Looseness
    - Broken wire mesh or screen
- Gears for:
    - Chipping
    - Galling
    - Wear

Measure

- Gear housing pocket depth
- Gear thickness

Important

- When deciding pump servicability based on pocket depth, consider depth of wear pattern in gear pocket and face of oil pump cover assembly.

Assemble

1. Lubricate all internal parts with engine oil.

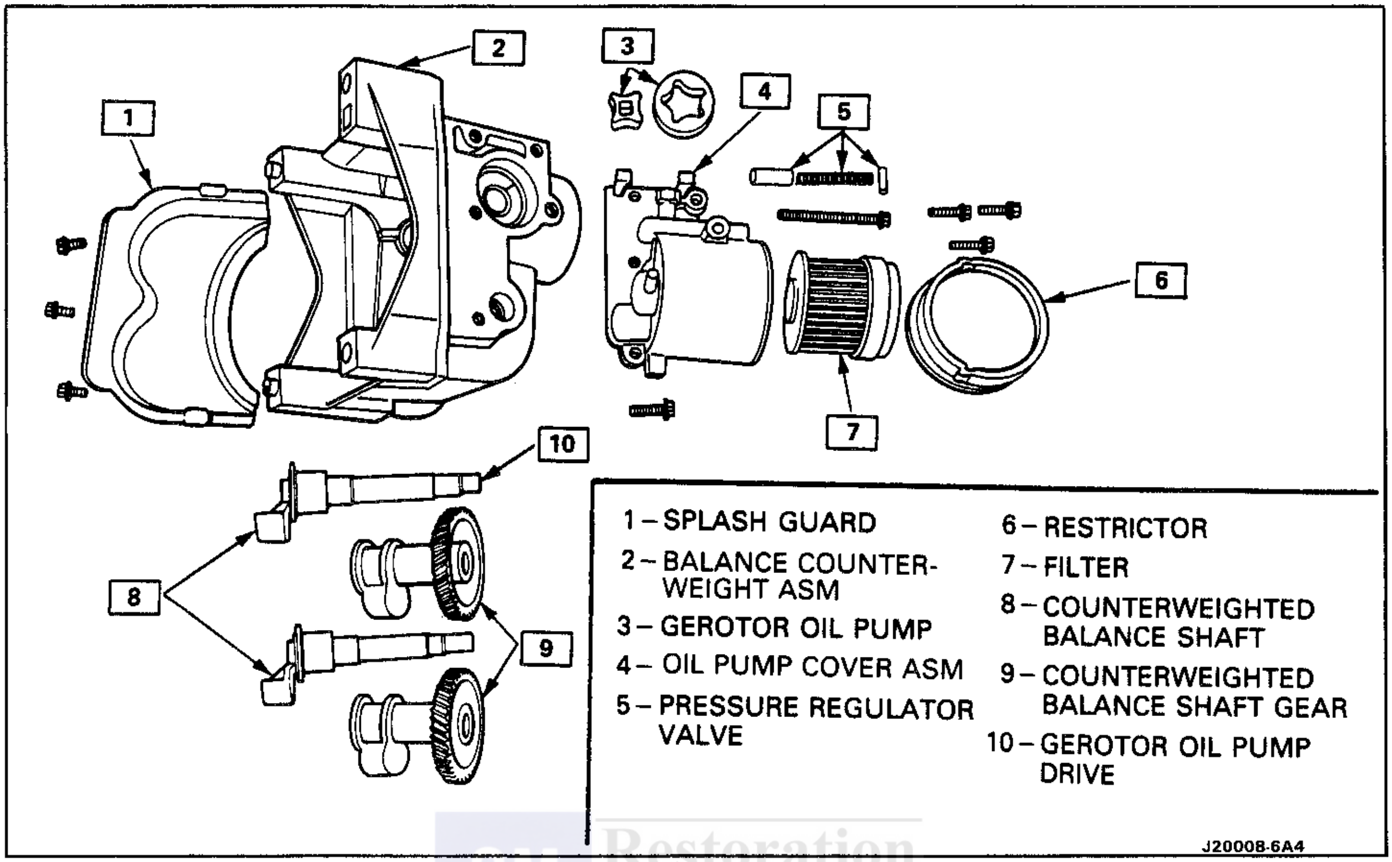


Fig. 16 Balancer Assembly Components

NOTICE: To avoid engine damage, **all** pump cavities must be packed with petroleum jelly **before** installing the gears to assure priming.

2. Pump gears.
3. Oil pump cover assembly.
4. Pressure regulator valve and spring.
5. Plug or pin.

Important

- Make sure the pin is properly secured.

6. Oil pump cover assembly - torque bolts to 10 N·m (7 lb. ft.).

Clean

- Oil pump intake screen.
- Oil pan.

7. Filter.
8. Restrictor.

Install or Connect

1. Oil pan.
2. Fill crankcase with clean engine oil.

Inspect

- Remove the 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 examine pump. If necessary, disassemble the oil pump and repack all cavities with petroleum jelly. 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.

REAR MAIN BEARING OIL SEAL AND/OR FLYWHEEL

Remove or Disconnect

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:

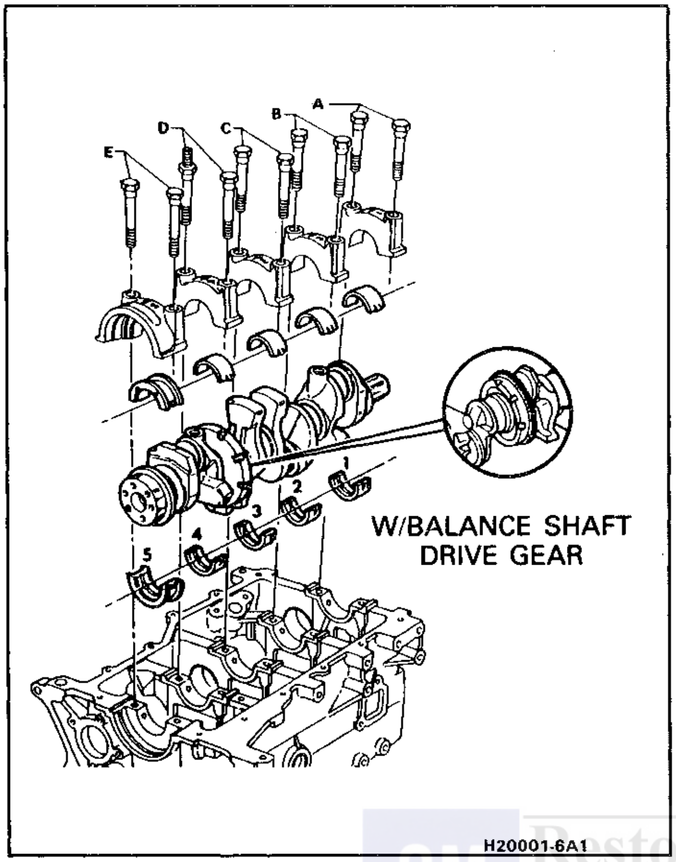


Fig. 17 Crankshaft and Bearings

J34924-A Seal Installer.

1. Rear main seal to block.
   - Press evenly into place with J34924-A.
   - 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

1. Cylinder head.

   Clean

   - Ridge or deposits from upper end of cylinder bore. Protect piston with cloth.
2. Raise car.
3. Oil pan.
4. Force balancer, when necessary.
5. Connecting rod bearing cap.
6. Piston and connecting rod.
   - Check identification of piston and connecting rod.

   Refer to Section 6A General Engine Mechanical for servicing of connecting rods, pistons, rings and bearings.
7. Lower car.

Install or Connect

1. Guide Set 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 guide set.
5. Connecting rod bearing cap.
6. Rod nuts - 44 N·m (32 lb. ft.).
7. Force balancer, if removed.
8. Oil pan.
9. Lower car.
10. 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. Crankshaft pulley and hub assembly.
6. Oil pan and force balancer.
7. Timing gear cover.
8. Crankshaft timing gear.
9. Connecting rod bearing caps with bearings and identify each for reinstallation.
10. Push connecting rod and piston assemblies away from crankshaft.
11. Main bearing caps with bearings and identify for reinstallation.
12. 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. Force balancer and oil pan, using new rear seal in rear main bearing cap and new front seal in timing gear cover.

Important

- Force balancer must be aligned after crankshaft is in place (see Force Balancer procedure).

13. Coat front cover oil seal contact area of pulley hub with oil and push into position.
14. Crankshaft pulley and hub.
15. Spark plugs.
16. Remove engine from stand.
17. Engine in car.
18. Add engine oil.

ON-CAR SERVICE

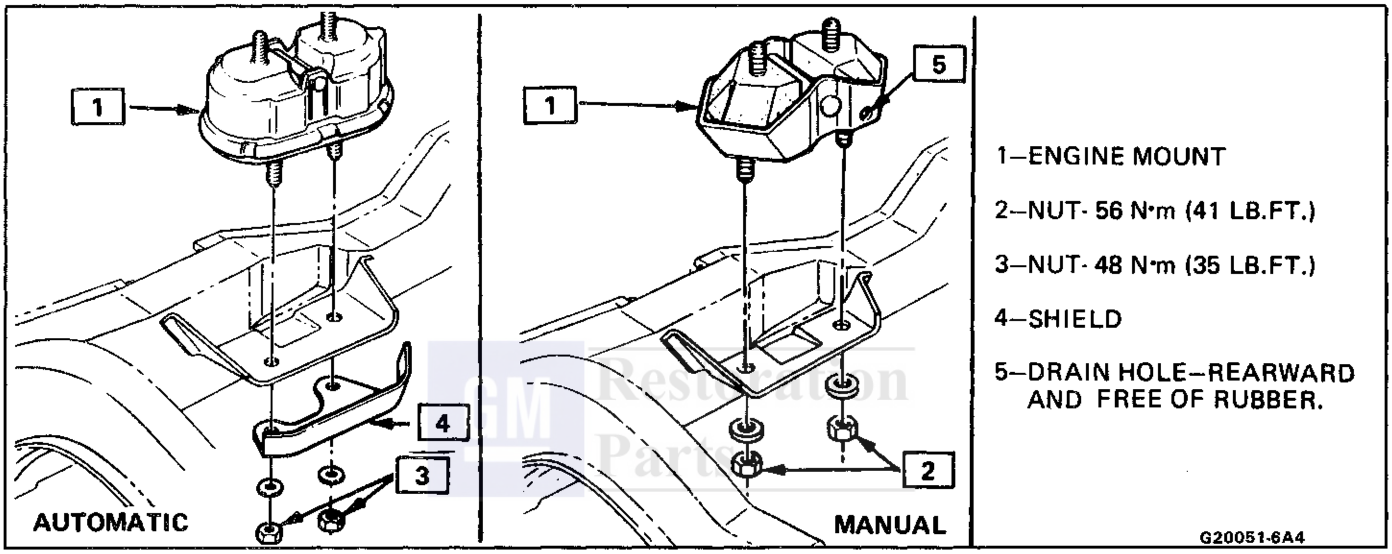


Fig. 801 Engine Mount to Frame

ENGINE AND TRANSAXLE MOUNTS

Figs. 801, 802, 803, 804 and 806

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 J28467.

Engine Mount

↔ Remove or Disconnect

1. Engine compartment lid and side panels.

Important

- Scribe hinges for later reassembly.

2. Trim - at sail panel below battery side panel.
3. Support engine with J28467, or other suitable equipment.
4. Bolt - engine torque strut.
5. Raise vehicle.
6. Nuts - engine mount to chassis.
7. Nuts - upper, mount to engine support bracket.
8. Engine mount.

→← Install or Connect

1. Support engine with J28467, position mount.
2. Nuts - mount to engine bracket (Fig. 801).
3. Nuts - mount to chassis (Fig. 801).
4. Lower vehicle.
5. Bolt - engine torque strut.
6. Remove support fixture.
7. Trim - at sail panel below battery side panel.
8. Engine compartment lid and side panels.

Automatic Transaxle Mount

↔ Remove or Disconnect

1. Engine compartment lid and side panels.

Important

- Scribe hinges for later reassembly.

2. Trim - at sail panel below battery side panel.

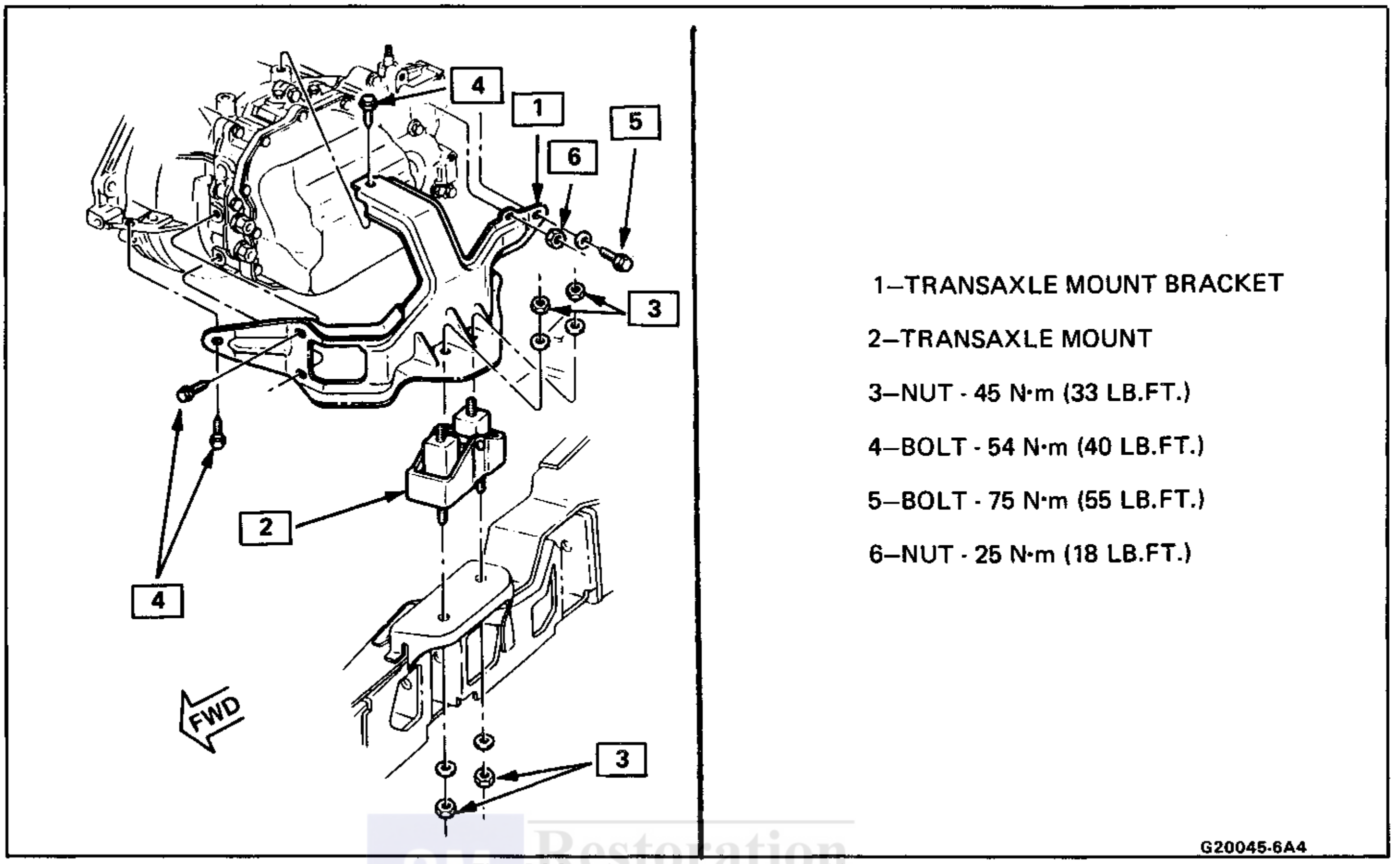


Fig. 802 Automatic Transaxle Mount

3. Support engine and transaxle with J28467 (See Section 2A).
4. Bolt - engine torque strut.
5. Upper mount nuts.
6. Raise vehicle.
7. Nuts - lower mount.
8. 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 - engine torque strut.
6. Remove support fixture.
7. Trim - at sail panel below battery side panel.
8. Engine compartment lid and side panels.

Manual Transmission Mounts

Remove or Disconnect

1. Engine compartment lid and side panels.

   Important

   - Scribe hinges for later reassembly.
2. Trim - at sail panel below battery side panel.
3. Support engine and transaxle with J28467.
4. Bolt - engine torque strut.
5. Raise vehicle.
6. Nuts - front mount to frame.
7. Nuts - rear mount to frame.
8. Nut - front mount to bracket.
9. Nut - rear mount to bracket.
10. Mounts, front and rear.

Install or Connect

1. Position front and rear mounts.
2. Nut - rear mount to bracket - 48 N·m (35 lb. ft.).
3. Nut - front mount to bracket - 48 N·m (35 lb. ft.).
4. Nuts - rear mount to frame - 24 N·m (18 lb. ft.).
5. Nuts - front mount to frame - 48 N·m (35 lb. ft.).
6. Lower vehicle.
7. Bolt - engine torque strut.
8. Remove support fixture.
9. Trim - at sail panel below battery side panel.
10. Engine compartment lid and side panels.

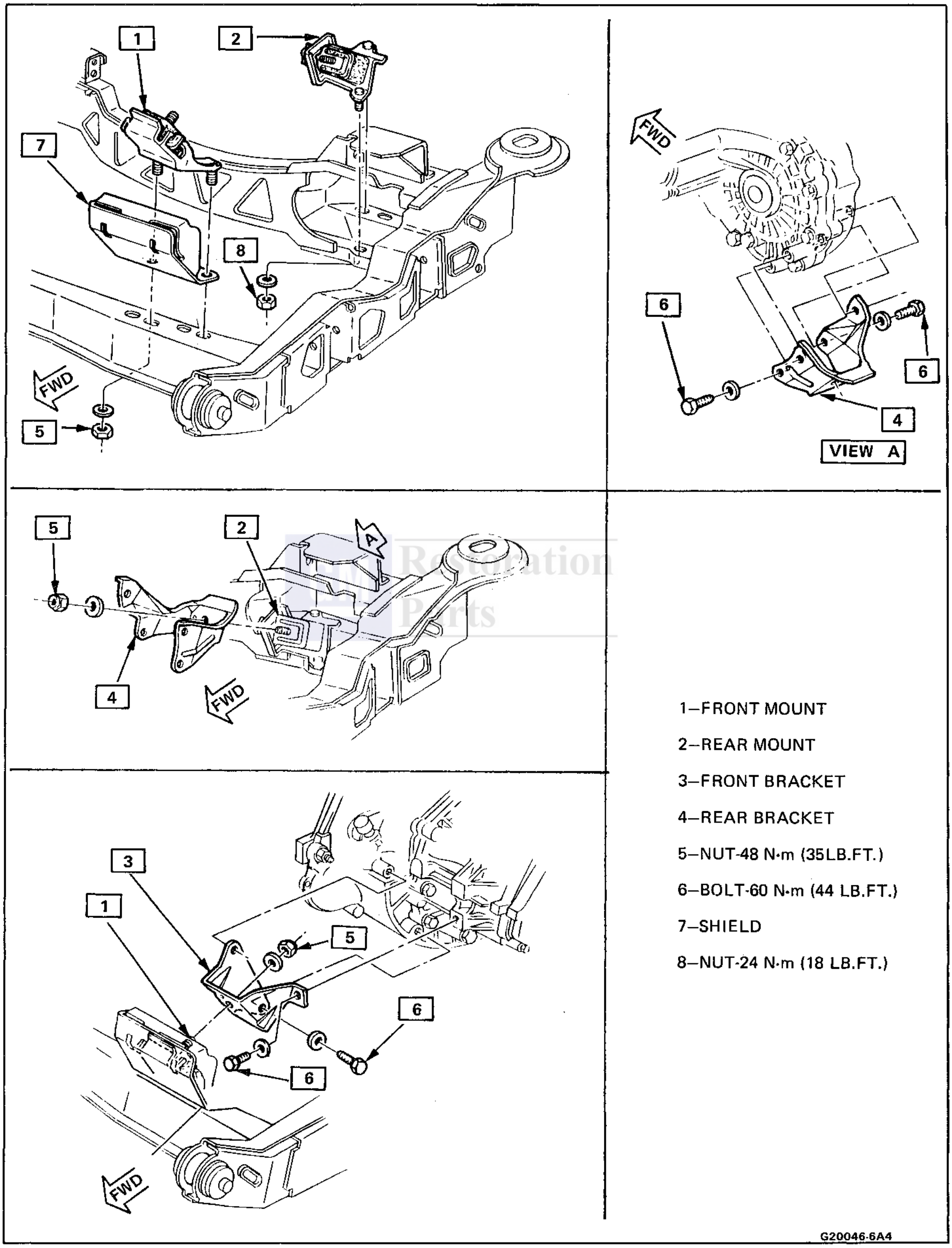
Engine Torque Strut

Remove or Disconnect

1. Rear strut bolt.
2. Front strut bolt.
3. Strut.

Install or Connect

1. Loosely insert front strut bolt.
   - Displace engine rearward with a horizontal load of 200-250 Newtons, applied through centerline of slots. Tighten while load is applied.



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

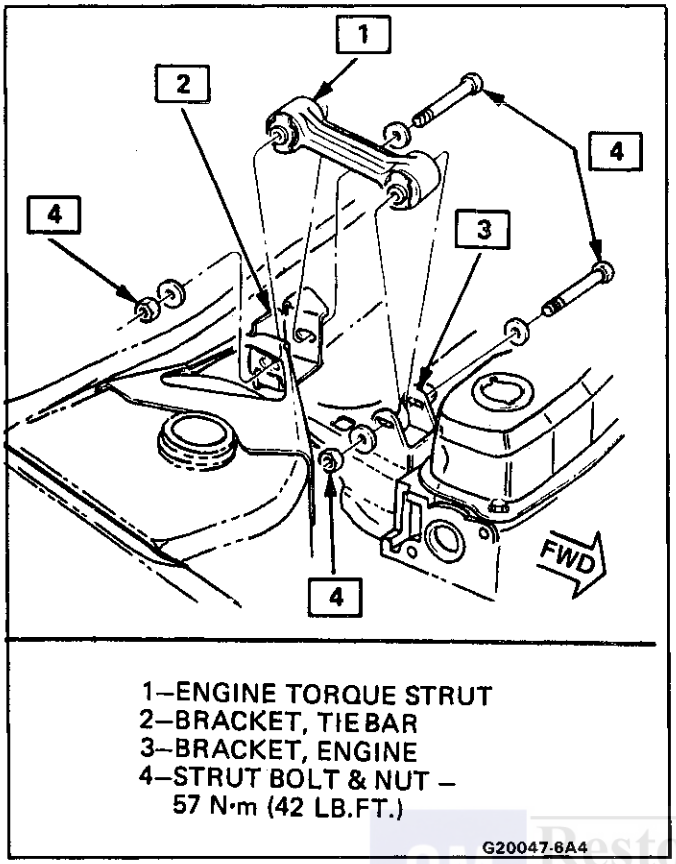


Fig. 804 Engine Torque Strut

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.

Important

- To remove the cover, unscrew the four nuts from the cover attaching studs, reverse two of the nuts so the washers face outward and screw them back onto the inner two studs. Assemble the two remaining nuts to the same two inner studs with washers facing inward. Using a small wrench on the inner nut, on each stud, jam the two nuts tightly together. Again using the small wrench, on the inner nut, unscrew the studs until the cover breaks loose.
- After breaking the cover loose, remove the jammed nuts from each stud. Remove the cover from the studs. Examine the stud and rubber washer assembly and replace if either stud or washer is damaged.

Clean

- Sealing surfaces on push rod cover and cylinder block.
- Dry surfaces with degreaser.

Install or Connect

Fig. 8

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 PAN

Remove or Disconnect

Fig. 805

Tool Required:
J28467 - Support Fixture.

1. Battery cables.
2. Engine compartment lid and side panels.

Important

- Scribe hinges on engine compartment lid for reassembly.

3. Trim - at sail panel below battery side panel.
4. Battery side shield.
5. Serpentine belt.
6. Generator bolts - move aside.
7. Raise car.
8. Engine oil and filter.
9. Nuts - front engine mount to cradle.
10. Starter and flywheel cover.
11. Starter.
12. Right rear wheel.
13. Splash shield.
14. Loosen lower generator bracket (at mount).
15. Heat shield at A/C compressor.
16. A/C compressor bolts - move aside.
17. Lower car.
18. Engine strut.
19. Support engine with J28467.
20. Raise car.
21. Engine front support bracket and mount.
22. Retaining bolts.
23. Oil pan.

Clean

- Sealing surfaces on oil pan, front cover and cylinder block.

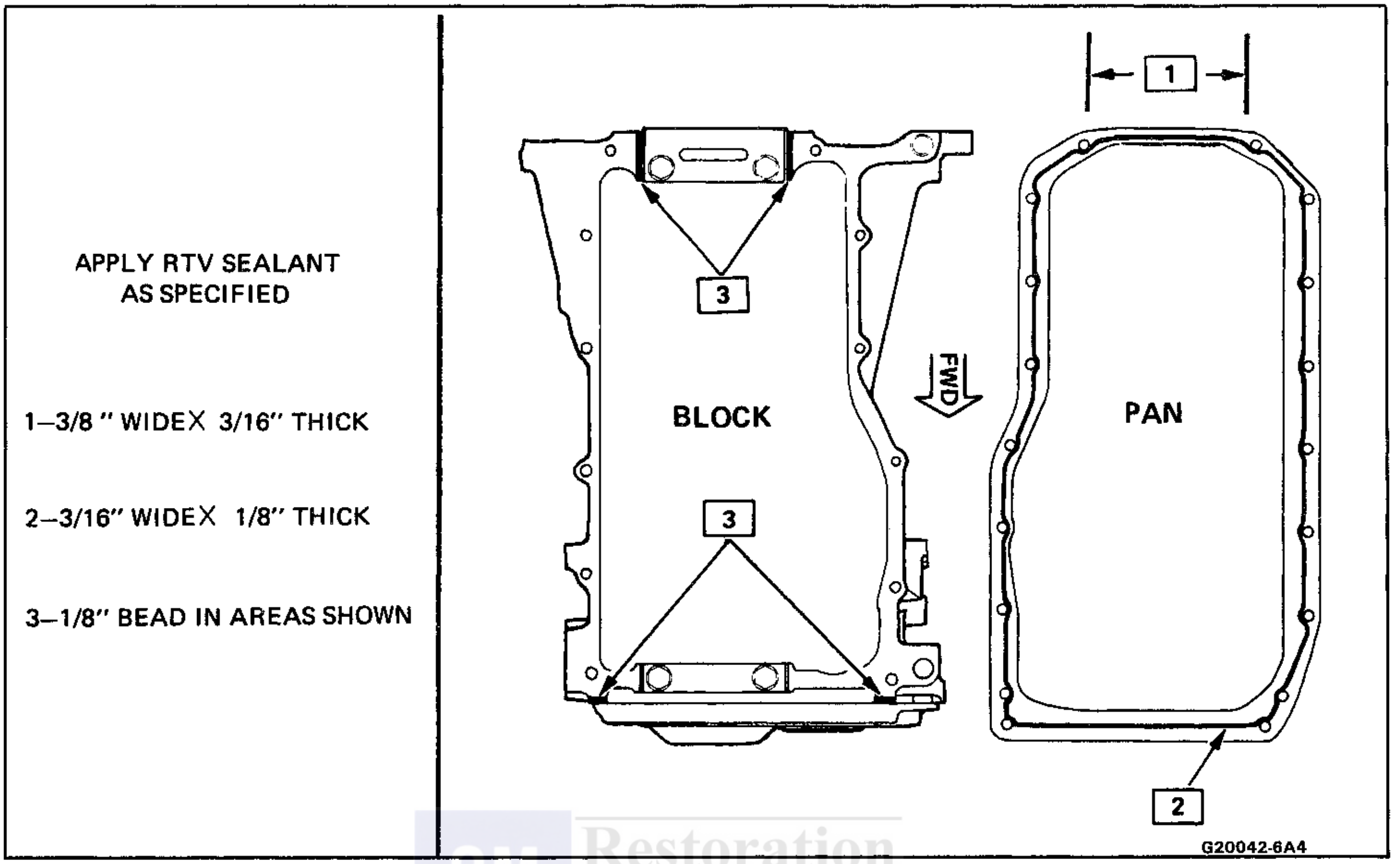


Fig. 805 Oil Pan Sealer Application

Install or Connect

1. RTV, see Fig. 805.
2. Oil pan, retaining bolts and filter.
3. Engine front support bracket and mount.
4. Lower car.
5. Lower engine onto mounts.
6. Remove J28467.
7. Engine strut.
8. Raise car.
9. Lower generator bolt (at mount).
10. A/C compressor bolts.
11. Heat shield at A/C compressor.
12. Nuts - front engine mount to cradle.
13. Splash shield.
14. Starter.
15. Starter and flywheel cover.
16. Right rear wheel.
17. Lower car.
18. Generator and serpentine belt.
19. Trim - at sail panel below battery side panel.
20. Engine compartment lid and side panels.
21. Engine oil.
22. Battery cables.

TIMING GEAR COVER/FRONT SEAL

Remove or Disconnect

Tools Required:
J28467 Engine Support Fixture.
J34995 Front Cover Seal Installer.

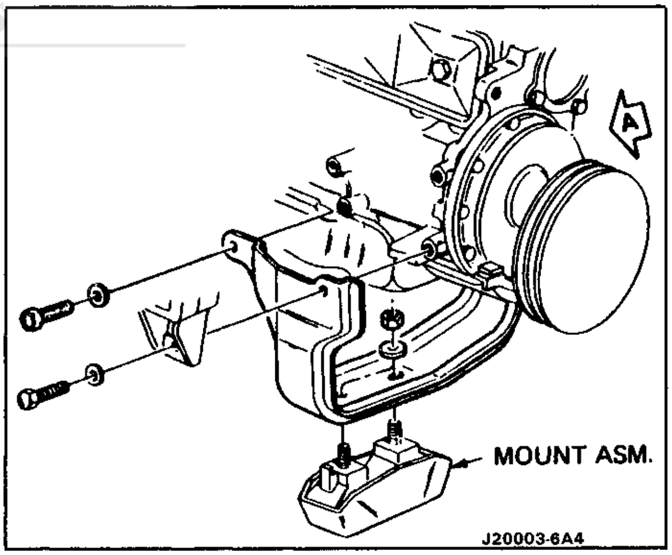


Fig. 806 Engine Support Bracket

1. Negative battery cable.
2. Engine compartment lid and side panels.

Important

- Scribe hinges for later reassembly.

3. Trim - at sail panel below battery side panel.
4. Serpentine belt.
5. Raise vehicle.
6. Right rear wheel and tire.
7. Inner splash shield.

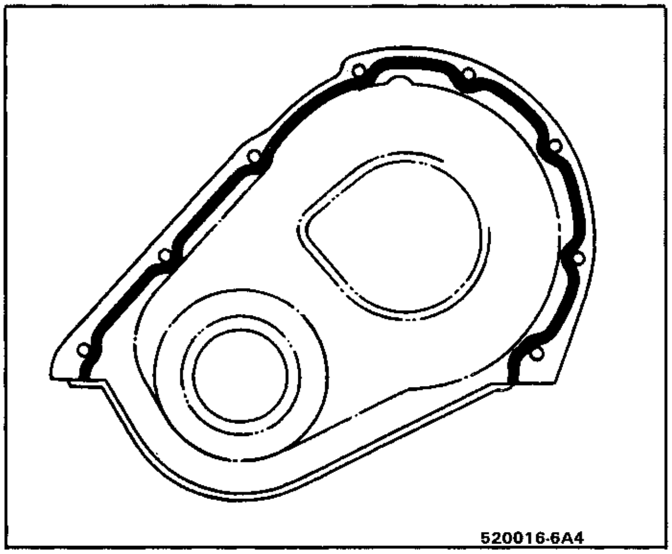


Fig. 807 Timing Gear Cover Sealer Application

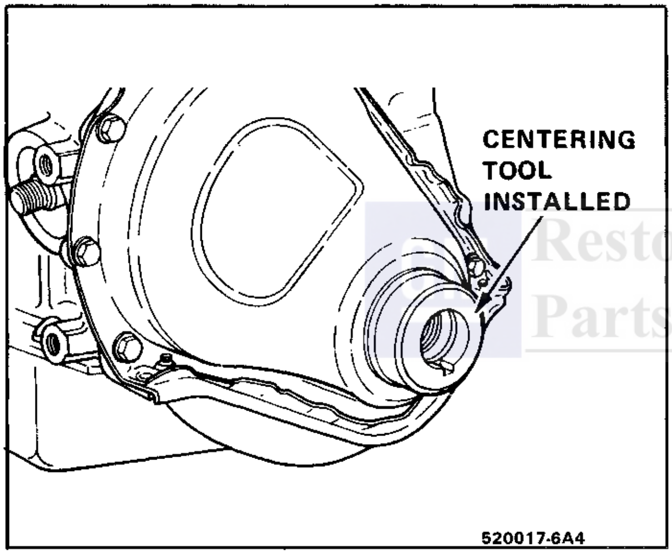


Fig. 808 Front Cover Centering Tool Installed

8. Starter - let hang.
9. Flywheel cover.
10. Pulley and hub.
11. Lower vehicle.
12. Support engine with J28467.
13. Engine torque strut.
14. Raise vehicle.
15. Engine mount.
16. Timing gear cover screws.
17. Timing gear cover.

Clean

- Sealing surfaces of cylinder block, oil pan and timing gear cover.

Install or Connect

(Fig. 807)

1. 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. 808).
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. Lower engine and remove J28467.
8. Hub and pulley.
9. Flywheel cover.
10. Starter.
11. Inner splash shield.
12. Right rear wheel and tire.
13. Lower vehicle.
14. Serpentine belt.
15. Trim - at sail panel below battery side panel.
16. Engine compartment lid and side panels.
17. Negative battery cable.

ENGINE ASSEMBLY

Remove or Disconnect

Tools required:
J28467 Engine Support Fixture.
J34043 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.
- Scribe hinges for later reassembly.
- Remove trim at sail panel below battery side panel.

4. Air cleaner.
5. Throttle and shift cables.
6. Heater hose at intake manifold.
7. Vacuum hoses to all components not engine mounted.
8. Fuel lines at TBI and filter (see Section 6C).
9. Fuel pump relay and oxygen sensor connectors.
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 J34043 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 and transaxle on 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 connectors.
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. Trim - at sail panel below battery side panel.
26. 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.
2. Raise vehicle.
3. Exhaust pipe.
4. Lower vehicle.
5. Battery side cover.
6. Oxygen sensor connector.
7. Dipstick tube at manifold.
8. Retaining bolts and washers.
9. 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. 810.

3. Dipstick tube at manifold.
4. Raise vehicle.
5. Exhaust pipe.
6. Lower vehicle.
7. Air cleaner.
8. Oxygen sensor connector.
9. Battery side cover.

Inspect

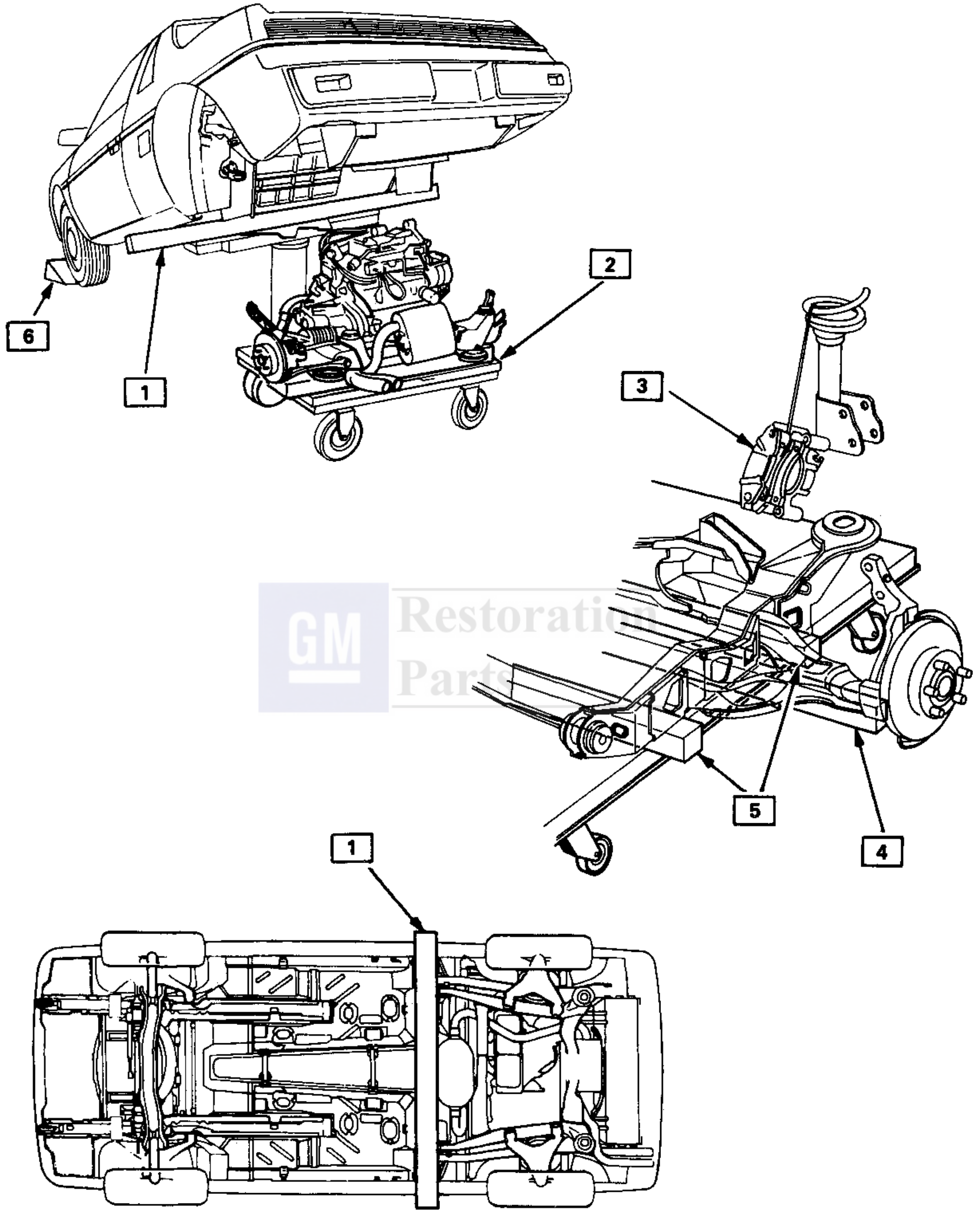
- For exhaust leaks.

CAMSHAFT

Remove or Disconnect

Figs. 811, 812 and 813

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. Front engine mount and bracket assembly (support engine and transaxle).
5. Front pulley and hub.
6. Timing gear cover.
7. Camshaft thrust plate screws.
8. Camshaft and gear through front of block.



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. 809 Engine Removal and Cradle Support Points

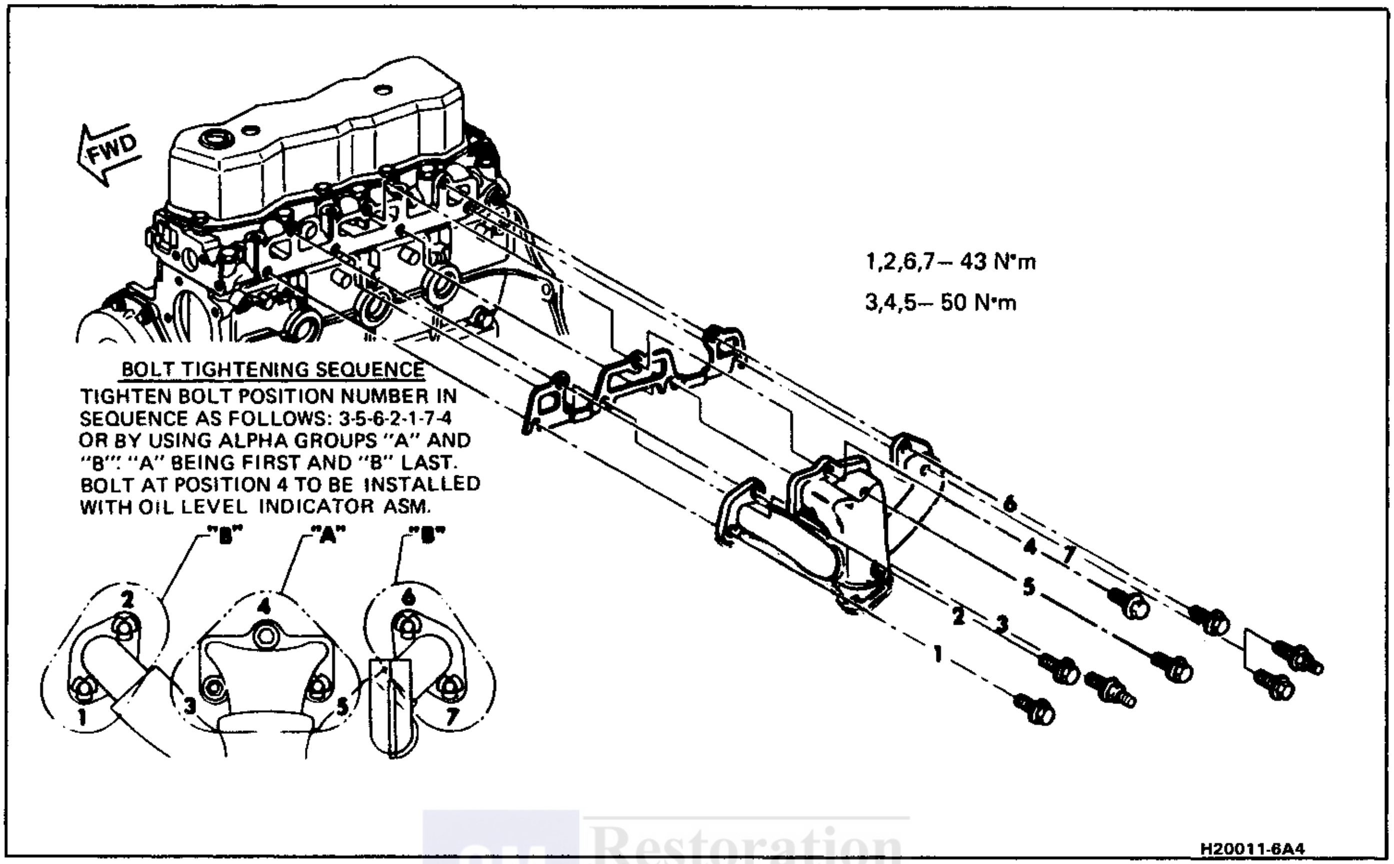


Fig. 810 Exhaust Manifold

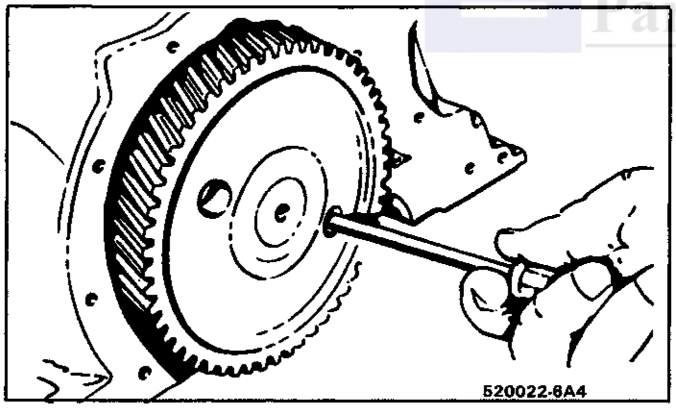


Fig. 811 Removing Camshaft Thrust Plate Screws

Important

- Support shaft to avoid damage to bearings.

9. Gear from camshaft.
   - Use arbor press and adapter.
   - Position thrust plate to avoid damage by interference with woodruff key as gear is removed.
   - 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.

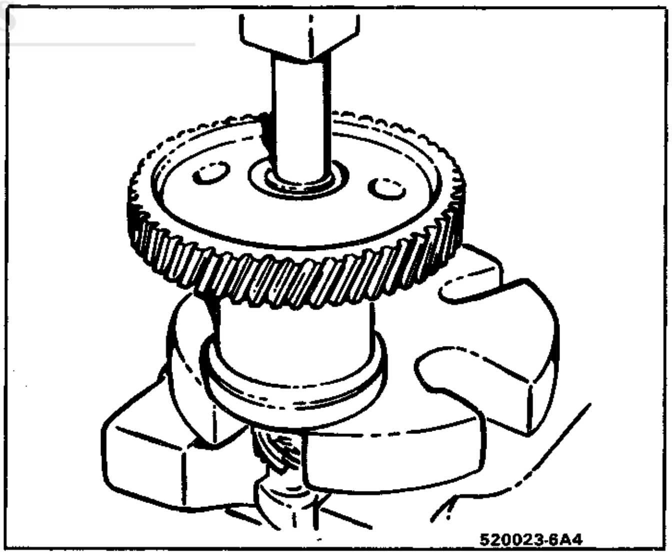


Fig. 812 Removing Camshaft Timing Gear

3. Press gear on shaft - bottom against spacer ring.

Measure

End clearance of thrust plate should be .0015" to .0050". Fig. 813.

- Less than .0015" - replace spacer ring.
- More than .0050" - replace thrust plate.

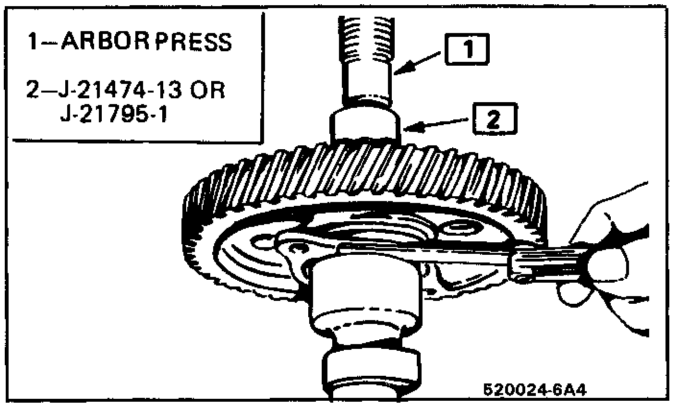


Fig. 813 Camshaft Timing Gear/Thrust Plate End Clearance

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.
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 220 N·m (162 lb. ft.).
6. Front engine mount and bracket.
7. Valve lifters and push rod cover.
8. Push rods, rocker arms and cover.
9. Engine/transaxle assembly into vehicle.

Inspect

- For proper completion of repair.

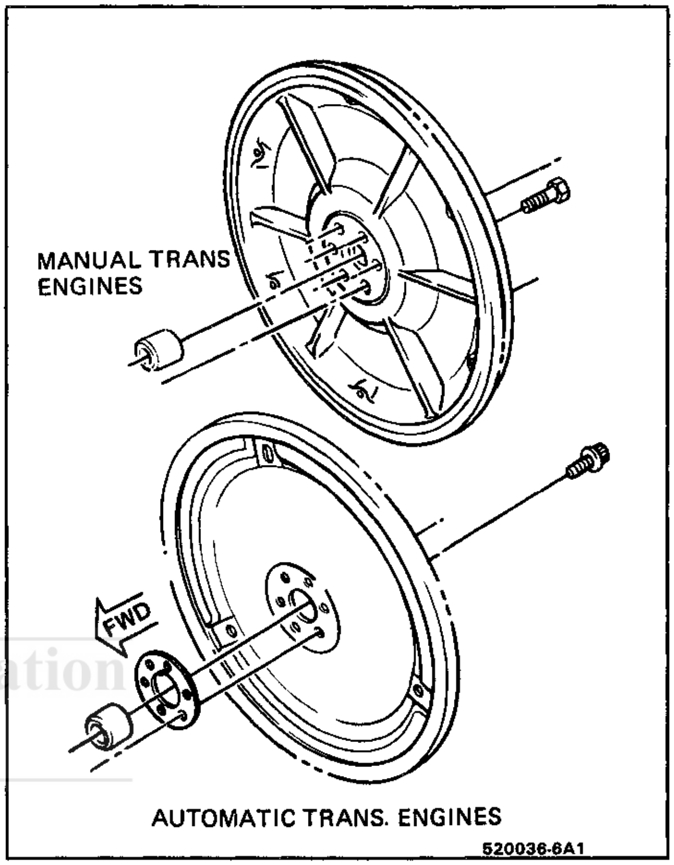


Fig. 814 Flywheel Attachment "Manual and Automatic Transaxle"

SPECIFICATIONS

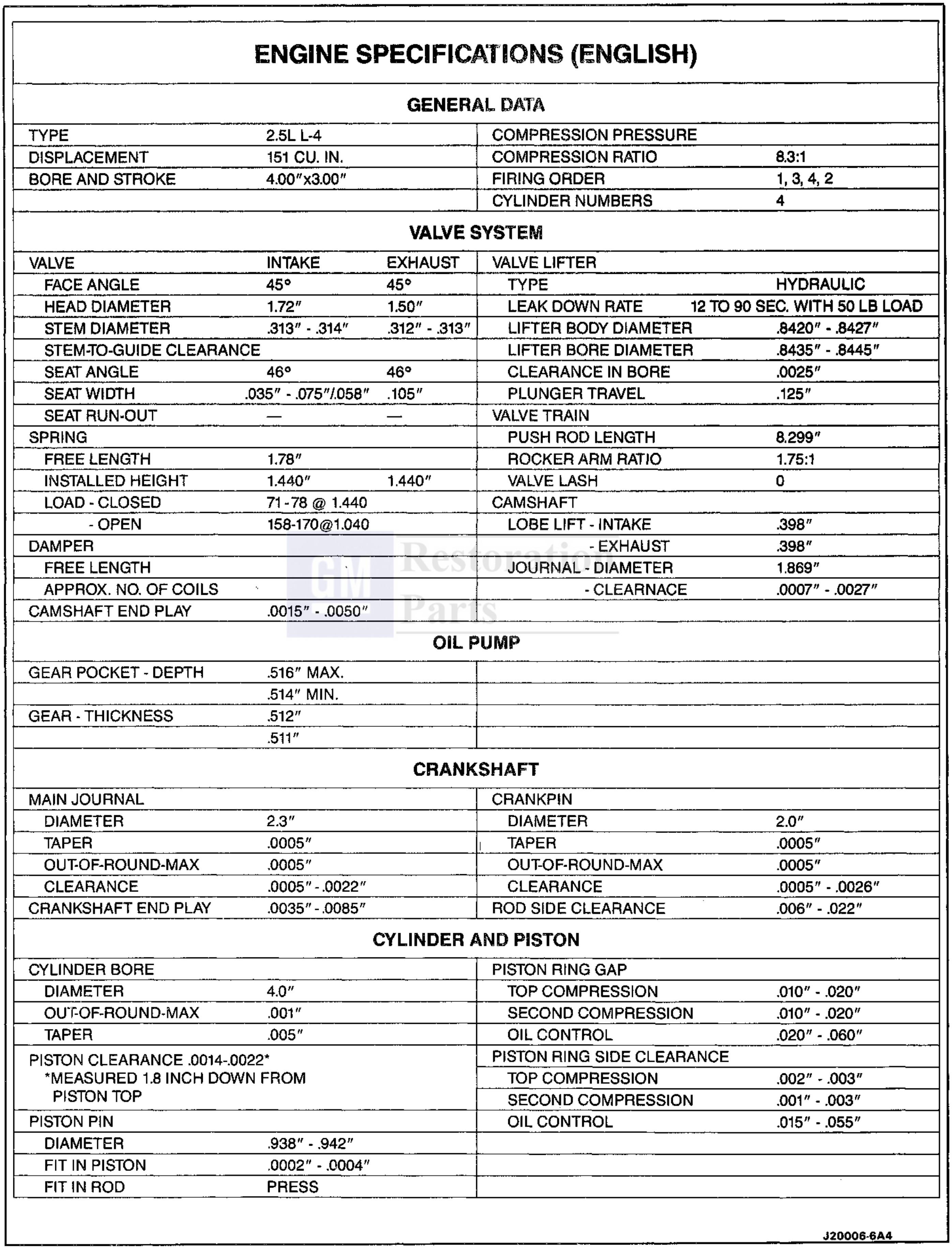
BOLT TORQUE

Balancer to Block Bolts	
Short Bolts (88mm)	12 N·m (9 lb. ft.) + 75° Turn
Long Bolts(108mm)	12 N·m (9 lb. ft.) + 90° Turn
Camshaft Thrust Plate To Block Bolt	10 N·m (90 lb. in.)
Clamps Radiator Hoses, All	2 N·m (17 lb. in.)
Connecting Rod Nut	44 N·m (32 lb. ft.)
Cylinder Head to Block Bolt	(see text)
EFI Assembly to Manifold Bolt	20 N·m (15 lb. ft.)
EFI Assembly to Manifold Nut	20 N·m (15 lb. ft.)
EGR Valve to Manifold Bolt	22 N·m (16 lb. ft.)
Exhaust Manifold to Cyl. Head Bolt	(see text)
Flywheel To Crankshaft (Automatic)	

LUBRICATION OIL CAPACITY

Bolt	75 N·m (55 lb. ft.)
Flywheel to Crankshaft (Manual) Bolt	93 N·m (69 lb. ft.)
Harmonic Balancer Bolt	220 N·m (162 lb. ft.)
Intake Manifold To Cyl. Head Bolt	(see text)
Main Bearing to Block Bolt	95 N·m (70 lb. ft.)
Plug Oil Pan Drain	34 N·m (25 lb. ft.)
Oil Pan to Block Bolt	27 N·m (20 lb. ft.)
Push Rod Cover To Block Nut	10 N·m (90 lb. in.)
Rocker Arm Bolt	32 N·m (24 lb. in.)
Rocker Arm Cover Bolt	5 N·m (45 lb. in.)
Stud Roller Lifter Guide Retainer to Block	10 N·m (90 lb. in.)
Thermostat Housing Bolt	27 N·m (20 lb. ft.)
Timing Gear Cover To Block Bolt	10 N·m (90 lb. in.)
Water Outlet Housing Bolt	27 N·m (20 lb. ft.)
Water Pump To Block Bolt	34 N·m (25 lb. ft.)

Without Filter Change	3.75 Liters (4 Qts.)
With Filter Change	3.75 Liters (4 Qts.)
Filter Type	PF1072, or Equivalent
Oil Pressure at RPM	(50 lb. @ 2000 RPM)



ENGINE SPECIFICATIONS (ENGLISH)

GENERAL DATA

TYPE	2.5L L-4	COMPRESSION PRESSURE	
DISPLACEMENT	151 CU. IN.	COMPRESSION RATIO	8.3:1
BORE AND STROKE	4.00″x3.00″	FIRING ORDER	1, 3, 4, 2
		CYLINDER NUMBERS	4

VALVE SYSTEM

VALVE	INTAKE	EXHAUST	VALVE LIFTER	
FACE ANGLE	45°	45°	TYPE	HYDRAULIC
HEAD DIAMETER	1.72″	1.50″	LEAK DOWN RATE	12 TO 90 SEC. WITH 50 LB LOAD
STEM DIAMETER	.313″ - .314″	.312″ - .313″	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″	.105″	PLUNGER TRAVEL	.125″
SEAT RUN-OUT	—	—	VALVE TRAIN	
SPRING			PUSH ROD LENGTH	8.299″
FREE LENGTH	1.78″		ROCKER ARM RATIO	1.75:1
INSTALLED HEIGHT	1.440″	1.440″	VALVE LASH	0
LOAD - CLOSED	71 - 78 @ 1.440		CAMSHAFT	
- OPEN	158-170@1.040		LOBE LIFT - INTAKE	.398″
DAMPER			- EXHAUST	.398″
FREE LENGTH			JOURNAL - DIAMETER	1.869″
APPROX. NO. OF COILS			- CLEARNACE	.0007″ - .0027″
CAMSHAFT END PLAY	.0015″ - .0050″			

OIL PUMP

GEAR POCKET - DEPTH	.516″ MAX.		
	.514″ MIN.		
GEAR - THICKNESS	.512″		
	.511″		

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		

J20006-6A4

Fig. 815 Engine Specifications (English)

ENGINE SPECIFICATIONS (METRIC)

GENERAL DATA

TYPE	2.5L L-4	COMPRESSION PRESSURE	
DISPLACEMENT	151 CU. IN.	COMPRESSION RATIO	8.3:1
BORE AND STROKE	4.00″x3.00″	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	7.95-7.98 / 7.92-7.95		LIFTER BODY DIAMETER	21.3868-21.4046 MM
STEM-TO-GUIDE CLEARANCE			LIFTER BORE DIAMETER	21.425-21.450 MM
			CLEARANCE IN BORE	.635 MM
SEAT ANGLE	46°	46°	PLUNGER TRAVEL	3.175 MM
SEAT WIDTH	.889-1.905/1.473-2.667		VALVE TRAIN	
SEAT RUN-OUT	—	—	PUSH ROD LENGTH	210.79 MM
SPRING			ROCKER ARM RATIO	1.75:1
FREE LENGTH	45.2		VALVE LASH	0
INSTALLED HEIGHT	36.58-36.58		CAMSHAFT	
LOAD - CLOSED	32-35 @ 36.58		LOBE LIFT - INTAKE	10.3124 MM
- OPEN	72-77 @ 26.42		- EXHAUST	10.3124
DAMPER			JOURNAL - DIAMETER	47.4726 MM
FREE LENGTH	—		- CLEARNACE	.01778-.0685 MM
APPROX. NO. OF COILS	—			
CAMSHAFT END PLAY	.0381-.127			

OIL PUMP

GEAR POCKET - DEPTH	13.1 MAX.	
	13.05 MIN.	
GEAR - THICKNESS	12.998 MM	
	12.973 MM	

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 46 MM 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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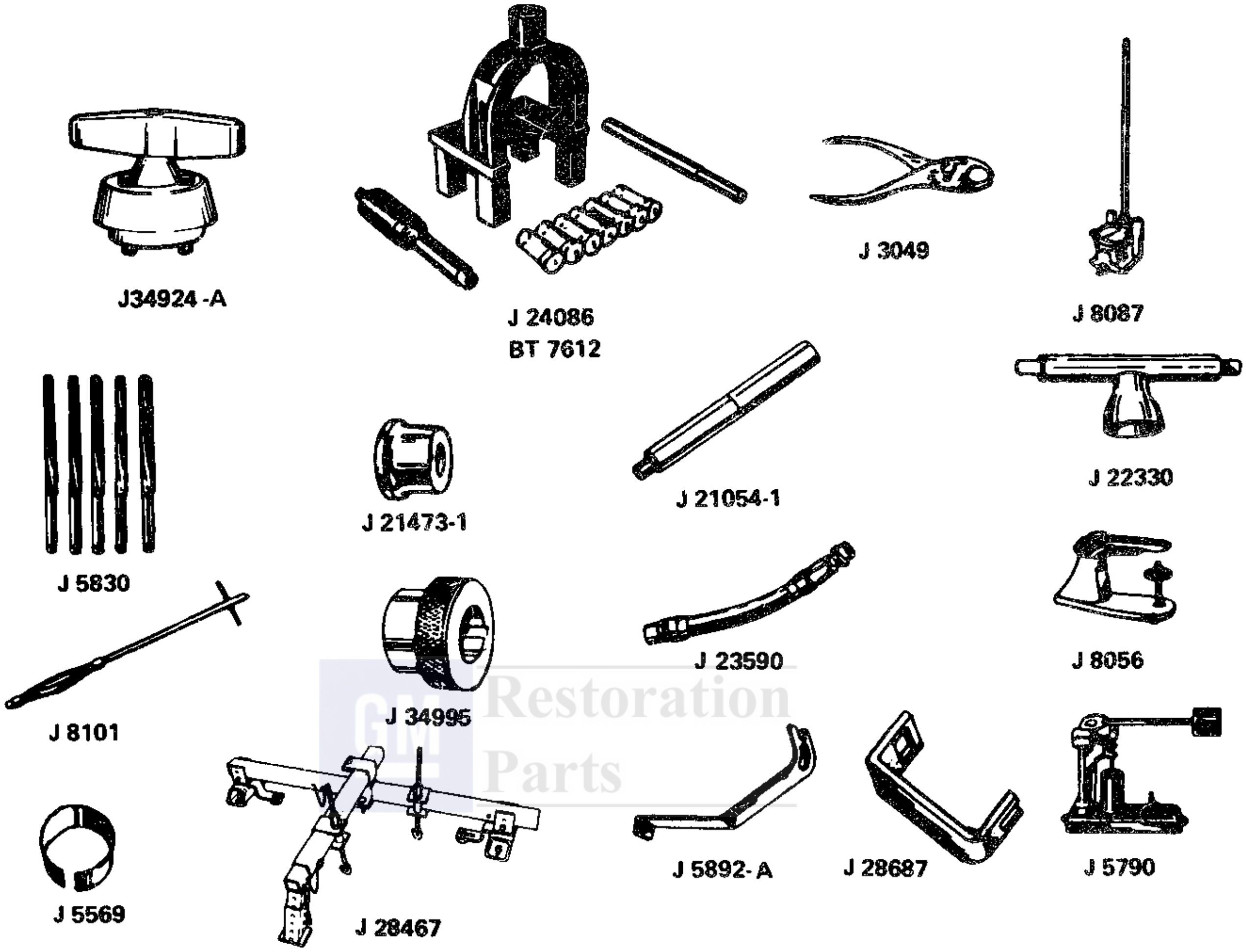
Fig. 816 Engine Specifications (Metric)



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)

G20043-6A4

Fig. 817 Special Tools

SECTION 6A2

2.8 LITRE V-6 VIN CODE 9 (L44)

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 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.

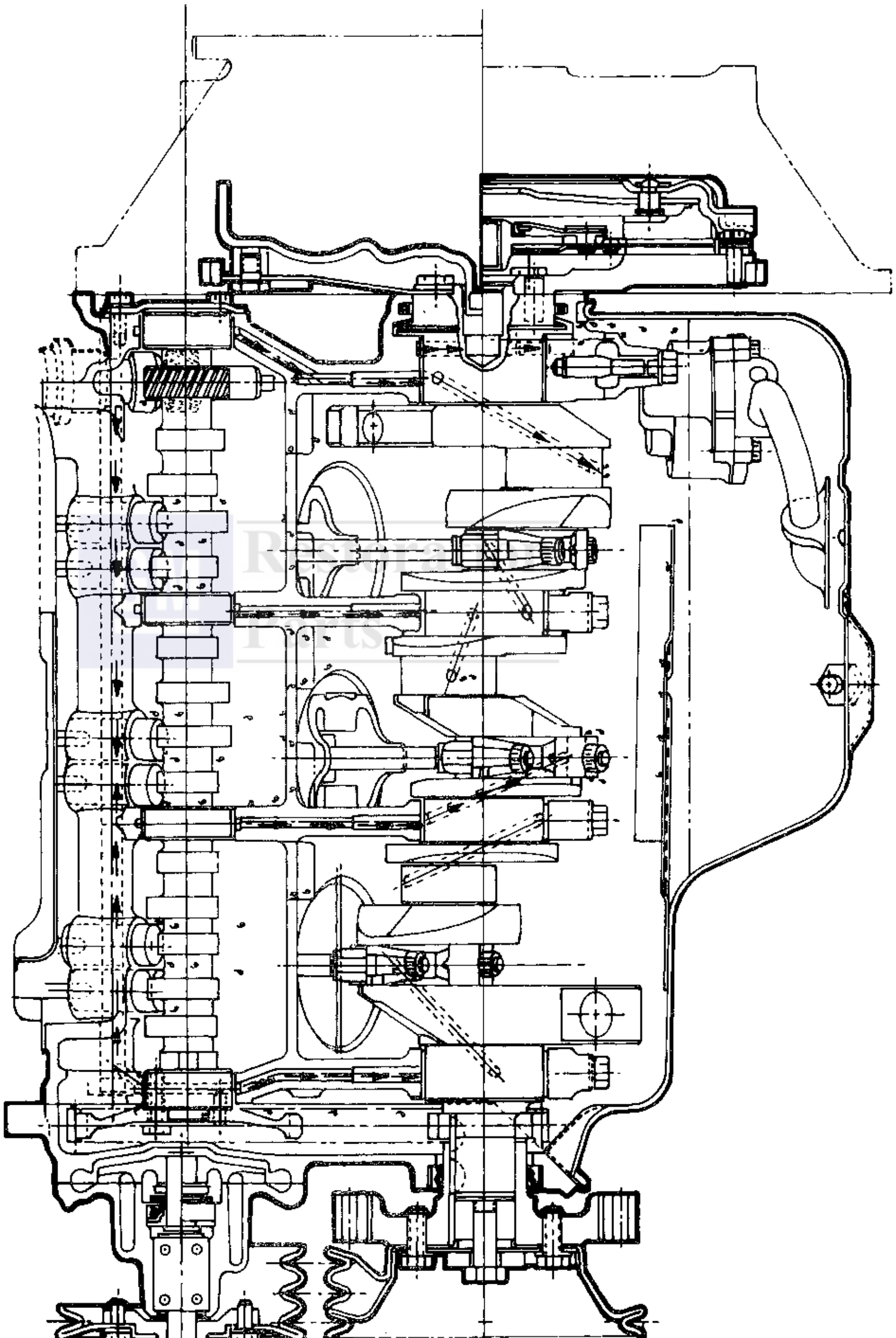


Figure 1 Engine Lubrication (1 of 4)

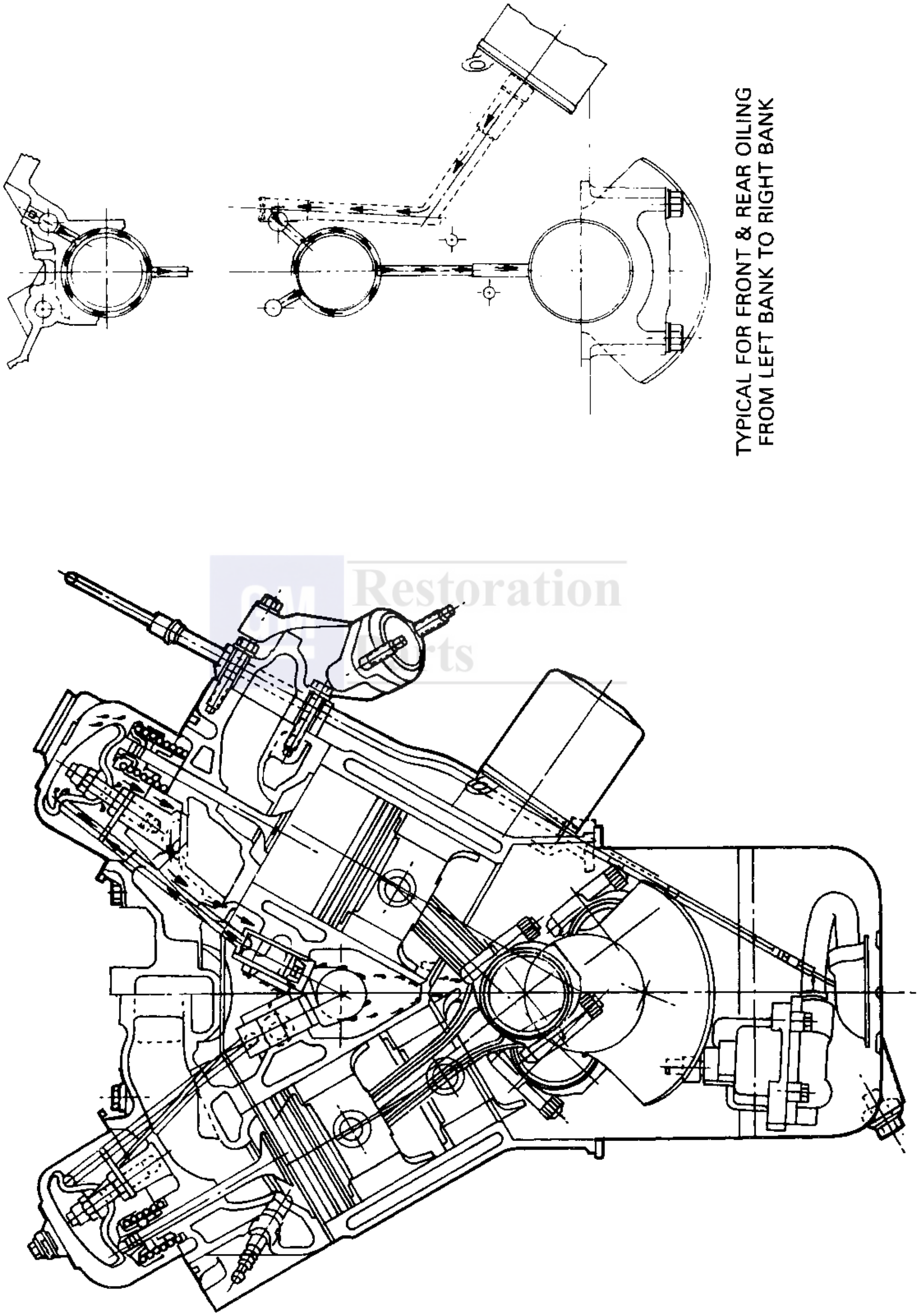
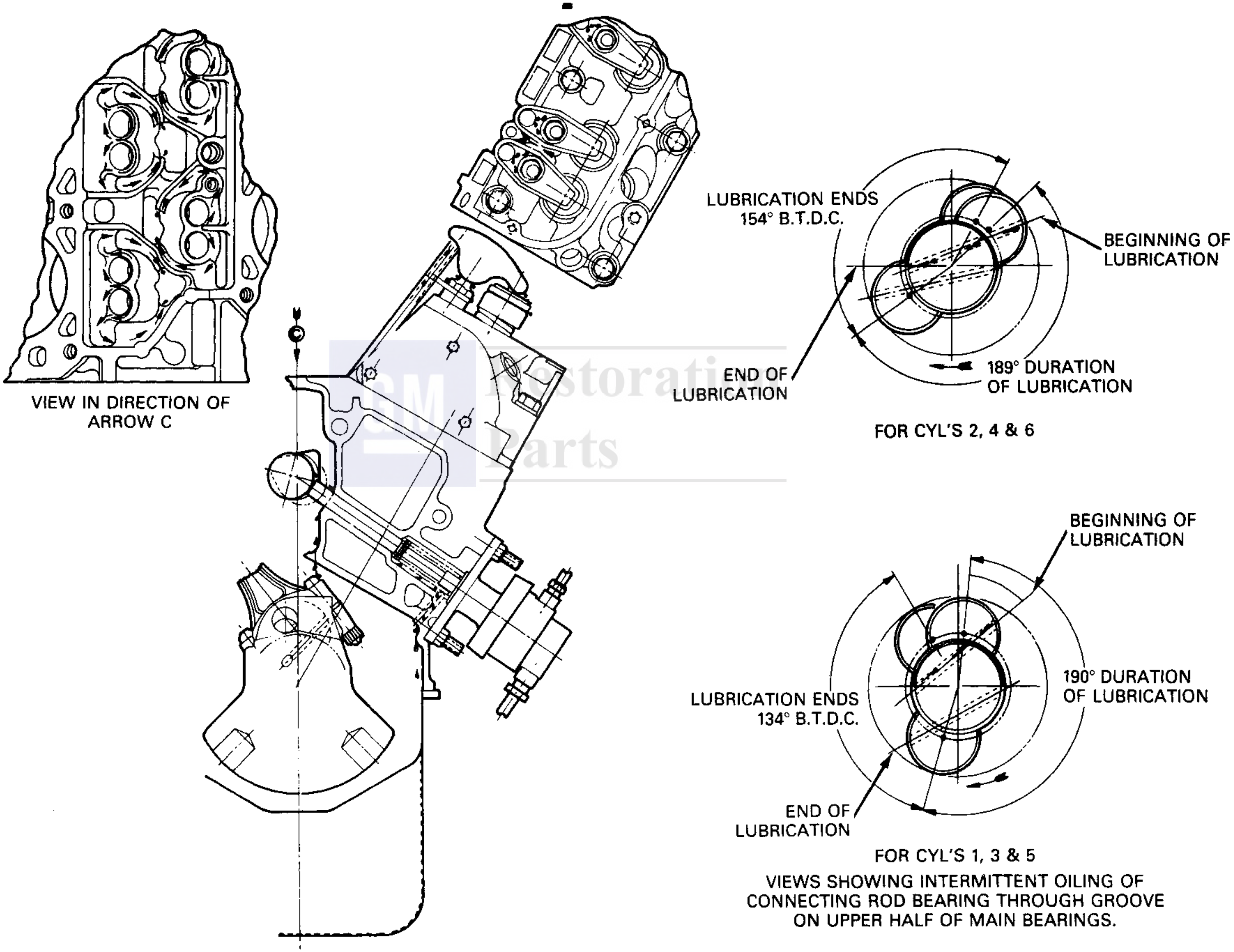


Figure 2 Engine Lubrication (2 of 4)



VIEW IN DIRECTION OF ARROW C

FOR CYL'S 2, 4 & 6

FOR CYL'S 1, 3 & 5

VIEWS SHOWING INTERMITTENT OILING OF CONNECTING ROD BEARING THROUGH GROOVE ON UPPER HALF OF MAIN BEARINGS.

Figure 3 Engine Lubrication (3 of 4)

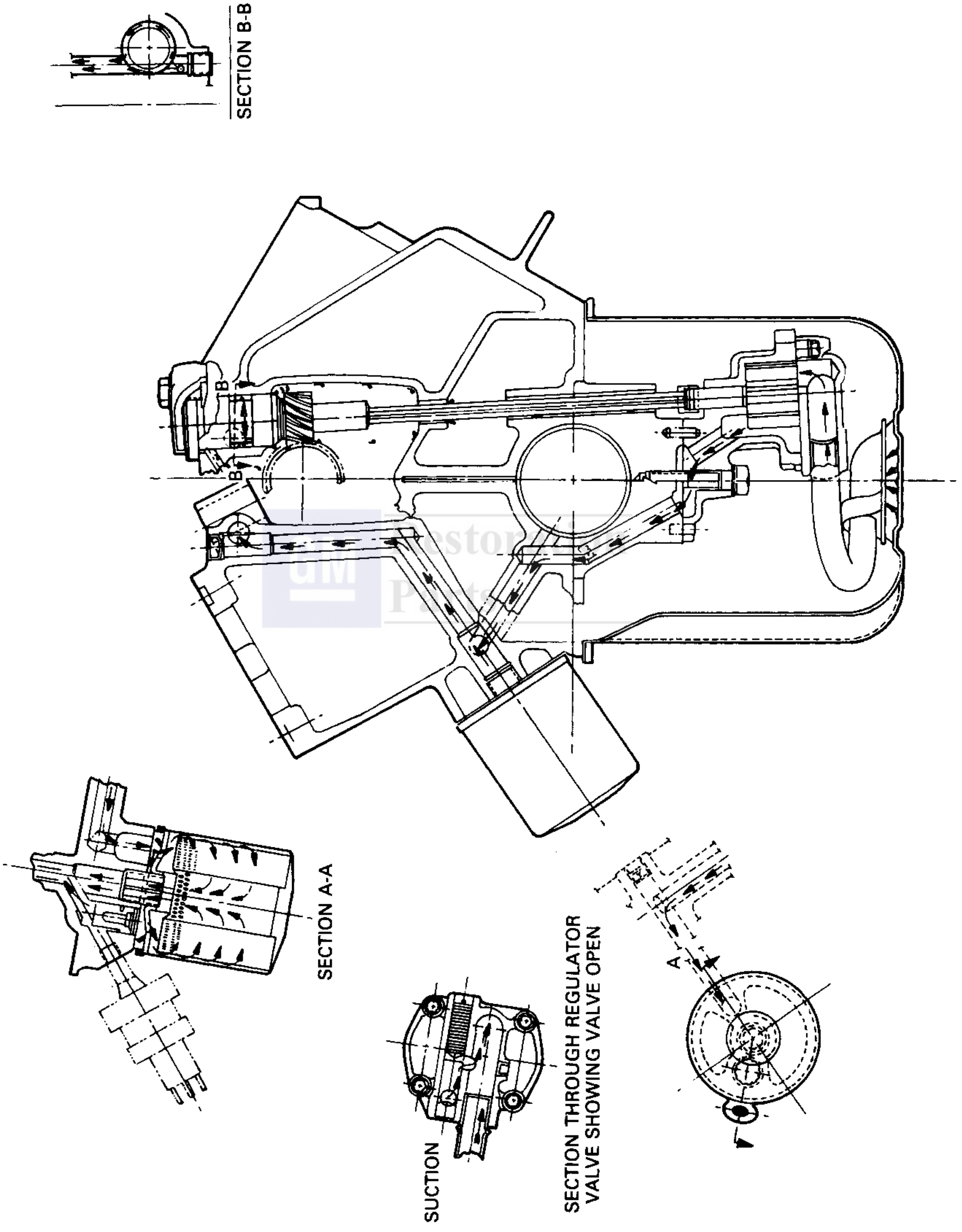


Figure 4 Engine Lubrication (4 of 4)

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.

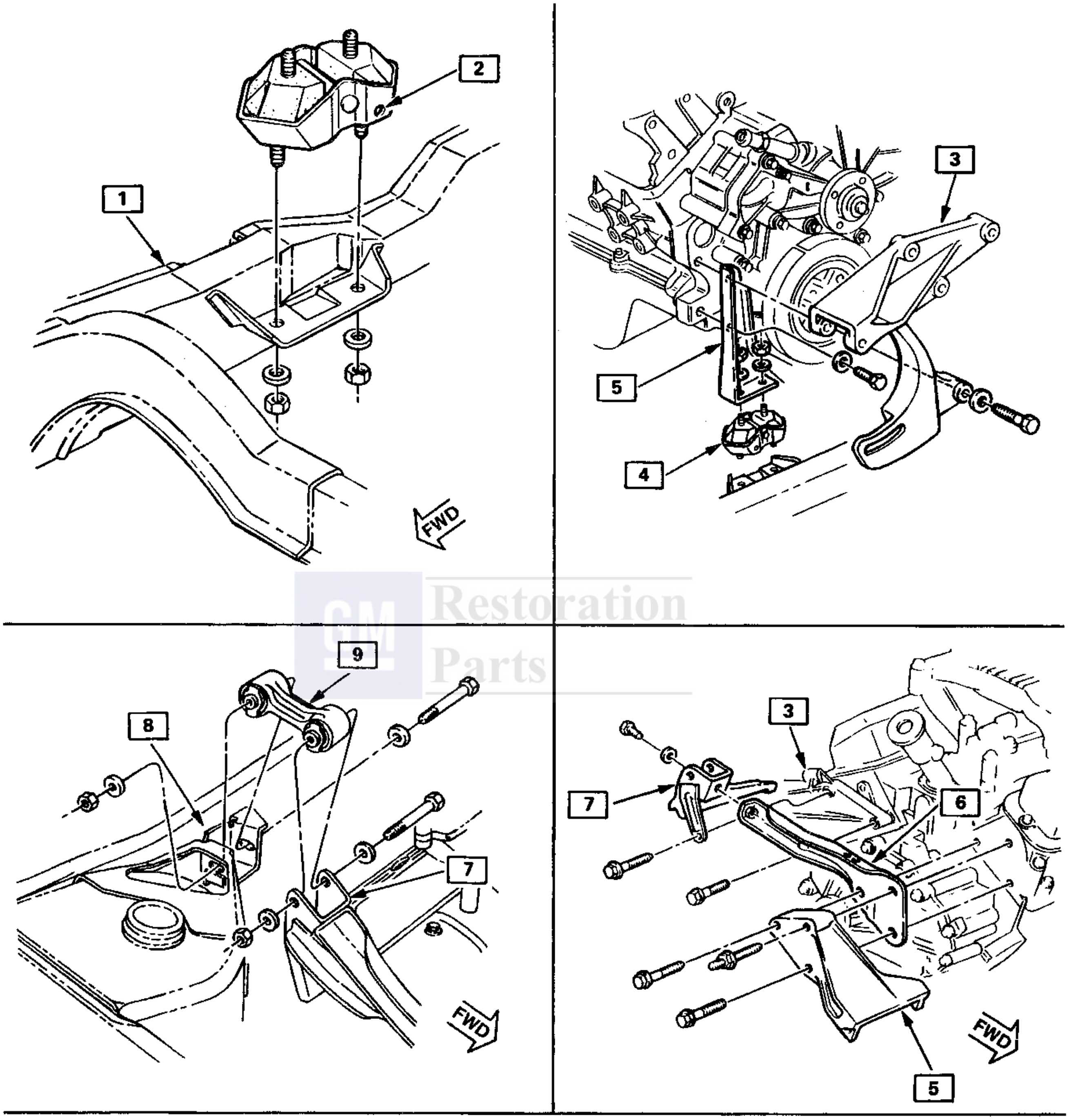
Checking Powertrain Mounts

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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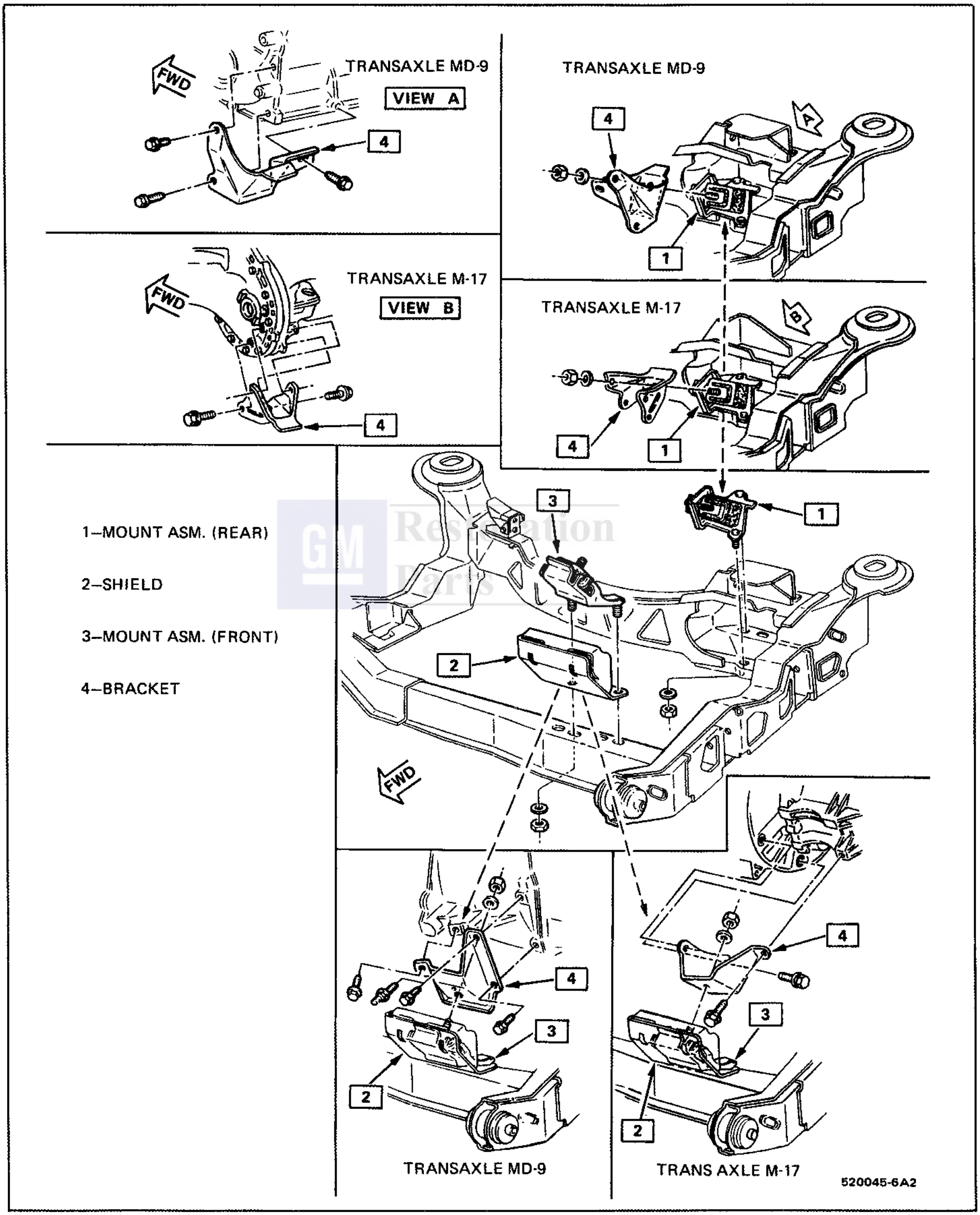
Figure 5 Engine Mounts and Torque Strut



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

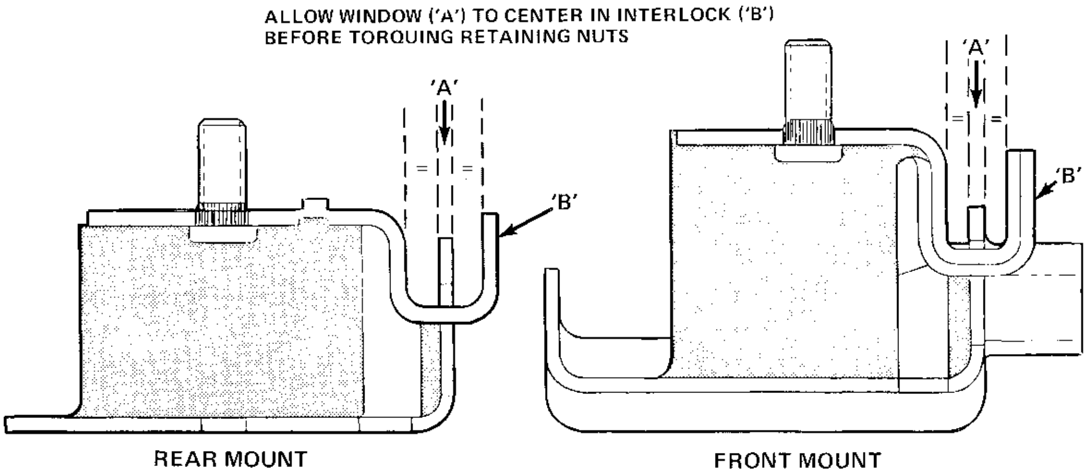


Fig. 7 Transaxle Mount Alignment

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.

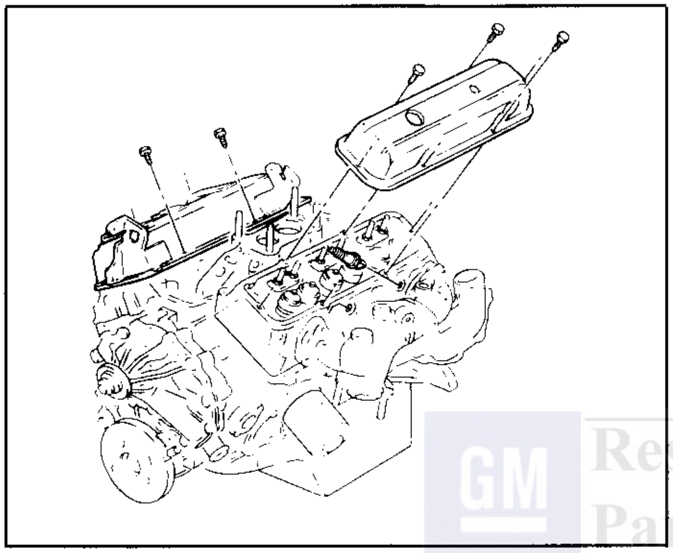


Fig. 8 Rocker Arm Cover Installation

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

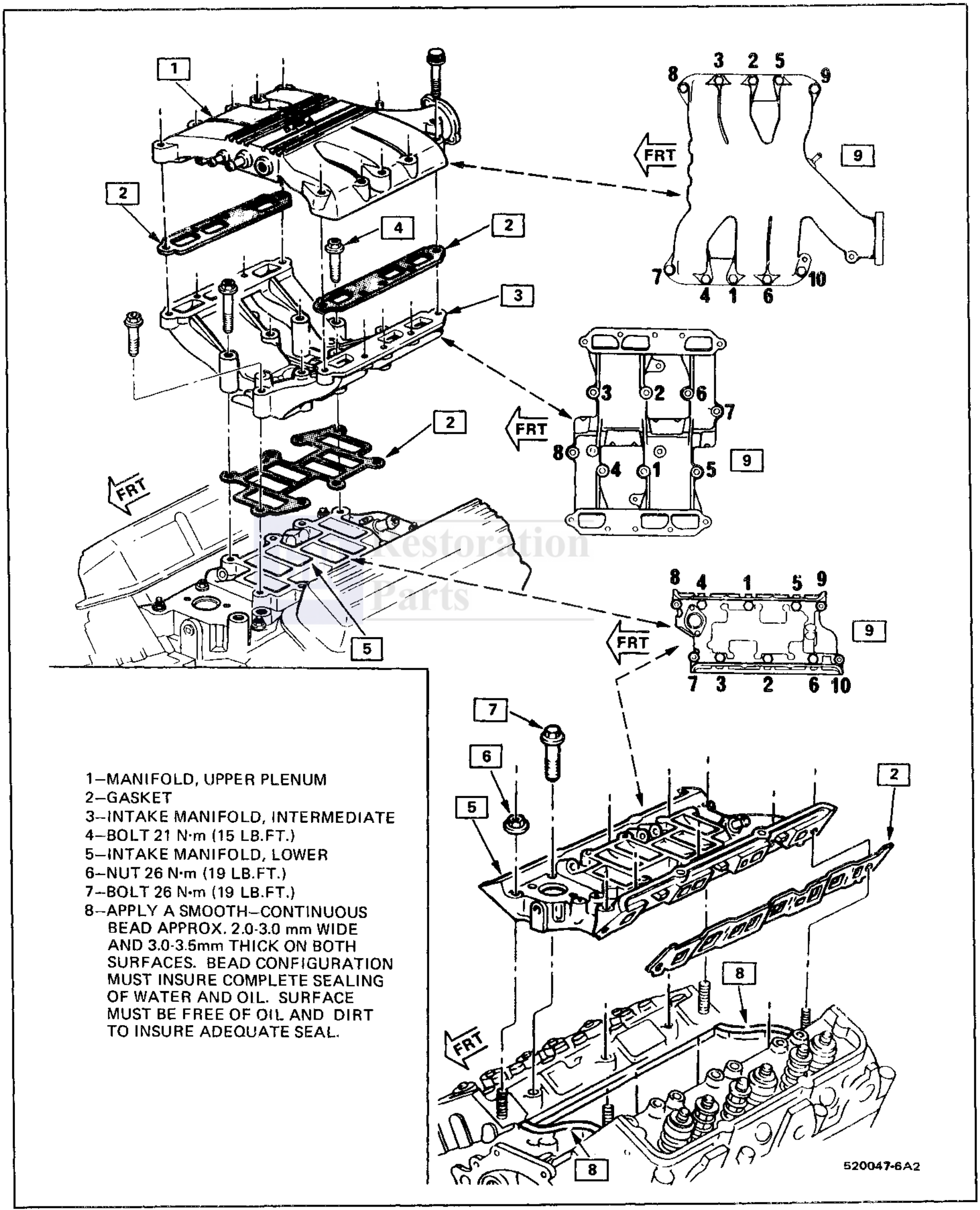
Remove or Disconnect

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

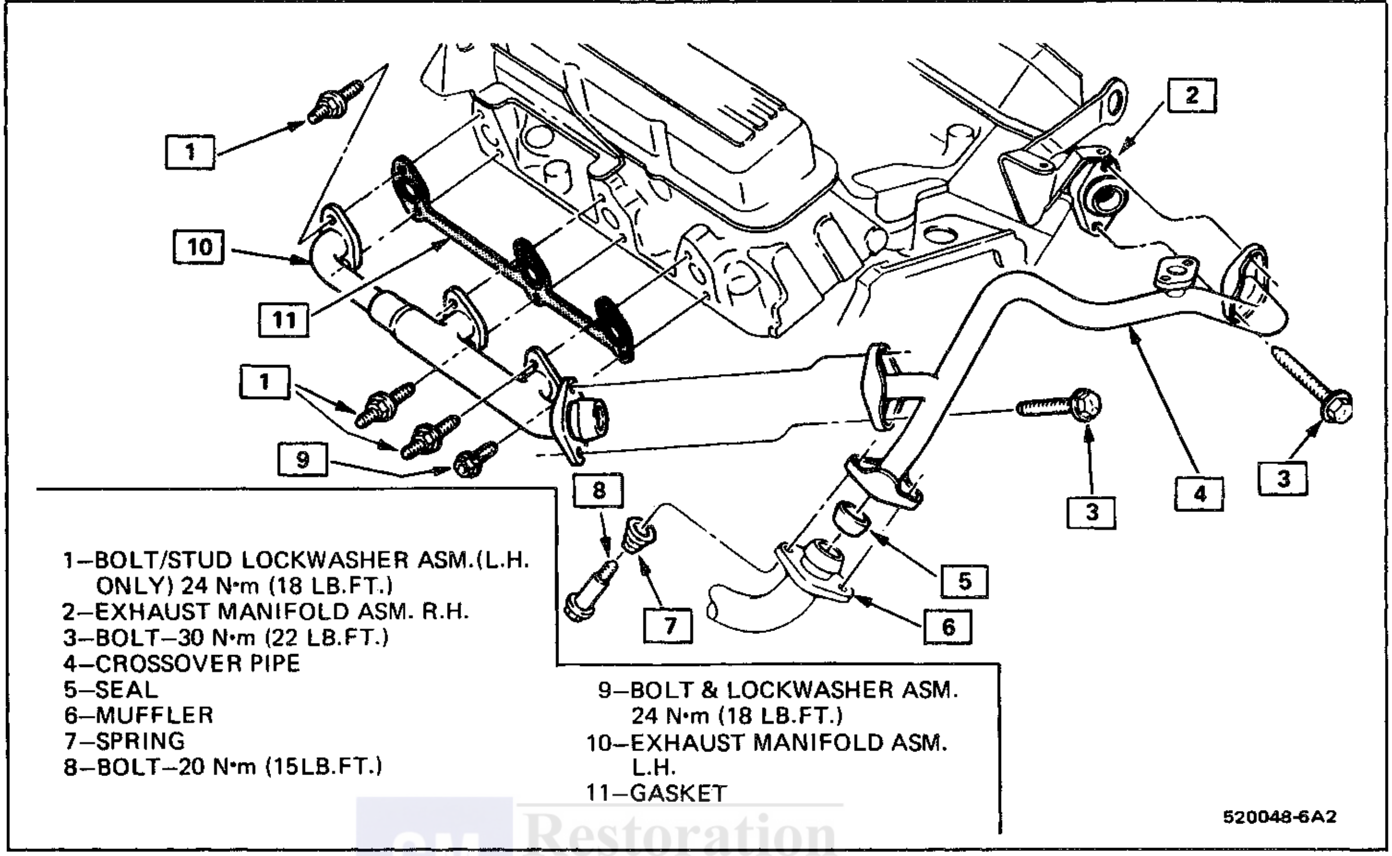


Fig. 10 Exhaust Manifold

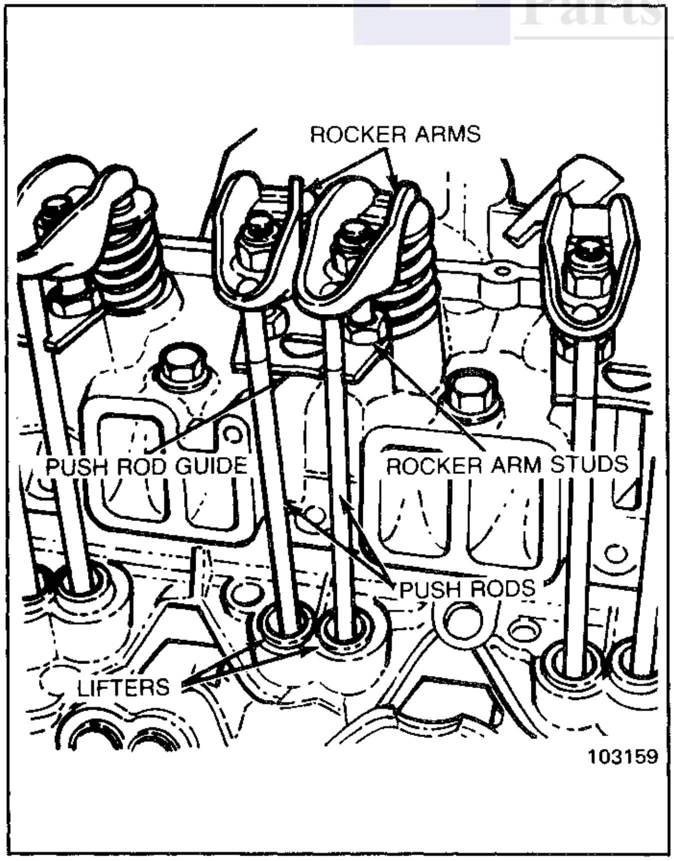


Fig. 11 Valve Mechanism

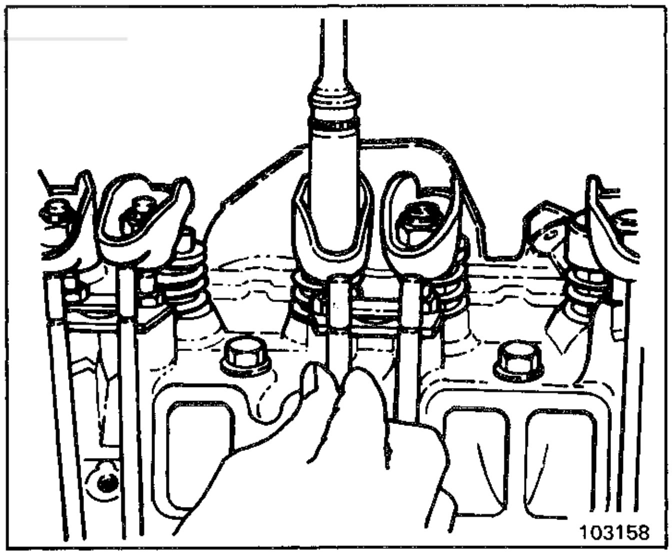


Figure 12 Adjusting Valve Lash

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

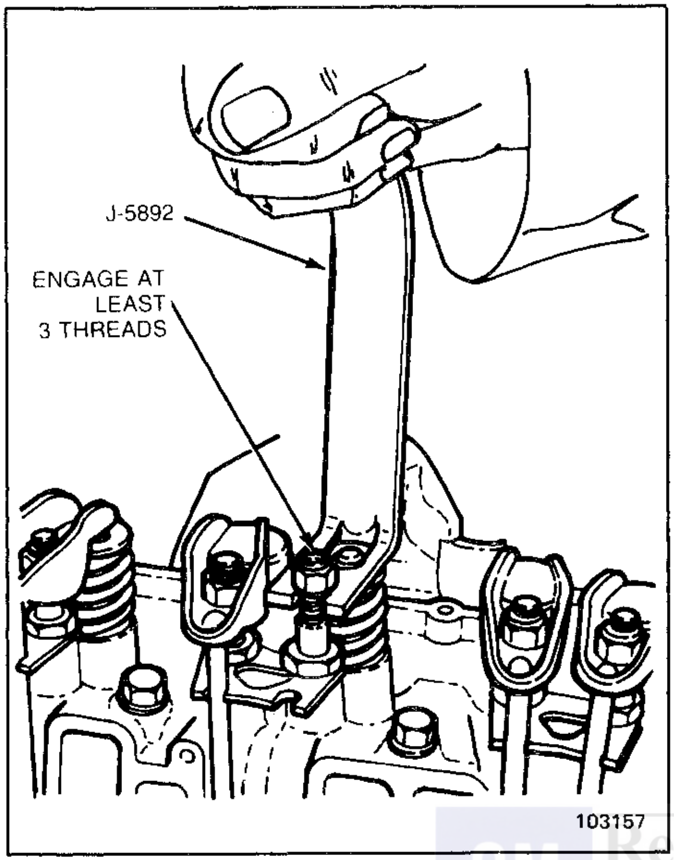


Figure 13 Depressing Valve Spring

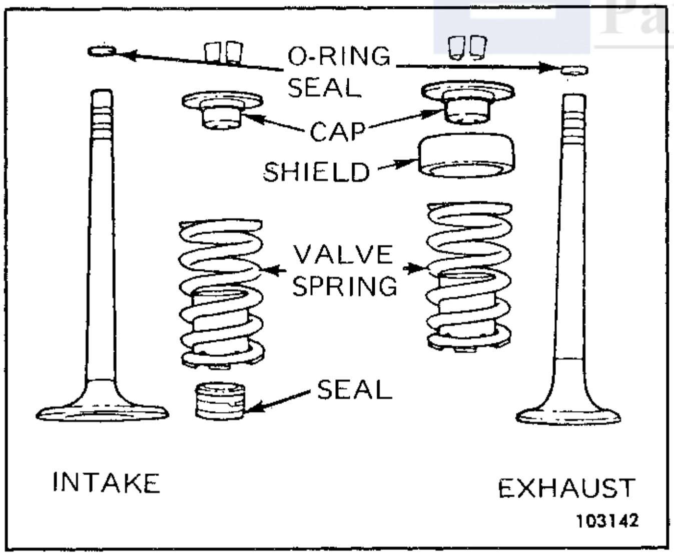


Figure 14 Valve Stem Seal

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).

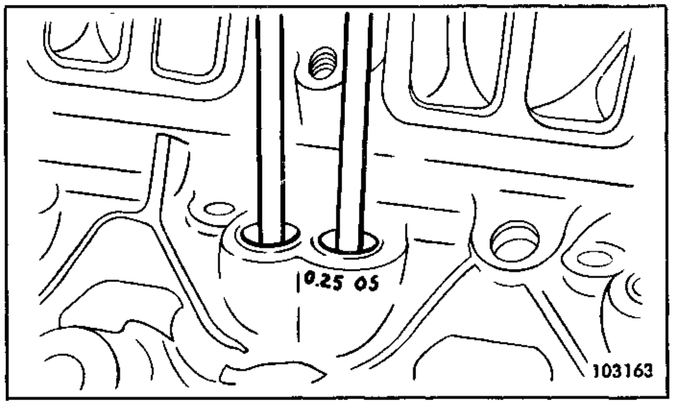


Figure 15 Oversize Lifter Marking

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.

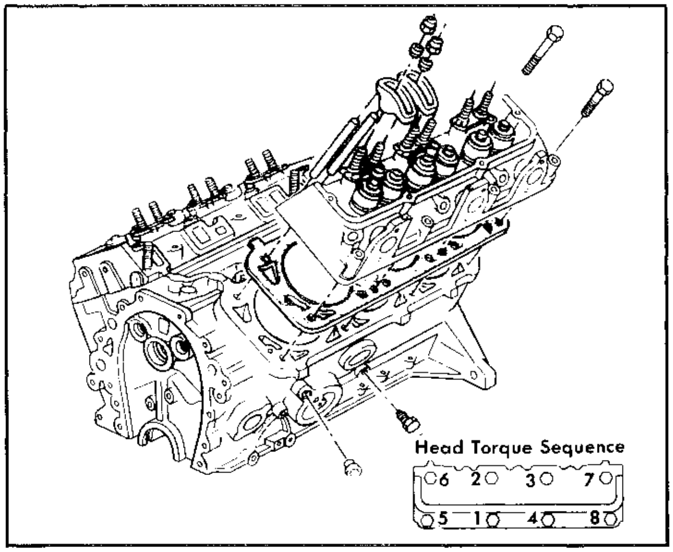


Figure 16 Cylinder Head Installation

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.

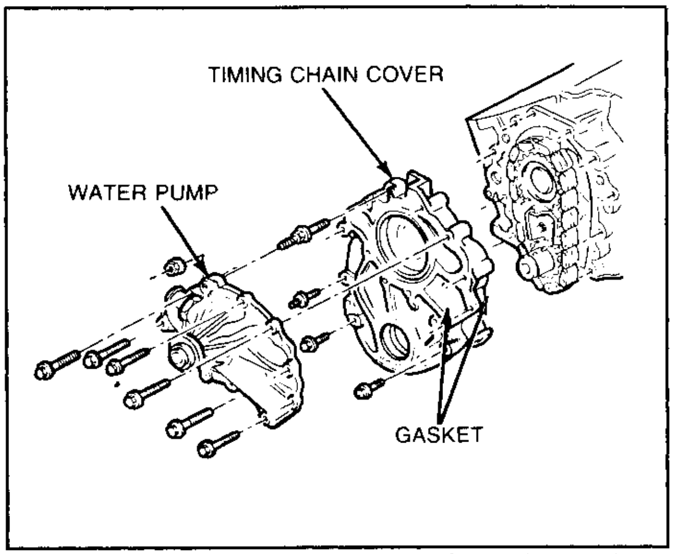


Figure 17 Water Pump/Front Cover Orientation

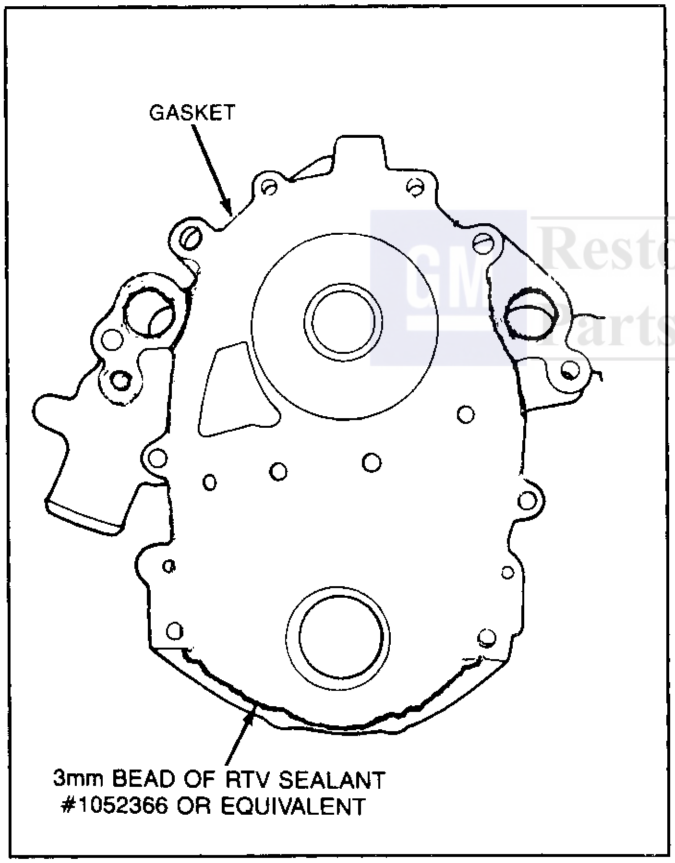


Figure 18 Front Cover Sealant Placement

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.

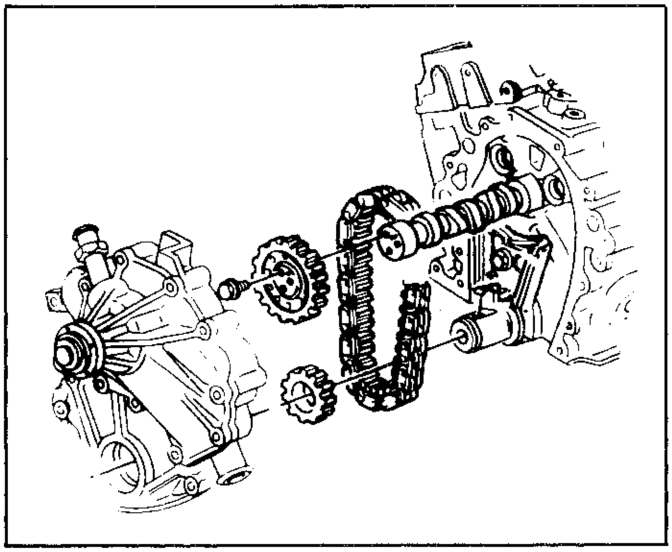


Figure 19 Timing Chain and Sprockets

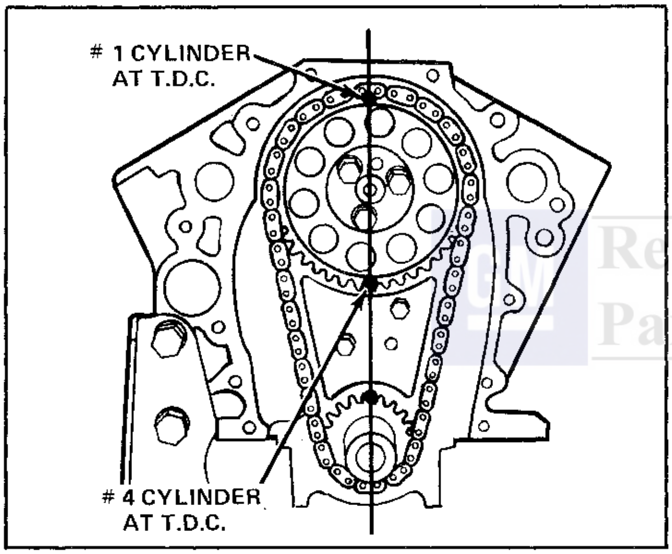


Figure 20 Camshaft Timing

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

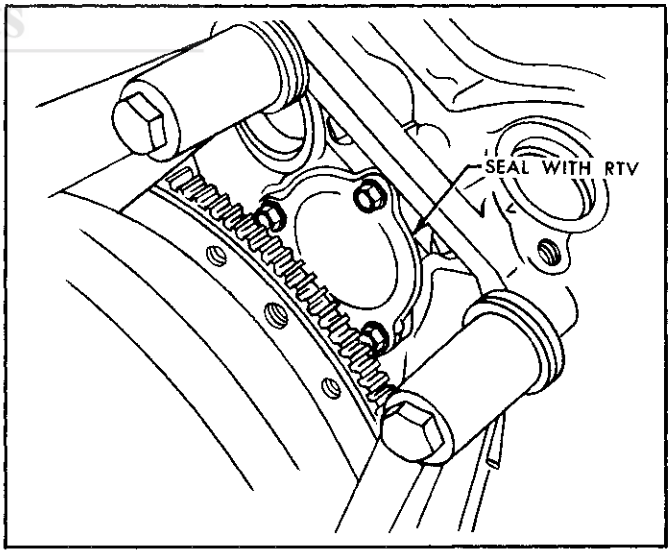


Figure 21 Camshaft Rear Cover

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

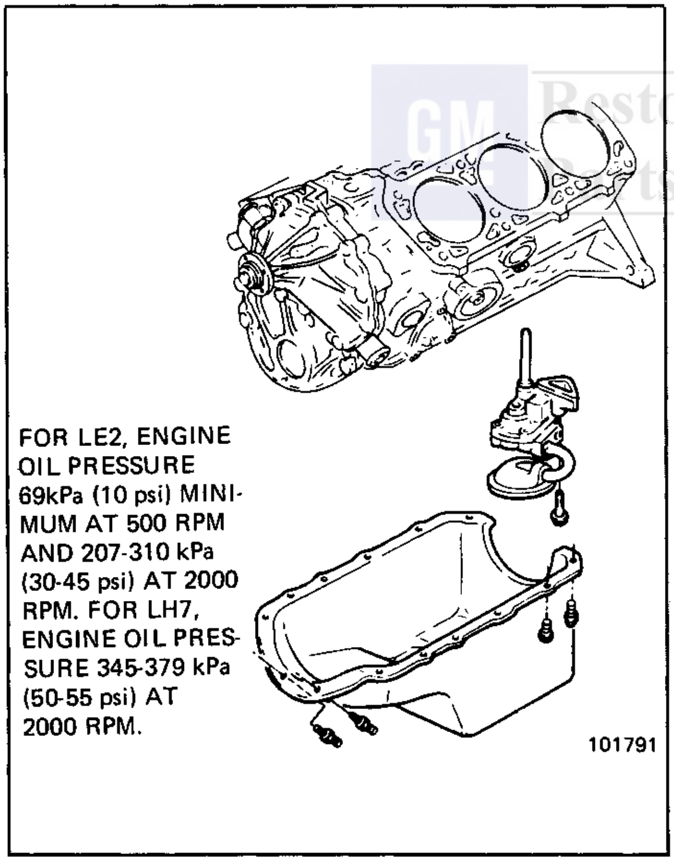
- Oil pan flanges
- Oil pan rail
- Front cover
- Rear main bearing cap
- Threaded holes

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

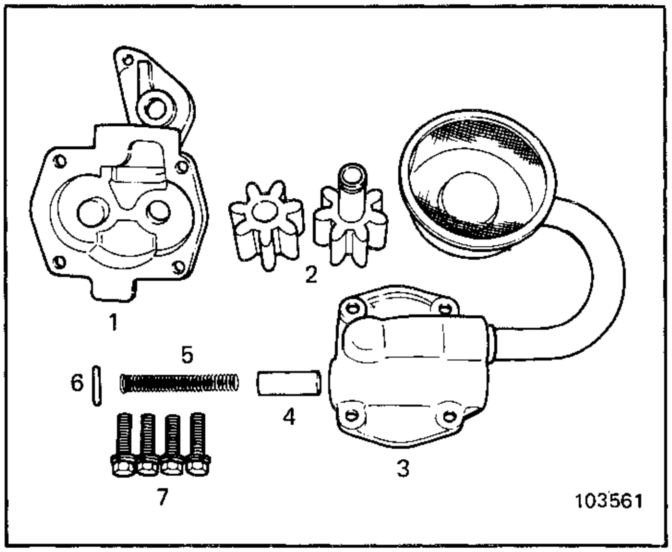


Figure 23 Oil Pump - Exploded

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

CONTENTS

GENERAL DESCRIPTION

The cooling system maintains engine temperature at an efficient level during all engine operating conditions. When the engine is cold the system cools slowly, or not at all, to allow the engine to warm up quickly.

The cooling system includes a radiator and recovery sub-system, cooling fan, thermostat and housing, water pump, and drive belt(s).

Operation of the cooling system requires proper functioning of all components. Coolant is drawn from the radiator by the water pump and circulated through water jackets in the engine block, intake manifold, and cylinder head(s), and then directed back to the radiator where it's cooled.

This system directs some coolant through hoses to the heater core, to provide for heating and defrosting. A recovery bottle is connected to the radiator to recover coolant displaced by expansion from high temperatures and maintain correct coolant level. As the coolant cools and contracts it is drawn back into the radiator by vacuum.

Radiator

A cross-flow radiator is used on all models. Tanks in this type radiator are located to the right and left of the core, instead of above and below.

Radiators used with automatic transmissions have oil coolers with inlet and outlet fittings for transmission fluid circulation. Cars with manual transmissions use radiators without oil coolers. Vehicles equipped with air conditioning use a radiator with extra cooling capability.

An aluminum-plastic radiator, used on some models, can be identified by a note on the outlet tank 5" below the filler neck which reads, "Important — for repair see Harrison Service Manual". Service procedures for the aluminum plastic radiator are described in that manual and in this section.

Radiator Cap

A pressure-vent cap is used on the cross-flow radiator to allow a buildup of 103 kPa (15 psi) in the cooling system. This pressure raises the boiling point of coolant to approximately 125°C (262°F) at sea level. **Do not remove radiator cap to check engine coolant level; check coolant visually at the see-through coolant reservoir. Coolant should be added only to the reservoir.**

CAUTION: As long as there is pressure in the cooling system, the temperature can be considerably higher than the boiling temperature of the solution in the radiator without causing the solution to boil. Removal of the radiator cap while engine is hot and pressure is high will cause the solution to boil instantaneously and possibly with explosive force, spewing the solution over engine, fenders and person removing cap. If the solution contains flammable antifreeze, such as alcohol (not recommended for use at any time), there is also the possibility of causing a serious fire.

The pressure-type radiator filler cap contains a blow off or pressure valve and a vacuum or atmospheric valve (Figure 1). The pressure valve is held against its seat by a spring of pre-determined strength, which protects the radiator by relieving pressure if it exceeds design limits. The vacuum valve is held against its seat by a light spring, which permits opening of the valve to relieve vacuum created in the system when it cools off and which otherwise might cause the radiator to collapse.

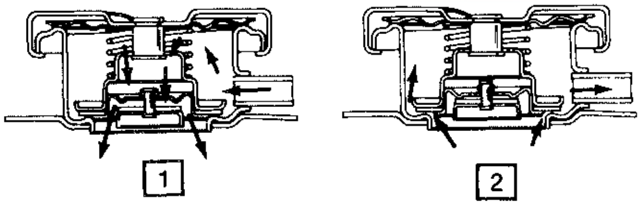


Figure 1 Pressure-Type Radiator Cap

The radiator cap is designed to discourage inadvertent removal. The finger grips have been removed so the cap is round in shape. It also must be pushed downward before it can be removed. A rubber asbestos gasket is added to the diaphragm spring at the top of the cap. Embossed on the cap is a caution against its being opened and arrows indicating the proper closed position.

Every vehicle has a radiator cap. Also, J, N and P Series vehicles with 2.0L and 2.5L engines have a thermostat housing cap. For these engines, add coolant through the thermostat housing (with the thermostat and cap removed).

Recovery Bottle

A "see-through" plastic reservoir, similar to the familiar windshield washer jar, is connected to the radiator by a hose. As the car is driven, the coolant is heated and expands. The portion of the fluid displaced by this expansion flows from the radiator into the recovery bottle. When the engine is stopped and the coolant cools and contracts, the displaced coolant is drawn back into the radiator by vacuum. Thus, the radiator is kept filled with coolant to the desired level at all times, resulting in increased cooling efficiency. Coolant level should be between "ADD" and "FULL" marks on recovery bottle. These marks are approximately two quarts apart so that a 50/50 mixture can be added (one quart of ethylene glycol anti-freeze and one quart of water).

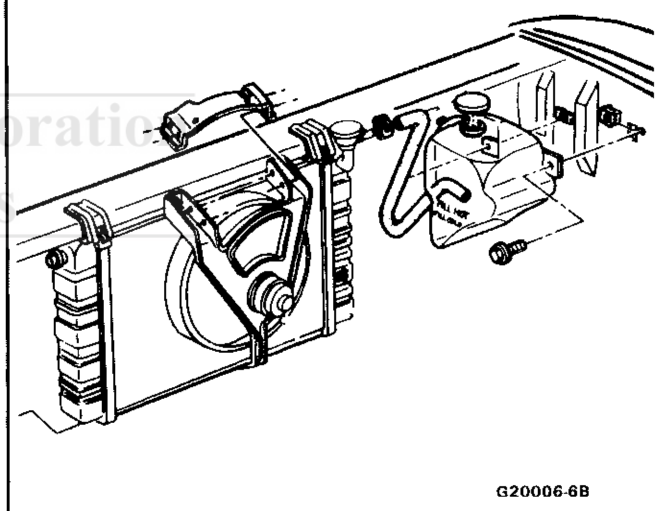


Figure 2 Coolant Recovery Bottle (Typical)

FAN

Electric Fan

Fans range in sizes from 290mm (11.6 in) to 422mm (16.9 in) with 4 to 7 blades to aid air flow through the radiator/condenser. The fan is driven by an electric motor which is attached to the radiator support.

The fan motor is activated by a coolant temperature switch. If the vehicle is equipped with 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.

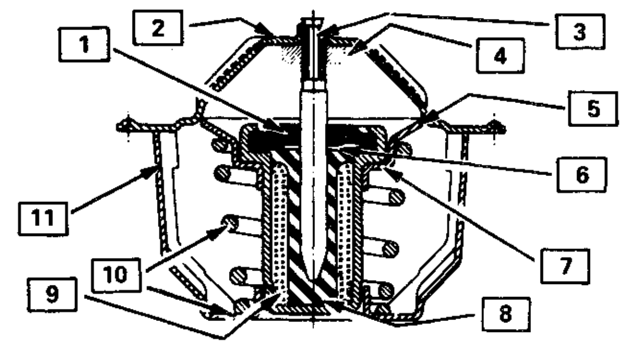
Coolant Temperature Fan Switch

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.



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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Figure 3 Pellet Type Thermostat

Coolant Recovery System

A recovery-type cooling system is standard on all cars and is designed to maintain the engine at proper operating temperatures. The recovery tank collects coolant that expands with rising temperature and would otherwise overflow from the system. When the system temperature drops, the coolant is drawn from the recovery tank back into the radiator by the suction created by coolant contraction. The cooling system has been filled at the factory with a high-quality, inhibited, year-around coolant that meets the standards of General Motors Specification 1825-M. This coolant solution provides freezing protection to at least −37°C (−34°F). It has been formulated to be used for two full calendar years or 30,000 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 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 K, M, 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 K, M, R and U).
3. With the thermostat removed, reinstall the thermostat housing cap (VIN K, M, R and U).
4. Open radiator drain valve and block drain plugs to drain coolant. On VIN R and 9 (P carline) engines, open coolant pipe plugs.
5. Close valve. Reinstall drain plugs, and add sufficient water to fill system.
6. Run engine, drain and refill the system, as described in steps 4 and 5 a sufficient number of times, until the drained liquid is nearly colorless.

Important

- BLOCK DRIVE WHEELS, place transmission in PARK (automatic transmission) or NEUTRAL (manual transmission) and set the parking brake.

7. Allow system to drain completely. Then close radiator drain valve tightly, and reinstall block drain plugs.
8. Remove recovery cap leaving hoses in place. Remove coolant recovery tank and empty of fluid. Flush tank with clean water, drain and reinstall.
9. Add sufficient ethylene glycol coolant, meeting GM specification 1825-M, to provide the required freezing and corrosion protection — at least 50 percent solution −37°C (−34°F). Fill radiator to the base of the radiator fill neck and add sufficient coolant to the recovery tank to raise level to the "FULL" mark. Reinstall recovery tank cap.
10. Run engine, with radiator cap or thermostat housing cap removed, until normal operating temperature is reached. (Radiator upper hose becomes hot.)
11. With engine idling, add coolant until level reaches bottom of filler neck and reinstall cap, making certain arrows line up with overflow tube.

CAUTION: Under some conditions, the ethylene glycol in engine coolant is flammable. To help avoid being burned when adding coolant, DO NOT spill it on the exhaust system or hot engine parts.

It is the owner's responsibility to keep the freeze protection at a level appropriate to the temperatures which may occur in the area of vehicle operation.

a. Maintain cooling system freeze protection at −37°C (−34°F), to ensure protection against corrosion and loss of coolant from boiling, even though freezing temperatures are not expected.

b. Add ethylene glycol base coolant that meets GM Specification 1825-M, when coolant additions are required because of coolant loss, or to provide additional protection against freezing at temperatures lower than −37°C (−34°F).

NOTICE: Alcohol or methanol base coolants, or plain water, are not recommended at any time.

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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Figure 4 Cooling System Diagnosis Chart (1 of 3)

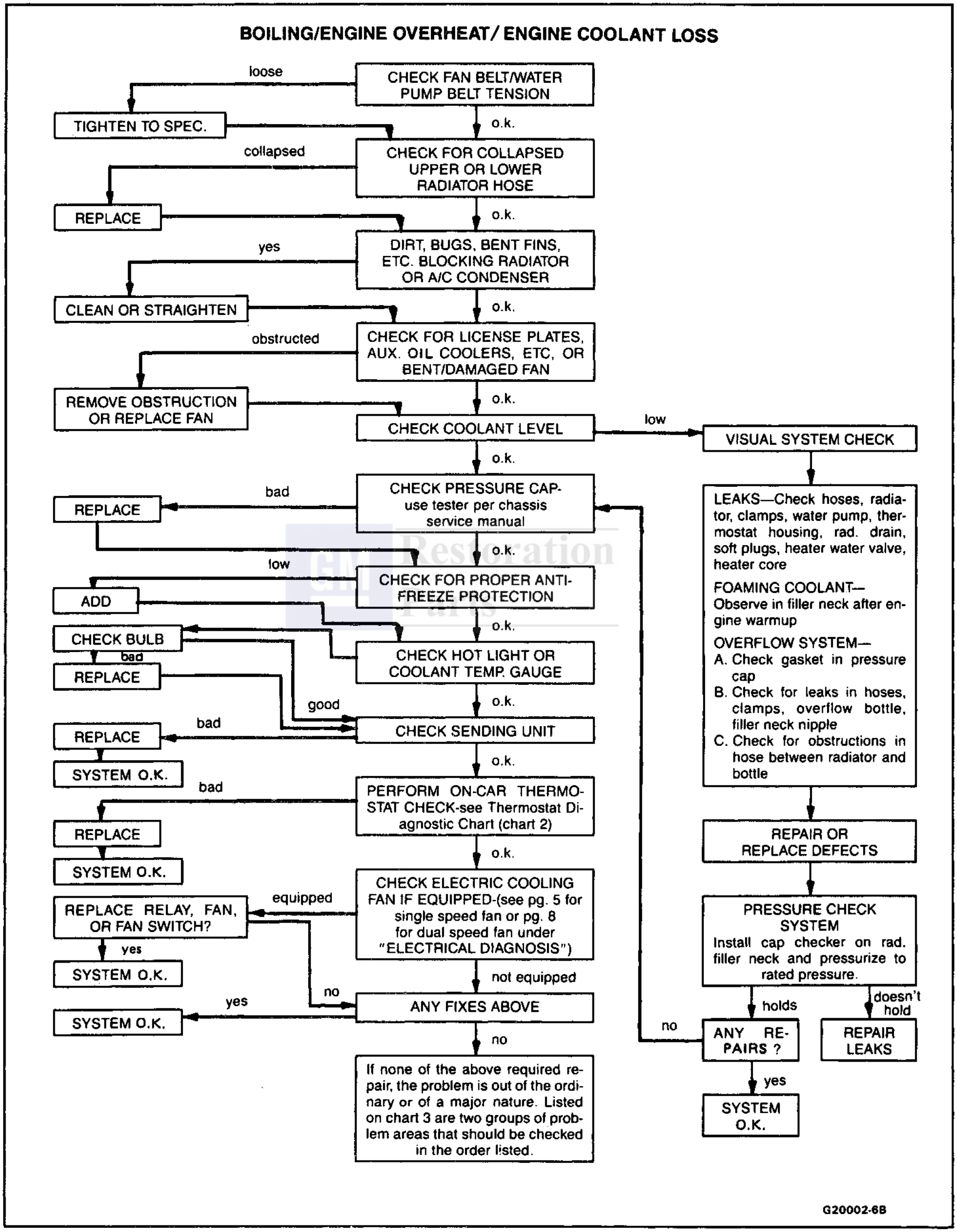

Figure 5 Cooling System Diagnosis Chart (2 of 3)

A. PROBLEMS NOT REQUIRING DISASSEMBLY OF COOLING SYSTEM –
1. LARGE OBSTRUCTIONS BLOCKING RADIATOR OR CONDENSER
   a. AUXILIARY OIL COOLERS ⎤
   b. LICENSE PLATES ⎬ RELOCATE
   c. SPARE TIRES ⎦
   d. ICE, MUD OR SNOW OBSTRUCTING GRILLE – REMOVE
2. ENGINE OIL OVERFILL – CHECK ENGINE OIL DIPSTICK
3. WRONG RADIATOR FOR APPLICATION – CHECK PART NO. AGAINST PARTS LIST
4. LOOSE, DAMAGED OR MISSING AIR SEALS – SEE BODY SERVICE MANUAL
5. MISSING OR DAMAGED LOWER AIR BAFFLE – SEE BODY SERVICE MANUAL
6. WRONG IGNITION TIMING – SEE CHASSIS SERVICE MANUAL

B. PROBLEMS REQUIRING DISASSEMBLY OF COOLING SYSTEM –
1. INCORRECT OR DAMAGED FAN – CHECK PART NO. AGAINST PARTS LIST
2. FAULTY EMISSION SYSTEM COMPONENTS (COULD CAUSE OVERHEATING AT IDLE)
   a. PCV VALVE ⎤
   b. TVS OR TCS ⎦ – SEE CHASSIS SERVICE MANUAL
3. PRESSURE CHECK COOLING SYSTEM WITH PRESSURE CAP INSTALLED – WILL SHOW IF PRESSURE CAP LEAKS BECAUSE OF RADIATOR FILLER NECK DAMAGE
4. DEFECTIVE WATER PUMP
   a. ERODED OR BROKEN IMPELLER VANES
   b. FAILED BEARING OR SEAL – CHECK FOR SHAFT OR BEARING PLAY
5. PLUGGED RADIATOR TUBES – SEND TO RADIATOR REPAIR SHOP FOR FLOW CHECK
6. INTERNAL SYSTEM LEAKS
   a. HEAD GASKET – SEE CHASSIS SERVICE MANUAL
   b. CRACKED BLOCK
   c. TIMING CHAIN COVER
   d. INTAKE MANIFOLD GASKET
7. PLUGGED COOLANT PASSAGES IN CYLINDER HEADS – REMOVE HEADS AND CHECK VISUALLY

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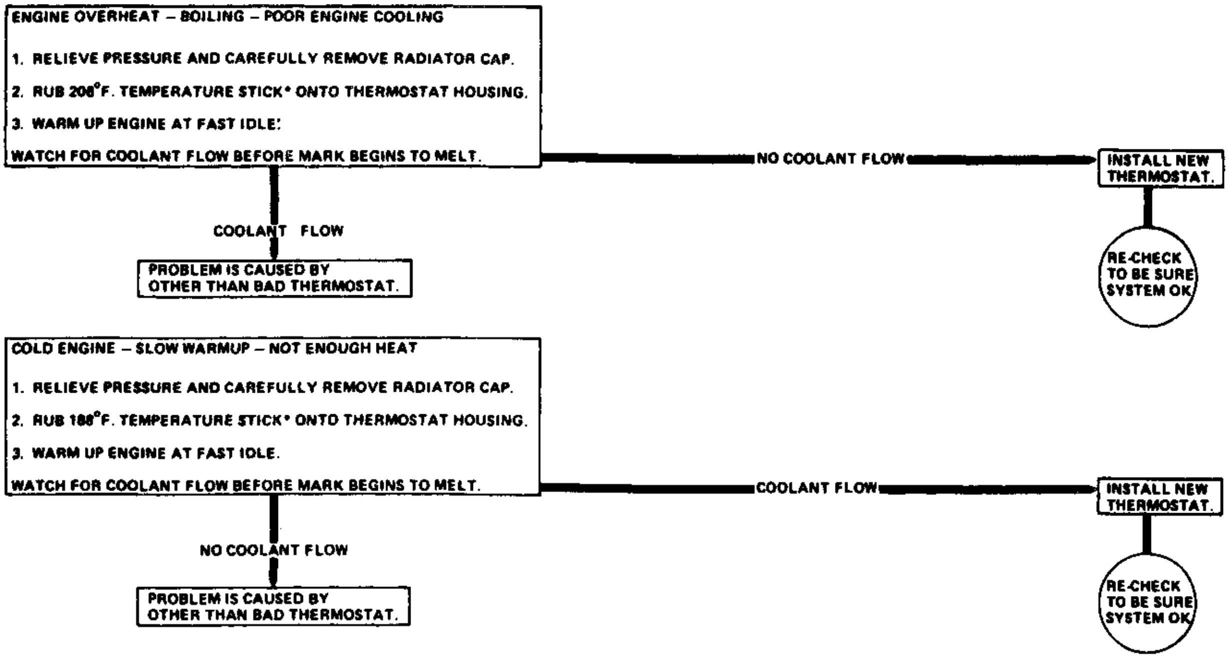
Figure 6 Cooling System Diagnosis Chart (3 of 3)



*NOTE: THE TEMPERATURE STICK IS A PENCIL LIKE DEVICE WHICH HAS A WAX MATERIAL CONTAINING CERTAIN CHEMICALS WHICH MELT AT A GIVEN TEMPERATURE. THEMPERATURE STICKS CAN BE USED TO DETERMINE A THERMOSTAT'S OPERATING TEMPERATURE BY RUBBING 188°F. AND 206°F. STICKS ON THE THERMOSTAT HOUSING. THE MARKS MADE BY THE STICKS SHOULD MELT WHEN COOLANT TEMPERATURES OF 188°F. AND 206°F. ARE REACHED, RESPECTIVELY. THESE TEMPERATURES ARE THE NORMAL OPERATING RANGE OF THE THERMOSTAT, THEREFORE, IF THE COOLANT FLOWS AS INDICATED ON THE DIAGNOSIS CHART, THE THERMOSTAT MAY BE DEFECTIVE.

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Figure 7 Thermostat Diagnosis Chart

DRIVE BELTS

Frayed or cracked belts should be replaced and tensioned to specifications using a strand tension gage, such as tool J 23600-B or equivalent.

Loose belts may place an extremely high impact load on driven component bearings due to the whipping action of the belt.

An over-tightened belt also places unnecessary loads on the component bearings.

When adjusting a drive belt, it is important that the proper adjustment specification be used. Refer to Accessory Drive Belt Tensioning Specifications for adjustment.

A "Used" belt is one that has been rotated at least one completed revolution on engine pulleys. This begins the "seating" of the belt and it should never be reset to "New" belt specifications.

SERPENTINE BELT

A single (serpentine) belt may be used to drive all engine mounted components. All driven components are rigidly mounted to the engine. Drive belt tension is maintained by a spring loaded belt tensioner.

A belt squeak when the engine is started or stopped is normal and has no effect on belt durability.

The drive belt tensioner can control belt tension over a broad range of belt lengths; however, there are limits to the tensioner's ability to compensate. Using the tensioner outside of its operating range can result in poor tension control and/or damage to the tensioner.

See "ON-VEHICLE SERVICE" for checking belt tension procedure and illustration.

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 Figure 8) The gasket must be replaced any time a tank is removed from the core.

Transaxle Oil Cooler

The transaxle oil cooler is located in one of the radiator side tanks. The oil cooler can be replaced by removing the tank from the core.

A leaking oil cooler gasket can be replaced without removing the tank from the core.

Drain Cock

The aluminum/plastic radiator utilizes a two piece plastic drain cock and a rubber seal. The drain cock is serviceable (See Fig. 9).

ALUMINUM RADIATOR SERVICE

The aluminum-plastic radiator can be repaired at the dealership. The following components are easily replaced:

- Core
- Tanks and gaskets
- Oil coolers and gaskets
- Drain cock and gasket

The **tanks cannot be repaired** if broken or cracked. The radiator core can be replaced and the new core used with the original tanks and oil cooler.

Precautions

As with all cooling system service, take measures to prevent personal injury and damage to the system.

CAUTION: To help avoid the danger of being burned, do not remove the radiator cap while the engine and radiator are still hot. Scalding fluid and steam can be blown out under pressure if the cap is taken off too soon.

NOTICE: DO NOT USE "BOIL OUT" TANKS OR VATS. Common service methods may actually destroy an aluminum radiator. Caustic or lye cleaning solutions must NOT be used for aluminum radiators.

- Do not open the hood if you can see, or hear, steam or coolant escaping from the engine compartment.
- Do not remove radiator cap if radiator feels warm.

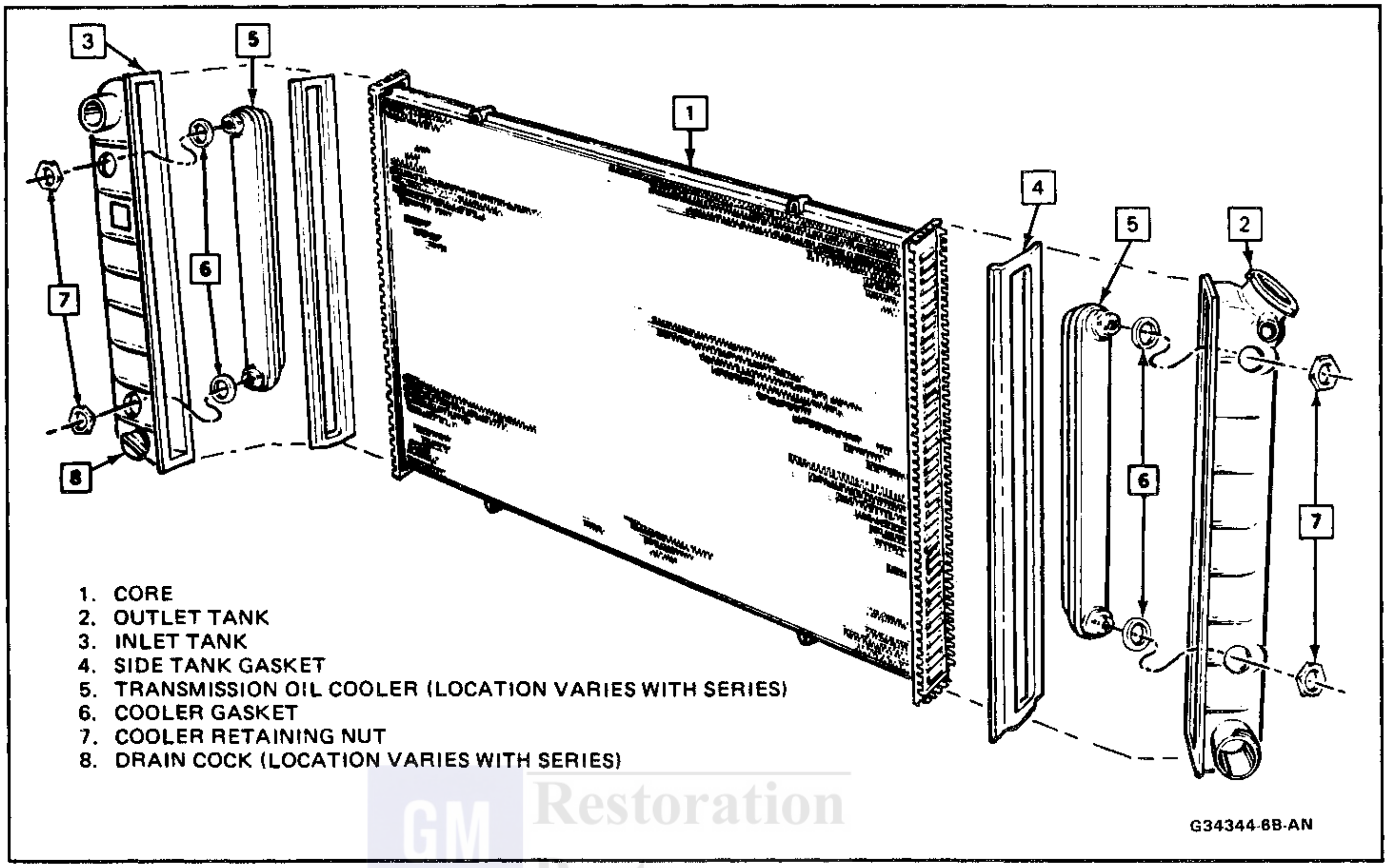


Figure 8 Aluminum Radiator

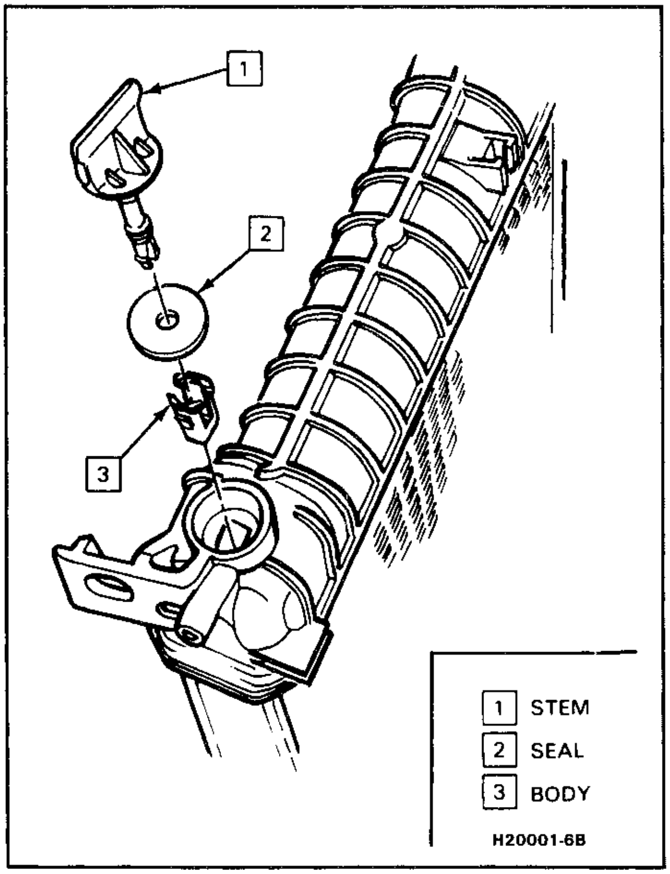


Figure 9 Aluminum Radiator Drain Cock

- Do not remove the radiator cap or coolant recovery tank cap if the coolant in the recovery tank looks like it is boiling.
- Wear eye protection.
- Wear gloves to protect your hands against excessive heat, or the effects of chemicals on your skin.
- Prevent dirt and water from entering the transmission oil cooler.
- Do not use boil-out tanks, or vats, or other tanks that have been used for copper and brass radiators. The flux, acid, and caustic cleaners remaining in these tanks will attack the aluminum and cause radiator failure. A separate test tank containing clean water is strongly recommended for servicing aluminum-plastic radiators.

  NOTICE: Never use shop air that is not regulated at 20 psi (138 kPa) to pressure test radiator. Pressures over 20 psi (138 kPa) will damage the radiator.

DIAGNOSIS

LEAK TESTING

Some core leaks can be detected by merely adding water to the radiator. It is helpful to clean the core so that the damaged area can be more easily found.

1. Remove dirt and insects from the fins with a common water hose without a nozzle. Excessive water pressure could damage the fins.
2. Scrub the core with a soft-bristle brush using clean, hot water, or hot water with a mild detergent solution.

On-Vehicle Pressure Testing

You can pressure-test the aluminum-plastic radiator with a common pump and gage, such as BT-7002-3 or J 24460-01 with J 23699 (Figure 10). With the system at a cool temperature, remove the radiator cap, connect the gage, and apply normal system operating pressure. Do not exceed 20 psi (138 kPa). Watch the gage needle for an indication of a leak, and examine the radiator and other cooling system parts for signs of escaping coolant.

Repair all hose and hose connections as required. Also check radiator cap to ensure that it will maintain the correct pressure.

If the radiator is found to be leaking during the pressure test, mark the leak area so that it is easily found once the radiator has been removed from the vehicle.

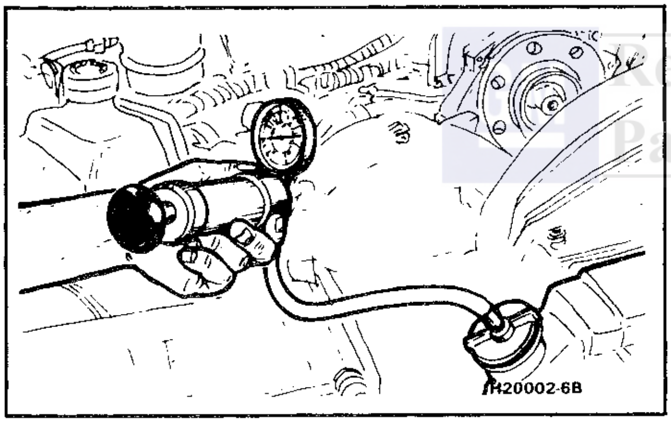


Figure 10 Pressure Testing Radiator

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 (Figure 11).
2. Attach pressure tester and gradually apply air pressure until 20 psi (138 kPa) is attained. Do not exceed 20 psi (138 kPa). Check pressure gage to see if there is a pressure loss. To ensure that there are no small leaks, run water over the repair area and look for bubbles. (A mild detergent is very helpful.)

If a large water tank is available, the radiator can be submerged, and a check for air bubbles can be made.

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.

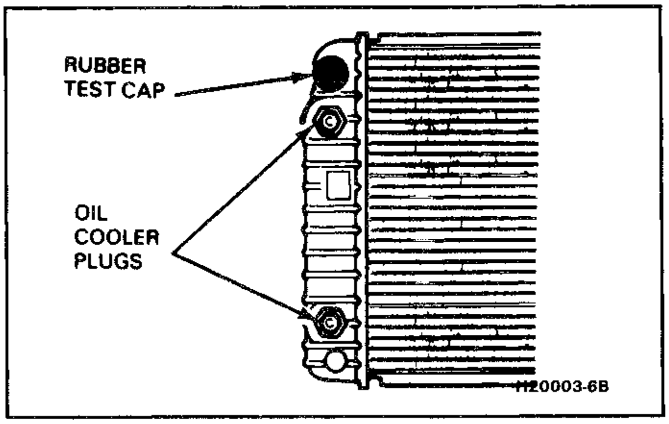


Figure 11 Aluminum Radiator and Oil Cooler Plugs

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.

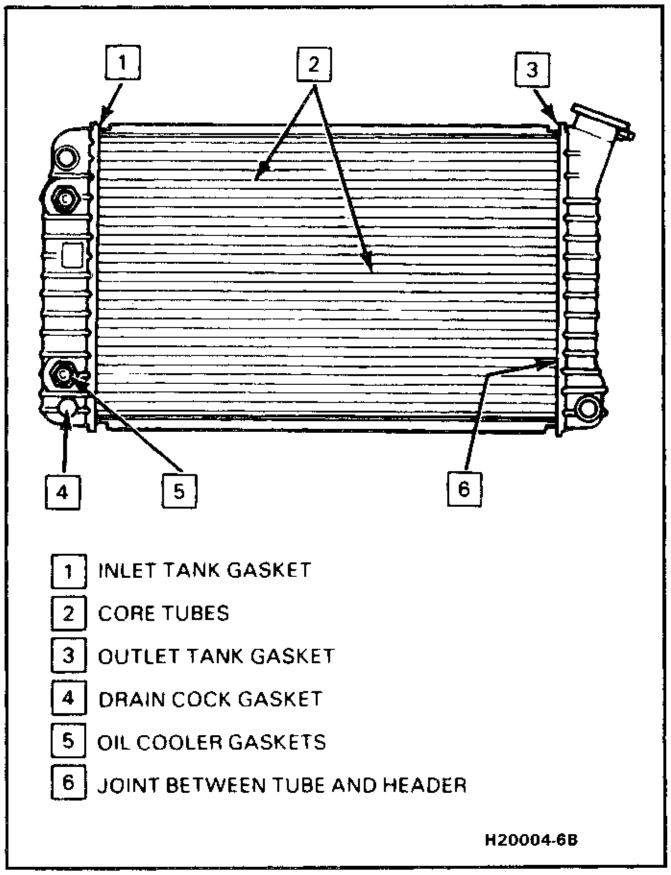


Figure 12 Possible Leak Areas

REPAIR METHODS

There are several methods that can be used to repair the radiator core, but the hot melt adhesive method has been found to be the most simple and effective.

The kit contains adhesive sticks, cotton swabs, wire brush and primer. The adhesive stick is reusable, has an indefinite shelf life, and is waste-free. The sticks must be stored in a sealed container to keep them dry (Figure 13).

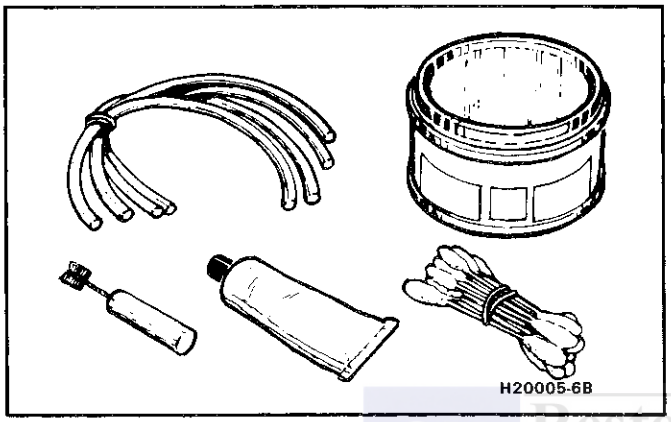


Figure 13 Hot Melt Adhesive Repair Kit

SPECIAL PREPARATION

Cooling Fin Removal

For damaged areas that are between the cooling fins, it may be necessary to remove some of the fins. Do not remove more fins than necessary. Usually 6mm (1/4″) beyond the leak or damage area is enough to make an effective repair. (Figure 14)

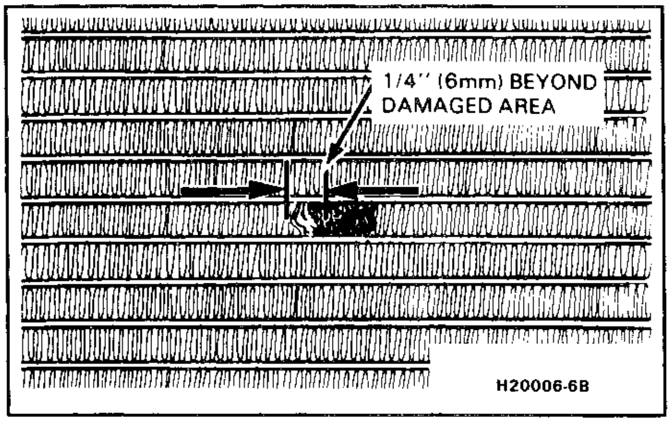


Figure 14 Fins Removed from Damaged Area

TUBE BLOCKING

If a tube is severely damaged, it can be blocked off. (Figure 15)

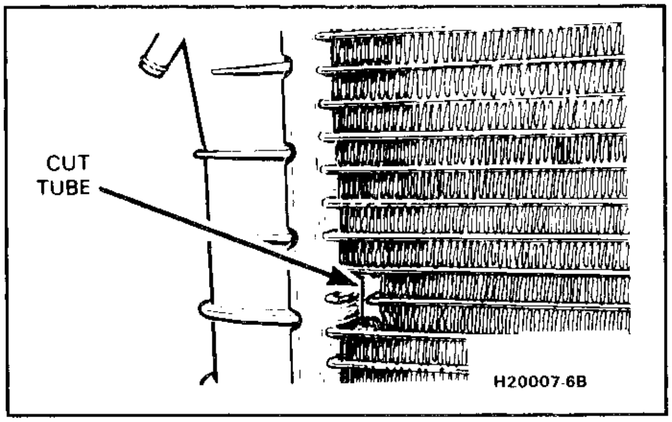


Figure 15 Tube Blocking

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.)

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 (Figure 16). The side tank can also be submerged in a tank of water up to the header (Figure 17).

NOTICE: One of these procedures has to be used when repairs are made on or near the header, to prevent damage to the tank or gasket.

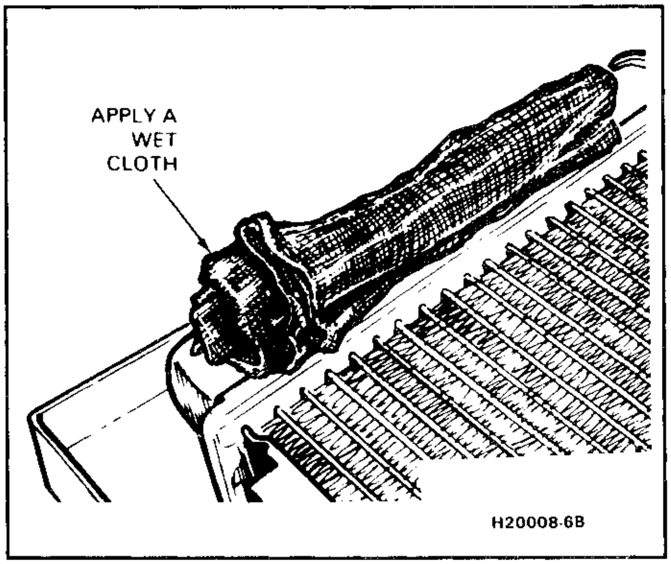


Figure 16 Using Wet Cloth on Side Tank

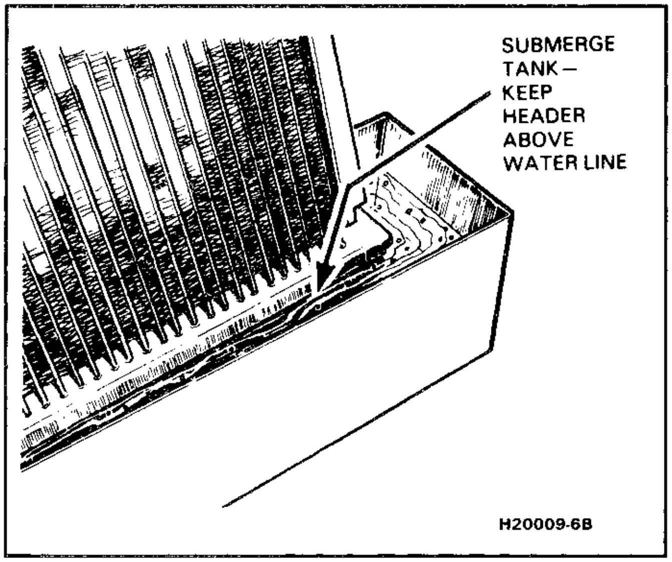


Figure 17 Submerging Side Tank

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 (Figure 16); or submerge the tank in water (Figure 17).
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 Figure 18)
5. Open the tube of primer, using the spurred cap or a pin, and apply primer to the repair area only. Use of the primer produces a stronger repair. **Do not heat the primer.**

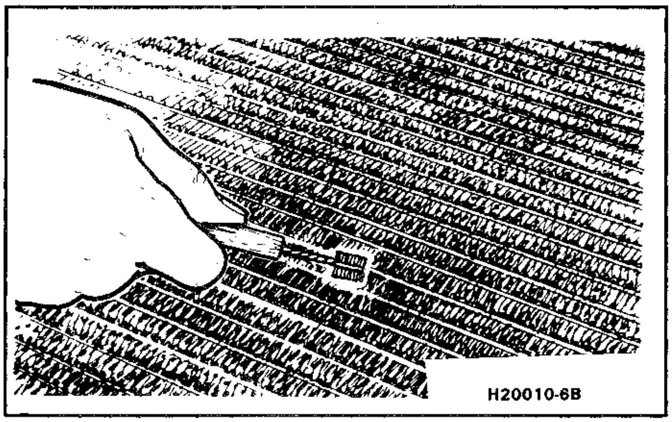


Figure 18 Cleaning Area With Steel Brush

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 (Figure 19).

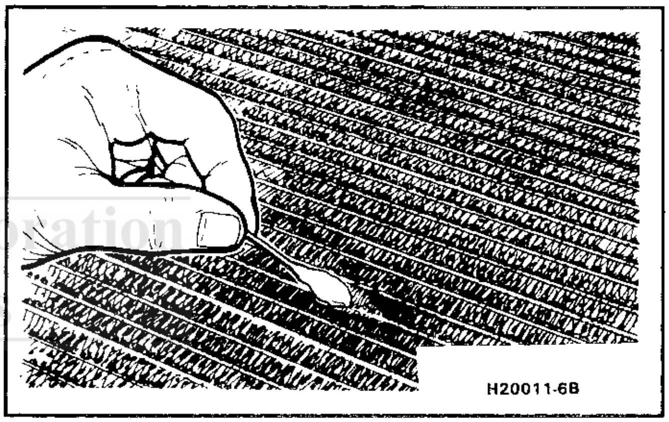


Figure 19 Scrubbing Area with Primer

7. Heat the repair area with the heat gun or by moving the torch in a circular pattern (Figure 20). Use a soft, small blue flame (like a gas stove flame).

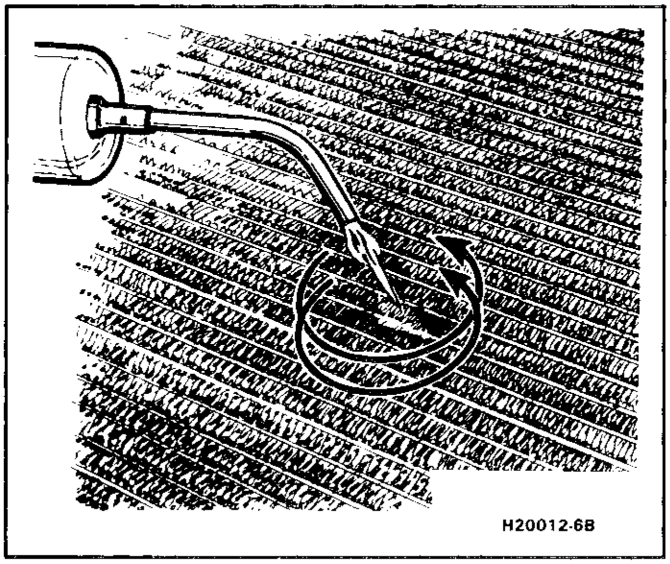


Figure 20 Heating the Repair Area

8. Withdraw the torch and rub the adhesive stick on the repair area (Figure 21). The adhesive will flow at a temperature of approximately 500°F (260°C). If the stick doesn't start to melt, remove it and reapply the heat. **Do not heat the stick directly with a flame. High heat will burn and char the adhesive.**

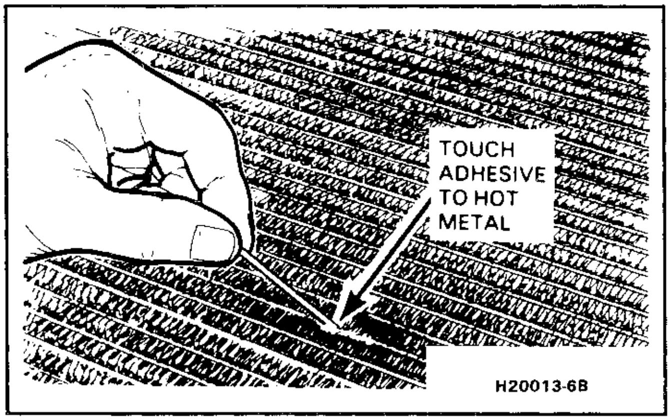


Figure 21 Applying Hot Melt Adhesive

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 locking-type pliers (Figure 22). If this method doesn't seal the leak, remove the tank for further inspection.

1. Pry open the clinch tabs, except those under inlet, outlet, and filler necks, using J 33419-1 or a screwdriver (Figure 23). Lift the tabs only enough to allow removal.

NOTICE: Care should be taken not to overbend tabs. Overbending could result in breakage. If there are more than 3 tabs broken on one side of the header, or more than 2 adjacent tabs together, the core must be replaced.

2. Lift the tank and slide it out from under the remaining clinched tab. You may have to tap the tank with your hand to dislodge the gasket. Lift the remaining tab(s) with pliers.

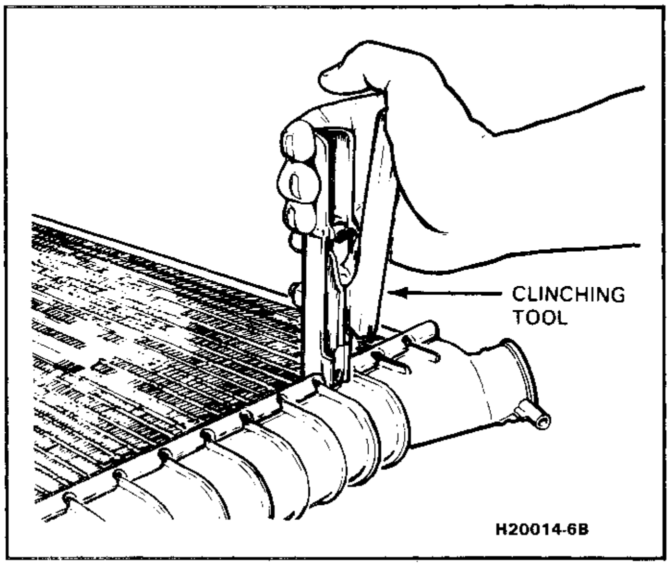


Figure 22 Tightening Clinch Tabs

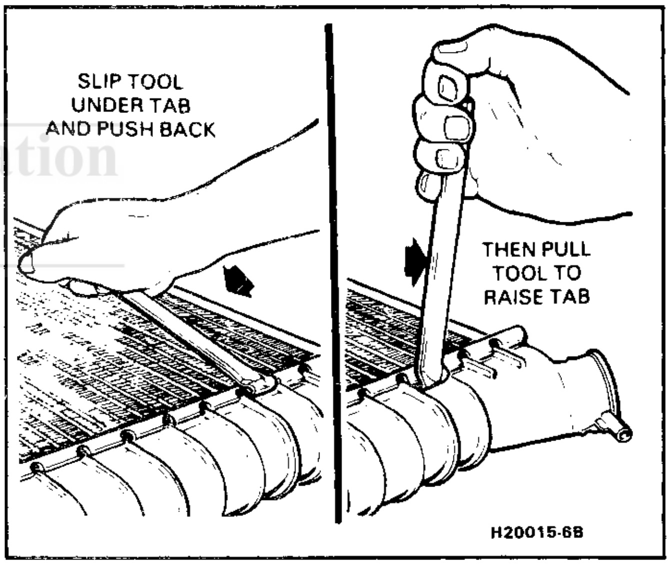


Figure 23 Opening Clinch Tabs

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 Figure 24.

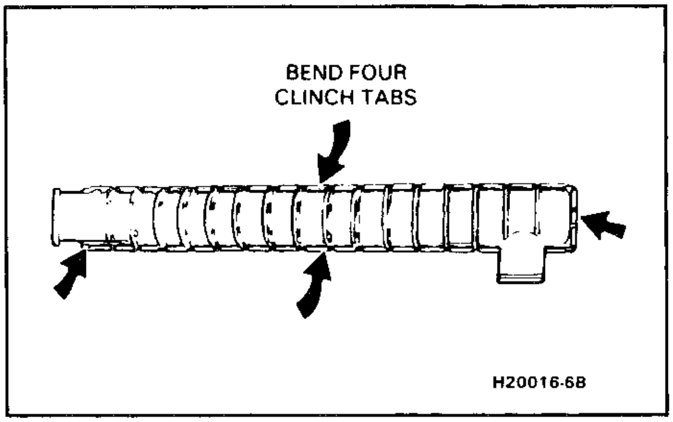


Figure 24 Seating Tank to Core

10. Clamp remaining clinch tabs around the header using the clinching tool or pliers (Figure 25).

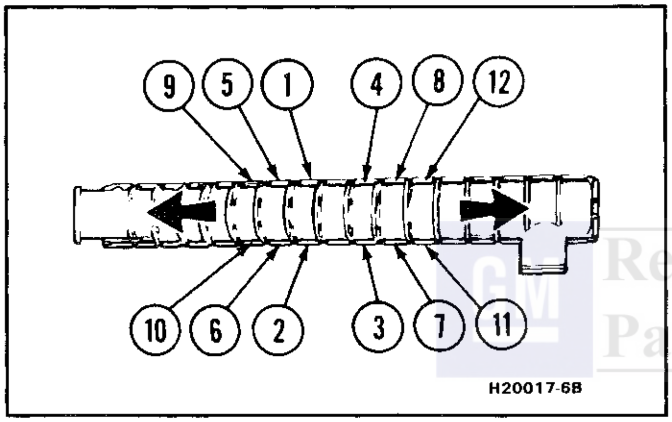


Figure 25 Clinching Sequence

NOTICE: Tighten the clinch tabs as you would cylinder head bolts, starting at the center and working out to the ends.

11. Replace the core if there are more than three tabs broken on one side or two adjacent tabs broken.
12. Install the drain cock, if removed.
13. Test the radiator for leaks.

OIL COOLER GASKET REPLACEMENT

The outlet tank must be removed to replace the oil cooler, but the oil cooler gaskets can be replaced without removing the tank.

1. Remove the radiator and lay it on a flat surface.
2. Remove the bottom oil cooler nut and loosen the top nut.
3. Press the oil cooler into the hole and remove the gasket using a small hook (Figure 26).
4. Blow-dry all surfaces on the tank and oil cooler.
5. Install a new gasket **without lubrication.** Be sure it is seated properly inside the lip of the fitting.
6. Reach into the inlet or outlet opening and push the oil cooler into position against the tank.

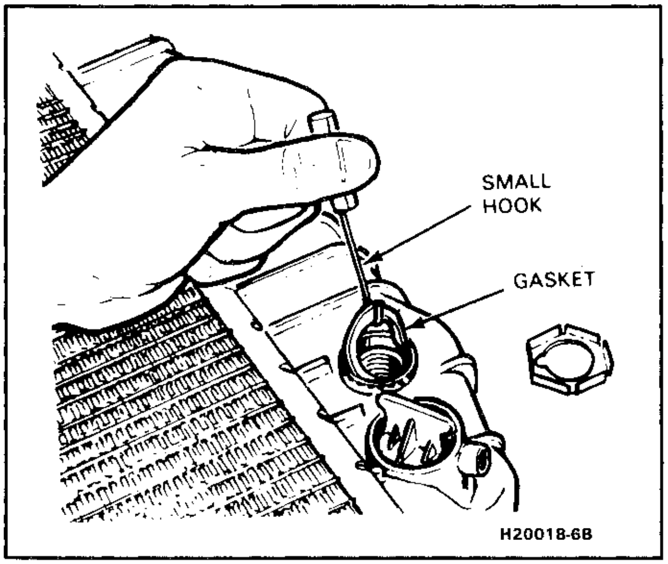


Figure 26 Removing Oil Cooler Gasket

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 (Figure 9).

SPECIAL TOOLS

Special tools are available through normal channels for servicing the aluminum-plastic radiator. The universal Cooling System and Cap Pressure Tester, BT-7518 or J 24460-01, can also be used with the aluminum-plastic radiator.

ON-VEHICLE SERVICE

THERMOSTAT (2.5L AND 2.8L)

Remove or Disconnect

1. Thermostat housing cap.
2. Grasp the handle of thermostat and gently pull upward.
   - 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.

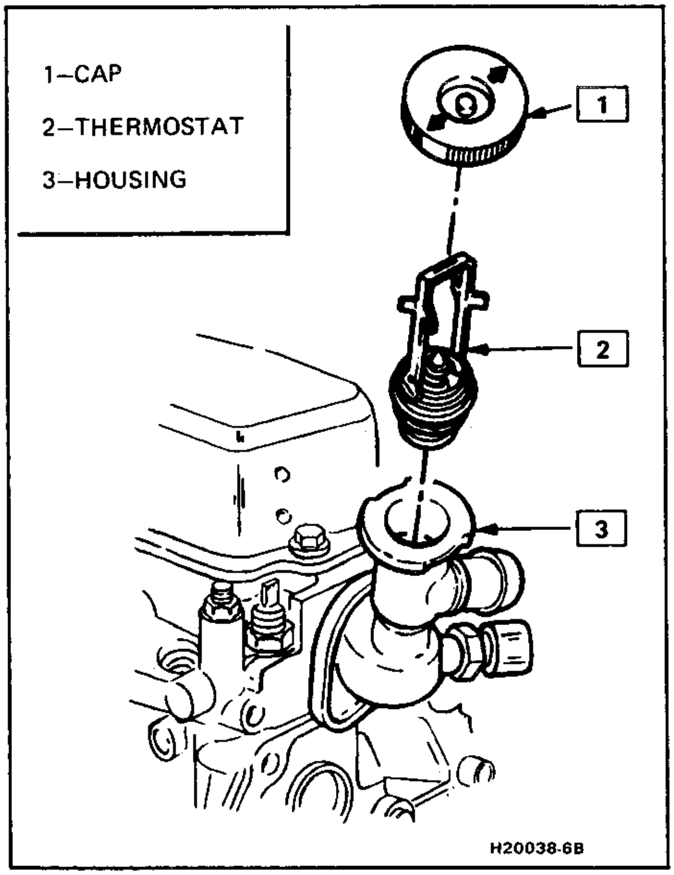


Figure 27 Thermostat Housing and Outlet — 2.5L

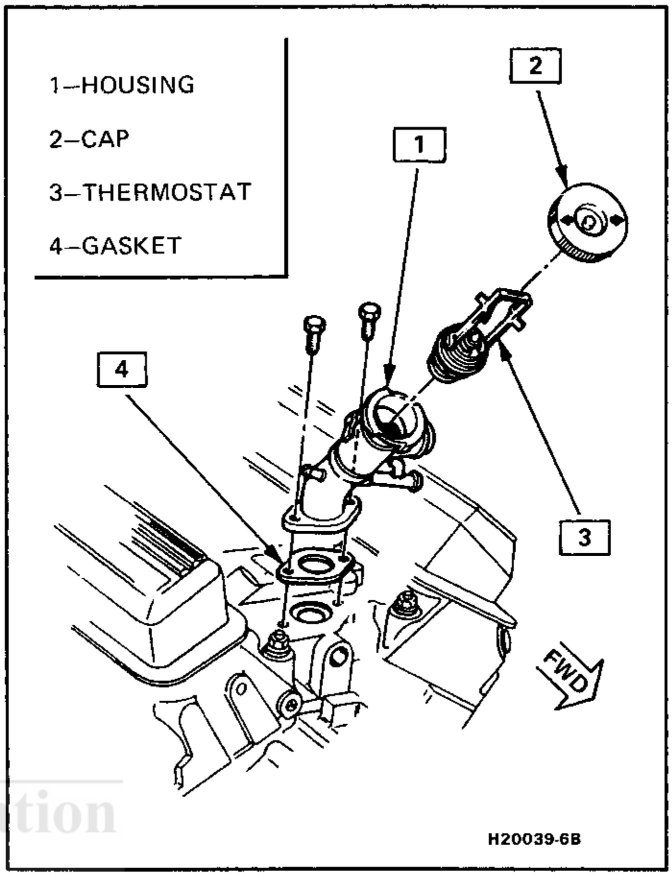


Figure 28 Thermostat Housing and Outlet — 2.8L

ELECTRIC COOLING FAN

CAUTION: Keep hands, tools, and clothing away from engine cooling fan to help prevent personal injury. This fan is electric and can come on whether or not the engine is running. The fan can start automatically in response to a heat sensor with the ignition in the "On" position.

Remove or Disconnect

1. Negative battery cable.
2. Harness from fan motor and fan frame.
3. Fan frame to radiator support attaching bolts.
4. Fan and frame assembly.

Install or Connect

1. Fan and frame assembly.
2. Fan frame to radiator support attaching bolts and torque to 6 N•m (54 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.

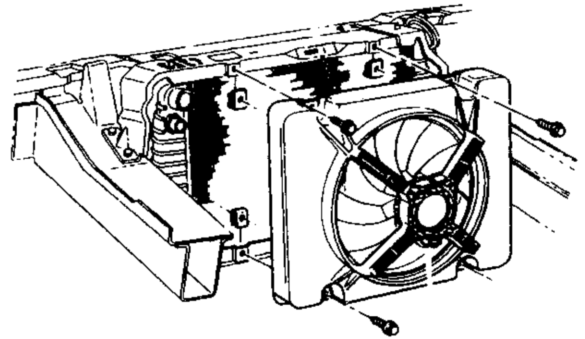
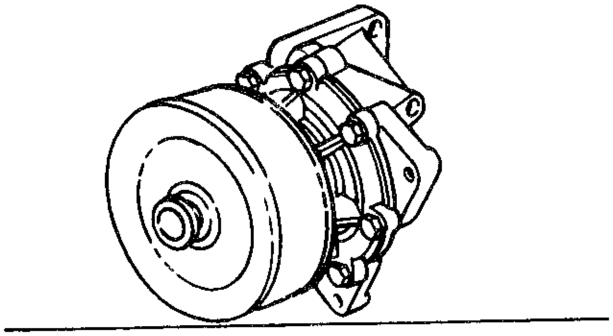


Figure 29 Electric Fan Mounting



REMOVE PULLEY WITH J25034-B
OR J29785-A
INSTALL PULLEY WITH J25033-B

Figure 30 Removing and Installing Water Pump Pulley — 2.5L

WATER PUMP — 2.5L

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. Serpentine drive belt.
4. Water pump front cover assembly attaching bolts.
5. Water pump front cover assembly.

Disassemble

- Pulley from old water pump front cover assembly using J25034-B or J29785-A.

Clean

- Water pump mating surfaces.

Assemble

- Pulley to new water pump front cover assembly using J25033-B.

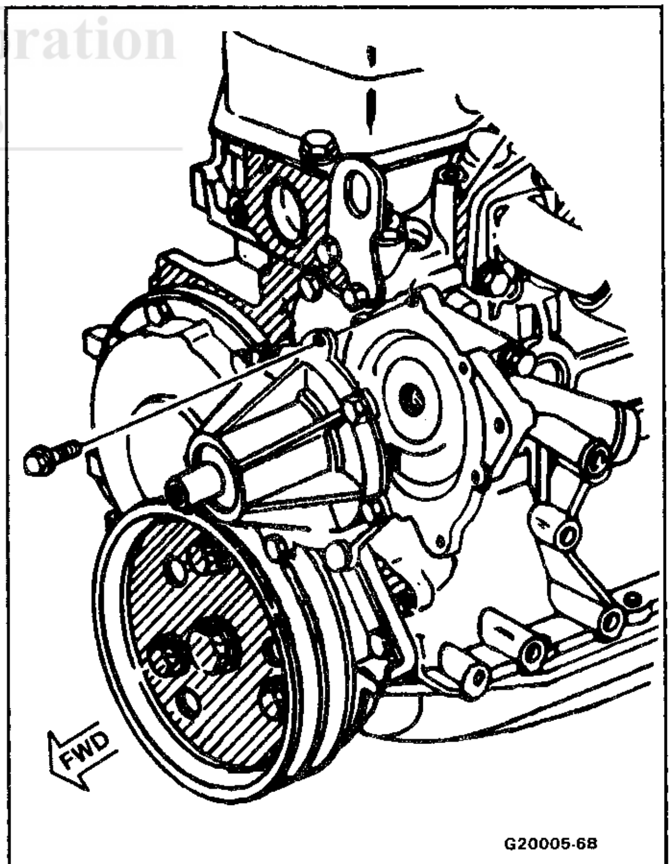


Figure 31 Water Pump Front Cover Assembly Mounting — 2.5L

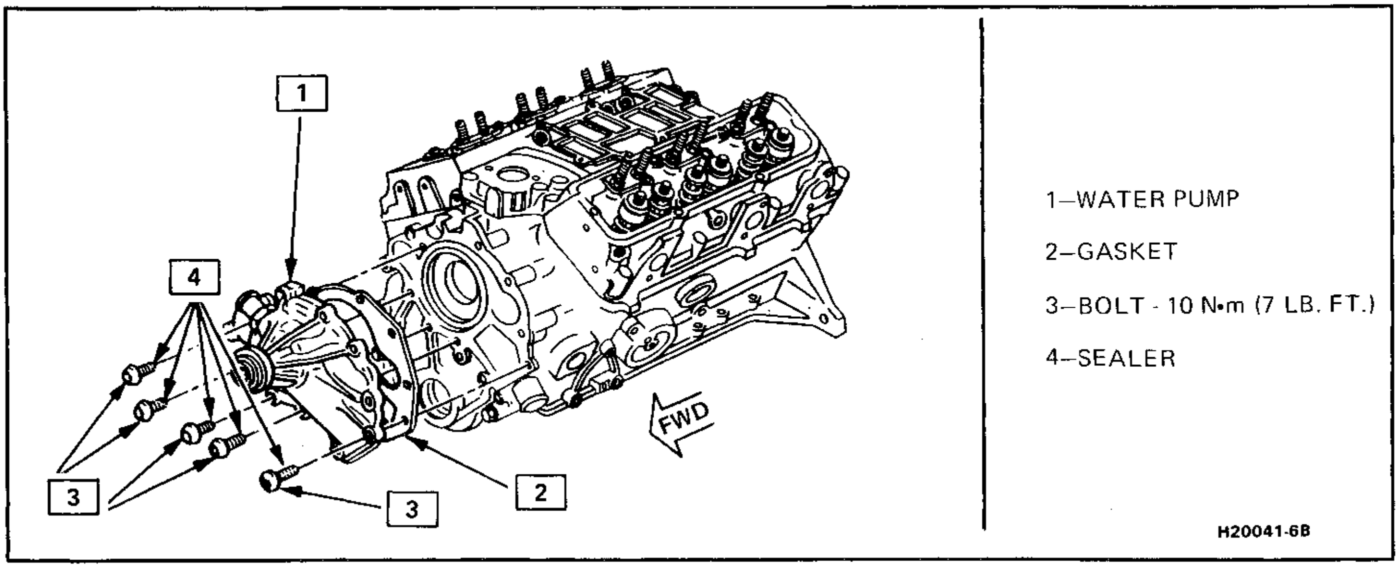


Figure 32 Water Pump — 2.8L

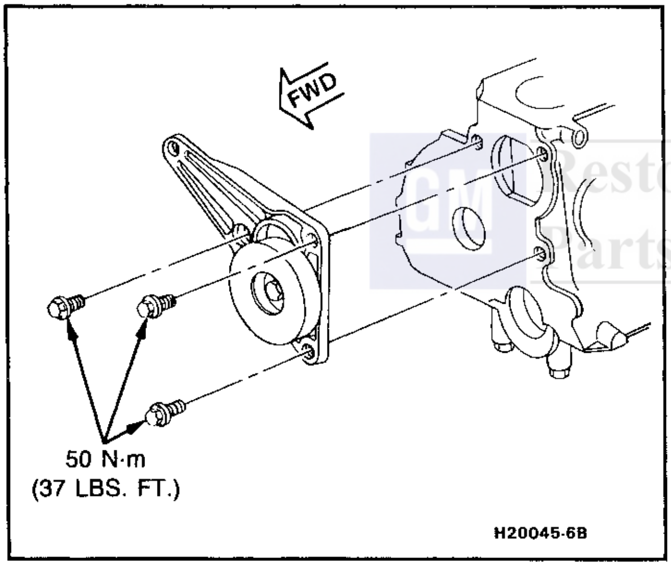


Figure 33 Tensioner — 2.5L

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. Serpentine belt.
5. Engine coolant.
6. Negative battery cable.

WATER PUMP — 2.8L

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.
5. Engine coolant.
6. Negative battery cable.

COOLANT RECOVERY BOTTLE

Remove or Disconnect

1. Hose from recovery bottle.
2. Attaching screws and remove bottle.

Clean

- Recovery bottle with suitable solution.

Install or Connect

1. Place bottle in vehicle and torque attaching screws to 3 N•m (27 lb. in.).
2. Coolant hose to bottle.
3. Fill bottle to appropriate mark.

RADIATOR

Remove or Disconnect

1. Negative battery cable.
2. Engine coolant.
3. 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.

COOLANT PIPES

Remove or Disconnect

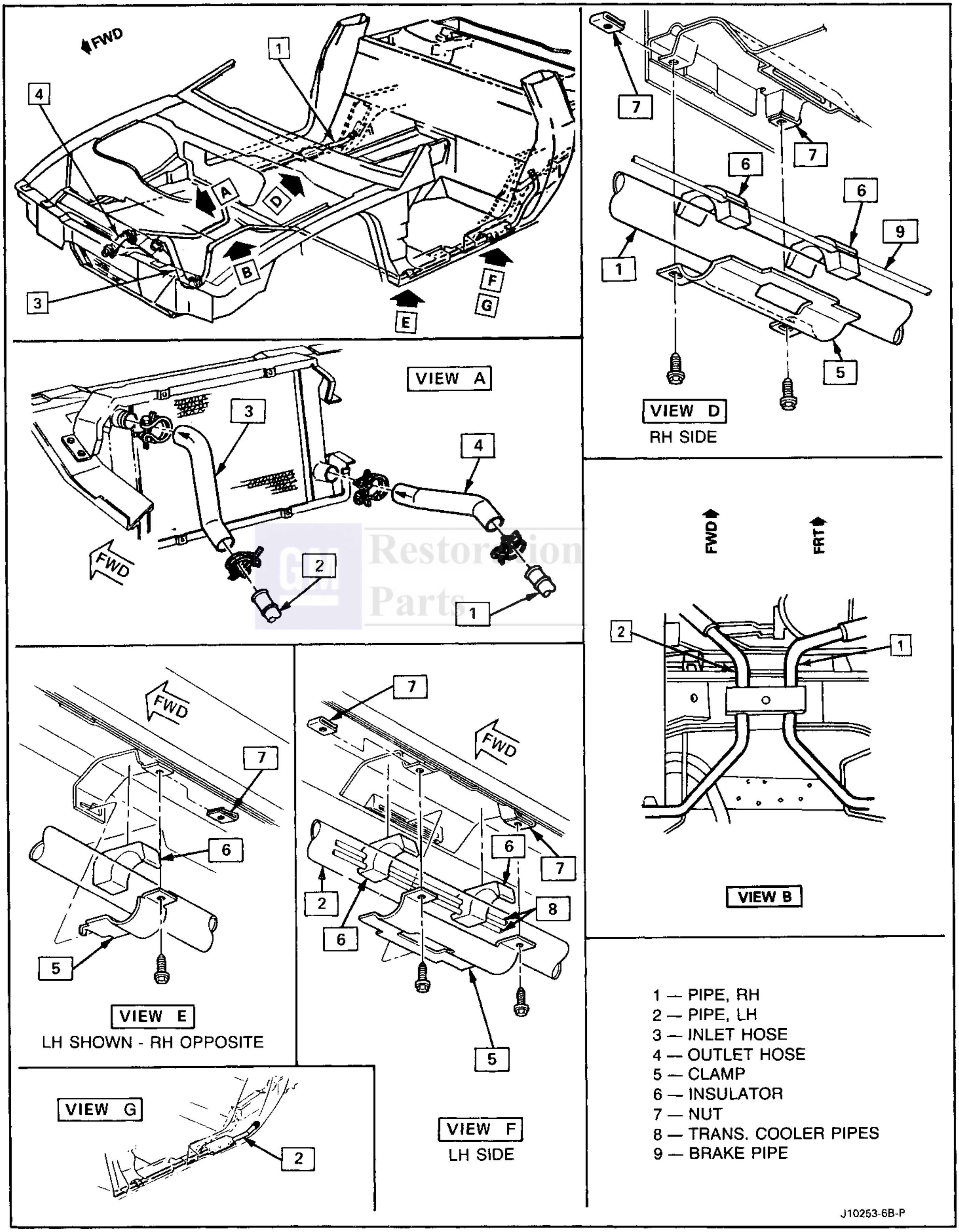
1. Raise car.
2. Drain coolant.
3. Inlet or outlet hose from front of pipe.
4. Inlet or outlet hose from rear of pipe.
5. Bolt from pipe bracket to front crossmember.
6. Front and rear pipe clamps.
7. Front tire.
8. Jack stands at front and lower front hoist post.
9. Coolant pipe.

Install or Connect

1. Coolant pipe.
2. Bolt pipe bracket to front crossmember.
3. Raise front hoist post and remove jack stands.
4. Front and rear pipe clamps.
5. Inlet or outlet hose to front of pipe.
6. Inlet or outlet hose to rear of pipe.
7. Front tire.
8. Lower car.
9. Add coolant.

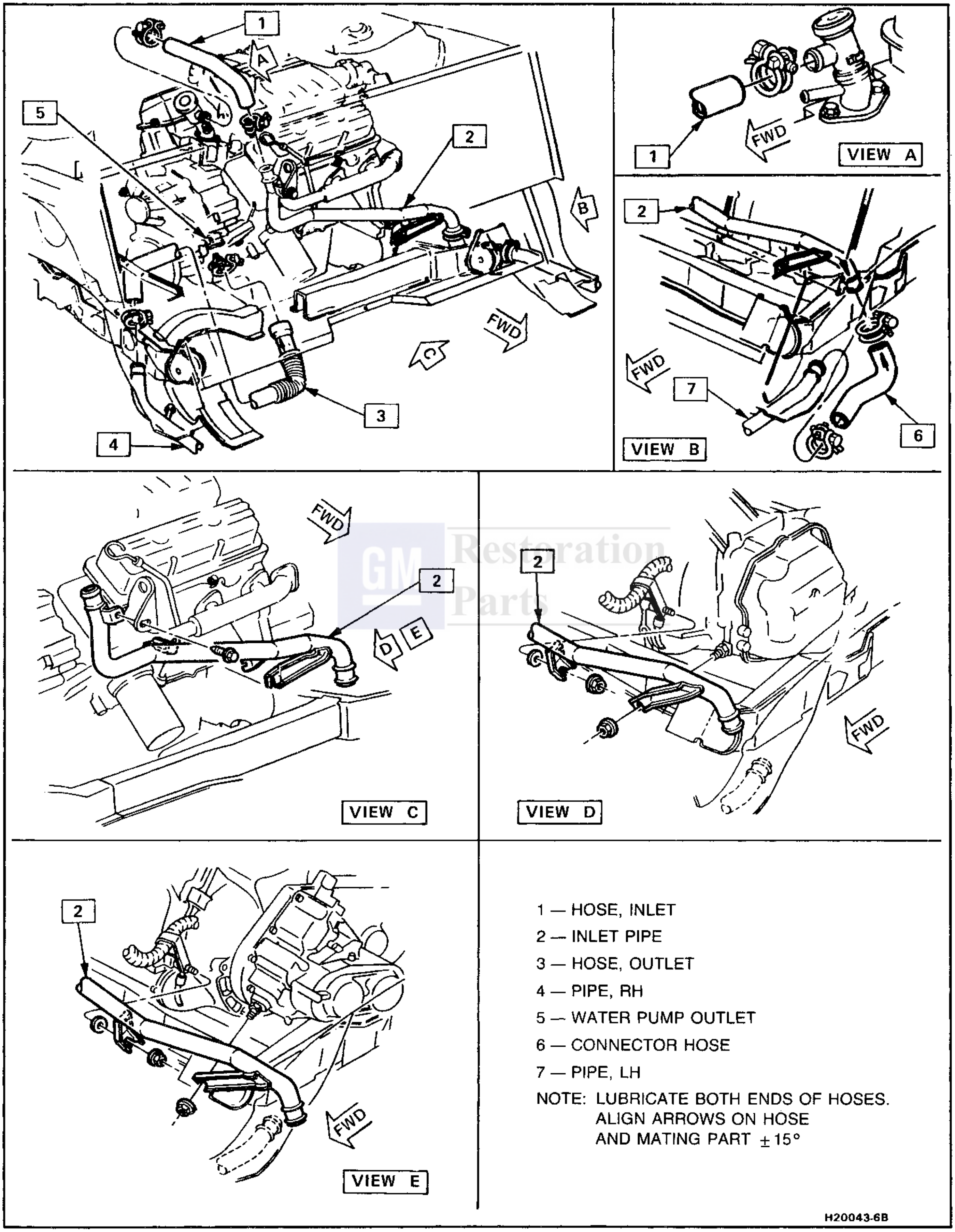
Inspect

- For proper completion of repair.
- For leaks.
- For entrapped air.



1 — PIPE, RH
2 — PIPE, LH
3 — INLET HOSE
4 — OUTLET HOSE
5 — CLAMP
6 — INSULATOR
7 — NUT
8 — TRANS. COOLER PIPES
9 — BRAKE PIPE

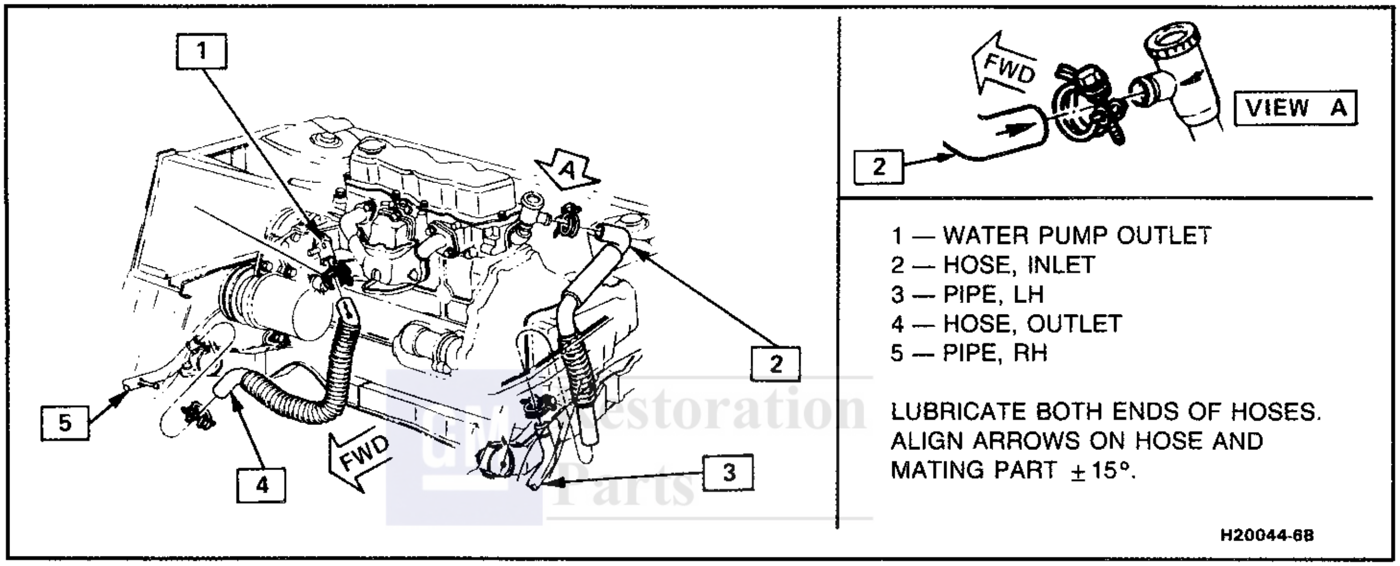
Figure 34 Cooling Pipe Routing



1 — HOSE, INLET
2 — INLET PIPE
3 — HOSE, OUTLET
4 — PIPE, RH
5 — WATER PUMP OUTLET
6 — CONNECTOR HOSE
7 — PIPE, LH

NOTE: LUBRICATE BOTH ENDS OF HOSES. ALIGN ARROWS ON HOSE AND MATING PART ±15°

Figure 35 Rear Radiator Hoses — V6



1 — WATER PUMP OUTLET
2 — HOSE, INLET
3 — PIPE, LH
4 — HOSE, OUTLET
5 — PIPE, RH

LUBRICATE BOTH ENDS OF HOSES. ALIGN ARROWS ON HOSE AND MATING PART ±15°.

H20044-6B

Figure 36 Rear Radiator Hoses — L4

BELT	GEN./A/C	P/S	A.I.R. PUMP
New	650 N/145 lb.	600 N/135 lb.	450 N/100 lb.
Used*	300 N/70 lb.	300 N/70 lb.	200 N/50 lb.
*Previously run			

J10252-6B-P

Figure 37 Belt Tension (2.8L)

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

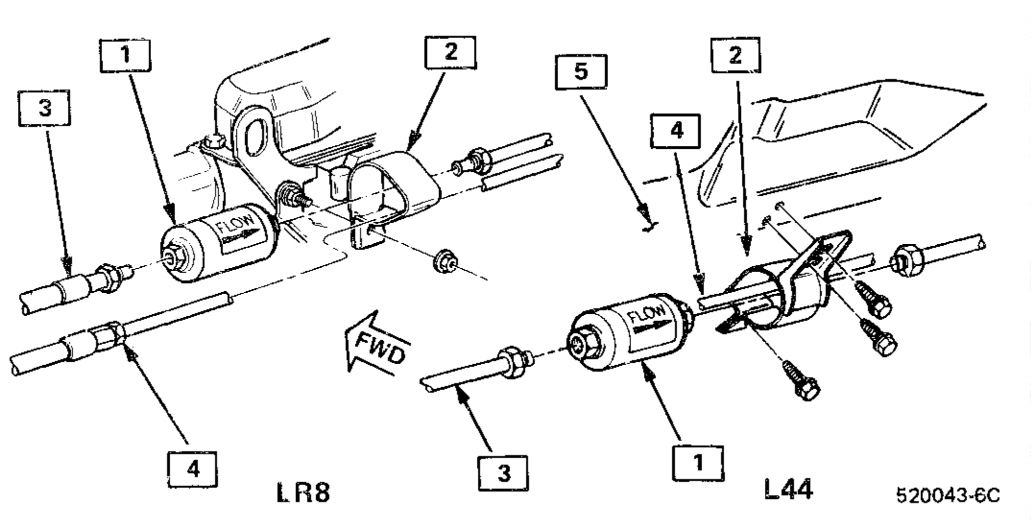


Fig. 1 Fuel Filter

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

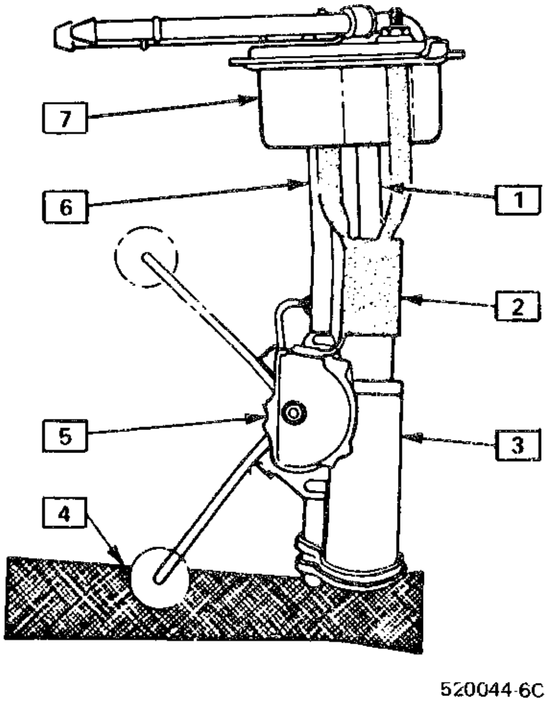
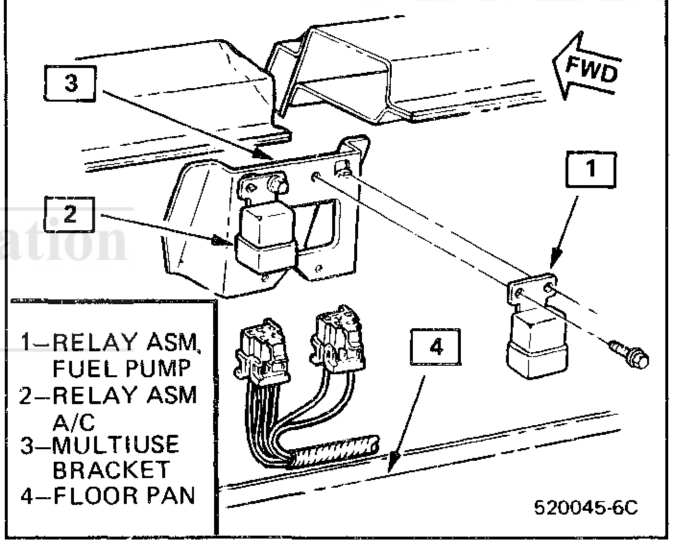


Fig. 2 Electric Fuel Pump & Sending Unit-Typical



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

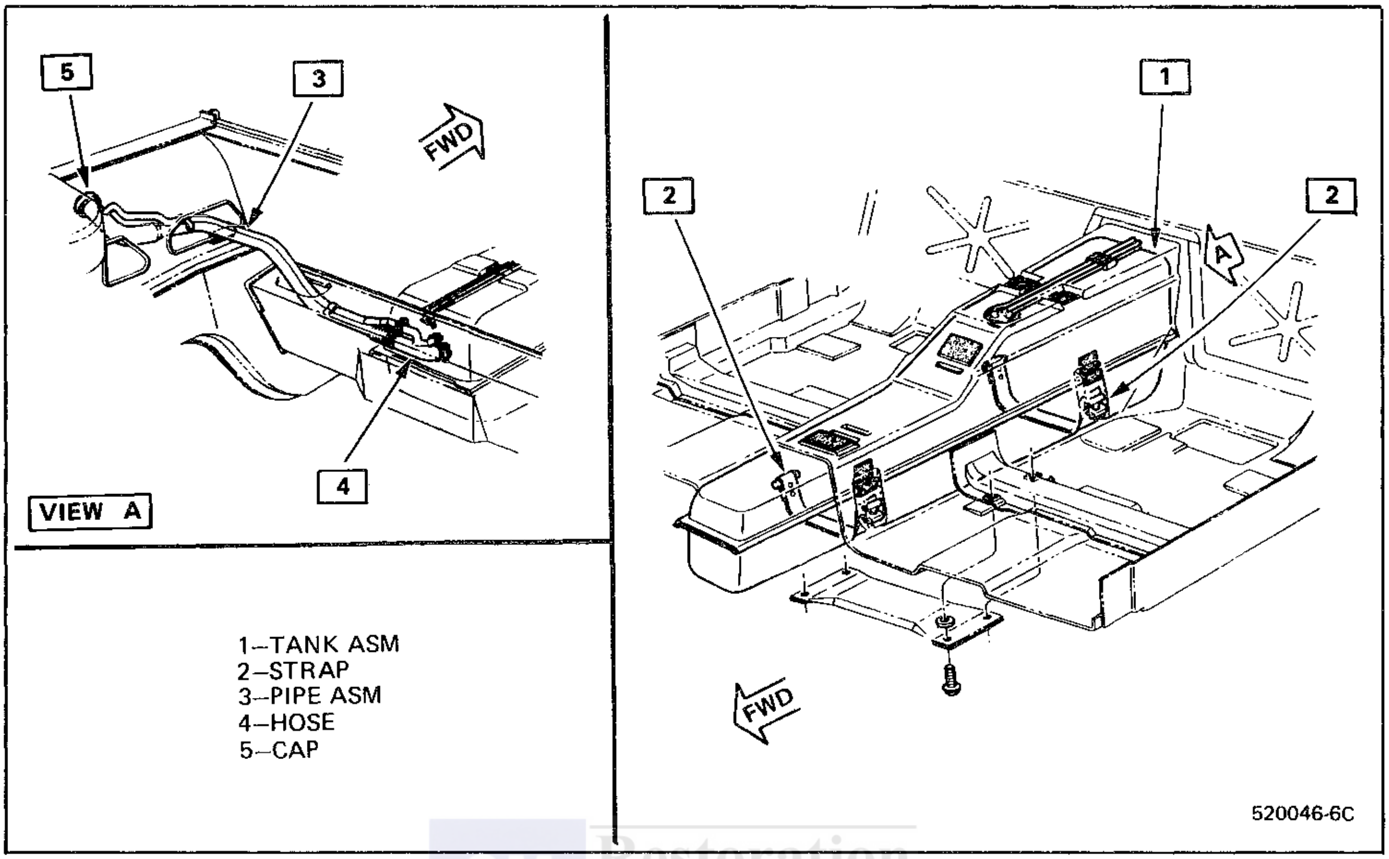


Fig. 4 Fuel Tank

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:

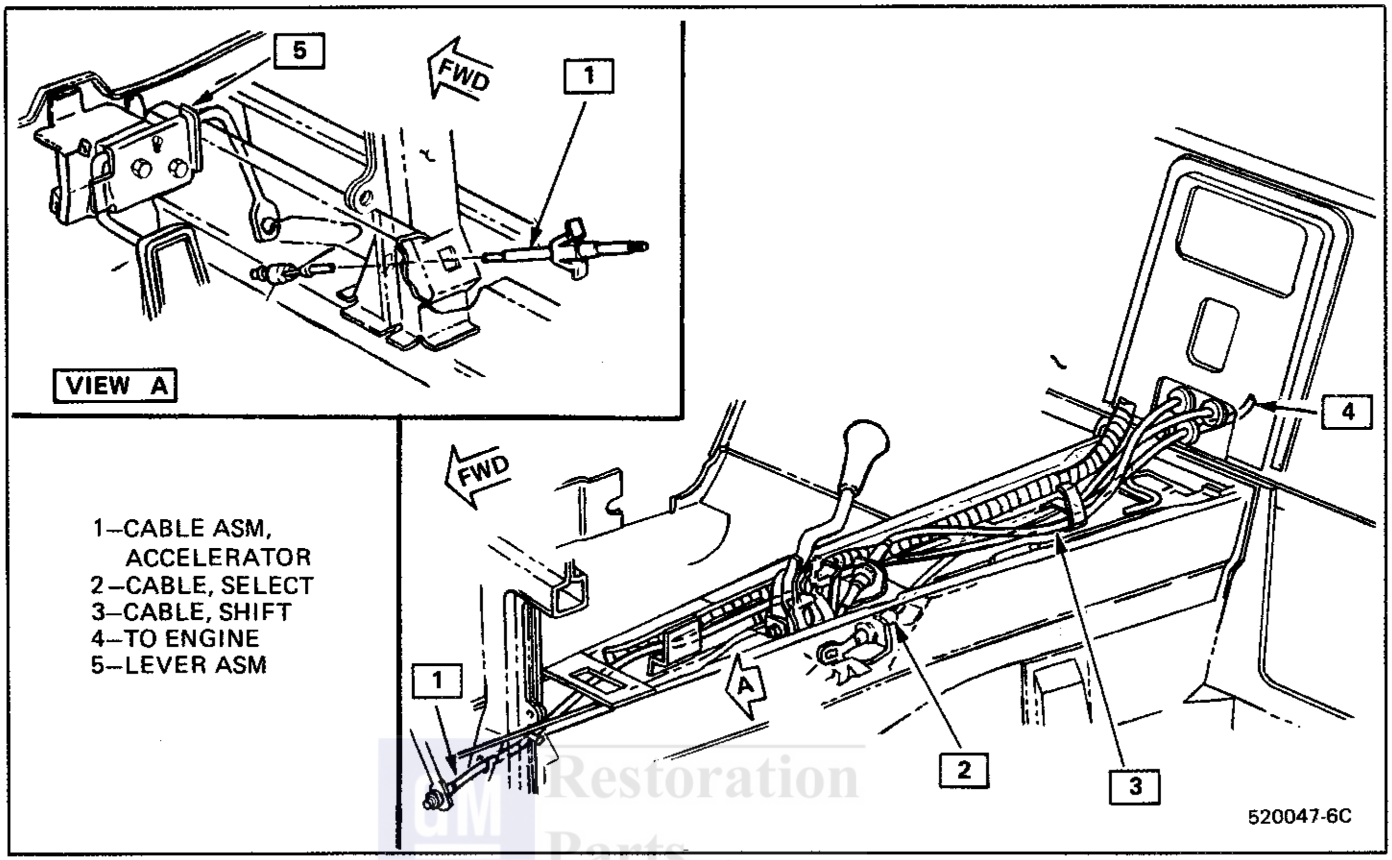
- The mounting surface between support and dash panel must be free of insulation. The carpet and jute in pedal and tunnel area must be positioned to lay flat and be free of wrinkles and bunches.
- Slip accelerator control cable through slot in rod and then install retainer in rod, being sure it is seated. 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.

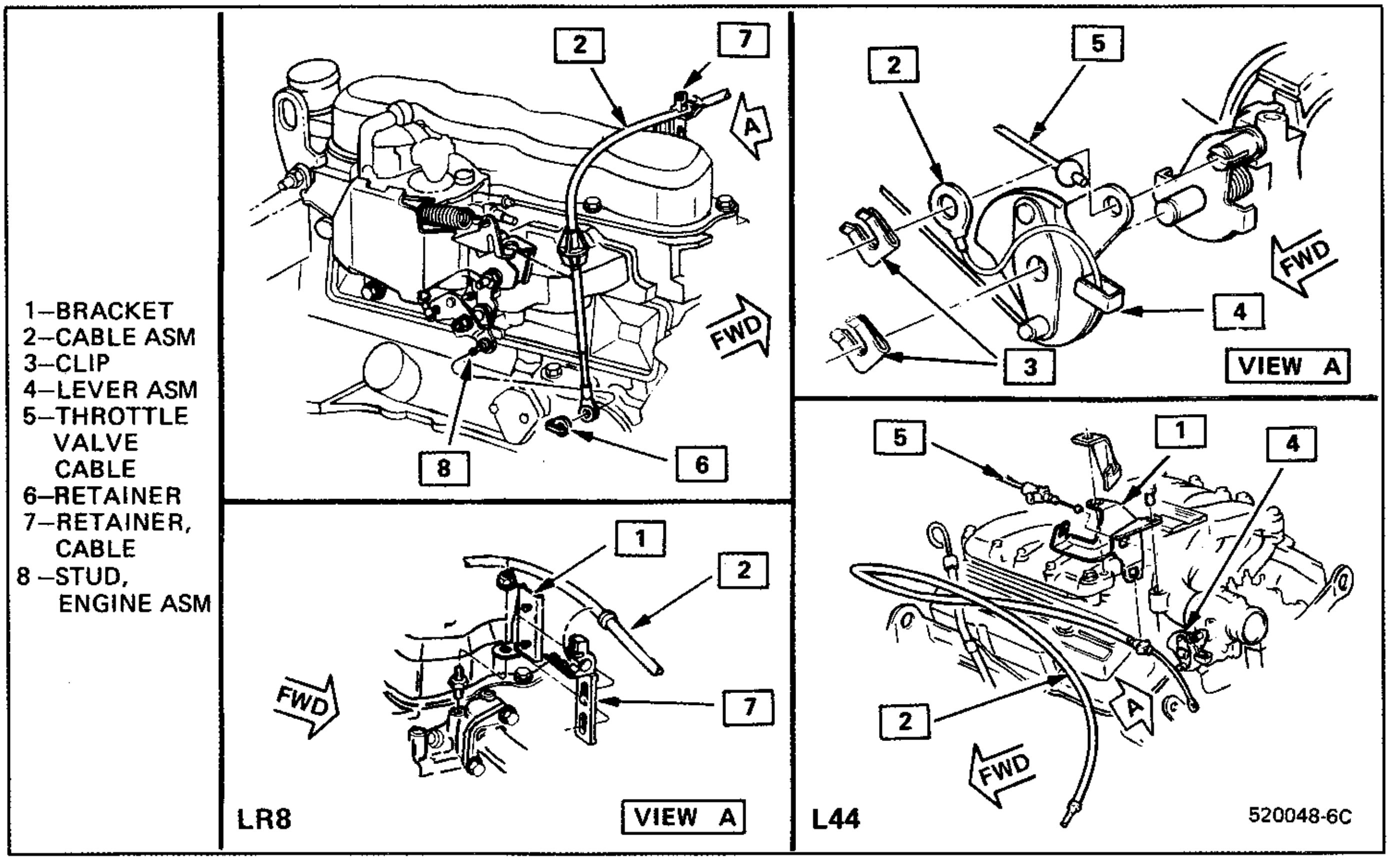
The amount of vapor drawn into the engine at any time is too small to have any effect on fuel economy or engine operation.

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:



1–CABLE ASM, ACCELERATOR
2–CABLE, SELECT
3–CABLE, SHIFT
4–TO ENGINE
5–LEVER ASM

Fig. 5 Accelerator Cable Routing



1–BRACKET
2–CABLE ASM
3–CLIP
4–LEVER ASM
5–THROTTLE VALVE CABLE
6–RETAINER
7–RETAINER, CABLE
8–STUD, ENGINE ASM

Fig. 6 Accelerator Cable to Engine

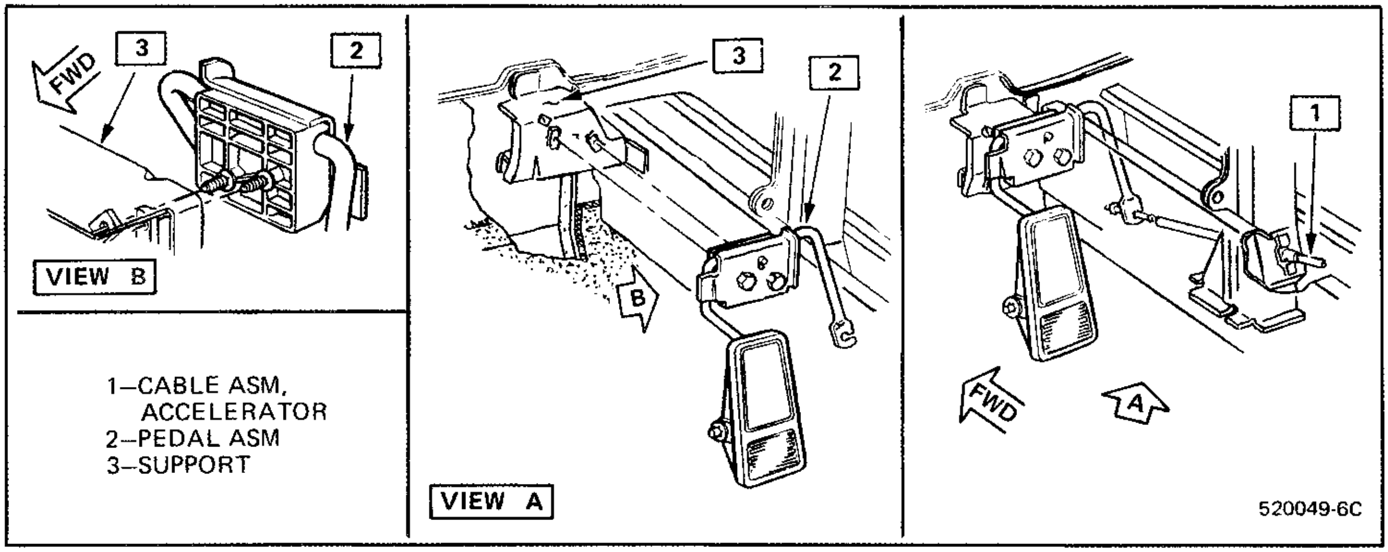


Fig. 7 Accelerator Pedal Assembly

- 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

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 is standard on all cars.

The battery has three major functions in the electrical system: First, it provides a source of energy for cranking the engine; Second, it acts as a voltage stabilizer for the electrical system; And third, it can, for a limited time, provide energy when the electrical load used exceeds the output of the generator.

CHARGING SYSTEM-CS

The CS Charging System has several sizes available, including the CS-130 and CS-144. The number (130 or 144) denotes the OD in mm of the stator laminations.

CS generators use a new type regulator and a diode trio is not used. A delta stator, rectifier bridge, and rotor with slip rings and brushes are electrically similar to earlier generators. A conventional pulley and fan is used and, on the CS-130, an internal fan cools the slip ring end frame, rectifier bridge and regulator.

IGNITION SYSTEM

Distributor Ignition

The ignition circuit consists of the battery, distributor, ignition switch, spark plugs and primary and secondary wiring. Refer to the Battery Section (6D1) for battery information.

Distributor

The High Energy Ignition (HEI) distributor with Electronic Spark Timing (EST), used on most engines, combines all ignition components in one unit. The ignition coil is in the distributor cap and connects through a resistance brush to the rotor. Another type of HEI/EST ignition system, used on some engines, has a separately mounted coil.

IGNITION SYSTEM

Distributorless Ignition

Distributorless ignition systems use a "waste spark" method of spark distribution. Each cylinder is paired with its opposing cylinder in the firing order, so that one cylinder on compression fires simultaneously with its opposing cylinder on exhaust. Since the cylinder on exhaust requires very little of the available voltage to fire its plug, most of the voltage is used to fire the cylinder on compression. The process reverses when the cylinders reverse roles. There are two coils for a 4-cylinder engine (Direct Ignition System - DIS) and three coils for a 6-cylinder engine (C^3I).

Ignition Timing

Timing specifications for each engine are listed in Section 6E. When using a timing light, connect an adapter between the No. 1 spark plug and the No. 1 spark plug wire, or use an inductive type

Secondary Wiring

The spark plug wiring used with ignition systems is a carbon impregnated cord conductor, encased in an 8MM (5/16") diameter silicone rubber jacket. The silicone jacket withstands very high temperatures and also provides an excellent insulator for the higher voltage of the system.

Spark Plugs

Resistor type, tapered seat spark plugs are used on all engines, except those with aluminum heads.

Ignition Switch

The mechanical switch is located in the steering column on the right hand side just below the steering wheel.

CRANKING SYSTEM

The cranking circuit consists of the battery, starting motor, ignition switch, and related electrical wiring.

Starter Motor

Wound field starter motors have pole pieces, arranged around the armature, that are energized by wound field coils.

Solenoid

Enclosed shift lever cranking motors have the shift lever mechanism and the solenoid plunger enclosed in the drive housing, protecting them from exposure to dirt, icing conditions and splash.

GENERAL ELECTRICAL SYSTEM DIAGNOSIS

Diagnosis and repair procedures for engine electrical subsystems are located in the following subsections:

6D1 - Battery
6D2 - Cranking System
6D3 - Charging System
6D4 - Ignition System
6D5 - Engine Wiring

Where a "driveability" complaint exists, or an ECM code is set, go to Section 6E. Wiring diagrams, component locations and system checks are located in Section 8A.

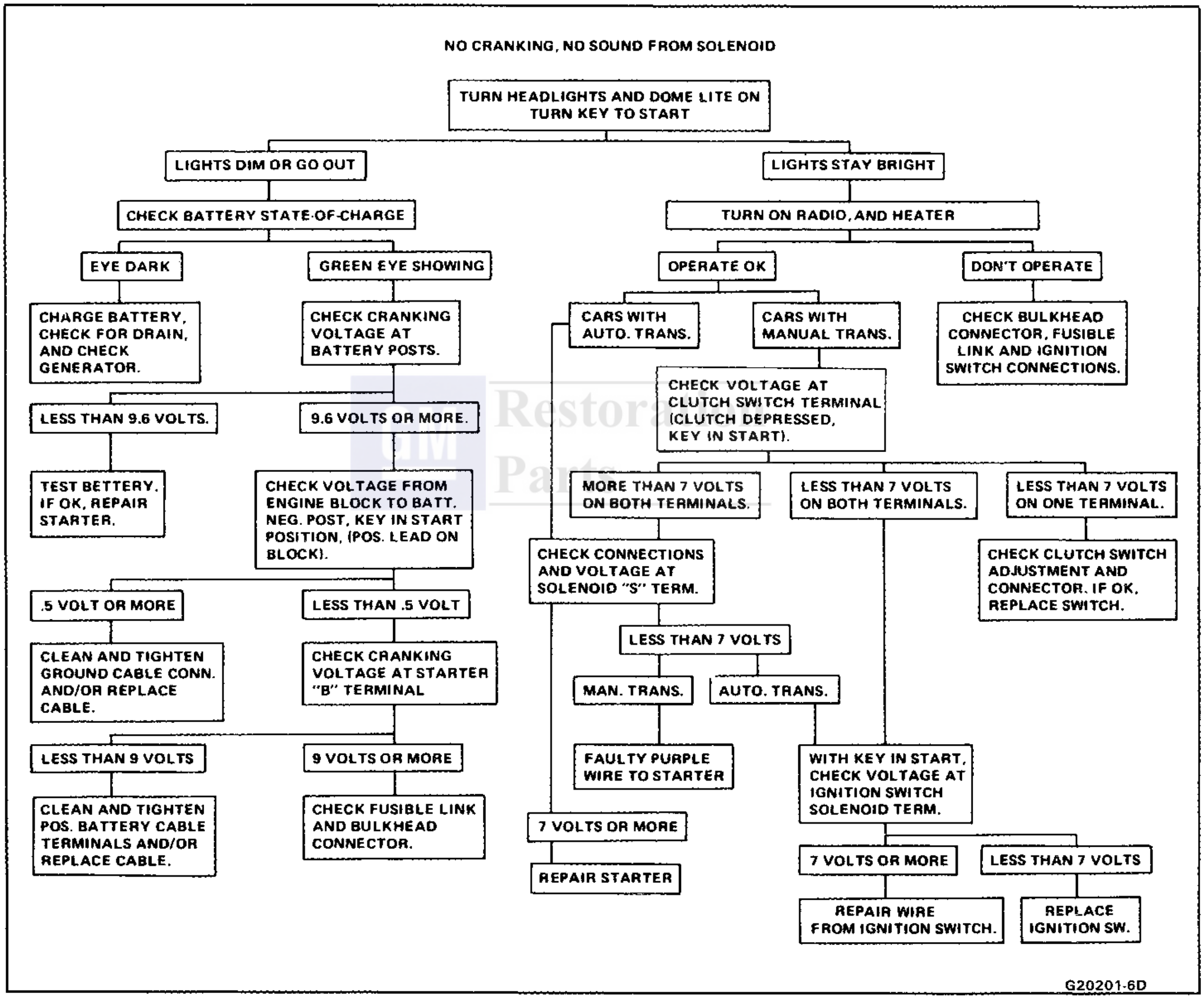
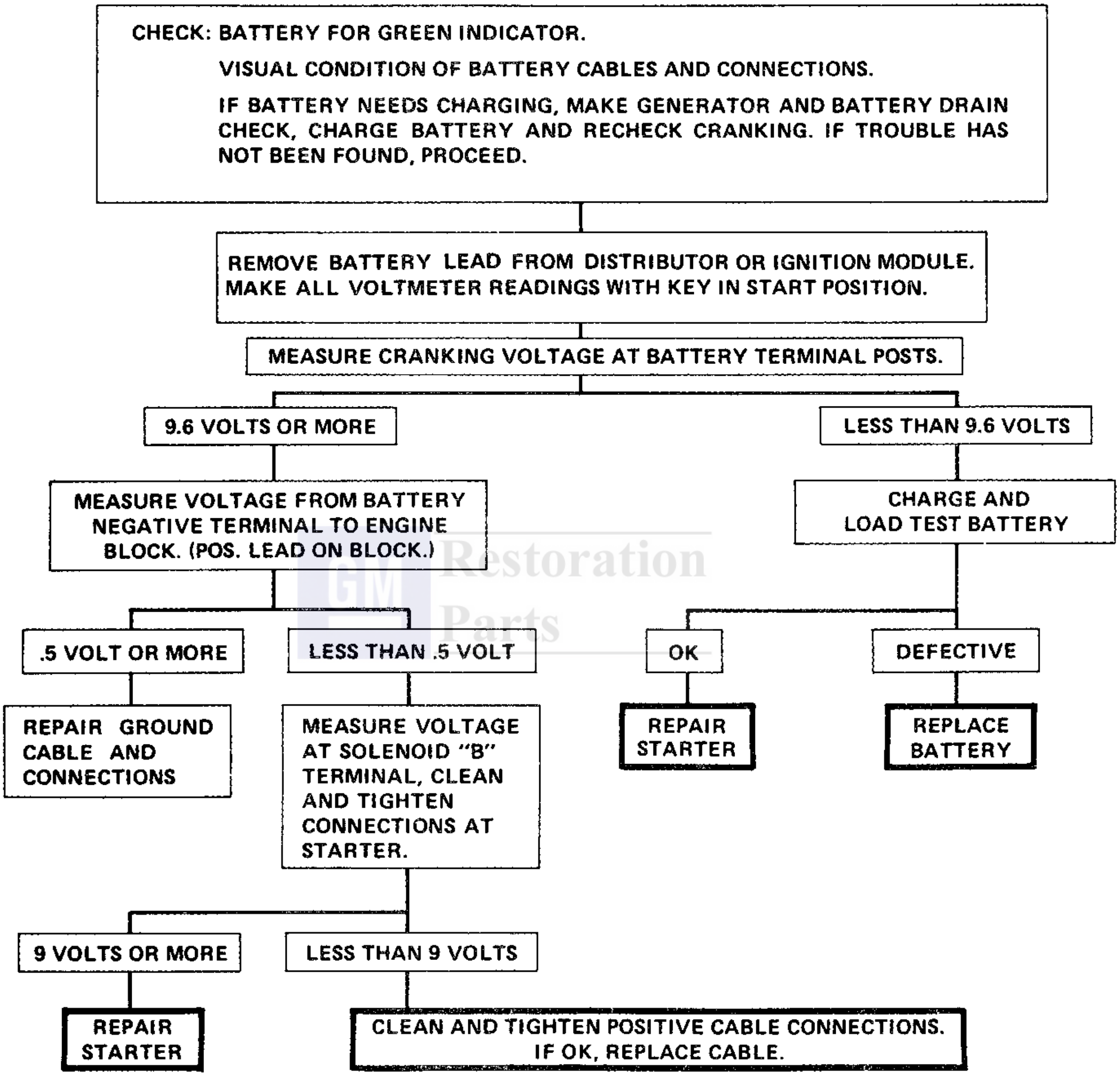


Fig. 1 Electrical System General Diagnosis - 1 of 2

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.

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. 2 Electrical System General Diagnosis - 2 of 2

SECTION 6D1

BATTERY

CONTENTS

GENERAL DESCRIPTION

The engine electrical system includes the battery, ignition (primary and secondary), starter (and related wiring) and the generator (and related wiring). Diagnostic charts (see Section 6D) will aid in trouble-shooting system faults. When a fault is traced to a particular component, refer to that components' section of the service manual.

BATTERY

The sealed battery (see Fig. 1) is standard on all cars. (See Specifications for specific applications.) There are no vent plugs in the cover. The battery is completely sealed, except for two small vent holes in the sides. These vent holes allow the small amount of gas produced in the battery to escape. The battery has the following advantages over conventional batteries:

1. No water addition for the life of the battery.
2. Overcharge protection. If too much voltage is applied to the battery, it will not accept as much current as a conventional battery. In a conventional battery, the excess voltage will still try to charge the battery, leading to gassing which causes liquid loss.
3. Not as liable to self-discharge as compared to a conventional battery. This is particularly important when a battery is left standing for long periods of time.
4. More power available in a lighter and smaller case.

The battery has three major functions in the electrical system: First, it provides a source of energy for cranking the engine; Second, it acts as a voltage stabilizer for the electrical system; And third, it can, for a limited time, provide energy when the electrical load used exceeds the output of the generator.

Ratings

A battery has two ratings: (1) a reserve capacity rating at 27°C (80°F) which is the time a fully charged battery will provide 25 amperes current flow at or above 10.5 volts; and (2) a cold rating at -18°C (0°F) which indicates the cranking load capacity (see Diagnosis Section for specific battery ratings).

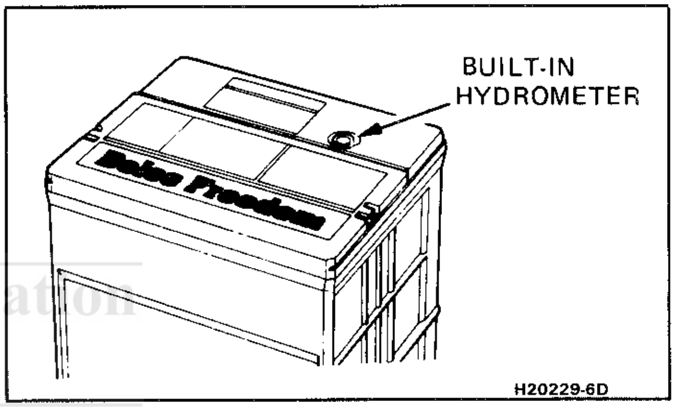


Fig. 1 Sealed Battery

Reserve Capacity

The "Reserve Capacity" is the maximum length of time it is possible to travel at night with minimum electrical load and no generator output.

Expressed in minutes it is the time required for a fully charged battery, at a temperature of 80°F being discharged at a constant current of 25-amperes, to reach a terminal voltage of 10.5 volts.

Cold Cranking Amperage

The "Cold Cranking Amperage" test is expressed at a battery temperature of 0°F. The current rating is the minimum amperage, which must be maintained by the battery for 30 seconds at the specified temperature, while meeting a minimum voltage requirement of 7.2 volts. This rating is a measure of cold cranking capacity.

The battery is not designed to last indefinitely; however, with proper care, it will provide many years of service.

If the battery tests good, but fails to perform satisfactorily in service for no apparent reason, the following are some of the more important factors that may point to the cause of trouble:

1. Vehicle accessories left on overnight.
2. Slow average driving speeds for short periods.

3. The vehicle's electrical load is more than the generator output, particularly with the addition of aftermarket equipment.
4. Defects in the charging system such as electrical shorts, slipping fan belt, faulty generator, or faulty voltage regulator.
5. Battery abuse, including failure to keep the battery cable terminals clean and tight, or loose battery hold-down. See "Service Procedures" for torque specifications.
6. Mechanical problems in the electrical system, such as shorted or pinched wires.

Electrolyte Freezing

The freezing point of electrolyte depends on its specific gravity. Since freezing may ruin a battery, it should be protected against freezing by keeping it in a charged condition.

Carrier and Hold-Down

The battery carrier and hold-down clamp should be clean and free from corrosion before installing battery.

The carrier should be in sound condition, to hold the battery securely and keep it level. Make certain there are no parts in the carrier before installing battery.

To prevent the battery from shaking in its carrier, the hold-down bolts should be tight, but not overtightened.

Built-In Hydrometer

The sealed battery has a built-in, temperature compensated hydrometer in the top of the battery. This hydrometer is to be used with the following diagnostic procedure.

When observing the hydrometer, make sure that the battery has a clean top. A light may be required, if the lighting is poor.

Under normal operation, two indications can be observed (see Fig. 4).

1. GREEN DOT VISIBLE
   Any green appearance is interpreted as a "green dot" and the battery is ready for testing.
2. DARK; GREEN DOT NOT VISIBLE
   If there is a cranking complaint, the battery should be tested as described in the "Diagnosis" section. The charging and electrical system should also be checked at this time.
   Occasionally, a third condition may appear:
3. CLEAR OR LIGHT YELLOW
   This means the fluid level is below the bottom of the hydrometer. This may have been caused by excessive or prolonged charging, a broken case, excessive tipping, or normal battery wearout. Finding a battery in this condition may indicate high charging voltages caused by a faulty charging system. Therefore, the charging and electrical systems may need to be checked. If a cranking complaint exists and is caused by the battery, it should be replaced.

DIAGNOSIS

BATTERY

1. VISUAL INSPECTION
   Check for obvious damage, such as cracked or broken case or cover, that could permit loss of electrolyte. If obvious damage is noted, replace the battery. Determine cause of damage and correct as needed. If not, proceed to step 2.
2. HYDROMETER CHECK
   a. GREEN DOT VISIBLE - Go To Step 3
   b. DARK; GREEN DOT NOT VISIBLE - Charge the battery as outlined under "Charging Procedure" section and proceed to Step 3.
3. LOAD TEST
   Load testing may require use of battery side terminal adapters to insure good connections (see Fig. 2).
   a. Connect a voltmeter and a battery load tester across the battery terminals.

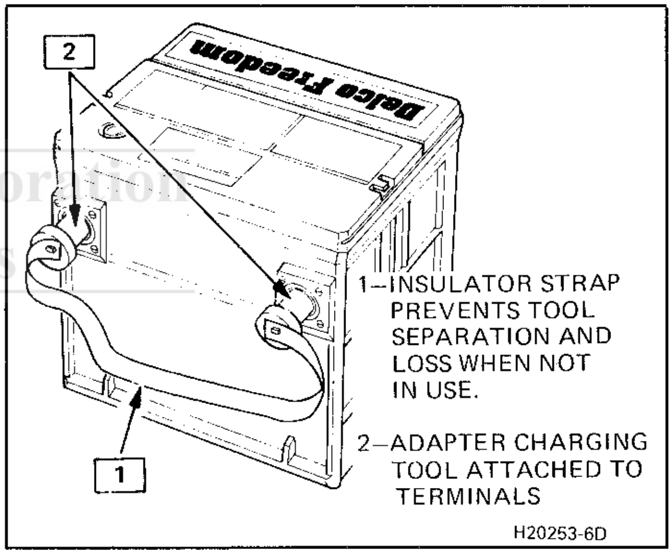


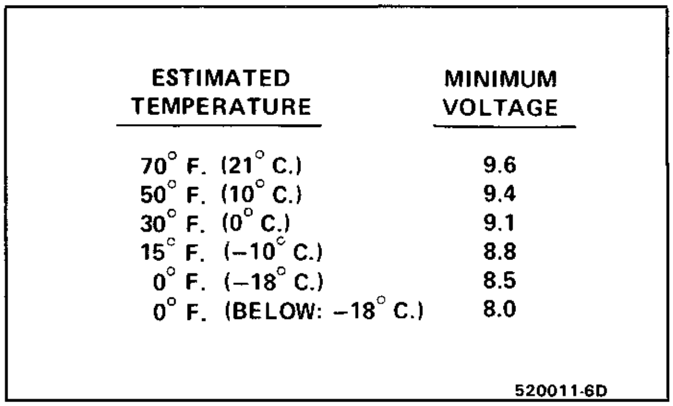
Fig. 2 Side Terminal Battery Adapters

   b. Apply 300 ampere load for 15 seconds to remove surface charge from the battery. Remove load.
   c. Wait 15 seconds to let battery recover and apply specified load from specifications. Read voltage after 15 seconds, then remove load.
   d. If voltage does not drop below the minimum listed in Fig. 3, the battery is good and should be returned to service. If voltage is less than minimum listed, replace battery. (The battery temperature must be estimated by feel and by the temperature the battery has been exposed to for the preceding few hours.)

SERVICE PROCEDURES

BATTERY CHARGING

When it is necessary to charge the battery, the following basic rules must be followed:



ESTIMATED TEMPERATURE	MINIMUM VOLTAGE
70° F. (21° C.)	9.6
50° F. (10° C.)	9.4
30° F. (0° C.)	9.1
15° F. (−10° C.)	8.8
0° F. (−18° C.)	8.5
0° F. (BELOW: −18° C.)	8.0

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Fig. 3 Minimum Voltage

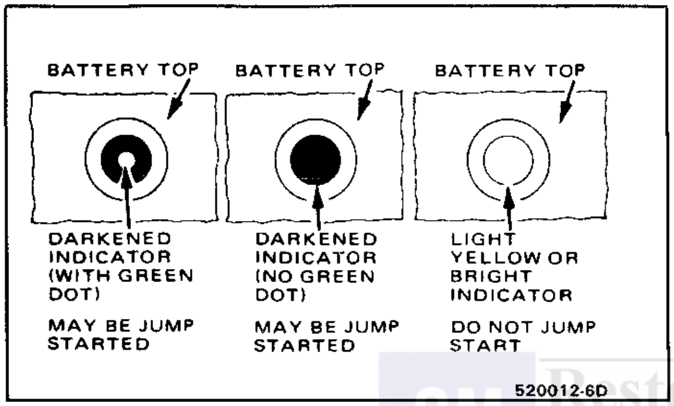


Fig. 4 Built-In Hydrometer

1. Do not charge battery if hydrometer is clear or light yellow. Replace battery.
2. If the battery feels hot 52°C (125°F), or if violent gassing or spewing of electrolyte through the vent holes occurs, discontinue charging or reduce charging rate.

Charging Procedure

1. Batteries with green dot showing do not require charging unless they have just been discharged (such as in cranking vehicle).
2. When charging sealed-terminal batteries out of vehicle, install adapter kit (AC Delco part number ST-1201 or GM part number 1846855, or equivalent). (Refer to Fig. 2.) Post-type batteries need no adapters.
3. Make sure all charger connections are clean and tight.
4. For best results, batteries should be charged while electrolyte and plates are at room temperature. A battery that is extremely cold may not accept current for several hours after starting charger.
5. Charge battery until green dot appears (see "Charging Time Required"). Battery should be checked every half-hour while charging. Tipping or shaking battery may be necessary to make green dot appear.
6. After charging, battery should be load tested as outlined in BATTERY DIAGNOSIS.

Charging Time Required:

The time required to charge a battery will vary depending upon the following factors:

- **Size of Battery** - A completely discharged large heavy-duty battery requires more than twice the recharging as a completely discharged small passenger car battery.
- **Temperature** - A longer time will be needed to charge any battery at 0°F than at 80°F. When a fast charger is connected to a cold battery, the current accepted by the battery will be very low at first. Then, in time, the battery will accept a higher rate as the battery warms.
- **Charger Capacity** - A charger which can supply only five amperes will require a much longer period of charging than a charger that can supply 30 amperes or more.
- **State-Of-Charge** - A completely discharged battery requires more than twice as much charge as a one-half charged battery. Because the electrolyte is nearly pure water and a poor conductor in a completely discharged battery, the current accepted by the battery is very low at first. Later, as the charging current causes the electrolyte acid content to increase, the charging current will likewise increase.

CHARGING A COMPLETELY DISCHARGED BATTERY (OFF THE VEHICLE)

The following procedure should be used to recharge a completely discharged battery:

Unless the procedure is properly followed, a perfectly good battery may be needlessly replaced.

1. Measure voltage at battery terminals with an accurate voltmeter. If below 10 volts, the charge current will be very low and it could take some time before it accepts current in excess of a few milliamperes.

   Such low current may not be detectable on ammeters available in the field.
2. Set battery charger on high setting.
3. Some chargers feature polarity protection circuitry, which prevents charging unless the charger leads are connected to the battery terminals correctly. A completely discharged battery may not have enough voltage to activate this circuitry, even though leads are connected properly, making it appear that the battery will not accept charging current. Therefore, follow the specific charger manufacturer's instruction telling how to bypass or override the circuitry so that the charger will turn on and charge a low-voltage battery.
4. Battery chargers vary in the amount of voltage and current they provide. The time required for the battery to accept measurable charger current at various voltages may be as follows:

VOLTAGE	HOURS
A. 16.0 or more	Up to 4 Hours
B. 14.0 - 15.9	Up to 8 Hours
C. 13.9 or less	Up to 16 Hours

If the charge current is still not measurable at the end of the above charging times, the battery should be replaced.

If the charge current is measurable during the charging time, the battery is considered to be good and charging should be completed in the normal manner.

5. It is important to remember that a completely discharged battery must be recharged for a sufficient number of ampere hours (AH) to restore it to a usable state. As a general rule of thumb, using the reserve capacity rating (RC) of the battery as the number of ampere hours of charge will usually bring the green dot into view.

   For example, if battery is rated at 75 RC minutes, it would be completely recharged as follows:

   10 ampere charge x 7-1/2 hours = 75 AH

   or

   25 ampere charge x 3 hours = 75 AH, etc.
6. It is recommended that any battery recharged by this procedure be **LOAD TESTED** to establish serviceability.

JUMP STARTING IN CASE OF EMERGENCY WITH AUXILIARY (BOOSTER) BATTERY

NOTICE: Do not push or tow the vehicle to start. Damage to the emission system, or to other parts of the vehicle may result.

Both booster and discharged battery should be treated carefully when using jumper cables. Follow the procedure outlined below, being careful not to cause sparks:

CAUTION: Departure from these conditions or the procedure below could result in: (1) Serious personal injury (particularly to eyes) or property damage from such causes as battery explosion, battery acid, or electrical burns; and/or (2) damage to electronic components of either vehicle.

Never expose battery to open flame or electric spark - batteries generate a gas which is flammable and explosive.

Remove rings, watches, and other jewelry. Wear approved eye protection.

Do not allow battery fluid to contact eyes, skin, fabrics, or painted surfaces - fluid is a corrosive acid. Flush any contacted area with water immediately and thoroughly. Be careful that metal tools or jumper cables do not contact the positive battery terminal (or metal in contact with it) and any other metal on the car, because a short circuit could occur. Batteries should always be kept out of the reach of children.

1. Set parking brake and place automatic transmission in "PARK" (NEUTRAL for manual transmission.) **Turn off the ignition, turn off lights, and all other electrical loads.**
2. Check the built-in hydrometer. If it is clear or light yellow, replace the battery.
3. Attach the end of one jumper cable to the positive terminal of the booster battery and the other end of the same cable to the positive terminal of the discharged battery. Do not permit vehicles to touch each other as this could cause a ground connection and counteract the benefits of this procedure. (Use 12-volt battery only to jump start the engine).
4. Attach one end of the remaining negative cable to the negative terminal of the booster battery, and the other end to a solid engine ground (such as A/C compresser bracket or generator mounting bracket) at least 18 inches from the battery of the vehicle being started (DO NOT CONNECT DIRECTLY TO THE NEGATIVE TERMINAL OF THE DEAD BATTERY).
5. Start the engine of the vehicle that is providing the jump start and turn off electrical accessories. Then start the engine in the car with the discharged battery.
6. Reverse these directions exactly when removing the jumper cables. The negative cable must be disconnected from the engine that was jump started first.

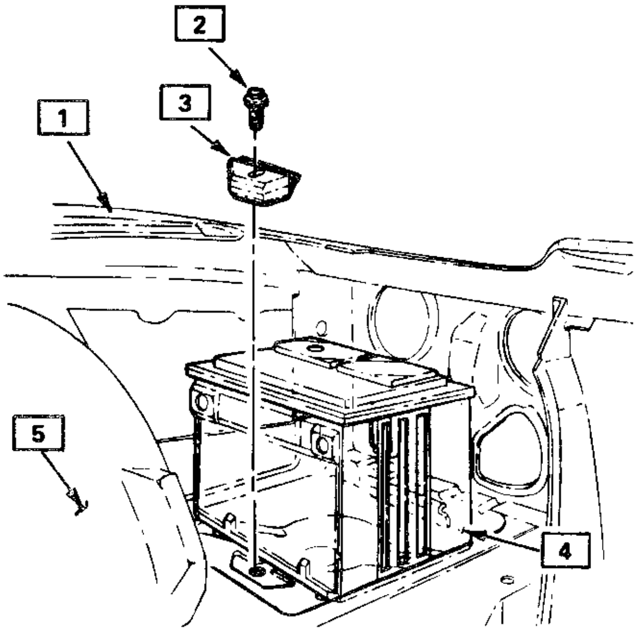


Fig. 5 Battery Hold-Down (Typical)

ON-CAR SERVICE

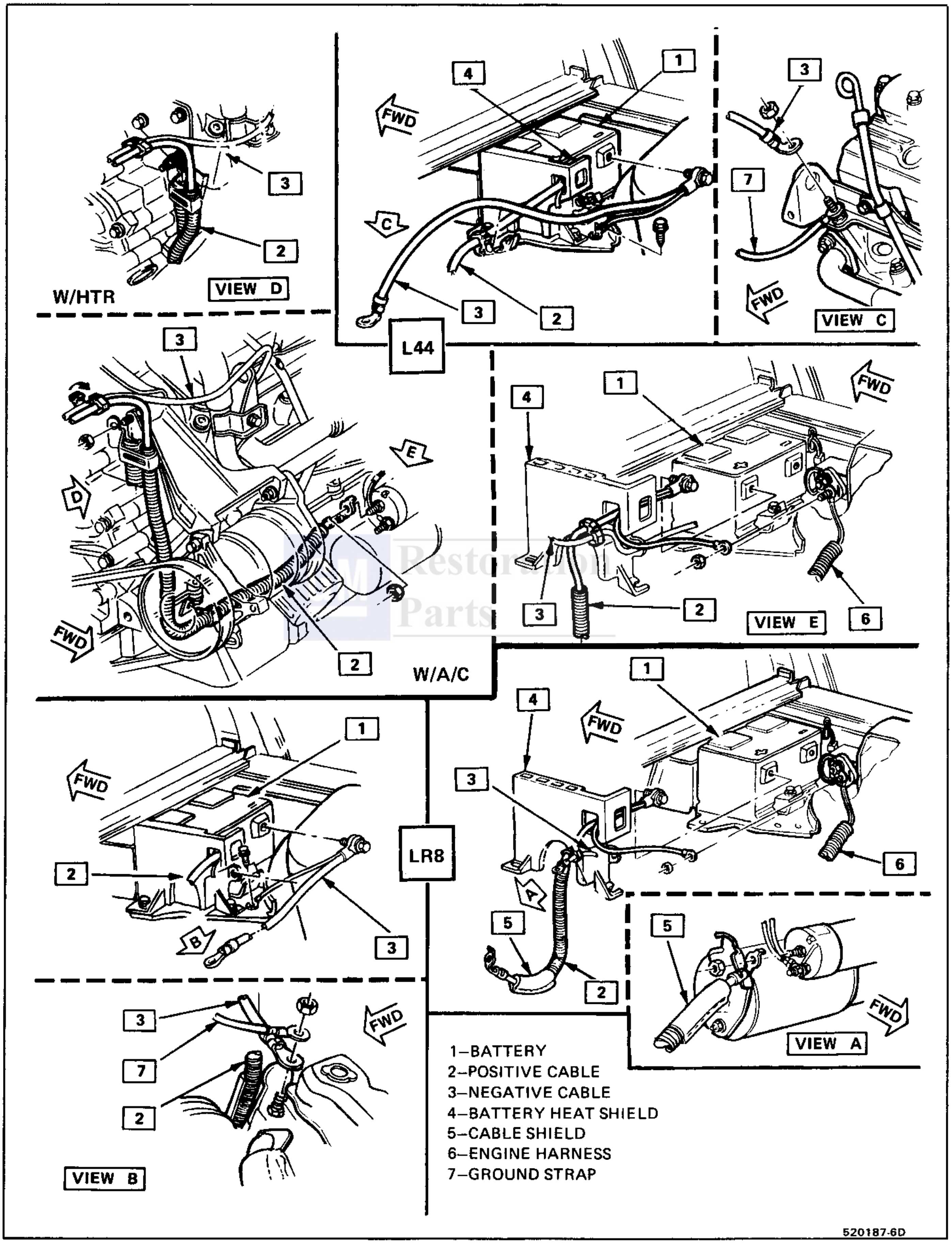
BATTERY

←→ Remove or Disconnect

1. Battery cover.
2. Battery heat shield.
3. Negative cable.
4. Positive cable.
5. Retainer screw and retainer.
6. Battery.

→← Install or Connect

1. Battery.
2. Retainer and retainer screw.
3. Positive cable - 17 N·m (13 lb.ft.).
4. Negative cable - 17 N·m (13 lb.ft.).
5. Battery head shield.
6. Battery cover.



1–BATTERY
2–POSITIVE CABLE
3–NEGATIVE CABLE
4–BATTERY HEAT SHIELD
5–CABLE SHIELD
6–ENGINE HARNESS
7–GROUND STRAP

Fig. 801 Battery Cables (LR8 & L44)

SPECIFICATIONS

ENGINE	BATTERY/FUNCTION	REPLACEMENT
LR8	1981601-STD CCA 630 RC(MIN)90 Load Test 310 Amps	601
L44	1981730 STD CCA 525 RC(MIN) 90 Load Test 260 AMPS	730
	1981731-HD CCA 570 RC(MIN)90 Load Test 280 AMPS	731

SECTION 6D2

CRANKING SYSTEM

CONTENTS

GENERAL DESCRIPTION

The engine electrical system includes the battery, ignition (primary and secondary), starter (and related wiring) and the generator (and related wiring). Diagnostic charts (see Section 6D) will aid in trouble-shooting system faults. When a fault is traced to a particular component, refer to that components' section of the service manual.

CRANKING SYSTEM

The cranking circuit consists of the battery, starting motor, ignition switch, and related electrical wiring. These components are connected electrically as shown in Fig. 1.

Starter Motor

Wound field starter motors have pole pieces, arranged around the armature, that are energized by wound field coils.

Solenoid

Enclosed shift lever cranking motors have the shift lever mechanism and the solenoid plunger enclosed in the drive housing, protecting them from exposure to dirt, icing conditions and splash.

In the basic circuit shown in Fig. 1, solenoid windings are energized when the switch is closed. The resulting plunger and shift lever movement causes the pinion to engage the engine flywheel ring gear and the solenoid main contacts to close, and cranking takes place. When the engine starts, pinion overrun protects the armature from excessive speed until the switch is opened, at which time the return spring causes the pinion to disengage. To prevent excessive overrun, the switch should open immediately when the engine starts.

DIAGNOSIS

CRANKING SYSTEM

Before removing any unit in a cranking circuit for repair, the following checks should be made:

Electrical System General Diagnosis: Follow the procedures shown in Section 6D to isolate problem.

Battery: To determine the condition of the battery, follow the testing procedure outlined in the Battery section (6D1).

Wiring: Inspect the wiring for damage. Inspect all connections to the cranking motor, solenoid, ignition switch and battery, including all ground connections. Clean and tighten all connections, as required.

Solenoid and Ignition Switch: Inspect all switches to determine their condition.

Starter Motor Noise: To correct starter motor noise during starting, use the following procedure:

1. Refer to Fig. 2 to determine the problem.
2. If the complaint is noise, correction can be achieved by proper "shimming" as follows:
   a. Check flywheel for damage - bent flywheel, unusual wear, etc.
   b. Start engine and carefully touch outside diameter of rotating flywheel ring gear with chalk or crayon to show high point of tooth runout. Turn engine off and rotate flywheel so that the marked teeth are in the area of the starter pinion gear.
   c. Disconnect negative battery cable to prevent cranking of engine.
   d. Check pinion to flywheel clearance, as shown in Fig. 3, by using a wire gage of .5mm (.020") minimum thickness (or diameter). Center a pinion tooth between two flywheel teeth and gage, as shown in Fig. 3. Do not gage in the corners, where a misleading larger dimension may be observed. If the clearance is under this minimum, shimming the starter away from the flywheel is required.
   e. If the clearance is grossly over .5mm (.020") in the vicinity of 1.5mm (.060") or more, shimming the starter toward the flywheel is required. (This is generally the problem causing broken flywheel teeth or starter housings.) Shimming the starter toward the flywheel can be accomplished by shimming only the outboard starter mounting pad. A shim of .4mm (.015") thickness, at this

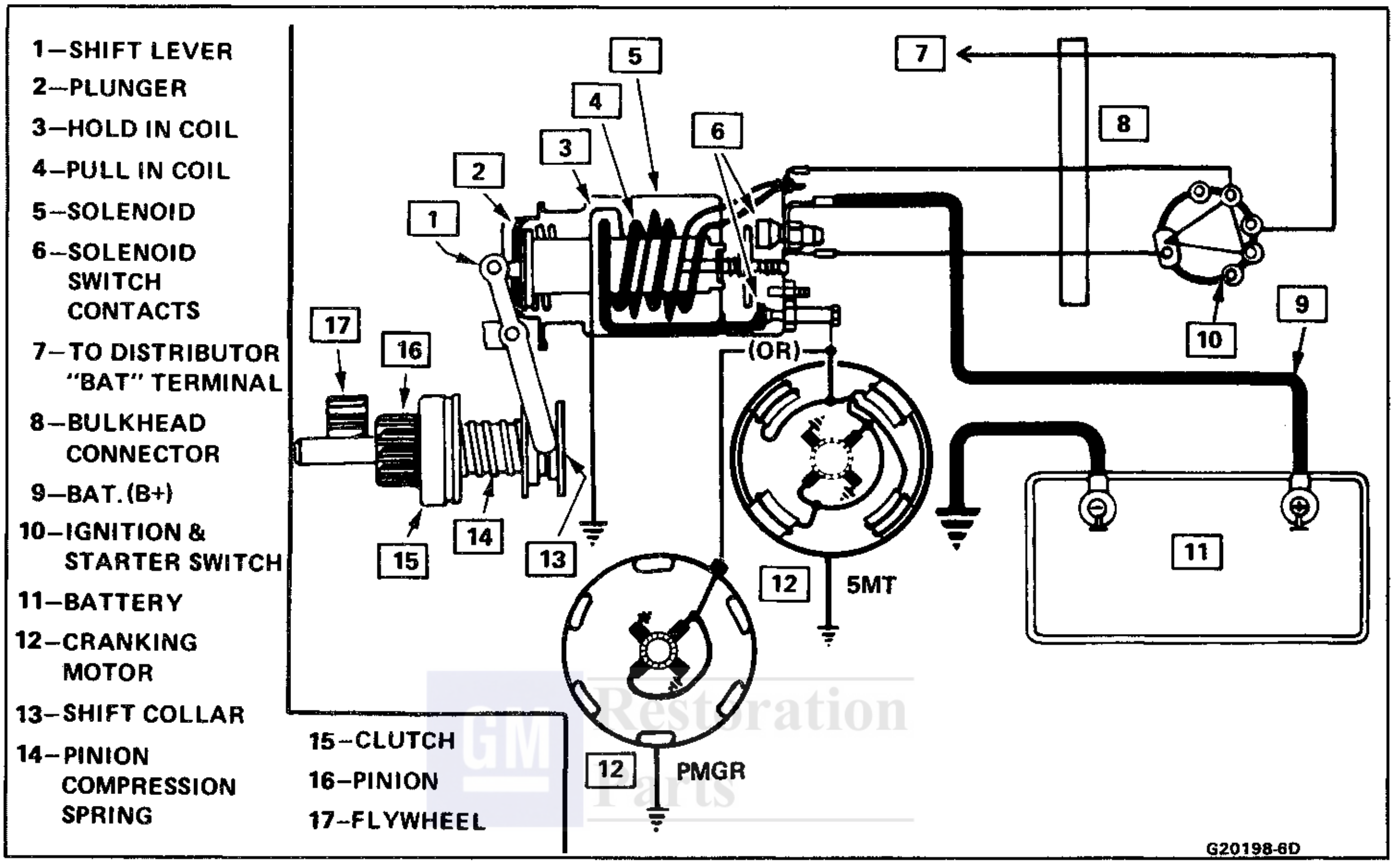


Fig. 1 Cranking Circuit - 5MT or PMGR

	PROBLEM	CAUSE
1.	HIGH PITCHED WHINE DURING CRANKING (BEFORE ENGINE FIRES) BUT ENGINE CRANKS AND FIRES OKAY.	DISTANCE TOO GREAT BETWEEN STARTER PINION AND FLYWHEEL.
2.	HIGH PITCHED "WHINE" AFTER ENGINE FIRES, AS KEY IS BEING RELEASED. ENGINE CRANKS AND FIRES OKAY. THIS INTERMITTENT COMPLAINT IS OFTEN DIAGNOSED AS "STARTER HANG-IN" OR "SOLENOID WEAK."	DISTANCE TOO SMALL BETWEEN STARTER PINION AND FLYWHEEL. FLYWHEEL RUNOUT CONTRIBUTES TO THE INTERMITTENT NATURE.
3.	A LOUD "WHOOP" AFTER THE ENGINE FIRES BUT WHILE THE STARTER IS STILL HELD ENGAGED. SOUNDS LIKE A SIREN IF THE ENGINE IS REVVED WHILE STARTER IS ENGAGED.	MOST PROBABLE CAUSE IS A DEFECTIVE CLUTCH. A NEW CLUTCH WILL OFTEN CORRECT THIS PROBLEM.
4.	A "RUMBLE", "GROWL" OR (IN SEVERE CASES) A "KNOCK" AS THE STARTER IS COASTING DOWN TO A STOP AFTER STARTING THE ENGINE.	MOST PROBABLE CAUSE IS A BENT OR UNBALANCED STARTER ARMATURE. A NEW ARMATURE WILL OFTEN CORRECT THIS PROBLEM.

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Fig. 2 Starter Motor Noise Diagnosis

location will decrease the clearance by approximately .3mm (.010″).

If normal starter shims are not available, they can be improvised from plain washers or other suitable material.

Starter Motor: If the battery, wiring and switches are in satisfactory condition, and the engine is known to be functioning properly, remove the motor and follow the procedures shown in Starter Motor Disassembly, Test and Reassembly (Unit Repair).

Never operate the cranking motor more than 30 seconds at a time without pausing to allow it to cool for at least two minutes. Overheating, caused by excessive cranking, will seriously damage the cranking motor.

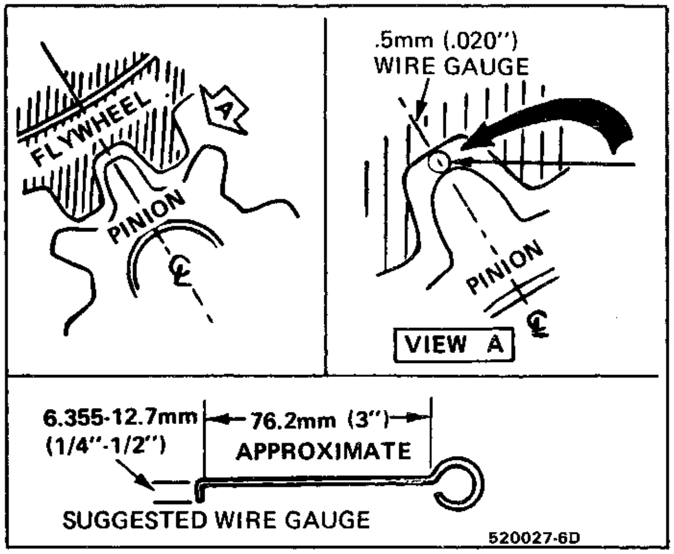


Fig. 3 Flywheel to Pinion Clearance

SERVICE PROCEDURES

CRANKING SYSTEM

Starting motors do not require lubrication except during overhaul.

When the motor is disassembled for any reason, lubricate as follows:

5MT and 10 MT Starters

1. The roll type overrunning clutch requires no lubrication; however, the drive assembly should be wiped clean. **Do Not** clean in any degreasing tank, or with grease dissolving solvents; this will dissolve the lubricant in the clutch mechanism. Use silicon grease General Electric CG321, Dow Corning 33 Medium, or equivalent, on the shaft underneath the overrunning clutch assembly.
2. Avoid excessive lubrication.

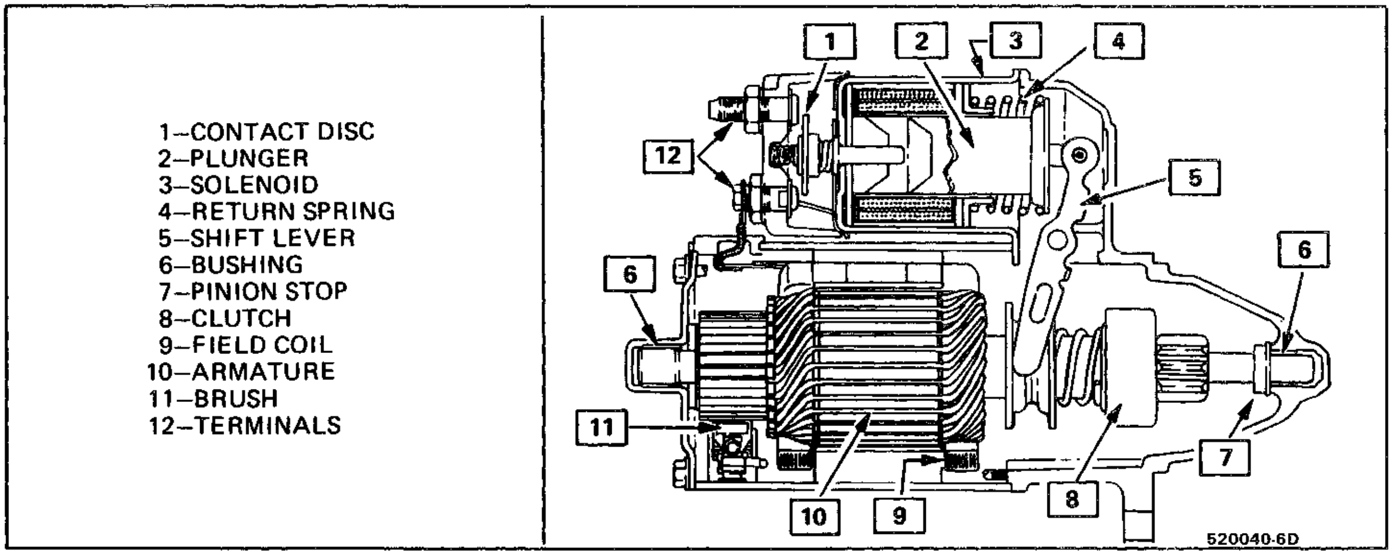
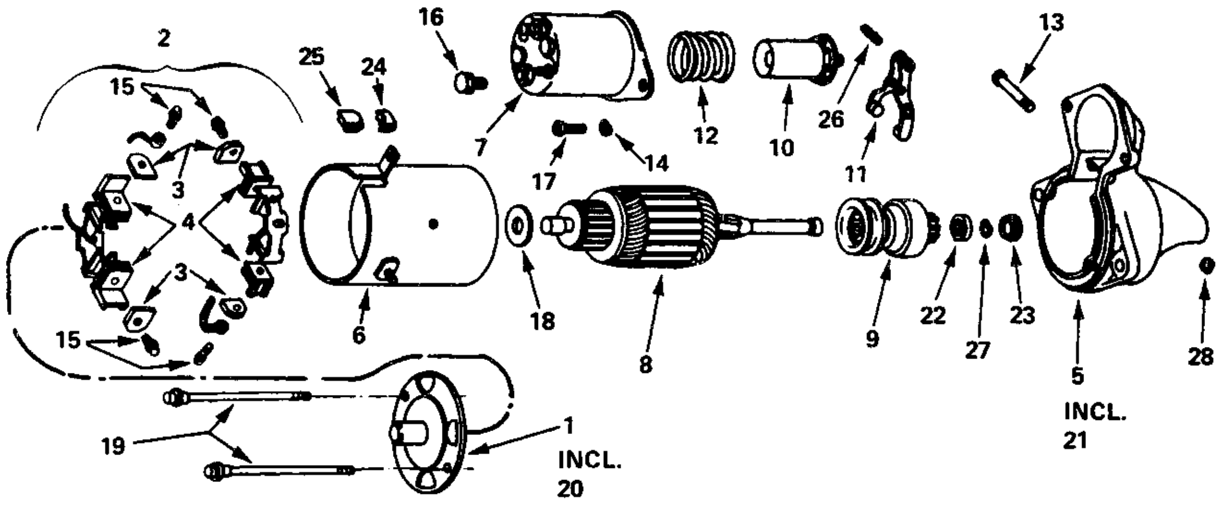


Fig. 4 Cross Section of 5MT Starting Motor



1–FRAME–COMMUTATOR END
2–BRUSH AND HOLDER PKG.
3–BRUSH
4–BRUSH HOLDER
5–HOUSING–DRIVE END
6–FRAME AND FIELD ASM.
7–SOLENOID SWITCH
8–ARMATURE
9–DRIVE ASM.
10–PLUNGER
11–SHIFT LEVER
12–PLUNGER RETURN SPRINGER
13–SHIFT LEVER SHAFT
14–LOCK WASHER
15–SCREW–BRUSH ATTACHING
16–SCREW–FIELD LEAD TO SWITCH
17–SCREW–SWITCH ATTACHING
18–WASHER–BRAKE
19—THRU BOLT
20—BUSHING–COMMUTATOR END
21—BUSHING–DRIVE END
22—PINION STOP COLLAR
23—THRUST COLLAR
24—GROMMET
25—GROMMET
26—PLUNGER PIN
27—PINION STOP RETAINER RING
28—LEVER SHAFT RETAINING RING

520041-6D

Fig. 4A 5MT Starting Motor - Disassembled View

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.

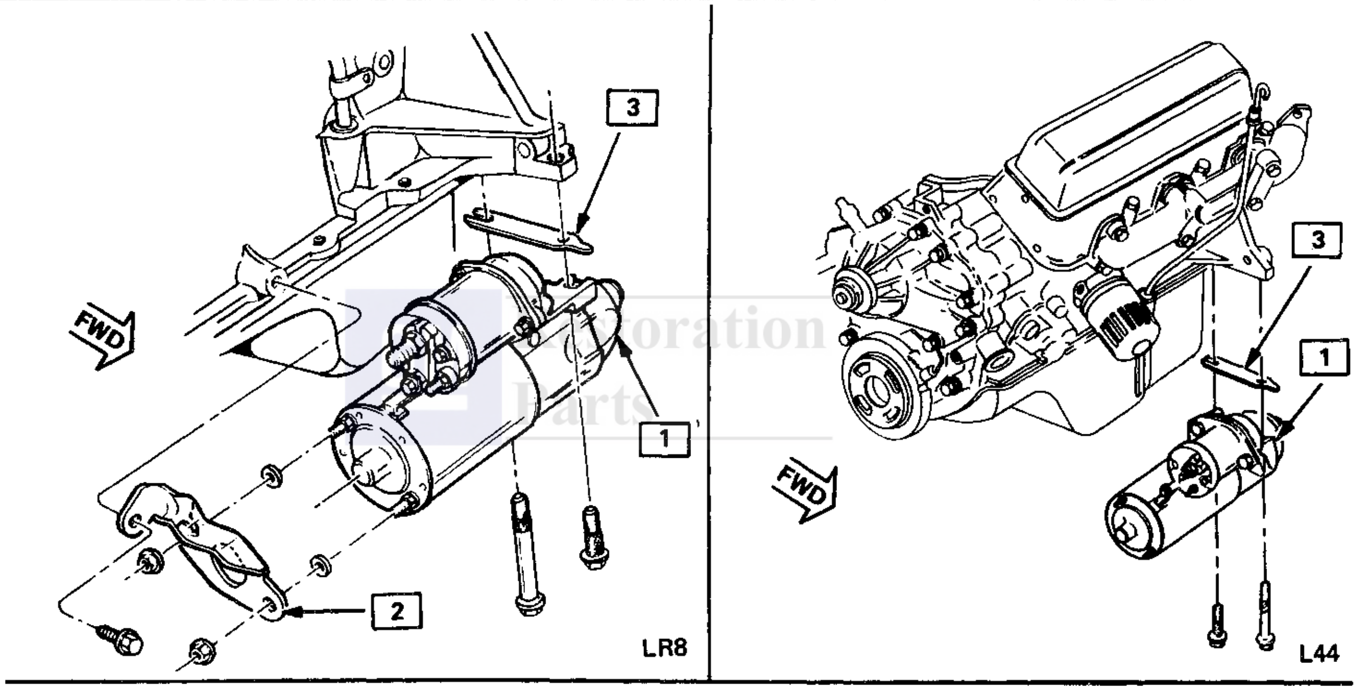
Install or Connect

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.



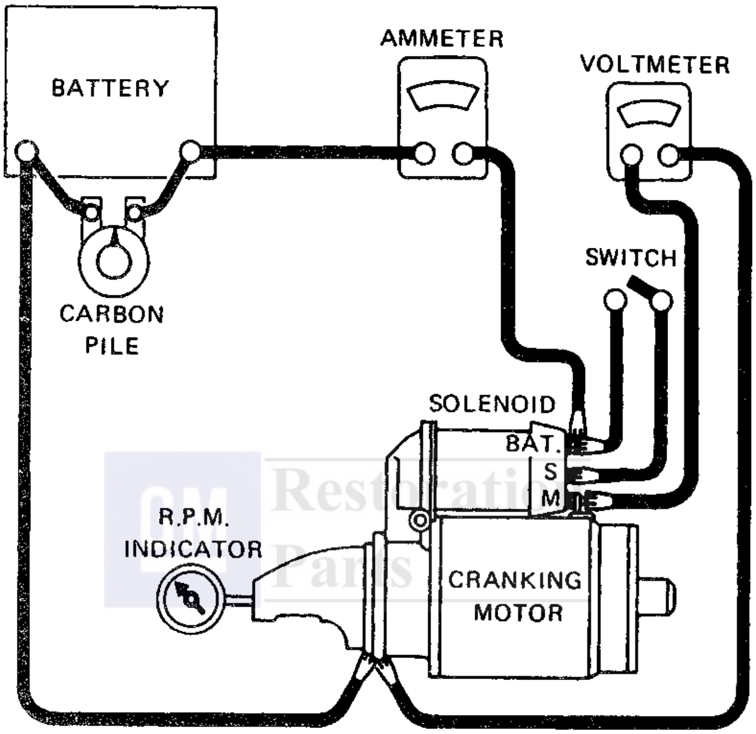
1. STARTER
2. BRACKET
3. SHIM

520186-6D

Fig. 801 Starter Motor Mounting

5MT AND 10MT STARTER MOTORS DISASSEMBLY, TEST AND REASSEMBLY (STARTER REMOVED FROM ENGINE)

NO-LOAD TEST



With the starter motor removed from the engine, the pinion should be checked for freedom of operation by turning it on the screw shaft. The armature should be checked for freedom of rotation by prying the pinion with a screwdriver. If the armature does not turn freely, the motor should be disassembled immediately. However, if the armature does rotate freely, the motor should be given a no-load test before disassembly.

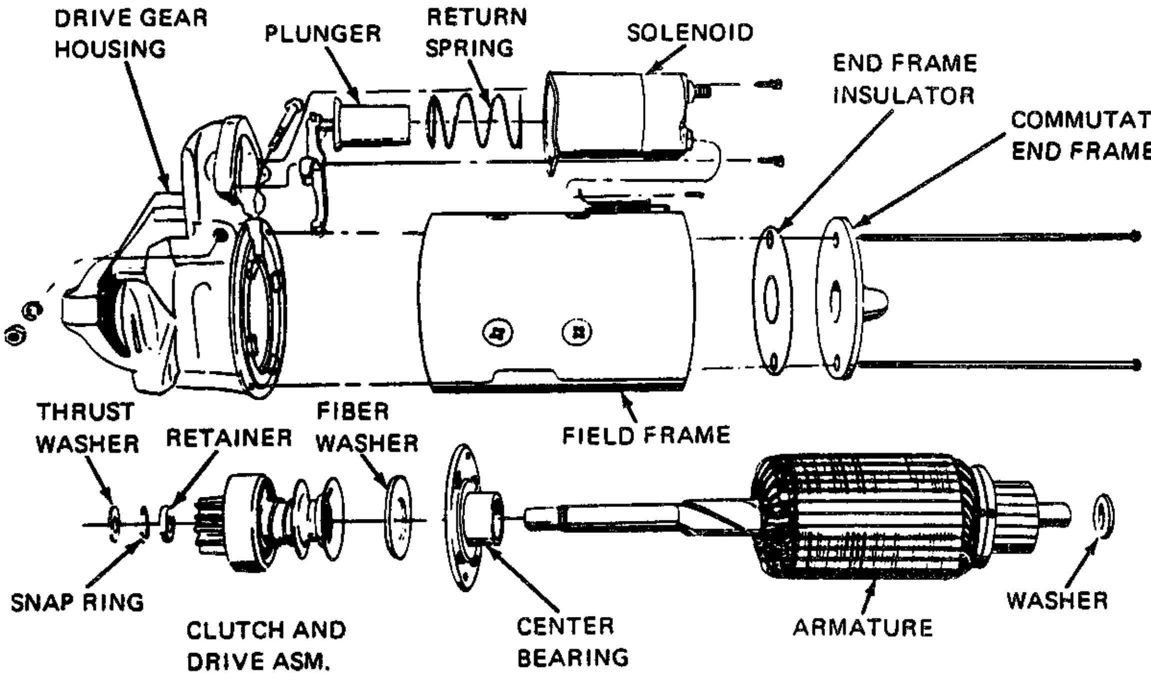
Make connections as shown. Close the switch and compare the RPM, current, and voltage readings with the specifications If the specified current draw does not include the solenoid, deduct from the ammeter reading the specified current draw of the solenoid hold-in winding. Make disconnections only with the switch open. Use the test results as follows:

1. **Rated current draw and no-load speed indicates normal condition of the starter motor.**
2. **Low free speed and high current draw indicates:**
   - Too much friction — tight, dirty, or worn bearings, bent armature shaft allowing armature to drag.
   - Shorted armature. This can be further checked on a growler after disassembly.
   - Grounded armature or fields. Check further after disassembly.
3. **Failure to operate with high current draw indicates:**
   - A direct ground in the terminal or fields.
   - "Frozen" bearings (this should have been determined by turning the armature by hand).
4. **Failure to operate with no current draw indicates:**
   - Open field circuit. This can be checked after disassembly by inspecting internal connections and tracing circuit with a test lamp.
   - Open armature coils. Inspect the commutator for badly burned bars after disassembly.
   - Broken brush springs, worn brushes, high insulation between the commutator bars or other causes which would prevent good contact between the brushes and commutator.
5. **Low no-load speed and low current draw indicates:**
   - High internal resistance due to poor connections, defective leads, dirty commutator and causes listed under Number 4.
6. **High free speed and high current draw usually indicate** shorted fields. If shorted fields are suspected, replace the field coil assembly. Also check for shorted armature, using a growler.

520042-6D

Fig. 802 Starter Motor Disassembly, Test and Reassembly 1 of 6

STARTER DISASSEMBLY

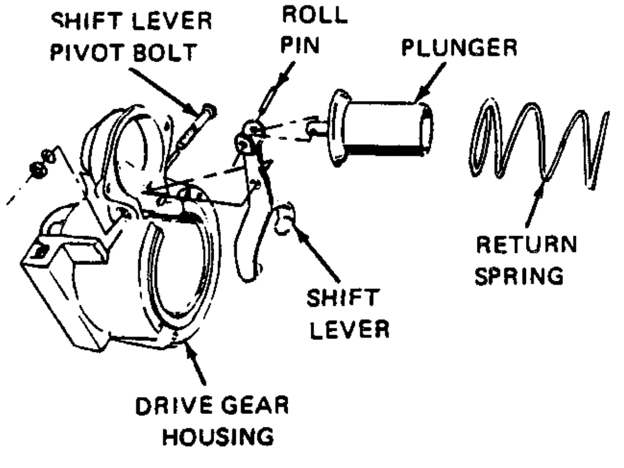


7. Remove screw from field coil connector and solenoid mounting screws. Rotate solenoid 90° and remove along with plunger return spring. Solenoid may now be serviced without further starter disassembly at this time.

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

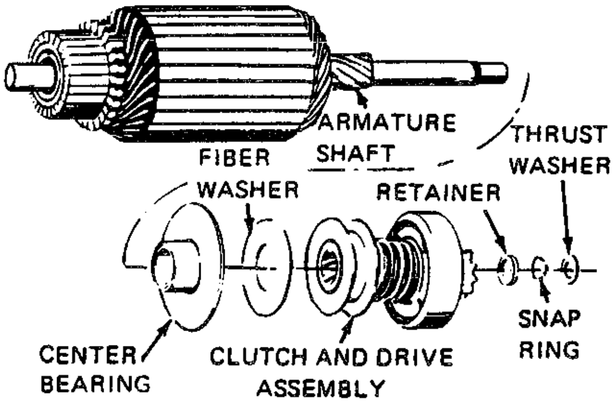


Steps 10 and 11 are required only on diesel starters.

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.

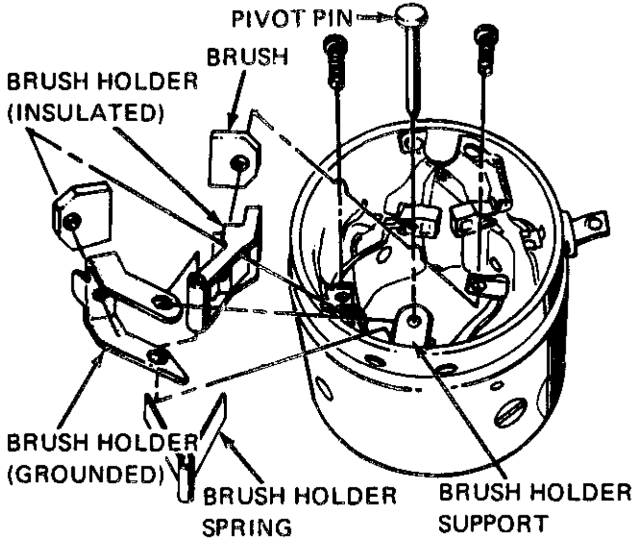
13. The shift lever and plunger may be disassembled at this time by removing the roll pin.

520043-6D

Fig. 803 Starter Motor Disassembly, Test and Reassembly 2 of 6

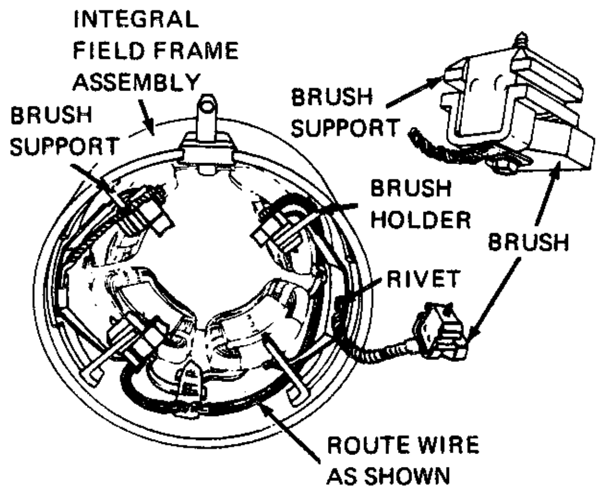
REPLACE BRUSH HOLDER

(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.

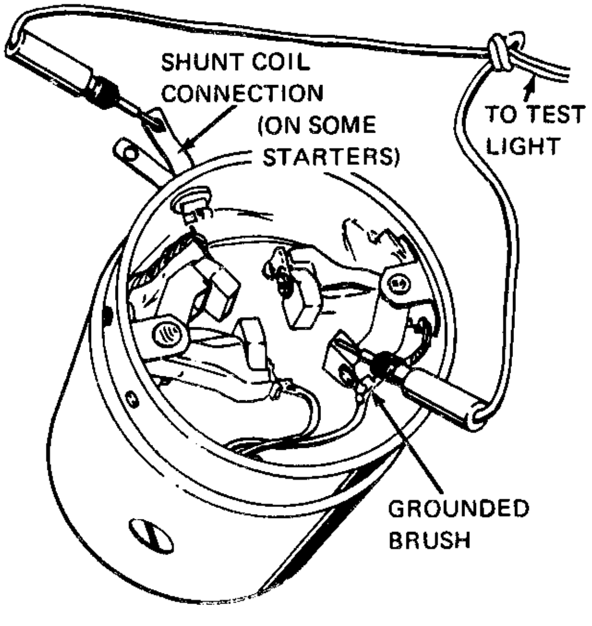
(SMALL 5MT STARTER)



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.

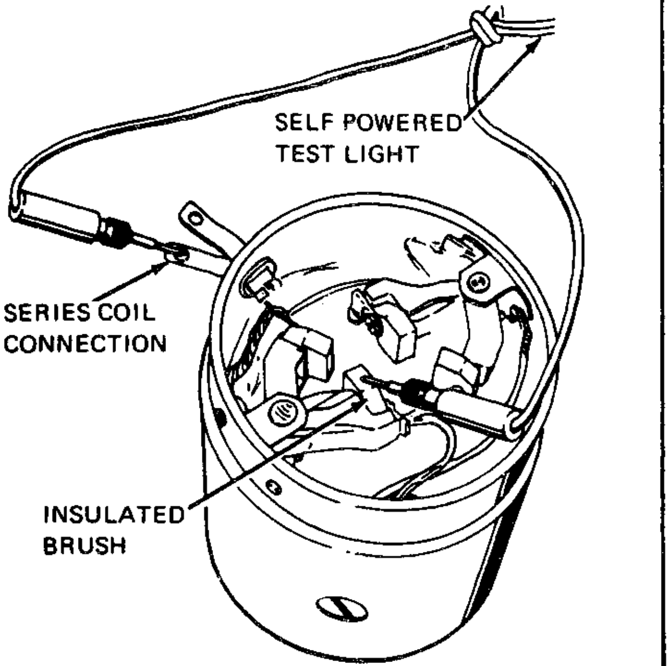
18. Inspect armature commutator. If commutator is rough, it should be turned down. Do not undercut or turn to less than 1.650" O.D. Do not turn out-of-round commutators. Inspect the points where the armature conductors join the commutator bars to make sure they have a good connection. A burned commutator 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

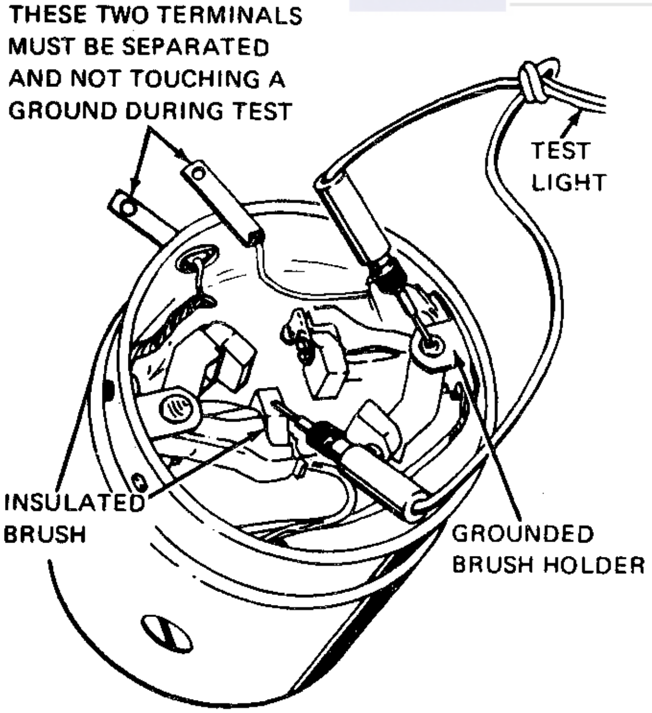
Fig. 804 Starter Motor Disassembly, Test and Reassembly 3 of 6

TESTING SERIES COIL FOR OPEN



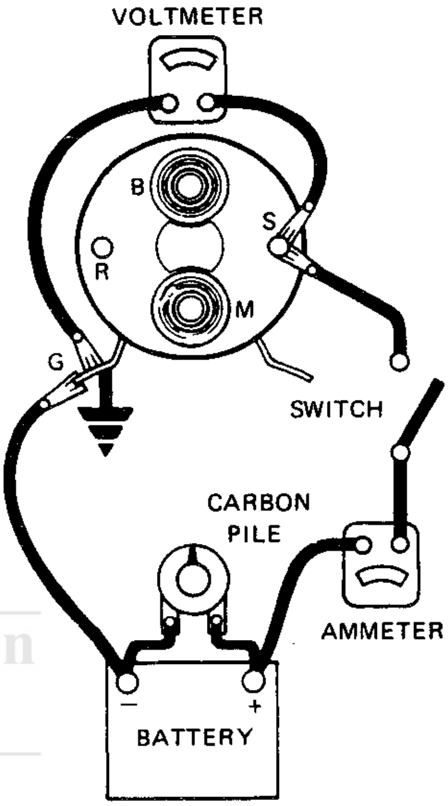
c. Using a test lamp, place one lead on the series coil terminal and the other lead on the insulated brush. If the lamp fails to light, the series coil is open and will require repair or replacement. This test should be made from each insulated brush to check brush and lead continuity.

TESTING SERIES COIL FOR GROUND



d. On starters with shunt coil, separtate series and shunt coil strap terminals during this test. Do not let strap terminals touch case or other ground. Using a test lamp place one lead on the grounded brush holder and the other lead on either insulated brush. If the lamp lights, a grounded series coil is indicated and must be repaired or replaced.

TESTING SOLENOID WINDINGS



e. Check the current draw of the solenoid winding as follows:

If solenoid is not removed from starting motor, the connector strap terminals must be removed from the terminal on the solenoid before making these tests. Complete tests in a minimum of time to prevent overheating of the solenoid.

To check hold-in winding, connect an ammeter in series with 12-volt battery and the "switch" terminal on the solenoid. Connect a voltmeter to the "switch" terminal and to ground. Connect carbon pile across battery. Adjust the voltage to 10 volts and note the ammeter reading. It should be 13 to 19 amperes for all starting motors.

To check both windings, connect as for previous test. Ground the solenoid motor terminal. Adjust the voltage to 10 volts and note the ammeter reading. It should be 59 to 79 amperes for all starting motors.

NOTE: Current will decrease as windings heat up.

Current draw readings that are over specifications indicate shorted turns or a ground in the windings of the solenoid and the solenoid should be replaced. Current draw readings that are under specifications indicate excessive resistance. No reading indicates an open circuit. Check connections then replace solenoid if necessary.

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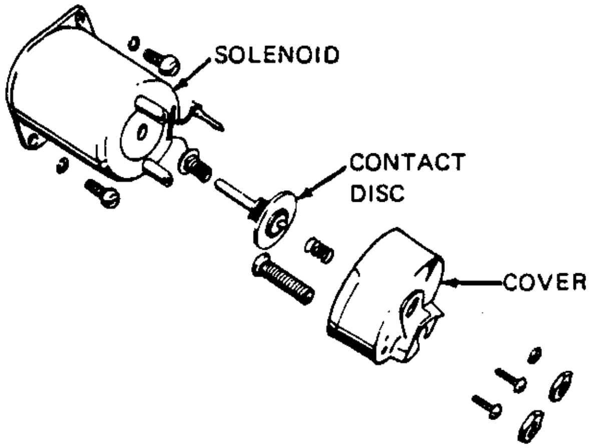
Fig. 805 Starter Motor Disassembly, Test and Reassembly 4 of 6

SOLENOID SWITCH DISASSEMBLY



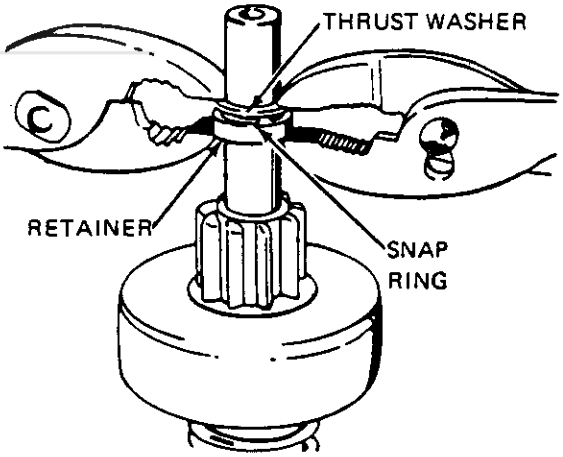
f. The starter solenoid switch is serviced as an assembly. The cover can be removed to inspect the contacts and contact disc if necessary.

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

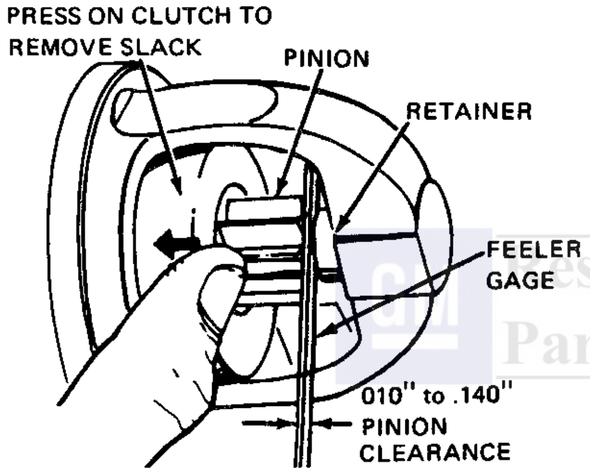


26. Position field frame against drive gear housing on alignment pin using care to prevent damage to brushes.
27. Lubricate commutator end-frame bushing with lubricant 1960954 or equivalent.
28. Install washer on armature shaft and slide end frame onto shaft, then install and tighten through-bolts. On 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.

520046-6D

Fig. 806 Starter Motor Disassembly, Test and Reassembly 5 of 6

CHECKING PINION CLEARANCE



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. 807 Starter Motor Disassembly, Test and Reassembly 6 of 6

SPECIFICATIONS

Engine (RPO/VIN)	2.5L-L4-LR8-R	2.8L-V6-L44-9
Starter	5MT-1998533	5MT-1998533
——No Load Test @10V	Min. 50A Max. 75A 6000 rpm - 11,900 rpm	Min. 50A Max. 75A 6000 rpm - 11,900 rpm
Solenoid		
——Hold-in Windings @10V	13-19A	13-19A
——Pull-in Windings @5V	23-30A	23-30A

SECTION 6D3

CHARGING SYSTEM

CONTENTS

GENERAL DESCRIPTION

The engine electrical system includes the battery, ignition (primary and secondary), starter (and related wiring) and the generator (and related wiring). Diagnostic charts (see Section 6D) will aid in trouble-shooting system faults. When a fault is traced to a particular component, refer to that components' section of the service manual.

CHARGING SYSTEM-CS

The CS Charging System has several sizes available, including the CS-130 and CS-144. The number (130 or 144) denotes the OD in mm of the stator laminations.

CS generators use a new type regulator and a diode trio is not used. A delta stator, rectifier bridge, and rotor with slip rings and brushes are electrically similar to earlier generators. A conventional pulley and fan is used and, on the CS-130, an internal fan cools the slip ring end frame, rectifier bridge and regulator.

Unlike three-wire generators, the CS-130 and CS-144 may be used with only two connections - battery positive and an "L" terminal to the charge indicator bulb. Use of "P", "F", and "S" terminals is optional. The "P" terminal is connected to the stator, and may be connected externally to a tachometer or other device. The "F" terminal is connected internally to field positive, and may be used as a fault indicator. The "S" terminal may be connected externally to a voltage, such as battery voltage, to sense voltage to be controlled.

As on other charging systems, the charge indicator lights when the switch is closed, and goes out when the engine is running. If the charge indicator is on with the engine running, a charging system defect is indicated. For all kinds of defects, the indicator will glow at full brilliance, not "half lit". Also, the charge indicator will be on with the engine running if system voltage is too high or too low. The regulator voltage setting varies with temperature, and limits system voltage by controlling rotor field current.

This regulator switches rotor field current on and off at a fixed frequency of about 400 cycles per second. By varying the on-off time, correct average field current for proper system voltage control is obtained. At high speeds, the on-time may be 10% and the off-time 90%. At low speeds, with high electrical loads, on-off time may be 90% and 10%, respectively.

No periodic maintenance on the generator is required.

DIAGNOSIS

CHARGING SYSTEM - CS

A basic wiring diagram for the CS charging system is shown in Service Procedures. 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.
    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 above.
- If within 15 amperes of rated output, generator is OK.
- If not within 15 amperes of rated output, replace or repair generator.

SERVICE PROCEDURES

CHARGING SYSTEM

The generator does not require periodic lubrication. The rotor shaft is mounted on ball bearings at the drive end and roller bearings at the slip ring end. Each contains a permanent grease supply. At periodic intervals, check mounting bolts for tightness and adjust belt tension (see Section 6B), if applicable.

- When adjusting belt tension, apply pressure at center of generator, never against either end frame.

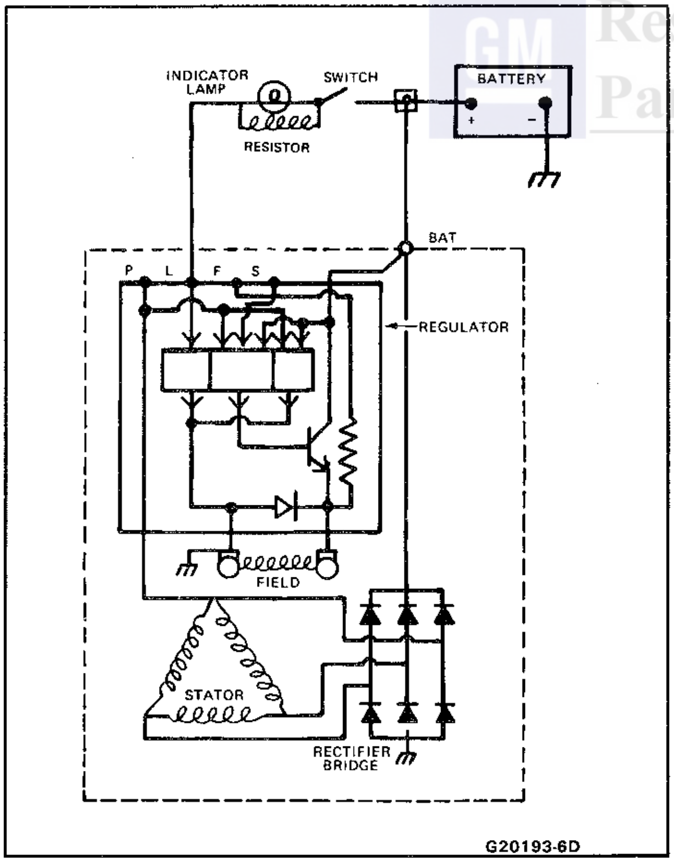


Fig. 1G CS Charging System Wiring Diagram

GENERATOR BENCH CHECK-CS

To check generator in a test stand, remove as specified in On-Car Service and proceed as follows:

1. Make connections as shown in Figure 1H, except leave the carbon pile disconnected. The ground polarity of generator and battery must be the same. The battery must be fully charged. Use a 30-500 OHM resistor between battery and "L" terminal.
2. Slowly increase generator speed and observe voltage.
3. If the voltage is uncontrolled and increases above 16.0 volts, the rotor field is shorted, the regulator is defective, or both. A shorted rotor field coil can cause the regulator to become defective. NOTE: The battery must be fully charged when making this test.
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.

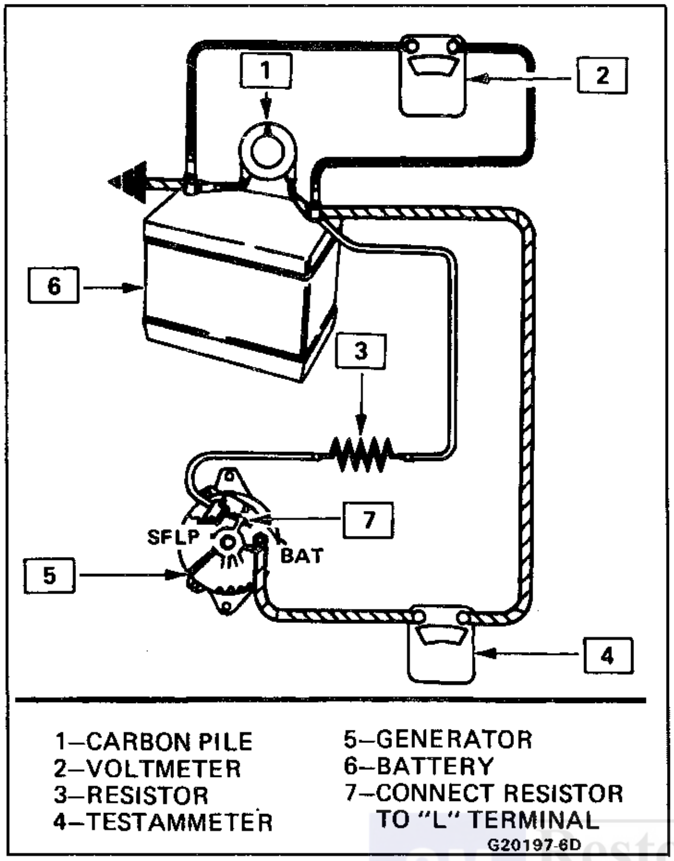


Fig. 1H Generator Bench Check - CS

ON-CAR SERVICE

GENERATOR - LR8

↔ Remove or Disconnect

1. Negative battery cable.

CAUTION: Failure to observe this step may result in an injury from hot battery lead at generator.

2. Battery cable and harness connector at generator.
3. Rear brace bolt.
4. Bolt at tensioner.
5. Through bolt.
6. Generator.

→← Install or Connect

1. Generator.
2. Through bolt-loosely.
3. Battery cable and harness connector (pivot generator for access, if necessary).
4. Bolt at tensioner - 27 N·m (20 lb.ft.).
5. Rear brace bolt - 27 N·m (20 lb.ft.).
6. Through bolt - 50 N·m (37 lb.ft.).
7. Negative battery cable.

GENERATOR - L44

↔ Remove or Disconnect

1. Negative battery cable.

CAUTION: Failure to observe this step may result in an injury from hot battery lead at generator.

2. Loosen top generator bracket to engine bolt.
3. Upper generator bracket to engine bolts (2).
4. Raise car.
5. Right rear wheel.
6. Splash guards.
7. Toe link rod outer end - swing up and left.
8. Lower generator bracket to engine bolt.
9. Generator adjusting bolt.
10. Generator belt.
11. Upper generator to bracket bolt.
12. Generator wires.
13. Rotate generator bracket lower end toward engine.
14. Generator.
15. Shield.

→← Install or Connect

1. Generator with shield.
2. Generator wires.
3. Upper generator to bracket bolt.
4. Generator adjusting bolt.
5. Rotate generator and bracket up into position.
6. Lower generator bracket to engine bolt.
7. Lower car.
8. Upper generator bracket to engine bolts (2) - 50 N·m (37 lb.ft.).

9. Top generator bracket to engine bolt - torque to 80 N·m (59 lb.ft.).
10. Raise car.
11. Generator belt.
12. Generator adjusting bolt (tension belt) - 27 N·m (20 lb.ft.).
13. Toe link rod outer end (do not change adjustment).
14. Splash guards.
15. Right rear wheel.
16. Lower car.
17. Upper generator to bracket bolt - torque to 50 N·m (37 lb.ft.).
18. Negative battery cable.

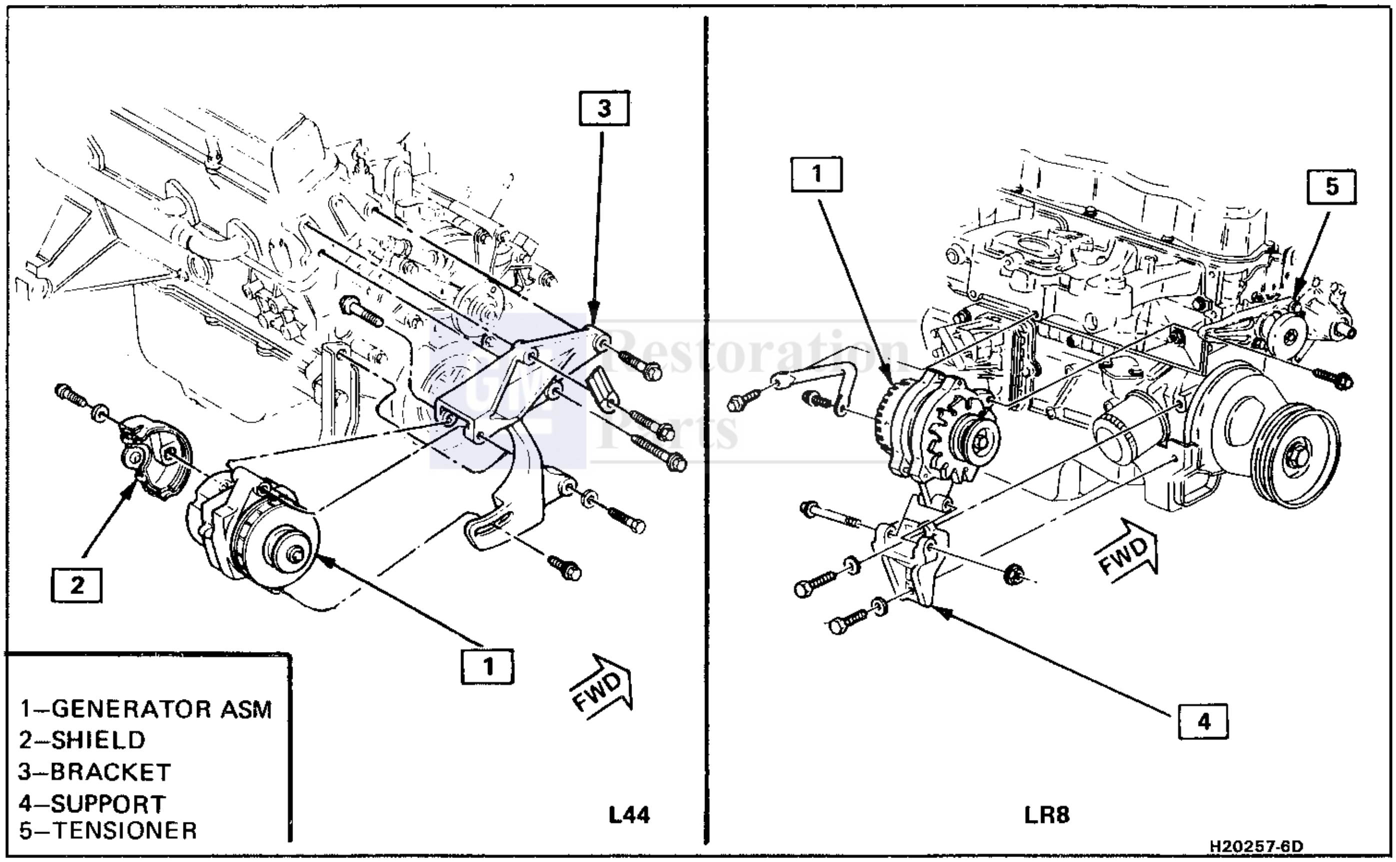


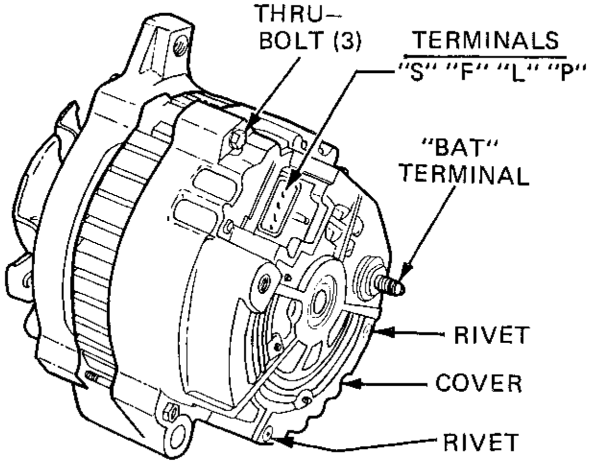
Fig. 801 Generator Mounting

SPECIFICATIONS

ENGINE	EQUIPMENT	GEN/MOD	AMP
2.5L	H-H/HBL-A-A/HBL	1101149/CS130	100A
2.8L	H-H/HBL-A-A/HBL	1101465/CS130	100A

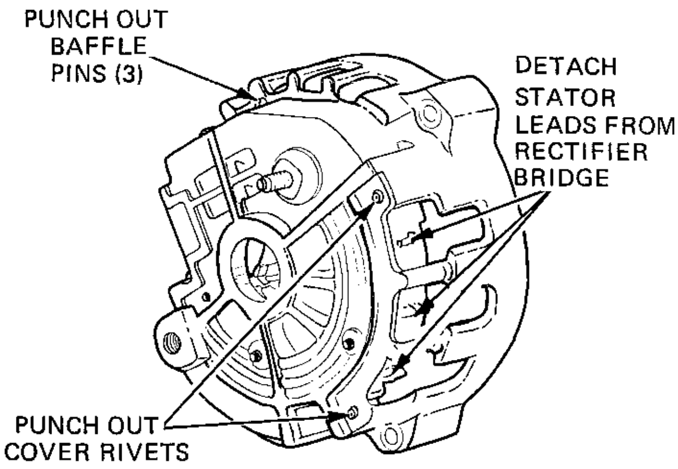
CS130 GENERATOR DISASSEMBLY, TEST AND REASSEMBLY (GENERATOR REMOVED FROM ENGINE)

THRU–BOLT LOCATION



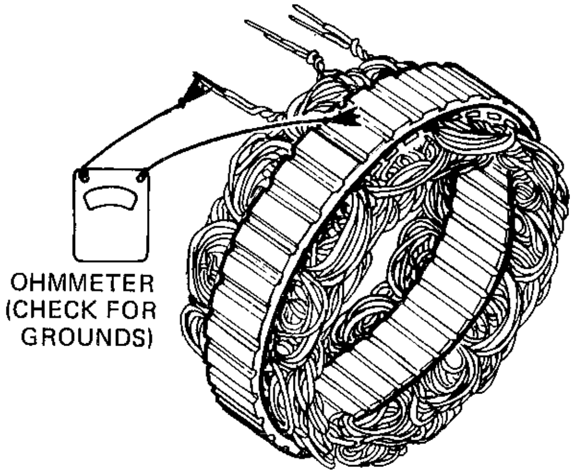
1. Make scribe marks on end frames to facilitate reassembly.
2. Remove thru-bolts and separate end frames.
3. Punch out cover rivets, or pins, and remove cover on slip ring end frame.

END FRAME VIEW



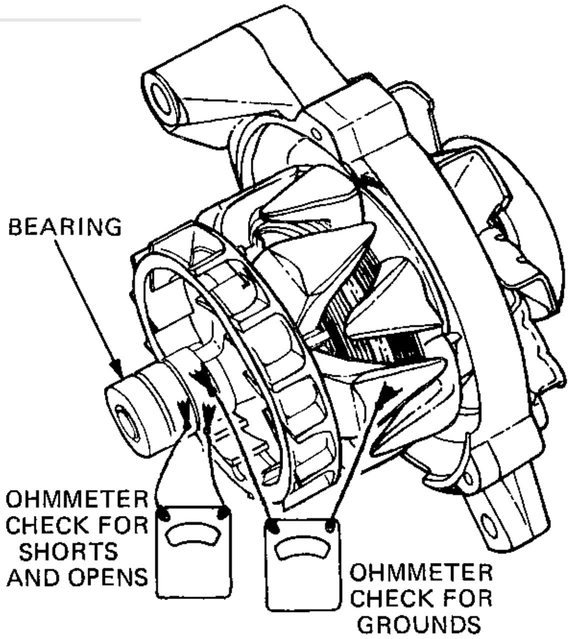
4. Unsolder stator leads at three terminals on rectifier bridge. Avoid excessive heat, which could damage diodes in rectifier bridge. NOTICE: If stator leads are welded, in place of soldered, cut stator leads about half way back on rectifier bridge terminals.
5. Remove stator.
6. Drive out three baffle pins and remove baffle from inside of slip ring end frame.

TESTING STATOR



7. Check stator for grounds with ohmmeter. If reading is low, replace stator.

TESTING ROTOR



8. Check rotor for grounds with ohmmeter. Check can be made with drive end frame assembled. Reading should be very high. If not, replace rotor. Hold rotor with hex wrench in shaft when removing shaft nut.
9. Check rotor for opens and shorts. Should read 1.7-2.3 ohms. If not, replace rotor.

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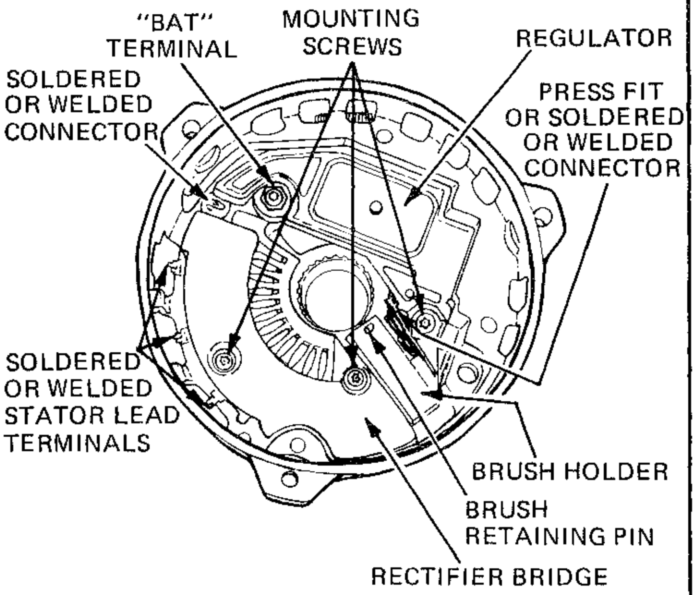
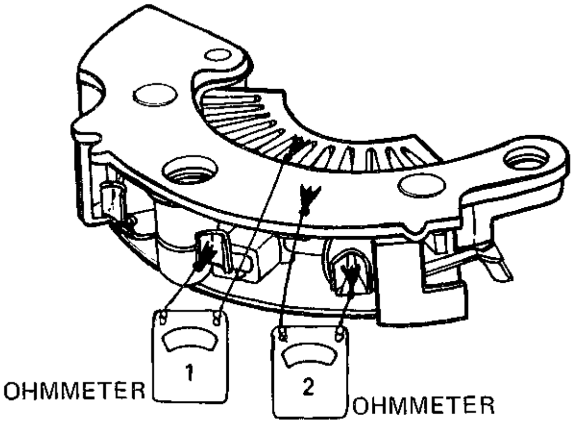
Fig. 802 CS130 Generator Disassembly, Test and Reassembly 1 of 3

REMOVE BRUSH HOLDER, REGULATOR AND RECTIFIER



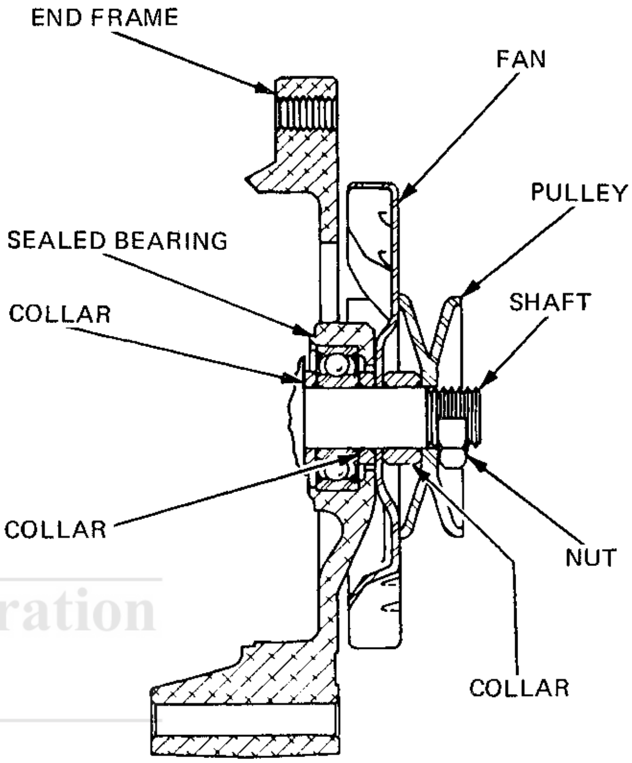
10. Remove brush holder screw, disconnect terminal and remove brush holder assembly. If brushes are to be reused, clean with a soft dry cloth and use retaining pin to hold brushes in holder.
11. Unsolder and pry open terminal between regulator and rectifier bridge. Remove terminal and attaching screws to remove regulator and rectifier bridge from end frame.

TESTING RECTIFIER BRIDGE



12. To check rectifier bridge, connect ohmmeter using low scale to one terminal and heat sink (step 1). Reverse leads. If both readings are the same, replace rectifier bridge. Check other two diodes in same manner as step 1. NOTICE: Some digital ohmmeters cannot be used to check diodes in bridge. Consult ohmmeter manufacturer to determine tester capabilities.
13. Check remaining three diodes in same manner by connecting ohmmeter from each terminal to base plate (step 2). If both readings are the same on any diode, replace rectifier bridge.

DRIVE END BEARING



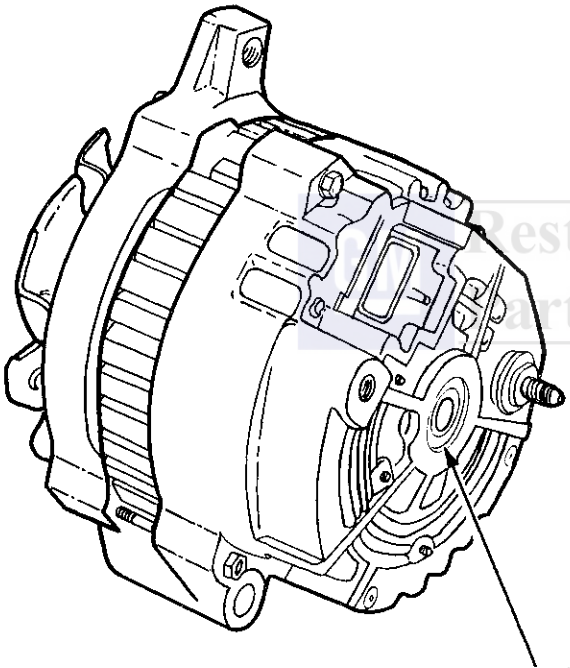
CROSS SECTION
DE FRAME CS–130

14. Note stack up of parts for drive end bearing assembly. Hold rotor with hex wrench to remove, or tighten shaft nut. Torque to 54-108 N•m (40-80 lb.-ft.).

G20213-6D

Fig. 803 CS130 Generator Disassembly, Test and Reassembly 2 of 3

SLIP RING END FRAME BEARING



15. Install new tolerance ring inside of slip ring end frame.
16. Press outer race of new bearing against bottom of end frame casting.
17. Assemble brush holder using insulated screw to end frame; position holder so brushes will ride squarely on commutator. Use retainer pin to hold brushes in holder.
18. Assemble rectifier bridge to end frame using silicone grease (to dissipate heat) between bridge and end frame. Securely crimp the electrical connection between bridge and brush holder.
19. Install regulator, crimp and solder connection between regulator and bridge.
20. Install new baffle. Use punch to drive pins down flush with baffle.
21. Install stator, solder and crimp to three connectors on bridge. Avoid excessive heat which could damage diodes in rectifier bridge.
22. Install outside cover using punch to drive pins down flush with cover.
23. To assemble drive end frame and rotor assembly into end frame, push on both inner and outer race to push slip ring end assembly over shaft. Then push on both inner and outer race until outer race is recessed 1.9-2.2 mm inside end frame casting.
24. Assemble three bolts and remove brush retaining pin.

G20214-6D

Fig. 804 CS130 Generator Disassembly, Test and Reassembly 3 of 3

SECTION 6D4

IGNITION SYSTEM

CONTENTS

GENERAL DESCRIPTION

The engine electrical system includes the battery, ignition (primary and secondary), starter (and related wiring) and the generator (and related wiring). Diagnostic charts (see Section 6D) will aid in trouble-shooting system faults. When a fault is traced to a particular component, refer to that components' section of the service manual.

IGNITION SYSTEM

Distributor Ignition

The ignition circuit consists of the battery, distributor, ignition switch, spark plugs and primary and secondary wiring. Refer to the Battery portion of this section for battery information.

HEI Distributor

The High Energy Ignition (HEI) distributor with Electronic Spark Timing (EST), used on most engines, combines all ignition components in one unit. The ignition coil is in the distributor cap and connects through a resistance brush to the rotor.

The distributor has an internal magnetic pick-up assembly which contains a permanent magnet, a pole piece with internal teeth and a pick-up coil. When the teeth of the timer core, rotating inside the pole piece, line up with the teeth of the pole piece, an induced voltage in the pick-up coil signals the electronic module to trigger the coil primary circuit. The primary current decreases and a high voltage is induced in the ignition coil secondary winding. This voltage is directed through the rotor and secondary leads to fire the spark plugs. The capacitor in the distributor is for radio noise suppression.

All spark timing changes in the HEI (EST) distributor are done electronically by an Electronic Control Module (ECM), which monitors information from various engine sensors, computes the desired spark timing and signals the distributor to change the timing accordingly. A back-up spark advance system is incorporated to signal the ignition module in case of (ECM) failure. No vacuum or mechanical advance is used. Further (EST) information is found in sections 6E Emissions Control, and 8A Electrical Troubleshooting.

IGNITION SYSTEM

Distributorless Ignition

Distributorless ignition systems use a "waste spark" method of spark distribution. Each cylinder is paired with its opposing cylinder in the firing order, so that one cylinder on compression fires simultaneously with its opposing cylinder on exhaust. Since the cylinder on exhaust requires very little of the available voltage to fire its plug, most of the voltage is used to fire the cylinder on compression. The process reverses when the cylinders reverse roles. There are two or three coils for a 4-cylinder or 6-cylinder engine (DIS - Direct Ignition System) and three coils for a 6-cylinder engine (C^{3}I).

Direct Ignition System

Components of the Direct Ignition System are a coil pack, ignition module, crankshaft reluctor ring, magnetic sensor, and the ECM. The coil pack consists of two separate, interchangeable, ignition coils. These coils operate in the same manner as previous coils. Two coils are needed because each coil only fires for two cylinders. The ignition module is located under the coil pack and is connected to the ECM by a 6-pin connector. The ignition module controls the primary circuit to the coils, turning them on and off, and controls spark timing below 400 rpm and if the ECM bypass circuit becomes open or grounded (see Section 6E2).

The magnetic pickup sensor inserts through the engine block, just above the pan rail, in proximity to

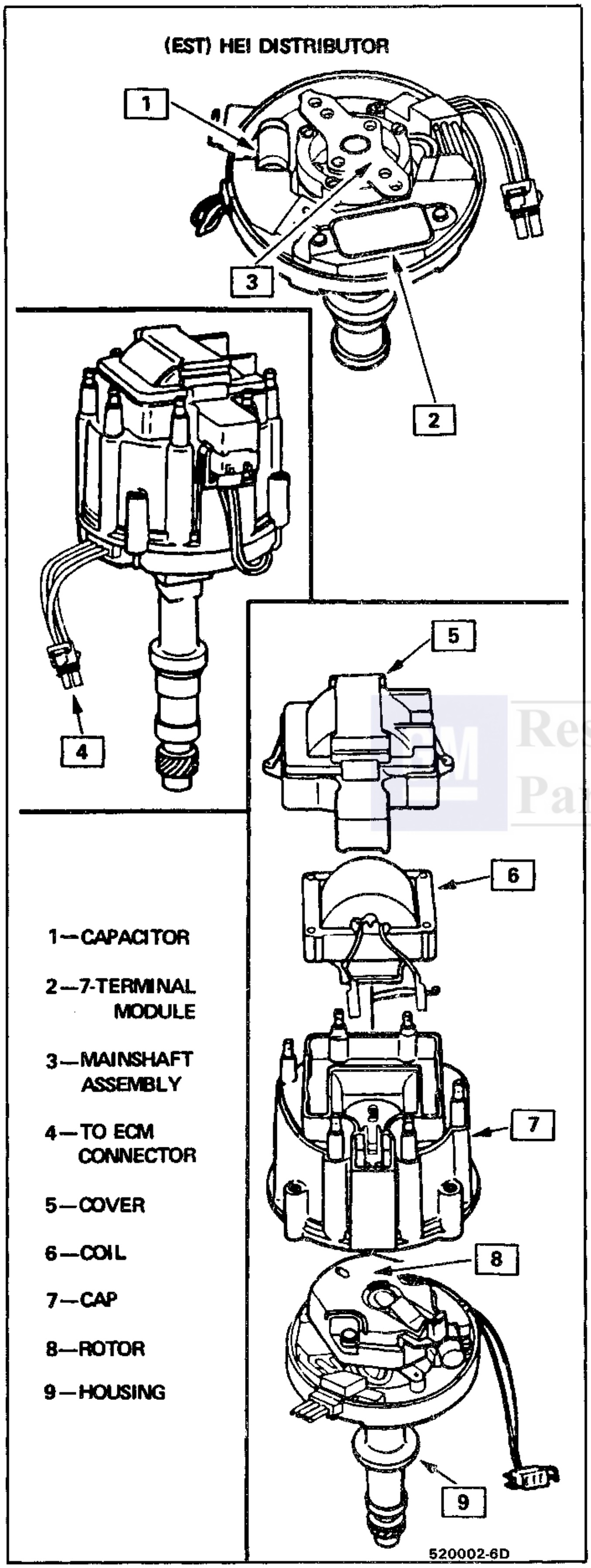


Fig. 1 HEI (EST) Distributor

the crankshaft reluctor ring. Notches in the crankshaft reluctor ring tigger the magnetic pickup sensor to provide timing information to the ECM. The magnetic pickup sensor provides a cam signal to identify correct firing sequence, and crank signals to trigger each coil at the proper time.

This system uses EST and control wires from the ECM, as with distributor systems. The ECM controls timing using crankshaft position, engine rpm, engine temperature, and manifold absolute pressure (MAP) sensing.

Further EST information is found in Sections 6E2 and 8A.

Ignition Timing

Timing specifications for each engine are listed in Section 6E. When using a timing light, connect an adapter between the No. 1 spark plug and the No. 1 spark plug wire, or use an inductive type pick-up. **Do not pierce the plug lead.** Once the insulation of the spark plug cable has been broken, voltage will jump to the nearest ground, and the spark plug will not fire properly. **Always follow the tune-up label procedures when adjusting timing.**

Some engines will incorporate a magnetic timing probe hole for use with special electronic timing equipment. Fig. 1A shows a typical magnetic probe hole. Consult manufacturer's instructions for use of this equipment.

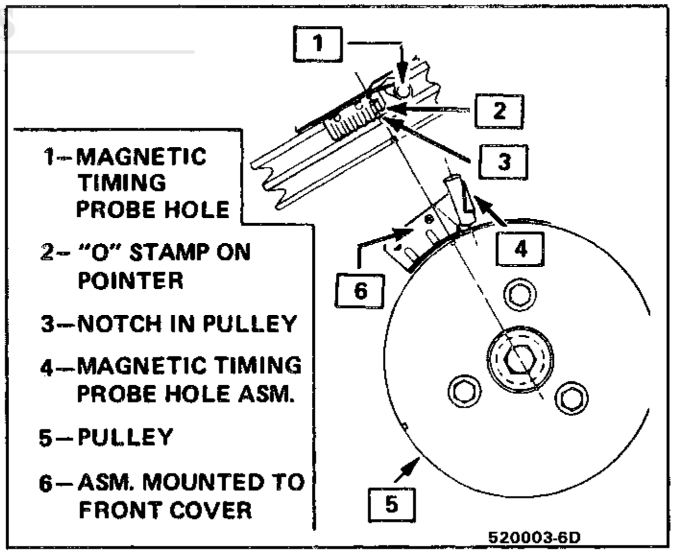


Fig. 1A Magnetic Timing Probe Hole

Secondary Wiring

The spark plug wiring used with ignition systems is a carbon impregnated cord conductor, encased in an 8MM (5/16") diameter silicone rubber jacket. The silicone jacket withstands very high temperatures and also provides an excellent insulator for the higher voltage of the HEI system. Silicone spark plug boots form a tight seal on the plug. **The boot should be twisted 1/2 turn before removing.** Care should also be exercised when connecting a timing light or other pick-up equipment. Do not force anything between the boot and wiring, or through the silicone jacket. Connections should be made in parallel using an adapter. DO NOT pull on the wire to remove. Pull on the boot, or use a tool designed for this purpose.

Spark Plugs

Resistor type, tapered seat spark plugs are used on all engines (except aluminum heads). No gasket is used on these tapered seat plugs. See Figs. 1B and 1C for an explanation of coding on spark plugs.

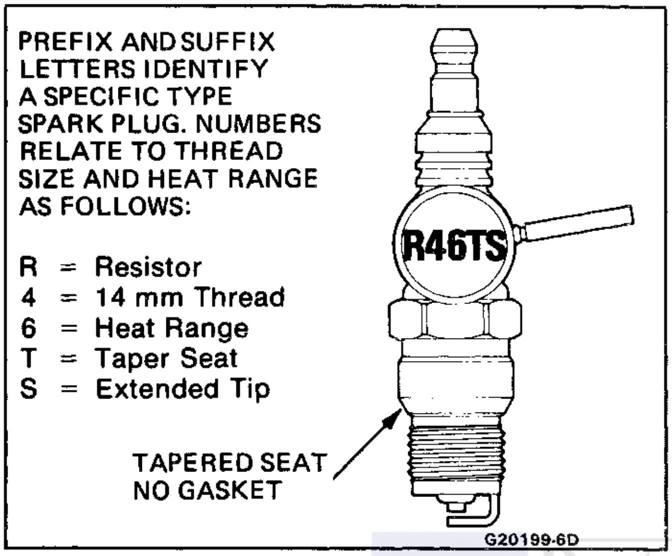


Fig. 1B Spark Plug Example

1st number denotes THREAD SIZE

4 = 14 mm
8 = 18 mm
10 = 10 mm
12 = 12 mm
2 = ½-inch taper
5 = ½-inch
6 = ¾-inch
7 = ⅞-inch

2nd number denotes HEAT RANGE

0-1-2-3-4-5-6-7-8-9
COLD ——— HOT

G20200-6D

Fig. 1C Spark Plug Coding

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 misfiring. Do not mistake corona discharge for flash-over, or a shorted insulator. Corona is a steady blue light appearing around the insulator, just above the shell crimp. It is the visible evidence of a high-tension field and has no effect on ignition performance. Usually it can be detected only in darkness. This discharge may repel dust particles, leaving a clear ring on the insulator just above the shell. This ring is sometimes mistakenly regarded as evidence that combustion gases have blown out between shell and insulator.

Ignition Switch

The mechanical switch is located in the steering column on the right hand side just below the steering wheel. The electrical switching portion of the assembly is separate from the key and lock cylinder. However, both are synchronized and work in conjunction with each other through the action of the actuator rod assembly.

For a complete explanation of the key and lock cylinder, and the actuator rod assembly, see STEERING, Section 3B. See Section 8 for electrical switching.

DIAGNOSIS

IGNITION SYSTEM

Spark Plugs

Worn or dirty plugs may give satisfactory operation at idling speed, but at higher RPM they frequently fail. Faulty plugs are indicated in a number of ways: poor fuel economy, power loss, loss of speed, hard starting and generally poor engine performance.

Spark plugs may also fail due to carbon fouling, excessive gap, or a broken insulator.

Fouled plugs may be indicated by black carbon deposits. The black deposits are usually the result of slow-speed driving and short runs, where sufficient engine operating temperature is seldom reached. Worn pistons, rings, faulty ignition, over-rich carburetion and spark plugs which are too cold will also result in carbon deposits.

Excessive gap wear, on plugs of low mileage, usually indicates the engine is operating at high speeds, or loads that are consistently greater than normal, or that a plug which is too hot is being used. Electrode wear may also be the result of plug overheating, caused by combustion gases leaking past the threads due to insufficient torquing of the spark plug. Excessively lean carburetion will also result in accelerated electrode wear.

Broken insulators are usually the result of improper installation, or carelessness when regapping the plug. Broken upper insulators usually result from a poor fitting wrench, or an outside blow. The cracked insulator may not show up right away, but will as soon as oil or moisture penetrates the crack. The crack is usually just below the crimped part of shell and may not be visible.

Broken lower insulators usually result from carelessness when regapping and generally are visible. This type of break may result from the plug operating too "hot", which may happen in periods of high-speed operation or under heavy loads. When regapping a spark plug, always make the gap adjustment by bending the ground (side) electrode. Spark plugs with broken insulators should always be replaced.

HEI Distributor

See Unit Repair for distributor disassembly, test and reassembly of individual distributor components, when the distributor is removed from the vehicle. See On-Car Service for distributor removal and installation and for component removal with distributor in car. See Section 6E for HEI and EST diagnosis.

Distributorless Ignition

Diagnosis for the distributorless ignition systems, C^{3}I and DIS, may be found in Section 6E3.

SERVICE PROCEDURES

IGNITION SYSTEM

Distributor Ignition

NOTICE: This procedure is generally true for most carlines. Where procedure is different, or where additional information is required, see "ON-CAR SERVICE" for specific carline.

HEI DISTRIBUTOR

Service Precautions

1. When making compression checks, disconnect the ignition switch feed wire at the distributor. When disconnecting this connector, **do not** use a screwdriver or tool to release the locking tab, as it may break.
2. No periodic lubrication is required. Engine oil lubricates the lower bushing and an oil-filled reservoir provides lubrication for the upper bushing.
3. The tachometer (TACH) terminal is next to the ignition switch (BAT) connector on the distributor cap.

NOTICE: The tachometer terminal must NEVER be allowed to touch ground, as damage to the module and/or ignition coil can result.

Some tachometers currently in use may NOT be compatible with the High Energy Ignition System. Consult the manufacturer of the tachometer if questions arise.

4. Dwell adjustment is controlled by the module, and cannot be adjusted.
5. The material used to construct the spark plug cables is very soft. This cable will withstand more heat and carry a higher voltage, but scuffing and cutting become easier. The spark plug cables must be routed correctly to prevent chaffing or cutting. See Spark Plug Section. When removing a spark plug wire from a spark plug, twist the boot on the spark plug and pull **on the boot** to remove the wire, or use a special tool designed to remove spark plug boots.

Remove or Disconnect

1. Ignition switch battery feed wire and tachometer lead (if equipped) from distributor cap. Also release the coil connectors from the cap. (DO NOT use a screwdriver or tool to release the locking tabs.)
2. Distributor cap by turning four screws counterclockwise. Move cap out of the way.
3. Four-terminal ECM harness from distributor.
4. If necessary, remove secondary wires from cap, release wiring harness latches and remove wiring harness retainer. The spark plug wire numbers are indicated on the retainer.
5. Distributor clamp screw and hold-down clamp.
6. Note position of rotor, then pull distributor up until rotor just stops turning counterclockwise and again note position of rotor.
   - To insure correct timing of the distributor, the distributor must be INSTALLED with the rotor correctly positioned as noted.

If the engine was accidentally cranked after the distributor was removed, the following procedure can be used for installing:

1. Remove No. 1 spark plug.
2. Place finger over No. 1 spark plug hole and crank engine slowly until compression is felt.
3. Align timing mark on pulley to "0" on engine timing indicator.
4. Turn rotor to point between No. 1 and No. 8 spark plug towers on distributor cap on V8 engines, between No. 1 and No. 6 on V6 engines, and No. 1 and No. 4 on 4 cylinder engines.
5. Install distributor and connect ignition feed wire.
6. Install distributor cap and spark plug wires.
7. Check engine timing (see Set Ignition Timing).

Install or Connect

1. Insert distributor, positioning rotor as removed.
2. Distributor hold-down clamp and screw.
3. Wiring harness retainer and secondary wires, if removed.
4. ECM harness connector.
5. Distributor cap.
6. Coil connectors.
7. Battery wire and tachometer lead, if equipped.

Module

It is not necessary to remove the distributor from car.

Remove or Disconnect

1. Distributor cap and rotor.
2. Two module attaching screws, and lift module up.
3. Leads from module. (Observe color code on leads as these cannot be interchanged.)
4. Do not wipe grease from module, or distributor base, if same module is to be replaced.

→← **Install or Connect**

NOTICE: If a new module is to be installed, a package of silicone grease will be included with it. Spread the grease on the metal face of the module and on the distributor base where the module seats. This grease is necessary for module cooling.

1. Module.
2. Module leads (observe color code).
3. Attaching screws to module.
4. Rotor.
5. Cap.

Pick-Up Coil

1. Remove distributor from car and follow instructions in Unit Repair, as applicable.

Rotor

Fig. 1

1. Remove distributor cap.
2. The rotor is retained by two screws and is provided with a slot which fits over a square lug, so that the rotor can be installed in only one position.

Integral Ignition Coil

Fig. 1

←→ **Remove or Disconnect**

1. Distributor cap.
2. Three coil cover attaching screws, and lift off cover.
3. Coil attaching screws and lift ignition coil and leads from cap.

→← **Install or Connect**

1. Coil and attaching screws.
2. Coil leads.
3. Coil cover and attaching screws.

Capacitor

Fig. 1

The capacitor is part of the coil wire harness assembly. Since the capacitor is used only for radio noise suppression, it will seldom need replacement.

←→ **Remove or Disconnect**

1. Distributor cap and rotor.
2. Capacitor attaching screw and unplug connector from module. It may help to loosen the module.

→← **Install or Connect**

1. Plug into module.
2. Capacitor and hold-down screw (be sure ground lead is under screw).
3. Rotor and cap.

Set Ignition Timing

1. Refer to the tune-up label located in the engine compartment. Follow all instructions on the label.
2. With ignition off, connect the pick-up lead of timing light to the number one spark plug. Use a jumper lead between the wire and plug, or an inductive type pick-up. **DO NOT** pierce the wire, or attempt to insert a wire between the boot and the wire. Connect the timing light power leads according to manufacturer's instructions.
3. Start the engine and aim the timing light at the timing mark. The line on the balancer or pulley will line up at the timing mark. If a change is necessary, loosen the distributor hold-down clamp bolt at the base of the distributor. While observing the mark with the timing light, slighty rotate the distributor until the line indicates the correct timing. Tighten the hold-down bolt and re-check the timing.
4. Turn off the engine and remove the timing light. Reconnect the number one spark plug wire, if removed.

Spark Plug Wires

Use care when removing spark plug wire boots from spark plugs. Twist the boot 1/2 turn before removing and pull on the **boot only** to remove the wire.

When replacing plug wires, route the wires correctly and through the proper retainers. Failure to route the wires properly can lead to radio ignition noise and crossfiring of the plugs, or shorting of the leads to ground.

Special care should be exercised when reinstalling spark plug boots, to assure that the metal terminal within the boot is fully seated on the spark plug terminal and that the boot has not moved on the wire. If boot to wire movement has occurred, the boot will give a false visual impression of being fully seated. A good check to assure that boots have been properly assembled is to push sideways on the installed boots. If they have been correctly installed, a stiff boot, with only slight looseness, will be noted. If the terminal has not been properly seated on the spark plug, only the resistance of the rubber boot will be felt when pushing sideways.

Distributorless Ignition

The distributorless ignition system consists of the following serviceable components.

1. Coil pack - Service as a complete unit (see On-Car Service).
2. Ignition module - Service as a complete unit (see On-Car Service).
3. Hall effect sensor(s) - Service as a complete unit (see On-Car Service).
4. ECM (see Section 6E3).

ON-CAR SERVICE

DISTRIBUTORLESS IGNITION - 2.5L

The 2.5L Direct Ignition System (DIS) consists of the following serviceable components:

1. Individual coils (2).
2. Ignition module - Service as a complete unit.
3. Crankshaft sensor - Attached below Ignition Module (inserts through block above pan rail). Service as a complete unit.
4. ECM (see section 6E2 or 6E3).

IGNITION COIL

←→ Remove or Disconnect

1. Negative battery cable.
2. Spark plug wires.
3. Coil attaching nuts.
4. Coil (do not bend module prongs).

→← Install or Connect

1. Coil.
2. Coil attaching nuts.
3. Spark plug wires.
4. Negative battery cable.

IGNITION MODULE

←→ Remove or Disconnect

1. Negative battery cable.
2. Module connectors.
3. Plug wires at coil.
4. Module attaching bolts and nuts.
5. Module.

NOTICE: Sensor is attached below module. Module must be removed slowly and carefully to avoid damage to sensor.

→← Install or Connect

1. Module (insert sensor carefully in hole above pan rail).
2. Module attaching bolts and nuts.
3. Plug wires at coil.
4. Module connectors.
5. Negative battery cable.

SENSOR

←→ Remove or Disconnect

1. Ignition module.
2. Unplug sensor.

→← Install or Connect

1. Replug sensor.
2. Ignition module.

IGNITION SYSTEM - 2.8L

Distributor

←→ Remove or Disconnect

1. Battery ground cable.
2. Distributor wiring harness at coil.
3. Distributor cap and position out of way.
4. Coil assembly, see Ignition Coil Removal.
5. Scribe a mark on the engine in line with rotor. Note approximate position of distributor housing in relation to engine.
6. Distributor hold-down nut and clamp.
7. Lift distributor from engine.

→← Install or Connect

1. Distributor, orienting rotor.
2. Distributor hold-down clamp and nut.
3. Move distributor housing to approximate position relative to engine noted during removal.
4. Position distributor cap to housing with tab in base of cap aligned with notch in housing and secure the two latches.
5. Wiring harness connector to terminals on side of distributor cap. Connector will fit only one way.
6. Adjust ignition timing.

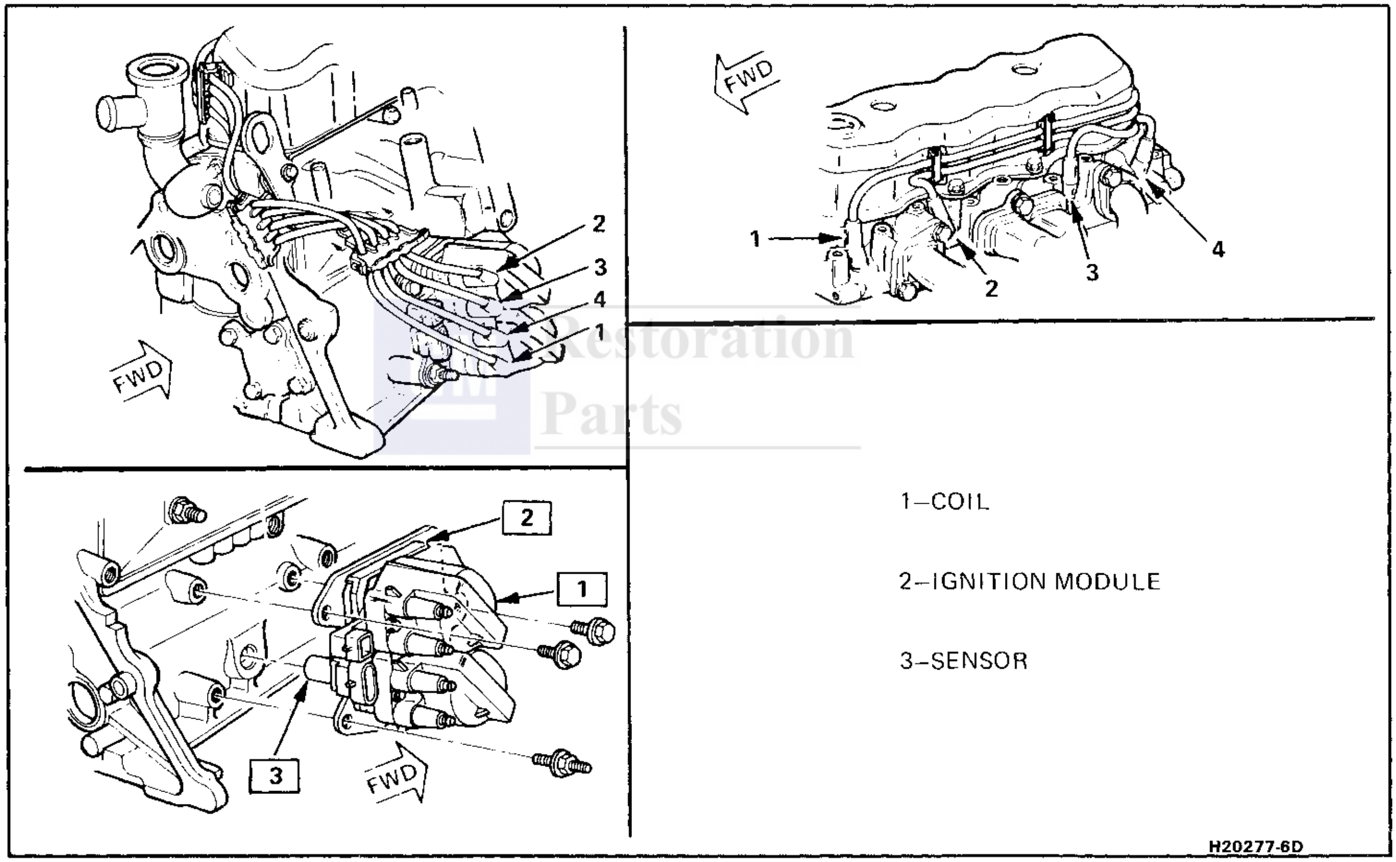
IGNITION COIL

←→ Remove or Disconnect

1. Shield.
2. Ignition switch to coil lead.
3. Coil to distributor lead.
4. Coil to bracket screws.

→← Install or Connect

1. Coil to bracket screws.
2. Coil to distributor lead.
3. Coil to ignition switch lead.
4. Shield.



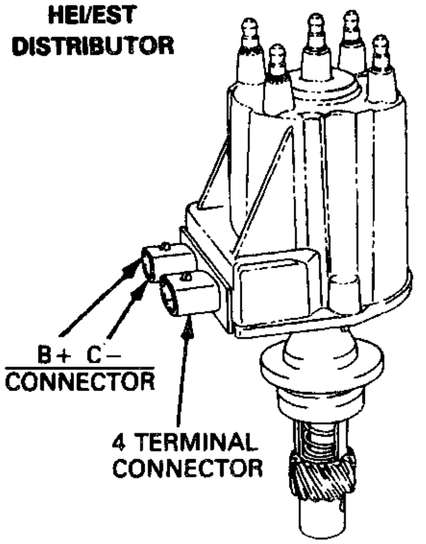
1—COIL

2—IGNITION MODULE

3—SENSOR

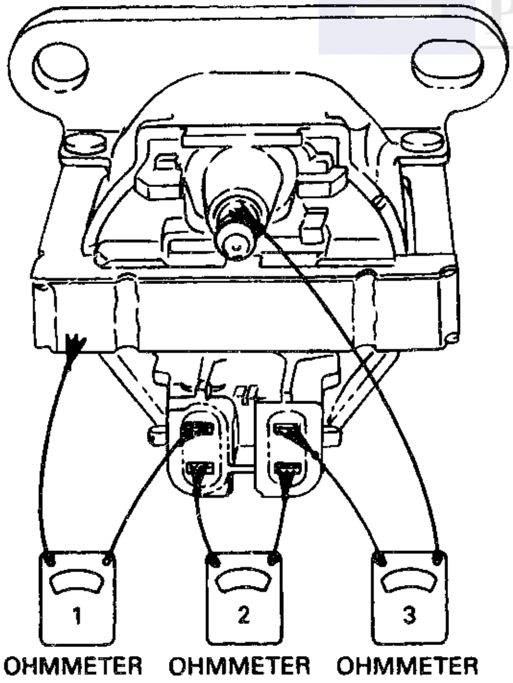
Fig. 801 Ignition Module, Coils and Wiring

DISTRIBUTOR DISASSEMBLY TEST AND REASSEMBLY (SEPARATELY MOUNTED COIL)



1. A TYPICAL DISTRIBUTOR USED WITH A SEPARATELY MOUNTED COIL IS SHOWN.

TESTING IGNITION COIL



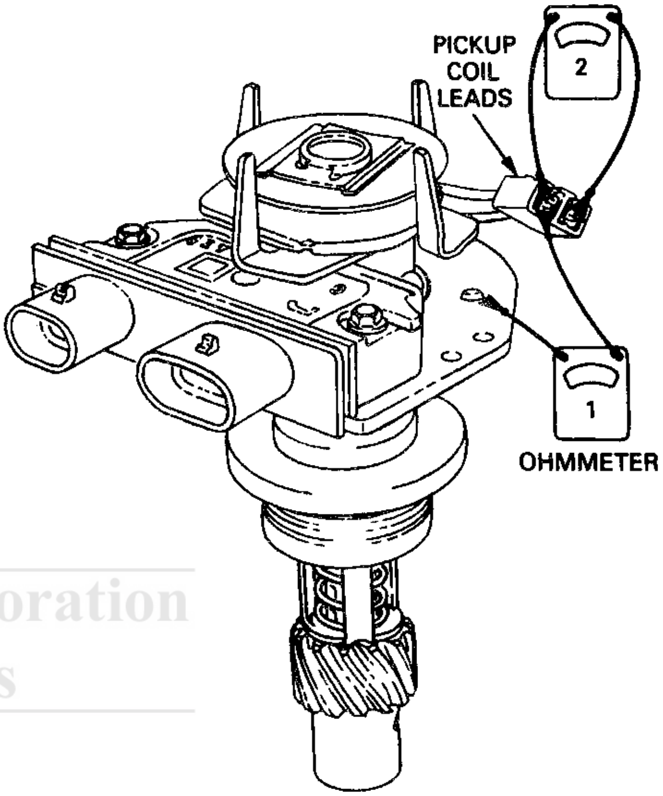
2. CHECK IGNITION COIL WITH OHMMETER FOR OPENS AND GROUNDS:

STEP 1. — USE HIGH SCALE. SHOULD READ VERY HIGH (INFINITE). IF NOT, REPLACE COIL.

STEP 2. — USE LOW SCALE. SHOULD READ VERY LOW OR ZERO. IF NOT, REPLACE COIL.

STEP 3. — USE HIGH SCALE. SHOULD NOT READ INFINITE. IF IT DOES, REPLACE COIL.

TESTING PICKUP COIL



3. REMOVE ROTOR AND PICKUP COIL LEADS FROM MODULE.

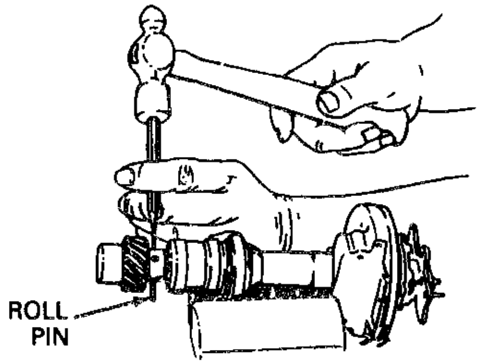
4. CONNECT OHMMETER PART 1 AND PART 2.

5. OBSERVE OHMMETER. FLEX LEADS BY HAND TO CHECK FOR INTERMITTENT OPENS.

STEP 1 — SHOULD READ INFINITE AT ALL TIMES. IF NOT, PICKUP COIL IS DEFECTIVE.

STEP 2 — SHOULD READ ONE STEADY VALUE BETWEEN 500-1500 OHMS AS LEADS ARE FLEXED BY HAND. IF NOT, PICKUP COIL IS DEFECTIVE.

DRIVING PIN FROM SHAFT



6. DRIVE ROLL PIN FROM GEAR AND REMOVE SHAFT ASSEMBLY. MARK GEAR AND SHAFT FOR CORRECT REASSEMBLY.

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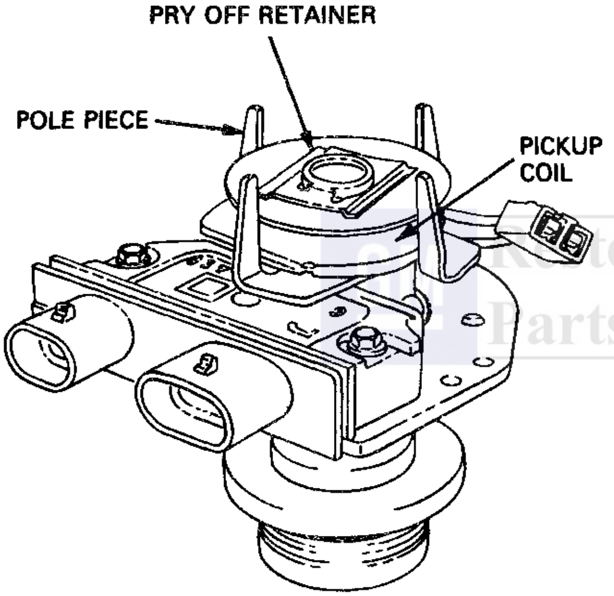
Fig. 802 Distributor Disassembly, Test and Reassembly (Separate Coil) 1 of 2

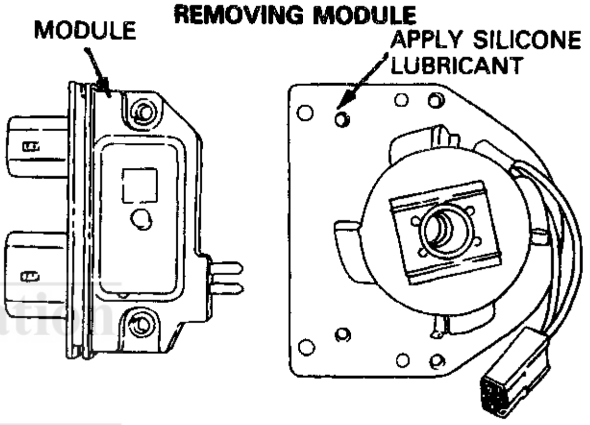
REMOVE PICKUP COIL



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. 803 Distributor Disassembly, Test and Reassembly (Separate Coil) 2 of 2

SECTION 6D5

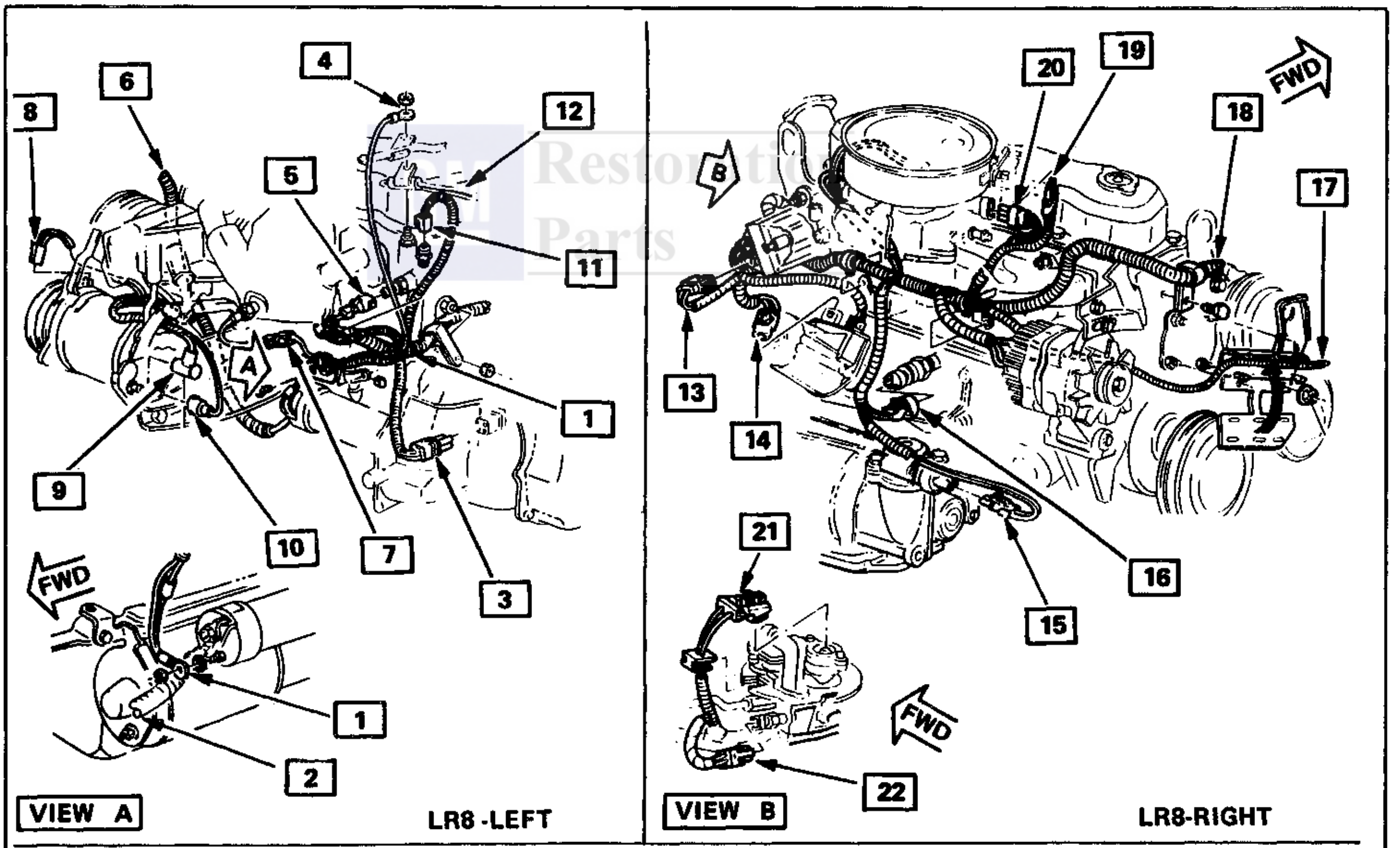
ENGINE WIRING

CONTENTS

GENERAL DESCRIPTION

The engine electrical system includes the battery, ignition (primary and secondary), starter (and related wiring) and the generator (and related wiring). Diagnostic charts (see Section 6D) will aid in trouble-shooting system faults. When a fault is traced to a particular component, refer to that components' section of the service manual.

ON-CAR SERVICE



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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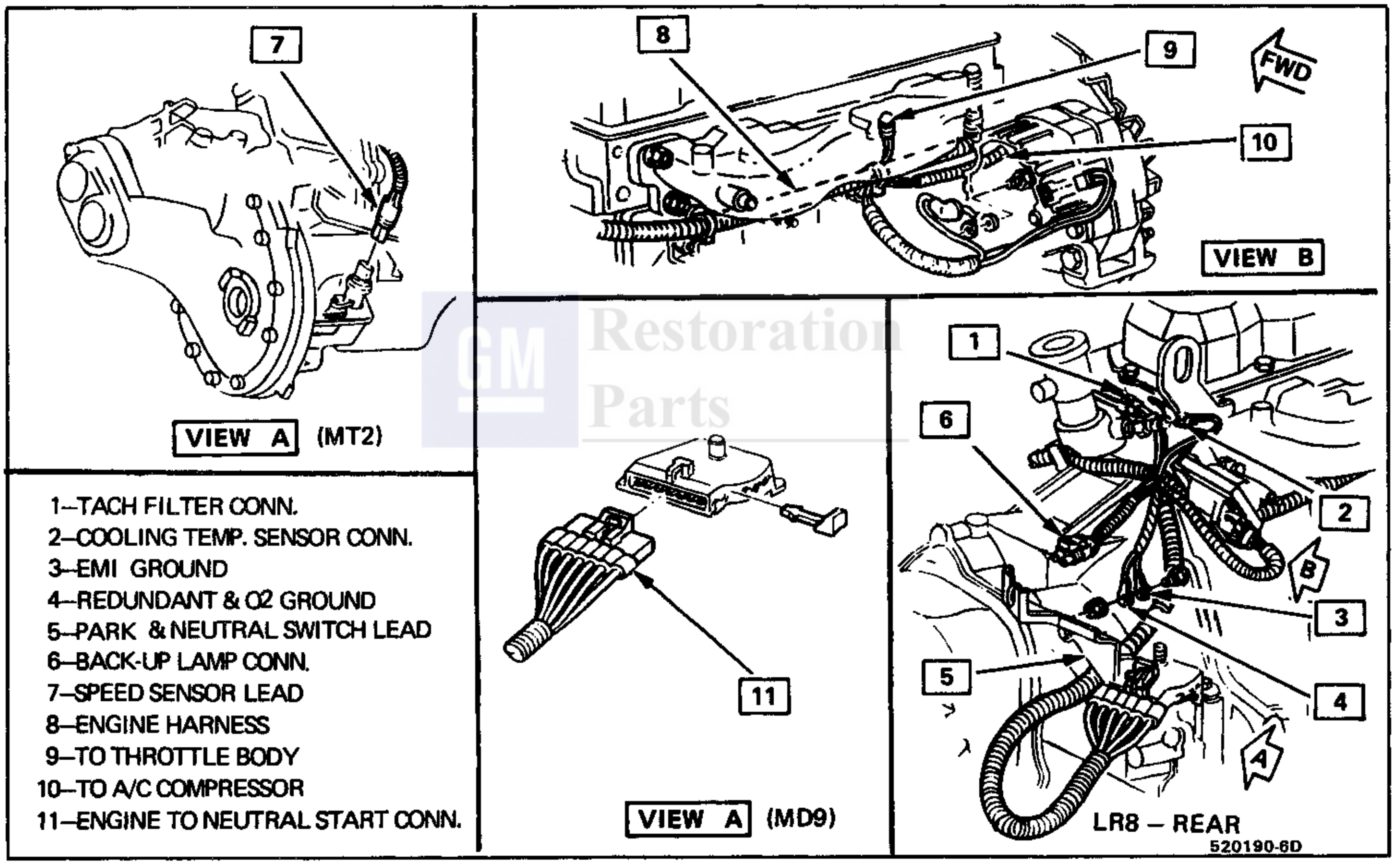
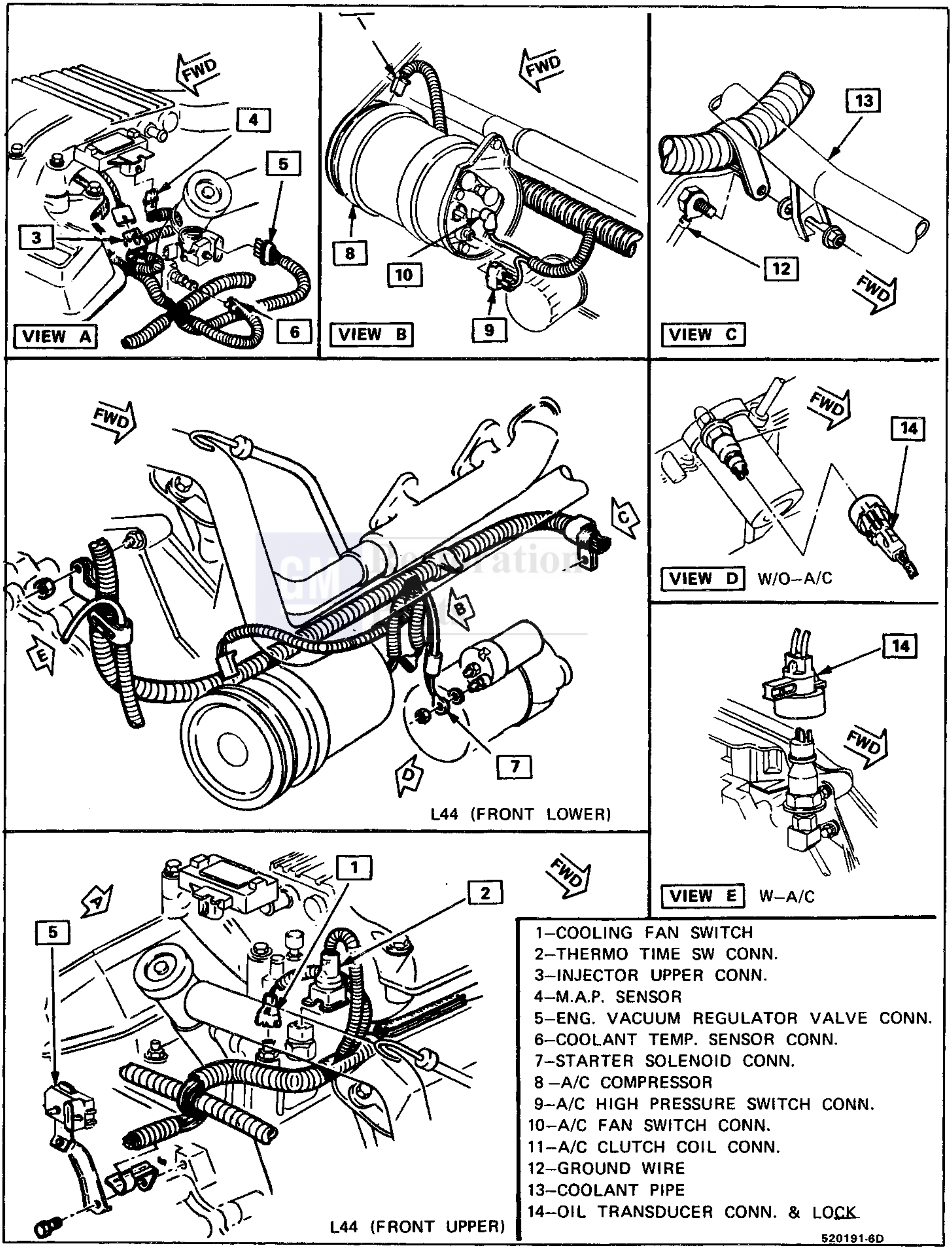
Fig. 801 Engine Wiring - Front (LR8)



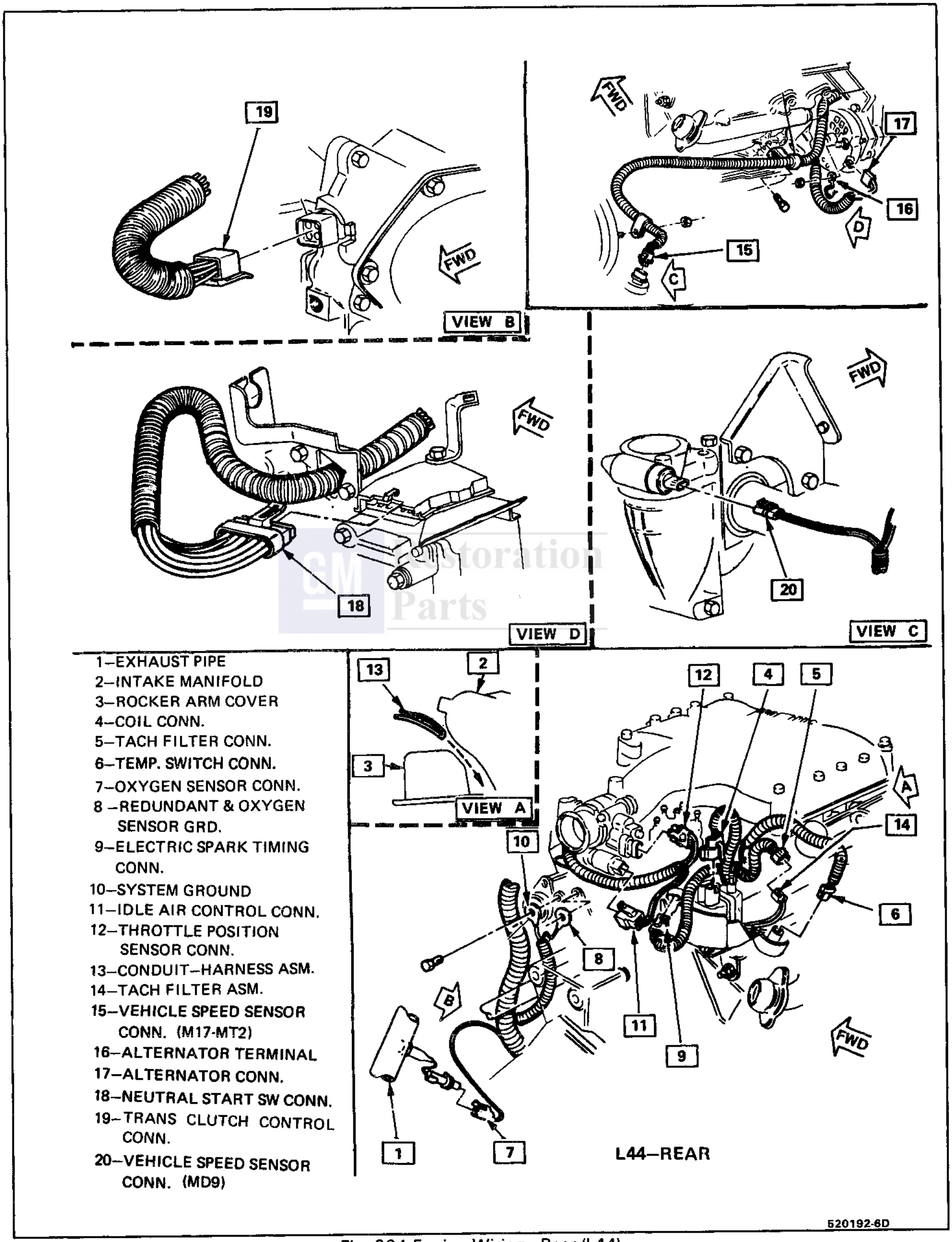
1–TACH FILTER CONN.
2–COOLING TEMP. SENSOR CONN.
3–EMI GROUND
4–REDUNDANT & O2 GROUND
5–PARK & NEUTRAL SWITCH LEAD
6–BACK-UP LAMP CONN.
7–SPEED SENSOR LEAD
8–ENGINE HARNESS
9–TO THROTTLE BODY
10–TO A/C COMPRESSOR
11–ENGINE TO NEUTRAL START CONN.

Fig. 802 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. 803 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. 804 Engine Wiring - Rear (L44)

SECTION 6E

DRIVEABILITY AND EMISSIONS

CONTENTS

General Information - Section 6E
Driveability and Emissions - Fuel Injected (TBI) - Section 6E2
Driveability and Emissions - Fuel Injected (PORT) - Section 6E3

6E CONTENTS

DRIVEABILITY

The driveability diagnosis procedures apply to various systems in current GM vehicles. The procedures assume that the vehicle worked right at one time and the problem is due to time, wear, dirt or other causes. Start with the introduction that follows. This will describe a systematic diagnostic procedure.

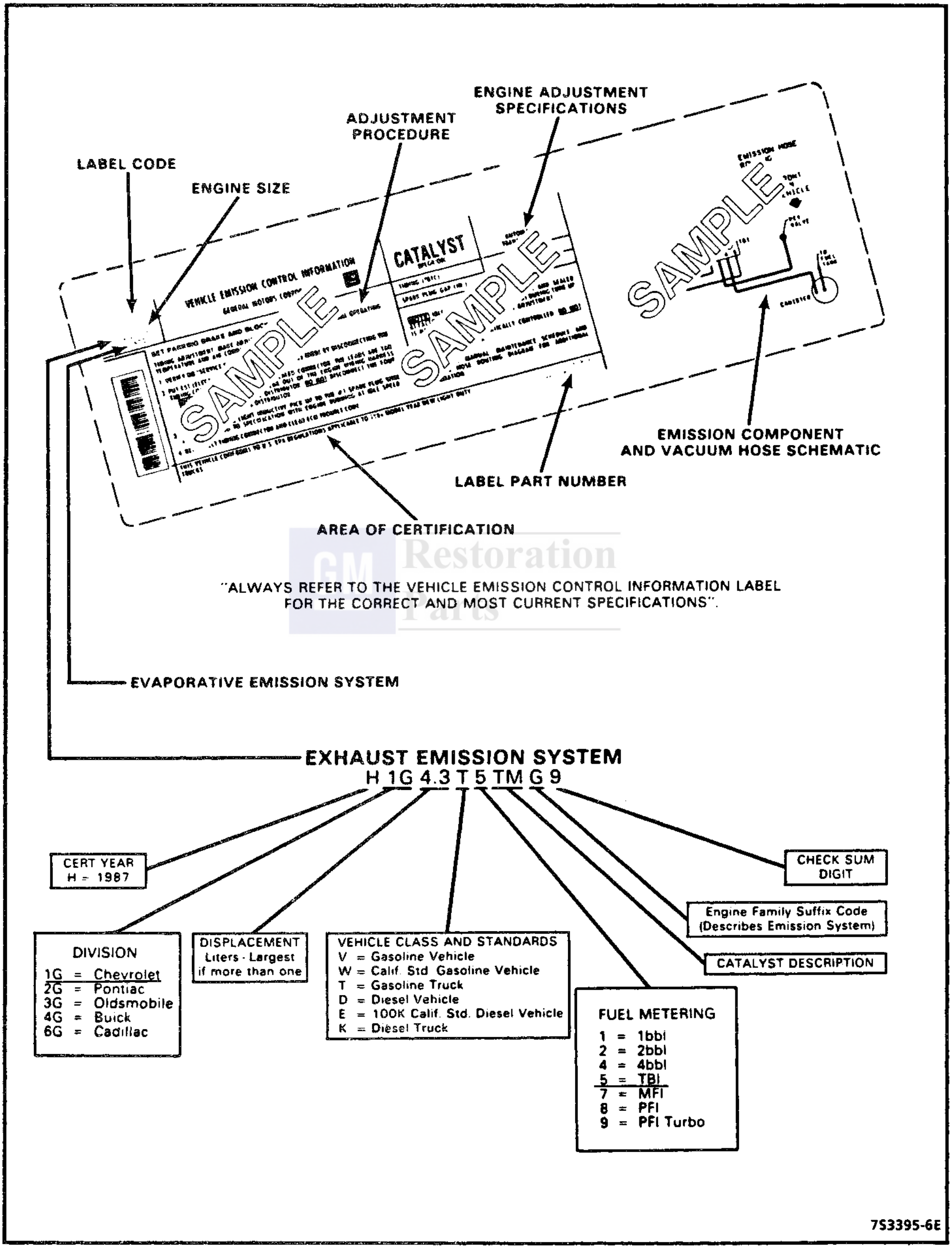
Any system disconnected during diagnosis should be reconnected. This includes wires, hoses, linkage, etc. When removing air cleaner, plug hose fittings that could cause an air leak.

EMISSIONS

The exhaust emission control systems used on General Motors engines perform a specific function to lower exhaust emissions while maintaining good fuel economy and driveability.

MAINTENANCE SCHEDULE

Refer to the General Motors Maintenance Schedule in Section "0B" of the Chassis Service Manual for the maintenance service that should be performed to retain emission control performance.



"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 (Figure 1) contains important emission specifications and setting procedures. In the upper left corner is exhaust emission information which identifies the year, the manufacturing division of the engine, the displacement in liters of the engine, the class of vehicle and type of fuel metering. Also there is an illustrated emission component and vacuum hose schematic. A similar label is located in the engine compartment of every General Motors Corporation vehicle. If the label has been removed, it can be ordered from the parts division. (WDDGM)

INTRODUCTION

Electronic Engine Control

Each engine has an electronic engine control module (ECM) to control the fuel system. The ECM varies the air/fuel ratio by controlling the fuel flow through the injector(s).

In addition, the ECM controls the ignition timing as well as the fuel pump and other systems.

It is important to review the component sections and wiring diagrams in Section "6E2" and "6E3" for a specific engine, to determine what is controlled by the ECM and what systems are non-ECM controlled.

What This Section Contains

Each General Motors engine has system controls to reduce exhaust emissions while maintaining good driveability and fuel economy. This section explains:

- How to use the Driveability and Emission Sections "6E2" for TBI, and "6E3" for Port Fuel engines.
- A brief description of systems used to control fuel and emissions.
- Abbreviations that are used in "Driveability and Emissions".
- Wiring harness service information for harnesses used with the ECM.
- Special tools used to diagnosis and repair a system.

Before checking the system, observe the following:

Blocking Drive Wheels

The vehicle drive wheels always should be blocked, and parking brake firmly set, while checking the system.

Cold Oxygen Sensor

On some engines, the oxygen sensor will cool off after only a short period of operation at idle. This will put the system into "Open Loop". To restore "Closed Loop" operation, run the engine at part throttle and accelerate from idle to part throttle a few times until the system goes "Closed Loop".

VISUAL/PHYSICAL UNDERHOOD INSPECTION

One of the most important checks that must be done as part of any diagnostic procedures or finding the cause of, an emissions test failure is a careful visual/physical underhood inspection. This can often lead to fixing a problem without further steps. Inspect all vacuum hoses for correct routing, pinches, cuts, or disconnects. Be sure to inspect hoses that are difficult to see beneath the air cleaner, compressor, generator, etc. Inspect all the wires in the engine compartment for correct and good connections, burned or chafed spots, pinched wires, or contact with sharp edges or hot exhaust manifolds. This visual/physical inspection is very important. It must be done carefully and thoroughly.

BASIC KNOWLEDGE REQUIRED

Before using this section of the service manual, there are some areas that you should be familiar with. Without this basic knowledge, you will have trouble using the diagnostic procedures contained in this section.

Basic Electric Circuits

You should understand the basic theory of electricity, and know the meaning of voltage, amps,

ALL NEW GENERAL MOTORS VEHICLES ARE CERTIFIED BY THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY AS CONFORMING TO THE REQUIREMENTS OF THE REGULATIONS FOR THE CONTROL OF AIR POLLUTION FROM NEW MOTOR VEHICLES. THIS CERTIFICATION IS CONTINGENT ON CERTAIN ADJUSTMENTS BEING SET TO FACTORY STANDARDS. IN MOST CASES, THESE ADJUSTMENT POINTS EITHER HAVE BEEN PERMANENTLY SEALED AND/OR MADE INACCESSIBLE TO PREVENT INDISCRIMINATE OR ROUTINE ADJUSTMENT IN THE FIELD. FOR THIS REASON, THE FACTORY PROCEDURE FOR TEMPORARILY REMOVING PLUGS, CAPS, ETC., FOR PURPOSES OF SERVICING THE PRODUCT, MUST BE STRICTLY FOLLOWED AND, WHEREVER PRACTICABLE, RETURNED TO THE ORIGINAL INTENT OF THE DESIGN.

and ohms. You should understand what happens in a circuit with an open or a shorted wire. You should be able to read and understand a wiring diagram. A short to ground is referred to 'as a ground to distinguish it from a short between wires.

Use of Circuit Testing Tools

You should know how to use a test light, how to connect and use a tachometer, and how to use jumper wires to by-pass components to test circuits. Care should be taken to not deform the terminal when testing.

Use of Digital Volt-Ohm Meter (DVM)

You should be familiar with the digital volt-ohm Meter, particularly essential tool J-29125-A, J34029A or equivalent. You should be able to measure voltage, resistance, and current, and know how to use the meter correctly.

The digital volt-ohm meter is covered in the "Special Tools"portion of this section.

DIAGNOSTIC INFORMATION

The electronic control module (ECM) is equipped with a self-diagnosis system which detects system failure and aids the technician by identifying the circuit at fault via a trouble code. Below is information about the way the ECM displays a problem and how this corresponds to a trouble code in the ECM. The ECM can also indicate an "Open Loop" or "Closed Loop" mode.

"Service Engine Soon" Light

This light is on the instrument panel, and has two functions:

- It is used to tell the driver that a problem has occurred, and that the vehicle should be taken for service as soon as reasonably possible.
- It is used by the technician to read out "Trouble Codes" to help diagnose system problems.

As a bulb and system check, the light will come "ON" with the key "ON" and the engine not running. When the engine is started, the light will turn "OFF". If the light remains "ON", the self-diagnostic system has detected a problem. If the problem goes away, the light will go out in most cases after 10 seconds, but a Trouble Code will remain stored in the ECM.

Intermittent "Service Engine Soon" Light

The diagnostic charts in Section "A" are set up to check whether or not a stored trouble code is "intermittent" or "hard".

An "intermittent" code is one which does not always reset when the code setting parameters are met, or is not present while you are working on the vehicle. This is often caused by a loose connection. The facing page will contain diagnostic aids to help in detecting intermittents.

A "hard" code is one which is present when you are working on the vehicle and the condition still exists while working on the vehicle. The chart with the stored trouble code number will lead you to the cause of the problem.

Trouble Codes

The engine control module (ECM) is really a computer. It uses sensors to look at many engine operating conditions. It has a memory and it knows what certain sensor readings should be under certain conditions. These conditions are described on the facing page of each Trouble Code chart. If a sensor reading is not what the ECM thinks it should be, the ECM will turn "ON" the "Service Engine Soon" light on the instrument panel, and will store a Trouble Code in the memory. The Trouble Code tells which circuit the trouble is in. A circuit consists of a sensor (such as coolant temperature), the wiring and connectors to it, and the ECM.

To get a Trouble Code out of the ECM, we use the assembly line diagnostic link (ALDL) connector.

ALDL Connector

The assembly line diagnostic link (ALDL) is a diagnostic connector located in the passenger compartment (Figure 2). It has terminals which are used in the assembly plant to check that the engine is operating properly before it leaves the plant.

Terminal "B" is the Diagnostic terminal, and it can be connected to terminal "A", or ground, to enter the Diagnostic mode, or the Field Service Mode.

The ALDL connector is also used by "Scan" tools to read information from the ECM via the Serial Data Line. Serial Data information is used extensively throughout the manual.

Diagnostic Mode

If the Diagnostic terminal is grounded with the ignition "ON" and the engine stopped, the system will enter the Diagnostic Mode. In this mode the ECM will:

1. Display a Code 12 by flashing the "Service Engine Soon" light (indicating the system is operating). A Code 12 consists of one flash, followed by a short pause, then two flashes in quick succession. This code will be flashed three times. If no other codes

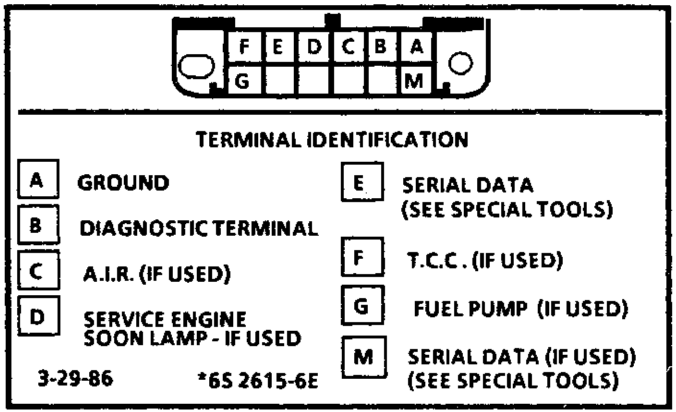


Figure 2 - ALDL Connector

are stored, Code 12 will continue to flash until the Diagnostic terminal is ungrounded.

Codes can only be obtained with the engine stopped. Grounding the Diagnostic terminal with the engine running gives the "field service mode".

2. Display any stored trouble codes by flashing the "Service Engine Soon" light. Each code will be flashed three times, then Code 12 will be flashed again.

   If a trouble code is displayed, the memory is cleared, then the engine is run to see if the code is a "hard" or "intermittent" failure. If it is a "hard" failure, a Diagnostic Code chart is used to find the problem. <u>If it is an intermittent failure, the charts are not used.</u> Diagnostic aids are usually included on the facing page. Section "B" also covers the topic of "Intermittents". A physical inspection of the applicable system most often will resolve the problem.
3. Energize all ECM controlled relays and solenoids except fuel pump relay .
4. The IAC valve on most models also moves to the fully extended position.

Field Service Mode

If the Diagnostic terminal is grounded with the engine running, the system will enter the Field Service mode. In this mode, the "Service Engine Soon" light will show whether the system is in "Open" or "Closed Loop".

In "Open Loop" the "Service Engine Soon" light flashes two and one-half times per second.

In "Closed Loop", the light flashes once per second: Also, in "Closed Loop", the light will stay OUT most of the time if the system is too lean. It will stay "ON" most of the time if the system is too rich.

While the system is in Field Service Mode, the ECM will be in the following mode:

1. New trouble codes cannot be stored in the ECM.
2. The "Closed Loop" timer is bypassed.

Clearing Trouble Codes

When the ECM sets a trouble code, the "Service Engine Soon" light will come "ON" and a trouble code will be stored in memory. If the problem is intermittent, the light will go out 10 seconds after the fault goes away. However, the trouble code will stay in the ECM memory until the battery voltage to the ECM is removed. Removing battery voltage for 30 seconds will clear all stored trouble codes.

Trouble Codes should be cleared after repairs have been completed. Also, some diagnostic charts will tell you to clear the codes before using the chart. This allows the ECM to set the code while going thru the chart, which will help to find the cause of the problem more quickly.

NOTICE: To prevent ECM damage, the key must be "OFF" when disconnecting or reconnecting power to ECM (for example battery cable, ECM pigtail, ECM fuse, jumper cables, etc.).

ECM Learning Ability

The ECM has a "learning" ability which allows it to make corrections for minor variations in the fuel system to improve driveability. If the battery is disconnected to clear diagnostic codes, or for repair, the "learning" process has to begin all over again. A change may be noted in the vehicle's performance. To "teach" the vehicle, make sure the engine is at operating temperature, and drive at part throttle, with moderate acceleration and idle conditions, until normal performance returns.

DRIVEABILITY AND EMISSIONS

SECTIONS 6E2 and 6E3 SUMMARY

The Driveability and Emissions sections are subdivided into three sub-sections:

SECTION A: STARTING POINT AND CODE CHARTS

- Diagnostic circuit check (Starting Point)
- No-start and fuel system check charts
- Code Charts

SECTION B: SYMPTOMS

- Based on driveability symptoms, when no codes, or intermittent codes, are stored.

SECTION C: COMPONENT SYSTEMS

- Circuit descriptions
- On-car service
- Functional check/Diagnosis charts

SECTION A

Diagnostic Procedure Summary

This is the starting point for the diagnostic procedures or an emissions test failure. The diagnostic charts are related to the ECM and will determine if the ECM is working properly. This section diagnoses the fuel system controlled by the ECM and has charts to diagnose a circuit when the ECM has displayed a trouble code.

The way to approach a problem is to follow three basic steps (shown in Figure 3):

1. Are the On-Vehicle Diagnostics working? We find this out by performing the "Diagnostic Circuit Check". **Since this is the starting point for the diagnostic procedures or finding the cause of an emissions test failure, always begin here.**
   If the On-Vehicle Diagnostics aren't working, the "Diagnostic Circuit Check" will lead you to a chart in Section "A" to correct the problem. If the On-Vehicle Diagnostics are OK, the next step is:
2. Is there a Trouble Code stored? If a trouble code is stored, go directly to the numbered code chart in Section "A". This will determine if the fault is still present. If no trouble code is stored, then:
3. "Scan" Serial Data.
   This involves reading the various pieces of information available on the Serial Data Stream with one of the tools available for that purpose. Information on these tools and the meaning of the various displays can be found in the succeeding paragraphs. Expected readings can be found on the facing page for the Diagnostic Circuit Check.

This short procedure will help lead you to repair the problem in the least amount of time.

ALDL "SCAN" TOOLS

The ALDL connector under the dash has a variety of information available on terminal "E" or "M" (depending on engine). There are several tools on the market for reading this information.

"Scan" tools do not make the use of diagnostic charts unnecessary. They do not tell exactly where a problem is in a given circuit. However, with an understanding of what each position on the equipment measures, and knowledge of the circuit involved, the tools can be very useful in getting information which would be more time consuming to get with other equipment.

In some cases, "Scan" tools will provide information that is either extremely difficult or impossible to get with other equipment.

A "SCAN" TOOL THAT DISPLAYS FAULTY DATA SHOULD NOT BE USED AND THE PROBLEM SHOULD BE REPORTED TO THE MANUFACTURER. THE USE OF A FAULTY "SCAN" TOOL CAN RESULT IN

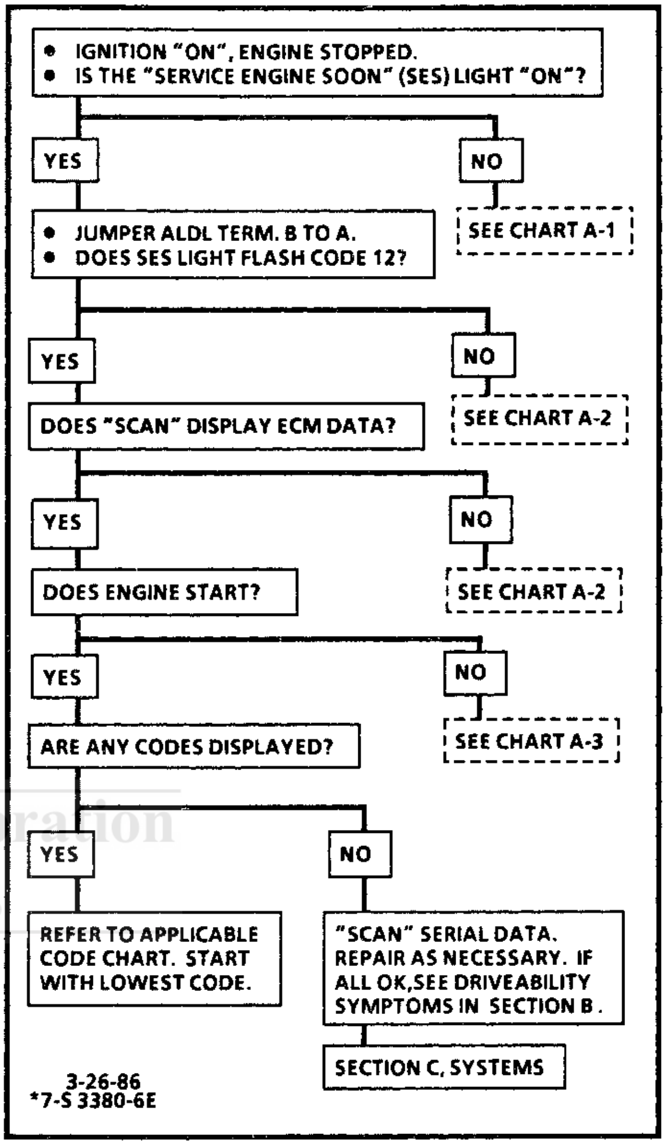


Figure 3 - Diagnostic Procedure Summary

MISDIAGNOSIS AND UNNECESSARY PARTS REPLACEMENT.

Trouble Tree Charts incorporate diagnosis procedures using an ALDL "Scan" tool where possible. Most charts require use of a "Scan" tool when it is applicable. Unless instructed otherwise, code charts in "6E" Section "A" should not be used for diagnosis unless the fault is still present (a "hard" failure).

Some ECM's have three modes for transmitting information but some only read data in the open mode.

The following information will describe each of the three modes where applicable and the effects they may cause.

Normal (Open) Mode

Not all engines and ECM families will transmit information on the Serial Data Line while in this mode.

On engines that can be monitored in the open mode, it allows certain parameters to be obtained without changing the engine operating characteristics. The parameters capable of being read vary from engine family to engine family. Most "Scan" tools are programmed so that the system will go directly into the special mode if the "open" mode is not available.

ALDL (10K, or Special) Mode (not used on all engines)

In this mode, all information incorporated into a specific engine and ECM is obtainable. However, in this mode the system operating characteristics are modified as follows.

- "Closed Loop" timers are bypassed
- EST (spark) is advanced
- IAC will control engine idle to 1000 rpm ± 50 rpm (if applicable)
- On some engines, canister purge solenoid will be enabled
- P/N restrict functions will be disabled.

Factory Test (Back-up or 3.9 K) Mode (TBI, Port)

In this mode, the ECM is operating on the fuel back-up logic and is calibrated by the Calpak or Mem-cal. These are used to control the fuel delivery if the ECM fails. This mode verifies that the back-up feature is OK. The parameters that can be read on a "Scan" tool in this mode are not of much use for service.

"SCAN" TOOL LIMITATIONS AND USE

The "Scan" tool allows a quick check of sensors and switches which are inputs to the ECM. However, on some applications the data update rate makes the tool less effective as a voltmeter when trying to detect an intermittent which lasts for a very short time. However, the "Scan" tool allows one to manipulate wiring harnesses or components under the hood while observing the "Scan" readout. This helps in locating intermittents with the engine not running.

Intermittent Conditions

The "Scan" tool is helpful in cases of intermittent operation. The tool can be plugged in and observed while driving the vehicle under the condition where the light comes "ON" momentarily, or the engine driveability is poor momentarily. If the problem seems to be related to certain areas that can be checked on the "Scan" tool, then those are the positions that should be checked while driving the vehicle. If there does not seem to be any correlation between the problem and any specific circuit, the "Scan" tool can be checked on each position, watching for a period of time to see if there is any change in the readings that indicates intermittent operation.

The "Scan" tool is also a useful and quick way of comparing operating parameters of a poorly operating engine with a known good one. For example; A sensor may shift in value but not set a code. Comparing with a known good vehicle may uncover the problem.

The "Scan" tool has the ability to save time in diagnosis and prevent the replacement of good parts. The key to using the "Scan" tool successfully for diagnosis lies in the technician's ability to understand the system he is trying to diagnose as well as an understanding of the "Scan" tool's limitations. Therefore, the technician should read the tool manufacturer's operating manual to become familiar with the operation. The following information will describe most of the "Scan" tool positions and how they can be helpful in diagnosis.

"SCAN" TOOL POSITIONS

The following positions may not be applicable to all engines. See the facing page of the diagnostic circuit check for a particular engine to decide which positions apply to that engine.

Mode

Check with the manufacturer to determine what the function of this mode is. In most cases it allows the user to place the ECM in different operating modes.

Injector Pulse Width

In this position, the reading is given in milliseconds, which is the "ON" time that the ECM is commanding to the injector(s).

Closed Loop/Open Loop

This position will indicate whether the engine control system is operating in "Open Loop" or "Closed Loop". Most systems go "Closed Loop" after a certain amount of running time, when coolant temperature is high enough, and the oxygen sensor becomes active.

Exhaust (Rich/Lean Indicator)

This indicates the O_2 sensor voltage at the instant that the data stream is sampled. If voltage is less than 350 mv, the value will be lean. If above 550 mv, a rich exhaust is indicated.

Trouble Codes

This will display any trouble codes stored in the ECM memory.

Throttle Position Sensor (TPS)

Values read will be the voltage as seen by the ECM. The voltage should be the TPS specification with the throttle closed and go up to about 5 volts with throttle wide open (WOT).

Throttle Angle

Displayed, in percent, is the amount the throttle is open. 0% is closed throttle, 100% is wide open throttle.

Oxygen (O_2) Sensor

The reading will be read out in millivolts (mv) with a range from 1 to 999 mv. If the reading is consistently below 350 (350 mv), the fuel system is running lean as seen by the ECM; and if the reading is consistently above 550 (550 mv), the system is running rich.

PROM ID

In this position, information is used for assembly verification only. PROM ID is useful only when the vehicle is equipped with the original ECM and PROM or Mem-Cal.

RPM

Reading displays engine rpm. It is often useful if extra reference pulses are suspected. A sudden high rpm indication while at a steady throttle would indicate electrical interference (EMI) in the reference circuit. This interference is usually caused by ECM wires too close to ignition secondary wires or an open distributor ground circuit.

MPH

Displayed is vehicle speed, useful in checking TCC application speed or speedometer accuracy.

MAF

This displays the amount of air passing the Mass Air Flow (MAF) sensor, in grams per second. It is useful when comparing the airflow between a problem vehicle and a known good one. Normal readings at idle are about 4 to 8 grams. If a MAF code is set, this reading will display the ECM default value.

Airflow

This display should be the same as MAF when there are no failures in the MAF sensor circuit. When an MAF code is set, however, this value will not change, and will indicate the gm/sec that the failure has detected.

Coolant Temperature

Engine temperature is displayed in Celsius degrees. After the engine is started, temperature should rise steadily to about 85-95° C, then stabilize when the thermostat opens.

Manifold Air Temperature (MAT) Sensor

This displays temperature of the intake manifold air. It should read close to ambient air temperature when the engine is cold, and rise as underhood and engine temperatures increase.

Manifold Absolute Pressure (MAP)

The MAP sensor produces a low signal voltage when manifold pressure is low (high vacuum) and a high voltage when the pressure is high (low vacuum).

With the ignition "ON" and the engine stopped, the manifold pressure is equal to atmospheric pressure, and the signal voltage will be high. This information is used by the ECM as an indication of vehicle altitude and is referred to as BARO. Comparison of this BARO reading with a known good vehicle with the same sensor is a good way to check accuracy of a "suspect" sensor *. Readings should be the same ± .4 volt.

* A MAP sensor has a colored plastic insert visible in the connector cavity. Sensors with the same insert color are identical in calibration. The harness electrical connector color also should be the same as the sensor insert color.

Vacuum (Differential Pressure) Sensor

The vacuum sensor produces a low signal voltage when manifold vacuum is low, and a high voltage when the vacuum is high .

With the ignition "ON" and the engine stopped, there is no vacuum, so the voltage is low (under 1 volt). With the engine idling the vacuum is high so the voltage is high (over 3 volts).

A vacuum sensor has a colored plastic insert visible in the connector cavity. Sensors with the same insert color are identical in calibration. The harness electrical connector color also should be the same as the sensor insert color.

Baro

This displays barometric pressure. The ECM uses this information to adjust for altitude and pressure. This value will vary depending on barometric pressure and altitude. Some vehicles use a dedicated baro sensor, while others take a MAP reading before the engine is started, and at various times during engine operation.

Park/Neutral Switch

The indication in this mode may vary with manufacturer so the type of reading for a particular tool should be checked in the operator's manual. The important thing is that the the reading changes state (switches) when the gear selector is moved from park/neutral to drive or reverse.

Torque Convertor Clutch (TCC)

In this position, the tool will indicate when the TCC has been commanded by the ECM to turn "ON". This does not necessarily mean that the clutch was engaged but only that the ECM grounded the circuit internally. The best way to determine if the clutch has engaged is to monitor engine rpm when the TCC comes "ON".

EGR (Duty Cycle)

The EGR system uses a valve to feed a small amount of exhaust gas back into the intake manifold to control formation of NO_x. Like all ECM outputs, the "Scan" tool only indicates that the ECM has commanded the function, and does not indicate that the function has really happened.

EGR Position

This indicates the position of the EGR pintle.

Integrator and Block Learn

Normal readings for these positions are around 128. If higher, it indicates that the ECM is adding fuel to the base fuel calculation because the system is lean, and if the numbers are below 128, the ECM is taking out fuel from the base calculation because the system is rich. The integrator gives short term corrective action, while the block learn portion (which is a long term correction) will only change if the integrator has seen a condition which lasts for a calibrated period of time.

Block Learn Multiplier (BLM) Cell - or - Block Learn Memory (BLM)

There are up to sixteen different cells, corresponding to ranges of rpm and engine load (indicated by MAF or MAP signals), and other conditions, such as A/C or P/N switch "ON" or "OFF", etc. The ECM learns how much adjustment is needed in each cell, and retains it in memory, so that the adjustment will immediately be made when the engine operates in that cell (or rpm/load range). This parameter will display what cell the ECM is currently using for the fuel calculation.

IAC (Idle Air Control)

This system is used to control engine idle speed to the desired rpm, for different operating conditions. In this mode, the numbers will indicate the position to which the ECM has moved the valve pintle. The ECM moves the IAC in counts, or steps, and the number of these counts are displayed on a "Scan" tool.

Desired RPM

This indicates the rpm to which the ECM is trying to control the idle.

Shift Light

This displays "yes" when the ECM is commanding the shift light to turn "ON".

PPSW (Pump Prime Switch)

This is the voltage on the fuel pump feed circuit. The ECM will adjust fuel injector base pulse width from this voltage value rather than from battery voltage.

A/C Request

The state of the A/C signal line to the ECM is shown. It should read "yes" whenever the A/C is requested.

A/C Clutch

"ON" is displayed when the ECM has commanded the A/C clutch "ON".

Knock Retard

This indicates the number of degrees the ECM is retarding the electronic spark timing (EST).

Knock Signal

This displays a "yes" when knock is detected by the ECM, and a "no" when knock is not detected.

Battery Voltage

This displays the battery voltage detected at the ECM ignition input.

Fan

"ON" is displayed when the cooling fan has been commanded "ON".

CCP (Carbon Canister Purge)

This displays "ON" when the canister purge solenoid is commanding purge. Some display duty cycle from 0-100%.

2nd Gear

This displays the state of the 2nd gear switch. Yes=2nd gear applied. It remains applied in 3rd and 4th gears.

3rd Gear

This displays the state of the 3rd gear switch. Yes=3rd gear applied. It remains applied in 4th gear.

4th Gear

This displays the state of the 4th gear switch. Yes=4th gear applied.

Fan Request

State of the A/C fan control switch is displayed. It should read "yes" when fan is requested. Some engines may display the state of the 2nd fan, if used.

Power Steering Pressure Switch

This reading displays the state of switch, and may vary with the tool used, and the type of switch installed on the vehicle. The important thing is that the reading changes state (switches) when the steering is moved against the stops.

SECTION B - DRIVEABILITY SYMPTOMS

Always start with Section "A" "Diagnostic Circuit Check" before proceeding to the driveability symptoms or an emissions test failure. Section "A" checks the ECM, which may cause the driveability problem. A definition of each symptom is included. This will then lead to the most probable causes of the driveability problem.

SECTION C - COMPONENT SYSTEMS

There are many component systems that are used to control fuel and emissions. Section "C" introduces each component system or control with a general description, diagnosis, and on-vehicle service.

Each of the Section "C" diagnosis sections contain information on how the "Scan" tool can be used for diagnosing a particular component when a trouble code has not been set. (example: Section "C1" under diagnosis will explain how the "Scan" tool can be used for diagnosis as well as what the normal readings would be for the ECM sensors.)

Electronic Control Module (ECM)

This section describes the ECM and the information sensors in the system. Figure 4 shows the operating conditions which the ECM may sense and the systems that the ECM may control. (See specific engines to determine which are applicable to that engine.)

Fuel Control System

The ECM controls the air/fuel delivery to the combustion chamber by controlling the fuel flow through the injector(s).

Electric Fuel Pump (In-tank)

The in-tank fuel pump is controlled by the ECM. When ignition is turned "ON", the pump will run for 2 seconds, then stop unless the ECM is receiving ignition pulses, as when cranking or running.

Evaporative Emission Control

This system has a canister which stores fuel vapor from the fuel tank. The fuel vapor is removed from the canister and consumed in the normal combustion process when the engine is running. This system is used on all engines and may or may not be controlled by the ECM.

Electronic Spark Timing (EST)

This system is controlled by the ECM, which controls spark advance (timing), and is used on all engines.

Electronic Spark Control (ESC)

This system uses a knock sensor in connection with the ECM to control spark timing, to allow the engine to have maximum spark advance without spark knock. This improves driveability and fuel economy, but will retard spark if detonation (spark knock) is detected.

Air Injection Reaction (A.I.R.)

The system provides additional oxygen to the exhaust gases to continue the combustion process. The system also supplies additional air to the catalytic converter under certain conditions. The A.I.R. system is not on all engines.

Early Fuel Evaporation (EFE)

The EFE system heats the engine induction system electrically or with exhaust gas during cold

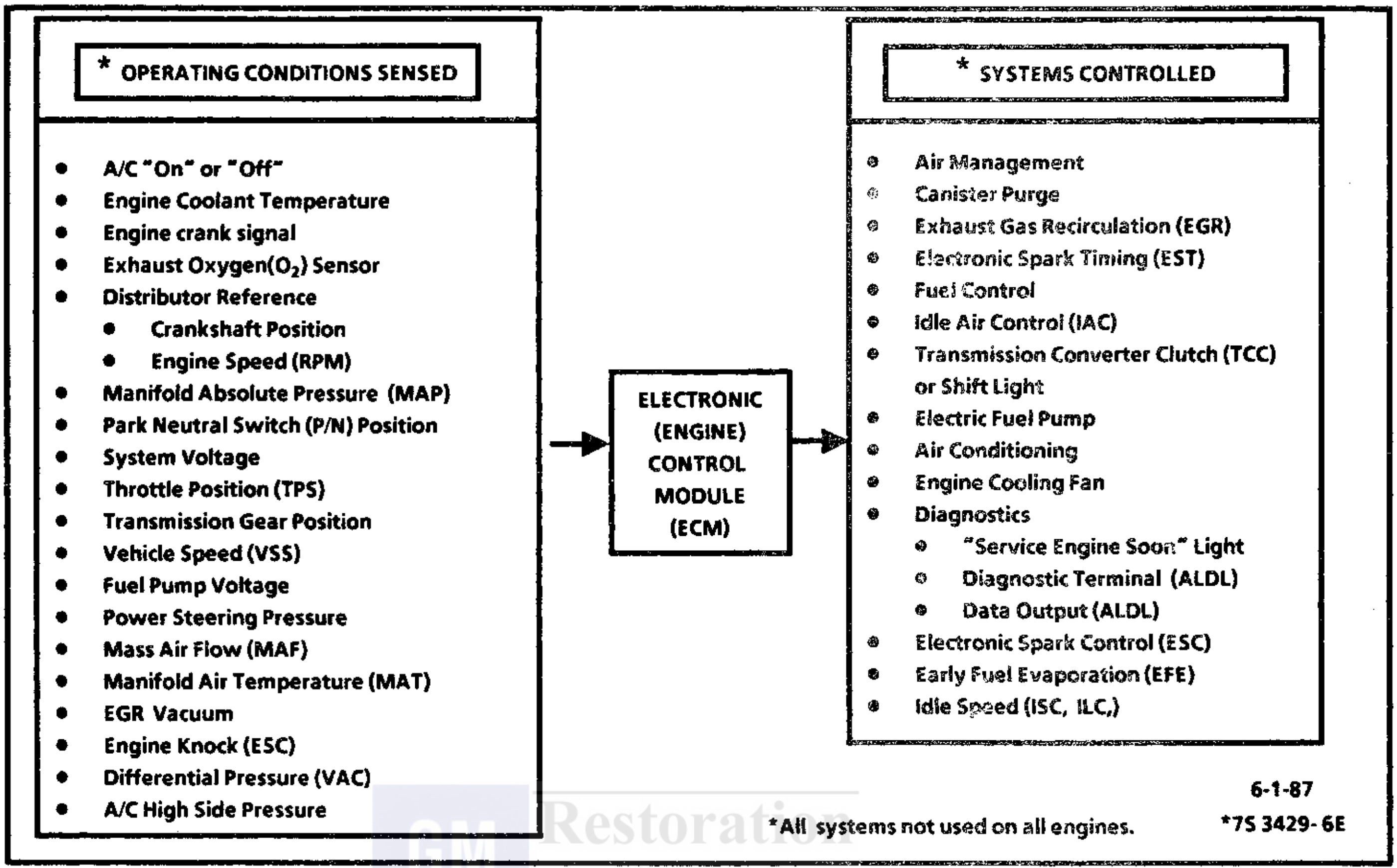


Figure 4 - ECM Operating Conditions Sensed and Systems Controlled

driveaway. This system is not used on all engines and may or may not be controlled by the ECM.

Exhaust Gas Recirculation (EGR)

The EGR system uses a valve to feed a small amount of exhaust gas back into the intake manifold to control formation of NO_x.

Transmission Converter Clutch (TCC)

The TCC is ECM controlled and is used on all engines with an automatic transmission. This system reduces slippage losses in the torque converter by coupling the engine flywheel to the output shaft of the transmission.

Shift Light Control

The ECM controls the shift light on some manual transmission vehicles to indicate the best shift point for maximum fuel economy. This control is not on all applications.

A/C Clutch Control

The ECM may control the A/C clutch on the compressor to improve idle quality. This control is not on all engines.

Electric Cooling Fan Control

Under certain conditions, the ECM may control the electric cooling fan to cool the engine and A/C condenser. At cruising speed, the ECM may turn the fan off for better fuel economy. This control is on transverse engine front wheel drive vehicles.

Positive Crankcase Ventilation (PCV) or Crankcase Ventilation (CV)

The PCV or CV system passes crankcase vapors into the intake manifold. This system is not controlled by the ECM and is used on all engines.

Thermostatic Air Cleaner (THERMAC)

The THERMAC system regulates heated air through the air cleaner to provide uniform inlet air temperature, which gives good driveability under various climatic conditions. This system is not controlled by the ECM.

ABBREVIATIONS AND GLOSSARY OF TERMS

Abbreviations used in this section are listed below in alphabetical order with an explanation of the abbreviation. There are some variations in the use of periods and in capitalization (as mph, m.p.h., Mph, and MPH) for abbreviations used in this Section, but all types are acceptable.

A/F - AIR/FUEL (A/F RATIO)

A.I.R. - AIR INJECTOR REACTION SYSTEM - Air flow from pump is directed into engine exhaust manifold and/or converter to reduce exhaust emissions.

ALDL - ASSEMBLY LINE DIAGNOSTIC LINK - Used at assembly to evaluate Computer Command Control, and for service to flash the "Service Engine Soon" light if there are trouble codes. It also is used by "Scan" tools to obtain ECM serial data.

BARO - BAROMETRIC ABSOLUTE PRESSURE SENSOR - Reads atmospheric pressure.

B + - Battery Positive Terminal (12 Volts) or system voltage with the engine running (approximately 13.8 v.)

CALPAK - A device used with fuel injection to allow fuel delivery in the event of a PROM or ECM malfunction.

CALIBRATOR - (PROM) - An electronic component that can be specifically programmed to meet engine operating requirements for a specific vehicle model. It plugs into the Engine Control Module (ECM).

CCC - COMPUTER COMMAND CONTROL - has an electronic control module to control air/fuel and emission systems.

CLCC - CLOSED LOOP CARBURETOR CONTROL - Used to describe oxygen sensor to ECM to M/C solenoid circuit operation.

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 - Used to describe engine size.

C/L OR C/LOOP - "CLOSED LOOP" - Describes ECM fuel control when using oxygen sensor information.

COOLANT TEMPERATURE SENSOR - Device that senses the engine coolant temperature, and passes that information to the engine control module.

CONV. - CATALYTIC CONVERTER, THREE-WAY - EXHAUST CONVERTER. Containing platinum and palladium to speed up conversion of HC and CO, and rhodium to accelerate conversion of NO$_x$.

CO - CARBON MONOXIDE - One of the pollutants found in engine exhaust.

CV - CRANKCASE VENTILATION - Prevents fumes in crankcase from passing into the atmosphere, by drawing them into the intake manifold and burning them in the the combustion process.

DIAGNOSTIC CODE - Pair of numbers obtained from flashing "Service Engine Soon" light or displaying on a "Scan" tool. This code can be used to determine the system malfunction.

DIAGNOSTIC TERM. - Lead of ALDL Connector which is grounded to get a Trouble Code. It is grounded with the engine running to enter the "Field Service Mode".

DIS - Direct Ignition System. Produces the ignition spark without the aid of an ignition distributor.

DVM (10 Meg.) - Digital Voltmeter with 10 Million ohms resistance - used for measurement in electronic systems.

DWELL - The amount of time (recorded on a dwell meter in degrees of crankshaft rotation) that current passes through a closed switch; for example, ignition contact points or internal switch in an electronic control module.

EAC - ELECTRIC AIR CONTROL - Used on A.I.R. system to direct air flow to air switching valve or to atmosphere.

EAS - ELECTRIC AIR SWITCHING - used to direct air flow to catalytic converter or exhaust ports of the engine.

ECM - ENGINE CONTROL MODULE (ELECTRONIC) - A metal case (located in passenger compartment) containing electronic circuitry which electrically controls and monitors air/fuel and emission systems on computer command control, and turns "ON" the "Service Engine Soon" light when a malfunction occurs in the system.

EFI - ELECTRONIC FUEL INJECTION - Computer Command Control using throttle body fuel injection.

EGR - EXHAUST GAS RECIRCULATION - Method of reducing NO$_x$ emission levels by causing exhaust gas to be added to air/fuel mixture in combustion chamber, thus cooling combustion.

EECS - EVAPORATIVE EMISSIONS CONTROL SYSTEM - Used to prevent gasoline vapors in the fuel tank from entering the atmosphere.

EFE - EARLY FUEL EVAPORATION - Method of warming the intake manifold during cold engine operation. Provides efficient air/fuel mixing.

ENERGIZE/DE-ENERGIZE - When current is passed through a coil (energized) such as the canister purge solenoid, the plunger is pulled into the solenoid.

When the voltage to the solenoid is turned off, (de-energized), a spring raises the plunger.

ESC - ELECTRONIC SPARK CONTROL - Used to sense detonation and retard spark advance when detonation occurs.

EST - ELECTRONIC SPARK TIMING - ECM controlled timing of ignition spark.

EVRV - ELECTRONIC VACUUM REGULATOR VALVE - Controls EGR vacuum.

FED - FEDERAL - Vehicle/Engine available in all states except California.

GROUND - The negative (-) side of the battery. Also could be a wire (conductor) shorted to ground.

HC - HYDROCARBONS - One of the pollutants found in engine exhaust.

HIGH IMPEDANCE VOLTMETER - Has high opposition to the flow of electrical current. Good for reading circuits with low current flow, such as found in electronic systems because it allows tests to be made without affecting the circuit.

HEI - HIGH ENERGY IGNITION - A distributor that uses an electronic module and pick-up coil in place of contact points.

Hg - MERCURY - A calibration material used as a standard for vacuum measurement.

IAC - IDLE AIR CONTROL - A valve installed in the throttle body of fuel injected systems and controlled by the ECM to regulate idle speed.

IDEAL MIXTURE - The air/fuel ratio which provides the best performance, while maintaining maximum conversion of exhaust emissions. Typically it is 14.7:1.

IDI - INTEGRATED DIRECT IGNITION - Produces the ignition spark without the aid of an ignition distributor or spark plug wires.

IDLE AIR BLEED VALVE - Controls the amount of air let into the idle fuel mixture prior to the mixture entering the carburetor idle system, when the M/C solenoid is energized.

IGN - IGNITION

ILC - IDLE LOAD COMPENSATOR - Device used to control throttle angle during long deceleration, such as coasting down a long grade; it extends at wide open throttle position or to prevent engine stalls at idle.

INPUTS - Information from sources (such as coolant temperature sensors, exhaust oxygen sensor, etc.) to the ECM that indicate how the systems are performing.

INTERMITTENT - Occurs now and then; not continuously. In electrical circuits, refers to occasional open, short, or ground.

I.P. - INSTRUMENT PANEL

ISC - IDLE SPEED CONTROL - Regulates throttle valve position to control idle speed. Idle speed is controlled by the ECM and is not adjustable.

KM/HR - KILOMETER PER HOUR - A metric unit measuring speed needed to travel distance of one kilometer (1000 meters) in one hour.

L - LITER - A metric unit of capacity.

L4 - FOUR CYLINDER IN-LINE ENGINE

MAF - MASS AIR FLOW - Sensor which measures the amount of air entering the engine.

MALFUNCTION - A problem that causes the system to operate incorrectly. Typical malfunctions are wiring harness opens or shorts, failed sensors or circuit components.

MANIFOLD VACUUM SENSOR - Indicates vacuum in the intake manifold by measuring the pressure in intake manifold in relation to barometric pressure. It is also called a differential pressure sensor because it measures the difference between the two pressures. It puts out a voltage which is highest when the vacuum is highest. The maximum voltage is between 4 and 5 volts.

MAP - MANIFOLD ABSOLUTE PRESSURE SENSOR - Reads pressure changes in intake manifold with reference to zero pressure. It puts out a voltage which is highest when the pressure is highest. The maximum voltage is between 4 and 5 volts.

MAT - Manifold Air Temperature Sensor. Measures temperature of air in the intake manifold.

M/C - MIXTURE CONTROL

MEM-CAL - MEMORY CALIBRATOR - Contains specific calibrations to meet the requirements of a specific engine.

MFI - MULTIPORT FUEL INJECTION - Individual injectors for each cylinder are mounted in the intake manifold. The injectors are fired in groups rather than individually.

MIXTURE CONTROL (M/C) SOLENOID - Device, installed in carburetor, to regulate the air/fuel ratio.

MODE - A particular state of operation.

MPH - MILES PER HOUR - A unit measuring speed needed to travel distance of one mile (5280 feet) in one hour.

N.C. - NORMALLY CLOSED - State of relay contacts or solenoid plunger when no voltage is applied.

N·m - NEWTON METER (Torque) - A metric unit describing force.

N.O. - NORMALLY OPEN - State of relay contacts or solenoid plunger when no voltage is applied.

NO$_x$ - NITROGEN, OXIDES OF - One of the pollutants found in engine exhaust.

O_2 - OXYGEN (Sensor) - Monitors the oxygen content of the exhaust system and generates a voltage signal to the ECM.

O/L or O/LOOP - OPEN LOOP - Describes ECM fuel control without use of oxygen sensor information.

OUTPUT - Result of a function typically controlled by the ECM.

OXYGEN SENSOR, EXHAUST - Device that detects the amount of oxygen (O_2) in the exhaust stream.

P.A.I.R - PULSE AIR INJECTION REACTOR system - pulsed air directed into engine to reduce exhaust emissions.

PCV - POSITIVE CRANKCASE VENTILATION - Prevent fumes in crankcase from passing into atmosphere.

PFI - PORT FUEL INJECTION

P/N - PARK/NEUTRAL

PORT - EXHAUST OR INTAKE PORT

PROM - PROGRAMABLE READ ONLY MEMORY- an electronic term used to describe the engine calibration unit .

RPM - REVOLUTIONS PER MINUTE - A measure of rotational speed.

RVB - REAR VACUUM BRAKE - is used to control choke operation during cold engine conditions.

SELF-DIAGNOSTIC CODE - The ECM can detect malfunctions in the system. If a malfunction occurs, the ECM turns on the "Service Engine Soon" light. A diagnostic code can be obtained from the ECM through the "Service Engine Soon" light, or by use of a "Scan" tool. This code will indicate the area of the malfunction.

SES - SERVICE ENGINE SOON LIGHT - Lights when a malfunction occurs in Computer Command Control system.

TACH - TACHOMETER

TBI - THROTTLE BODY INJECTION (Unit) - is controlled by the ECM to supply precise air/fuel mixture into the intake manifold.

TCC - TRANSMISSION / TRANSAXLE CONVERTER CLUTCH - ECM controlled solenoid in transmission which positively couples the transmission to the engine.

THERMAC - THERMOSTATIC AIR CLEANER - provides preheated air to intake manifold to provide better driveability when engine is cold.

TPS - THROTTLE POSITION SENSOR - Device that tells the ECM the throttle position.

TVS - THERMAL VACUUM SWITCH - Used to control vacuum in relationship to engine temperature.

V - VOLT

V-6 - SIX CYLINDER ENGINE - Two banks of cylinders, arranged in a "V".

V-8 - EIGHT CYLINDER ENGINE - Two banks of cylinders, arranged in a "V".

VACUUM - Negative pressure; less than atmospheric pressure.

VACUUM, MANIFOLD - Vacuum source in manifold below throttle plate.

VACUUM, PORTED - A vacuum source above (atmospheric side) of closed throttle plate.

VAC SENSOR - Abbreviation for differential pressure sensor which is a vacuum sensor.

VIN - VEHICLE IDENTIFICATION NUMBER.

VSS - VEHICLE SPEED SENSOR - Sensor which sends vehicle speed information to the ECM.

WASTEGATE - A means of controlling the amount of boost available for a Turbo charged engine.

WOT - WIDE OPEN THROTTLE.

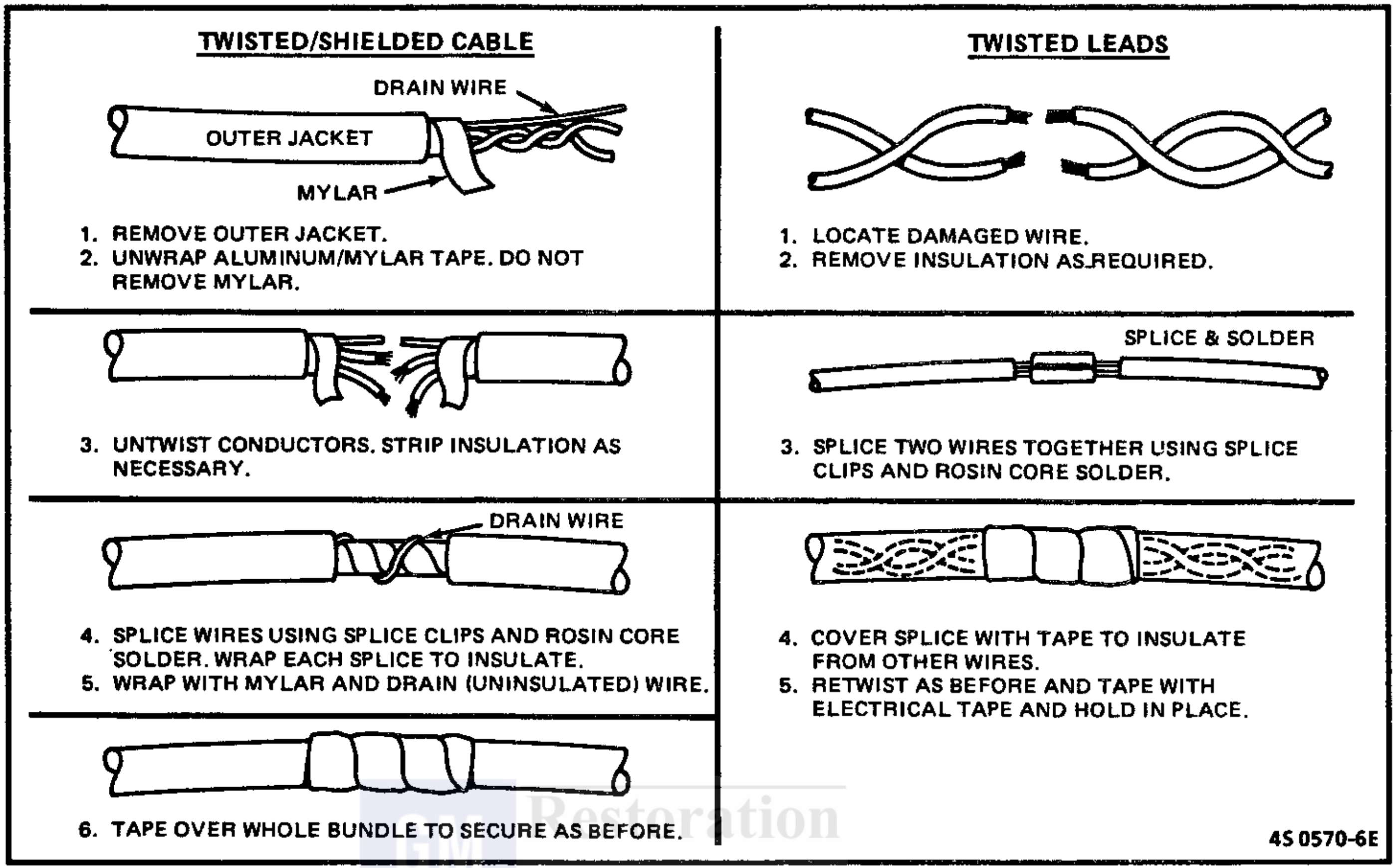
WIRING HARNESS SERVICE

The ECM wire harness electrically connects the ECM to the various solenoids, switches, and sensors in vehicle engine compartment. The ECM is located inside the vehicle passenger compartment.

Most connectors in the engine compartment are protected against moisture and dirt which could create oxidation and deposits on the terminals. This protection is important because of the very low voltage and current levels found in the electronic system. The connectors have a lock which secures the male and female terminals together. A secondary lock holds the seal and terminal into the connector.

GENERAL

Molded-on connectors (like Metri-Pack) require complete replacement of the connector. This means splicing a new connector assembly into the harness.



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 5 - Wire Harness Repair

WIRE HARNESS

Wire harnesses should be replaced with proper part number harnesses. When signal wires are spliced into a harness, use wire with high temperature insulation only. See Figure 5 for instructions.

With the low current and voltage levels found in the system, it is important that the best possible bond at all wire splices be made by soldering the splices as shown.

Use care when probing the connector or replacing terminals in them. It is possible to short between opposite terminals. If this happens to the wrong terminal pair, it is possible to damage certain components. Always use jumper wires between connectors for circuit checking. **NEVER** probe through the Weather-Pack seals or insulation. Even microscopic damage or holes may result in eventual water intrusion, corrosion and/ or component or circuit failure.

When diagnosing, open circuits are often difficult to locate by sight because oxidation or terminal misalignment are hidden by the connectors. Merely wiggling a connector on a sensor or in the wiring harness may correct the open circuit condition. This should always be considered when an open circuit or failed sensor is indicated. Intermittent problems may also be caused by oxidized or loose connections.

Before making a connector repair, be certain of the type of connector. Weather-Pack and Compact Three connectors look similar but are serviced differently. Replacement connectors and terminals are listed in Group 8.965 of the Standard Parts Catalog.

CONNECTORS

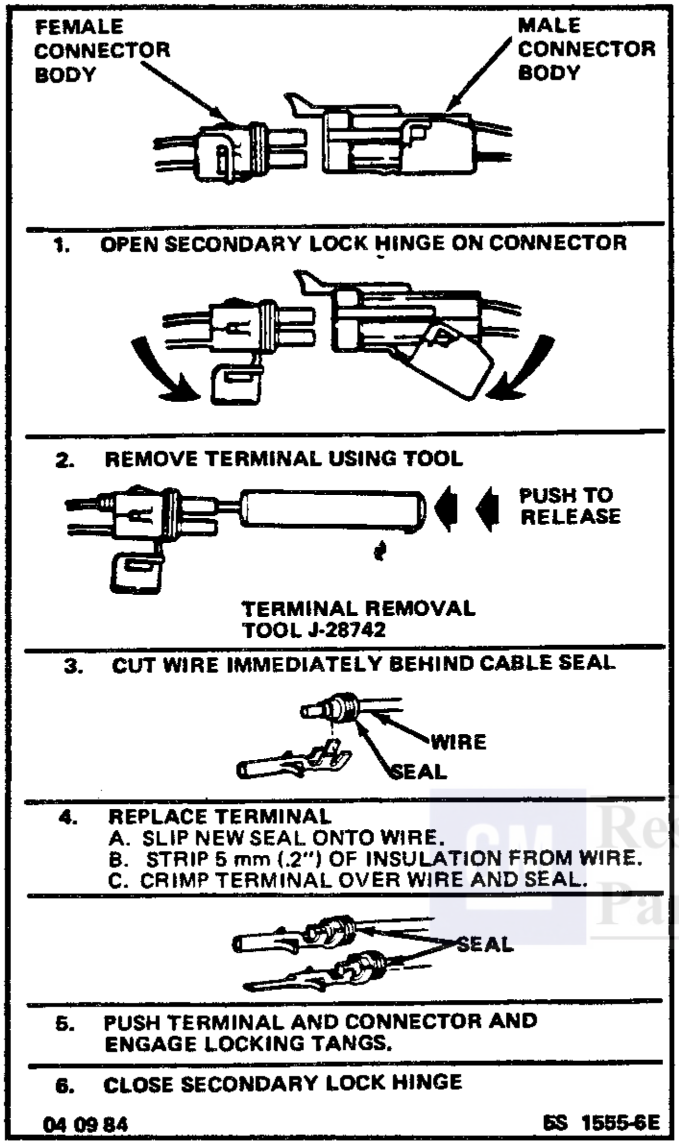
Weather-Pack

Some connectors used with an ECM are called Weather-Pack. Figure 6 shows a Weather-Pack terminal and the tool (J-28742, BT-8234-A or equivalent) required to service it. This tool is used to remove the pin and sleeve terminals. If removal is attempted with an ordinary pick, there is a good chance that the terminal will be bent or deformed and, unlike standard blade type terminals, these terminals cannot be straightened once they are bent.

Make certain that the connectors are properly seated and all of the sealing rings in place when connecting leads. The hinge type flap provides a backup, or secondary locking feature for the connector.

They are used to improve the connector reliability by retaining the terminals if the small terminal lock tangs are not positioned properly.

Weather-pack connections cannot be replaced with standard connections. Instructions are provided with Weather-pack connector and terminal packages.



1. OPEN SECONDARY LOCK HINGE ON CONNECTOR
2. REMOVE TERMINAL USING TOOL
3. CUT WIRE IMMEDIATELY BEHIND CABLE SEAL
4. REPLACE TERMINAL
   A. SLIP NEW SEAL ONTO WIRE.
   B. STRIP 5 mm (.2") OF INSULATION FROM WIRE.
   C. CRIMP TERMINAL OVER WIRE AND SEAL.
5. PUSH TERMINAL AND CONNECTOR AND ENGAGE LOCKING TANGS.
6. CLOSE SECONDARY LOCK HINGE

04 09 84 6S 1555-6E

Figure 6 - Weather-Pack Terminal Repair

Compact Three

The compact three connector, which looks similar to a Weather-pack connector, is not sealed and is used where resistance to the environment is not required. This type of connector most likely is used at the air control solenoid. Use the standard method when repairing a terminal. Do not use the Weather-pack terminal tool J-28742.

Metri-Pack Series 150 - Terminal Removal

Some connectors used to connect various sensors to the ECM harness use terminals called "Metri-Pack" (Figure 7). These may be used at the Coolant Sensors as well as at ignition modules.

They are also called "Pull-To-Seat" terminals because, to install a terminal on a wire the wire is first inserted through the seal (5) and connector (4). The terminal is then crimped on the wire, and the terminal pulled back into the connector to seat it in place.

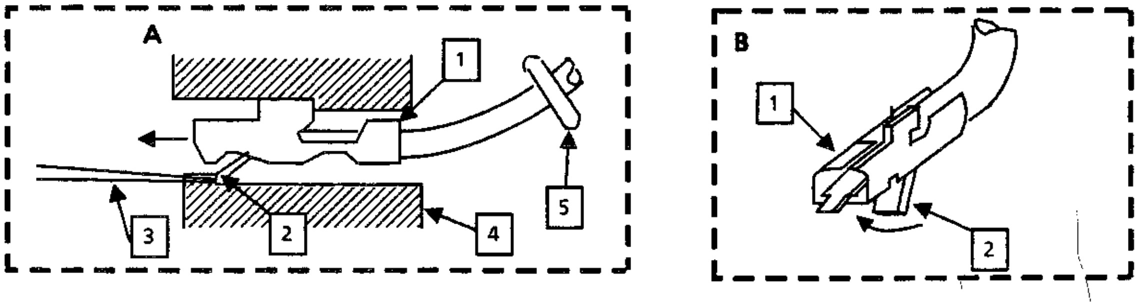
To remove a terminal:

1. Slide the seal back on the wire,
2. Insert tool (3) BT-8518 or J 35689, or equivalent, as shown in insert "A" and "B" to release the terminal locking tang (2).
3. Push the wire and terminal out through the connector.

If you are reusing the terminal, reshape the locking tang (2).

Micro-Pack

Some connectors used on harness to connect to the ECM are called Micro-Pack (Figure 8). Terminal replacement requires the use of special tool J-33095, BT-8234-A or equivalent.



1. METRI-PACK SERIES 150 FEMALE TERMINAL
2. LOCKING TANG
3. TOOL J35689 OR BT-8446
4. CONNECTOR BODY
5. SEAL

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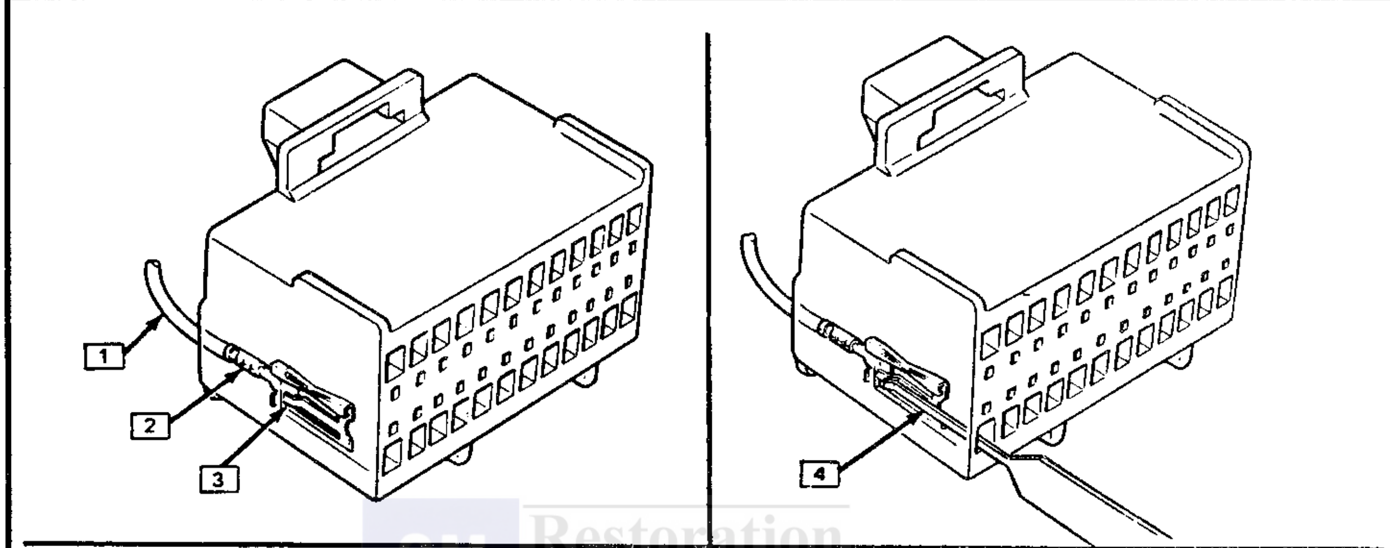
Figure 7 - Metri-Pack Series 150 Terminal Removal



1 CABLE
2 TERMINAL
3 LOCKING TANG
4 TOOL J33095

1. GRASP CABLE AND PUSH TERMINAL TO THE MOST FORWARD POSITION.
2. INSERT TOOL J33095 STRAIGHT INTO THE FRONT OF THE CONNECTOR CAVITY. DO NOT USE CONVENTIONAL PICK TO REMOVE TERMINAL.
3. WITH TOOL IN PLACE, GENTLY PULL ON THE CABLE TO REMOVE TERMINAL.
4. VISUALLY CHECK TERMINAL AND REPLACE IF TERMINAL CAVITY OR TANG IS DAMAGED.
5. INSTALL TERMINAL INTO CONNECTOR CAVITY UNTIL LOCKING TANG HAS SNAPPED INTO POSITION.

03 21 84

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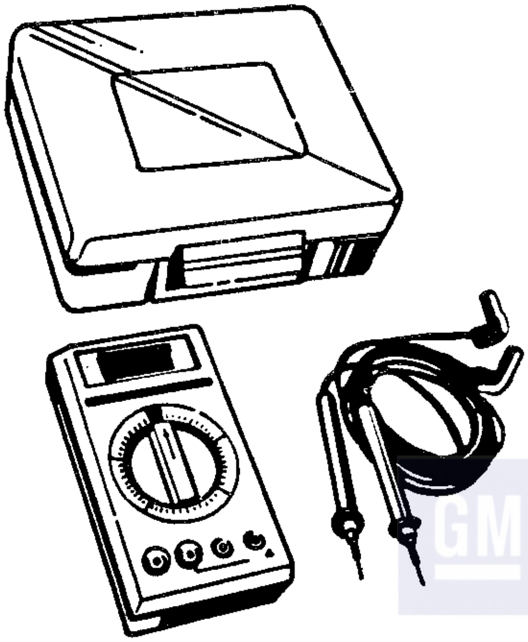
Figure 8 - Micro-Pack Terminal Replacement

TOOLS NEEDED TO SERVICE THE SYSTEM

The system requires an ALDL read-out ("Scan") tool, tachometer, test light, ohmmeter, digital voltmeter with 10 megohms impedance (J-29125A, J-34029A or equivalent), vacuum gage and jumper wires for diagnosis. A test light or voltmeter must be used when specified in the procedures. They must NOT be interchanged. See Figures 9 through 13 for Special Tools needed to diagnosis or repair a system. For more complete information on the operation of these tools, see the manufacturer's instructions.



HIGH IMPEDANCE MULTIMETER
(DIGITAL VOLTMETER-DVM)
J34029-A

VOLTMETER - Voltage Position Measures amount of voltage. When connected in parallel to an existing circuit. A digital voltmeter with 10 meg ohm input impedence is used because this type of meter will not load down the circuit and result in faulty readings.some circuits require accurate low voltage readings, and some circuits in the ECM have a very high resistance .

AMMETER - When used as ammeter, this meter also accurately measures extremely low current flow. Refer to meter instructions for more information.

- Selector must be set properly for both function and range. DC is used for most automotive measurements.

OHMMETER - Measures resistance of circuit directly in ohms. Refer to meter for more information.

- OL Display in all ranges indicates open circuit.
- Zero display in all ranges indicates a short circuit.
- Intermittent connection in circuit may be indicated by digital reading that will not stabilize on circuit.
- Range Switch.

☐ 200Ω – Reads ohms directly
2K,20K,200KΩ – Reads ohms in thousands
2M and 20MΩ - Reads ohms in millions

J23738

VACUUM PUMP (20 IN. HG. MINIMUM)
Use gage to monitor manifold engine vacuum and the hand pump to check vacuum sensors, solenoids and valves.

J34142-A

UNPOWERED TEST LIGHT
Used to check wiring for complete circuit and short to ground or voltage.

TACHOMETER
Use inductive trigger signal pickup type to check RPM.

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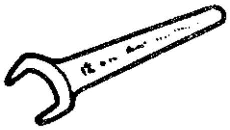
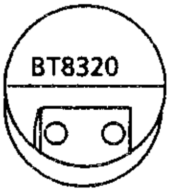
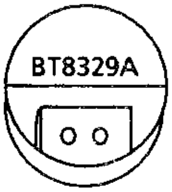
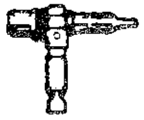
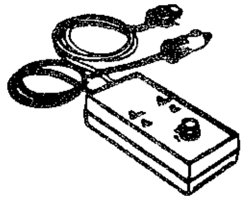
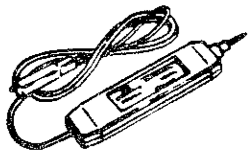
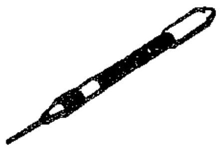
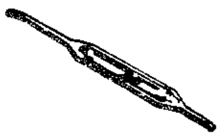
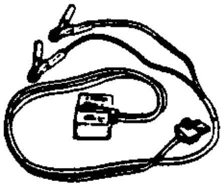
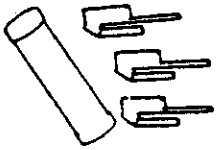
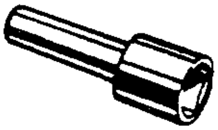
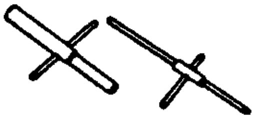
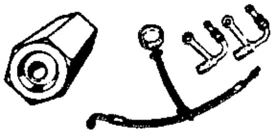
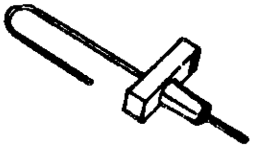
 J29533A/BT8127	**OXYGEN SENSOR WRENCH** Used to remove or install the oxygen sensor.
 J33031/BT8130	**IDLE AIR CONTROL WRENCH** Used to remove or install IAC valve on throttle body.
 J34730-A	**PORT FUEL INJECTION DIAGNOSTIC KIT** Used to diagnose port fuel injection systems. The kit includes: ● Fuel Pressure Gage - to check fuel pump pressure and compare injector pressure drop for equal fuel distribution. ● Injector Test Light - to check electrical circuit to an injector. ● Injector Tester - to energize each fuel injector for a precise amount of time to perform injector balance test in CHART C-2A by checking each injector's pressure drop using pressure gage.
 J34730-1	**FUEL PRESSURE GAGE** Used to check and monitor fuel line pressure of port fuel system. Part of Diagnostic Kit J34730-A
 J34730-2	**INJECTOR TEST LIGHT** Used to check electrical circuit to a port fuel injector Part of Diagnostic Kit J34730-A
 BT8320	**INJECTOR TEST LIGHT** Used to check electrical circuit to a TBI fuel injector (except TBI 700)
 BT8329A	**INJECTOR TEST LIGHT** Used to check electrical circuit to a TBI 700 fuel injector and a port fuel injector. 5-2-86 7S 3396-6E

 J26792/BT7220-1	**SPARK TESTER** Use to check available secondary ignition voltage . Also called an ST125.
 J36101	**MASS AIR FLOW (MAF) SENSOR TESTER** Used for static test of MAF Sensor on vehicles equipped with an A/C type MAF Sensor.
 J36179	**CRANKSHAFT SENSOR ALIGNMENT TOOL (C^{3}I SYSTEMS)** Used to properly align crank or combination sensor to harmonic balancer interrupter.
 J35616	**CONNECTOR TEST ADAPTER KIT** Used to make electrical test connections in current Weather Pack, Metri - Pack and Micro-Pack style terminals.
 J34636	**CIRCUIT TESTER** Used to check all relays and solenoids before connecting them to a new ECM. Measures the circuit resistance and indicates pass or fail via green or red LED. Amber LED indicates current polarity. Can also be used as a non-powered continuity checker.
 J28687-A/BT8220	**OIL PRESSURE TRANSDUCER WRENCH** Used to remove or install oil pressure transducer on engine.
 J35689	**METRI-PACK TERMINAL REMOVER** Used to remove 150 series Metri-Pack "pull-to-seat " terminals from connectors. Refer to wiring harness service in Section 6E for removal procedure.
 J28742/BT8234-A	**WEATHER PACK TERMINAL REMOVER** Used to remove Terminals from Weather Pack connectors. Refer to wiring harness service in Section 6E for removal procedure.
 J33095/BT8234-A	**ECM CONNECTOR TERMINAL REMOVER** Used to remove terminal from Micro-Pack connectors. Refer to wiring harness service Section 6E for removal procedure. 5-2-86 7S 3384-6E

 J29607/BT8022	**ISC ADJUSTING WRENCH** Used to adjust ISC on carburetor to obtain maximum specification RPM..
 J34025/BT8256A	**ISC MOTOR TESTER** Used to test operation of ISC Motor on carburetor in either direction, and condition of the internal switch.
 J9789-135/BT8104	**FLOAT LEVEL GAGE SET** Used to check float level on 2SE or E2SE carburetor.
 J34935/BT8420A	**FLOAT LEVEL GAGE** Used to check float level or M/C Solenoid travel on E2ME or E4ME carburetor.
 J29030-B/BT7610B	**IDLE MIXTURE SOCKET** Used to adjust idle mixture needle on an E2SE carburetor.
 J28696-B/BT7928	**MIXTURE ADJUSTMENT TOOL** Used to adjust lean mixture and rich mixture stop screws on E2SE, E2ME, and E4ME carburetors.
 J22646-02	**CARBURETOR ADJUSTMENT WRENCH** Used to adjust idle mixture on carburetor
 J33815-1/BT8253-A	**M/C SOLENOID GAGING TOOL** Used to adjust the Mixture Control Solenoid plunger on E2ME, and E4ME carburetors.

 J34730-3	**INJECTOR TESTER** Used to energize each fuel injector for a precise amount of time to perform injector balance test in CHART C-2A by checking each injector's pressure drop using pressure gage. Part of Diagnostic Kit J34730-A.
 J29698-A/BT8251	**FUEL LINE WRENCH** Used to disconnect or connect fuel lines at Throttle Body Unit by holding fuel nut at throttle body.
 J33179-20	**MINIMUM AIR RATE ADJUSTING WRENCH** Used to adjust throttle stop screw on TBI unit.
 J29658/BT8205	**FUEL PRESSURE GAGE** Used to check and monitor fuel line pressure of port fuel system.
 J33815-2/BT8253-A	**AIR BLEED VALVE GAGING TOOL** Used to adjust Idle Air Bleed Valve on E2ME, and E4ME carburetors.
 J25322/BT7523	**PUMP LEVER PIN PUNCH** Used to drive pump lever pin inward to allow removal of the pump lever on E2ME carburetor.

GENERAL SPECIFICATIONS

Many of the specifications used in this section are located on the Vehicle Emission Control Information label under the hood.

Listed on the chart below are locations of specifications used in this Section.

SPECIFICATION	LOCATION OF INFORMATION
Engine Timing	Vehicle Emission Control information label.
Idle Speed, ECM Controlled	Not adjustable. ECM controls idle.
Spark Plug Type	See Owner's Manual, Section "7".
Spark Plug Gap	Vehicle Emission Control Information Label.
Engine Code	8th digit of VIN number. See Section "OA". Also Owner's Manual, Section "7".
Engine Family	Vehicle Emission Control Information label.
Filter Part Numbers	See Owner's Manual, Section "7".
Part Numbers of Major Components	WDD-GM Parts Book.
Replacement of Vehicle Emission Control Information Label	WDD-GM Label Catalog.

SECTION 6E2

DRIVEABILITY AND EMISSIONS FUEL INJECTION (TBI)

THIS SECTION APPLIES TO:
2.5L LR8 (P SERIES) VIN CODE "R"

CONTENTS

INTRODUCTION

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 SYSTEM

SECTION C4
DIRECT IGNITION SYSTEM / EST

SECTION C7
EXHAUST GAS RECIRCULATION (EGR) SYSTEM

SECTION C8
TRANSMISSION CONVERTER CLUTCH SYSTEM

SECTION C10
ECM CONTROLED AIR CONDITIONING

SECTION C12
ELECTRIC COOLING FAN

SECTION C13
POSITIVE CRANKCASE VENTILATION (PCV)

ALL NEW GENERAL MOTORS VEHICLES ARE CERTIFIED BY THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY AS CONFORMING TO THE REQUIREMENTS OF THE REGULATIONS FOR THE CONTROL OF AIR POLLUTION FROM NEW MOTOR VEHICLES. THIS CERTIFICATION IS CONTINGENT ON CERTAIN ADJUSTMENTS BEING SET TO FACTORY STANDARDS. IN MOST CASES, THESE ADJUSTMENT POINTS EITHER HAVE BEEN PERMANENTLY SEALED AND/OR MADE INACCESSIBLE TO PREVENT INDISCRIMINATE OR ROUTINE ADJUSTMENT IN THE FIELD. FOR THIS REASON, THE FACTORY PROCEDURE FOR TEMPORARILY REMOVING PLUGS, CAPS, ETC., FOR PURPOSES OF SERVICING THE PRODUCT, MUST BE STRICTLY FOLLOWED AND, WHEREVER PRACTICABLE, RETURNED TO THE ORIGINAL INTENT OF THE DESIGN.

INTRODUCTION

GENERAL DESCRIPTION

This section applies to engines which have a fuel injector mounted above a throttle body assembly. The entire assembly is mounted to the intake manifold and is referred to as "Throttle Body Injection".

These engines have controls to reduce exhaust emissions, while maintaining good driveability and fuel economy.

An engine control module (ECM) is the heart of this control system and has sensors used to provide information about engine operation and the various systems it controls. Details of basic operation, diagnosis, functional checks, and on-vehicle service are covered in Section "C", Component Systems.

The ECM has the ability to do some diagnosis of itself, and of other parts of the system. When it finds a problem, it lights a "Service Engine Soon" light on the instrument panel and a trouble code will be stored in the ECM memory. This does not mean that the engine should be stopped right away, but that the cause of the light coming on should be checked as soon as reasonably possible.

DIAGNOSIS PROCEDURE

The following sections(s) are written for specific engine applications and are clearly indentified. Be sure to use only the section which applies to the engine family being diagnosed.

Before using this section of the manual, you should be familiar with the information and the proper diagnosing procedures as described in Section "6E". If the proper diagnosis procedures are not followed, as described in Section "6E", it may result in unnecessary replacement of good parts.

Trouble tree charts incorporate diagnosis procedures using an ALDL "Scan" tool, where possible. The "Scan" tool has the ability to save time in diagnosis and prevent the replacement of good parts. **The key to using the "Scan" tool successfully for diagnosis lies in the technician's ability to understand the system he is trying to diagnose, as well as an understanding of the "Scan" tool's limitations. See Section 6E for more information.**

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

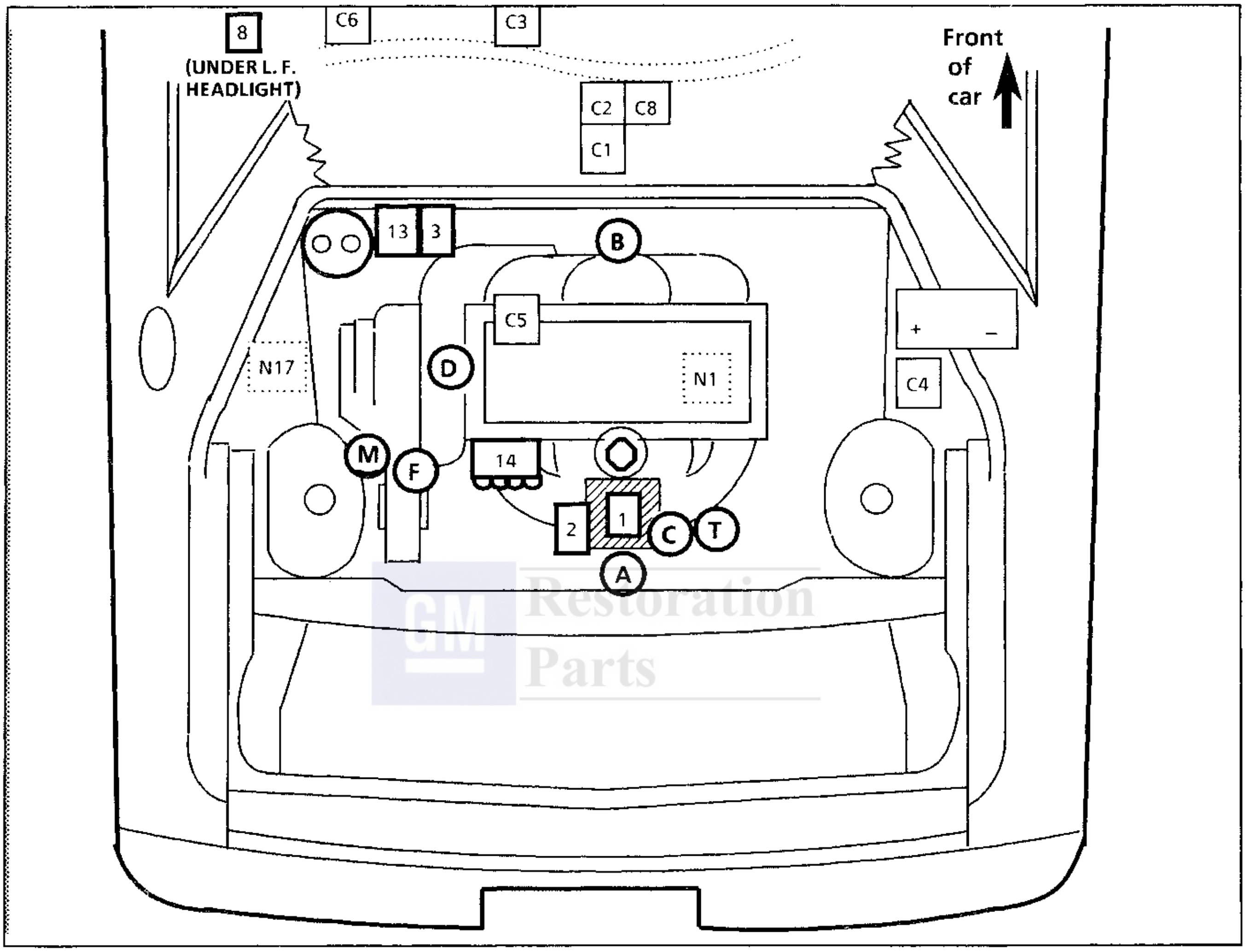
On some engines, the Oxygen Sensor will cool off after only a short period of operation at idle. This will put the system into "Open Loop." To restore "Closed Loop" operation, run the engine at part throttle several minutes and accelerate from idle to part throttle a few times.

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 ALDL diagnostic connector
- C3 "SERVICE ENGINE SOON" light
- C4 ECM power
- C5 ECM harness ground
- C6 Fuse panel
- C8 Fuel pump test (terminal "G" of ALDL)

☐ NOT ECM CONNECTED

- N1 Crankcase vent valve (PCV)
- N17 Fuel vapor canister

☐ CONTROLLED DEVICES

- 1 Fuel injector
- 2 Idle air control valve
- 3 Fuel pump relay
- 8 Engine fan relay (located under left front headlight)
- 13 A/C compressor relay
- 14 Direct ignition system assembly

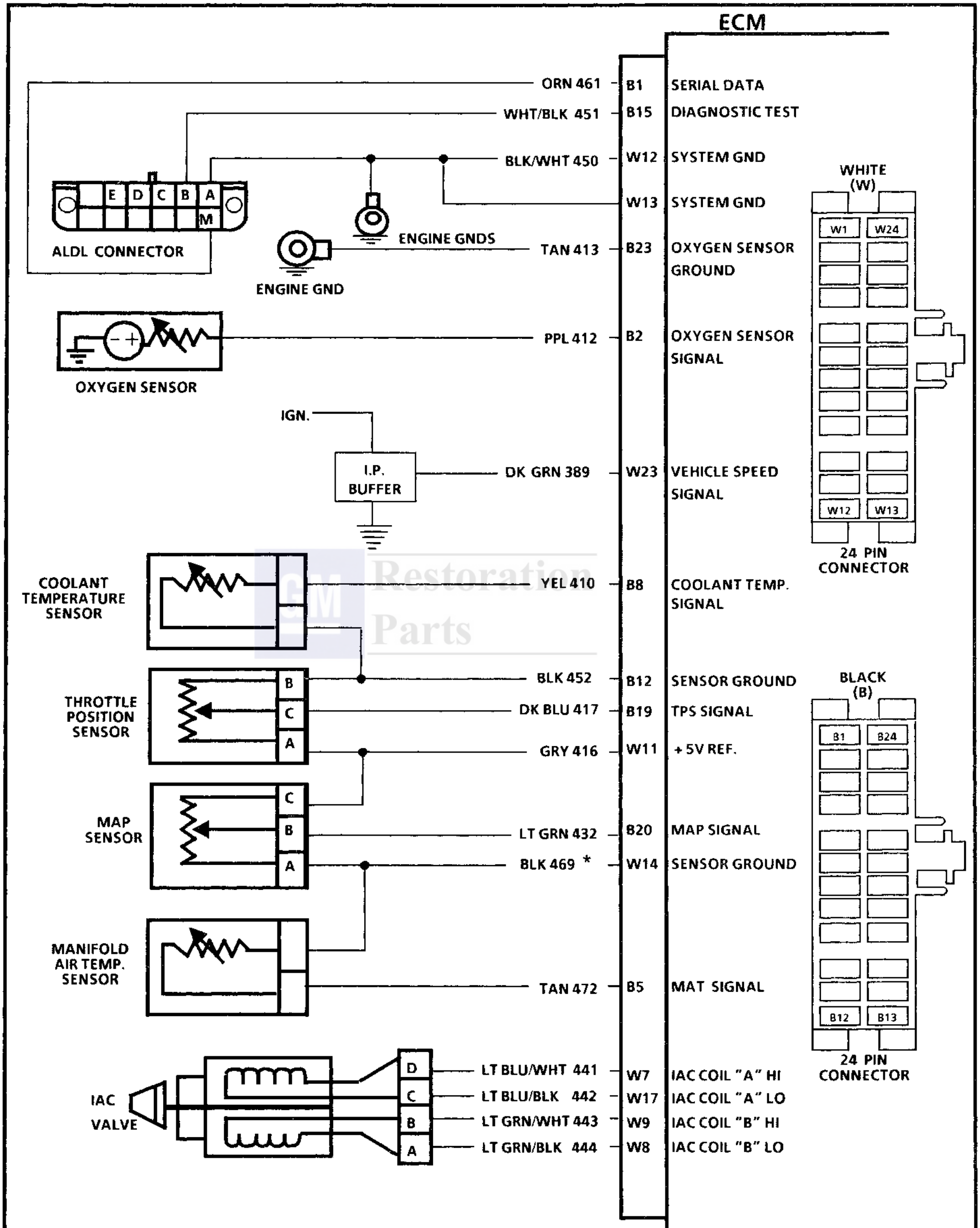
⬡ Exhaust gas recirculation valve

○ INFORMATION SENSORS

- A Manifold absolute pressure (located on air cleaner)
- B Exhaust oxygen
- C Throttle position
- D Coolant temperature
- F Vehicle speed (PM generator)
- M P/N switch
- T Manifold air temperature

4-22-87
* 5S 2122-6E

Figure A-1 Component Locations, 2.5L "P" Series



* THIS WIRE MAY ALSO HAVE TRACER COLOR.

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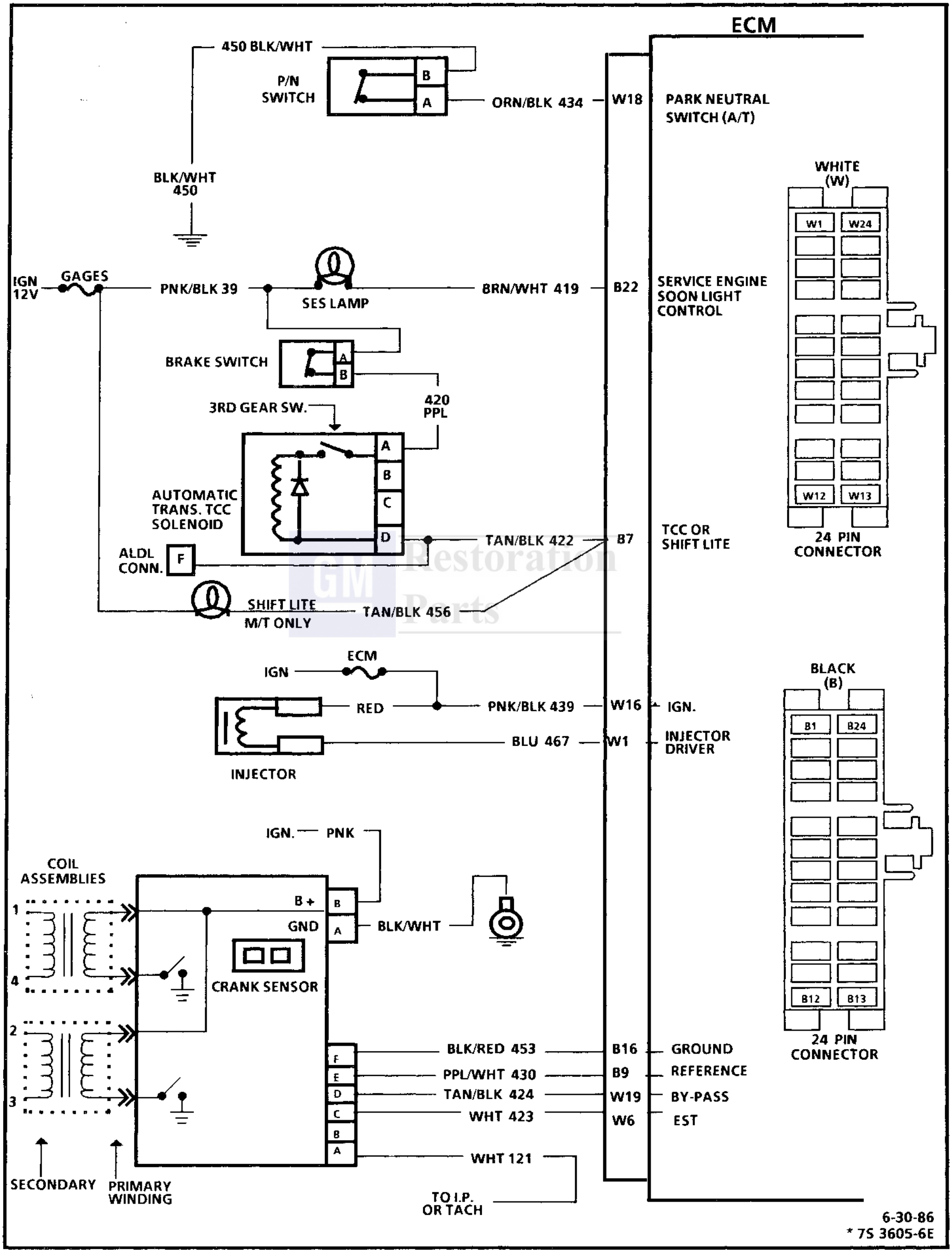
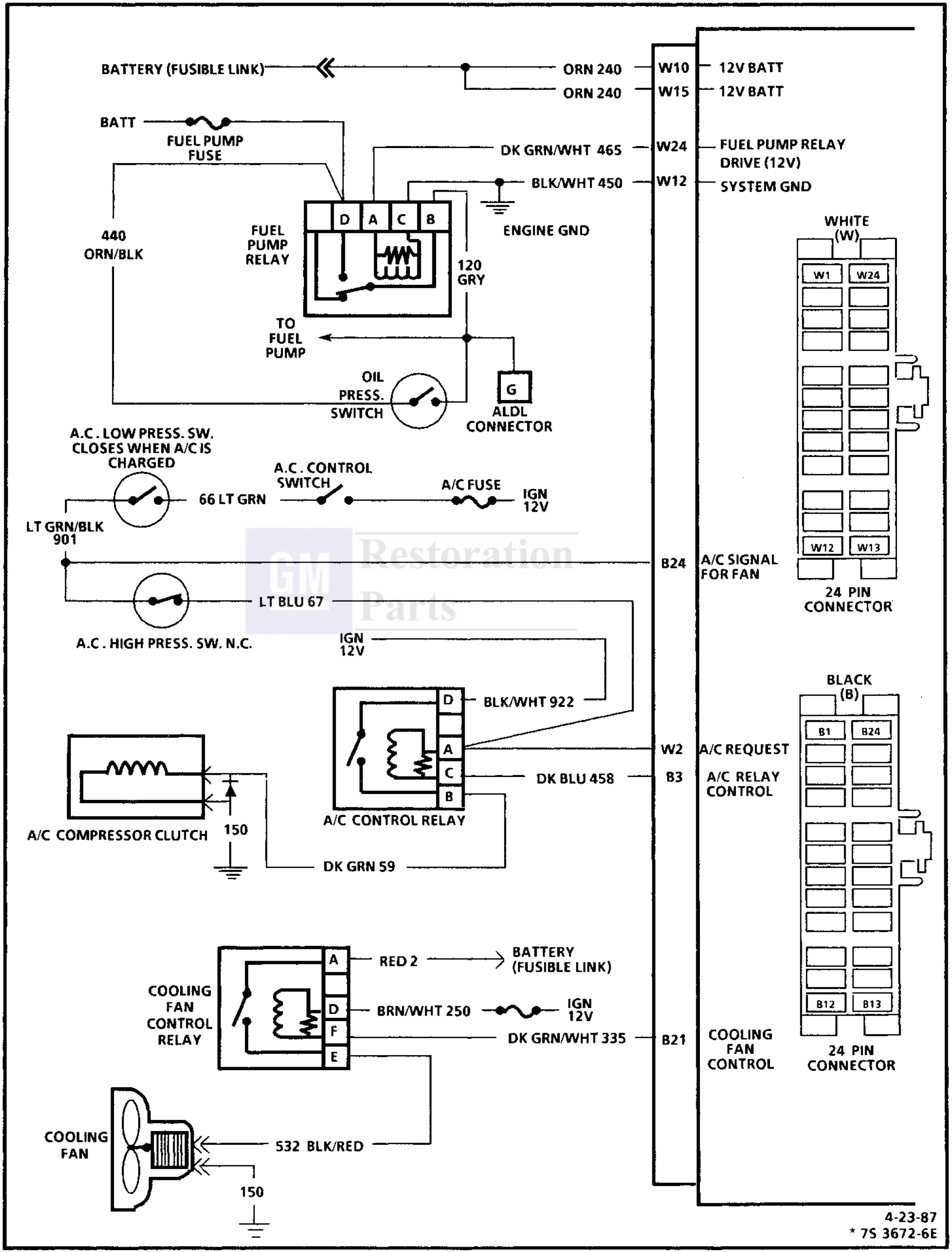
*7S 3946-6E

Figure A-2 Wiring Diagram 2.5L "P" Series (1 of 3)



6-30-86
* 7S 3605-6E

Figure A-3 Wiring Diagram 2.5L "P" Series (2 of 3)



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* 7S 3672-6E

Figure A-4 2.5L Wiring Diagram, 2.5L "P" Series (3 of 3)

FUEL INJECTION ECM CONNECTOR IDENTIFICATION

This ECM voltage chart is for use with a digital voltmeter to further aid in diagnosis. The voltages you get may vary due to low battery charge or other reasons, but they should be very close.

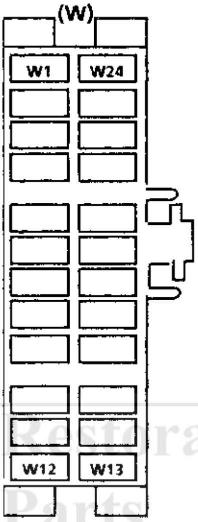
THE FOLLOWING CONDITIONS MUST BE MET BEFORE TESTING:

● Engine at operating temperature ● Engine idling in closed loop (for "Engine Run" column)
●Test terminal not grounded ● "Scan" tool not installed
B + Indicates battery or charging system voltage

VOLTAGE

	KEY "ON"	ENG. RUN	CIRCUIT	PIN	WIRE COLOR
	B +	B +	INJECTOR DRIVE	W1	DK. BLU
②	0	0	A/C REQUEST	W2	DK GRN/ WHT
			NOT USED	W3	
			CRUISE	W4	GRY/ BLK
			NOT USED	W5	
	0	1.3	EST	W6	WHT
	⑥	⑥	IAC "A" HI	W7	LT.BLU/ WHT
	⑥	⑥	IAC "B" LOW	W8	LT GRN/ BLK
	⑥	⑥	IAC "B" HI	W9	LT.GRN/ WHT
	B +	B +	12V BATT	W10	ORN
	5.0	5.0	5 VOLT REFERENCE	W11	GRY
	0 *	0 *	ECM GROUND	W12	BLK/ WHT

WHITE (W)



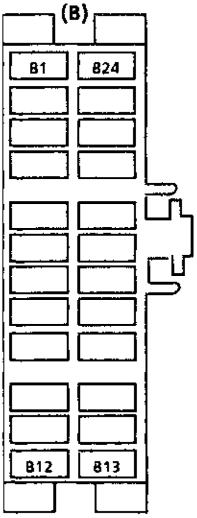
24 PIN CONNECTOR

VOLTAGE

WIRE COLOR	PIN	CIRCUIT	KEY "ON"	ENG. RUN	
DK.GRN/ WHT	W24	FUEL PUMP	12.0	13.0	④
DK. GRN	W23	VSS INPUT	③	③	
	W22	NOT USED			
DK BLU	W21	CRUISE			
GRY	W20	CRUISE			
TAN/ BLK	W19	BY-PASS	0	4.5	
ORN/ BLK	W18	P/N SWITCH	0	0	
LT.BLU BLK	W17	IAC "A" LOW	⑥	⑥	
PNK/ BLK	W16	12 V IGN.	B +	B +	
ORN	W15	12V BATT.	B +	B +	
BLK ①	W14	MAP,MAT,GND	0 *	0 *	
BLK/ WHT	W13	ECM GROUND	0 *	0 *	

	2-5	volts varing	SERIAL DATA	B1	ORN
	.33-.55	.1-.9	OXYGEN SENSOR SIGNAL	B2	PPL
②	B +	B +	A/C CLUTCH RELAY	B3	DK BLU
②	B +	B +	FAN (H.D. COOL)	B4	LT. GRN/ BLK
⑤	1.3	1.3	MAT	B5	TAN
			NOT USED	B6	
			TCC OR SHIFTLITE	B7	TAN/ BLK
⑤	1.9	1.9	COOLANT	B8	YEL
	4.6	3.0	IGNITION REF. HI	B9	PPL/ WHT
			CRUISE	B10	LT GRN
			CRUISE	B11	DK BLU/ WHT
	0 *	0 *	COOLANT AND TPS GND.	B12	BLK

BLACK (B)



24 PIN CONNECTOR

LT.BLU/ BLK	B24	A/C SIGNAL FOR FAN	0 *	0 *	②
TAN	B23	OXYGEN SENSOR GROUND	0 *	0 *	
BRN/ WHT	B22	SERVICE ENG. SOON LITE	0 *	B +	
DK.GRN/ WHT	B21	ENG. COOLING FAN	B +	B +	②
LT.GRN	B20	MAP	4.75	1.1	
DK.BLU	B19	TPS	.6	.6	
WHT	B18	CRUISE			
	B17	NOT USED			
BLK/ RED	B16	GROUND (IGN. REF. LOW)	0 *	0 *	
WHT/ BLK	B15	ALDL DIAG.	5	5	
DK BRN	B14	CRUISE			
	B13	NOT USED			

* All voltages shown "0" should read less than .5 volt
①This wire may also have tracer color
②A/C, Fan Off
③Varies from 0 to 10 volts depending on position of drive wheels
④Reads battery voltage for 2 seconds after ignition "on" then should read 0 volts
⑤ Varies depending on temperature
⑥ Not useable

ENGINE 2.5L
CARLINE P

5-18-86
* 7S 3603-6E

Figure A-5 - 2.5L - "P" SERIES ECM Terminal End View

BLANK

DIAGNOSTIC CIRCUIT CHECK

The Diagnostic Circuit Check is an organized approach to identifying a problem created by an Electronic Engine Control System malfunction. It must be the starting point for any driveability complaint diagnosis, because it directs the Service Technician to the next logical step in diagnosing the complaint.

The "Scan Data" listed in the table may be used for comparison, after completing the Diagnostic Circuit Check and finding the on-board diagnostics functioning properly and no trouble codes displayed. The "Typical Values" are an average of display values recorded from normally operating vehicles and are intended to represent what a normally functioning system would typically display.

A "SCAN" TOOL THAT DISPLAYS FAULTY DATA SHOULD NOT BE USED, AND THE PROBLEM SHOULD BE REPORTED TO THE MANUFACTURER. THE USE OF A FAULTY "SCAN" CAN RESULT IN MISDIAGNOSIS AND UNNECESSARY PARTS REPLACEMENT.

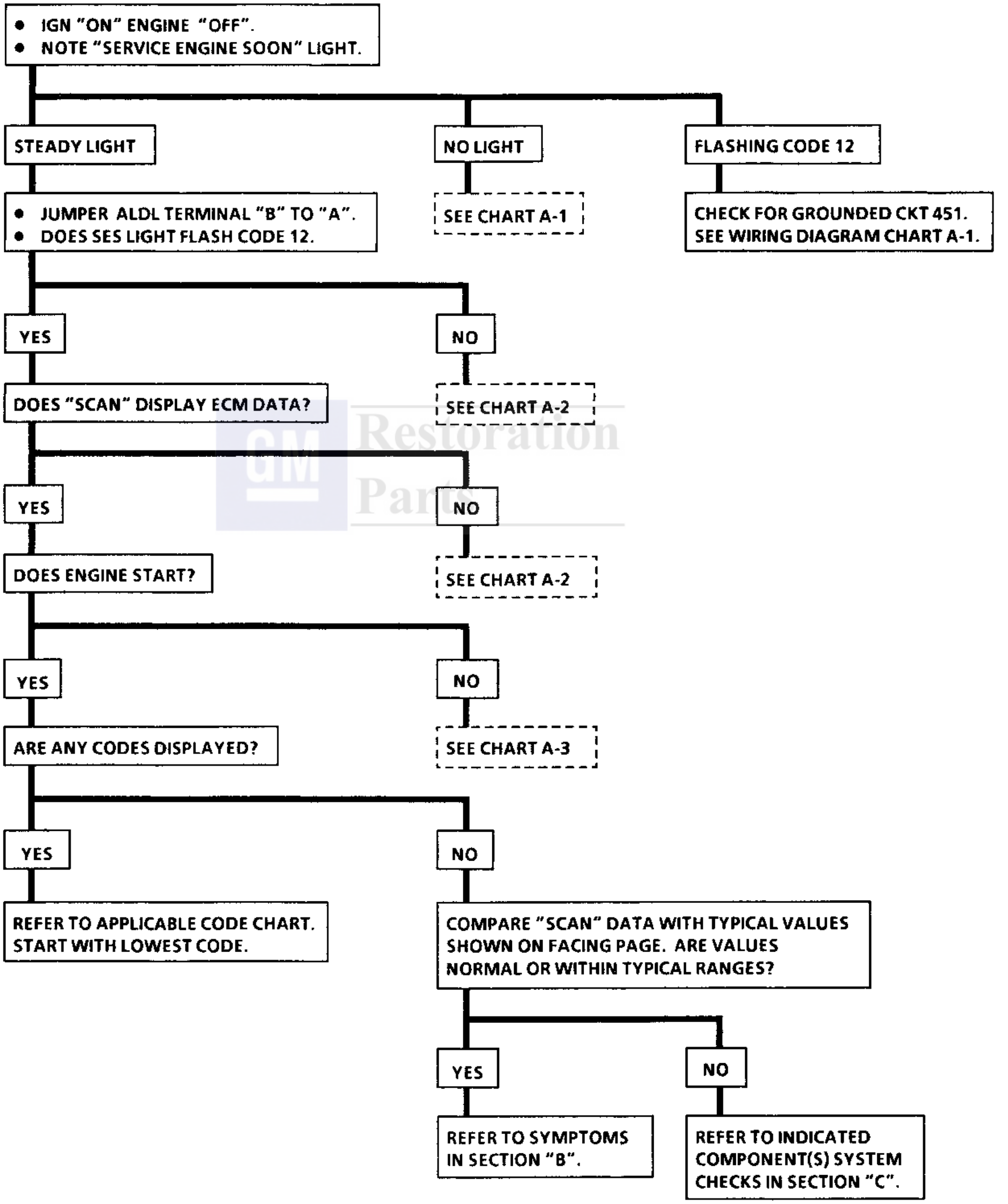
Only the parameters listed below are used in this manual for diagnosis. If a "Scan" reads other parameters, the values are not recommended by General Motors for use in diagnosis. For more description on the values and use of the "Scan" to diagnosis ECM inputs, refer to the applicable diagnosis section in Section C. If all values are within the range illustrated, refer to symptoms in Section B.

"SCAN" DATA

Idle / Upper Radiator Hose Hot / Closed Throttle / Park or Neutral / Closed Loop / Acc. off

"SCAN" Position	Units Displayed	Typical Data Value
Desired RPM	RPM	ECM idle command (varies with temp.)
RPM	RPM	± 50 RPM from desired RPM in drive(Auto) ± 100 RPM from desired RPM in neutral (Manual)
Coolant Temp.	C°	85° - 105°
MAT Temp.	C°	10° - 90° (varies with underhood temp. and sensor location)
MAP	Volts	1 - 2 (depends on Vac. & Baro pressure)
BPW (base pulse width)	M/Sec	.8 - 3.0
O_2	Volts	.1 - 1 and varies
TPS	Volts	.4 - 1.25
Throttle Angle	0 - 100%	0
IAC	Counts (steps)	1 - 50
P/N Switch	P/N and RDL	Park/Neutral (P/N)
INT (Integrator)	Counts	110 - 145
BLM (Block Learn)	Counts	118 - 138
Open/Closed Loop	Open/Closed	Closed Loop (may go open with extended idle)
VSS	MPH	0
TCC	On/Off	Off/ (on with TCC commanded)
Spark Advance	# of Degrees	Varies
Battery	Volts	13.5 - 14.5
Fan	On/Off	Off (below 102°C)
A/C Request	Yes/No	No (yes, with A/C requested)
A/C Clutch	On/Off	Off (on, with A/C commanded on)
Shift Light (M/T)	On/Off	Off

DIAGNOSTIC CIRCUIT CHECK
2.5L “P” SERIES (TBI)



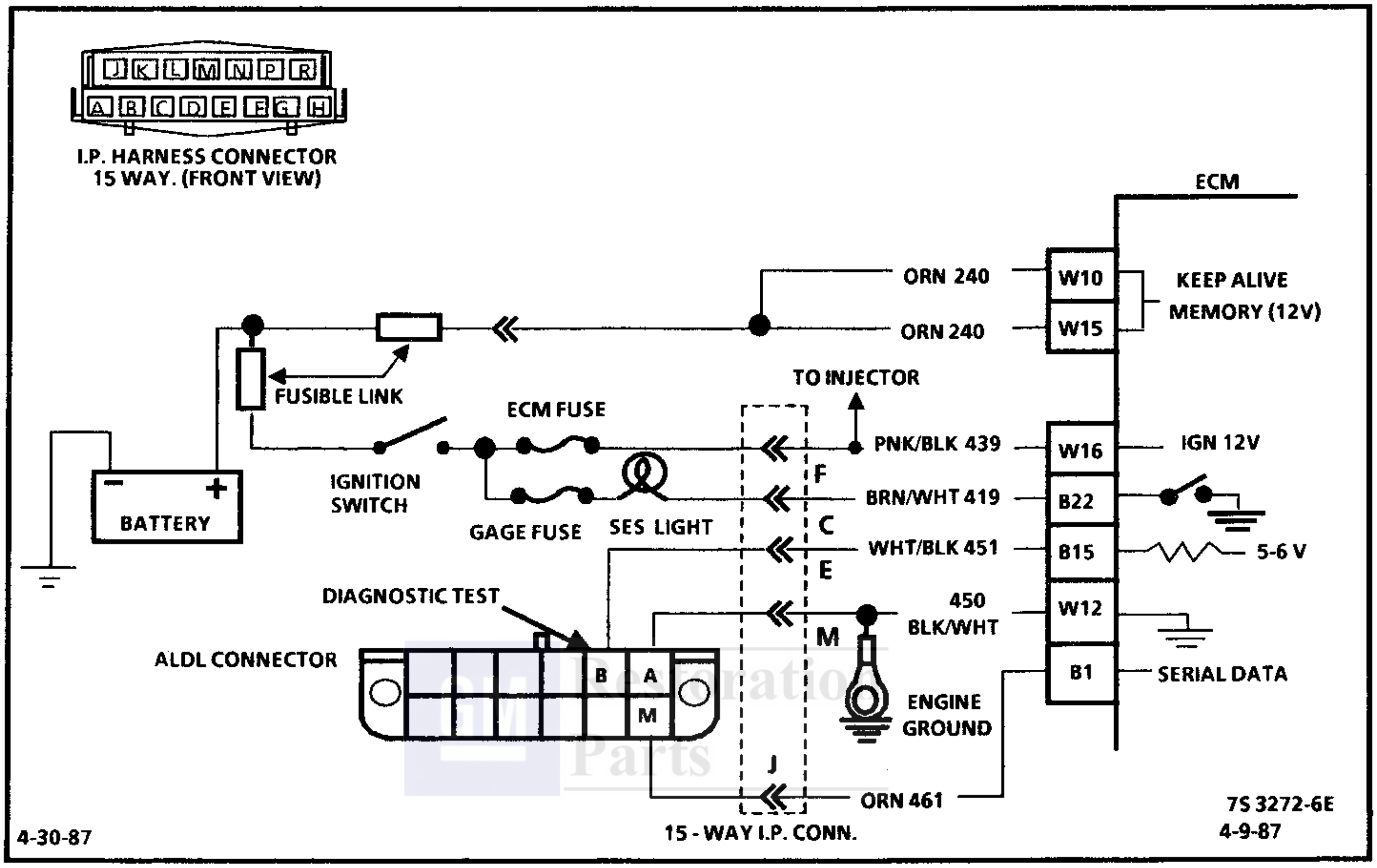


CHART A-1

NO "SERVICE ENGINE SOON" LIGHT
2.5L "P " SERIES (TBI)

Circuit Description:

There should always be a steady "Service Engine Soon" light, when the ignition is "ON" and engine stopped. Battery is supplied directly to the light bulb. The electronic control module (ECM) will control the light and turn it "ON" by providing a ground path through CKT 419 to the ECM.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Battery feed CKT 240 is protected by a fusible link, at the battery.
2. Using a test light connected to 12 volts, probe each of the system ground circuits to be sure a good ground is present. See ECM terminal end view in front of this section for ECM pin locations of ground circuits.

Diagnostic Aids:

Engine runs OK, check:

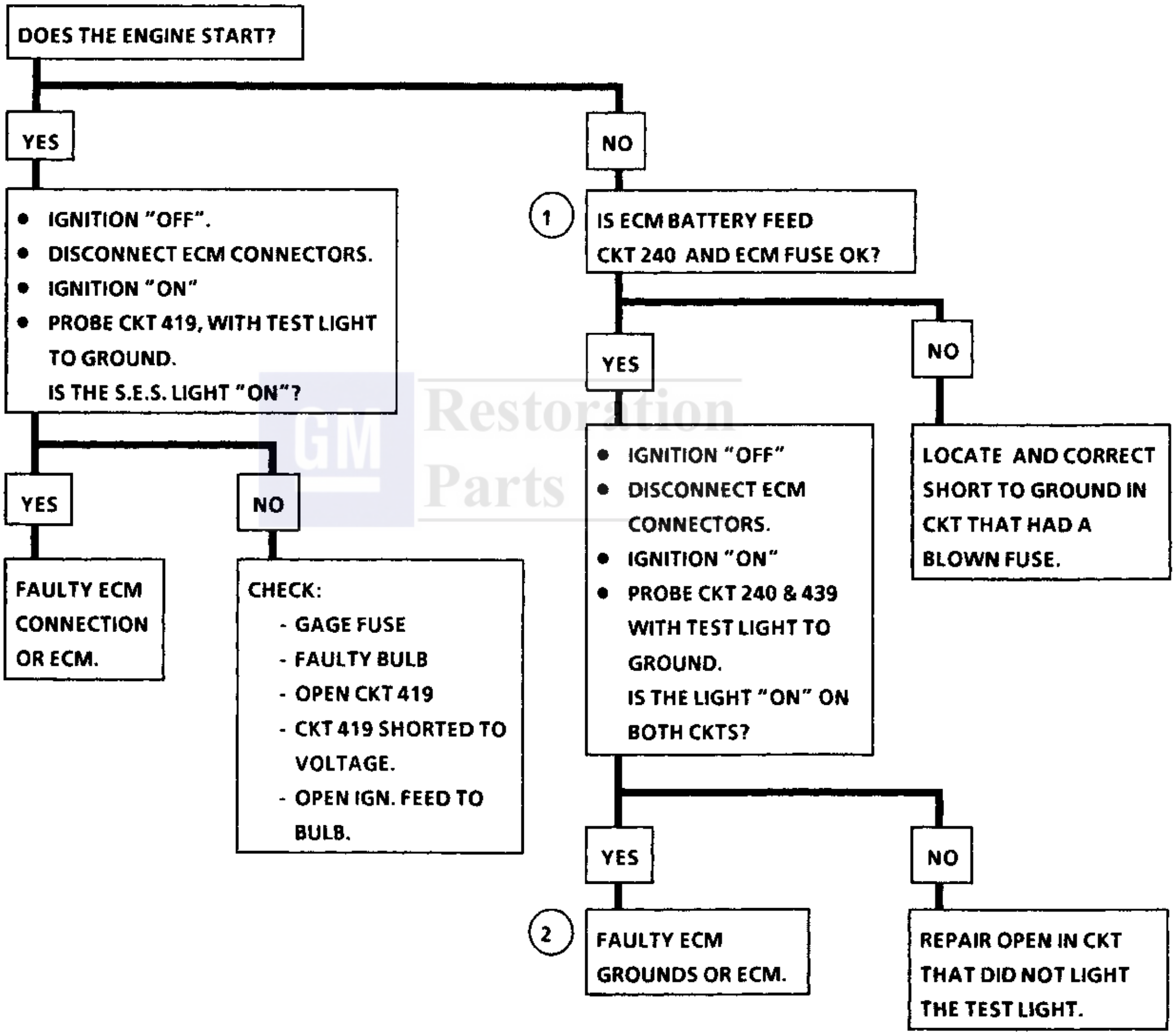
- Faulty light bulb
- CKT 419 open
- Gage fuse blown. This will result in no oil, or generator lights, seat belt reminder, etc.

Engine cranks, but will not run.

- Continuous battery - fuse or fusible link open
- ECM ignition fuse open
- Battery CKT 240 to ECM open
- Ignition CKT 439 to ECM open
- Poor connection to ECM

CHART A-1

NO "SERVICE ENGINE SOON" LIGHT
2.5L "P" SERIES (TBI)



CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

4-24-86
7S 3273-6E

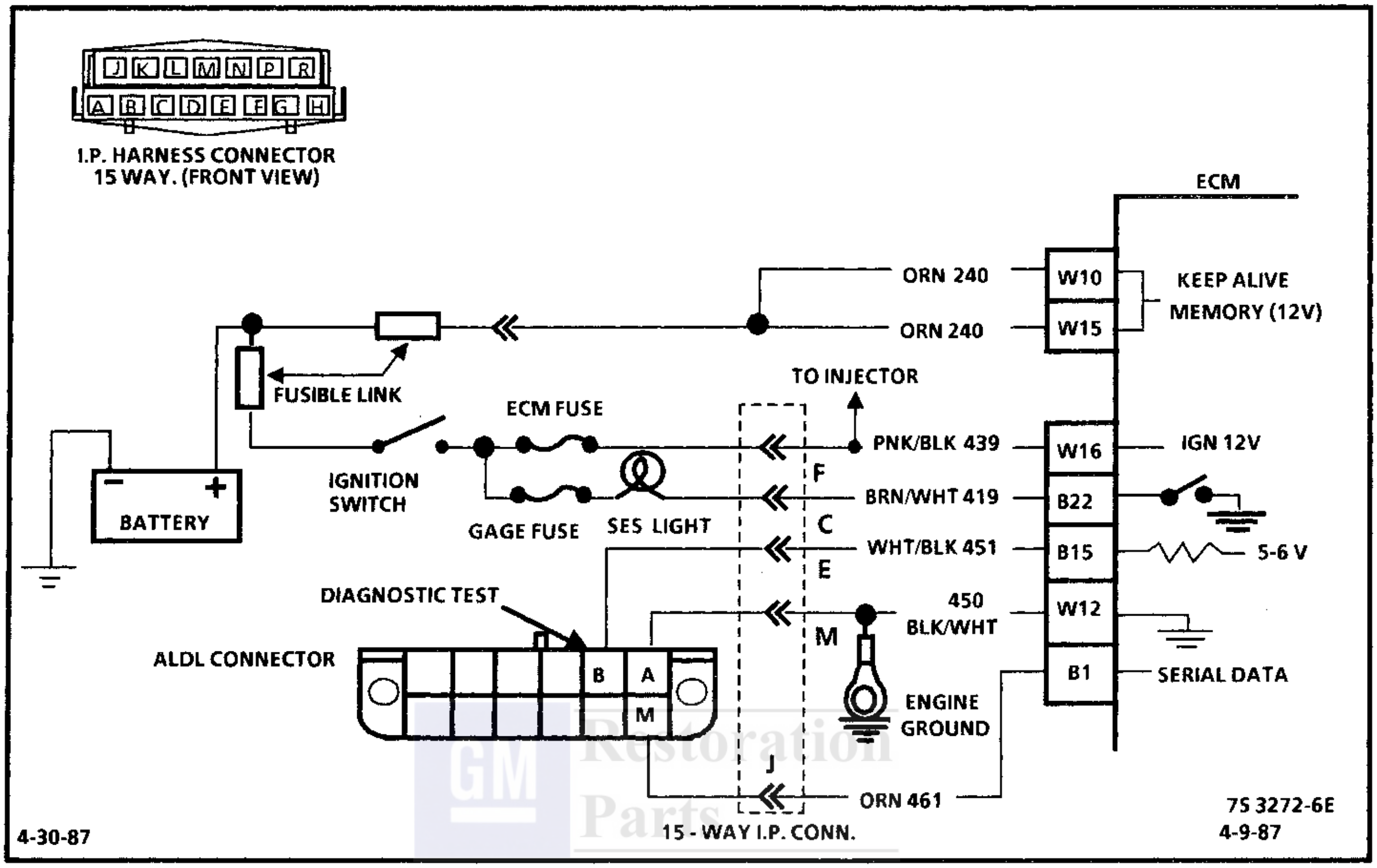


CHART A-2

NO ALDL DATA OR WON'T FLASH CODE 12 "SERVICE ENGINE SOON" LIGHT ON STEADY 2.5L "P " SERIES (TBI)

Circuit Description:

There should always be a steady "Service Engine Soon" Light, when the ignition is "ON" and engine stopped. Battery is supplied directly to the light bulb. The electronic control module (ECM) will turn the light "ON" by grounding CKT 419 at the ECM.

With the diagnostic terminal grounded, the light should flash a Code 12, followed by any trouble code(s) stored in memory.

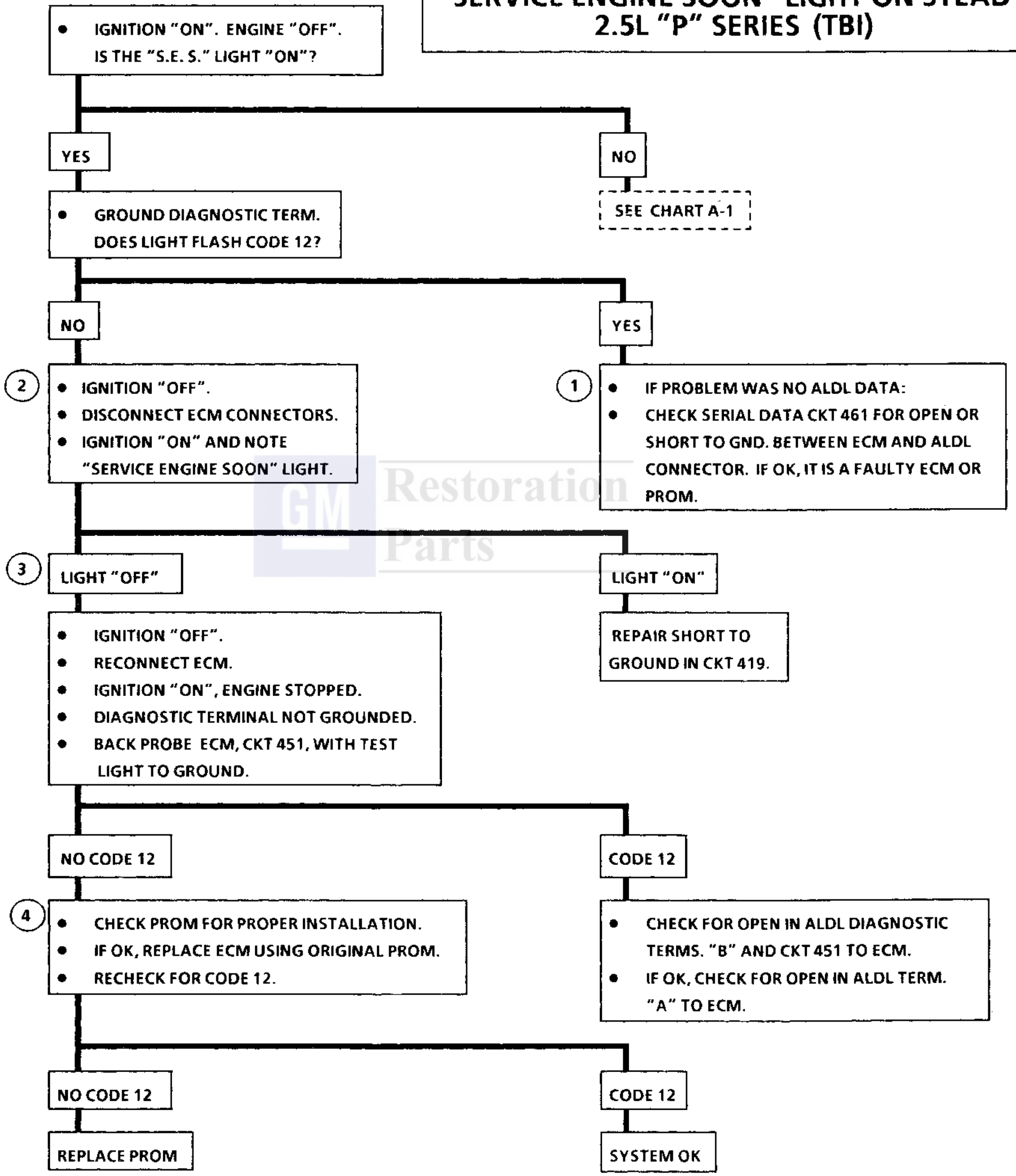
A steady light suggests a short to ground in the light control CKT 419, or an open in diagnostic CKT 451.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. If there is a problem with the ECM that causes a "Scan" tool to not read Serial data, then the ECM should not flash a Code 12. If Code 12 does flash, be sure that the "Scan" tool is working properly on another vehicle. If the "Scan" is functioning properly and CKT 461 is OK, the PROM or ECM may be at fault for the No ALDL symptom.
2. If the light goes "OFF", when the ECM connector is disconnected, then CKT 419 is not shorted to ground.
3. This step will check for an open diagnostic CKT 451.
4. At this point, the "Service Engine Soon" light wiring is OK. The problem is a faulty ECM or PROM. If Code 12 does not flash, the ECM should be replaced using the original PROM. Replace the PROM only after trying an ECM, as a defective PROM is an unlikely cause of the problem.

CHART A-2

NO ALDL DATA OR WON'T FLASH CODE 12 "SERVICE ENGINE SOON" LIGHT ON STEADY 2.5L "P" SERIES (TBI)



- IGNITION "ON". ENGINE "OFF". IS THE "S.E.S." LIGHT "ON"?

YES

- GROUND DIAGNOSTIC TERM. DOES LIGHT FLASH CODE 12?

NO

SEE CHART A-1

NO

②
- IGNITION "OFF".
- DISCONNECT ECM CONNECTORS.
- IGNITION "ON" AND NOTE "SERVICE ENGINE SOON" LIGHT.

YES

①
- IF PROBLEM WAS NO ALDL DATA:
- CHECK SERIAL DATA CKT 461 FOR OPEN OR SHORT TO GND. BETWEEN ECM AND ALDL CONNECTOR. IF OK, IT IS A FAULTY ECM OR PROM.

③ LIGHT "OFF"

- 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

④
- CHECK PROM FOR PROPER INSTALLATION.
- IF OK, REPLACE ECM USING ORIGINAL PROM.
- RECHECK FOR CODE 12.

CODE 12

- CHECK FOR OPEN IN ALDL DIAGNOSTIC TERMS. "B" AND CKT 451 TO ECM.
- IF OK, CHECK FOR OPEN IN ALDL TERM. "A" TO ECM.

NO CODE 12

REPLACE PROM

CODE 12

SYSTEM OK

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

5-15-87
7S 3341-6E

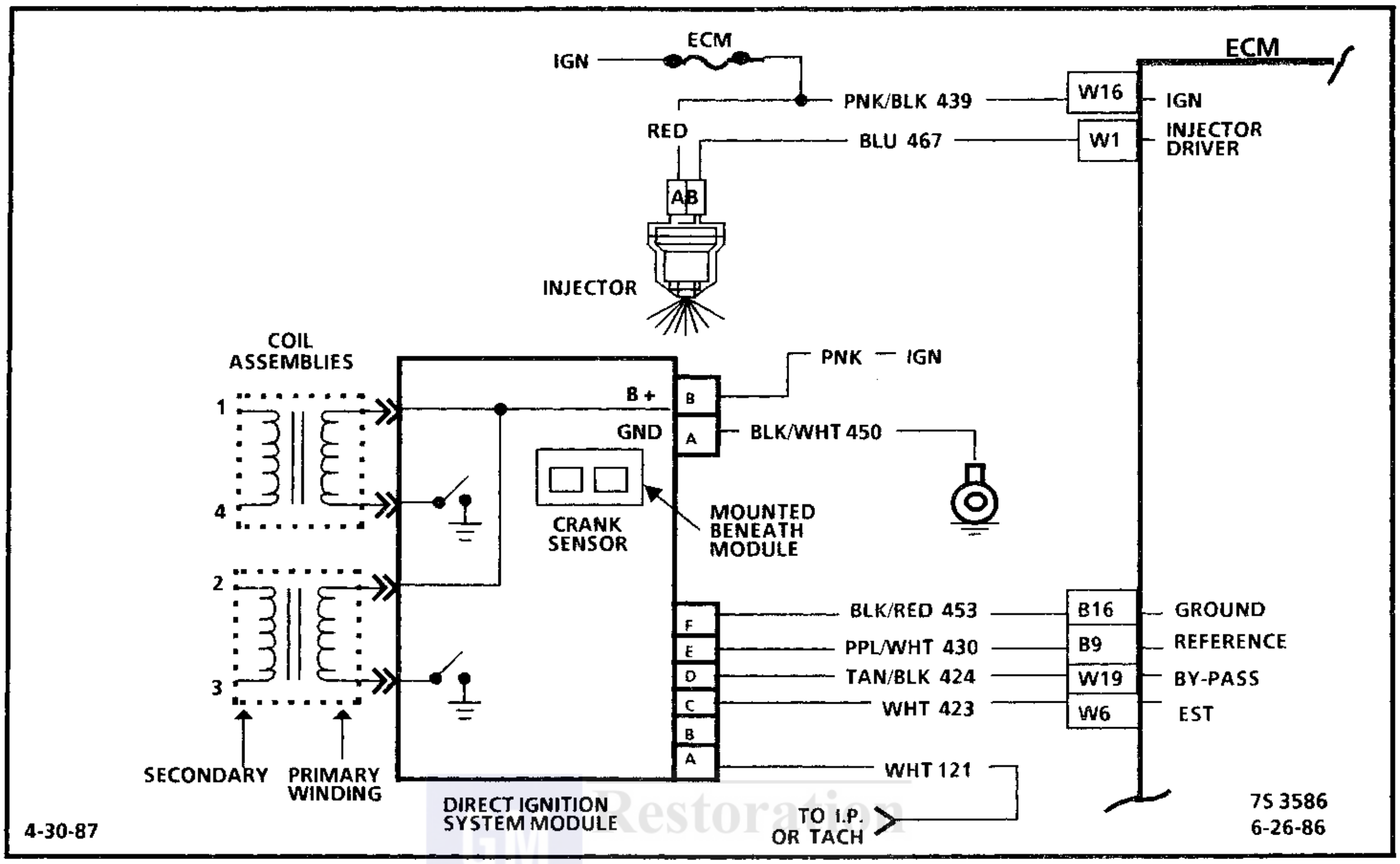


CHART A-3

(Page 1 of 3)

ENGINE CRANKS BUT WON'T RUN
2.5L "P" SERIES (TBI)

Circuit Description:

Before using this chart, battery condition, engine cranking speed, and fuel quantity should be checked and verified as being OK.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. A "Service Engine Soon" light "ON" is a basic test to determine if there is a 12 volt supply and ignition 12 volts to ECM. No ALDL may be due to an ECM problem, and CHART A-2 will diagnose the ECM. If TPS is over 2.5 volts, the engine may be in the clear flood mode, which will cause starting problems. The engine will not start without reference pulses and, therefore, the "Scan" should read rpm (reference) during cranking.
2. Because the Direct Ignition System uses two plugs and wires to complete the circuit of each coil, the opposite spark plug wire, should be left connected. If rpm was indicated during crank, the ignition module is receiving a crank signal, but "No Spark" at this test indicates the ignition module is not triggering the coil.
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. The test light should blink, indicating the ECM is controlling the injectors OK. How bright the light blinks is not important. However, the test light should be a BT 8329 or equivalent.
5. Fuel Spray from the injector indicates that fuel is available. However, the engine could be severly flooded due to too much fuel. No fuel spray from injector indicates a faulty fuel system or no ECM control of injector.

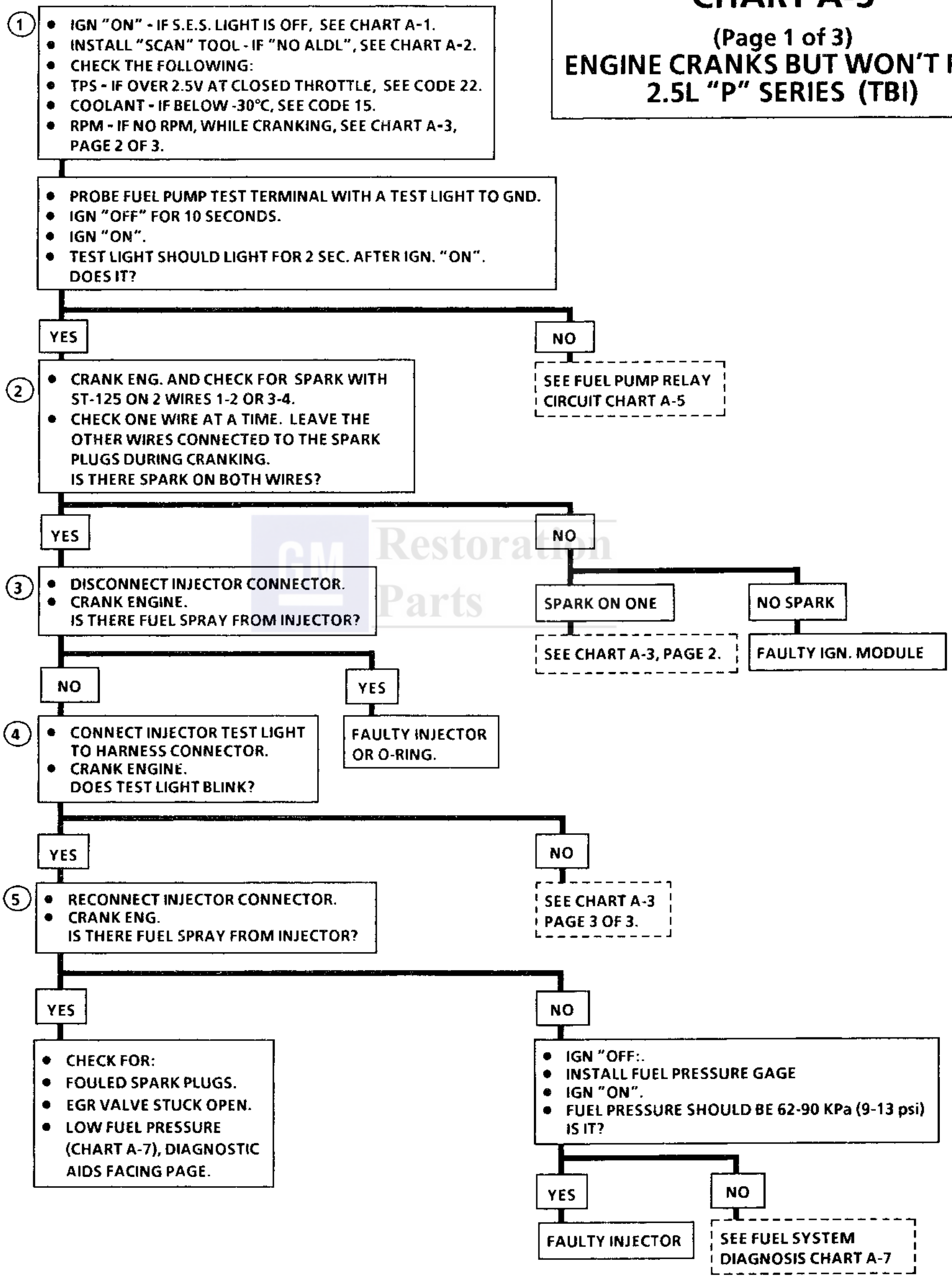
Diagnostic Aids:

- The fuel pump test terminal is terminal "G" of the ALDL connector.
- 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 re-occur until an overnight park in freezing temperatures.
- An EGR 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.
- Fuel pressure: Low fuel pressure can result in a very lean air/fuel ratio. See CHART A-7.

CHART A-3

(Page 1 of 3)

ENGINE CRANKS BUT WON'T RUN 2.5L "P" SERIES (TBI)



①
- IGN "ON" - IF S.E.S. LIGHT IS OFF, SEE CHART A-1.
- INSTALL "SCAN" TOOL - IF "NO ALDL", SEE CHART A-2.
- CHECK THE FOLLOWING:
- TPS - IF OVER 2.5V AT CLOSED THROTTLE, SEE CODE 22.
- COOLANT - IF BELOW -30°C, SEE CODE 15.
- RPM - IF NO RPM, WHILE CRANKING, SEE CHART A-3, PAGE 2 OF 3.

- PROBE FUEL PUMP TEST TERMINAL WITH A TEST LIGHT TO GND.
- IGN "OFF" FOR 10 SECONDS.
- IGN "ON".
- TEST LIGHT SHOULD LIGHT FOR 2 SEC. AFTER IGN. "ON". DOES IT?

YES

NO

SEE FUEL PUMP RELAY CIRCUIT CHART A-5

②
- CRANK ENG. AND CHECK FOR SPARK WITH ST-125 ON 2 WIRES 1-2 OR 3-4.
- CHECK ONE WIRE AT A TIME. LEAVE THE OTHER WIRES CONNECTED TO THE SPARK PLUGS DURING CRANKING. IS THERE SPARK ON BOTH WIRES?

YES

NO

SPARK ON ONE

SEE CHART A-3, PAGE 2.

NO SPARK

FAULTY IGN. MODULE

③
- DISCONNECT INJECTOR CONNECTOR.
- CRANK ENGINE. IS THERE FUEL SPRAY FROM INJECTOR?

NO

YES

FAULTY INJECTOR OR O-RING.

④
- CONNECT INJECTOR TEST LIGHT TO HARNESS CONNECTOR.
- CRANK ENGINE. DOES TEST LIGHT BLINK?

YES

NO

SEE CHART A-3 PAGE 3 OF 3.

⑤
- RECONNECT INJECTOR CONNECTOR.
- CRANK ENG. IS THERE FUEL SPRAY FROM INJECTOR?

YES

- CHECK FOR:
- FOULED SPARK PLUGS.
- EGR VALVE STUCK OPEN.
- LOW FUEL PRESSURE (CHART A-7), DIAGNOSTIC AIDS FACING PAGE.

NO

- IGN "OFF:.
- INSTALL FUEL PRESSURE GAGE
- IGN "ON".
- FUEL PRESSURE SHOULD BE 62-90 KPa (9-13 psi) IS IT?

YES

FAULTY INJECTOR

NO

SEE FUEL SYSTEM DIAGNOSIS CHART A-7

4-14-86
* 7S 3230-6E

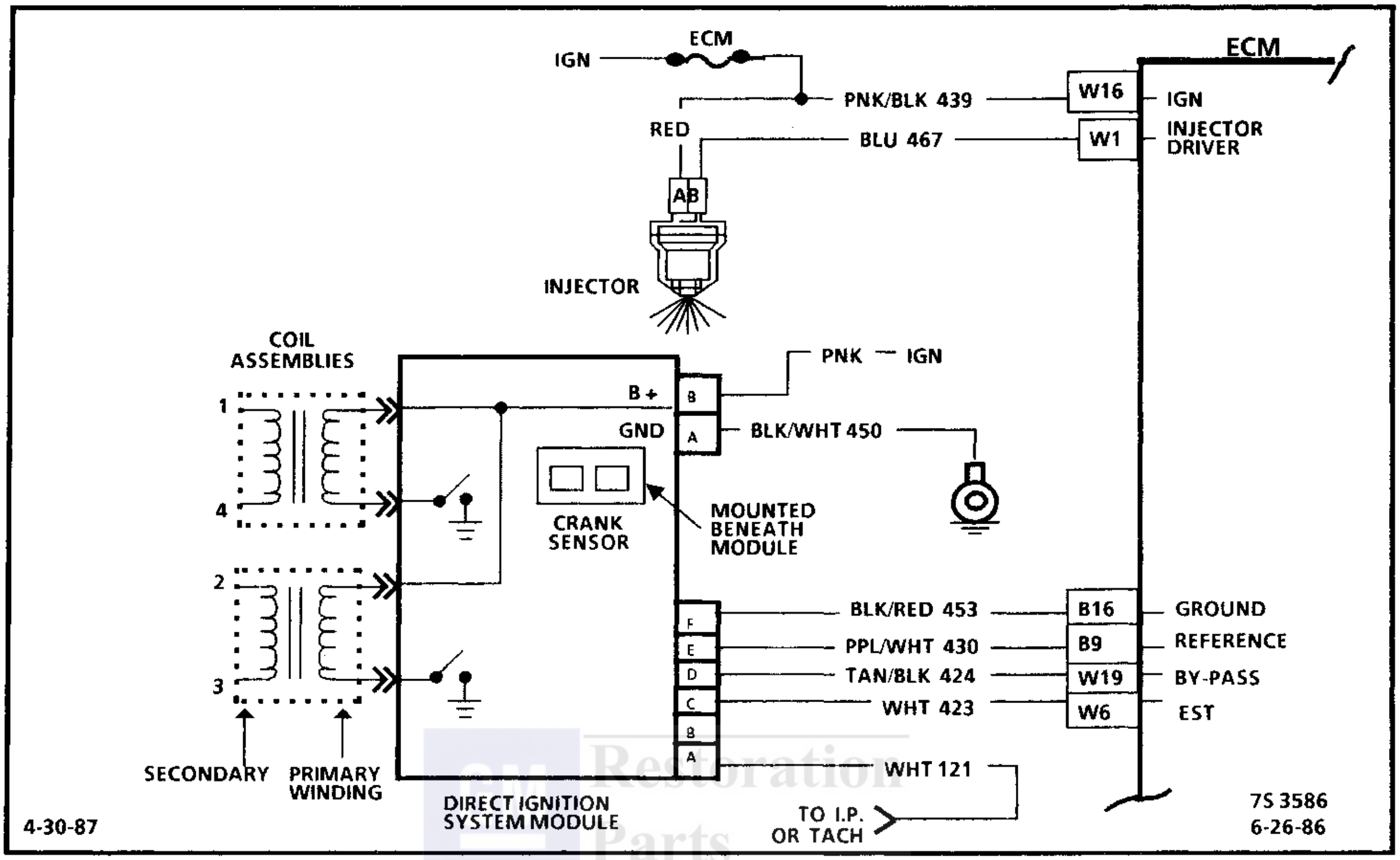


CHART A-3

(Page 2 of 3)

ENGINE CRANKS BUT WON'T RUN
2.5L "P" SERIES (TBI)

Circuit Description:

A magnetic crank sensor is used to determine engine crankshaft position, much the same way as the pick-up coil did in HEI type systems. The sensor is mounted in the block, near a slotted wheel on the crankshaft. The rotation of the wheel creates a flux change in the sensor, which produces a voltage signal. The "DIS" ignition module then processes this signal and creates the reference pulses needed by the ECM and the signal triggers the correct coil at the correct time.

If the "Scan" tool did not indicate cranking rpm, and there is no spark present at the plugs, the problem lies in the Direct Ignition System or the power and ground supplies to the module.

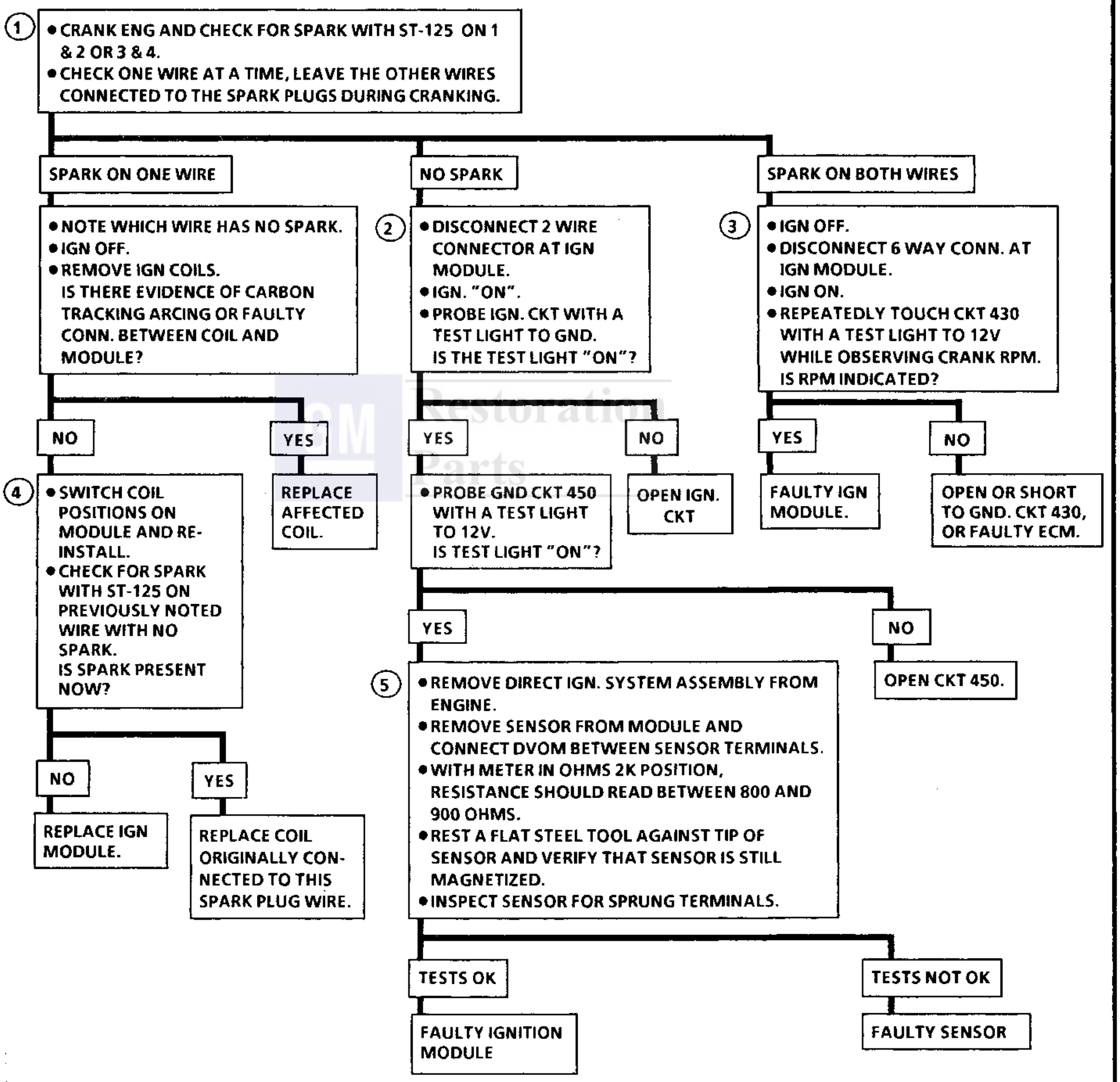
Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Because the Direct Ignition System uses two plugs and wires to complete the circuit of each coil, the opposite spark plug wire should be left connected.
2. This test will determine if the 12 volt supply and a good ground is available at the "DIS" ignition module.
3. This test will determine if the ignition module is not generating the reference pulse, or if the wiring or ECM are at fault. By touching and removing a test light to 12 volts on CTK 430, a reference pulse should be generated. If rpm is indicated, the ECM and wiring are OK.
4. This test will determine if the ignition module is not triggering the problem coil, or if the tested coil is at fault. This test could, also, be performed by using another known good coil.
   The secondary coil winding may be checked by using a DVM across the coil towers. Resistance readings should be 5000-10,000 ohms. There should not be any continuity between either coil tower and ground.
5. Checks for continuity of the crank sensor and connections, as well as sensor magnetism.

CHART A-3

(Page 2 of 3)

ENGINE CRANKS BUT WON'T RUN
2.5L "P" SERIES (TBI)



① • CRANK ENG AND CHECK FOR SPARK WITH ST-125 ON 1 & 2 OR 3 & 4.
• CHECK ONE WIRE AT A TIME, LEAVE THE OTHER WIRES CONNECTED TO THE SPARK PLUGS DURING CRANKING.

SPARK ON ONE WIRE

• NOTE WHICH WIRE HAS NO SPARK.
• IGN OFF.
• REMOVE IGN COILS.
IS THERE EVIDENCE OF CARBON TRACKING ARCING OR FAULTY CONN. BETWEEN COIL AND MODULE?

NO

④ • SWITCH COIL POSITIONS ON MODULE AND RE-INSTALL.
• CHECK FOR SPARK WITH ST-125 ON PREVIOUSLY NOTED WIRE WITH NO SPARK.
IS SPARK PRESENT NOW?

NO: REPLACE IGN MODULE.

YES: REPLACE COIL ORIGINALLY CONNECTED TO THIS SPARK PLUG WIRE.

YES: REPLACE AFFECTED COIL.

NO SPARK

② • DISCONNECT 2 WIRE CONNECTOR AT IGN MODULE.
• IGN. "ON".
• PROBE IGN. CKT WITH A TEST LIGHT TO GND.
IS THE TEST LIGHT "ON"?

YES

• PROBE GND CKT 450 WITH A TEST LIGHT TO 12V.
IS TEST LIGHT "ON"?

YES

⑤ • REMOVE DIRECT IGN. SYSTEM ASSEMBLY FROM ENGINE.
• REMOVE SENSOR FROM MODULE AND CONNECT DVOM BETWEEN SENSOR TERMINALS.
• WITH METER IN OHMS 2K POSITION, RESISTANCE SHOULD READ BETWEEN 800 AND 900 OHMS.
• REST A FLAT STEEL TOOL AGAINST TIP OF SENSOR AND VERIFY THAT SENSOR IS STILL MAGNETIZED.
• INSPECT SENSOR FOR SPRUNG TERMINALS.

TESTS OK: FAULTY IGNITION MODULE

TESTS NOT OK: FAULTY SENSOR

NO: OPEN CKT 450.

NO: OPEN IGN. CKT

SPARK ON BOTH WIRES

③ • IGN OFF.
• DISCONNECT 6 WAY CONN. AT IGN MODULE.
• IGN ON.
• REPEATEDLY TOUCH CKT 430 WITH A TEST LIGHT TO 12V WHILE OBSERVING CRANK RPM.
IS RPM INDICATED?

YES: FAULTY IGN MODULE.

NO: OPEN OR SHORT TO GND. CKT 430, OR FAULTY ECM.

6-12-86
* 7S 3231-6E

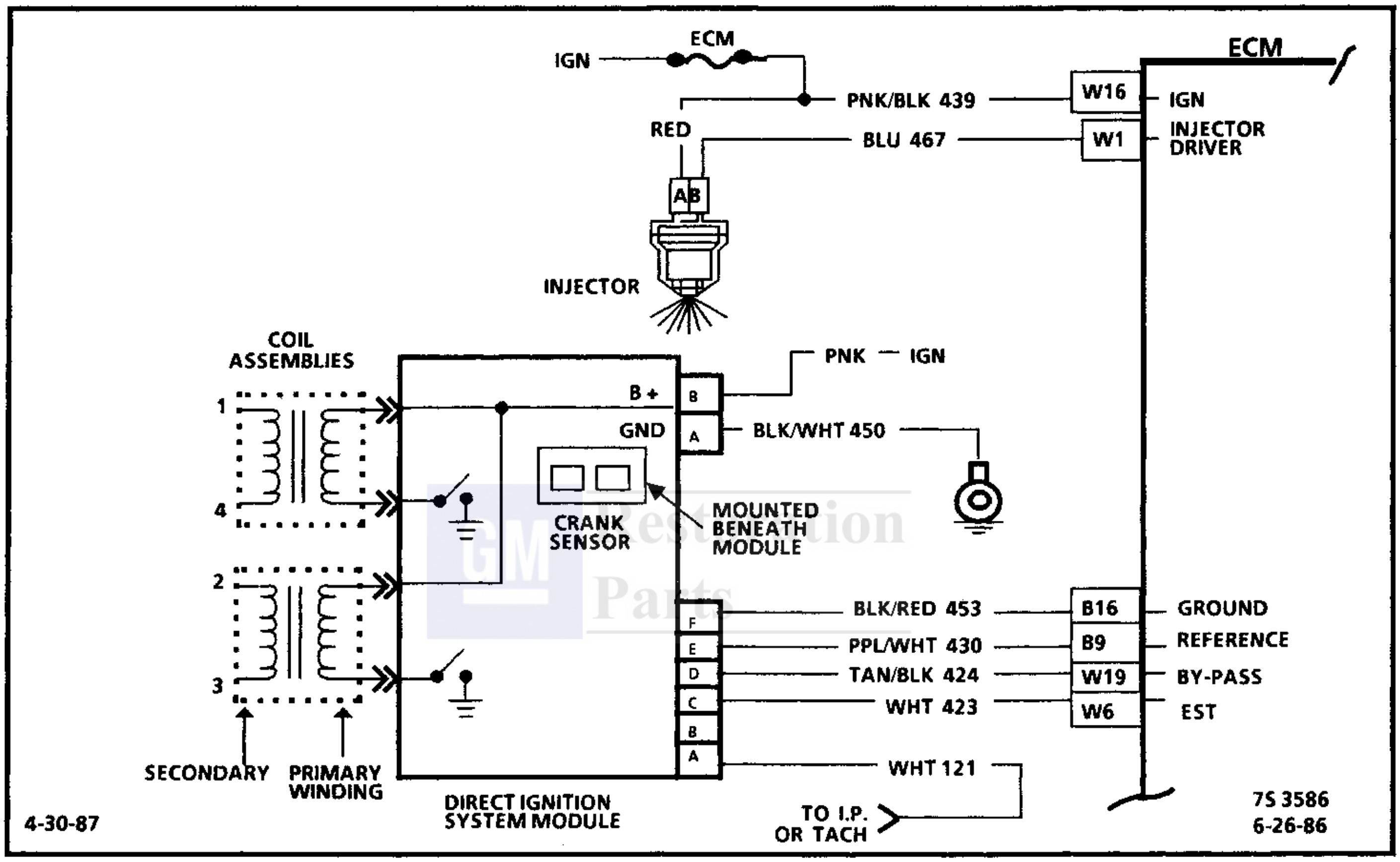


CHART A-3

(Page 3 of 3)

ENGINE CRANKS BUT WON'T RUN
2.5L "P" SERIES (TBI)

Circuit Description:

Ignition voltage is supplied to the fuel injector on CKT 439. The injector will be pulsed (turned "ON" and "OFF"), when the ECM opens and grounds injector drive CKT 467.

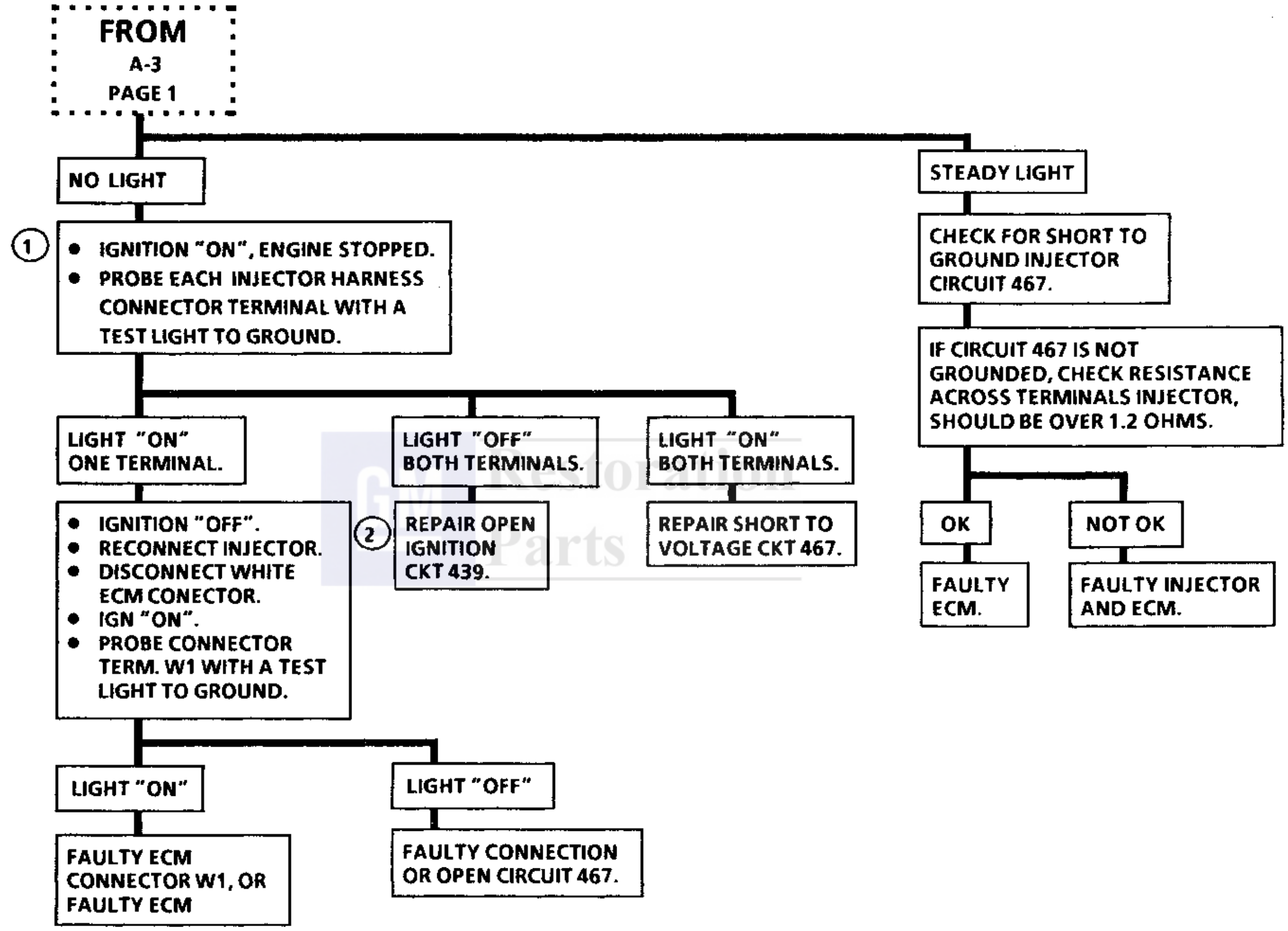
Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. No blinking light indicates no ECM control of the injector or a wiring problem.
2. There is a remote possibility that the resistance across the injector terminals is less than 1.2 ohms and has resulted in a blown fuse for CKT 439 in which case the injector should be replaced.

CHART A-3

(Page 3 of 3)

ENGINE CRANKS BUT WON'T RUN
2.5L "P" SERIES (TBI)



CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

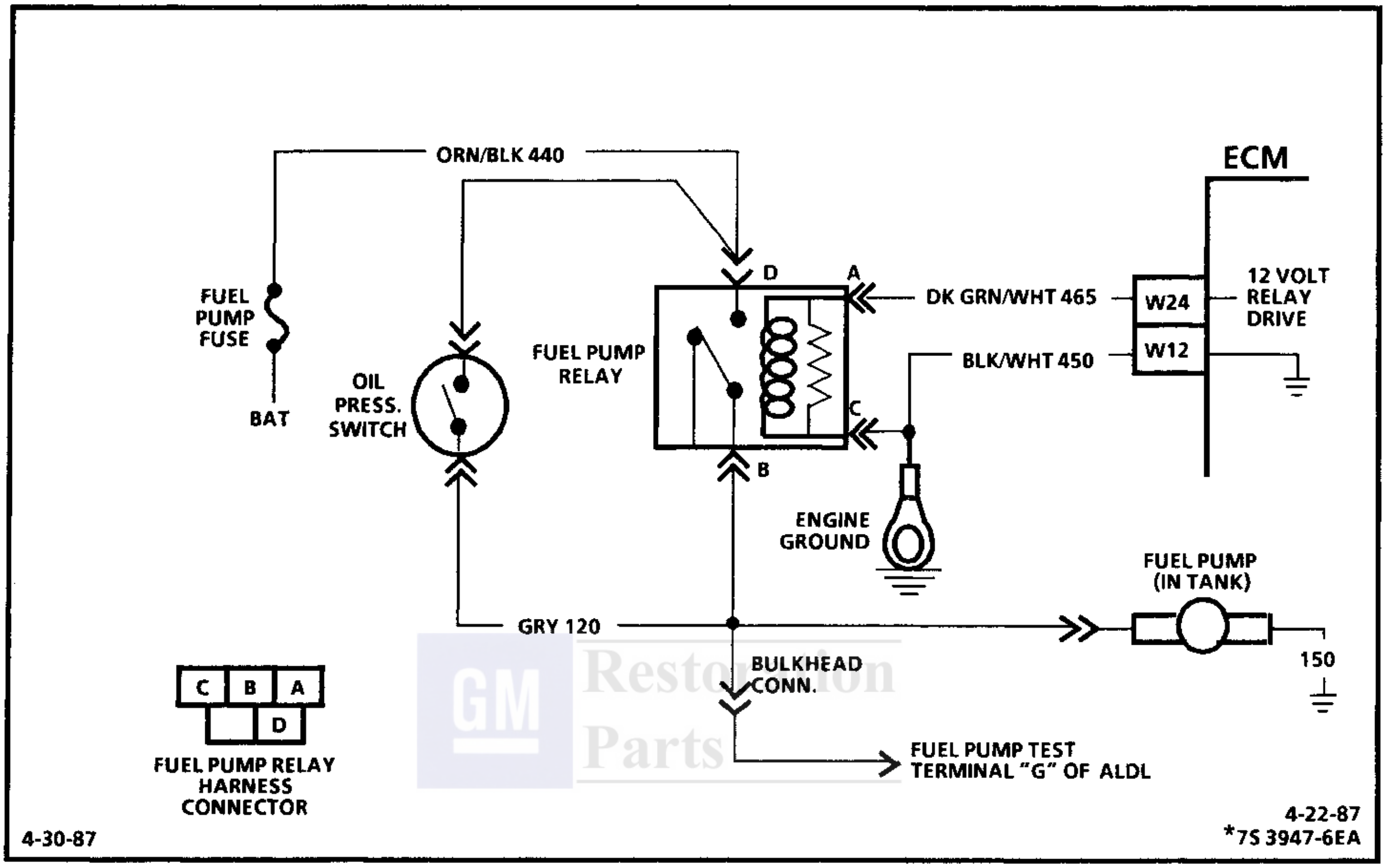


CHART A-5

FUEL PUMP RELAY CIRCUIT
2.5L "P" SERIES (TBI)

Circuit Description:

When the ignition switch is turned "ON", the electronic control module (ECM) will activate the fuel pump relay and run the in-tank fuel pump. The fuel pump will operate as long as the engine is cranking or running, and the ECM is receiving ignition reference pulses.

If there are no reference pulses, the ECM will shut "OFF" the fuel pump within 2 seconds after key "ON".

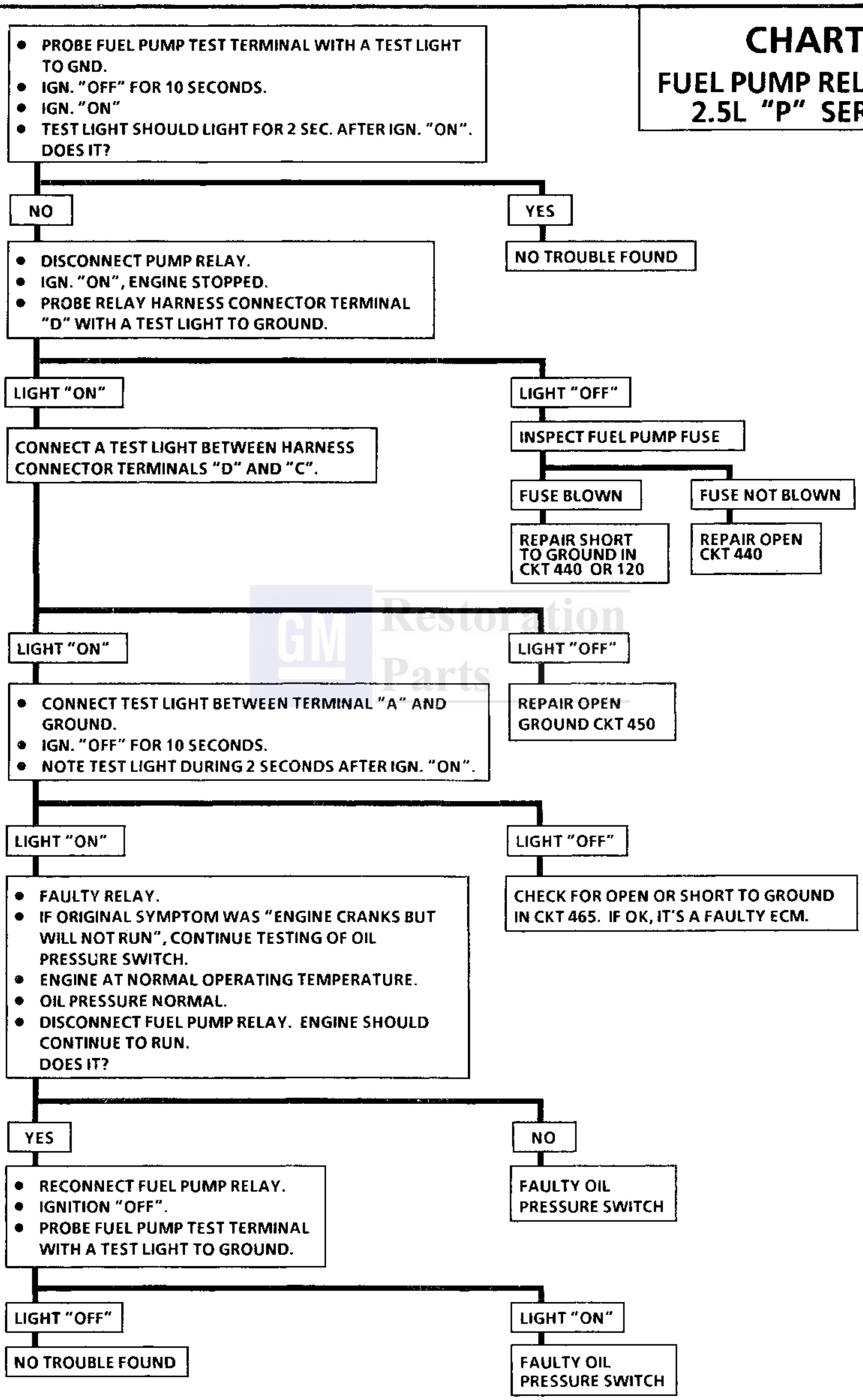
Should the fuel pump relay, or the 12 volt relay drive from the ECM fail, the fuel pump will be run through an oil pressure switch back-up circuit.

Diagnostic Aids:

An inoperative fuel pump relay can result in long cranking times, particularly if the engine is cold or engine oil pressure is low. The extended crank period is caused by the time necessary for oil pressure to build enough to close the oil pressure switch and turn on the fuel pump.

CHART A-5

FUEL PUMP RELAY CIRCUIT 2.5L "P" SERIES (TBI)



- PROBE FUEL PUMP TEST TERMINAL WITH A TEST LIGHT TO GND.
- IGN. "OFF" FOR 10 SECONDS.
- IGN. "ON"
- TEST LIGHT SHOULD LIGHT FOR 2 SEC. AFTER IGN. "ON". DOES IT?

NO

- DISCONNECT PUMP RELAY.
- IGN. "ON", ENGINE STOPPED.
- PROBE RELAY HARNESS CONNECTOR TERMINAL "D" WITH A TEST LIGHT TO GROUND.

YES

NO TROUBLE FOUND

LIGHT "ON"

CONNECT A TEST LIGHT BETWEEN HARNESS CONNECTOR TERMINALS "D" AND "C".

LIGHT "OFF"

INSPECT FUEL PUMP FUSE

FUSE BLOWN

REPAIR SHORT TO GROUND IN CKT 440 OR 120

FUSE NOT BLOWN

REPAIR OPEN CKT 440

LIGHT "ON"

- CONNECT TEST LIGHT BETWEEN TERMINAL "A" AND GROUND.
- IGN. "OFF" FOR 10 SECONDS.
- NOTE TEST LIGHT DURING 2 SECONDS AFTER IGN. "ON".

LIGHT "OFF"

REPAIR OPEN GROUND CKT 450

LIGHT "ON"

- FAULTY RELAY.
- IF ORIGINAL SYMPTOM WAS "ENGINE CRANKS BUT WILL NOT RUN", CONTINUE TESTING OF OIL PRESSURE SWITCH.
- ENGINE AT NORMAL OPERATING TEMPERATURE.
- OIL PRESSURE NORMAL.
- DISCONNECT FUEL PUMP RELAY. ENGINE SHOULD CONTINUE TO RUN. DOES IT?

LIGHT "OFF"

CHECK FOR OPEN OR SHORT TO GROUND IN CKT 465. IF OK, IT'S A FAULTY ECM.

YES

- RECONNECT FUEL PUMP RELAY.
- IGNITION "OFF".
- PROBE FUEL PUMP TEST TERMINAL WITH A TEST LIGHT TO GROUND.

NO

FAULTY OIL PRESSURE SWITCH

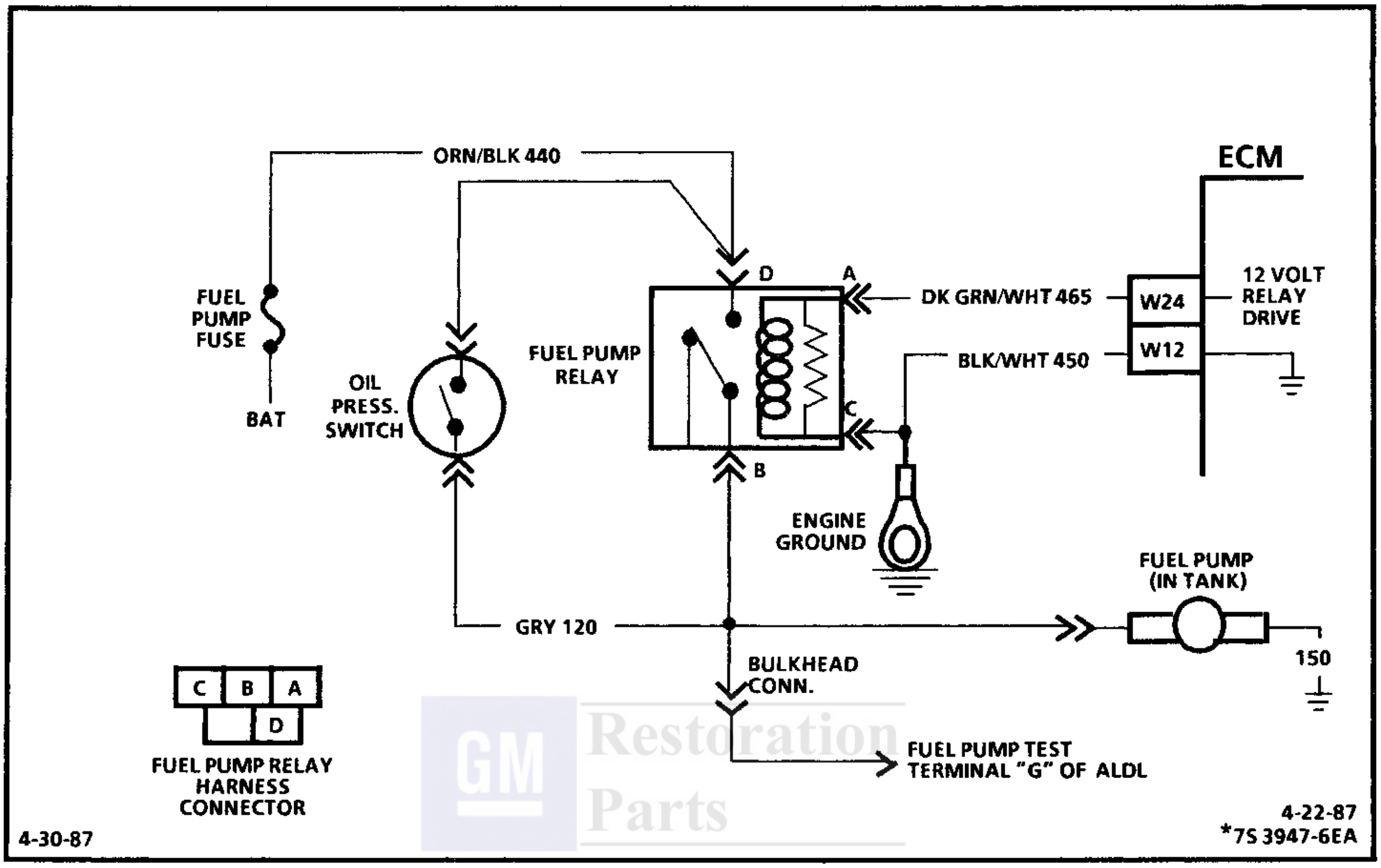
LIGHT "OFF"

NO TROUBLE FOUND

LIGHT "ON"

FAULTY OIL PRESSURE SWITCH

4-11-87
*7S 3234-6E



4-30-87

4-22-87
*7S 3947-6EA

CHART A-7

(Page 1 of 2)

FUEL SYSTEM DIAGNOSIS
2.5L "P" SERIES (TBI)

Circuit Description:

When the ignition switch is turned "ON", the electronic control module (ECM) will turn "ON" the in-tank fuel pump. It will remain "ON" as long as the engine is cranking or running, and the ECM is receiving ignition reference pulses.

If there are no reference pulses, the ECM will shut "OFF" the fuel pump within 2 seconds after key "ON".

The pump will deliver fuel to the TBI unit, where the system pressure is controlled to 62 to 90 kPa (9 to 13 psi). Excess fuel is then returned to the fuel tank.

The fuel pump test terminal is located in the left side of the engine compartment. When the engine is stopped, the pump can be turned "ON" by applying battery voltage to the test terminal.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. If fuse in jumper wire blows, check CKT 120 for a short to ground.

Diagnostic Aids:

Improper fuel system pressure can result in one of the following symptoms:

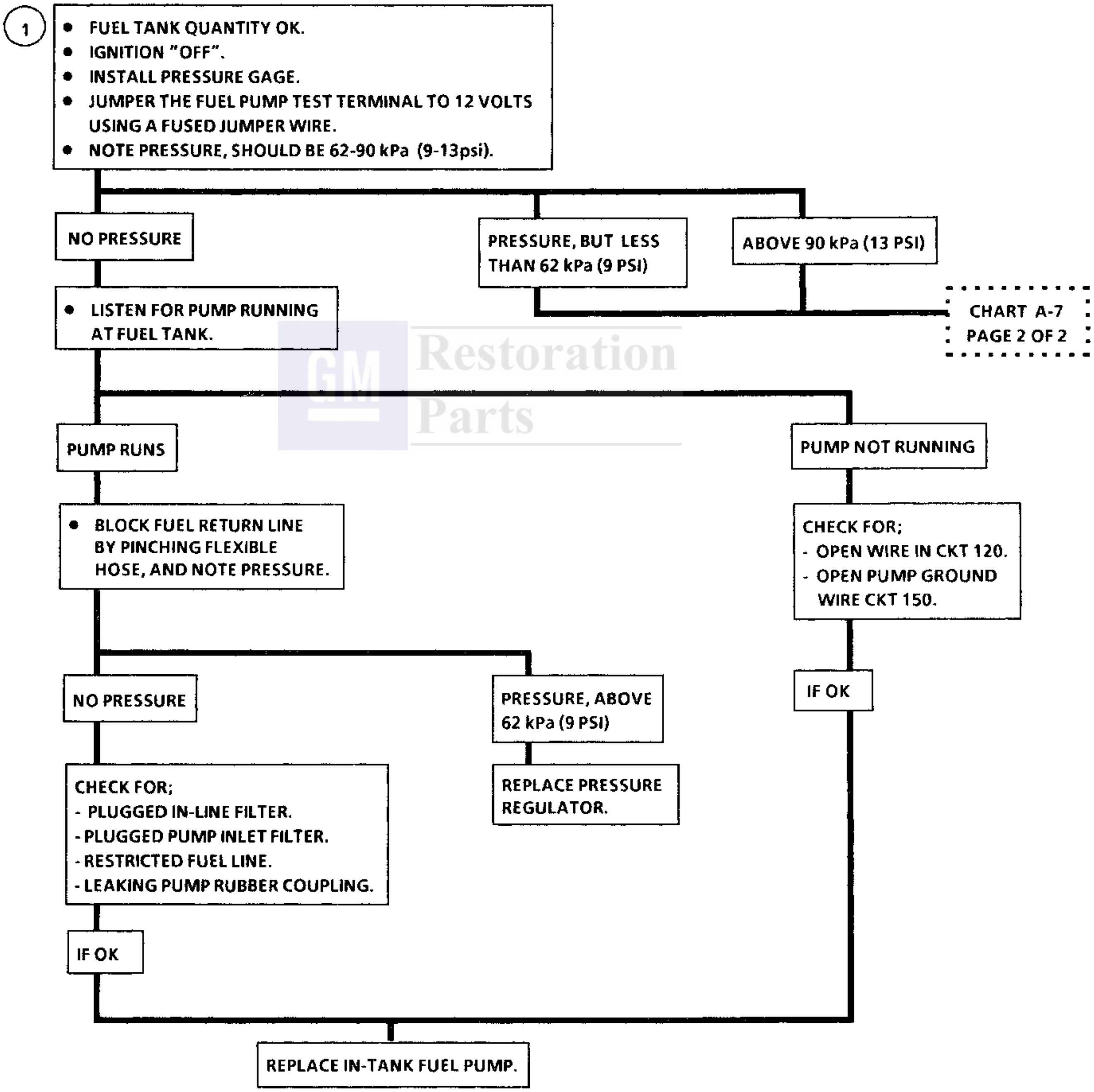
- Cranks, but won't run.
- Code 44.
- Code 45.
- Cuts out, may feel like ignition problem.
- Poor fuel economy, loss of power.
- Hesitation.

CHART A-7

(Page 1 of 2)

FUEL SYSTEM DIAGNOSIS
2.5L "P" SERIES (TBI)

NOTICE: FUEL SYSTEM UNDER PRESSURE. TO AVOID FUEL SPILLAGE, REFER TO FIELD SERVICE PROCEDURE FOR TESTING OR MAKING REPAIRS REQUIRING DISASSEMBLY OF FUEL LINES OR FITTINGS.



①
- FUEL TANK QUANTITY OK.
- IGNITION "OFF".
- INSTALL PRESSURE GAGE.
- JUMPER THE FUEL PUMP TEST TERMINAL TO 12 VOLTS USING A FUSED JUMPER WIRE.
- NOTE PRESSURE, SHOULD BE 62-90 kPa (9-13psi).

NO PRESSURE

PRESSURE, BUT LESS THAN 62 kPa (9 PSI)

ABOVE 90 kPa (13 PSI)

CHART A-7 PAGE 2 OF 2

- LISTEN FOR PUMP RUNNING AT FUEL TANK.

PUMP RUNS

PUMP NOT RUNNING

- BLOCK FUEL RETURN LINE BY PINCHING FLEXIBLE HOSE, AND NOTE PRESSURE.

CHECK FOR;
- OPEN WIRE IN CKT 120.
- OPEN PUMP GROUND WIRE CKT 150.

NO PRESSURE

PRESSURE, ABOVE 62 kPa (9 PSI)

IF OK

CHECK FOR;
- PLUGGED IN-LINE FILTER.
- PLUGGED PUMP INLET FILTER.
- RESTRICTED FUEL LINE.
- LEAKING PUMP RUBBER COUPLING.

REPLACE PRESSURE REGULATOR.

IF OK

REPLACE IN-TANK FUEL PUMP.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

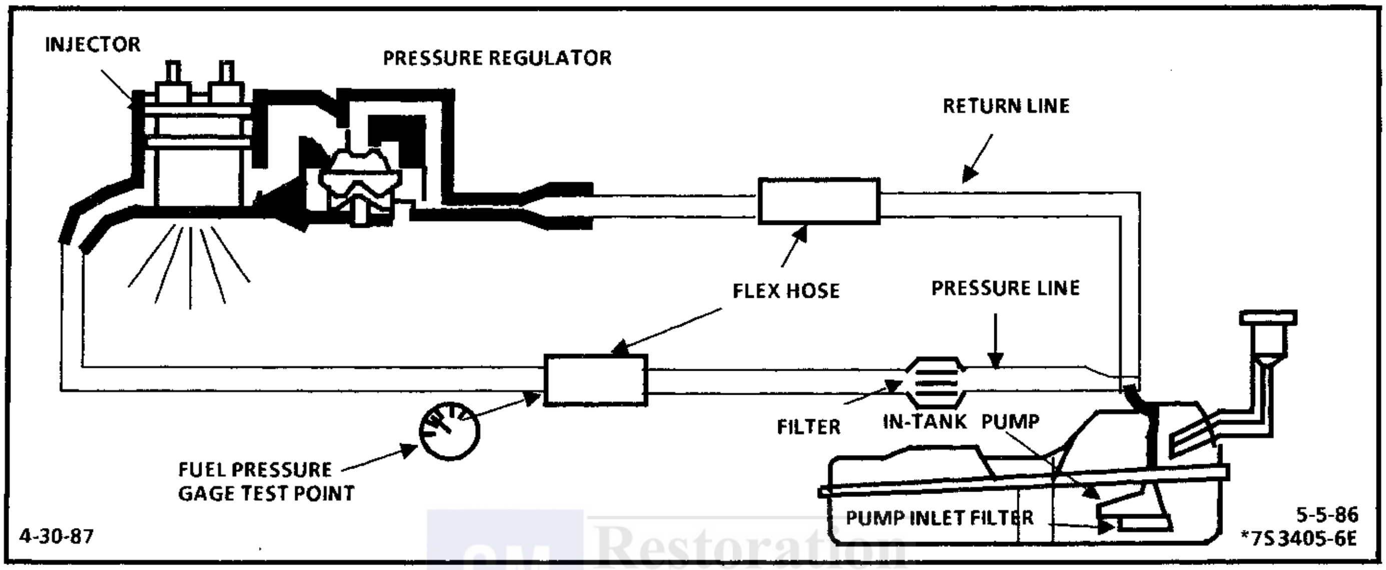


CHART A-7

(Page 2 of 2)

FUEL SYSTEM DIAGNOSIS
2.5L "P" SERIES (TBI)

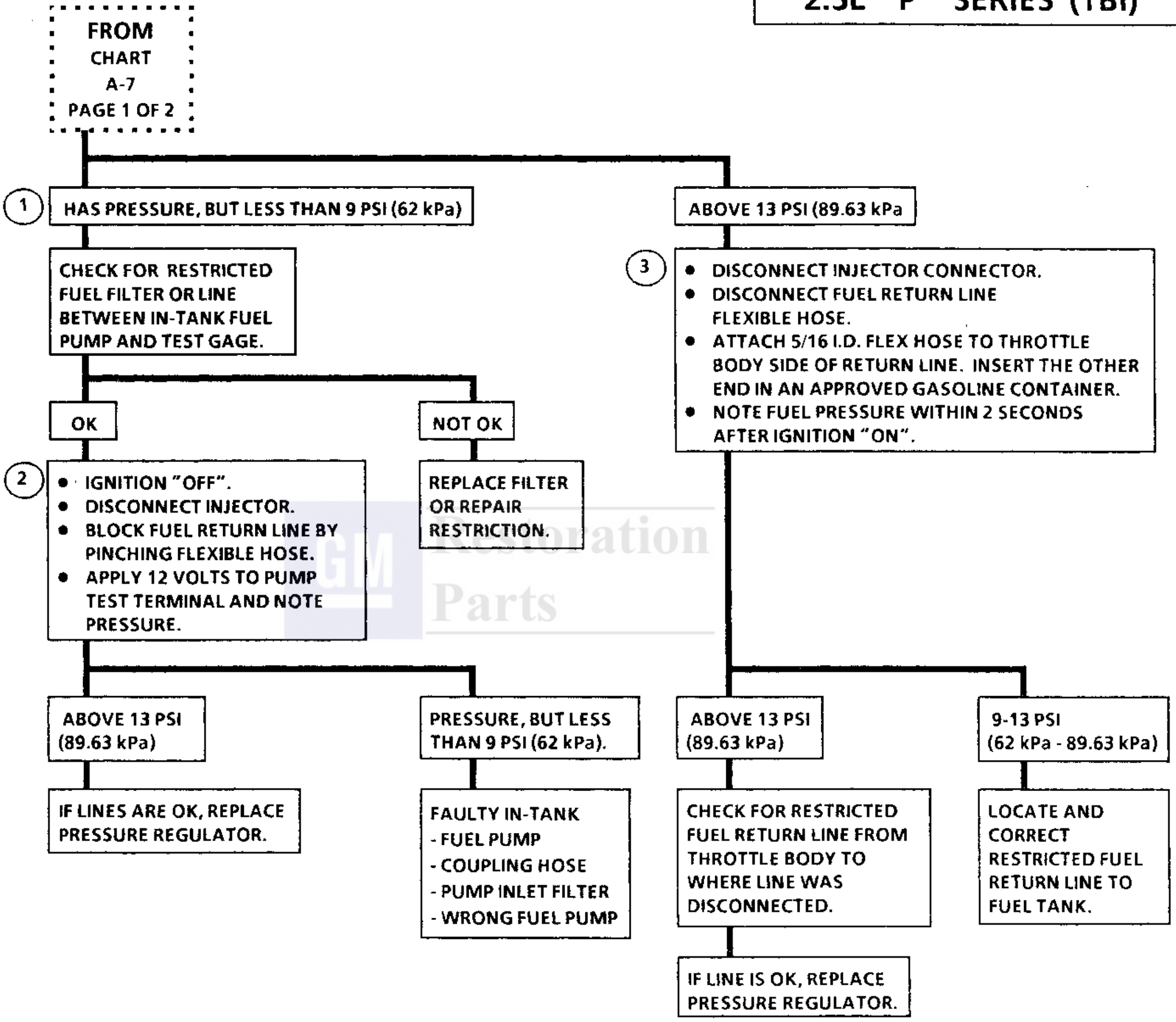
Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Pressure but, less than 62 kPa (9 psi), falls into two areas:
   - Amount of fuel to injector OK, but pressure is too low. System will be running lean and may set Code 44. Also, hard starting cold and poor overall performance.
   - Restricted flow causing pressure drop - Normally, a vehicle with a fuel pressure of less than 62 kPa (9 psi) at idle will not be driveable. However, if the pressure drop occurs only while driving, the engine will normally surge then stop as pressure begins to drop rapidly to zero.
2. Restricting the fuel return line allows the fuel pump to develop its maximum pressure (dead head pressure). When battery voltage is applied to the pump test terminal, pressure should be from 90 to 124 kPa (13 to 18 psi).
3. This test determines if the high fuel pressure is due to a restricted fuel return line, or a throttle body pressure regulator problem.

CHART A-7

(Page 2 of 2)

FUEL SYSTEM DIAGNOSIS
2.5L "P" SERIES (TBI)



FROM CHART A-7 PAGE 1 OF 2

① HAS PRESSURE, BUT LESS THAN 9 PSI (62 kPa)

CHECK FOR RESTRICTED FUEL FILTER OR LINE BETWEEN IN-TANK FUEL PUMP AND TEST GAGE.

REPLACE FILTER OR REPAIR RESTRICTION.

②
- IGNITION "OFF".
- DISCONNECT INJECTOR.
- BLOCK FUEL RETURN LINE BY PINCHING FLEXIBLE HOSE.
- APPLY 12 VOLTS TO PUMP TEST TERMINAL AND NOTE PRESSURE.

ABOVE 13 PSI (89.63 kPa)

IF LINES ARE OK, REPLACE PRESSURE REGULATOR.

PRESSURE, BUT LESS THAN 9 PSI (62 kPa).

FAULTY IN-TANK
- FUEL PUMP
- COUPLING HOSE
- PUMP INLET FILTER
- WRONG FUEL PUMP

ABOVE 13 PSI (89.63 kPa

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 13 PSI (89.63 kPa)

CHECK FOR RESTRICTED FUEL RETURN LINE FROM THROTTLE BODY TO WHERE LINE WAS DISCONNECTED.

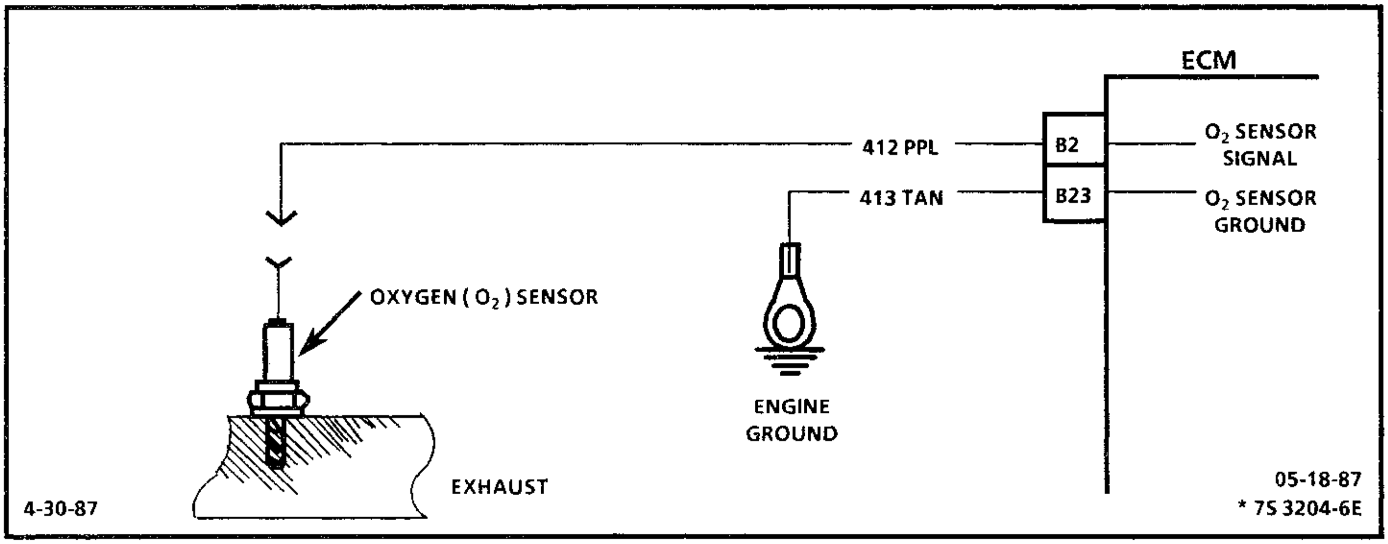
IF LINE IS OK, REPLACE PRESSURE REGULATOR.

9-13 PSI (62 kPa - 89.63 kPa)

LOCATE AND CORRECT RESTRICTED FUEL RETURN LINE TO FUEL TANK.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

*7S 3135-6E
4-24-86



CODE 13

OXYGEN SENSOR CIRCUIT

(OPEN CIRCUIT)

2.5L "P" SERIES (TBI)

Circuit Description:

The ECM supplies a voltage of about of .45 volt between terminals "B2" and "B23". (If measured with 10 megohm digital voltmeter, this may read as low as .32 volts).

The O_2 sensor varies the voltage within a range of about 1 volt, if the exhaust is rich, down through about .10 volt, if exhaust is lean.

The sensor is like an open circuit and produces no voltage, when it is below 360° C (600°F). An open sensor circuit, or cold sensor, causes "Open Loop" operation.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 13 will set:
   - Engine at normal operating temperature.
   - At least 2 minutes engine time after start.
   - O_2 signal voltage steady between .35 and .55 volts.
   - Throttle angle above 7%.
   - All conditions must be met for about 60 seconds.

   If the conditions for a Code 13 exist, the system will not go "Closed Loop".
2. This test determines if the O_2 sensor is the problem, or if the ECM and wiring are at fault.
3. In doing this test, use only a high impedence digital volt ohm meter. This test checks the continuity of CKT(s) 412 and 413. If CKT 413 is open, the ECM voltage on CKT 412 will be over .6 volts (600 mv).

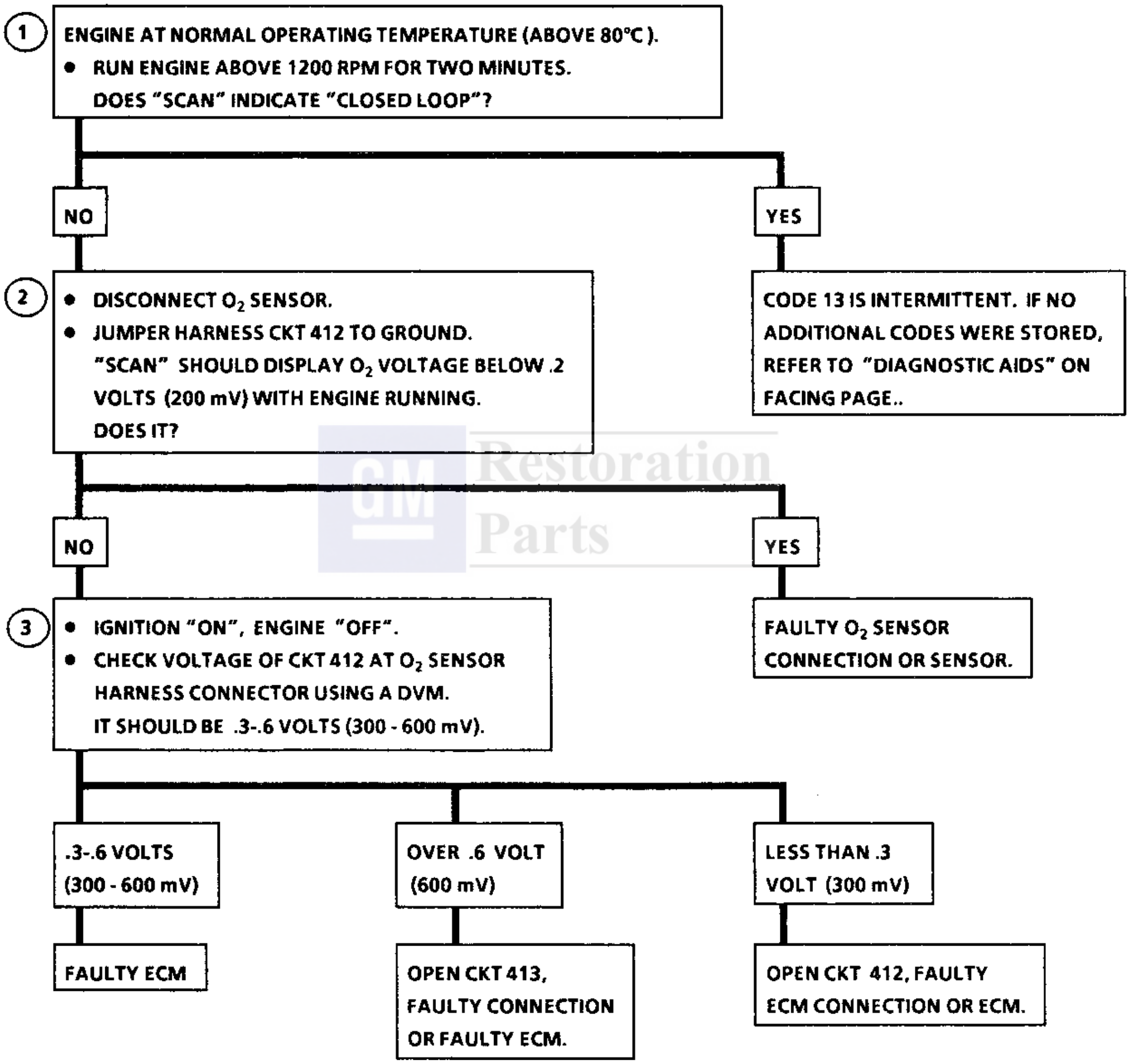
Diagnostic Aids:

Normal "Scan" voltage varies between 100 mv to 999 mv (.1 and 1.0 volt), while in "Closed Loop". Code 13 sets in one minute, if voltage remains between .35 and .55 volts, but the system will go "Open Loop" in about 15 seconds.

Verify a clean, tight ground connection for CKT 413. Open CKT(s) 412 or 413 will result in a Code 13. If Code 13 is intermittent, refer to Section "B".

CODE 13

OXYGEN SENSOR CIRCUIT
(OPEN CIRCUIT)
2.5L "P" SERIES (TBI)



① ENGINE AT NORMAL OPERATING TEMPERATURE (ABOVE 80°C).
- RUN ENGINE ABOVE 1200 RPM FOR TWO MINUTES.
DOES "SCAN" INDICATE "CLOSED LOOP"?

YES: CODE 13 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE..

NO:

②
- DISCONNECT O_2 SENSOR.
- JUMPER HARNESS CKT 412 TO GROUND.
"SCAN" SHOULD DISPLAY O_2 VOLTAGE BELOW .2 VOLTS (200 mV) WITH ENGINE RUNNING.
DOES IT?

YES: FAULTY O_2 SENSOR CONNECTION OR SENSOR.

NO:

③
- IGNITION "ON", ENGINE "OFF".
- CHECK VOLTAGE OF CKT 412 AT O_2 SENSOR HARNESS CONNECTOR USING A DVM.
IT SHOULD BE .3-.6 VOLTS (300 - 600 mV).

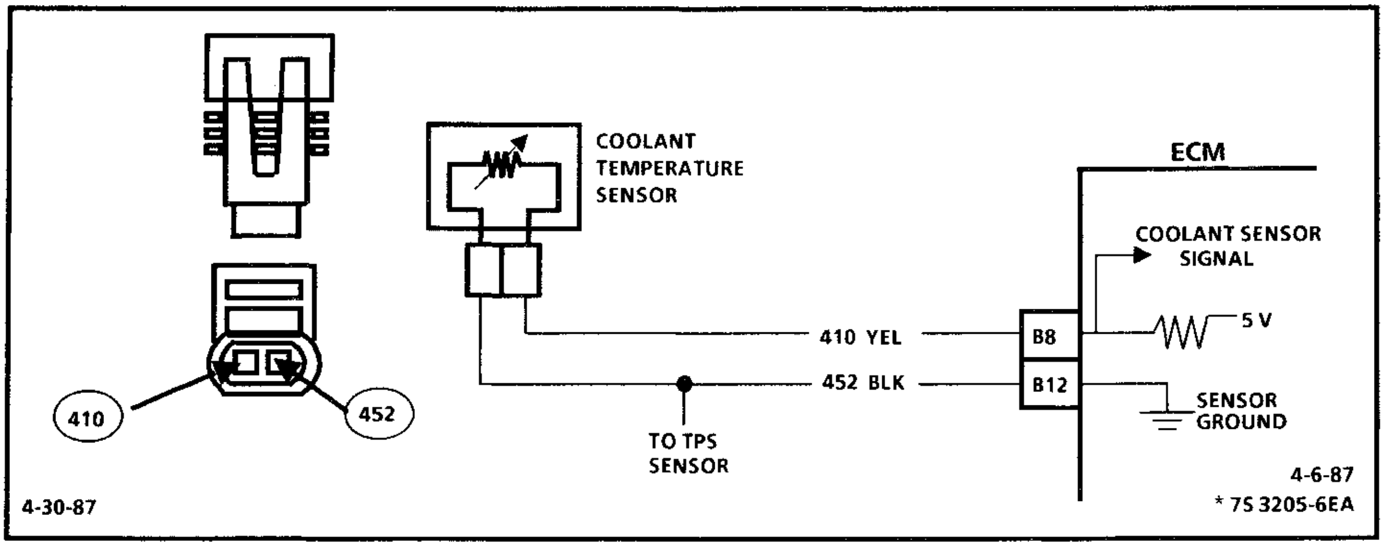
.3-.6 VOLTS (300 - 600 mV): FAULTY ECM

OVER .6 VOLT (600 mV): OPEN CKT 413, FAULTY CONNECTION OR FAULTY ECM.

LESS THAN .3 VOLT (300 mV): OPEN CKT 412, FAULTY ECM CONNECTION OR ECM.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

2-20-87
• 7S 3054-6E



CODE 14

COOLANT TEMPERATURE SENSOR CIRCUIT

(HIGH TEMPERATURE INDICATED)

2.5L "P" SERIES (TBI)

Circuit Description:

The coolant temperature sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies a voltage on CKT 410 to the sensor. When the engine is cold, the sensor (thermistor) resistance is high, therefore, the ECM will see high signal voltage.

As the engine warms, the sensor resistance becomes less, and the voltage drops. At normal engine operating temperature, the voltage will measure about 1.5 to 2.0 volts at the ECM terminal "B8".

Coolant temperature is one of the inputs used to control:

- Fuel delivery
- Electronic Spark Timing(EST)
- Cooling Fan
- Convertor Clutch (TCC)
- Idle (IAC)

Test Description:

Numbers below refer to circled numbers on the diagnostic chart.

1. Checks to see if code was set as result of hard failure or intermittent condition.
   Code 14 will set if:
   - Signal voltage indicates a coolant temperature above 135°C (275°F) for 3 seconds.
2. This test simulates conditions for a Code 15. If the ECM recognizes the open circuit (high voltage), and displays a low temperature, the ECM and wiring are OK.

Diagnostic Aids:

A "Scan" tool reads engine temperature in degrees centigrade.

After the engine is started, the temperature should rise steadily to about 90°, then stabilize, when the thermostat opens.

If the engine has been allowed to cool to an ambient temperature (overnight), coolant and MAT temperature may be checked with a "Scan" tool and should read close to each other.

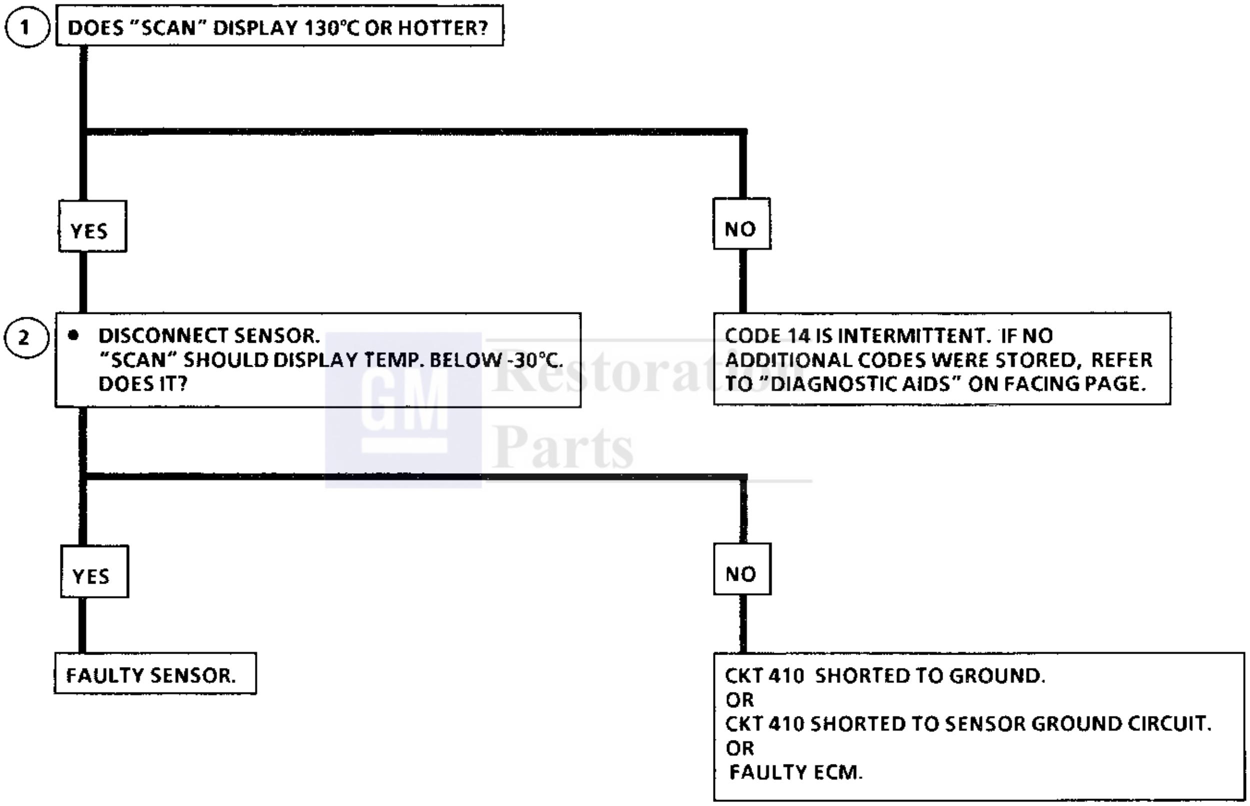
When a Code 14 is set, the ECM will turn "ON" the engine cooling fan.

A Code 14 will result if CKT 410 is shorted to ground.

If Code 14 is intermittent, refer to Section "B".

CODE 14

COOLANT TEMPERATURE SENSOR CIRCUIT (HIGH TEMPERATURE INDICATED) 2.5L "P" SERIES (TBI)



① DOES "SCAN" DISPLAY 130°C OR HOTTER?

② • DISCONNECT SENSOR.
"SCAN" SHOULD DISPLAY TEMP. BELOW -30°C.
DOES IT?

CODE 14 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

FAULTY SENSOR.

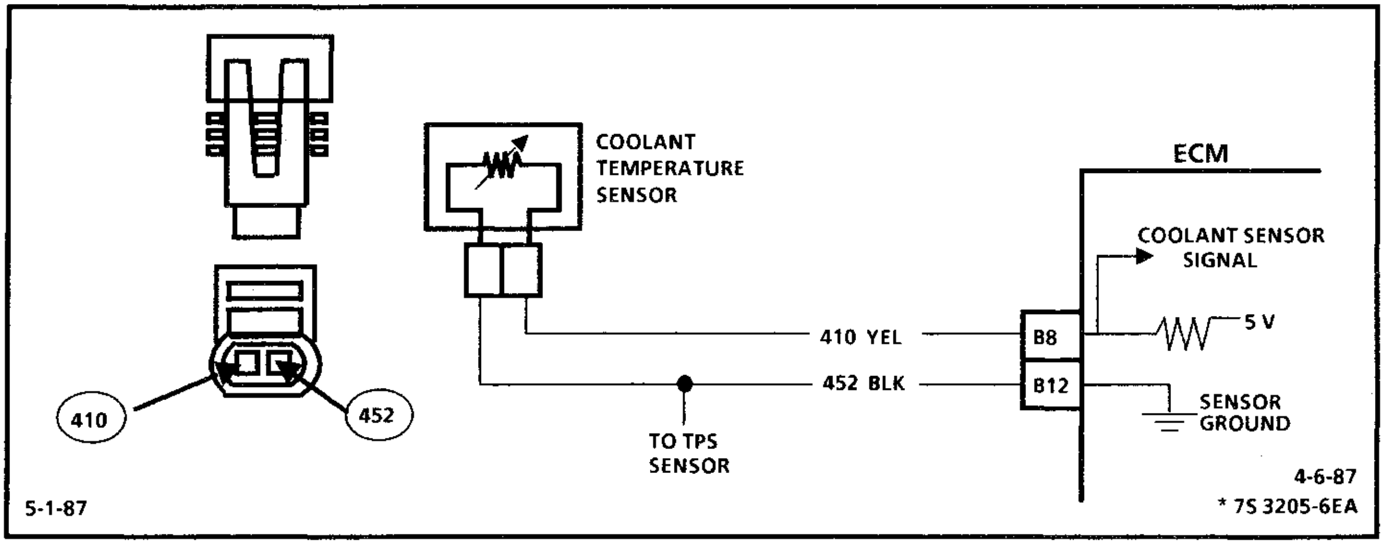
CKT 410 SHORTED TO GROUND.
OR
CKT 410 SHORTED TO SENSOR GROUND CIRCUIT.
OR
FAULTY ECM.

DIAGNOSTIC AID

COOLANT SENSOR TEMPERATURE TO RESISTANCE VALUES (APPROXIMATE)		
°F	°C	OHMS
210	100	185
160	70	450
100	38	1,800
70	20	3,400
40	4	7,500
20	-7	13,500
0	-18	25,000
-40	-40	100,700

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

4-28-87
• 7S 3055-6E



CODE 15

COOLANT TEMPERATURE SENSOR CIRCUIT

(LOW TEMPERATURE INDICATED)

2.5L "P" SERIES (TBI)

Circuit Description:

The coolant temperature sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies a voltage on CKT 410 to the sensor. When the engine is cold, the sensor (thermistor) resistance is high, therefore, the ECM will see high signal voltage.

As the engine warms, the sensor resistance becomes less, and the voltage drops. At normal engine operating temperature, the voltage will measure about 1.5 to 2.0 volts at the ECM terminal "B8".

Coolant temperature is one of the inputs used to control:

- Fuel delivery
- Electronic Spark Timing(EST)
- Cooling Fan
- Convertor Clutch (TCC)
- Idle (IAC)

Test Description:

Numbers below refer to circled numbers on the diagnostic chart.

1. Checks to see if code was set as result of hard failure or intermittent condition.
   Code 15 will set if:
   - Signal Voltage indicates a coolant temperature below -30°C (-22°F) for 60 seconds.
2. This test simulates conditions for a Code 14. If the ECM recognizes the grounded circuit (low voltage), and displays a high temperature, the ECM and wiring are OK.
3. This test will determine if there is a wiring problem or a faulty ECM. If CKT 452 is open, there may also be a Code 21 stored.

Diagnostic Aids:

A "Scan" tool reads engine temperature in degrees centigrade. After the engine is started, the temperature should rise steadily to about 90°, then stabilize, when the thermostat opens.

If the engine has been allowed to cool to an ambient temperature (overnight), coolant and MAT temperatures may be checked with a "Scan" tool and should read close to each other.

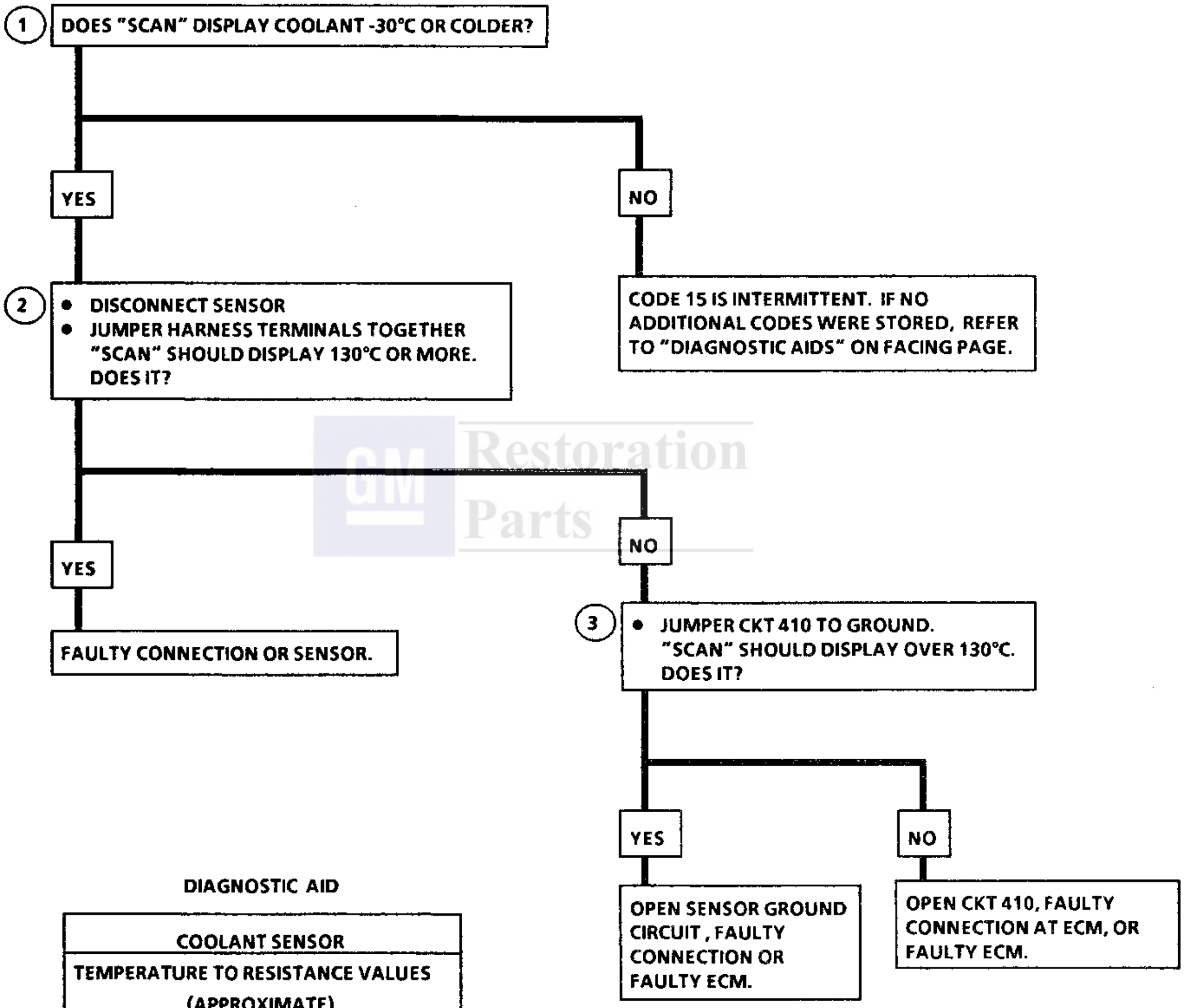
When a Code 15 is set, the ECM will turn "ON" the Engine Cooling Fan.

A Code 15 will result if CKTs 410 or 452 are open.

If Code 15 is intermittent refer to Section "B".

CODE 15

COOLANT TEMPERATURE SENSOR CIRCUIT
(LOW TEMPERATURE INDICATED)
2.5L "P" SERIES (TBI)



① DOES "SCAN" DISPLAY COOLANT -30°C OR COLDER?

②
- DISCONNECT SENSOR
- JUMPER HARNESS TERMINALS TOGETHER "SCAN" SHOULD DISPLAY 130°C OR MORE. DOES IT?

CODE 15 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

FAULTY CONNECTION OR SENSOR.

③
- JUMPER CKT 410 TO GROUND. "SCAN" SHOULD DISPLAY OVER 130°C. DOES IT?

OPEN SENSOR GROUND CIRCUIT, FAULTY CONNECTION OR FAULTY ECM.

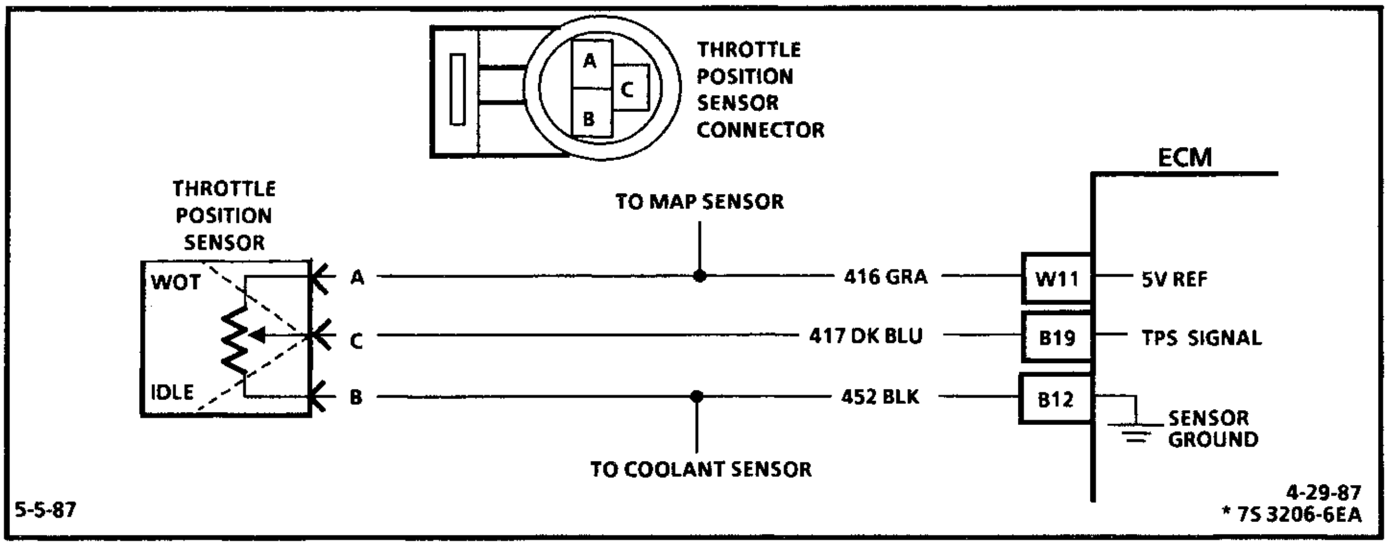
OPEN CKT 410, FAULTY CONNECTION AT ECM, OR FAULTY ECM.

DIAGNOSTIC AID

COOLANT SENSOR TEMPERATURE TO RESISTANCE VALUES (APPROXIMATE)		
°F	°C	OHMS
210	100	185
160	70	450
100	38	1,800
70	20	3,400
40	4	7,500
20	-7	13,500
0	-18	25,000
-40	-40	100,700

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

2-11-87
• 7S 3261-6E



CODE 21

THROTTLE POSITION SENSOR (TPS) CIRCUIT
(SIGNAL VOLTAGE HIGH)
2.5L "P" SERIES (TBI)

Circuit Description:

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 (WOT).

The TPS signal is one of the most important inputs used by the ECM for fuel control and for many of the ECM controlled outputs.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

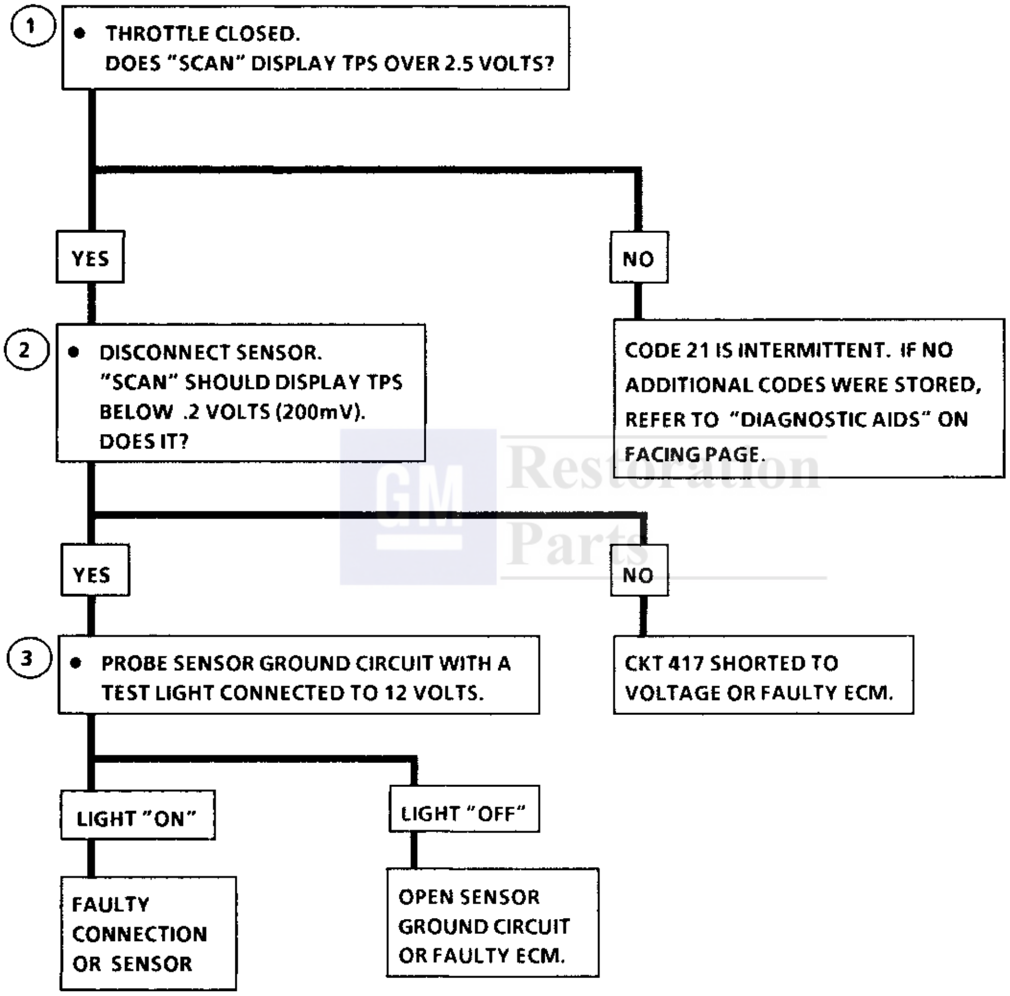
1. This step checks to see if Code 21 is the result of a hard failure or an intermittent condition.
   A Code 21 will set if:
   - TPS reading above 2.5 volts.
   - Engine speed less than 1800 rpm.
   - MAP reading below 60 kPa.
   - All of the above conditions present for 2 seconds.
2. This step simulates conditions for a Code 22. If the ECM recognizes the change of state, the ECM and CKTs 416 and 417 are OK.
3. This step isolates a faulty sensor, ECM, or an open CKT 452. If CKT 452 is open, there may also be a Code 15 stored.

Diagnostic Aids:

A "Scan" tool displays throttle position in volts. Closed throttle voltage should be less than 1.25 volts. TPS voltage should increase at a steady rate as throttle is moved to WOT.

A Code 21 will result if CKT 452 is open or CKT 417 is shorted to voltage. If Code 21 is intermittent, refer to Section "B".

CODE 21
THROTTLE POSITION SENSOR (TPS) CIRCUIT
(SIGNAL VOLTAGE HIGH)
2.5L "P" SERIES (TBI)



① • THROTTLE CLOSED.
DOES "SCAN" DISPLAY TPS OVER 2.5 VOLTS?

YES:

② • DISCONNECT SENSOR.
"SCAN" SHOULD DISPLAY TPS BELOW .2 VOLTS (200mV).
DOES IT?

NO:

CODE 21 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

YES:

③ • PROBE SENSOR GROUND CIRCUIT WITH A TEST LIGHT CONNECTED TO 12 VOLTS.

NO:

CKT 417 SHORTED TO VOLTAGE OR FAULTY ECM.

LIGHT "ON":

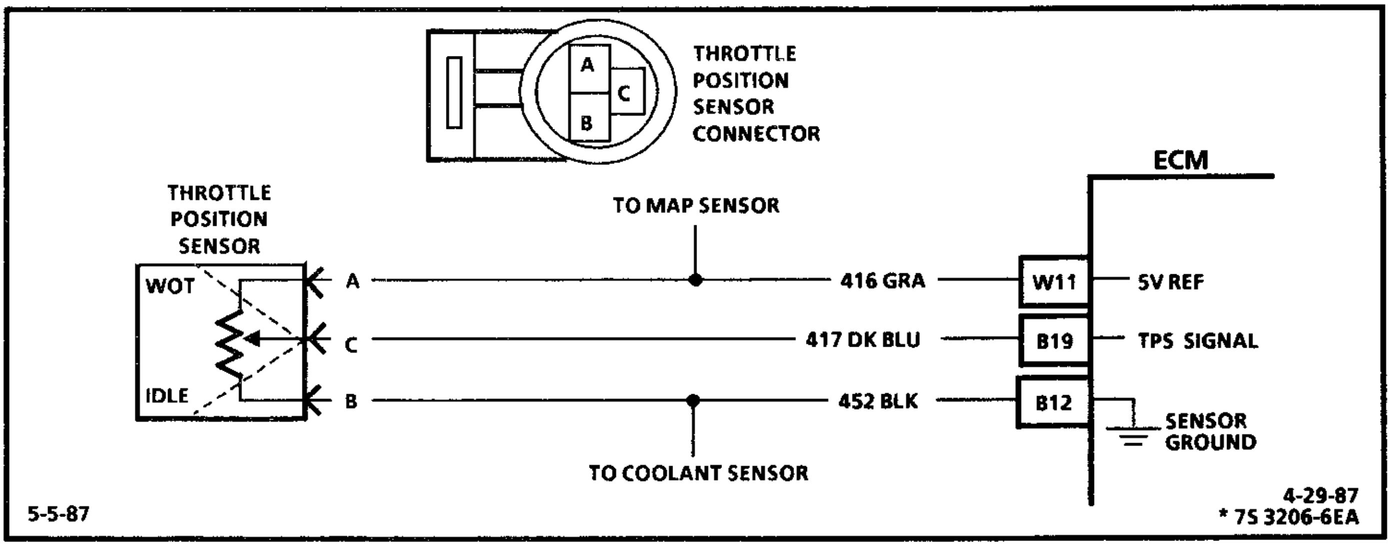
FAULTY CONNECTION OR SENSOR

LIGHT "OFF":

OPEN SENSOR GROUND CIRCUIT OR FAULTY ECM.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

2-24-87
• 7S 3057-6E



5-5-87

4-29-87
* 7S 3206-6EA

CODE 22

THROTTLE POSITION SENSOR (TPS) CIRCUIT

(SIGNAL VOLTAGE LOW)

2.5L "P" SERIES (TBI)

Circuit Description:

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 (WOT).

The TPS signal is one of the most important inputs used by the ECM for fuel control and for many of the ECM controlled outputs.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. This step checks to see if Code 22 is the result of a hard failure or an intermittent condition.
   A Code 22 will set if:
   - The engine is running.
   - TPS voltage is below .2 volts (200 mv).
2. This step simulates conditions for a Code 21. If a Code 21 is set, or the "Scan" tool displays over 4 volts, the ECM and wiring are OK.
3. The "Scan" tool may not display 12 volts. The important thing is that the ECM recognizes the voltage as over 4 volts, indicating that CKT 417 and the ECM are OK.
4. If CKT 416 is shorted to ground, there may also be a stored Code 34.

Diagnostic Aids:

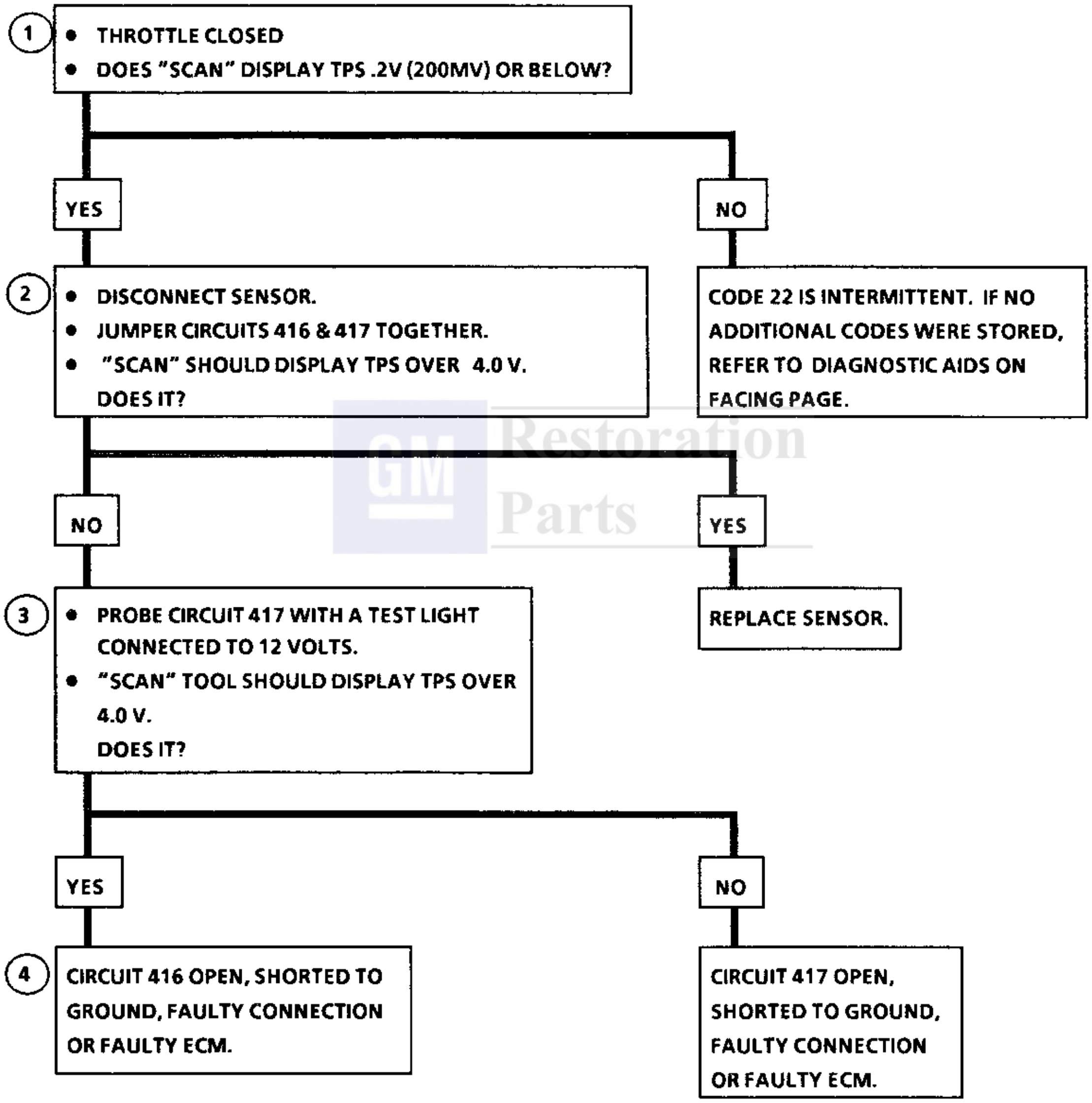
A "Scan" tool displays throttle position in volts. Closed throttle voltage should be less than 1.25 volts. TPS voltage should increase at a steady rate as throttle is moved to WOT.

An open, or grounded, 416 or 417 will result in a Code 22.

If Code 22 is intermittent, refer to Section "B".

CODE 22

THROTTLE POSITION SENSOR (TPS) CIRCUIT
(SIGNAL VOLTAGE LOW)
2.5L "P" SERIES (TBI)



①
- THROTTLE CLOSED
- DOES "SCAN" DISPLAY TPS .2V (200MV) OR BELOW?

CODE 22 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO DIAGNOSTIC AIDS ON FACING PAGE.

②
- DISCONNECT SENSOR.
- JUMPER CIRCUITS 416 & 417 TOGETHER.
- "SCAN" SHOULD DISPLAY TPS OVER 4.0 V.

DOES IT?

REPLACE SENSOR.

③
- PROBE CIRCUIT 417 WITH A TEST LIGHT CONNECTED TO 12 VOLTS.
- "SCAN" TOOL SHOULD DISPLAY TPS OVER 4.0 V.

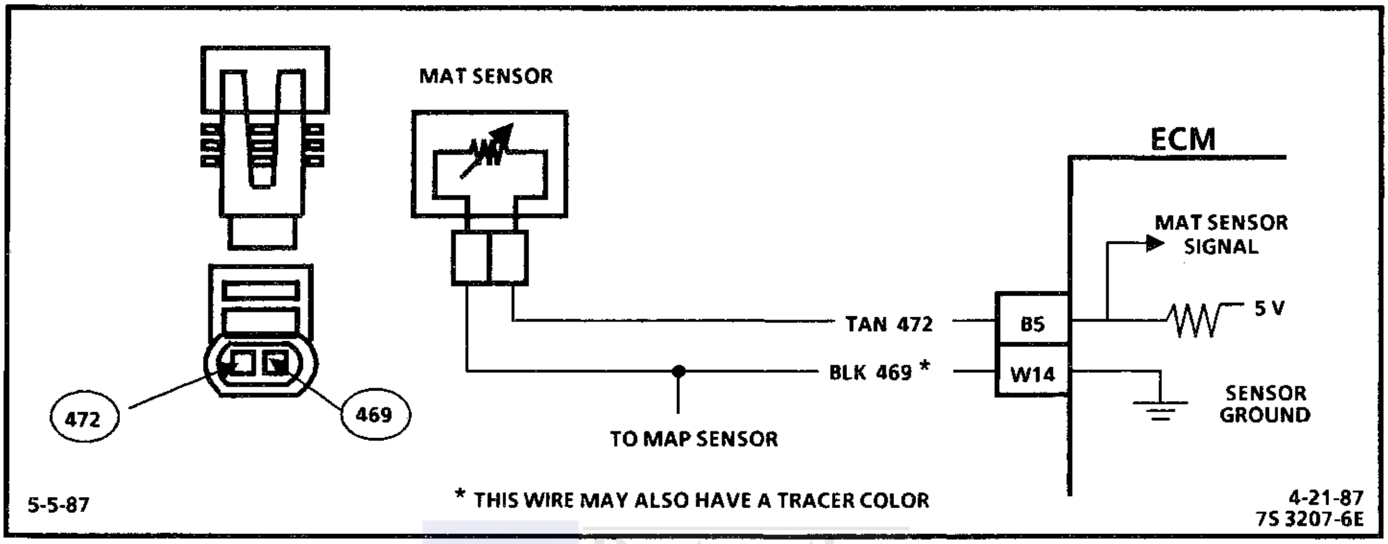
DOES IT?

④ CIRCUIT 416 OPEN, SHORTED TO GROUND, FAULTY CONNECTION OR FAULTY ECM.

CIRCUIT 417 OPEN, SHORTED TO GROUND, FAULTY CONNECTION OR FAULTY ECM.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

10-30-86
*7S 3260-6E



CODE 23

MANIFOLD AIR TEMPERATURE (MAT) SENSOR CIRCUIT
(LOW TEMPERATURE INDICATED)
2.5L "P" SERIES (TBI)

Circuit Description:

The manifold air temperature sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies a voltage (4-6 volts) on CKT 472 to the sensor. When manifold air is cold, the sensor (thermistor) resistance is high, therefore, the ECM will see a high signal voltage. As the air warms, the sensor resistance becomes less and the voltage drops.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. This step checks to see if Code 23 is the result of a hard failure or, an intermittent condition.
   A Code 23 will set if:
   - Signal voltage indicates a MAT temperature less than -30°C.
   - Engine is running for longer than 58 seconds.
2. This test simulates conditions for a Code 25. If the "Scan" tool displays a high temperature, the ECM and wiring are OK.
3. This step checks continuity of CKTs 472 and 469. If CKT 469 is open, there may also be a Code 33.

Diagnostic Aids:

If the engine has been allowed to cool to an ambient temperature (overnight), coolant and MAT temperatures may be checked with a "Scan" tool and should read close to each other.

A Code 23 will result if CKTs 472 or 469 become open.

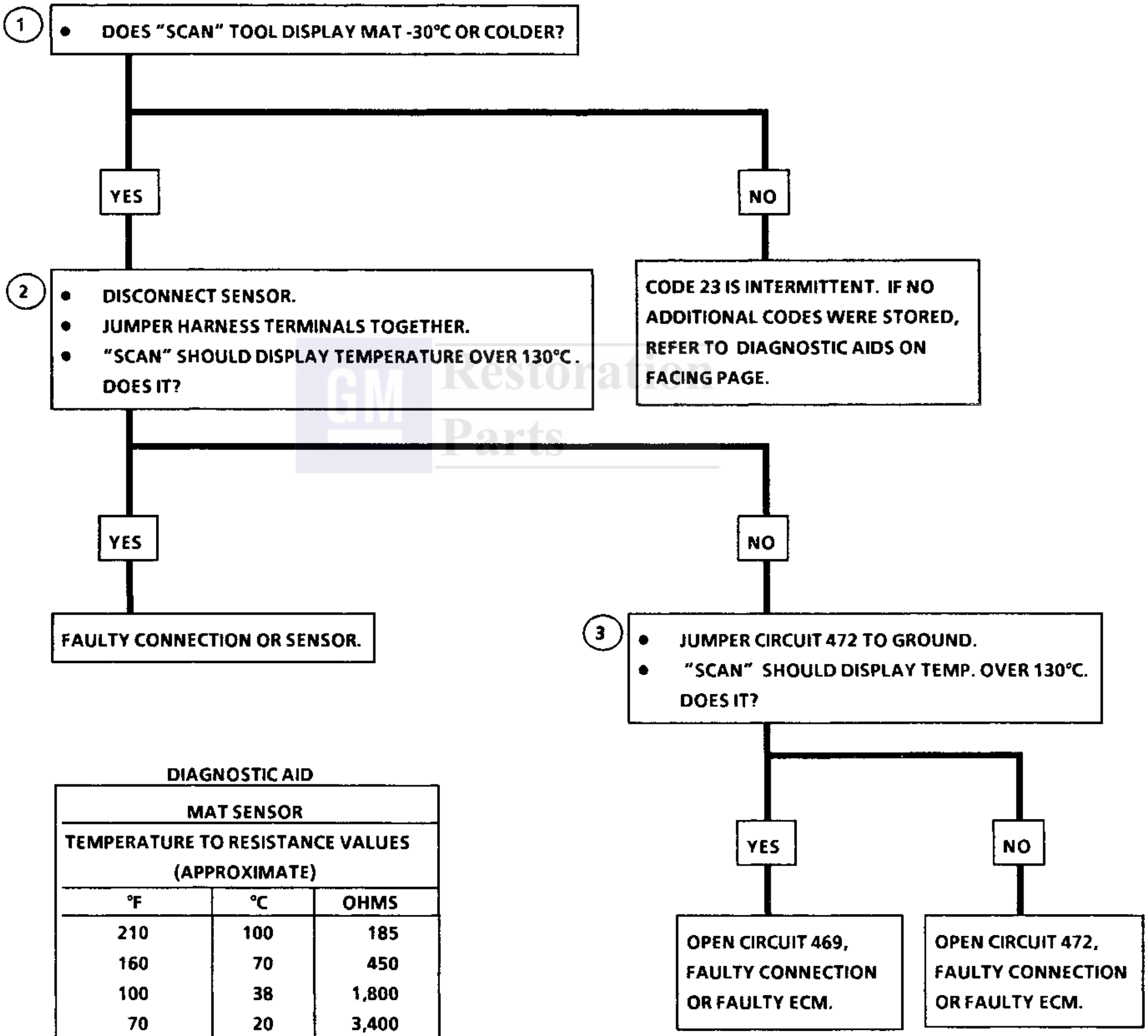
If Code 23 is intermittent, refer to Section "B".

CODE 23

MANIFOLD AIR TEMPERATURE (MAT) SENSOR CIRCUIT

(LOW TEMPERATURE INDICATED)

2.5L "P" SERIES (TBI)



①
- DOES "SCAN" TOOL DISPLAY MAT -30°C OR COLDER?

YES

②
- DISCONNECT SENSOR.
- JUMPER HARNESS TERMINALS TOGETHER.
- "SCAN" SHOULD DISPLAY TEMPERATURE OVER 130°C. DOES IT?

YES

FAULTY CONNECTION OR SENSOR.

NO

③
- JUMPER CIRCUIT 472 TO GROUND.
- "SCAN" SHOULD DISPLAY TEMP. OVER 130°C. DOES IT?

YES

OPEN CIRCUIT 469, FAULTY CONNECTION OR FAULTY ECM.

NO

OPEN CIRCUIT 472, FAULTY CONNECTION OR FAULTY ECM.

NO

CODE 23 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO DIAGNOSTIC AIDS ON FACING PAGE.

DIAGNOSTIC AID

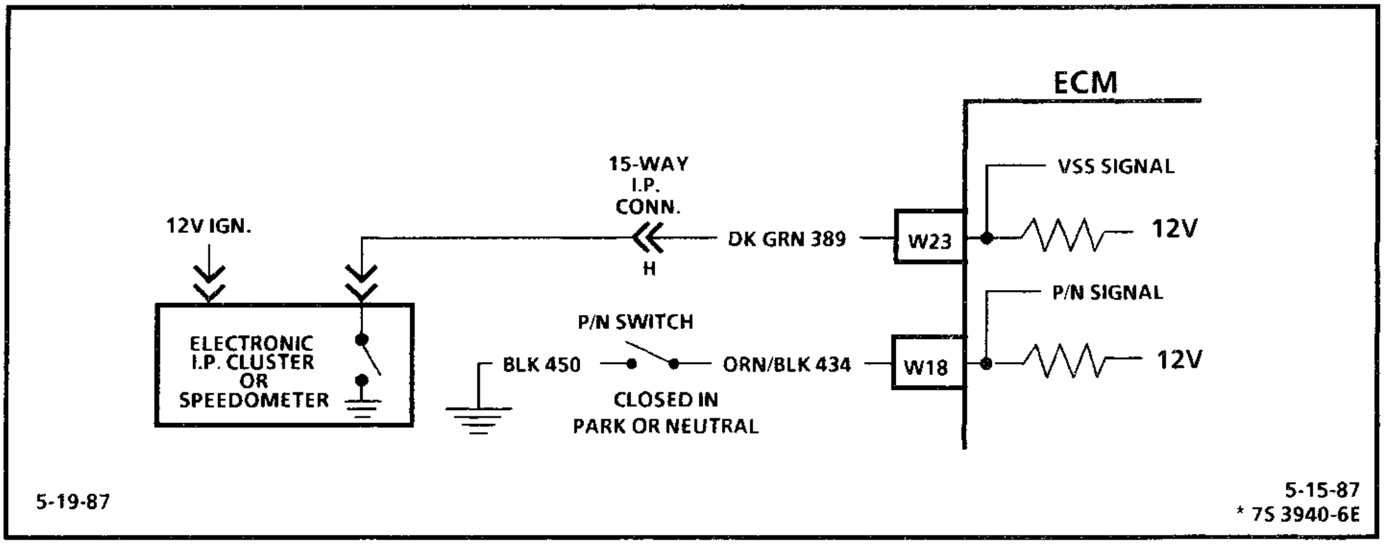
MAT SENSOR

TEMPERATURE TO RESISTANCE VALUES (APPROXIMATE)

°F	°C	OHMS
210	100	185
160	70	450
100	38	1,800
70	20	3,400
40	4	7,500
20	-7	13,500
0	-18	25,000
-40	-40	100,700

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

3-19-86
*7S 3262



CODE 24

VEHICLE SPEED SENSOR (VSS) CIRCUIT
2.5L "P" SERIES (TBI)

Circuit Description:

The ECM applies and monitors 12 volts on CKT 389. CKT 389 connects to the vehicle speed sensor which alternately grounds CKT 389 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".

"Scan" reading should closely match with speedometer reading with drive wheels turning.

** 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.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 24 will set if vehicle speed equals 0 mph when:
   - Engine speed is between 1400 and 3600 rpm
   - TPS is less than 2%
   - Low load condition
   - Not in park or neutral
   - All conditions met for 5 seconds

   These conditions are met during a road load deceleration. Disregard Code 24 that sets when drive wheels are not turning.
2. 8-12 volts, at the I.P. connector, indicates CKT 389 is open between the I.P. connector and the VSS, or there is a faulty vehicle speed sensor. A voltage of less than 1 volt, at the I.P. connector, indicates that CKT 389 wire is shorted to ground or open between the connector and the ECM

   The I. P. connector is located in the center console near the ECM.

Diagnostic Aids:

"Scan" should indicate a vehicle speed whenever the drive wheels are turning greater than 3 mph.

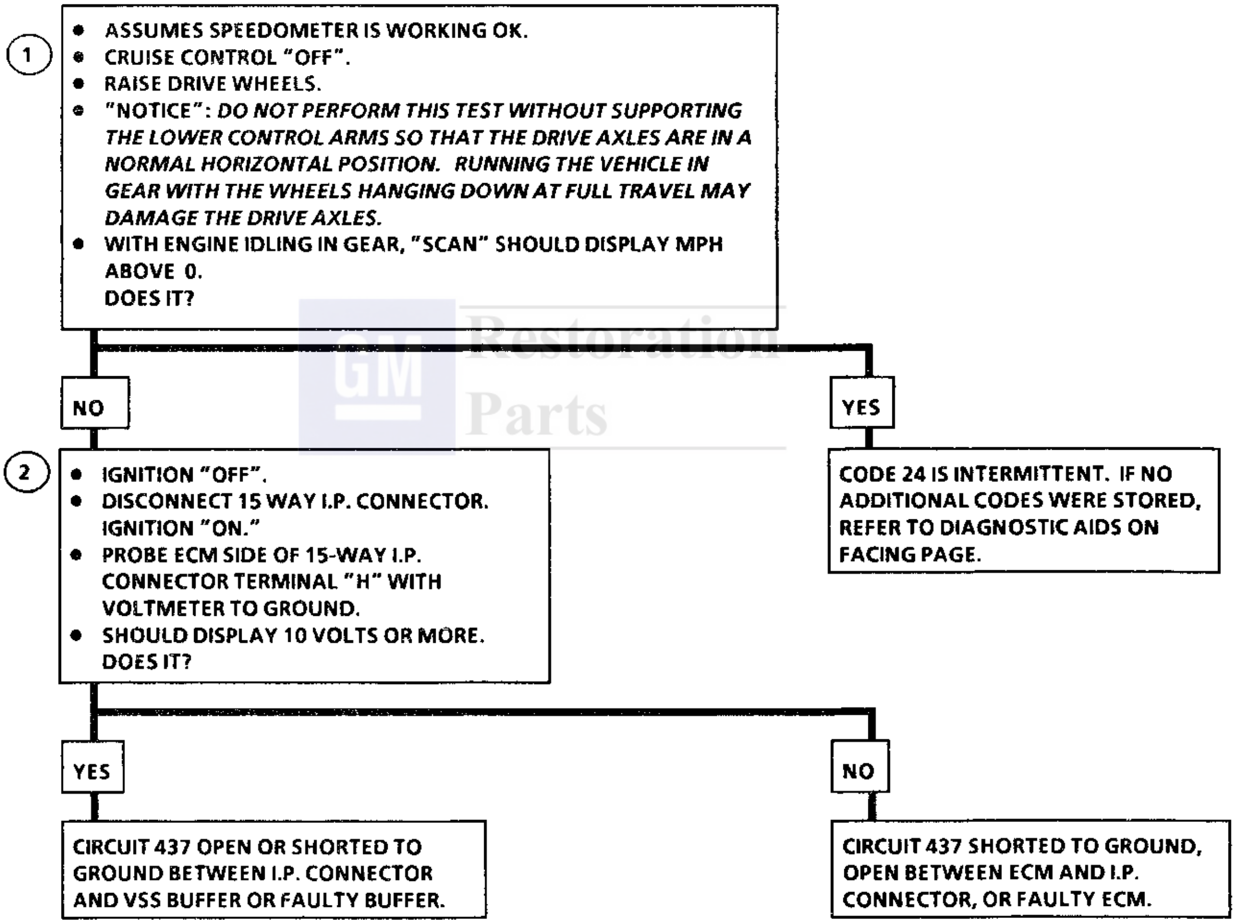
A faulty or misadjusted park/neutral switch can result in a false Code 24. Use a "Scan" and check for proper signal while in drive. Refer to CHART C-1A for P/N switch diagnosis check.

If all OK, refer to "Intermittents" in Section "B".

CODE 24

VEHICLE SPEED SENSOR (VSS) CIRCUIT
2.5L "P" SERIES (TBI)

DISREGARD CODE 24 IF SET WHILE DRIVE WHEELS ARE NOT TURNING.



①
- ASSUMES SPEEDOMETER IS WORKING OK.
- CRUISE CONTROL "OFF".
- RAISE DRIVE WHEELS.
- "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.*
- WITH ENGINE IDLING IN GEAR, "SCAN" SHOULD DISPLAY MPH ABOVE 0.
  DOES IT?

NO

②
- IGNITION "OFF".
- DISCONNECT 15 WAY I.P. CONNECTOR. IGNITION "ON."
- PROBE ECM SIDE OF 15-WAY I.P. CONNECTOR TERMINAL "H" WITH VOLTMETER TO GROUND.
- SHOULD DISPLAY 10 VOLTS OR MORE.
  DOES IT?

YES

CIRCUIT 437 OPEN OR SHORTED TO GROUND BETWEEN I.P. CONNECTOR AND VSS BUFFER OR FAULTY BUFFER.

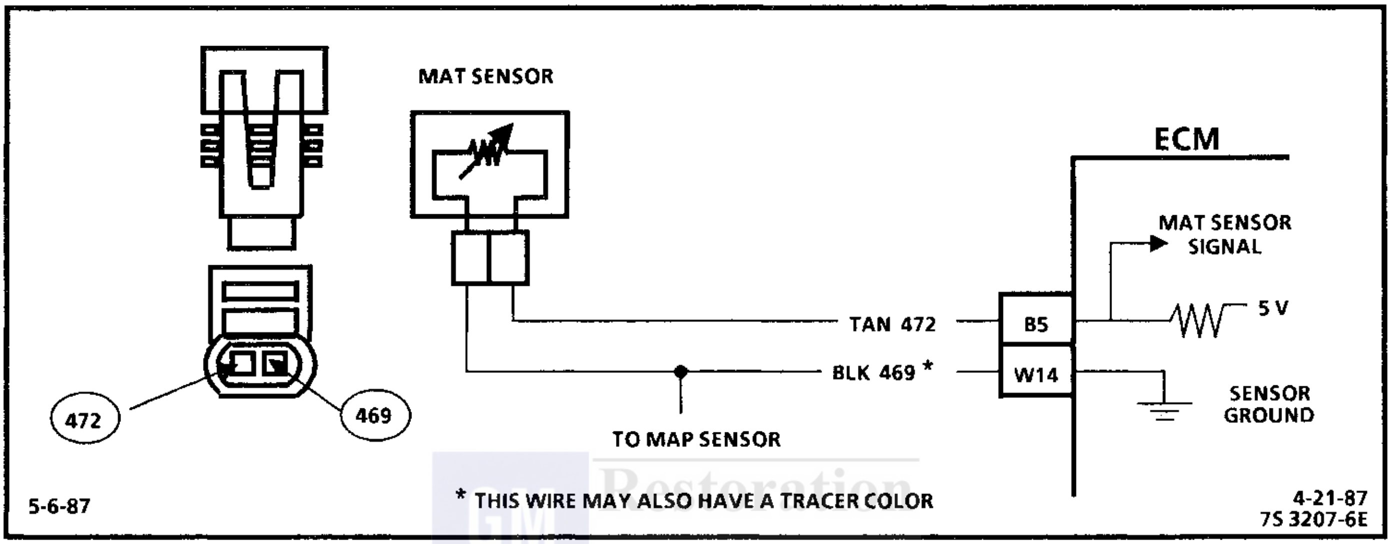
NO

CIRCUIT 437 SHORTED TO GROUND, OPEN BETWEEN ECM AND I.P. CONNECTOR, OR FAULTY ECM.

YES

CODE 24 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO DIAGNOSTIC AIDS ON FACING PAGE.

CLEAR CODES AND CONFIRM "CLOSED LOOP " OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.



5-6-87

* THIS WIRE MAY ALSO HAVE A TRACER COLOR

4-21-87
7S 3207-6E

CODE 25

MANIFOLD AIR TEMPERATURE (MAT) SENSOR CIRCUIT
(HIGH TEMPERATURE INDICATED)
2.5L "P" SERIES (TBI)

Circuit Description:

The manifold air temperature sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies a voltage (4-6 volts) on CKT 472 to the sensor. When manifold air is cold, the sensor (thermistor) resistance is high, therefore, the ECM will see a high signal voltage. As the air warms, the sensor resistance becomes less and the voltage drops.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. This check determines if the Code 25 is the result of a hard failure or an intermittent condition.
   A Code 25 will set if:
   - A MAT temperature greater than 135°C is detected for a time longer than 2 seconds.

Diagnostic Aids:

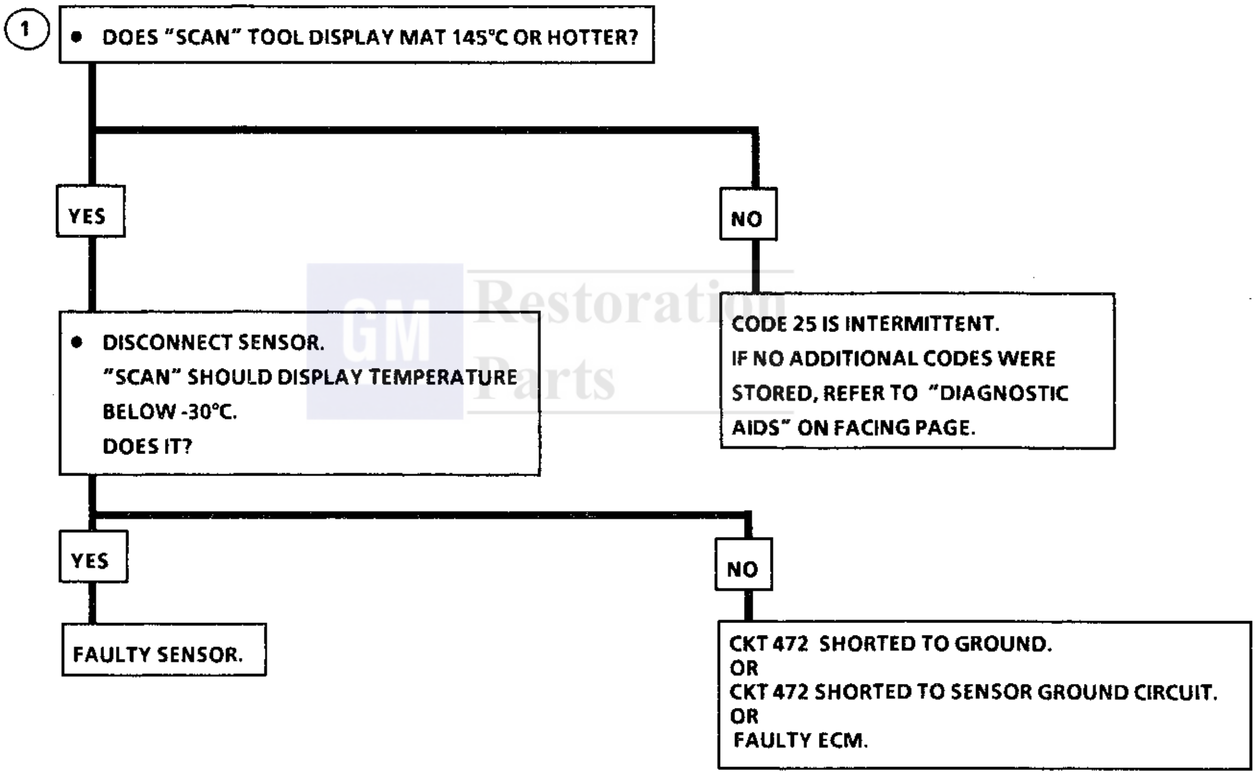
If the engine has been allowed to cool to an ambient temperature (overnight), coolant and MAT temperatures may be checked with a "Scan" tool and should read close to each other.

A Code 25 will result if CKT 472 is shorted to ground.

If Code 25 is intermittent, refer to Section "B".

CODE 25

MANIFOLD AIR TEMPERATURE (MAT) SENSOR CIRCUIT
(HIGH TEMPERATURE INDICATED)
2.5L "P" SERIES (TBI)



① • DOES "SCAN" TOOL DISPLAY MAT 145°C OR HOTTER?

YES

• DISCONNECT SENSOR.
"SCAN" SHOULD DISPLAY TEMPERATURE BELOW -30°C.
DOES IT?

YES

FAULTY SENSOR.

NO

CKT 472 SHORTED TO GROUND.
OR
CKT 472 SHORTED TO SENSOR GROUND CIRCUIT.
OR
FAULTY ECM.

NO

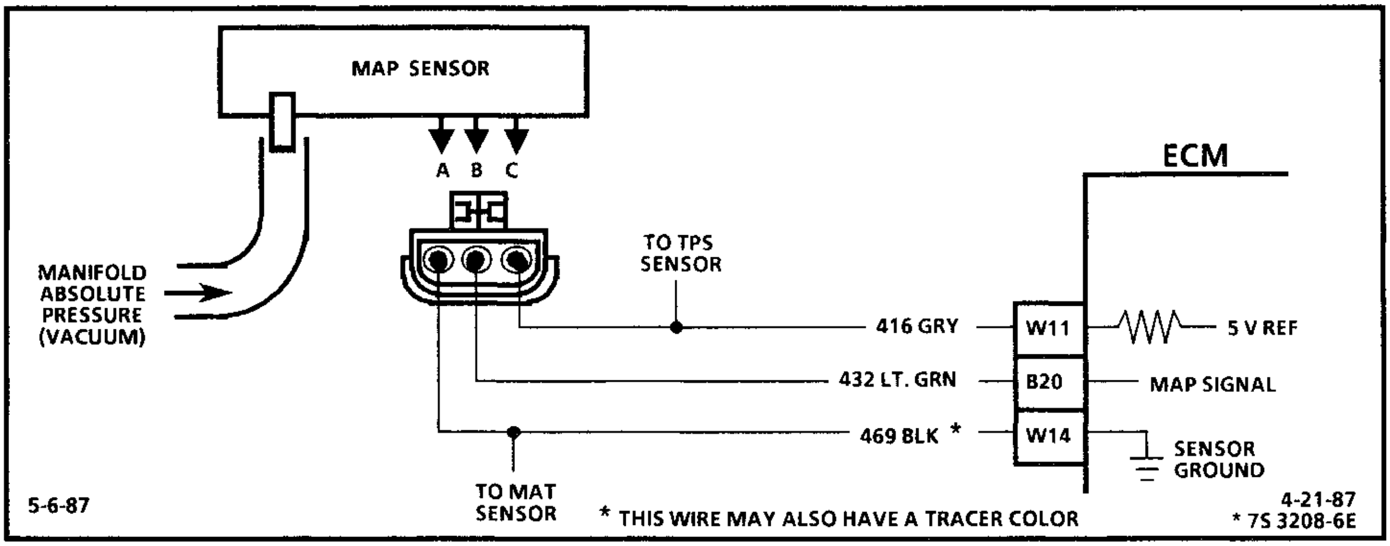
CODE 25 IS INTERMITTENT.
IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

DIAGNOSTIC AID

MAT SENSOR
TEMPERATURE TO RESISTANCE VALUES
(APPROXIMATE)

°F	°C	OHMS
210	100	185
160	70	450
100	38	1,800
70	20	3,400
40	4	7,500
20	-7	13,500
0	-18	25,000
-40	-40	100,700

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.



* THIS WIRE MAY ALSO HAVE A TRACER COLOR

CODE 33

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR CIRCUIT

(SIGNAL VOLTAGE HIGH - LOW VACUUM)

2.5L "P" SERIES (TBI)

Circuit Description:

The manifold absolute pressure sensor (MAP) responds to changes in manifold pressure (vacuum). The ECM receives this information as a signal voltage that will vary from about 1 to 1.5 volts, at closed throttle idle, to 4-4.5 volts at wide open throttle (low vacuum).

If the MAP sensor fails, the ECM will sustitute a fixed MAP value and use the throttle position sensor (TPS) to control fuel delivery.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. This step will determine if Code 33 is the result of a hard failure or an intermittent condition.
   A Code 33 will set if:
   - MAP signal voltage is too high (low vacuum).
   - TPS less than 4%.
   - These conditions for a time longer than 48 seconds.
2. This step simulates conditions for a Code 34. If the ECM recognizes the change, the ECM, and CKTs 416 and 432 are OK. If CKT 469 is open, there may also be a stored Code 23.

Diagnostic Aids:

With the ignition "ON", and the engine stopped, the manifold pressure is equal to atmospheric pressure and the signal voltage will be high. This information is used by the ECM as an indication of vehicle altitude and is referred to as BARO. Comparison of the BARO reading with a known good vehicle with the same sensor is a good way to check accuracy of a "suspect" sensor. Readings should be the same ± .4 volt.

A Code 33 will result if CKT 469 is open, or if CKT 432 is shorted to voltage or to CKT 416.

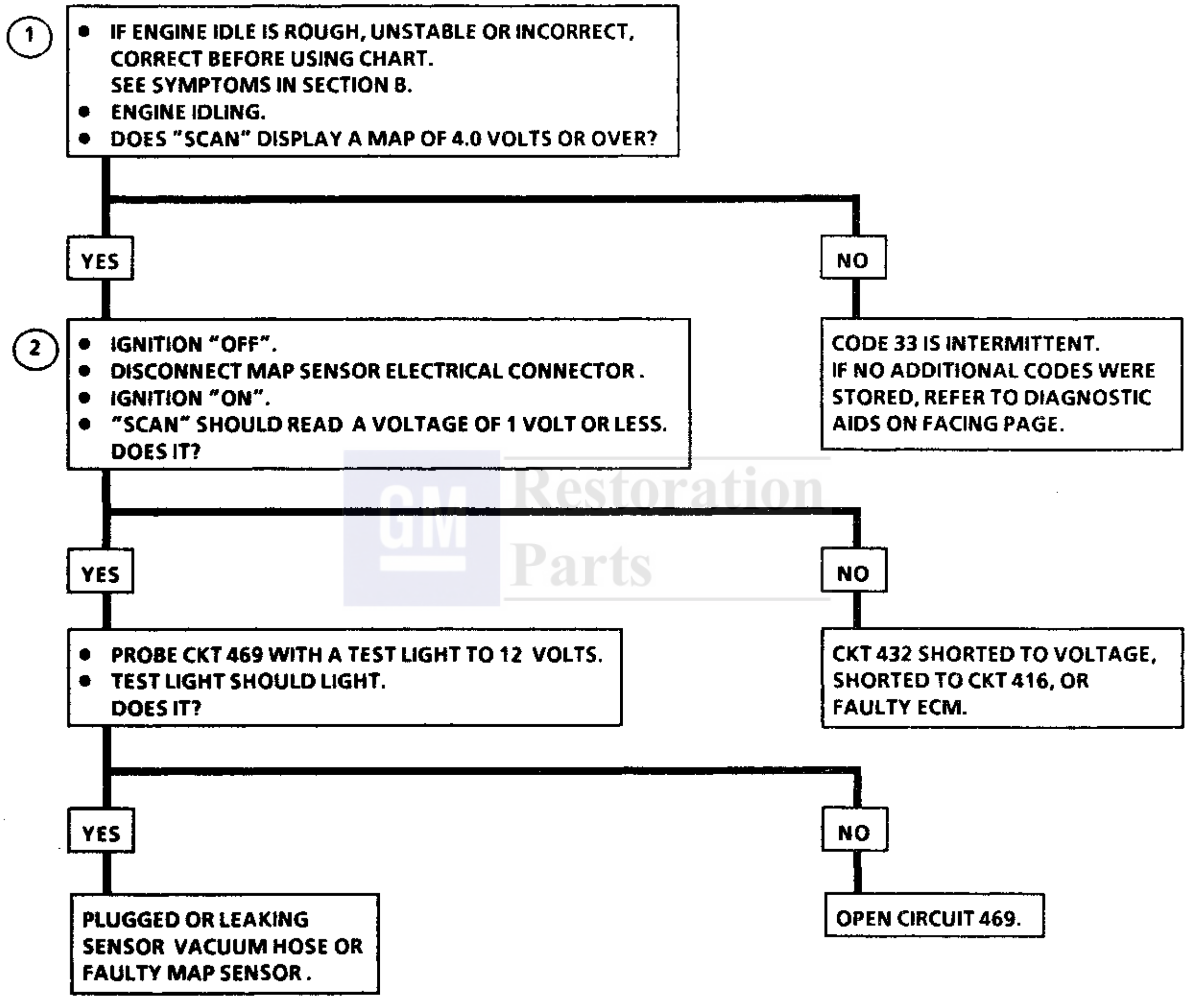
If Code 33 is intermittent, refer to Section "B".

CODE 33

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR CIRCUIT

(SIGNAL VOLTAGE HIGH - LOW VACUUM)

2.5L "P" SERIES (TBI)

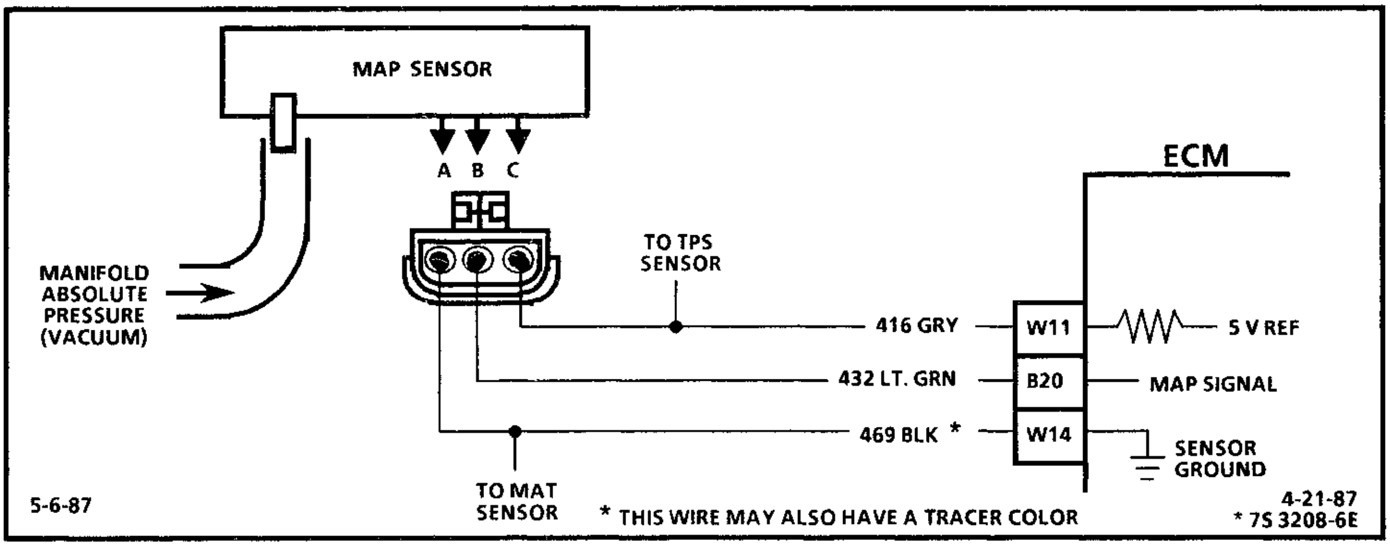


IGNITION "ON" ENGINE STOPPED VOLTAGES

ALTITUDE Meters	 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

5-1-86
7S 3210-6E



* THIS WIRE MAY ALSO HAVE A TRACER COLOR

CODE 34

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR CIRCUIT
(SIGNAL VOLTAGE LOW - HIGH VACUUM)
2.5L "P" SERIES (TBI)

Circuit Description:

The manifold absolute pressure sensor (MAP) responds to changes in manifold pressure (vacuum). The ECM receives this information as a signal voltage that will vary from about 1 to 1.5 volts at closed throttle idle, to 4 - 4.5 volts at wide open throttle.

If the MAP sensor fails, the ECM will sustitute a fixed MAP value and use the throttle position sensor (TPS) to control fuel delivery.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. This step determines if Code 34 is the result of a hard failure or an intermittent condition.
   A Code 34 will set when:
   - MAP signal voltage is too low.
   - The ignition is "ON".
2. Jumpering harness terminals "B" to "C", 5 volt to signal, will determine if the sensor is at fault, or if there is a problem with the ECM or wiring.
3. The "Scan" tool may not display 12 volts. The important thing is that the ECM recognizes the voltage as more than 4 volts, indicating that the ECM and CKT 432 are OK.

Diagnostic Aids:

With the ignition "ON", and the engine stopped, the manifold pressure is equal to atmospheric pressure and the signal voltage will be high. This information is used by the ECM as an indication of vehicle altitude and is referred to as BARO. Comparison of the BARO reading with a known good vehicle with the same sensor is a good way to check accuracy of a "suspect" sensor. Readings should be the same ± .4 volt.

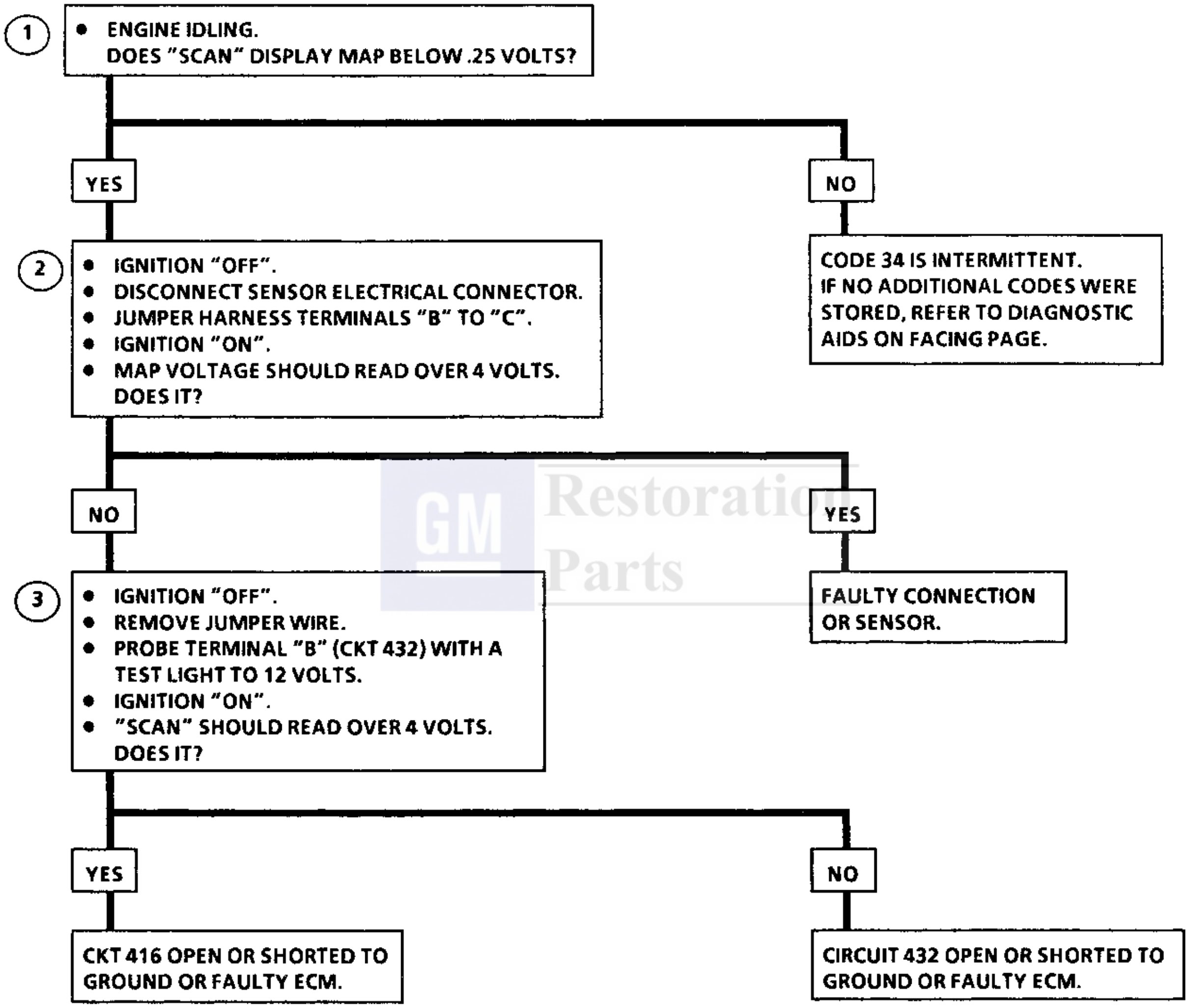
A Code 34 will result if CKTs 416 or 432 are open or shorted to ground.

If CKT 416 is open or shorted to ground, there may also be a stored Code 22.

If Code 34 is intermittent, refer to Section "B".

CODE 34

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR CIRCUIT
(SIGNAL VOLTAGE LOW - HIGH VACUUM)
2.5L "P" SERIES (TBI)



①
- ENGINE IDLING.
  DOES "SCAN" DISPLAY MAP BELOW .25 VOLTS?

YES:

②
- IGNITION "OFF".
- DISCONNECT SENSOR ELECTRICAL CONNECTOR.
- JUMPER HARNESS TERMINALS "B" TO "C".
- IGNITION "ON".
- MAP VOLTAGE SHOULD READ OVER 4 VOLTS.
  DOES IT?

NO:

CODE 34 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO DIAGNOSTIC AIDS ON FACING PAGE.

NO:

③
- IGNITION "OFF".
- REMOVE JUMPER WIRE.
- PROBE TERMINAL "B" (CKT 432) WITH A TEST LIGHT TO 12 VOLTS.
- IGNITION "ON".
- "SCAN" SHOULD READ OVER 4 VOLTS.
  DOES IT?

YES:

FAULTY CONNECTION OR SENSOR.

YES:

CKT 416 OPEN OR SHORTED TO GROUND OR FAULTY ECM.

NO:

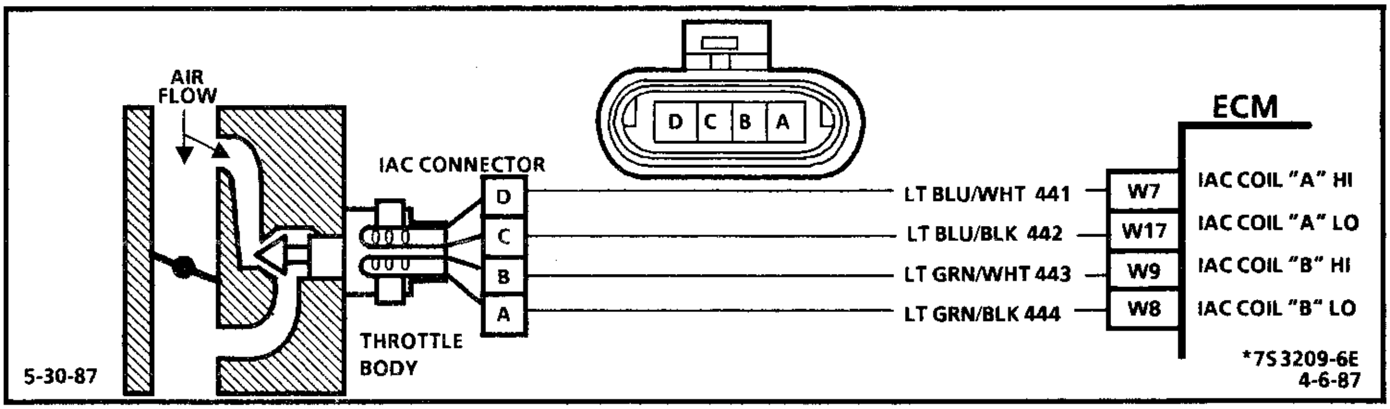
CIRCUIT 432 OPEN OR SHORTED TO GROUND OR FAULTY ECM.

IGNITION "ON" ENGINE STOPPED VOLTAGES

ALTITUDE Meters	ALTITUDE Feet	VOLTAGE RANGE
Below 305	Below 1,000	3.8---5.5V
305--- 610	1,000--2,000	3.6---5.3V
610--- 914	2,000--3,000	3.5---5.1V
914--1219	3,000--4,000	3.3---5.0V
1219--1524	4,000--5,000	3.2---4.8V
1524--1829	5,000--6,000	3.0---4.6V
1829--2133	6,000--7,000	2.9---4.5V
2133--2438	7,000--8,000	2.8---4.3V
2438--2743	8,000--9,000	2.6---4.2V
2743--3048	9,000--10,000	2.5---4.0V

LOW ALTITUDE = HIGH PRESSURE = HIGH VOLTAGE

11-7-86
7S 3211-6E



CODE 35

IDLE SPEED ERROR
2.5L "P" SERIES (TBI)

Circuit Description:

Code 35 will set, when the closed throttle engine speed is 150 rpm above or below the desired idle speed for 20 seconds. Review general description in Section "C".

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Continue with test, even if engine will not idle. If the idle is too low, "Scan" will display 80 or more counts, or steps. If idle is too high, it will display "0" counts. Occasionally, an erratic or unstable idle may occur. Engine speed may vary 200 rpm or more up and down. Disconnect IAC. If the condition is unchanged, the IAC is not at fault.
2. When the engine was stopped, the IAC Valve retracted (more air) to a fixed "Park" position for increased air flow and idle speed during the next engine start. A "Scan" will display 100 or more counts.
3. Be sure to disconnect the IAC valve prior to this test. The test light will confirm the ECM signals by a steady or flashing light on all circuits.
4. There is a remote possibility that one of the circuits is shorted to voltage, which would have been indicated by a steady light. Disconnect ECM and turn the ignition "ON" and probe terminals to check for this condition.

Diagnostic Aids:

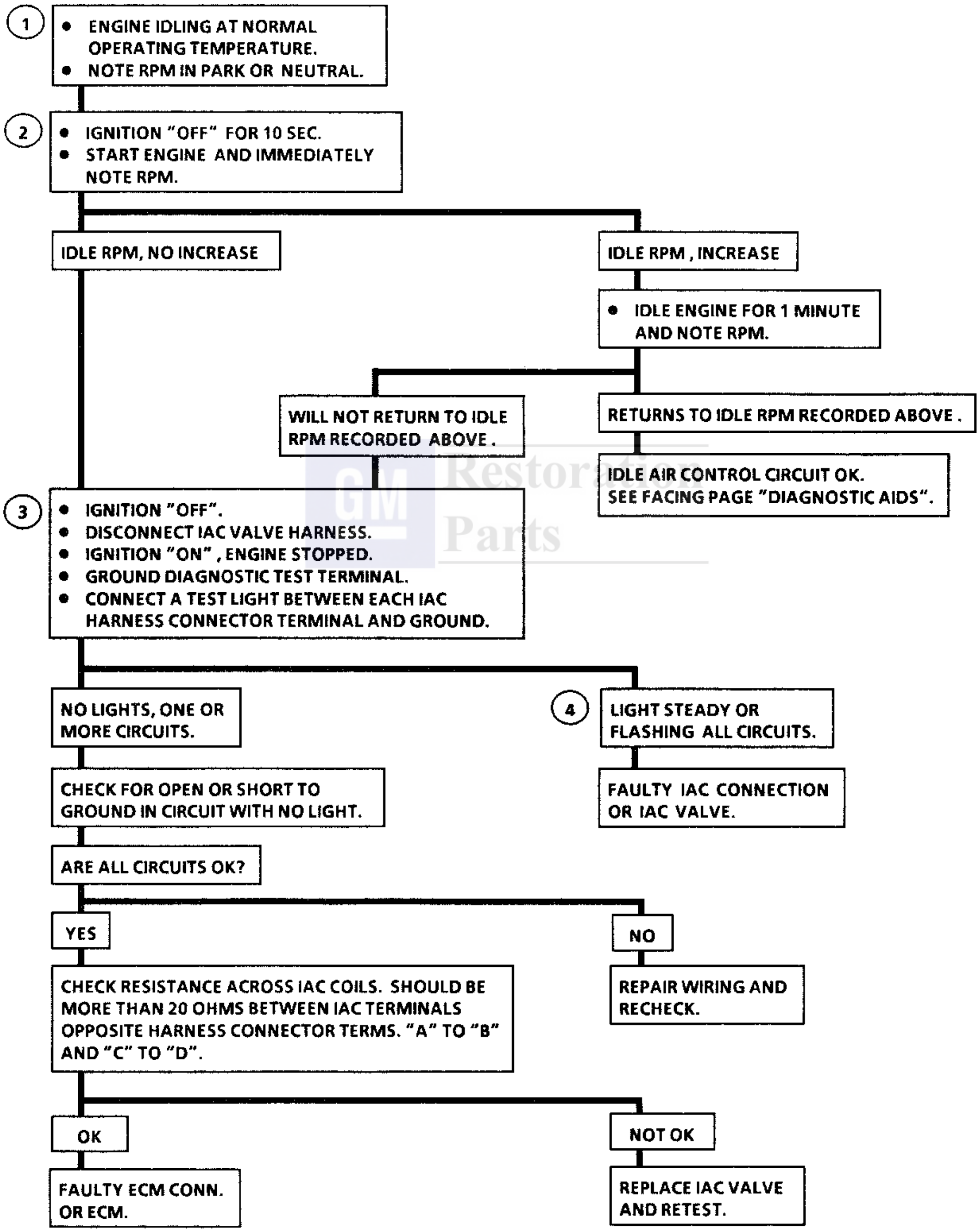
A slow unstable idle may be caused by a system problem that cannot be overcome by the IAC. "Scan" counts will be above 60 counts, if idle is too low, and "0" counts, if idle is too high.

If idle is too high, stop engine. Ignition "ON". Ground diagnostic terminal. Wait 45 seconds for IAC to seat, then, disconnect IAC. Start engine. If idle speed is above 800 rpm, locate and correct vacuum leak.

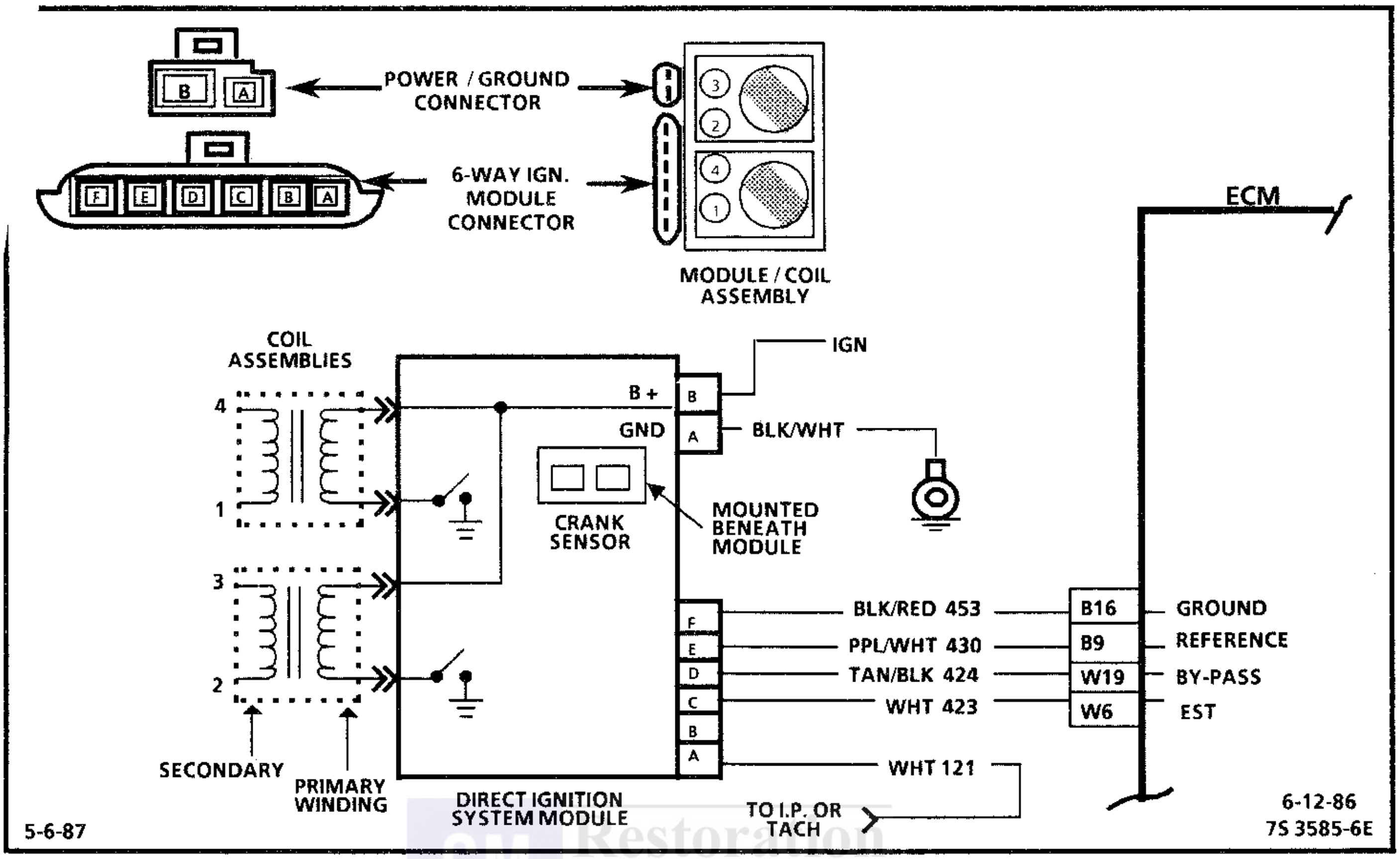
- System too lean (High Air/Fuel Ratio)
  Idle speed may be too high or too low. Engine speed may vary up and down, disconnecting IAC does not help. May set Code 44.
  "Scan" and/or Voltmeter will read an oxygen sensor output less than 300 mv (.3 volts). Check for low regulated fuel pressure or water in fuel. A lean exhaust, with an oxygen sensor output fixed above 800 mv (.8 volts), will be a contaminated sensor, usually silicone. This may also set a Code 45.
- System too rich (Low Air/Fuel Ratio)
  Idle speed too low. "Scan" counts usually above 80. System obviously rich and may exhibit black smoke exhaust.
  "Scan" tool and/or Voltmeter will read an oxygen sensor signal fixed above 800 mv (.8 volts).
  Check:
  - High fuel pressure
  - Injector leaking or sticking
- Throttle Body - Remove IAC and inspect bore for foreign material or evidence of IAC valve dragging the bore.
- IAC Harness connections
  Carefully inspect harness connections for proper contact.
- PCV Valve
  An incorrect or faulty PCV Valve may result in an incorrect idle speed.
- Refer to "Rough, Unstable, Incorrect Idle or Stalling" in Symptoms in Section "B".

CODE 35

IDLE SPEED ERROR
2.5L "P" SERIES (TBI)



CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.



CODE 42

ELECTRONIC SPARK TIMING (EST) CIRCUIT
2.5L "P" SERIES (TBI)

Circuit Description:

The ignition module sends a reference signal (CKT 430) to the ECM, when the engine is cranking. While the engine speed is under 400 rpm, the ignition module will control ignition timing. When the engine speed exceeds 400 rpm, the ECM applies 5 volts to the "bypass" line (CKT 424) to switch the timing to ECM control (EST CKT 423).

When the system is running on the ignition module, that is, no voltage on the bypass line, the ignition module grounds the EST signal. The ECM expects to see no voltage on the EST line during this condition. If it sees a voltage, it sets Code 42 and will not go into the EST mode.

When the rpm for EST is reached (about 400 rpm), voltage will be applied to the bypass line, the EST should no longer be grounded in the ignition module, so the EST voltage should be varying.

If the bypass line is open or grounded, the ignition module will not switch to EST mode so the EST voltage will be low and Code 42 will be set.

If the EST line is grounded, the ignition module will switch to EST but, because the line is grounded, there will be no EST signal. A Code 42 will be set.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 42 means the ECM has seen an open or short to ground in the EST or bypass circuits. This test confirms Code 42 and that the fault causing the code is present.
2. Checks for a normal EST ground path through the ignition module. An EST CKT 423, shorted to ground, will also read less than 500 ohms, however, this will be checked later.
3. As the test light voltage touches CKT 424, the module should switch, causing the ohmmeter to "overrange", if the meter is in the 1000-2000 ohms position. Selecting the 10 - 20,000 ohms position will indicate above 5000 ohms. The important thing is that the module "switched".
4. The module did not switch and this step checks for:
   - EST CKT 423 shorted to ground.
   - Bypass CKT 424 open.
   - Faulty ignition module connection or module.
5. Confirms that Code 42 is a faulty ECM and not an intermittent in CKTs 423 or 424.

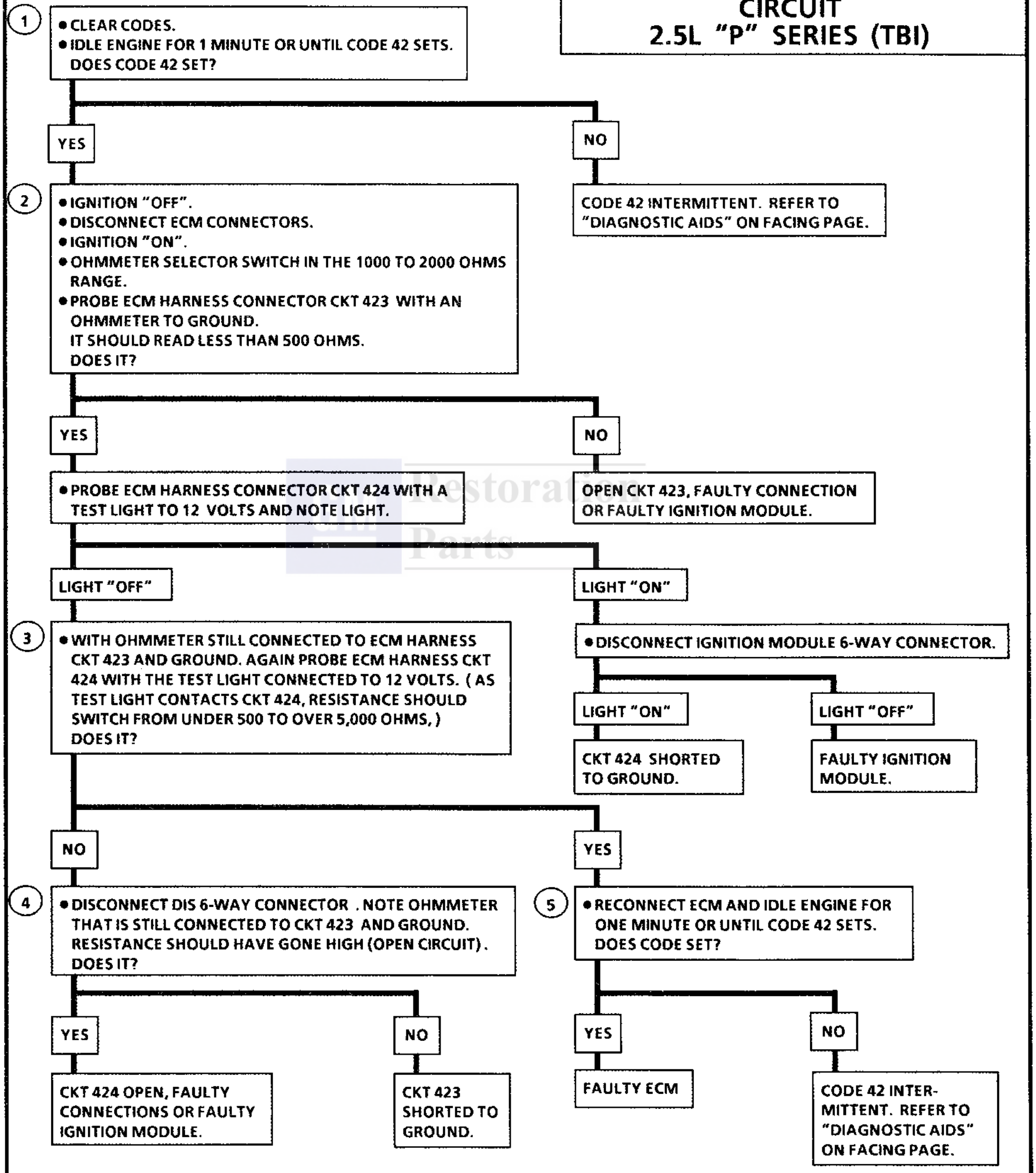
Diagnostic Aids:

The "Scan" tool does not have any ability to help diagnose a Code 42 problem.

If Code 42 is intermittent, refer to Section "B".

CODE 42

ELECTRONIC SPARK TIMING (EST) CIRCUIT
2.5L "P" SERIES (TBI)



①
- CLEAR CODES.
- IDLE ENGINE FOR 1 MINUTE OR UNTIL CODE 42 SETS. DOES CODE 42 SET?

NO: CODE 42 INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

YES:

②
- IGNITION "OFF".
- DISCONNECT ECM CONNECTORS.
- IGNITION "ON".
- OHMMETER SELECTOR SWITCH IN THE 1000 TO 2000 OHMS RANGE.
- PROBE ECM HARNESS CONNECTOR CKT 423 WITH AN OHMMETER TO GROUND. IT SHOULD READ LESS THAN 500 OHMS. DOES IT?

NO: OPEN CKT 423, FAULTY CONNECTION OR FAULTY IGNITION MODULE.

YES:
- PROBE ECM HARNESS CONNECTOR CKT 424 WITH A TEST LIGHT TO 12 VOLTS AND NOTE LIGHT.

LIGHT "ON":
- DISCONNECT IGNITION MODULE 6-WAY CONNECTOR.

LIGHT "ON": CKT 424 SHORTED TO GROUND.

LIGHT "OFF": FAULTY IGNITION MODULE.

LIGHT "OFF":

③
- WITH OHMMETER STILL CONNECTED TO ECM HARNESS CKT 423 AND GROUND. AGAIN PROBE ECM HARNESS CKT 424 WITH THE TEST LIGHT CONNECTED TO 12 VOLTS. (AS TEST LIGHT CONTACTS CKT 424, RESISTANCE SHOULD SWITCH FROM UNDER 500 TO OVER 5,000 OHMS,) DOES IT?

NO:

④
- DISCONNECT DIS 6-WAY CONNECTOR . NOTE OHMMETER THAT IS STILL CONNECTED TO CKT 423 AND GROUND. RESISTANCE SHOULD HAVE GONE HIGH (OPEN CIRCUIT). DOES IT?

YES: CKT 424 OPEN, FAULTY CONNECTIONS OR FAULTY IGNITION MODULE.

NO: CKT 423 SHORTED TO GROUND.

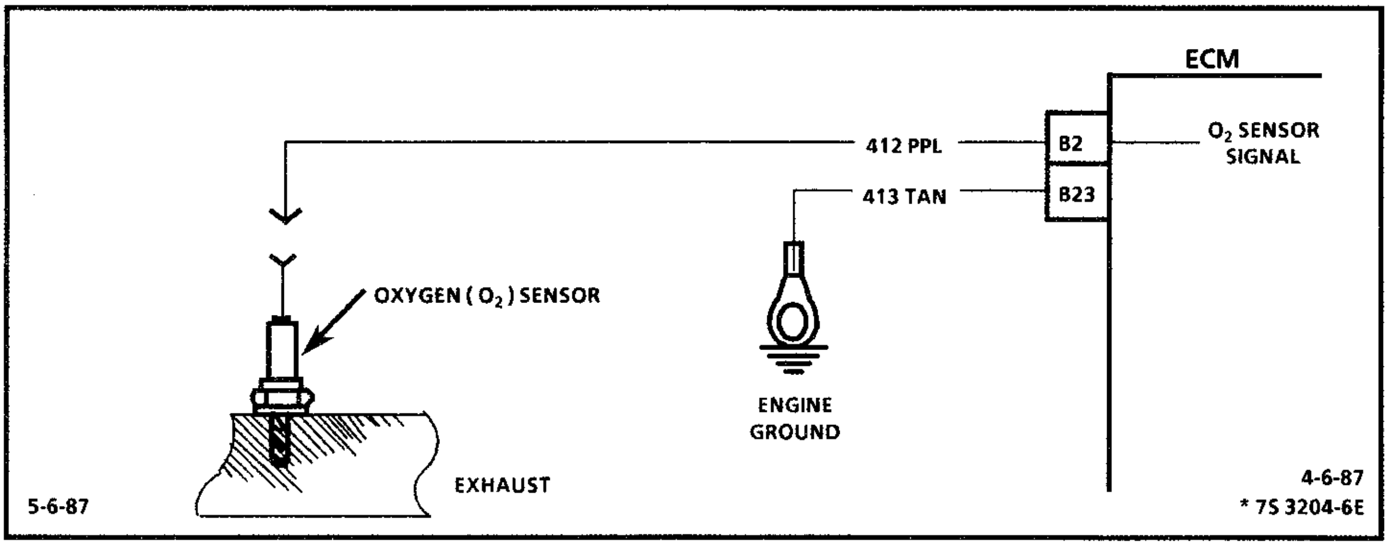
YES:

⑤
- RECONNECT ECM AND IDLE ENGINE FOR ONE MINUTE OR UNTIL CODE 42 SETS. DOES CODE SET?

YES: FAULTY ECM

NO: CODE 42 INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

84-85 CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.



CODE 44

OXYGEN SENSOR CIRCUIT
(LEAN EXHAUST INDICATED)
2.5L "P" SERIES (TBI)

Circuit Description:

The ECM supplies a voltage of about .45 volt between terminals "B2" and "B23". (If measured with a 10 megohm digital voltmeter, this may read as low as .32 volts.) The O_2 sensor varies the voltage within a range of about 1 volt, if the exhaust is rich, down through about .10 volt, if exhaust is lean.

The sensor is like an open circuit and produces no voltage, when it is below about 360°C (600°F). An open sensor circuit, or cold sensor, causes "Open Loop" operation.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 44 is set, when the O_2 sensor signal voltage on CKT 412:
   - Remains below .2 volt for 60 seconds or more;
   - And the system is operating in "Closed Loop".

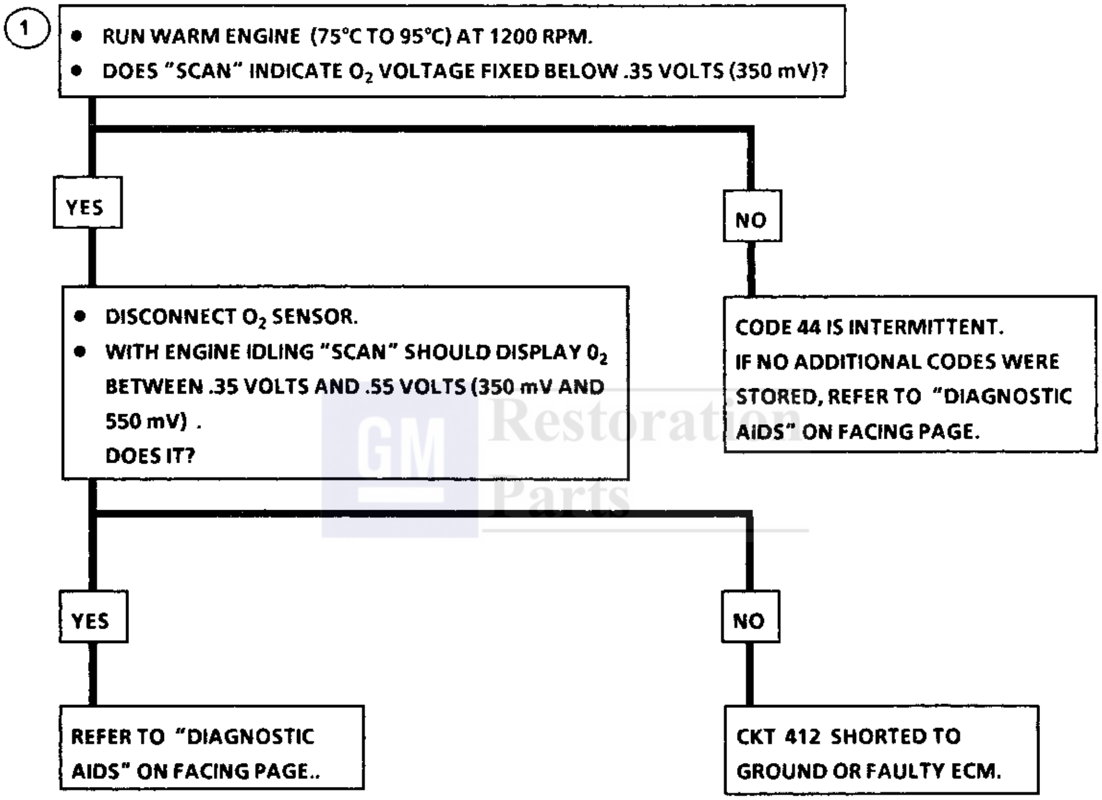
Diagnostic Aids:

Using the "Scan", observe the block learn value at different rpms. The "Scan" also displays the block cells, so the block learn values can be checked in each of the cells, to determine when the Code 44 may have been set. If the conditions for Code 44 exists, the block learn values will be around 150 or higher.

- O_2 Sensor Wire - Sensor pigtail may be mispositioned and contacting the exhaust manifold.
- Check for ground in wire between connector and sensor.
- 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.
- Fuel Pressure - System will be lean if pressure is too low. It may be necessary to monitor fuel pressure, while driving the car at various road speeds and/or loads to confirm. See Fuel System diagnosis CHART A-7.
- Exhaust Leaks - If there is an exhaust leak, the engine can cause outside air to be pulled into the exhaust and past the sensor. Vacuum or crankcase leaks can cause a lean condition.
- If Code 44 intermittent, refer to Section "B".

CODE 44

OXYGEN SENSOR CIRCUIT
(LEAN EXHAUST INDICATED)
2.5L "P" SERIES (TBI)



①
- RUN WARM ENGINE (75°C TO 95°C) AT 1200 RPM.
- DOES "SCAN" INDICATE O_2 VOLTAGE FIXED BELOW .35 VOLTS (350 mV)?

YES

- DISCONNECT O_2 SENSOR.
- WITH ENGINE IDLING "SCAN" SHOULD DISPLAY 0_2 BETWEEN .35 VOLTS AND .55 VOLTS (350 mV AND 550 mV) .
  DOES IT?

YES

REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE..

NO

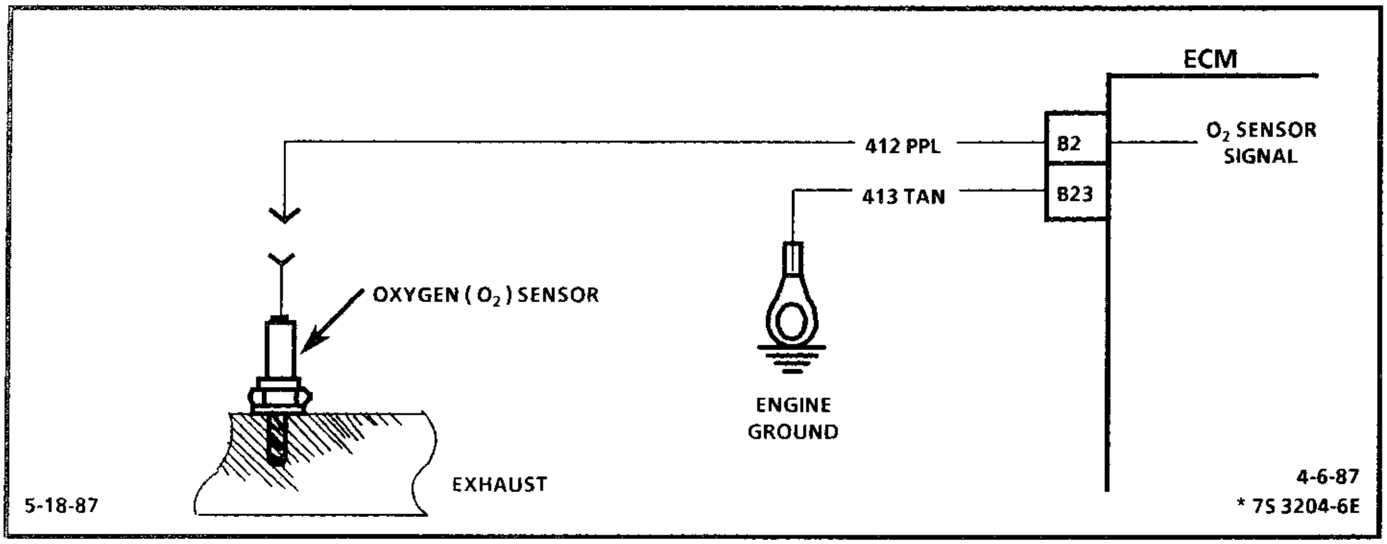
CKT 412 SHORTED TO GROUND OR FAULTY ECM.

NO

CODE 44 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

2-24-87
*7S 3191-6E



CODE 45

OXYGEN SENSOR CIRCUIT
(RICH EXHAUST INDICATED)
2.5L "P" SERIES (TBI)

Circuit Description:

The ECM supplies a voltage of about .45 volt between terminals "B2" and "B23". (If measured with a 10 megohm digital voltmeter, this may read as low as .32 volts.) The O_2 sensor varies the voltage within a range of about 1 volt, if the exhaust is rich, down through about .10 volt, if exhaust is lean.

The sensor is like an open circuit and produces no voltage, when it is below about 360°C (600°F). An open sensor circuit, or cold sensor, causes "Open Loop" operation.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 45 is set, when the O_2 sensor signal voltage on CKT 412:
   - Remains above .7 volt for 30 seconds or more; and in "Closed Loop".
   - Engine time after start is 1 minute or more.
   - Throttle angle between 3% and 45%.

Diagnostic Aids:

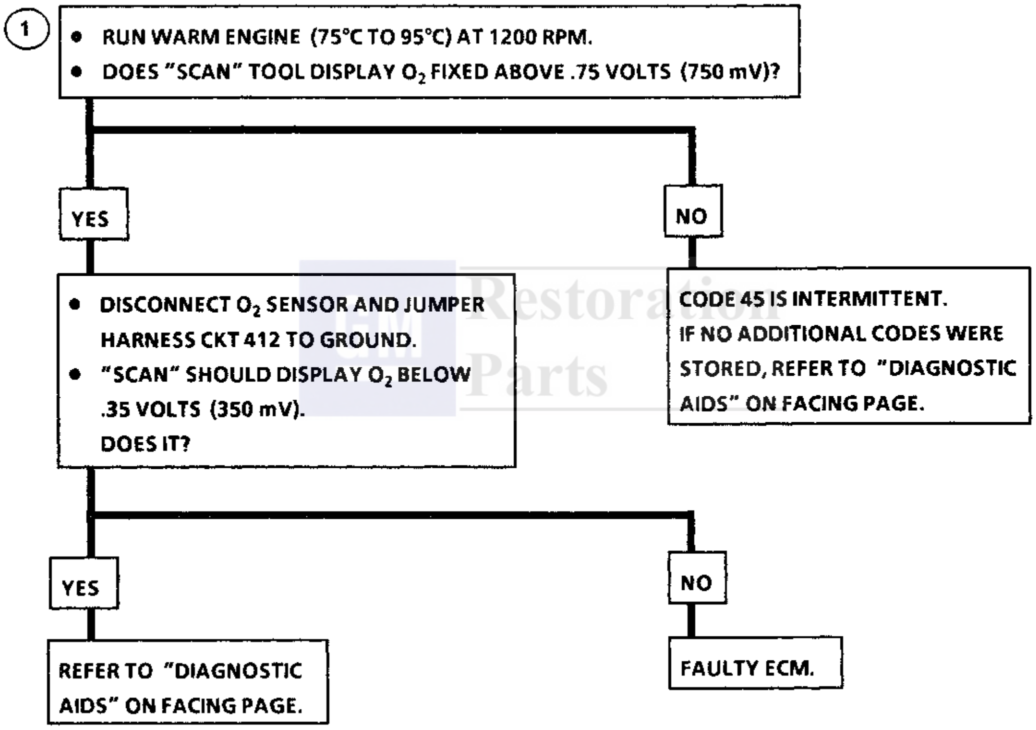
The Code 45, or rich exhaust, is most likely caused by one of the following:

- 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.
- Leaking Injector - See CHART A-7.
- HEI Shielding - An open ground CKT 453 may result in EMI, or induced electrical "noise". The ECM looks at this "noise" as reference pulses. The additional pulses result in a higher than actual engine speed signal. The ECM then delivers too much fuel, causing system to go rich. Engine tachometer will, also, show higher than actual engine speed, which can help in diagnosing this problem.
- Canister Purge - Check for fuel saturation. If full of fuel, check canister control and hoses. See Canister Purge, Section "C3".
- MAP Sensor - An output that causes the ECM to sense a 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 rich condition is gone while the sensor is disconnected.
- TPS - An intermittent TPS output will cause the system to go rich, due to a false indication of the engine accelerating.
- O_2 Sensor Contamination - Inspect Oxygen Sensor for silicone contamination from fuel, or use of improper RTV sealant. The sensor may have a white, powdery coating and result in a high, but false signal voltage (rich exhaust indication). The ECM will then reduce the amount of fuel delivered to the engine, causing a severe surge driveability problem.
- EGR Valve - An EGR staying open at idle usually accompanied by a rough idle complaint.

If Code 45 is intermittent, refer to Section "B".

CODE 45

OXYGEN SENSOR CIRCUIT
(RICH EXHAUST INDICATED)
2.5L "P" SERIES (TBI)



①
- RUN WARM ENGINE (75°C TO 95°C) AT 1200 RPM.
- DOES "SCAN" TOOL DISPLAY O_2 FIXED ABOVE .75 VOLTS (750 mV)?

- DISCONNECT O_2 SENSOR AND JUMPER HARNESS CKT 412 TO GROUND.
- "SCAN" SHOULD DISPLAY O_2 BELOW .35 VOLTS (350 mV). DOES IT?

REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

FAULTY ECM.

CODE 45 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

2-18-87
*7S 3192-6E

CODE 51
CODE 53
2.5L "P" SERIES (TBI)

CODE 51
FAULTY PROM

CHECK THAT ALL PINS ARE FULLY INSERTED IN THE SOCKET AND THAT PROM IS PROPERLY SEATED.
IF OK, REPLACE, PROM, CLEAR MEMORY, AND RECHECK. IF CODE 51 REAPPEARS, REPLACE ECM.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

CODE 53
SYSTEM OVERVOLTAGE

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 10 SECONDS .
- CHECK AND REPAIR CHARGING SYSTEM. SEE SECTION 6D .

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

11-7-86
*7S 3331-6E

SECTION B
SYMPTOMS

TABLE OF CONTENTS

BEFORE STARTING

Before using this section you should have performed the DIAGNOSTIC CIRCUIT CHECK.

Verify the customer complaint, and locate the correct SYMPTOM below. Check the items indicated under that symptom.

If the ENGINE CRANKS BUT WILL NOT RUN, see CHART A-3.

Several of the following symptom procedures call for a careful visual (physical) check.

The importance of this step cannot be stressed too strongly - it can lead to correcting a problem without further checks and can save valuable time.

This check should include:

- Vacuum hoses for splits, kinks, and proper connections, as shown on Emission Control Information label.
- Air leaks at throttle body mounting and intake manifold.
- Ignition wires for cracking, hardness, proper routing, and carbon tracking.
- Wiring for proper connections, pinches, and cuts.

The following symptoms cover several engines. To determine if a particular system or component is used, refer to the ECM wiring diagrams for application .

INTERMITTENTS

Problem may or may not turn "ON" the "Service Engine Soon" light, or store a code.

DO NOT use the Trouble Code Charts in Section "A" for intermittent problems. The fault must be present to locate the problem. If a fault is intermittent, use of Trouble Code Charts may result in replacement of good parts.

- Most intermittent problems are caused by faulty electrical connections or wiring. Perform careful check of suspect circuits for:
  - Poor mating of the connector halves, or terminals not fully seated in the connector body (backed out).
  - Improperly formed or damaged terminals. All connector terminals in problem circuit should be carefully reformed to increase contact tension.
  - Poor terminal to wire connection. This requires removing the terminal from the connector body to check as outlined in the Introduction to Section "6E".
- If a visual (physical) check does not find the cause of the problem, the car can be driven with a voltmeter connected to a suspected circuit or a "Scan" tool may be used. An abnormal voltage reading when the problem occurs indicates the problem may be in that circuit. If the wiring and connectors check OK and a Trouble Code was stored for a circuit having a sensor, except for Codes 44 and 45, substitute a known good sensor and recheck.
- Loss of trouble code memory. To check, disconnect TPS and idle engine until "Service Engine Soon" light comes on. Code 22 should be stored, and kept in memory when ignition is turned "OFF" for at least 10 seconds. If not, the ECM is faulty.
- An intermittent "Service Engine Soon" light and No Trouble Codes may be caused by:
  - Electrical system interference caused by a defective relay, ECM driven solenoid, or switch. They can cause a sharp electrical surge. Normally, the problem will occur when the faulty component is operated.
  - Improper installation of electrical options, such as lights, 2-way radios, etc.
  - EST wires should be routed away from spark plug wires, ignition system components, and generator. Wire for CKT 453 from ECM to ignition system should be a good ground.
  - Ignition secondary shorted to ground.
  - CKTs 419 ("Service Engine Soon" light) and 451 (Diagnostic Test) intermittently shorted to ground.
  - ECM grounds.

HARD START

Definition: Engine cranks OK, but does not start for a long time. Does eventually run, or may start but immediately dies.

- **CHECK:**
  - For water contaminated fuel.
  - Fuel system pressure CHART A-7.
  - TPS for sticking or binding should read less than 1.25 volts on a "Scan" tool.
  - EGR operation. CHART C-7.
  - Fuel pump relay - Connect test light between pump test terminal and ground. Light should be on for 2 seconds following ignition "ON". If not, refer to CHART A-5.
  - 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.
  - Bare and shorted wires.
  - Crank sensor resistance or connections.
  - Loose ignition coil connections.
  - Spark plugs, wet plugs, cracks, wear, improper gap, burned electrodes, or heavy deposits.

SURGES AND/OR CHUGGLE

Definition: Engine power variation under steady throttle or cruise. Feels like the car speeds up and slows down with no change in the accelerator pedal.

- Use a "Scan" tool to make sure reading of VSS matches vehicle speedometer. See "Special Information", Section "6E".
- **CHECK:**
  - For intermittent EGR at idle. See appropriate CHART C-7.
  - Inline fuel filter for dirt or restriction.
  - Fuel pressure. See CHART A-7.
  - Generator output voltage. Repair if less than 9 or more than 16 volts.
  - TCC Operation. (CHART C-8)
- Inspect oxygen sensor for silicon contamination from fuel, or use of improper RTV sealant. The sensor may have a white, powdery coating and result in a high but false signal voltage (rich exhaust indication). The ECM will then reduce the amount of fuel delivered to the engine, causing a severe driveability problem.
- Remove spark plugs. Check for cracks, wear, improper gap, burned electrodes, or heavy deposits. Also check condition of the rest of the Ignition System.

LACK OF POWER, SLUGGISH, OR SPONGY

Definition: Engine delivers less than expected power. Little or no increase in speed when accelerator pedal is pushed down part way.

- Compare customer's car to similar unit. Make sure the customer's car has an actual problem.
- Remove air cleaner and check air filter for dirt, or for being plugged. Replace as necessary.
- **CHECK:**
  - For restricted fuel filter, contaminated fuel or improper fuel pressure. See CHART A-7.
  - ECM Grounds.
  - EGR operation for being open or partly open all the time - CHART C-7.
  - Generator output voltage. Repair if less than 9 or more than 16 volts.
  - Engine valve timing and compression.
  - Engine for proper or worn camshaft. See Section "6A".
  - Transmission torque converter operation. See Section "7A".
  - Secondary ignition voltage using a scope or ST-125.
  - Proper operation of EST. See Section "C4".
- Check Exhaust system for restriction using CHART B-1:
  1. With engine at normal operating temperature, connect a vacuum gage to any convenient manifold vacuum port on intake manifold.
  2. Run engine at 1000 rpm and record vacuum reading.
  3. Increase rpm slowly to 2500 rpm. Note vacuum reading at steady 2500 rpm.
  4. If vacuum at 2500 rpm decreases more than 3" from reading at 1000 rpm, the exhaust system should be inspected for restrictions.
  5. 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.
  - Faulty or incorrect thermostat.
  - Inoperative electric cooling fan circuit. See CHART C-12.
  - Coolant Sensor which has shifted in value.
  - Correct coolant solution - should be a 50/50 mix of GM #1052753 anti-freeze coolant (or equiv.) and water.
- **CHECK:**
  - For poor fuel quality, proper octane rating.
  - For correct PROM.
  - Spark plugs for correct heat range.
  - Fuel system for low pressure. See CHART A-7.
  - Check EGR system for proper operation- CHART C-7.
  - For proper transmission shift points. See Section "7".
  - TCC operation. See CHART C-8.
  - For incorrect basic engine parts such as cam, heads, pistons, etc.
  - Excessive oil entering combustion chamber.
- Remove carbon with top engine cleaner. Follow instructions on can.

HESITATION, SAG, STUMBLE

Definition: Momentary lack of response as the accelerator is pushed down. Can occur at all car speeds. Usually most severe when first trying to make the car move, as from a stop sign. May cause the engine to stall if severe enough.

- Perform careful visual (physical) check as described at start of Section "B".
- **CHECK:**
  - Fuel pressure. See CHART A-7.
  - Water contaminated fuel.
  - TPS for binding or sticking.
  - Generator output voltage. Repair if less than 9 or more than 16 volts.
  - For open Ignition System ground, CKT 453.
  - Canister purge system for proper operation. See Section "C3".
  - EGR valve operation CHART C-7.

CUTS OUT, MISSES

Definition: Steady pulsation or jerking that follows engine speed, usually more pronounced as engine load increases. The exhaust has a steady spitting sound at idle or low speed.

- Perform careful visual (physical) check as described at start of Section "B".
- If Ignition System is suspected of causing a miss at idle or cutting, out under load:
- Refer to appropriate ignition "Misfire" Chart in Section "C4".
- If the previous checks did not find the problem:
  - Visually inspect ignition system for moisture, dust, cracks, burns, etc. Spray plug wires with fine water mist to check for shorts.
  - Use a "Scan" tool to check for erratic TPS voltage.
  - Fuel System - Plugged fuel filter, water, low pressure. See CHART A-7.
  - Perform compression check.
  - Valve Timing.
  - Remove rocker covers. Check for bent pushrods, worn rocker arms, broken or weak valve springs, worn camshaft lobes. Repair as necessary. See Section 6A.

POOR FUEL ECONOMY

Definition: Fuel economy, as measured by an actual road test, is noticeably lower than expected. Also, economy is noticeably lower than it was on this car at one time, as previously shown by an actual road test.

- **CHECK:**
  - Engine thermostat for faulty part (always open) or for wrong heat range. See Section "6B".
  - Fuel Pressure. See CHART A-7.
- Check owner's driving habits.
  - Is A/C "ON" full time (Defroster mode "ON")?
  - Are tires at correct pressure?
  - Are excessively heavy loads being carried?
  - Is acceleration too much, too often?
  - Suggest driver read "Important Facts on Fuel Economy" in Owner's Manual.
- Perform "Diagnostic Circuit Check."
- Check air cleaner element (filter) for dirt or being plugged.
- Check for proper calibration of speedometer.
- Visually (physically) Check:
  - Vacuum hoses for splits, kinks and proper connections as shown on Vehicle Emission Control Information label.
  - Ignition wires for cracking, hardness and proper connections.
- Remove spark plugs. Check for cracks, wear, improper gap, burned electrodes or heavy deposits. repair or replace as necessary.
- Check compression. See Section "6A".
- Check TCC for proper operation. See CHART C-8. Use "Scan" tool if available.
- Check for dragging brakes.
- Check for exhaust system restriction. See CHART "B-1"
- Suggest owner fill fuel tank and recheck fuel economy.

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:**
  - Vacuum hoses for splits, kinks and proper connections as shown on Vehicle Emission Control Information label.
  - P/N switch circuit. See CHART C-1A.
  - For injector leaking. Check Fuel Pressure CHART A-7.
  - IAC - See Code 35.
  - If a sticking throttle shaft or binding linkage causes a high TPS Voltage (open throttle indication) the ECM will not control idle. Monitor TPS voltage. "Scan" and/or Voltmeter should read less than 1.2 volts with throttle closed.
  - EGR "ON" while idling will cause roughness, stalling and hard starting. CHART C-7.
  - Battery cables and ground straps should be clean and secure. Erratic voltage will cause IAC to change its position resulting in poor idle quality.
  - IAC valve will not move if system voltage is below 9 or greater than 17.8 volts.
  - 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 MAP 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 pressure switch.
  - Cooling fan inoperative - See CHART C-12.
  - PCV valve for proper operation by placing finger over inlet hole in valve end several times. Valve should snap back. If not, replace valve.
  - Run a cylinder compression check See Section "6".
  - Inspect oxygen sensor for silicon contamination from fuel, or use of improper RTV sealant. The sensor will have a white, powdery coating, and will result in a high but false signal voltage (rich exhaust indication). The ECM will then reduce the amount of fuel delivered to the engine, causing a severe driveability problem.

EXCESSIVE EXHAUST EMISSIONS OR ODORS

Definition: Vehicle fails an emission test. Vehicle has excessive "rotten egg" smell. Excessive odors do not necessarily indicate excessive emissions.

- Perform "Diagnostic Circuit Check."
- IF TEST SHOWS EXCESSIVE CO AND HC, (or also has excessive odors):
  - Check items which cause car to run RICH.
    - Make sure engine is at normal operating temperature.
- **CHECK:**
  - Fuel pressure. See CHART A-7.
  - Incorrect timing. See vehicle emission control information label.
  - Canister for fuel loading. See CHART C-3.
  - PCV valve for being plugged, stuck, or blocked PCV hose, or fuel in the crankcase.
  - Spark plugs, plug wires, and ignition components. See Section "6D".
  - Check for lead contamination of catalytic converter (look for removal of fuel filler neck restrictor).
  - Check for properly installed fuel cap.
  - If the system is running rich, (block learn less than 118), refer to "Diagnostic Aids" on facing page of Code 45.
- IF TEST SHOWS EXCESSIVE NOx:
  - Check items which cause car to run LEAN, or to run too hot.
    - EGR valve for not opening. See CHART C-7.
    - Vacuum leaks.
    - Coolant system and coolant fan for proper operation. See CHART C-12.
    - Remove carbon with top engine cleaner. Follow instructions on can.
- If the system is running lean, (block learn greater than 138), refer to "Diagnostic Aids" on facing page of Code 44.

DIESELING, RUN-ON

Definition: Engine continues to run after key is turned "OFF", but runs very roughly. If engine runs smoothly, check ignition switch and adjustment.

- Check injector for leaking. Apply 12 volts to fuel pump test terminal to turn on fuel pump and pressurize fuel system. Visually check injector and TBI assembly for fuel leakage.

BACKFIRE

Definition: Fuel ignites in intake manifold, 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(s).
  - For crossfire between spark plugs (ignition coils, spark plug wires, and proper routing of plug wires).
  - For faulty spark plugs and/or plug wires or boots.
- Perform a compression check - look for sticking or leaking valves.
  - For proper valve timing.
  - Broken or worn valve train parts.

CHART B-1

RESTRICTED EXHAUST SYSTEM CHECK

ALL ENGINES

Proper diagnosis for a restricted exhaust system is essential before any components are replaced. Either of the following procedures may be used for diagnosis, depending upon engine or tool used:

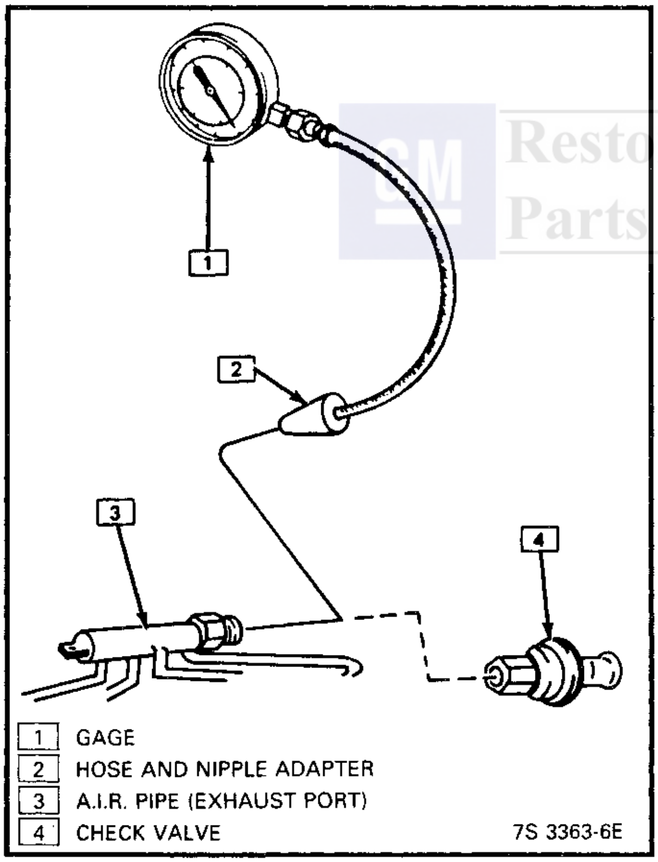
CHECK AT A. I. R. PIPE:

1. Remove the rubber hose at the exhaust manifold A.I.R. pipe check valve. Remove check valve.
2. Connect a fuel pump pressure gauge to a hose and nipple from a Propane Enrichment Device (J26911) (see illustration).
3. Insert the nipple into the exhaust manifold A.I.R. pipe.

OR

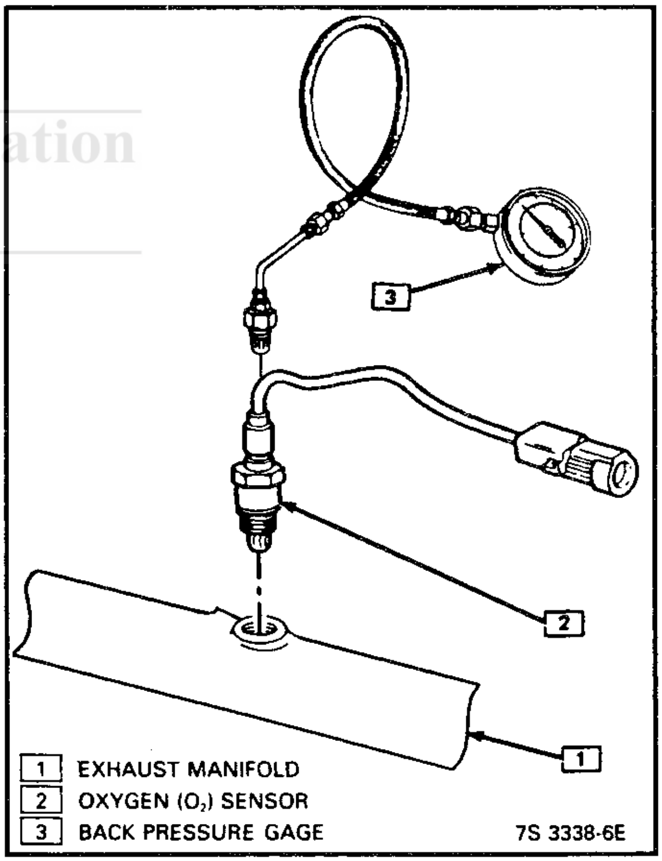
CHECK AT O_2 SENSOR:

1. Carefully remove O_2 sensor.
2. Install Borroughs Exhaust Backpressure Tester (BT 8515 or BT 8603) or equivalent in place of O_2 sensor (see illustration).
3. After completing test described below, be sure to coat threads of O_2 sensor with anti-seize compound P/N 5613695 or equivalent prior to re-installation.



1 GAGE
2 HOSE AND NIPPLE ADAPTER
3 A.I.R. PIPE (EXHAUST PORT)
4 CHECK VALVE

7S 3363-6E



1 EXHAUST MANIFOLD
2 OXYGEN (O_2) SENSOR
3 BACK PRESSURE GAGE

7S 3338-6E

DIAGNOSIS:

1. With the engine idling at normal operating temperature, observe the exhaust system backpressure reading on the gauge. Reading should not exceed 1 ¼ psi (8.6 kPa).
2. Accelerate engine to 2000 rpm and observe gauge. Reading should not exceed 3 psi (20.7 kPa).
3. If the backpressure, at either rpm, exceeds specification, a restricted exhaust system is indicated.
4. Inspect the entire exhaust system for a collapsed pipe, heat distress, or possible internal muffler failure.
5. If there are no obvious reasons for the excessive backpressure, a restricted catalytic converter should be suspected and replaced using current recommended procedures.

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7S 3340-6E

SECTION C
COMPONENT SYSTEMS

Section C provides information on the following:

- General description of components and systems.
- On-vehicle service.
- Part names and group numbers.
- Diagnostic charts. These include a functional check of the system as well as diagnosis of any problem found in the functional check.

For locations of components, wiring diagrams, and ECM Terminal End View, refer to the front on the A Section of the engine being diagnosed.

Following are the sub-section identification and the system covered:

DIAGNOSTIC CHARTS

The Diagnostic Charts for each system are found after the on-car service and parts information at the back of each section. Following are the charts found in this section.

SECTION C1

ELECTRONIC CONTROL MODULE (ECM) AND SENSORS

CONTENTS

GENERAL DESCRIPTION

ELECTRONIC CONTROL MODULE (ECM)

The electronic control module (ECM) (Figure C1-1), located under the instrument panel, is the control center of the fuel injection system. It constantly monitors the information from various sensors, and controls the systems that affect vehicle performance. The ECM performs the diagnostic function of the system. It can recognize operational problems, alert the driver through the "Service Engine Soon" light, and store a code or codes which identify the problem areas to aid the technician in making repairs. See "Introduction" for more information on using the diagnostic function of the ECM.

For 1988, the ECM used in 2.5L equipped vehicles will be a type, called GMP4. For service, this ECM consists of only two parts; a controller (the ECM without a PROM), and a calibrator, called a PROM (Programmable Read Only Memory).

PROM

The PROM is programmed with information relative to a certain vehicle (vehicle weight, engine type, transmission type, axle ratio, etc.) This allows the PROM to calibrate the ECM control for most efficient vehicle operation.

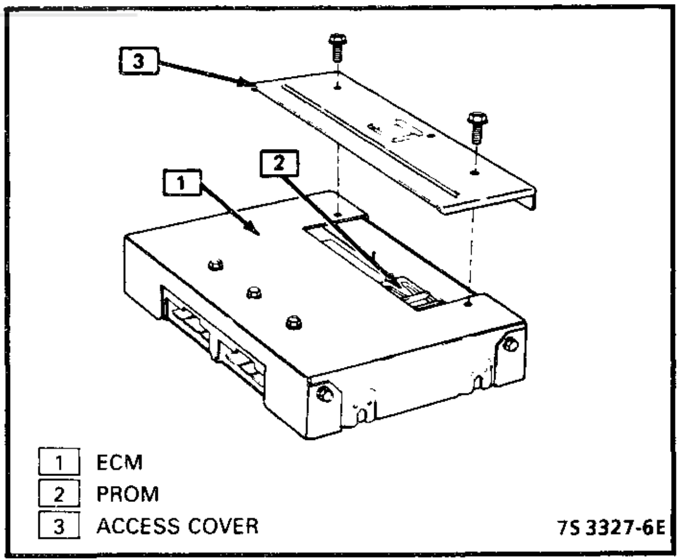


Figure C1-1 - Electronic Control Module (ECM)

While one ECM part number may 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 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 voltmeter is required to assure accurate voltage readings.

The ECM controls output circuits such as the Injector, IAC, Cooling Fan Relay, etc. by controlling the ground circuit through transistors in the ECM.

INFORMATION SENSORS

Engine Coolant Temperature Sensor (Figure C1-2)

The coolant sensor is a thermistor (a resistor which changes value based on temperature) mounted in the engine coolant stream. Low coolant temperature produces a high resistance (100,000 ohms at -40°C/-40°F) while high temperature causes low resistance (70 ohms at 130°C/266°F).

The ECM supplies a 5-volt signal to the coolant sensor 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.

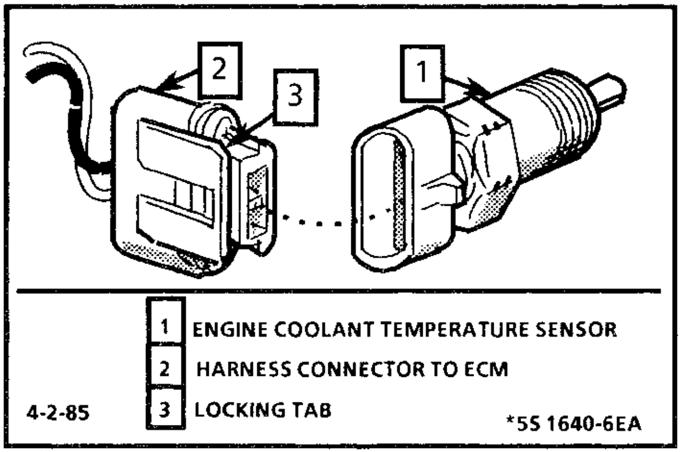


Figure C1-2 - Engine Coolant Temperature Sensor

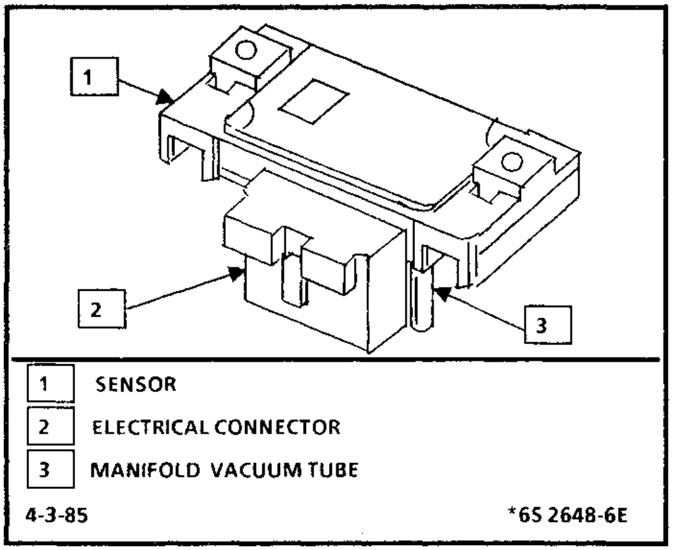


Figure C1-3 - MAP Sensor

MAP Sensor (Figure C1-3)

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.

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 at start up and under certain conditions, which allows the ECM to automatically adjust for different altitudes.

The ECM sends a 5-volt reference signal to the MAP sensor. As the manifold pressure changes, the electrical resistance of the sensor also changes. By monitoring the sensor output voltage, the ECM knows the manifold pressure. A higher pressure, low vacuum (high voltage) requires more fuel, while a lower pressure, higher vacuum (low voltage) requires less fuel.

The ECM uses the MAP sensor to control fuel delivery and ignition timing.

A failure in the MAP sensor circuit should set a Code 33 or Code 34.

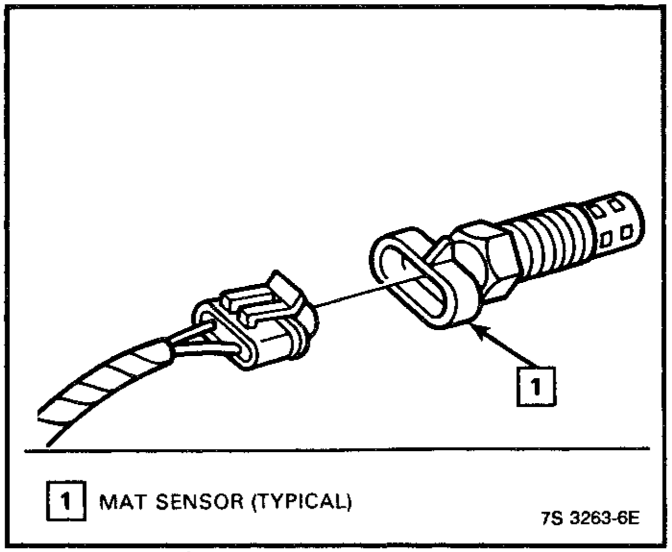


Figure C1-4 - MAT Sensor

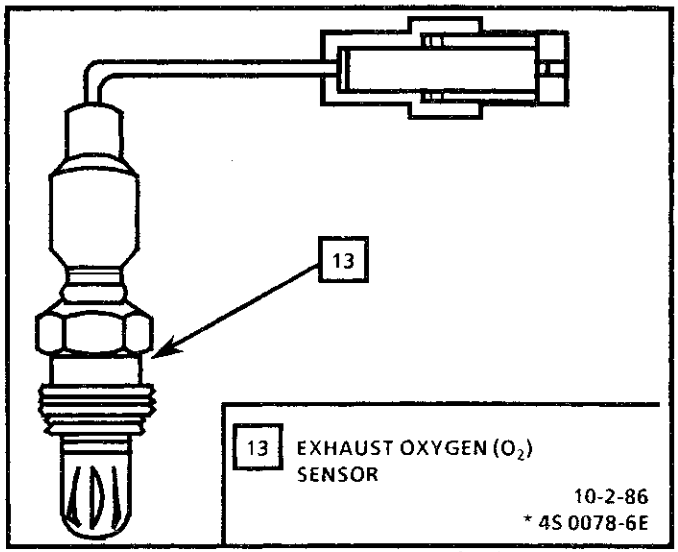


Figure C1-5 - Exhaust Oxygen (O_2) Sensor

MAT Sensor (Figure C1-4)

The manifold air temperature (MAT) sensor is a thermistor, a resistor which changes value based on temperature, mounted in the intake manifold. Low manifold air temp. produces a high resistance (100,000 ohms at -40°C), while high temp. causes low resistance (70 ohms at 130°C/266°C).

The ECM supplies a 5 volt signal to the MAT Sensor, through a resistor in the ECM, and monitors the voltage. The voltage will be high when the manifold air is cold and low when the air is hot. By monitoring the voltage, the ECM calculates the air temp. and adjusts fuel and spark advance.

A failure in the MAT circuit should set either a Code 23 or Code 25. Proper use of the code charts should lead to either repairing a wiring problem or replacing the sensor.

Oxygen (O_2) Sensor (Figure 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 megohms input impedance. Use of standard shop type voltmeters will result in very inaccurate readings.

By monitoring the voltage output of the O_2 sensor, the ECM will know what fuel mixture command to give to the Injector (lean mixture - low O_2 voltage = rich command; rich mixture - high O_2 voltage = lean command).

The O_2 sensor circuit, if open, should set a Code 13. A constant low voltage in the sensor circuit should set a Code 44, while a constant 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.

Throttle Position Sensor (TPS) (Figure C1-6)

The throttle position sensor (TPS) is a potentiometer, connected to the throttle shaft on the throttle body. The TPS electrical circuit consists of a 5V supply line and a ground path line, both provided by the ECM. A third wire is used as a signal line to the ECM. By monitoring the voltage on this signal line, the ECM calculates throttle position. As the throttle valve angle is changed (accelerator pedal moved), the signal voltage of the TPS also changes. At a closed throttle position, the signal of the TPS is below 1.25 volts. As the throttle valve opens, the signal voltage increases so that, at wide-open throttle, it should be approximately 5 volts.

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.

The TPS is not adjustable. The ECM uses the reading at closed throttle 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.

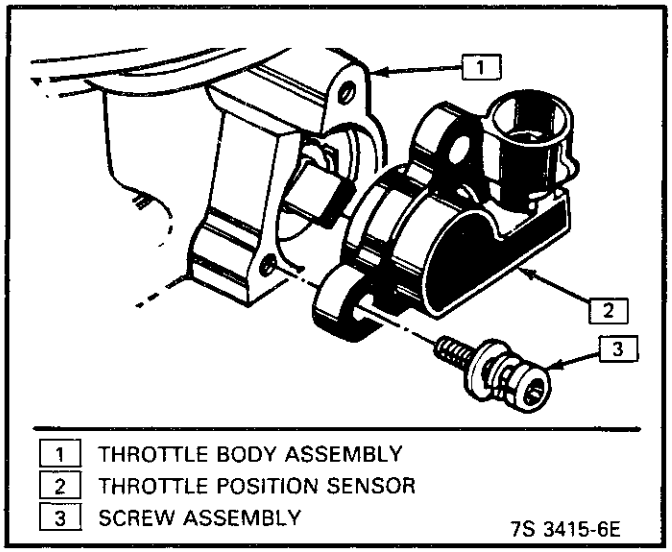


Figure C1-6 - Throttle Position Sensor

Important

Vehicle should not be driven with park/neutral switch disconnected as idle quality will be affected and a possible false Code 24 (VSS).

See Section "8A" for more information on the P/N switch, which is part of the neutral/start and backup light switch assembly.

A/C Request Signal

This signal tells the ECM that the A/C selector switch is turned "ON", and that the low pressure switches 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.

Crankshaft Sensor

The crankshaft sensor sends a signal, through the DIS module, to the ECM. The ECM uses this reference signal to calculate rpm and crankshaft position. See Section "C4" 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 affect only one circuit, following the Diagnostic Procedures in this section will determine which circuit has a problem and where it is.

If a diagnostic chart indicates that the ECM connections or ECM is the cause of a problem, and the ECM is replaced, but does not correct the problem, one of the following may be the reason:

- There is a problem with the ECM terminal connections.-The diagnostic chart will say ECM connections or ECM. The terminals may have to be removed from the connector in order to check them properly.
- The ECM or PROM is not correct for the application.- The incorrect components may cause a malfunction and may, or may not, set a code.
- The problem is intermittent - This means that the problem is not present at the time the system is being checked. In this case, refer to the "Symptoms" portion of the manual and make a careful physical inspection of all portions of the system involved.
- Shorted solenoid, relay coil, or harness - Solenoids and relays are turned "ON" and "OFF" by the ECM, using internal electronic switches, called "Drivers". Each driver is part of a group of four called "Quad-drivers". Failure of one driver can damage any other driver in the set.

A shorted solenoid, relay coil, or harness in a GMP4 computer will not damage the ECM, but will cause the circuit and controlled component to be inoperative. When the circuit fault is not present or has been repaired, the "Quad Driver" will again operate in a normal manner due to it's fault protected design. If a fault has been repaired in a circuit controlled by a "Quad Driver", the original ECM should be reinstalled and the circuit checked for proper operation. ECM replacement will not be necessary if the repaired circuit or component now operates correctly.

J34636 or BT8405 testers, or equivalent, provide a fast, accurate means of checking for a shorted coil, or a short to battery voltage.

- The PROM may be faulty - Although these rarely fail, it operates as part of the ECM. Therefore, it could be the cause of the problem. Substitute a known good PROM.
- The replacement ECM may be faulty - After the ECM is replaced, the system should be rechecked for proper operation. If the diagnostic chart again

PROM

An incorrect or faulty PROM, which is part of the ECM, may set a Code 51.

ECM INPUTS

All of the sensors and input switches can be diagnosed by the use of a "Scan" tool. Following is a short description of how the sensors and switches can be diagnosed by the use of "Scan". The "Scan" can also by used to compare the values for a normal running engine with the engine you're diagnosing.

Coolant Temp. Sensor

A "Scan" tool displays engine temp. in degrees centigrade. After the engine is started, the temperature should rise steadily to about 90°C, then stabilize when thermostat opens. If the engine has not been run for several hours (overnight), the coolant temperature and MAT temperatures should read close to each other. A fault in the coolant sensor circuit should set a Code 14 or 15. The code charts also contain a chart to check for sensor resistance values relative to temperature.

MAP Sensor

A "Scan" tool reads manifold pressure and will display either volts or kPa of pressure.

Key "ON", engine stopped, (no vacuum), MAP will read high voltage or pressure, while at idle (high vacuum), MAP will read low voltage or pressure. Likewise, on accel., MAP will read high and on decel., will read low.

A failure in the MAP sensor, or circuit, should result in a Code 33 or 34.

MAT

A "Scan" tool displays temperature of the air entering the engine and should read close to ambient air temperature, when engine is cold, and rise as underhood temperature increases. If the engine has not been run for several hours (overnight), the MAT sensor temperatue and coolant temperature should read close to each other. A failure in the MAT sensor circuit should set a Code 23 or 25. The code charts also contain a chart to check for sensor resistance values relative to temperature.

Oxygen (O_2) Sensor

The "Scan" has several positions that will indicate the state of the exhaust gases, O_2 voltage, integrator, and block learn. See "Scan" position information in Introduction, Section "6E".

A problem in the O_2 sensor circuit should set a Code 13 (open circuit), Code 44 (lean exhaust indication), Code 45 (rich exhaust indication). Refer to applicable chart, if any of these codes were stored in memory.

Throttle Position Sensor (TPS)

A "Scan" tool displays throttle position in volts. The 2.5L should read below 1.25 volts, with throttle closed and ignition "ON", or at idle. Voltage should increase at a steady rate as throttle is moved toward WOT.

The ECM has the ability to Auto-Zero the TPS voltage, if it is below about 1.25 volts. This means that any voltage less than 1.25 volts will be determined by the ECM to be 0% throttle. Some "Scan" tools have the ability to read the percentage of throttle angle and should read 0%, when the throttle is closed. A failure in the TPS, or circuit, should set a Code 21 or 22.

VSS

A "Scan" tool reading should closely match with speedometer reading, with drive wheels turning. A failure in the VSS circuit should set a Code 24.

P/N Switch

A "Scan" tool should read "ON", when in park or neutral and "OFF", when in drive. This reading may vary with different makes of tools. Refer to CHART C-1A for P/N switch diagnosis.

A/C Request Signal

If the low pressure switch is closed and A/C is "ON", the "Scan" tool should indicate A/C "ON". See Section "C10" for A/C electrical system diagnosis.

DIS Reference Signal

A "Scan" tool will read this signal and is displayed in rpm. See Section "C4", for more information on the direct ignition system (DIS).

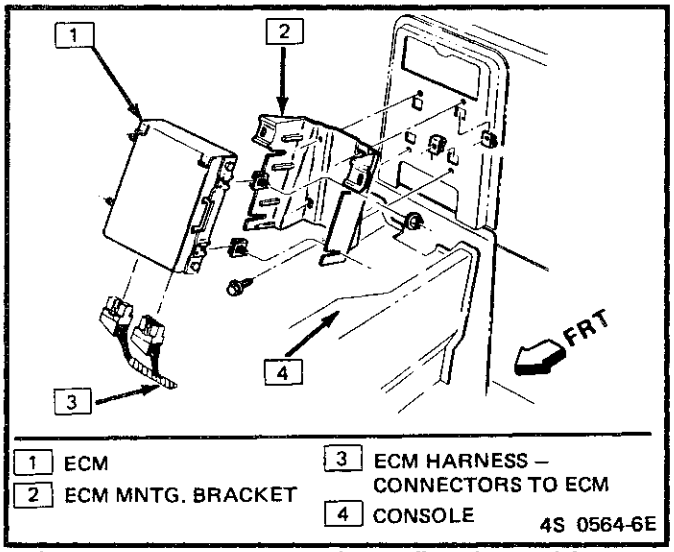


Figure C1-7 - ECM Mounting "P" Series - with A/C

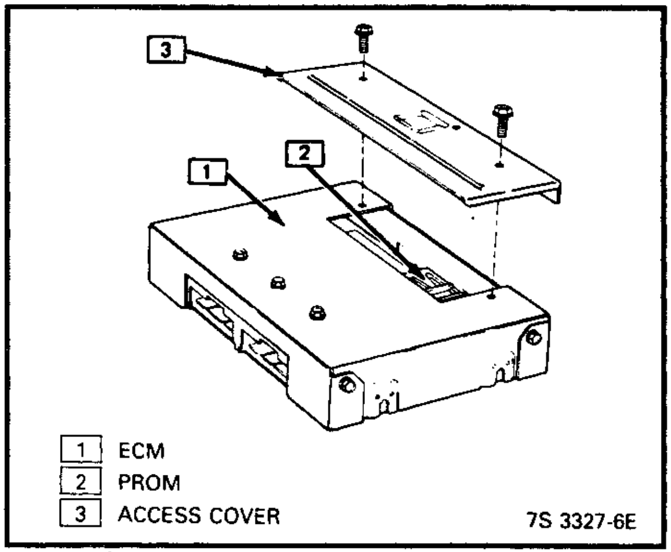


Figure C1-8 - ECM PROM Access Cover

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.

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. Console cover.
3. Connectors to ECM.
4. ECM mounting hardware (Figure C1-7).

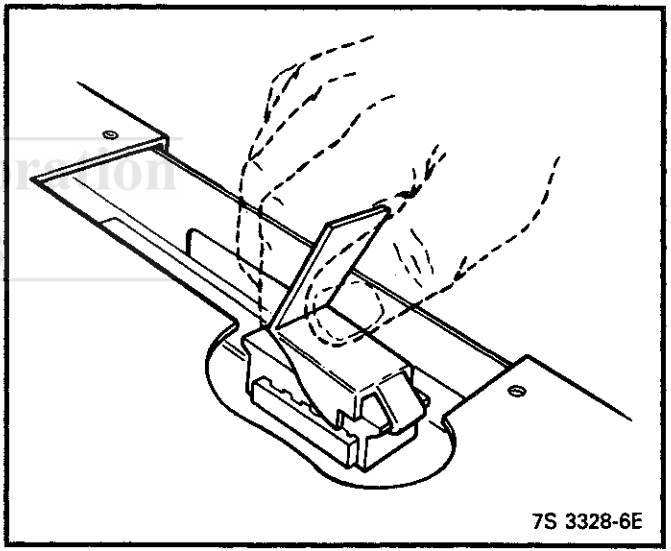


Figure C1-9 - PROM Removal Tool

5. ECM.
6. PROM from ECM. See PROM procedure.
7. New ECM from its packaging and check the service number to make sure it is the same as the defective ECM.

Important

Replacement ECM is supplied without a PROM, so care should be used when removing it from the defective ECM, because it will be reused in the new ECM.

Install or Connect

1. Old PROM in new ECM.
2. ECM into vehicle.
3. Connectors.
4. Console cover.
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.

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. PROM assembly. (Figure C1-9).

Important

Using the rocker-type PROM removal tool, engage one end of the PROM carrier with the hook end of the tool (see Figure C1-8). Press on the vertical bar end of the tool and rock the engaged end of the PROM carrier up as far as possible.

Engage the opposite end of the PROM carrier in the same manner and rock this end up as far as possible. Repeat this process until the PROM carrier and PROM are free of the PROM socket. The PROM carrier, with PROM in it, should lift off of the PROM socket easily. PROM carrier should only be removed by using the pictured PROM removal tool. Other methods could cause damage to the PROM or PROM socket.

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, see Figure C1-10.

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.

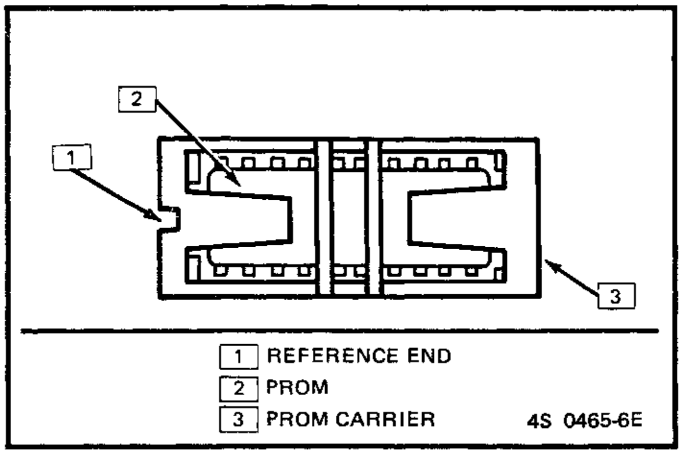


Figure C1-10 - PROM in PROM Carrier

3. ECM in passenger compartment.
4. Connectors to ECM.

Functional Check

1. Turn ignition "ON".
2. Enter diagnostics.
   A. Allow Code 12 to flash four times to verify no other codes are present). This indicates the PROM is installed properly and the ECM is functioning.
   B. If trouble Code 51 occurs, or if the "Service Engine Soon" light is on constantly, with no codes, the PROM is not fully seated or is defective.
      - If not fully seated, press firmly on the ends of the PROM carrier.
      - If it is necessary to remove the PROM, follow the previous removal instructions.

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. Relieve coolant pressure.
2. Negative battery cable.
3. Electrical connector.
4. Carefully back out coolant sensor.

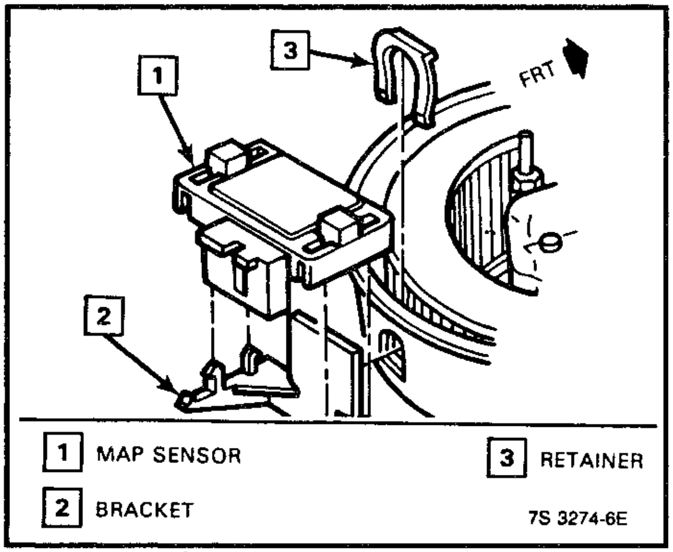


Figure C1-11 - MAP Sensor

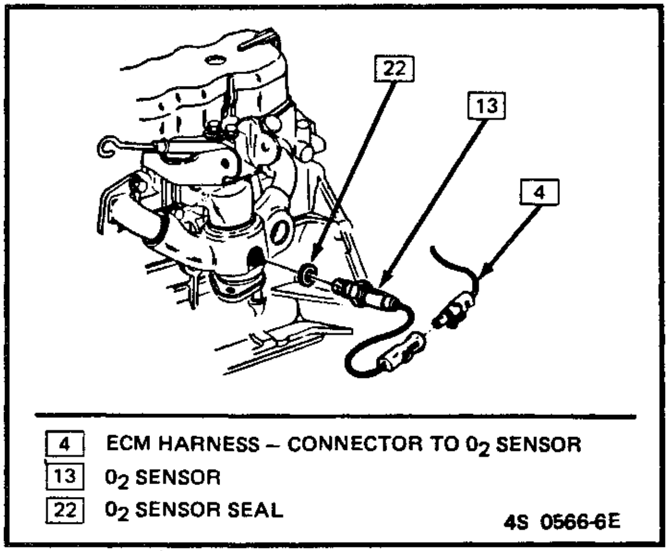


Figure C1-12 - Oxygen Sensor

Install or Connect

1. Coat threads only with sealant, P/N 1052080 or equivalent.
2. Sensor in engine, torque to 30 N·m (22 lbs. Ft).
3. Electrical connector.
4. Negative battery cable.
5. Refill lost coolant.

MAP SENSOR (Figure 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.

MAT SENSOR

Remove or Disconnect

1. Negative battery cable.
2. Electrical connector.
3. Carefully back out sensor.

Install or Connect

1. Coat threads only with sealant, P/N 1052080 or equivalent.
2. Sensor in engine.
3. Electrical connector.
4. Negative battery cable.

OXYGEN SENSOR (Figure 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.

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) REPLACEMENT (Figure C1-13)

Remove or Disconnect

1. Air cleaner and gasket. Discard gasket.
2. Two TPS attaching screw assemblies.
3. TPS from throttle body assembly.

NOTICE: The throttle position sensor is an electrical component, and should not be immersed in any type of liquid solvent or cleaner, as damage may result.

Install or Connect

1. With throttle valve closed, install TPS on throttle shaft. Rotate counter-clockwise to align mounting holes.
2. Two TPS attaching screw assemblies.
3. Air cleaner and new gasket.

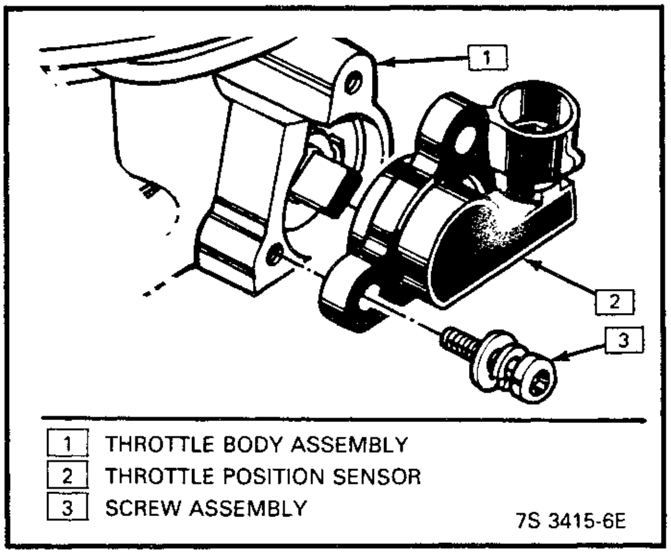


Figure C1-13 - Throttle Position Sensor (TPS)

PARK/NEUTRAL SWITCH

See Section "8A" for location of park/neutral switch. On-car service and adjustment procedures are listed in Section "3B4".

PARTS INFORMATION

PART NAME	GROUP
Controller, ECM	3.670
Calibrator, PROM	3.670
Sensor, Clnt. Temp.	3.682
Sensor, Exhaust Oxygen	3.682
Sensor, Manif. Abs. Press.	3.682
Sensor Kit, Throttle Position	3.764
Sensor, MAT	3.764
Switch, NeuSaf	2.698

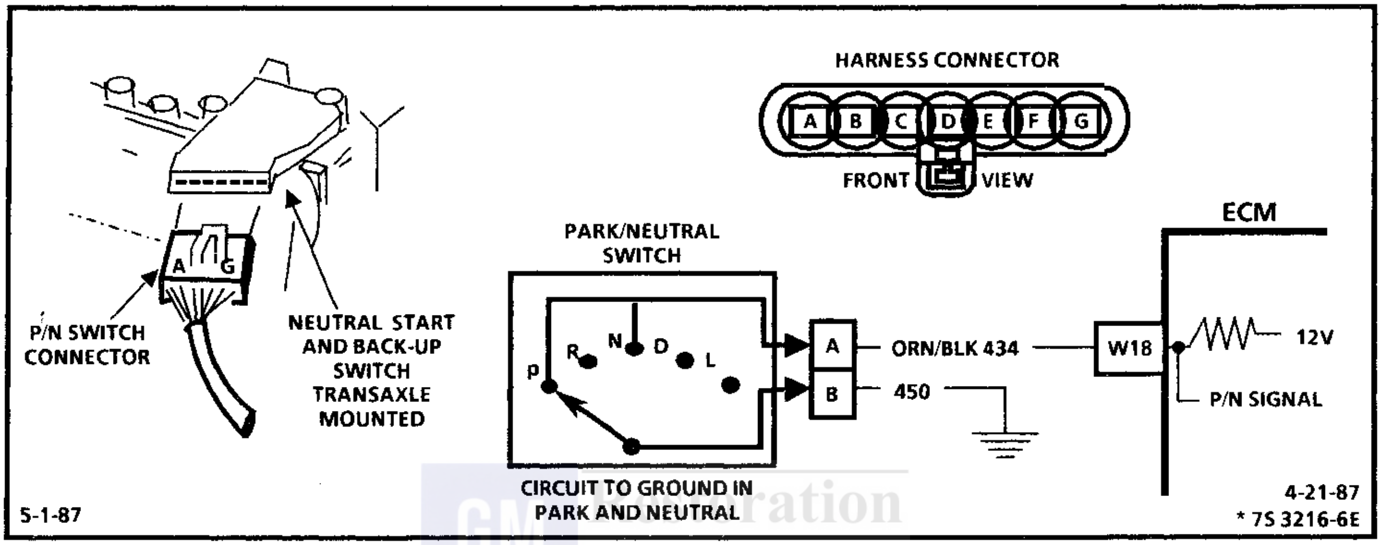


CHART C-1A

PARK/NEUTRAL SWITCH DIAGNOSIS
2.5L "P" SERIES (TBI)

Circuit Description:

The Park/Neutral switch contacts are a part of the neutral start switch and are closed to ground in park or neutral, and open in drive ranges.

The ECM supplies ignition voltage through a current limiting resistor to CKT 434 and senses a closed switch, when the voltage on CKT 434 drops to less than one volt.

The ECM uses the P/N signal as one of the inputs to control:

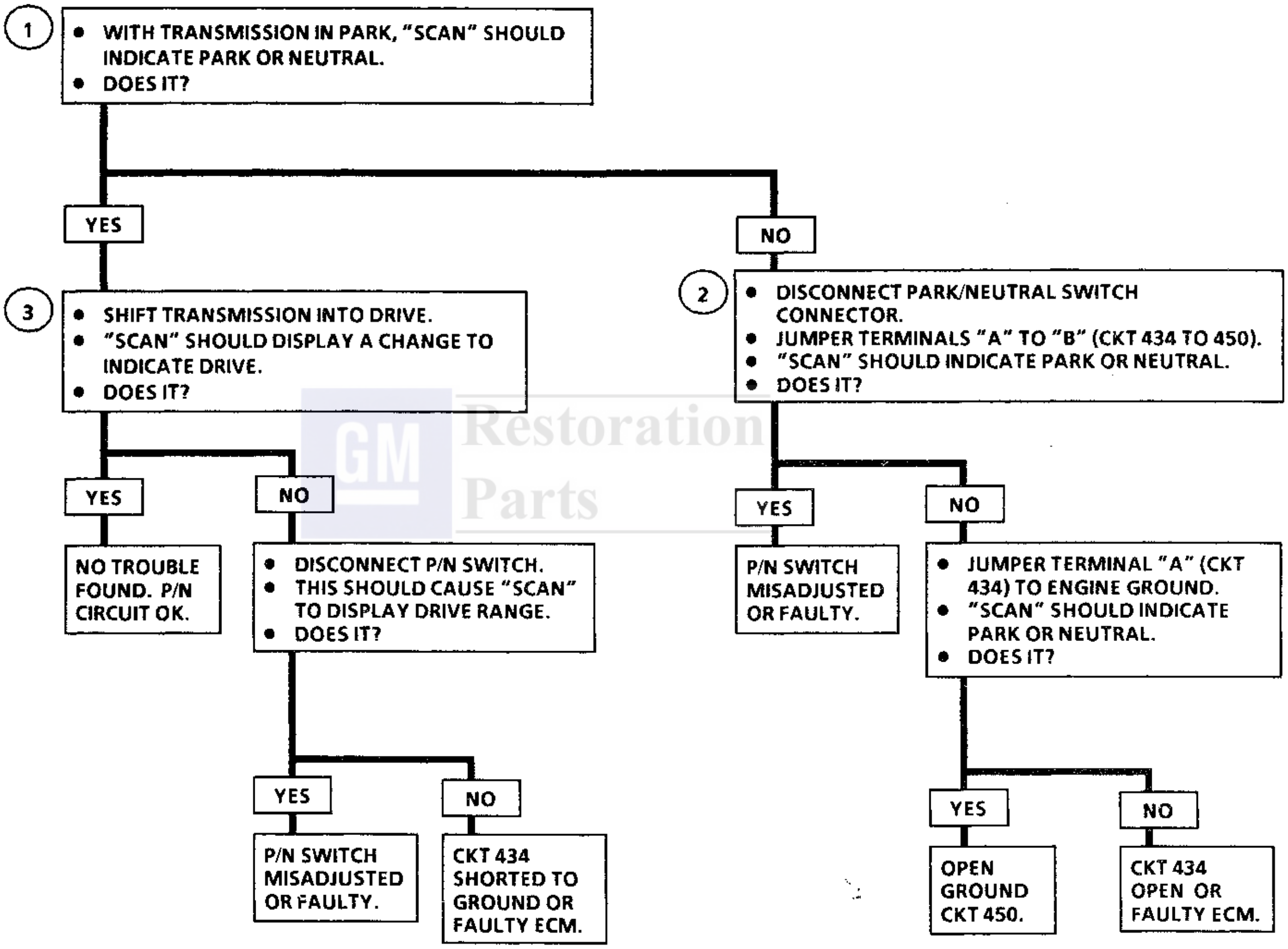
Idle Air Control
VSS Diagnostics

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Checks for a closed switch to ground in park position. Different makes of "Scan" tools will read P/N differently. Refer to tool operations manual for type of display used.
2. Checks for an open switch in drive range.
3. Be sure "Scan" indicates drive, even while wiggling shifter to test for an intermittent or misadjusted switch in drive range.

CHART C-1A

PARK/NEUTRAL SWITCH DIAGNOSIS 2.5L "P" SERIES (TBI)



①
- WITH TRANSMISSION IN PARK, "SCAN" SHOULD INDICATE PARK OR NEUTRAL.
- DOES IT?

YES

③
- SHIFT TRANSMISSION INTO DRIVE.
- "SCAN" SHOULD DISPLAY A CHANGE TO INDICATE DRIVE.
- DOES IT?

YES

NO TROUBLE FOUND. P/N CIRCUIT OK.

NO

- DISCONNECT P/N SWITCH.
- THIS SHOULD CAUSE "SCAN" TO DISPLAY DRIVE RANGE.
- DOES IT?

YES

P/N SWITCH MISADJUSTED OR FAULTY.

NO

CKT 434 SHORTED TO GROUND OR FAULTY ECM.

NO

②
- DISCONNECT PARK/NEUTRAL SWITCH CONNECTOR.
- JUMPER TERMINALS "A" TO "B" (CKT 434 TO 450).
- "SCAN" SHOULD INDICATE PARK OR NEUTRAL.
- DOES IT?

YES

P/N SWITCH MISADJUSTED OR FAULTY.

NO

- JUMPER TERMINAL "A" (CKT 434) TO ENGINE GROUND.
- "SCAN" SHOULD INDICATE PARK OR NEUTRAL.
- DOES IT?

YES

OPEN GROUND CKT 450.

NO

CKT 434 OPEN OR FAULTY ECM.

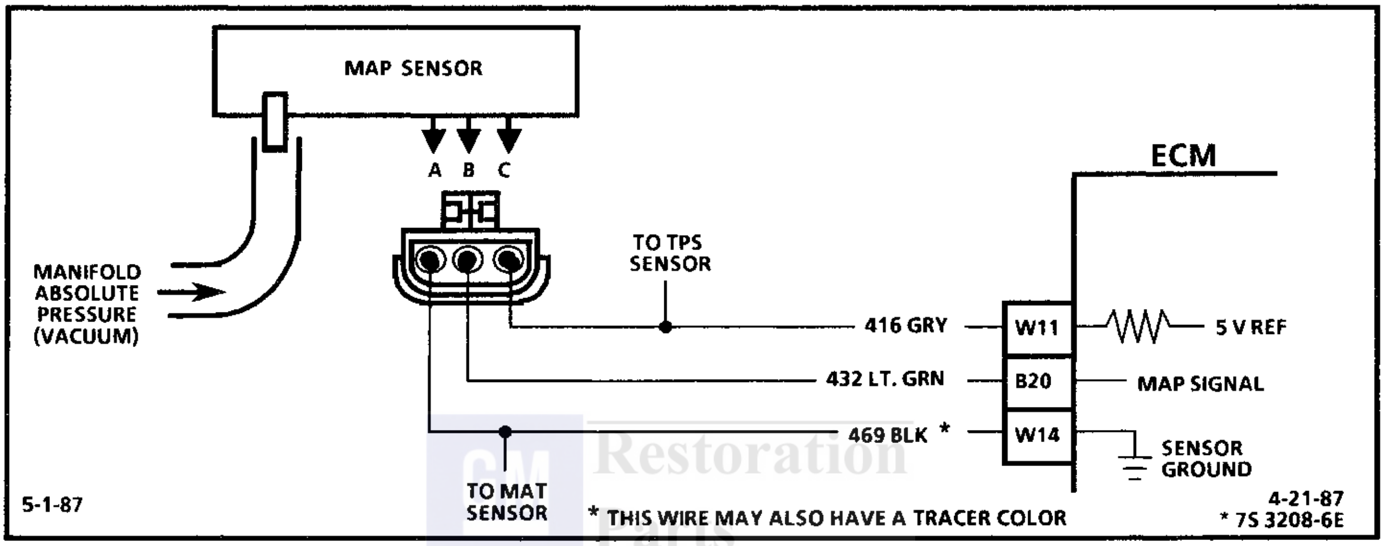


CHART C-1D

MAP OUTPUT CHECK
2.5L "P" SERIES (TBI)

Circuit Description:

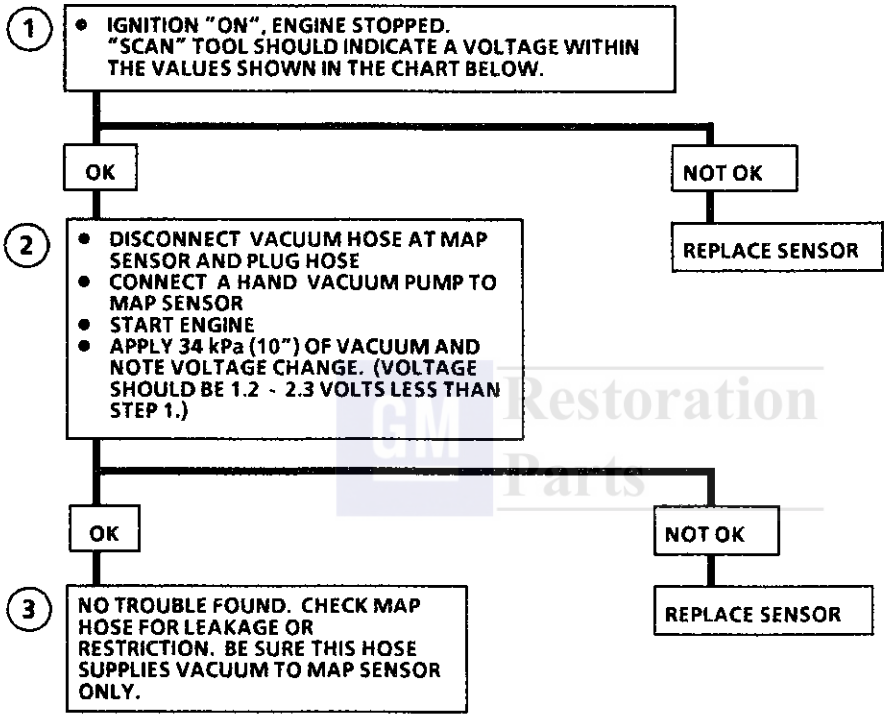
The manifold absolute pressure (MAP) sensor measures manifold pressure (vacuum) and sends that signal to the ECM. The MAP sensor is mainly used to calculate engine load, which is a fundamental input for spark and fuel calculations. The MAP sensor is also used to determine barometric pressure.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Checks MAP sensor output voltage to the ECM. This voltage, without engine running, represents a barometer reading to the ECM. 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.
2. Applying 34 kPa (10" Hg) vacuum to the MAP sensor should cause the voltage to be 1.2 volts less than the voltage at Step 1. Upon applying vacuum to the sensor, the change in voltage should be instantaneous. A slow voltage change indicates a faulty sensor.
3. Check vacuum hose to sensor for leaking or restriction. Be sure no other vacuum devices are connected to the MAP hose.

CHART C-1D

MAP OUTPUT CHECK
2.5L "P" SERIES (TBI)



① • IGNITION "ON", ENGINE STOPPED. "SCAN" TOOL SHOULD INDICATE A VOLTAGE WITHIN THE VALUES SHOWN IN THE CHART BELOW.

OK

NOT OK

REPLACE SENSOR

②
- DISCONNECT VACUUM HOSE AT MAP SENSOR AND PLUG HOSE
- CONNECT A HAND VACUUM PUMP TO MAP SENSOR
- START ENGINE
- APPLY 34 kPa (10") OF VACUUM AND NOTE VOLTAGE CHANGE. (VOLTAGE SHOULD BE 1.2 - 2.3 VOLTS LESS THAN STEP 1.)

OK

NOT OK

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

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

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SECTION C2

FUEL CONTROL SYSTEM - TBI MODEL 700

CONTENTS

GENERAL DESCRIPTION

PURPOSE

The basic function of the fuel control system is to control fuel delivery to the engine.

Fuel is delivered to the engine by a throttle body injection (TBI) unit.

The main control sensor is the oxygen (O_2) sensor, which is located in the exhaust manifold. The O_2 sensor tells the engine control module (ECM) how much oxygen is in the exhaust gas, and the ECM changes the air/fuel ratio to the engine by controlling the fuel injector. A 14.7:1 air/fuel ratio is required for efficient catalytic converter operation. Because of the constant measuring and adjusting of the air/fuel ratio, the fuel injection system is called a "Closed Loop" System (Figure C2 -1).

MODES OF OPERATION

The ECM 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.

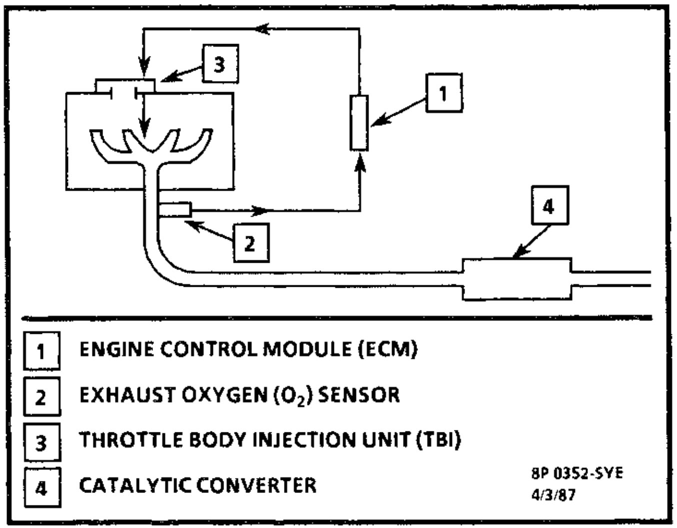


Figure C2-1 - Closed Loop System

Starting Mode

When the key is first turned "ON," the ECM turns on the fuel pump relay for two seconds, and the fuel pump builds up pressure to the TBI unit. The ECM checks the coolant temperature sensor, the throttle position sensor (TPS), and manifold absolute pressure (MAP) sensor, then determines the proper air/fuel ratio for starting. This ranges from 1.5:1 at -36°C (-33°F) to 14.7:1 at 94°C (201°F) running temperature.

The ECM controls the amount of fuel delivered in the Starting Mode by changing how long the injector is turned "ON" and "OFF". This is done by "pulsing" the injector for very short times.

Clear Flood Mode

If the engine floods, clear it by pushing the accelerator pedal down all the way. The ECM then pulses the injector to deliver a 20:1 air/fuel ratio. The ECM holds this injector rate as long as the throttle stays wide open, and the engine is below 600 rpm. If the throttle position becomes less than 80%, the ECM returns to the Starting Mode.

Run Mode

The RUN mode has two conditions called "Open Loop" and "Closed Loop".

"Open Loop"

When the engine is first started, and engine is above 400 rpm, the system goes into "Open Loop" operation. In "Open Loop", the ECM will ignore the signal from the oxygen (O_2) sensor, and calculates the air/fuel ratio based on inputs from the coolant temperature 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 temperature sensor is above a specified temperature.
3. A specific amount of time has elapsed after starting the engine.

"Closed Loop"

The specific values for the above conditions vary with different engines, and are stored in the PROM. When these conditions are met, the system goes into "Closed Loop" operation. In "Closed Loop", the ECM calculates the air/fuel ratio (injector on-time) based on the signal from the O_2 sensor. This allows the air/fuel ratio to stay very close to 14.7:1.

Acceleration Mode

The ECM looks at rapid changes in throttle position and manifold pressure, and provides extra fuel.

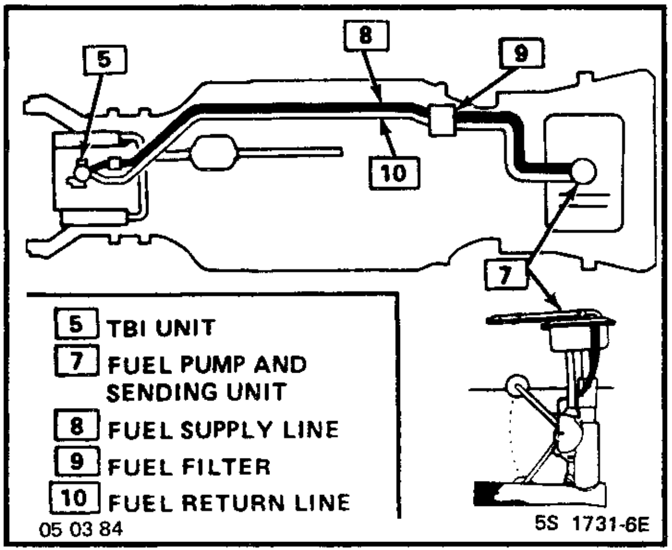


Figure C2-2 - Fuel Control System

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 by:

- Increasing injector on time of fuel delivered
- Increasing the idle rpm

Fuel Cutoff Mode

No fuel is delivered by the injectors when the ignition is "OFF". This prevents dieseling. Also, fuel is not delivered if no reference pulses are present, which means the engine is not running. **Fuel cutoff also occurs at high engine rpm to protect internal engine components from damage.**

FUEL CONTROL SYSTEM COMPONENTS

The fuel control system is made up of the following parts:

- Throttle body injection (TBI) unit
- Fuel pump
- Fuel pump relay.

BASIC SYSTEM OPERATION

The fuel control system (Figure C2-2) has an electric fuel pump, located in the fuel tank with the gage sending unit, which pumps fuel to the TBI through the fuel supply line , then through an in-line fuel filter. The pump is designed to provide pressurized fuel at about 125 kPa (18 psi). A pressure regulator in the TBI keeps fuel available to the injector at a constant pressure between 62 and 90 kPa (9 and 13 psi). Fuel in excess of injector need is returned to the fuel tank by a separate line.

The ECM controls the injector, located in the fuel meter body assembly of the TBI. The injector 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 (see Fuel Pump Electrical Circuit).

THROTTLE BODY INJECTION (TBI) UNIT

The Model 700 TBI unit (Figure C2-3) is made up of two major casting assemblies:

1. A fuel meter body with:
   - A fuel meter assembly, including a pressure regulator
   - A fuel injector
2. A throttle body with:
   - A throttle valve
   - An idle air control (IAC) valve
   - A throttle position sensor (TPS).

The throttle body portion of the TBI unit may contain ports located above, or below the throttle valve. These ports generate the vacuum signals for the exhaust gas recirculation (EGR) valve, MAP sensor, and the canister purge system.

Fuel Injector

The fuel injector (Figure C2-4) is a solenoid operated device controlled by the ECM. 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 needed by the injector passes through the pressure regulator before being returned to the fuel tank.

A fuel injector which does not open may cause a no-start condition. An injector which is stuck partly open could cause loss of pressure after engine shutdown, so long crank times would be noticed on some engines. Also, dieseling could occur because some fuel could be delivered to the engine after the key is turned "OFF."

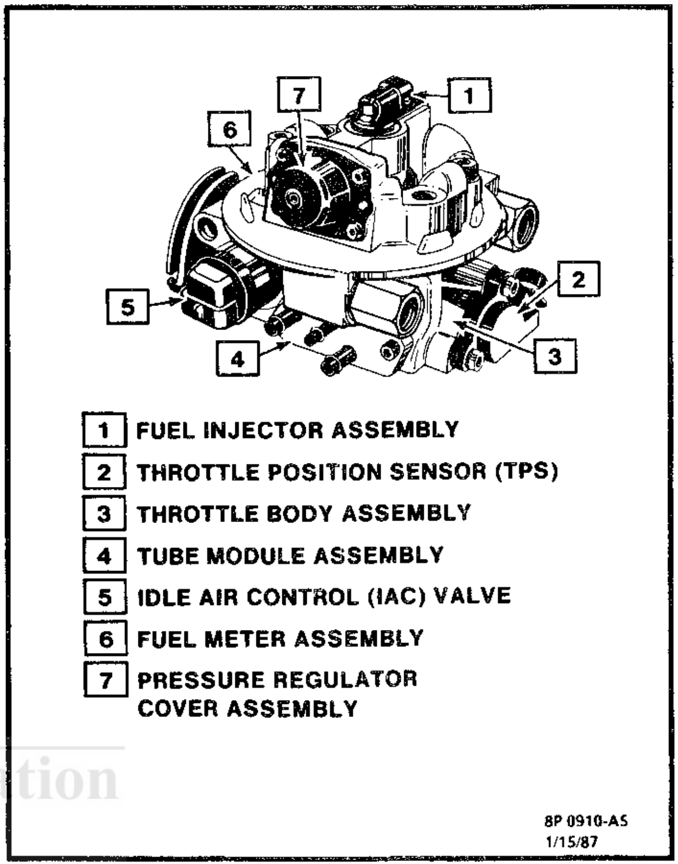


Figure C2-3 - Model 700 TBI

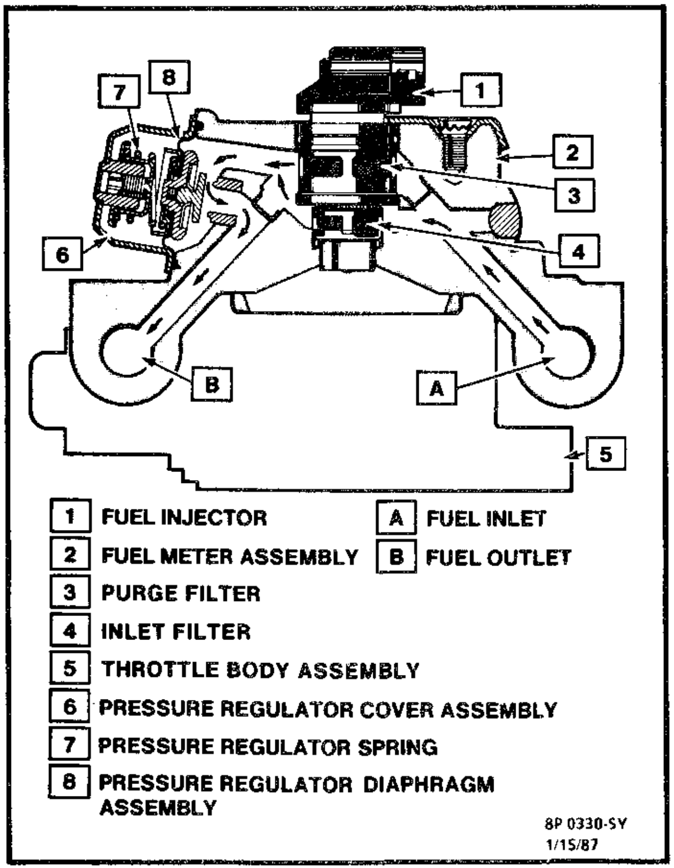


Figure C2-4 - TBI 700 Fuel Metering System

Pressure Regulator

The pressure regulator 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 fuel pressure at the injector at all times, by controlling the flow in the return line (by means of a calibrated bypass).

The pressure regulator is serviced as part of the fuel meter assembly and can be disassembled.

If the pressure regulator in the TBI supplies pressure which is too low (below 62 kPa or 9 psi), poor performance could result. If the pressure is too high, unpleasant exhaust odor may result.

Idle Air Control (IAC) Valve

The purpose of the idle air control (IAC) valve is to control engine idle speed, while preventing stalls due to changes in engine load (Figure C2-5).

The IAC valve, mounted on the throttle body, controls bypass air around the throttle valve. By moving a conical valve IN (to decrease air flow) or OUT (to increase air flow), a controlled amount of air can move around the throttle valve. If rpm is too low, more air is bypassed around the throttle valve to increase rpm. If rpm is too high, less air is bypassed around the throttle valve to decrease rpm.

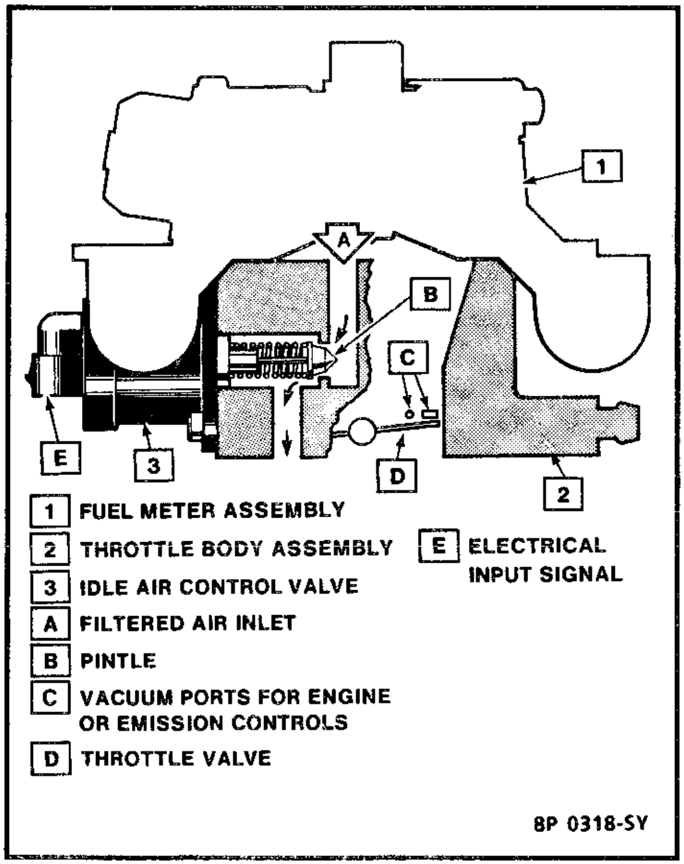


Figure C2-5 - Idle Air Control System

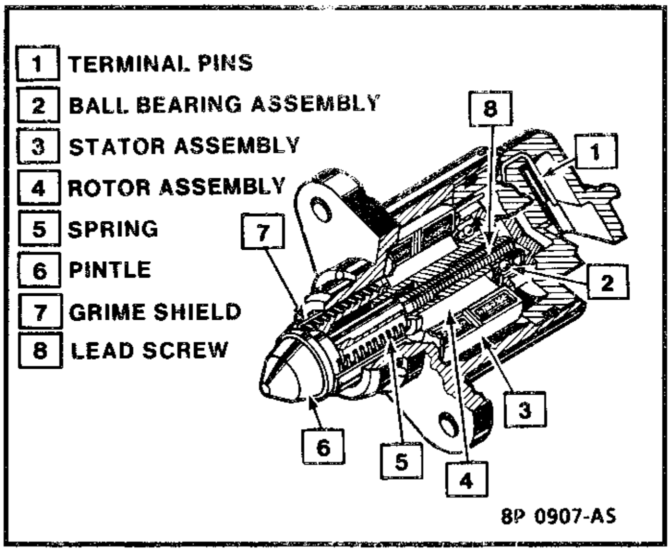


Figure C2-6 - Idle Air Control (IAC) Valve

The IAC valve moves in small steps called "Counts", which can be monitored by a "Scan" tool which plugs into the ALDL connector.

During idle, the proper position of the IAC valve is calculated by the ECM, based on battery voltage, coolant temperature, engine load, and engine rpm. If the rpm drops below a specified rpm, the throttle valve closes and the ECM senses a near stall condition, then calculates a new IAC valve position to prevent stalls.

If the IAC valve is disconnected or connected with the engine running, the idle rpm may be wrong. In this case, the IAC valve may be reset by driving the vehicle over 30 mph, or by raising the rpm over 2000 while in ALDL mode (test terminal grounded).

The IAC valve affects only the idle characteristics of the engine. 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. If it is stuck part way open, the idle may be rough, and will not respond to engine load changes.

On TBI Model 700 applications, the IAC valve (Figure C2-6) is flange-mounted. The IAC valve has a dual taper, 10 mm diameter, pintle. For replacement, use only an IAC valve with the correct part number and appropriate pintle shape and diameter.

Throttle Position Sensor (TPS)

The throttle position sensor (TPS) is mounted on the side of the throttle body opposite the throttle lever assembly. Its function is to sense the throttle valve position and relay that information to the ECM (Figure C2-7). Knowledge of throttle position is needed by the ECM to generate the required injector control signals (base pulse). If the TPS senses a wide open throttle, a voltage signal indicating this condition is sent to the ECM. The ECM then widens

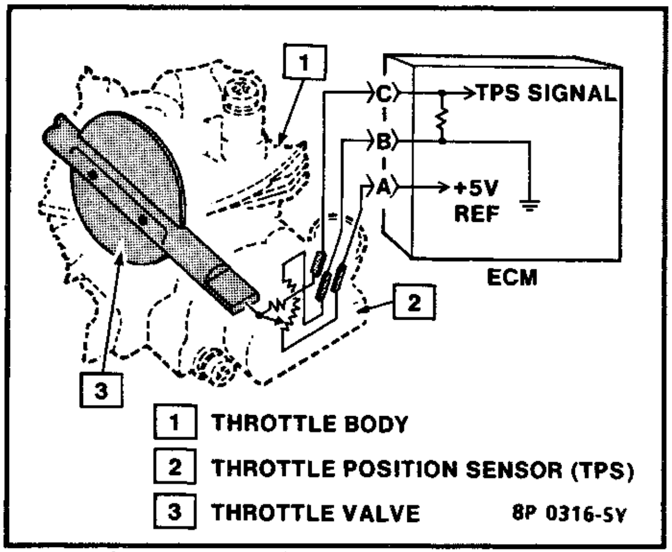


Figure C2-7 - Throttle Position Sensor

the injector pulses or increases the repetition rate (frequency of the applied pulses), permitting increased fuel flow.

As the throttle valve rotates in response to movement of the accelerator pedal, the throttle shaft transfers this rotational movement to the TPS. A potentiometer (variable resistor) within the TPS assembly changes its resistance (and voltage drop) in proportion to throttle movement.

By applying a reference voltage (5.0 volts) to the TPS input, a varying voltage (reflecting throttle position) is available at the TPS output. For example, approximately 2.5 volts results from a 50% throttle valve opening (depending on TPS calibration). The voltage output from the TPS assembly is routed to the ECM for use in determining throttle position.

FUEL PUMP

The fuel pump is a turbine type, low pressure electric pump, mounted in the fuel tank. Fuel is pumped at a positive pressure (above 62 kPa or 9 psi) from the fuel pump through the in-line filter to the pressure regulator in the TBI assembly. Excess fuel is returned to the fuel tank through the fuel return line.

The fuel pump is attached to the fuel gage sender assembly. A fuel strainer is attached to the fuel pump inlet line and prevents dirt particles from entering the fuel line and tends to separate water from the fuel.

Vapor lock problems are reduced when using an electric pump because the fuel is pushed from the tank under pressure rather than being pulled under vacuum, a condition that produces vapor.

An inoperative fuel pump would cause a no start condition. A fuel pump which does not provide enough pressure can result in poor performance. (See "Fuel System Pressure Test" procedure).

FUEL PUMP ELECTRICAL CIRCUIT

When the key is first turned "ON" without the engine running, the ECM turns the fuel pump relay "ON" for two seconds. This builds up the fuel pressure quickly. If the engine is not started within two seconds, the ECM shuts the fuel pump "OFF"and waits until the engine starts. As soon as the engine is cranked, the ECM turns the relay "ON" and runs the fuel pump.

As a backup system to the fuel pump relay, the fuel pump can also be turned on by the oil pressure switch. The oil pressure switch has two circuits internally. One operates the oil pressure indicator or gage in the instrument cluster, and the other 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 will turn on the fuel pump as soon as oil pressure reaches about 28 kPa (4psi).

DIAGNOSIS

FUEL CONTROL

Always start with the "Diagnostic Circuit Check" in Section "6E2-A". This will reduce diagnosis time and prevent unnecessary replacement of parts. The information in this check will direct diagnosis concerning "Engine Cranks But Won't Run" and the "Fuel System", Section "6E2-C2", including diagnosis of an injector, pressure regulator, fuel pump, fuel pump relay, and oil pressure switch.

Idle Air Control Valve

A "Scan" tool will display IAC position in "steps" (or counts). "O" steps indicates the ECM is commanding the IAC to be driven in, to a fully seated position (minimum idle air). The higher the number steps, the more idle air being allowed to pass by the IAC valve.

If the IAC valve is unable to control the idle speed within 100 rpm of the ECM commanded speed, a Code 35 should set.

Refer to Code CHART 35 for information to diagnose the operation of the idle air control (IAC) valve.

Driveability

Refer to Section "B" for driveability symptoms related to the fuel control.

ON-CAR SERVICE

GENERAL SERVICE INFORMATION

CAUTION:

- **To prevent personal injury or damage to the vehicle as the result of an accidental start, disconnect and reconnect the negative battery cable before and after service is performed. (Where Delco-Loc^{tm} radio is installed on Pontiac cars, refer to NOTICE in beginning of Section "9A" to reactivate radio.)**
- **To minimize the risk of fire, and personal injury, relieve the fuel system pressure before servicing the fuel rail, or any of its fuel handling components. (See "Fuel Pressure Relief Procedure," below).**
- **Also, catch any fuel that leaks out when disconnecting the fuel lines, by covering the fittings with a shop cloth. Place the cloth in an approved container when work is complete.**

The TBI unit repair procedures cover component replacement with the unit on the vehicle. However, throttle body replacement requires that the complete unit be removed from the engine.

Refer to the disassembled view (Figure C2-8) for identification of parts during repair procedures. Service repair of individual components is performed without removing the TBI unit from the engine. If removed, it is essential that care is taken to prevent damage to the throttle valve or sealing surface while performing any service.

Whenever service is performed on the TBI or any of its components, first remove the air cleaner and air cleaner gasket. Discard the gasket and replace it with a new one before replacing the air cleaner after service is complete.

Fuel Pressure Relief Procedure

On the 2.5L engine, the TBI Model 700 contains no constant bleed feature to relieve pressure. Therefore, the procedures listed below are required for relieving fuel pressure.

1. Place transmission selector in Park (Neutral on manual transmissions), set parking brake, and block drive wheels.
2. Remove fuse for fuel pump.
3. Start engine and allow to run a few seconds until it stops for lack of fuel.
4. Engage starter for three seconds to dissipate fuel pressure in lines. Fuel connections are now safe for servicing.
5. When pressure is relieved and servicing is complete, return fuse to fuse block.

Fuel System Pressure Test

A fuel system pressure test is part of several of the Diagnostic Charts and Symptom checks. To perform this test, follow this procedure:

1. Turn engine "OFF" and relieve fuel pressure, following instructions under "Fuel Pressure Relief Procedure," above.
2. Remove air cleaner and gasket. Discard gasket.
3. Uncouple fuel supply flexible hose in engine compartment. Install fuel pressure gage J-29658/BT8205 and adapter 29658-85 between the steel line and flexible hose.
4. Tighten gage in line to ensure no leaks occur during testing.
5. Start car and observe fuel pressure reading. It should be 62-90 kPa (9-13 psi); if not, refer to CHART A-5 or A-7.
6. Relieve fuel pressure (see above instructions).
7. Remove fuel pressure gage.
8. Reinstall fuel line.
9. Start car and check for fuel leaks.
10. Install air cleaner with new gasket.

Cleaning and Inspection

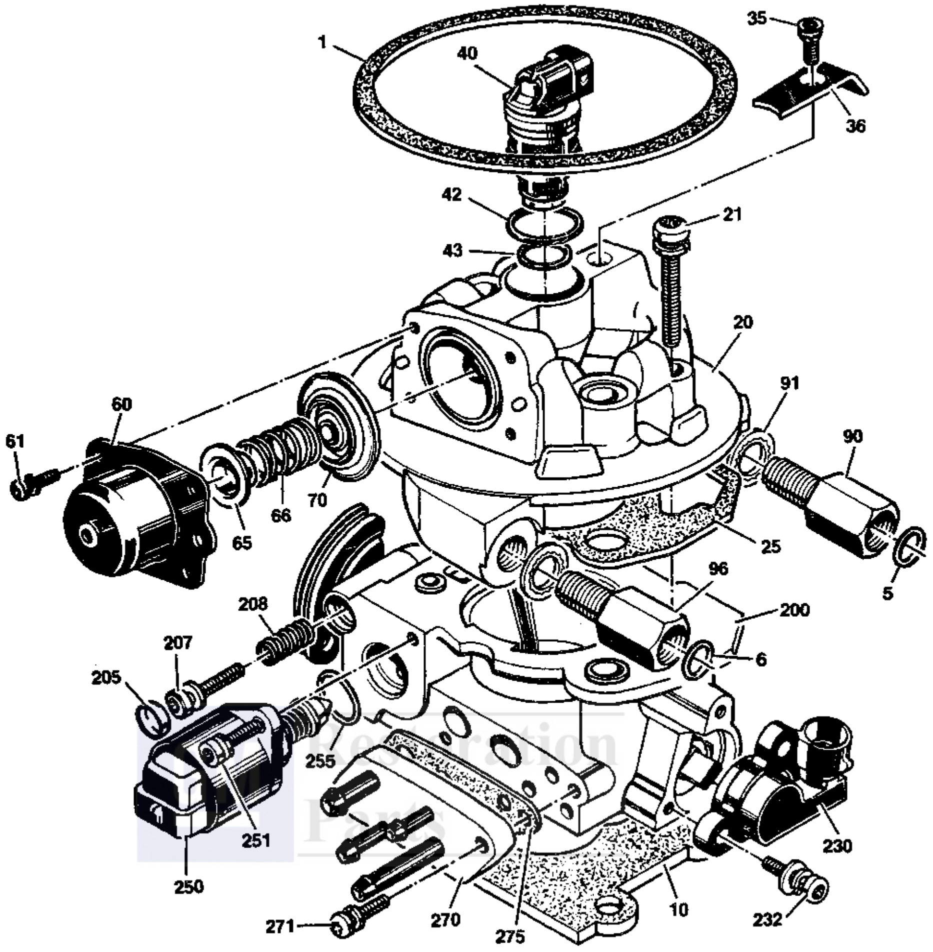
All TBI component parts, with the exception of those noted below, should be cleaned in a cold immersion cleaner such as Carbon X (X-55) or equivalent.

NOTICE: The throttle position sensor (TPS), idle air control (IAC) valve, pressure regulator diaphragm assembly, fuel injector or other components containing rubber, SHOULD NOT be placed in a solvent or cleaner bath. A chemical reaction will cause these parts to swell, harden or distort. Do not soak the throttle body with the above parts attached. If the throttle body requires cleaning, soaking time in the cleaner should be kept to a minimum. Some models have hidden throttle shaft dust seals that could lose their effectiveness by extended soaking.

1. Clean all metal parts thoroughly, and blow dry with shop air. Be sure that all fuel and air passages are free of dirt or burrs.
2. Inspect mating casting surfaces for damage that could affect gasket sealing.

Thread Locking Compound

A service repair kit is supplied with a small vial of thread locking compound, with directions for use. If this material is not available, use Loctite 262, or GM part number 10522624, or equivalent.



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PARTS IDENTIFICATION
Model 700 TBI

1	Gasket - Air FilterCleaner
5	O-Ring - Fuel Line Inlet Nut
6	O-Ring - Fuel Line Outlet Nut
10	Gasket -Flange
20	Fuel Meter Assembly
21	Screw & Washer Assembly - Fuel Meter Body Attaching
25	Gasket - Fuel Meter Body to Throttle Body
35	Screw - Injector Retainer
36	Retainer - Injector
40	Fuel Injector
42	O-Ring - Fuel Injector - Upper
43	O-Ring - Fuel Injector - Lower
60	Pressure Regulator Cover Assembly
61	Screw - Pressure Regulator Attaching
65	Seat - Spring
66	Spring - Pressure Regulator
70	Pressure Regulator Diaphragm Assembly
90	Nut - Fuel Inlet
91	Seal - Fuel Nut
96	Nut - Fuel Outlet
200	Throttle Body Assembly
205	Plug - Idle Stop Screw
207	Screw & Washer Assembly - Idle Stop
208	Spring - Idle Stop Screw
230	Sensor - Throttle Position (TPS)
232	Screw & Washer Assembly - TPS Attaching
250	Idle Air Control (IAC) Valve
251	Screw - IAC Valve Attaching
255	O-Ring - IAC Valve
270	Tube Module Assembly
271	Screw Assembly - Tube Module Assembly Attaching
275	Gasket - Tube Module Assembly

Figure C2-8 - Model 700 TBI Parts Identification (2.5L Engine)

NOTICE: Do not use a higher strength locking compound than recommended, since to do so could make removing the screw extremely difficult, or result in damaging the screw head.

FUEL INJECTOR ASSEMBLY

Replacement (Figure C2-9)

The fuel injector is serviced only as a complete assembly.

NOTICE: Use care in removing injector, to prevent damage to the electrical connector on top of the injector, and nozzle. Also, because the fuel injector is an electrical component, it should not be immersed in any type of liquid solvent or cleaner, as damage may occur.

Remove or Disconnect

1. Electrical connector to fuel injector.
2. Injector retainer screw and retainer.
3. Using a fulcrum, place screwdriver blade under ridge opposite connector end and carefully pry injector out (see Figure C2-10).
4. Remove upper and lower o-rings from injector and in fuel injector cavity and discard.

Inspect

Fuel injector filter for evidence of dirt and contamination. If present, check for presence of dirt in fuel lines and fuel tank.

Important

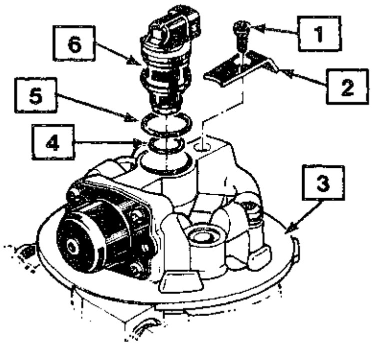
Be sure to replace the injector with an identical part. Injectors from other models can fit in the Model 700 TBI, but are calibrated for different flow rates. (See Figure C2-11 for part number location.)

Install or Connect

1. Lubricate new upper and lower o-rings with automatic transmission fluid and place them on injector. (Make sure upper o-ring is in groove and lower one is flush up against filter.)
2. Injector assembly, pushing it straight into fuel injector cavity.

Important

Be sure the electrical connector end on the injector is facing in the general direction of the cut-out in the fuel meter body for the wire grommet.



1 INJECTOR RETAINER SCREW ASSEMBLY
2 INJECTOR RETAINER
3 FUEL METER ASSEMBLY
4 FUEL INJECTOR O-RING (LOWER)
5 FUEL INJECTOR O-RING (UPPER)
6 MULTEC INJECTOR ASSEMBLY

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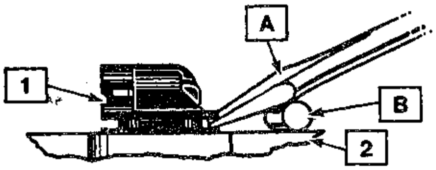
Figure C2-9 - Fuel Injector Parts



1 FUEL INJECTOR ASSEMBLY
2 FUEL METER BODY
A SCREWDRIVER BLADE
B FULCRUM

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Figure C2-10 - Removing TBI 700 Fuel injector

3. Injector retainer, using approriate thread locking compound on retainer attaching screw.
4. Electrical connector to fuel injector.

Tighten

- Injector retainer attaching screw to 3.0 N·m (27.0 lb. in.).

5. With engine "OFF" and ignition "ON," check for fuel leaks.

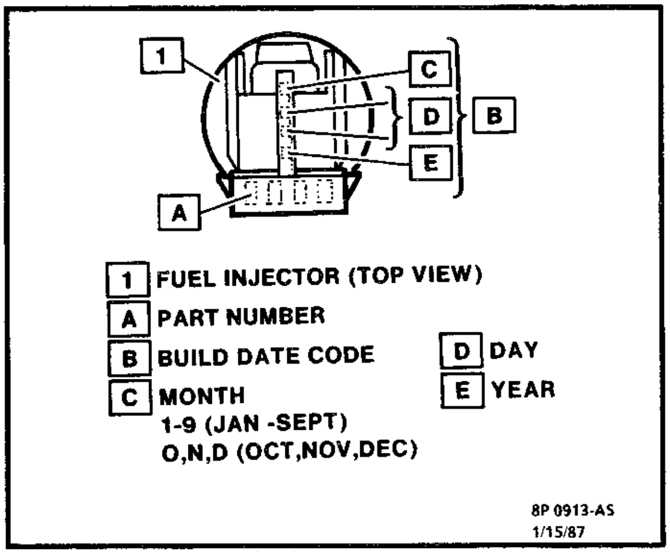

Figure C2-11 - Fuel Injector Part Number Location

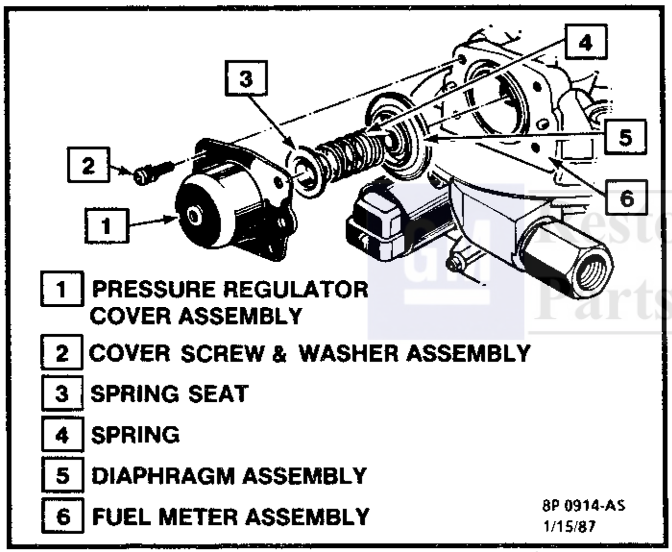

Figure C2-12 - TBI 700 Pressure Regulator

PRESSURE REGULATOR ASSEMBLY
Replacement (Figure C2-12)

NOTICE: To prevent leaks, the pressure regulator diaphragm assembly must be replaced whenever the cover is removed.

Remove or Disconnect

1. Four pressure regulator attaching screws, while keeping pressure regulator compressed.

CAUTION: **The pressure regulator contains a large spring under heavy compression. Use care when removing the screws to prevent personal injury.**

2. Pressure regulator cover assembly.
3. Pressure regulator spring.
4. Spring seat.
5. Pressure regulator diaphragm assembly.

Inspect

- Pressure regulator seat in fuel meter body cavity for pitting, nicks, or irregularities. (Use magnifying glass if necessary.) If any of above is present, the whole fuel body casting must be replaced.

Install or Connect

1. New pressure regulator diaphragm assembly, making sure it is seated in groove in fuel meter body.
2. Regulator spring seat and spring into cover assembly.
3. Cover assembly over diaphram, while aligning mounting holes.

NOTICE: Use care while installing the pressure regulator to prevent misalignment of diaphragm and possible leaks.

4. Four screw assemblies that have been coated with appropriate thread locking compound, while maintaining pressure on regulator spring.

Tighten

- Attaching screw assemblies to 2.5 N·m (22.0 lb. in.).

5. With engine "OFF" and ignition "ON," check for fuel leaks.

FUEL METER ASSEMBLY
Replacement (Figure C2-13)

Remove or Disconnect

1. Electrical connector from fuel injector.
2. Grommet with wires from fuel meter assembly.
3. Inlet and outlet fuel line nuts, using back-up wrench J-29698-A, or BT-8251-A.
4. Fuel line o-rings from nuts and discard.
5. TBI mounting hardware.
6. Two fuel meter body attaching screw and washer assemblies.
7. Fuel meter assembly from throttle body assembly.
8. Fuel meter body to throttle body gasket and discard.

Install or Connect

1. New fuel meter body to throttle body gasket. Match cut-out portions of gasket with openings in throttle body assembly.
2. Fuel meter assembly.
3. Two fuel meter body attaching screw and washer assemblies that have been coated with appropriate locking compound.

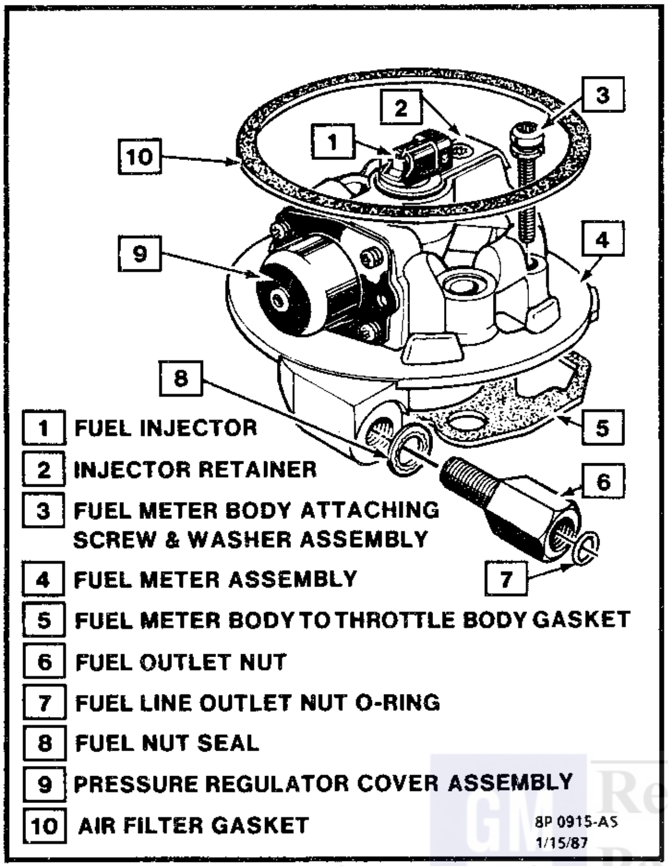

Figure C2-13 - Fuel Meter Assembly

Tighten

- Attaching screws to 6.0 N·m (53 lb. in.).

4. Throttle body injection unit mounting hardware.

Tighten

- Mounting hardware to 17N·m (12 lb. ft.).

5. New o-rings on fuel line nuts.
6. Fuel line inlet and outlet nuts by hand.

Tighten

- Inlet and outlet nuts to 27 N·m (20 lb. ft.). (Use back-up wrench J-29698-A, or BT-8251-A to keep TBI nuts from turning.)

7. Grommet with wires to fuel meter assembly.
8. Electrical connector to fuel injector, making sure it is fully seated and latched.
9. With engine "OFF" and ignition "ON," check for leaks around fuel line nuts.

THROTTLE POSITION SENSOR (TPS) Replacement (Figure C2-14)

Remove or Disconnect

1. Electrical connector from TPS.
2. Screw assemblies and TPS.

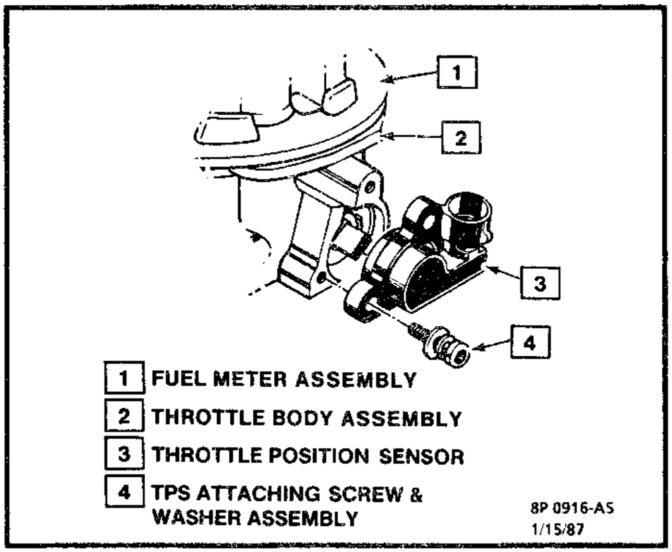

Figure C2-14 - Throttle Position Sensor (TPS)

NOTICE: The throttle position sensor is an electrical component, and should not be immersed in any type of liquid solvent or cleaner, as damage may result.

Install or Connect

1. With throttle valve in normally closed position, install TPS on throttle shaft and rotate counterclockwise to align mounting holes.
2. Attaching screw and washer assemblies.

Tighten

- Screw assemblies to 2.0 N·m (18.0 lb. in.)

3. Electrical connector to TPS.
4. Check for TPS output as follows:
   - Connect ALDL scanner to read TPS output voltage.
   - With ignition "ON" and engine stopped, TPS voltage should be less than 1.25 volts. If more than 1.25 volts, replace TPS.

IDLE AIR CONTROL (IAC) VALVE Replacement (Figure C2-15)

NOTICE: The IAC valve is an electrical component and must not be soaked in any liquid cleaner or solvent. Otherwise damage could result.

Important

On TBI Model 700, the IAC valve is flange-mounted, with a dual taper, 10 mm diameter pintle. If replacement is necessary, only an IAC valve identified with the correct part number (having the appropriate pintle shape and diameter) should be used.

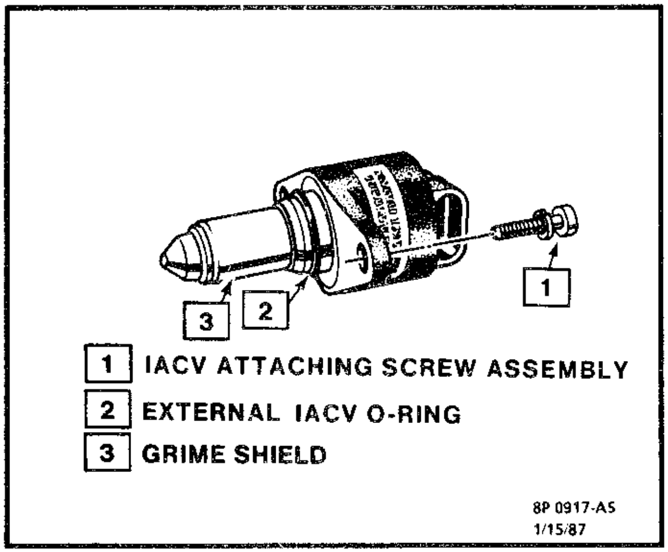

Figure C2-15 - Flange-Mount IAC Valve

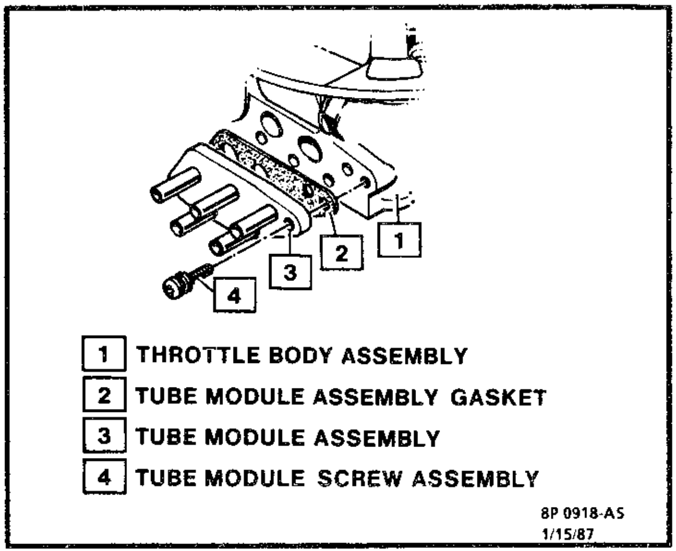

Figure C2-16 - Tube Module Assembly

Remove or Disconnect

1. Electrical connector from IAC valve.
2. Screw assemblies and IAC valve.
3. IAC valve o-ring and discard.

Clean

- IAC valve seating surfaces on throttle body to assure proper seal of new o-ring and contact of IAC valve flange.

NOTICE: If the IAC valve has been removed during service, its operation may be tested electrically with the IAC/ISC Motor Tester (Available Tool # J-37027, or BT-8256K). However, if the valve pintle is extended electrically, it must also be retracted electrically. Under no circumstances should the valve pintle be tampered with by hand, screwed, or pushed in, or pulled out, as damage could occur.

Important

No physical adjustment of the IAC valve assembly is required after installation. The IAC valve is reset by the ECM. When the vehicle is operated at normal engine temperature at approximately 30 mph (48 km/hr.), the ECM causes the valve pintle to seat in the throttle body. The ECM then has a reset procedure to set the correct pintle position. Proper idle regulation should result.

Install or Connect

1. Lubricate new o-ring with transmission fluid and install on IAC valve.
2. IAC valve to throttle body.

NOTICE: New IAC valves that have been preset at the factory should be installed in the throttle body in an "as is" condition, without any adjustment.

3. IAC valve attaching screw assemblies that have been coated with appropriate thread locking compound.

Tighten

- Screw assemblies to 3.2 N·m (28.0 lb. in.).

4. Electrical connector to idle air control valve.
5. Start engine and allow engine to reach operating temperature.

TUBE MODULE ASSEMBLY Replacement (Figure C2-16)

Remove or Disconnect

1. Tube module assembly attaching screws.
2. Tube module assembly.
3. Tube module assembly gasket and discard.

Clean

- Old gasket material from surface of throttle body assembly to insure proper seal of new gasket.

Install or Connect

1. New tube module assembly gasket.
2. Tube module assembly
3. Tube module assembly attaching screws.

Tighten

- Screw assemblies to 3.0 N·m (28.0 lb. in.).

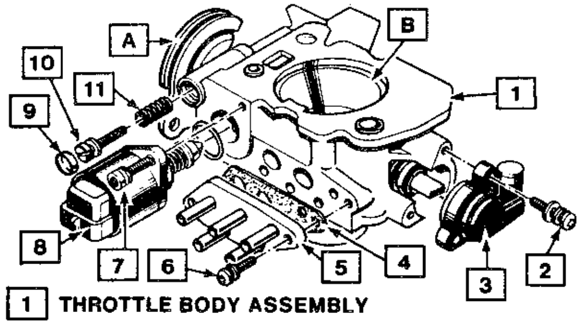

Figure C2-17 - Throttle Body Assembly

THROTTLE BODY ASSEMBLY Replacement (Figure C2- 17)

NOTICE: Procedures related to replacement of the individual components below have been described previously and should be followed, or damage could occur.

Remove or Disconnect

1. Throttle body injection (TBI) unit, as described below.
2. Fuel meter body-to-throttle body attaching screw and washer assemblies.
3. Fuel meter assembly.
4. Fuel meter body to throttle body gasket and discard.

Disassemble

- TPS, IAC valve and tube module assembly from old throttle body assembly, according to previous instructions.

Assemble

- TPS, IAC valve, and tube module assembly onto replacement throttle body assembly, according to previous instructions.

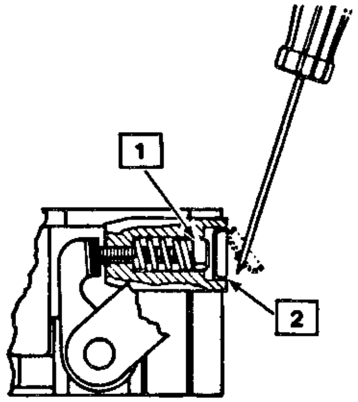

Figure C2-18 - Removing Idle Stop Screw Plug

Install or Connect

1. New fuel meter body to throttle body gasket.
2. Fuel meter assembly on throttle body assembly.
3. Fuel meter body-to-throttle body attaching screw and washer assemblies.

Tighten

- Screws to 6.0 N.m (53 lb. in.).

4. TBI unit onto engine, as described below.
5. Check minimum idle speed of engine as described below.

MINIMUM IDLE SPEED CHECK

The idle stop screw, used in mechanically setting minimum engine idle speed has been set at the factory and should not require further adjustment. However, to check that the setting is correct, proceed as follows:

1. Plug any vacuum ports, as required.
2. If present, remove idle stop screw plug by piercing it with an awl, then applying leverage (see Figure C2-18).
3. Connect tachometer to engine.
4. With IAC valve connected, ground the diagnostic terminal (ALDL connector).
5. Turn "ON" ignition, do not start engine. Wait at least 45 seconds (this allows IAC valve pintle to extend and seat in throttle body).
6. With ignition "ON," engine stopped, test terminal still grounded, disconnect IAC valve electrical connector.
7. Remove ground from diagnostic terminal and "start" engine. With transmission in neutral, allow engine rpm to stabilize.
8. The tachometer should read 600, ± 50 rpm. If not, adjust the idle stop speed screw accordingly.

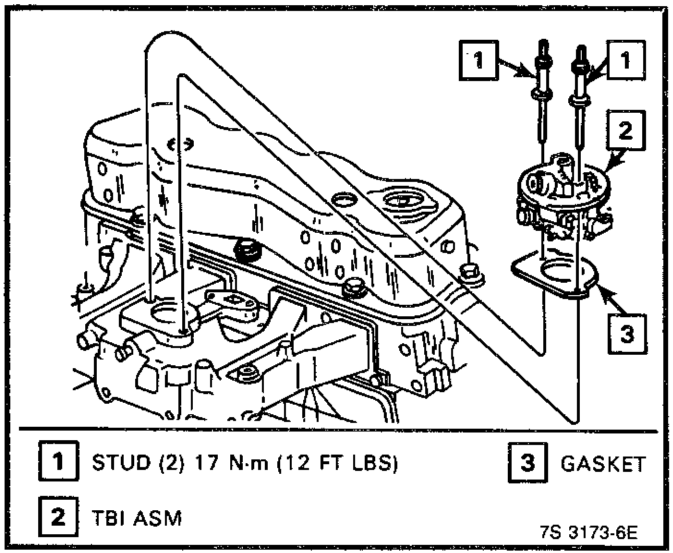

Figure C2-19 - Replacing TBI 700 Unit - 2.5L Engine

9. Turn ignition "OFF" and reconnect IAC valve electrical connector.
10. Use silicon sealant or equivalent to cover minimum idle adjustment screw hole.
11. Unplug any plugged vacuum ports.

THROTTLE BODY INJECTION UNIT Replacement (Figure C2-19)

Remove or Disconnect

1. Electrical connectors for IAC valve, TPS, and fuel injector.
2. Grommet with wires from fuel meter assembly.
3. Throttle linkage, return spring(s), transmission control cable and cruise control (wherever applicable).
4. Vacuum hoses, noting positions of hoses.
5. Inlet and outlet fuel line nuts, using back-up wrench J-29698-A or BT-8251-A.

CAUTION: **Refer to fuel pressure relief procedure (above) before disconnecting fuel lines.**

6. Fuel line o-rings from nuts and discard.
7. TBI mounting hardware.
8. TBI unit from intake manifold.
9. TBI flange (manifold mounting) gasket and discard.

NOTICE: Stuff the manifold opening with a rag to prevent material from entering the engine, and remove the old gasket material from surface of intake manifold.

Inspect

- Manifold bore for loose parts, foreign material, etc.
- Intake manifold sealing surface for cleanliness.

Install or Connect

1. New TBI flange (manifold mounting) gasket.
2. TBI with mounting hardware.

Tighten

- Mounting hardware to 17N·m (12 lb. ft.).

3. New o-rings on fuel line nuts.
4. Fuel line inlet and outlet nuts by hand.

Tighten

- Inlet and outlet nuts to 27 N·m (20 lb. ft.). (Use back-up wrench to keep TBI nuts from turning.)

5. Vacuum hoses.
6. Throttle linkage, return spring(s), transmission control cable and cruise control (wherever applicable).
7. Grommet with wires to fuel meter assembly.
8. Electrical connectors, making sure connectors are fully seated and latched.
9. Check to see if accelerator pedal is free by depressing pedal to the floor and releasing while engine is "OFF".
10. With engine "OFF" and ignition "ON," check for leaks around fuel line nuts.
11. Start engine and check for fuel leaks.

FUEL HOSE/PIPE ASSEMBLIES

Materials

Fuel Lines - Welded steel tubing meeting GM Specification 124-M or its equivalent. Fuel feed line is 3/8″ diameter and fuel return line is 5/16″ diameter. Do not use copper or aluminum tubing to replace steel tubing. Those materials do not have satisfactory durability to withstand normal vehicle vibration.

Coupled Hose - Not to be repaired, replace only as an assembly.

Uncoupled Hose - Use only reinforced fuel resistant hose made of "Fluroelastomer" material. Do not use hose within 4 inches (100 mm) of any part of the exhaust system or within 10 inches (254 mm) of the catalytic converter.

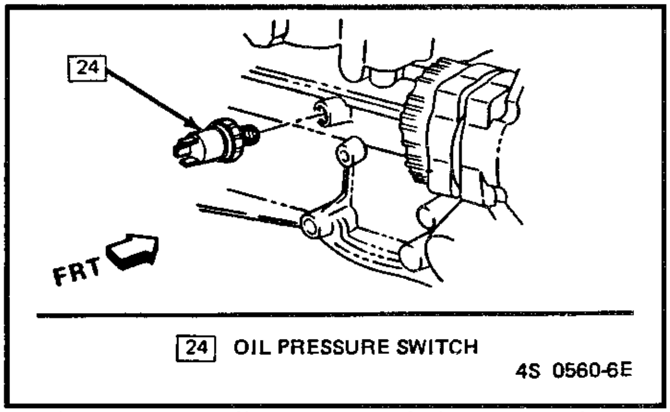

Figure C2 - 20 Oil Pressure Switch - 2.5L Engine

Hose inside diameter must match pipe outside diameter.

Clamps - Stainless steel screw band type #2494772 or equivalent.

Fuel Line Repair

1. Cut a piece of fuel hose 4 inches (100 mm) longer than the section of line to be removed. If more than 6 inches (152 mm) is to be removed, use a combination of steel pipe and hose. Hose length should not be more than 10 inches total.
2. Cut section of pipe to be replaced with a tube cutter. Use the first step of a double flaring tool to form a bead on the ends of the pipe and also, on the new section of pipe, if used.
3. Slide hose clamps onto pipe and push hose 2 inches (51 mm) onto each portion of the fuel pipe. Tighten clamp on each side of repair.
4. Secure fuel line to the frame.

FUEL PUMP/OIL PRESSURE SWITCH (Figure C2 - 20)

The oil pressure switch is mounted on the Bulkhead Side of the engine, as shown in figure 31. This switch is a parallel power supply with the fuel pump relay. If the fuel pump relay should fail, the oil pressure switch will provide battery voltage to the fuel pump after 28 kPa (4 psi) oil pressure is reached.

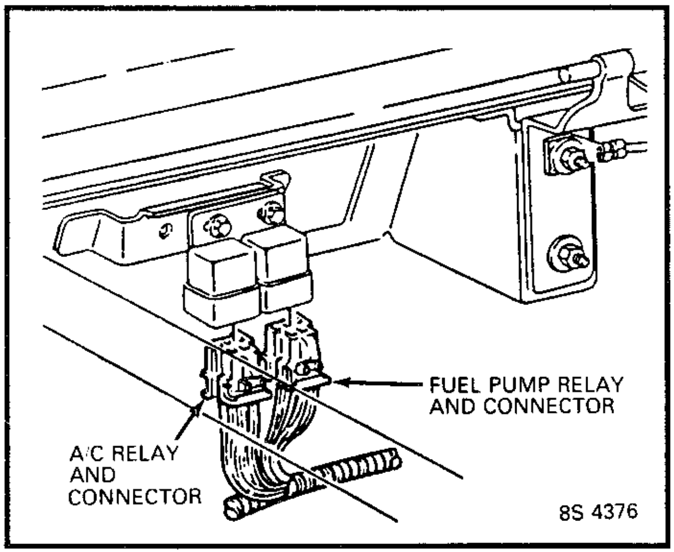

Figure C2-21 - Fuel Pump Relay - 2.5L Engine

FUEL PUMP RELAY (Figure C2 - 21)

The fuel pump relay is mounted in the engine compartment. Other than checking for loose connectors, the only service possible is replacement.

PARTS INFORMATION

PART NAME	GROUP
Meter Kit, Fuel	3.734
Injector Kit, Fuel	3.774
Pump, Fuel (In Tank)	3.900
Relay, Fuel Pump	3.900
Switch, Oil Press	1.800
Throttle Body Injection Unit	3.725
Control Kit, Idle Air Valve	3.820

SECTION C3
EVAPORATIVE EMISSION CONTROL SYSTEM (EECS)
CONTENTS

FUNCTIONAL TESTS

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.

EVAPORATIVE EMISSION SYSTEM

This system uses a canister with an integral diaphragm operated purge valve. The fuel vapors vent from the fuel tank to 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 location.

To increase the capacity of the fuel tank there is a vapor storage tank located near the fuel tank. Vapors vent to the canister from this storage tank.

RESULTS OF INCORRECT OPERATION

Evidence of fuel loss or fuel vapor odor can be caused by:

- Liquid fuel leaking from fuel lines or TBI
- Inoperative purge valve
- Disconnected, misrouted, kinked, deteriorated or damaged vapor hoses, or control hoses
- Air cleaner or air cleaner gasket improperly seated.

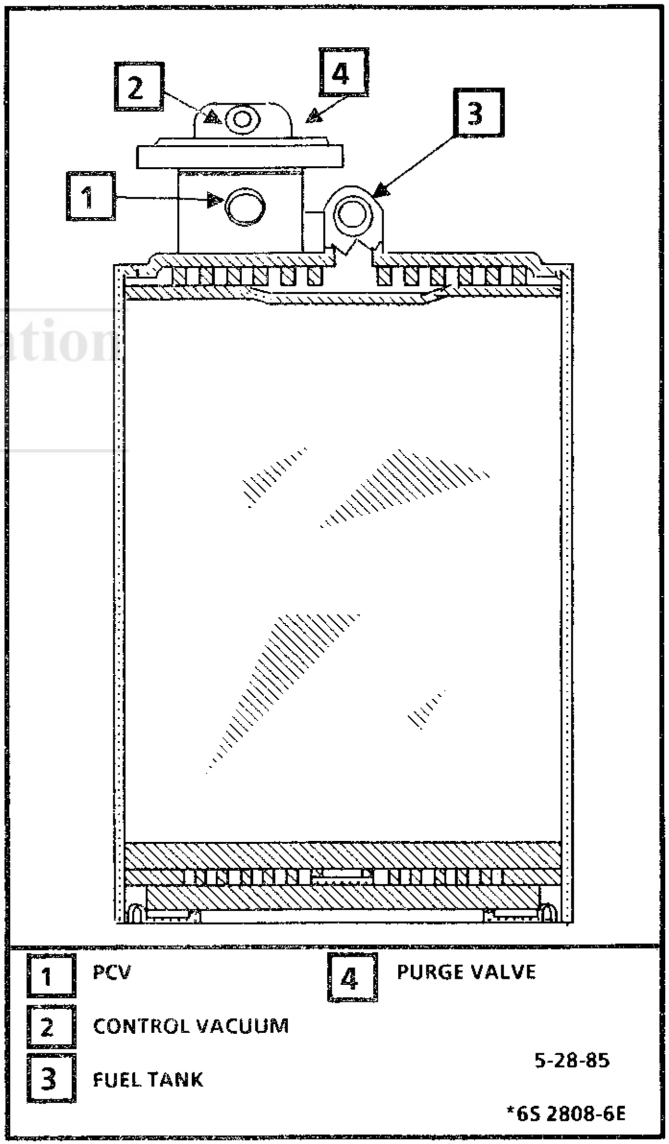

Figure C3-1 - Vapor Canister

Poor idle, stalling and poor driveability can be caused by:

- Inoperative purge valve
- Damaged canister
- Hoses split, cracked and or, not connected to the proper tubes.

DIAGNOSIS

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.

FUNCTIONAL TESTS

Canister Purge Valve

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. (A small amount of air will pass if the canister has a constant purge hole).

With hand vacuum pump, apply vacuum (15"Hg. or 51 kPa) through the control valve tube (upper tube). The diaphragm should hold vacuum for at least 20 seconds. If it does not hold vacuum 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.

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

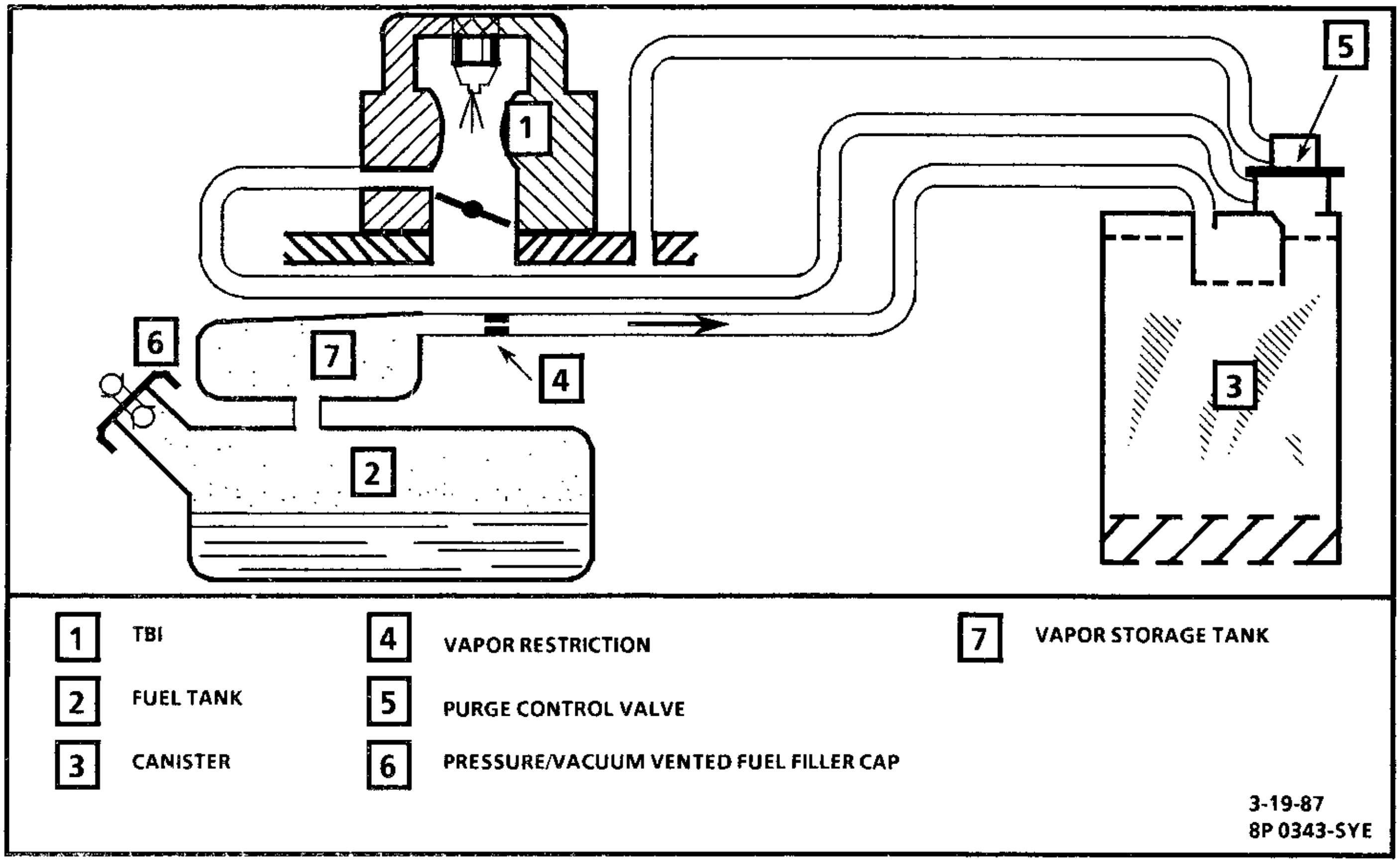

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Figure C3-2 - Evaporative Emissions Control System Schematic 2.5L VIN R "P" Series

SECTION C4

DIRECT IGNITION SYSTEM (DIS) / EST - 2.5L

CONTENTS

GENERAL DESCRIPTION

SYSTEM OPERATION

The Direct Ignition System (DIS) does not use the conventional distributor and coil. This ignition system consists of two separate ignition coils, a "DIS" ignition module and Crankshaft Sensor as well as the related connecting wires and the EST (Electronic Spark Timing) portion of the ECM.

A distributorless ignition system, such as this one, uses a "waste spark" method of spark distribution. Each cylinder is paired with the cylinder that is opposite it (1-4 or 2-3). The spark occurs simultaneously in the cylinder coming up on the compression stroke and in the cylinder coming up on the exhaust stroke.

The cylinder on the exhaust stroke requires very little of the available energy to fire the spark plug. The remaining energy will be used as required by the cylinder on the compression stroke. The same process is repeated when the cylinders reverse roles.

It is possible in a no load condition for one plug to fire even though the spark plug lead from the same coil is disconnected from the other spark plug. The disconnected spark plug lead acts as one plate of a capacitor, with the engine being the other plate. These two "capacitor plates" are charged as a current surge (spark) jumps across the gap of the connected spark plug. The "plates" are then discharged as the secondary energy is dissipated in an oscillating current across the gap of the spark plug still connected. Because of the direction of current flow in the primary winding and thus in the secondary winding, one plug will fire from the center electrode to the side electrode while the other will fire from side electrode to center electrode.

These systems utilize the EST signal from the ECM, as do distributor type ignition systems equipped with EST, to control spark timing. Under 400 rpm, the "DIS" module controls spark timing (module timing mode) and over 400 rpm, the ECM controls spark timing (EST mode). To properly control ignition timing, the ECM relies on the following information:

- Engine load (manifold pressure or vacuum).
- Atmospheric (barometric) pressure.
- Engine temperature.
- Manifold air temperature.
- Crankshaft position.
- Engine speed (rpm).

SYSTEM COMPONENTS

Crankshaft Sensor

This system uses a magnetic crankshaft sensor, mounted to the bottom of the "DIS" module which protrudes into the block, within approximately .050" of the crankshaft reluctor. Figure C4-1 illustrates a typical sensor in relationship to the crankshaft reluctor. The reluctor is a special wheel cast into the crankshaft with seven slots machined into it, six of which are equally spaced (60° apart). A seventh slot is spaced 10° from one of the other slots and serves to generate a "sync-pulse". As the reluctor rotates as part of the crankshaft, the slots change the magnetic field of the sensor, creating an induced voltage pulse.

Based on the crank sensor pulses, the "DIS" module sends reference signals to the ECM which are used to indicate crankshaft position and engine speed. The "DIS" module will continue to send these reference pulses to the ECM at a rate of one per each 180° of crankshaft rotation. The ECM will activate the fuel injector based on the recognition of every other reference pulse beginning at a crankshaft position of 120° after top dead center. By comparing the time between pulses, the "DIS" module can recognize the pulse representing the seventh slot (sync pulse) which starts the calculation of ignition coil sequencing.

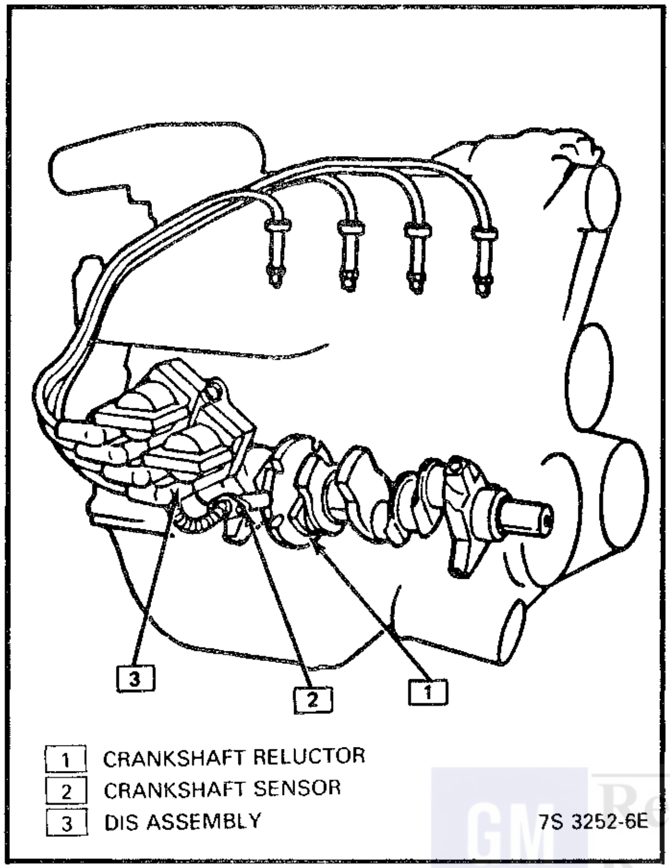

Figure C4-1 Sensor To Crank Reluctor Relationship

The second crank pulse following the "sync pulse" signals the "DIS" module to fire the #2/3 ignition coil and the fifth crank pulse signals the module to fire the # 1/4 ignition coil.

Ignition Coils

Two separate coils are mounted to the Module assembly (Figure C4-2). Each coil provides the spark for two plugs simultaneously (Waste Spark Distribution). Each coil can also be replaced separately.

DIS Module

The "DIS" Module monitors the Crank Sensor signals and based on these signals sends a reference signal to the ECM so that correct spark and fuel injector control can be maintained during all driving conditions. During cranking, the "DIS" module monitors the "sync-pulse" to begin the ignition firing sequence and below 400 rpm the module controls spark advance by triggering each of the two coils at a pre-determined interval based on engine speed only. Above 400 rpm the ECM controls the spark timing (EST) and compensates for all driving conditions. The "DIS" module must receive a "sync-pulse" and then a Crank Signal in that order to enable the engine to start.

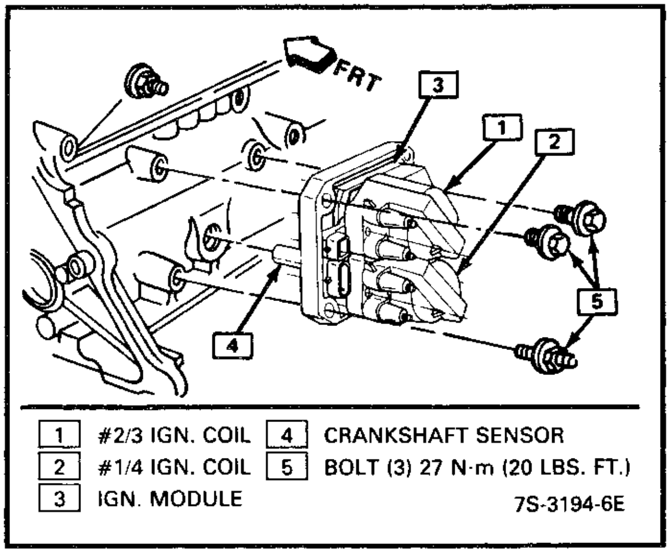

Figure C4-2 Ignition Coils,Module and Sensor (2.5L)

The "DIS" module is not repairable. When a module is replaced, the remaining "DIS" components must be transferred to the new module. (See Figure C4-2)

Electronic Spark Timing (EST)

This system uses the same EST to ECM circuits that distributor type systems use. Following is a brief description for each of the EST circuits.

- "DIS" Reference - CKT 430.
  The crankshaft sensor generates a signal to the ignition module which results a reference pulse being sent to the ECM. The ECM uses this signal to calculate crankshaft position and engine speed and injector pulse width.
- Reference ground - CKT 453.
  This wire is grounded through the module and insures that the ground circuit has no voltage drop between the ignition module and the ECM, which could affect performance.
- By-Pass - CKT 424.
  At about 400 rpm, the ECM applies 5 volts to this circuit to switch spark timing control from the "DIS" module to the ECM. An open or grounded by-pass circuit will set a Code 42 and result in the engine operating in a back-up ignition timing mode (module timing) at a calculated timing value. This may cause poor performance and reduced fuel economy.
- EST - CKT 423.
  The "DIS" module sends a reference signal to the ECM when the engine is cranking. While the engine is under 400 rpm, the "DIS" module controls the ignition timing. When the engine speed exceeds 400 rpm, the ECM applies 5 volts to the "By-pass" line to switch the timing to ECM control (EST).

An open or ground in the EST circuit will result in the engine continuing to run, but in a back-up ignition timing mode (module timing) at a calculated timing value and the "Service Engine Soon" light will not be on. If the EST fault is still present the next time the engine is restarted, a Code 42 will be set and the engine will operate in module timing. This may cause poor performance and reduced fuel economy.

DIAGNOSIS

SYMPTOM DIAGNOSIS

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.

If the engine cranks but will not run or immediately stalls, CHART A-3 must be used to determine if the failure is in the "DIS" system or the fuel system.

Code 42

If Code 42 is set, that code chart must be used for diagnosis. If the symptom is "Engine Misses" and the ignition system is suspected, use CHART C4-D "DIS Misfire" for diagnosis.

Code 12

Code 12 is used during the Diagnostic Circuit Check procedure to test the diagnostic and 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.

SETTING TIMING

Because the reluctor wheel is an integral part of the crankshaft and the crankshaft sensor is mounted in a fixed position, timing adjustment is not possible .

ON-CAR SERVICE

"DIS" ASSEMBLY (Figure C4-2)

←→ Remove or Disconnect

1. Negative Battery cable.
2. "DIS" electrical connectors.
3. Spark plug wires. (Note proper relationship of wires to coils).
4. "DIS" Assembly to block bolts (3).
5. "DIS" Assembly from engine.

Inspect

Crankshaft sensor O-Ring for wear, cracks, or leakage. Replace if necessary. Lube new O-Ring with engine oil before installing.

→← Install or Connect

1. "DIS" Assembly to engine.
2. "DIS" Assembly to block bolts (3).
   Torque to 27 N·m (20 Lbs.Ft.).
3. Spark plug wires to proper coils.
4. "DIS" electrical connectors.
5. Negative battery cable.

CRANKSHAFT SENSOR (Figure C4-3)

←→ Remove or Disconnect

1. Negative battery cable.
2. "DIS" Assembly (See previous procedure).
3. Sensor screws (2).
4. Sensor from "DIS" Assembly.

Inspect

Sensor O-Ring for wear, cracks or leakage. Replace if necessary. Lube new O-Ring with engine oil before installing.

→← Install or Connect

1. Sensor to "DIS" Assembly.
2. Sensor screws (2)
   Torque to 2.3 N-m (20 Lbs.In.)
3. "DIS" Assembly to engine. (See previous procedure).
4. Negative battery cable.

IGNITION COIL(S) (Figure C4-3)

Remove or Disconnect

1. Coil Retaining nuts. (2 Per Coil).
2. Coil(s) from module.

Install or Connect

1. Coil(s) to module.
2. Coil retaining nuts. Torque to 4.5 N-m (40 lbs.In.).

IGNITION MODULE (Figure C4-3)

Remove or Disconnect

1. Negative battery cable.
2. "DIS" Assembly from engine. (See previous procedure).
3. Coils from assembly. (See previous procedure).
4. Module from assembly plate.

Install or Connect

1. Module to assembly plate. (Carefully engage sensor to module terminals).
2. Coils (See previous procedure).
3. "DIS" Assembly to engine. (See previous procedure).
4. Negative battery cable.

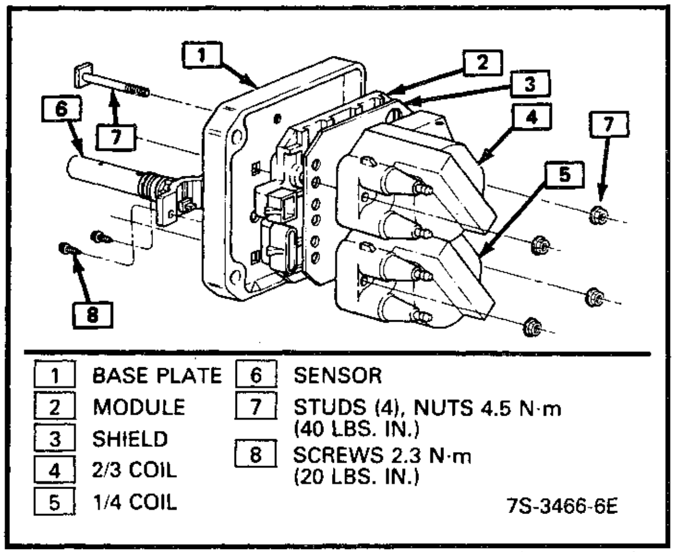

Figure C4-3 "DIS" Assembly Exploded View (2.5L)

PARTS INFORMATION

PART NAME	GROUP
Coil, Ignition	2.170
Module	2.383
Sensor,Crank. Shaft. Position	2.383

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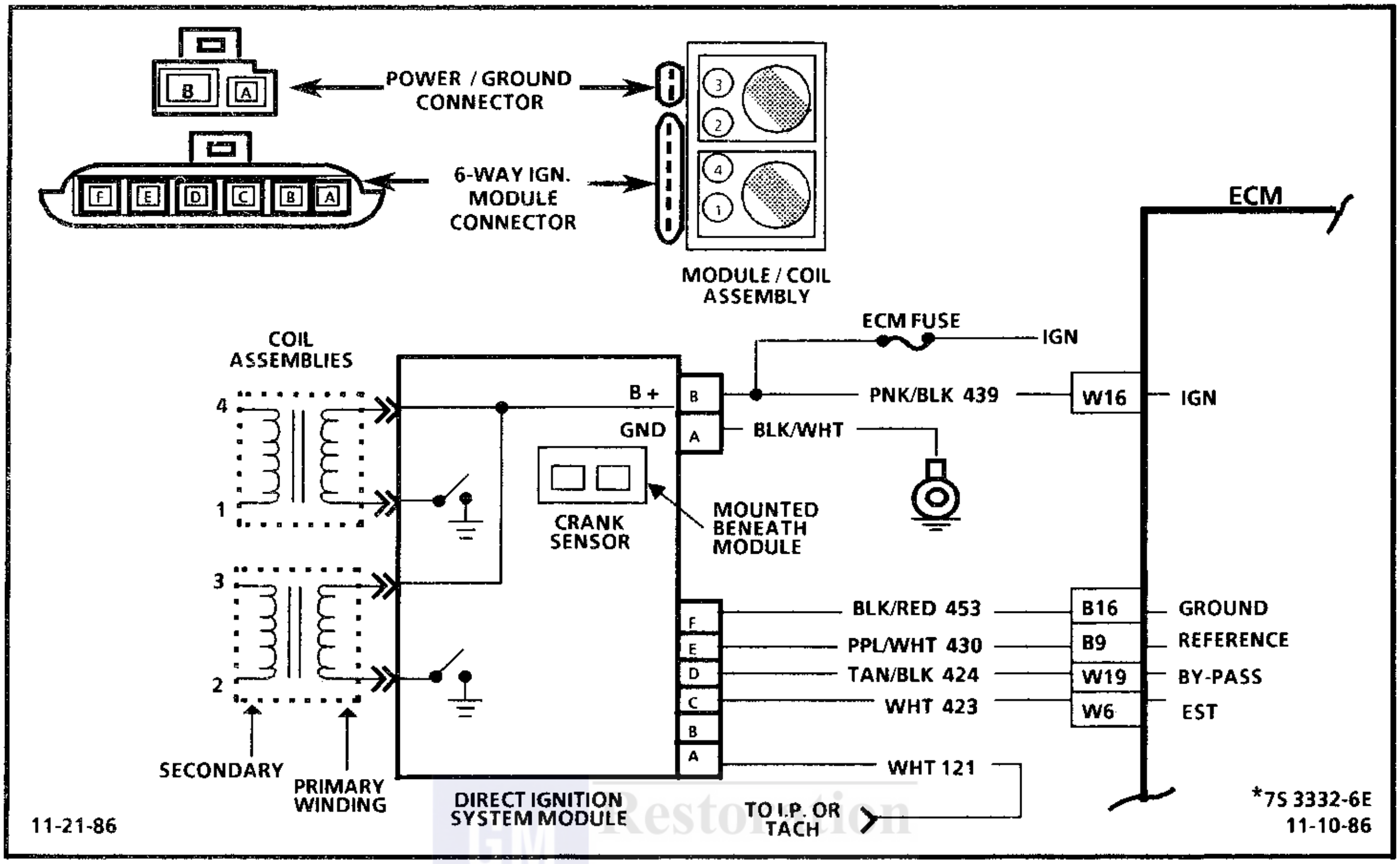


CHART C-4D-1

"DIS" MISFIRE AT IDLE
2.5L "P" SERIES (TBI)

Circuit Description:

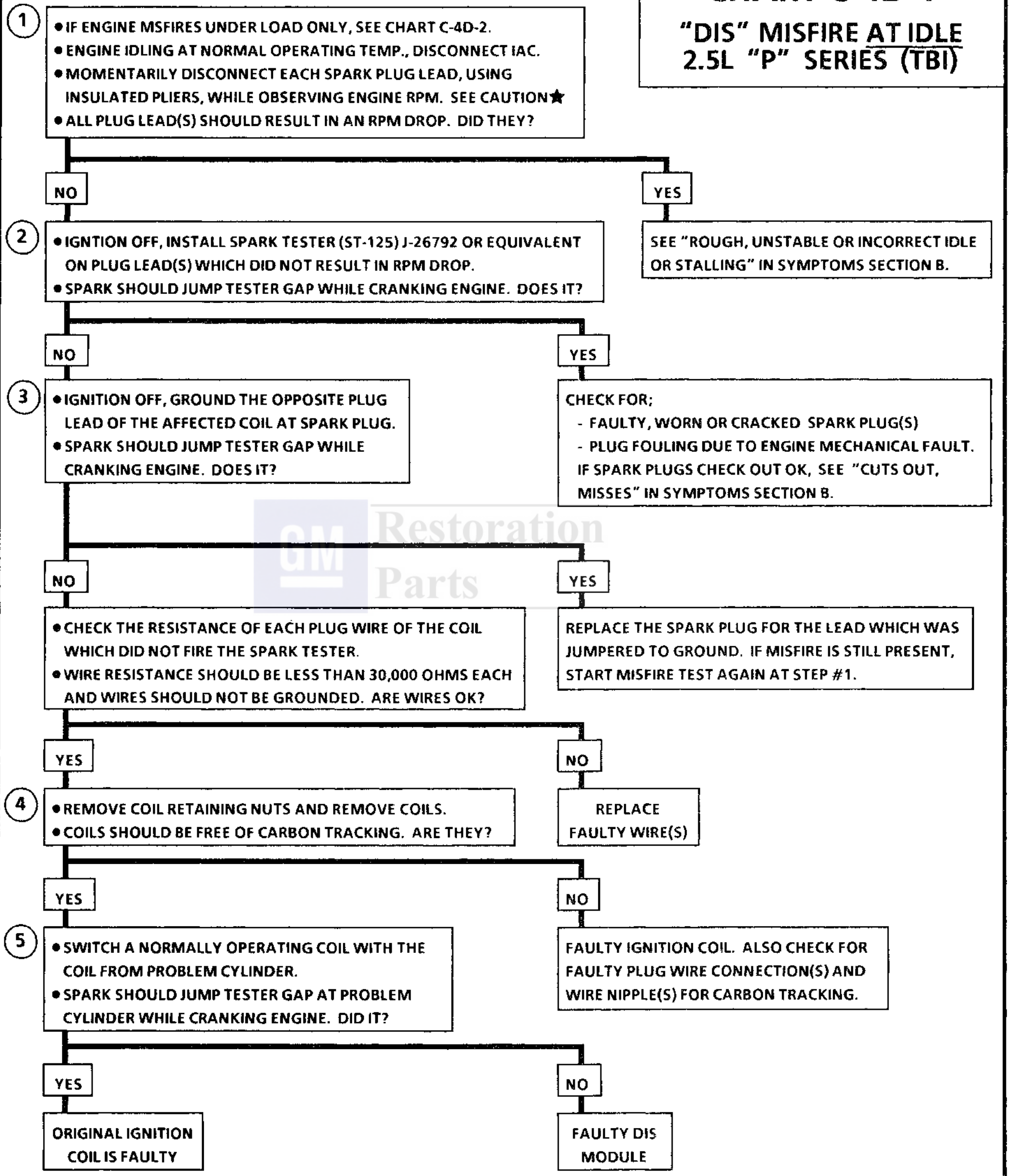
The Direct Ignition System (DIS) uses a waste spark method of distribution. In this type of system, the ignition module triggers the #1/4 coil pair resulting in both #1 and #4 spark plugs firing at the same time. #1 cylinder is on the compression stroke at the same time #4 is on the exhaust stroke, resulting in a lower energy requirement to fire #4 spark plug. This leaves the remainder of the high voltage to be used to fire #1 spark plug. On this application, the crank sensor is mounted to the bottom of the coil/module assembly and protrudes through the block to within approximately .050" of the crankshaft reluctor. Since the reluctor is a machined portion of the crankshaft and the crank sensor is mounted in a fixed position on the block, timing adjustments are not possible or necessary.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. If the "Misfire" complaint exists <u>under load only</u>, the diagnostic chart on page 2 must be used. Engine rpm should drop approximately equally on all plug leads.
2. A spark tester such as a ST-125 must be used because it is essential to verify adequate available secondary voltage at the spark plug. (25,000 volts).
3. If the spark jumps the test gap after grounding the opposite plug wire, it indicates excessive resistance in the plug which was bypassed. A faulty or poor connection at that plug could also result in the miss condition. Also check for carbon deposits inside the spark plug boot.
4. If carbon tracking is evident, replace coil and be sure plug wires relating to that coil are clean and tight. Excessive wire resistance or faulty connections could have caused the coil to be damaged.
5. If the no spark condition follows the suspected coil, that coil is faulty. Otherwise, the ignition module is the cause of no spark. This test could also be performed by substituting a known good coil for the one causing the no spark condition.

CHART C-4D-1

"DIS" MISFIRE AT IDLE
2.5L "P" SERIES (TBI)



①
- IF ENGINE MSFIRES UNDER LOAD ONLY, SEE CHART C-4D-2.
- ENGINE IDLING AT NORMAL OPERATING TEMP., DISCONNECT IAC.
- MOMENTARILY DISCONNECT EACH SPARK PLUG LEAD, USING INSULATED PLIERS, WHILE OBSERVING ENGINE RPM. SEE CAUTION★
- ALL PLUG LEAD(S) SHOULD RESULT IN AN RPM DROP. DID THEY?

YES: SEE "ROUGH, UNSTABLE OR INCORRECT IDLE OR STALLING" IN SYMPTOMS SECTION B.

NO:

②
- IGNTION OFF, INSTALL SPARK TESTER (ST-125) J-26792 OR EQUIVALENT ON PLUG LEAD(S) WHICH DID NOT RESULT IN RPM DROP.
- SPARK SHOULD JUMP TESTER GAP WHILE CRANKING ENGINE. DOES IT?

YES: CHECK FOR;
- FAULTY, WORN OR CRACKED SPARK PLUG(S)
- PLUG FOULING DUE TO ENGINE MECHANICAL FAULT.

IF SPARK PLUGS CHECK OUT OK, SEE "CUTS OUT, MISSES" IN SYMPTOMS SECTION B.

NO:

③
- IGNITION OFF, GROUND THE OPPOSITE PLUG LEAD OF THE AFFECTED COIL AT SPARK PLUG.
- SPARK SHOULD JUMP TESTER GAP WHILE CRANKING ENGINE. DOES IT?

YES: REPLACE THE SPARK PLUG FOR THE LEAD WHICH WAS JUMPERED TO GROUND. IF MISFIRE IS STILL PRESENT, START MISFIRE TEST AGAIN AT STEP #1.

NO:
- CHECK THE RESISTANCE OF EACH PLUG WIRE OF THE COIL WHICH DID NOT FIRE THE SPARK TESTER.
- WIRE RESISTANCE SHOULD BE LESS THAN 30,000 OHMS EACH AND WIRES SHOULD NOT BE GROUNDED. ARE WIRES OK?

NO: REPLACE FAULTY WIRE(S)

YES:

④
- REMOVE COIL RETAINING NUTS AND REMOVE COILS.
- COILS SHOULD BE FREE OF CARBON TRACKING. ARE THEY?

NO: FAULTY IGNITION COIL. ALSO CHECK FOR FAULTY PLUG WIRE CONNECTION(S) AND WIRE NIPPLE(S) FOR CARBON TRACKING.

YES:

⑤
- SWITCH A NORMALLY OPERATING COIL WITH THE COIL FROM PROBLEM CYLINDER.
- SPARK SHOULD JUMP TESTER GAP AT PROBLEM CYLINDER WHILE CRANKING ENGINE. DID IT?

YES: ORIGINAL IGNITION COIL IS FAULTY

NO: FAULTY DIS MODULE

★**CAUTION:** When handling secondary spark plug leads with engine running, insulated pliers must be used and care exercised to prevent a possible electrical shock.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

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7S 3573-6E

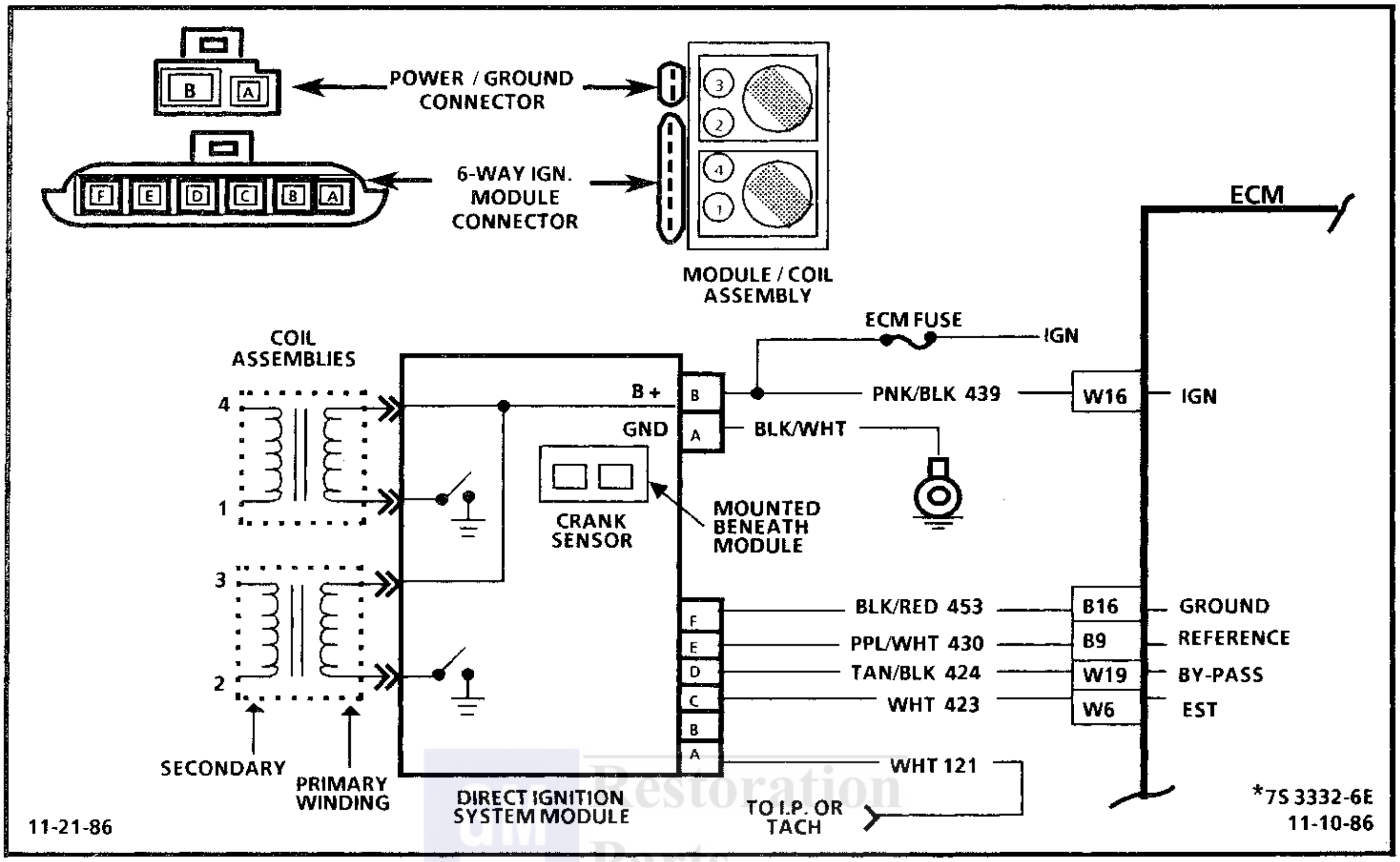


CHART C-4D-2

"DIS" MISFIRE UNDER LOAD
2.5L "P" SERIES (TBI)

Circuit Description:

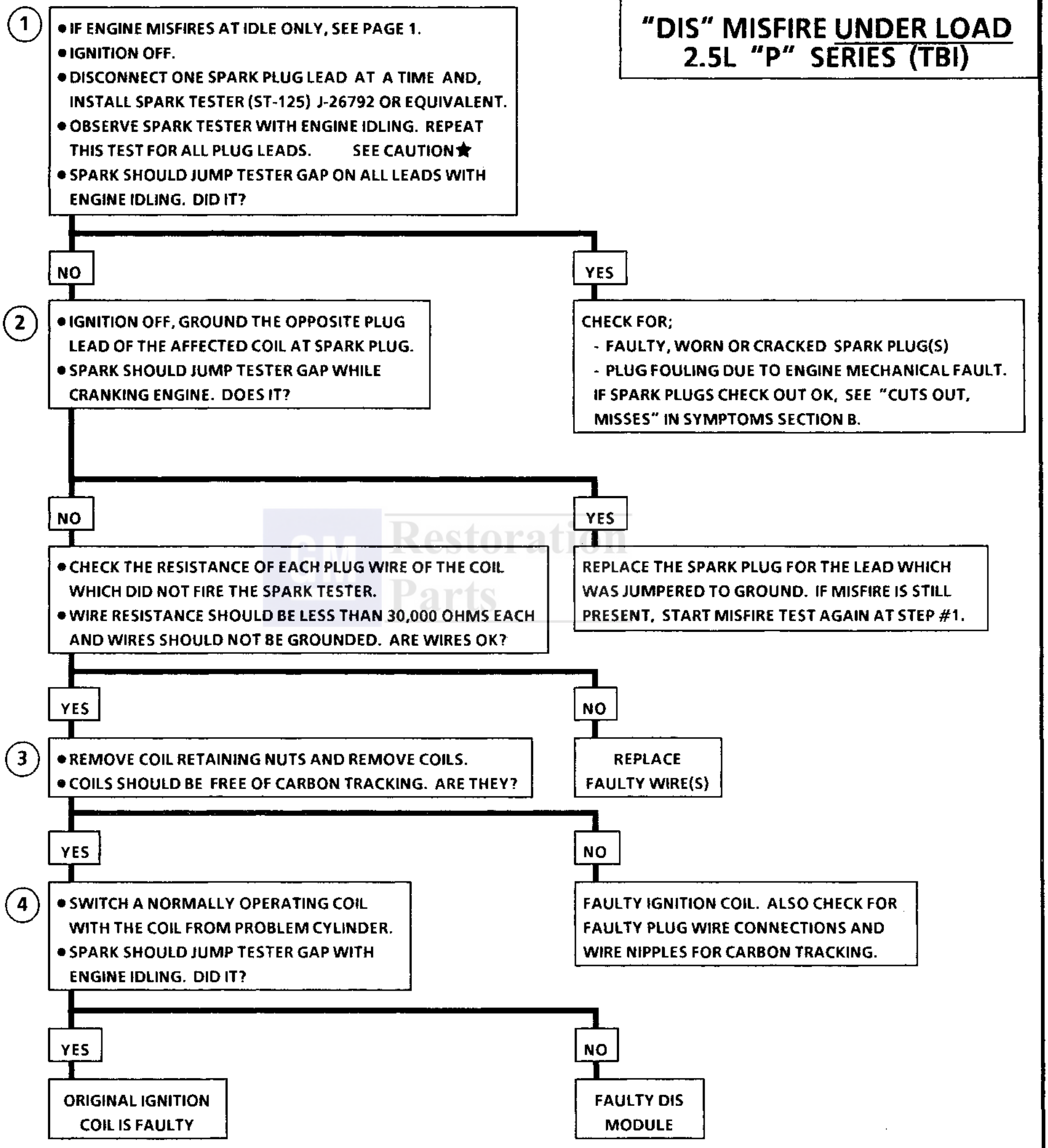
The "Direct Ignition System" (DIS) uses a waste spark method of distribution. In this type of system, the ignition module triggers the #1/4 coil pair resulting in both #1 and #4 spark plugs firing at the same time. #1 cylinder is on the compression stroke at the same time #4 is on the exhaust stroke, resulting in a lower energy requirement to fire #4 spark plug. This leaves the remainder of the high voltage to be used to fire #1 spark plug. On this application, the crank sensor is mounted to the bottom of the coil/module assembly and protrudes through the block to within approximately .050" of the crankshaft reluctor. Since the reluctor is a machined portion of the crankshaft and the crank sensor is mounted in a fixed position on the block, timing adjustments are not possible or necessary.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. If the "Misfire" complaint exists <u>at idle only</u>, the diagnostic chart on page 1 must be used. A spark tester such as a ST-125 must be used because it is essential to verify adequate available secondary voltage at the spark plug. (25,000 volts). Spark should jump the test gap on all 4 leads. This simulates a "load" condition.
2. If the spark jumps the tester gap after grounding the opposite plug wire, it indicates excessive resistance in the plug which was bypassed. A faulty or poor connection at that plug could also result in the miss condition. Also check for carbon deposits inside the spark plug boot.
3. If carbon tracing is evident replace coil and be sure plug wires relating to that coil are clean and tight. Excessive wire resistance or faulty connections could have caused the coil to be damaged.
4. If the no spark condition follows the suspected coil, that coil is faulty. Otherwise, the ignition module is the cause of no spark. This test could also be performed by substituting a known good coil for the one causing the no spark condition.

CHART C-4D-2

"DIS" MISFIRE UNDER LOAD
2.5L "P" SERIES (TBI)



①
- IF ENGINE MISFIRES AT IDLE ONLY, SEE PAGE 1.
- IGNITION OFF.
- DISCONNECT ONE SPARK PLUG LEAD AT A TIME AND, INSTALL SPARK TESTER (ST-125) J-26792 OR EQUIVALENT.
- OBSERVE SPARK TESTER WITH ENGINE IDLING. REPEAT THIS TEST FOR ALL PLUG LEADS. SEE CAUTION★
- SPARK SHOULD JUMP TESTER GAP ON ALL LEADS WITH ENGINE IDLING. DID IT?

NO

②
- IGNITION OFF, GROUND THE OPPOSITE PLUG LEAD OF THE AFFECTED COIL AT SPARK PLUG.
- SPARK SHOULD JUMP TESTER GAP WHILE CRANKING ENGINE. DOES IT?

YES

CHECK FOR;
- FAULTY, WORN OR CRACKED SPARK PLUG(S)
- PLUG FOULING DUE TO ENGINE MECHANICAL FAULT.

IF SPARK PLUGS CHECK OUT OK, SEE "CUTS OUT, MISSES" IN SYMPTOMS SECTION B.

NO

- CHECK THE RESISTANCE OF EACH PLUG WIRE OF THE COIL WHICH DID NOT FIRE THE SPARK TESTER.
- WIRE RESISTANCE SHOULD BE LESS THAN 30,000 OHMS EACH AND WIRES SHOULD NOT BE GROUNDED. ARE WIRES OK?

YES

REPLACE THE SPARK PLUG FOR THE LEAD WHICH WAS JUMPERED TO GROUND. IF MISFIRE IS STILL PRESENT, START MISFIRE TEST AGAIN AT STEP #1.

YES

③
- REMOVE COIL RETAINING NUTS AND REMOVE COILS.
- COILS SHOULD BE FREE OF CARBON TRACKING. ARE THEY?

NO

REPLACE FAULTY WIRE(S)

YES

④
- SWITCH A NORMALLY OPERATING COIL WITH THE COIL FROM PROBLEM CYLINDER.
- SPARK SHOULD JUMP TESTER GAP WITH ENGINE IDLING. DID IT?

NO

FAULTY IGNITION COIL. ALSO CHECK FOR FAULTY PLUG WIRE CONNECTIONS AND WIRE NIPPLES FOR CARBON TRACKING.

YES

ORIGINAL IGNITION COIL IS FAULTY

NO

FAULTY DIS MODULE

★CAUTION: When handling secondary spark plug leads with engine running, insulated pliers must be used and care exercised to prevent a possible electrical shock.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

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7S 3574-6E

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SECTION C7

EXHAUST GAS RECIRCULATION (EGR) SYSTEM

CONTENTS

GENERAL DESCRIPTION

PURPOSE

The EGR system is used to lower NOx (oxides of nitrogen) emission levels, caused by high combustion temperatures, by decreasing the combustion temperature.

The main element of the system is an EGR valve operated by vacuum, and mounted on the intake manifold.

The EGR valve feeds small amounts of exhaust gas back into the combustion chamber as shown in Figure C7-1 .

OPERATION

The EGR valve is opened by ported 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, and none at idle. The EGR valve is usually open under the engine is above idle speed.

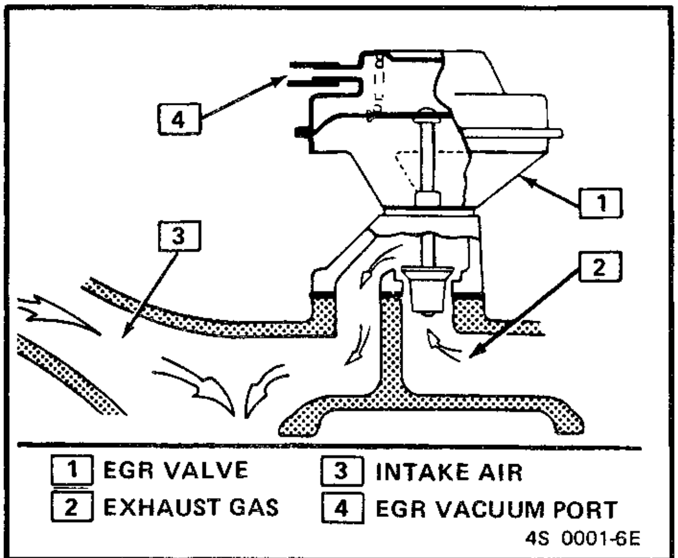


Figure C7-1 - Exhaust Gas Recirculation

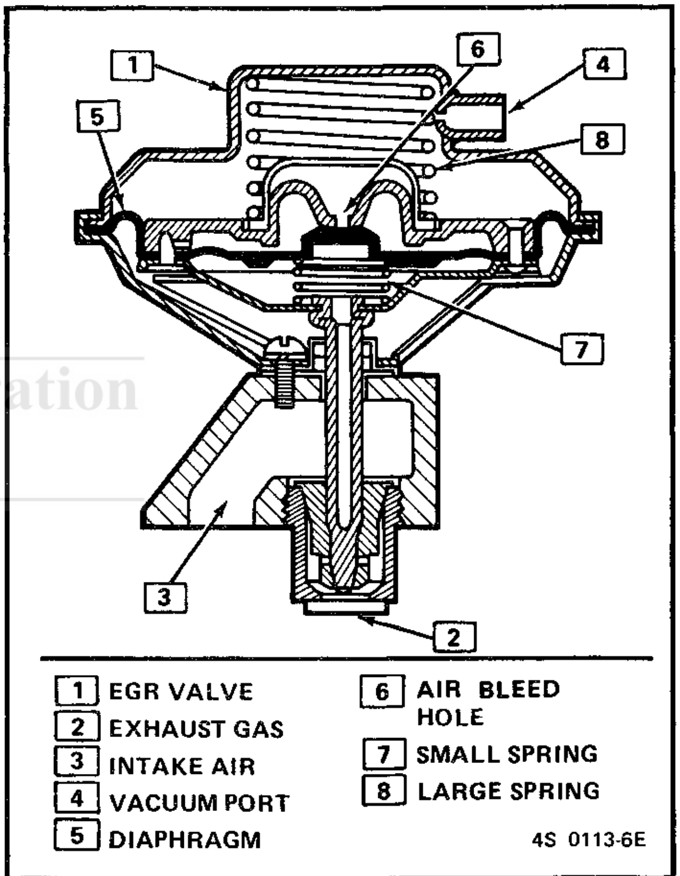


Figure C7-2 - Negative Backpressure EGR Valve

NEGATIVE BACKPRESSURE VALVE

The valve used on this engine is a negative backpressure valve. It varies the amount of exhaust gas flow into the manifold depending on manifold vacuum and variations in exhaust backpressure.

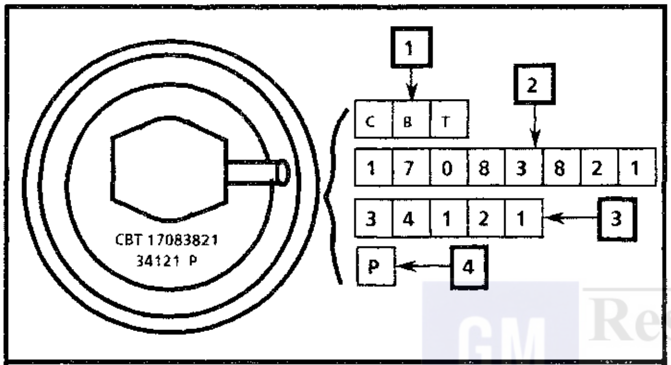
The diaphragm on this valve (shown in Figure C7-2) has an internal vacuum bleed hole which is held closed by a small spring when there is no exhaust backpressure.

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.

EGR VALVE IDENTIFICATION

- Negative backpressure EGR valves will have an "N" stamped on the top side of the valve after the part number (Figure C7-3).
- Positive backpressure EGR valves will have a "P" stamped on the top side of the valve, after the part number.
- Port EGR valves have no identification stamped after the part number.

When replacing an EGR valve, always check for correct part number in the parts catalog or supplemental bulletin.



1. ASSEMBLY PLANT CODE
2. PART NUMBER
3. DATE BUILT
4. LOOK HERE FOR LETTER:
   P = POSITIVE BACK PRESSURE
   N = NEGATIVE BACK PRESSURE
   BLANK = PORTED VALVE

* 4S 0538-6E
2-27-87

Figure C7-3 - EGR Valve Identification

RESULTS OF INCORRECT OPERATION

Too much EGR flow (at idle, cruise, or cold operation) and may result in any of the following conditions:

- Engine stops after cold start.
- Engine stops at idle after deceleration.
- Car surges during cruise.
- Rough idle.

Too little or no EGR flow allows combustion temperatures to get too high during acceleration and load conditions. This could causes:

- Spark knock (detonation).
- Engine overheating.
- Emission test failure.

DIAGNOSIS

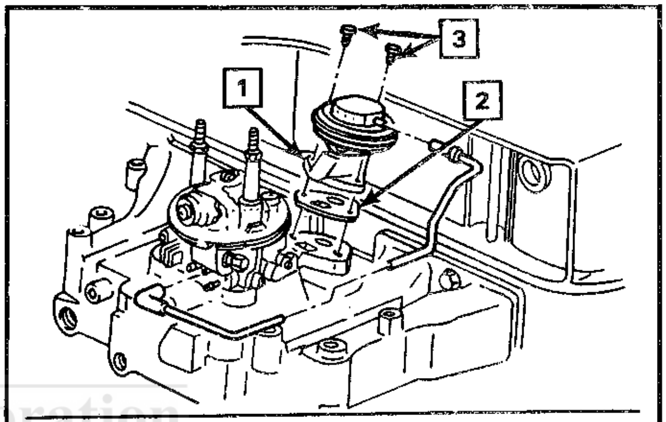
Because the EGR on 2.5L equipped vehicles is not ECM controlled, a "Scan" tool cannot be used for diagnosis. Diagnosis of the EGR system on the 2.5L is covered in CHART C-7 at the end of this section.

ON-CAR SERVICE

EGR VALVE

Remove or Disconnect

1. Air cleaner.
2. EGR valve vacuum hose at valve.
3. Bolts.
4. EGR valve from manifold.



1 EGR VALVE
3 BOLT (2) 22 N·m (16 FT LBS)
2 GASKET

7S 3184-6E

Figure C7-4 EGR to Manifold Mounting 2.5L

EGR Manifold Passage

Inspect

If EGR passages in the inlet manifold indicate excessive build-up of deposits, the passages should be cleaned. Care should be taken to ensure that all loose particles are completely removed to prevent them from clogging the EGR valve or from being ingested into the engine.

Clean

1. With a wire wheel, buff the exhaust deposits from the mounting surface and around the valve.
2. Look for exhaust deposits in the valve outlet. Remove deposit build-up with a screwdriver.
3. Clean mounting surfaces of intake manifold and valve assembly.

Install or Connect

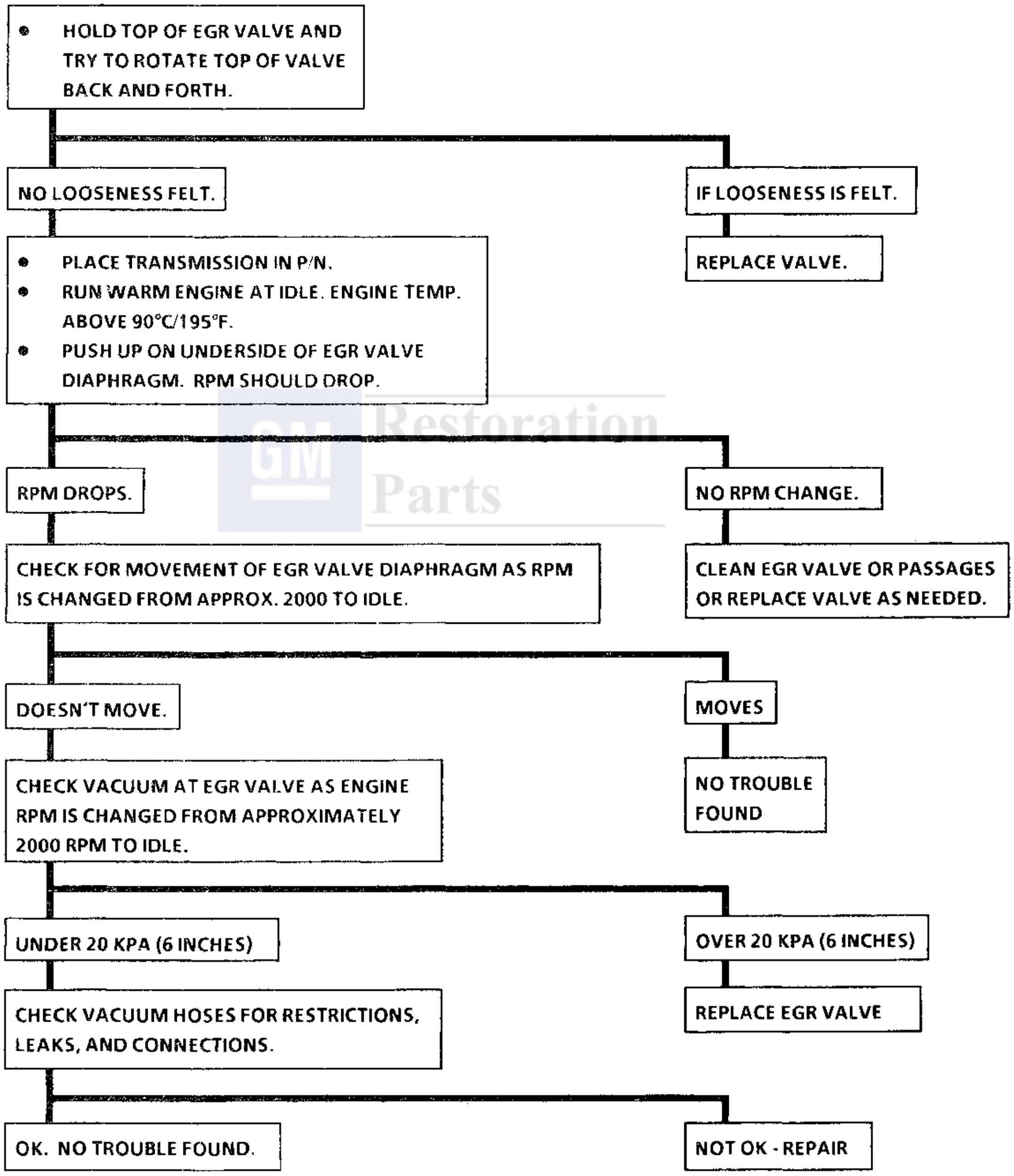
1. EGR valve on intake manifold using new gasket.
2. Bolts and tighten to 22 N · m (16 lb. ft.).
3. Vacuum hose to valve.
4. Air cleaner.

PARTS INFORMATION

PART NAME	GROUP
Valve, EGR	3.670
Gasket, EGR Valve	3.680

CHART C-7

EXHAUST GAS RECIRCULATION (EGR) VALVE CHECK (NON-ECM CONTROLLED) 2.5L "P" SERIES (TBI)



- HOLD TOP OF EGR VALVE AND TRY TO ROTATE TOP OF VALVE BACK AND FORTH.

NO LOOSENESS FELT.

- PLACE TRANSMISSION IN P/N.
- RUN WARM ENGINE AT IDLE. ENGINE TEMP. ABOVE 90°C/195°F.
- PUSH UP ON UNDERSIDE OF EGR VALVE DIAPHRAGM. RPM SHOULD DROP.

IF LOOSENESS IS FELT.

REPLACE VALVE.

RPM DROPS.

CHECK FOR MOVEMENT OF EGR VALVE DIAPHRAGM AS RPM IS CHANGED FROM APPROX. 2000 TO IDLE.

NO RPM CHANGE.

CLEAN EGR VALVE OR PASSAGES OR REPLACE VALVE AS NEEDED.

DOESN'T MOVE.

CHECK VACUUM AT EGR VALVE AS ENGINE RPM IS CHANGED FROM APPROXIMATELY 2000 RPM TO IDLE.

MOVES

NO TROUBLE FOUND

UNDER 20 KPA (6 INCHES)

CHECK VACUUM HOSES FOR RESTRICTIONS, LEAKS, AND CONNECTIONS.

OK. NO TROUBLE FOUND.

NOT OK - REPAIR

OVER 20 KPA (6 INCHES)

REPLACE EGR VALVE

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

* 4S 1325-6E
6-07-85

SECTION C8

TRANSMISSION CONVERTER CLUTCH (TCC) SYSTEM

CONTENTS

GENERAL DESCRIPTION

PURPOSE

The transmission converter clutch (TCC) system is designed to eliminate power loss by the converter (slippage) thus increasing fuel economy. By locking the converter clutch, a more effective coupling to the flywheel is achieved. The converter clutch is operated by an ECM controlled solenoid.

OPERATION

Engagement of the TCC is accomplished by a solenoid operated valve within the transmission. The solenoid is activated when an internal switch in the ECM is grounded. Although the ECM may command the TCC "ON", the converter clutch will not apply until internal transmission fluid pressure requirements are met. See Section "7A".

Before the ECM activates the TCC apply solenoid, several inputs must be monitored:

- Vehicle Speed - Must be above a certain value before the TCC can be applied.
- Coolant Temperature - The engine coolant temperature must be above a certain value before the TCC can be applied.
- Throttle Position Sensor - After the TCC is applied, during low engine load condition, the ECM uses the information from the TPS to release the clutch when the car is accelerating or decelerating at a certain rate.

CIRCUIT DESCRIPTION

The 12 volt power supply for the solenoid in the transmission is provided through a normally closed switch located on the brake pedal linkage. When the brake pedal is depressed (switch open) the power supply to the TCC solenoid is interrupted and the TCC is disengaged regardless of any other conditions. A 3rd gear apply switch (closed in 3rd gear) is placed in series between the brake switch and the TCC solenoid.

This switch will prevent TCC engagement until the transmission is in 3rd gear.

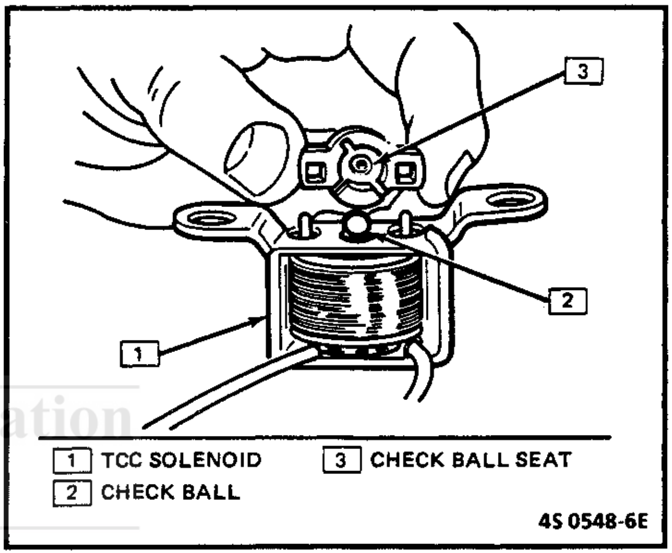


Figure C8-1 - TCC Solenoid

When the brake pedal is not depressed (switch closed) and the transmission is in 3rd gear (3rd gear switch closed), battery voltage will be fed to the TCC solenoid. If the ECM has determined that conditions are correct, the circuit from the TCC solenoid will be completed to ground through the ECM and the TCC solenoid will be activated.

DIAGNOSIS

The diagnosis of the TCC system is covered in CHART C-8. If the ECM detects a VSS input problem in the 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 TCC 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.

ON-CAR SERVICE

- See Section "7" for TCC solenoid service information.
- See Section "8A" for VSS service information.

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 "8C", if the shift light bulb needs replacement.
- See Section "6E" Introduction, to repair wiring problem.
- See Section "6E-C1", if ECM is to be replaced.

PARTS INFORMATION

PART NAME	GROUP
Sensor, Vehicle Speed	3.682
Solenoid, TCC	4.122

BLANK

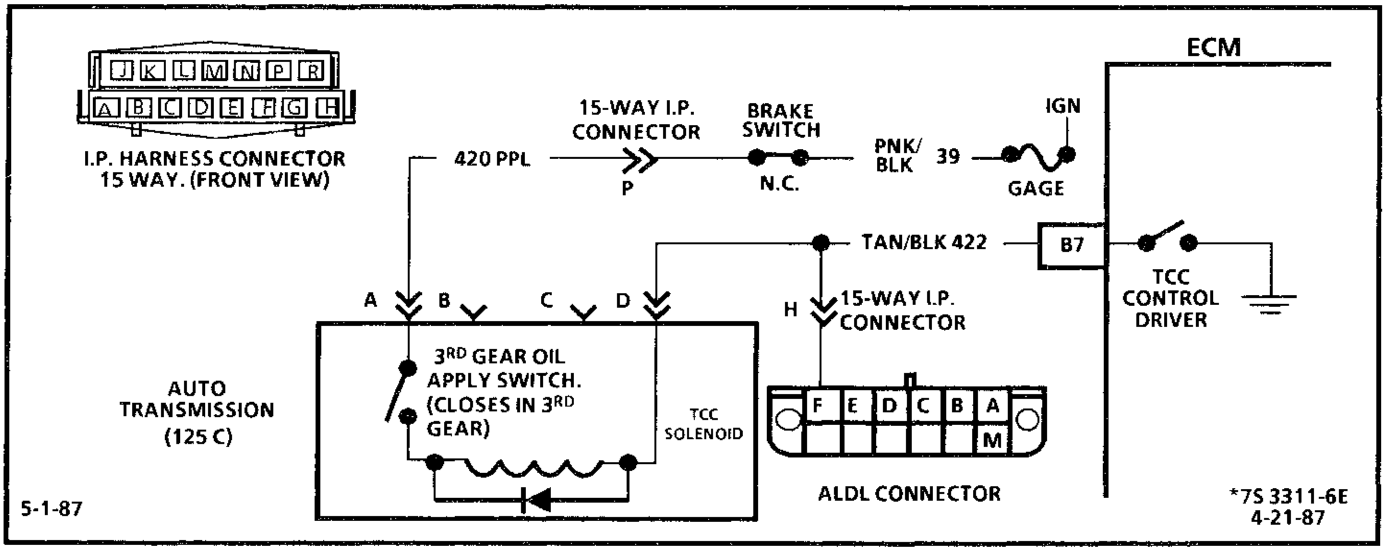


CHART C-8A

125C TRANSMISSION CONVERTER CLUTCH (TCC)
(ELECTRICAL DIAGNOSIS)
2.5L "P" SERIES (TBI)

Circuit Description:

The purpose of the automatic transmission torque converter clutch is to eliminate the power loss of the torque converter, when the vehicle is in a cruise condition. This allows the convenience of the automatic transmission and the fuel economy of a manual transmission.

Fused battery ignition is supplied to the TCC solenoid through the brake switch 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 30 mph (48 km/h).
- Engine at normal operating temperature (above 70°C, 156°F).
- Throttle position sensor output not changing, indicating a steady road speed.
- Transmission third gear switch closed.
- Brake switch closed.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Light "OFF" confirms transmission third gear apply switch is open.
2. At 48 km/h (30 mph), the transmission third gear switch should close. Test light will come on and confirm battery supply, and close 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.

Check TCC solenoid resistance as follows:

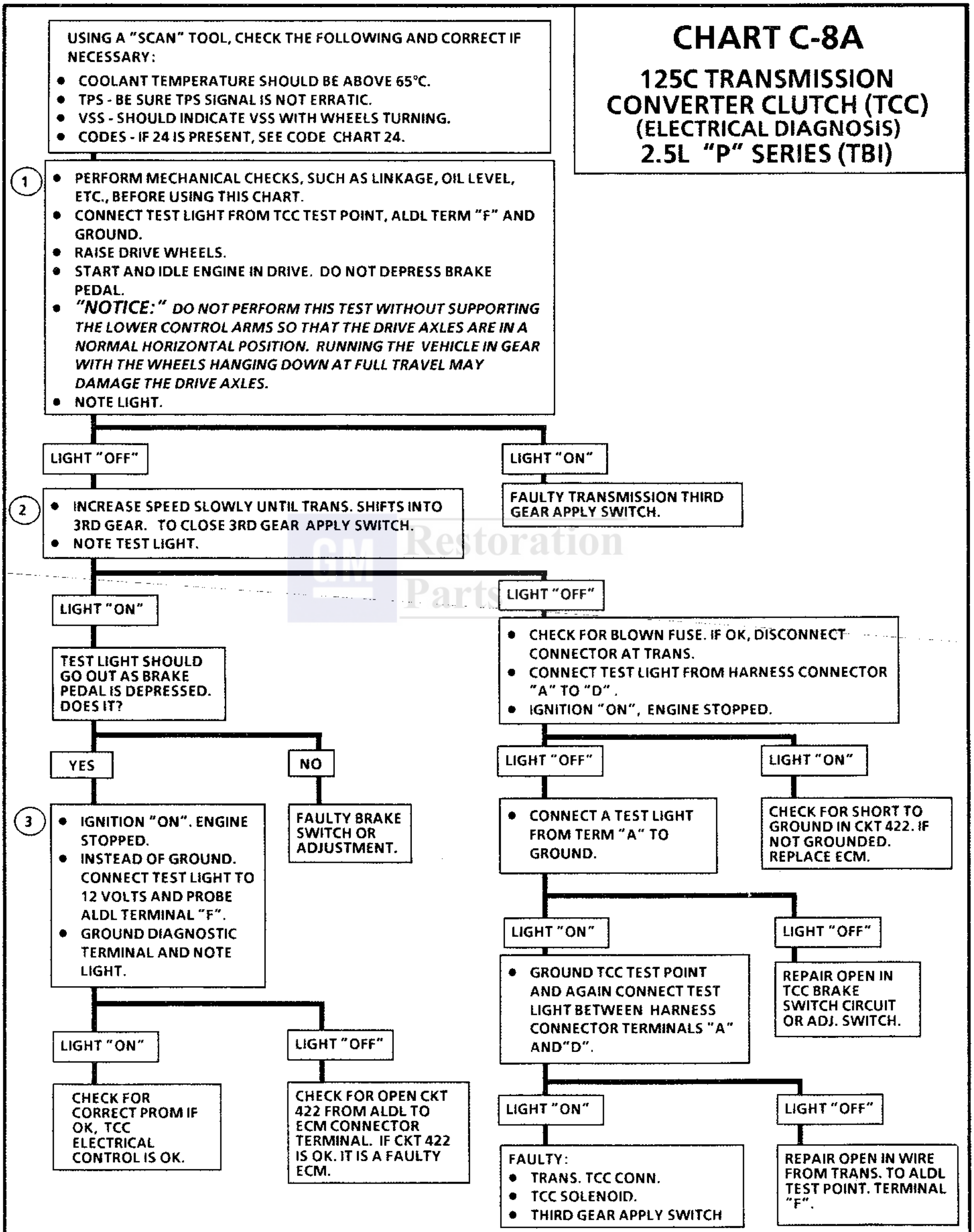
1. Disconnect TCC at transmission.
2. Connect ohmmeter between transmission connector, opposite harness connector terminal "A" and "D".
3. Raise drive wheels.
4. Run engine in drive about 48 km/h (30 mph) to close third gear apply switch.
5. Replace the TCC solenoid, and ECM, if resistance measures less than 20 ohms, when switch is closed.

Diagnostic Aids:

An engine coolant thermostat that is stuck open, or opens at too low a temperature, may result in an inoperative TCC.

CHART C-8A

125C TRANSMISSION CONVERTER CLUTCH (TCC)
(ELECTRICAL DIAGNOSIS)
2.5L "P" SERIES (TBI)



USING A "SCAN" TOOL, CHECK THE FOLLOWING AND CORRECT IF NECESSARY:

- COOLANT TEMPERATURE SHOULD BE ABOVE 65°C.
- TPS - BE SURE TPS SIGNAL IS NOT ERRATIC.
- VSS - SHOULD INDICATE VSS WITH WHEELS TURNING.
- CODES - IF 24 IS PRESENT, SEE CODE CHART 24.

①
- PERFORM MECHANICAL CHECKS, SUCH AS LINKAGE, OIL LEVEL, ETC., BEFORE USING THIS CHART.
- CONNECT TEST LIGHT FROM TCC TEST POINT, ALDL 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 SLOWLY UNTIL TRANS. SHIFTS INTO 3RD GEAR. TO CLOSE 3RD GEAR APPLY SWITCH.
- NOTE TEST LIGHT.

LIGHT "ON"

TEST LIGHT SHOULD GO OUT AS BRAKE PEDAL IS DEPRESSED. DOES IT?

NO

FAULTY BRAKE SWITCH OR ADJUSTMENT.

YES

③
- IGNITION "ON". ENGINE STOPPED.
- INSTEAD OF GROUND. CONNECT TEST LIGHT TO 12 VOLTS AND PROBE ALDL TERMINAL "F".
- GROUND DIAGNOSTIC TERMINAL AND NOTE LIGHT.

LIGHT "ON"

CHECK FOR CORRECT PROM IF OK, TCC ELECTRICAL CONTROL IS OK.

LIGHT "OFF"

CHECK FOR OPEN CKT 422 FROM ALDL TO ECM CONNECTOR TERMINAL. IF CKT 422 IS OK. IT IS A FAULTY ECM.

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 "ON"

CHECK FOR SHORT TO GROUND IN CKT 422. IF NOT GROUNDED. REPLACE ECM.

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 TERMINALS "A" AND "D".

LIGHT "ON"

FAULTY:
- TRANS. TCC CONN.
- TCC SOLENOID.
- THIRD GEAR APPLY SWITCH

LIGHT "OFF"

REPAIR OPEN IN WIRE FROM TRANS. TO ALDL TEST POINT. TERMINAL "F".

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

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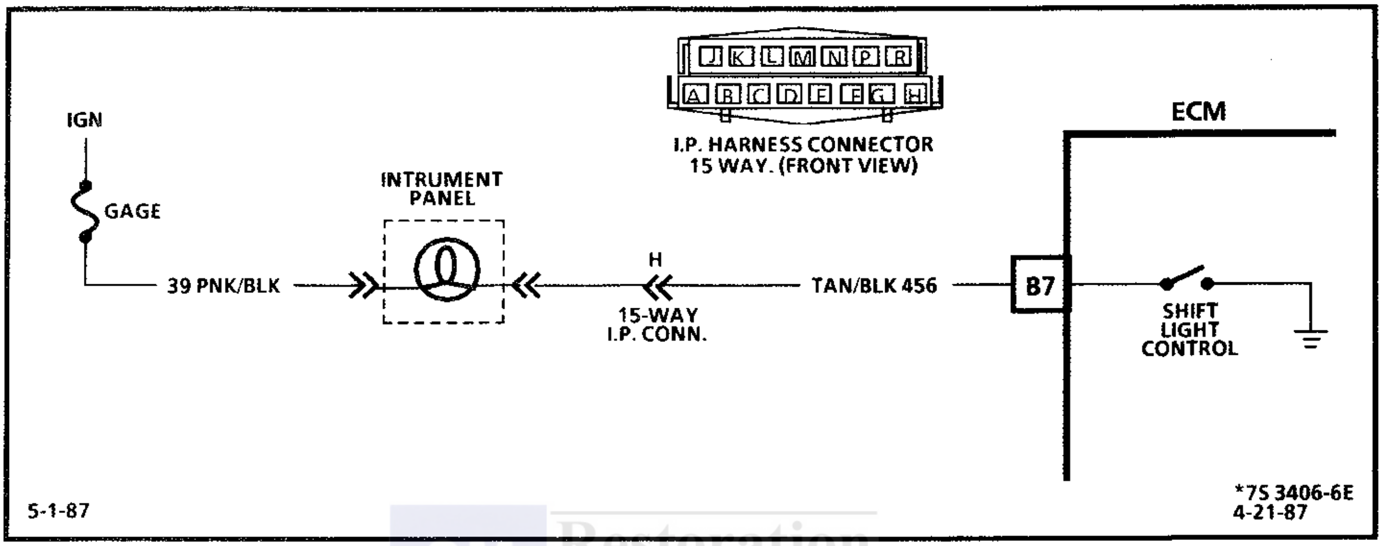


CHART C-8B

MANUAL TRANSMISSION (M/T) SHIFT LIGHT CHECK
2.5L "P" SERIES (TBI)

Circuit Description:

The shift indicates the best transmission shift point for maximum fuel economy. The light is controlled by the ECM and is turned "ON" by grounding CKT 456.

The ECM uses information from the following inputs to control the shift light:

- Coolant temperature
- TPS
- VSS
- RPM

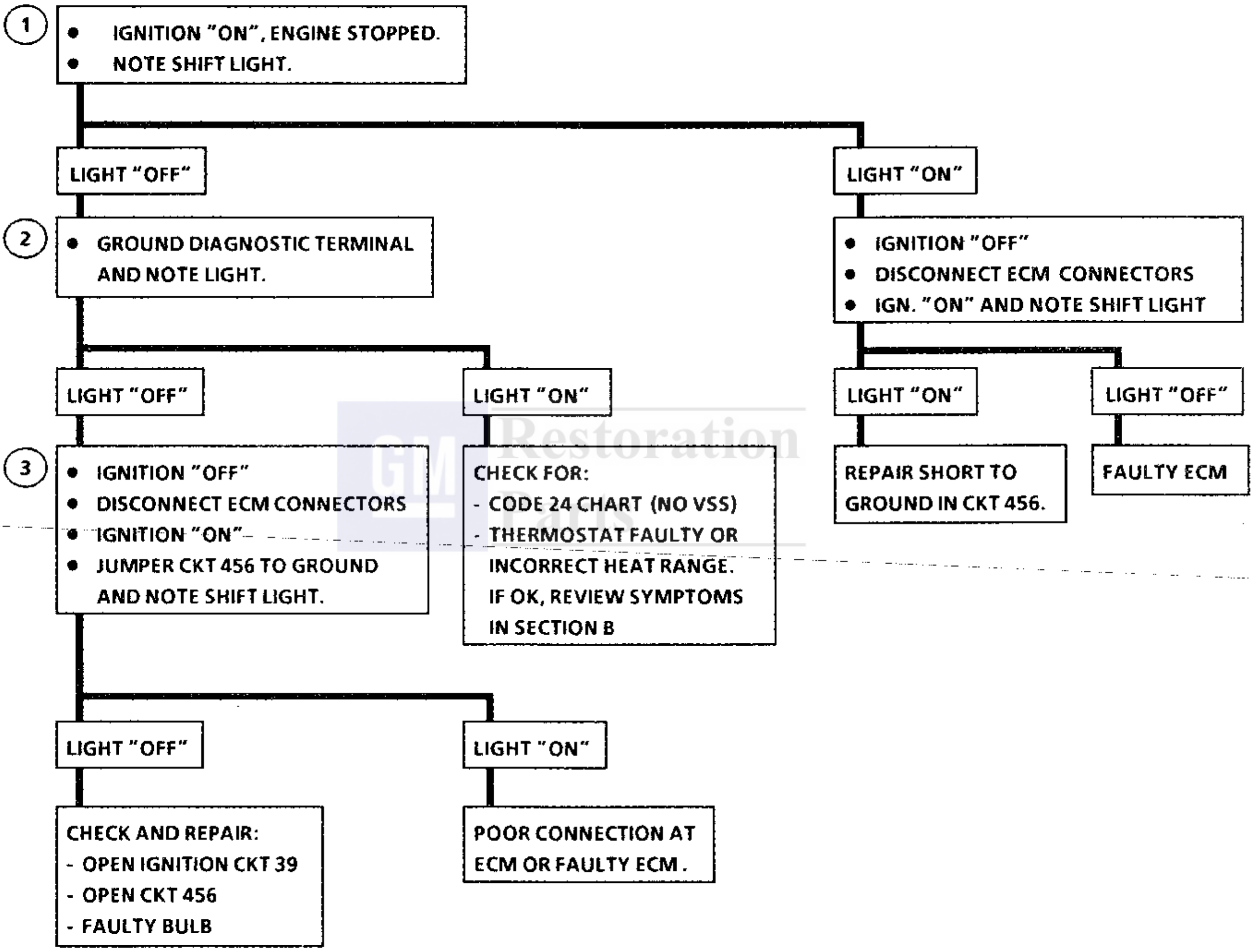
The ECM uses the measured rpm and the vehicle speed to calculate what gear the vehicle is in. It is this calculation that determines when the shift light should be turned "ON".

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. This should not turn "ON" the shift light. If the light is "ON", there is a short to ground in CKT 456 wiring, or a fault in the ECM.
2. When the diagnostic terminal is grounded, the ECM should ground CKT 456, and the shift light should come on.
3. This checks the shift light circuit up to the ECM connector. If the shift light illuminates, then the ECM connector is faulty, or the ECM does not have the ability to ground the circuit.

CHART C-8B

MANUAL TRANSMISSION (M/T)
SHIFT LIGHT CHECK
2.5L "P" SERIES (TBI)



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SECTION C10

ECM CONTROLLED AIR CONDITIONING

CONTENTS

GENERAL DESCRIPTION

In order to improve idle quality and wide open throttle performance, the A/C compressor is controlled by the ECM.

There are two different types of A/C systems used in GM vehicles. One is referred to as C.C.O.T. (cycling clutch orifice tube), which uses a fixed displacement compressor. The other type of system uses a compressor with a variable displacement, and is referred to as the V-5 type system. The V-5 type meets A/C requirements without cycling. For descriptions of both types, and an explanation of the components used, refer to Section "1B" of the service manual.

OPERATION: V-5 Type (2.5L)

This system consists of a low pressure switch, a high pressure cut-out switch, a control relay, and the compressor.

The low pressure switch is closed, when there is sufficient system pressure (depending on refrigerant charge and ambient temp.). When A/C control switch is "ON", and low pressure switch is closed, a signal is sent to the ECM which then turns "ON" the cooling fan.

The high pressure cut-out switch (normally closed), opens when the head pressure gets too high. This disables the A/C clutch, before damage can occur to the system.

The A/C control relay is controlled by the ECM, so that the ECM can increase idle speed before turning on the clutch, to disable the clutch during WOT, or during high power steering loads.

See appropriate C-10 chart for specific wiring and circuit description.

DIAGNOSIS

CHART C-10 should be used for diagnosing the electrical portion of the A/C circuit. Section 1B should be used for diagnosing the refrigerant portion of the system.

The "Scan" tool will be used in diagnosing the system, as it has the ability to read the A/C request input to the ECM, as well as displaying when the ECM has commanded the A/C clutch "ON"

ON-CAR SERVICE

For removal and replacement procedures of A/C components, refer to Section "1" of the service manual.

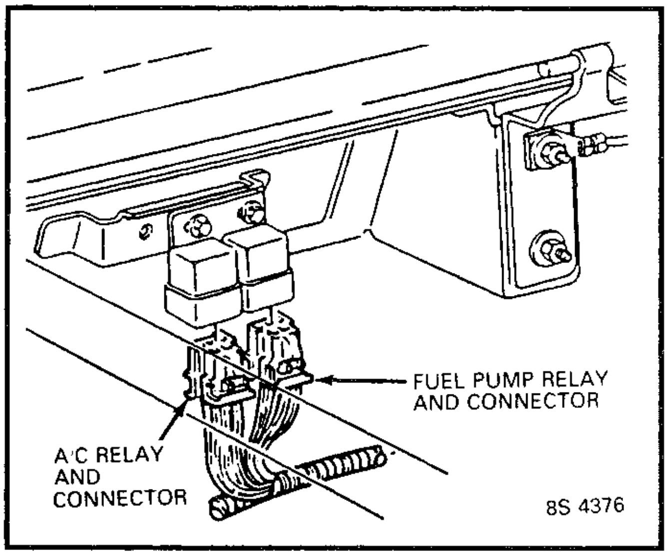

Figure C10-1 A/C Relay, 2.5L

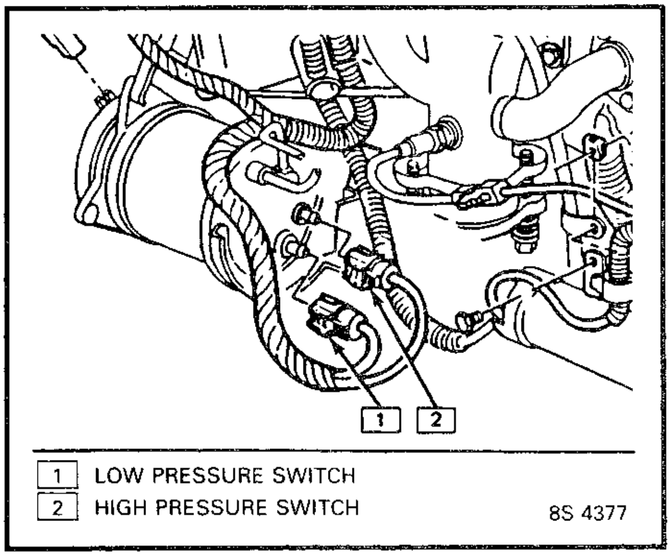

Figure C10-2 A/C Press. Switches, 2.5L

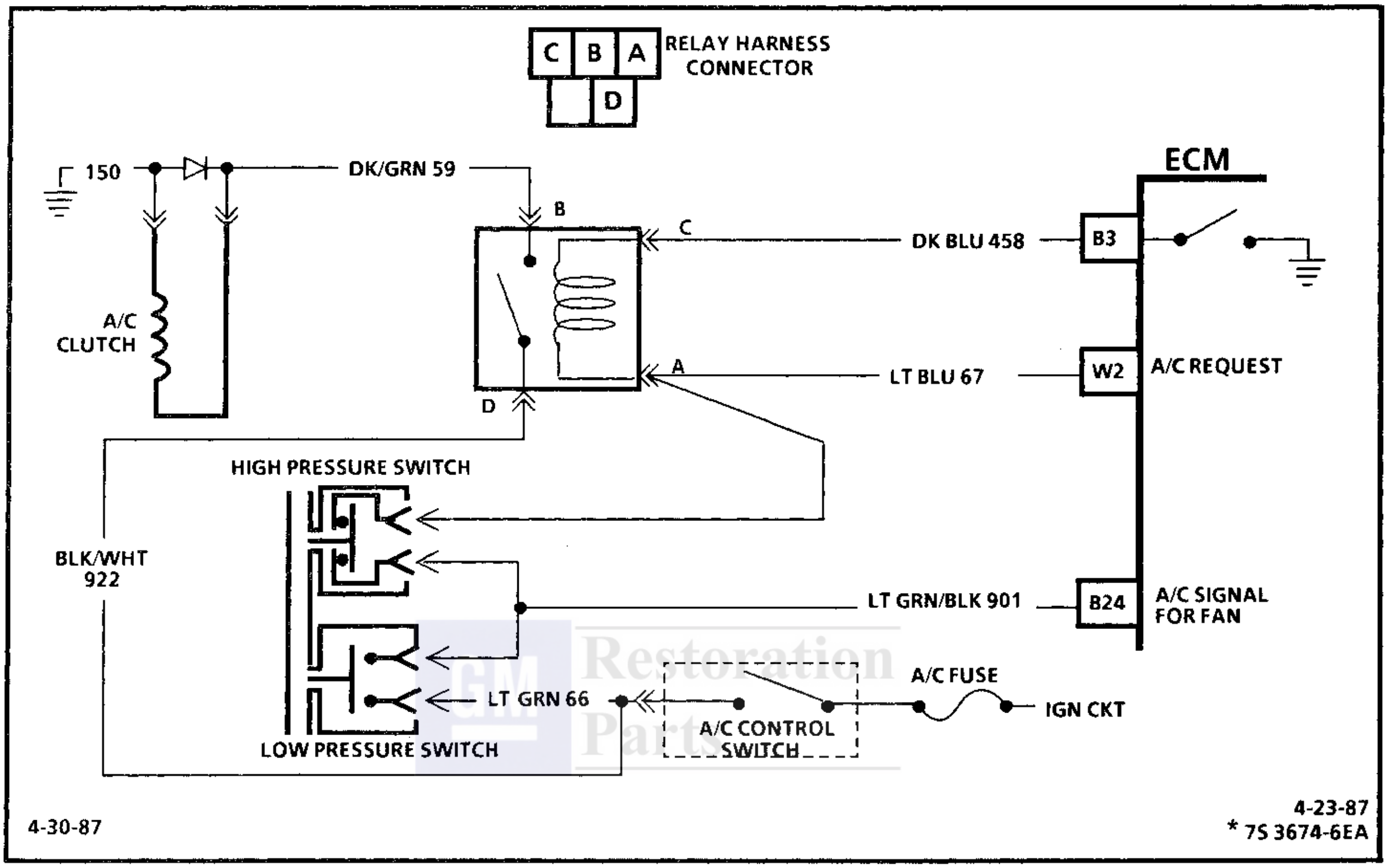

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CHART C-10

A/C CLUTCH CONTROL
2.5L "P" SERIES (TBI)

Circuit Description:

When an A/C Mode is selected on the A/C control switch, ignition voltage is supplied to the compressor low pressure switch. If there is sufficient A/C refrigerant pressure, the low pressure switch will be closed and complete the circuit to the closed high pressure cut-off switch and to CKTs 67 and 901. The voltage on CKT 67 to the ECM is shown by the "Scan" tool as A/C request "ON" (voltage present), "OFF" (no voltage). When a request for A/C is seen by the ECM, the ECM will ground CKT 458 of the A/C clutch control relay, the relay contact will close, and current will flow from CKT 922 to CKT 59 and engage the A/C compressor clutch. A "Scan" tool will show the grounding of CKT 458, as A/C clutch "ON". If voltage is seen by the ECM on CKT 901, the cooling fan will be turned "ON".

Diagnostic Aids:

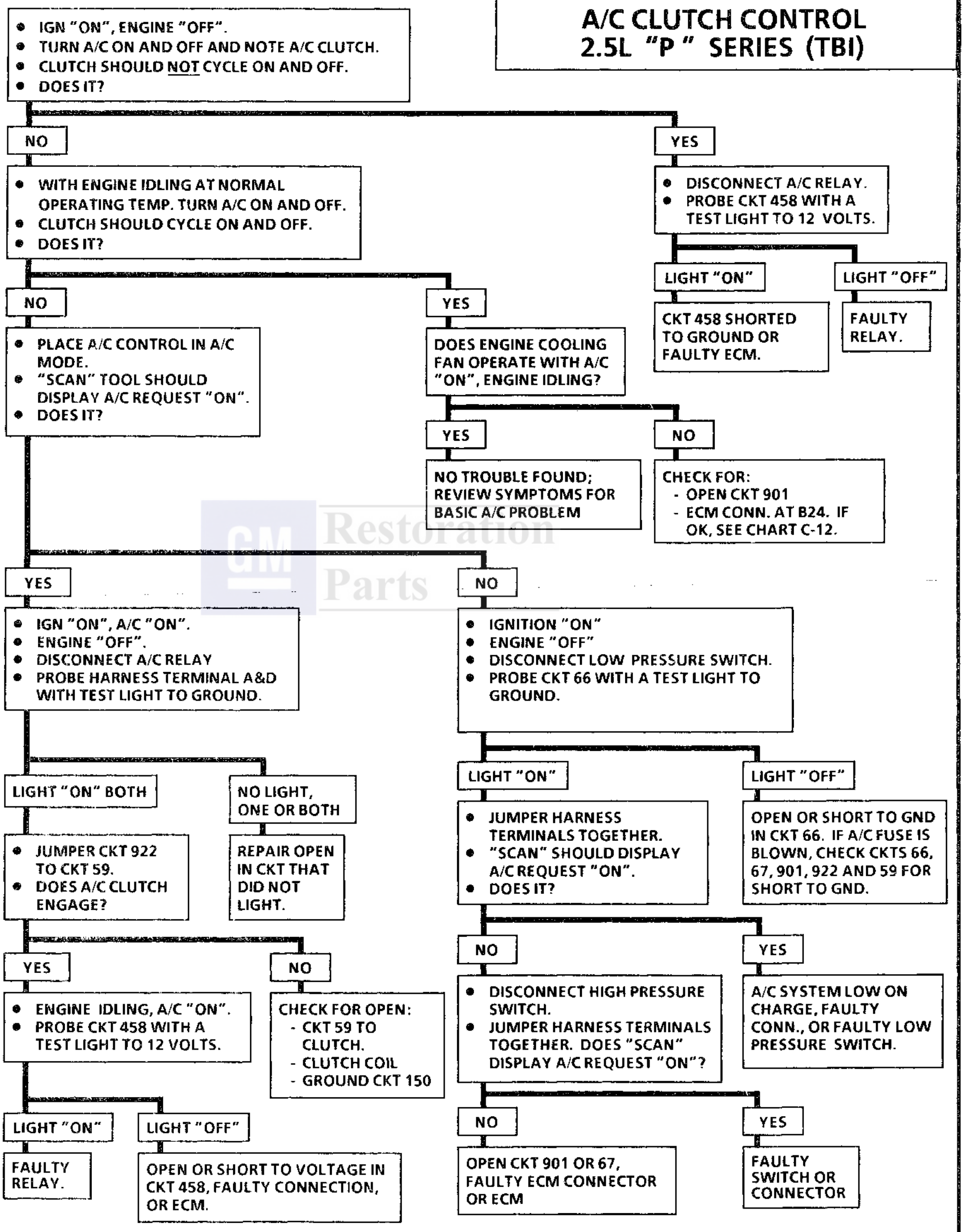
Both pressure switches are located on the high side of the A/C System. The low pressure switch will be closed at 40-47 psi and allow A/C clutch operation. Below 37 psi, the low pressure switch will be open and the A/C clutch will not operate.

At about 430 psi, the high pressure switch will open to disengage the A/C clutch and prevent system damage.

CKT 922 will have voltage when the ignition switch and A/C control are "ON". The high and low pressure switches are located at the rear of A/C compressor.

CHART C-10

A/C CLUTCH CONTROL 2.5L "P" SERIES (TBI)



- IGN "ON", ENGINE "OFF".
- TURN A/C ON AND OFF AND NOTE A/C CLUTCH.
- CLUTCH SHOULD NOT CYCLE ON AND OFF.
- DOES IT?

NO

- WITH ENGINE IDLING AT NORMAL OPERATING TEMP. TURN A/C ON AND OFF.
- CLUTCH SHOULD CYCLE ON AND OFF.
- DOES IT?

NO

- PLACE A/C CONTROL IN A/C MODE.
- "SCAN" TOOL SHOULD DISPLAY A/C REQUEST "ON".
- DOES IT?

YES

- IGN "ON", A/C "ON".
- ENGINE "OFF".
- DISCONNECT A/C RELAY
- PROBE HARNESS TERMINAL A&D WITH TEST LIGHT TO GROUND.

LIGHT "ON" BOTH

- JUMPER CKT 922 TO CKT 59.
- DOES A/C CLUTCH ENGAGE?

YES

- ENGINE IDLING, A/C "ON".
- PROBE CKT 458 WITH A TEST LIGHT TO 12 VOLTS.

LIGHT "ON"

FAULTY RELAY.

LIGHT "OFF"

OPEN OR SHORT TO VOLTAGE IN CKT 458, FAULTY CONNECTION, OR ECM.

NO

CHECK FOR OPEN:
- CKT 59 TO CLUTCH.
- CLUTCH COIL
- GROUND CKT 150

NO LIGHT, ONE OR BOTH

REPAIR OPEN IN CKT THAT DID NOT LIGHT.

NO

- IGNITION "ON"
- ENGINE "OFF"
- DISCONNECT LOW PRESSURE SWITCH.
- PROBE CKT 66 WITH A TEST LIGHT TO GROUND.

LIGHT "ON"

- JUMPER HARNESS TERMINALS TOGETHER.
- "SCAN" SHOULD DISPLAY A/C REQUEST "ON".
- DOES IT?

NO

- DISCONNECT HIGH PRESSURE SWITCH.
- JUMPER HARNESS TERMINALS TOGETHER. DOES "SCAN" DISPLAY A/C REQUEST "ON"?

NO

OPEN CKT 901 OR 67, FAULTY ECM CONNECTOR OR ECM

YES

FAULTY SWITCH OR CONNECTOR

YES

A/C SYSTEM LOW ON CHARGE, FAULTY CONN., OR FAULTY LOW PRESSURE SWITCH.

LIGHT "OFF"

OPEN OR SHORT TO GND IN CKT 66. IF A/C FUSE IS BLOWN, CHECK CKTS 66, 67, 901, 922 AND 59 FOR SHORT TO GND.

YES

DOES ENGINE COOLING FAN OPERATE WITH A/C "ON", ENGINE IDLING?

YES

NO TROUBLE FOUND; REVIEW SYMPTOMS FOR BASIC A/C PROBLEM

NO

CHECK FOR:
- OPEN CKT 901
- ECM CONN. AT B24. IF OK, SEE CHART C-12.

YES

- DISCONNECT A/C RELAY.
- PROBE CKT 458 WITH A TEST LIGHT TO 12 VOLTS.

LIGHT "ON"

CKT 458 SHORTED TO GROUND OR FAULTY ECM.

LIGHT "OFF"

FAULTY RELAY.

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SECTION C12

ELECTRIC COOLING FAN

CONTENTS

GENERAL DESCRIPTION

All front wheel drive vehicles, with transversely mounted engines, use an electric cooling fan. The fan is used for engine and A/C condenser cooling and is ECM controlled.

OPERATION

The ECM provides a ground path to energize the fan relay, which turns "ON" the cooling fan. The ECM will command the fan "ON", when coolant temp. is above 108°C. When the engine cools down to about 101°C, the ECM de-energizes the fan relay, and the fan stops. If the coolant sensor fails (Code 14 or 15 set), the ECM will command constant fan.

A/C equipped vehicles have a separate signal line to the ECM for fan control. When the A/C control switch is on and the low pressure switch closed, the ECM receives a signal on this line and turns on the fan. The A/C clutch does not have to engage for the ECM to turn "ON" the fan.

DIAGNOSIS

The following charts will diagnose the ECM controlled cooling fans. For specific system components and wiring see the Electrical Troubleshooting Manual.

ON-CAR SERVICE

Cooling system component replacement can be found in Section "6B".

PARTS INFORMATION

PART NAME	GROUP
Fan kit, Elec. Clg.	1.055
Motor kit, Elec Clg. Fan	1.055
Relay, Engine Fan	1.055

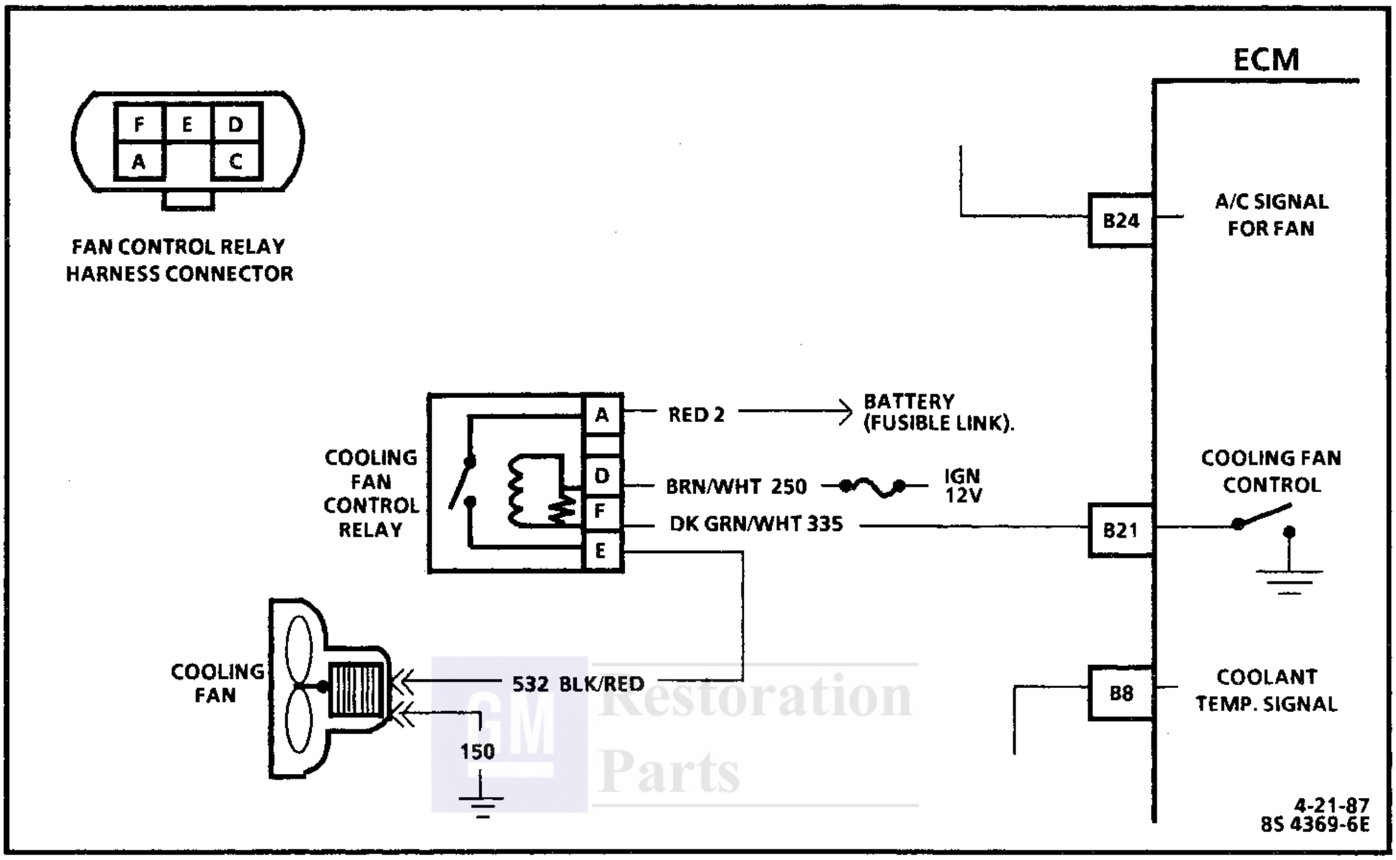


CHART C-12

ENGINE COOLING FAN
2.5L "P" SERIES (TBI)

Circuit Description:

Battery voltage to operate the cooling fan motor is supplied to relay terminal "A". Ignition voltage to energize the relay is supplied to relay terminal "D". When the ECM grounds CKT 335, the relay is energized and the cooling fan is turned "ON". When the engine is running, the ECM will turn the cooling fan "ON" if:

- A/C is "ON" and vehicle speed is less than 30 mph (48 Km/h).
- Coolant temperature greater than 108°C (230°F).
- Code 14 or 15, coolant sensor failure.

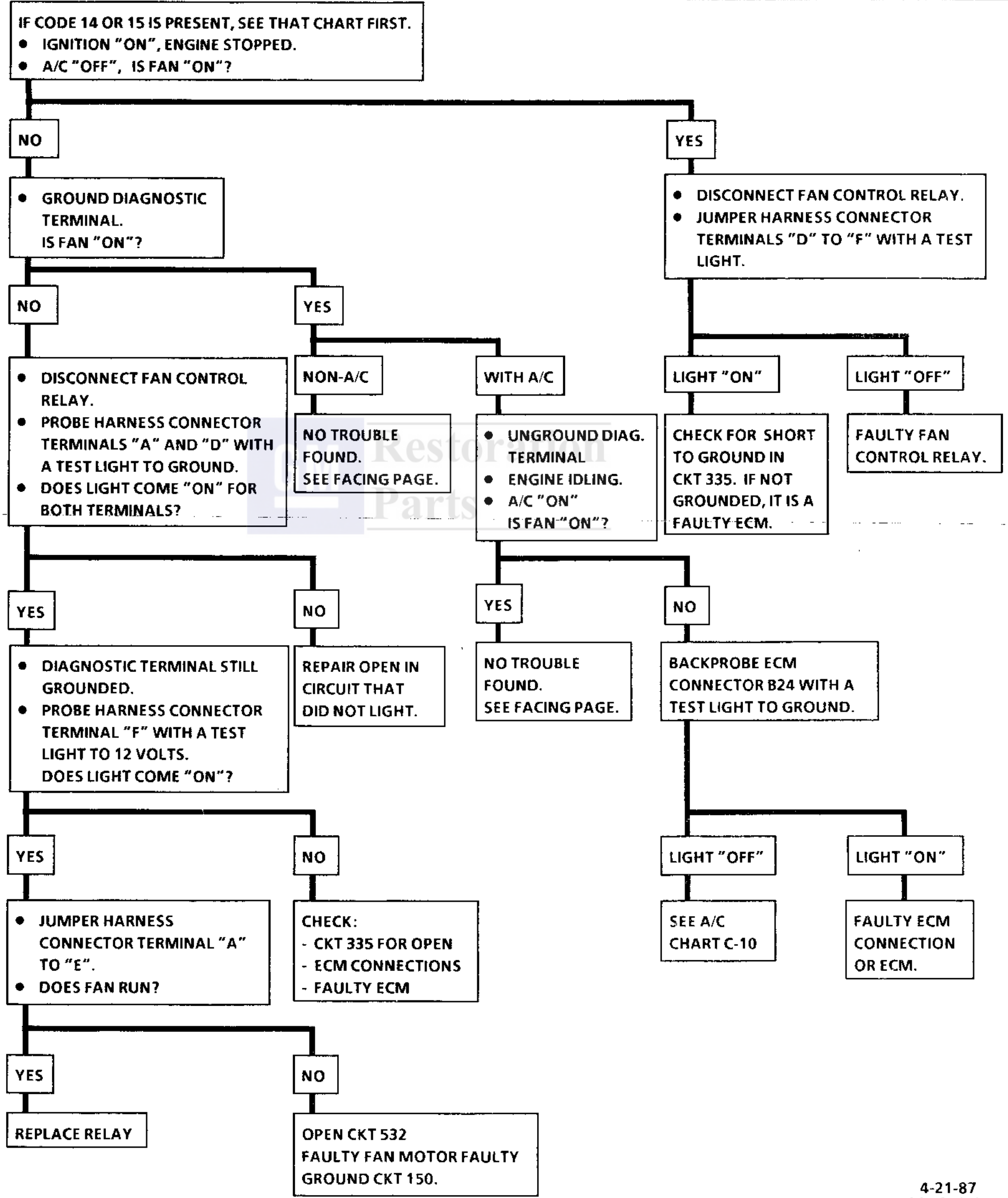
Diagnostic Aids:

If the owner complained of an overheating problem, it must be determined if the complaint was due to an actual boil over, or the hot light, or temp. gage indicated over heating.

If the gage, or light, indicates overheating, but no boilover is detected, the gage circuit should be checked. The gage accuracy can, also, be checked by comparing the coolant sensor reading using a "SCAN" tool and comparing its reading with the gage reading.

If the engine is actually overheating and the gage indicates overheating, but the cooling fan is not coming on, the coolant sensor has probably shifted out of calibration and should be replaced.

CHART C-12
ENGINE COOLING FAN
2.5L "P" SERIES (TBI)



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SECTION C13

POSITIVE CRANKCASE VENTILATION (PCV)

CONTENTS

GENERAL DESCRIPTION

A positive crankcase ventilation (PCV) system is used to consume crankcase vapors in the combustion process instead of venting to atmosphere. Fresh air from the air cleaner is supplied to the crankcase, mixed with blow-by gases and then passed through a positive crankcase ventilation (PCV) valve into the intake manifold (Figure C13-1).

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.

DIAGNOSIS

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.

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.

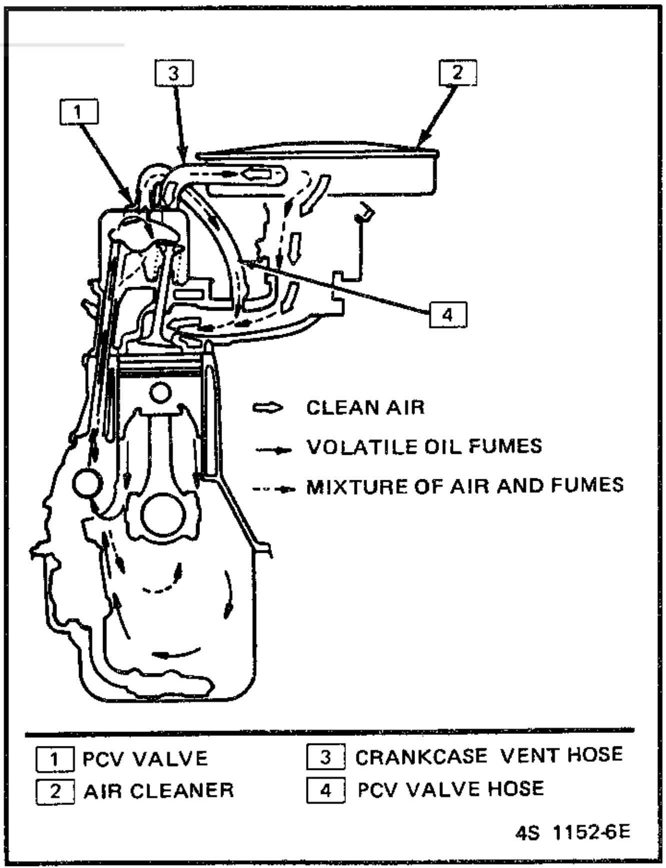


Figure C13-1 - PCV Flow - Typical

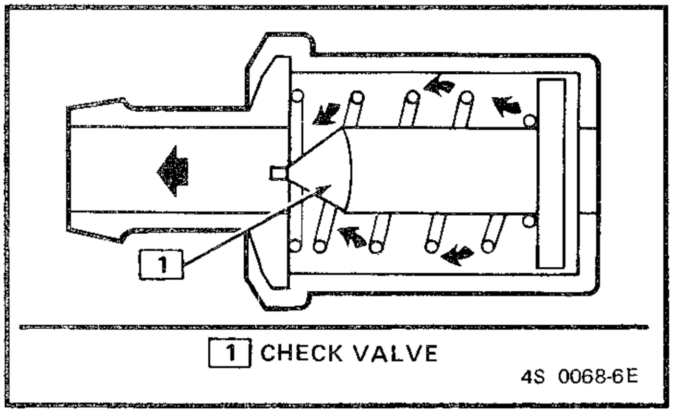


Figure C13-2 - PCV Valve Cross Section

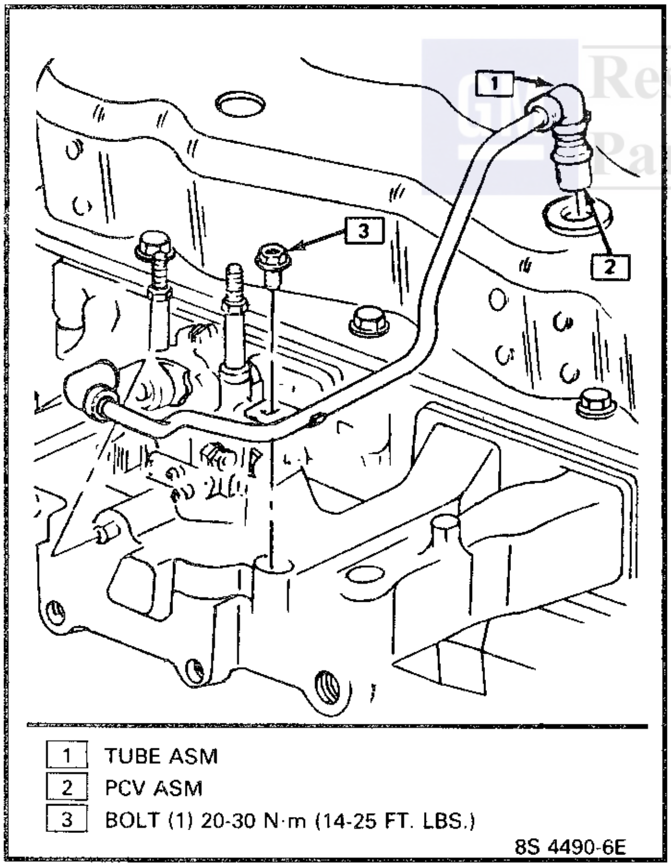


Figure C13-3 - PCV System - 2.5L

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, Cr/Case Vent	1.745
Tube, Cr/Case Vent	1.762

SECTION 6E3

DRIVEABILITY AND EMISSIONS FUEL INJECTION (PORT)

THIS SECTION APPLIES TO:

2.8L L44 (P SERIES) VIN CODE "9"

CONTENTS

INTRODUCTION

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 (EGR) SYSTEM

SECTION C8

TRANSMISSION/TRANSAXLE CONVERTER CLUTCH AND MANUALTRANSMISSION SHIFT LIGHT

SECTION C10

ECM CONTROLED AIR CONDITIONING

SECTION C13

POSITIVE CRANKCASE VENTILATION (PCV)

ALL NEW GENERAL MOTORS VEHICLES ARE CERTIFIED BY THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY AS CONFORMING TO THE REQUIREMENTS OF THE REGULATIONS FOR THE CONTROL OF AIR POLLUTION FROM NEW MOTOR VEHICLES. THIS CERTIFICATION IS CONTINGENT ON CERTAIN ADJUSTMENTS BEING SET TO FACTORY STANDARDS. IN MOST CASES, THESE ADJUSTMENT POINTS EITHER HAVE BEEN PERMANENTLY SEALED AND/OR MADE INACCESSIBLE TO PREVENT INDISCRIMINATE OR ROUTINE ADJUSTMENT IN THE FIELD. FOR THIS REASON, THE FACTORY PROCEDURE FOR TEMPORARILY REMOVING PLUGS, CAPS, ETC., FOR PURPOSES OF SERVICING THE PRODUCT, MUST BE STRICTLY FOLLOWED AND, WHEREVER PRACTICABLE, RETURNED TO THE ORIGINAL INTENT OF THE DESIGN.

INTRODUCTION

GENERAL DESCRIPTION

This Section applies to engines which have a fuel injector in the intake manifold near the intake valve for each cylinder. It is commonly referred to as "Port Fuel Injection".

These engines have controls to reduce exhaust emissions, while maintaining good driveability and fuel economy.

An Engine Control Module (ECM) is the heart of this control system and has sensors used to provide information about engine operation and the various systems it controls. Details of basic operation, diagnosis, functional checks, and on-vehicle service are covered in Section C, Component Systems.

The ECM has the ability to do some diagnosis of itself, and of other parts of the system. When it finds a problem, it lights a "Service Engine Soon" Light on the instrument panel and a trouble code will be stored in the ECM memory. This does not mean that the engine should be stopped right away, but that the cause of the light coming on should be checked as soon as reasonably possible.

DIAGNOSIS PROCEDURE

The following Sections(s) are written for specific engine applications and are clearly indentified. Be sure to use only the section which applies to the engine family being diagnosed.

Before using this Section of the manual, you should be familiar with the information and the proper diagnosing procedures as described in Section 6E. If the proper diagnosis procedures are not followed, as described in Section 6E, it may result in unnecessary replacement of good parts.

Trouble Tree Charts incorporate diagnosis procedures using an ALDL "Scan" tool, where possible. The "Scan" tool has the ability to save time in diagnosis and prevent the replacement of good parts. **The key to using the "SCAN" tool successfully for diagnosis lies in the technician's ability to understand the system he is trying to diagnose, as well as an understanding of the "SCAN" tool's limitations. See Section 6E for more information.**

SECTION A
2.8L ENGINE

BASIC PROCEDURE

If you have not reviewed the basic information on how to use the diagnostic procedures, go to the introduction of this section. The facing page of each chart in this section will provide a general circuit description and in some instances, alternate diagnostic steps or other diagnostic aids specific to that chart or circuit.

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

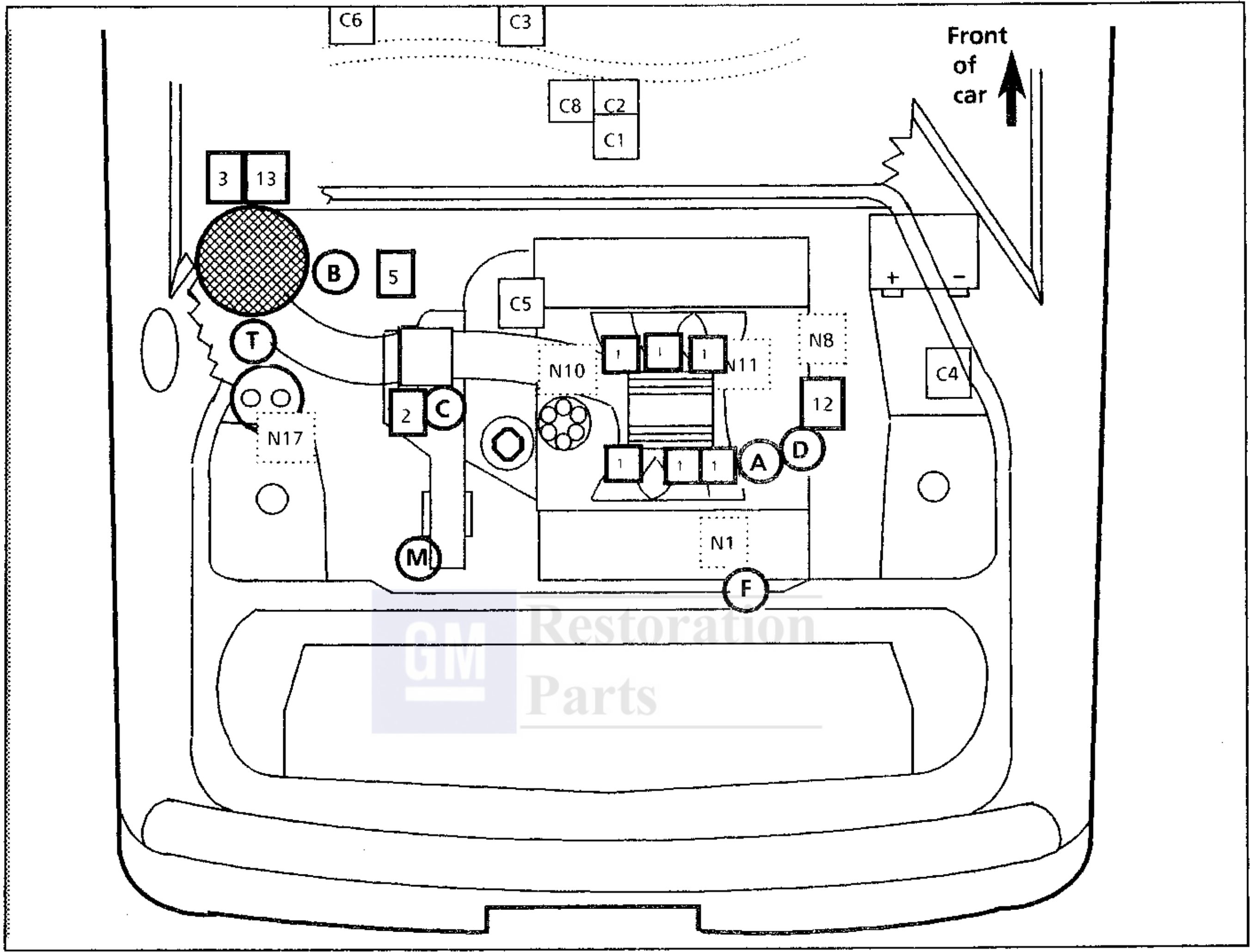
The vehicle drive wheels should always be blocked while checking the system.

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.

SECTION A - DIAGNOSTIC CHARTS

'P' SERIES RPO: L44 VIN CODE: 9 2.8L V6 PFI



☐ COMPUTER HARNESS

C1 Electronic Control Module (ECM)
C2 ALDL diagnostic connector
C3 "SERVICE ENGINE SOON" light
C4 ECM power
C5 ECM harness ground
C6 Fuse panel
C8 Fuel pump test connector
(ALDL 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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Figure A-1 - Component Locations 2.8L "P" Series

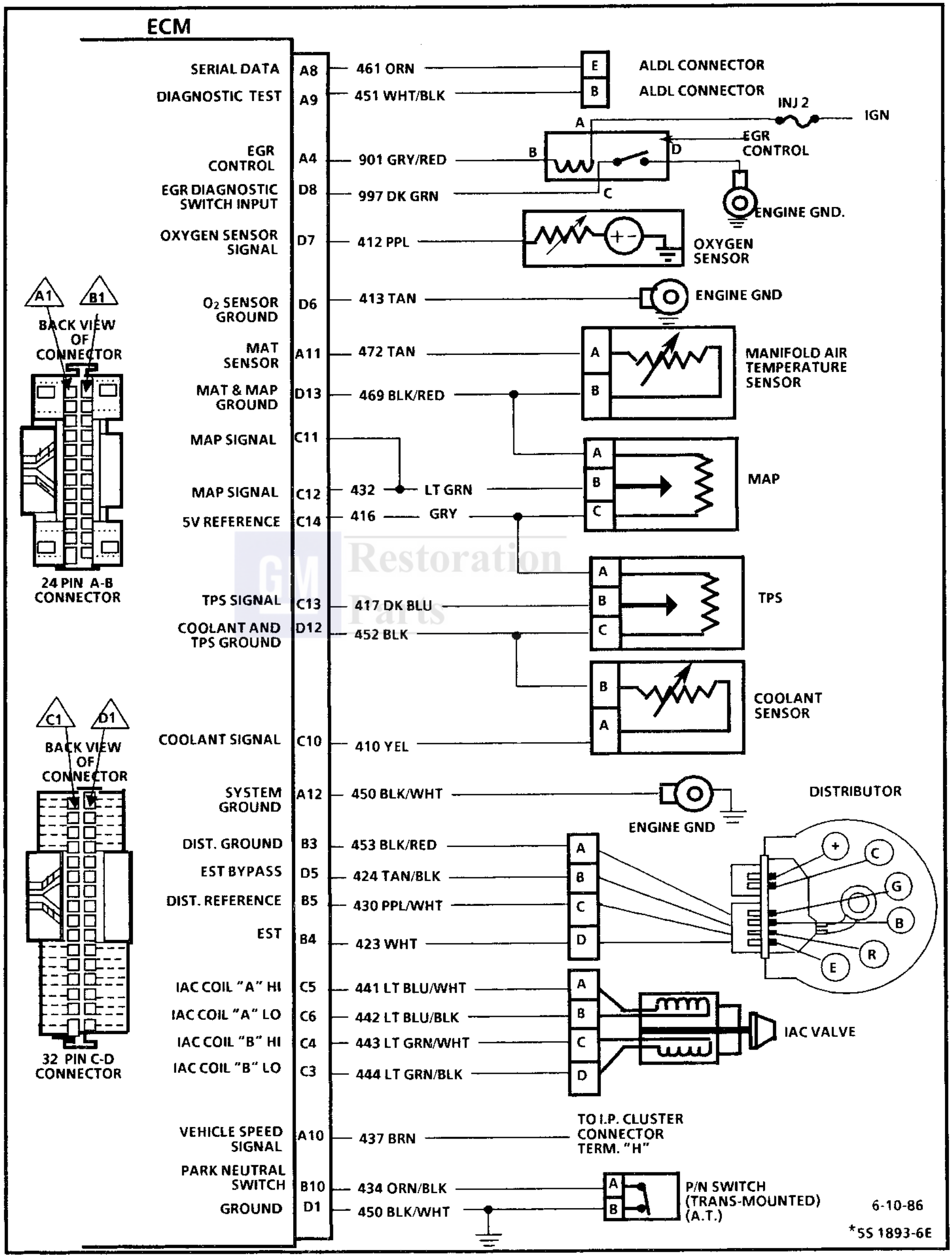


Figure A-2 - ECM Wiring Diagram 2.8L "P" Series

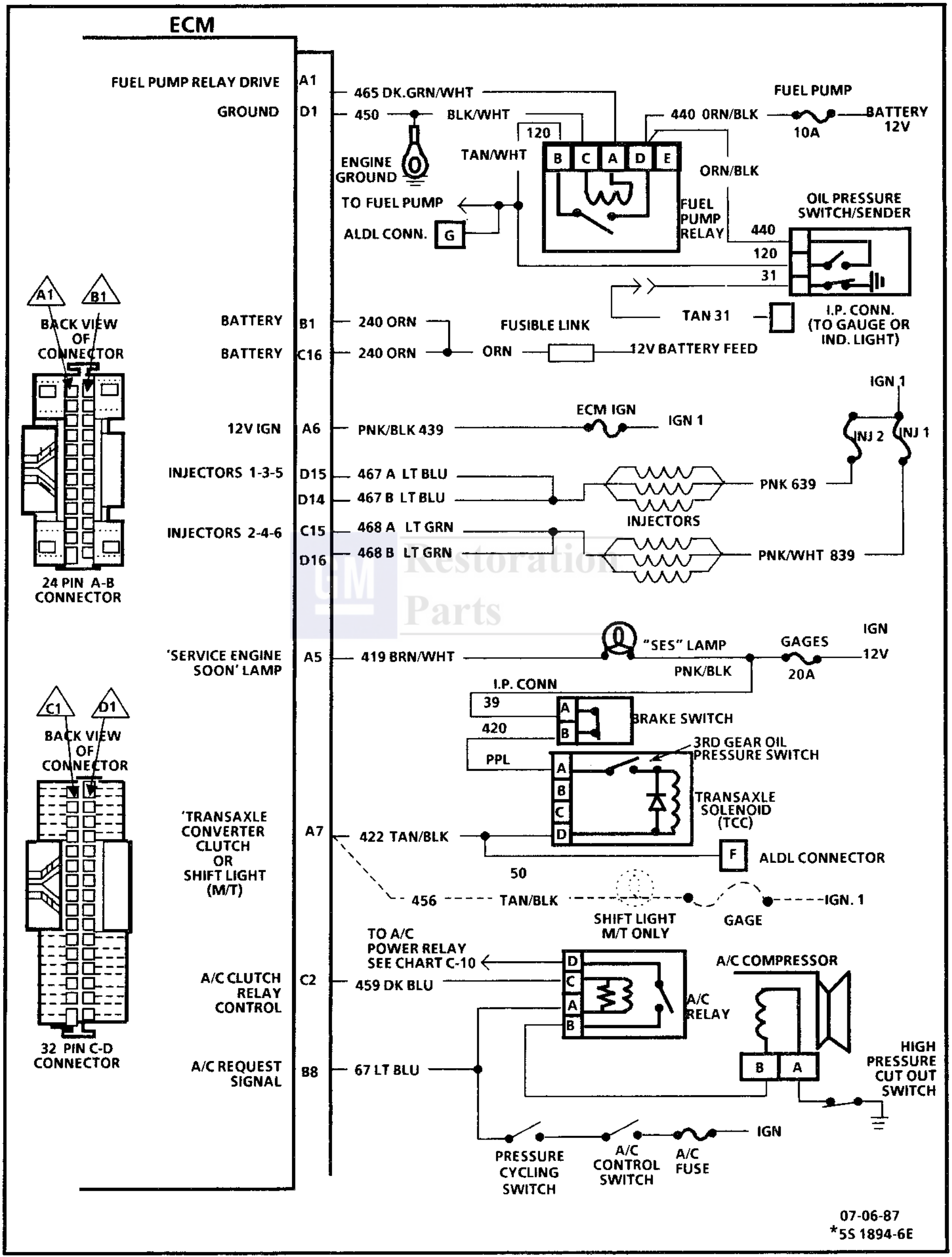


Figure A-3 - ECM Wiring Diagram 2.8L "P" Series

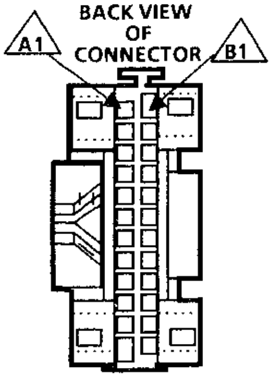
PORT FUEL INJECTION ECM CONNECTOR IDENTIFICATION

This ECM voltage chart is for use with a digital voltmeter to further aid in diagnosis. The voltages you get may vary due to low battery charge or other reasons, but they should be very close.

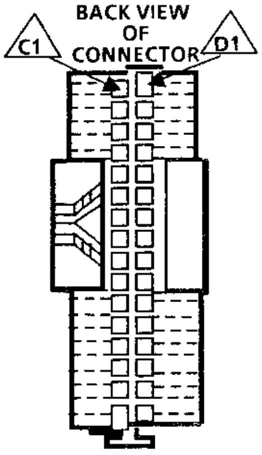
THE FOLLOWING CONDITIONS MUST BE MET BEFORE TESTING:

- Engine at operating temperature
- Engine idling in closed loop (for "Engine Run" column)
- Test terminal not grounded
- ALDL tool not installed

	VOLTAGE KEY ON"	VOLTAGE ① ENG. RUN	CIRCUIT	PIN
④	0*	B +	FUEL PUMP RELAY	A1
			NOT USED	
			NOT USED	
	B +	B +	EGR VALVE	A4
	0*	B +	"SERVICE ENGINE SOON LIGHT"	A5
	B +	B +	IGN .-ECM FUSE	A6
	B + 0*	B + 0*	SHIFT LIGHT M/T TCC CONTROL A/T	A7
	2-5	2-5	SERIAL DATA	A8
	5	5	DIAG. TERM.	A9
	0	0	SENSOR SIGNAL VEHICLE SPEED	A10
②			MAT SIGNAL	A11
	0 *	0 *	GROUND	A12
			NOT USED	C1
	B +	B +	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
	B +	B +	INJ. 2.4.6 "B"	C15
	B +	B +	BATT. 12 VOLTS	C16



24 PIN A-B CONNECTOR



32 PIN C-D CONNECTOR

PIN	CIRCUIT	VOLTAGE KEY "ON"	VOLTAGE ① ENG. RUN	
B1	BATT. 12 VOLTS	B +	B +	
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	B +	B +	
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"	B +	B +	
D15	INJ. 1, 3,-5 "A"	B +	B +	
D16	INJ. 2,4,6 "B"	B +	B +	

1 Varies from .60 to battery voltage depending on position of drive wheels
2 Varies with temperature.
3 Varies
4 12V first two seconds.
* Less than .5 volts.

ENGINE 2.8 L44

CARLINE "P"

6-17-87
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Figure A-4 - ECM Connector Terminal End View 2.8L "P" Series

DIAGNOSTIC CIRCUIT CHECK

The diagnostic circuit check is an organized approach to identifying a problem created by an electronic engine control system malfunction. It must be the starting point for any driveability complaint diagnosis, because it directs the service technician to the next logical step in diagnosing the complaint.

The "Scan Data" listed in the table may be used for comparison, after completing the diagnostic circuit check and finding the onboard diagnostics functioning properly and no trouble codes displayed. The "typical values" are an average of display values recorded from normally operating vehicles and are intended to represent what a normally functioning system would typically display.

A "SCAN" TOOL THAT DISPLAYS FAULTY DATA SHOULD NOT BE USED, AND THE PROBLEM SHOULD BE REPORTED TO THE MANUFACTURER. THE USE OF A FAULTY "SCAN" CAN RESULT IN MISDIAGNOSIS AND UNNECESSARY PARTS REPLACEMENT.

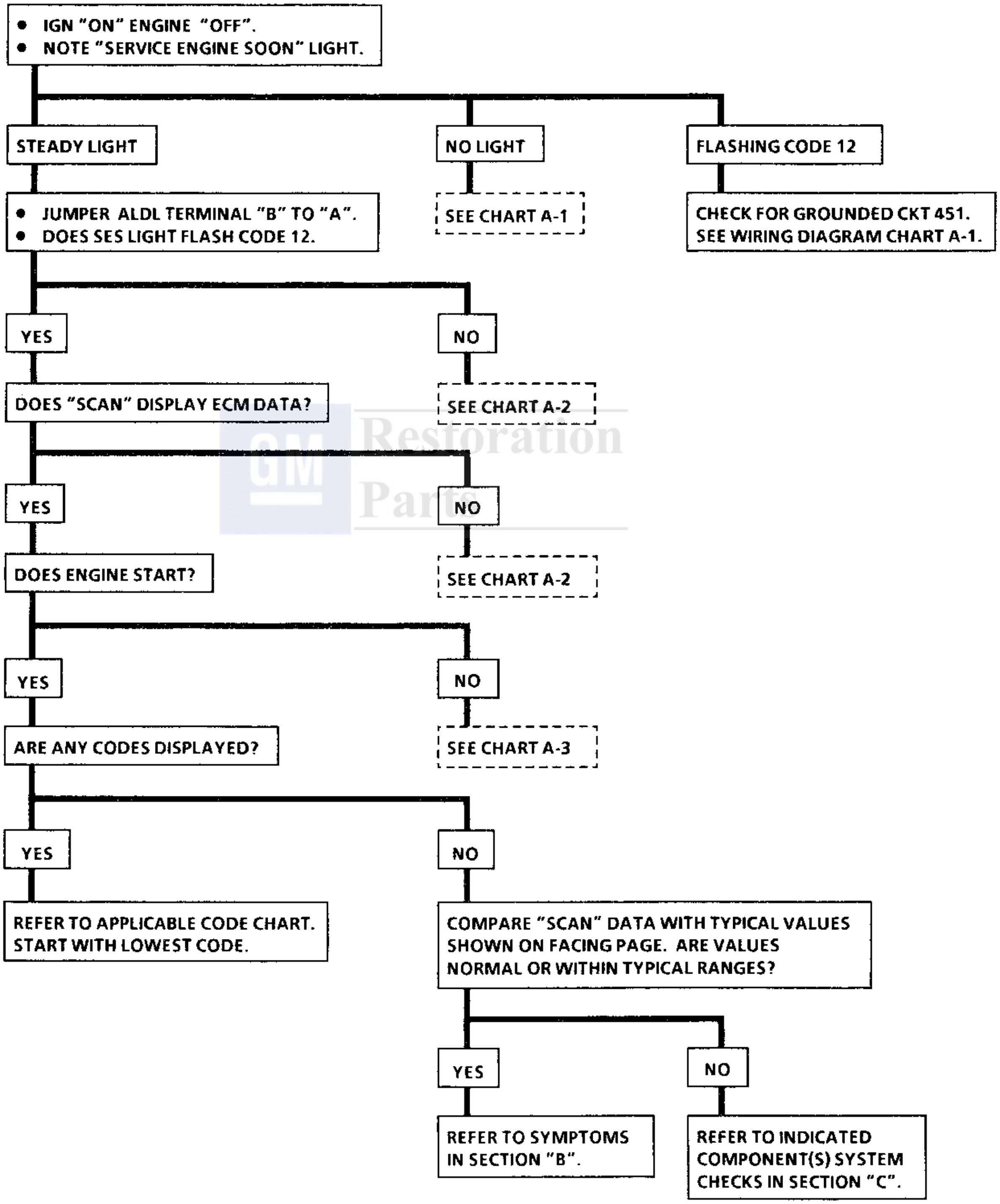
Only the parameters listed below are used in this manual for diagnosis. If a "Scan" reads other parameters, the values are not recommended by General Motors for use in diagnosis. For more description on the values and use of the "Scan" to diagnosis ECM inputs, refer to the applicable diagnosis section in Section "C". If all values are within the range illustrated, refer to Symptoms in Section "B".

"SCAN" DATA

Idle / Upper Radiator Hose Hot / Closed Throttle / Park or Neutral / Closed Loop / Acc. off

"SCAN" Position	Units Displayed	Typical Data Value
Coolant Temp.	C°	85° - 105°
MAT Temp.	C°	10° - 60° (depends on underhood temp.)
TPS	Volts	.4 - 1.25
MAP	Volts	1 - 2 (depends on Vac. & Baro pressure)
INT (Integrator)	Counts	Varies
BLM (Block Learn)	Counts	118 - 138
IAC	Counts (steps)	1 - 50
RPM	RPM	900 ± 75 RPM (depends on temperature)
O_2	Volts	.1 - 1 and varies
Open/Closed Loop	Open/Closed	Closed Loop (may go open with extended idle)
Spark Advance	# of Degrees	Varies
BPW (base pulse width)	M/Sec	.7 - 2.0
EGR Duty Cycle	0-100%	0% (at idle)
EGR Vacuum Switch	On-Off	Off
A/C Request	Yes/No	No (yes, with A/C requested)
A/C Clutch	On/Off	Off (on, with A/C commanded on)
P/N Switch	P/N and RDL	Park/Neutral (P/N)
TCC	On/Off	Off/ (on, with TCC commanded)
VSS	MPH	0
Battery	Volts	13.5 - 14.5

DIAGNOSTIC CIRCUIT CHECK
2.8L "P" SERIES (PORT)



- IGN "ON" ENGINE "OFF".
- NOTE "SERVICE ENGINE SOON" LIGHT.

STEADY LIGHT

- JUMPER ALDL TERMINAL "B" TO "A".
- DOES SES LIGHT FLASH CODE 12.

YES

DOES "SCAN" DISPLAY ECM DATA?

YES

DOES ENGINE START?

YES

ARE ANY CODES DISPLAYED?

YES

REFER TO APPLICABLE CODE CHART. START WITH LOWEST CODE.

NO

COMPARE "SCAN" DATA WITH TYPICAL VALUES SHOWN ON FACING PAGE. ARE VALUES NORMAL OR WITHIN TYPICAL RANGES?

YES

REFER TO SYMPTOMS IN SECTION "B".

NO

REFER TO INDICATED COMPONENT(S) SYSTEM CHECKS IN SECTION "C".

NO

SEE CHART A-3

NO

SEE CHART A-2

NO

SEE CHART A-2

NO LIGHT

SEE CHART A-1

FLASHING CODE 12

CHECK FOR GROUNDED CKT 451. SEE WIRING DIAGRAM CHART A-1.

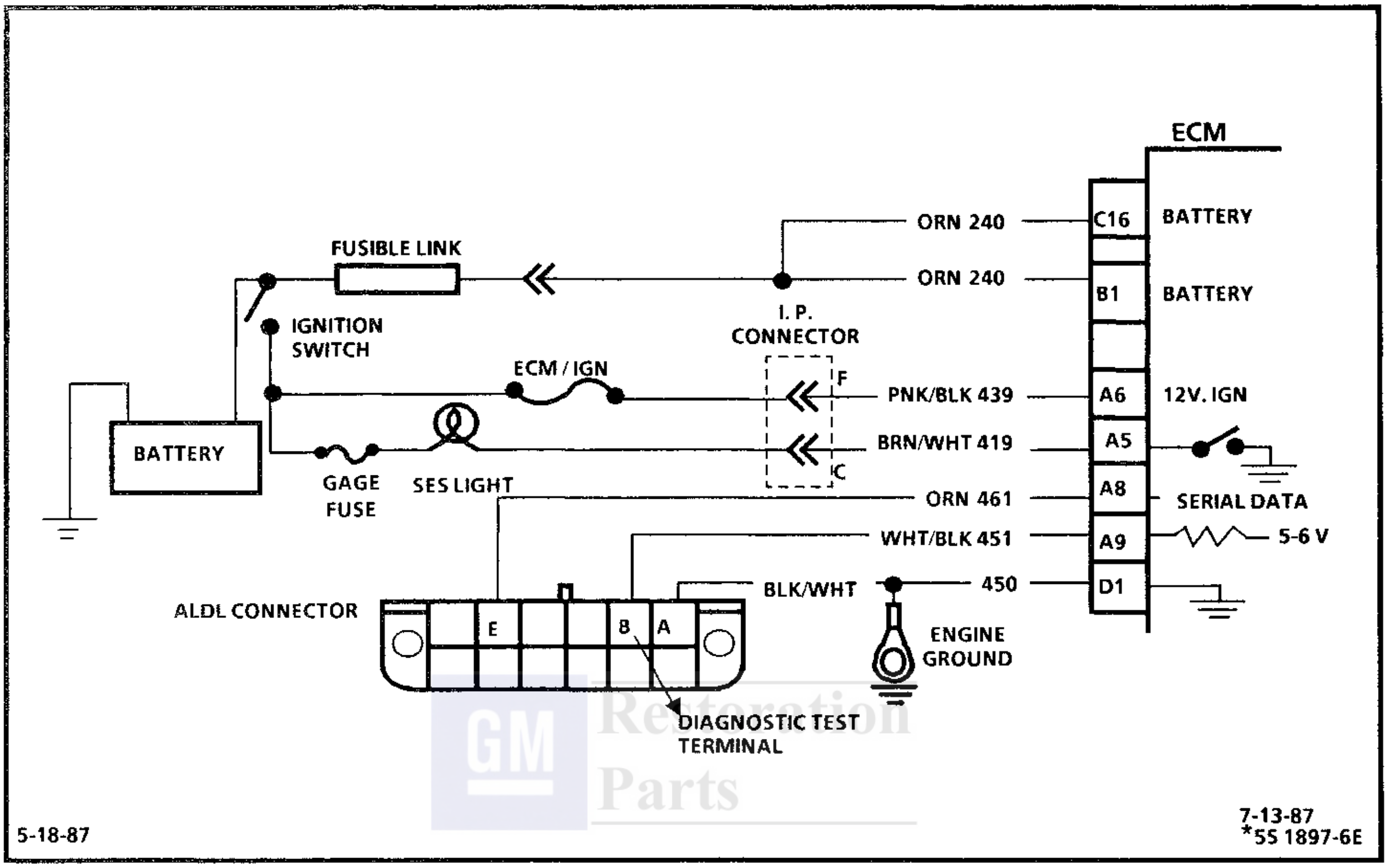


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CHART A-1

NO "SERVICE ENGINE SOON" LIGHT
2.8L "P" SERIES (PORT)

Circuit Description:

There should always be a steady "Service Engine Soon" light, when the ignition is "ON" and engine stopped. Battery is supplied directly to the light bulb. The electronic control module (ECM) will control the light and turn it "ON" by providing a ground path through CKT 419 to the ECM.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Battery feed CKT 240 is protected by a fusible link at the battery.
2. Using a test light connected to 12 volts, probe each of the system ground circuits to be sure a good ground is present. See ECM terminal end view in front of this section for ECM pin locations of ground circuits.

Diagnostic Aids:

Engine runs OK, check:

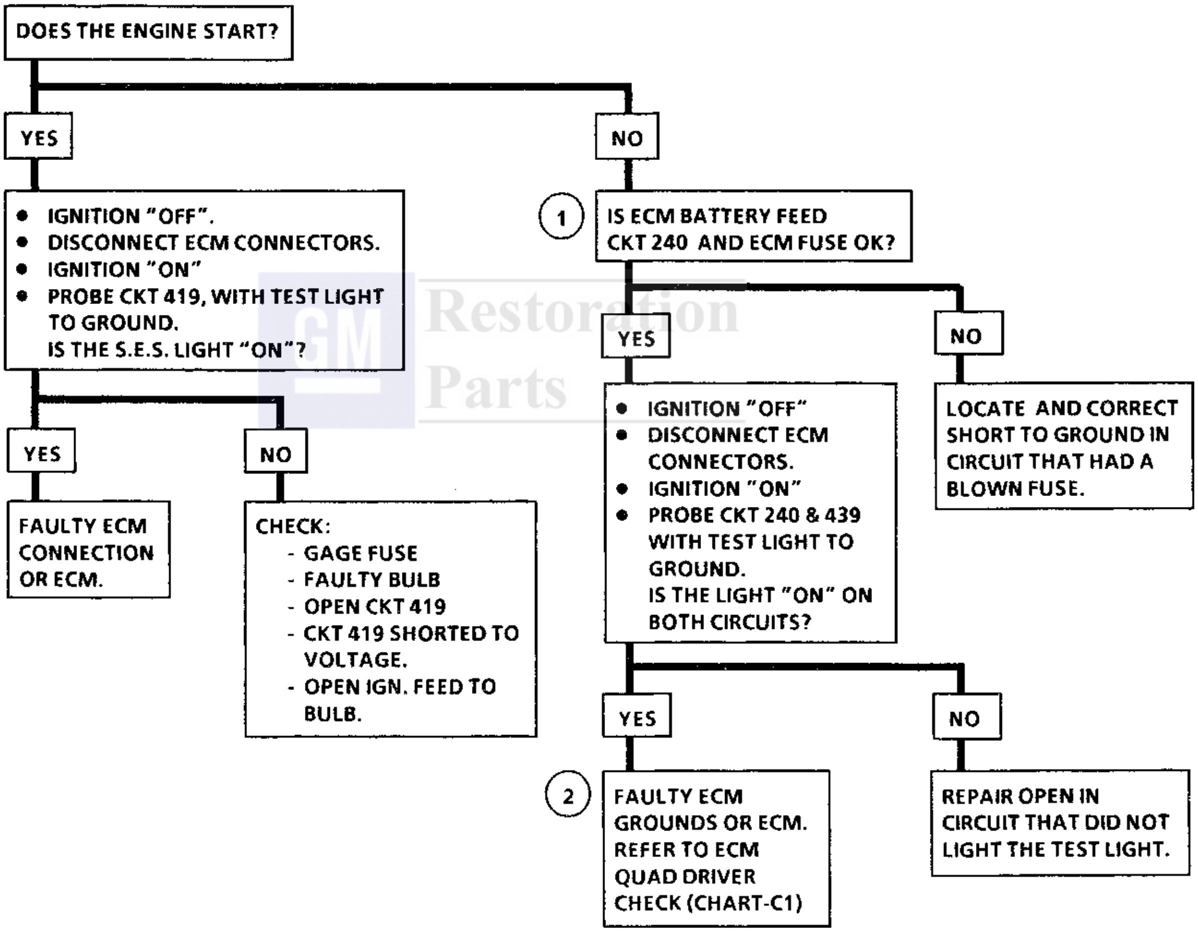
- Faulty light bulb
- CKT 419 open
- Gage fuse blown. This will result in no stop lights, oil, or generator lights, seat belt reminder, etc.

Engine cranks, but will not run, check:

- Continuous battery - fuse or fusible link open
- ECM ignition fuse open
- Battery CKT 240 to ECM open
- Ignition CKT 439 to ECM open
- Poor connection to ECM

CHART A-1

NO "SERVICE ENGINE SOON" LIGHT
2.8L "P" SERIES (PORT)



CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

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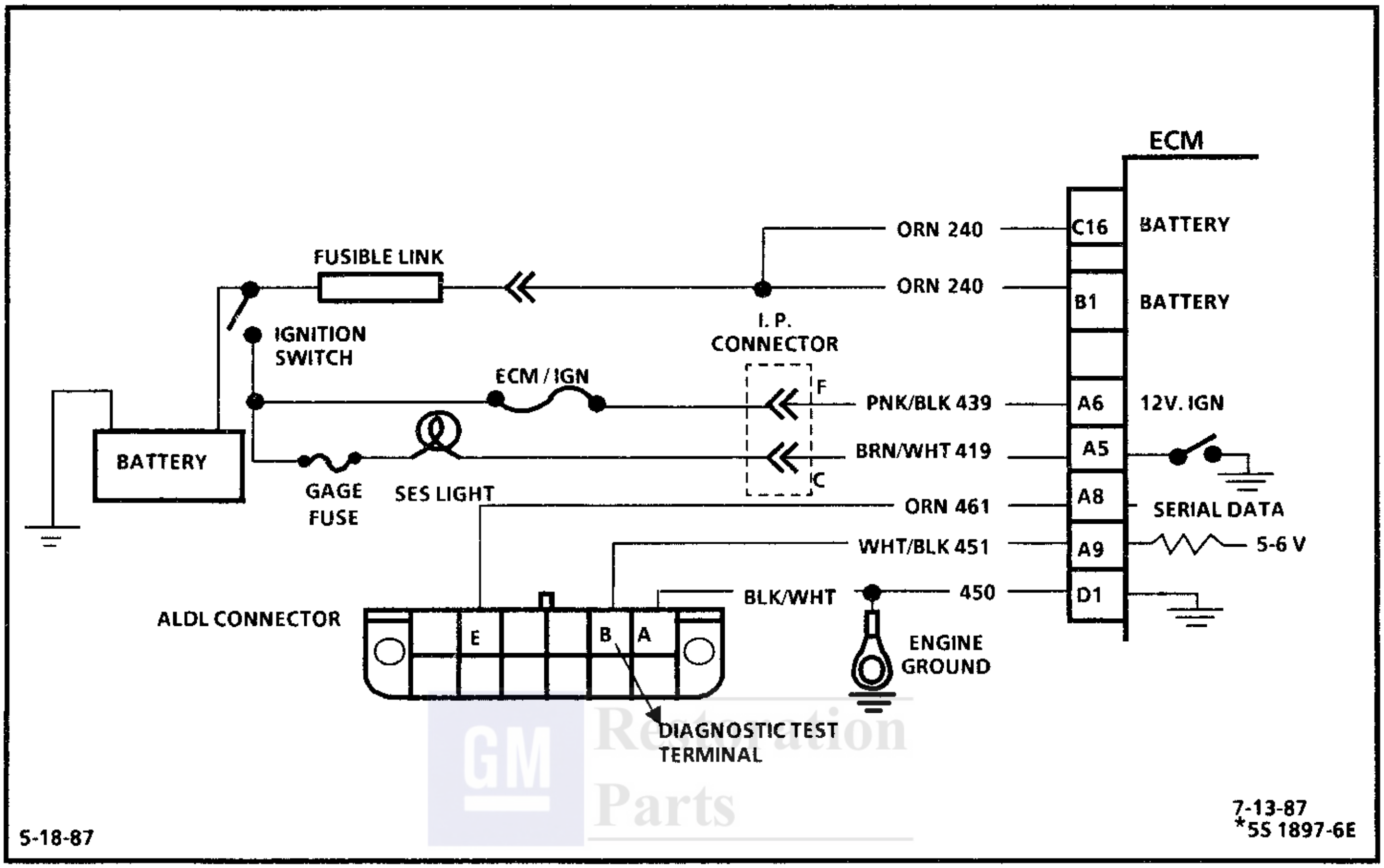

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CHART A-2

NO ALDL DATA OR WON'T FLASH CODE 12
"SERVICE ENGINE SOON" LIGHT ON STEADY
2.8L "P" SERIES (PORT)

Circuit Description:

There should always be a steady "Service Engine Soon" Light when the ignition is "ON" and engine stopped. Battery ignition voltage is supplied to the light bulb. The electronic control module (ECM) will turn the light "ON" by grounding CKT 419 at the ECM.

With the diagnostic terminal grounded, the light should flash a Code 12, followed by any trouble code(s) stored in memory.

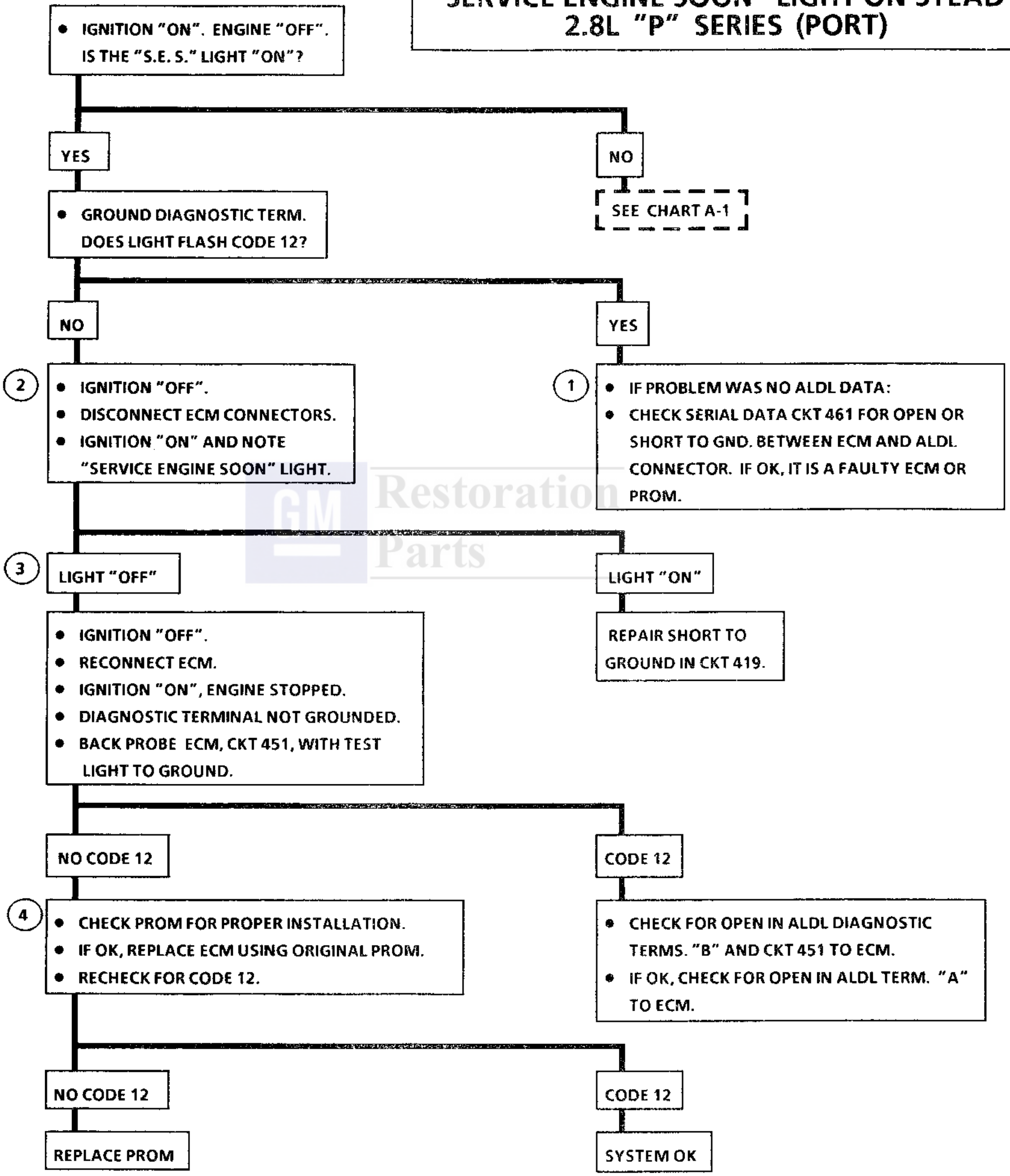
A steady light suggests a short to ground in the light control CKT 419 or an open in diagnostic CKT 451.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. If there is a problem with the ECM that causes a "Scan" tool to not read serial data, the ECM should not flash a Code 12. If Code 12 is flashing, check for CKT 451 short to ground. If Code 12, does flash be sure that the "Scan" tool is working properly on another vehicle. If the "Scan" is functioning properly and CKT 461 is OK, the PROM or ECM may be at fault for the NO ALDL symptom.
2. If the light goes "OFF" when the ECM connector is disconnected, CKT 419 is not shorted to ground.
3. This step will check for an open diagnostic CKT 451.
4. At this point the "Service Engine Soon" light wiring is OK. The problem is a faulty ECM or PROM. If Code 12 does not flash, the ECM should be replaced using the original PROM. Replace the PROM only after trying an ECM, as a defective PROM is an unlikely cause of the problem.

CHART A-2

NO ALDL DATA OR WON'T FLASH CODE 12 "SERVICE ENGINE SOON" LIGHT ON STEADY 2.8L "P" SERIES (PORT)



- IGNITION "ON". ENGINE "OFF". IS THE "S.E.S." LIGHT "ON"?

YES

- GROUND DIAGNOSTIC TERM. DOES LIGHT FLASH CODE 12?

NO

SEE CHART A-1

NO

②
- IGNITION "OFF".
- DISCONNECT ECM CONNECTORS.
- IGNITION "ON" AND NOTE "SERVICE ENGINE SOON" LIGHT.

YES

①
- IF PROBLEM WAS NO ALDL DATA:
- CHECK SERIAL DATA CKT 461 FOR OPEN OR SHORT TO GND. BETWEEN ECM AND ALDL CONNECTOR. IF OK, IT IS A FAULTY ECM OR PROM.

③ LIGHT "OFF"

- 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

④
- CHECK PROM FOR PROPER INSTALLATION.
- IF OK, REPLACE ECM USING ORIGINAL PROM.
- RECHECK FOR CODE 12.

CODE 12

- CHECK FOR OPEN IN ALDL DIAGNOSTIC TERMS. "B" AND CKT 451 TO ECM.
- IF OK, CHECK FOR OPEN IN ALDL TERM. "A" TO ECM.

NO CODE 12

REPLACE PROM

CODE 12

SYSTEM OK

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

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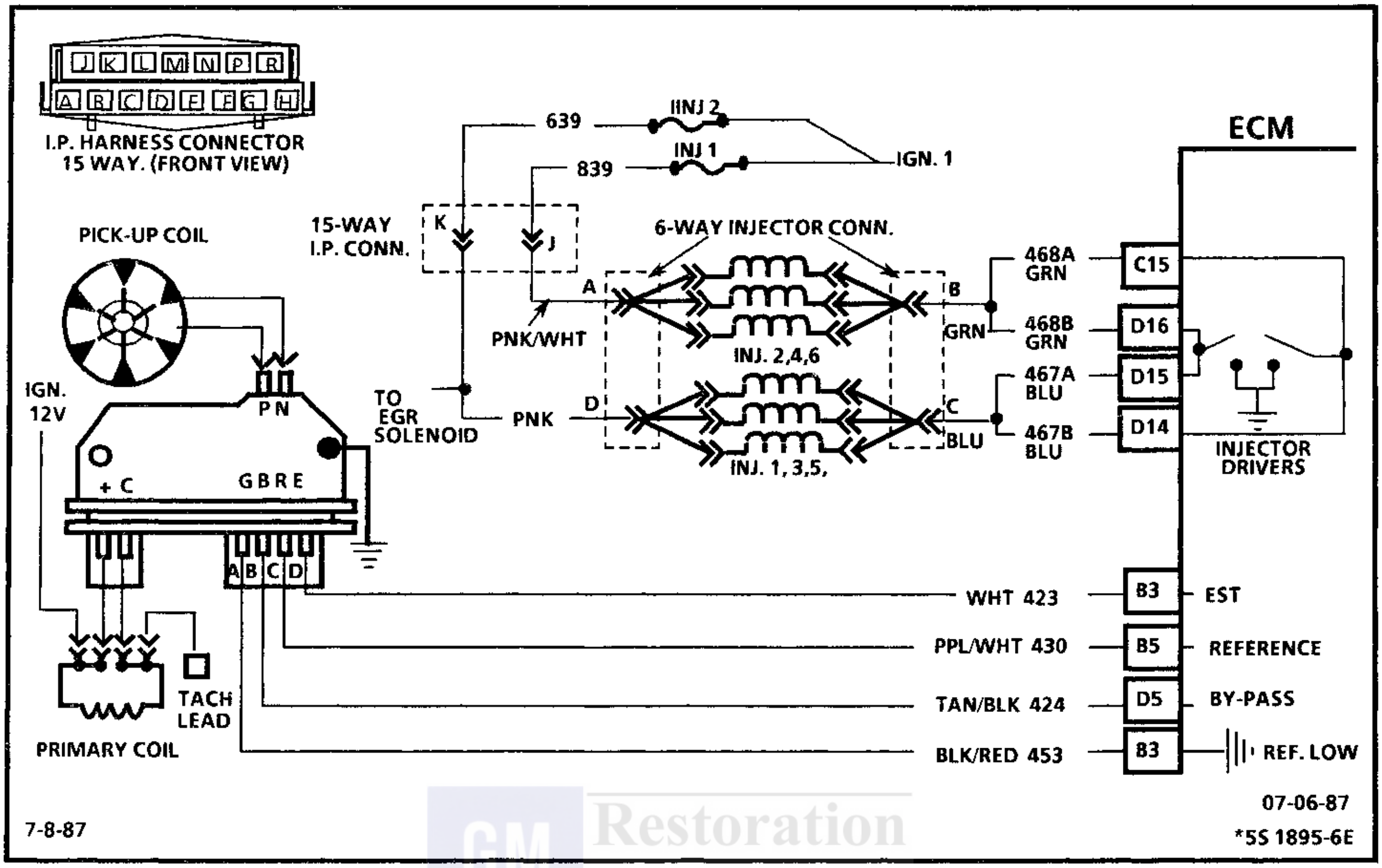

CHART A-3

(Page 1 of 2)

ENGINE CRANKS BUT WON'T RUN
2.8L "P" SERIES (PORT)

Circuit Description:

This chart assumes that battery condition and engine cranking speed are OK, and there is adequate fuel in the tank.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. A "Service Engine Soon" light "ON" is a basic test to determine if there is a 12 volt supply and ignition 12 volts to ECM. No ALDL may be due to an ECM problem and CHART A-2 will diagnose the ECM. If TPS is over 2.5 volts the engine may be in the clear flood mode which will cause starting problems. The engine will not start without reference pulses, and, therefore, the "Scan" should read rpm (reference) during crank.
2. No spark may be caused by one of several components related to the ignition system. CHART C-4 will address all problems related to the causes of a no spark condition.
3. The test light should blink, indicating the ECM is controlling the injectors OK. How bright the light blinks is not important. However, the test light should be a J-34730-3 or equivalent.
4. Use fuel pressure gage J-34730-1 or equivalent. Wrap a shop towel around the fuel pressure tap to absorb any small amount of fuel leakage that may occur when installing the gage.

Diagnostic Aids:

- An EGR valve sticking open can cause a low air/fuel ratio during cranking. Unless engine enters "clear flood" at the first indication of a flooding condition, it can result in a no start.
- Check for fouled plugs.
- A defective cold start circuit or water in fuel line can cause a no start in cold weather. See CHART A-9.
- Also check that injectors on both sides of engine will cause a test light to "blink". If not OK, check injector fuses.
  Checking of two injectors on each bank will locate a shorted injector.
- Also check that injectors are not opened or shorted. Injector resistance should be greater than 10 ohms.

If above are all OK, refer to "Symptoms" in Section "B," "Hard Start".

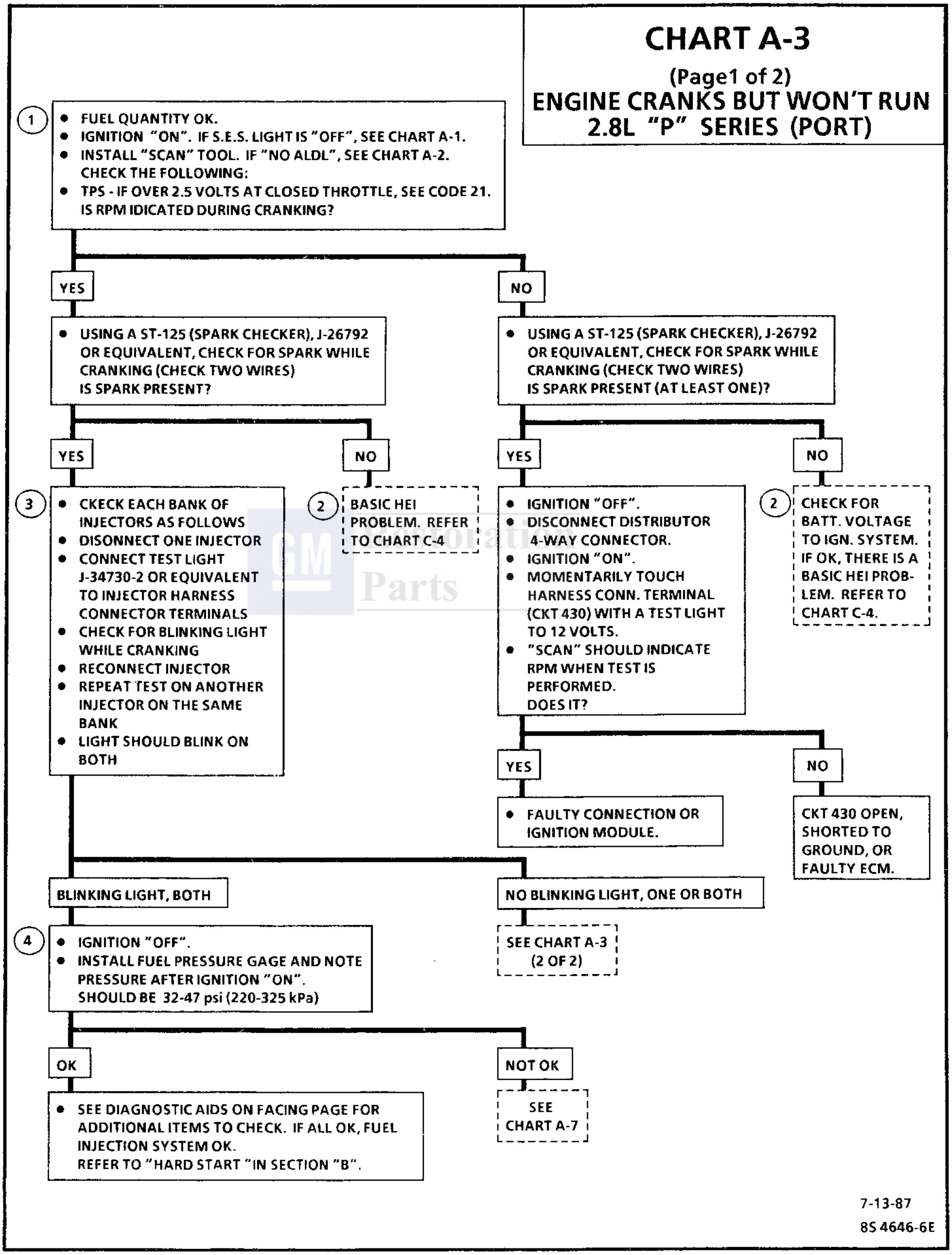

CHART A-3

(Page1 of 2)

ENGINE CRANKS BUT WON'T RUN
2.8L "P" SERIES (PORT)

①
- FUEL QUANTITY OK.
- IGNITION "ON". IF S.E.S. LIGHT IS "OFF", SEE CHART A-1.
- INSTALL "SCAN" TOOL. IF "NO ALDL", SEE CHART A-2.
  CHECK THE FOLLOWING:
- TPS - IF OVER 2.5 VOLTS AT CLOSED THROTTLE, SEE CODE 21.
  IS RPM IDICATED DURING CRANKING?

YES

- USING A ST-125 (SPARK CHECKER), J-26792 OR EQUIVALENT, CHECK FOR SPARK WHILE CRANKING (CHECK TWO WIRES)
  IS SPARK PRESENT?

YES

③
- CKECK EACH BANK OF INJECTORS AS FOLLOWS
- DISONNECT ONE INJECTOR
- CONNECT TEST LIGHT J-34730-2 OR EQUIVALENT TO INJECTOR HARNESS CONNECTOR TERMINALS
- CHECK FOR BLINKING LIGHT WHILE CRANKING
- RECONNECT INJECTOR
- REPEAT TEST ON ANOTHER INJECTOR ON THE SAME BANK
- LIGHT SHOULD BLINK ON BOTH

BLINKING LIGHT, BOTH

④
- IGNITION "OFF".
- INSTALL FUEL PRESSURE GAGE AND NOTE PRESSURE AFTER IGNITION "ON".
  SHOULD BE 32-47 psi (220-325 kPa)

OK

- SEE DIAGNOSTIC AIDS ON FACING PAGE FOR ADDITIONAL ITEMS TO CHECK. IF ALL OK, FUEL INJECTION SYSTEM OK.
  REFER TO "HARD START "IN SECTION "B".

NOT OK

SEE CHART A-7

NO BLINKING LIGHT, ONE OR BOTH

SEE CHART A-3 (2 OF 2)

NO (SPARK)

② BASIC HEI PROBLEM. REFER TO CHART C-4

NO (RPM)

- USING A ST-125 (SPARK CHECKER), J-26792 OR EQUIVALENT, CHECK FOR SPARK WHILE CRANKING (CHECK TWO WIRES)
  IS SPARK PRESENT (AT LEAST ONE)?

YES

- IGNITION "OFF".
- DISCONNECT DISTRIBUTOR 4-WAY CONNECTOR.
- IGNITION "ON".
- MOMENTARILY TOUCH HARNESS CONN. TERMINAL (CKT 430) WITH A TEST LIGHT TO 12 VOLTS.
- "SCAN" SHOULD INDICATE RPM WHEN TEST IS PERFORMED.
  DOES IT?

YES

- FAULTY CONNECTION OR IGNITION MODULE.

NO

CKT 430 OPEN, SHORTED TO GROUND, OR FAULTY ECM.

NO

② CHECK FOR BATT. VOLTAGE TO IGN. SYSTEM. IF OK, THERE IS A BASIC HEI PROBLEM. REFER TO CHART C-4.

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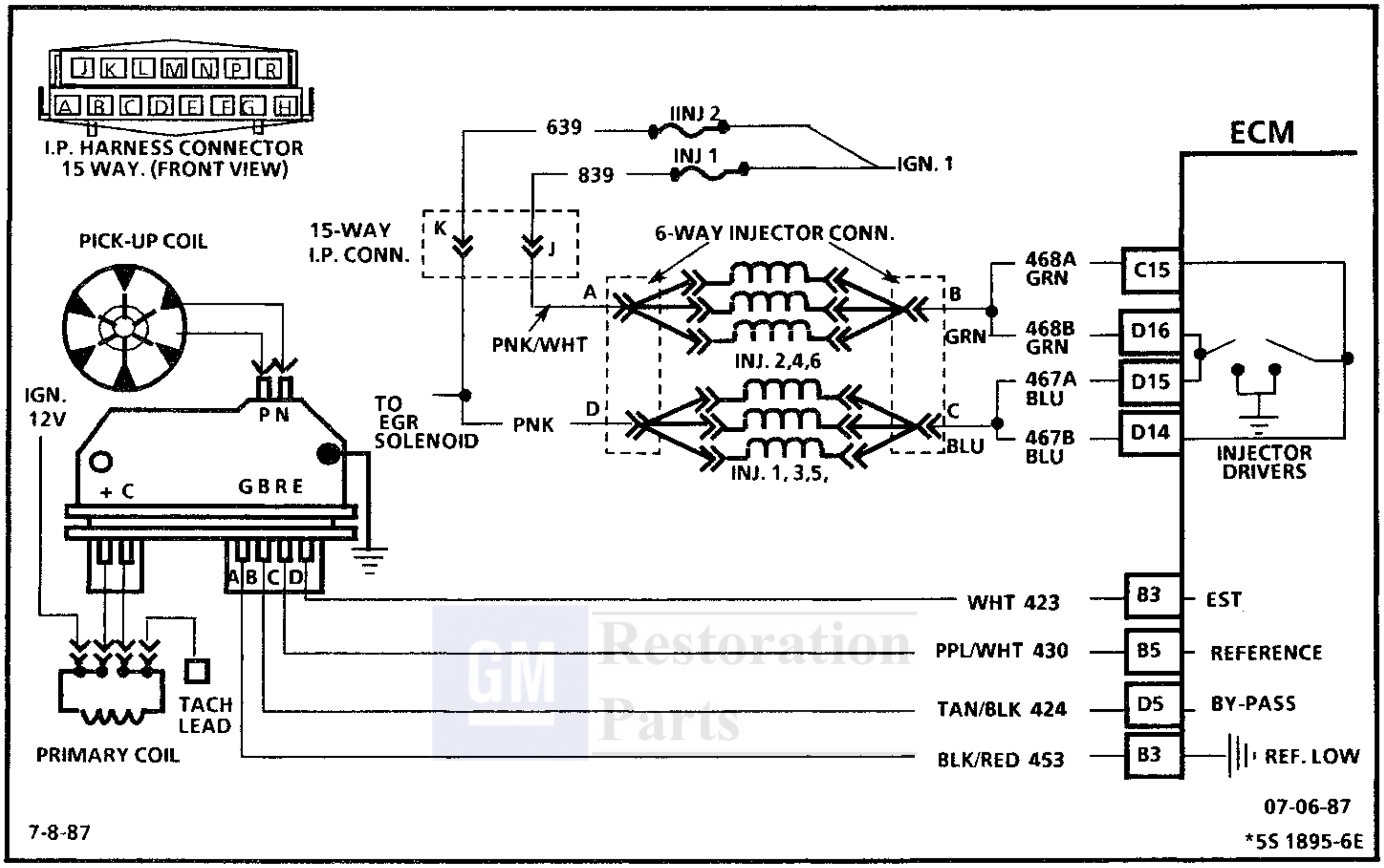


CHART A-3

(Page 2 of 2)

ENGINE CRANKS BUT WON'T RUN
2.8L "P" SERIES (PORT)

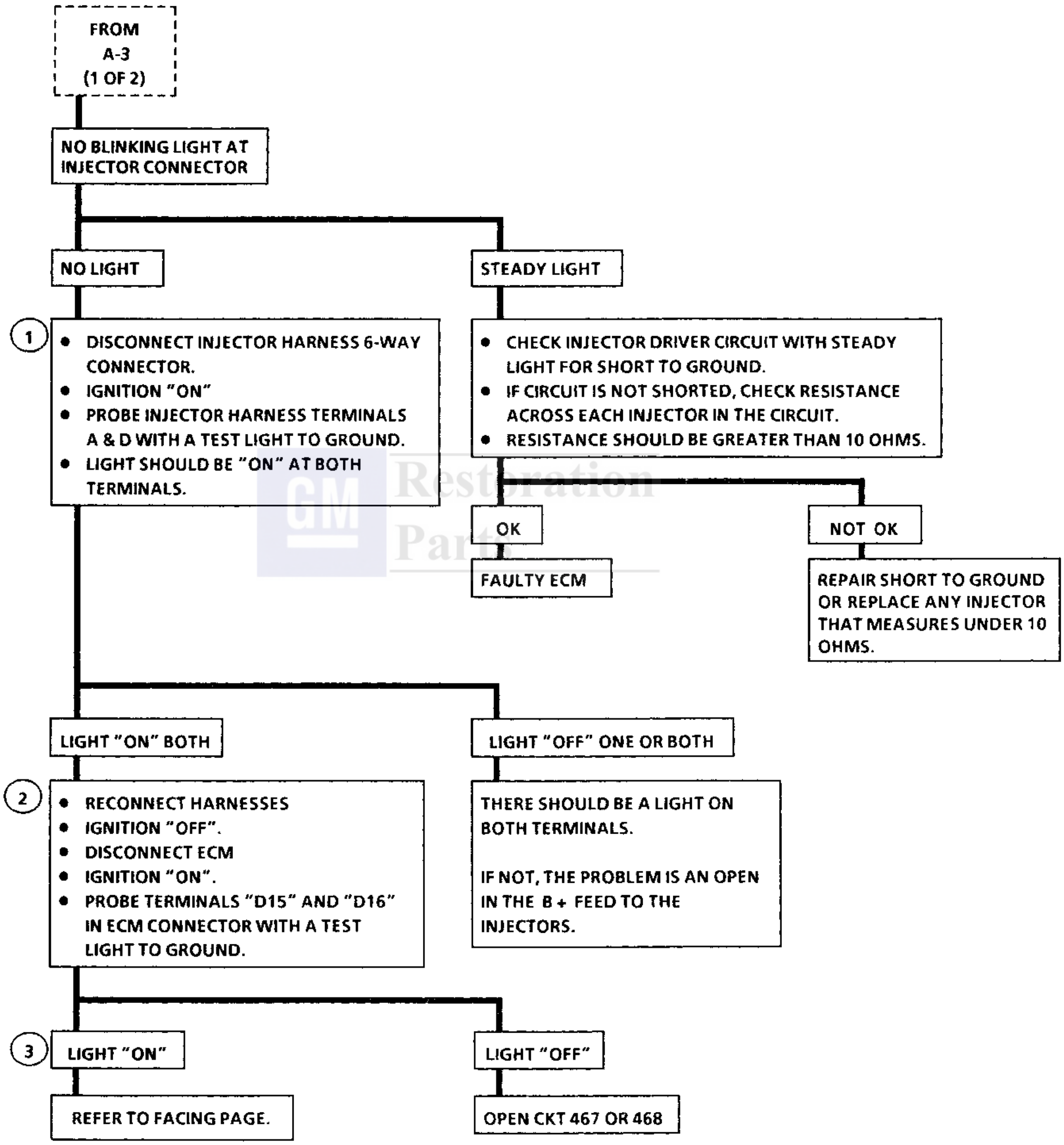
Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Checks for 12 volt supply to injectors. Due to the injectors wired in parallel there should be a light "ON" on both terminals.
2. Checks continuity of CKT 467 and 468.
3. All checks made to this point would indicate that the ECM is at fault. However, there is a possibility of CKT 467 or 468 being shorted to a voltage source either in the engine harness or in the injector harness.
   - To test for this condition:
     - Disconnect 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 light is "ON" repair short to voltage.
   - If OK, check the resistance of the injector harness between terminals "A" & "C", "A" & "D", "B" & "D", and "D" & "C".
   - Should be more than 4 ohms.
   - If less than 4 ohms, check harness for wires shorted together and check each injector resistance. (Resistance should be 10 ohms or more.)
   - If all OK, replace ECM.

CHART A-3

(Page 2 of 2)

ENGINE CRANKS BUT WON'T RUN
2.8L "P" SERIES (PORT)



FROM A-3 (1 OF 2)

NO BLINKING LIGHT AT INJECTOR CONNECTOR

NO LIGHT

①
- DISCONNECT INJECTOR HARNESS 6-WAY CONNECTOR.
- IGNITION "ON"
- PROBE INJECTOR HARNESS TERMINALS A & D WITH A TEST LIGHT TO GROUND.
- LIGHT SHOULD BE "ON" AT BOTH TERMINALS.

LIGHT "ON" BOTH

②
- RECONNECT HARNESSES
- IGNITION "OFF".
- DISCONNECT ECM
- IGNITION "ON".
- PROBE TERMINALS "D15" AND "D16" IN ECM CONNECTOR WITH A TEST LIGHT TO GROUND.

③ LIGHT "ON"

REFER TO FACING PAGE.

LIGHT "OFF"

OPEN CKT 467 OR 468

LIGHT "OFF" ONE OR BOTH

THERE SHOULD BE A LIGHT ON BOTH TERMINALS.

IF NOT, THE PROBLEM IS AN OPEN IN THE B+ FEED TO THE INJECTORS.

STEADY LIGHT

- CHECK INJECTOR DRIVER CIRCUIT WITH STEADY LIGHT FOR SHORT TO GROUND.
- IF CIRCUIT IS NOT SHORTED, CHECK RESISTANCE ACROSS EACH INJECTOR IN THE CIRCUIT.
- RESISTANCE SHOULD BE GREATER THAN 10 OHMS.

OK

FAULTY ECM

NOT OK

REPAIR SHORT TO GROUND OR REPLACE ANY INJECTOR THAT MEASURES UNDER 10 OHMS.

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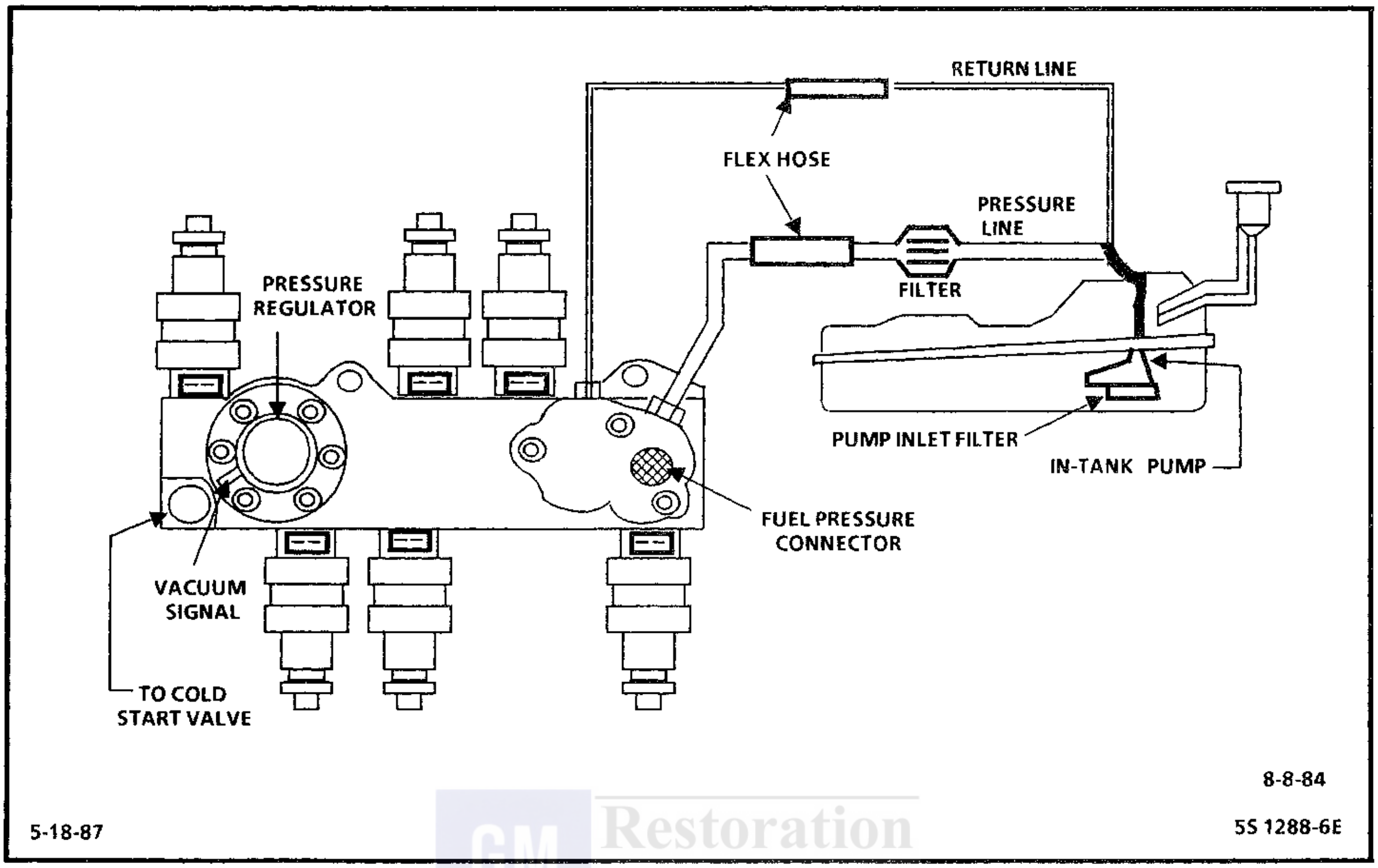


CHART A-7

(Page 1 of 4)

FUEL SYSTEM DIAGNOSIS 2.8L "P" SERIES (PORT)

Circuit Description:

When the ignition switch is turned "ON", the electronic control module (ECM) will turn "ON" the in-tank fuel pump. It will remain "ON" as long as the engine is cranking or running, and the ECM is receiving reference pulses. If there are no reference pulses, the ECM will shut "OFF" the fuel pump within 2 seconds after ignition "ON" or engine stops.

The pump will deliver fuel to the fuel rail and injectors, then to the pressure regulator, where the system pressure is controlled to about 234 to 325 kPa (34 to 47 psi). Excess fuel is then returned to the fuel tank.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Wrap a shop towel around the fuel pressure connector to absorb any small amount of fuel leakage that may occur when installing the gage. Ignition "ON" pump pressure should be 280-325 kPa (40.5-47 psi). This pressure is controlled by spring pressure within the regulator assembly.
2. When the engine is idling, the manifold pressure is low (high vacuum) and is applied to the fuel regulator diaphragm. This will offset the spring and result in a lower fuel pressure.This idle pressure will vary somewhat depending on barometric pressure, however, the pressure idling should be less indicating pressure regulator control.
3. Pressure that continues to fall is caused by one of the following:
   - In-tank fuel pump check valve not holding
   - Pump coupling hose or pulsator leaking
   - Fuel pressure regulator valve leaking
   - Injector(s) sticking open
4. An injector sticking open can best be determined by checking for a fouled or saturated spark plug(s). If a leaking injector can not be determined by a fouled or saturated spark plug the following procedure should be used.
   - Remove plenum, and remove fuel rail bolts. Follow the procedures in the fuel control section of this manual, but leave fuel lines connected.
   - Lift fuel rail out just enough to 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.**

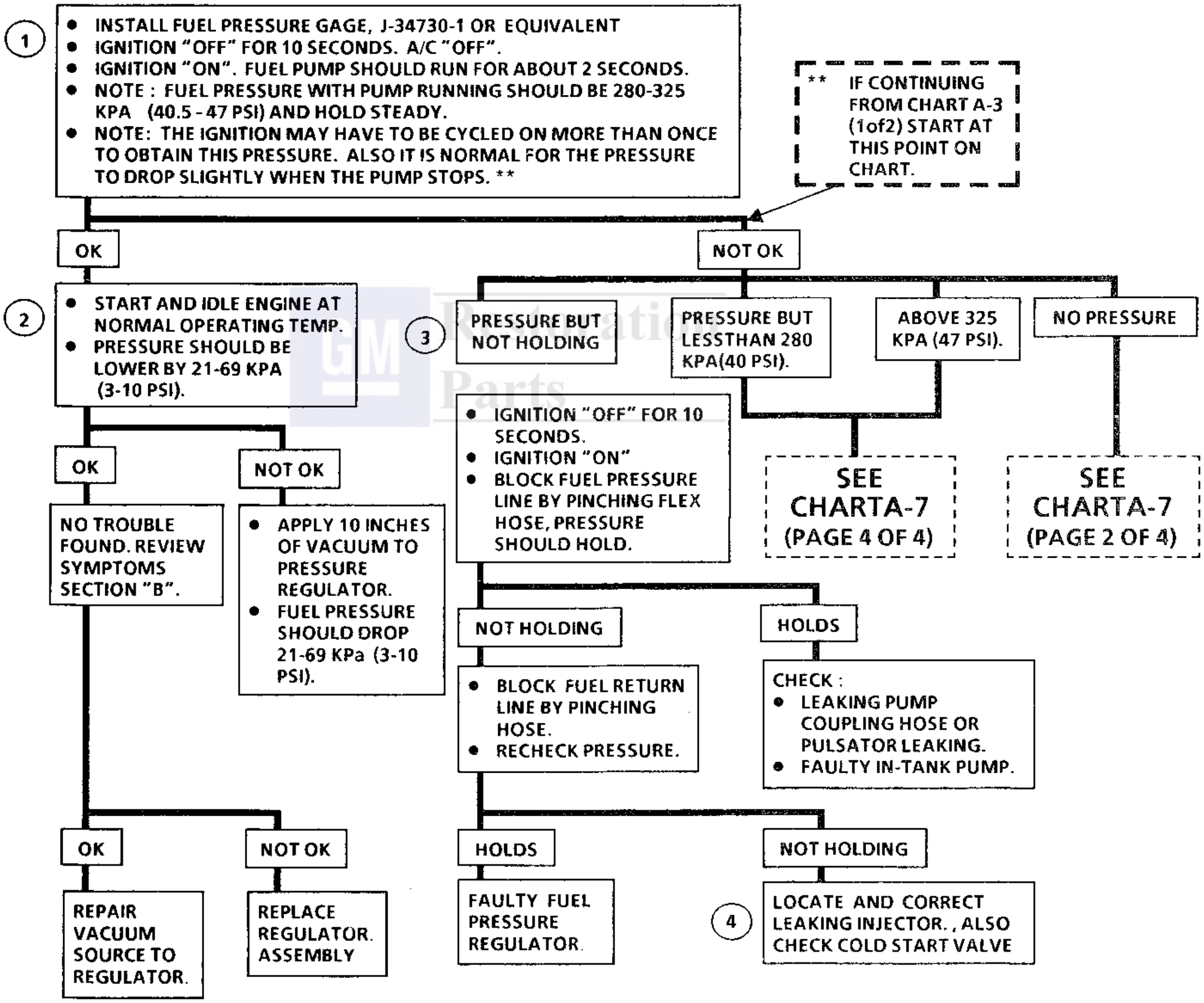
- Pressurize the fuel system and observe injector nozzles.

NOTICE- *EFI SYSTEM UNDER PRESSURE. TO AVOID FUEL SPILLAGE, REFER TO FIELD SERVICE PROCEDURES FOR TESTING OR MAKING REPAIRS REQUIRING DISASSEMBLY OF FUEL LINES OR FITTINGS.*

CHART A-7

(Page 1 of 4)

FUEL SYSTEM DIAGNOSIS 2.8L "P" SERIES (PORT)



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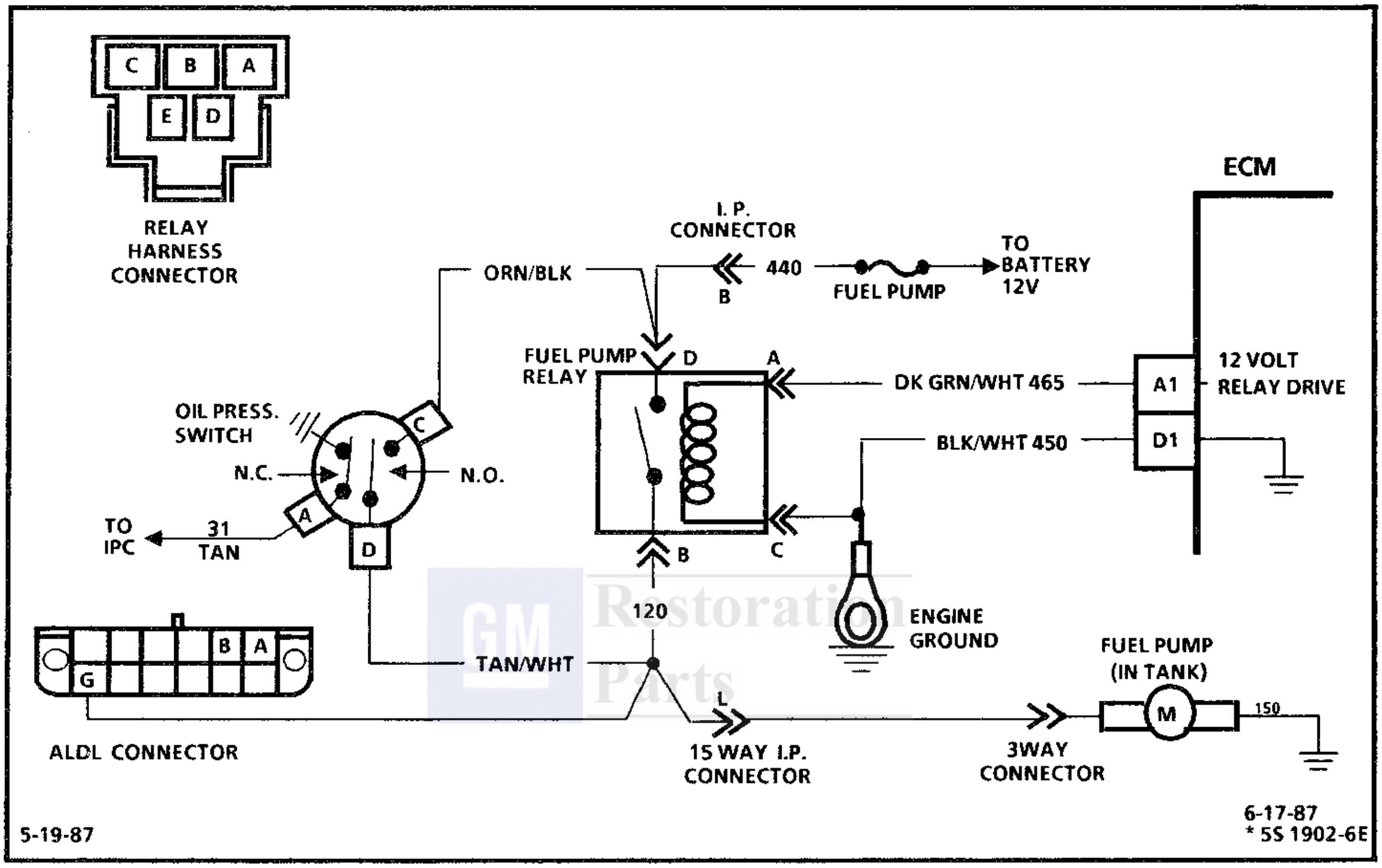


CHART A-7

(Page 2 of 4)

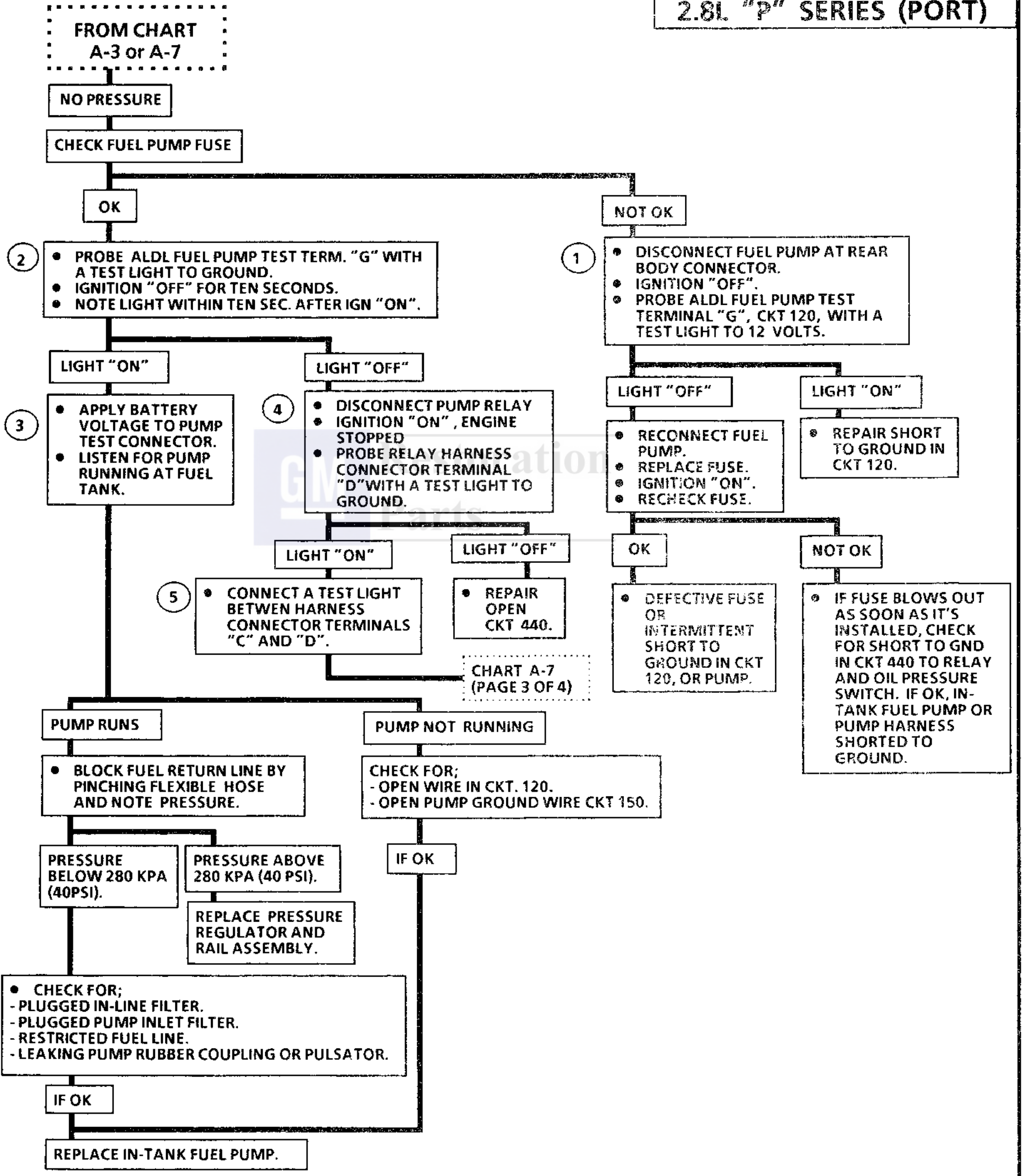
FUEL SYSTEM DIAGNOSIS
2.8L "P" SERIES (PORT)

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. If the fuse is blown, this test will confirm a short to ground on CKT 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 CKT 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.

CHART A-7
(Page 2 of 4)
FUEL SYSTEM DIAGNOSIS
2.8L "P" SERIES (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.*



CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

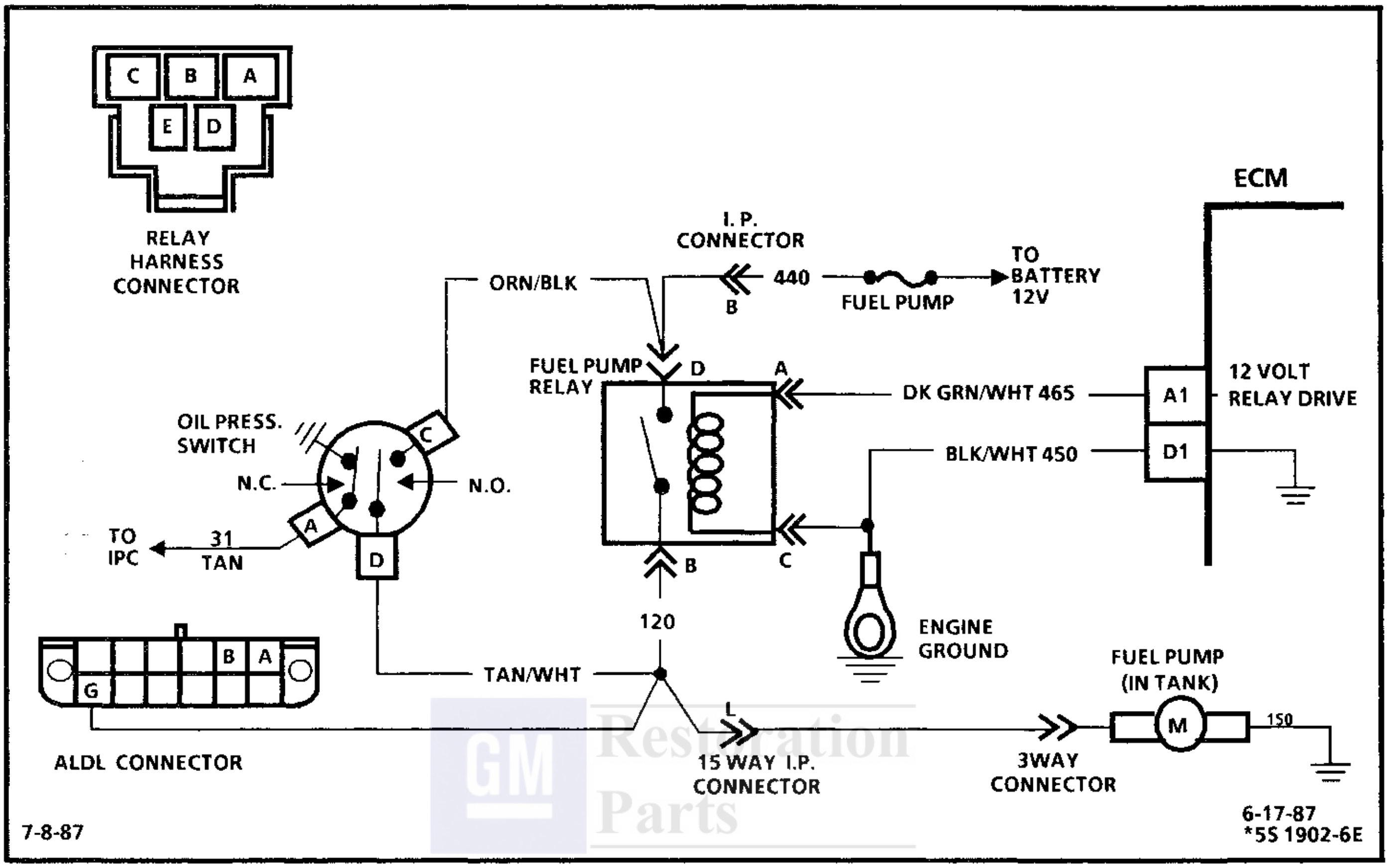


CHART A-7

(Page 3 of 4)

FUEL SYSTEM DIAGNOSIS
2.8L "P" SERIES (PORT)

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

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 separate 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 may 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.

Diagnostic Aids:

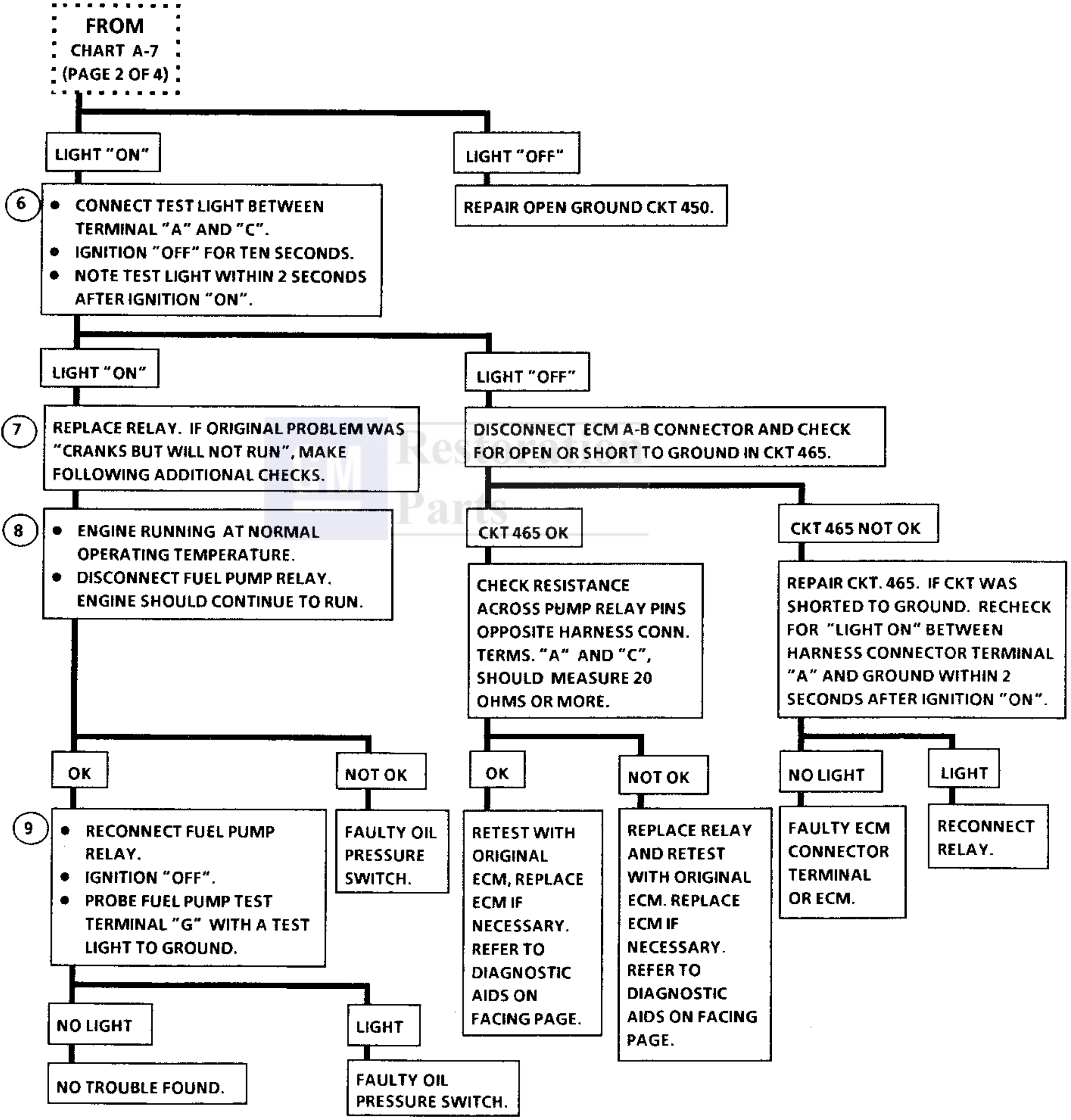
Fuel pump relay driver is fault protected. Before replacing ECM, replace relay and retest with original ECM.

CHART A-7

(Page 3 of 4)

FUEL SYSTEM DIAGNOSIS
2.8L "P" SERIES (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.*



FROM CHART A-7 (PAGE 2 OF 4)

LIGHT "ON"

⑥
- CONNECT TEST LIGHT BETWEEN TERMINAL "A" AND "C".
- IGNITION "OFF" FOR TEN SECONDS.
- NOTE TEST LIGHT WITHIN 2 SECONDS AFTER IGNITION "ON".

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 TERMINAL "G" WITH A TEST LIGHT TO GROUND.

NO LIGHT

NO TROUBLE FOUND.

LIGHT

FAULTY OIL PRESSURE SWITCH.

NOT OK

FAULTY OIL PRESSURE SWITCH.

LIGHT "OFF"

DISCONNECT ECM A-B CONNECTOR AND CHECK FOR OPEN OR SHORT TO GROUND IN CKT 465.

CKT 465 OK

CHECK RESISTANCE ACROSS PUMP RELAY PINS OPPOSITE HARNESS CONN. TERMS. "A" AND "C", SHOULD MEASURE 20 OHMS OR MORE.

OK

RETEST WITH ORIGINAL ECM, REPLACE ECM IF NECESSARY. REFER TO DIAGNOSTIC AIDS ON FACING PAGE.

NOT OK

REPLACE RELAY AND RETEST WITH ORIGINAL ECM. REPLACE ECM IF NECESSARY. REFER TO DIAGNOSTIC AIDS ON FACING PAGE.

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".

NO LIGHT

FAULTY ECM CONNECTOR TERMINAL OR ECM.

LIGHT

RECONNECT RELAY.

LIGHT "OFF"

REPAIR OPEN GROUND CKT 450.

7-7-87

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

*5S 1904-6E

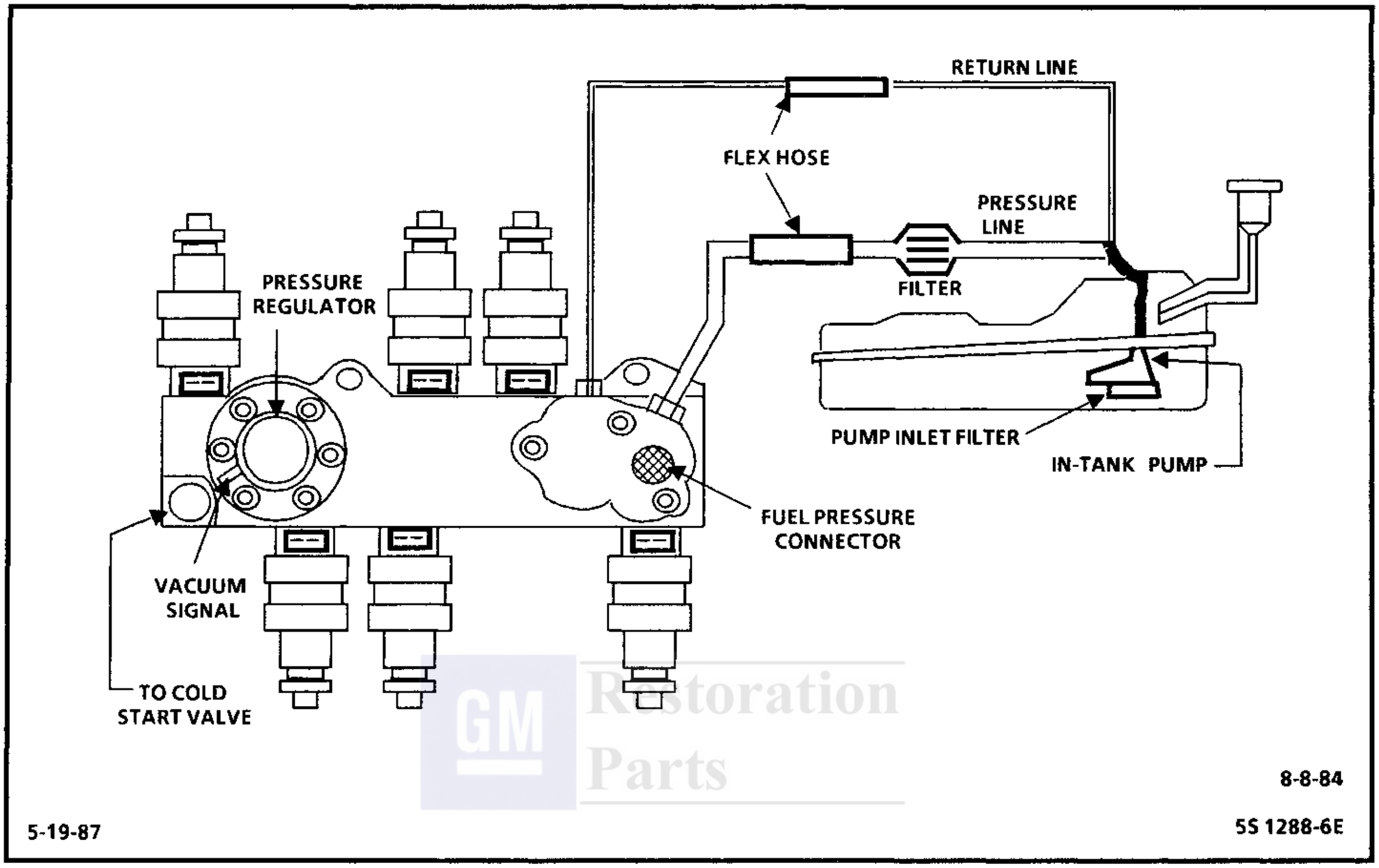


CHART A-7

(Page 4 of 4)

FUEL SYSTEM DIAGNOSIS
2.8L "P" SERIES (PORT)

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

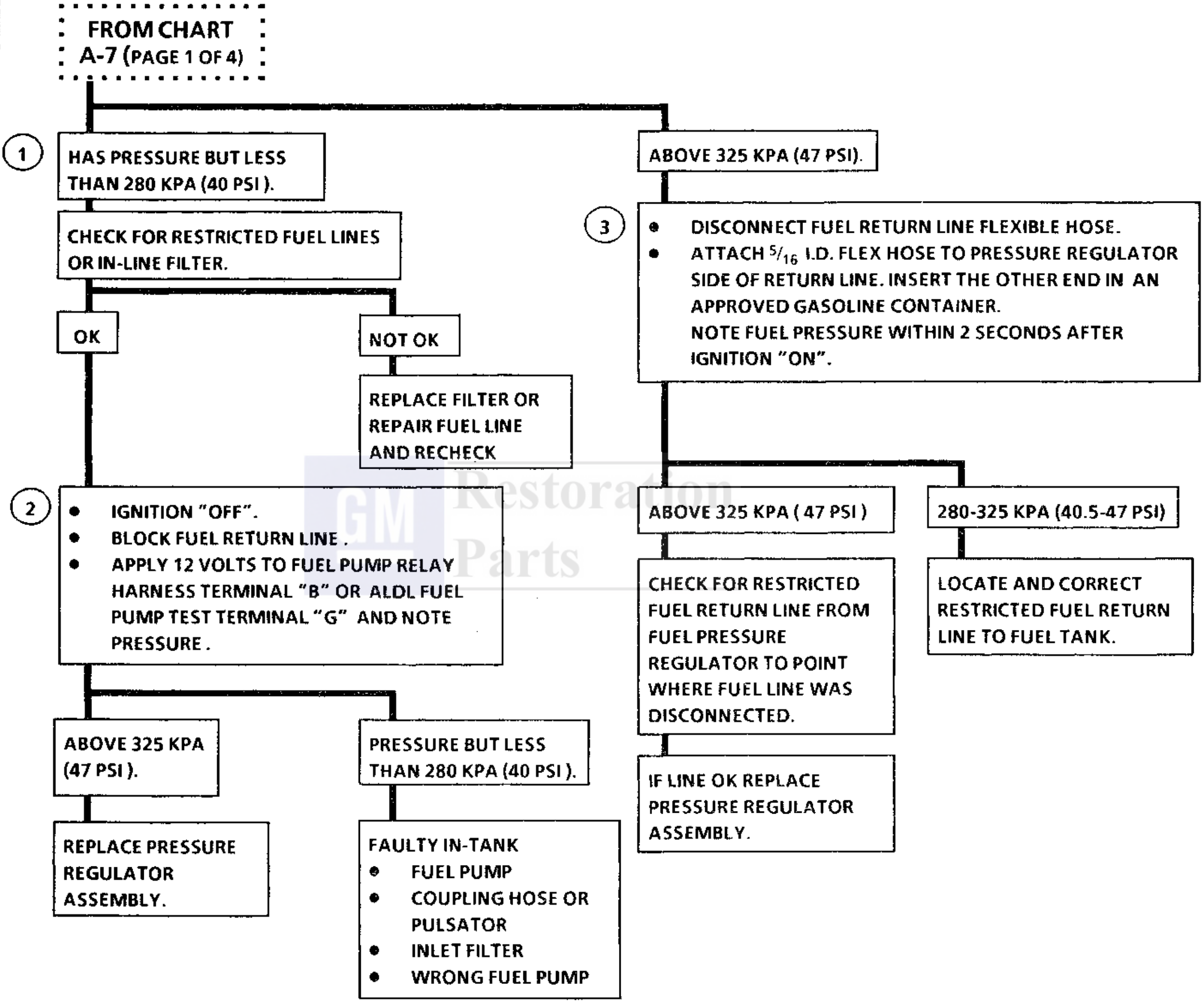
1. Pressure but less than 280 kPa (40.5 psi) falls into two areas:
   - Regulated pressure but less than 280 kPa (40.5 psi) Amount of fuel to injectors OK but pressure is too low. System will be lean running and may set Code 44. Also, hard starting cold and overall poor performance.
   - Restricted flow causing pressure drop - Normally, a vehicle with a fuel pressure of less than 165 kPa (24 psi) at idle will not be driveable. However, if the pressure drop occurs only while driving, the engine will normally surge then stop as pressure begins to drop rapidly.
2. Restricting the the fuel return line allows the fuel pump to develop its maximum pressure (dead head pressure). When battery voltage is applied to the pump test terminal, pressure should be above 414 kPa.(60 psi)
3. This test determines if the high fuel pressure is due to a restricted fuel return line or a pressure regulator problem.

CHART A-7

(Page 4 of 4)

FUEL SYSTEM DIAGNOSIS
2.8L "P" SERIES (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.*



FROM CHART A-7 (PAGE 1 OF 4)

① HAS PRESSURE BUT LESS THAN 280 KPA (40 PSI).

CHECK FOR RESTRICTED FUEL LINES OR IN-LINE FILTER.

OK

NOT OK

REPLACE FILTER OR REPAIR FUEL LINE AND RECHECK

②
- IGNITION "OFF".
- BLOCK FUEL RETURN LINE.
- APPLY 12 VOLTS TO FUEL PUMP RELAY HARNESS TERMINAL "B" OR ALDL FUEL PUMP TEST TERMINAL "G" AND NOTE PRESSURE.

ABOVE 325 KPA (47 PSI).

REPLACE PRESSURE REGULATOR ASSEMBLY.

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)

CHECK FOR RESTRICTED FUEL RETURN LINE FROM FUEL PRESSURE REGULATOR TO POINT WHERE FUEL LINE WAS DISCONNECTED.

IF LINE OK REPLACE PRESSURE REGULATOR ASSEMBLY.

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.

5-5-86
* 5S 1905-6E

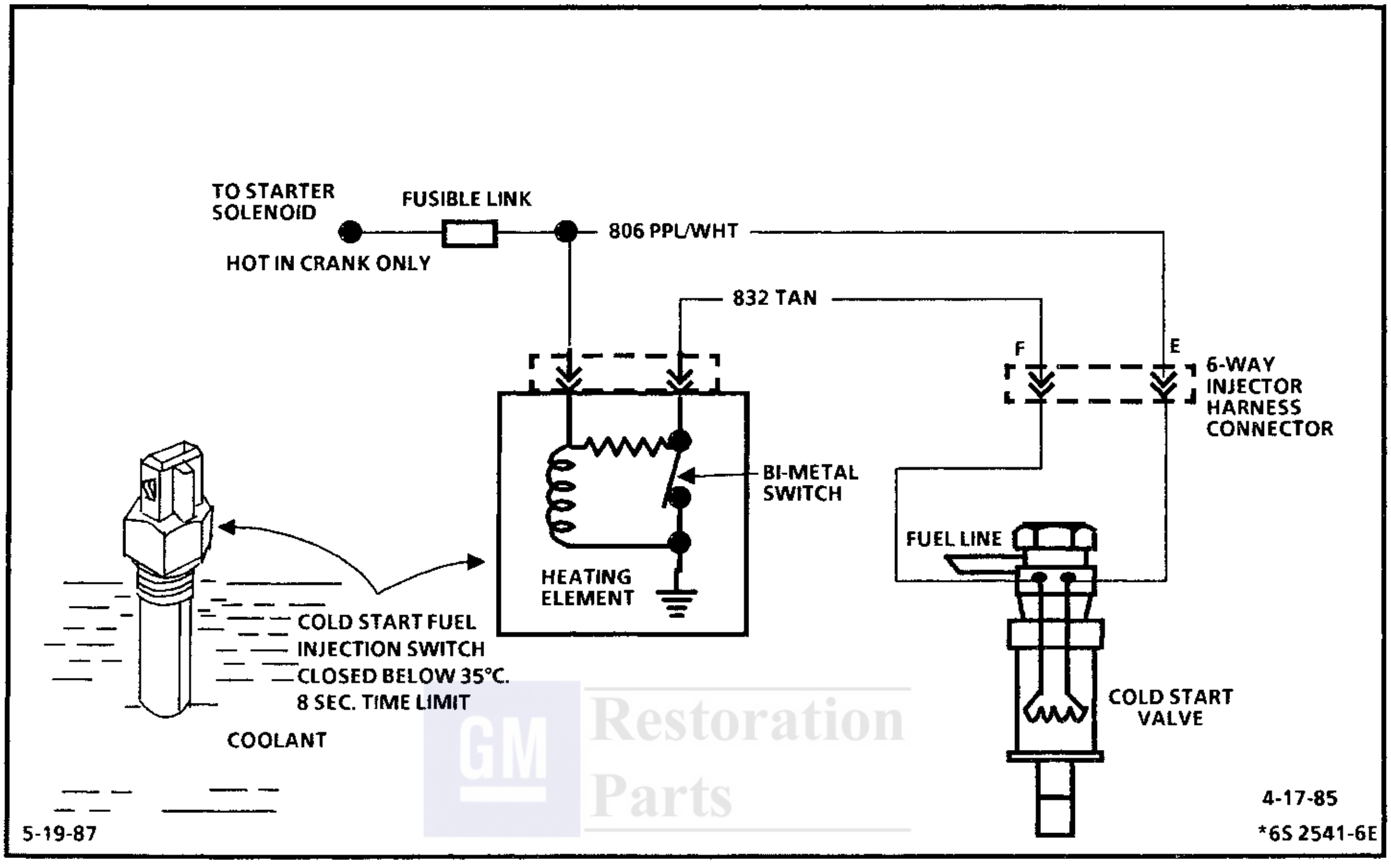


CHART A-9

COLD START VALVE TEST
2.8L "P" SERIES (PORT)

Circuit Description:

The cold start valve is used to provide additional fuel during the crank mode to improve cold startups. 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).

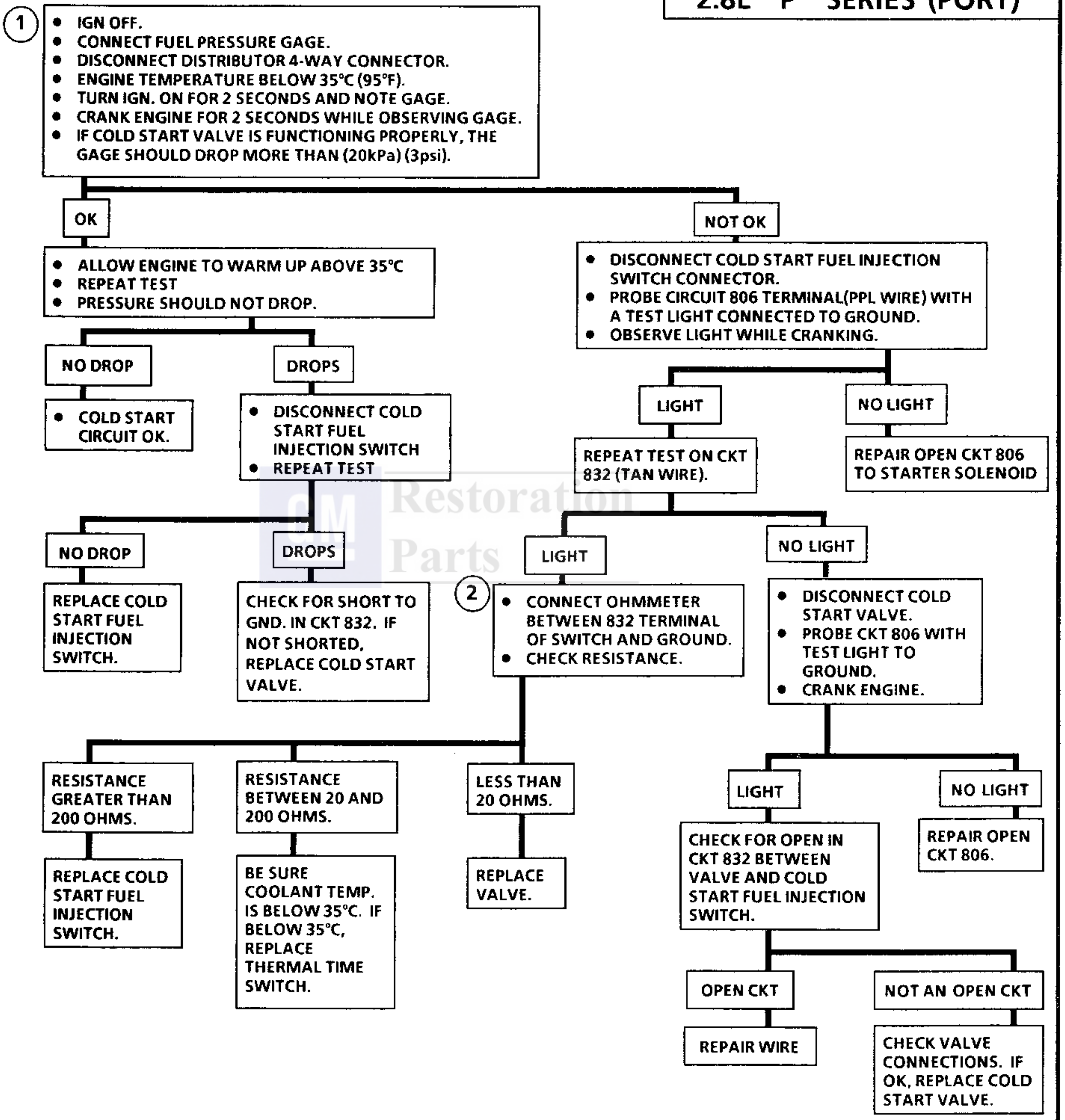
The cold start fuel injection switch contains a bimetal switch, which opens at a specified coolant temperature. This bimetal is also heated by the winding in the cold start fuel injection switch, which allows the valve to stay "ON" for 8 seconds at -20°C (-5°F) coolant. The time the switch will stay closed varies inversely with coolant temperature. In other words, as the coolant temperature goes up, the cold start valve "ON" time goes down.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

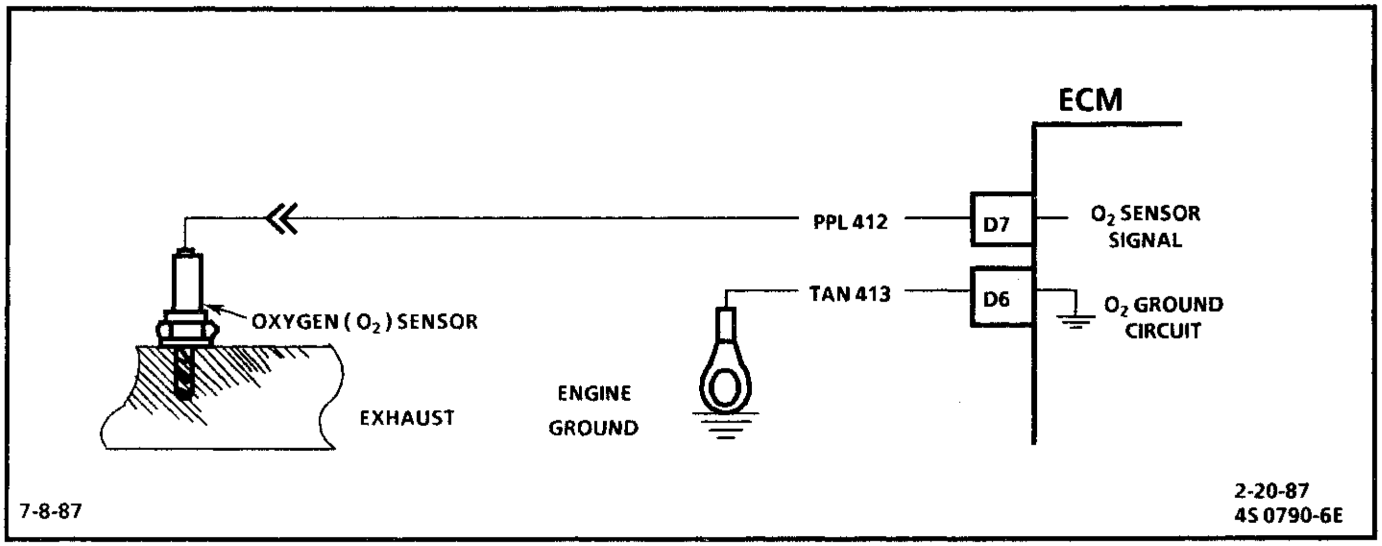
1. Disconnecting the distributor 4-way connector will disable the other injectors. The amount of pressure drop depends on the temperature of the engine. This test could also be performed by removing the two injector fuses.
2. This test will determine the continuity through the switch to ground.

CHART A-9

COLD START VALVE TEST
2.8L "P" SERIES (PORT)



12-09-85
*5S 1789-6E



CODE 13

OXYGEN SENSOR CIRCUIT
(OPEN CIRCUIT)
2.8L "P" SERIES (PORT)

Circuit Description:

The ECM supplies a voltage of about .45 volt between terminals "D7" and "D6". (If measured with a 10 megohm digital voltmeter, this may read as low as .32 volts.) The O_2 sensor varies the voltage within a range of about 1 volt if the exhaust is rich, down through about .10 volt if exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below 315°C (600°F). An open sensor circuit or cold sensor causes "Open Loop" operation.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 13 WILL SET:
   - Engine at normal operating temperature
   - At least 2 minutes engine time after start
   - O_2 signal voltage steady between .35 and .55 volts
   - RPM above 1600
   - Throttle position sensor signal above 12% (about .5 volts above closed throttle voltage)
   - All conditions must be met for about 20 seconds.

     If the conditions for a Code 13 exist, the system will not go "Closed Loop".
2. This will determine if the sensor is at fault, or the wiring or ECM is the cause of the Code 13.
3. In doing this test, use only a high impedence digital volt ohm meter. This test checks the continuity of CKT's 412 and 413, because if CKT 413 is open the ECM voltage on CKT 412 will be over .6 volts (600 mV).

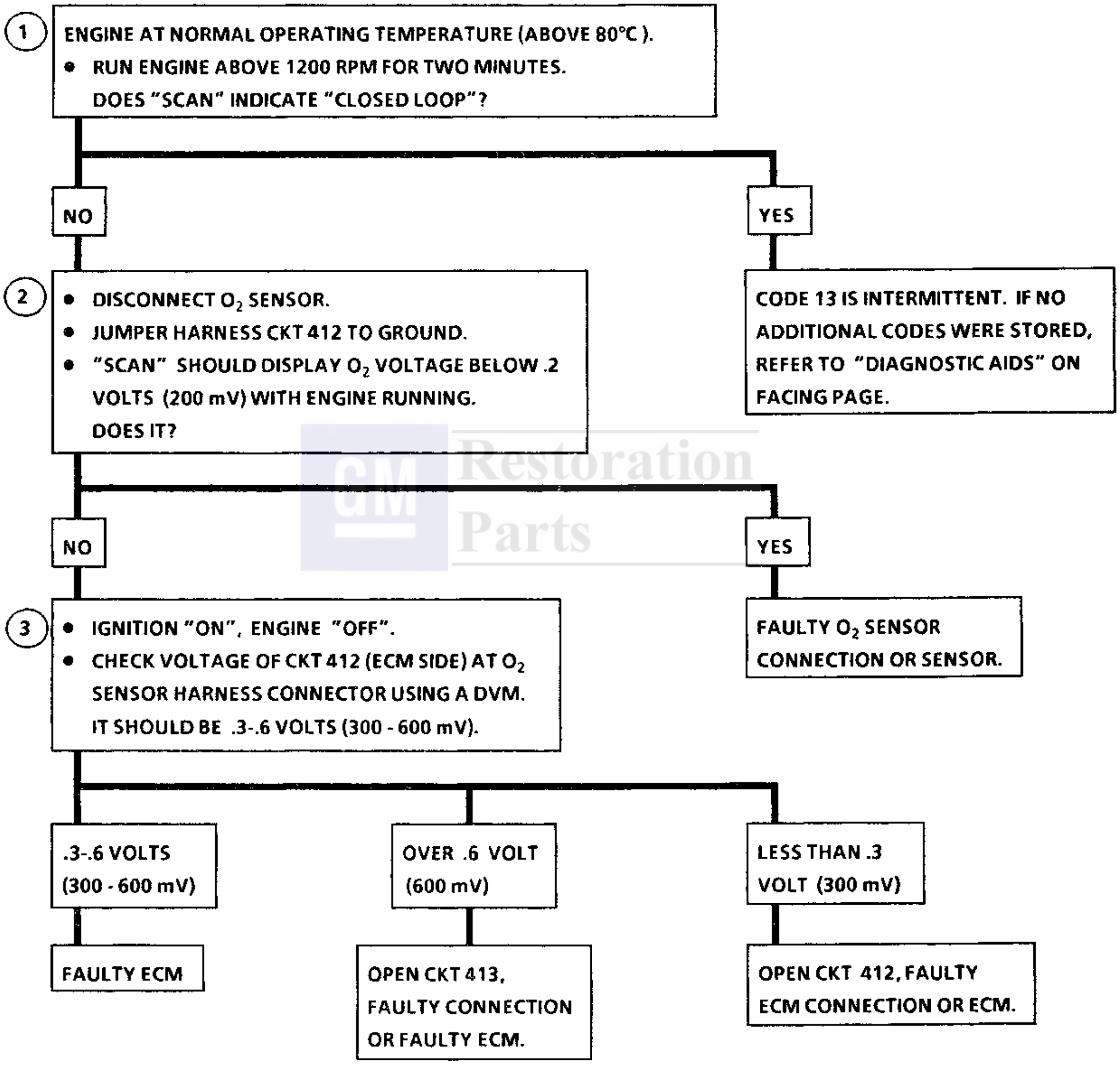
Diagnostic Aids:

Normal "Scan" voltage varies between 100 mV to 999 mV (.1 and 1.0 volt) while in "Closed Loop". Code 13 sets in one minute if voltage remains between .35 and .55 volts, but the system will go "Open Loop" in about 15 seconds.

Refer to "Intermittents" in Section "B".

CODE 13

OXYGEN SENSOR CIRCUIT
(OPEN CIRCUIT)
2.8L "P" SERIES (PORT)



① ENGINE AT NORMAL OPERATING TEMPERATURE (ABOVE 80°C).
- RUN ENGINE ABOVE 1200 RPM FOR TWO MINUTES.
  DOES "SCAN" INDICATE "CLOSED LOOP"?

CODE 13 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

②
- DISCONNECT O_2 SENSOR.
- JUMPER HARNESS CKT 412 TO GROUND.
- "SCAN" SHOULD DISPLAY O_2 VOLTAGE BELOW .2 VOLTS (200 mV) WITH ENGINE RUNNING.
  DOES IT?

FAULTY O_2 SENSOR CONNECTION OR SENSOR.

③
- IGNITION "ON", ENGINE "OFF".
- CHECK VOLTAGE OF CKT 412 (ECM SIDE) AT O_2 SENSOR HARNESS CONNECTOR USING A DVM.
  IT SHOULD BE .3-.6 VOLTS (300 - 600 mV).

.3-.6 VOLTS (300 - 600 mV)

FAULTY ECM

OVER .6 VOLT (600 mV)

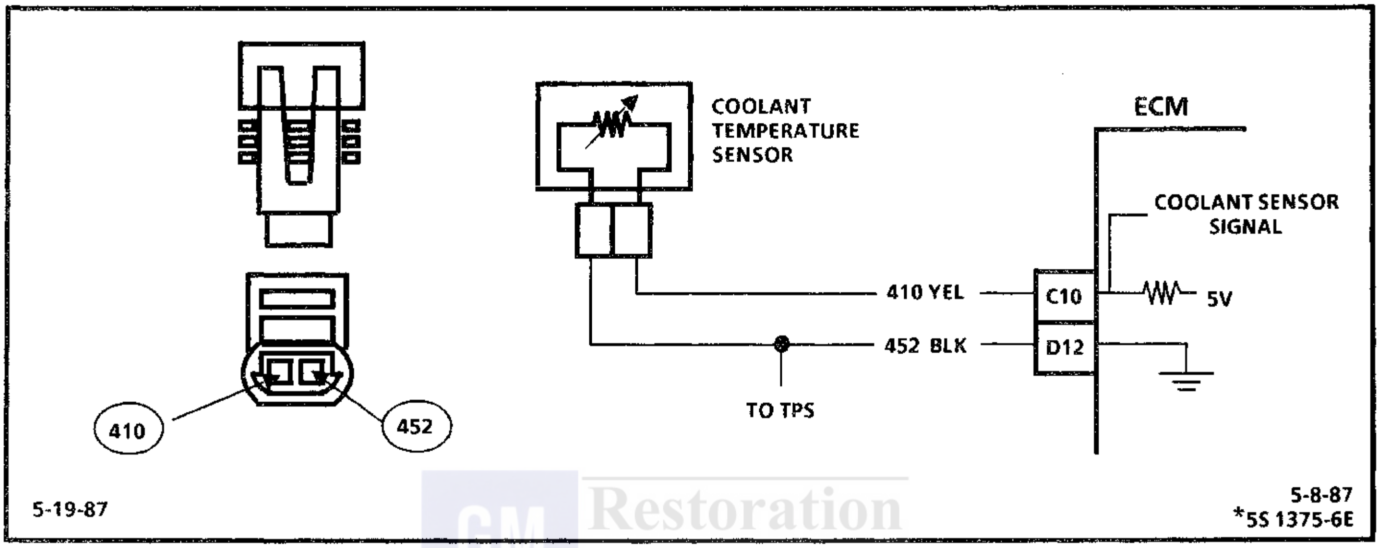
OPEN CKT 413, FAULTY CONNECTION OR FAULTY ECM.

LESS THAN .3 VOLT (300 mV)

OPEN CKT 412, FAULTY ECM CONNECTION OR ECM.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

6-23-87
• 7S 3054-6E



5-19-87

5-8-87
*5S 1375-6E

CODE 14

COOLANT TEMPERATURE SENSOR CIRCUIT
(HIGH TEMPERATURE INDICATED)
2.8L "P" SERIES (PORT)

Circuit Description:

The coolant temperature sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies a voltage on CKT 410 to the sensor. When the engine is cold the sensor (thermistor) resistance is high, therefore, the ECM will see high signal voltage.

As the engine warms, the sensor resistance becomes less, and the voltage drops. At normal engine operating temperature (85°C to 95°C) the voltage will measure about 1.5 to 2.0 volts.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 14 will set if:
   - Signal voltage indicates a coolant temperature above 135°C (275°F) for 3 seconds
   - Engine running longer than 20 seconds
2. This test will determine if CKT 410 is shorted to ground which will cause the conditions for Code 14.

Diagnostic Aids:

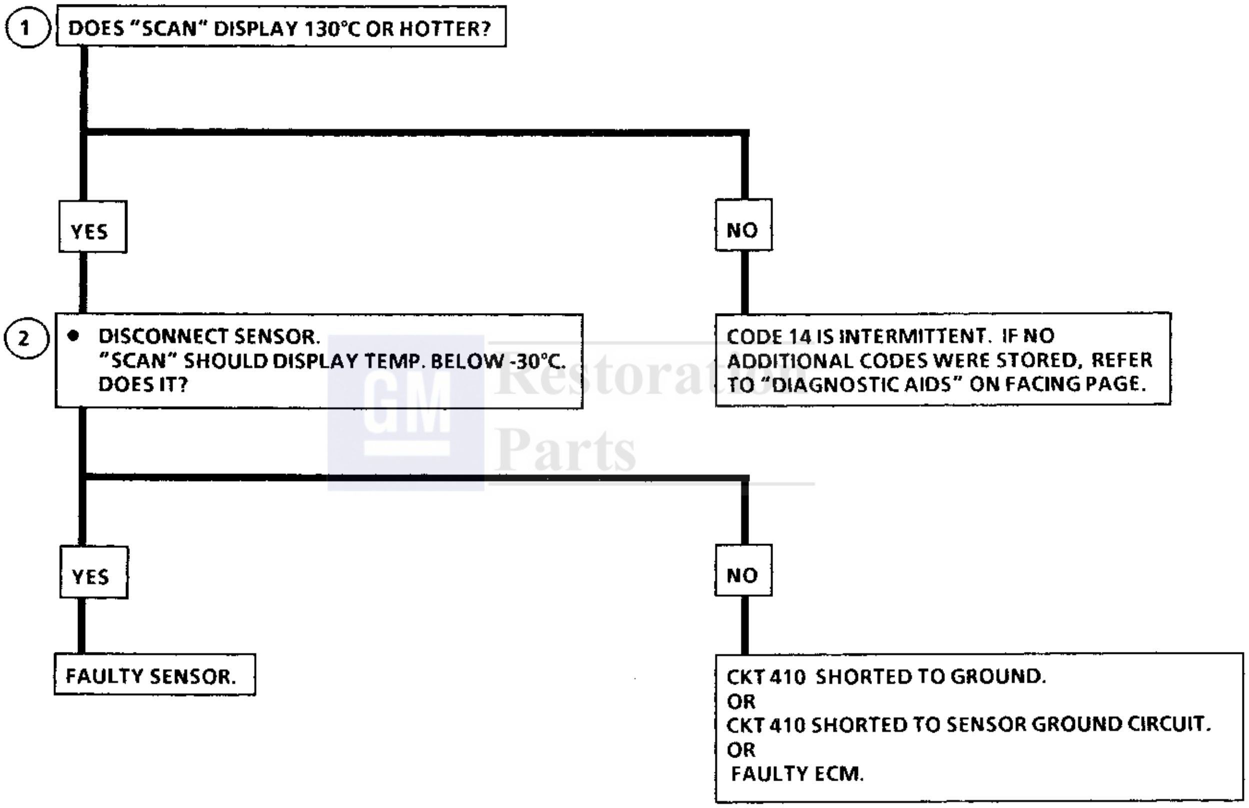
Check harness routing for a potential short to ground in CKT 410.

"Scan" tool displays engine temp. in degrees centigrade. After engine is started, the temperature should rise steadily to about 90°C then stabilize when thermostat opens.

Refer to "Intermittents" in Section "B".

CODE 14

COOLANT TEMPERATURE SENSOR CIRCUIT
(HIGH TEMPERATURE INDICATED)
2.8L "P" SERIES (PORT)

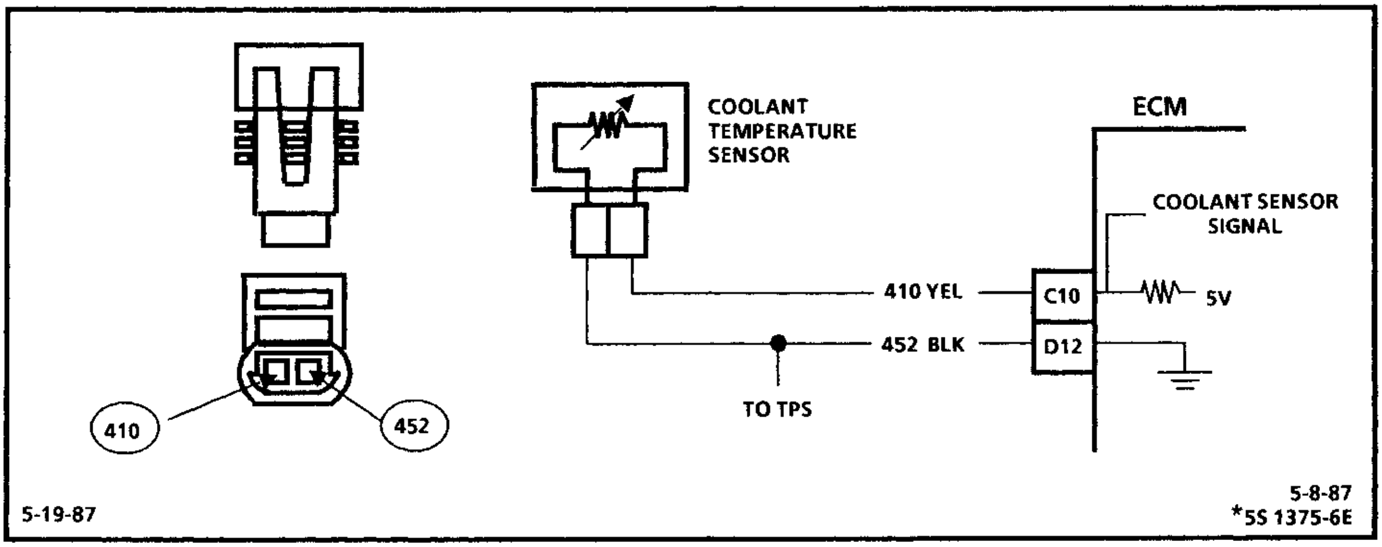


DIAGNOSTIC AID

COOLANT SENSOR
TEMPERATURE TO RESISTANCE VALUES
(APPROXIMATE)

°F	°C	OHMS
210	100	185
160	70	450
100	38	1,800
70	20	3,400
40	4	7,500
20	-7	13,500
0	-18	25,000
-40	-40	100,700

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.



CODE 15

COOLANT TEMPERATURE SENSOR CIRCUIT
(LOW TEMPERATURE INDICATED)
2.8L "P" SERIES (PORT)

Circuit Description:

The coolant temperature sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies a voltage on CKT 410 to the sensor. When the engine is cold, the sensor (thermistor) resistance is high, therefore the ECM will see high signal voltage.

As the engine warms, the sensor resistance becomes less, and the voltage drops. At normal engine operating temperature (85°C to 95°C) the voltage will measure about 1.5 to 2.0 volts at the ECM.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 15 will set if:
   - Ignition "ON" engine not running
   - Coolant temperature less than -30°C (-22°F), for 3 seconds
   - No Code 23
   - MAT temperature indicated above -25°C (-13°F)

   or

   - Engine running longer than 1 min
   - Signal voltage indicates a coolant temp. less than -30°C (-22°F) for 3 seconds
2. This test simulates a Code 14. If the ECM recognizes the low signal voltage (high temp.) and the "Scan" reads 130°C or above, the ECM and wiring are OK.
3. This test will determine if CKT 410 is open. There should be 5 volts present at sensor connector if measured with a DVOM.

Diagnostic Aids:

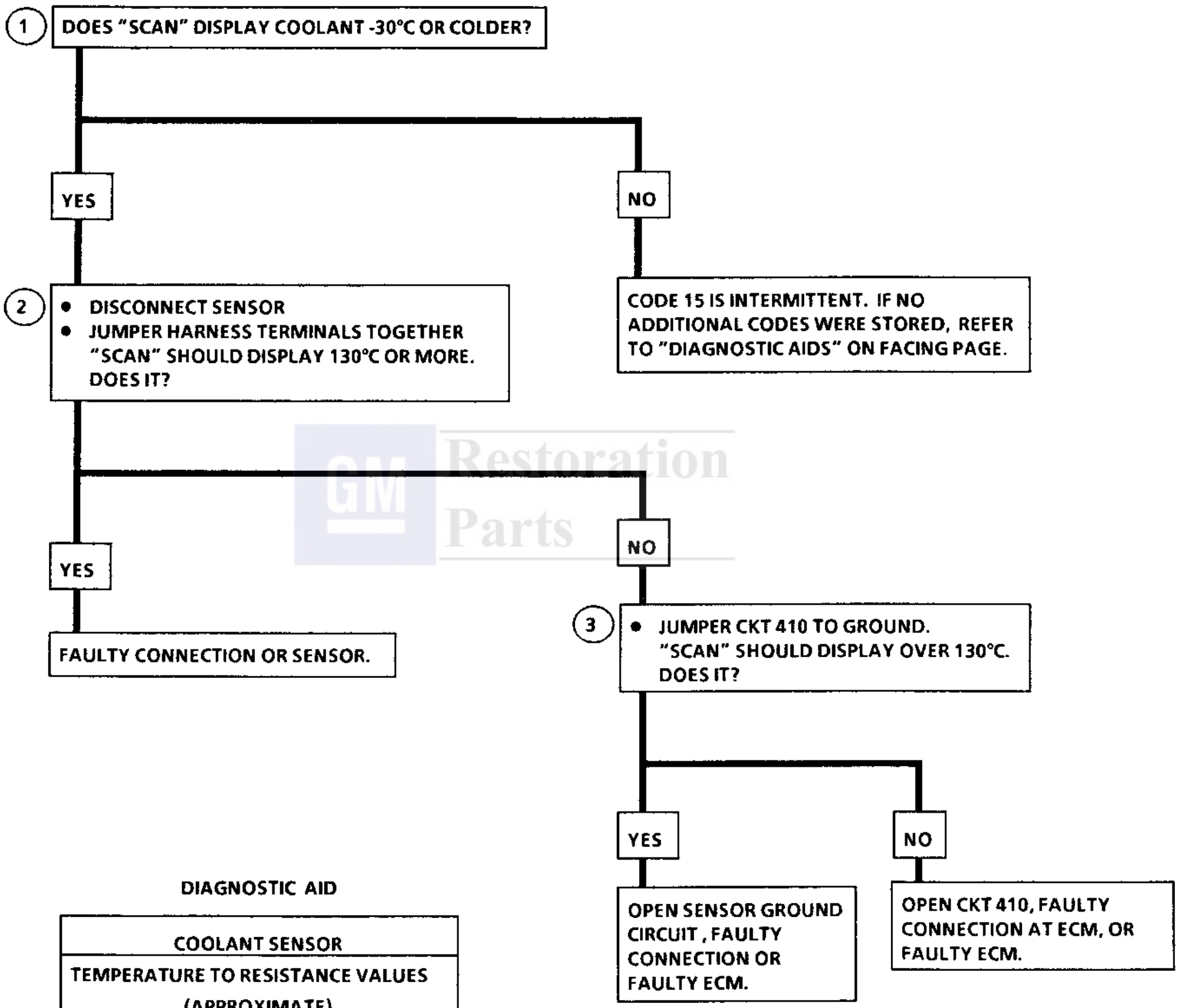
A "Scan" tool reads engine temperature in degrees centigrade. After engine is started, the temperature should rise steadily to about 90°C, then stabilize when thermostat opens.

If Code 21 is also set, check CKT 452 for faulty wiring or connections. Check terminals at sensor for good contact.

Refer to Intermittents in Section "B".

CODE 15

COOLANT TEMPERATURE SENSOR CIRCUIT
(LOW TEMPERATURE INDICATED)
2.8L "P" SERIES (PORT)



① DOES "SCAN" DISPLAY COOLANT -30°C OR COLDER?

YES

②
- DISCONNECT SENSOR
- JUMPER HARNESS TERMINALS TOGETHER "SCAN" SHOULD DISPLAY 130°C OR MORE. DOES IT?

YES

FAULTY CONNECTION OR SENSOR.

NO

③
- JUMPER CKT 410 TO GROUND. "SCAN" SHOULD DISPLAY OVER 130°C. DOES IT?

YES

OPEN SENSOR GROUND CIRCUIT, FAULTY CONNECTION OR FAULTY ECM.

NO

OPEN CKT 410, FAULTY CONNECTION AT ECM, OR FAULTY ECM.

NO

CODE 15 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

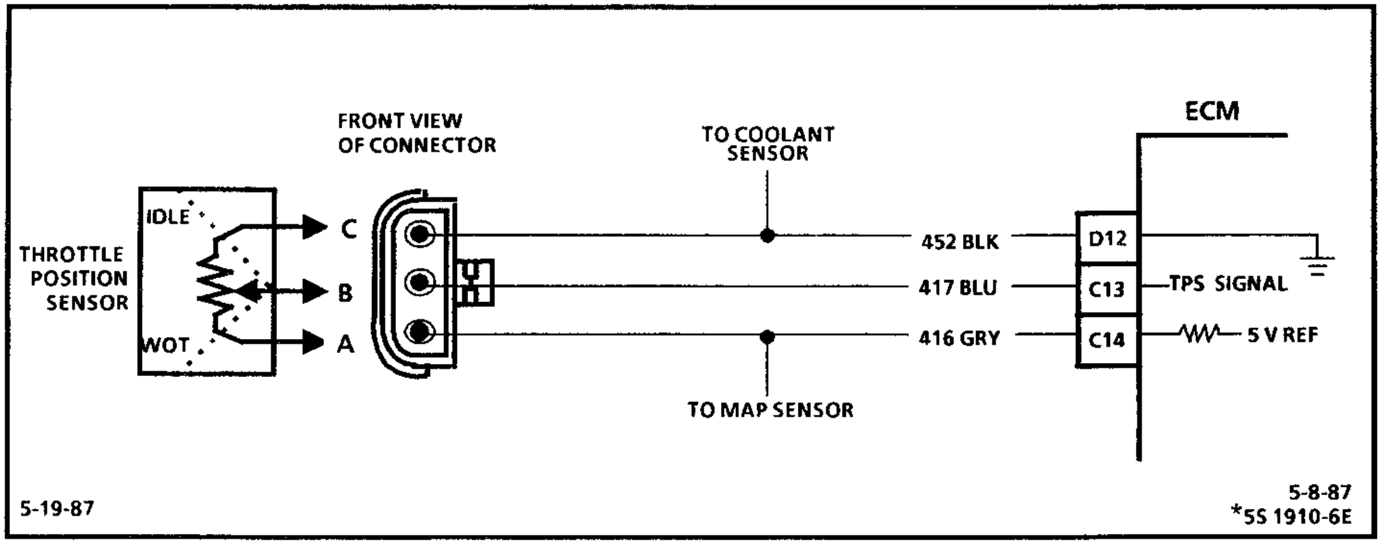
DIAGNOSTIC AID

COOLANT SENSOR
TEMPERATURE TO RESISTANCE VALUES (APPROXIMATE)

°F	°C	OHMS
210	100	185
160	70	450
100	38	1,800
70	20	3,400
40	4	7,500
20	-7	13,500
0	-18	25,000
-40	-40	100,700

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

2-11-87
• 7S 3261-6E



5-19-87

5-8-87
*5S 1910-6E

CODE 21

THROTTLE POSITION SENSOR (TPS) CIRCUIT
(SIGNAL VOLTAGE HIGH)
2.8L "P" SERIES (PORT)

Circuit Description:

The throttle position sensor (TPS) provides a voltage signal that changes relative to the throttle blade. Signal voltage will vary from about .5 at idle to about 5 volts at wide open throttle.

The TPS signal is one of the most important inputs used by the ECM for fuel control and for most of the ECM control outputs.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 21 will set if:
   - Engine running less than 1600
   - TPS signal voltage is greater than 2.5 volts.
   - All conditions met for 2 seconds.
   - MAP less than 70 kPa

   With throttle closed the TPS should read less than 1.25 volts. If it does not replace TPS.
2. With the TPS sensor disconnected, the TPS voltage should go low if the ECM and wiring are OK.
3. Probing CKT 452 with a test light checks the 5V return CKT, because a faulty 5V return will cause a Code 21.

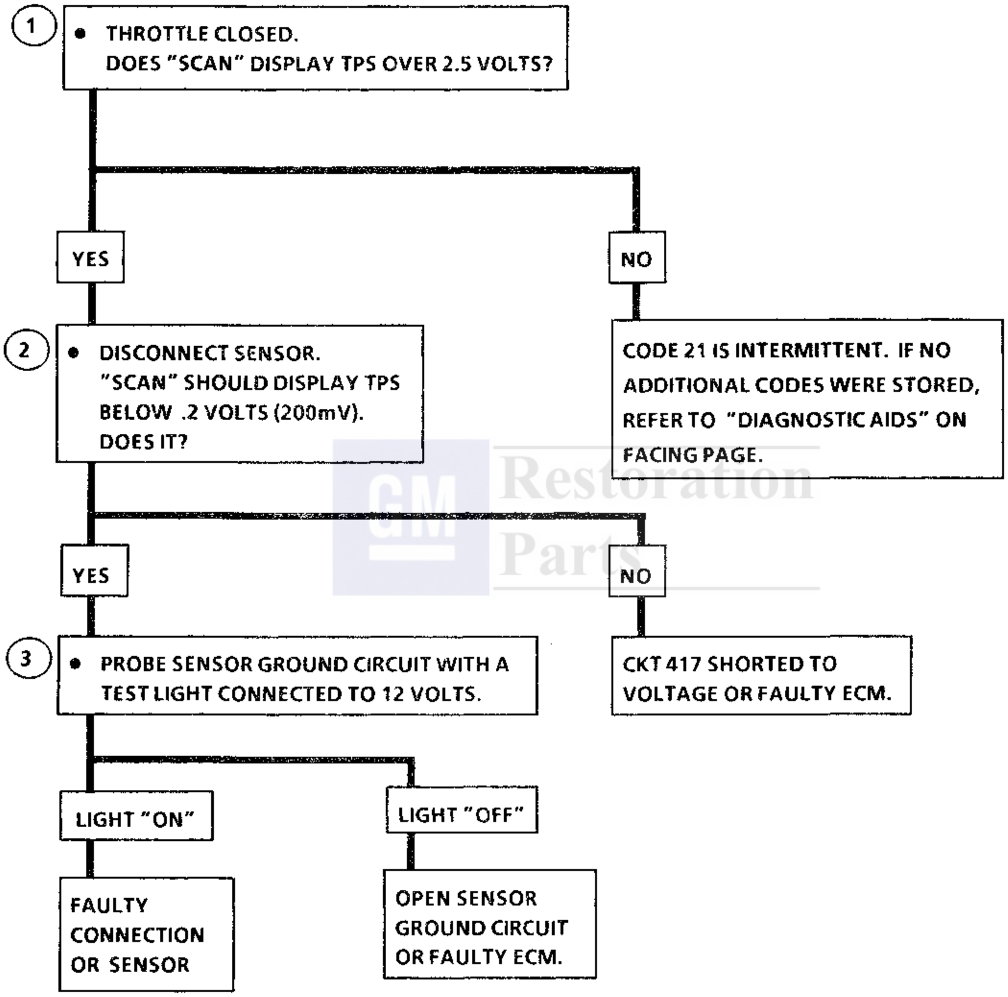
Diagnostic Aids:

A "Scan" tool reads throttle position in volts. Should read less than 1.25 volts with throttle closed and ignition "ON" or at idle. Voltage should increase at a steady rate as throttle is moved toward WOT.

An open in CKT 452 will result in a Code 21. Refer to Intermittents in Section "B".

CODE 21

THROTTLE POSITION SENSOR (TPS) CIRCUIT
(SIGNAL VOLTAGE HIGH)
2.8L "P" SERIES (PORT)



① • THROTTLE CLOSED.
DOES "SCAN" DISPLAY TPS OVER 2.5 VOLTS?

CODE 21 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

② • DISCONNECT SENSOR.
"SCAN" SHOULD DISPLAY TPS BELOW .2 VOLTS (200mV).
DOES IT?

CKT 417 SHORTED TO VOLTAGE OR FAULTY ECM.

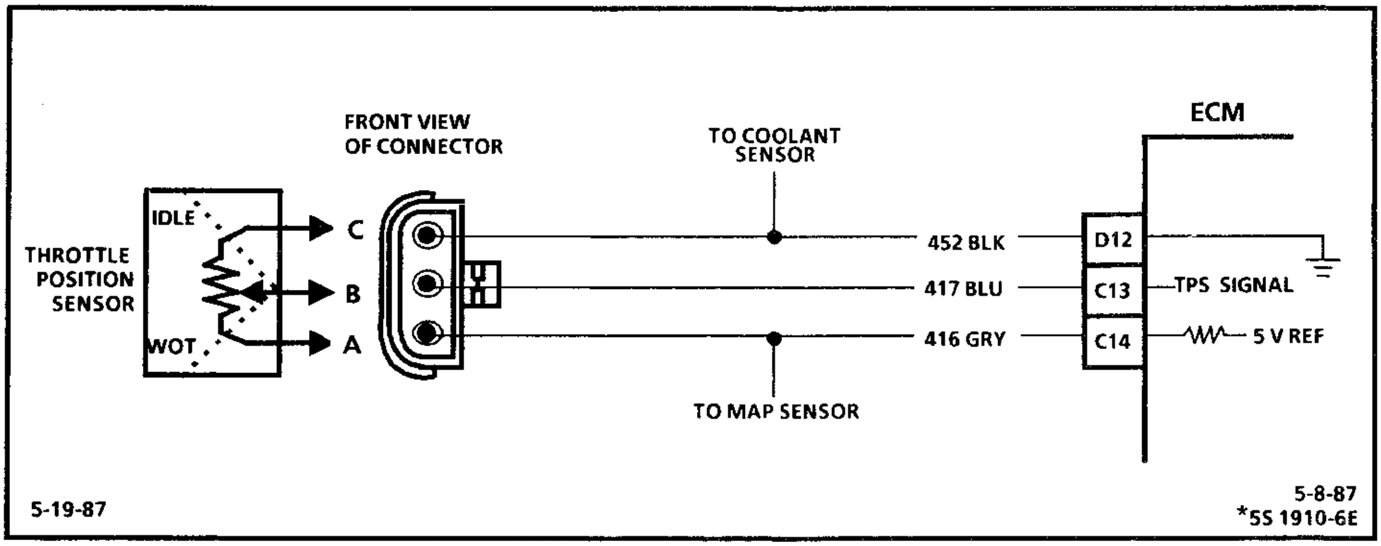
③ • PROBE SENSOR GROUND CIRCUIT WITH A TEST LIGHT CONNECTED TO 12 VOLTS.

FAULTY CONNECTION OR SENSOR

OPEN SENSOR GROUND CIRCUIT OR FAULTY ECM.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

2-24-87
• 7S 3057-6E



CODE 22

THROTTLE POSITION SENSOR (TPS) CIRCUIT

(SIGNAL VOLTAGE LOW)

2.8L "P" SERIES (PORT)

Circuit Description:

The throttle position sensor (TPS) provides a voltage signal that changes relative to the throttle blade. Signal voltage will vary from about .5 at idle to about 5 volts at wide open throttle.

The TPS signal is one of the most important inputs used by the ECM for fuel control and for most of the ECM control outputs.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 22, will set if:
   - Engine running
   - TPS signal voltage is less than about .2 volt for 2 seconds
2. Simulates Code 21: (high voltage) If the ECM recognizes the high signal voltage, the ECM and wiring are OK.
3. This simulates a high signal voltage to check for an open in CKT 417. The "Scan" tool will not read up to 12 volts, but what is important is that the ECM recognizes the signal on CKT 417.
4. There should be 5 volts at terminal "A" if measured with a DVOM when ignition is "ON".

Diagnostic Aids:

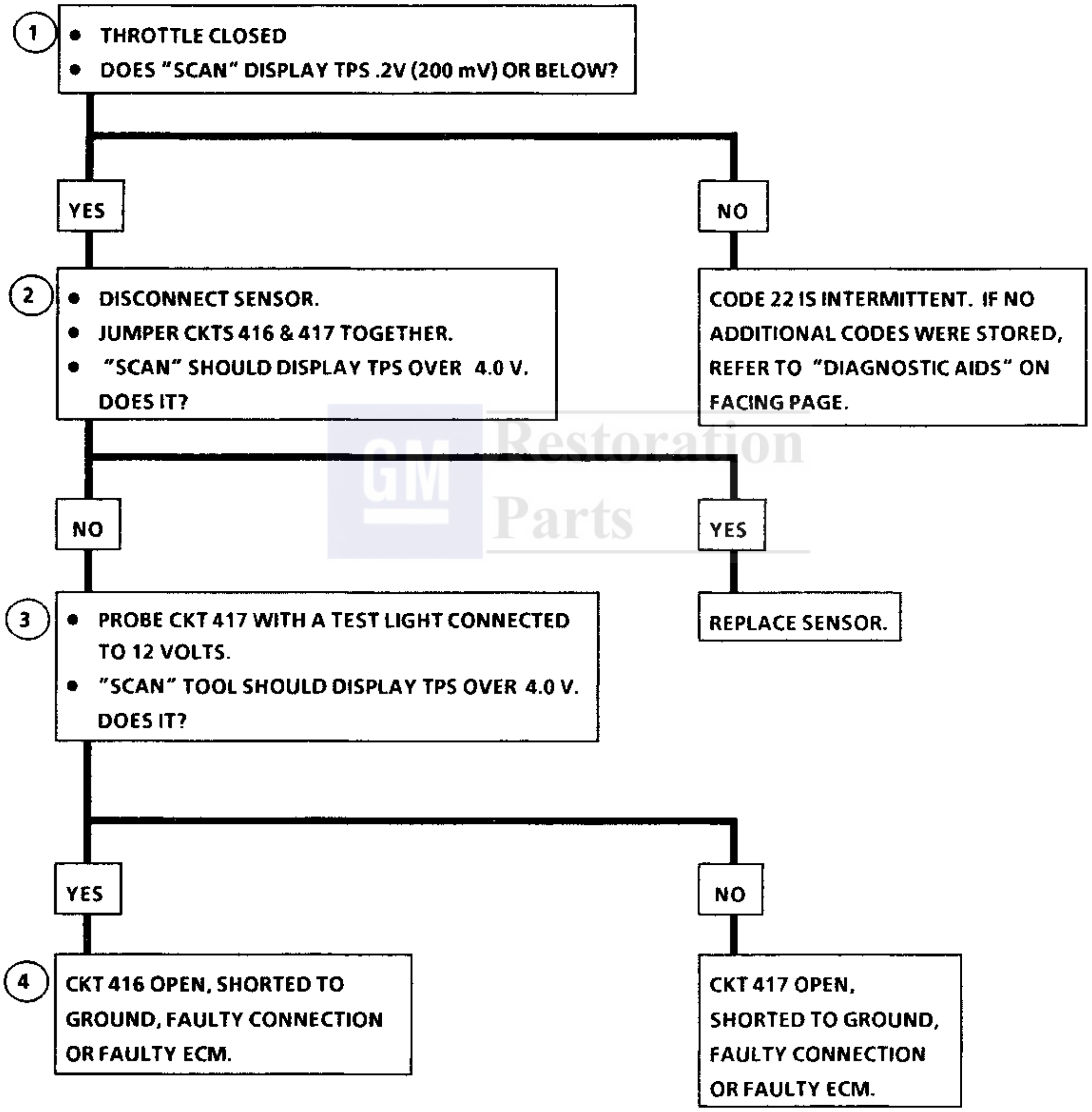
A "Scan" tool reads throttle position in volts. Should read less than 1.25 volts with throttle closed and ignition "ON" or at idle. Voltage should increase at a steady rate as throttle is moved toward WOT.

An open or short to ground in CKTs 416 or 417 will result in a Code 22.

Refer to Intermittents in Section "B".

CODE 22

THROTTLE POSITION SENSOR (TPS) CIRCUIT
(SIGNAL VOLTAGE LOW)
2.8L "P" SERIES (PORT)



①
- THROTTLE CLOSED
- DOES "SCAN" DISPLAY TPS .2V (200 mV) OR BELOW?

②
- DISCONNECT SENSOR.
- JUMPER CKTS 416 & 417 TOGETHER.
- "SCAN" SHOULD DISPLAY TPS OVER 4.0 V. DOES IT?

CODE 22 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

③
- PROBE CKT 417 WITH A TEST LIGHT CONNECTED TO 12 VOLTS.
- "SCAN" TOOL SHOULD DISPLAY TPS OVER 4.0 V. DOES IT?

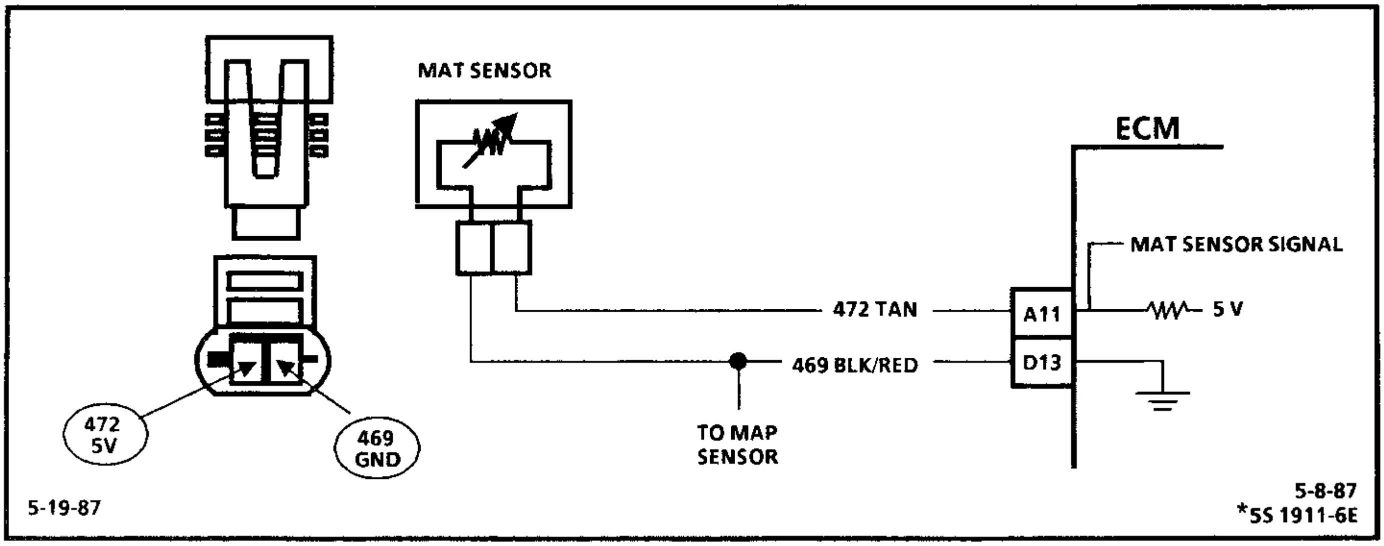
REPLACE SENSOR.

④ CKT 416 OPEN, SHORTED TO GROUND, FAULTY CONNECTION OR FAULTY ECM.

CKT 417 OPEN, SHORTED TO GROUND, FAULTY CONNECTION OR FAULTY ECM.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

6-18-87
*7S 3260-6E



CODE 23

MANIFOLD AIR TEMPERATURE (MAT) SENSOR CIRCUIT
(LOW TEMPERATURE INDICATED)
2.8L "P" SERIES (PORT)

Circuit Description:

The MAT sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies a voltage (about 4-6 volts) on CKT 472 to the sensor. When the air is cold the sensor (thermistor) resistance is high, therefore, the ECM will see a high signal voltage. If the air is warm the sensor resistance is low therefore the ECM will see a low voltage.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 23 will set if:
   - A signal voltage indicates a manifold air temperature below −25°C (-13°F) for 3 seconds.
   - Time since engine start is 1 minute
     or
   - Engine not running
   - MAT temperature less than -25°C (-13°F)
   - No Code 15
   - Coolant temperature reading greater than -26°C (-15°F)
2. A Code 23 will set, due to an open sensor, wire, or connection. This test will determine if the wiring and ECM are OK.
3. This will determine if the signal CKT 472 or the 5V return CKT 469 is open.

Diagnostic Aids:

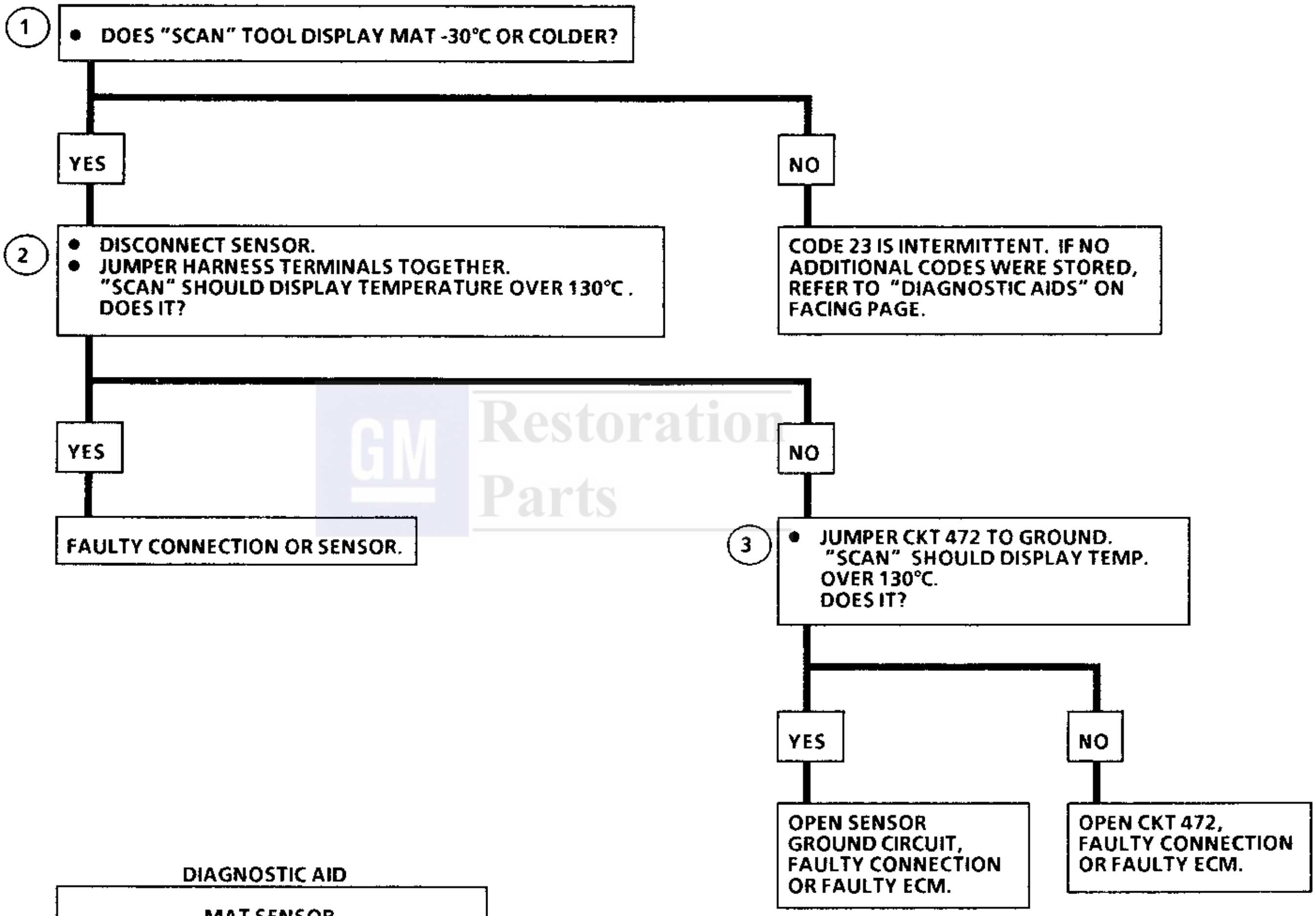
A "Scan" tool reads temperature of the air entering the engine and should read close to ambient air temperature when engine is cold, and rises as underhood temperature increases.

Inspect CKTS 472 & 469 for intermittent opens. If Code 33 is also set carefully inspect CKT 469.

Refer to "Intermittents" in Section "B".

CODE 23

MANIFOLD AIR TEMPERATURE (MAT) SENSOR CIRCUIT
(LOW TEMPERATURE INDICATED)
2.8L "P" SERIES (PORT)



① • DOES "SCAN" TOOL DISPLAY MAT -30°C OR COLDER?

② • DISCONNECT SENSOR.
• JUMPER HARNESS TERMINALS TOGETHER.
"SCAN" SHOULD DISPLAY TEMPERATURE OVER 130°C . DOES IT?

CODE 23 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

FAULTY CONNECTION OR SENSOR.

③ • JUMPER CKT 472 TO GROUND.
"SCAN" SHOULD DISPLAY TEMP. OVER 130°C.
DOES IT?

OPEN SENSOR GROUND CIRCUIT, FAULTY CONNECTION OR FAULTY ECM.

OPEN CKT 472, FAULTY CONNECTION OR FAULTY ECM.

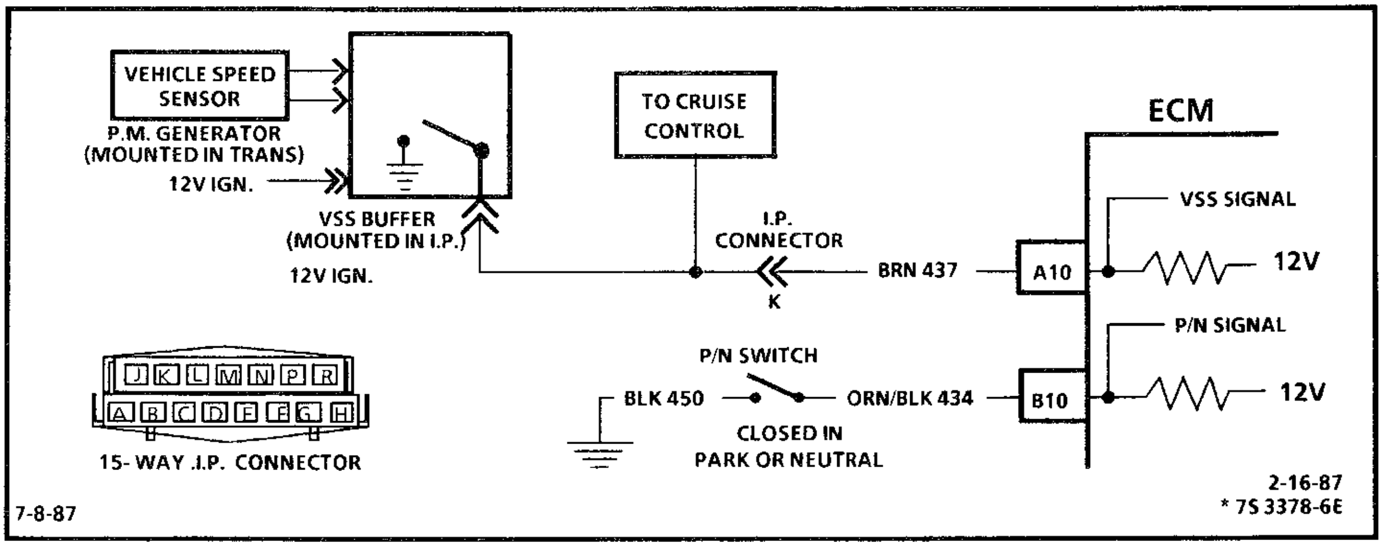
DIAGNOSTIC AID

MAT SENSOR

TEMPERATURE TO RESISTANCE VALUES (APPROXIMATE)

°F	°C	OHMS
210	100	185
160	70	450
100	38	1,800
70	20	3,400
40	4	7,500
20	-7	13,500
0	-18	25,000
-40	-40	100,700

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.



CODE 24

VEHICLE SPEED SENSOR (VSS) CIRCUIT
2.8L "P" SERIES (PORT)

Circuit Description:

The ECM applies and monitors 12 volts on CKT 437. CKT 437 connects to the vehicle speed sensor which alternately grounds CKT 437 when drive wheels are turning. This pulsing action takes place about 2000 times per mile and the ECM will calculate vehicle speed based on the time between "pulses".

"Scan" reading should closely match with speedometer reading with drive wheels turning.

** To prevent misdiagnosis, the technician should review electrical Section "8A" or the electrical trouble shooting 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.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 24 will set if vehicle speed equals 0 mph when:
   - Engine speed is between 2000 and 4400 rpm
   - TPS is less than 2% (closed throttle)
   - Low load condition (high vacuum)
   - Not in park or neutral
   - All conditions met for 5 seconds

   These conditions are met during a road load deceleration. Disregard Code 24 that sets when drive wheels are not turning.
2. 8-12 volts, at the I.P. connector, indicates CKT 437 is open between the I.P. connector and the VSS, or there is a faulty vehicle speed sensor. A voltage of less than 1 volt, at the I.P. connector, indicates that CKT 437 wire is shorted to ground. If after disconnecting CKT 437 at the vehicle speed sensor the voltage reads above 10 volts, the vehicle speed sensor is faulty. If voltage remains less than 8 volts, then CKT 437 wire is grounded. If 437 is not grounded, there is a faulty connection at the ECM, or a faulty ECM. The I.P. connector is located in the center console near the ECM.

Diagnostic Aids:

"Scan" should indicate a vehicle speed whenever the drive wheels are turning greater than 3 mph.

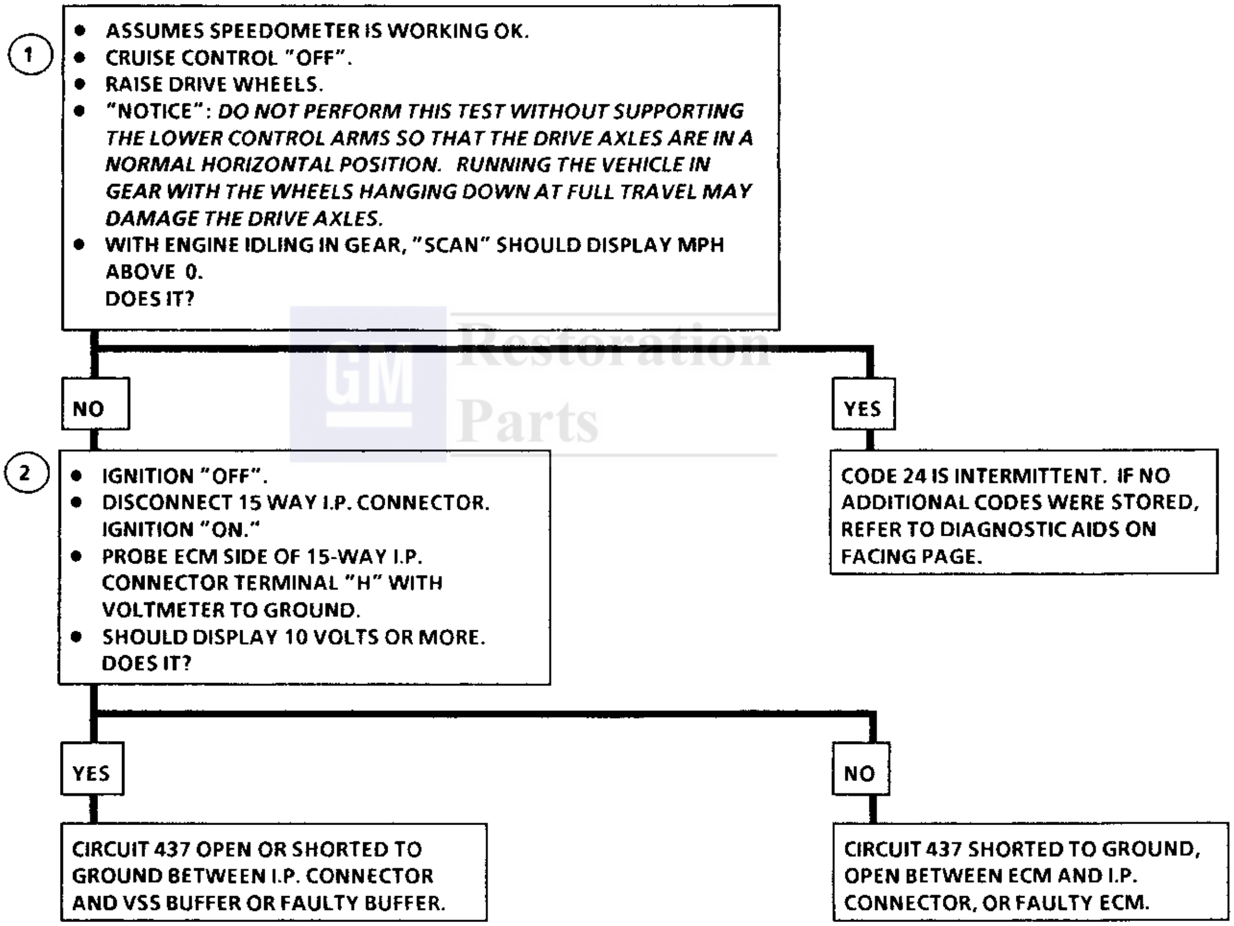
A faulty or misadjusted park/neutral switch can result in a false Code 24. Use a "Scan" and check for proper signal while in drive. Refer to CHART C-1A for P/N switch diagnosis check.

If all OK, refer to "Intermittents" in Section "B".

CODE 24

VEHICLE SPEED SENSOR (VSS) CIRCUIT
2.8L "P" SERIES (PORT)

DISREGARD CODE 24 IF SET WHILE DRIVE WHEELS ARE NOT TURNING.



①
- ASSUMES SPEEDOMETER IS WORKING OK.
- CRUISE CONTROL "OFF".
- RAISE DRIVE WHEELS.
- "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.*
- WITH ENGINE IDLING IN GEAR, "SCAN" SHOULD DISPLAY MPH ABOVE 0.
  DOES IT?

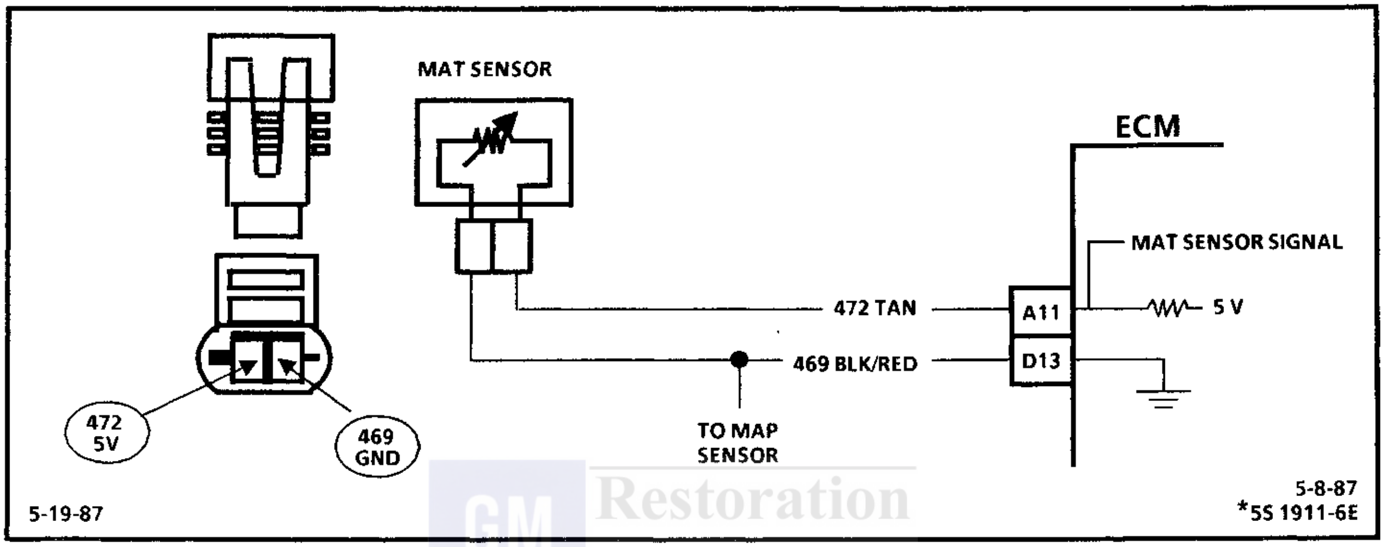
CODE 24 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO DIAGNOSTIC AIDS ON FACING PAGE.

②
- IGNITION "OFF".
- DISCONNECT 15 WAY I.P. CONNECTOR. IGNITION "ON."
- PROBE ECM SIDE OF 15-WAY I.P. CONNECTOR TERMINAL "H" WITH VOLTMETER TO GROUND.
- SHOULD DISPLAY 10 VOLTS OR MORE.
  DOES IT?

CIRCUIT 437 OPEN OR SHORTED TO GROUND BETWEEN I.P. CONNECTOR AND VSS BUFFER OR FAULTY BUFFER.

CIRCUIT 437 SHORTED TO GROUND, OPEN BETWEEN ECM AND I.P. CONNECTOR, OR FAULTY ECM.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.



CODE 25

MANIFOLD AIR TEMPERATURE (MAT) SENSOR CIRCUIT

(HIGH TEMPERATURE INDICATED)

2.8L "P" SERIES (PORT)

Circuit Description:

The manifold air temperature (MAT) sensor uses a thermistor to control the signal-voltage to the ECM. The ECM applies a voltage (4-6) on CKT 472 to the sensor. When manifold air is cold, the sensor (thermistor) resistance is high, therefore, the ECM will see a high signal voltage. As the air warms, the sensor resistance becomes less, and the voltage drops.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 25 will set if:
   - Signal voltage indicates a manifold air temperature greater than 135°C (275° F) for 2 seconds
   - Time since engine start is 1 minute or longer

Diagnostic Aids:

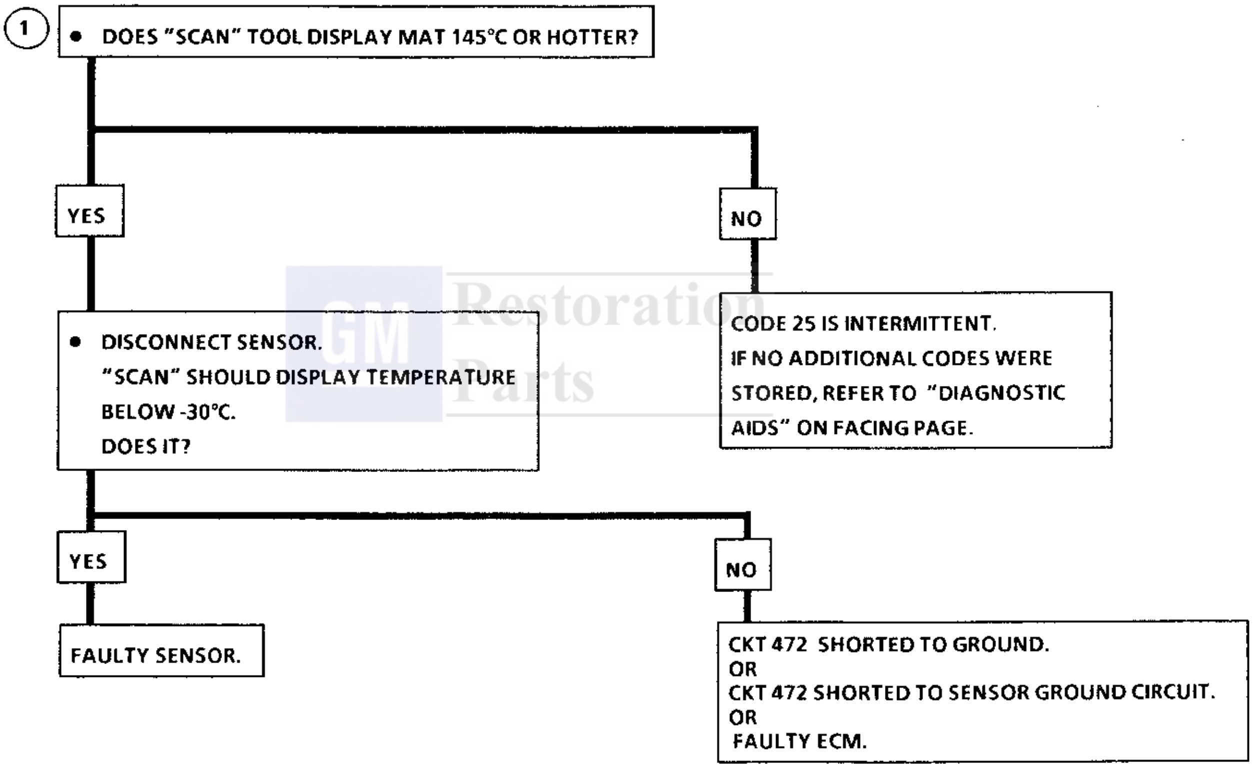
A "Scan" tool reads temperature of the air entering the engine and should read close to ambient air temperature when engine is cold and rise as underhood temperature increases.

Check harness routing for possible short to ground in CKT 472.

Refer to "Intermittents" in Section "B".

CODE 25

MANIFOLD AIR TEMPERATURE (MAT) SENSOR CIRCUIT
(HIGH TEMPERATURE INDICATED)
2.8L "P" SERIES (PORT)



① • DOES "SCAN" TOOL DISPLAY MAT 145°C OR HOTTER?

YES

• DISCONNECT SENSOR.
"SCAN" SHOULD DISPLAY TEMPERATURE BELOW -30°C.
DOES IT?

YES

FAULTY SENSOR.

NO

CKT 472 SHORTED TO GROUND.
OR
CKT 472 SHORTED TO SENSOR GROUND CIRCUIT.
OR
FAULTY ECM.

NO

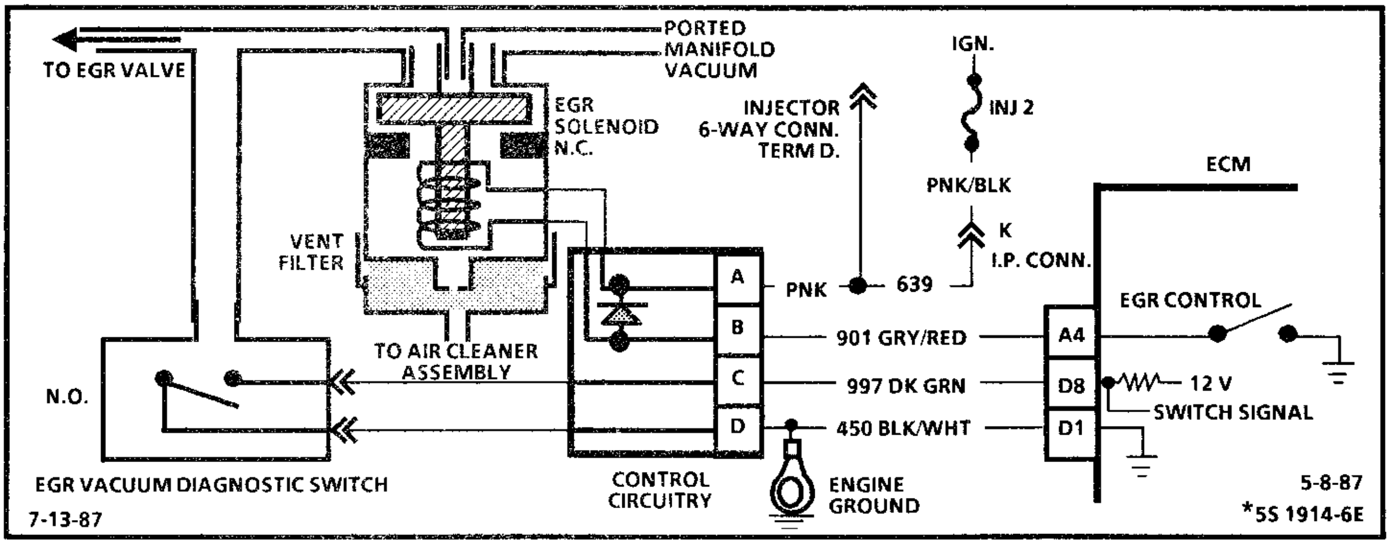
CODE 25 IS INTERMITTENT.
IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

DIAGNOSTIC AID

MAT SENSOR
TEMPERATURE TO RESISTANCE VALUES
(APPROXIMATE)

°F	°C	OHMS
210	100	185
160	70	450
100	38	1,800
70	20	3,400
40	4	7,500
20	-7	13,500
0	-18	25,000
-40	-40	100,700

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.



CODE 32

EXHAUST GAS RECIRCULATION (EGR) CIRCUIT
2.8L "P" SERIES (PORT)

Circuit Description:

The EGR valve vacuum is controlled by an ECM operated solenoid. 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 sensor, MAP sensor, and engine rpm. There should be 0% (NO EGR) when in Park or Neutral, TPS input below a specified value, or TPS indicating wide open throttle (WOT).

With the ignition "ON", engine stopped, the EGR solenoid is de-energized, unless the diagnostic terminal is grounded.

Code 32 means that the EGR diagnostic switch was not detected closed under the following conditions:

- Coolant temperature greater than specified amount.
- 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 about 8 seconds

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

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 checks will diagnose 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.

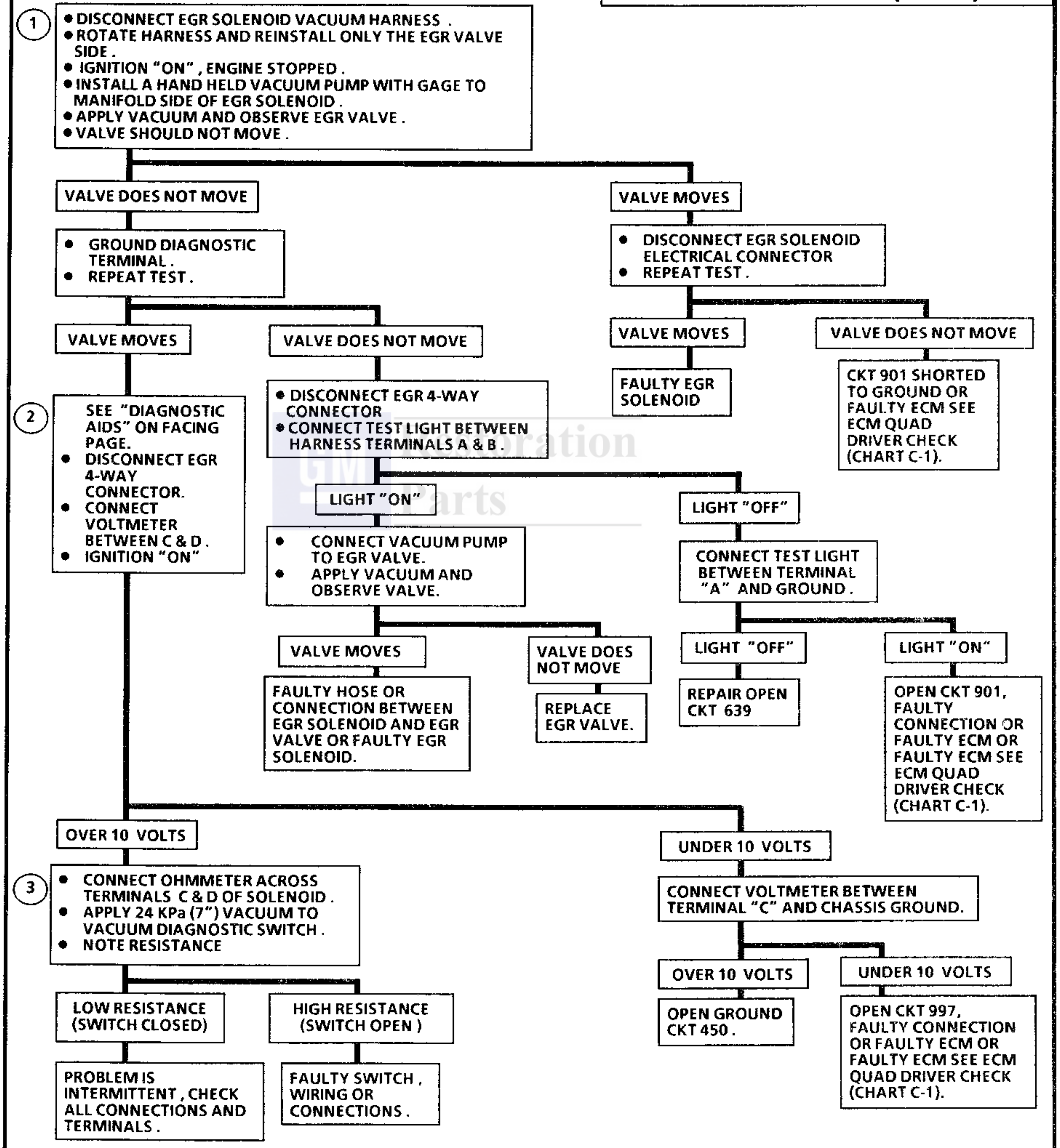
Diagnostic Aids:

A "Scan" tool can also be used to check the diagnostic switch circuit. The "Scan" should display "ON" when vacuum is applied to the diagnostic switch. The switch should also be indicated as being closed whenever the ECM is commanding an EGR duty cycle of greater than 50%. EGR duty cycle can also be monitored by a "Scan" tool.

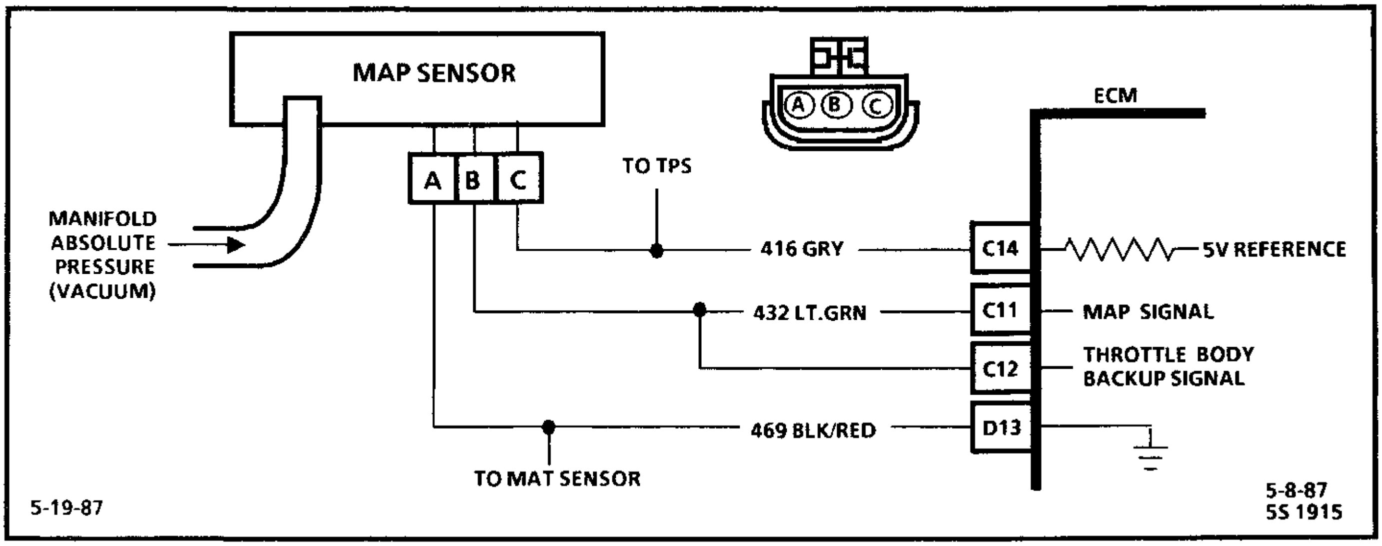
CODE 32

EXHAUST GAS RECIRCULATION (EGR) CIRCUIT
2.8L "P" SERIES (PORT)

BEFORE USING THIS CHART, CHECK FOR PORTED VACUUM TO EGR SOLENOID , ALSO CHECK HOSES FOR LEAKS OR RESTRICTIONS .SHOULD BE AT LEAST 7" HG VACUUM AT 2000 RPM.



7-1-87
*5S 1913-6E



CODE 33

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR CIRCUIT

(SIGNAL VOLTAGE HIGH - LOW VACUUM)

2.8L "P" SERIES (PORT)

Circuit Description:

The manifold absolute pressure sensor (MAP) responds to changes in manifold pressure (vacuum). The ECM receives this information as a signal voltage that will vary from about 1-1.5 volts at idle to 4-4.5 volts at wide open throttle.

A "Scan" displays manifold pressure in volts. Low pressure (high vacuum) reads a low voltage, while a high pressure (low vacuum) reads a high voltage.

If the MAP sensor fails, the ECM will substitute a fixed MAP value and use the throttle position sensor (TPS) to control fuel delivery.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 33 will set when:
   - Signal is too high, (kPa greater than 69 kPa with A/C "OFF" or greater than 75 kPa with A/C "ON") for a time greater than 5 seconds
   - TPS less than 1.6%

   Engine misfire or a low unstable idle may set Code 33. Disconnect MAP sensor and system will go into backup mode. If the misfire or idle condition remains, see Symptoms in Section "B".
2. If the ECM recognizes the low MAP signal, the ECM and wiring are OK.

Diagnostic Aids:

If idle is rough or unstable, refer to symptoms in Section "B" for items which can cause an unstable idle.

An open in CKT 469 or the connection will result in a Code 33.

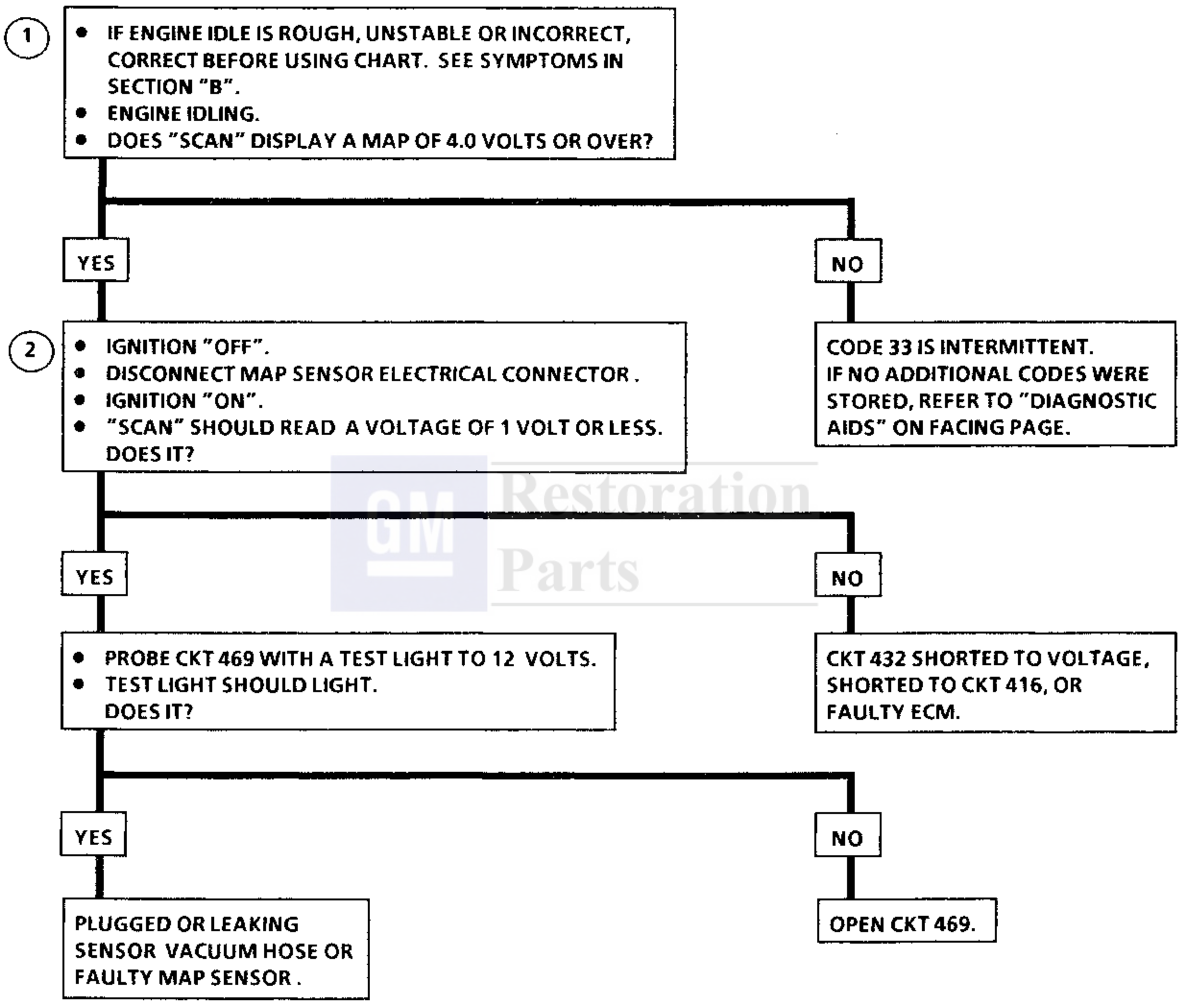
Ignition "ON" engine "OFF", voltages should be within the values shown in the table on the chart.

Also CHART C-1D can be used to test the MAP sensor.

Refer to "Intermittents" in Section "B".

CODE 33

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR CIRCUIT
(SIGNAL VOLTAGE HIGH - LOW VACUUM)
2.8L "P" SERIES (PORT)



①
- IF ENGINE IDLE IS ROUGH, UNSTABLE OR INCORRECT, CORRECT BEFORE USING CHART. SEE SYMPTOMS IN SECTION "B".
- ENGINE IDLING.
- DOES "SCAN" DISPLAY A MAP OF 4.0 VOLTS OR OVER?

NO: CODE 33 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

YES: ②
- IGNITION "OFF".
- DISCONNECT MAP SENSOR ELECTRICAL CONNECTOR .
- IGNITION "ON".
- "SCAN" SHOULD READ A VOLTAGE OF 1 VOLT OR LESS. DOES IT?

NO: CKT 432 SHORTED TO VOLTAGE, SHORTED TO CKT 416, OR FAULTY ECM.

YES:
- PROBE CKT 469 WITH A TEST LIGHT TO 12 VOLTS.
- TEST LIGHT SHOULD LIGHT. DOES IT?

YES: PLUGGED OR LEAKING SENSOR VACUUM HOSE OR FAULTY MAP SENSOR .

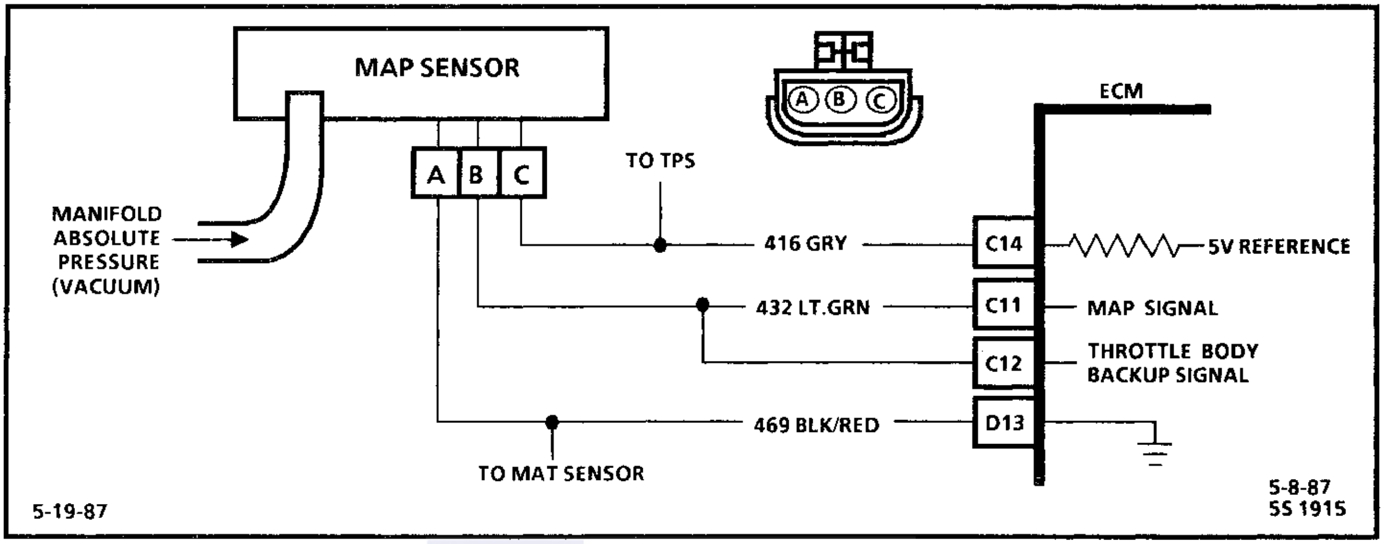
NO: OPEN CKT 469.

IGNITION "ON" ENGINE STOPPED VOLTAGES

ALTITUDE		VOLTAGE RANGE
Meters	Feet	
Below 305	Below 1,000	3.8---5.5V
305--- 610	1,000--2,000	3.6---5.3V
610--- 914	2,000--3,000	3.5---5.1V
914--1219	3,000--4,000	3.3---5.0V
1219--1524	4,000--5,000	3.2---4.8V
1524--1829	5,000--6,000	3.0---4.6V
1829--2133	6,000--7,000	2.9---4.5V
2133--2438	7,000--8,000	2.8---4.3V
2438--2743	8,000--9,000	2.6---4.2V
2743--3048	9,000--10,000	2.5---4.0V

LOW ALTITUDE = HIGH PRESSURE = HIGH VOLTAGE

6-17-87
7S 3210-6E



CODE 34

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR CIRCUIT

(SIGNAL VOLTAGE LOW - HIGH VACUUM)

2.8L "P" SERIES (PORT)

Circuit Description:

The manifold absolute pressure sensor (MAP) responds to changes in manifold pressure (vacuum). The ECM receives this information as a signal voltage that will vary from about 1-1.5 volts at idle to 4-4.5 volts at wide open throttle.

If the MAP sensor fails, the ECM will substitute a fixed MAP value and use the throttle position sensor (TPS) to control fuel delivery.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 34 will set when signal voltage is too low (kPa less than 13) and ignition is turned "ON".
   or
   Engine running greater than 1200 rpm and throttle open greater than 25%
2. If the ECM recognizes the high MAP signal, the ECM and wiring are OK.
3. The "Scan" tool may not display 12 volts. The important thing is that the ECM recognizes the voltage as more than 4 volts, indicating that the ECM and CKT 432 are OK.

Diagnostic Aids:

An intermittent open in CKTs 432 or 416 will result in a Code 34.

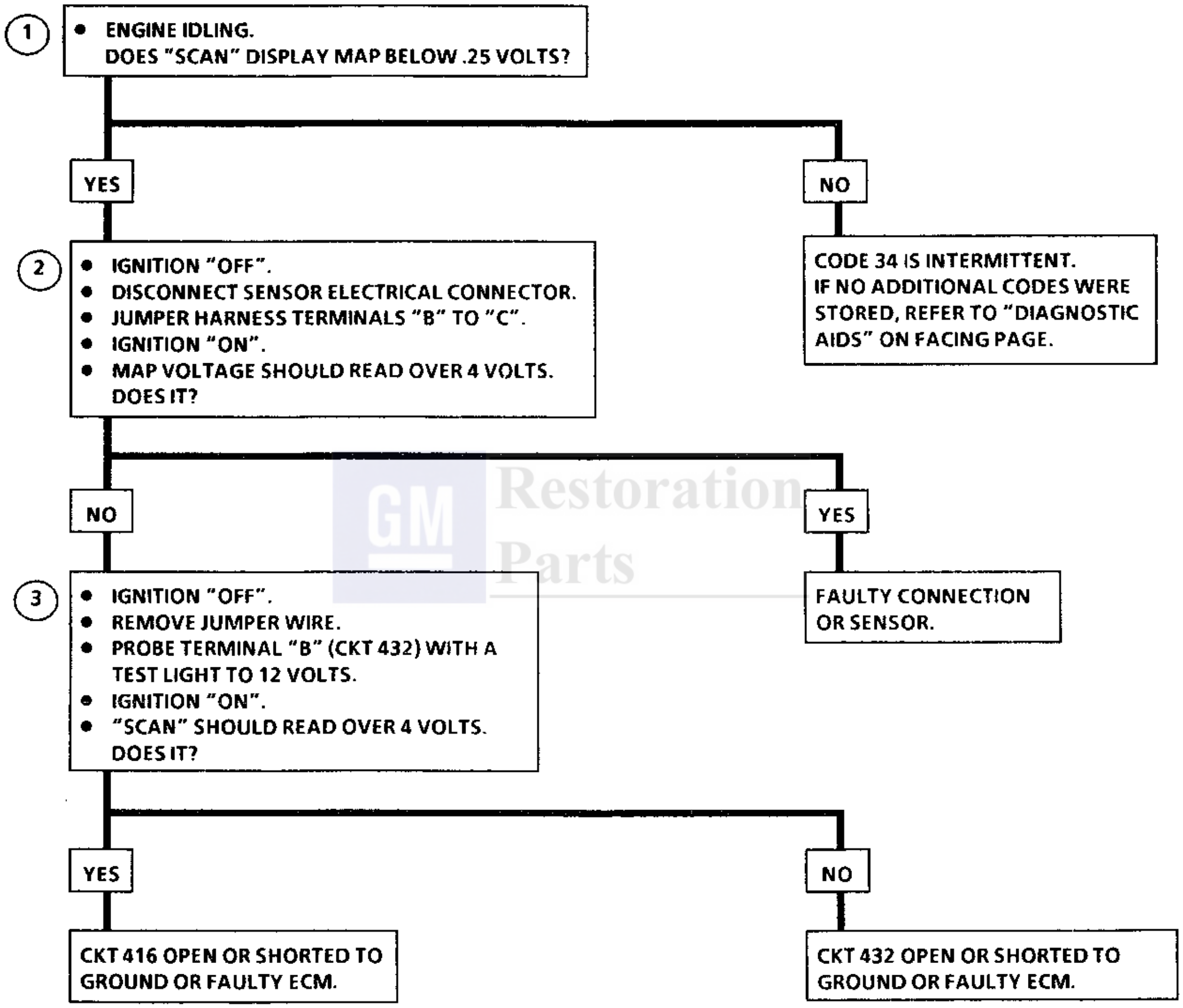
Ignition "ON" engine "OFF", voltages should be within the values shown in the table on the chart.

Also CHART C-1D can be used to test MAP sensor.

Refer to "Intermittents" in Section "B".

CODE 34

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR CIRCUIT
(SIGNAL VOLTAGE LOW - HIGH VACUUM)
2.8L "P" SERIES (PORT)



①
- ENGINE IDLING.
  DOES "SCAN" DISPLAY MAP BELOW .25 VOLTS?

YES:

②
- IGNITION "OFF".
- DISCONNECT SENSOR ELECTRICAL CONNECTOR.
- JUMPER HARNESS TERMINALS "B" TO "C".
- IGNITION "ON".
- MAP VOLTAGE SHOULD READ OVER 4 VOLTS.
  DOES IT?

NO:

CODE 34 IS INTERMITTENT.
IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

NO:

③
- IGNITION "OFF".
- REMOVE JUMPER WIRE.
- PROBE TERMINAL "B" (CKT 432) WITH A TEST LIGHT TO 12 VOLTS.
- IGNITION "ON".
- "SCAN" SHOULD READ OVER 4 VOLTS.
  DOES IT?

YES:

FAULTY CONNECTION OR SENSOR.

YES:

CKT 416 OPEN OR SHORTED TO GROUND OR FAULTY ECM.

NO:

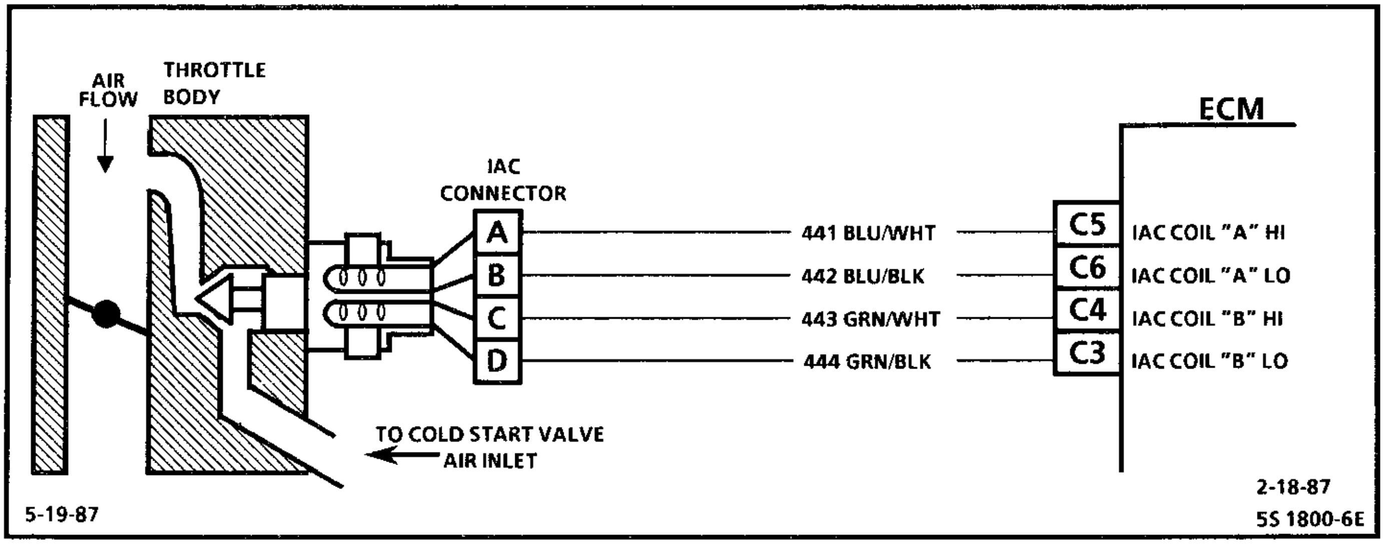
CKT 432 OPEN OR SHORTED TO GROUND OR FAULTY ECM.

IGNITION "ON" ENGINE STOPPED VOLTAGES

ALTITUDE		VOLTAGE RANGE
Meters	Feet	
Below 305	Below 1,000	3.8---5.5V
305--- 610	1,000--2,000	3.6---5.3V
610--- 914	2,000--3,000	3.5---5.1V
914--1219	3,000--4,000	3.3---5.0V
1219--1524	4,000--5,000	3.2---4.8V
1524--1829	5,000--6,000	3.0---4.6V
1829--2133	6,000--7,000	2.9---4.5V
2133--2438	7,000--8,000	2.8---4.3V
2438--2743	8,000--9,000	2.6---4.2V
2743--3048	9,000--10,000	2.5---4.0V

LOW ALTITUDE = HIGH PRESSURE = HIGH VOLTAGE

6-17-87
7S 3211-6E



CODE 35

IDLE SPEED ERROR
2.8L "P" SERIES (PORT)

Circuit Description:

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	ALDL
Neutral	900 ± 75	900 ± 75	1000±75
Drive	800 ± 75		1000±75

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Continue with test even if engine will not idle. If idle is too low, "Scan" will display 80 or more counts, or steps. If idle is high, it will display "O" counts and may be caused by a vacuum leak. Occasionally, an erratic or unstable idle may occur. Engine speed may vary 200 rpm or more up and down. Disconnect IAC. If the condition is unchanged, the IAC is not at fault.
2. When the engine was stopped, the IAC Valve retracted (more air) to a fixed "park" position for increased air flow during the next engine start. A "Scan" will display 95 or more counts.
3. Be sure to disconnect the IAC valve prior to this test. The test light will confirm the ECM signals by a steady or flashing light on all circuits.
4. There is a remote possibility that one of the CKTs is shorted to voltage, which would have been indicated by a steady light. Disconnect ECM and turn the ignition "ON" and probe terminals to check for this condition.

Diagnostic Aids:

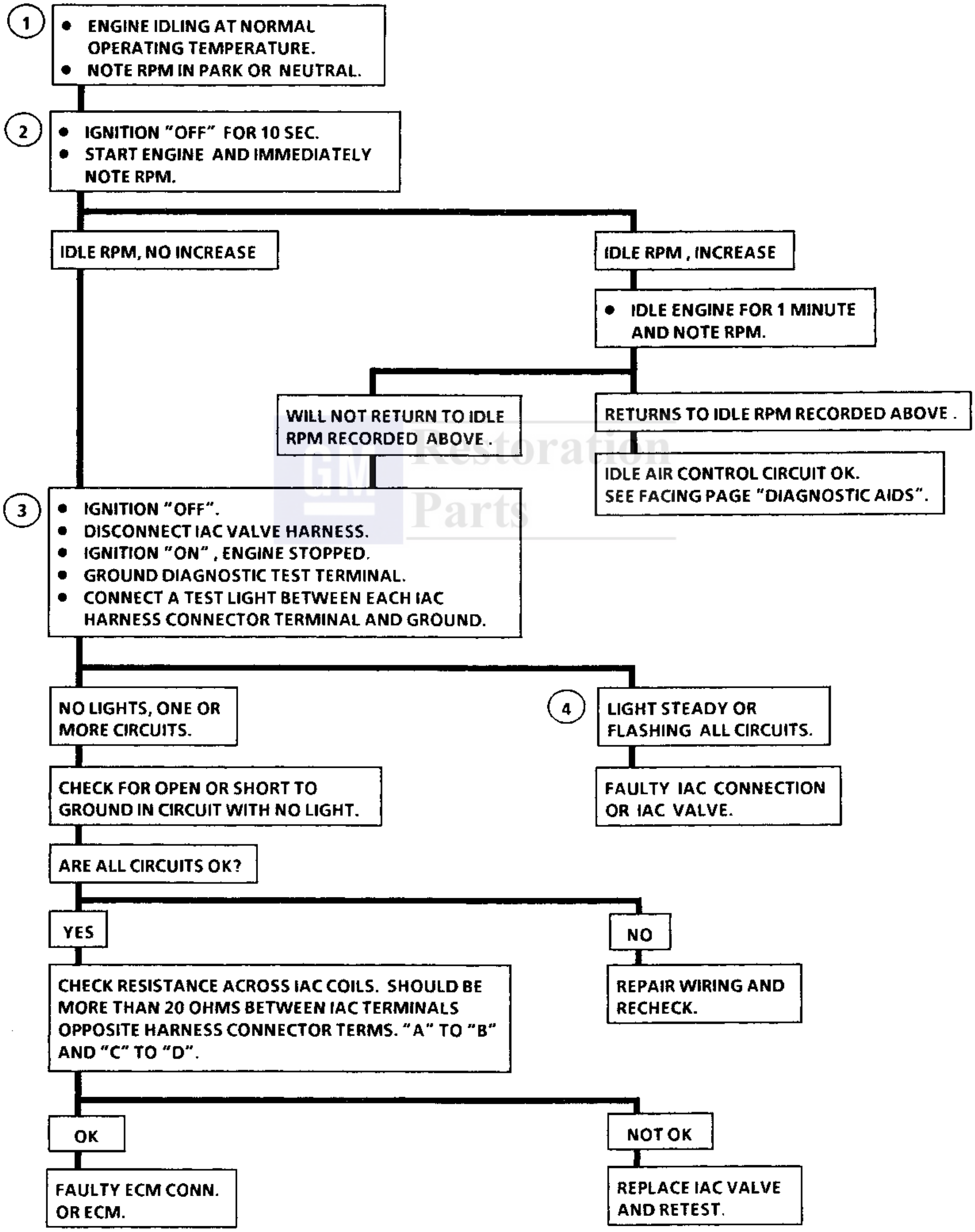
A slow unstable idle may be caused by a system problem that cannot be corrected by the IAC. "Scan" counts will be above 60 counts if too low and "0" counts if too high.

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, and disconnecting IAC does not help. This may set Code 44.
  "Scan" and/or voltmeter will read an oxygen sensor output less than 300 mV (.3V). Check for low regulated fuel pressure or water in fuel. A lean exhaust with an oxygen sensor output fixed above 800 mV (.8 mV) 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".

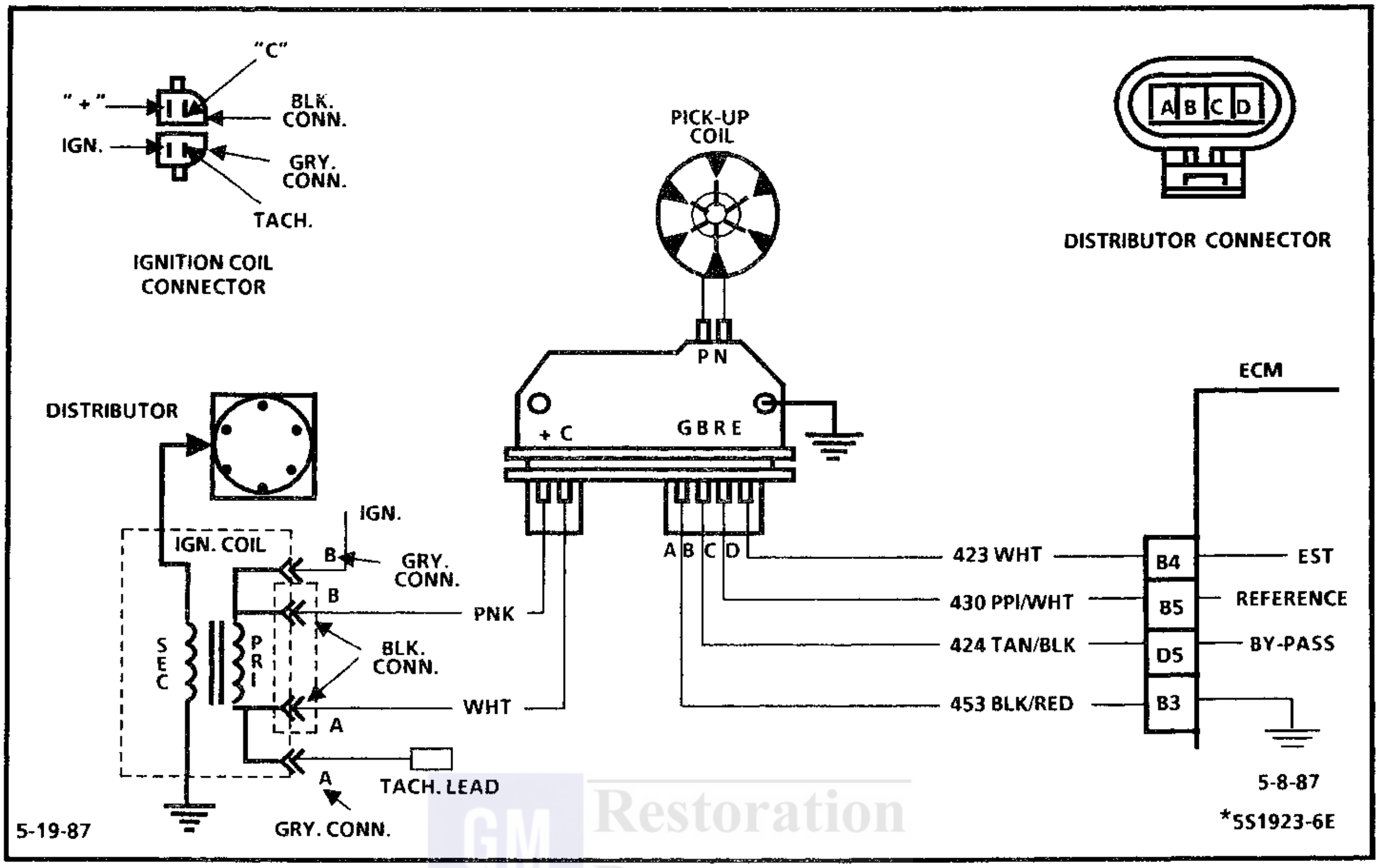
CODE 35

IDLE SPEED ERROR
2.8L "P" SERIES (PORT)



CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

3-31-87
* 7S 3151-6E



5-19-87

5-8-87

*5S1923-6E

CODE 42

ELECTRONIC SPARK TIMING (EST) CIRCUIT
2.8L "P" SERIES (PORT)

Circuit Description:

When the system is running on the ignition module, that is no voltage on the bypass line, the ignition module grounds the EST signal. The ECM expects to see no voltage on the EST line during this condition. If it sees a voltage, it sets Code 42 and will not go into the EST mode.

When the rpm for EST is reached (about 400 rpm) and bypass voltage applied, the EST should on longer be grounded in the ignition module so the EST voltage should be varying.

If the bypass line is open or grounded, the ignition module will not switch to EST mode so the EST voltage will be low and Code 42 will be set.

If the EST line is grounded, the ignition module will switch to EST, but because the line is grounded there will be no EST signal. A Code 42 will be set.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 42 means the ECM has seen an open or short to ground in the EST or by-pass circuits. This test confirms Code 42 and that the fault causing the code is present.
2. Checks for a normal EST ground path through the ignition module. An EST CKT 423 shorted to ground will also read less than 500 ohms, however, this will be checked later.
3. As the test light voltage touches CKT 424, the module should switch, causing the ohmmeter to "overrange" if the meter is in the 1000-2000 ohms position. Selecting the 10-20,000 ohms position will indicate above 5000 ohms. The important thing is that the module "switched".
4. The module did not switch and this step checks for:
   - EST CKT 423 shorted to ground
   - Bypass CKT 424 open
   - Faulty ignition module connection or module
5. Confirms that Code 42 is a faulty ECM and not an intermittent in CKTS 423 or 424.

Diagnostic Aids:

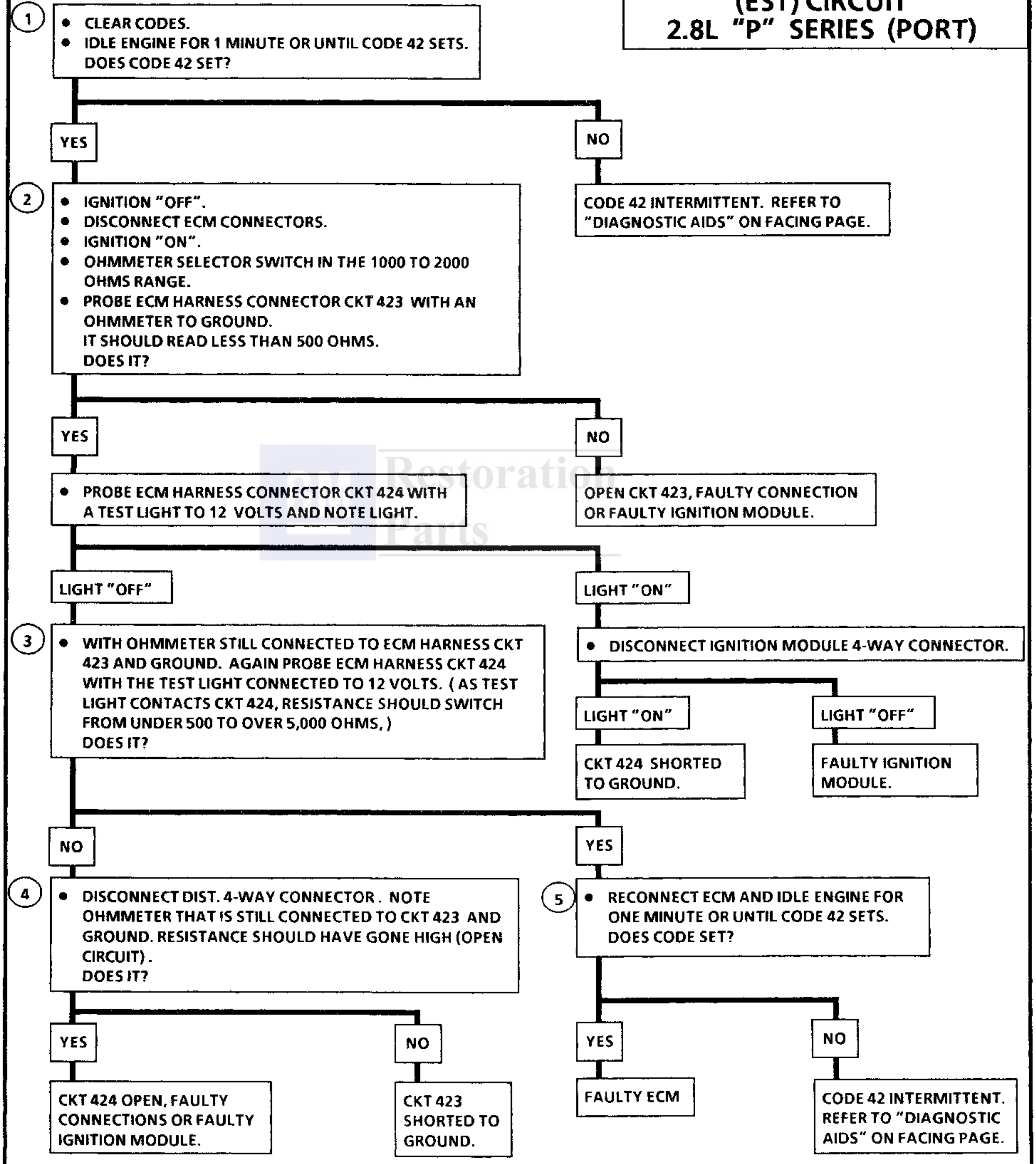
The "Scan" tool does not have any ability to help diagnose a Code 42 problem.

A PROM not fully seated in the ECM can result in a Code 42.

Refer to "Intermittents" in Section "B".

CODE 42

ELECTRONIC SPARK TIMING (EST) CIRCUIT 2.8L "P" SERIES (PORT)



①
- CLEAR CODES.
- IDLE ENGINE FOR 1 MINUTE OR UNTIL CODE 42 SETS.

DOES CODE 42 SET?

NO: CODE 42 INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

YES:

②
- IGNITION "OFF".
- DISCONNECT ECM CONNECTORS.
- IGNITION "ON".
- OHMMETER SELECTOR SWITCH IN THE 1000 TO 2000 OHMS RANGE.
- PROBE ECM HARNESS CONNECTOR CKT 423 WITH AN OHMMETER TO GROUND.

IT SHOULD READ LESS THAN 500 OHMS.
DOES IT?

NO: OPEN CKT 423, FAULTY CONNECTION OR FAULTY IGNITION MODULE.

YES:

- PROBE ECM HARNESS CONNECTOR CKT 424 WITH A TEST LIGHT TO 12 VOLTS AND NOTE LIGHT.

LIGHT "ON":

- DISCONNECT IGNITION MODULE 4-WAY CONNECTOR.

LIGHT "ON": CKT 424 SHORTED TO GROUND.

LIGHT "OFF": FAULTY IGNITION MODULE.

LIGHT "OFF":

③
- WITH OHMMETER STILL CONNECTED TO ECM HARNESS CKT 423 AND GROUND. AGAIN PROBE ECM HARNESS CKT 424 WITH THE TEST LIGHT CONNECTED TO 12 VOLTS. (AS TEST LIGHT CONTACTS CKT 424, RESISTANCE SHOULD SWITCH FROM UNDER 500 TO OVER 5,000 OHMS,)

DOES IT?

NO:

④
- DISCONNECT DIST. 4-WAY CONNECTOR . NOTE OHMMETER THAT IS STILL CONNECTED TO CKT 423 AND GROUND. RESISTANCE SHOULD HAVE GONE HIGH (OPEN CIRCUIT) .

DOES IT?

YES: CKT 424 OPEN, FAULTY CONNECTIONS OR FAULTY IGNITION MODULE.

NO: CKT 423 SHORTED TO GROUND.

YES:

⑤
- RECONNECT ECM AND IDLE ENGINE FOR ONE MINUTE OR UNTIL CODE 42 SETS.

DOES CODE SET?

YES: FAULTY ECM

NO: CODE 42 INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

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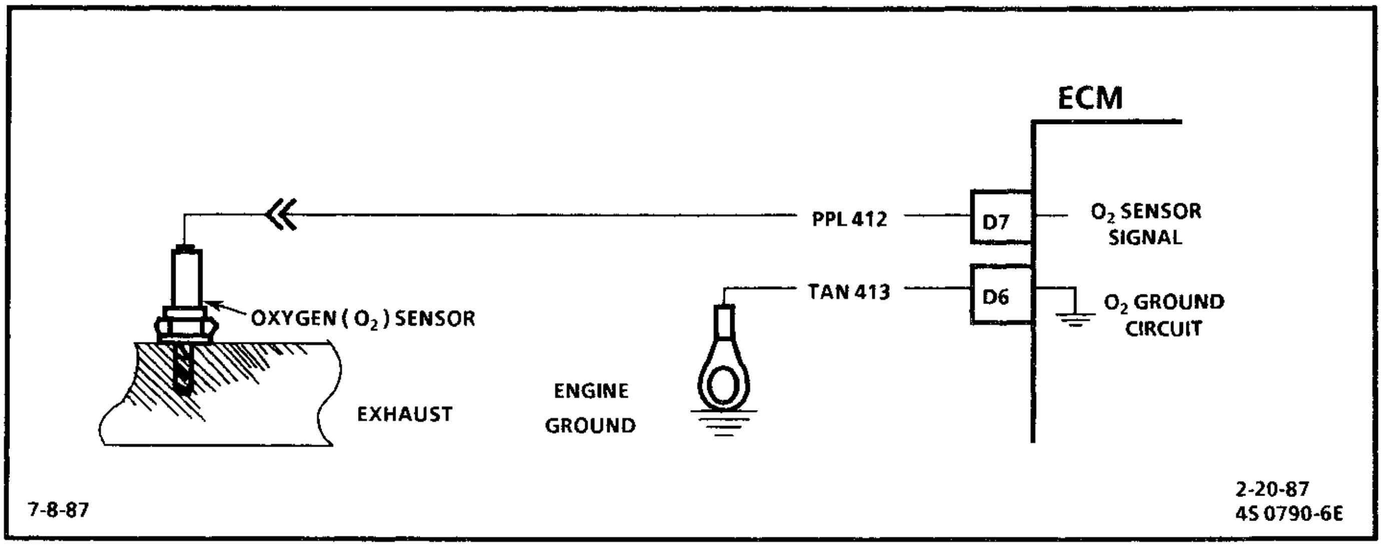
* 7S 3291-6E



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2-20-87
4S 0790-6E

CODE 44

OXYGEN SENSOR CIRCUIT
(LEAN EXHAUST INDICATED)
2.8L "P" SERIES (PORT)

Circuit Description:

The ECM supplies a voltage of about .45 volt to CKT 412. (If measured with a 10 megohm digital voltmeter, this may read as low as .32 volt.) The O_2 sensor varies the voltage within a range of about 1 volt if the exhaust is rich, down through about .10 volt if exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below about 315°C (600°F). An open sensor circuit or cold sensor causes "Open Loop" operation.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 44 is set when the O_2 sensor signal voltage on CKT 412
   - Remains below .2 volt for 20 seconds
   - And the system is operating in "Closed Loop"

Diagnostic Aids:

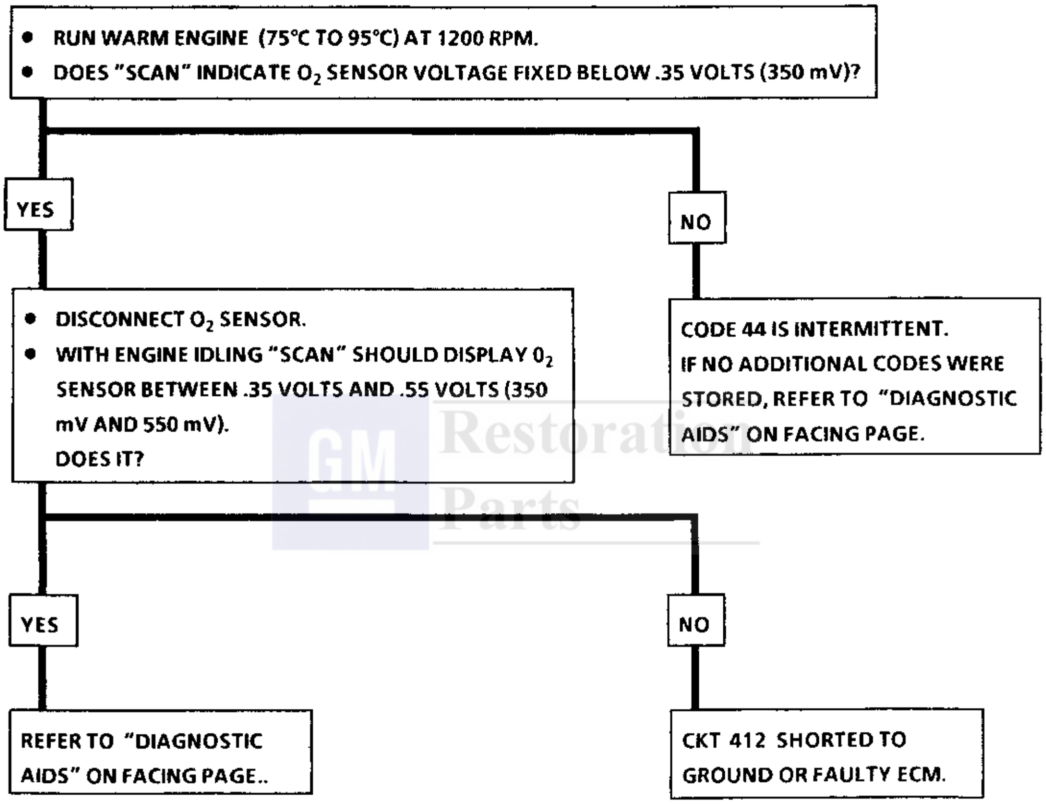
Using the "Scan", observe the block learn values at different rpm and air flow conditions to determine when the Code 44 may have been set. If the conditions for Code 44 exists, the block learn values will be around 150.

Check:

- O_2 sensor wire Sensor pigtail may be mispositioned and contacting the exhaust manifold.
- For intermittent ground in wire between connector and sensor
- MAP sensor A (MAP) sensor output that causes the ECM to sense a higher than normal vacuum will cause the system to go lean. Disconnect the MAP sensor, and if the lean condition is gone, check for Code 34.
- For lean injector(s) Perform injector balance test CHART C-2A.
- For fuel contamination Water, even in small amounts, near the in-tank fuel pump inlet can be delivered to the injectors. The water causes a lean exhaust and can set a Code 44.
- Fuel pressure System will be lean if pressure is too low. It may be necessary to monitor fuel pressure while driving the car at various road speeds and/or loads to confirm. See fuel system diagnosis CHART A-7.
- Exhaust leaks If there is an exhaust leak, the engine can cause outside air to be pulled into the exhaust and past the sensor. Vacuum or crankcase leaks can cause a lean condition.
- 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.

CODE 44

OXYGEN SENSOR CIRCUIT
(LEAN EXHAUST INDICATED)
2.8L "P" SERIES (PORT)



- RUN WARM ENGINE (75°C TO 95°C) AT 1200 RPM.
- DOES "SCAN" INDICATE O_2 SENSOR VOLTAGE FIXED BELOW .35 VOLTS (350 mV)?

YES:

- DISCONNECT O_2 SENSOR.
- WITH ENGINE IDLING "SCAN" SHOULD DISPLAY O_2 SENSOR BETWEEN .35 VOLTS AND .55 VOLTS (350 mV AND 550 mV).
  DOES IT?

NO:

CODE 44 IS INTERMITTENT.
IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

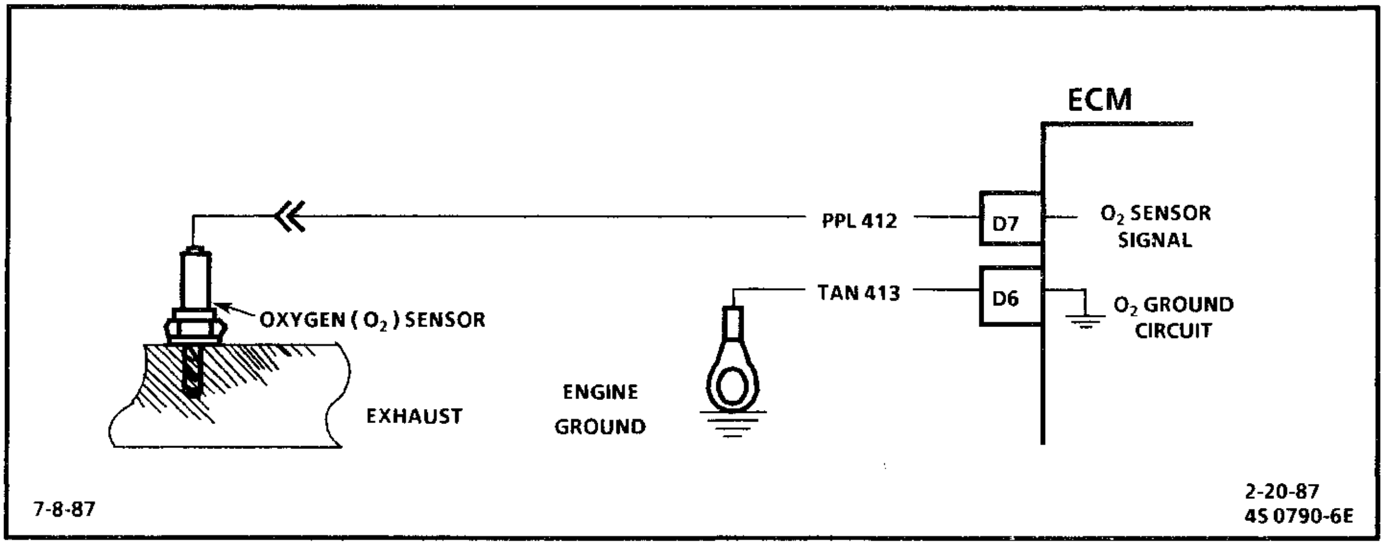
YES:

REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE..

NO:

CKT 412 SHORTED TO GROUND OR FAULTY ECM.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.



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2-20-87
4S 0790-6E

CODE 45

OXYGEN SENSOR CIRCUIT
(RICH EXHAUST INDICATED)
2.8L "P" SERIES (PORT)

Circuit Description:

The ECM supplies a voltage of about .45 volt between terminals "D6" and "D7". (If measured with a 10 megohm digital voltmeter, this may read as low as .32 volt.) The O_2 sensor varies the voltage within a range of about 1 volt if the exhaust is rich, down through about .10 volt if exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below about 315°C (600°F). An open sensor circuit or cold sensor causes "Open Loop" operation.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 45 is set when the O_2 sensor signal voltage or CKT 412
    - Remains above .7 volt for 50 seconds; and in "Closed Loop"
    - Engine time after start is 1 minute or more
    - Throttle angle greater than 2% (about .2 volt above idle voltage)

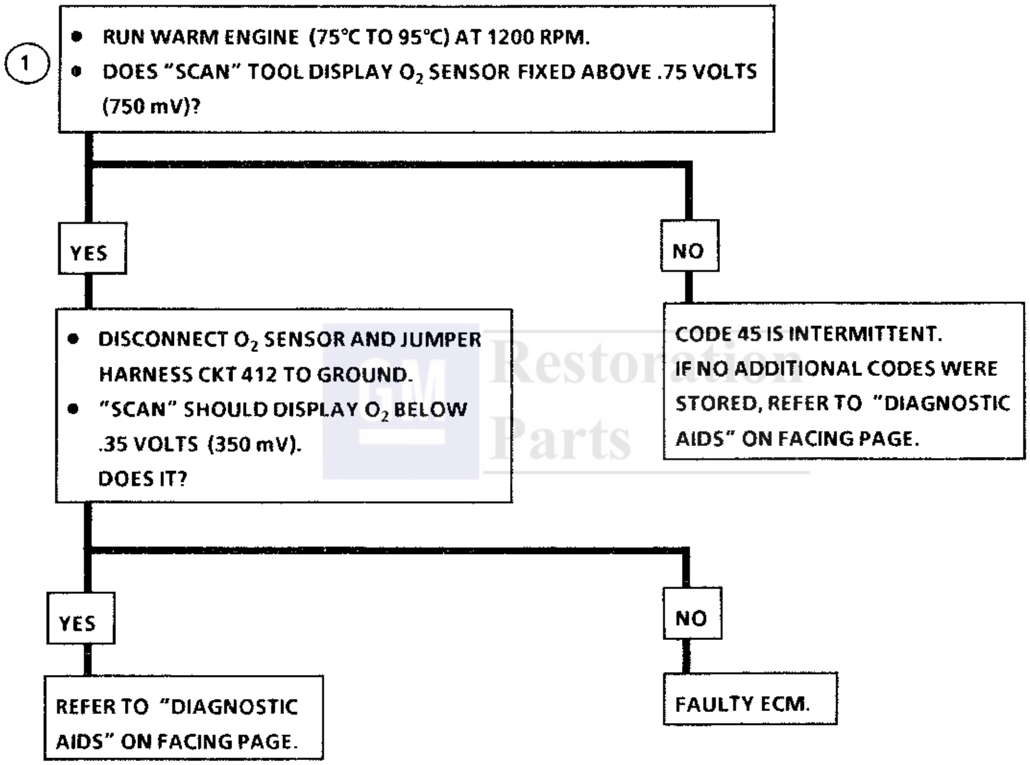
Diagnostic Aids:

Using the "Scan", observe the block learn values at different rpm conditions to determine when the Code 45 may have been set. If the conditions for Code 45 exists, The block learn values will be around 115.
Check:

- Fuel pressure System will go rich if pressure is too high. The ECM can compensate for some increase. However, if it gets too high, a Code 45 may be set. See fuel system diagnosis CHART A-7.
- For rich injector Perform injector balance test CHART C-2A.
- For leaking injector See CHART A-7.
- For fuel contaminated oil
- HEI shielding An open ground CKT 453 (ignition system reflow) may result in EMI, or induced electrical "noise". The ECM looks at this "noise" as reference pulses. The additional pulses result in a higher than actual engine speed signal. The ECM then delivers too much fuel, causing system to go rich. Engine tachometer will also show higher than actual engine speed, which can help in diagnosing this problem.
- Canister purge Check for fuel saturation. If full of fuel, check canister control and hoses. See canister purge Section "C3".
- MAP sensor An output that causes the ECM to sense a lower than normal vacuum can cause the system to go rich. Disconnecting the MAP sensor will allow the ECM to set a fixed value for the sensor. Substitute a different MAP sensor if the the rich condition is gone while the sensor is disconnected, and check for a Code 34.
- For leaking fuel pressure regulator diaphram by checking vacuum line to regulator for fuel
- TPS An intermittent TPS output will cause the system to go rich, due to a false indication of the engine accelerating.

CODE 45

OXYGEN SENSOR CIRCUIT
(RICH EXHAUST INDICATED)
2.8L "P" SERIES (PORT)



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 (PORT)

CODE 51
PROM ERROR

CHECK THAT ALL PINS ARE FULLY INSERTED IN THE SOCKET. IF OK, REPLACE PROM, CLEAR MEMORY, AND RECHECK. IF CODE 51 REAPPEARS, REPLACE ECM.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

CODE 52
CALPAK ERROR
(FAULTY OR MISSING CALPAK)

CHECK THAT ALL PINS ARE FULLY INSERTED IN THE SOCKET. IF OK, REPLACE CALPAK, CLEAR MEMORY, AND RECHECK. IF CODE 52 REAPPEARS, REPLACE ECM.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

CODE 53
SYSTEM OVER VOLTAGE

THIS CODE INDICATES THERE IS A BASIC GENERATOR PROBLEM.

- CODE 53 WILL SET IF VOLTAGE AT ECM TERMINAL B2 IS GREATER THAN 17.1 VOLTS FOR 2 SECONDS.
- CHECK AND REPAIR CHARGING SYSTEM. SEE SECTION 6D.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

CODE 55
ECM ERROR

BE SURE ECM GROUNDS ARE OK. IF OK
REPLACE ELECTRONIC CONTROL MODULE (ECM)

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

11-19-86

*5S 1516-6E

SECTION B
SYMPTOMS

TABLE OF CONTENTS

BEFORE STARTING

Before using this section you should have performed the DIAGNOSTIC CIRCUIT CHECK and found out that:

1. The electronic control module (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 electronic control module (ECM) shorted to ground. (CKT 419).
  - Diagnostic "Test" Terminal wire to ECM, shorted to ground. (CKT 451)
  - ECM power grounds. See ECM wiring diagrams.
- Loss of trouble code memory. To check, disconnect throttle position sensor (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.
- Electronic spark timing (EST) wires should be kept away from spark plug wires, distributor wires, distributor housing, coil, and generator. Wire from CKT 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 throttle position sensor (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.
  - Exhaust gas recirculation (EGR) operation. Be sure valve seats properly and is not staying open. See CHART C-7.
  - Fuel pump relay - See CHART A-7.
  - 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.
  - Programmable read only memory (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 wide open throttle (WOT).
  - Manifold absolute pressure (MAP) Sensor - CHART C-1D.
  - Ignition timing. See Emission Control Information label.
  - Generator output voltage. Repair if less than 9 or more than 16 volts.
  - High energy ignition (HEI) ground, CKT 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.

- ■ If a "Scan" tool is available which plugs in to the assembly line data link (ALDL) connector, make sure reading of vehicle speed sensor (VSS) matches vehicle speedometer. See Introduction explaining "Scan" tool positions.
- 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.
  - Exhaust gas recirculation (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 electronic control module (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. See CHART B-1.
  - 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.
  - Exhaust gas recirculation (EGR) system for not opening - CHART C-7.
  - Transmission/transaxle converter clutch (TCC) operation - CHART C-8.
  - Fuel system pressure. See CHART A-7.
  - Programmable read only memory (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 misfiring cylinder by:
  1. Disconnect idle air control (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.
  - Exhaust gas recirculation (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" or Section "6E3-C4."
  - 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.

- Check owner's driving habits.
  - Is A/C "ON" full time (Defroster mode "ON")?
  - Are tires at correct pressure?
  - Are excessively heavy loads being carried?
  - Is acceleration too much, too often?
  - Suggest owner fill fuel tank and recheck fuel economy.
  - Suggest driver read "Important Facts on Fuel Economy " in Owner's Manual.
- Check for proper calibration of speedometer.
- Visually (physically) Check:
  - Vacuum hoses for splits, kinks, and proper connections as shown on Vehicle Emission Control Information label.
  - Ignition wires for cracking, hardness, and proper connections.
  - Air cleaner element (filter) for dirt or being plugged.
- Remove spark plugs. Check for cracks, wear, improper gap, burned electrodes, or heavy deposits. Repair or replace as necessary.
- **CHECK:**
  - Engine thermostat for faulty part (always open) or for wrong heat range. Using a "Scan" tool, monitor engine temperature. A "Scan" displays engine temp. in degrees centigrade. After engine is started, the temperature should rise steadily to about 90°C, then stabilize, when thermostat opens. See Section "6B".
  - Fuel Pressure. See CHART A-7.
  - Compression. See Section "6A".
  - Transmission/transaxle converter clutch (TCC) for proper operation. See CHART C-8A. A "Scan" should indicate an rpm drop, when the TCC is commanded "ON".
  - Exhaust system restriction. See CHART B-1.

DIESELING, RUN-ON

Definition: Engine continues to run after key is turned "OFF", but runs very roughly. If engine runs smoothly, check ignition switch and adjustment.

- Check injectors for leaking. See CHART A-7.
- If engine runs smoothly, check ignition switch and adjustment.

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.
  - Idle air control (IAC) system. IAC valve will not move if system voltage is below 9 or greater than 17.8 volts. 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.
  - For vacuum leaks.
  - Manifold absolute pressure (MAP) Sensor - Ignition on engine stopped. Compare MAP voltage with known good vehicle. Voltage should be the same ± 400 mV (.4 volts).

    or

    Start and idle engine. Disconnect sensor electrical connector. If idle improves, substitute a known good sensor and recheck.
  - A/C Refrigerant Pressure too high. Check for overcharge or faulty cycling switch. See CHART C-10.
  - Exhaust gas recirculation (EGR) valve: There should be no EGR at idle.
  - For fuel in pressure regulator hose. If present replace regulator assembly.
  - Ignition system; wires, plugs, rotor, etc.
- Run a cylinder compression check. See Section "6".
- Inspect Oxygen sensor for silicon contamination from fuel, or use of improper room temperature vulcanizing (RTV) sealant. The sensor will have a white, powdery coating, and will result in a high but false signal voltage (rich exhaust indication). The electronic control module (ECM) will then reduce the amount of fuel delivered to the engine, causing a severe driveability problem.

EXCESSIVE EXHAUST EMISSIONS OR ODORS

Definition: Vehicle fails an emission test. Vehicle has excessive "rotten egg" smell. Excessive odors do not necessarily indicate excessive emissions.

- Perform "Diagnostic Circuit Check."
- IF TEST SHOWS EXCESSIVE CO AND HC, (or also has excessive odors):
  - Check items which cause car to run RICH.
    - Make sure engine is at normal operating temperature.
- **CHECK:**
  - Fuel pressure. See CHART A-7.
  - Incorrect timing. See vehicle emission control information label.
  - Canister for fuel loading. See CHART C-3.
  - Injector balance. See CHART C-2A.
  - PCV valve for being plugged, stuck, or blocked PCV hose, or fuel in the crankcase.
  - Spark plugs, plug wires, and ignition components. See Section "6D".
  - Check for lead contamination of catalytic converter (look for removal of fuel filler neck restrictor).
  - Check for properly installed fuel cap.
  - If the system is running rich, (block learn less than 118), refer to "Diagnostic Aids" on facing page of Code 45.
- IF TEST SHOWS EXCESSIVE NOx:
  - Check items which cause car to run LEAN, or to run too hot.
    - EGR valve for not opening. See CHART C-7.
    - Vacuum leaks.
    - Coolant system and coolant fan for proper operation. See CHART C-12.
    - Remove carbon with top engine cleaner. Follow instructions on can.
    - Check ignition timing for excessive base advance. See emission control information label.
- If the system is running lean, (block learn greater than 138), refer to "Diagnostic Aids" on facing page of Code 44.

CHART B-1

RESTRICTED EXHAUST SYSTEM CHECK
ALL ENGINES

Proper diagnosis for a restricted exhaust system is essential before any components are replaced. Either of the following procedures may be used for diagnosis, depending upon engine or tool used:

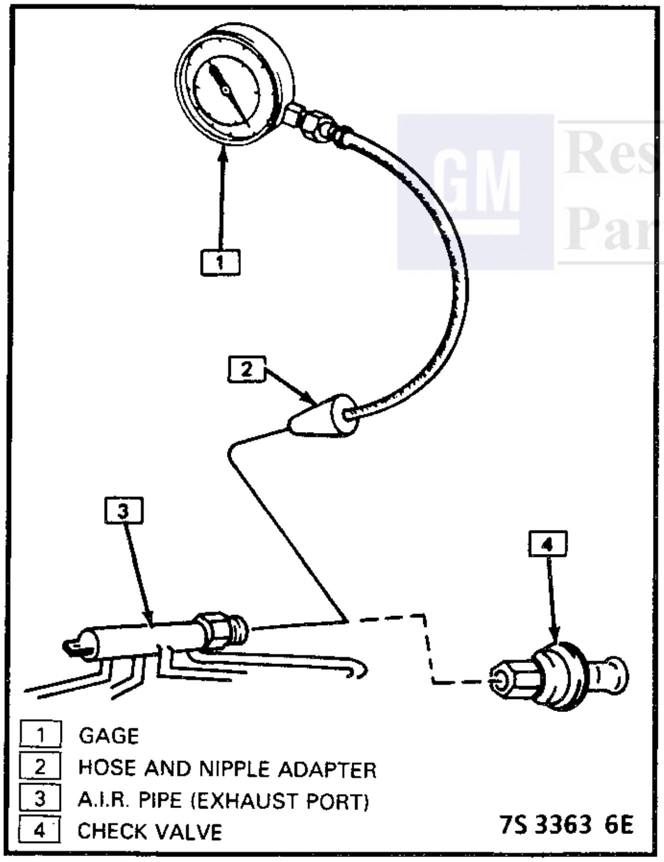
CHECK AT A. I. R. PIPE:

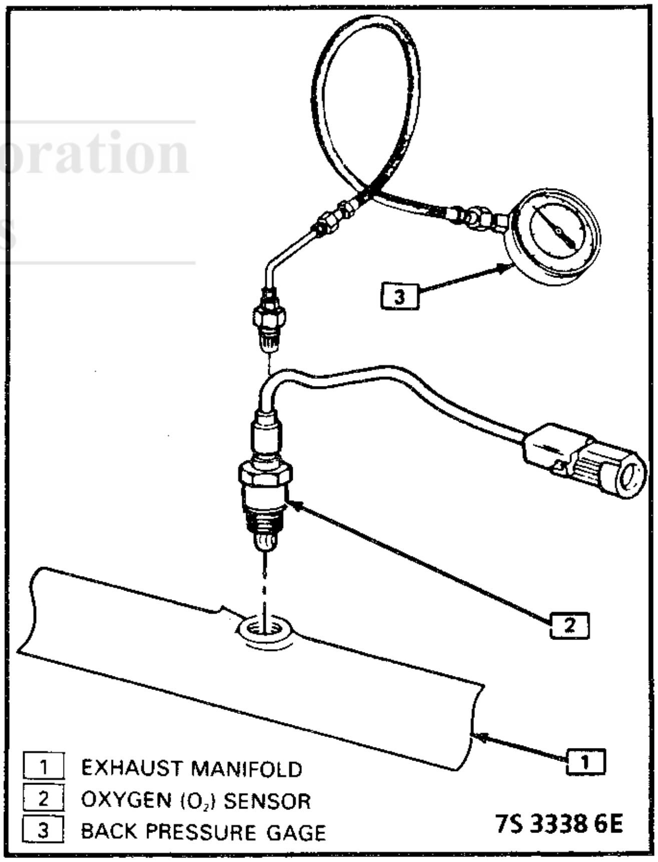
1. Remove the rubber hose at the exhaust manifold A.I.R. pipe check valve. Remove check valve.
2. Connect a fuel pump pressure gauge to a hose and nipple from a Propane Enrichment Device (J26911) (see illustration).
3. Insert the nipple into the exhaust manifold A.I.R. pipe.

OR

CHECK AT O_2 SENSOR:

1. Carefully remove O_2 sensor.
2. Install Borroughs Exhaust Backpressure Tester (BT 8515 or BT 8603) or equivalent in place of O_2 sensor (see illustration).
3. After completing test described below, be sure to coat threads of O_2 sensor with anti-seize compound P/N 5613695 or equivalent prior to re-installation.





DIAGNOSIS:

1. With the engine idling at normal operating temperature, observe the exhaust system backpressure reading on the gauge. Reading should not exceed 1 $\frac{1}{4}$ psi (8.6 kPa).
2. Accelerate engine to 2000 rpm and observe gauge. Reading should not exceed 3 psi (20.7 kPa).
3. If the backpressure, at either rpm, exceeds specification, a restricted exhaust system is indicated.
4. Inspect the entire exhaust system for a collapsed pipe, heat distress, or possible internal muffler failure.
5. If there are no obvious reasons for the excessive backpressure, a restricted catalytic converter should be suspected and replaced using current recommended procedures.

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SECTION C
COMPONENT SYSTEMS

Section C provides information on the following:

- General description of components and systems.
- On-vehicle service.
- Part names and group numbers.
- Diagnostic charts. These include a functional check of the system as well as diagnosis of any problem found in the functional check.

For locations of components, wiring diagrams, and ECM Terminal End View, refer to the front on the A Section of the engine being diagnosed.

Following are the sub-section identification and the system covered:

DIAGNOSTIC CHARTS

The Diagnostic Charts for each system are found after the on-car service and parts information at the back of each section. Following are the charts found in this section.

SECTION C1

ELECTRONIC CONTROL MODULE (ECM) AND SENSORS

CONTENTS

GENERAL DESCRIPTION

ELECTRONIC CONTROL MODULE (ECM)

The Electronic Control Module (ECM) (Figure C1-1), is the control center of the fuel injection system. It constantly looks at the information from various sensors, and controls the various systems that affect vehicle performance. For service, the ECM has three parts: a separate Controller (the ECM without the PROM), a separate calibrator (PROM), and a CALPAK.

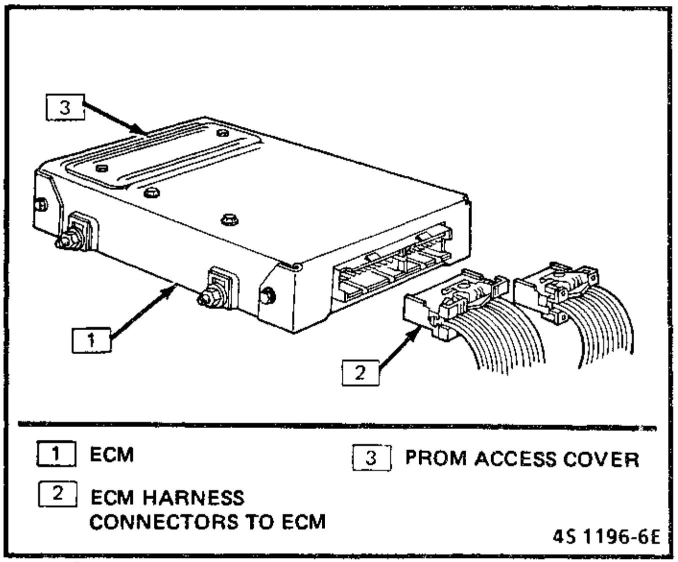

Figure C1-1 Electronic Control Module (ECM)

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, idle air control (IAC), A/C 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 programmable read only memory PROM) 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.

An ECM used for service (called a controller) comes without a PROM. The PROM from the old ECM must be carefully removed and installed in the new ECM (see On-Car Service).

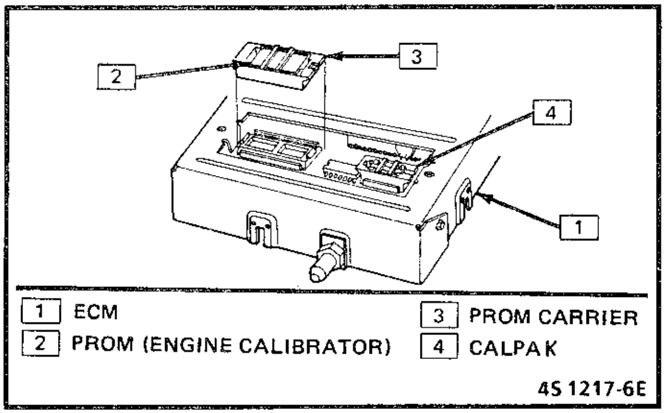

Figure C1-2 PROM (Calibrator) and CALPAK

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).

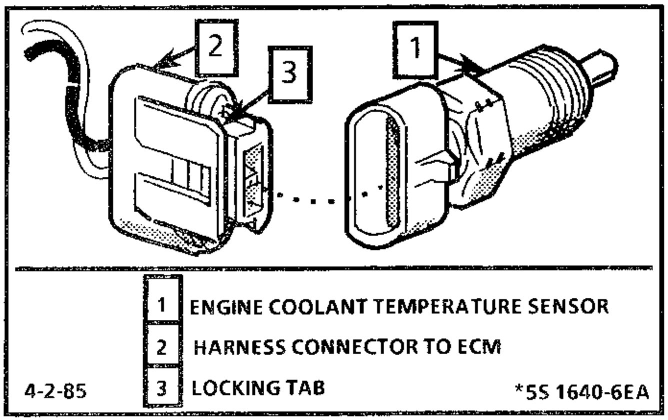

Figure C1-3 Engine Coolant Temperature Sensor

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.

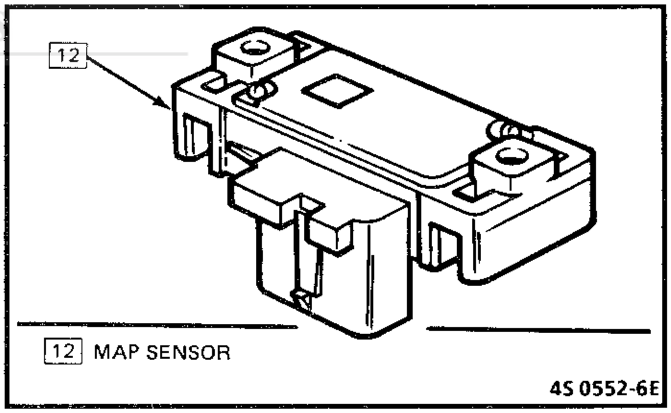

Figure C1-4 MAP Sensor

A closed throttle on engine coast down 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.

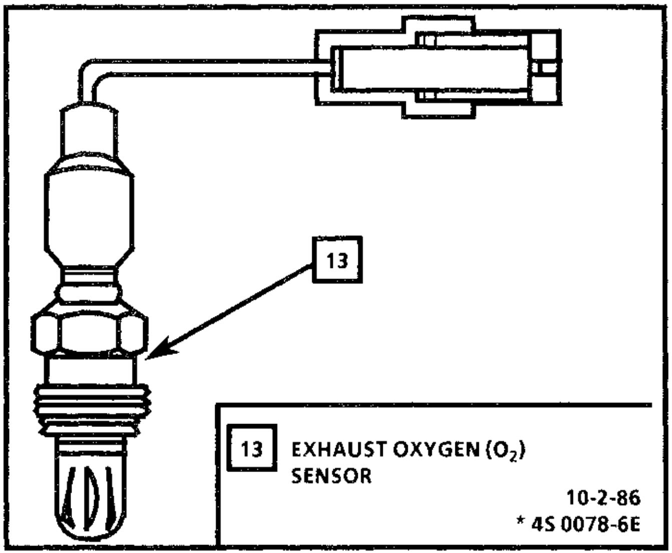

Figure C1-5 Exhaust Oxygen (O_2) Sensor

A failure in the manifold absolute pressure (MAP) sensor circuit should set a Code 33 or Code 34.

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 electronic control module (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 circuit, 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.

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).

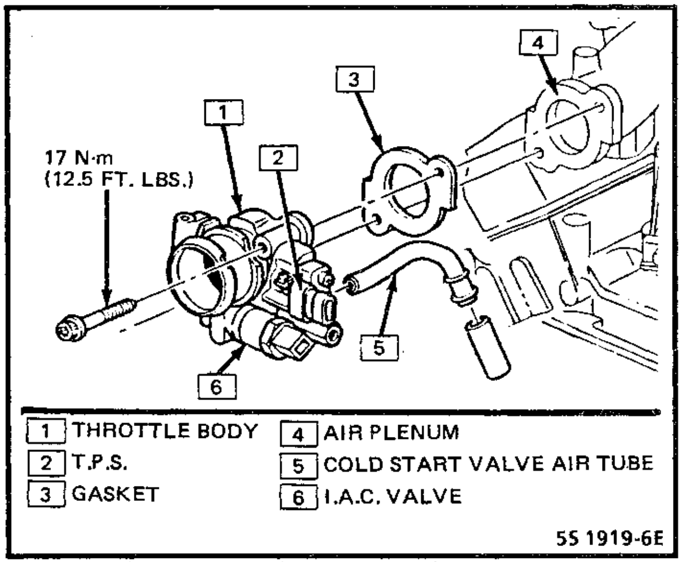

Figure C1-6 Throttle Position Sensor

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 transmission/transaxle converter clutch (TCC) system, IAC valve operation, and exhaust gas recirculation (EGR) control.

NOTICE: Vehicle should not be driven with Park/Neutral 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 12 volt pigtail connector located near the battery.
- Refer to ECM Quad Driver Check (CHART C-1) before replacing ECM.

Since the electronic control module (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.

ECM

A faulty ECM will be determined in the diagnostic charts or by a Code 55.

PROM

An incorrect or faulty PROM, which is part of the ECM, may set a Code 51.

ECM INPUTS

All of the sensors and input switches can be diagnosed by the use of a "Scan" tool. Following is a short description of how the sensors and switches can be diagnosed by the use of "Scan". The "Scan" can also be used to compare the values for a normal running engine with the engine you're diagnosing.

Coolant Temperature Sensor

A "Scan" tool displays engine temperature in degrees centigrade. After engine is started, the temperature should rise steadily to about 90°C then stabilize when thermostat opens. If the engine has not been run for several hours (overnight), the coolant temperature and manifold air temperature (MAT) temperatures should read close to each other. A fault in the coolant sensor circuit should set a Code 14 or 15. The code charts also contain a chart to check for sensor resistance values relative to temperature.

MAT Sensor

A "Scan" tool displays temperature of the air entering the engine and should read close to ambient air temperature when engine is cold, and rise as underhood temperature increases. If the engine has not been run for several hours (overnight) the MAT sensor temperature and coolant temperature should read close to each other. A failure in the MAT sensor circuit should set a Code 23 or 25. The code charts also contain a chart to check for sensor resistance values relative to temperature.

Oxygen O_2 Sensor

The "Scan" has several positions that will indicate the state of the exhaust gases , O_2 voltage, integrator, and block learn. See "Scan" position information in Introduction, Section "6E".

A problem in the O_2 sensor circuit, or fuel system should set a Code 13 (open circuit), Code 44 (lean indication), or Code 45 (rich indication). Refer to applicable chart if any of these codes were stored in memory.

TPS

A "Scan" tool displays throttle position in volts. The 2.8L should read less than 1.25 volts, with throttle closed and ignition "ON," or at idle. Voltage should increase at a steady rate as throttle is moved toward wide open throttle (WOT).

The electronic control module (ECM) has the ability to Auto-Zero the throttle position sensor (TPS) voltage if it is below about 1.25 volts. This means that any voltage less than 1.25 volts will be determined by the ECM to be 0% throttle. A failure in the TPS or circuit should set a Code 21 or 22.

MAP Sensor

"Scan" displays manifold pressure in volts. Low pressure (high vacuum) reads a low voltage while a high pressure (low vacuum) reads a high voltage. A failure in the manifold absolute pressure (MAP) sensor circuit should set a Code 33 or 34 and using the chart will find the cause of the problem. A Code 33 may be set if a rough or unstable idle exists. CHART C-1D can also be used to check MAP sensor.

VSS

A "Scan" tools reading should closely match with speedometer reading with drive wheels turning. A failure in the vehicle speed sensor (VSS) circuit should set a Code 24.

P/N Switch

A "Scan" tool should read P/N when in Park, or Neutral, and R-D, L, when in Drive or Overdrive. This reading may vary with different makes of tools. Refer to CHART C-1A for P/N switch diagnosis.

A/C Request Signal

If the pressure cycling switch is closed and A/C is "ON," the "Scan" tool should indicate A/C "ON".

See Section "C10" for electrical system diagnosis.

Reference Signal

A "Scan" tool will read this signal and is displayed in RPM. See Section "C4" for more information on the Ignition System.

ON-CAR SERVICE

ELECTRONIC CONTROL MODULE (ECM)

Service of the ECM should normally consist of either replacement of the ECM or a programmable read only memory (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.

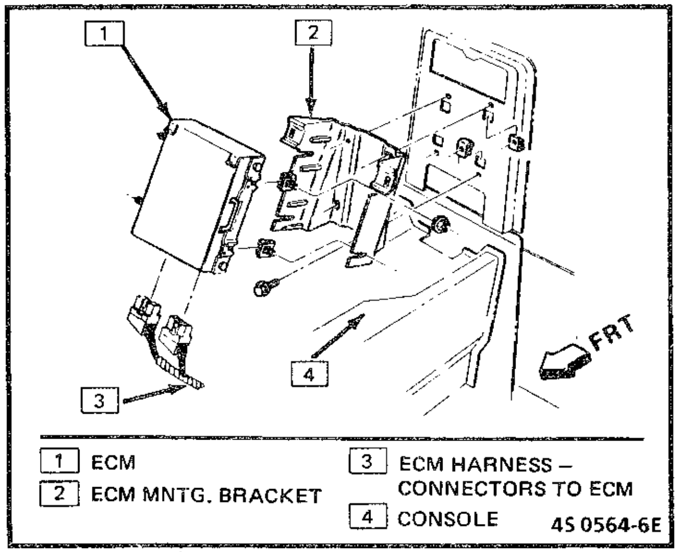

Figure C1-7 ECM Mounting

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.

PROM/CALPAK

Code 51 indicates a faulty programmable read only memory (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.

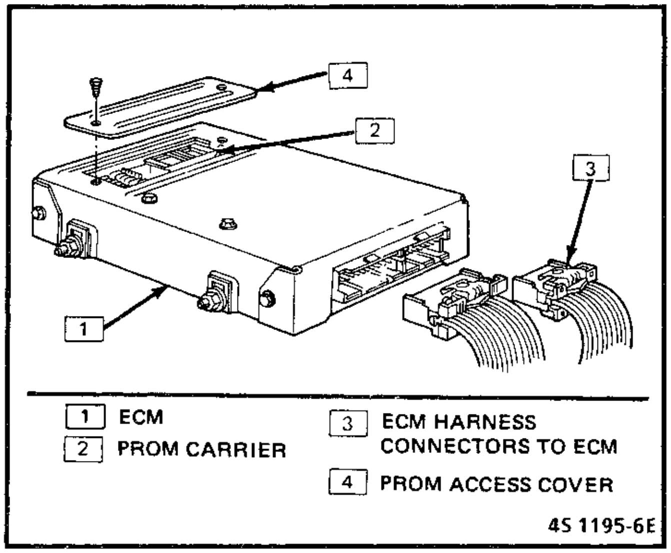

Figure C1-8 PROM Access Cover

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.

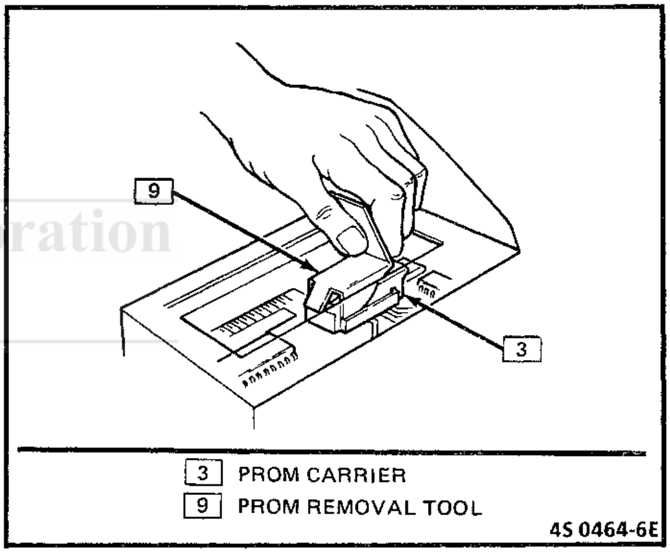

Figure C1-9 PROM Removal Tool

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.

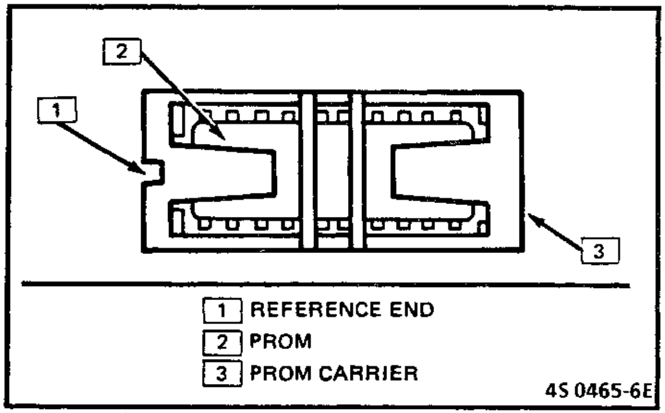

Figure C1-10 PROM in PROM Carrier

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.

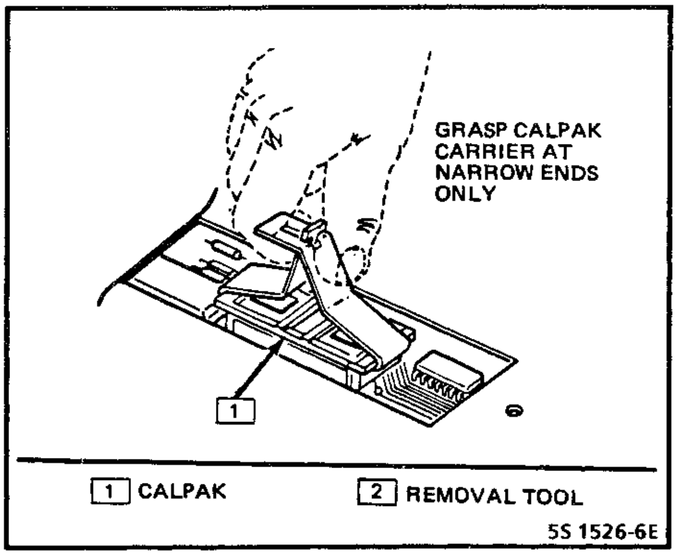

Figure C1-11 Removing CALPAK

Important

Any time the PROM is installed backwards and the ignition switch turned on, the PROM is destroyed.

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.

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 manifold absolute pressure (MAP) sensor.

MAT SENSOR

Replacement of the manifold air temperature (MAT) Sensor, mounted in the air cleaner assembly, uses the same procedure as for the coolant sensor

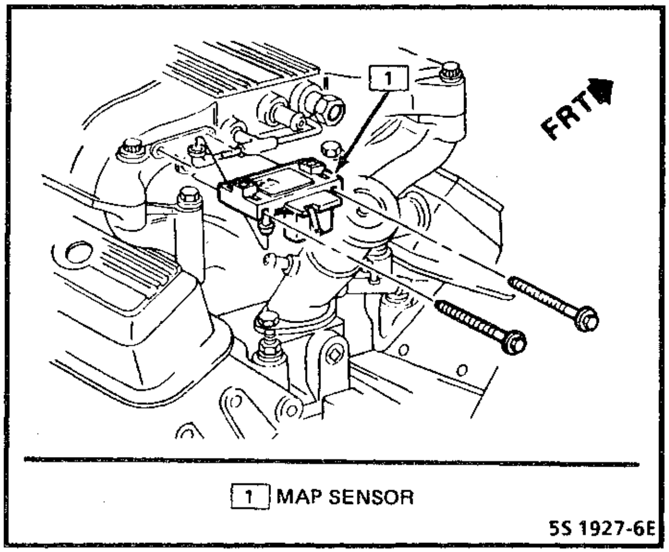

Figure C1-12 MAP Sensor Service

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.

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.

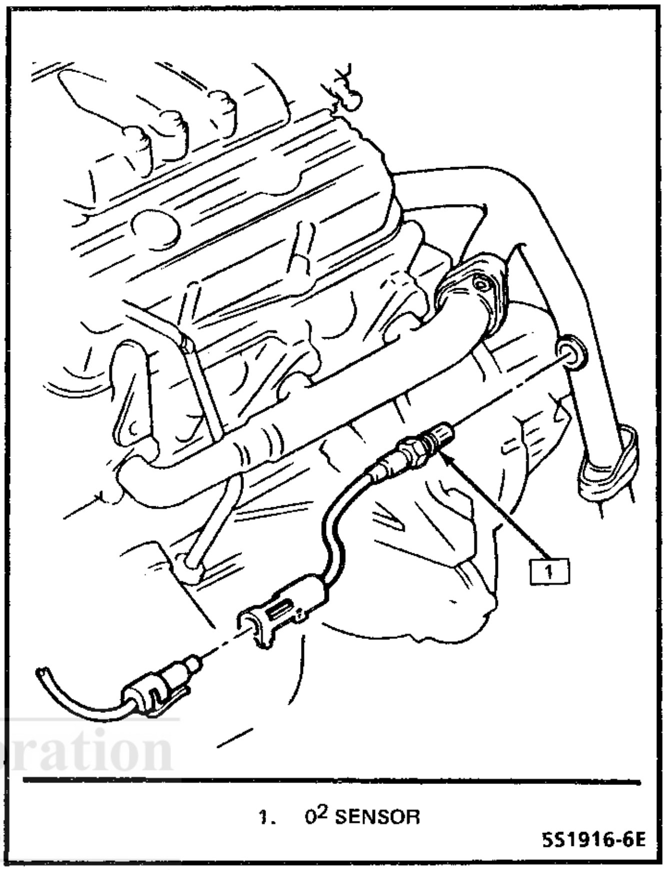

Figure C1-13 Oxygen Sensor

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 TPS 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 Nm (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, Manifold Absolute Sensor (MAP)	3.682
Sensor, Manifold Air Temp (MAT)	3.682
Sensor, Throttle Position: Part of Sensor Kit, Throttle Position	3.440
Sensor, Vehicle Speed	3.682

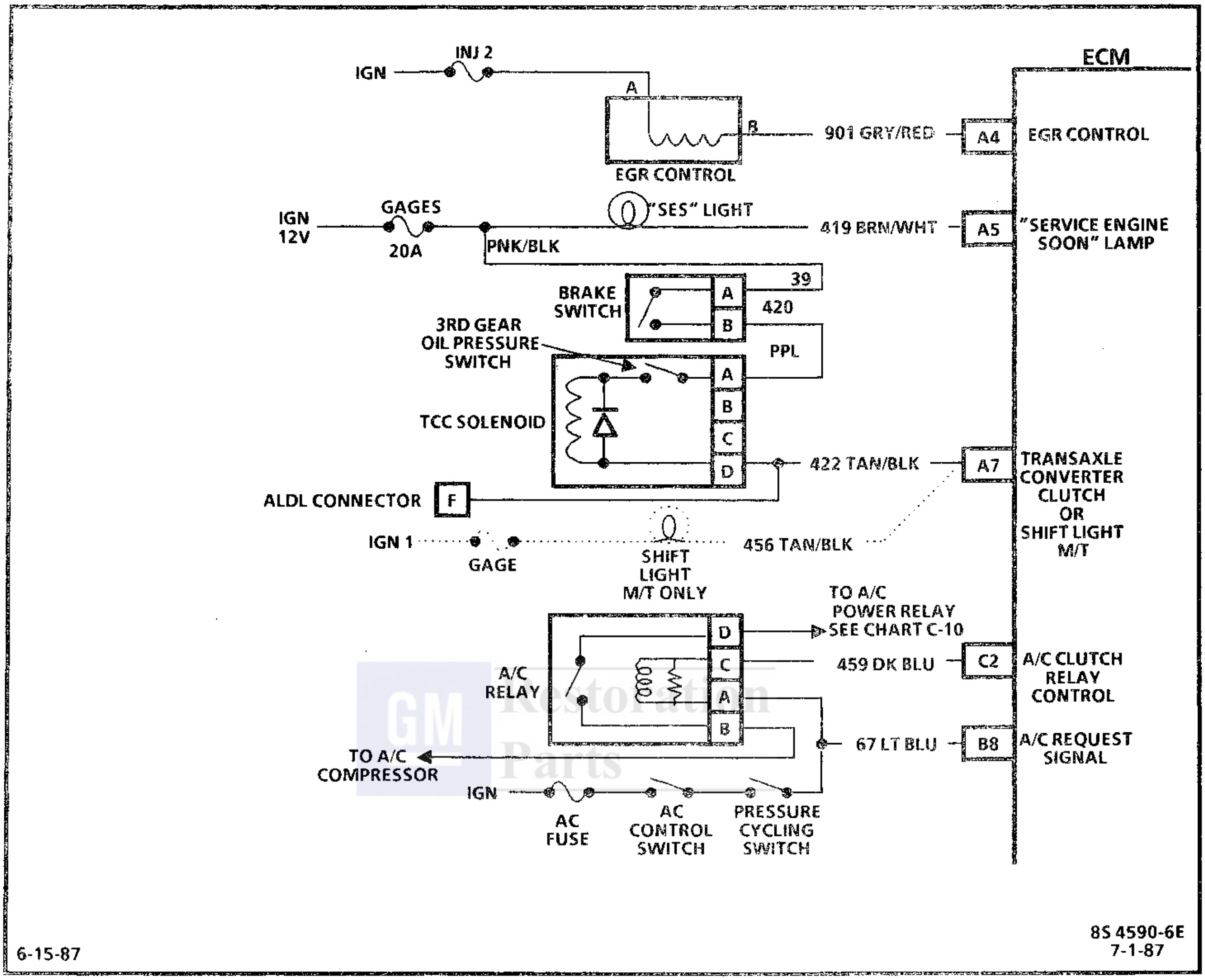

CHART C-1

ECM QDR CHECK
2.8L "P" SERIES (PORT)

ECM Quad Driver (QDR) Check

The ECM used an integrated circuit (IC) called a quad driver (QDR) in place of separate transistors to turn "ON" or "OFF" different circuits controlled by the ECM. Each QDR has four separate outputs that can independently turn "ON" or "OFF" four different circuits.

ECM service part number 1227170, used with this engine, does not have fault protection, therefore, a single faulty circuit many times causes all four QDR outputs to be inoperative or "ON" all the time. A failed QDR usually results in either a shorted or open ECM output. Because of the increased current flow, two QDR outputs are used to drive the TCC solenoid.

Refer to the ECM QDR check procedure on the facing page. This check will not test all ECM functions, but it will determine if a specific circuit has caused a specific QDR to fail in the ECM.

A faulty circuit is the largest cause of a failed QDR, therefore, the check procedure should be used whenever ECM replacement is indicated, especially if the removed ECM exhibits characteristics of a damaged QDR such as:

- SES light with no code stored.
- Engine will not start and/or ECM will not flash Code 12.
- Flickering, intermittent, or dim SES light.
- Output, such as TCC circuit, is inoperative or "ON" at all times.
- Engine misfires, surges or stalls.
- "Scan" tool is erratic or inoperative.

CHART C-1

ECM QDR CHECK
2.8L "P" SERIES (PORT)

USE THIS CHECK PROCEDURE ONLY AFTER OTHER DIAGNOSTIC CHARTS , IN THIS SERVICE MANUAL HAVE DETERMINED THAT THERE WAS AN ECM FAILURE.

- REMOVE THE ECM FROM THE VEHICLE.

- REFER TO LIST BELOW OF THE ECM TERMINALS WHICH ARE QDR OUTPUTS.
- USING THE 100/200 K OHM SCALE ON DVM*, MEASURE RESISTANCE BETWEEN THE ECM CASE AND EACH ECM TERMINAL LISTED, BLACK (NEG.) LEAD TO CASE AND RED (POS.) LEAD TO ECM TERMINAL.
- ALL TERMINALS LISTED SHOULD HAVE RESISTANCE OF 50K OHMS OR MORE.
- DO THEY?

NO

THE PRIOR TEST HAS DETERMINED THAT A QDR IN THE ECM HAS BEEN DAMAGED. IT IS MOST IMPORTANT TO LOCATE AND REPAIR THE CIRCUIT OR COMPONENT THAT CAUSED THE DAMAGE. FAILURE TO DO SO WILL RESULT IN ANOTHER FAILURE OF THE NEWLY REPLACED ECM. ANY TERMINAL WITH LESS THAN 50K OHMS RESISTANCE IS CONNECTED TO A DEFECTIVE QDR. THE ECM TERMINAL WITH THE LOWEST RESISTANCE WAS CONNECTED TO THE VEHICLE CIRCUIT MOST LIKELY TO HAVE CAUSED THE QDR FAILURE.

- DISCONNECT THE COMPONENT IN THAT VEHICLE CIRCUIT AND CHECK FOR A SHORT TO VOLTAGE. IF THE CIRCUIT IS NOT SHORTED TO VOLTAGE, REPLACE THE COMPONENT IN THAT CIRCUIT AND THE ECM.

YES

- KEY "ON", ENGINE NOT RUNNING.
- USE A FUSED AMMETER CAPABLE OF MEASURING AT LEAST 2 AMPS (J-34029-A OR EQUIVALENT).
- CONNECT ONE LEAD OF THE AMMETER TO CHASSIS GROUND.
- CONNECT THE REMAINING LEAD TO EACH VEHICLE CIRCUIT WHICH WAS LISTED ABOVE.
- MEASURE SUSTAINED CURRENT FLOW THROUGH EACH CIRCUIT FOR 2 MINUTES EACH (IN MOST CASES, THE TCC SOLENOID CANNOT BE EASILY TESTED FOR CURRENT DRAW).
- NOTE AMPERAGE.

IF A CIRCUIT(S) HAS MORE THAN 0.75 AMPS CURRENT DRAW.

- CHECK FOR A SHORT TO VOLTAGE IN EXCESSIVE CURRENT DRAW CIRCUIT.
- IF NO SHORT TO VOLTAGE, REPLACE RELATED SOLENOID OR RELAY.

IF NO CIRCUIT HAS MORE THAN 0.75 AMPS CURRENT DRAW.

- REPLACE ECM

ECM# 1227170

QDR NUMBER	ECM OUTPUT TERMINAL	CIRCUIT
1	A2	NOT USED
	A4	EGR CONTROL
	A5	SES LIGHT
2	A3	NOT USED
	D2	NOT USED
3	A7	SHIFT LIGHT M/T TCC CONTROL A/T
	C2	A/C RELAY CONTROL

* USE DVM J-34029-A OR EQUIVALENT

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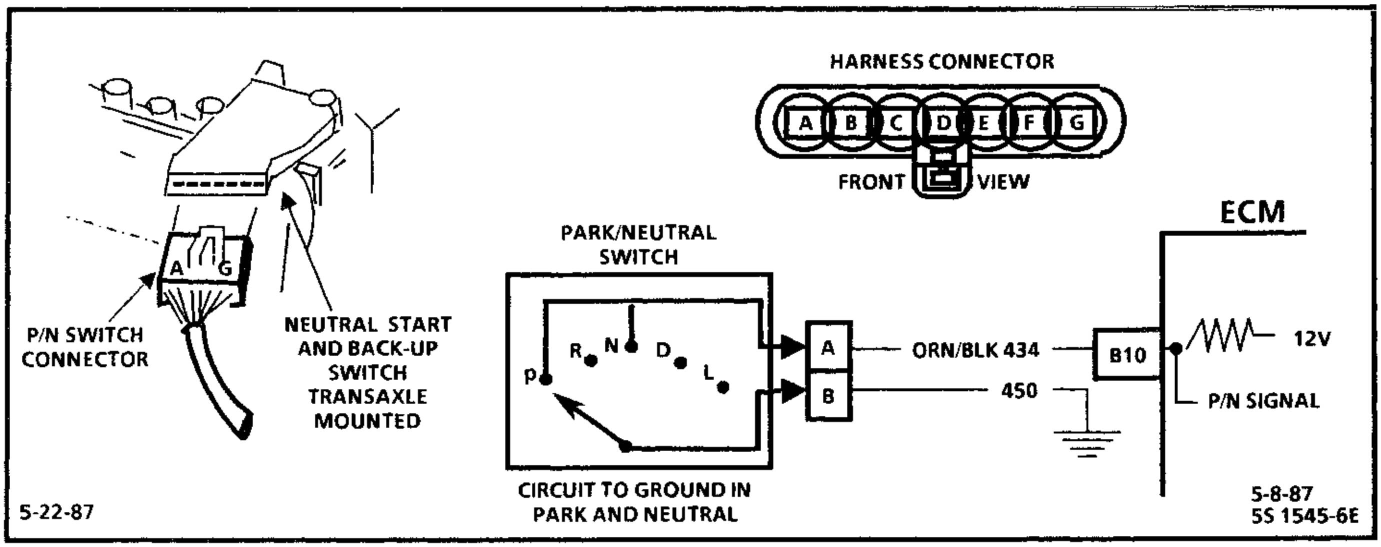


CHART C-1A

PARK/NEUTRAL SWITCH DIAGNOSIS
(AUTO TRANSAXLE ONLY)
2.8L "P" SERIES (PORT)

Circuit Description:

The park/neutral switch contacts are a part of the neutral start switch and are closed to ground in park or neutral, and open in drive ranges.

The electronic control module (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
Vehicle Speed Sensor Diagnostics
Exhaust Gas Recirculation

If CKT 434 indicates P/N (grounded) while in drive range the EGR would be inoperative resulting in possible detonation.

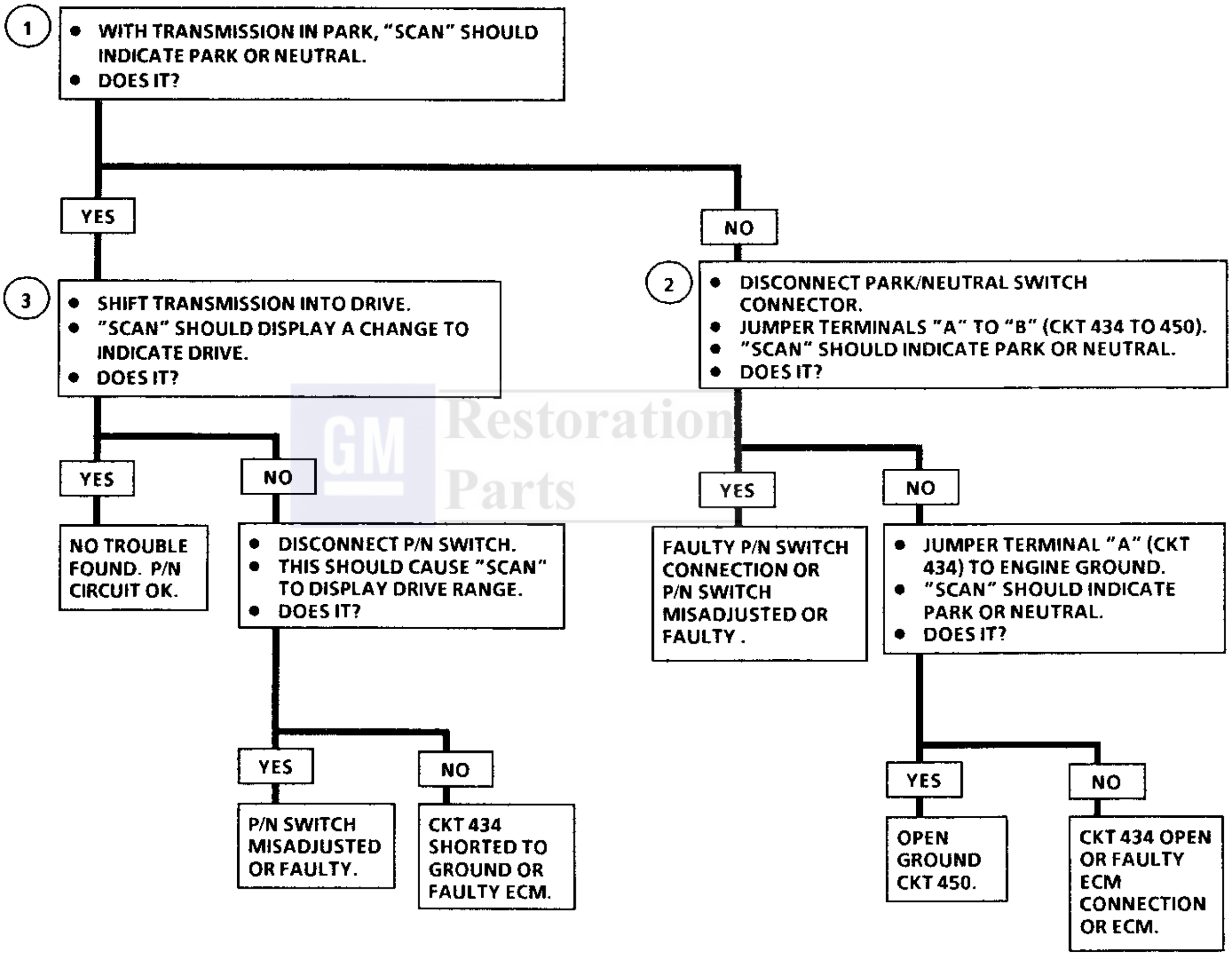
If CKT 434 indicates drive (open) a dip in the idle may exist when the gear selector is moved into drive range.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Checks for a closed switch to ground in park position. Different makes of "Scan" tools will read P/N differently. Refer to tool operators manual for type of display used for a specific tool.
2. Checks for an open switch in drive range.
3. Be sure "Scan" indicates drive even while wiggling shifter to test for an intermittent or misadjusted switch in drive.

CHART C-1A

PARK/NEUTRAL SWITCH DIAGNOSIS
(AUTO TRANSAXLE)
2.8L "P" SERIES (PORT)



①
- WITH TRANSMISSION IN PARK, "SCAN" SHOULD INDICATE PARK OR NEUTRAL.
- DOES IT?

③
- SHIFT TRANSMISSION INTO DRIVE.
- "SCAN" SHOULD DISPLAY A CHANGE TO INDICATE DRIVE.
- DOES IT?

NO TROUBLE FOUND. P/N CIRCUIT OK.

- DISCONNECT P/N SWITCH.
- THIS SHOULD CAUSE "SCAN" TO DISPLAY DRIVE RANGE.
- DOES IT?

P/N SWITCH MISADJUSTED OR FAULTY.

CKT 434 SHORTED TO GROUND OR FAULTY ECM.

②
- DISCONNECT PARK/NEUTRAL SWITCH CONNECTOR.
- JUMPER TERMINALS "A" TO "B" (CKT 434 TO 450).
- "SCAN" SHOULD INDICATE PARK OR NEUTRAL.
- DOES IT?

FAULTY P/N SWITCH CONNECTION OR P/N SWITCH MISADJUSTED OR FAULTY .

- JUMPER TERMINAL "A" (CKT 434) TO ENGINE GROUND.
- "SCAN" SHOULD INDICATE PARK OR NEUTRAL.
- DOES IT?

OPEN GROUND CKT 450.

CKT 434 OPEN OR FAULTY ECM CONNECTION OR ECM.

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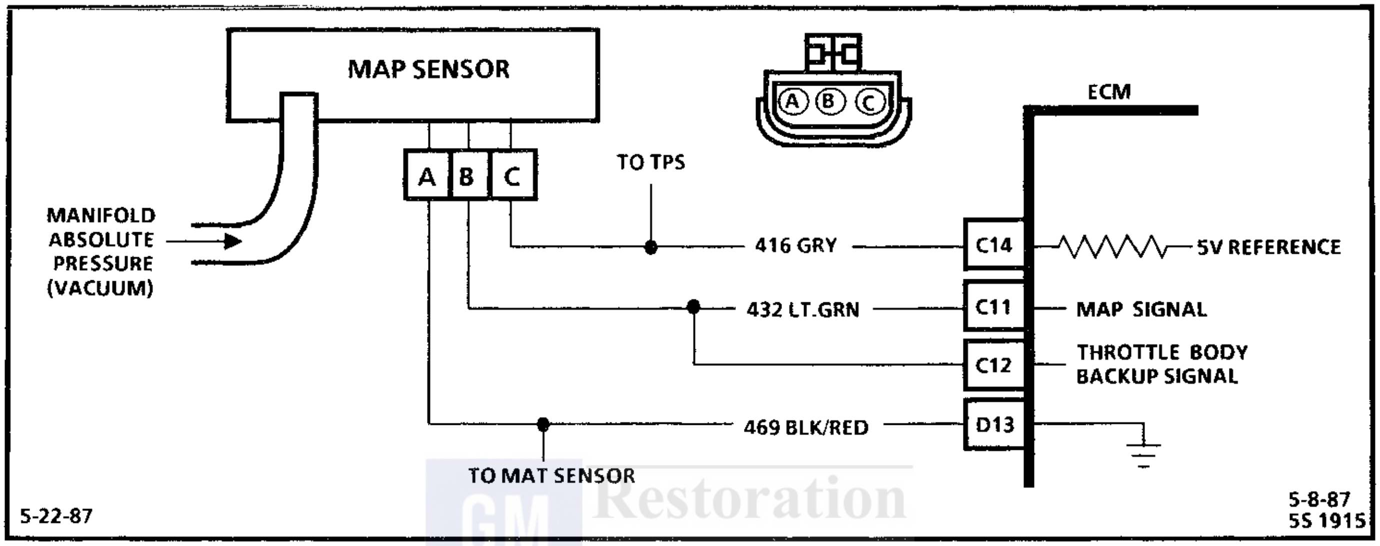


CHART C-1D

MAP OUTPUT CHECK
2.8L "P" SERIES (PORT)

Circuit Description:

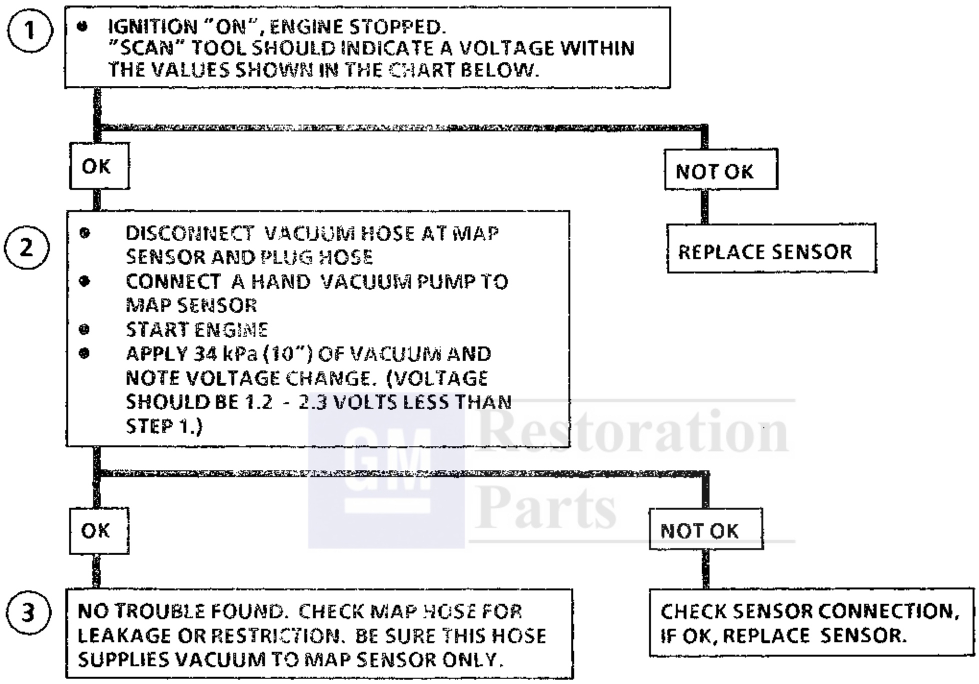
The manifold absolute pressure (MAP) sensor measures manifold pressure (vacuum) and sends that signal to the electronic control module (ECM). The MAP Sensor is mainly used for fuel calculation when the ECM is running in the throttle body backup mode. The MAP is also used to determine the barometric pressure and to help calculate fuel delivery.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Checks MAP sensor output voltage to the ECM. This voltage, without engine running, represents a barometer reading to the ECM.
2. Applying 34 kPa (10 inches Hg) vacuum to the MAP sensor should cause the voltage to be 1.2 volts less than the voltage at Step 1. Upon applyng vacuum to the sensor, the change in voltage should be instantaneous. A slow voltage change indicates a faulty sensor. The engine should be running in this step or the "Scanner" may not indicate a change in voltage. The "Service Engine Soon" light may come "ON" and the system may set a code during this test.
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 (PORT)



1
- IGNITION "ON", ENGINE STOPPED.
  "SCAN" TOOL SHOULD INDICATE A VOLTAGE WITHIN THE VALUES SHOWN IN THE CHART BELOW.

NOT OK: REPLACE SENSOR

2
- DISCONNECT VACUUM HOSE AT MAP SENSOR AND PLUG HOSE
- CONNECT A HAND VACUUM PUMP TO MAP SENSOR
- START ENGINE
- APPLY 34 kPa (10") OF VACUUM AND NOTE VOLTAGE CHANGE. (VOLTAGE SHOULD BE 1.2 - 2.3 VOLTS LESS THAN STEP 1.)

NOT OK: CHECK SENSOR CONNECTION, IF OK, REPLACE SENSOR.

3 NO TROUBLE FOUND. CHECK MAP HOSE FOR LEAKAGE OR RESTRICTION. BE SURE THIS HOSE SUPPLIES VACUUM TO MAP SENSOR ONLY.

ALTITUDE		VOLTAGE RANGE
Meters	Feet	
Below 305	Below 1,000	3.8---5.5V
305--- 610	1,000--2,000	3.6---5.3V
610--- 914	2,000--3,000	3.5---5.1V
914--1219	3,000--4,000	3.3---5.0V
1219--1524	4,000--5,000	3.2---4.8V
1524--1829	5,000--6,000	3.0---4.6V
1829--2133	6,000--7,000	2.9---4.5V
2133--2438	7,000--8,000	2.8---4.3V
2438--2743	8,000--9,000	2.6---4.2V
2743--3048	9,000--10,000	2.5---4.0V

LOW ALTITUDE = HIGH PRESSURE = HIGH VOLTAGE

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

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BLANK

SECTION C2

FUEL CONTROL SYSTEM

CONTENTS

GENERAL DESCRIPTION

PURPOSE

The basic function of the fuel control system is to control fuel delivery to the engine.

Fuel is delivered to the engine by individual fuel injectors mounted in the intake manifold, near each cylinder.

The main control sensor is the oxygen (O_2) sensor, which is located in the exhaust manifold. The O_2 sensor tells the engine control module (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 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).

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.

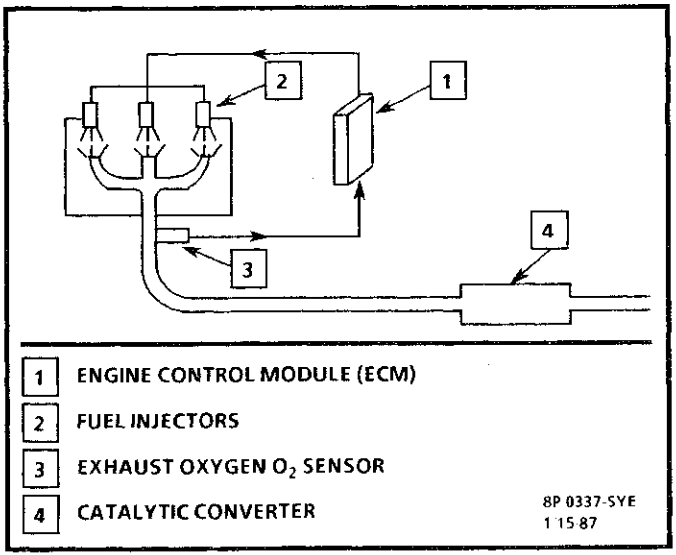

Figure C2-1 - "Closed Loop" System

Starting Mode

When the ignition is first turned "ON," the ECM turns "ON" the fuel pump relay for two seconds, and the fuel pump builds up fuel pressure. The ECM also checks the coolant temperature sensor, the throttle position sensor (TPS) and the manifold absolute pressure (MAP) sensor, to determine the proper air/fuel ratio for starting.

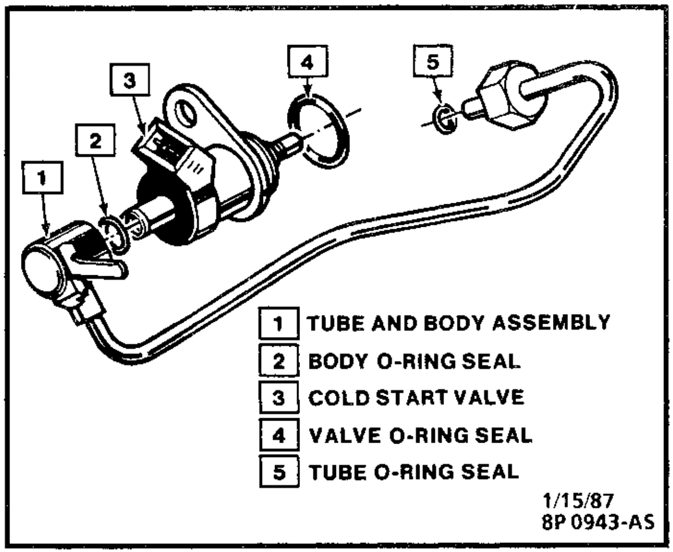

Figure C2-2 - Cold Start Valve Assembly

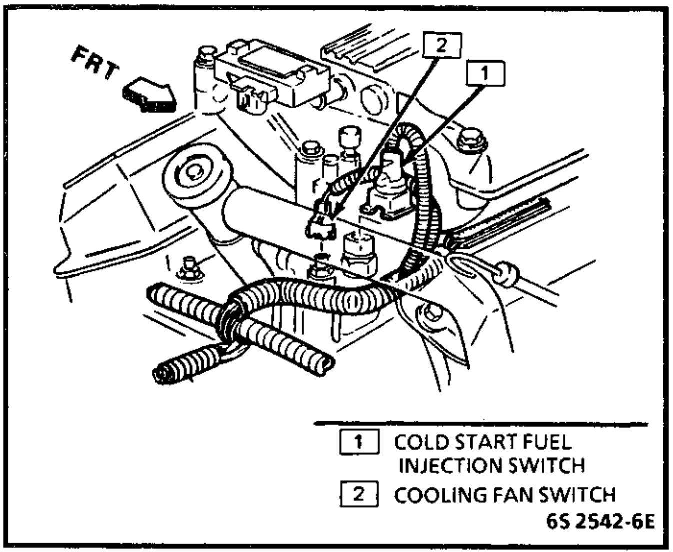

Figure C2-3 - Cold Start Fuel Injection Switch

This ranges from 1.5:1 at -36°C (-33°F) to 14.7:1 at 94°C (201°F) running temperature.

The electronic control module (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 different from the other injectors in that it causes the fuel to be vaporized for a better combustible mixture.

This circuit is activated only in the crank mode. The power is supplied directly from the starter solenoid and only "ON" 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 (see Figure C2-3) consists of a bimetal material which opens the circuit at specified coolant temperature. This bimetal is also heated by the winding in the switch which allows the cold start valve to stay "ON" 8 seconds at -20°C (-4° F) or below. Above (-20°C), the maximum time the switch stays closed is proportional to the coolant temperature. In other words, as the coolant temperature goes up the maximum cold start valve "ON" time goes down.

Clear Flood Mode

If the engine floods, clear it by pushing the accelerator pedal down all the way. The ECM then pulses the injectors at an air/fuel ratio of 20:1. The ECM holds this injector rate as long as the throttle stays wide open, and the engine rpm is below 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 (O_2) sensor, and calculate the air/fuel ratio based on inputs from the coolant temperature and MAP sensors.

The system stays in "Open Loop" until the following conditions are met:

1. The O_2 sensor has varying voltage output, showing that it is hot enough to operate properly. (This depends on temperature.)
2. The coolant 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 programmable read only memory (PROM). When these conditions are met, the system goes into "Closed Loop" operation. In "Closed Loop," the ECM calculates the air/fuel ratio (injector on-time) based on the signal from the O_2 sensor. This allows the air/fuel ratio to stay very close to 14.7:1 .

Acceleration Mode

The ECM looks at rapid changes in throttle position and manifold pressure (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 electronic control module (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
- 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:

1) Fuel rail assembly, including:
    - Fuel injectors
    - Pressure regulator
2) Throttle body assembly, including:
    - Idle air control (IAC) valve
    - Throttle position sensor (TPS)
3) Fuel pump
4) 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 separate line. (For further information on the fuel tank, in-line filter, and fuel lines, see Section "6C").

The injectors are controlled by the ECM. They deliver fuel in one of several modes, as described above.

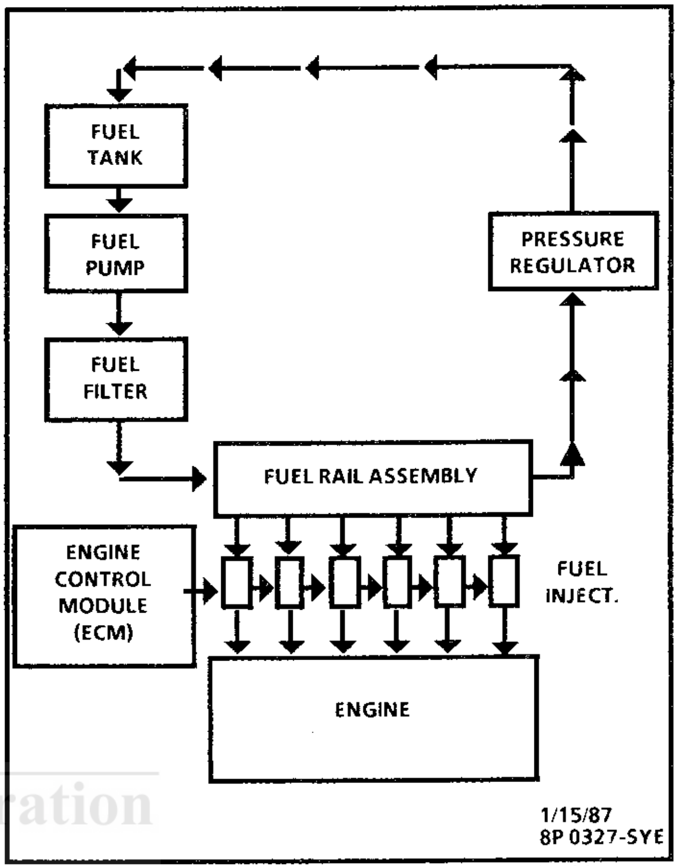

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Figure C2-4 - Fuel Supply System (Typical)

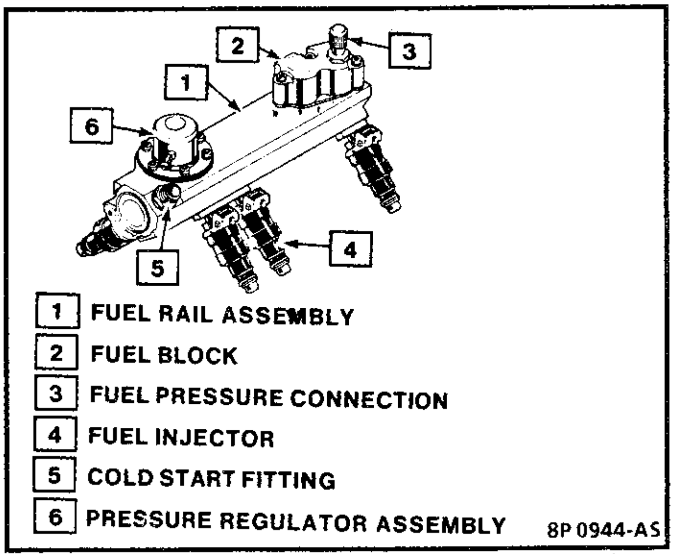

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Figure C2-5 Model R610 (F6A) Fuel Rail Assembly

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," below).

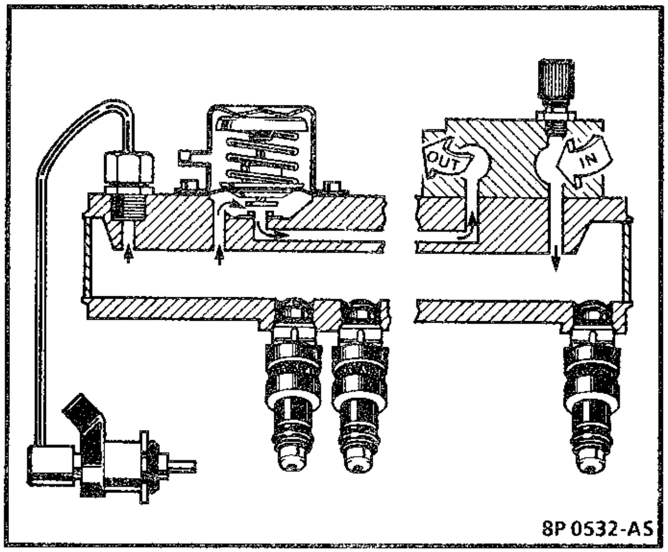

Figure C2-6 - Fuel Rail Flow Diagram

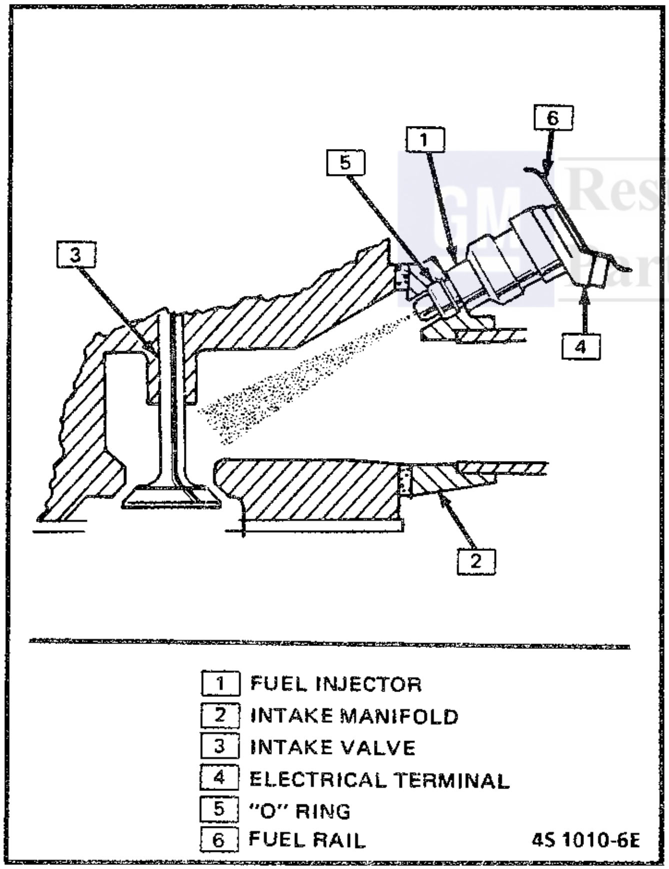

Figure C2-7 - Fuel Injector Assembly

FUEL RAIL ASSEMBLY

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 through 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 (see Figure C2-6).

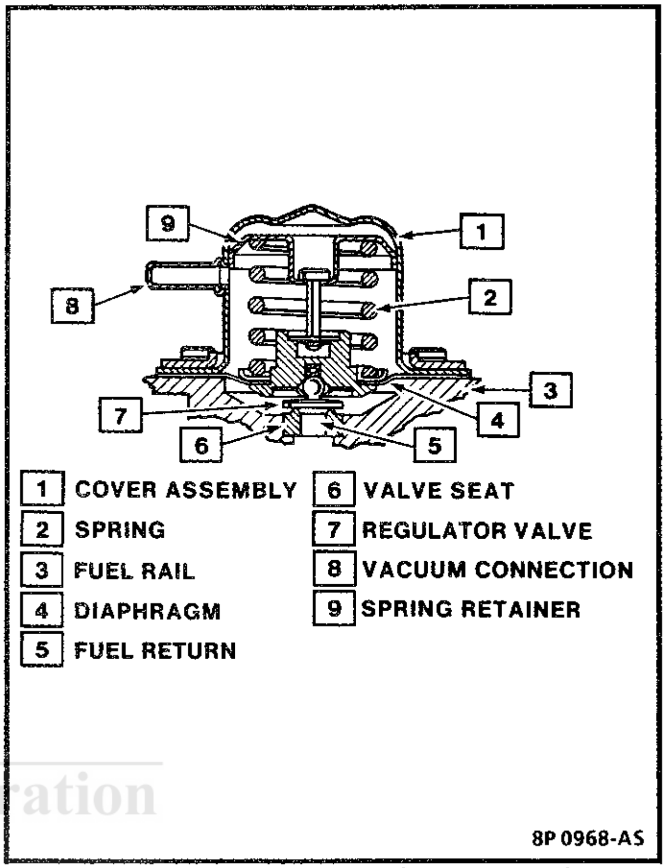

Figure C2-8 - Pressure Regulator Assembly

Fuel Injector Assembly

The fuel injector is a solenoid operated device, controlled by the electronic control module (ECM), that meters pressurized fuel to a single cylinder (see Figure C2-7). The ECM energizes the solenoid, which opens a valve to allow fuel delivery. The fuel, under pressure, is injected in a conical spray pattern at the opening of the intake valve. The fuel which is not used by the injectors passes through the pressure regulator before being returned to the fuel tank.

An injector that is stuck partly open would cause loss of pressure after engine shut down. Consequently, long cranking times would be noticed on some engines. Dieseling could also occur because some fuel could be delivered to the engine after the ignition is turned "OFF".

Pressure Regulator Assembly

The pressure regulator assembly (see Figure C2-8) 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 at the end of the fuel rail and is not serviceable.

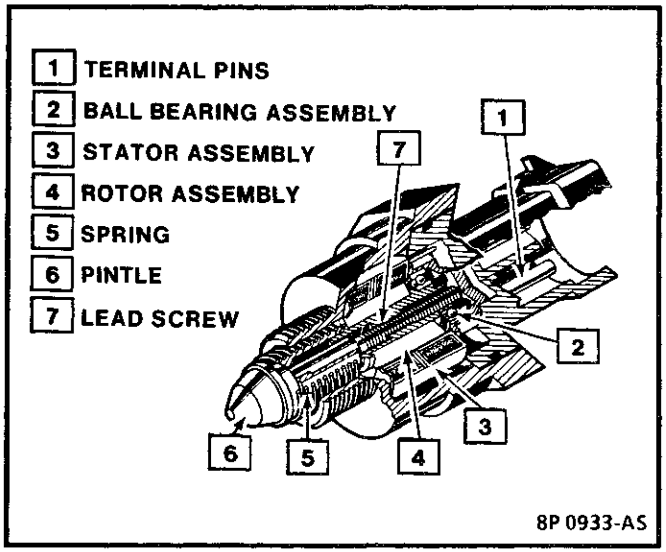

Figure C2-9 - Idle Air Control (IAC) Valve

The pressure regulator compensates for engine load by by increasing fuel pressure as engine vacuum drops. 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.

THROTTLE BODY ASSEMBLY

The throttle body assembly has a throttle valve to control the amount of air delivered to the engine. The throttle position sensor (TPS) and idle air control (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. Engine coolant is directed through the throttle body to warm the throttle body and to prevent icing.

The system operates in an acceptable pressure range of 234 - 325 kPa (41 - 47 psi). If the pressure is too low, poor performance could result. If the pressure is too high, excessive odor and a Code 45 may result. CHART A-7 has information on diagnosing fuel pressure conditions.

Idle Air Control (IAC) Valve Assembly

The purpose of the idle air control (IAC) valve (shown in Figure C2-9) 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.

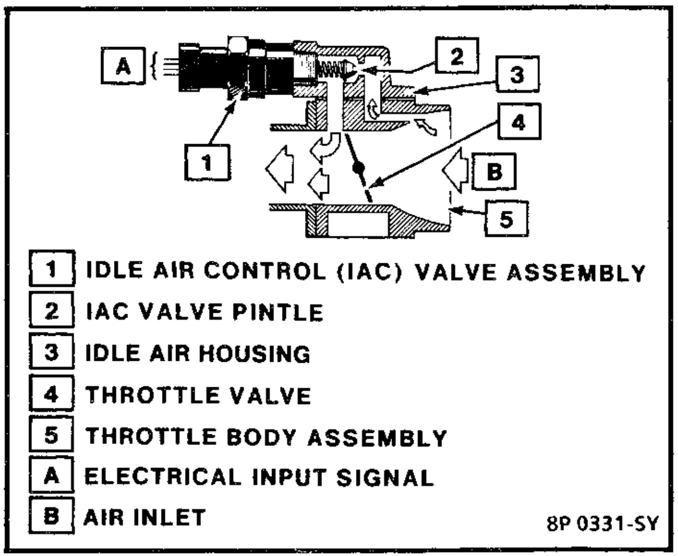

Figure C2-10 - IAC Valve Air Flow Diagram (Typical)

The IAC valve moves in small steps called "counts," which can be measured by some test equipment which plugs into the assembly line data link (ALDL) connector (see Figure C2-10).

During idle, the proper position of the IAC valve is calculated by the electronic control module (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, and then calculates a new valve position to prevent stalls.

If the IAC valve is disconnected and reconnected with the engine running, the idle rpm may be wrong. In this case, the IAC valve can be reset by starting the engine momentarily and then turning the ignition "OFF".

Different designs are used for the IAC valve. Be sure to use the correct design when replacement is required.

The IAC valve affects the idle characteristics of the vehicle. If it is open too far, too much air will be allowed into the manifold and idle speed will be high. If it is not open far enough, too little air will be allowed in the manifold, and idle speed will be too low. If it is stuck part of the way open, the idle speed may be incorrect, and will not respond to engine load changes.

Throttle Position Sensor (TPS)

The TPS is mounted on the side of the throttle body opposite the throttle lever. Its function is to sense the throttle valve angle and relay that information to the ECM. Knowledge of throttle angle is needed by the ECM to generate the required injector control signals (base pulses). If the TPS voltage indicates a wide open throttle, the ECM then increases the injector base pulse width, permitting increased fuel flow. (see Figure C2-11)

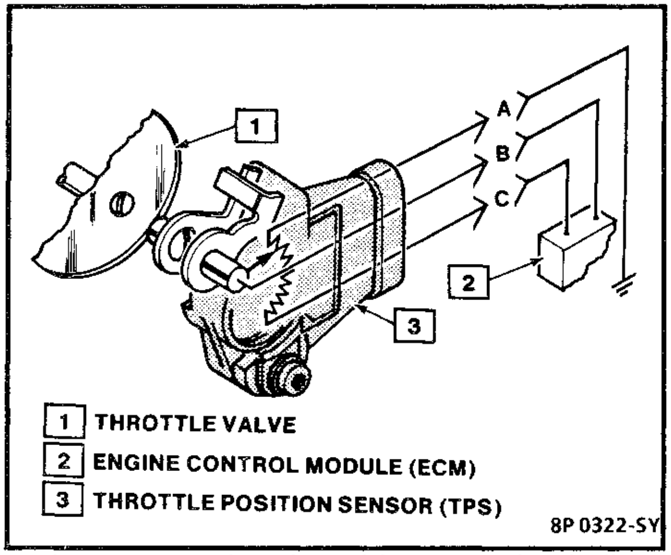

Figure C2-11 - Throttle Position Sensor (Typical)

As the throttle valve rotates in response to movement of the accelerator pedal, the throttle shaft transfers this rotational movement to the throttle position sensor (TPS). A potentiometer (variable resistor) within the TPS assembly changes its resistance (voltage drop) in proportion to throttle movement. By applying a reference voltage (5.0 volts) to the TPS input, a varying voltage (reflecting throttle position) is available at the TPS output. For example, the TPS output at engine idle should be between 0.45 and 0.65 volts. (For further information on the TPS, refer to Section "6E3-C1").

FUEL PUMP

The fuel pump is a roller vane type, high pressure electric pump, mounted in the fuel tank. Fuel is pumped at a positive pressure (above 62 kPa or 9 psi) from the fuel pump through the in-line filter to the pressure regulator on the fuel rail assembly. Excess fuel is returned to the fuel tank through the fuel return line.

The fuel pump is attached to the fuel gage sender assembly. A fuel strainer is attached to the fuel pump inlet line and prevents dirt particles from entering the fuel line and tends to separate water from the fuel.

Vapor lock problems are reduced when using an electric pump because the fuel is pushed from the tank under pressure rather than pulled under vacuum, a condition that produces vapor.

An inoperative fuel pump would cause a no start condition. A fuel pump which does not provide enough pressure can result in poor performance. (See "Fuel System Pressure Test" procedure).

FUEL PUMP ELECTRICAL CIRCUIT

When the key is first turned "ON" without the engine running, the ECM 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

FUEL CONTROL SYSTEM

Some failures of this system will result in an "Engine Cranks But Won't Run." If this condition exists, See CHART A-3. This chart will determine if the problem is caused by the ignition system, ECM or fuel pump circuit. If it's determined to be a fuel problem, CHART A-7 will be used. This includes the injectors, pressure regulator, fuel pump and fuel pump relay. The fuel system wiring schematic is covered on the facing page of Code CHART 54.

If a malfunction occurs in the fuel control system, it usually results in either a rich or lean exhaust condition. This condition is sensed by the oxygen sensor and the ECM will change the fuel calculation (injector pulse width) based on O_2 sensor reading. The change made to the fuel calculation will be indicated by a change in the block learn values which can be monitored by a "Scan" tool. The normal block learn values are around 128 and if the O_2 sensor is sensing a lean condition the ECM will add fuel and this will result in a block learn value above 128. Some variations in block learn values are normal because all engines are not exactly the same. However, if the block learn values are ± 10 counts from 128 a system problem exists. If the block learn values are greater than 138 see Code 44 for items which can cause a lean system.

If the block learn values are less than 118, see Code 45 for items which can cause the system to run rich. If a driveability symptom exists refer to the particular symptom in Section "B" for additional items to check.

IDLE AIR CONTROL VALVE

A "Scan" tool will read idle air control (IAC) position in steps (counts). "0" steps indicates the electronic control module (ECM) is commanding the IAC to be driven all the way in, to a fully seated position, and this is usually caused by a vacuum leak.

The higher the number of counts, the more air is being allowed to pass the IAC valve. If the IAC valve is unable to control the idle speed within 100 rpm of the ECM commanded speed, a Code 35 should set. A Code Chart should be used to diagnose the IAC system. Refer to "Rough, Unstable, or Incorrect Idle, Stalling" in the Symptoms Section "B" for other possibilities for the cause of idle problems.

FUEL SYSTEM PRESSURE TEST

A Fuel System Pressure Test is part of several of the Diagnostic Charts and Symptom checks. To perform this test, use the procedure on the page opposite CHART A-7.

ON-VEHICLE SERVICE

PORT FUEL INJECTION COMPONENTS

CAUTION: **To prevent personal injury or damage to the vehicle as the result of an accidental start, disconnect and reconnect the negative battery cable before and after service is performed. (Where Delco-Loc tm radio is installed on Pontiac cars, refer to NOTICE in beginning of Section "9A" to reactivate radio).**

CAUTION: **To minimize the risk of fire, and personal injury, relieve the fuel system pressure before servicing the fuel rail, or any of its fuel handling components. (See "Fuel Pressure Relief Procedure," below).**

CAUTION: **Also, catch any fuel that leaks out when disconnecting the fuel lines, by covering the fittings with a shop cloth. Place the cloth in an approved container when work is complete.**

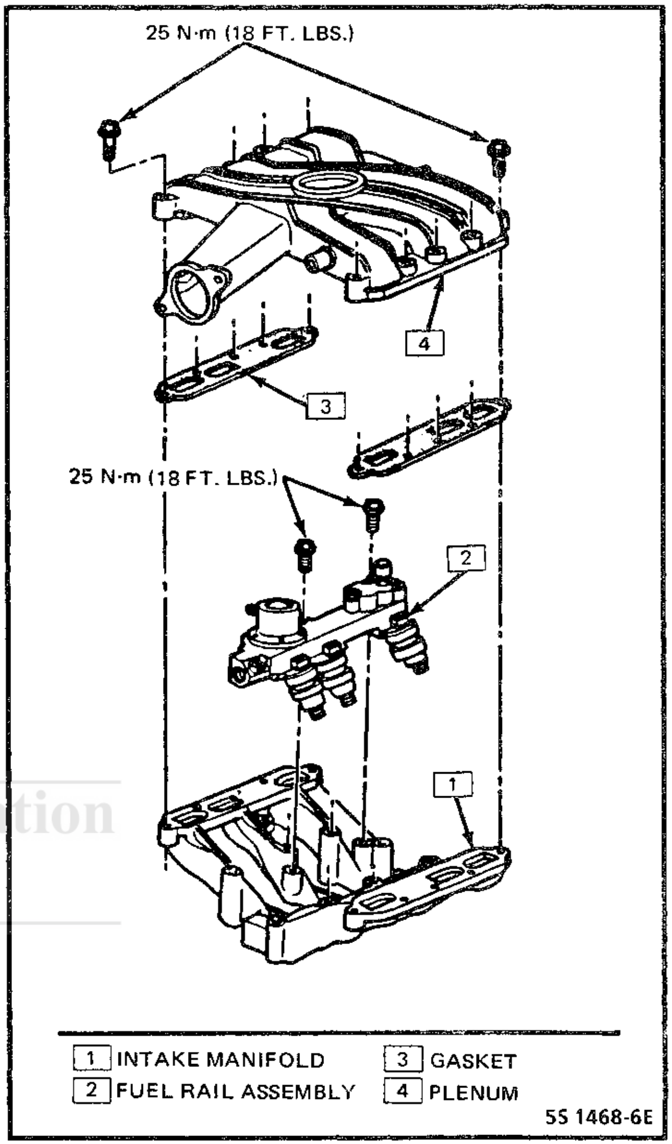

Figure C2-12 - Removing Plenum and Fuel Rail

FUEL PRESSURE RELIEF PROCEDURE

1. Connect fuel gage J 34730-1 or equivalent to fuel pressure valve. Wrap a shop towel around fitting while connecting gage to avoid spillage.
2. Install bleed hose into an approved container and open valve to bleed system pressure.

PLENUM
Removal and Installation (Figure C2-12)

Removing the fuel rail assembly from the engine requires removing the top portion of the tuned intake manifold, called the "plenum".

↔ Remove or Disconnect

1. Vacuum lines, noting location of lines.
2. EGR pipe to EGR valve base bolts.
3. Throttle cable bracket bolts.
4. Throttle body bolts.
5. Plenum bolts.
6. Plenum and gaskets. Discard gaskets.

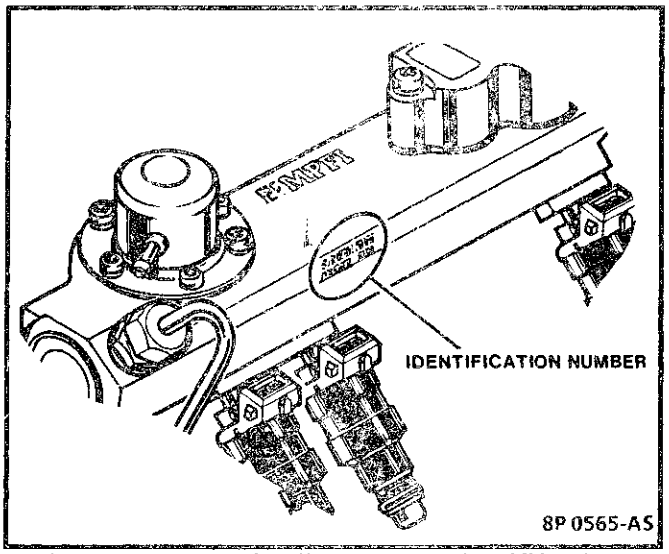

Figure C2-13 - Fuel Rail Assembly Identififcation

Install or Connect

1. New plenum gaskets.
2. Plenum.
3. Plenum bolts.

Tighten

- Plenum bolts to 25 N·m (18 lb.ft.)

4. Throttle body bolts.

Tighten

- Throttle body bolts to 17 N·m (12.5 lb.ft.)

5. EGR pipe.
6. Throttle cable bracket bolts.
7. Vacuum lines.

FUEL RAIL ASSEMBLY
Replacement (Figure C2-13 and C2-14)

An eight digit identification number is stamped on the side of the fuel rail, as shown in Figure C2-13. Refer to this number if servicing or part replacement is required.

The names of component parts appear in the numbered list on the disassembled view (Figure C2-14) on the following page.

Important

- When servicing the fuel rail assembly, be careful to prevent dirt and other contaminants from entering the fuel passages. Fittings should be capped, and holes plugged, during servicing.
- At any time the fuel system is opened for service, the o-ring seals used with related components should be replaced.

Cleaning and Inspection

Before removal, the fuel rail assembly may be cleaned with a spray type engine cleaner, AC-Delco X-30A or equivalent, following package instructions. Do not immerse fuel rails in liquid cleaning solvent.

Remove or Disconnect

1. Plenum. (see above procedure).
2. Cold start valve line at fuel rail fitting.
3. Cold start tube o-ring seal and discard.
4. Fuel lines at rail.
5. Fuel inlet and return line o-rings and discard.
6. Vacuum line at pressure regulator.
7. Injector electrical connectors.
8. Rail retaining bolts.
9. Fuel rail assembly.

NOTICE: Use care in removing the fuel rail assembly, to prevent damage to the injector electrical connector terminals and the injector spray tips. When removed, support the rail to avoid damaging its components. The fuel injectors are serviced as complete assemblies only. Since they are electrical components, they should not be immersed in any cleaner.

Disassemble

Injector o-ring seal from spray tip end of each injector. Discard seals.

Assemble

Lubricate new injector o-ring seal and install on spray tip end of each injector.

Install or Connect

1. Fuel rail assembly in intake manifold.
   Tilt rail assembly to install injectors.
2. Fuel rail attaching bolts.

Tighten

- Attaching bolts to 25 N·m (19 lb. ft.)

3. Injector electrical connectors.
4. Vacuum line to pressure regulator.
5. New fuel inlet and return line o-rings on fuel feed and return lines.
6. Fuel feed and return lines to appropriate ports in fuel block.

Tighten

- Fittings to 10 N·m (88 lb. in.). (Use back-up wrench on inlet and outlet fittings to prevent them from turning).

7. New o-ring seal on cold start tube.
8. Cold start valve line at fuel rail fitting.

Inspect

- Energize fuel pump and check for leaks.

9. Plenum, following previously described instructions.

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	O-ring Seal - 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

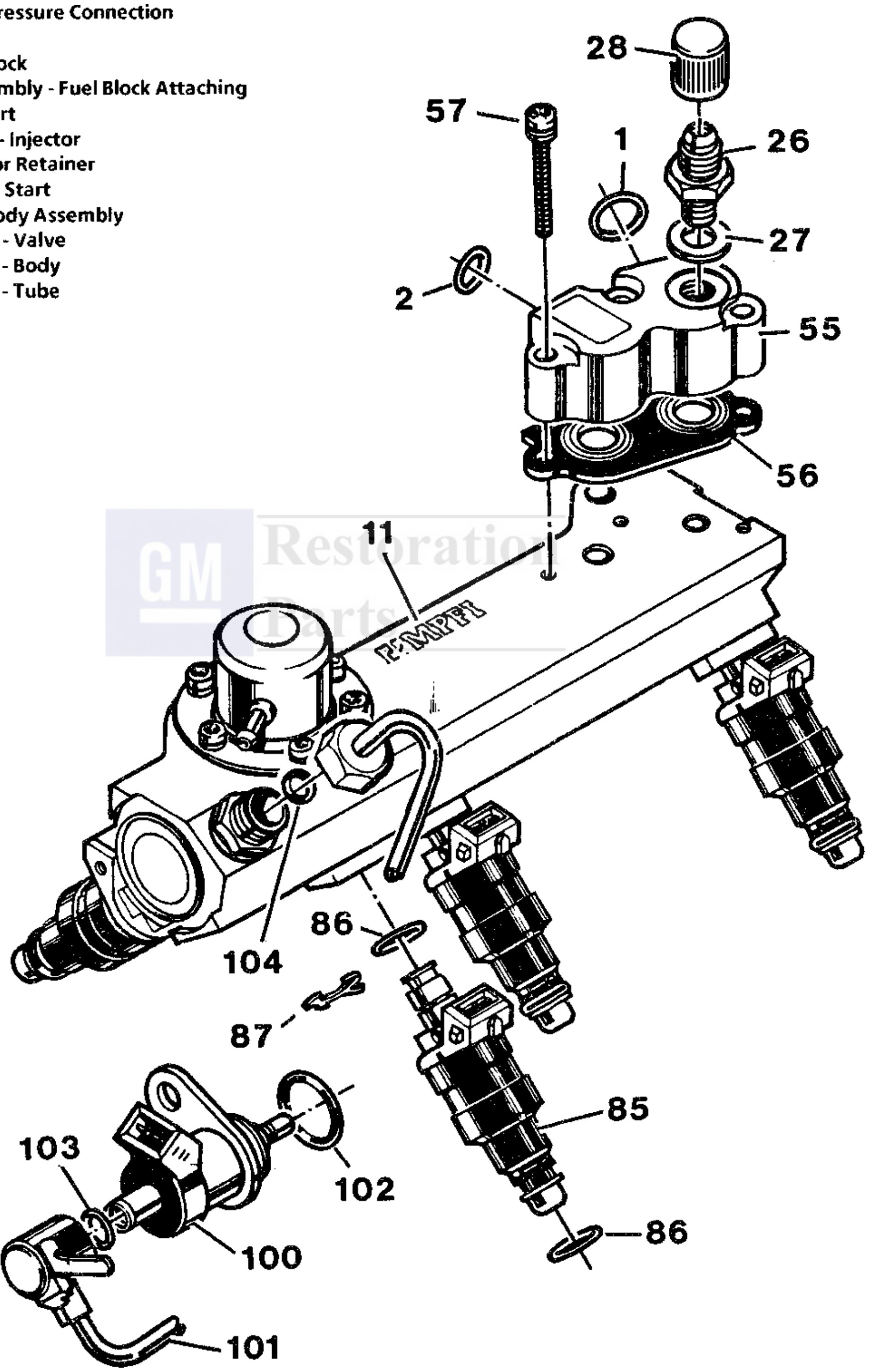

Figure C2-14 - Model R610 (F6A) Fuel Rail Assembly

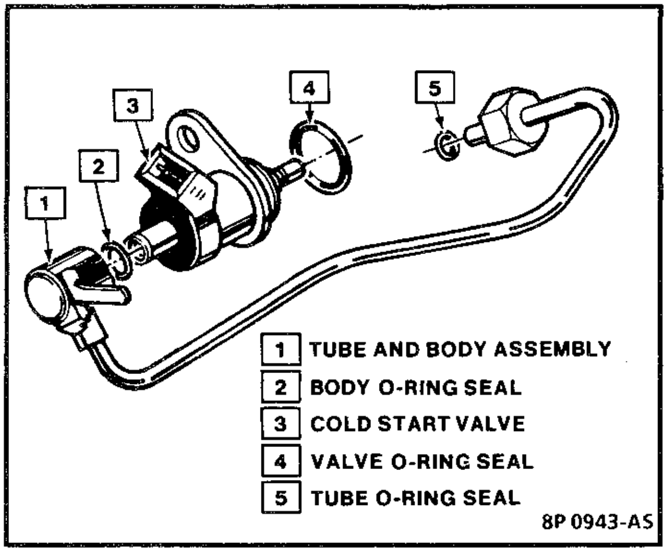

Figure C2-15 - Cold Start Valve

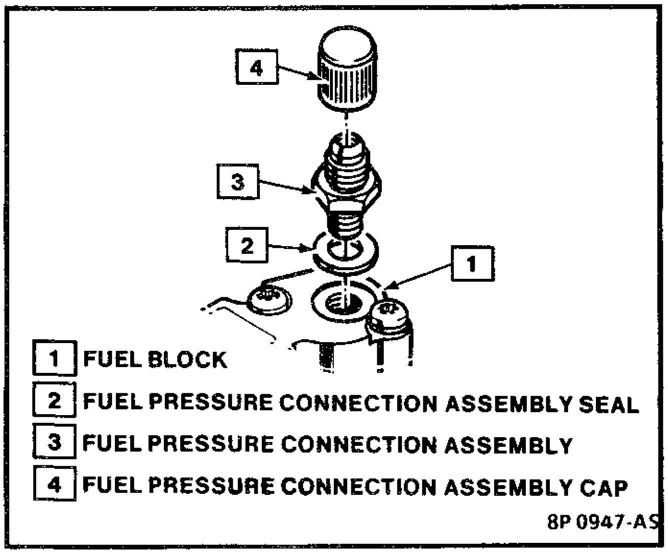

Figure C2-16 - Fuel Pressure Connection Assembly

COLD START VALVE ASSEMBLY Replacement (Figure C2-15)

Remove or Disconnect

1. Plenum, following above instructions.
2. Tube and body assembly from fitting on fuel rail.
3. Cold start valve electrical connector.
4. Cold start valve retaining bolt.
5. Cold start valve from intake manifold.

Clean

- Areas around valve and connection with AC-Delco X-30A or equivalent.

Disassemble

1. Raise tab on tube and body assembly so it will clear electrical connector and unscrew cold start valve.
2. Remove o-ring seals from tube and body assembly, cold start valve, and fuel rail fitting and discard.

Assemble

1. Lubricate new o-ring seals and install on tube and body assembly, cold start valve, and fuel rail fitting.
2. Cold start valve onto tube and body assembly.
   Screw in valve until it bottoms, then back off until hole in valve mounting lug will be aligned with hole in intake manifold when assembly is mounted.
   Bend tab over cold start valve to lock it in position.

Install or Connect

1. Cold start valve into port in intake manifold.
2. Cold start valve retaining bolt.

Tighten

- Retaining bolt to 25 N·m (19 lb. ft.).

3. Tube and body assembly at rail fitting.

Tighten

- Fitting to 10 N·m (88 lb. in.).

4. Electrical connector on cold start valve.

Inspect

- Energize fuel pump and inspect for leaks.

5. Intake manifold plenum, per previous instructions.

FUEL PRESSURE CONNECTION ASSEMBLY Replacement (Figure C2-16)

Remove or Disconnect

1. Fuel pressure connection assembly.
2. Fuel pressure connection seal. Discard seal.

Clean

- Area around fuel pressure connection with AC Delco X-30A or equivalent.

Install or Connect

1. New seal on fuel pressure connection assembly.
2. Fuel pressure connection assembly in fuel rail.

Tighten

- Fuel pressure connection assembly to 10.0 N·m (88.0 lb.in.).

Inspect

- Energize fuel pump and check for leaks.

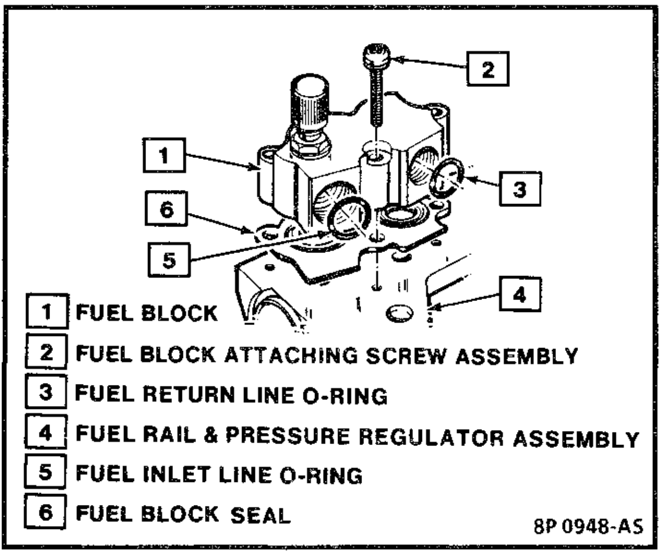

Figure C2-17 - Fuel Block Assembly

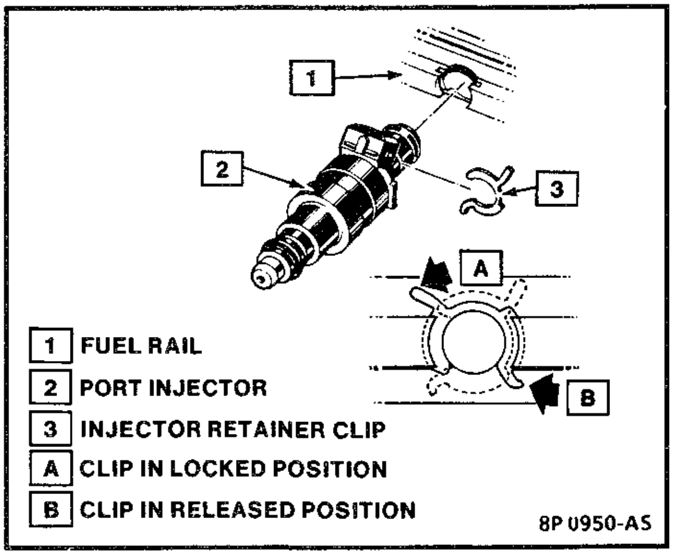

Figure C2-18 - Port Fuel Injector

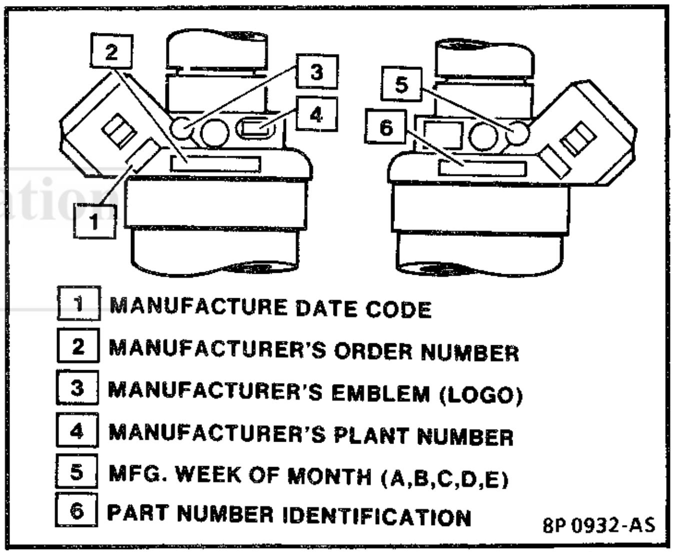

Figure C2-19 - Injector Part Number Information

FUEL BLOCK ASSEMBLY
Replacement (Figure C2-17)

Remove or Disconnect

1. Plenum, following instructions previously described.

Clean

- Area around fuel fuel block and adjacent line connections with AC Delco X-30A or equivalent..

2. Fuel inlet and return lines.
3. Inlet and return line o-ring seals and discard.
4. Fuel block attaching screw assemblies.
5. Fuel block assembly.
6. Fuel block seal and discard.

Clean

- Sealing surfaces of fuel block and fuel rail assembly to ensure a good seal.

Install or Connect

1. New-o-ring seals on fuel inlet and return lines.
2. New fuel block seal.
3. Fuel block assembly.
4. Fuel block attaching screw assemblies.

Tighten

- Attaching screw assemblies to 5.0 N·m (44.0 lb. in.).

5. Fuel inlet and return lines.

Tighten

- Fittings to 23.7 N·m (17.5 lb. ft.) (Use back-up wrench on inlet and outlet fittings to prevent them from turning).

6. Plenum, following instructions previously described.

Inspect

- Energize fuel pump and check for fuel leaks.

PORT FUEL INJECTOR
Replacement (Figure C2-18 and C2-19)

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. Since it is an electrical component, it should not be immersed in any type of cleaner. Support the fuel rail to avoid damaging other components while removing the injector.

NOTICE: To prevent dirt from entering the engine, the area around the injectors should be clean before servicing.

Remove or Disconnect

1. Plenum and fuel rail assembly, following previous instructions.
   Rotate injector retainer clip to release position, as shown in Figure C2-18.
2. Port fuel injector.

Important

When ordering new fuel injectors, refer to Figure C2-19 for part number information.

Disassemble

Injector o-ring seals from both ends of injector and discard.

Assemble

1. Lubricate new injector o-ring seals with engine oil and install on injector.
2. Retainer clip onto injector.

Install or Connect

1. Injectors to fuel rail and pressure regulator assembly.
2. Rotate injector retainer clip to locking position (see Figure C2-18).
3. Plenum and fuel rail assembly, following previous instructions.

PRESSURE REGULATOR ASSEMBLY

Important

The pressure regulator assembly is factory adjusted and is not serviceable. Do not attempt to remove the regulator from the fuel rail.

COLD START FUEL INJECTION SWITCH Replacement

Remove or Disconnect

1. Electrical connector.
2. Cold start fuel injection switch.

Install or Connect

1. Coat threads with pipe sealant.
2. Cold start fuel injection switch.
3. Electrical connector.

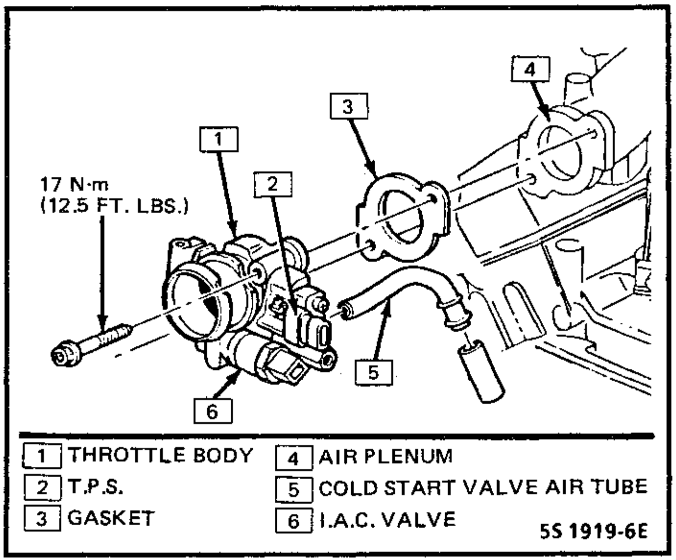

Figure C2-20 - Throttle Body Assembly Removal

THROTTLE BODY ASSEMBLY Replacement (Figure C2-20)

The throttle body assembly 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.

NOTICE: The throttle position sensor (TPS), idle air control (IAC) valve, throttle body, with seals, or gaskets in place, should NOT be soaked in liquid solvent or cleaner, as they may be damaged. If the TPS or IAC valve is still mounted in the throttle body, do not immerse.

Cleaning and Inspection

Throttle body parts, except as noted above, may be cleaned in a cold immersion-type cleaner such as AC Delco X-55 or equivalent.

1. Clean all metal parts thoroughly and blow dry with shop air. Be sure air passages are free from burrs and dirt.
2. Inspect mating casting surfaces for damage that could affect gasket sealing.

Remove or Disconnect

1. TPS and IAC valve electrical connectors.
2. Coolant lines.
3. Throttle linkages.
4. Air inlet duct.
5. Throttle body retaining bolts.
6. Throttle body assembly.
7. Flange gasket and discard.

Clean

- Gasket surface on intake manifold.

Install or Connect

1. New flange gasket.
2. Throttle body assembly.
3. Retaining bolts.

Tighten

- Retaining bolts to 17 N·m (12.5 lb. ft.).

4. Air inlet duct.
5. Throttle linkages.
6. Coolant lines.
7. TPS and IAC valve electrical connectors.
8. Negative battery cable. (Where Delco-Loc tm radio is installed on Pontiac cars, refer to NOTICE in beginning of Section "9A" to reactivate radio.)

IDLE AIR CONTROL VALVE Replacement (Figure C2-21)

Remove or Disconnect

1. Electrical connector from idle air control (IAC) valve assembly.
2. IAC valve assembly .
   Do not remove any thread locking compound from threads.
3. IAC valve assembly gasket, and discard.

NOTICE: If the IAC valve has been removed during service, its operation may be tested electrically with the IAC/ISC Motor Tester (Available Tool No. J-37027, or BT-8256K). However, if the valve pintle is extended electrically, it must also be retracted electrically. Under no circumstances should the valve pintle be tampered with by hand, screwed, or pushed in, or pulled out, as damage could occur.

Clean

- Gasket mounting surface of throttle body assembly to ensure a good seal.

NOTICE: The IAC valve assembly is an electrical component, and must not be soaked in any liquid cleaner or solvent, as damage may result.

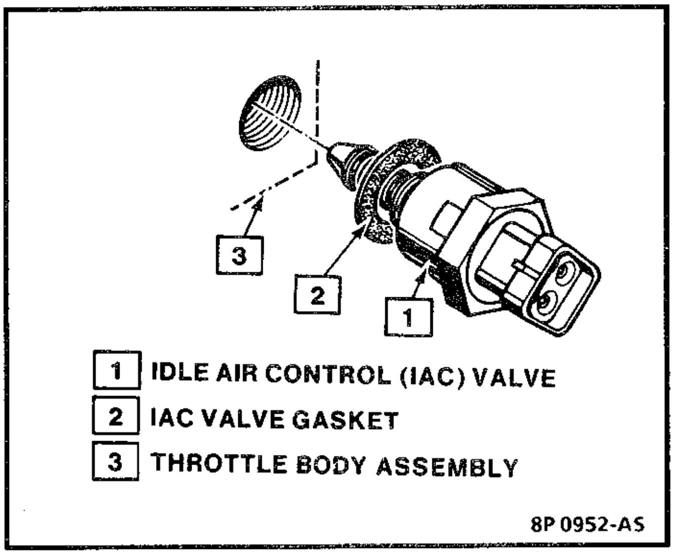

Figure C2-21 - IAC Valve Removal

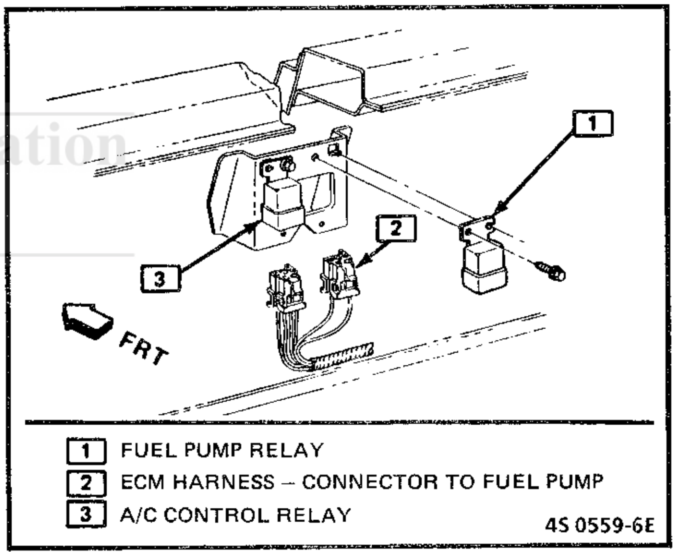

Figure C2-22 - Fuel Pump Relay

Install or Connect

1. New IAC valve assembly gasket on IAC valve assembly.
2. IAC valve assembly.

Tighten

- IAC valve assembly to 18 N·m (13 lb. ft.) with wrench on hex surface only.

NOTICE: New IAC valves that have been preset at the factory should be installed in the throttle body in an "as is" condition, without any adjustment.

3. Electrical connector at IAC valve assembly.

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.

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.

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

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CHART C-2A

INJECTOR BALANCE TEST

The injector balance tester is a tool used to turn the injector on for a precise amount of time, thus spraying a measured amount of fuel into the manifold. This causes a drop in fuel rail pressure that we can record and compare between each injector. All injectors should have the same amount of pressure drop (± 10 kpa). Any injector with a pressure drop that is 10 kpa (or more) greater or less than the average drop of the other injectors should be considered faulty and replaced.

STEP 1

Engine "cool down" period (10 minutes) is necessary to avoid irregular readings due to "Hot Soak" fuel boiling. With ignition "OFF" connect fuel gauge J347301 or equivalent to fuel pressure tap. Wrap a shop towel around fitting while connecting gage to avoid fuel spillage.

Disconnect harness connectors at all injectors, and connect injector tester J-34730-3, or equivalent, to one injector. On Turbo equipped engines, use adaptor harness furnished with injector tester to energize injectors that are not accessible. Follow manufacturers instructions for use of adaptor harness. Ignition must be "OFF" at least 10 seconds to complete ECM shutdown cycle. Fuel pump should run about 2 seconds after ignition is turned "ON". At this point, insert clear tubing attached to vent valve into a suitable container and bleed air from gauge and hose to insure accurate gauge operation. Repeat this step until all air is bled from gauge.

STEP 2

Turn ignition "OFF" for 10 seconds and then "ON" again to get fuel pressure to its maximum. Record this initial pressure reading. Energize tester one time and note pressure drop at its lowest point (Disregard any slight pressure increase after drop hits low point.). By subtracting this second pressure reading from the initial pressure, we have the actual amount of injector pressure drop.

STEP 3

Repeat step 2 on each injector and compare the amount of drop. Usually, good injectors will have virtually the same drop. Retest any injector that has a pressure difference of 10kPa, either more or less than the average of the other injectors on the engine. Replace any injector that also fails the retest. If the pressure drop of all injectors is within 10kPa of this average, the injectors appear to be flowing properly. Reconnect them and review Symptoms, Section B.

NOTE: *The entire test should not be repeated more than once without running the engine to prevent flooding. (This includes any retest on faulty injectors).*

CHART C-2A

INJECTOR BALANCE TEST 2.8L "P" SERIES (PORT)

NOTE: If injectors are suspected of being dirty, they should be cleaned using an approved tool and procedure prior to performing this test. The fuel pressure test in Section A, Chart A-7, should be completed prior to this test.

Step 1. If engine is at operating temperature, allow a 10 minute "cool down" period then connect fuel pressure gauge and injector tester.

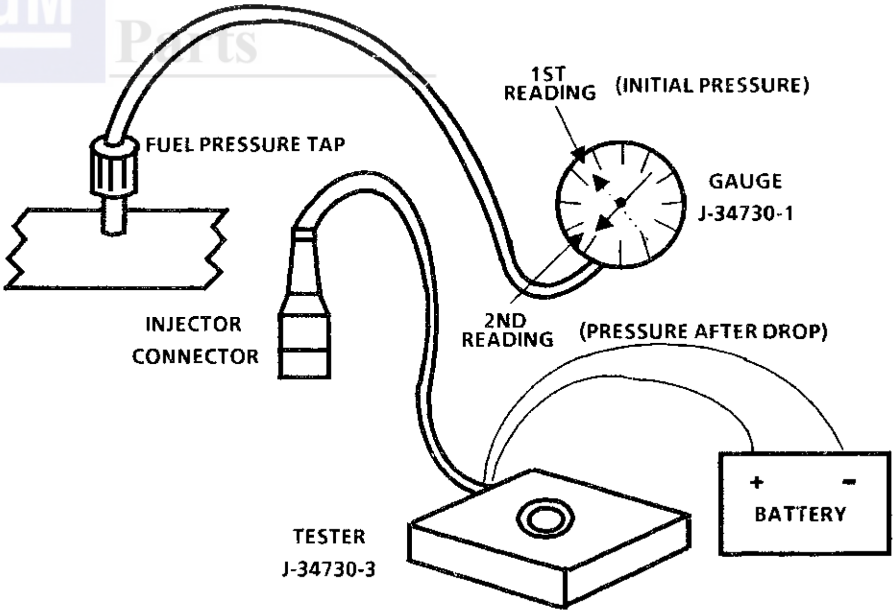
1. Ignition "OFF".
2. Connect fuel pressure gauge and injector tester.
3. Ignition "ON".
4. Bleed off air in gauge. Repeat until all air is bled from gauge.

Step 2. Run test:

1. Ignition "OFF" for 10 seconds.
2. Ignition "ON". Record gauge pressure. (Pressure must hold steady, if not see the Fuel System diagnosis, Chart A-7, in Section A) .
3. Turn injector on, by depressing button on injector tester, and note pressure at the instant the gauge needle stops.

Step 3.

1. Repeat step 2 on all injectors and record pressure drop on each.
   Retest injectors that appear faulty (Any injectors that have a 10 kPa difference, either more or less, in pressure from the average). If no problem is found, review Symptoms Section B.



— EXAMPLE —

CYLINDER	1	2	3	4	5	6
1ST READING	225	225	225	225	225	225
2ND READING	100	100	100	90	100	115
AMOUNT OF DROP	125	125	125	135	125	110
	OK	OK	OK	FAULTY, RICH (TOO MUCH) (FUEL DROP)	OK	FAULTY, LEAN (TOO LITTLE) (FUEL DROP)

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SECTION C3

EVAPORATIVE EMISSION CONTROL SYSTEM (EECS)

CONTENTS

GENERAL DESCRIPTION

PURPOSE

The basic Evaporative Emission Control System (EECS) used on all vehicles is the charcoal canister storage method. This method transfers fuel vapor from the fuel tank to an activated carbon (charcoal) storage device (canister) to hold the vapors when the vehicle is not operating. When the engine is running, the fuel vapor is purged from the carbon element by intake air flow and consumed in the normal combustion process.

EVAPORATIVE EMISSION SYSTEM

This system uses a canister with an integral diaphragm operated purge valve. The fuel vapors vent from the vapor storage tank to 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 throttle valve. The rate of purge is controlled through this port by throttle location.

To increase the capacity of the fuel tank there is a vapor storage tank located near the fuel tank.

RESULTS OF INCORRECT OPERATION

Evidence of fuel loss or fuel vapor odor can be caused by:

- Liquid fuel leaking from fuel lines, fuel pump, or fuel rail,
- Inoperative purge valve,
- Disconnected, misrouted, kinked, deteriorated or damaged vapor hoses, or control hoses.

Poor idle, stalling, and poor driveability can be caused by:

- Inoperative purge valve,
- Damaged canister,
- Hoses split, cracked and or, not connected to the proper tubes.

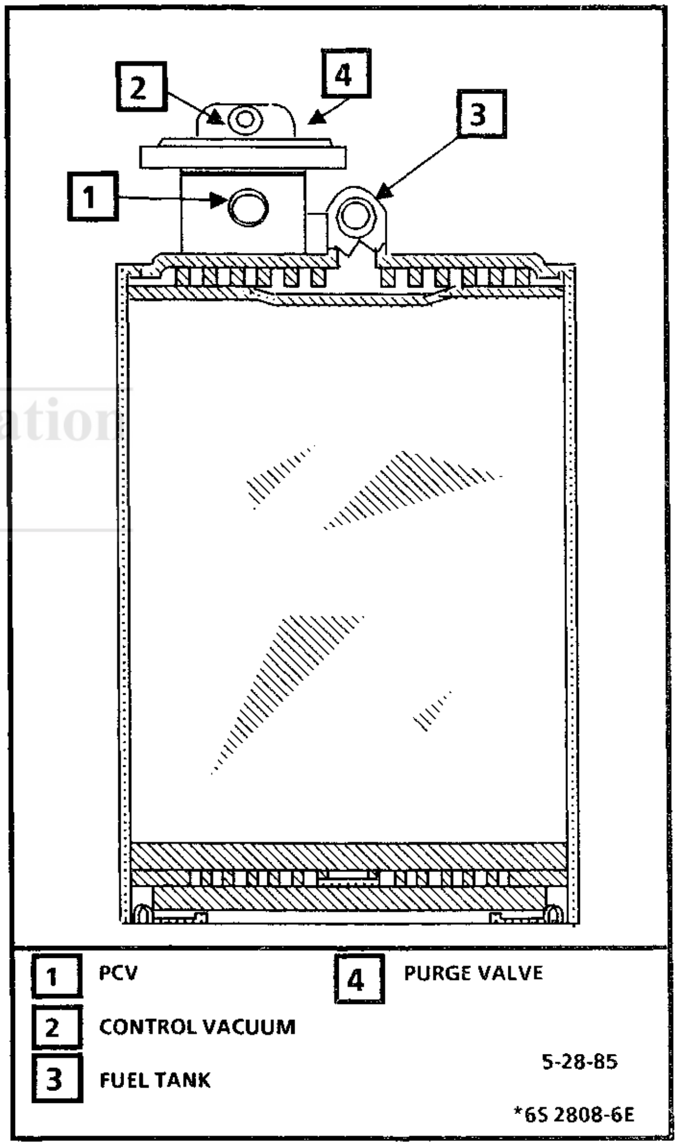
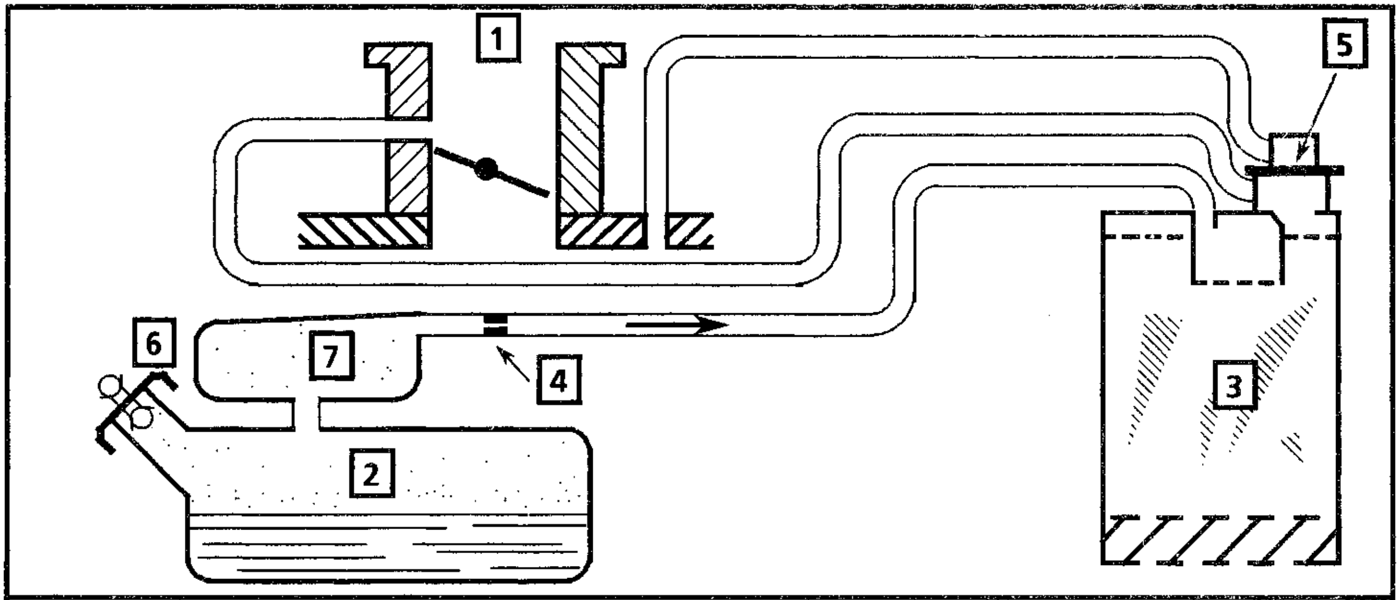


Figure C3-1 - Vapor Canister

DIAGNOSIS

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.



1	THROTTLE BODY	4	VAPOR RESTRICTION	7	VAPOR STORAGE TANK
2	FUEL TANK	5	PURGE CONTROL VALVE		
3	CANISTER	6	PRESSURE/VACUUM VENTED FUEL FILLER CAP		

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Figure C3-2 - Evaporative Emissions Control System Schematic 2.8L VIN 9

FUNCTIONAL TESTS

Canister Purge Valve

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. (A small amount of air will pass if the canister has a constant purge hole).

With hand vacuum pump, apply vacuum (15" Hg. or 51 kPa) through the control valve tube (upper tube). The diaphragm should hold vacuum for at least 20 seconds. If it does not hold vacuum 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.

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

CONTENTS

GENERAL DESCRIPTION

PURPOSE

The High Energy Ignition (HEI) system controls fuel combustion by providing a spark to ignite the compressed air/fuel mixture at the correct time. To provide improved engine performance, fuel economy, and control of exhaust emissions, the electronic control module (ECM) controls distributor spark advance (timing) with the Electronic Spark Timing (EST) system.

Only the 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-4B.

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.

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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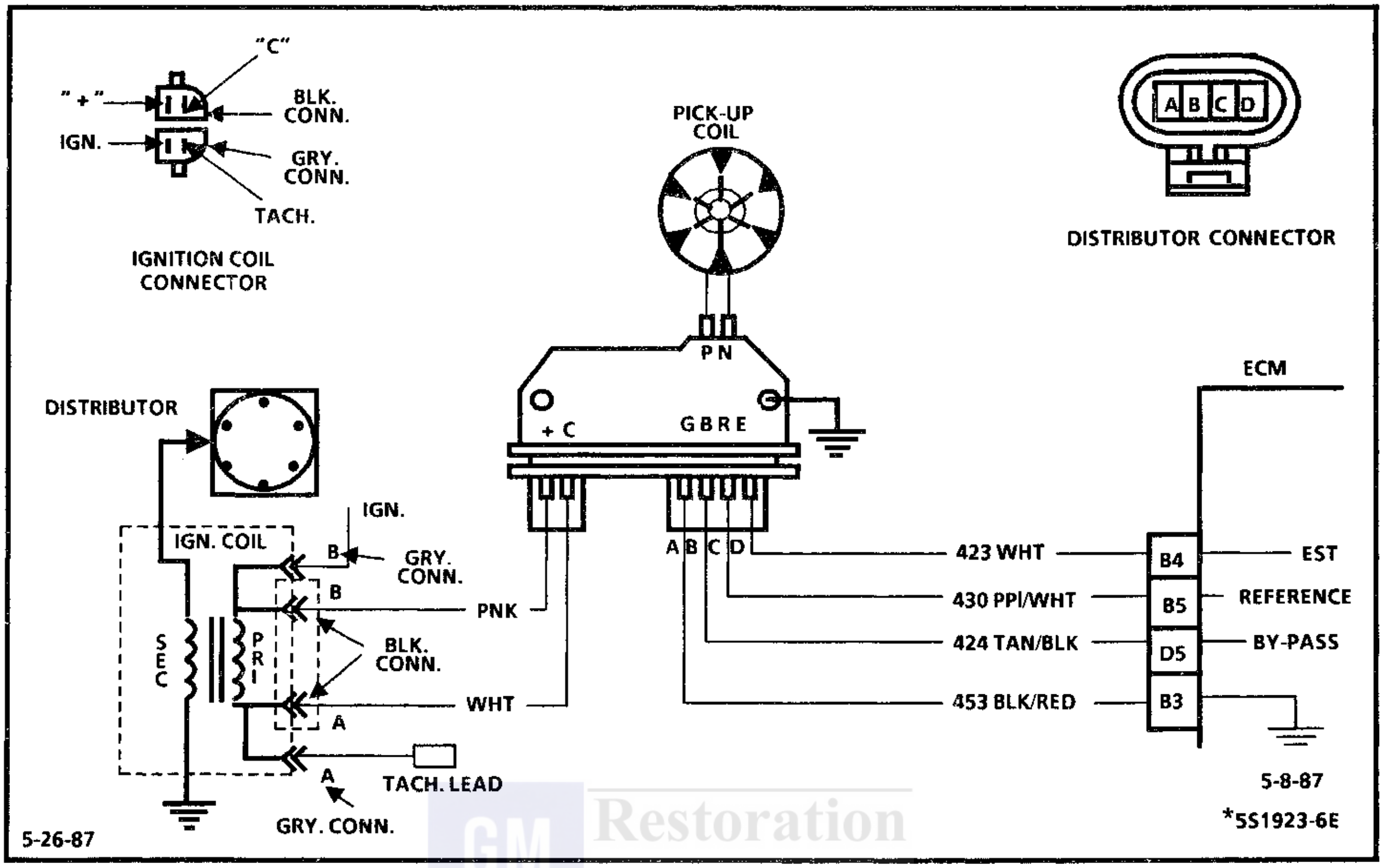

CHART C-4B

IGNITION SYSTEM CHECK
(REMOTE COIL/SEALED MODULE CONNECTOR DISTRIBUTOR)
2.8L "P" SERIES (PORT)

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Two wires are checked, to ensure that an open is not present in a spark plug wire.

1A. If spark occurs with 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 ignition coil or ignition coil primary winding is open.

4. Checks for a shorted module or grounded circuit from the ignition coil to the module. The distributor module should be turned "OFF," so normal voltage should be about 12 volts.

   If the module is turned "ON," the voltage would be low, but above 1 volt. This could cause the ignition coil to fail from excessive heat.

   With an open ignition coil primary winding, a small amount of voltage will leak through the module from the "Bat." to the tach terminal.

5. Applying a voltage (1.5 to 8 volts) to module terminal "P" should turn the module "ON" and the tach. term. voltage should drop to about 7-9 volts. This test will determine whether the module or coil is faulty or if the pick-up coil is not generating the proper signal to turn the module "ON". This test can be performed by using a DC battery with a rating of 1.5 to 8 volts. The use of the test light is mainly to allow the "P" terminal to be probed more easily.

   Some digital multi-meters can also be used to trigger the module by selecting ohms, usually the diode position. In this position the meter may have a voltage across it's terminals which can be used to trigger the module. The voltage in the ohm's position can be checked by using a second meter or by checking the manufacture's specification of the tool being used.

6. This should turn "OFF" the module and cause a spark. If no spark occurs, the fault is most likely in the ignition coil because most module problems would have been found before this point in the procedure. A module tester (J24642) could determine which is at fault.

CHART C-4B

IGNITION SYSTEM CHECK
(REMOTE COIL/SEALED MODULE CONNECTOR DISTRIBUTOR)
2.8L "P" SERIES (PORT)

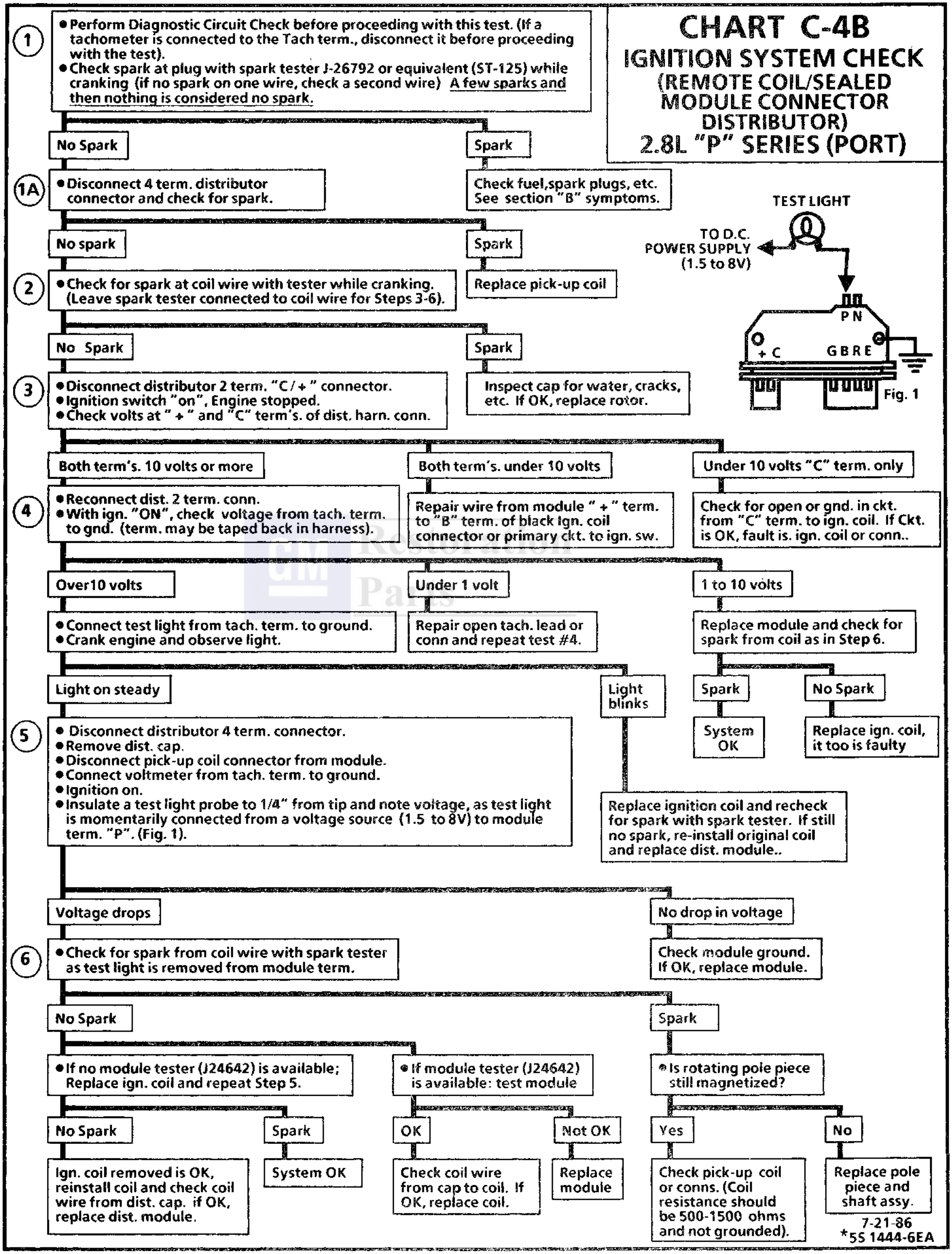

Fig. 1

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
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.

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

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..

⑤
- Disconnect distributor 4 term. connector.
- Remove dist. cap.
- Disconnect pick-up coil connector from module.
- Connect voltmeter from tach. term. to ground.
- Ignition on.
- Insulate a test light probe to 1/4" from tip and note voltage, as test light is momentarily connected from a voltage source (1.5 to 8V) to module term. "P". (Fig. 1).

Voltage drops → 6
No drop in voltage → Check module ground. If OK, replace module.

⑥
- Check for spark from coil wire with spark tester as test light is removed from module term.

No Spark →
- If no module tester (J24642) is available; Replace ign. coil and repeat Step 5.
  - **No Spark** → Ign. coil removed is OK, reinstall coil and check coil wire from dist. cap. if OK, replace dist. module.
  - **Spark** → System OK
- If module tester (J24642) is available: test module
  - **OK** → Check coil wire from cap to coil. If OK, replace coil.
  - **Not OK** → Replace module

Spark →
- Is rotating pole piece still magnetized?
  - **Yes** → Check pick-up coil or conns. (Coil resistance should be 500-1500 ohms and not grounded).
  - **No** → Replace pole piece and shaft assy.

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SECTION C7

EXHAUST GAS RECIRCULATION (EGR) SYSTEM

CONTENTS

GENERAL DESCRIPTION

PURPOSE

The exhaust gas recirculation (EGR) system is used to lower NO_x (oxides of nitrogen) emission levels caused by high combustion temperature. It does this by decreasing combustion temperature.

The main element of the system is the EGR valve operated by vacuum and mounted on the intake manifold.

The EGR valve feeds small amounts of exhaust gas back into the combustion chamber as shown in Figure C7-1.

OPERATION

The EGR valve is opened by 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 during warm engine operation and when the vehicle is above idle speed.

The amount of exhaust gas recirculated is controlled by variations in vacuum and the EGR vacuum control solenoid.

ELECTRONIC VACUUM REGULATOR VALVE

The electronic vacuum regulator valve (EVRV) uses "pulse width modulation" to control EGR flow. This means the electronic control module (ECM) turns the solenoid "ON" and "OFF" many times a second and varies the amount of "ON" time ("pulse width") to vary the amount of EGR.

The ECM uses information from the following sensors to enable the EVRV:

- Throttle position sensor (TPS)
- P/N Switch
- Manifold absolute temperature (MAT)

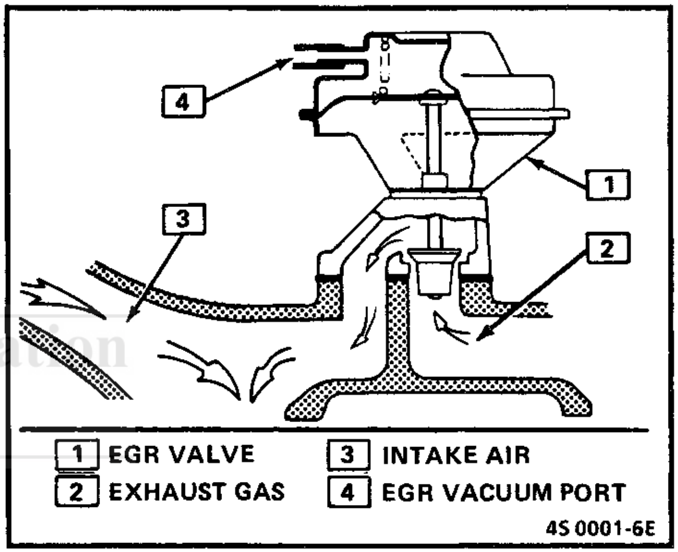


Figure C7-1 - Exhaust Gas Recirculation

The ECM uses information from the following sensors to regulate the EVRV:

- Engine Load
- Coolant Temperature
- Distributor (rpm Signal)
- Torque Converter Clutch (TCC)

A diagnostic switch is part of the control and monitors vacuum to the EGR valve. This switch will trigger a "Service Engine Soon" light, and set a Code 32 in the event of a vacuum circuit failure.

PORT EGR VALVE

The port EGR valve (Figure C7-2) is controlled by a flexible diaphragm which is spring loaded to hold the valve closed. Ported vacuum applied to the top side of the diaphragm overcomes the spring pressure and opens the valve in the exhaust gas port. This allows exhaust gas to be pulled into the intake manifold and enter the engine cylinders.

EGR VALVE IDENTIFICATION

- Port EGR valves have no identification stamped after the part number (Figure C7-3).

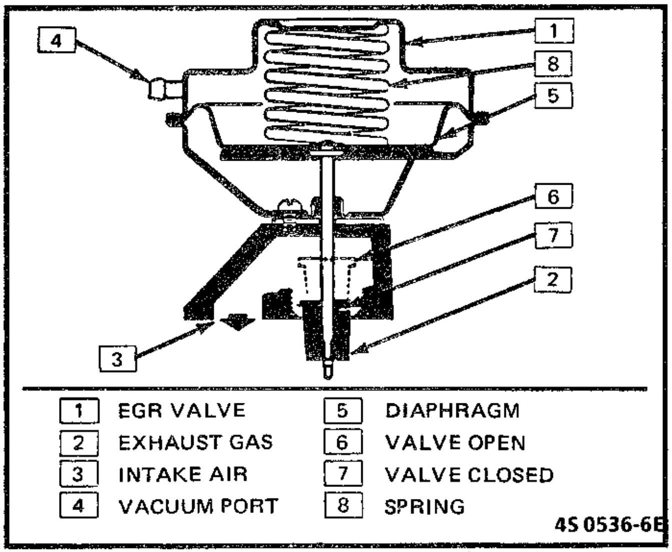


Figure C7-2 - Port EGR Valve

- Negative backpressure exhaust gas recirculation (EGR) valves will have an "N" stamped on the top side of the valve after the part number.
- Positive backpressure EGR valves will have a "P" stamped on the top side of the valve, after the part number.

When replacing an EGR valve, always check for correct part number in the parts catalog or supplemental bulletin.

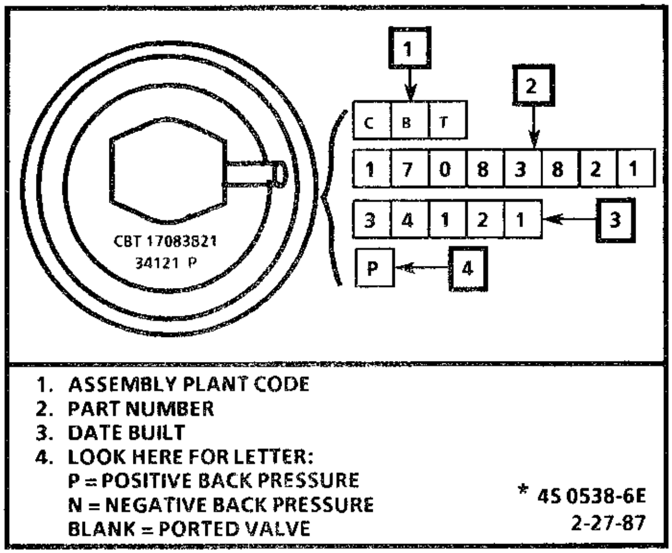


Figure C7-3 - EGR Valve Identification

RESULTS OF INCORRECT OPERATION

Too much EGR flow tends to weaken combustion, causing the engine to run roughly or stop and any of the following could 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.

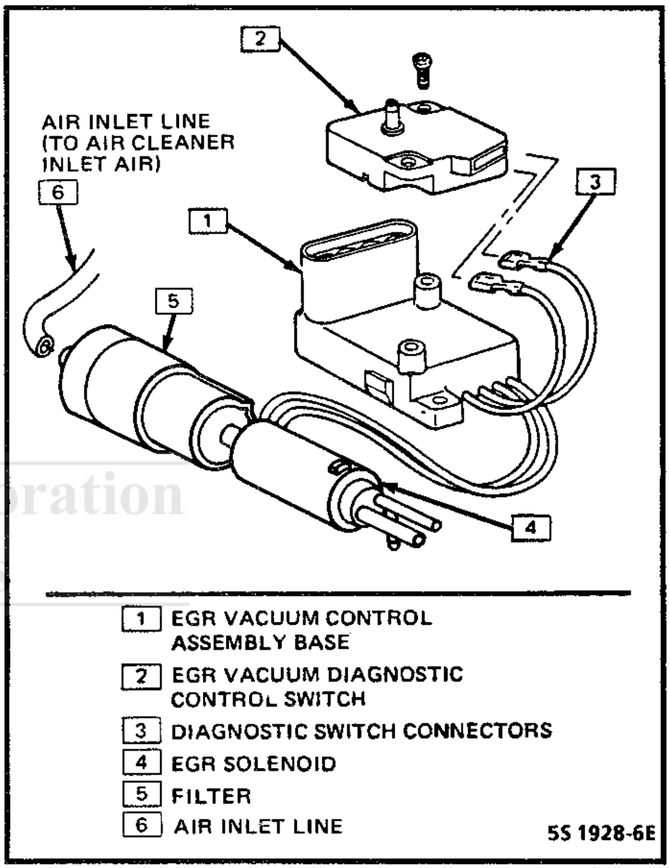


Figure C7-4 - Electronic Vacuum Regulator Valve

DIAGNOSIS

A "Scan" tool will display the duty cycle being commanded to the EGR solenoid by the electronic control module (ECM). and also whether the diagnostic switch is open or closed.

Diagnosis of the EGR system is covered in CHART C-7A at the end of this section. If a code 32 has been set, refer to Code Chart 32

ON-CAR SERVICE

EGR VALVE

↔ Remove or Disconnect

1. Vacuum line
2. Bolts
3. EGR valve

EGR Manifold Passage

Inspect

If exhaust gas recirculation (EGR) passages in the inlet manifold indicate excessive build-up of deposits, the passages should be cleaned. Care should be taken to ensure that all loose particles are completely removed to prevent them from clogging the EGR valve or from being ingested into the engine.

Do not wash EGR valve in solvents or degreaser--permanent damage to valve diaphragm may result. Also, sand blasting of the valve is not recommended since this can affect the operation of the valve.

Clean

1. With a wire wheel, buff the exhaust deposits from the mounting surface and around the valve.
2. Look for exhaust deposits in the valve outlet. Remove deposit build-up with a screwdriver.
3. Clean mounting surfaces of intake manifold and valve assembly.

Install or Connect

1. EGR valve using new gasket.
2. Bolts and tighten to 18 N · m (14 lb. ft.)
3. Vacuum line to valve

ELECTRONIC VACUUM REGULATOR VALVE

Remove or Disconnect

1. Negative battery cable.
2. Electrical connector at regulator valve
3. Vacuum hoses.
4. Nut and regulator valve.

Install or Connect

1. Regulator valve and bracket, tighten nut to 24 N · m (17 lb. ft.).
2. Vacuum hoses
3. Electrical connector
4. Negative battery cable

EVRV FILTER REPLACEMENT 2.8L VIN S

The EVRV filter should be replaced every 30,000 miles.

1. Grasp and pull filter off with a rocking motion.
2. Push new filter on, making sure cut-out for wires is properly aligned.

PARTS INFORMATION

PARTS NAME	GROUP
Valve, EGR	3.670
Gasket, EGR Valve	3.680
Valve, Electr Vac Reg	3.670

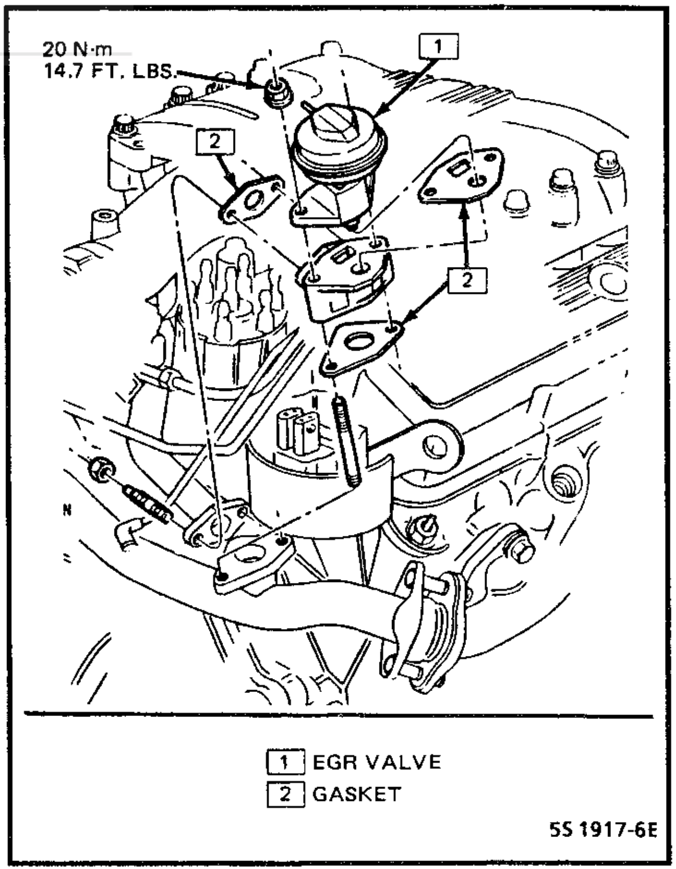


Figure C7-5 - EGR to Manifold Mounting

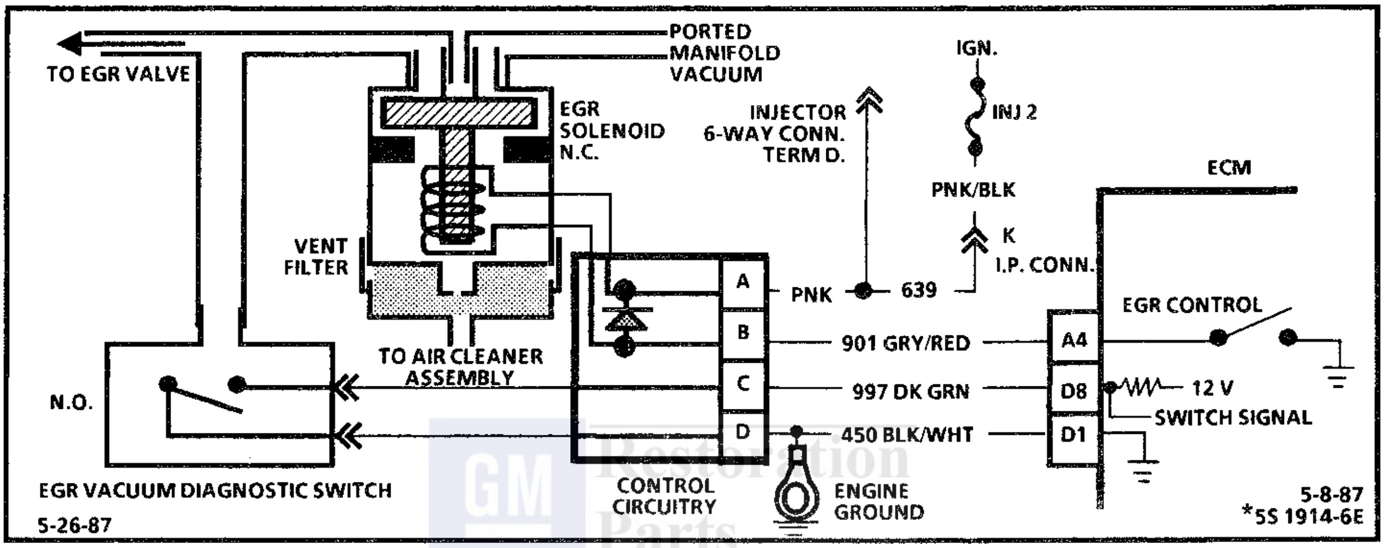


CHART C-7

EXHAUST GAS RECIRCULATION (EGR) CHECK
2.8L "P" SERIES (PORT)

Circuit Description:

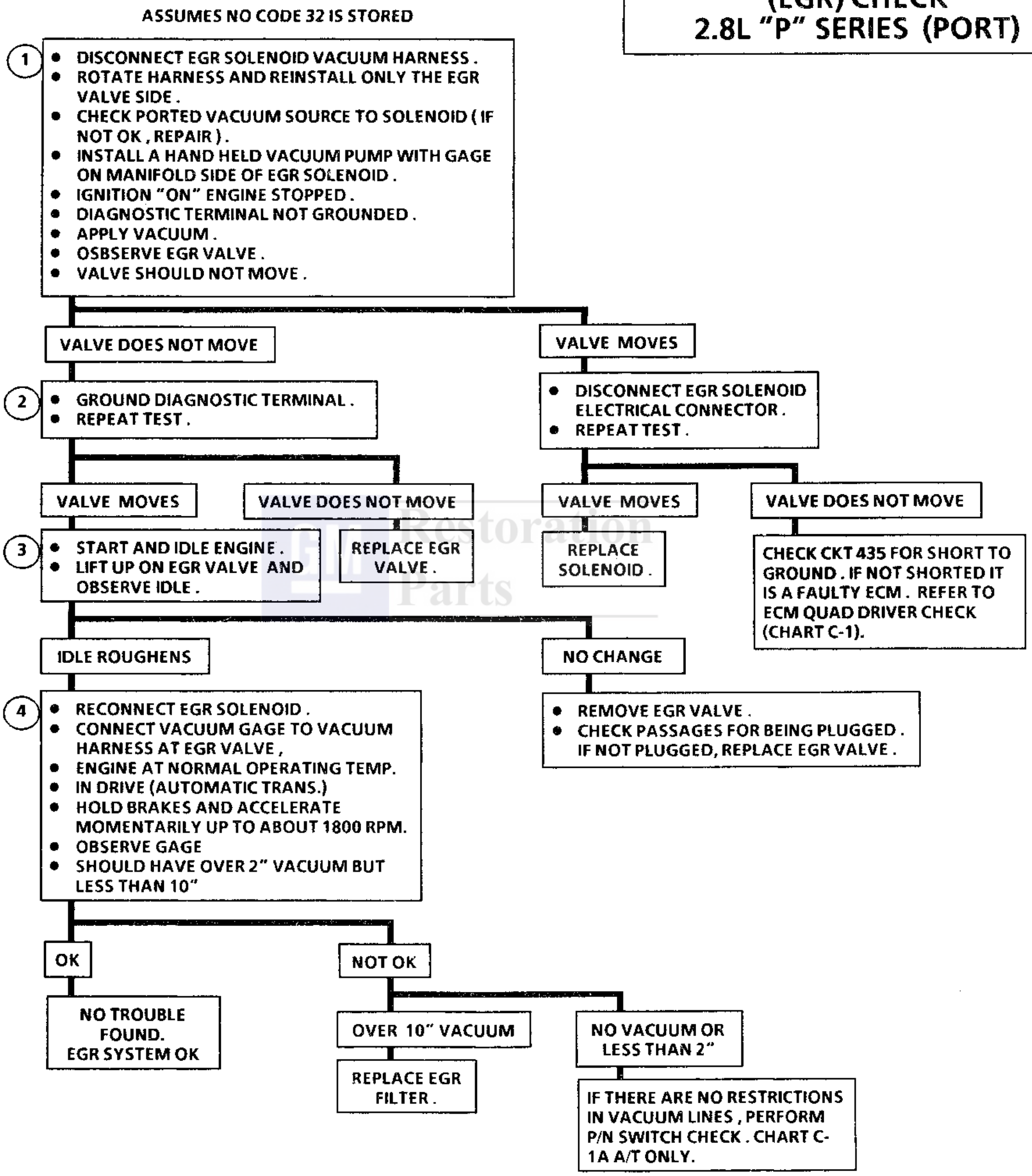
The exhaust gas recirculation (EGR) valve is controlled by a normally closed solenoid (allow a vacuum to pass when energized). The electronic control module (ECM) energizes the solenoid to turn the EGR "ON," and monitors vacuum to the EGR with the EGR diagnostic switch. Code 32 will detect a faulty solenoid, vacuum switch, or vacuum supply. CHART C-7 checks for plugged EGR passages, a sticking EGR valve, or a stuck open solenoid.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. With the ignition "ON," engine stopped, the solenoid should not be energized and vacuum should not pass to the EGR valve.
2. Grounding the diagnostic terminal will energize the solenoid and allow vacuum to pass to valve.
3. Checks for 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 received by the ECM .

CHART C-7

EXHAUST GAS RECIRCULATION (EGR) CHECK
2.8L "P" SERIES (PORT)



ASSUMES NO CODE 32 IS STORED

①
- DISCONNECT EGR SOLENOID VACUUM HARNESS.
- ROTATE HARNESS AND REINSTALL ONLY THE EGR VALVE SIDE.
- CHECK PORTED VACUUM SOURCE TO SOLENOID (IF NOT OK, REPAIR).
- INSTALL A HAND HELD VACUUM PUMP WITH GAGE ON MANIFOLD SIDE OF EGR SOLENOID.
- IGNITION "ON" ENGINE STOPPED.
- DIAGNOSTIC TERMINAL NOT GROUNDED.
- APPLY VACUUM.
- OSBSERVE EGR VALVE.
- VALVE SHOULD NOT MOVE.

VALVE DOES NOT MOVE

②
- GROUND DIAGNOSTIC TERMINAL.
- REPEAT TEST.

VALVE MOVES

③
- START AND IDLE ENGINE.
- LIFT UP ON EGR VALVE AND OBSERVE IDLE.

IDLE ROUGHENS

④
- RECONNECT EGR SOLENOID.
- CONNECT VACUUM GAGE TO VACUUM HARNESS AT EGR VALVE,
- ENGINE AT NORMAL OPERATING TEMP.
- IN DRIVE (AUTOMATIC TRANS.)
- HOLD BRAKES AND ACCELERATE MOMENTARILY UP TO ABOUT 1800 RPM.
- OBSERVE GAGE
- SHOULD HAVE OVER 2" VACUUM BUT LESS THAN 10"

OK

NO TROUBLE FOUND. EGR SYSTEM OK

NOT OK

OVER 10" VACUUM

REPLACE EGR FILTER.

NO VACUUM OR LESS THAN 2"

IF THERE ARE NO RESTRICTIONS IN VACUUM LINES, PERFORM P/N SWITCH CHECK. CHART C-1A A/T ONLY.

NO CHANGE

- REMOVE EGR VALVE.
- CHECK PASSAGES FOR BEING PLUGGED. IF NOT PLUGGED, REPLACE EGR VALVE.

VALVE DOES NOT MOVE

REPLACE EGR VALVE.

VALVE MOVES

- DISCONNECT EGR SOLENOID ELECTRICAL CONNECTOR.
- REPEAT TEST.

VALVE MOVES

REPLACE SOLENOID.

VALVE DOES NOT MOVE

CHECK CKT 435 FOR SHORT TO GROUND. IF NOT SHORTED IT IS A FAULTY ECM. REFER TO ECM QUAD DRIVER CHECK (CHART C-1).

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

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SECTION C8

TRANSMISSION/TRANSAXLE CONVERTER CLUTCH (TCC) AND MANUAL TRANSMISSION SHIFT LIGHT

CONTENTS

GENERAL DESCRIPTION

PURPOSE

The transmission/transaxle 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 electronic control module (ECM) grounds a switch internally to turn on a solenoid in the transmission. This moves a check ball, which will allow the converter clutch to apply, if the hydraulic pressure is correct, as described above.

The ECM controls the TCC apply solenoid by looking at several sensors:

- 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.

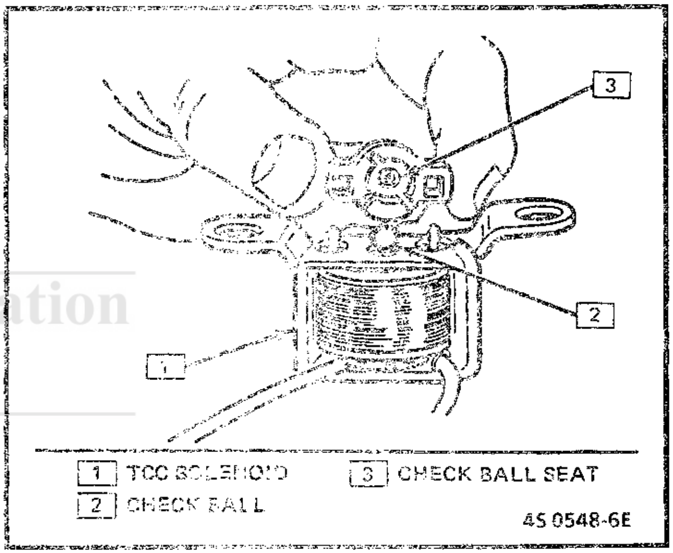

Figure C8-1 TCC Solenoid

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 economy 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 transmission/transaxle converter clutch (TCC) system is covered in CHART C-8A. If the electronic control module (ECM) detects a problem in the vehicle speed sensor (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 "6E" to repair wiring problem.
- See Section "6E3-C1-5" if ECM is to be replaced.

PARTS INFORMATION

PART NAME	GROUP
Sensor, Vehicle Speed	9.761
Solenoid, TCC	4.122

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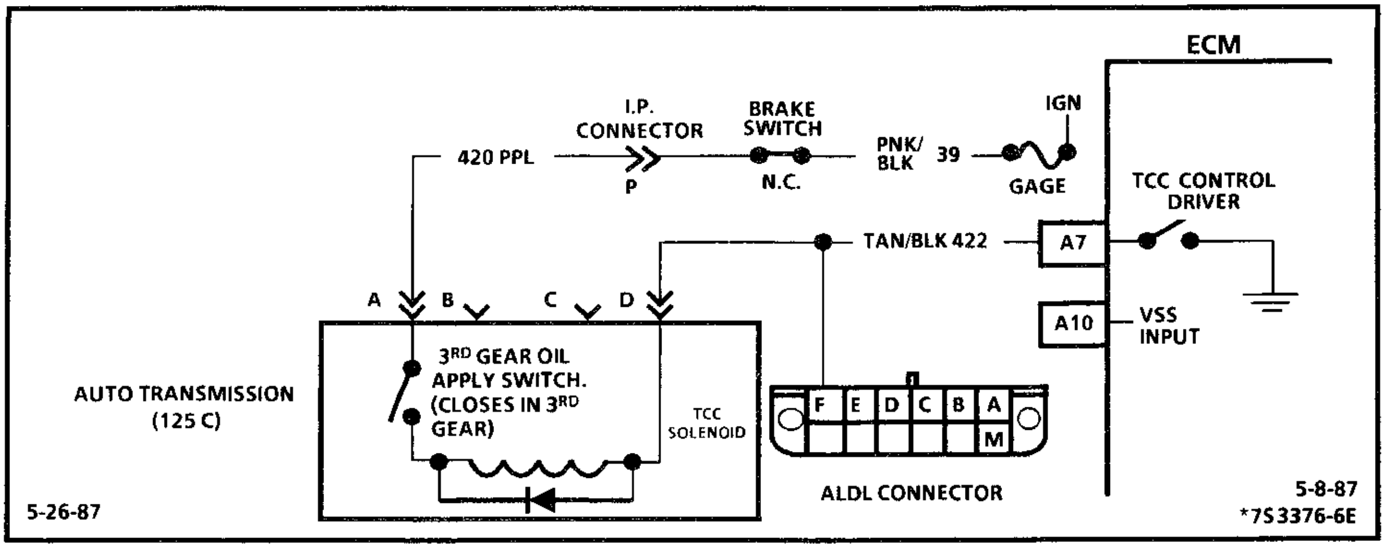

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CHART C-8A

125C TRANSMISSION/TRANSAXLE CONVERTER CLUTCH (TCC)
(ELECTRICAL DIAGNOSIS)
2.8L " P" SERIES (PORT)

Circuit Description:

The purpose of the transmission converter clutch feature is to eliminate the power loss of the transmission 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 transmission/transaxle converter clutch (TCC) solenoid through the brake switch, and transmission third gear apply switch. The electronic control module (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 (about 32 mph 51 km/h).
- Throttle position sensor output not changing, indicating a steady road speed.
- Transmission third gear switch closed
- Brake switch closed

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

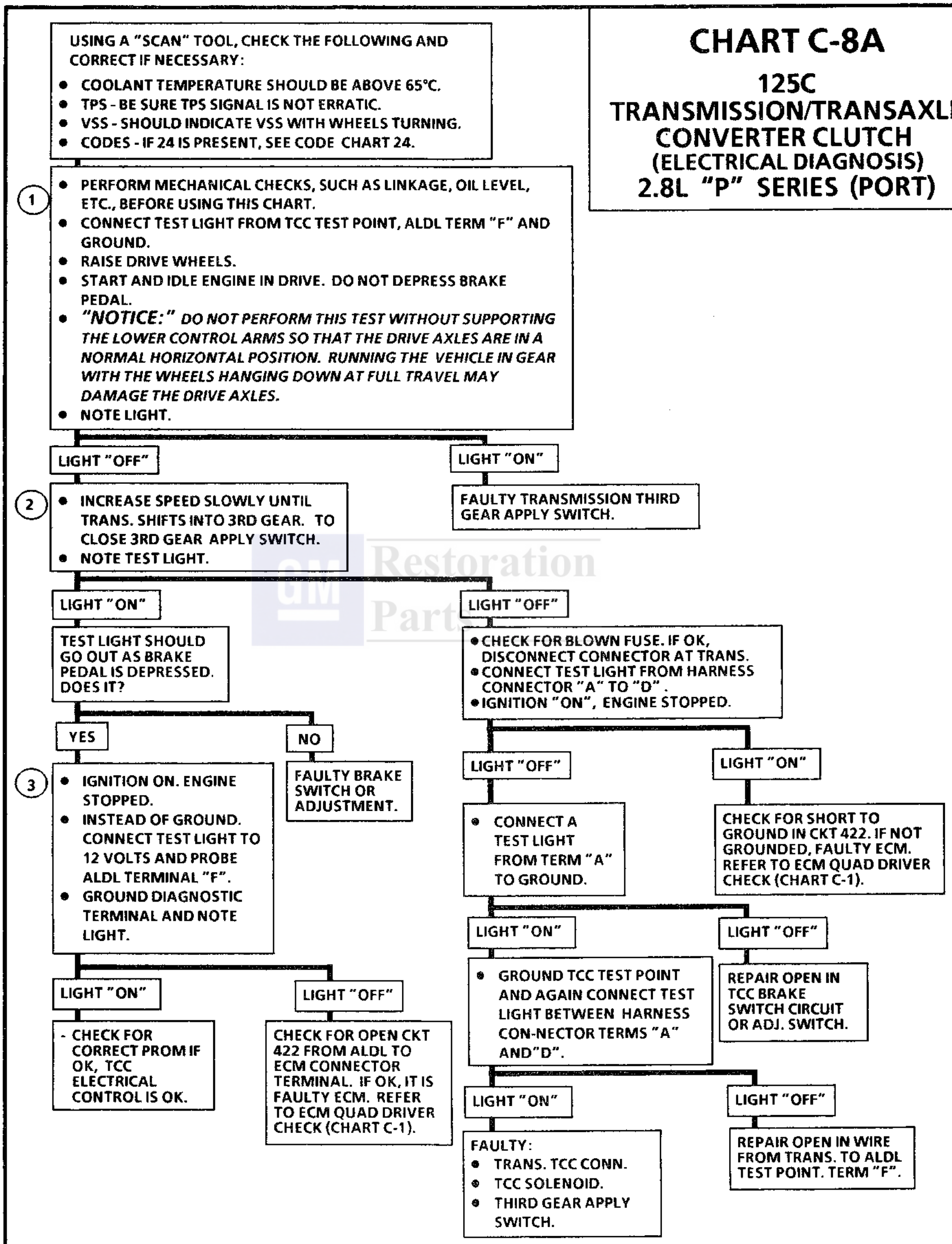
1. Light "OFF" confirms transmission third gear apply switch is open.
2. At 25 mph the transmission third gear apply switch should close. Test light will come on and confirm battery supply and closed brake switch.
3. Grounding the diagnostic terminal with ignition "ON," engine "OFF" should energize the TCC solenoid by grounding CKT 422. This test checks the capability of the ECM to supply a ground to the TCC solenoid. The test checks the ability of the ECM to supply a ground to the TCC solenoid. The test light connected from 12 volts to assembly line data link (ALDL) terminal "F" will turn "ON" as CKT 422 is grounded.

Diagnostic Aids:

A "Scan" tool only indicates when the ECM has turned on the TCC driver, and this does not confirm that the TCC has engaged. To determine if TCC is functioning properly, engine rpm should decrease when the "Scan" indicates the TCC driver has turned "ON".

CHART C-8A

125C
TRANSMISSION/TRANSAXLE CONVERTER CLUTCH
(ELECTRICAL DIAGNOSIS)
2.8L "P" SERIES (PORT)



USING A "SCAN" TOOL, CHECK THE FOLLOWING AND CORRECT IF NECESSARY:

- COOLANT TEMPERATURE SHOULD BE ABOVE 65°C.
- TPS - BE SURE TPS SIGNAL IS NOT ERRATIC.
- VSS - SHOULD INDICATE VSS WITH WHEELS TURNING.
- CODES - IF 24 IS PRESENT, SEE CODE CHART 24.

①
- PERFORM MECHANICAL CHECKS, SUCH AS LINKAGE, OIL LEVEL, ETC., BEFORE USING THIS CHART.
- CONNECT TEST LIGHT FROM TCC TEST POINT, ALDL 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 "OFF"

②
- INCREASE SPEED SLOWLY UNTIL TRANS. SHIFTS INTO 3RD GEAR. TO CLOSE 3RD GEAR APPLY SWITCH.
- NOTE TEST LIGHT.

LIGHT "ON"

TEST LIGHT SHOULD GO OUT AS BRAKE PEDAL IS DEPRESSED. DOES IT?

YES

③
- IGNITION ON. ENGINE STOPPED.
- INSTEAD OF GROUND. CONNECT TEST LIGHT TO 12 VOLTS AND PROBE ALDL TERMINAL "F".
- GROUND DIAGNOSTIC TERMINAL AND NOTE LIGHT.

LIGHT "ON"

- CHECK FOR CORRECT PROM IF OK, TCC ELECTRICAL CONTROL IS OK.

LIGHT "OFF"

CHECK FOR OPEN CKT 422 FROM ALDL TO ECM CONNECTOR TERMINAL. IF OK, IT IS FAULTY ECM. REFER TO ECM QUAD DRIVER CHECK (CHART C-1).

NO

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 "ON"

- GROUND TCC TEST POINT AND AGAIN CONNECT TEST LIGHT BETWEEN HARNESS CON-NECTOR 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 ALDL TEST POINT. TERM "F".

LIGHT "OFF"

REPAIR OPEN IN TCC BRAKE SWITCH CIRCUIT OR ADJ. SWITCH.

LIGHT "ON"

CHECK FOR SHORT TO GROUND IN CKT 422. IF NOT GROUNDED, FAULTY ECM. REFER TO ECM QUAD DRIVER CHECK (CHART C-1).

LIGHT "ON"

FAULTY TRANSMISSION THIRD GEAR APPLY SWITCH.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

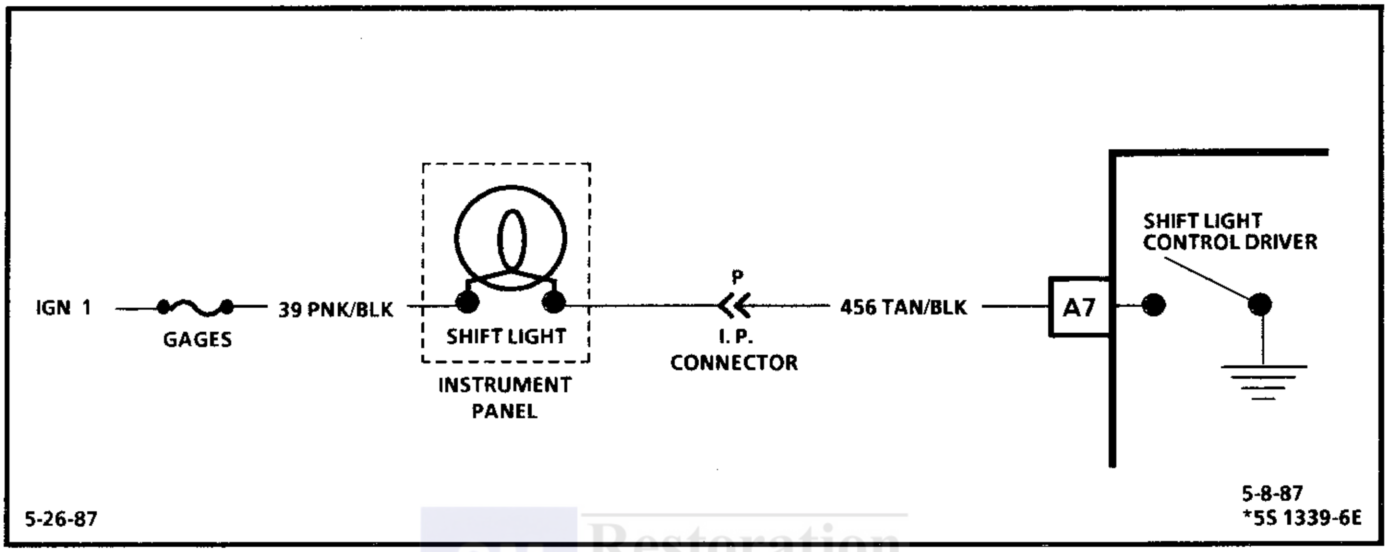


CHART C-8B

MANUAL TRANSMISSION (M/T) SHIFT LIGHT CHECK
2.8L "P" SERIES (PORT)

Circuit Description:

The shift light indicates the best transmission shift point for maximum fuel economy. The light is controlled by the electronic control module (ECM) and is turned "ON" by grounding CKT 456.

The ECM uses information from the following inputs to control the shift light:

- Coolant temperature
- TPS
- VSS
- RPM

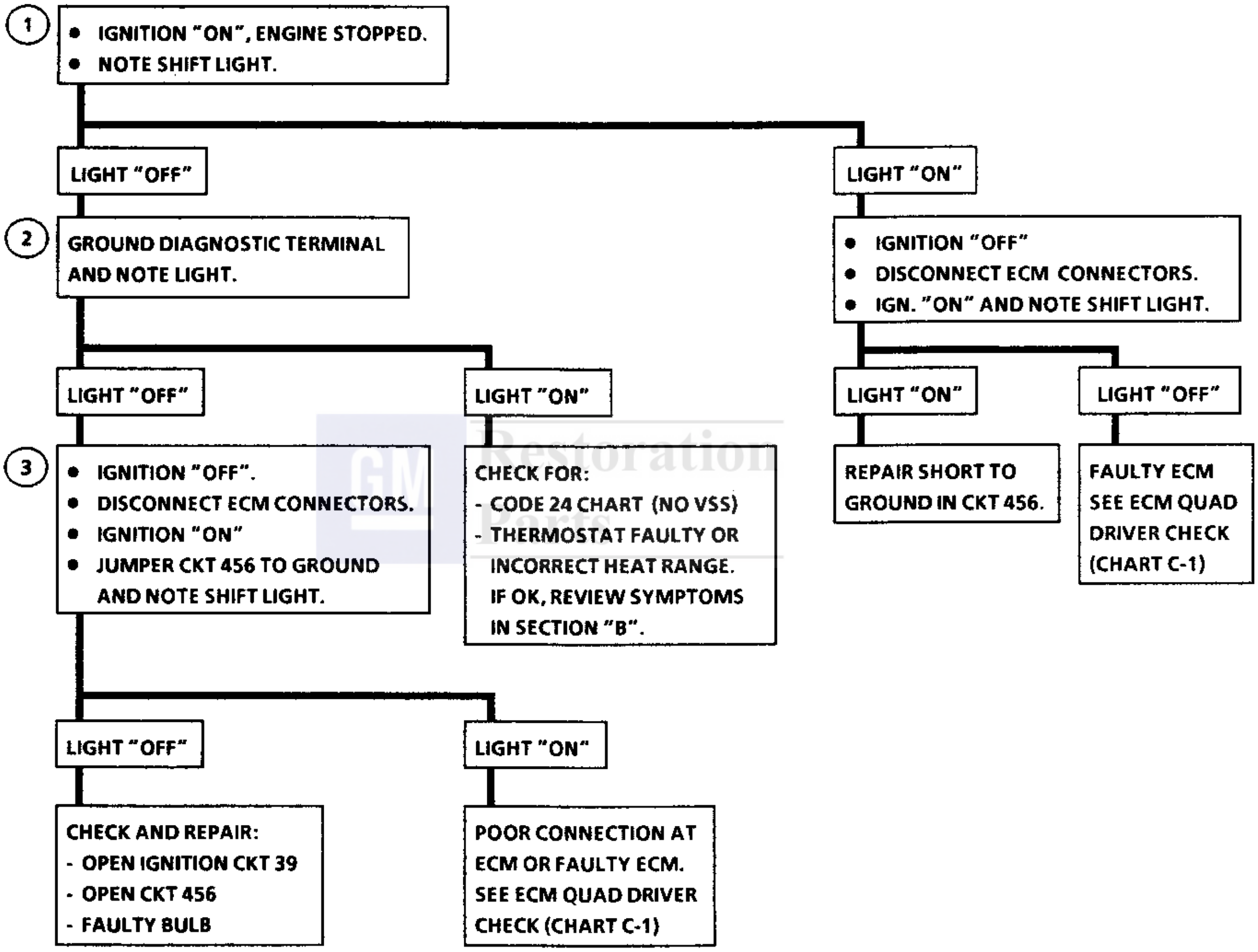
The ECM uses the measured rpm and the vehicle speed to calculate what gear the vehicle is in. It's this calculation that determines when the shift light should be turned "ON".

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. This should not turn "ON" the shift light. If the light is "ON," there is a short to ground in CKT 456 wiring or a fault in the ECM.
2 When the diagnostic terminal is grounded, the ECM should ground CKT 456 and the shift light should come on.
3. This checks the shift light circuit up to the ECM connector. If the shift light illuminates, then the ECM connector is faulty or the ECM does not have the ability to ground the circuit.

CHART C-8B

MANUAL TRANSMISSION (M/T) SHIFT LIGHT CHECK 2.8L "P" SERIES (PORT)



①
- IGNITION "ON", ENGINE STOPPED.
- NOTE SHIFT LIGHT.

LIGHT "OFF"

② GROUND DIAGNOSTIC TERMINAL AND NOTE LIGHT.

LIGHT "OFF"

③
- IGNITION "OFF".
- DISCONNECT ECM CONNECTORS.
- 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. SEE ECM QUAD DRIVER CHECK (CHART C-1)

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 SEE ECM QUAD DRIVER CHECK (CHART C-1)

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BLANK

SECTION C10

ECM CONTROLLED AIR CONDITIONING

CONTENTS

GENERAL DESCRIPTION

In order to improve idle quality and wide open throttle performance, the A/C compressor is controlled by the electronic control module (ECM).

There are two different types of A/C systems used in GM vehicles. One is referred to as C.C.O.T. (cycling clutch orifice tube), which uses a fixed displacement compressor. The other type of system uses a compressor with a variable displacement, and is referred to as the V-5 type system. The V-5 type meets A/C requirements without cycling. For descriptions of both types, and an explanation of the components used, refer to Section "1B" of the service manual.

OPERATION

The 2.8L engine uses the C.C.O.T. type A/C system, and is controlled by the ECM. When A/C is requested, 12V power is supplied to the pressure cycling switch and to the A/C power relay. The ECM controls the A/C clutch by energizing the A/C control relay. This allows the ECM to increase idle speed before turning on A/C to improve the quality.

The low pressure switch, mounted in the compressor, is closed when the system contains a sufficient refrigerant charge. This switch opens, when pressure is less than about 40 psi (276 kPa).

The high pressure cut-out switch (normally closed) opens when head pressure gets too high. This disables the A/C clutch, before damage can occur to the system. This switch opens, when pressure is greater than about 440 psi (3034 kPa).

See CHART C-10 for diagnosis and wiring diagram of the electrical portion of the A/C circuit.

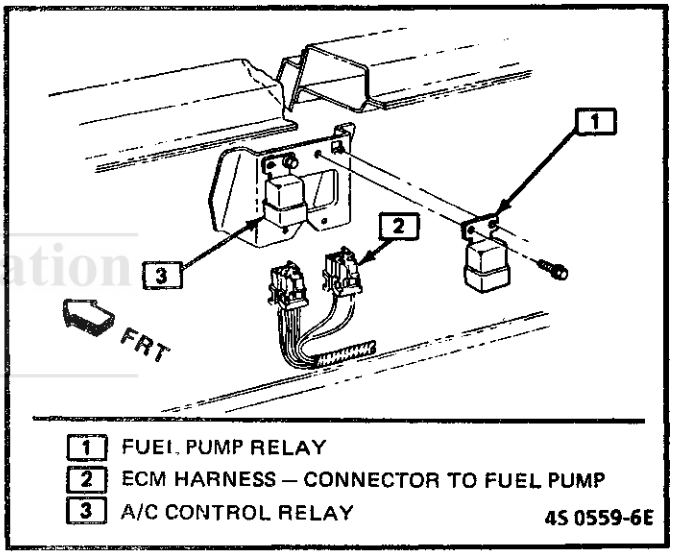


Figure C10-1 A/C Control Relay

DIAGNOSIS

CHART C-10 should be used for diagnosing the electrical portion of the A/C circuit. Section "1B" should be used for diagnosing the refrigerant portion of the system.

The "Scan" tool will be used in diagnosing the system, as it has the ability to read the A/C request input to the ECM, as well as displaying when the ECM has commanded the A/C clutch "ON".

ON-CAR SERVICE

For removal and replacement procedures of A/C components, refer to Section "1" of the service manual.

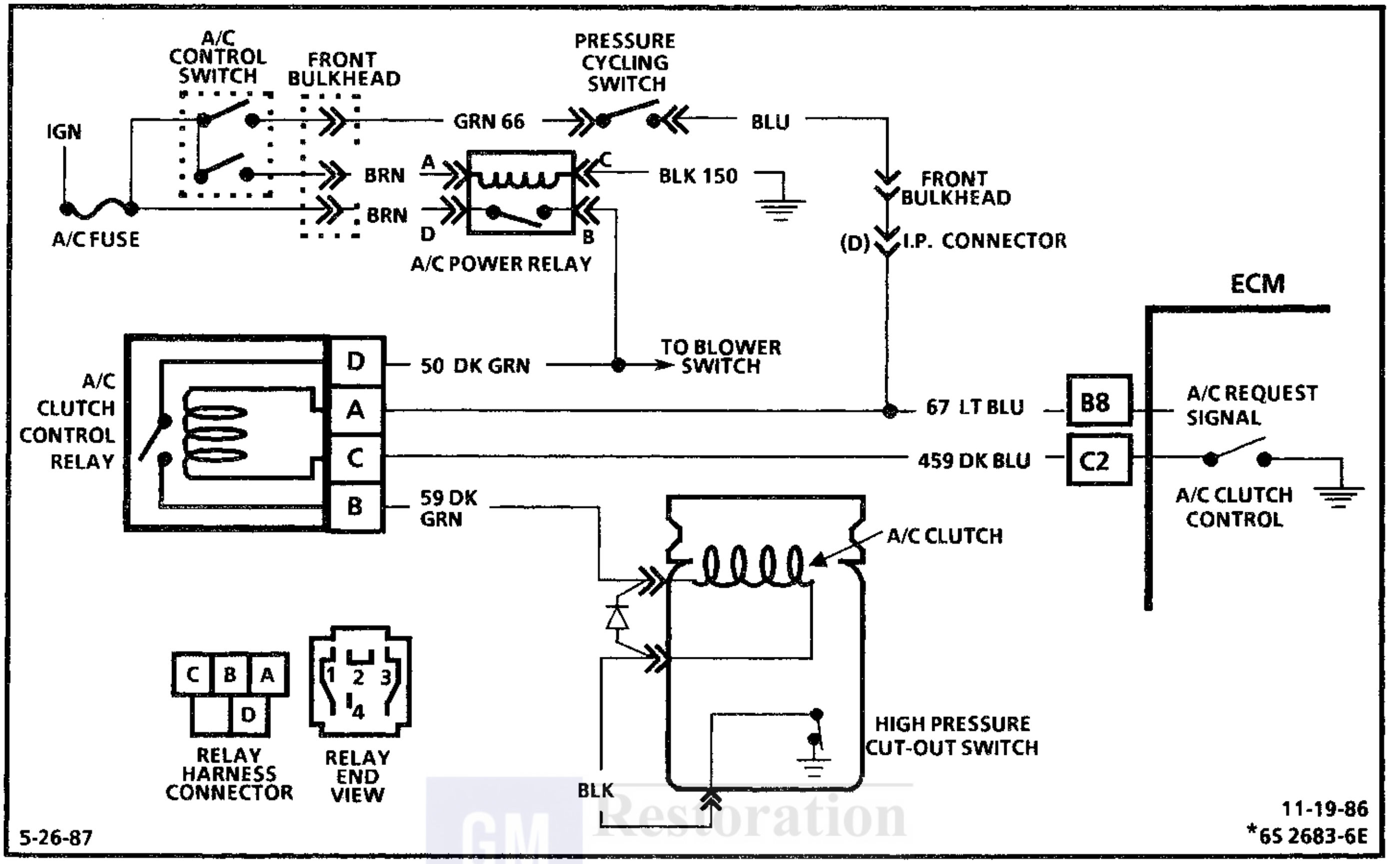


CHART C-10

A/C CLUTCH CONTROL DIAGNOSIS
2.8L "P" SERIES (PORT)

Circuit Description:

Electronic control module (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 contacts.

When relay is energized battery voltage from CKT 50 is supplied to the A/C clutch through the relay and CKT 59.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

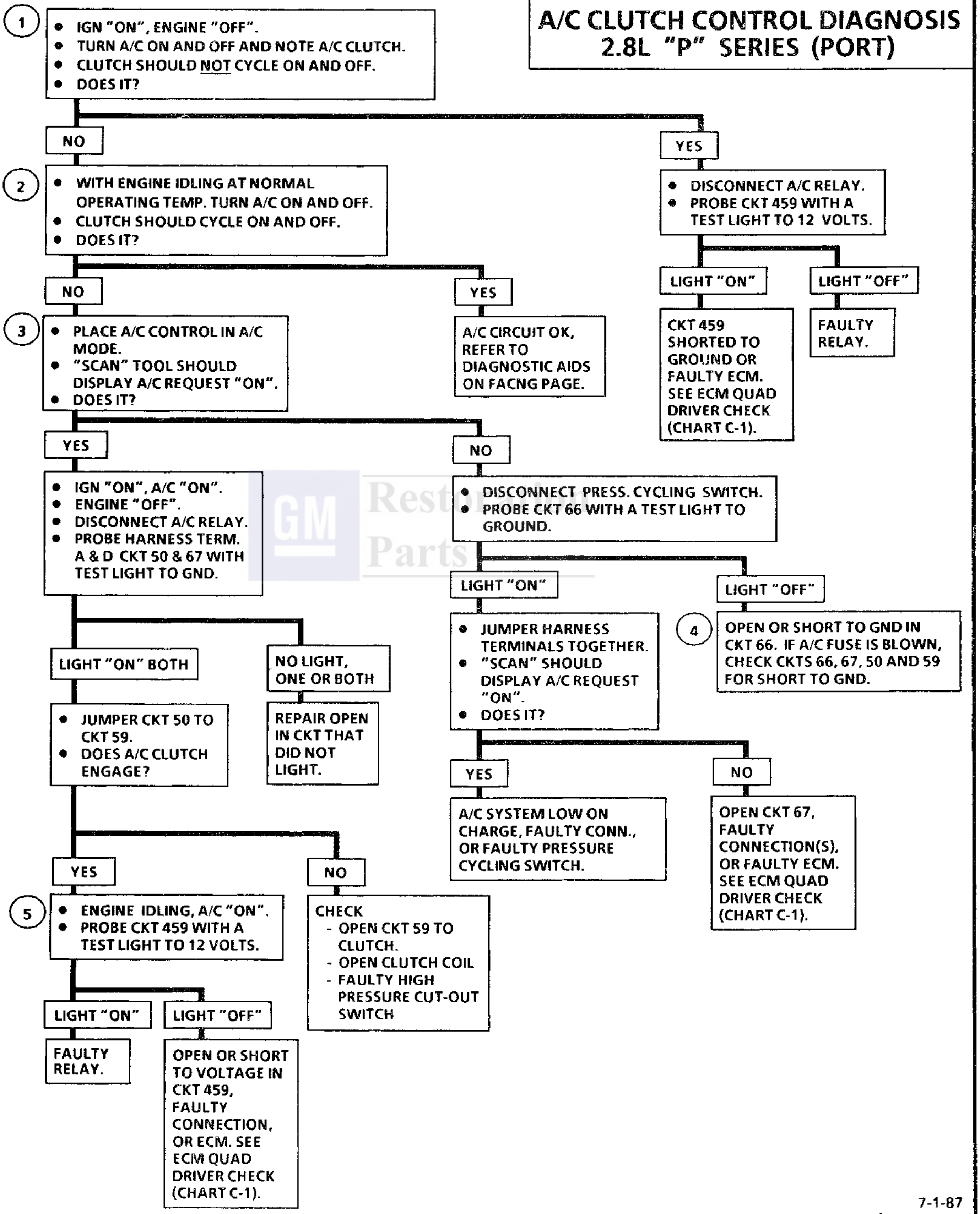
1. The ECM will only energize the A/C relay, when the engine is running. This test will determine if the relay, or CKT 459, is faulty.
2. In order for the clutch to properly be engaged, the low pressure switch must be closed to provide 12 volts to the relay, and the high pressure switch must be closed, so the A/C request (12 volts) will be present at the ECM.
3. Determines if the signal is reaching the ECM on CKT 366 from the A/C control panel. Signal should only be present when the A/C mode or defrost mode has been selected.
4. A short to ground in any part of the A/C request circuit, CKT 67 to the relay, CKT 902 to the A/C clutch, or the A/C clutch, could be the cause of the blown fuse.
5. With the engine idling and A/C "ON", the ECM should be grounding CKT 459, which should cause the test light to be "ON".

Diagnostic Aids:

If complaint was insufficient cooling, the problem may be caused by a inoperative cooling fan. The engine cooling fan should turn "ON", when A/C is "ON". If not, see Section "8A" for fan diagnosis.

CHART C-10

A/C CLUTCH CONTROL DIAGNOSIS
2.8L "P" SERIES (PORT)



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BLANK

SECTION C13

POSITIVE CRANKCASE VENTILATION (PCV)

CONTENTS

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 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.

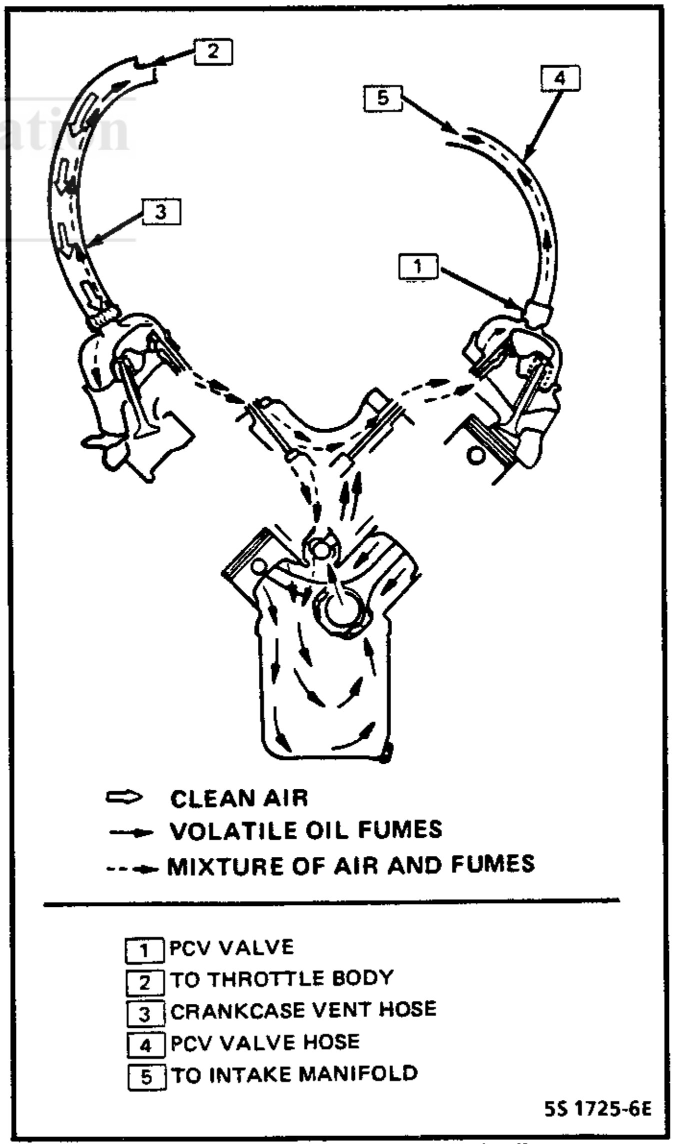


Figure C13-1 PCV Flow (Typical)

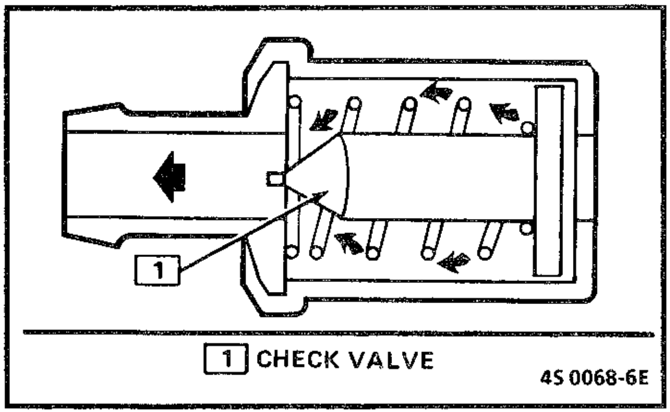


Figure C13-2 PCV Valve Cross Section

Proper operation of the positive crankcase ventilation (PCV) System is dependent upon a sealed engine. If oil sludging or dilution is noted, and the PCV System is functioning properly, check engine for possible cause and correct to ensure that system will function as intended.

ON-CAR SERVICE

An engine which is operated without any crankcase ventilation can be damaged. Therefore, it is important to replace the PCV valve and air cleaner breather 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	11.162

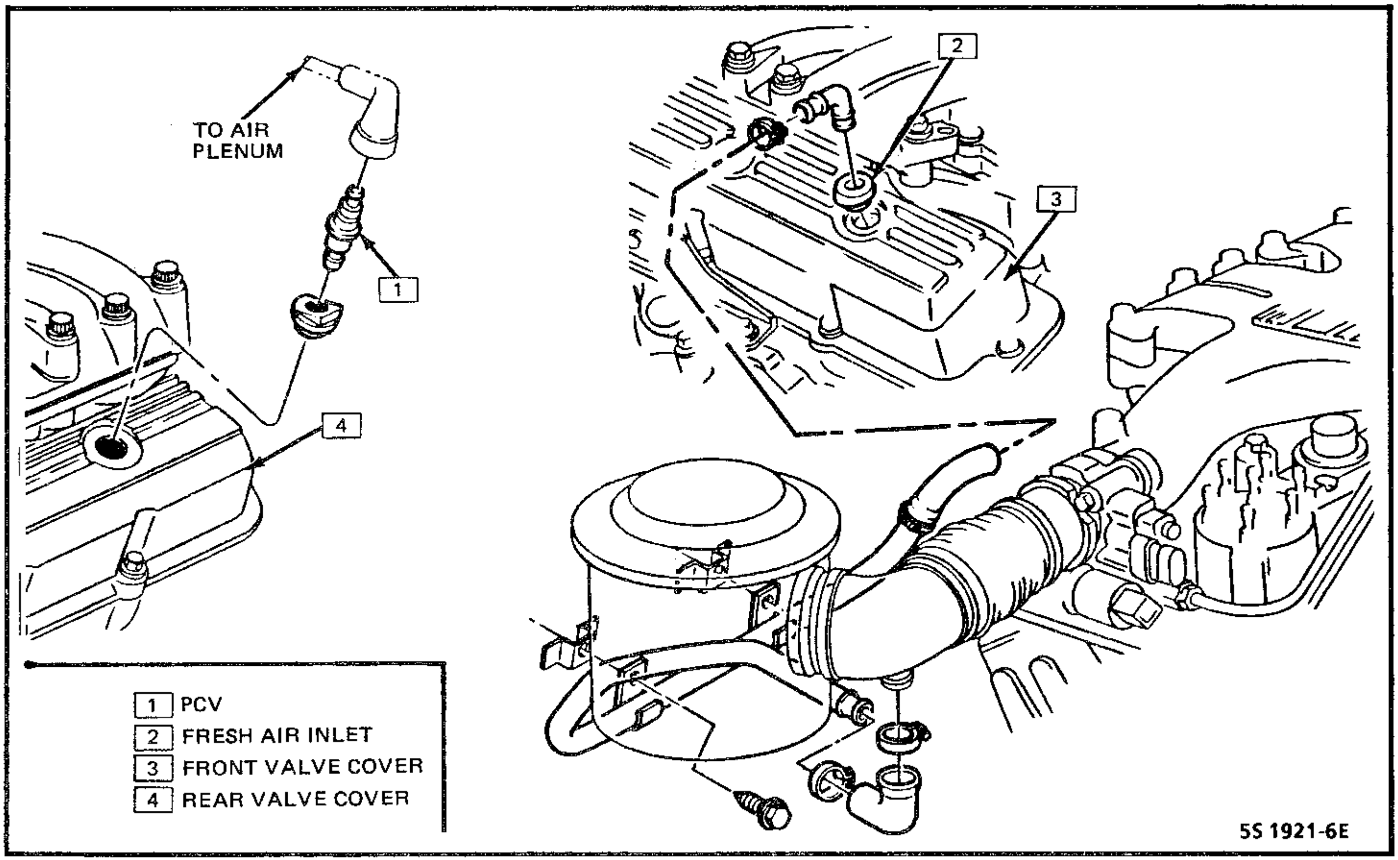


Figure C13-3 PCV System Service

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 exhaust fumes to seep into the passenger compartment. Dust or water in the passenger compartment may be an indication of a problem in one of these areas. Any defects should be corrected immediately. To help insure continued integrity, the exhaust system pipe rearward of the catalytic converter must be replaced whenever a new muffler is installed.

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 (Figure 1).

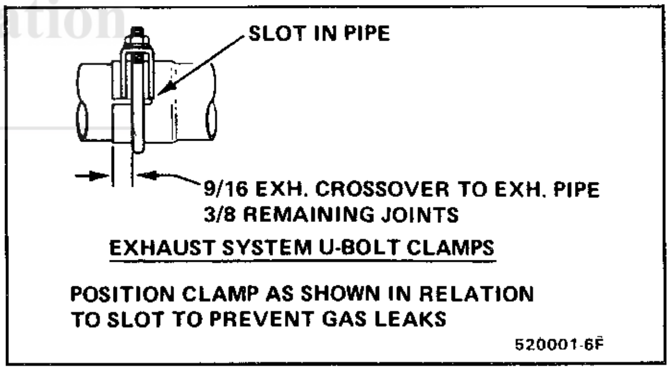


Figure 1 Installation of Exhaust System Clamp

CATALYTIC CONVERTER

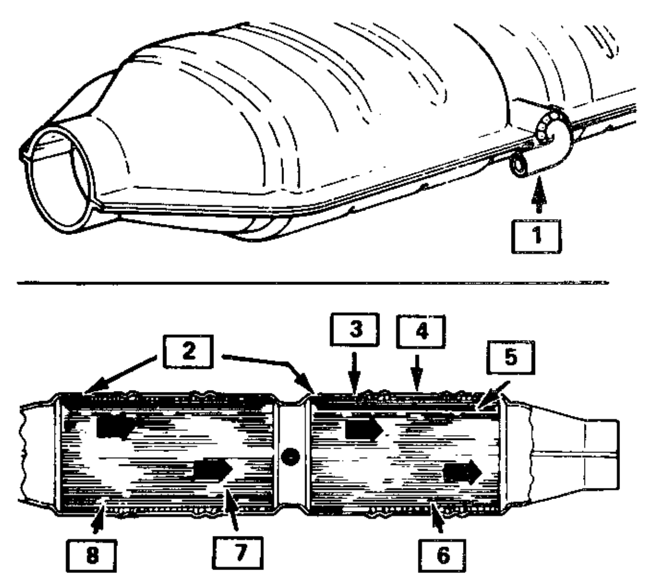
The catalytic converter is an emission control device added to the exhaust system to reduce pollutants from the exhaust gas stream.

NOTICE: THE CATALYTIC CONVERTER REQUIRES THE USE OF UNLEADED FUEL ONLY.

Periodic maintenance of the exhaust system is not required, however, if the car is raised for other service, it is advisable to check the general condition of the catalytic converter, pipes and mufflers.

Three different converter designs are used in combination with two different types of catalyst.

1. Converter Design:
   - Dual Bed Monolith
   - Single Bed Pellet
   - Dual Bed Pellet



1—AIR MANAGEMENT SYSTEM AIR INLET
2—SEAL
3—METAL MESH
4—SHELL
5—OXIDATION CATALYST
6—REAR BED
7—THREE-WAY CATALYST
8—FRONT BED

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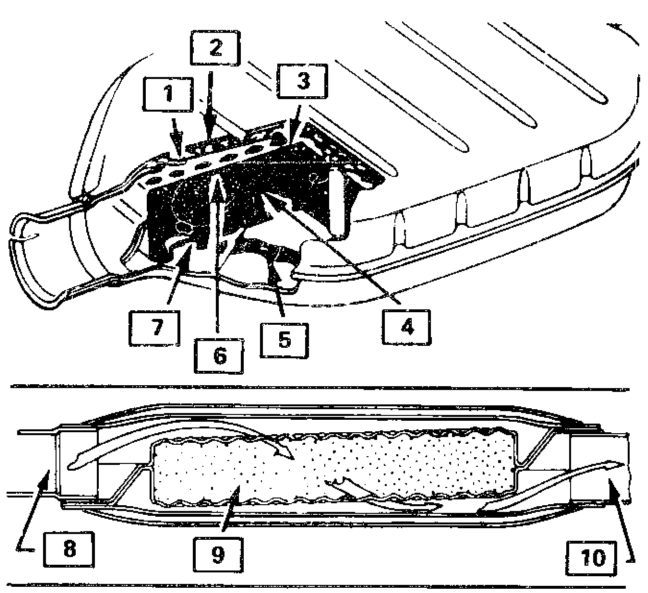
Figure 2 Dual Bed Monolith



1— INSULATION
2— OUTER WRAP
3— CONVERTER SHELL
4— CATALYST
5— INSULATION
6— BED SUPPORT
7— FILL PLUG
8— INLET GAS
9— CATALYTIC PELLET COMPOUND
10— OUTLET GAS

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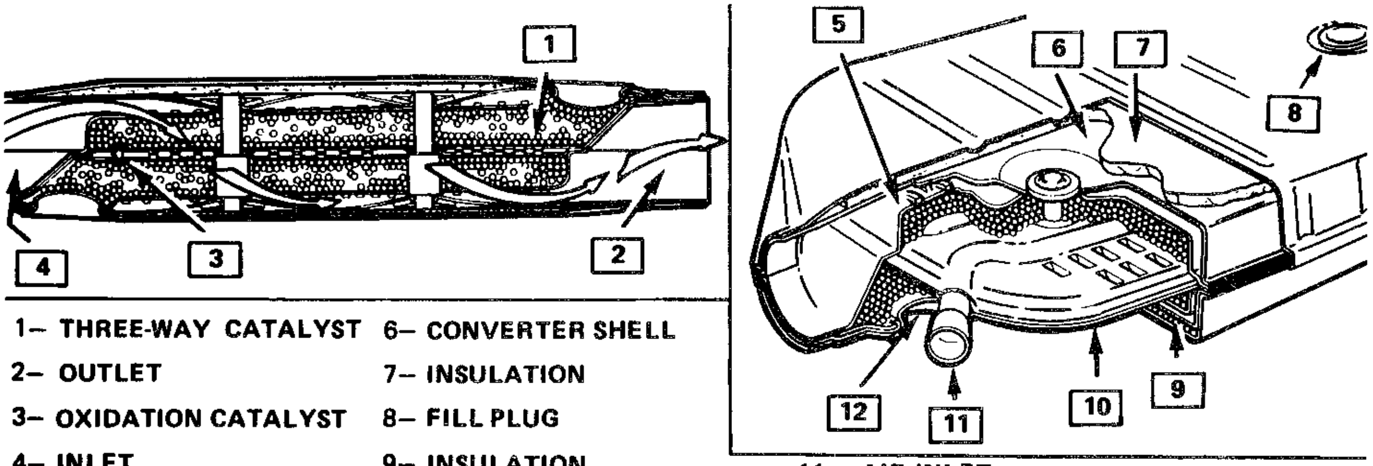
Figure 3 Single Bed Pellet Converter



1— THREE-WAY CATALYST
2— OUTLET
3— OXIDATION CATALYST
4— INLET
5— RETAINER
6— CONVERTER SHELL
7— INSULATION
8— FILL PLUG
9— INSULATION
10— AIR PLENUM
11— AIR INLET (AIR MANAGEMENT SYSTEM)
12— FILL PLUG

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Figure 4 Dual Bed Pellet

2. Catalyst Types:
    - Oxidation Catalyst
    - Three-Way (Reduction) Catalyst

The oxidation catalyst is coated with a catalytic material containing platinum and palladium which lowersw levels of hydrocarbon (HC) and carbon monoxide (CO). The catalytic coating on the three-way (reduction) catalyst contains platinum and rhodium, which lower levels of oxide of nitrogen (NO_x) as well as hydrocarbons (HC) and carbon monoxide(CO).

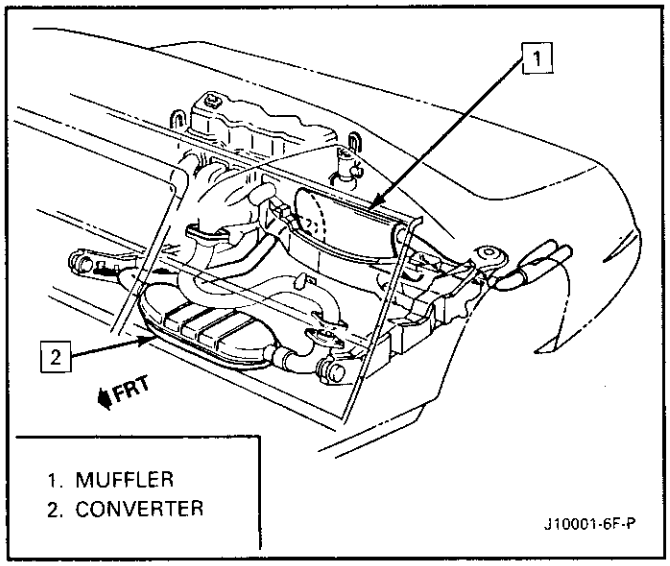

Figure 5 Exhaust System (LR8)

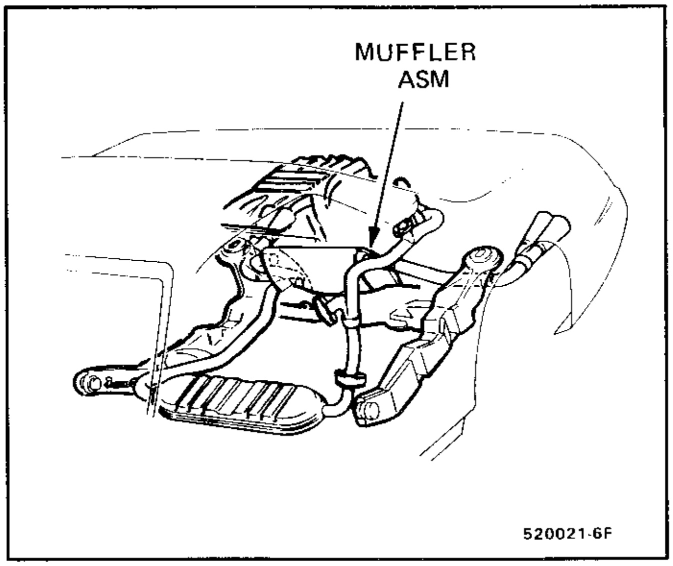

Figure 6 Exhaust System (L44)

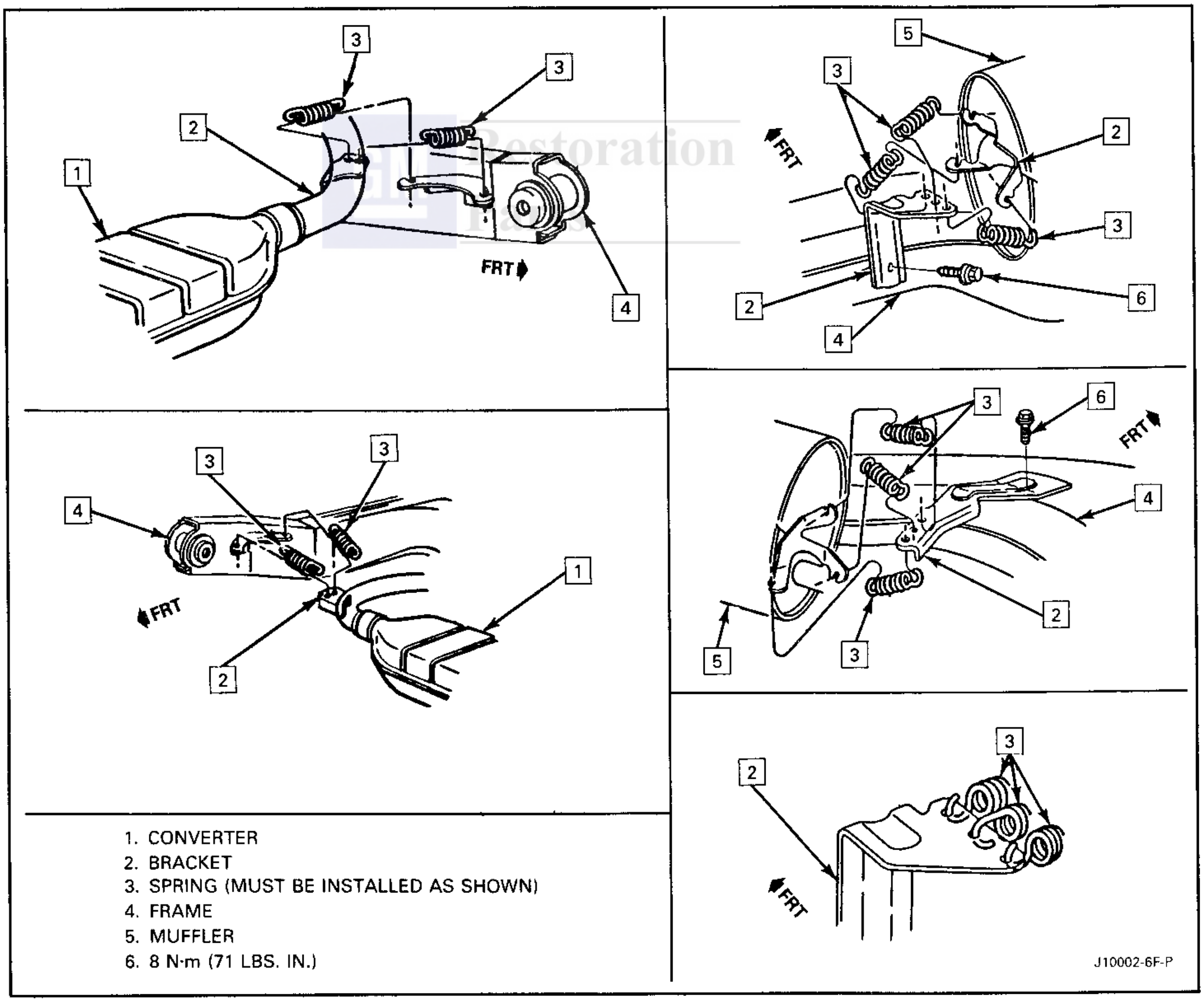

Figure 7 Exhaust System Spring Installation

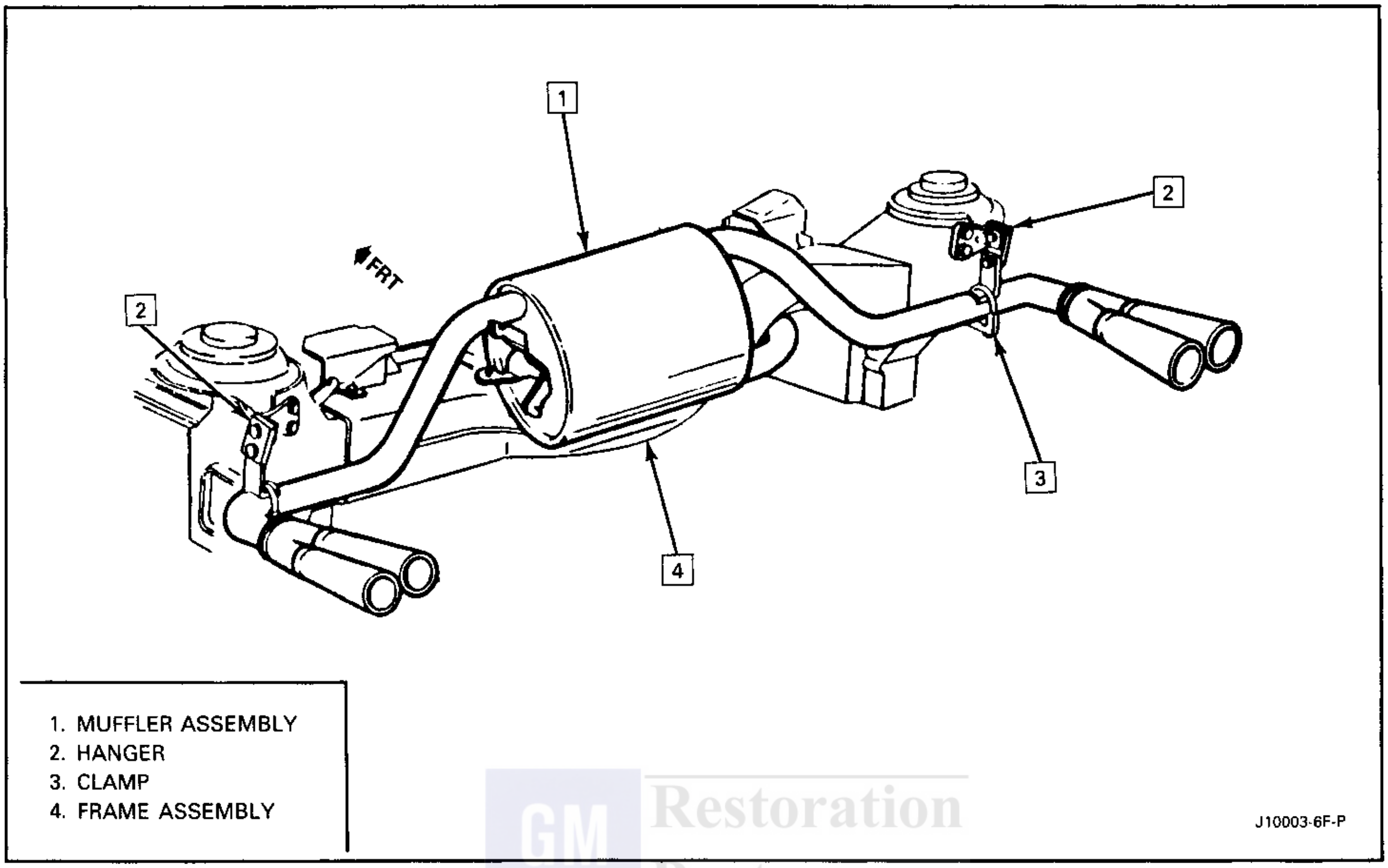

Figure 8 Muffler and Tailpipe (L44)

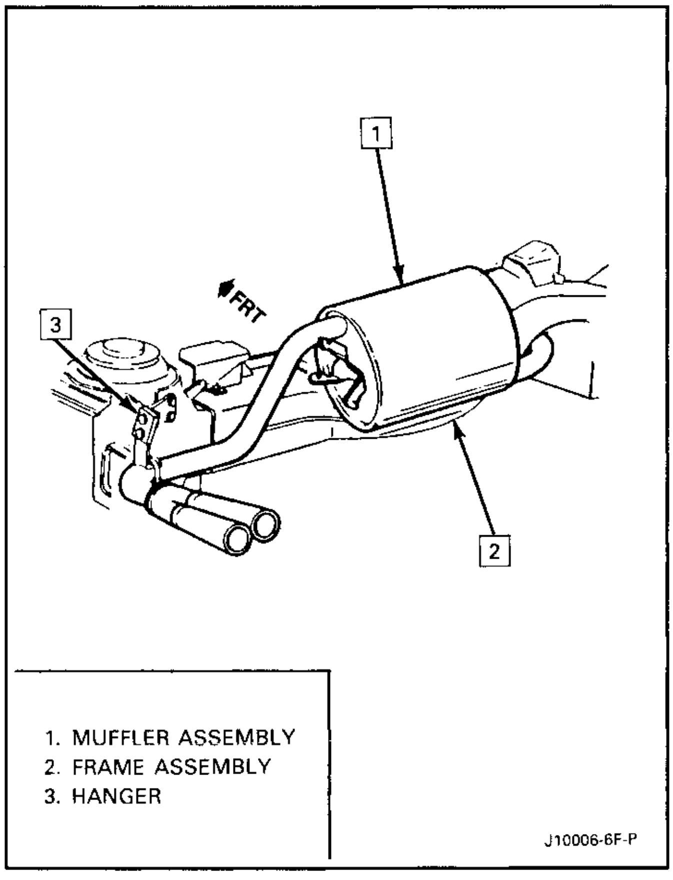

Figure 9 Muffler and Tailpipe (LR8)

1–CROSSOVER PIPE
2–SEAL
3–BOLT
4–SPRING (MUST BE INSTALLED AS SHOWN)
5–EXHAUST MANIFOLD–FRONT
6–EXHAUST MANIFOLD–REAR

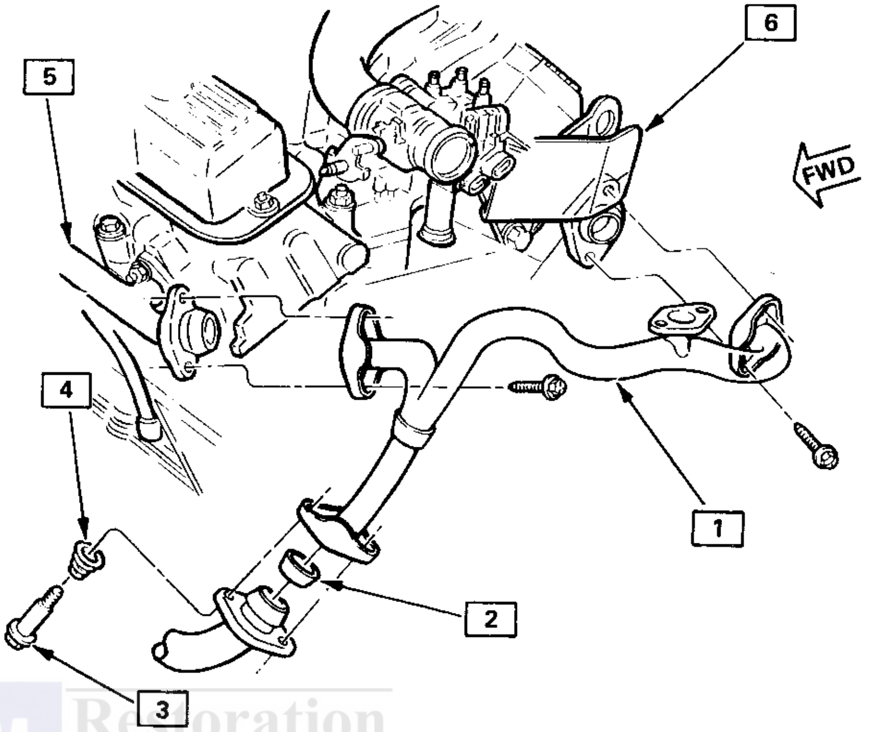

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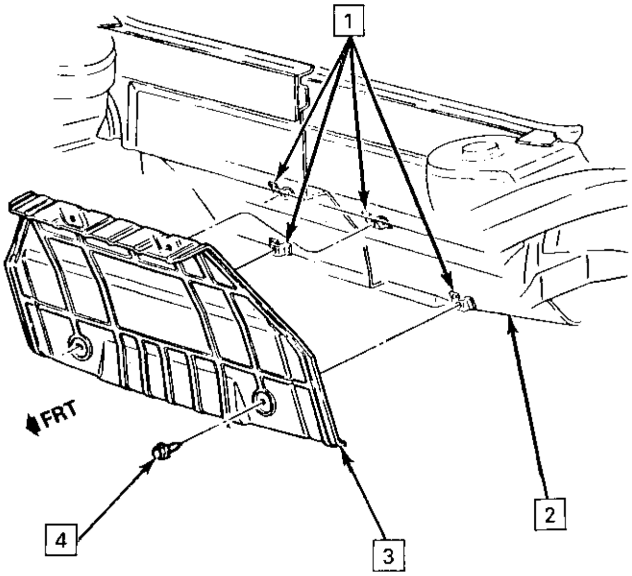
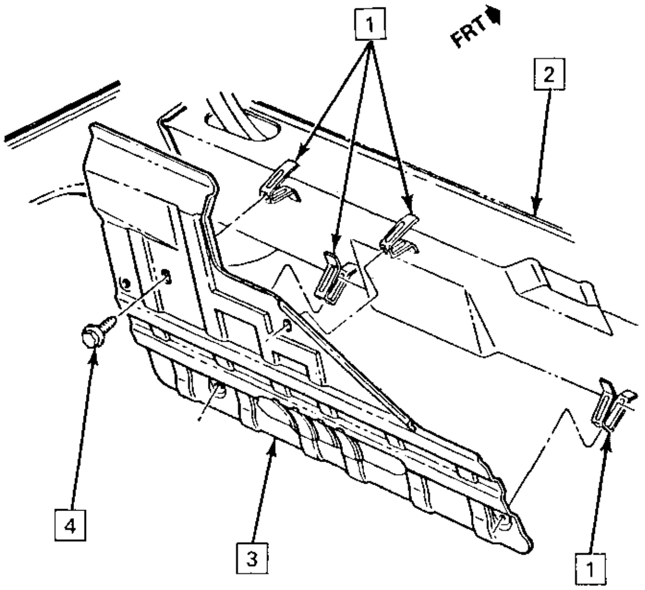
Figure 10 Exhaust Crossover Pipe



1. BRACKETS
2. BODY ASSEMBLY
3. HEAT SHIELD
4. 2 N·m (18 LBS. IN.)

J10004-6F-P

Figure 11 Muffler Heat Shield



1. BRACKETS
2. TORQUE BAR
3. HEAT SHIELD
4. 1.5 N·m (13 LBS. IN.)

J10005-6F-P

Figure 12 Converter Heat Shield

SECTION 7

AUTOMATIC TRANSAXLE

CONTENTS

SECTION 7A

TRANSAXLE GENERAL INFORMATION

CONTENTS

The information contained in this section is common to all automatic transaxles. For on-vehicle service procedures refer to Section 7A1. For complete Diagnosis and Unit Repair refer to the specific transaxle sections.

For vehicles sold in Canada also refer to the appropriate Canadian Service Manual Supplement for driveability diagnosis.

TRANSAXLE IDENTIFICATION INFORMATION

All automatic transaxles have a metal identification nameplate attached to the case exterior. The location of this name plate is shown in Figure 1. The information on the nameplate will assist in the servicing and determination of replacement parts when ordered through a GM Parts Catalog.

Additional Transaxle identification is provided on the Service Parts Identification label. This label contains information on the regular production options (RPO) as well as standard and mandatory options. This label is affixed to the inside of each vehicle at the assembly plant. Refer to Section 0A of this Service Manual for label location and information.

TRANSAXLE DEFINITIONS

The following definitions are being provided to establish a common language and assist the user in describing transaxle related conditions. Some of these terms or conditions are used in the transaxle sections of this Service Manual.

Throttle Positions

- **Minimum Throttle** - the least amount of throttle opening required for an upshift.
- **Light Throttle** - approximately 1/4 of accelerator pedal travel.
- **Medium Throttle** - approximately 1/2 of accelerator pedal travel.
- **Heavy Throttle** - approximately 3/4 of the accelerator pedal travel.
- **Wide Open Throttle (WOT)** - full travel of the accelerator pedal.
- **Full Throttle Detent Downshift** - a quick apply of the accelerator pedal to its full travel, forcing a downshift.
- **Zero Throttle Coastdown** - a full release of the accelerator pedal while the vehicle is in motion and in drive range.
- **Engine Braking** - a condition where the engine is used to slow the vehicle by manually downshifting during a zero throttle coastdown.

Shift Conditions

- **Bump** - a sudden and forceful apply of a clutch or band.
- **Chuggle** - a bucking or jerking condition that may be engine related. May be most noticeable when the converter clutch is engaged. Similar to the feel of towing a trailer.
- **Delayed** - a condition where a shift is expected but does not occur for a period of time. Samples of this condition could be described as clutch or band engagement does not occur as quickly as expected during a part throttle or wide open

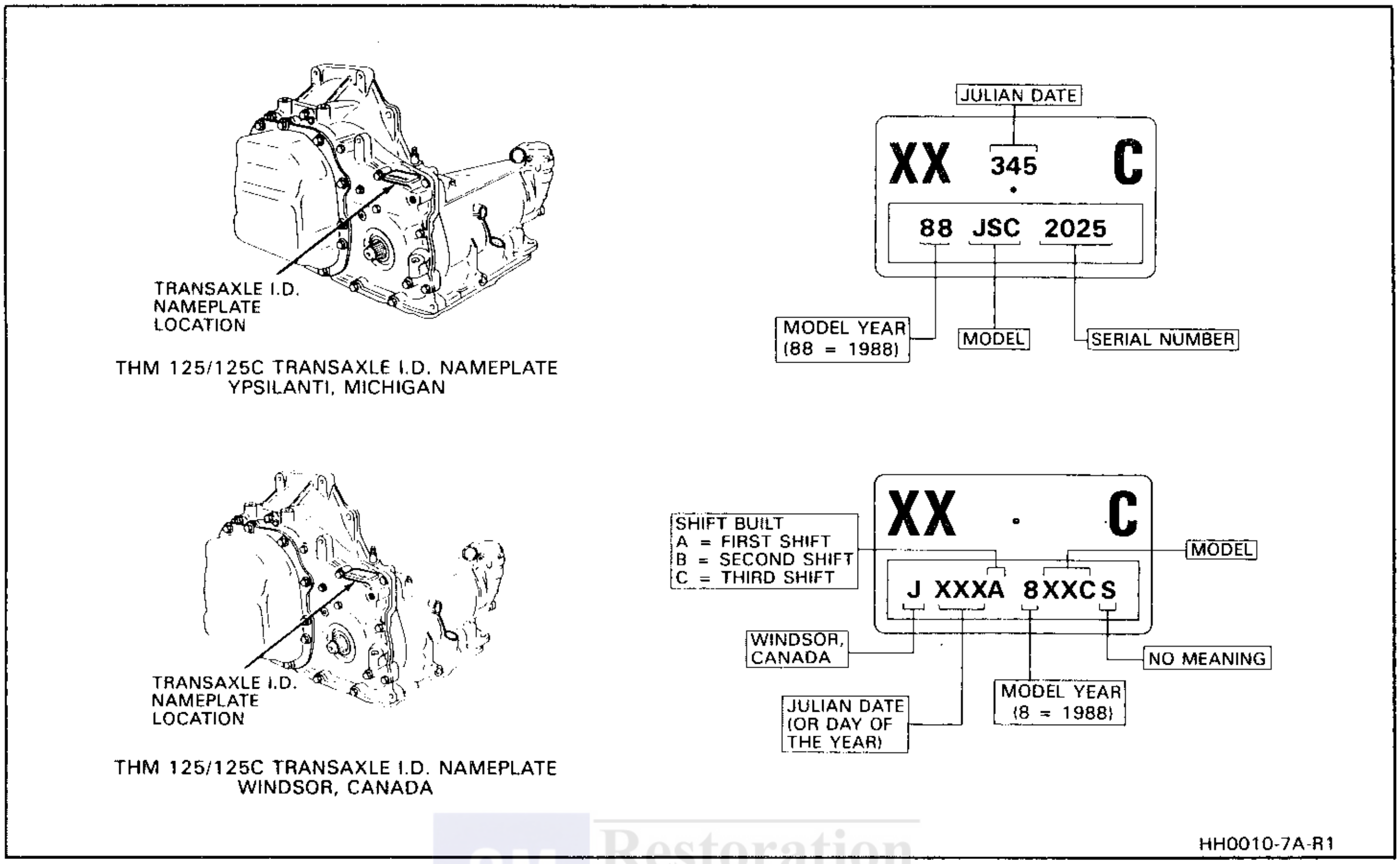
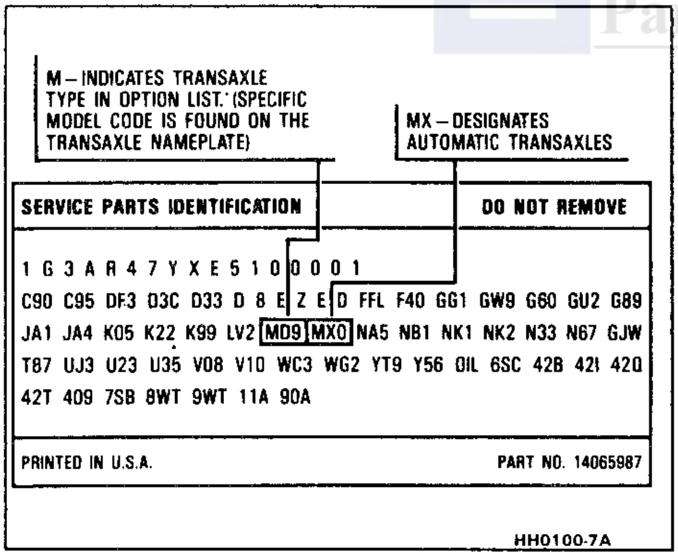


Figure 1 Transaxle Identification Information



M – INDICATES TRANSAXLE TYPE IN OPTION LIST. (SPECIFIC MODEL CODE IS FOUND ON THE TRANSAXLE NAMEPLATE)

MX – DESIGNATES AUTOMATIC TRANSAXLES

SERVICE PARTS IDENTIFICATION DO NOT REMOVE

1 G 3 A R 4 7 Y X E 5 1 0 0 0 0 1

C90 C95 DF3 03C D33 D 8 E Z E D FFL F40 GG1 GW9 G60 GU2 G89

JA1 JA4 K05 K22 K99 LV2 MD9 MX0 NA5 NB1 NK1 NK2 N33 N67 GJW

T87 UJ3 U23 U35 V08 V10 WC3 WG2 YT9 Y56 0IL 6SC 42B 42I 42O

42T 409 7SB 8WT 9WT 11A 90A

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Figure 2 Service Parts Identification Label

throttle apply of the accelerator or, when manually downshifting to a lower range.

Also defined as "LATE" or, "EXTENDED."

- **Double Bump ("Double Feel")** - two sudden and forceful applies of a clutch or band.
- **Early** - a condition where the shift occurs before the vehicle has reached a proper speed and tends to labor the engine after the upshift.
- **End Bump** - a firmer feel at the end of a shift as compared to the feel at the start of the shift. Also defined as "END FEEL" or, "SLIP BUMP."
- **Firm** - a noticeable quick apply of a clutch or band that is considered **normal** with a medium to heavy throttle shift. Should not be confused with "HARSH" or "ROUGH."
- **Flare** - a quick increase in engine rpm accompanied with a momentary loss of torque. This most generally occurs during a shift. Also defined as "SLIPPING."
- **Harsh ("Rough")** - a more noticeable apply of a clutch or band as compared to "FIRM." This condition is considered undesireable at any throttle position.
- **Hunting** - a repeating quick series of upshifts and downshifts that causes a noticeable change in engine rpm. An example could be described as a 4-3-4 shift pattern. Also defined as "BUSYNESS."
- **Initial Feel** - a distinct firmer feel at that start of a shift as compared to the finish of the shift.
- **Late** - a shift that occurs when the engine is at a higher than normal rpm for a given amount of throttle.
- **Shudder** - a repeating jerking sensation similar to "CHUGGLE" but more severe and rapid in nature. This condition may be most noticeable during certain ranges of vehicle speed. May also be used to define the condition after converter clutch engagement.
- **Slipping** - a noticeable increase in engine rpm without a vehicle speed increase. A slip usually occurs during or after initial clutch or band engagement.

- **Soft** - a slow, almost unnoticeable clutch apply with very little shift feel.
- **Surge** - a repeating engine related feeling of acceleration and deceleration that is less intense than "CHUGGLE."
- **Tie-Up** - a condition where two opposing clutches are attempting to apply at the same time causing the engine to labor with a noticeable loss of engine rpm.

Noise Conditions

- **Drive Link Noise** – a whine or growl that increases and fades with vehicle speed and is most noticeable under light throttle acceleration. May also be noticeable in "PARK" or "NEUTRAL" operating ranges with the vehicle stationary.
- **Final Drive Noise** - a hum related to vehicle speed and is most noticeable under light throttle acceleration.
- **Gear Noise** - a whine, most noticeable in first gear and reverse that is related to vehicle speed. A gear noise condition may become less noticeable or go away after an upshift.
- **Pump Noise** – a high pitch whine that increases in intensity with engine rpm. This condition may also be noticeable in "PARK" and "NEUTRAL" operating ranges with the vehicle stationary.

PRELIMINARY CHECKING PROCEDURE

The condition of an automatic transaxle not operating properly may be influenced by one, or a combination of the following items:

- Fluid level high/low
  (Refer to Section 7A1)
- Engine performance
  (Refer to Sections 6 and 6E)
- T.V. cable adjustment
  (Refer to Section 7A1)
- Manual linkage adjustment
  (Refer to Section 7A1)
- Internal fluid leaks
  (Refer to Transaxle Unit Repair section)
- Electrical system
  (Refer to Section 6E and 8A)
- Transaxle or other mechanical component
  (Refer to Transaxle Unit Repair section)
- Vacuum modulator
  (Refer to appropriate Hydraulic Diagnosis Section)

NOISE AND VIBRATION ANALYSIS

A noise or vibration that is noticeable when the vehicle is in motion, MAY NOT be the result of the transaxle.

If noise or vibration is noticeable in "Park" (P) and "Neutral" (N) with engine at idle, but is less noticeable as RPM increases, the cause may be from poor engine performance.

Inspect

- Tires for
  - Uneven wear
  - Imbalance
  - Mixed sizes
  - Mixed radial and bias ply
  (Refer to Section 3E)
- Suspension components for
  - Alignment and wear
  - Loose fasteners
  (Refer to Section 3C)
- Engine/Transaxle mounts for
  - Damage
  - Loose bolts
  (Refer to Sections 6A and 7A1)
- Transaxle case mounting holes for:
  - Missing bolts, nuts, studs
  - Stripped threads
  - Cracks
- Flexplate for:
  - Missing or loose bolts
  - Cracks
  - Imbalance
  (Refer to Section 6A)
- Torque converter for:
  - Missing or loose bolts or lugs
  - Missing or loose balance weights
  - Imbalance

TRANSAXLE FLUID LEVEL INFORMATION

Checking fluid level, color and condition at regular intervals will provide early diagnosis information about the transaxle. This information may then be used to correct a condition that, if not detected early, could result in major transaxle repairs.

When adding or changing fluid, use only DEXRON® II, or equivalent. Refer to Section 0B of this Service Manual for maintenance information and servicing intervals.

- Fluid level should be checked when it reaches normal operating temperatures of 190-200°F. (88-93°C). This temperature is reached after approximately 15 miles (24 km) of highway driving.
- Fluid color
  - Should be dark red (may be dark green)

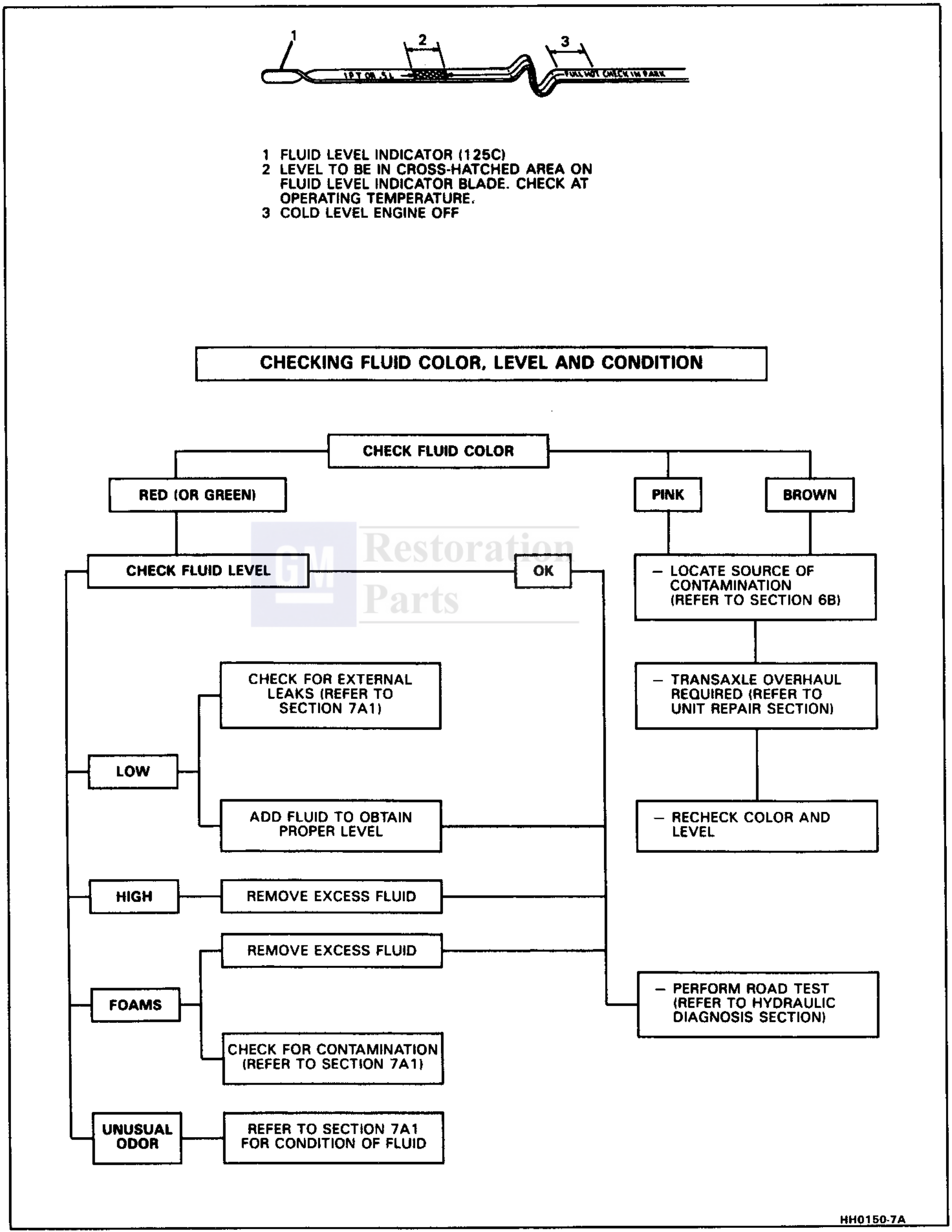
NOTICE: Do not overfill. Overfilling will cause foaming, loss of fluid and possible damage to the transaxle.

- Inaccurate fluid level readings will result if checked immediately after the vehicle has been operated:
  - In high abmient temperatures above 90°F (32°C)
  - At sustained high speeds
  - In heavy city traffic during hot weather
  - As a towing vehicle
  - In commercial service (taxi or police use)

TRANSAXLE FLUID CHECKING PROCEDURE

(Refer to Figure 3)

1. Park vehicle on level ground.
2. Apply parking brake and block wheels.
3. Start engine and operate vehicle for 15 minutes or until a normal operating temperature is reached.
4. Move gear selector through all gear positions.
5. Move gear selector to "Park" (P).
6. Check fluid level, color and condition.



1 FLUID LEVEL INDICATOR (125C)
2 LEVEL TO BE IN CROSS-HATCHED AREA ON FLUID LEVEL INDICATOR BLADE. CHECK AT OPERATING TEMPERATURE.
3 COLD LEVEL ENGINE OFF

Figure 3 Checking Fluid Color, Level and Condition

SECTION 7A1

ON-VEHICLE SERVICE

CONTENTS

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.)

DIAGNOSIS

Automatic transaxle 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(s)
- Mechanical failure

PRELIMINARY CHECKING PROCEDURE

Most automatic transaxle problems are caused by improper external adjustments. Before servicing a 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", Figure 1.
3. Engine idle speed.

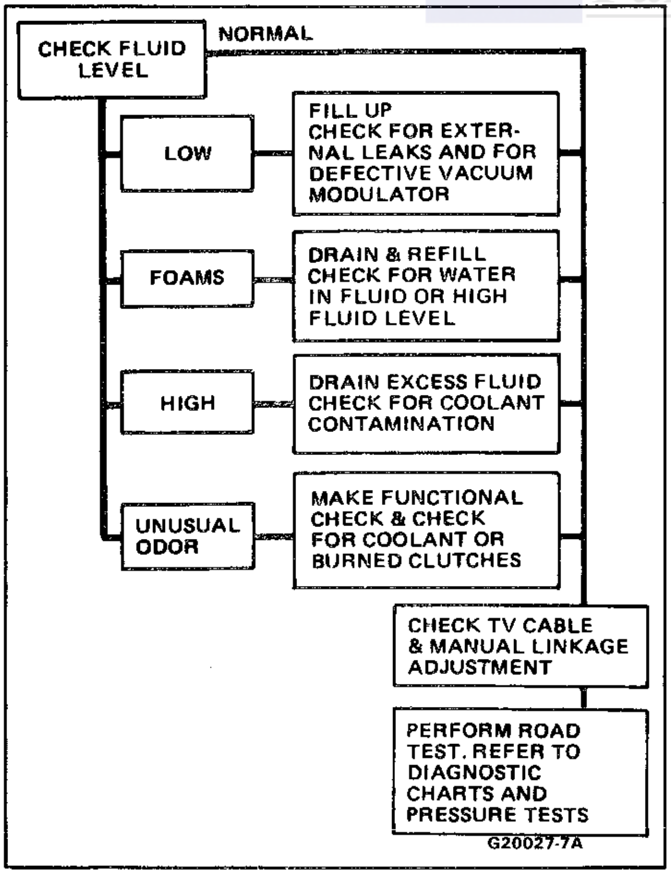


Figure 1 Preliminary Checking Procedure

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.
5. Shift control linkage. Make sure the linkage does not bind and is properly adjusted.
6. Test drive car.

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 Diagnostic Charts in the Hydraulic Diagnosis and Unit Repair Section.

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 position.
   c. Observe Torque Converter Clutch (TCC) engagement. This should occur between 35-50 mph (57-80 km/h). Refer to Hydraulic 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 (1 or 2) — 3rd gear is inoperative.
   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. 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)
   a. Place gear selector into "R" and observe reverse.
   b. Do not place gear selector into "R" while vehicle is moving.

FLUID PRESSURE TEST PROCEDURE

1. Install pressure gage J 21867. See Hydraulic Diagnosis.
2. Note transmission model code and refer to Hydraulic Diagnosis.

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.
   - T.V. linkage binding or incorrect cable.
   - Throttle valve stuck.
   - Manual valve stuck.
3. Oil strainer plugged or damaged.
4. Oil strainer seal leaking.
5. Fluid contaminated or lost viscosity.
6. Control valve spring weak.
7. Control valve and pump bolts loose.
8. 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. valve loose
     - — Pressure relief valve
   - 1-2 accumulator piston and/or seal leaking or missing.
   - Internal leaks.
9. ("Low" only) Low blow off valve damaged, check ball missing or off location.
10. ("Reverse" only) Low-Reverse clutch housing to case cup plug assembly leaking. Low-Reverse oil pipe or seal leaking.
11. Pump vane seals cut or missing.
12. Intermediate oil passages to pressure regulator blocked.
13. Drive 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.
   - 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. valve loose
   - Pump slide stuck
3. Low blow-off valve stuck closed ("Low" only).
4. Internal pump or case cover leaking.

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 type, engine oil, transmission fluid, anti-freeze, or 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 all gasket mating surfaces for leaks. A mirror is useful in finding leaks in hidden areas.
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 and dry. 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 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.

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 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 seal missing, damaged, or improperly installed.
   - Governor cover and "O" rings damaged or missing.
   - Speedometer drive gear/speed sensor seal damaged.
   - Manual valve bore plug loose.
   - Oil cooler lines fittings loose or damaged.
   - Axle oil seals worn or damaged.
   - Parking pawl shaft cup plug loose.
   - Governor pressure pick up plug loose.
   - Line pressure pick up 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.
- Case or drive sprocket support.
- Turbine shaft oil seal worn or damaged.

4. **Fluid comes out vent pipe or fill tube:**
   - Over-filled
   - Coolant 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 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 Section 6E.
- For diagnosis of TCC Hydraulic controls, refer to Hydraulic Diagnosis.

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.
4. Lightly touch the brake pedal and check for slight bump when the TCC releases 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 impediance 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 a 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

Important

- Connect voltmeter between transmission connector and ground.
- Turn key "On".
- If 12 volts are present at the connector, refer to the Hydraulic 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 in "Drive". Oil pressure should be equal or not more than 10 psi (34 kPa) higher than in "Park".
8. Increase engine speed to 1400 RPM. If oil pressure does not increase, adjust T.V. cable.

NOISE AND VIBRATION DIAGNOSIS

1. Vibration with car in motion.

Inspect

- Engine and transmission mounts damaged or loose. Refer to Sections 6A, 7A, and 7A1.
- Tires out of balance or unevenly worn. Snow tires, mixed sizes or mixed radial and bias ply. Refer to Section 3E.

- Drive shaft couplings worn. Refer to Section 4D.
- Shock absorbers worn or loose. Refer to Section 3.
- Front suspension worn, loose or misaligned. Refer to Sections 3 and 3A.

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 weight loose or missing. Refer to Section 6A.
  - — Torque converter out of balance.

SERVICE PROCEDURES

CHANGING FLUID AND FILTER

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.

CHANGING FLUID AND FILTER

1. Raise vehicle and suitably support. See Section 0A.
2. Place drain pan under transaxle oil pan.
3. Oil pan bolts front and sides.
4. Loose 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.

Important

- 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

Remove or Disconnect

1. Screen, using a new filter and seal. Coat seal with petroleum jelly. Torque screen to specification, see Unit Repair Section.
2. Oil pan, using a new gasket. Torque bolts to specification, see Unit Repair Section.
3. Lower vehicle.
4. Fill transaxle with the proper quantity of Dexron II®. Refer to fluid capacities.
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.

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 2), 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 3.

Insert tool between lever and nylon end at the pin center line. Rotate tool and cable end will snap off pin.

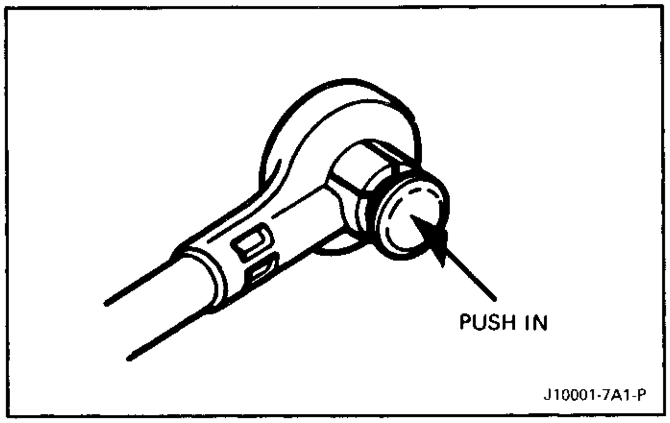


Figure 2 Cable Removal (Plug Type)

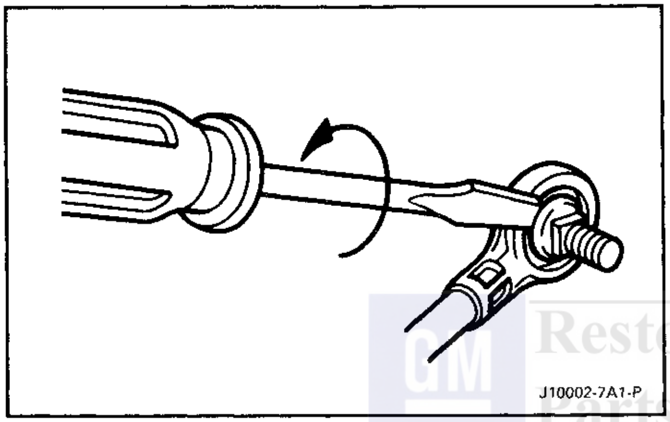


Figure 3 Cable Removal (Without Plug)

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

Figures 5 and 7

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 assembly) 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

Remove or Disconnect

Figures 4 and 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.

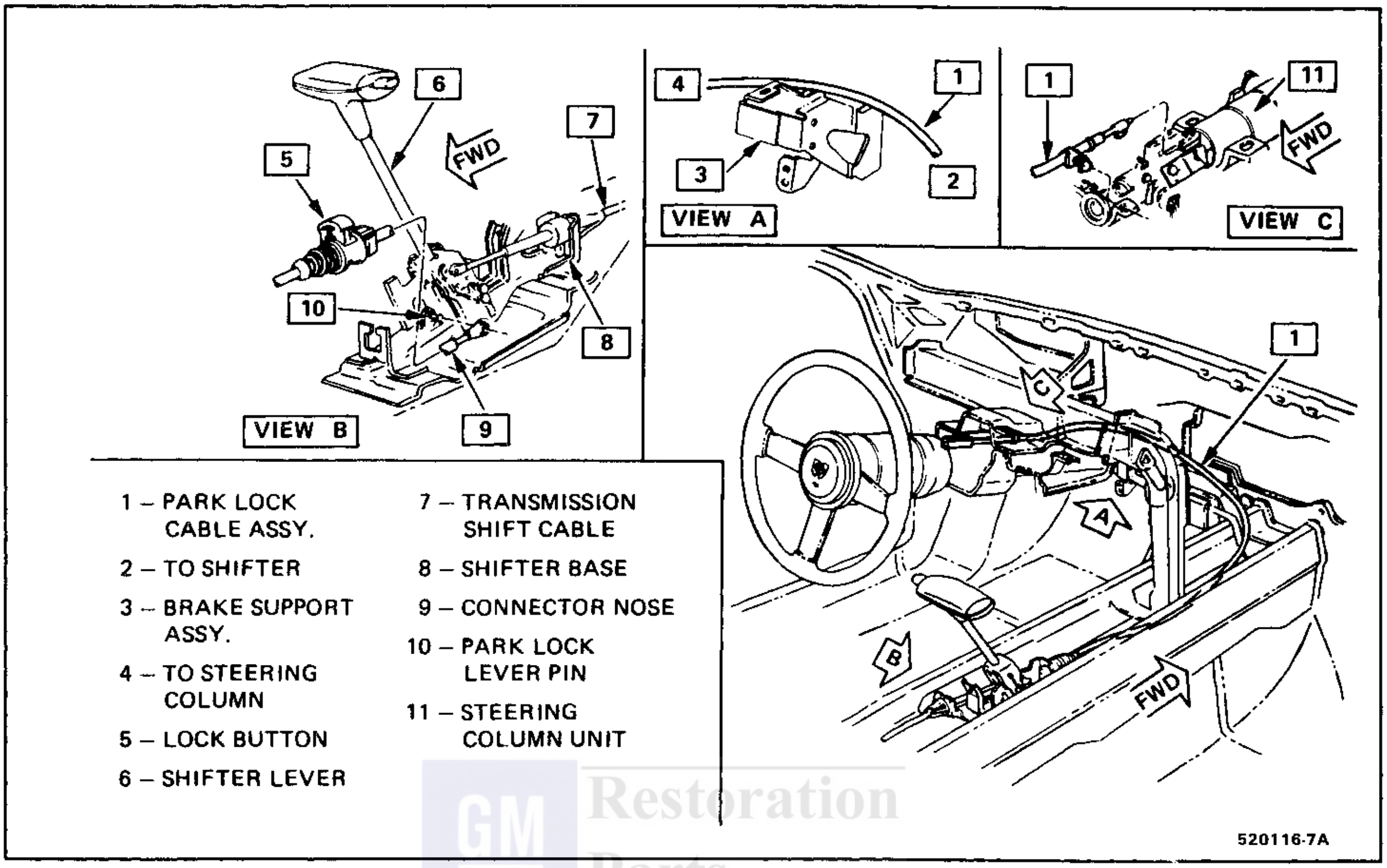
5. Cable from park lock lever pin.
6. Cable from shifter base.
7. Cable.

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.

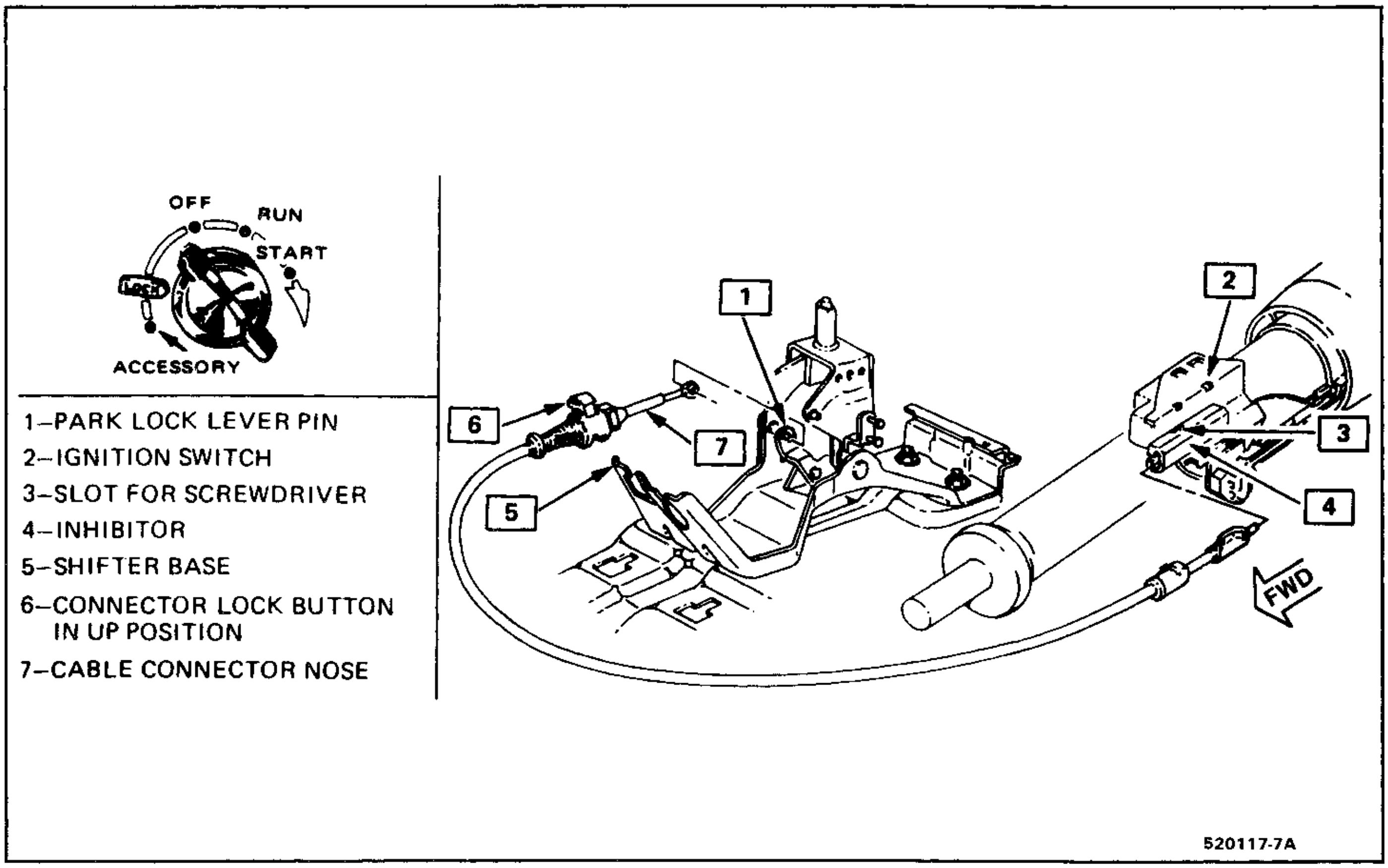
Tighten

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.



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

Figure 4 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

Figure 5 Park Lock Cable Adjustment Illustration

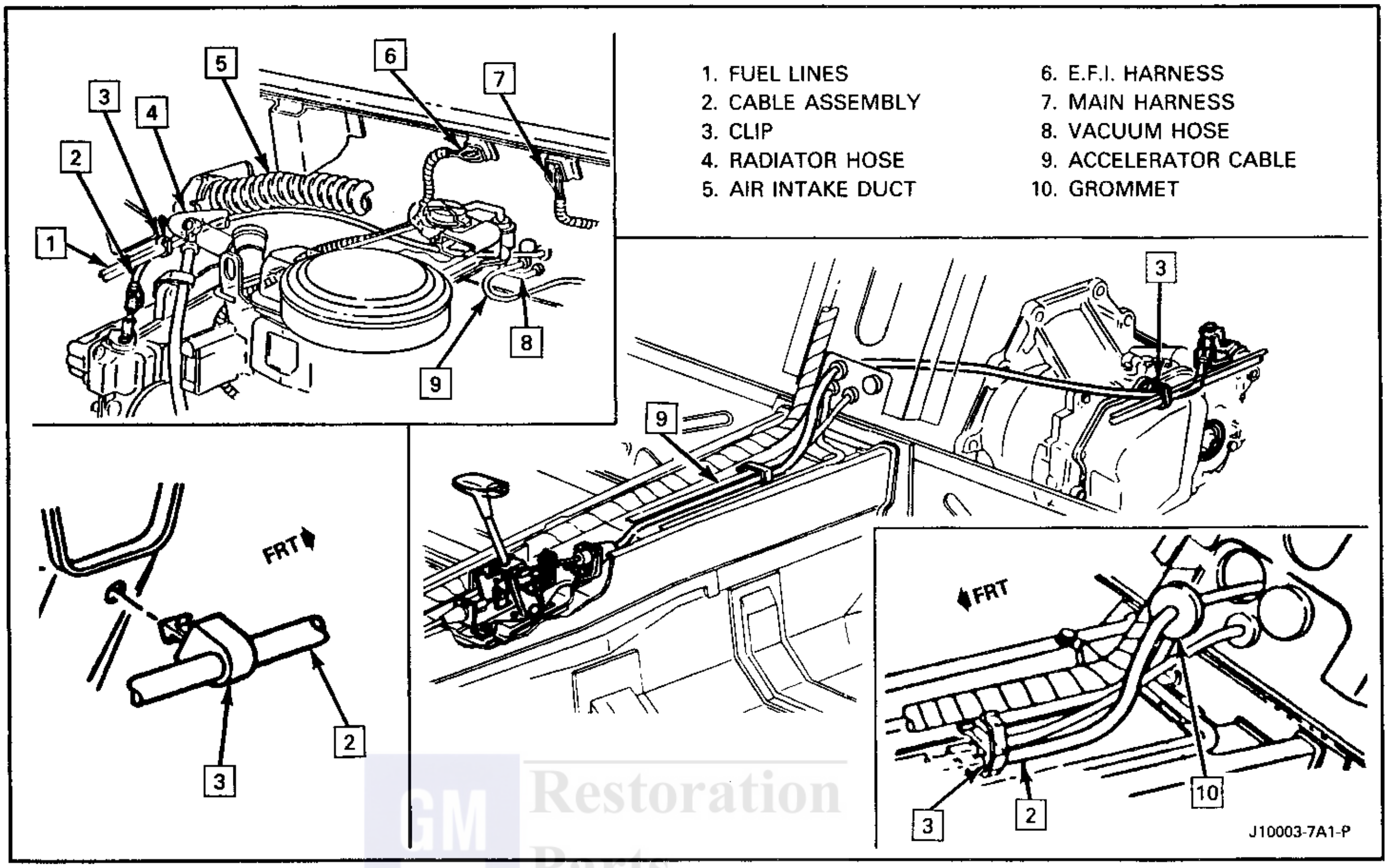


Figure 6 Transaxle Control Cable Routing

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.

Neutral Safety and Backup Lamp Switch

Adjust

Figure 7

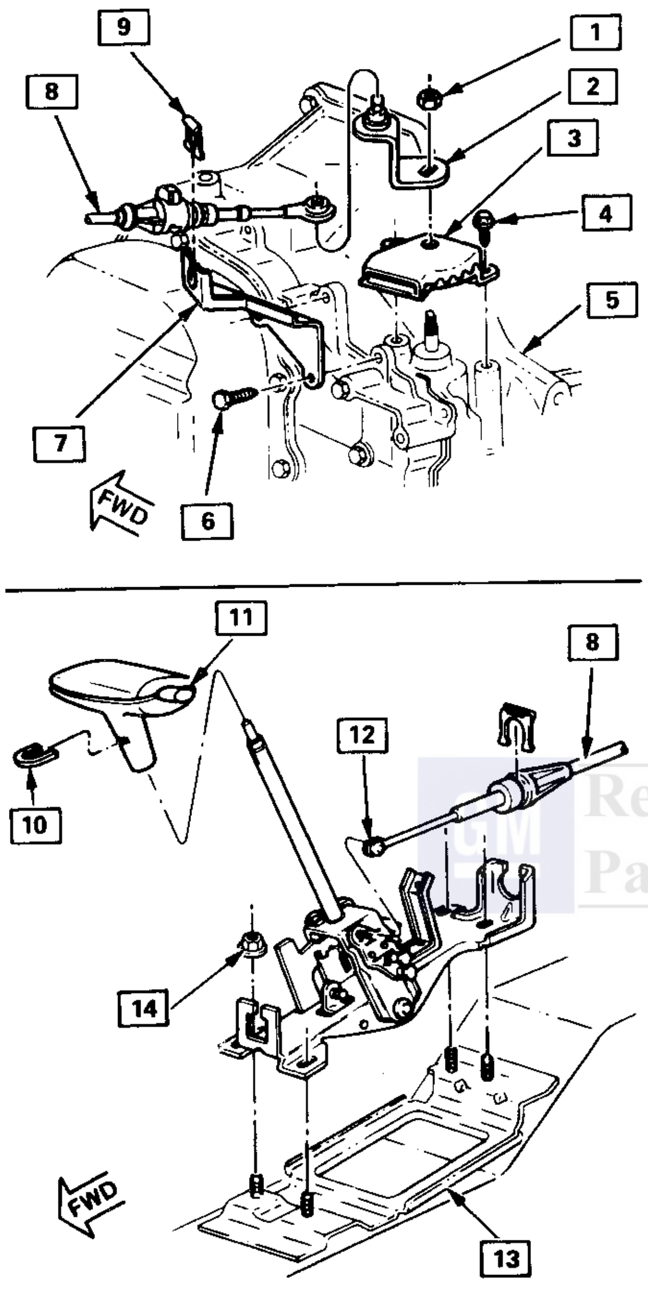
1. Place transmission shaft in "NEUTRAL" position.
2. Align flats in switch insert with flats on transmission shaft and push switch over shaft.
3. Loosely assemble bolts to transmission case.
4. Insert 2.34 diameter gage pin (or rounded shank end of a 3/32 inch drill bit) into service adjustment hole. Rotate the switch until the gage pin drops to a depth of 9mm.
5. Tighten attaching bolts to recommended torque.
6. Remove gage pin.

OIL COOLER AND PIPE FLUSHING

Tools Required:

J 35944 Cooler Flushing Tool
J 35944-20 Flushing Solution
Water Supply
Air Supply (with water and oil filter)
Oil Drain Container
5 Gallon Pail

1. Remove the fill cap on J 35944 and fill with .6 liter 20-21 ounces of J 35944-20 flushing solution.
   - Do not overfill.
   - Follow manufacturer's suggested procedures for solution handling.
2. Replace cap on J 35944 and pressurize it to 550-700 kPa (80-100 psi).
3. Connect J 35944 to the transaxle end of the oil cooler pipe that feeds the BOTTOM fitting of the oil cooler.
4. Connect the discharge hose to the TOP oil cooler pipe and clip the discharge hose to oil drain container.
5. With the water valve on J 35944 in the off position, connect the water supply to the tool.



1 – NUT/SHIFTING LEVER
2 – LEVER/SHIFTING
3 – SWITCH/NEUTRAL START AND BACK-UP
4 – BOLT/NEUTRAL START SWITCH (2)
5 – TRANSAXLE
6 – BOLT/BRACKET
7 – BRACKET
8 – CABLE ASSY.
9 – RETAINER ASSY.
10 – RETAINER
11 – T HANDLE
12 – SNAP SECURELY ONTO PIN
13 – GEAR SHIFT SUPPORT
14 – NUT 23 N·M (17 FT. LB.)

H20021-7A

Figure 7 Transaxle Controls, Cable Attachment and Neutral Start Switch

6. Turn the water supply on.
7. Flush the transaxle fluid by opening the water valve to the “On” position for about 10 seconds.

Important

- If water does not flow thru the cooler the system is completely plugged. Do not complete the flushing procedure. Replace the cooler and/or the cooler pipes as required.

8. Close the water valve and clip the discharge hose to the five gallon pail. Cover the pail with a shop towel to prevent splash.
9. Turn the water valve to the “on” position and depress the trigger to mix flushing solution into the water flow. Use the bale clip provided to hold the trigger down.
10. Flush the cooler with water and solution for 2 minutes. During this flush, attach the air supply to the air valve located on the tool for 3 to 5 seconds every 15-20 seconds. This will create a surging action to ensure complete cleaning.
11. Release the trigger and turn the water valve off.
12. Disconnect both hoses from the oil cooler pipes.
13. Reconnect the hoses to the pipes opposite the initial flush to perform a backflush.
14. Repeat Steps 9 and 10.
15. Release the trigger and allow water to rinse for one minute.
16. Turn the water valve off.
17. Attach the air supply to the air valve and dry the system out with air until no moisture is seen leaving the discharge hose.
18. Connect the cooler feed pipe to the transaxle.

    - 125C the cooler feed is the bottom connection at the TRANSAXLE.

19. Clip the discharge hose to the oil drain container.
20. After filling the transaxle with fluid, start the engine and run for 30 seconds. This will remove any residual moisture from the oil cooler. A minimum of 2 quarts of fluid should flow during the 30 second period. If fluid flow is insufficient, check the fluid flow by disconnecting the feed line at the cooler and observe the flow with the engine running.

    - Insufficient flow: inspect the transaxle for causes
    - Sufficient flow: inspect cooler pipes, fittings and repeat cooler flushing procedure. If the flow is still insufficient, replace the cooler.

21. Remove the discharge hose and reconnect the cooler pipe. Adjust fluid level as needed.

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 prevent 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.

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. Fluid level indicator 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.
12. Spring and seal, thermostatic element assembly, manual detent spring and roller assembly, sprockets, drive link and thrust washer.
13. 3rd clutch pressure switch, solenoid, auxiliary valve body, cover and gasket.
14. Park/Neutral and back-up lamp switch.

SPEEDOMETER DRIVEN GEAR

↔ Remove or Disconnect

Figure 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.

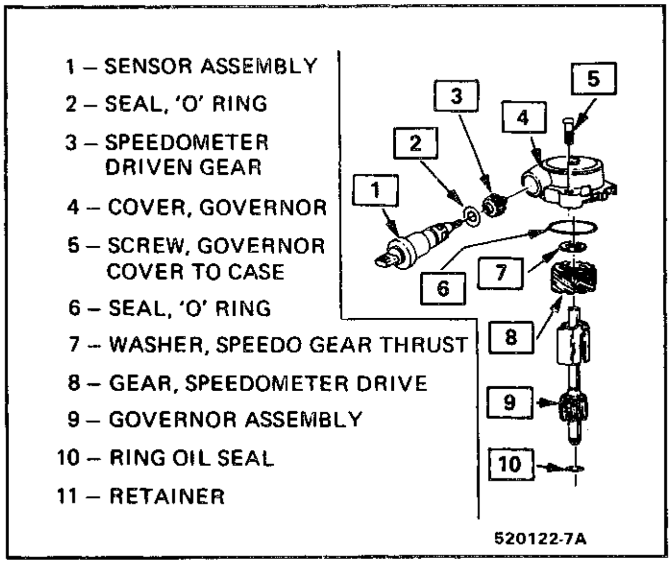


Figure 8 Governor and Speedometer Sensor Assembly

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 8

1. Negative (−) battery cable.
2. Electrical connection at sensor.
3. Sensor assembly retainer.
4. Sensor assembly and gear.
5. Governor cover screws.
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 screws.
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 (62-89 lb. in.).

Install or Connect

1. T.V. cable at injector.
2. Clip securing T.V. cable to valve cover.
3. Air cleaner assembly.

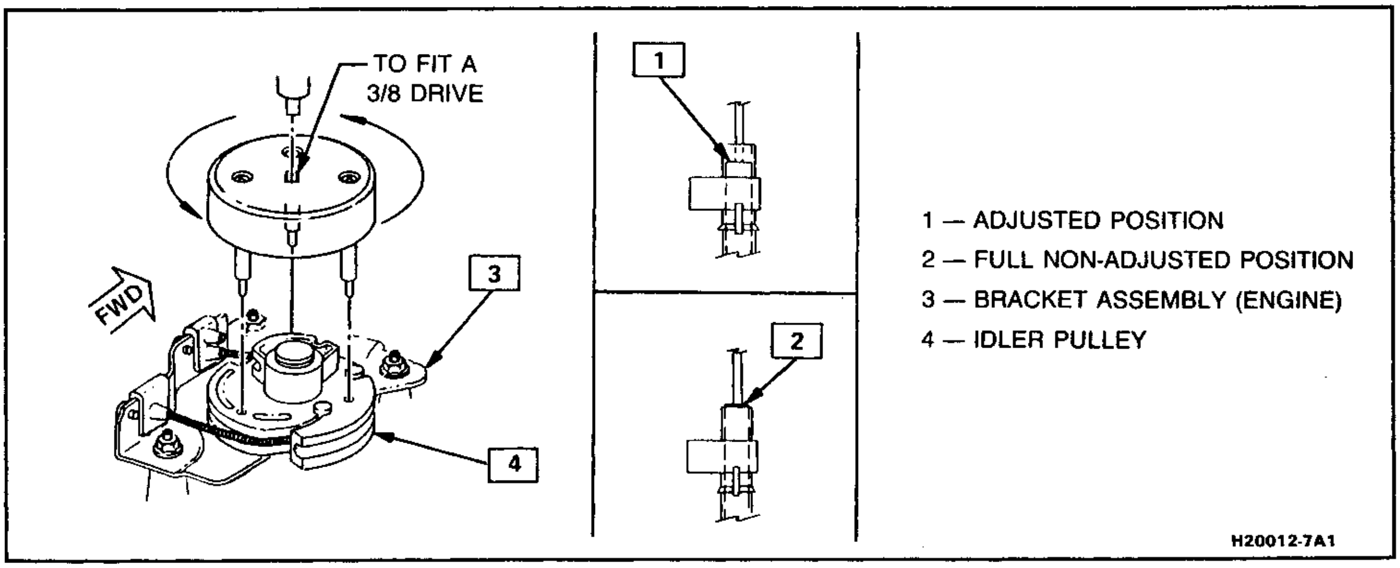


Figure 9 T.V. Cable Adjustment Procedure

Adjust

- Make all necessary adjustments to T.V. cable as outlined below.

T.V. Cable Adjustment

1. Prior to adjustment check that cable is in full non-adjusted position.
2. Check that the T.V. cable is connected at transaxle and working freely.
3. Check T.V. cable for twists or kinks.
4. Be certain accelerator cable is installed before adjustment is made.
5. Rotate idler pulley counter clockwise to 7 N•m (65 lb. in.) for adjustment with.

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 rivets 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 rivets 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.

LO AND REVERSE PIPES

Remove or Disconnect

1. Raise vehicle and suitably support, see Section 0A.
2. Oil pan.
3. Oil strainer and "O" ring seal.
4. Reverse oil pipe, seal back-up ring and "O" ring seal.
5. Low and reverse cup plug assembly.

Install or Connect

1. Low and reverse cup plug assembly.
2. Reverse oil pipe back-up ring with a new "O" ring.
3. Oil strainer with a new "O" ring.
4. Oil pan.
5. Lower vehicle.

Adjust

- Fluid level. Refer to Section 7A.

PARKING PAWL SHAFT

Remove or Disconnect

1. Raise vehicle and suitably support.
2. Oil pan.
3. Oil strainer and "O" ring seal.
4. Fluid level indicator stop.
5. Rod retainer and parking lock bracket.
6. Clip, pin, rod and spring.

Install or Connect

- Refer to exploded view in the Transaxle Unit Repair Section.

1. Rod, spring, clip and pin.
2. Rod retainer and parking lock bracket.
3. Fluid lever indicator stop.
4. Oil strainer with a new "O" ring.
5. Oil pan. Refer to Section 7A.
6. Lower vehicle.

Adjust

- Fluid level. Refer to Section 7A.

Inspect

- Shift linkage.

INTERMEDIATE SERVO AND/OR ACCUMULATOR CHECK VALVE

Remove or Disconnect

1. Raise vehicle and suitably support, see Section 0A.
2. Oil pan.
3. Oil strainer and "O" ring seal.
4. Reverse oil pipe brackets.
5. Intermediate servo cover and gasket.
6. Third accumulator valve and spring.
7. Intermediate servo assembly.

Install or Connect

- Refer to exploded view in the Transaxle Unit Repair Section.

1. Intermediate servo assembly.
2. Third accumulator valve and spring.
3. Servo cover with a new gasket.
4. Reverse oil pipe brackets.
5. Oil strainer with a new seal.
6. Oil pan. Refer to Section 7A.
7. Lower vehicle.

Adjust

- Fluid level. Refer to Section 7A.

GOVERNOR

Remove or Disconnect

1. Raise vehicle and suitably support, see Section 0A.
2. Governor cover and "O" ring.
3. Governor assembly.

Install or Connect

1. Governor assembly.
2. Governor cover and "O" ring.
3. Lower vehicle.

FILLER TUBE

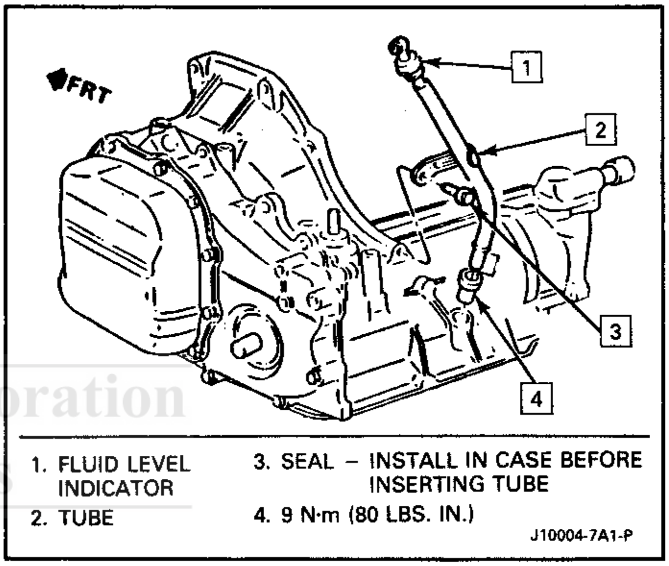
Figure 10

Remove or Disconnect

1. Fluid level indicator and nut or bolt retaining tube mounting bracket.
2. Raise vehicle and suitably support, see Section 0A.
3. Loosen tube from transaxle.
4. Lower vehicle.
5. Pull tube and seal out of vehicle from the top.

Install or Connect

1. Filler tube and seal.
2. Raise vehicle and suitably support, see Section 0A.
3. Locate filler and seal tube on transaxle.
4. Lower vehicle.
5. Filler tube mounting bracket.
6. Fluid level indicator.



1. FLUID LEVEL INDICATOR
2. TUBE
3. SEAL – INSTALL IN CASE BEFORE INSERTING TUBE
4. 9 N·m (80 LBS. IN.)

Figure 10 Filler Tube and Indicator

VALVE BODY COVER

Remove or Disconnect

1. Raise vehicle and suitably support, see Section 0A.
2. Left rear wheel and tire assembly.
3. Valve body cover to transaxle bolts.

Install or Connect

1. Valve body cover with a new gasket and bolts.
2. Left rear wheel and tire assembly.
3. Lower vehicle.

AUXILIARY VALVE BODY, VALVE BODY AND OIL PUMP ASSEMBLY

Remove or Disconnect

1. Negative battery cable.
2. Air cleaner.
3. T.V. Cable.
4. Raise vehicle and suitably support.
5. Left rear wheel and tire assembly.
6. Valve body cover.

7. Bolt securing TCC solenoid to auxiliary valve body and solenoid. Remove TCC solenoid wiring connector from case connector.
8. TCC wires from third gear pressure switch.
9. Bolt securing T.V. linkage and bracket assembly to valve body and T.V. linkage.
10. Remaining bolts securing valve body to case cover and valve body being careful not to loose the six check balls. Do not remove the green bolt.
11. Green bolt and separate auxiliary valve body from valve body.

Install or Connect

1. Auxiliary valve body to valve body with green bolt.
2. Check balls in valve body.
3. If necessary, use petroleum jelly to hold check balls in.
4. For placement of check balls, refer to specific transaxle Section 125C.
5. Valve body to case cover.
6. T.V. bracket and linkage.
7. TCC wires and wiring connectors.
8. TCC solenoid.
9. Valve body cover with a new gasket.
10. Left rear wheel and tire assembly.
11. Lower vehicle.
12. T.V. cable.
13. Air cleaner.
14. Negative battery cable.

Adjust

- T.V. cable. Refer to Figure 9.
- Fluid level. Refer to Section 7A.

TRANSAXLE SIDE CASE COVER

Tools Required:

J 28467-A

1. Negative battery cable.
2. Air cleaner.
3. T.V. cable at injection linkage.
4. T.V. cable from transaxle rod.
   - Install J 28467-A. Raise engine enough to take pressure from motor mounts.

CAUTION: Bodily injury could result with improper use of support fixture. Engine support must be located in center of cowl and fasteners must be torqued before supporting engine. Fixture is not intended to support entire weight of engine and transaxle.

5. Transaxle engine mount bolts.
6. Raise vehicle and suitably support.
7. Left rear wheel and tire assembly.
8. Valve body.
9. Oil pump drive shaft.
10. Transaxle cooler pipes and plug to prevent leakage.
11. External transaxle electrical connector.
12. Case attaching bolts and manual valve.
    - Install two 12 X 1.95 X 14 bolts in dowel pin holes and tighten to pull case cover loose.

Install or Connect

1. Manual valve.
2. Case cover, 11 N•m (98 lbs. in.).
3. Electrical connector.
4. Oil cooler lines.
5. Oil pump drive shaft.
6. Valve body.
7. Left rear wheel and tire assembly.
8. Lower vehicle.
9. Remove engine support fixture.
10. T.V. cable at injector linkage and transaxle.
11. Air cleaner.
12. Negative battery cable.

Adjust

- T.V. cable.

DRIVE LINK ASSEMBLY (CHAIN)

When disassembling any 125/125C inspect the drive link assembly (chain) for wear.

1. Remove the case side cover to expose the drive link (chain).

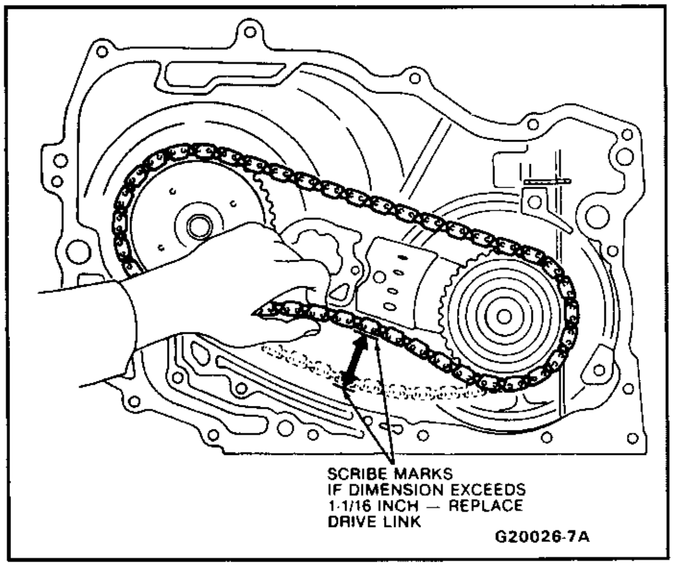


Figure 11 Checking Drive Link (Chain) Wear

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.
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 27.4mm (11/16 inches), replace the drive link (chain).

OIL COOLER LINES AND/OR FITTINGS

Figure 12

If replacement of transaxle cooler lines is required, use only double wrapped and brazed steel tubing meeting GM specification 123M or equivalent. Tubing should be double flared.

NOTICE: Allow sufficient clearance around cooler lines to prevent damage or wear which may cause fluid loss.

DRIVE AXLE SEALS

Remove or Disconnect

1. Raise vehicle and suitably support. See Section 0A.
2. Wheel and tire assembly.
3. Bolt to lower ball joint, see Section 3D.
4. Loosen tie rod end nut, see Section 3D.

NOTICE: Drive axle seal protector J 3362 on all Tri-pot inner joints with silicone boots. Failure to observe this can result in seal damage and possible joint failure. Refer to Section 4D for information on tool J 3362 and for proper drive axle removal and handling procedures.

5. Drive axle, see Section 4D.
6. Pry out seal with a screwdriver or other suitable tool.
   - Do not damage seal bore.

Install or Connect

1. New seal using tool J 34115. Lubricate seal lip with a light wipe of transmission fluid.
2. Axle into transaxle.

Important

- Carefully guide axle shaft past lip seal. Do not allow shaft splines to contact any portion of the seal lip surface, otherwise damage to the seal will occur.

3. Tighten tie rod end nut, see Section 3D.
4. Bolt thru lower ball joint, see Section 3D.
5. Wheel and tire assembly.
6. Lower vehicle.

TRANSMISSION ASSEMBLY

Remove or Disconnect

1. Battery negative (−) cable.
2. Air cleaner.
3. Right engine vent cover.
4. Left engine vent cover.
5. Throttle valve cable at transmission and carburetor.
6. Shift cable at transmission bracket.
7. Neutral start switch electrical connection.
8. Transmission converter clutch electrical connection.
9. Speedometer pick-up electrical connection.
10. Wire harness at transmission to engine retaining bolts.
11. Transmission cooler line support bracket.
12. Transmission to engine retaining bolts (5).

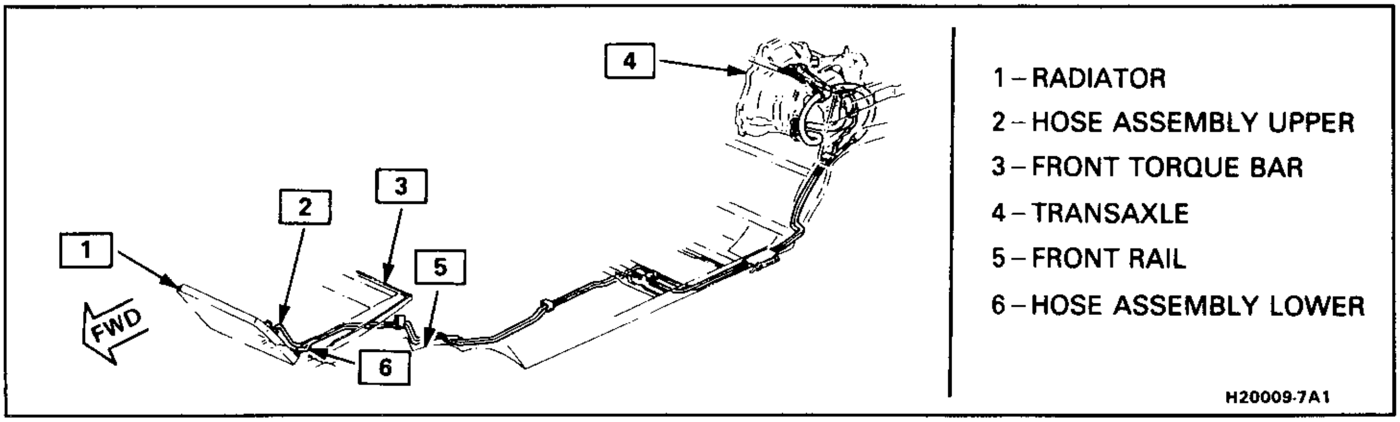


Figure 12 Cooler Pipes

13. Shift cable bracket to remove neutral start switch harness.
14. Install engine fixture tool J 28467-A
15. Raise vehicle and support with suitable jack stands.
16. Rear wheels.
17. Install rear axle boot protectors. (See Section 4D)
18. Fixed adjusting link/lateral control arm through bolts.
19. Trailing arms at knuckles.

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.

20. Rear axle shafts from transmission. (See Section 4D)
21. Support rear axle shafts.
22. Splash shields.
23. Brake cables at calipers.
24. Brake control cable at frame.
25. Exhaust at manifold.
26. Engine mounts to cradle nuts. (2)
27. Transmission mounts to cradle nuts. (2)
28. Front cradle retaining bolts. (2)
29. Rear cradle retaining bolts. (2)
30. Cradle from vehicle.
31. Starter/flexplate shield.
32. Flexplate bolts.
33. Cooler lines.
34. Plug cooler lines.
35. Install transmission support jack.
36. Transmission support bracket at back right. (2)
37. Remaining transmission to engine retaining bolts including ground wire.
38. Transmission from vehicle.

Install or Connect

1. Transmission to vehicle
2. Transmission to engine retaining bolts including ground wire.
3. Transmission support bracket.
4. Remove transmision support jack.
5. Unplug cooler lines.
6. Cooler lines.
7. Flexplate bolts.
8. Starter/flexplate shield.
9. Cradle to vehicle.
10. Rear cradle retaining bolts. (2)
11. Front cradle retaining bolts. (2)
12. Transmission mounts to cradle nuts. (2)

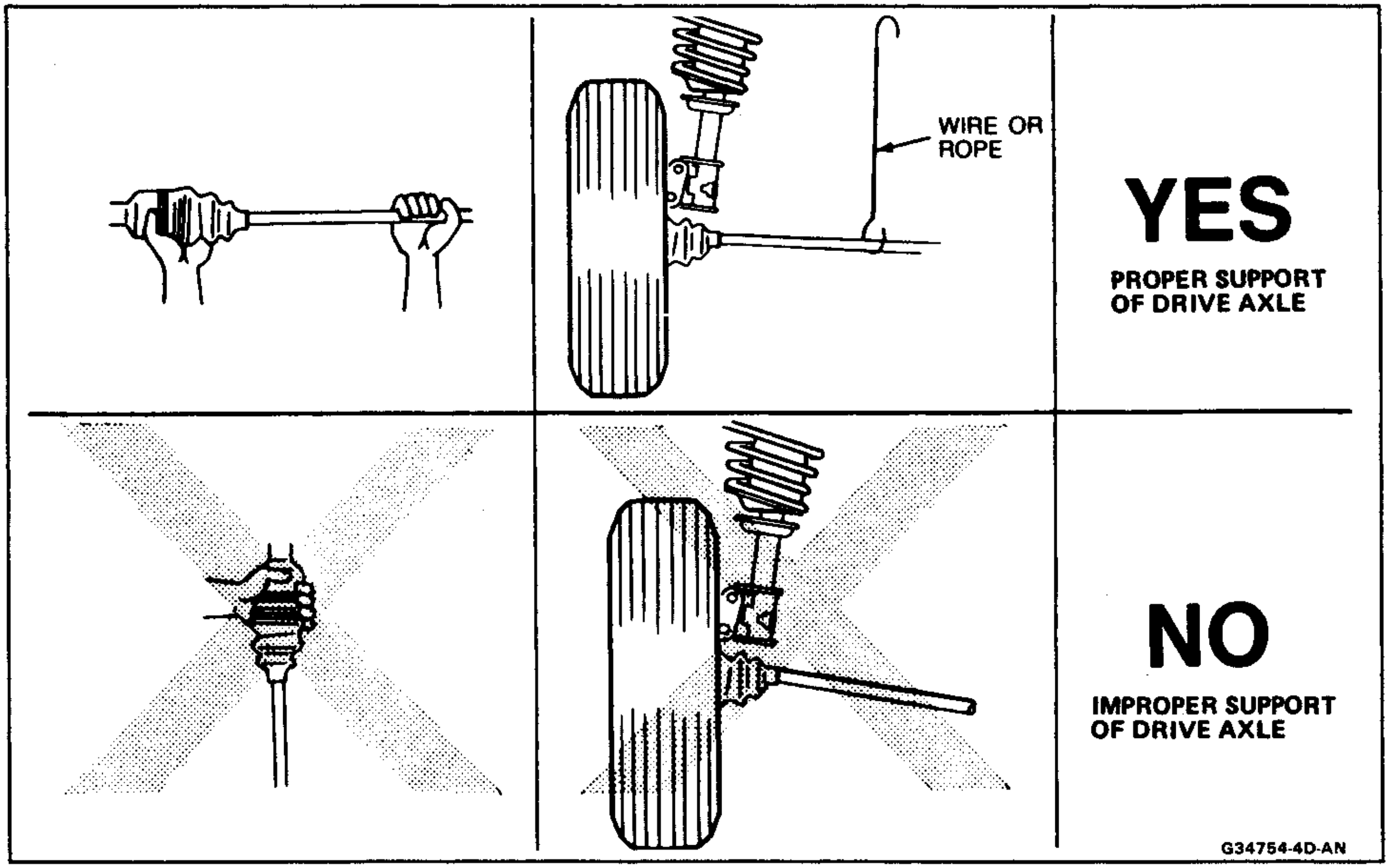


Figure 13 Joint Handling Precaution

13. Enging mounts to cradle nuts. (2)
14. Exhaust to manifold.
15. Brake control cable at frame.
16. Brake cables to calipers.

    Adjust

    1. Brake cable. (See Section 5)

17. Splash shields.
18. Disconect rear axle shaft from support.
19. Rear axle shaft to transmission. (See Section 4D)
20. Trailing arms to knuckles.

    Tighten

    1. Torque trailing arm at knuckle to 60 N•m (44 lbs. ft.) +90°.

21. Fixed adjusting link/lateral control arm through bolts.

    Tighten

    1. Torque fixed adjusting link/lateral control arm through bolt to 50 N•m (37 lbs. ft.) +90°.

22. Remove rear axle boot protector.
23. Rear wheels.
24. Remove jack stands and lower vehicle.
25. Remove engine fixture tool J 28467-A.
26. Neutral start switch harness and shift cable bracket.
27. Transmission to engine retaining bolts.
28. Transmission cooler line support bracket.
29. Wire harness at transmission to engine retaining bolts.
30. Speedometer pick-up electrical connection.
31. Transmission converter clutch electrical connection.
32. Neutral start switch electrical connection.
33. Shift cable to transmission bracket.
34. Throttle valve cable to transmission and carburetor.
35. Left engine vent cover.
36. Right engine vent cover.
37. Air cleaner.
38. Battery negative (–) cable.

SECTION 125C

MD8

AUTOMATIC TRANSAXLE HYDRAULIC DIAGNOSIS

CONTENTS

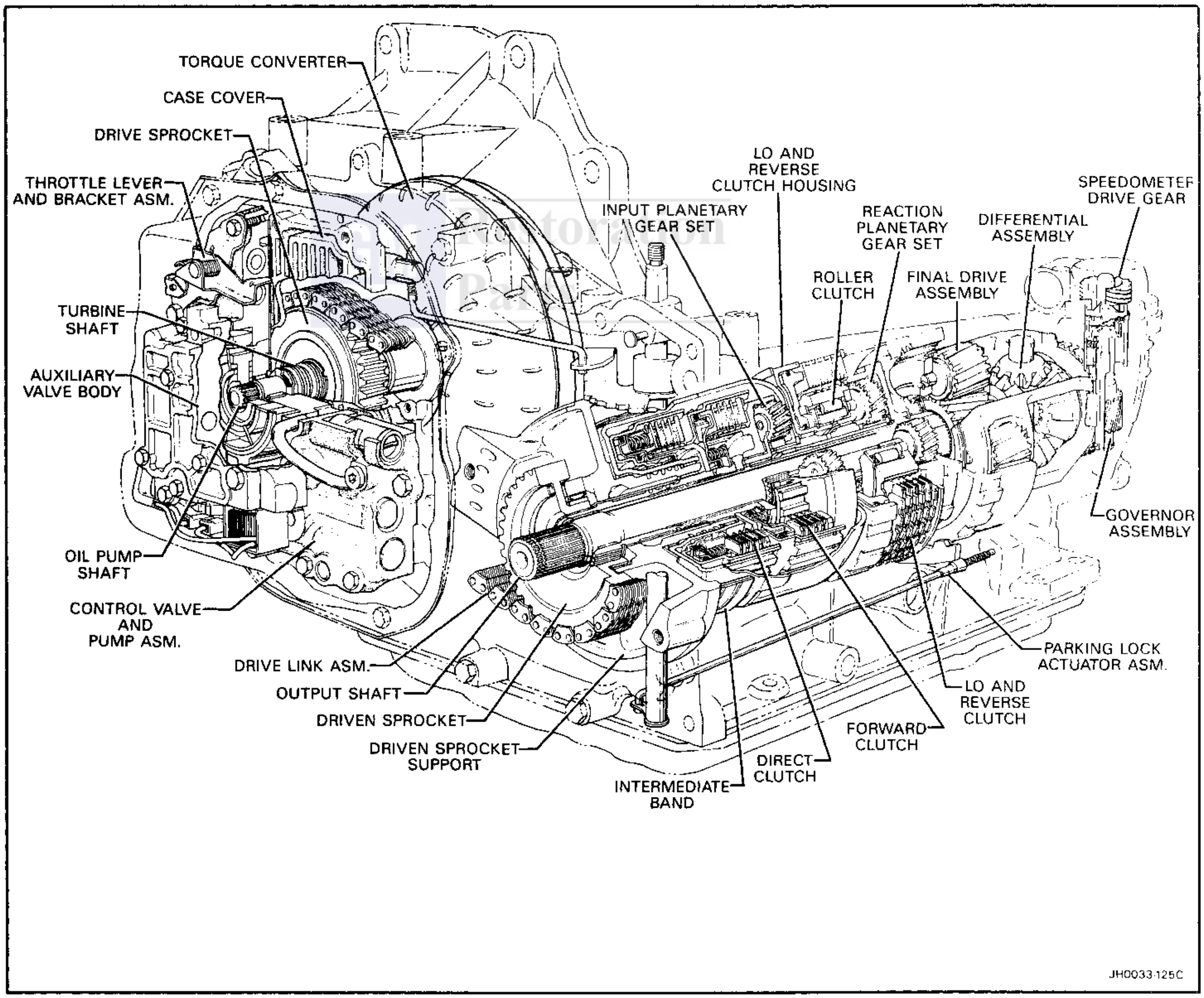


Figure 1 THM 125C Transaxle

GENERAL DESCRIPTION

The THM 125C transaxle is a fully automatic unit for front wheel drive and mid-engine rear wheel drive vehicles, which provides three forward gear ranges and a reverse.

The major components of this transaxle are:

- 4-element hydraulic torque converter
- Compound planetary gear set
- Dual sprocket and drive link assembly
- Three multiple disc clutches
- One roller clutch
- Intermediate band assembly
- Valve body assembly
- Vane type oil pump

The oil pressure and shift points are controlled by throttle opening via a throttle valve cable (See the 7A section for T.V. cable information).

The transaxle can be operated in any of six different modes shown on the shift quadrant.

P– Park position prevents the vehicle from rolling either forward or backward. (For safety reasons the parking brake should be used in addition to the park position.)

R– Reverse allows the vehicle to be operated in a rearward direction.

N– Neutral allows the engine to be started and operated without driving the vehicle. If necessary this position may be selected if the engine must be restarted with the vehicle moving.

D– Drive position is used for all normal driving conditions. It provides three gear ratios plus converter clutch operation. Downshifts are available for safe passing by depressing the accelerator.

2– Manual second is used to provide acceleration and engine braking. This range may be selected at any vehicle speed.

1– Manual Lo is used to provide maximum engine braking. This range may also be selected at any vehicle speed.

DIAGNOSIS INFORMATION

ROAD TEST PROCEDURE

- Perform the road test following the sequence given
- MPH (KPH) shift points will vary with actual throttle position and driver habits
- Compare the results of the test with speed shift chart information. Use these results with the diagnosis information in the specific Automatic Transaxle Unit Repair Section to evaluate the transaxle.
- This test should only be performed when traffic and road conditions permit
- Observe all traffic safety regulations

Garage Shift Check

1. Start engine
2. Depress brake pedal
3. Move gear selector:
   - "Park" (P) to "Reserve" (R)
   - "Reverse" (R) to "Neutral" (N) to "Drive" (D)

   Gear selections should be immediate and not harsh.

Upshifts and Torque Converter Clutch (TCC) Apply (Figure 2)

With gear selector in "Drive" (D)

1. Accelerate using a steady increasing throttle pressure
2. Note the shift speed point gear engagements for:
   - 2nd gear
   - 3rd gear
3. Note the speed shift point for TCC apply. This should occur between 15 - 25 MPH (24 - 40 KPH). If the apply is not noticed, refer to the Preliminary Torque Converter Clutch Diagnosis information contained in this section of the Service Manual.

Important

The torque converter clutch will not engage if engine coolant has not reached a minimum operating temperature of approximately 54°C (130°F).

Part Throttle Detent Downshift

At vehicle speeds of 25-55 MPH (40-88 KPH) quickly depress the accelerator to a half open position and observe:

- TCC releases
- Transaxle downshift to 2nd gear immediately

Full Throttle Detent Downshift

At vehicle speeds of 25-55 MPH (40-88 KPH) quickly depress the accelerator to a wide open position and observe:

- TCC releases
- Transaxle downshifts to 2nd gear immediately

Manual Downshift

1. At vehicle speeds of 25-55 MPH (40 to 88 KPH) release the accelerator pedal while moving the gear selector to "Second" gear (2) and observe:
   - TCC release
   - Transaxle downshift to 2nd gear should be immediate
   - Engine should slow vehicle down
2. Move gear selector to "Drive" (D) and accelerate to 25 MPH (40 KPH). Release the accelerator pedal while moving the gear selector to "First" gear (1) and observe:
   - TCC release
   - Transaxle downshift to 1st gear should be immediate
   - Engine should slow vehicle down

Coastdown Downshift

1. With the gear selector in "Drive" (D) accelerate the vehicle to 3rd gear with TCC applied.
2. Release the accelerator pedal and lightly apply the brakes to observe:
   - TCC

   - Speed shift points for a third to second and second to first gear downshift.

Manual Gear Range Selection

MANUAL SECOND (2)

1. With vehicle stopped, place gear selector in "Second" (2) and accelerate to observe:
   - The first to second gear shift point
2. Accelerate to 25 MPH (40 KPH) and observe:
   - That a second to third gear shift does not occur
   - That TCC does not engage

MANUAL FIRST (1)

1. With vehicle stopped, place gear selector in "First" (1) and accelerate to 15 MPH (24 KPH) and observe:
   - That no upshift occurs
   - That TCC does not engage

REVERSE

1. With vehicle stopped, place gear selector in "Reverse" (R) and slowly accelerate to observe reverse gear operation.
   All possible throttle positions and corresponding MPH shift point information has not been provided.

TRANSAXLE PRESSURE CHECK PROCEDURE RETURN

Inspect

- Fluid level
- TV cable adjustment
- Manual linkage
- Engine mechanical, emissions, electrical and fuel delivery systems

Install or Connect (Figure 3)

- Oil pressure gage
- Tachometer

1988 "THM 125C" SHIFT SPEED CHART

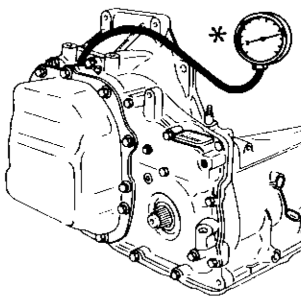
MODEL	FINAL DRIVE RATIO	1-2 MIN THROTTLE	2-3 MIN THROTTLE	1-2 W.O.T.*	3-2 COAST DOWN	2-1 COAST DOWN
BHC, BJC	2.84	10-14	20-21	47-55	17-19	7-12
CBC	2.84	13-16	20-22	45-53	19-21	11-15
CJC, CUC	2.84	9-12	20-22	38-46	18-21	6-10
CMC	2.84	13-16	20-22	45-53	19-21	11-15
CPC	3.33	9-11	18-20	36-43	17-18	6-10
CRC	2.84	3-16	20-22	45-53	19-21	11-15
CTC	2.84	10-14	22-24	38-49	18-21	6-10
HFC	3.06	10-12	18-19	35-41	15-17	8-11
HHC	3.06	10-12	20-22	35-41	16-17	8-11
HLC	3.06	9-11	18-20	32-40	16-18	6-10
HRC	3.06	9-12	18-20	38-45	17-18	5-10
HWC, HZC	3.33	10-11	17-19	34-40	14-16	8-10
HYC	3.33	10-12	19-20	40-46	15-17	8-11
JAC	3.06	10-12	18-19	37-43	15-17	8-11
JDC	3.06	7-7	15-16	33-38	12-14	5-8
JFC	3.33	9-11	17-18	31-37	14-15	6-10
JKC	3.33	9-11	17-18	33-39	14-15	8-10
JMC	3.33	7-9	15-16	33-38	12-14	5-8
JNC	3.33	7-9	12-13	24-28	8-9	5-8
JPC	3.06	10-12	18-19	32-37	15-17	8-11
JUC	3.33	10-12	18-19	30-37	15-17	8-11
JWC	3.06	7-9	12-13	27-31	7-9	5-8
JXC	3.33	9-11	18-20	39-45	13-16	5-9
KDC	2.84	9-12	17-19	51-55+	15-17	6-10
KHC	3.33	9-12	20-21	43-51	17-19	5-10
LSC	2.84	10-14	22-24	45-54	20-22	6-11
PDC, PNC, PSC, PZC	2.84	10-13	20-21	39-45	18-20	7-11
PKC, TRC	2.84	11-15	19-21	45-52	17-19	9-13
PMC, POC, PPC	2.84	9-13	20-23	43-47	18-20	6-11
PTC	3.06	11-13	17-18	38-45	15-17	9-12
PUC	3.06	9-12	20-21	40-47	18-20	6-10
PVC	2.84	11-15	23-25	43-51	21-23	8-12
RAC	3.33	9-11	17-18	33-39	14-15	8-10
RLC	3.33	10-12	18-19	39-45	15-17	8-11
TAC	3.06	10-12	18-19	37-43	15-17	8-11
TBC	3.06	10-12	18-19	36-42	15-17	8-11
TNC	2.84	10-14	22-24	45-54	20-22	6-11

NOTES:
1. ALL SPEEDS INDICATED ARE IN MILES PER HOUR. CONVERSION TO KPH = MPH × 1.609.
2. SHIFT POINTS WILL VARY SLIGHTLY DUE TO ENGINE LOADS AND VEHICLE OPTIONS.
3. SPEEDS LISTED WITH + EXCEED 55 MPH.

JH0017-125C

Figure 2 Speed Shift Chart

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.

CAUTION Brakes must be applied at all times.

NOTICE Total running time for this combination not to exceed 2 minutes.

RANGE	MODEL	MINIMUM T.V.		MAXIMUM T.V.	
		kPa	P.S.I.	kPa	P.S.I.
Park @ 1000 RPM	8BJC,8BHC,8CBC,8CMC,8CRC,8HFC,8HHC,8HWC,8HYC,8HZC,8JAC,8JDC,8JFC, 8JKC,8JMC,8JNC,8JPC,8JUC,8JWC,8PDC,8PUC,8RAC,8RCC,8TAC,8TBC	396-436	57-62	396-436	57-62
	8CJC,8CTC,8CUC,8HKC,8HLC,8JXC,8KDC,8KHC,8LSC,8PKC,8PDC,8PMC,8PNC,8PPC, 8PSC,8PTC,8PVC,8PZC,8TRC	460-506	67-73	460-506	67-73
Reverse @ 1000 RPM	8PMC,8PPC,8POC	673-741	98-107	1718-1720	249-278
	8BJC,8BHC,8CPC,8JFC	694-764	101-111	1603-1785	233-259
	8CBC,8CMC,8CRC	694-764	101-111	1652-1845	240-268
	8JDC,8JKC,8JMC,8PTC,8PUC,8RAC	694-764	101-111	1412-1574	205-228
	8JNC	694-764	101-111	1190-1312	173-190
	8JPC	694-764	101-111	1376-1530	200-222
	8JWC	694-764	101-111	1456-1611	211-234
	8PDC,8PZC	694-764	101-111	1772-1980	257-287
	8HFC,8HHC	760-837	110-121	1507-1676	219-243
	8JAC,8JUC,8TAC,8TBC	760-837	110-121	1547-1725	224-250
	8RCC	760-837	110-121	1679-1873	244-272
	8HWC,8HYC,8HZC	760-837	110-121	1810-2021	263-293
	8TNC,8PVC	805-886	117-129	1524-1696	221-246
	8JXC	805-886	117-129	1601-1779	232-258
	8HLC	805-886	117-129	1636-1825	237-265
	8HRC,8PKC,8PNC,8TRC	805-886	117-129	1643-1831	238-266
	8CJC,8CUC	805-886	117-129	1714-1907	249-277
	8CTC,8KDC,8LSC	805-886	117-129	1763-1966	256-285
	8KHC	805-886	117-129	1784-2052	259-298
Neutral/ Drive @ 1000 RPM	8JNC	396-436	57-63	679-749	98-109
	8JPC,8HFC,8HHC	396-436	57-63	786-874	114-127
	8JAC,8JDC,8JKC,8JMC,8JUC,8PTC,8PUC,8RAC,8TAC,8TBC	396-436	57-63	807-899	117-130
	8JWC	396-436	57-63	832-920	121-133
	8PVC	396-436	57-63	870-967	126-140
	8RCC	396-436	57-63	875-976	127-142
	8BJC,8BHC,8CPC,8JFC	396-436	57-63	916-1019	133-148
	8CBC,8CMC,8CRC,8HZC,8HYC,8HWC	396-436	57-63	943-1053	137-153
	8PDC,8PMC,8POC,8PPC,8PZC	396-436	57-63	1012-1131	147-164
	8TNC	460-506	67-73	870-969	126-141
	8JXC	460-506	67-73	914-1016	133-147
	8HLC	460-506	67-73	934-1042	135-151
	8HRC,8PKC,8PNC,8PSC,8TRC	460-506	67-73	939-1046	136-152
	8CUC,8CJC	460-506	67-73	980-1089	142-158
	8CTC,8KDC,8LSC	460-506	67-73	1007-1123	146-163
	8KHC	460-506	67-73	1019-1172	148-170
Intermediate/ Lo @ 1000 RPM	8BHC,8BJC,8CBC,8CMC,8CPC,8CRC,8JDC,8JFC,8JKC,8JMC,8JNC,8JPC, 8JWC,8PDC,8PTC,8PUC,8PZC,8RAC	680-749	99-109	680-749	99-109
	8CJC,8CTC,8CUC,8HLC,8HRC,8JXC,8KDC,8KHC,8LSC,8PKC,8PNC,8PSC,8PVC,8TNC,8TRC	789-868	114-126	789-868	114-126
	8HFC,8HHC,8HWC,8HYC,8HZC,8JAC,8JUC,8PMC,8POC,8PPC,8RCC,8TAC,8TBC	827-910	120-132	827-910	120-132

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 3 Preliminary Check Procedure

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 4 Range Reference Chart

CONDITION	INSPECT COMPONENT	FOR CAUSE
CHATTERS/SLIPS IN 1ST GEAR	• Oil Level	— Low.
	• T.V. Cable	— Not adjusted properly. — Wrong cable.
	• Oil Pressure	— (See causes of high or low oil pressure.)
	• Forward Clutch	— Restricted feed. — Burned clutch plates.
	• Driven Sprocket Support	— Rough machine surface.
	• Case Cover Gasket	— Incorrect gasket.
NO REVERSE OR SLIPS IN REVERSE	• Forward Clutch	— Burned clutch plates. — Seal ring off piston. — Exhaust check ball sticking.
	• Lo & Reverse Clutch	— Housing cup plug assembly restricted/not fully seated. — Leaking seals.
	• Lo & Reverse Pipe	— "O" ring seal damaged or missing.
	• Case To Cover Gasket	— Incorrect (driven sprocket support height wrong). — Damaged or leaking.
	• Direct Clutch	— Burned plates.
	• Lo & Reverse Clutch	— Burned plates.
	• Low Line Pressure	— Check causes of low line pressure.
NO UPSHIFTS, DELAYED UPSHIFTS OR FULL THROTTLE UPSHIFTS	• Manual Linkage	— Misadjusted.
	• T.V. Cable	— Misadjusted, unhooked, bound or broken.
	• Oil Level	— Low.
	• Governor	— Cover worn. — Thrust washer missing. — Governor seal worn or cut. — Governor spring not seated. — Governor weights binding on pin. — Ball missing. — Governor driven gear stripped.
	• Intermediate Servo	— Wrong or sticking apply pin. — Seals cut, damaged or missing. — Piston sticking or damaged. — Porosity in case servo bore.
	• Control Valve Assembly	— Valves sticking. — Spacer plate gaskets leaking or incorrectly installed.
	• Valve Body Spacer	— Governor feed orifice to 1-2 and 2-3 shift valve plugged. — Drive to governor orifice plugged.
	• Intermediate Band	— Burned or worn.

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Figure 5 Diagnosis Chart

CONDITION	INSPECT COMPONENT	FOR CAUSE
NO UPSHIFTS, DELAYED UPSHIFTS OR FULL THROTTLE UPSHIFTS (Continued)	• Case Cover	— Porosity. — Undrilled holes. — Missing cup plugs. — 2nd oil passage leaking.
	• Case	— Leaks in governor passage and/or pipe. — 2nd oil passage leaking.
SLIPPING OR ROUGH 1-2 SHIFT	• Oil Level	— High or low.
	• T.V. Cable	— Misadjusted, unhooked, bound or broken.
	• Oil Pressure	— (See causes of high or low oil pressure.)
	• Intermediate Servo	— Seals cut, damaged or leaking. — Piston damaged. — Servo bore in case damaged. — Apply pin too long or too short. — Servo orifice bleed cup plug missing. — Leak between servo apply pin and case.
	• Intermediate Band	— Binding servo band apply pin.
	• T.V. Link	— Bent or wrong link.
	• Control Valve Assembly	— T.V. plunger binding. — Shift T.V. valve binding. — 1-2 accumulator valve binding.
	• 1-2 Accumulator	— Binding 1-2 accumulator piston. — Broken 1-2 accumulator spring. — Piston seal or groove damaged. — 1-2 accumulator bore damaged.
	• Spacer Plate	— Incorrect spacer plate or gasket. — Gasket incorrectly installed.
	• Case	— 2nd oil passage leaking.
	• Case Cover	— 2nd oil passage leaking.
2-3 SHIFT ROUGH OR DELAYED	• Oil Level	— Incorrect level.
	• T.V. Valve	— Misadjusted, unhooked, bound or broken.
	• Manual Linkage	— Misadjusted.
	• Oil Pressure	— (Check for causes of high or low oil pressure.)
	• Direct Clutch	— Plugged accumulator exhaust port.
	• Direct Clutch Exhaust #1 Check ball	— Mispositioned or missing.
	• Control Valve Assembly	— Binding plunger and throttle valve. — Binding shift T.V. valve.
2-3 SHIFT SOFT, SLIPS OR EARLY	• Oil Level	— Incorrect level.
	• T.V. Cable	— Misadjusted, unhooked, bound or broken.
	• Manual Linkage	— Misadjusted.
	• Oil Pressure	— (Check for causes of high or low oil pressure.)

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Figure 6 Diagnosis Chart

CONDITION	INSPECT COMPONENT	FOR CAUSE
2-3 SHIFT SOFT, SLIPS OR EARLY (Continued)	• Intermediate Servo	— Piston to case oil seal damaged. — Servo piston damaged. — Servo bore in case damaged.
	• Accumulator Exhaust Check Valve	— Not seating in case.
	• Spacer Plate	— Plugged or restricted direct clutch feed orifice. — Spacer plate or gaskets leaking, damaged or incorrectly installed. — Wrong spacer plate.
	• Check Ball #5	— Not seating or missing.
	• Case Cover	— Porosity in direct clutch case cover passage. — Incorrect case cover gaskets. — Driven sprocket support passages interconnected, leaking, or restricted. — Driven sprocket support oil seal rings damaged or missing. — Sleeve loose or out of position.
	• Direct Clutch	— Check ball leaking. — Check ball capsule damaged. — Damaged/missing seals. — Cracked/damaged housing or piston. — Missing or incorrect apply ring. — Wrong number of clutch plates.
NO 2-3 SHIFT OR 2-3 SHIFT DELAYED	• Oil Level	— Incorrect level.
	• T.V. Valve	— Misadjusted, unhooked, bound or broken.
	• Manual Linkage	— Misadjusted.
	• Governor	— Cover worn. — Thrust washer missing. — Governor seal worn or cut. — Governor spring not seated. — Governor weights binding on pin. — Ball missing. — Governor driven gear stripped.
	• Intermediate Servo	— Piston to case oil seal damaged. — Servo piston damaged. — Servo bore in case damaged. — Servo orifice bleed cup plug missing in case.
	• Accumulator Exhaust Check Valve	— Not seating in case.
	• Case	— Direct clutch accumulator cup plug (3rd oil) leaking or missing. — Case to governor shaft sleeve missing or damaged. — Center gasket leaking.

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Figure 7 Diagnosis Chart

CONDITION	INSPECT COMPONENT	FOR CAUSE
NO 2-3 SHIFT OR 2-3 SHIFT DELAYED (Continued)	• Case Cover	— Case cover bolts loose. — Driven sprocket support passages interconnected, leaking, or restricted. — Driven sprocket support oil seal rings damaged or missing. — Sleeve loose or out of position.
	• Throttle Lever & Bracket Assembly	— Binding.
	• T.V. Link	— Wrong, unhooked or binding T.V. link.
	• Control Valve Assembly	— 2-3 shift valve, 2-3 T.V. valve sticking. — Shift T.V. valve sticking. — Governor feed to 2-3 shift valve restricted. — Direct clutch feed orifice restricted. — #5 check ball missing or mislocated.
	• Spacer Plate	— Spacer plate or gaskets leaking, damaged or incorrectly installed.
	• Case To Governor Shaft Sleeve	— Damaged or missing.
	• Direct Clutch	— Check ball leaking. — Check ball capsule damaged. — Seals damaged/missing. — Cracked/damaged housing or piston. — Backing plate snap ring out of groove. — Clutch plates damaged/missing.
DELAY IN DRIVE AND REVERSE	• Oil Level	— Incorrect level.
	• Oil Pressure	— Check cause of low oil pressure.
	• Converter, Drive Sprocket Support Bushings	— Converter drainback.
	• Turbine Shaft	— Scarf seals damaged or leaking.
NO DRIVE IN DRIVE OR INTERMEDIATE RANGE (Lo & Reverse OK)	• Lo Roller Clutch	— Springs missing. — Rollers galled or missing.
NO DRIVE IN FORWARD RANGES (Reverse Ties Up)	• Driven Sprocket Support	— Sleeve turned.
NO DRIVE IN ALL RANGES	• Oil Level	— Incorrect level.
	• Torque Converter	— Converter to flex plate bolts missing.
	• Oil Pressure	— Pressure regulator valve sticking in bushing. — Worn pump seals. — Oil pump shaft broken.
	• Differential	— Differential damaged/broken up.

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Figure 8 Diagnosis Chart

CONDITION	INSPECT COMPONENT	FOR CAUSE
NO DRIVE IN ALL RANGES (Continued)	• Drive Link	— Broken drive link. — Object between drive link and sprocket.
	• Manual Linkage	— Misadjusted.
	• Input Shaft	— Loose or broken away from forward clutch drum.
	• Reaction Carrier	— Broken at lo roller clutch cam.
NO DRIVE IN DRIVE RANGE (Intermediate, Lo & Reverse OK)	• Oil Level	— Incorrect level. — External leaks.
	• Forward Clutch	— Feed in input shaft restricted (may occur with cold engine at fast engine idle).
	• Case Cover	— Leak between case cover and driven sprocket support passages. — Incorrect gaskets between case cover and driven sprocket support passages.
NO DRIVE IN ANY FORWARD RANGE (Reverse OK)	• Oil Pressure	— See causes of low oil pressure.
	• Manual Linkage	— Not moving manual valve.
	• Driven Sprocket Support	— Drive oil passage blocked in driven sprocket support or gasket. — Sleeve loose or mislocated.
	• Case Cover	— Drive oil passage leak.
	• Forward Clutch	— Burned or damaged plates.
	• Control Valve Assembly	— Valve body pipe leaking or missing.
SECOND SPEED START (Misses 1st At Times)	• Governor	— Springs distorted or out of place. — Governor weights binding on pin.
	• Control Valve Assembly	— 1-2 shift valve sticking in upshifted position. — 1-2 throttle valve sticking in upshifted position.
SHIFTS 1-3, MISSES 2ND	• Intermediate Servo	— Wrong or sticking apply pin. — Seals cut, damaged or missing. — Piston sticking or damaged. — Porosity in case servo bore.
	• Accumulator Exhaust Valve	— Sticking, not seating.
	• Control Valve Assembly	— 1-2 shift valve sticking.
	• Spacer Plate	— Gaskets incorrectly installed. — Governor feed to 1-2 shift valve blocked. — Intermediate band apply feed orifice blocked. — Wrong spacer plate.

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Figure 9 Diagnosis Chart

CONDITION	INSPECT COMPONENT	FOR CAUSE
SHIFTS 1-3, MISSES 2ND (Continued)	• Case	— Intermediate servo apply passage (2nd oil) blocked.
	• Case Cover	— Intermediate servo apply passage (2nd oil) blocked.
	• Intermediate Band	— Band improperly installed. — Band burned/broken.
SHIFTS 3-1 AT HIGH SPEEDS FOR PASSING GEAR (Detent Downshifts)	• Governor	— Cover worn. — Thrust washer missing. — Governor seal worn or cut. — Governor spring not seated. — Governor weights binding on pin. — Ball missing. — Governor driven gear stripped.
	• Intermediate Servo	— Intermediate servo sticking.
	• Direct Clutch Orifice Controlled by #2 Check Ball	— Restriction in orifice.
	• 1-2 Accumulator	— Piston missing. — Seal leaking.
NO FULL THROTTLE (DETENT) DOWNSHIFT	• T.V. Cable	— Misadjusted, unhooked, bound or broken.
	• Throttle Cable Assembly	— Not opening throttle sufficiently.
	• Control Valve Assembly	— Shift T.V. valve binding. — T.V. valve binding.
	• Spacer Plate	— Spacer plate holes plugged. — Gasket mispositioned or damaged.
NO OVERRUN BRAKING IN LO (L1) (Reverse OK)	• Manual Linkage	— Misadjusted.
	• Lo & Reverse Clutch	— Lo and reverse pipe leaking. — Piston seals leaking.
	• Control Valve Assembly	— Lo blow off valve assembly damaged.
NO INTERMEDIATE RANGE (2ND GEAR)	• Intermediate Servo	— Oil seal ring missing or damaged.
	• Intermediate Band	— Band mispositioned, broken or burned.
	• 1-2 Accumulator	— Accumulator piston or pin missing or damaged.

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Figure 10 Diagnosis Chart

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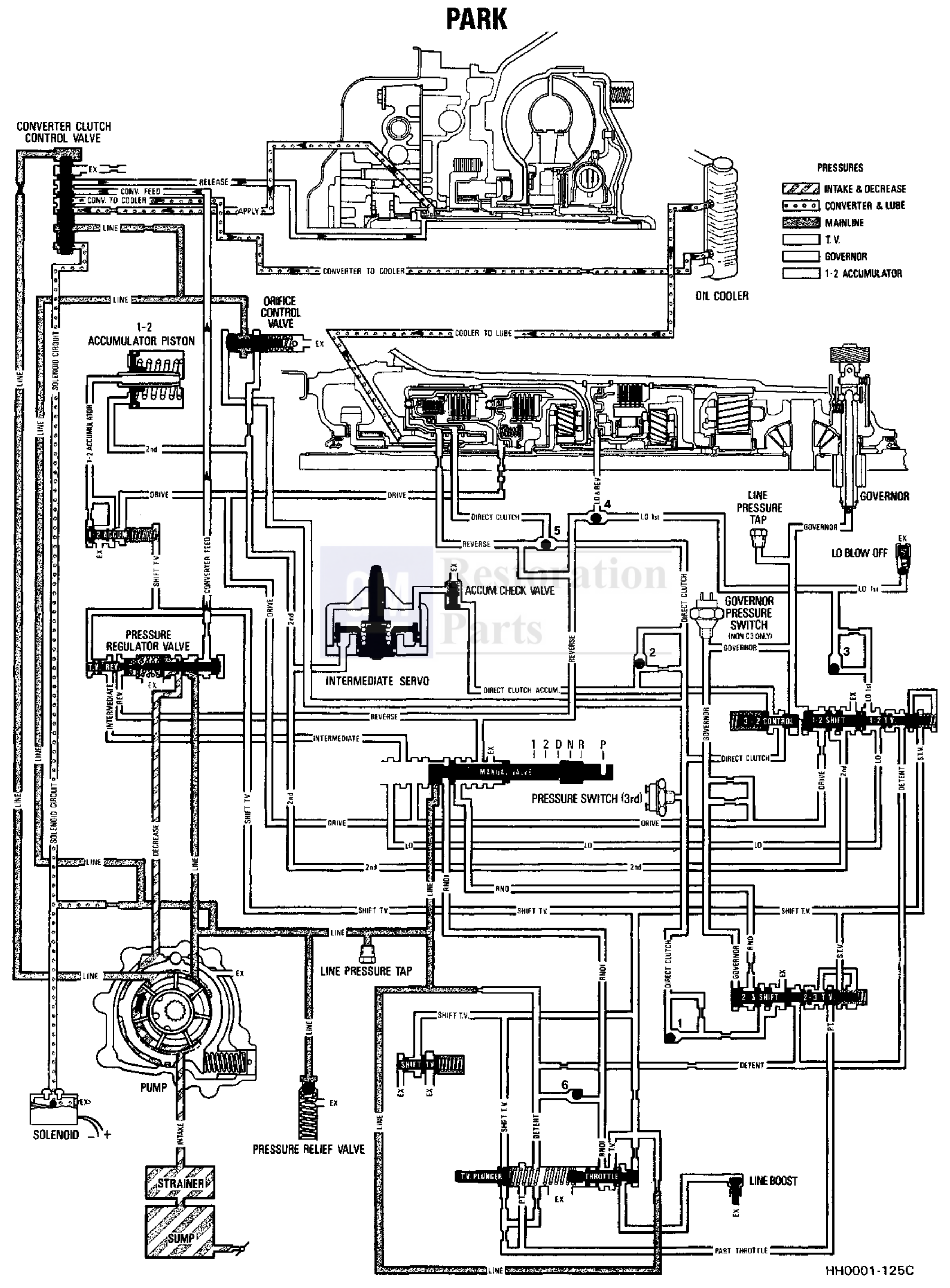

Figure 11 Park - Engine Running

PARK—ENGINE RUNNING

DIRECT CLUTCH – RELEASED **FORWARD CLUTCH – RELEASED** **LO AND REVERSE CLUTCH – RELEASED**

CONVERTER CLUTCH – RELEASED **INTERMEDIATE BAND – RELEASED** **ROLLER CLUTCH – NOT HOLDING**

With the selector lever in the Park (P) position, oil from the pump is directed to the following:

1. Pressure Regulator Valve
2. Converter and Lubrication System
3. Pump Slide
4. Manual Valve
5. Pressure Relief Valve
6. Line Pressure Tap

Oil flows from the pump to the pressure regulator valve which regulates the pump pressure. When the pump output exceeds the demand of line pressure, oil from the pressure regulator valve is directed to the converter feed passage to fill the converter. Converter return oil is directed to the transmission cooler. Oil from the cooler is directed to the transmission lubrication system.

Oil is also directed from the pressure regulator valve to the pump slide to decrease pump output to the pressure of the regulator valve spring force, or 482 kPa (70 psi). Line pressure acts on the pressure relief valve which will exhaust any oil above 2,068 to 3,102 kPa (300 - 450 psi).

Line pressure at the manual valve is available for use in other drive ranges.

SUMMARY

The converter is filled; all clutches and the band are released. Manual linkage has the parking pawl engaged in the reaction internal gear lugs. The transmission is in Park (P). Line pressure is regulated to approximately 483 kPa (70 psi).

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Figure 12 Park-Engine Running

NEUTRAL—ENGINE RUNNING

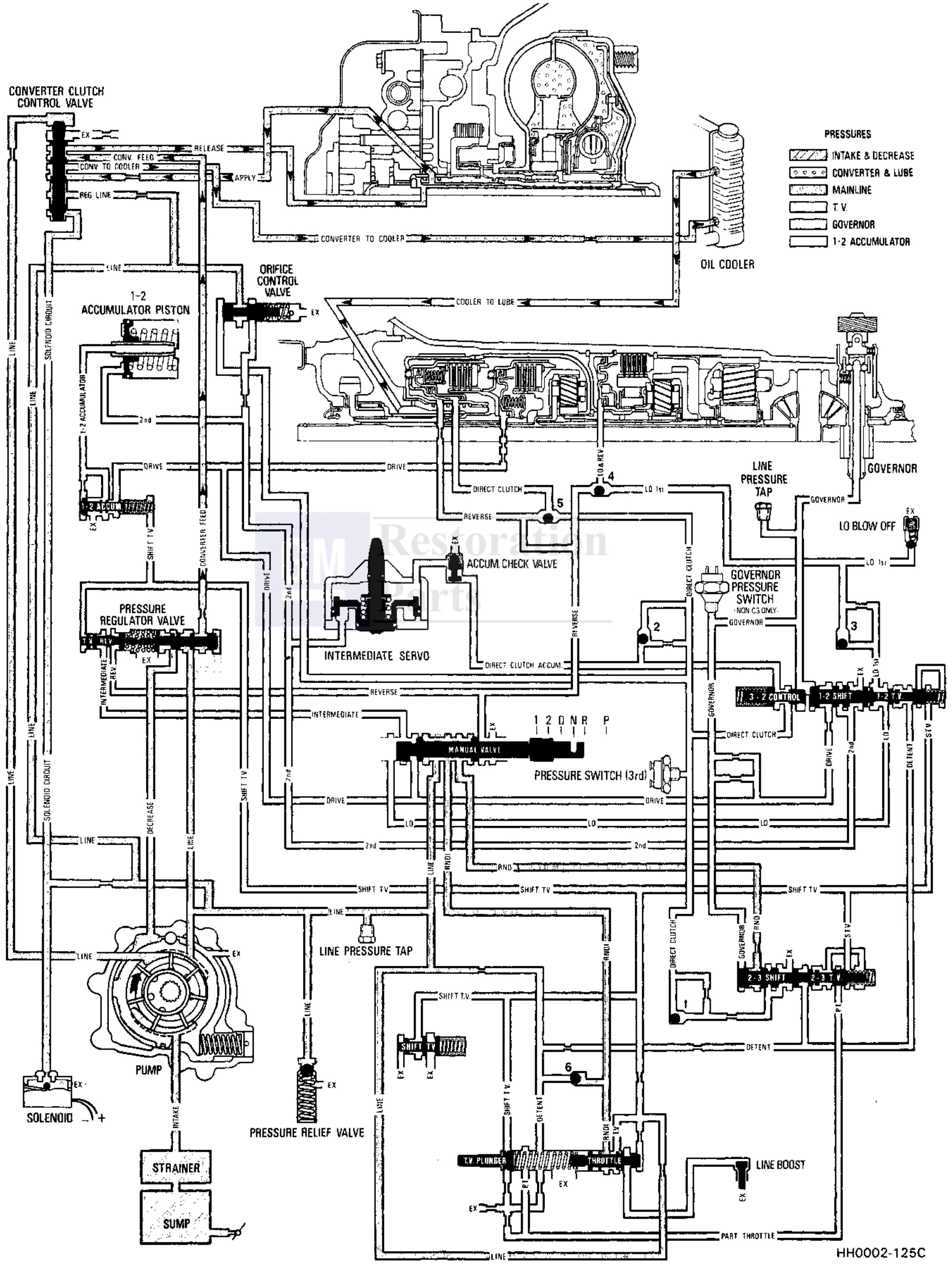

Figure 13 Neutral - Engine Running

NEUTRAL—ENGINE RUNNING

DIRECT CLUTCH – RELEASED **FORWARD CLUTCH – RELEASED** **LO AND REVERSE CLUTCH – RELEASED**

CONVERTER CLUTCH – RELEASED **INTERMEDIATE BAND – RELEASED** **ROLLER CLUTCH – NOT HOLDING**

When the selector lever is moved to the Neutral (N) position, the manual valve is positioned to allow line pressure to enter two (2) passages as follows:

FIRST: It enters the Reverse, Neutral, Drive, Intermediate (RNDI) passage. RNDI oil is directed to the seat RNDI and detent check ball (6), and to the throttle valve where it is regulated to a variable pressure called throttle valve (T.V.) pressure. T.V. pressure increases with carburetor opening and is directed to the shift throttle valve. This valve limits shift T.V. oil pressure from going above 620 kPa (90 psi).

Shift T.V. oil is then directed to the 1-2 and 2-3 throttle valves, T.V. boost valve, T.V. plunger and the 1-2 accumulator valve.

Shift T.V. oil acting on the T.V. boost valve will boost line pressure according to throttle opening.

SECOND: Line pressure enters the Reverse, Neutral, Drive (RND) passage and is directed to a land on the 2-3 shift valve.

SUMMARY

The converter is filled; all the clutches and the band are released; the transmission is in Neutral (N).

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Figure 14 Neutral - Engine Running

DRIVE RANGE—FIRST GEAR

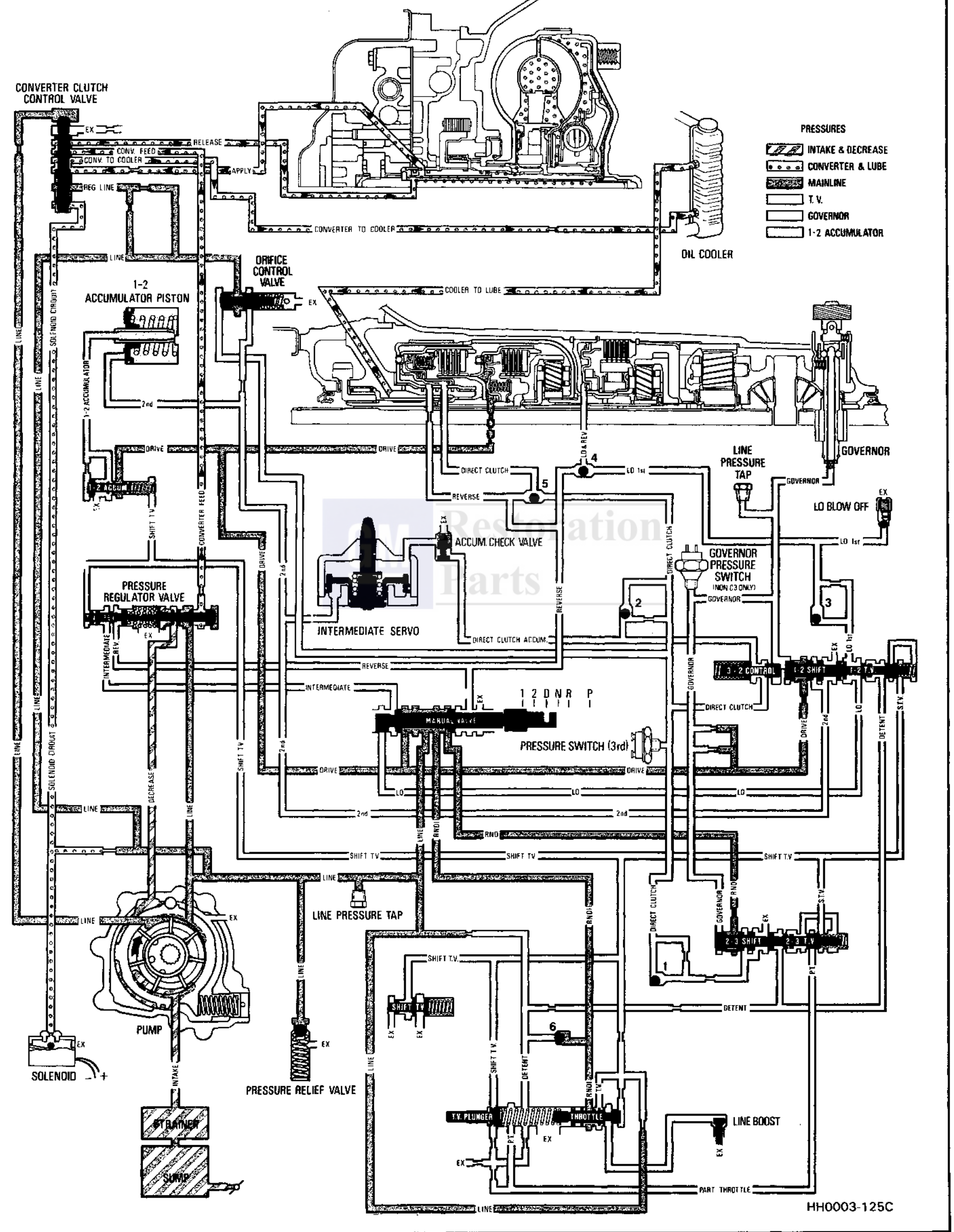

Figure 15 Drive Range - First Gear

DRIVE RANGE—FIRST GEAR

FORWARD CLUTCH – APPLIED

ROLLER CLUTCH – HOLDING

When the selector lever is moved to the Drive (D) position, the manual valve is repositioned to allow line pressure to enter the Drive passage. Drive oil then flows to the following:

1. Forward Clutch
2. Governor Assembly
3. 1-2 Shift Valve
4. 1-2 Accumulator Valve

BASIC CONTROL

Drive oil is directed to the forward clutch through an orifice where it acts on the clutch piston to apply the forward clutch.

Drive oil is directed to the 1-2 shift valve.

Drive oil is directed to the 1-2 accumulator valve and is regulated to a pressure called 1-2 accumulator pressure; this pressure is directed to the 1-2 accumulator piston to act as a cushion for the band apply on a 1-2 shift.

Drive oil at the governor assembly is regulated to another variable pressure called governor pressure. Governor pressure increases with vehicle speed and acts against the 1-2 and 2-3 shift valves and the 3-2 control valve.

SUMMARY

The converter is filled; the forward clutch is applied; the transmission is in Drive (D) Range — First Gear.

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Figure 16 Drive Range - First Gear

DRIVE RANGE—SECOND GEAR

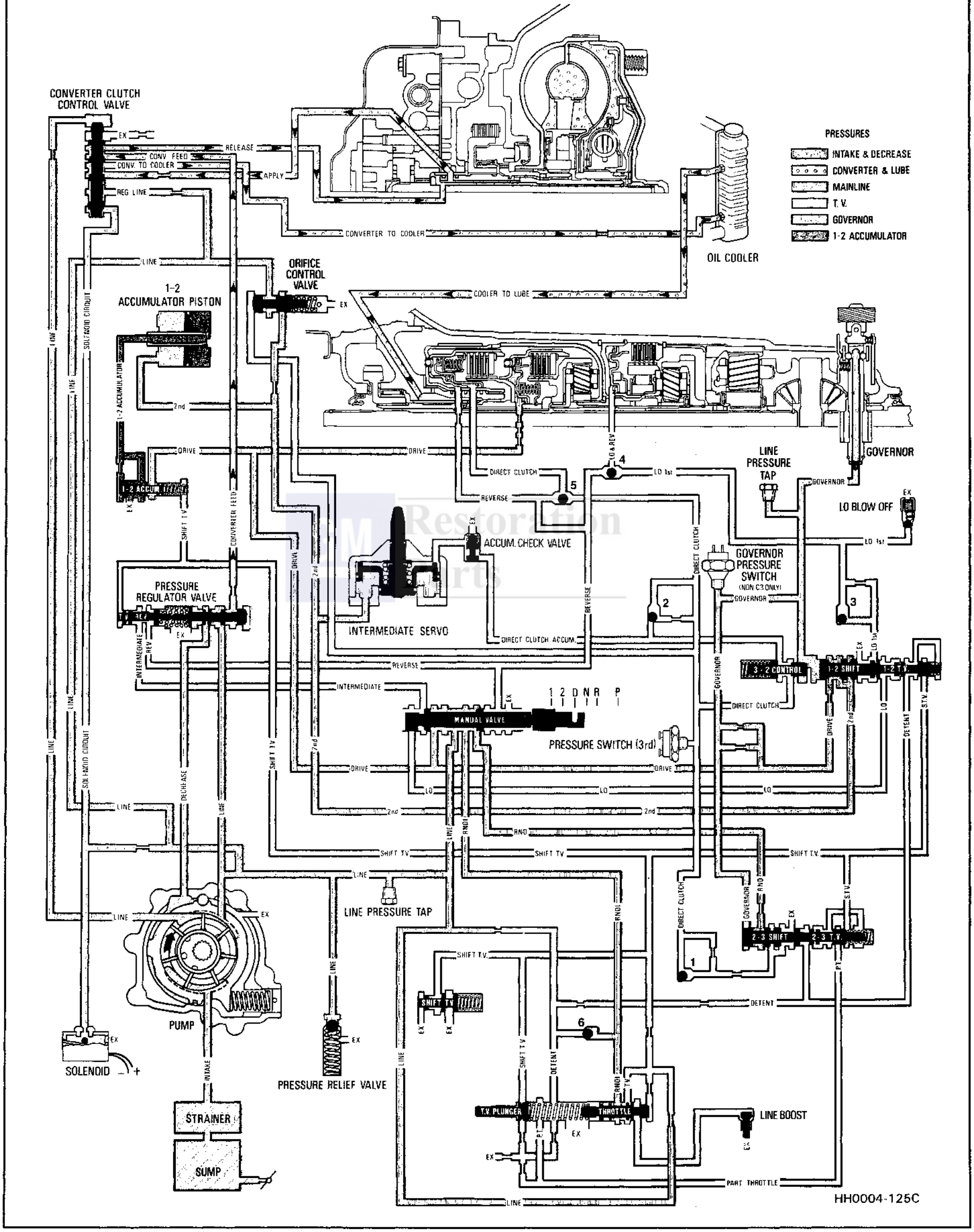

Figure 17 Drive Range - Second Gear

DRIVE RANGE—SECOND GEAR

FORWARD CLUTCH – APPLIED

INTERMEDIATE BAND – APPLIED

As both vehicle speed and governor pressure increase, the force of governor oil acting on the 1-2 shift valve overcomes the pressure of shift T.V. oil and the force of the 1-2 T.V. spring. This allows the 1-2 valve to open and drive oil to enter the second (2nd) oil passage. This oil is called second (2nd) oil.

Second oil from the 1-2 shift valve is directed to the following:

1. Intermediate Servo
2. 1-2 Accumulator Piston

BASIC CONTROL

Second oil from the 1-2 shift valve is directed to the intermediate servo to apply the intermediate band. At the same time, 2nd oil moves the 1-2 accumulator piston against 1-2 accumulator pressure and the accumulator spring to maintain a controlled build-up of pressure on the intermediate servo during the 1-2 shift for a smooth band apply.

SUMMARY

The forward clutch and the intermediate band are applied; the transmission is in Drive (D) Range — Second Gear.

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Figure 18 Drive Range - Second Gear

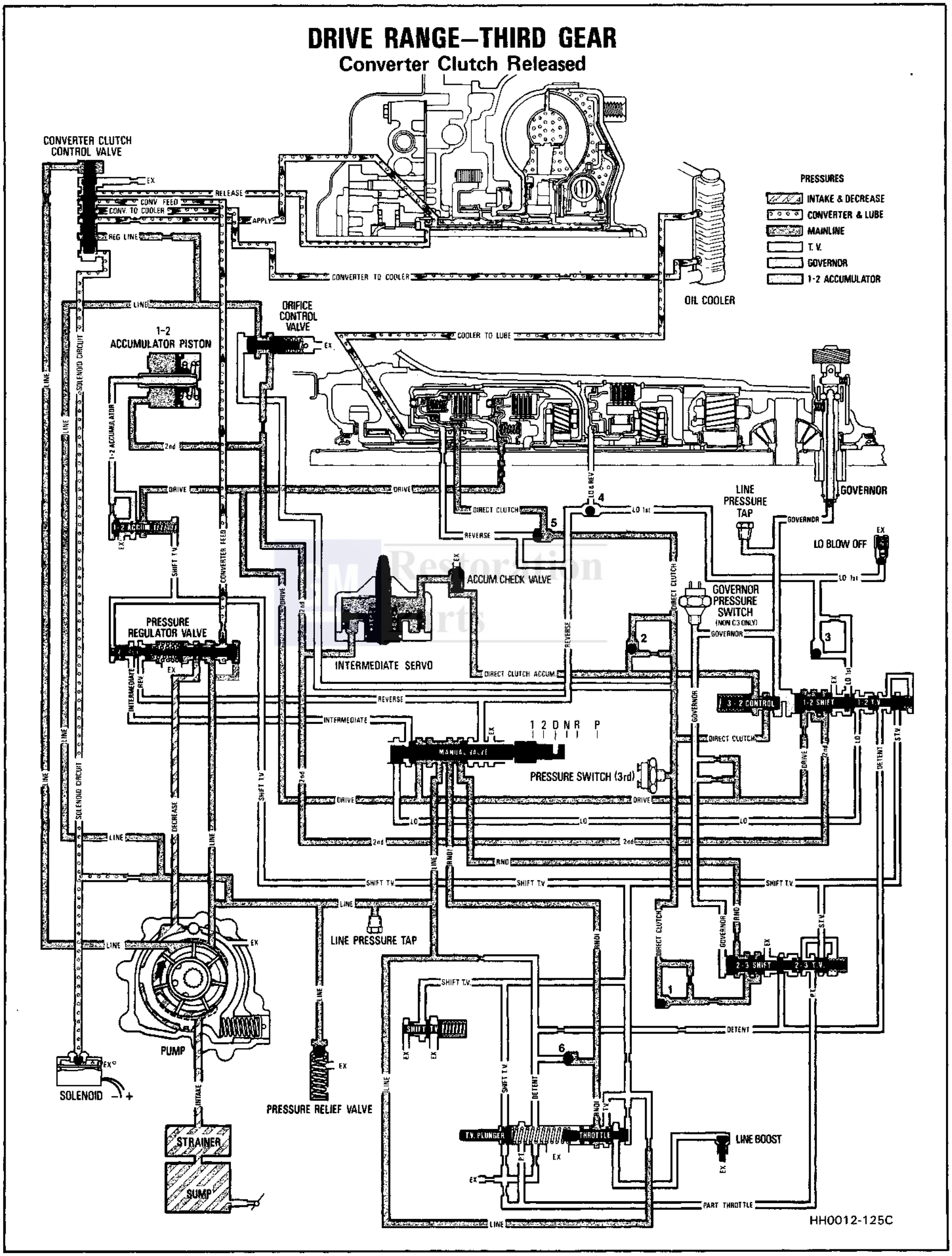

Figure 19 Drive Range - Third Gear - Converter Clutch Released

DRIVE RANGE—THIRD GEAR

CONVERTER CLUTCH – RELEASED **FORWARD CLUTCH – APPLIED** **DIRECT CLUTCH – APPLIED**

As both vehicle speed and governor pressure increase, the force of governor oil acting on the 2-3 shift valve overcomes the force of the 2-3 T.V. spring and shift T.V. oil. This allows the 2-3 shift valve to open and RND oil enters the direct clutch oil passage. This oil is called direct clutch oil.

Direct clutch oil from the 2-3 shift valve is directed to the following:

1. Direct Clutch Exhaust Checkball (1)
2. 3-2 Control Valve
3. Direct Clutch and Reverse Checkball (5)
4. Direct Clutch Accumulator Checkball (2)
5. Accumulator Check Valve
6. Intermediate Servo
7. 3rd Clutch Pressure Switch

BASIC CONTROL

Direct clutch oil from the 2-3 shift valve flows past the direct clutch exhaust checkball (1), past the 3rd clutch pressure switch, to the direct clutch and reverse checkball (5), seating it in the reverse passage, and to the inner area of the direct clutch piston, applying the direct clutch. At the same time, direct clutch oil is directed past the direct clutch accumulator checkball (2) into the direct clutch accumulator passage, where it is called direct clutch accumulator oil, to the direct clutch accumulator check valve, seating it; and to the release side of the intermediate servo. The pressure of the direct clutch accumulator oil combined with the servo cushion spring, moves the servo piston against 2nd oil and acts as an accumulator for a smooth intermediate band release and direct clutch apply.

Direct clutch oil also flows through the 3-2 control valve to the direct clutch accumulator passage.

SUMMARY

The forward and direct clutches are applied and the intermediate band is released; the transmission is in Drive (D) Range — Third Gear (direct drive).

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Figure 20 Drive Range - Third Gear - Converter Clutch Released

DRIVE RANGE—THIRD GEAR
Converter Clutch Applied

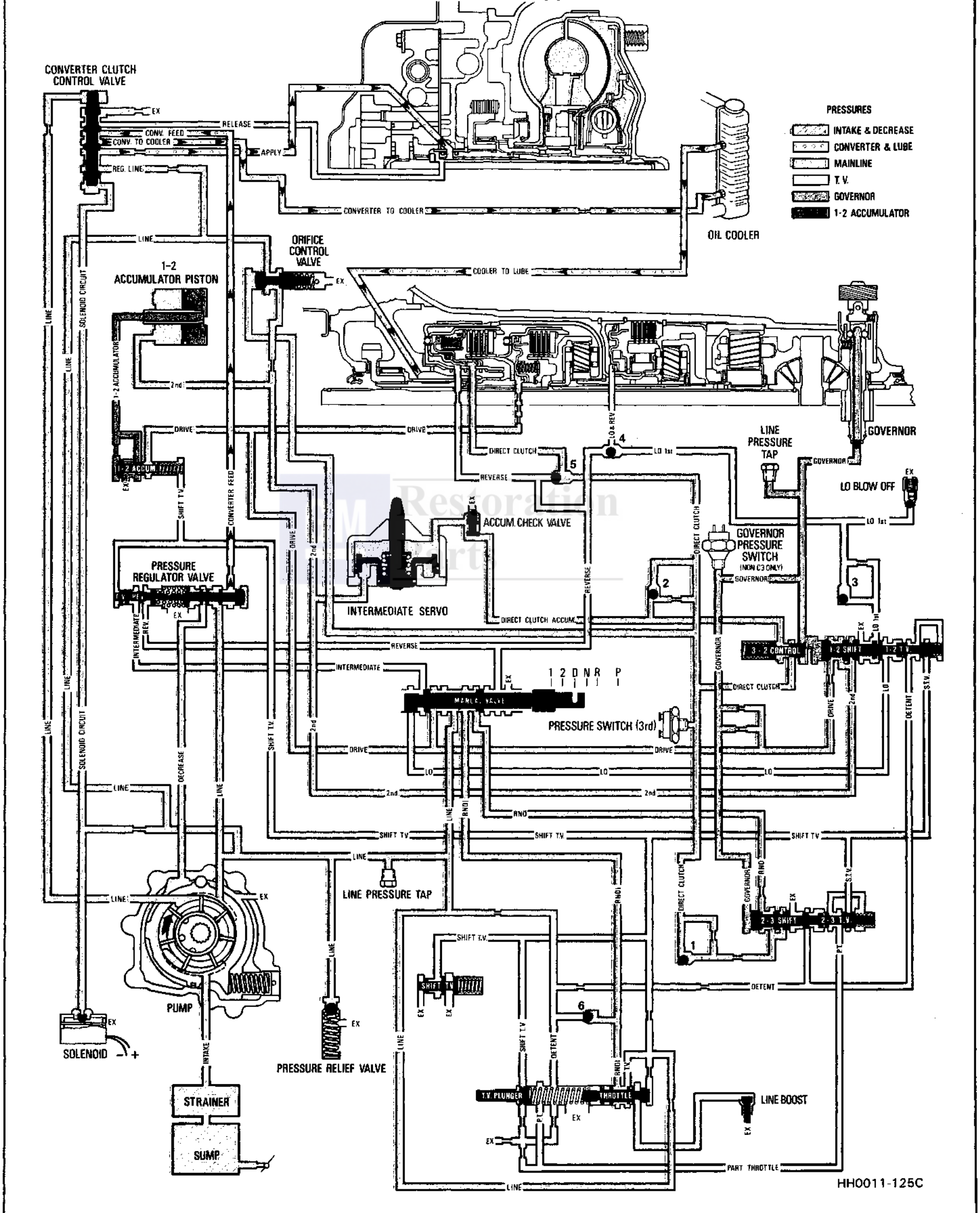

Figure 21 Drive Range - Third Gear - Converter Clutch Applied

DRIVE RANGE—THIRD GEAR

CONVERTER CLUTCH – APPLIED **FORWARD CLUTCH – APPLIED** **DIRECT CLUTCH – APPLIED**

BASIC CONTROL

When car speed in Drive Range 3rd Gear, reaches converter clutch engagement speed, the C3 or governor pressure switch (depending on system) will activate the solenoid, closing the exhaust valve. This allows solenoid circuit oil to move the converter clutch control valve against line pressure. With the converter clutch control valve in the apply position, regulated line oil, from the converter clutch regulator valve, is allowed to pass into the converter apply passage. It then flows through the turbine shaft to the apply side of the converter clutch. The regulated line oil, from the converter clutch regulator valve, controls the apply feel of the pressure plate.

As the pressure plate begins to move to its applied position, release oil on the front side of the pressure plate is redirected back between the turbine shaft and pump drive shaft and exhausted at the converter clutch control valve through an orifice, to time the clutch apply. When the converter clutch control valve moved to the apply position, orificed converter feed oil entered the converter to cooler passage to provide oil to the lubrication system.

SUMMARY

The forward and direct clutches are applied, the converter clutch is applied and the intermediate band is released; the transmission is in Drive (D) Range — Third Gear (direct drive).

Figure 22 Drive Range - Third Gear - Converter Clutch Applied

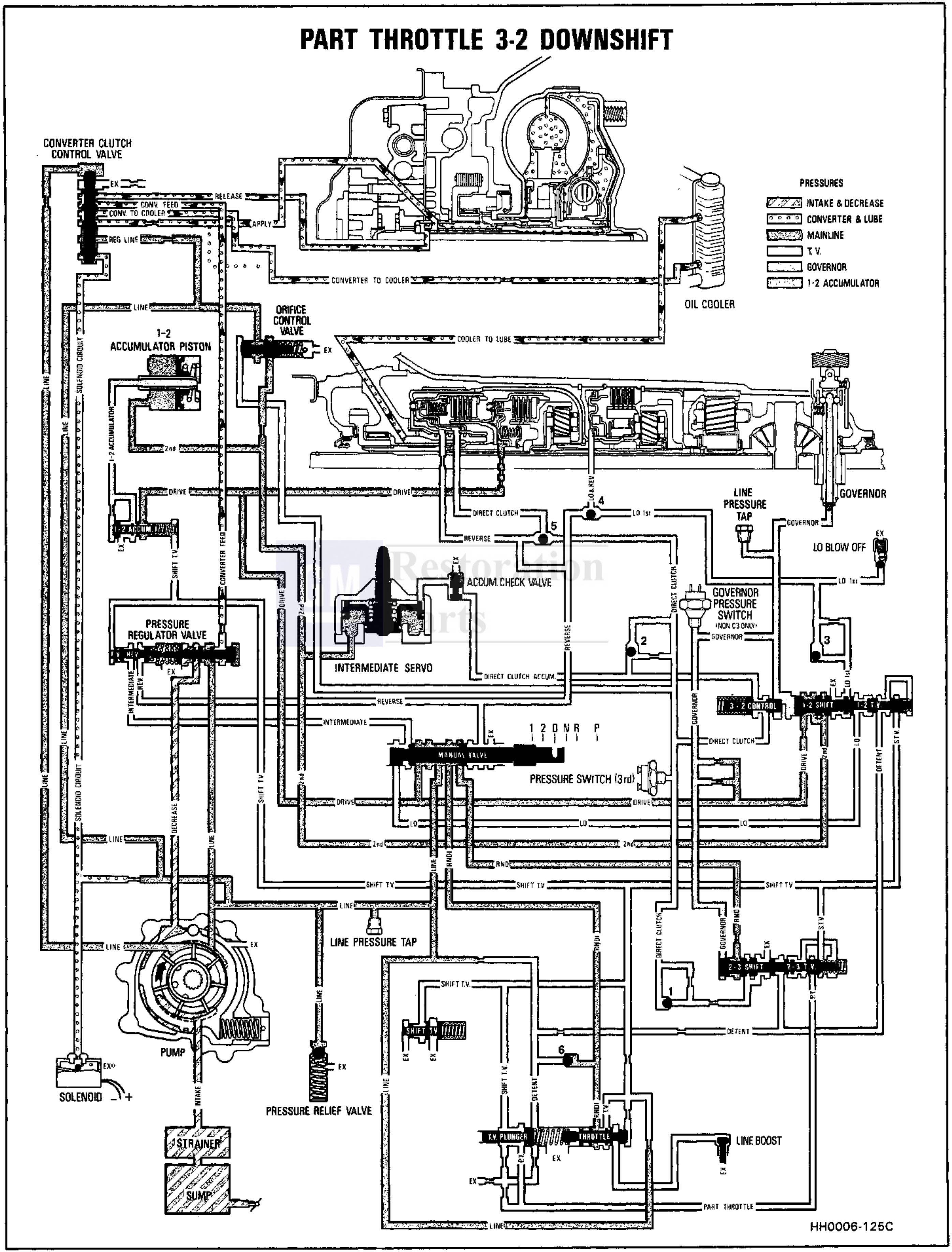

Figure 23 Part Throttle 3-2 Downshift - Valves in Second Gear Position

PART THROTTLE 3-2 DOWNSHIFT

(Valves In Second Gear Position)

CONVERTER CLUTCH – RELEASED **FORWARD CLUTCH – APPLIED** **INTERMEDIATE BAND – APPLIED**

A part throttle 3-2 downshift can be accomplished below approximately 50 mph (80 km/h) by depressing the accelerator pedal far enough to move the throttle valve (T.V.) plunger to allow shift T.V. oil to enter the part throttle (P.T.) passage. This oil, called part throttle (P.T.) oil, is then routed to the 2-3 T.V. valve.

Part throttle oil and the 2-3 spring force will close the 2-3 shift valve against governor oil, shutting off RND oil to the direct clutch passage. Exhausting direct clutch oil opens the 3rd clutch pressure switch releasing the torque converter clutch, seats the direct clutch exhaust checkball (1), flows through the two orifices, and is exhausted at the 2-3 shift valve. At the same time, direct clutch accumulator oil from the intermediate servo also exhausts through the same route as directed clutch oil. Second oil acting on the servo piston applies the band for a smooth band apply as the direct clutch is released.

JH0024-125C

Figure 24 Part Throttle 3-2 Downshift - Valves in Second Gear Position

DETENT DOWNSHIFT

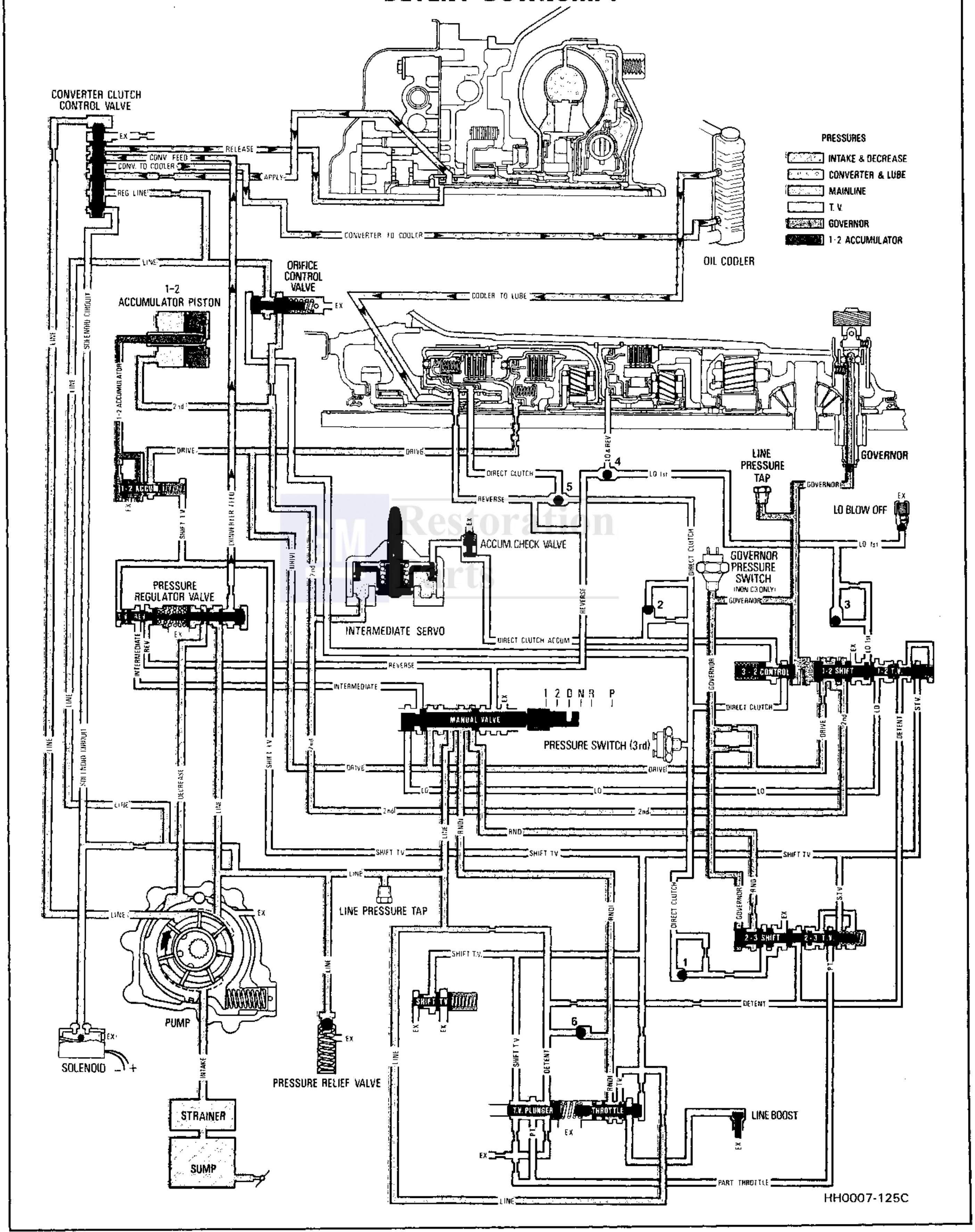

Figure 25 Detent Downshifts - Valves in Second Gear Position

DETENT DOWNSHIFTS

(Valves In Second Gear Position)

FORWARD CLUTCH – APPLIED

INTERMEDIATE BAND – APPLIED

While operating at speeds below approximately 65 mph (105 km/h), a forced or detent 3-2 downshift is possible by depressing the accelerator pedal fully. This will position the throttle valve (T.V.) plunger to allow shift T.V. oil to enter the detent passage. This oil, called detent oil, is then routed to the following:

1. 2-3 Throttle Valve
2. 1-2 Throttle Valve
3. RNDI and Detent Checkball (6)

Detent oil from the T.V. plunger flows to the 2-3 throttle valve. Detent and part throttle (P.T.) oil pressure combined with the 2-3 spring force will close the 2-3 shift valve against governor oil and allow direct clutch oil through two orifices to exhaust at the 2-3 shift valve.

At high vehicle speeds, above approximately 50 mph (80 km/h), governor oil acting on the 3-2 control valve will close it. Now the exhausting direct clutch accumulator oil from the intermediate servo will seat the direct clutch accumulator checkball (2) and flow through another orifice controlling the intermediate band apply for a smooth 3-2 shift at high speed.

A detent 2-1 downshift can be accomplished at speeds below approximately 30 mph (48 km/h), because detent oil pressure and the 1-2 spring force acting on the 1-2 throttle valve will close the 1-2 shift valve, shifting the transmission to First Gear.

Detent oil acts on the RNDI and detent checkball (6) but will not unseat it because RNDI oil is at a higher pressure.

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Figure 26 Detent Downshifts - Valves in Second Gear Position

MANUAL SECOND

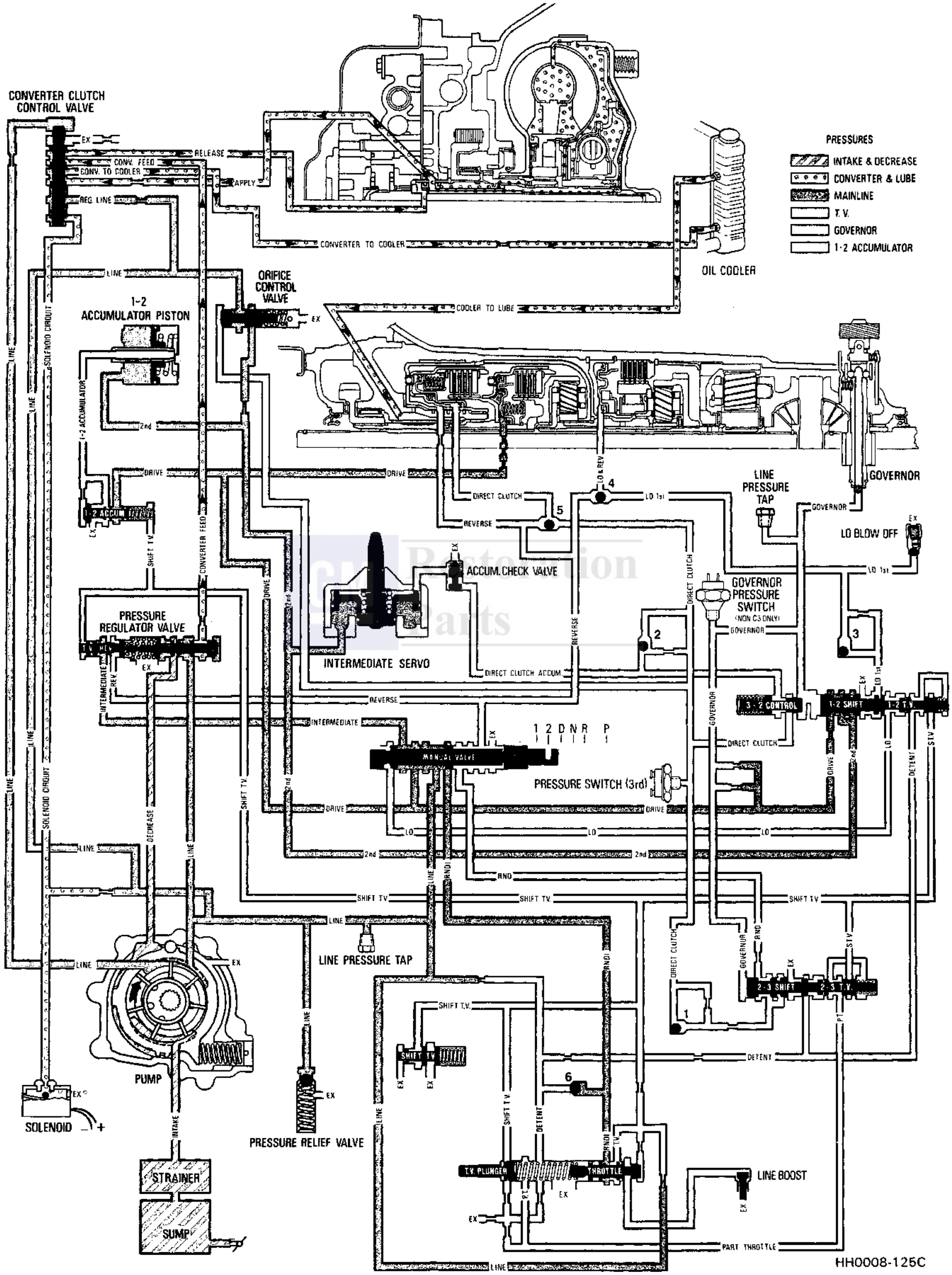


Figure 27 Manual Second

MANUAL SECOND

INTERMEDIATE BAND – APPLIED

FORWARD CLUTCH – APPLIED

A 3-2 downshift can be accomplished by moving the selector lever from Drive (D) range to manual Second.

When the selector lever is in manual Second position, RND oil will exhaust at the manual valve. Intermediate oil from the manual valve is directed between the reverse and T.V. boost valves.

Intermediate oil acting on the reverse boost valve plus the pressure regulator spring force will boost line pressure to 827 kPa (120 psi) which is required to hold the intermediate band and forward clutch on.

Because RND oil is exhausted, the transmission will shift to 2nd gear, regardless of vehicle speed. (RND oil is the feed for direct clutch oil in 3rd gear.) With the transmission in 2nd gear, manual Second, it cannot upshift to 3rd gear regardless of vehicle speed.

SUMMARY

The forward clutch and intermediate band are applied. The transmission is in manual Second gear.

JH0026 125C

Figure 28 Manual Second

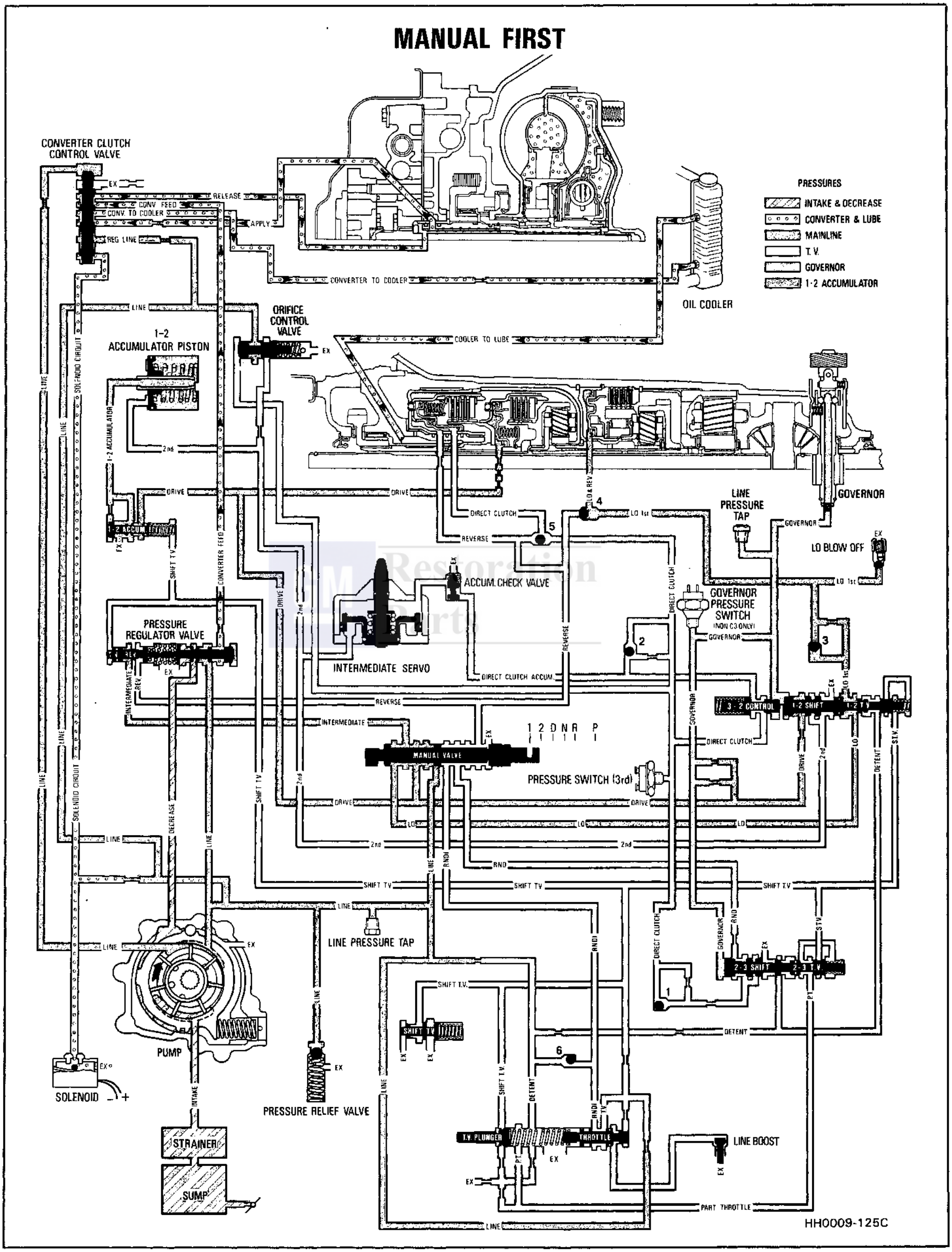


Figure 29 Manual First

MANUAL FIRST

FORWARD CLUTCH – APPLIED

LO AND REVERSE CLUTCH – APPLIED

Maximum downhill braking can be attained at speeds below approximately 40 mph (64 km/h), with the selector lever in manual First position. Manual First oil pressure is the same as intermediate 827 kPa (120 psi) because intermediate oil is still present.

Lo oil from the manual valve is directed to the 1-2 throttle valve. Lo oil pressure and the 1-2 T.V. spring force will close the 1-2 shift valve at speeds below approximately 40 mph (64 km/h). This allows lo oil to enter the lo 1st passage where it seats the lo 1st checkball (3) and passes through an orifice to the lo blow off valve, which exhausts lo 1st oil down to 241 kPa (35 psi). The lo 1st oil is then directed to seat the lo and reverse checkball (4) and to the lo and reverse clutch for a smooth apply.

SUMMARY

The forward clutch is applied. The lo and reverse clutch is applied. The transmission is in Manual First Gear.

JH0027-125C

Figure 30 Manual First

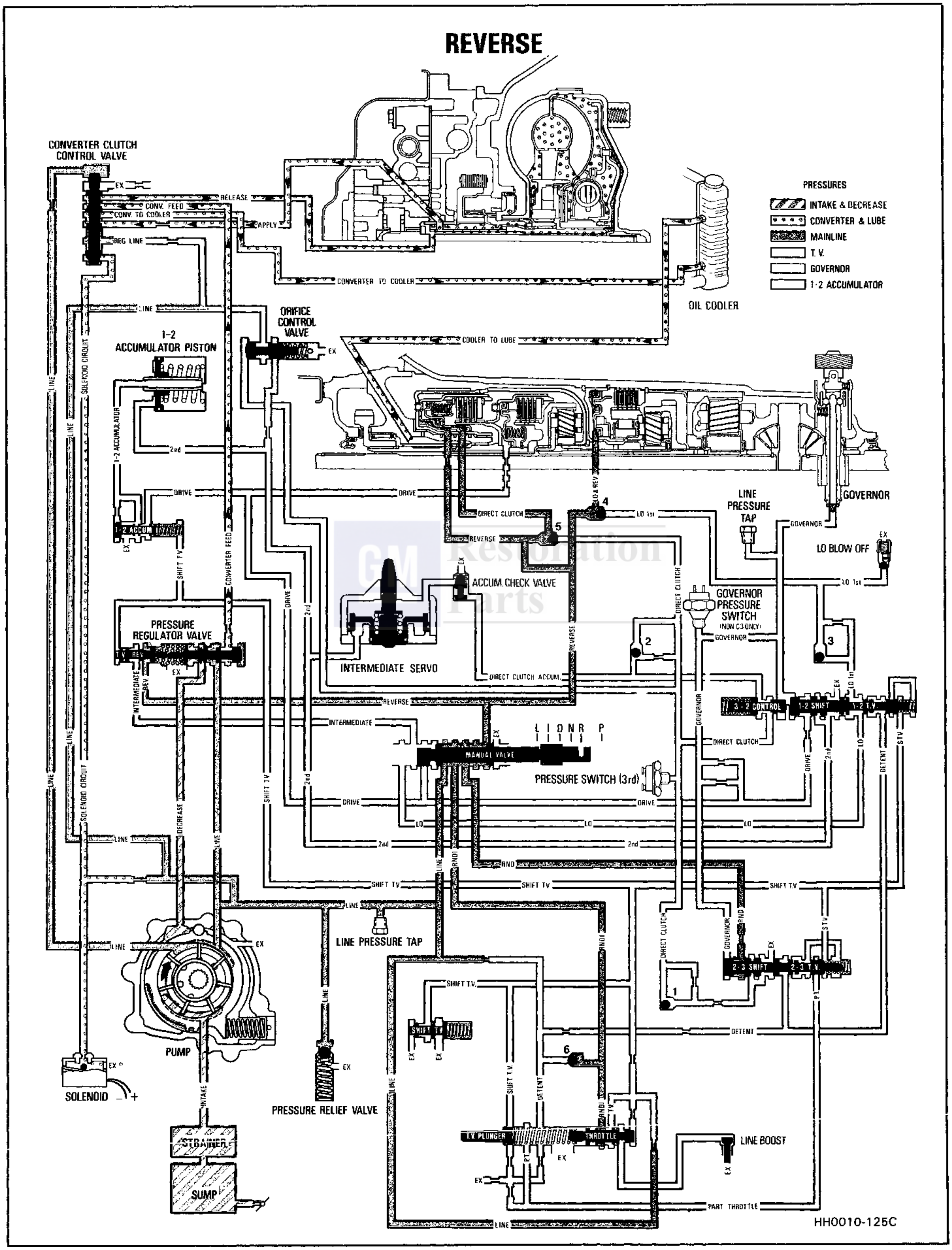


Figure 31 Reverse

REVERSE

DIRECT CLUTCH – APPLIED

LO AND REVERSE CLUTCH – APPLIED

When the selector lever is moved to the Reverse (R) position, the manual valve is repositioned to allow line pressure to enter three (3) passages, as follows:

1. Reverse
2. RNDI (Reverse, Neutral, Drive and Intermediate)
3. RND (Reverse, Neutral, and Drive)

FIRST — Reverse oil from the manual valve seats direct clutch and reverse checkball (5) in the direct clutch passage and flows to both the inner and outer areas of the clutch piston, applying the direct clutch. Reverse oil also seats the lo and reverse checkball (4) in the lo 1st passage and applies the lo and reverse clutch. Reverse oil flows to the reverse boost valve and will boost reverse line pressure to about 827 kPa (120 psi).

SECOND — RNDI oil from the manual valve flows to the throttle valve and is regulated to T.V. pressure. T.V. oil flows through the shift T.V. valve and is limited by it to approximately 620 kPa (90 psi).

Oil from the shift T.V. valve is directed to the T.V. boost valve. Shift T.V. oil acting on the T.V. boost valve will boost reverse line pressure to approximately 1447 kPa (210 psi).

THIRD — RND oil from the manual valve is directed to the 2-3 shift valve, but this has no function in Reverse.

SUMMARY

The direct clutch is applied. The lo and reverse clutch is applied. The transmission is in Reverse (R).

JH0028-125C

Figure 32 Reverse

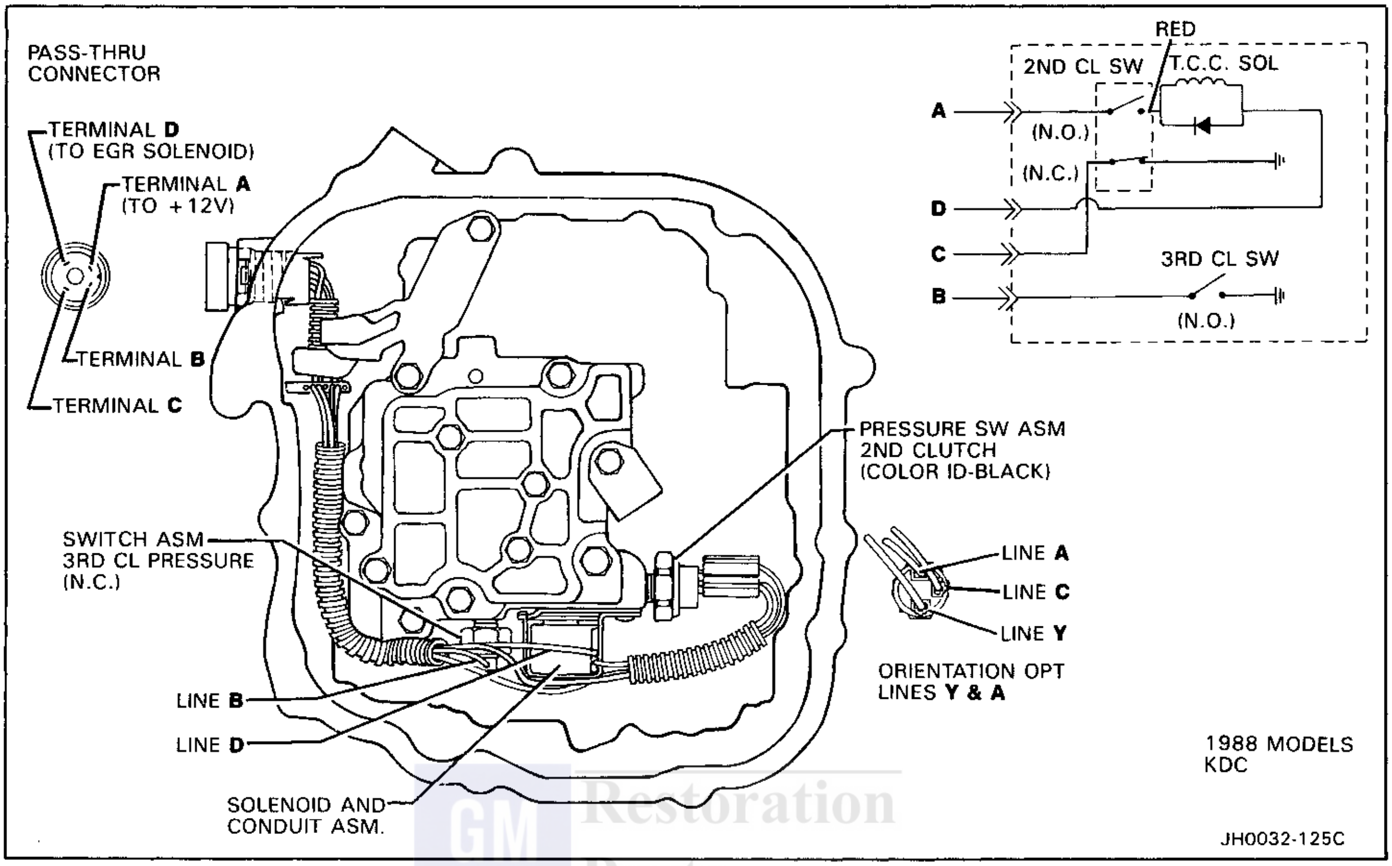


Figure 33 Wiring Diagram

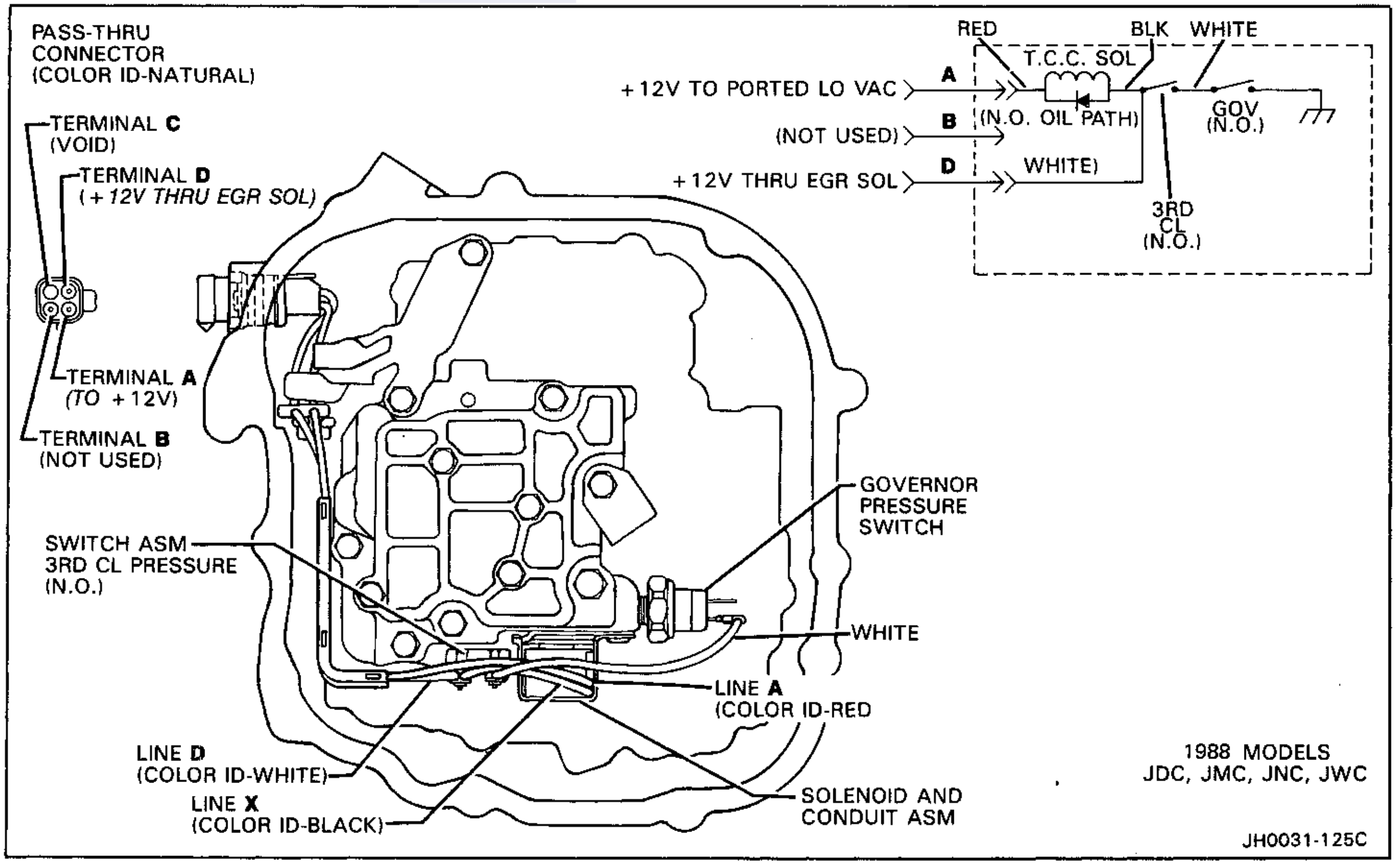


Figure 34 Wiring Diagram

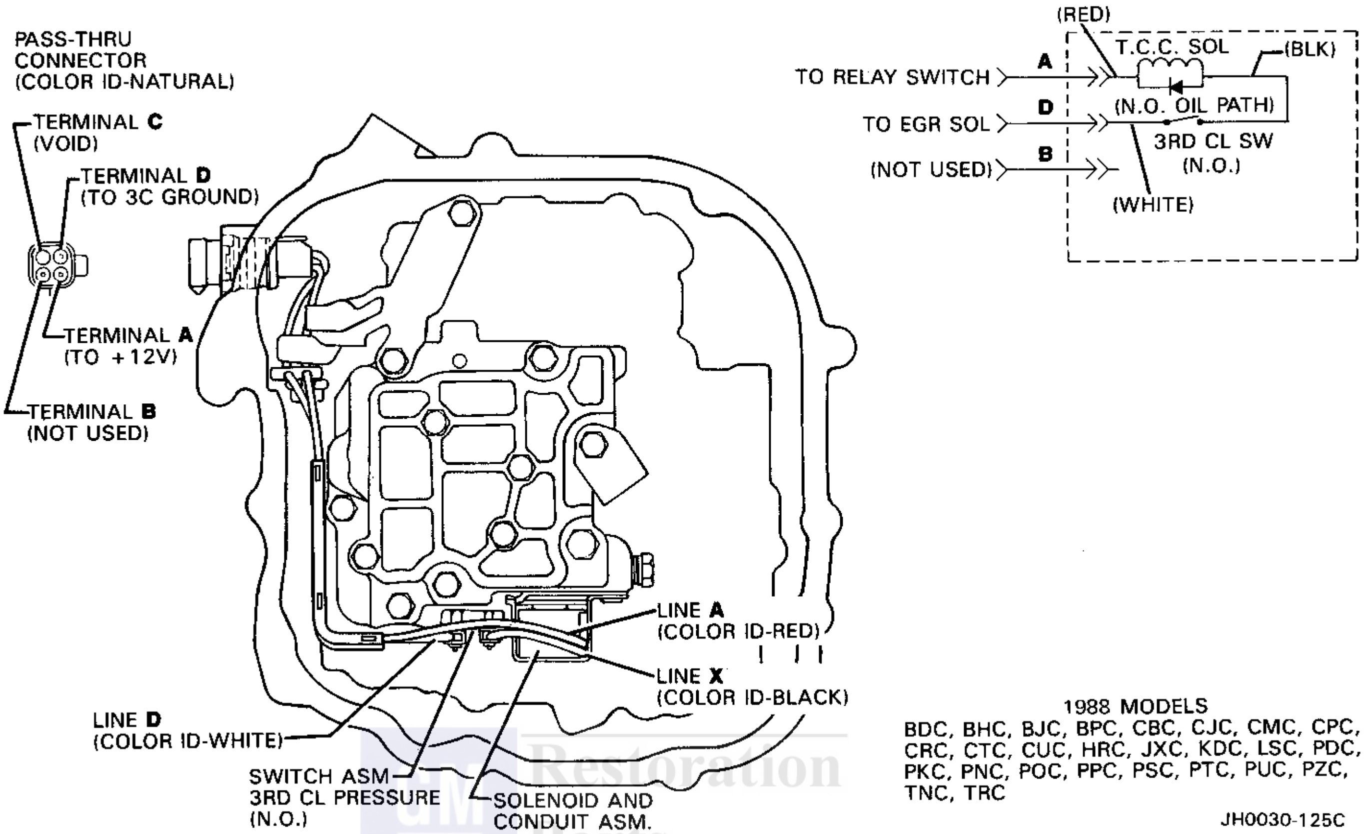


Figure 35 Wiring Diagram

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

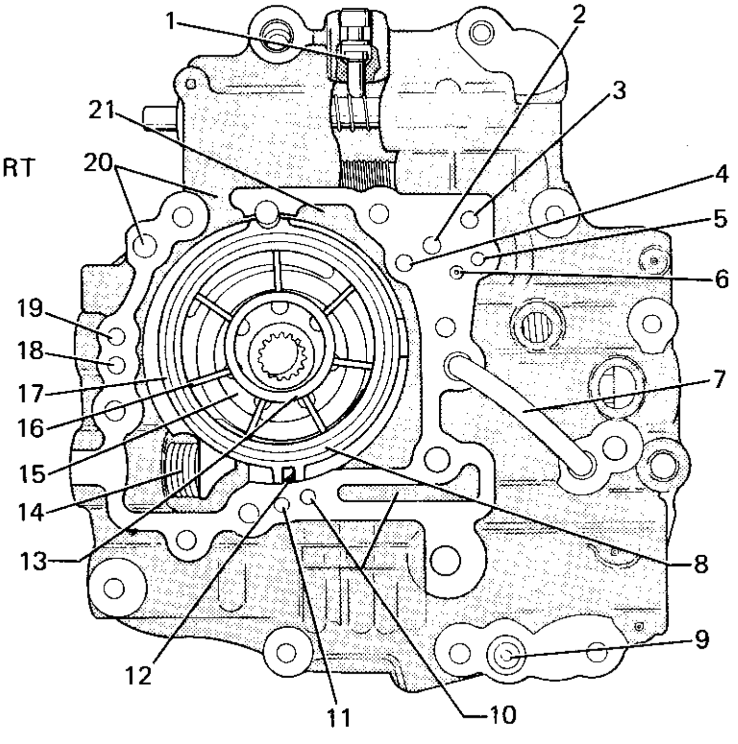


Figure 36 Variable Capacity Vane Oil Pump

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)

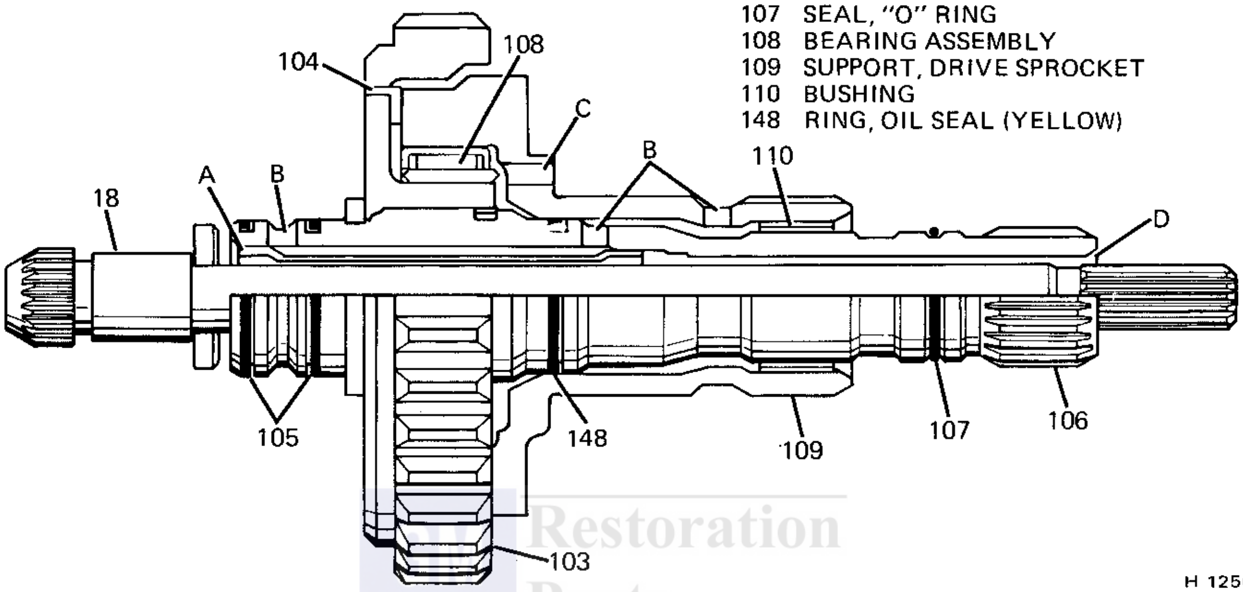


Figure 37 Converter Oil Passages - Parts Cut-Away View

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

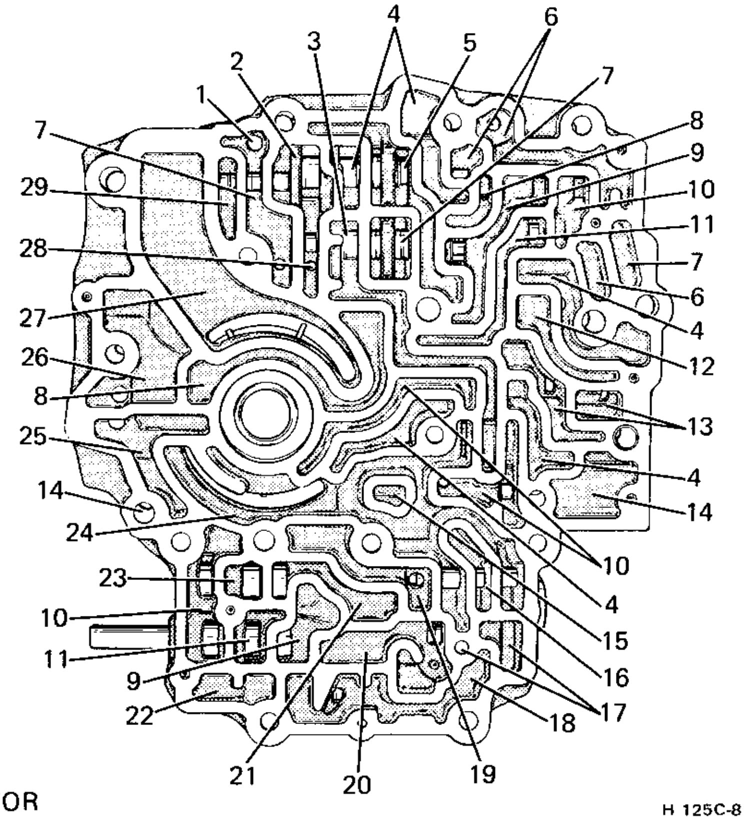
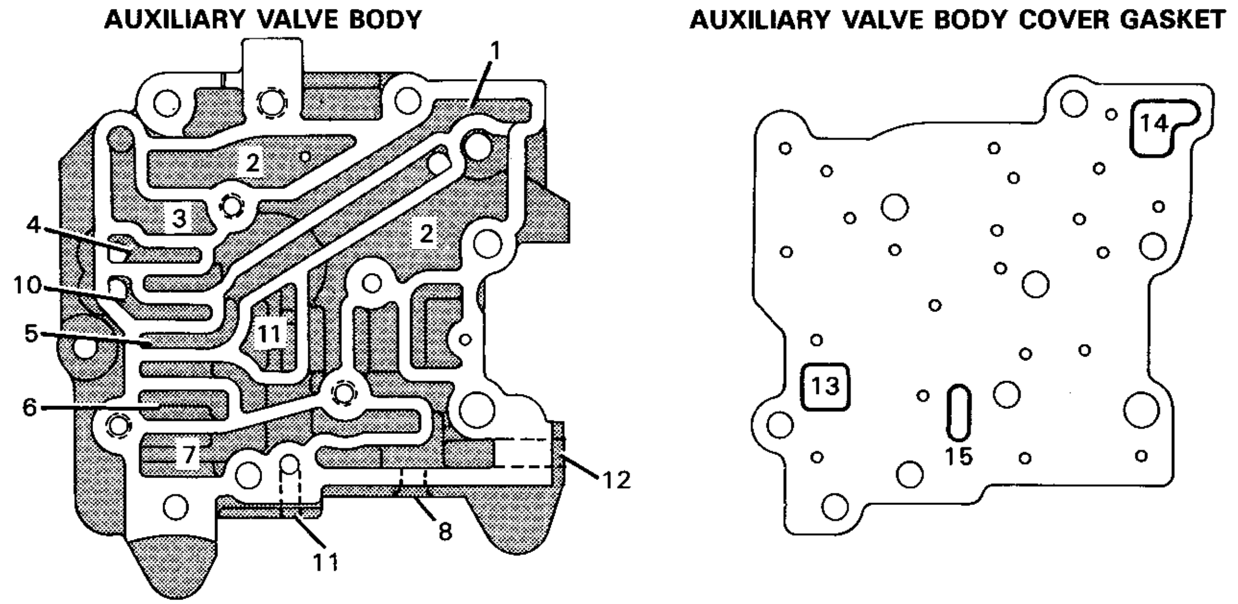


Figure 38 Valve Body Passages



1 CONVERTER FEED
2 LINE
3 EXHAUST
4 RELEASE
5 APPLY
6 ORIFICE LINE
7 SOLENOID CIRCUIT
8 GOVERNOR
9 SHIFT TV
10 TO COOLER
11 3RD CLUTCH
12 DRILLED & TAPPED HOLE (NON C3 ONLY)
13 LINE/ORIFICE LINE
14 LINE/CONVERTER FEED
15 LINE/SOLENOID CIRCUIT

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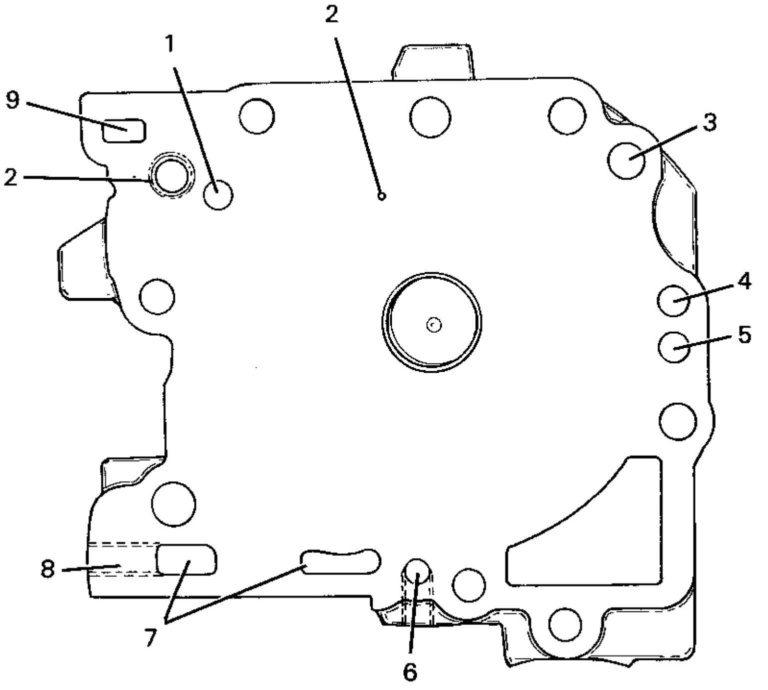
Figure 39 Auxiliary Valve Body and Cover Gasket



1 APPLY
2 LINE
3 EXHAUST
4 RELEASE
5 TO COOLER
6 DIRECT CLUTCH (3RD)
7 VOID/2ND/GOVERNOR
8 DRILLED & TAPPED HOLE (NON C3 ONLY)
9 CONVERTER FEED

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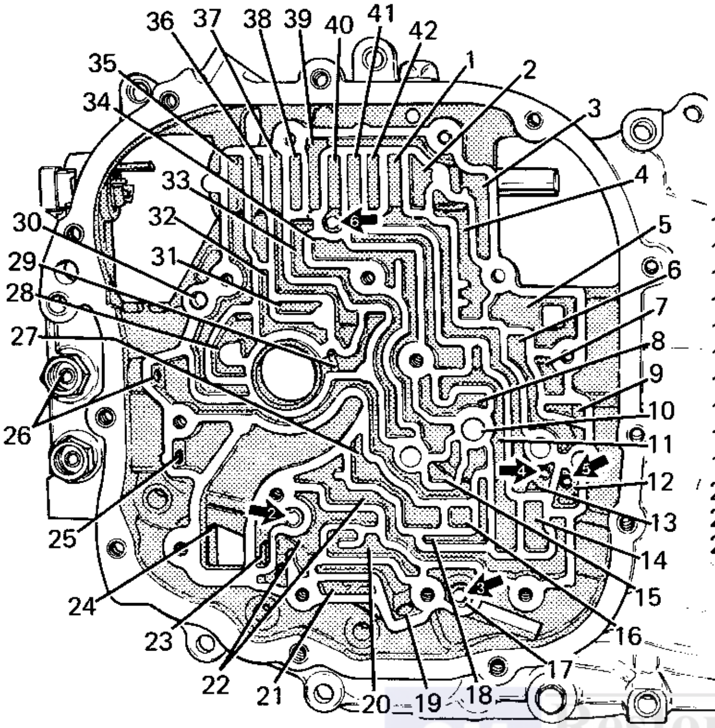
Figure 40 Auxiliary Valve Body - Pump Side



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

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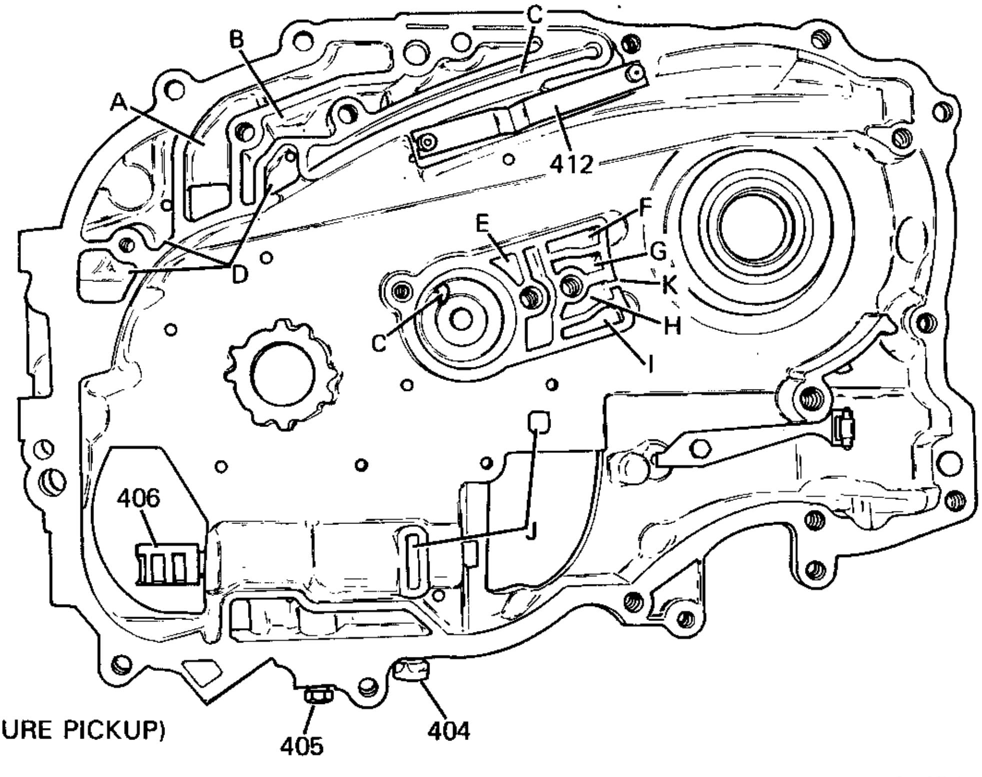
Figure 41 Case Cover - Valve Body Side



A	INTAKE
B	ACCUMULATOR, DIRECT CLUTCH
C	2ND
D	VOID
E	LO - REVERSE
F	DIRECT CLUTCH
G	REVERSE
H	DRIVE
I	LUBE
J	EXHAUST
K	OIL LUBE SLOT
404	VENT ASSEMBLY
405	PLUG, PIPE (LINE PRESSURE PICKUP)
406	VALVE, MANUAL
412	THERMO-ELEMENT

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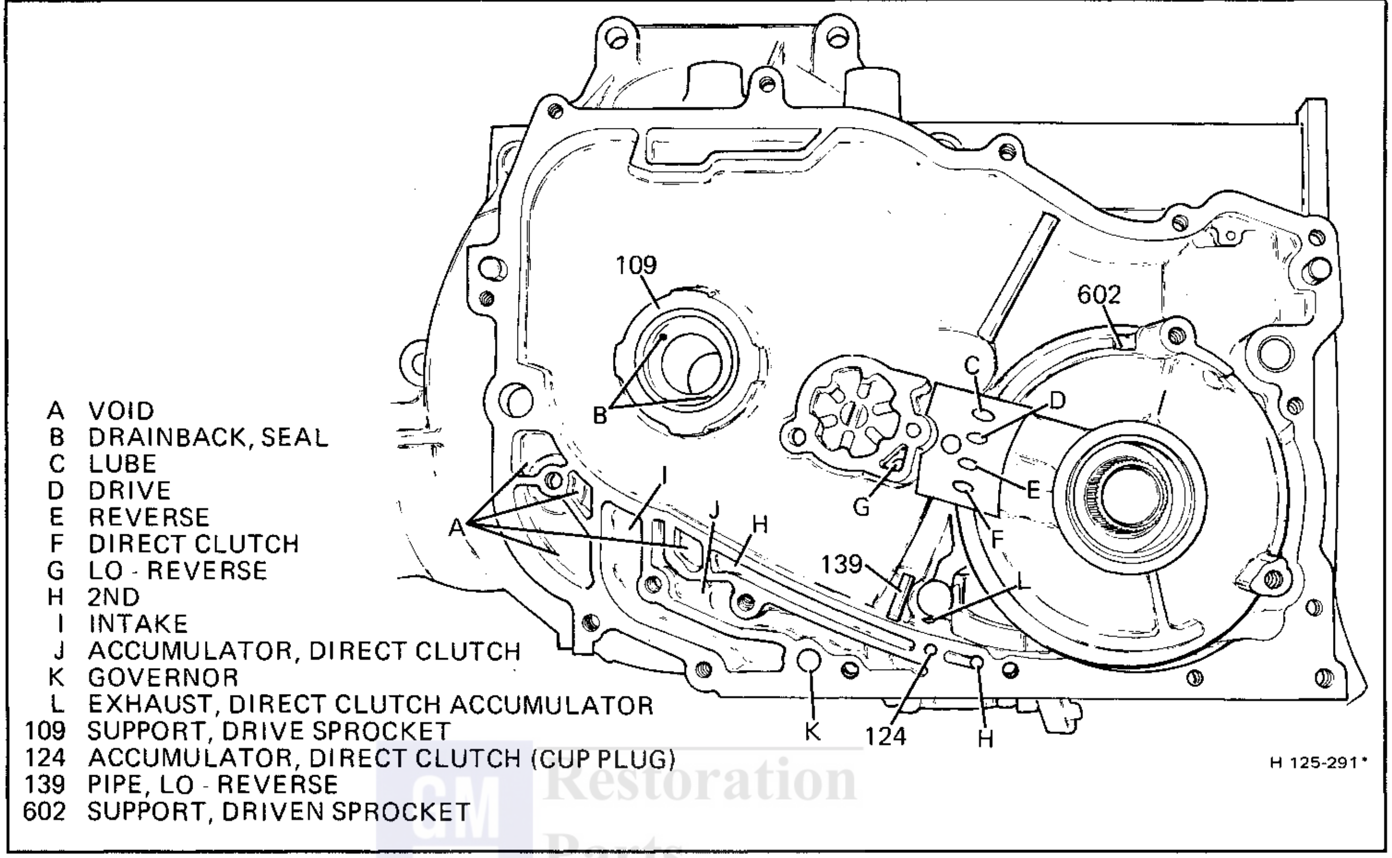
Figure 42 Case Cover - Case Side



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 43 Case - Case Cover Side

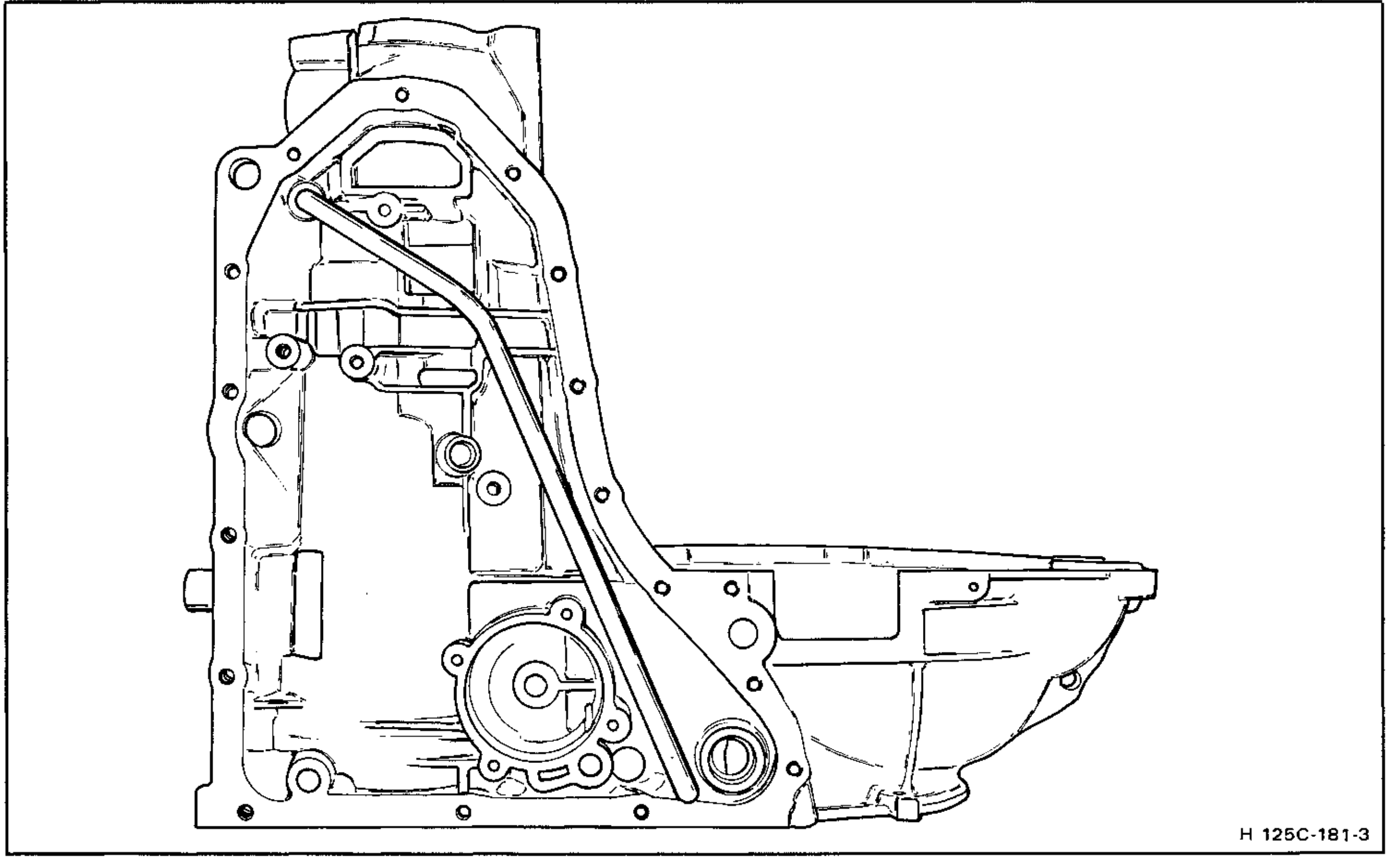


Figure 44 Case - Oil Pan Side

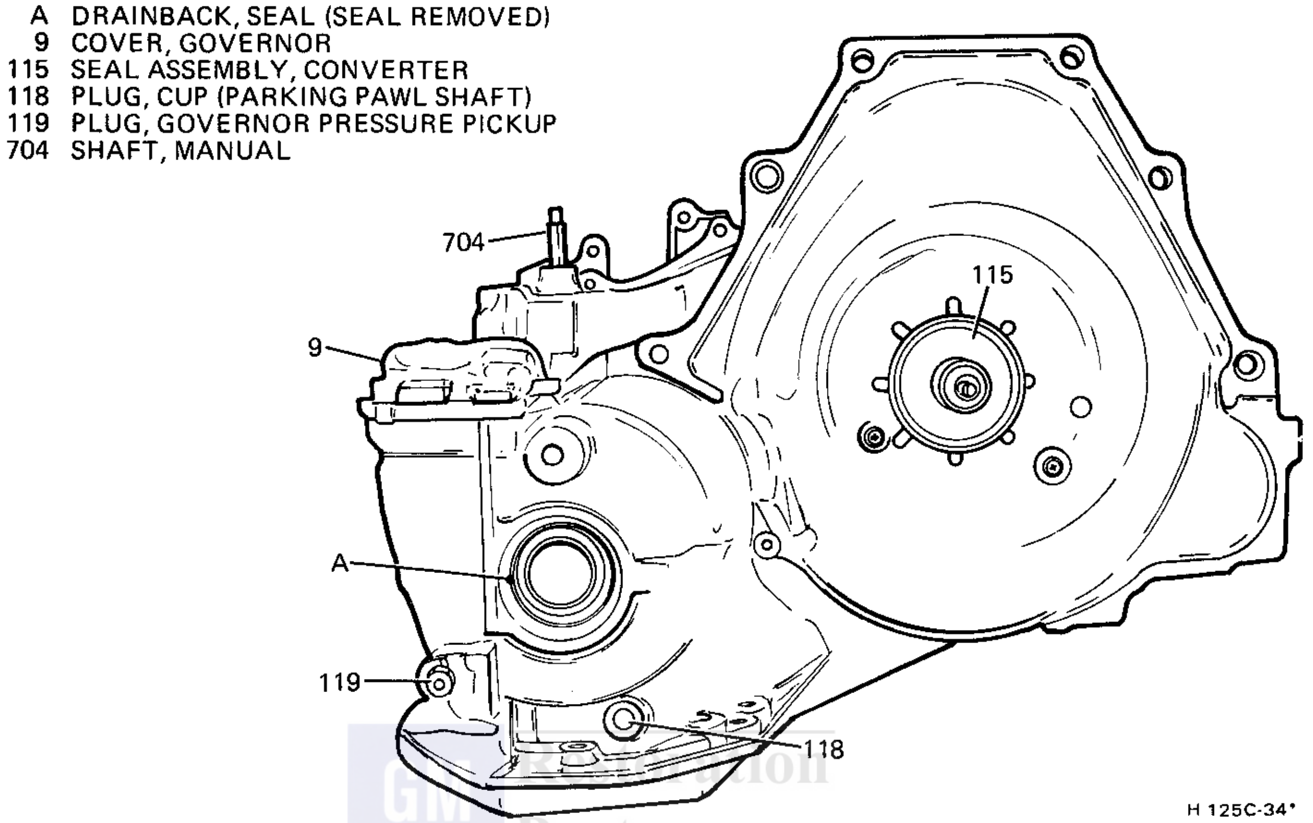


Figure 45 Right Hand Axle End

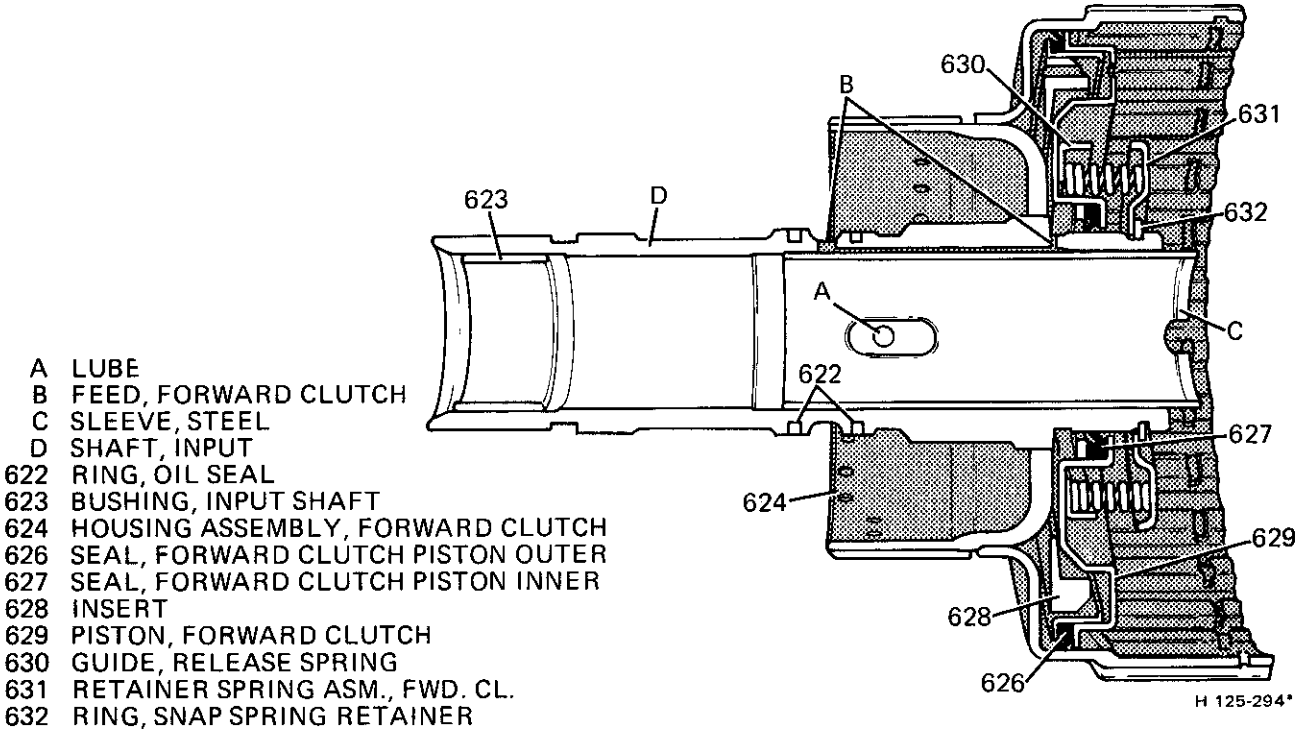
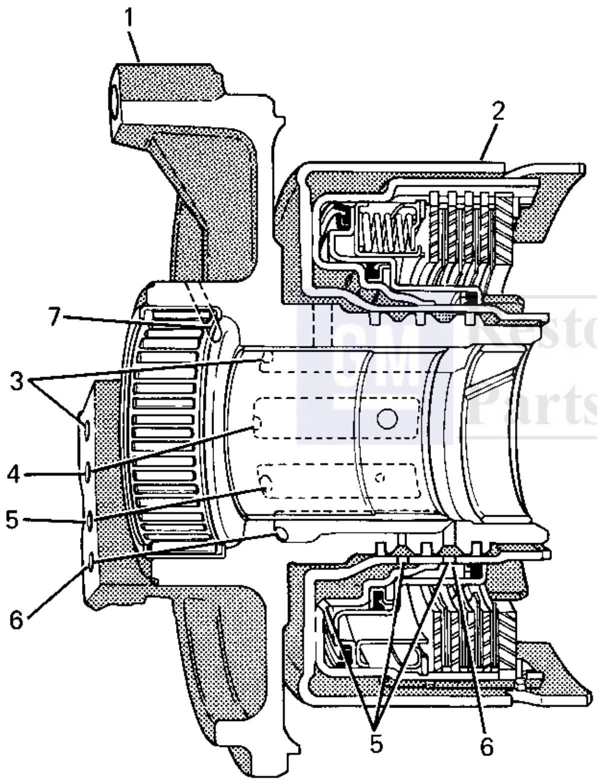
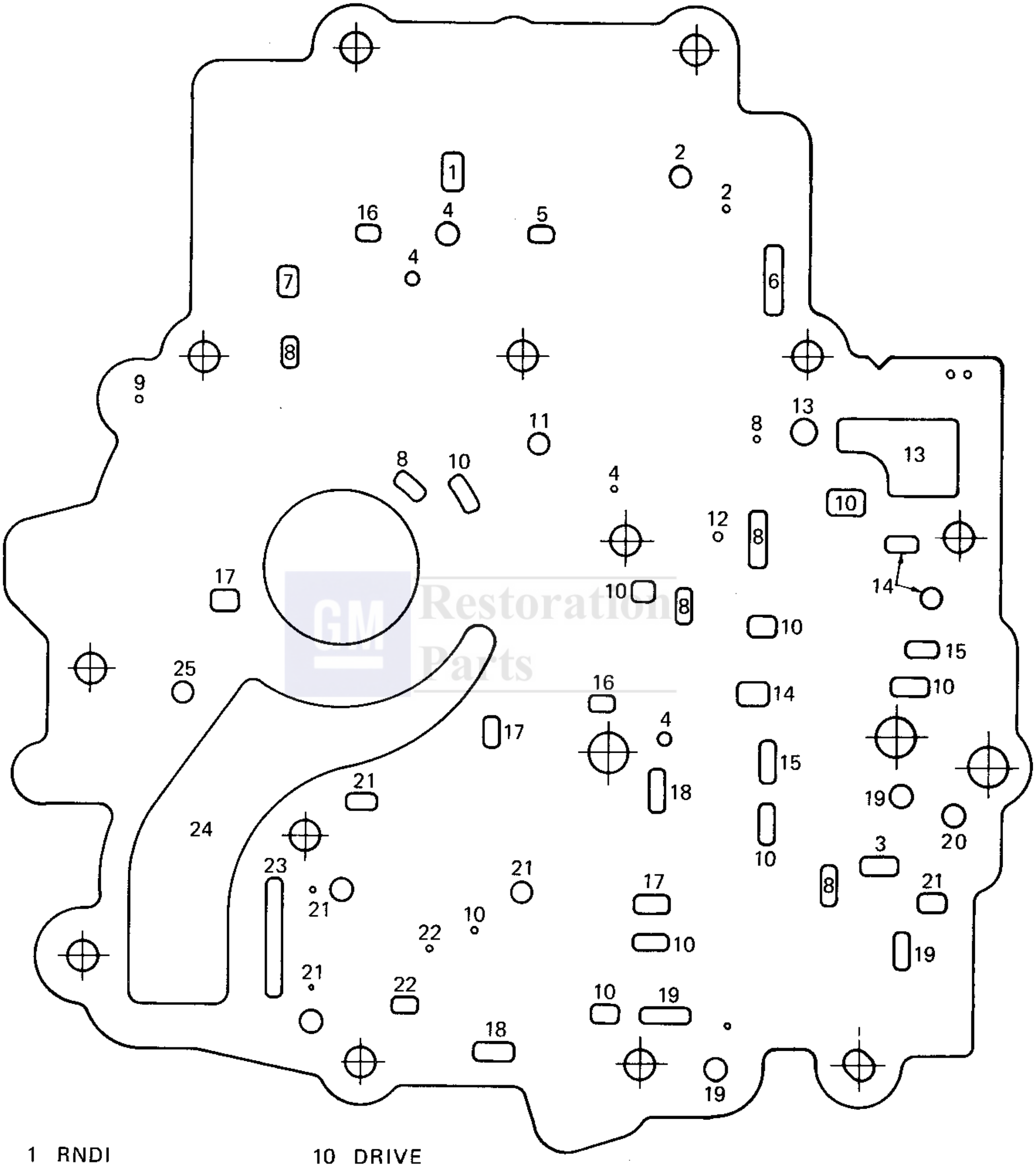


Figure 46 Forward Clutch Assembly - Cut Away View



1	DRIVEN SPROCKET SUPPORT
2	DIRECT CLUTCH
3	LUBE
4	DRIVE
5	REVERSE
6	DIRECT CLUTCH
7	DRAIN BACK

Figure 47 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 48 Typical Valve Body Spacer Plate

TORQUE CONVERTER CLUTCH (TCC) DIAGNOSIS

To properly diagnose the Torque Converter Clutch (TCC) system perform all electrical testing first and then the hydraulic testing. Refer to Torque Converter Section 6E2-C8 for additional information.

The TCC is applied by fluid pressure which is controlled by a solenoid located inside the Automatic Transaxle assembly. The solenoid is energized or released by making or breaking an electrical circuit thru a combination of switches and sensors.

TCC Electrical Diagnosis

- For electrical diagnosis of TCC, refer to the specific vehicle section in Section 8A, Electrical Diagnosis.
- For diagnosis of emission control related components of TCC, refer to the specific section of 6E, Driveability and Emissions.
- For the diagnosis of TCC Hydraulic Controls, refer to the Procedure and Wiring Diagrams provided in this section.

Functional Check Procedure

Inspect

1. Install a tachometer
2. Operate the vehicle until proper operating temperature is reached
3. Drive vehicle at 50-55 mph (80-88 Km/h) with light throttle (road load)
4. Maintaining throttle, lightly touch the brake pedal and check for a slight bump when the TCC releases and a slight increase in engine speed (RPM).
5. Release the brake, slowly accelerate and check for a re-apply of the converter clutch and a slight decrease in engine speed (RPM).

Preliminary Checking Procedure

The purpose of the preliminary checking procedure is to isolate external (electrical) problems from internal (electrical or mechanical) ones.

Important

- Use only a scale type ohmmeter. High impedance type ohmmeters and those with a digital readout will not work.
- An ALCL scanner may be used to verify the electrical circuit. Remember, a completed circuit does not indicate that the solenoid will apply.
- Do not bench test using an automotive type battery. Accidentally crossed wires will damage the internal diodes of the TCC solenoid.

External Controls

Inspect

- Connect voltmeter between transmission connector and ground.
- Turn key "ON"
- If 0 or low voltage is found, refer to Sections 6E and 8A for electrical diagnosis.
- If 12 volts are present at the connector, refer to the TCC hydraulic diagnosis.

TORQUE CONVERTER EVALUATION

Torque Converter Stator

The Torque Converter Stator roller clutch can have one of two different type malfunctions:

A. Stator Assembly freewheels in both directions.

B. Stator Assembly remains locked up at all times.

Condition A-Poor Acceleration Low Speed

The 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. Checking for poor performance in "Drive" and Reverse will help determine if the stator is freewheeling at all times.

Condition B-Poor Acceleration High Speed

Engine r.p.m. and car speed limited or restricted at high speeds. Performance when accelerating from a standstill is normal. Engine may over-heat. Visual examination of the converter may reveal a blue color from over-heating.

If the converter has been removed, the stator roller clutch can be checked by inserting a finger into the splined inner race of the roller clutch and trying to turn the race in both directions. The inner race should turn freely clockwise, but not turn or be very difficult to turn counterclockwise.

Do not use such items as the driven sprocket support or shafts to turn the race, as the results may be misleading.

The Converter Should be Replaced If:

- Leaks externally, such as at the hub weld area.
- Converter has an imbalance which cannot be corrected. (Refer to Converter Vibration Test Procedure).
- Converter is contaminated with engine coolant containing antifreeze.

The Converter Should Not be Replaced If:

- The fluid has an odor, is discolored, and there is no evidence of metal or clutch facing particles in the fluid.
- The threads in one or more of the three converter bolt holes are damaged.
  - Correct with thread insert. Refer to Section

SECTION 125C

AUTOMATIC TRANSAXLE UNIT REPAIR

CONTENTS

TRANSAXLE DISASSEMBLY
GENERAL SERVICE INFORMATION

COMPONENT REPAIR AND TRANSAXLE ASSEMBLY

DISASSEMBLY

Remove or Disconnect

1. J-21366 Converter holding strap
2. Converter (1)

Install or Connect (Figure 2)

Tools Required:

J-28644 - 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-28644 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.

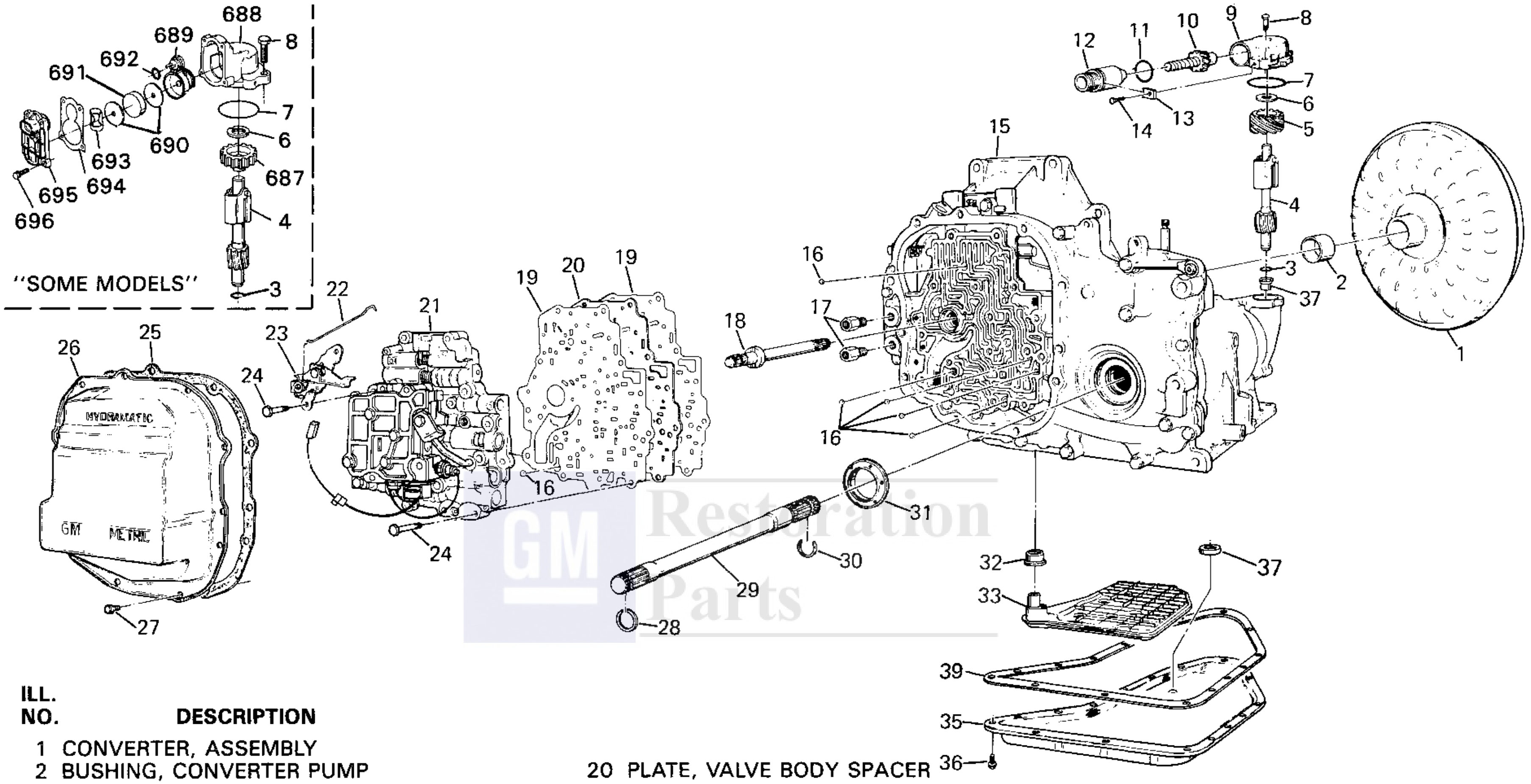

Figure 1 External Components

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	GEAR, SPEEDO DRIVEN
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
33	STRAINER ASSEMBLY, TRANSMISSION OIL
35	PAN, TRANSMISSION OIL
36	SCREW, TRANSMISSION OIL PAN
37	SLEEVE, GOVERNOR SHAFT
40	MAGNET, CHIP COLLECTOR
687	ROTOR, SPEED SENSOR
688	HOUSING, SPEED SENSOR
689	COIL ASSEMBLY
690	WASHER
691	MAGNET
692	SEAL, "O" RING
693	WASHER, WAVE SPRING
694	GASKET, COVER
695	COVER, HOUSING
696	BOLT

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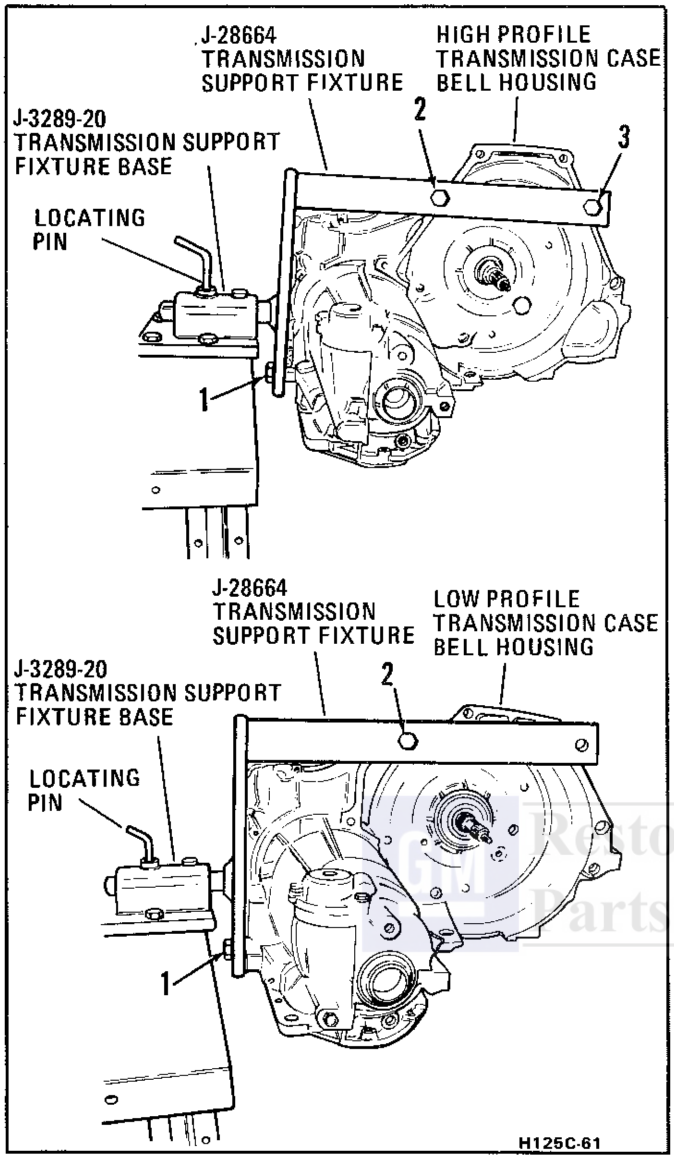


Figure 2 Transaxle in Holding Fixture

Governor Assembly

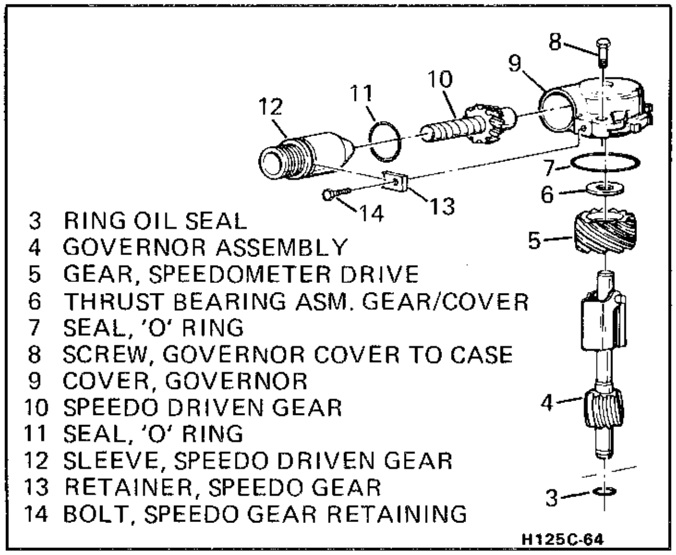
↔ Remove or Disconnect (Figure 3)

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)

Governor Assembly (ITSS) (Some Models)

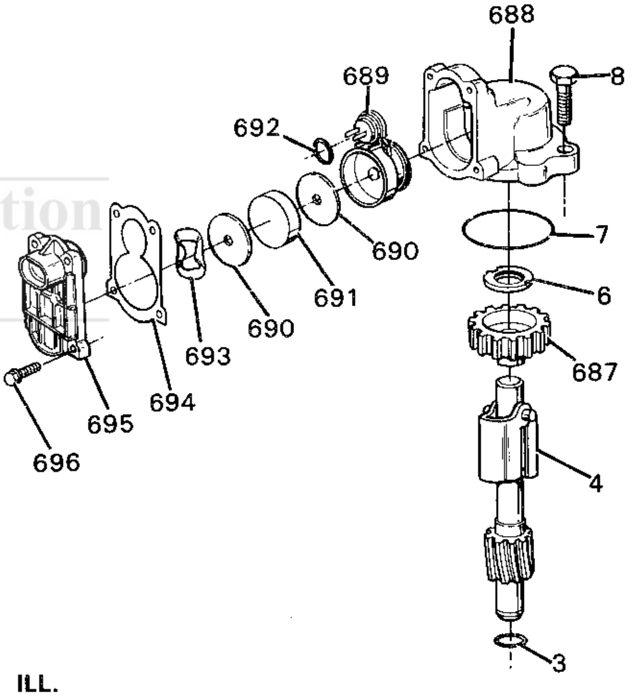
↔ Remove or Disconnect (Figure 3A)

1. Screws (10)
2. Housing (688) and oil seal (8)
3. Bearing (7)
4. Rotor (687)
5. Governor assembly (5)



3	RING OIL SEAL
4	GOVERNOR ASSEMBLY
5	GEAR, SPEEDOMETER DRIVE
6	THRUST BEARING ASM. 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

Figure 3 Governor Assembly



ILL. NO.	DESCRIPTION
3	RING, OIL SEAL (GOVERNOR SHAFT)
4	GOVERNOR ASSEMBLY
6	BEARING ASSEMBLY, THRUST
7	SEAL, "O" RING
8	BOLT
687	ROTOR, SPEED SENSOR
688	HOUSING, SPEED SENSOR
689	COIL ASSEMBLY
690	WASHER
691	MAGNET
692	SEAL, "O" RING
693	WASHER, WAVE SPRING
694	GASKET, COVER
695	COVER, HOUSING
696	BOLT

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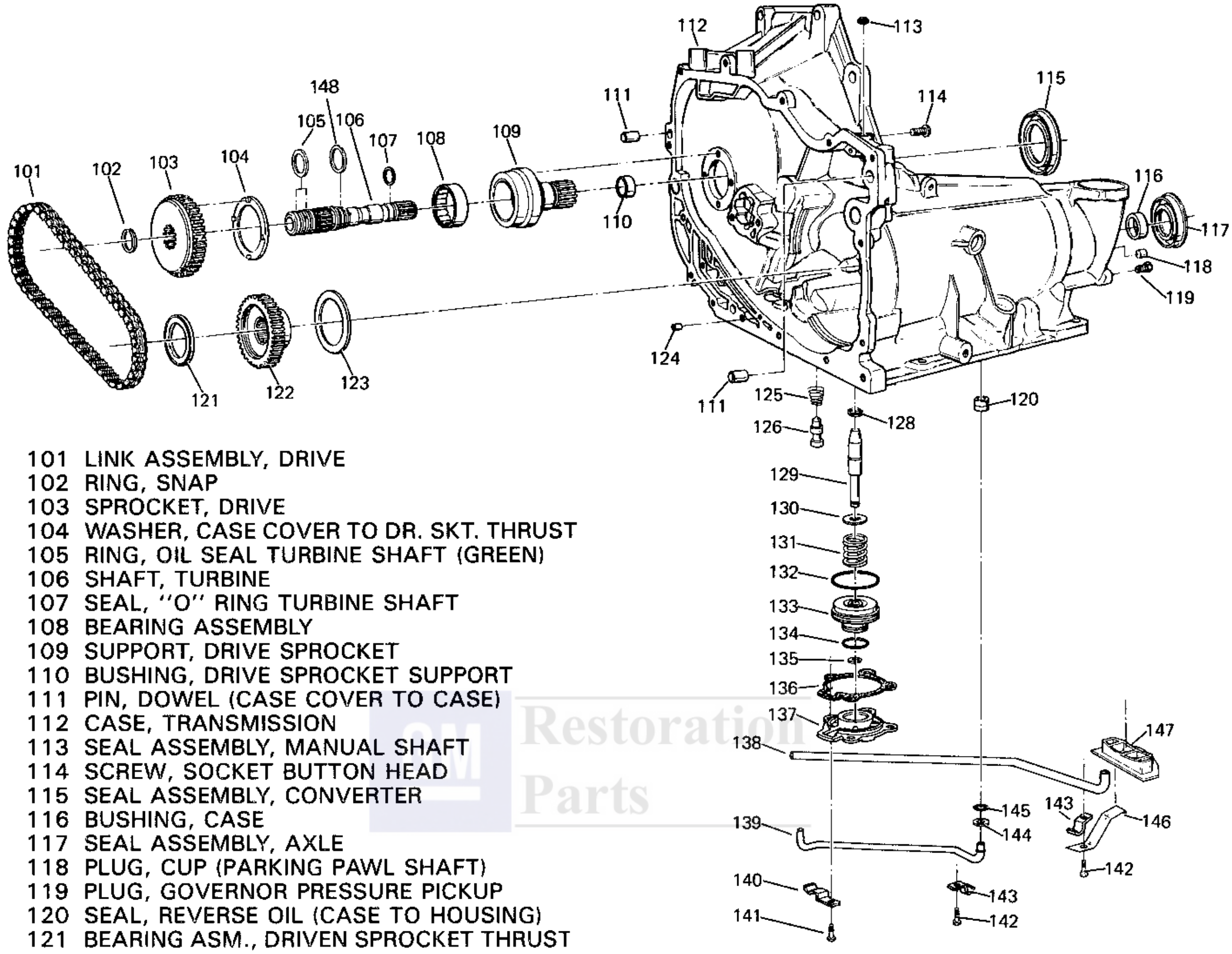
Figure 3A Governor and Internal Transaxle Speed Sensor



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	SEAL, REVERSE OIL (CASE TO HOUSING)
121	BEARING ASM., DRIVEN SPROCKET THRUST
122	SPROCKET, DRIVEN
123	WASHER, DRIVE SKT./SUPPORT THRUST
124	PLUG, CUP (3RD OIL)
125	SPRING, ACCUMULATOR EXHAUST
126	VALVE, ACCUMULATOR EXHAUST
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) INTER. SERVO
133	PISTON, INTERMEDIATE SERVO
134	RING, OIL SEAL (INNER) INTER. 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 AND REV. 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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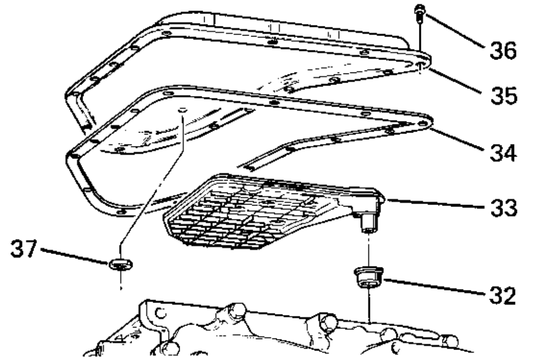
Figure 4 Drive Link Assembly, Servo, Oil Pipes

Bottom Pan, Oil Strainer, Oil Pipes

Remove or Disconnect (Figures 3 and 5)



32	SEAL
33	STRAINER ASM., TRANSMISSION OIL
34	GASKET, OIL PAN
35	PAN, TRANSMISSION OIL
36	SCREW, TRANSMISSION OIL PAN
37	MAGNET, CHIP COLLECTOR

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Figure 5 Bottom Pan & Oil Strainer

1. Bolts (36)
2. Pan (35) – Leave two bolts finger tight – tap open with a rubber mallet
3. Strainer (33) and seal (32)

Remove or Disconnect (Figures 4 and 6)

1. Bolts (141) and (142)
2. (140) and retainers (143)
3. Servo cover (137) and gasket (136)
4. Servo assembly (128 - 135)
5. "E" ring (135) from pin (129)
6. Pin (129) from piston (133)

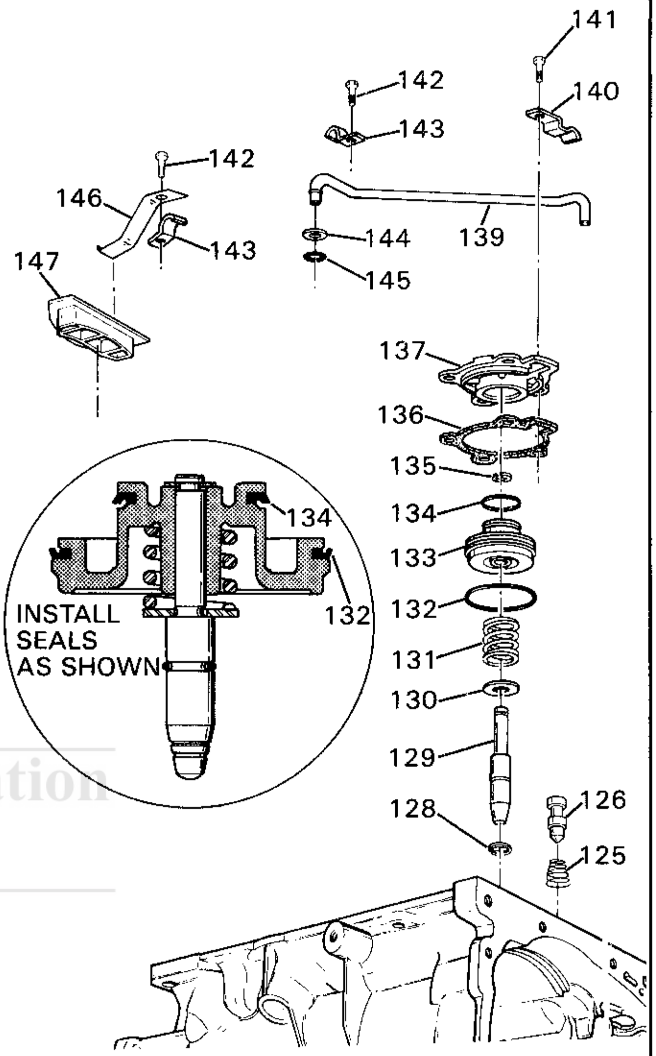
Measure (Figures 7 and 8)

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 and 10)

1. Bolt (712)
2. Stop bracket (711)
3. Bracket (710)
4. Bolts (146)
5. Weir (147)
6. Check valve (126) and spring (125)



125	SPRING, ACCUMULATOR EXHAUST
126	VALVE, ACCUMULATOR EXHAUST
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) INTER. SERVO
133	PISTON, INTERMEDIATE SERVO
134	RING, OIL SEAL (INNER) INTER. SERVO
135	RING, SNAP
136	GASKET, INTERMEDIATE SERVO COVER
137	COVER, INTERMEDIATE SERVO
139	PIPE, REVERSE OIL
140	RETAINER, REVERSE OIL PIPE
141	BOLT, INTERMEDIATE SERVO COVER
142	BOLT, PIPE RETAINER/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

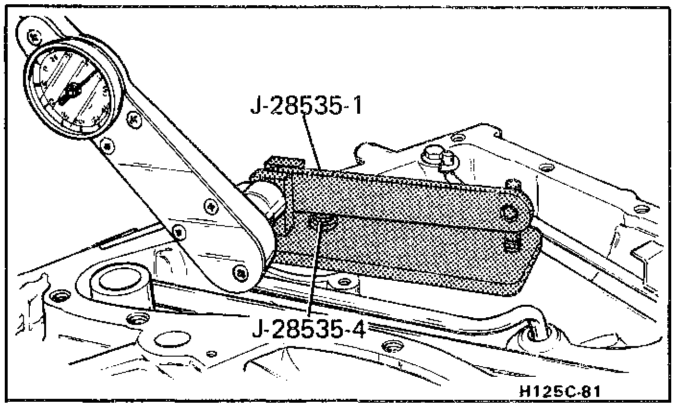

Figure 7 Checking for Proper Apply Pin

INTERMEDIATE BAND APPLY PIN

LENGTH	IDENTIFICATION
Short	2 Grooves
Medium	1 Groove
Long	No Grooves

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Figure 8 Apply Pin Chart

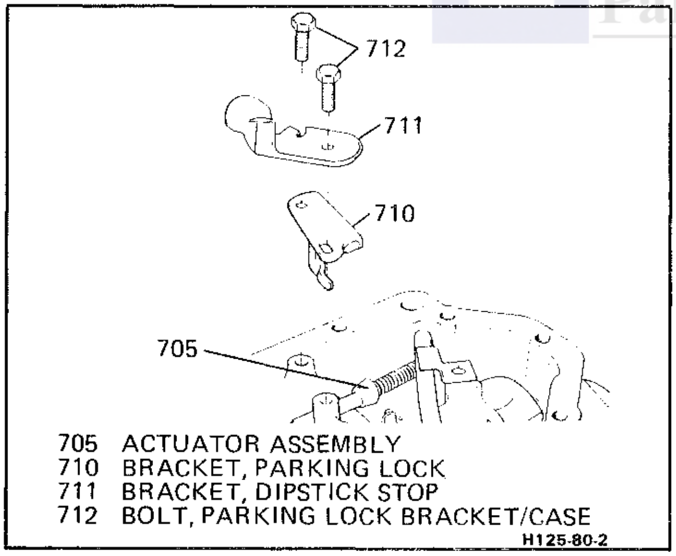


Figure 9 Dip Stick Stop & Brackets

7. Pipe (139), backup ring (144) and "O" Ring (145)

LO AND REVERSE SEAL AND OUTPUT SHAFT

↔ Remove or Disconnect (Figures 11 and 12)

Tool Required:

J-34757 - "C" ring remover/installer, output shaft

Modified No. 4 screw extractor

1. Lo and reverse cup plug (120)
   - Use a modified No. 4 screw extractor
2. Output shaft "C" ring (30) with J-34757
   - Push ring with remover – rotate shaft (29) – pull the ring with needle nose pliers
3. Output shaft (29) from case

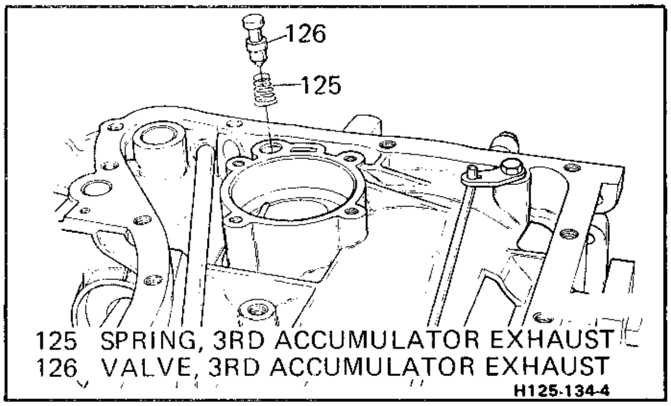


Figure 10 3rd Accumulator Exhaust Valve and Spring

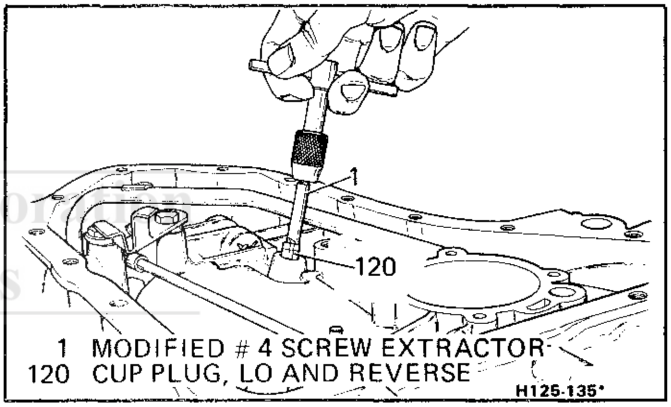


Figure 11 Lo & Reverse Cup Plug

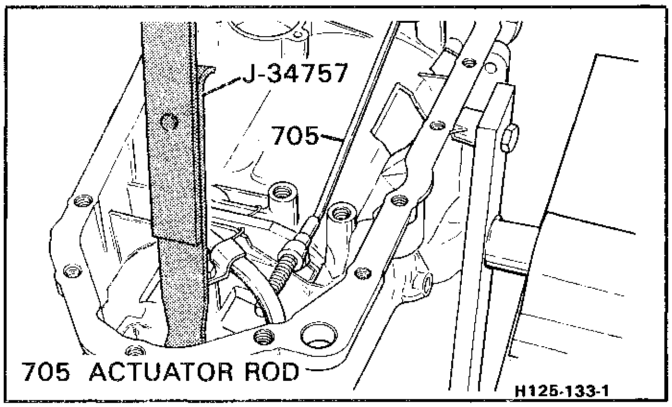


Figure 12 Expanding "C" Ring

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)

Assembly

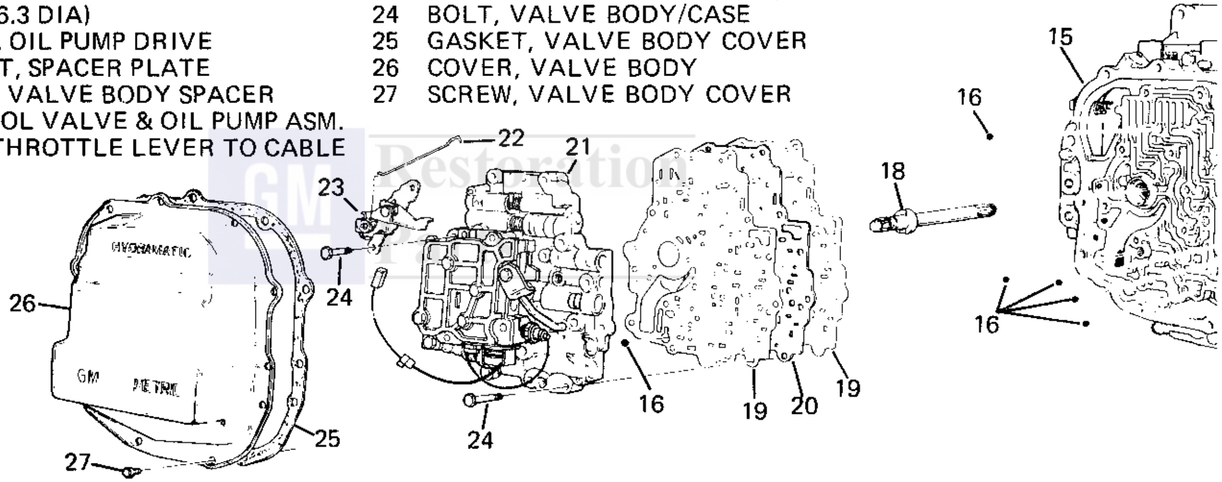
Input Shaft to Case Cover Selective Snap Ring End Play Check

Tighten (Figures 16, 17 and 18)

Tools required:

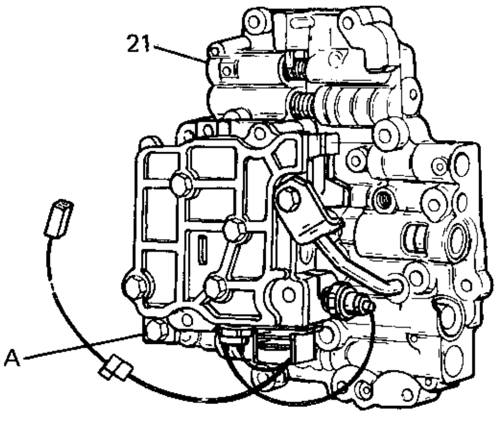
J-26958-10 Adapter Plug
J-26958 Loading tool
J-26958-11 Bracket
J-28544 Input shaft lifter
J-25025-7 Dial indicator post
J-26900-12 or 58001 (M) dial indicator

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 15. For choice of selective snap rings for proper end play ranges – record the reading.
6. Remove the dial indicator set and the lifter.



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 13 Side Cover & the Control Valve, Pump



21 CONTROL VALVE AND OIL PUMP ASM.
A DO NOT REMOVE THIS SCREW

Figure 14 Control Valve/Pump Assembly

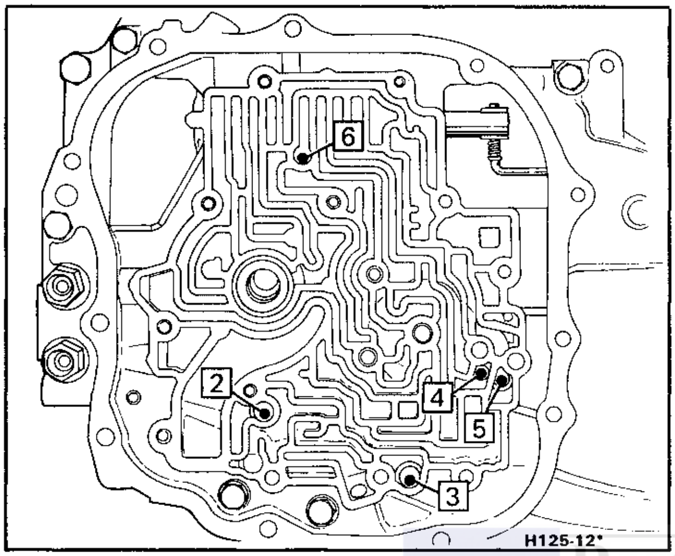


Figure 15 Check Ball Locations

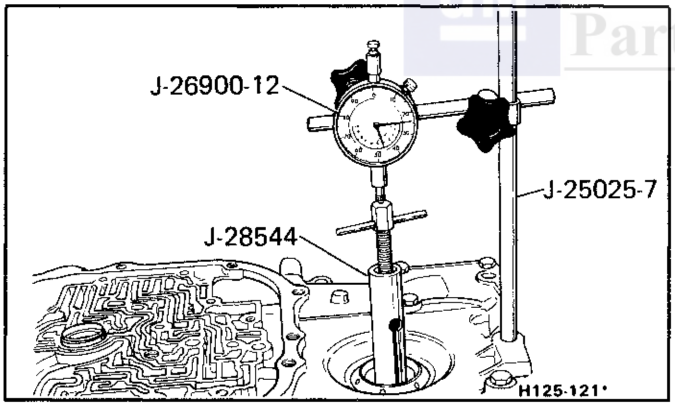


Figure 17 Input Shaft to Case Cover End Play

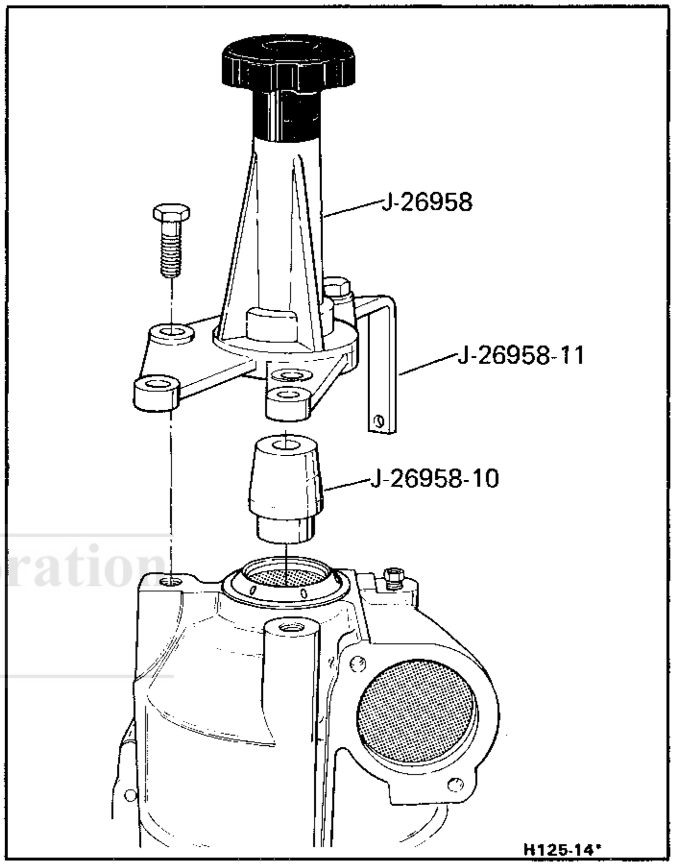


Figure 16 Output Shaft Loading Tool

INPUT SHAFT SELECTIVE SNAP RING (621)

THICKNESS		IDENTIFICATION COLOR
1.83-1.93mm	(0.071"-0.076")	WHITE
2.03-2.31mm	(0.078"-0.084")	BLUE
2.23-2.33mm	(0.088"-0.092")	RED
2.43-2.53mm	(0.095"-0.099")	YELLOW
2.63-2.73mm	(0.103"-0.107")	GREEN

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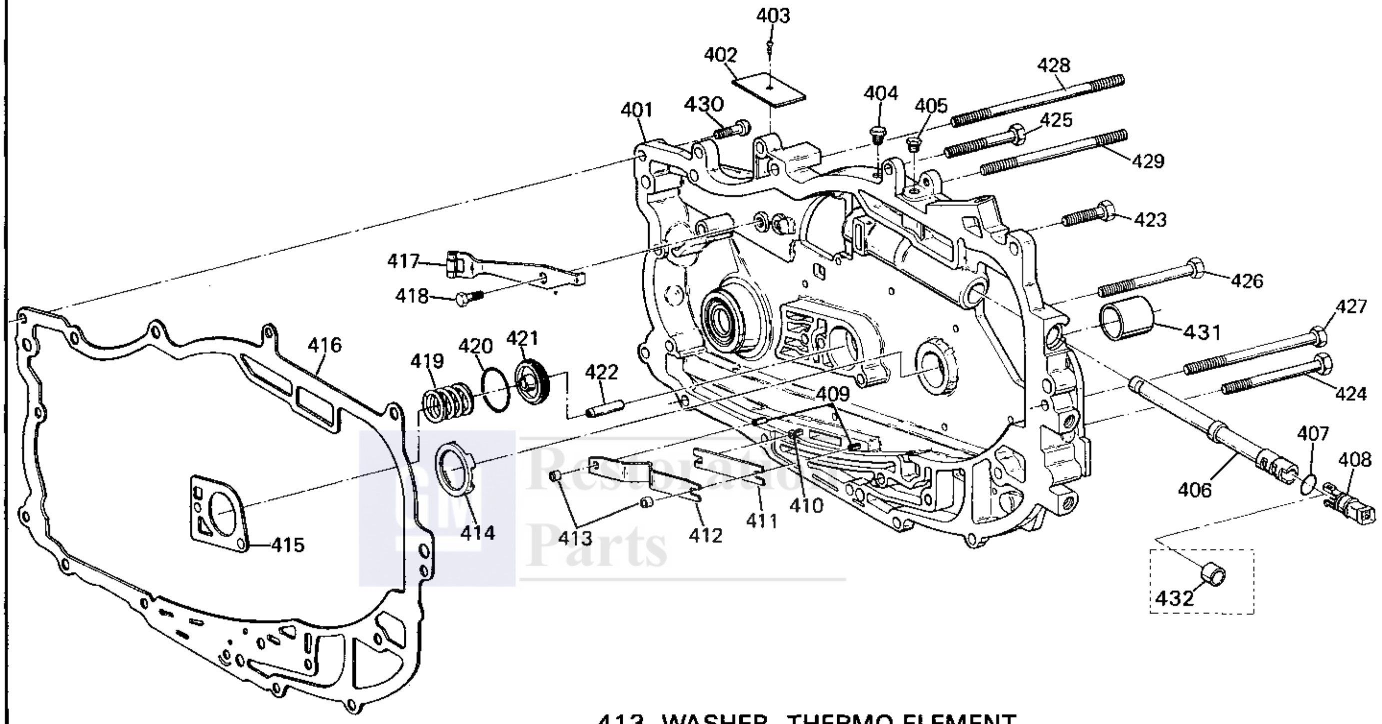
Figure 18 Selective Snap Ring Chart



ILL. NO.	DESCRIPTION
401	COVER, TRANSMISSION CASE
402	NAMEPLATE
403	SCREW, NAMEPLATE
404	VENT ASSEMBLY
405	PLUG, PIPE (LINE PRESSURE PICKUP)
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 DRIVE SOCKET
415	GASKET, CASE TO CASE COVER (CENTER)
416	GASKET, CASE TO CASE COVER
417	SPRING & ROLLER ASM., MANUAL DETENT
418	BOLT, MANUAL DETENT 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
430	SCREW, SOCKET MODIFIED PAN HEAD
431	SLEEVE, TRANSAXLE CASE COVER
432	PLUG, MANUAL VALVE BORE (NON T.C.C.)

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Figure 19 Case Cover - Case Side

Case Cover

↔ Remove or Disconnect (Figures 19, 20, 21, 22 and 23)

Tools Required:

Two M12 bolts 50 mm (2" long)

1. Rod (701) and retainer 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 cover (401) from the case (112) **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 bearing (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)

INPUT UNIT PARTS

↔ Remove or Disconnect (Figures 23, 24, 25, 26, 26L, 27, and 28)

1. Pin (702), nail (713)
2. Detent lever (703), manual shaft (704) and actuator rod (705)
3. Driven sprocket support (602) and thrust washer (605) on direct clutch side
4. Plug (607) and band (606)
5. Direct and forward clutch assemblies (610-634) by lifting input shaft (624)
6. Thrust washer (636)

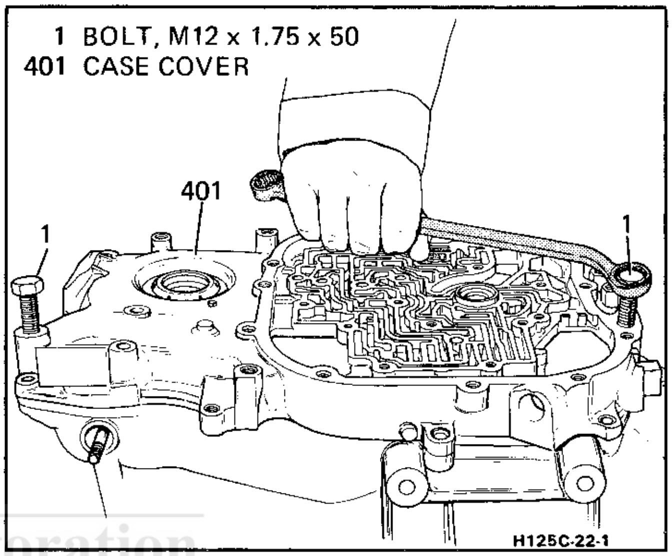


Figure 20 Case Cover Removal

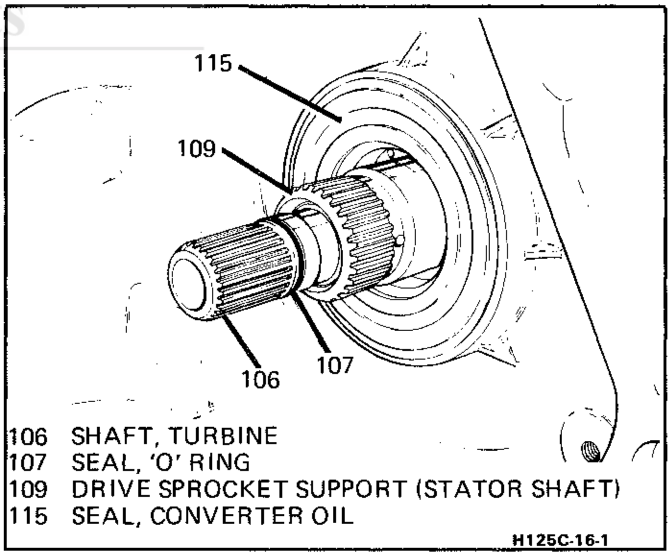
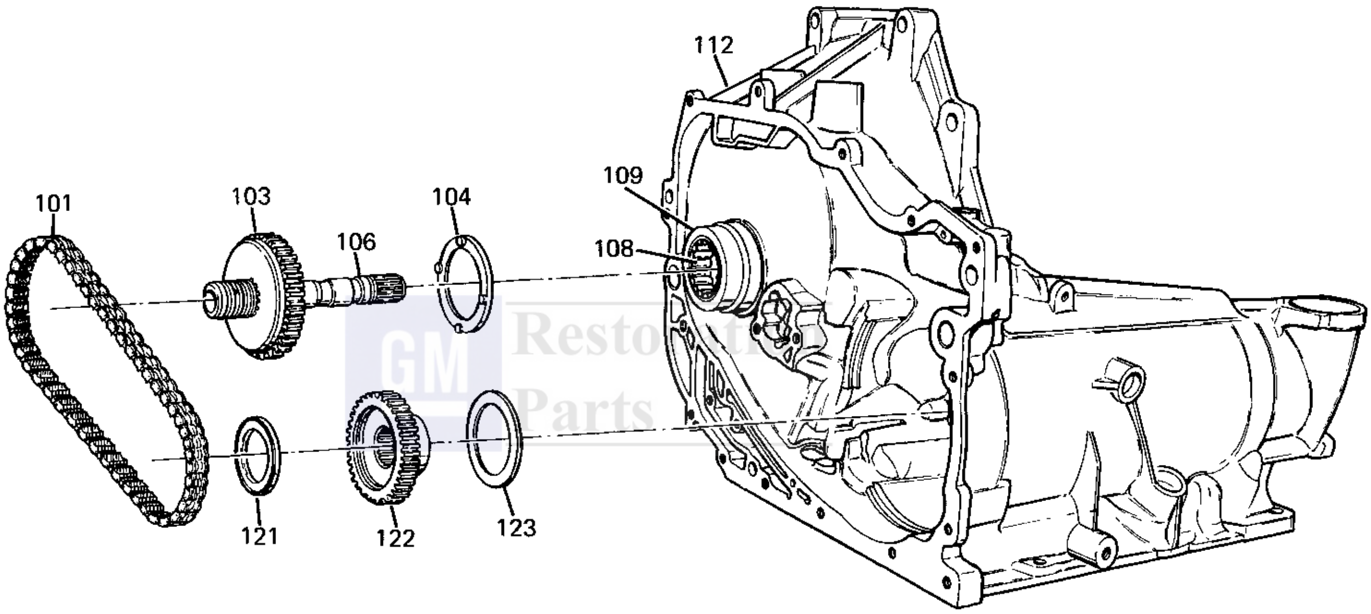


Figure 21 Turbine Shaft "O" Ring Seal

7. Internal gear (637), input carrier (640) and thrust washer (641)
8. Input sun gear (642) and input drum (643)



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

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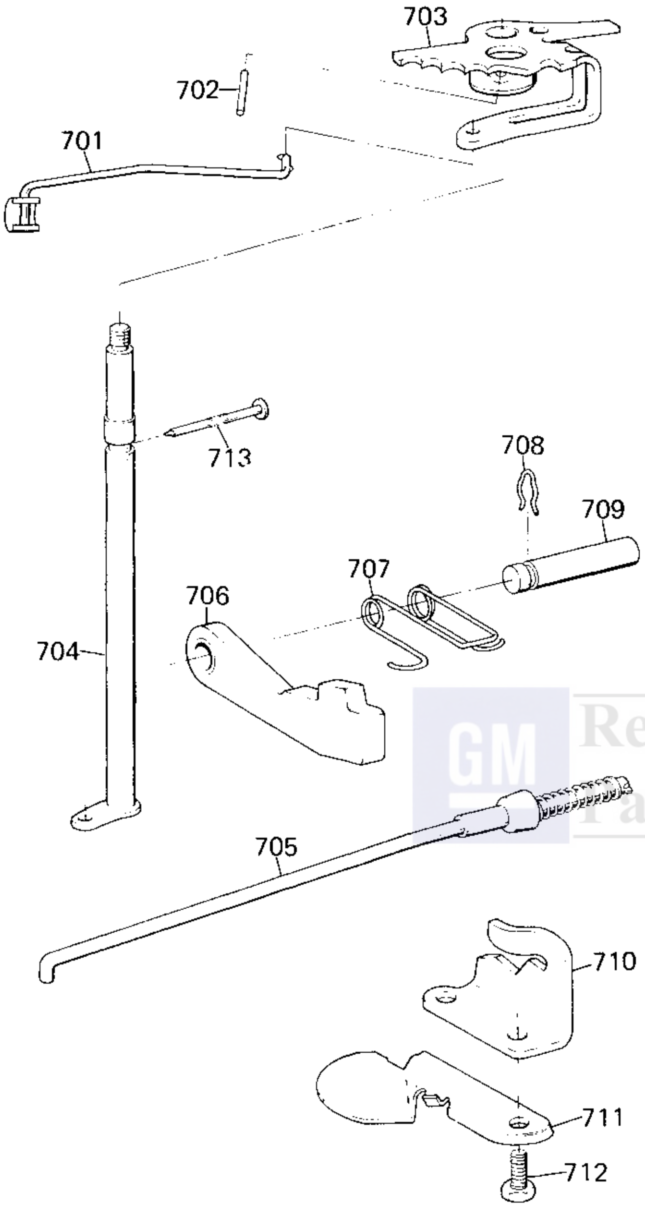
Figure 22 Drive Link Assembly



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

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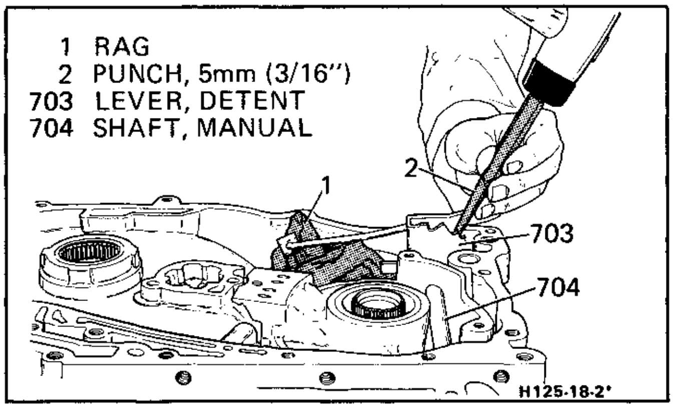
Figure 23 Manual Linkage



1 RAG
2 PUNCH, 5mm (3/16")
703 LEVER, DETENT
704 SHAFT, MANUAL

Figure 24 Retaining Pin Removal

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

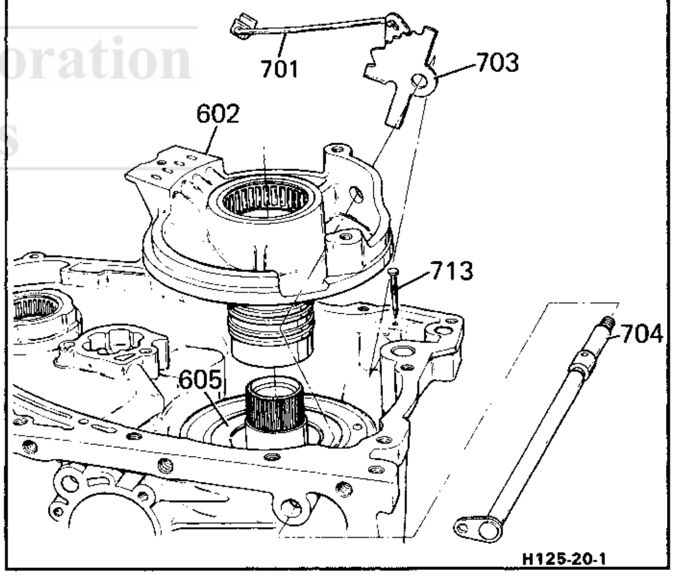


Figure 25 Removing Manual Linkage

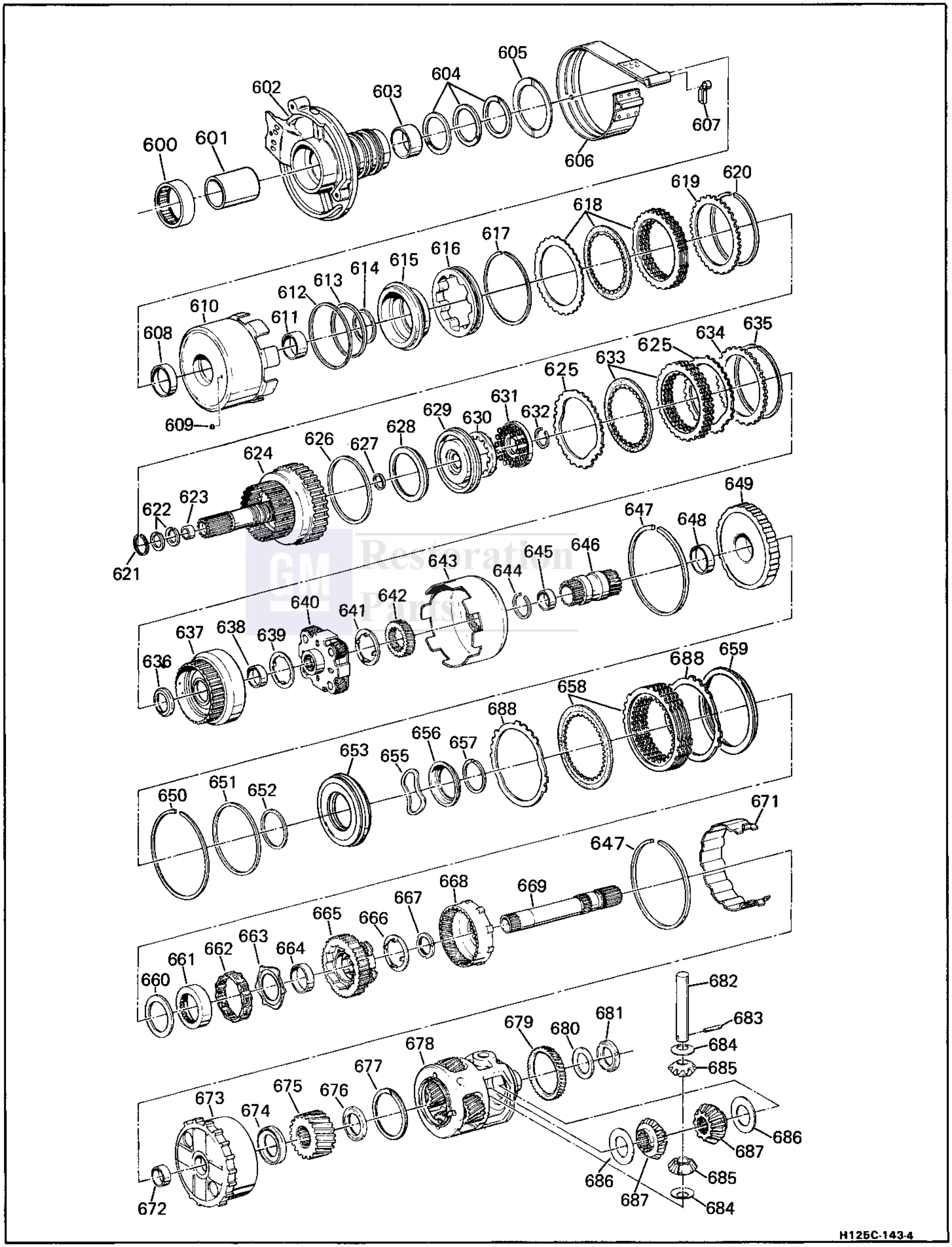


Figure 26 Internal Components

ILL. NO.	DESCRIPTION
600	BEARING ASSEMBLY
601	SLEEVE, SUPPORT 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 ASM., DIRECT CLUTCH
619	PLATE, CLUTCH BACKING (DIRECT)
620	RING, SNAP
621	RING, SNAP (SELECTIVE)
622	RING, OIL SEAL
623	BUSHING, INPUT SHAFT
624	HOUSING ASSEMBLY, FORWARD CLUTCH
625	PLATE, FORWARD CLUTCH WAVED
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 ASM., FORWARD CLUTCH
634	PLATE, FORWARD CL. BACKING (SELECTIVE)
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 INPUT DRUM/SUN GR. (SELECTIVE)
645	BUSHING, REACTION SUN GEAR
646	GEAR, REACTION SUN
647	RING, SNAP
648	BUSHING, LO & REVERSE CLUTCH HSG.
649	HOUSING ASM., LO & REVERSE CLUTCH
650	RING, SNAP
651	SEAL, LO & REVERSE PISTON (OUTER)
652	SEAL, LO & REVERSE PISTON (INNER)
653	PISTON, LO & REVERSE CLUTCH
655	SPRING, LO & REVERSE CLUTCH RELEASE
656	RETAINER, LO & REVERSE CLUTCH SPRING
657	RING, SNAP
658	PLATE ASM., LO & REVERSE CLUTCH
659	PLATE, LO & REVERSE CL. BACKING (SELECTIVE)
660	SPACER, REV. HOUSING/LO RACE (SELECTIVE)
661	RACE, LO ROLLER CLUTCH
662	ROLLER ASSEMBLY, LO CLUTCH
663	WASHER, REACTION CARR./INT. GEAR THRUST
664	BUSHING, REACTION CARRIER
665	CARRIER ASSEMBLY, REACTION
666	WASHER, REACTION CARR./INT. GEAR THRUST
667	BEARING, REACTION SUN/INT. GR. THRUST
668	GEAR, REACTION INTERNAL
669	SHAFT, FINAL DRIVE SUN GEAR
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, DIFFERENTIAL SIDE GEAR THRUST
687	GEAR, DIFFERENTIAL SIDE
688	PLATE, LO & REVERSE CLUTCH WAVED

LEGEND
H 125C-143-4L

Figure 27 Legend

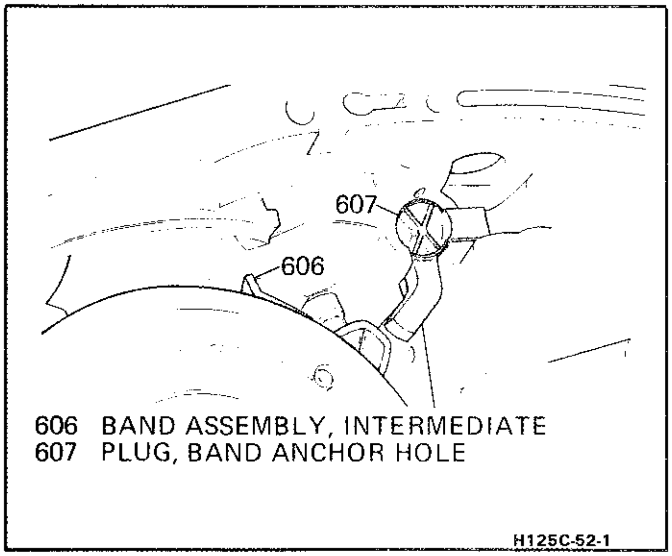


Figure 28 Band Anchor Hole Plug

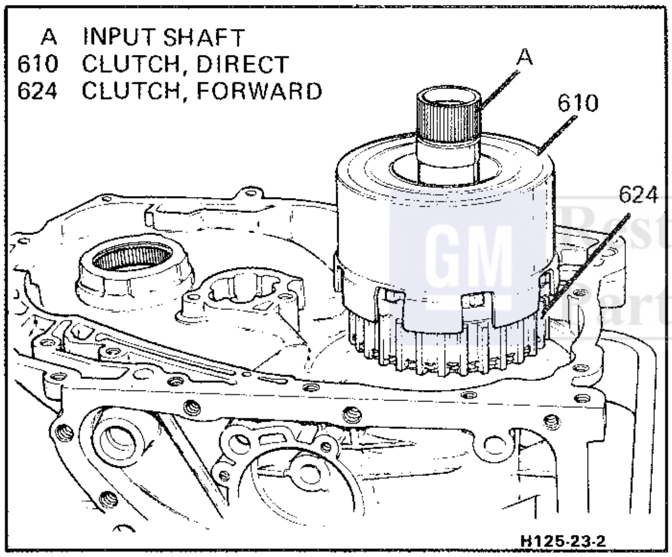


Figure 29 Removing Forward & Direct Clutches

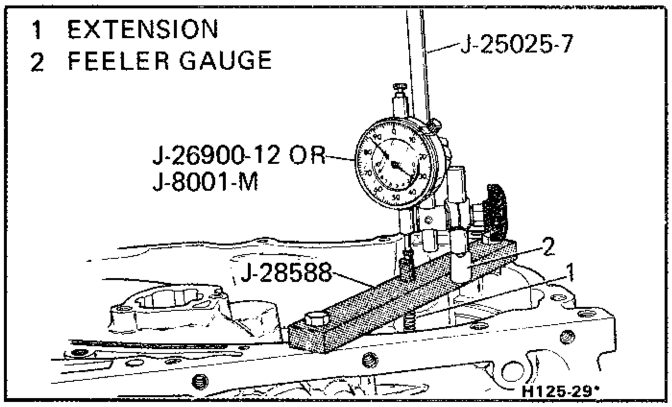


Figure 30 Selective Snap Ring End Play (Sun Gear/Input Drum)

Reaction Sun Gear to Input Drum End Play

Measure (Figures 26, 30 and 31)

Tools Required:

J-26958 Loading tool

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.

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

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.

REACTION UNIT PARTS

Remove or Disconnect (Figures 25, 33, 34, 35 and 36)

Tool Required:

J-28542 Lo-Reverse Clutch Unit Remover and Installer (J-34008 Available)

1. Sun gear (646)
2. Snap ring (647) – ring is 2.36 mm (0.092") thick
3. Lo reverse clutch housing (649) with J-28542

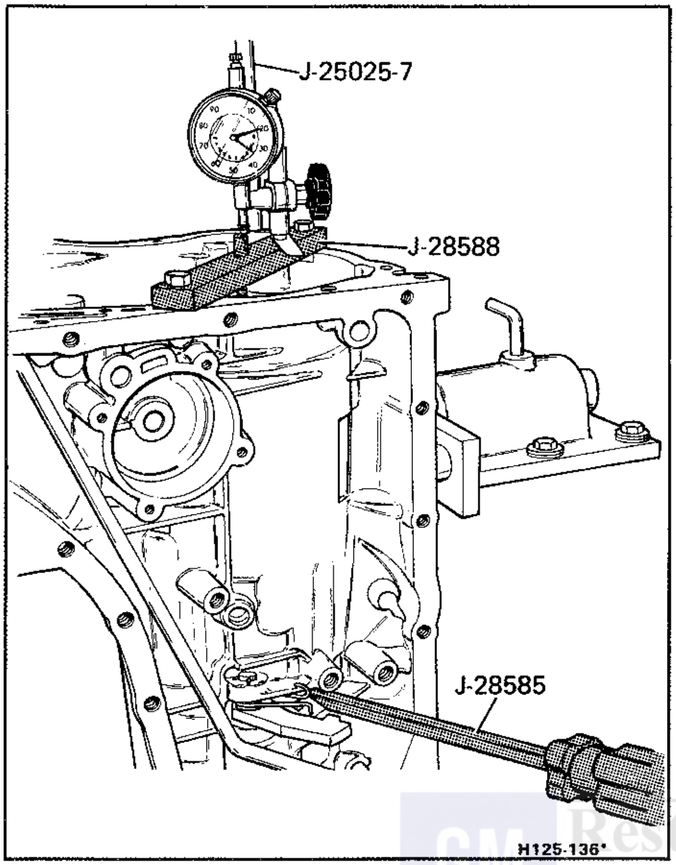

Figure 32 Lo Roller Clutch Race Selective Thrust Spacer

REVERSE CLUTCH HOUSING TO LO RACE SELECTIVE SPACER (660)

THICKNESS		IDENTIFICATION
1.00-1.10mm	(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

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).

Disassemble (Figure 26 and 36)

- Clutch plates (658) & Backing plate (659)
- Roller clutch assembly (665)
- Internal gear (668)
- Shaft (669)

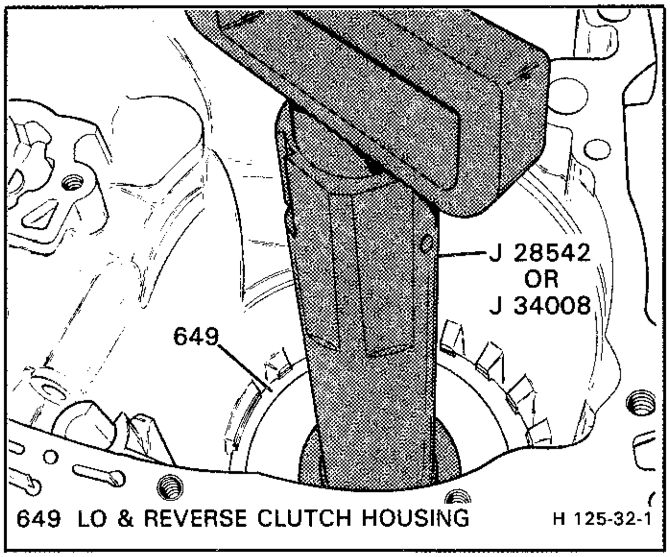


Figure 34 Removing the Lo & Reverse Clutch Housing

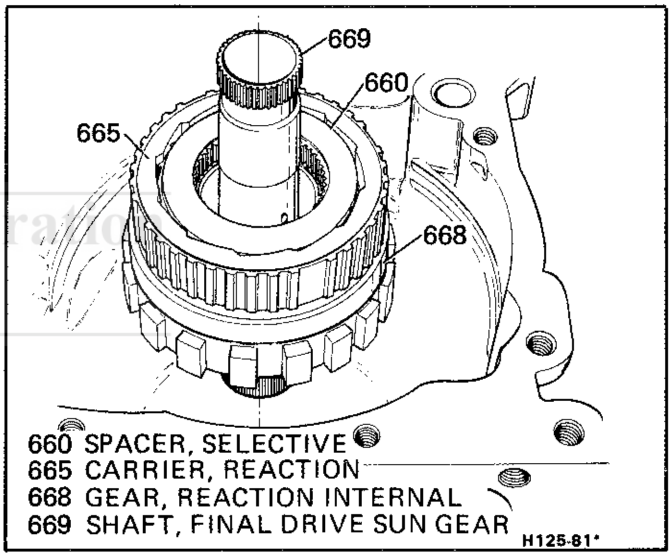


Figure 35 Removing Reaction Components

FINAL DRIVE ASSEMBLY

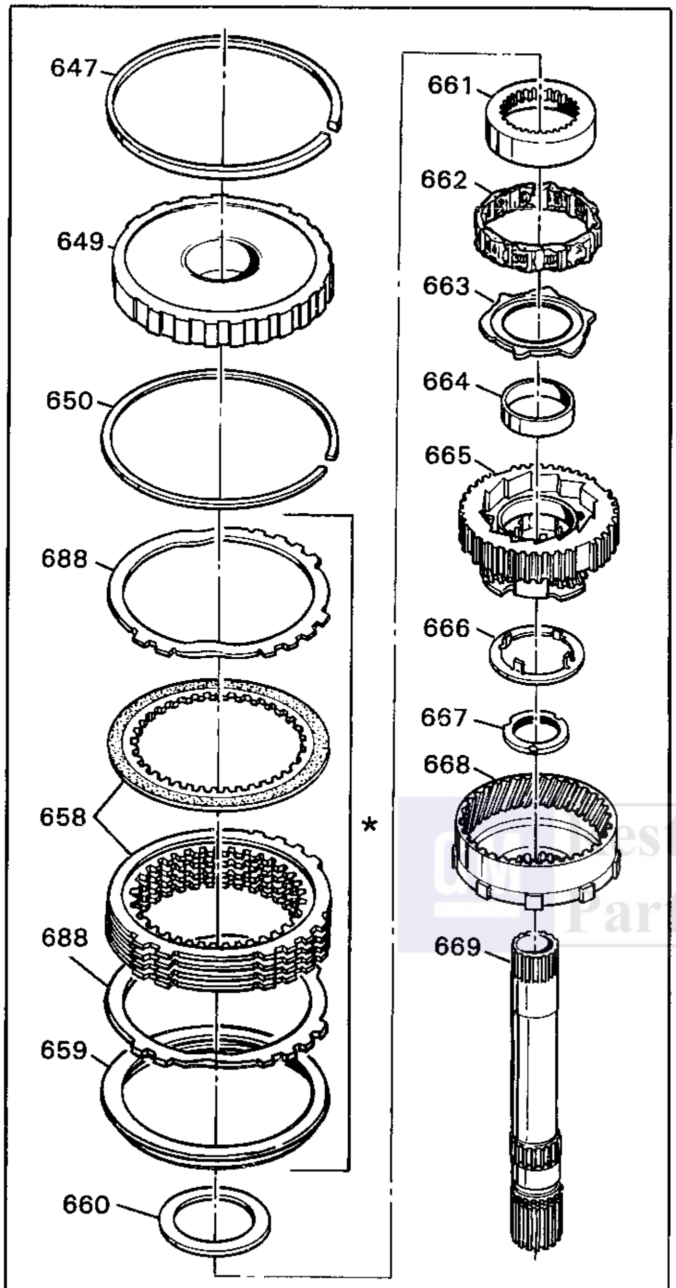
Measure (Figures 37, 38, 39 and 40)

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.
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 38.
5. Remove the dial indicator set and the adpater.

Remove or Disconnect (Figures 26, 38, 39 and 48)

Tool Required:
J-33381 Final Drive Unit Remover and



647	RING, SNAP
649	HOUSING ASM., LO & REVERSE CLUTCH
650	RING, SNAP
658	PLATE ASM., LO & REVERSE CLUTCH
659	PLATE, LO & REV. CL. BACKING (SELECTIVE)
660	SPACER, REV. HSG./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

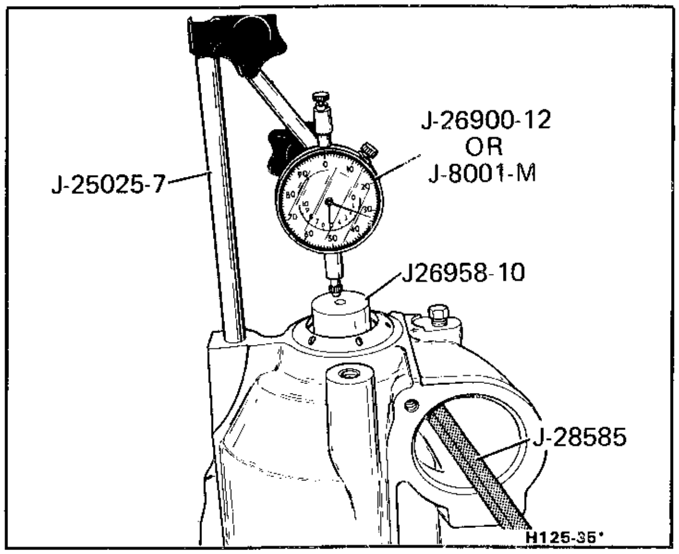

Figure 37 Final Drive End Play Selective Thrust Washer (680) Measurement

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

1. Snap ring (647) – Ring is 2.36mm (0.092") thick.
2. Spacer (671)
3. Final drive assembly (673-688) with J-33381
4. Thrust bearing (681)
5. Selective washer (680)

CASE ASSEMBLY

Clean

- Case (112) thoroughly with solvent and air dry.

Inspect (Figure 41)

- Case – see Section 7A for Case Repair
  - Lug damage
  - Snap ring groove damage
  - Oil passage damage
  - Servo bore damage
  - Casting porosity
  - Stripped threads

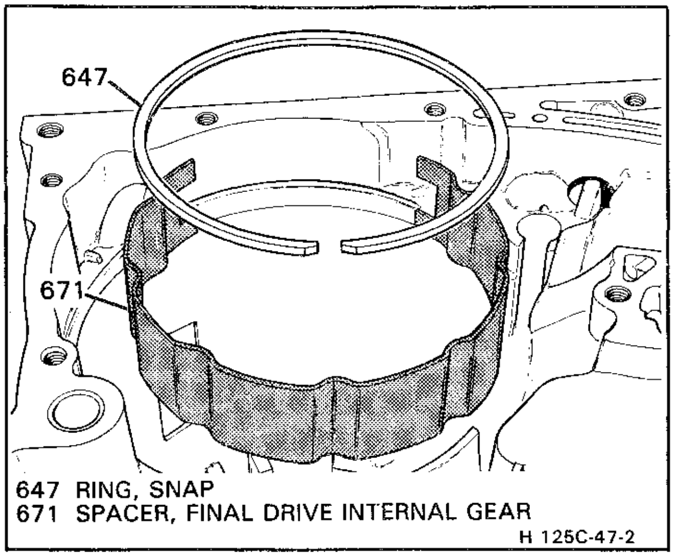


Figure 39 Final Drive Spacer & Snap Ring

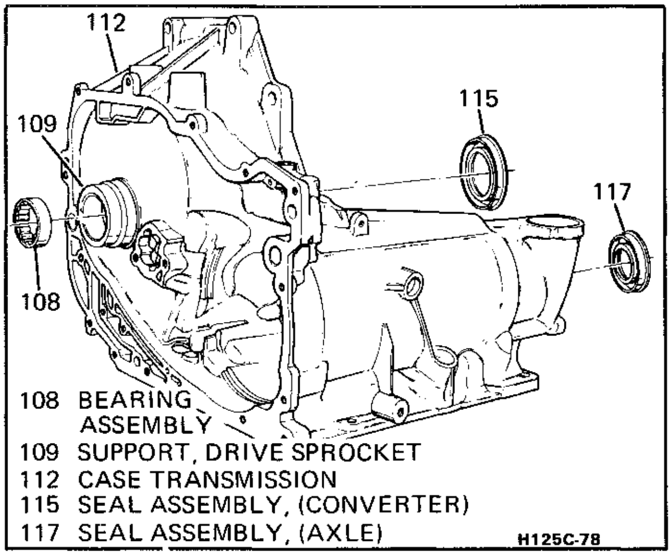


Figure 41 Axle Seals & Sprocket Bearing

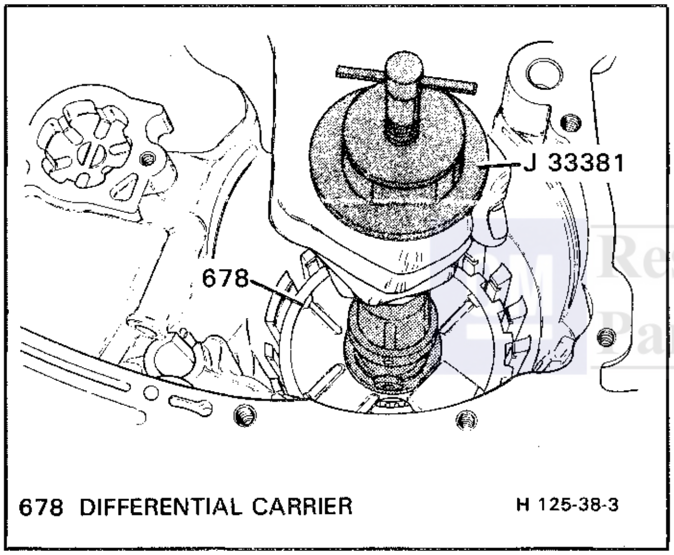


Figure 40 Removing Final Drive Assembly

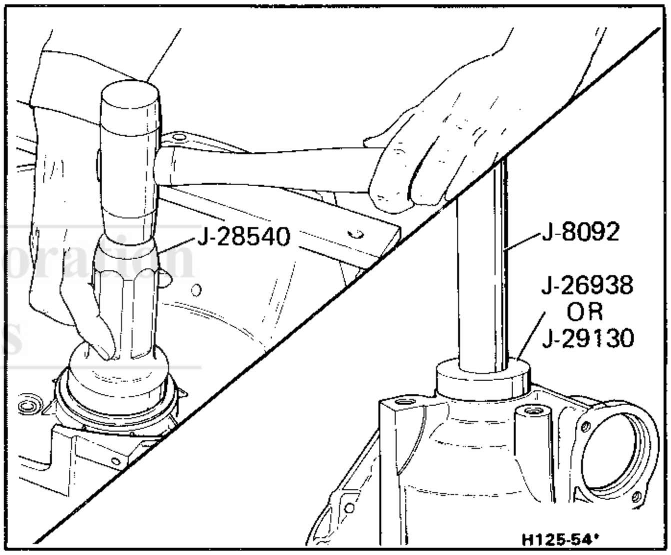


Figure 42 Converter Seal and Axle Seal Installation

- Case bushing (116) – for scoring
- Converter seal (115) – see drive sprocket support inspection replace
- Axle seal (117) – for damage

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 (103) 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

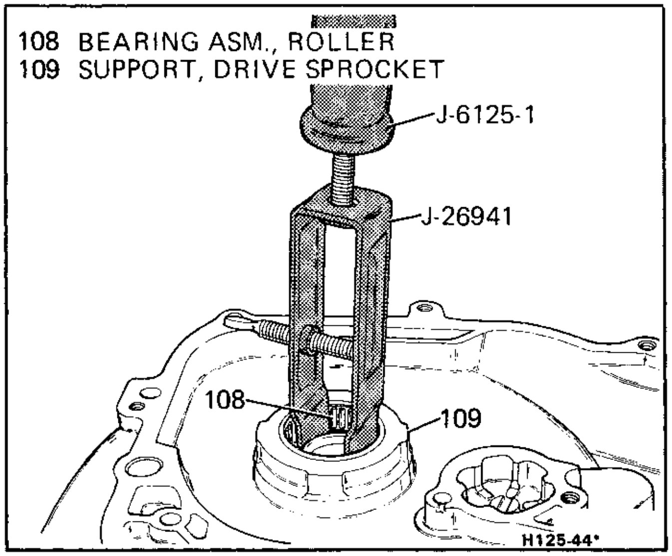


Figure 43 Removing Bearing

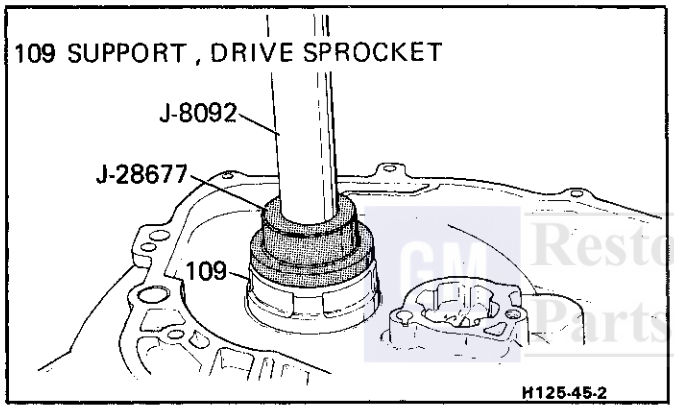


Figure 44 Installing Bearing

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

Inspect (Figure 46)

- Parking pawl (706) for damage

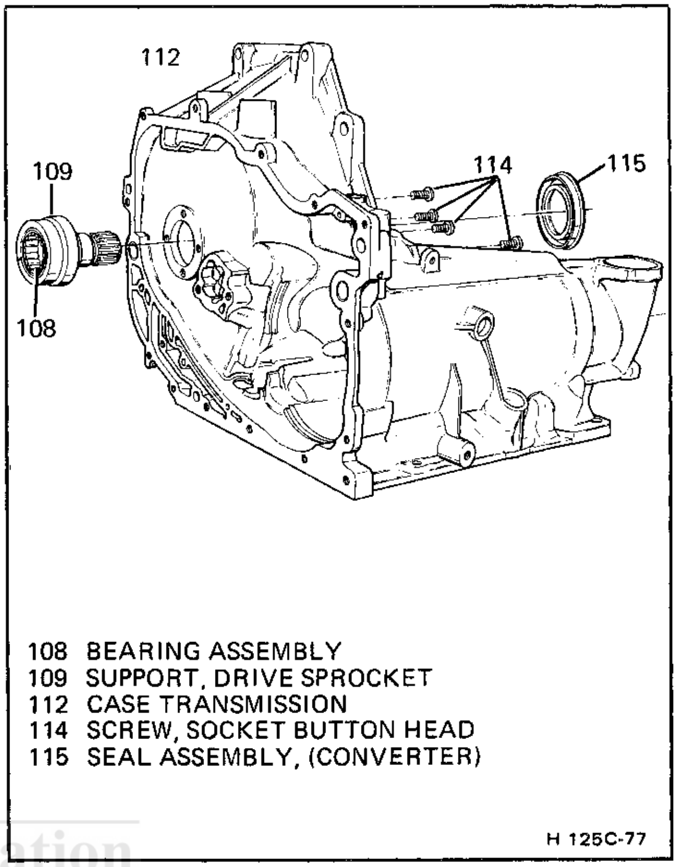


Figure 45 Sprocket Support Replacement

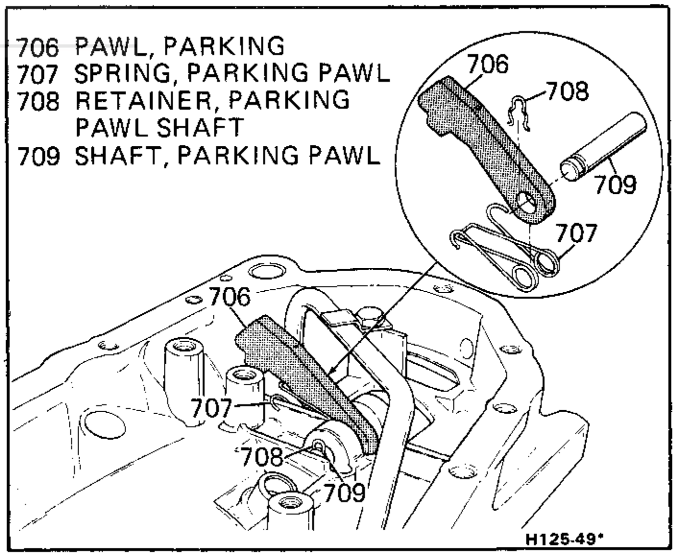


Figure 46 Parking Pawl

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

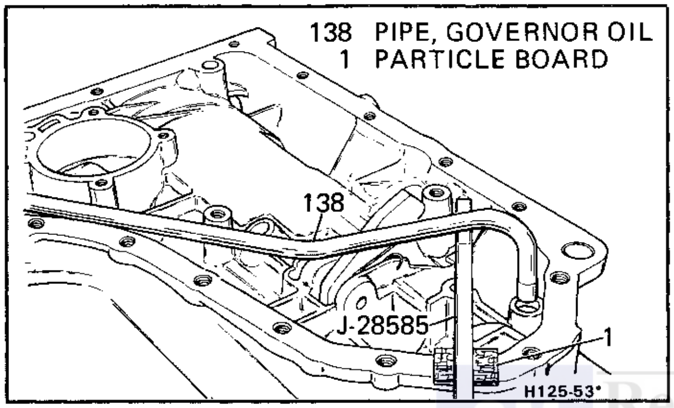


Figure 47 Governor Pipe Replacement

Inspect (Figure 47)

- Governor pipe (138) for damage or cracks

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 719 ® 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)

- Cup Plug (2) - use #3 screw extractor with 13 mm (1/2″) ground off.

Install or Connect

- Cup Plug (2) tap until seated in case - use a 6 mm (1/4″) rod.

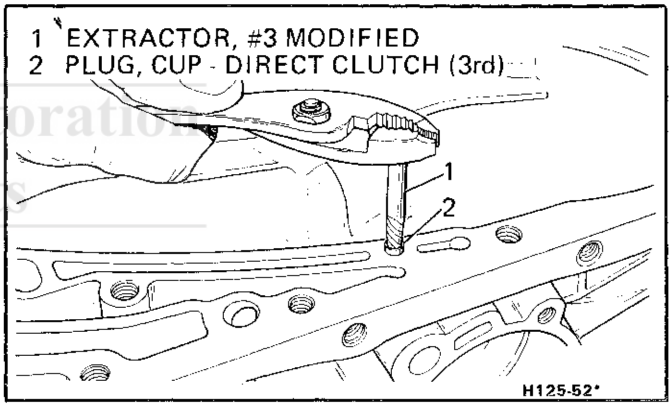


Figure 48 Cup Plug Removal

Inspect (Figure 4)

- Manual Shaft oil seal (113) for damage

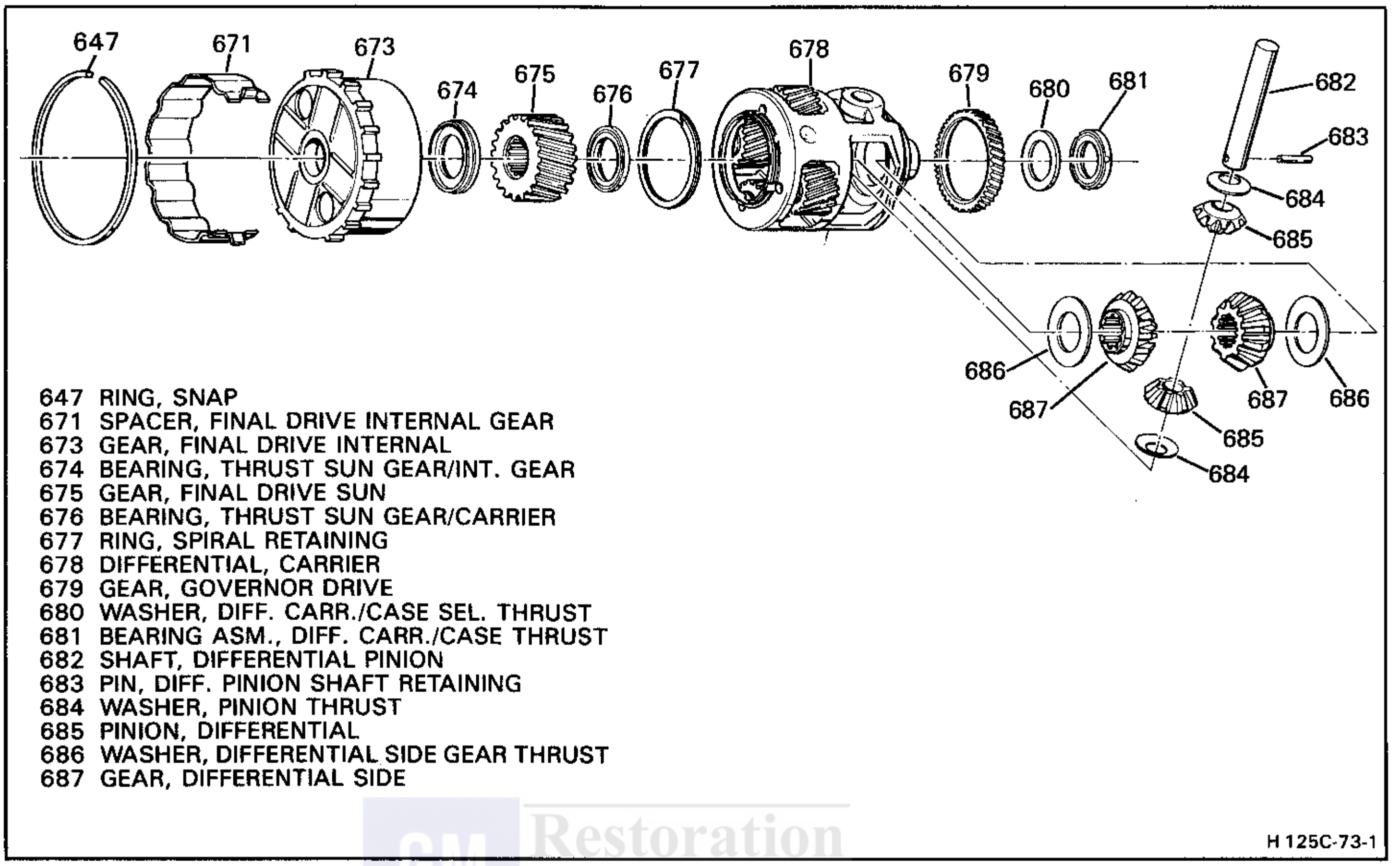
Manual Shaft Replacement Procedure

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.



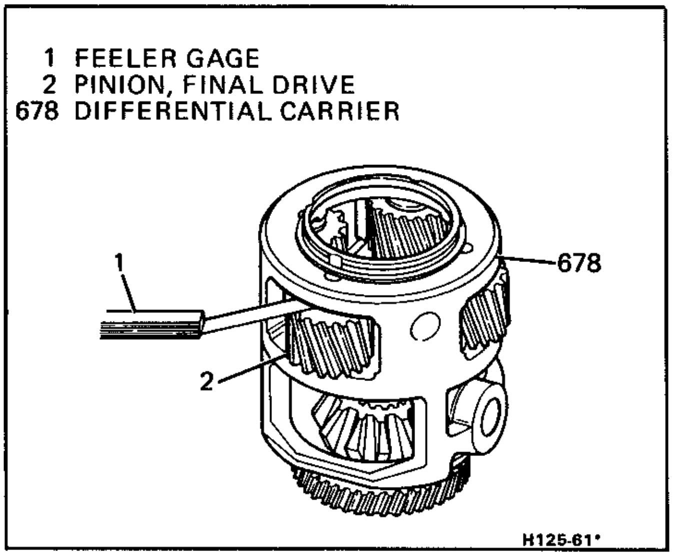
647	RING, SNAP
671	SPACER, FINAL DRIVE INTERNAL GEAR
673	GEAR, FINAL DRIVE INTERNAL
674	BEARING, THRUST SUN GEAR/INT. GEAR
675	GEAR, FINAL DRIVE SUN
676	BEARING, THRUST SUN GEAR/CARRIER
677	RING, SPIRAL RETAINING
678	DIFFERENTIAL, CARRIER
679	GEAR, GOVERNOR DRIVE
680	WASHER, DIFF. CARR./CASE SEL. THRUST
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, DIFFERENTIAL SIDE GEAR THRUST
687	GEAR, DIFFERENTIAL SIDE

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)

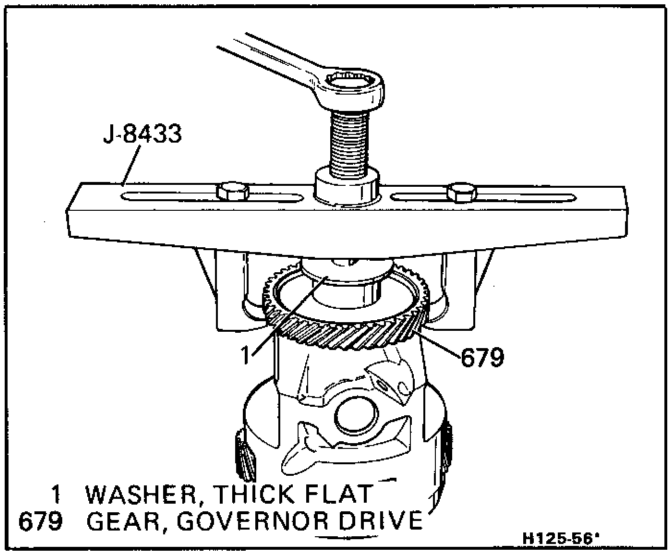


1	FEELER GAGE
2	PINION, FINAL DRIVE
678	DIFFERENTIAL CARRIER

Figure 50 Final Drive Pinion End Play

Inspect (Figures 49 and 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

Figure 51 Governor Drive Gear Replacement

Governor Drive Gear Replacement

Remove or Disconnect (Figure 51)

Tool Required:

J-8433 Puller

- Governor drive gear (679) 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

Install or Connect (Figures 49 and 53)

Tool Required:

J-33381 Final Drive Remover and Installer

1. Thrust washer (680) onto carrier assembly, retain with petrolatum
2. Thrust bearing (681) onto carrier assembly, inner race toward carrier, retain with petrolatum
3. Carrier assembly into case with J-33381

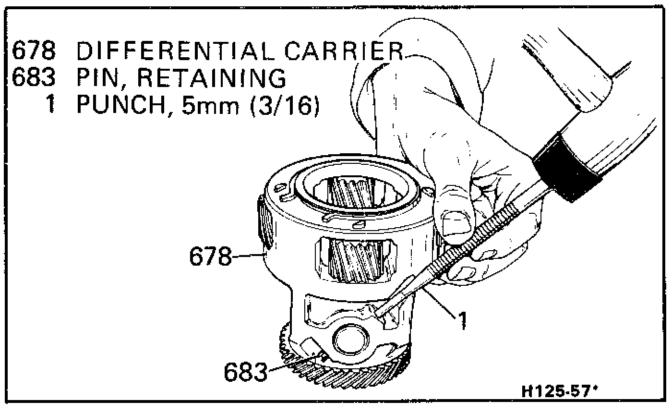


Figure 52 Pinion Shaft Retaining Pin

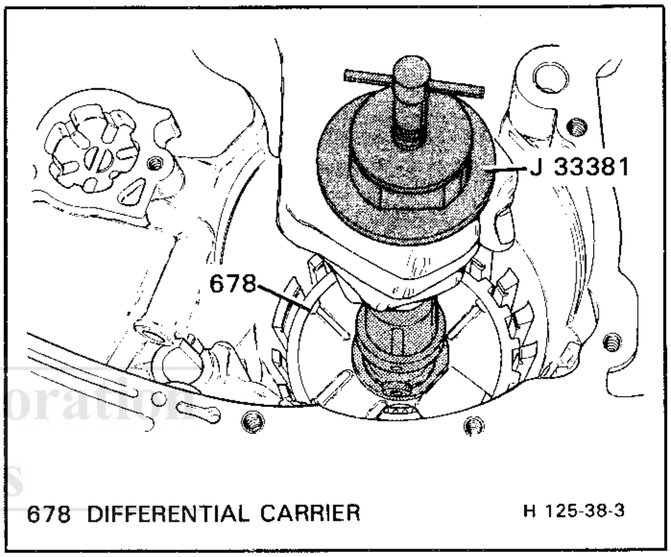


Figure 53 Installing the Final Drive Assembly

Inspect

- Spacer (671) for damage
- Snap ring (647) 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 (647) into the snap ring groove.

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).

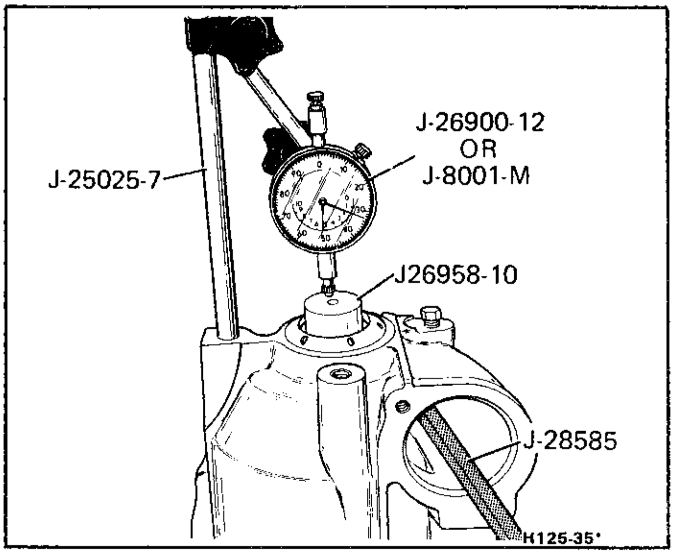


Figure 54 Final Drive End Play Selective Thrust Washer (680) Measurement

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 55.
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.

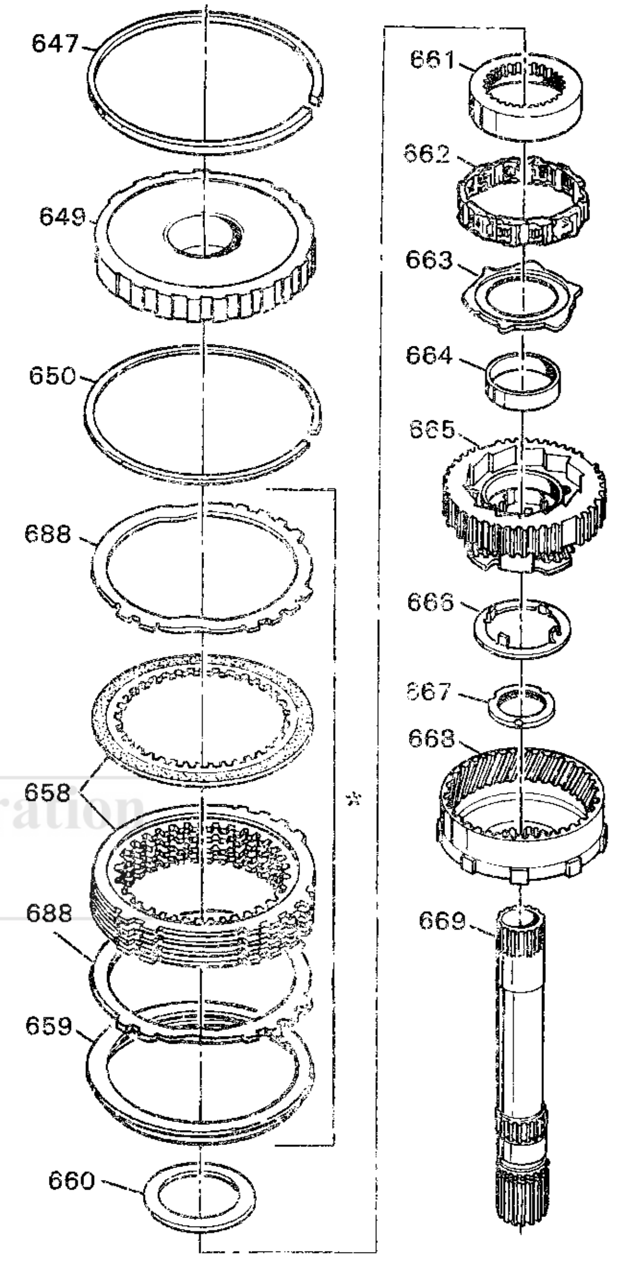
REACTION CARRIER ASSEMBLY

Inspect (Figures 56 and 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)



647	RING, SNAP
649	HOUSING ASM., LO & REVERSE CLUTCH
650	RING, SNAP
658	PLATE ASM., LO & REVERSE CLUTCH
659	PLATE, LO & REV. CL. BACKING (SELECTIVE)
660	SPACER, REV. HSG./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

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 (Figures 56 and 26)

- 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 (Figures 56 and 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 (Figures 56 and 70)

1. Backing plate (659) stepped side down into case
2. Steel waved plate (688)
3. Lubricant on composition plates (658) before installation
4. Alternate composition plate first, then steel plate (See Figure 70)
5. Steel waved (688) plate
6. Spacer ring (650) – ring is 1.07 mm (0.042") thick

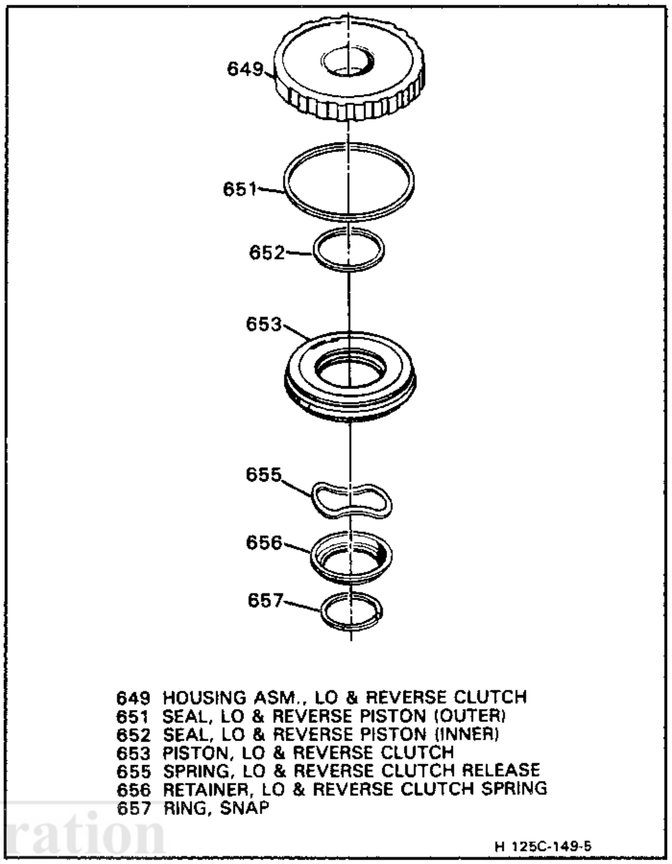

Figure 57 Lo & Reverse Clutch Housing Assembly

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 cracks or damage

Assemble (Figures 56, 57 and 58)

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)

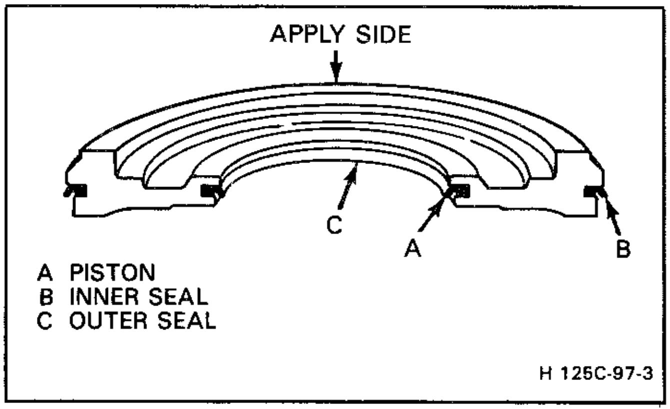

Figure 58 Typical Lo and Reverse Clutch Apply Piston

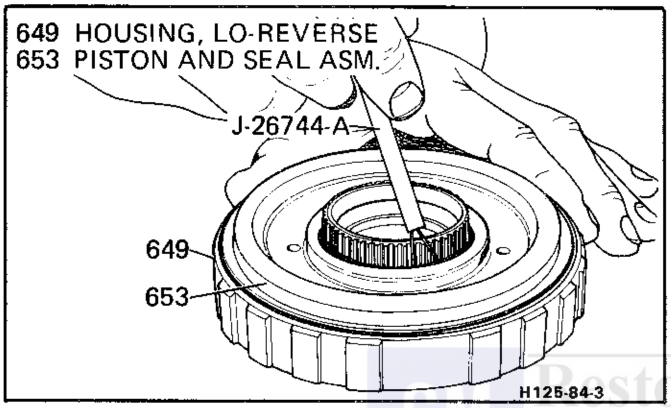

Figure 59 Installing the Lo & Reverse Piston

LO AND REVERSE CLUTCH FUNCTIONAL AIR CHECK

Apply air (max 90 psi) to feed hole. Piston must apply and release when pressure is removed.

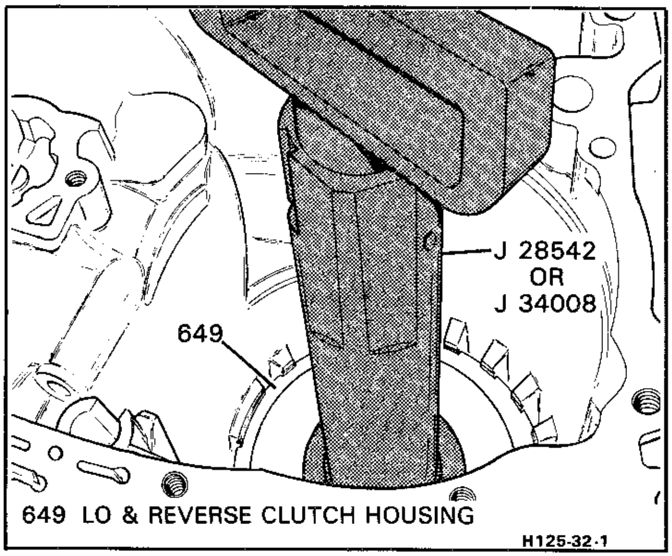

Figure 60 Installing the Lo & Reverse Clutch

Install or Connect (Figure 60)

1. Lo and reverse clutch housing (649) with J-28542 into case (J-34008 Available)
   - 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.

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).

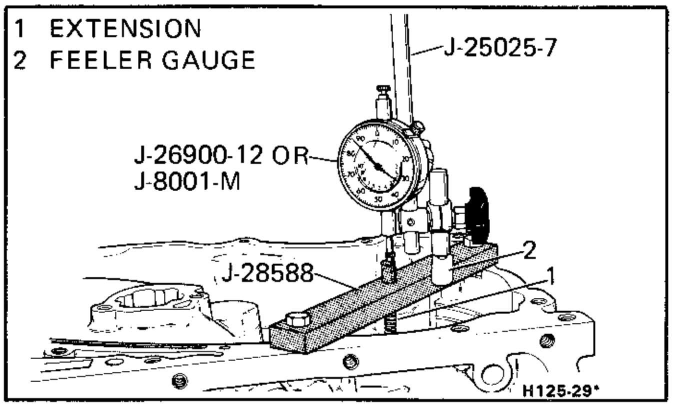

Figure 61 Selective Snap Ring End Play (Sun Gear/Input Drum)

Lo Roller Clutch Race Selective Spacer End Play

Measure (Figures 63 and 64)

Tools Required:

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

Tools from previous measurement check J-28585 Snap Ring Remover

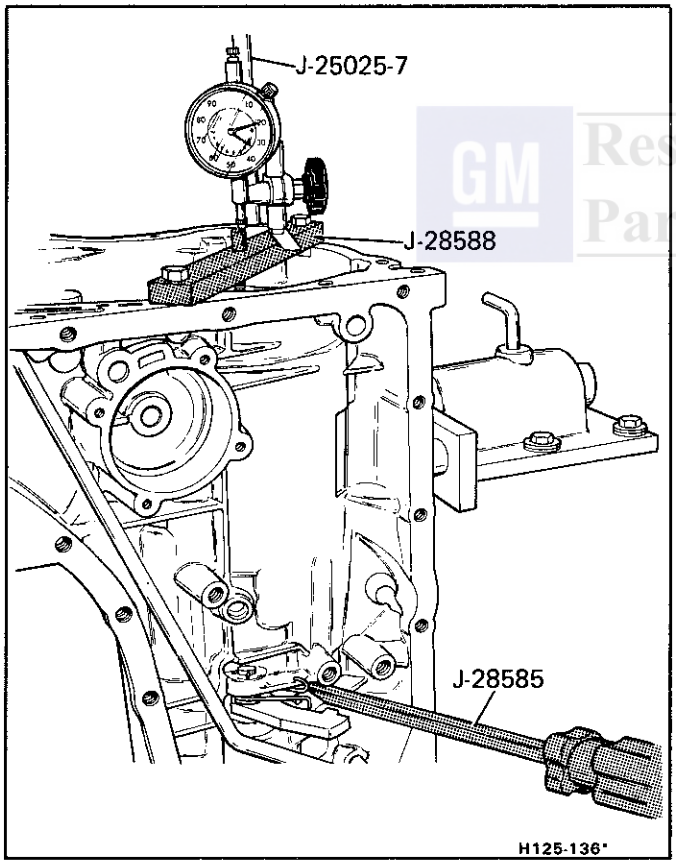

Figure 63 Lo Roller Clutch Race Selective Spacer

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).
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.

REVERSE CLUTCH HOUSING TO LO RACE SELECTIVE SPACER (660)

THICKNESS		IDENTIFICATION
1.00-1.10mm	(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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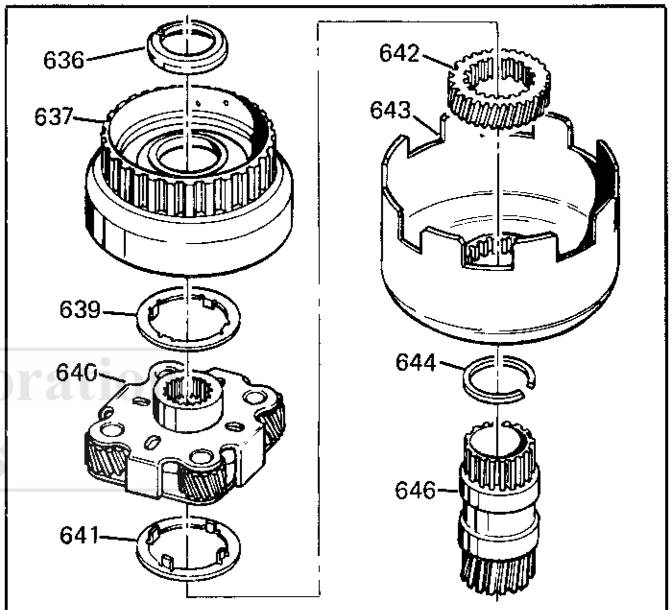
Figure 64 Lo Race Selective Spacer Chart



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

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
- 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 waved plate (625)
4. Steel and composition clutch plates (633)
5. Steel waved plate (625)
6. Snap ring (632) – use an arbor press or J-23456.
7. Retainer and spring assembly (631) and guide (630)
8. Piston (629)
9. Insert (628)
10. Piston seals (626 and 627)

Inspect (Figure 66)

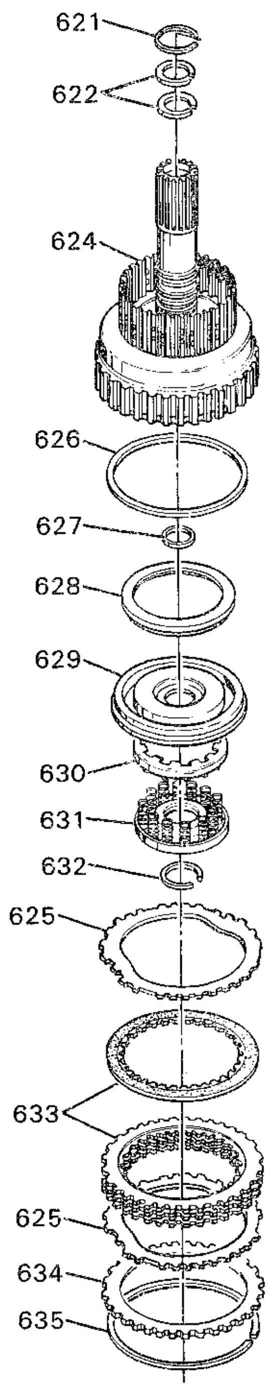
- Forward clutch housing (624) for cracks, broken welds
- Input shaft (A) splines and journals for damage
- Input sleeve for damage, alignment and tightness – sleeve must not turn and slot must line up with input shaft hole.
- Seal rings (622) for damage – do not remove unless replacing.
- Piston (629) 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 plates (625) for wear or burning – flatness
- Backing plate (634) for damage or cracks

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.



621	RING, SNAP (SELECTIVE)
622	RING, OIL SEAL
624	HOUSING ASSEMBLY, FORWARD CLUTCH
625	PLATE, FORWARD CLUTCH WAVED
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 ASM., FORWARD CLUTCH
634	PLATE, FORWARD CL. BACKING (SELECTIVE)
635	RING, SNAP

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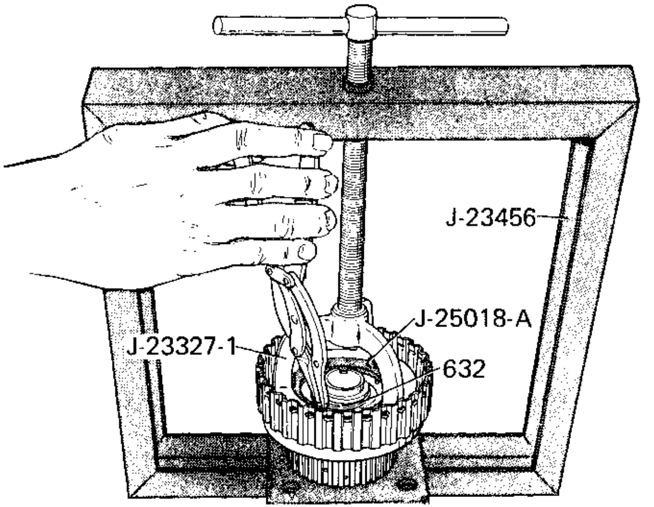
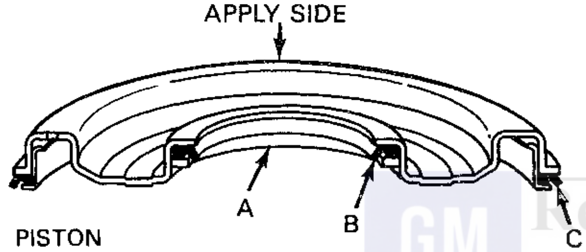
Figure 66 Forward Clutch Assembly



632 RING, SNAP- SPRING RETAINER

Figure 67 Forward Clutch Disassembly



A PISTON
B INNER SEAL
C OUTER SEAL

Figure 68 Typical Apply Piston

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. Steel waved plate (625).
8. Lubricate composition plates (633).
9. Alternate composition and steel plates (633).
10. Steel waved plate (625).
11. Backing plate (634) I.D. side up.
12. Snap ring (632).
13. New seal rings (622) if required.

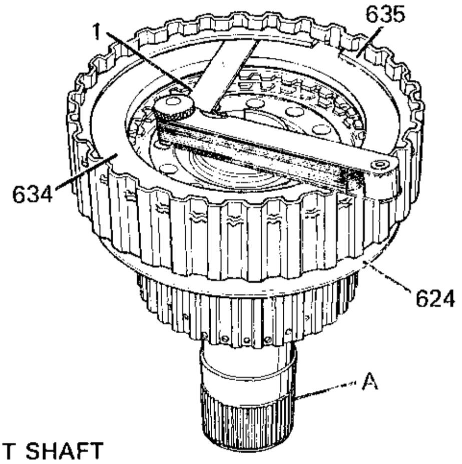
Measure

- 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.

DIRECT CLUTCH ASSEMBLY

Disassemble (Figure 71)

1. Snap ring (620)
2. Backing plate (619)
3. Composition and steel clutch plates (618)
4. Snap ring (617)



A INPUT SHAFT
1 FEELER GAGE 1.0-1.5mm (.04"-.06")
624 HOUSING ASSEMBLY, FORWARD CLUTCH
634 PLATE, FORWARD CL. BACKING (SELECTIVE)
635 RING, SNAP

BACKING PLATE THICKNESS		IDENTIFICATION CODE	
MM	Inches	Steel	Powdered Metal
5.0 - 4.9	.197 - .191	A	6
4.5 - 4.3	.175 - .170	B	7
3.9 - 3.8	.154 - .148	C	8
3.3 - 3.2	.132 - .126	D	9

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Figure 69 Forward Clutch Backing Plate Selection

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
CJC,CPC,CTC, CUC,CXC,HLC, HRC,PMC,PPC	5	2.3mm (0.09")	5	–	––	7	19.0mm (0.75")
JFC,JKC,RAC	3	2.3mm (0.09")	3	–	––	2	27.4mm (1.08")
ALL OTHERS	4	2.3mm (0.09")	4	–	––	1	23.1mm (0.91")
FORWARD ALL	3	1.9mm (0.07")	4	2	1.25mm (0.05")	–	––
LO & REVERSE ALL	4	2.2mm (0.09")	5	2	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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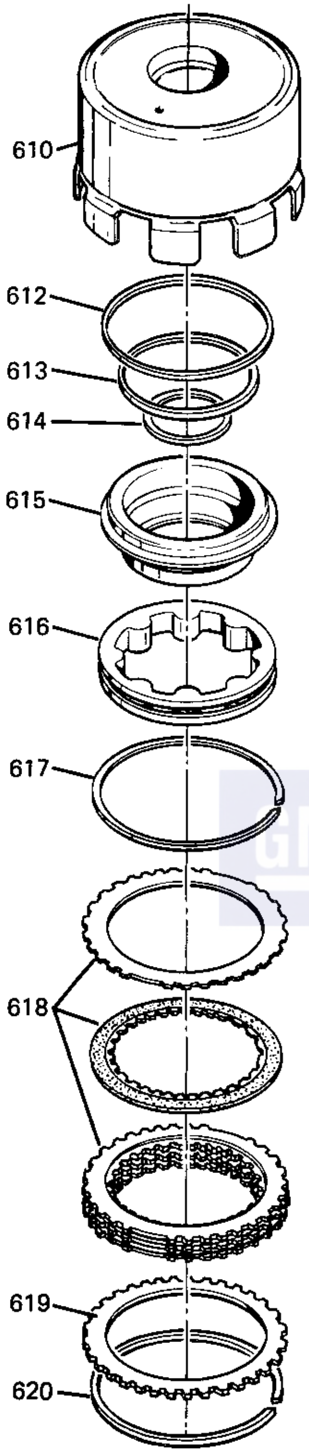
Figure 70 Clutch Plate Usage Chart



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
618	PLATE ASM., DIRECT CLUTCH
619	PLATE, CLUTCH BACKING (DIRECT)
620	RING, SNAP

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Figure 71 Direct Clutch Assembly

5. Apply ring and release spring assembly (616).
6. Piston (615)
   - Inner (614) and outer (612) seals
   - Center seal (613) from housing

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 and 71)

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)
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)

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 35.8mm (1-13/32")

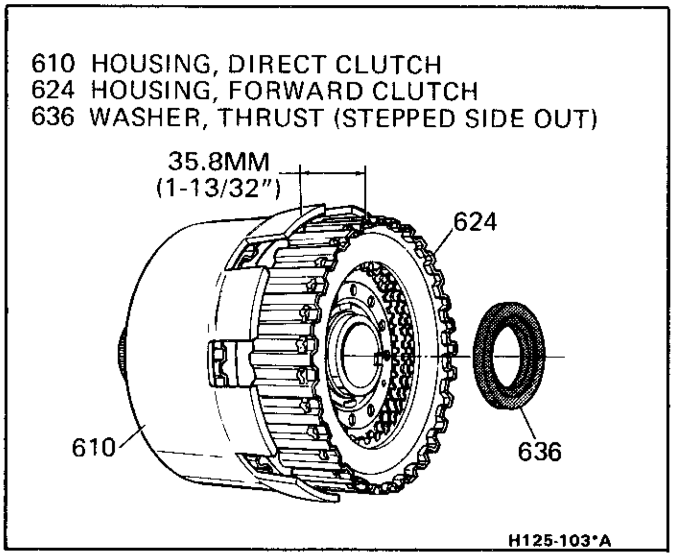


Figure 72 Assembled Height of Clutch Assemblies

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")

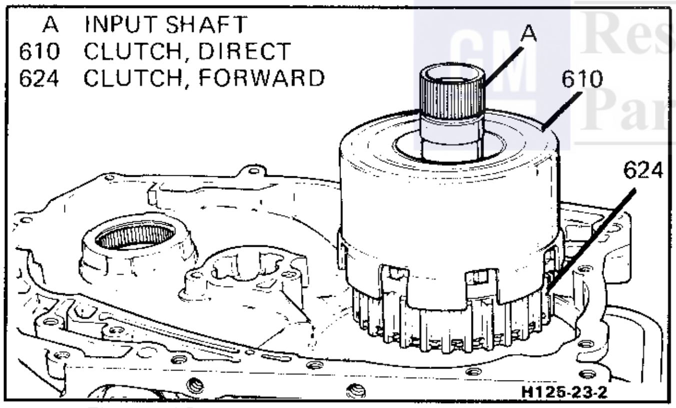


Figure 73 Installing the Clutch Assemblies

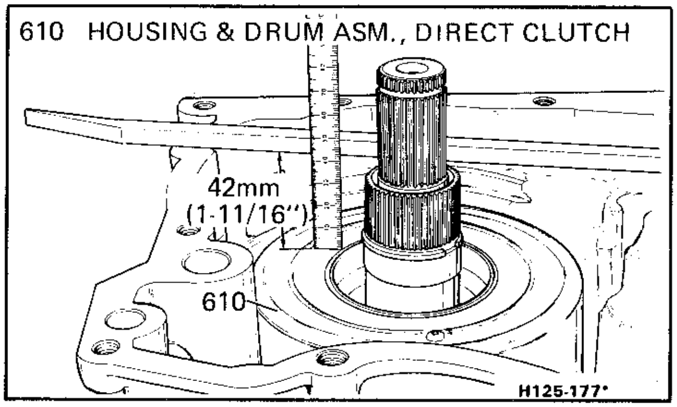


Figure 74 Proper Clutch Installation

INTERMEDIATE BAND ASSEMBLY

Inspect

- Band (606) for burns, flaking or damage

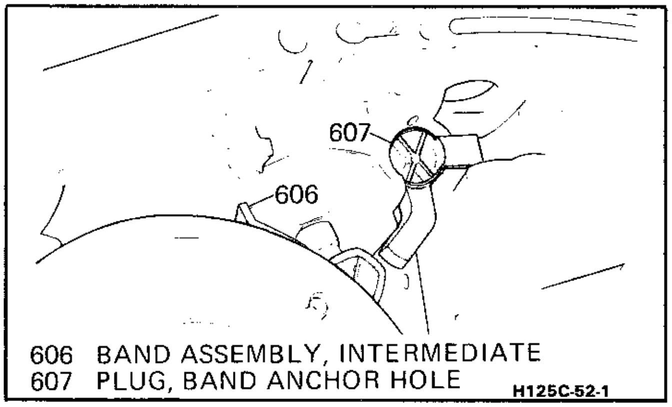


Figure 75 Intermediate Band Anchor Hole Plug

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

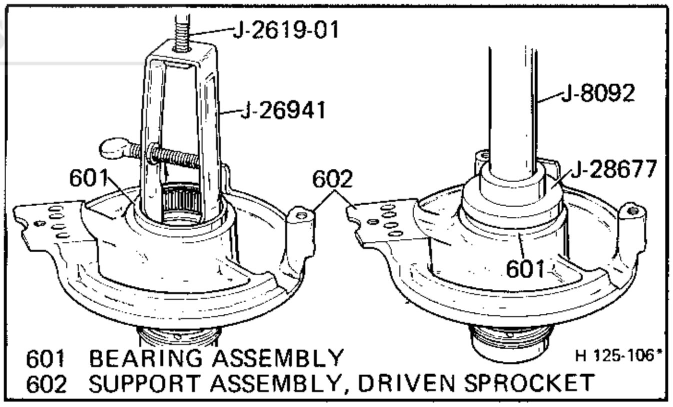


Figure 76 Bearing Replacement

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

Install or Connect

- New bearing – manufacturing identification faces up

Linkage

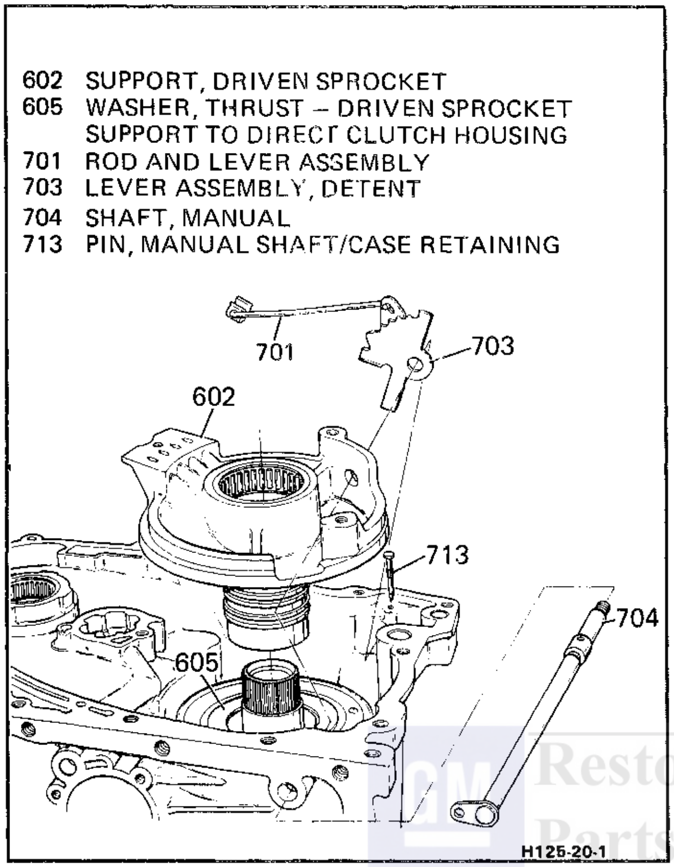


Figure 77 Driven Sprocket Support & Manual

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 (Figures 23 and 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
- Thrust bearing (121) for damage or wear
- Driven support thrust washer (123) for damage or wear

Turbine Shaft Seal and Drive Sprocket Replacement Procedure

Remove or Disconnect (Figure 79)

- Seals (105) from turbine shaft (cut with a knife)
- Snap ring (102) from turbine shaft
- Drive sprocket (103) from turbine shaft

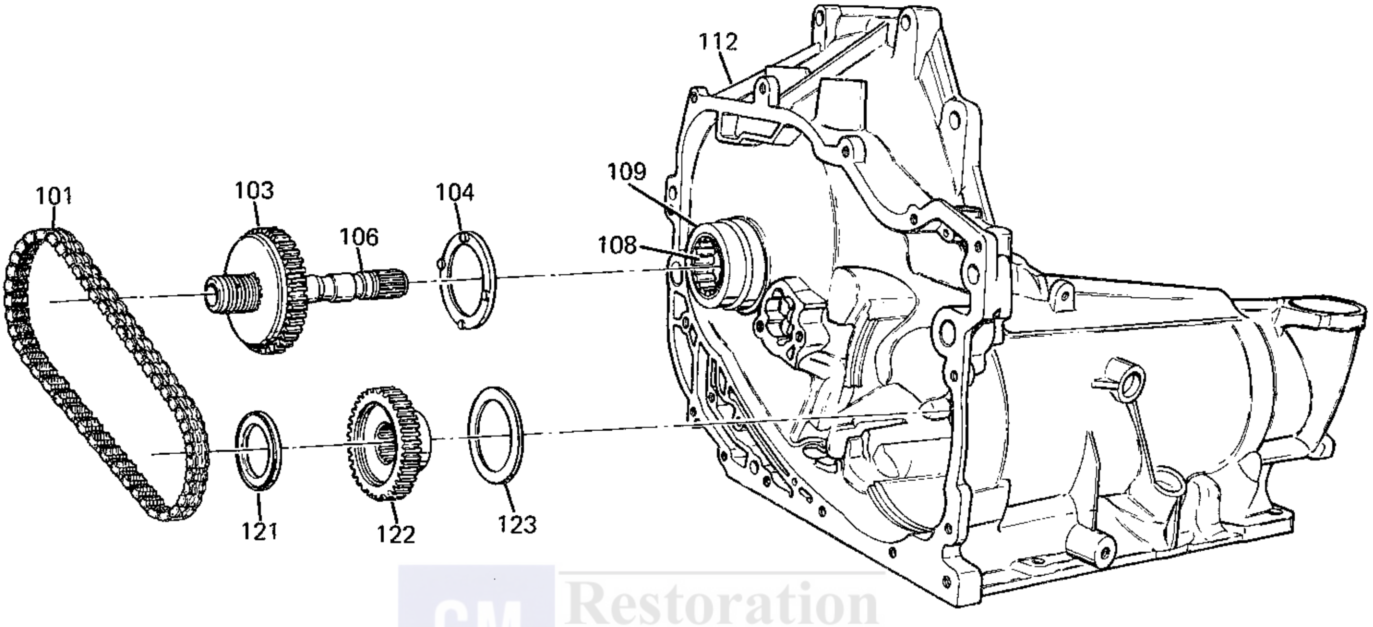
Install or Connect (Figures 4 and 79)

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.

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 onto the turbine shaft from the converter side of case (Figure 80)
6. Thrust bearing (121) onto sprocket (122)



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

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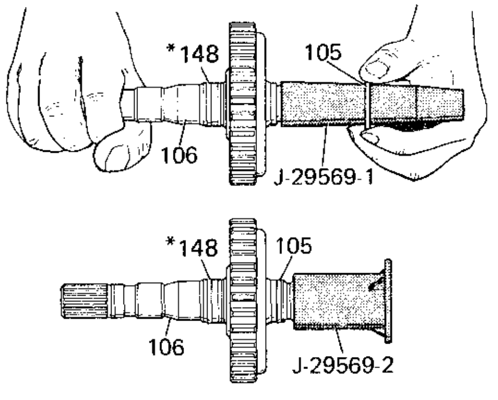
Figure 78 Drive Link Assembly



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

109 DRIVE SPROCKET SUPPORT (STATOR SHAFT)
115 SEAL, CONVERTER OIL
107 SEAL, 'O' RING
106 SHAFT, TURBINE

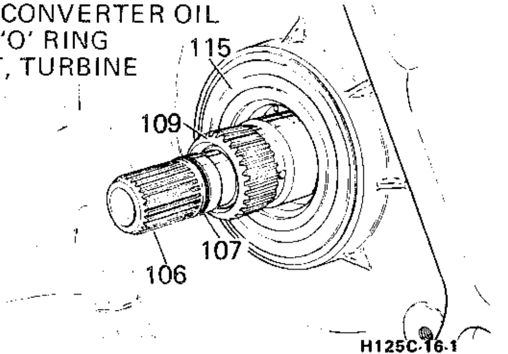


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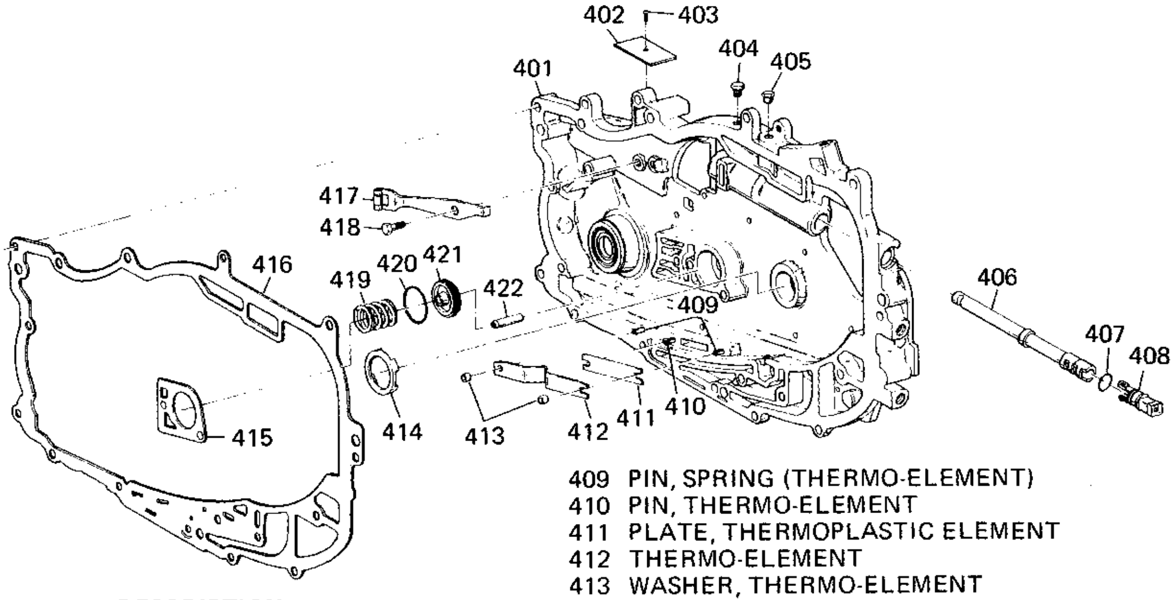
Figure 80 Turbine Shaft "O" Ring Seal



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.
- T the vent (404) into case cover with a

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 (Figure 81)

- 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

Thermostatic Element Replacement Procedure

Disassemble (Figure 81)

Tool Required:
J-29023
Washers (413)

- Element (412)
- Element plate (411)

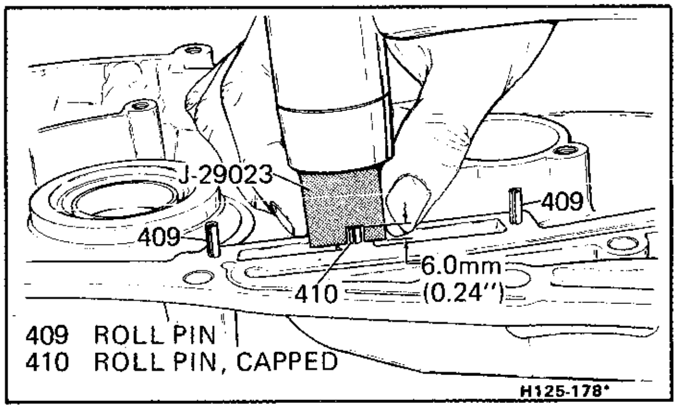

Figure 82 Setting Center Roll Pin Height

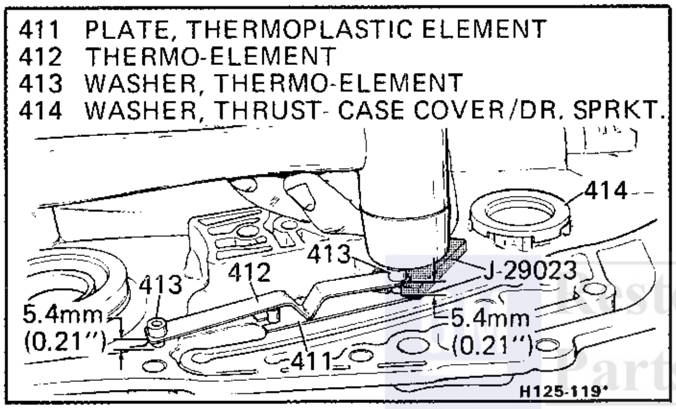

Figure 83 Setting Element Height

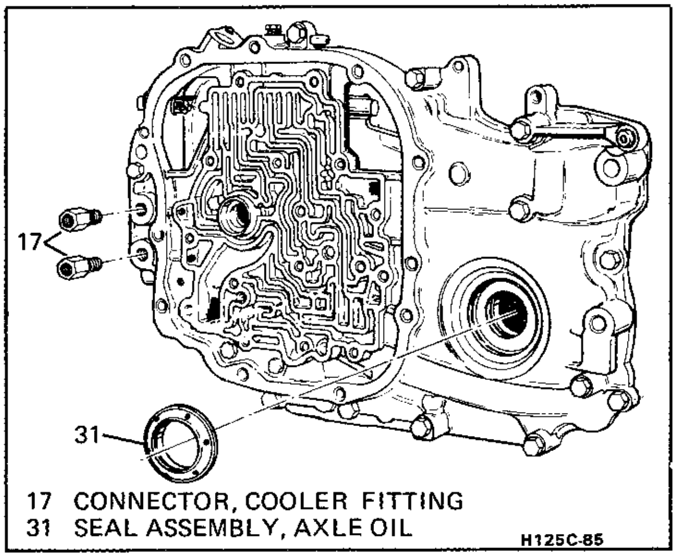

Figure 84 Left Hand Axle Seal & Cooler Fittings

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 (Figures 81 and 85)

- Gasket (416) to case cover
- Case cover (401) to case
- Coat (A) with thread sealer (Figure 84-A)
- Remaining bolts and torque as shown in Figure 84A
- Retainer (701) to manual valve (406)

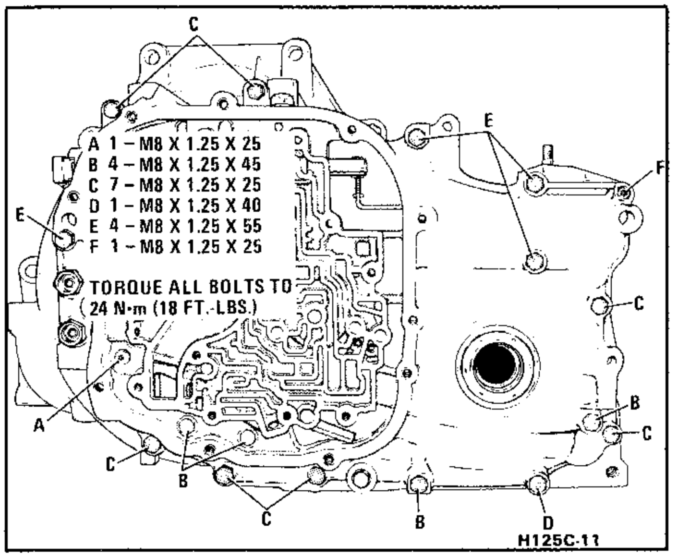

Figure 84A Bolt Hole Locations

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

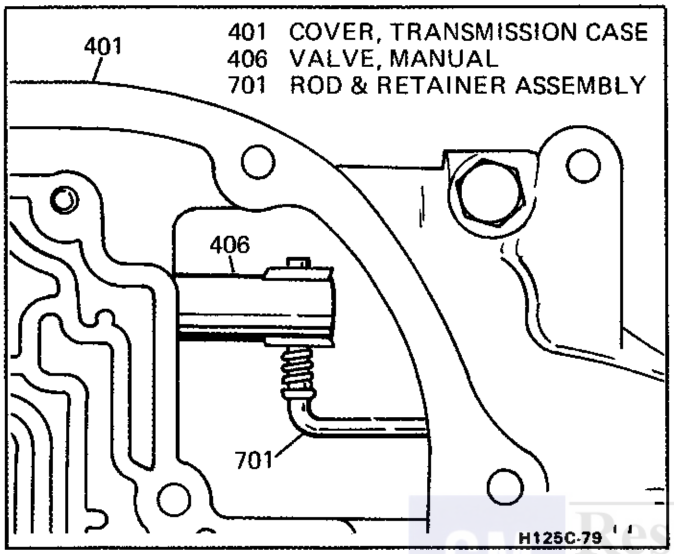

Figure 85 Manual Valve

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 (.004-0.033").

   See (Figure 87) for snap ring selection – correct as necessary.
5. Remove tools.

CONTROL VALVE AND OIL PUMP ASSEMBLY

Disassemble (Figures 88, 89, 90, and 91)

- Control Valve Assembly

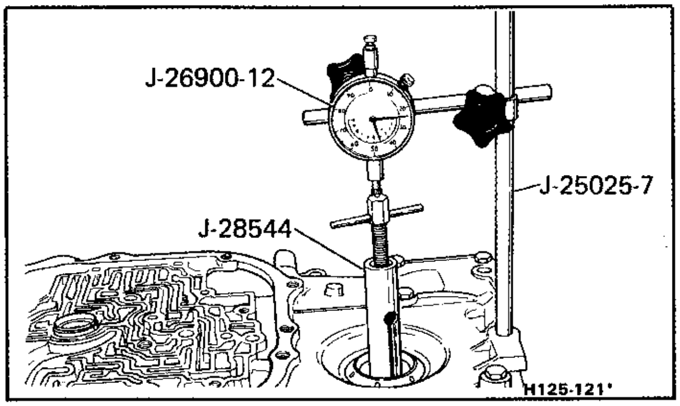

Figure 86 Input Shaft to Case Cover End Play

INPUT SHAFT SELECTIVE SNAP RING (621)

THICKNESS		IDENTIFICATION COLOR
1.83-1.93mm	(0.071"-0.076")	WHITE
2.03-2.31mm	(0.078"-0.084")	BLUE
2.23-2.33mm	(0.088"-0.092")	RED
2.43-2.53mm	(0.095"-0.099")	YELLOW
2.63-2.73mm	(0.103"-0.107")	GREEN

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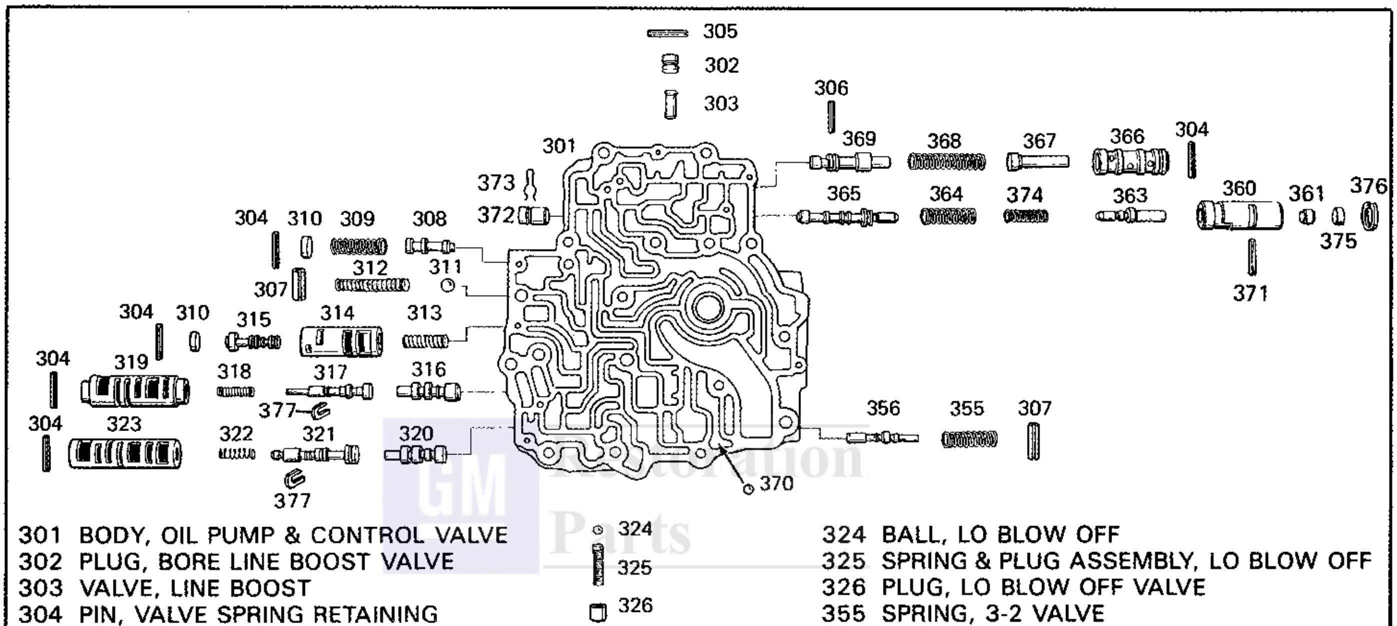
Figure 87 Selective Snap Ring Chart

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.
- Roll pins 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



301	BODY, OIL PUMP & CONTROL VALVE
302	PLUG, BORE LINE BOOST VALVE
303	VALVE, LINE BOOST
304	PIN, VALVE SPRING 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
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
377	RETAINER, THROTTLE VALVE

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Figure 88 Control Valve - Pump Assembly

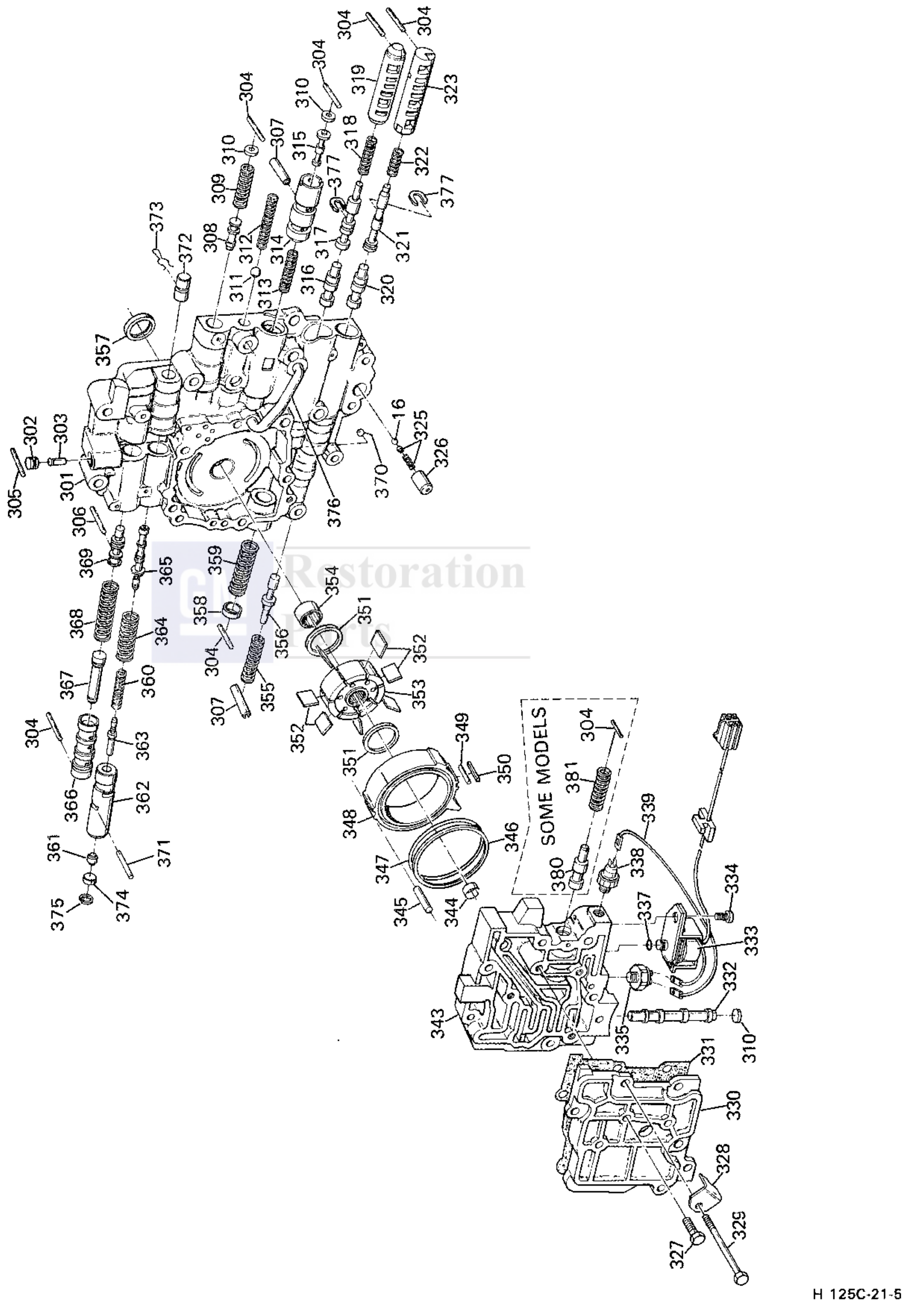

Figure 89 Control Valve and Oil Pump Assembly

ILL. NO.	DESCRIPTION
301	BODY, OIL PUMP & CONTROL VALVE
302	PLUG, BORE LINE BOOST VALVE
303	VALVE, LINE BOOST
304	PIN, VALVE SPRING RETAINING
305	PIN, COILED SPRING LINE BOOST PLUG
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
343	BODY, AUXILIARY VALVE

ILL. NO.	DESCRIPTION
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	ASSEMBLY, PUMP SHAFT ROLLER BRG. & SEAL
355	SPRING, 3-2 VALVE
356	VALVE, 3-2 CONTROL
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
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
377	RETAINER, THROTTLE VALVE
380	VALVE, ORIFICE CONTROL
381	SPRING, ORIFICE CONTROL VALVE

LEGEND
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Figure 89L Control Valve and Oil Pump Assembly Legend

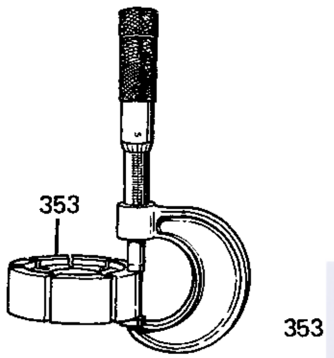
1. Bolt (327)
2. Cover (330) and gasket (331)
3. Screw (334), solenoid assembly (333) and "O" ring seal (337)
4. Switches (335 and 338)
5. Auxiliary valve body (343)
6. Orifice control valve (380), spring (381), pin (304) (some models)
7. Converter clutch control valve (332) and plug (310)
8. Pin (345) and slide (348)
9. Vanes (352) and rotor (353)
10. Pump vane ring (351)

Clean

- Valve body (301) and auxiliary valve body (343) 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



OIL PUMP ROTOR/SLIDE SELECTION CHART

ROTOR THICKNESS (mm)	ROTOR THICKNESS (in.)
17.917 - 17.930	0.7054 - 0.7059
17.930 - 17.943	0.7059 - 0.7064
17.943 - 17.956	0.7064 - 0.7069
17.956 - 17.969	0.7069 - 0.7074
17.969 - 17.982	0.7074 - 0.7080

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Figure 91 Oil Pump Rotor and Slide Selection

Oil Pump Rotor and Slide Replacement

Measure (Figure 91)

Tool Required:
One Inch Micrometer
Oil Pump Rotor (353) Thickness

Measurement of rotor must be made on undamaged surface. Use the original rotor measurement (Figure 91) to order the proper service package, which includes both the rotor and slide.

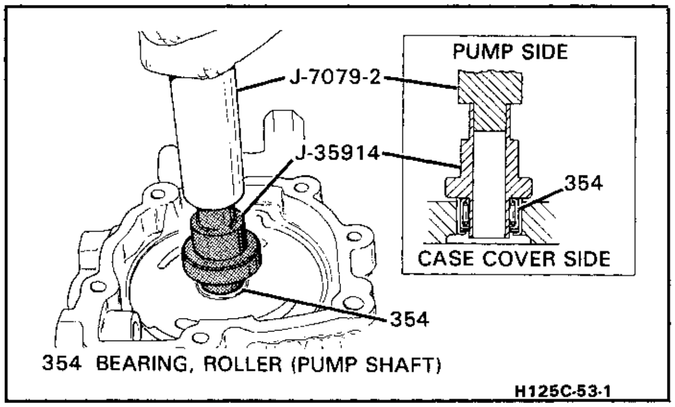


Figure 92 Pump Bearing Installation

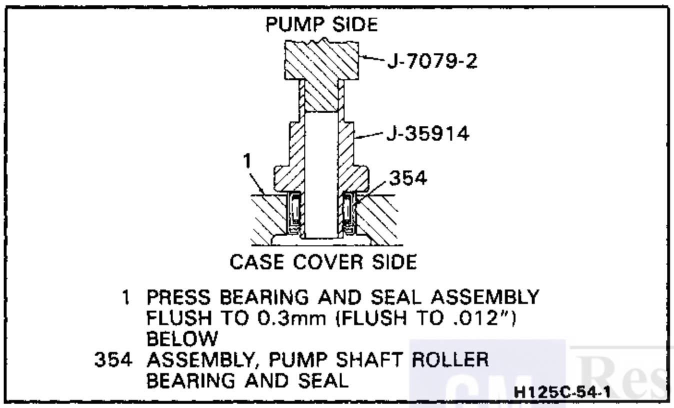


Figure 93 Bearing Dimension

Pump Shaft Bearing Replacement

Remove or Disconnect

Tools Required:

J-35914 Pump Bearing Remover and Installer

J-7079-2 Driver Handle

- Bearing with J-35914 and J-7079-2 (Drive toward pump pocket)

Install or Connect (Figures 92, 93, and 94)

Tools Required:

J-35914 Pump Bearing Remover and Installer

J-7079-2 Driver Handle

- New bearing, use J-35914 and J-7079-2 – install from pump pocket side – bearing cup must be flush to 0.3mm (flush to 0.012") below pump pocket

Assemble (Figure 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) into pocket
  6. Vane ring (351) on top of rotor
  7. "O" ring seal (347) on top of rotor
  8. "O" ring seal (346) (slide to cover)
- Auxiliary valve body
  - Control valve (332) and plug (310)
  - Switches (335 and 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 and 89)

- Control valve assembly
- All valves, springs, bushings, bore plugs and roll pins as shown

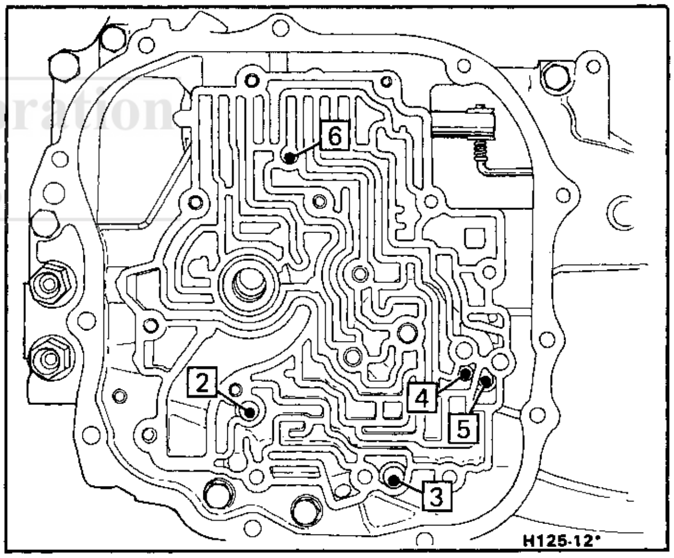


Figure 95 Check Ball Locations

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.

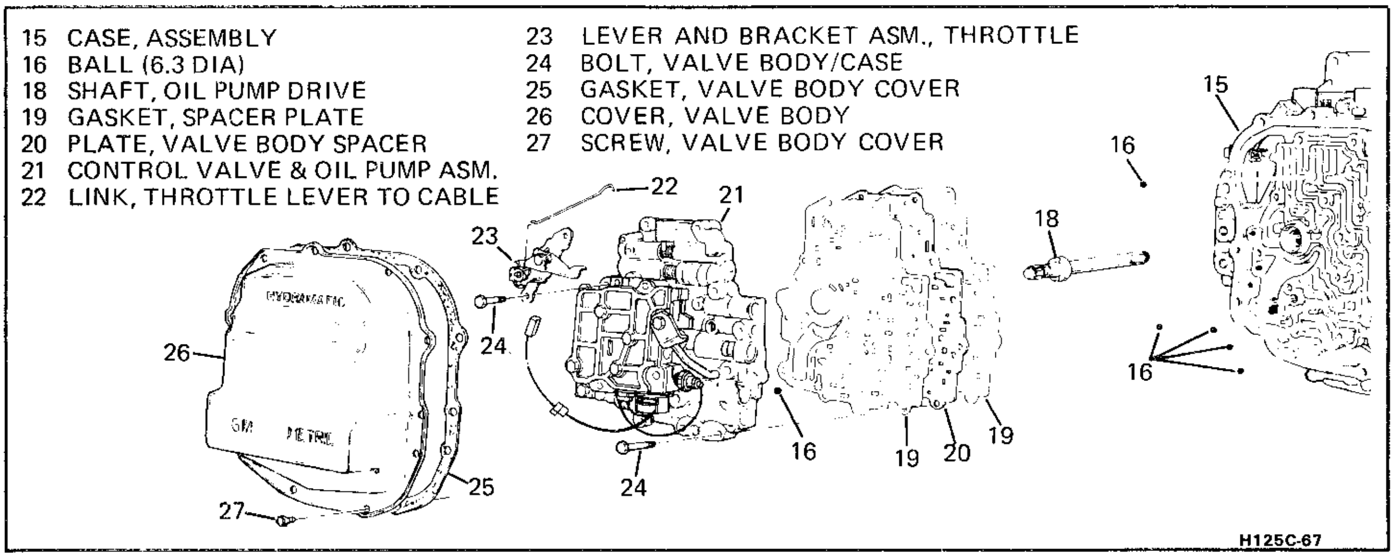


Figure 96 Control Valve Pump Assembly, Oil Pump Shaft

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.).

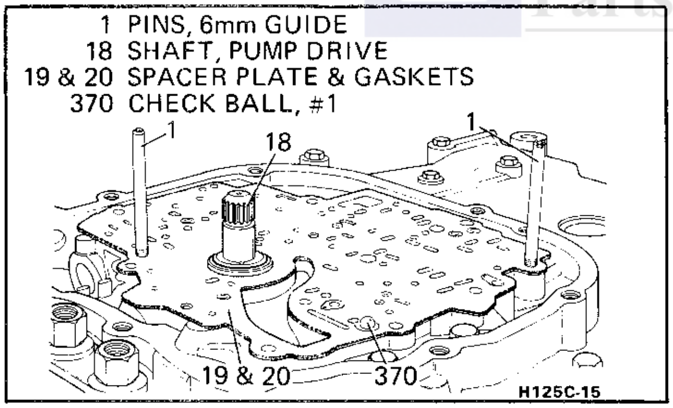


Figure 97 Spacer Plate & Gaskets

Install or Connect

1. Gasket (25)
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)

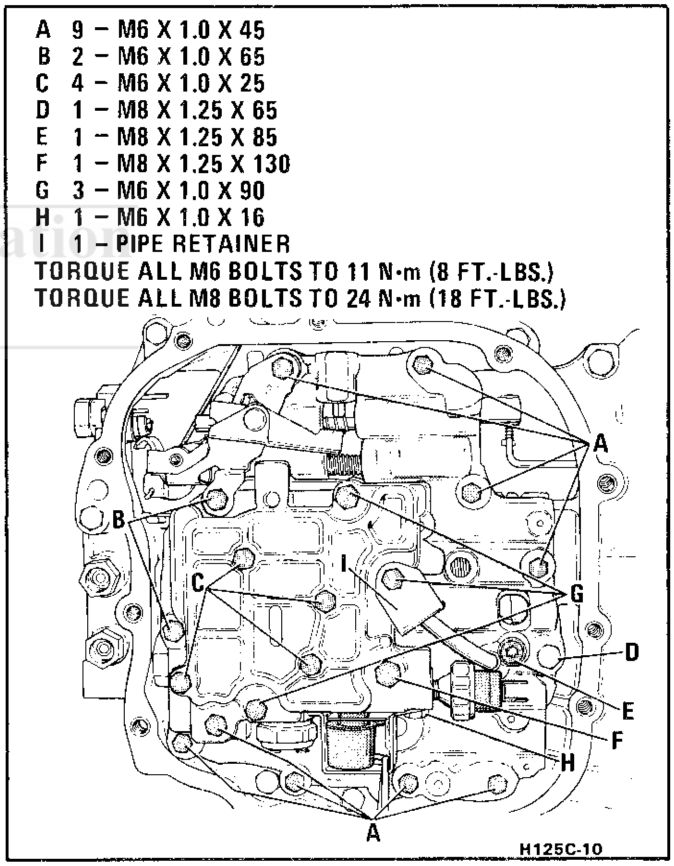


Figure 98 Valve Body Bolt Location

Reverse Pipe and Parking Bracket

Install or Connect (Figures 102 and 103)

1. Weir (147)
2. Bracket (143)
3. Retainers (143) and (146)
4. Bolt (142)
5. Bracket (710)
6. Stop (711)
7. Screw (712)

MODEL USAGE — BDC, BHC, BJC, BPC, CBC, CDC, CJC, CMC, CNC, CPC, CRC, CSC, CTC, CUC, CXC, HRC, JPC, JXC, KDC, LHC, PDC, PHC, PKC, PMC, PNC, PPC, PSC, PTC, PWC

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

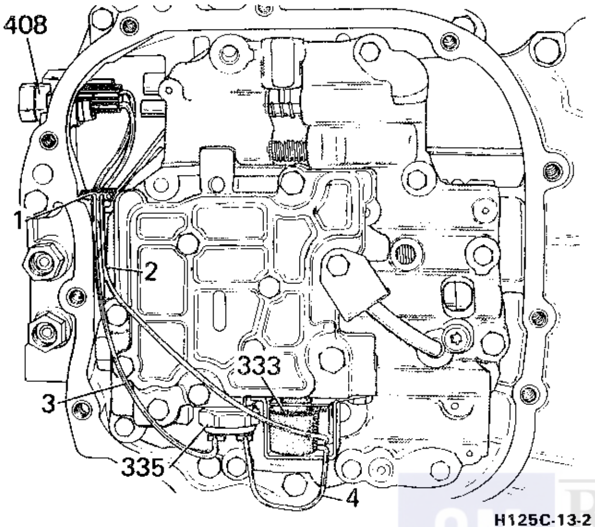
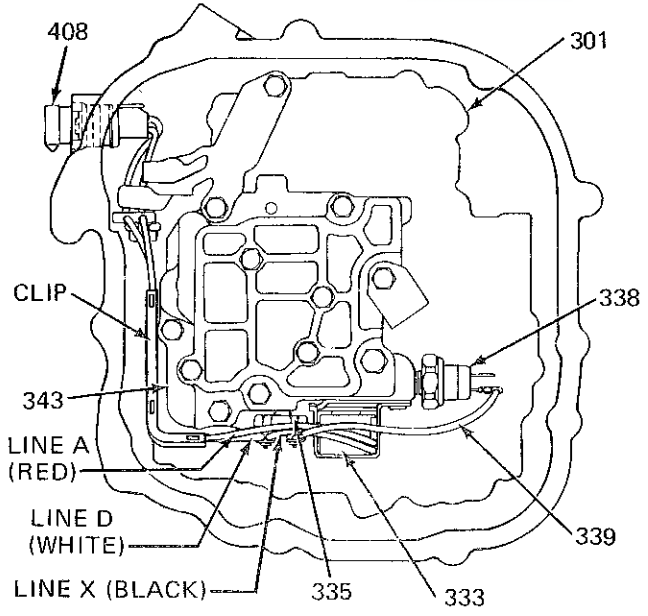


Figure 99 T.C.C. Wiring Diagram

MODELS JDC, JMC, JNC, JWC



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

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Figure 100 T.C.C. Wiring Diagram

29	SHAFT, OUTPUT
30	RING, SNAP

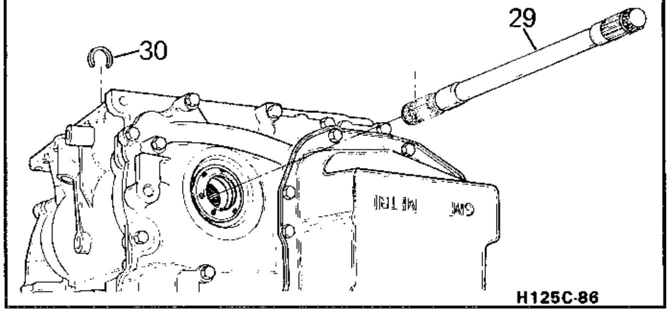
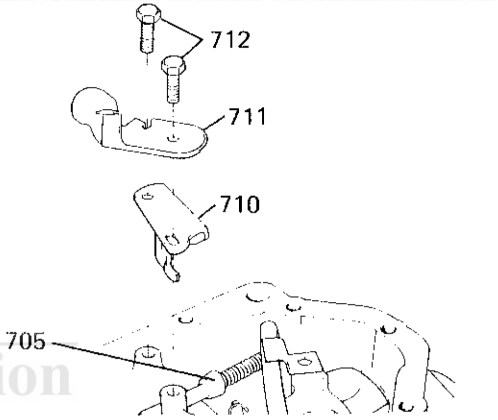


Figure 101 Output Shaft & "C" Ring



705	ACTUATOR ASSEMBLY
710	BRACKET, PARKING LOCK
711	BRACKET, DIPSTICK STOP
712	BOLT, PARKING LOCK BRACKET/CASE

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Figure 102 Dipstick Stop & Parking Lock

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)

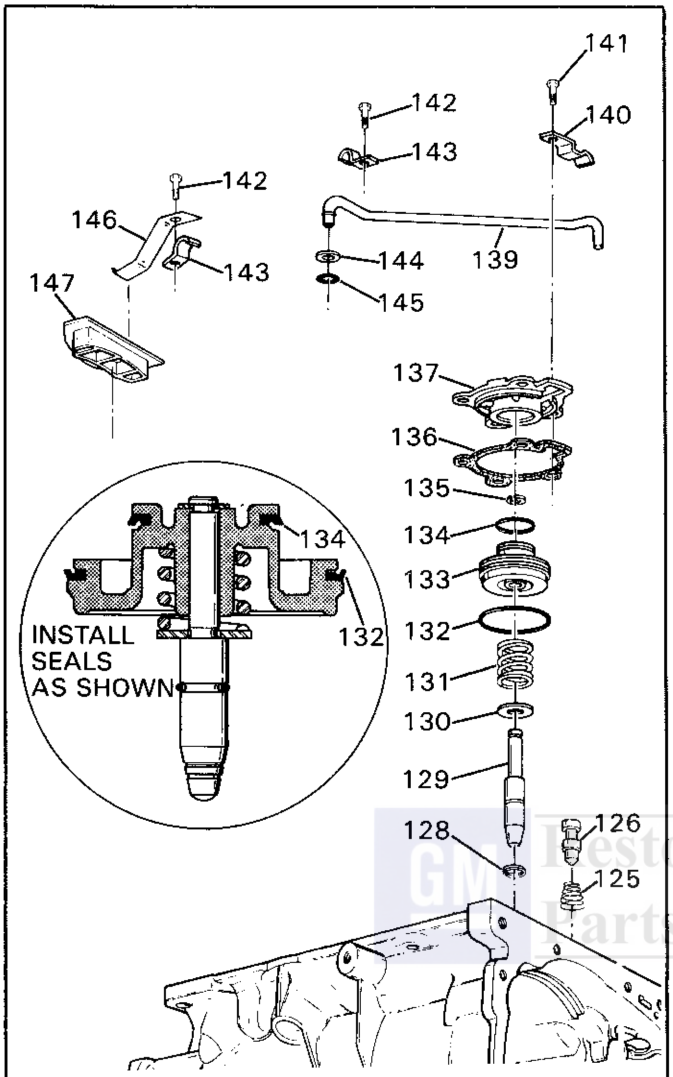
Tighten

- Torque the screws (42, 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)



125	SPRING, ACCUMULATOR EXHAUST
126	VALVE, ACCUMULATOR EXHAUST
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) INTER. SERVO
133	PISTON, INTERMEDIATE SERVO
134	RING, OIL SEAL (INNER) INTER. SERVO
135	RING, SNAP
136	GASKET, INTERMEDIATE SERVO COVER
137	COVER, INTERMEDIATE SERVO
139	PIPE, REVERSE OIL
140	RETAINER, REVERSE OIL PIPE
141	BOLT, INTERMEDIATE SERVO COVER
142	BOLT, PIPE RETAINER/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 103 Oil Pipe & Servo

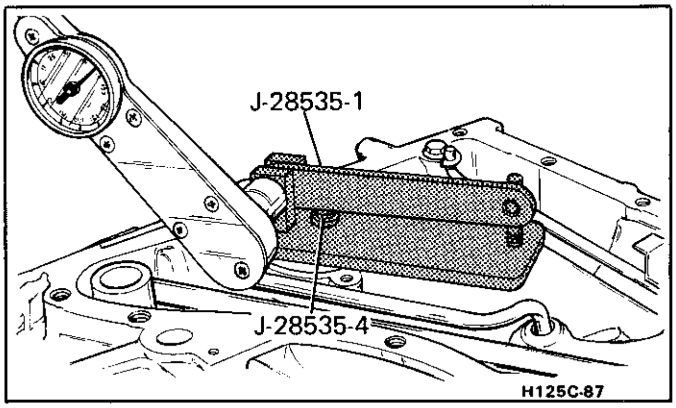

Figure 104 Checking for Proper Apply Pin

Inspect

- Pin (129) for damage and seal (128) for cuts or nicks
- 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

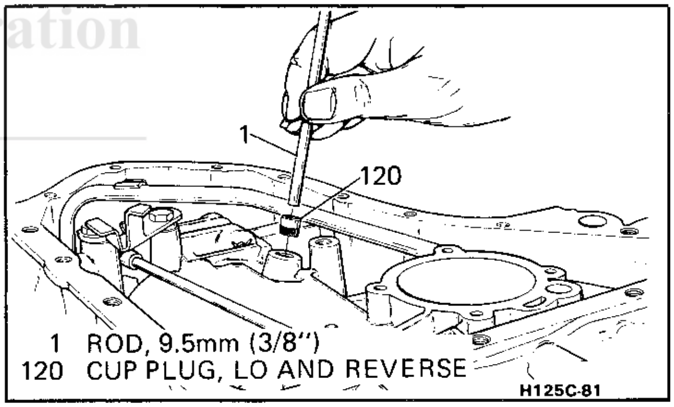

Figure 105 Lo & Reverse Cup Plug

Measure (Figures 103 and 104)

Tools Required:

J-28535 Intermediate Band apply pin gage

1. Install J-28535 on the case and the 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 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

INTERMEDIATE BAND
APPLY PIN

LENGTH	IDENTIFICATION
Short	2 Grooves
Medium	1 Groove
Long	No Grooves

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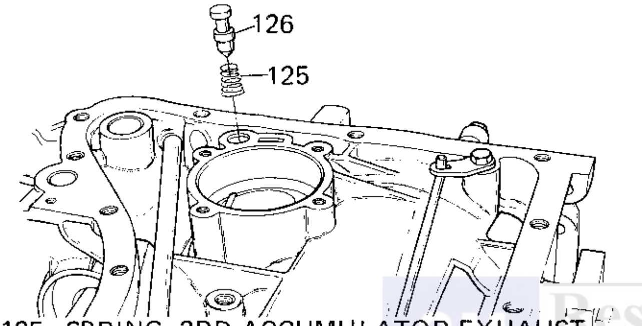
Figure 106 Apply Pin Chart

4. "E" ring (135) onto pin



125 SPRING, 3RD ACCUMULATOR EXHAUST
126 VALVE, 3RD ACCUMULATOR EXHAUST

H125-134-4

Figure 107 3rd Accumulator Exhaust Valve & Spring

Install or Connect (Figures 107 and 103)

1. Spring (125) into bore
2. Check valve (126) into bore
3. Servo assembly (133) into servo bore
4. Gasket (136)
5. Cover (137)
6. Retainer (140)
7. Bolt (141)

Tighten

- Torque the screws (141) to 11 N·m (8 ft. lbs.).

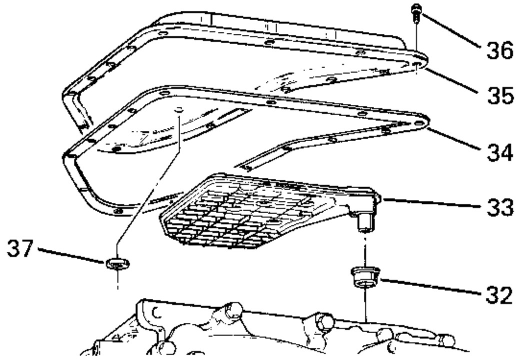
OIL PAN AND STRAINER

Install or Connect (Figure 108)

1. Seal (32) onto the strainer tube
2. Strainer (33) into the case
3. Gasket (34)
4. Pan (35) onto the case
5. Bolts (36)

Tighten

- Torque the pan bolts (36) to 11 N·m (8 ft. lbs.).



32 SEAL
33 STRAINER ASM., TRANSMISSION OIL
34 GASKET, OIL PAN
35 PAN, TRANSMISSION OIL
36 SCREW, TRANSMISSION OIL PAN
37 MAGNET, CHIP COLLECTOR

H125C-65-3

Figure 108 Bottom Pan and Oil Strainer

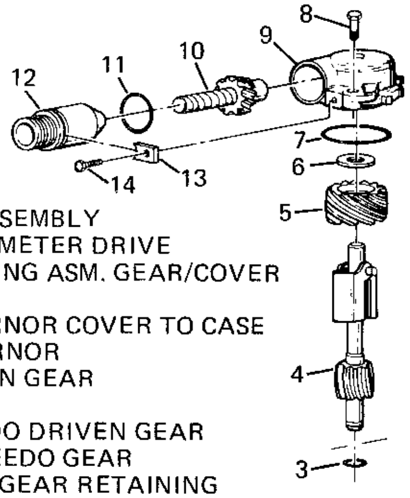
GOVERNOR AND SPEEDOMETER GEAR ASSEMBLY

Clean

- Governor assembly (4)

Inspect (Figure 109)

- Governor
  - Oil passage blocked
  - Damaged springs
  - Missing check balls
  - Seal (3) damage
  - Binding weights



3 RING OIL SEAL
4 GOVERNOR ASSEMBLY
5 GEAR, SPEEDOMETER DRIVE
6 THRUST BEARING ASM. 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

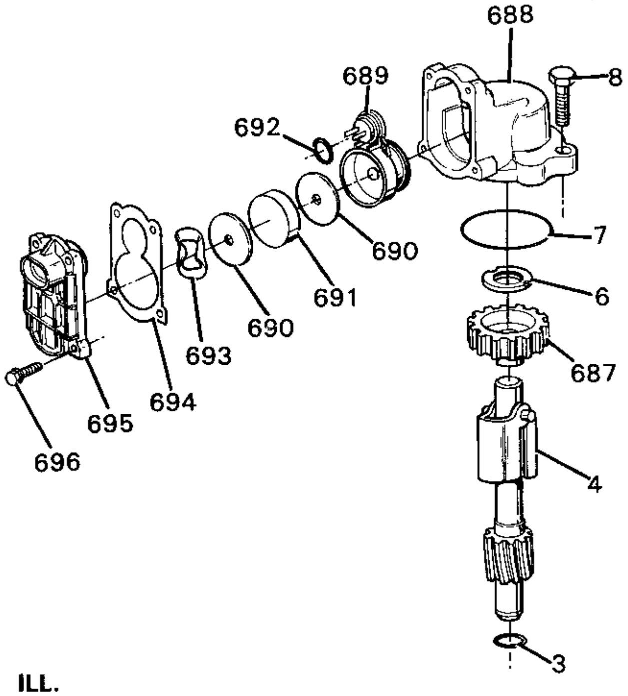
H125C-64

Figure 109 Governor Assembly

Seal Replacement Procedure

Remove or Disconnect

- Seal (3) – cut off



ILL. NO.	DESCRIPTION
3	RING, OIL SEAL (GOVERNOR SHAFT)
4	GOVERNOR ASSEMBLY
6	BEARING ASSEMBLY, THRUST
7	SEAL, "O" RING
8	BOLT
687	ROTOR, SPEED SENSOR
688	HOUSING, SPEED SENSOR
689	COIL ASSEMBLY
690	WASHER
691	MAGNET
692	SEAL, "O" RING
693	WASHER, WAVE SPRING
694	GASKET, COVER
695	COVER, HOUSING
696	BOLT

H125C-350

Figure 109A - Governor and Internal Transaxle Speed Sensor

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 Assembly (4) 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 Governor shaft is piloted into cover.
6. Bolt (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. Bolt (14)

Tighten

- Torque the screw (14) to 9 N·m (75 inch pounds)

Governor Assembly (ITSS) (Some Models)

Inspect (Figure 109A)

- Governor (4) for
  - blocked oil passage
  - damaged springs or binding weights
  - damaged seal--replace as required
- Rotor (687) for
  - cracks
  - damaged or missing teeth
- Damaged bearing (6)

Install or Connect (Figure 109A)

1. Governor assembly (4) into case
2. Rotor (687) onto governor assembly
3. Bearing (6) onto rotor
4. New oil seal (7) onto housing (688)
5. Housing (688) onto case--governor shaft must pilot in the housing
6. Bolt (8)

Internal Transaxle Speed Sensor (ITSS)

Disassemble (Figure 109A)

1. Screws (696)
2. Cover (695) and gasket (694)
3. Wave spring washer (693), washers (690) and magnet (691)
4. Coil assembly (689) and "O" ring (692)

Inspect

- Housing (688) and cover (695) for porosity or cracks
- Gaskets (694) and "O" ring (692) for damage
  - Replace as required
- Coil assembly (689) for missing or damaged
  - Washer (690)
  - Magnet (691)
  - Spring washer (693)

Install or Connect (Figure 109A)

1. Coil assembly (689) and "O" ring (692) into housing (688)
2. Washers (690), magnet (691) and wave spring washer (693) into housing (688)
3. Gasket (694) and cover (695) onto housing (688)
4. Bolts (696)

Install or Connect

- Transaxle into transmission jack

Remove or Disconnect

- J-28664

TORQUE CONVERTER ASSEMBLY

Inspect

The torque converter assembly (1) must be replaced for any of the following conditions:

- Evidence of damage to the pump assembly
- Metal particles are found after flushing the cooler and cooler lines
- External leaks in hub weld area
- Converter pilot is broken, damaged or poor fit into crankshaft
- Converter hub is scored or damaged
- Internal failure to stator
- Contamination from engine coolant
- Excess end play

Measure (Figure 110)

Tool Required:
J-35138 Torque Converter End Play Checking Tool

- Install J-35138 and measure end play
  - 0mm - .5mm (.020") for 245mm Torque Converters
  - 0mm - .6mm (.024") for 298mm Torque Converters

The Torque Converter Should Not Be Replaced If:

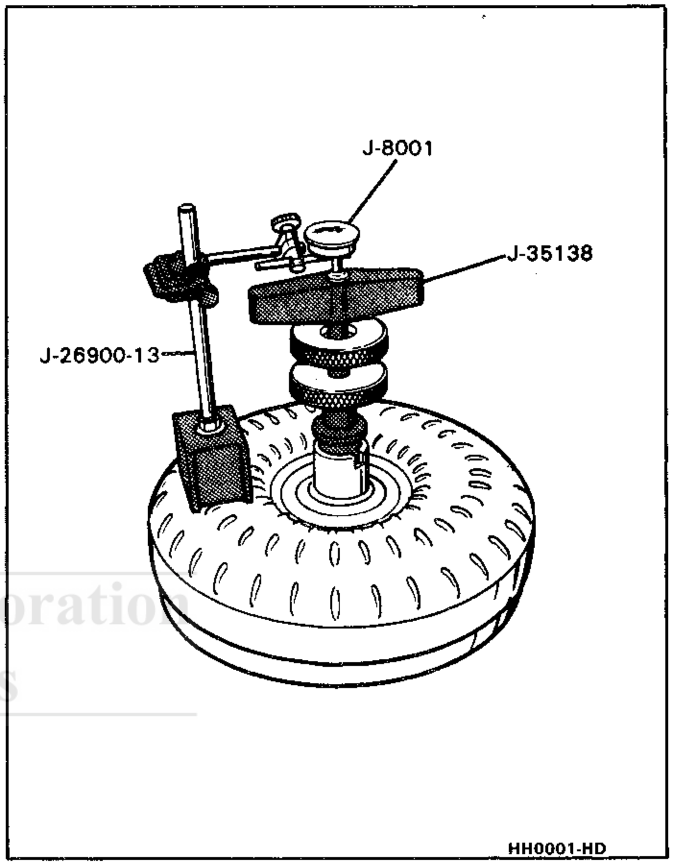


Figure 110 Checking Torque Converter End Play

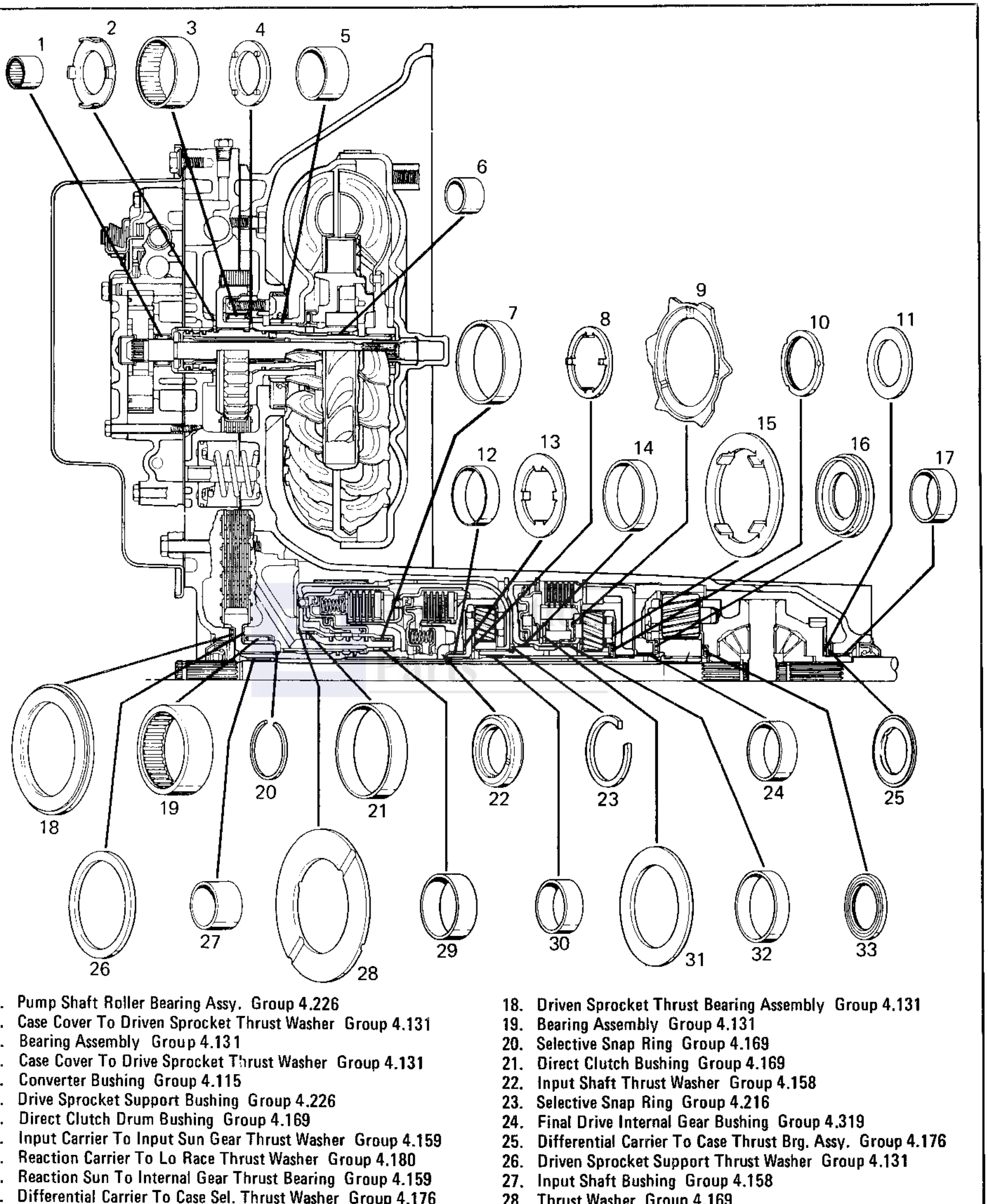
- The fluid has an odor, discolored or no evidence of metal or clutch plate material
  - Drain out as much fluid as possible
  - Replace the oil filter and pan gasket
  - Fill to proper level (Refer to Section 7A)
- The converter bolt hole threads are damaged
  - Correct with thread insert (Refer to Section 6A)

Flushing the torque converter is not recommended.

Install or Connect

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 111 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.)

H125C-84A

Figure 112 Torque Specifications

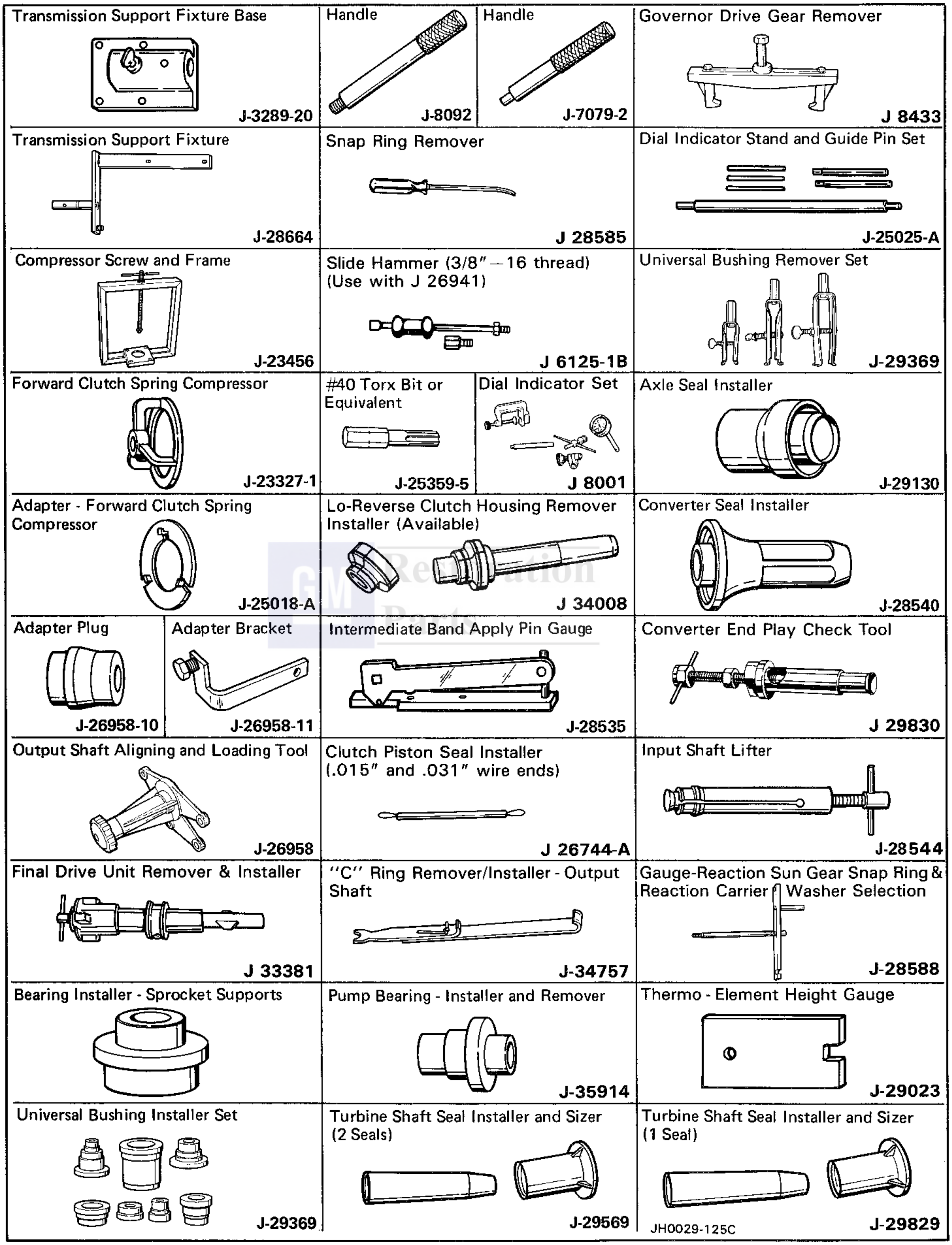


Figure 113 Tool List

SECTION 7B2

5-SPEED (ISUZU) 76MM MANUAL TRANSAXLE

CONTENTS

GENERAL DESCRIPTION

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 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 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. If the fluid level is low, add manual transaxle oil, Syncromesh Transmission Fluid (12345349).

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 permanent magnet generator on the driver's side of the case, above the axle shaft.

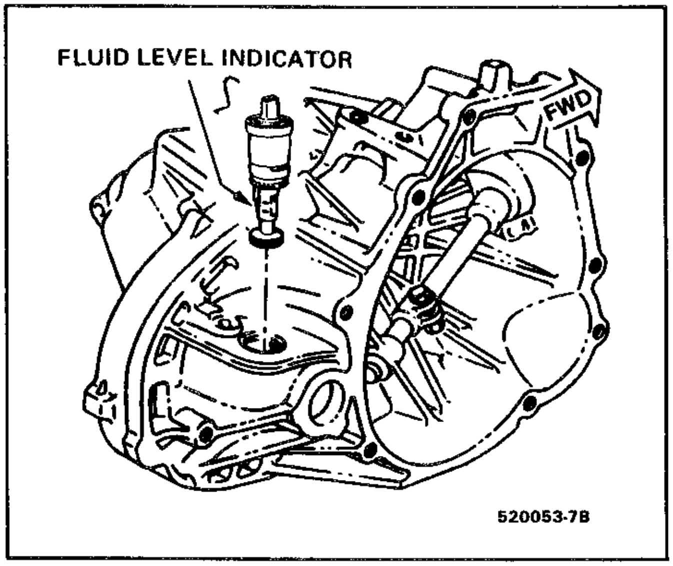


Figure 1 Filling Procedure

Be sure the fluid level is between the "L" and "H"marks on permanent magnet generator.

If needed, add enough fluid to bring the level up to the "L" mark. Be sure to seat the permanent magnet generator fully when reinstalling.

Cable Adjustment Procedure

Figure 4

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 4.
4. Remove console and trim plates as required for access to shifter.
5. With shifter lever in first gear position (pulled to left and held against stop), insert alignment pins H 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 H 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-VEHICLE SERVICE

TRANSMISSION SHIFT CABLES

Remove or Disconnect

Figures 2 and 3

1. Negative (−) battery cable.
2. Place shifter in first gear.
3. Shift knob.
4. Front trim plate, see Section 8C.
5. Shifter trim plate.
6. Rear console pad assembly.
7. E.C.M., see Section 6E2.
8. E.C.M. electrical connections.
9. Front carrier to I.P. reinforcement.
10. Carrier reinforcement, see Section 8C.
11. Carpet clips and rivets at console.
12. Heater control.
13. Radio, see Section 9A.
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, see Section 8C.
8. Radio, see Section 9A.
9. Heater control, see Section 8C.
10. Carpet clips and rivets at console.

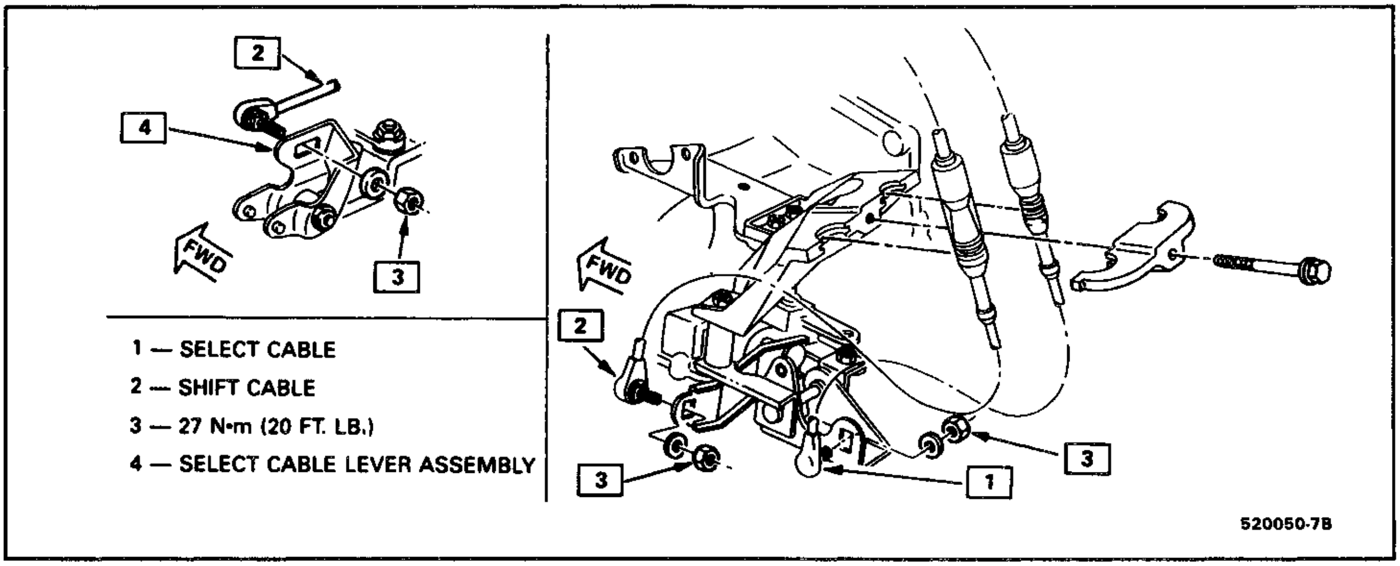


Figure 2 Shift & Select Cable Routing & Attachment at Transaxle

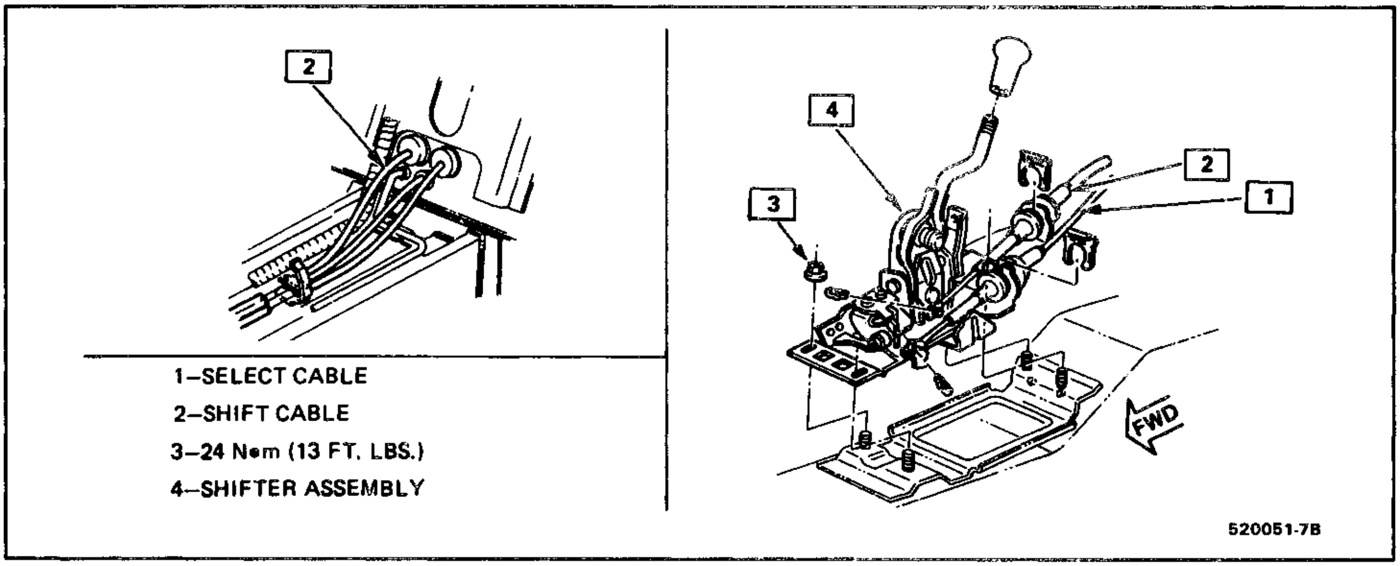


Figure 3 Shift Cable & Select Cable Routing and Cable Attachment at Shifter

11. Carrier reinforcements.
12. E.C.M. electrical connection, see Section 6E2.
13. E.C.M.
14. Front pad assembly, see Section 8C.
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 3

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 pin 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 pin 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.
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.

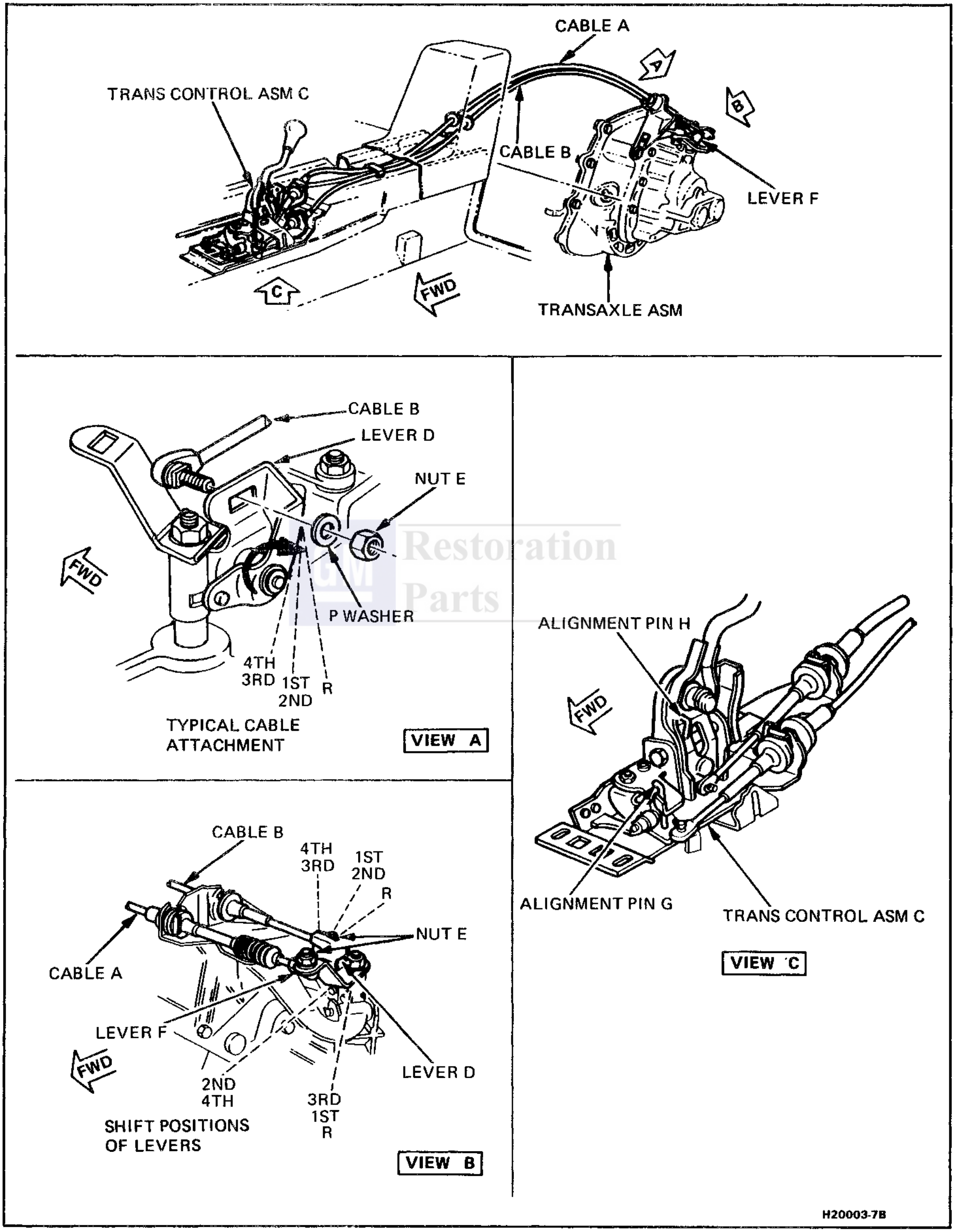


Figure 4 Cable Adjustment

MANUAL TRANSAXLE

Remove or Disconnect

Figure 5

Tools required:

- J 28467-A — 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-A

Remove or Disconnect

1. Hoist car.
2. Slave cylinder from clutch (do not disconnect hydraulic line), see Section 7C.
3. Shift cables from transmission.
4. EGR valve output pipe from exhaust manifold, see Section 6E2.
5. Wheels and Tires.
6. Parking brake cable from calipers, see Section 5B8.
7. Parking brake cable from body, see Section 5.
8. Lateral control arm/fixed adjusting link through bolts, see Section 3D.
9. Trailing arms, see Section 3D.
10. Axle shafts from transmission. See Section 4D.
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, see Section 6A2.
15. Cradle bolts and cradle from engine and support cradle on adjustable stand.
16. Oxygen sensor wire.
17. Crossover pipe heat shields, see Section 6A2.
18. Exhaust crossover pipe.
19. Upper transmission bolts to engine.
20. Clutch inspection plate cover, see Section 7C.
21. Lower engine bolt studs and coolant pipe from stud and nut.
22. Transaxle.

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.).

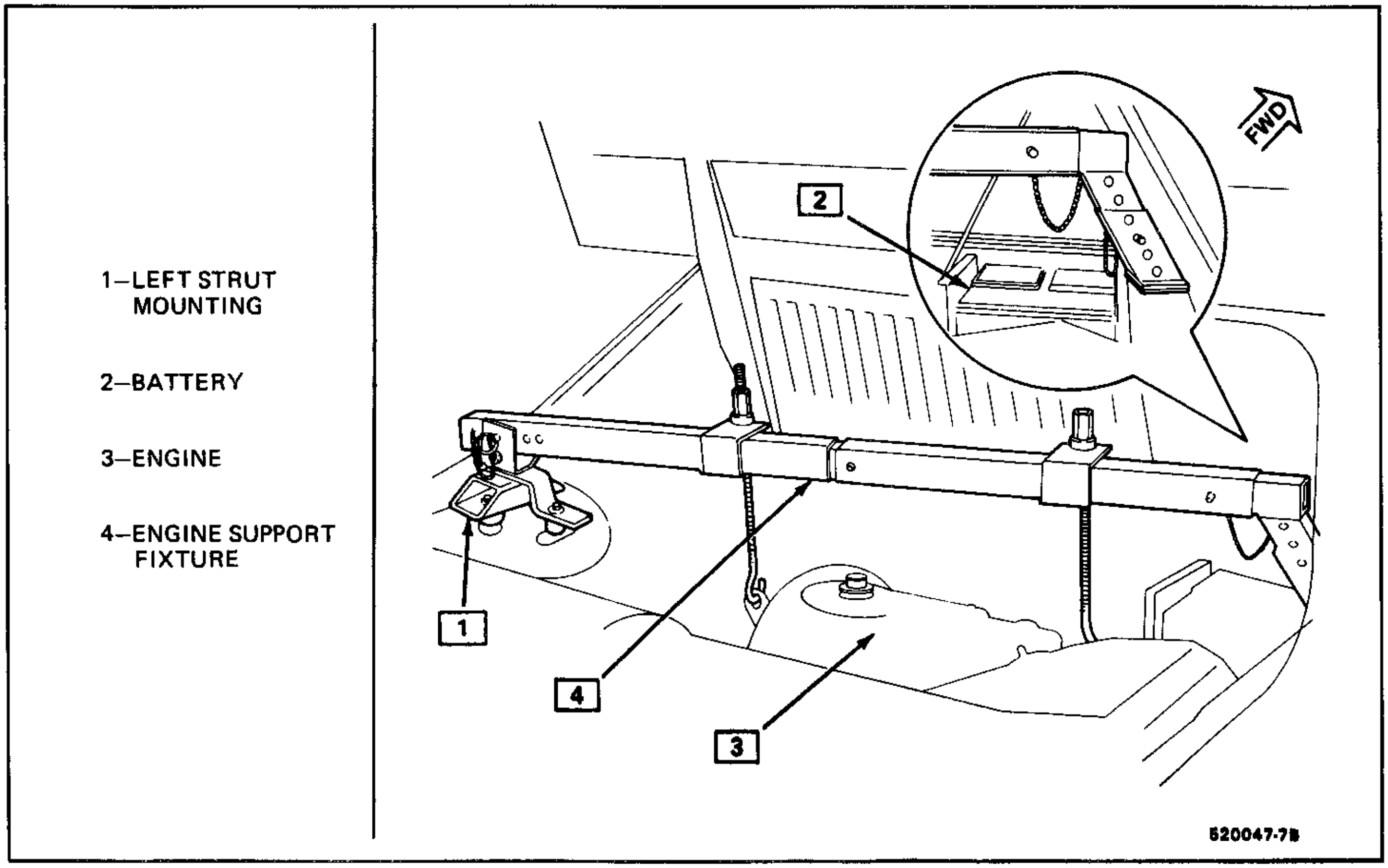


Figure 5 Engine Support Fixture J 28467-A Installed

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 on permanent magnet generator.
4. Axle shafts. See Section 4D.
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. Lateral control arm/fixed adjusting link through bolts, see Section 3D.
10. Trailing arm, see Section 3D.
11. Parking brake cables. See Section 5B8 for parking brake adjustment procedure.
12. Splash shield retainers.
13. Wheels and tires, see Section 3E.

Remove or Disconnect

1. Engine support fixture — J 28467-A.

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.

REAR TRANSAXLE MOUNT

Remove or Disconnect

1. Disconnect negative battery cable.
2. Remove two nuts and wire harness from studs attaching lower half of transaxle mount to frame.
3. Install J 28467-A and J 35563 engine support fixture. Attach fixture hook to engine lift ring and raise engine enough to take the pressure off the mount (Figure 5).
4. Four bolts attaching rear transaxle mount to transaxle.
5. Nut from stud connecting upper and lower halfs of mount.

Install or Connect

1. Nut 48 N•m (35 lb. ft.) connecting upper and lower mount halfs.
2. Four bolts attaching rear transaxle mount 55 N•m (41 lb. ft.).
3. Lower engine and remove tools J 28467-A and J 35563.
4. Two nuts and wire harness 48 N•m (35 lb. ft.) attaching rear transaxle mount to frame.
5. Negative battery cable.

FRONT TRANSAXLE MOUNT

Remove or Disconnect

1. Negative battery cable.
2. Two bolts attaching upper half of transaxle mount.
3. Nut from stud attaching coolant pipe to stud and stud from mount.
4. Install J 28467-A and J 35563 engine support fixtures. Attach fixture hook to engine lift ring and raise enough to take the pressure off the mounts (Figure 5).
5. Two nuts from studs attaching lower half of mount to frame and remove mount.
6. Nut from stud attaching rear transaxle upper and lower halfs.

Install or Connect

1. Nut on stud 48 N•m (35 lb. ft.) attaching upper and lower halfs of transaxle mount.
2. Upper half of transaxle mount with stud 54 N•m (40 lb. ft.).
3. Two bolts and one nut on stud 54 N•m (40 lb. ft.) attaching upper half of transaxle mount to transaxle.
4. Lower engine and remove tools J 28467-A and J 35563.
5. Two nuts on studs 48 N•m (35 lb. ft.) attaching lower half of transaxle mount to frame.
6. Negative battery cable.

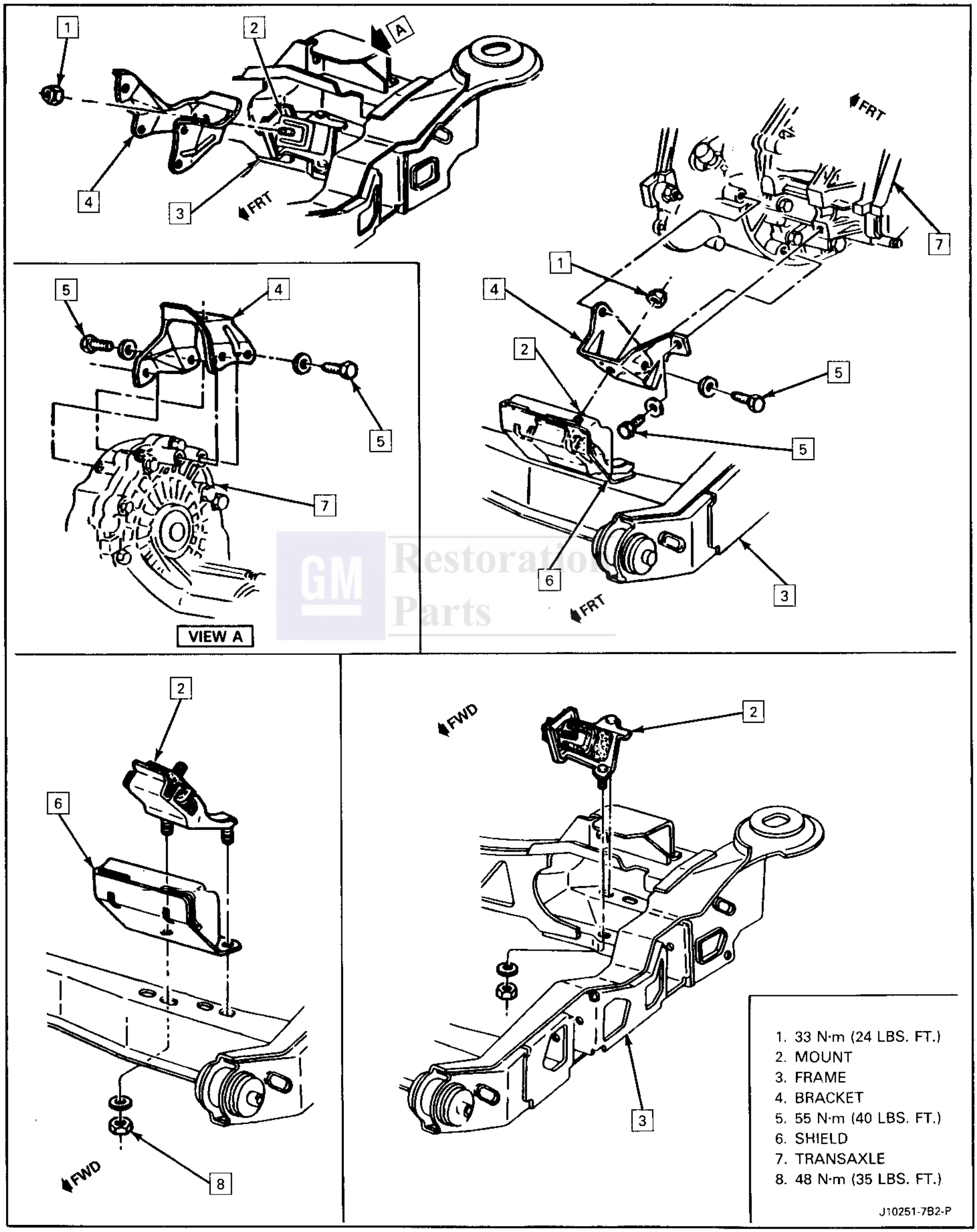
AXLE SHAFT SEALS

Remove or Disconnect

1. Axle shaft and inner joint from transaxle, see Section 4D.
2. Pry out and discard axle shaft seal from transaxle.

Install or Connect

1. New axle shaft seal with Tool J 26938.
2. Axle shaft and inner joint in transaxle, see Section 4D.



1. 33 N·m (24 LBS. FT.)
2. MOUNT
3. FRAME
4. BRACKET
5. 55 N·m (40 LBS. FT.)
6. SHIELD
7. TRANSAXLE
8. 48 N·m (35 LBS. FT.)

Figure 6 Transaxle Mounting

SECTION 7B2A

5-SPEED ISUZU MANUAL TRANSAXLE

RPO'S MK7 AND MT2

CONTENT

DIAGNOSIS

Figure 1

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 transaxle may actually be originating from other sources, such as tires, road surfaces, wheel bearings, engine, and exhaust system.

These noises may vary by car 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 car far enough to thoroughly warm up all lubricants.
3. Note speed at which noise occurs, and, in which gear range the transaxle is in at the time.
4. Check for noises with engine running and car stopped.
5. Determine in which of the following drive conditions noise is occurring:
   A. Drive — light acceleration or heavy pull.
   B. Float — maintaining constant car 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 car, refer to the following conditions and probable causes along with the Diagnosis Chart.

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.

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.

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Figure 1 Diagnosis Chart

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 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.

A rough wheel bearing produces a vibration or "growl" which continues with the car coasting and transaxle in Neutral. Since wheel bearings are not preloaded, noise should diminish if 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 bearing assembly.

UNIT REPAIR

CASE 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 3289-20 (Figure 2).
2. Remove seven bolts from the rear cover and remove cover (Figure 3).
3. Remove the control box assembly together with four bolts from the transaxle case (Figure 4).

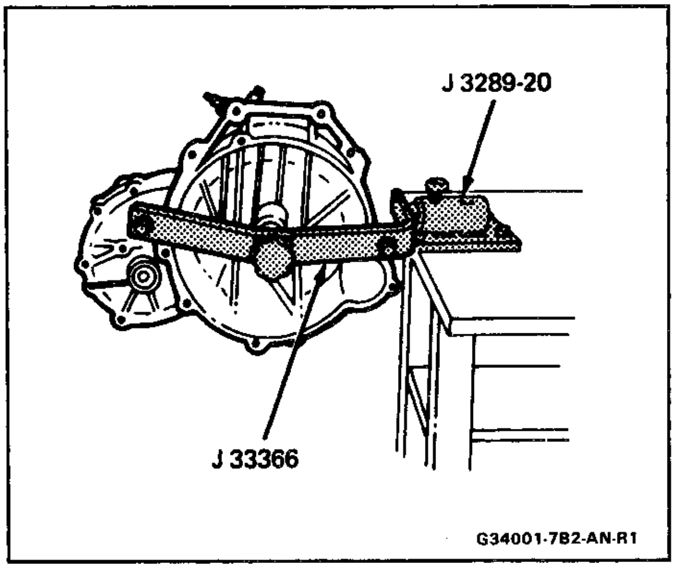

Figure 2 Transaxle Attached to J 33366

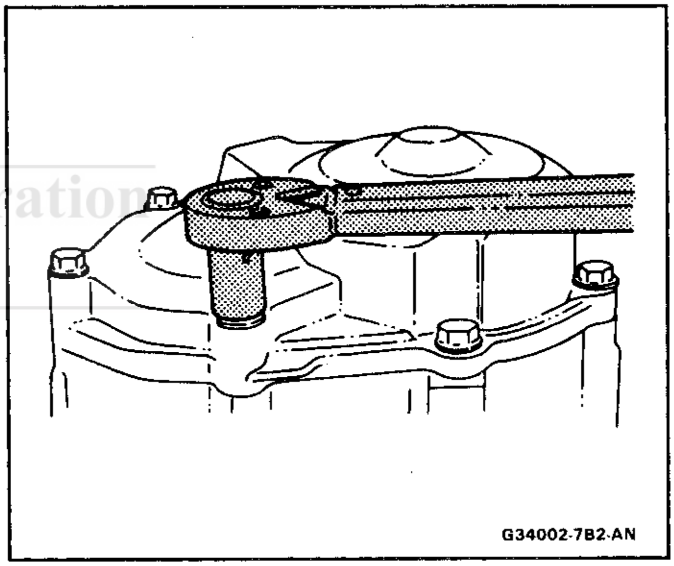

Figure 3 Rear Cover

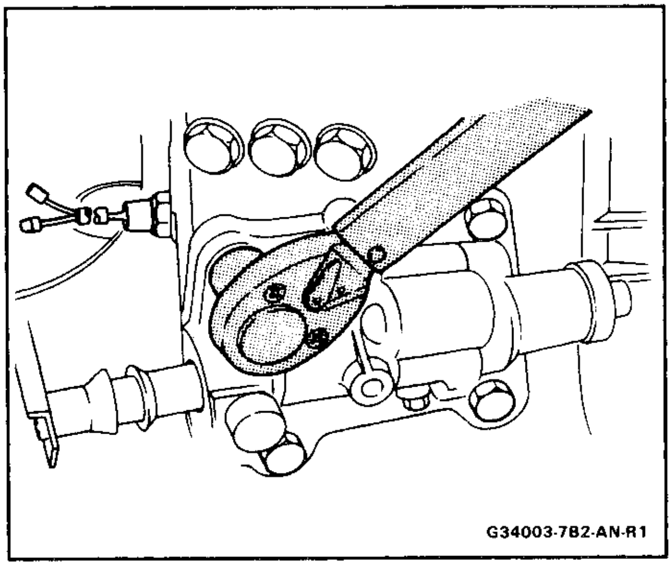

Figure 4 Control Box

4. Using a screwdriver, shift transaxle into gear. Remove fifth speed drive and driven gear retaining nuts from the input and output shaft (Figure 5) 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 6). Remove reverse detent spring retaining bolts and remove spring and detent ball (Figure 7).
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 8).
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 9).
8. Remove the bolt used to retain the reverse idler shaft at the transaxle case (Figure 10).
9. Remove the collar and thrust washer from the output shaft using J 22888 and J 22888-30 (Figure 11).
10. Remove 14 bolts retaining the transaxle case and separate the transaxle case from the clutch housing and remove.
11. Lift the 5th gear shaft. With the detent aligned facing the same way and remove 5th and reverse shafts at the same time (Figure 12).
12. Remove the reverse idler gear and reverse idler shaft (Figure 13).
13. Using a punch and hammer, remove the roll pin from the 1-2 shift fork and discard the roll pin. Slide 1-2 shaft upward to clear housing and remove fork and shaft from case (Figure 14).

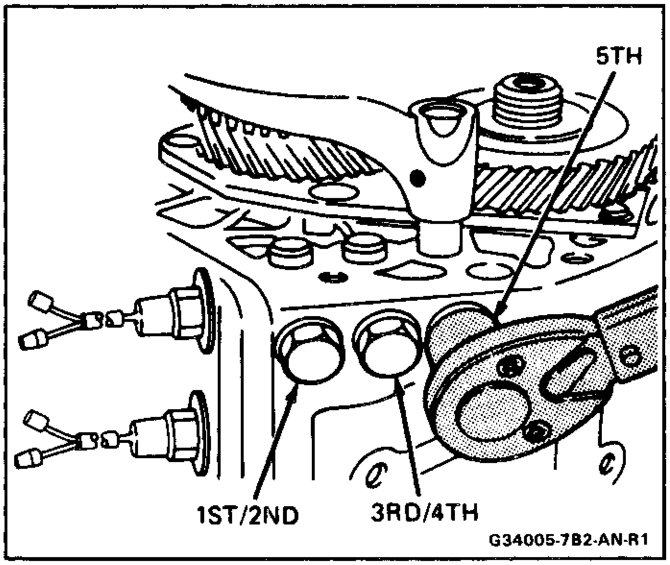

Figure 6 Detent Spring/Ball Location (1st through 5th)

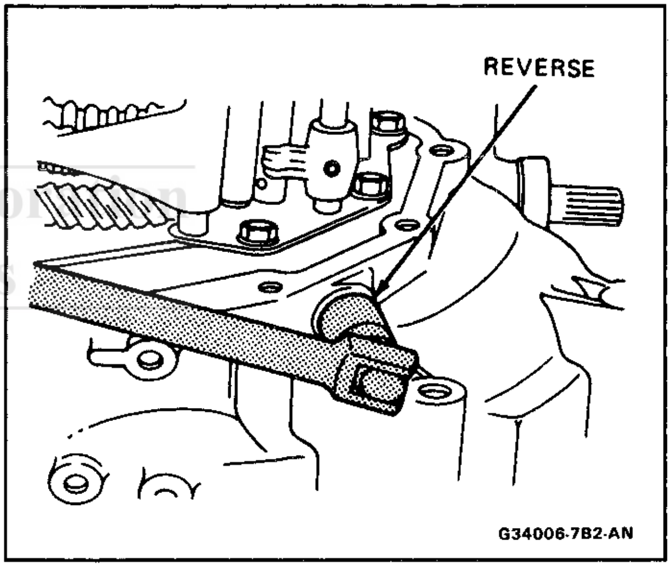

Figure 7 Detent Spring/Ball Location (Reverse)

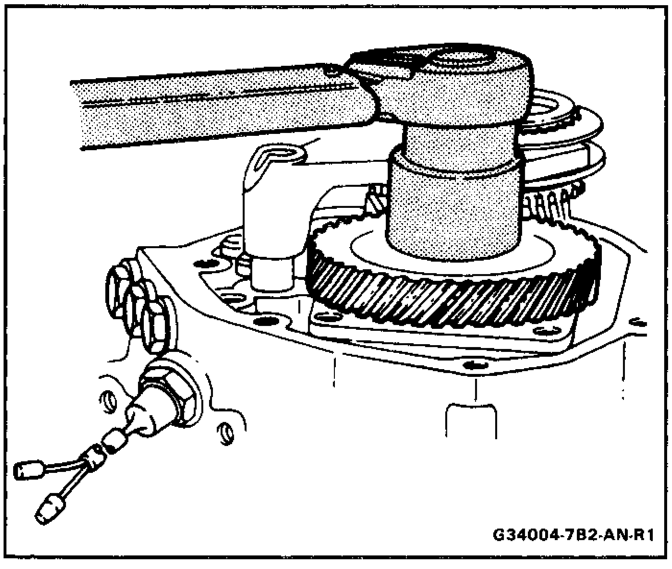

Figure 5 Fifth Gear Retaining Nuts

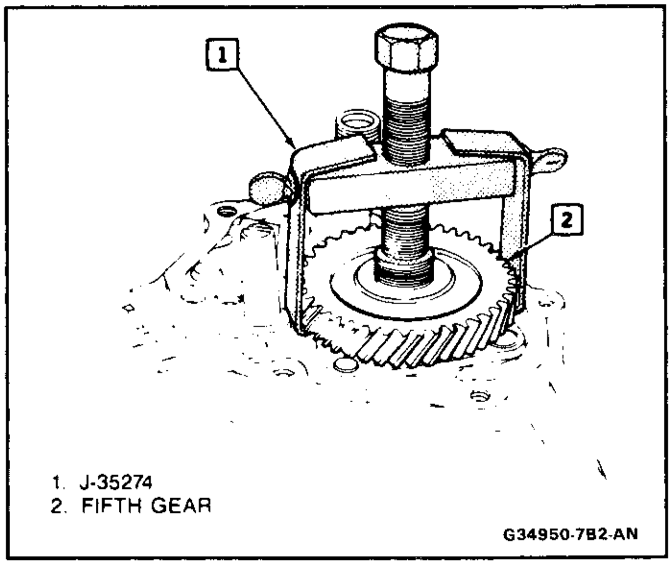

Figure 8 Fifth Gear Removal

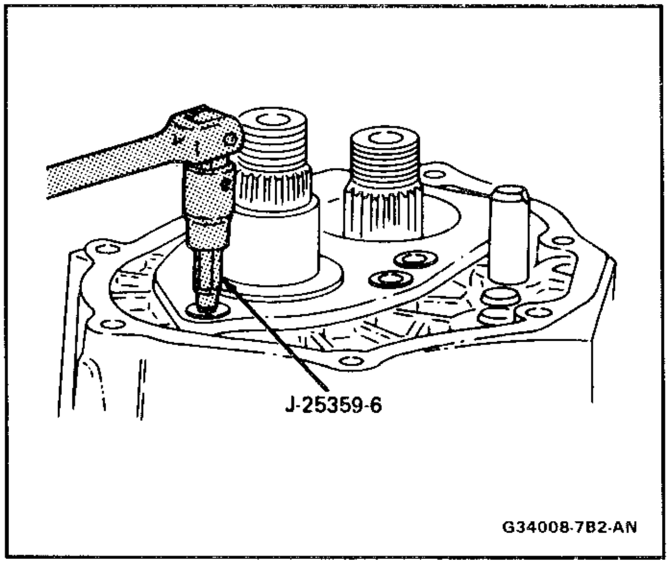

Figure 9 Bearing and Shim Retainer

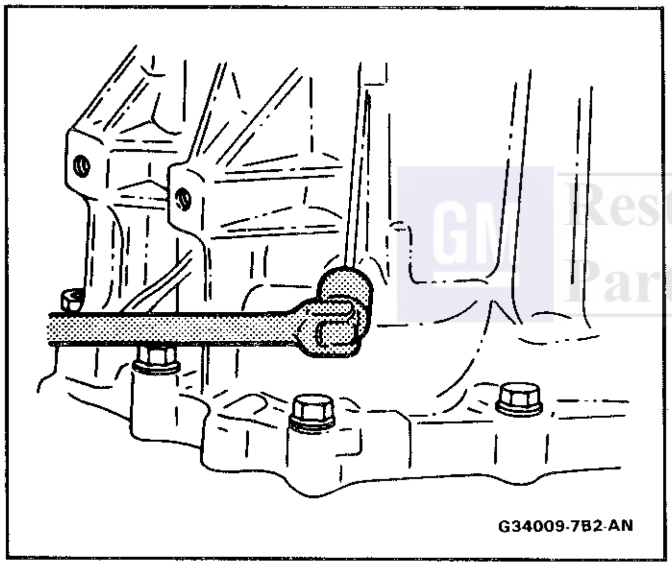

Figure 10 Reverse Idler Shaft Bolt

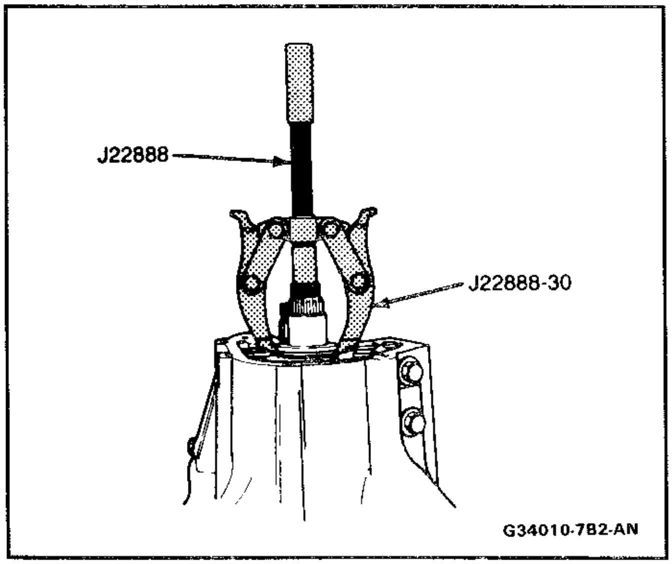

Figure 11 Collar and Thrust Washer

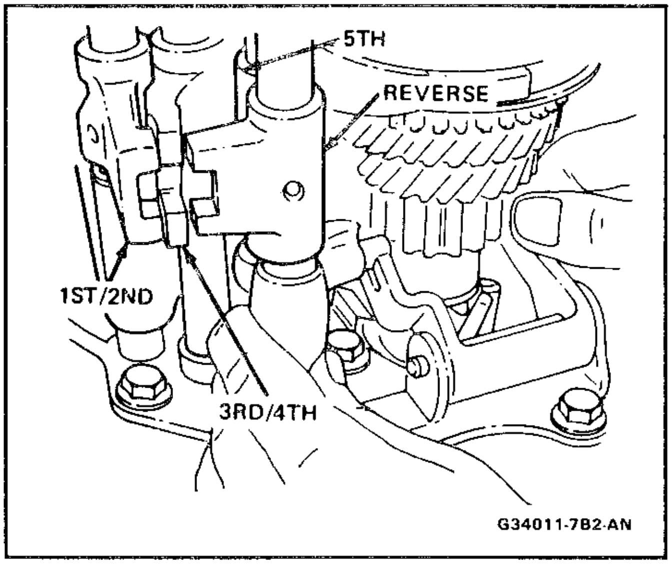

Figure 12 5th and Reverse Shift Shafts

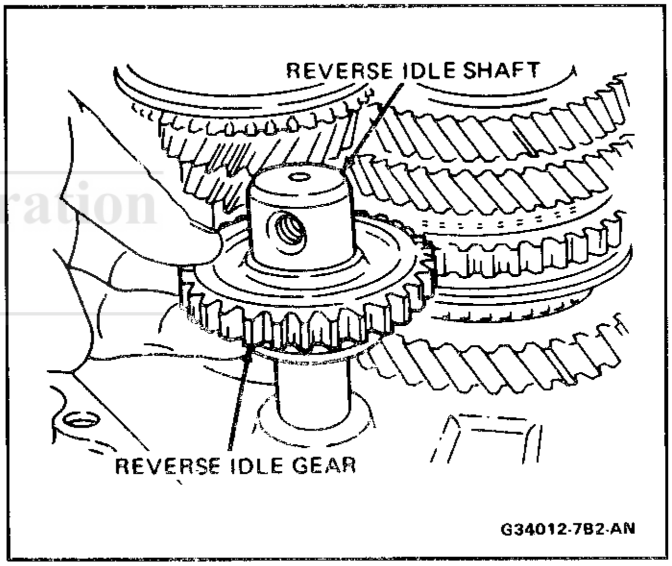

Figure 13 Reverse Idler Shaft and Gear

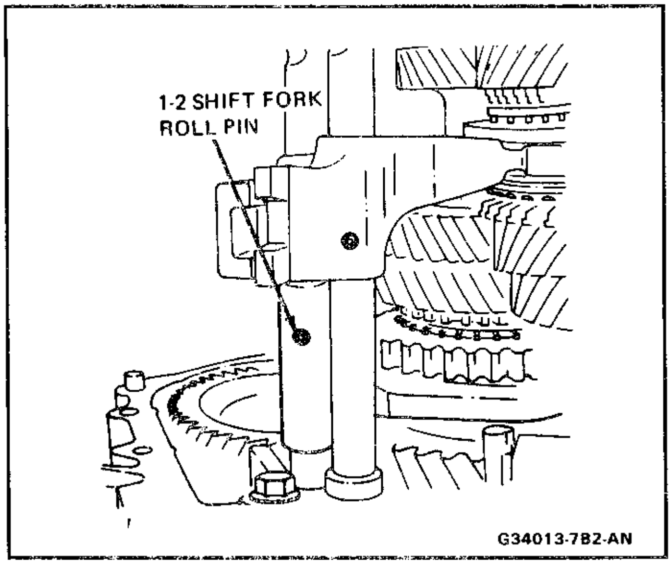

Figure 14 1st/2nd Shift Fork Roll Pin

14. Remove the roll pin, and then remove the pin and reverse shift lever.
15. Remove input and output shafts with 3-4 shift fork and shaft as an assembly.
16. Remove differential case assembly.
17. Remove the reverse shift bracket together with four bolts, and take out three interlock pins (Figure 15).
18. Remove the rear bearing outer races from the transaxle case. Use J 24256-A with driver handle J 8092 for the input shaft race. Use J 33370 with driver handle J 8092 for the output shaft race (Figure 16).
19. Remove the outer races for the input shaft front bearing, output shaft front and differential side bearings. Use J 26941 with J 33367 for removing the input and output races in the housing and the differential race in the case. Use J 26941 with a slide hammer to remove the differential race in the housing (Figure. 17, 18 and 19).

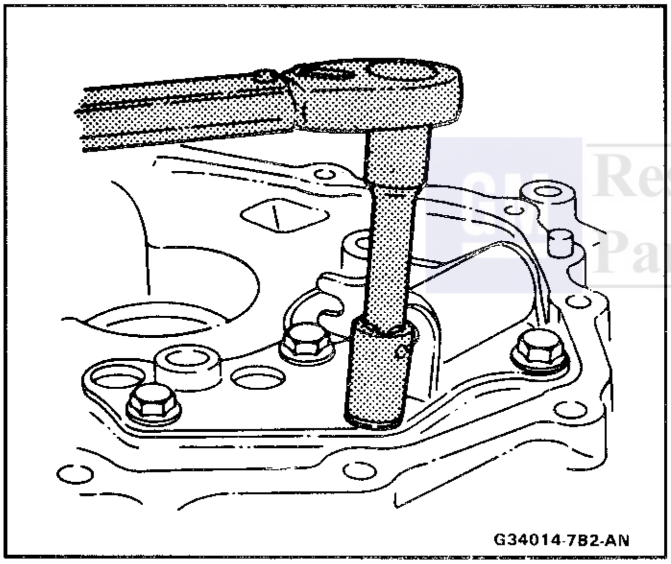

Figure 15 Reverse Shift Lever and Bracket

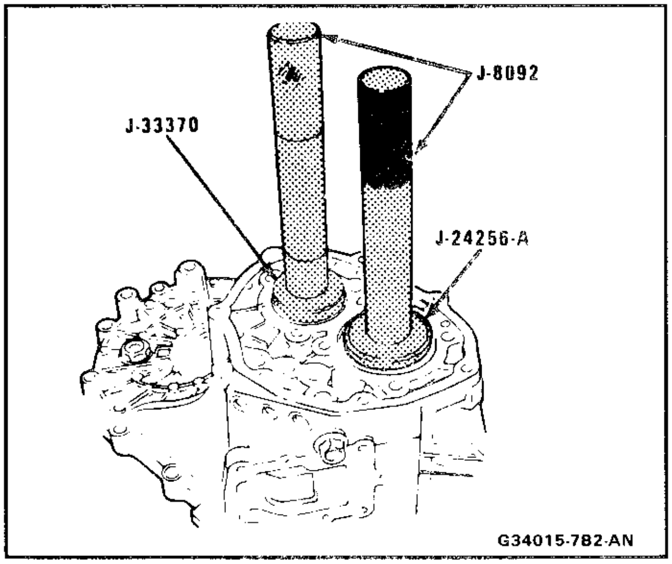

Figure 16 Input/Output Rear Bearing Races

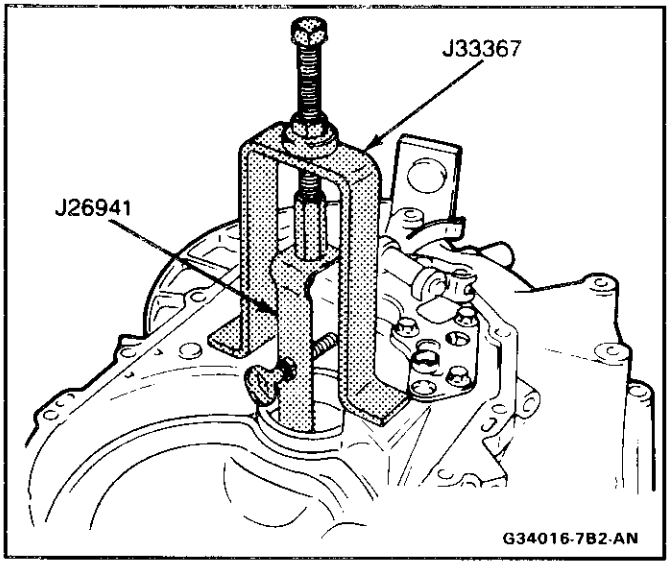

Figure 17 Input/Output Front Bearing Races

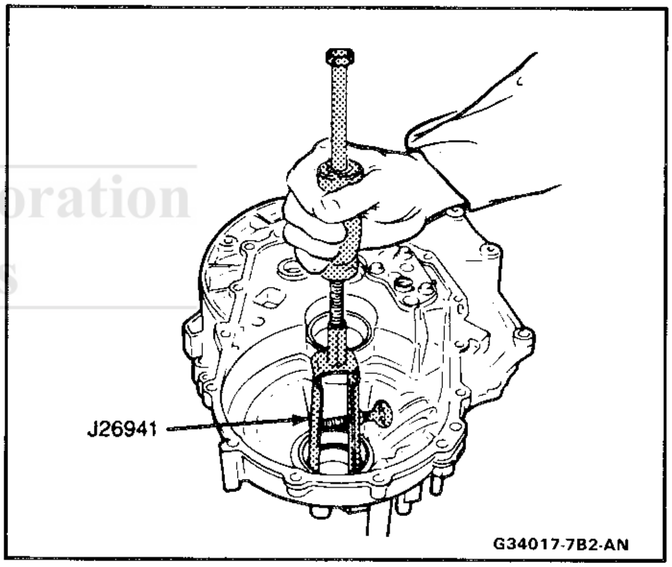

Figure 18 Differential Front Bearing Race

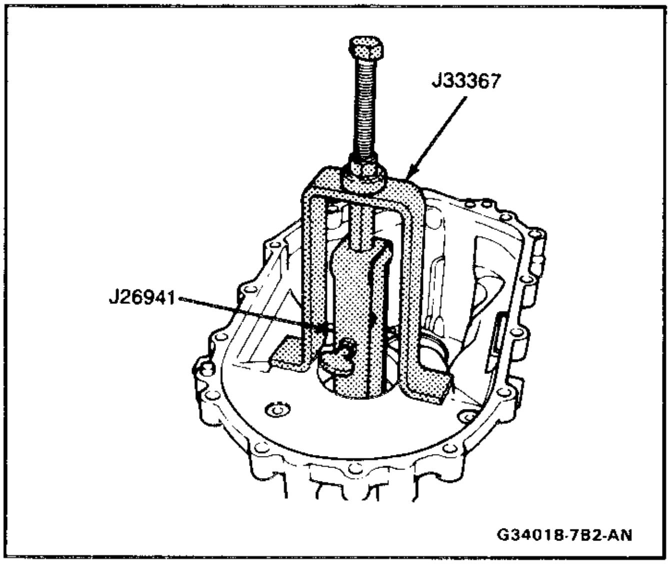

Figure 19 Differential Rear Bearing Race

20. Remove the input shaft seal from the housing. Remove the clutch shaft seal only when replacement is required.
21. Drive the bushing toward the inside of the housing using J 28412 and discard the bushing. Remove the clutch fork assembly. Remove the clutch shaft and bushing only when replacement is required.

SHAFT DISASSEMBLY

Input Shaft

1. Remove the front bearing using J 22912-01 with a press (Figure 21).
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 22).
3. Remove other parts from the input shaft.

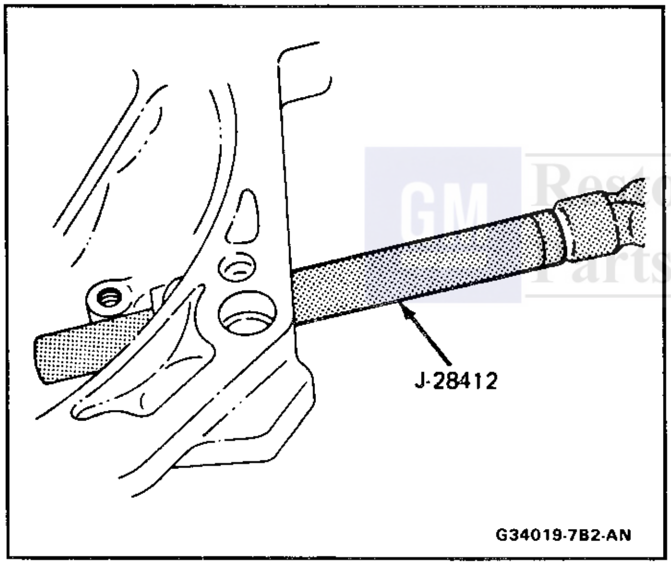

Figure 20 Clutch Shaft Bushing

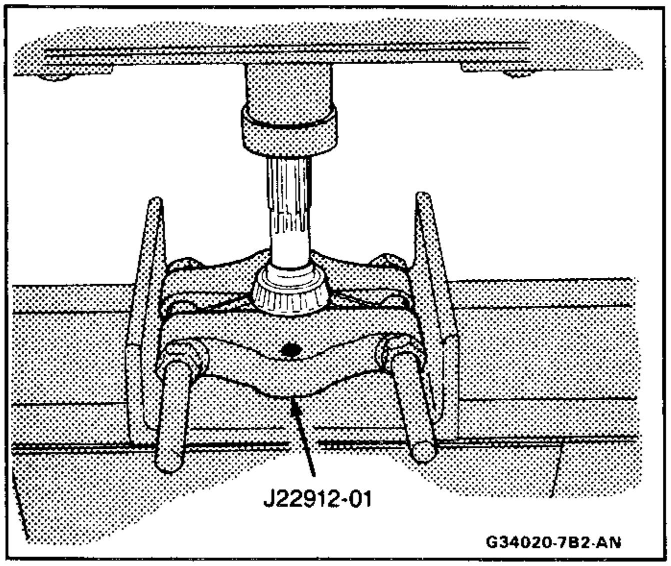

Figure 21 Front Input Bearing

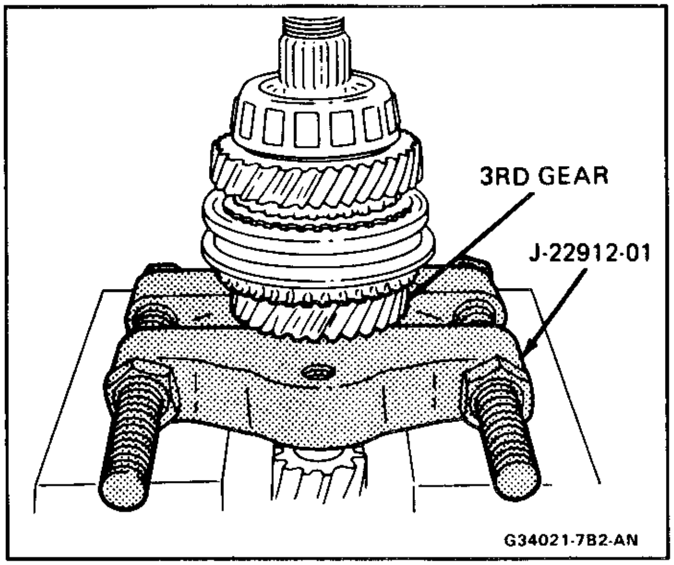

Figure 22 Rear Input Bearing

Output Shaft

1. Remove the front bearing using J 22227-A with J 33369 and a press (Figure 23).
2. Remove the rear bearing and 3rd/4th gear simultaneously using J 22912-1 and a press (Figure 24).
3. Remove the key, 2nd gear, needle bearing and blocker ring.
4. Remove the collar, reverse gear assembly and 1st gear all together by the use of a press (Figure 25).
5. Remove the thrust bearing and washer.

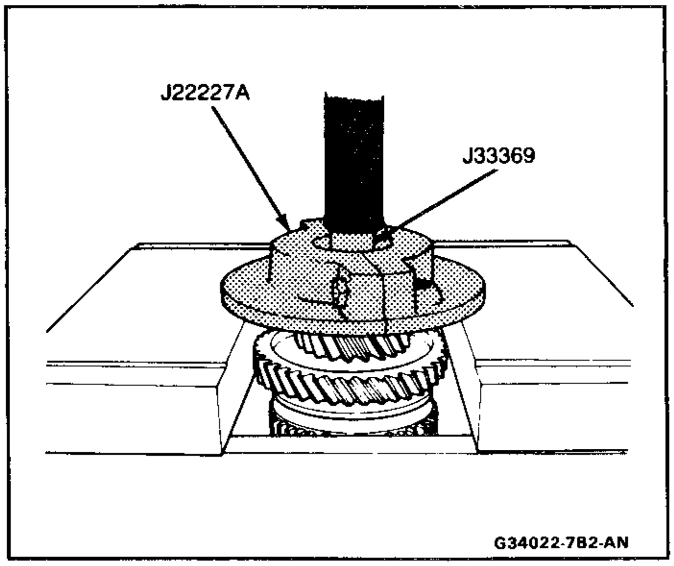

Figure 23 Front Output Bearing

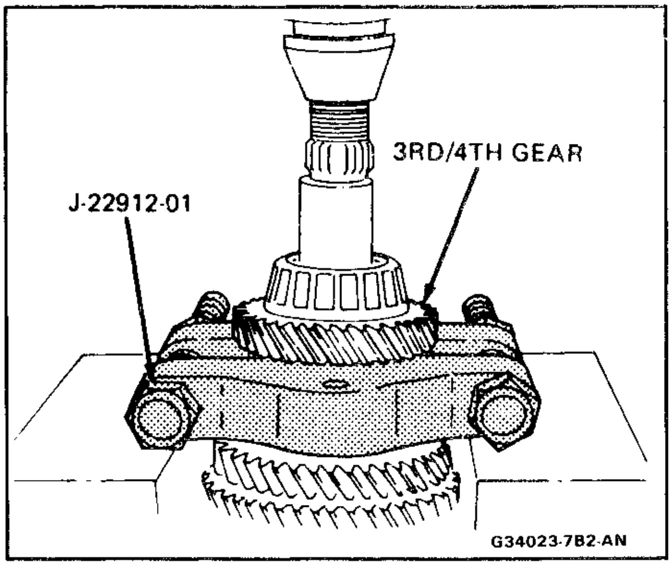

Figure 24 Rear Output Bearing

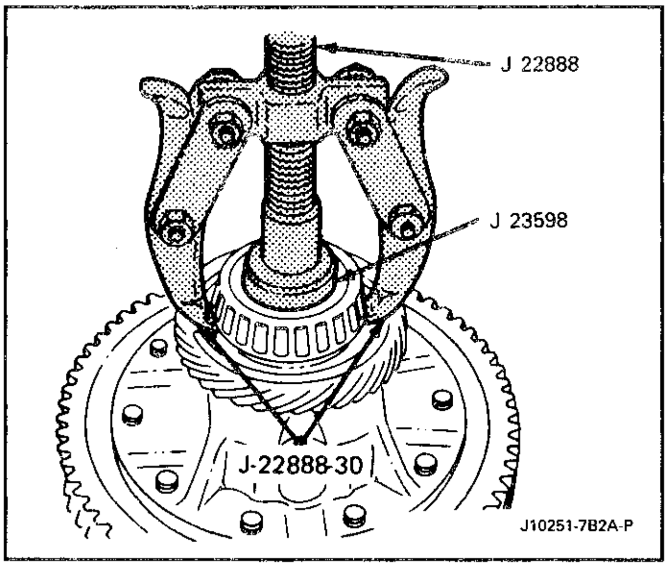

Figure 26 Differential Side Bearings

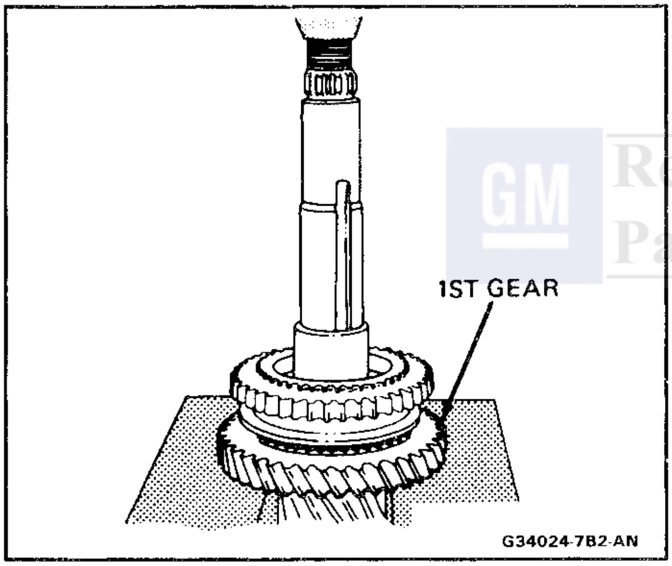

Figure 25 Collar, Reverse and 1st Gear

Differential Case

Disassembly

1. Remove the side bearing using J 22888 with puller leg kit J 22888-30 and pilot J 2241-11 (Figure 26).
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 reuse the speedometer drive gear.
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 with 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 bearing 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, 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 Reassembly

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 27). Before installing, apply oil to the collar and hub interiors. After installation, apply oil to the circumference of the collar. Check to ensure the insert springs do not interfere with the hub after installation.
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 (Figure 28 and 29). Before installing, apply oil to the bearing interior and race surface.

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 30).

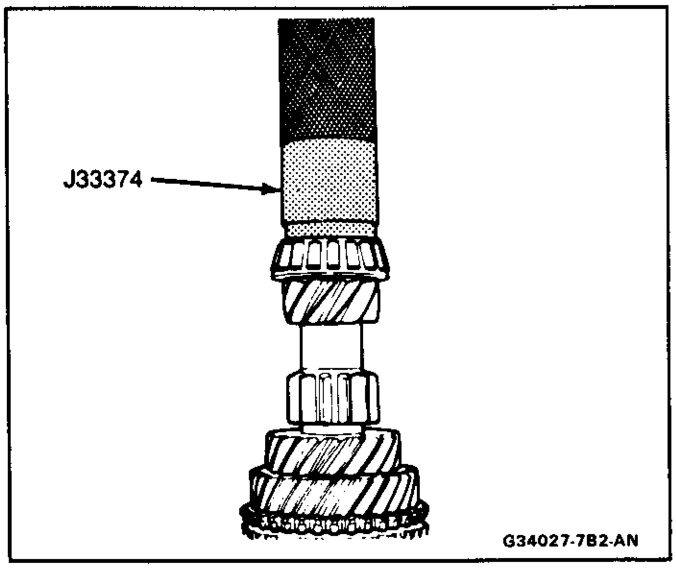

Figure 28 Front Bearing Input Shaft

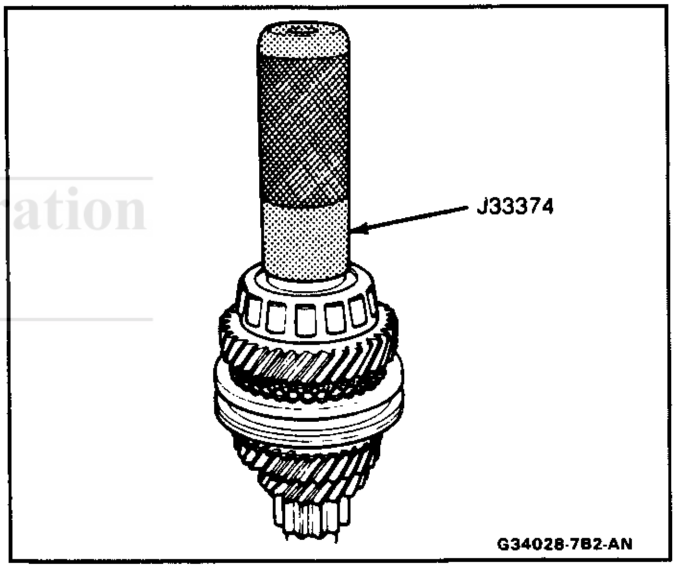

Figure 29 Rear Bearing Input Shaft

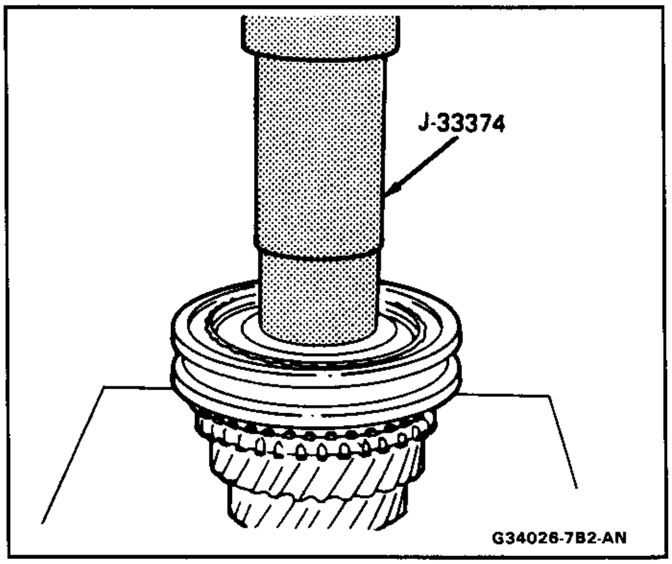

Figure 27 3rd/4th Sleeve/Hub and Collar

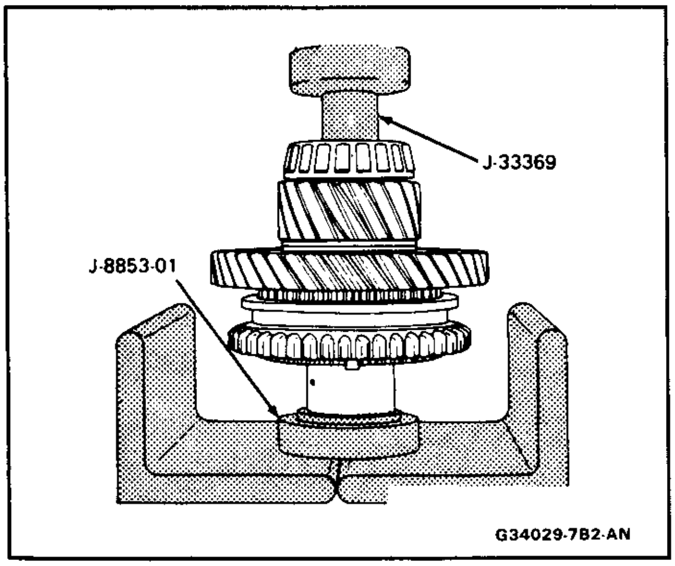

Figure 30 Collar Sleeve and Hub (1st)

Before installing the sleeve and hub assembly, oil should be applied to the hub and collar interiors. After installation, apply oil to the collar exterior. Check to ensure that the insert springs do not interfere with the hub after installation.

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 31).
5. Press the front bearing on the shaft using J 33368 and a press (Figure 32).

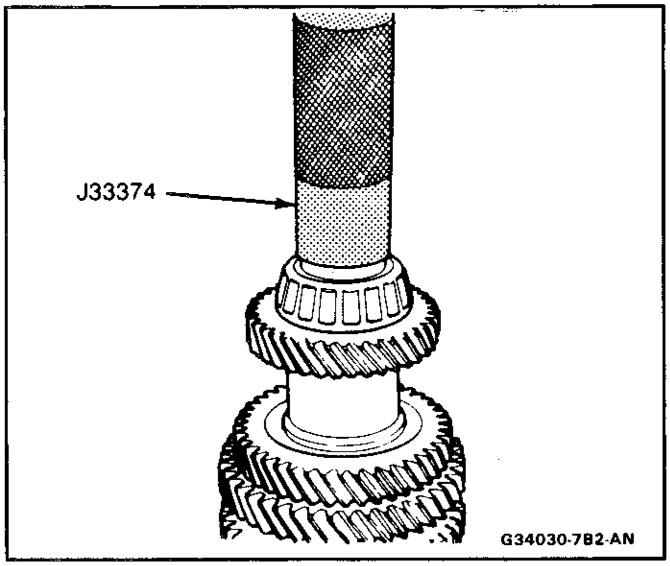

Figure 31 Rear Bearing Output Shaft

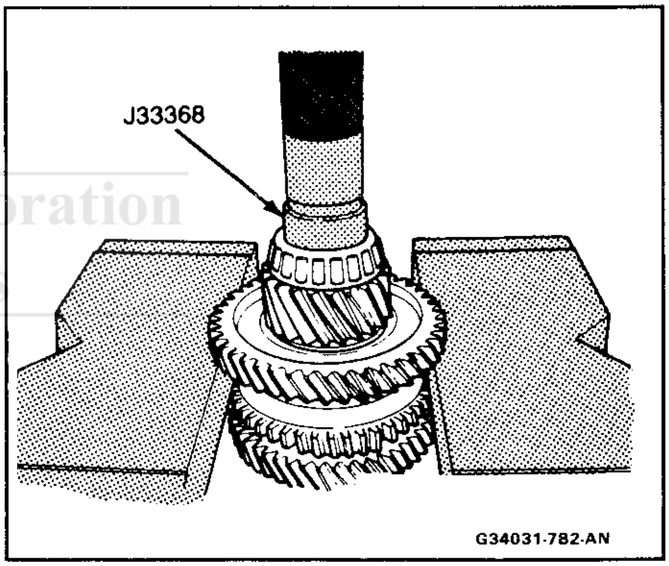

Figure 32 Front Bearing Output Shaft

Differential Case

Assemble

Before assembling, apply oil to the bearing inner and outer race surfaces.

1. Install two side gears on the differential case together with the thrust washers. Next, position two thrust washers and pinion gears opposite of each other, and install them in their positions by turning the side gear.
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 (200°F) using a hot air dryer (do not use hot water) and then install it on the differential.
5. Apply oil on the inside diameter of the ring gear then position the ring gear on the differential case. Apply a small amount of oil to the bottom side of the ten new bolt heads ONLY, then install bolts and tighten them to the specified torque in a diagonal sequence.

   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

Assemble

Before reassembly, attach the clutch housing to the transaxle holding fixture if removed.

1. Install a new input shaft seal using J 26540 (Figure 33).

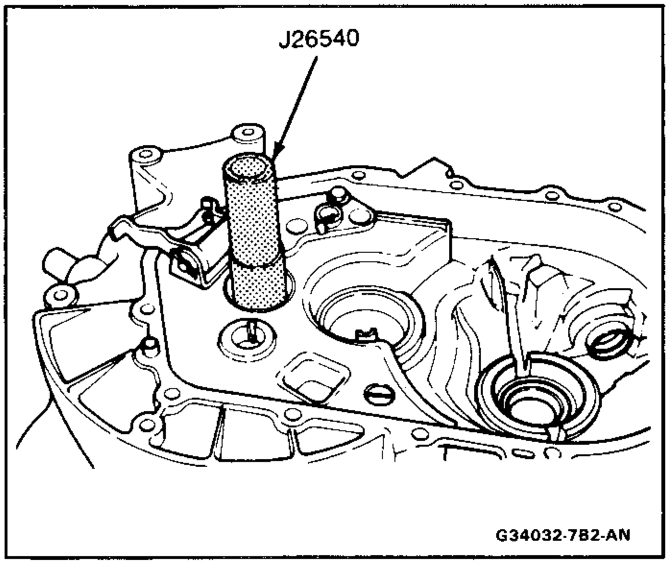

Figure 33 Input Shaft Seal

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 34). Using J 7817 with driver handle J 8092, press output race into housing (Figure 35). Using J 8611-01 with driver handle J 8092, press differential race into housing (Figure 36).
3. Apply grease to three interlock pins, and install them on the clutch housing (Figure 37).
4. Install the reverse shift bracket on the clutch housing. Use 3rd/4th shift shaft to align bracket to housing. Install retaining bolts and tighten to specification. Make sure shaft operates smoothly after installation (Figure 38).

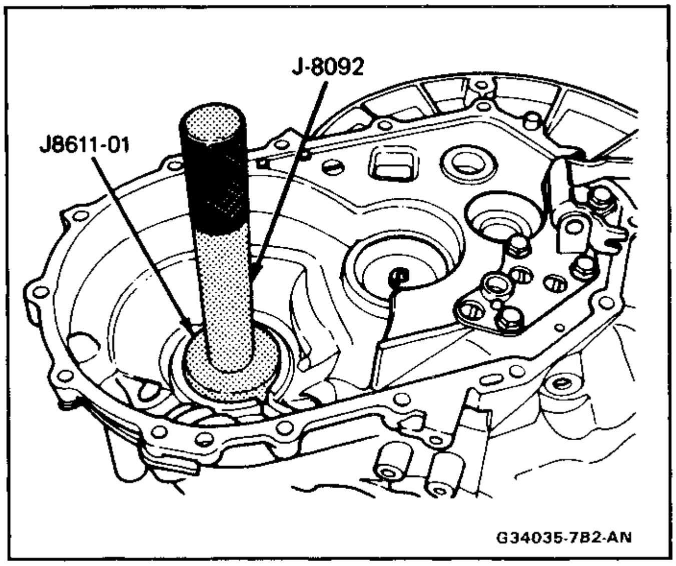

Figure 36 Front Differential Bearing Race

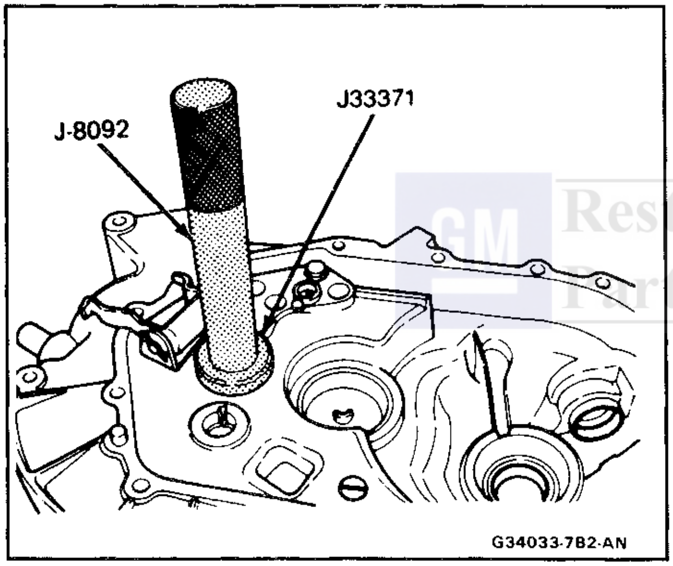

Figure 34 Front Input Shaft Bearing Race

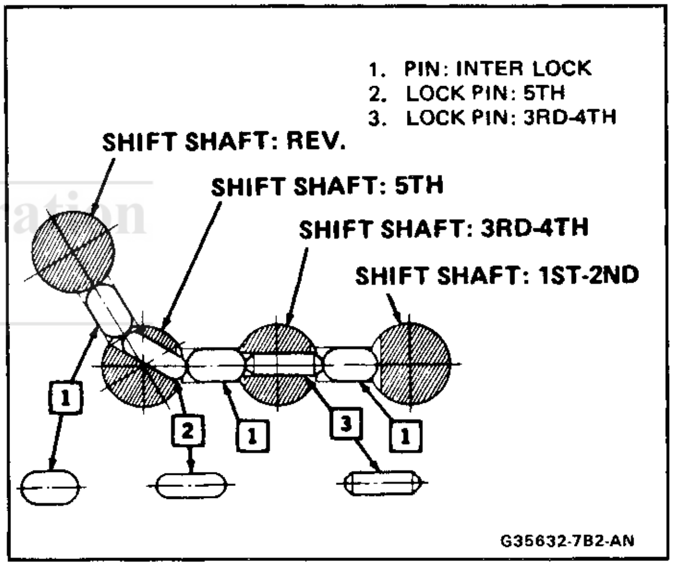

Figure 37 Interlock Pins

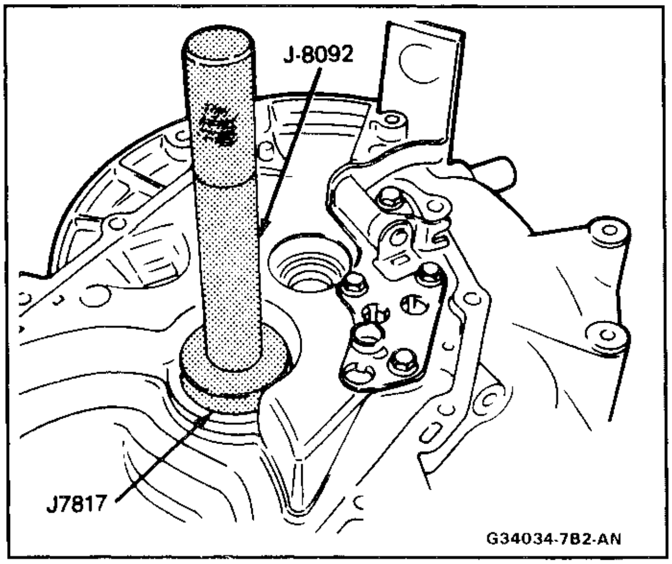

Figure 35 Front Output Shaft Bearing Race

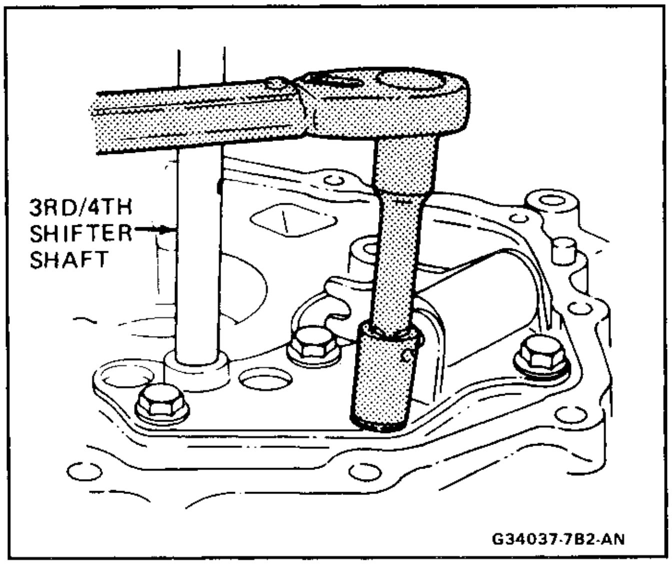

Figure 38 Reverse Shift Bracket

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 the lock 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 shift shaft into the reverse shift lever bracket. Align hole in fork with the shaft and install a new double 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 lock pin is in the 5th gear shifter shaft before installing.
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 39. 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 40).
    - C. Install bearing and shim retainer on transaxle case. Tighten screws to 17 N•m (13 lbs. ft.). 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 tighten bolts alternately until case is seated on spacers. Tighten bolts to 15 N•m (10 lbs. ft.).
    - 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 41). The input shaft shim should be two sizes 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 has been selected, remove the transaxle case, seven spacers and three gages.

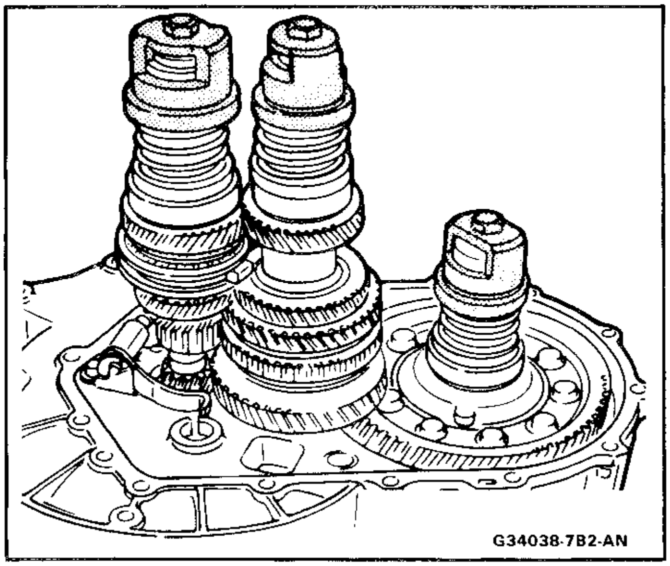

Figure 39 Gages in Position

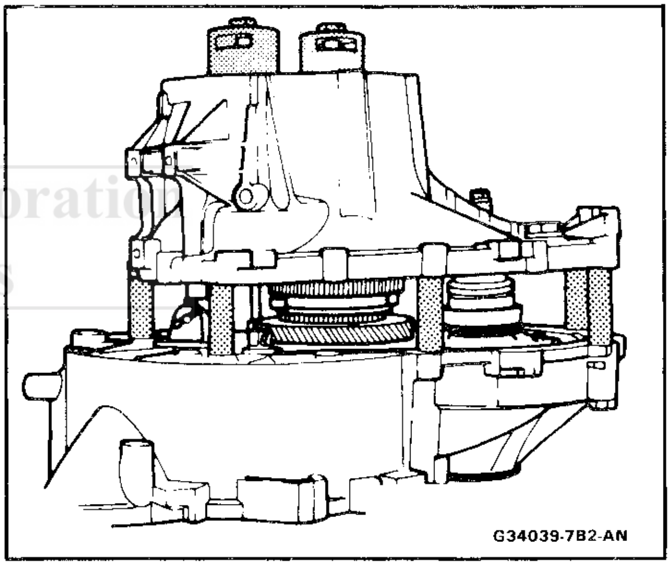

Figure 40 Gages and Spacers in Position

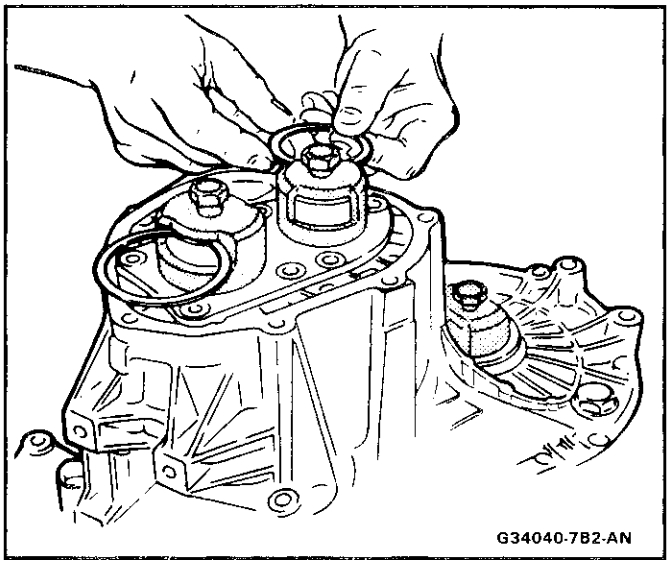

Figure 41 Checking Shim Size

THICKNESS mm(in.)		AVAILABLE INPUT	AVAILABLE OUTPUT	AVAILABLE DIFF	THICKNESS mm(in.)		AVAILABLE INPUT	AVAILABLE OUTPUT	AVAILABLE DIFF
1.00	0.0394	●			1.76	0.0693	●		●
1.04	0.0410	●			1.80	0.0709	●	●	●
1.08	0.0426	●		●	1.84	0.0725	●		●
1.12	0.0441	●		●	1.88	0.0741	●	●	●
1.16	0.0457	●	●	●	1.92	0.0756	●		●
1.20	0.0473	●		●	1.96	0.0772	●	●	●
1.24	0.0489	●	●	●	2.00	0.0788	●		●
1.28	0.0504	●		●	2.04	0.0804	●	●	
1.32	0.0520	●	●	●	2.08	0.0820	●		
1.36	0.0536	●		●	2.12	0.0835	●	●	
1.40	0.0552	●	●	●	2.16	0.0851	●		
1.44	0.0567	●		●	2.20	0.0867	●	●	
1.48	0.0583	●	●	●	2.24	0.0883	●		
1.52	0.0599	●		●	2.28	0.0899	●	●	
1.56	0.0615	●	●	●	2.32	0.0914	●		
1.60	0.0630	●		●	2.36	0.0930	●	●	
1.64	0.0646	●	●	●	2.40	0.0946	●		
1.68	0.0662	●		●	2.44	0.0951	●	●	
1.72	0.0678	●	●	●	2.48	0.0977	●		

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Figure 42 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 No. 518 or equivalent to the mating surfaces of the clutch housing and clutch housing.
16. Be sure magnet is installed in clutch housing.
17. Install the transaxle case on the clutch housing. Install the reverse idle shaft bolt into the transaxle case. Tighten the bolt to 38 N•m (28 lbs. ft.).
18. Install 14 case bolts. Tighten bolts to 38 N•m (28 lbs. ft.) in a diagonal sequence.
19. Install drive axle seals using J 26938 or J 29130 with J 8092 (Figure 43).
20. Install the thrust washer and collar to the output shaft using J 33374 (Figure 44).

    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 shift shaft and install a new double roll pin (Figure 45).

    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 tighten to 25 N•m (18 lbs. ft.).

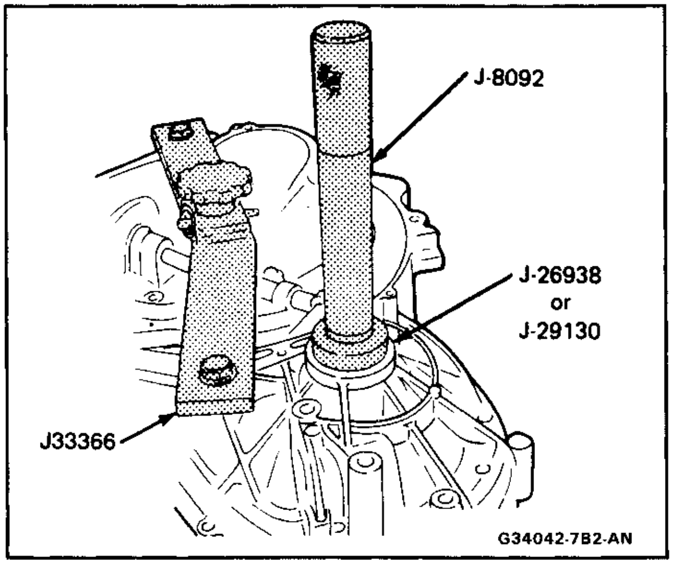

Figure 43 Drive Axle Seals

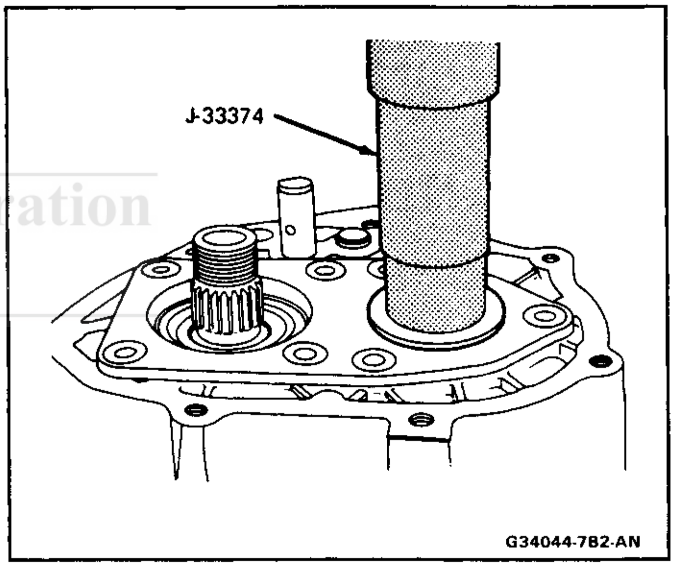

Figure 44 Fifth Gear Thrust Bearing and Collar

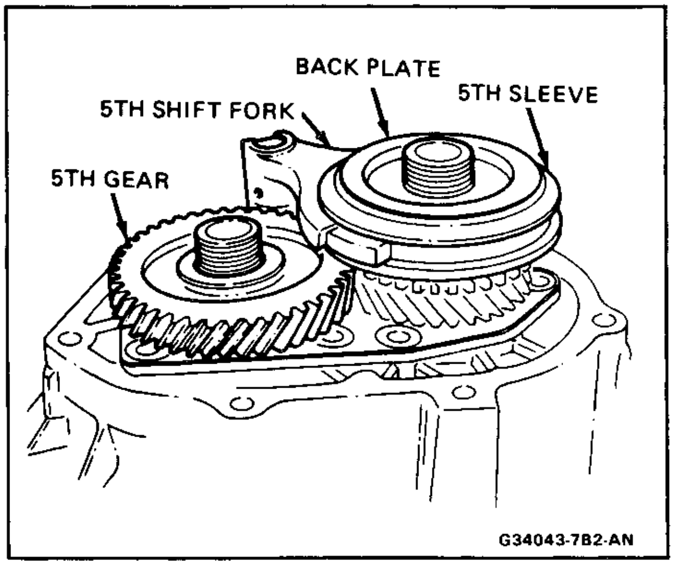

Figure 45 Fifth Gear and Shift Fork

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 material to flow into the splines of the 5th gear and input shaft. Install new retaining nuts and tighten to 128 N•m (94 lbs. ft.). Stake nuts after reaching final torque.
24. Assemble the control box as follows:
    - 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 assembly.
    - Align the stopper cam alignment mark with the center on the internal lever (Figure 46).
    - Check to see that the reverse inhibitor mechanism operates properly.
    - Use a new roll pin to attach the internal lever during assembly.
25. Install a new gasket with the control box assembly on the transaxle case and tighten four bolts to 17 N•m (13 lbs. ft.).

    Make sure transaxle shifts properly before installing rear cover.
26. Install a new gasket with the rear cover. Install seven bolts and tighten the bolts to 17 N•m (13 lbs. ft.).
27. Install the clutch fork assembly if it has been removed. Install the bushing into the upper hole using J 28412 (Figure 47). Install the oil seal next using J 28406. Install the clutch shaft cap.

    Before installing the bushing, apply grease to both the inside and outside of bushings.

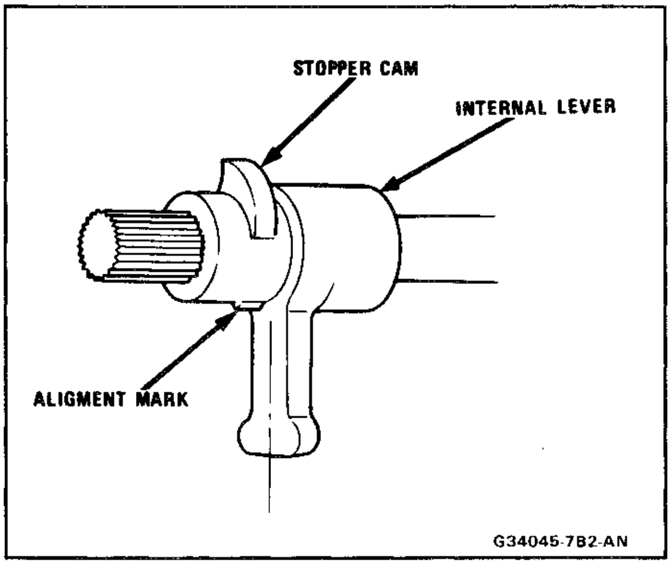

Figure 46 Stopper Cam Alignment Mark

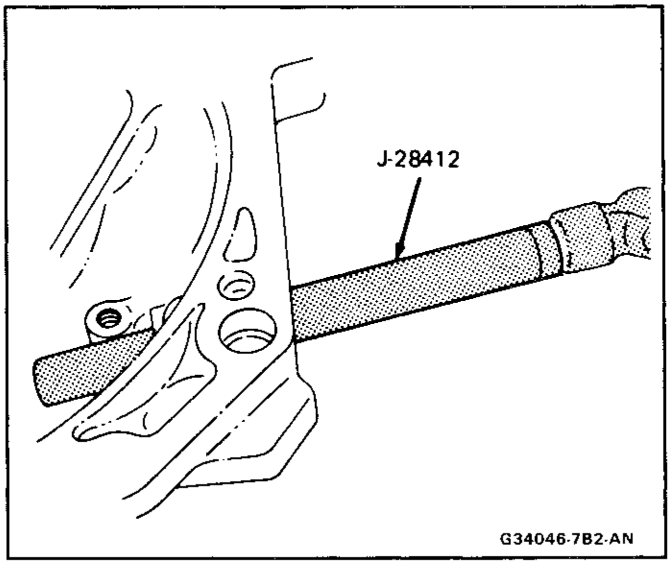

Figure 47 Clutch Shaft Bushing

28. Install the clutch release bearing, see Section 7C. Measure the rotating torque on the input shaft as shown in Figure 48. 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 lbs. in.

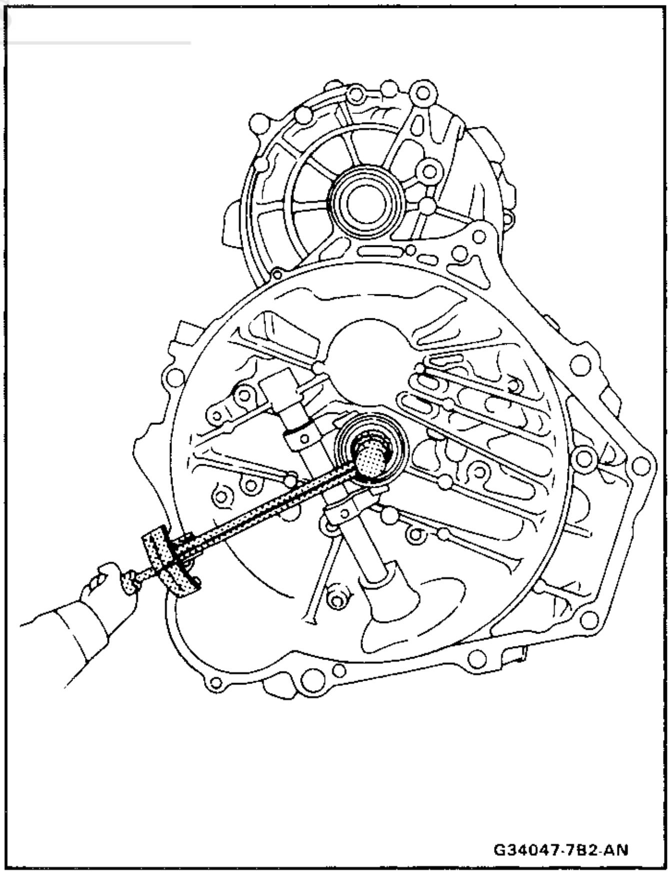

Figure 48 Checking Input Shaft Rotating Torque

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 LITERS (2.7 QT.)

LUBE RECOMMENDED — MANUAL TRANSAXLE OIL NO. 12345349 OR EQUIVALENT

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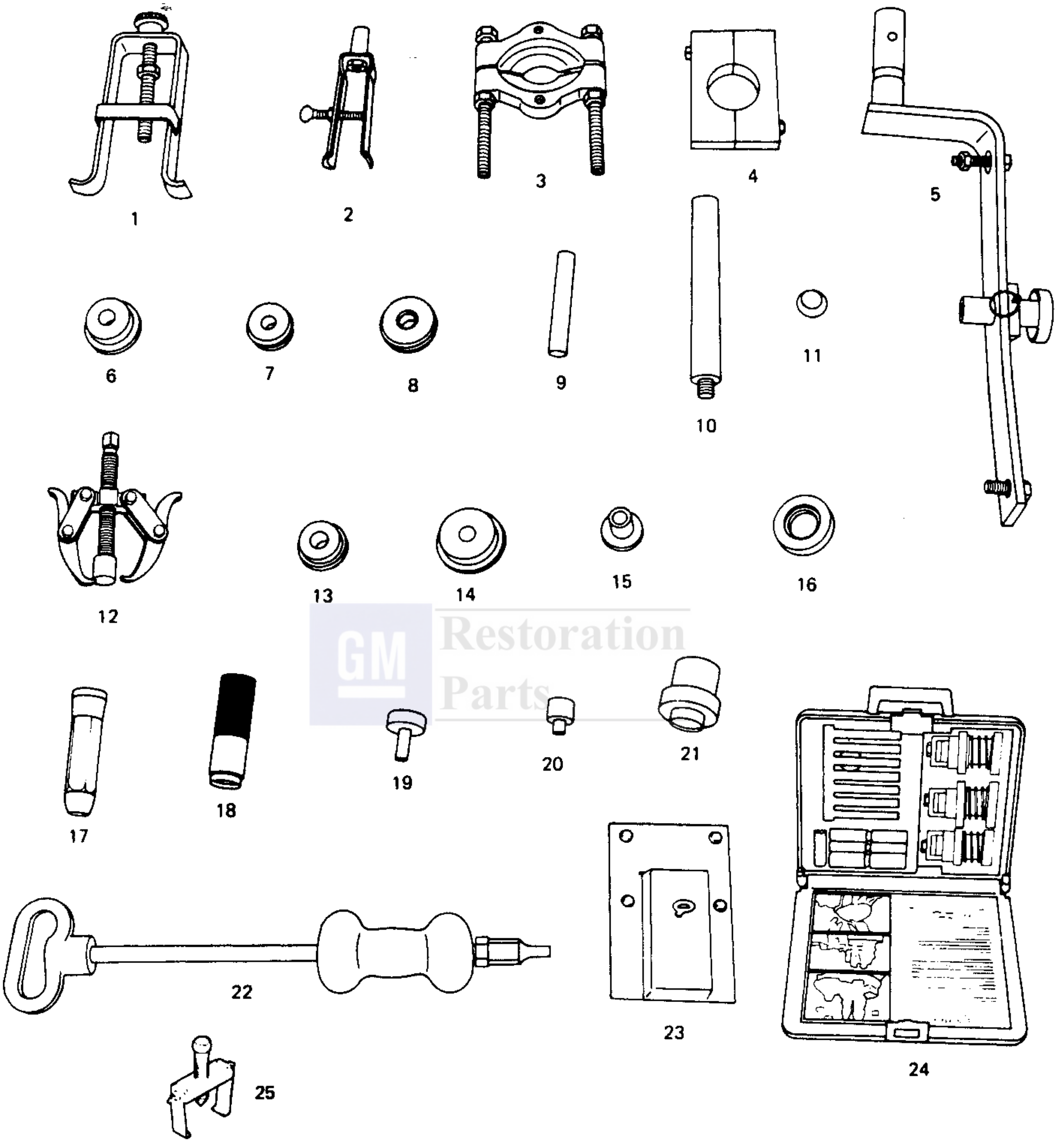
Figure 49 Specifications



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
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 2619-01
23. J 3289-20
24. J 33373
25. J 35274

J10252-7B2A-P

Figure 50 Special Tools

SECTION 7B3

MUNCIE 282 FIVE-SPEED MANUAL TRANSAXLE

RPO'S MG1 AND MG2

CONTENTS

GENERAL DESCRIPTION

The Muncie 282 (five-speed) transaxle assembly is a constant-mesh design transmission. Combined in the assembly are all forward gears, reverse gear, and the differential output. Selection and shifting is accomplished by a combination of synchronizers with blocker rings controlled by sliding rail shift forks. Reverse gear is non-synchronized with the idler gear supported on a sliding spindle idler shaft.

The basic components of this unit are:

- Transmission case
- Clutch and differential case
- Input shaft and gears
- Output shaft and gears
- Ring gear and differential assembly

Unique features of the Muncie (five-speed) transaxle are:

- Fifth speed overdrive
- Needle bearing support of speed gears
- Sintered bronze synchronizers
- Hard finished gears with laser welded clutch teeth rings
- Low-drag ball bearing support of input shaft
- Individual sliding shift rails for each shift fork

The differential is a conventional arrangement of gears that is supported by tapered roller bearings. The final output gear (an integral part of the output shaft) turns the ring gear and differential assembly, thereby turning the drive axle shafts.

The shifter cables are called select and shift cables. When one cable moves the other cable should be stationary. The shifter cables are pressed on the shifter ball studs. The shifter cables are attached at the transaxle levers with nuts on the cable ball studs. The shifter cables are adjustable at the transaxle levers.

The cradle and transaxle are attached. The cradle swings down for transaxle removal. 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 transaxle mounts be certain the mounts are aligned to the center of the mounts. Alignment of mounts will keep the driveline centered in installation. Refer to Section 2A for cradle alignment.

Transaxle to engine attachment is accomplished with three bolts and three studs. The bolts and studs pass through the transaxle clutch housing into the engine bosses.

The shift and select cables are routed rearward through the passenger compartment into the engine compartment. The inner cables are attached to the shifter with retainer clips. The cables in the engine compartment are attached to the transaxle shift levers with nuts on cable ball studs.

The transaxle has an inhibitor built into the shift linkage to prevent a shift from fifth gear into reverse.

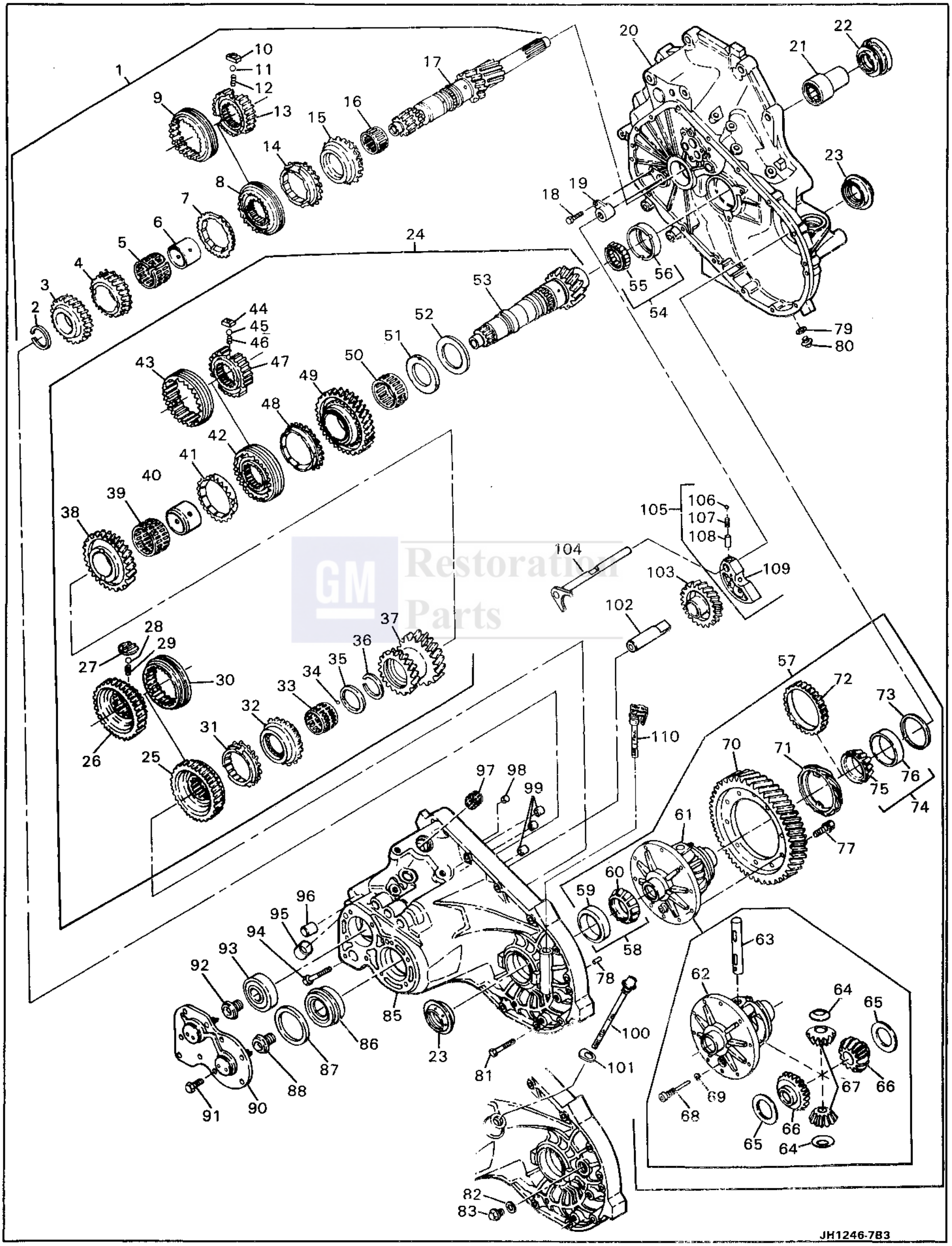


Figure 1 Disassembled View-Gear and Case Group

MUNCIE 282 (5-SPEED) TRANSAXLE GEAR AND CASE GROUP

1. SHAFT & GEAR ASSEMBLY, INPUT CLUSTER
2. SNAP RING
3. GEAR, FIFTH INPUT
4. GEAR, FOURTH INPUT
5. BEARING, CAGE
6. RACE, NEEDLE
7. RING, BLOCKER 4TH
8. SYNCHRONIZER ASSEMBLY, 3RD/4TH
9. SLEEVE, 3RD/4TH SYNCHRONIZER
10. KEY, 3RD/4TH SYNCHRONIZER (THREE)
11. BALL, 3RD/4TH SYNCHRONIZER (THREE)
12. SPRING, 3RD/4TH SYNCHRONIZER (THREE)
13. HUB, CLUTCH, 3RD/4TH SYNCHRONIZER
14. RING, BLOCKER 3RD
15. GEAR, THIRD INPUT
16. BEARING, CAGE (TWO)
17. SHAFT, INPUT
18. BOLT/SCREW, M6 X 1 X 12
19. GUIDE, REVERSE SHIFT RAIL
20. HOUSING, CLUTCH AND DIFFERENTIAL
21. BEARING/SLEEVE ASSEMBLY, INPUT SHAFT
22. BEARING ASSEMBLY, CLUTCH RELEASE
23. SEAL, OIL DRIVE AXLE
24. SHAFT & GEAR ASSEMBLY, OUTPUT CLUSTER
25. GEAR, REVERSE OUTPUT/5TH SYNCHRONIZER ASSEMBLY
26. GEAR, REVERSE
27. KEY, 5TH SYNCHRONIZER (THREE)
28. BALL, 5TH SYNCHRONIZER (THREE)
29. SPRING, 5TH SYNCHRONIZER (THREE)
30. SLEEVE, 5TH SYNCHRONIZER
31. RING, BLOCKER 5TH GEAR
32. GEAR, 5TH SPEED OUTPUT
33. BEARING, 5TH SPEED OUTPUT
34. BALL, THRUST WASHER POSITIONER
35. WASHER, THRUST
36. SNAP RING
37. GEAR, 3RD/4TH CLUSTER
38. GEAR, 2ND OUTPUT
39. BEARING, 2ND OUTPUT
40. RACE, BEARING 2ND OUTPUT
41. RING, BLOCKER 2ND GEAR
42. SYNCHRONIZER ASSEMBLY, 1ST/2ND GEAR
43. SLEEVE, 1ST/2ND SYNCHRONIZER
44. KEY, 1ST/2ND SYNCHRONIZER (THREE)
45. BALL, 1ST/2ND SYNCHRONIZER (THREE)
46. SPRING, 1ST/2ND SYNCHRONIZER (THREE)
47. HUB, 1ST/2ND SYNCHRONIZER
48. RING, BLOCKER 1ST GEAR
49. GEAR, 1ST OUTPUT
50. BEARING, 1ST OUTPUT
51. BEARING, THRUST
52. WASHER, THRUST
53. SHAFT, OUTPUT
54. BEARING, OUTPUT SHAFT SUPPORT
55. BEARING, OUTPUT
56. RACE, BEARING OUTPUT
57. GEAR AND DIFFERENTIAL ASSEMBLY
58. BEARING ASSEMBLY, DIFFERENTIAL
59. RACE, BEARING DIFFERENTIAL
60. BEARING, DIFFERENTIAL
61. CASE, DIFFERENTIAL ASSEMBLY
62. CASE, DIFFERENTIAL
63. PIN, CROSS DIFFERENTIAL
64. WASHER, THRUST PINION GEAR
65. WASHER, THRUST SIDE GEAR
66. GEAR, SIDE DIFFERENTIAL
67. GEAR, PINION DIFFERENTIAL
68. BOLT/SCREW, PINION GEAR SHAFT
69. WASHER, LOCK
70. GEAR, RING DIFFERENTIAL
71. GEAR, SPEEDO OUTPUT (MECHANICAL)
72. GEAR, SPEEDO OUTPUT (ELECTRONIC)
73. SHIM, DIFFERENTIAL (SELECTIVE)
74. BEARING ASSEMBLY, DIFFERENTIAL
75. BEARING, DIFFERENTIAL
76. RACE, BEARING DIFFERENTIAL
77. BOLT/SCREW, DIFFERENTIAL RING (10)
78. PIN (TWO)
79. PLUG, OIL DRAIN
80. WASHER
81. BOLT/SCREW, TRANSMISSION CASE, M8 X 1.25.50 (15)
82. WASHER
83. PLUG
85. CASE, TRANSMISSION
86. BEARING, OUTPUT GEAR
87. SHIM, OUTPUT GEAR (SELECTIVE)
88. RETAINER, OUTPUT GEAR BEARING
90. END PLATE, TRANSMISSION CASE
91. BOLT/SCREW, M8 X 1 X 18 (9)
92. RETAINER, INPUT GEAR BEARING
93. BEARING, INPUT GEAR
94. BOLT/SCREW, REVERSE IDLER, M8 X 1.25.50
95. BUSHING, DETENT LEVER
96. BUSHING, SLIDING SLEEVE
97. BEARING, NEEDLE SHIFT SHAFT
98. BUSHING, REVERSE RAIL
99. BUSHING, SHIFT RAIL (THREE)
100. WASHER, FLUID LEVEL INDICATOR
101. FLUID LEVEL INDICATOR
102. SHAFT, REVERSE IDLER
103. GEAR, REVERSE IDLER
104. RAIL, REVERSE SHIFT IDLER GEAR
105. BRACKET ASSEMBLY, REVERSE IDLER GEAR
106. BALL, BRACKET REVERSE IDLER GEAR
107. SPRING, BRACKET REVERSE IDLER GEAR
108. SLEEVE, DETENT BRACKET REVERSE IDLER GEAR
109. BRACKET, REVERSE IDLER GEAR
110. INDICATOR ASSEMBLY, TRANSMISSION FLUID LEVEL

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Figure 1(L)

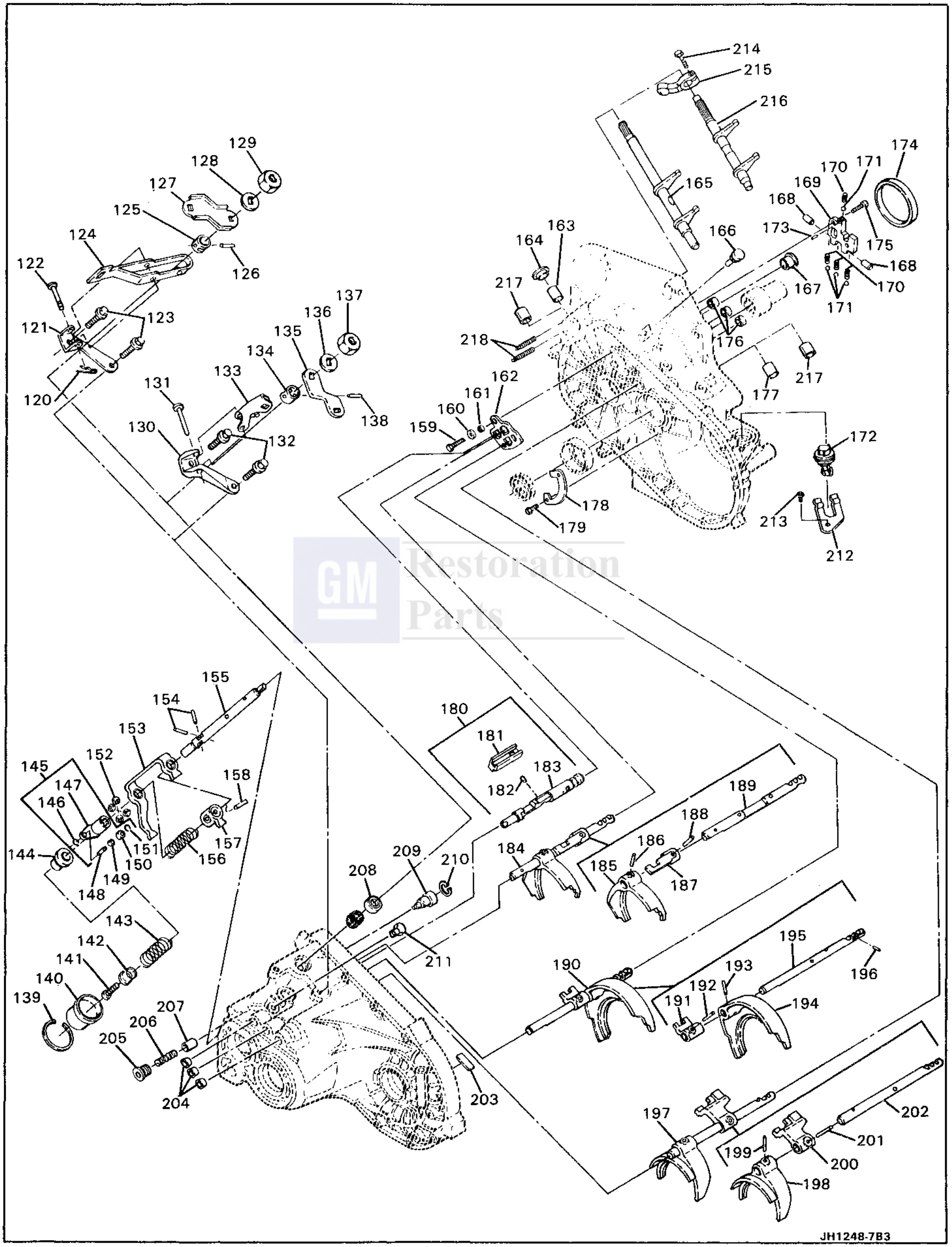

Figure 2 Disassembled View - Shift Mechanism Group

MUNCIE 282 (5-SPEED) TRANSAXLE SHIFT MECHANISM GROUP

120. RETAINER, SELECTOR PIN
121. RETAINER, SELECTOR LEVER
122. PIN, SELECTOR LEVER PIVOT
123. BOLT/SCREW, M8 X 1.25 X 20 (TWO)
124. LEVER, SELECTOR
125. COLLAR, SHIFT SHAFT
126. PIN, SPRING
127. LEVER, SHIFT
128. WASHER
129. NUT, M14 X 2
130. RETAINER, SELECTOR LEVER
131. PIN, SELECTOR LEVER PIVOT
132. BOLT/SCREW, M8 X 1.25 X 20 (TWO)
133. LEVER, SELECTOR
134. COLLAR, SHIFT SHAFT
135. LEVER, SHIFT
136. WASHER
137. NUT, M14 X 2
138. PIN, SPRING
139. SNAP RING
140. COVER, SHIFT SHAFT
141. BOLT/SCREW, M20 X 1.5
142. SEAT, SPRING 5TH DETENT OUTER
143. SPRING
144. SEAT, SPRING 5TH DETENT INNER
145. LEVER, DETENT ASSEMBLY
146. RETAINER, PIN DETENT
147. LEVER, DETENT
148. PIN, DETENT LEVER
149. SPACER, DETENT LEVER
150. ROLLER, DETENT LEVER
151. RETAINER, PIN DETENT
152. ROLLER, DETENT (FOUR)
153. LEVER, REVERSE
154. PIN, DETENT LEVER ROLLERS (TWO)
155. SHAFT, SHIFT
156. SPRING, 3RD/4TH BIAS
157. LEVER, SHIFT
158. PIN, ROLL
159. BOLT/SCREW, M6 X 1 X 12 (THREE)
160. WASHER, FLAT (THREE)
161. SPACER (THREE)
162. PLATE, SHIFT INTERLOCK
163. BUSHING, OUTER CLUTCH FORK
164. SEAL, CLUTCH FORK
165. SHAFT, CLUTCH FORK
166. BREATHER ASSEMBLY
167. BUSHING, REVERSE SHIFT RAIL
168. PIN, INTERLOCK (TWO)
169. HOLDER, DETENT
170. SPRING, DETENT (FOUR)
171. BALL, DETENT (FOUR)
172. SPEEDO SIGNAL ASSEMBLY
173. PIN, SPRING
174. COVER, DETENT HOLDER
175. BOLT/SCREW, M6 X 1 X 30 (TWO)
176. BUSHINGS, SHIFT RAIL (THREE)
177. BUSHING, INNER CLUTCH FORK
178. RETAINER, OUTPUT BEARING RACE
179. BOLT/SCREW, M6 X 1 X 12 (TWO)
180. RAIL, REVERSE SHIFT ASSEMBLY
181. SHIFT GATE, 5TH/REVERSE
182. ROLLER, GEAR DISENGAGE
183. SHAFT, REVERSE SHIFT
184. RAIL, 3RD/4TH SHIFT ASSEMBLY
185. FORK, 3RD/4TH SHIFT SHAFT
186. PIN, FORK RETAINER
187. LEVER, 3RD/4TH SELECT
188. PIN, LEVER RETAINER
189. SHAFT, 3RD/4TH SHIFT
190. RAIL, 1ST/2ND SHIFT ASSEMBLY
191. LEVER, 1ST/2ND SELECT
192. PIN, LEVER RETAINER
193. PIN, FORK RETAINER
194. FORK, 1ST/2ND SHIFT
195. SHAFT, 1ST/2ND SHIFT
196. PIN, LOCK
197. RAIL, 5TH SHIFT ASSEMBLY
198. FORK, 5TH SHIFT
199. PIN, FORK RETAINER
200. LEVER, 5TH SHIFT
201. PIN, LEVER RETAINER
202. SHAFT, 5TH SHIFT
203. MAGNET, CHIP COLLECTOR
204. PLUG, SHIFT RAIL (THREE)
205. BOLT/SCREW, M2 X 1.5
206. SPRING, SLIDING SLEEVE
207. SLEEVE, SLIDING
208. SEAL, SHIFT SHAFT
209. PLUG
210. SNAP RING
211. STUD
212. SPEEDO SIGNAL ASSEMBLY, RETAINER
213. BOLT
214. BOLT
215. LEVER, CLUTCH RELEASE
216. SHAFT, CLUTCH FORK
217. BEARING, CLUTCH SHAFT (TWO)
218. STUD, CLUTCH CYLINDER (TWO)

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Figure 2(L)

DIAGNOSIS

Before attempting to repair the clutch, transaxle or related linkages for any reason other than an obvious condition, the condition and probable cause should be identified. Clutch and manual transaxle troubles are manifested by shifting difficulties such as high shift effort, gear clash and grinding or blockout. When any of these conditions occur, a careful analysis should be done, and the following checks and adjustments made before disassembling the clutch or transaxle for repairs.

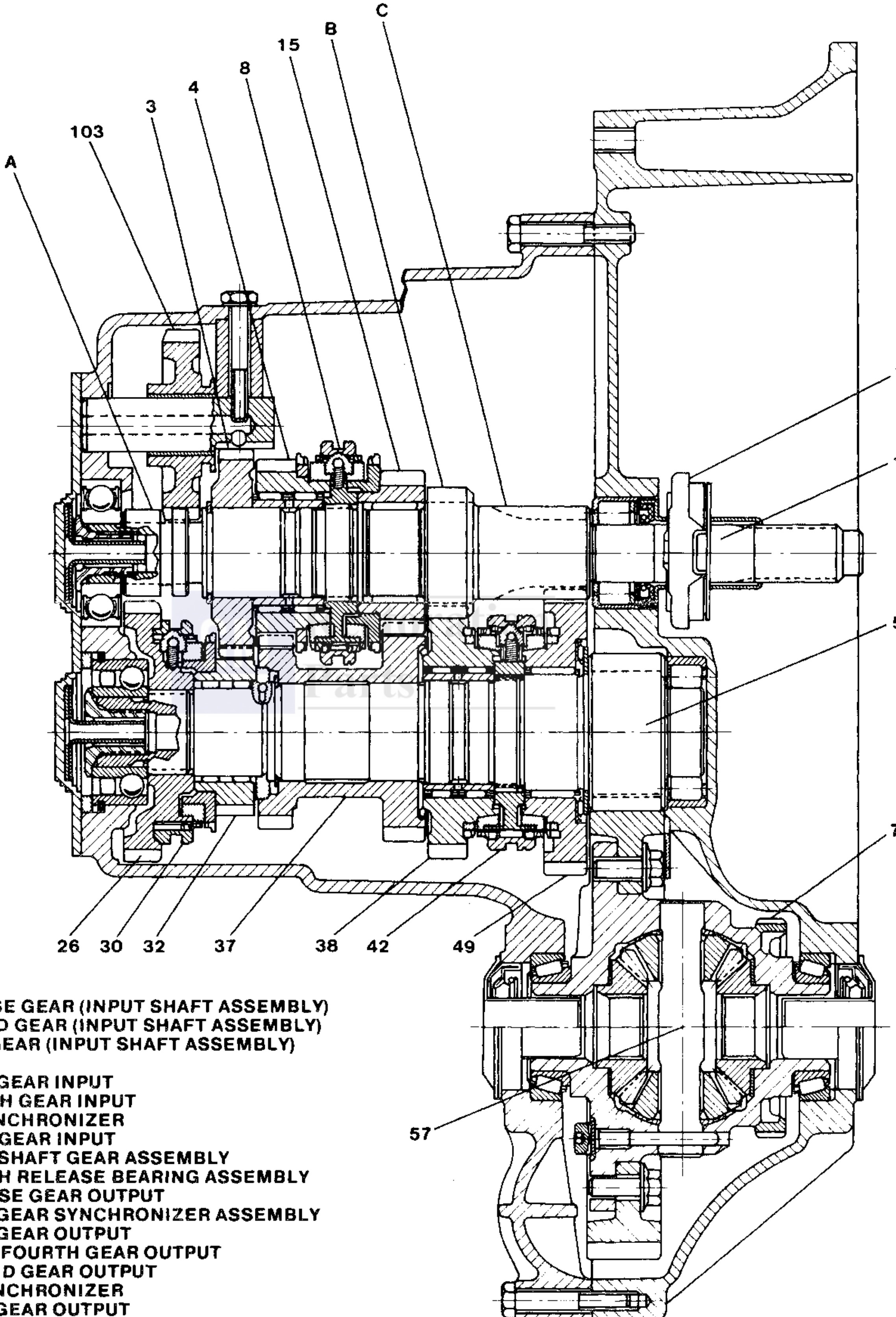
ISOLATE NOISE

Many noises believed to be coming from the transaxle may actually originate at other sources, such as tires, road surfaces, wheel bearings, the engine, or exhaust system. These noises may vary by car size, type and amount of body insulation used.

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 car far enough to thoroughly warm up all lubricants.
3. Record speed at which noise occurs and gear range the transaxle 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 the above.
6. After road testing the car, refer to the DIAGNOSIS CHART.



A. REVERSE GEAR (INPUT SHAFT ASSEMBLY)
B. SECOND GEAR (INPUT SHAFT ASSEMBLY)
C. FIRST GEAR (INPUT SHAFT ASSEMBLY)

3. FIFTH GEAR INPUT
4. FOURTH GEAR INPUT
8. 3-4 SYNCHRONIZER
15. THIRD GEAR INPUT
17. INPUT SHAFT GEAR ASSEMBLY
22. CLUTCH RELEASE BEARING ASSEMBLY
26. REVERSE GEAR OUTPUT
30. FIFTH GEAR SYNCHRONIZER ASSEMBLY
32. FIFTH GEAR OUTPUT
37. THIRD/FOURTH GEAR OUTPUT
38. SECOND GEAR OUTPUT
42. 1-2 SYNCHRONIZER
49. FIRST GEAR OUTPUT
53. OUTPUT SHAFT GEAR ASSEMBLY
57. DIFFERENTIAL GEAR ASSEMBLY
71. SPEEDOMETER DRIVE GEAR
103. REVERSE IDLER GEAR

GX1005-7B3

Figure 3 Cross Section View - Muncie 282 (5-Speed) Transaxle

Bearing Noise

Differential **side bearing** noise can easily be confused with wheel bearing noise. Since side bearings are preloaded, the noise should not diminish much when the differential (transaxle is run with the wheels off the ground.

Wheel bearings produce a rough growl or grating sound. This sound will continue when the vehicle is coasting and the transaxle is in Neutral. Since these bearings are not preloaded, the noise should diminish considerably when the wheels are off the ground.

Brinelling

A brinelled bearing causes a "knock" or "click" approximately every two revolutions of the wheel because the bearing rollers do not travel at the same speed as the wheel.

Brinelling is caused by excessive thrust which pushes the balls up on the pathway and creates a triangular shaped dent or "Brinell" spot. Brinnelling can also be caused by pressing the ring on a shaft or in a housing through the other ring.

False brinnell occurs as a result of vibration outside of the area where the bearing is mounted. The condition is identified by slight brinell marks giving a washboard effect in the ring. In operation, the effect is characterized by excessively noisy operation on a low note.

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.

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. Pre-loading of regular type taper roller bearings, higher than specified, can also cause locking of bearings.

Pitting

Pitting is a result of normal wear. This shows itself in the form of pitting on the rolling surface. Pitting may also result from some installation or operational conditions, such as indenting from foreign material.

Spalling

Spalling is caused by overload or incorrect assembly. Spalled bearings have either flaked or pitted rollers or races. Incorrect assembly consists of misalignment, cocking of bearings, or adjustments that are too tight.

DIAGNOSIS CHART

CONDITION	PROBABLE CAUSE
A knock at low speeds.	a. Worn drive axle CV or TRI-Pot 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 drive axle inboard TRI-POT joints. c. Worn differential pinion shaft in case. d. Side gear hub counterbore in case worn oversize.
Clicking noise in turns.	Worn outboard CV joint.
Vibration	a. Rough wheel bearing. b. Bent drive axle shaft. c. Out of round tires. d. Tire unbalance. e. Worn CV joint in drive axle shaft. f. Incorrect drive axle angle. (Trim Height)
Noisy in Neutral with Engine Running	a. Worn input gear bearings. b. Worn clutch release bearing.
Noisy in First Only	a. Chipped, scored, or worn first-speed constant-mesh gears. b. Worn 1-2 synchronizer.

Noisy in Second Only	a. Chipped, scored, or worn second speed constant-mesh gears. b. Worn 1-2 synchronizer.
Noisy in Third Only	a. Chipped, scored, or worn third-gear constant-mesh gears. b. Worn 3-4 synchronizer.
Noisy in Fourth Only	a. Worn 3-4 gear synchronizer. b. Chipped, scored, or worn fourth-gear or output gear.
Noisy in Fifth Gear Only	a. Worn 5th gear synchronizer. b. Chipped, scored, or worn fifth-speed gear or output gear.
Noisy in Reverse Only	a. Chipped, scored, or worn reverse idler gear, idler gear bushing, input or output gear(s).
Noisy in All Gears	a. Insufficient lubricant. b. Worn bearings. c. Chipped, scored, or worn input gear (shaft) and/or output gear (shaft).
Slips out of Gear	a. Worn or improperly adjusted linkage. b. Shift linkage does not work freely; binds. c. Bent or worn cables. d. Input gear bearing retainer broken or loose. e. Worn or bent shift fork.
Leaks Lubricant	a. Fluid level indicator not seated in fill port, causing fluid leakage at vent plug. b. Worn axle shaft seals. c. Excessive amount of lubricant in transaxle. d. Loose or broken input gear (shaft) bearing retainer. e. Worn input gear bearing and/or lip seal damaged. f. Worn shift lever seal leaks. g. Lack of sealant between case and clutch cover or loose clutch cover.

MAINTENANCE AND ADJUSTMENT

CHECKING TRANSAXLE MOUNTS

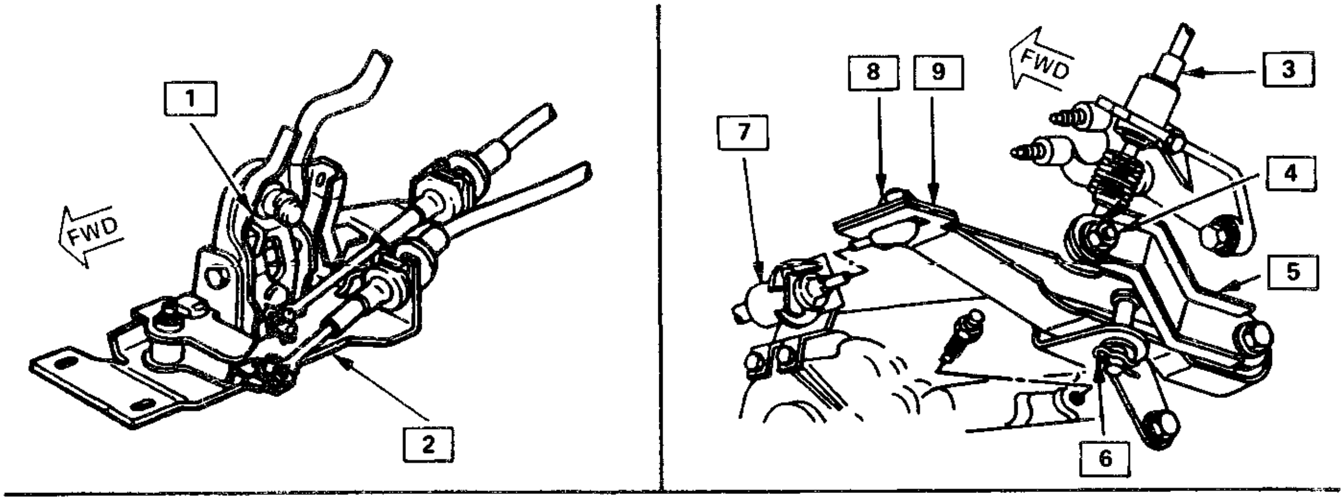
Raise the vehicle on a hoist. Push up and pull down on the transaxle while observing the mounts. If the rubber separates from the metal plate of the mount or if the case moves up but not down (mount bottomed out) replace the mount. If there is relative movement between a metal plate of the mount and its attaching point, tighten the screws or nuts attaching the mount to the case or crossmember.

CABLE ADJUSTMENT PROCEDURE

Only the shift cable is adjustable and it is adjusted at the transaxle. Do not adjust the select cable.

Adjust

1. Loosen nut on transaxle shift lever ball stud on shift cable only.
2. Place transaxle in third gear.
3. Screw and shift knob.
4. Front trimplate, see Section 8C.
5. Shifter trimplate.
6. Pin floor shift mechanism in third gear.
7. Tighten nut 25 N•m (18 lb. ft.) on shift cable ball stud.
8. Install trim plates and shift knob.



1—ALIGNMENT PIN
2—TRANSAXLE CONTROLS
3—SHIFT CABLE
4—NUT
5—LEVER
6—LOCKING PIN
7—SELECT CABLE
8—NUT
9—LEVER

Figure 4 Cable Adjustment at Transaxle

CHECKING FLUID LEVEL

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 dipstick and read level indicated. When the dipstick indicates H, (hot) is full when the transaxle is warm. If the dipstick indicates ADD or below, add fluid. Syncromesh Transmission Fluid (12345349) or equivalent lubricant to fill transaxle. Be sure the fluid level is between the H (hot) and C (cold) marks on the dipstick.

ON-VEHICLE SERVICE

TRANSMISSION SHIFT CABLES

Remove or Disconnect

1. Negative battery cable.
2. Screw and shift knob.
3. Front trim plate, see Section 8C.
4. Shifter trim plate.
5. Rear console pad assembly.
6. E.C.M., see Section 6E2.
7. E.C.M. electrical connections.
8. Front carrier to I.P. reinforcement, see Section 8C.
9. Carrier reinforcement.
10. Carpet clips and rivets at console.
11. Heater control.
12. Radio, see Section 9A.
13. Carrier assembly. see Section 8C.
14. Shift and select cable nuts from cable ball studs and transaxle brackets.
15. Release rubber grommet on cable from body.
16. Bolt and retainer securing shift cable to transaxle.
17. Retainers from select and shift cable.
18. Pull cables through body into passenger compartment.

Install or Connect

1. Guide cable from passenger side through body into engine compartment.
2. Select cable with retainer.
3. Shift cable to retainer with bolt 25 N•m (18 lb. ft.).
4. Rubber grommet on cable and body.
5. Shift and select cables with nuts 25 N•m (18 lb. ft.) on cable studs to transaxle brackets.
6. Carrier assembly, see Section 8C.
7. Radio, see Section 9A.
8. Heater control, see Section 8C.
9. Carpet clips and rivets at console.
10. Carrier reinforcements.

11. Front carrier to I.P. reinforcement.
12. E.C.M. electrical connection, see Section 6E2.
13. E.C.M.
14. Rear console pad assembly, see Section 8C.
15. Shifter trimplate.
16. Front trimplate.
17. Shift knob and screw.
18. Negative battery cable.

SHIFTER ASSEMBLY

Remove or Disconnect

1. Steps 1 thru 14 as outlined in shaft cable and select cable removal procedure.
2. Mark location of shifter assembly for installation.
3. Shifter assembly nuts.
4. Shifter assembly from studs.

Install or Connect

1. Shifter assembly on four studs with nuts 24 N•m (17 lb. ft.).
2. Shift and select cables on shifter assembly with retainers.
3. Steps 6-16 as outlined in shift and select cables in installation procedures.

SHIFT AND SELECT CABLES

Remove or Disconnect

1. Retainers from cable ends securing cables to shifter assembly.
2. Bolt and retainer fastening shift cable at transaxle.
3. Retainer from select cable.
4. Shift and select cables nuts from cable ball studs at transaxle brackets.
5. Remove rubber grommet on cables from body.

Install or Connect

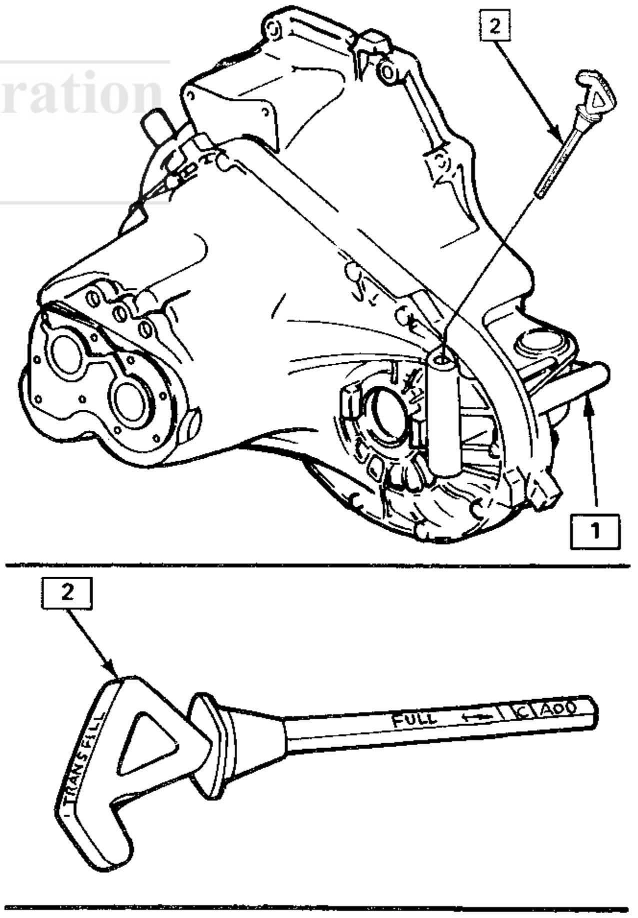
1. Cables from passenger side through body into engine compartment.
2. Rubber grommet on cables to body.
3. Shift and select cable nuts 25 N•m (18 lb. ft.) on cable studs through transaxle brackets.
4. Retainer on select cable.
5. Bolt 25 N•m (18 lb. ft.) and retainer fastening shift cable to transaxle.
6. Secure shift and select cables on shifter assembly with retainers.

TRANSAXLE SHIFT LEVERS AND BRACKETS

Figure 9

Remove or Disconnect

1. Select and shift cable nuts from cable studs.
2. Retainer from select cable.
3. Bolt and retainer from shift cable.
4. Bolt (1) and bracket (2) from select cable.
5. Nut (3) and washer (4) from manual shaft (5).
6. Shift cable lever (6) from manual shaft (5).
7. Pin (7) from collar (8) and select cable lever (11).
8. Collar (8) from manual shaft (5).
9. Pin (9) and retainer (10) from select cable lever (11).
10. Select cable lever (11).
11. Bolt (13) from bracket (12) and transaxle (14).



1–TRANSAXLE

2–FLUID LEVEL INDICATOR

J10005-7B3-A

Figure 5 Transaxle Dipstick

Install or Connect

1. Bolt 23 N•m (17 lb. ft.) (13) through bracket (12) to transaxle (14).
2. Select cable lever (11) on bracket (12).
3. Pin (9) through select cable lever (11) and bracket (12) secured with retainer (10).
4. Collar (8) over manual shaft (5) with pin (7) to select cable lever (11).
5. Shift cable lever (6) on manual shaft (5) with washer (4) and nut (3) 83 N•m (61 lb. ft.).

Important

Do not allow manual shaft (5) to move while torquing nut (3). Internal damage can occur.

6. Bracket (2) with bolt (1) 25 N•m (18 lb. ft.) to transaxle (14).
7. Retainer to select cable.
8. Bolt 25 N•m (18 lb. ft.) and retainer securing shift cable to transaxle (14).
9. Select and shift cable nuts 27 N•m (20 lb. ft.).

MANUAL TRANSAXLE

Remove or Disconnect

1. Drain plug and drain transaxle.
2. Select and shift cables nuts securing cables to transaxle brackets.
3. Back-up light switch wire and switch.
4. Shift cables and nut on stud securing bracket to transaxle.
5. Two bolts securing select cable mount.
6. Two bolts attaching clutch slave cylinder bracket.
7. Exhaust crossover pipe, see Section 6A2.
8. Nut, clip and wire from center stud.
9. Three upper bolts and one stud attaching transaxle to engine.
10. Install J 28467-A, J 35563, engine support fixtures. Attach fixture hook to engine lift ring and raise engine enough to take the pressure off the mounts (Figure 7).
11. Front and rear transaxle mounts.

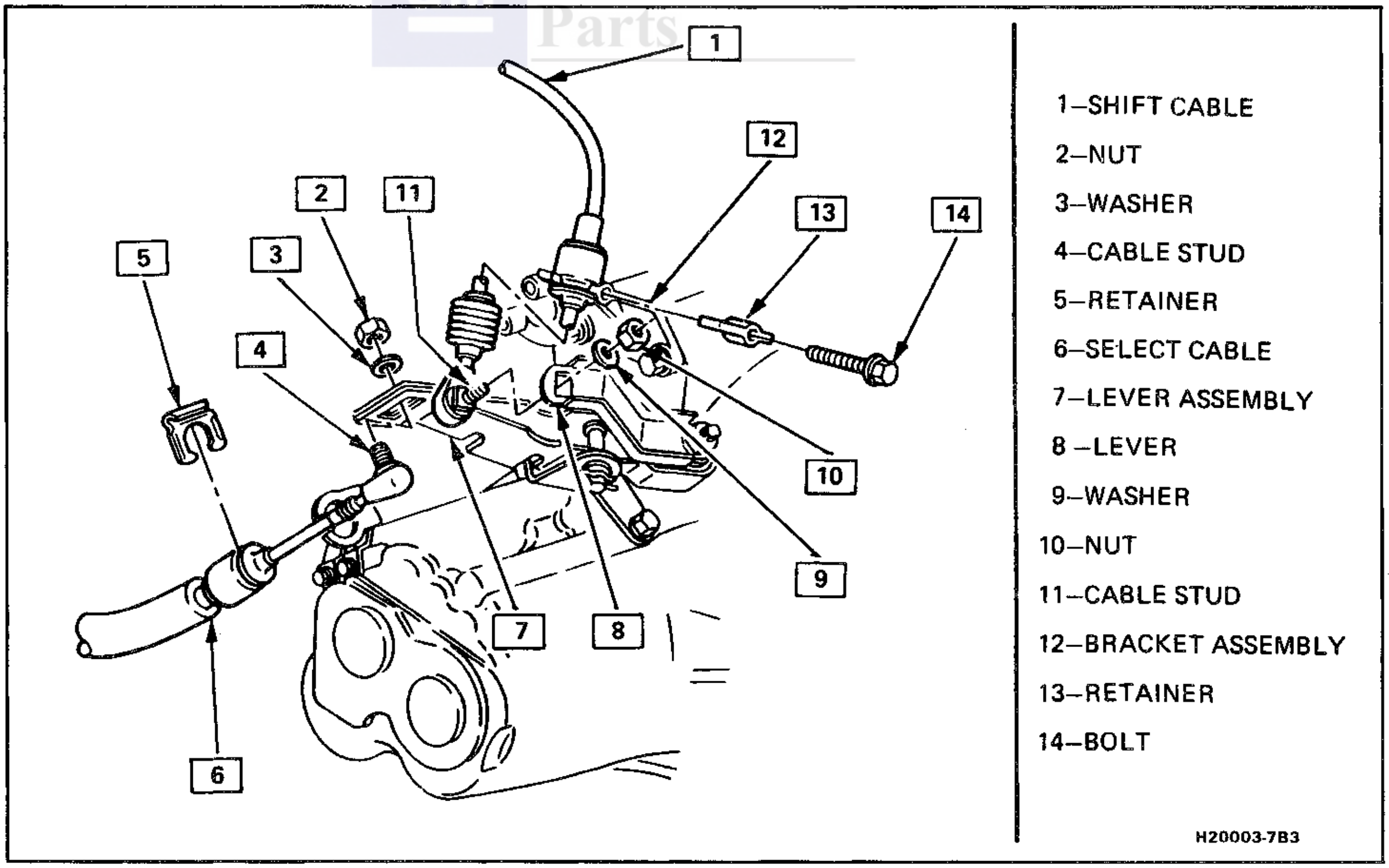


Figure 6 Shift and Select Cable Routing and Attachment at Transaxle

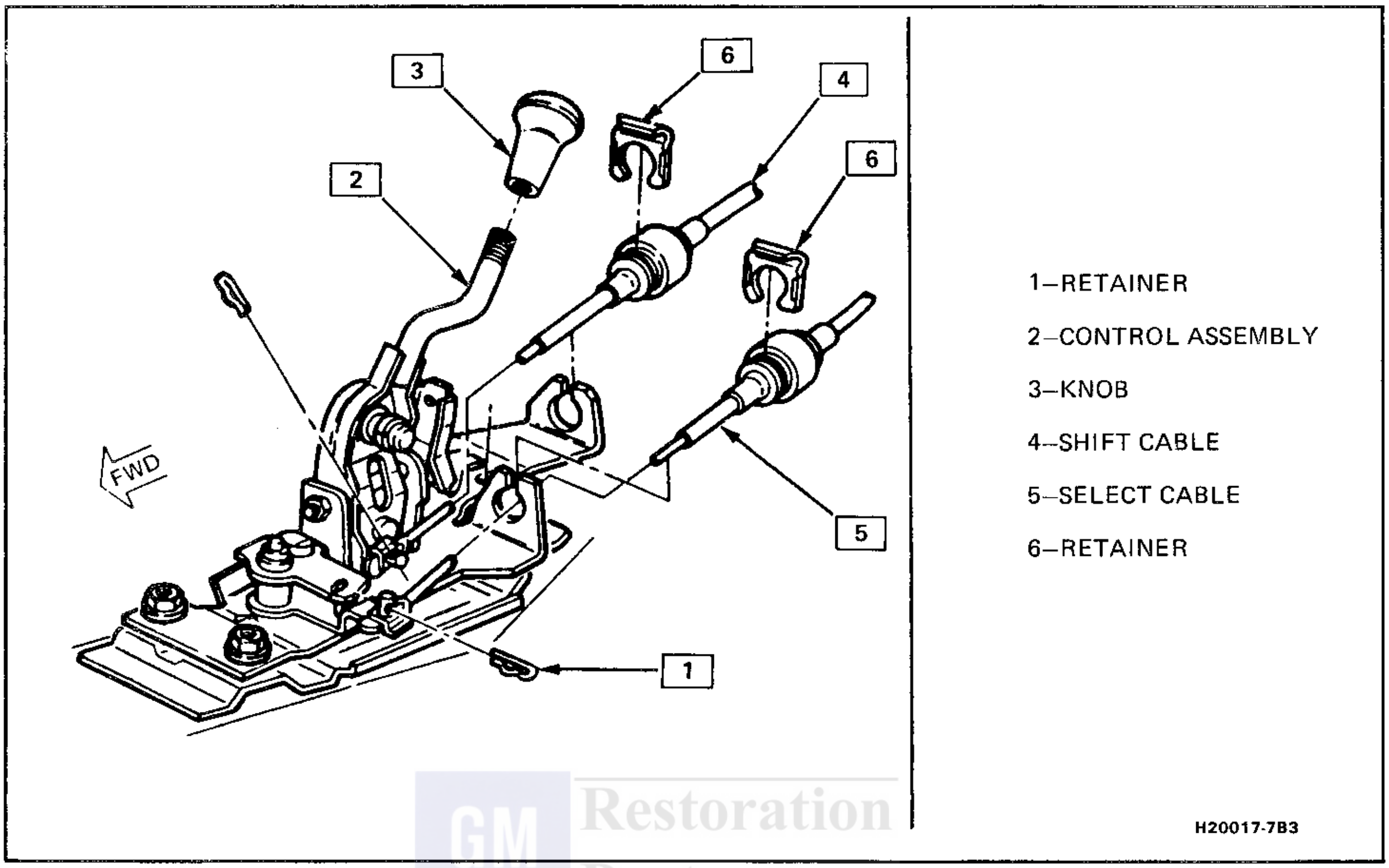


Figure 7 Shift and Select Cable Attachment At Shifter

12. Raise car, see Section 0A.
13. Four clutch inspection plate screws and inspection plate.
14. Lower frame and tilt, see Section 2A.
15. Remove axle shafts, see Section 4D.
16. Two nuts retaining wire harness on two lower studs.
17. Two studs and transaxle from bottom of vehicle, tilt engine down for clearance removal.

Install or Connect

1. Transaxle through bottom and attach engine to transaxle with two studs. Do not torque studs.
2. Raise frame, see Section 2A, and install axle shafts, see Section 4D.
3. Clutch inspection plate and four screws 13 N•m (10 lb. ft.).
4. Front and rear transaxle mounts.
5. Lower car.
6. Lower engine and remove J 28467-A and J 35563.
7. Three upper bolts and one stud 75 N•m (55 lb. ft.). Also torque two lower studs in Step 1.
8. Wire harnesses on two lower and center studs and three nuts 17 N•m (13 lb. ft.).
9. Exhaust crossover pipe, see Section 6A2.

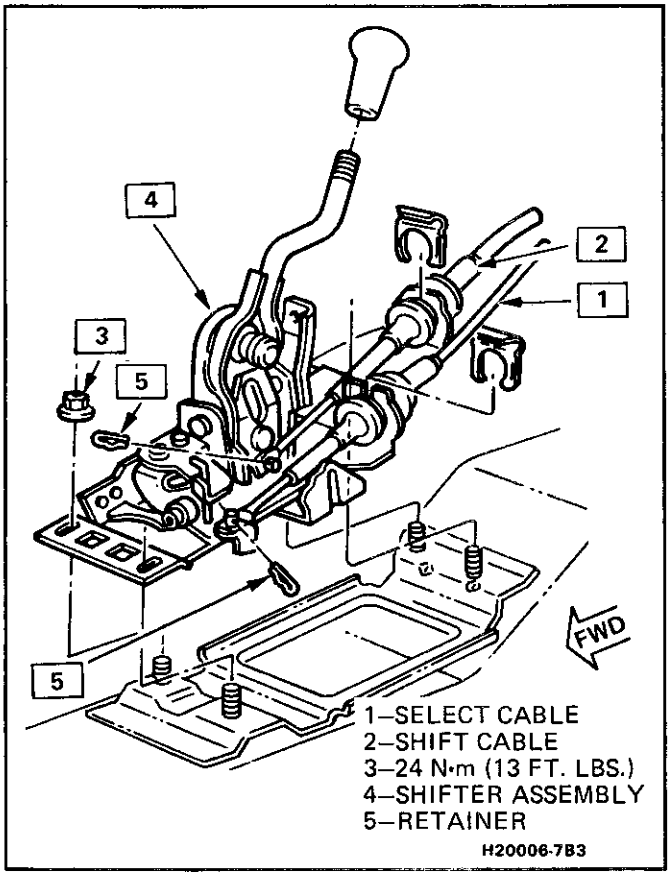


Figure 8 Transaxle Control Assembly

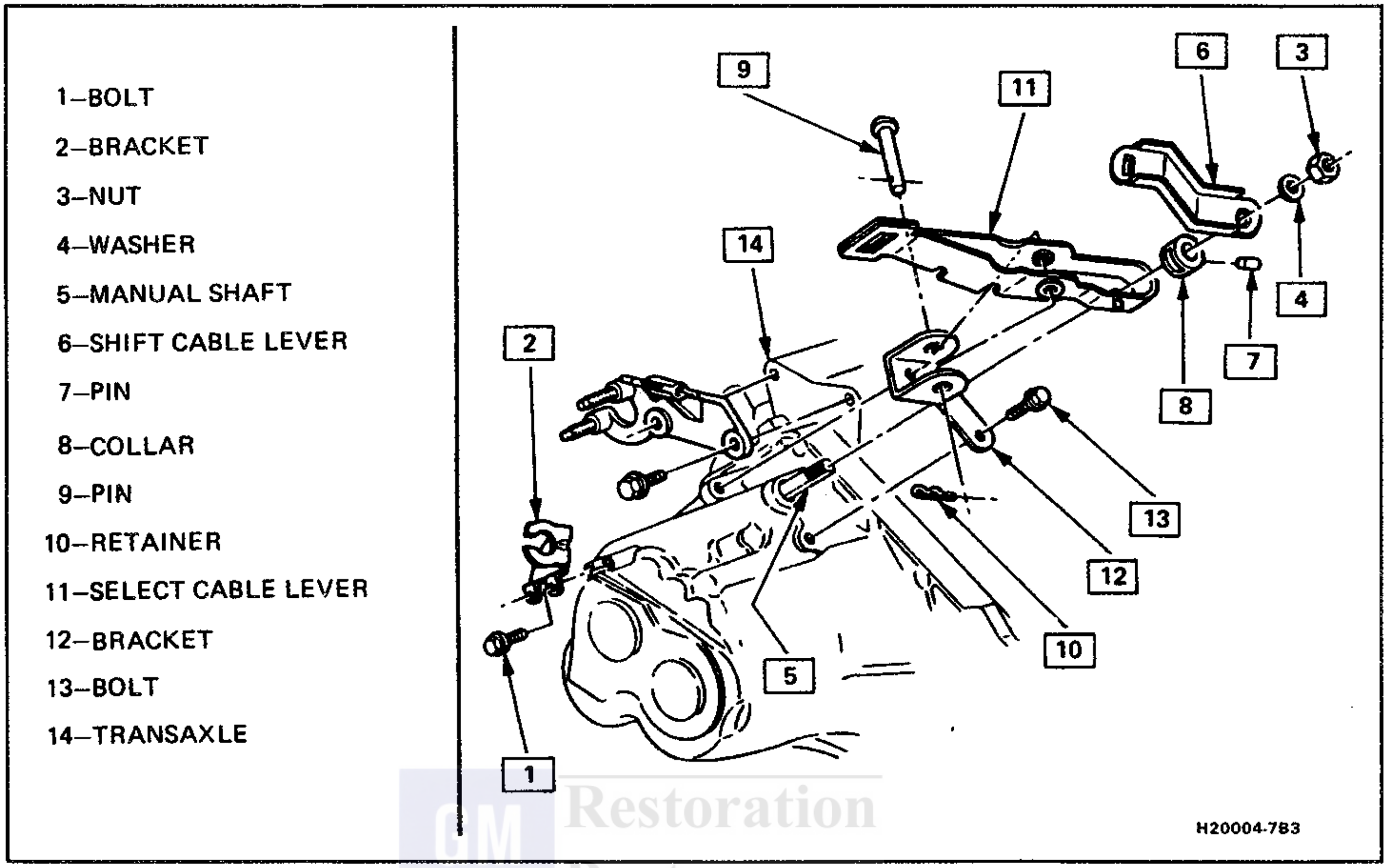


Figure 9 Transaxle Shift Levers and Brackets

10. Two bolts 50 N•m (37 lb. ft.) attaching clutch slave cylinder bracket.
11. Two bolts 10 N•m (89 lb. in.) retaining select cable mount.
12. Select and shift cable to mount on stud with nut 10 N•m (89 lb. in.).
13. Select and shift cables nut 25 N•m (18 lb. ft.).
14. Back-up light switch 34 N•m (25 lb. ft.) and wire.
15. Drain plug 24 N•m (18 lb. ft.).
16. Remove screw and retainer from permanent magnet generator and fill transaxle with Syncromesh Transmission Fluid (12345349) or equivalent. Install retainer and screw 5 N•m (45 lb. in.).

REAR TRANSAXLE MOUNT

↔ Remove or Disconnect

1. Disconnect negative battery cable.
2. Remove two nuts and wire harness from studs attaching lower half of transaxle mount to frame.
3. Install J 28467-A, J 35563, engine support fixture. Attach fixture hook to engine lift ring and raise engine enough to take the pressure off the mount (Figure 7).
4. Four bolts attaching rear transaxle mount to transaxle.
5. Nut from stud connecting upper and lower halves of mount.

→← Install or Connect

1. Nut 48 N•m (35 lb. ft.) connecting upper and lower mount halves.
2. Four bolts attaching rear transaxle mount 55 N•m (41 lb. ft.).
3. Lower engine and remove tools J 28467-A, and J 35563.
4. Two nuts and wire harness 48 N•m (35 lb. ft.) attaching rear transaxle mount to frame.
5. Negative battery cable.

FRONT TRANSAXLE MOUNT

↔ Remove or Disconnect

1. Negative battery cable.
2. Two bolts attaching upper half of transaxle mount.
3. Nut from stud attaching coolant pipe to stud and stud from mount.

4. Install J 28467-A, and J 35563 engine support fixtures. Attach fixture hook to engine lift ring and raise enough to take the pressure off the mounts.
5. Two nuts from studs attaching lower half of mount to frame and remove mount.
6. Nut from stud attaching rear transaxle upper and lower halfs.

Install or Connect

1. Nut on stud 48 N•m (35 lb. ft.) attaching upper and lower halfs of transaxle mount.
2. Upper half of transaxle mount with stud 54 N•m (40 lb. ft.) and coolant pipe over stud.
3. Two bolts and one nut on stud 54 N•m (40 lb. ft.) attaching upper half of transaxle mount to transaxle.
4. Lower engine and remove tools J 28467-A and J 35563.
5. Two nuts on studs 48 N•m (35 lb. ft.) attaching lower half of transaxle mount to frame.
6. Negative battery cable.

AXLE SHAFT SEALS

Remove or Disconnect

1. Axle shaft and inner joint from transaxle, see Section 4D.
2. Pry out and discard axle shaft seal from transaxle.

Install or Connect

1. New axle shaft seal with tool J 26938 and J 8092.
2. Axle shaft and inner joint in transaxle, see Section 4D.

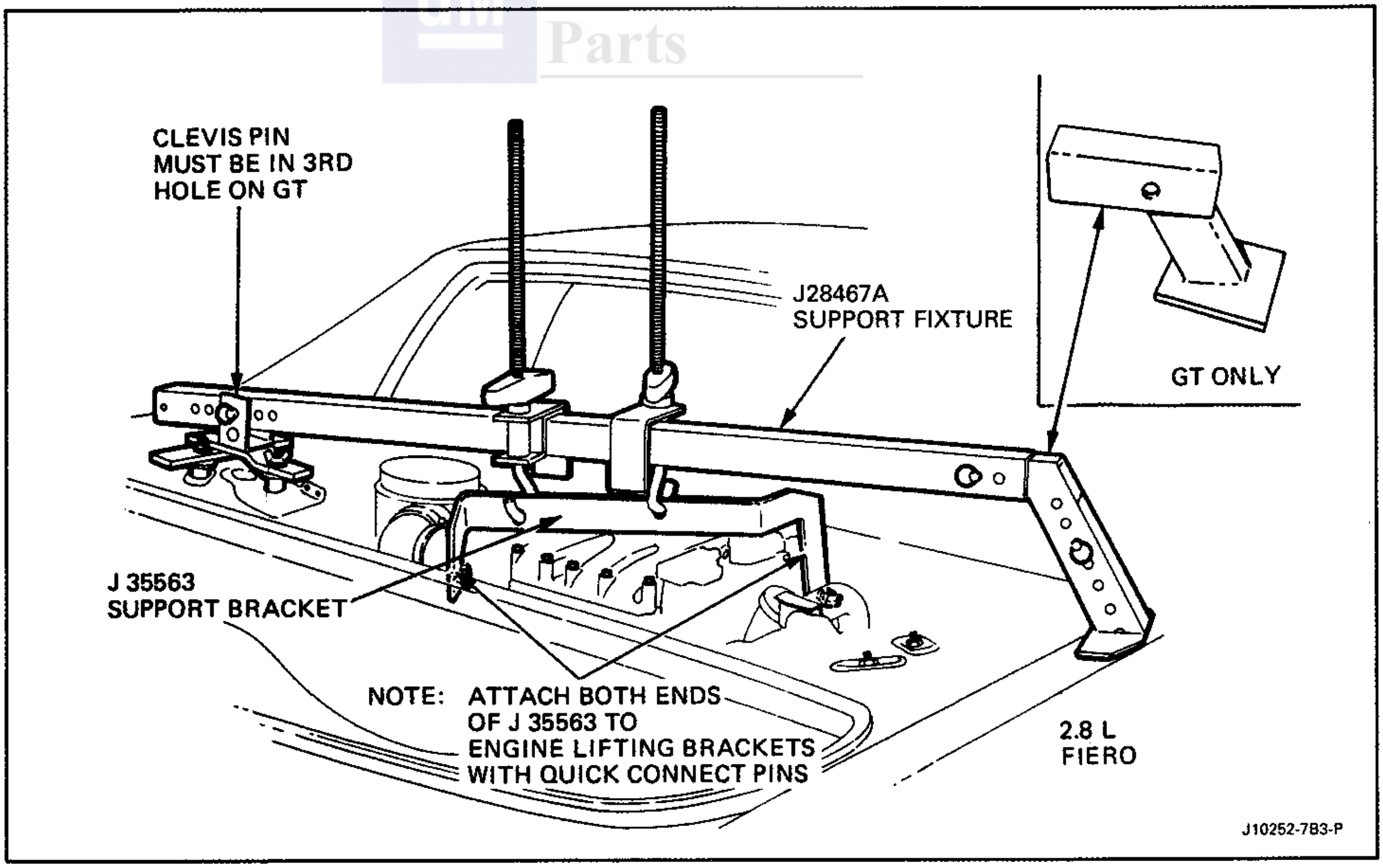


Figure 10 Special Tool Engine Support

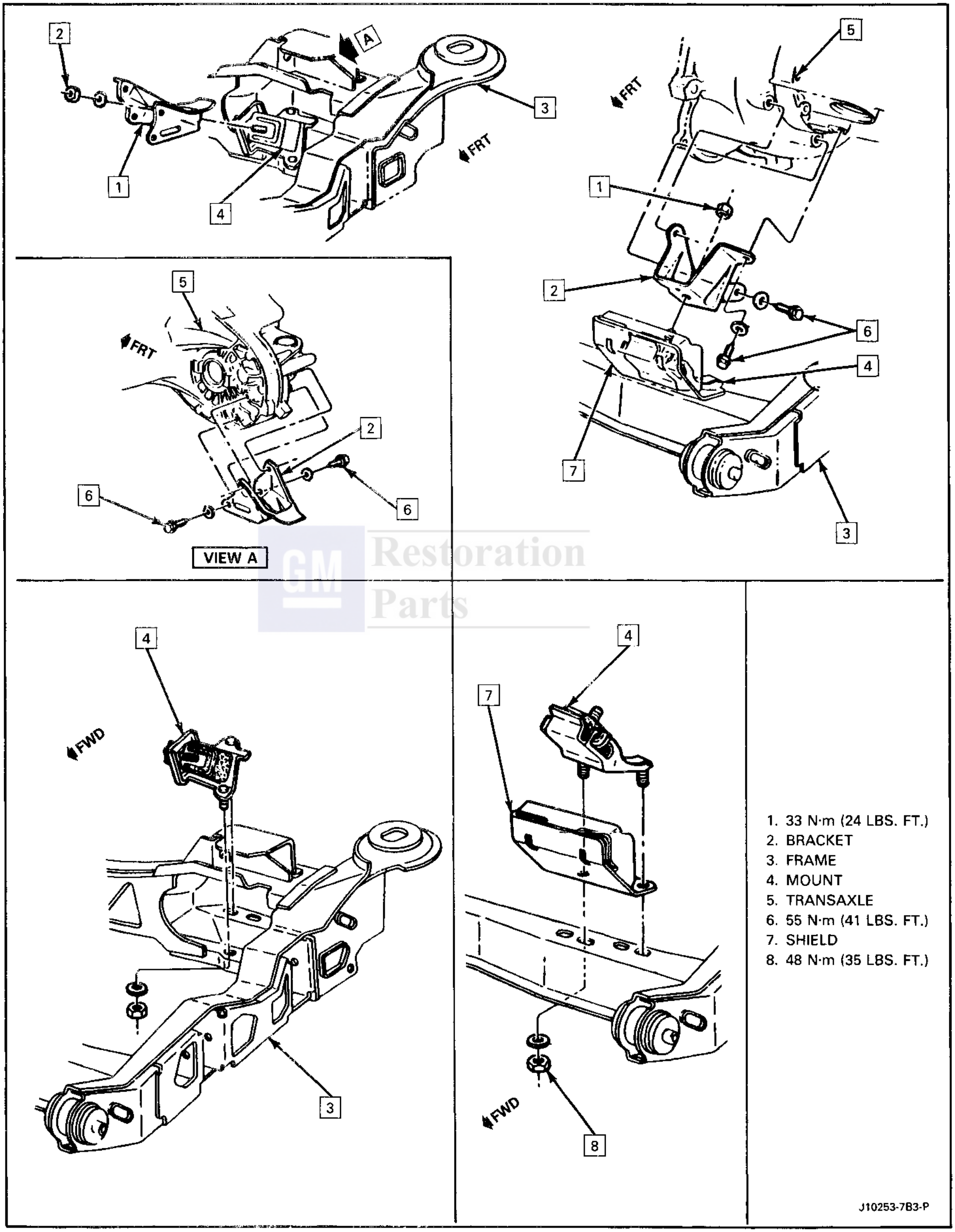
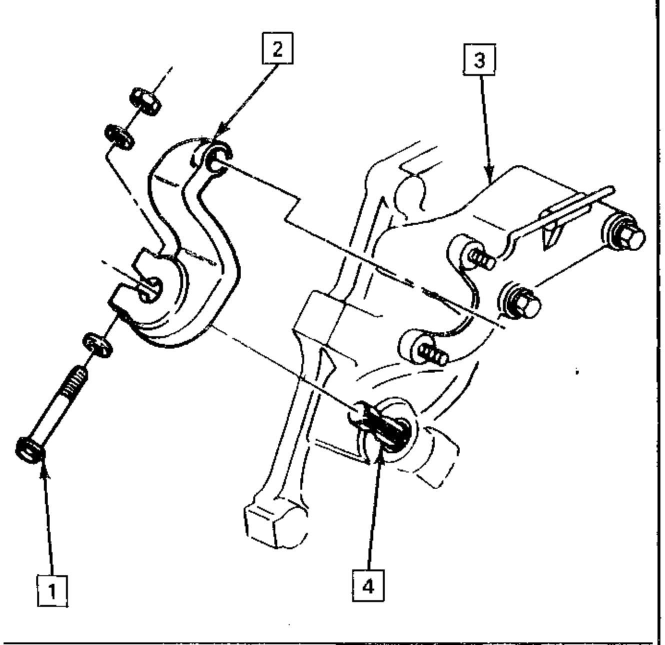


Figure 11 Transaxle Mountings

SHIFT SHAFT SEAL



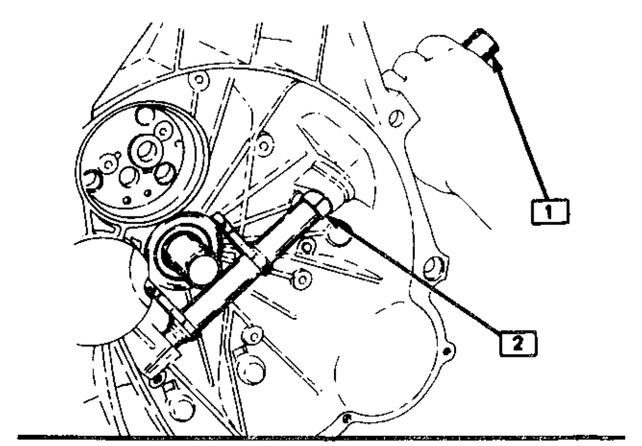
1. 27 N·m (20 LBS. FT.)
2. LEVER
3. TRANSAXLE
4. SHIFT SHAFT AND SEAL

J10254-7B3-P

Figure 12 Shift Shaft Seal

NOTICE: Prior to any vehicle service that requires removal of the clutch lever assembly, the master cylinder pushrod must be disconnected from the clutch pedal. If not disconnected, permanent damage to the slave cylinder will occur if the clutch pedal is depressed while the clutch lever assembly is disconnected.

CLUTCH SHAFT AND/OR BUSHINGS



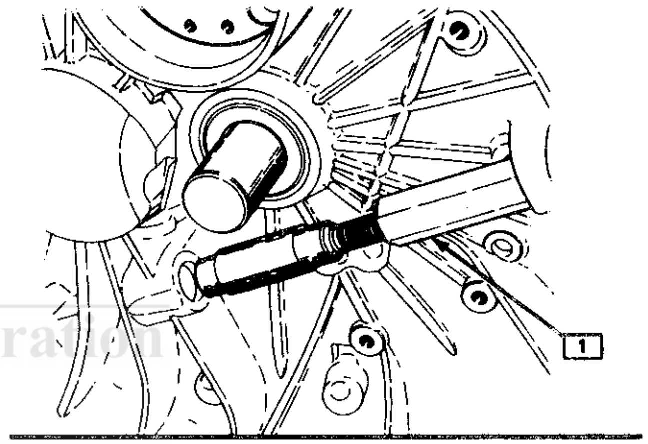
1 J36037
2 UPPER BUSHING

H20024-7B3

Figure 13 Upper Bushing Removal

Remove or Disconnect

1. Transaxle.
2. Clutch Release Lever.
3. Pry out seal.
4. Using J 36037 and a hammer, drive the upper clutch shaft bushing into the housing.
5. Clutch shaft and bushing by sliding shaft out of the case at a slight angle.
6. Lower clutch shaft bushing by using J 36032 in bushing engaging the second step on remover below the bushing. Tighten the screw to expand legs.



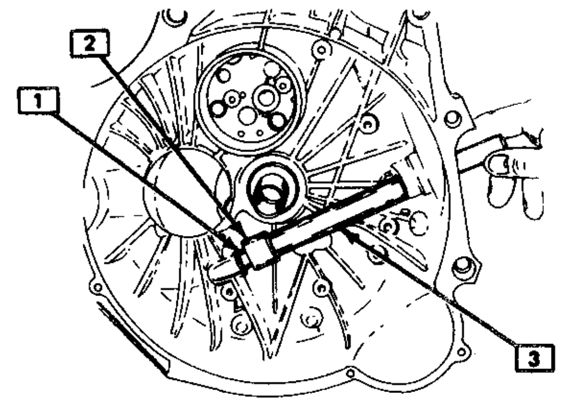
1 J36032

H20025-7B3

Figure 14 Lower Bushing Removal

Install or Connect

1. Lower bushing using J 36033 with J 36190.
2. Clutch shaft.



1 LOWER BUSHING
2 J36033
3 J36190

H20026-7B3

Figure 15 Lower Bushing Installation

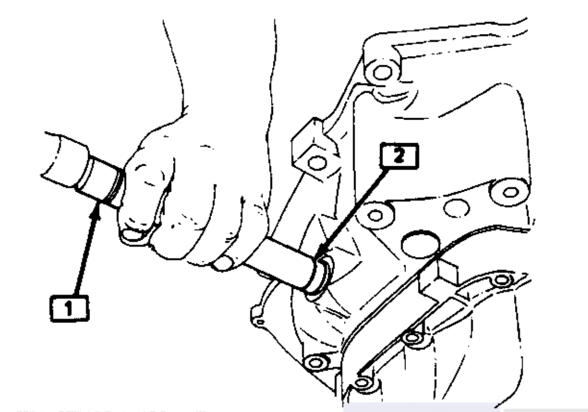
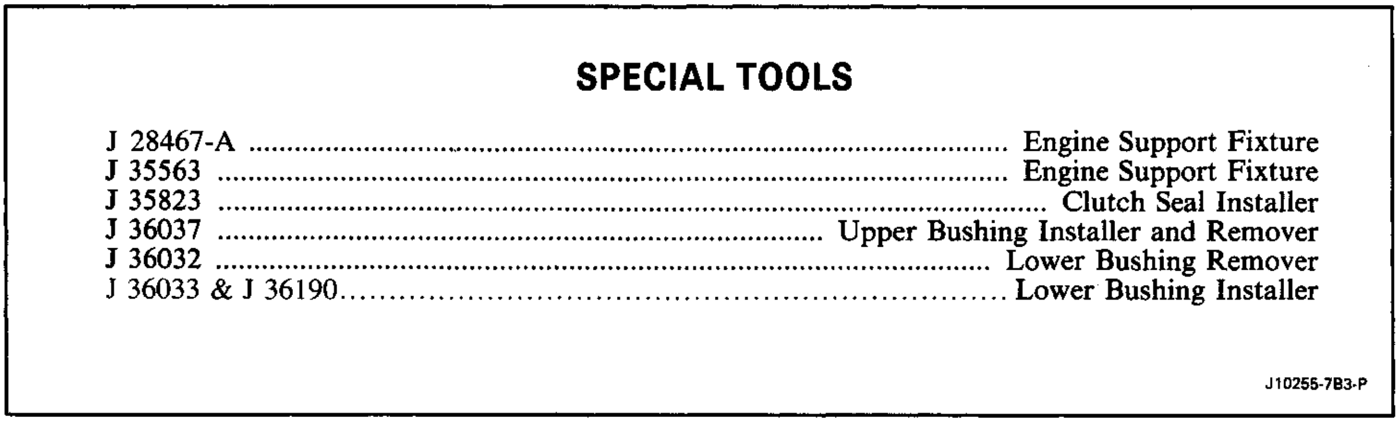


Figure 16 Upper Bushing Installation

3. Slide upper bushing down clutch shaft.
4. Using J 36037 and a hammer, drive bushing into housing until the line on J 36037 is flush with housing surface.
5. Dust seal.
6. Clutch release lever.
7. Transaxle.

SPECIAL TOOLS



SPECIAL TOOLS

J 28467-A	Engine Support Fixture
J 35563	Engine Support Fixture
J 35823	Clutch Seal Installer
J 36037	Upper Bushing Installer and Remover
J 36032	Lower Bushing Remover
J 36033 & J 36190	Lower Bushing Installer

J10255-7B3-P

Special Tools

SECTION 7B3A

MUNCIE 282 FIVE-SPEED MANUAL TRANSAXLE

UNIT REPAIR

RPO'S MG1 AND MG2

CONTENTS

UNIT DISASSEMBLY

Major disassembled views are shown in Section 7B-3, Figures 1 and 2.

EXTERNAL TRANSAXLE MOUNTED LINKAGE REMOVAL

Remove or Disconnect (Figure 1)

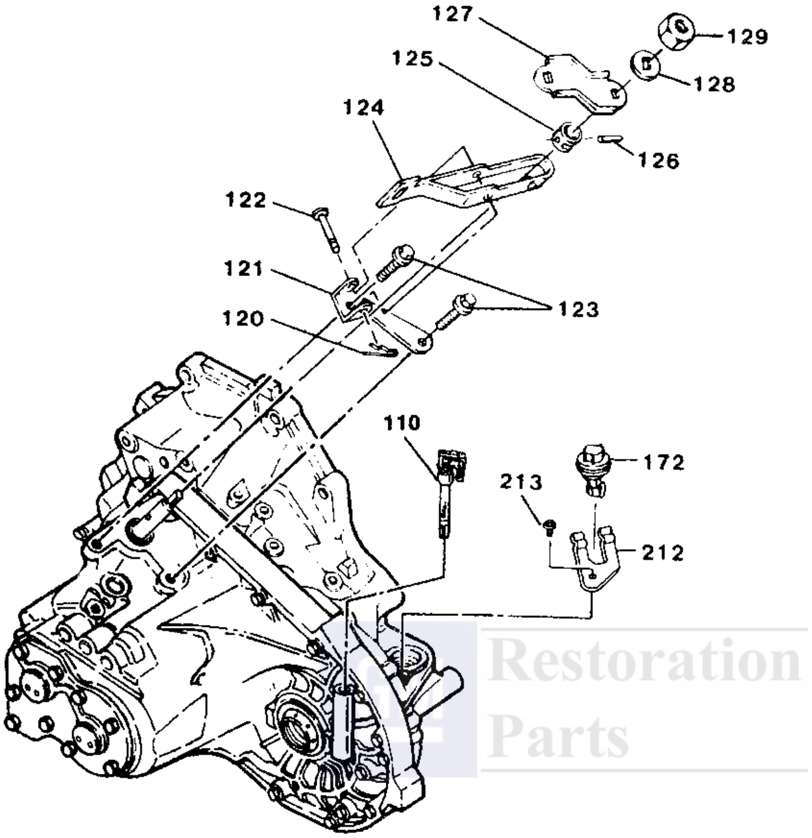
1. Nut (129).
   - DO NOT ALLOW lever (127) to move during removal of nut (129). Use a 3/8-in. drive to hold the external shift lever by the slot.
2. Washer (128).
3. Lever (127).
4. Retainer (120).
5. Pivot pin (122) and pivot (124).
6. Pin (126) and collar (125).
7. Bolts (123).
9. Fluid level indicator assembly (110).
10. Electronic speedo signal assembly (172), retainer (212) and bolt (213).

SHIFT RAIL DETENT/CLUTCH AND DIFFERENTIAL HOUSING

Remove or Disconnect (Figure 2)

1. Bearing (22).
2. Detent holder cover (174).
   - puncture cover in middle and pry off.
3. Bolts (175).
4. Holder, detent (169), springs (170) and interlock pins (168).
5. Balls, detent (171).
6. Bushing (167).

Pry loose (two small pry bars in slots).



110. INDICATOR ASSEMBLY TRANSMISSION FLUID LEVEL
120. RETAINER, SELECTOR PIN
121. RETAINER, SELECTOR LEVER
122. PIN, SELECTOR LEVER PIVOT
123. BOLT/SCREW, M8 X 1.25 X 20 (TWO)
124. LEVER, SELECTOR
125. COLLAR, SHIFT SHAFT
126. PIN, SPRING
127. LEVER, SHIFT
128. WASHER
129. NUT, M14 X 2
172. SPEEDO SIGNAL ASSEMBLY
212. SPEEDO SIGNAL ASSEMBLY, RETAINER
213. BOLT

JH1250-MN5TX

Figure 1 External Transaxle Mounted Linkage

SHIFT SHAFT DETENT/TRANSMISSION HOUSING

Remove or Disconnect (Figure 3)

1. Snap ring (139).
2. Cover (140).
3. Screw (141) and outer spring seat (142).
4. Fifth/Rev. bias spring (143) and inner spring seat (144).

TRANSMISSION CASE AND CLUTCH HOUSING SEPARATION

Remove or Disconnect (Figure 4)

1. Bolts (81).
2. Clutch housing (20).
   - Transaxle must be in neutral.
3. Differential gear assembly (57).
4. Magnet (203).
5. Bearing (55).

SHIFT SHAFT COMPONENTS

Remove or Disconnect (Figures 5 and 6)

1. Pin (158).
   - pin may fall into case.
2. Shift shaft assembly (A).
   - Shaft (155), rollers (152) and pins (154).
   - 1st/2nd bias Spring (156).
   - Shift lever (157).
   - Reverse lever (153).

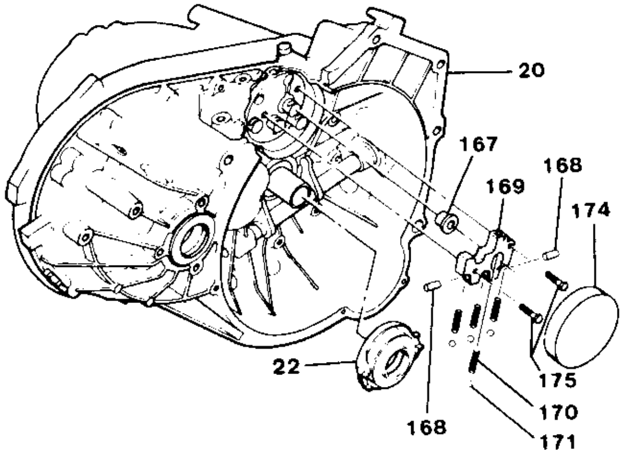
GEAR CLUSTER SUPPORT COMPONENTS

Remove or Disconnect (Figures 7 and 8)

Tool Required:

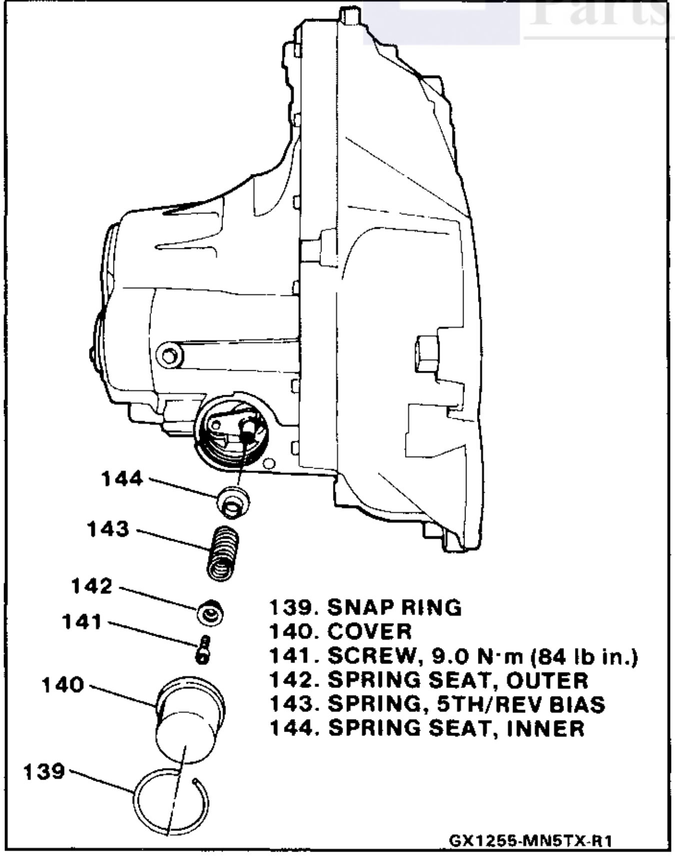
J-36031 Bearing Retainer Bolt Hex Socket or Equivalent

- Engage the gear cluster in Fourth (A) and reverse (B).



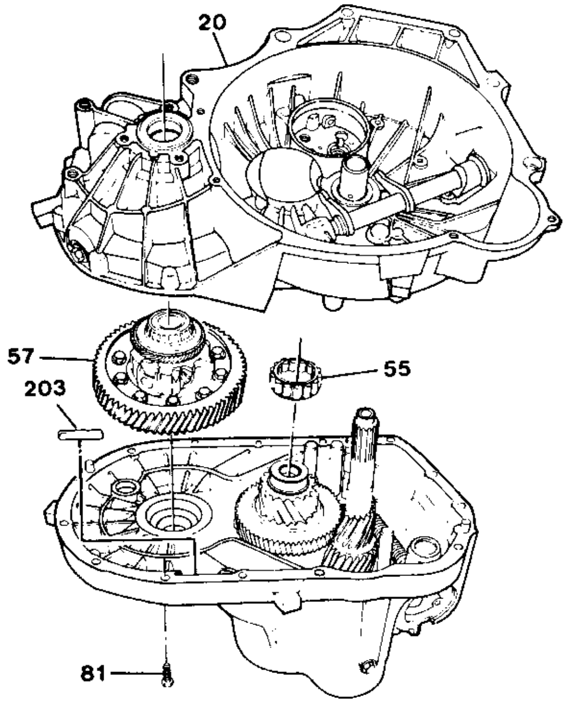
20. HOUSING, CLUTCH AND DIFFERENTIAL
22. BEARING, CLUTCH DISENGAGE
167. BUSHING, REVERSE SHIFT RAIL
168. PIN, INTERLOCK (TWO)
169. HOLDER, DETENT
170. SPRING, DETENT (FOUR)
171. BALL, DETENT (FOUR)
174. COVER, DETENT HOLDER
175. BOLT (TWO), 9 N·m (84 lb in.)

Figure 2 Shift Control Components, Clutch and Differential Housing



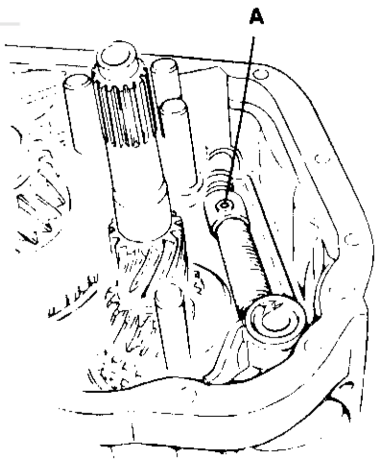
139. SNAP RING
140. COVER
141. SCREW, 9.0 N·m (84 lb in.)
142. SPRING SEAT, OUTER
143. SPRING, 5TH/REV BIAS
144. SPRING SEAT, INNER

Figure 3 Shift Shaft Detent Components/Transmission Housing



20. CASE, CLUTCH AND DIFFERENTIAL
55. BEARING, OUTPUT
57. DIFFERENTIAL ASSEMBLY
81. BOLT (15), 21 N·m (15 lb ft)
203. MAGNET

Figure 4 Clutch and Transmission Housing Components



A. LOCATION OF PIN (158)

Figure 5 Shift Lever Pin Removal

2. Cover (90).
3. Shim (selective) (87).
4. Retainer (88), output gear cluster, using J-36031 or equivalent.
5. Retainer (92), input gear cluster, using J-36031 or equivalent.

- Return transmission to neutral.

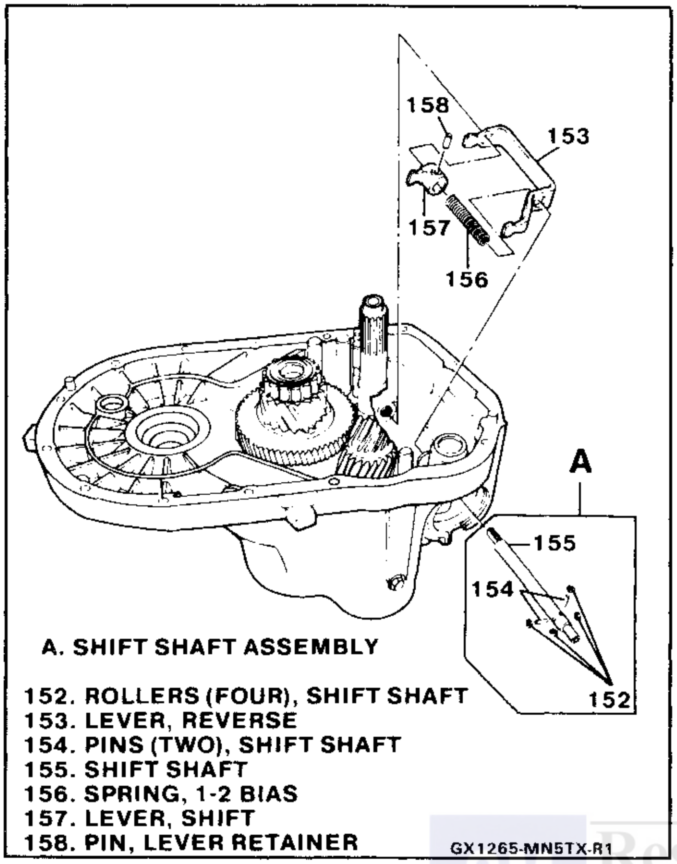


Figure 6 Shift Shaft Components

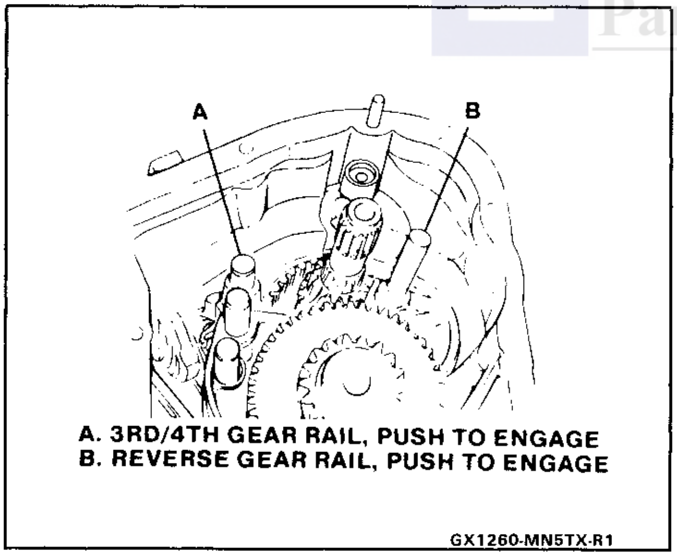


Figure 7 Engage Fourth and Reverse

GEAR CLUSTERS

Remove or Disconnect (Figure 9)

Tool Required:

Hydraulic Press

J-36182-1 Gear Cluster and Transmission Case Assembly/Disassembly Pallet

J-36182-2 Disassembly Adapters (two)

J-36185 Gear Cluster Remover

1. Position J-36182-1 and -2 in hydraulic press.

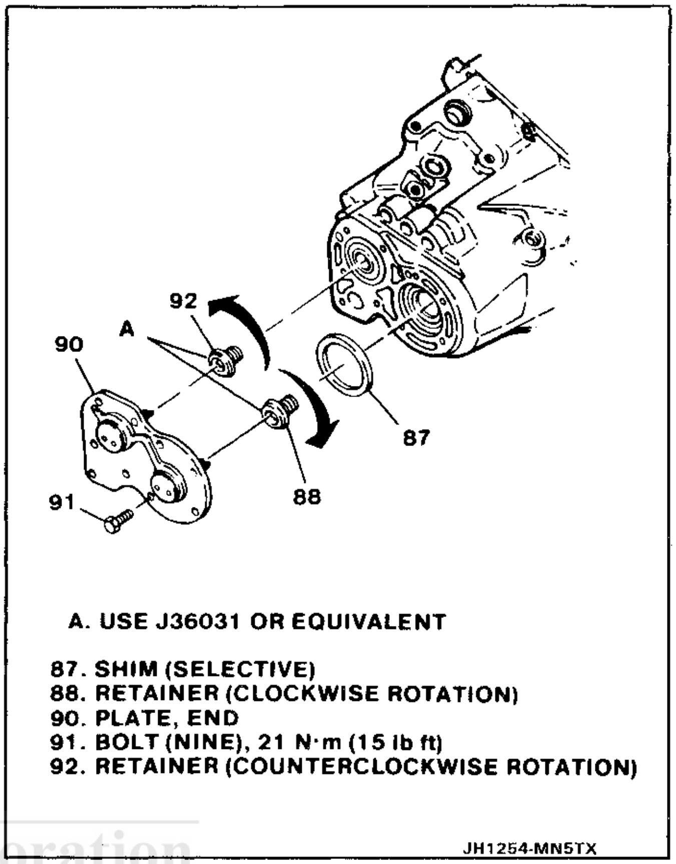


Figure 8 Gear Cluster Support Components

2. Position transmission case/gear cluster assembly (A) on J-36182-1 and -2.
   - Align shift rail and shaft pilots to the fixture.
3. Position J-36185 on shaft support bearings and pilots.

   Using a hydraulic press, separate the shaft and gear clusters from the transmission case.

GEAR CLUSTERS AND SHIFT RAILS

Remove or Disconnect (Figure 10)

- 1-2 shift rail assembly (190), lock pin (196).
- 3-4 rail assembly (184).
- 5th rail assembly (197).
- Reverse rail assembly (180).
  - shift gate (181), disengage roller (182)

UNIT SUBASSEMBLY REPAIR AND INSPECTION

Important (Section 7B3, Figure 1)

The following components will require heating prior to installation during assembly procedures.

- 7-10 minutes, 120°C (250°F).
  - race (6), (40)
  - gear assembly (3)
  - speedo gear (electronic) (72)
- 5 minutes, hot tap water.

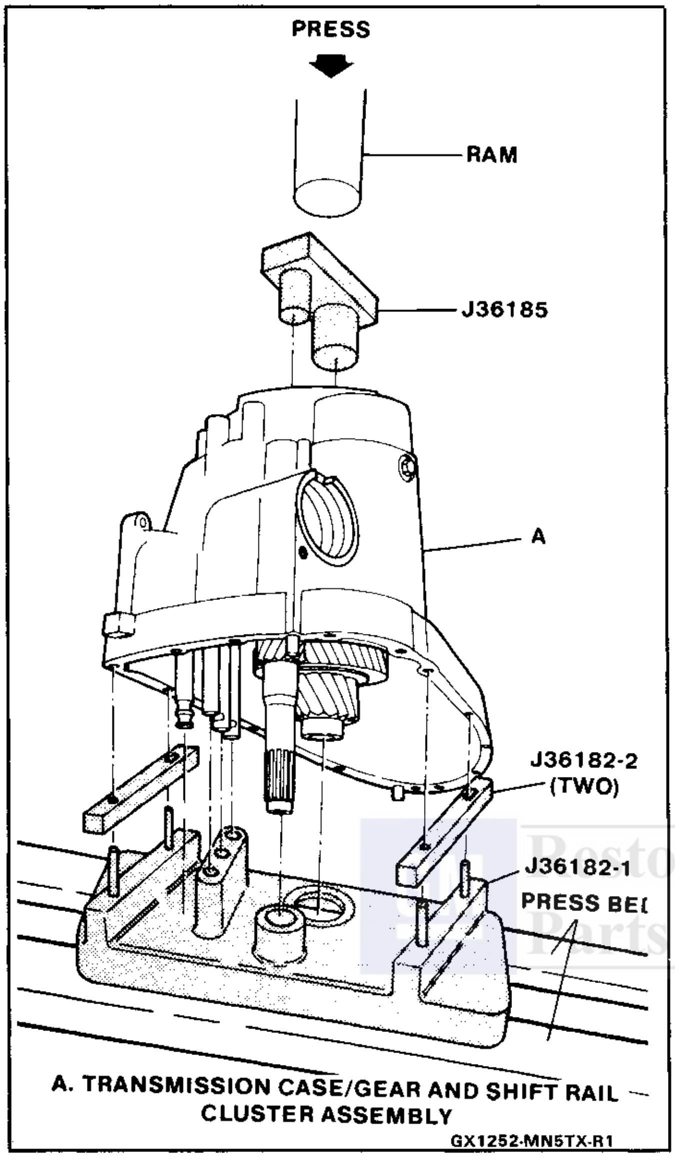


Figure 9 Transmission Case and Gear/Shift Rail Clusters Separation

   - speedo gear (mechanical) (71)
- 20 minutes MINIMUM, 120°C (250°F).
   - gear cluster (37)

INPUT SHAFT

Disassemble (Figure 11)

Tool Required:

Hydraulic Press

J-36183 Input/Output Shaft Gears Press Tube

J-36184 Input/Output Shaft Press Tube Reducer

Important (Figure 11)

- Identify blocker ring (14) for third gear and blocker ring (7) for fourth gear. DO NOT MIX.

1. Snap ring (2).

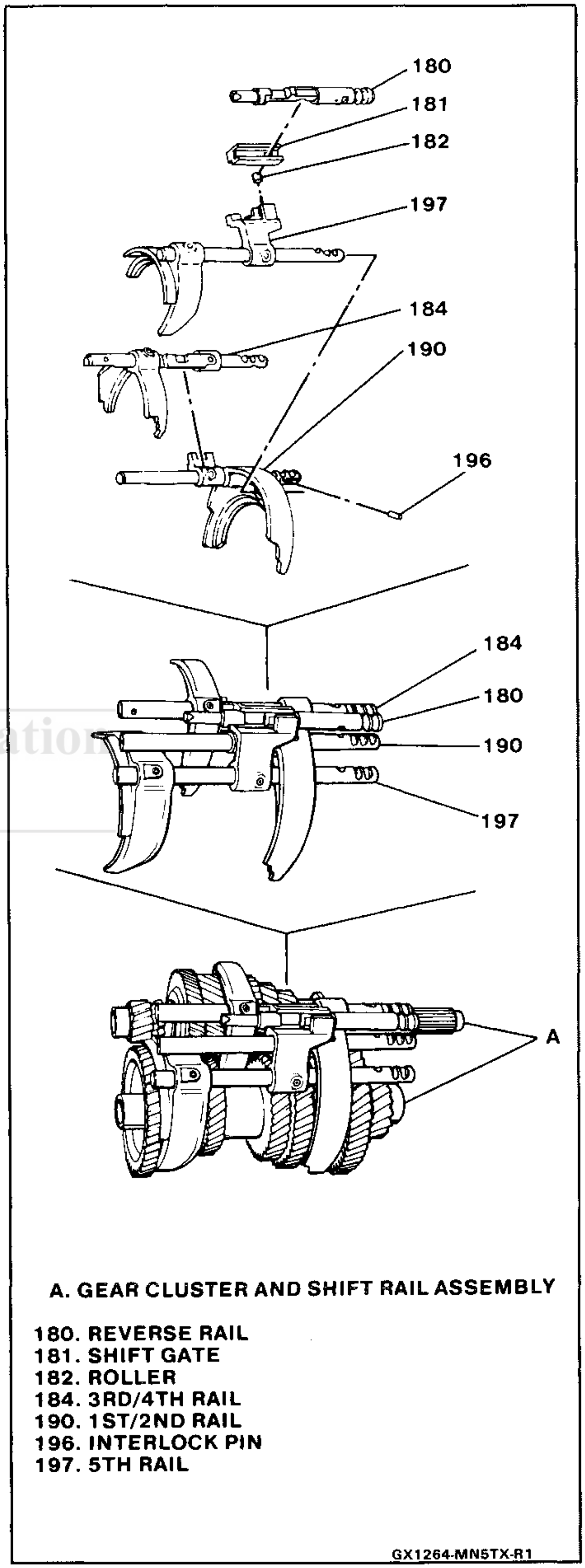


Figure 10 Shift Rail Assemblies

2. Gear (3) and (4), bearings (5), race (6), blocker ring (7 and 14), synchronizer assembly (8) and gear (15), using J-36183, J-36184 and hydraulic press.
3. Third gear bearing (16).

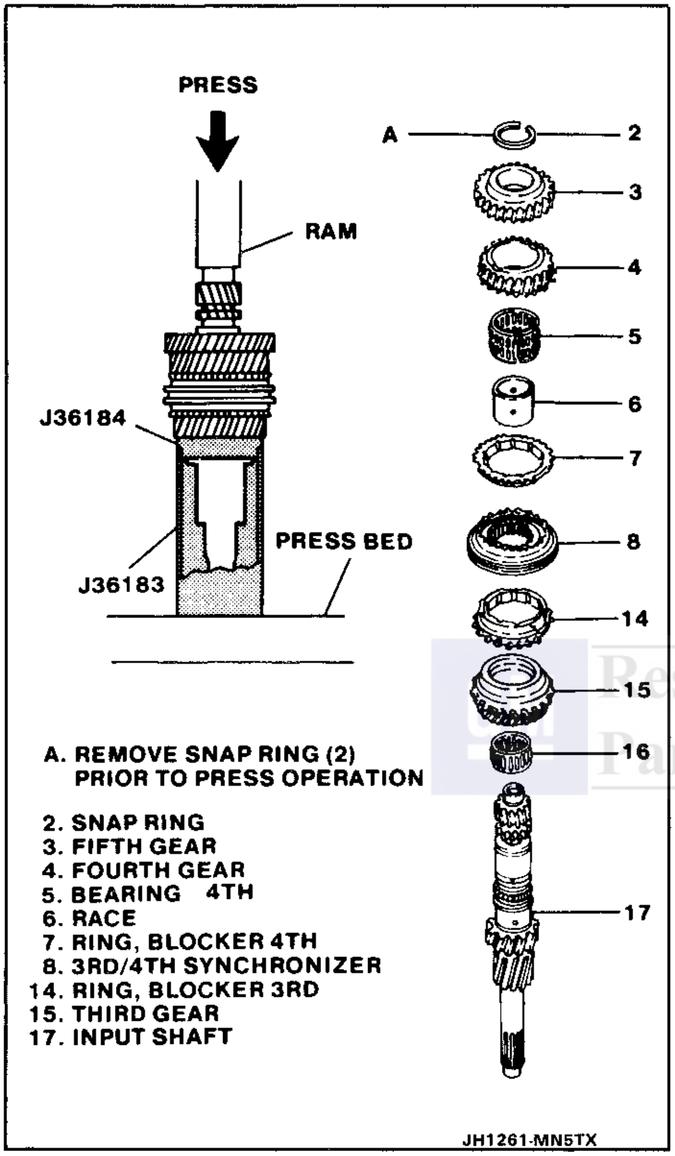


Figure 11 Input Shaft Components Removal

Inspect (Figure 11)

- Clean with solvent, air dry.
- Input shaft components.
  - shaft (17), spline wear or cracks, replace if these conditions exist
  - gear teeth (3), (4), (15), for scuffed, nicked, burred, or broken teeth
  - bearings (5), (16) for roughness of rotation, burred or pitted condition, replace if these conditions exist
  - bearing races (6), (17, shaft), for scoring, wear or overheating
  - synchronizer assembly (8) (REFER TO SYNCHRONIZER REPAIR)
- If scuffed, nicked, burred or scoring conditions cannot be removed with a soft stone or crocus cloth, replace the component.

Assemble (Figure 12)

Tools Required:

Oven
Hydraulic Press
J-22912-01 Input/Output Shaft Gears Remover/Installer
J-36183 Input/Output Shaft Gears Press Tube
J-36184 Input/Output Shaft Press Tube Reducer

- Lubricate all components as assembly progresses. Use lubricant P/N 12345349 or equivalent.
- Bearing race (6) and fifth gear (3) require heating in oven at 120°C (250°F) for 7-10 minutes.

Install or Connect (Figure 12)

1. Bearing (16).
2. Third gear (15).
   - cone up.
3. Blocker ring (14).

Important

- When pressing the 3-4 synchronizer assembly (8):
  - start press operation, STOP, before tangs engage
  - lift and rotate gears (14 and 15) into synchronizer tangs
  - continue to press until seated
  - be sure all shavings are removed

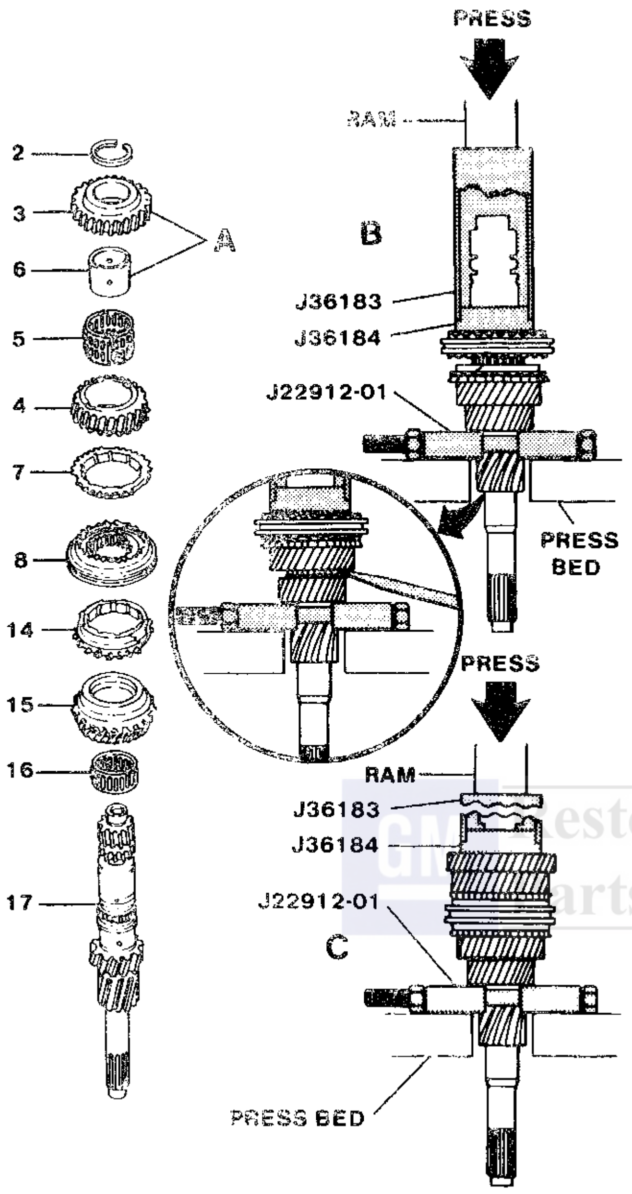
4. 3-4 synchronizer (8), using J-22912-01, J-36183, J-36184 and hydraulic press.
   - side marked 3RD gear and small O.D. groove of sleeve toward third gear (15).
5. Bearing race (6) and bearing (5).
6. Blocker ring (7).
7. Fourth gear (4).
   - cone down.
8. Fifth gear (3) using J-36183, J-36184 and hydraulic press.
   - flat side down.
9. New snap ring (2).

OUTPUT SHAFT

Disassemble (Figure 13)

Tool Required:

15-Ton Press (MINIMUM)
J-22912-01 Input/Output Shaft Gears Remover/Installer
J-36183 Input/Output Shaft Gears Press Tube



A. FIFTH GEAR (3), BEARING RACE (6) REQUIRE HEATING PRIOR TO INSTALLATION
B. START PRESS OPERATION OF 3RD/4TH GEAR SYNCHRONIZER (8). DO NOT CONTACT BLOCKER RING (14)
LIFT GEARS (15) AND (14) WITH PROBE TO ENGAGE BLOCKER RING (14) INTO SYNCHRONIZER (8). CONTINUE PRESS OPERATION
C. PRESS FIFTH GEAR (3)

2. SNAP RING
3. 5TH GEAR
4. 4TH GEAR
5. BEARING, 4TH GEAR
6. RACE, BEARING 4TH GEAR
7. BLOCKER RING, 4TH GEAR
8. SYNCHRONIZER ASSEMBLY, 3RD/4TH GEAR
14. BLOCKER RING, 3RD GEAR
15. 3RD GEAR
16. BEARING, 3RD GEAR
17. SHAFT, INPUT

JH1259-MN5TX

Figure 12 Input Shaft Components Installation

Important (Figure 13)

- Identify blocker ring (31) for fifth gear, blocker ring (41) for second gear and blocker ring (48) for first gear. DO NOT MIX.

Remove or Disconnect (Figure 13)

1. Reverse gear-fifth gear synchronizer assembly (25), using J-22912-01 and hydraulic press.
2. Blocker ring (3).
3. Fifth speed gear (32).
4. Fifth gear bearing (33).
5. Thrust washer (35).
6. Ball (34).
7. Snap ring (36).
8. First gear (49), bearing (50), caged thrust bearing (51) and thrust washer (52), using J-36183 and 15 ton press MINIMUM.
   - second gear (38), bearing (39), race (40), 1-2 synchronizer (42), blocker rings (41 and 48) and 3-4 gear cluster (37) will press off with first gear.

Inspect (Figure 13)

- Clean with solvent, air dry.
- Output shaft components.
  - shaft (53) for spline wear or cracks, replace if these conditions exist
  - gear teeth (53), (49), (38), (37), (32), (25) for scuffed, nicked, burred, or broken teeth
  - bearing races (53), (40), for scoring, wear or overheating
  - bearings, for roughness of rotation, burred or pitted condition, replace if these conditions exist
  - synchronizer (42) and (25) (REFER TO SYNCHRONIZER REPAIR)
- If scuffed, nicked, burred or scoring conditions cannot be removed with a soft stone or crocus cloth, replace the component.

Assemble (Figure 14)

Tools Required:

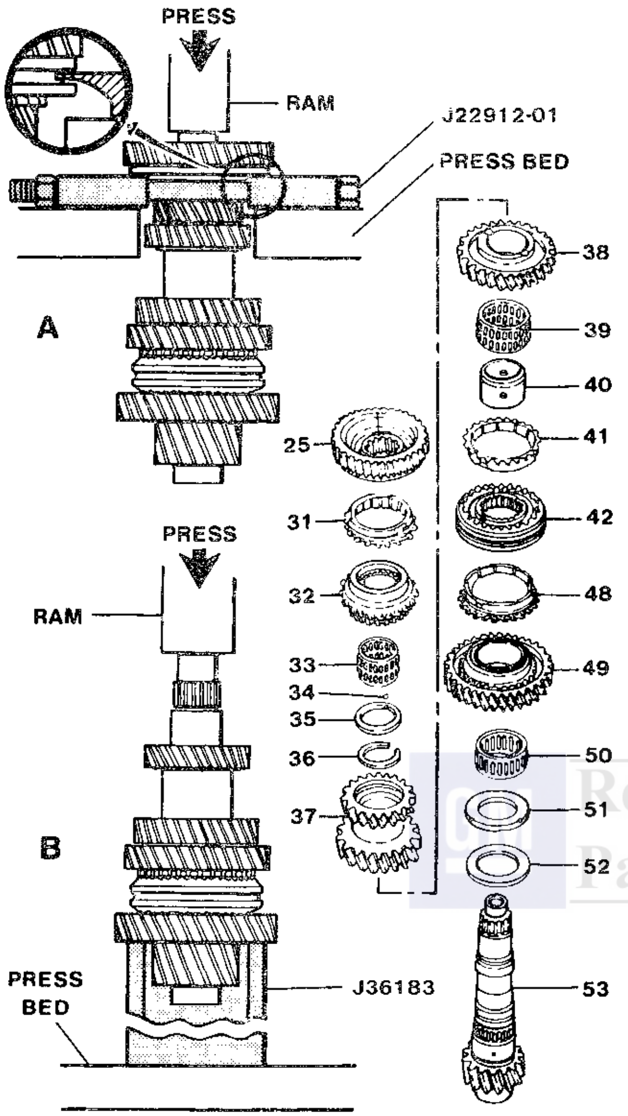
Oven

Hydraulic Press

J-36183 Input/Output Shaft Gears Press Tube

J-36184 Input/Output Shaft Press Tube Reducer

- Bearing race (40) requires heating 120°C (250°F) in oven, minimum 7-10 minutes. 3-4 gear cluster (37) requires heating 120°C (25°0F) in oven, MINIMUM 20 minutes.
- Lubricate all components as assembly progresses. Use lubricant P/N 12345349 or equivalent.



A. INSTALL J22912-01 IN SLEEVE GROOVE OR ON GEAR FACE ONLY
B. SNAP RING (36) MUST BE REMOVED PRIOR TO PRESS OPERATION. FIRST GEAR (49) ON J36183

25. REVERSE GEAR/5TH GEAR SYNCHRONIZER
31. BLOCKER RING, 5TH GEAR
32. GEAR, 5TH SPEED
33. BEARING, 5TH GEAR
34. BALL, THRUST WASHER POSITIONER
35. THRUST WASHER
36. SNAP RING
37. GEAR, 3RD/4TH CLUSTER
38. GEAR, 2ND SPEED
39. BEARING, 2ND GEAR
40. RACE, 2ND GEAR BEARING
41. BLOCKER RING, 2ND GEAR
42. SYNCHRONIZER ASSEMBLY, 1ST/2ND GEAR
48. BLOCKER RING, 1ST GEAR
49. GEAR, 1ST SPEED
50. BEARING, 1ST GEAR
51. BEARING, THRUST
52. WASHER, THRUST
53. SHAFT, OUTPUT

GX1278-MN5TX-R1

Figure 13 Output Shaft Components Removal

Install or Connect (Figure 14)

1. Thrust washer (52).
   - CHAMFER down.

   Caged thrust bearing (51).
   - needles down.

   First gear bearing (50).
   First gear (49).
   - cone up.
2. Blocker ring (48).

Important (Figure 14)

- When pressing the 1-2 synchronizer assembly (42):
  - start press operation, STOP before tangs engage
  - lift and rotate gears (49) and (48), to engage blocker ring tangs
  - continue to press until seated.
  - be sure all shavings are removed

3. 1-2 synchronizer (42), using J-36183, J-36184 and hydraulic press.
   - side marked 1ST and small O.D. groove on sleeve toward first gear (49).
4. Second gear bearing race (40), bearing (39), second gear (38)
   - cone down.
5. Third-fourth gear cluster (37), using J-36183, J-36184 and hydraulic press.
   - large O.D. gear down.
6. Snap ring (36), thrust washer positioning ball (34) (retain with petroleum jelly), slotted thrust washer (35).
   - align I.D. slot with ball (34).
7. Fifth gear bearing (33) and fifth gear (32).
   - cone up.
8. Blocker ring (31).

Important (Figure 14)

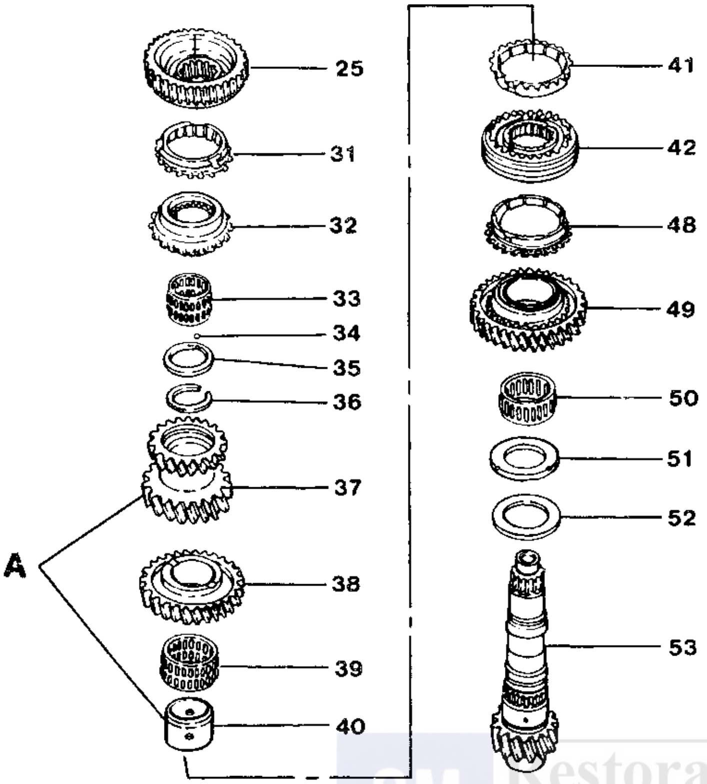
- When pressing reverse gear and fifth synchronizer (25):
  - start press operation, STOP before tangs engage
  - lift and rotate fifth gear (32) and blocker ring (31) (THRUST WASHER (35) MUST STAY DOWN), engaging tangs
  - continue to press until seated
  - be sure all shavings are removed

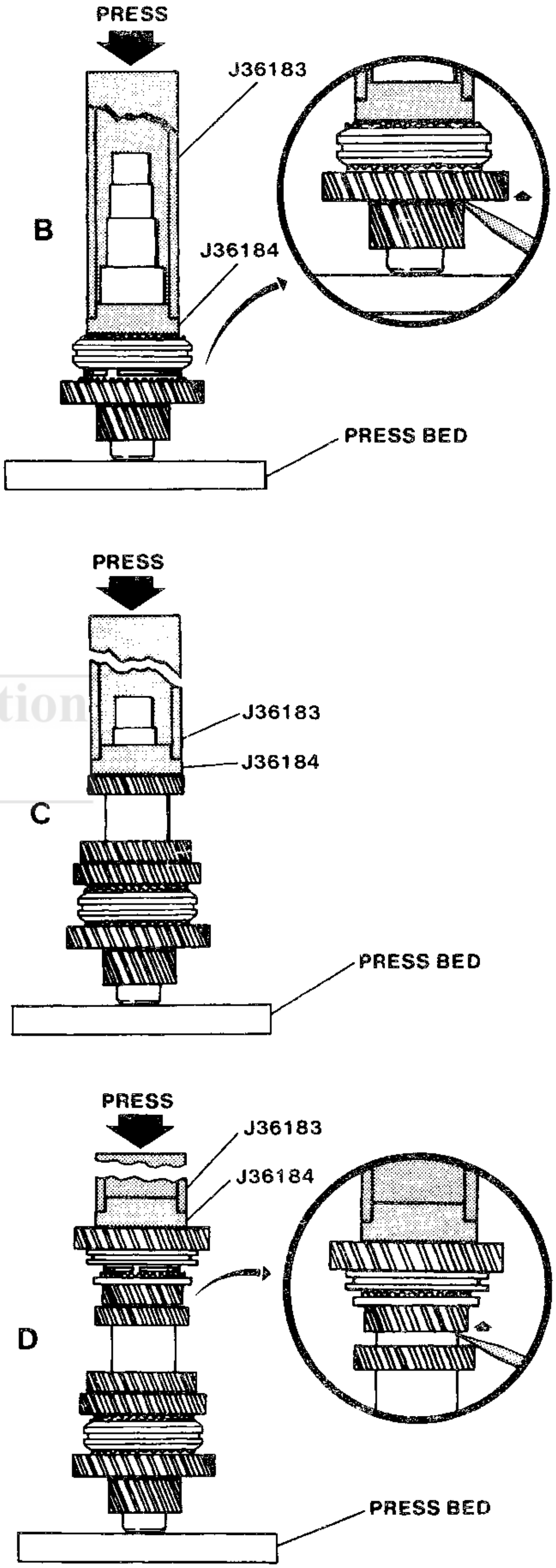
9. Reverse gear and fifth gear synchronizer assembly (25), using J-36183, J-36184 and hydraulic press.

REVERSE IDLER GEAR

Disassemble (Figure 15)

1. Bolt (94).
2. Shift rail (104), gear (103), shaft (102) and bracket (109).
3. Shift rail (104), detent ball (106) and spring (107).





A. THIRD-FOURTH GEAR CLUSTER (37) AND RACE (40) REQUIRE HEATING PRIOR TO INSTALLATION

B. START PRESSING 1ST/2ND SYNCHRONIZER (42). STOP PRIOR TO ENGAGING BLOCKER RING TANGS (48).
USING PROBE, PUSH UP GEAR (49) ENGAGING BLOCKER RING TANGS (48).
CONTINUE PRESS OPERATION

C. PRESS 3RD/4TH GEAR CLUSTER (37)

D. START PRESSING REVERSE GEAR/5TH SYNCHRONIZER ASSEMBLY (25).
STOP PRIOR TO ENGAGING BLOCKER RING TANGS (31).
USING PROBE, PUSH UP GEAR (32). THRUST WASHER (35) MUST STAY DOWN.
CONTINUE PRESS OPERATION

25. GEAR, REVERSE/5TH SYNCHRONIZER ASSEMBLY
31. RING, BLOCKER, 5TH GEAR
32. GEAR, 5TH SPEED
33. BEARING, 5TH GEAR
34. BALL, THRUST WASHER POSITIONER
35. WASHER, THRUST
36. SNAP RING
37. GEAR, 3RD/4TH GEAR CLUSTER
38. GEAR, 2ND SPEED
39. BEARING, 2ND SPEED
40. RACE, BEARING, 2ND GEAR
41. RING, BLOCKER, 2ND GEAR
42. SYNCHRONIZER ASSEMBLY, 1ST/2ND GEAR
48. RING, BLOCKER, 1ST GEAR
49. GEAR, 1ST SPEED
50. BEARING, 1ST GEAR
51. BEARING, THRUST
52. WASHER, THRUST
53. SHAFT, OUTPUT

GX1268-MN5TX-R2

Figure 14 Output Shaft Components Installation

Inspect (Figure 15)

- Clean with solvent, air dry.
- Reverse gear components.
    - gear teeth (103), for scuffed, nicked, burred, or broken teeth
    - bushing (part of gear assembly 103), for scores, burrs, roundness, or overheating
    - shaft (102), for scoring, wear, or overheating
- If scuffed, nicked, burred or scoring conditions cannot be removed with a soft stone or crocus cloth, replace the component.

Assemble (Figure 15)

- Lubricate all components as assembly progresses. Use lubricant P/N 12345349 or equivalent.

Install or Connect (Figure 15)

1. Assemble spring (107), ball (106) in bracket (109).
2. Shaft (104) in bracket assembly.
3. Gear (103) on shaft (102).
    - slot on gear toward threaded hole in shaft (102).
4. Reverse Idler gear assembly.
5. Bolt (94), 21 N·m (16 lb ft).

TRANSMISSION CASE

Disassemble (Figure 16)

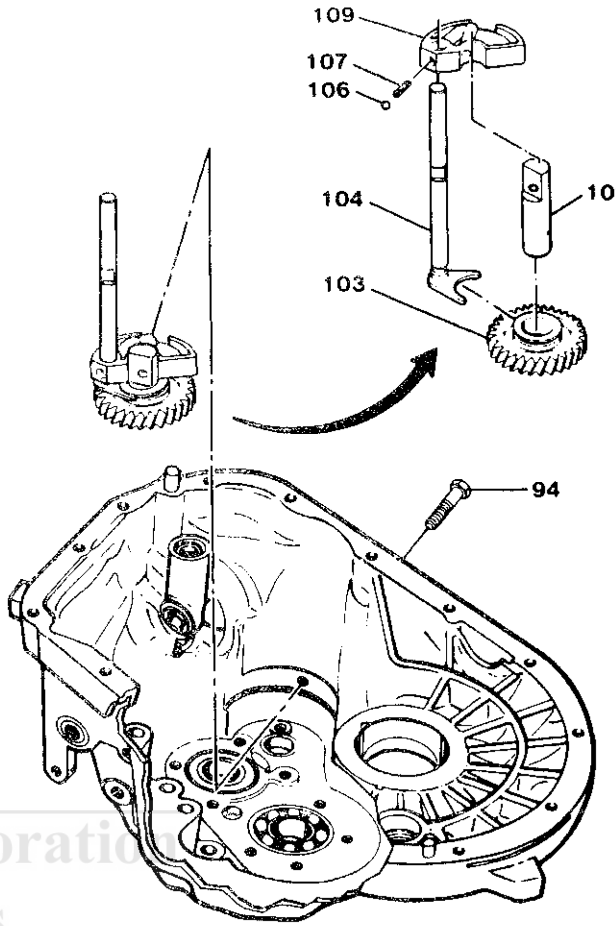
Tools Required:

J-8092 Universal Driver Handle
J-23907 Slide Hammer and Adapter Set
J-26941 Bushing Remover
J-36027 Shift Shaft Bearing Remover
J-36029 Shift Rail Bushing Remover/Installer
J-36032 Clutch Shaft Inner Bushing/Reverse Shift Rail Remover
J-36034 Sliding Sleeve Bushing Remover/Installer
J-36039 Shift Detent Lever Bushing Remover/Installer
J-36190 Universal Driver Handle

Remove or Disconnect (Figure 16)

- Remove bearings and bushings only if there is evidence of damage or a mating part is being replaced.

1. Snap ring (210).
2. Plug (209).
3. Screw (205), spring (206) and sliding sleeve (207).
4. Bushing (95) sliding sleeve, using J-36034 and J-36190 (VIEW A).
5. Detent lever (145).



94. BOLT, 21 N·m (16 lb ft)
102. SHAFT, SLIDING SPINDLE
103. GEAR, REVERSE IDLER
104. RAIL, REVERSE SHIFT IDLER GEAR
106. BALL, DETENT
107. SPRING, DETENT
109. BRACKET, REVERSE IDLER GEAR

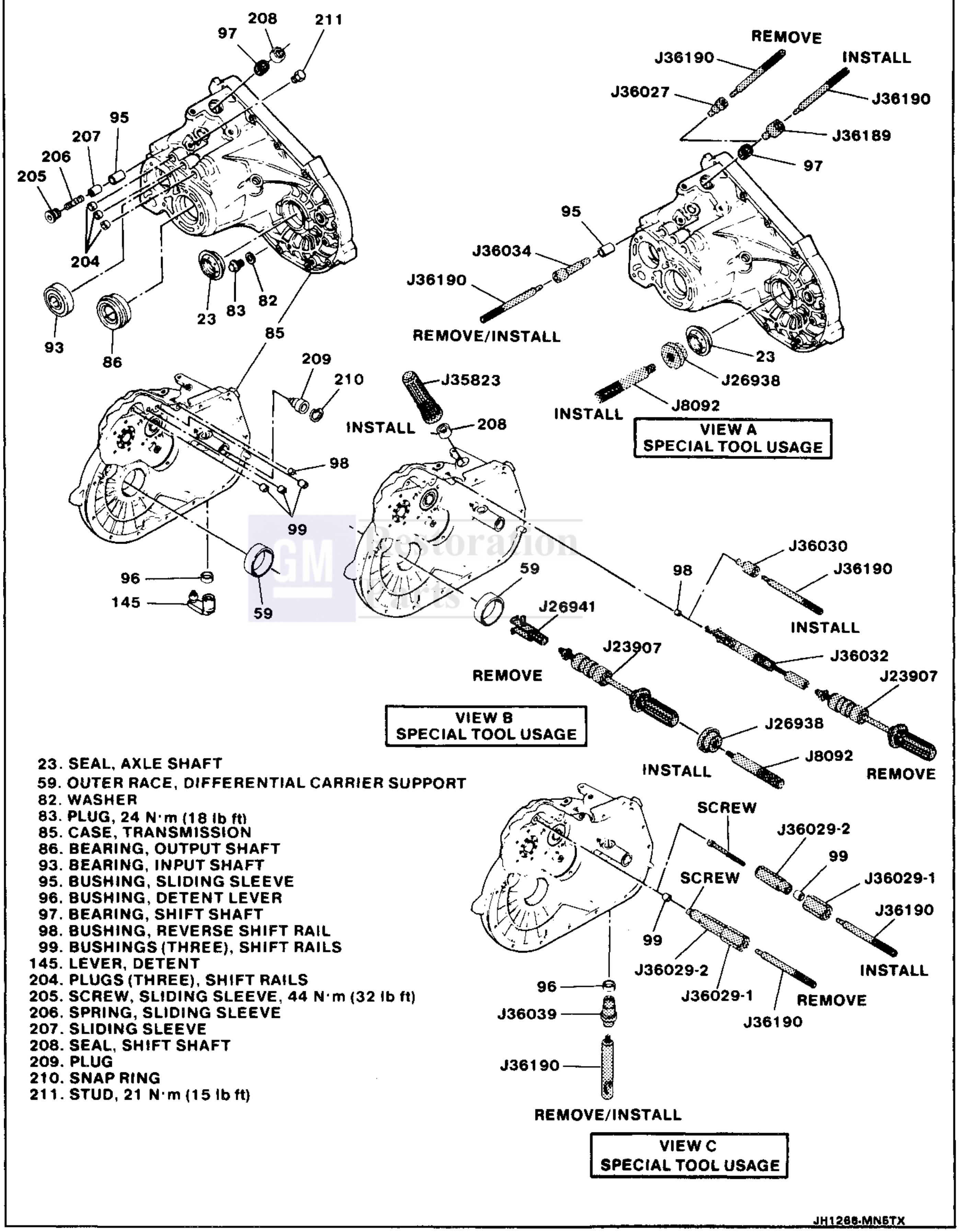
GX1256-MN5TX-R1

Figure 15 Reverse Idler Gear Components

6. Bushing (96) shift detent lever, using J-36039 and J-36190 (VIEW C).
7. Seal (208) shift shaft, using a small screwdriver.
8. Bearing (97) shift shaft, using J-36027 and J-36190 (VIEW A).
9. Axle seal (23).
10. Outer race (59), differential carrier support, using J-26941 and J-23907 (VIEW B).
11. Plugs (204).
12. Bearing (93), input shaft support.
13. Bearing (86), output shaft support.
14. Bushings (99) (three) shift rail, using J-36029 (small end of -2 adapter in bushing) and J-36190 (VIEW C).
15. Bushing (98), reverse shift rail, using J-36032 and J-23907 or drive bushing down and remove through back-up light switch hole (VIEW B).
16. Stud (211).

Inspect (Figure 16)

- Clean with solvent, air dry.
- Transmission case components.



23. SEAL, AXLE SHAFT
59. OUTER RACE, DIFFERENTIAL CARRIER SUPPORT
82. WASHER
83. PLUG, 24 N·m (18 lb ft)
85. CASE, TRANSMISSION
86. BEARING, OUTPUT SHAFT
93. BEARING, INPUT SHAFT
95. BUSHING, SLIDING SLEEVE
96. BUSHING, DETENT LEVER
97. BEARING, SHIFT SHAFT
98. BUSHING, REVERSE SHIFT RAIL
99. BUSHINGS (THREE), SHIFT RAILS
145. LEVER, DETENT
204. PLUGS (THREE), SHIFT RAILS
205. SCREW, SLIDING SLEEVE, 44 N·m (32 lb ft)
206. SPRING, SLIDING SLEEVE
207. SLIDING SLEEVE
208. SEAL, SHIFT SHAFT
209. PLUG
210. SNAP RING
211. STUD, 21 N·m (15 lb ft)

Figure 16 Transmission Case Components

  - bearing race bore, for wear, scratches or grooves
  - bushings, for scores, burrs, roundness or evidence of overheating
  - case, for cracks, threaded openings for damaged threads, mounting faces for nicks, burrs or scratches; if case is cracked, it must be replaced
- If scratches, grooves or scoring cannot be removed with a soft stone or crocus cloth, replace the component.
- Clean-up damaged threads with correct size "used" tap (a new tap can cut oversize).

Assemble (Figure 16)

Tools Required:
J-26938 Seal and Race, Differential Installer
J-35823 Shift Shaft Seal Installer
J-36029 Shift Rail Bushing Remover/Installer
J-36030 Reverse Shift Rail Bushing Installer
J-36034 Sliding Sleeve Bushing Remover/Installer
J-36039 Shift Detent Lever Remover/Installer
J-36189 Shift Shaft Bearing Installer
J-36190 Universal Driver Handle

Install or Connect Connect (Figure 16)

1. Bearing (97) shift shaft, using J-36189 and J-36190 (VIEW A).
2. Seal (208) shift shaft, using J-35823 (VIEW B).
3. Bushings (99) (three) shift rail, using J-36029 (place new bushing on -2 adapter and retain between the -1 and -2 tool parts) and J-36190 (VIEW C).
4. Bushing (98) reverse rail, using J-36030 and J-36190 (VIEW B).
5. Outer race (59) differential carrier support, using J-26938 (VIEW B).
6. Axle seal (23), using J-26938 (VIEW A).
7. Plugs (204).
   - even with bore surface.
8. Bushing (96) detent lever, using J-36039 and J-36190 (VIEW C).
9. Bushing (95) Sliding sleeve, using J-36034 and J-36190 (VIEW A).
10. Detent lever (145).
11. Sleeve (207), spring (206) and screw (205), 44 N·m (32 lb ft).
12. Plug (209) and snap ring (210), flat side up.
13. Stud (211), chamfer end out, 21 N·m (15 lb ft).

CLUTCH AND DIFFERENTIAL HOUSING

Disassemble (Figure 17)

Tools Required:
Hydraulic Press
J-6125-1B Slide Hammer
J-8092 Universal Driver Handle
J-23907 Slide Hammer and Adapter Set
J-35824 Input Bearing Assembly Remover/Installer
J-36029 Shift Rail Bushing Installer/Remover
J-36032 Clutch Shaft Inner Bushing/Reverse Shift Rail Remover
J-36037 Clutch Shaft Upper Bushing Remover/Installer
J-36038 Output Shaft Race Bearing Remover
J-37107-1 Clutch Shaft Inner Bearing Remover
J-37107-2 Clutch Shaft Inner Bearing Remover Guide

Remove or Disconnect (Figure 17)

- Remove bearings and bushings only if there is evidence of damage or a mating part is being replaced.

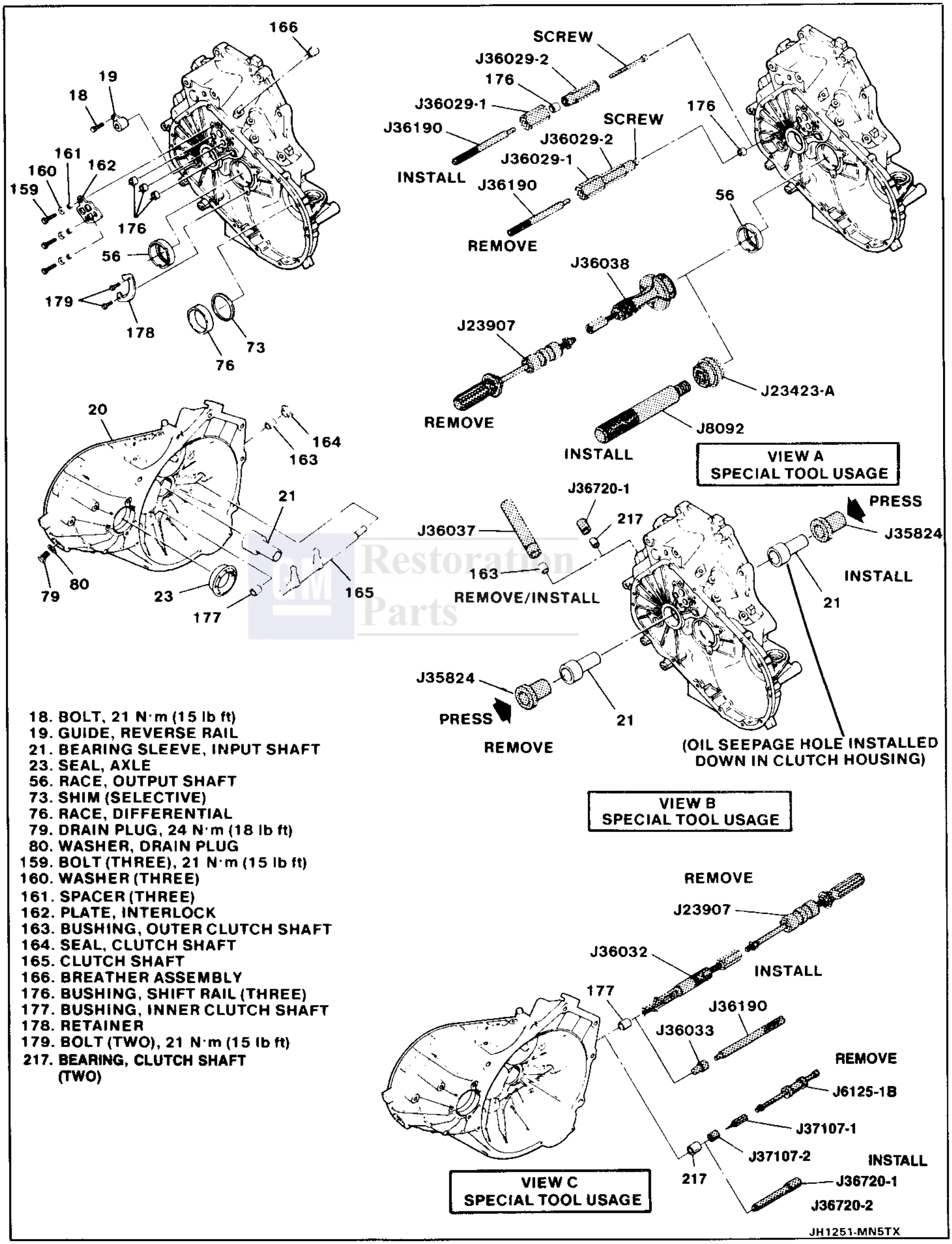
1. Bolts (179) and retainer (178).
2. Race (56), using J-36038 and J-23907 (VIEW A).
3. Bolts (159), washers (160), spacer (161), plate (162).
4. Bolt (18) and guide (19).
5. Axle seal (23).
6. Race (76) and shim (73) differential, using J-26941 and J-23907
7. Seal (164) clutch shaft, using small pry.
8. Bushing (163) upper, using J-36037 (VIEW B).
   - External clutch release models only.

   Bearing (217) upper.
   - Remove bolt (214).
   - Tap on clutch fork finger to drive out upper bearing.
     - Internal release models only.
9. Clutch shaft (165) or (216).
10. Bushing (177) inner, using J-36032 and J-23907 (VIEW C).
    - External clutch release models only.

    Bearing (217) inner, using J-37107-2, J-37107-1 and J-6125-1B (VIEW C).
    - Install J-37107-2 into bearing.
    - Drive J-37107-1 through J-3107-2 and bearing case.
    - Screw J-37107-1 into bearing case and slide hammer out.
      - Internal release models only.
11. Bearing sleeve assembly (21), using J-35824 and hydraulic press (VIEW B).
12. Bushings (176) shift rail, using J-36029 (small end of -2 adapter in bushing) (VIEW A).
13. Drain plug (79) and washer (80).
14. Breather assembly (166).

Inspect (Figure 17)

- Clean with solvent, air dry.
- Clutch and differential housing.



18. BOLT, 21 N·m (15 lb ft)
19. GUIDE, REVERSE RAIL
21. BEARING SLEEVE, INPUT SHAFT
23. SEAL, AXLE
56. RACE, OUTPUT SHAFT
73. SHIM (SELECTIVE)
76. RACE, DIFFERENTIAL
79. DRAIN PLUG, 24 N·m (18 lb ft)
80. WASHER, DRAIN PLUG
159. BOLT (THREE), 21 N·m (15 lb ft)
160. WASHER (THREE)
161. SPACER (THREE)
162. PLATE, INTERLOCK
163. BUSHING, OUTER CLUTCH SHAFT
164. SEAL, CLUTCH SHAFT
165. CLUTCH SHAFT
166. BREATHER ASSEMBLY
176. BUSHING, SHIFT RAIL (THREE)
177. BUSHING, INNER CLUTCH SHAFT
178. RETAINER
179. BOLT (TWO), 21 N·m (15 lb ft)
217. BEARING, CLUTCH SHAFT (TWO)

Figure 17 Clutch and Differential Housing Components

  - bearing race bore for wear, scratches or grooves
  - bushings, for scores, burrs, roundness or evidence of overheating
  - case, for cracks, threaded openings for damaged threads, mounting faces for nicks, burrs or scratches; if case is cracked, it must be replaced
- If scratches, grooves or scoring cannot be removed with a soft stone or crocus cloth, replace the component.
- Clean-up damaged threads with the correct size "used" tap (a new tap can cut oversize).

Assemble (Figure 17)

Tools Required:

Hydraulic Press
J-8092 Universal Drive Handle
J-23423-A Differential/Output Shaft Bearing Cup Installer
J-35824 Input Bearing Assembly Remover/Installer
J-36029 Shift Rail Bushing Installer
J-36033 Clutch Shaft Inner Bushing Installer
J-36037 Clutch Shaft Upper Bushing Remover/Installer
J-36190 Universal Driver Handle
J-36720-1 Clutch Shaft Outer Bearing Installer
J-36720-2 Clutch Shaft Inner Bering Installer

Install or Connect (Figure 17)

- Bearings sleeve assembly (21), Bolts (159) and (179) require a small amount of thread sealant P/N 12345382 or equivalent, 21 N·m (16 lb ft).
- Do not install differential bearing race (76) and axle seal (23) or shim (73). INSTALLATION WILL BE AFTER DIFFERENTIAL BEARING SELECTIVE SHIMMING.

1. Drain plug (79) and NEW washer (80), 24 N·m (18 lb ft).
2. Bushings (176) shift rail, using J-36029 (place new bushing on -2 adapter and retain between the -1 and -2 tool parts) and J-36190 (VIEW A).
   - BUSHINGS (176) MUST NOT PROTRUDE INTO CASE SIDE OF CLUTCH HOUSING.
3. Bearing sleeve assembly (21).
   - OIL SEEPAGE HOLE INSTALLED **DOWN** IN CLUTCH HOUSING, using J-35824 and hydraulic press (VIEW B).
4. Bushing (177) inner, using J-36033 and J-36190 (VIEW C).
   - External clutch release models only.

   Bearing (217) inner, using J-36720-1 and J-36720-2 (VIEW C).
   - Internal clutch release models only.
5. Clutch shaft (165) or (216).
6. Bushing (163) upper, using J-36037 (VIEW B).
   - outer end of bushing flush to bottom of seal bore
   - External clutch release models only.

   Bearing (217) upper, using J-36720-1 (VIEW B).
   - Internal clutch release models only.
7. Seal (164) clutch shaft.
8. Guide (19)
   - short side in bore and bolt (18), 21 N·m (15 lb ft).
9. Race (56), using J-23423-A and J-8092 (VIEW A).
   - ALIGN RACE CUTOUTS WITH SLOTS IN CASE.
   - recessed side up to clear ring gear.
10. Retainer (178) and bolts (179), 21 N·m (15 lb ft).
11. Plate (162) innerlock, spacers (161), washers (160) and bolts (159), 21 N·m (15 lb ft).
12. Breather assembly (166).

SYNCHRONIZERS

Disassemble (Figures 18, 19 and 20)

- Place 1-2, 3-4, and 5th speed synchronizers in separate shop towels, wrap assemblies and press against inner hub.

Inspect (Figures 18, 19 and 20)

- Clean with solvent, air dry.
- Synchronizer components.
  - teeth for wear, scuffed, nicked, burred or broken teeth
  - keys, for wear or distortion, replace if these conditions are present
  - balls and springs, for distortion, cracks or wear, replace if these conditions are present
- If scuffed, nicked or burred conditions cannot be corrected with a soft stone or crocus cloth, replace the component.

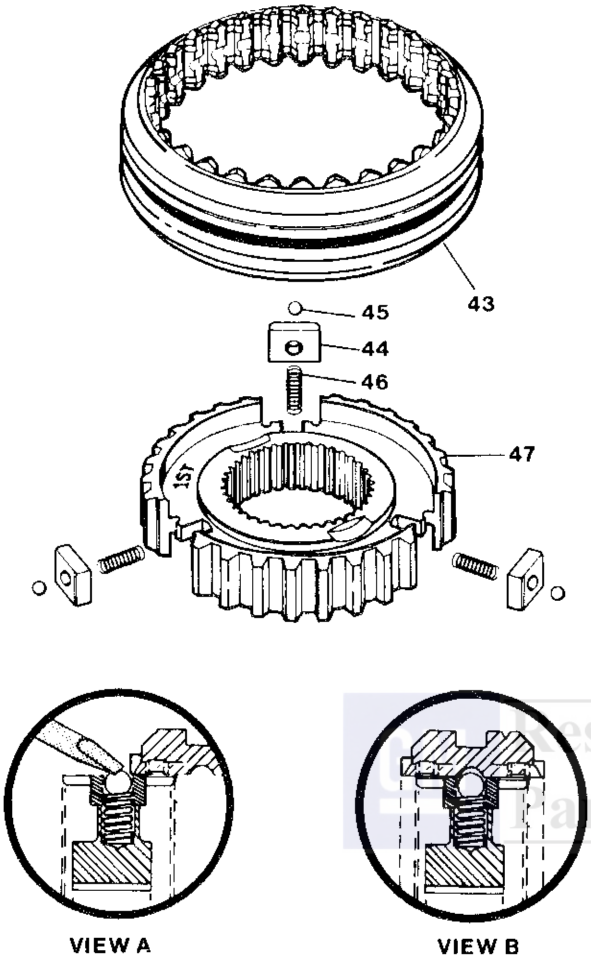
Assemble (Figures 18, 19 and 20)

- 1st/2nd gear synchronizer assembly, Figure 18.
- 3rd/4th gear synchronizer assembly, Figure 19.
- 5th gear synchronizer assembly, Figure 20.

SHIFT RAIL AND FORK ASSEMBLIES

Inspect (Figure 21)

- Clean with solvent, air dry.
- Shift rail and fork assemblies.
- The parts that compose the 1-2, 3-4, 5TH gear and reverse shift rail and fork assemblies are serviceable as an assembly only.
  - shaft (183, 189, 195 and 202) for wear or scoring



43. SLEEVE, 1ST/2ND SYNCHRONIZER
44. KEY, 1ST/2ND SYNCHRONIZER (THREE)
45. BALL, 1ST/2ND SYNCHRONIZER (THREE)
46. SPRING, 1ST/2ND SYNCHRONIZER (THREE)
47. HUB, 1ST/2ND SYNCHRONIZER

1ST/2ND ASSEMBLY PROCEDURES

Install

1. Sleeve (43), small O.D. groove up, onto hub (47), side marked 1ST up.
2. Spring (46) into key (44).
3. Spring and key assemblies bevel cut on keys toward sleeve.
4. Position assembly as in View A.
5. Balls (45). Push the ball and key into the sleeve using a screwdriver.
6. Center the hub, keys and balls, View B. Balls will click" into position.

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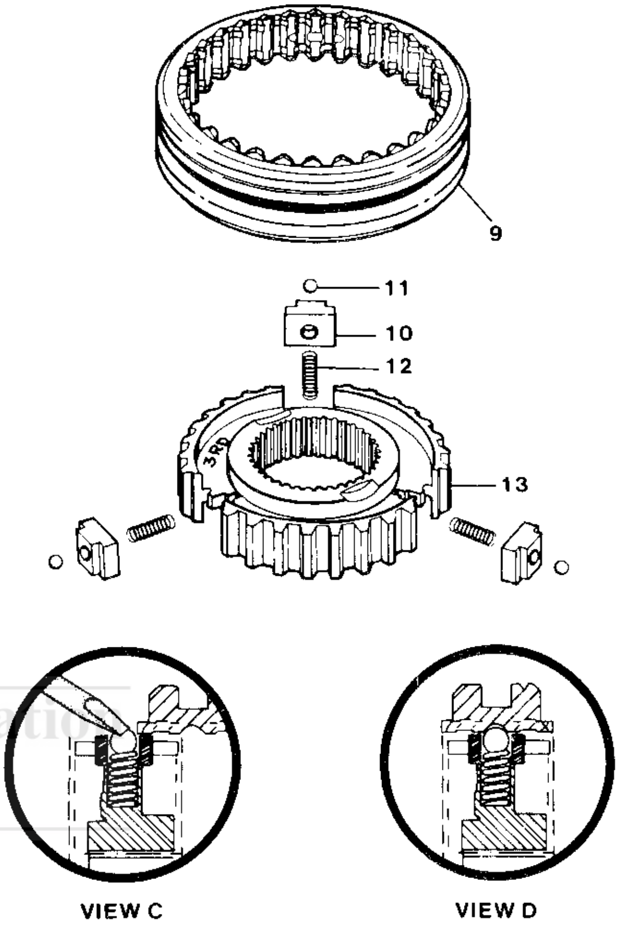
Figure 18 1ST/2ND Gear Synchronizer Components



9. SLEEVE, 3RD/4TH SYNCHRONIZER
10. KEY, 3RD/4TH SYNCHRONIZER (THREE)
11. BALL, 3RD/4TH SYNCHRONIZER (THREE)
12. SPRING, 3RD/4TH SYNCHRONIZER (THREE)
13. HUB, CLUTCH 3RD/4TH SYNCHRONIZER

3RD/4TH ASSEMBLY PROCEDURES

Install

1. Sleeve (9), small O.D. groove up, onto hub (13), side marked 3RD up. Align the ball and spring pockets.
2. Spring (12) into key (10).
3. Spring and key assemblies, stepped side of keys toward sleeve.
4. Position assembly as in View C.
5. Balls (11). Push the ball and key into the sleeve using a small screwdriver.
6. Center the hub, keys and balls, View D. Balls will "click" into position.

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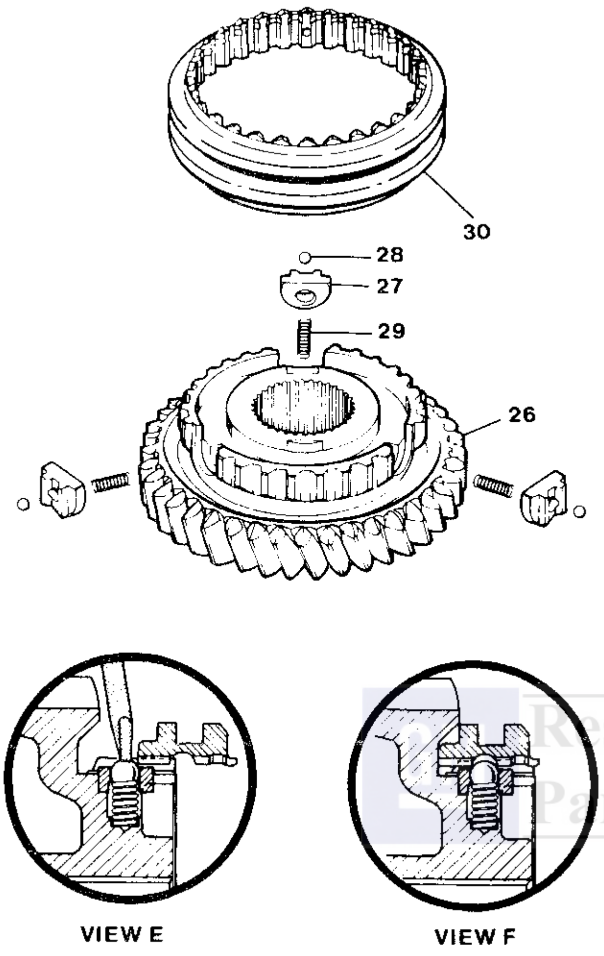
Figure 19 3RD/4TH Gear Synchronizer Components



26. GEAR, REVERSE
27. KEY, 5TH SYNCHRONIZER (THREE)
28. BALL, 5TH SYNCHRONIZER (THREE)
29. SPRING, 5TH SYNCHRONIZER (THREE)
30. SLEEVE, 5TH SYNCHRONIZER

5TH ASSEMBLY PROCEDURES

→← Install

1. Spring (29) into key (27).
2. Spring and key assemblies, teeth on keys out into slots on gear (26).
3. Sleeve (30), teeth up. Align the ball and spring pockets.
4. Position assembly as in View E.
5. Balls (28). Push the ball and key into the sleeve using a small screwdriver.
6. Center the sleeve, keys and balls, View F. Balls will "click" into position.

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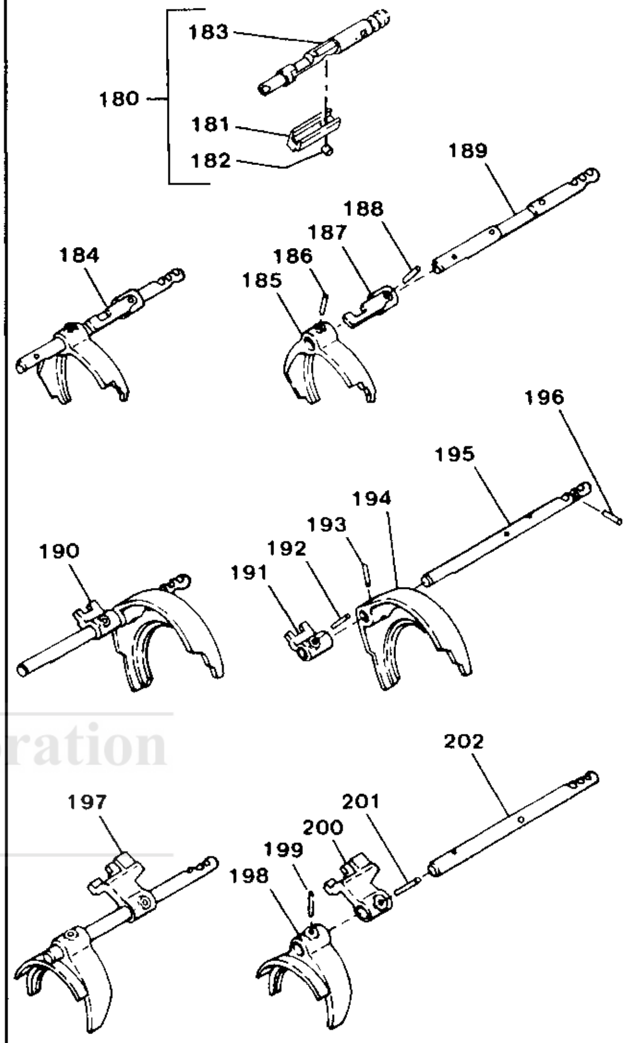
Figure 20 5TH Gear Synchronizer Components



180. RAIL, REVERSE SHIFT ASSEMBLY
181. SHIFT GATE, 5TH/REVERSE
182. ROLLER, GEAR DISENGAGE
183. SHAFT, REVERSE SHIFT
184. RAIL, 3RD/4TH SHIFT ASSEMBLY
185. FORK, 3RD/4TH SHIFT SHIFT
186. PIN, FORK RETAINER
187. LEVER, 3RD/4TH SELECT
188. PIN, LEVER RETAINER
189. SHAFT, 3RD/4TH SHIFT
190. RAIL, 1ST/2ND SHIFT ASSEMBLY
191. LEVER, 1ST/2ND SELECT
192. PIN, LEVER RETAINER
193. PIN, FORK RETAINER
194. FORK, 1ST/2ND SHIFT
195. SHAFT, 1ST/2ND SHIFT
196. PIN, LOCK
197. RAIL, 5TH SHIFT ASSEMBLY
198. FORK, 5TH SHIFT
199. PIN, FORK RETAINER
200. LEVER, 5TH SHIFT
201. PIN, LEVER RETAINER
202. SHAFT, 5TH SHIFT

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Figure 21 Shift Rail and Fork Assemblies

  - fork (185, 194 and 198) for wear, scoring or distortion
  - lever (181, 187, 191 and 200) for wear or distortion
- Wear, scoring or distortion requires replacement of assembly.

DIFFERENTIAL AND RING GEAR

Disassemble (Figure 22)

Tools Required:

J-2241-11 or J-23598 Side Bearing Puller Adapter (Alternate)
J-22888 Bearing Remover
J-22888-35 Bearing Remover Leg (Two)

Remove or Disconnect (Figure 22)

1. Bolts (77).
2. Gear (70).
3. Bearings (75 and 60), using J-22888, J-22888-35 (two), and J-2241-11 or J-23598.
4. Speedo gear (71 or 72).
   - removal will destroy gear (71).
5. Bolt (68) and washer (69).
6. Pin (63).
7. Gears (67) and washer (64), gears (66) and washers (65).

Inspect (Figure 22)

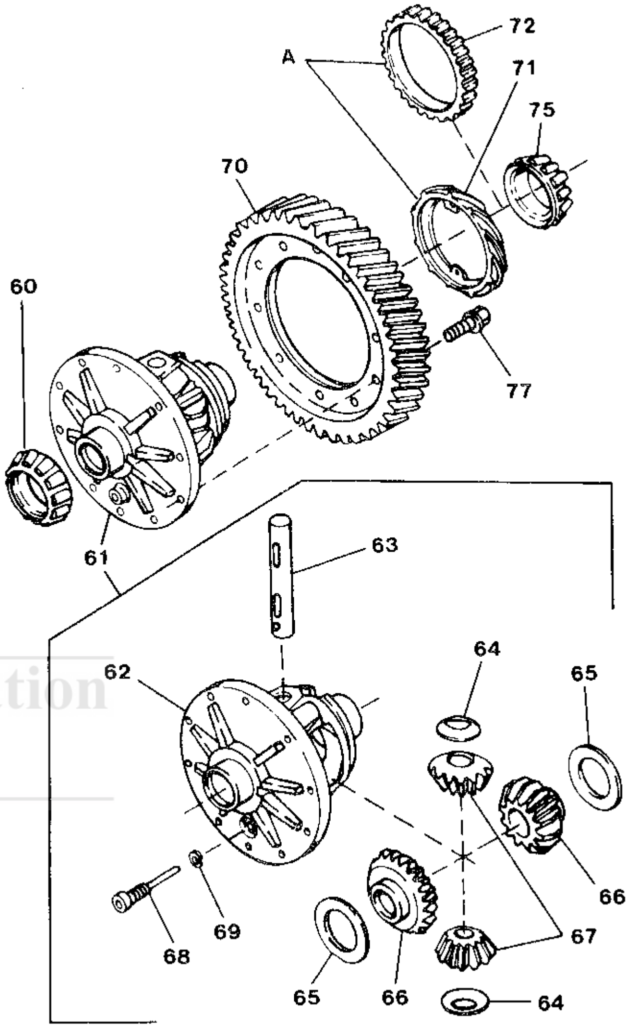
- Clean with solvent, air dry.
- Differential components.
  - gears (70, 71 or 72, 67 and 66), for scuffed, nicked, burred or broken teeth
  - carrier (61), for distortion, bores out of round or scoring, replace if these conditions are present
  - bearings (60 and 75) for roughness of rotation, burred or pitted condition, replace if these conditions exist
  - Thrust washers (64 and 65) for wear, scuffed, nicked or burred condition
- If scuffed, nicked, burred or scoring conditions cannot be removed with a soft stone or crocus cloth, replace the component.

Assemble (Figure 22)

Tools Required:

Hydraulic Press
J-22919 Differential Inner Bearing Installer

- Heat mechanical configuration nylon speedo drive gear (71) in hot tap water for five minutes prior to installation.
- Heat electronic configuration steel speedo drive gear (72) in oven at 120°C (250°F) for 7-10 minutes prior to installation.
- Do not reuse bolts (77) ONE TIME USE ONLY.



A. ELECTRONIC SPEEDO GEAR (72) REQUIRES HEATING PRIOR TO INSTALLATION MECHANICAL SPEEDO GEAR (71) REQUIRES HEATING (HOT TAP WATER) PRIOR TO INSTALLATION

60. BEARING, DIFFERENTIAL
61. CARRIER, ASSEMBLY DIFFERENTIAL
62. CARRIER, DIFFERENTIAL
63. PIN, CROSS DIFFERENTIAL
64. WASHER, THRUST PINION GEAR
65. WASHER, THRUST SIDE GEAR
66. GEAR, SIDE DIFFERENTIAL
67. GEAR, PINION DIFFERENTIAL
68. SCREW, 9 N·m (84 lb in.)
69. WASHER, LOCK
70. GEAR, RING DIFFERENTIAL
71. GEAR, SPEEDO (MECHANICAL)
72. GEAR, SPEEDO (ELECTRONIC)
75. BEARING, DIFFERENTIAL
77. BOLT (TEN), 83 N·m (61 lb ft)

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Figure 22 Differential and Ring Gear Components

Install or Connect (Figure 22)

1. Speedo gear (71 or 72), allow to cool.
2. Bearings (60 and 75), using J-22919 and hydraulic press.
3. Gears (66) and washers (65), gears (67) and washers (64).
4. Pin (63).
5. Screw (68) and washer (69), 9 N·m (84 lb in).
6. Ring gear (70).
   - ID chamfer to carrier (61).
7. NEW bolts (77), 83 N·m (61 lb ft).

DIFFERENTIAL ASSEMBLY SELECTIVE SHIM PRELOAD PROCEDURE

Important (Section 7B3, Figure 1)

- This procedure must be performed when any of the following components are replaced:
  - Transmission Case (85)
  - Clutch and Differential Case (20)
  - Differential Carrier (62)
  - Differential Bearing Assemblies (58 and 74)

Install or Connect (Figure 23)

Tools Required:

J-8092 Universal Drive Handle
J-26935 Shim Selection Set
J-26938 Axle Seal and Bearing Race Installer

1. J-26935 to clutch housing (20) and transmission housing (85).
2. Measure largest shim (73) possible in area 'U', use shim TWO SIZES LARGER (Chart, Figure 23).
3. Selected shim (73).
4. Bearing race (76), using J-26938 and J-8092.
5. Axle seal (23), using J-26938 and J-8092.

UNIT ASSEMBLY

GEAR/SHIFT RAIL ASSEMBLIES AND SUPPORT COMPONENT

Assemble (Figure 24)

1. Input and output shaft gear assemblies (A).
2. Install on gear clusters:
   - 1-2 shift rail (190).
   - Lock pin (196), retain with petroleum jelly.
   - 3-4 shift rail (184).
   - 5TH shift rail (197).
   - Reverse shift rail (180).
   - Shift gate (181) and disengage roller (182).

Install or Connect (Figures 25 and 26)

Tools Required:

Hydraulic Press
J-35824 Output/Input Shaft Support Bearing Installer
J-36031 Retainer Bolt Hex Socket
J-36182-1 Gear Cluster and Transmission Case Assembly/Disassembly Pallet

1. Position gear cluster/shift rail assembly (A) on J-36182-1.
   - align shift rail and shaft pilots to the fixture.
2. Transmission case (85).
   - align bearing bores in case with shaft pilots.
3. NEW bearing (86) output shaft, using J-35824 and hydraulic press.
4. NEW bearing (93) input shaft, using J-35824 and hydraulic press.
   - BE SURE bearings (86 and 93) are seated.
   - Push rails (A and B) to engage and hold transmission in fourth and reverse gear.
5. NEW retainer (88), using J-36031 or equivalent, 70 N·m (50 lb ft).
6. NEW retainer (92), using J-36031 or equivalent, 70 N·m (50 lb ft).
   - Return transmission to neutral

SHIFT SHAFT

Install or Connect (Figure 27)

- Reverse shift lever (153).
- Shift lever (157).
- 1st/2nd bias spring (156).

1. Assemble pins (154) and rollers (152) on shift shaft (155).
   - retain with petroleum jelly.
2. Shift shaft assembly (A).
   - tap with light hammer
   - align hole in shaft (155) with hole in shift lever (157).
3. Pin (158).
   - even with surface of shift lever (157).

CLUTCH AND DIFFERENTIAL HOUSING

Install or Connect (Figure 28)

- Apply sealant P/N 1052943 or equivalent to the outside of the bolt hole pattern of the gear case flange.

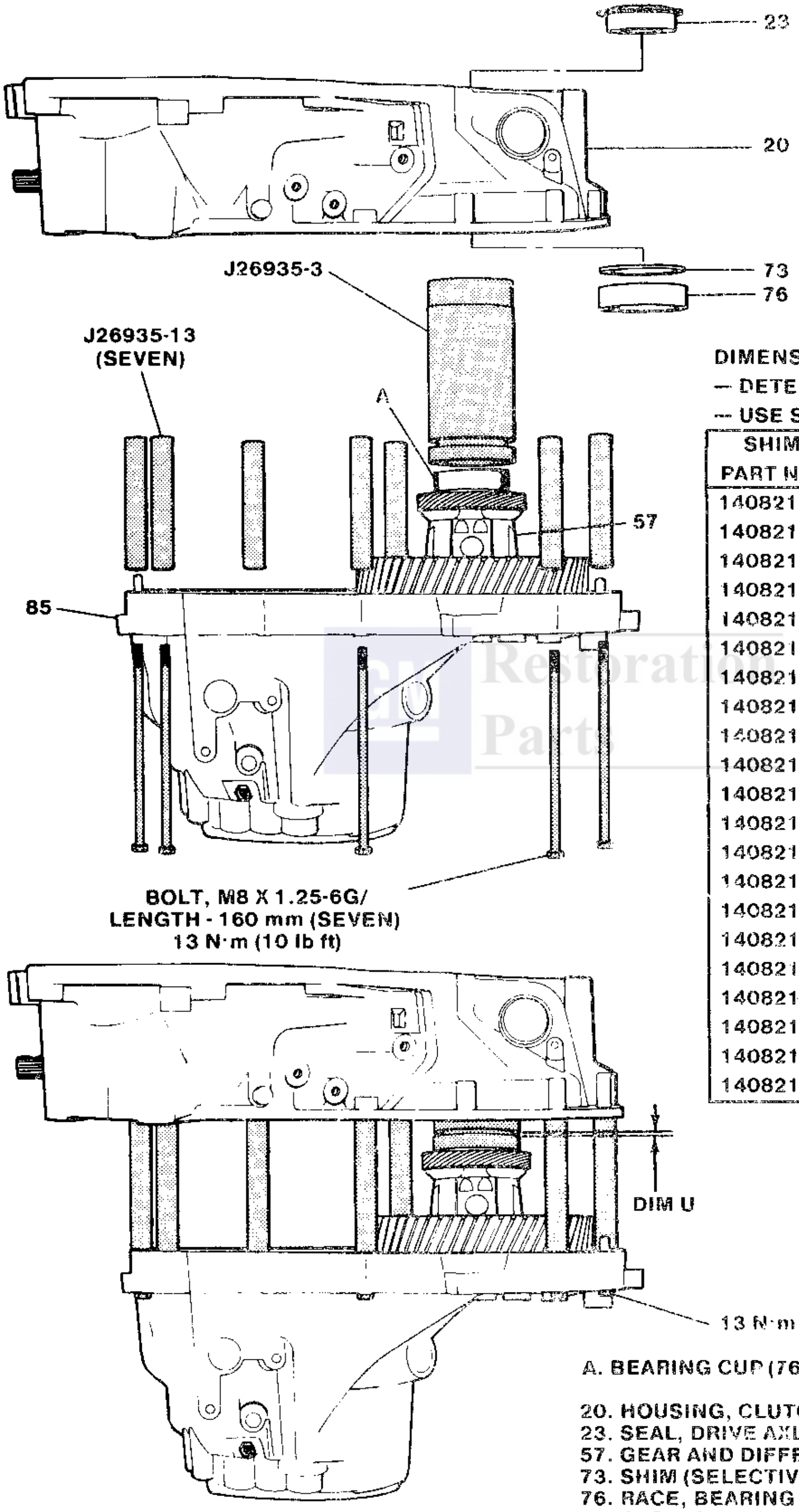
1. Differential (57).
2. Bearing (55).
   - SMALL I.D. DIAMETER OF BEARING CAGE TOWARD CLUTCH HOUSING (20).
3. Magnet (203).
4. Clutch housing (20).
5. Bolts (81), 21 N·m (15 lb ft).

OUTPUT SHAFT SUPPORT BEARING SELECTIVE SHIM PROCEDURE

Tool Required:

Dial Depth Gage or Equivalent

- Be sure OUTPUT BEARING (86) is seated in bore.
- Be sure bearing RETAINER (88) is properly torqued.



DIMENSION U
— DETERMINE LARGEST SHIM WITHOUT BINDING
— USE SHIM TWO SIZES LARGER

SHIM PART NO.	DIM U mm (IN.)	COLOR	STRIPES
14082132	0.30 (0.012)	ORANGE	1
14082133	0.35 (0.014)	ORANGE	2
14082134	0.40 (0.016)	ORANGE	3
14082135	0.45 (0.018)	ORANGE	4
14082136	0.50 (0.020)	YELLOW	1
14082137	0.55 (0.022)	YELLOW	2
14082138	0.60 (0.024)	YELLOW	3
14082139	0.65 (0.026)	YELLOW	4
14082140	0.70 (0.028)	WHITE	1
14082141	0.75 (0.030)	WHITE	2
14082142	0.80 (0.031)	WHITE	3
14082143	0.85 (0.033)	WHITE	4
14082144	0.90 (0.035)	GREEN	1
14082145	0.95 (0.037)	GREEN	2
14082146	1.00 (0.039)	GREEN	3
14082147	1.05 (0.041)	GREEN	4
14082148	1.10 (0.043)	BLUE	1
14082149	1.15 (0.045)	BLUE	2
14082150	1.20 (0.047)	BLUE	3
14082151	1.25 (0.049)	BLUE	4
14082152	1.30 (0.051)	RED	1

A. BEARING CUP (76) MUST BE INSTALLED OVER BEARING

20. HOUSING, CLUTCH AND DIFFERENTIAL
23. SEAL, DRIVE AXLE
57. GEAR AND DIFFERENTIAL ASSEMBLY
73. SHIM (SELECTIVE)
76. RACE, BEARING DIFFERENTIAL
85. CASE, TRANSMISSION

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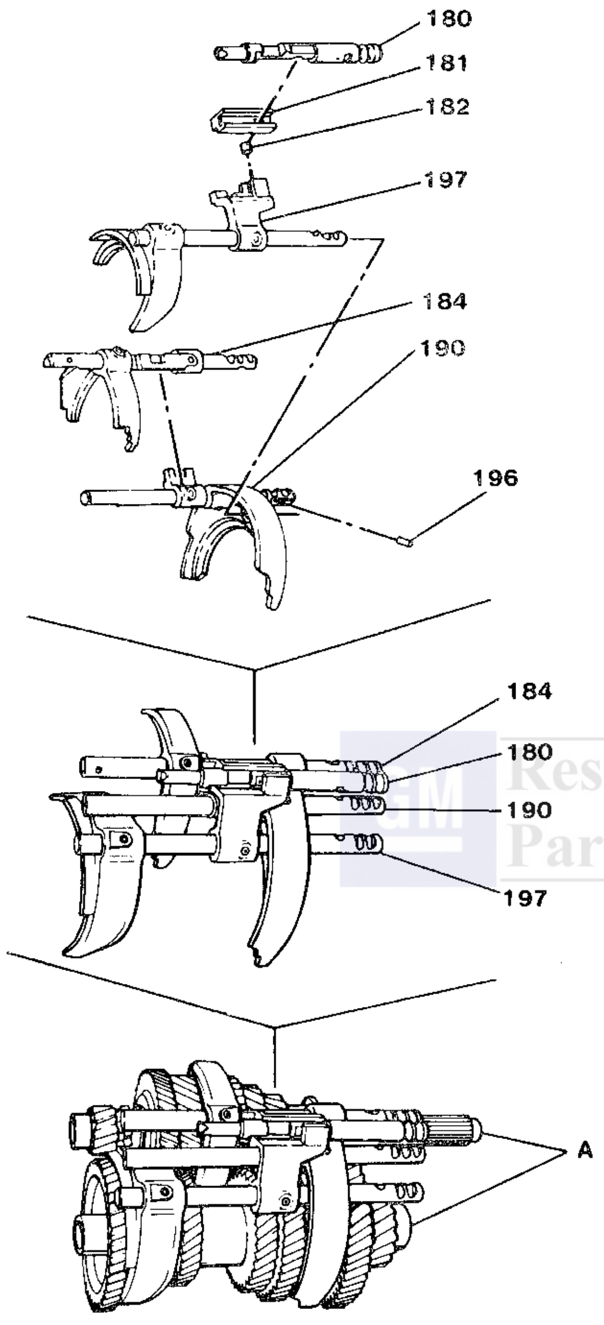
Figure 23 Differential Assembly Selective Shim Preload Procedure



A. GEAR CLUSTER AND SHIFT RAIL ASSEMBLY

180. REVERSE RAIL
181. SHIFT GATE
182. ROLLER
184. 3RD/4TH RAIL
190. 1ST/2ND RAIL
196. INTERLOCK PIN
197. 5TH RAIL

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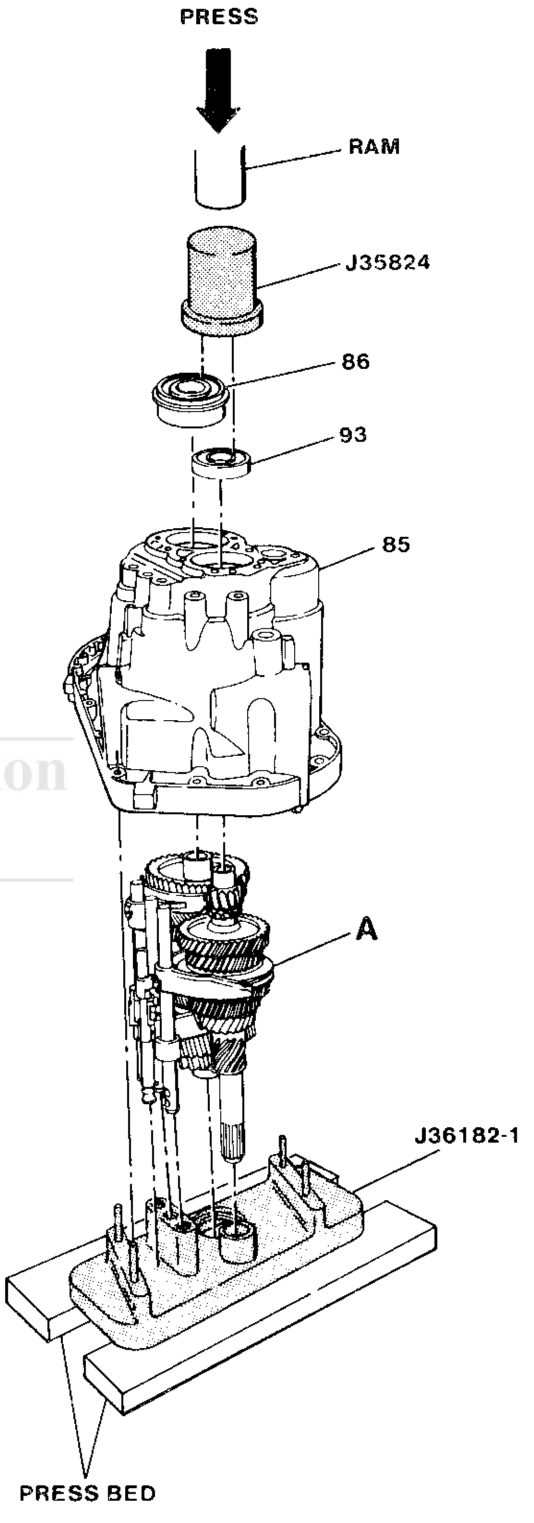
Figure 24 Gear and Shift Rail Assemblies



A. GEAR CLUSTER/SHIFT RAIL ASSEMBLY
85. TRANSMISSION CASE
86. BEARING, OUTPUT SHAFT
93. BEARING, INPUT SHAFT

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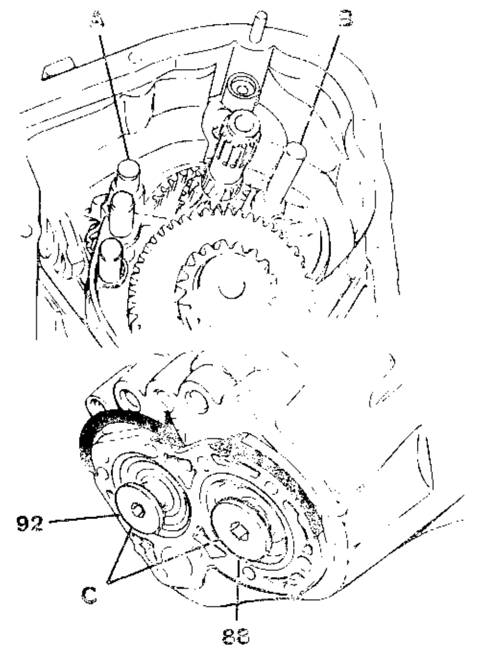
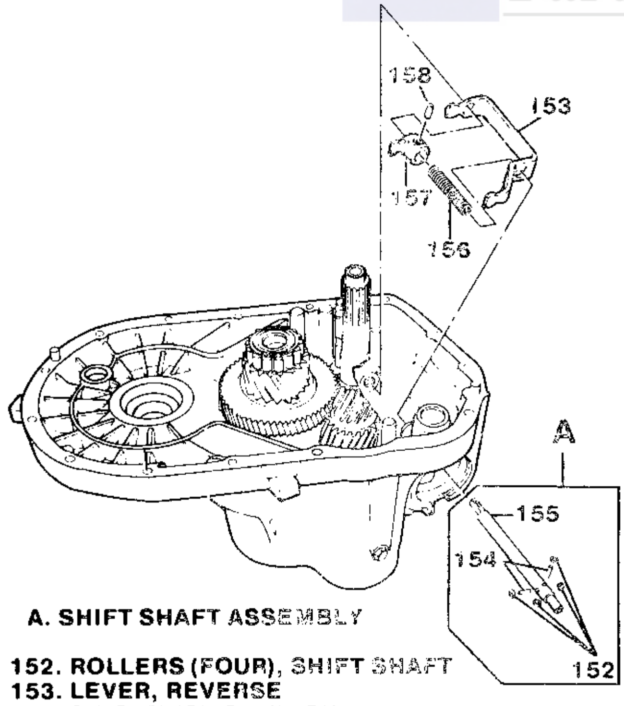
Figure 25 Gear Cluster and Shift Rail Assembly Installation



A. 3RD/4TH GEAR SHIFT RAIL
B. REVERSE GEAR SHIFT RAIL
C. USE J36031 OR EQUIVALENT
88. RETAINER, OUTPUT (COUNTERCLOCKWISE) 70 N·m (50 lb ft)
92. RETAINER, INPUT (CLOCKWISE) 70 N·m (50 lb ft)

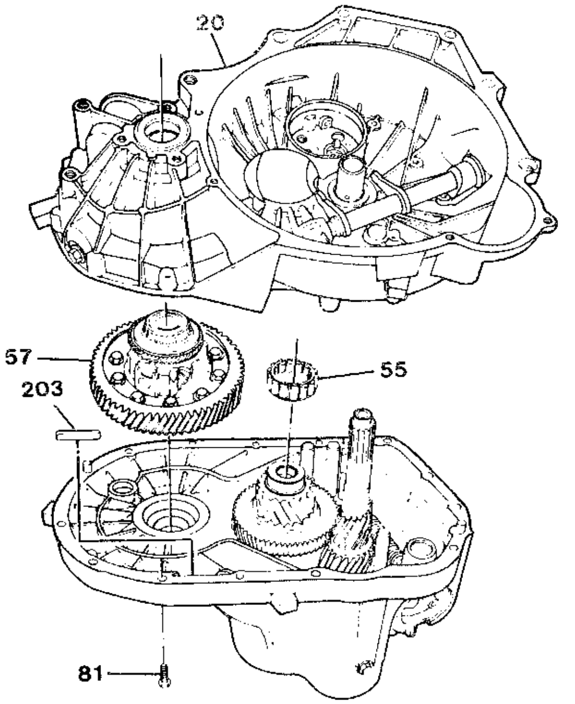
Figure 26 Engaging Transmission in Gear Shaft Support Components Installation



A. SHIFT SHAFT ASSEMBLY

152. ROLLERS (FOUR), SHIFT SHAFT
153. LEVER, REVERSE
154. PINS (TWO), SHIFT SHAFT
155. SHIFT SHAFT
156. SPRING, 1-2 BIAS
157. LEVER, SHIFT
158. PIN, LEVER RETAINER

Figure 27 Shift Shaft Components



20. CASE, CLUTCH AND DIFFERENTIAL
55. BEARING, OUTPUT
57. DIFFERENTIAL ASSEMBLY
81. BOLT (15), 21 N·m (15 lb ft)
203. MAGNET

Figure 28 Clutch and Transmission Housing Components

- Selected shim can be 0.03 mm (0.001 in.) above or 1.12 mm (0.004 in.) below the end plate mounting surface.

Measure (Figure 29)

1. Distance between end plate mounting surface and outer race of output shaft bearing (86).
2. Select shim from Chart (Figure 29).

TRANSMISSION CASE END PLATE

Install or Connect (Figure 30)

- Apply sealant P/N 1052943 or equivalent to the outside end plate (90) bolt hole pattern of case (85).

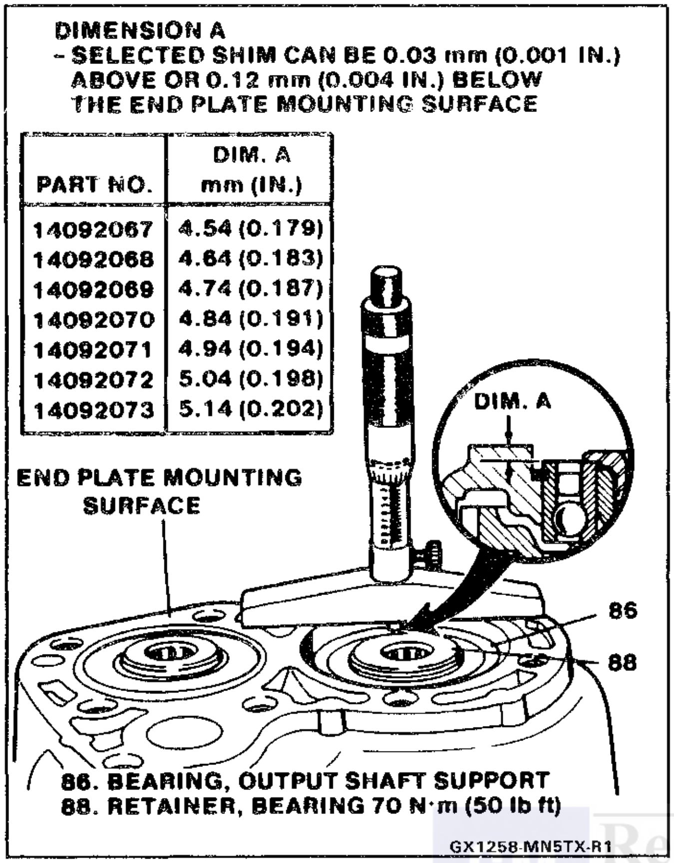
1. Shim (87).
2. End cover plate (90).
3. Bolts (91), 21 N·m (15 lb ft).

SHIFT RAIL DETENT/CLUTCH AND DIFFERENTIAL HOUSING

Install or Connect (Figures 31 and 32)

- Position shift rails so the 5th gear shift rail (197) is 1/4" BELOW the other three shift rails - that MUST be at the same height (neutral position).

1. Reverse bushing (167).
2. Assemble interlock pins (168) and springs (170) into bores in detent holder (169) retain with petroleum jelly.



DIMENSION A
- SELECTED SHIM CAN BE 0.03 mm (0.001 IN.) ABOVE OR 0.12 mm (0.004 IN.) BELOW THE END PLATE MOUNTING SURFACE

PART NO.	DIM. A mm (IN.)
14092067	4.54 (0.179)
14092068	4.64 (0.183)
14092069	4.74 (0.187)
14092070	4.84 (0.191)
14092071	4.94 (0.194)
14092072	5.04 (0.198)
14092073	5.14 (0.202)

86. BEARING, OUTPUT SHAFT SUPPORT
88. RETAINER, BEARING 70 N·m (50 lb ft)

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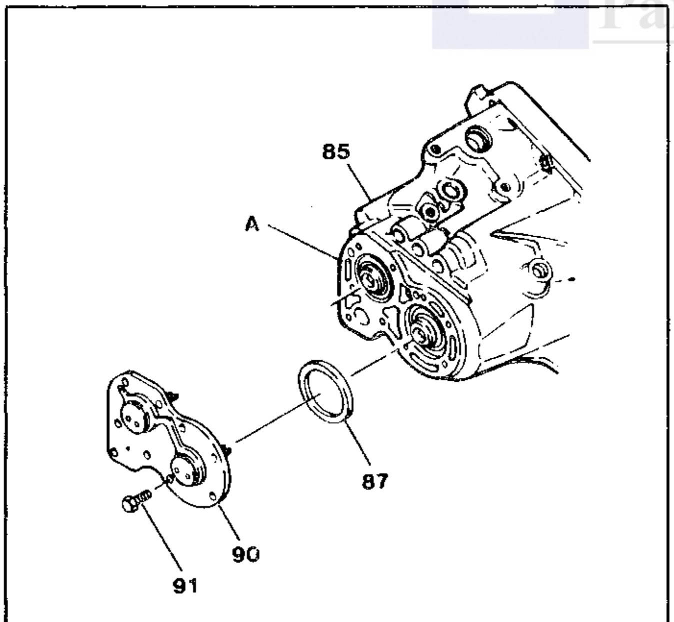
Figure 29 Output Shaft Support Bearing Selective Shim Procedure



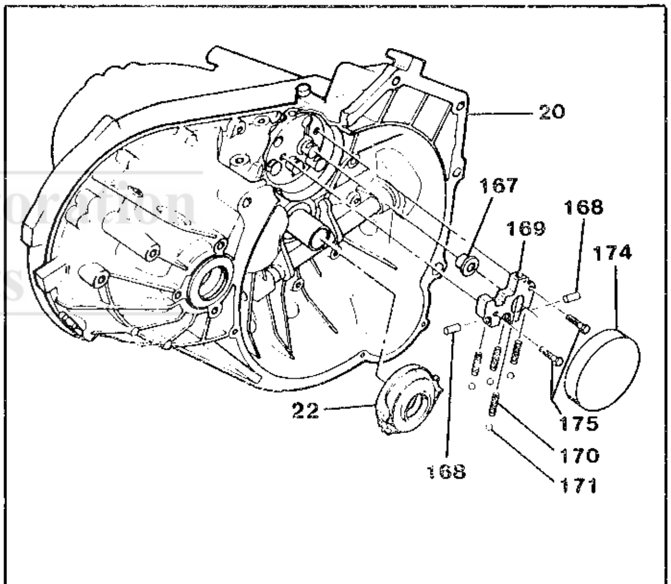
A. APPLY SEALANT, OUTSIDE BOLT HOLE PATTERN

85. TRANSMISSION CASE
87. SHIM (SELECTIVE)
90. END COVER
91. BOLT (NINE), 21 N·m (15 lb ft)

JH1270-MN5TX-R1

Figure 30 Gear Case End Plate

3. Detent holder and spring assembly (169) with the detent ball (171) for the reverse shift rail (183) (Figure 32).
4. Detent balls (171), using a small screwdriver (VIEW B).
   - Install the detent balls for the shift rails in the following order.
     - 1-2 shift rail (190).
     - 3-4 shift rail (184).
     - 5th gear shift rail (197).
5. Position holder (169), using pry to align bolt holes with threads.
6. Bolts (175), 9.0 N·m (84 lb in).
   - BE SURE shift rails are in the correct detent positions.
7. Protective cover (174)
   - Tap until seated in bore.
8. Bearing (22).
   - Apply high temperature grease to inside bore.



20. HOUSING, CLUTCH AND DIFFERENTIAL
22. BEARING, CLUTCH DISENGAGE
167. BUSHING, REVERSE SHIFT RAIL
168. PIN, INTERLOCK (TWO)
169. HOLDER, DETENT
170. SPRING, DETENT (FOUR)
171. BALL, DETENT (FOUR)
174. COVER, DETENT HOLDER
175. BOLT (TWO), 9 N·m (84 lb in.)

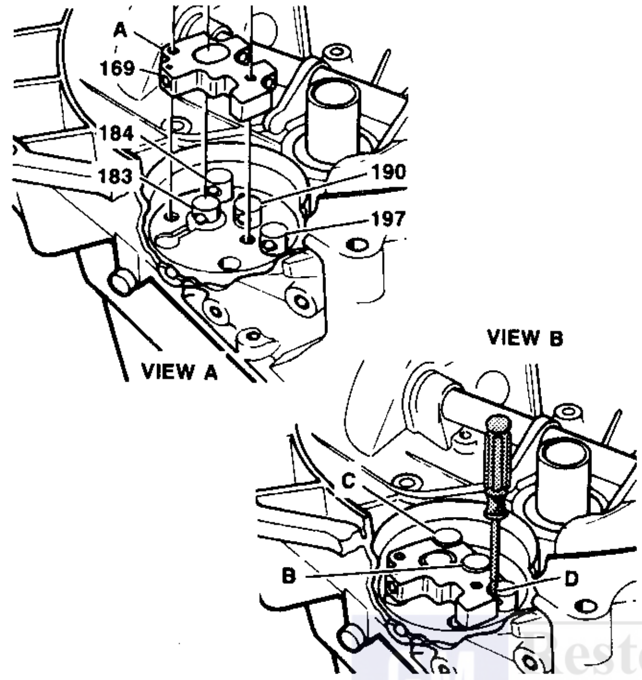
JH1263-MN5TX

Figure 31 Shift Rail Detent Components/Clutch and Differential Housing

SHIFT SHAFT DETENT/TRANSMISSION HOUSING

→← Install or Connect (Figure 33)

1. Spring seat (144) inner.
2. 5th/Rev. bias spring (143).
3. Spring seat (142) outer.
4. Screw (141).



NOTICE: POSITION SHIFT RAILS SO THE 5TH GEAR SHIFT RAIL 197 IS 1/4" BELOW THE OTHER THREE SHIFT RAILS—ALL THREE MUST BE AT THE SAME HEIGHT

A. ASSEMBLED DETENT HOLDER AND SPRING ASSEMBLY 169 (VIEW A) WITH SPRINGS 170, PINS 168 AND THE DETENT BALL 171 FOR THE REVERSE SHIFT RAIL 183.

INSTALL DETENT BALLS WITH SCREWDRIVER (VIEW B):

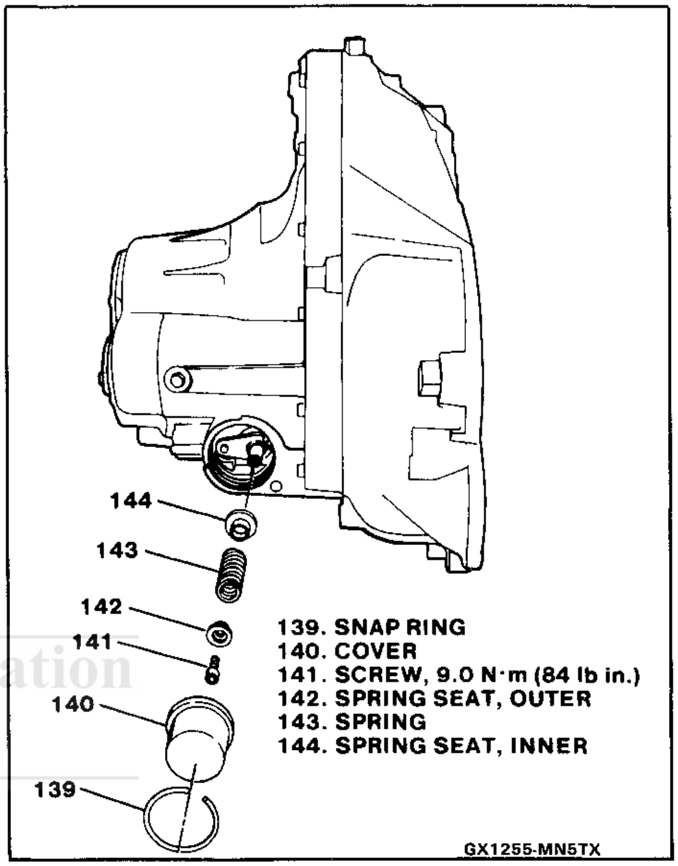
B. 1-2 SHIFT RAIL 190
C. 3-4 SHIFT RAIL 184
D. 5TH GEAR SHIFT RAIL 197
169. HOLDER, DETENT
183. SHAFT, REVERSE SHIFT
184. RAIL, 3RD/4TH SHIFT ASSEMBLY
190. RAIL, 1ST/2ND SHIFT ASSEMBLY
197. RAIL, 5TH SHIFT ASSEMBLY

JH1556-MN5TX

Figure 32 Detent Holder Installation

- use small amount of threat sealant GM P/N—1052624 or equivalent, 9.0 N·m (84 lb in).

5. Protective cover (140).
   - position to below snap ring groove.
6. Snap ring (139).



139. SNAP RING
140. COVER
141. SCREW, 9.0 N·m (84 lb in.)
142. SPRING SEAT, OUTER
143. SPRING
144. SPRING SEAT, INNER

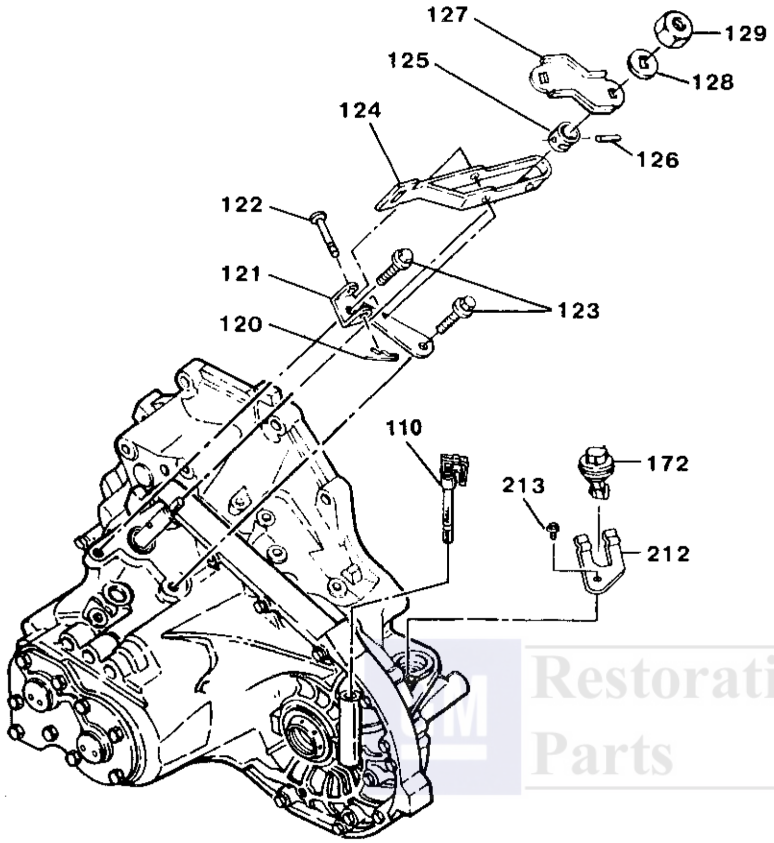
GX1255-MN5TX

Figure 33 Shift Shaft Detent Components/Transmission Housing

EXTERNAL TRANSAXLE MOUNTED LINKAGE INSTALLATION

Install or Connect (Figure 34)

1. Bracket (121).
2. Bolts (123).
   - 23 N·m (17 lb ft).
3. Collar (125) and pin (126).
4. Pivot (124) and pin (122).
5. Retainer (120).
6. Lever (127).
7. Washer (128) and nut (129).
   - 83 N·m (61 lb ft).
   - DO NOT ALLOW lever (127) to move during installation of nut (129).
8. Fluid level indicator assembly (110).
9. Electronic speedo sensor assembly (172), retainer (212) and bolt (213).
   - 9 N·m (84 lb. in.)



110. INDICATOR ASSEMBLY TRANSMISSION FLUID LEVEL
120. RETAINER, SELECTOR PIN
121. RETAINER, SELECTOR LEVER
122. PIN, SELECTOR LEVER PIVOT
123. BOLT/SCREW, M8 X 1.25 X 20 (TWO)
124. LEVER, SELECTOR
125. COLLAR, SHIFT SHAFT
126. PIN, SPRING
127. LEVER, SHIFT
128. WASHER
129. NUT, M14 X 2
172. SPEEDO SIGNAL ASSEMBLY
212. SPEEDO SIGNAL ASSEMBLY, RETAINER
213. BOLT

Figure 34 External Transaxle Mounted Linkage

TORQUE SPECIFICATIONS

P/N*	DESCRIPTION OF USAGE	TORQUE
18	Reverse shift rail guide	21 N·m (15 lb ft)
68	Differential pin	9 N·m (84 lb in)
77	Differential gear	83 N·m (61 lb ft)
79	Fluid drain plug	24 N·m (18 lb ft)
81	Clutch housing to gear housing	21 N·m (15 lb ft)
83	Alternate oil level check/fill plug	24 N·m (18 lb ft)
88	Output shaft bearing support	70 N·m (50 lb ft)
91	End plate to gear housing	21 N·m (15 lb ft)
92	Input shaft bearing support	70 N·m (50 lb ft)
94	Reverse idler gear bracket	21 N·m (15 lb ft)
(123 or 132)	Shift pivot bracket	23 N·m (17 lb ft)

(129 or 137)	Shift lever nut	83 N·m (61 lb ft)
141	Shift shaft detent	9 N·m (84 lb in)
159	Interlock plate	21 N·m (15 lb ft)
169	Shift rail detent holder	9 N·m (84 lb in)
179	Output bearing race	21 N·m (15 lb ft)
205	Sliding sleeve detent	44 N·m (32 lb ft)
211	Stud	21 N·m (15 lb ft)
212	Electronic speed sensor retainer	9 N·m (84 lb in)
219	Back-up light switch assembly	9 N·m (84 lb in)

* Disassembled Parts Illustration, Section 7B3 (Figures 1 and 2)

LUBRICANT SPECIFICATIONS

Lube Capacity (Approximate)
A, N (with 2.5L or 2.3L engine) and
P Carline .... 1.9 Liters (2 Quarts)
J, L, N (with 2.0L Turbo) and
W Carline .... 2.1 Liters (5 Pints)
Recommended Lube .... P/N 12345349 or Equivalent

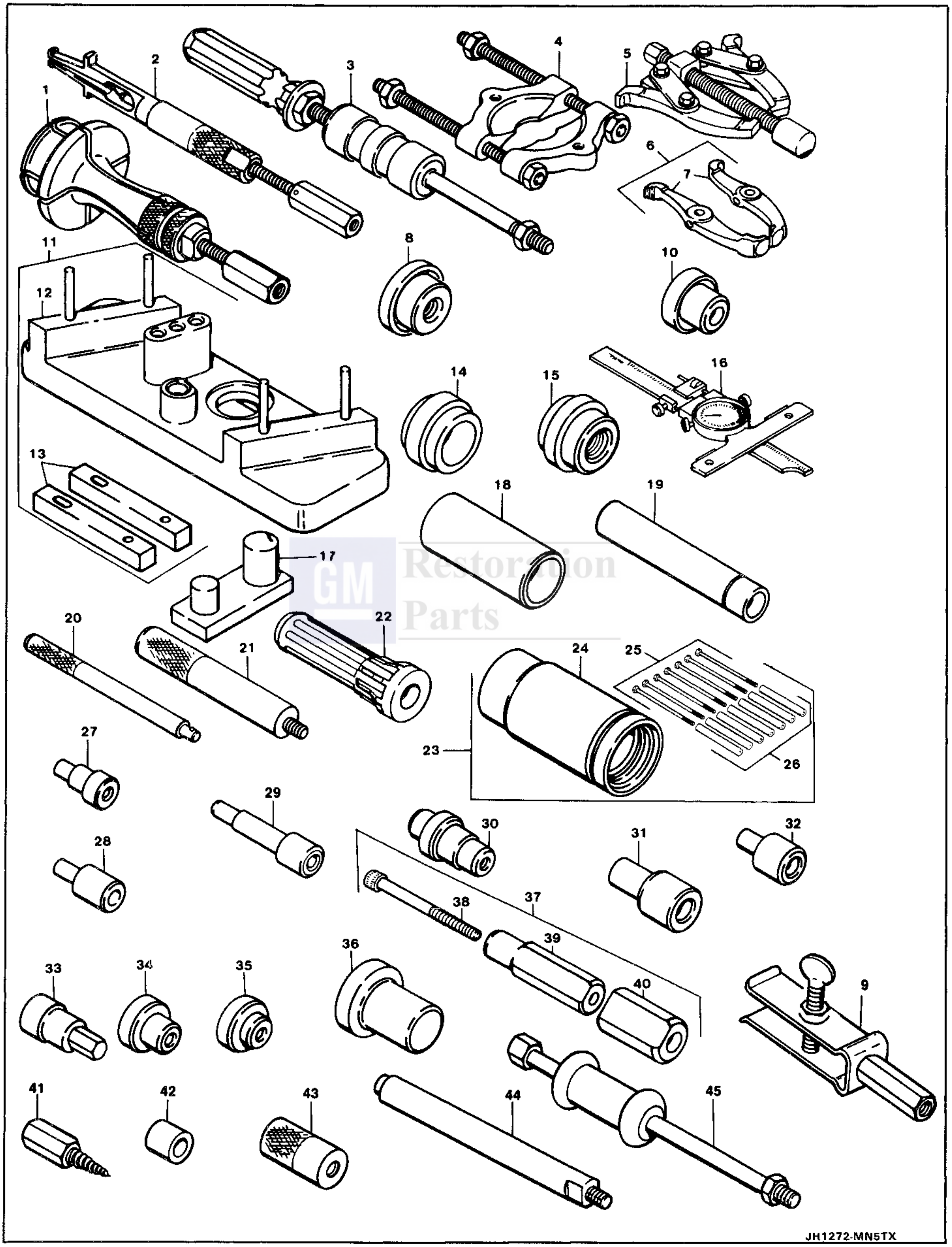


Figure 35 Special Tools, Muncie 282 (5-Speed) Transaxle

SPECIAL TOOLS MUNCIE 282 (5-SPEED) TRANSAXLE

TOOL NUMBER	TOOL NAME	ITEM NUMBER
J6125-1B	SLIDE HAMMER	45
J8092	UNIVERSAL DRIVER HANDLE	21
J2241-11	SIDE BEARING PULLER ADAPTER, DIFFERENTIAL	34
J22888	BEARING REMOVER	5
J22888-35	BEARING REMOVER LEG (TWO)	7
J22888-50	BEARING REMOVER LEG SET	6
J22912-01	INPUT/OUTPUT SHAFT GEARS REMOVER	4
J22919	DIFFERENTIAL INNER BEARING INSTALLER	10
J23423-A	DIFFERENTIAL AND OUTPUT SHAFT BEARING CUP INSTALLER	15
J23598	SIDE BEARING PULLER ADAPTER, DIFFERENTIAL	35
J23907	SLIDE HAMMER AND ADAPTER SET	3
	DIAL DEPTH GAGE	16
J26935	SHIM SELECTION SET	23
J26935-3	DIFFERENTIAL SHIMMING GAGE	24
J26935-13	SHIM SELECTION SET SPACERS (SEVEN)	26
	BOLTS, M8 x 1.25-6G / LENGTH - 160 mm (SEVEN)	25
J26938	SEAL AND RACE, DIFFERENTIAL, INSTALLER	8
J26941	BEARING REMOVER	9
J35823	SHIFT SHAFT SEAL INSTALLER	22
J35824	INPUT BEARING ASSEMBLY REMOVER/INSTALLER/SHAFT SUPPORT BEARING INSTALLER	36
J36027	SHIFT SHAFT BEARING REMOVER	27
J36029	SHIFT RAIL BUSHING REMOVER/INSTALLER	37
J36029-1	ADAPTER TO DRIVE HANDLE	40
J36029-2	INSTALL/REMOVER ADAPTER	39
	CAP SCREW, 1/4-20 x 2 1/2	38
J36030	REVERSE SHIFT RAIL BUSHING INSTALLER	28
J36031	BEARING RETAINER BOLT HEX SOCKET	33
J36032	CLUTCH SHAFT INNER REVERSE SHIFT RAIL BUSHING REMOVER	2
J36033	CLUTCH SHAFT INNER BUSHING INSTALLER	31
J36034	SLIDING SLEEVE BUSHING REMOVER/INSTALLER	29
J36037	CLUTCH SHAFT UPPER BUSHING REMOVER/INSTALLER	19
J36038	OUTPUT SHAFT BEARING CUP REMOVER	1
J36039	SHIFT DETENT LEVER BUSHING REMOVER/INSTALLER	30
J36182	INPUT/OUTPUT SHAFT REMOVER/INSTALLER ASSEMBLY SET	11
J36182-1	PALLET	12
J36182-2	DISASSEMBLY ADAPTER (TWO)	13
J36183	INPUT SHAFT REMOVER/INSTALLER PRESS TUBE	18
J36184	OUTPUT SHAFT REMOVER/INSTALLER ADAPTER PRESS TUBE REDUCER	14
J36185	INPUT/OUTPUT SHAFT BEARING REMOVER	17
J36189	SHIFT SHAFT BEARING INSTALLER	32
J36190	UNIVERSAL DRIVER HANDLE	20
J36720-1	CLUTCH SHAFT INNER BEARING INSTALLER	43
J36720-2	CLUTCH SHAFT OUTER BEARING INSTALLER	44
J37101-1	CLUTCH SHAFT INNER BEARING REMOVER	41
J37107-2	CLUTCH SHAFT INNER BEARING REMOVER GUIDE	42

ITEM NUMBER/TOOL NUMBER CROSS REFERENCE

1 - J36038
2 - J36032
3 - J23907
4 - J22912-01
5 - J22888
6 - J22888-50
7 - J22888-35
8 - J26938
9 - J26941
10 - J22919
11 - J36182
12 - J36182-1
13 - J36182-2
14 - J36184
15 - J23423-A
16 -
17 - J36185
18 - J36183
19 - J36037
20 - J36190
21 - J8092
22 - J35823
23 - J26935
24 - J26935-3
25 - BOLTS (SEVEN)
26 - J26935-13 (SEVEN)
27 - J36027
28 - J36030
29 - J36034
30 - J36039
31 - J36033
32 - J36189
33 - J36031
34 - J2241-11
35 - J23598
36 - J35824
37 - J36029
38 - CAP SCREW
39 - J36029-2
40 - J36029-1
41 - J37107-1
42 - J37107-2
43 - J36720-1
44 - J36720-2
45 - J6125-1B

JH1273-MN5TX

Figure 35(L)

SECTION 7C

HYDRAULIC CLUTCH

CONTENTS

GENERAL DESCRIPTION

PRINCIPAL COMPONENTS

(Figures 1 and 2)

The principal parts of the clutch system are the driving members, the driven members and the operating members. Figure 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 assembly.

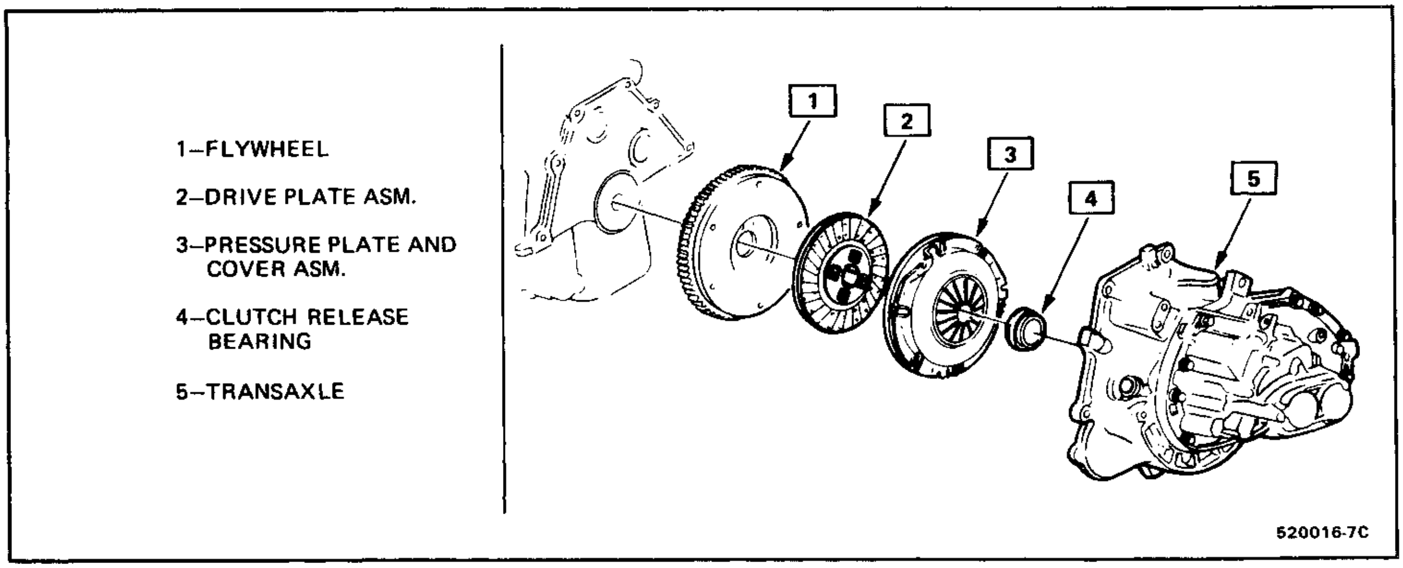


Figure 1 Clutch Exploded

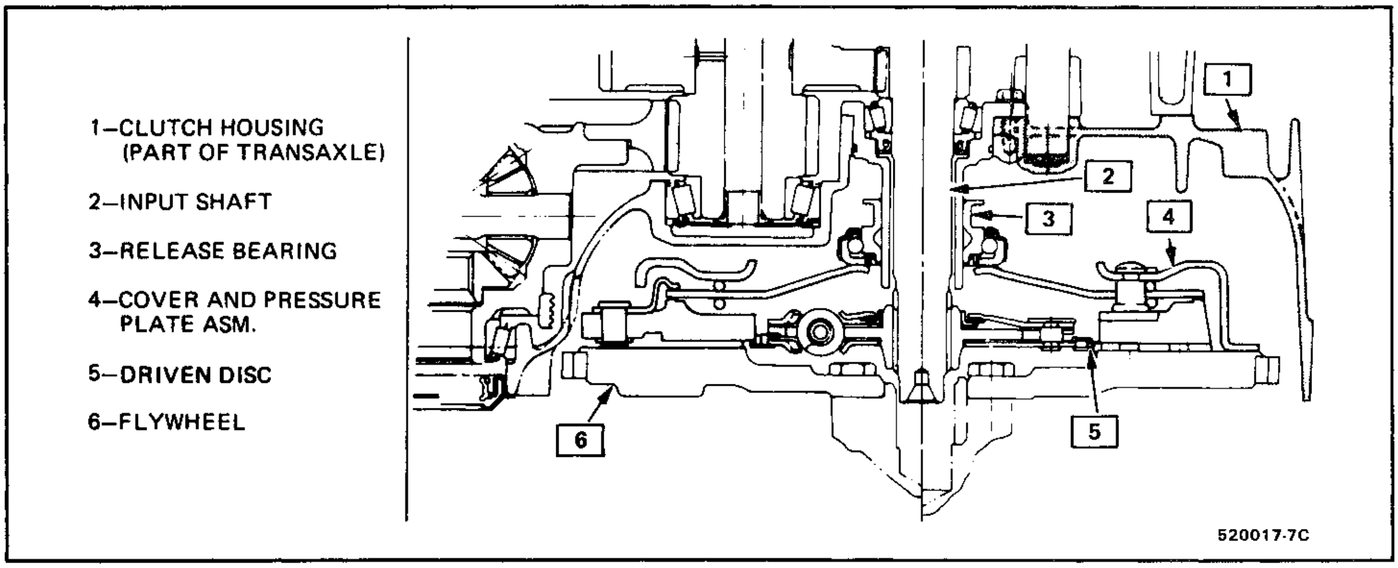


Figure 2 Clutch Cross Section

Operating Members

(Figure 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

(Figure 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

(Figure 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.

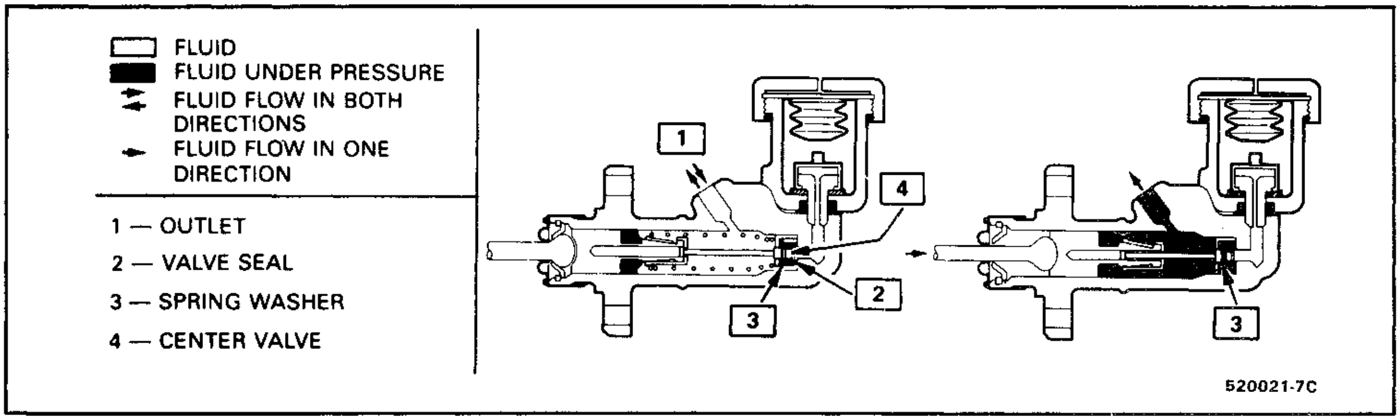


Figure 3 Master Cylinder Cross Section

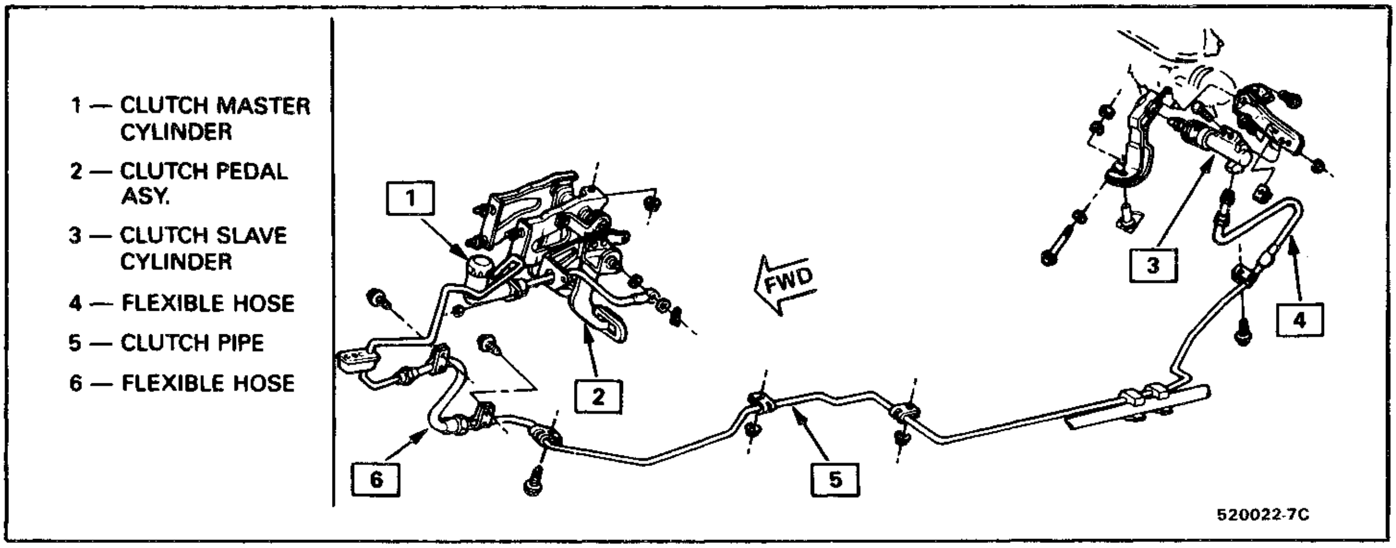


Figure 4 Hydraulic Clutch, Pipe Routing

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-VEHICLE 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 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

(Figure 5)

1. Cylinder push rod at clutch pedal.
2. Hydraulic line at master cylinder.
3. Nuts attaching cylinder to cowl, remove cylinder.

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.).

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.

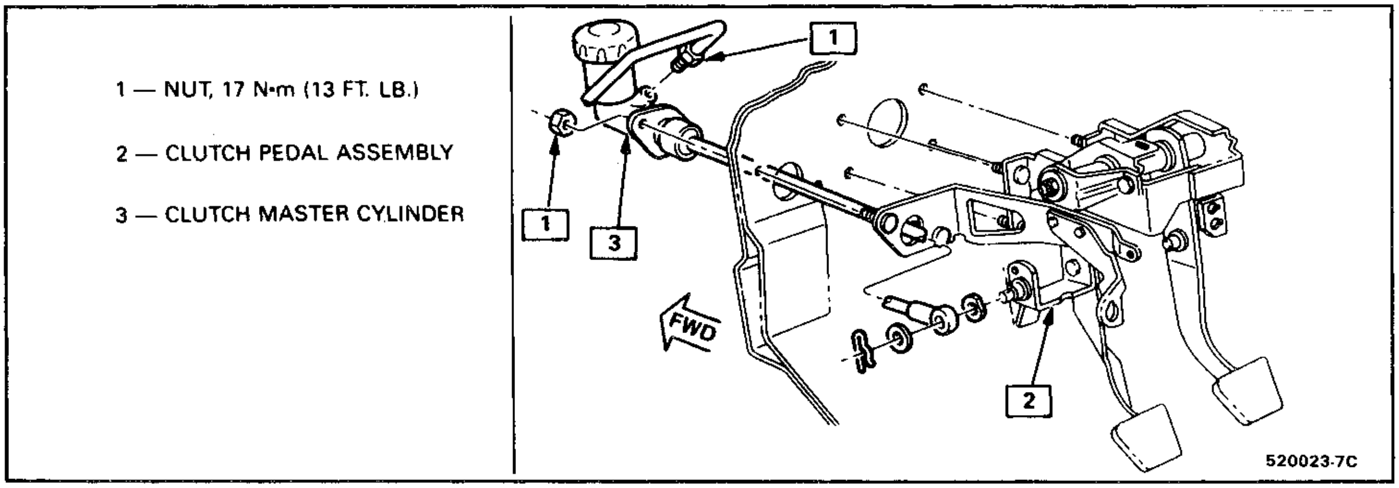


Figure 5 Clutch Pedal & Master Cylinder Assembly

CLUTCH SLAVE CYLINDER

Remove or Disconnect

(Figure 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

(Figure 6)

1. Engine wire harness clamp at slave 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.

Tighten

Torque nuts to 22 N•m (16 lb. ft.).

CLUTCH RELEASE LEVER

Remove or Disconnect

(Figure 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.).

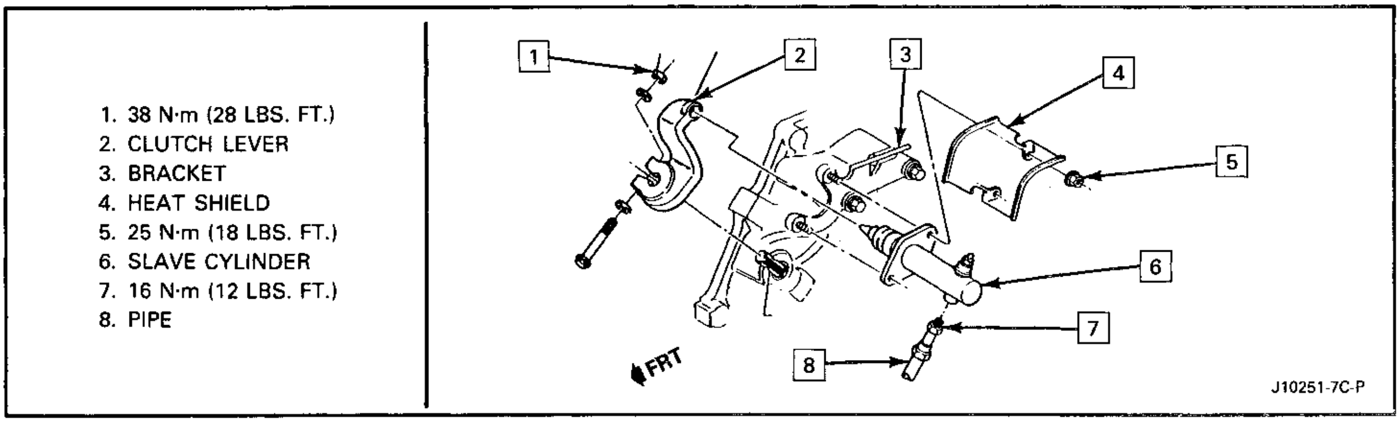
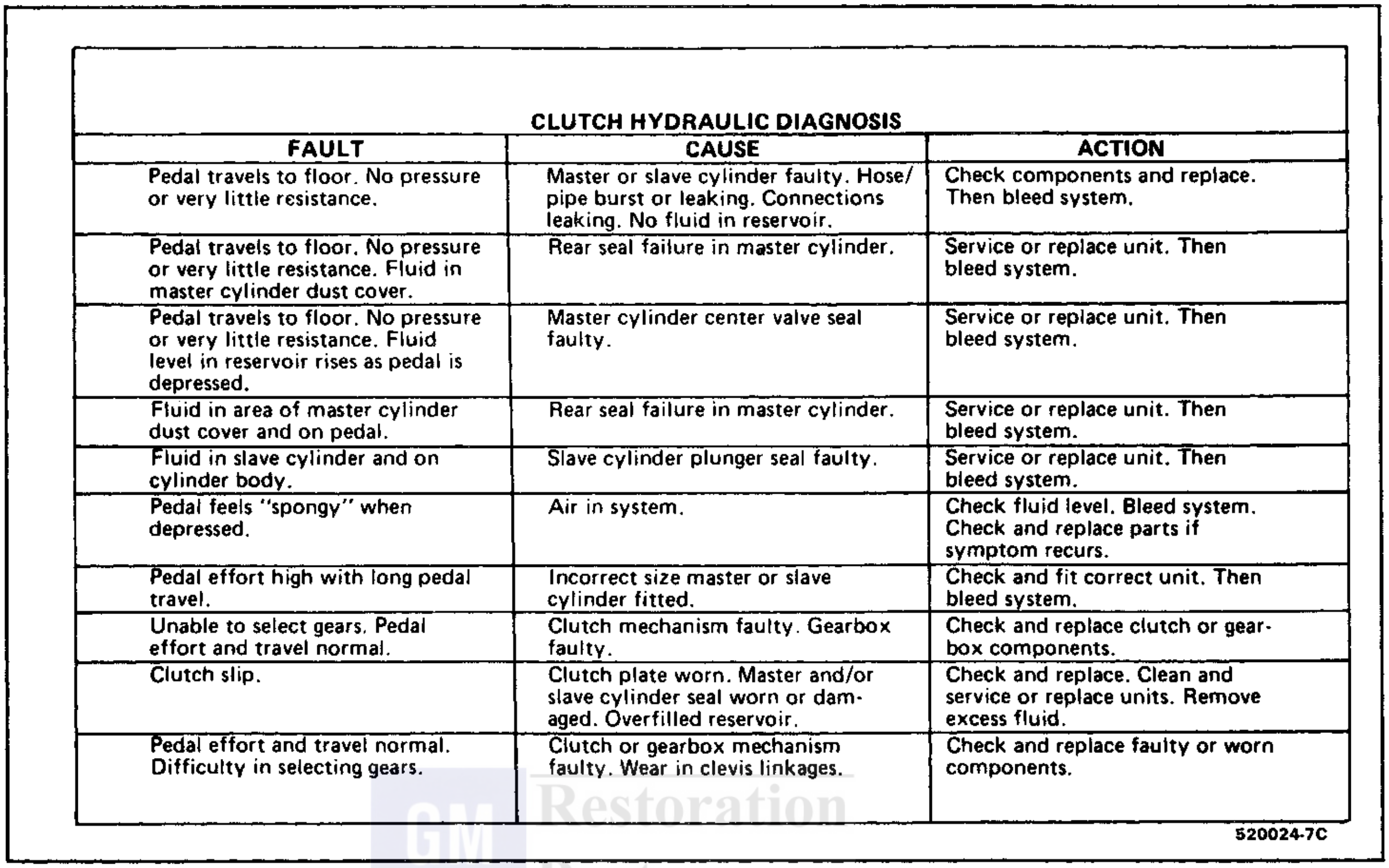


Figure 6 Clutch Slave Cylinder & Clutch Lever Mounting



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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Figure 7 Clutch Hydraulic Diagnosis

CLUTCH PEDAL PUSH ROD

Figure 9

Important

Apply clutch and verify the clutch push rod remains parallel to bracket. The clutch pedal lever and pivot pin must be square to pedal. The clutch pedal pivot pin needs a snug fit to the clutch master cylinder push rod.

CLUTCH PRESSURE PLATE & DISC

Remove or Disconnect

(Figure 1)

1. Transaxle assembly as outlined in Section 7B2 or 7B3 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.)

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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Figure 8 Clutch Mechanical Diagnosis

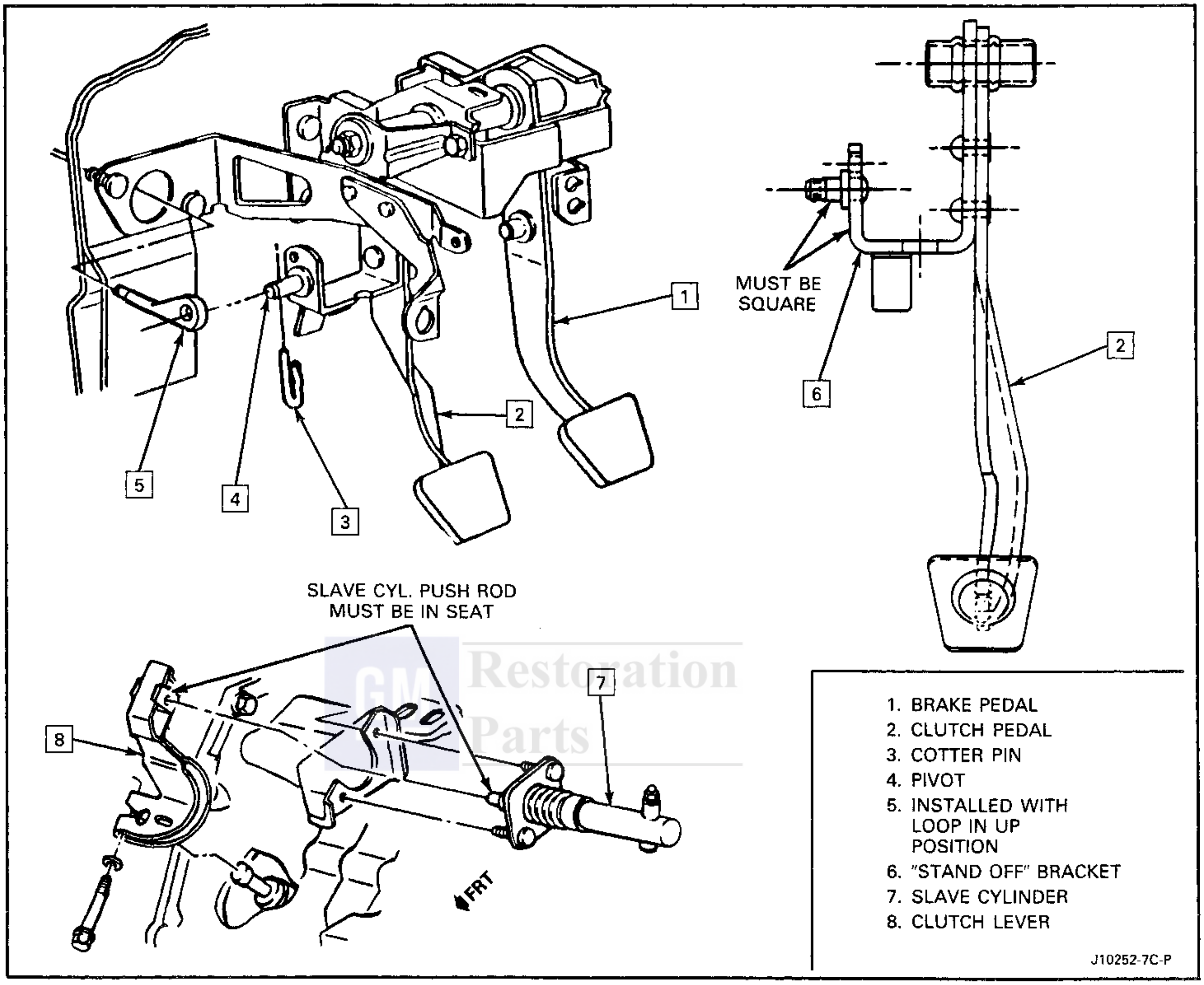


Figure 9 Master and Slave Cylinder Push Rod Alignment

3. Lightly lubricate the O.D. groove and completely pack full the I.D. recess of the release bearing, as shown in Figure 12 with P/N 1051344 or equivalent.
4. Transaxle as outlined in Section 7B2 or 7B3.

CLUTCH RELEASE BEARING

Remove or Disconnect

(Figure 1)

1. Transaxle assembly as outlined in Sections 7B2 or 7B3.
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.

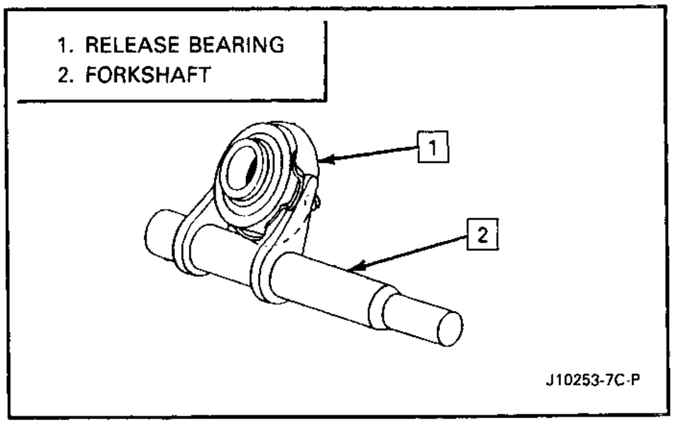


Figure 10 Release Bearing Installation

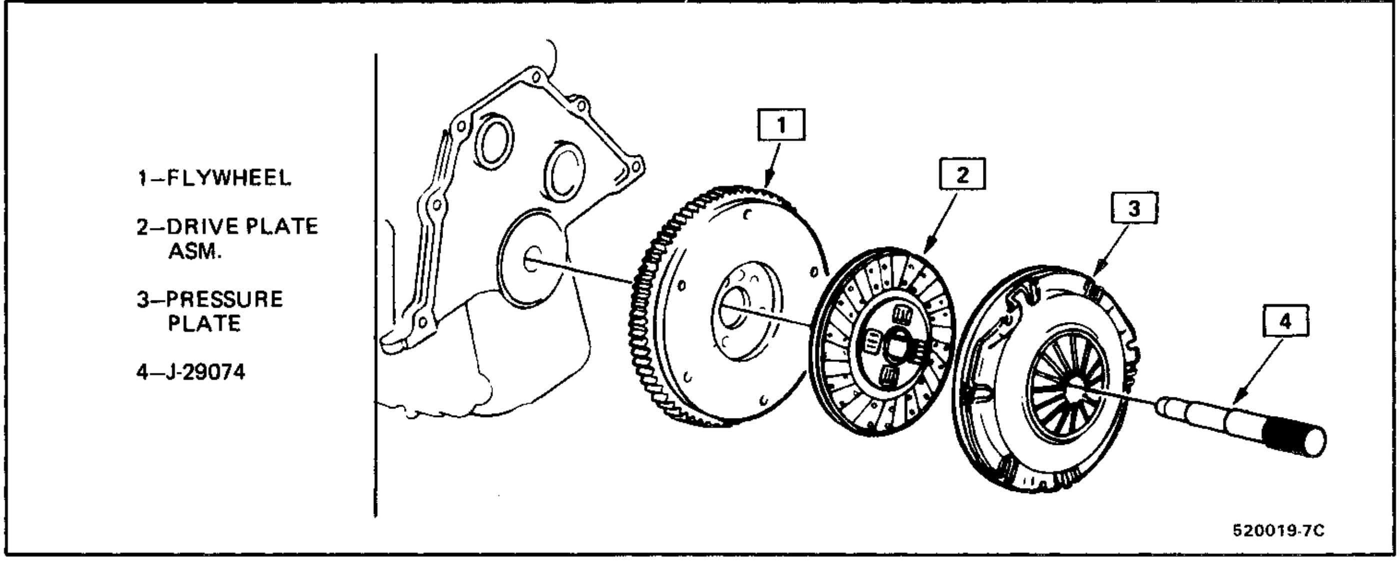


Figure 11 Clutch Pressure Plate & Disc

Install or Connect

1. Lightly lubricate the clutch fork ends that contact the bearing and completely pack full the I.D. recess or the release bearing, with P/N 1051344 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 7B2 or 7B3 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

(Figure 11)

1. Transaxle assembly as outlined in Section 7B2 or 7B3.
2. Pressure plate and clutch disc assembly as previously outlined in this section.
3. Flywheel attaching bolts and flywheel assembly.

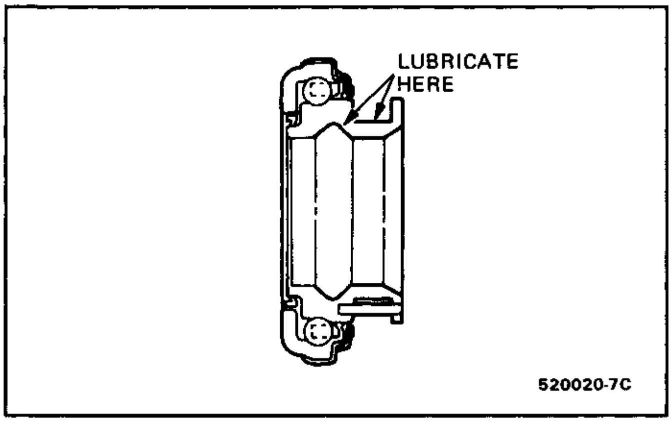


Figure 12 Release Bearing Lubrication

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 outlined in this section.
2. Transaxle assembly as outlined in Sections 7B2 or 7B3.

UNIT REPAIR

CLUTCH MASTER CYLINDER

Remove or Disconnect

(Figure 13)

1. Master cylinder as outlined in On-vehicle 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.

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.
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

(Figure 14)

1. Slave cylinder as outlined in On-vehicle Service.
2. Pull back dust cover and remove circlip together with retaining ring and push rod.
3. Shake cylinder to remove piston and seal.

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

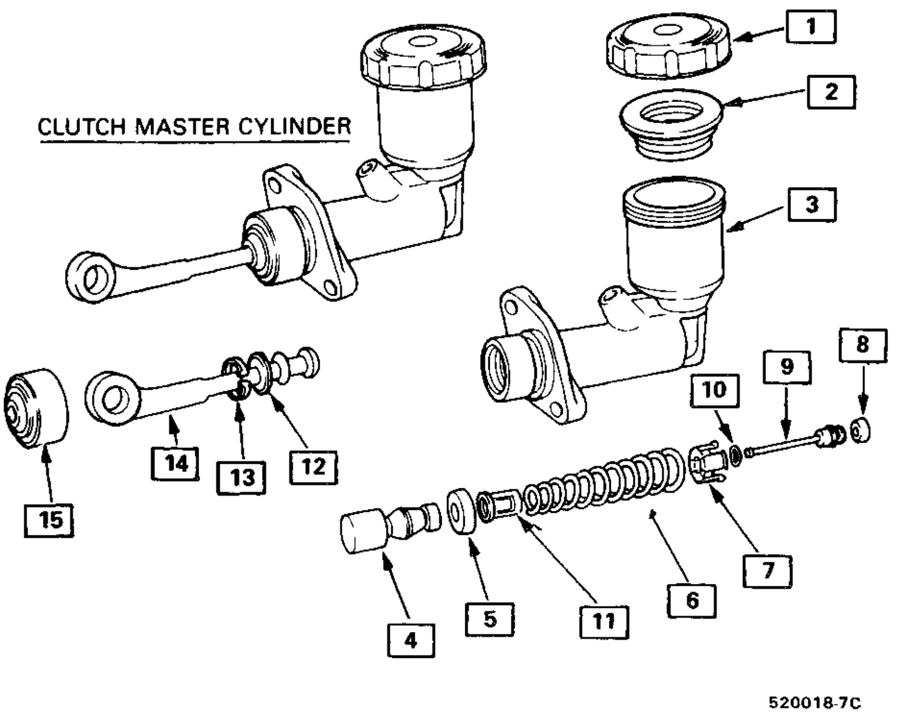
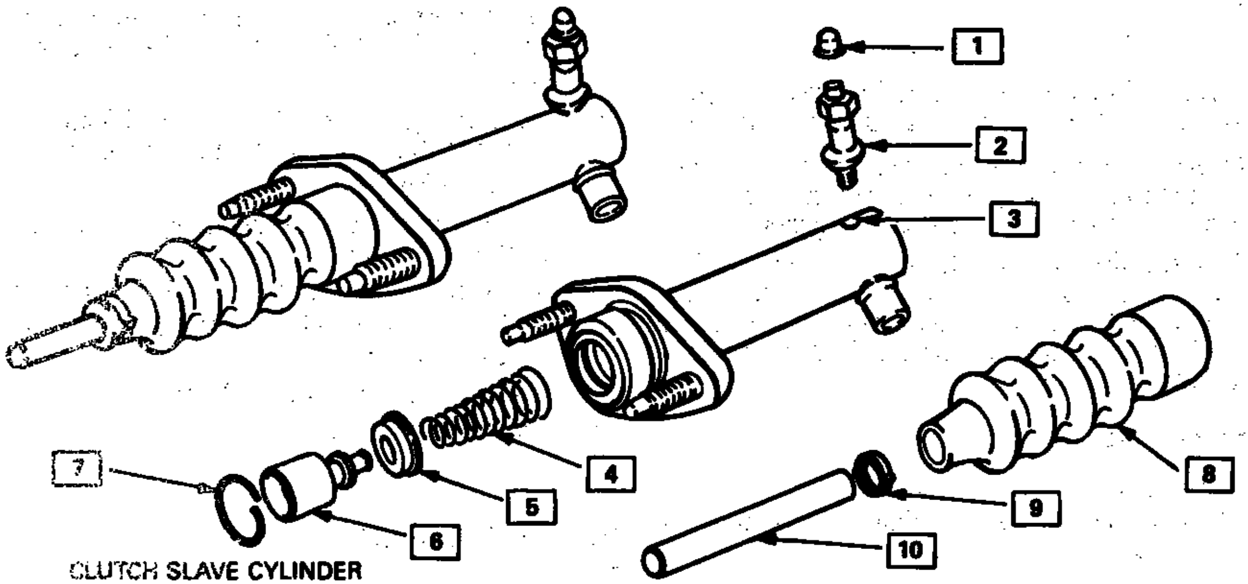


Figure 13 Clutch Master Cylinder



CLUTCH SLAVE 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

520014-7C

Figure 14 Clutch Slave Cylinder

> **NOTICE:** 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.

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 known 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. Close bleedscrew immediately after last downward stroke of pedal when air bubbles no longer appear.
5. Repeat procedure until air is dispelled at bleedscrew.

CLUTCH SHAFT AND/OR BUSHINGS

Remove or Disconnect

Tools Required:

J36037 Bushing Remover/Installer
J36032 Bushing Remover
J23907 Slide Hammer
J36190 Driver

1. Transaxle assembly, see Section 7B2 or 7B3.
2. Clutch release lever.
3. Clutch dust seal.
4. Drive upper bushing with J36037 into housing.
5. Clutch shaft and upper bushing. Slide shaft out of case at a slight angle.
6. Lower bushing using J36032 with J23907.
   - — Engage second step on J36032 below bushing and tighten screw to expand legs.

Install or Connect

1. Lower bushing using J36033 with J36190.
2. Clutch shaft.
3. Upper bushing.
   - — Drive bushing into housing until line on J36037 is flush with housing surface.
4. Dust seal.
5. Clutch release lever.
   - — 50 N•m (37 lb. ft.).
6. Transaxle assembly, see Sections 7B2 or 7B3.

Adjust

- Fluid Level.
  - — Manual transaxle oil 5W-30, #1052931 or equivalent.
  - — Lube capacity 1.9 liters (2 quarts).

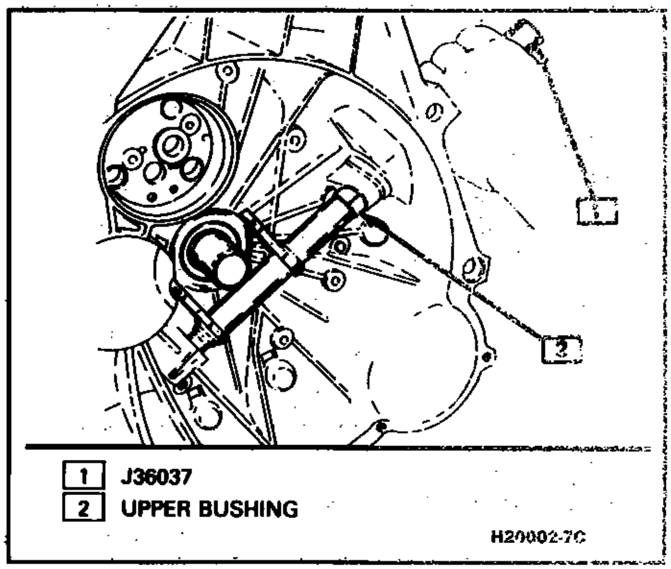


Figure 15 Upper Bushing Removal

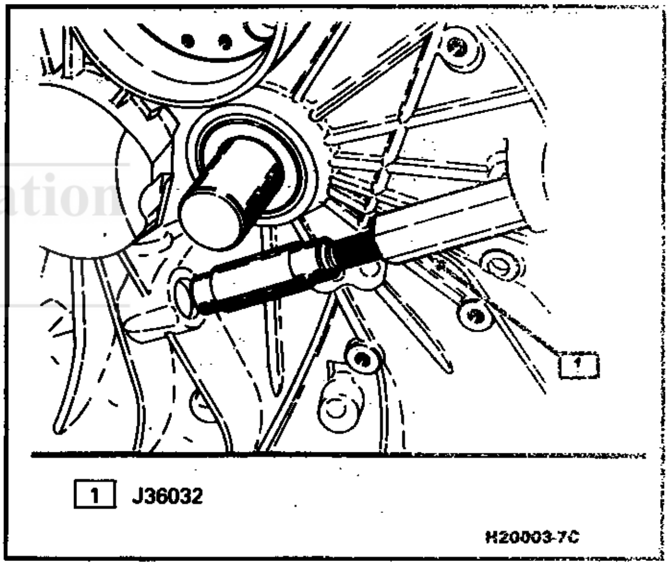


Figure 16 Lower Bushing Removal

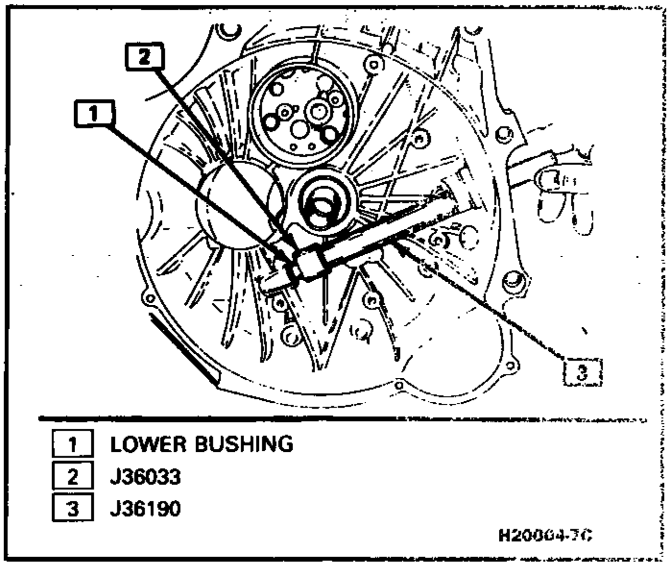
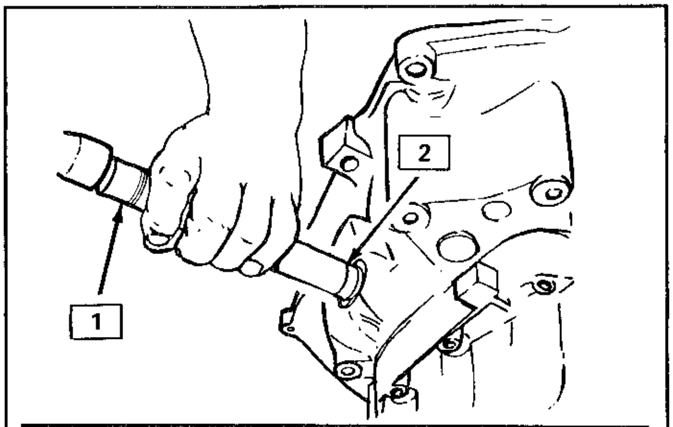


Figure 17 Lower Bushing Installation



1 J36037
2 BUSHING DEPTH GAGE

H20005-7C

Figure 18 Upper Bushing Installation

SPECIFICATIONS

HYDRAULIC FLUID SPECIFICATIONS

Fluid type Delco Supreme No. 11 Hydraulic Brake Fluid or equivalent. Must meet DOT 3 requirement.

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	22	16
● Slave Cylinder Bracket To Transaxle	50	32

J10254-7C-P

Figure 19 Specifications

CONTENTS

SECTION 8A

ELECTRICAL DIAGNOSIS

FIERO

INDEX

DIAGNOSTIC INFORMATION

This manual contains the following kinds of diagnostic information:

- Electrical Schematics
- Component Location Lists
- Harness Connector Faces
- Troubleshooting Hints
- System Checks
- System Diagnoses
- Circuit Operation Descriptions
- Harness Routing Views

Using these elements together will make electrical troubleshooting faster and easier. Each element is described below.

The **Electrical Schematic** should always be your starting point in using this Electrical Troubleshooting Manual. The schematic shows the electrical current paths when a circuit is operating properly. It is essential to understand how a circuit *should* work before trying to figure out why it doesn't.

The **Harness Connector Faces** show the cavity or terminal locations in all the multi-pin connectors shown in the schematic. Together with the wire colors and terminals given in the schematic, they help you locate test points. The drawings show the connector faces you see after the harness connector has been disconnected from a component. When more than one connector is connected to a component the connectors are all shown together.

The **Troubleshooting Hints** offer short-cuts or checks to help you determine the cause of a complaint. They are not intended to be a rigid procedure for solving an electrical situation. Rather, Troubleshooting Hints represent a common-sense approach, based on an understanding of the circuit.

The **System Check** gives a summary of how the circuit should be operated and what should happen. This is especially important when you are working on a new system. The System Check will help you identify symptoms, lead you to diagnosis and confirm the system after repair.

The **System Diagnosis** provides a procedure to follow that will locate the condition in a circuit. If your own knowledge of the system and the Troubleshooting Hints have not produced a quick fix, follow the System Diagnosis. All procedures are based on symptoms to assist you in locating the condition as fast as possible.

The **Circuit Operation** will help you understand the circuit. It describes the components and how the circuit works.

The **Component Location List** helps you find where the parts of the circuit are in the vehicle. A brief statement of the location is given and also a reference to a drawing that shows the component and its connecting wires. These **Component Location Views** are in cell 201.

Harness Routing Views are found in cell 203. These views show the routing of the major wiring harnesses and the in-line connectors between the major harnesses. These views will make troubleshooting easier when you are not sure about harness routing.

PAGE NUMBER

This section is organized into cells with most cells containing a circuit schematic and the text for that circuit. This makes the section easy to use, since the page number for a schematic will normally stay the same year after year, and it will also be the same in all the GM publications about that circuit. For example, the Cruise Control schematics will always be the first pages of cell 34. The other information for Cruise Control follows them on pages 34-2, 34-3, etc.

Some cells may have more than one circuit schematic, such as Power Distribution, Interior Lights, and Air Conditioning. The circuit you want can either be located by using the index, or by a quick look through the related cell.

All the engine circuits for a particular engine VIN type are in the same cell. This makes that cell easy to use, since schematics for other cars are not in your way. The instrument panel schematics are organized similarly. If you are working on a car with a Digital Cluster, only the schematics that apply to that car's Digital Cluster will be in the cell you use. Information on the Indicators and Gages Clusters will be in other cells.

SCHEMATICS

These schematics break the entire electrical system down into individual circuits. You are not distracted by wiring which is not part of the circuit you're working on.

It is important to realize that no attempt is made on the schematic to represent components and wiring as they physically appear on the car. For example, a 4-foot length of wire is treated no differently in a schematic from one which is only a few inches long. The number of cavities for each connector is listed in the Component Location List. Similarly, switches and other components are shown as simply as possible, with regard to function only.

The following example shows how to read a Horn schematic, see figure 1. Locate the Horn schematic using the Index. The circuit schematic will look somewhat like the one to the right. The schematic is read from top to bottom.

Voltage is applied to the Horn Relay at all times. When the relay coil is grounded by closing the Horn Switch, the relay contacts close. When the relay contacts are closed, both the LH and RH Horns are energized.

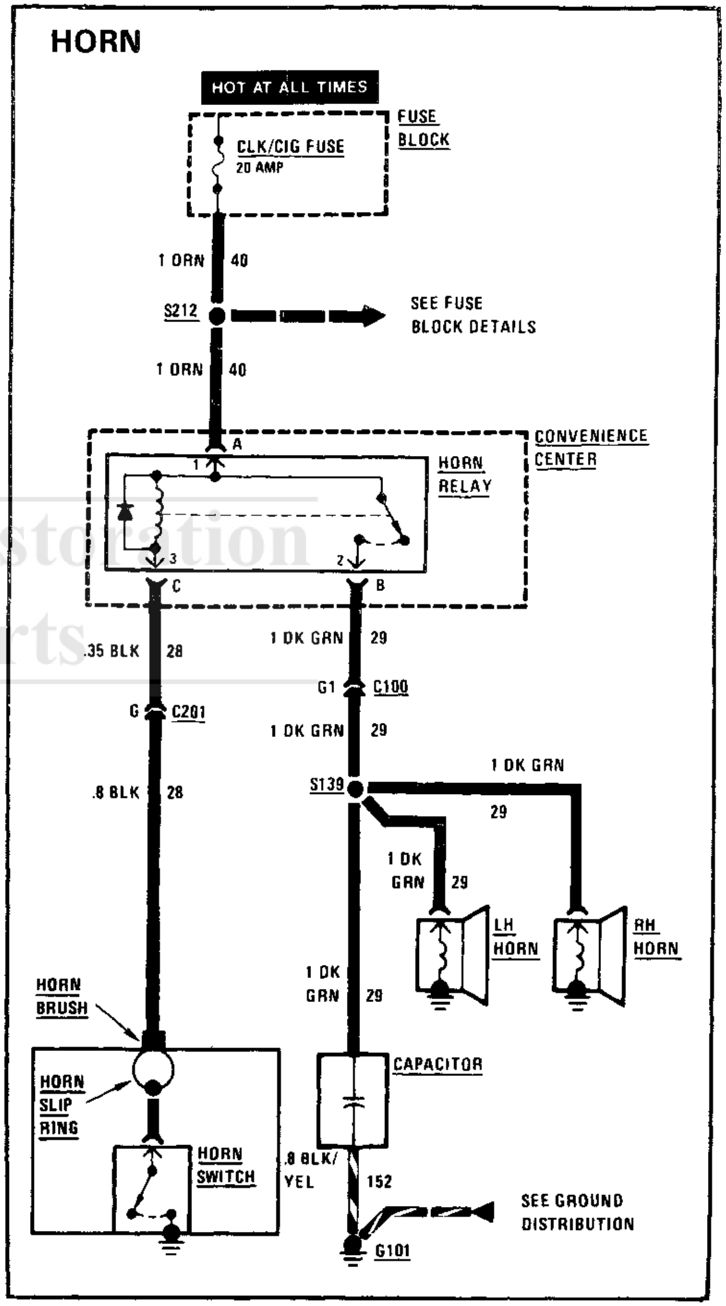


Figure 1 - Typical Horn Schematic

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

HARNESS CONNECTOR FACES

The connectors, see figure 3, are labeled with the component they are connected to, or the connector number from the schematic where they appear, and their color. The identifying number is for reference only; it is not the connector part number. For in-line connectors, the half shown is usually the Socket half. If both views are shown, the other half is the Pin Half.

Only connectors that have two or more terminals are shown.

If you need to backprobe a connector while it is on the component, the order of the terminals must be mentally reversed. The wire color is a help in this situation. If there is more than one wire of the same color, you may need to locate a test point from its terminal number. A useful trick is to imagine that you are probing a terminal from behind the page you are looking at. Then mentally locate that terminal with respect to the keyway or other reference mark.

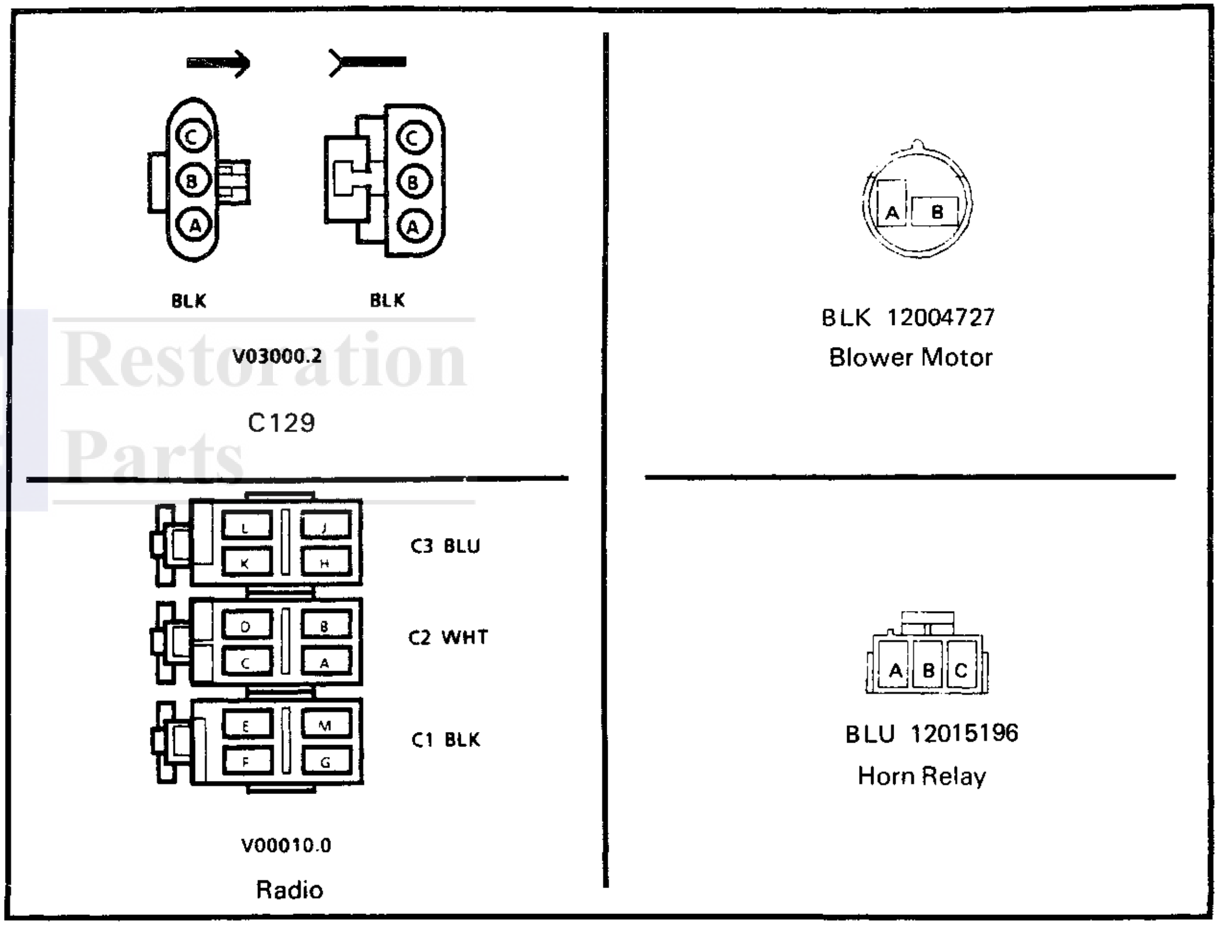


Figure 3 -Typical Harness Connector Faces

INTRODUCTION

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.

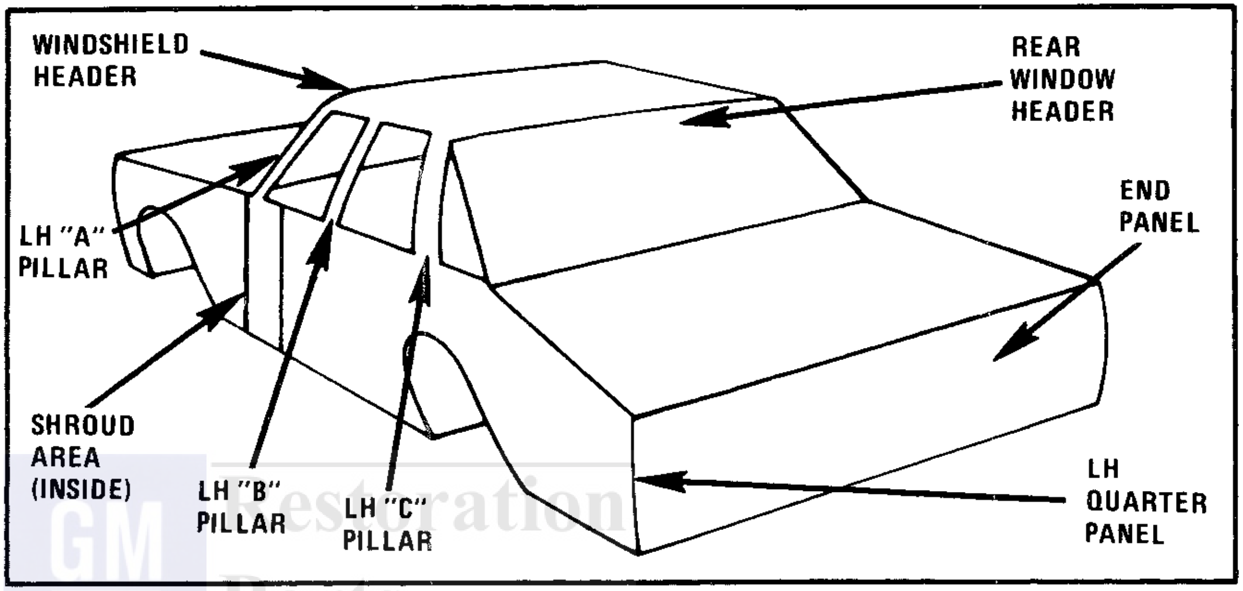


Figure 4 - Body Part Names

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, Fusible Link D, the RED wire and connector C100 to Fuse 1 and Fuse 2 in the Fuse Block and the Light Switch in the LH Pod. These fuses are said to be "Hot At All Times", since Battery voltage is always applied to them.

Notice that Battery voltage is also applied to Fusible Link F and the RED wire to the Coolant Fan Relay.

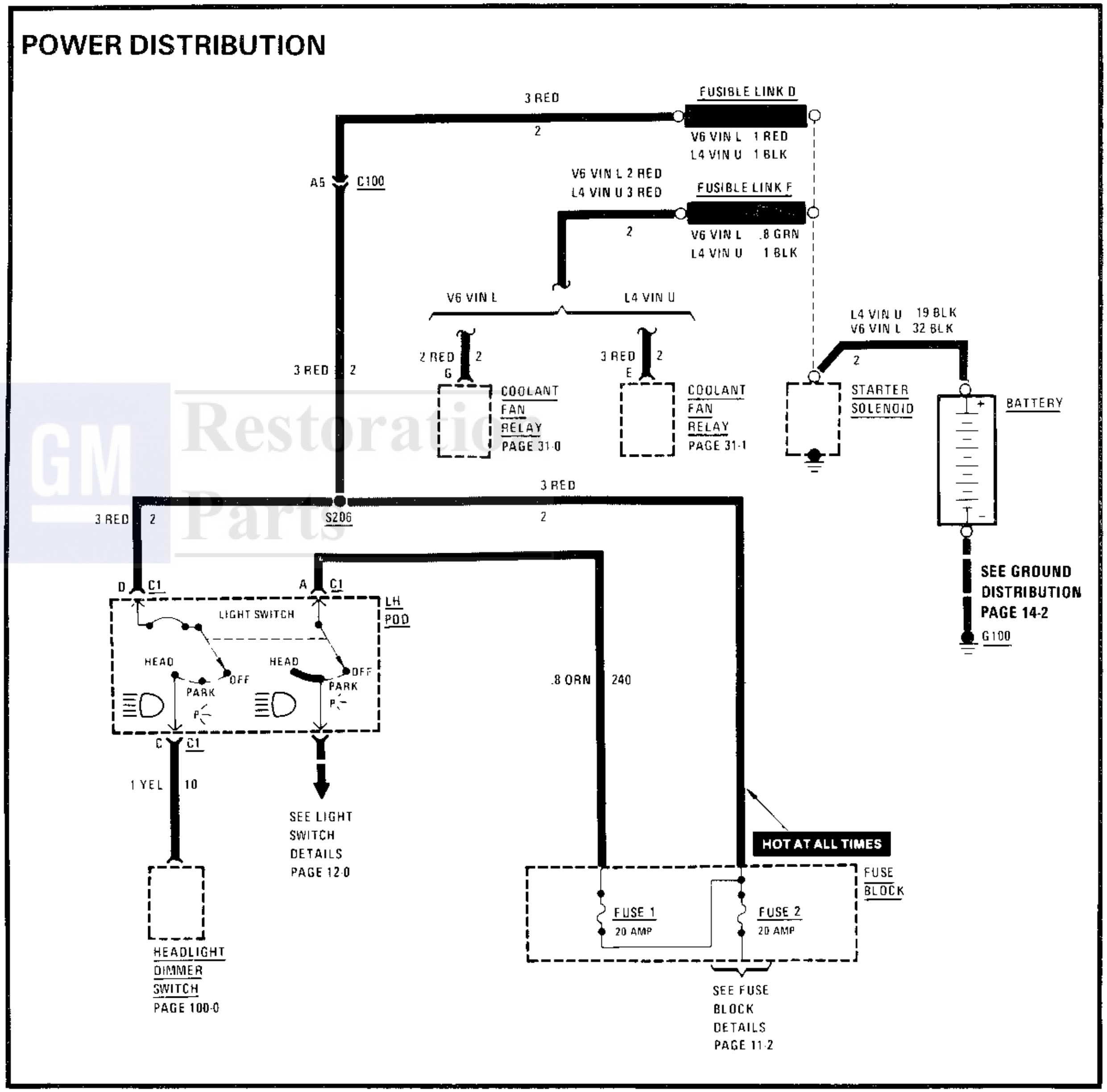


Figure 5 - Typical Power Distribution Schematic

Fuse Block Details

The Fuse Block Details schematic, see figure 6, shows all the wiring between a fuse and the components connected to the output of the fuse. In certain instances where space permits, this detail is shown on the Power Distribution schematic. The Fuse Block Details schematic is extremely helpful in locating a short circuit that causes a fuse to open.

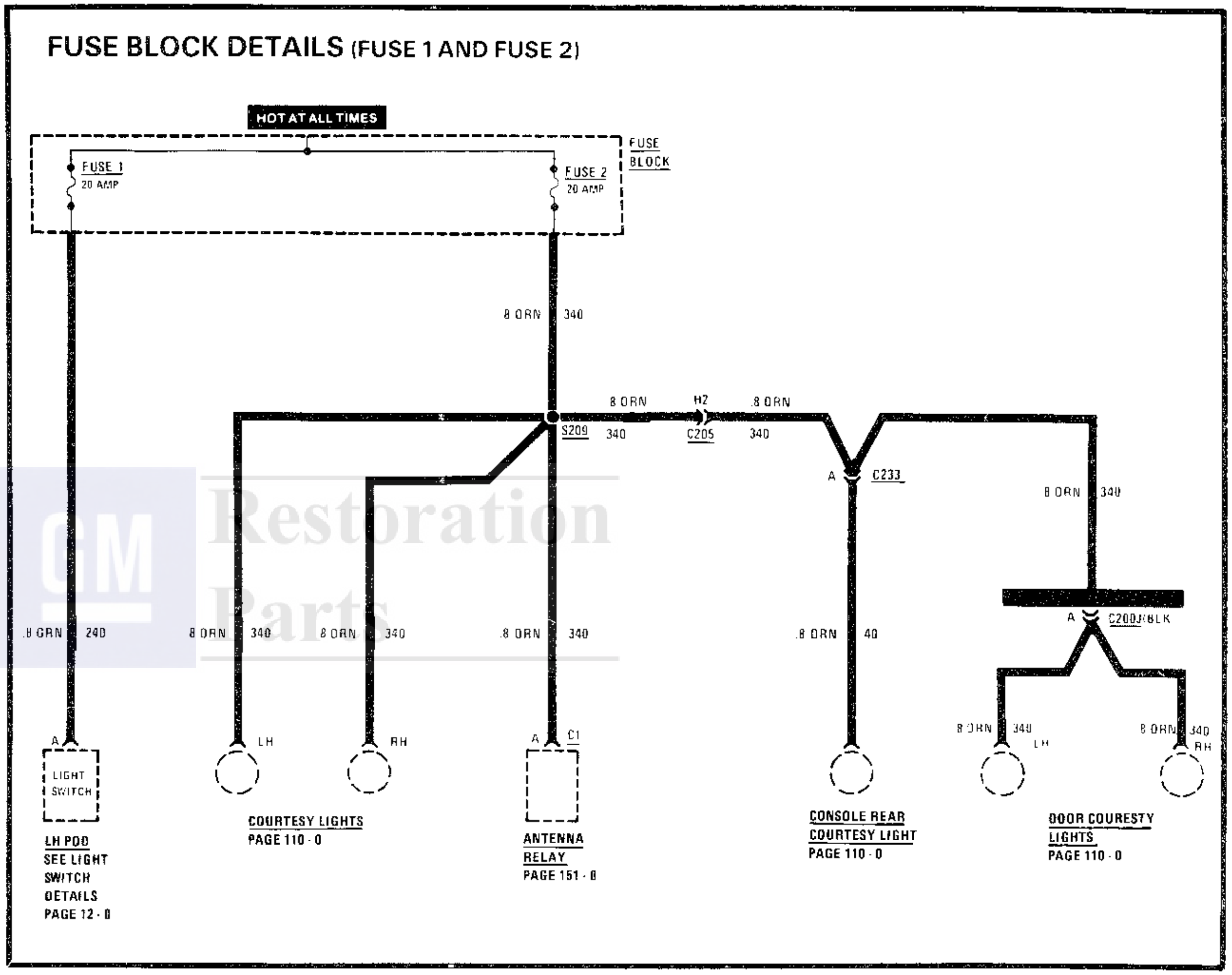


Figure 6 - Typical Fuse Block Details Schematic

INTRODUCTION

Light Switch Details

The Light Switch Details schematic, see figure 7, shows the wiring between the Light Switch and the components connected to the output of the Light Switch. In certain instances where space permits, some of this detail may be shown on the Power Distribution schematic. The Light Switch Details schematic helps you understand the many wires that come from the Light Switch. This schematic is also helpful in locating a short circuit that causes the fuse ahead of the Light Switch to open.

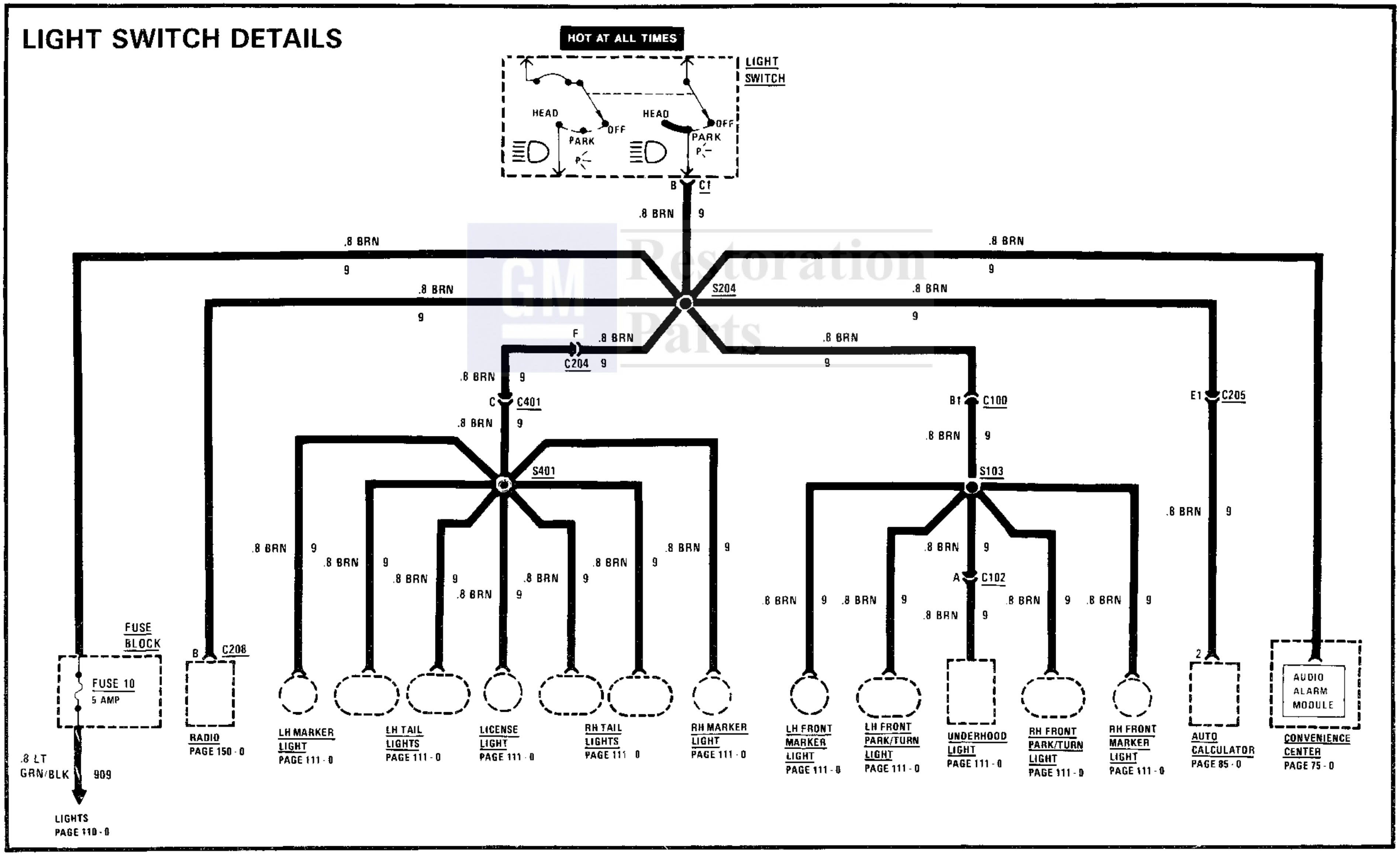

LIGHT SWITCH DETAILS

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.

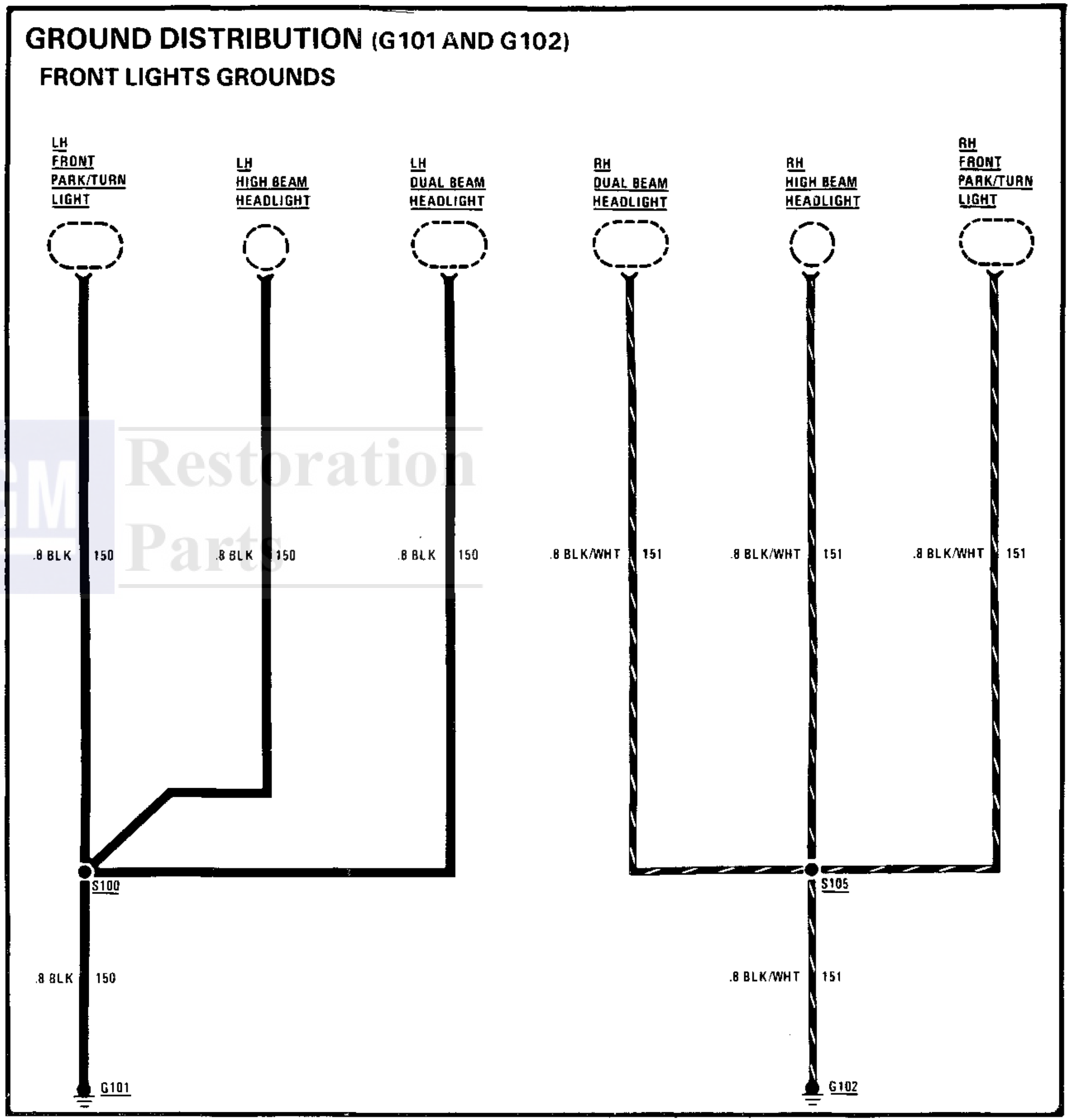
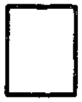
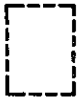


Figure 8 - Typical Ground Distribution Schematic

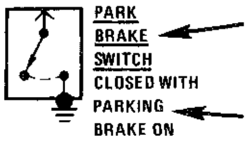
SYMBOLS



ENTIRE COMPONENT SHOWN

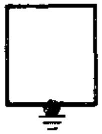


PART OF A COMPONENT SHOWN



NAME OF COMPONENT

DETAILS ABOUT COMPONENT OR ITS OPERATION



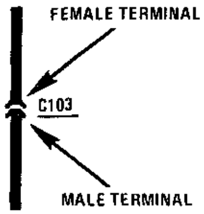
COMPONENT CASE IS DIRECTLY ATTACHED TO METAL PART OF CAR (GROUNDED)

WIRE IS ATTACHED TO METAL PART OF CAR (GROUNDED)

GROUND IS NUMBERED FOR REFERENCE ON COMPONENT LOCATION TABLE

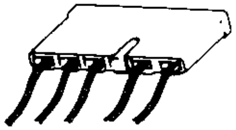
WIRE IS INDIRECTLY CONNECTED TO GROUND

WIRE MAY HAVE ONE OR MORE SPLICES BEFORE IT IS GROUNDED



CONNECTOR REFERENCE NUMBER FOR COMPONENT LOCATION TABLE

TABLE ALSO SHOWS TOTAL NUMBER OF TERMINALS POSSIBLE: C103 (6 CAVITIES)

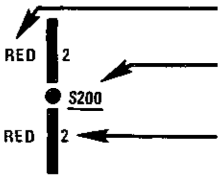


5 CAVITY CONNECTOR (5 OUT OF 5 CAVITIES ARE USED)

5 CAVITY CONNECTOR (4 OUT OF 5 CAVITIES ARE USED)

CONNECTOR ATTACHED TO COMPONENT

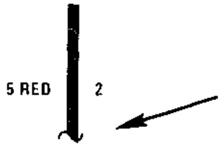
CONNECTOR ON COMPONENT LEAD (PIGTAIL)



INSULATION COLOR IS BOTH SHOWN AND LABELED

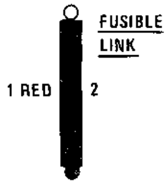
SPLICES ARE SHOWN AND NUMBERED

CIRCUIT NUMBER IS SHOWN TO HELP IN TRACING CIRCUITS

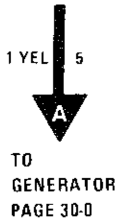


A WAVY LINE MEANS A WIRE IS TO BE CONTINUED

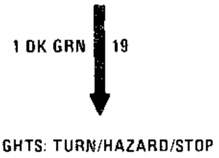
WIRE INSULATION IS ONE COLOR WITH ANOTHER COLOR STRIPE (RED WITH YELLOW)



WIRE SIZE AND INSULATION COLOR ARE LABELED



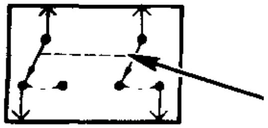
CURRENT PATH IS CONTINUED AS LABELED. THE ARROW SHOWS THE DIRECTION OF CURRENT FLOW AND IS REPEATED WHERE CURRENT PATH CONTINUES.



A WIRE WHICH CONNECTS TO ANOTHER CIRCUIT. THE WIRE IS SHOWN AGAIN ON THAT CIRCUIT.

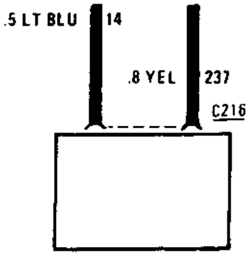
SYMBOLS

CIRCUIT BREAKER



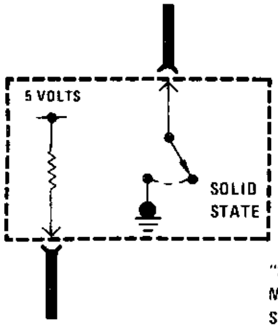
SWITCH CONTACTS THAT MOVE TOGETHER

DASHED LINE SHOWS A MECHANICAL CONNECTION BETWEEN SWITCH CONTACTS



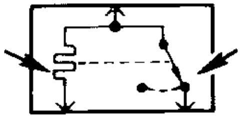
TWO TERMINALS IN THE SAME CONNECTOR

DASHED LINE SHOWS A PHYSICAL CONNECTION BETWEEN PARTS (SAME CONNECTOR)



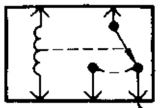
ELECTRONIC CONTROL MODULE (ECM) SOLID STATE

"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

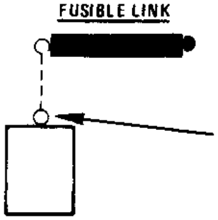


RELAY SHOWN WITH NO CURRENT FLOWING THROUGH COIL

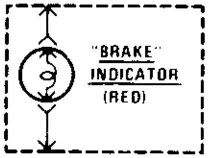
NORMALLY CLOSED CONTACT

WHEN CURRENT FLOWS THROUGH COIL, CONTACT MOVES TO NORMALLY OPEN POSITION

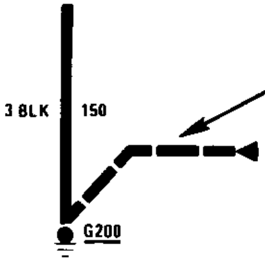
NORMALLY OPEN CONTACT



FUSIBLE LINK CONNECTS TO SCREW TERMINAL, SHOWN SEPARATED

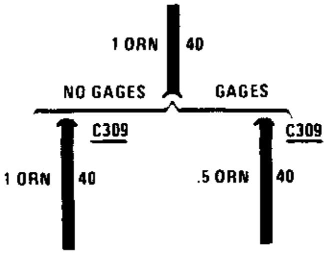


AN INDICATOR WHICH DISPLAYS THE LIGHTED WORD "BRAKE"

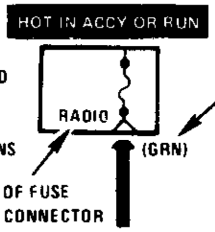


INDICATES THAT THE CIRCUITRY IS NOT SHOWN IN COMPLETE DETAIL BUT IS COMPLETE IN THE INDICATED CELL

SEE GROUND DISTRIBUTION



WIRE CHOICES FOR OPTIONS OR DIFFERENT MODELS ARE SHOWN AND LABELED

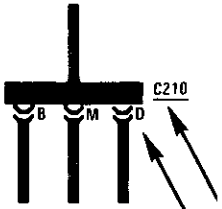


COLOR OF FUSE BLOCK CONNECTOR

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

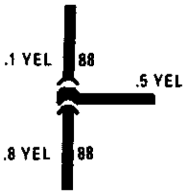


3 CONNECTORS ARE SHOWN CONNECTED TOGETHER AT A JUNCTION BLOCK. FOURTH WIRE IS SOLDERED TO COMMON CONNECTION ON BLOCK.

CONNECTOR NUMBER

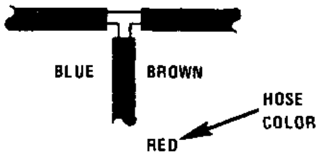
LETTERS FOR EACH CAVITY

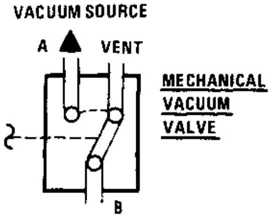
SYMBOLS



3 WIRES ARE SHOWN CONNECTED TOGETHER WITH A PIGGYBACK CONNECTOR

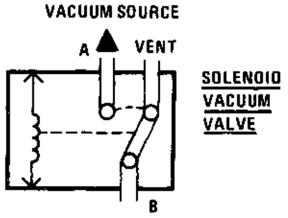
VACUUM JUNCTION





WHEN THE VALVE IS IN THE " AT REST " POSITION, PORT B IS VENTED. THE VACUUM AT PORT A HAS NO EFFECT.

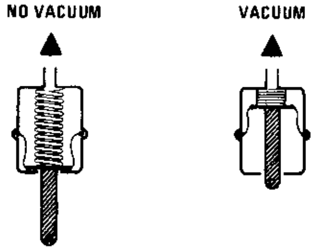
WHEN THE VALVE IS MOVED TO THE "OPERATED" POSITION VACUUM FROM PORT A IS CONNECTED TO PORT B

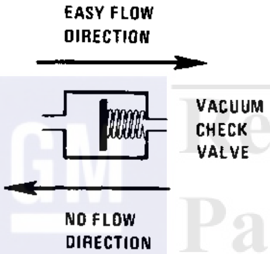


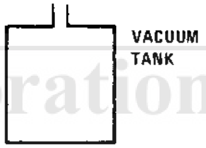
THE SOLENOID VACUUM VALVE USES THE SOLENOID TO MOVE THE VALVE

Vacuum motors operate like electrical solenoids, mechanically pushing or pulling a shaft between two fixed positions. When vacuum is applied, the shaft is pulled in. When no vacuum is applied, the shaft is pushed all the way out by a spring.

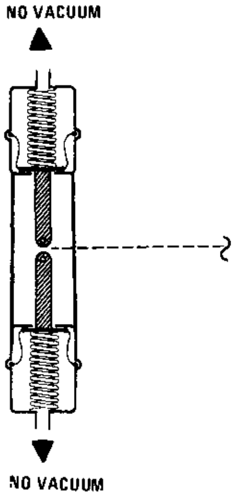
SINGLE DIAPHRAGM MOTOR



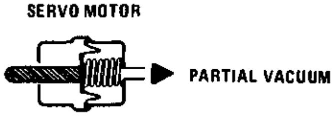




DOUBLE DIAPHRAGM MOTOR



Double diaphragm motors can be operated by vacuum in two directions. When there is no vacuum, the motor is in the center "at rest" position.



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 as given in the System Diagnosis.
- Before you replace a component, check power, signal, and ground wires at the component harness connector. If these are OK, the component must be bad.

Step 4: Test the Repair

Repeat the System Check to be sure you have fixed the whole problem.

Example

A customer brings in a car and says that the high beams do not work.

Step 1: Perform a System Check on the Headlights Circuit. You may discover that both low beams operate. In "Hi," you may notice that the High Beam Indicator comes on, but neither high beam operates.

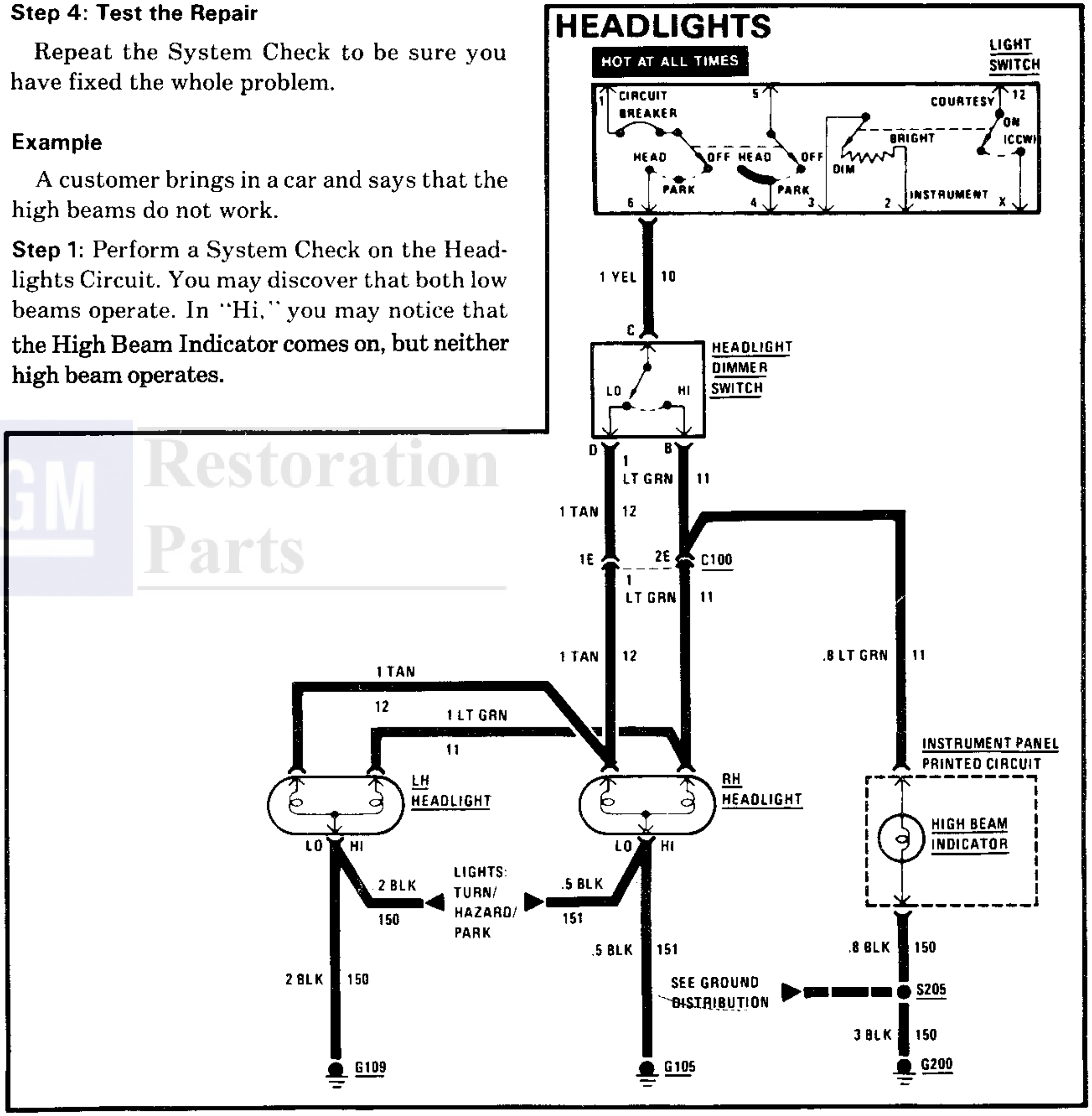


Figure 9 - Typical Headlights Schematic

Step 2: Read the Headlights electrical schematic, see figure 9. This is the step that will save you time and labor. Remember, it is essential to understand how a circuit *should* work, before trying to figure out why it doesn't.

After you understand how the circuit should operate, read the schematic again, this time keeping in mind what you have learned by operating the circuit.

Since both low beams work, you know that the Light Switch, the YEL wire, the Lo contacts of the Headlight Dimmer Switch, terminal 1E of C100, the TAN wires, and grounds G105 and G109 are all good.

Furthermore, since you saw that the High Beam Indicator came on when the Headlight Dimmer Switch was moved to Hi, you know that the Hi contacts of the dimmer switch and the LT GRN wire between the dimmer switch and C100 are good.

At this point, you could test for voltage at the RH Headlight with the dimmer switch in Hi. However, it is extremely unlikely that the high beam filaments have burned out in *both* headlights, or that *both* headlight connections are bad. The cause must be a bad connection at C100, or a break in the LT GRN wire between C100 and the RH Headlight.

You have quickly narrowed the possible causes down to one specific area, and have *done* absolutely *no* work on the car itself.

Step 3: Find the cause and repair it. Using the Component Location List and the corresponding figure, you can quickly find C100 and the LT GRN wire, locate the exact trouble point, and make the repair.

Step 4: Check the repair by performing a system check on the Headlights circuit. This, of course, means making sure that both high beams, both low beams, and the High Beam Indicator are all working.

Now suppose that the symptoms were different. You may have operated the Headlights and found that the low beams were working, but neither the high beams nor the High Beam Indicator were working. Looking at the schematic, you might conclude the following.

It is unlikely that both high beam filaments and the High Beam Indicator have all burned out at once. The cause is probably the dimmer switch or its connector.

TROUBLESHOOTING TOOLS

Electrical troubleshooting requires the use of common electrical test equipment.

TEST LIGHT/VOLTMETER

Use a test light to check for voltage. A Test Light (BT-7905 or equivalent) is made up of a 12-Volt light bulb with a pair of leads attached. After grounding one lead, touch the other lead to various points along the circuit where voltage should be present. When the bulb goes on, there is voltage at the point being tested.

A voltmeter can be used instead of a test light. While a test light shows whether or not voltage is present, a voltmeter indicates how much voltage is present.

An increasing number of circuits include solid state control modules. One example is the Electronic Control Module (ECM) used with Computer Command Control and Electronic Fuel Injection. Voltages in these circuits should be tested only with a 10-megohm or higher impedance digital voltmeter or multimeter (J-29125 or equivalent). Never use a test light on circuits that contain solid state components, since damage to these components may result.

When testing for voltage or continuity at a connection, you do not have to separate the two halves of the connector. Unless you are testing a "weather-pack" connector, you should probe the connector from the back. Always check both sides of the connector. An accumulation of dirt and corrosion between contact surfaces is sometimes a cause of electrical problems.

CONNECTOR TEST ADAPTERS

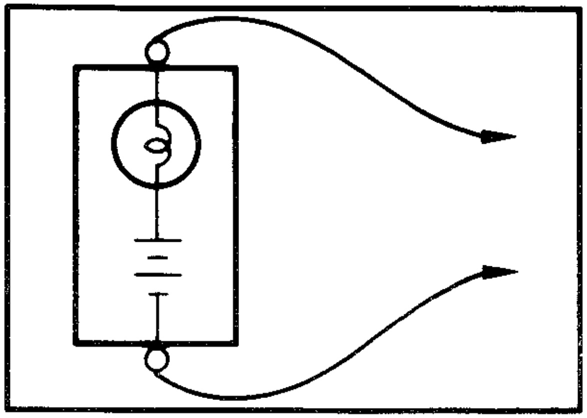
A connector Adapter Kit is available (J35616) for making tests and measurements at separated connectors. This kit contains an assortment of probes which mate with many of the types of connectors you will see. Avoid using paper clips and other substitutes since they can damage terminals and cause incorrect measurements.

SELF-POWERED TEST LIGHT

Use a self-powered test light (J-21008 or equivalent) to check for continuity. This tool is made up of a light bulb, battery, and two leads. If the leads are touched together, the bulb will go on.

A self-powered test light is used only on an unpowered circuit. First disconnect the car's Battery, or remove the fuse which feeds the circuit you're working on. Select two specific points along the circuit through which there should be continuity. Connect one lead of the self-powered test light to each point. If there is continuity, the test light's circuit will be completed and the bulb will go on.

Never use a self-powered test light on circuits that contain solid state components, since damage to these components may result.



Self-Powered Test Light

OHMMETER

An ohmmeter can be used instead of a self-powered test light. The ohmmeter shows how much resistance there is between two points along a circuit. Low resistance means good continuity.

Circuits which include any solid state control modules, such as the Electronic Control Module (ECM), should be tested only with a 10-megohm or higher impedance digital multimeter (J-29125 or equivalent).

When measuring resistance with a digital multimeter, the vehicle Battery should be disconnected. This will prevent incorrect readings. Digital meters apply such a small voltage to measure resistance that the presence of voltages can upset a resistance reading.

Diodes and solid state components in a circuit can cause an ohmmeter to give a false reading. To find out if a component is affecting a measurement, take a reading once, reverse the leads and take a second reading. If the readings differ, the solid state component is affecting the measurement.

FUSED JUMPER WIRE

A fused jumper is available (J-36169 or equivalent) with small clamp connectors providing adaptation to most connectors without damage. This fused jumper wire is supplied with a 20 amp fuse which may not be suitable for some circuits. Do not use a fuse with a higher rating than the fuse that protects the circuit being tested.

CAUTION: Do not use fused jumper wire in any instance to substitute for inputs or outputs at the ECM (Electronic Control Module), BCM (Body Control Module), or any microprocessor device.

SHORT FINDER

Short Finders are available (J-8681 or equivalent) to locate hidden shorts to ground. The short finder creates a pulsing magnetic field in the shorted circuit and shows you the location of the short through body trim or sheet metal.

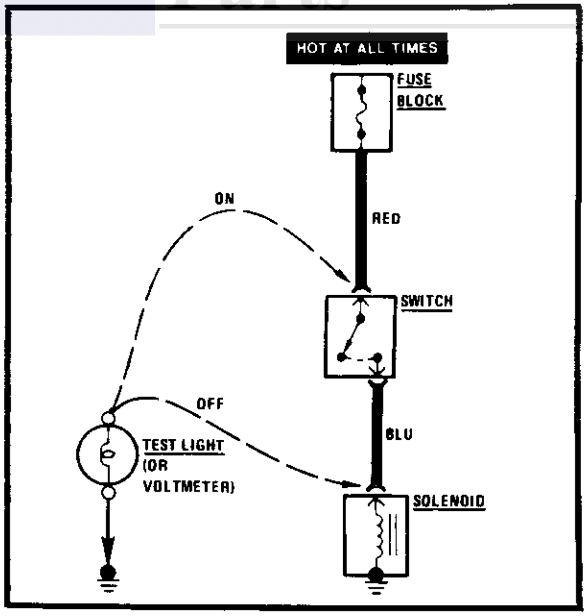
FUSE TESTER

A simple tester that indicates a blown fuse is available (J-34764 or equivalent). To check a fuse the tester is applied directly to the fuse in the fuse block. Two probes contact the fuse. The probes are either placed into the slots of a flat fuse or to the metal ends of a glass fuse. With power on, a red LED in the tester lights if the fuse is open. The handle of the tester is a tool for removing either type of fuse.

TROUBLESHOOTING TESTS

TESTING FOR VOLTAGE

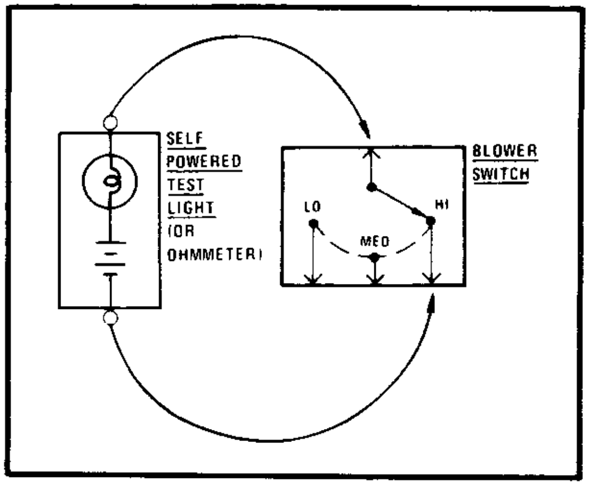
1. Connect one lead of a test light to a known good ground. If you are using a voltmeter, be sure it is the voltmeter's negative lead that you have connected to ground.
2. Connect the other lead of the test light or voltmeter to a selected test point (connector or terminal).
3. If the test light glows, there is voltage present. If you are using a voltmeter, note the voltage reading. It should be within one volt of measured Battery voltage. A loss of more than one volt indicates a problem.



Voltage Check

TESTING FOR CONTINUITY

1. Disconnect the car battery.
2. Connect one lead of a self-powered test light or ohmmeter to one end of the part of the circuit you wish to test.
3. Connect the other lead to the other end of the circuit.
4. If the self-powered test light glows, there is continuity. If you are using an ohmmeter, low or no resistance means good continuity.



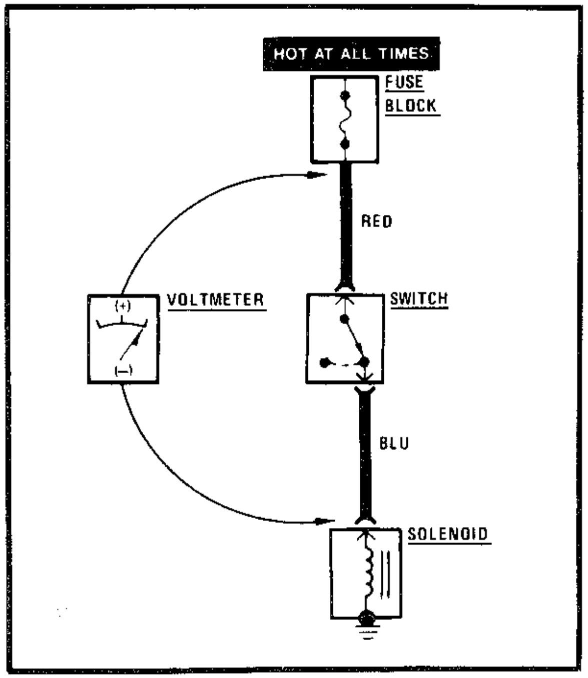
Continuity Check Through A Switch

TROUBLESHOOTING TESTS

TESTING FOR VOLTAGE DROP

This test checks for voltage being lost along a wire, or through a connection or switch.

1. Connect the positive lead of a voltmeter to the end of the wire (or to one side of the connection or switch) which is closer to the Battery.
2. Connect the negative lead to the other end of the wire (or the other side of the connection or switch).
3. Operate the circuit.
4. The voltmeter will show the difference in voltage between the two points. A difference (or drop) of more than one volt indicates a problem.

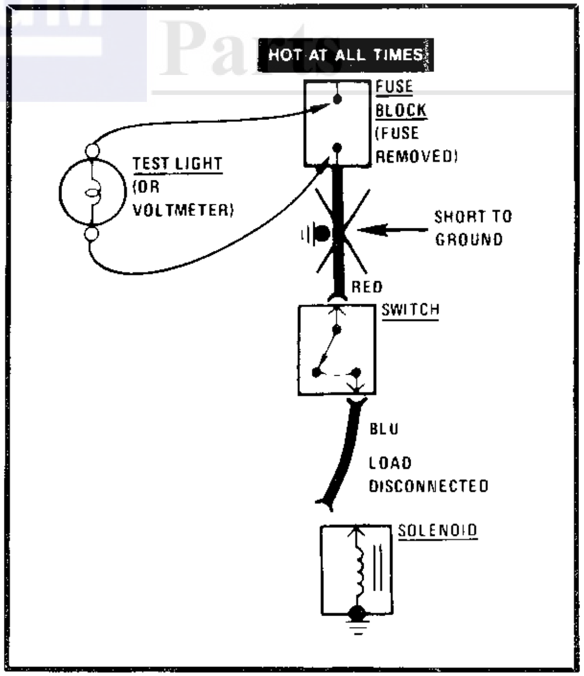


Voltage Drop Test

TESTING FOR SHORT TO GROUND

With a Test Light or Voltmeter

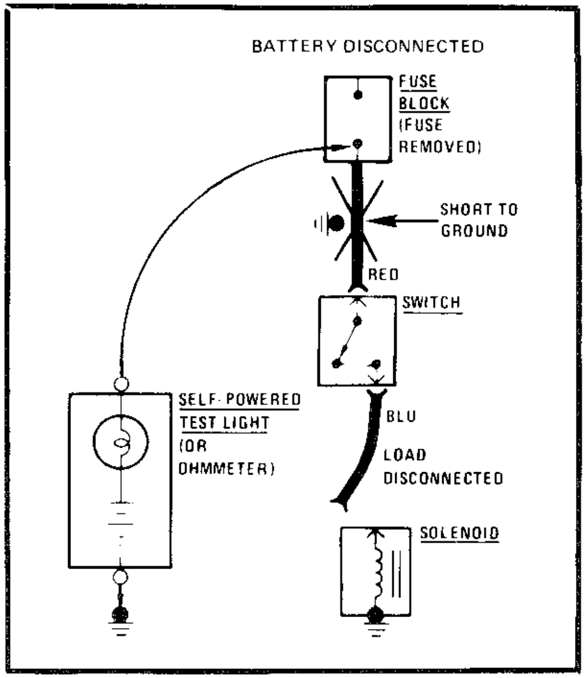
1. Remove the blown fuse and disconnect the load.
2. Connect a test light or voltmeter across the fuse terminals (be sure that the fuse is powered).
3. Beginning near the fuse block, wiggle the harness from side to side. Continue this at convenient points (about 6 inches apart) while watching the test light or voltmeter.
4. When the test light glows, or the voltmeter registers, there is a short to ground in the wiring near that point.



Testing For Short With Test Light or Voltmeter

With a Self-Powered Test Light or Ohmmeter

1. Remove the blown fuse and disconnect the battery and load.
2. Connect one lead of a self-powered test light or ohmmeter to the fuse terminal on the load side.
3. Connect the other lead to a known good ground.
4. **Beginning near the fuse block, wiggle the harness from side to side. Continue this at convenient points (about 6 inches apart) while watching the self-powered test light or ohmmeter.**
5. When the self-powered test light glows, or the ohmmeter registers, there is a short to ground in the wiring near that point.



Testing For Short With Self-Powered Test Light or Ohmmeter

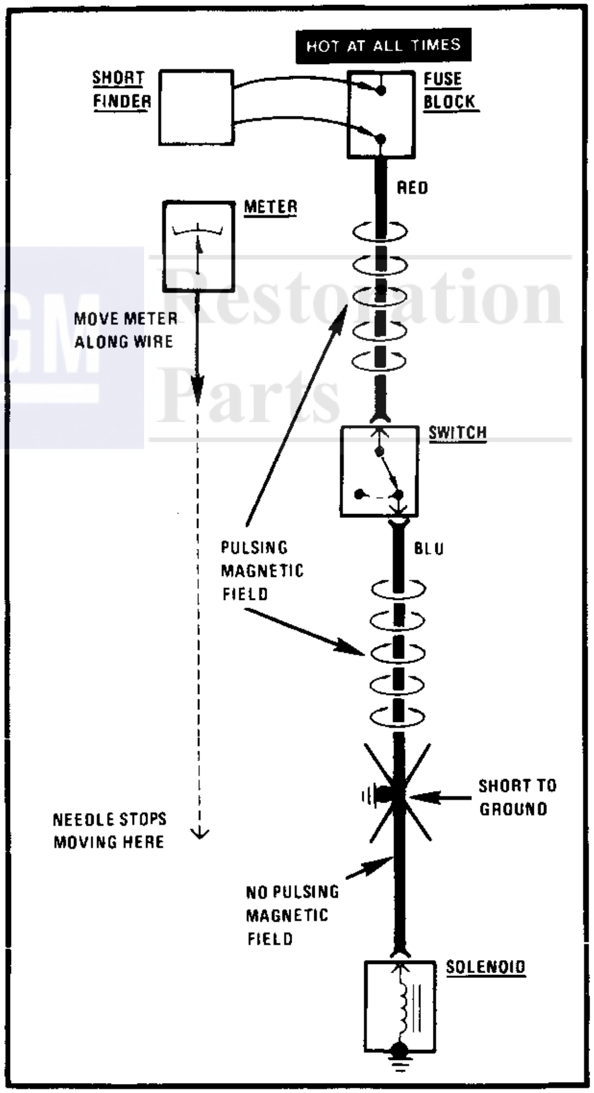
TROUBLESHOOTING TESTS

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.

Fuses Powering Several Loads

1. Find the schematic in Fuse Block Details (8A-11) for the fuse that has blown.
2. Open the first connector or switch leading from the fuse to each load.
3. Replace the fuse.
    - If the fuse blows, the short is in the wiring leading to the first connector or switch. Use a test light, meter, or short finder as described above.
    - If fuse does not blow, go to next step.
4. Close each connector or switch until the fuse blows, to find which circuit the short is in. Connect test lamp, meter, or short finder at the connector to the suspect circuit (disconnected) rather than at the fuse terminals.



Finding Short With Short Finder

PROPER JUMP STARTING PROCEDURES

With the use of electronic components (such as solid-state radios, electronic control modules, and others) becoming more wide-spread each model year, the potential for damage caused by improper jump starts increases. The following guidelines are presented to reduce the likelihood of such damage.

JUMP START ONLY IF BUILT-IN HYDROMETER "EYE" ON BATTERY IS DARK. If the "eye" is clear or yellow, do not attempt to jump start. If the "eye" is green, the Battery is charged and does not require a jump start. Both the booster and the discharged Battery should be treated carefully when using jumper cables.

CAUTION: Do not expose the Battery to open flame or sparks. Serious personal injury, particularly to the eyes, may result from a Battery explosion, Battery acid, or electrical burns.

- The Ignition Switch must be in OFF when connecting or disconnecting the jumper cables.
- All accessories, including the Radio, should be turned off before jump starting.
- Cable polarity must be correct. Component damage can occur if the polarity is reversed, even if only briefly.
- Connect the positive jumper cable first, then connect the negative cable to the engine ground (not the negative terminal of the dead Battery).

REPAIR PROCEDURES

ELECTRICAL REPAIRS

This section provides instruction in the following repairs:

- Circuit Protection
- Typical Electrical Repairs
- Splicing Copper Wire
- Splicing Aluminum Wire
- Splicing Twisted/Shielded Cable
- Repairing Connectors (Except Weather Pack®) and
- Repairing Weather Pack® (Environmental) Connectors

Note: After any electrical repair is made, always test the circuit by operating the devices in the circuit. This confirms not only that the repair is correct, but also that the cause of the complaint was correctly identified.

CIRCUIT PROTECTION

All electrical circuits are protected against excessive loads which might occur because of shorts or overloads in the wiring system. Such protection is provided by a fuse, circuit breaker, or fusible link.

Fuses

The most common method of automotive wiring circuit protection is the fuse. Whenever there is an excessive amount of current flowing through a circuit the fusible element will melt and create an open or incomplete circuit (see Figure 1). Fuses are a "one time" protection device and must be replaced each time the circuit is overloaded.

Auto-fuses are color coded. The standardized color identification and ratings are shown in Figure 2.

For service replacement, non-color coded fuses of the same respective current rating can be used. The current rating of each fuse is molded into its head.

To determine whether or not an auto-fuse is blown, remove the suspect fuse and examine the element in the fuse for a break, (see Figure 1). If the element is broken, replace the fuse with one of equal current rating.

There are, however, additional specific circuits with in-line fuses. In-line fuses are located within the individual wiring harness. They are usually housed in spring-loaded, twist-type receptacles.

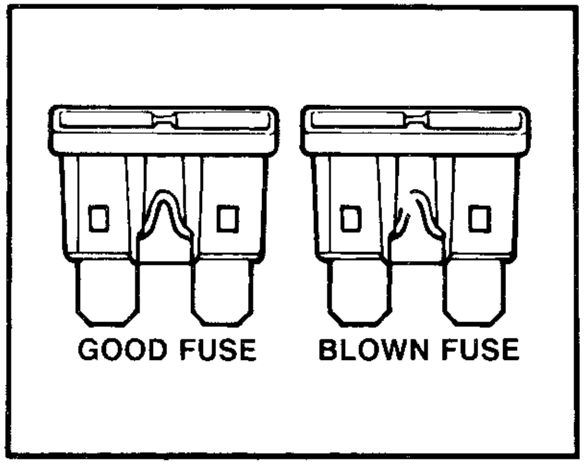


Figure 1 - Sample Fuses

CURRENT RATING (AMPERES)	COLOR
3	VIOLET
5	TAN
7.5	BROWN
10	RED
15	BLUE
20	YELLOW
25	WHITE
30	GREEN

Figure 2 - Fuse Rating And Color

Circuit Breakers

A circuit breaker is a protective device designed to open the circuit when a current load is in excess of rated breaker capacity. If there is a short or other type of overload condition in the circuit, the excessive current will open the circuit between the circuit breaker terminals. The circuit breaker will remain open until the trouble is found and corrected. The circuit breaker will close automatically when the excessive current is removed. The condition of a circuit breaker may be verified by removing it from the circuit and checking the resistance. A good circuit breaker will have less than 1 ohm resistance between the two terminals.

REPAIR PROCEDURES

Fusible Links

In addition to circuit breakers and fuses, some circuits use fusible links to protect the wiring. Like fuses, fusible links are "one time" protection devices that will melt and create an open circuit (see Figure 3).

Not all fusible link open circuits can be detected by observation. Always inspect that there is Battery voltage past the fusible link to verify continuity.

Fusible links are used instead of a fuse in wiring circuits that are not normally fused, such as the ignition circuit. Each fusible link is four wire-gauge sizes smaller than the cable it is designed to protect. Links are marked on the insulation with wire-gauge size because the heavy insulation makes the link appear to be a heavier gauge than it actually is. The same wire size fusible link must be used when replacing a blown fusible link.

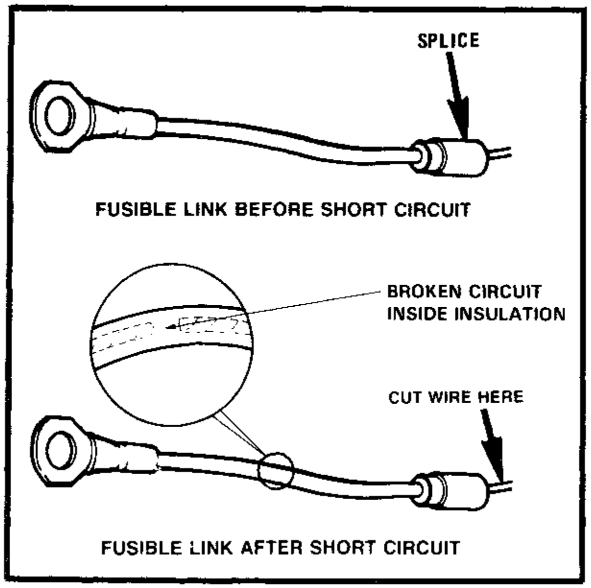


Figure 3 - Good And Damaged Fusible Links

Fusible links are available with two types of insulation: Hypalon® and Silicone/GXL (SIL/GXL). Service fusible links made with SIL/GXL may be used to replace either Hypalon® or SIL/GXL fusible links. Service fusible links made with Hypalon® may only be used to replace Hypalon® fusible links. To determine the fusible link type: nick the insulation of the blown fusible link with a knife. SIL/GXL will have a white inner core under the outer color. Hypalon® insulation is one color. Service fusible links are available in many lengths. Choose the shortest length that is suitable. If the fusible link is to be cut from a spool, NEVER make a fusible link longer than 228 mm (9 in).

CAUTION: Fusible links cut longer than 228 mm (9 in) will not provide sufficient overload protection.

To replace a damaged fusible link, cut it off beyond the splice. Replace with a repair link. When connecting the repair link, strip wire and use staking-type pliers to crimp the splice securely in two places (see Figure 4). For more details on splicing procedures see Splicing Copper Wire.

To replace a damaged fusible link which feeds two harness wires, cut them both off beyond the splice. Use two repair links, one spliced to each harness wire (see Figure 5).

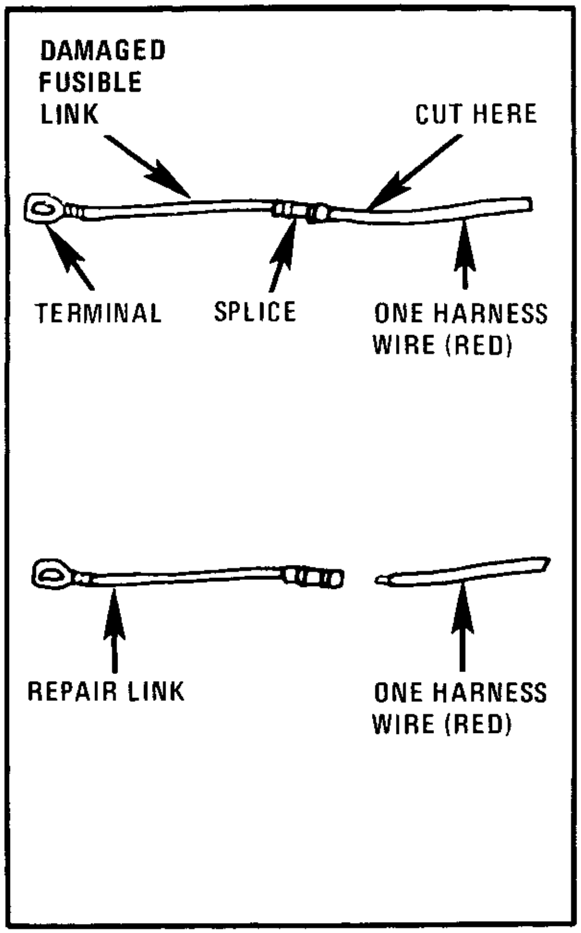


Figure 4 - Single Wire Feed Fusible Link

TYPICAL ELECTRICAL REPAIRS

An open circuit is an incomplete circuit. Power cannot reach the load or reach ground. If a circuit is open, active components do not energize. A short circuit is an unwanted connection between one part of the circuit and either ground or another part of the circuit. A **short circuit causes a fuse to blow or a circuit breaker to open.**

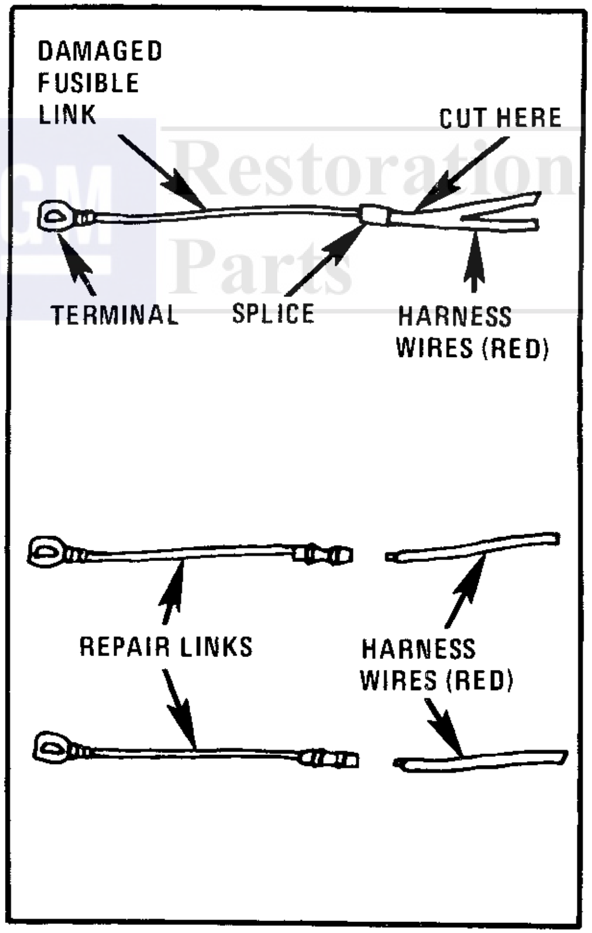


Figure 5 - Double Wire Feed Fusible Link

Short Circuits Caused by Damaged Wire Insulation

—Locate the damaged wire.
—Find and correct the cause of the wire insulation damage.
—For minor damage, tape over the wire. If damage is more extensive, replace the faulty segment of the wire. (Refer to the splicing instructions for copper, aluminum, or shielded cable for the correct splicing procedure.)

SPLICING COPPER WIRE

Step One: Open the Harness

If the harness is taped, remove the tape. To avoid wire insulation damage, use a sewing "seam ripper" to cut open the harness (available from sewing supply stores).

If the harness has a black plastic conduit, simply pull out the desired wire. Note that aluminum wire is enclosed in brown conduit. Refer to Splicing Aluminum Wire if necessary.

Step Two: Cut the Wire

Begin by cutting as little wire off the harness as possible. You may need the extra length of wire later if you decide to cut more wire off to change the location of a splice. You may have to adjust splice locations to make certain that each splice is at least 40mm (1 1/2") away from other splices, harness branches, or connectors.

REPAIR PROCEDURES

Step Three: Strip the Insulation

When replacing a wire, use a wire of the same size as the original wire or larger. The schematics list wire size in metric units. The following table (see Figure 6) shows the commercial (AWG) wire sizes that can be used to replace each metric wire size. Each AWG size is either equal to or larger than the equivalent metric size.

METRIC WIRE SIZES	AWG SIZES
.22	24
.35	22
.5	20
.8	18
1.0	16
2.0	14
3.0	12
5.0	10
8.0	8
13.0	6
19.0	4
32.0	2

Figure 6 - Wire Size Conversion Table

To find the correct wire size either find the wire on the schematic page and convert the metric size to the AWG size, or use an AWG wire gage.

If you aren't sure of the wire size, start with the largest opening in your wire stripper and work down until you get a clean strip of the insulation. Be careful to avoid nicking or cutting any of the wires.

Check the stripped wire for nicks or cut strands. If the wire is damaged, repeat the procedure on a new section of wire. The two stripped wire ends should be equal in length.

Step Four: Crimp the Wires

Select the proper clip to secure the splice. To determine the proper clip size for the wire being spliced, follow the directions included with your clips. Select the correct anvil on the crimper. (On most crimpers your choice is limited to either a small or large anvil.) Overlap the two stripped wire ends and hold them between your thumb and forefinger as shown in Figure 7. Then, center the splice clip under the stripped wires and hold it in place.

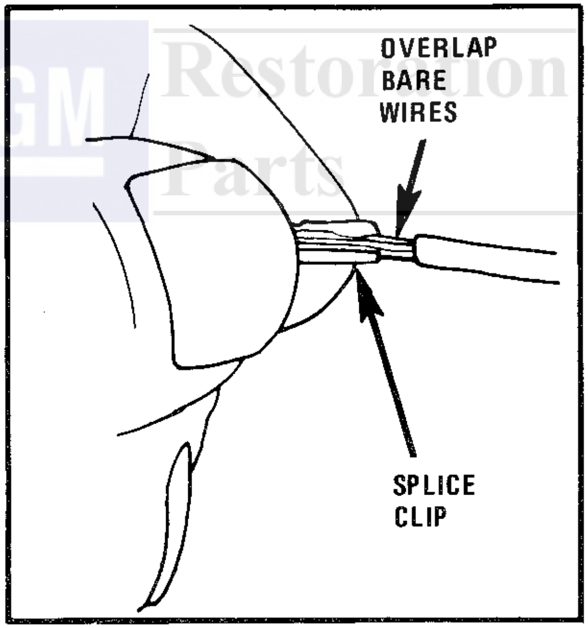


Figure 7 - Centering The Splice Clip

- —Open the crimping tool to its full width and rest one handle on a firm flat surface.
- —Center the back of the splice clip on the proper anvil and close the crimping tool to the point where the former touches the wings of the clip.
- —Make sure that the clip and wires are still in the correct position. Then, apply steady pressure until the crimping tool closes (see Figure 8).

Before crimping the ends of the clip, be sure that:

- —The wires extend beyond the clip in each direction.
- —No strands of wire are cut loose, and
- —No insulation is caught under the clip.

Crimp the splice again, once on each end. Do not let the crimping tool extend beyond the edge of the clip or you may damage or nick the wires (see Figure 9).

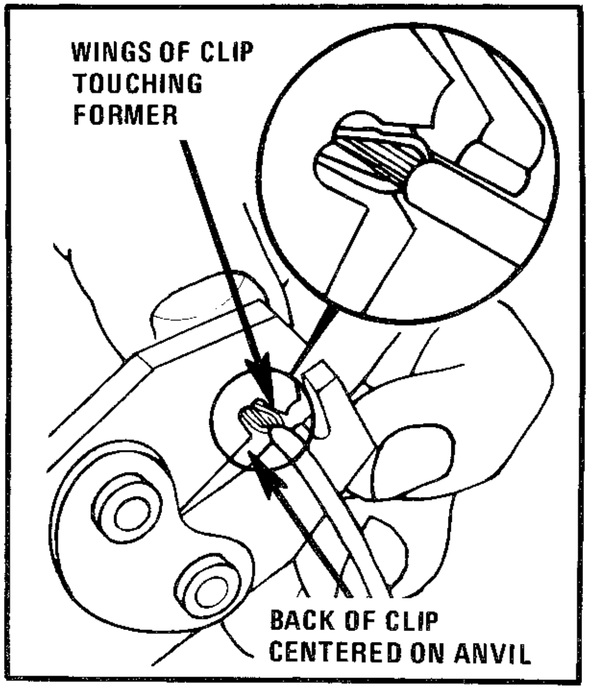


Figure 8 - Crimping The Splice Clip

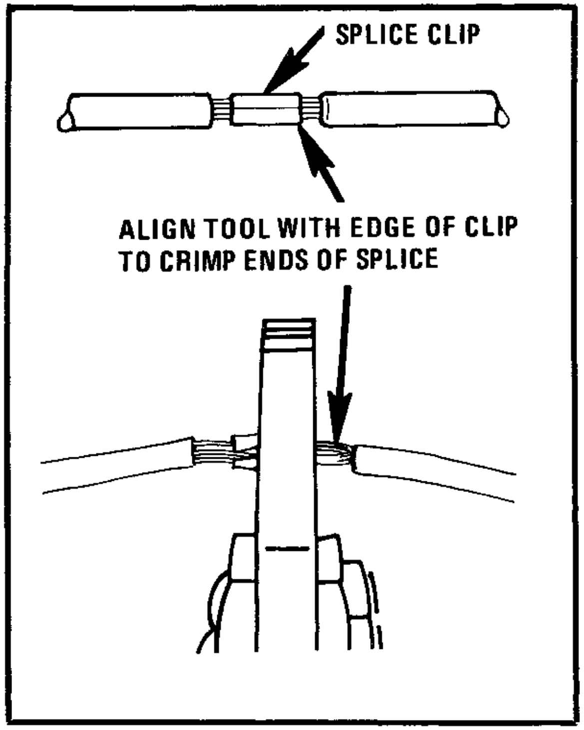


Figure 9 - Completing The Crimp

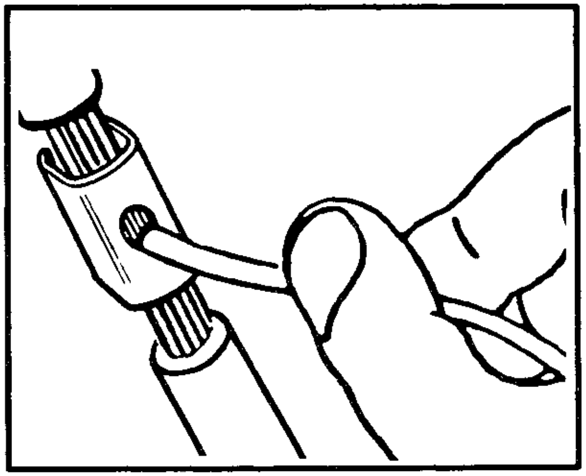


Figure 10 - Applying The Solder

Step Five: Solder

Apply 60/40 rosin core solder to the opening in the back of the clip (see Figure 10). Follow the manufacturer's instructions for the solder equipment you are using.

Step Six: Tape the Splice

Center and roll the splicing tape. The tape should cover the entire splice. Roll on enough tape to duplicate the thickness of the insulation on the existing wires. Do not flag the tape. Flagged tape may not provide enough insulation, and the flagged ends will tangle with the other wires in the harness (see Figure 11).

If the wire does not belong in a conduit or other harness covering, tape the wire again. Use a winding motion to cover the first piece of tape (see Figure 12).

SPLICING ALUMINUM WIRE

General Motors cars have a front body wiring harness made of 2.0 metric and 1.0 metric (14 and 16 gauge) insulated solid cable aluminum wires. These wires are enclosed in a brown solid plastic conduit from behind the instrument panel to the rear of the car..

A special repair kit (1684873-GR.2.530-KIT-ALUM-WIRE TERMINAL REPAIR) is available to help make repairs on aluminum wires. This kit contains materials and instructions that can be used either to splice wire or crimp on new terminals. The kit includes the following parts:

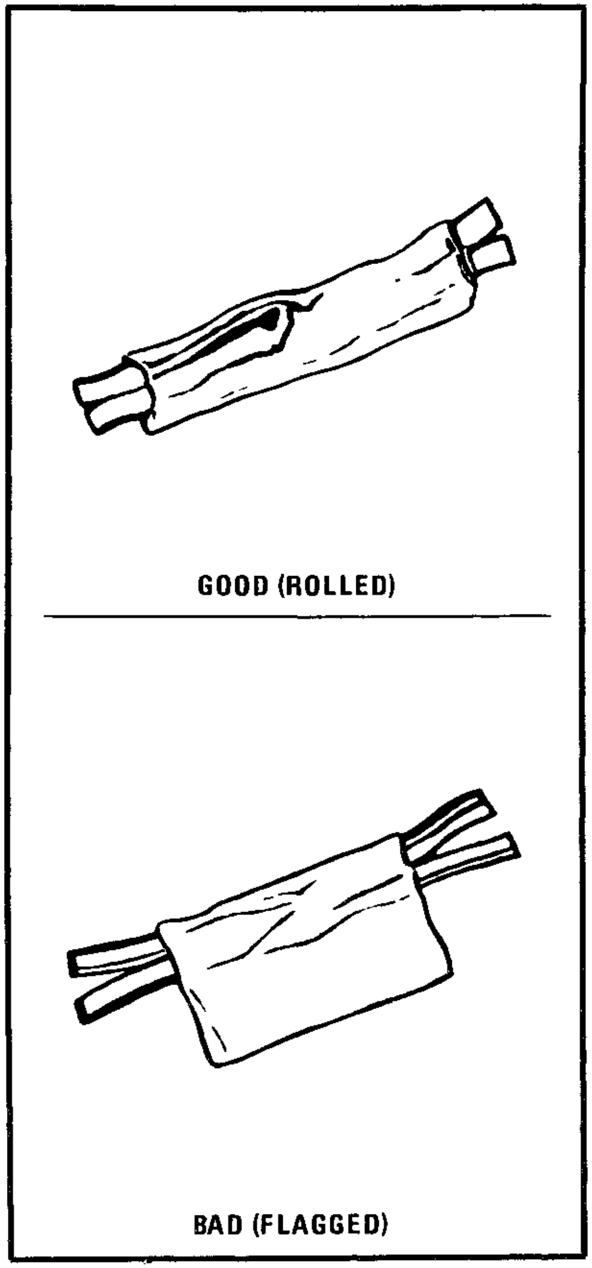


Figure 11 - Proper First Taping

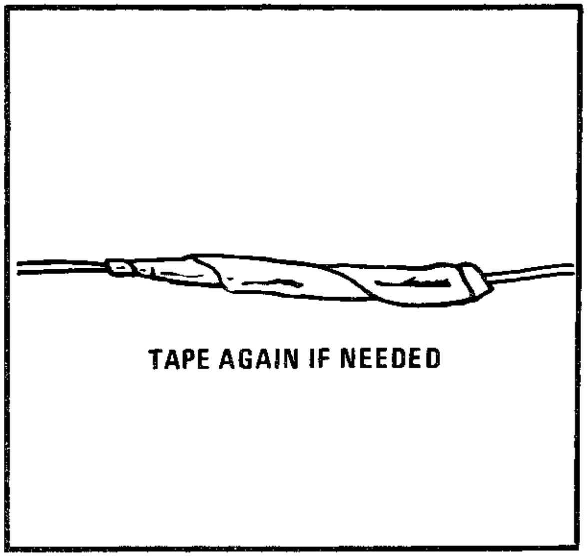


Figure 12 - Proper Second Taping

- —Small cylindrical metal splice clips.
- —A plastic tube of petroleum jelly.
- —Ten 2.0 metric (14 gauge) DK GRN leads: 150mm (6") long with terminals.
- —Ten 1.0 metric (16 gauge) BRN leads: 150 mm (6") long with terminals.

Use of the special materials in this kit will help prevent galvanic corrosion. Galvanic corrosion causes increased resistance between the terminal and wire, or the splice clip and wire, or both. Increased resistance would affect the operation of the electrical components in the repaired circuit.

Step One: Open the Harness

Because the harness has a solid plastic conduit, simply cut the conduit open with diagonal cutters and pull out the desired wire. Be careful not to damage any of the wires when cutting open the conduit.

Step Two: Cut the Wire

Begin by cutting as little wire off the harness as possible. You may need the extra length of wire later if you decide to cut more wire off to change the location of a splice. You may have to adjust splice locations to make certain that each splice is at least 40mm (1 1/2") away from the other splices, harness branches, or connectors.

Step Three: Strip the Insulation

When replacing a wire or lead, use a wire of the same size as the original wire, or larger. Look up the metric wire size on the schematic and select the proper-sized leads from the special repair kit. Remember that the wires in this harness can only be one of two sizes-2.0 metric or 1.0 metric (14 or 16 gauge).

Use wire strippers of the proper gauge to strip approximately 6mm (1/4") of insulation from each wire end.

When stripping the outer jacket from the aluminum wire core, be careful not to nick or damage the core. A damaged core will weaken the assembly at this point.

Step Four: Coating the Splice/Terminal

To prevent corrosion, apply a generous coating of petroleum jelly to the splice area. If you are replacing a lead, also thoroughly coat the terminal crimp area and aluminum core with petroleum jelly. Both areas are shown in Figure 13 and identified with the letter "A."

Step Five: Crimp the Wires

- —Select the proper-sized splice clip (follow the instructions included in the special repair kit).
- —Place one wire end in each end of the splice clip.
- —Crimp the clip firmly to the wire using 10" slip joint pliers. Do NOT solder the splice (see Figure 14).
- —Repeat this procedure for the second wire or lead in the splice clip.

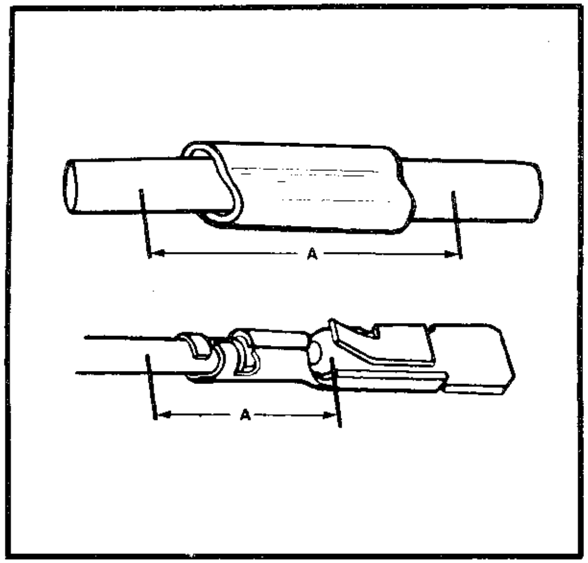


Figure 13 - Where To Apply Petroleum Jelly

Step Six: Tape Splice/Insert Terminal

Tape over both the splice clip and the petroleum jelly to seal out moisture and insulate the splice (see Figure 15). If you have replaced a lead, do not tape over the terminal crimp area but insert the lead into the connector body.

SPLICING TWISTED/ SHIELDED CABLE

Twisted/shielded cable is sometimes used to protect wiring from electrical noise (stray signals). For example, two-conductor cable of this construction is used between the ECM and the distributor. See Figure 16 for a breakdown of twisted/shielded cable construction.

Step One: Remove Outer Jacket

Remove the outer jacket and discard it. Be careful to avoid cutting into the drain wire or the mylar tape.

Step Two: Unwrap the Tape

Unwrap the aluminum/mylar tape, but do not remove it. The tape will be used to rewrap the twisted conductors after the splices have been made.

Step Three: Prepare the Splice

Untwist the conductors. Then, prepare the splice by following the splicing instructions for copper wire presented earlier. Remember to stagger splices to avoid shorts (see Figure 17).

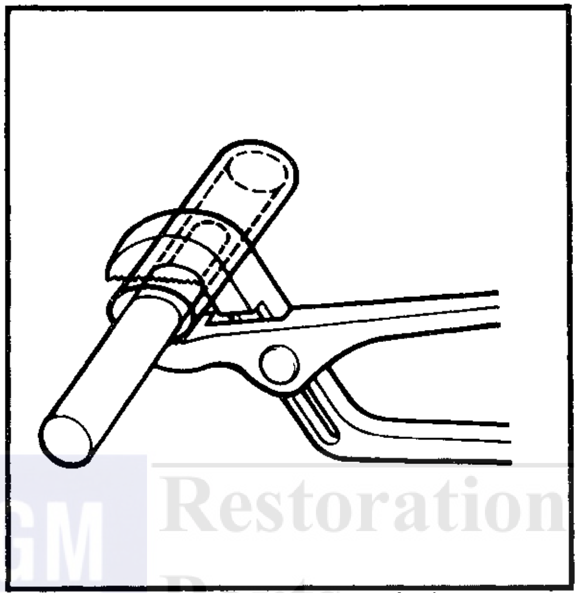


Figure 14 - Crimping The First Half Of The Splice Clip (Aluminum Wire)

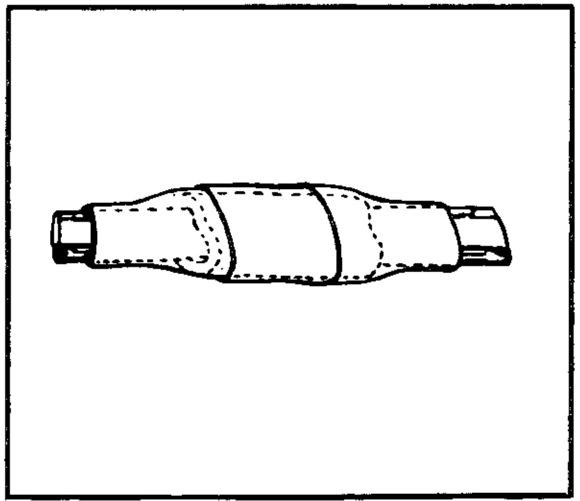


Figure 15 - The Tape Covers The Splice Clip And The Petroleum Jelly To Seal And Insulate

Step Four: Re-Assemble the Cable

After you have spliced and taped each wire, rewrap the conductors with the mylar tape. Be careful to avoid wrapping the drain wire in the tape.

Next, splice the drain wire following the splicing instructions for copper wire. Then, wrap the drain wire around the conductors and mylar tape (see Figure 18).

Step Five: Tape the Cable

Tape over the entire cable using a winding motion (see Figure 19). This tape will replace the section of the jacket you removed to make the repair.

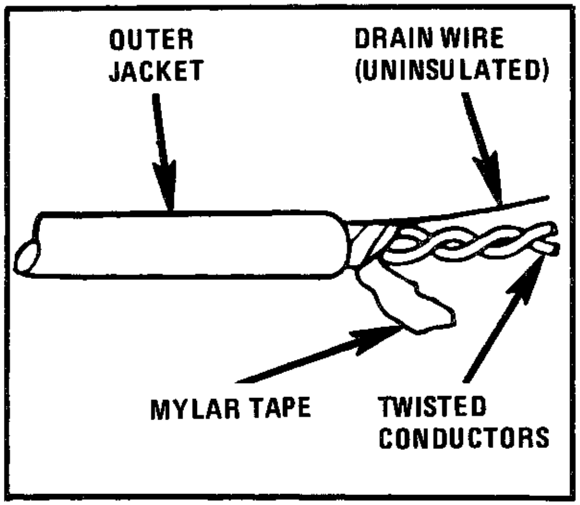


Figure 16 - Twisted/Shielded Cable

REPAIR PROCEDURES

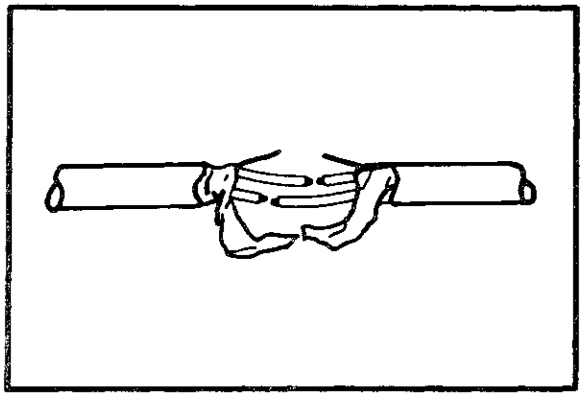


Figure 17 - The Untwisted Conductors

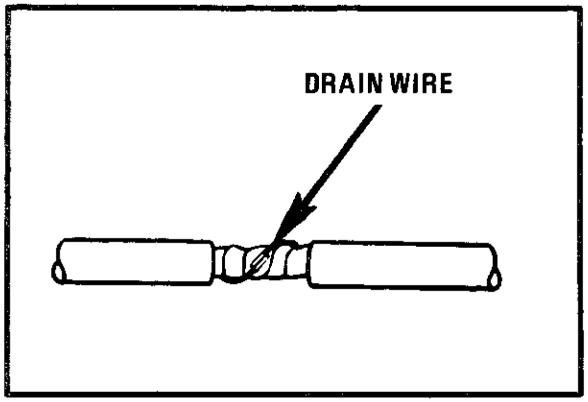


Figure 18 - The Re-Assembled Cable

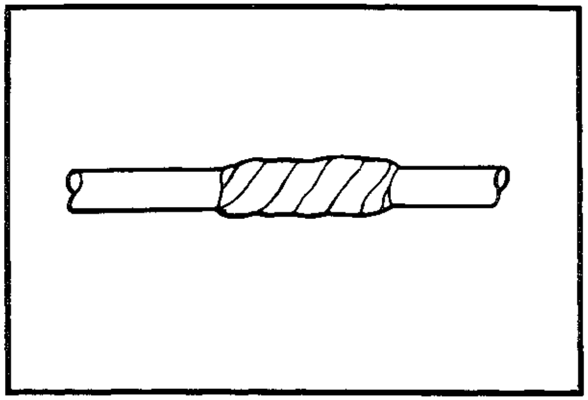


Figure 19 - Proper Taping

REPAIRING CONNECTORS

(Except Weather Pack® and Metri-Pack Series 150 Pull-to-Seat Type)

The following general repair procedures can be used for High Density, Printed Circuit and Bulkhead connectors. Prior to starting any repairs, separate connector halves and remove any terminal covers or retainers.

Instruction in the disassembly, repair, and assembly of connectors follows. Consult the figures for details on each specific type of connector. The instruction is divided into steps. Only perform those steps necessary to make the repair.

Step One: Remove the Lead

Depress the terminal locking tang using the proper size pick.

CAUTION: Do not place fingers or other parts of the body next to or around the back of the connector. If too much force is used, the pick and terminal both could be pushed out the back of the connector and cause injury.

- —Place the pick between the locking tang of the terminal and the plastic of the connector body.
- —Ease the lead back enough to release the locking tang.
- —Pull the pick out.
- —Gently pull the lead out of the back of the connector body.

Step Two: Re-Form the Locking Tang

If the lead and terminal are in good condition, reform the locking tang:

- —Hold the lead firmly to prevent the splice between the terminal and the wire from flexing.
- —Use the pick to bend the locking tang back into its original shape. Also check to see that the remainder of the terminal is still in its original shape.

Step Three: Make the Repair

When you make a repair, use the correct types of terminals and wires.

- —Attach a new wire or a new terminal using the procedures in Splicing Copper Wire or Splicing Aluminum Wire.

Step Four: Insert the Lead

Before inserting the lead, make certain that the terminal is correctly shaped. Be careful to insert terminals in their proper locations.

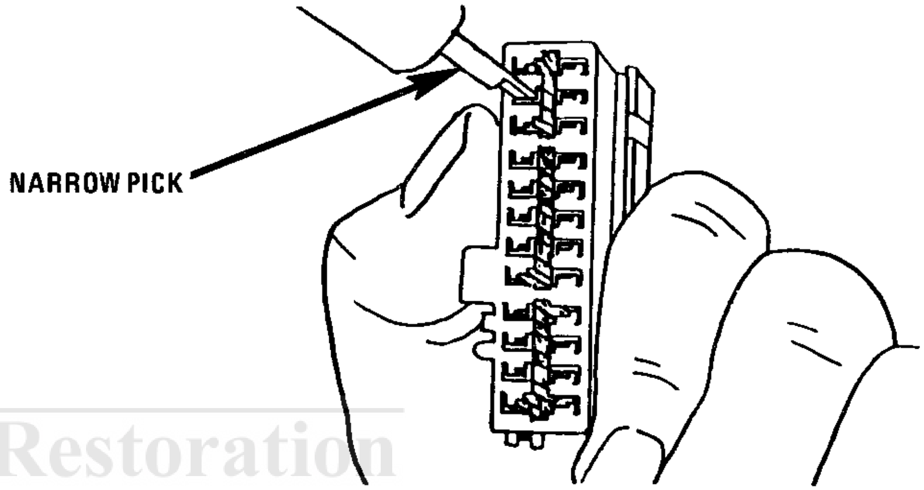
- —Gently insert the lead from the back.

The terminal should stop or "catch" about halfway through the connector body.

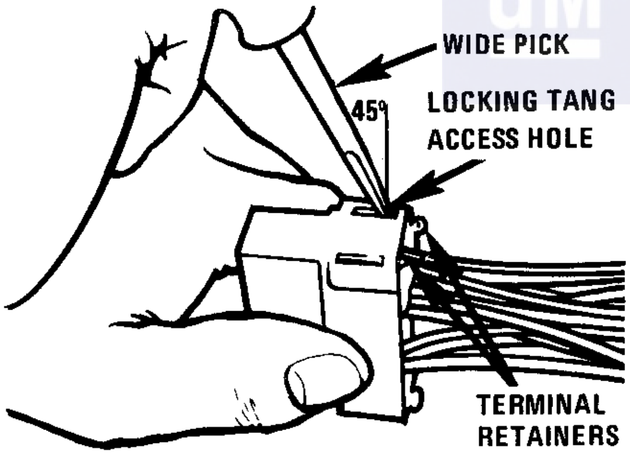
Note: With bulkhead connectors, in many cavities it is possible for the terminal to be inserted in two ways. Be sure it is inserted in the same direction as it was removed, or to mate correctly with the facing terminal.

- Push back and forth gently on the lead to be sure the terminal is held in place in both directions. If the terminal easily pushes or pulls out, review Step Two; "Re-Form the Locking Tang."

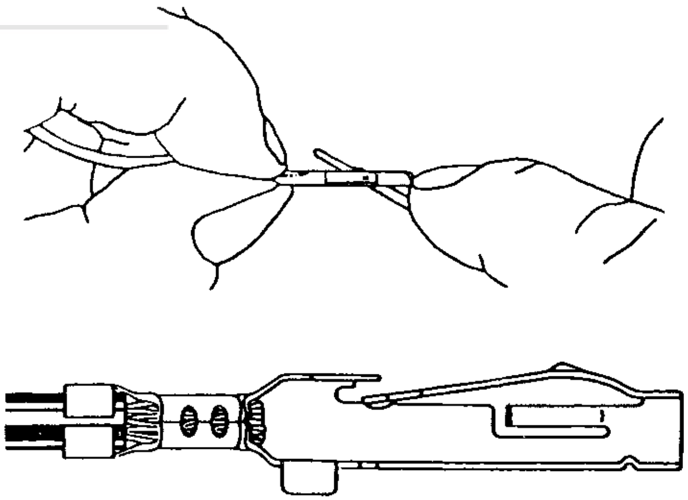
Before mating the connector halves replace any terminal covers or retainers that were removed, and apply grease to prevent corrosion.



DEPRESSING THE LOCKING TANG

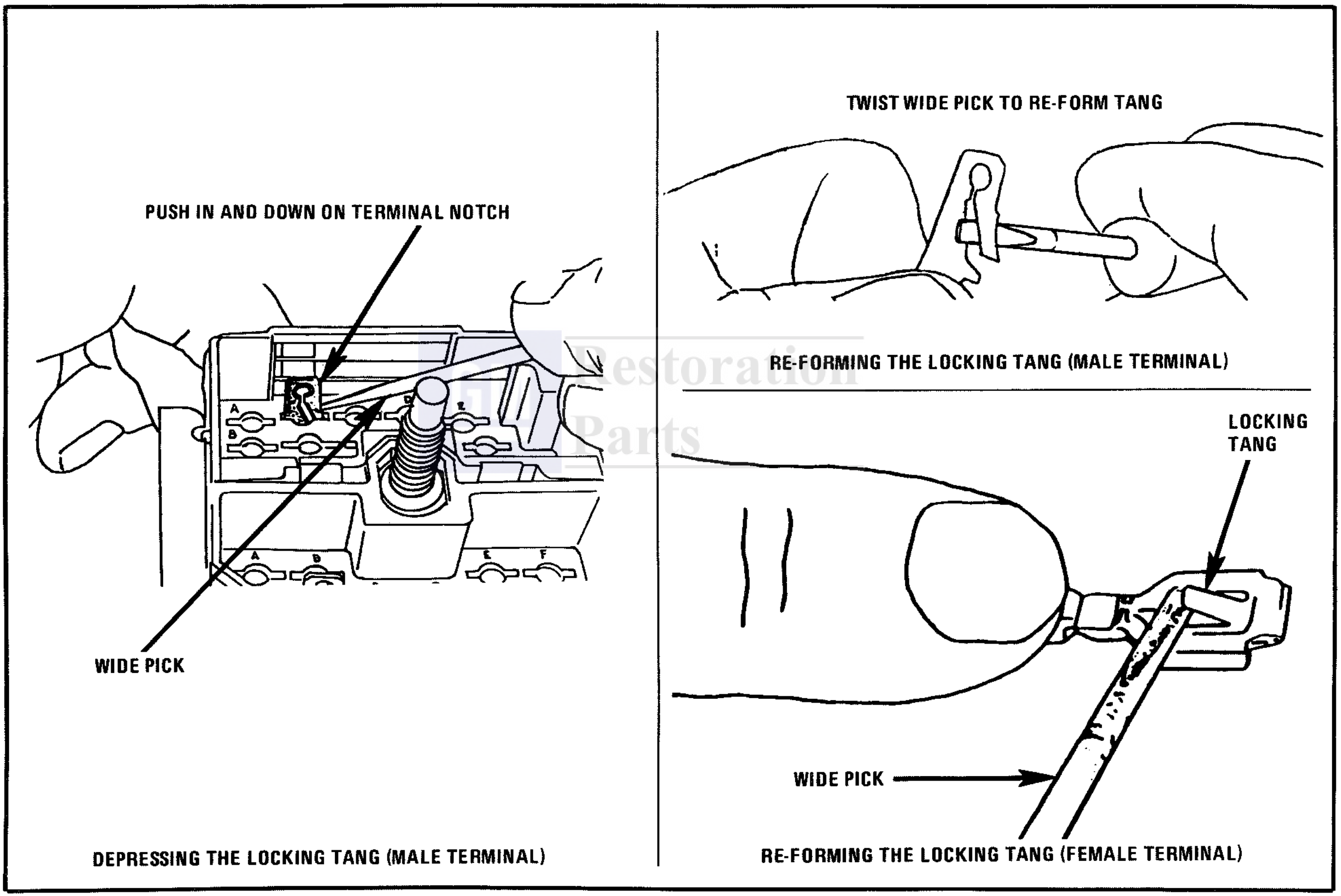


REMOVING TERMINAL RETAINERS



RE-FORMING THE LOCKING TANG

Figure 20 - High Density Connectors

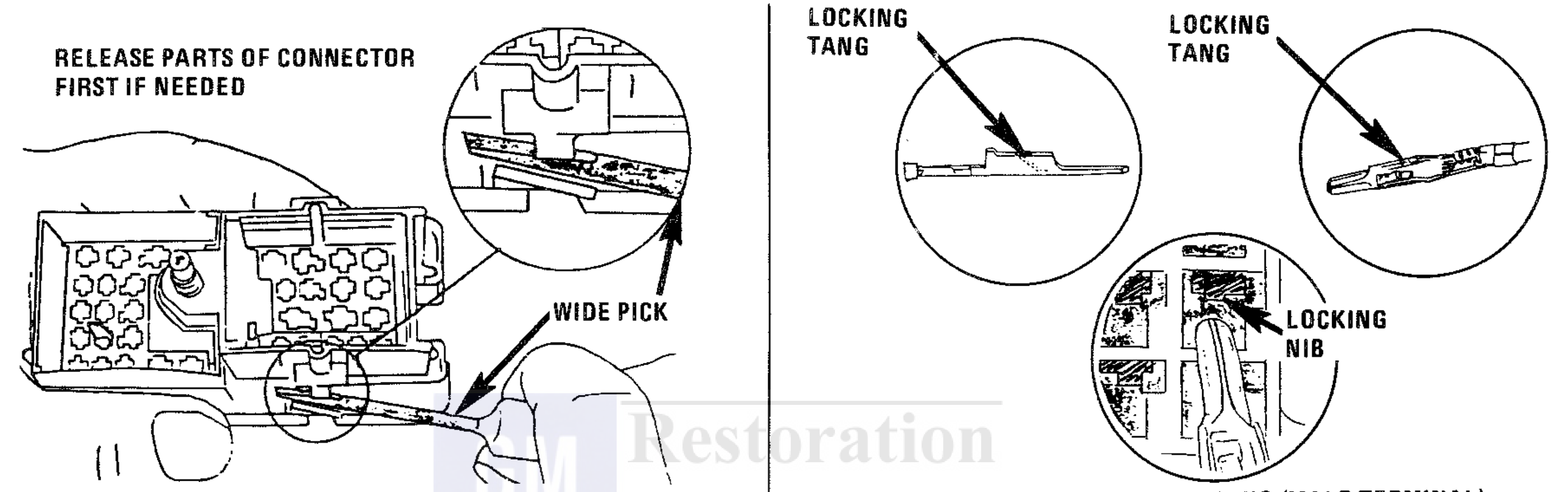


DEPRESSING THE LOCKING TANG (MALE TERMINAL)

RE-FORMING THE LOCKING TANG (MALE TERMINAL)

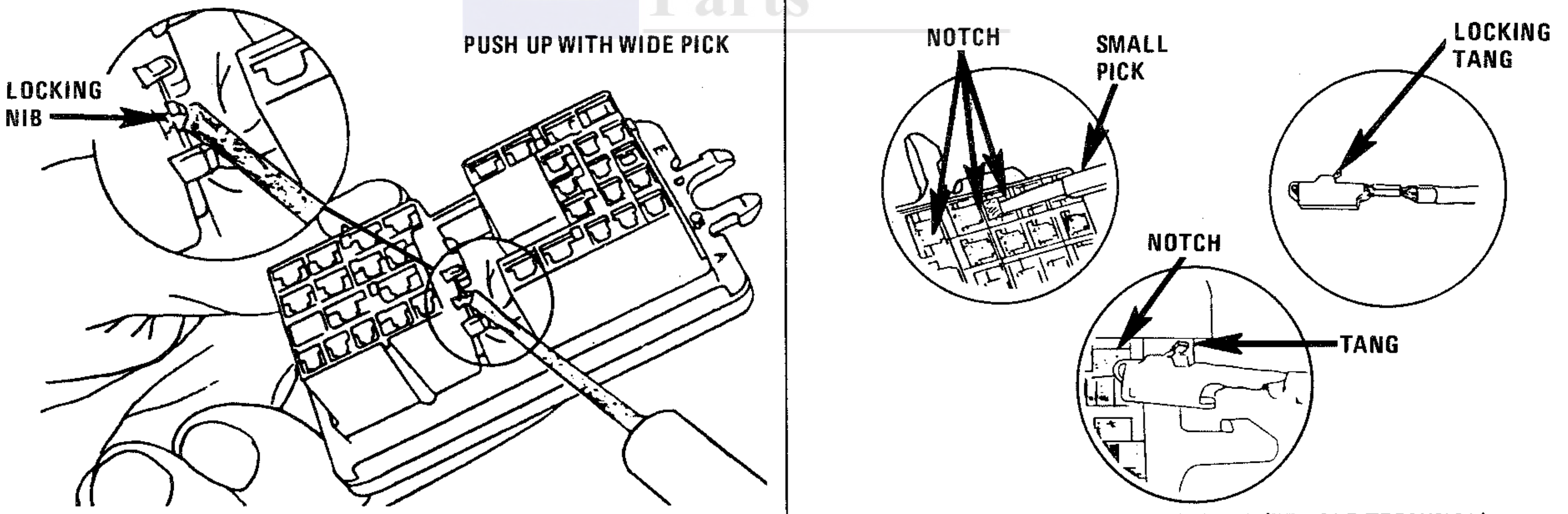
RE-FORMING THE LOCKING TANG (FEMALE TERMINAL)

Figure 21 - Bulkhead Type Connectors



REMOVING TERMINAL RETAINERS (MALE TERMINALS)

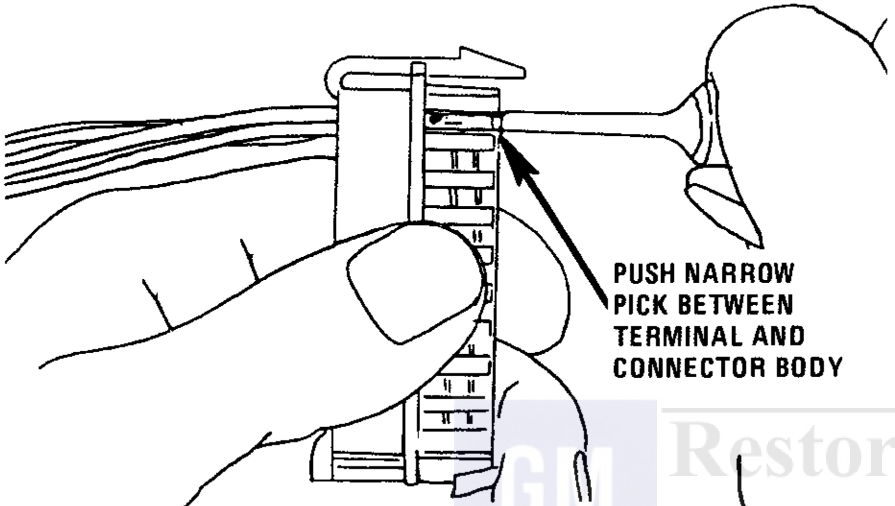
RE-FORMING THE LOCKING TANG (MALE TERMINAL)



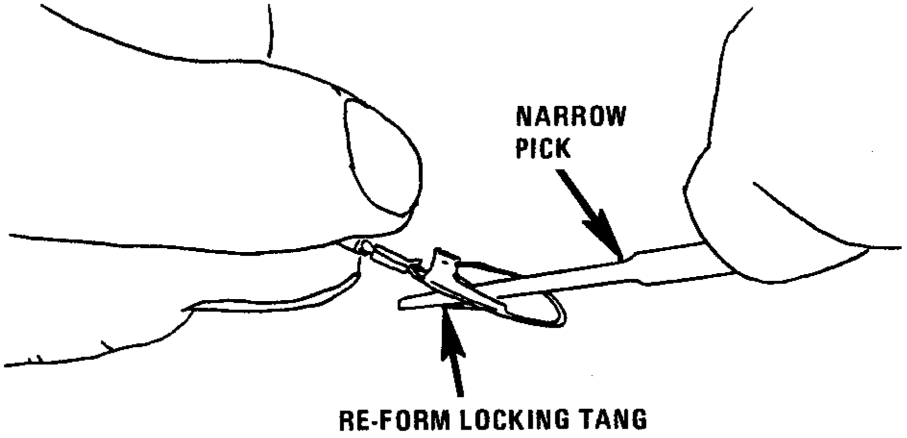
REMOVING TERMINAL RETAINERS (FEMALE TERMINALS)

RE-FORMING THE LOCKING TANG (FEMALE TERMINAL)

Figure 22 · Metri-pack Type Connectors – Push-To-Seat Type



DEPRESSING THE LOCKING TANG



RE-FORMING THE LOCKING TANG

Figure 23 - Printed Circuit Type Connectors

REPAIRING WEATHER PACK® (Environmental) CONNECTORS

Weather Pack® or weatherproof connectors provide environmental protection on certain electrical circuits. This protection consists of a moisture-proof rubber flexible seal between the two connector halves and rubber cable seals attached to each terminal. The terminals and the cable seals are secured by a hinged secondary lock on small Weather Pack® connectors and by plastic terminal retainers on large Weather Pack® connectors.

If a Weather Pack® connector requires repair, do not replace the Weather Pack® parts with other types of connectors and temrinals. Also, do not omit either the large seal or the cable seals when making a repair.

Instruction in the disassemly, repair, and assembly of both small and large Weather Pack® connectors follows. The instruction is divided into steps. Only perform those steps necessary to make the repair.

Step One: Separate the Connector Halves

To separate a large connector, unscrew the bolt in the center of the connector body. Then pull the two halves apart. To separate a small connector, simply pull up on the primary lock and simultaneously pull the two halves apart.

Step Two: Remove the Terminal Retainer(s) (Large Connectors)/Open the Secondary Locks (Small Connectors)

To remove a terminal retainer, press a wide pick at a 45° angle against the locking nib (see Figure 24). Push the nib up as far as possible. Then, pull the retainer out.

To open the secondary locks on small connectors, flip down the lock hinges as shown in Figure 25.

Step Three: Remove the Lead

Depress the terminal locking tangs using a Weather Pack® pick(J28742-A or the equivalent):

- —Push the hollow cylinder of the pick into the terminal cavity from the front until it stops (see Figures 26 and 27).The pick should surround the terminal (see Figure 28 for drawings of locking tangs).
- —Pull the pick out.
- —Gently pull the lead out of the back of the connector body.

Note that the male connector body half contains female terminals and the female half houses male terminals.

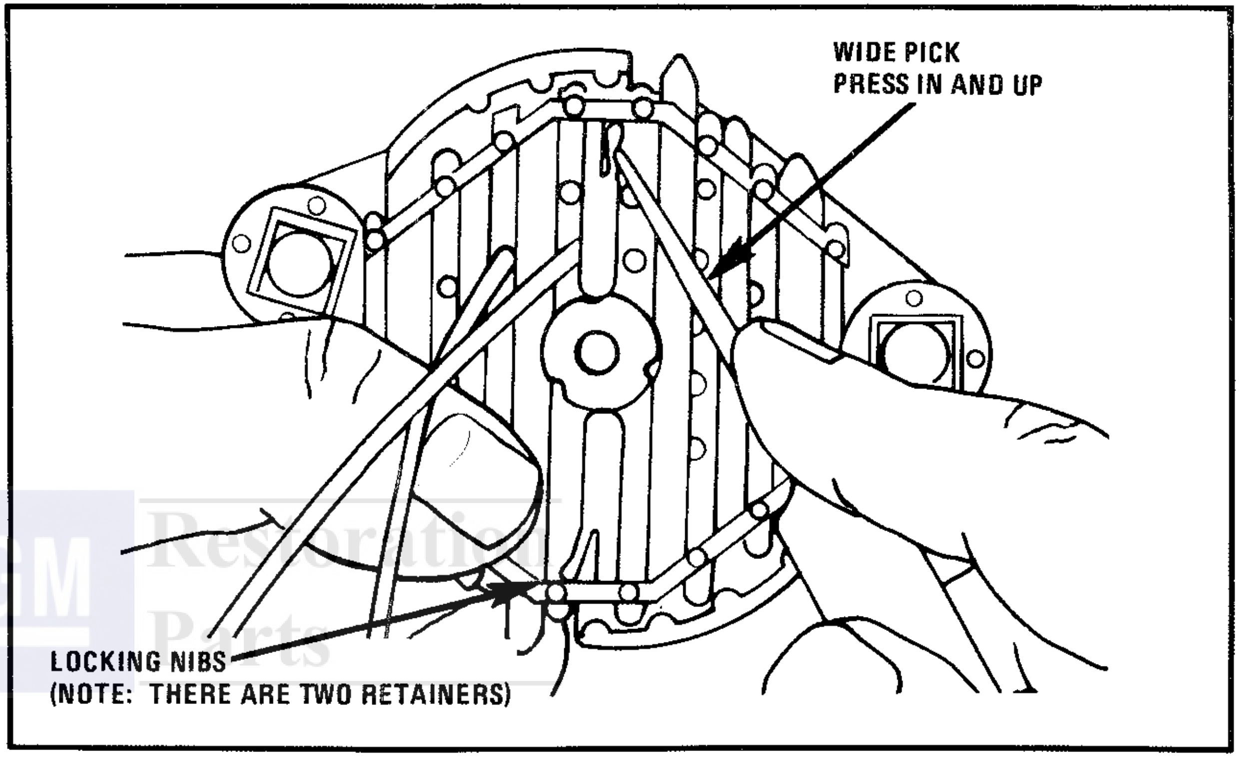


Figure 24 - Releasing the Terminal Retainers (Large Connectors)

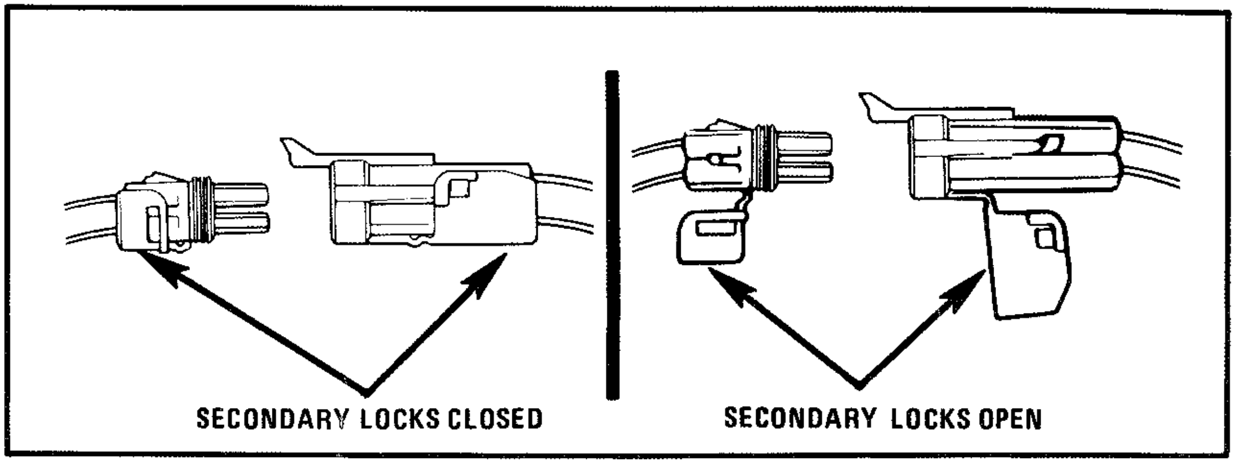


Figure 25 - Opening the Secondary Locks (Small Connectors)

Step Four: Re-Form the Locking Tang

If the lead and terminal are in good condition, re-form the locking tang.

- Hold the lead firmly to prevent the splice between the terminal and the wire from flexing.
- Use the pick (J28742-A or the equivalent) to bend the locking tang back into its original shape (see Figure 28). Also, check to see that the remainder of the terminal is still in its original shape. (See Step Six for instruction in inserting the lead.)

Step Five: Make the Repair

When you make a repair, use the correct types of terminals, wires, and seals.

To add a new lead, cut the wire and crimp and solder on the Weather Pack® lead assembly (see Figure 29) using rosin core solder. (Follow the instructions for splicing wire outlined earlier in this section for a review of splicing procedures.)

If Weather Pack® lead assemblies are not available, splice a new terminal and cable seal onto the existing wire.

- Cut the wire immediately behind the cable seal.
- Slip the new cable seal onto the wire and push it back out of the way.
- Strip 5.0mm (3/16") of insulation from the wire.

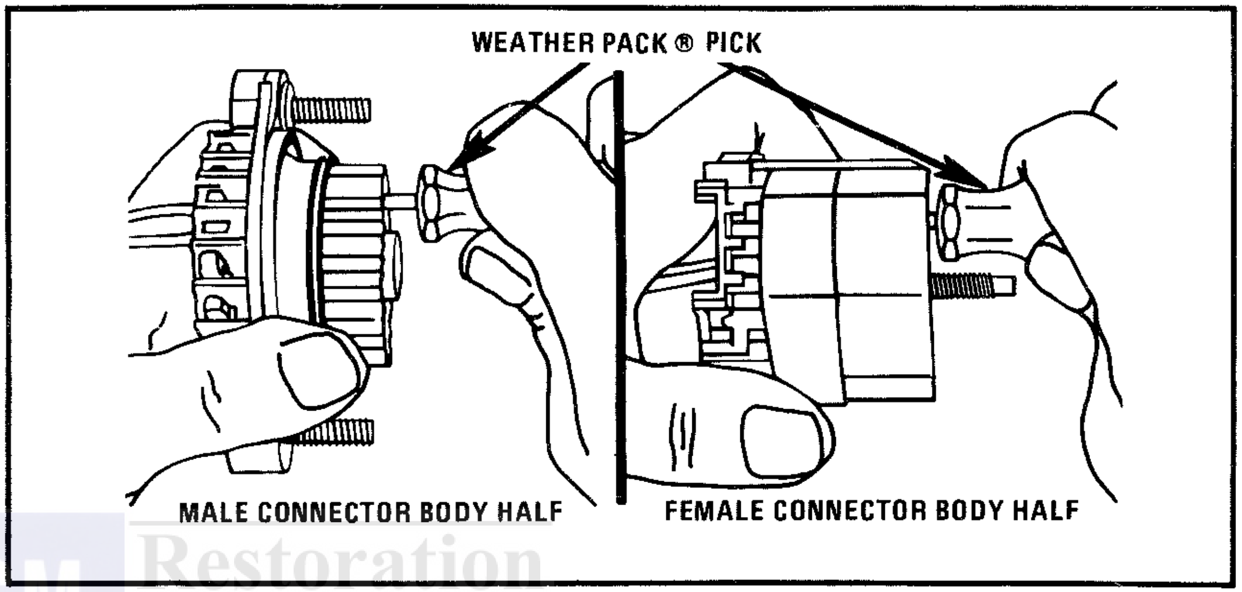


Figure 26 - Releasing The Terminal Locking Tangs (Large Connector)

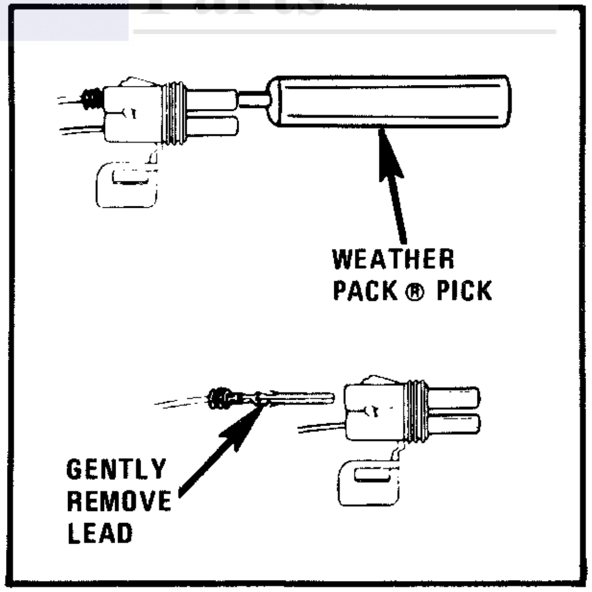


Figure 27 - Releasing The Terminal Locking Tangs (Small Connectors)

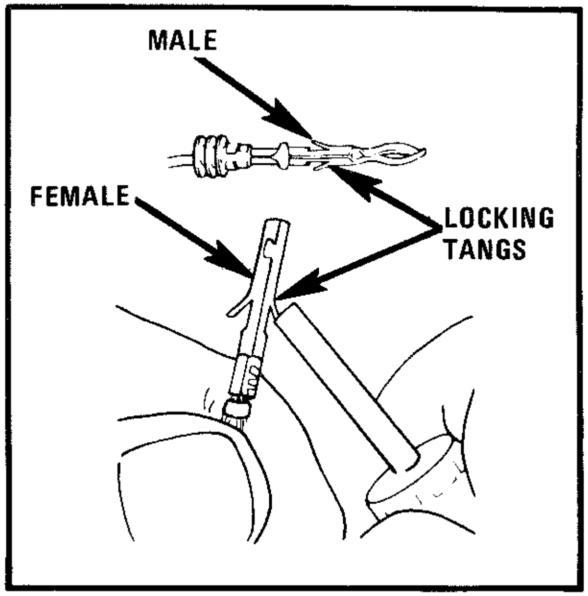


Figure 28 - Re-Forming The Locking Tang

- Crimp the new terminal over the copper strands (core crimp) as shown in Figure 30. (Use a standard crimping tool, number J25563 in the Kent-Moore catalog.)
- Solder with rosin core solder.
- Move the cable seal to edge of the insulation.
- Crimp the grips at the end of the terminal around the cable seal and insulated wire as shown in Figure 30 (insulation crimp). Apply light pressure for this crimp.

Remember to use the proper types of terminals and seals for this repair.

Step Six: Insert the Lead

Before inserting the lead, make certain that the terminal is correctly shaped (see Figure 28). Then, gently insert the lead from the back. The terminal should stop or "catch" about halfway through the connector body. Gently push back and forth on the lead to be sure the terminal is held in place in both directions. If the terminal easily pushes or pulls out, review Step Four; "Re-Form the Locking Tang."

Be careful to insert leads in their proper locations.

Step Seven: Replace the Terminal Retainer(s) (Large Connectors)/Secondary Locks (Small Connectors)

Replace the terminal retainers by slipping the retainer halves into the connector body (as shown in Figure 31).

To close the secondary locks on small connectors, flip the hinges back to their original [illegible] (see Figure 32).

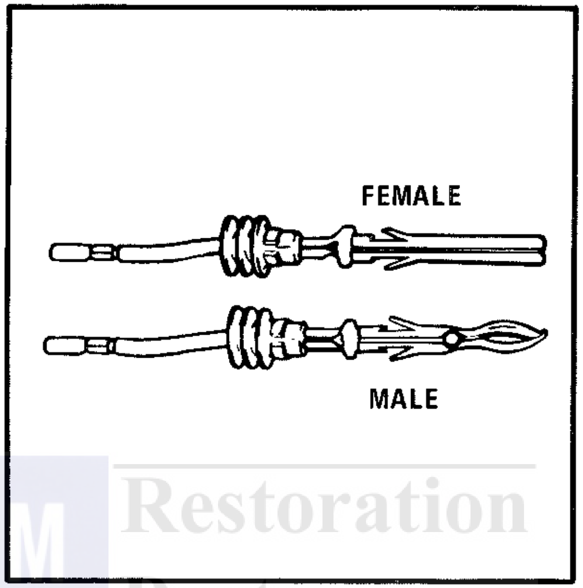


Figure 29 - Lead Assemblies

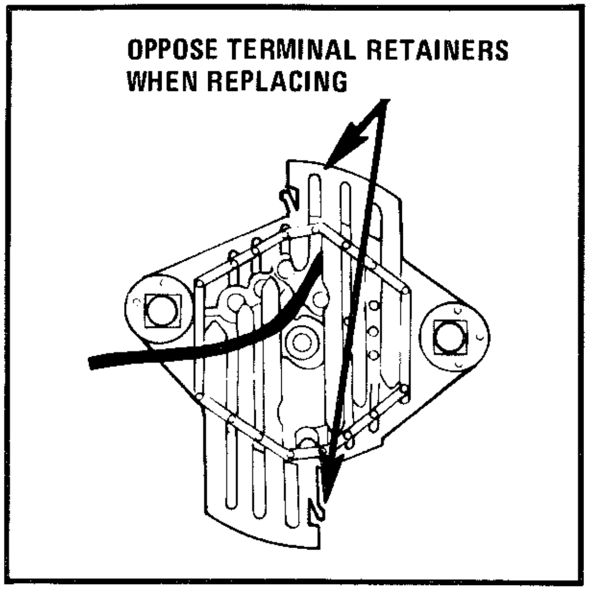


Figure 31 - Replacing The Terminal Retainers (Large Connectors)

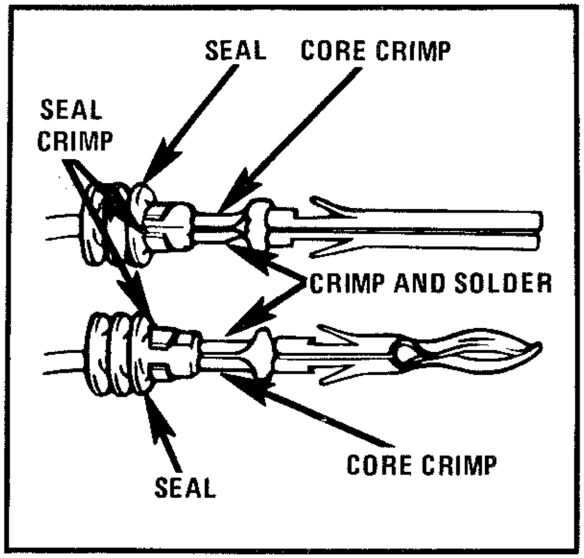


Figure 30 - Replacing The Terminal

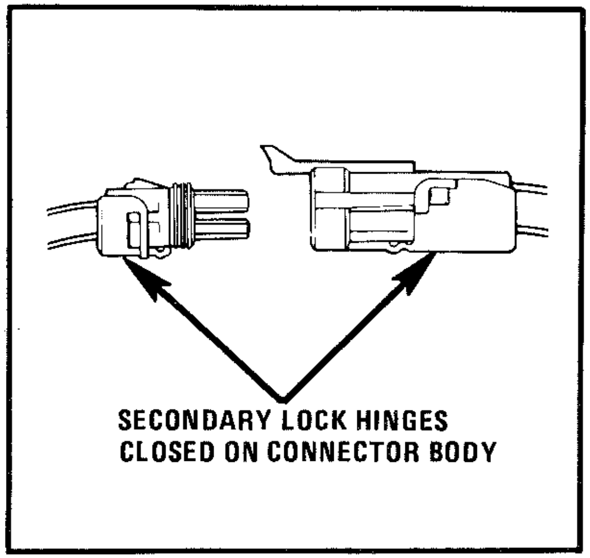


Figure 32 - Closing The Secondary Locks

REPAIRING METRI-PACK SERIES 150 CONNECTORS

(Pull-to-Seat Type)

Metri-Pack connectors are used to connect various sensors such as the cam, crankshaft and coolant sensors to primary harnesses in the engine compartment. The Metri-Pack connector consists of three parts (see Figure 35): a Pull to Seat type terminal, a connector body and a rubber seal which is inserted in the back of the connector body to provide environmental protection.

Do not replace the Metri-Pack parts with parts of other types of connectors and terminals or omit the environmental seals when repairing Metri-Pack connectors.

Repair instructions are divided into two steps, connector disassembly and terminal removal and connector assembly and terminal insertion. (Refer to figures 33 to 36)

Step One: Connector Disassembly and Terminal Removal

Insert tool BT-8446 or J35689 into the connector (Figure 33). Pull back on the wire slightly, pry up the locking tang and then push the wire through the front of the connector. If the terminal will be reused, reshape the locking tang.

Step 2: Connector Assembly and Terminal Insertion

Insert the wire through the seal and the connector body (Figure 35). Crimp the terminal to the stripped wire. Pull the wire and the terminal back through the connector body until it locks in place (Figure 36).

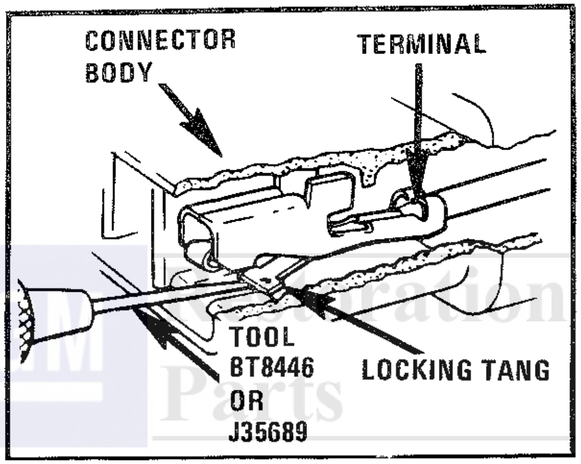


Figure 33 - Terminal Removal From Connector Body

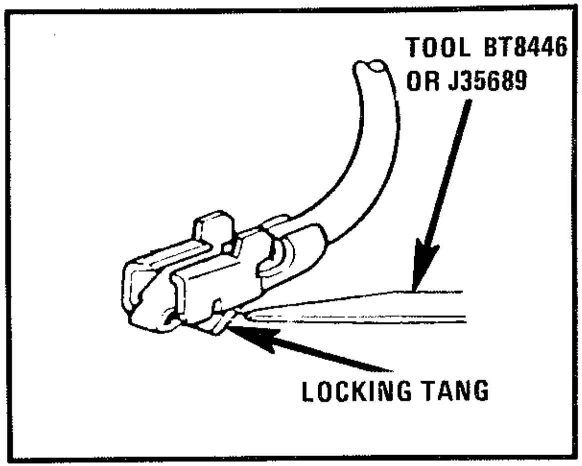


Figure 34 - Reforming The Locking Tang

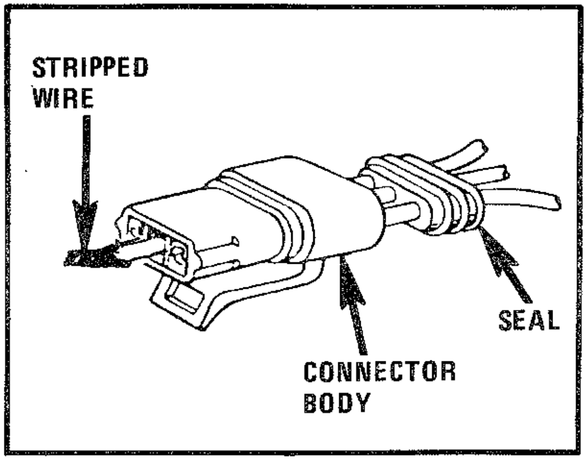


Figure 35 - Connector Reassembly

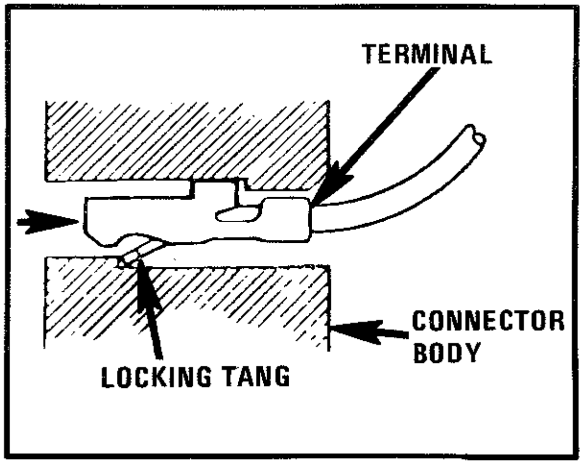
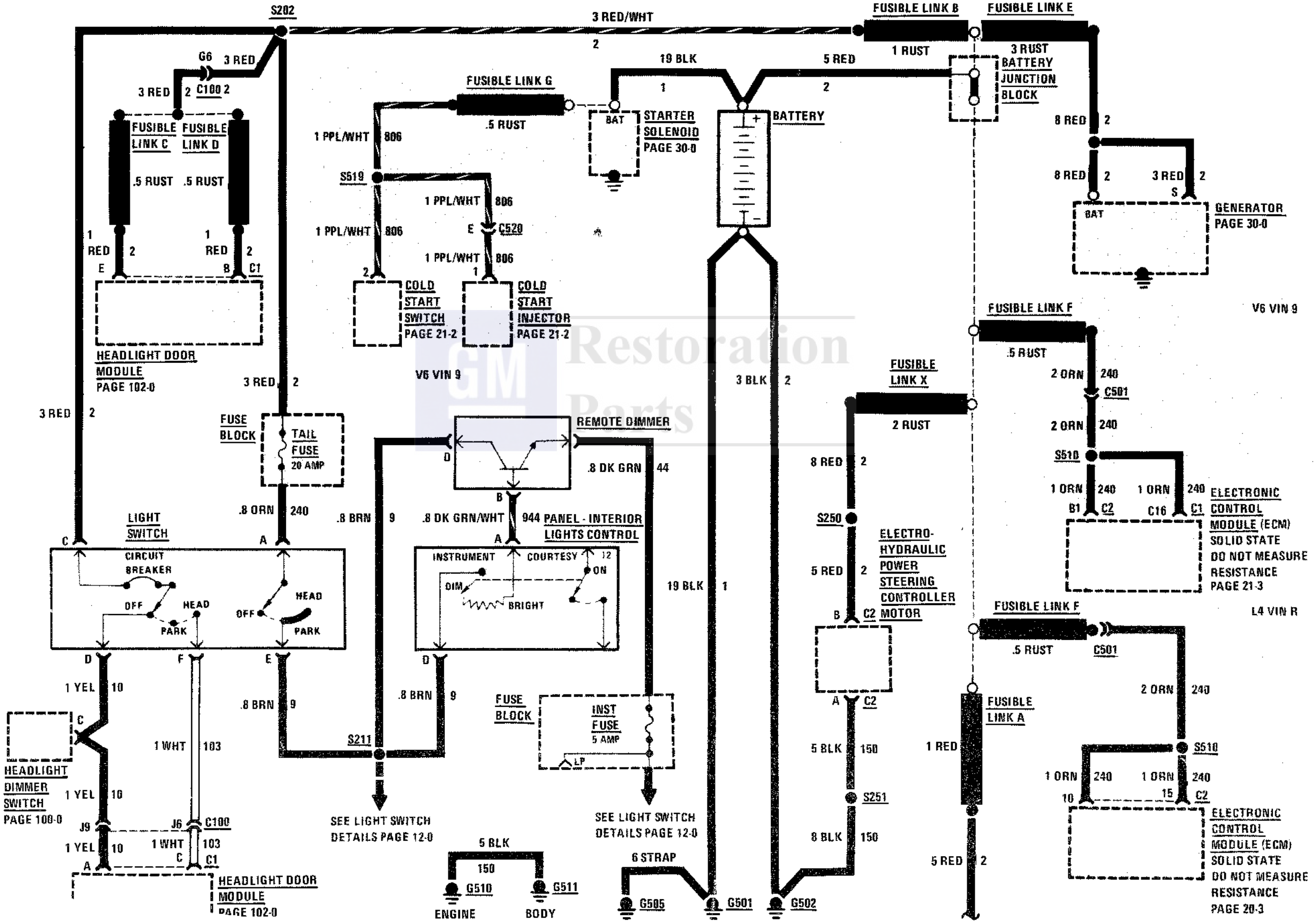
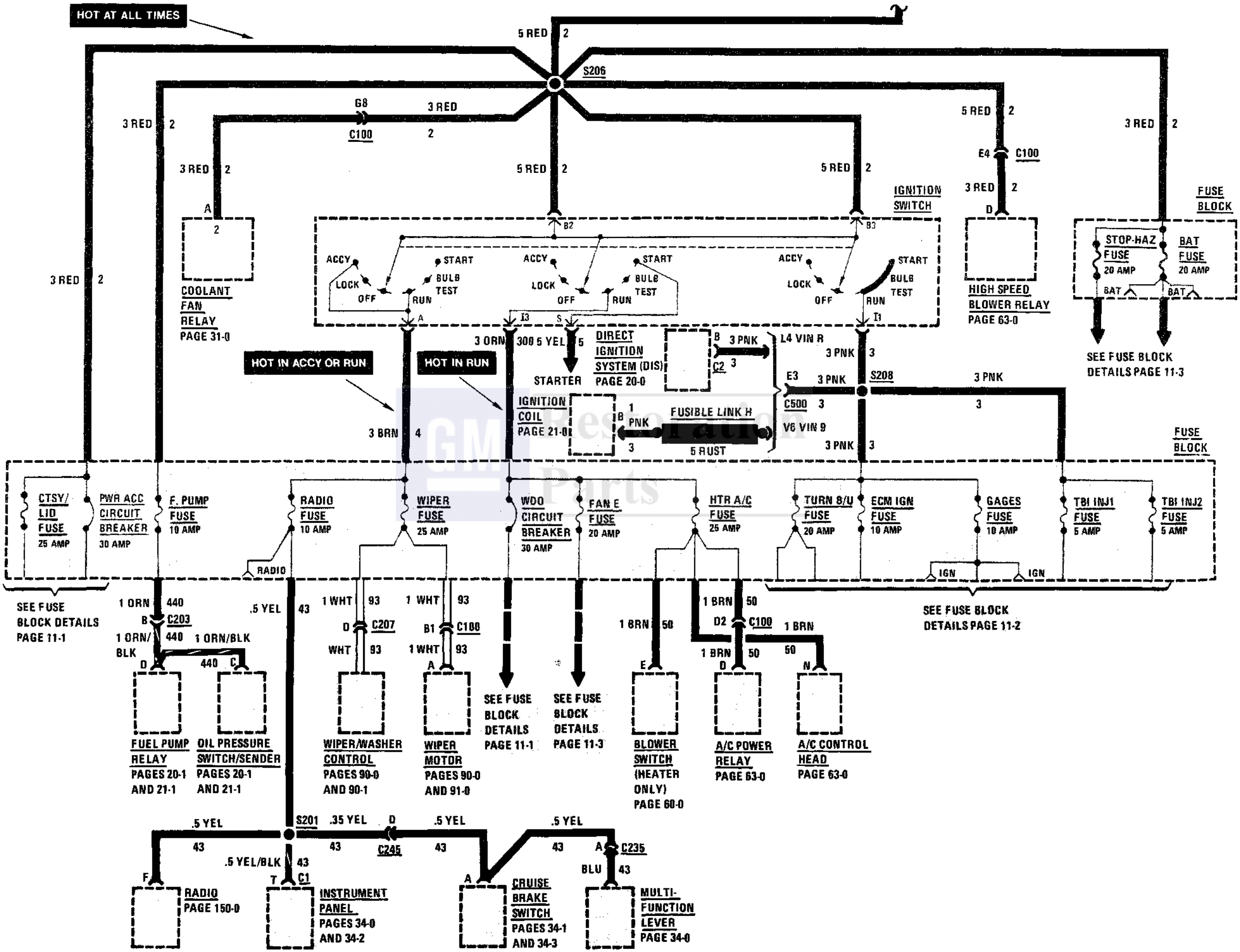


Figure 36 - Terminal Reinsertion

POWER DISTRIBUTION




HOT AT ALL TIMES
5 RED 2
S206
3 RED 2
G8
C100
3 RED
2
3 RED 2
A
2
COOLANT FAN RELAY PAGE 31-0
5 RED 2
5 RED 2
5 RED 2
E4 C100
3 RED 2
D
HIGH SPEED BLOWER RELAY PAGE 63-0
3 RED 2
FUSE BLOCK
STOP-HAZ FUSE 20 AMP
BAT FUSE 20 AMP
BAT
BAT
SEE FUSE BLOCK DETAILS PAGE 11-3
IGNITION SWITCH
B2
B3
ACCY
LOCK
OFF
RUN
START
BULB TEST
A
I3
S
I1
HOT IN ACCY OR RUN
HOT IN RUN
3 ORN
300 5 YEL 5
STARTER
DIRECT IGNITION SYSTEM (DIS) PAGE 20-0
B
C2
3 PNK
3
L4 VIN R
3 PNK 3
E3
3 PNK
S208
C500 3
3 PNK
3
V6 VIN 9
3 PNK 3
IGNITION COIL PAGE 21-0
B
1 PNK
3
FUSIBLE LINK H
5 RUST
3 BRN 4
FUSE BLOCK
CTSY/ LID FUSE 25 AMP
PWR ACC CIRCUIT BREAKER 30 AMP
F. PUMP FUSE 10 AMP
RADIO FUSE 10 AMP
RADIO
WIPER FUSE 25 AMP
WDO CIRCUIT BREAKER 30 AMP
FAN E FUSE 20 AMP
HTR A/C FUSE 25 AMP
TURN B/U FUSE 20 AMP
ECM IGN FUSE 10 AMP
GAGES FUSE 10 AMP
IGN
IGN
TBI INJ1 FUSE 5 AMP
TBI INJ2 FUSE 5 AMP
SEE FUSE BLOCK DETAILS PAGE 11-1
SEE FUSE BLOCK DETAILS PAGE 11-2
1 ORN 440
B C203
1 ORN/ BLK 440
1 ORN/BLK
D
440 C
FUEL PUMP RELAY PAGES 20-1 AND 21-1
OIL PRESSURE SWITCH/SENDER PAGES 20-1 AND 21-1
.5 YEL 43
1 WHT 93
D C207
WHT 93
WIPER/WASHER CONTROL PAGES 90-0 AND 90-1
1 WHT 93
B1 C100
1 WHT 93
A
WIPER MOTOR PAGES 90-0 AND 91-0
SEE FUSE BLOCK DETAILS PAGE 11-1
SEE FUSE BLOCK DETAILS PAGE 11-3
1 BRN 50
E
BLOWER SWITCH (HEATER ONLY) PAGE 60-0
1 BRN 50
D2 C100
1 BRN 50
D
A/C POWER RELAY PAGE 63-0
1 BRN
50
N
A/C CONTROL HEAD PAGE 63-0
.5 YEL
43
S201
.35 YEL
43
D
C245
.5 YEL
43
.5 YEL
43
A C235
BLU 43
.5 YEL/BLK 43
F
RADIO PAGE 150-0
T C1
INSTRUMENT PANEL PAGES 34-0 AND 34-2
A
CRUISE BRAKE SWITCH PAGES 34-1 AND 34-3
MULTI-FUNCTION LEVER PAGE 34-0

POWER DISTRIBUTION

CIRCUIT OPERATION

Electrical power for the car is provided by the Generator when the engine is running. The schematic diagram shows how each circuit gets its power. For more detail about the Generator, and connections to the Battery and Starter, see the Starter and Charging System, Section 8A-30.

The car's Power Distribution System consists of Fusible Links, Fuses, Circuit Breakers, the Light Switch, and the Ignition Switch. Fusible Links are short pieces of wire several sizes smaller than the circuit wire to which they supply power. They are covered with a special high-temperature insulation. When conducting too high a current, they will melt and stop current flow. They are designed to protect the car's electrical system from electrical shorts where it is not protected by the Circuit Breakers and Fuses. See Fuse Block Details for complete distribution of power from each fuse to its individual components.

The Ignition Switch has six positions, five of which have detents. The detented positions are ACCY, LOCK, OFF, RUN and START. The BULB TEST position is after the RUN position and just before the START position and does not have a detent.

Individual schematics show their Fuses suplied from a heading such as HOT IN RUN, corresponding to the Ignition Switch position in which power is supplied to the circuit.

COMPONENT LOCATION

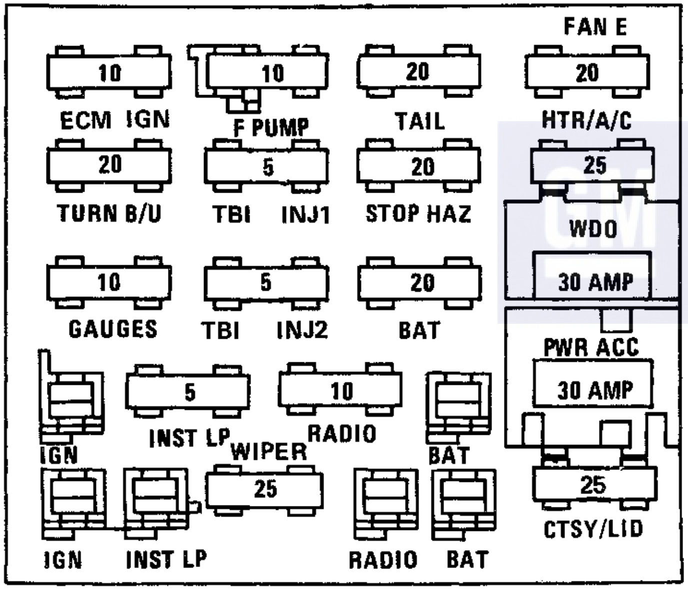
		Page-Figure
A/C Power Relay	Front compartment, on RH side of heater-A/C module	201-11-B
Battery Junction Block	RH front of engine compartment, near battery	201- 4-A
Cold Start Injector	Top of engine, on throttle body	
Cold Start Switch	Top RH side of engine, on intake manifold	201- 3-C
Coolant Fan Relay	LH front corner of front compartment	201- 3-D
Cruise Brake Switch	On brake pedal support	201-11-A
Direct Ignition System (DIS)	Top rear of engine	201- 2-B
Electro-Hydraulic Power Steering (EHPS) Controller	Lower LH side of front compartment	201- 3-D
Electronic Control Module (ECM)	Between seats, on front of rear bulkhead	201- 5-B
Fuel Pump Relay	Engine compartment, LH side of rear bulkhead	201- 5-D
Fuse Block	Behind LH side of I/P	201- 6-D
Fusible Link A	RH front of engine compartment, at Battery Junction Block	201- 4-A
Fusible Link B	RH front of engine compartment, at Battery Junction Block	201- 4-A
Fusible Link C	In forward lamp harness, right of brake master cylinder	201-10-C
Fusible Link D	In forward lamp harness, right of brake master cylinder	201-10-C
Fusible Link E	RH front of engine compartment, at Battery Junction Block	201- 4-A
Fusible Link F	RH front of engine compartment, at Battery Junction Block	201- 4-A
Fusible Link G	Lower LH front of engine, at Starter Solenoid	201- 3-B
Fusible Link H	Engine compartment, near rear bulkhead connector	201- 4-A
Fusible Link X	RH front of engine compartment, at Battery Junction Block	201- 4-A
Headlight Dimmer Switch	Lower LH side of steering column	201- 8-B
Headlight Door Module	Lower LH side of front compartment	201-11-C
High Speed Blower Relay	On RH side of heater-A/C plenum	201-13-A
Ignition Coil	Top of engine, left of throttle body	201- 3-A
Ignition Switch	At base of steering column	201- 8-F
Multi-Function Lever	Top LH side of steering column	201- 8-E

(Continued on next page)

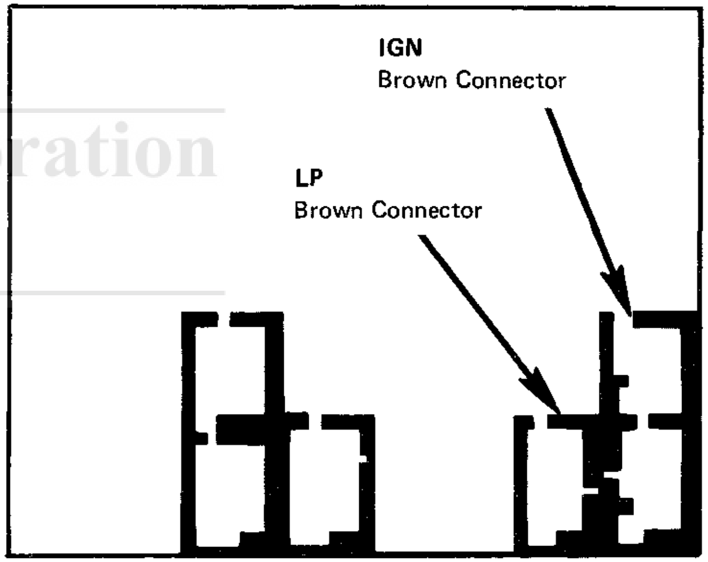
COMPONENT LOCATION

		Page-Figure
Oil Pressure Switch/Sender (VIN 9)	Lower RH front of engine	201- 3-B
Oil Pressure Switch/Sender (VIN R)	Rear of engine, center of engine block	201- 1-A
Remote Dimmer	Below center of I/P, near steering column support	201- 8-D
Starter Solenoid (VIN 9)	Lower LH front of engine.	201- 3-B
Starter Solenoid (VIN R)	Lower LH front of engine.	201- 2-A
Wiper Motor	Front compartment, center of front bulkhead	201-10-B
C100 (34 cavities)	LH side of front bulkhead, right of brake master cylinder	201-13-A
C203 (15 cavities)	Between seats, in front of rear bulkhead.	201- 5-A
C207 (7 cavities)	Behind dash, near steering column	201- 8-F
C235 (4 cavities)	Middle of steering column	201- 8-E
C245 (8 cavities)	Beneath center console	
C500 (34 cavities)	Engine compartment, near battery	201- 4-A
C501 (1 cavity)	RH side of engine, near Battery Junction Block	
C520 (6 cavities)	Top RH side of engine	201- 4-B
G501 (VIN 9)	RH front of engine, near dipstick	201- 3-E
G501 (VIN R)	RH side of engine, below oil fill cap	201- 1-B
G502	Engine compartment, on battery tray	201- 2-C
G505	On trunk lid RH hinge brace	201- 4-E
G510	Engine compartment, on front of engine	
G511	Engine compartment, on rear of bulkhead	201- 5-A
S201	Main harness, above steering column	201- 7-A
S202	Main harness, behind I/P	201- 7-A
S206	Main harness, above LH side of steering column.	201- 8-F
S208	Main harness, near Fuse Block	201- 6-C
S211	Main harness, behind RH side of I/P.	201- 6-C
S250	Power steering harness, lower LH side of front compartment	201- 3-D
S251	Power steering harness, lower LH side of front compartment	201- 3-D
S501 (VIN 9)	Engine harness, near generator	
S501 (VIN R)	Engine harness, near generator	201- 1-A
S510	Engine harness, under rear console	201- 5-A
S519	Engine harness, near Starter Solenoid	201- 3-B

FUSE BLOCK DETAILS

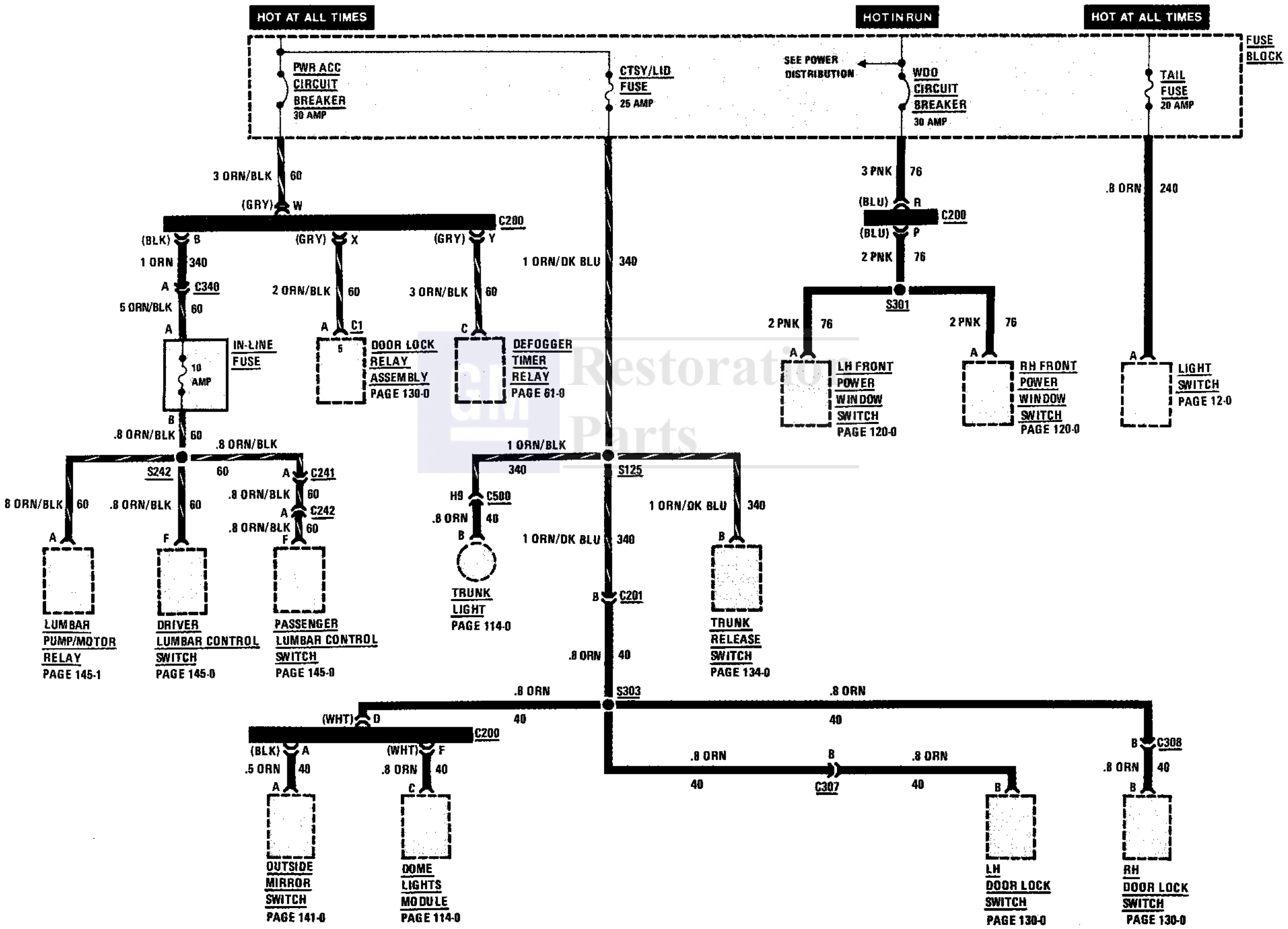


FRONT VIEW OF FUSE BLOCK

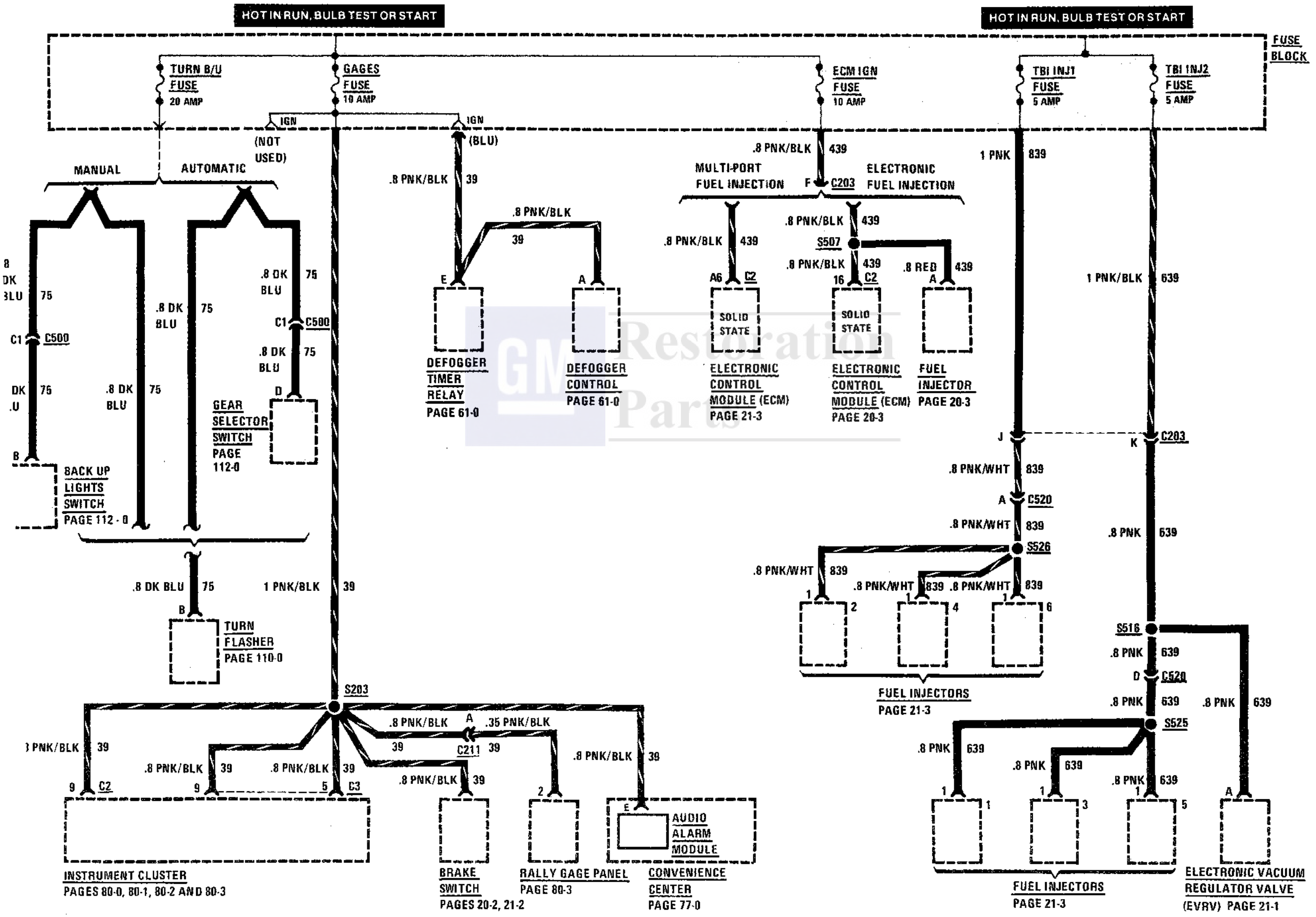


REAR VIEW OF FUSE BLOCK
Connector Cavity Locations

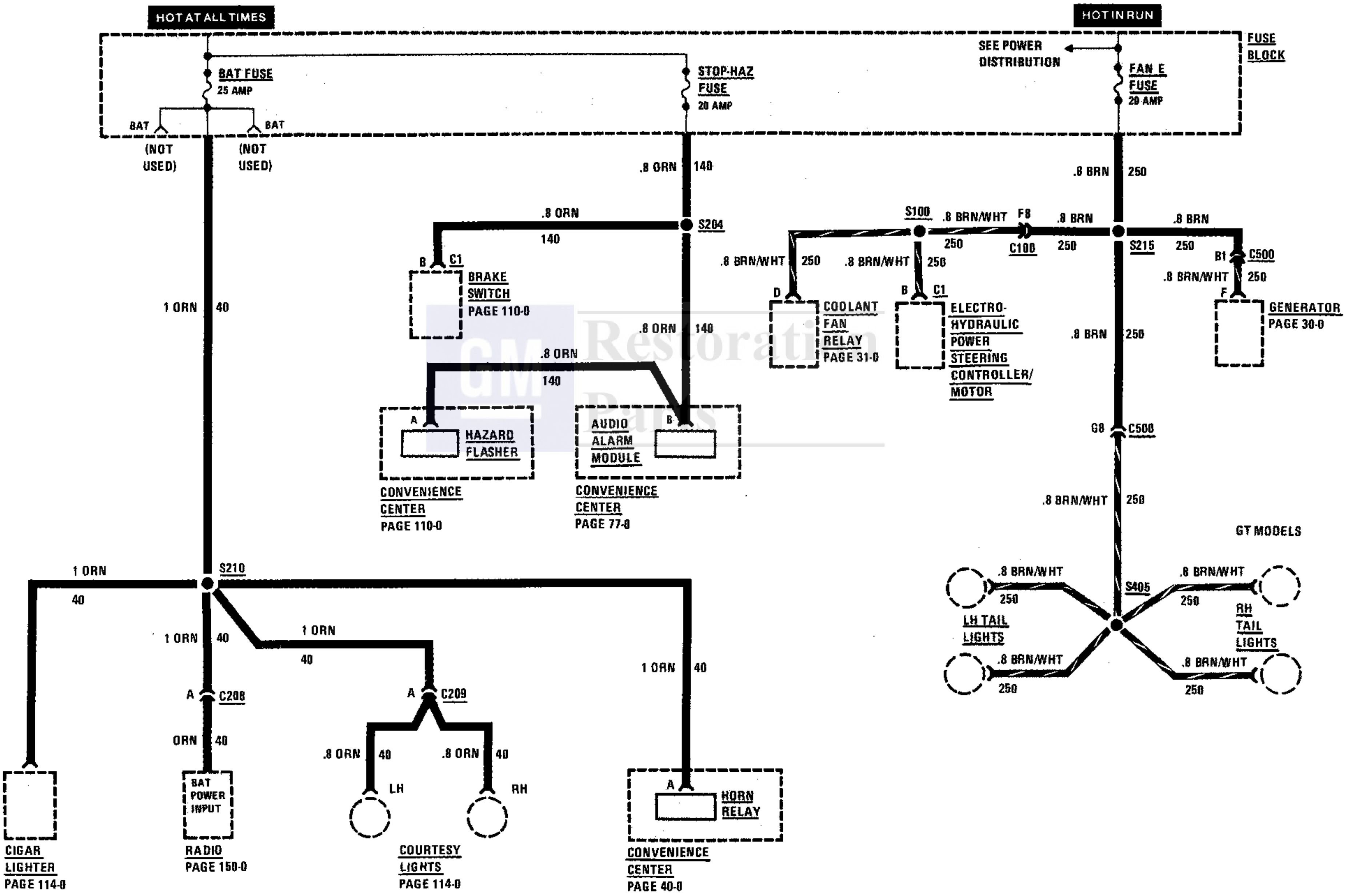
JSE BLOCK DETAILS



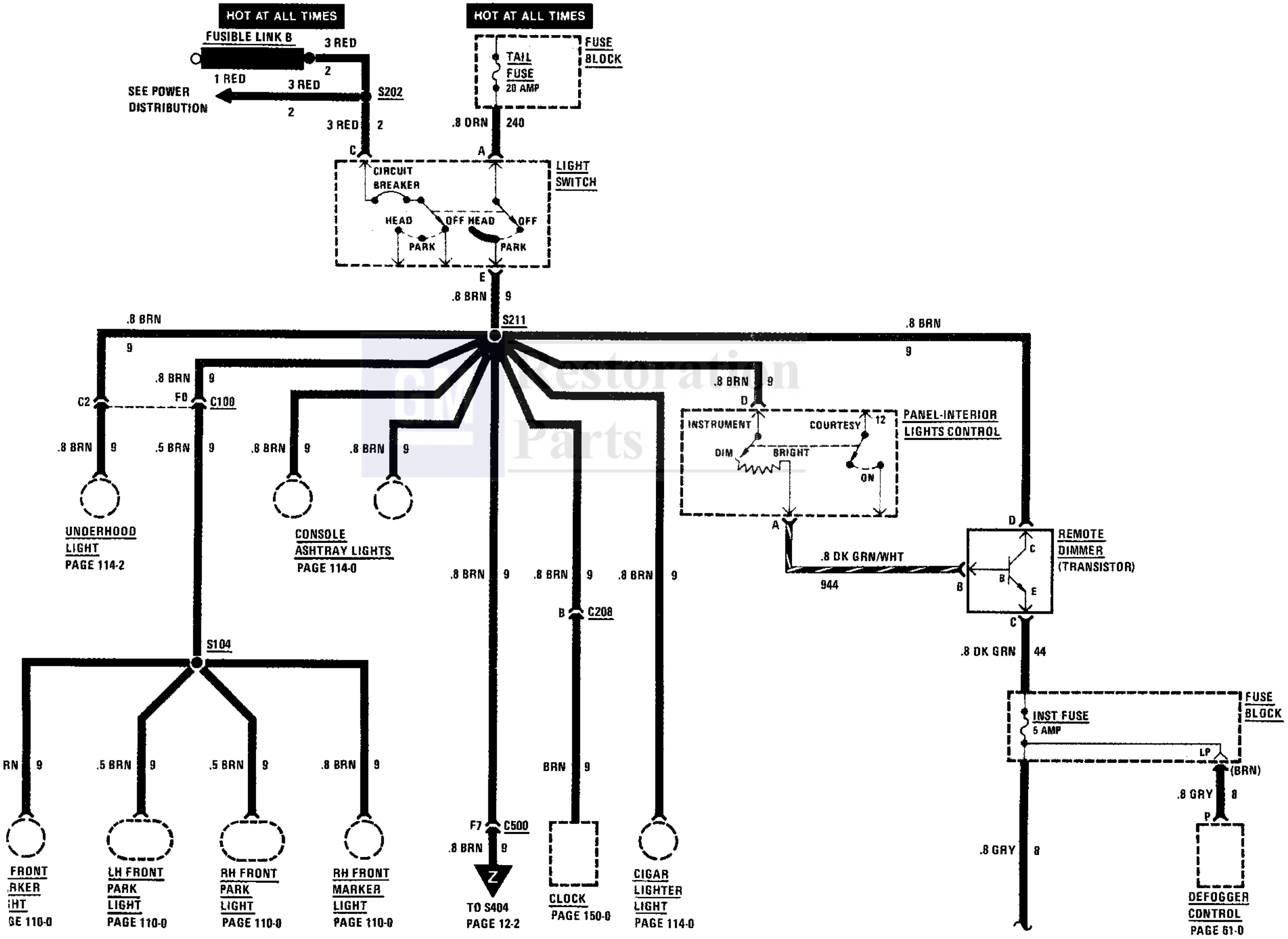
FUSE BLOCK DETAILS

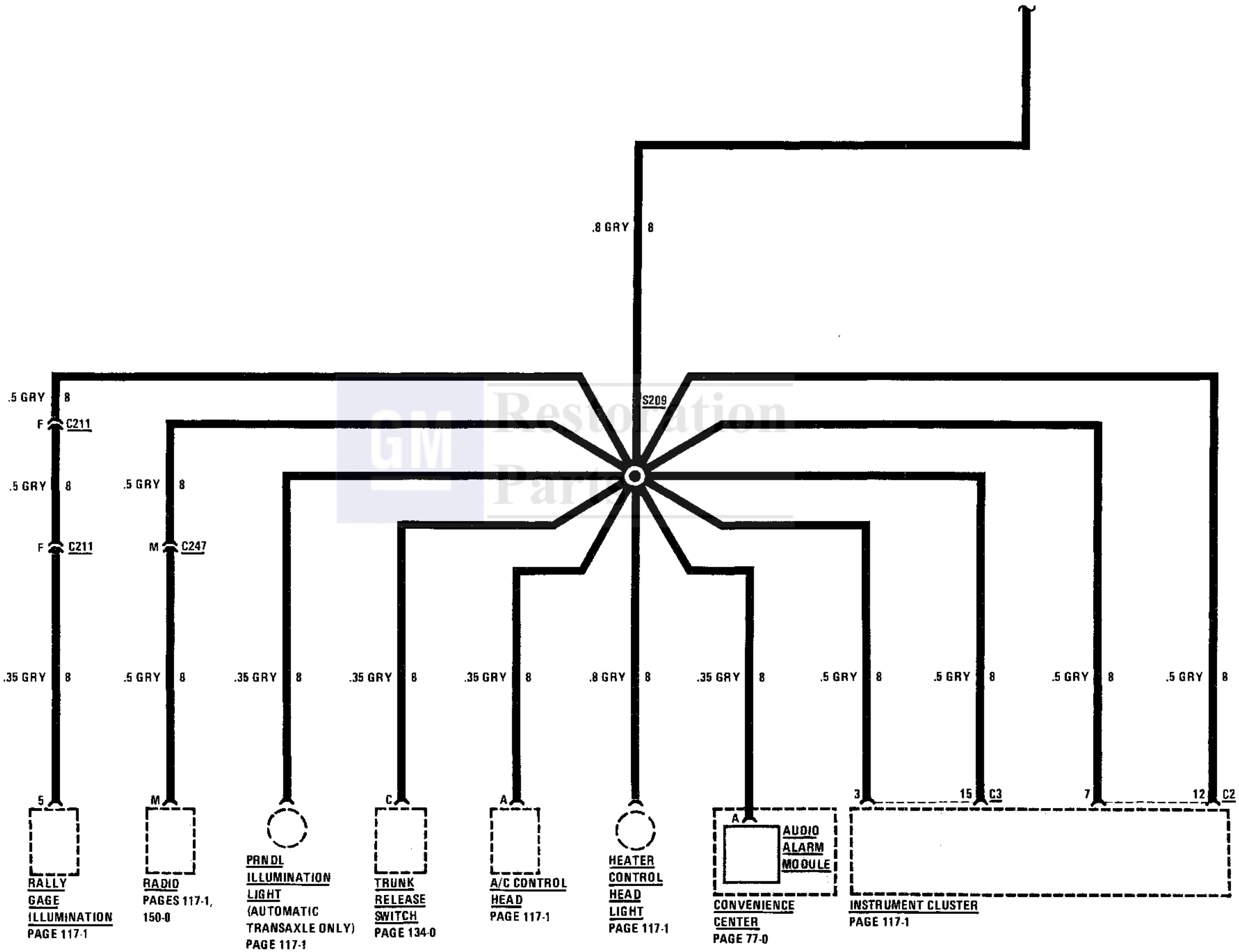


FUSE BLOCK DETAILS



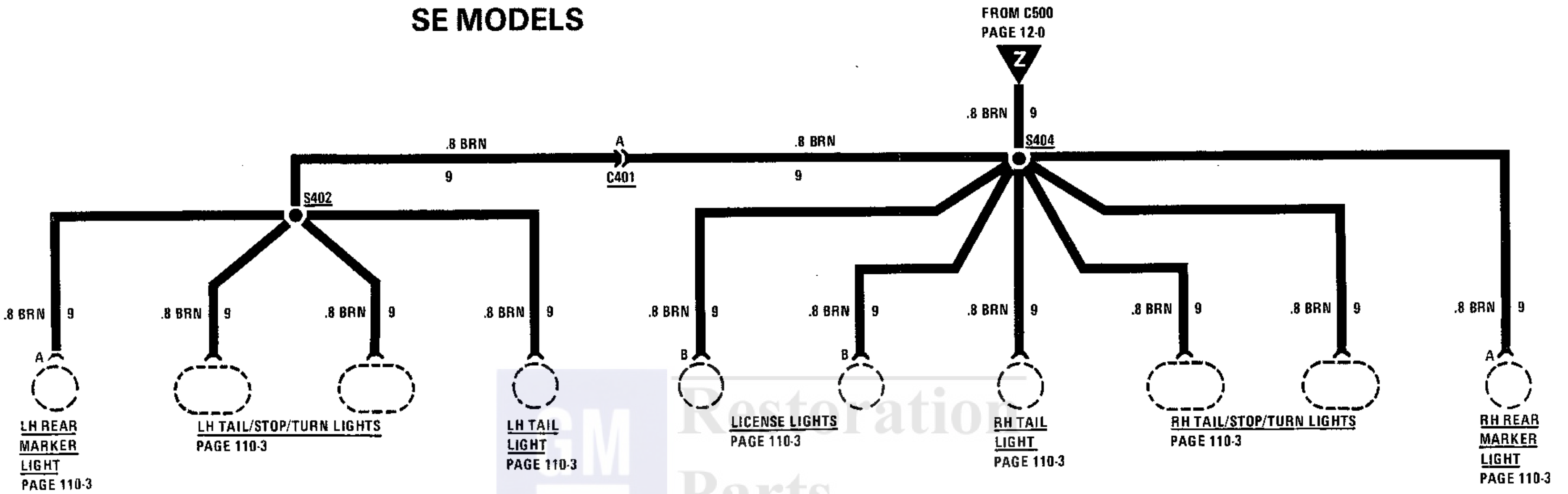
LIGHT SWITCH DETAILS



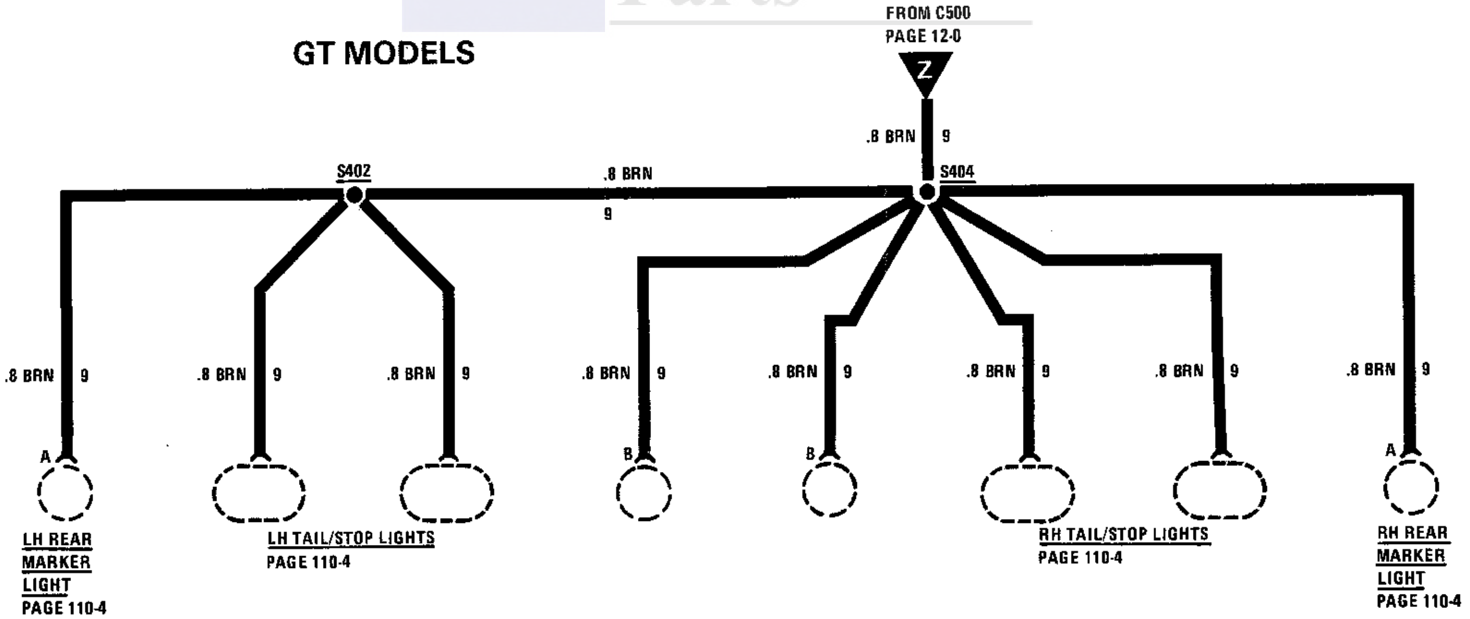

.8 GRY 8
S209
.5 GRY 8
F C211
.5 GRY 8
F C211
.5 GRY 8
M C247
.35 GRY 8
.5 GRY 8
.35 GRY 8
.35 GRY 8
.35 GRY 8
.8 GRY 8
.35 GRY 8
.5 GRY 8
.5 GRY 8
.5 GRY 8
.5 GRY 8
5
M
C
A
A
3
15 C3
7
12 C2
RALLY GAGE ILLUMINATION PAGE 117-1
RADIO PAGES 117-1, 150-0
PRNDL ILLUMINATION LIGHT (AUTOMATIC TRANSAXLE ONLY) PAGE 117-1
TRUNK RELEASE SWITCH PAGE 134-0
A/C CONTROL HEAD PAGE 117-1
HEATER CONTROL HEAD LIGHT PAGE 117-1
AUDIO ALARM MODULE
CONVENIENCE CENTER PAGE 77-0
INSTRUMENT CLUSTER PAGE 117-1

LIGHT SWITCH DETAILS

SE MODELS



GT MODELS



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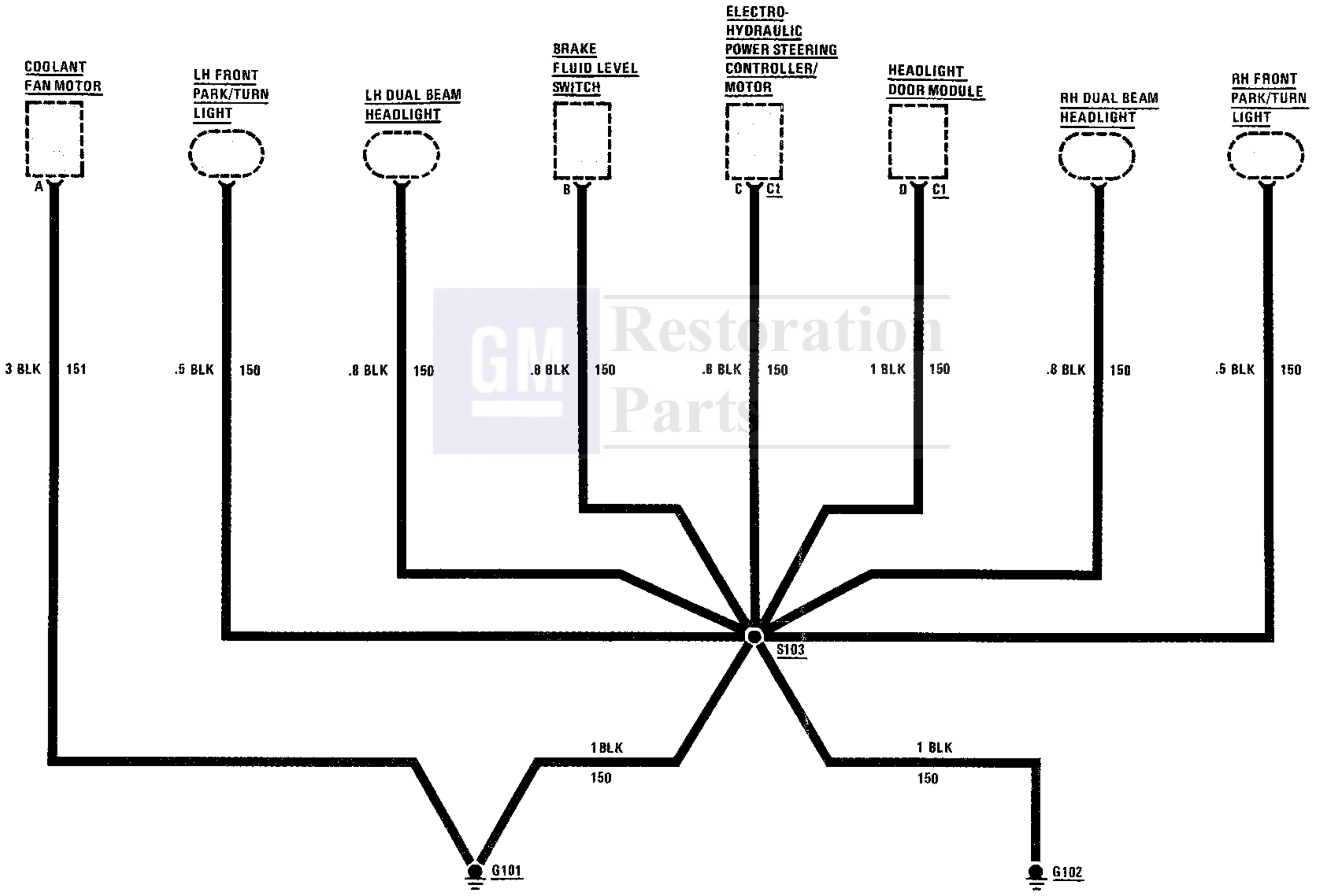
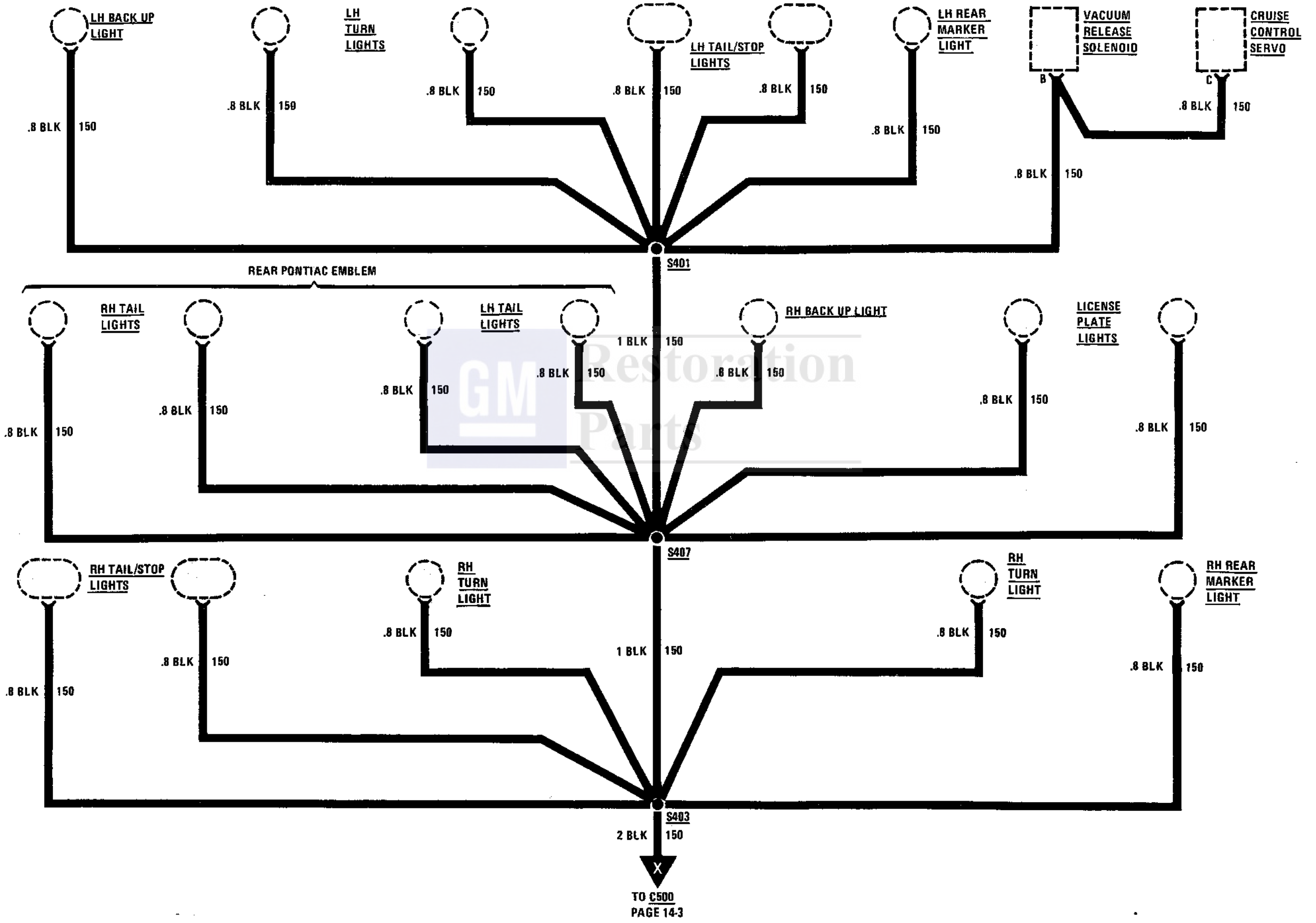
GROUND DISTRIBUTION: G101, G102, FRONT LIGHTS GROUNDS



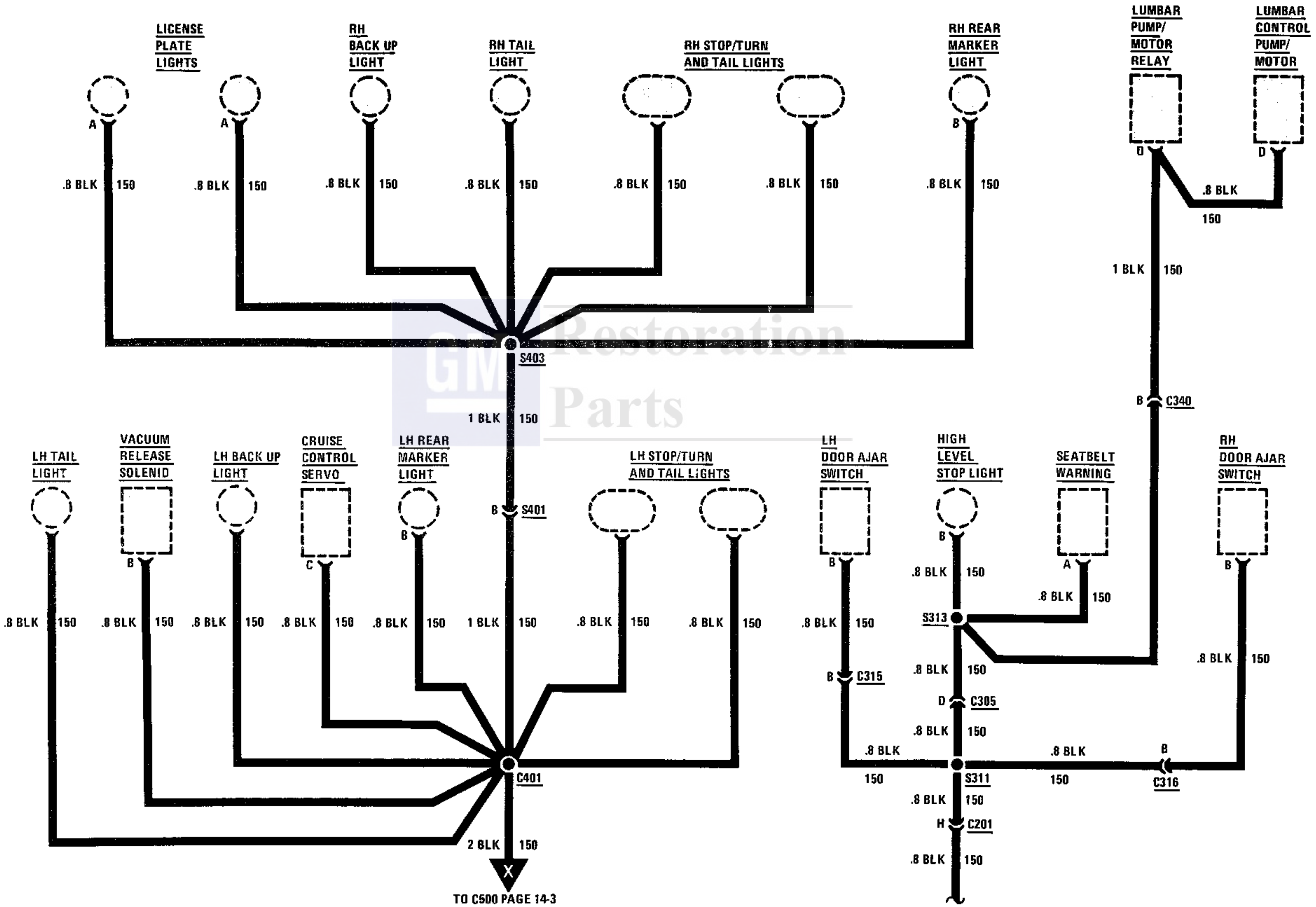
GROUND DISTRIBUTION: GT MODELS

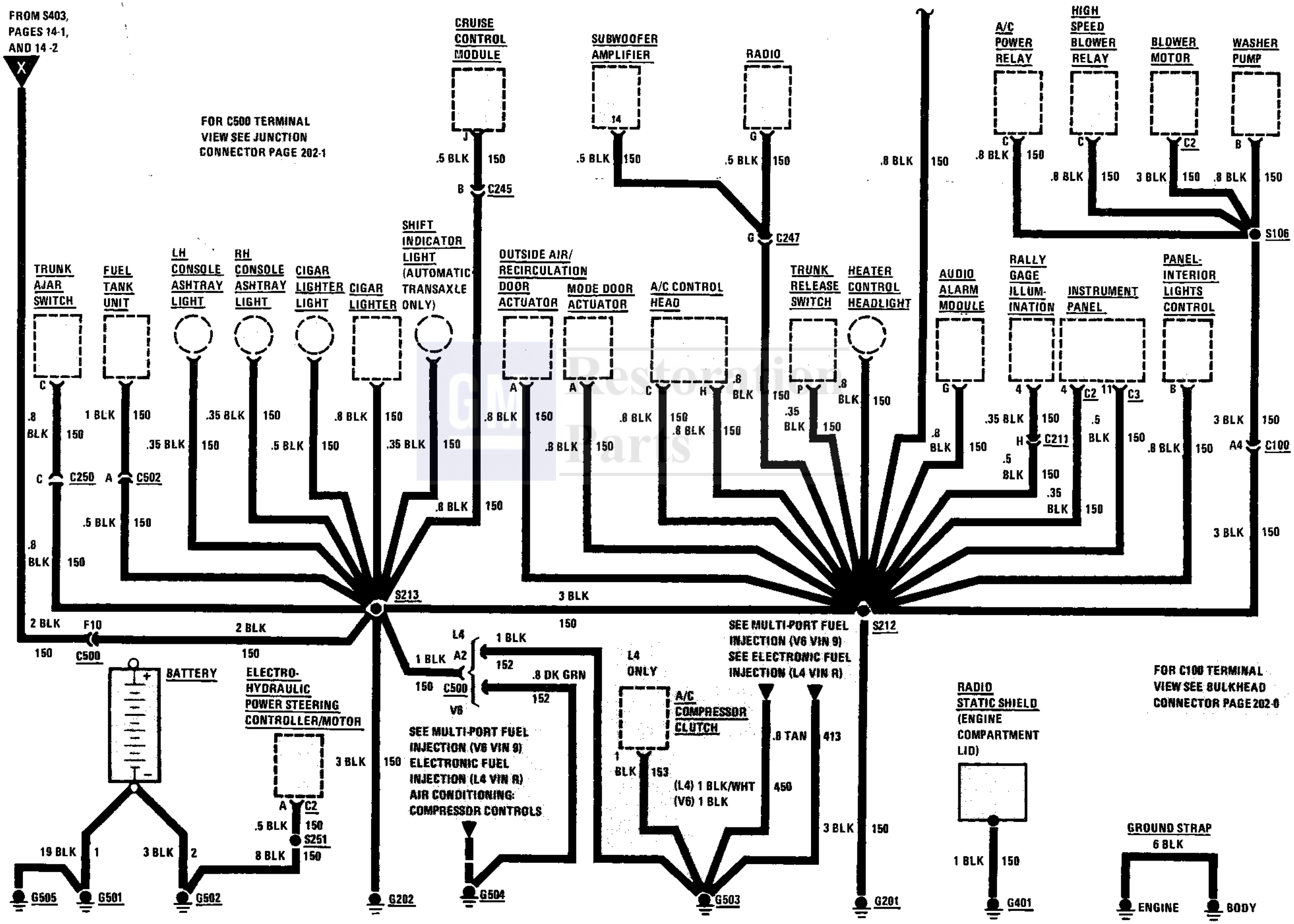
REAR LIGHTS GROUNDS



GROUND DISTRIBUTION: SE MODELS

REAR LIGHTS GROUNDS




FOR C500 TERMINAL VIEW SEE JUNCTION CONNECTOR PAGE 202-1

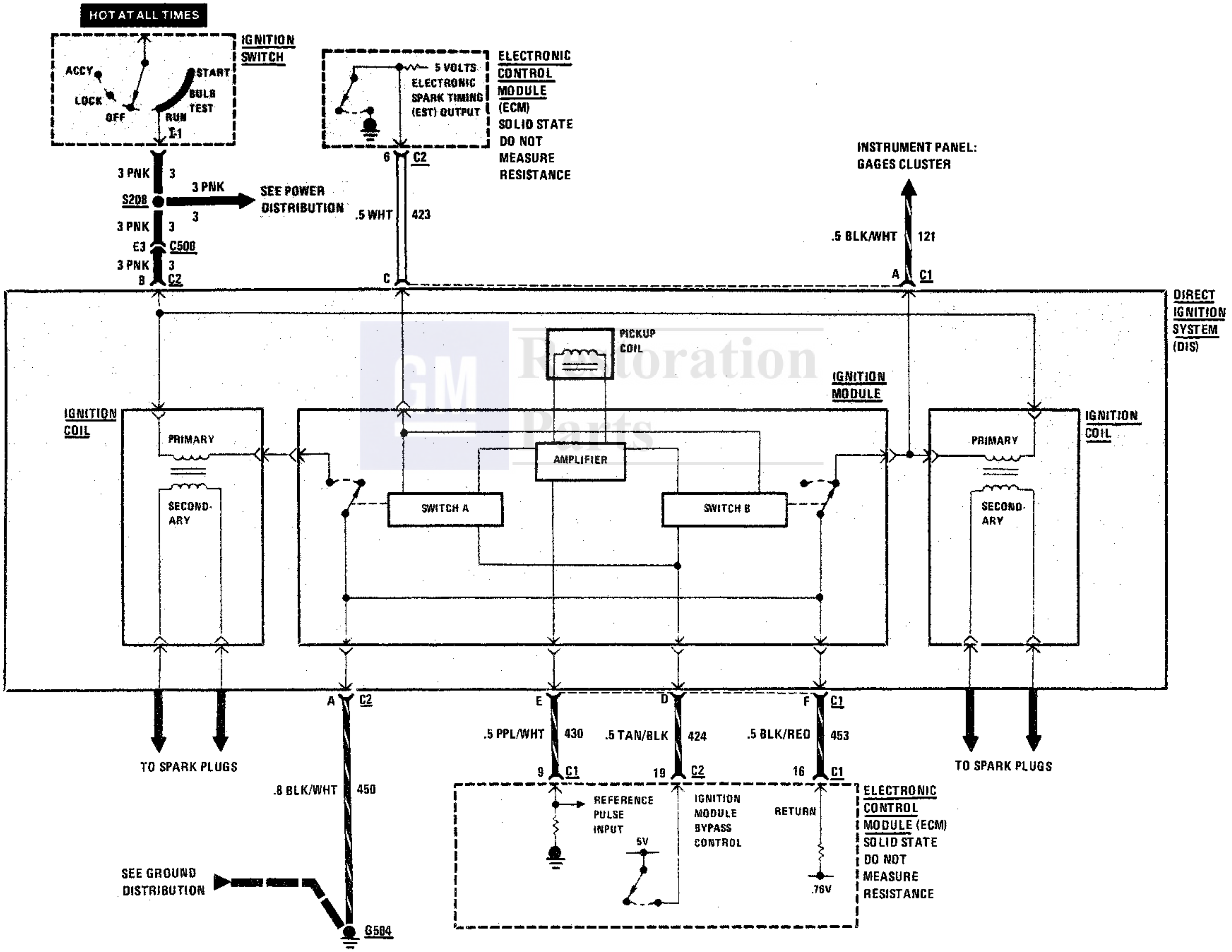
FOR C100 TERMINAL VIEW SEE BULKHEAD CONNECTOR PAGE 202-0

SEE MULTI-PORT FUEL INJECTION (V6 VIN 9) SEE ELECTRONIC FUEL INJECTION (L4 VIN R)

SEE MULTI-PORT FUEL INJECTION (V6 VIN 9) ELECTRONIC FUEL INJECTION (L4 VIN R) AIR CONDITIONING: COMPRESSOR CONTROLS

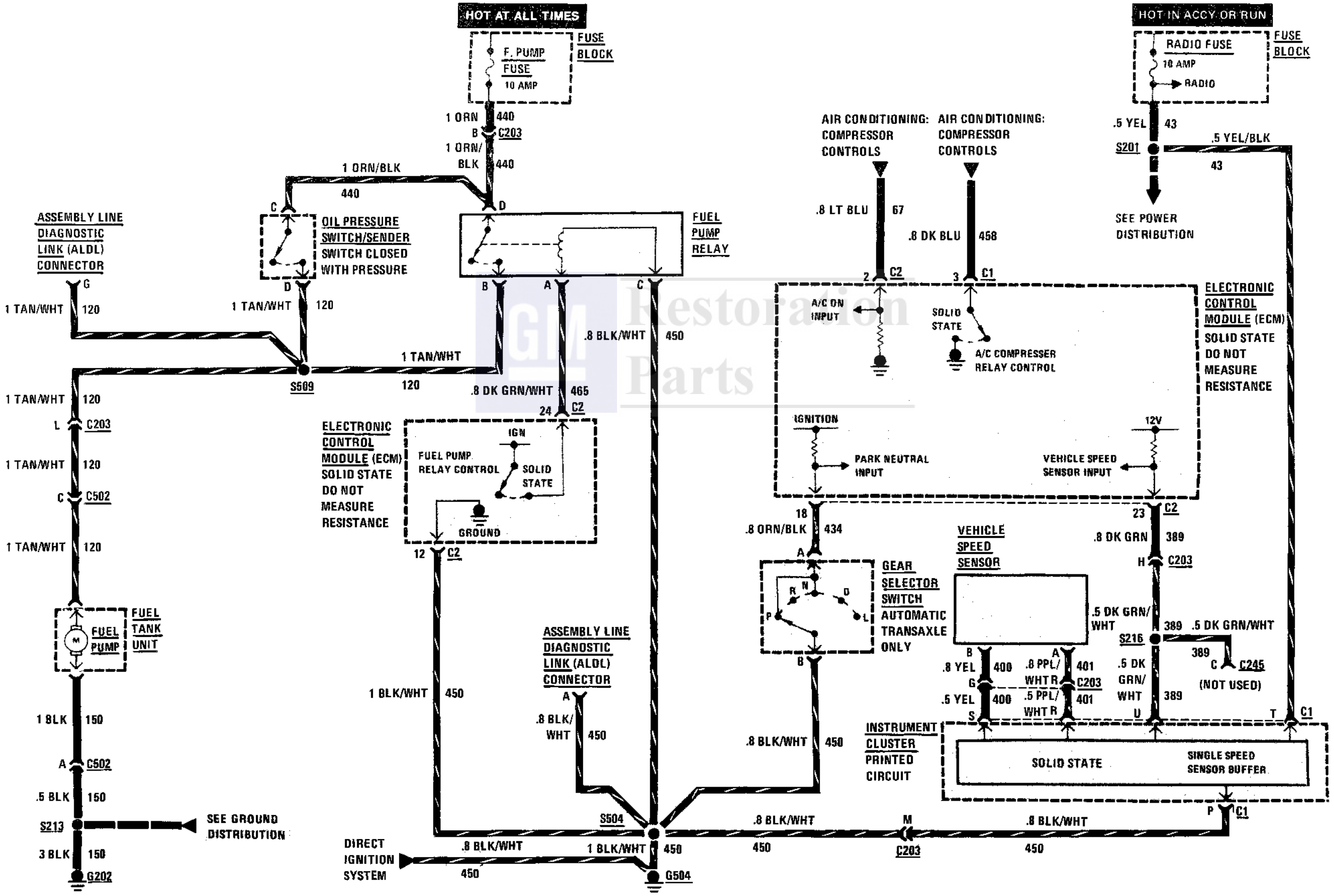
ELECTRONIC FUEL INJECTION: L4 VIN R

IGNITION



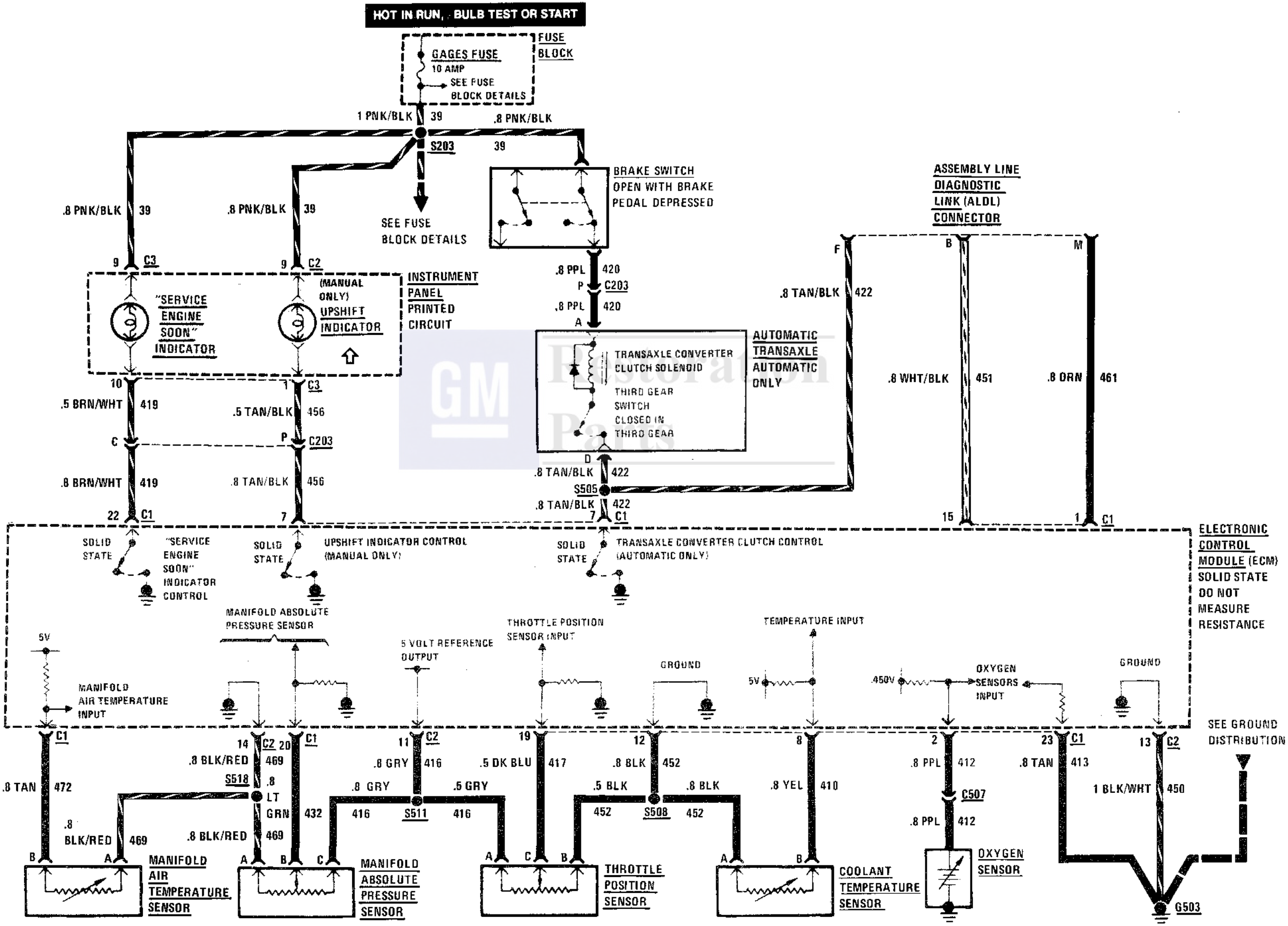
ELECTRONIC FUEL INJECTION: L4 VIN R

FUEL CONTROL



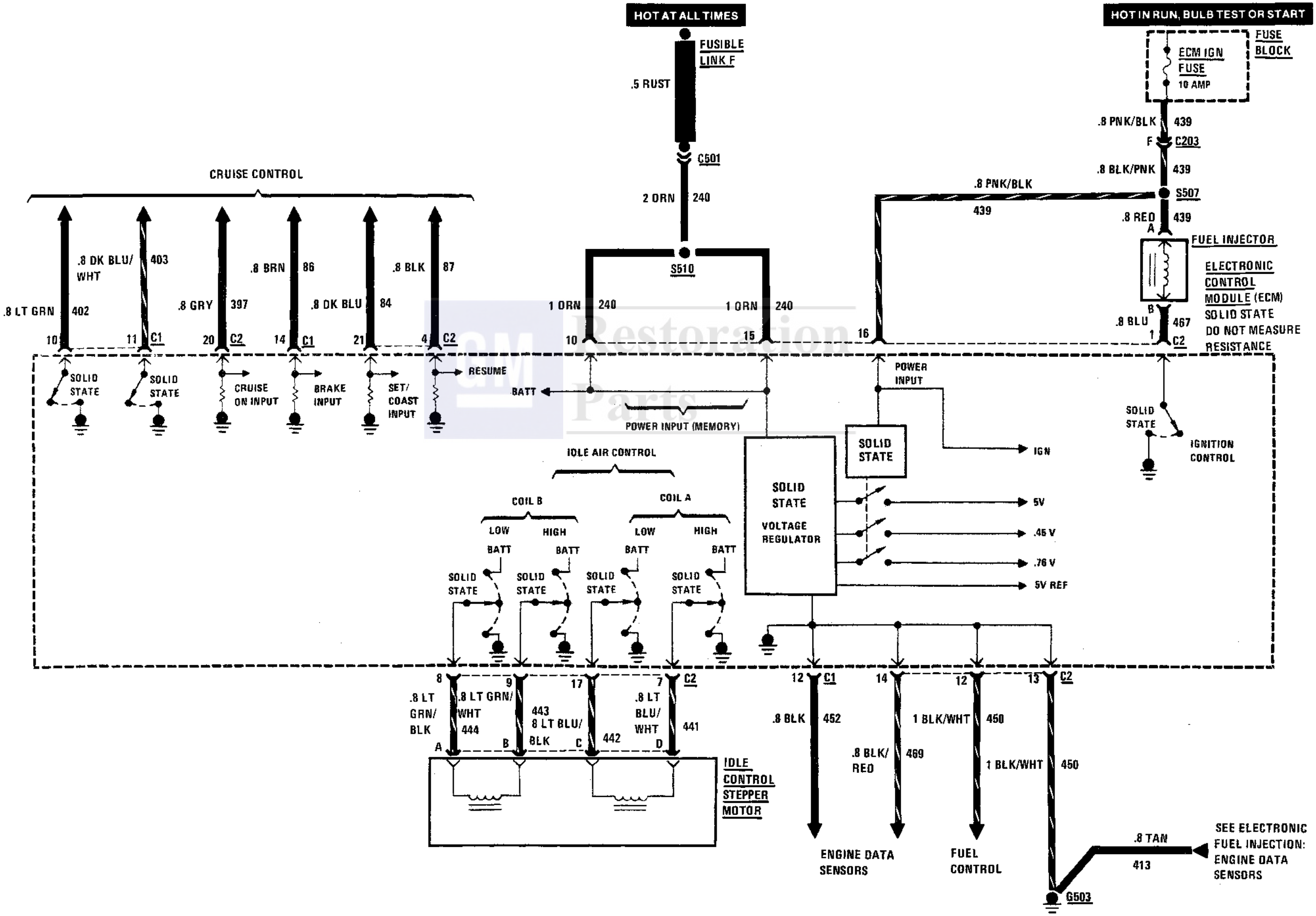
ELECTRONIC FUEL INJECTION: L4 VIN R

ENGINE DATA SENSORS, TRANSAXLE CONVERTER CLUTCH, UPSHIFT AND SERVICE ENGINE SOON INDICATORS



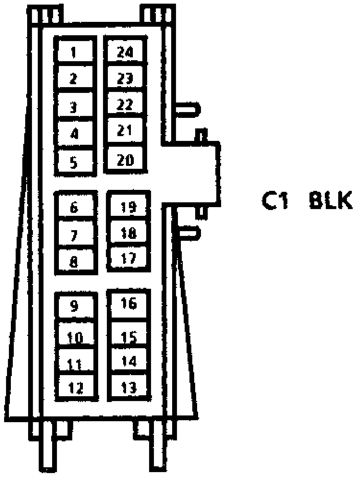
ELECTRONIC FUEL INJECTION: L4 VIN R

IDLE AIR CONTROL AND FUEL CONTROL



COMPONENT LOCATION

		Page-Figure
Assembly Line Diagnostic Link (ALDL) Connector	In console, near rear of shifter	201- 5-B
Brake Switch	Top of brake pedal support	201-11-A
Coolant Temperature Sensor (VIN R)	Top LH rear of engine	201- 2-B
Direct Ignition System (DIS)	Top rear of engine	201- 2-B
Electronic Control Module (ECM)	Between seats, on front of rear bulkhead	201- 5-B
Fuel Injector	Top of engine, top of throttle body	201- 1-C
Fuel Pump Relay	Engine compartment, LH side of rear bulkhead	201- 5-D
Fuel Tank Unit	Top of fuel tank	
Fuse Block	Behind LH side of I/P	201- 6-D
Fusible Link F	RH front of engine compartment, at Battery Junction Block	201- 4-A
Idle Air Control Stepper Motor	Rear of engine, LH side of throttle body	201- 1-C
Ignition Switch	At base of steering column	201- 8-F
Manifold Absolute Pressure (MAP) Sensor (VIN R)	On LH side of air cleaner	201- 2-B
Manifold Air Temperature Sensor (VIN R)	Top of engine, in front of air cleaner	201- 1-A
Oil Pressure Switch/Sender (VIN R)	Rear of engine, center of engine block	201- 1-A
Oxygen Sensor (VIN R)	Front of engine, base of manifold	201- 2-A
Throttle Position Sensor (VIN R)	Top of engine, right of throttle body	201- 1-A
Transaxle Position Switch	LH rear of engine, top of transaxle	201- 2-B
Vehicle Speed Sensor	RH end of transaxle	201- 1-A
C203 (15 cavities)	Between seats, in front of rear bulkhead	201- 5-A
C245 (8 cavities)	Beneath center console	
C500 (34 cavities)	Engine compartment, near battery	201- 4-A
C501 (1 cavity)	RH side of engine, near Battery Junction Block	
C502 (3 cavities)	Engine compartment, center of rear bulkhead	201- 4-A
C507 (1 cavity) (VIN R)	Lower LH front of engine, ahead of Starter Solenoid	201- 2-A
G202	Between seats, near rear bulkhead	201- 6-A
G503 (VIN R)	LH rear of engine, above transaxle	201- 2-B
G504 (VIN R)	Top LH front of engine, above Starter Solenoid	201- 2-A
S201	Main harness, above steering column	201- 7-A
S203	Main harness, above steering column	201- 7-A



ELECTRONIC CONTROL MODULE
(ECM) (L4 VIN R)

V00212.0

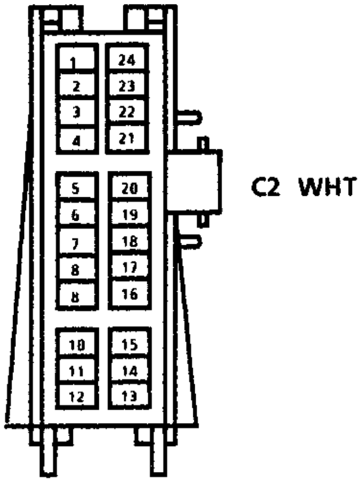
COMPONENT LOCATION

		Page-Figure
S208	Main harness, near Fuse Block	201- 6-C
S213	Main harness, behind rear bulkhead grommet	201-15-A
S216	Main harness, behind center I/P	201-15-A
S504	Engine harness, under rear console	201- 5-A
S505	Engine harness, under rear console	201- 5-A
S507	Engine harness, under rear console	201- 5-A
S508 (VIN R)	Engine harness, under rear console	201- 5-A
S509	Engine harness, under rear console	201- 5-A
S510	Engine harness, under rear console	201- 5-A
S511 (VIN R)	Engine harness, top RH rear of engine	201- 1-A
S518	Engine harness, LH rear of engine	201- 2-B

C1 CHART

Cavity	Wire Color Socket Half	Circuit Number	Circuit Function
1	BLU	467	Fuel Injector Control
2	LT BLU	67	A/C On Input
3	—	—	Not Used
4	BLK	87	Resume/Accelerate Input
5	—	—	Not Used
6	WHT	423	Spark Timing Output
7	LT BLU/WHT	441	Idle Air Control A: HI
8	LT GRN/BLK	444	Idle Air Control B: LO
9	LT GRN/WHT	443	Idle Air Control B: HI
10	ORN	240	Battery
11	GRY	416	5 Volt Reference
12	BLK/WHT	450	Ground
13	BLK/WHT	450	Ground
14	BLK/RED	469	Reference Ground
15	ORN	240	Battery
16	PNK/BLK	439	Ignition
17	LT BLU/BLK	442	Idle Air Control A: LO
18	ORN/BLK	434	Park/Neutral Input
19	TAN/BLK	424	Ignition Module Bypass Input
20	GRY	397	Cruise On Input
21	DK BLU	84	Set/Coast Input
22	—	—	Not Used
23	DK GRN	389	Vehicle Speed Sensor Input
24	DK GRN/WHT	465	Fuel Pump Relay Control

ELECTRONIC FUEL INJECTION: L4 VIN R



ELECTRONIC CONTROL MODULE (ECM) (L4 VIN R)

V00212.0

C2 CHART

Cavity	Wire Color	Circuit Number	Circuit Function
	Socket Half		
1	ORN	461	Serial Data Link
2	PPL	412	Oxygen Sensor Input HI
3	DK BLU	458	A/C Compressor Relay Control
4	—	—	Not Used
5	TAN	472	Manifold Air Temperature Input
6	—	—	Not Used
7	TAN/BLK	422	Transaxle Convertor Clutch Control(Automatic Only)
7	TAN/BLK	456	Upshift Indicator Control (Manual Only)
8	YEL	410	Coolant Temperature Sensor Input
9	PPL/WHT	430	Reference Pulse Input HI
10	LT GRN	402	Vacuum Valve Feed
11	DK BLU/WHT	403	Vent Valve Feed
12	BLK	452	Reference Ground
13	—	—	Not Used
14	BRN	86	Brake Input
15	WHT/BLK	451	Diagnostic "Test" Input
16	BLK/RED	453	Reference Pulse Input LO
17	—	—	Not Used
18	—	—	Not Used
19	DK BLU	417	Throttle Position Sensor Input
20	LT GRN	432	Manifold Absolute Pressure (MAP) Sensor Input
21	DK GRN/WHT	335	Coolant Fan Relay Control
22	BRN/WHT	419	"Service Engine Soon" Indicator Control
23	TAN	413	Oxygen Sesnor Input LO
24	GRY/RED	901	Coolant Fan Enable

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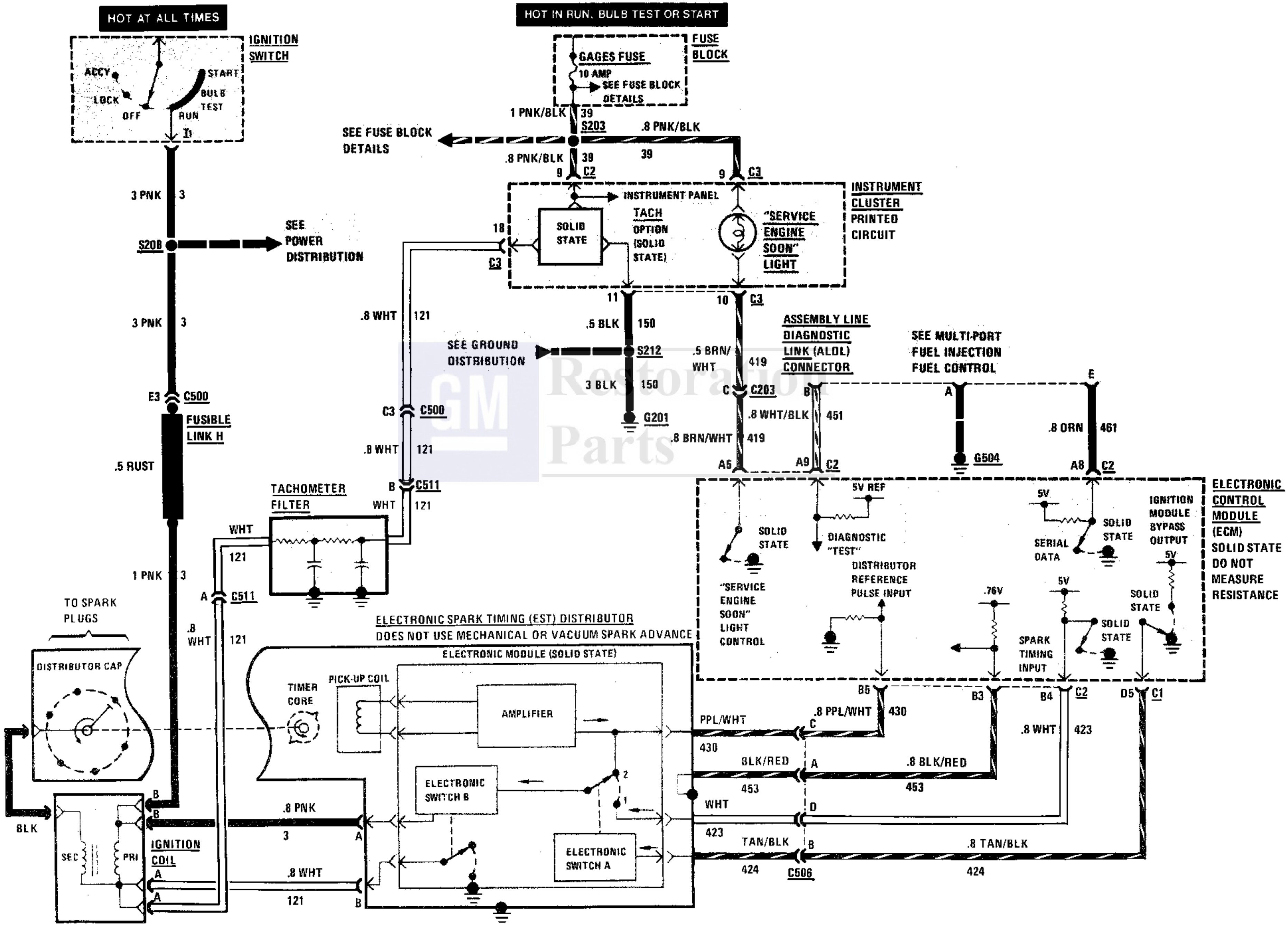
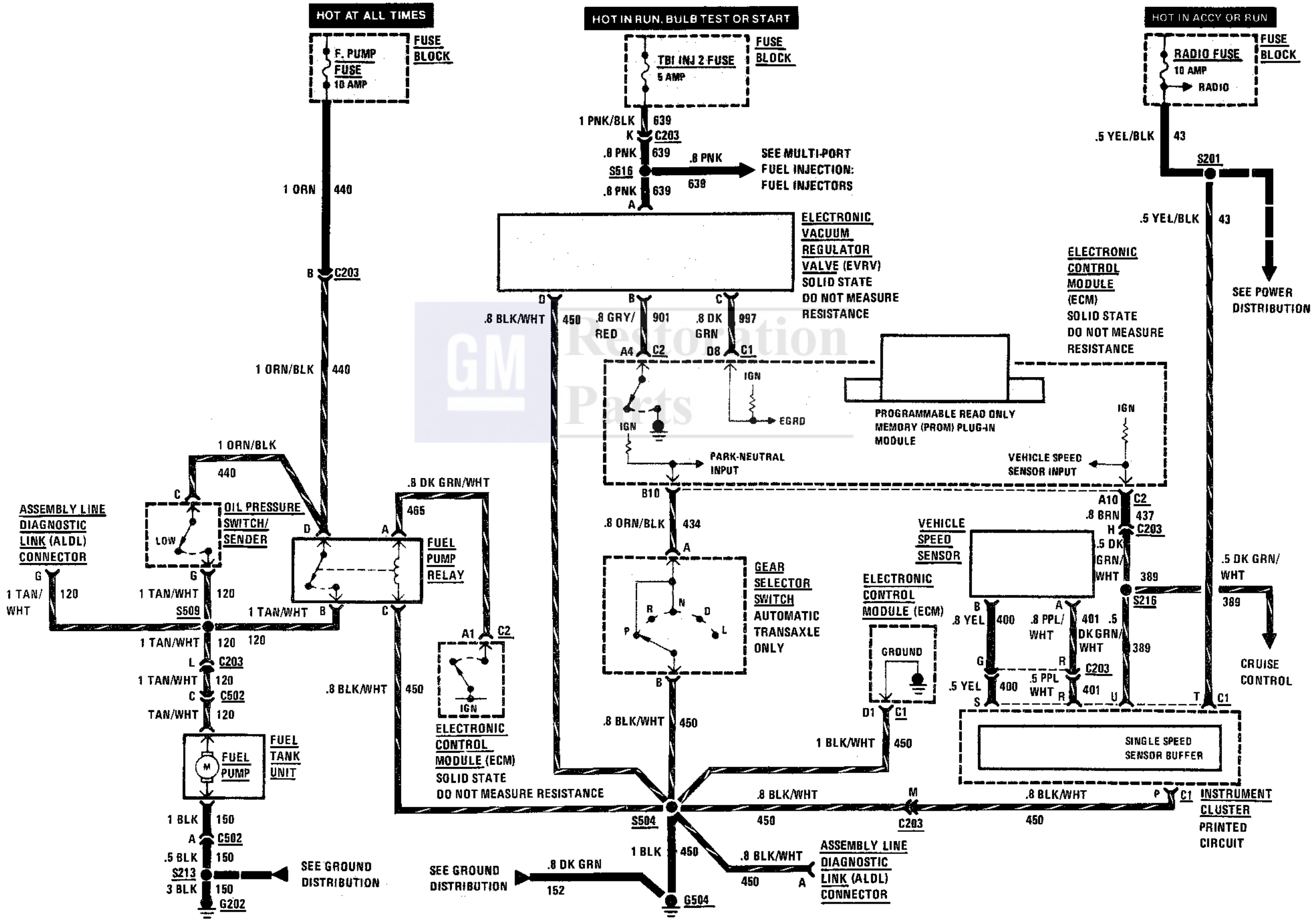
MULTI-PORT FUEL INJECTION: V6 VIN 9

IGNITION AND SERVICE ENGINE SOON LIGHT



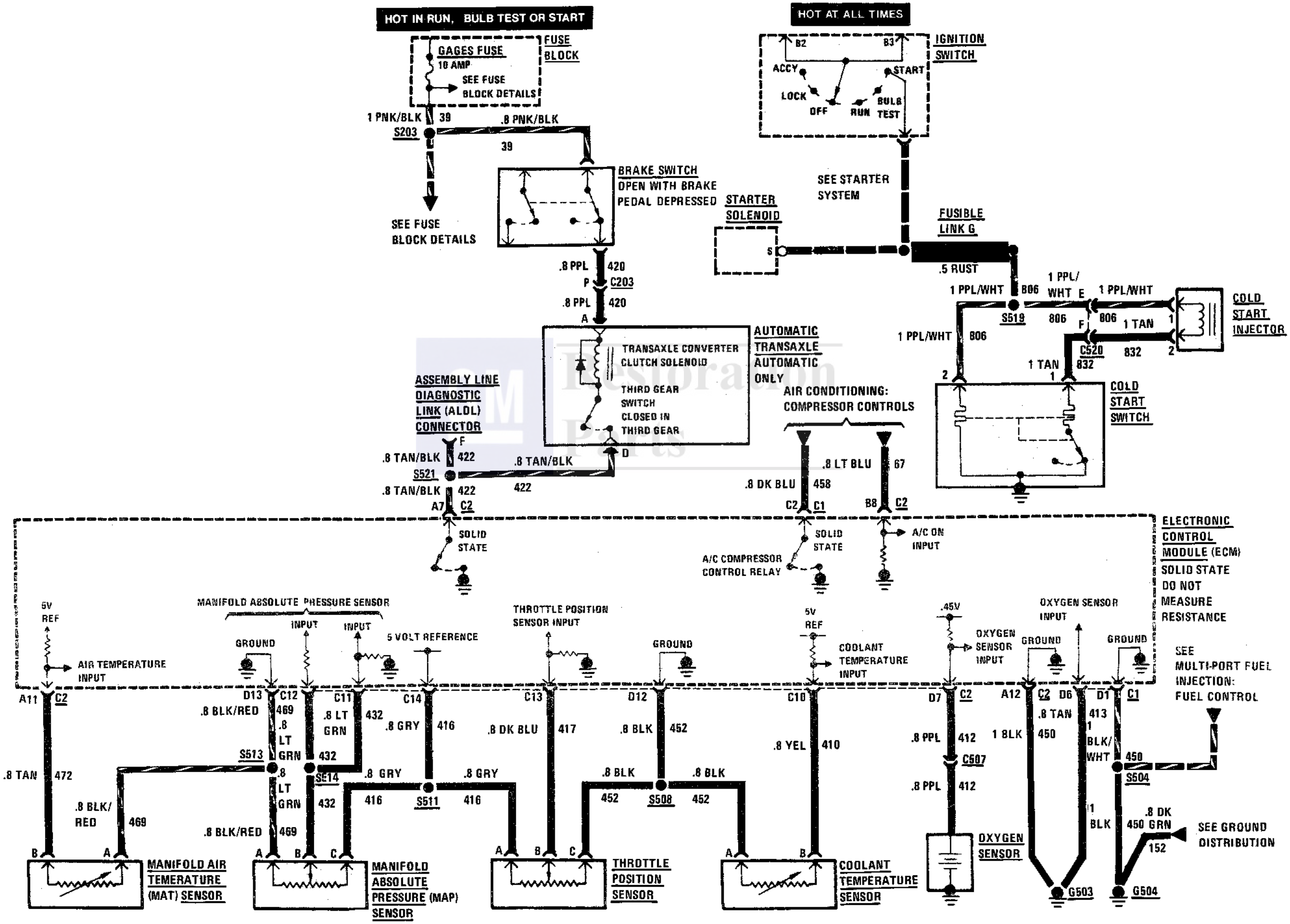
MULTI-PORT FUEL INJECTION: V6 VIN 9

FUEL CONTROL



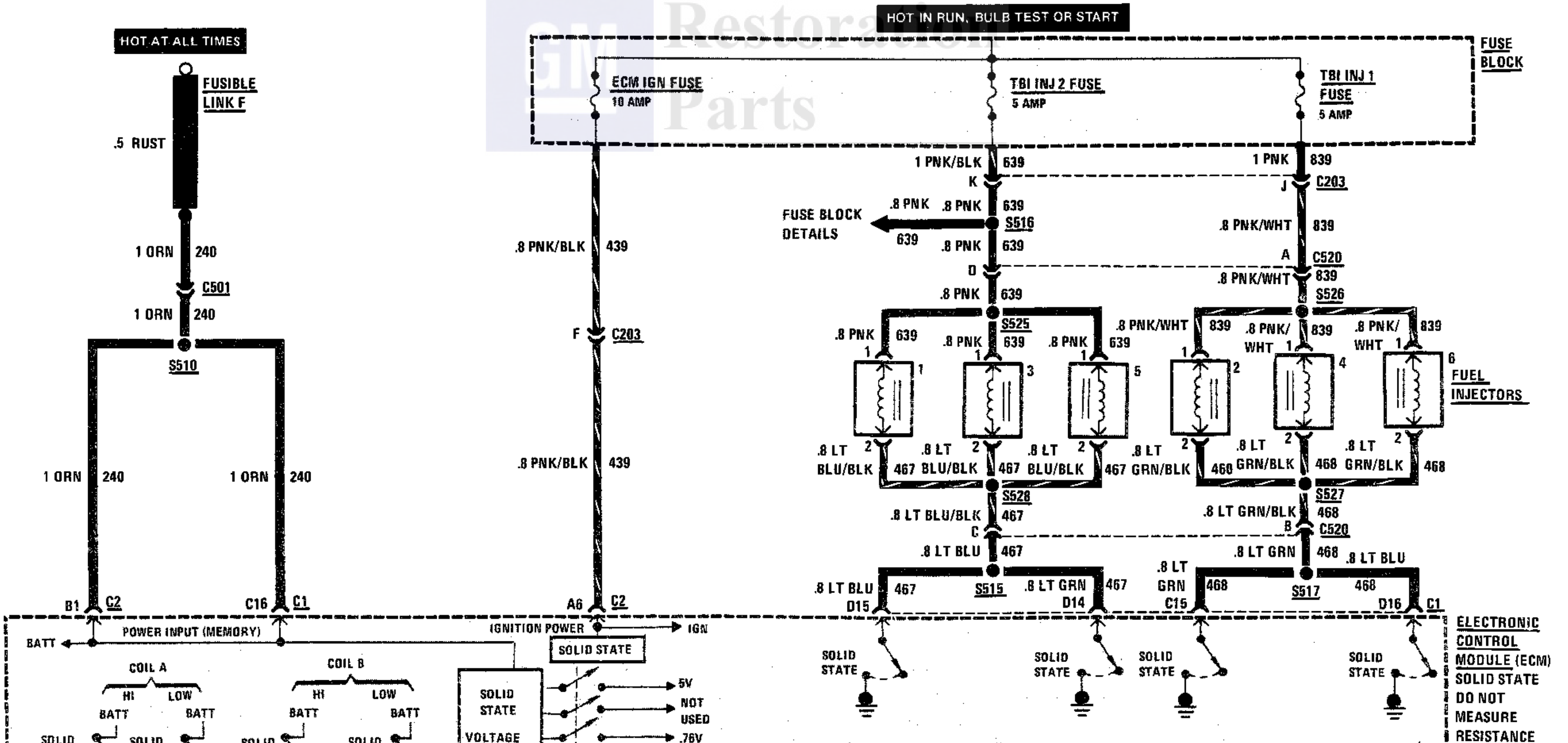
MULTI-PORT FUEL INJECTION: V6 VIN 9

ENGINE DATA SENSORS, TRANSAXLE CONVERTOR CLUTCH, AND START



MULTI-PORT FUEL INJECTION: V6 VIN 9

FUEL INJECTORS



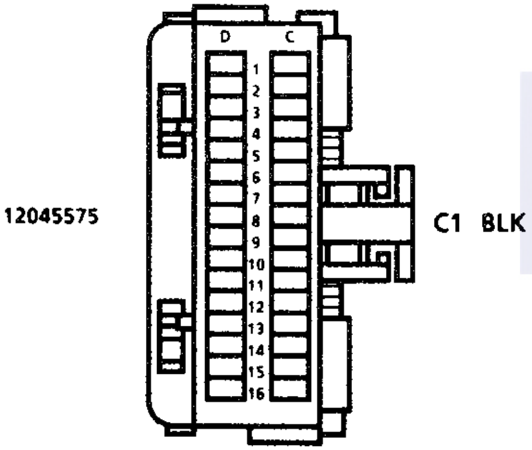
COMPONENT LOCATION

		Page-Figure
Assembly Line Diagnostic Link (ALDL) Connector	In console, near rear of shifter	201- 5-B
Brake Switch	Top of brake pedal support	201-11-A
Cold Start Injector	Top of engine, on throttle body	
Cold Start Switch	Top RH side of engine, on intake manifold	201- 3-C
Coolant Temperature Sensor (VIN 9)	Top RH side of engine	201- 4-B
Electronic Control Module (ECM)	Between seats, on front of rear bulkhead	201- 5-B
Electronic Spark Timing (EST) Distributor	Top LH side of engine	201- 3-A
Electronic Vacuum Regulator Valve (EVRV)	RH front of engine, on air intake duct	201- 4-B
Fuel Injectors	Top of engine, at each intake port	
Fuel Pump Relay	Engine compartment, LH side of rear bulkhead	201- 5-D
Fuel Tank Unit	Top of fuel tank	
Fuse Block	Behind LH side of I/P	201- 6-D
Fusible Link F	RH front of engine compartment, at Battery Junction Block	201- 4-A
Fusible Link G	Lower LH front of engine, at Starter Solenoid	201- 3-B
Fusible Link H	Engine compartment, near rear bulkhead connector	201- 4-A
Idle Air Control Valve	LH front of engine, on throttle body	201- 3-A
Ignition Coil	Top of engine, left of throttle body	201- 3-A
Ignition Switch	At base of steering column	201- 8-F
Manifold Absolute Pressure (MAP) Sensor (VIN 9)	RH top of engine, on air intake duct	201- 4-B
Manifold Air Temperature Sensor (VIN 9)	LH front of engine compartment, on air cleaner	201- 4-C
Oil Pressure Switch/Sender (VIN 9)	Lower RH front of engine	201- 3-B
Oxygen Sensor (VIN 9)	LH front of engine, on exhaust manifold	201- 3-A
Starter Solenoid (VIN 9)	Lower LH front of engine	201- 3-B
Tachometer Filter	Top of engine, near ignition coil	201- 5-C
Throttle Position Sensor (VIN 9)	LH top of engine, on throttle body	201- 3-A
Transaxle Position Switch	LH rear of engine, top of transaxle	201- 2-B
Vehicle Speed Sensor	RH end of transaxle	201- 1-A
C203 (15 cavities)	Between seats, in front of rear bulkhead	201- 5-A
C500 (34 cavities)	Engine compartment, near battery	201- 4-A
C501 (1 cavity)	RH side of engine, near Battery Junction Block	

COMPONENT LOCATION

		Page-Figure
C502 (3 cavities)	Engine compartment, center of rear bulkhead	201- 4-A
C506 (4 cavities)	Top LH side of engine	201- 3-A
C507 (1 cavity) (VIN 9)	LH front of engine compartment, near exhaust manifold	201- 3-A
C511 (2 cavities)	Top of engine, near Ignition Coil	201- 3-A
C520 (6 cavities)	Top RH side of engine	201- 4-B
G201	Behind center of I/P	201- 6-C
G202	Between seats, near rear bulkhead	201- 6-A
G503 (VIN 9)	LH top of engine, below throttle body	201- 3-A
G504 (VIN 9)	LH top of engine, below throttle body	201- 3-A
S201	Main harness, above steering column	201- 7-A
S203	Main harness, above steering column	201- 7-A
S208	Main harness, near Fuse Block	201- 6-C
S212	Main harness, behind center of dash	201- 6-C
S213	Main harness, behind rear bulkhead grommet	201-15-A
S216	Main harness, behind center I/P	201-15-A
S504	Engine harness, under rear console	201- 5-A
S508 (VIN 9)	Engine harness, lower RH front of engine	201- 3-B
S509	Engine harness, under rear console	201- 5-A
S510	Engine harness, under rear console	201- 5-A
S511 (VIN 9)	Engine harness, lower RH front of engine	201- 3-B
S513	Engine harness, center of rear bulkhead, in engine compartment	201- 5-B
S514	Engine harness, under rear console	201- 5-B
S515	Engine harness, under rear console	201- 5-B
S516	Engine harness, lower RH front of engine	201- 3-B
S517	Engine harness, under rear console	201- 5-B
S519	Engine harness, near Starter Solenoid	201- 3-B
S521	Engine harness, center of rear bulkhead	201- 5-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	

MULTI-PORT FUEL INJECTION: V6 VIN 9



ELECTRONIC CONTROL MODULE (ECM)

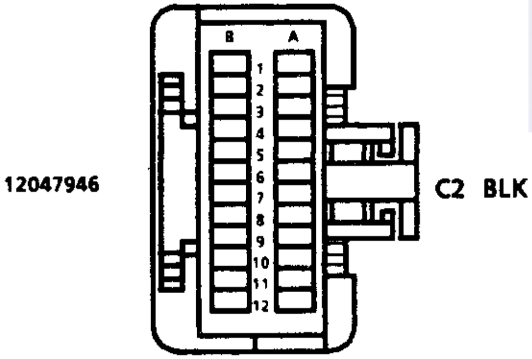
V00005 0

C1 CHART

Cavity	Wire Color Socket Half	Circuit Number	Circuit Function
C1	—	—	Not Used
C2	DK BLU	459	A/C Compressor Relay Control
C3	LT GRN/BLK	444	Idle Air Control B: LO
C4	LT GRN/WHT	443	Idle Air Control B: HI
C5	LT BLU/WHT	441	Idle Air Control A: HI
C6	LT BLU/BLK	442	Idle Air Control A: LO
C7	—	—	Not Used
C8	—	—	Not Used
C9	—	—	Not Used
C10	YEL	410	Coolant Temperature Sensor Input
C11	LT GRN	432	Manifold Absolute Pressure (MAP) Sensor Input
C12	LT GRN	432	Manifold Absolute Pressure (MAP) Sensor Input
C13	DK BLU	417	Throttle Position Sensor Input
C14	GRY	416	5 Volt Reference
C15	LT GRN	468	Fuel Injector Control
C16	ORN	240	Battery

C1 CHART

Cavity	Wire Color Socket Half	Circuit Number	Circuit Function
D1	BLK/WHT	450	Ground
D2	—	—	Not Used
D3	—	—	Not Used
D4	—	—	Not Used
D5	TAN/BLK	424	Ignition Module Bypass Output
D6	TAN	413	Oxygen Sensor Input: LO
D7	PPL	412	Oxygen Sensor Input: HI
D8	DK GRN	997	EVRV Control
D9	—	—	Not Used
D10	—	—	Not Used
D11	—	—	Not Used
D12	BLK	452	Reference GROUND
D13	BLK/RED	469	Reference GROUND
D14	LT GRN	468	Fuel Injector Control
D15	LT BLU	467	Fuel Injector Control
D16	LT BLU	467	Fuel Injector Control



ELECTRONIC CONTROL MODULE (ECM)

v00005.0

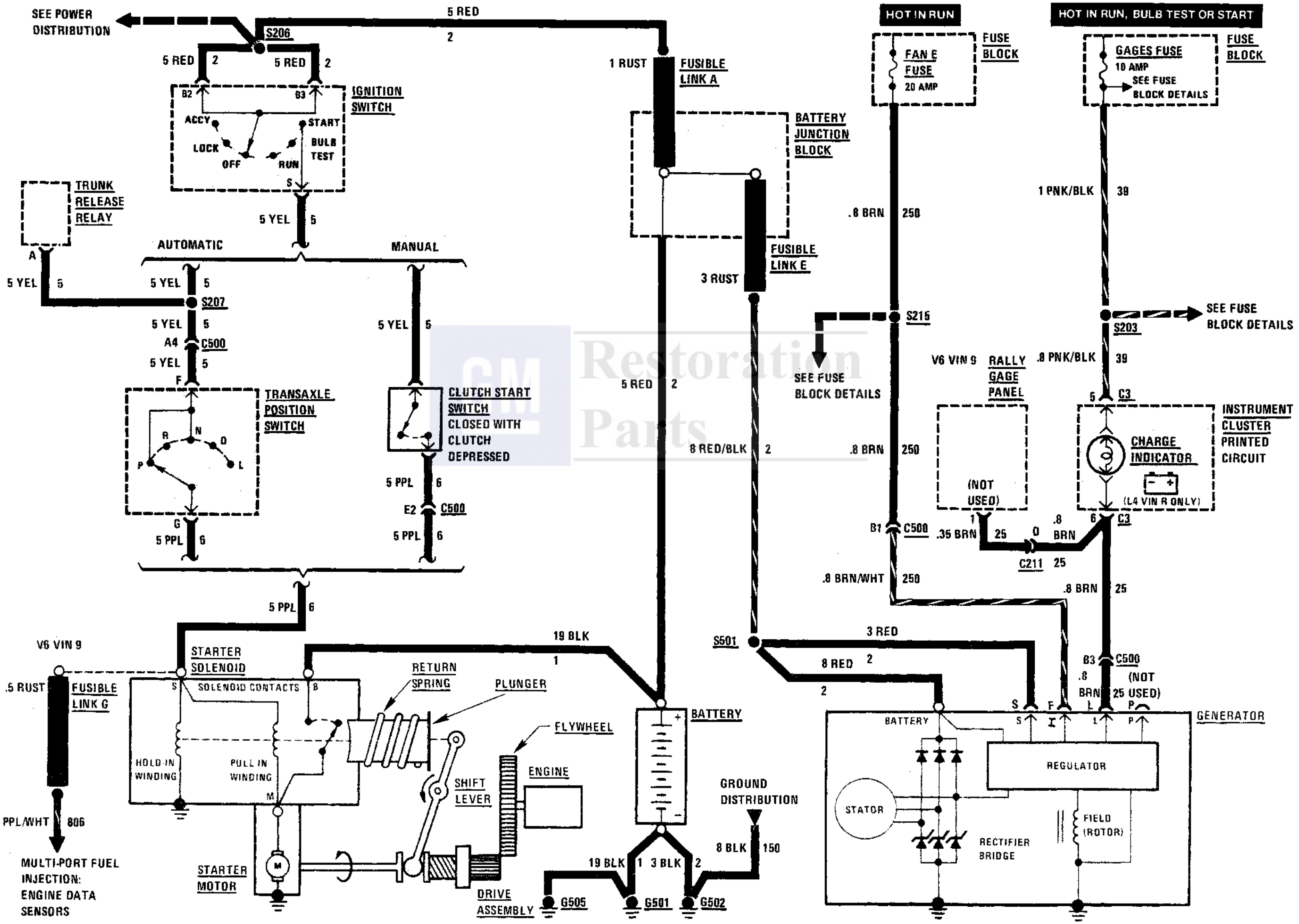
C2 CHART

Cavity	Wire Color Socket Half	Circuit Number	Circuit Function
A1	DK GRN/WHT	465	Fuel Pump Relay Control
A2	—	—	Not Used
A3	—	—	Not Used
A4	GRY/RED	901	EVRV Control
A5	BRN/WHT	419	"Service Engine Soon" Indicator Control
A6	PNK/BLK	439	Ignition
A7	TAN/BLK	422	TCC Control (Auto)
A8	ORN	461	Serial Data Link
A9	WHT/BLK	451	Diagnostic "Test" Input
A10	BRN	437	Vehicle Speed Sensor Input
A11	TAN	472	Manifold Air Temperature Sensor Input
A12	BLK	450	Ground

C2 CHART

Cavity	Wire Color Socket Half	Circuit Number	Circuit Function
B1	ORN	240	Battery
B2	—	—	Not Used
B3	BLK/RED	453	Distributor Reference Pulse Input: LOW
B4	WHT	423	Spark Timing Output
B5	PPL/WHT	430	Distributor Reference Pulse Input: HI
B6	—	—	Not Used
B7	—	—	Not Used
B8	LT BLU	67	A/C On Input
B9	—	—	Not Used
B10	ORN/BLK	434	Park/Neutral Input
B11	—	—	Not Used
B12	—	—	Not Used

STARTER AND CHARGING SYSTEM



STARTER AND CHARGING SYSTEM

V6 VIN 9 AND L4 VIN R

TROUBLESHOOTING HINTS STARTER

- **Try the following checks before doing the System Diagnosis.**

1. Check the hydrometer eye that is built into the vehicle Battery before troubleshooting the Starter System.
   - Green eye—Battery is charged.
   - Dark eye—Battery is discharged. Recharge Battery.
   - Clear or yellow eye—Battery fluid is low. Replace Battery.
2. Check that Starter Solenoid terminals S and B and Battery connections are clean and tight.
3. Check that grounds G501 and G502 are clean and tight.

- **Go to System Diagnosis for diagnostic tests.**

TROUBLESHOOTING HINTS CHARGING

- **Try the following checks before doing the System Diagnosis.**

1. Check the hydrometer eye that is built into the vehicle Battery before troubleshooting the Charging System.
   - Green eye—Battery is charged.
   - Dark eye—Battery is discharged. Recharge Battery.
   - Clear or yellow eye—Battery fluid is low. Replace Battery.
2. Check Generator belt.
3. Check that Generator and battery terminal Generator connector are clean and tight.
4. Check FAN E Fuse.
5. Check GAGES Fuse by observing the BRAKE Indicator with Ignition Switch in RUN and the Park Brake applied
6. Check that the battery connections are clean and tight.
7. Check vehicle voltmeter (if equipped) to assure accurate voltage readings.

- **Go to System Diagnosis for diagnostic tests.**

COMPONENT LOCATION

		Page-Figure
Battery Junction Block	RH front of engine compartment, near battery	201- 4-A
Clutch Start Switch	Upper portion of clutch pedal	201-11-A
Fuse Block	Behind LH side of I/P	201- 6-D
Fusible Link A	RH front of engine compartment, at Battery Junction Block	201- 4-A
Fusible Link E	RH front of engine compartment, at Battery Junction Block	201- 4-A
Fusible Link G	Lower LH front of engine, at Starter Solenoid	201- 3-B
Ignition Switch	At base of steering column	201- 8-F
Starter Solenoid (VIN 9)	Lower LH front of engine	201- 3-B
Starter Solenoid (VIN R)	Lower LH front of engine	201- 2-A
Transaxle Position Switch	LH rear of engine, top of transaxle	201- 2-B
Trunk Release Relay	Behind I/P, on RH side of steering column support	201- 7-B
C211 (8 cavities)	Behind center of I/P, near radio	
C500 (34 cavities)	Engine compartment, near battery	201- 4-A
G501 (VIN 9)	RH front of engine, near dipstick	201- 3-E
G501 (VIN R)	RH side of engine, below oil fill cap	201- 1-B
G502	Engine compartment, on battery tray	201- 2-C
G505	On trunk lid RH hinge brace	201- 4-E
S203	Main harness, above steering column	201- 7-A
S206	Main harness, above LH side of steering column	201- 8-F
S207	Main harness, left of steering column	201- 8-F
S215	Main harness, behind I/P, near front of console	201-15-A
S501 (VIN 9)	Engine harness, near generator	
S501 (VIN R)	Engine harness, near generator	201- 1-A

SYSTEM DIAGNOSIS

STARTER

- **The following tests are designed for engines and batteries at normal operating temperatures and assumes that there are no en-**

STARTER AND CHARGING SYSTEM

V6 VIN 9 AND L4 VIN R

gine symptoms that would cause a no start condition. To use the tests under other conditions could result in misdiagnosis.

- **Diagnostic steps for the symptoms listed in the following table are listed after the table.**

SYMPTOM TABLE

A: Starter Solenoid does not click and engine does not crank
B: Starter Solenoid clicks, but engine does not crank or cranks slowly

A: STARTER SOLENOID DOES NOT CLICK AND ENGINE DOES NOT CRANK (TABLE 1)

Measure: VOLTAGE
At: STARTER SOLENOID
Conditions:

- **Transaxle Position: PARK (Automatic Transmission)**
- **Clutch: DEPRESSED (Manual Transmission)**
- **Ignition Switch: START**

Measure Between	Correct Voltage	For Diagnosis
S (PPL) & Ground	Battery	See 1

- If voltage is correct, replace Starter Solenoid. (Check that the Starter Motor is properly grounded to the engine before replacing the Starter Solenoid. Scrape any excess paint, rust or dirt from the Starter Motor mounting bolts.) Refer to section 6D for replacement procedures.

1. Go to Table 2 (Automatic Transmission) or Table 3 (Manual Transmission).

A: STARTER SOLENOID DOES NOT CLICK AND ENGINE DOES NOT CRANK (TABLE 2—AUTOMATIC TRANSAXLE)

Measure: VOLTAGE
At: TRANSAXLE POSITION SWITCH CONNECTOR (Disconnected)
Condition:

- **Ignition Switch: START**

Measure Between	Correct Voltage	For Diagnosis
F (YEL) & Ground	Battery	See 1

- If voltage is correct, go to Table 4.

1. Go to Table 6.

A: STARTER SOLENOID DOES NOT CLICK AND ENGINE DOES NOT CRANK (TABLE 3—MANUALTRANSAXLE)

Measure: VOLTAGE
At: CLUTCH START SWITCH CONNECTOR (Disconnected)
Condition:

- **Ignition Switch: START**

Measure Between	Correct Result	For Diagnosis
YEL (5) wire & Ground	Battery	See 1

- If voltage is correct, go to Table 5.

1. Go to Table 6.

A: STARTER SOLENOID DOES NOT CLICK AND ENGINE DOES NOT CRANK (TABLE 4—AUTOMATIC TRANSAXLE)

Connect: FUSED JUMPER
At: TRANSAXLE POSITION SWITCH CONNECTOR (Disconnected)
Condition:

- **Ignition Switch: START**

Jumper Between	Correct Result	For Diagnosis
F (YEL) & G (PPL)	Engine cranks	See 1

- If engine cranks, replace Transaxle Position Switch (Check Transaxle Position Switch adjustment before replacing the Switch.)

1. Check PPL (6) wire for an open.

A: STARTER SOLENOID DOES NOT CLICK AND ENGINE DOES NOT CRANK (TABLE 5—MANUAL TRANSAXLE)

Connect: FUSED JUMPER
At: CLUTCH START SWITCH CONNECTOR (Disconnected)
Condition:

- **Ignition Switch: START**

Jumper Between	Correct Result	For Diagnosis
YEL (5) wire & PPL (6) wire	Engine cranks	See 1

- If engine cranks, check/replace the Clutch Start Switch.

1. Check PPL (6) wire for an open.

(Continued on next page)

STARTER AND CHARGING SYSTEM

V6 VIN 9 AND L4 VIN R

(Continued from previous page)

A: STARTER SOLENOID DOES NOT CLICK AND ENGINE DOES NOT CRANK (TABLE 6)

Measure: VOLTAGE
At: IGNITION SWITCH CONNECTOR (Connected)

Measure Between	Correct Voltage	For Diagnosis
B2 (RED) & Ground	Battery	See 1
B3 (RED) & Ground	Battery	See 1
• Ignition Switch: START		
S (YEL) & Ground	Battery	See 2

- If all voltages are correct, check YEL (5) wire for an open (see schematic).

1. Check RED (2) wire(s) and Fusible Link A (see schematic).
2. Replace Ignition Switch.

B: STARTER SOLENOID CLICKS, BUT ENGINE DOES NOT CRANK OR CRANKS SLOWLY (TABLE 1)

Measure: VOLTAGE
At: BATTERY TERMINALS
Conditions:

- **Battery: FULLY CHARGED**
- **ECM IGN Fuse: REMOVED**
- **Ignition Switch: START**
- **Engine: BEING CRANKED**

Measure Between	Correct Voltage	For Diagnosis
Positive & negative Battery terminals	Greater than 9.5 volts	See 1

- If voltage is correct, go to Table 2.

1. Refer to Section 6D for Battery Load Test. If Battery is OK, remove Starter Assembly for repairs.

B: STARTER SOLENOID CLICKS, BUT ENGINE DOES NOT CRANK OR CRANKS SLOWLY (TABLE 2)

Measure: VOLTAGE
At: BATTERY CABLES
Conditions:

- **Battery: FULLY CHARGED**
- **ECM IGN Fuse: REMOVED**
- **Ignition Switch: START**
- **Engine: BEING CRANKED**

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Measure Between	Correct Voltage	For Diagnosis
Negative battery terminal & engine block	Less than .5 volts	See 1
Positive battery terminal & Starter Solenoid, terminal B	Less than .5 volts	See 2

- If both voltages are correct, remove Starter Assembly for repairs. Refer to section 6D for removal procedures.

1. Replace negative Battery cable.
2. Replace positive Battery cable.

SYSTEM DIAGNOSIS CHARGING

- **Diagnostic steps for the symptoms listed in the following table are listed after the table.**

SYMPTOM TABLE

A: Charge Indicator does not light with the Ignition Switch in RUN and engine stopped. (L4 VIN R ONLY)
B: Charge Indicator stays on when engine is running (L4 VIN R ONLY)
C: Battery is undercharged or overcharged

STARTER AND CHARGING SYSTEM

V6 VIN 9 AND L4 VIN R

A: CHARGE INDICATOR DOES NOT LIGHT WITH IGNITION SWITCH IN RUN AND ENGINE STOPPED (L4 VIN R ONLY)

Connect: FUSED JUMPER
At: GENERATOR CONNECTOR
(Disconnected)
Condition:
- **Ignition Switch: RUN**

Connect Between	Correct Result	For Diagnosis
L (BRN) & Ground	Charge Indicator lights	See 1

- If result is correct, repair/replace Generator. Refer to section 6D.

1. Check/repair GAGES Fuse, Indicator bulb, PNK/BLK (39), BRN (25) wires and Instrument Cluster Printed Circuit for opens (see schematic).

B: CHARGE INDICATOR STAYS ON WHEN THE ENGINE IS RUNNING (L4 VIN R ONLY)

Disconnect: CONNECTOR
At: GENERATOR
Condition:
- **Ignition Switch: RUN**

Disconnect	Correct Result	For Diagnosis
Generator connector	Charge Indicator does not light	See 1

- If result is correct, repair/replace Generator. Refer to Section 6D.

1. Check/repair BRN (25) wire and Instrument Cluster Printed Circuit for shorts to ground (see schematic).

C: BATTERY IS UNDERCHARGED OR OVERCHARGED (TABLE 1)

Measure: VOLTAGE
At: GENERATOR CONNECTOR
(Disconnected) and GENERATOR
BATTERY TERMINAL
Condition:
- **Ignition Switch: RUN**

Measure Between	Correct Voltage	For Diagnosis
L (BRN) (L4 VIN R) & Ground	Battery	See 1
F (BRN//WHT) & Ground	Battery	See 2
S (RED) & Ground	Battery	See 3
Battery terminal & Ground	Battery	See 3

- If all voltages are correct, reconnect connector and go to Table 2.

1. Check/repair GAGES Fuse, Indicator bulb, PNK/BLK (39), BRN (25) wires and the Instrument Cluster Printed Circuit for opens (see schematic).
2. Check/repair the BRN and BRN/WHT (250) wires and FAN E Fuse for an open (see schematic).
3. Check/repair RED and RED/BLK (2) wire and Fusible Link E for an open (see schematic).
4. Check/repair RED (2) wire for an open.

C: BATTERY IS UNDERCHARGED OR OVERCHARGED (TABLE 2)

Measure: VOLTAGE
At: GENERATOR
Conditions:
- **All accessories turned off**
- **Engine running at fast idle**

Measure Between	Correct Voltage	For Diagnosis
Battery terminal & Ground	Less than 16 volts	See 1

- If voltage is correct, perform a Generator Load Test. Refer to Section 6D. If Generator is good, perform a Battery Load Test. Refer to Section 6D.

1. Repair/replace Generator. Refer to Section 6D.

STARTER AND CHARGING SYSTEM

V6 VIN 9 AND L4 VIN R

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 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

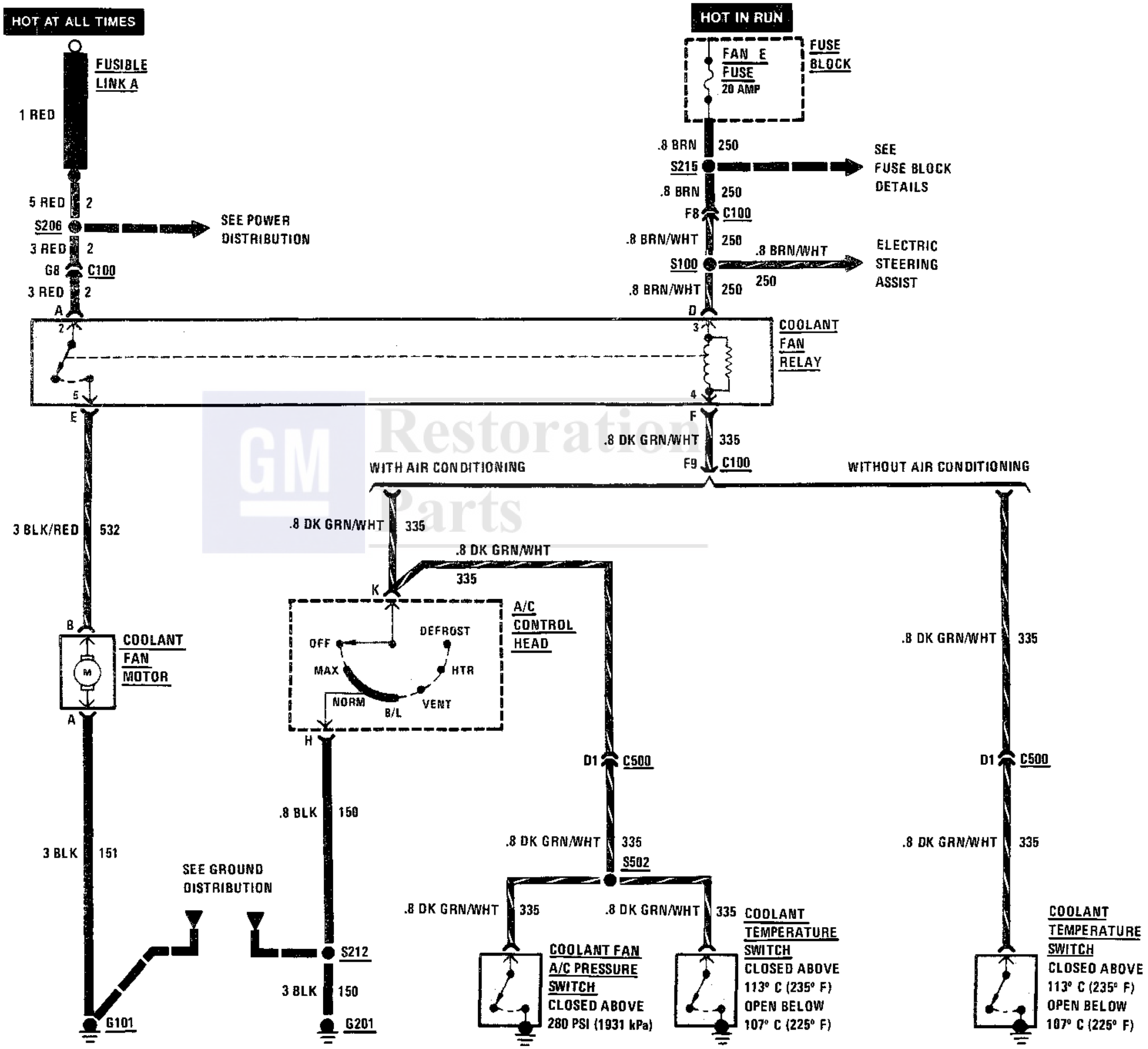
The Generator provides voltage to operate the car's electrical system and to charge its Battery. A magnetic field is created when current flows through the Rotor. This field rotates as the Rotor is driven by the engine, creating an AC voltage in the Stator windings. The AC voltage is converted to DC by the rectifier bridge and is supplied to the elctrical system at the Battery terminal.

The Generator's regulator uses digital techniques to supply the Rotor current and thereby control the output voltage. The Rotor current is proportional to the width of the electrical pulses supplied it by the Regulator. When the Ignition Switch is placed in RUN, voltage is supplied to terminals L and F, turning on the Regulator. Narrow width pulses are supplied to the Rotor creating a weak magnetic field. When the engine is started, the Regulator senses Generator rotation by detecting AC voltage at the stator through an internal wire. Once the engine is running the Regulator varies the field current by controlling the pulse width. This regulates the Generator output voltage for proper battery charging and electrical system operation.

The digital regulator controls the Charge Indicator light with a solid state driver. The driver turns on the light whenever undervoltage, overvoltage or a stopped generator is detected.

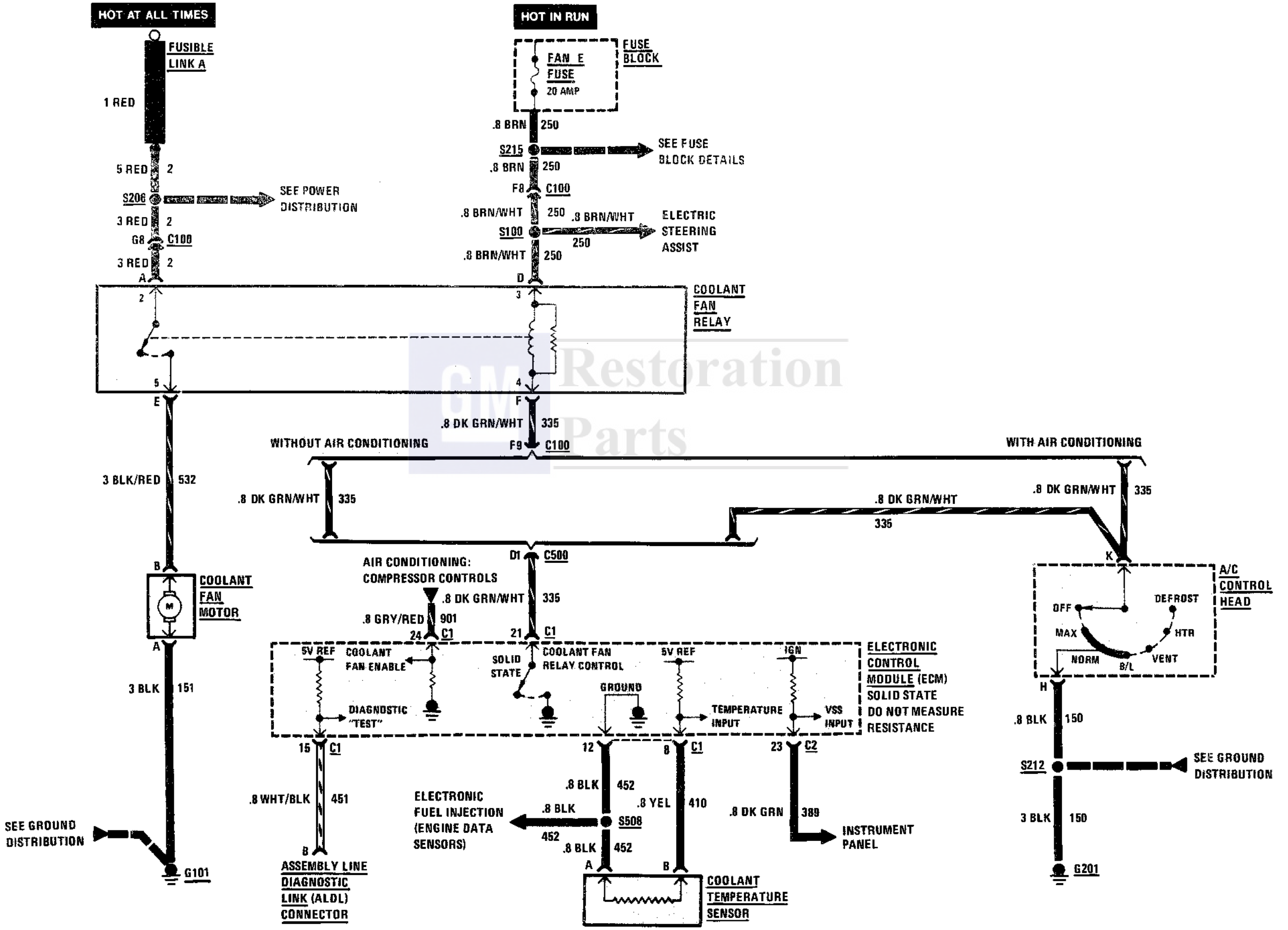
COOLANT FAN

V6 VIN 9, COOLANT FAN ASSEMBLY AND ENGINE BLOWER ASSEMBLY



COOLANT FAN

L4 VIN R



COOLANT FAN

L4 VIN R AND V6 VIN 9

L4 VIN R

TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Check.**

1. Check FAN E Fuse and Fusible Link A if the Coolant Fan does not run.
2. If Coolant Fan operates with Ignition Switch in OFF, replace the Coolant Fan Relay.
3. Check ground G201 by operating the Radio.
4. Check ground G101 by operating the Front Park/Turn Lights.

- **Go to System Check for a guide to normal operation.**
- **Go to System Diagnosis for diagnostic tests.**

V6 VIN 9

TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Check.**

1. Check FAN E Fuse and Fusible Link A if the Coolant Fan does not run.
2. Check ground G101 by operating the Front Park/Turn Lights.
3. If the Coolant Fan runs with the Ignition Switch OFF, replace the Coolant Fan Relay.

- **Go to System Check for a guide to normal operation.**
- **Go to System Diagnosis for diagnostic tests.**

COMPONENT LOCATION

		Page-Figure
Assembly Line Diagnostic Link (ALDL) Connector	In console, near rear of shifter	201- 5-B
Coolant Fan A/C Pressure Switch	RH front of engine, on rear of A/C compressor	201- 4-D
Coolant Fan Relay	LH front corner of front compartment	201- 3-D
Coolant Temperature Sensor (VIN R)	Top LH rear of engine	201- 2-B
Coolant Temperature Switch (VIN 9)	Top RH side of engine, on intake manifold	201- 3-C
Electronic Control Module (ECM)	Between seats, on front of rear bulkhead	201- 5-B
Fuse Block	Behind LH side of I/P	201- 6-D
Fusible Link A	RH front of engine compartment, at Battery Junction Block	201- 4-A
C100 (34 cavities)	LH side of front bulkhead, right of brake master cylinder	201-13-A
C500 (34 cavities)	Engine compartment, near battery	201- 4-A
G101	On LH fender, below headlamp	201-11-C
G201	Behind center of I/P	201- 6-C
S100	Forward lamp harness, behind LH headlights	201-11-C
S206	Main harness, above LH side of steering column	201- 8-F
S212	Main harness, behind center of dash	201- 6-C
S215	Main harness, behind I/P, near front of console	201-15-A
S502	Engine harness, lower RH front of engine	201- 3-B
S508 (VIN R)	Engine harness, under rear console	201- 5-A

L4 VIN R AND V6 VIN 9

SYSTEM CHECK

- **Use the System Check Table as a guide to normal operation.**
- **Refer to System Diagnosis for a list of symptoms and diagnostic steps.**

COOLANT FAN

L4 VIN R

SYSTEM CHECK TABLE

ACTION	NORMAL RESULT
With the engine cold and idling, move the A/C Function Selector to NORM (if equipped with A/C)	Coolant Fan and Engine Blower turn on
With Engine Coolant below operating temperature, move the A/C Function Selector to OFF	Coolant Fan and Engine Blower turn off
With engine warm, run engine at a fast idle for several minutes	Coolant Fan and Engine Blower turn on before Coolant Temperature Indicator in the Instrument Panel comes on

- **Refer to System Diagnosis when a result is not normal.**

L4 VIN R
SYSTEM DIAGNOSIS

- **Diagnostic steps for the symptoms listed in the following table are listed after the table.**

SYMPTOM TABLE

A: Coolant Fan does not run
B: Coolant Fan does not run with A/C on
C: Coolant Fan runs continuously

A: COOLANT FAN DOES NOT RUN (TABLE 1)

Connect: FUSED JUMPER
At: ASSEMBLY LINE DIAGNOSTIC LINK (ALDL) CONNECTOR
Condition:
- **Ignition Switch: RUN**

Jumper Between	Correct Result	For Diagnosis
Terminal B & Ground	Coolant Fan runs	See 1

- If the Coolant Fan runs, refer to Section 6E for ECM diagnosis.

1. Go to Table 2.

A: COOLANT FAN DOES NOT RUN (TABLE 2)

Connect: FUSED JUMPER
At: ELECTRONIC CONTROL MODULE (ECM) CONNECTOR (Connected)
Conditions:
- **Ignition Switch: RUN**
- **A/C Function Selector: OFF**

Jumper Between	Correct Result	For Diagnosis
21 (DK GRN/WHT) & Ground	Coolant Fan runs	See 1

- If the Coolant Fan runs, refer to Section 6E for ECM diagnosis.

1. Leave fused jumper in place and go to Table 3.

A: COOLANT FAN DOES NOT RUN (TABLE 3)

Connect: TEST LAMP
At: COOLANT FAN RELAY CONNECTOR (Disconnected)
Conditions:
- **Ignition Switch: RUN**
- **Fused jumper from Table 2 in place**

Connect Between	Correct Result	For Diagnosis
D (BRN/WHT) & Ground	Test Lamp lights	See 1
D (BRN/WHT) & F (DK GRN/WHT)	Test Lamp lights	See 2
A (RED) & Ground	Test Lamp lights	See 3

- If the results are correct, go to Table 4.

1. Check FAN E Fuse and BRN/WHT (250) wire for an open.
2. Check DK GRN/WHT (335) wire for an open.
3. Check Fusible Link A and RED (2) wire for an open.

(Continued on next page)

COOLANT FAN

L4 VIN R

(Continued from previous page)

A: COOLANT FAN DOES NOT RUN (TABLE 4)

Connect: 20 AMP FUSED JUMPER
At: COOLANT FAN RELAY CONNECTOR (Disconnected)

Jumper Between	Correct Result	For Diagnosis
A (RED) & E (BLK/RED)	Coolant Fan runs	See 1

- If the Coolant Fan runs, replace the Coolant Fan Relay.

1. Leave fused jumper in place and go to Table 5.

A: COOLANT FAN DOES NOT RUN (TABLE 5)

Connect: TEST LAMP
At: COOLANT FAN MOTOR CONNECTOR (Disconnected)
Condition:
- **Fused jumper from Table 4 in place**

Connect Between	Correct Result	For Diagnosis
B (BLK/RED) & Ground	Test Lamp lights	See 1
B (BLK/RED) & A (BLK)	Test Lamp lights	See 2

- If the results are correct, replace the Coolant Fan Motor.

1. Check BLK/RED (532) wire for an open.
2. Check BLK (151) wire for an open.

B: COOLANT FAN DOES NOT RUN WITH A/C ON

Connect: FUSED JUMPER
At: A/C CONTROL HEAD CONNECTOR (Disconnected)
Condition:
- **Ignition Switch: RUN**

Jumper Between	Correct Result	For Diagnosis
K (DK GRN/ WHT) & Ground	Coolant Fan runs	See 1
K (DK GRN/ WHT) & H (BLK)	Coolant Fan runs	See 2

- If the Coolant Fan runs, replace the A/C Control Head.

1. Check DK GRN/WHT (335) wire for an open (see schematic).
2. Check BLK (150) wire for an open.

C: COOLANT FAN RUNS CONTINUOUSLY

1. With the Ignition Switch in RUN, disconnect the Coolant Fan Relay connector and connect a Test Lamp between D (BRN/WHT) and F (DK GRN/WHT).
   - If the Test Lamp lights, go to step 2.
   - If the Test Lamp does not light, replace the Coolant Fan Relay.
2. Disconnect the A/C Control Head connector.
   - If the Coolant Fan runs, go to step 3.
   - If the Coolant Fan does not run, replace the A/C Control Head.
3. Disconnect the Electronic Control Module (ECM) connector C2.
   - If the Coolant Fan runs, check DK GRN/WHT (335) wire for short to ground.
   - If the Coolant Fan does not run, refer to Section 6E for ECM diagnosis.

V6 VIN 9

SYSTEM DIAGNOSIS

- **Diagnostic steps for the symptoms listed in the following table are listed after the table.**

SYMPTOM TABLE

A:	Coolant Fan does not run with engine hot.
B:	Coolant Fan does not run with A/C on
C:	Coolant Fan does not run at all
D:	Coolant Fan runs continuously

A: COOLANT FAN DOES NOT RUN WITH ENGINE HOT

Connect: FUSED JUMPER
At: COOLANT TEMPERATURE SWITCH CONNECTOR (Disconnected)
Conditions:
- **Ignition Switch: RUN**
- **A/C Function Selector: OFF**

Jumper Between	Correct Result	For Diagnosis
DK GRN/ WHT & Ground (see schematic)	Coolant Fan and Engine Blower run	See 1

(Continued on next page)

COOLANT FAN

V6 VIN 9

(Continued from previous page)

- If the results are correct, replace the Coolant Temperature Switch.

1. Perform Test C.

B: COOLANT FAN AND ENGINE BLOWER DO NOT RUN WITH A/C ON

Connect: FUSED JUMPER
At: A/C CONTROL HEAD CONNECTOR (Disconnected)
Condition:

- **Ignition Switch: RUN**

Jumper Between	Correct Result	For Diagnosis
K (DK GRN/ WHT) & Ground	Coolant Fan and Engine Blower run	See 1
K (DK GRN/ WHT) & H (BLK)	Coolant Fan and Engine Blower run	See 2

- If the results are correct, replace the A/C Control Head.

1. Perform Test C.
2. Check BLK (150) wire for an open.

C: COOLANT FAN DOES NOT RUN AT ALL (TABLE 1)

Connect: FUSE JUMPER
At: COOLANT FAN RELAY CONNECTOR (Connected)
Condition:

- **Ignition Switch: RUN**

Jumper Between	Correct Result	For Diagnosis
F (DK GRN/ WHT) & Ground	Coolant Fan runs	See 1

- If result is correct, check/repair the DK GRN/WHT wire for an open.

1. Go to Table 2.

C: COOLANT FAN DOES NOT RUN AT ALL (TABLE 2)

Connect: TEST LAMP
At: COOLANT FAN RELAY CONNECTOR (Disconnected)
Condition:

- **Ignition Switch: RUN**

Connect Between	Correct Result	For Diagnosis
D (BRN/WHT) & Ground	Test Lamp lights	See 1
A (RED) & Ground	Test Lamp lights	See 2

- If the results are correct, go to Table 3.

1. Check the FAN E Fuse and BRN/WHT (250) wire for an open.
2. Check Fusible Link A and RED (2) wire for an open.

C: COOLANT FAN DOES NOT RUN AT ALL (TABLE 3)

Connect: 20 AMP FUSED JUMPER
At: COOLANT FAN RELAY CONNECTOR (Disconnected)

Jumper Between	Correct Result	For Diagnosis
D (RED) & A (BLK/RED) (see schematic)	Coolant Fan runs	See 1

- If the Coolant Fan runs, replace the Coolant Fan Relay.

1. Leave fused jumper in place and go to Table 4.

C: COOLANT FAN DOES NOT RUN AT ALL (TABLE 4)

Connect: TEST LAMP
At: COOLANT FAN MOTOR CONNECTOR (Disconnected)
Condition:

- **Fused jumper from Table 3 in place**

Connect Between	Correct Result	For Diagnosis
B (BLK/RED) & Ground	Test Lamp lights	See 1
B (BLK/RED) & A (BLK)	Test Lamp lights	See 2

- If the results are correct, replace the Coolant Fan Motor.

1. Check BLK/RED (532) wire for an open.
2. Check BLK (151) wire for an open.

(Continued on next page)

COOLANT FAN

V6 VIN 9

(Continued from previous page)

D: COOLANT FAN AND ENGINE BLOWER RUN CONTINUOUSLY

1. With the Ignition Switch in RUN, disconnect the Coolant Temperature Switch connector.
    - If the Coolant Fan runs, go to step 2.
    - If the Coolant Fan does not run, replace the Coolant Temperature Switch.
2. Disconnect the A/C High Pressure Cut-Out Switch connector.
    - If the Coolant Fan runs, go to step 3.
    - If the Coolant Fan does not run, replace the A/C High Pressure Cut-Out Switch.
3. Disconnect the A/C Control Head connector.
    - If the Coolant Fan runs, check DK GRN/WHT (335) wire for short to ground.
    - If the Coolant Fan does not run, replace the A/C Control Head.

L4 VIN R AND V6 VIN 9 CIRCUIT OPERATION

L4 VIN R

The Coolant Fan is turned on and off by the ECM based on inputs from the Coolant Temperature Sensor, Vehicle Speed Sensor and the A/C System. Battery Voltage is applied at all times to terminal A of the Coolant Fan Relay. The ECM energizes the Coolant Fan Relay by grounding circuit 335. The Relay energizes and battery voltage is applied to the Coolant Fan. See Section 6E for specific conditions of the Coolant Fan operation.

The A/C Control Head also energizes the Coolant Fan Relay by grounding circuit 335 whenever the A/C Function Selector is in MAX, NORM or B/L.

V6 VIN 9

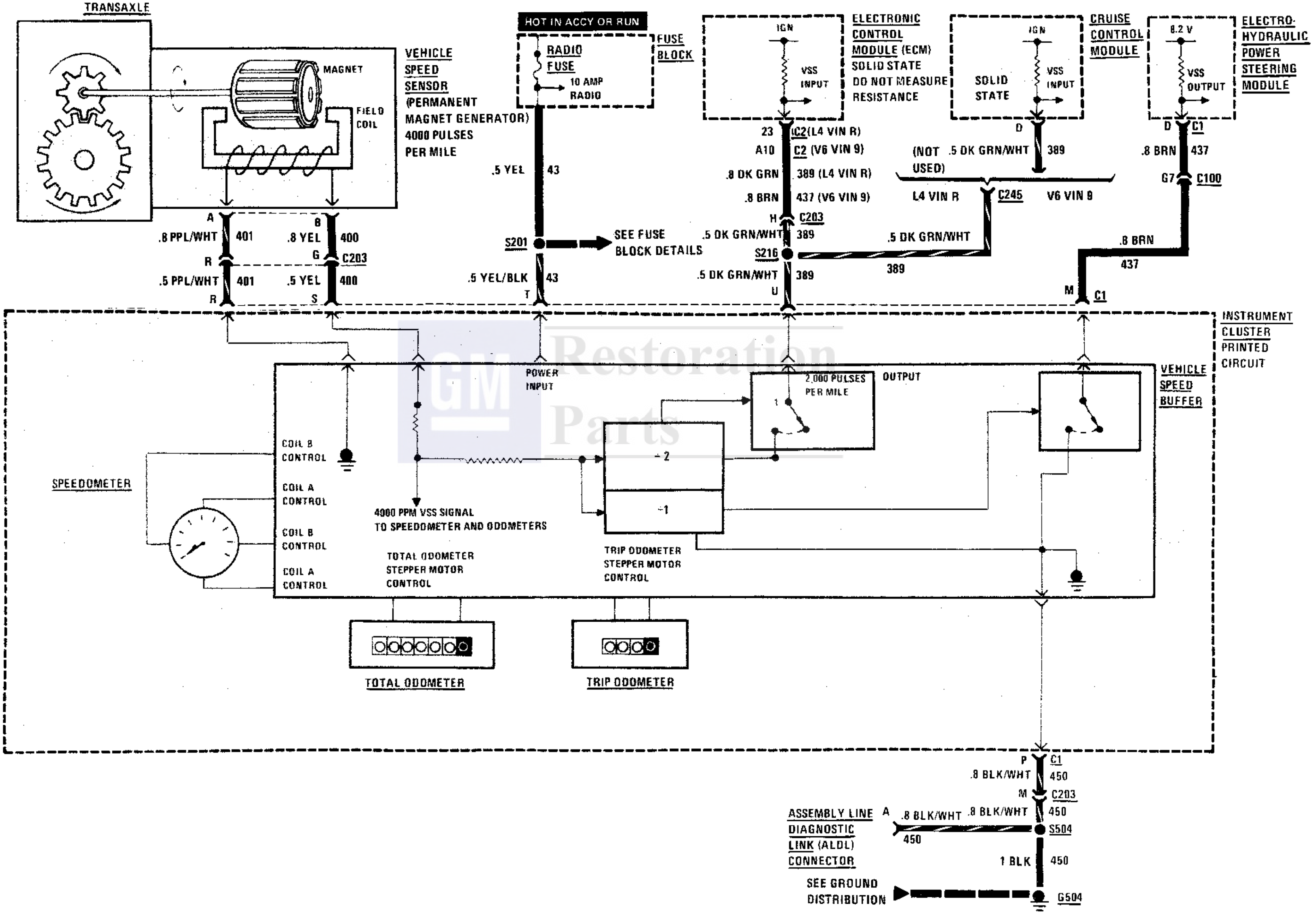
The Coolant Fan is operated by the Coolant Fan Relay. Battery voltage is applied at all times through Fusible Link A to terminal A of the Coolant Fan Relay. With the Ignition Swith in RUN, voltage is applied through the FAN E Fuse to terminal D of the Relay coil.

When the coolant temperature exceeds 113°C (235°F), the Coolant Temperature Switch closes. By grounding circuit 335, the Relay coil is energized and battery voltage is applied to the Coolant Fan.

If equipped with Air Conditioning, the A/C High Pressure Cut-Out Switch and A/C Control Head also energize the Coolant Fan Relay by grounding circuit 335 whenever the A/C High Pressure Cut-Out Switch closes above 280 PSI (1931 kPa) and the A/C Function Selector is in MAX, NORM or B/L.

BLANK

VEHICLE SPEED SENSOR



VEHICLE SPEED SENSOR

TROUBLESHOOTING HINTS

- **Try the following check before doing the System Diagnosis.**

  Check the RADIO Fuse by operating the Radio.

- **Go to System Diagnosis for diagnostic tests.**

SYSTEM DIAGNOSIS

- **Do the tests listed for your symptom in the Symptom Table below.**
- **Tests follow the Symptom Table.**

SYMPTOM TABLE

SYMPTOM	FOR DIAGNOSIS
Speedometer does not operate properly, ECM Code 24 is not set	Replace Instrument Cluster, see Section 8C for removal and replacement procedures
ECM Code 24 is set, Speedometer operates properly	Do Test B
Speedometer does not operate properly, ECM Code 24 is set	Do Test A
Cruise Control (if equipped) does not operate properly, ECM Code 24 is not set	Do Test B
Power Steering does not operate properly, ECM Code 24 is not set	Do Test C

- If your symptom is not listed in the Symptom Table, perform all the tests.

COMPONENT LOCATION

		Page-Figure
Assembly Line Diagnostic Link (ALDL) Connector	In console, near rear of shifter	201- 5-B
Cruise Control Module	Under console, near radio	201- 9-D
Electro-Hydraulic Power Steering (EHPS) Controller	Lower LH side of front compartment	201- 3-D
Electronic Control Module (ECM)	Between seats, on front of rear bulkhead	201- 5-B
Fuse Block	Behind LH side of I/P	201- 6-D
Vehicle Speed Sensor	RH end of transaxle	201- 1-A
C100 (34 cavities)	LH side of front bulkhead, right of brake master cylinder	201-13-A
C203 (15 cavities)	Between seats, in front of rear bulkhead	201- 5-A
C245 (8 cavities)	Beneath center console	
G504 (VIN 9)	LH top of engine, below throttle body	201- 3-A
G504 (VIN R)	Top LH front of engine, above Starter Solenoid	201- 2-A
S201	Main harness, above steering column	201- 7-A
S216	Main harness, behind center I/P	201-15-A
S504	Engine harness, under rear console	201- 5-A

A: VEHICLE SPEED SENSOR BUFFER TEST (TABLE 1)

Measure: VOLTAGE
At: INSTRUMENT CLUSTER CONNECTOR C1 (Disconnected)
Condition:
- **Ignition Switch: RUN**

Measure Between	Correct Voltage	For Diagnosis
T (YEL/BLK) & Ground	Battery	See 1
T (YEL/BLK) & P (BLK/WHT)	Battery	See 2

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- If both voltages are correct, go to Table 2.

1. Check/repair YEL/BLK and YEL (43) wires for an open (see schematic).
2. Check/repair BLK/WHT and BLK (450) wires for an open (see schematic). Check that ground G504 is clean and tight.

(Continued on next page)

VEHICLE SPEED SENSOR

(Continued from previous page)

A: VEHICLE SPEED SENSOR BUFFER TEST (TABLE 2)

Measure: AC VOLTAGE
At: INSTRUMENT CLUSTER CONNECTOR C1 (Connected)
Conditions:

- **Ignition Switch: RUN**
- **Gear Selector: NEUTRAL**
- **Raise car off the ground and turn drive wheels by hand while making measurement**

Measure Between	Correct Voltage	For Diagnosis
S (YEL) & R (PPL/WHT)	Varying from 1 to 5 Volts AC	See 1

- If the voltage is correct, check the printed circuit for flaws and cracks. If OK, replace Instrument Cluster (see Section 8C).

1. Check/repair the YEL (400) and PPL/WHT (401) wires (see schematic). Replace the Vehicle Speed Sensor if both wires are OK and connector C203 is correctly mated (see Section 8C).

B: VEHICLE SPEED SENSOR BUFFER OUTPUT TEST (TABLE 1) V6 VIN 9 ONLY

Measure: VOLTAGE
At: INSTRUMENT CLUSTER CONNECTOR C1 (Disconnected)
Conditions:

- **Ignition Switch: RUN**
- **Connector C245: DISCONNECTED**

Measure Between	Correct Voltage	For Diagnosis
U (DK GRN/WHT) & Ground	Battery	See 1
• Connector C245: CONNECTED • Cruise Control: ON • Connector C203: DISCONNECTED		
U (DK GRN/WHT) & Ground	Battery	See 2

- If all voltages are correct, go to Table 2.

1. Check the DK GRN/WHT (389) wire and BRN (437) wire for an open and check that connector C203 is mated correctly. If all are good, replace the Electronic Control Module.
2. Check the DK GRN/WHT (389) wire for an open and check that connector C245 is mated correctly. If both are OK and Cruise Control diagnostics in Section 8A-34 have been completed, replace Cruise Control Module.

B: VEHICE SPEED SENSOR BUFFER OUTPUT TEST (TABLE 1) L4 VIN R ONLY

Measure: VOLTAGE
At: INSTRUMENT CLUSTER CONNECTOR C1 (Disconnected)
Condition:

- **Ignition Switch: RUN**

Measure Between	Correct Voltage	For Diagnosis
U (DK GRN/WHT) & Ground	Battery	See 1

- If the voltage is correct, go to Table 2.

1. Check the DK GRN (389) wires for an open (see schematic). Check that connector C203 is mated correctly. If all are good, replace ECM.

B: VEHICLE SPEED SENSOR BUFFER OUPUT TEST (TABLE 2)

Measure: VOLTAGE
At: INSTRUMENT CLUSTER CONNECTOR C1 (Connected)
Conditions:

- **Ignition Switch: RUN**
- **Gear Selector: NEUTRAL**
- **Raise car off the ground and turn the drive wheels by hand while making measurement**

Measure Between	Correct Voltage	For Diagnosis
U (DK GRN/WHT) & Ground	Varying from less than 1 volt to more than 4 volts	See 1

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VEHICLE SPEED SENSOR

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- If the voltage at U is correct and code 24 is set, replace the ECM.
- If the voltage at U is correct and the Cruise Control does not operate properly, replace the Cruise Control.

1. Replace the Instrument Cluster (see Section 8C).

C: POWER STEERING INPUT TEST

Measure: VOLTAGE
At: INSTRUMENT CLUSTER CONNECTOR C1 (Disconnected)
Condition:
- **Ignition Switch: RUN**

Measure Between	**Correct Voltage**	**For Diagnosis**
M (BRN) & Ground	8.2 volts	See 1

- Connector C1: CONNECTED
- Gear Selector: NEUTRAL
- Raise car and turn drive wheels by hand

Measure Between	**Correct Voltage**	**For Diagnosis**
M (BRN) & Ground	Varying from less than 1 volt to more than 3 volts	See 2

- If voltages are correct, replace the Electro-Hydraulic Power Steering Controller.

1. Check BRN (437) wire for an open. If OK, replace the Electro-Hydraulic Power Steering Controller.
2. Replace Instrument Cluster (see Section 8C).

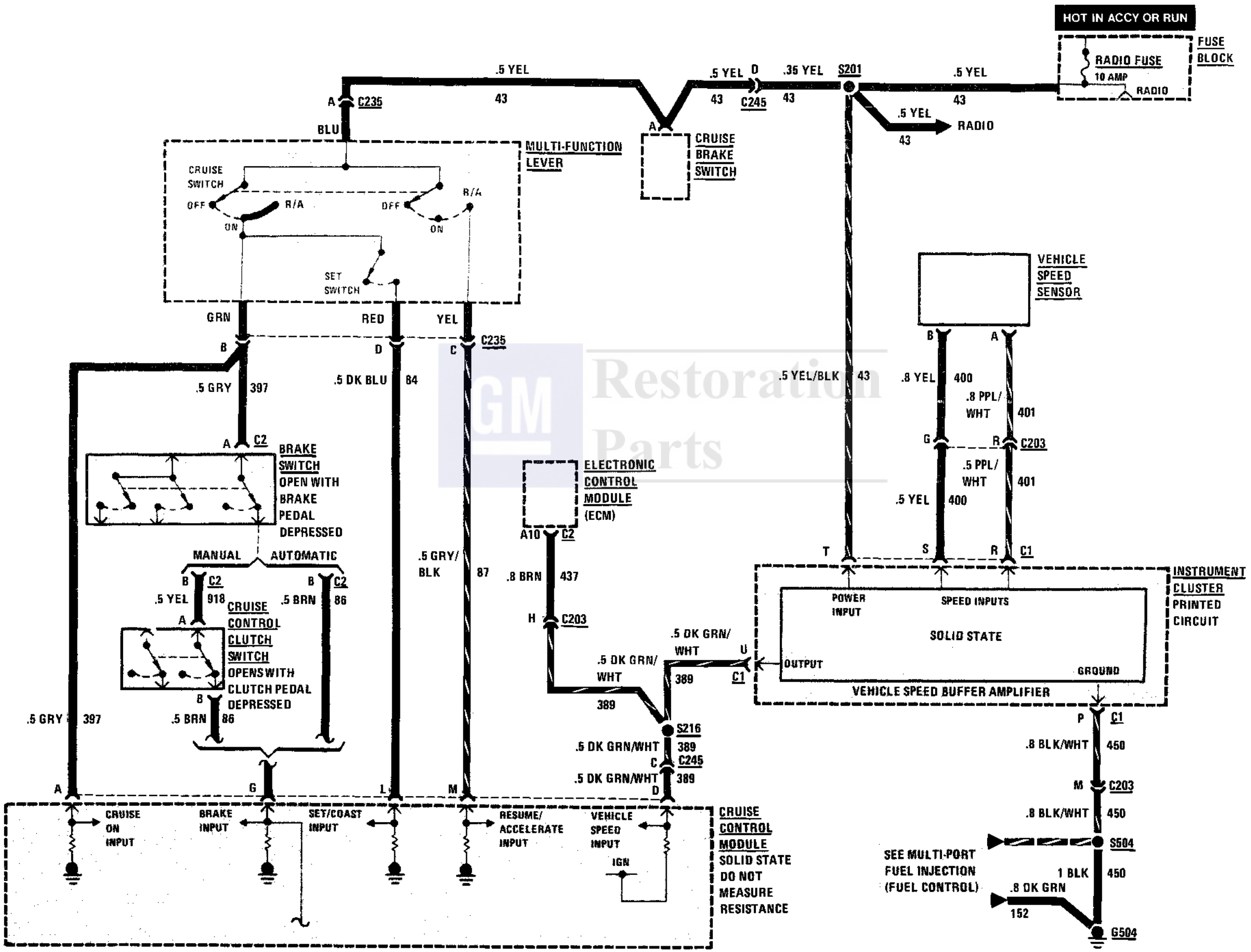
CIRCUIT OPERATION

The Vehicle Speed Sensor generates a signal that indicates the speed of the vehicle. The signal produced is a sine wave, which is processed into a square wave by the Vehicle Speed Sensor Buffer to supply inputs to the Speedometer, Electronic Control Module, Cruise Control Module (if equipped) and Electro-Hydraulic Power Steering Module.

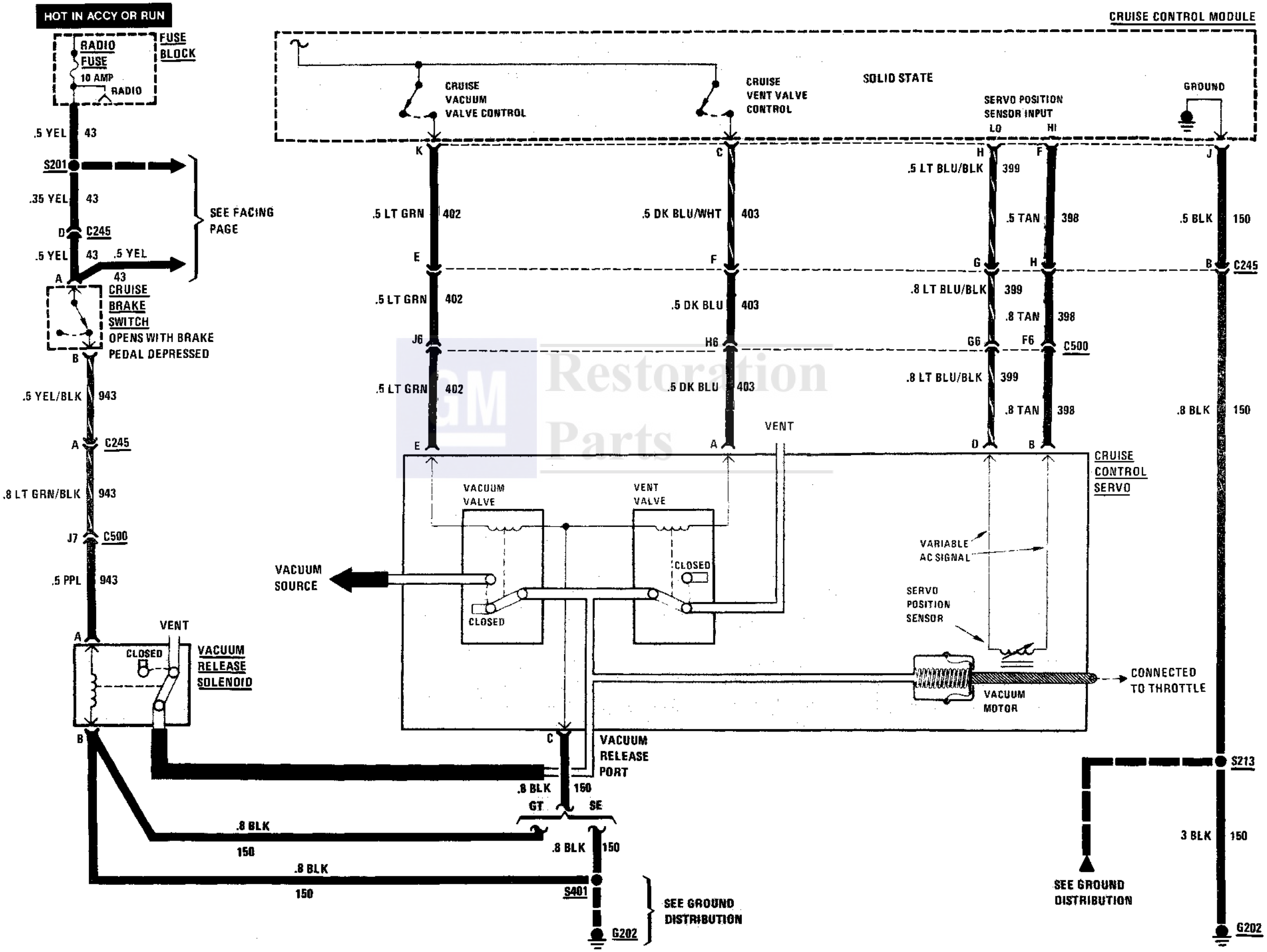
The Vehicle Speed Sensor is mounted in the Transaxle. A magnet rotates near a coil, producing voltage pulses in the coil. The frequency of the AC voltage coming from this coil depends on the vehicle's speed. As the speed increases, so does the number of voltage pulses per second.

The Vehicle Speed Sensor Buffer takes the sensor/voltage pulses from the Sensor, through the PPL/WHT and YEL wires, and uses them to close Solid State output switches. The output terminals are switched to ground at a rate that is proportional to the speed of the car. The output to the ECM and Cruise Control is switched at 2000 pulses per mile after it has been through a "divide by two circuit" in the ECM. The output to the Electro-Hydraulic Power Steering Controller is switched at 4000 pulses per mile.

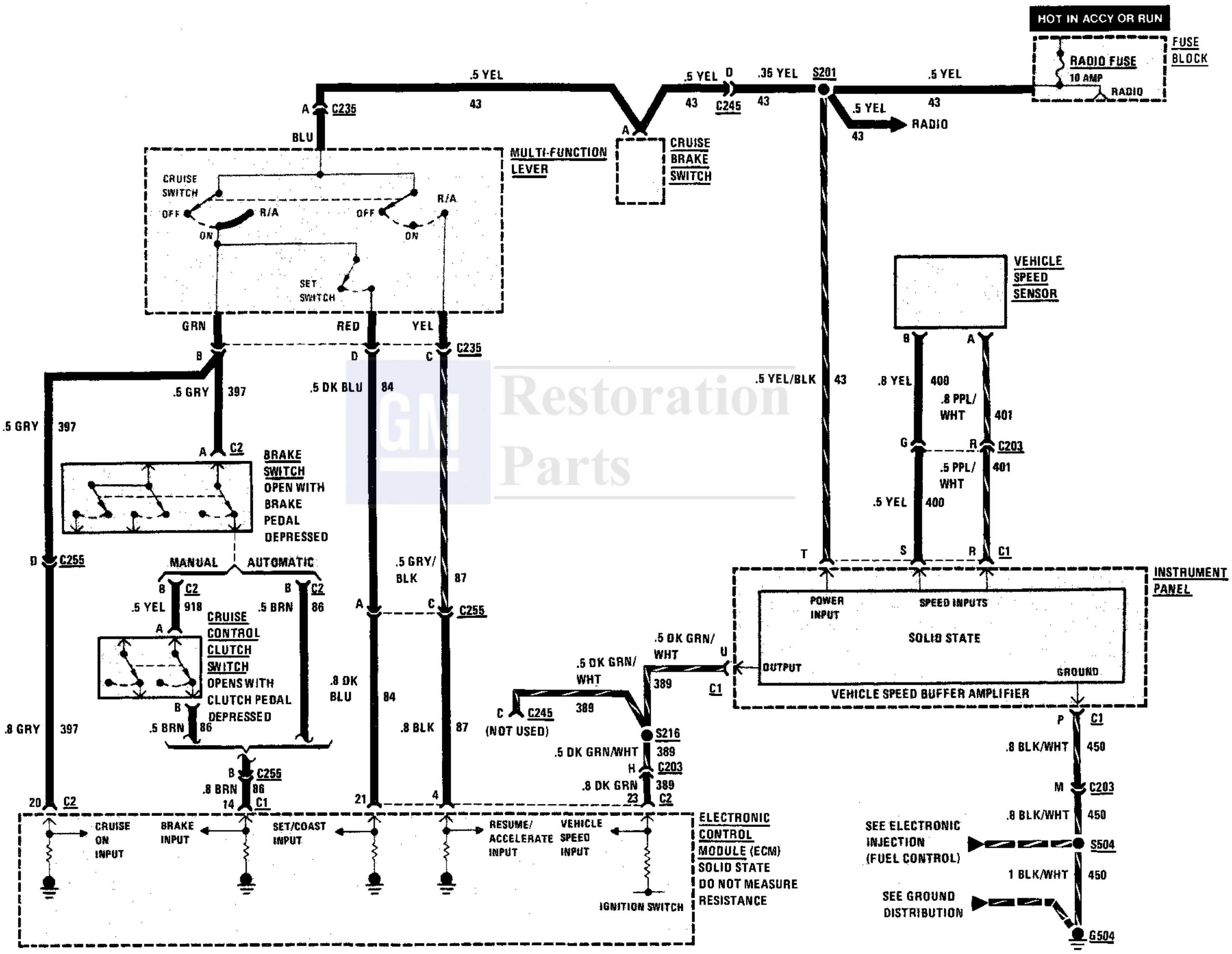
CRUISE CONTROL: K34, V6 VIN 9



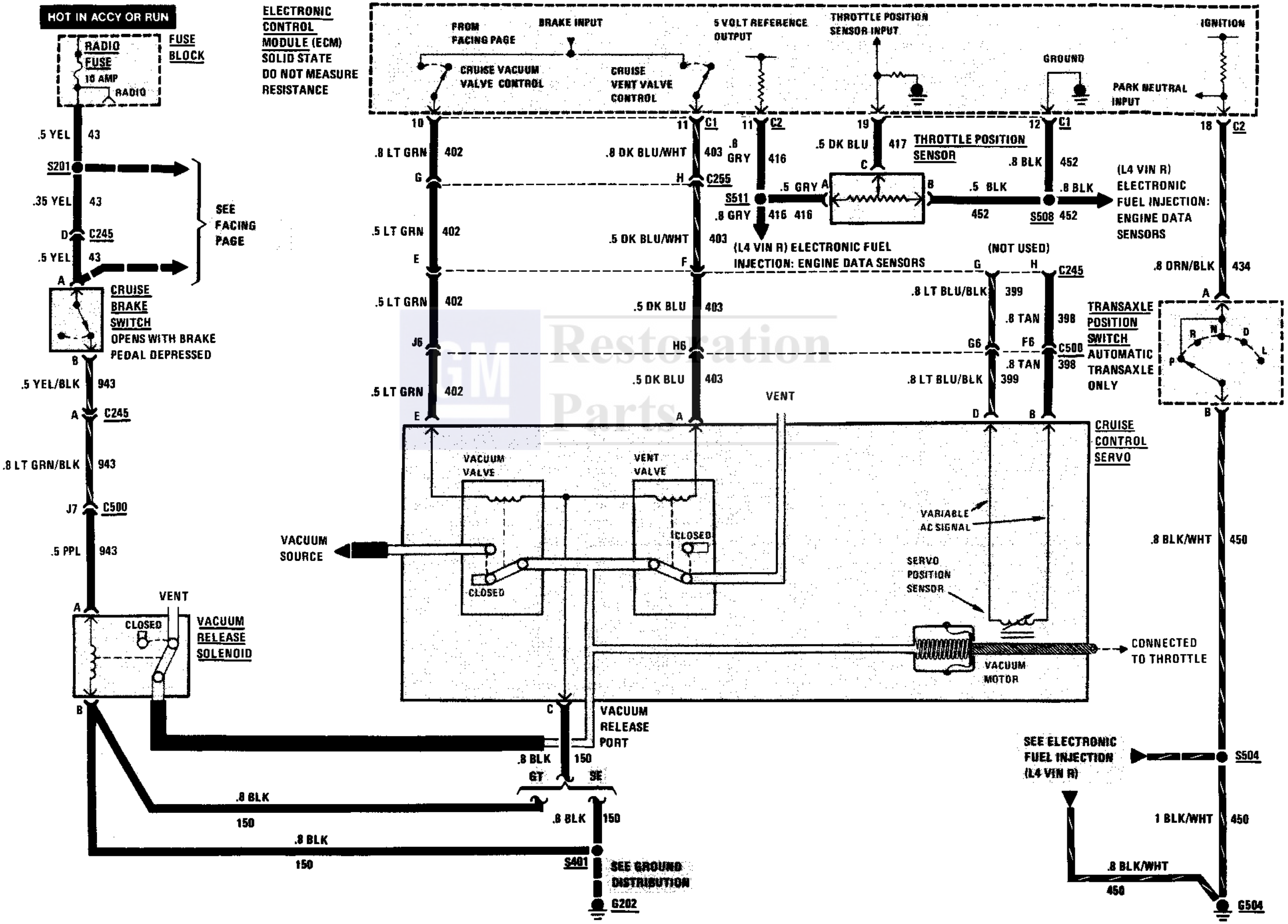
CRUISE CONTROL: VACUUM, V6 VIN 9



CRUISE CONTROL: K34, L4 VIN R



CRUISE CONTROL: VACUUM, L4 VIN R



CRUISE CONTROL

TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Diagnosis.**

1. Check vacuum hose for leaks, kinks, and/or restrictions. Also check Cruise Control Servo linkage. Refer to Section 9 for vacuum hose routing and servo linkage adjustments.
2. If the system works except for the Tap-Up and Tap-Down functions, replace the Cruise Control Module (V6 VIN 9).

- **Go to System Diagnosis for diagnostic tests.**

SYSTEM CHECK (ROAD TEST)

- **Use the System Check Table as a guide to normal operation.**

SYSTEM CHECK TABLE

ACTION	CORRECT RESULT
1. Drive car faster than 25 mph. Turn Cruise Switch ON. Depress Set button at the end of the Multi-Function Lever	Car should maintain speed
2. Hold Set button in and take 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 (Cruise disengages)
7. Slide Cruise Switch momentarily to R/A	Car should accelerate to former set speed
8. While cruising, accelerate, then remove foot from accelerator	Car should coast back to set speed

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COMPONENT LOCATION

		Page-Figure
Brake Switch	Top of brake pedal support	201-11-A
Cruise Brake Switch	On brake pedal support	201-11-A
Cruise Clutch Switch	On clutch pedal support	201-11-A
Cruise Control Module	Under console, near radio	201- 9-D
Cruise Control Servo	Engine compartment, near LH shock tower	201-14-A
Electronic Control Module (ECM)	Between seats, on front of rear bulkhead	201- 5-B
Fuse Block	Behind LH side of I/P	201- 6-D
Multi-Function Lever	Top LH side of steering column	201- 8-E
Throttle Position Sensor (VIN 9)	LH top of engine, on throttle body	201- 3-A
Throttle Position Sensor (VIN R)	Top of engine, right of throttle body	201- 1-A
Transaxle Position Switch	LH rear of engine, top of transaxle	201- 2-B
Vacuum Release Solenoid	Engine compartment, on LH shock tower	201-14-A
Vehicle Speed Sensor	RH end of transaxle	201- 1-A
C203 (15 cavities)	Between seats, in front of rear bulkhead	201- 5-A
C235 (4 cavities)	Middle of steering column	201- 8-E
C245 (8 cavities)	Beneath center console	
C255 (8 cavities)	Beneath center console	201- 5-A
C500 (34 cavities)	Engine compartment, near battery	201- 4-A
G202	Between seats, near rear bulkhead	201- 6-A
G504 (VIN 9)	LH top of engine, below throttle body	201- 3-A
G504 (VIN R)	Top LH front of engine, above Starter Solenoid	201- 2-A
S201	Main harness, above steering column	201- 7-A
S213	Main harness, behind rear bulkhead grommet	201-15-A
S216	Main harness, behind center I/P	201-15-A
S401	Rear lights harness, LH side of back panel	201-14-A
S504	Engine harness, under rear console	201- 5-A
S508 (VIN R)	Engine harness, under rear console	201- 5-A
S511 (VIN R)	Engine harness, top RH rear of engine	201- 1-A

9. While cruising, tap Cruise Switch to R/A	Car speed should increase 1 mph for each tap, up to ten taps, then system may have to be reset to a new speed
10. While cruising, tap Set button	Car speed should decrease by 1 mph for each tap, until 25 mph is reached when Cruise Control will not operate
11. Slide Cruise Switch to OFF	Cruise Control turns off

- **Refer to System Diagnosis when a result is not normal.**

SYSTEM DIAGNOSIS
V6 VIN 9

- **Use the Isolation Test below to choose the proper diagnostic tests.**
- **Tests follow the Isolation Test.**

1. Do not press both the Set and R/A Switches at the same time while the engine is running and Cruise Control Servo is connected to the Throttle.
2. If the Quick Checker displays a short light, release the switches immediately. Shorts can damage the Quick Checker.

ISOLATION TEST

Connect: QUICK CHECKER (J-34185, SPECMO QC-3 or EQUIVALENT) or VOLT-OHMMETER
At: CRUISE CONTROL MODULE CONNECTOR (Disconnected)
Conditions:

- **Ignition Switch: RUN**
- **Test with Quick Checker (J-34185 or equivalent) or Digital Meter**
- **Do tests in the sequence listed**

Test	Condition	With Quick Checker, Correct Response	Without Quick Checker, Using a Digital Meter			For Different Response, do Test
			Meter Range	Connector Terminals	Correct Response	
1	Cruise Switch Off	—	200 ohms	J & Ground	0 ohms	B
		All Lights Off	20 VDC	A & J	0 volts	A
			20 VDC	M & J	0 volts	
2	Cruise Switch On	ON/OFF Light On	20 VDC	A & J	Battery voltage	B
		BRK Light On	20 VDC	G & J	Battery voltage	C
		VENT Light On	200 ohms	C & J	30 to 55 ohms	D
		VAC Light On	200 ohms	K & J	30 to 55 ohms	E
		SPS Light On	200 ohms	F & H	15 to 25 ohms	F
		R/A Light Off	20 VDC	M & J	0 volts	A
		SC Light Off	20 VDC	L & J	0 volts	A
3	Cruise Switch On, Set Switch pressed	SC Light On	20 VDC	L & J	Battery voltage	G
		VAC & SHORT Lights Off	200 ohms	K & J	30 to 55 ohms	H
4	Cruise Switch in R/A	ON/OFF Light On	20 VDC	A & J	Battery voltage	A
		R/A Light On	20 VDC	M & J	Battery voltage	I
		VENT & SHORT Lights Off	200 ohms	C & J	30 to 55 ohms	J

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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	K, L
6	Run engine for one minute, then turn it off. With Ignition Switch in RUN, and holding Cruise Switch in R/A, press Set Switch, wait for servo to pull in, and release Set Switch.	Vacuum holds the servo all the way in	Connect fused jumper from C to M and from K to L before operating switches		Vacuum holds the servo all the way in	M
7	Quick Checker not connected		200 ohms	F & J	Over range	N

- If all responses are correct, do Test O.

A: CRUISE SWITCH SHORT TEST

Check for shorts to voltage in the wires to terminals G, A, M, and L of the Cruise Control Module (see schematic).

- If the wires are good, replace the Multi-Function Lever.

B: POWER CIRCUIT OPEN TEST

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 Switch in RUN.

- If battery voltage is missing, check/repair YEL (43) wire.

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 GRY (397) wire between terminal B of connector C235 and terminal A of the Cruise Control Module connector.

C: BRK CIRCUIT OPEN TEST

1. Check for an open Brake Switch or Cruise Control Clutch Switch (see schematic).
2. Check for an open in the BRN (86) wire, GRY (397) wire or YEL (918) wire.

D: VENT CIRCUIT OPEN TEST

If you are testing with a digital voltmeter and you measured less than 30 ohms, perform Test J. Otherwise, proceed to the following action:

- Remove the connector from the Cruise Control Servo. Measure the resistance between terminals A and C of the Servo.
  - If it is greater than 55 ohms, replace the Servo.
  - If it is less than 55 ohms, check for an open DK BLU or DK BLU/WHT (403) wire between terminal C of the Cruise Control Module and terminal A of the Cruise Control Servo. Check that terminal C of the servo connector is grounded (see schematic).

E: VAC CIRCUIT OPEN TEST

If you are testing with a digital voltmeter and you measured less than 30 ohms, perform Test H. Otherwise, proceed with the following action:

- Remove the connector from the Cruise Control Servo. Measure the resistance between terminals E and C of the servo.
  - If it is more than 55 ohms, replace the servo.
  - If it is less than 55 ohms, check for an open in the LT GRN (402) wire between terminal K of the Cruise Control Module and terminal E of the Cruise Control Servo. Check that terminal C of the servo connector is grounded (see schematic).

F: SPS CIRCUIT OPEN TEST

If you are testing with a digital voltmeter and you measured less than 15 ohms, perform Test N. Otherwise, proceed to the following action:

- Remove the connector from the Cruise Control Servo. Measure the resistance between terminals B and D of the servo.
  - — If it is more than 25 ohms, replace the servo.
  - — If it is less than 25 ohms, check for an open in the LT BLU/BLK (399) wire between terminal H of the Cruise Control Module and terminal D of the Cruise Control Servo. Check for an open in the TAN (398) wire between terminal F of the module and terminal B of the servo.

G: SC CIRCUIT OPEN TEST

Disconnect C235 and check the switch 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.
- If the switch is not open, check for an open in the DK BLU (84) wire between terminal D of connector C235 and terminal L of the module.

H: VAC CIRCUIT SHORT TEST

Remove the connector from the Cruise Control Servo and measure the resistance between terminals C and E of the Cruise Control Servo.

- If it is less than 30 ohms, replace the servo.
- If it is 30 ohms or more, check for a short to ground in the wire from terminal K of the module to terminal E of the servo.

I: R/A CIRCUIT OPEN TEST

Disconnect C235 and check switch 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.
- If the switch is not open, check for an open in the GRY/BLK (87) wire between terminal C of connector C235 and terminal M of the Cruise Control Module.

J: VENT CIRCUIT SHORT TEST

Remove the connector from the Cruise Control 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 to ground in the wire from terminal C of the Cruise Control Module to terminal A of the Cruise Control Servo.

K: VSS CIRCUIT OPEN TEST

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 DK GRN/WHT (389) wire from the Vehicle Speed Sensor Buffer. Refer to p. 33-0 for diagnosis of Vehicle Speed Sensor.

L: VSS CIRCUIT SHORT TEST

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 DK GRN/WHT (389) wire from the Vehicle Speed Sensor Buffer. Refer to p. 33-0 for diagnosis of Vehicle Speed Sensor.

M: VACUUM SYSTEM TEST

Connect: TEST LAMP
At: VACUUM RELEASE SOLENOID CONNECTOR (Disconnected)
Condition:
- Ignition Switch: ACCY

Connect Between	Correct Result	For Diagnosis Of Incorrect Results
A (PPL) & Ground	Test Lamp lights	See 1
A (PPL) & B (BLK)	Test Lamp lights	See 2

- If both results are correct, go to M1.

1. Check/adjust Cruise Brake Switch, and check YEL/BLK, LT GRN/BLK, and PPL (943) wires for an open.
2. Check BLK (150) wire for an open.

M1. Check for a blocked or leaking vacuum source. If the vacuum source is good, plug the Vacuum Release Port and repeat Test 6 of the Isolation Test.

- If the vacuum now holds the throttle open, replace or repair the Vacuum Release Solenoid or the hose to it.
- If the test still fails, replace the Cruise Control Servo.

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N: SPS CIRCUIT SHORT TEST

Disconnect the Cruise Control Servo connector. Repeat Test 7 of the Isolation Test.

- If the resistance is now over range, replace the Cruise Control Servo.
- If the resistance is still low, find and repair the short in the wire from terminal F of the Cruise Control Module to terminal B of the Cruise Control Servo.

O: CRUISE MODULE TEST

1. Check the resistance between G202 and G504.

- 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.
- If it is less than 0.1 ohm, connect a new Cruise Control Module and check for normal operation.

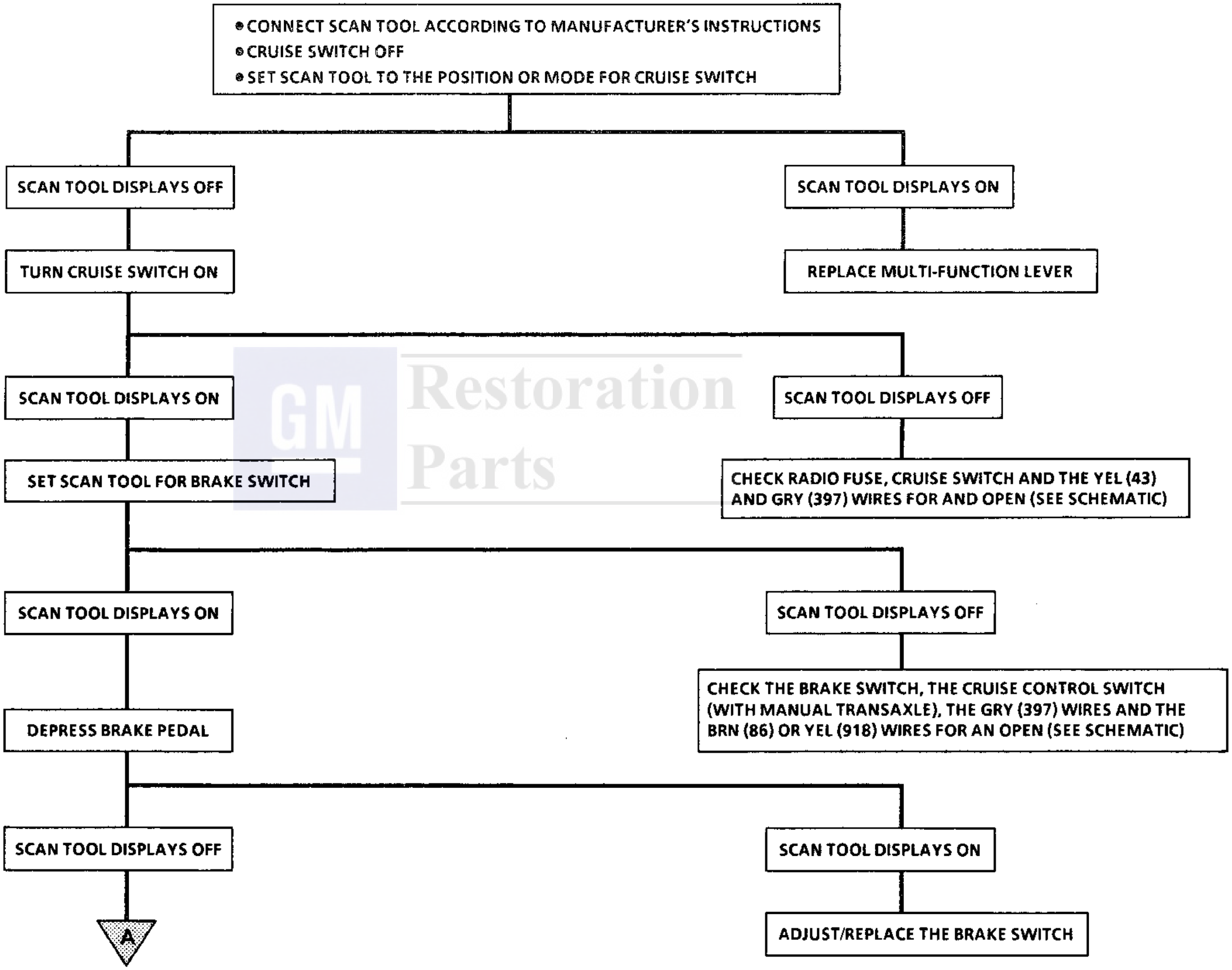
SYSTEM DIAGNOSIS

L4 VIN R

Note: If any diagnostic codes are set, refer to Section 6E.

- If the Cruise Control does not work, follow Test A (if you are using a Scan Tool) or Test B (if you are using a Digital Voltmeter).

A: SCAN TOOL TEST



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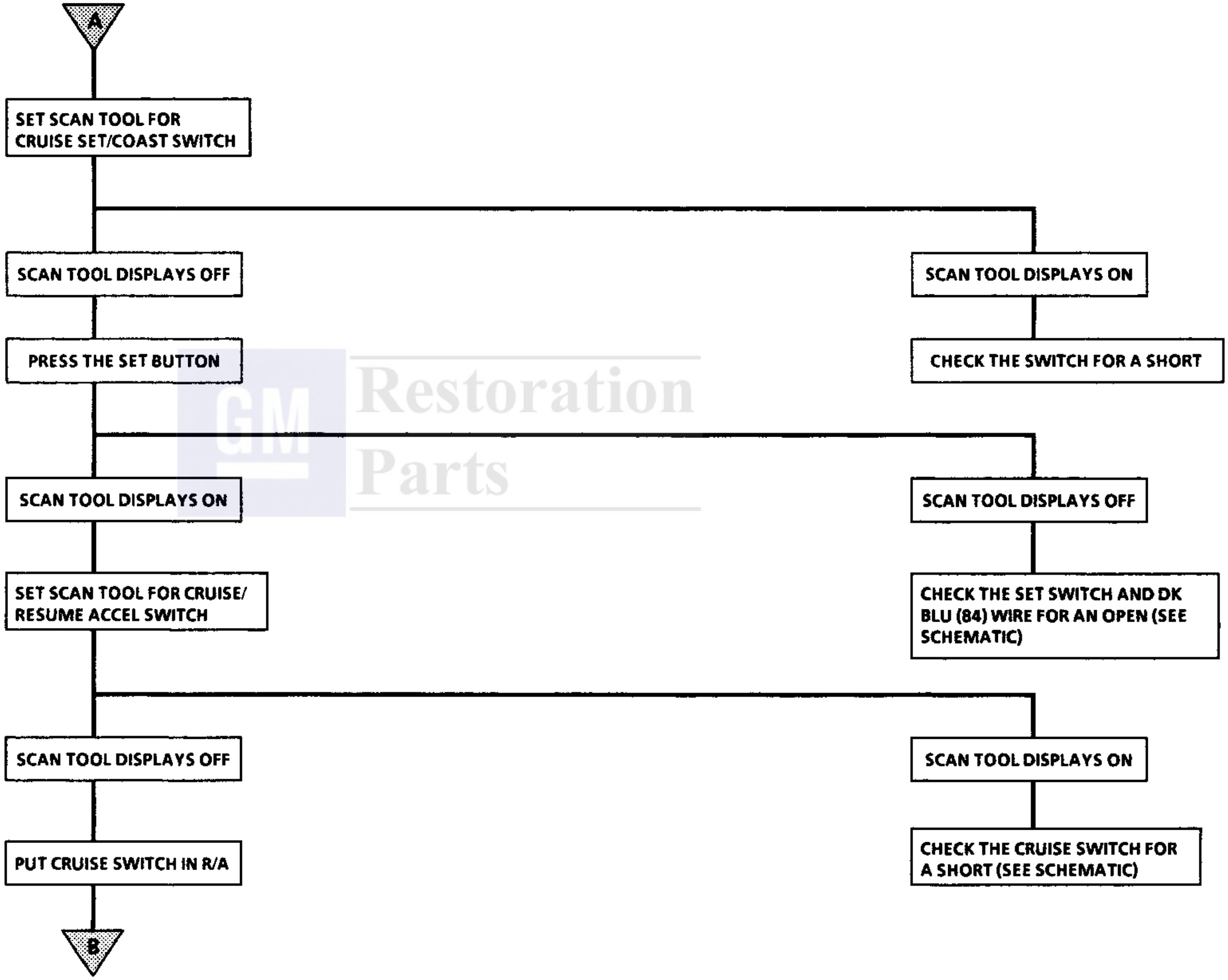

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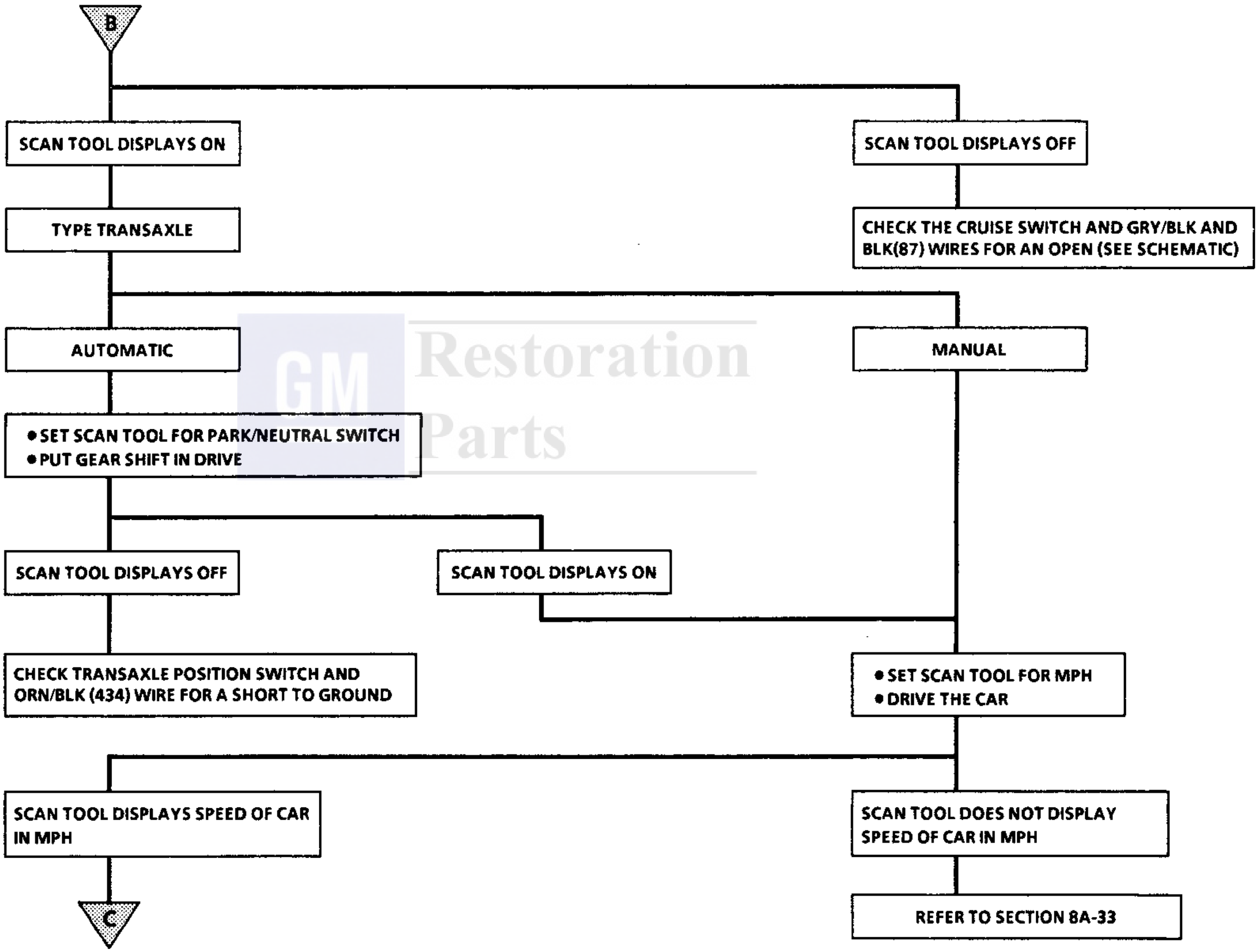
CRUISE CONTROL: K34

L4 VIN R



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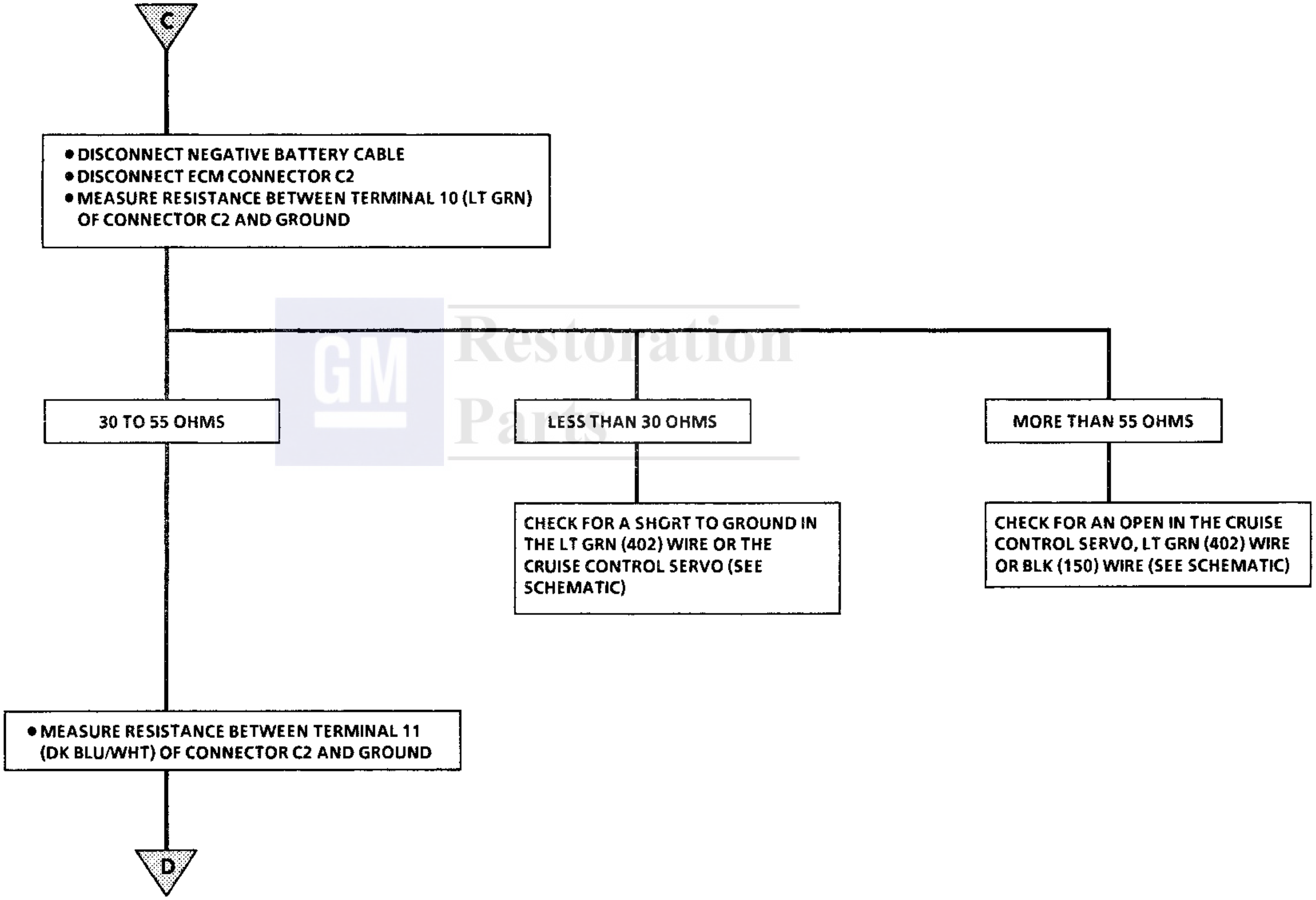

- DISCONNECT NEGATIVE BATTERY CABLE
- DISCONNECT ECM CONNECTOR C2
- MEASURE RESISTANCE BETWEEN TERMINAL 10 (LT GRN) OF CONNECTOR C2 AND GROUND

30 TO 55 OHMS

LESS THAN 30 OHMS

MORE THAN 55 OHMS

CHECK FOR A SHORT TO GROUND IN THE LT GRN (402) WIRE OR THE CRUISE CONTROL SERVO (SEE SCHEMATIC)

CHECK FOR AN OPEN IN THE CRUISE CONTROL SERVO, LT GRN (402) WIRE OR BLK (150) WIRE (SEE SCHEMATIC)

- MEASURE RESISTANCE BETWEEN TERMINAL 11 (DK BLU/WHT) OF CONNECTOR C2 AND GROUND

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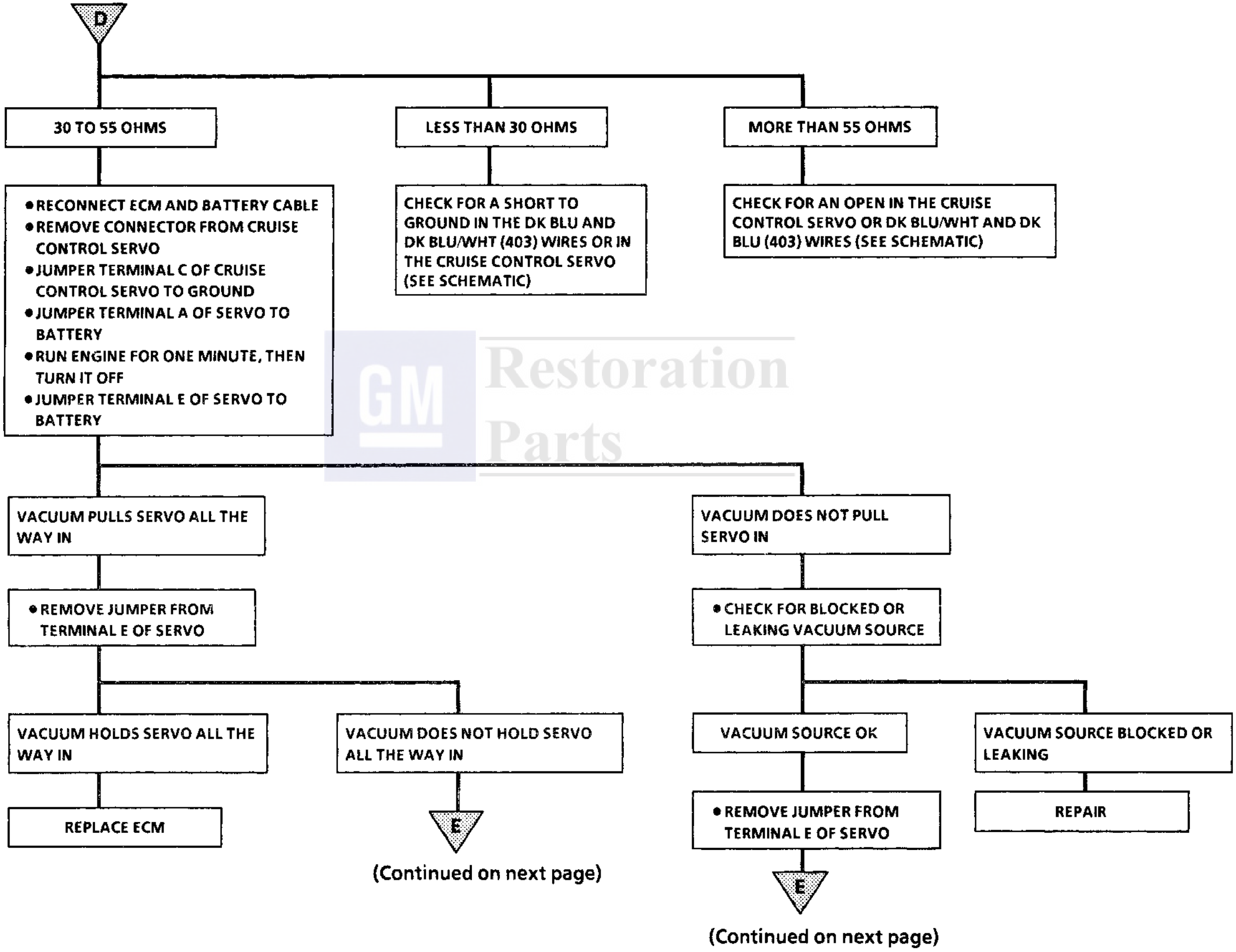
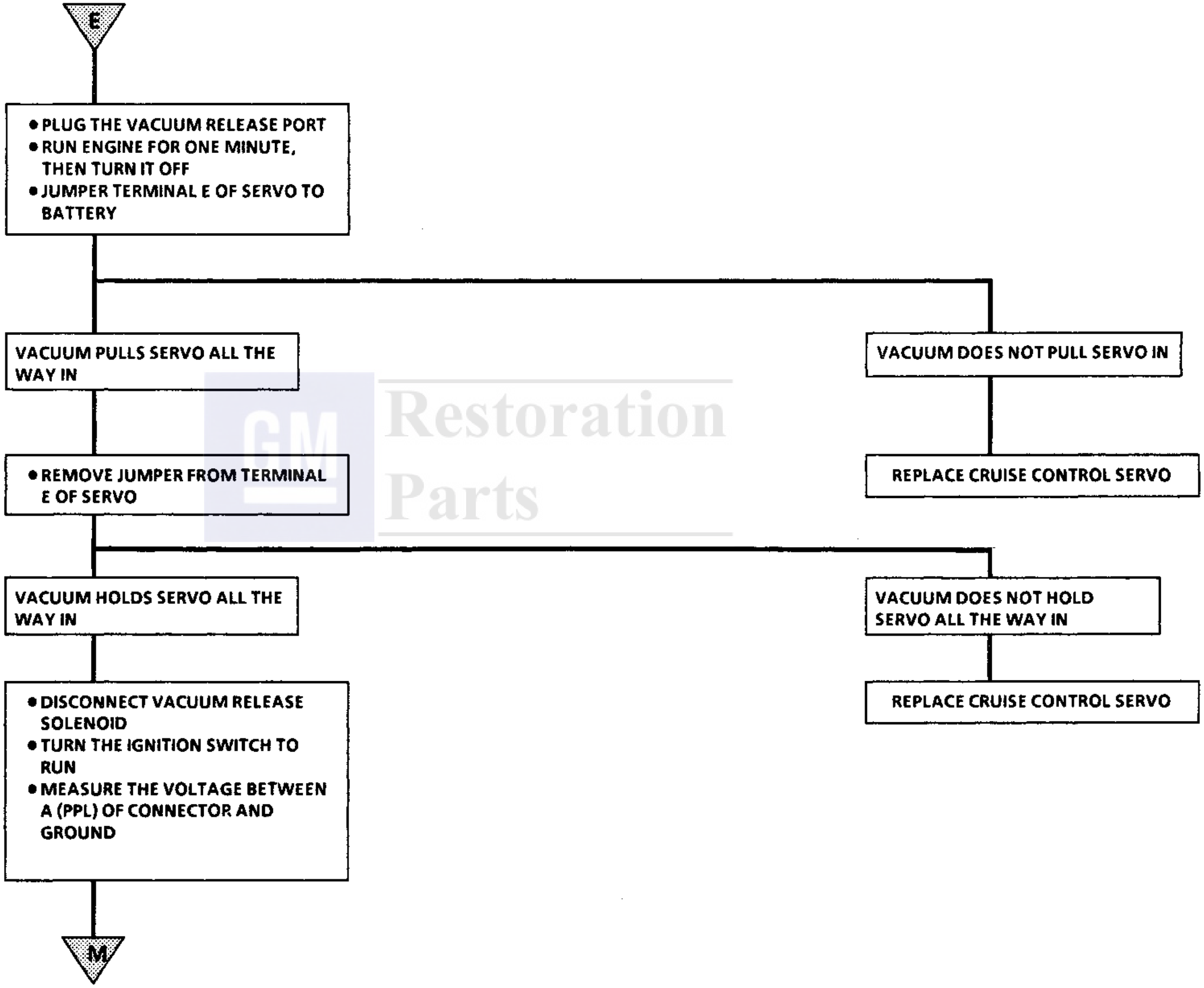

D
30 TO 55 OHMS
LESS THAN 30 OHMS
MORE THAN 55 OHMS
● RECONNECT ECM AND BATTERY CABLE
● REMOVE CONNECTOR FROM CRUISE CONTROL SERVO
● JUMPER TERMINAL C OF CRUISE CONTROL SERVO TO GROUND
● JUMPER TERMINAL A OF SERVO TO BATTERY
● RUN ENGINE FOR ONE MINUTE, THEN TURN IT OFF
● JUMPER TERMINAL E OF SERVO TO BATTERY
CHECK FOR A SHORT TO GROUND IN THE DK BLU AND DK BLU/WHT (403) WIRES OR IN THE CRUISE CONTROL SERVO (SEE SCHEMATIC)
CHECK FOR AN OPEN IN THE CRUISE CONTROL SERVO OR DK BLU/WHT AND DK BLU (403) WIRES (SEE SCHEMATIC)
VACUUM PULLS SERVO ALL THE WAY IN
VACUUM DOES NOT PULL SERVO IN
● REMOVE JUMPER FROM TERMINAL E OF SERVO
● CHECK FOR BLOCKED OR LEAKING VACUUM SOURCE
VACUUM HOLDS SERVO ALL THE WAY IN
VACUUM DOES NOT HOLD SERVO ALL THE WAY IN
VACUUM SOURCE OK
VACUUM SOURCE BLOCKED OR LEAKING
REPLACE ECM
E
(Continued on next page)
● REMOVE JUMPER FROM TERMINAL E OF SERVO
REPAIR
E
(Continued on next page)



- PLUG THE VACUUM RELEASE PORT
- RUN ENGINE FOR ONE MINUTE, THEN TURN IT OFF
- JUMPER TERMINAL E OF SERVO TO BATTERY

VACUUM PULLS SERVO ALL THE WAY IN

- REMOVE JUMPER FROM TERMINAL E OF SERVO

VACUUM HOLDS SERVO ALL THE WAY IN

- DISCONNECT VACUUM RELEASE SOLENOID
- TURN THE IGNITION SWITCH TO RUN
- MEASURE THE VOLTAGE BETWEEN A (PPL) OF CONNECTOR AND GROUND

VACUUM DOES NOT PULL SERVO IN

REPLACE CRUISE CONTROL SERVO

VACUUM DOES NOT HOLD SERVO ALL THE WAY IN

REPLACE CRUISE CONTROL SERVO

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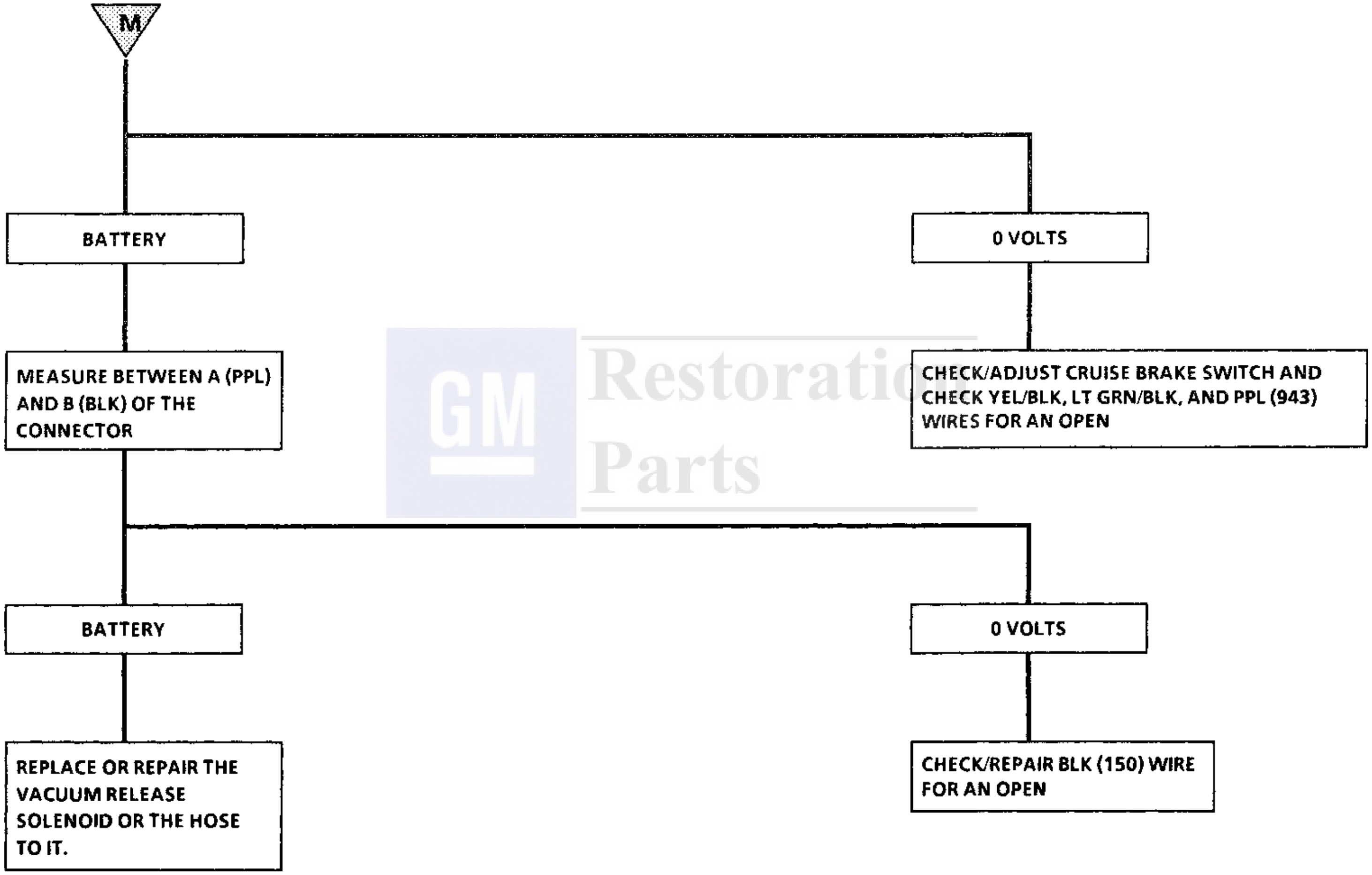
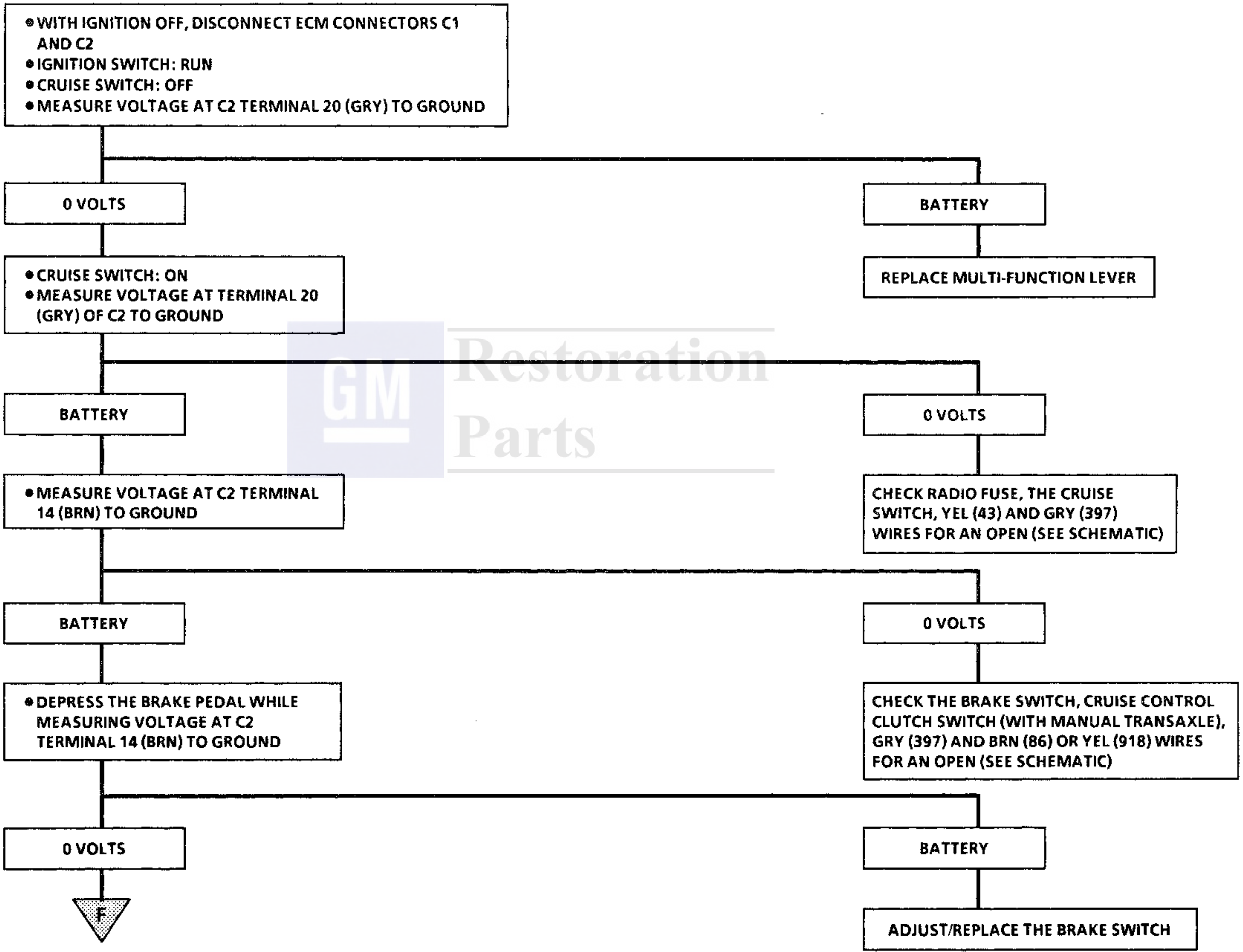
CRUISE CONTROL: K34

L4 VIN R



B: ALTERNATE CRUISE SYSTEM TEST (NO SCAN TOOL)



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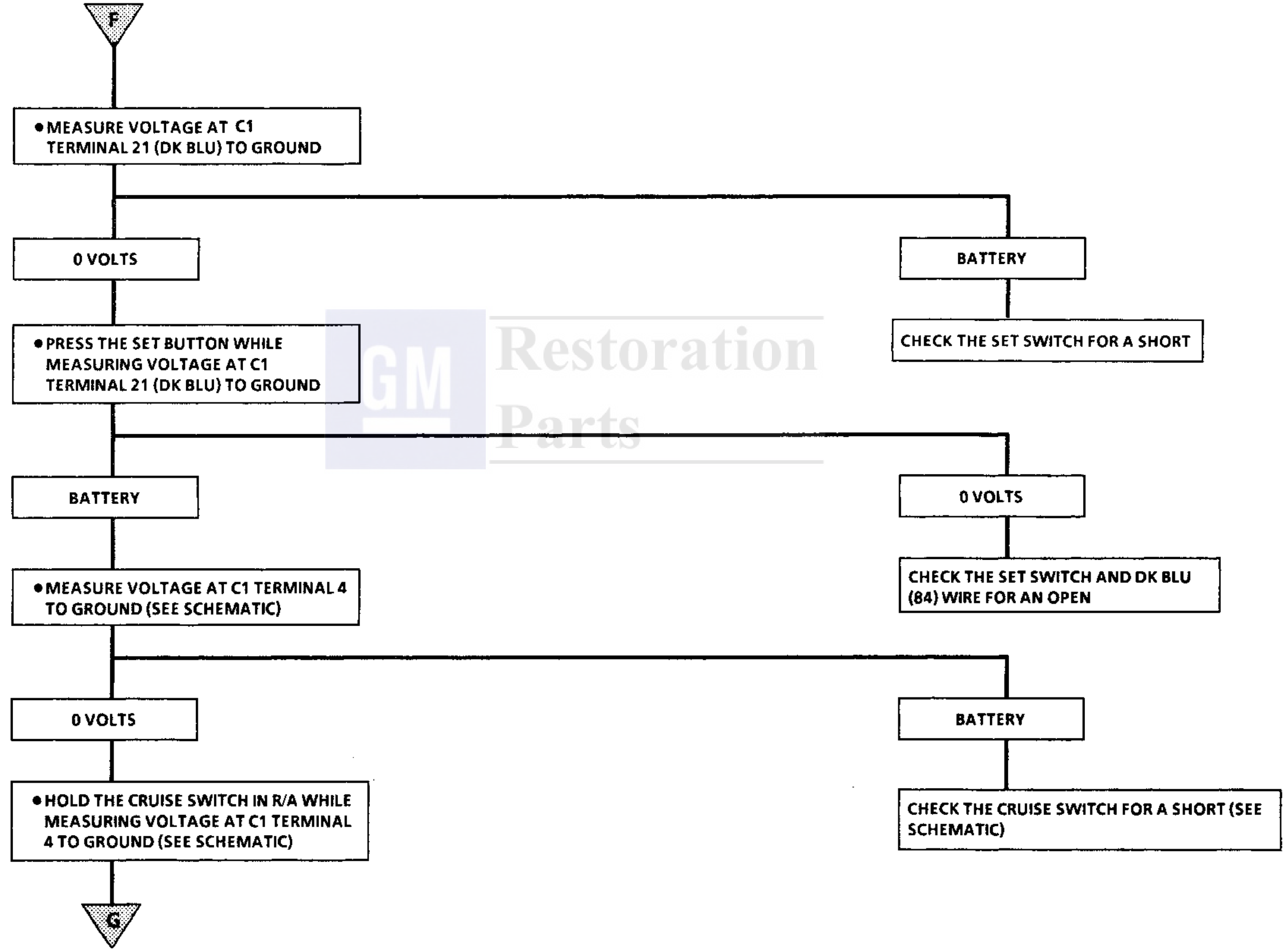
CRUISE CONTROL: K34

L4 VIN R



- MEASURE VOLTAGE AT C1 TERMINAL 21 (DK BLU) TO GROUND

0 VOLTS

- PRESS THE SET BUTTON WHILE MEASURING VOLTAGE AT C1 TERMINAL 21 (DK BLU) TO GROUND

BATTERY

- MEASURE VOLTAGE AT C1 TERMINAL 4 TO GROUND (SEE SCHEMATIC)

0 VOLTS

- HOLD THE CRUISE SWITCH IN R/A WHILE MEASURING VOLTAGE AT C1 TERMINAL 4 TO GROUND (SEE SCHEMATIC)

BATTERY

CHECK THE SET SWITCH FOR A SHORT

0 VOLTS

CHECK THE SET SWITCH AND DK BLU (84) WIRE FOR AN OPEN

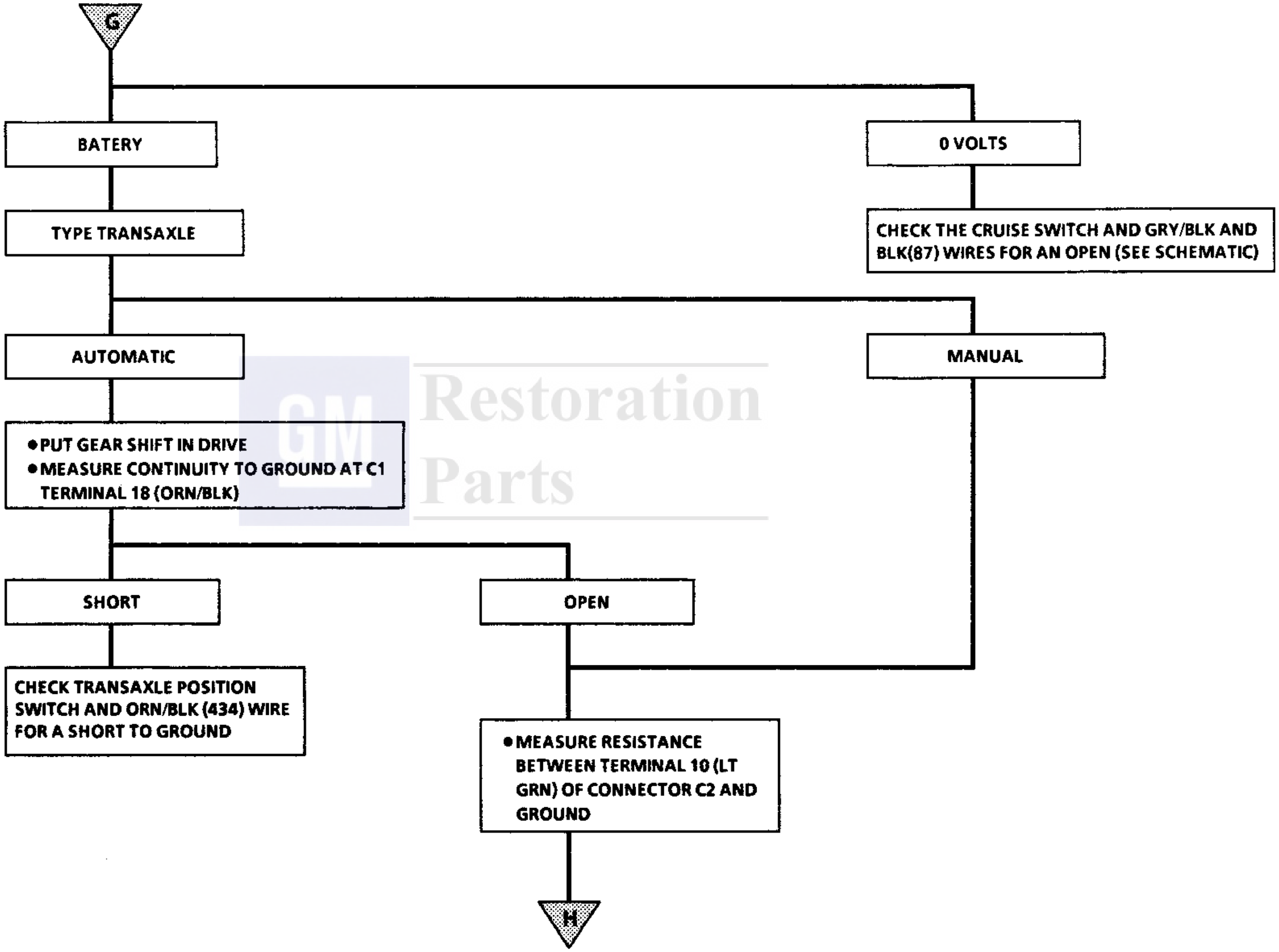
BATTERY

CHECK THE CRUISE SWITCH FOR A SHORT (SEE SCHEMATIC)

(Continued on next page)

CRUISE CONTROL: K34

L4 VIN R



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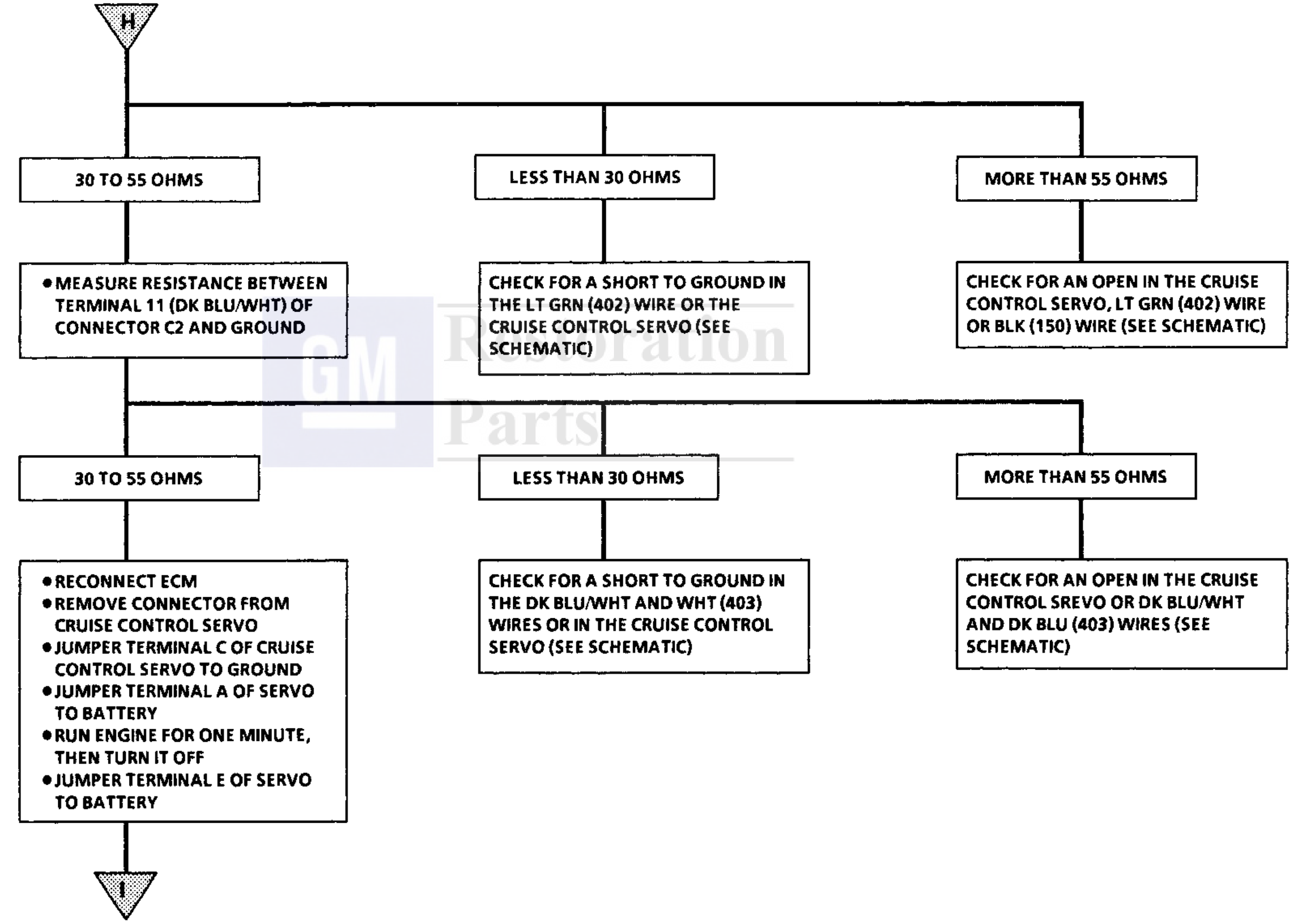
CRUISE CONTROL: K34

L4 VIN R



30 TO 55 OHMS

- MEASURE RESISTANCE BETWEEN TERMINAL 11 (DK BLU/WHT) OF CONNECTOR C2 AND GROUND

LESS THAN 30 OHMS

CHECK FOR A SHORT TO GROUND IN THE LT GRN (402) WIRE OR THE CRUISE CONTROL SERVO (SEE SCHEMATIC)

MORE THAN 55 OHMS

CHECK FOR AN OPEN IN THE CRUISE CONTROL SERVO, LT GRN (402) WIRE OR BLK (150) WIRE (SEE SCHEMATIC)

30 TO 55 OHMS

- RECONNECT ECM
- REMOVE CONNECTOR FROM CRUISE CONTROL SERVO
- JUMPER TERMINAL C OF CRUISE CONTROL SERVO TO GROUND
- JUMPER TERMINAL A OF SERVO TO BATTERY
- RUN ENGINE FOR ONE MINUTE, THEN TURN IT OFF
- JUMPER TERMINAL E OF SERVO TO BATTERY

LESS THAN 30 OHMS

CHECK FOR A SHORT TO GROUND IN THE DK BLU/WHT AND WHT (403) WIRES OR IN THE CRUISE CONTROL SERVO (SEE SCHEMATIC)

MORE THAN 55 OHMS

CHECK FOR AN OPEN IN THE CRUISE CONTROL SREVO OR DK BLU/WHT AND DK BLU (403) WIRES (SEE SCHEMATIC)

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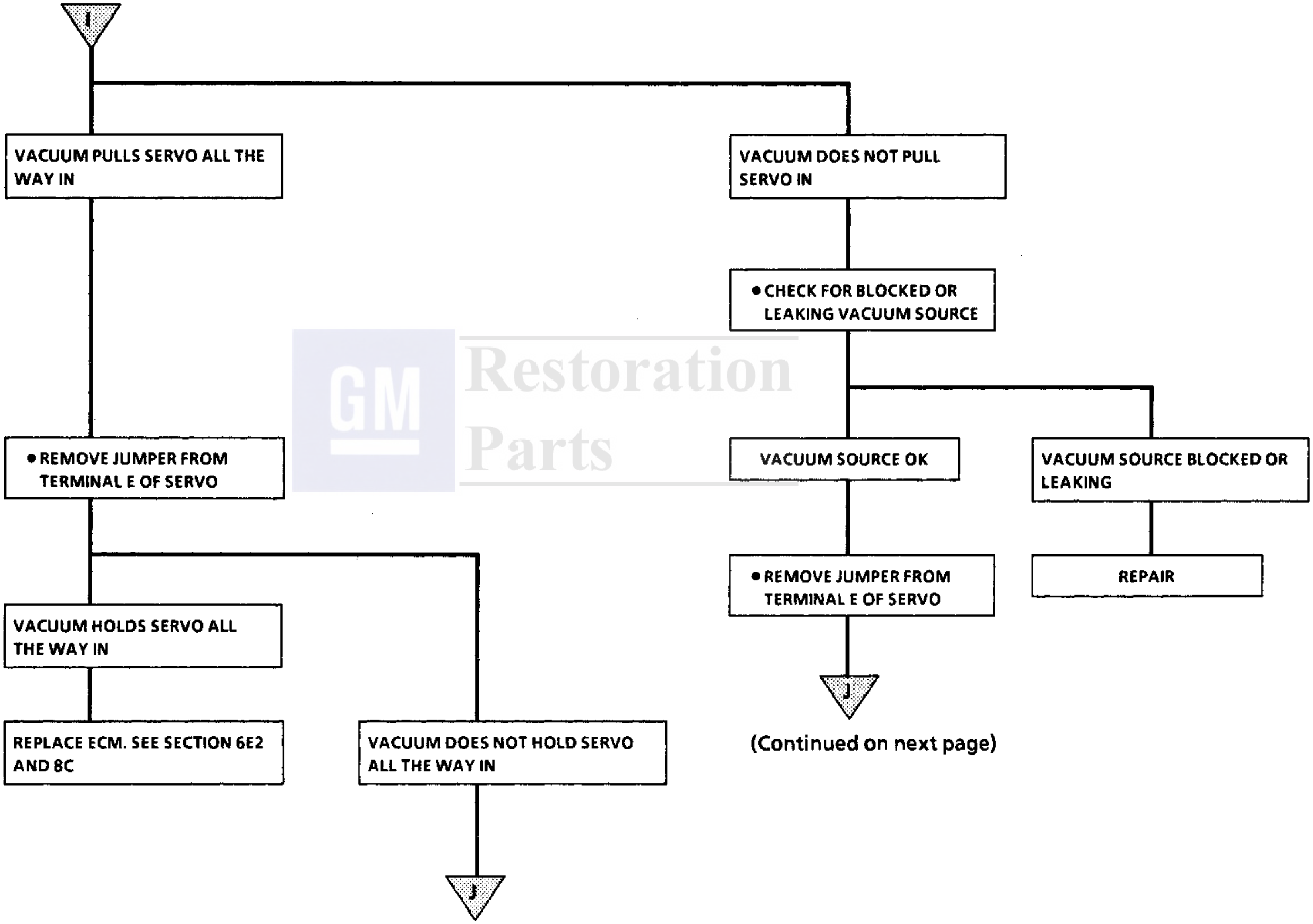

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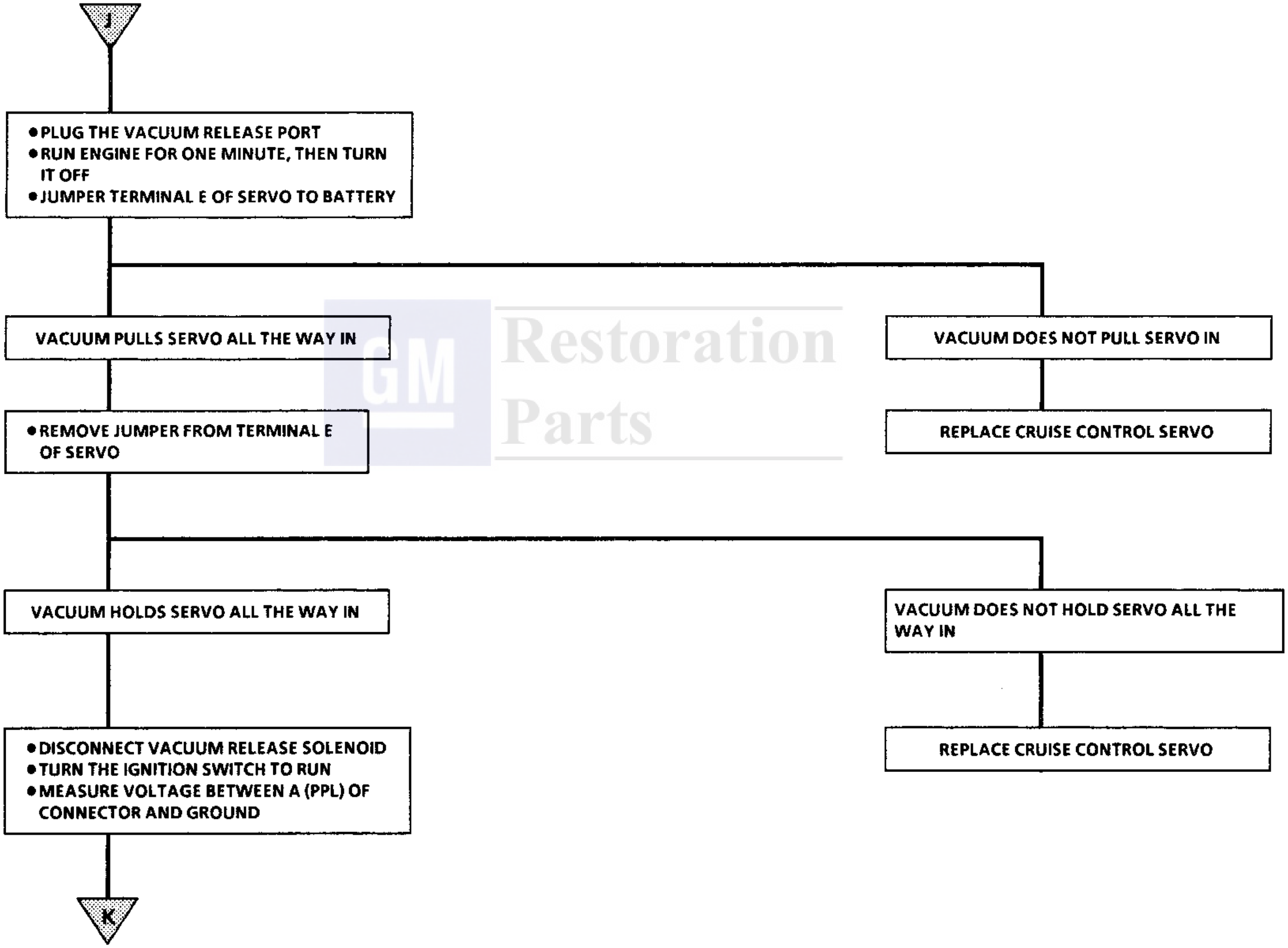
CRUISE CONTROL: K34

L4 VIN R



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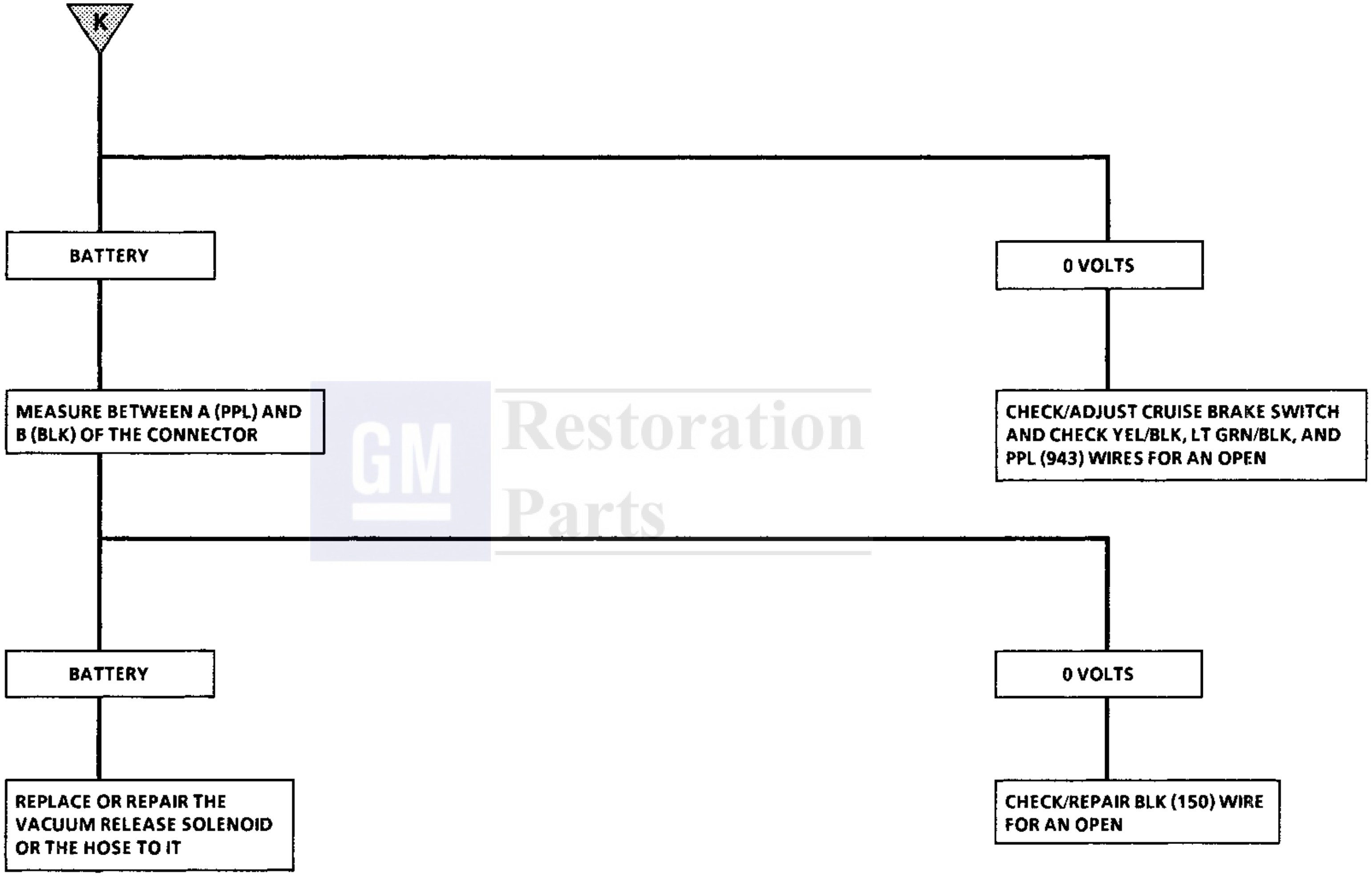
CRUISE CONTROL: K34

L4 VIN R



MEASURE BETWEEN A (PPL) AND B (BLK) OF THE CONNECTOR

CHECK/ADJUST CRUISE BRAKE SWITCH AND CHECK YEL/BLK, LT GRN/BLK, AND PPL (943) WIRES FOR AN OPEN

REPLACE OR REPAIR THE VACUUM RELEASE SOLENOID OR THE HOSE TO IT

CHECK/REPAIR BLK (150) WIRE FOR AN OPEN

CRUISE CONTROL

V6 VIN 9 AND L4 VIN R

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 (V6 VIN 9) or Electronic Control Module (L4 VIN R) 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 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 speed set. 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 Cruise Brake Switch on the brake pedal.

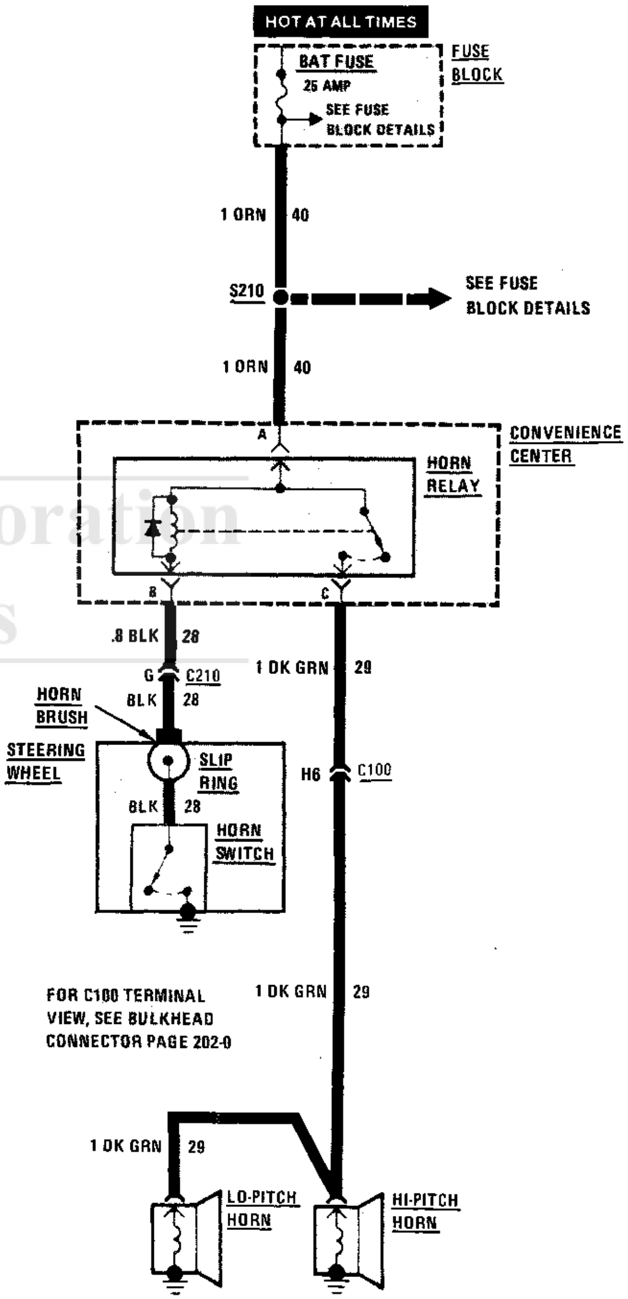
The two outputs of the Cruise Control Module operate the coils of the Vacuum Valve and the Vent Valve. Both valves are located in the Cruise Control Servo. These valves move the throttle by means of the Vacuum Motor.

With V6 VIN 9 engine, 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.

With the L4 VIN R, the Throttle Position Sensor in the Throttle Body senses the position and motion of the vacuum motor. It feeds information back to the module to provide smooth throttle changes while the vehicle is in Cruise Control.

With the L4 VIN R a number of additional safety features are included in the system. If the ECM diagnostics detect a fault with the throttle position sensor (codes 21 and 22), with the vehicle speed sensor (code 24) or with a constant check engine light that will not display a code cruise is inhibited. Cruise will also be inhibited if cruise is requested above 90 MPH; or with automatic transaxle, if the transaxle is shifted to NEUTRAL, resulting in a very rapid change in RPM; or with manual transaxle, if the engine exceeds red line RPM. NOTE: With manual transaxle, changing the transaxle speedometer gear to a new gear ratio may adversely affect cruise control in lower gears.

HORNS



HOT AT ALL TIMES
BAT FUSE
25 AMP
SEE FUSE BLOCK DETAILS
FUSE BLOCK
1 ORN 40
S210
SEE FUSE BLOCK DETAILS
1 ORN 40
A
CONVENIENCE CENTER
HORN RELAY
B
C
.8 BLK 28
G C210
BLK 28
1 DK GRN 29
HORN BRUSH
STEERING WHEEL
SLIP RING
BLK 28
HORN SWITCH
H6 C100
FOR C100 TERMINAL VIEW, SEE BULKHEAD CONNECTOR PAGE 202-0
1 DK GRN 29
1 DK GRN 29
LO-PITCH HORN
HI-PITCH HORN

HORNS

TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Diagnosis.**

1. Check the BAT Fuse by operating the Cigar Lighter.
2. Check that grounds are clean and tight.
3. If only one Horn sounds, check the DK GRN (29) wire for an open between the Horns (see schematic).

- **Go to System Diagnosis for diagnostic tests.**

SYSTEM DIAGNOSIS

- **Diagnostic steps for the symptoms listed in the following table are listed after the table.**

SYMPTOM TABLE

A. Horns sound continuously
B. None of the Horns sound

A: HORNS SOUND CONTINUOUSLY

Connect: TEST LAMP
At: CONVENIENCE CENTER
Conditions:

- **Horn Relay: REMOVED**
- **Horn Switch: OFF**

Connect Between	Correct Indication	For Diagnosis
A (ORN) & B (BLK)	Test Lamp OFF	See 1

- If the test yields the correct response, replace the Horn Relay.

1. Check BLK (28) wire and Horn Switch for a short to ground (see schematic).

COMPONENT LOCATION

		Page-Figure
Convenience Center	Behind RH side of I/P	201- 9-A
Fuse Block	Behind LH side of I/P	201- 6-D
Horn Brush	Top of steering column	
Horn Brush Slip Ring	Top of steering column, below steering wheel	
C210 (11 cavities)	Lower RH side of steering column	201- 8-B
S210	Main harness, behind RH side of I/P	201- 6-C

B: NONE OF THE HORNS SOUND

Connect: TEST LAMP
At: CONVENIENCE CENTER
Conditions:

- **Horn Relay: REMOVED**
- **Horn Switch: OFF**

Connect Between	Correct Indication	For Diagnosis
A (ORN) & Ground	Test Lamp ON	See 1
• Horn Switch: ON		
A (ORN) & B (BLK)	Test Lamp ON	See 2

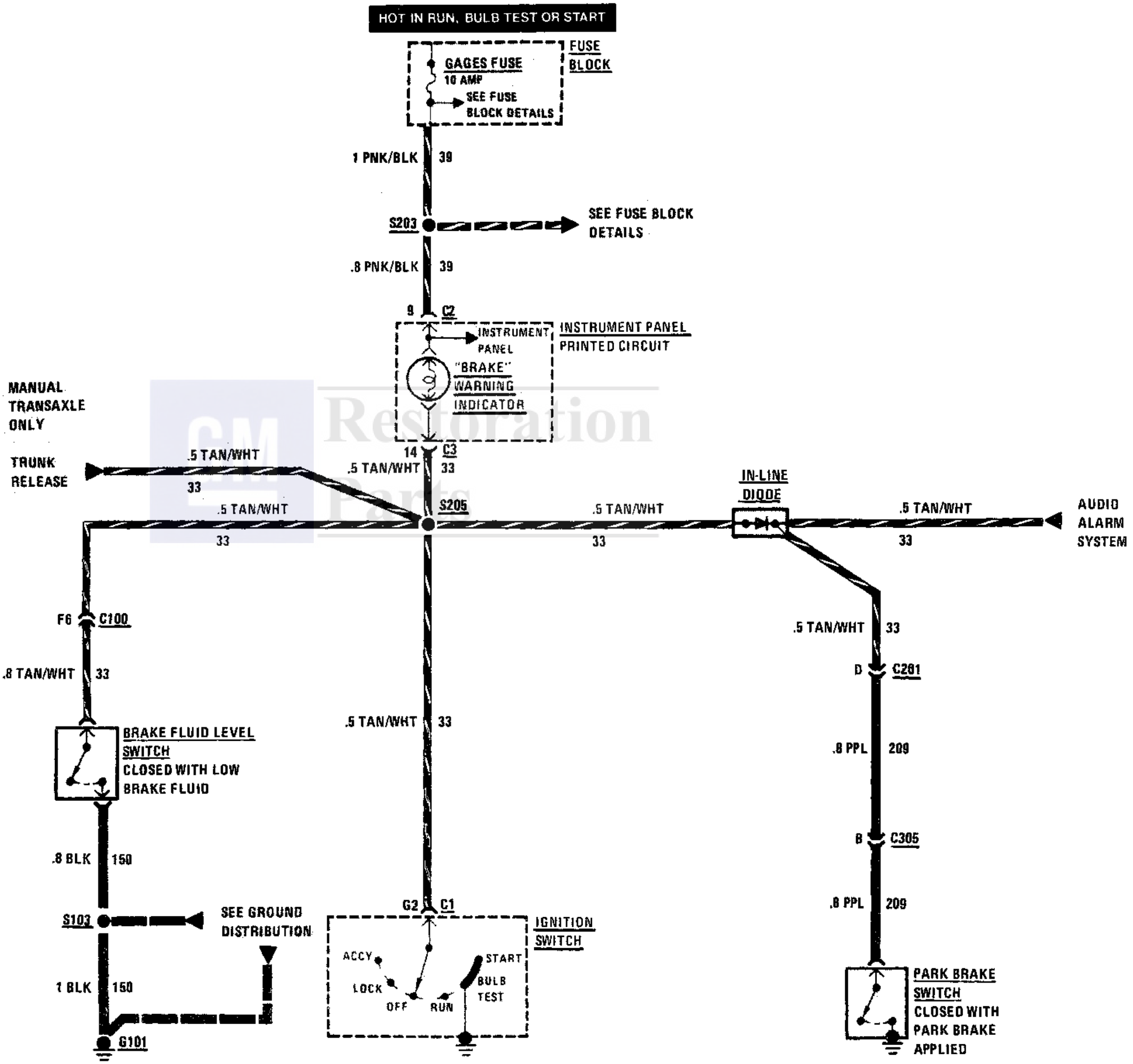
- If all the tests yield the correct results, check the Horns and the DK GRN (29) wire for an open. If OK, replace the Horn Relay (see schematic).

1. Check the ORN (40) wire for an open (see schematic).
2. Check the BLK (28) wire and the Horn Switch for an open (see schematic).

CIRCUIT OPERATION

When the Horn Switch is depressed, one side of the coil of the Horn Relay is grounded. The relay is energized. Its contacts close and battery voltage is applied to the Horns.

BRAKE WARNING SYSTEM



BRAKE WARNING SYSTEM

TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Check.**

1. Check GAGES Fuse by observing the Service Engine Soon Indicator with the Ignition Switch in RUN and engine off.
2. If brake fluid is low and the BRAKE Warning Indicator does not light, check the Brake Fluid Level Switch.
3. If the BRAKE Warning Indicator does not light and the Audio Alarm sounds with the Park Brake applied and the Ignition Switch in RUN, check the In-Line Diode.

- **Go to System Check for a guide to normal operation.**
- **Refer to System Diagnosis for diagnostic tests.**

SYSTEM CHECK

- **Use the System Check Table as a guide to normal operation.**
- **Refer to System Diagnosis for a list of symptoms and diagnostic steps.**

SYSTEM CHECK TABLE

ACTION	NORMAL RESULT
With the Park Brake released, turn the Ignition Switch slowly past the RUN position	BRAKE Warning Indicator lights
Release the Ignition Switch to the RUN position	BRAKE Warning Indicator does not light
With the Ignition Switch in RUN, apply the Park Brake	BRAKE Warning Indicator lights and Park Brake warning sounds
Release the Park Brake	BRAKE Warning Indicator does not light and Park Brake warning does not sound

(Continued in next column)

(Continued from previous column)

- **Refer to System Diagnosis when a result is not normal.**

COMPONENT LOCATION

		Page-Figure
Brake Pressure Switch	Front compartment, left of brake master cylinder	201- 9-E
Fuse Block	Behind LH side of I/P	201- 6-D
Ignition Switch	At base of steering column	201- 8-F
In-Line Diode	Behind I/P, near LH shroud	201- 8-A
Parking Brake Switch	On parking brake support	201- 9-C
C100 (34 cavities)	LH side of front bulkhead, right of brake master cylinder	201-13-A
C201 (8 cavities)	LH shroud above center access hole	201-12-C
C305 (4 cavities)	Behind dash, near LH shroud	201-13-B
G101	On LH fender, below headlamp	201-11-C
S103	Forward lamp harness, near bulkhead connector	201-10-C
S203	Main harness, above steering column	201- 7-A
S205	Main harness, above steering column	201- 7-A

SYSTEM DIAGNOSIS

- **Diagnostic steps for the symptoms listed in the following table are listed after the table.**

SYMPTOM TABLE

A. BRAKE Warning Indicator remains on with the Ignition Switch in RUN and the Park Brake OFF

B. BRAKE Warning Indicator does not light at all

C. BRAKE Warning Indicator does not light with the Park Brake applied

D. BRAKE Warning Indicator does not light with the Ignition Switch in BULB TEST

(Continued on next page)

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A: BRAKE WARNING INDICATOR REMAINS ON WITH THE IGNITION SWITCH IN RUN AND THE PARK BRAKE OFF (TABLE 1)

Separate: CONNECTOR
At: BRAKE FLUID LEVEL SWITCH
Conditions:

- **Ignition Switch: RUN**
- **Park Brake: OFF**

Action	Correct Result	For Diagnosis
Disconnect Brake Fluid Level Switch Connector	BRAKE Warning Indicator does not light	See 1

- If result is correct, refer to Section 5 of the Chassis Service Manual to test the Brake Hydraulic System. Replace the Brake Fluid Level Switch if the Brake Hydraulic System is OK.

1. Go to Table 2.

A: BRAKE WARNING INDICATOR REMAINS ON WITH THE IGNITION SWITCH IN RUN AND THE PARK BRAKE OFF (TABLE 2)

Separate: CONNECTOR
At: PARK BRAKE SWITCH
Condition:

- **Ignition Switch: RUN**

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Action	Correct Result	For Diagnosis
Disconnect Park Brake Switch Connector	BRAKE Warning Indicator does not light, Park Brake warning does not sound	See 1

- If result is correct, replace the Park Brake Switch.

1. Go to Table 3.

A: BRAKE WARNING INDICATOR REMAINS ON WITH THE IGNITION SWITCH IN RUN AND THE PARK BRAKE OFF (TABLE 3)

Measure: RESISTANCE
At: IGNITION SWITCH CONNECTOR
Condition:

- **Ignition Switch: RUN**

Connect Between	Correct Result	For Diagnosis
G2 & terminal ground	Infinite Ohms	See 1

- If result is correct, check/repair TAN/WHT (33) wires and Instrument Cluster (Printed Circuit) for shorts to ground.

1. Replace the Ignition Switch.

B: BRAKE WARNING INDICATOR DOES NOT LIGHT AT ALL

Remove the Brake Fluid Level Switch Connector and connect a fused jumper from the center terminal to ground. Turn the Ignition Switch to RUN.

- If the BRAKE Warning Indicator lights, perform tests for Symptoms C and D.
- If the BRAKE Warning Indicator does not light, check/repair the Indicator bulb, PNK/BLK (39), TAN/WHT (33) wires and the Instrument Cluster (Printed Circuit) for opens.

C: BRAKE WARNING INDICATOR DOES NOT LIGHT WITH THE PARK BRAKE APPLIED

Connect: FUSED JUMPER
At: PARK BRAKE SWITCH CONNECTOR (Disconnected)
Condition:

- **Ignition Switch: RUN**

Connect Between	Correct Result	For Diagnosis
Park Brake Switch Connector & Ground	BRAKE Warning Indicator lights, Park Brake warning sounds	See 1

- If BRAKE Warning Indicator lights, replace the Park Brake Switch.

1. Check/repair TAN/WHT (33) and PPL (209) wires for an open (see schematic).

D: BRAKE WARNING INDICATOR DOES NOT LIGHT WITH THE IGNITION SWITCH IN BULB TEST

Connect: FUSED JUMPER
At: IGNITION SWITCH CONNECTOR C1 (Connected)
Condition:

- **Ignition Switch: RUN**

Connect Between	Correct Result	For Diagnosis
G2 (TAN/WHT) & Ground	BRAKE Warning Indicator lights	See 1

- If BRAKE Warning Indicator lights, check/repair the connector terminal. Replace the Ignition Switch if the connector terminal is OK.

1. Check/repair TAN/WHT (33) wire for an open (see schematic).

CIRCUIT OPERATION

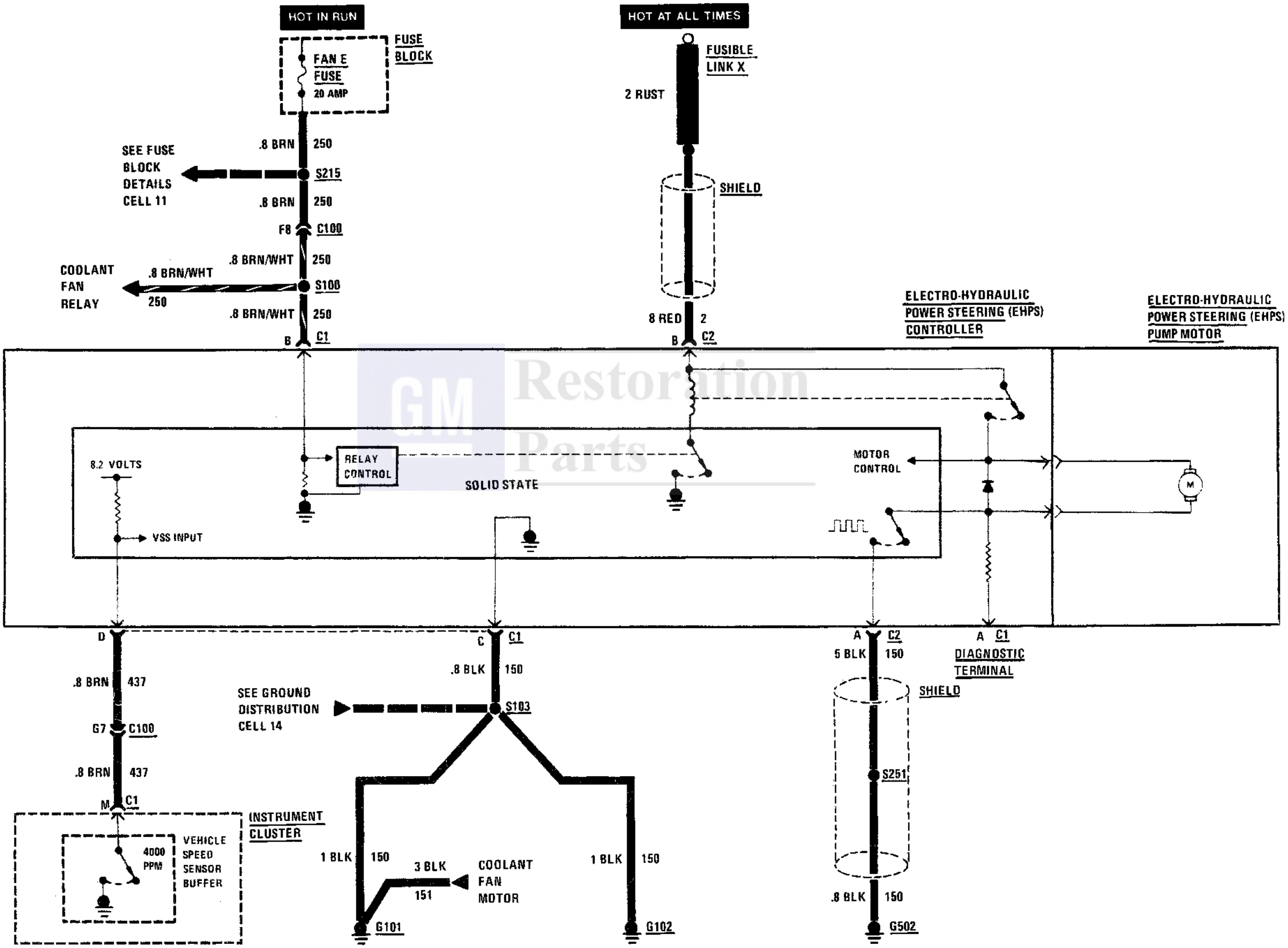
Battery voltage is applied to the BRAKE Warning Indicator when the Ignition Switch is in RUN, BULB TEST, or START. Three switches are connected to the BRAKE Warning Indicator. When any one of these Switches closes, ground is provided and the Indicator lights.

The Ignition Switch provides a ground when it is in the BULB TEST and START positions. The BRAKE Warning Indicator lights.

The Park Brake Switch provides a ground when the Park Brake is applied. The BRAKE Warning Indicator lights and the Audio Alarm sounds to alert the driver.

The Brake Fluid Level Switch closes to light the BRAKE Warning Indicator when there is low brake fluid in the hydraulic brake systems. This could be caused by a leak in one of the brake lines. The Switch can be reset to an open condition by refilling the reservoir. This can only be accomplished after the faulty system has been repaired.

ELECTRIC STEERING ASSIST



ELECTRIC STEERING ASSIST

- **For diagnosis, see Section 3.**

TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Check.**

1. Check the FAN E Fuse by observing Coolant Fan operation.
2. Verify that fluid level is correct and that proper fluid (Electro-Hydraulic Steering Fluid #9985567) is being used-refer to Section 3B3 of the Service Manual.
3. Check that ground G502 is clean and tight.
4. Verify that all EHPS Controller connections are clean and secure.

COMPONENT LOCATION

		Page-Figure
Electro-Hydraulic Power Steering (EHPS) Controller	Lower LH side of front compartment	201- 3-D
Electro-Hydraulic Power Steering (EHPS) Pump Motor	Lower LH side of front compartment	201- 3-D
Fuse Block	Behind LH side of I/P	201- 6-D
Fusible Link X	RH front of engine compartment, at Battery Junction Block	201- 4-A
C100 (34 cavities)	LH side of front bulkhead, right of brake master cylinder	201-13-A
G101	On LH fender, below headlamp	201-11-C
G102	On RH fender, below headlamp	201-11-C
G502	Engine compartment, on battery tray	201- 2-C
S100	Forward lamp harness, behind LH headlights	201-11-C
S103	Forward lamp harness, near bulkhead connector	201-10-C
S215	Main harness, behind I/P, near front of console	201-15-A

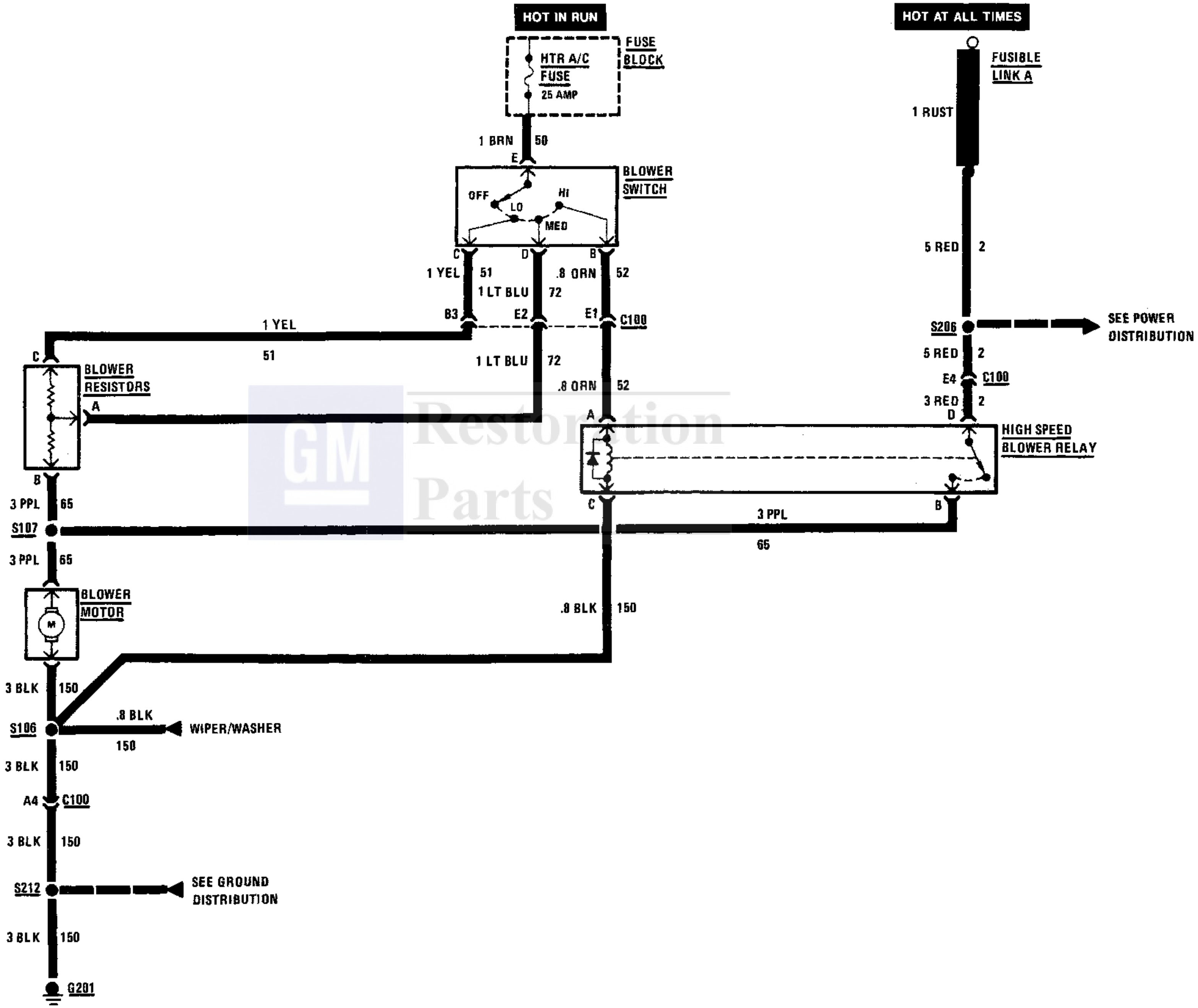
CIRCUIT OPERATION

The Electro-Hydraulic Power Steering (EHPS) System employs an electrically driven hydraulic pump to provide hydraulic power assisted steering. This eliminates the need for a belt driven hydraulic pump. The amount of power steering assistance is varied in proportion to the car's speed. At a complete stop, the available assistance is maximum. Since the pump is electrically driven, the maximum assistance is available even when the engine is stopped (Ignition still in RUN). The assistance will decrease as the vehicle speed increases; this increases road "feel" at higher speeds. At approximatley 50 mph the assistance will be minimal and the steering will be similar to manual steering.

The EHPS Controller has two voltage inputs. When the Ignition Switch is turned to RUN, voltage is applied to connector C1 terminal B. When the controller receives this voltage, it will ground the relay thereby closing the relay contacts. Voltage is then applied from Fusible Link X, through the relay contacts, to the Pump Motor, and back through the EHPS Controller to ground. The Pump Motor can then provide maximum steering assistance.

The vehicle speed input is at connector C1, terminal D. The EHPS Controller will vary the amount of voltage applied to the motor in relation to the vehicle speed. The higher the vehicle speed, the less voltage that the EHPS Controller will apply to the Pump Motor. This reduces the power of the Pump Motor, causing less power steering assistance.

HEATER: C41


HOT IN RUN
FUSE BLOCK
HTR A/C FUSE
25 AMP
1 BRN
50
E
BLOWER SWITCH
OFF
LO
HI
MED
C
D
B
1 YEL
51
1 LT BLU
72
.8 ORN
52
B3
E2
E1
C100
1 YEL
51
C
BLOWER RESISTORS
A
1 LT BLU
72
.8 ORN
52
B
3 PPL
65
S107
3 PPL
65
BLOWER MOTOR
M
3 BLK
150
S106
.8 BLK
150
WIPER/WASHER
3 BLK
150
A4
C100
3 BLK
150
S212
SEE GROUND DISTRIBUTION
3 BLK
150
G201
HOT AT ALL TIMES
FUSIBLE LINK A
1 RUST
5 RED
2
S206
SEE POWER DISTRIBUTION
5 RED
2
E4
C100
3 RED
2
D
A
HIGH SPEED BLOWER RELAY
C
B
3 PPL
65
.8 BLK
150

HEATER: C41

TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Check.**

1. If Blower Motor does not operate at all, check the HTR A/C Fuse.
2. Check ground G201 by operating the Wiper/ Washer.

- **Go to System Check for a guide to normal operation.**
- **Go to System Diagnosis for diagnostic tests.**

SYSTEM CHECK

- **Use the System Check Table as a guide to normal operation.**
- **Refer to System Diagnosis for a list of symptoms and diagnostic steps.**

SYSTEM CHECK TABLE

ACTION	NORMAL RESULT
With the Ignition Switch in RUN, set the Blower Switch to OFF	Blower Motor does not operate
Set Blower Switch to LO	Blower Motor operates at Low speed
Set Blower Switch to MED	Blower Motor operates faster at Medium speed
Set Blower Switch to HI	Blower Motor operates at High speed

- **Refer to System Diagnosis when a result is not normal.**

COMPONENT LOCATION

		Page-Figure
Blower Motor	Center of front bulkhead	201-13-A
Blower Resistors	Front compartment, lower RH side of heater-A/C module	201-13-A
Fuse Block	Behind LH side of I/P	201- 6-D
Fusible Link A	RH front of engine compartment, at Battery Junction Block	201- 4-A
High Speed Blower Relay	On RH side of heater-A/C plenum	201-13-A
C100 (34 cavities)	LH side of front bulkhead, right of brake master cylinder	201-13-A
G201	Behind center of I/P	201- 6-C
S106	Heater-A/C harness, center of front bulkhead	201-13-A
S107	Heater-A/C harness, RH side of front bulkhead	201-13-A
S206	Main harness, above LH side of steering column	201- 8-F
S212	Main harness, behind center of dash	201- 6-C

SYSTEM DIAGNOSIS

- **Do the tests listed for your symptom in the Symptom Table below.**
- **Tests follow the Symptom Table.**

SYMPTOM TABLE

SYMPTOM	FOR DIAGNOSIS
Blower Motor does not operate at all	C: Blower Motor Test
Blower Motor does not operate in HI but operates in LO and/ or MED	D: High Speed Blower Relay Test
Blower Motor does not operate in LO and/or MED, but operates in HI	A: Blower Switch Test
Blower Motor operates with the Blower Switch in OFF and the Ignition Switch in RUN	Replace the Blower Switch
Blower Motor operates in HI with the Ignition Switch OFF	Replace the High Speed Blower Relay

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A: BLOWER SWITCH TEST

Measure: VOLTAGE
At: BLOWER SWITCH CONNECTOR (Connected)
Condition:
- **Ignition Switch: RUN**

Measure Between	Correct Voltage	For Diagnosis
E (BRN) & Ground	Battery	See 1
• Blower Switch: LO		
C (YEL) & Ground	Battery	See 2
• Blower Switch: MED		
D (LT BLU) & Ground	Battery	See 2
• Blower Switch: HI		
B (ORN) & Ground	Battery	See 2

- If all results are correct, perform Test B: Blower Resistors Test.

1. Check/repair BRN (50) wire for an open (see schematic).
2. Replace Blower Switch.

B: BLOWER RESISTORS TEST

Measure: VOLTAGE
At: BLOWER RESISTORS CONNECTOR (Disconnected)
Conditions:
- **Ignition Switch: RUN**
- **Blower Switch: LO**

Measure Between	Correct Voltage	For Diagnosis
C (YEL) & Ground	Battery	See 1
• Blower Switch: MED		
A (LT BLU) & Ground	Battery	See 2
• Blower Switch: HI		
B (PPL) & Ground	Battery	See 3

- If all voltages are correct, replace the Blower Resistors.

1. Check YEL (51) wire for an open (see schematic).
2. Check LT BLU (72) wire for an open (see schematic).
3. Check PPL (65) wire for an open (see schematic).

C: BLOWER MOTOR TEST

Measure: VOLTAGE
At: BLOWER MOTOR CONNECTOR (Disconnected)
Conditions:
- **Ignition Switch: RUN**
- **Blower Switch: HI**

Measure Between	Correct Voltage	For Diagnosis
PPL (65) wire & Ground	Battery	See 1
PPL (65) wire & BLK (150) wire	Battery	See 2

- If all results are correct, replace the Blower Motor.

1. Check PPL (65) wire for an open. If wire is OK, perform Test A: Blower Switch Test.
2. Check BLK (150) wire for an open (see schematic).

D: HIGH SPEED BLOWER RELAY TEST (TABLE 1)

Measure: VOLTAGE
At: HIGH SPEED BLOWER RELAY CONNECTOR (Disconnected)
Conditions:
- **Ignition Switch: RUN**
- **Blower Switch: HI**

Measure Between	Correct Voltage	For Diagnosis
D (RED) & Ground	Battery	See 1

(Continued on next page)

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A (ORN) & Ground	Battery	See 2
A (ORN) & C (BLK)	Battery	See 3

- If all voltages are correct, go to Table 2.

1. Check RED (2) wire and Fusible Link A for an open (see schematic).
2. Check ORN (52) wire for an open. Perform Test A: Blower Switch Test if ORN (52) wire is OK.
3. Check BLK (150) wire for an open (see schematic).

D: HIGH SPEED BLOWER RELAY TEST (TABLE 2)

Connect: FUSED JUMPER
At: HIGH SPEED BLOWER RELAY CONNECTOR (Disconnected)

Jumper Between	Correct Result	For Diagnosis
D (RED) & B (PPL)	Blower Motor runs	See 1

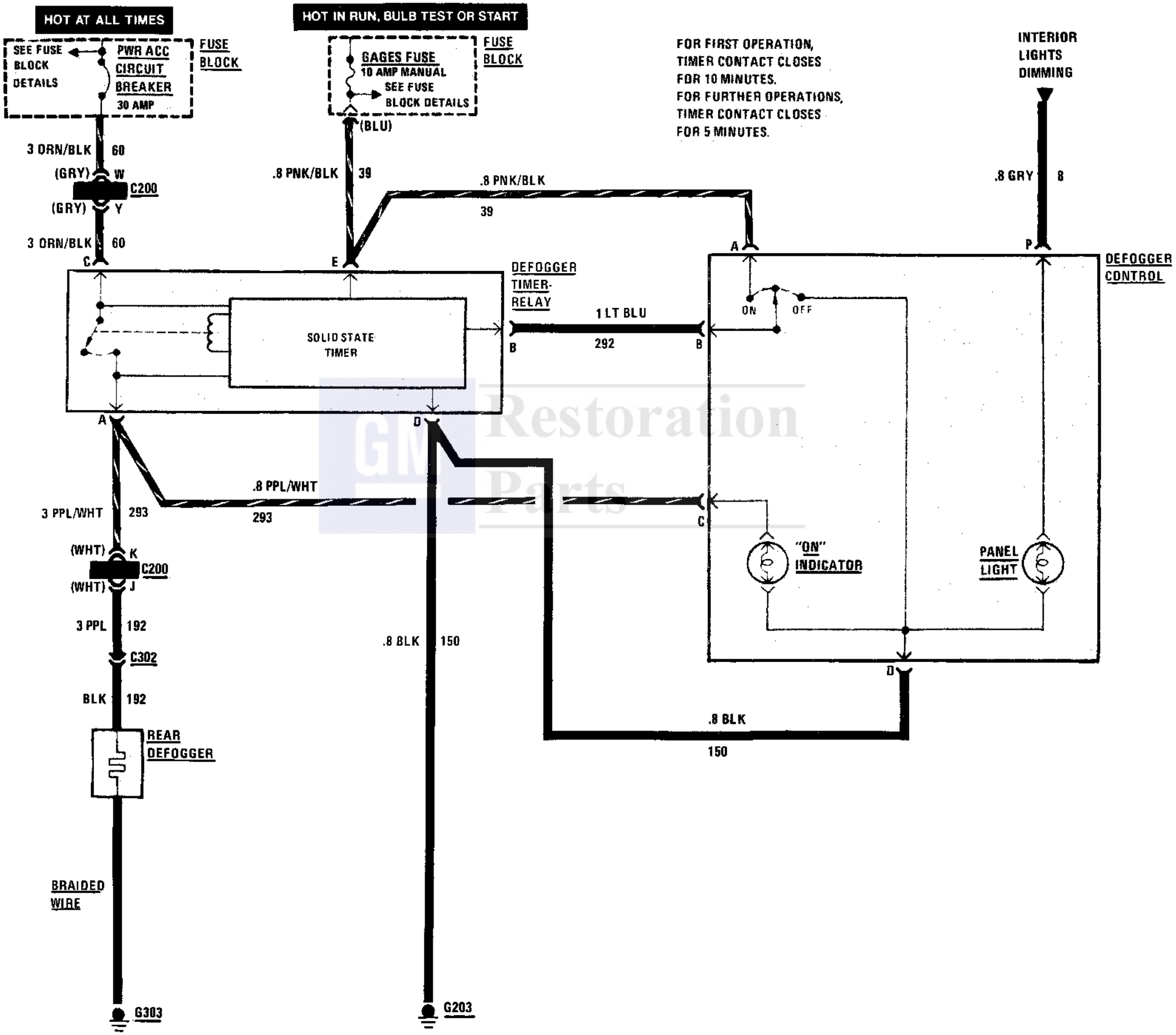
- If the result is correct, replace the High Speed Blower Relay.

1. Check PPL (65) wire for an open (see schematic).

CIRCUIT OPERATION

The Blower Motor delivers air to the interior of the vehicle. Its speed is controlled by the Blower Switch and the Blower Resistors. When the Ignition Switch is in RUN, battery voltage is applied to the Blower Switch. With the Blower Switch in LO, voltage is applied across both Blower Resistors and the Blower Motor. The Blower Motor runs at its slowest speed. With the Blower Switch in MED, one of the Blower Resistors is bypassed and the Blower Motor runs faster. When the Blower Switch is set to HI, the High Speed Blower Relay is energized. The relay contacts close and battery voltage is applied directly to the Blower Motor. The Blower Motor runs at its fastest speed.

REAR DEFOGGER: C49



FOR FIRST OPERATION, TIMER CONTACT CLOSES FOR 10 MINUTES.
FOR FURTHER OPERATIONS, TIMER CONTACT CLOSES FOR 5 MINUTES.

REAR DEFOGGER: C49

TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Check.**

1. Check the GAGES Fuse by leaving the key in the ignition, opening the driver's door, and observing that the key warning chime sounds.
2. Check the PWR ACC Circuit Breaker by operating the Power Door Locks (if equipped).
3. Check grounds G303 and G203 to make sure they are clean and tight.
4. If the symptom only involves the time that the Rear Defogger operates, replace the Defogger Timer-Relay.
5. If the problem is panel illumination, see Interior Lights Dimming, Section 8A-117.

- **Go to System Check for a guide to normal operation.**
- **Go to System Diagnosis for diagnostic tests.**

SYSTEM CHECK

- **Use the System Check Table as a guide to normal operation. Refer to the diagnosis given if other results occur.**
- **Tests follow in System Diagnosis.**

COMPONENT LOCATION

		Page-Figure
Defogger Timer Relay	On brake pedal support	201- 6-E
Fuse Block	Behind LH side of I/P	201- 6-D
C200 (16 cavities)	LH shroud ahead of center access hole	201- 6-D
C302 (1 cavity)	Near LH side of rear window	201-13-B
G203	On RH steering column support	201- 6-F
G303	On RH "B" pillar	

SYSTEM CHECK TABLE

ACTION	NORMAL RESULT	FOR DIAGNOSIS OF OTHER RESULTS
1. Turn the Ignition Switch to RUN, and depress the Defogger Control Switch	The switch button returns to the rest position, and the ON Indicator in the center of the Defogger Control lights	Do Test A
	The Defogger grid removes fog from the rear window	Do Test B Do Test C
	The ON Indicator and the Rear Defogger turn off after approximately 10 minutes	Replace the Defogger Timer-Relay
2. Depress the Defogger Control Switch again	The ON Indicator and the Rear Defogger turn on, and after approximately 5 minutes, they turn off	Replace the Defogger Timer-Relay
3. Depress the Defogger Control Switch, and immediately press the Defogger Control Switch again	The ON Indicator and the Rear Defogger turn on, and then turn off	Do Test A

- **If all results are normal, the system is OK.**

(Continued on next page)

REAR DEFOGGER: C49

SYSTEM DIAGNOSIS

- **Do the tests below when directed by the System Check.**

A: DEFOGGER TIMER-RELAY INPUT VOLTAGE TEST

Measure: VOLTAGE
At: DEFOGGER TIMER-RELAY CONNECTOR (Connected)
Condition:
- **Ignition Switch: RUN**

Measure Between	Correct Voltage	For Diagnosis
C (ORN/BLK) & Ground	Battery	See 1
E (PNK/BLK) & Ground	Battery	See 2

- If all the voltages are correct, go to Test B.

1. Check the ORN/BLK (60) wire for an open (see schematic). If the wire is OK, check the PWR ACC Circuit Breaker.
2. Check the PNK/BLK (39) wire for an open (see schematic). If the wire is OK, check the GAGES Fuse.

B: DEFOGGER TIMER-RELAY TEST

Connect: TEST LAMP
At: DEFOGGER TIMER-RELAY CONNECTOR (Connected)
Conditions:
- **Ignition Switch: RUN**
- **Defogger Control Switch: ON (Hold)**

Connect Between	Correct Result	For Diagnosis
B (LT BLU) & Ground	Lamp lights	See 3
D (BLK) & B (LT BLU)	Lamp lights	See 2
A (PPL/WHT) & Ground	Lamp lights	See 1
• Defogger Switch: OFF		
B (LT BLU) & Ground	Lamp does not light	See 4
D (BLK) & B (LT BLU)	Lamp does not light	See 4
A (PPL/WHT) & Ground	Lamp does not light	See 1

- If all the results are correct, do Test D.

1. Replace the Defogger Timer-Relay.
2. Check the BLK (150) wire for an open (see schematic). Check that ground G203 is clean and tight.
3. Check the LT BLU (292) wire for an open (see schematic). If the wire is OK, do Test C.
4. Replace the Defogger Control.

C: DEFOGGER CONTROL VOLTAGE TEST

Measure: VOLTAGE
At: DEFOGGER CONTROL CONNECTOR (Connected)
Conditions:
- **Ignition Switch: RUN**
- **Defogger Control Switch: ON (Hold)**

Measure Between	Correct Voltage	For Diagnosis
A (PNK/BLK) & Ground	Battery	See 1
B (LT BLU) & Ground	Battery	See 2
C (PPL/WHT) & Ground	Battery	See 3
D (BLK) & Ground	0 Volts	See 2

- If all the voltages are correct, and the Rear Defogger still does not operate properly, do Test D.

1. Check the PNK/BLK (39) wire for an open (see schematic). If the wire is OK, check the GAGES Fuse.
2. Replace the Defogger Control.
3. Check the PPL/WHT (293) wire for an open (see schematic).

D: REAR DEFOGGER TEST

With the Ignition Switch in RUN, and the Defogger Control Switch pressed ON, connect one lead of a test lamp to ground. From inside the car at the Rear Window Defogger, lightly touch the other lead to each grid line, and slowly move it along the length of the grid. The brilliance of the test lamp bulb should increase as the test lamp is moved from left (passenger's side) to right (driver's side).

- If the test lamp does not light along any one of the grid lines, check PPL/WHT (293) and PPL (192) wires to the Defogger Timer-Relay for an open (see schematic). If OK, do Test E.
- If the test lamp bulb shows full brilliance at both ends of the grid, check the braided wire for an open to ground (see schematic).
- If the test lamp suddenly lights as it is moved along the grid, a break in the continuity of the grid line exists. Refer to the GM Body Service Manual for grid line repair procedure.

E: DEFOGGER LAMP TEST

Connect: TEST LAMP
At: REAR DEFOGGER CONNECTOR C302 (Connected)
Conditions:
- **Ignition Switch: RUN**
- **Defogger Control Switch: ON**

Connect Between	Correct Result	For Diagnosis
C302 (PPL) & Ground	Lamp lights	See 1
C302 (PPL) & G303 Braided Wire	Lamp lights	See 2

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- If all the results are correct, refer to the GM Body Service Manual, Section 2, for grid line repair.

1. Do Test B.
2. Check the braided wire for an open. Check that ground G303 is clean and tight (see schematic).

CIRCUIT OPERATION

With the Ignition Switch in RUN, voltage is applied to the Defogger Control.

When the Defogger Control Switch is pressed ON, voltage is then applied to the Defogger Timer-Relay. The contact closes, which provides voltage to the ON Indicator and the Rear 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 until the timer cycle is complete.

The first time the Defogger Control Switch is pushed in, the Defogger Timer-Relay will allow the Rear Defogger to operate for approximately 10 minutes. Each time after the Defogger Control Switch is pushed in, the Defogger Timer-Relay will reset to operate for approximately 5 minutes. The Defogger Timer-Relay will reset to 10 minutes when the Ignition Switch is turned OFF and then back to the RUN position.

The timer also shuts off at any time when the Defogger Control On-Off Switch is depressed OFF. In order to reset the Defogger Timer-Relay for the initial 10 minute time interval, the Ignition Switch must be turned OFF and then back to the RUN position before activating the Rear Defogger.

AIR CONDITIONING: SYSTEM CHECK

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.

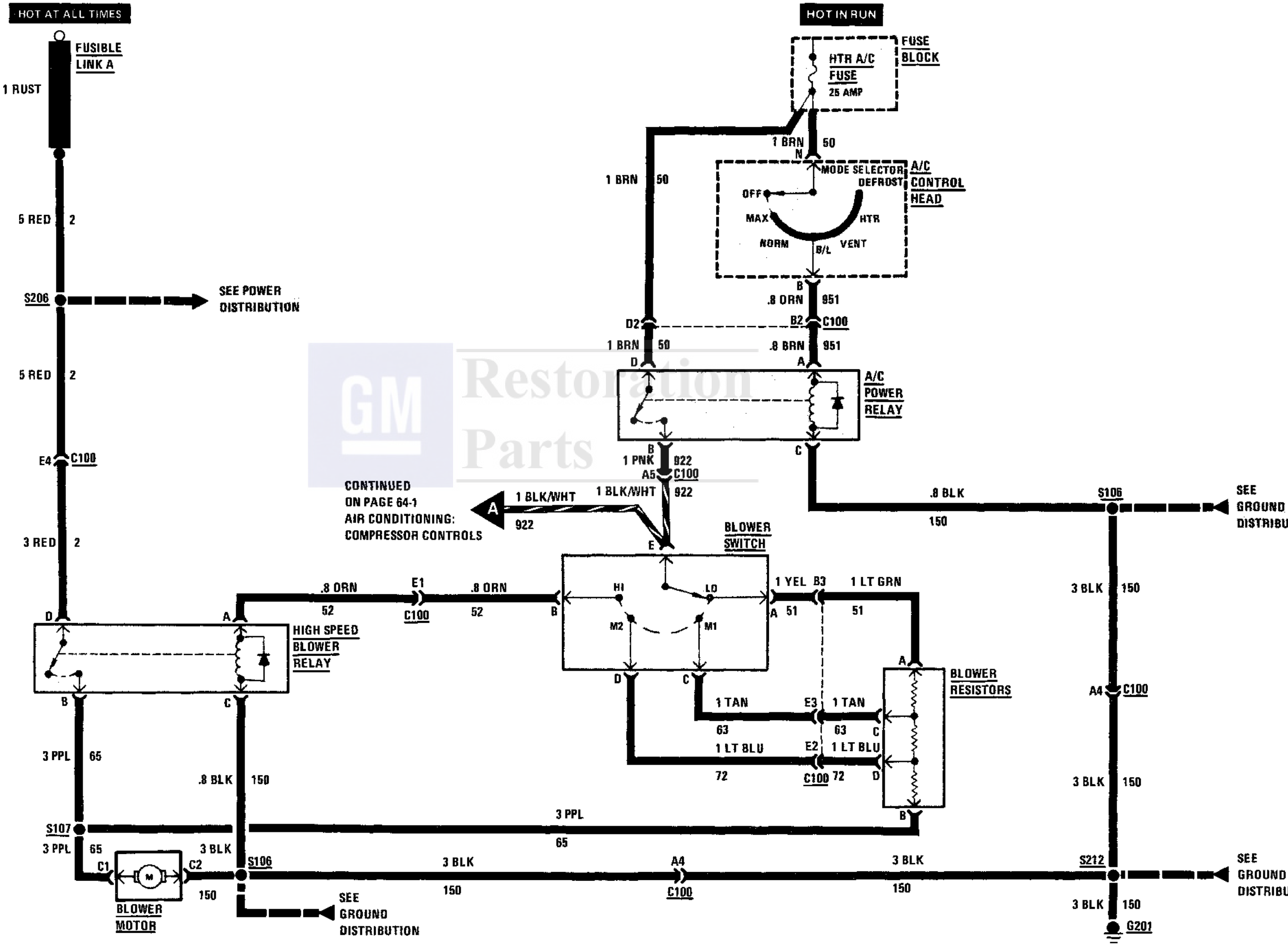
Complete this procedure with the temperature outside the car above 60 °F (16 °C) and with the engine running at idle.

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-65 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-65 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-65 Air Delivery 8A-64 Compressor Controls
6. VENT Temperature Lever at COLD	• Air at outside temperature flows from Instrument Panel outlets. • Compressor does not run.	8A-65 Air Delivery 8A-64 Compressor Controls
7. BI-LEVEL	• Air flows from Instrument Panel and floor outlets with slight air flow at windshield. • Compressor turns on. • Engine coolant fan may run. • Air flow becomes cold.	8A-65 Air Delivery 8A-64 Compressor Controls 8A-31 Coolant Fans 8A-64 Compressor Controls
8. NORMAL	• Air flows from Instrument Panel outlets with slight air flow at floor. • Compressor continues to run.	8A-65 Air Delivery 8A-64 Compressor Controls
9. MAX	• Blower noise increases as outside air door closes.	8A-65 Air Delivery
10. OFF	• Blower and Compressor turn off.	8A-63 Blower Controls 8A-64 Compressor Controls

BLANK

AIR CONDITIONING: BLOWER CONTROLS

C60, MANUAL



AIR CONDITIONING: BLOWER CONTROLS

C60, MANUAL

TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Diagnosis.**

1. Check the HTR A/C Fuse by visual inspection.
2. Check that ground G201 is clean and tight.
3. Check that Blower Motor connectors and Blower Relay are mated correctly and firmly seated.

- **Go to the A/C System Check in 8A-62 for a guide to normal operation of the entire A/C System.**
- **Go to System Diagnosis for diagnostic tests of Blower Controls.**

SYSTEM DIAGNOSIS

- **Do the tests listed for your symptom in the Symptom Table below.**
- **Tests follow the Symptom Table.**

SYMPTOM TABLE

SYMPTOM	FOR DIAGNOSIS
Blower runs all the time with Ignition OFF	Replace High Speed Blower Relay
Blower runs all the time with Ignition in RUN	Do Test E
Blower will not run in any mode	Do Test A Do Test E Do Test F
No low speed operation	Do Test C
No high speed operation	Do Test B Do Test D
High speed operation only	Do Test B Do Test D
None of the above	Do Tests A, B, C, D and E

COMPONENT LOCATION

		Page-Figure
A/C Power Relay	Front compartment, on RH side of heater-A/C module	201-11-B
Blower Motor	Center of front bulkhead	201-13-A
Blower Resistors	Front compartment, lower RH side of heater-A/C module	201-13-A
Fuse Block	Behind LH side of I/P	201- 6-D
Fusible Link A	RH front of engine compartment, at Battery Junction Block	201- 4-A
High Speed Blower Relay	On RH side of heater-A/C plenum	201-13-A
C100 (34 cavities)	LH side of front bulkhead, right of brake master cylinder	201-13-A
G201	Behind center of I/P	201- 6-C
S106	Heater-A/C harness, center of front bulkhead	201-13-A
S107	Heater-A/C harness, RH side of front bulkhead	201-13-A
S206	Main harness, above LH side of steering column	201- 8-F
S212	Main harness, behind center of dash	201- 6-C

A: BLOWER MOTOR TEST

Measure: VOLTAGE
At: BLOWER MOTOR CONNECTOR (Disconnected)
Conditions:

- **Ignition Switch: RUN**
- **A/C Mode: VENT**
- **Blower Switch: HI**

(Continued on next page)

AIR CONDITIONING: BLOWER CONTROLS

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Measure Between	Correct Voltage	For Diagnosis
C1 (PPL) & Ground	Battery	See 1
C1 (PPL) & C2 (BLK)	Battery	See 2

- If the voltages are correct but the blower does not run, install a new Blower Motor.

1. Check the PPL (65) wire for an open. If wire is good, do Test B and Test D.
2. Check the BLK (150) wire for an open and that ground G201 is clean and tight.

B: HIGH SPEED BLOWER RELAY TEST (TABLE 1)

Measure: VOLTAGE
At: HIGH SPEED BLOWER RELAY CONNECTOR (Disconnected)
Conditions:

- **Ignition Switch: RUN**
- **A/C Mode: VENT**
- **Blower Switch: HI**

Measure Between	Correct Voltage	For Diagnosis
D (RED) & Ground	Battery	See 1
A (ORN) & Ground	Battery	See 2

- If voltages are correct, proceed to Table 2.

1. Check RED (2) wire for an open back to Fusible Link A.
2. Check ORN (52) wire for an open. If wire is good, do Test D.

B: HIGH SPEED BLOWER RELAY TEST (TABLE 2)

Measure: RESISTANCE
At: HIGH SPEED BLOWER RELAY CONNECTOR (Disconnected)
Conditions:

- **Ignition Switch: OFF**
- **Negative Battery Terminal: DISCONNECTED**

Measure Between	Correct Resistance	For Diagnosis
C (BLK) & Ground	0 ohms	See 1
B (PPL) & Ground	Less than 3 ohms	See 2

- If voltages in Table 1 and resistances in Table 2 are correct, but Blower Relay does not operate, replace the Blower Relay.

1. Check the BLK (150) wire for an open.
2. Check the PPL (65) wire for an open. If wire is good, recheck measurements made in Test A.

C: BLOWER RESISTORS TEST

Measure: RESISTANCE
At: BLOWER RESISTORS (Disconnected)
Condition:

- **Ignition Switch: OFF**

Measure Between	Correct Resistance	For Diagnosis
A & C	1.5 ± .5 ohm	See 1
C & D	0.7 ± .5 ohm	See 1
D & B	0.2 ± .1 ohm	See 1

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- If resistances are correct, Blower Resistors are operating normally. If Blower does not operate in LO, M1 or M2, but does operate in HI, check for an open in the PPL (65) wire between Blower Resistors Terminal B and S107.

1. Install new Blower Resistors.

D: BLOWER SWITCH TEST (TABLE 1)

Measure: VOLTAGE
At: BLOWER RESISTORS CONNECTOR (Disconnected)
Conditions:

- **Ignition Switch: RUN**
- **A/C Mode: VENT**
- **Blower Switch: LO**

Measure Between	Correct Voltage	For Diagnosis
A (LT GRN) & Ground	Battery	See 1 & 5
C (TAN) & Ground	0 Volts	See 2
• Blower Switch: M1		
C (TAN) & Ground	Battery	See 3 & 5
D (LT BLU) & Ground	0 Volts	See 2
• Blower Switch: M2		
D (LT BLU) & Ground	Battery	See 4 & 5

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AIR CONDITIONING: BLOWER CONTROLS

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(Continued from previous page)

- If all voltages are correct, go to Table 2.

1. Check LT GRN (51) wire for an open.
2. If battery voltage is present, check for a wire to wire short to voltage (see schematic). If wire is good, replace the Blower Switch.
3. Check TAN (63) wire for an open.
4. Check LT BLU (72) wire for an open.
5. If voltage is not present at any of the terminals A, C, or D, check the PNK and BLK/WHT (922) wire for an open between the A/C Power Relay Terminal B and the Blower Switch Terminal E. If wire is good, do Test E. If voltage is missing from only one or two terminals, replace the Blower Switch.

D: BLOWER SWITCH TEST (TABLE 2)

Measure: VOLTAGE
At: HIGH SPEED BLOWER RELAY CONNECTOR (Disconnected)
Conditions:
- **Ignition Switch: RUN**
- **A/C Mode: VENT**
- **Blower Switch: M2**

Measure Between	Correct Voltage	For Diagnosis
A (ORN) & Ground	0 Volts	See 1
• Blower Switch: HI		
A (ORN) & Ground	Battery	See 2

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- If voltages are correct, Blower Switch is operating normally. Return to Symptom Table.

1. If voltage is present, check ORN (52) wire for a wire to wire short to voltage. If wire is good, replace Blower Switch.
2. Check ORN (52) wire for an open. If wire is good, replace Blower Switch.

E: A/C POWER RELAY TEST

Measure: VOLTAGE
At: A/C POWER RELAY CONNECTOR (Disconnected)
Conditions:
- **Ignition Switch: RUN**
- **A/C Mode: VENT**
- **Blower Switch: LO, M1 or M2**

Measure Between	Correct Voltage	For Diagnosis
D (BRN) & Ground	Battery	See 1
A (BRN) & Ground	Battery	See 2
A (BRN) & C (BLK)	Battery	See 3
E (BRN) & B (PNK)	Battery	See 4

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- If all voltages are correct but Blower will not operate in any mode or it runs when A/C mode is OFF, replace the A/C Power Relay.

1. Check HTR A/C Fuse and BRN (50) wire for an open.
2. Check for an open in the BRN and ORN (951) wires. If wires are good, do Test F.
3. Check for an open in the BLK (150) wire.
4. Check for an open in the PNK and BLK/WHT (922) wires. If wires are good, do Test D.

F: A/C MODE SELECTOR TEST

Measure: VOLTAGE
At: A/C CONTROL HEAD CONNECTOR (Connected)
Conditions:
- **Ignition Switch: RUN**
- **A/C Mode: OFF**

Measure Between	Correct Voltage	For Diagnosis
N (BRN) & Ground	Battery	See 1
B (ORN) & Ground	0 Volts	See 2
• A/C Mode: All positions except OFF		
B (ORN) & Ground	Battery	See 2

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- If all voltages are correct, A/C Mode Selector is operating normally. Return to Symptom Table.

1. Check BRN (50) wire for an open back to HTR A/C Fuse.
2. Replace A/C Control Head.
3. If battery voltage is present at Terminal N but is not present at Terminal B, replace the A/C Control Head.

CIRCUIT OPERATION

The Blower Motor is a variable speed Motor, which runs at a speed proportional to the applied voltage. The higher the voltage applied to the Motor, the faster the speed.

When the Ignition Switch is in the RUN position, battery voltage is applied to the A/C Control Head through the HTR A/C Fuse. With the Mode Selector in the OFF position, no voltage is supplied to the A/C Power Relay coil and its contacts remain open. In any other mode the relay is energized and its contacts close providing voltage to the Blower Switch.

With the Blower Switch in the LO position, voltage is applied through all three Blower Resistors to the Blower Motor. The blower runs at low speed.

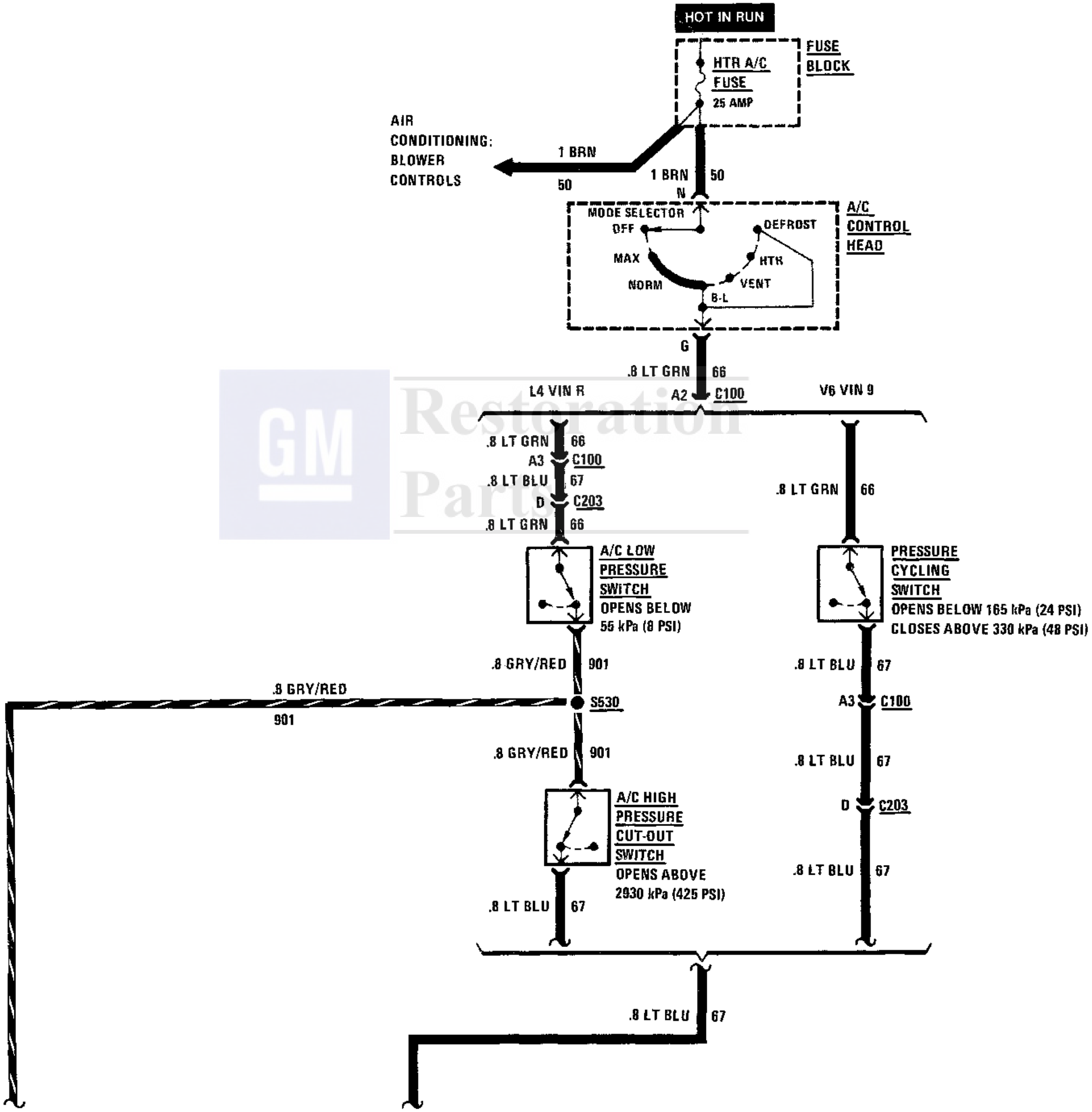
As the Blower Switch is moved through positions M1 and M2, the switch bypasses part of the Blower Resistors. This allows more voltage to be applied to the Blower Motor which will increase its speed.

When the Blower Switch is in the HI position, voltage is applied through the ORN (52) wire to the coil of the High Speed Blower Relay. The High Speed Blower Relay operates, applying battery voltage directly to the Blower Motor. The Motor runs at maximum speed.

ANK

AIR CONDITIONING: COMPRESSOR CONTROLS

C60, MANUAL



AIR CONDITIONING: COMPRESSOR CONTROLS

C60, MANUAL

TROUBLESHOOTING HINTS

- **Try the following check before doing the System Diagnosis.**

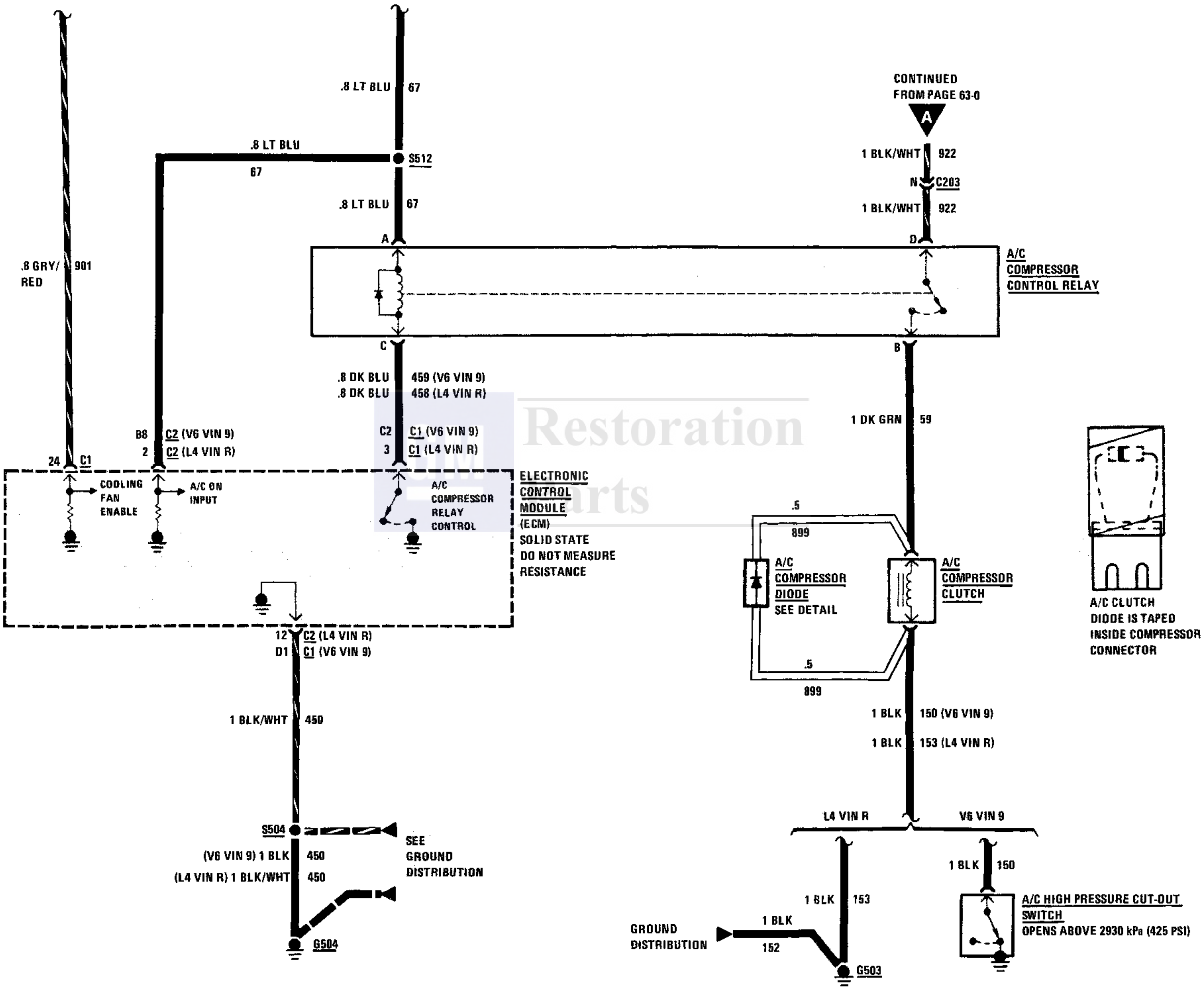
  Check the HTR A/C Fuse.
- **Go to System Check for a guide to normal operation.**
- **Go to System Diagnosis for diagnostic tests.**

SYSTEM CHECK

- **Go to A/C System Check in 8A-62 for a guide to normal operation of the A/C System.**
- **Use the System Check Table on next page as a guide to normal operation.**
- **Refer to System Diagnosis for a list of symptoms and diagnostic steps.**

COMPONENT LOCATION

		Page-Figure
A/C Compressor Clutch	Lower RH front of engine	201- 2-A
A/C Compressor Control Relay	Engine compartment, LH side of rear bulkhead	201- 5-D
A/C Compressor Diode	Taped inside compressor clutch connector	201- 2-A
A/C High Pressure Cut-Out Switch	RH front of engine, LH end of A/C compressor	201- 4-D
A/C Low Pressure Switch	RH front of engine, LH end of A/C compressor	201- 2-A
Electronic Control Module (ECM)	Between seats, on front of rear bulkhead	201- 5-B
Fuse Block	Behind LH side of I/P	201- 6-D
Pressure Cycling Switch	Front compartment, on accumulator	201-11-B
C100 (34 cavities)	LH side of front bulkhead, right of brake master cylinder	201-13-A
C203 (15 cavities)	Between seats, in front of rear bulkhead	201- 5-A
G503 (VIN R)	LH rear of engine, above transaxle	201- 2-B
G504 (VIN 9)	LH top of engine, below throttle body	201- 3-A
G504 (VIN R)	Top LH front of engine, above Starter Solenoid	201- 2-A
S504	Engine harness, under rear console	201- 5-A
S512 (VIN 9)	Engine harness, center of rear bulkhead, in engine compartment	201- 5-B
S512 (VIN R)	Engine harness, under rear console	201- 5-A
S530	Engine harness, RH front of engine	201- 2-A


.8 GRY/ RED
901
24
C1
COOLING FAN ENABLE
.8 LT BLU
67
B8
C2 (V6 VIN 9)
2
C2 (L4 VIN R)
A/C ON INPUT
.8 LT BLU
67
S512
.8 LT BLU
67
A
C
.8 DK BLU
459 (V6 VIN 9)
.8 DK BLU
458 (L4 VIN R)
C2
C1 (V6 VIN 9)
3
C1 (L4 VIN R)
A/C COMPRESSOR RELAY CONTROL
ELECTRONIC CONTROL MODULE (ECM)
SOLID STATE DO NOT MEASURE RESISTANCE
12
C2 (L4 VIN R)
D1
C1 (V6 VIN 9)
1 BLK/WHT
450
S504
SEE GROUND DISTRIBUTION
(V6 VIN 9) 1 BLK
450
(L4 VIN R) 1 BLK/WHT
450
G504
CONTINUED FROM PAGE 63-0
A
1 BLK/WHT
922
N
C203
1 BLK/WHT
922
D
A/C COMPRESSOR CONTROL RELAY
B
1 DK GRN
59
.5
899
A/C COMPRESSOR DIODE
SEE DETAIL
A/C COMPRESSOR CLUTCH
.5
899
A/C CLUTCH DIODE IS TAPED INSIDE COMPRESSOR CONNECTOR
1 BLK
150 (V6 VIN 9)
1 BLK
153 (L4 VIN R)
L4 VIN R
V6 VIN 9
1 BLK
153
1 BLK
150
GROUND DISTRIBUTION
1 BLK
152
G503
A/C HIGH PRESSURE CUT-OUT SWITCH
OPENS ABOVE 2930 kPa (425 PSI)

AIR CONDITIONING: COMPRESSOR CONTROLS

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SYSTEM CHECK TABLE

ACTION	NORMAL RESULT
1. Turn Ignition Switch to RUN and start engine Move A/C Mode Selector to OFF then to MAX	A click can be heard when the clutch engages
2. Move A/C Mode Selector between OFF and MAX several times	Verify that clutch engages in MAX position Clutch plate movement can be seen on the front of the compressor pulley If clutch does not engage, go to step 4 If clutch operates normally, continue to step 3
3. Put A/C Mode Selector in MAX to engage clutch	Engine Coolant Fan runs when Compressor is engaged Air moves freely through condenser Feel the suction (cold) and output (warm) pipes of the Compressor If there is not a wide temperature difference after the Compressor has run for several seconds, see Section 1B for Refrigerant and Compressor diagnostics
4. Turn off Ignition Switch and check refrigerant pressure at the low side service fitting	If pressure is less than 207 kPa (30 psi), refer to Section 1B for refrigerant diagnostics If refrigerant pressure is higher than 207 kPa (30 psi), isolate trouble conditions using procedures in System Diagnosis

- **Refer to System Diagnosis when a result is not normal.**

SYSTEM DIAGNOSIS

L4 VIN R

- **Use the Isolation Tests below to choose the proper diagnostic test.**

ISOLATION TEST (TABLE 1)

Measure: VOLTAGE
At: A/C COMPRESSOR CONTROL RELAY CONNECTOR (Disconnected)
Conditions:
- **Ignition Switch: RUN (Engine need not be running)**
- **A/C Mode: NORM**
- **Temperature Outside Car: ABOVE 60°F (16°C)**

Measure Between	Correct Voltage	For Diagnosis
D (BLK/WHT) & Ground	Battery	See 1
A (LT BLU) & Ground	Battery	See 2

- If both voltages are correct, leave A/C Compressor Control Relay disconnected and go to Table 2.

1. Check BLK/WHT (922) wire for an open.
2. Do Test C.

(Continued on next page)

AIR CONDITIONING: COMPRESSOR CONTROLS

C60, MANUAL

(Continued from previous page)

ISOLATION TEST (TABLE 2)

Connect: FUSED JUMPER
At: A/C COMPRESSOR CONTROL RELAY CONNECTOR (Disconnected)
Conditions:

- **Ignition Switch: RUN (Engine not running)**
- **A/C Mode: NORM**
- **Temperature Outside Car: ABOVE 60°F (16°C)**

Jumper Between	Correct Result	For Diagnosis
D (BLK/ WHT) & B (DK GRN)	Clutch engages	See 1

- If the result is correct, do Test A.

1. Do Test B.

A: ECM COMPRESSOR CONTROL TEST (TABLE 1)

Measure: VOLTAGE
At: ECM CONNECTORS C1 & C2 (Disconnected)
Conditions:

- **Ignition Switch: RUN (Engine not running).**
- **A/C Mode: NORM**
- **Temperature Outside Car: ABOVE 60°F (16°C)**
- **A/C Compressor Control Relay: CONNECTED**

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Measure Between	Correct Voltage	For Diagnosis
C2/24 (GRY/RED) & Ground	Battery	See 1
C1/2 (LT BLU) & Ground	Battery	See 2
C2/3 (DK BLU) & Ground	Battery	See 3

- If all voltages are correct, go to Table 2.

1. Check for an open in the GRY/RED (901) wire.
2. Check for an open in the LT BLU (67) wire.
3. Check for an open in the DK BLU (458) wire. If wire is good, replace the A/C Compressor Control Relay.

A: ECM COMPRESSOR CONTROL TEST (TABLE 2)

Connect: FUSED JUMPER
At: ECM CONNECTOR C2 (Disconnected)
Conditions:

- **Ignition Switch: RUN (Engine not running)**
- **A/C Mode: NORM**
- **Temperature Outside Car: ABOVE 60°F (16°C)**

(Continued in next column)

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Jumper Between	Correct Result	For Diagnosis
3 (DK BLU) & Ground	A/C Compressor Control Relay operates and clutch engages	See 1

- If the result is correct, but A/C System does not operate normally, condition is due to the ECM. Refer to Section 6E for ECM diagnostic procedures.

1. Replace A/C Compressor Control Relay.

B: A/C COMPRESSOR CLUTCH TEST

Measure: VOLTAGE
At: A/C COMPRESSOR CLUTCH CONNECTOR (Disconnected)
Conditions:

- **Ignition Switch: RUN (Engine not running)**
- **A/C Mode: NORM**
- **A/C Compressor Control Relay: DISCONNECTED**
- **A/C Compressor Control Relay Terminals B and D: JUMPERED**

Measure Between	Correct Voltage	For Diagnosis
DK GRN (59) & Ground	Battery	See 1
DK GRN (59) & BLK (153)	Battery	See 2

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- If both voltages are correct, but clutch does not engage when connected, replace the A/C Compressor Clutch.

1. Check for open in DK GRN (59) wire.
2. Check for open in BLK (153) wire to ground.

C: A/C COMPRESSOR FUNCTION CONTROL TEST

Measure: VOLTAGE
At: A/C CONTROL HEAD CONNECTOR (Connected)
Conditions:

- **Ignition Switch: RUN (Engine need not be running)**
- **A/C Mode: NORM**
- **Temperature Outside Car: ABOVE 60°F (16°C)**

Measure Between	Correct Voltage	For Diagnosis
N (BRN) & Ground	Battery	See 1
G (LT GRN) & Ground	Battery	See 2

- If both voltages are correct, go to C1.

1. Check for open HTR A/C Fuse or open BRN (50) wire.
2. Replace A/C Control Head.

C1. Measure the voltage at terminal A of the A/C Compressor Control Relay with a fused jumper connected across the terminals of the A/C Low Pressure Switch connector (disconnected).

- If battery voltage is present, refer to Section 1B to check for normal refrigerant charge. If refrigerant charge is normal, replace the A/C Low Pressure Switch.
- If battery voltage is not present, go to C2.

C2. Measure the voltage at terminal A of the A/C Compressor Control Relay with a fused jumper connected across the terminals of the A/C High Pressure Cut-Out Switch connector (disconnected).

- If battery voltage is present, replace the A/C High Pressure Cut-Out Switch.
- If battery voltage is not present, check the wiring between the switches back to the A/C Control Head (see schematic).

SYSTEM DIAGNOSIS

V6 VIN 9

- **Use the Isolation Tests below to choose the proper diagnostic tests.**

ISOLATION TEST (TABLE 1)

Measure: VOLTAGE
At: A/C COMPRESSOR CONTROL RELAY CONNECTOR (Disconnected)
Conditions:

- **Ignition Switch: RUN (Engine need not be running)**
- **A/C Mode: NORM**
- **Temperature Outside Car: ABOVE 60°F (16°C)**

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Measure Between	Correct Voltage	For Diagnosis
D (BLK/WHT) & Ground	Battery	Check BLK/WHT (922) wire for an open
A (LT BLU) & Ground	Battery	Check LT BLU (67) wire for an open If wire is good, do Test C

- If voltages are correct, leave the A/C Compressor Control Relay disconnected and go to Table 2.

ISOLATION TEST (TABLE 2)

Connect: FUSED JUMPER
At: A/C COMPRESSOR CONTROL RELAY CONNECTOR (Disconnected)
Conditions:

- **Ignition Switch: RUN (Engine not running)**
- **A/C Mode: NORM**
- **Temperature Outside Car: ABOVE 60°F (16°C)**

Jumper Between	Correct Result	For Diagnosis
D (BLK/WHT) & B (DK GRN)	Clutch engages	Do Test B

- If the result is correct, do Test A.

(Continued on next page)

AIR CONDITIONING: COMPRESSOR CONTROLS

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(Continued from previous page)

A: ECM COMPRESSOR CONTROL TEST (TABLE 1)

Measure: VOLTAGE
At: ECM CONNECTORS C1 & C2 (Disconnected)
Conditions:

- **Ignition Switch: RUN (Engine not running)**
- **A/C Mode: NORM**
- **Temperature Outside Car: ABOVE 60°F (16°C)**
- **A/C Compressor Control Relay: CONNECTED**

Measure Between	Correct Voltage	For Diagnosis
C2/B8 (LT BLU) & Ground	Battery	See 1
C1/C2 (DK BLU) & Ground	Battery	See 2

- If both voltages are correct, go to Table 2.

1. Check for open in LT BLU (67) wire.
2. Check for an open in the DK BLU (459) wire. If wire is good, replace A/C Compressor Control Relay.

A: ECM COMPRESSOR CONTROL TEST (TABLE 2)

Connect: FUSED JUMPER
At: ECM CONNECTOR C1 (Connected)
Conditions:

- **Ignition Switch: RUN**
- **A/C Mode: NORM**
- **Temperature Outside Car: ABOVE 60°F (16°C)**

Jumper Between	Correct Result	For Diagnosis
C1/C2 (DK BLU) & Ground	A/C Compressor Control Relay operates and A/C Compressor Clutch engages	See 1

- If the result is correct, but A/C System does not operate normally, condition is due to the ECM. Refer to Section 6E for ECM diagnostic procedures.

1. Replace the A/C Compressor Control Relay.

B: A/C COMPRESSOR CLUTCH TEST

Measure: VOLTAGE
At: A/C COMPRESSOR CLUTCH CONNECTOR (Disconnected)
Conditions:

- **Ignition Switch: RUN (Engine not running)**
- **A/C Mode: NORM**
- **A/C Compressor Control Relay: DISCONNECTED**
- **A/C Compressor Control Relay Terminals D and B: JUMPERED**

Measure Between	Correct Voltage	For Diagnosis
DK GRN & Ground	Battery	See 1
DK GRN & BLK	Battery	See 2

- If both voltages are correct, but clutch does not engage when connected, replace the A/C Compressor Clutch.

1. Check for open in DK GRN (59) wire.
2. Check for open in BLK (150) wire to ground. Check that A/C High Pressure Cut-Out Switch is closed. If it is open, replace it.

AIR CONDITIONING: COMPRESSOR CONTROLS

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C: A/C COMPRESSOR FUNCTION CONTROL TEST

Measure: VOLTAGE
At: A/C CONTROL HEAD CONNECTOR (Connected)
Conditions:

- **Ignition Switch: RUN (Engine need not be running)**
- **A/C Mode: NORM**
- **Temperature Outside Car: ABOVE 60°F (16°C)**

Measure Between	Correct Voltage	For Diagnosis
N (BRN) & Ground	Battery	See 1
G (LT GRN) & Ground	Battery	See 2

- If both voltages are correct, go to C1.

1. Check for open HTR A/C Fuse or open BRN (50) wire.
2. Replace A/C Control Head.

C1. Measure the voltage at terminal A of the A/C Compressor Control Relay with a fused jumper connected across the terminals of the Pressure Cycling Switch connector (disconnected).

- If battery voltage is not present with the jumper connected, check the wiring between the switches back to the A/C Control Head (see schematic).
- If battery voltage is present, refer to Section 1B to check for normal refrigerant charge. If refrigerant charge is normal, replace the Pressure Cycling Switch.

CIRCUIT OPERATION

The Compressor for the Air Conditioning System is belt driven by the engine through the A/C Compressor Clutch. The clutch allows the Compressor to be disengaged when air conditioning is not required, and also allows the air conditioning load to be removed from the engine when needed.

Operation of the Compressor depends on the particular mode selected by the driver. When the A/C Mode Selector is in MAX, NORM, BI-LEVEL, or DEF, battery voltage is applied through the HTR A/C Fuse and A/C Control Head Selector to the A/C Compressor Control Relay.

L4 VIN R

For vehicles equipped with the L4 VIN R engine, the path to the A/C Compressor Control Relay is through the A/C Low Pressure Switch and the A/C High Pressure Cut-Out Switch, which are both normally closed. The A/C Low Pressure Switch opens if the refrigerant charge is too low to operate the A/C Compressor without possible damage to it. The A/C High Pressure Cut-Out Switch opens when refrigerant pressure is too high for normal operation.

The A/C Compressor Control Relay is operated by the ECM. When the ECM receives the A/C On signal at terminal 2, it grounds terminal 3, energizing the Relay. When the Relay is energized, voltage is applied to the A/C Compressor Clutch through the contact of the relay. If the ECM determines that engine load should be reduced, such as during full throttle, the A/C Compressor Control Relay is de-energized. This removes voltage from the A/C Compressor and removes the A/C load from the engine.

V6 VIN 9

The voltage path from the A/C Control Head is through the Pressure Cycling Switch to the coil of the A/C Compressor Control Relay. Voltage is also applied to terminal B8 of the Electronic Control Module (ECM). When the ECM receives the voltage input at terminal B8, it will ground terminal C2 to energize the A/C Compressor Control Relay. The Pressure Cycling Switch opens when the refrigerant pressure is less than 165 kPa (24 psi). It closes again when the pressure rises enough to indicate that additional cooling is required. This operation causes the Compressor to cycle on and off so that the evaporator temperature does not drop low enough to cause icing.

When the A/C Compressor Control Relay operates, it applies voltage from the A/C Power Relay through its contacts to the A/C Compressor Clutch. The ECM will remove the ground at terminal C2 to de-energize the A/C Compressor Control Relay when the air conditioning load should be removed from the engine, such as during wide open throttle.

The A/C Compressor Clutch is grounded through the normally closed A/C High Pressure Cut-Out Switch which opens if refrigerant pressure rises too high.

AIR CONDITIONING: AIR DELIVERY

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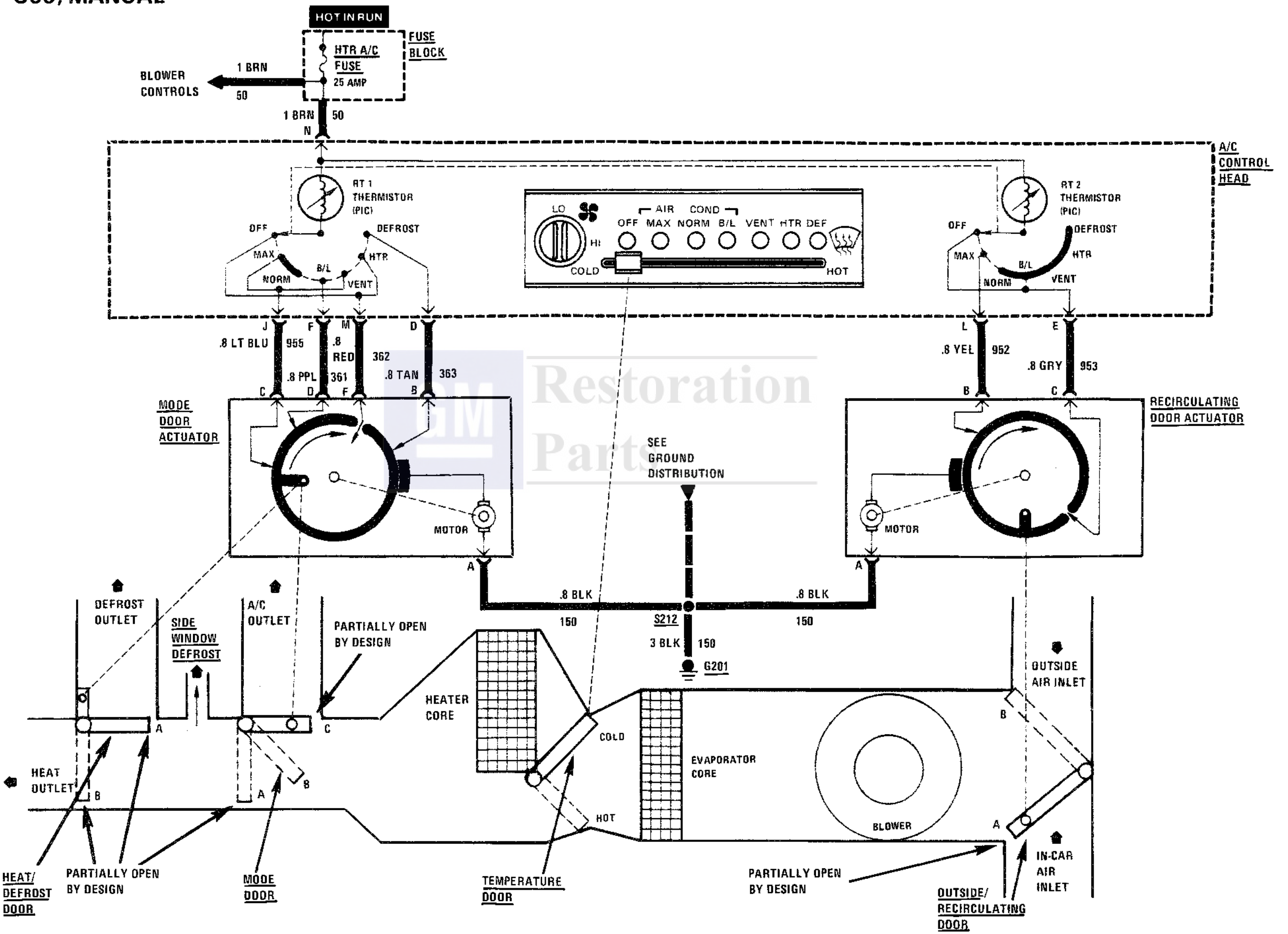

AIR CONDITIONING: AIR DELIVERY

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TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Check.**

1. 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.
2. If actuator operation can be heard, but air delivery is not correct, check actuator linkage.

- **Go to System Check 8A-62 for a guide to normal operation of the entire A/C System.**
- **Go to System Check for a guide to normal operation of the A/C Air Delivery.**
- **Go to System Diagnosis for diagnostic tests.**

SYSTEM CHECK

- **Use the System Check Table as a guide to normal operation of the A/C Air Delivery.**
- **Refer to System Diagnosis for a list of symptoms and diagnostic steps.**

SYSTEM CHECK TABLE

Mode Selector	Heat/ Defrost Door	Mode Door	Outside/ Recirculating 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 Outlets
VENT	A	A	A	Fresh Air from Instrument Panel Outlets and Floor
HTR	A	C	A	Fresh Air from Floor and bypass to Windshield
DEF	B	C	A	Fresh Air from Windshield and bypass to Floor

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- **Refer to System Diagnosis when a result is not normal.**

COMPONENT LOCATION

		Page-Figure
Fuse Block	Behind LH side of I/P	201- 6-D
Mode Door Actuator	Rear of heater-A/C module	201- 8-C
Recirculating Door Actuator	Rear of heater-A/C module	201- 8-C
G201	Behind center of I/P	201- 6-C
S212	Main harness, behind center of dash	201- 6-C

SYSTEM DIAGNOSIS

- **Do the tests listed for your symptom in the Symptom Table below.**
- **Tests follow the Symptom Table.**

SYMPTOM TABLE

SYMPTOM	DO TEST
Air delivery does not switch from recirculate to outside to recirculate when Mode pushbuttons are set for MAX, then NORM, then MAX	Test A
Air delivery does not switch from A/C Outlets to A/C and Heat Outlets to Heat Outlets to Defrost Outlets as Mode pushbuttons are set for VENT, B/L, HTR, and DEFROST	Test B

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AIR CONDITIONING: AIR DELIVERY

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(Continued from previous page)

A: RECIRCULATING DOOR ACTUATOR TEST

Connect: TEST LAMP
At: RECIRCULATING DOOR ACTUATOR HARNESS CONNECTOR (Disconnected)
Conditions:

- **Ignition Switch: RUN**
- **A/C Mode: MAX**

Connect Between	Correct Result	For Diagnosis
B (YEL) & Ground	Test Lamp lights	See 1
B (YEL) & A (BLK)	Test Lamp lights	See 2
• A/C Mode: NORM		
C (GRY) & A (BLK)	Test Lamp lights	See 3

- If all results are normal but actuator does not operate, replace the Recirculating Door Actuator.
- If none of the results are correct or the Test Lamp lights only dimly in all tests, check Thermistor RT2 for high resistance. If Thermistor is good, check Mode pushbuttons for poor contacts.

1. Check YEL (952) wire for an open. If wire is good, check Mode pushbutton.
2. Check BLK (150) wire for an open.
3. Check GRY (953) wire for an open. If wire is good, check Mode pushbutton.

B: MODE DOOR ACTUATOR TEST

Connect: TEST LAMP
At: MODE DOOR ACTUATOR HARNESS CONNECTOR (Disconnected)
Conditions:

- **Ignition Switch: RUN**
- **A/C Mode: DEFROST**

Connect Between	Correct Result	For Diagnosis
B (TAN) & Ground	Test Lamp lights	See 1
B (TAN) & A (BLK)	Test Lamp lights	See 2
• A/C Mode: OFF		
F (RED) & A (BLK)	Test Lamp lights	See 3
• A/C Mode: HTR		
F (RED) & A (BLK)	Test Lamp lights	See 3
• A/C Mode: B/L		
D (PPL) & A (BLK)	Test Lamp lights	See 4
• A/C Mode: MAX		
C (LT BLU) & A (BLK)	Test Lamp lights	See 5
• A/C Mode: NORM		
C (LT BLU) & A (BLK)	Test Lamp lights	See 5
• A/C Mode: VENT		
C (LT BLU) & A (BLK)	Test Lamp lights	See 5

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- If all results are correct but the Mode Door Actuator does not operate, replace the Actuator.
- If none of the results are correct or the Test Lamp lights only dimly in all checks, check Thermistor RT1 for high resistance. If Thermistor is good, check Mode pushbuttons for poor contacts.

1. Check TAN (363) wire for an open. If wire is good, check Mode pushbutton.
2. Check BLK (150) wire for an open.
3. Check RED (362) wire for an open. If wire is good, check Mode pushbutton.
4. Check PPL (361) wire for an open. If wire is good, check Mode pushbutton.
5. Check LT BLU (955) wire for an open. If wire is good, check Mode pushbutton.

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 Door is cable operated by the Temperature Lever.

The Mode Door has 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.

AIR CONDITIONING: AIR DELIVERY

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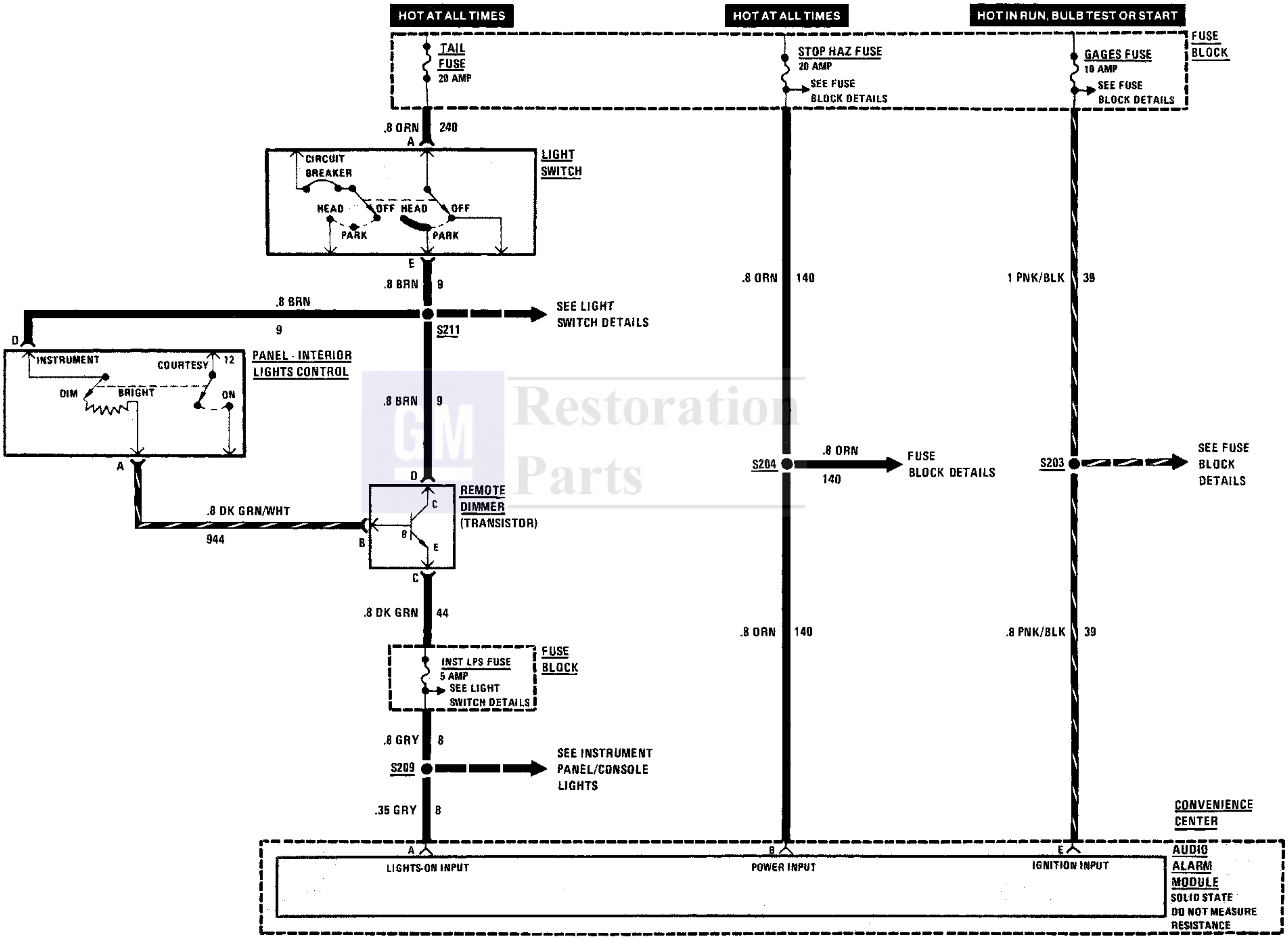
The Heat/Defrost Door routes to either the Heat Vent or the Defrost Vent with a slight air bypass in either position. An electric actuator operates both the Mode and Heat/Defrost Doors as controlled by the A/C Mode Switch.

The actuator consists of a non-reversing 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 assembly 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.

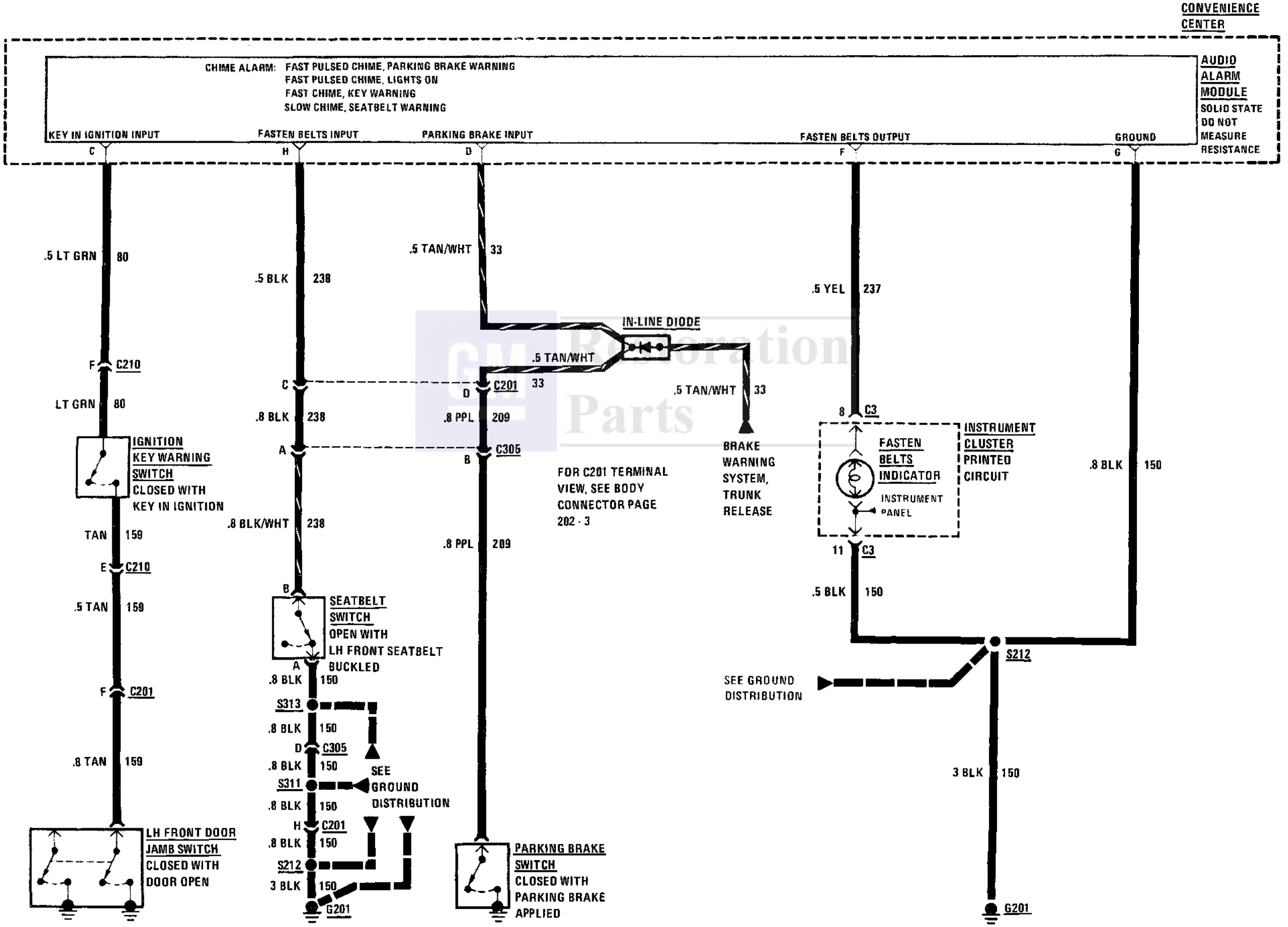
The Outside/Recirculating Door has two positions, allowing either outside air or recirculated air with a portion of outside air into the blower. An electric actuator similar to the Mode Door Actuator, but with only two positions, operates this door.

The Mode Switch contains the contacts required to select each of the seven modes.

WARNINGS AND ALARMS: CHIME



WARNINGS AND ALARMS: CHIME



WARNINGS AND ALARMS: CHIME

TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Check.**

1. Check the STOP HAZ Fuse by operating the Hazard Flashers.
2. Check the GAGES Fuse by observing the Defogger Indicator.
3. Check the TAIL Fuse by putting Light Switch in PARK and observing Tail Lights.
4. Check that ground G201 is clean and tight.
5. Check the INST LPS Fuse by observing Instrument Cluster illumination.
6. If the Fasten Belts Chime Reminder and Indicator operate continuously, replace the Audio Alarm Module.

- **Go to System Check for a guide to normal operation.**
- **Go to System Diagnosis for diagnostic tests.**

SYSTEM CHECK

- **Use the System Check Table as a guide to normal operation.**

SYSTEM CHECK TABLE

ACTION	NORMAL RESULT
Sit in the driver's seat and close the driver's door	A slow chime alarm sounds
Turn the Ignition Switch to RUN	The Fasten Belts Indicator lights in the Instrument Cluster
Do not buckle the seatbelt	The chime stops and the indicator goes out after 4 to 8 seconds
Repeat above, but buckle seatbelt	No chime sounds The Fasten Belts Indicator lights for 4 to 8 seconds
With the Ignition Switch in ACCY, LOCK, or OFF, and the key still in the ignition, open the LH Front Door	The fast chime alarm sounds (faster than the seatbelt chime)
Remove the key from the ignition	The alarm stops

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COMPONENT LOCATION

		Page-Figure
Convenience Center	Behind RH side of I/P	201- 9-A
Fuse Block	Behind LH side of I/P	201- 6-D
Ignition Key Warning Switch	In upper portion of steering column	201- 9-B
In-Line Diode	Behind I/P, near LH shroud	201- 8-A
Parking Brake Switch	On parking brake support	201- 9-C
Remote Dimmer	Below center of I/P, near steering column support	201- 8-D
Seatbelt Switch	Behind LH seat	201-13-B
C201 (8 cavities)	LH shroud above center access hole	201-12-C
C210 (11 cavities)	Lower RH side of steering column	201- 8-B
C305 (4 cavities)	Behind dash, near LH shroud	201-13-B
G201	Behind center of I/P	201- 6-C
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- 6-C
S211	Main harness, behind RH side of I/P	201- 6-C
S212	Main harness, behind center of dash	201- 6-C
S311	Crosscar harness, LH side of I/P	201-12-C
S313	Body harness, under LH front seat	201-13-B

WARNINGS AND ALARMS: CHIME

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With the key removed from the ignition, and the dimmer at maximum brightness, turn the Light Switch to PARK	The fast chime alarm sounds (faster than the key chime)
Turn the Light Switch OFF	The alarm stops
With the Ignition Switch in RUN, depress the Parking Brake	The fast chime alarm sounds
Release the Parking Brake	The alarm stops

- **Refer to System Diagnosis when a result is not normal.**

SYSTEM DIAGNOSIS

- **Do the tests listed for your symptom in the Symptom Table below.**
- **Tests follow the Symptom Table.**

SYMPTOM TABLE

SYMPTOM	DO TEST
None of the chime alarms operate	A: Audio Alarm Module Test
Only the Key In Ignition Warning does not operate	B: Key In Ignition Input Test
The Key In Ignition Warning operates when it should not	B: Key In Ignition Input Test
The Fasten Belts Chime Reminder does not operate	C: Fasten Belts Input Test
The Fasten Belts Chime Reminder operates when seatbelt is buckled	C: Fasten Belts Input Test
The Fasten Belts Indicator does not operate, but the Fasten Belts Chime Reminder operates	D: Fasten Belts Indicator Test
The Fasten Belts Indicator is always on, but the chime operates properly	D: Fasten Belts Indicator Test
Only the Lights-On Chime Reminder does not operate	E: Lights-On Input Test
Only the Lights-On Chime Reminder operates when it should not	E: Lights-On Input Test
Only the Parking Brake Warning does not operate	F: Parking Brake Input Test
Only the Parking Brake Warning operates when it should not	F: Parking Brake Input Test

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A: AUDIO ALARM MODULE TEST

Connect: TEST LAMP
At: CONVENIENCE CENTER
Condition:

- **Audio Alarm Module: REMOVED**

Connect Between	Correct Result	For Diagnosis
B (ORN) & Ground	Test Lamp lights	See 1
B (ORN) & G (BLK)	Test Lamp lights	See 2

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- If results are correct and none of the chime functions were working, replace the Audio Alarm Module.

1. Check the ORN (140) wire for an open.
2. Check the BLK (150) wire for an open.

B: KEY IN IGNITION INPUT TEST

Connect: SELF-POWERED TEST LAMP
At: CONVENIENCE CENTER
Conditions:

- **Audio Alarm Module: REMOVED**
- **Ignition Switch (Key In): ACCY, LOCK, or OFF**
- **LH Front Door: OPEN**

Connect Between	Correct Result	For Diagnosis
C (LT GRN) & Ground	Test Lamp lights	See 1

- Ignition Switch (Key In): ACCY, LOCK or OFF
- LH Front Door: CLOSED

Connect Between	Correct Result	For Diagnosis
C (LT GRN) & Ground	Test Lamp does not light	See 2

- Ignition Switch: KEY OUT
- LH Front Door: OPEN

Connect Between	Correct Result	For Diagnosis
C (LT GRN) & Ground	Test Lamp does not light	See 3

- If all the test lamp results are correct, replace the Audio Alarm Module.

1. Make certain LH Front Door Jamb Switch is properly grounded. Check LT GRN (80) and TAN (159) wires for an open. If wires are OK, check that switches are closed. If a switch is open, replace it.

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2. Check LT GRN (80) and TAN (159) wires for a short to ground. If wires are OK, check that LH Front Door Jamb Switch is open. If closed, replace it.
3. Check that Ignition Key Warning Switch is open. If closed, replace it.

C: FASTEN BELTS INPUT TEST

Connect: TEST LAMP
At: CONVENIENCE CENTER
Conditions:
- **Audio Alarm Module: REMOVED**
- **Ignition Switch: RUN**
- **LH Front Seatbelt: UNBUCKLED**

Connect Between	Correct Result	For Diagnosis
E (PNK/BLK) & Ground	Test Lamp lights	See 1
E (PNK/BLK) & H (BLK)	Test Lamp lights	See 2
• LH Front Seatbelt: BUCKLED		
E (PNK/BLK) & H (BLK)	Test Lamp does not light	See 3

- If all the results are correct, replace the Audio Alarm Module.

1. Check the PNK/BLK (39) wire for an open.
2. Check for an open Seatbelt Switch or an open in the BLK or BLK/WHT (238) wires or the BLK (150) wires (see schematic).
3. Check that the Seatbelt Switch is open, or for a short to ground in the BLK (238) wire (see schematic).

D: FASTEN BELTS INDICATOR TEST

Connect: FUSED JUMPER
At: CONVENIENCE CENTER
Condition:
- **Audio Alarm Module: REMOVED**

Connect Between	Correct Result	For Diagnosis
B (ORN) & F (YEL)	Fasten Belts Indicator lights	See 1
Remove Jumper	Fasten Belts Indicator does not light	See 2

- If the indicator response was correct, replace the Audio Alarm Module.

1. Check/repair the bulb, the YEL (237) wire, the BLK (150) wire, and the Instrument Cluster Printed Circuit for opens.
2. Check the Instrument Cluster Printed Circuit for a short to Battery.

E: LIGHTS-ON INPUT TEST

Measure: VOLTAGE
At: CONVENIENCE CENTER
Conditions:
- **Audio Alarm Module: REMOVED**
- **Ignition Switch: RUN**
- **Light Switch: OFF**

Measure Between	Correct Voltage	For Diagnosis
A (GRY) & Ground	0 volts	See 1
• Dimmer: Maximum Brightness • Light Switch: PARK or HEAD		
A (GRY) & Ground	Approximately 10 volts	See 1

(Continued in next column)

(Continued from previous column)

- If both the voltages are correct, replace the Audio Alarm Module.

1. Check/repair the GRY (8) wire.

F: PARKING BRAKE INPUT TEST

Connect: SELF-POWERED TEST LAMP
At: CONVENIENCE CENTER
Conditions:
- **Audio Alarm Module: REMOVED**
- **Parking Brake: APPLIED**

Connect Between	Correct Result	For Diagnosis
D (TAN/WHT) & Ground	Test Lamp lights	See 1
• Parking Brake: RELEASED		
D (TAN/WHT) & Ground	Test Lamp does not light	See 2

- If both results are correct, replace the Audio Alarm Module.

1. Check the Parking Brake Switch, PPL (209) wire, and TAN/WHT (33) wire for an open (see schematic).
2. Check Parking Brake Switch and In-Line Diode for shorts. Check PPL (209) and TAN/WHT (33) wires for shorts to ground.

(Continued on next page)

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 is in the ignition and the LH front door is open, 3) the lights are on and the Ignition Switch is not in RUN, BULB TEST or START and 4) the Parking Brake is applied and the Ignition Switch is in RUN, BULB TEST or START.

Battery voltage to operate the module is supplied at all times to terminal B. Voltage is also applied to two other inputs. One of these, at terminal A receives voltage from the Instrument Panel Lights whenever the Headlights or PARK Lights are on. The other, at terminal E 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 Input, and 2) a ground at the Fasten Belts Input. This occurs when the Seatbelt Switch is closed and because the LH front seatbelt is not buckled. While the slow chime sounds, the module also supplies steady battery voltage to the Fasten Belts Output to light the Fasten Belts Indicator.

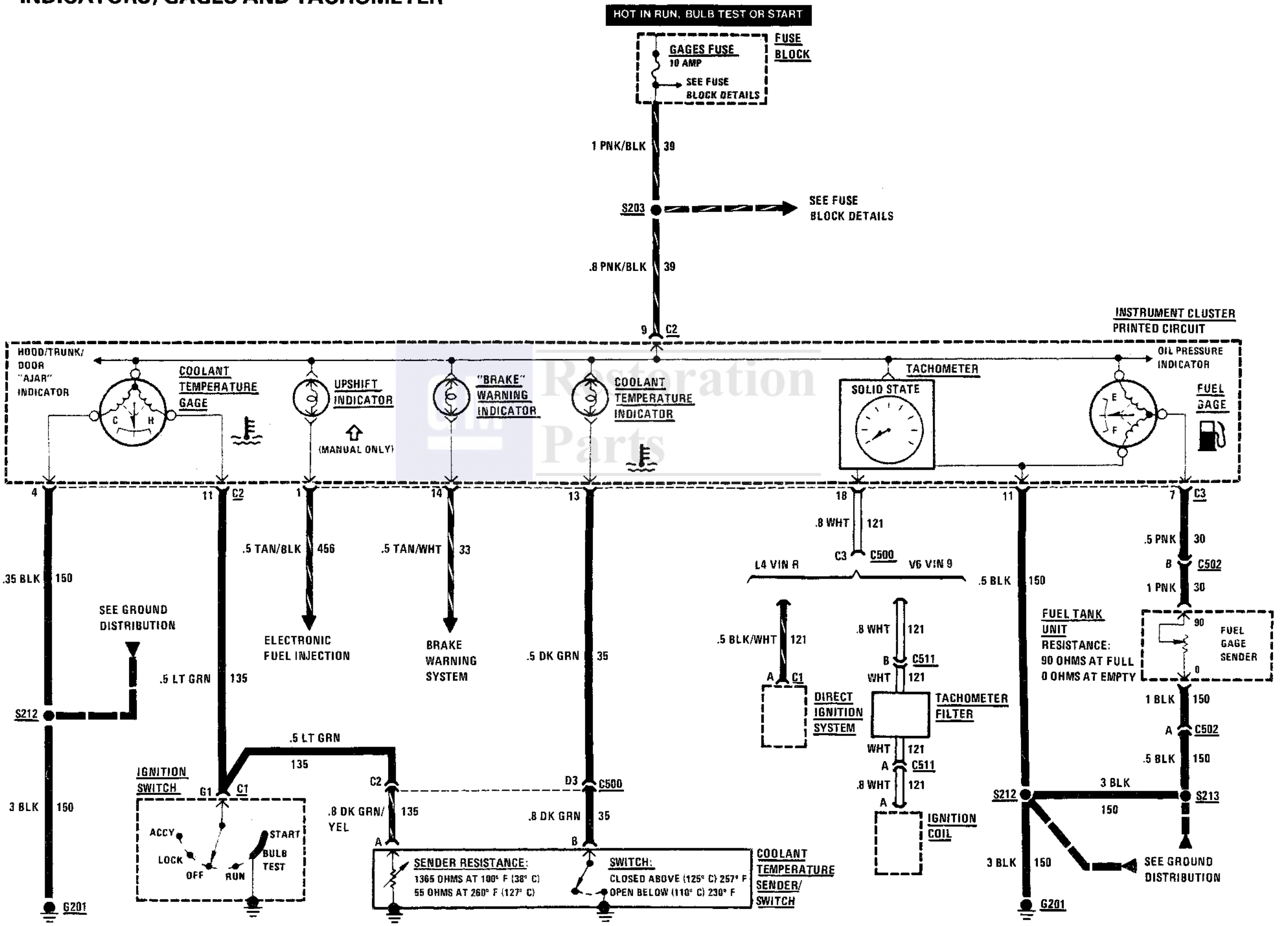
To sound the Key In Ignition Warning, both the Ignition Key Warning Switch and the LH Front Door Jamb Switch must be closed. This condition grounds terminal C of the Audio Alarm Module. These switches are closed when the LH front door is open and the key is in the ignition.

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. When the dimmer is at a dim setting, the alarm will not be activated since there is not enough voltage at the Lights-On Input.

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.

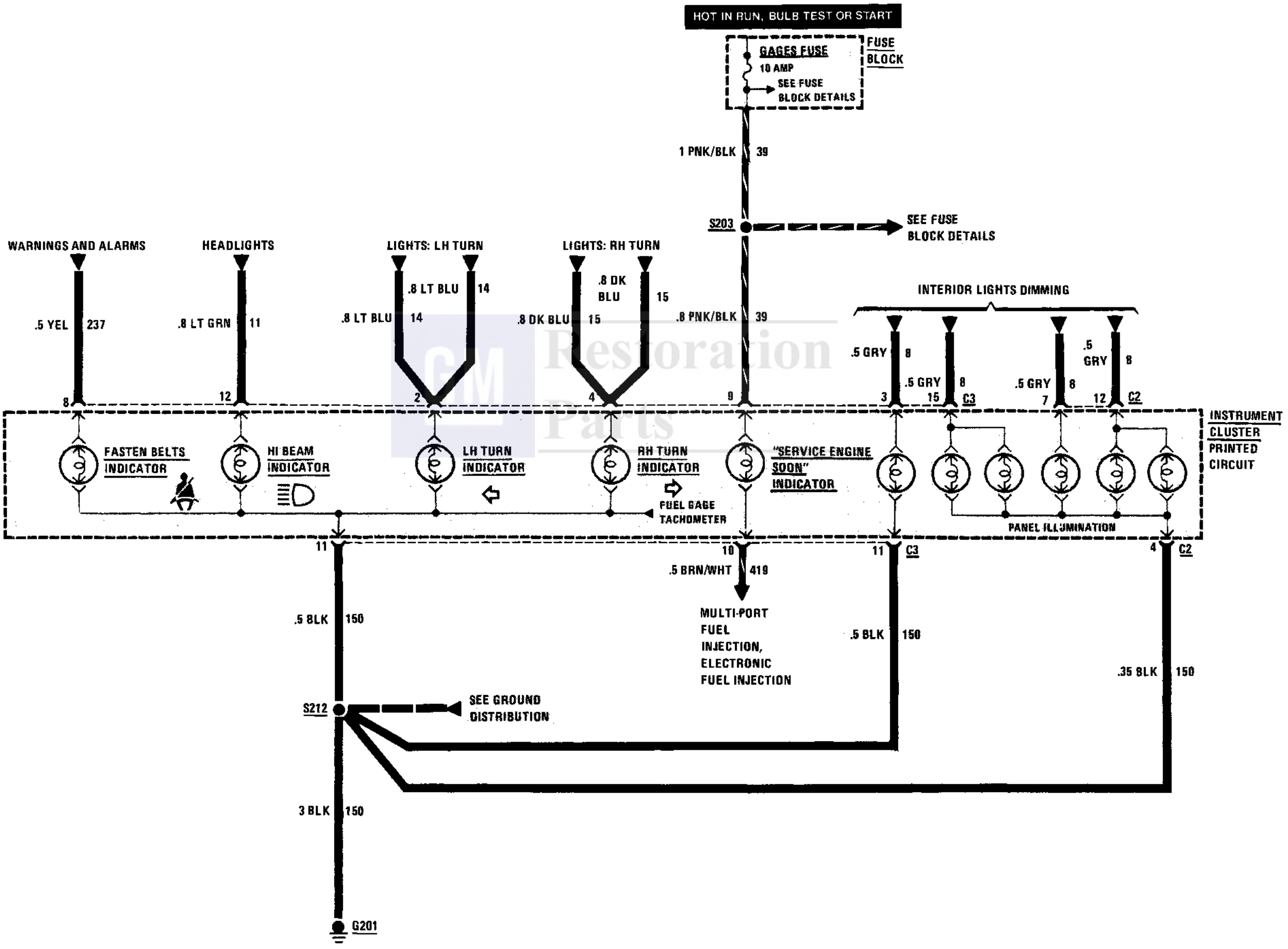
INSTRUMENT PANEL: INDICATORS CLUSTER

INDICATORS, GAGES AND TACHOMETER



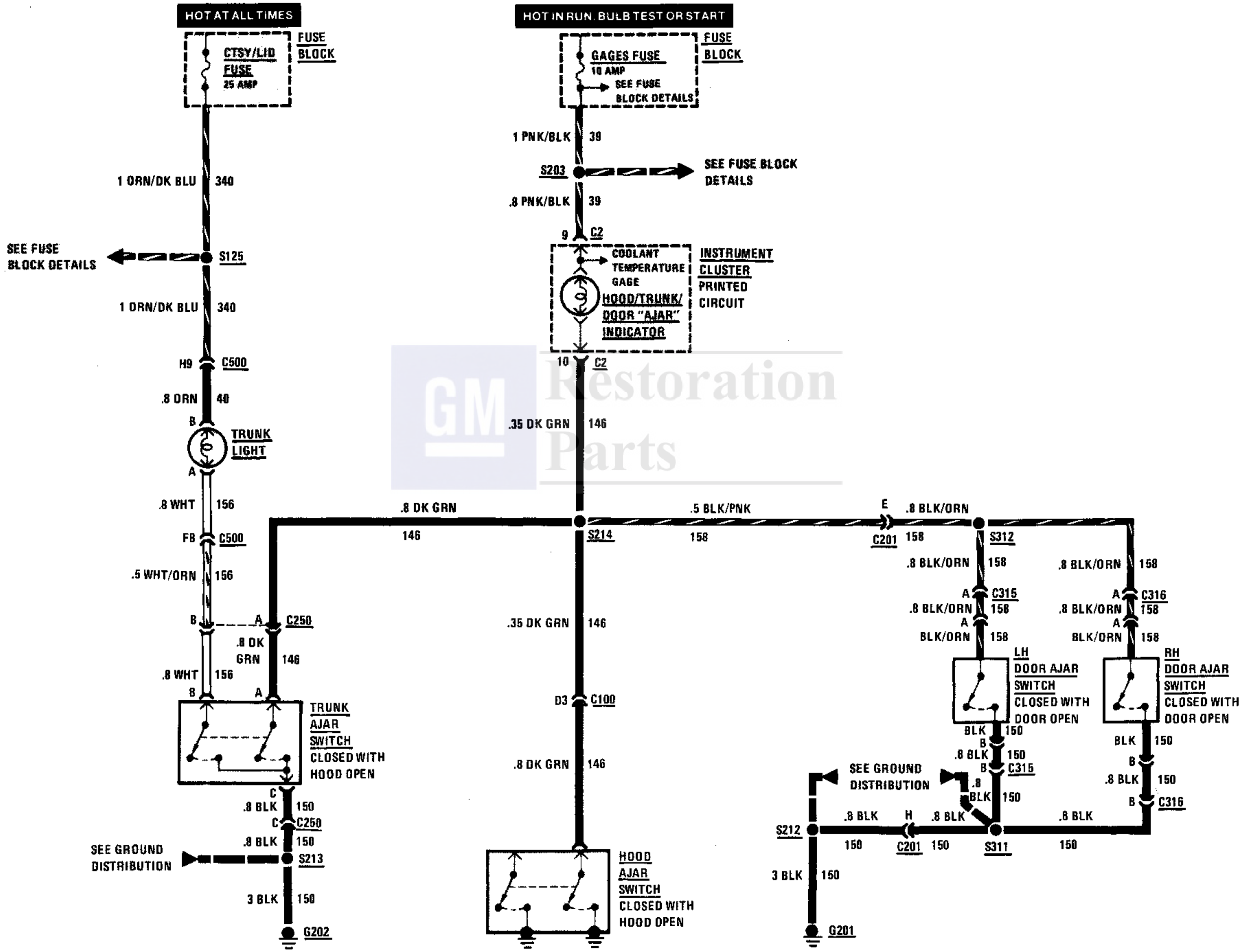
INSTRUMENT PANEL: INDICATORS CLUSTER

INDICATORS



INSTRUMENT PANEL: INDICATORS CLUSTER

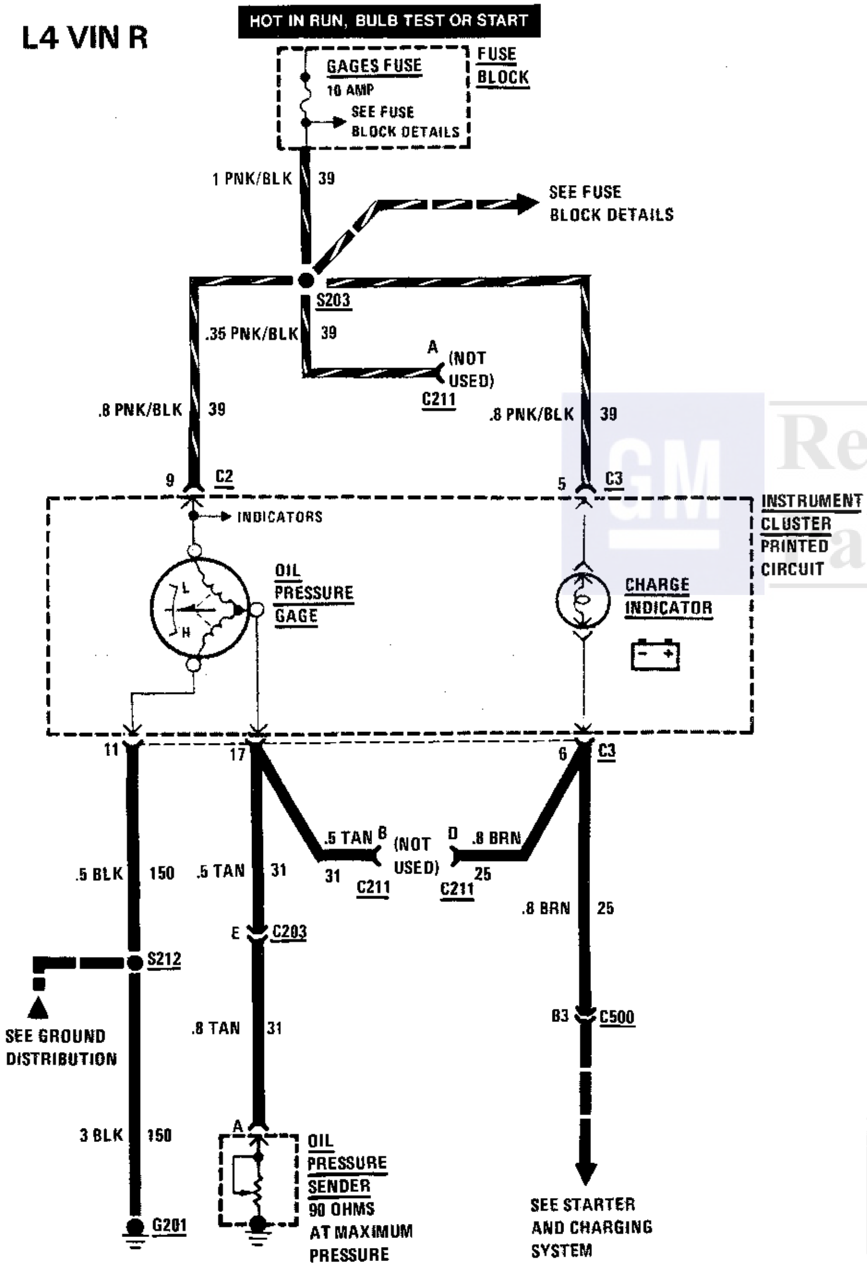
HOOD/TRUNK/DOOR AJAR INDICATOR



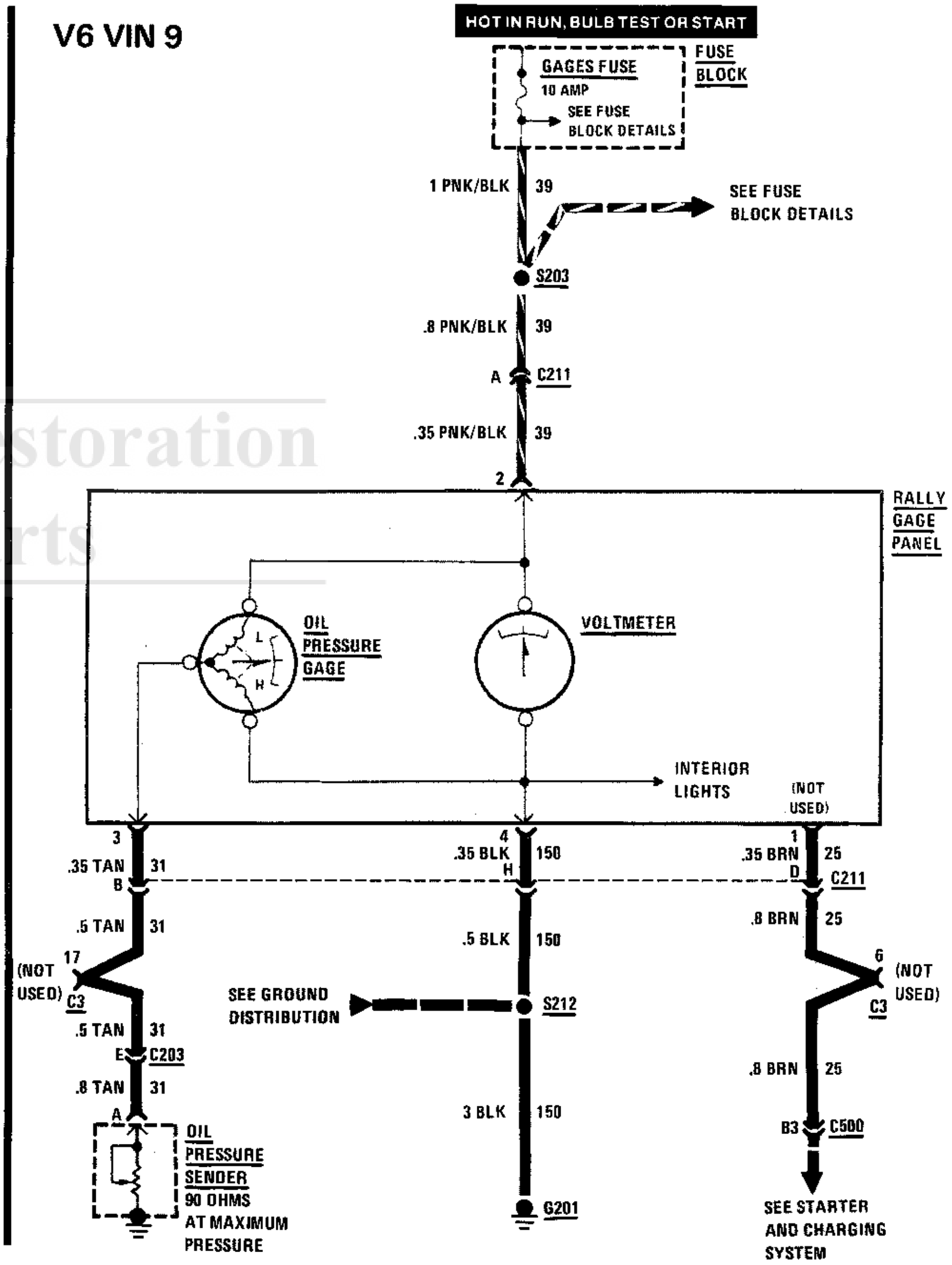
INSTRUMENT PANEL: INDICATORS CLUSTER

GAGES AND VOLTMETER

L4 VIN R

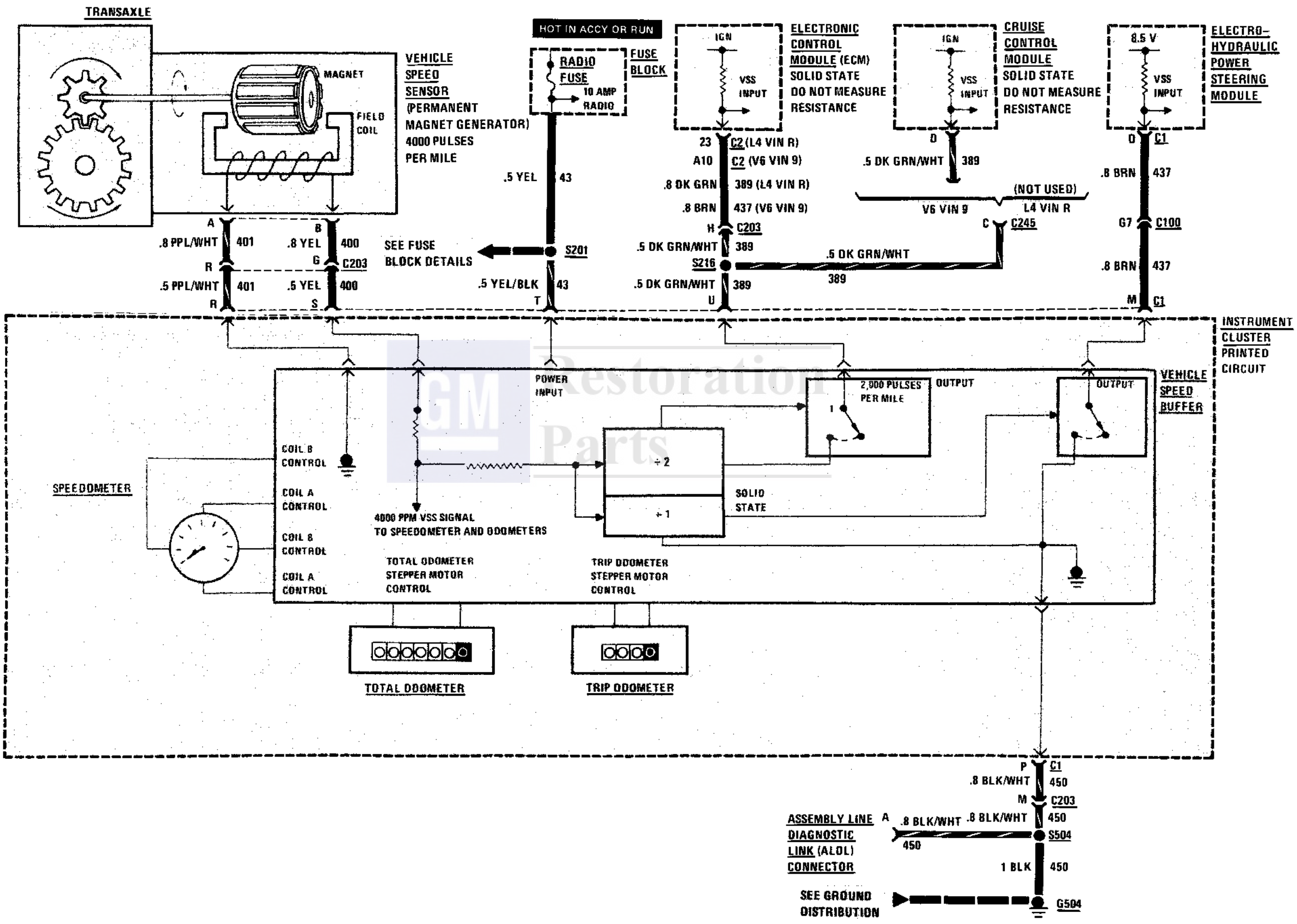


V6 VIN 9



INSTRUMENT PANEL: INDICATORS CLUSTER

ODOMETERS AND SPEEDOMETER



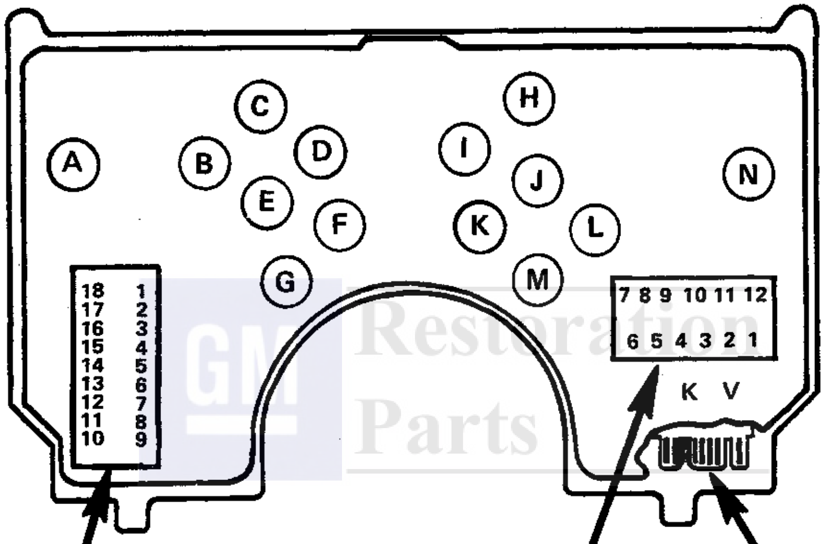
INSTRUMENT PANEL: INDICATORS CLUSTER

REAR VIEW

CONNECTOR C1 PINOUT

A	Not Used
B	Not Used
C	Not Used
D	Not Used
E	Not Used
F	Not Used
G	Not Used
H	Not Used
J	Not Used
K	Not Used
L	Not Used
M	Speed Signal to Electro Hydraulic Power Steering Module
N	Not Used
P	Ground
R	Vehicle Speed Sensor Lo
S	Vehicle Speed Sensor High
T	Ignition
U	Speed Signal To ECM and Cruise Control Module

CLUSTER PRINTED CIRCUIT



CONNECTOR C3 PINOUT

1	Upshift Indicator
2	LH Turn Indicator
3	Illumination
4	RH Turn Indicator
5	Ignition
6	Charge Indicator
7	Fuel Gage
8	Fasten Belts Indicator
9	Ignition
10	SERVICE ENGINE SOON Indicator
11	Ground
12	Hi Beam Indicator
13	Coolant Temperature Indicator
14	Brake Indicator
15	Illumination
16	Not Used
17	Oil Pressure Gage
18	Tachometer

CONNECTOR C2 PINOUT

1	Not Used
2	Not Used
3	Not Used
4	Ground
5	Not Used
6	Not Used
7	Illumination
8	Not Used
9	Ignition
10	Door AJAR Indicator
11	Coolant Temperature Gage
12	Illumination

CONNECTOR C1

BULB LOCATIONS

A	Illumination
B	Illumination
C	UPSHIFT Indicator
D	RH Turn Indicator
E	Charge Indicator
F	Fasten Belts Indicator
G	SERVICE ENGINE SOON INDICATOR
H	AJAR Indicator
I	LH Turn Indicator
J	Coolant Temperature Indicator
K	Hi Beam Indicator
L	Illumination
M	BRAKE Indicator
N	Illumination

INSTRUMENT PANEL: INDICATORS CLUSTER

TROUBLESHOOTING HINTS

- **For a list of possible symptoms, go to System Diagnosis.**
- **For Instrument Cluster removal and replacement procedures, see Section 8C of the Chassis Service Manual.**
- **Try the following checks before doing the System Check.**

1. Check GAGES Fuse by visual inspection.
2. Check the CTSY/LID Fuse by visual inspection.
3. Check the RADIO Fuse by visual inspection.
4. Check Indicator bulbs.

- **Go to System Check for a guide to normal operation.**
- **Go to System Diagnosis for diagnostic tests.**

SYSTEM CHECK

- **Use the System Check Table as a guide to normal operation. Refer to the diagnosis given if other results occur.**
- **Tests follow in System Diagnosis.**

COMPONENT LOCATION

		Page-Figure
Assembly Line Diagnostic Link (ALDL) Connector	In console, near rear of shifter	201- 5-B
Coolant Temperature Switch/Sender (VIN 9)	Top LH of engine, above exhaust manifold	201- 3-A
Coolant Temperature Switch/Sender (VIN R)	LH top of engine	201- 2-A
Cruise Control Module	Under console, near radio	201- 9-D
Direct Ignition System (DIS)	Top rear of engine	201- 2-B
Electro-Hydraulic Power Steering (EHPS) Controller	Lower LH side of front compartment	201- 3-D
Electronic Control Module (ECM)	Between seats, on front of rear bulkhead	201- 5-B
Fuel Tank Unit	Top of fuel tank	
Fuse Block	Behind LH side of I/P	201- 6-D
Hood Ajar Switch	Front compartment, center of front bulkhead	201-10-B
Ignition Coil	Top of engine, left of throttle body	201- 3-A
Ignition Switch	At base of steering column	201- 8-F
Oil Pressure Switch/Sender (VIN 9)	Lower RH front of engine	201- 3-B
Oil Pressure Switch/Sender (VIN R)	Rear of engine, center of engine block	201- 1-A
Tachometer Filter	Top of engine, near ignition coil	201- 5-C
Trunk Ajar Switch	LH side of engine compartment	
Vehicle Speed Sensor	RH end of transaxle	201- 1-A
C100 (34 cavities)	LH side of front bulkhead, right of brake master cylinder	201-13-A
C201 (8 cavities)	LH shroud above center access hole	201-12-C
C203 (15 cavities)	Between seats, in front of rear bulkhead	201- 5-A
C211 (8 cavities)	Behind center of I/P, near radio	
C245 (8 cavities)	Beneath center console	
C250 (4 cavities)	Center of rear bulkhead, in engine compartment	201-13-C
C315 (2 cavities)	Near center of LH shroud	201-12-C
C316 (2 cavities)	Near center of RH shroud	201-12-D
C500 (34 cavities)	Engine compartment, near battery	201- 4-A
C502 (3 cavities)	Engine compartment, center of rear bulkhead	201- 4-A
C511 (2 cavities)	Top of engine, near Ignition Coil	201- 3-A
G201	Behind center of I/P	201- 6-C
G202	Between seats, near rear bulkhead	201- 6-A

COMPONENT LOCATION

		Page-Figure
G504 (VIN 9)	LH top of engine, below throttle body	201- 3-A
G504 (VIN R)	Top LH front of engine, above Starter Solenoid	201- 2-A
S125	Main harness, behind LH side of I/P, near Fuse Block	201- 6-D
S201	Main harness, above steering column	201- 7-A
S203	Main harness, above steering column	201- 7-A
S212	Main harness, behind center of dash	201- 6-C
S213	Main harness, behind rear bulkhead grommet	201-15-A
S214	Main harness, behind LH side of I/P	201- 7-A
S216	Main harness, behind center I/P	201-15-A
S311	Crosscar harness, LH side of I/P	201-12-C
S312	Crosscar harness, LH side of I/P	201-12-C
S504	Engine harness, under rear console	201- 5-A

SYSTEM CHECK TABLE

ACTION	NORMAL RESULT	FOR DIAGNOSIS
Turn Ignition Switch to RUN	SERVICE ENGINE SOON Indicator is on Fasten Belts Indicator will come on for 4 to 5 seconds The Audio Alarm will sound if the Passenger's seatbelt is unbuckled Fuel Gage shows current fuel level Voltmeter shows battery voltage Oil Pressure Gage shows 0 psi Coolant Temperature Gage shows the coolant temperature Tachometer displays 0 rpm	See Section 6E See Warnings and Alarms, Section 8A-76 See Warnings and Alarms, Section 8A-76 See Symptom Table Do Test O See Symptom Table See Symptom Table Do Test P
With Ignition Switch in RUN, operate first the RH Turn Signal then the LH Turn Signal	RH and LH Turn Indicators flash	See Exterior Lights, Section 8A-110

INSTRUMENT PANEL: INDICATORS CLUSTER

(Continued from previous page)

With Ignition Switch in RUN, apply the Park Brake	Brake Warning Indicator is on	See Brake Warning System, Section 8A-41
With Ignition Switch in RUN, turn the Head or Park Lights on and adjust the dimmer control	Instrument Cluster illumination varies with dimmer control	See Instrument Panel Dimming, Section 8A-117
Start engine and let idle	Brake Warning Indicator lights while cranking Coolant Temperature Gage indicates current coolant temperature Oil Presssure Gage indicates current oil pressure Tachometer indicates the engine rpm	See Symptom Table See Symptom Table See Symptom Table Do Test P

- **If all results are normal, the system is OK.**

SYSTEM DIAGNOSIS

- **Do the tests listed for your symptom in the Symptom Table below.**
- **Tests follow the Symptom Table.**

SYMPTOM TABLE

SYMPTOM	FOR DIAGNOSIS
Fuel Gage indicates E when there is fuel in the tank	Do Test D (also see Test C terminal 7)
Fuel Gage indicates F or beyond at all times	Do Test F (also see Test C terminal 7)
Fuel Gage is inaccurate	Do Test E (also see Test C terminal 7)
Coolant Temperature Gage indicates hot with engine cool and Ignition Switch in RUN	Do Test G (also see Test B terminal 11)
Coolant Temperature Gage indicates cold at all times	Do Test H (also see Test B terminal 11)
Coolant Temperature Gage is inaccurate	Do Test I (also see Test B terminal 11)
Coolant Temperature Indicator lights when engine coolant is not overheated	Do Test J (also see Test C terminal 13)
Coolant Temperature Indicator does not light with the engine coolant overheated	Do Test K (also see Test C terminal 13)
Coolant Temperature Indicator is always on	Do Test J (also see Test C Terminal 13)
Oil Pressure Gage indicates low pressure when oil pressure is normal	Do Test L (also see Test C terminal 17)
Oil Pressure Gage indicates high pressure at all times	Do Test M (also see Test C terminal 17)
Oil Pressure Gage is inaccurate	Do Test N (also see Test C terminal 17)
Voltmeter is inaccurate	Do Test O
Tachometer does not operate	Do Test P

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Either Speedometer or Odometers do not operate	Replace the Speedometer Assembly (see Section 8C)
Speedometer and odometers do not operate	See Vehicle Speed Sensor, Section 8A-33
Speedometer is not accurate	Repalce the Speedometer Assembly (See Section 8C)
Speedometer and Odometers are not accurate	Do Test T
Odometer(s) are not accurate	Do Test U
Service Engine Soon Indicator does not operate properly	See Section 6E
Hi Beam Indicator does not operate properly	See Headlights, Section 8A-100
Fasten Belts Indicator does not operate properly	See Warnings and Alarms, Section 8A-76
BRAKE Indicator does not operate properly	See Brake Warning System, Section 8A-41
Turn Indicator does not operate properly	See Exterior Lights, Section 8A-110 (also see Test C terminals 1 and 4)
Charge Indicator does not operate properly	See Starter and Charging System, Section 8A-30
AJAR Indicator is always on	Do Test Q
AJAR Indicator does not light for only one input	Do Test R
Upshift Indicator does not operate properly	Do Test S
Cluster Illumination lights do not operate properly	See Interior Lights Dimming, Section 8A-117

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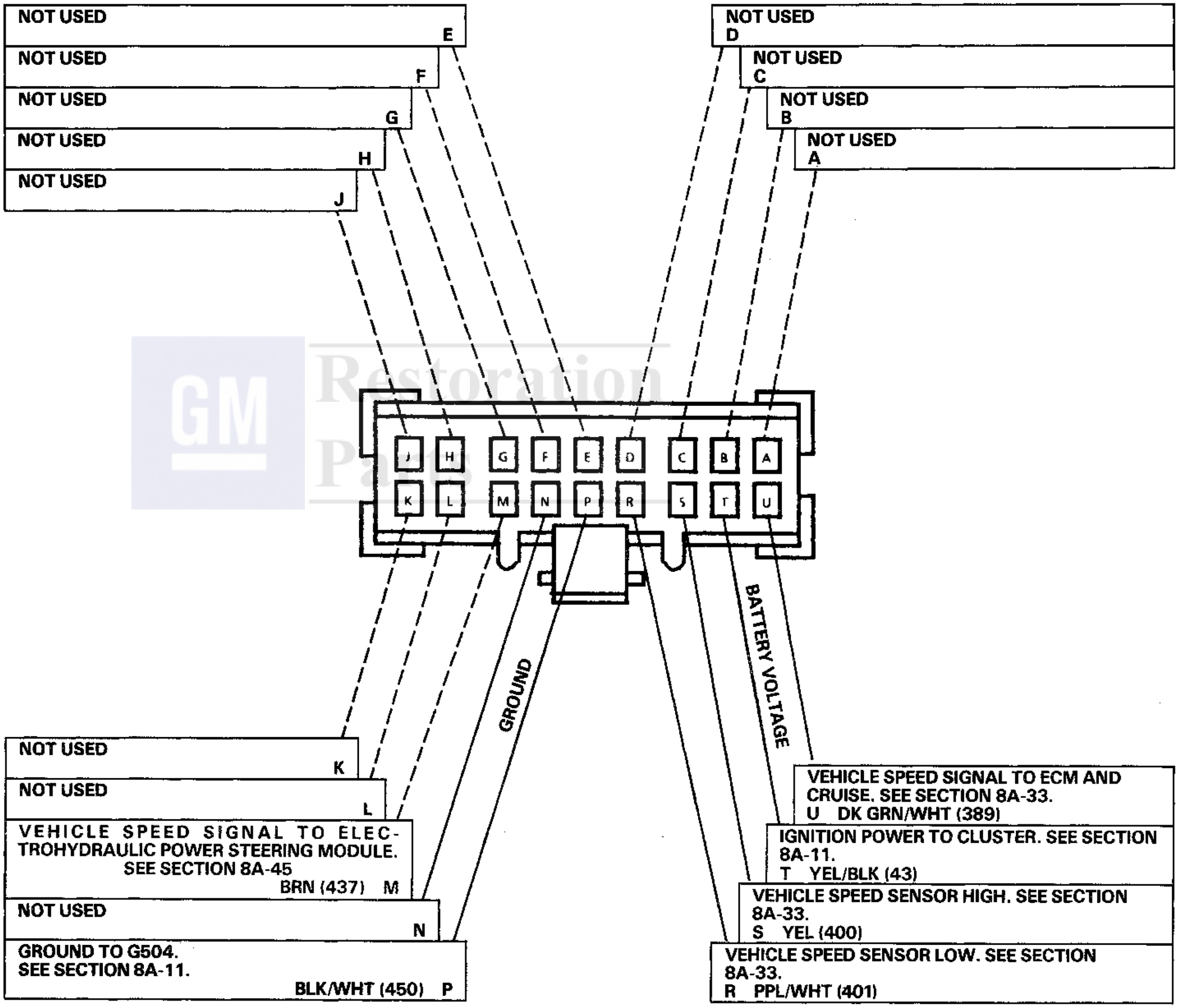
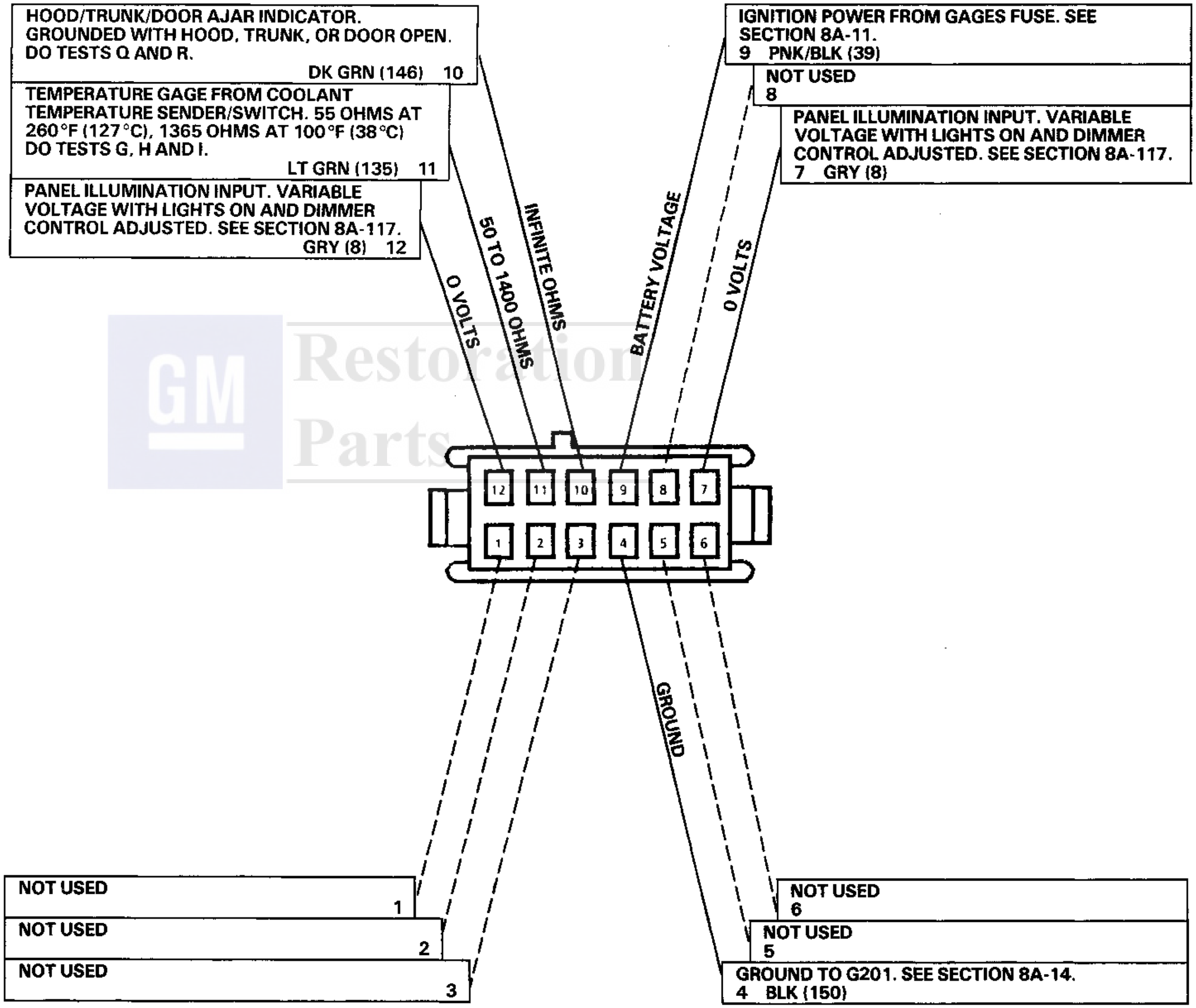
A: CONNECTOR C1 PINOUT TEST

- IGNITION SWITCH IN RUN EXCEPT FOR RESISTANCE MEASUREMENTS
- MAKE ALL RESISTANCE MEASUREMENTS TO GROUND WITH THE NEGATIVE BATTERY CABLE REMOVED
- MEASURE VOLTAGES TO GROUND UNLESS ANOTHER TERMINAL IS GIVEN
- CLUSTER CONNECTOR C1 AS SEEN FROM THE DRIVER'S SEAT WITH THE INDICATORS CLUSTER REMOVED
- CONNECTOR C1 IS AT THE LOWER LEFT SIDE OF THE CLUSTER, FACING UP
- IF THE CORRECT VOLTAGE OR RESISTANCE IS FOUND AT THE TERMINALS, AND THE CLUSTER FUNCTION THAT USES THOSE TERMINALS DOES NOT OPERATE, CHECK BULBS, AND PRINTED CIRCUIT. IF OK, REPLACE THE INSTRUMENT CLUSTER (SEE SECTION 8C)
- IF THE CORRECT VOLTAGE OR RESISTANCE IS NOT FOUND AT A TERMINAL, DO THE TEST GIVEN OR GO TO THE PAGE REFERRED



B: CONNECTOR C2 PINOUT TEST

- IGNITION SWITCH IN RUN EXCEPT FOR RESISTANCE MEASUREMENTS
- MAKE ALL RESISTANCE MEASUREMENTS TO GROUND WITH THE NEGATIVE BATTERY CABLE REMOVED
- MEASURE VOLTAGES TO GROUND UNLESS ANOTHER TERMINAL IS GIVEN
- CLUSTER CONNECTOR C2 AS SEEN FROM THE DRIVER'S SEAT WITH THE INDICATORS CLUSTER REMOVED
- CONNECTOR C2 IS ON THE LEFT SIDE
- IF THE CORRECT VOLTAGE OR RESISTANCE IS FOUND AT THE TERMINALS, AND THE CLUSTER FUNCTION THAT USES THOSE TERMINALS DOES NOT OPERATE, CHECK THE BULBS AND PRINTED CIRCUIT. IF OK REPLACE THE INSTRUMENT CLUSTER (SEE SECTION 8C)
- IF THE CORRECT VOLTAGE OR RESISTANCE IS NOT FOUND AT A TERMINAL, DO THE TEST GIVEN OR GO TO THE PAGE REFERRED



HOOD/TRUNK/DOOR AJAR INDICATOR. GROUNDED WITH HOOD, TRUNK, OR DOOR OPEN. DO TESTS Q AND R.
DK GRN (146) 10

TEMPERATURE GAGE FROM COOLANT TEMPERATURE SENDER/SWITCH. 55 OHMS AT 260°F (127°C), 1365 OHMS AT 100°F (38°C) DO TESTS G, H AND I.
LT GRN (135) 11

PANEL ILLUMINATION INPUT. VARIABLE VOLTAGE WITH LIGHTS ON AND DIMMER CONTROL ADJUSTED. SEE SECTION 8A-117.
GRY (8) 12

IGNITION POWER FROM GAGES FUSE. SEE SECTION 8A-11.
9 PNK/BLK (39)

NOT USED
8

PANEL ILLUMINATION INPUT. VARIABLE VOLTAGE WITH LIGHTS ON AND DIMMER CONTROL ADJUSTED. SEE SECTION 8A-117.
7 GRY (8)

NOT USED
1

NOT USED
2

NOT USED
3

NOT USED
6

NOT USED
5

GROUND TO G201. SEE SECTION 8A-14.
4 BLK (150)

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C: CONNECTOR C3 PINOUT TEST

- IGNITION SWITCH IN RUN EXCEPT FOR RESISTANCE MEASUREMENTS
- MAKE ALL RESISTANCE MEASUREMENTS TO GROUND WITH THE NEGATIVE BATTERY CABLE REMOVED
- MEASURE VOLTAGES TO GROUND UNLESS ANOTHER TERMINAL IS GIVEN
- CLUSTER CONNECTOR C3 AS SEEN FROM THE DRIVER'S SEAT WITH THE INDICATORS CLUSTER REMOVED
- CONNECTOR C3 IS ON THE RIGHT SIDE
- IF THE CORRECT VOLTAGE OR RESISTANCE IS FOUND AT THE TERMINALS, AND THE CLUSTER FUNCTION THAT USES THOSE TERMINALS DOES NOT RESPOND CORRECTLY TO THE MEASURED INPUTS, CHECK THE BULBS AND PRINTED CIRCUIT, THEN REPLACE THE GAGE OR INSTRUMENT CLUSTER (SEE SECTION 8C)
- IF THE CORRECT VOLTAGE OR RESISTANCE IS NOT FOUND AT A TERMINAL, DO THE TEST GIVEN OR GO TO THE PAGE REFERRED

FROM ECM TO UPSHIFT INDICATOR. DO TEST S.
TAN/BLK (456) 1

LH TURN INDICATOR. FLASHING BATTERY VOLTAGE WITH LH TURN SIGNAL ON.
SEE SECTION 8A-110.
LT BLU (14) 2

PANEL ILLUMINATION. VARIABLE VOLTAGE WITH LIGHTS ON AND DIMMER CONTROL ADJUSTED.
SEE SECTION 8A-117.
GRY (8) 3

RH TURN INDICATOR. FLASHING BATTERY VOLTAGE WITH RH TURN SIGNAL ON.
SEE SECTION 8A-110.
DK BLU (15) 4

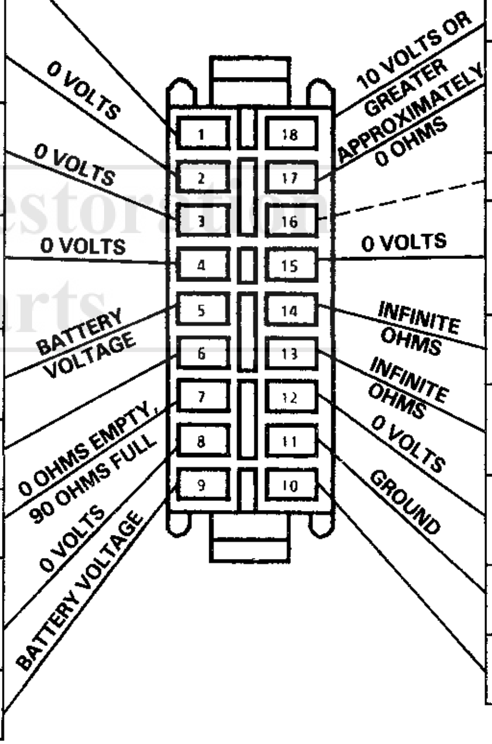
IGNITION POWER TO THE CHARGE INDICATOR.
SEE SECTION 8A-11.
PNK/BLK (39) 5

CHARGE INDICATOR.
SEE SECTION 8A-30.
BRN (25) 6

FUEL GAGE INPUT. 0 OHMS (EMPTY) TO 90 OHMS (FULL). DO TESTS D, F AND E.
PNK (30) 7

FASTEN BELTS INDICATOR. BATTERY VOLTAGE FOR ABOUT 6 SECONDS AFTER KEY IS SWITCHED TO RUN.
SEE SECTIONS 8A-75, 76, 77.
YEL (237) 8

IGNITION POWER FROM GAGES FUSE.
SEE SECTION 8A-11.
PNK/BLK (39) 9



TACHOMETER INPUT. DO TEST P.
18 WHT (121)

OIL PRESSURE GAGE FROM OIL PRESSURE SENDER. 0 OHMS (LOW) TO 90 OHMS (HIGH) OIL PRESSURE. DO TESTS L, M AND N.
17 TAN (31)

NOT USED
16

PANEL ILLUMINATION INPUT. VARIABLE VOLTAGE WITH LIGHTS ON AND DIMMER CONTROL ADJUSTED.
SEE SECTION 8A-117.
15 GRY (8)

BRAKE INDICATOR. 0 OHMS WITH PARK BRAKE SET. SEE SECTION 8A-41.
14 TAN/WHT (33)

COOLANT TEMPERATURE INDICATOR FROM COOLANT TEMPERATURE SENDER/SWITCH. DO TEST J AND K.
13 DK GRN (35)

HI BEAM INDICATOR. BATTERY VOLTAGE WITH HI BEAMS ON.
SEE SECTION 8A-100.
12 LT GRN (11)

GROUND TO G201.
SEE SECTION 8A-14.
11 BLK (150)

SERVICE ENGINE SOON INDICATOR.
SEE SECTION 6E.
10 BRN/WHT (419)

D: FUEL GAGE SHORT TEST

Disconnect Fuel Tank Unit connector. Turn the Ignition Switch to RUN. Wait 1 minute to allow the Gage to reach full.

- If Fuel Gage now indicates full, repair/replace the Fuel Gage Sender.
- If Fuel Gage still indicates empty, check/repair PNK (30) wires for shorts to ground, the Instrument Cluster Printed Circuit for flaws and the Fuel Gage connections. Replace the Fuel Gage if PNK (30) wires, Printed Circuit and Gage connections are OK (see Section 8C).

E: FUEL GAGE SENDER TEST

Disconnect Fuel Tank Unit connector and connect one red clip lead of tester J-33431 to the PNK (30) wire and the other to ground. Set the resistance dials of the tester to 0 ohms and then to 90 ohms. The Fuel Gage should read E and then F. Wait 1 minute to allow the Gage to reach Full.

- If the Gage responds correctly check the BLK (150) wire for an open. If OK, replace the Fuel Gage Sender.
- If the Gage does not respond correctly, check PNK (30) wire to the Instrument Cluster for high resistance. Also, inspect the Printed Circuit for proper mating of the connectors. Replace the Fuel Gage if the wire and Printed Circuit are good (see Section 8C).

F: FUEL GAGE OPEN TEST

Connect: FUSED JUMPER
At: FUEL TANK UNIT CONNECTOR (HARNESS HALF) (Disconnected)
Condition:
- **Ignition Switch: RUN**

Jumper Between	Correct Result	For Diagnosis
PNK & Ground	Fuel Gage reads E	See 1
PNK & BLK	Fuel Gage reads E	See 2

- If the Fuel Gage indicates correctly repair/replace the Fuel Gage Sender and its wires.

1. Check/repair PNK (30) wires for opens. Check Printed Circuit for flaws and for clean and tight Fuel Gage connections. Replace Fuel Gage if the above checks are OK (see Section 8C).
2. Check/repair the BLK (150) wire for an open (see schematic).

G: COOLANT TEMPERATURE GAGE SHORT TEST

Disconnect the Coolant Temperature Sender/Switch connector and put the Ignition Switch in RUN.

- If the Coolant Temperature Gage reads Cold, replace the Coolant Temperature Sender/Switch.
- If the Coolant Temperature Gage does not read Cold, check the Instrument Cluster Printed Circuit and the LT GRN and DK GRN/YEL (135) wires for a short to ground (see schematic). Replace the Coolant Temperature Gage if all wires are good (see Section 8C).

H: COOLANT TEMPERATURE GAGE OPEN TEST

Disconnect the Coolant Temperature Sender/Switch connector. Jumper the DK GRN/YEL (135) wire to ground and put the Ignition Switch in RUN.

- If the Coolant Temperature Gage reads Hot, replace the Coolant Temperature Sender/Switch.
- If the Coolant Temperature Gage still reads cold, check the LT GRN and DK GRN/YEL (135) wires, Printed Circuit, and Gage connections for an open. If OK, replace the Coolant Temperature Gage (see Section 8C).

I: COOLANT TEMPERATURE GAGE ACCURACY TEST

Disconnect the Coolant Temperature Sender connector. Connect one red clip lead of the J-33431 tester to the harness connector DK GRN/YEL (135) wire, and the other red clip lead to ground. Adjust the resistance dials of the tester to 1400 ohms and then to 55 ohms. The Coolant Temperature Gage should show Cold and then Hot.

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- If the Coolant Temperature Gage reads correctly, the wiring and Gage are good. Replace the Coolant Temperature Sender/Switch.
- If the Gage is not correct, check the Gage connection and the DK GRN/YEL (135) wire for high resistance. If OK replace the Coolant Temperature Gage (see Section 8C).

J: COOLANT TEMPERATURE INDICATOR SHORT TEST

Disconnect the Coolant Temperature Sender/Switch and put the Ignition Switch in RUN.

- If the Indicator stays on, check the DK GRN (35) wire and Printed Circuit for a short to ground.
- If the Indicator goes out, replace the Coolant Temperature Sender/Switch.

K: COOLANT TEMPERATURE INDICATOR OPEN TEST

Connect: A FUSED JUMPER
At: COOLANT TEMPERATURE SENDER/ SWITCH CONNECTOR (Disconnected)
Condition:
- **Ignition Switch: RUN**

Jumper Between	Correct Result	For Diagnosis
B (DK GRN) & Ground	Coolant Temperature Indicator comes on	See 1

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- If the result is correct, replace Coolant Temperature Sender/Switch.

1. Check DK GRN (35) wire and Instrument Cluster Printed Circuit for an open.

L: OIL PRESSURE GAGE SHORT TEST

Disconnect: CONNECTOR
At: OIL PRESSURE SENDER
Condition:
- **Ignition Switch: RUN**

Action	Correct Result	For Diagnosis
Disconnect Oil Pressure Sender Connector	Oil Pressure Gage shows high pressure	See 1

- If the result is correct, replace the Oil Pressure Sender.

1. Check TAN (31) wire (see schematic) for for a short to ground. Replace the Oil Pressure Gage, if the wire is OK (see Section 8C).

M: OIL PRESSURE GAGE OPEN TEST

Connect: FUSED JUMPER
At: OIL PRESSURE SENDER CONNECTOR (Disconnected)
Condition:
- **Ignition Switch: RUN**

Jumper Between	Correct Result	For Diagnosis
A (TAN) & Ground	Oil Pressure Gage shows low pressure	See 1

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- If the result is correct, replace the Oil Pressure Sender.

1. Check TAN (31) wire and Instrument Cluster Printed Circuit for an open. If wire and Printed Circuit are OK, replace the Oil Pressure Gage (see Section 8C).

N: OIL PRESSURE GAGE ACCURACY TEST

Disconnect the Oil Pressure Sender. Connect one red clip lead of the J-33431 tester to the harness connector, TAN (31) wire, and connect the other red clip lead to ground. Set the resistance dials of the sender to 0 ohms and then to 90 ohms. The Oil Pressure Gage should read low pressure and then high pressure.

- If the Oil Pressure Gage reads correctly, replace the Oil Pressure Sender.
- If the Oil Pressure Gage does not read correctly, check the TAN (31) wire, the Gage connections, and Printed Circuit. If they are good, replace the Oil Pressure Gage (see Section 8C).

O: VOLTMETER TEST

With the Ignition Switch in RUN, connect a voltmeter between the positive and negative terminals of the Battery.

- If the voltage reading on the test voltmeter is the same as the car's Voltmeter, the car's Voltmeter is OK.

- If the voltage reading on the test voltmeter is different from the car's Voltmeter, check the Voltmeter Gage connections and the PNK/BLK (39) wire for an open. If both are OK, repair/replace the Voltmeter (see Section 8C).

P: TACHOMETER TEST

Disconnect the Ignition Coil connector (VIN 9) or the Direct Ignition System connector (VIN R). Connect the J-33431 Instrument Panel Tester to the Ignition Coil connector (VIN 9) or Direct Ignition System connector (VIN R) using the J-33431-4 or J-33431-10 harness connector. Connect the tester ground lead to a known good ground. Plug the tester into an outlet and put the Ignition Switch in RUN. Turn the tester on and set the speed signal switch to 54 mph.

- If the Tachometer reads 1350 rpm (VIN 9) 1800 (VIN R), check the Ignition Coil connector (VIN 9) or Direct Ignition System connector (VIN R). It should be clean and tight.
- If the Tachometer does not read correctly, check the WHT (121) wire for an open. If OK, replace the Tachometer (see Section 8C).

Q. AJAR INDICATOR IS ALWAYS ON

With the Ignition switch in RUN disconnect the Trunk Ajar Switch, Hood Ajar Switch, LH Door Ajar Switch and RH Door Ajar Switch connectors one at a time (see schematic).

- If the AJAR Indicator goes out replace the Switch at fault.
- If the AJAR Indicator is still lit with all four wires disconnected, check the DK GRN (146), BLK/PNK (158), and BLK/ORN (158) wires and Instrument Cluster Printed Circuit for a short to ground.

R: AJAR INDICATOR DOES NOT LIGHT FOR ONLY ONE INPUT

Disconnect the suspect door, trunk, or Hood Ajar Switch connector. Jumper the connector wire to ground and put the Ignition Switch in RUN.

- If the Indicator lights, check the BLK (150) wire for an open (except Hood Ajar Switch connector). If OK, replace the suspect Switch.
- If the Indicator does not light, check the suspect wire for an open (see schematic).

S: UPSHIFT INDICATOR WIRE TEST

Disconnect ECM connector C2. Put the Ignition Switch in RUN and measure the voltage at terminal 7 (Electronic Fuel Injection), terminal A7 (Multi-port Fuel Injection) (see Section 8A-20).

- If battery voltage is present, see section 6E for ECM diagnosis.
- If battery voltage is not present, check the TAN/BLK (456) wire for an open.

T: INACCURATE SPEEDOMETER AND ODOMETER TEST

Remove the connector to the Vehicle Speed Sensor. Plug the mating connector from the J-33431 I/P tester into the Vehicle Speed Sensor connector harness. With the tester set to "ON", "54 mph" and "60 Hz" and the Ignition Switch in RUN: the Speedometer should read 54 mph ±2 mph.

- If the Speedometer reads correctly, replace the Vehicle Speed Sensor.
- If the Speedometer reads incorrectly, check the PPL/WHT (401) and YEL (400) wires for high resistance. If the wires are OK, replace the Speedometer assembly.

U: ODOMETER(S) ARE NOT ACCURATE

Remove the Instrument Cluster. See Section 8C of the Service Manual for Cluster Removal. Disassemble the cluster and remove the small Odometer connectors from the Speedometer circuit board. Connect I/P tester J-33431-3. Plug in the I/P tester and set it to ON, 54 mph, and 60 Hz. With the Odometer test switch held down, the Odometer should turn and change the mileage shown, about 1.8 miles per minute.

- If the Odometer does not turn, replace the stepper motor (see Section 8C).
- If the Odometer turns about 2.9 miles per minute, a metric Odometer could have been installed. Check to see that the correct Odometer assembly was installed (see Section 8C).

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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 system's battery voltage.

Coolant Temperature Indicator

The Coolant Temperature Indicator warns the driver of high coolant temperature. With the Ignition Switch in RUN, BULB TEST or START, voltage from the GAGES Fuse is applied to 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 indicator light 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 Cluster. The Solid State circuit drives the pointer of the Speedometer. This 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. The Tachometer responds to the frequency of the voltage pulses which increases with engine speed. In coil equipped vehicles (VIN 9) there is a Tachometer Filter in the circuit that rounds off the pulses and removes voltage spikes.

Solid State circuits process these pulses into a signal that drives the pointer of the meter.

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

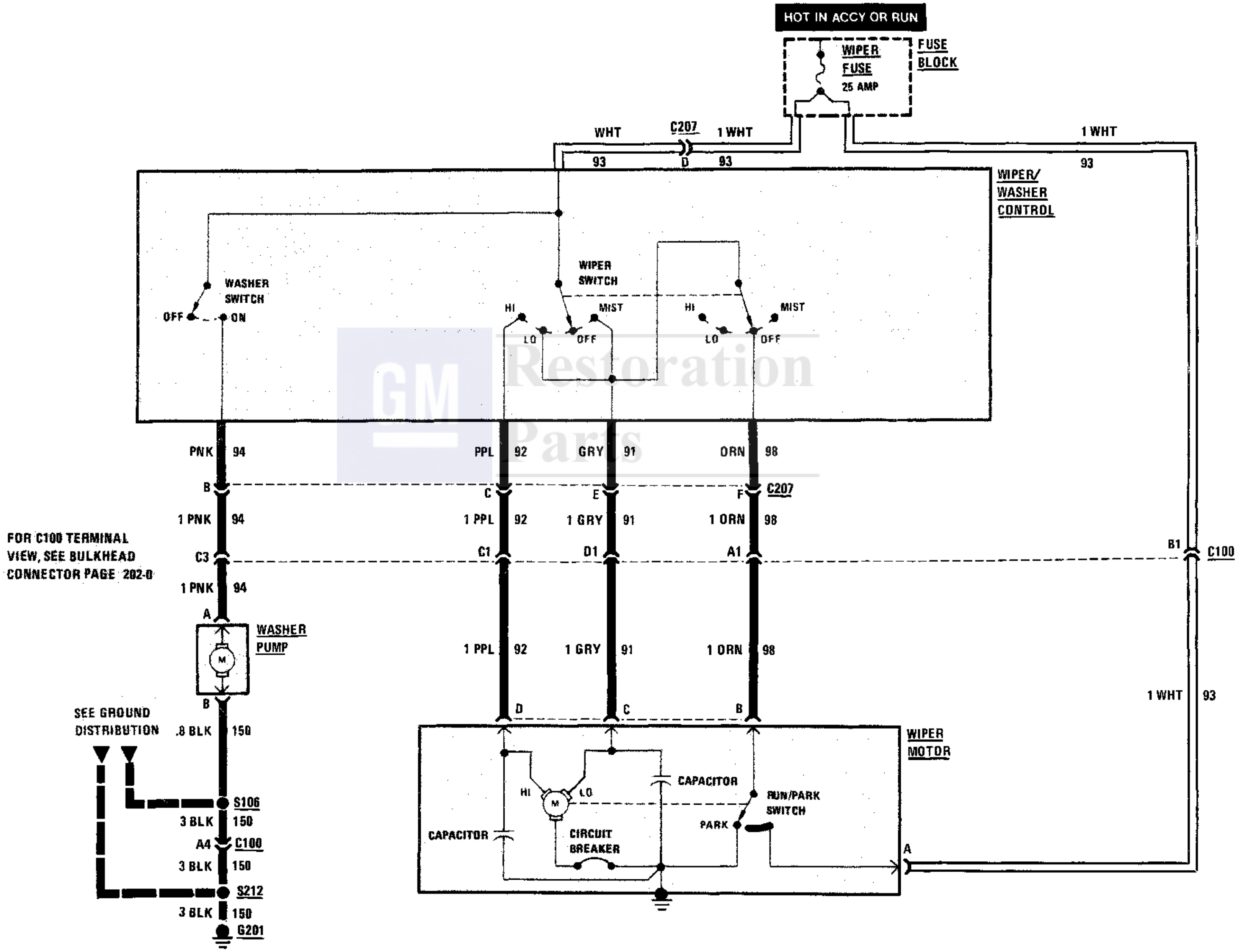
The Voltmeter measures the electrical system voltage with the Ignition Switch in RUN, BULB TEST, or START. With the engine running, the Voltmeter indicates Charging System operation. With the engine stopped, the Voltmeter indicates battery condition.

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.

BLANK

WIPER/WASHER



WIPER/WASHER

TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Check.**

1. Check WIPER Fuse by visual inspection.
2. Check that the three Wiper Motor mounting bolts are clean and tight.
3. Check that the Wiper/Washer Control connector C207 is mated correctly.
4. If the Washer does not operate, check that:

— Washer reservoir if filled.
— Hoses are not pinched or kinked.
— Hoses are correctly attached.
— Nozzles are not clogged.

- **Go to System Check for a guide to normal operation.**
- **Go to System Diagnosis for diagnostic tests.**

SYSTEM CHECK

- **Use the System Check Table as a guide to normal operation.**
- **Refer to System Diagnosis for a list of symptoms and diagnostic steps.**

SYSTEM CHECK TABLE

ACTION	NORMAL OPERATION
Hold Washer Switch ON for about 1 second	Washer sprays windshield as long as Washer Button is held ON Wipers run at Low speed and continue to run at Low speed until turned off manually
With Wiper Switch in HI, hold the Washer Switch ON for about 1 second	Same operation as Low speed wash except that the wipers run at High speed
Move Wiper Switch to LO	Wipers run continuously at Low speed
Move Wiper Switch to HI	Wipers run continuously at high speed
Move Wiper Switch to OFF	Wipers return to PARK position at Low speed

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COMPONENT LOCATION

		Page-Figure
Fuse Block	Behind LH side of I/P	201- 6-D
Washer Pump	Front compartment, LH side of washer fluid reservoir	201- 9-F
Wiper Motor	Front compartment, center of front bulkhead	201-10-B
C100 (34 cavities)	LH side of front bulkhead, right of brake master cylinder	201-13-A
C207 (7 cavities)	Behind dash, near steering column	201- 8-F
G201	Behind center of I/P	201- 6-C
S106	Heater-A/C harness, center of front bulkhead	201-13-A
S212	Main harness, behind center of dash	201- 6-C

- **Refer to System Diagnosis when a result is not normal.**

SYSTEM DIAGNOSIS

- **Do the tests listed for your symptom in the Symptom Table below.**
- **Tests follow the Symptom Table.**

SYMPTOM TABLE

SYMPTOM	DO TEST
Wipers do not operate in any mode	A: Wiper/Washer Control Battery Voltage Test B: Wiper Motor Input Voltage Test
Wipers run in Low speed only (High speed inoperative)	B: Wiper Motor Input Voltage Test
Wipers run in High speed only (Low Speed inoperative)	B: Wiper Motor Input Voltage Test
Wipers will not shut off	B: Wiper Motor Input Voltage Test
Washer will not operate	C: Washer Pump Voltage Test

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A: WIPER/WASHER CONTROL BATTERY VOLTAGE TEST

Measure: VOLTAGE
At: WIPER/WASHER CONTROL CONNECTOR C207 (Disconnected)
Condition:
- **Ignition Switch: ACCY**

Measure Between	Correct Voltage	For Diagnosis
D (WHT) & Ground	Battery	See 1

- If voltage is correct, do Test B.

1. Check WIPER Fuse and WHT (93) wire for an open.

B: WIPER MOTOR INPUT VOLTAGE TEST

Measure: VOLTAGE
At: WIPER MOTOR CONNECTOR (Disconnected)
Conditions:
- **Ignition Switch: ACCY**
- **Wiper Switch: LO & MIST**

Measure Between	Correct Voltage	For Diagnosis
C (GRY) & Ground	Battery	See 1
• Wiper Switch: HI		
D (PPL) & Ground	Battery	See 2
• Wiper Switch: OFF		
B (ORN) & Ground	0 Volts	See 3
• Wiper Switch: OFF, LO, & HI		
A (WHT) & Ground	Battery	See 4

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- If all voltages are correct, but the Wiper Motor does not operate normally, remove the Wiper Motor for repair. See Section 8E for diagnostic procedures.

1. Check GRY (91) wire for an open. Check that connectors C207 and C100 are correctly mated. If wire and connectors are OK, replace the Wiper/Washer Control.
2. Check PPL (92) wire for an open. Check that connectors C207 and C100 are properly mated. If wire and connectors are OK, replace the Wiper/Washer Control.
3. Check ORN (98) wire for an open. Check that connectors C207 and C100 are properly mated. If wire and connectors are OK, replace the Wiper/Washer Control.
4. Check WHT (93) wire for an open. If OK, check the WIPER Fuse.

C: WASHER PUMP VOLTAGE TEST

Measure: VOLTAGE
At: WASHER PUMP CONNECTOR (Disconnected)
Conditions:
- **Ignition Switch: ACCY**
- **Wiper Switch: OFF, HI, or LO**
- **Washer Switch: ON**

Measure Between	Correct Voltage	For Diagnosis
A (PNK) & Ground	Battery	See 1
A (PNK) & B (BLK)	Battery	See 2

- If all voltages are correct, replace the Washer Pump.

1. Check that connectors C207 and C100 are properly mated. Check PNK (94) wire for an open. If OK, replace the Wiper/Washer Control.
2. Check BLK (150) wire for an open. Check that ground G201 is clean and tight.

CIRCUIT OPERATION

When the Wiper/Washer Switch is in LO or MIST, Battery voltage is applied to the Wiper Motor through the GRY wire. In Lo, the Wiper Motor will continue to run at Low speed until the Wiper Switch is turned to the OFF position.

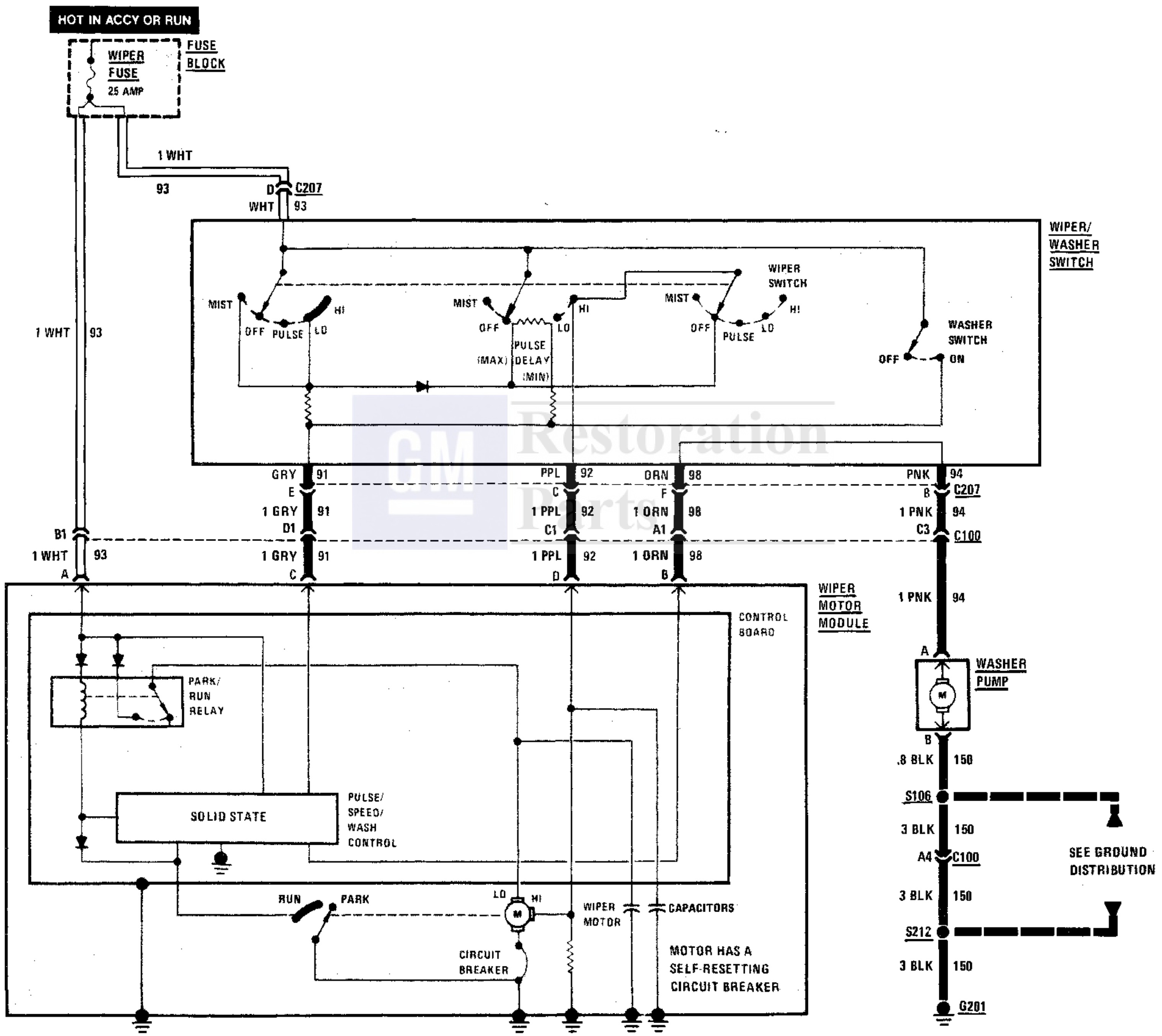
When the Wiper Switch is turned to OFF, voltage is still applied to the Wiper Motor at the Low speed brushes through the Run/Park Switch, and ORN and GRY wires. The wipers complete the last sweep in Low speed. When the wiper blades reach the PARK position, the Run/Park Switch opens, shunting the Wiper Motor causing it to stop immediately. The wipers remain in the PARK position.

When the Wiper Switch is in HI, Battery voltage is applied directly to the Wiper Motor through the PPL wire to the High speed brushes. The wipers run continuously at High speed. When turned off, the wipers make the last sweep in Low speed and park, similar to LO speed operation.

The Wiper Motor is protected by a Circuit Breaker. The Circuit Breaker opens if the wipers are blocked by ice on the windshield, for example. The Circuit Breaker resets automatically when it cools.

When the Washer Switch is pressed, Battery voltage is applied to the Washer Pump and the Wiper Switch is mechanically advanced to the LO position. The washer sprays the windshield as long as the switch is held on. The wipers must be turned off manually after the wash cycle.

WIPER/WASHER: PULSE



WIPER/WASHER: PULSE

TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Check.**

1. Check the Wiper Fuse by visual inspection.
2. Check that the three Wiper Motor mounting bolts are clean and tight.
3. Check that connector C207 and the Wiper Motor Module connector are mated correctly.
4. If the Washer does not operate, check that:
   - The Washer reservoir is filled.
   - The hoses are not pinched or kinked.
   - The hoses are correctly attached.
   - The nozzles are not clogged.

- **Go to System Check for a guide to normal operation.**
- **Go to System Diagnosis for diagnostic tests.**

SYSTEM CHECK

- **Use the System Check Table as a guide to normal operation.**
- **Refer to System Diagnosis for a list of symptoms and diagnostic steps.**

COMPONENT LOCATION

		Page-Figure
Fuse Block	Behind LH side of I/P	201- 6-D
Washer Pump	Front compartment, LH side of washer fluid reservoir	201- 9-F
Wiper Motor Module	Front compartment, center of front bulkhead	201-10-B
C100 (34 cavities)	LH side of front bulkhead, right of brake master cylinder	201-13-A
C207 (7 cavities)	Behind dash, near steering column	201- 8-F
G201	Behind center of I/P	201- 6-C
S106	Heater-A/C harness, center of front bulkhead	201-13-A
S212	Main harness, behind center of dash	201- 6-C

SYSTEM CHECK TABLE

ACTION	NORMAL OPERATION
Press the Washer Switch for a short interval (less than one second)	The Washer sprays the windshield and continues to spray for 2½ seconds after switch is released The Wipers run at low speed and continue for approximately 6 seconds after spray cycle is completed, then return to park
Turn the Wiper Switch to PULSE (delay mode)	The Wipers make one complete stroke, then pause for 0 to 25 seconds before making the next stroke The wait time is adjusted by turning the Wiper Switch through the delay range

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WIPER/WASHER: PULSE

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With the Wiper Switch in PULSE, push Washer Switch to ON for one or two seconds	The Washer sprays the windshield as long as the Washer Switch is held ON The Wipers run at low speed during spray period and continue running for approximately 6 seconds after the Washer stops The Wipers return to pulse operation
Turn the Wiper Switch to LO	The Wipers run continuously at low speed
Turn the Wiper Switch to HI	The Wipers run at a faster speed
Turn the Wiper Switch to OFF	The Wipers return to the park position at low speed
Turn the Wiper Switch to MIST	The Wipers make one complete stroke and then park

- **Refer to System Diagnosis when a result is not normal.**

SYSTEM DIAGNOSIS

- **Do the tests listed for your symptom in the Symptom Table below.**
- **Tests follow the Symptom Table.**

SYMPTOM TABLE

SYMPTOM	DO TEST
Wipers do not operate in any mode	A: Wiper/Washer Battery Voltage Test B: Wiper Motor Module Input Voltage Test
No delay in pulse mode	C: Wiper/Washer Pulse Control Resistance Test
Wipers will not shut off Wipers run at high speed only (low speed inoperative)	B: Wiper Motor Module Input Voltage Test
Washer will not operate	B: Wiper Motor Module Input Voltage Test D: Washer Pump Test
Wipers run at low speed only, high speed inoperative	B: Wiper Motor Module Input Voltage Test

A: WIPER/WASHER BATTERY VOLTAGE TEST

Measure: VOLTAGE
At: WIPER/WASHER SWITCH CONNECTOR C207 (Disconnected)
Condition:

- **Ignition Switch: ACCY**

Measure Between	Correct Voltage	For Diagnosis
D (WHT) & Ground	Battery	See 1

- If the voltage is correct, return to the Symptom Table.

1. Check the WIPER Fuse and the WHT (93) wire for opens.

B: WIPER MOTOR MODULE INPUT VOLTAGE TEST

Measure: VOLTAGE
At: WIPER MOTOR MODULE CONNECTOR (Connected)
Condition:

- **Ignition Switch: ACCY**

Measure Between	Correct Voltage	For Diagnosis
• Wiper Switch: ANY POSITION		
A (WHT) & Ground	Battery	See 1
• Wiper Switch: MIST, LO, or HI		
C (GRY) & Ground	Battery	See 2
• Wiper Switch: HI		
D (PPL) & Ground	Battery	See 3

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WIPER/WASHER: PULSE

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- Wiper Switch: OFF
- Washer Switch: ON

C (GRY) & Ground	Battery	See 4

- If all the voltages are correct but the Wiper Motor Module does not operate normally, remove the Wiper Motor Module for repair. See Section 8E for diagnostic procedures.

1. Check the WHT (93) wire for an open back to the WIPER Fuse.
2. Check the GRY (91) wire for an open. If the wire is good, replace the Wiper/Washer Switch.
3. Check the PPL (92) wire for an open. If the wire is good, replace the Wiper/Washer Switch.
4. Replace the Wiper/Washer Switch.

C: WIPER/WASHER PULSE CONTROL RESISTANCE TEST

Measure: RESISTANCE
At: WIPER MOTOR MODULE CONNECTOR (Disconnected)
Conditions:

- **Ignition Switch: OFF**
- **Negative Battery Terminal: DISCONNECTED**
- **Wiper Switch: LO**
- **Ohmmeter positive lead to terminal A (WHT)**

Measure Between	Correct Resistance	For Diagnosis
A (WHT) & C (GRY)	Approx. 10 K ohms	See 1

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- Move the Wiper Switch through delay range to the maximum delay position

A (WHT) & C (GRY)	Resistance increases to approximately 500 K ohms	See 1

- If the resistances are correct but the pulse mode does not operate, remove the Wiper Motor Module for repair (see Section 8E for diagnostic instructions).

1. Check the WHT (93) and GRY (91) wires for opens. If the wires are good, replace the Wiper/Washer Switch.

D: WASHER PUMP TEST (TABLE 1)

Measure: VOLTAGE
At: WIPER MOTOR MODULE (Connected)
Conditions:

- **Ignition Switch: ACCY**
- **Washer Switch: ON**

Measure Between	Correct Voltage	For Diagnosis
C (GRY) & Ground	Battery	See 1
B (ORN) & Ground	Battery	See 2

- If the voltages are correct, go to Table 2.

1. Check the GRY (91) wire for an open. If the wire is good, replace the Wiper/Washer Switch.
2. Replace the Control Board.

D: WASHER PUMP TEST (TABLE 2)

Measure: VOLTAGE
At: WASHER PUMP (Disconnected)
Conditions:

- **Ignition Switch: ACCY**
- **Washer Switch: ON**

Measure Between	Correct Voltage	For Diagnosis
A (PNK) & Ground	Battery	See 1
A (PNK) & B (BLK)	Battery	See 2

- If the voltages are correct, replace the Washer Pump (see Section 8E for the procedure).

1. Check the ORN (98) and PNK (94) wires for an open. If they are good, replace the Wiper/Washer Switch.
2. Check the BLK (150) wire for an open to ground.

CIRCUIT OPERATION

The Wiper/Washer Switch sends signals to the Solid State Pulse/Speed/Wash Control which is mounted inside the Wiper Motor Module.

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.

LOW SPEED

Battery voltage is applied to the Wiper/Washer Switch and the Park/Run Relay through the WHT (93) wires. With the Wiper/Washer

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Switch in MIST, LO, HI, or WASHER position, voltage is applied to the Solid State Control through the GRY (91) wire. This voltage signals the Solid State Control to ground the coil of the Park/Run Relay. With the Park/Run Relay energized, voltage is applied through the contacts of the relay to the Wiper Motor for low speed operation.

PARK

When the Wiper/Washer switch is turned to OFF, the Park/Run Switch provides the ground for the Park/Run Relay. The relay contacts remain closed and the Wiper Motor continues to run in low speed until the Wipers reach PARK position. At this time, a cam on the large gear mechanically opens the Park/Run Switch, which removes ground from the Park/Run Relay. This de-energizes the relay, and the relay contacts open. Battery voltage is removed from the Wiper Motor, shutting off the Wipers.

HIGH SPEED

For high speed wiping, battery voltage from the Wiper/Washer Switch is directly applied to the HI speed terminal of the Wiper Motor through the PPL (92) wire. When the Wiper/Washer Switch is turned to OFF, the Wipers park at the low speed under control of the Park/Run Switch.

PULSE

With the Wiper/Washer Switch in PULSE, voltage is applied to the Solid State Pulse/Speed/Wash Control through the GRY (91) wire. This voltage signals the Solid State Pulse/Speed/Wash Control to momentarily ground the coil of the Park/Run Relay. With the Park/Run Relay energized, voltage is applied through the contacts of the relay to the Wiper Motor.

After the Wipers have started, the Park/Run Switch supplies battery voltage until the Wipers return to PARK position. The Wipers remain parked until the Solid State Pulse/Speed/Wash Control again grounds the Park/Run Relay coil.

The length of the delay time between strokes is controlled by the variable pulse delay resistor. From the low position, the delay cycles are 18, 10, 6, 3, and 1.25 seconds.

MIST

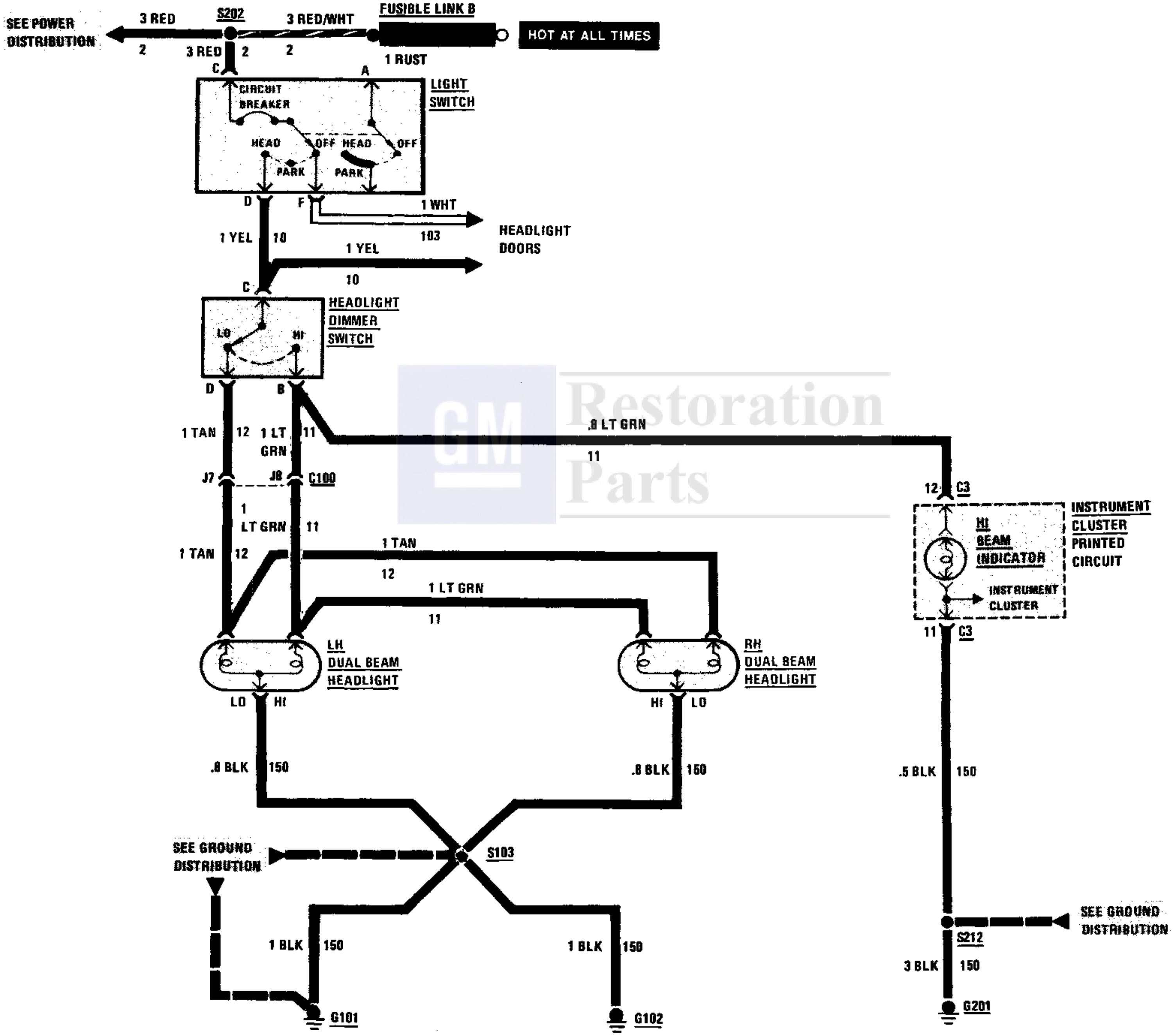
When the control is moved to MIST and released, the Wipers make one sweep at low speed and return to park. The circuit operation is the same as that of LO.

WASHER

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.**

BLANK

HEADLIGHTS


SEE POWER DISTRIBUTION
3 RED
2
S202
3 RED
2
3 RED/WHT
2
FUSIBLE LINK B
1 RUST
HOT AT ALL TIMES
C
A
CIRCUIT BREAKER
LIGHT SWITCH
HEAD
OFF
HEAD
OFF
PARK
PARK
D
F
1 WHT
103
HEADLIGHT DOORS
1 YEL
10
1 YEL
10
C
HEADLIGHT DIMMER SWITCH
LO
HI
D
B
1 TAN
12
1 LT GRN
11
.8 LT GRN
11
J7
J8
C100
1 LT GRN
11
1 TAN
12
1 TAN
12
1 LT GRN
11
LH DUAL BEAM HEADLIGHT
RH DUAL BEAM HEADLIGHT
LO
HI
HI
LO
.8 BLK
150
.8 BLK
150
SEE GROUND DISTRIBUTION
S103
1 BLK
150
1 BLK
150
G101
G102
12
C3
INSTRUMENT CLUSTER PRINTED CIRCUIT
HI BEAM INDICATOR
INSTRUMENT CLUSTER
11
C3
.5 BLK
150
S212
SEE GROUND DISTRIBUTION
3 BLK
150
G201

HEADLIGHTS

TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Diagnosis.**

1. If the Headlights on one side are on dimly, check the ground on that side.
2. If Hi Beams do not light, but the Hi Beam Indicator lights, check the LT GRN (11) wire for an open (see schematic).
3. If one Headlight doesn't work, check the Headlight, connections, and wires to the Headlight.
4. If the Headlights do not turn off, replace the Light Switch.

- **Go to System Diagnosis for diagnostic tests.**

SYSTEM DIAGNOSIS

- **Diagnostic steps for the symptoms listed in the following table are listed after the table.**

SYMPTOM TABLE

A. All Headlights are inoperative or intermittent

B. Lo Beams on both sides are inoperative or Hi Beams and Hi Beam Indicator are inoperative.

COMPONENT LOCATION

COMPONENT LOCATION		Page-Figure
Fusible Link B	RH front of engine compartment, at Battery Junction Block	201- 4-A
Headlight Dimmer Switch	Lower LH side of steering column	201- 8-B
C100 (34 cavities)	LH side of front bulkhead, right of brake master cylinder	201-13-A
G101	On LH fender, below headlamp	201-11-C
G102	On RH fender, below headlamp	201-11-C
G201	Behind center of I/P	201- 6-C
S103	Forward lamp harness, near bulkhead connector	201-10-C
S202	Main harness, behind I/P	201- 7-A
S212	Main harness, behind center of dash	201- 6-C

A: ALL HEADLIGHTS ARE INOPERATIVE OR INTERMITTENT (TABLE 1)

Connect: TEST LAMP
At: LIGHT SWITCH CONNECTOR
(Connected)
Condition:
- **Light Switch: HEAD**

Connect Between	Correct Result	For Diagnosis
C (RED) & Ground	Test Lamp lights	See 1
D (YEL) & Ground	Test Lamp lights	Go to Table 2

- If both results are correct, go to Test B.

1. Check Fusible Link B and RED (2) wire for an open (see Power Distribution).

A: ALL HEADLIGHTS ARE INOPERATIVE OR INTERMITTENT (TABLE 2)

Connect: FUSED JUMPER
At: LIGHT SWITCH CONNECTOR
(Disconnected)
Conditions:
- **Put a 15 amp fuse in the fused jumper**
- **Dimmer Switch: LO**

Connect Between	Correct Indication	For Diagnosis
C (RED) & D (YEL)	Headlights light	See 1
• Dimmer Switch: HI		
C (RED) & D (YEL)	Hi Beams Light	See 1

- If results are correct, replace the Light Switch.

1. Check for short to ground in wiring to Headlights.

(Continued on next page)

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B: LO BEAMS ON BOTH SIDES ARE INOPERATIVE OR HI BEAMS AND HI BEAM INDICATOR ARE INOPERATIVE

Connect: TEST LAMP
At: HEADLIGHT DIMMER SWITCH CONNECTOR (Connected)
Conditions:
- **Light Switch: HEAD**
- **Dimmer Switch: LO**

Connect Between	Correct Result	For Diagnosis
(YEL) & Ground	Test Lamp lights	See 1
(TAN) & Ground	Test Lamp lights	See 2
• Dimmer Switch: HI		
(LT GRN) & Ground	Test Lamp lights	See 2

- If all results are correct, check wiring to lights for an open.

1. Check YEL (10) wire for an open.
2. Replace Headlight Dimmer Switch.

CIRCUIT OPERATION

Voltage is applied to the Light Switch at all times. The Light Switch includes a self-resetting Circuit Breaker. The Circuit Breaker opens when the Headlight circuit draws too much current. When the Circuit Breaker opens, it interrupts the current flow. With no current flow, the Circuit Breaker cools off and resets automatically. When the Light Switch is in HEAD, the Headlight Dimmer Switch directs voltage to either the Lo Beams or the Hi Beams. The Hi Beam Indicator also receives voltage along with the Hi Beams.

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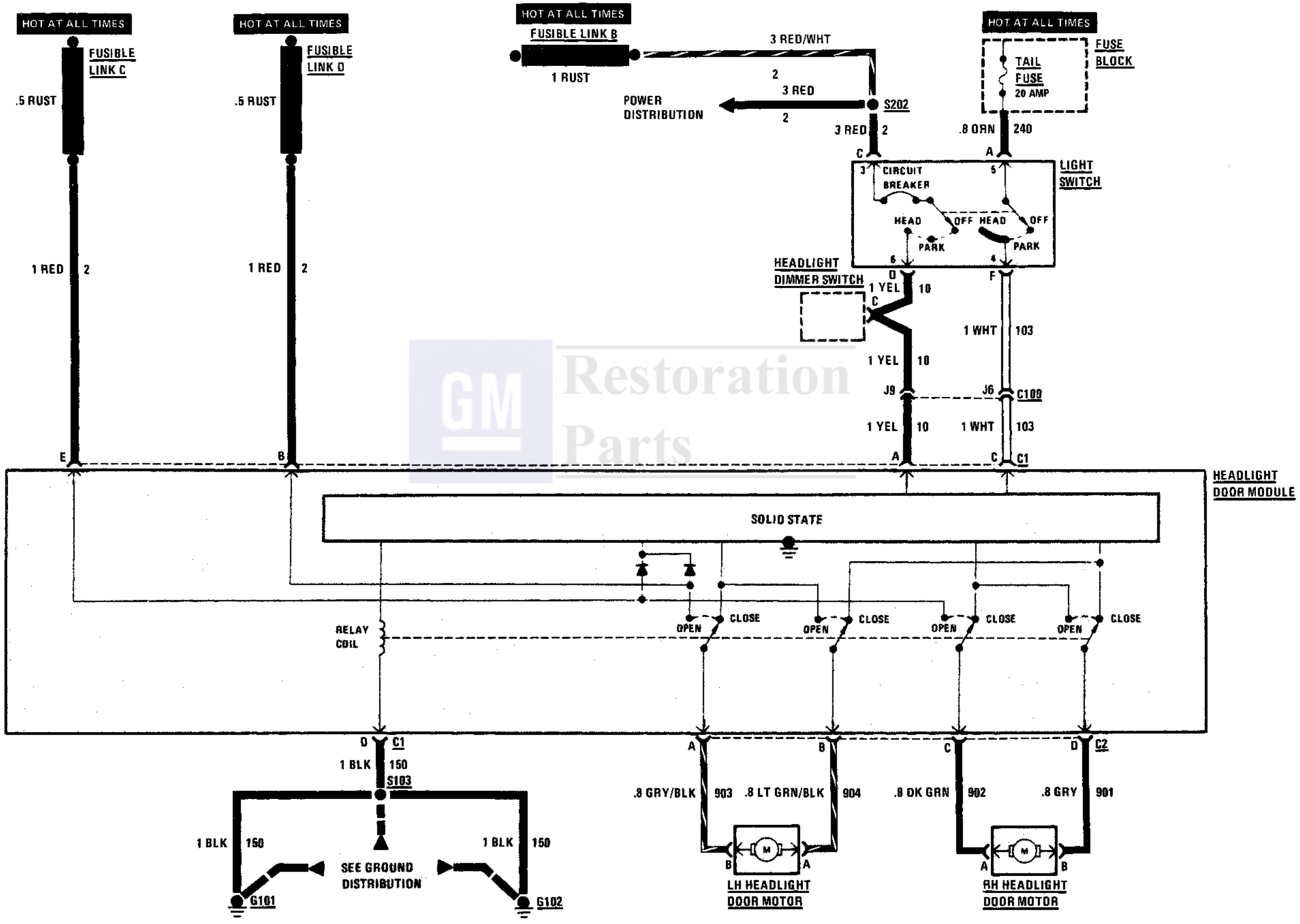
HEADLIGHT DOORS



HEADLIGHT DOORS

TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Check.**

1. If the Headlight Doors do not operate, check Fusible Link B and associated wiring to the Light Switch for an open.
2. Check that grounds G101 and G102 are clean and tight.
3. Check Fusible Links C and D for an open.

- **Go to System Check for a guide to normal operation.**
- **Go to System Diagnosis for diagnostic tests.**

SYSTEM CHECK

- **Use the System Check Table as a guide to normal operation.**
- **Refer to System Diagnosis for a list of symptoms and diagnostic steps.**

SYSTEM CHECK TABLE

ACTION	NORMAL RESULT
Put Light Switch in HEAD	Headlight Doors open and Headlights light
Put Light Switch in PARK	Headlights go out; Headlight Doors stay open
Put Light Switch in OFF	Headlight Doors close

- **Refer to System Diagnosis when a result is not normal.**

COMPONENT LOCATION

		Page-Figure
Fuse Block	Behind LH side of I/P	201- 6-D
Fusible Link B	RH front of engine compartment, at Battery Junction Block	201- 4-A
Fusible Link C	In forward lamp harness, right of brake master cylinder	201-10-C
Fusible Link D	In foward lamp harness, right of brake master cylinder	201-10-C
Headlight Dimmer Switch	Lower LH side of steering column	201- 8-B
Headlight Door Module	Lower LH side of front compartment	201-11-C
Headlight Door Motors	Front compartment, in each headlight assembly	201-11-C
C100 (34 cavities)	LH side of front bulkhead, right of brake master cylinder	201-13-A
G101	On LH fender, below headlamp	201-11-C
G102	On RH fender, below headlamp	201-11-C
S103	Forward lamp harness, near bulkhead connector	201-10-C
S202	Main harness, behind I/P	201- 7-A

SYSTEM DIAGNOSIS

- **Do the tests listed for your symptom in the Symptom Table below.**
- **Tests follow the Symptom Table.**

SYMPTOM TABLE

A. Neither Headlight Door operates properly
B. LH Headlight Door does not operate properly.
C. RH Headlight Door does not operate properly.

A: NEITHER HEADLIGHT DOOR OPERATES PROPERLY

Connect: TEST LAMP
At: HEADLIGHT DOOR MODULE CONNECTOR C1 (Disconnected)
Condition:

- **Light Switch: OFF**

Connect Between	Correct Result	For Diagnosis
B (RED) & Ground	Test Lamp lights	See 1
E (RED) & Ground	Test Lamp lights	See 1

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HEADLIGHT DOORS

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C (WHT) & Ground	Test Lamp lights	See 2
C (WHT) & D (BLK)	Test Lamp lights	See 3
• Light Switch: HEAD		
A (YEL) & Ground	Test Lamp lights	See 4

- If all results are correct, replace Headlight Door Module.

1. Check Fusible Link C or D and RED (2) wire for an open (see schematic).
2. Check TAIL Fuse, Light Switch, and WHT (103) wire for an open (see schematic).
3. Check BLK (150) wire for an open.
4. Refer to Headlights, Section 8A-100.

B: LH HEADLIGHT DOOR DOES NOT OPERATE PROPERLY

1. Check for mechanical binding.
2. Remove connector C2 from the Headlight Door Module. (Leave C1 connected.) Connect fused jumpers from terminal A (GRY/BLK) of connector C2 to terminal C of the Module, and from terminal B (LT GRY/BLK) of the connector to terminal D of the Module. Operate the Headlights.
   - If the LH Headlight Door works, replace the Headlight Door Module.
   - If LH Headlight Door does not work, check wiring to the motor. Replace the motor if the wiring is OK.

C: RH HEADLIGHT DOOR DOES NOT OPERATE PROPERLY

1. Check for mechanical binding.
2. Remove connector C2 from the Headlight Door Module. (Leave C1 connected.) Connect fused jumpers from terminal C (DK GRN) of connector C2 to terminal A of the Module, and from terminal D (GRY) of the connector to terminal B of the Module. Operate the Headlights.

- If RH Headlight Door works, replace the Headlight Door Module.
- If RH Headlight Door does not work, check wiring to the motor. Replace the motor if the wiring is OK.

CIRCUIT OPERATION

Voltage to open the Headlight Doors and to power the Solid State circuitry is applied at all times to the Headlight Door Module at terminals B and E of connector C1. With the Light Switch in OFF, voltage to close the Headlight Doors is applied to terminal C of connector C1. With the Light Switch in HEAD, voltage to energize the Relay coil is applied to terminal A of connector C1.

When the Light Switch is moved to HEAD, voltage is applied to the Headlight Door Motors through the relay contacts in the OPEN position. Ground is provided for the motors through the Solid State circuitry until the Headlight Doors are open.

When the Light Switch is moved to OFF, voltage is reversed across the Headlight Door Motors and the motors run in the opposite direction to close the Headlight Doors. When the Headlight Doors are closed, the Solid State circuitry senses that the motors are not operating and ground is removed.

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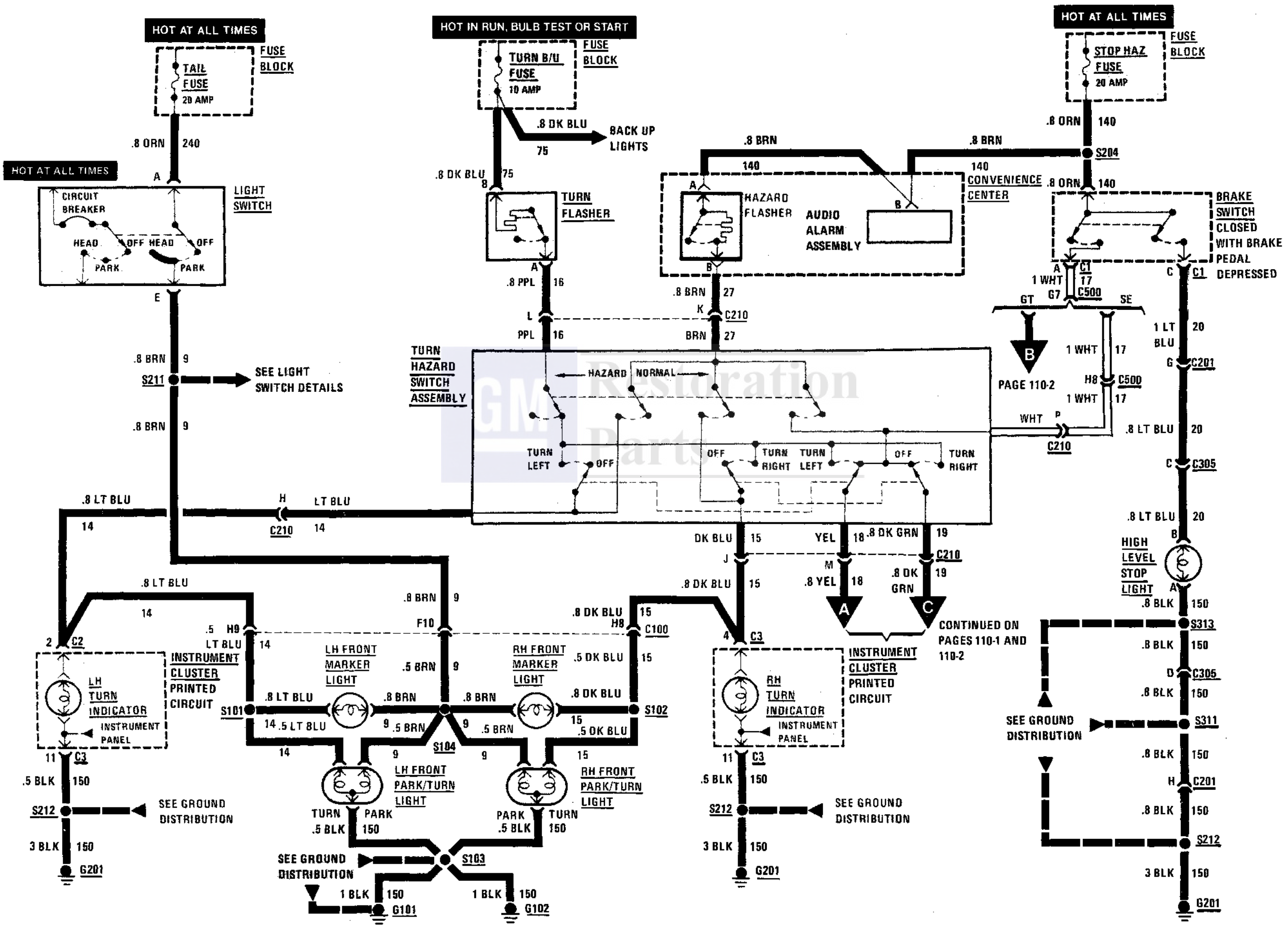
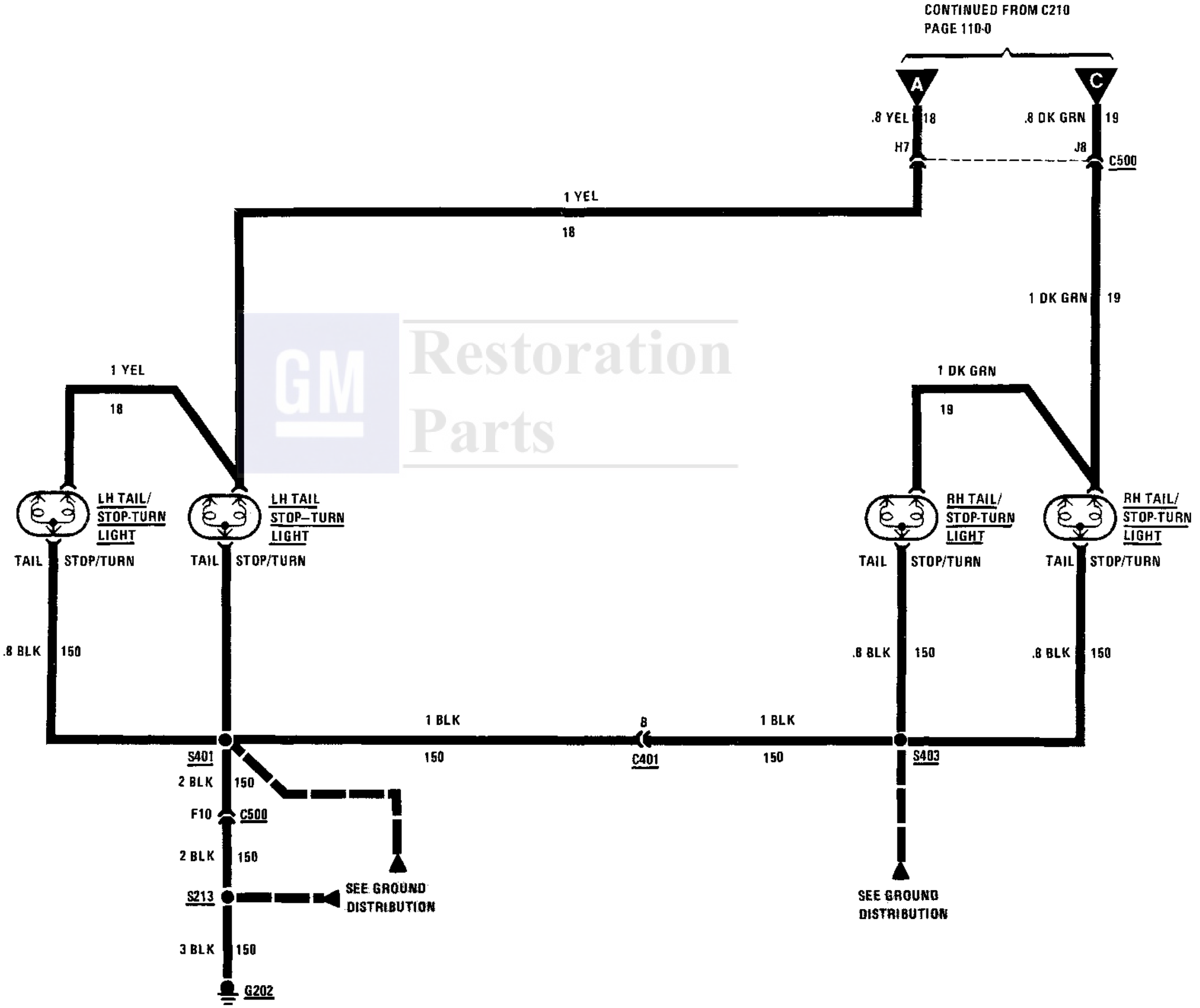
EXTERIOR LIGHTS: TURN/HAZARD/PARK/FRONT MARKER/STOP/ HIGH LEVEL STOP



EXTERIOR LIGHTS: TAIL/STOP/TURN

SE MODELS



EXTERIOR LIGHTS: TAIL/STOP/TURN

GT MODELS

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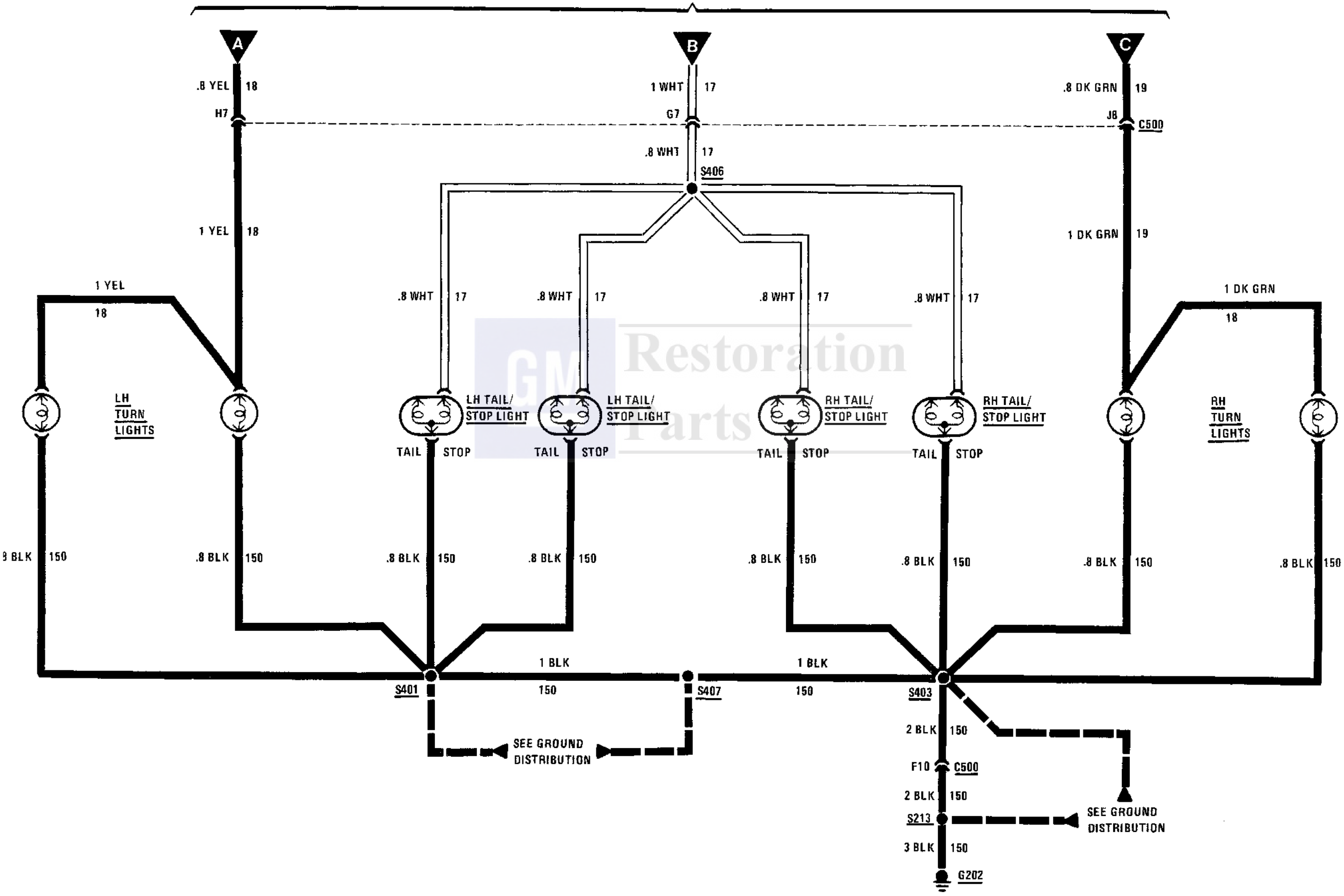
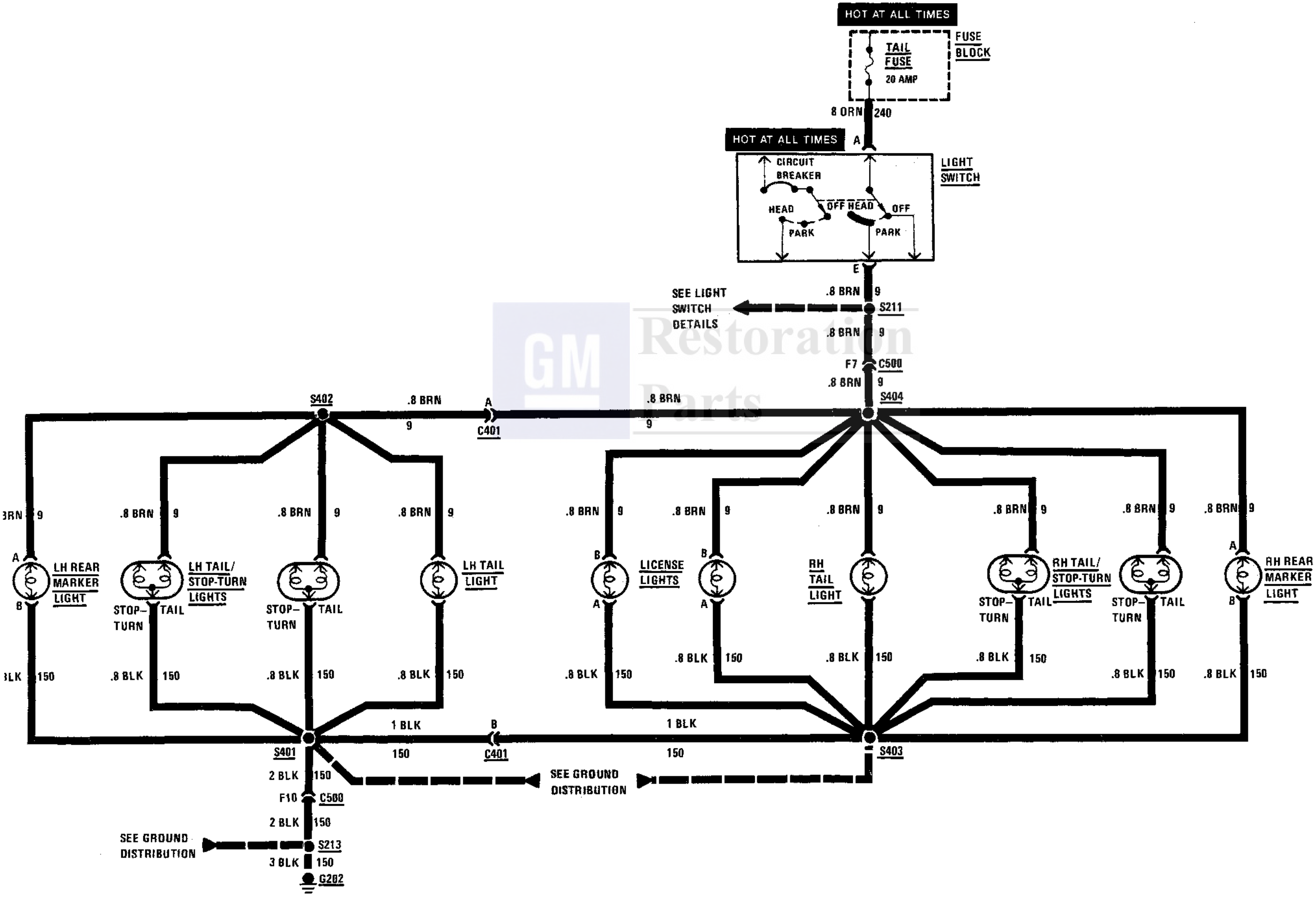


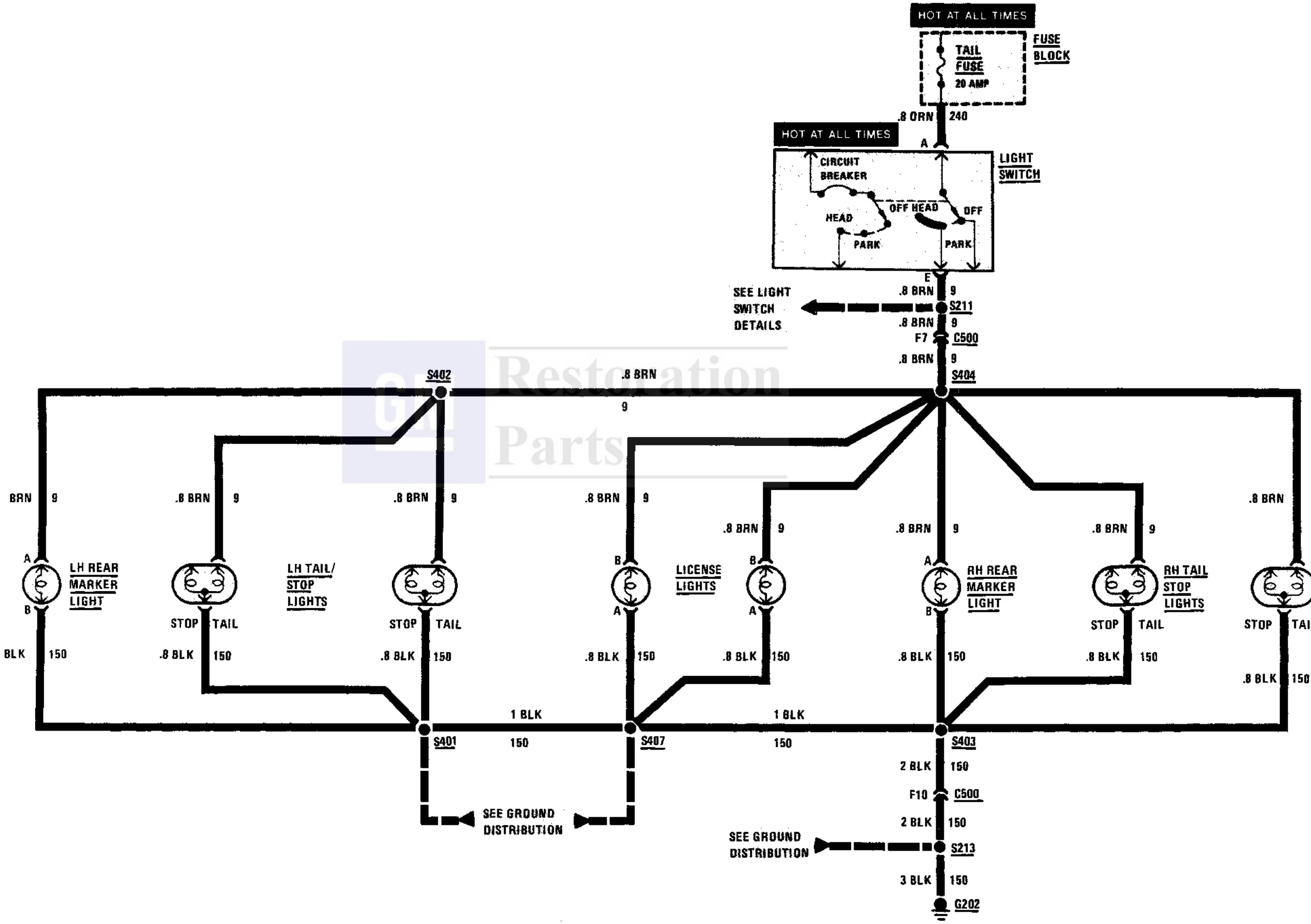
EXTERIOR LIGHTS: TAIL/STOP/TURN/REAR MARKER/LICENSE

SE MODELS



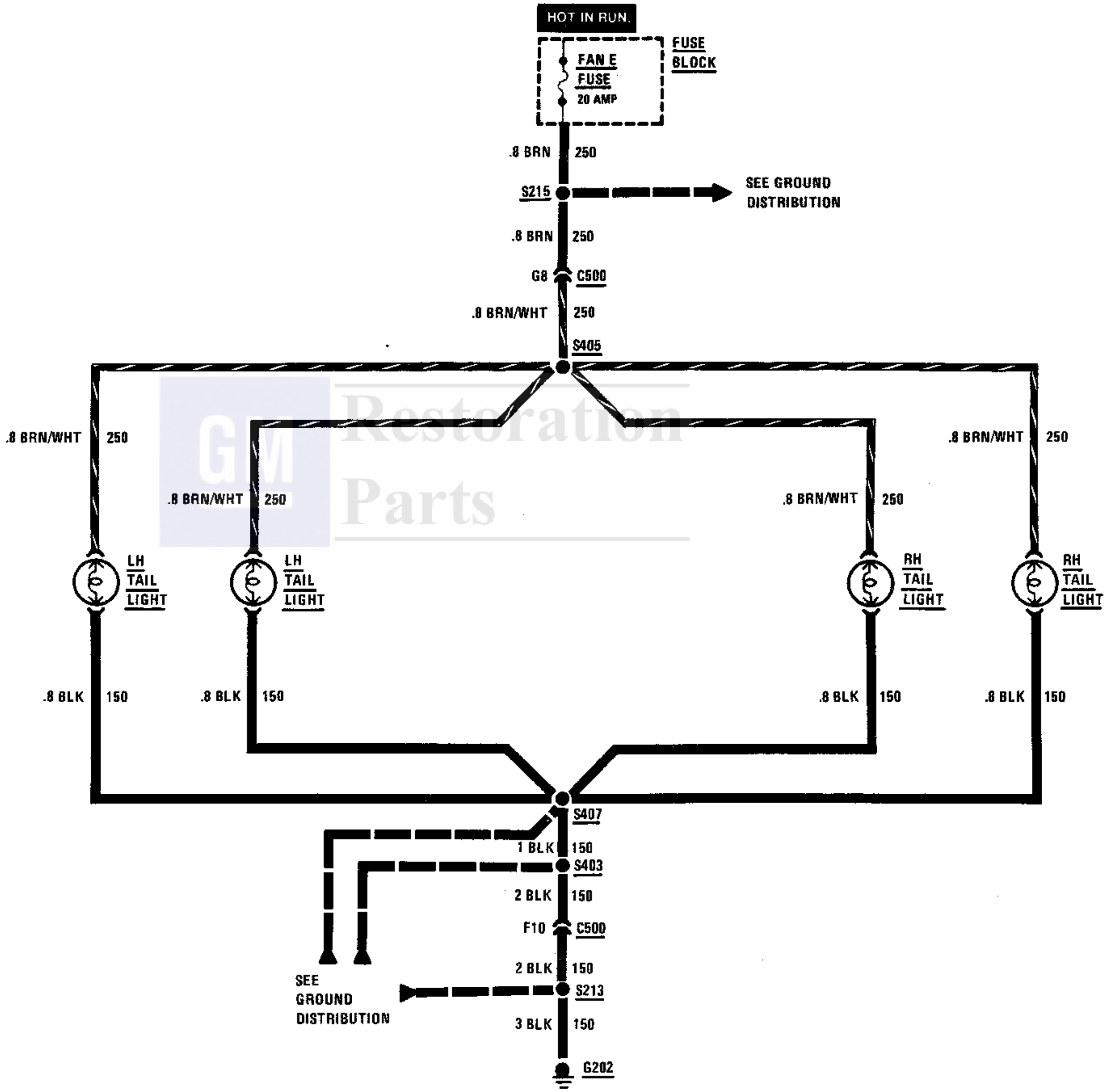
EXTERIOR LIGHTS: TAIL/STOP/TURN/REAR MARKER/LICENSE

GT MODELS



EXTERIOR LIGHTS: REAR PONTIAC EMBLEM

GT MODELS



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 does not flash properly:
   - 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 does not flash:
   - Check for a faulty bulb.
   - Check that ground is clean and tight.

Stop

If both Stop Lights do not go on:

- Check the Stop HAZ Fuse by operating the Hazard Lights.
- Check that G202 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	201-11-A
Convenience Center	Behind RH side of I/P	201- 9-A
Fuse Block	Behind LH side of I/P	201- 6-D
Turn Flasher	On LH steering column bracket	201- 7-C
Turn-Hazard Switch Assembly	At top of steering column	201- 9-B
C100 (34 cavities)	LH side of front bulkhead, right of brake master cylinder	201-13-A
C201 (8 cavities)	LH shroud above center access hole	201-12-C
C210 (11 cavities)	Lower RH side of steering column	201- 8-B
C305 (4 cavities)	Behind dash, near LH shroud	201-13-B
C401 (2 cavities)	Taped to rear lights harness, to right of license plate lamps	201-14-A
C500 (34 cavities)	Engine compartment, near battery	201- 4-A
G101	On LH fender, below headlamp	201-11-C
G102	On RH fender, below headlamp	201-11-C
G201	Behind center of I/P	201- 6-C
G202	Between seats, near rear bulkhead	201- 6-A
S101	Forward lamp harness, LH side of front compartment	201-10-C
S102	Forward lamp harness, LH side of front compartment	201-10-C
S103	Forward lamp harness, near bulkhead connector	201-10-C
S104	Forward lamp harness, LH side of front compartment	201-10-C
S204	Main harness, to right of steering column	201- 7-A
S211	Main harness, behind RH side of I/P	201- 6-C
S212	Main harness, behind center of dash	201- 6-C
S213	Main harness, behind rear bulkhead grommet	201-15-A
S215	Main harness, behind I/P, near front of console	201-15-A
S311	Crosscar harness, LH side of I/P	201-12-C
S313	Body harness, under LH front seat	201-13-B
S401	Rear lights harness, LH side of back panel	201-14-A
S402	Rear lights harness, LH side of back panel	201-14-A
S403	Rear lights harness, RH side of back panel	201-14-A
S404	Rear lights harness, RH side of back panel	201-14-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 Flasher.**
- 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 do not come on:
   - Check power and ground to the bulb.
3. If just the RH Front Park and Marker Lights don't come on:
   - Check power and ground to the bulb.

License, Tail, or Rear Marker

1. If none of the License, Tail, or Rear Marker Lights come on:
   - Check the Tail Fuse.
   - Check that G202 is clean and tight.
   - Check that the Front Park/Front Marker Lights come on.
     - — If they do go on, check connectors C500, C401 and ground G202.
     - — If they do not go on, check the Light Switch and related wiring.

COMPONENT LOCATION

		Page-Figure
S405	Rear lights harness, RH rear of car	201-14-A
S406	Rear lights harness, behind RH stop lights	201-14-A
S407	Rear lights harness, behind RH stop lights	201-14-A

(For GT Models Only)

If no Rear Pontiac Emblem Lights go on:

- Check the Fan E Fuse.
- Check that ground G202 is clean and tight.

CIRCUIT OPERATION

Stop Lights

Voltage is applied to the Stop Lights through the Stop HAZ Fuse, Brake Switch, and the Turn-Hazard Switch Assembly. When the brake pedal is depressed, the Brake Switch will close and the Stop Lights will operate.

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. When the Switch connected to the LT BLU wire closes, the LH Front Turn Light and the LH Turn Indicator 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 remain on. The Turn Lights continue to operate independently of the Brake Lights.

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Hazard Lights
(For SE Models Only)

With the Hazard Switches in the HAZARD position, voltage for all lights is supplied through the Hazard Flasher. The Stop-Turn Lights will flash repeatedly. With the Brake depressed, the Hazard Lights will not flash.

(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 flash repeatedly. The Brake Lights 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 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 Lights System. As before, the small marker bulbs light up, but not all 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.

(For GT Models Only)

For the Rear Pontiac Emblem Lights, with the Ignition Switch in RUN voltage is applied through the Fan E Fuse to the Rear Pontiac Emblem Lights. 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.

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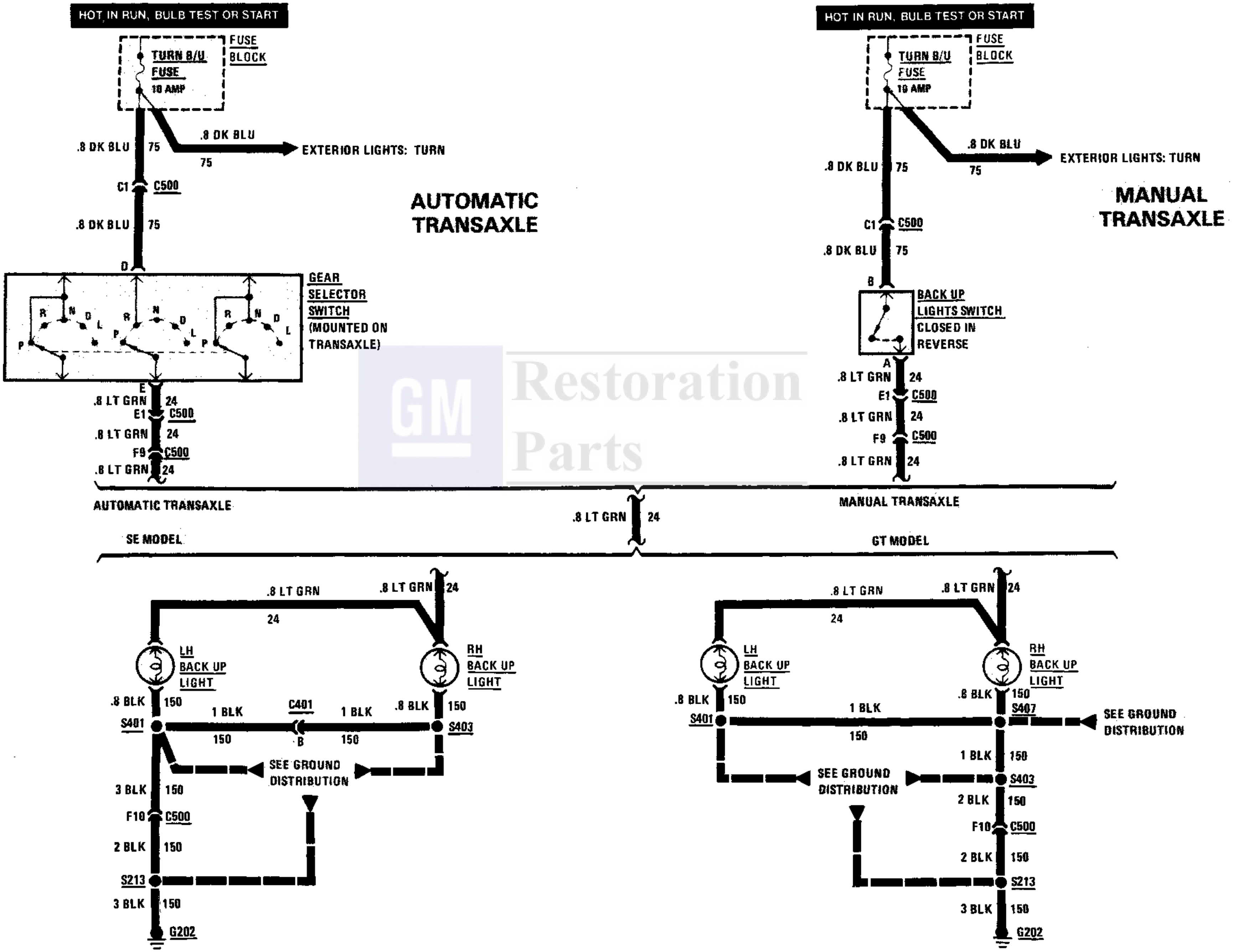
BACK UP LIGHTS



BACK UP LIGHTS

TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Check.**

1. Check the TURN B/U Fuse by operating the Turn Lights.
2. Check that ground G202 is clean and tight.
3. If only one Back Up Light does not operate, check the bulb, socket and related wiring.

- **Go to System Check for a guide to normal operation.**
- **Go to System Diagnosis for diagnostic tests.**

SYSTEM CHECK

- **Use the System Check Table as a guide to normal operation.**
- **Refer to System Diagnosis for a list of symptoms and diagnostic steps.**

SYSTEM CHECK TABLE

ACTION	NORMAL RESULT
Turn the Ignition Switch to RUN, and move the Gear Shift to PARK or NEUTRAL	Back Up Lights are off
Move the Gear Shift to REVERSE	RH and LH Back Up Lights come on
Move the Gear Shift to NEUTRAL	Back Up Lights go off

- **Refer to System Diagnosis when a result is not normal.**

SYSTEM DIAGNOSIS

- **Diagnostic steps for the symptoms listed in the following table are listed after the table.**

COMPONENT LOCATION

		Page-Figure
Back Up Light Switch	Top rear of transaxle	201- 2-B
Fuse Block	Behind LH side of I/P	201- 6-D
Transaxle Position Switch	LH rear of engine, top of transaxle	201- 2-B
C401 (2 cavities)	Taped to rear lights harness, to right of license plate lamps	201-14-A
C500 (34 cavities)	Engine compartment, near battery	201- 4-A
G202	Between seats, near rear bulkhead	201- 6-A
S213	Main harness, behind rear bulkhead grommet	201-15-A
S401	Rear lights harness, LH side of back panel	201-14-A
S403	Rear lights harness, RH side of back panel	201-14-A
S407	Rear lights harness, behind RH stop lights	201-14-A

SYMPTOM TABLE

A. Back Up Lights do not operate
B. Back Up Lights stay on

A: BACK UP LIGHTS DO NOT OPERATE

Measure: VOLTAGE
At: CONNECTOR C500 (Connected)
Conditions:
- **Ignition Switch: RUN**
- **Gear Shift: REVERSE**

Measure Between	Correct Voltage	For Diagnosis
C1 (DK BLU) & Ground	Battery	See 1
F9 (LT GRN) & Ground	Battery	See 2

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- If voltages are correct, check the bulbs, sockets, LT GRN (24) and BLK (150) wires and related connectors (see schematic).

1. Check the DK BLU (75) wire and the TURN B/U Fuse.
2. Adjust or replace the Gear Selector Switch (for automatic) or Back Up Lights Switch (for manual) as necessary.

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B: BACK UP LIGHTS STAY ON

Disconnect connector C500. Put the Ignition Switch in RUN and the Gear Shift in PARK or NEUTRAL.

- If Back-Up Lights go off, check/repair LT GRN (24) wire to switch for a short to Battery. If OK, adjust/replace the Gear Selector Switch (for automatic) or the Back Up Lights Switch (for manual).
- If Back Up Lights remain on, check the bulbs, sockets, and LT GRN (24) wire for a short to Battery.

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 Lights Switch (with manual transaxle). Whenever the Gear Selector Lever is shifted to REVERSE, the Gear Selector Switch or the Back Up Lights Switch closes, providing voltage to the Back Up Lights and causing the Back Up Lights to light.

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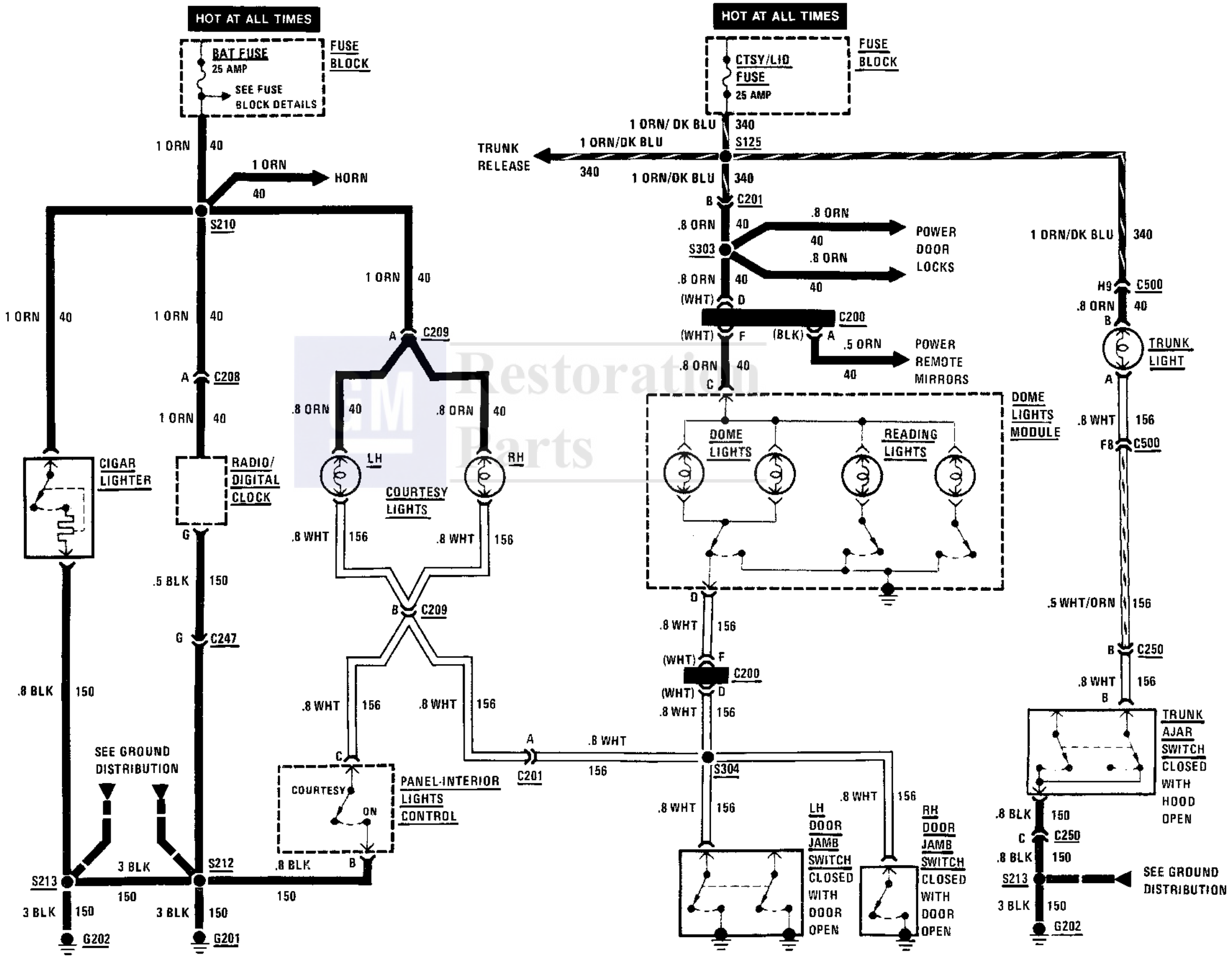
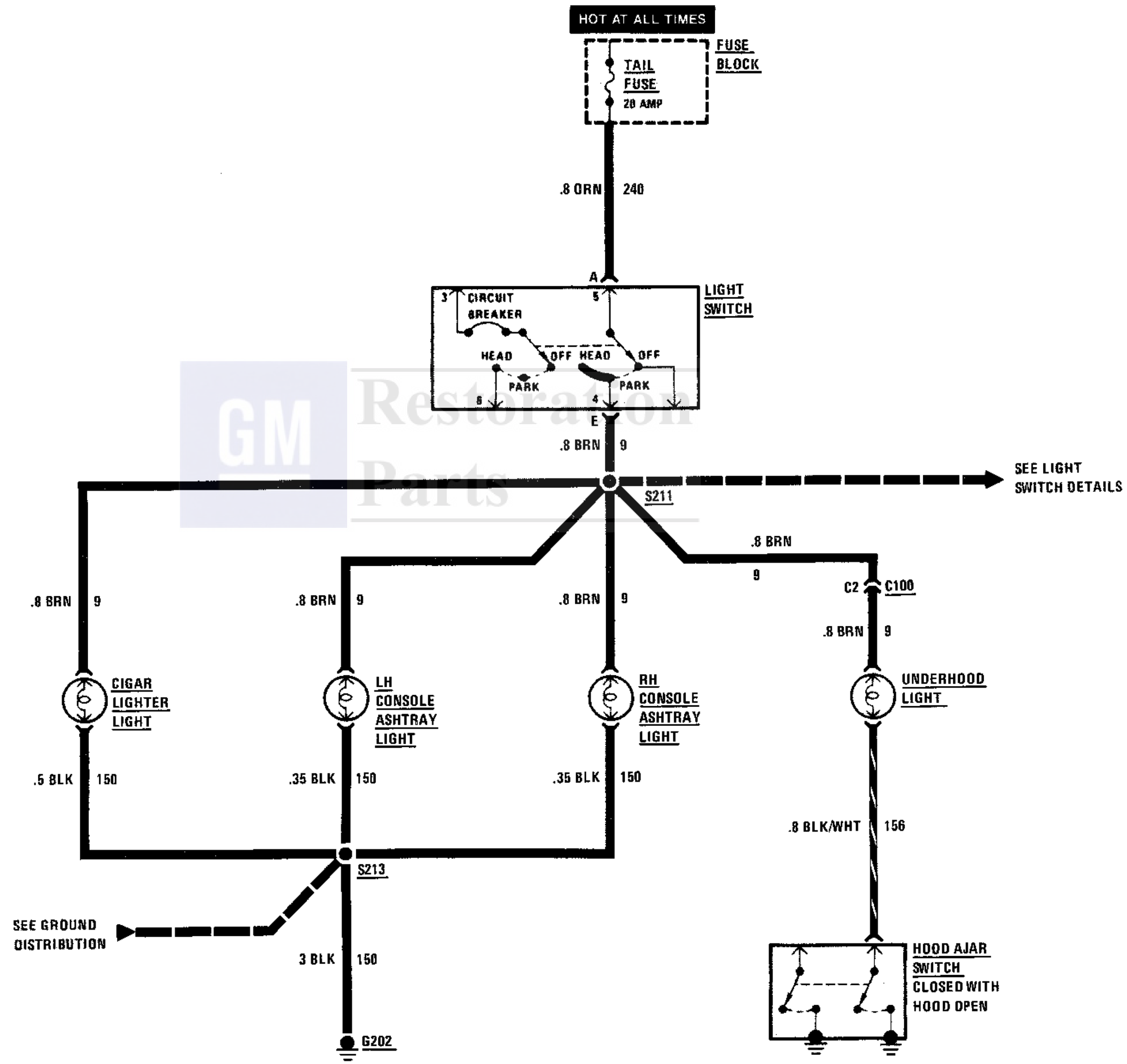
INTERIOR LIGHTS: CIGAR LIGHTER, CLOCK AND TRUNK LIGHT



INTERIOR LIGHTS: CONSOLE AND UNDERHOOD



INTERIOR LIGHTS

TROUBLESHOOTING HINTS

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 the Door Jamb Switches, the Trunk Ajar Switch, or G202 to make sure they are clean and tight.

COMPONENT LOCATION

		Page-Figure
Dome Light Module	At dome lamp, in roof	
Fuse Block	Behind LH side of I/P	201- 6-D
Hood Ajar Switch	Front compartment, center of front bulkhead	201-10-B
Trunk Ajar Switch	LH side of engine compartment	
C100 (34 cavities)	LH side of front bulkhead, right of brake master cylinder	201-13-A
C200 (16 cavities)	LH shroud ahead of center access hole	201- 6-D
C201 (8 cavities)	LH shroud above center access hole	201-12-C
C208 (2 cavities)	Center of dash, behind radio	
C209 (2 cavities)	Behind LH side of I/P, near shroud	201- 8-A
C247 (12 cavities)	Center console, behind radio	201-10-A
C250 (4 cavities)	Center of rear bulkhead, in engine compartment	201-13-C
C500 (34 cavities)	Engine compartment, near battery	201- 4-A
G201	Behind center of I/P	201- 6-C
G202	Between seats, near rear bulkhead	201- 6-A
S125	Main harness, behind LH side of I/P, near Fuse Block	201- 6-D
S210	Main harness, behind RH side of I/P	201- 6-C
S211	Main harness, behind RH side of I/P	201- 6-C
S212	Main harness, behind center of dash	201- 6-C
S213	Main harness, behind rear bulkhead grommet	201-15-A
S303	Crosscar harness, above steering column	201-12-B
S304	Crosscar harness, above steering column	201-12-B

CIRCUIT OPERATION

Cigar Lighter, Clock, Underhood Light, and Trunk Light

Voltage is applied at all times to Fusible Link B, which feeds the Light Switch. See Fuse Block Details. When the Light Switch is turned to PARK or HEAD, voltage is applied to the Underhood Light. When the hood is raised, the Underhood Light turns on.

Voltage is applied at all times through the BAT Fuse to the Cigar Lighter, the Radio/Digital Clock, and the Courtesy Lights. The Cigar Lighter operates when it is connected to ground by pressing the lighter into its socket. The Courtesy Lights operate when either the Panel-Interior Lights Control, or the Door Jamb Switches on both doors close to ground.

Voltage is applied at all times through the CTSY/LID Fuse to the Trunk Light and C200 to the Dome/Reading Lights. The Dome/Reading Lights operate when they are connected to ground through the Panel-Interior Lights Control or the Door Jamb Switches.

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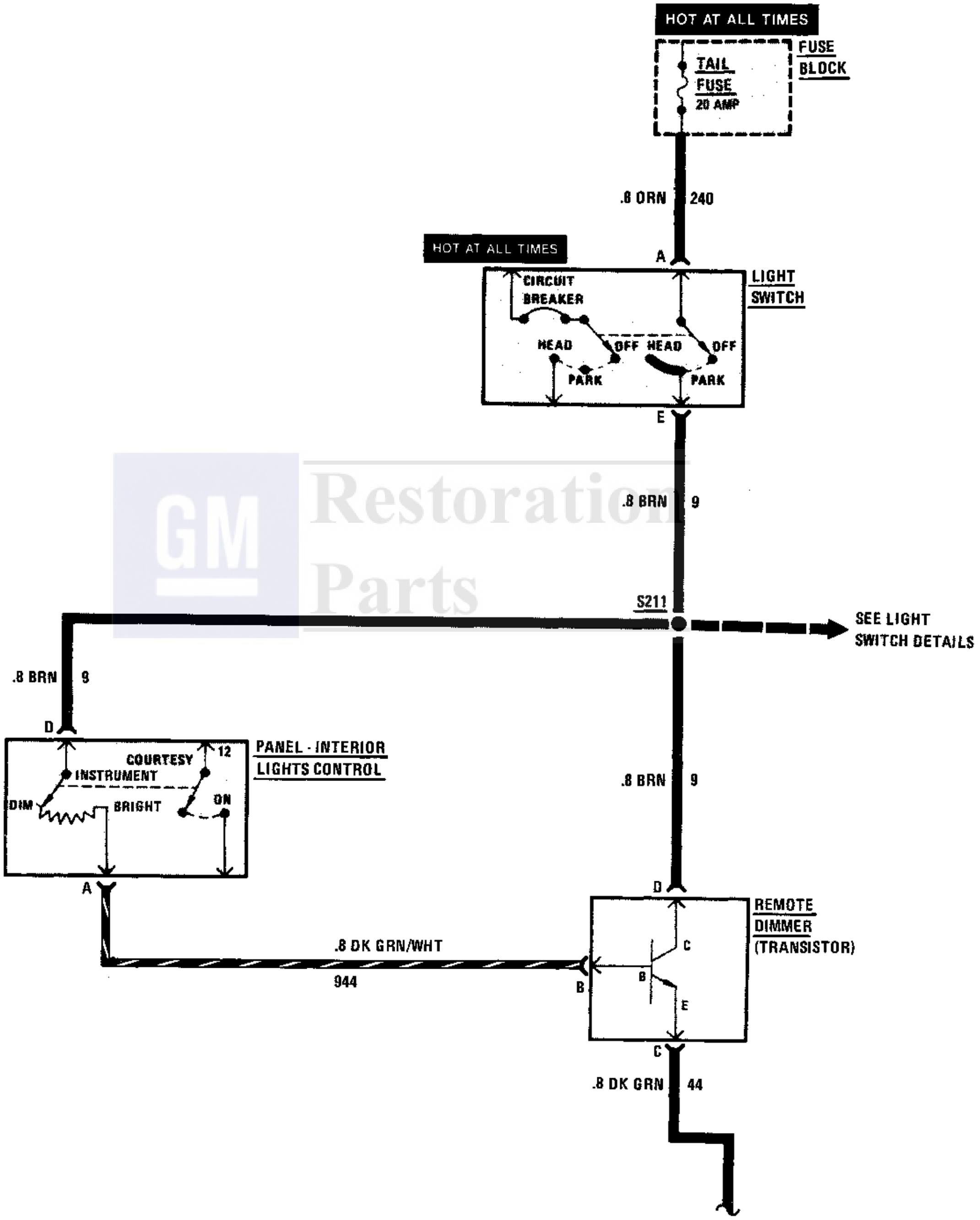
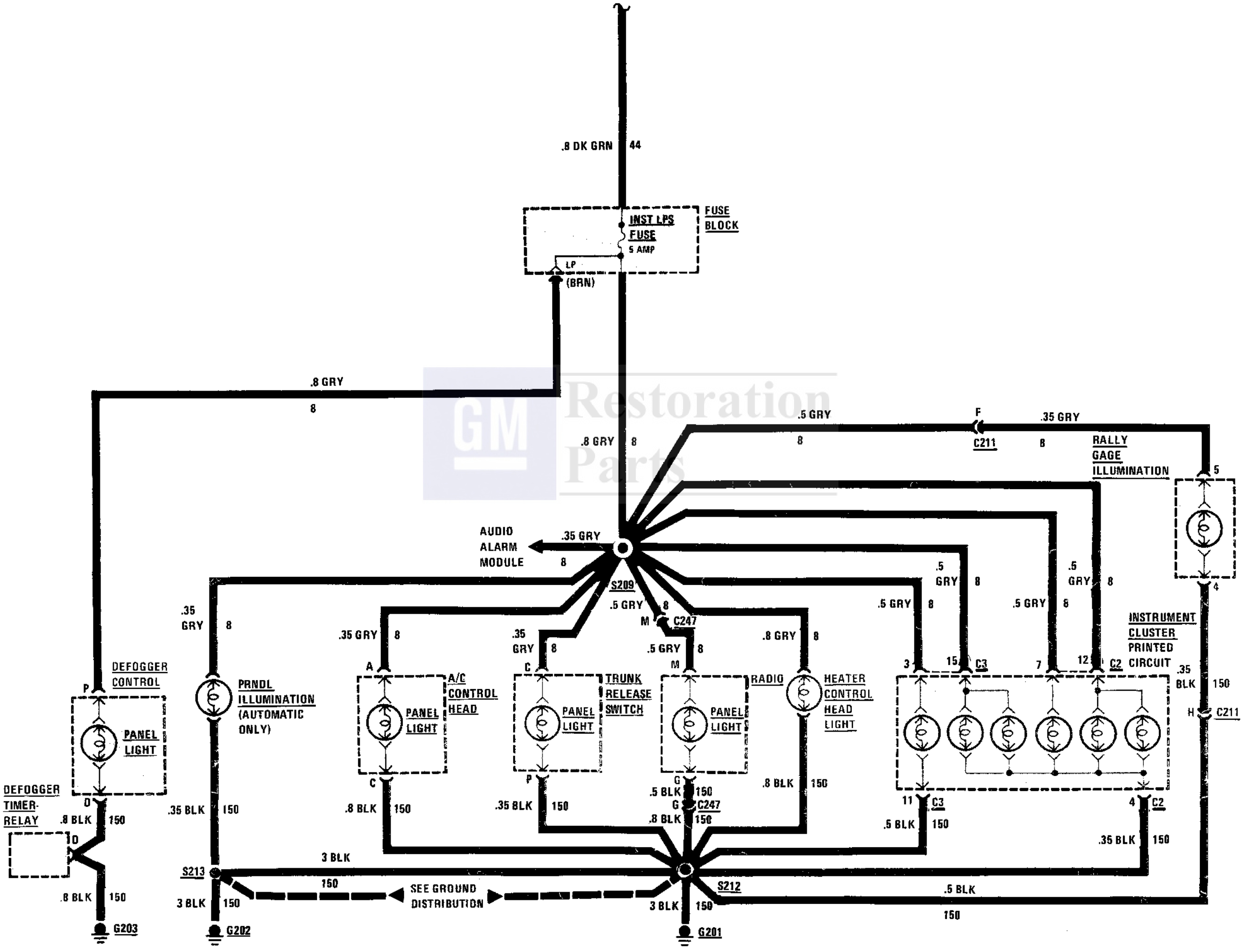
INTERIOR LIGHTS DIMMING

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44
INST LPS FUSE
5 AMP
FUSE BLOCK
LP
(BRN)
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C211
.35 GRY
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RALLY GAGE ILLUMINATION
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4
AUDIO ALARM MODULE
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8
S209
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C247
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8
INSTRUMENT CLUSTER PRINTED CIRCUIT
DEFOGGER CONTROL
P
PANEL LIGHT
D
PRNDL ILLUMINATION (AUTOMATIC ONLY)
A
A/C CONTROL HEAD
PANEL LIGHT
C
C
TRUNK RELEASE SWITCH
PANEL LIGHT
P
M
RADIO
PANEL LIGHT
G
HEATER CONTROL HEAD LIGHT
3
15
C3
7
12
C2
11
C3
4
C2
.35 BLK
150
H
C211
DEFOGGER TIMER-RELAY
D
.8 BLK
150
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G203
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S213
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S212
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G201

INTERIOR LIGHTS DIMMING

TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Diagnosis.**

1. Check the TAIL Fuse and ORN (240) wire by observing the Park Lights. Refer to Section 8A-110 if the Park Lights do not operate.
2. Check the INST LPS Fuse.
3. If only one light does not operate, check the bulb and wiring to the suspect light (see schematic).
4. If the Instrument Panel Lights do not operate, check GRY (8) and BLK (150) wires. Check the Printed Circuit and the bulbs if the GRY (8) and BLK (150) wires are OK.

- **Go to System Diagnosis for diagnostic tests.**
- **Do the test below if none of the Panel Lights operate, but the Park Lights operate.**

COMPONENT LOCATION

		Page-Figure
Defogger Timer Relay	On brake pedal support	201- 6-E
Fuse Block	Behind LH side of I/P	201- 6-D
Remote Dimmer	Below center of I/P, near steering column support	201- 8-D
C211 (8 cavities)	Behind center of I/P, near radio	
C247 (12 cavities)	Center console, behind radio	201-10-A
G201	Behind center of I/P	201- 6-C
G202	Between seats, near rear bulkhead	201- 6-A
G203	On RH steering column support	201- 6-F
S209	Main harness, right of steering column	201- 6-C
S211	Main harness, behind RH side of I/P	201- 6-C
S212	Main harness, behind center of dash	201- 6-C
S213	Main harness, behind rear bulkhead grommet	201-15-A

A: INTERIOR LIGHTS DIMMING TEST (TABLE 1)

Connect: A TEST LAMP
AT: FUSE BLOCK HOT SIDE OF INST LPS FUSE CAVITY
Conditions:
- **INST LPS Fuse: REMOVED**
- **Light Switch: PARK**
- **Dimming Control: BRIGHT**

Connect Between	Correct Result	For Diagnosis
INST LPS Fuse Cavity & Ground	Test Lamp lights brightly	See 1
• Slowly adjust dimming control to DIM		
INST LPS Fuse Cavity & Ground	Test Lamp dims	See 1

- If all the results are correct, check GRY (8) wire for an open.

1. Go to Table 2.

A: INTERIOR LIGHTS DIMMING TEST (TABLE 2)

Connect: A TEST LAMP
At: PANEL-INTERIOR LIGHTS CONTROL CONNECTOR (Connected)
Conditions:
- **Light Switch: PARK**
- **Dimming Control: BRIGHT**

Connect Between	Correct Result	For Diagnosis
D (BRN) & Ground	Test Lamp lights	See 1
A (DK GRN/ WHT) & Ground	Test Lamp lights	See 2
• Slowly adjust dimming control to DIM		
A (DK GRN/ WHT) & Ground	Test Lamp dims	See 2

- If all the results are correct, go to Table 3.

1. Check BRN (9) wire for an open (see schematic).
2. Replace Panel-Interior Lights Control.

A: INTERIOR LIGHTS DIMMING TEST (TABLE 3)

Connect: A TEST LAMP
At: REMOTE DIMMER CONNECTOR (Connected)
Conditions:

- **Light Switch: PARK**
- **Dimming Control: BRIGHT**

Connect Between	Correct Result	For Diagnosis
D (BRN) & Ground	Test Lamp lights	See 1
B (DK GRN/ WHT) & Ground	Test Lamp lights	See 2
C (DK GRN) & Ground	Test Lamp lights	See 3
• Slowly **adjust** dimming control to DIM		
C (DK GRN) & Ground	Test Lamp dims	See 3

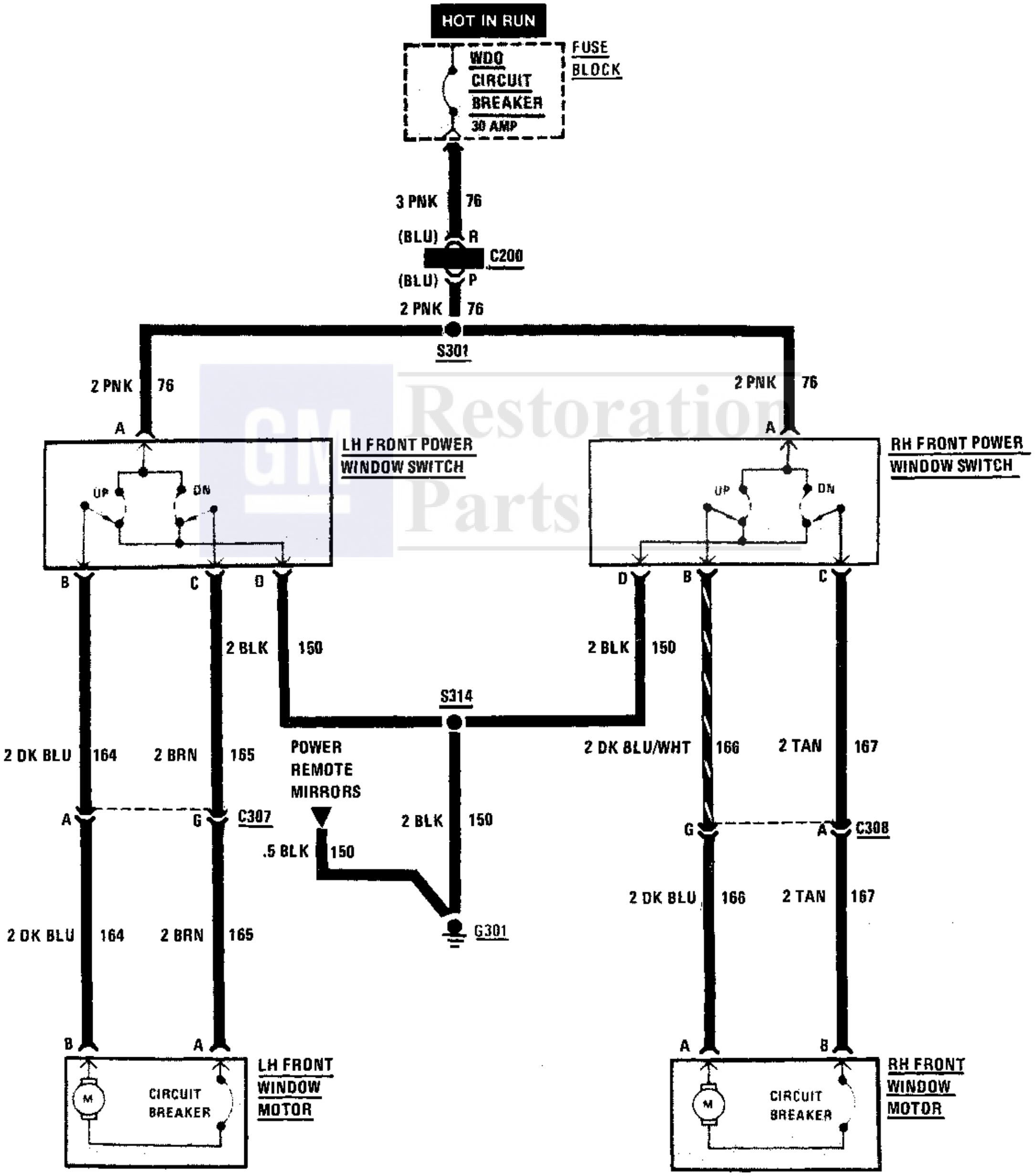
- If all the results are correct, check the DK GRN (44) wire for an open (see schematic).

1. **Check BRN (9) wire for an open (see schematic)**
2. **Check** DK GRN/WHT (944) wire for **an open** (see schematic).
3. **Replace** Remote Dimmer.

CIRCUIT OPERATION

Battery voltage is applied at all times through the TAIL Fuse to the Light Switch. When the Light Switch is in PARK or HEAD, battery voltage is applied to the dimming control in the Panel-Interior Lights Control and to the Remote Dimmer. Adjusting the dimming control changes the voltage applied to terminal B of the Remote Dimmer. As the voltage at terminal B increases, the Remote Dimmer increases the current flow to the bulbs and the bulbs become brighter. As the voltage at terminal B decreases, the Remote Dimmer decreases the current flow to the bulbs and the bulbs get dimmer.

POWER WINDOWS: A31



POWER WINDOWS: A31

TROUBLESHOOTING HINTS

- **Try the following check before doing the System Check.**

  If no windows operate, check the BLK (150) wire and ground G301 by operating the Power Mirrors (if equipped).
- **Go to System Check for a guide to normal operation.**
- **Go to System Diagnosis for diagnostic tests.**

SYSTEM CHECK

- **Use the System Check Table as a guide to normal operation.**
- **Refer to System Diagnosis for a list of symptoms and diagnostic steps.**

SYSTEM CHECK TABLE

Operate the LH Front Window UP and DN from the LH Front Power Window Switch	LH Front Window operates quietly and smoothly, with no sticking
Operate the RH Front Window UP and DN from the RH Front Power Window Switch	RH Front Window operates quietly and smoothly, with no sticking.

- **Refer to System Diagnosis when a result is not normal.**

COMPONENT LOCATION

		Page-Figure
Fuse Block	Behind LH side of I/P	201- 6-D
Window Motors	In lower front of each door	201-12-A
C200 (16 cavities)	LH shroud ahead of center access hole	201- 6-D
C307 (8 cavities)	Near center of LH shroud	201-12-C
C308 (8 cavities)	Near center of RH shroud	201-12-D
G301	On upper RH shroud	201-12-D
S301	Crosscar harness, under console	201-12-B
S314	Crosscar harness, under console	201-12-B

SYSTEM DIAGNOSIS

- **Do the tests listed for your symptom in the Symptom Table below, or when directed by the System Check.**
- **Tests follow the Symptom Table.**

SYMPTOM TABLE

No Power Windows operate	A: LH Front Power Window Switch Test B: RH Front Power Window Switch Test C: Window Motor Test
LH Front Power Window does not operate	A: LH Front Power Window Switch Test C: Window Motor Test
RH Front Power Window does not operate	B: RH Front Power Window Switch Test C: Window Motor Test

A: LH FRONT POWER WINDOW SWITCH TEST

Connect: TEST LAMP
At: LH FRONT POWER WINDOW SWITCH CONNECTOR (Connected)
Condition:
- **Ignition Switch: RUN**

Connect Between	Correct Result	For Diagnosis
A (PNK) & Ground	Test Lamp Lights	See 1
A (PNK) & D (BLK)	Test Lamp Lights	See 2

- Operate LH Front Power Window Switch UP and DN

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B (DK BLU) & C (BRN)	Test Lamp Lights	See 3

- If all the results are correct, go to Test C.

1. Check PNK (76) wire for an open (see schematic).
2. Check BLK (150) wire for an open (see schematic).
3. Replace LH Front Power Window Switch.

B: RH FRONT POWER WINDOW SWITCH TEST

Connect: TEST LAMP
At: RH FRONT POWER WINDOW SWITCH CONNECTOR (Connected)
Condition:

- **Ignition Switch: RUN**

Connect Between	Correct Result	For Diagnosis
A (PNK) & Ground	Test Lamp Lights	See 1
A (PNK) & D (BLK)	Test Lamp Lights	See 2
• Operate RH Front Power Window Switch UP and DN		
B (DK BLU/ WHT) & C (TAN)	Test Lamp Lights	See 3

- If all results are correct, go to Test C.

1. Check PNK (76) wire for an open (see schematic).
2. Check BLK (150) wire for an open (see schematic).
3. Replace RH Front Power Window Switch.

C: WINDOW MOTOR TEST

Connect: TEST LAMP
At: SUSPECT WINDOW MOTOR CONNECTOR (Disconnected)
Conditions:

- **Ignition Switch: RUN**
- **Operate associated Power Window Switch UP and DN**

Connect Between	Correct Result	For Diagnosis
A (BRN) or (DK BLU) & B (DK BLU) or (TAN)	Test Lamp Lights	See 1

- If the result is correct, replace the Window Motor. Refer to the Body Section 5 for replacement procedures.

1. Check the wiring to that Power Window Switch for an open (see schematic).

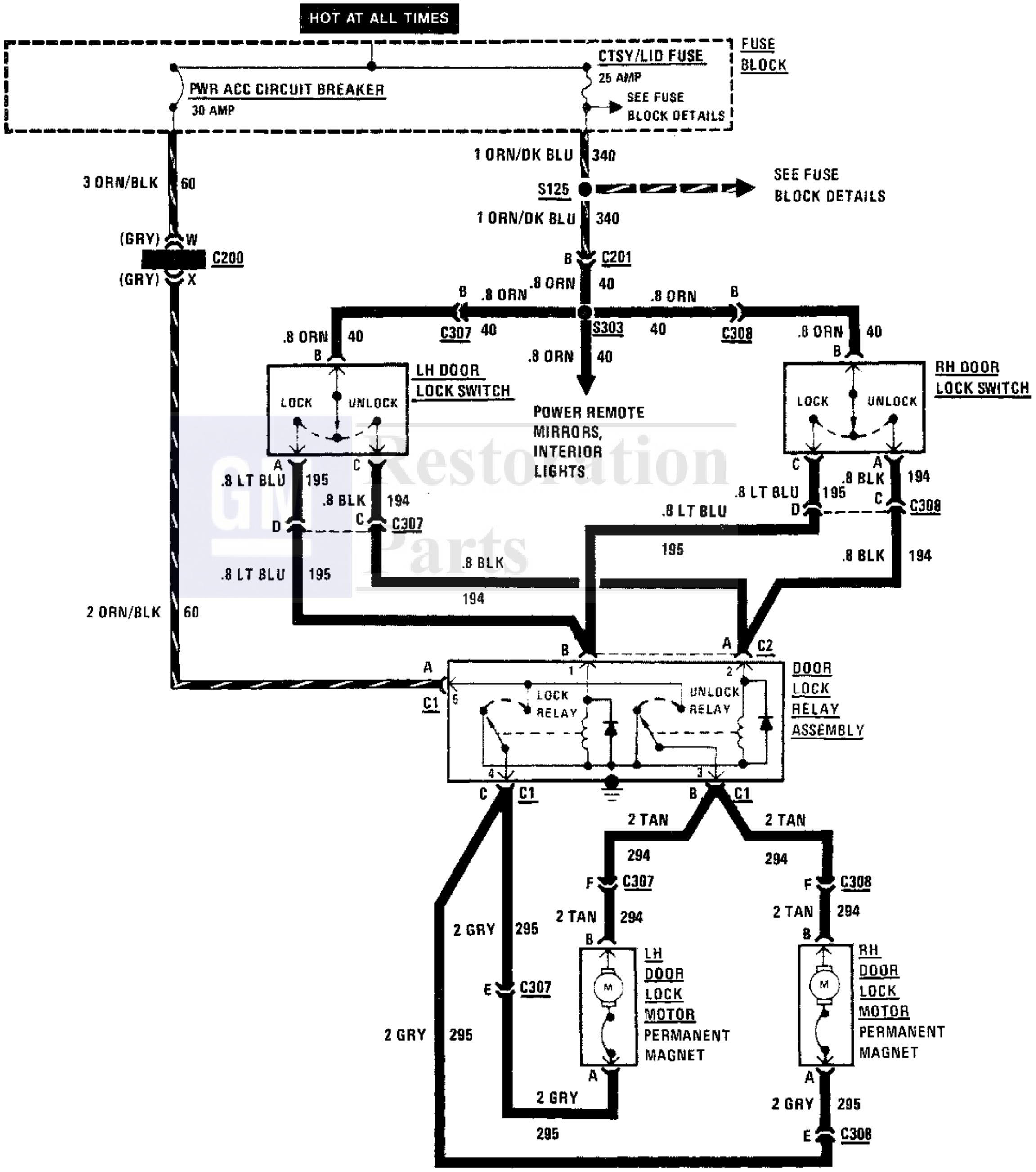
CIRCUIT OPERATION

With the Ignition Switch in RUN, voltage is applied through the WDO Circuit Breaker and the PNK wire to the Power Window Switches. With the LH Front Power Window Switch in UP, voltage is applied through the LH Front Power Window Switch, and the DK BLU wire to the LH Front Window Motor. The motor is grounded through the BRN wire and the DN contacts of the LH Front Power Window Switch to G301. The motor runs and the window goes up. Voltage is similarly applied with the RH Front Power Window Switch in UP.

In DN, voltage is applied to each motor in the opposite direction and the window goes down.

BLANK

POWER DOOR LOCKS: AU3



EACH MOTOR CONTAINS
A SELF-RESETTING
CIRCUIT BREAKER

POWER DOOR LOCKS: AU3

TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Check.**

1. Check the PWR ACC Circuit Breaker by operating the Power Seats (if equipped).
2. Check the CTSY/LID Fuse by observing that the Courtesy Lights come on when the door is opened.
3. Check that the Door Lock Relay Assembly case ground is making good contact.
4. If one of the Door Lock Motors does not operate properly, but the other Door Lock Motor functions normally, check the wiring to the motor. If the wiring is correct, replace that motor.
5. Check for mechanical binds in the Door Lock System.

- **Go to System Check for a guide to normal operation.**
- **Go to System Diagnosis for diagnostic tests.**

SYSTEM CHECK

- **Use the System Check Table as a guide to normal operation.**
- **Refer to System Diagnosis for a list of symptoms and diagnostic steps.**

COMPONENT LOCATION

		Page-Figure
Door Lock Motors	In rear of each door	201-12-A
Door Lock Relay Assembly	Near upper RH shroud	201-12-D
Fuse Block	Behind LH side of I/P	201- 6-D
C200 (16 cavities)	LH shroud ahead of center access hole	201- 6-D
C201 (8 cavities)	LH shroud above center access hole	201-12-C
C307 (8 cavities)	Near center of LH shroud	201-12-C
C308 (8 cavities)	Near center of RH shroud	201-12-D
S125	Main harness, behind LH side of I/P, near Fuse Block	201- 6-D
S303	Crosscar harness, above steering column	201-12-B

SYSTEM CHECK TABLE

ACTION	NORMAL OPERATION
Operate the LH Door Lock Switch	All the doors lock and unlock
Operate the RH Door Lock Switch	All the doors lock and unlock
Unlock one door using the vehicle key	That door unlocks, but the other door remains locked
With all the doors closed and locked, operate the inside door handles to try and open each door	The doors will not open
Open the LH door and move the LH Door Lock Switch to the LOCK position, close the door, and try to open each door from the outside	The doors will not open

- **Refer to System Diagnosis when a result is not normal.**

SYSTEM DIAGNOSIS

- **Do the tests listed for your symptom in the Symptom Table below.**
- **Tests follow the Symptom Table.**

SYMPTOM TABLE

SYMPTOM	DO TEST
Only one of the doors locks and unlocks	A: Door Lock Motor Test (on suspect Door Lock Motor)

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The Power Door Locks do not operate from one Door Lock Switch	B: Door Lock Switch Test (on suspect Door Lock Switch)
The Power Door Locks do not operate from both Door Lock Switches	C: Door Lock Relay Assembly Test B: Door Lock Switch Test

A: DOOR LOCK MOTOR TEST

Measure: VOLTAGE
At: SUSPECT DOOR LOCK MOTOR CONNECTOR (Disconnected)
Condition:
- **Door Lock Switch: UNLOCK and hold**

Measure Between	Correct Voltage	For Diagnosis
B (TAN) & Ground (see schematic)	Battery	See 1
B (TAN) & A (GRY) (see schematic)	Battery	See 2

- If all the voltages are correct, replace the suspect Door Lock Motor.

1. Check the TAN (294) wire for an open (see schematic).
2. Check the GRY (295) wire for an open (see schematic).

B: DOOR LOCK SWITCH TEST

Measure: VOLTAGE
At: SUSPECT DOOR LOCK SWITCH CONNECTOR (Connected)

Measure Between	Correct Voltage	For Diagnosis
B (ORN) & Ground	Battery	See 1
• Door Lock Switch: LOCK and hold		
LT BLU & Ground	Battery	See 2
• Door Lock Switch: UNLOCK and hold		
BLK & Ground	Battery	See 2

- If all the voltages are correct, check the LT BLU (195) wire and BLK (194) wire for an open (see schematic).

1. **Check the CTSY/LID Fuse. Check the ORN (40) and ORN/DK BLU (340) wires for opens (see schematic).**
2. Replace the suspect Door Lock Switch.

C: DOOR LOCK RELAY ASSEMBLY TEST (TABLE 1)

Connect: TEST LAMP
At: DOOR LOCK RELAY ASSEMBLY CONNECTOR C1

Connect Between	Correct Result	For Diagnosis
A (ORN/BLK) & Ground	Test Lamp lights	See 1

- **If the result is correct, proceed to Table 2.**

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1. Check the PWR ACC Circuit Breaker. Check the ORN/BLK (60) wire for an open (see schematic).

C: DOOR LOCK RELAY ASSEMBLY TEST (TABLE 2)

Connect: TEST LAMP
At: DOOR LOCK RELAY ASSEMBLY CONNECTORS C1 & C2 (Connected)
Condition:
- **Door Lock Switch: LOCK and hold**

Connect Between	Correct Result	For Diagnosis
C2/B (LT BLU) & Ground	Test Lamp lights	See 1
C1/C (GRY) & Ground	Test Lamp lights	See 3
C1/C (GRY) & C1/B (TAN)	Test Lamp lights	See 3
• Door Lock Switch: UNLOCK and hold		
C2/A (BLK) & Ground	Test Lamp lights	See 2
C1/B (TAN) & Ground	Test Lamp lights	See 3
C1/C (GRY) & C1/B (TAN)	Test Lamp lights	See 3

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- If all the results are correct, check the TAN (294) and GRY (295) wires for opens (see schematic). If OK, do Test A.

1. Check the LT BLU (195) wire for an open (see schematic). If the wire is good, do Test B.
2. Check the BLK (194) wire for an open (see schematic). If the wire is good, do Test B.
3. Replace the Door Lock Relay Assembly.

CIRCUIT OPERATION

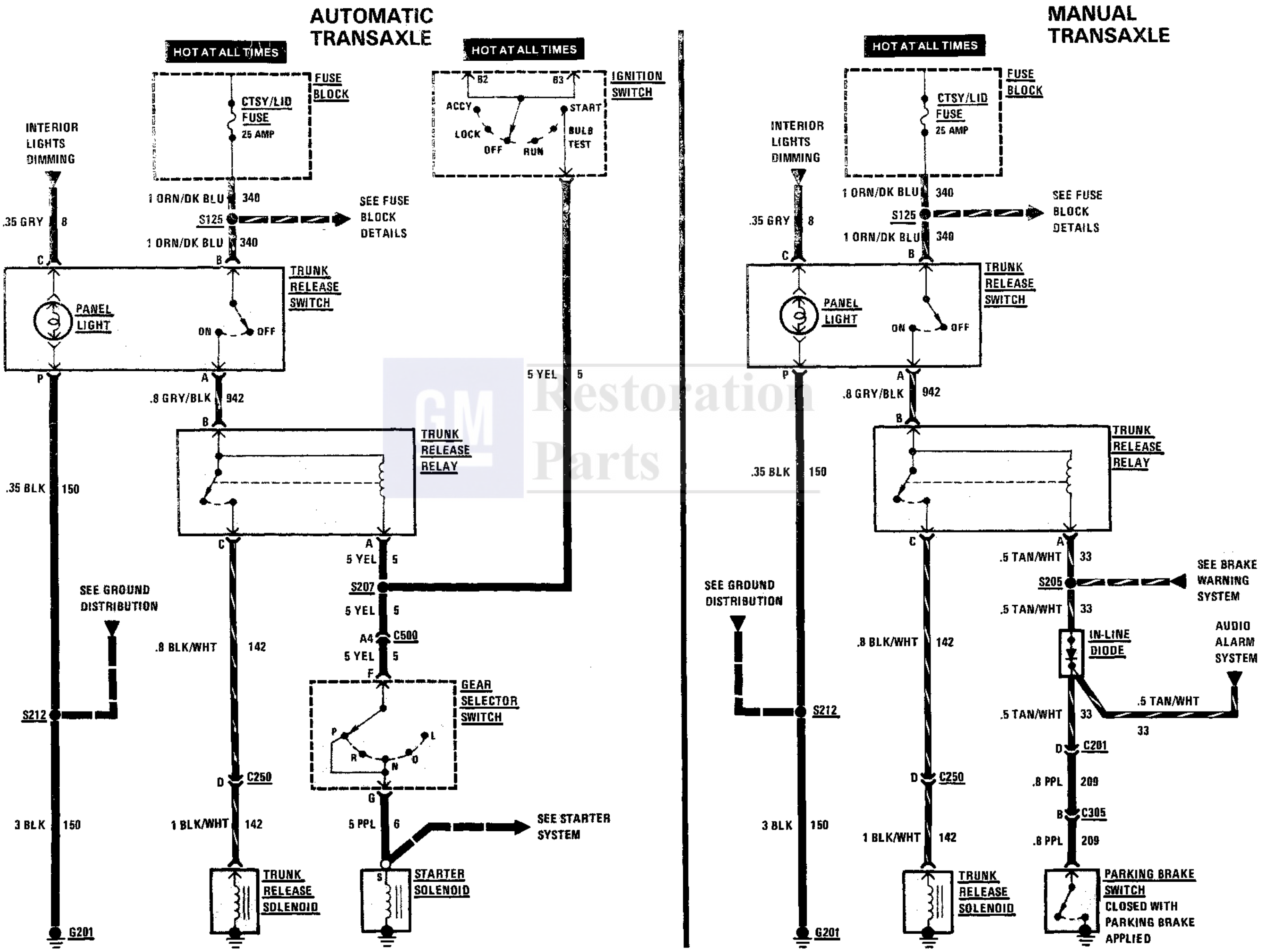
When a Door Lock Switch is activated in the Power Door Lock system, all of the doors will lock or unlock in unison. Each lock can also be operated manually from the locking post. The locks are operated by reversible motors that receive voltage from two relays in the Door Lock Relay Assembly. These relays operate to turn the motors on by applying a voltage to one of the terminals and a ground to the other terminal.

When either Door Lock Switch is moved to the LOCK position, it completes the circuit to the coil of the Door Lock Relay Assembly. The lock relay is energized. The contact for the lock relay closes, and is connected to battery voltage through the ORN/BLK wire. Voltage is then applied to the GRY wire and the Door Lock Motors. The motors are grounded by the TAN wire from the other terminal of the motor through the contact for the unlock relay. The motor in each door runs to operate the Door Locks. When the Door Lock Switch is released, the lock relay contact returns to ground and the motors turn off.

A similar action occurs with the unlock relay when it is energized by either of the Door Lock Switches closing to the UNLOCK position. Now the TAN wires to the motors carry battery voltage and the GRY wires are grounded. The polarity of the voltage to the motors has been reversed. The motors run in the opposite direction to unlock the doors.

The Door Lock Switches are usually closed for just a moment. If they are held closed, a circuit breaker in each motor will open to protect against damage. The circuit breakers close automatically when they cool off.

TRUNK RELEASE: A90



TRUNK RELEASE: A90

TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Check.**

1. Check the CTSY/LID Fuse by noting if the Dome Lights work.
2. Check that ground G201 is clean and tight.
3. Check that Trunk Release Solenoid is properly grounded.
4. (Manual Transaxle only) Check the Parking Brake Switch by applying Parking Brake with Ignition Switch in RUN and observing the BRAKE Indicator.

- **Go to System Check for a guide to normal operation.**
- **Go to System Diagnosis for diagnostic tests.**

SYSTEM CHECK

- **Use the System Check Table as a guide to normal operation.**

SYSTEM CHECK TABLE

ACTION	NORMAL RESULT
Press Trunk Release button with the Parking Brake applied (Manual Transaxle) or Gear Selector Switch in PARK (Automatic Transaxle)	Trunk unlatches

SYSTEM DIAGNOSIS

- **Do the tests below if the Trunk Release does not operate properly.**

COMPONENT LOCATION

		Page-Figure
Fuse Block	Behind LH side of I/P	201- 6-D
Ignition Switch	At base of steering column	201- 8-F
In-Line Diode	Behind I/P, near LH shroud	201- 8-A
Parking Brake Switch	On parking brake support	201- 9-C
Starter Solenoid (VIN 9)	Lower LH front of engine	201- 3-B
Starter Solenoid (VIN R)	Lower LH front of engine	201- 2-A
Transaxle Position Switch	LH rear of engine, top of transaxle	201- 2-B
Trunk Release Relay	Behind I/P, on RH side of steering column support	201- 7-B
Trunk Release Solenoid	On rear of trunk lid	201-13-C
C201 (8 cavities)	LH shroud above center access hole	201-12-C
C250 (4 cavities)	Center of rear bulkhead, in engine compartment	201-13-C
C305 (4 cavities)	Behind dash, near LH shroud	201-13-B
C500 (34 cavities)	Engine compartment, near battery	201- 4-A
G201	Behind center of I/P	201- 6-C
S125	Main harness, behind LH side of I/P, near Fuse Block	201- 6-D
S205	Main harness, above steering column	201- 7-A
S207	Main harness, left of steering column	201- 8-F
S212	Main harness, behind center of dash	201- 6-C

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TRUNK RELEASE TEST (TABLE 1)

Measure: VOLTAGE
At: TRUNK RELEASE SOLENOID CONNECTOR (Disconnected)
Conditions:
- **Parking Brake: APPLIED (Manual Transaxle)**
- **Gear: PARK (Automatic Transaxle)**

Measure Between	Correct Voltage	For Diagnosis
BLK/WHT & Ground	0 Volts	See 1
• Trunk Release button pressed		
BLK/WHT & Ground	Battery	See 1

- If both voltages are correct, repair/replace Trunk Rlease Solenoid.

1. Reconnect Solenoid and go to Table 2.

TRUNK RELEASE TEST (TABLE 2)

Measure: VOLTAGE
At: TRUNK RELEASE SWITCH CONNECTOR (Connected)

Measure Between	Correct Voltage	For Diagnosis
B (ORN/DK BLU) & Ground	Battery	See 1
• Trunk Release Switch: Depressed		
A (GRY/BLK) & Ground	Battery	See 2

- If both voltages are correct, go to Table 3.

1. Check/repair ORN/DK BLU (340) wire for an open.
2. Replace the Trunk Release Switch.

TRUNK RELEASE TEST (TABLE 3)

Measure: VOLTAGE
At: TRUNK RELEASE RELAY CONNECTOR (Disconnected)
Conditions:
- **Trunk Release Switch: DEPRESSED (hold)**
- **Parking Brake: APPLIED (Manual Transaxle)**
- **Gear: PARK (Automatic Transaxle)**
- **Ignition Switch: LOCK**

Measure Between	Correct Voltage	For Diagnosis
B (GRY/BLK) & Ground	Battery	See 1
B (GRY/BLK) & A (see schematic)	Battery	See 2

- If both voltages are correct, go to Table 4.

1. Check/repair GRY/BLK (942) wire for an open.
2. Check/repair YEL (5) (Automatic Transaxle) or TAN/WHT (33) (Manual Transaxle) wires.

TRUNK RELEASE TEST (TABLE 4)

Connect: FUSED JUMPER
At: TRUNK RELEASE RELAY CONNECTOR (Disconnected)
Condition:
- **Trunk Release Switch: DEPRESSED**

Jumper Between	Correct Result	For Diagnosis
B (GRY/BLK) & C (BLK/WHT)	Trunk unlatches	See 1

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- If the result is correct, replace the Trunk Release Relay.

1. Check/repair BLK/WHT (142) wire.

CIRCUIT OPERATION

Voltage is applied at all times through the CTSY/LID Fuse to the Trunk Release Switch. With the switch closed, voltage is applied through the Trunk Release Switch to the Trunk Release Relay coil and contact.

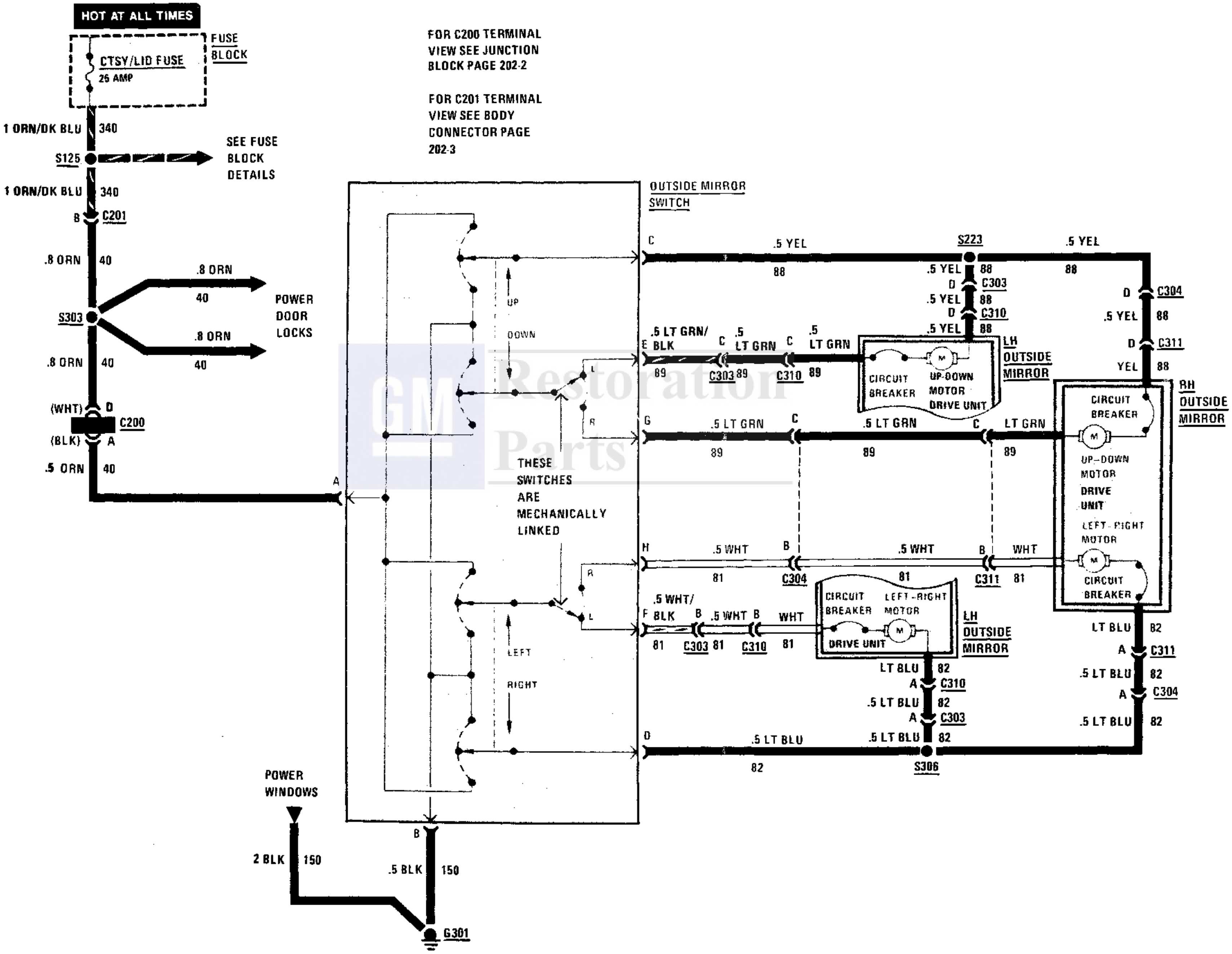
Manual Transaxle

When the Parking Brake is applied, the Parking Brake Switch closes and provides ground for the relay coil. The relay operates and voltage is applied from the closed relay contact to the Trunk Release Solenoid, releasing the lock.

Automatic Transaxle

Voltage is applied from the closed Trunk Release Switch through the Trunk Release Relay coil to the Gear Selector Switch. With the Gear Selector Switch in PARK or NEUTRAL, the Starter Solenoid provides ground for the relay. The relay contacts close and voltage is applied to the Trunk Release Solenoid, releasing the lock.

POWER REMOTE MIRRORS



POWER REMOTE MIRRORS

TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Check.**
  Check the CTSY/LID Fuse by checking the operation of the Dome Light.
- **Go to System Check for a guide to normal operation.**
- **Go to System Diagnosis for diagnostic tests.**

SYSTEM CHECK

- **Use the System Check Table as guide to normal operation.**
- **Refer to System Diagnosis for a list of symptoms and diagnostic steps.**

SYSTEM CHECK TABLE

ACTION	NORMAL RESULT
Put Mirror Select Switch in LEFT position, operate Mirror Control Switch in UP and DOWN positions	LH Outside Mirror moves smoothly upward and downward
Operate the Mirror Control Switch in the LEFT and RIGHT positions	LH Outside Mirror moves smoothly to the left and right
Put Mirror Select Switch in RIGHT position, operate Mirror Control Switch in UP and DOWN positions	RH Outside Mirror moves smoothly upward and downward
Operate Mirror Control Switch in the LEFT and RIGHT positions	RH Outside Mirror moves smoothly to the left and right

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- **Refer to System Diagnosis when a result is not normal.**

COMPONENT LOCATION

		Page-Figure
Fuse Block	Behind LH side of I/P	201- 6-D
C200 (16 cavities)	LH shroud ahead of center access hole	201- 6-D
C201 (8 cavities)	LH shroud above center access hole	201-12-C
C303 (4 cavities)	LH shroud, near center access hole	201-12-C
C304 (4 cavities)	RH shroud, near center access hole	201-12-D
C310 (4 cavities)	In LH door, below mirror	201- 7-A
C311 (4 cavities)	In RH door, below mirror	201-12-A
G301	On upper RH shroud	201-12-D
S125	Main harness, behind LH side of I/P, near Fuse Block	201- 6-D
S223	Power mirror harness	201-12-B
S303	Crosscar harness, above steering column	201-12-B
S306	Power mirror harness, behind center of I/P	201-12-B

SYSTEM DIAGNOSIS

- **Do the tests listed for your symptom in the Symptom Table below.**
- **Tests follow the Symptom Table.**

SYMPTOM TABLE

SYMPTOM	DO TEST
Both mirrors do not operate in any mode	A: Outside Mirror Switch Power and Ground Test
LH Outside Mirror does not operate in one or more modes	B: LH Outside Mirror Switch Test
RH Outside Mirror does not operate in one or more modes	C: RH Outside Mirror Switch Test

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A: OUTSIDE MIRROR SWITCH POWER AND GROUND TEST

Measure: VOLTAGE
At: OUTSIDE MIRROR SWITCH CONNECTOR (Disconnected)

Measure Between	Correct Voltage	For Diagnosis
A (ORN) & Ground	Battery	See 1
A (ORN) & B (BLK)	Battery	See 2

- If all voltages are correct, replace Outside Mirror Switch.

1. Check/repair ORN (40) wire.
2. Check/repair BLK (150) wire.

B: LH OUTSIDE MIRROR SWITCH TEST

Measure: VOLTAGE
At: OUTSIDE MIRROR SWITCH CONNECTOR (Connected)
Conditions:
- **Mirror Select Switch: LH**
- **Mirror Control Switch: Hold in UP & DOWN**

Measure Between	Correct Voltage	For Diagnosis
C (YEL) & E (LT GRN/BLK)	Battery	See 1

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- Hold Mirror Control Switch in LEFT & RIGHT

Measure Between	Correct Voltage	For Diagnosis
D (LT BLU) & F (WHT/BLK)	Battery	See 1

- If all voltages are correct, replace the LH Outside Mirror Drive Unit after checking connector C310, YEL (88), LT GRN (89), WHT (81) and LT BLU (82) wires.

1. Replace the Outside Mirror Switch.

C: RH OUTSIDE MIRROR SWITCH TEST

Measure: VOLTAGE
At: OUTSIDE MIRROR SWITCH CONNECTOR (Connected)
Conditions:
- **Mirror Select Switch: RH**
- **Mirror Control Switch: Hold in UP and DOWN**

Measure Between	Correct Voltage	For Diagnosis
C (YEL) & G (LT GRN)	Battery	See 1

- Hold Mirror Control Switch LEFT & RIGHT

Measure Between	Correct Voltage	For Diagnosis
D (LT BLU) & H (WHT)	Battery	See 1

- If all voltages are correct, replace the RH Outside Mirror Drive Unit after checking connector C311, YEL (88), LT GRN (89), WHT (81) and LT BLU (82) wires.

1. Replace Outside Mirror Switch.

CIRCUIT OPERATION

Each Outside Mirror has two reversible motors, one motor adjusts the mirror view up and down, the other motor adjusts the mirror view right and left. The driver operates four switches that control the polarity of the voltage to the motors. The Mirror Select Switch directs these control voltages to either the RH or LH Outside Mirror.

With the switches in the positions shown in the schematic, the LH Outside Mirror is moved. When the Up-Down Switch is moved UP, battery voltage from the ORN wire is applied to the YEL wire and the Up-Down Motor in each Outside Mirror. The LH Outside Mirror Up-Down Motor has a path to ground through the LT GRN/BLK wire, the UP contacts of the Up-Down Switches and the BLK wire. The LH motor runs and turns the mirror up.

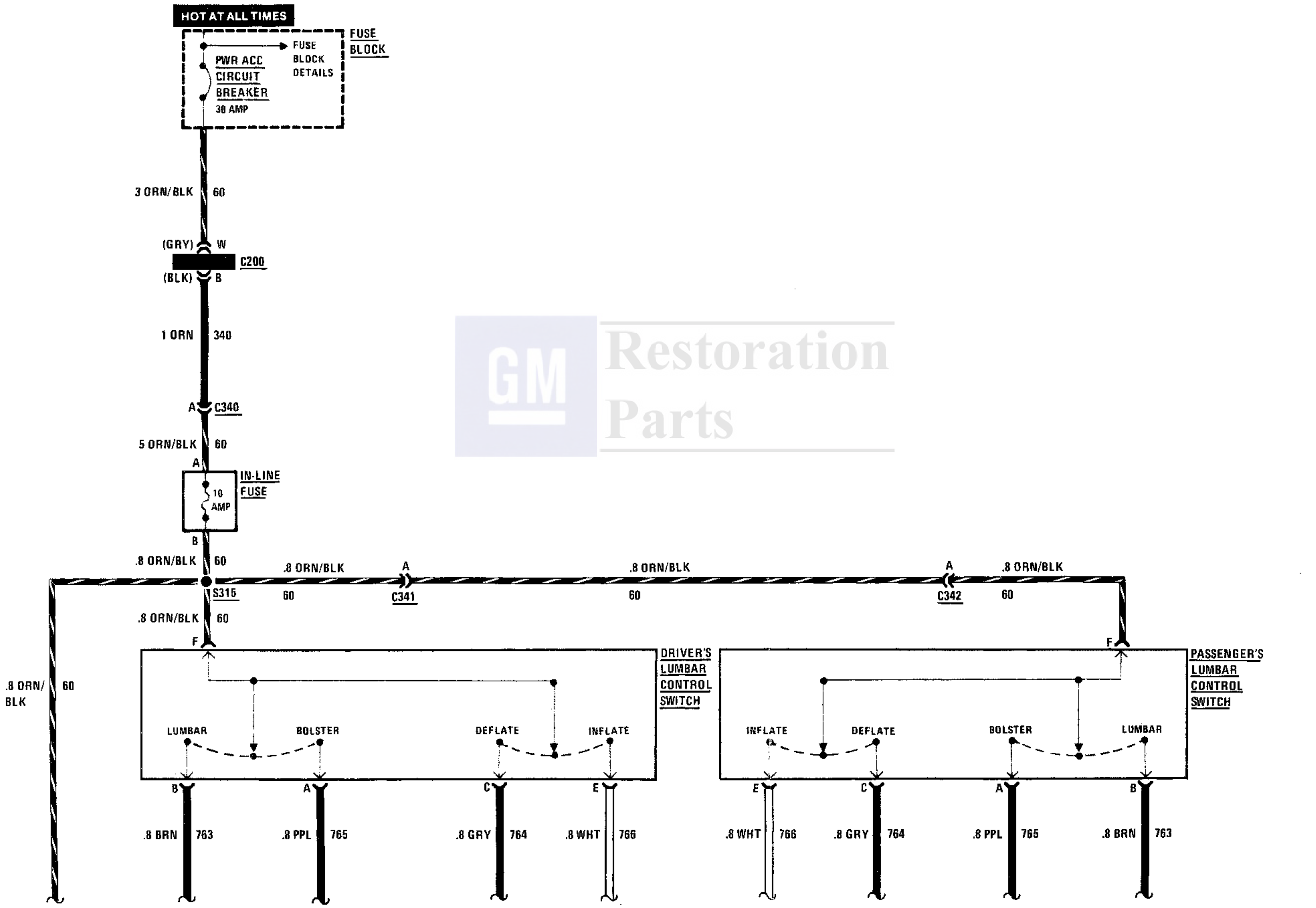
If the Mirror Control Switch is pushed to the DOWN position, the same motor receives voltage. Now the polarity is reversed, with the YEL wire grounded. The motor runs in the opposite direction.

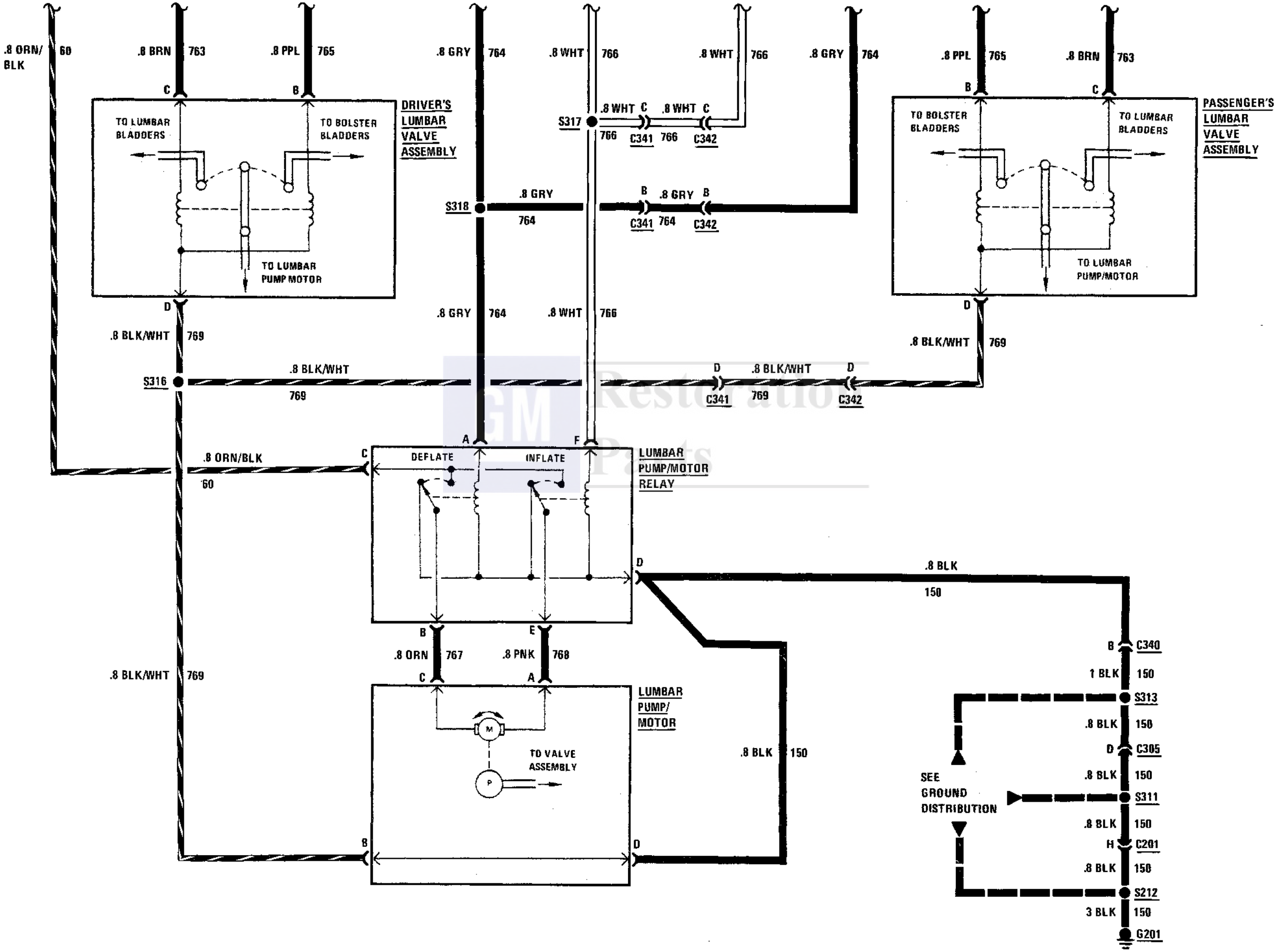
The LH Outside Mirror Left-Right Motor operates in a similar manner when the joy stick moves the Left-Right Switch to LEFT. The WHT/BLK wire gets battery voltage and the LT BLU wire is grounded through the Left-Right Switch.

The RH Outside Mirror works the same way as the LH Outside Mirror when the Mirror Select is moved to the RH position and the joy stick is operated.

BLANK

LUMBAR AND BOLSTER SUPPORT




.8 ORN/ BLK
60
.8 BRN
763
.8 PPL
765
.8 GRY
764
.8 WHT
766
.8 WHT
766
.8 GRY
764
.8 PPL
765
.8 BRN
763
C
B
TO LUMBAR BLADDERS
TO BOLSTER BLADDERS
DRIVER'S LUMBAR VALVE ASSEMBLY
TO LUMBAR PUMP MOTOR
D
S317
.8 WHT
766
C341
.8 WHT
766
C342
S318
.8 GRY
764
B
C341
.8 GRY
764
C342
B
C
TO BOLSTER BLADDERS
TO LUMBAR BLADDERS
PASSENGER'S LUMBAR VALVE ASSEMBLY
TO LUMBAR PUMP/MOTOR
D
.8 BLK/WHT
769
.8 GRY
764
.8 WHT
766
.8 BLK/WHT
769
S316
.8 BLK/WHT
769
D
C341
.8 BLK/WHT
769
D
C342
A
F
C
.8 ORN/BLK
60
DEFLATE
INFLATE
LUMBAR PUMP/MOTOR RELAY
D
.8 BLK
150
B
E
.8 ORN
767
.8 PNK
768
C
A
LUMBAR PUMP/ MOTOR
M
TO VALVE ASSEMBLY
P
.8 BLK/WHT
769
.8 BLK
150
B
D
B
C340
1 BLK
150
S313
.8 BLK
150
D
C305
.8 BLK
150
SEE GROUND DISTRIBUTION
S311
.8 BLK
150
H
C201
.8 BLK
150
S212
3 BLK
150
G201

LUMBAR AND BOLSTER SUPPORT

TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Check.**

1. Check the In-Line Fuse.
2. Check the PWR ACC Circuit Breaker.
3. If the Lumbar Pump/Motor runs, but both Driver's and Passenger's Lumbar and Bolster Supports do not operate, check the continuity to ground of BLK/WHT (769) wire (see schematic).
4. Check the hose between the Valve Assemblies and the Pump/Motor for leaks or cracks.

- **Go to System Check for a guide to normal operation.**
- **Go to System Diagnosis for diagnostic tests.**

SYSTEM CHECK

- **Use the System Check Table as a guide to normal operation.**

COMPONENT LOCATION

		Page-Figure
Driver's Lumbar Control Switch	Under driver's seat	
Driver's Lumbar Valve Assembly	Under driver's seat	
Fuse Block	Behind LH side of I/P	201- 6-D
In Line Fuse	Under RH side of driver's seat	
Lumbar Pump/Motor	Under driver's seat	
Lumbar Pump/Motor Relay	Under driver's seat	
Passenger's Lumbar Control Switch	Under passenger's seat	
Passenger's Lumbar Valve Assembly	Under passenger's seat	
C200 (16 cavities)	LH shroud ahead of center access hole	201- 6-D
C201 (8 cavities)	LH shroud above center access hole	201-12-C
C305 (4 cavities)	Behind dash, near LH shroud	201-13-B
C340	Under RH side of driver's seat	201-13-B
C341	Under RH side of driver's seat	
C342	Under RH side of driver's seat	
G201	Behind center of I/P	201- 6-C
S212	Main harness, behind center of dash	201- 6-C
S311	Crosscar harness, LH side of I/P	201-12-C
S313	Body harness, under LH front seat	201-13-B
S315	Power seat harness, under driver's seat	
S316	Power seat harness, under driver's seat	
S317	Power seat harness, under driver's seat	
S318	Power seat harness, under driver's seat	

LUMBAR AND BOLSTER SUPPORT

SYSTEM CHECK TABLE

SET CONTROLS	NORMAL OPERATION
Driver's Lumbar Control Switch: BOLSTER and INFLATE	The Bolster Support on the driver's seat inflates
Driver's Lumbar Control Switch: LUMBAR and INFLATE	The Lumbar Support on the driver's seat inflates
Driver's Lumbar Control Switch: BOLSTER and DEFLATE	The Bolster Support on the driver's seat deflates
Driver's Lumbar Control Switch: LUMBAR and DEFLATE	The Lumbar Support on the driver's seat deflates
Repeat the above settings using the Passenger's Lumbar Control Switch and note the operation of the passenger's seat	The Bolster and Lumbar Supports in the passenger's seat operate the same as those in the driver's seat

- **Refer to System Diagnosis when a result is not normal.**

SYSTEM DIAGNOSIS

- **Do the tests listed for your symptom in the Symptom Table below.**
- **Tests follow the Symptom Table.**

SYMPTOM TABLE

SYMPTOM	DO TEST
Both Lumbar Controls do not inflate and/or deflate the Supports	A. Lumbar Pump/ Motor Relay Test
Lumbar and/or Bolster Supports do not operate in the driver's seat only	B. Lumbar Control Switch Test C. Lumbar Valve Assembly Test
Lumbar and/or Bolster Supports do not operate in the passenger's seat only	B. Lumbar Control Switch Test C. Lumbar Valve Assembly Test

A: LUMBAR PUMP/MOTOR RELAY TEST (TABLE1)

<table>
<tr><td colspan="3">Measure: VOLTAGE
At: LUMBAR PUMP/MOTOR RELAY CONNECTOR (Disconnected)
Condition:
• Driver's Lumbar Control Switch: DEFLATE</td></tr>
<tr><th>Measure Between</th><th>Correct Voltage</th><th>For Diganosis</th></tr>
<tr><td>C (ORN/BLK) & Ground</td><td>Battery</td><td>See 1</td></tr>
<tr><td>C (ORN/BLK) & D (BLK)</td><td>Battery</td><td>See 2</td></tr>
<tr><td colspan="3">• Driver's Lumbar Control Switch: DEFLATE</td></tr>
<tr><td>A (GRY) & Ground</td><td>Battery</td><td>See 3</td></tr>
<tr><td colspan="3">• Driver's Lumbar Control Switch: INFLATE</td></tr>
<tr><td>F (WHT) & Ground</td><td>Battery</td><td>See 4</td></tr>
<tr><td colspan="3">• If voltages are correct, go to Table 2.
1. Check ORN/BLK (60) wire for an open.
2. Check BLK (150) wire for an open.
3. Check GRY (764) wire for an open.
4. Check WHT (766) wire for an open.</td></tr>
</table>

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LUMBAR AND BOLSTER SUPPORT

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A: LUMBAR PUMP/MOTOR RELAY TEST (TABLE 2)

Connect: FUSED JUMPERS
At: LUMBAR PUMP/MOTOR RELAY CONNECTOR (Disconnected)
Condition:

- **Driver's Lumbar Control Switch: LUMBAR**

Jumper Between	Correct Result	For Diagnosis
C (ORN/BLK) & E (PNK) and B (ORN) & D (BLK)	Driver's Lumbar Support inflates	See 1
C (ORN/BLK) & B (ORN) and E (PNK) & D (BLK)	Driver's Lumbar Support deflates	See 1

- If results are correct, replace the Lumbar Pump/Motor Relay.

1. Check ORN (767) and PNK (768) wires and connectors for continuity. If the connections and wires are good, replace the Lumbar Pump/Motor.

B: LUMBAR CONTROL SWITCH TEST

Measure: VOLTAGE
At: DRIVER'S OR PASSENGER'S LUMBAR CONTROL SWITCH (Connected)
Condition:

- **Lumbar Control Switch: LUMBAR & INFLATE**

Measure Between	Correct Voltage	For Diagnosis
F (ORN/BLK) & Ground	Battery	See 1
B (BRN) & Ground	Battery	See 2
E (WHT) & Ground	Battery	See 2
• Lumbar Control Switch: BOLSTER & DEFLATE		
A (PPL) & Ground	Battery	See 2
C (GRY) & Ground	Battery	See 2

- If voltages are correct, do Test C.

1. Check In-Line Fuse and ORN/BLK (60) wire for an open.
2. Check attached wire for a short to ground. Replace Lumbar Control Switch if wire is good.

C: LUMBAR VALVE ASSEMBLY TEST

Measure: VOLTAGE
At: DRIVER'S OR PASSENGER'S LUMBAR VALVE ASSEMBLY CONNECTOR
Condition:

- **Lumbar Control Switch: LUMBAR**

Measure Between	Correct Voltage	For Diagnosis
C (BRN) & Ground	Battery	See 1
C (BRN) & D (BLK/WHT)	Battery	See 2
• Lumbar Control Switch: BOLSTER		
B (PPL) & Ground	Battery	See 3

- If voltages are correct, replace the suspect Lumbar Valve Assembly.

1. Check BRN (763) wire for an open.
2. Check Lumbar Pump/Motor BLK/WHT (769) and BLK (150) wires for an open (see schematic).
3. Check PPL (765) wire for an open.

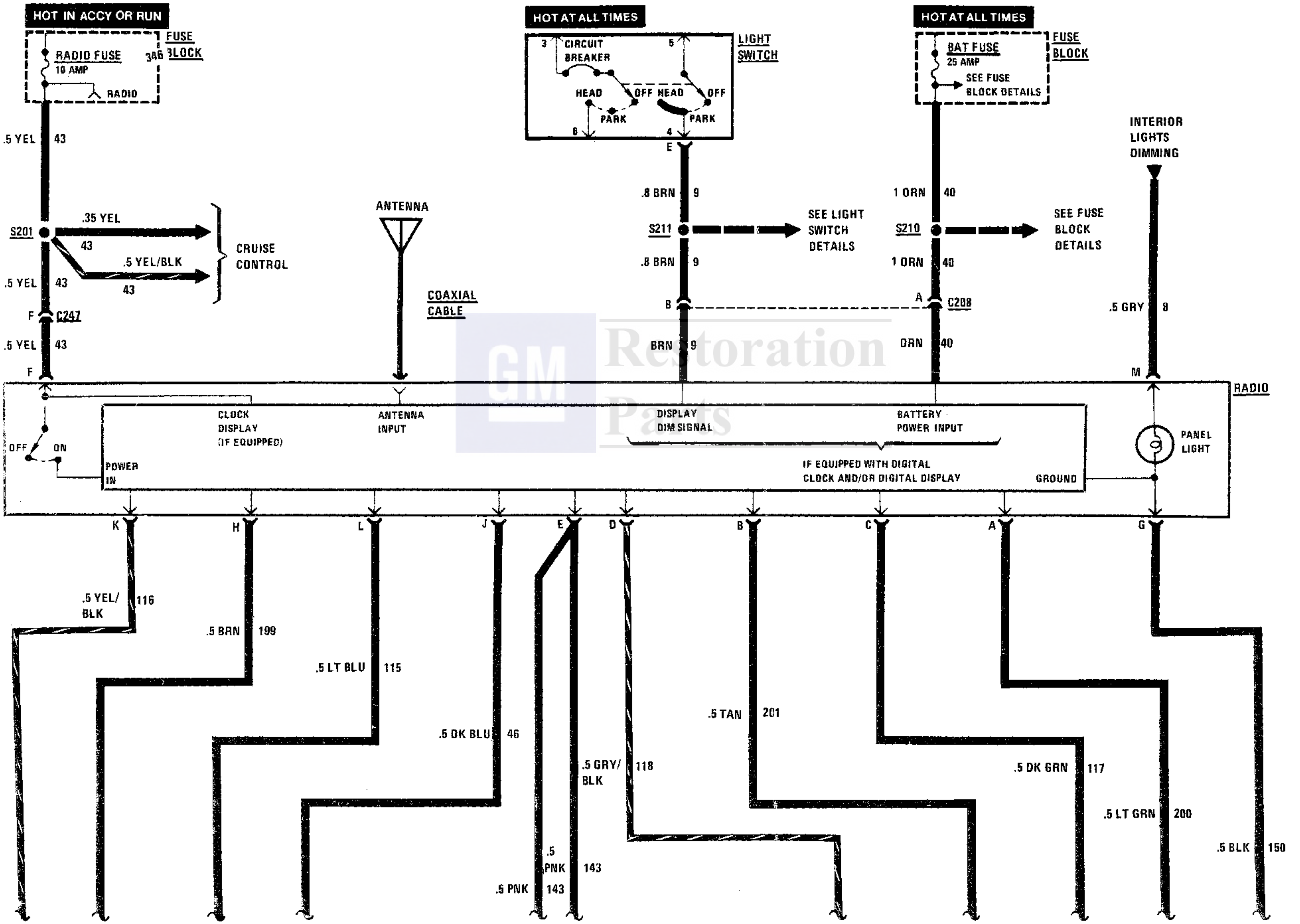
LUMBAR AND BOLSTER SUPPORT

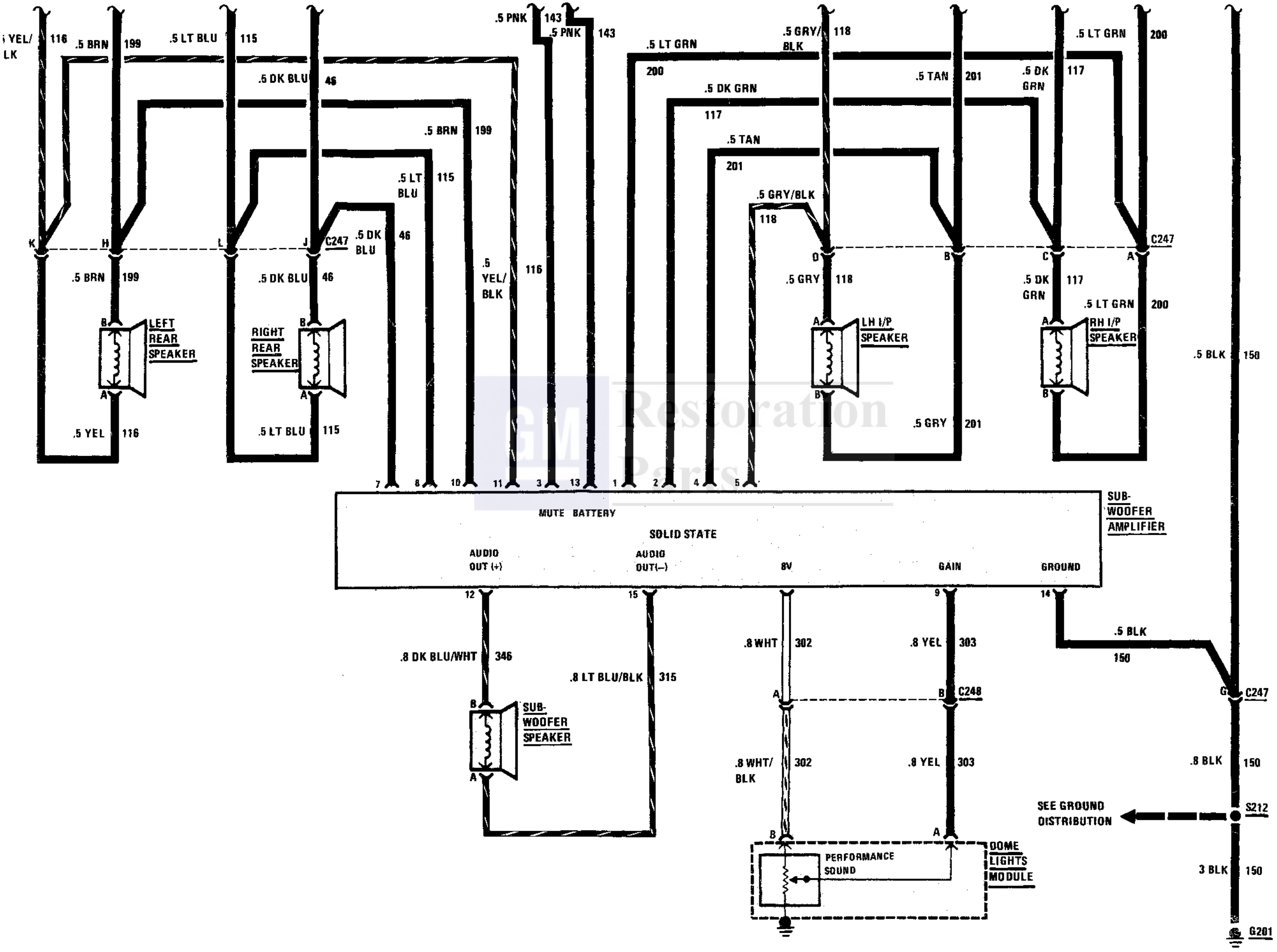
CIRCUIT OPERATION

Voltage is applied at all times through the PWR ACC Circuit Breaker. When the Lumbar Control Switch is moved to LUMBAR and INFLATE, the Lumbar Pump/Motor starts to operate to pump up the Lumbar Support. When the Lumbar Control Switch is moved to DEFLATE, the Lumbar Control Pump/Motor reverses to pull the air from the Lumbar Support.

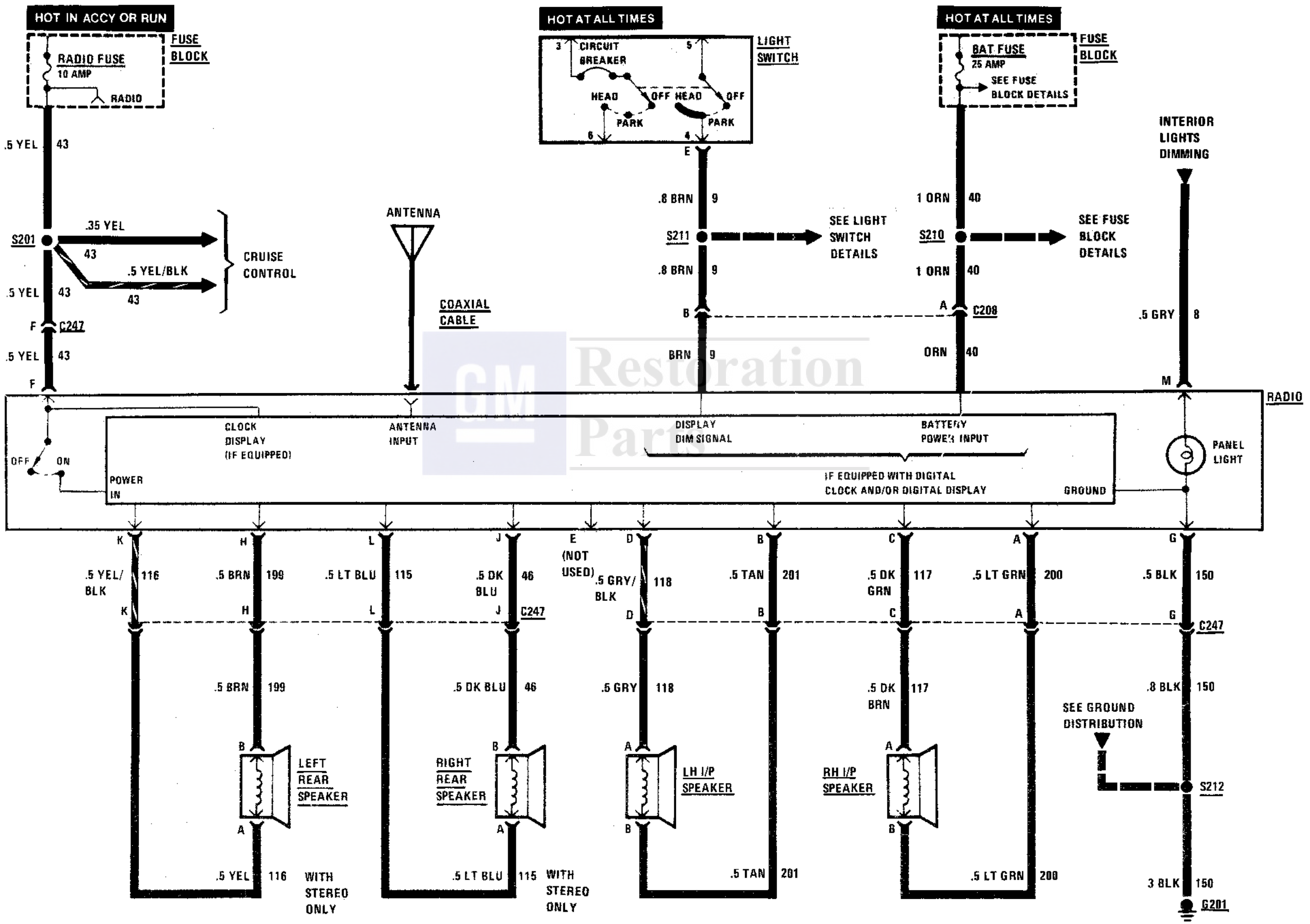
A similar action occurs when the Lumbar Control Switch is operated for the Bolster Support.

RADIO: UM6/UM7/UQ6/UT4/UX1




YEL/
LK
116
.5 BRN
199
.5 LT BLU
115
.5 DK BLU
46
.5 PNK
143
.5 PNK
143
.5 LT GRN
200
.5 GRY/
BLK
118
.5 LT GRN
200
.5 TAN
201
.5 DK
GRN
117
.5 DK GRN
117
.5 BRN
199
.5 TAN
201
.5 LT
BLU
115
.5 GRY/BLK
118
K
H
L
J
C247
.5 DK
BLU
46
D
B
C
A
C247
.5 BRN
199
.5 DK BLU
46
.5
YEL/
BLK
116
.5 GRY
118
.5 DK
GRN
117
.5 LT GRN
200
B
LEFT
REAR
SPEAKER
A
RIGHT
REAR
SPEAKER
B
A
A
LH I/P
SPEAKER
B
A
RH I/P
SPEAKER
B
.5 BLK
150
.5 YEL
116
.5 LT BLU
115
.5 GRY
201
7
8
10
11
3
13
1
2
4
5
MUTE
BATTERY
SOLID STATE
SUB-
WOOFER
AMPLIFIER
AUDIO
OUT (+)
AUDIO
OUT(−)
8V
GAIN
GROUND
12
15
9
14
.8 DK BLU/WHT
346
.8 LT BLU/BLK
315
.8 WHT
302
.8 YEL
303
.5 BLK
150
A
B
C248
G
C247
B
SUB-
WOOFER
SPEAKER
A
.8 WHT/
BLK
302
.8 YEL
303
.8 BLK
150
SEE GROUND
DISTRIBUTION
S212
B
A
PERFORMANCE
SOUND
DOME
LIGHTS
MODULE
3 BLK
150
G201

RADIO: UM6/UM7/U63/UT4/UX1/U66



TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Check.**

1. Check the RADIO Fuse.
2. Check the BAT Fuse by operating the cigar lighter.
3. Check that the Antenna connector and coaxial cable are properly connected.
4. Adjusting Radio controls will change the operation of the sound system. Consult the Delco Sound Service Guide for information regarding the operation of these controls.
5. Before troubleshooting a suspect speaker, check all connections to that speaker.
6. For proper noise diagnosis, take car outside where signals are strong. Close hood and keep away from metal buildings or sources of radio interference.
7. Ignition noise on FM may indicate a defective Ignition System.
8. Coated screws or bolts can cause a poor ground condition. Scrape ground screws clean of any paint or varnish.

- **Go to System Check for a guide to normal operation.**
- **Go to System Diagnosis for diagnostic tests.**

SYSTEM CHECK

- **Use the System Check Table as a guide to normal operation.**
- **Refer to System Diagnosis for a list of symptoms and diagnostics steps.**

COMPONENT LOCATION

		Page-Figure
Dome Light Module	At dome lamp, in roof	
Fuse Block	Behind LH side of I/P	201- 6-D
Sub-Woofer Amplifier	Under RH side of center console	201-10-A
C208 (2 cavities)	Center of dash, behind radio	
C247 (12 cavities)	Center console, behind radio	201-10-A
C248 (2 cavities)	Behind LH side of I/P	201- 6-B
G201	Behind center of I/P	201- 6-C
S201	Main harness, above steering column	201- 7-A
S210	Main harness, behind RH side of I/P	201- 6-C
S211	Main harness, behind RH side of I/P	201- 6-C
S212	Main harness, behind center of dash	201- 6-C

SYSTEM CHECK TABLE

ACTION	NORMAL RESULT
With Ignition Switch in RUN, turn the Radio ON	The display comes on The Digital Clock operates (Electronically Tuned Radio only) Sound comes from all four speakers
Operate Radio controls	Consult the Delco Sound Service Guide for information regarding the operation of the controls
Turn Headlight Switch to PARK	The Panel Light comes on The Digital display dims

- **Refer to System Diagnosis when a result is not normal.**

SYSTEM DIAGNOSIS

- **Do the tests listed for your symptom in the Symptom Table below. If the vehicle's symptom is not in the table, perform all tests.**
- **Tests follow the Symptom Table.**
- **Tests apply to both Electronically Tuned Radio (ETR) and Delco Bose® Music System unless otherwise indicated.**

SYMPTOM TABLE

SYMPTOM	DO TEST
Radio does not appear to work (no display lights, no sound)	A: Radio Power Input Test
Panel Light does not come on	B: Panel Light Test
Display Dimming function will not operate	C: Display Dimming Test

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[Electronically Tuned Radio (ETR)] No sound or distorted sound comes from speaker	D: Speaker Test
(Delco Bose® Music System) No sound or distorted sound comes from the Subwoofer Speaker	E: Subwoofer Amplifier Test
Excessive noise comes from all speakers	H: Noise Diagnosis Test

A: RADIO POWER INPUT TEST (TABLE 1)

Measure: VOLTAGE
At: RADIO CONNECTOR (Disconnected)
Condition:
- **Ignition Switch: RUN**

Measure Between	Correct Voltage	For Diagnosis
F (YEL) & Ground	Battery	See 1
F (YEL) & G (BLK)	Battery	See 2

- If voltages are correct, go to Table 2.

1. Check YEL (43) wire for an open (see schematic).
2. Check BLK (150) wire for an open to ground (see schematic).

A: RADIO POWER INPUT TEST (TABLE 2)

Measure: VOLTAGE
At: RADIO CONNECTOR C208 (Disconnected)

Measure Between	Correct Voltage	For Diagnosis
A (ORN) & Ground	Battery	See 1

- If voltage is correct, remove Radio for service.

1. Check ORN (40) wire for an open (see schematic).

B: PANEL LIGHT TEST

Measure: VOLTAGE
At: RADIO CONNECTOR (Disconnected)
Conditions:
- **Light Switch: PARK**
- **Dimming Switch: BRIGHT**

Measure Between	Correct Voltage	For Diagnosis
M (GRY) & Ground	Battery	See 1

- If voltage is correct, remove Radio for service.

1. Check GRY (8) wire for an open (see schematic).

C: DISPLAY DIMMING TEST

Measure: VOLTAGE
At: RADIO CONNECTOR C208 (Disconnected)
Condition:
- **Light Switch: HEAD or PARK**

Measure Between	Correct Voltage	For Diagnosis
B (BRN) & Ground	Battery	See 1

- If voltage is correct, remove Radio for service.

1. Check BRN (9) wire for an open (see schematic).

D: SPEAKER TEST (TABLE 1)

Connect: ANALOG OHMMETER
At: SUSPECT SPEAKER
Conditions:
- **Ohmmeter set on RX1 scale**
- **Speaker Wires: DISCONNECTED**

Action	Correct Result	For Diagnosis
Connect ohmmeter across speaker terminals	Speaker "pops"	See 1

- If the result is correct, go to Table 2.

1. Replace the problem speaker with a new one.

D: SPEAKER TEST (TABLE 2)

Measure: AC VOLTAGE
At: RADIO OUTPUT FOR SUSPECT SPEAKER
Conditions:
- **Ignition Switch: RUN**
- **Radio: ON (High Volume)**

Action	Correct Voltage	For Diagnosis
Connect voltmeter across outputs for suspect Speaker with Radio tuned to a strong signal	Varying around 1 volt AC	See 1

- If voltage is correct, repair wires between Radio and suspect Speaker.

1. Remove Radio for service.

E: SUBWOOFER AMPLIFIER TEST (TABLE 1)

Measure: VOLTAGE
At: SUBWOOFER AMPLIFIER CONNECTOR (Connected)
Conditions:
- **Ignition Switch: RUN**
- **Radio: ON**

Measure Between	Correct Voltage	For Diagnosis
3 (PNK) & Ground	Battery	See 1
13 (PNK) & Ground	Battery	See 1
13 (PNK) & 14 (BLK)	Battery	See 2

- If voltages are correct, go to Table 2.

1. Check/repair PNK (143) wires (see schematic). If PNK (143) wires are good remove Radio for service.
2. Check/repair BLK (150) wire (see schematic).

E: SUBWOOFER AMPLIFIER TEST (TABLE 2)

Measure: AC VOLTAGE
At: SUBWOOFER AMPLIFIER CONNECTOR (Connected)
Conditions:
- **Ignition Switch: RUN**
- **Radio: ON (High Volume)**

Measure Between	Correct Voltage	For Diagnosis
7 (DK BLU) & 8 (LT BLU)	Varying Around 1 Volt AC	See 1
10 (BRN) & 11 (YEL/BLK)		
1 (LT GRN) & 2 (DK GRN)		
4 (TAN) & 5 (GRY/BLK)		

- If voltages are correct, go to Table 3.

1. Check/repair wires between connector C247 and Subwoofer Amplifier.

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E: SUBWOOFER AMPLIFIER TEST (TABLE 3)

Measure: VOLTAGE
At: SUBWOOFER AMPLIFIER CONNECTOR (Connected)
Conditions:

- **Ignition Switch: RUN**
- **Radio: ON**

Measure Between	Correct Voltage	For Diagnosis
6 (WHT) & Ground	Approx. 8 volts	See 1
• Performance sound control at minimum		
9 (YEL) & Ground	3.5 to 4.5 volts	See 2
• Performance sound control at maximum		
9 (YEL) & Ground	Approx. 8 volts	See 2

- If all voltages are correct, go to Test G: Subwoofer Speaker Test.

1. Check WHT (302) wire for a short to ground, if OK replace Subwoofer Amplifier Assembly.
2. Go to Test F: Performance Sound Control Test.

F: PERFORMANCE SOUND CONTROL TEST

Measure: VOLTAGE
At: DOME LIGHTS MODULE CONNECTOR (Connected)
Conditions:

- **Ignition Switch: RUN**
- **Radio: ON**

Measure Between	Correct Voltage	For Diagnosis
B (WHT/BLK) & Ground	Approximately 8 volts	See 1
• Performance sound control at minimum		
A (YEL) & Ground	3.5 to 4.5 volts	See 2
• Performance sound control at maximum		
A (YEL) & Ground	Approximately 8 volts	See 2

- If all voltages are correct, check/repair YEL (303) wire (see schematic).

1. Check/repair WHT/BLK or WHT (302) wire (see schematic).
2. Check/repair YEL (303) wire for a short to ground. If OK, replace Performance Sound Control.

G: SUBWOOFER SPEAKER TEST (TABLE 1)

Connect: ANALOG OHMMETER
At: SUSPECT SUBWOOFER SPEAKER(S) (Disconnected)
Conditions:

- **Speaker Wires: DISCONNECTED**
- **Ohmmeter set on RX1 scale**

Action	Correct Result	For Diagnosis
Connect Ohmmeter across Subwoofer Speaker Terminals	Speaker “pops”	See 1

- If result is correct, go to Table 2.

1. Replace Subwoofer Speaker.

G: SUBWOOFER SPEAKER TEST (TABLE 2)

Measure: AC VOLTAGE
At: SUBWOOFER AMPLIFIER CONNECTOR (Connected)
Conditions:

- **Speaker Wires: RECONNECTED**
- **Ignition Switch: RUN**
- **Radio: ON (High Volume)**
- **Performance sound control at Maximum**

Measure Between	Correct Voltage	For Diagnosis
15 (LT BLU/ BLK) & 12 (DK BLU/ WHT)	Varying around 1 volt AC	See 1

- If the voltage is correct, check/repair wires between the Subwoofer Amplifier and the Subwoofer Speaker.

1. Remove Subwoofer Amplifier for service.

H: NOISE DIAGNOSIS TEST

Unplug Antenna at the back of the Radio.

- If noise disappears, it was being picked up by the Antenna. Consult the Delco Sound Service Guide for Antenna noise diagnosis.
- If noise persists, it is coming in from the Radio wiring. Refer to the following chart for a possible cause and corrective action.

NOISE SYMPTOM TABLE

SYMPTOM	POSSIBLE CAUSE	REPAIR ACTION
Harsh popping noise that changes with engine rpm	Ignition noise	Perform the steps under Ignition noise, page 150-9
High whine (like a siren) that changes with engine rpm	Generator noise	Add filter package 1224205 to power and/or memory lead to the Radio (See Fig. 2, page 150-9) By-pass the Generator output with 250 MFD 100v capacitor (See Fig. 3, page 150-8) Install a dedicated ground strap on the Radio (See Fig. 1, page 150-9) Run a direct wire from Battery (+) to Generator Exchange the defective Radio with a good Radio. If noise disappears, send the defective Radio for repair Replace Generator
Noise occurs only when an accessory is on	Condition in that accessory	Install filter package 1224205 in the power lead(s) to that accessory (See Fig. 2, page 150-9) Install a .5 MFD by-pass capacitor and power lead to that accessory Consult Delco Sound Service Guide
All stations weak, noisy, both AM and FM	Defective Antenna or lead-in wire	Temporarily replace the Antenna with another one. Repair/replace the defective one if the Radio reception improves Check at the Antenna Coax lead-in and the connector
AM only, weak & noisy	AM alignment	Remove Radio for repair
FM only, weak & noisy	FM alignment	Remove Radio for repair
Noise present with engine not running	ECM or Digital Cluster	Install filter package 1224205 in the power leads of the Electronic Control Module (ECM) and/or Instrument Panel Digital Cluster
Noise that stops when Antenna is unplugged from the back of Radio	Antenna noise	Replace defective Antenna with a good Antenna If noise disappears repair/replace the defective Antenna Check Antenna ground, Coaxial Cable Braid, and grounds at connectors If noise presists with replacement Antenna, the problem must be repaired at the source of the noise (Generator, Ignition System, accessory, etc). See Delco Sound Service Guide for noise "sniffing" procedures

RADIO

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 of wiring and components
- Locating vehicle noise

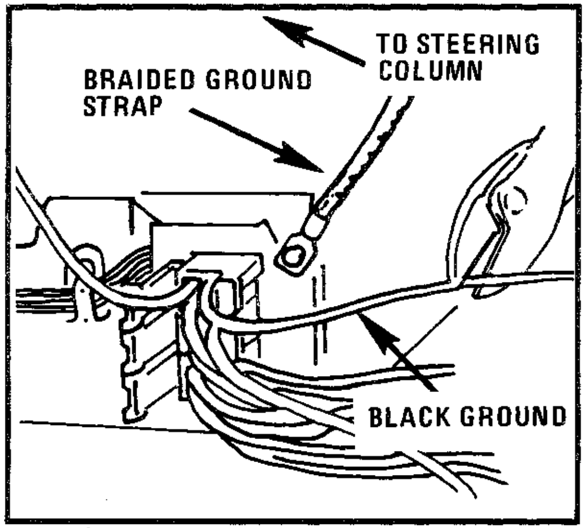


Figure 1 - Cut the BLACK (ground) wire from the black plug at the back of the Radio and run a braided ground strap from the case of the Radio to a good, unpainted body ground.

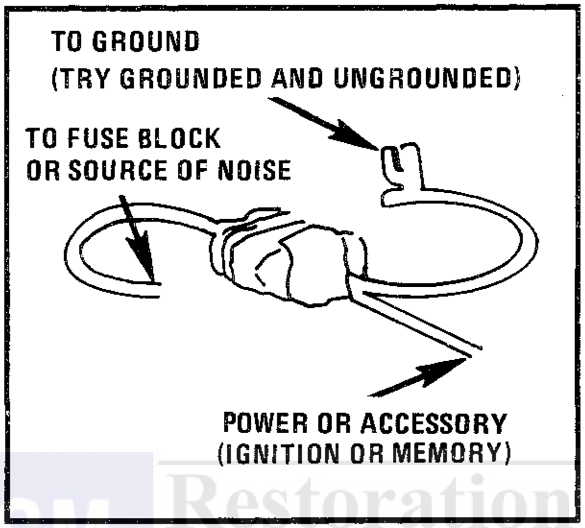


Figure 2 - Install a 1224205 filter package.

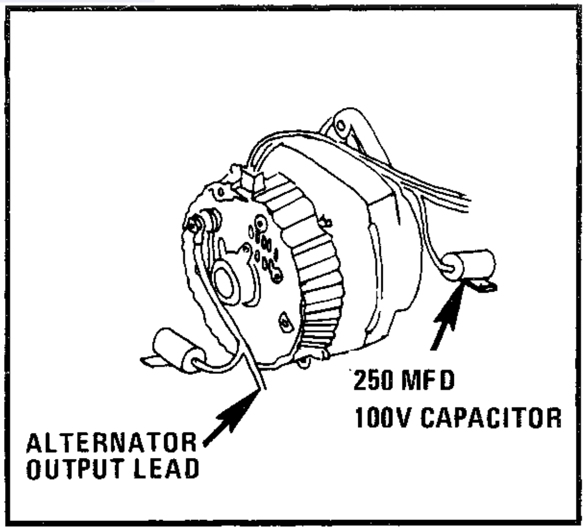


Figure 3 - Install a 250 MFD 100V capacitor on the alternator output lead to ground.

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. Replace distributor cap and rotor.
6. Check the ground from engine to firewall; install a braided ground strap if necessary.
7. Install a braided ground strap on the hood.
8. Check heater core ground; clean or install braided ground strap if necessay.
9. Check air conditioner accumulator ground; clean or install a braided ground strap if necessary.

(Continued on next page)

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.

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, Subwoofer Speaker and a Performance Sound Control located in the Dome Lights Module. Voltage is applied to the Subwoofer Amplifier at terminals 3 and 13 whenever the Radio is on. The Amplifier is grounded at G201 at terminal 14. There are eight audio inputs to the Subwoofer Amplifier from the Radio Audio Outputs. Amplifier gain is controlled by the Performance Sound Control. The Subwoofer Amplifier applies a signal voltage of 8 volts to the Performance Sound Control. The gain voltage will vary between 3.5 and 8.0 volts at terminal 9 as the Performance Sound Control is moved between the Minimum and Maximum positions. The Subwoofer Amplifier then adjusts the audio output to the Subwoofer Speaker.

BLANK

COMPONENT LOCATION VIEWS

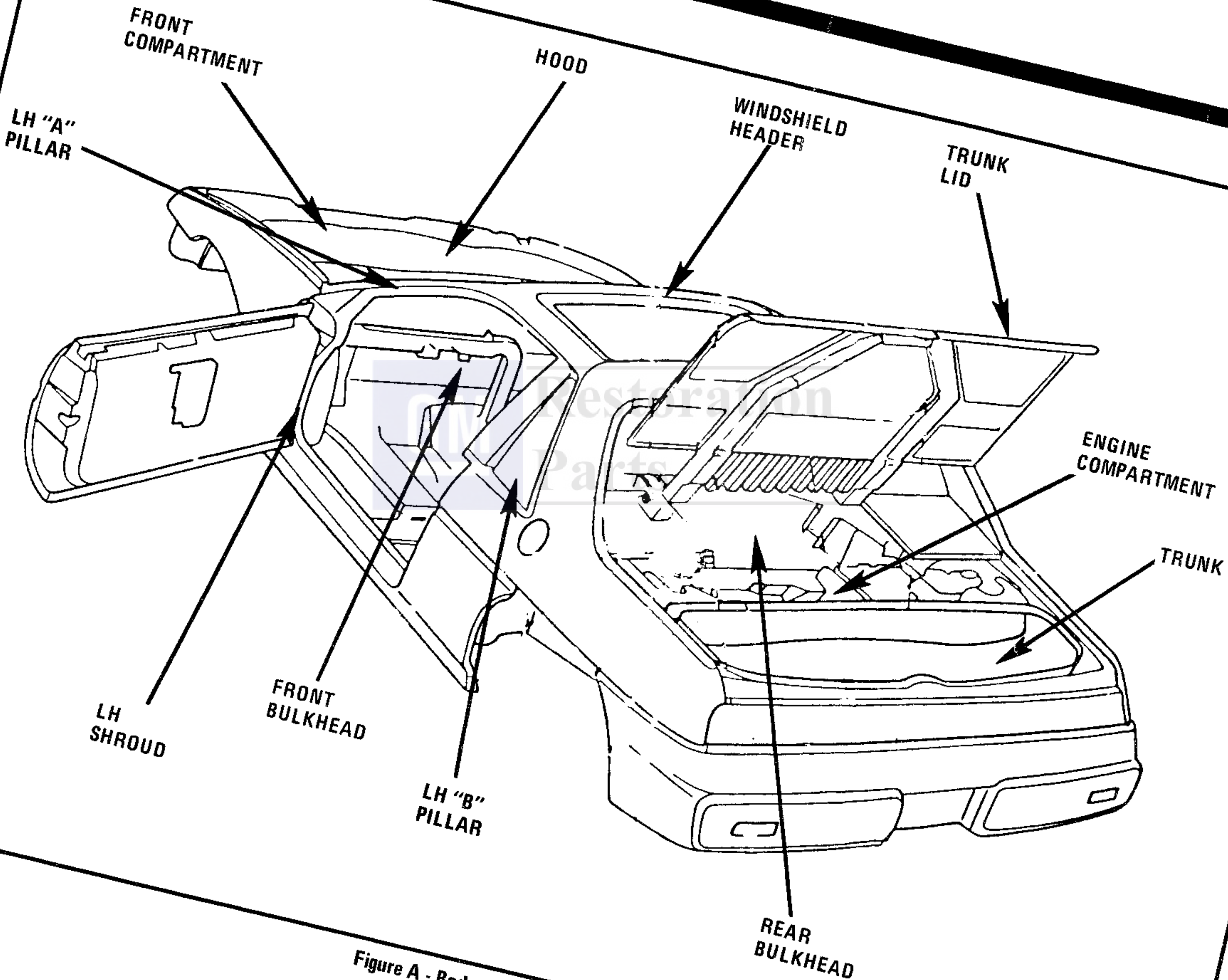


Figure A - Body Component Locations

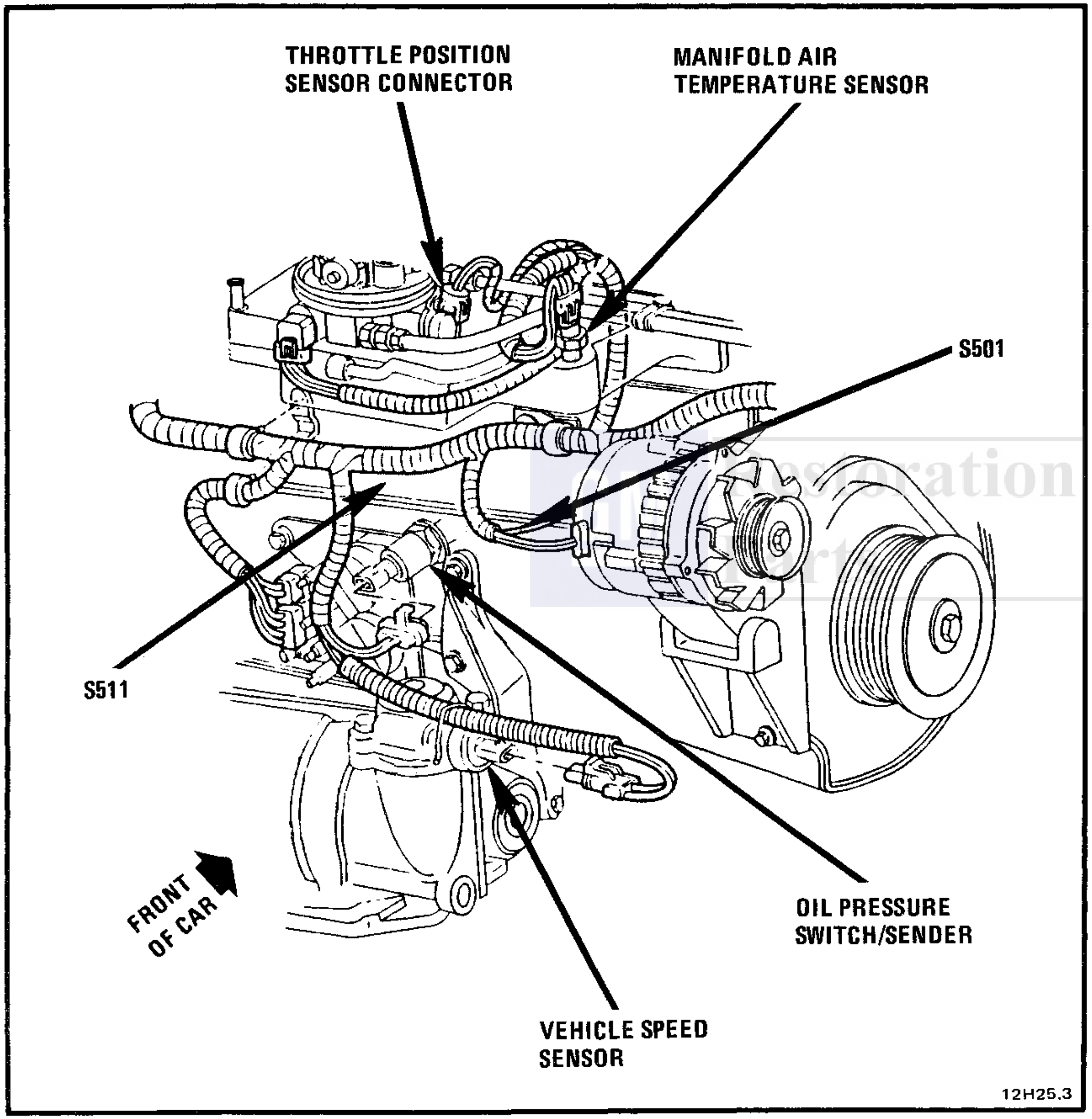


Figure A - RH Rear Of VIN R Engine

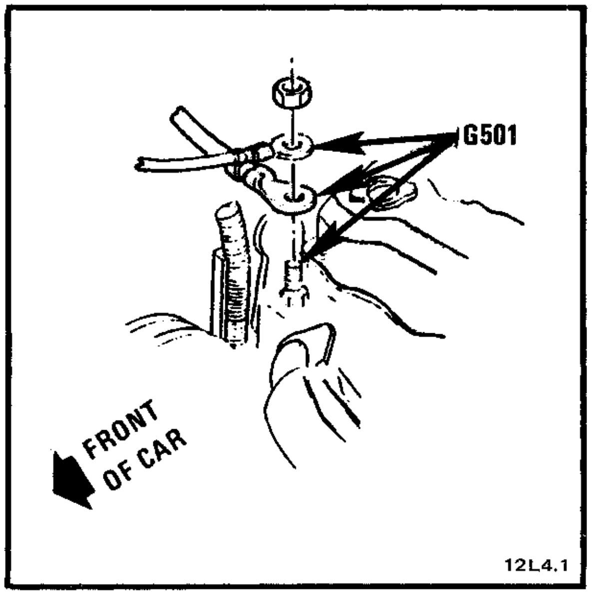


Figure B-RH Side OF VIN R Engine, Near Oil Fill Cap

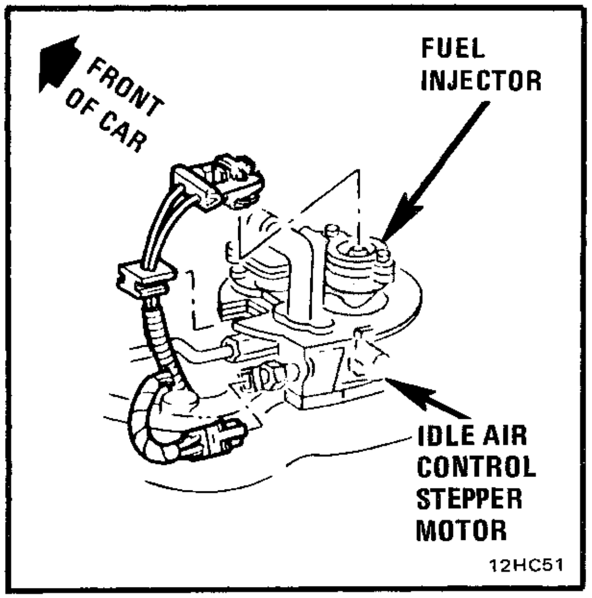


Figure C - Rear Of Throttle Body

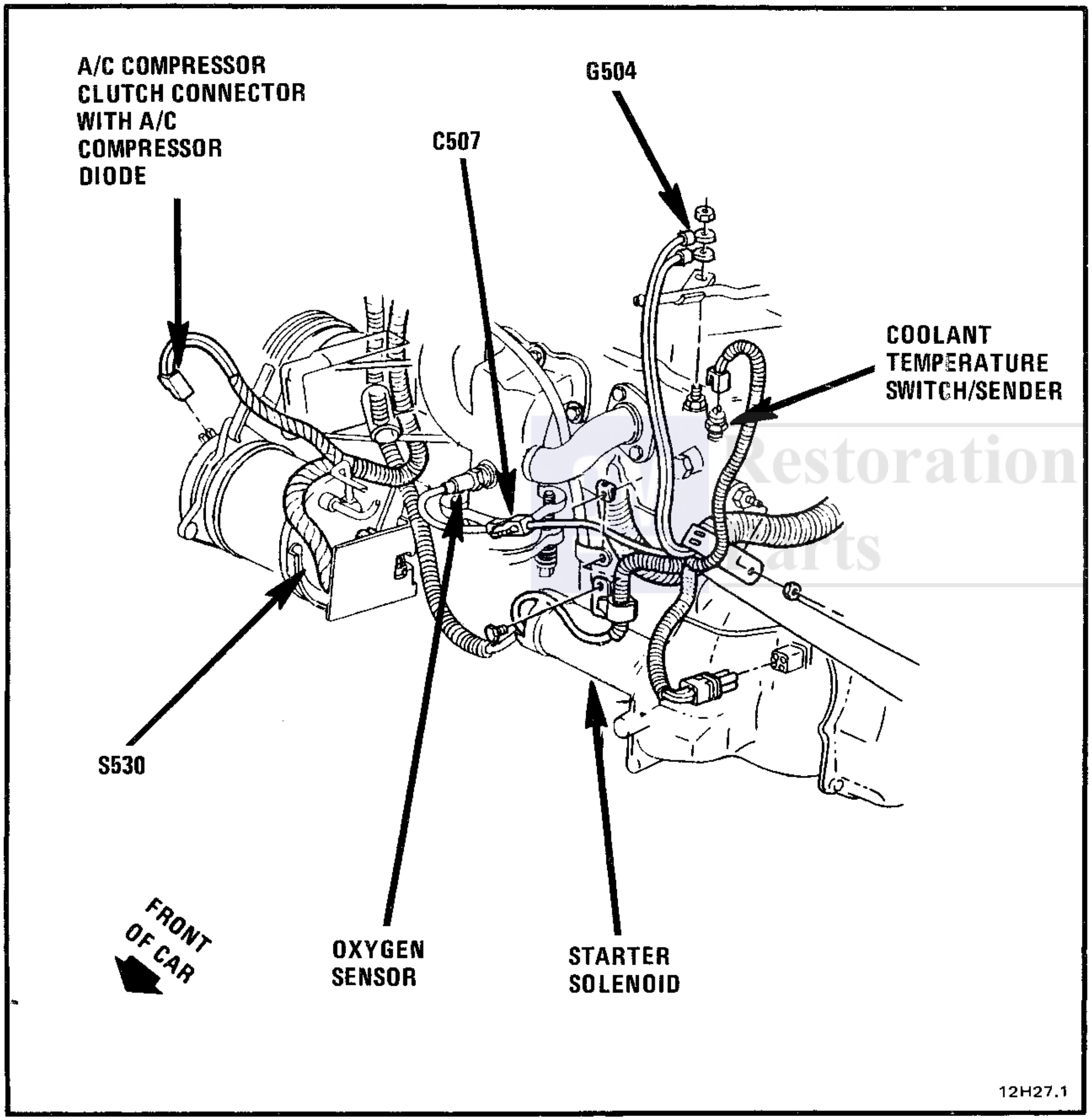


Figure A - Front Of VIN R Engine

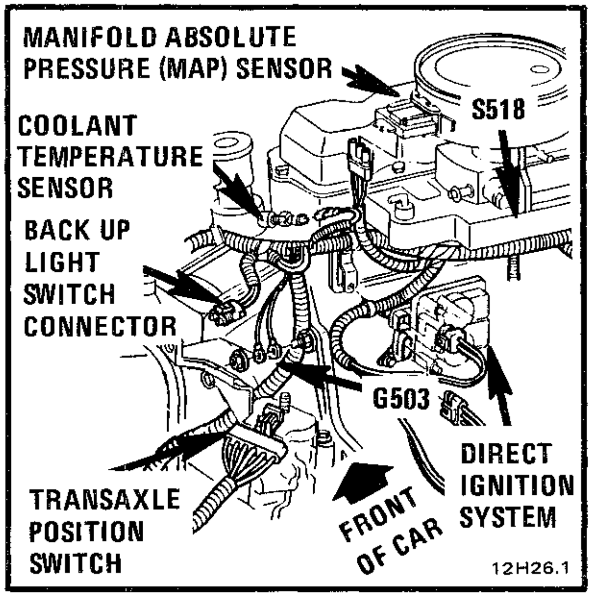


Figure B - LH Rear Of VIN R Engine

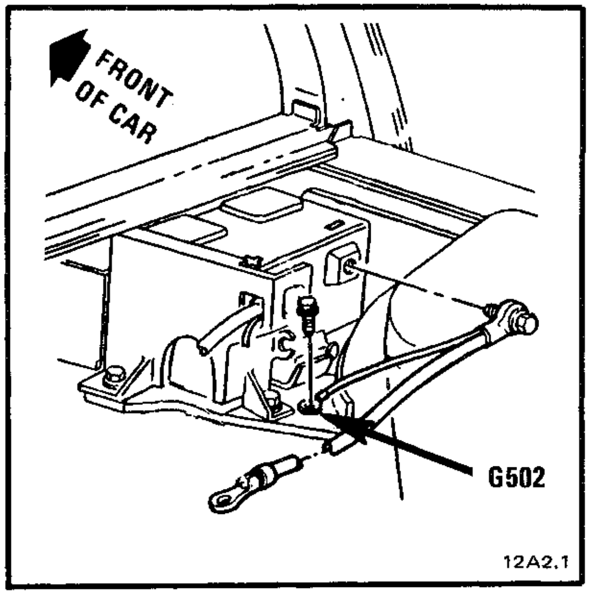


Figure C - RH Front Of Engine Compartment

COMPONENT LOCATION VIEWS

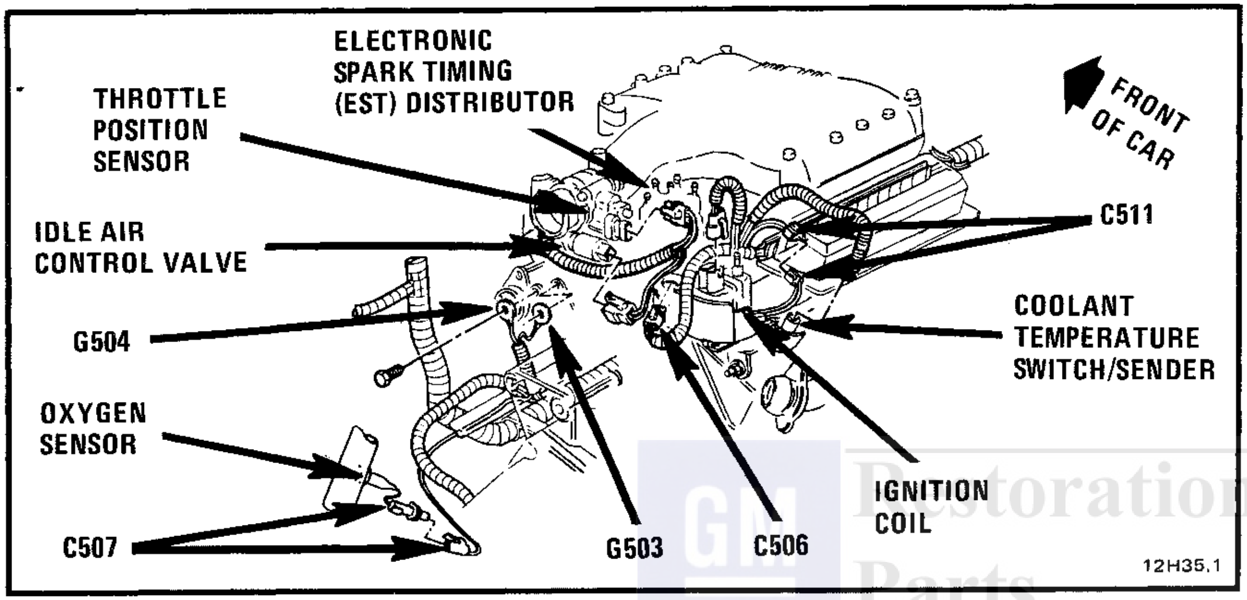


Figure A - LH Top Of VIN 9 Engine

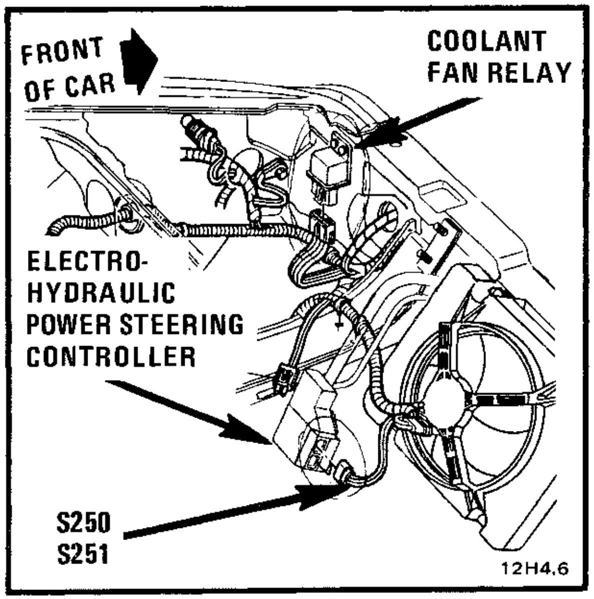


Figure D - LH Side Of Front Compartment

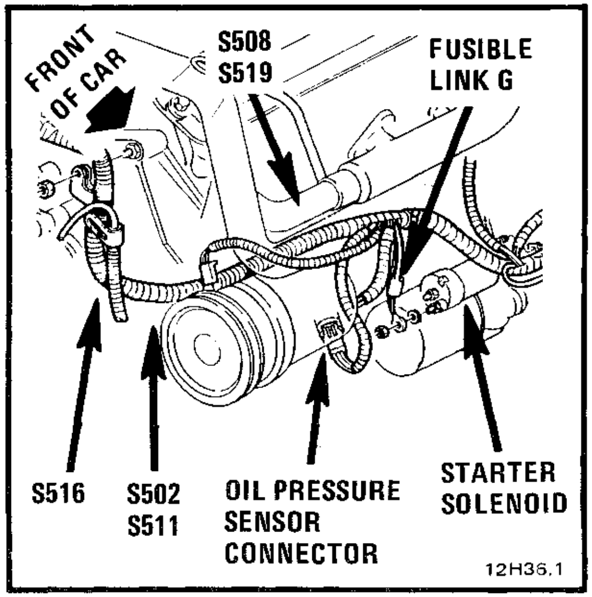


Figure B - Lower RH Front Of VIN 9 Engine

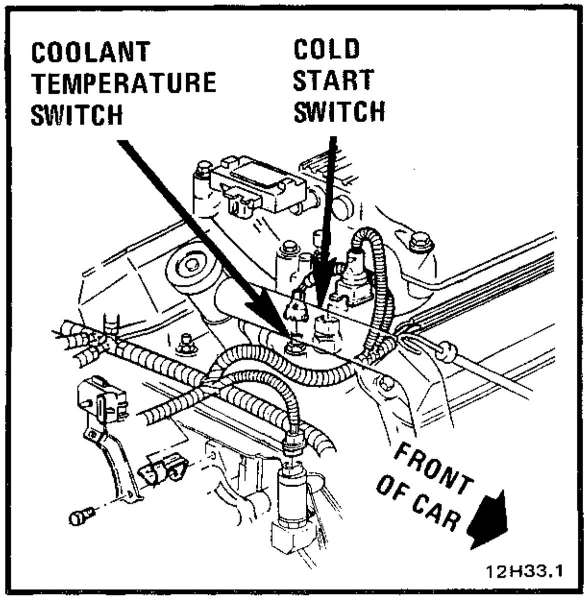


Figure C - RH Front Of VIN 9 Engine

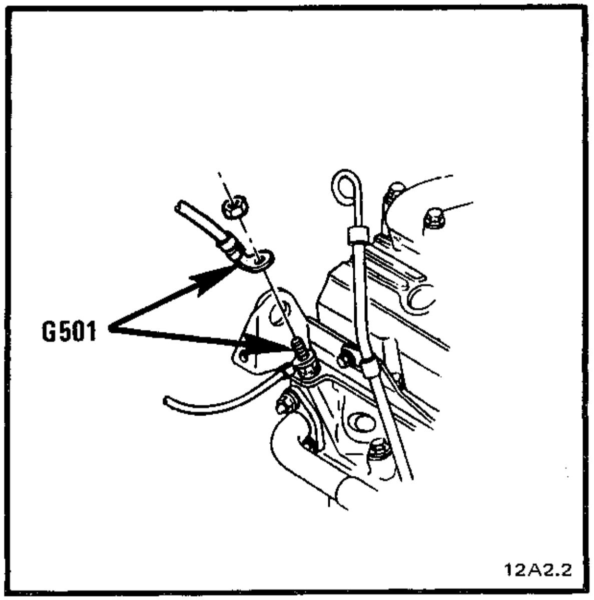


Figure E - RH Front Of VIN 9 Engine, Near Dipstick

COMPONENT LOCATION VIEWS

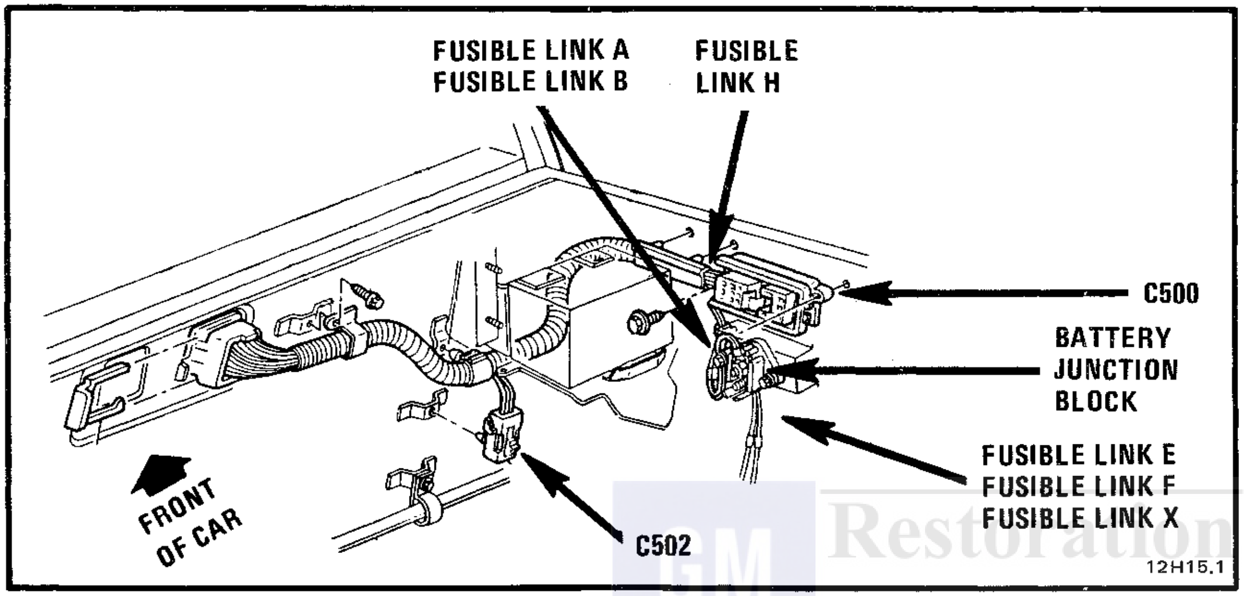


Figure A - RH Front Of Engine Compartment

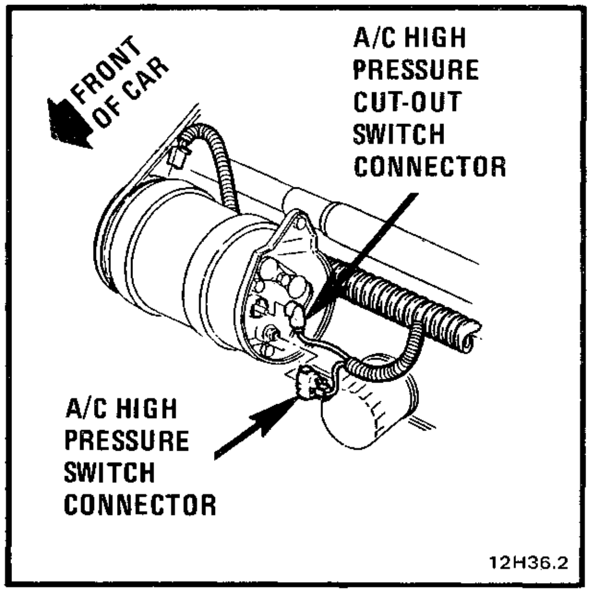


Figure D - Lower Front Of VIN 9 Engine

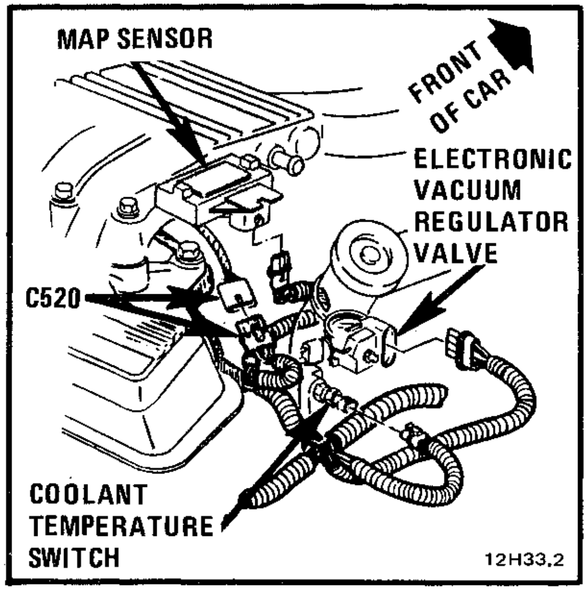


Figure B - RH Top Of VIN 9 Engine

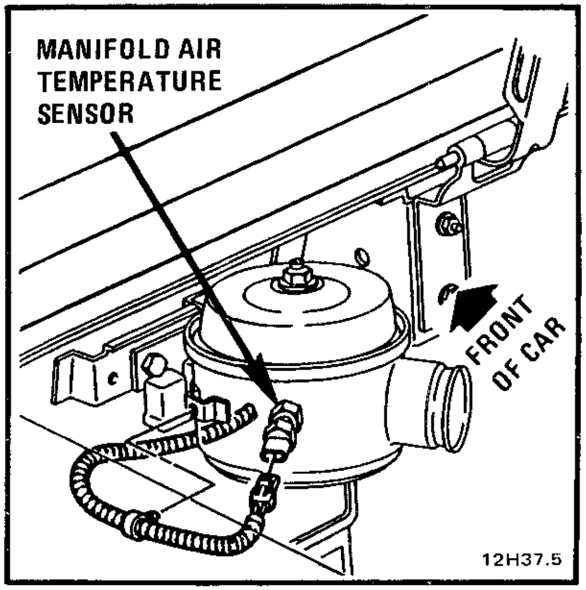


Figure C - LH Front Corner Of Engine Compartment

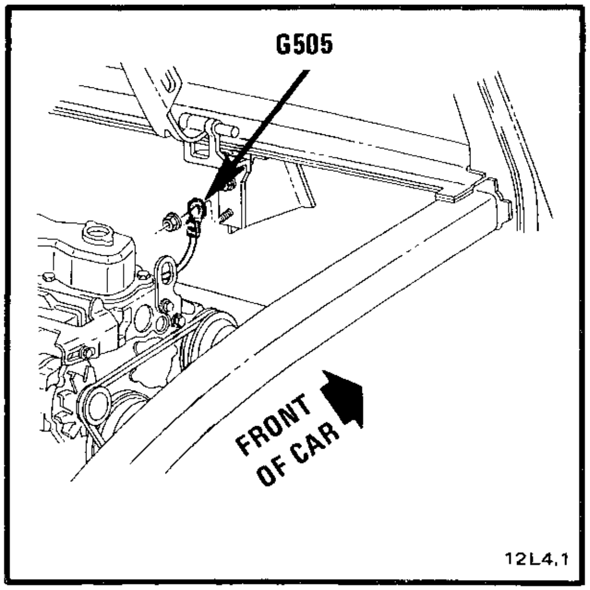


Figure E - RH Front Of Engine Compartment

COMPONENT LOCATION VIEWS

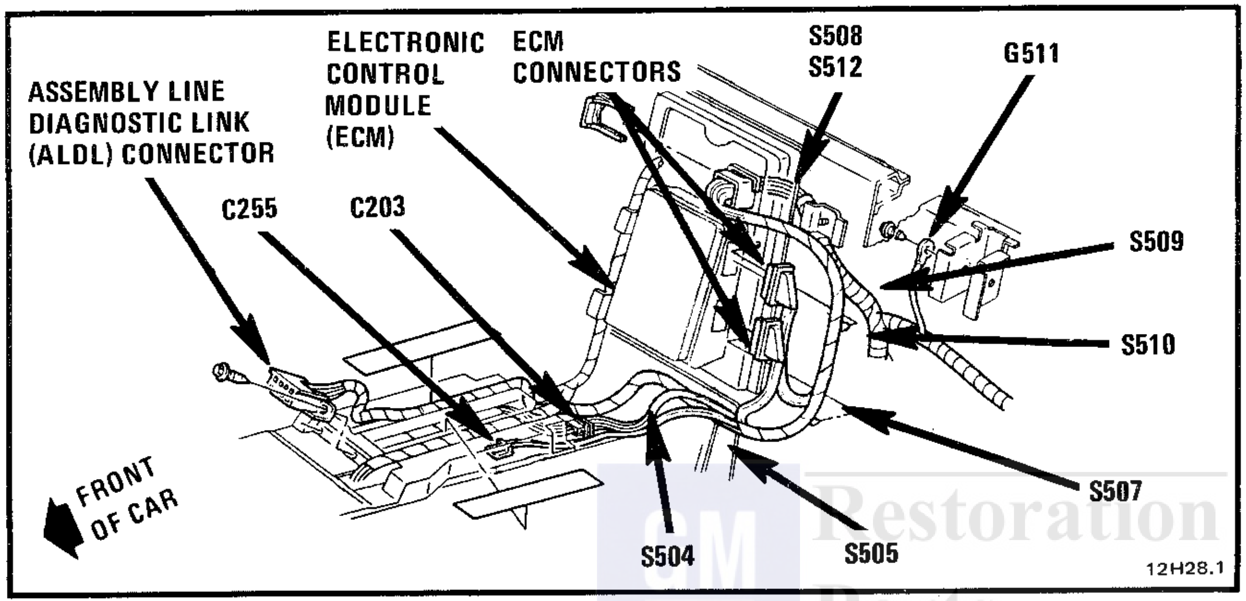


Figure A - Between Seats, Rear Bulkhead VIN R

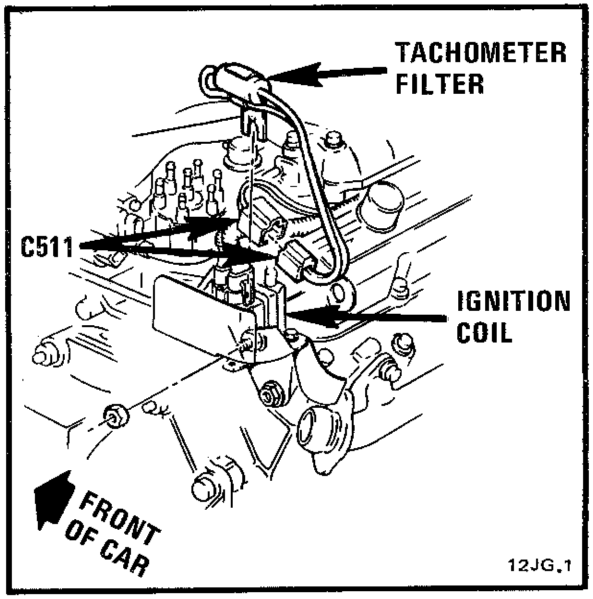


Figure B - Top LH Rear Of VIN 9 Engine

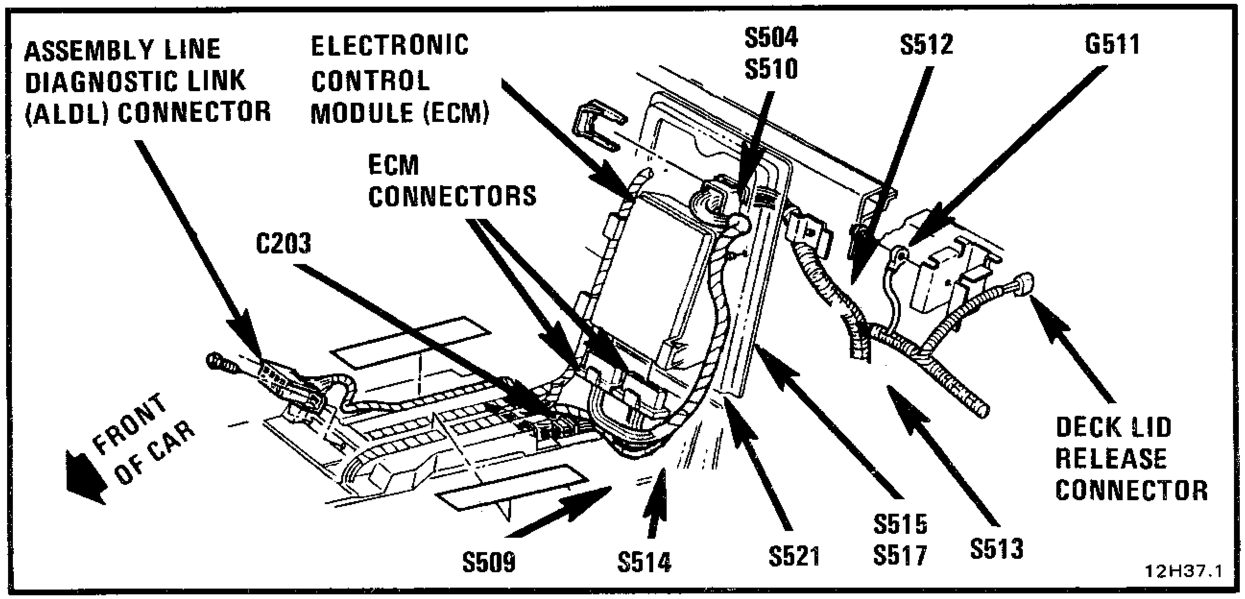


Figure B - Between Seats, Rear Bulkhead VIN 9

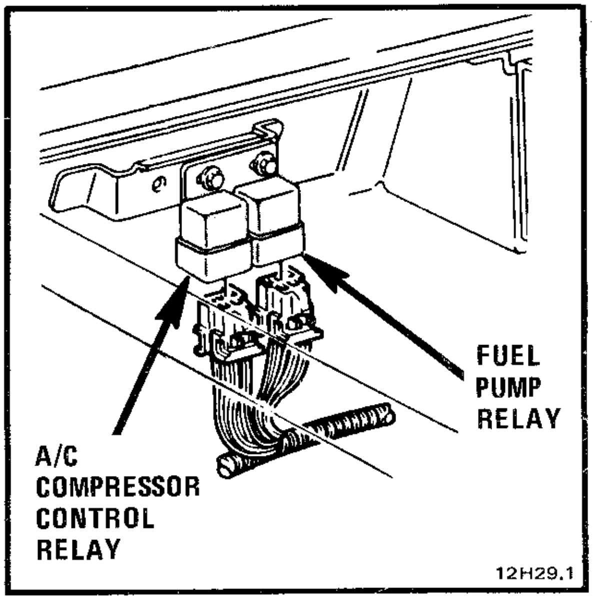


Figure D - LH Front Of Engine Compartment

COMPONENT LOCATION VIEWS

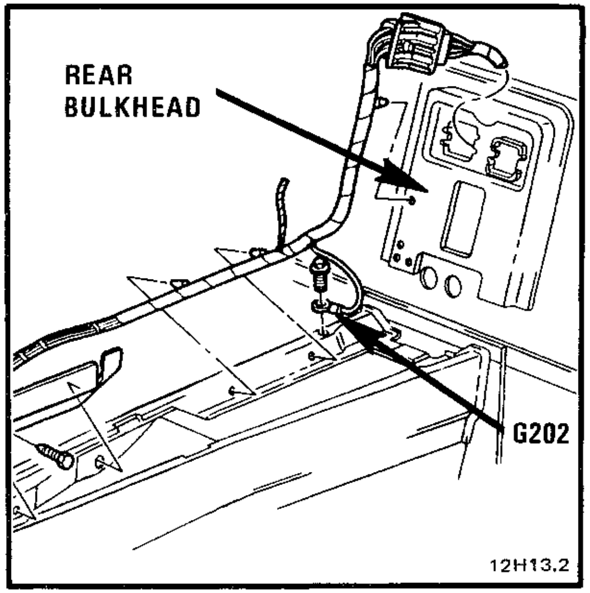


Figure A - Under Rear Of Console

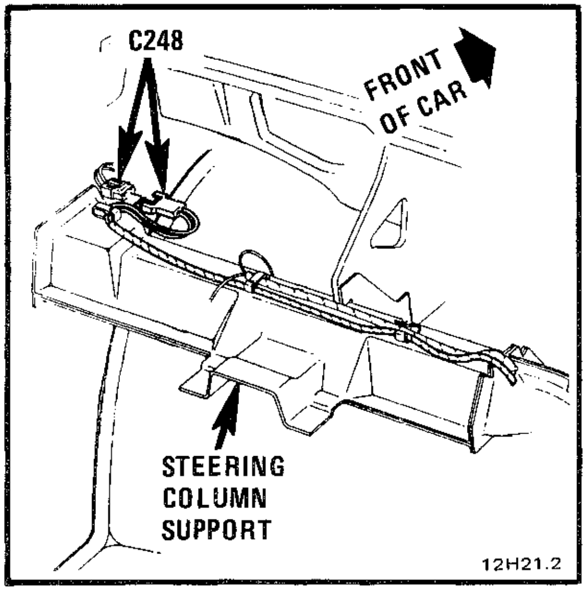


Figure B - Under Front Of Console

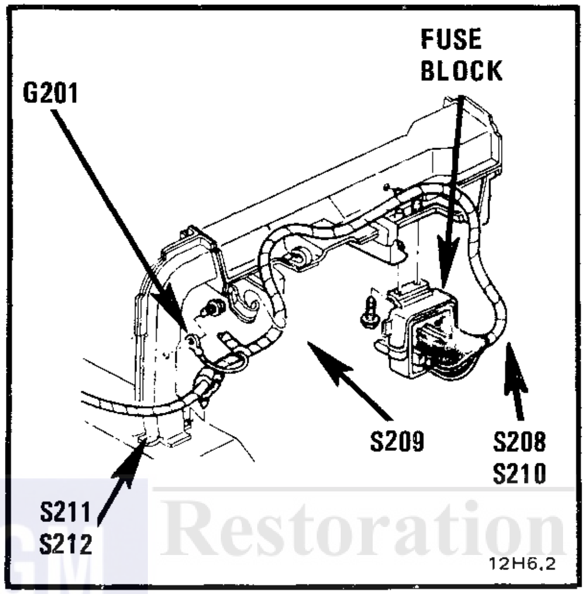


Figure C - Behind Cluster

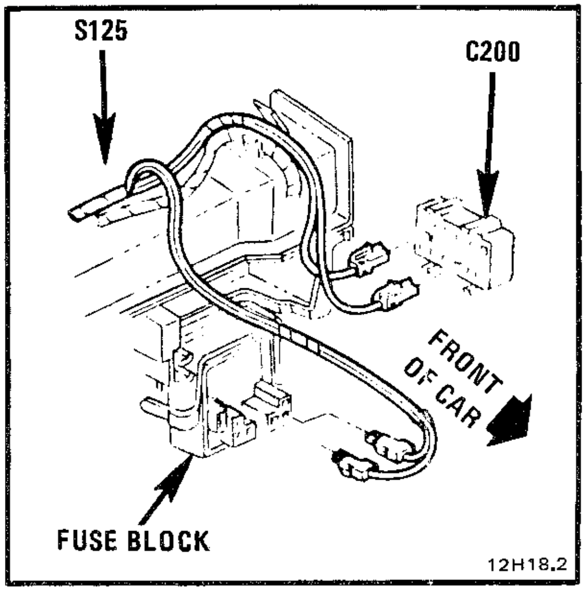


Figure D - Behind LH Side Of I/P

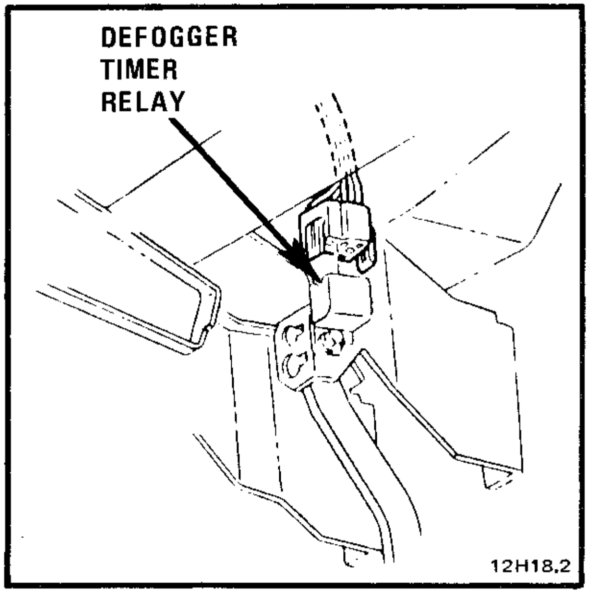


Figure E - Above Brake Pedal

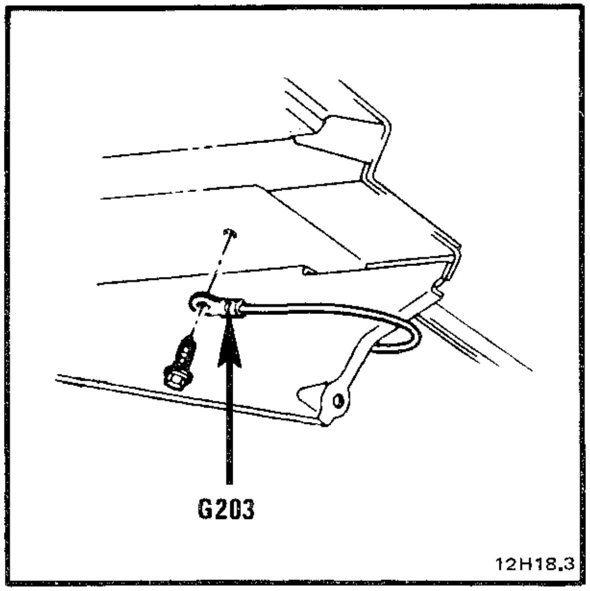


Figure F - Right Of Steering Column

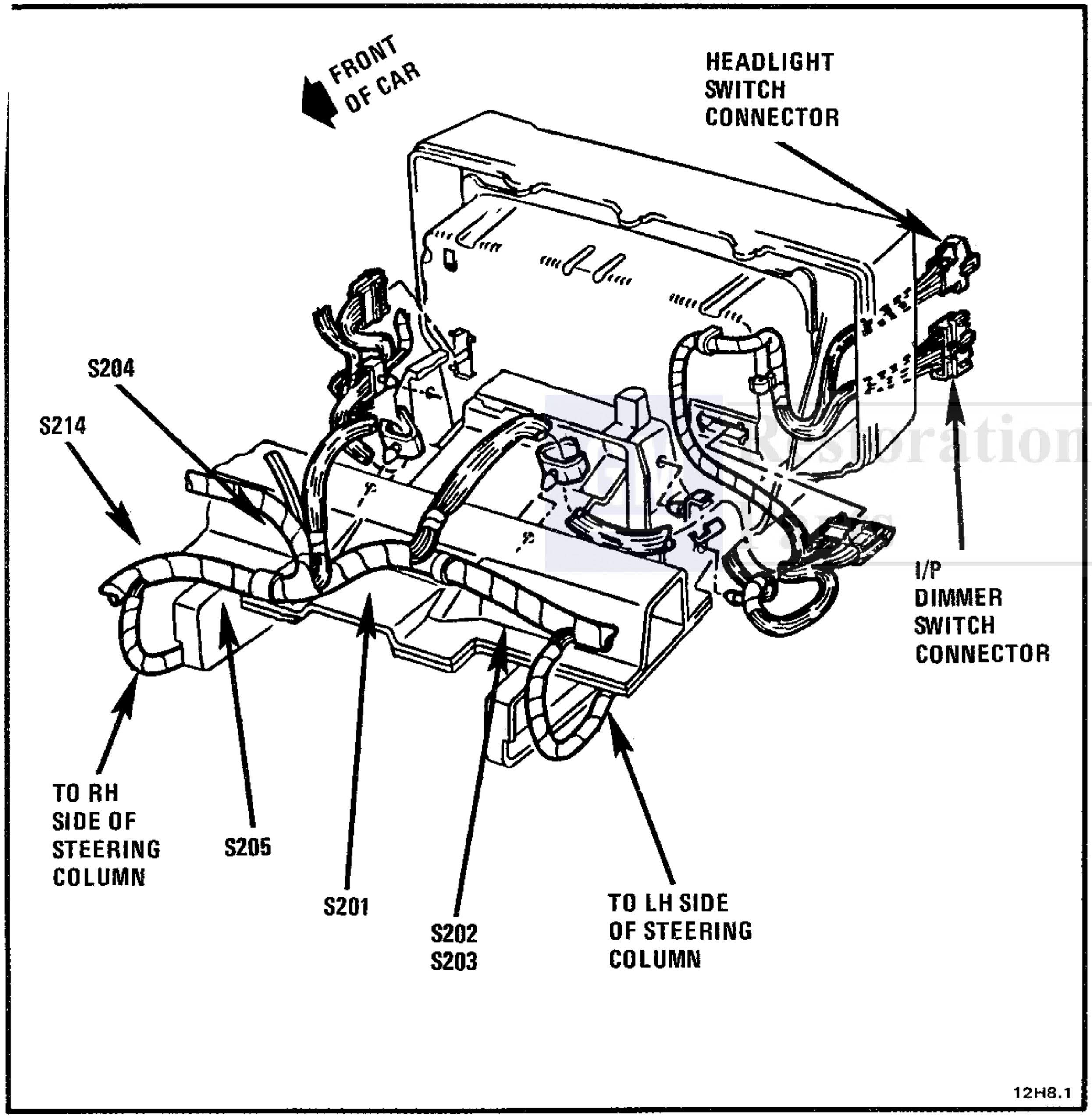


Figure A - Behind LH Side Of I/P

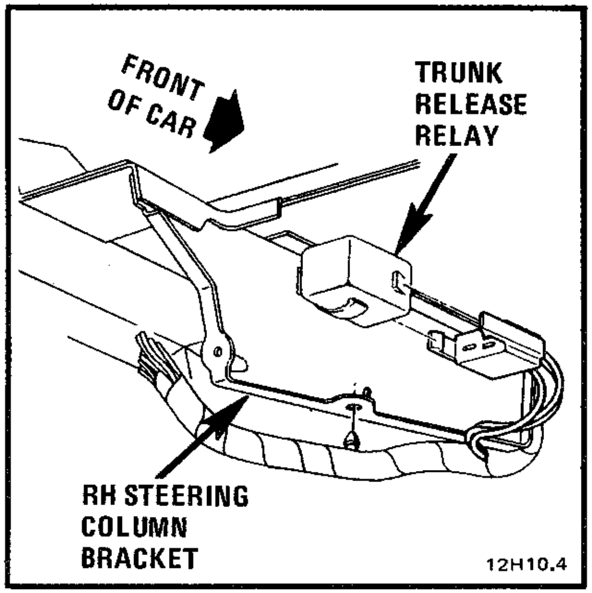


Figure B - Below LH Side Of I/P

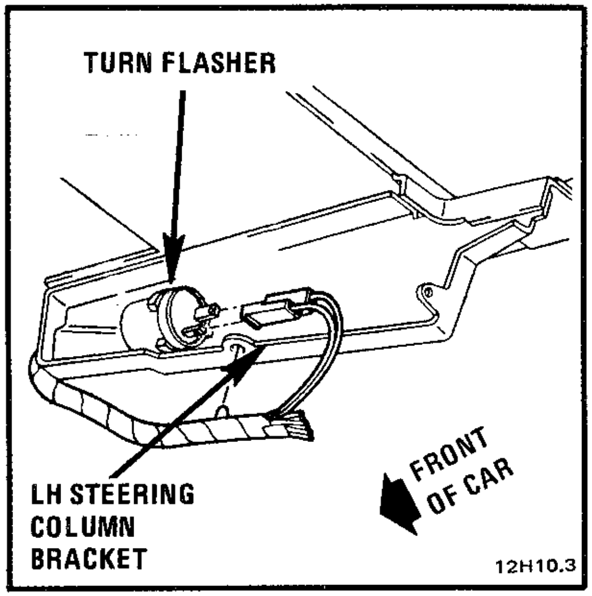


Figure C - Left Of Steering Column

COMPONENT LOCATION VIEWS

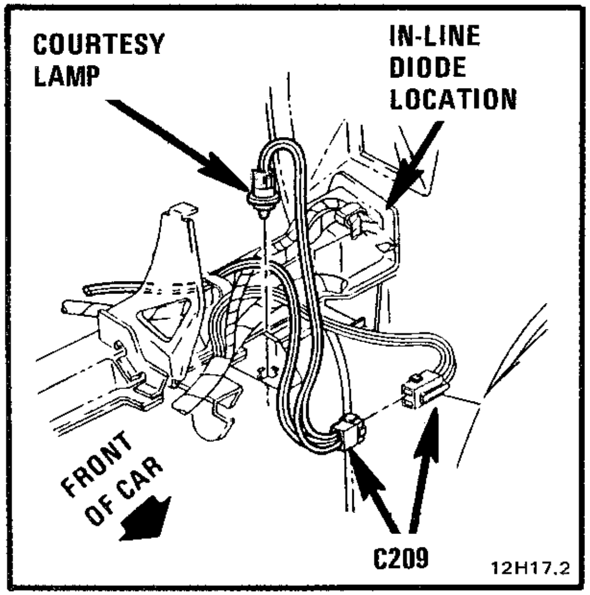


Figure A - Behind LH Side Of I/P

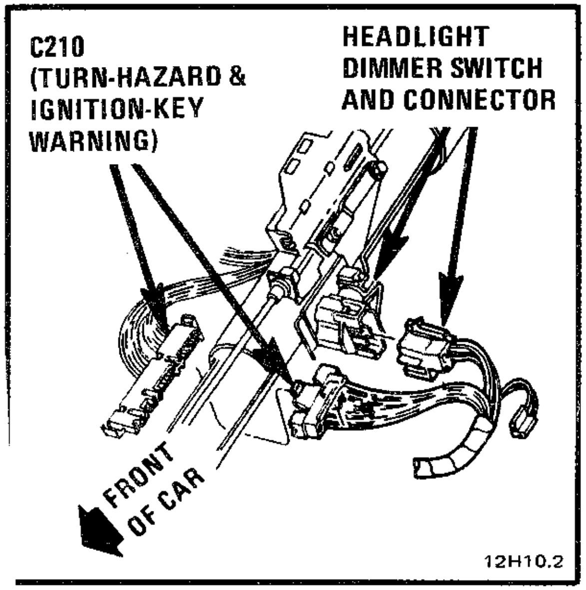


Figure B - Center Of Steering Column

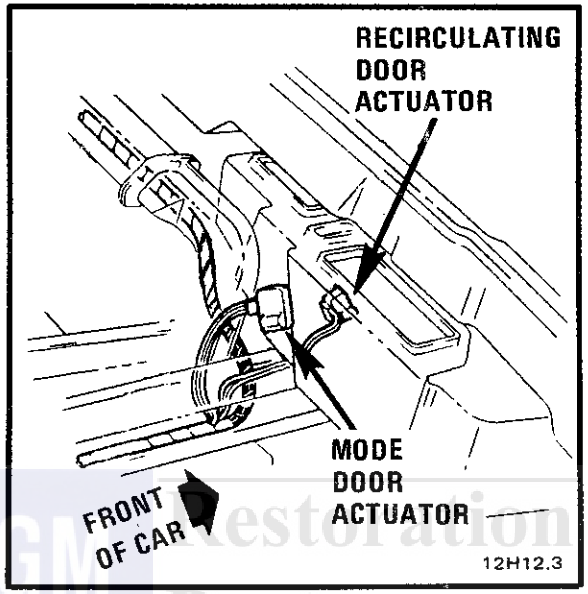


Figure C - Behind Center Of I/P

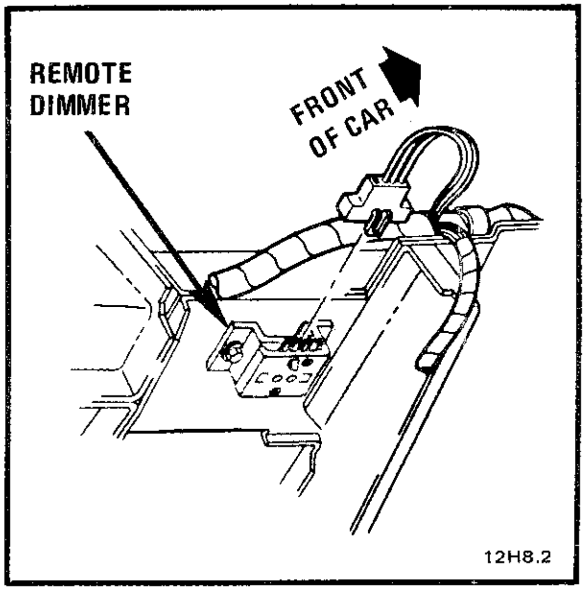


Figure D - Below Center Of I/P

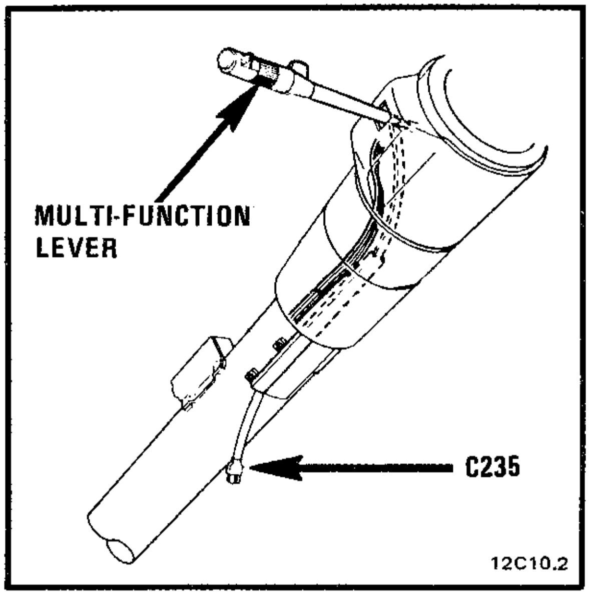


Figure E - Top LH Of Steering Column

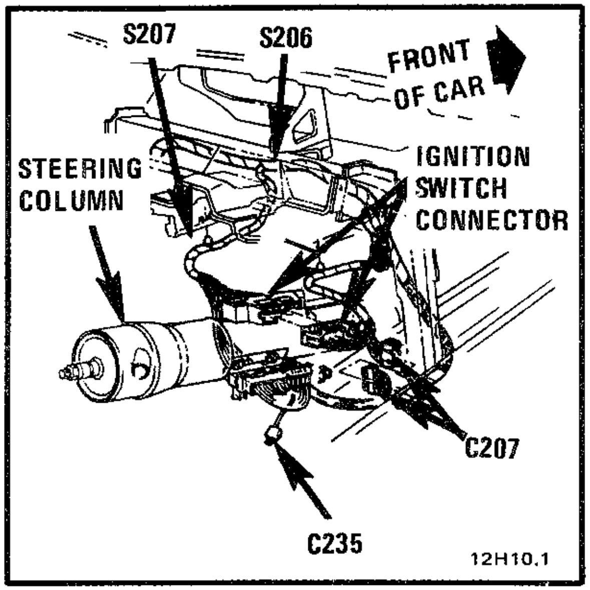


Figure F - RH Side Of Steering Column

COMPONENT LOCATION VIEWS

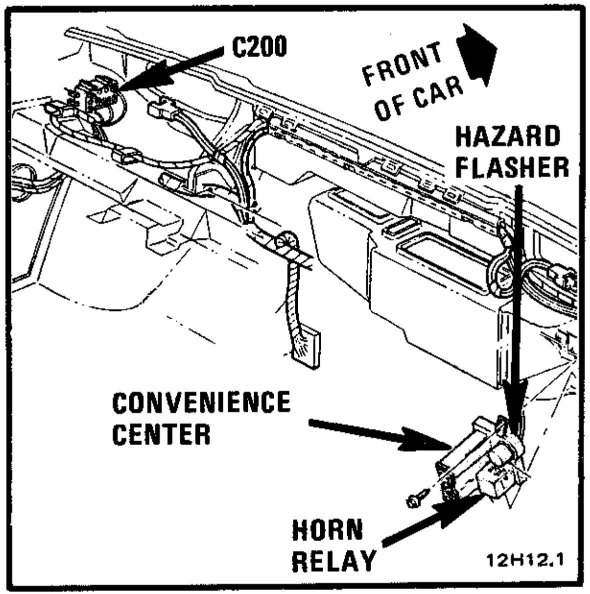


Figure A - Behind I/P

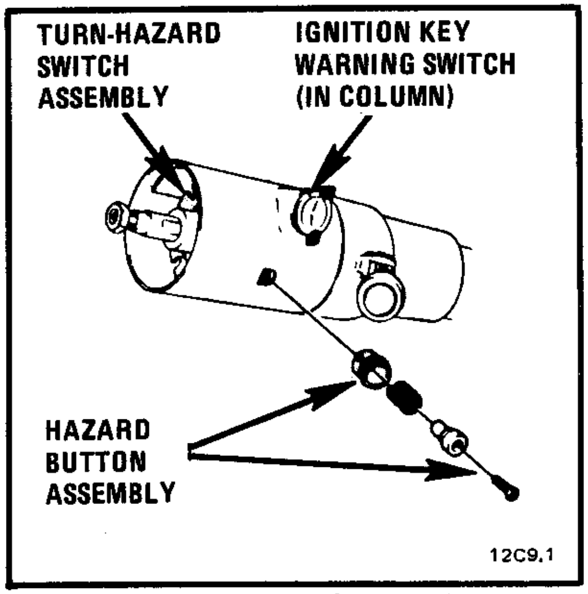


Figure B - Top RH Side Of Steering Column

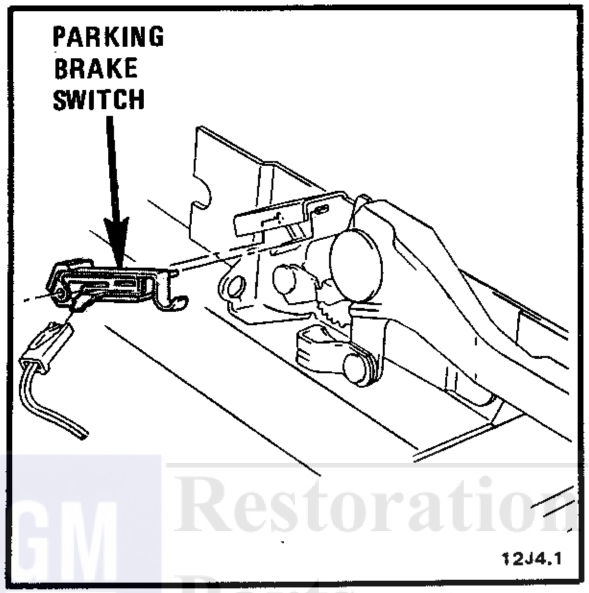


Figure C - At Base Of Parking Brake

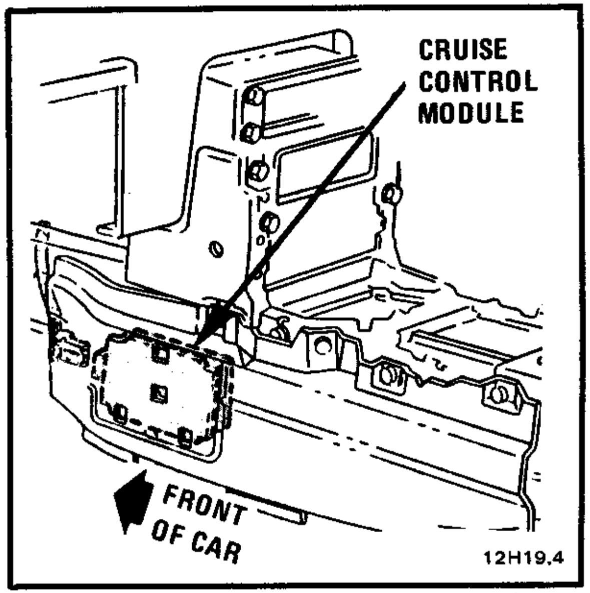


Figure D - Behind Carpet Support, Between Seats

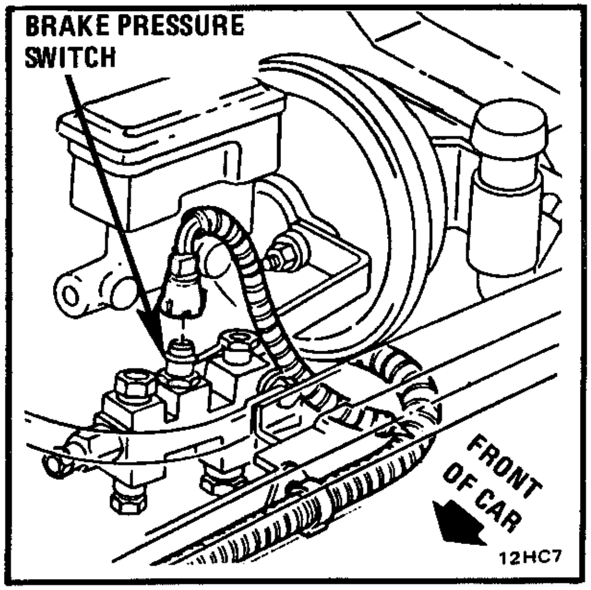


Figure E - LH Rear Corner Of Front Compartment

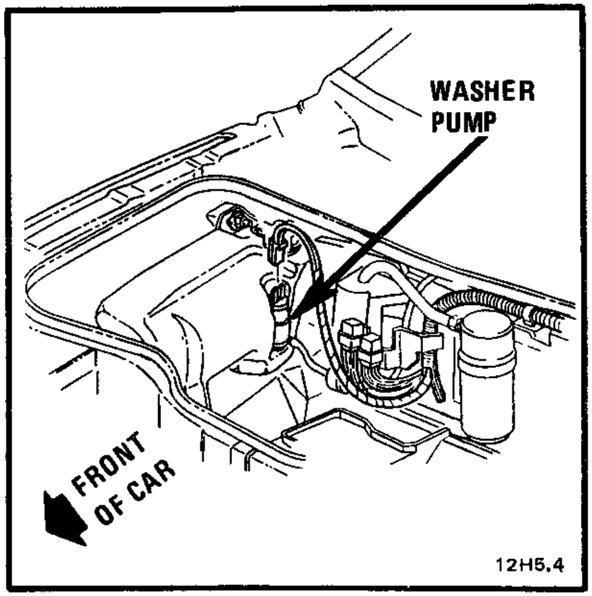


Figure F - RH Side Of Front Bulkhead

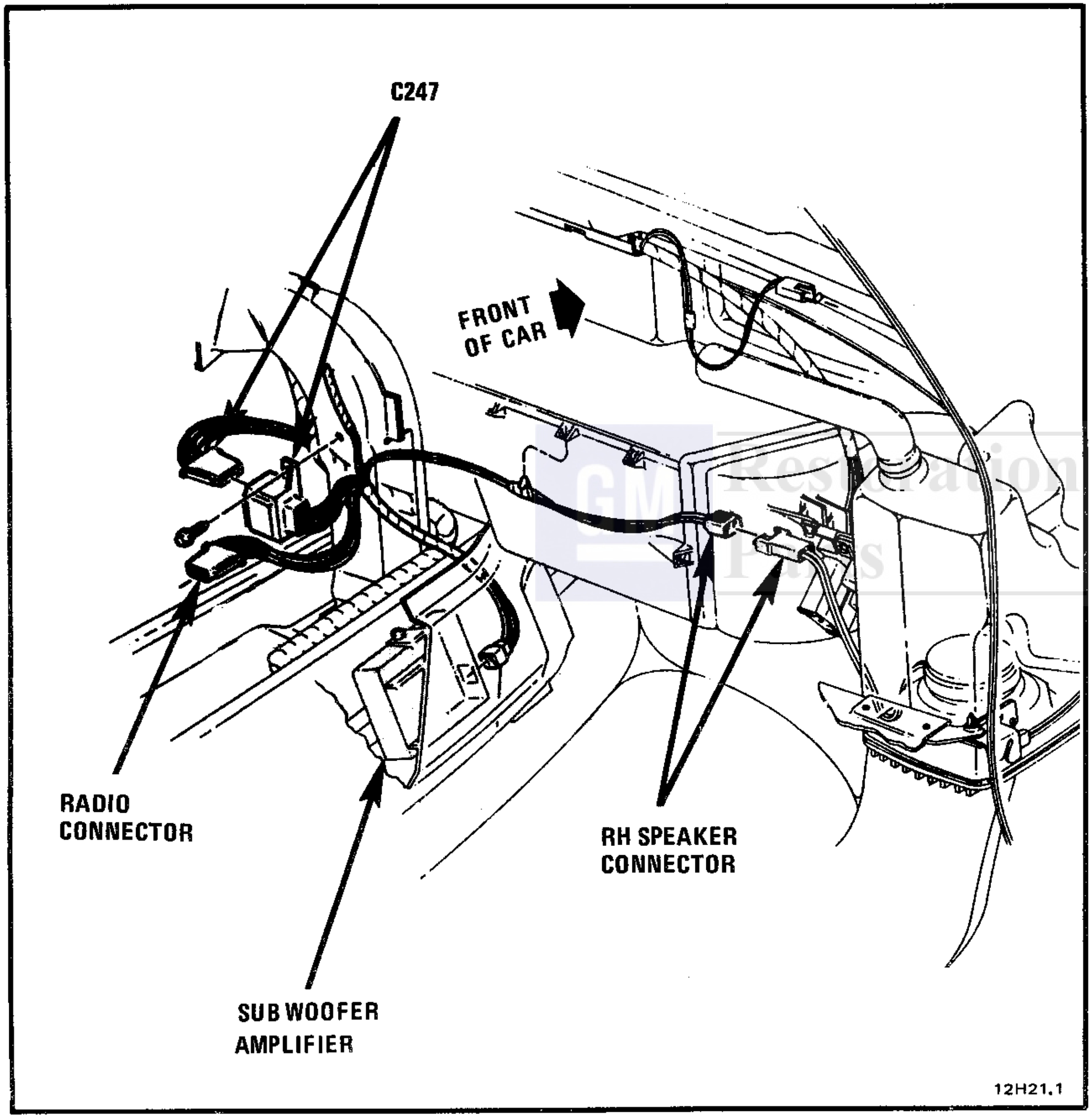


Figure A - Center Of I/P

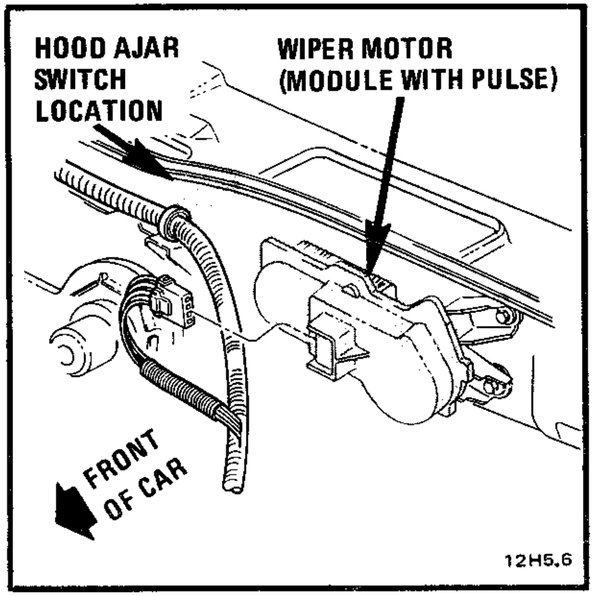


Figure B - Front Compartment, Center Of Bulkhead

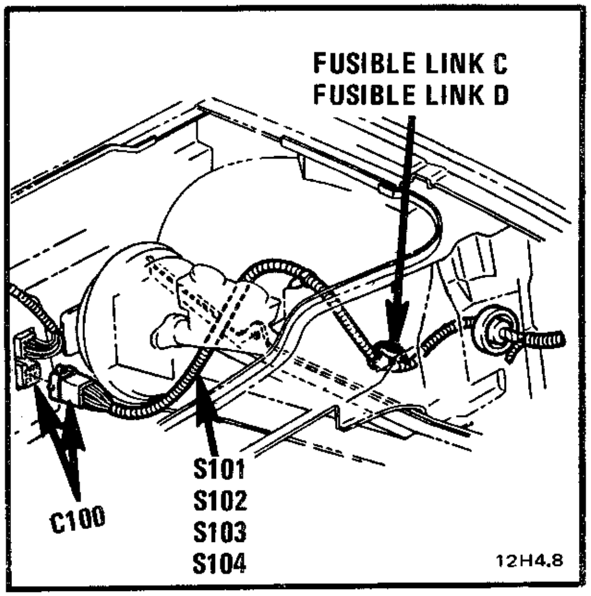


Figure C - LH Corner Of Front Compartment

COMPONENT LOCATION VIEWS

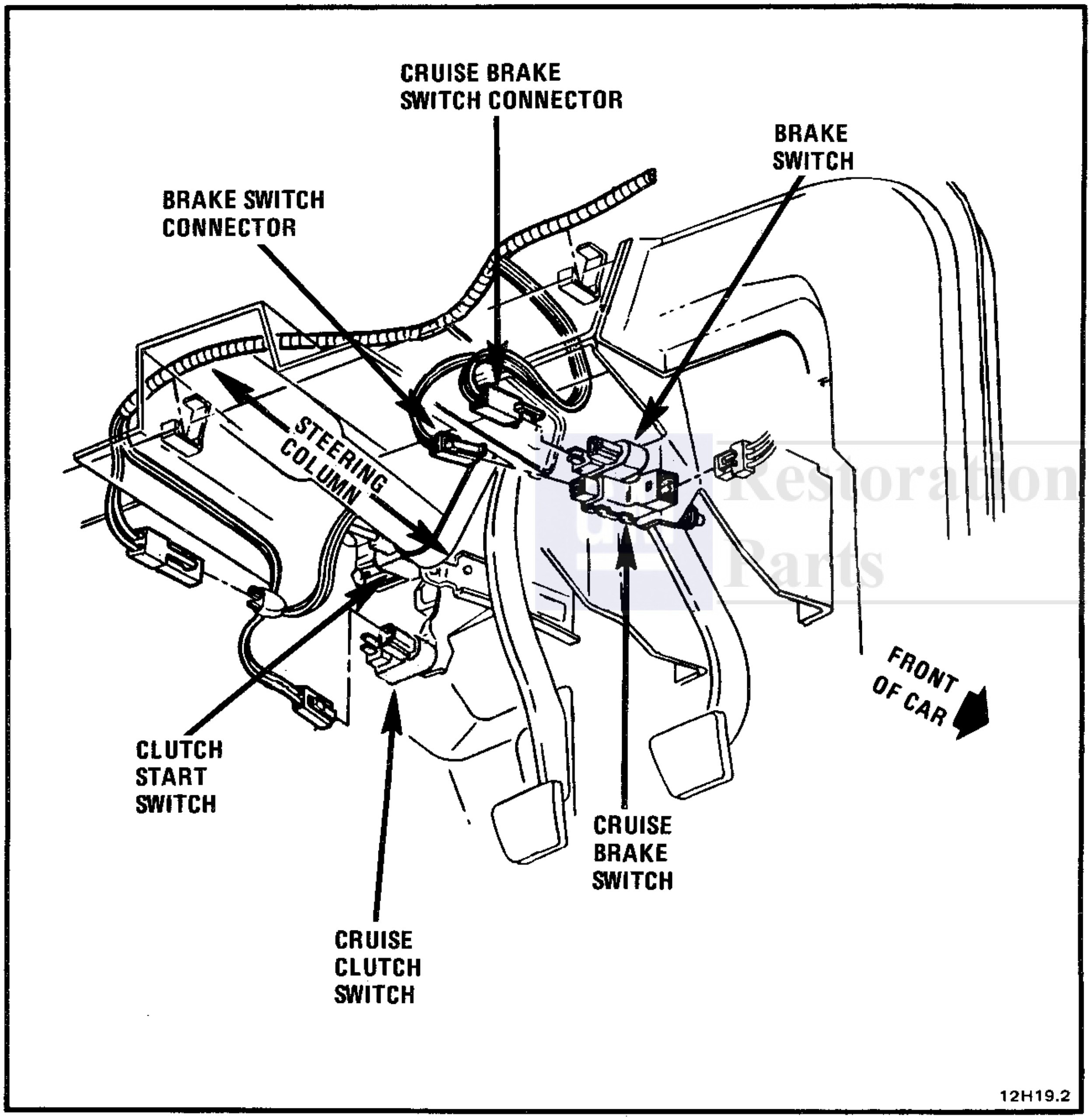


Figure A - Below LH Side Of I/P

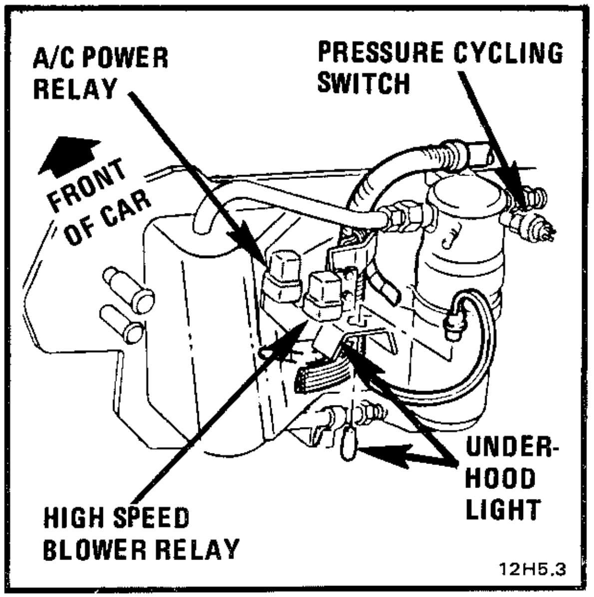


Figure B- RH Front Of Dash

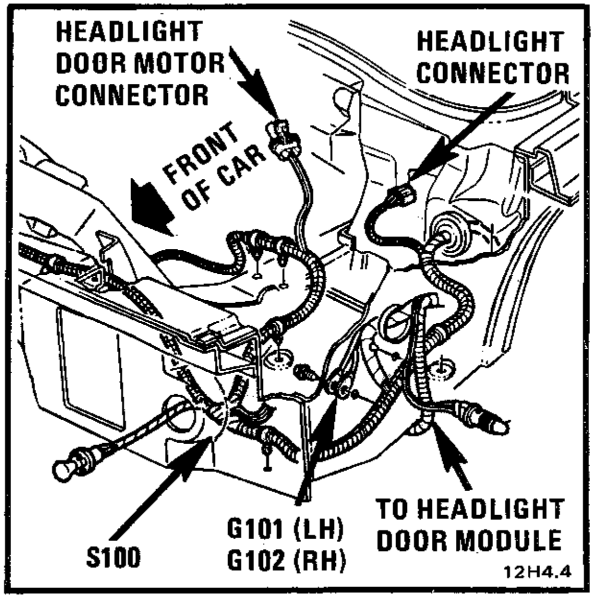


Figure C - LH Front Of Car

COMPONENT LOCATION VIEWS

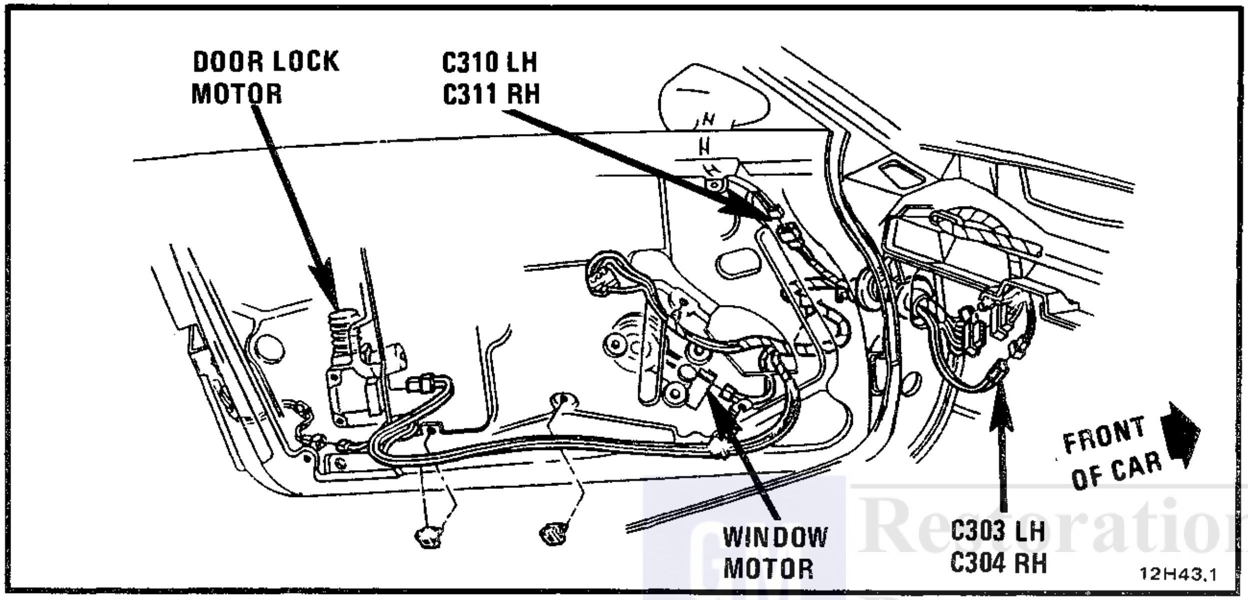


Figure A - LH Door, RH Door Similar

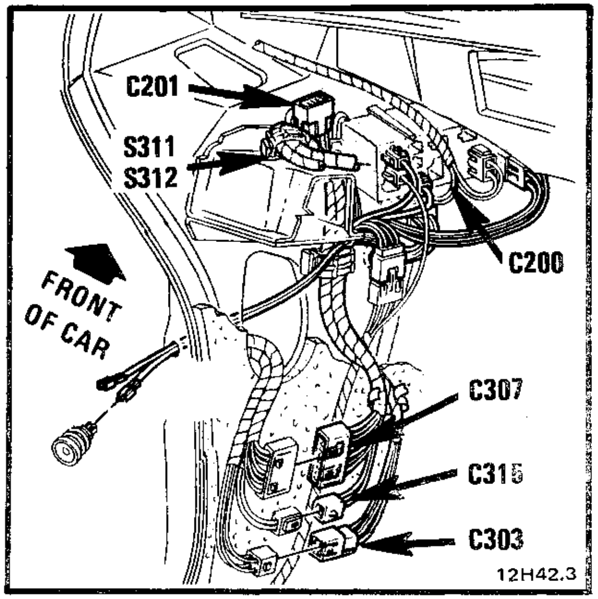


Figure C - LH Shroud

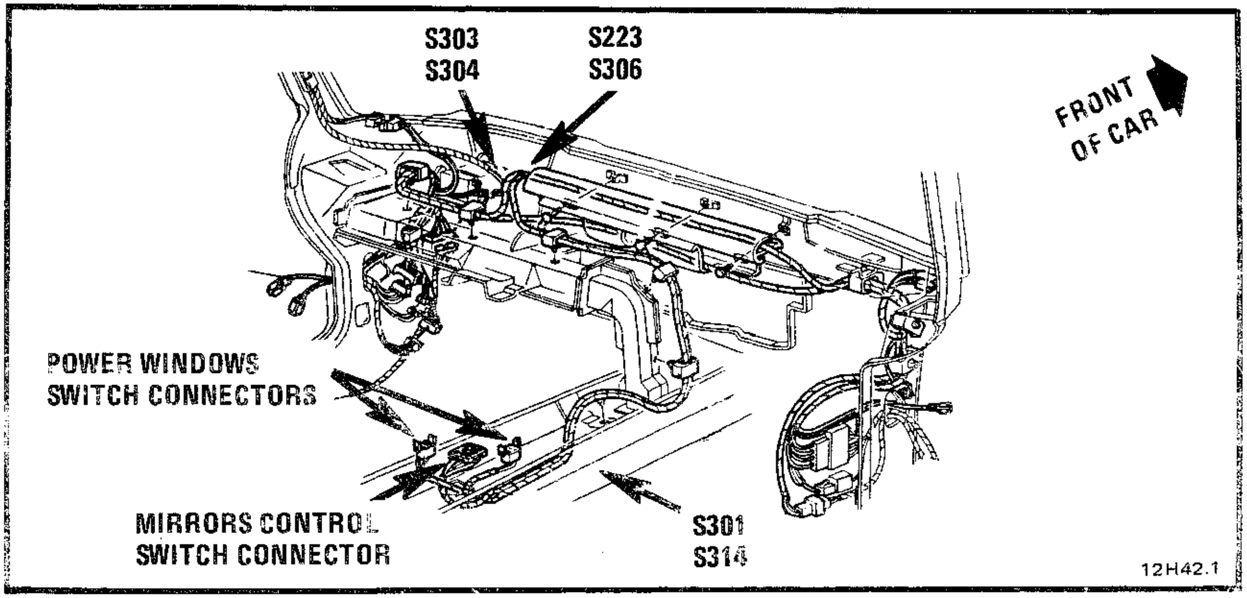


Figure B - Front Of Passenger Compartment, Behind I/P

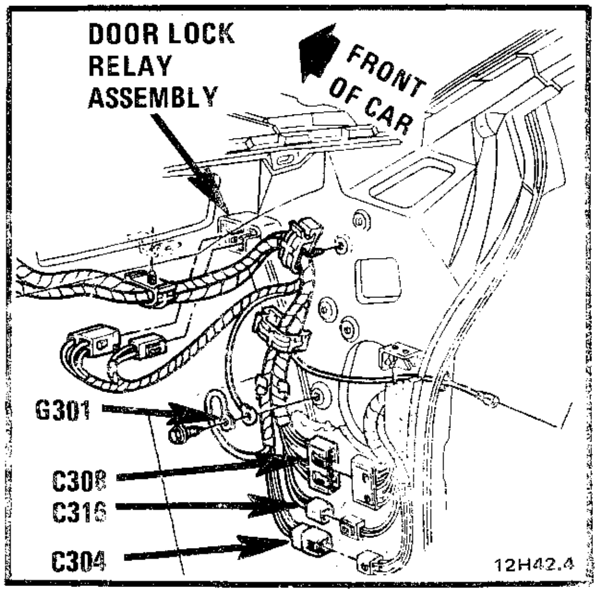


Figure D - RH Shroud

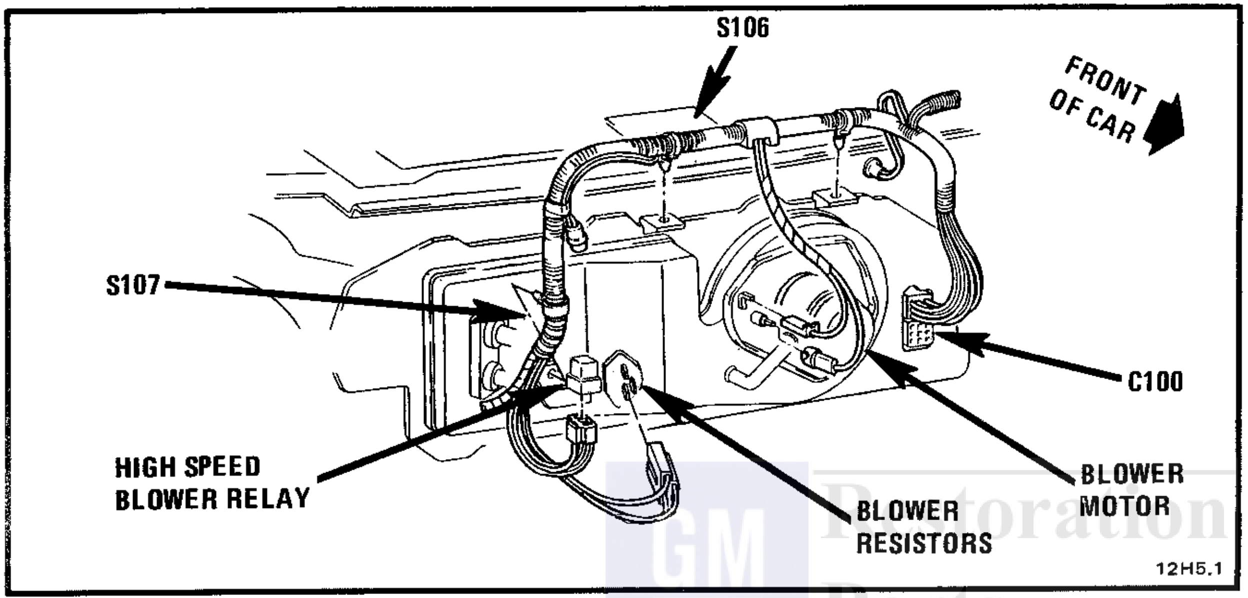


Figure A - RH Side Of Front Compartment

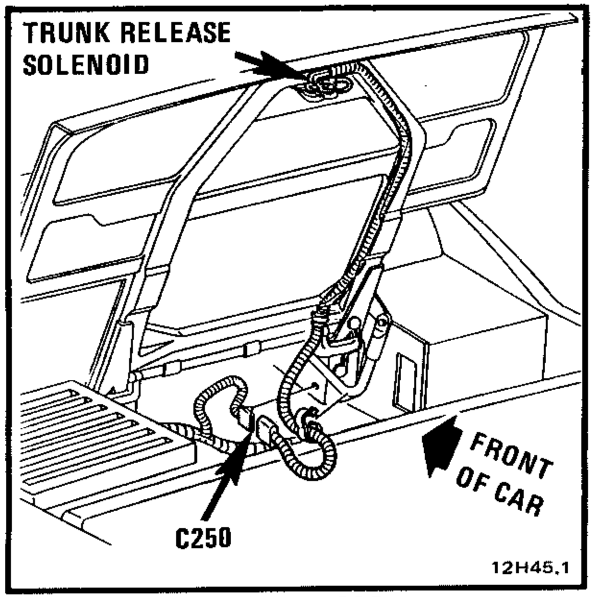


Figure C - Rear Of Car

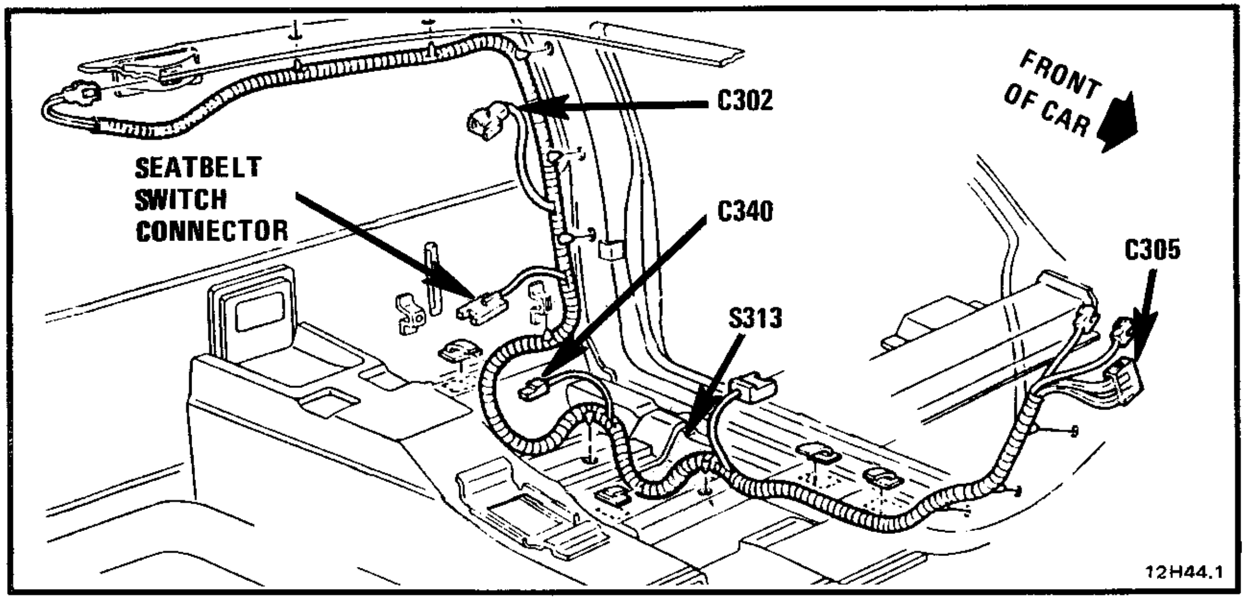


Figure B - LH Side Of Passenger Compartment

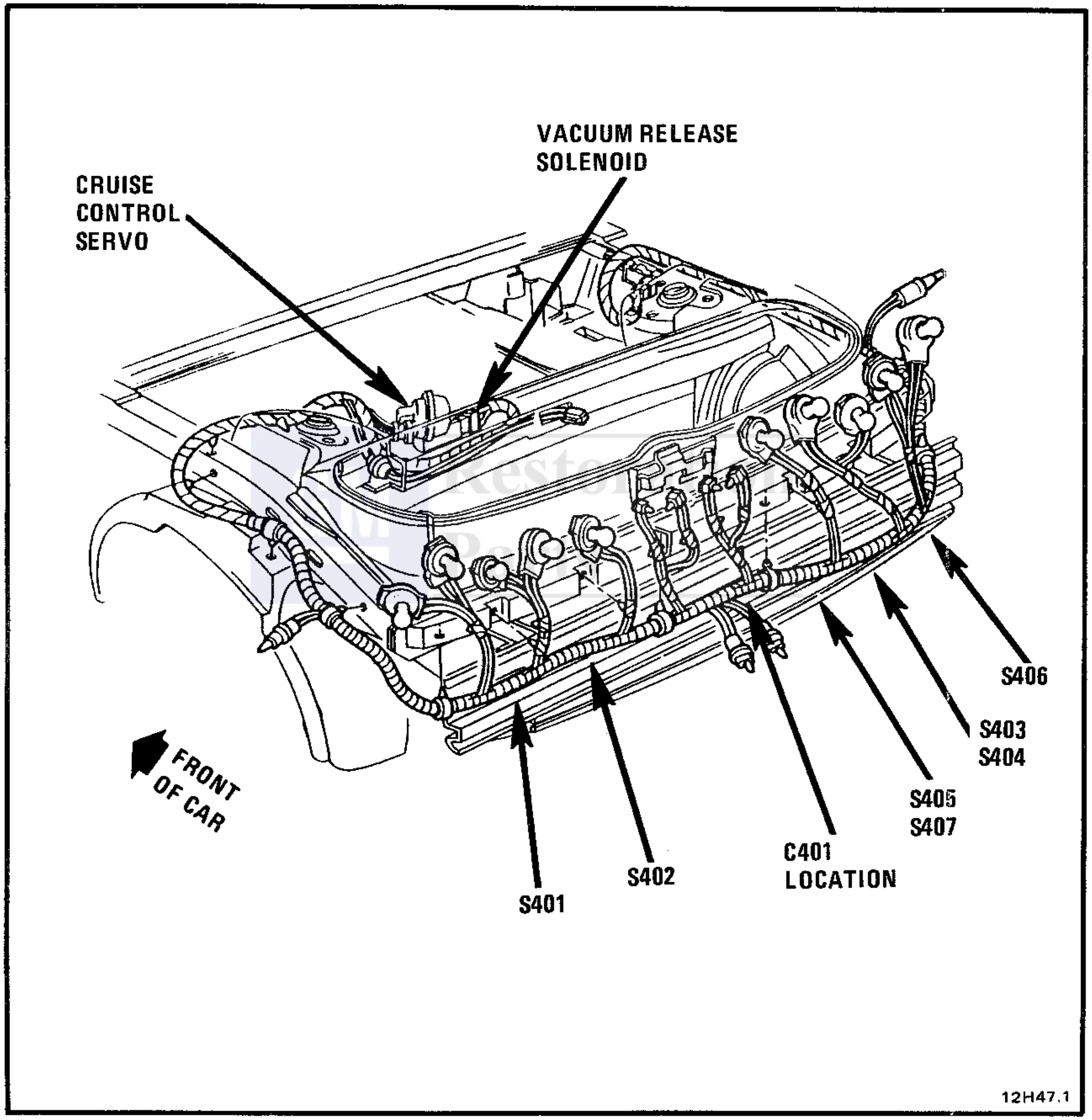


Figure A- Rear Of Car

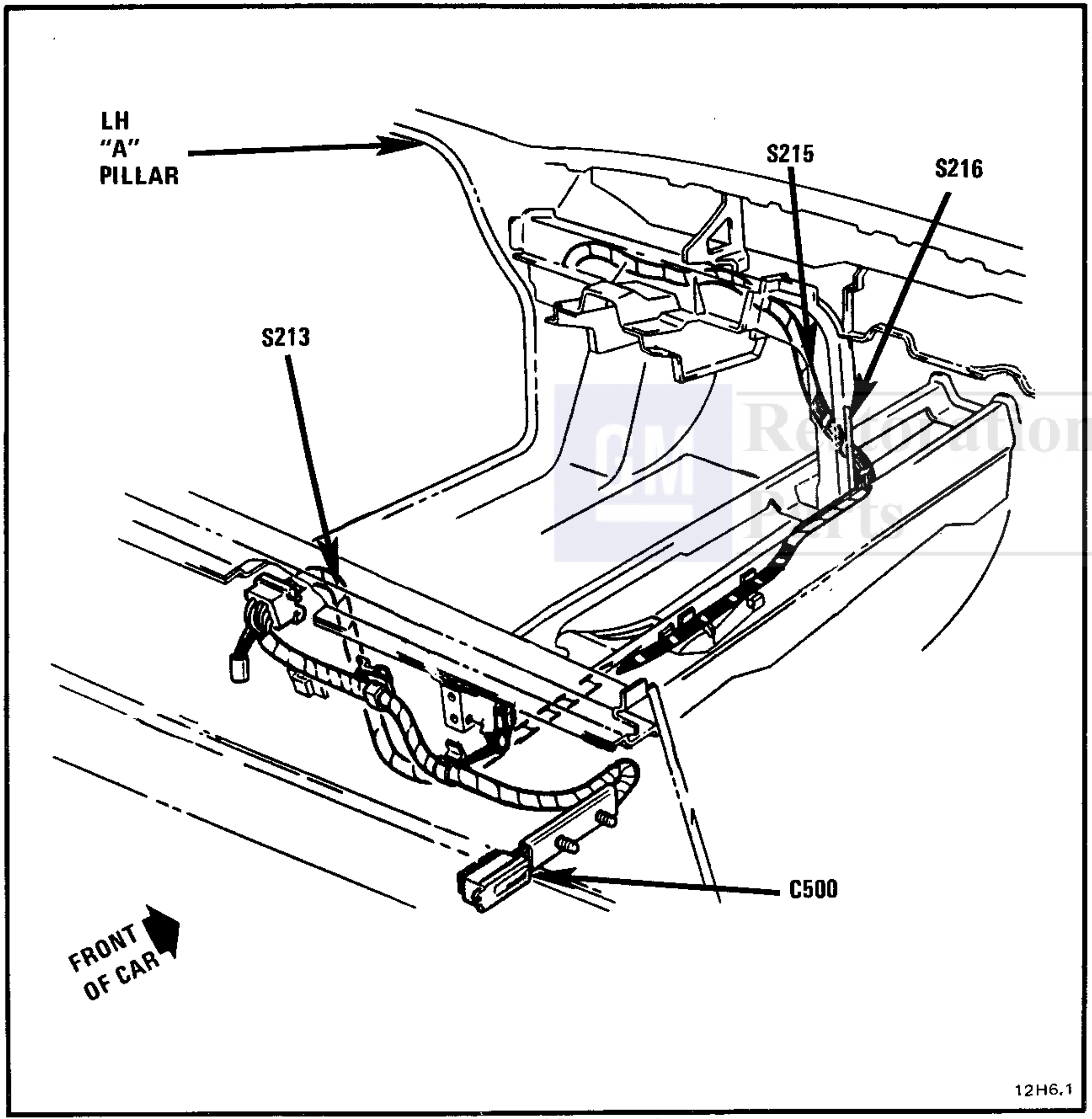
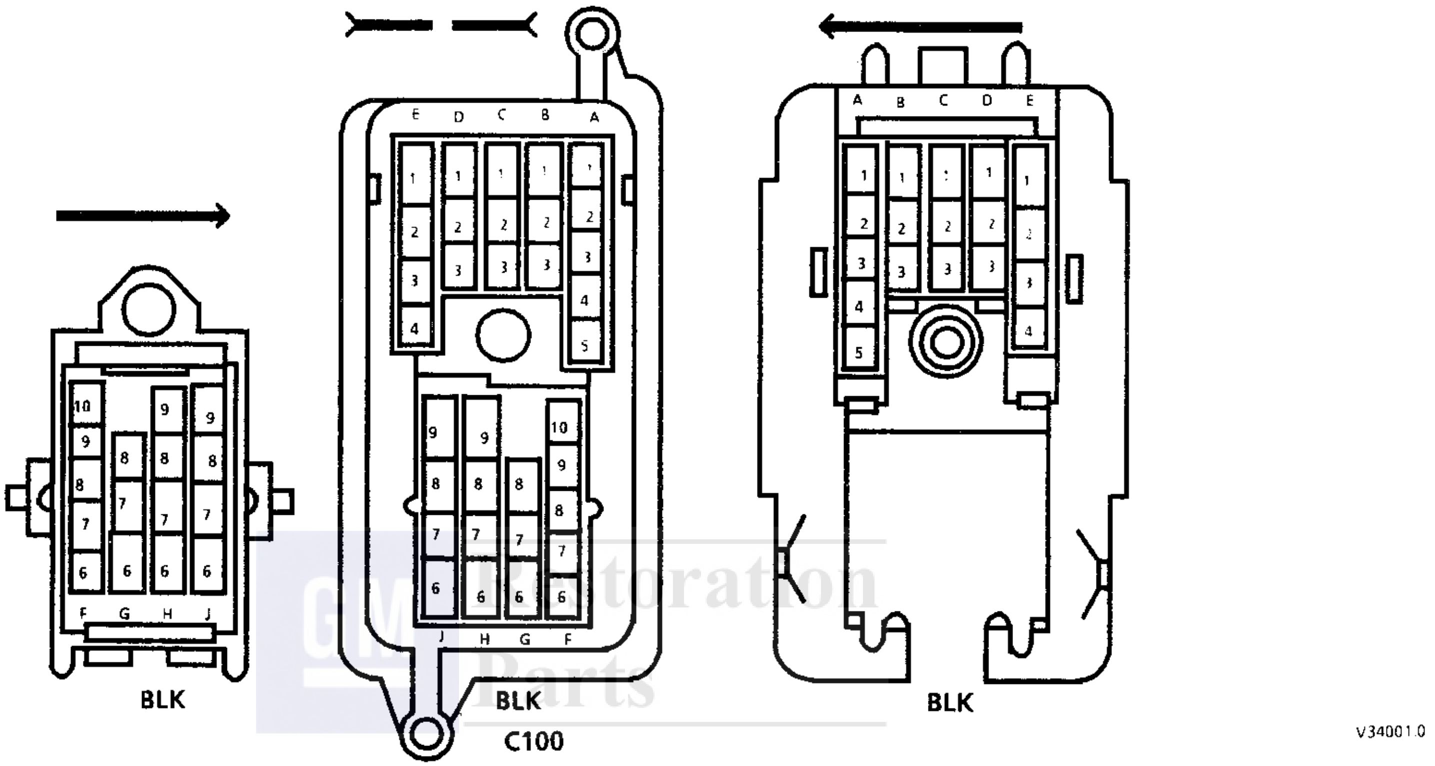


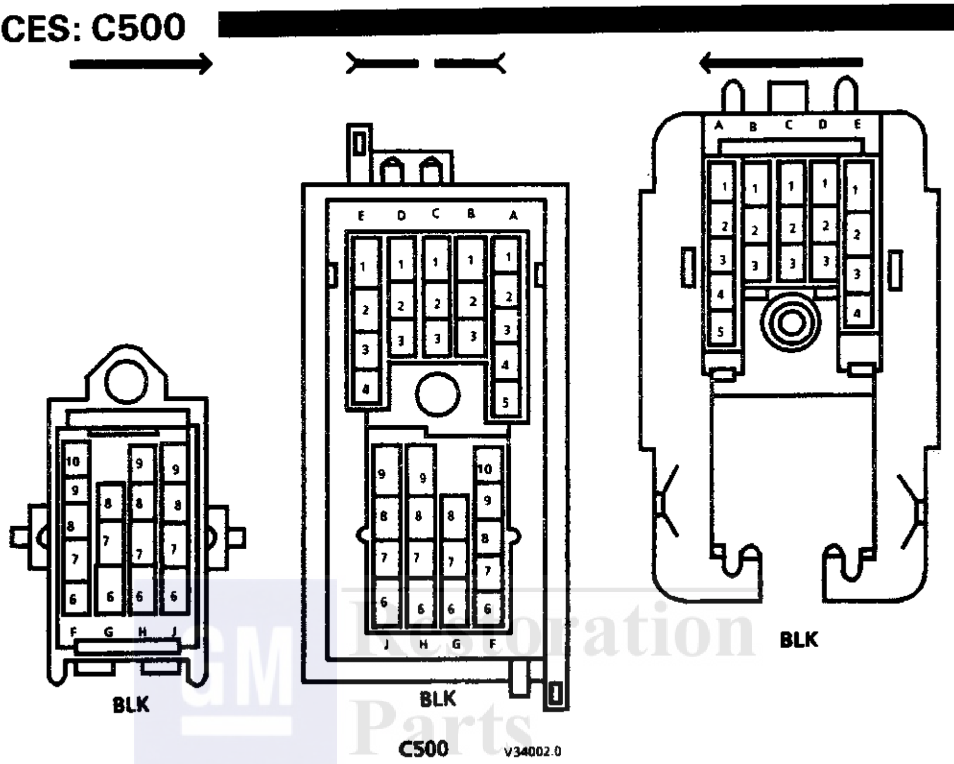
Figure A - Center Of Passenger Compartment

HARNESS CONNECTOR FACES: C100



CAVITY	WIRE COLOR		SCHEMATIC-PAGE
	PIN HALF	SOCKET HALF	
A1	ORN	ORN	Wiper/Washer — 90-0
A2	LT GRN	LT GRN	Air Conditioning: Compressor Controls — 64-0
A3	LT GRN (L4 VIN R)	LT BLU	Air Conditioning: Compressor Controls — 64-0
A3	LT BLU (V6 VIN 9)	LT BLU	Air Conditioning: Compressor Controls, 64-0
A4	BLK	BLK	Ground Distribution — 14-3
A5	PNK	BLK/WHT	Air Conditioning: Blower Controls — 63-0
B1	WHT	WHT	Wiper/Washer — 90-0
B2	BRN	ORN	Air Conditioning: Blower Controls — 63-0
B3	LT GRN	YEL	Air Conditioning: Blower Controls — 63-0
C1	PPL	PPL	Wiper/Washer — 90-0
C2	BRN	BRN	Interior Lights: Console and Underhood — 114-1
C3	PNK	PNK	Wiper/Washer — 90-0
D1	GRY	GRY	Wiper/Washer — 90-0
D2	BRN	BRN	Air Conditioning: Blower Controls — 63-0
D3	DK GRN	DK GRN	Instrument Panel: Indicators Cluster Hood/Trunk/ Door Ajar Indicator — 80-2
E1	ORN	ORN	Air Conditioning: Blower Controls — 63-0
E2	LT BLU	LT BLU	Air Conditioning: Blower Controls — 63-0
E3	TAN	TAN	Air Conditioning: Blower Controls — 63-0
E4	RED	RED	Air Conditioning: Blower Controls — 63-0
F6	TAN/WHT	TAN/WHT	Brake Warning System — 41-0
F7	—	—	(Not Used)
F8	BRN/WHT	BRN	Coolant fan — 31-0
F9	DK GRN/WHT	DK GRN/WHT	Coolant Fan — 31-0
F10	BRN	BRN	Exterior Lights: Turn/Hazard/Park/Front Marker/ Stop/High Level Stop — 110-0
G6	RED	RED	Power Distribution — 10-0
G7	BRN	BRN	Electric Steering Assist — 45-0
G8	RED	RED	Coolant Fan — 31-0
H6	DK GRN	DK GRN	Horn — 40-0
H7	—	—	(Not Used)
H8	DK BLU	DK BLU	Exterior Lights: Turn/Hazard/Park/Front Marker/ Stop/High Level Stop — 110-0
H9	LT BLU	LT BLU	Exterior Lights: Turn/Hazard/Park/Front Marker/ Stop/High Level Stop — 110-0
J6	WHT	WHT	Headlight Doors — 102-0
J7	TAN	TAN	Headlights — 100-0
J8	LT GRN	LT GRN	Headlights — 100-0
J9	YEL	YEL	Headlight Doors — 102-0

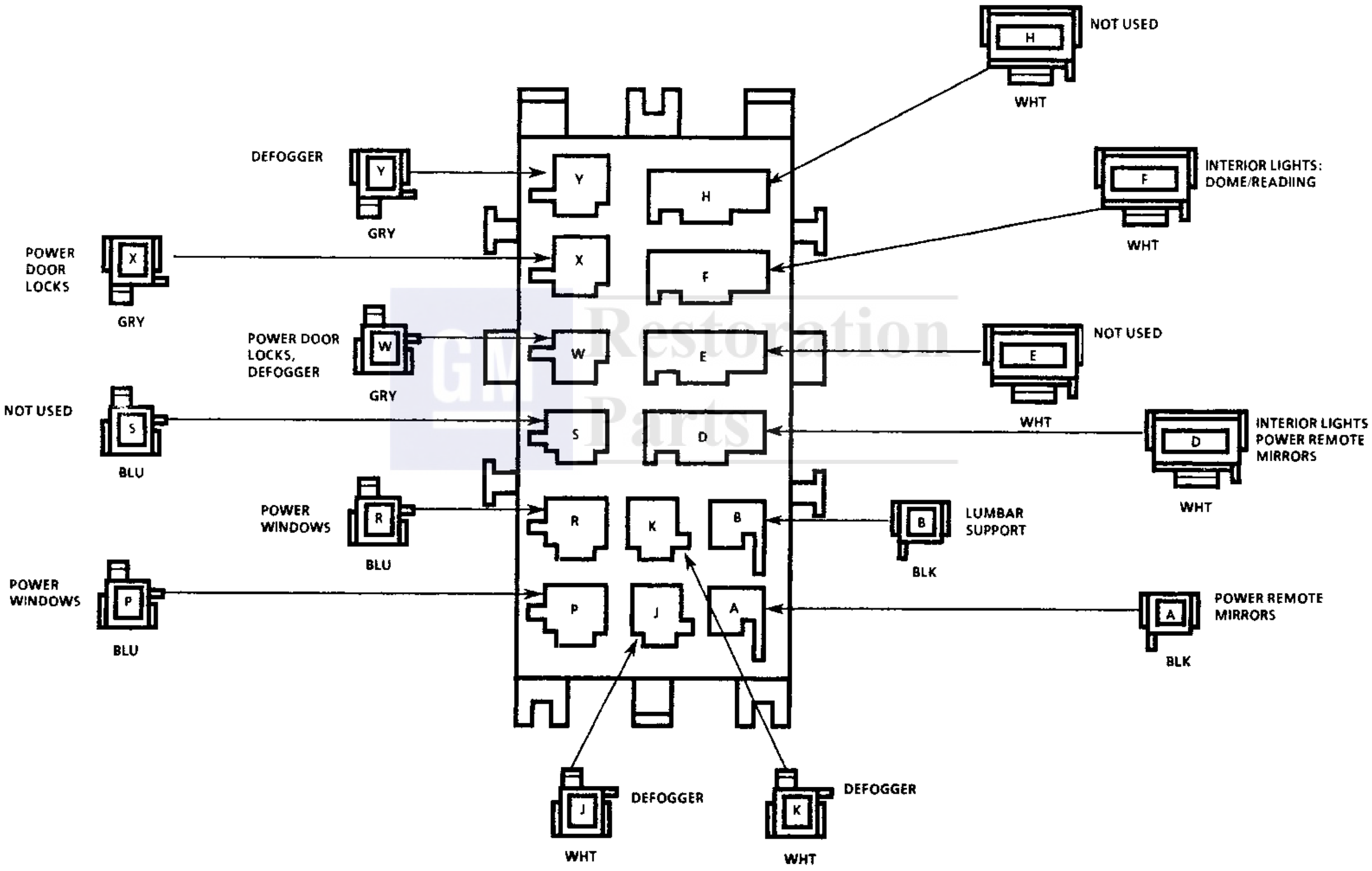
HARNESS CONNECTOR FACES: C500



CAVITY	WIRE COLOR		SCHEMATIC-PAGE
	PIN HALF	SOCKET HALF	
A1	—	—	(Not Used)
A2	BLK (L4 VIN R)	BLK	Ground Distribution — 14-3
A2	DK GRN (V6 VIN 9)	BLK	Ground Distribution — 14-3
A3	—	—	(Not Used)
A4	YEL	YEL	Starter and Charging System — 30-0
A5	—	—	(Not Used)
B1	BRN/WHT	BRN	Starter and Charging System — 30-0
B2	—	—	(Not Used)
B3	BRN	BRN	Starter and Charging System — 30-0
C1	DK BLU	DK BLU	Backup Lights — 112-0
C2	DK GRN/YEL	LT GRN	Instrument Panel: Indicators Cluster — 80-0
C3	WHT (V6 VIN 9)	WHT	Instrument Panel: Indicators Cluster — 80-0
C3	BLK/WHT (L4 VIN R)	WHT	Instrument Panel: Indicators Cluster — 80-0
D1	DK GRN/WHT	DK GRN/WHT	Coolant Fan — 31-0
D2	—	—	(Not Used)
D3	DK GRN	DK GRN	Instrument Panel: Indicators Cluster — 80-0
E1	LT GRN	LT GRN	Backup Lights — 112-0
E2	PPL	PPL	Starter and Charging System — 30-0
E3	PNK (L4 VIN R)	PNK	Electronic Fuel Injection: Ignition — 20-0
E3	RUST (V6 VIN 9)	PNK	Multi-port Fuel Injection: Ignition — 21-0

CAVITY	WIRE COLOR		SCHEMATIC-PAGE
	PIN HALF	SOCKET HALF	
E4	—	—	(Not Used)
F6	TAN	TAN	Cruise Control: Vacuum — 34-1
F7	BRN	BRN	Exterior Lights: Tail/Rear Marker/License — 110-3
F8	WHT/ORN	WHT	Instrument Panel: Indicators Cluster Hood/Trunk/ Door Ajar Indicator — 80-2
F9	LT GRN	LT GRN	Backup Lights — 112-0
F10	DK GRN/BLK	DK GRN/BLK	Ground Distribution — 14-3
G6	LT BLU/BLK	LT BLU/BLK	Cruise Control: Vacuum — 34-1
G7	WHT	WHT	Exterior Lights: Turn/Hazard/Park/Front Marker/ Stop/High level Stop — 110-0
G8	BRN/WHT	BRN	Exterior Lights: Rear Pontiac Emblem — 110-5
H6	DK BLU	DK BLU	Cruise Control: Vacuum — 34-1
H7	YEL	YEL	Exterior Lights: Turn/Hazard/Park/Stop — 110-2
H8	WHT	WHT	Exterior Lights: Turn/Hazard/Park/Front Marker/ Stop/High Level Stop — 110-0
H9	ORN	ORN/DK BLU	Interior Lights: Cigar Lighter, Clock and Trunk Light — 114-0
J6	LT GRN	LT GRN	Cruise Control: Vacuum — 34-1
J7	PPL	LT GRN/BLK	Cruise Control: Vacuum — 34-1
J8	—	—	(Not Used)
J9	—	—	(Not Used)

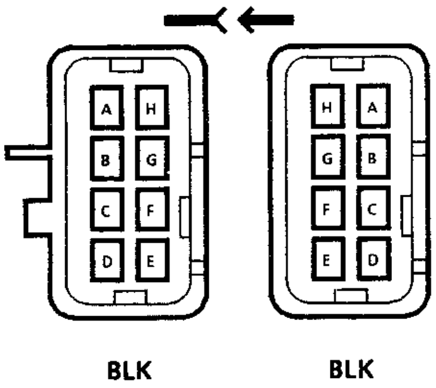
HARNESS CONNECTOR FACES



C200

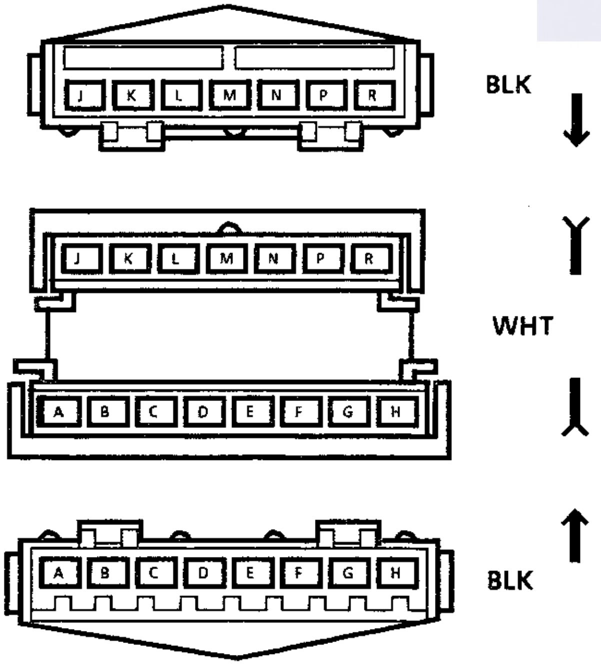
V18004.0

HARNESS CONNECTOR FACES



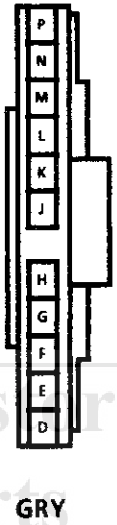
C201

V08000.E



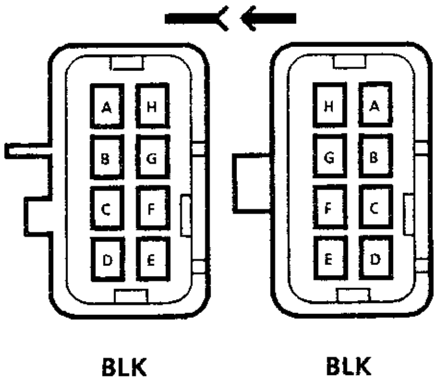
C203

V15001.5



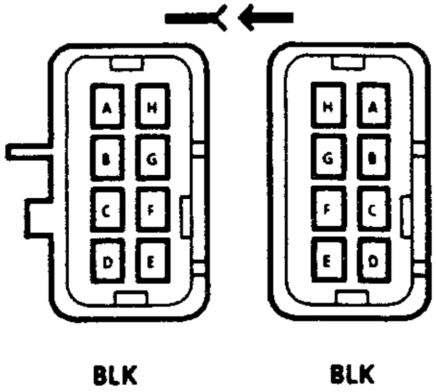
C210

V00211.0



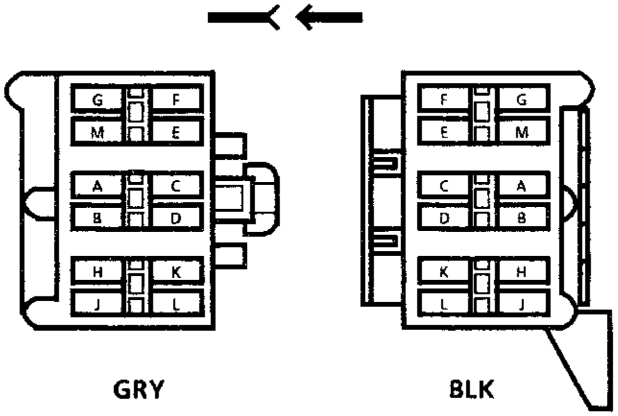
C211

V08006.0



C245

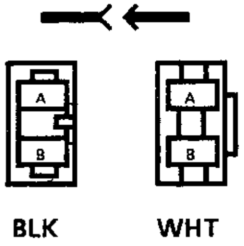
V08000.8



C247

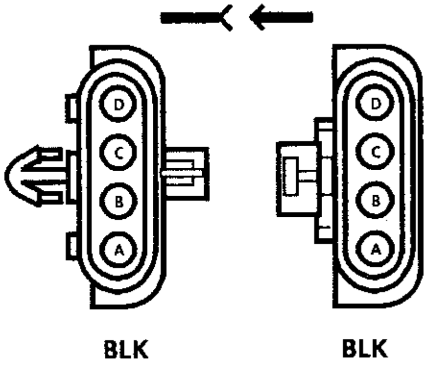
V12000.1

HARNESS CONNECTOR FACES



C248

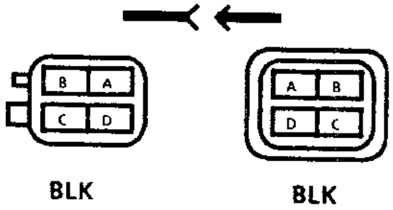
V02002.5



C250

V04010.0

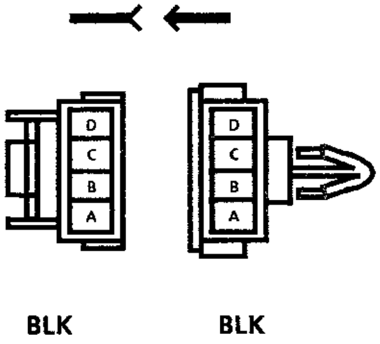
C255 (L4 VIN R ONLY), SEE C245



C303

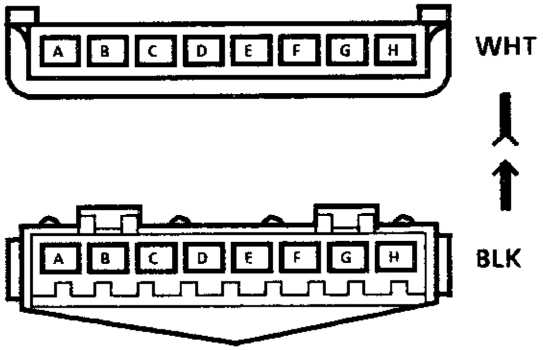
V04006.5

C304, SEE C303



C305

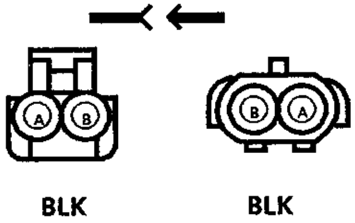
V04011.0



C307

V08005.0

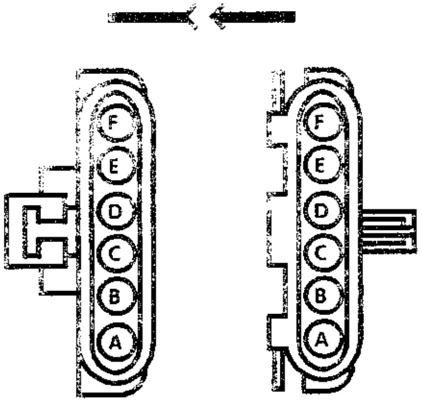
C308, SEE C307



C401

V02010.3

HARNESS CONNECTOR FACES



BLK BLK

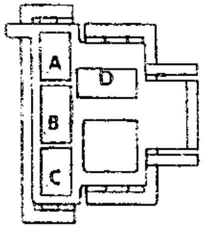
C520

V06008 0

BLK

A/C COMPRESSOR CLUTCH

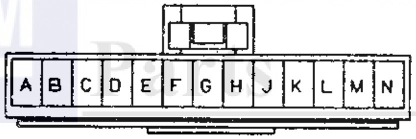
2973407



BLK

A/C COMPRESSOR CONTROL RELAY

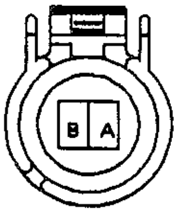
12020015



BLK

A/C CONTROL HEAD

12015130

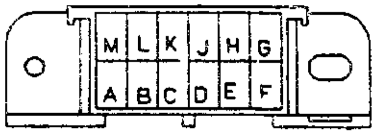


BLK

A/C HIGH PRESSURE SWITCH

12041139

A/C POWER RELAY, SEE A/C COMPRESSOR CONTROL RELAY



BLK

ASSEMBLY LINE DIAGNOSTIC LINK (ALDL) CONNECTOR

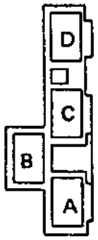
12010043

BLK

BACK UP LIGHT SWITCH

12015792

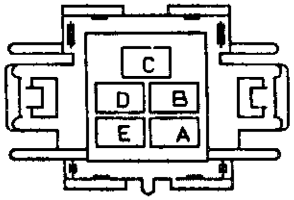
HARNESS CONNECTOR FACES



GRY

BLOWER RESISTORS

02965019

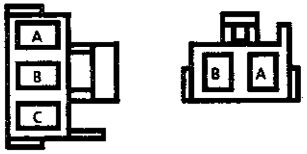


BLK

BLOWER SWITCH

12020813

BRAKE SWITCH
SEE CRUISE CLUTCH SWITCH

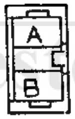


C1 BLK

C2 BLU

BRAKE SWITCH

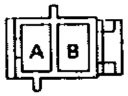
V00269.0



BLK

CLOCK (C208)

8900444

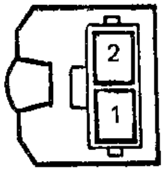


BLK

CLUTCH START SWITCH

12015034

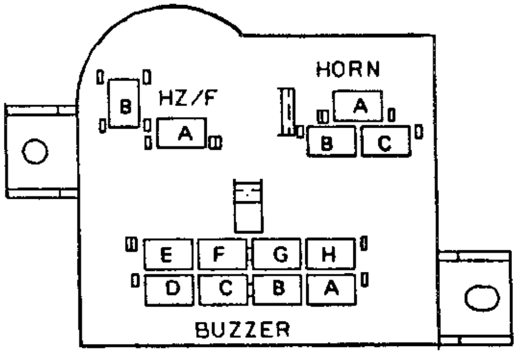
COLD START INJECTOR,
SEE COLD START SWITCH



BLK

COLD START SWITCH

12048039

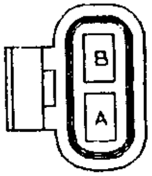


BLK

CONVENIENCE CENTER

12015999

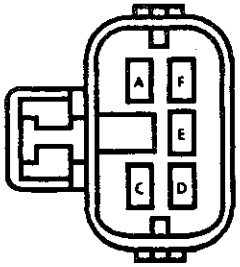
HARNESS CONNECTOR FACES



BLK

COOLANT FAN

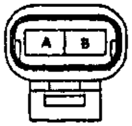
12033769



GRY

COOLANT FAN RELAY

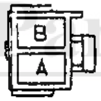
V00488.0



BLK

COOLANT TEMPERATURE SENSOR

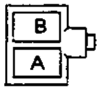
12040753



BLK

COOLANT TEMPERATURE SWITCH/SENDER

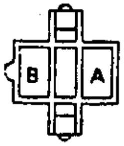
12033709



GRY

CRUISE BRAKE SWITCH

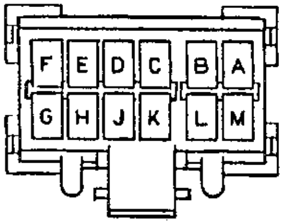
2977373



WHT

CRUISE CLUTCH SWITCH

12010649



WHT

CRUISE CONTROL MODULE

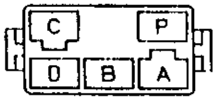
12034125

GRY

CRUISE CONTROL SERVO

12020646

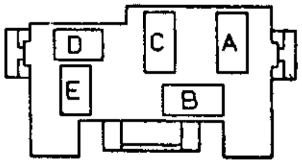
HARNESS CONNECTOR FACES



BLK

DEFOGGER CONTROL

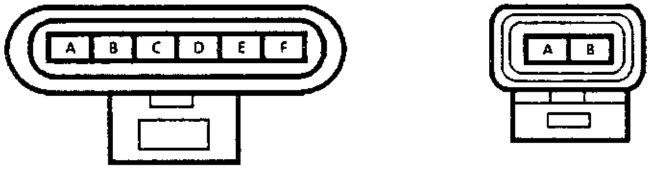
12015163



BLK

DEFOGGER TIMER-RELAY

12004099

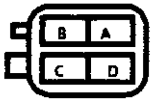


C1 BLK **C2 BLK**

DIRECT IGNITION MODULE

V00042 0

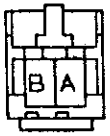
DOME READING LIGHTS, SEE CLOCK (C208)



BLK

DOME READING LIGHTS (WITH AMPLIFIER SWITCH)

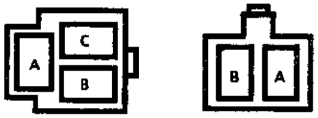
V00122.3



BLK

DOOR LOCK MOTORS

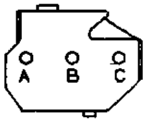
12004140



C1 BLK **C2 GRY**

DOOR LOCK RELAY ASSEMBLY

V00213.0



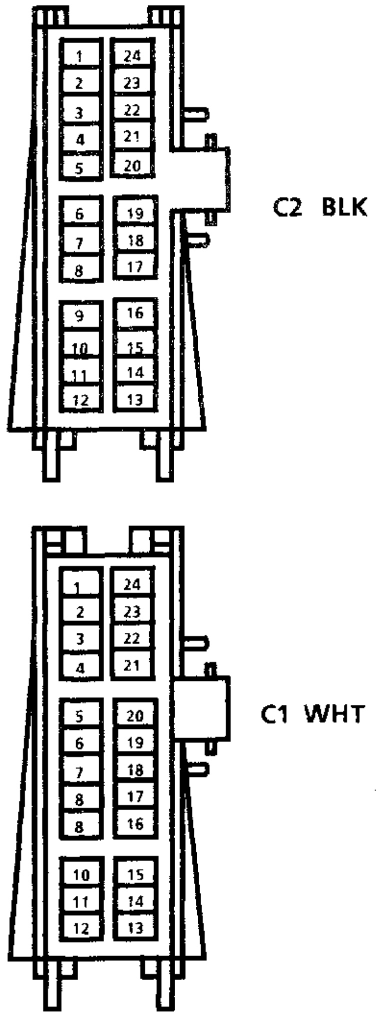
BLK

DOOR LOCK SWITCH (LH)

12015683

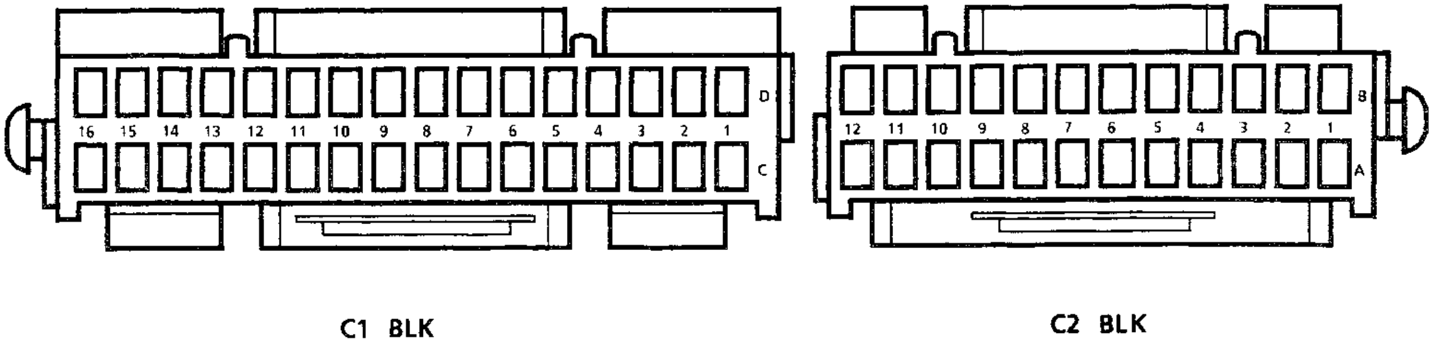
DOOR LOCK SWITCH (RH), SEE DOOR LOCK SWITCH (LH)

HARNESS CONNECTOR FACES



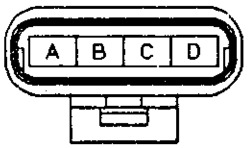
ELECTRONIC CONTROL MODULE (ECM) (L4 VIN R)

v00212.0



ELECTRONIC CONTROL MODULE (ECM) (V6 VIN 9)

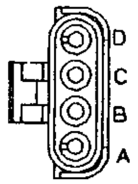
v00058 0



BLK

ELECTRONIC SPARK TIMING (EST) DISTRIBUTOR (C506)

12040754



BLK

ELECTRONIC VACUUM REGULATOR VALVE (EVRV)

12015797

HARNESS CONNECTOR FACES

FRONT POWER WINDOW MOTOR (LH), SEE DOOR LOCK MOTORS

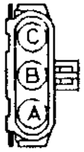
FRONT POWER WINDOW MOTOR (RH), SEE DOOR LOCK MOTORS

BLK

FUEL INJECTOR (L4 VIN R)

V00040.0

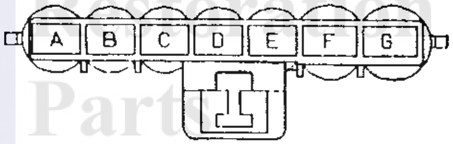
FUEL PUMP RELAY, SEE A/C COMPRESSOR CONTROL RELAY



BLK

FUEL TANK AND SENDER (C502)

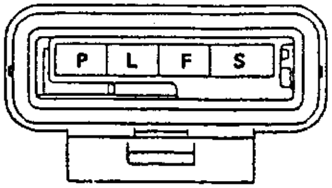
12020827



BLK

GEAR SELECTOR SWITCH

12034169



BLK

GENERATOR

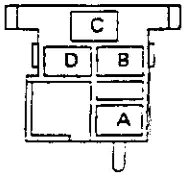
12045896

WHT

HEADLIGHT (LH)

6288471

HEADLIGHT (RH) SEE HEADLIGHT (LH)

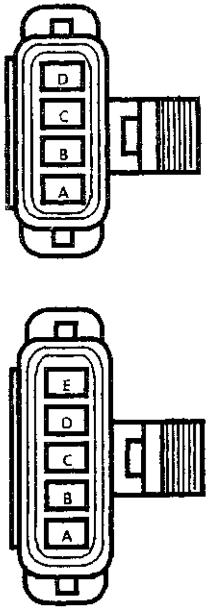


BLK

HEADLIGHT DIMMER SWITCH

8917643

HARNESS CONNECTOR FACES



C2 BLK

C1 BLK

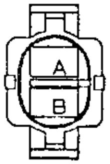
HEADLIGHT DOOR MODULE

V00207.0

BLK

HEATER CONTROL HEAD LIGHT

2977647

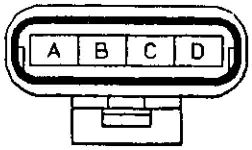


GRY/BLK

HIGH LEVEL STOP LIGHT

12020809

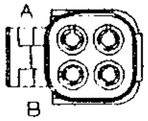
HIGH SPEED BLOWER RELAY, SEE A/C COMPRESSOR CLUTCH RELAY



BLK

IDLE AIR CONTROL MOTOR (L4 VIN R)

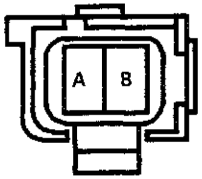
12040754



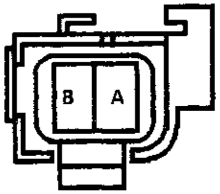
BLK

IDLE AIR CONTROL MOTOR (V6 VIN 9)

12015798



C2 BLK

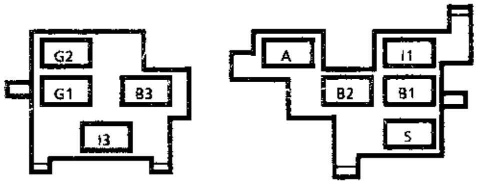


C1 GRY

IGNITION COIL (V6 VIN 9)

V00367.0

HARNESS CONNECTOR FACES

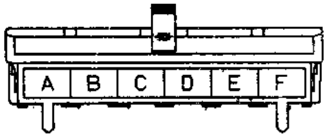


C1 BLK

C2 BLU

IGNITION SWITCH

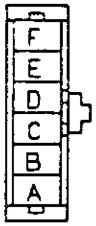
V00019.0



WHT

LIGHT SWITCH

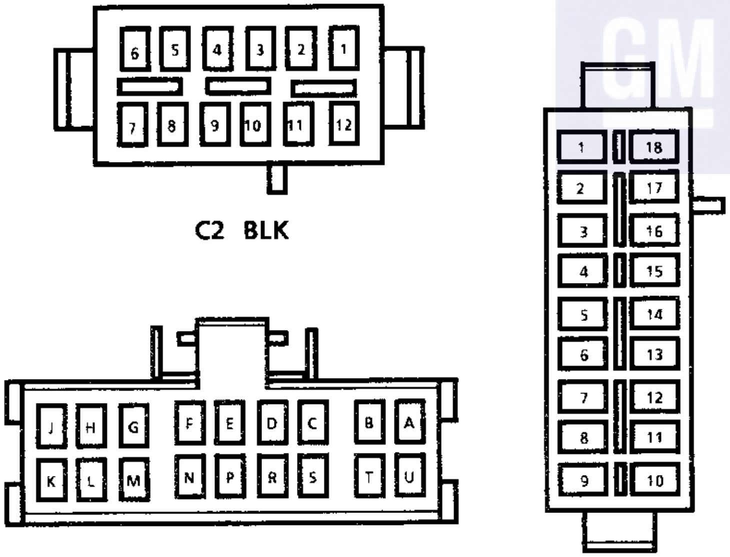
12034061



WHT

MODE DOOR ACTUATOR

8900443



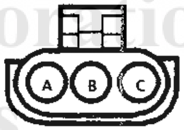
C2 BLK

C1 BLK

C3 BLK

INSTRUMENT PANEL

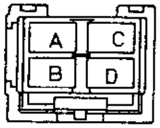
V00221.0



GRN

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR

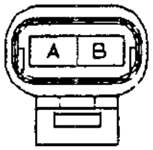
V00222.0



BLK

MULTI-FUNCTION LEVER (C235)

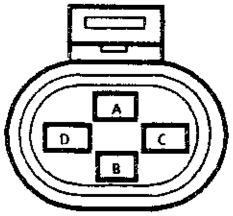
12020651



GRY

MANIFOLD AIR TEMPERATURE (MAT) SENSOR

12041411

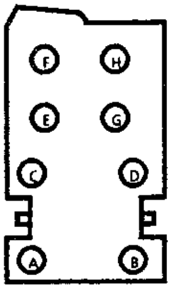


GRY

OIL PRESSURE SWITCH

V00003.1

HARNESS CONNECTOR FACES



BLK

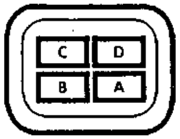
OUTSIDE MIRROR SWITCH

V00489.0

BLK

OUTSIDE AIR/RECIRCULATION DOOR ACTUATOR

V00368.0



BLK

OUTSIDE MIRROR (LH) C310

V00119.0

OUTSIDE MIRROR (RH) C311,
SEE OUTSIDE MIRROR (LH) C310

WHT

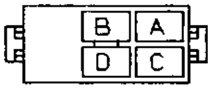
PANEL INTERIOR LIGHTS CONTROL

12034060

BLK

POWER STEERING

V00007.1



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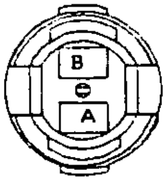
POWER WINDOW SWITCH (RH)

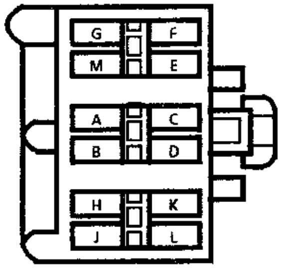
12004101



BLK

PRESSURE CYCLING SWITCH

12004827

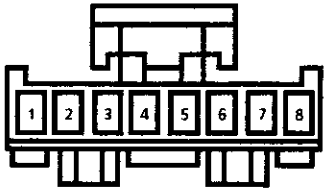


GRY

RADIO

V00361.1

RADIO SPEAKERS, SEE CLOCK (C208)



BLK

RALLY GAGE PANEL

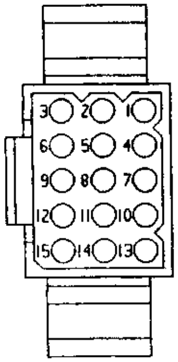
V00337.1

WHT

REMOTE DIMMER

12034060

HARNESS CONNECTOR FACES



WHT

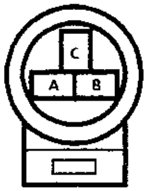
SUB-WOOFER AMPLIFIER

12034325

WHT

TACHOMETER FILTER (C511)

06288248



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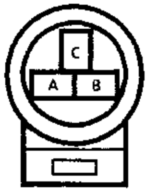
THROTTLE POSITION SENSOR (L4 VIN R)

V00041.0



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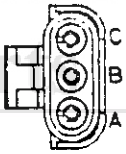
THROTTLE POSITION SENSOR (TPS)

V00041.0



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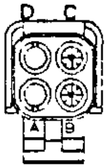
THROTTLE POSITION SENSOR (V6 VIN 9)

12015793



BLU

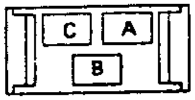
TRANSAXLE CONVERTER CLUTCH SOLENOID

12015390

BLK

TRUNK AJAR SWITCH

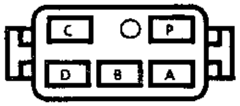
V00127.6



BLK

TRUNK RELEASE RELAY

02984164



GRY

TRUNK RELEASE SWITCH

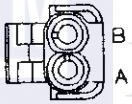
V00490.0

HARNESS CONNECTOR FACES

BLK

UNDERHOOD LIGHT

8900863



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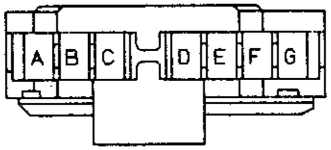
VEHICLE SPEED SENSOR

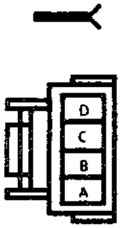
12015792



GRY

WINDSHIELD WIPER SWITCH (C207)

12010430



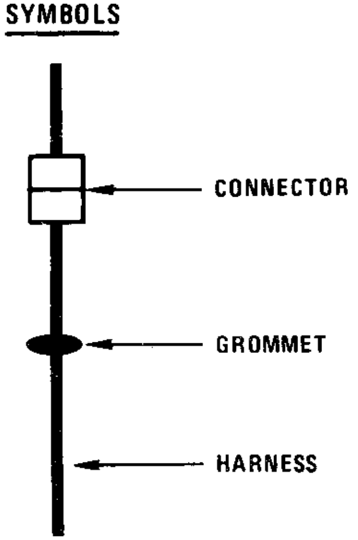
BLK

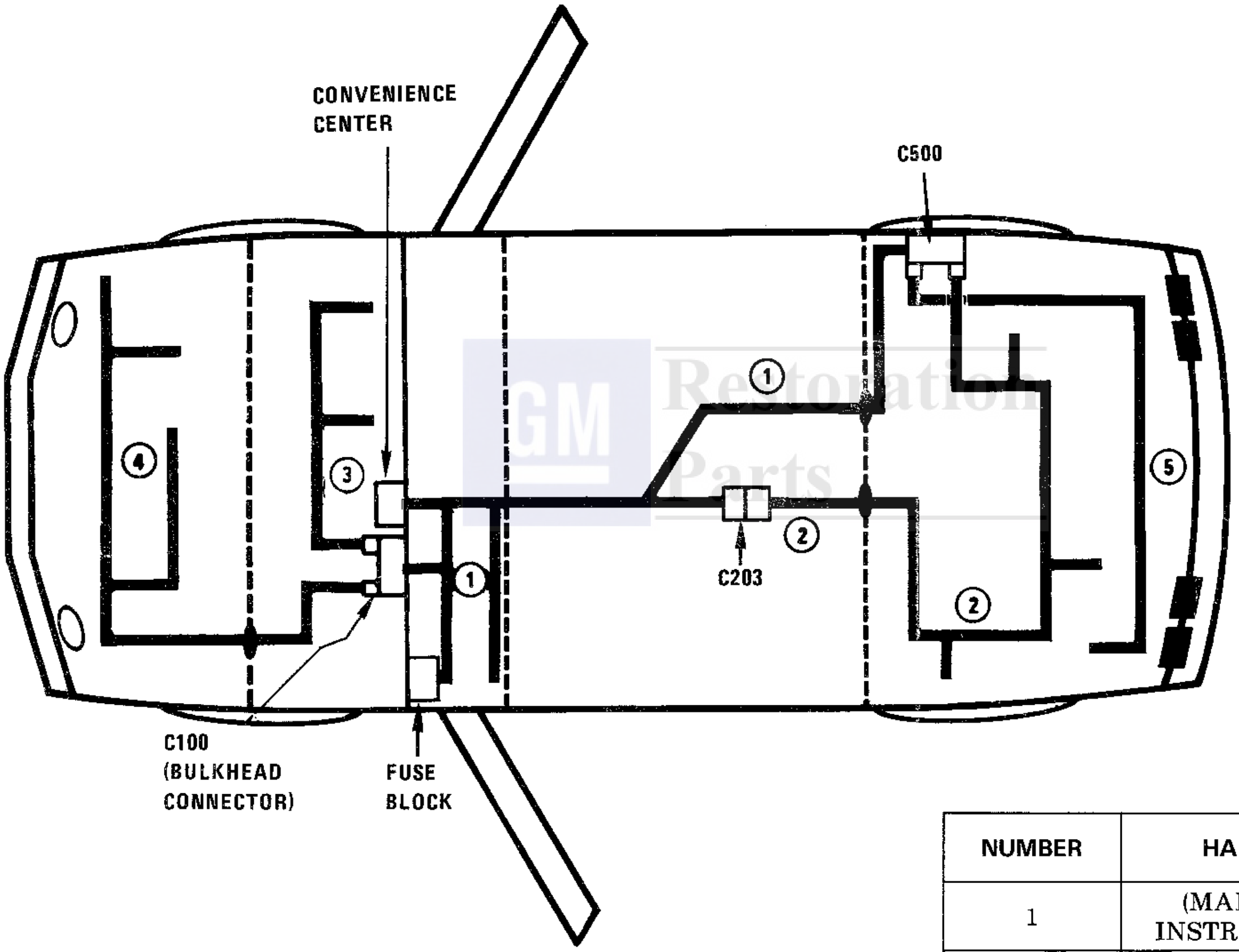
WIPER MOTOR

V00491.0

HARNESS ROUTING VIEWS

L4 VIN R

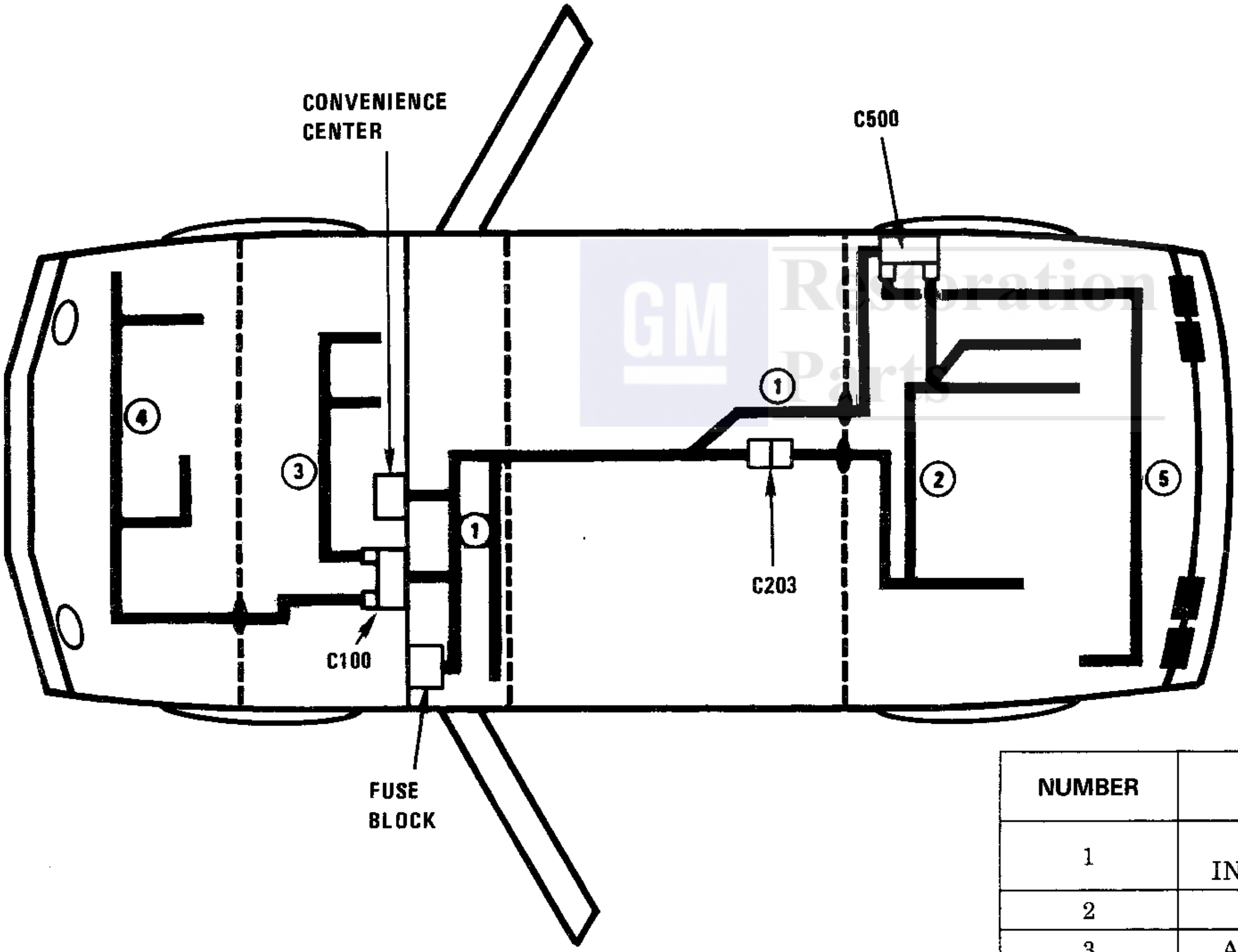


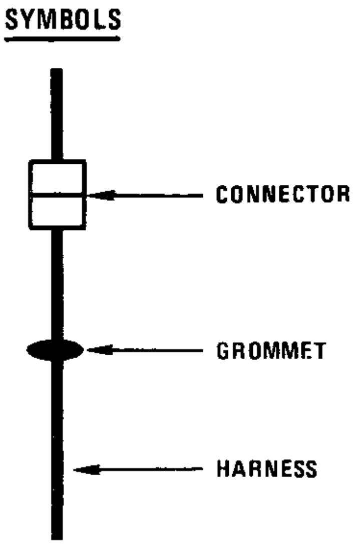


NUMBER	HARNESS NAME	DETAIL VIEW PAGE-FIGURE
1	(MAIN HARNESS) INSTRUMENT PANEL	201-15-A
2	ENGINE	201-2-B
3	AIR CONDITIONING	201-13-A
4	FORWARD LAMP	201-11-C
5	BODY REAR	201-14-A

HARNESS ROUTING VIEWS

V6 VIN 9





NUMBER	HARNESS NAME	DETAIL VIEW PAGE-FIGURE
1	(MAIN HARNESS) INSTRUMENT PANEL	201-15-A
2	ENGINE	201-3-A
3	AIR CONDITIONING	201-13-A
4	FORWARD LAMP	201-11-C
5	BODY REAR	201-14-A

SECTION 8B

LIGHTING SYSTEMS AND HORNS

CONTENTS

Exterior Lights

Exterior Lights

The following information, previously shown in this section, has been moved to the section(s) shown.

Cooling Fan Relay 6B
Fuse Block 8A
Ignition Switch 3B4
Instrument Panel Bulb Replacement 8C
Multifunction Switch 3B4
Neutral Start Switch 3B4, 7
Overhead Light .... Body Service Manual, 8J
Parking Brake Warning Switch 5
Pulse Wiper Module 8E2
Rear Window Defogger 8A
Seat Belt, Key and Headlight Warning Alarm 8A
Stoplight Switch 5

GENERAL DESCRIPTION

EXTERIOR LIGHTS

The exterior lighting system includes the headlights (and headlight motors to raise or lower the headlights), front parking/turn signal lights, rear tail/stop/turn signal lights, back-up lights, license plate lights, center high-mounted stoplight, and the front and rear compartment lights; it also includes all associated wiring, controls and related hardware for these lights.

BACK-UP LIGHTS – The back-up lights are in the middle of the rear light assembly. They will come on when the transaxle is shifted to Reverse. On cars with an automatic transaxle, the back-up lights are activated by the neutral start switch. On cars with a manual transaxle, they are activated by a separate back-up light switch located on the transaxle. For more information, see Section 7.

CENTER HIGH-MOUNTED STOPLIGHT – The center high-mounted stoplight, attached to the roof in the center of the rear window, will come on whenever the brake pedal is pushed down. This light is powered separately from the rear stop/tail/turn signal lights through a separate circuit in the stoplight switch (see Section 8A).

FRONT COMPARTMENT LIGHT – If the headlights or parking lights are on, the front compartment light will come on when the front compartment lid is raised.

FRONT PARKING/TURN SIGNAL LIGHTS – Pushing either side of the instrument panel switch will turn on the front parking lights. When the ignition is on and the turn signal lever is moved, the appropriate front parking light flashes to signal a turn. Both lights will flash when the hazard flashers are on.

If the driver's door is opened when the parking lights are on, a warning tone will sound. For more information, see Section 8A-77.

HAZARD FLASHERS – The hazard warning flasher is part of the turn signal circuit. Pushing in the button (on the right side of the steering column) will cause the front and rear turn signals, and the front sidemarker lights, to flash. Pull out the collar around the button to turn off the hazard flashers.

The hazard flashers will work with the ignition either off or on. When the hazard flashers are on, the turn signals do not work.

On all cars except GT models, the hazard flashers will stop flashing and stay on brightly if the brake pedal is pushed down. (On GT models, the turn signal lights will continue flashing even if the brake pedal is pushed.)

HEADLIGHTS – The headlights are controlled by the switch on the instrument panel (to the left of the steering column). They will come on whether or not the ignition is turned on. Pushing the upper left side of the switch turns on the headlights and causes the headlight motors to raise the headlights. Pushing the bottom part of the switch turns off the headlights, and they should lower.

If the driver's door is opened when the ignition is off and the headlights are on, a warning tone will sound. For more information, see Section 8A-77.

Headlight low-beam and high-beam are controlled by the turn signal/multifunction lever on the left side of the steering column. When the headlights are on, pull the lever toward the steering wheel until the switch clicks; the lights will change from low-beam to high-beam, or from high-beam to low-beam. An indicator light on the center instrument cluster will come on when the high-beam headlights are on.

The headlights must be aimed for proper illumination of the road. Headlight aim should be checked: at least once a year; when a new headlight bulb is installed; or if service or repairs in the front end area have (or may have) disturbed the headlights or their mountings. The headlight bezels do not need to be removed to aim the headlights.

Headlight focus is set when the sealed-beam unit is made; no adjustment for focus is necessary or possible.

Some state and local laws specify requirements for headlight aim; these laws must be followed.

LICENSE PLATE LIGHTS – Lights above both sides of the rear license plate will come on when the headlights or parking lights are on.

LIGHT SWITCH – Most exterior lights are controlled by the switch on the instrument panel, to the left of the steering column. Pushing the upper right part of the switch turns on the front parking lights, the taillights and the sidemarker lights. (It also turns on the instrument panel lights.) Pushing the upper left part of the switch turns on all these lights plus the headlights. Pushing the bottom part of the switch turns off all lights.

In some cases (such as going through a car wash), it may be desirable to raise the headlights without leaving the headlights on. To do so, push the upper right part of the switch to turn on the parking lights. Then, lightly push the upper left side of the switch; the headlights will raise but will not come on. (Remember that the parking lights will stay on.)

For more information on this switch (including on-car service), see Section 8C. Also see Section 8C for information on interior lights.

REAR COMPARTMENT LIGHT – The rear compartment light will come on when the rear compartment lid is raised, whether or not the headlights or parking lights are on.

REAR TAIL/STOP/TURN SIGNAL LIGHTS – The rear taillights, stoplights and turn signal lights are part of the same light assembly. Pushing either side of the instrument panel switch turns on the taillights. When the brake pedal is pushed down, these lights glow brighter to serve as stoplights.

Moving the turn signal lever when the ignition is on causes the appropriate rear lights to flash. (If the brake pedal is held down and a turn is signalled, one side will flash and the other will stay on brightly.) All lights will flash when the hazard flashers are on. However, if the brake pedal is pushed while the hazard flashers are on, the lights will stop flashing and stay on brightly.

On GT models, the stoplights are separate from the turn signal lights. The stoplights on both sides will stay on if the brake pedal is pushed while signalling a turn. And, the hazard flashers on GT models will continue flashing even if the brake pedal is pushed.

SIDEMARKER LIGHTS – The front and rear sidemarker lights will come on when the headlights or parking lights are on. Both front and rear sidemarker lights also have reflectors; they will shine when struck by light, whether or not the car's lights are on.

If the lights are *off* when a turn is signalled, the front sidemarker light will flash in unison with the front turn signal light on the same side. If the lights are *on* when a turn is signalled, the front sidemarker light and front turn signal light flash alternately.

TURN SIGNALS – The front turn signals are combined with the front parking lights. The rear turn signals are part of the rear tail/stop/turn signal light assembly. The turn signals work only when the ignition is on, and the hazard flashers are turned off.

The turn signals are controlled by the turn signal/multifunction lever on the left side of the steering column. Moving the lever all the way up or down (past the detent) will turn on the turn signals. When the turn is completed, the lever will return to neutral and the turn signals will stop flashing.

For changing lanes or shallow turns where the steering wheel does not move far enough to cancel the signal, move the turn signal lever only to the first detent. When the lever is released, it will return to neutral and the turn signals will cancel.

HORNS

The two horns are mounted behind the front fascia on the front compartment rail at both sides of the car. Pushing the pad in the center of the steering wheel closes the horn relay (in the convenience center) and sounds the horns. The horns use a solenoid-operated diaphragm to generate sound. See Section 8A-40 for wiring and circuit information.

ON-CAR SERVICE

Wiring diagrams and other diagnosis information is given in Section 8A. Information on properly repairing wiring harnesses, connectors, etc., is on 8A-5.

Most lighting problems are caused by loose connectors, open or shorted wiring, burned-out bulbs, bad switches, inadequate ground or blown fuses. Many of these require only replacement of a defective part. When replacing a part that requires a special procedure (such as a lens and housing assembly sealed together), follow the instructions normally included in the replacement parts package.

When removing a part that requires special sealing items (such as sealing washers), be sure to reinstall those items when replacing the part. Also, if any body sealing items (grommets, etc.) are disturbed, be sure to repair them so the passenger compartment remains properly sealed.

EXTERIOR LIGHTS

BACK-UP LIGHTS

Fig. 8B-7

Replacement Bulb: Trade No. 1156, 32 Candlepower

To replace a back-up light bulb, see "Rear Tail/Stop/Turn Signal Lights" later in this section. For information on the back-up light switch on the transaxle, see Section 7.

CENTER HIGH-MOUNTED STOPLIGHT

Fig. 8B-1

The center high-mounted stoplight is attached to the roof in the center of the rear window.

Assembly Replacement

↔ Remove or Disconnect

1. Two screws in cover
2. Cover
3. Electrical connector
4. Two bolts

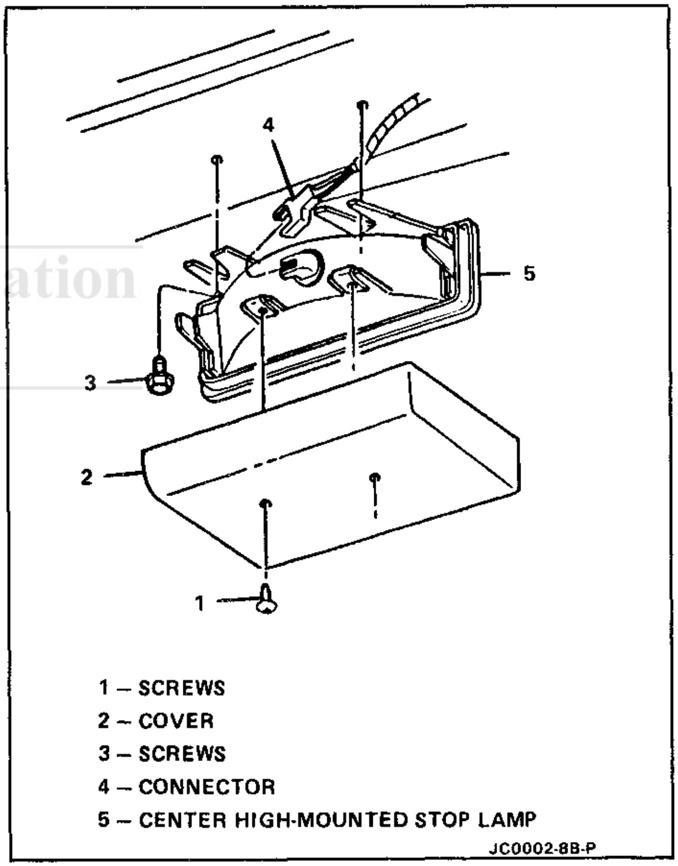


Fig. 8B-1 Center High-Mounted Stoplight

→← Install or Connect

1. Two bolts
2. Electrical connector
3. Cover
4. Two screws in cover

Bulb Replacement

Replacement Bulb: Bulb and socket are replaced as an assembly

↔ Remove or Disconnect

1. Two screws in cover

2. Cover
3. Electrical connector
4. Bulb and socket from assembly

Install or Connect

1. Bulb and socket into assembly
2. Electrical connector
3. Cover
4. Two screws in cover

FRONT COMPARTMENT LIGHT

Bulb Replacement

Replacement Bulb: Trade No. 168, 3 Candlepower

Remove or Disconnect

1. Raise front compartment lid
2. Bulb from socket

Install or Connect

1. Bulb into socket
2. Close compartment lid

Switch Replacement

Remove or Disconnect

1. Two electrical connectors at switch
2. Unscrew switch from vent duct panel

Install or Connect

1. Switch to vent duct panel
2. Two electrical connectors at switch

FRONT PARKING/TURN SIGNAL LIGHTS

Fig. 8B-2

Bulb Replacement

Replacement Bulb: Trade No. 2057, 32/2 Candlepower

Remove or Disconnect

1. Two screws from light assembly
2. Light assembly
3. Bulb socket from light assembly
4. Bulb from socket

Install or Connect

1. Bulb into socket
2. Bulb socket in light assembly
3. Light assembly
4. Two screws into light assembly

HAZARD FLASHER

The hazard flasher is in the convenience center, on the right side of the heater or A/C module under the instrument panel. To remove it, release the tab lock on the side and pull it straight out.

HEADLIGHTS

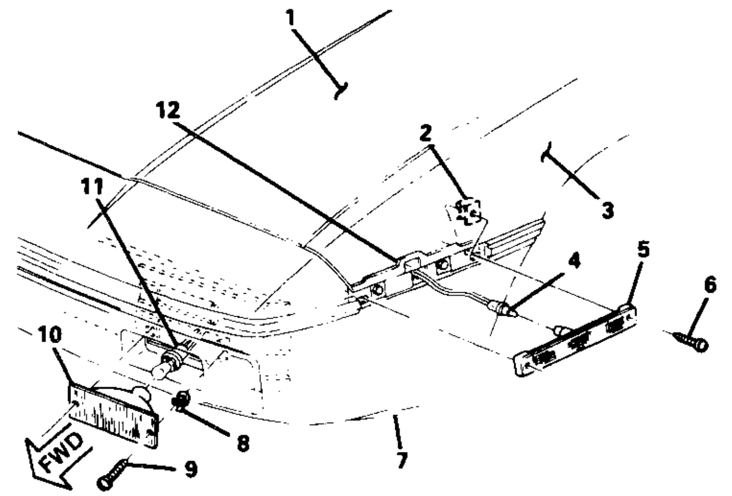
Actuators

Fig. 8B-3

Before removing the headlight mounting bracket, note the position by marking around the two upper attaching bolts and onto the mounting bracket.

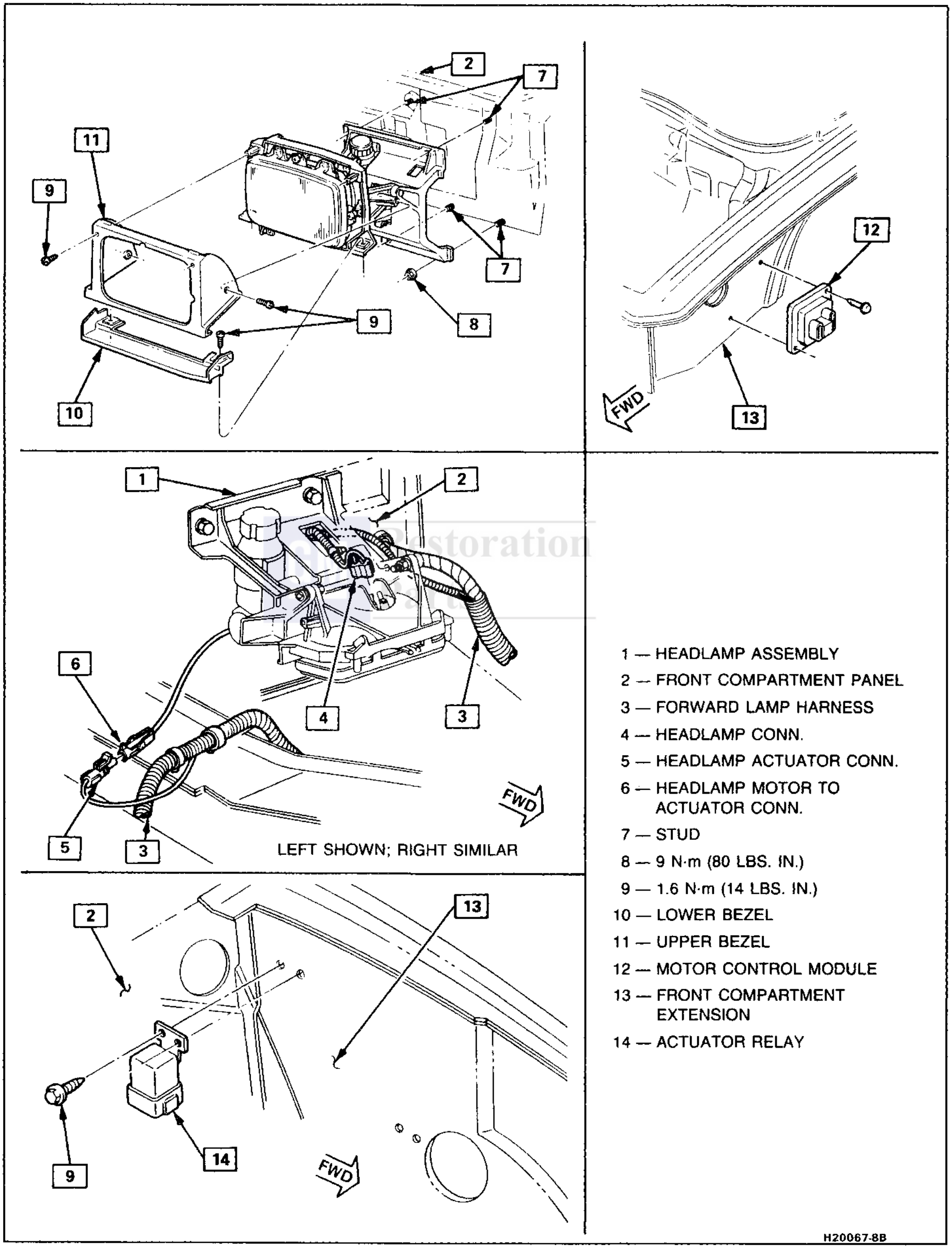
Remove or Disconnect

1. Negative (–) battery cable
2. Open front compartment lid
3. Electrical connection at light
4. Two bolts, one at each side of light assembly
5. One bolt at link assembly



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. 8B-2 Front Parking/Turn Signal Lights



1 — HEADLAMP ASSEMBLY
2 — FRONT COMPARTMENT PANEL
3 — FORWARD LAMP HARNESS
4 — HEADLAMP CONN.
5 — HEADLAMP ACTUATOR CONN.
6 — HEADLAMP MOTOR TO ACTUATOR CONN.
7 — STUD
8 — 9 N·m (80 LBS. IN.)
9 — 1.6 N·m (14 LBS. IN.)
10 — LOWER BEZEL
11 — UPPER BEZEL
12 — MOTOR CONTROL MODULE
13 — FRONT COMPARTMENT EXTENSION
14 — ACTUATOR RELAY

Fig. 8B-3 Headlight and Retractor System Components

6. Light, light assembly and bezel as a unit
7. Four attaching bolts at mounting bracket
8. All electrical connections
9. Headlight mounting bracket
10. Clip at actuator cam linkage

Important

Note position of linkage to actuator before removal to aid in reassembly

11. Linkage
12. Three actuator attaching bolts
13. Actuator

Install or Connect

1. Actuator
2. Three actuator attaching bolts
3. Linkage
4. Clip at actuator cam linkage
5. Electrical connections at mounting bracket
6. Headlight mounting bracket (align marks on bracket)

Tighten

Four bolts at headlight mounting bracket to 9 N·m (80 lbs.-in.)

7. Light, light assembly and bezel
8. Two bolts, one at each side of light assembly
9. One bolt at link assembly
10. Electrical connection at light
11. Close front compartment lid
12. Negative (–) battery cable

Actuator Switch and Harness Assembly

Figs. 8B-3 and 8B-4

Before removing the headlight mounting bracket, note the position by marking around the two upper attaching bolts and onto the mounting bracket.

Remove or Disconnect

1. Negative (–) battery cable
2. Open front compartment lid
3. Electrical connection at light
4. Two bolts, one at each side of the light assembly
5. One bolt at link assembly
6. Light, light assembly and bezel as a unit
7. Four attaching bolts at mounting bracket
8. All electrical connections
9. Headlight mounting bracket assembly
10. Switch cover plate
11. Rubber slot filler
12. Switch and harness assembly

Install or Connect

1. Switch and harness assembly
2. Rubber slot filler
3. Switch cover plate
4. Headlight mounting bracket (align marks on bracket)
5. Electrical connections at mounting bracket
6. Four attaching bolts at mounting bracket

Tighten

Four bolts at headlight mounting bracket to 9 N·m (80 lbs.-in.)

7. Light, light assembly and bezel
8. One bolt at link assembly
9. Two bolts, one at each side of light assembly
10. Electrical connection at light
11. Close front compartment lid
12. Negative (–) battery cable

Headlight Aiming

Fig. 8B-5

Horizontal and vertical aiming of each sealed-beam headlight is done by two (2) adjusting screws which move the mounting ring in the body against the tension of a coil spring. When using mechanical aimers, follow the manufacturer's instructions.

Headlight Bulb Replacement

Fig. 8B-3

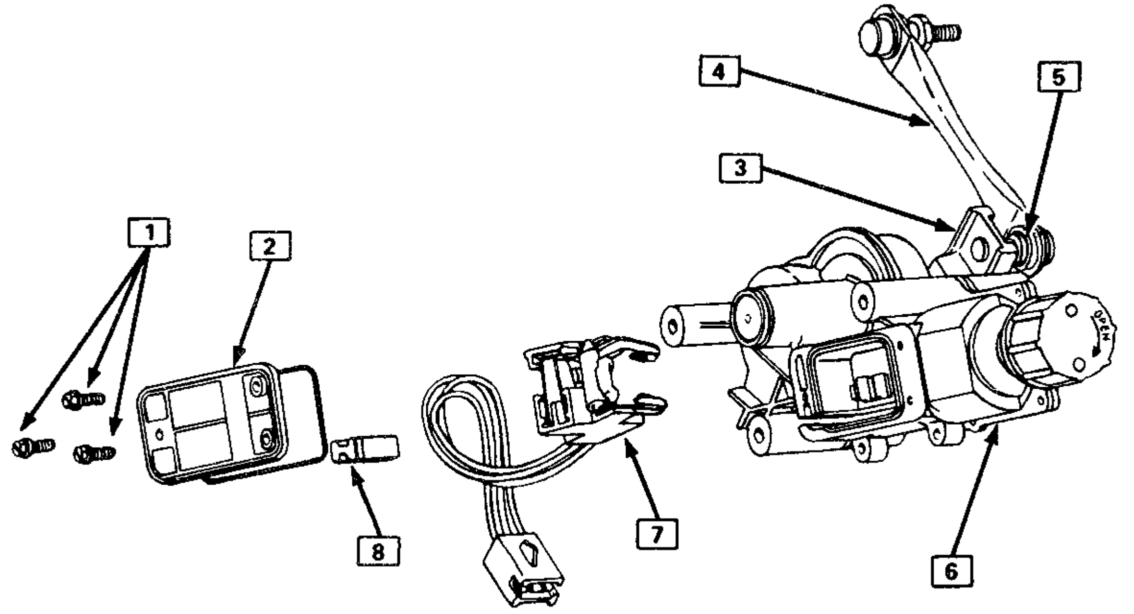
Replacement Bulb: Trade No. H6054, 35 Watt/65 Watt

Remove or Disconnect

1. Open front compartment lid
2. Turn on headlights
3. Connector at wire near headlight motor (No. 5 in Fig. 8B-3)
4. Turn off headlights (disconnected headlight should stay up)
5. Electrical connections at light
6. Close front compartment lid
7. Torx screws at top right and top left of bezel
8. Raise front compartment lid
9. Torx screw at each side of bezel
10. Bezel
11. With a hooked tool, pull retaining spring to one side to release light assembly
12. Light assembly from aiming pins
13. Four screws from retaining ring
14. Headlight

Install or Connect

1. Headlight
2. Retaining ring (4 screws)
3. Close front compartment lid
4. Light assembly to aiming pins
5. Retaining spring
6. Open front compartment lid
7. Bezel
8. Torx screws at each side of bezel
9. Electrical connections at headlight
10. Close front compartment lid



1—COVER SCREWS
2—SWITCH COVER PLATE AND "O" RING
3—CRANK ARM
4—LINK ASSEMBLY
5—CRANK ARM BALL
6—HEADLAMP ACTUATOR
7—SWITCH AND HARNESS ASSEMBLY
8—RUBBER SLOT FILLER

520060-2C

Fig. 8B-4 Headlight Actuator Switch and Harness

HEADLAMP AIM SPECIFICATIONS

I. CALIBRATE MECHANICAL AIMERS CONFORMING TO SAE J602 AS FOLLOWS:
1. SET MASTER FIXTURE TO "0" U/D AND "0" R/L
2. CALIBRATE AIMERS ON MASTER FIXTURE TO READ "0" U/D AND R/L.

II. PREPARE VEHICLE FOR CHECKING OR SETTING AIM AS FOLLOWS:
1. COMPLETELY ASSEMBLE ALL COMPONENTS ON VEHICLE.
2. PLACE VEHICLE ON LEVEL PAD.
3. STOP ALL OTHER OPERATIONS OR WORK ON VEHICLE.
4. CLOSE DOORS.
5. ATTACH AIMERS TO HEADLAMPS.
6. ROCK VEHICLE SIDEWAYS.

III. TO CHECK OR SET AIM PER SAE J599 USE THE FOLLOWING LIMITS:

VERTICAL AIM	HORIZONTAL AIM
2 UP TO 2.5 DOWN	4"R TO 4"L

FUEL LOAD TO BE 1/2 TANK OR LESS

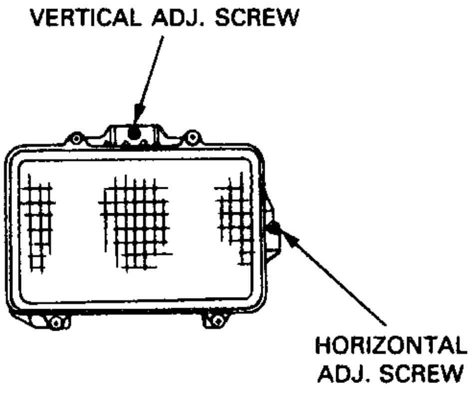


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Fig. 8B-5 Headlight Aiming

12. Turn headlights on
13. Connector at wire near motor (No. 5 in Fig. 8B-3)
14. Turn headlights off (both should lower)

Adjust

Headlight aim

LICENSE PLATE LIGHTS

Fig. 8B-6

Replacement Bulb: Trade No. 194, 2 Candlepower

Remove or Disconnect

1. Two screws at light assembly
2. Light assembly
3. Bulb socket from assembly
4. Bulb from socket

Install or Connect

1. Bulb into socket
2. Bulb socket into assembly
3. Light assembly

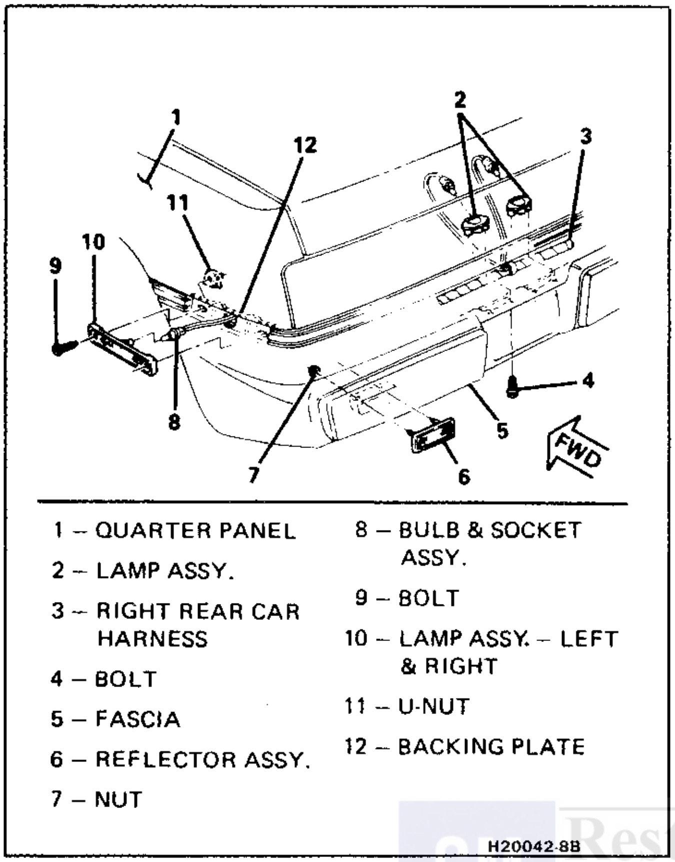


Fig. 8B-6 License Plate and Rear Sidemarker Lights

4. Two screws at light assembly

REAR COMPARTMENT LIGHT

Replacement Bulb: Trade No. 168, 3 Candlepower

1. Raise rear compartment lid
2. Bulb from socket

→← Install or Connect

1. Bulb into socket
2. Lower rear compartment lid

REAR TAIL/STOP/TURN SIGNAL LIGHTS

Fig. 8B-7

Replacement Bulb (All Except GT Models): Trade No. 2057, 32/2 Candlepower

Replacement Bulbs (GT Models Only):

- *Tail/Stoplights: Trade No. 2057, 32/2 Candlepower*
- *Taillights Only: Trade No. 194, 2 Candlepower*
- *Turn Signals Only: Trade No. 1156, 32 Candlepower*

The taillight lens is two pieces. To remove a bulb, remove the appropriate piece. Each piece is attached to the body by three screws which are recessed under rectangular black tabs.

←→ Remove or Disconnect

1. Open rear compartment lid
2. Three black tabs covering screws by prying carefully with a screwdriver
3. One screw under each tab
4. Tailight lens
5. Bulb socket from lens by pushing locking tabs and turning to the left
6. Bulb from socket

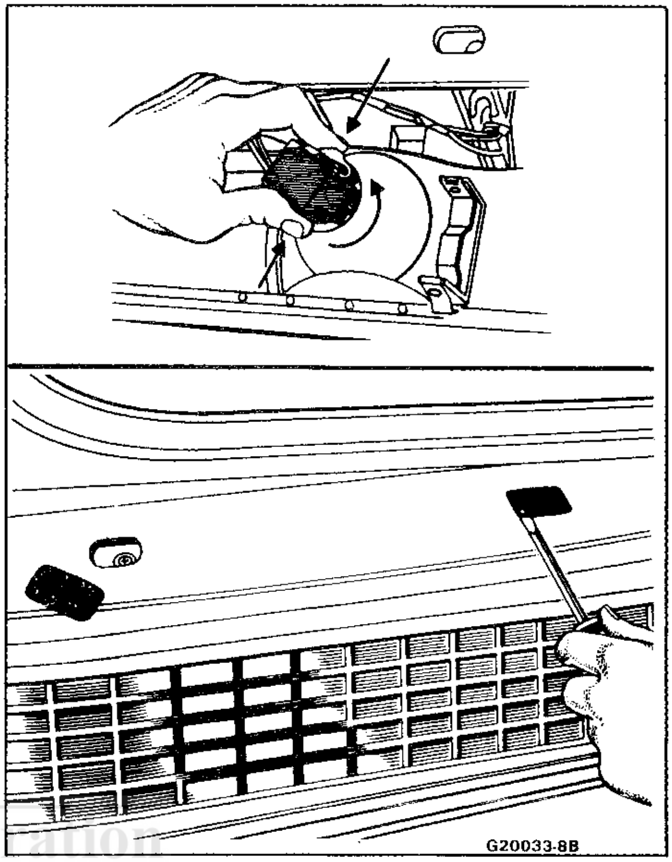


Fig. 8B-7 Rear Tail/Stop/Turn Signal Lights

→← Install or Connect

1. Bulb into socket
2. Socket into lens (be sure tabs lock)
3. Taillight lens
4. Three screws

Adjust

Lens position as needed before final tightening of screws

5. Three black tabs
6. Close rear compartment lid

REMOTE DIMMER SWITCH

The remote dimmer switch assembly is on the steering column support under the instrument panel.

←→ Remove or Disconnect

1. Instrument panel steering column cover (see Section 8C)
2. Electrical connection at dimmer assembly
3. Two screws at assembly
4. Dimmer assembly

Install or Connect

1. Dimmer assembly
2. Two screws into assembly
3. Electrical connection
4. Instrument panel steering column cover

SIDEMARKER LIGHTS (FRONT AND REAR)

Figs. 8B-2 (Front) and 8B-6 (Rear)

Replacement Bulb: Trade No. 194, 2 Candlepower

Remove or Disconnect

1. Two Torx screws at each side of lens
2. Light assembly
3. Bulb socket from assembly
4. Bulb from socket

Install or Connect

1. Bulb into socket
2. Bulb socket into assembly
3. Light assembly
4. Bulb from socket

TURN SIGNAL FLASHER

The turn signal flasher is on the left side of the lower steering column bracket.

Remove or Disconnect

1. Electrical connector
2. Flasher from clip

Install or Connect

1. Flasher into clip
2. Electrical connector

HORNS

If the horns do not blow, or blow constantly, follow the diagnostic procedures in Section 8A.

Horn Tone Poor

1. **Horn Tone Poor** – Tighten bolts in mounting area.
2. **Low-Pitched Moan** – Sounds like "mooing." Caused by current too high. Adjust current (see the following).
3. **Weak Tone** – Current too low. Correct poor connections or ground, or adjust current (see the following).
4. **Weak, Strained Tone** – Remove foreign object in horn.
5. **Harsh Vibration** – Bend bracket so horn is not touching sheet metal.

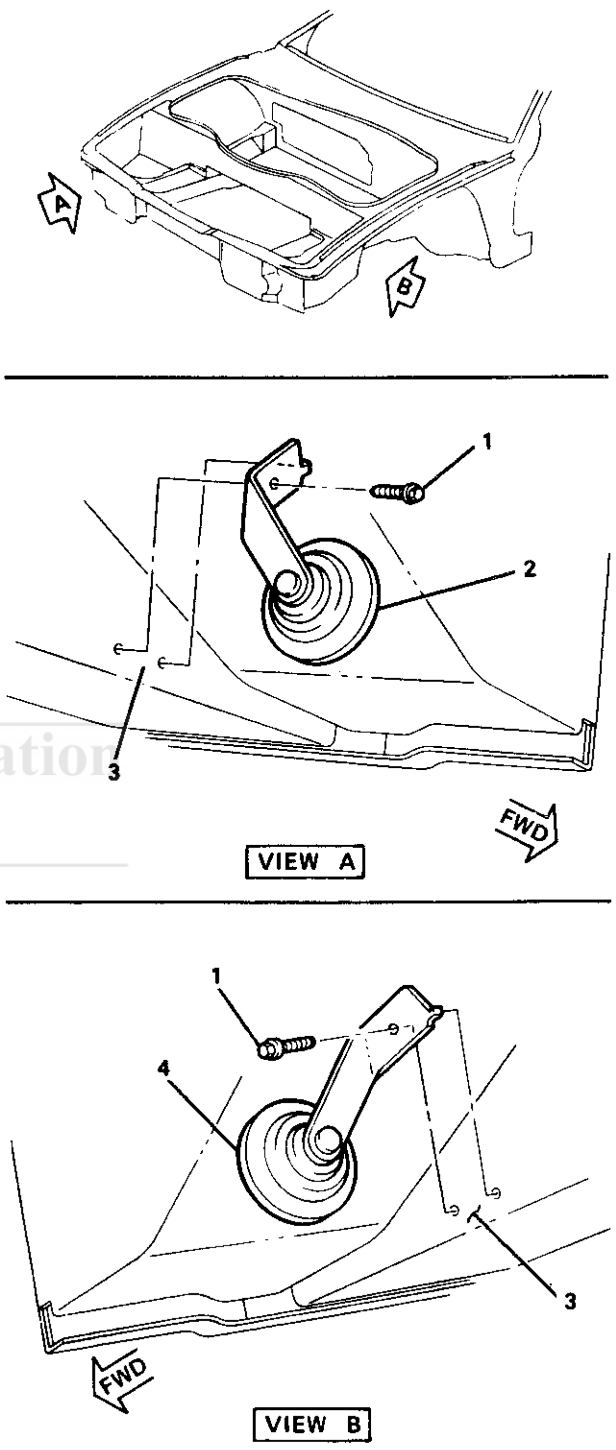


Fig. 8B-8 Horn Mounting

Current Adjustment

Current draw for a horn while operating should be 4.5 to 5.5 amperes at 11.5 to 12.5 volts. High current (more than 20 amperes) indicates an overheated winding or shorted horn; replace the horn. A current reading of about 18 amperes means the contact points are not opening; adjust the horn current (see the following).

No current reading indicates a broken connection, or an open circuit due to a broken lead or overheated horn. An overheated horn must be replaced. No current reading may also mean the contact points are open; adjust the horn (see the folowing).

Adjust

1. Increase Current – Turn adjusting screw clockwise
2. Decrease Current – Turn adjusting screw counterclockwise
3. Current adjustments should be made 1/4 turn (90°) at a time

Horn Assembly

Fig. 8B-8

The horns are mounted behind the front fascia on the front compartment rail.

Remove or Disconnect

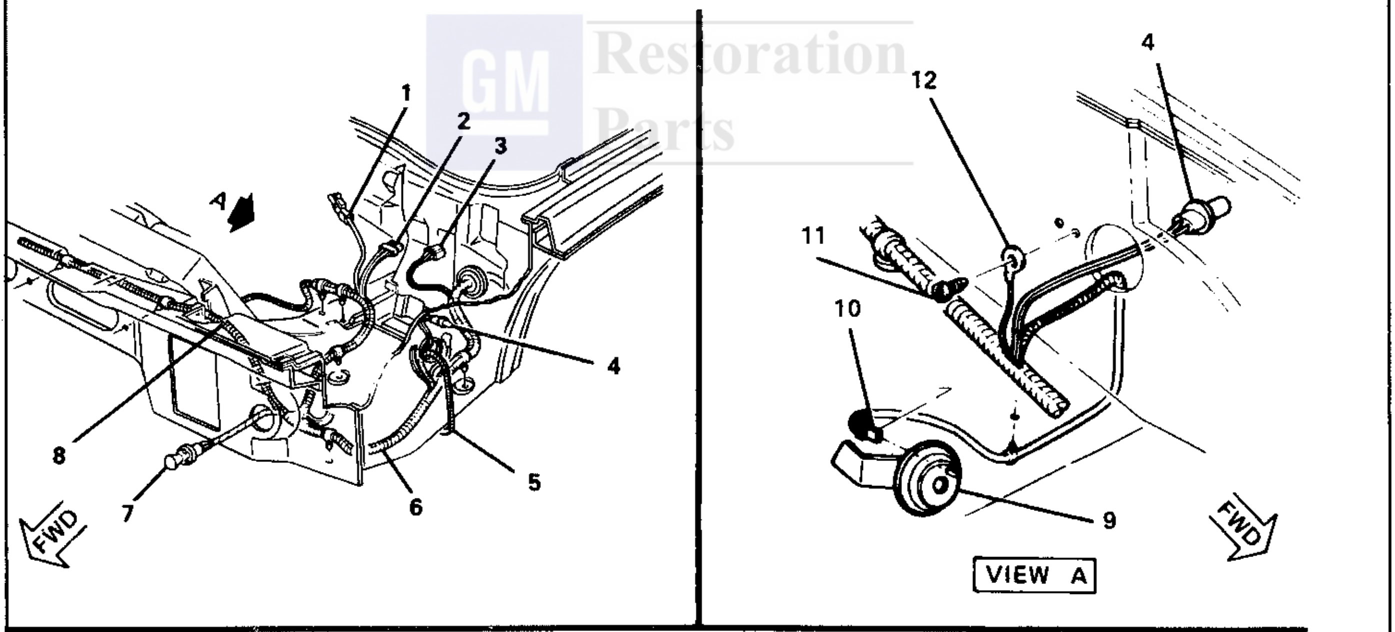
1. Electrical connector
2. Bolt

Install or Connect

1. Bolt
2. Electrical connector

Horn Relay

The horn relay is located in the convenience center on the right side of the heater or A/C module under the instrument panel. To remove the relay, pull it straight out.



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 – HORN
10 – HORN CONNECTOR
11 – SCREW
12 – GROUND

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Fig. 8B-9 Forward Light Harness

REPLACEMENT LIGHT BULBS

For exterior light replacement procedures, see the rest of this section. For interior light replacement procedures, see Section 8A and Section 8C.

EXTERIOR LIGHTS	Trade No.
Back-up Lights	1156
Front Compartment Light	168
Front Parking/Turn Signal Lights	2057
Headlights	H6054
License Plate Lights	194
Rear Compartment Light	168
Rear Tail/Stop/Turn Signal Lights	
All Except GT Models	2057
Tail/Stoplights (GT Models)	2057
Taillights Only (GT Models)	194
Turn Signals Only (GT Models)	1156
Sidemarker Lights (Front and Rear)	194

INTERIOR LIGHTS	Trade No.
Air Conditioner/Heater Controls	37
Ashtray	194
Cigarette Lighter	168
Cluster Lighting	194
Gage Pod (V-6 Engines)	161
Console Ashtray	70
Dome/Reading	906
Gear Selector Indicator	70
Headlight High-Beam Indicator	194
Indicator Lights	
"AJAR" (Deck or Door)	194
"BRAKE"	194
Charging System Warning	194
Coolant Temperature Warning	194
Fasten Seat Belts Reminder	194
Oil Pressure Warning	194
"SERVICE ENG SOON"	194
Upshift Reminder	194
Instrument Panel Courtesy Lights	168
Oil Pressure Gage (V-6 Engines)	161
Turn Signal Indicators	194
Voltmeter (V-6 Engines)	161

SECTION 8C

INSTRUMENT PANEL, GAGES & CONSOLE

CONTENTS

GENERAL DESCRIPTION

INSTRUMENT PANEL AND GAGES

The instrument panel on most cars is a single unit design and all parts attach to the main instrument panel with clips and screws. To service the instrument panel and components see On-Car Service information.

PRINTED CIRCUIT

All models are equipped with printed circuits which supply current to most instrument panel lights and instruments. These circuits are made of copper foil which is die cut and bonded to a polyester base film (usually mylar). The printed circuit electrical power is supplied by a connector containing several wires, as shown in the instrument panel wiring harness installation instructions. The connector also helps retain the printed circuit to the speedo cluster. The rest of the circuit is retained by additional connectors (if used) and snap-in bulbs/sockets. For individual printed circuit diagrams, see Section 8A-80/81/82/83, 'Instrument Panel'.

INSTRUMENTS

Instruments consist of fuel gage, temperature indicator light, generator light, oil pressure indicator light, and speedometer. See Section 9F for optional Rally Gages and tachometer. Service on instruments can be obtained through authorized repair stations. However, knowledge of instrument circuit checks will help in determining if operating difficulties lie in the instrument itself or its related circuit.

Instruments have been designed for easy removal by elimination of separate wiring. With the wiring provisions integrated with the instrument panel wiring, the instruments can be removed after removing the trim and lens.

SPEED SENSORS

There are three speed sensors currently in use:

1. PINION GEAR; used in mechanical systems
2. PHOTO SPEED SENSORS; used in mechanical systems
3. PM GENERATOR; used in electronic systems

Pinion Gear

The PINION GEAR is attached to the transmission/transaxle output shaft and rotates in proportion to the speed of the car. This rotation is transferred from the pinion gear to the speedometer head by the speedometer cable.

Photo Speed Sensor

On vehicles that use a mechanical drag-cup speedometer, the PHOTO SPEED SENSOR is inserted into the frame of the mechanical speedometer to provide an electrical feedback to the ECM that represents vehicle speed. The ECM needs to know how fast the car is traveling in order to control and operate the cruise control, cooling fan, and transmission and evaporative systems.

The photo speed sensor is made up of two special electronic devices: a Light-Emitting Diode (LED) and a photo transistor (a light-sensitive amplifying device). In the mechanical speedometer, there is a reflective blade attached to the rotating magnet that is polished to reflect light from the LED back to the photo transistor. Whenever the light strikes the photo transistor, it conducts electricity. The rate that the transistor conducts and does not conduct is proportional to the speed of the magnet, which reflects the speed of the vehicle. This voltage signal from the photo transistor is sent to a buffer amplifier (part of the speed sensor) to be conditioned to a signal the ECM can understand and use.

PM Generator

The PM (Permanent Magnet) GENERATOR is a small AC generator used to sense vehicle speed. The shaft of the generator fits into a pinion gear in the transmission/transaxle output shaft (as does the cable in a mechanical system).

When the output shaft rotates, the magnet rotates and generates a voltage. Except for the permanent magnet, the PM Generator is exactly like a miniature alternator. The PM generator is constructed to provide a voltage whose frequency is about 1.1 cycles per second for every mile per hour of vehicle speed. This signal is sent to a buffer amplifier, and then to the speedometer and the ECM.

SPEEDOMETER

The speedometer is a road speed indicator with an odometer to record total mileage, and, on some cars, a resettable trip odometer.

The major types of speedometers in use are mechanical instruments and electronic instruments. Mechanical speedometers use a dial needle to indicate road speed. Electronic speedometers include instruments that use a dial indicator and those using bar-graph LCD's (Liquid Crystal Displays) or VTF (Vacuum Tube Fluorescent) displays.

Mechanical Speedometers

A mechanical speedometer uses a cable driven (through a pinion gear) by the transmission output shaft. The cable connects to a magnetic drag-cup inside the speedometer, which rotates the speedometer needle. The end of the rotating cable causes a small bar magnet to rotate within a metal cup. As the magnet rotates within the cup, it magnetically attracts (drags) the metal cup along behind it. Two things work to prevent the cup from rotating as quickly as the magnet.

1. The distance of the magnet from the cup reduces its effect on the cup.
2. A counterspring is wound around the shaft of the cup in such a way as to oppose the normal rotation of the cup. The counterspring loads the drag-cup to give correct indication of the speed, prevent needle overshoot, and also to return the drag cup to a zero point.

Mechanical speedometers require a photo speed sensor to provide road speed information for the ECM and other systems, such as Cruise Control and the TCC (Torque Converter Clutch).

The odometer on these instruments consists of numbered wheels that are rotated by the speedometer cable through worm gears.

Quartz Speedometer

The quartz speedometer is an electrically driven instrument. The indicator needle is driven by a precision DC motor, and is countersprung to provide a mechanical load, prevent overshoot of the needle, and return the indicator to zero when the road speed is zero.

The source of speed information for a quartz speedometer is the PM generator. From the PM generator, speed information goes to the buffer amplifier to be converted to digital voltage, and then to the cluster circuitry, which interprets the speed of the vehicle and produces small voltage to apply to the speedometer motor.

The odometer on this instrument consists of numbered wheels that are electrically driven by a special precision DC motor called a stepper motor.

Digital Speedometer

Digital clusters utilize two types of displays: LCD (Liquid Crystal Display) and VTF (Vacuum Tube Fluorescent). They are used in digital speedometers and bar-graph tachometers, fuel gages, etc.

Speed information entering the cluster from the buffer amplifier is interpreted by a microcomputer which controls the speed indication, the tachometer display and the odometer reading.

The odometers associated with these instruments utilize either numbered wheels driven by a small motor or electronic displays. With an electronic display, the mileage reading is stored in a computer chip (called a non-volatile RAM chip; NVRAM) that does not become ‘erased’ when the vehicle is turned off, as the display does not retain the information.

FUEL GAGE

An electrical fuel gage is used on all models, consisting of an instrument panel gage and a fuel tank pick-up. The fuel gage indicates the quantity of fuel in tank only when ignition switch is turned to “ON” or “ACCESSORY” positions.

When ignition is turned to “OFF” or “START” positions, the pointer may come to rest at any position. The letters “E” and “F” on the fuel gage are used to point out direction of indicator travel only.

TEMPERATURE WARNING LIGHT

The engine temperature warning light is controlled by a thermal switch which senses engine coolant temperatures.

When the ignition switch is turned to “START” position, a test circuit is closed and the light will come on to indicate whether the light is functioning properly.

It is important to note that with low boiling-point coolants (such as plain water) the temperature light may not come on even though the coolant is boiling.

GENERATOR WARNING LIGHT

The generator warning light, located in the instrument cluster, should come on when the ignition switch is turned “ON” and engine is **not** running. If not, either the bulb is burned out or wiring to generator has an open circuit.

When the generator voltage output becomes greater than the battery voltage, the “GEN” light should go out. This does not, however, indicate whether the battery is being charged or if the voltage regulator is functioning properly.

Checks of the charging system are covered in Section 6D, ‘Engine Electrical’.

ENGINE OIL PRESSURE LIGHT

The engine oil pressure warning light is mounted in the instrument cluster and controlled by a pressure operated switch located on the engine block. When the ignition switch is in the “run” or “start” position, the oil pressure light should come on. If not, the bulb is burned out, there is an open circuit between the bulb and the oil pressure switch, or there is an open circuit between the oil pressure switch and the choke heater. After the engine is running, the oil pressure light should go out when the oil pressure reaches the correct specification. If not an oil pressure problem, a faulty oil pressure switch or an open circuit from the choke heater fuse to the oil pressure switch is indicated.

“SERVICE ENGINE SOON” LIGHT

All cars have a “SERVICE ENGINE SOON” light mounted in the instrument cluster. The “SERVICE ENGINE SOON” light should come on during engine starting. The light may stay on a short time after the engine starts. If the light comes on while driving, service to the emission control system may be required. See Section 6E and Section 8A-80, ‘Instrument Cluster’, for complete diagnosis and wiring diagrams of the “SERVICE ENGINE SOON” light circuit.

UPSHIFT INDICATOR LIGHT

If your vehicle has a manual transmission, there may be an “Upshift” light on the instrument panel. This light is illuminated to indicate optimum shift points throughout the range from optimum fuel economy to optimum performance. When this light is on, shift your transmission to the next higher gear range if conditions permit. For fuel economy, accelerate slowly and shift when the light goes on. For performance, accelerate as desired and shift when the light goes on.

Safe operation of the vehicle may require shifting differently than indicated by the “Upshift” light to adapt to weather, road or traffic conditions.

Downshifting one or more gears may be required to keep the engine running smoothly or to maintain satisfactory performance.

DIAGNOSIS

Diagnostic information for all instrument panel electrical systems is found in Section 8A-80, ‘Instrument Panel’.

CAUTION: When removing or installing any electrical units, disconnect the negative battery cable to prevent possible short circuits which could lead to personal injury and/or property damage.

SPEEDOMETER

When replacing a speedometer or odometer assembly, the law requires the odometer reading of the replacement unit to be set to register the same mileage as the prior odometer. If the same mileage cannot be set, the law requires that the replacement odometer be set to zero and a label be installed on the driver’s door frame to show the previous odometer reading and the date of replacement.

GENERAL DESCRIPTION

INSTRUMENT PANEL AND GAGES

Figures 801 and 802

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 quartz speedometer utilizes an accurate clock signal supplied by a quartz crystal, along with integrated electronic circuitry to process an electrical speed 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 ignition is turned off. This is a normal condition and should not be diagnosed as a problem in the tachometer.

PM GENERATOR SPEED SENSOR

Figure 803

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.

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

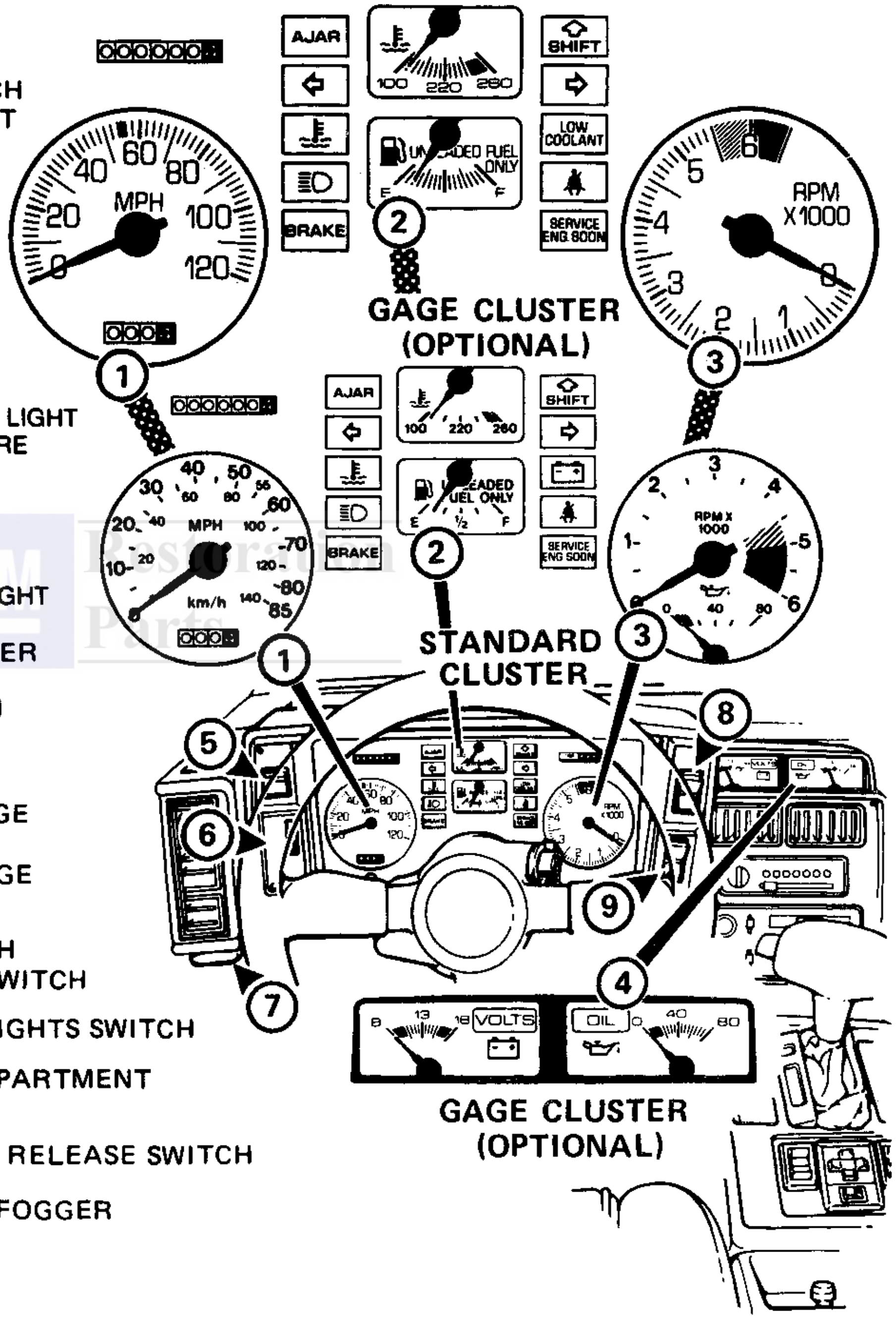

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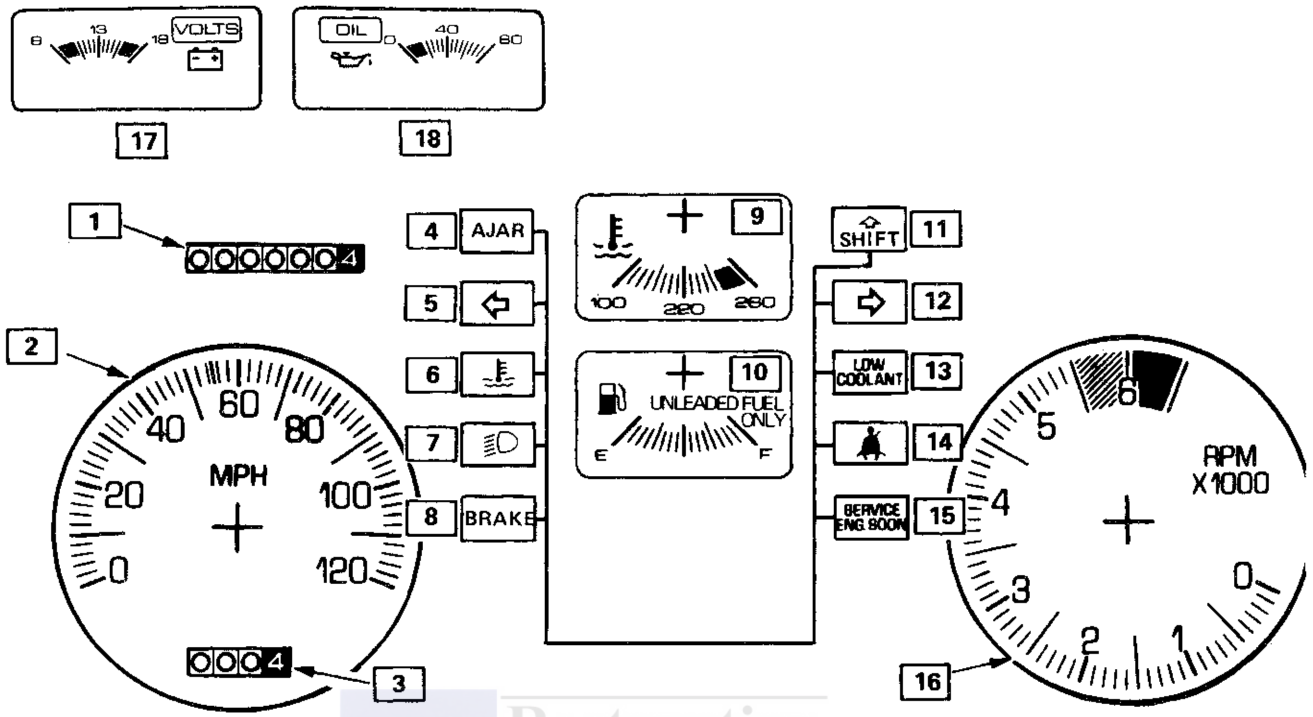
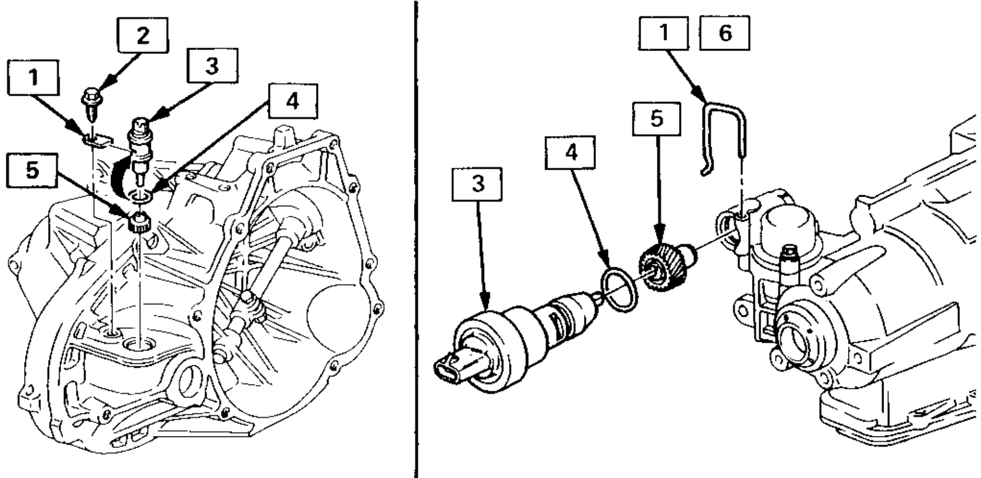
Fig. 801 Instrument Clusters



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

Fig. 2 Instrumentation



5-SPEED MANUAL

AUTO. TRANS.

1 — RETAINER
2 — 5 N·m (45 LBS. FT.)
3 — SENSOR
4 — SEAL
5 — GEAR
6 — RETAINER MUST BE SEATED ON SENSOR ASSEMBLY, NOT ON TRANS. GOVERNOR COVER

Fig. 803 Speed Sensors

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.

ON-CAR SERVICE

INSTRUMENT PANEL WIRE HARNESS

Instrument panel wire harness removal procedures are in Section 8B.

INSTRUMENT PANEL PAD ASSEMBLY

Figure 815

←→ **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. 809).
7. Front console trim plate.
8. Front console pad asm.
9. I/P to reinforcement screws.
10. I/P pad asm.

→← **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

Figure 809

←→ **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.

POWER WINDOW/MIRROR SWITCHES

Figure 808

←→ **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.

CONSOLE PAD ASSEMBLY - FRONT

Figure 812

←→ **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.

CONSOLE PAD ASSEMBLY - REAR

Figure 810

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

Figure 813

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.

RADIO AMPLIFIER

Remove or Disconnect

1. Console shift plate.
2. Console pad.
3. Carpet from retainers.
4. 4 button fasteners. Remove carpet and console side cover.
5. Screw from amplifier bracket. Disconnect amplifier connector.

Install or Connect

Reverse above steps.

INSTRUMENT PANEL CLUSTER

Figures 804 and 806

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

Figures 804 and 806

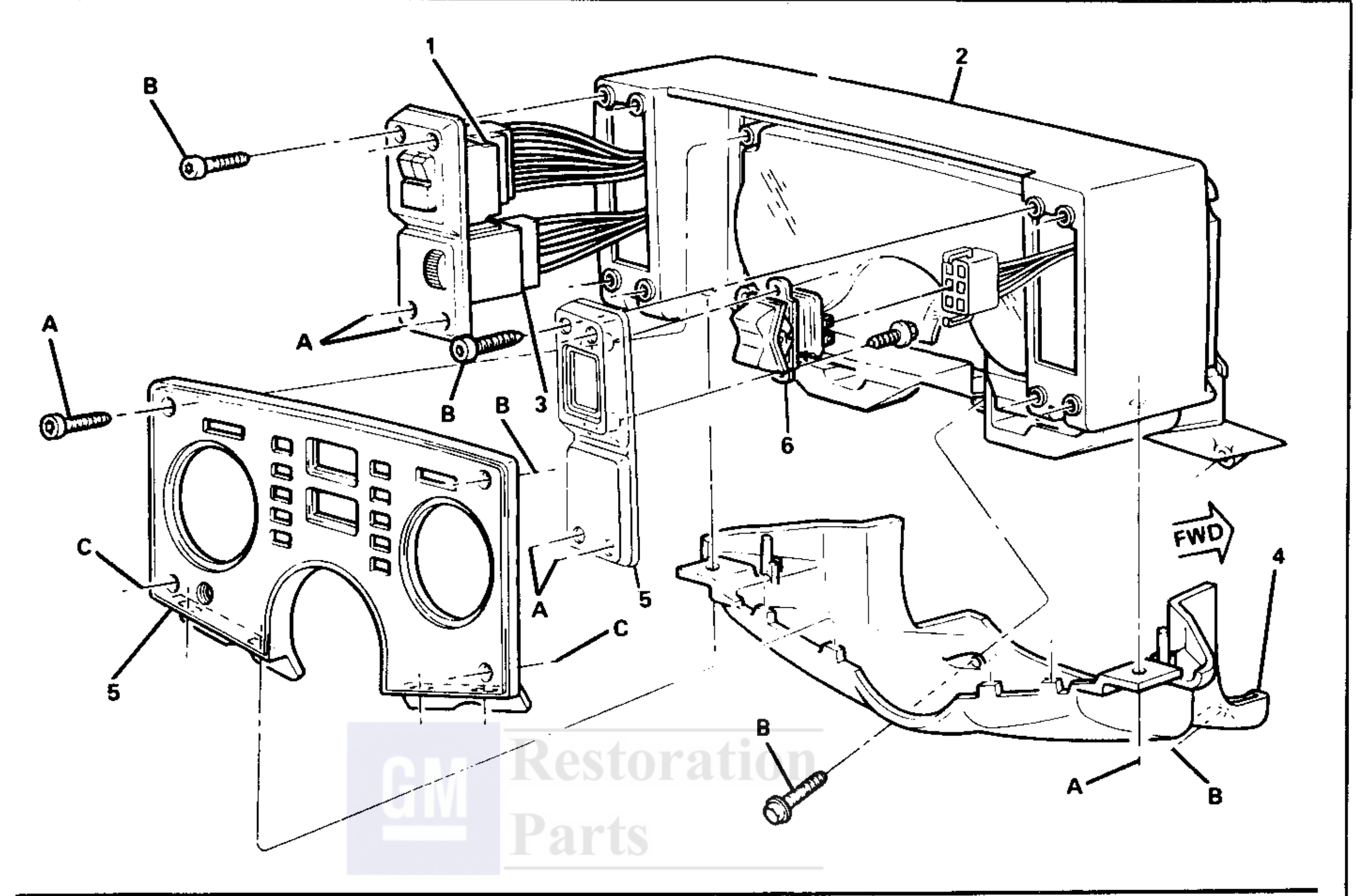
Remove or Disconnect

- 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.

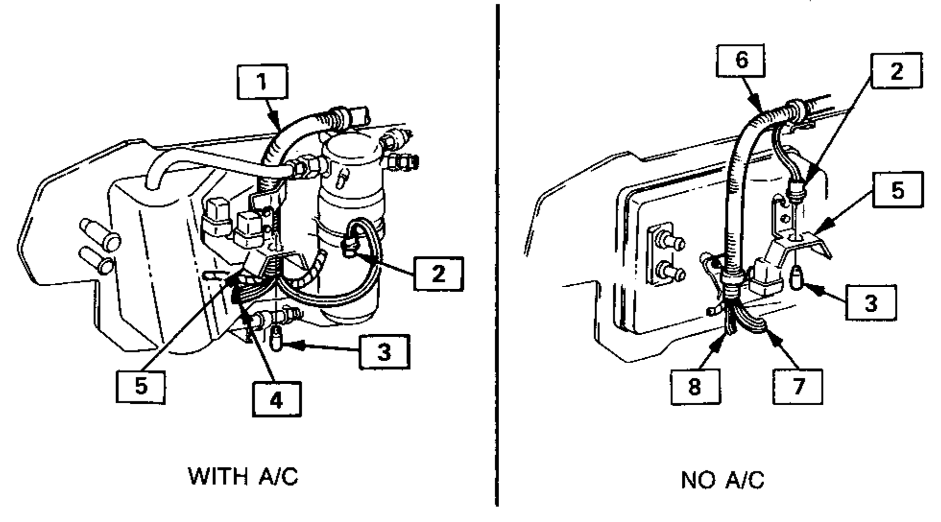


1 — HEADLAMP SWITCH
2 — CLUSTER PAD ASM.
3 — DIMMER SWITCH
4 — COVER ASM.
5 — TRIM PLATE
6 — DECK LID SWITCH

A — INSTALL THESE BOLT/SCREWS FIRST
B — INSTALL THESE BOLT/SCREWS SECOND
C — INSTALL THESE BOLT/SCREWS LAST

H20071-8C

Fig. 804 IP Trimplates



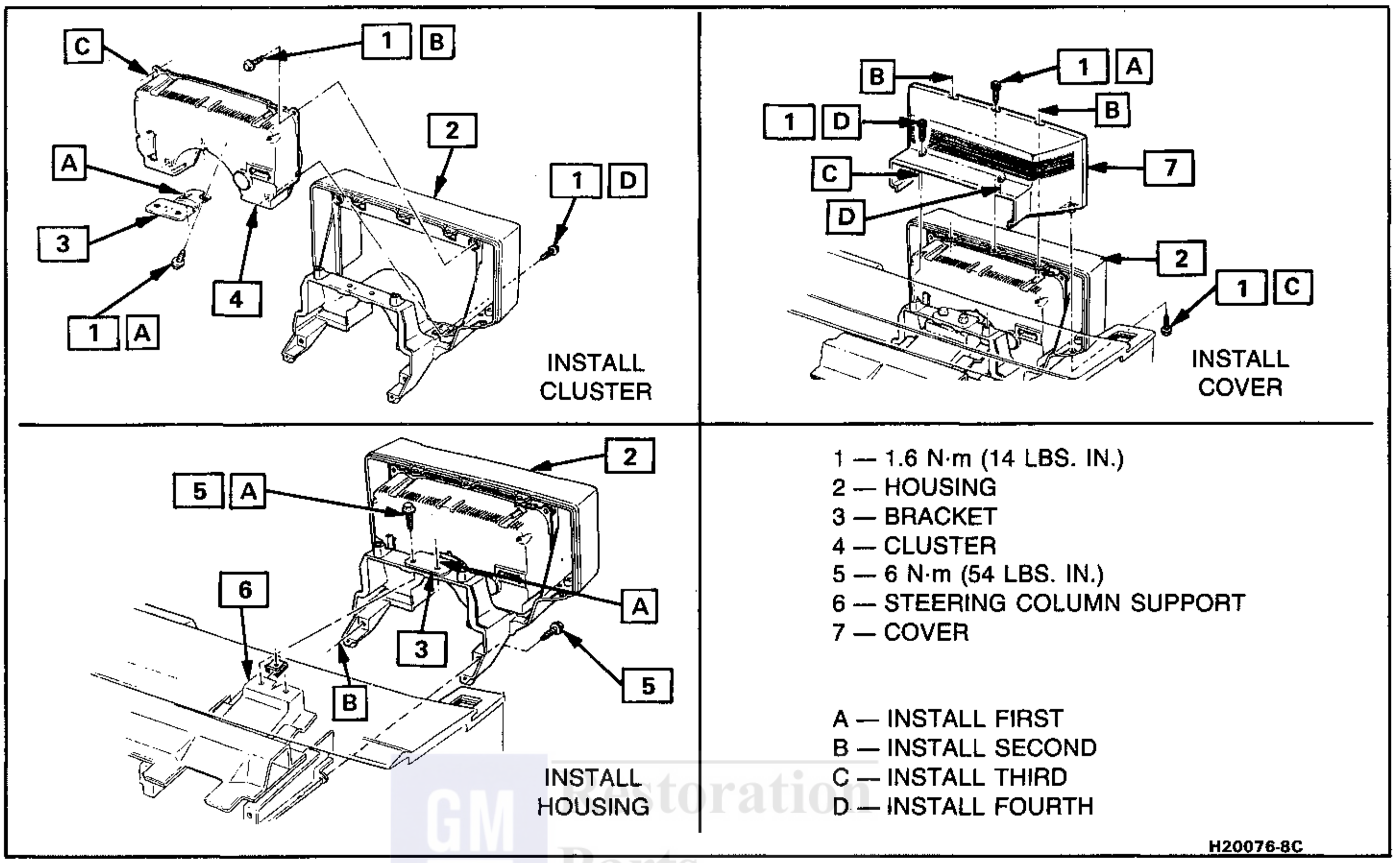
WITH A/C

NO A/C

1 — A/C WIRE ASSEMBLY
2 — LAMP SOCKET
3 — BULB
4 — TO A/C RELAYS
5 — FORWARD COURTESY LAMP HOUSING
6 — HEATER WIRE ASSEMBLY
7 — TO HEATER RELAY
8 — TO HEATER BLOWER RESISTOR

H20077-8C

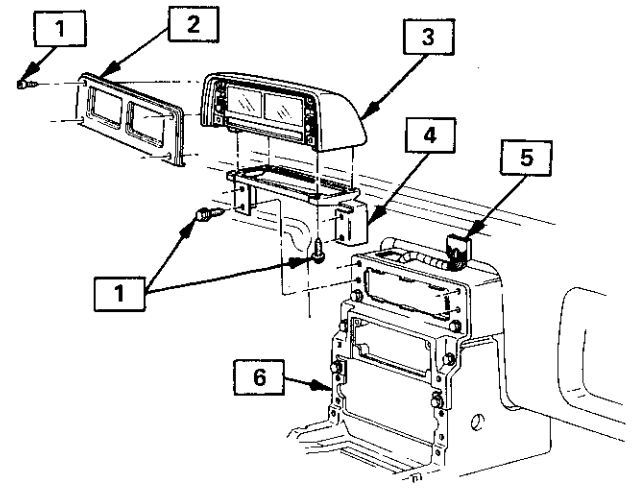
Fig. 805 Courtesy Lamps



1 — 1.6 N·m (14 LBS. IN.)
2 — HOUSING
3 — BRACKET
4 — CLUSTER
5 — 6 N·m (54 LBS. IN.)
6 — STEERING COLUMN SUPPORT
7 — COVER

A — INSTALL FIRST
B — INSTALL SECOND
C — INSTALL THIRD
D — INSTALL FOURTH

Fig. 806 IP Cover/Housing/Cluster



1 — 1.6 N·m (14 LBS. IN.)
2 — TRIM PLATE
3 — CLUSTER & HOUSING ASSEMBLY
4 — SUPPORT BRACKET
5 — GAGE CONNECTOR
6 — SUPPORT ASSEMBLY

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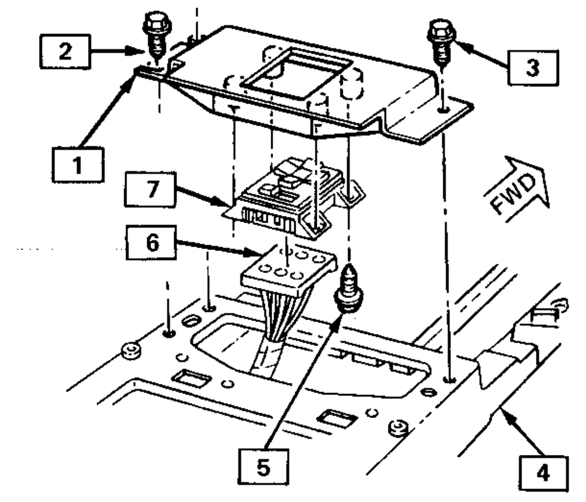
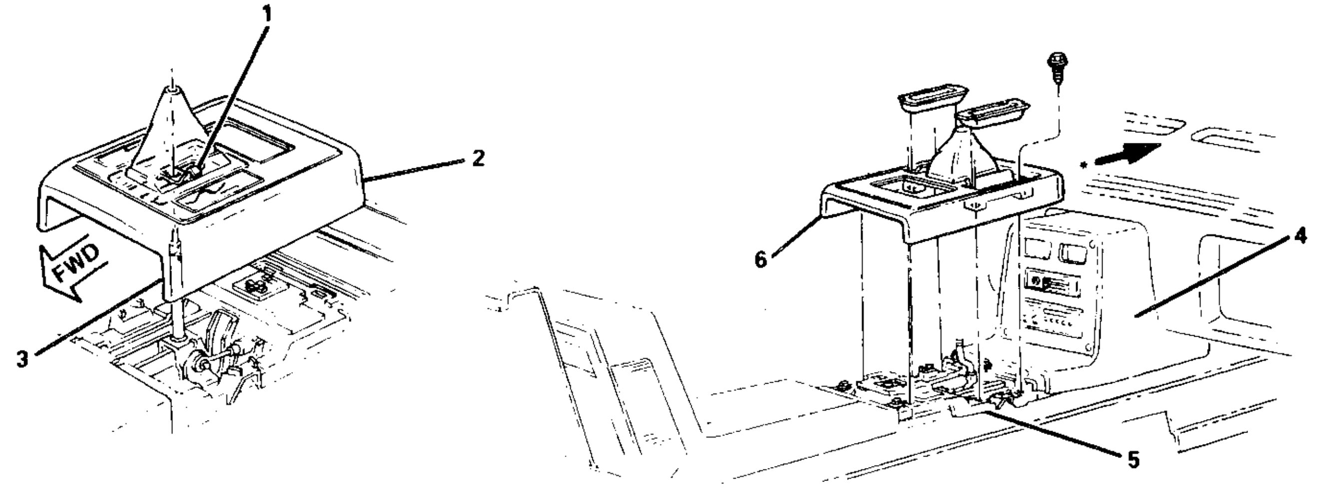
Fig. 807 Gage Cluster/Housing/Trimplate - V6



1 — TRIM PLATE
2 — 1.6 N·m (14 LBS. IN.); INSTALL FIRST
3 — 1.6 N·m (14 LBS. IN.); INSTALL SECOND
4 — SUPPORT ASSEMBLY
5 — 1.6 N·m (14 LBS. IN.)
6 — CONNECTOR
7 — POWER MIRROR SWITCH

H20072-8C

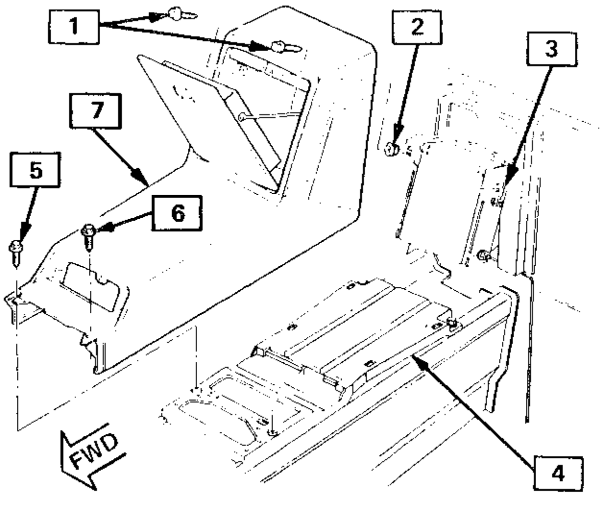
Fig. 808 Power Miror Switch & Trimplate



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

H20068-8C

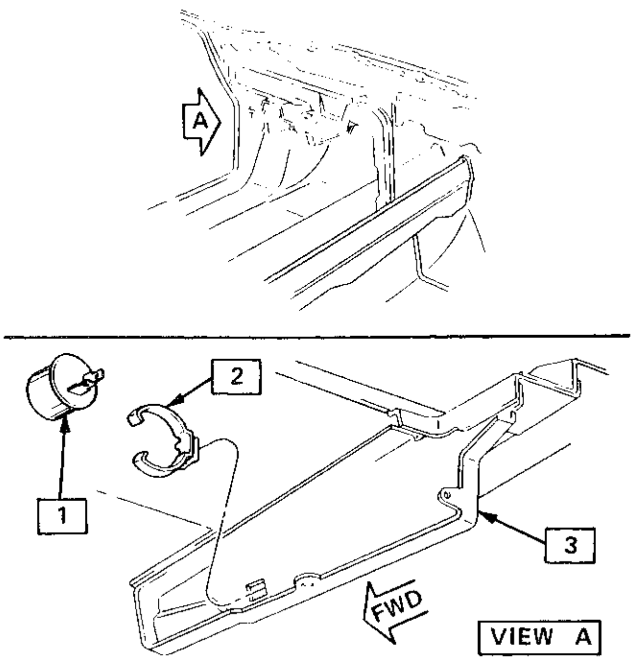
Fig. 809 Shift Plate



1 — 1.6 N·m (14 LBS. IN.); INSTALL FIRST
2 — NUT
3 — ECM BRACKET
4 — SUPPORT ASSEMBLY
5 — 1.6 N·m (14 LBS. IN.); INSTALL SECOND
6 — 1.6 N·m (14 LBS. IN.); INSTALL LAST
7 — REAR CONSOLE PAD

H20073-8C

Fig. 810 Rear Console Pad to Support



1 — FLASHER
2 — CLIP
3 — LH STEERING COLUMN SUPPORT BRACKET

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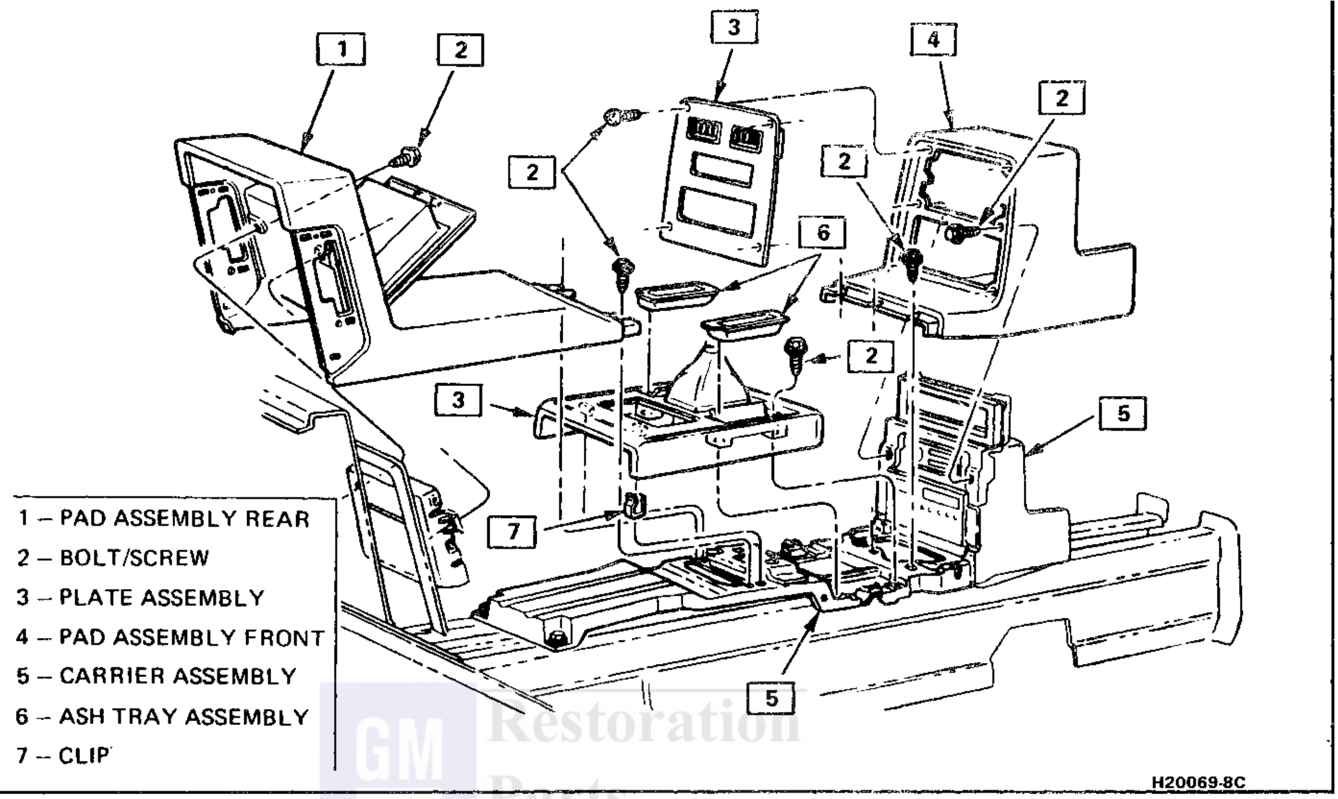
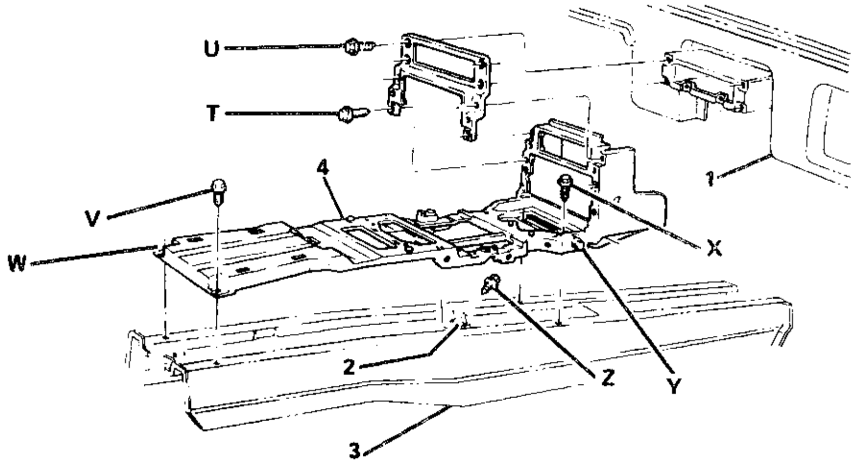
Fig. 811 Turn Signal Flasher



1 – PAD ASSEMBLY REAR
2 – BOLT/SCREW
3 – PLATE ASSEMBLY
4 – PAD ASSEMBLY FRONT
5 – CARRIER ASSEMBLY
6 – ASH TRAY ASSEMBLY
7 – CLIP

Fig. 812 Console Pad



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. 813 Console Support Assembly

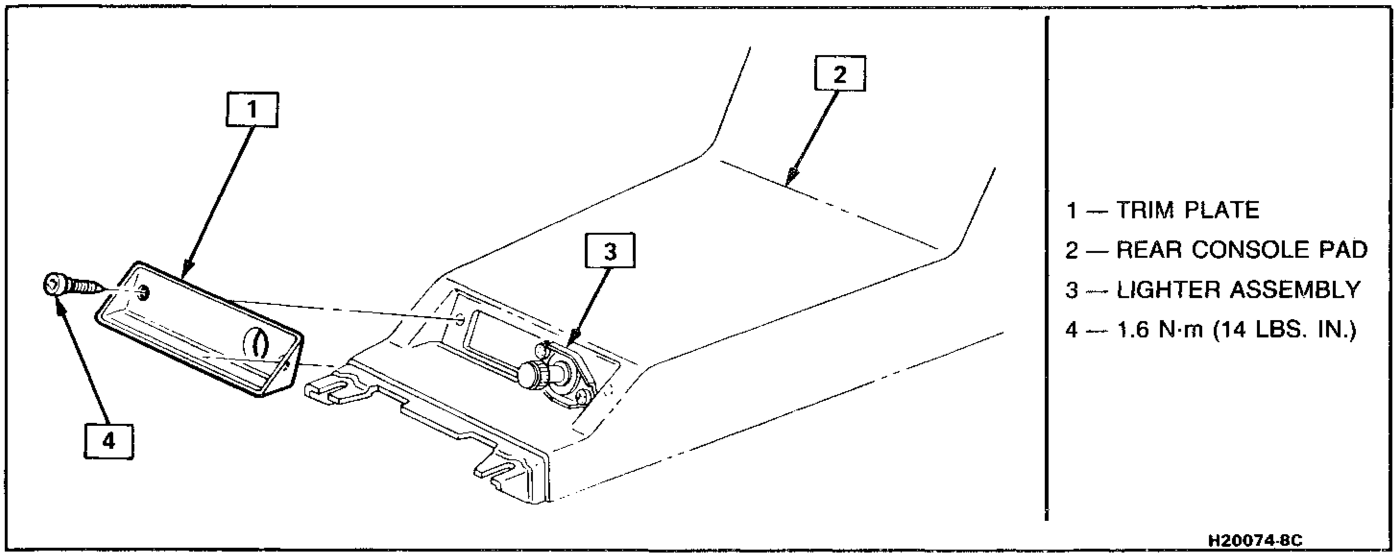


Fig. 814 Lighter Trimplate

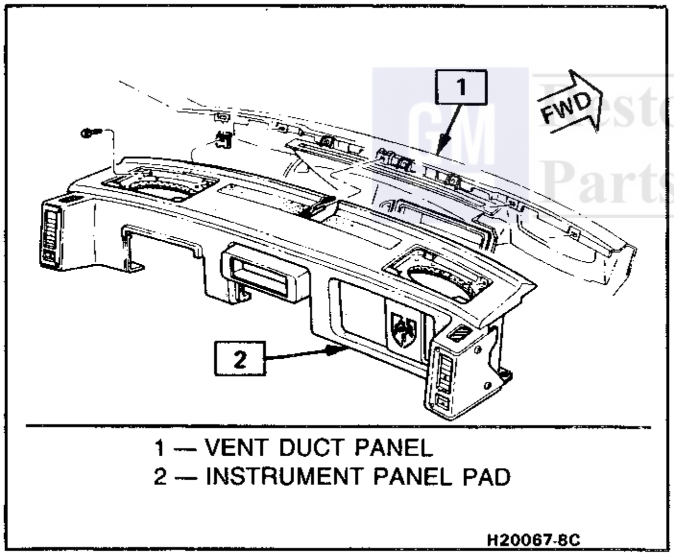


Fig. 815 IP Pad

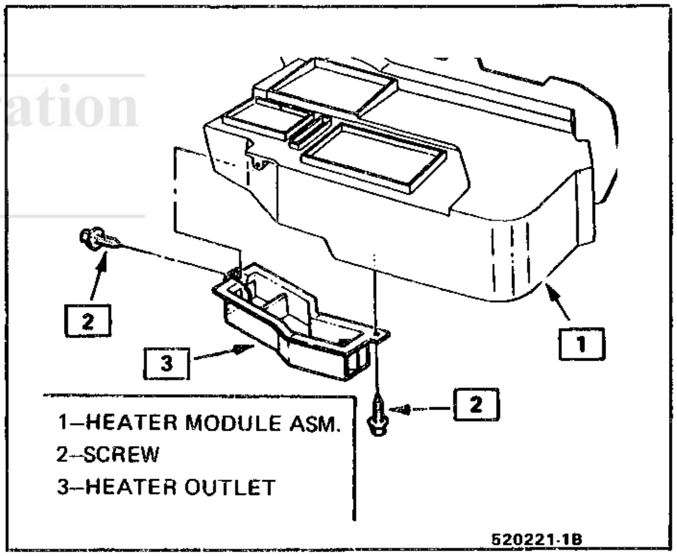


Fig. 816 Lower (Floor) Heater Outlet

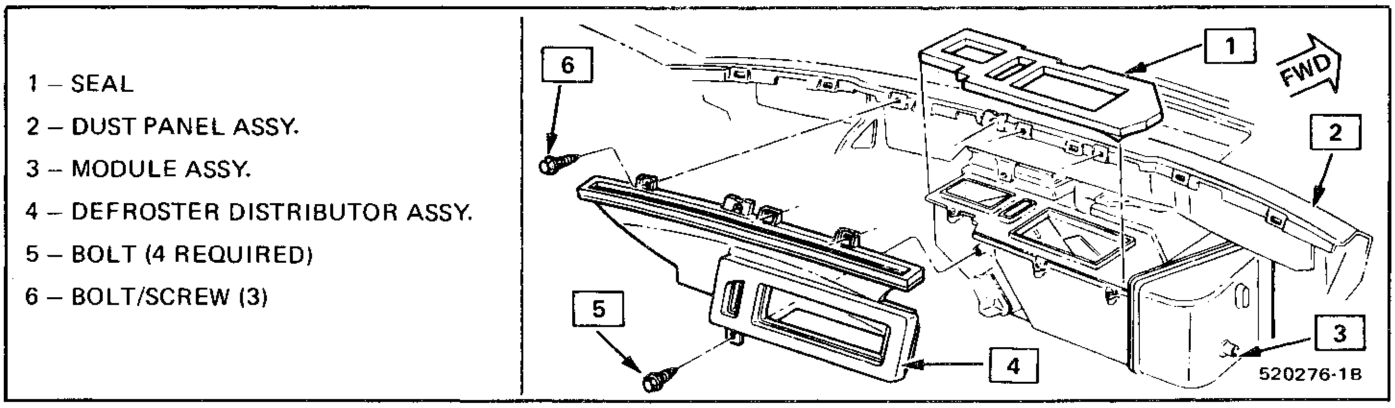


Fig. 817 Defroster Ductwork

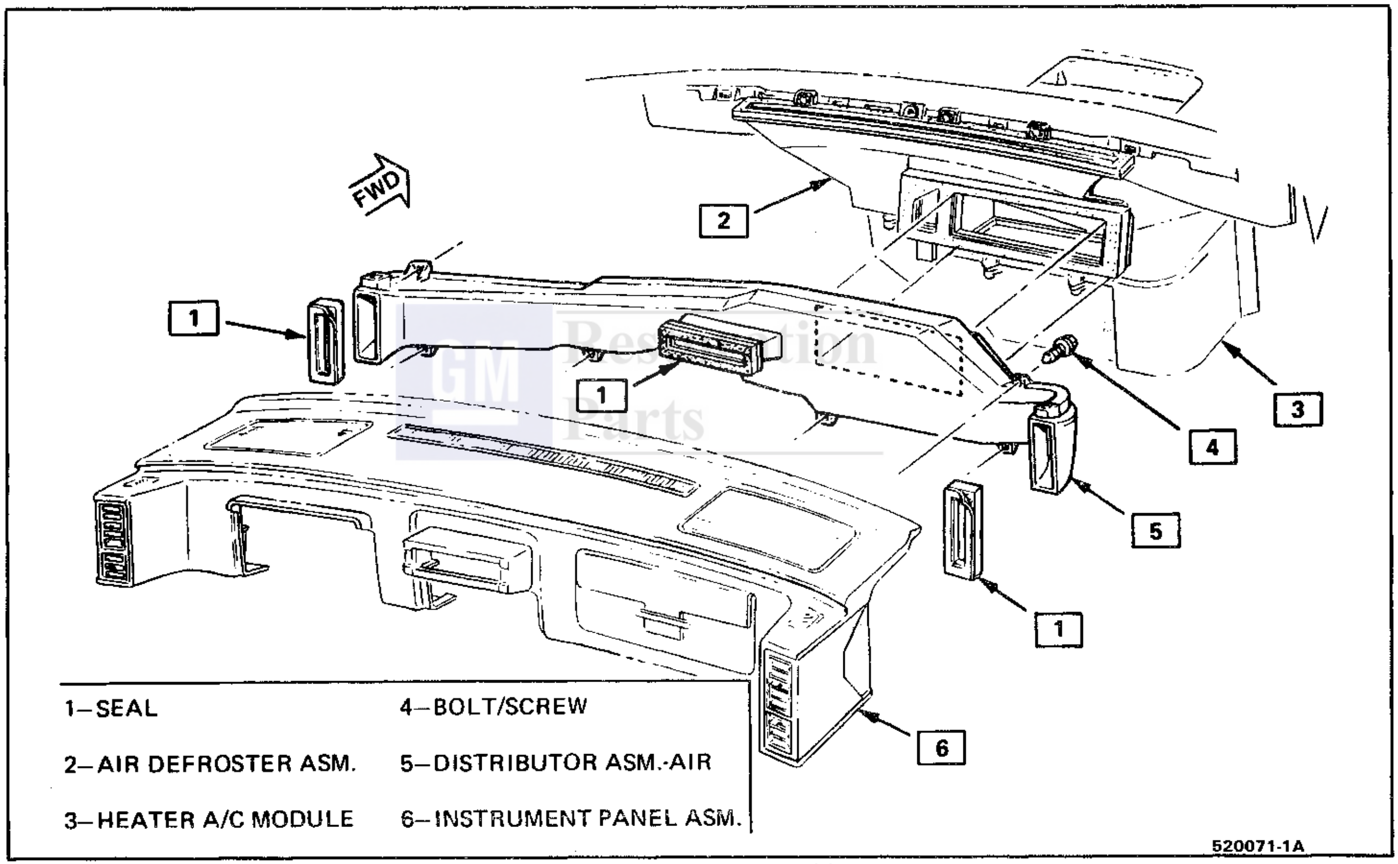


Fig. 818 IP Duct Assembly

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 consists of a permanent magnet positive park pulse wiper, a washer pump mounted in 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 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 Fig. 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.

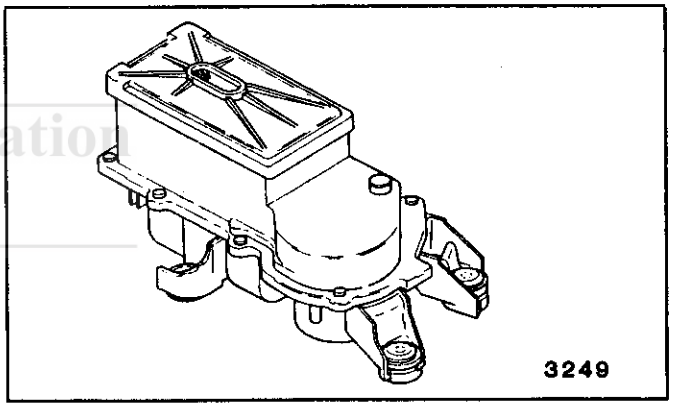


Fig. 1 Permanent Magnet Pulse Windshield Wiper Motor

As shown in Fig. 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 through terminals C and D. The armature is grounded through the common brush via the ground strap.

FLUIDIC WASHER NOZZLE

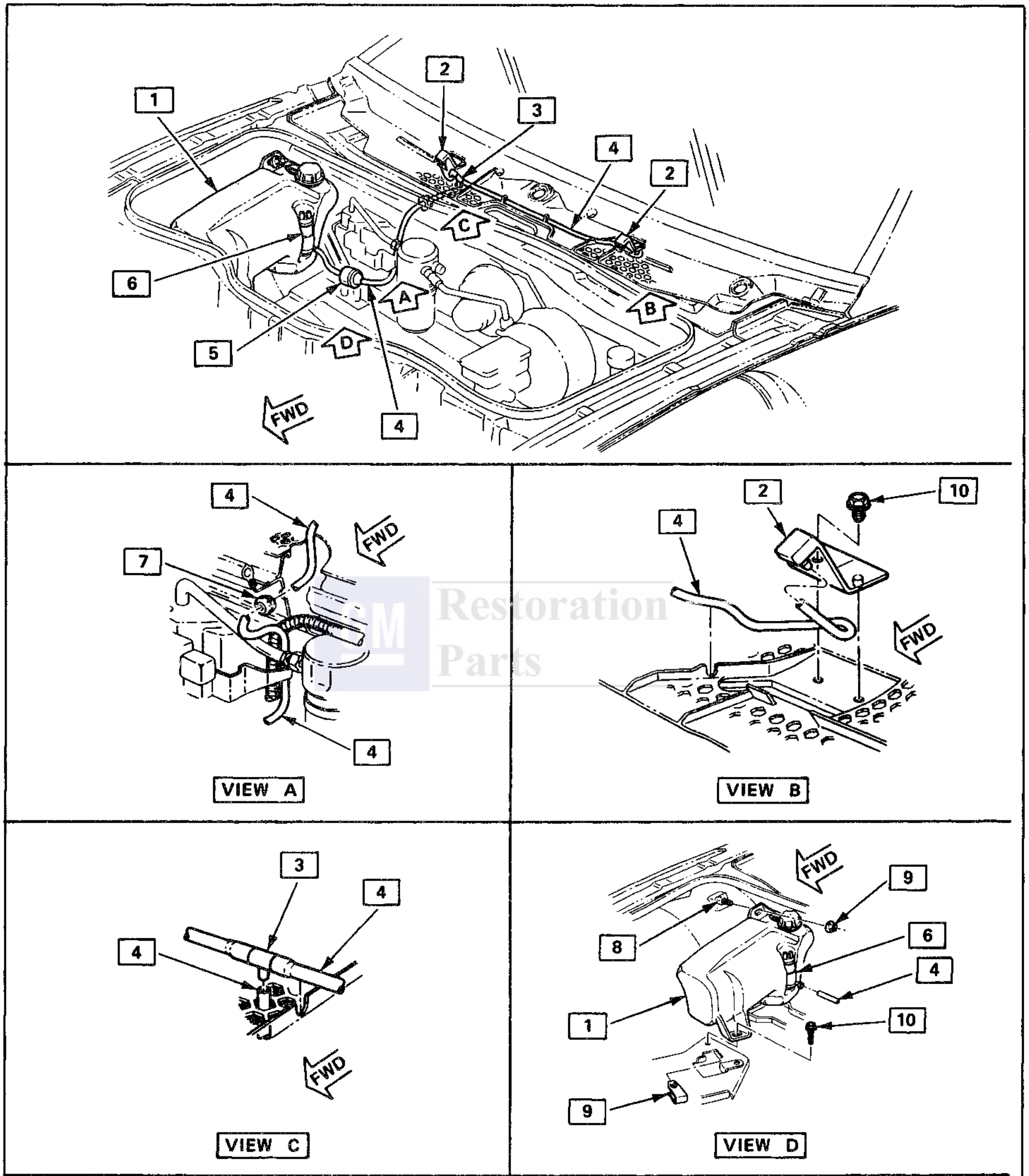
(Fig. 2)

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.



1 – CONTAINER
2 – NOZZLE
3 – CONNECTOR
4 – HOSE
5 – CHECK VALVE
6 – PUMP
7 – GROMMET
8 – STUD
9 – NUT
10 – BOLT/SCREW

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Fig. 2 Windshield Washer System Components

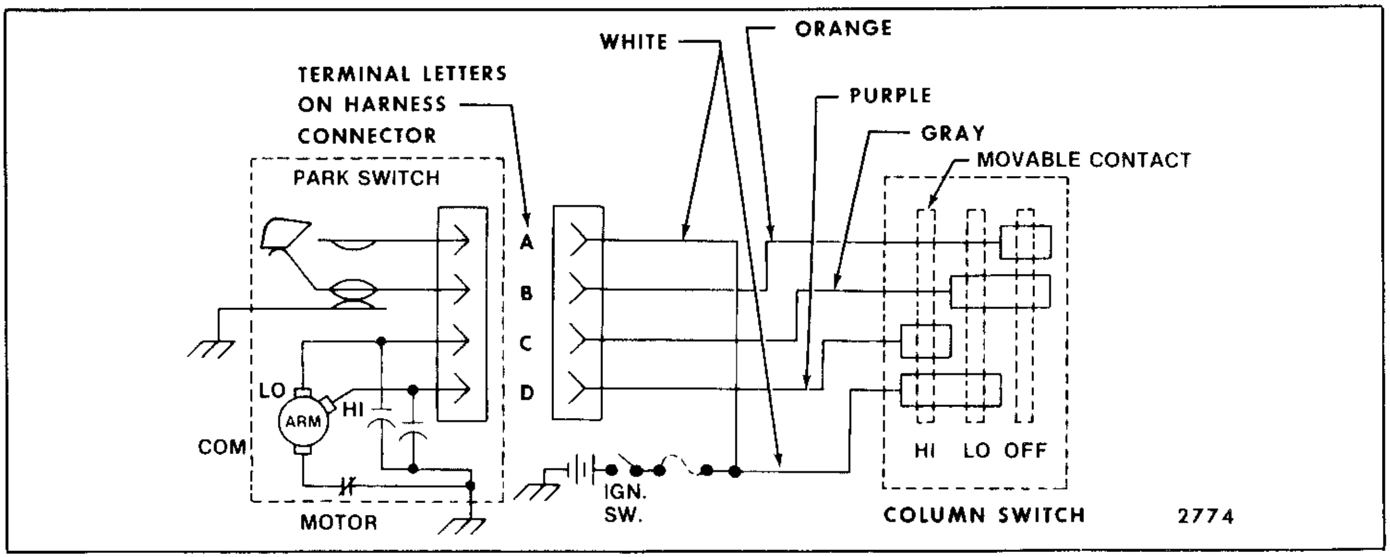

Fig. 3 Wiper Motor and Switch Circuit Diagram (Non-Pulse)

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 Fig. 4. 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 multi-function lever to the delay mode operates the motor intermittently. There are five detents, each detent is a different timed cycle. From the low poistion the cycles are 18, 10, 6, 3 and 1.25 seconds.

An instantaneous wipe can be obtained by rotating the switch to the mist position and a continuous wipe will be performed if the switch is held. A circuit diagram of the wiper is shown in Figure 5.

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.

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 in the windshield washer container. 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

Fig. 6

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

WIPER SWITCH POSITION		WASH BUTTON POSITION	
		OFF	BUTTON HELD MORE THAN .3 SECONDS
	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 18 to 1.25 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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Fig. 4 On-Car W/S Wiper-Washer System Operation (Pulse)

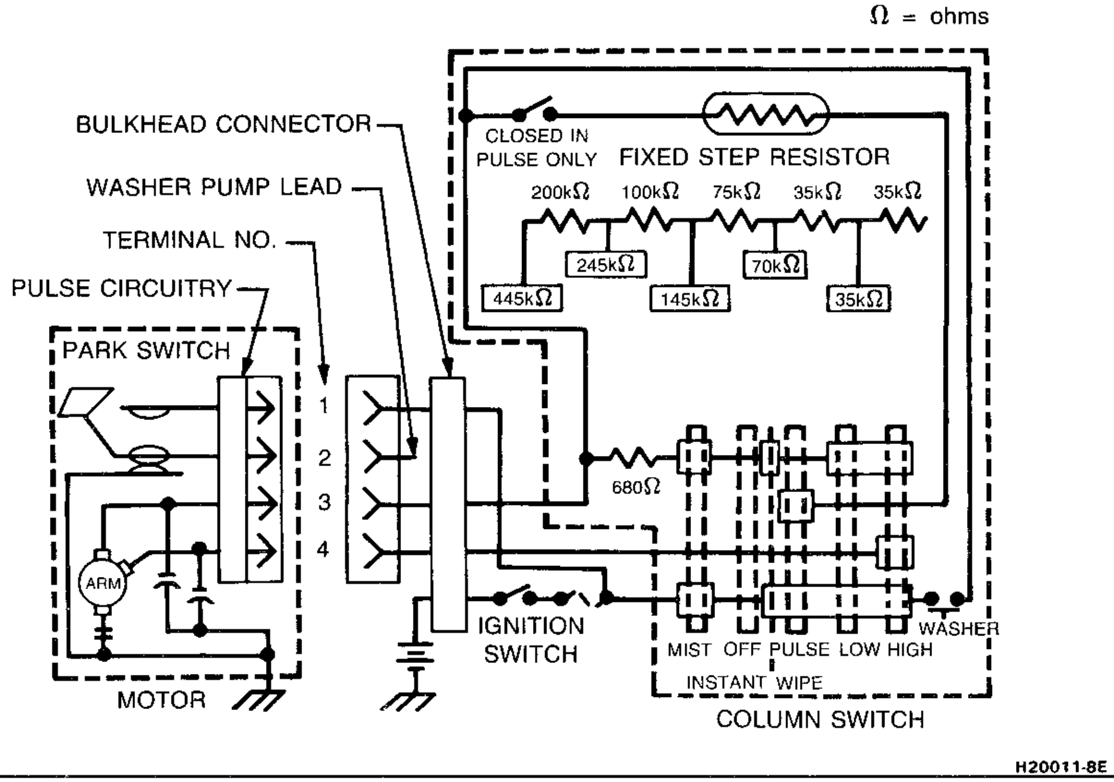


Fig. 5 Pulse Wiper Wiring Diagram

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 Multi-Function Lever Test (Fig. 7).
2. If the motor does not function in any one of the above checks, see Wiper and Washer Motor Mechanical Diagnostic chart (Fig. 8).

WASHER PUMP

Check for washer pump operation before removing from vehicle. Remove connector and apply B(+) to #2 wiring harness terminal (Fig. 9).

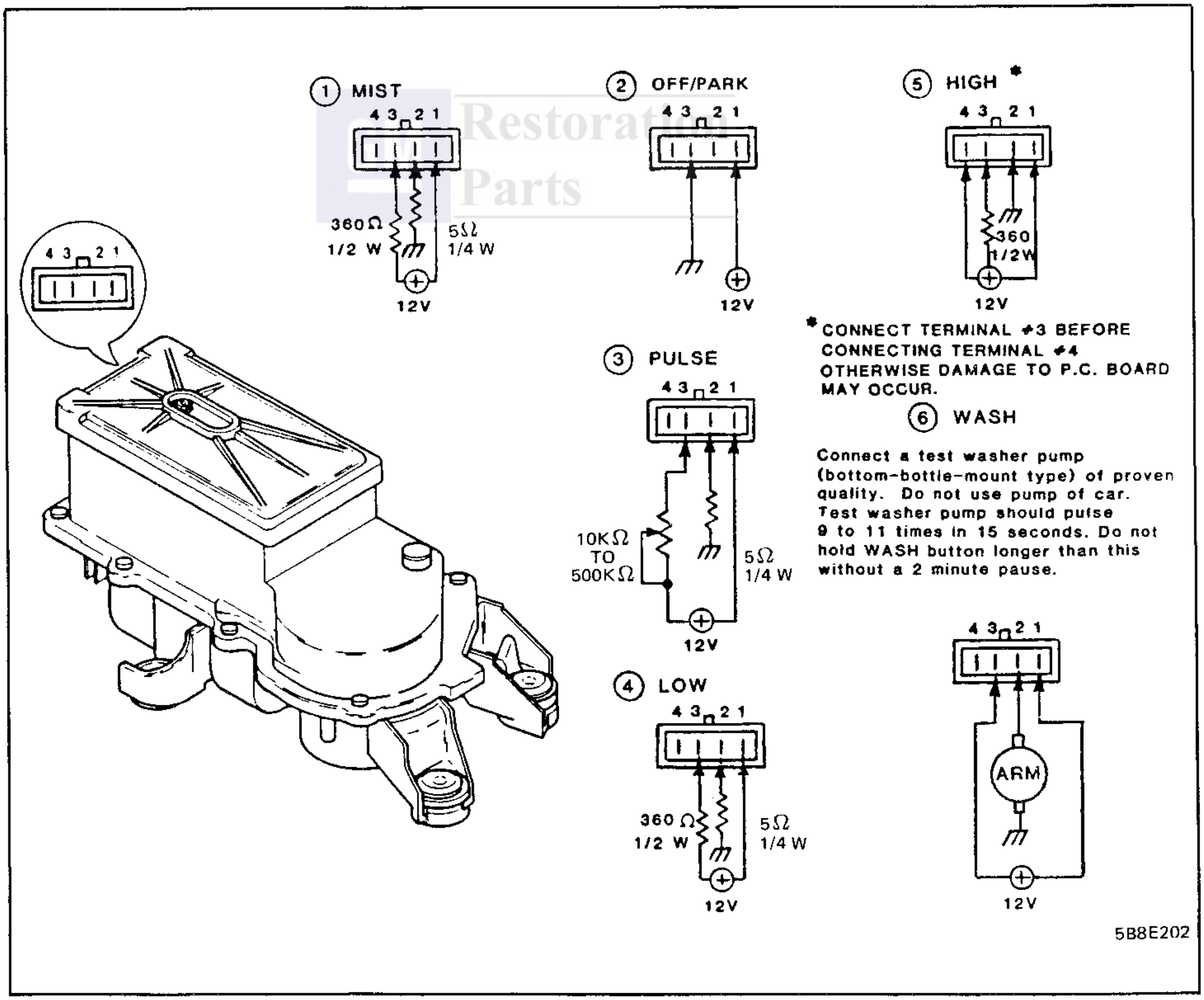
1. If motor does not run or pump water, replace washer pump.
2. If motor runs and pumps water, problem is in circuit board, motor park switch or wiper switch. (See Wiper/Washer Multi-function Lever Test, Fig. 7.)

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 (Fig. 11), 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, Fig. 8).



*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.

Fig. 6 Wiper On-Car Check

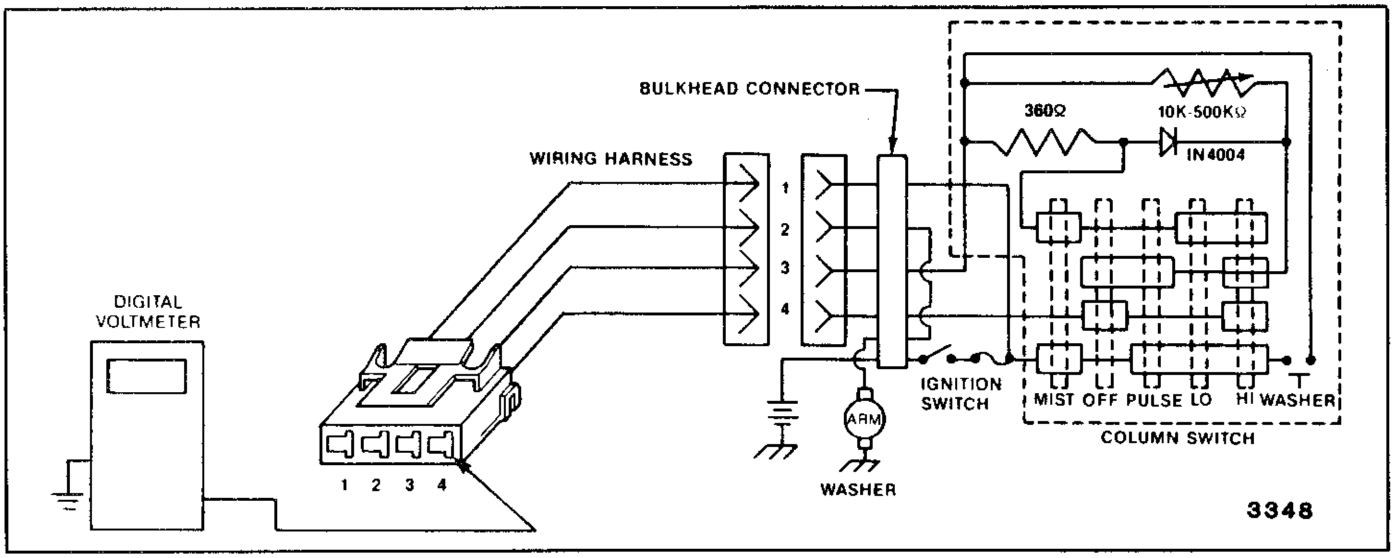


Fig. 7 Wiper and Washer Multi-function Lever Check

SYMPTOM / PROBABLE CAUSE	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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Fig. 8 Wiper and Washer Motor Mechanical Diagnostic Chart

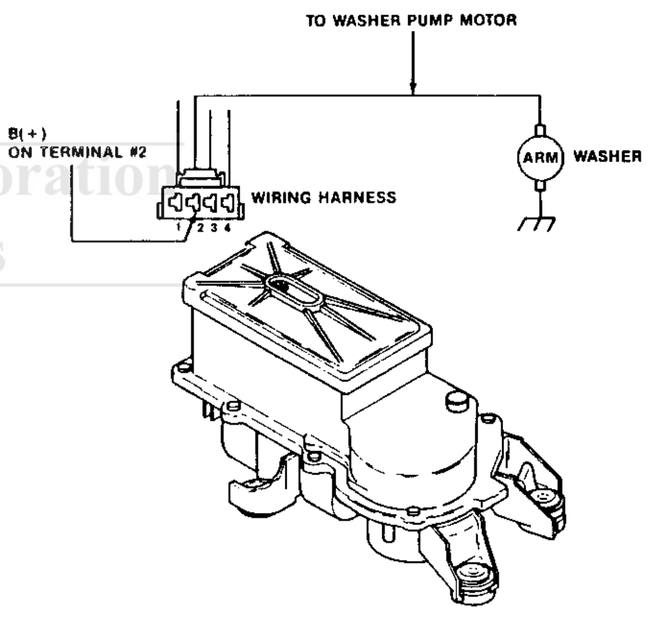

Fig. 9 Washer Pump On-car Check

Make sure the wiring harness has been checked before starting Wiper On-Car diagnostic procedures (Figs. 12 through 17).

ON-CAR/OFF-CAR SERVICE

WIPER ARM

↔ Remove or Disconnect

1. Using Tool J-8966 (or equivalent) lift arm off transmission spindle shaft (Fig. 18).
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 (Fig. 19) as near as possible to the top edge of the blackout line on the glass with the motor in park position.

Inspection

The correct blade out-wipe position is 28 mm (1-3/32") from the tip of the blade to the left windshield pillar molding (driver's side) plus 17 mm

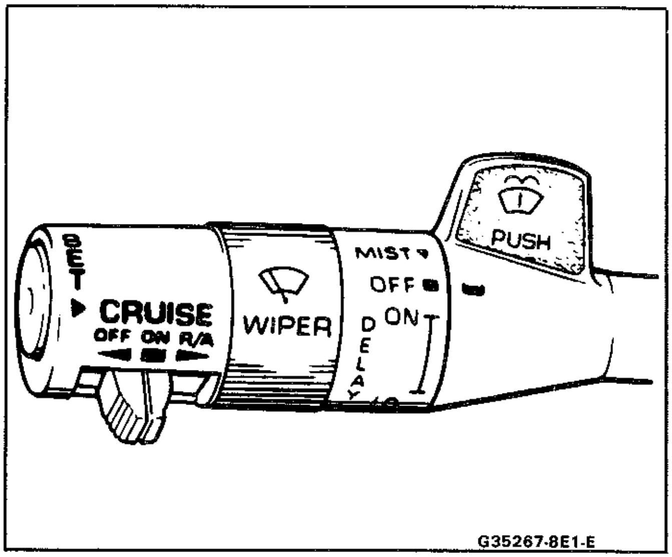

Fig. 10 Wiper/Washer Multi-Function Lever

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

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Fig. 11 Wiper and Washer Multi-function Lever Test

(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 ensure 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 (Fig. 20). 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 (Fig. 21). 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 (Fig. 22). 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 (Fig. 21). To remove element, insert and rotate a screwdriver as shown.
2. The second element (Fig. 20) 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 (Fig. 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

Fig. 23

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 7 N·m (64 lbs. in.).

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 (Fig. 23). 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 (Fig. 24).
2. Replace motor attaching screws and tighten to 5.5 N·m (48 lbs. in.).
3. Install transmission drive link to crank arm (motor in park position – refer to Fig. 25).
4. Replace shroud top vent grille and wiper arms.
5. Check operation of wiper system.

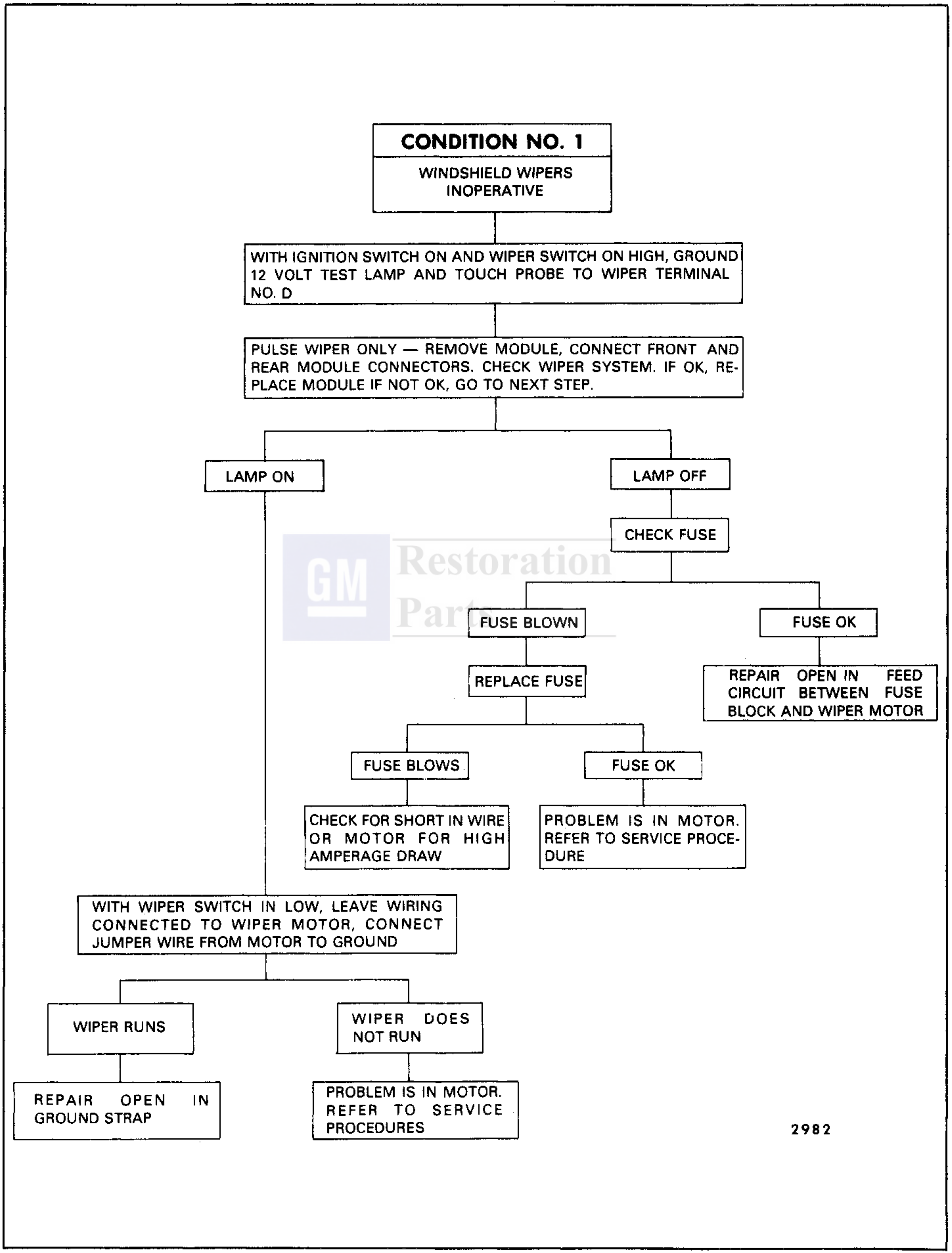
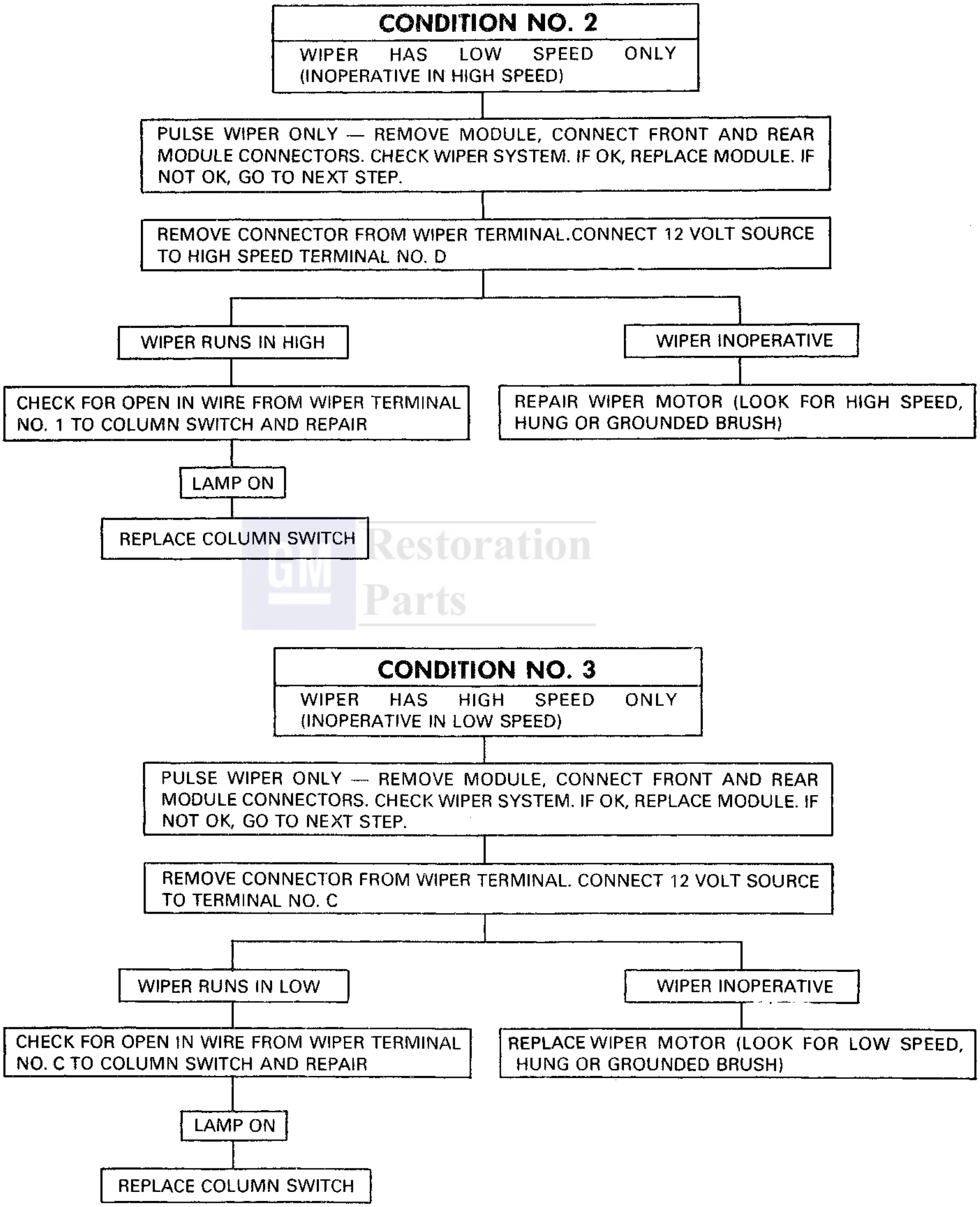


Fig. 12 Windshield Wiper Diagnosis Chart – Condition 1



CONDITION NO. 2

WIPER HAS LOW SPEED ONLY (INOPERATIVE IN HIGH SPEED)

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 HIGH SPEED TERMINAL NO. D

WIPER RUNS IN HIGH

CHECK FOR OPEN IN WIRE FROM WIPER TERMINAL NO. 1 TO COLUMN SWITCH AND REPAIR

LAMP ON

REPLACE COLUMN SWITCH

WIPER INOPERATIVE

REPAIR WIPER MOTOR (LOOK FOR HIGH SPEED, HUNG OR GROUNDED BRUSH)

CONDITION NO. 3

WIPER HAS HIGH SPEED ONLY (INOPERATIVE IN LOW SPEED)

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 TERMINAL NO. C

WIPER RUNS IN LOW

CHECK FOR OPEN IN WIRE FROM WIPER TERMINAL NO. C TO COLUMN SWITCH AND REPAIR

LAMP ON

REPLACE COLUMN SWITCH

WIPER INOPERATIVE

REPLACE WIPER MOTOR (LOOK FOR LOW SPEED, HUNG OR GROUNDED BRUSH)

Fig. 13 Windshield Wiper Diagnosis Chart – Condition 2 and 3

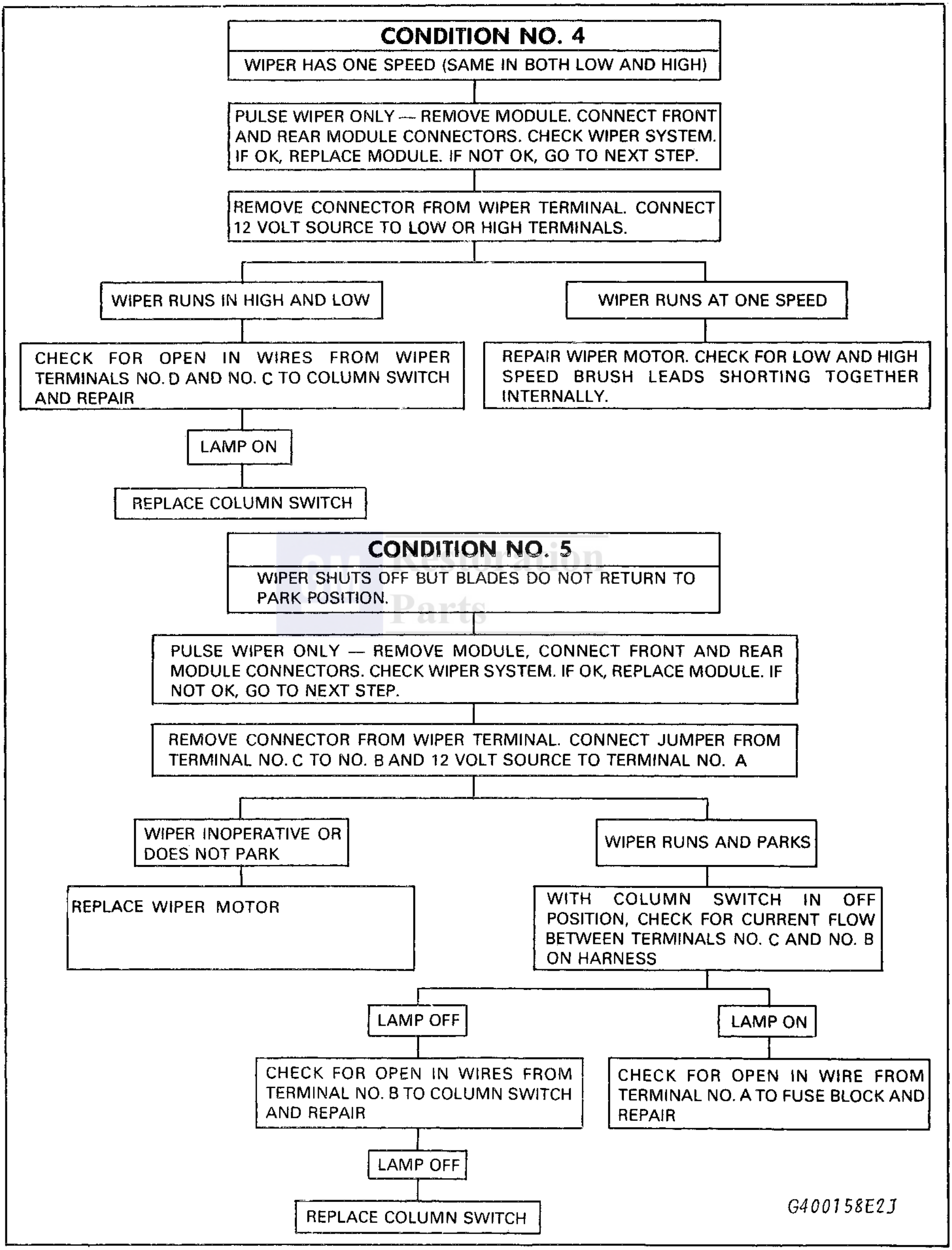
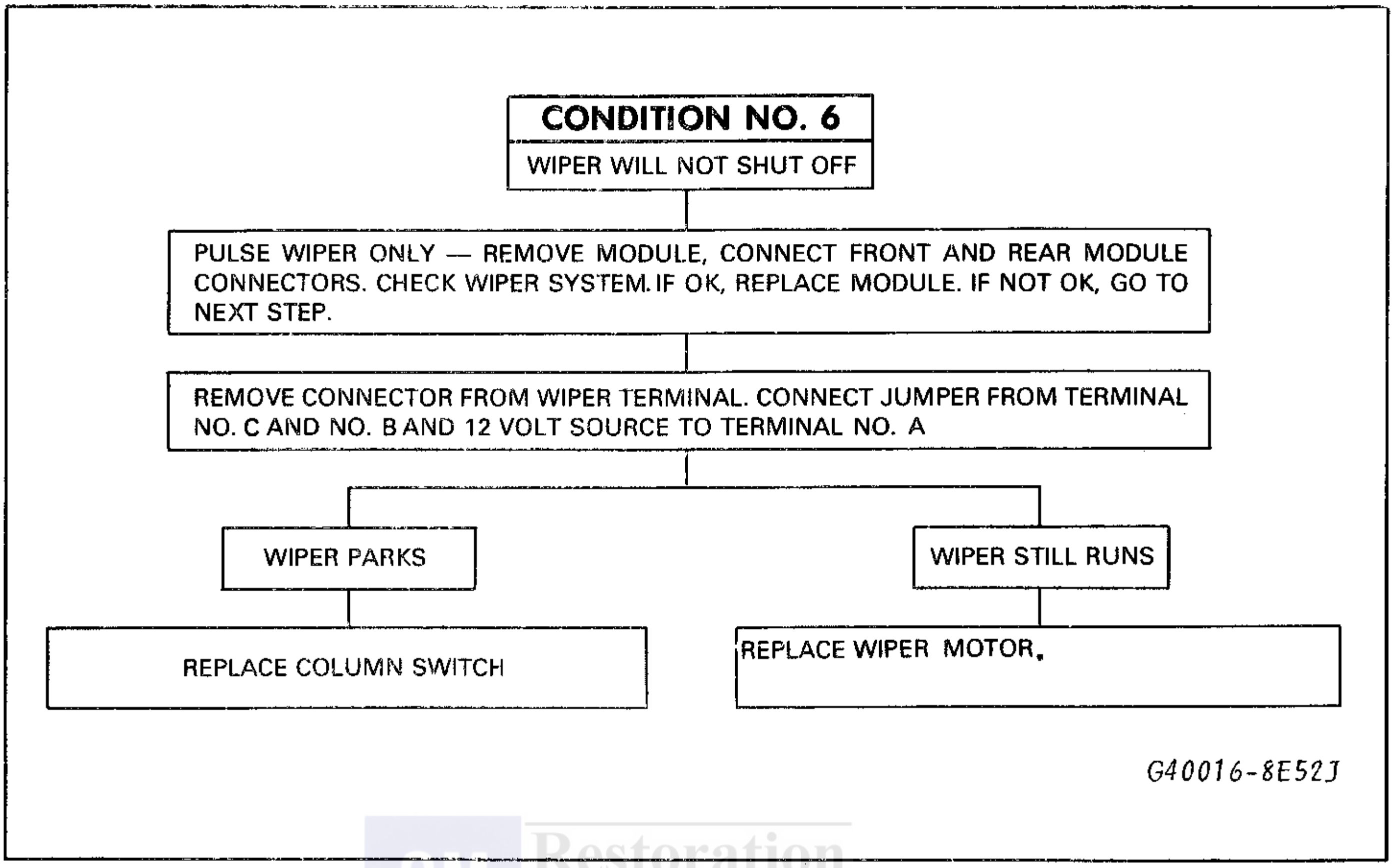


Fig. 14 Windshield Wiper Diagnosis Chart – Condition 4 and 5



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.

G40016-8E52J

Fig. 15 Windshield Wiper Diagnosis Chart – Condition 6

WIPER MOTOR COVER

Fig. 26

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.

Circuit Board Replacement

Fig. 27

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 (Fig. 27).

1. New circuit board.
2. Circuit board cover.
3. Screw.

Tighten

Screw to 2.6 N·m (23 lbs. in.).

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 42 N·m (31 lbs. ft.).

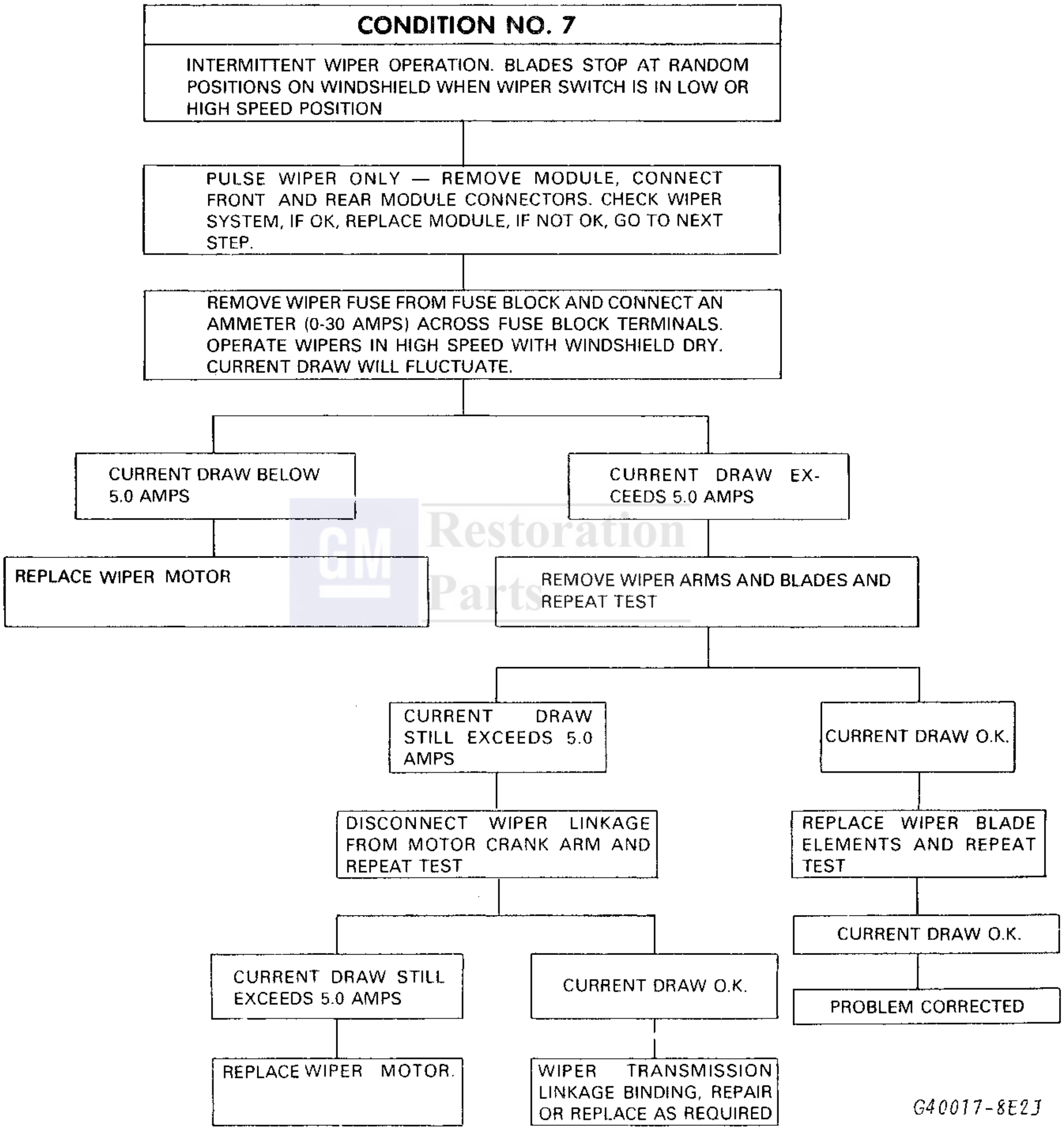


Fig. 16 Windshield Wiper Diagnosis Chart – Condition 7

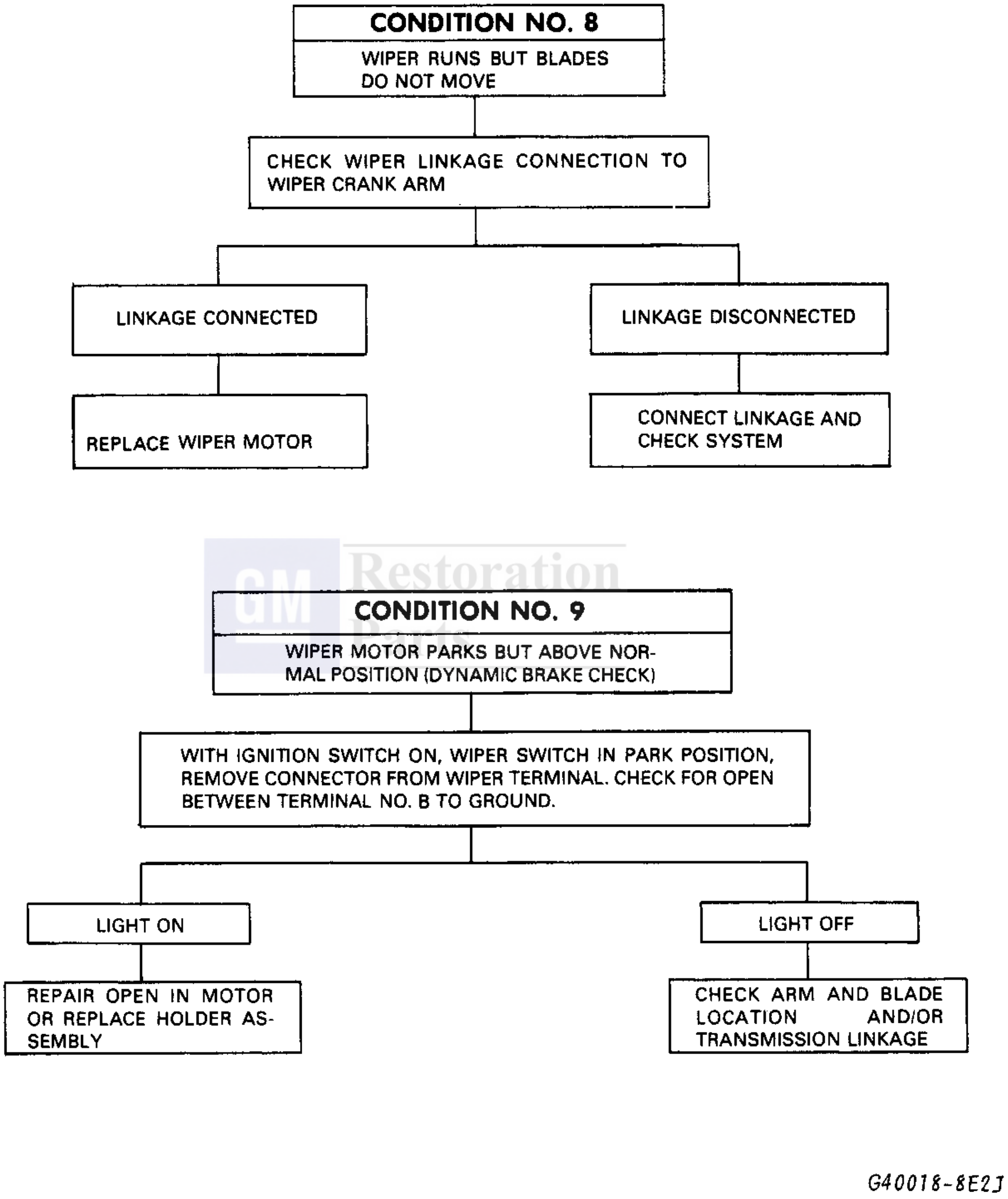


Fig. 17 Windshield Wiper Diagnosis Chart – Condition 8 and 9

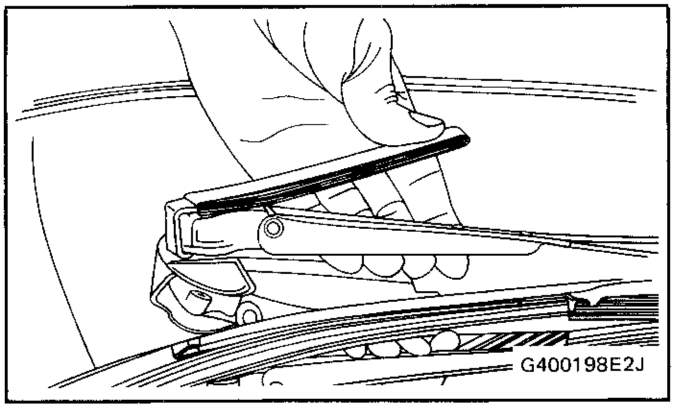


Fig. 18 Wiper Arm Removal Tool J-8966 (or equivalent)

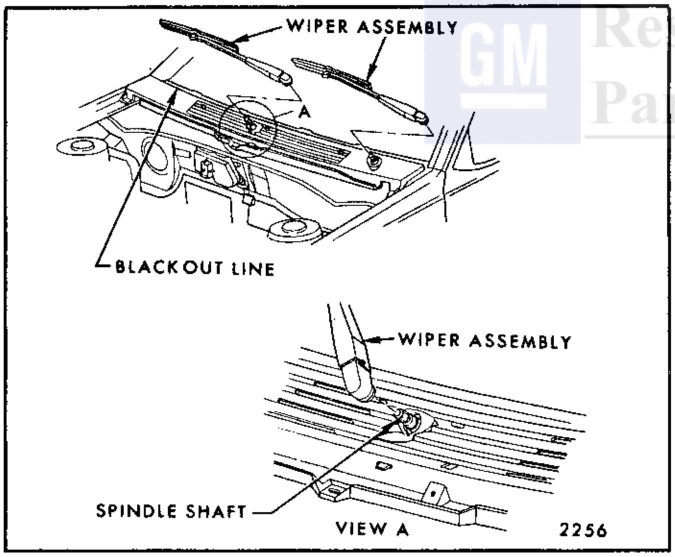
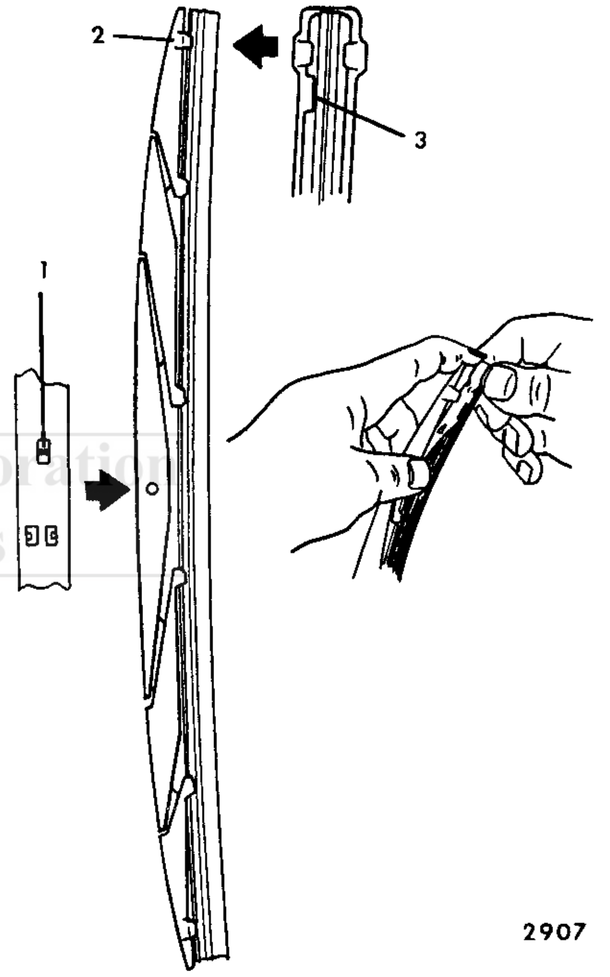


Fig. 19 Windshield Wiper Blade Arm Installation



1. BLADE RELEASE SPRING
2. HOUSING TABS
3. ELEMENT RELEASE NOTCH

Fig. 20 Blade Assembly – Type 1

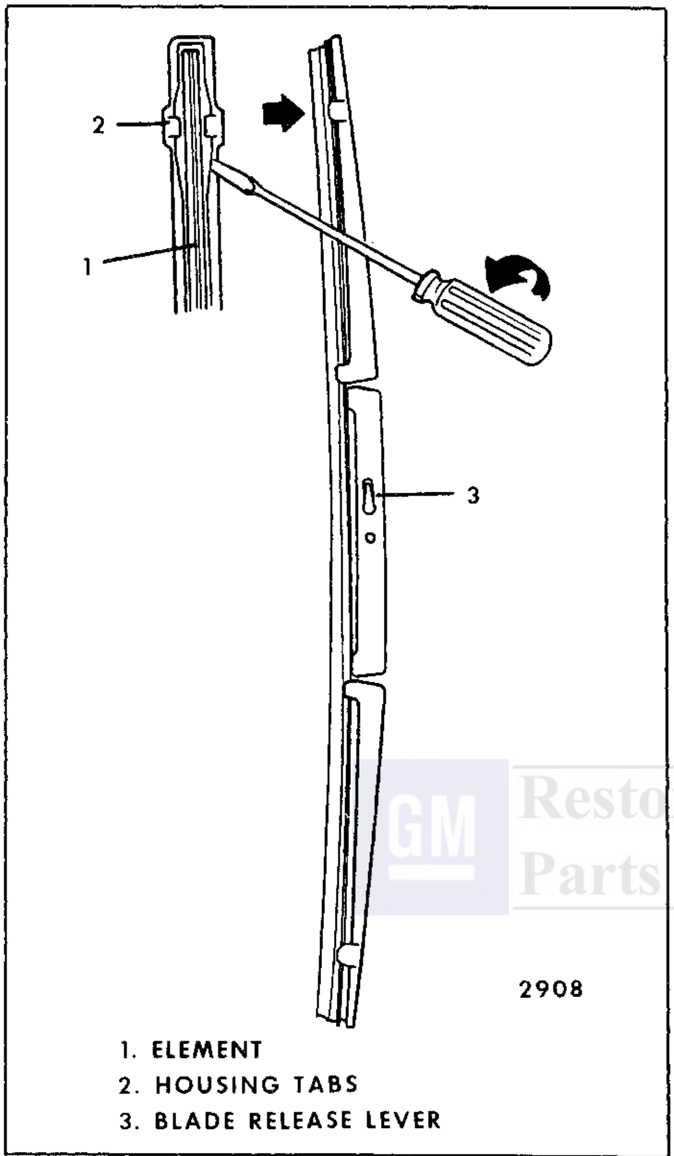


Fig. 21 Blade Assembly – Type 2

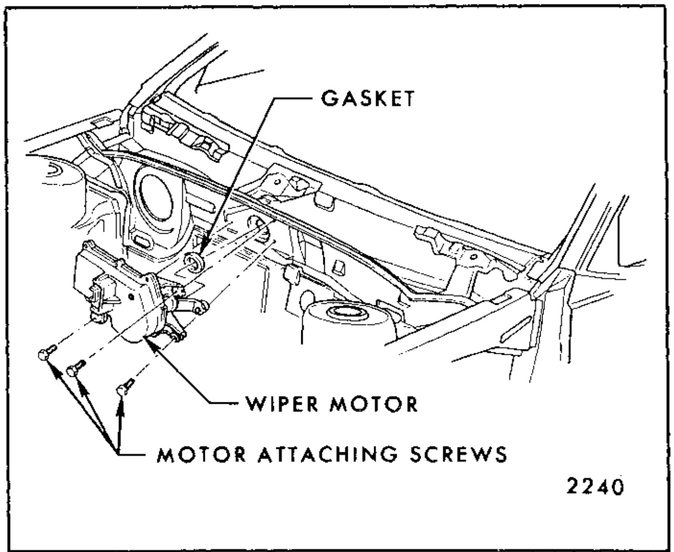


Fig. 24 Wiper Motor Installation

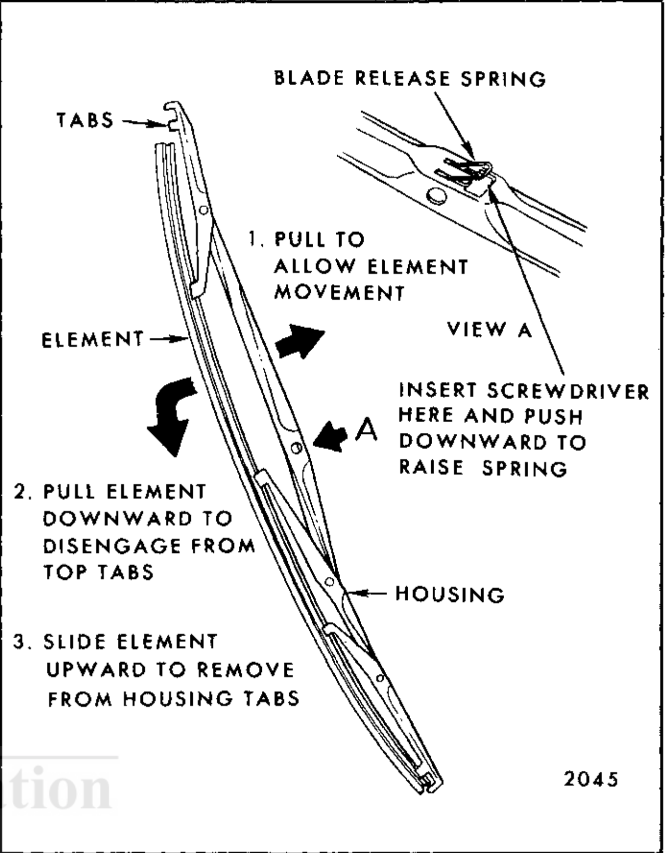


Fig. 22 Blade Assembly – Type 3

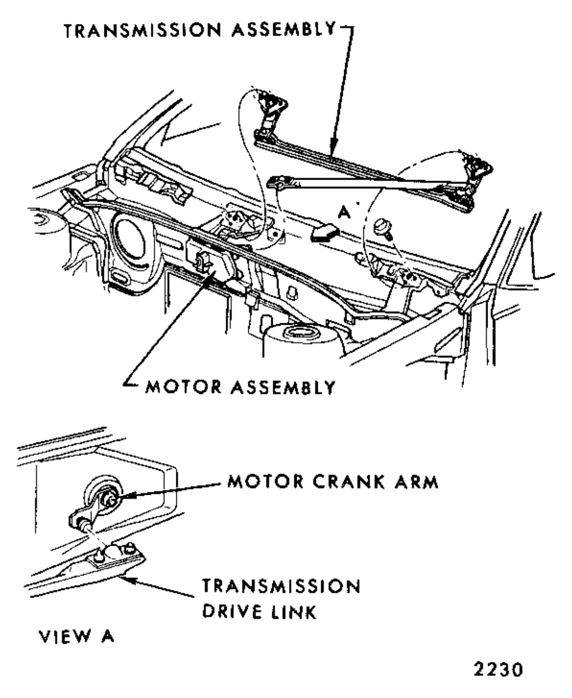


Fig. 23 Windshield Wiper Transmission Assembly

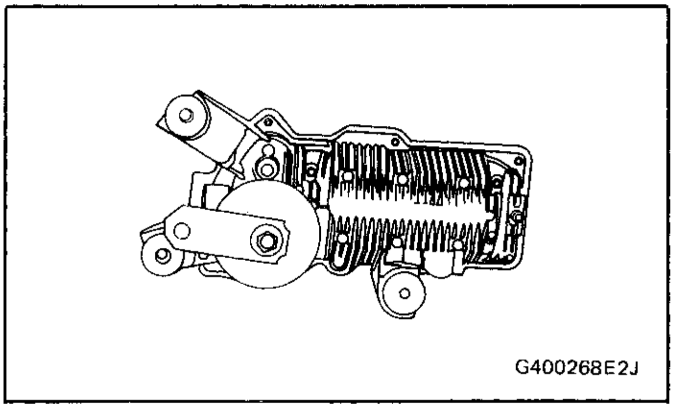
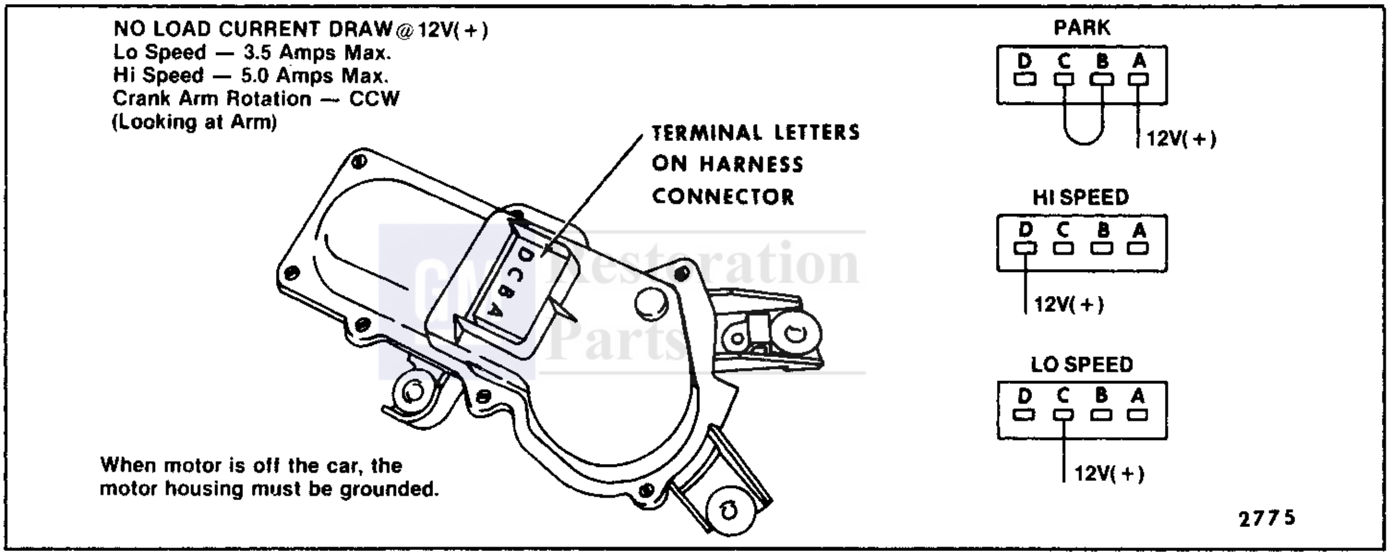


Fig. 25 Motor Crank Arm in Park Position

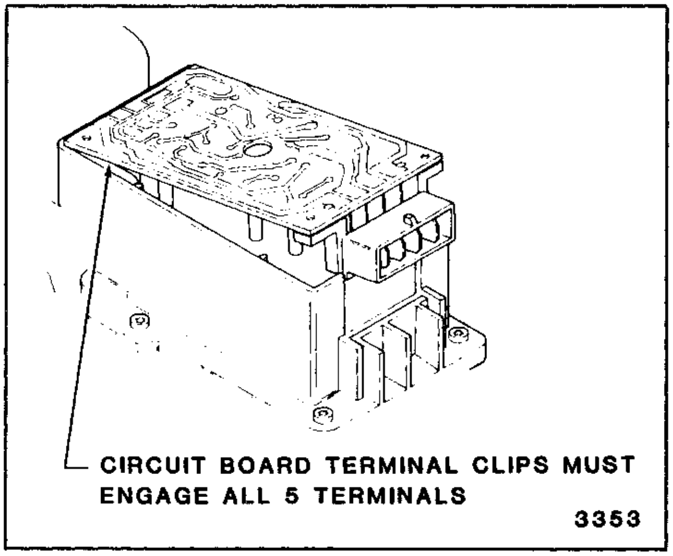


NO LOAD CURRENT DRAW @ 12V(+)
Lo Speed — 3.5 Amps Max.
Hi Speed — 5.0 Amps Max.
Crank Arm Rotation — CCW
(Looking at Arm)

TERMINAL LETTERS ON HARNESS CONNECTOR

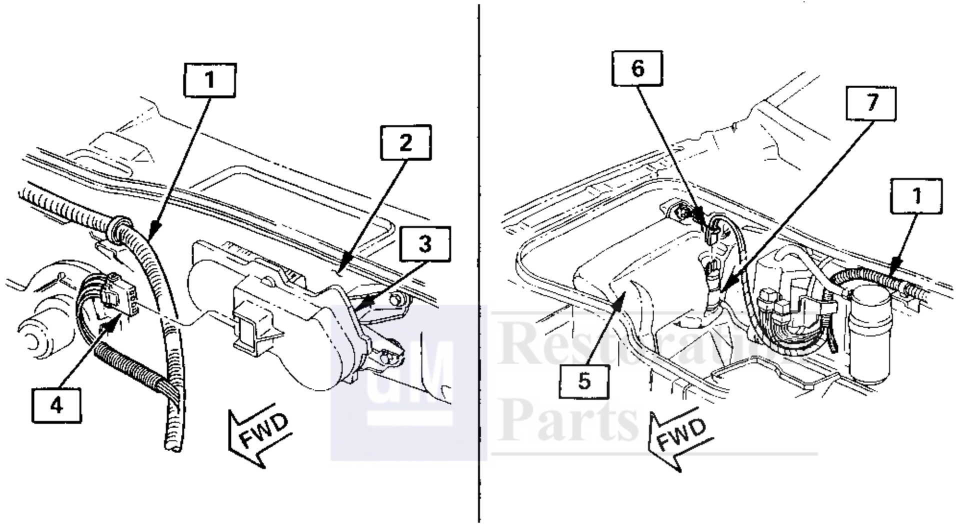
When motor is off the car, the motor housing must be grounded.

Fig. 26 Operating Wiper Motor Independent of Vehicle Wiring



CIRCUIT BOARD TERMINAL CLIPS MUST ENGAGE ALL 5 TERMINALS

Fig. 27 Pulse Wiper Circuit Board Installation



1 — HEATER — A/C HARNESS
2 — DUCT VENT PANEL
3 — WIPER MOTOR ASM.
4 — WIPER MOTOR CONNECTOR
5 — CONTAINER ASM.
6 — WINDSHIELD WASHER PUMP CONNECTOR
7 — WINDSHIELD WASHER PUMP

H20010-8E

Fig. 28 Windshield Wiper/Washer Wiring

SECTION 9A

RADIO SYSTEMS AND ANTENNAS

CONTENTS

GENERAL DESCRIPTION

RADIO

For radios and radio use see the "Radio Operation" section. ETR means 'Electronically Tuned Receiver'.

ANTENNAS

Fixed Antenna

The fixed antenna on the right front fender cannot be adjusted up or down. It may provide improved reception in rural areas.

The fixed antenna is designed to withstand most car washes without damage. If the antenna becomes slightly bent, you can straighten it by hand. The antenna can be replaced if severely bent (by vandalism, etc.). Antennas must be kept clean for good performance.

DIAGNOSIS

RADIO

Because radio problems are normally repaired at authorized warranty repair stations, the tendency is to remove the set when a problem is reported, without any preliminary diagnosis. This results in a large number of radios being "No Trouble Found" units when received by the warranty repair stations. Often the trouble can be corrected without radio removal.

ETR radios require clock and button reset if the battery is disconnected.

Static and Noise

Ground strap connections must be clean and tight, spark plug cables must be TVRS type and in good condition and resistance-type spark plugs used. Capacitors are used in the generator, heating/air conditioning system, and fuse panel to reduce noise entering the radio through the feed wires. If the car has a heater only, the capacitor is in the blower motor feed wire. If equipped with A/C, the blower motor has a built-in capacitor. Extra electrical equipment added to the static if not properly grounded or wiring was improperly routed.

Weak FM station reception will be affected by nearby buildings, car speed and direction. These "flutter" and "fading" conditions are characteristic of weak FM signals.

Popping Noise

Operating devices such as turn signals, pushing in cigarette lighter, operating stop lights, etc., may cause a popping noise on distant (weak) AM signals.

Preliminary Diagnostics

The inconvenience of driving without a radio while the set is being serviced can often be avoided if the following quick checks are used to eliminate external radio system problems before removing the radio for repair:

1. Turn ignition to the accessory position and turn radio on.
2. On AM-FM radios, if the radio is dead on FM but the AM plays normally, the radio should be removed for repair. (The reverse of this condition does not necessarily call for radio removal).
3. On combination radio/tape units, if the radio operates properly but the tape player does not, the unit should be removed for repair. (The reverse of this condition does not necessarily call for radio/tape removal.)

   Always determine the exact nature of the radio problem as an aid to diagnosis. Knowing whether the condition is intermittent or constant, whether it occurs with engine offor running, and whether it occurs with car parked or moving will help to pinpoint the problem.

   Radio diagnostic information is in Section 8A.

FIXED ANTENNA

Testing For Good Ground of Antenna Mounting and Connections

Poor grounding of the power antenna, either at the antenna mounting or at any other connection in the antenna/lead-in system, can result in seriously reduced radio performance. A poor ground can be a reason for excess ignition noise in AM reception, or erratic audio.

To check for a poor ground of the antenna, perform the following:

1. Fully lower antenna.
2. Disconnect antenna motor electrical connector.
3. Remove escutcheon from fender.
4. Attach alligator clip to upper end of antenna to act as antenna. Leave other end of clip unattached.
5. Tune radio for weak AM station or signal which is dependent on clip, i.e., clip attached, station is present; clip removed, no station.
6. Remove clip.
7. Ground upper end of antenna to fender (preferably with knife blade, very short jumper wire, etc.).
8. If radio station is not received, then the antenna grounds are good. If the station is still present or stronger, a poor ground or no ground connection is present in the system.

   Possible ground loss points are:

   - Antenna upper mounting (screws loose, paint overspray, etc.)
   - Coaxial connector at antenna not tight or corroded. (Remove to inspect inside the connector for corrosion.)
   - Coaxial connector at radio not tight or corroded.
   - Quick connect connector corroded.

Checking Antennas

Unplug antenna lead-in at back of radio and plug a test antenna into radio. Make sure test antenna base is grounded to the car chassis and keep hands off of the antenna. Check radio reception in an area away from

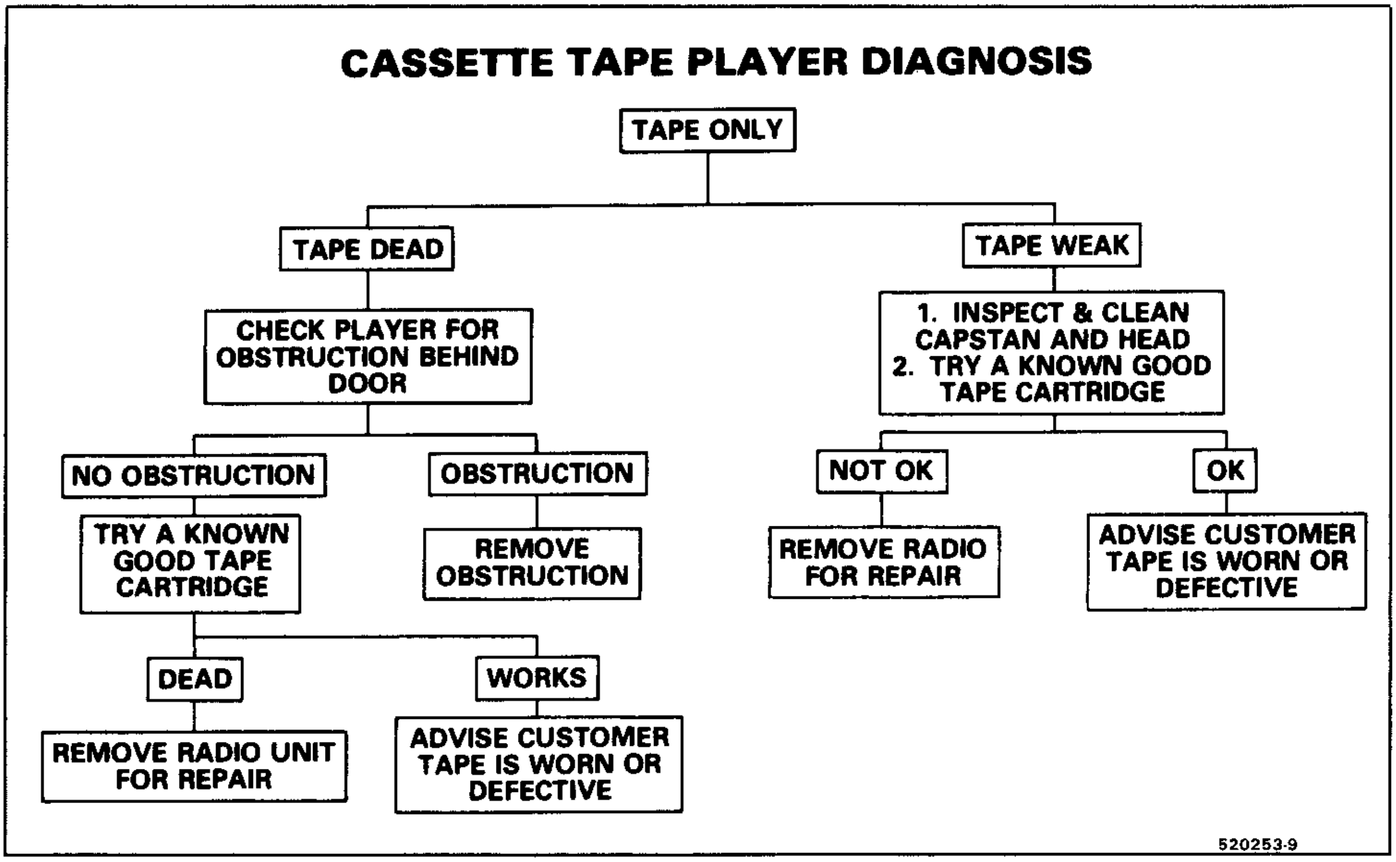


Fig. 1 Tape Player Diagnosis

electrical interferences. These include tall buildings, metal structures, power lines, fluorescent lighting, and power tools. Tune to high and low ends of the dial on both AM and FM checking weak and strong station reception. If reception is OK, problem exists with antenna and/or its lead-in cable. If reception is still poor, refer to Section 8A.

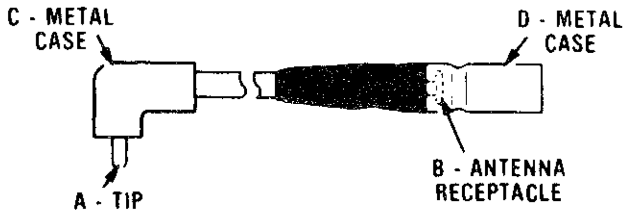
Checking Lead-In Cables

Figure 2

Usually symptons of broken center conductor of the lead-in cable will result in no AM and weak FM. In case of continued reception or noise complaints, always check the lead-in with an ohmmeter. The chart and diagram shown in Figure 2 show readings which should be obtained. When checking resistance, cautiously wiggle the lead-in tip and cable. If the readings shown in Figure 2 are not obtained, some portion of the lead-in is intermittent and the lead-in should be replaced.

CHECKING FIXED ANTENNAS

Unplug antenna lead-in at back of radio and plug a test antenna into radio. Make sure test antenna base is grounded to the car chassis and keep hands off of the antenna (see "Testing for Good Grounds"). Check radio reception in an area away from electrical interferences. These include tall buildings, metal structures, power lines, fluorescent lighting, and power tools. Tune to high and low ends of the dial on both AM and FM checking weak and strong station reception. If reception is OK, problem exists with antenna and/or its lead-in cable. If reception is still poor, refer to Section 8A, page 150-0 or 151-0.



Ohmmeter probes at points;	Resistance measured in ohms
A and B	less than 0.5*
C and D	less than 0.5
A and D	infinite
C and B	infinite
A and C	infinite
B and D	infinite

*On some long lengths of lead-ins, such as power antennas, capacitance is added in the tip. This results in a resistance reading of approximately 100,000 ohms.

G35209-9-E

Fig. 2 Lead-In Cable Diagnosis

SERVICE PROCEDURES

RADIO AND SPEAKERS

NOTICE: All radios are the bridge audio type, using two wires to each speaker. It is very important when changing speakers or performing any radio work to avoid pinching the wires. A short circuit to ground from either wire will cause damage to the output circuit in the radio.

Also, all Delco sound systems have ungrounded speakers. Installing add-on tape players, CB radios or other units which use the car speakers may damage your Delco sound system. Please consult your dealer in advance if you are considering additions.

See On-Car Service for radio or front speaker replacement. See Body Service Manual at end of this manual for door or rear speaker replacement.

RADIO NOISE SUPPRESSION EQUIPMENT

Figure 3

When installing a new radio, or when noise is a problem, ensure that radio suppression equipment is present and properly installed.

STEREO CASSETTE TAPE PLAYER

Figure 4

Tape and Tape Player Care

Optimum performance can be maintained by cleaning the internal tape head, capstan, and pinch roller periodically (approx. each 100 hours of operation). This can be done by inserting a nonabrasive cleaning cassette in place of the music tape.

DO NOT USE silicone spray lubricants for switch, plunger or tape head lubrication.

NO LUBRICANTS should be used since they cause the player to operate improperly, especially at extreme temperatures.

Do not bring any magnetized tools near the tape head. If the head becomes magnetized, every cassette played will be degraded.

Store cassettes away from extreme heat or direct sunlight. Protect the open ends from dirt or damage; store them in their original cases or other protective cases. For best results, 120 minute tapes are not recommended.

When leaving the car, cassettes may be left in the tape player (tapes are either automatically ejected or internally protected).

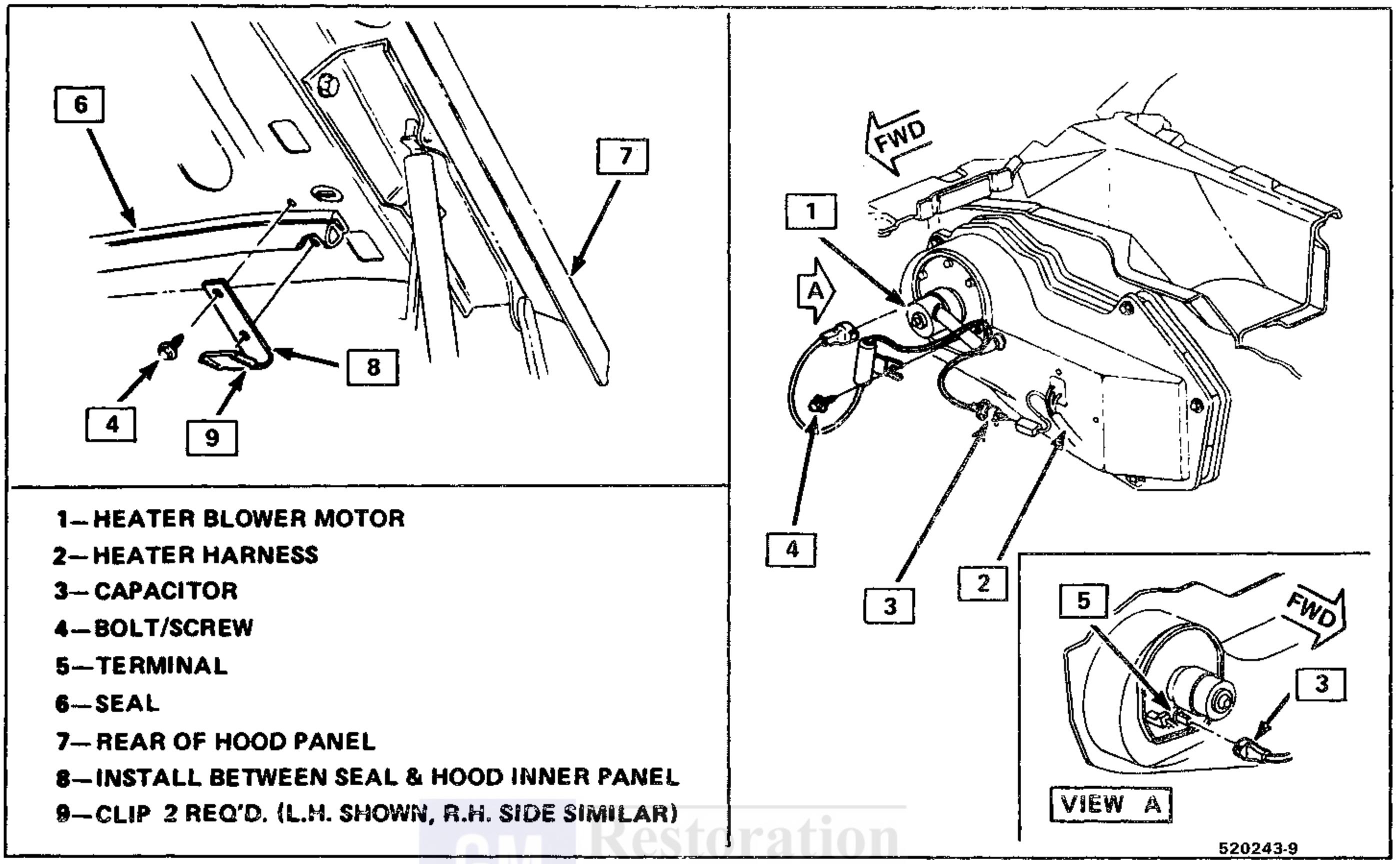


Fig. 3 Radio Suppression Equipment - Typical

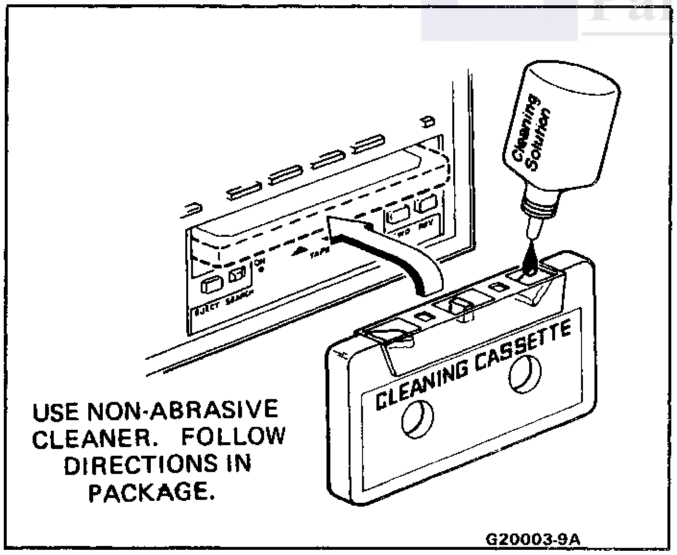


Fig. 4 Cleaning the Cassette Player

RADIO OPERATION

ETR AM-FM STEREO (UM-7)

Figure 801

ETR AM-FM Stereo Radio Operation

- **Power Button** ("PWR") - press to turn radio on. Press again to turn radio off.
- **Upper Knob** - rotate knob to control volume. Press knob to recall station frequency when listening to the radio with ignition on or to display time of day with ignition off.
- **Balance Control** (located behind upper knob) - turn to adjust left/right speaker balance.
- **Lower Knob** - rotate knob to tune radio stations manually. Frequency will be displayed during tuning. Press knob to select AM or FM band alternately.

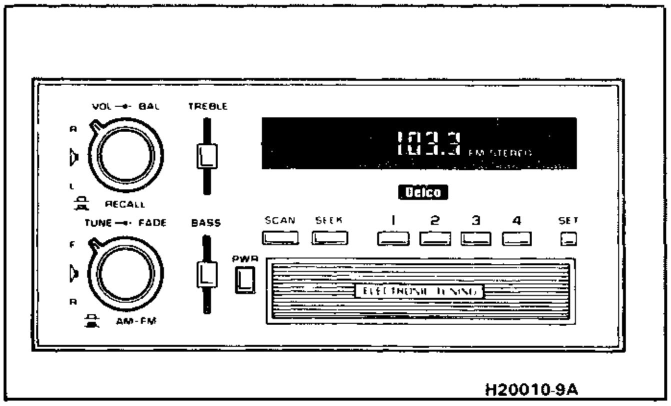


Fig. 801 UM7 Radio

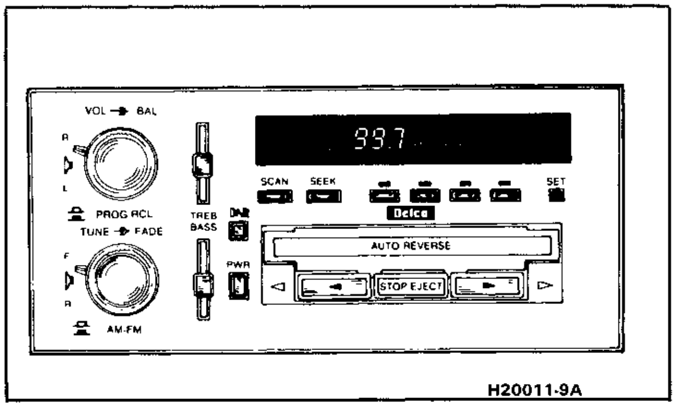


Fig. 802 UM6 Radio

- **Front/Rear Speaker Control** (located behind lower knob) - rotate control to adjust the sound between the front and rear speakers.
- **Bass and Treble Controls** - slide treble control up to increase treble or down to decrease treble. Slide bass control up to increase bass or down to decrease bass.
- **Station Preset Buttons**

  The radio has four pushbuttons for presetting favorite stations:

  1. Select the desired band (AM or FM), and tune to the desired station.
  2. Press SET button. Within five seconds press one of the four station buttons.

     The radio will tune in the selected station whenever you press that station button.
- **Seek and Scan**

  Use the SEEK and SCAN buttons for automatic station tuning. Press SCAN button to sample each station being received automatically. To stop SCAN, press SCAN button again. The SCAN indicator light on the frequency dial will be lit during SCAN operation. Press the SEEK button to locate and retain the next listenable station on the band automatically.

  The FM stereo indicator will light when tuned to an FM station broadcasting in stereo. Stereo (daul channel) sound is more realistic.
- **Time Set**

  To set hour, press SET button. The SET indicator light on the dial will then light up and the **radio** frequency will be displayed. Then press the SCAN button, holding SCAN button in until correct hour appears.

  To set minutes, press SET button. The SET indicator light will then light up and the **radio** frequency will be displayed. Then press SEEK button, holding SEEK button in until correct minute appears.

  NOTE: After you press the SET button, the radio frequency will be displayed. The time of day will be displayed when you press the SCAN or SEEK button.

ETR STEREO/CASSETTE (UM-6)

Figure 802

ETR AM-FM Stereo Radio Operation

- **Power Button** ("PWR") - press to turn radio on Press again to turn radio off.
- **Upper Knob** - rotate knob to control volume. Press knob to recall station frequency when listening to the radio with the ignition on, or to display time of day with ignition off. Press knob to select the other side of the tape when the cassette is playing.
- **Balance Control** (located behind upper knob) - turn to adjust left/right speaker balance.
- **Lower Knob** - rotate knob to tune radio stations manually. Frequency will be displayed during tuning. Press knob to select AM or FM band alternately.
- **Front/Rear Speaker Control** (located behind lower knob) - rotate control to adjust the sound between the front and rear speakers.
- **Bass and Treble Controls** - slide treble control up to increase treble or down to decrease treble. Slide bass control up to increase bass or down to decrease bass.
- **Station Preset Buttons**

  The radio has four pushbuttons for presetting favorite stations:

  1. Select the desired band (AM or FM) and tune to the desired station.
  2. Press SET button. Within five seconds, press one of the four station set buttons.

  The radio will tune in the selected station whenever you push that station button.

  Note: Up to three additional stationson each band may be preset by "pairing" the pushbuttons:

  1. Tune in the desired station;

  2. press SET, and within five seconds press any two adjacent pushbuttons at the same time. (The station will return when the two buttons are pressed again.)
- **Seek and Scan**

  Use the SEEK and SCAN buttons for automatic station tuning.

  Press SCAN button to sample each station being received automatically. To stop SCAN, press SCAN button again.

  The SCAN indicator light on the frequency dial will be lit during SCAN operation.

Press the SEEK button to locate and retain the next listenable station on the band automatically.

The FM stereo indicator will light when tuned to an FM station broadcasting in stereo. Stereo (dual stereo) sound is more realistic.

- **Time Set**

  To set hour, press SET button. The SET indicator light on the dial will then light up and the radio frequency will be displayed. Then press SCAN button, holding SCAN button in until the correct hour appears.

  To set minutes, press SET button. The SET indicator light will then light up and the radio frequency will be displayed. Then press SEEK button, holding SEEK button in until correct minute appears.

  NOTE: After you press the SET button, the radio frequency will be displayed. The time of day will be displayed when you press the SCAN or SEEK button.

- **To Operate Tape Player**

  Insert the cassette squarely into tape door, with exposed edge entering first. Tape will snap into position when fully inserted. This automatically switches the unit from radio to tape operation. After the cassette has snapped into position, adjust the volumn and fader controls to your preference.

  To advance tape rapidly, press the button next to the lighted arrow (arrow on button points in the same direction as lighted arrow). To reverse tape and located an earlier selection, press the button which has an arrow pointing in the opposite direction. To stop fast motion and return to playing speed, press STOP-EJECT lightly; press again, but more firmly to eject the tape. **Reversing Sides - Press the upper left knob (volumn control) to play the other side of the tape. When the end of tape is reached, it automatically reverses and plays the other side. Tape Indicator Light**

  When the left indicator light is lit, the top side of the tape is playing. When the right indicator light is lit, the bottom side of the tape is playing.

  NOTE: When end-of-tape is reached in one direction, the unit will automatically play the other side of the tape.

  To remove the tape or listen to the radio, push the STOP-EJECT button.

  Press the Dynamic Noise Reduction (DNR®) button to reduce high frequency background hiss on AM, FM, FM stereo, and tape.

  For best results, 120 minute tapes are not recommended.

ETR STEREO/CASSETTE/EQUALIZER (UX-1)

Figure 803

ETR AM Stereo-FM Stereo Radio Operation

- **Power Button** ("PWR") - press to turn radio on. Press again to turn radio off.

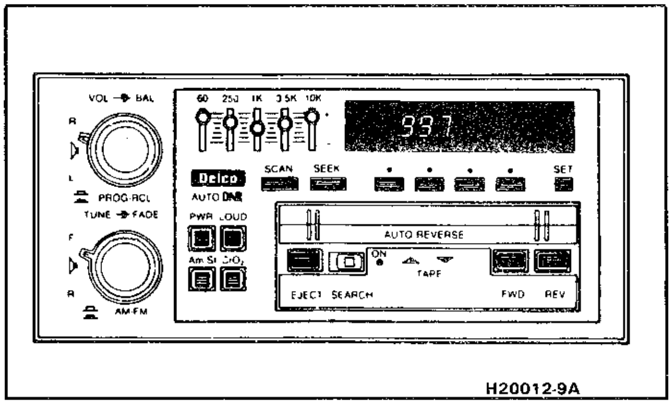


Fig. 803 UX1 Radio

- **Upper Knob** - rotate knob to control volume. Press knob to recall station frequency when listening to the radio with the ignition on, or to display time of day with ignition off. Press knob to select the other side of the tape when the cassette is playing.
- **Loudness Button** ("LOUD") - Press to boost bass frequencies when the system is playing at low volume.
- **Balance Control** (located behind upper knob) - turn to adjust left/right speaker balance.
- **Lower Knob** - rotate knob to tune radio stations manually. Frequency will be displayed during tuning. Press knob to select AM or FM band alternately.
- **Front/Rear Speaker Control** (located behind lower knob) - rotate control to adjust the sound between the front and rear speakers.
- **AM Stereo** ("AM-ST") - press to receive AM stereo. " Stereo" indicator light will be displayed when tuned to a station broadcasting C-QUAM® AM stereo, provided it is being received with adequate signal strength in your locality. When the button is "out", all AM stations will be received in monaural, "single-channel" sound.

  C-Quam® is a registered trademark of Motorola, Inc.
- **FM Stereo**

  The stereo indicator light will be displayed whenever tuned to an FM station broadcasting in stereo. Stereo (dual channel) sound is more realistic.

  "Stereo" operation means the radio is separating a stereo broadcast back into the original two channel, called "left" and "right."Stereo sound is noticably realistic to the ear.
- **5-Band Graphic Equalizer** - allows you to adjust bass, midrange, and treble to suit personal taste. Move control up to increase frequency range or down to decrease frequency range.

  NOTE: 60 and 250 denote bass; 1K denotes midrange; 3.5K and 10K denote treble.

  Generally, the 1k control is placed in the center (detent) position, while the bass and treble controls are adjusted upwards to varying degrees Since the 10K control has the most influence on treble, it may produce high frequency hiss when fully up. If this occurs, move it down until the hiss disappears.

This radio has automatic Dynamic Noise Reduction (DNR®) to reduce high frequency background hiss on AM, FM, AM Stereo, FM Stereo, and tape.

- **Station Preset Buttons**

  The radio has four pushbuttons for presetting favorite stations:

  1. Select the desired band (AM or FM), and tune to the desired station.
  2. Press SET button. Within five seconds press one of the four station buttons.

     The radio will tune in the selected station whenever you press that station button.

     NOTE: Up to three additional stations on each band may be preset by "pairing" the pushbuttons:

     1. Tune in the desired station;

     2. press SET, and within five seconds press any two adjacant pushbuttons at the same time. (The station will return when the two buttons are pressed again.)

- **Seek and Scan**

  Use the SEEK and SCAN buttons for automatic station tuning.

  Press SCAN button to sample each station being received automatically. To stop SCAN, press SCAN button again.

  The SCAN indicator light on the frequency dial will be lit during SCAN operation.

  Press the SEEK button to locate and retain the next listenable station on the band automatically.

  The FM stereo indicator will light when tuned to an FM station broadcasting in stereo. Stereo (dual channel) sound is more realistic.

- **Time Set**

  To set hour, press SET button. The SET indicator light on the dial will then light up. Then press SCAN button, holding SCAN button in until correct hour appears.

  To set minutes, press SET button. The SET indicator light will then light up. Then press SEEK button, holding SEEK button in until correct minute appears.

  NOTE: After you press the SET button, the radio frequency will be displayed. The time of day will be displayed when you press the SCAN or SEEK button.

- **To Operate Tape Player:**

  Insert the cassette squarely through the door. This automatically switches the unit from radio to tape operation. If the sound is garbled (or there is no sound), eject the tape and reinsert it squarely.

  To advance the tape, press the forward ("FWD") button. To listen to the earlier portion of the tape, press the reverse ("REV") button. To stop forward or reverse movement, press the opposite button lightly.

  To listen to the next selection, slide the "SEARCH" button to the right and press the forward ("FWD") button. The radio will seek the next selection.

  To listen to the previous selection again, slide the "SEARCH" button to the right and press the reverse ("REV") button. The radio will repeat the previous selection.

  The "ON" light, to the right of the search switch, will be on while the search function is engaged.

  When the left triangle indicator light is lit, the top side of the tape is playing. When the right triangle indicator light is lit, the bottom side of the tape is playing.

  To play the other side of the tape before the present side has ended, press the upper left knob. This will automatically play the opposite side of the tape.

  NOTE: When end-of-tape is reached in one direction, the unit will automatically play the other side of the tape. To remove the tape or listen to the radio, push the EJECT button.

  When the ignition is turned off, the tape is automatically ejected.

  The equalization setting which is desired will vary according to the type of tape being used. Chrome ($Cr0_2$) 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.

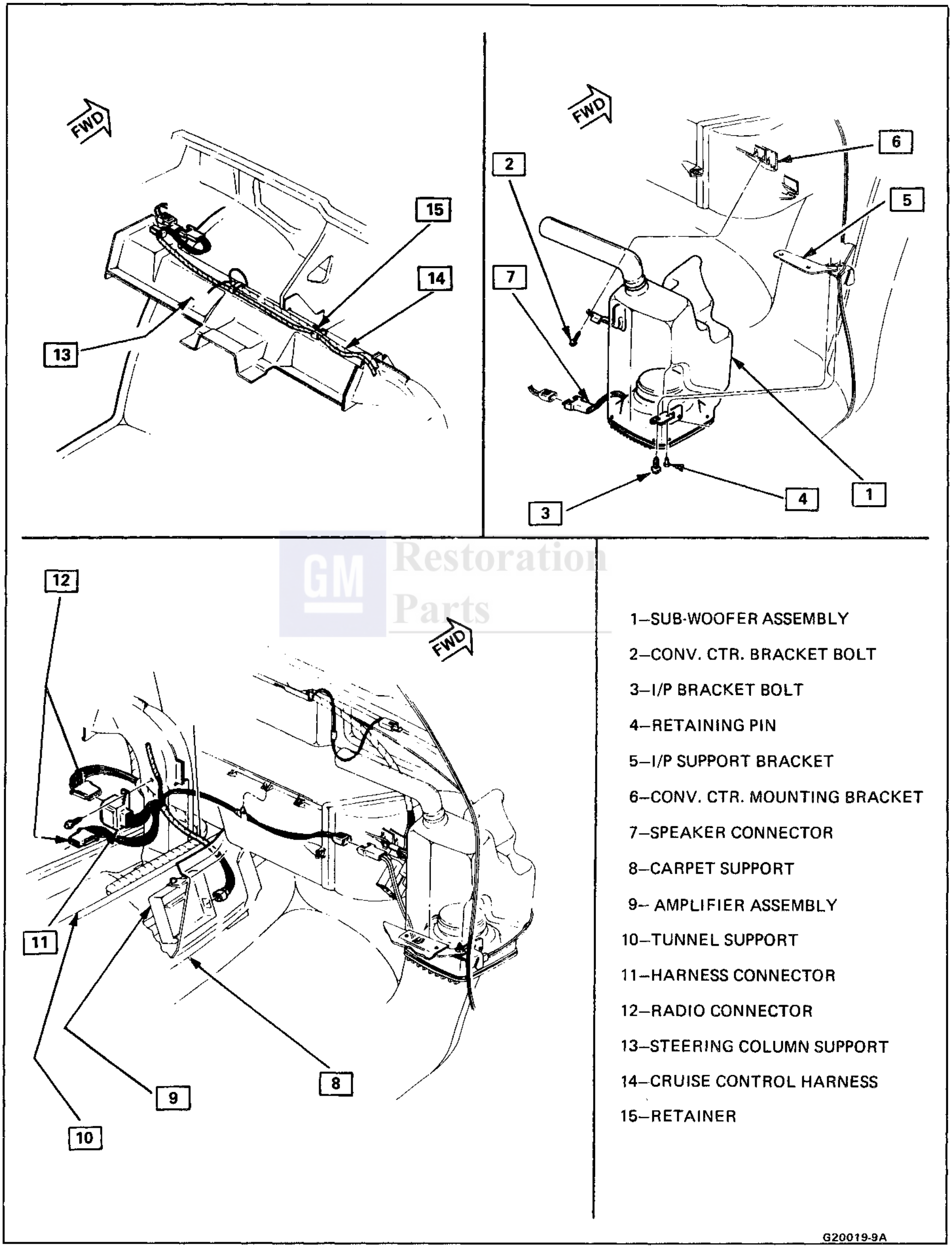
  Select the setting for proper tape equalization as follows:

  1. Select 70 usec (push button in).
  2. Select 120 usec (button is out).

ON-CAR SERVICE

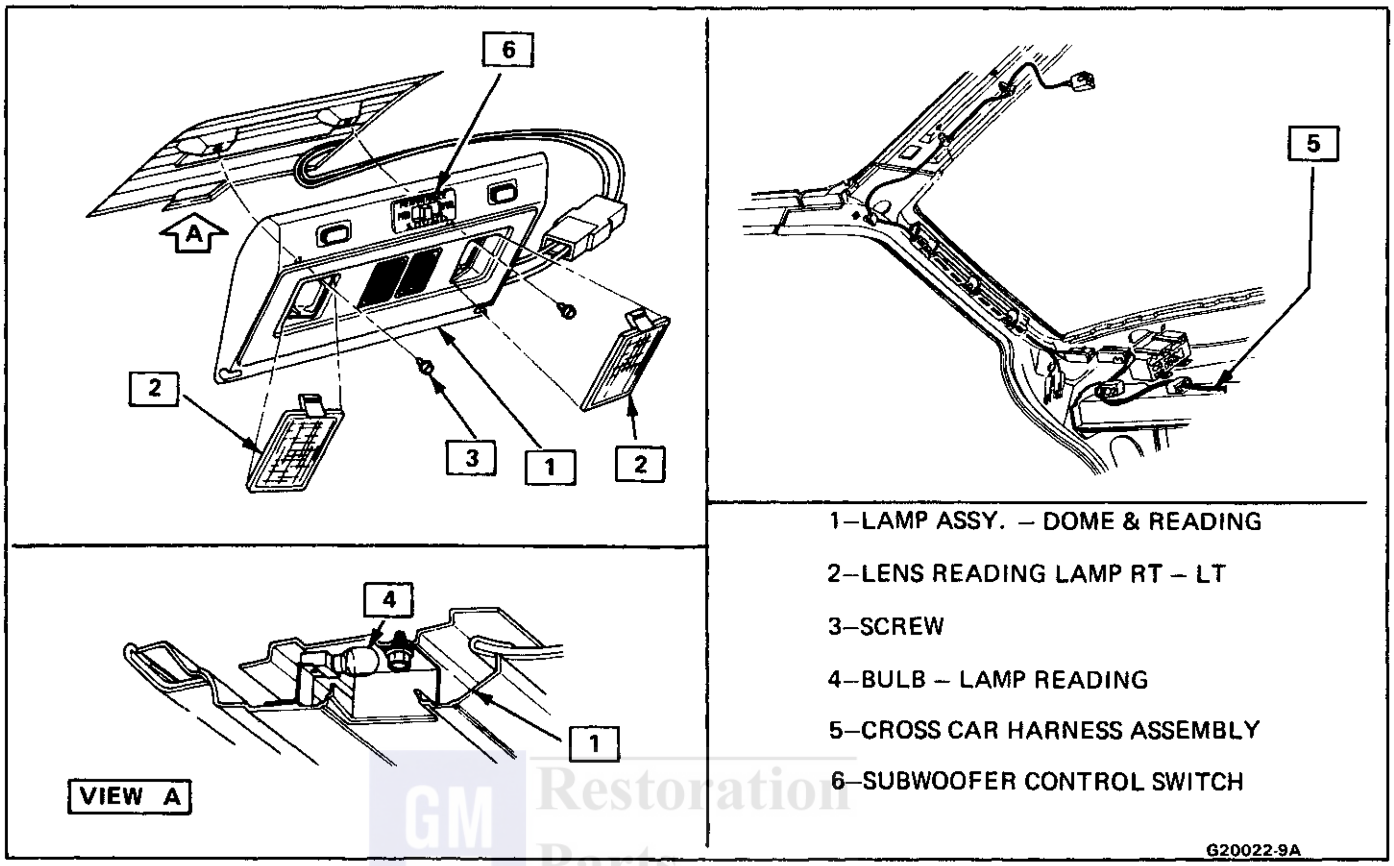
REAR SPEAKERS/SUB-WOOFER SPEAKER

See Section 6 of Body Service Manual and Figures 804, 805, 807 and 811.



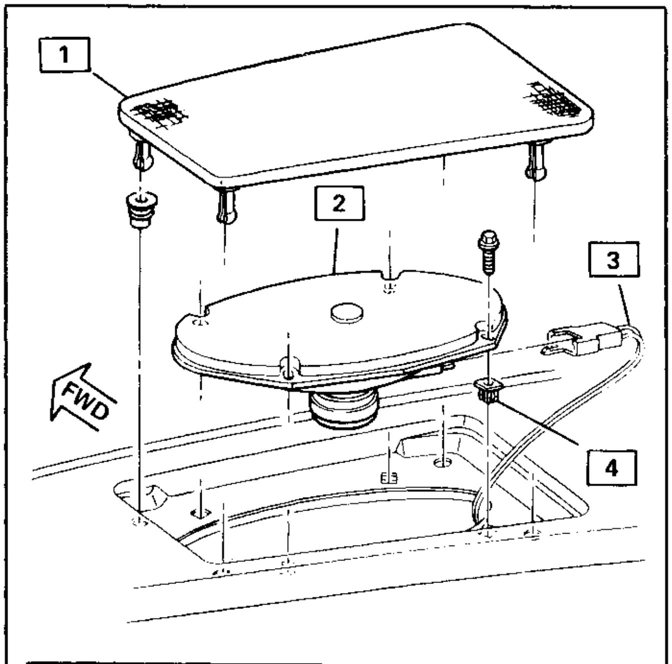
1–SUB-WOOFER ASSEMBLY
2–CONV. CTR. BRACKET BOLT
3–I/P BRACKET BOLT
4–RETAINING PIN
5–I/P SUPPORT BRACKET
6–CONV. CTR. MOUNTING BRACKET
7–SPEAKER CONNECTOR
8–CARPET SUPPORT
9– AMPLIFIER ASSEMBLY
10–TUNNEL SUPPORT
11–HARNESS CONNECTOR
12–RADIO CONNECTOR
13–STEERING COLUMN SUPPORT
14–CRUISE CONTROL HARNESS
15–RETAINER

Fig. 804 Sub-Woofer, Amplifier & Wiring



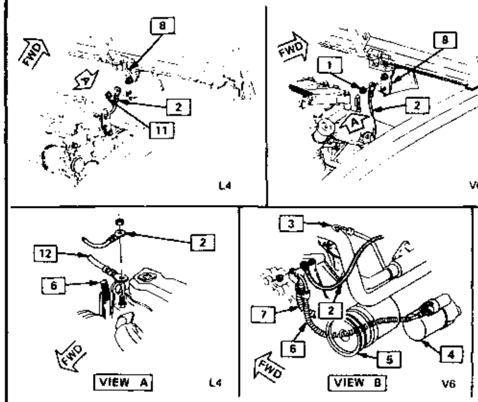
1–LAMP ASSY. – DOME & READING
2–LENS READING LAMP RT – LT
3–SCREW
4–BULB – LAMP READING
5–CROSS CAR HARNESS ASSEMBLY
6–SUBWOOFER CONTROL SWITCH

Fig. 805 Sub-Woofer Switch/Wiring



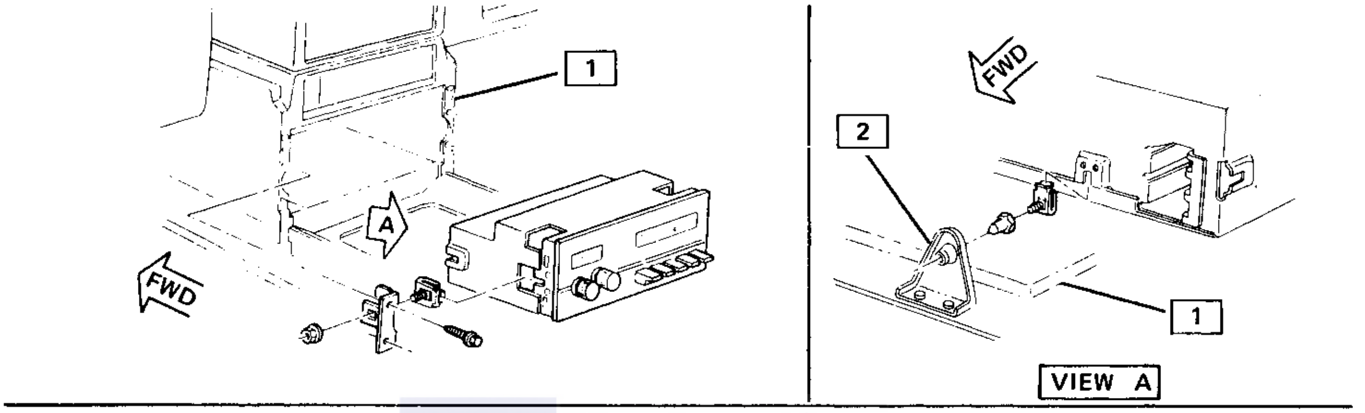
1 — GRILLE
2 — SPEAKER ASM.
3 — TO CONVENIENCE CTR WIRING
4 — INSTRUMENT PANEL

Fig. 806 Front Speaker & Grille



1 — 24 N·m (18 LBS. FT.)
2 — GROUND STRAP
3 — OIL DIPSTICK
4 — STARTER
5 — A/C COMPRESSOR
6 — BATTERY CABLE (+)
7 — ENGINE HARNESS
8 — DECK LID HINGE
9 — STATIC SHIELD
10 — 28 N·m (21 LBS. FT.)
11 — 50 N·m (37 LBS. FT.)
12 — BATTERY CABLE (–)

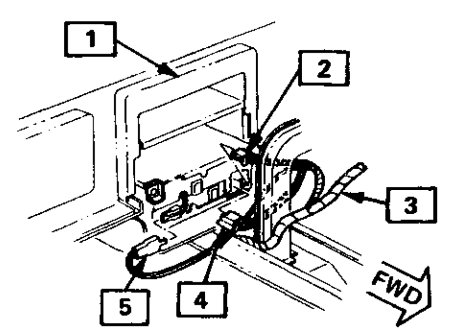
Fig. 807 Rear Speaker Wiring



1 — CONSOLE SUPPORT ASM
2 — BRACKET

520254-9

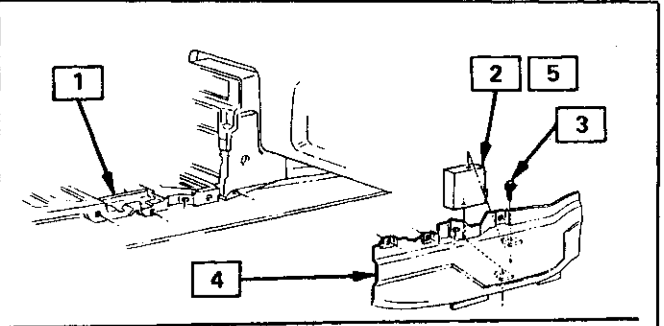
Fig. 808 Radio Mounting



1 — IP
2 — POWER FEED
3 — MAIN BODY WIRING HARNESS
4 — FRONT SPEAKERS
5 — CLOCK LEAD

H20030-9A

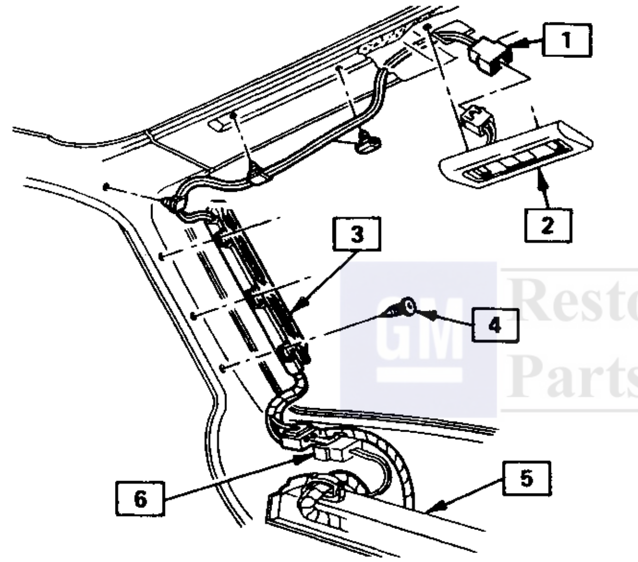
Fig. 809 Radio Wiring



1 — CONSOLE SUPPORT
2 — AMPLIFIER
3 — 1.6 N·m (14 LBS. IN.)
4 — CARPET SUPPORT
5 — AMPLIFIER MUST BE ASSEMBLED TO CARPET SUPPORT PRIOR TO ASSEMBLY TO CONSOLE SUPPORT

H20032-9A

Fig. 810 Amplifier to Carpet Support



1 —DOME LAMP CONN.
2 —DOME/READING LAMP & SUBWOOFER CONTROL ASSEMBLY
3 —CONDUIT
4 —FASTENER
5 —STEERING COLUMN SUPPORT
6 —CROSS CAR HARNESS

H20031-9A

Fig. 811 Dome/Reading Lamp & Sub-Woofer Harness

SECTION 9B

CRUISE CONTROL

CONTENTS

GENERAL DESCRIPTION

Cruise control is a speed control system which maintains a desired car speed under normal driving conditions. However, steep grades up or down may cause variations in the selected speeds. The electronic cruise control system has the capability to cruise, coast, resume speed, accelerate, and "tap-up" and "tap-down".

The main parts of the cruise control system are the mode control switches, controller (module), servo unit, speed sensor, vacuum supply, electrical and vacuum release switches, and electrical harness.

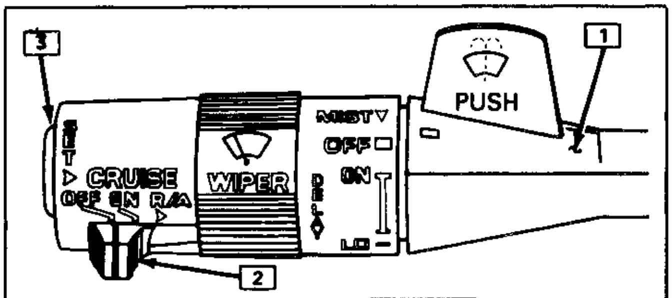
The cruise control system uses vacuum to operate a throttle servo unit. The servo unit maintains a desired car speed by trapping vacuum in the servo unit at the proper servo position. The controller monitors vehicle speed and servo position and operates the vacuum and vent valves in the servo to maintain desired speed. The controller contains a low speed limit which will prevent system engagement below a minimum speed of about 25 mph. The operation of the controller is controlled by mode control switches located in the end of the directional signal lever. To disengage the system, two release switches are provided. An electrical release switch mounted on the brake pedal bracket (brake and clutch pedal bracket on cars equipped with manual transmission) disengages the system electrically when the brake pedal (or clutch pedal) is depressed. A vacuum release valve, mounted on the brake pedal bracket, vents the trapped vacuum in the servo to atmosphere when the brake pedal is depressed, allowing the servo unit to quickly return the throttle to idle position.

OFF/ON/RESUME/ACCEL SWITCH (OPERATION)

Figure 1

The Off/On/Resume/Accel Switch has three positions. This switch turns the cruise control system ON and OFF and also returns cruise control operation to the last speed setting when MOMENTARILY moved towards the R/A position after braking. (Do not hold the slider in the R/A position ... release it immediately.) If the slider is held in the R/A position for more than one second, the system goes into the Accel mode. To accelerate the car, move the slider switch to the R/A position and hold it there until the car reaches the desired speed. When the slider switch is released, the system will maintain the new cruise speed. In order to use the Accel mode, the cruise OFF/ON/Resume/Accel switch must be in the "ON" position and the car must be above the low speed limit of 25 mph.

The slide switch can also be used to "tap-up" car speed. In order to do this the cruise must be engaged and operating. "Tapping-up" is done by quickly pressing the slide switch toward the R/A position and quickly releasing it, or "tapping" the lever. Do not hold the lever in the R/A position or the system will go into the Accel mode. "Tap-up" is a function in which cruise speed can be increased by 1 mph increments (one tap = 1 mph increase).



1—DIRECTIONAL SIGNAL LEVER
2—OFF/ON/RESUME/ACCEL SWITCH
3—SET/COAST SWITCH

Fig. 1 Multi-Function Lever

SET/COAST BUTTON SWITCH

Figure 1

The cruise control Set/Coast Switch (located in the end of the turn signal lever) has two positions - "Normal" and "Depressed".

- **The Set Position** - With the button switch depressed and then released (car speed must exceed the low speed limit point, and the Off/On/Resume/Accel Switch must be in the ON position) the cruise speed will be set at the speed the car was at when the button was released. Car cruise speed will be within ±1 mph of the actual speed at engaged speed. The system will cruise until either the Off/On/Resume/Accel Switch is moved to OFF, the ignition switch is turned off, and/or the Set/Coast Button is pushed in fully and held. Pushing the brake pedal (or clutch pedal) releases the cruise but not the resume capability.
- **The Coast Position** - With the button switch fully depressed, the driver can raise or lower his speed. To increase speed, the driver can accelerate to a new speed, fully depress the switch and release the button. The controller "forgets" the previously set speed. An increased control speed can also be more easily set by the Off/On/Resume/Accel Switch as previously described. To decrease cruise speed, the button switch is held in, disengaging the cruise system, which allows the throttle to return to the idle position. When the car has slowed to the desired cruise speed, releasing the switch will re-engage the system.
- **The "Tap-Down" Position** - In order to do this the cruise must be engaged and operating. "Tapping-down" is done by quickly pressing and releasing the Set/Coast Button, or "tapping" the button. Do not hold the button in the depressed position or the system will go into the "coast" mode. "Tap-down" is a function in which cruise speed can be decreased by 1 mph increments (one tap = 1 mph decrease).

  The accelerator may be depressed at any time to override the cruise system. Release of the accelerator will return the car to the previous set cruise speed.

NOTICE: To keep the vehicle under control, and to prevent possible vehicle damage, it is not advisable to use the cruise control on slippery roads. It is not recommended to use the cruise control in conditions such as on winding roads or in traffic of heavy or varying volume. When traveling down a steeply graded hill, the cruise control should be disengaged by depressing the brake pedal lightly. The transmission can then be shifted into a lower gear range to help control vehicle speed.

ELECTRONIC CONTROLLER (MODULE)

Figure 2

The controller interprets the position of the servo, the position of the control switches and the output of the speed sensor. In response to these inputs, the controller electrically signals the opening or closing of the vent and vacuum solenoid valves in the servo.

The controller is usually mounted on the accelerator pedal bracket,but is integral with the ECM on A/N/P Carlines with 2.5L, and J Carline with 2.0L non-turbo. For specific location, see the On-Car Service portion of this section.

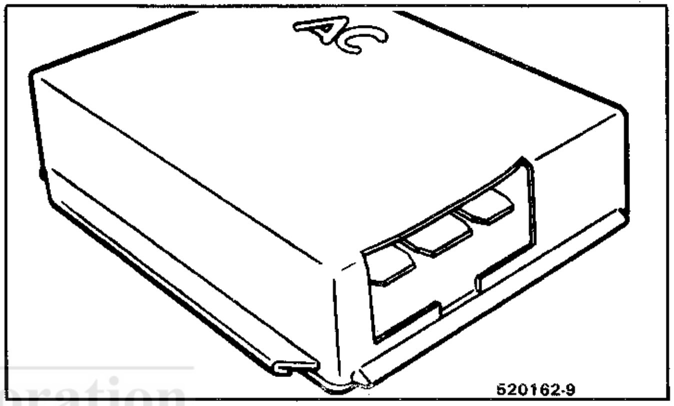


Fig. 2 Controller (Module)

SERVO UNIT

Figure 3

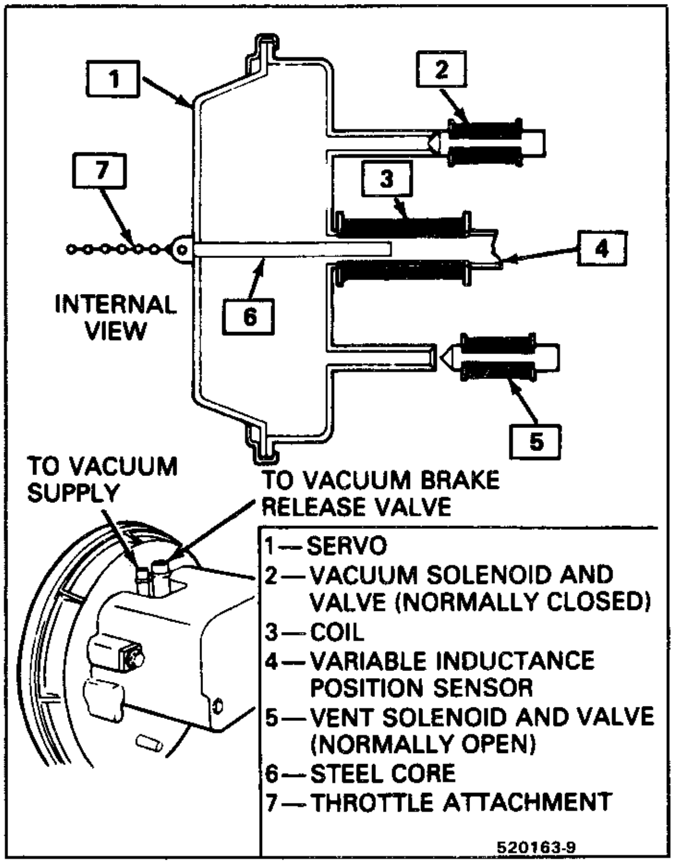


Fig. 3 Servo Unit

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 vacuum source, and a variable inductance position sensor.

The servo incorporates a steel core which moves within a coil. Its resulting variable inductance provides a continuous (voltage) servo position signal to the controller. This voltage signal is constantly compared to the vehicle speed signal. This comparison determines if the cruise system has corrected the speed error or if additional changes are required.

The servo operates the throttle in response to signals from the electronic controller as follows:

- **Steady Cruise State** (system engaged and operating) - Both vacuum and vent valves are closed or sealed. The servo has a constant vacuum on the diaphragm and places no requirements on the vacuum source, as vacuum is trapped in the diaphragm chamber.
- **Vehicle Losing Speed** (due to steep grades or driver wishes to increase speed by using the Accel or 'tap-up' feature) - The controller energizes the vacuum solenoid to open the vacuum valve to the vacuum source. This increases the vacuum level 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 ±1/2 mph from set speed.

When the controller senses an over or underspeed condition it will pulse the opening of the vent or vacuum valve. The pulse will be repeated as required until the speed correction necessary brings the car to the set speed. From any set speed, under normal road load conditions, the vacuum valve will remain in a completely open position when vehicle speed has dropped 5 mph below set speed. Likewise, when vehicle speed has exceeded 3 mph over the set speed, such as down a steep grade, the vent will go into constant open position.

The servo will go into an open vent valve position under the following conditions:

- When the brake (or clutch) pedal is depressed.
- An open variable inductance position sensor coil in the servo.
- A loss of electrical power to the system.
- The ignition is turned off.

SPEED SENSORS

VSS/Buffer Amplifier

Figure 4

This device supplies the vehicle speed input to the controller on some cars. The optic head portion of the VSS is located in the speedometer frame. A reflective blade is attached to the speedometer cable/head assembly. The blade spins like a propeller, with its blades passing through a light beam from a L.E.D. in the optic head. As each blade enters the L.E.D. light beam, light is reflected back to a photocell in the optic head, causing a low power speed signal to be sent to the buffer for amplification and signal conditioning. This amplified signal is then sent to the cruise controller.

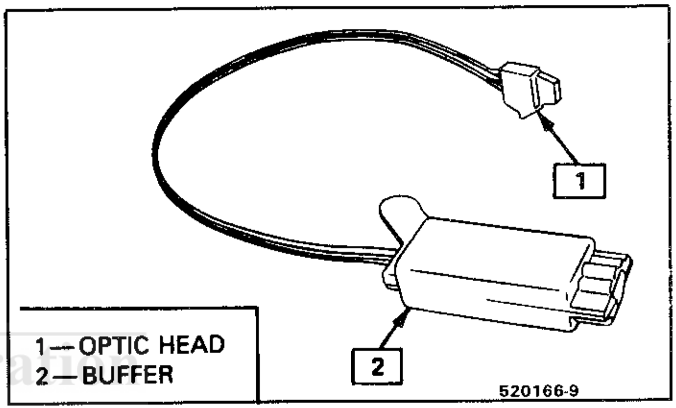


Fig. 4 VSS (Vehicle Speed Sensor) Buffer

P. M. Generator

Figure 5

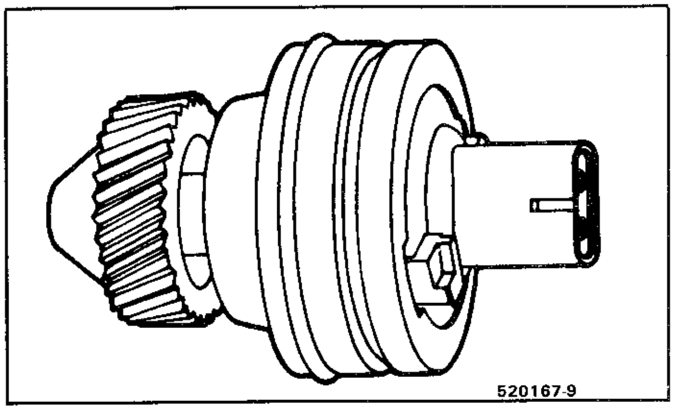


Fig. 5 P. M. Generator

This device supplies the vehicle speed input to the controller on some cars. Vehicle speed information is provided to the controller by a P. M. (permanent magnet) generator driven by the transmission. The output frequency of the P. M. generator is sent to the buffer, which amplifies and conditions the signal to the controller.

VACUUM SUPPLY

The vacuum to operate the Cruise Control servo can come from: manifold vacuum connected straight to the servo, from manifold through a vacuum storage tank, or straight from a vacuum pump. For specific vacuum routing, see On-Car Service.

ELECTRICAL AND VACUUM RELEASE SWITCHES

These switches are used to disengage the cruise control system. An electrical release switch mounted on the brake pedal bracket (and clutch pedal bracket on cars equipped with manual transaxle) disengages the system electrically when the brake (or clutch) pedal is depressed. This is done by interrupting the flow of current to the controller. A vacuum release valve mounted on the brake pedal bracket vents the trapped vacuum in the servo to atmosphere when the brake pedal is depressed, allowing the servo unit to more quickly return the throttle to idle position. This is done by routing a separate hose directly to the servo from the normally closed vacuum switch. These two types of switches will also sometimes be combined with stop light switch, TCC switch, or other switches. For specific usage and adjustment of these switches, see On-Car Service.

ELECTRICAL HARNESS

For specific wiring and connector locations, see Section 8A-34, 'Cruise Control'. Some wiring routing information is also included in the On-Car Service portion of this section.

DIAGNOSIS

Improper operation can be caused by one or a combination of mechanical, electrical and vacuum problems. In resolving any cruise system operating problem, first make a visual inspection. Check the system to ensure there are no bare, broken, or disconnected wires or any pinched, damaged, or disconnected vacuum hoses. The servo and throttle linkage should operate freely and smoothly. The servo linkage should be adjusted as described in the On-Car Service portion of this section.

Since any problem in this system is either vacuum, mechanical, or electrical, the technician should perform a few initial checks before turning to Section 8A. This can be done by first eliminating a vacuum or mechanical problem by starting the engine and using finger to feel for source vacuum at the servo, and by visual inspection of vacuum release valve, throttle linkage, vacuum hoses, etc. If preliminary inspection reveals no solution and the system is inoperative, use the diagnostic information in Section 8A-34, 'Cruise Control'.

Several versions of a quick check instrument similar to tool J 34185 are available. This quick check instrument is installed in place of the controller and determines which part of the system has a problem. Instructions on the operation of the instrument will be provided with the unit.

CRUISE SYSTEM SURGES

- The servo and throttle linkages should operate freely and smoothly. This linkage should be adjusted as described in the On-Car Service portion of this section.
- Check hose routing for pinches, leaks or restrictions. (See vacuum schematics in the On-Car Service portion of this section).
- See Section 8A-34, 'Cruise Control'.

CRUISE SET SPEED HIGH OR LOW

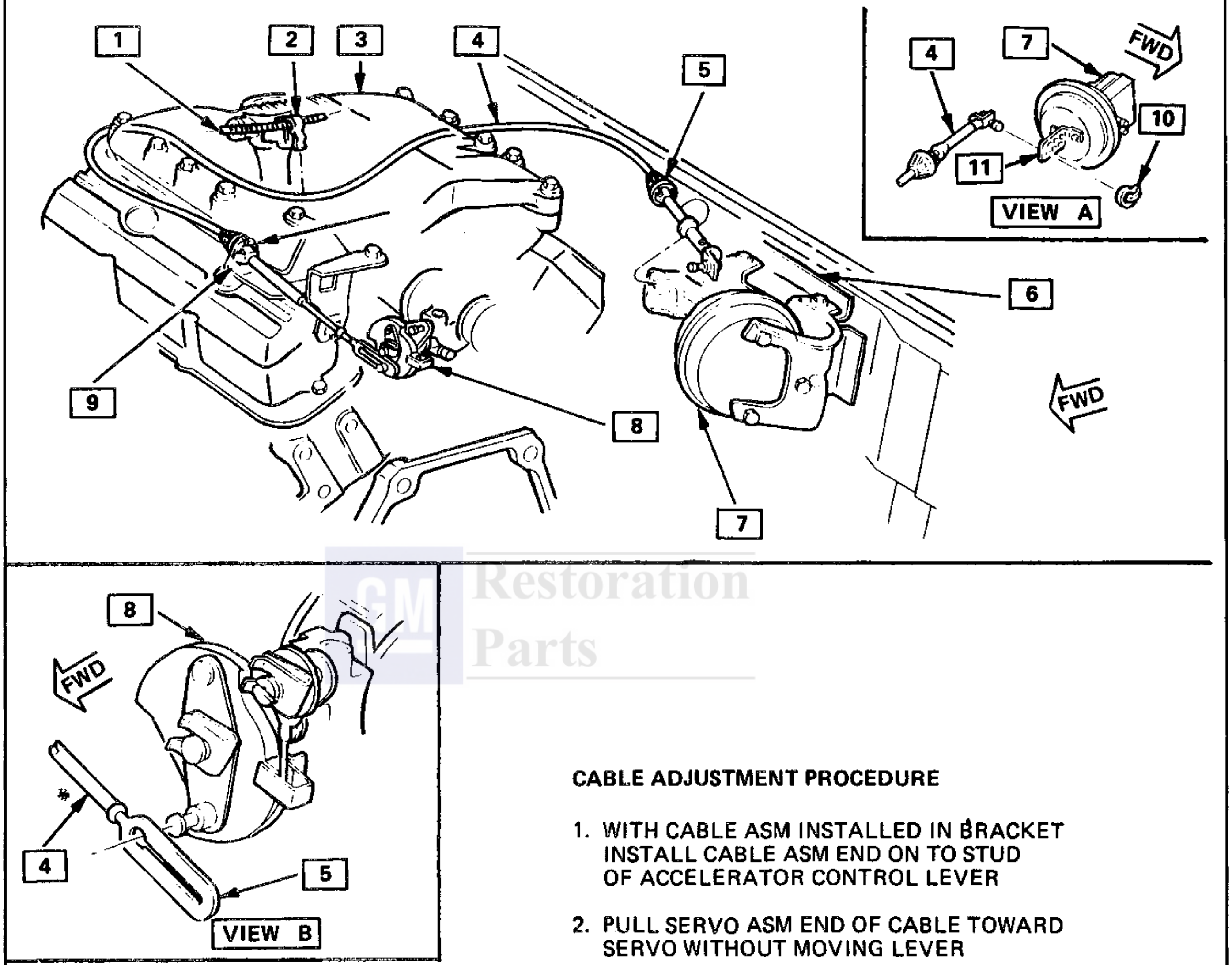
- Check vacuum hoses for proper routing, restrictions or leaks. Adjust or replace as required. (See vacuum schematics in the On-Car Service portion of this section.)
- Check servo linkage for excess slack and adjust as described in the On-Car Service portion of this section.
- If no system problem is noted, replace the electronic controller (module).

EXCESSIVE CRUISE SPEED LOSS ON HILLS

- Check hoses for vacuum leaks. (See vacuum schematics in the On-Car Service portion of this section).
- Determine if check valve is functional (where applicable).

CRUISE TAP-UP & TAP-DOWN

If all other functions of cruise control are working except "tap-up" and "tap-down" the controller (module) is at fault.



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)

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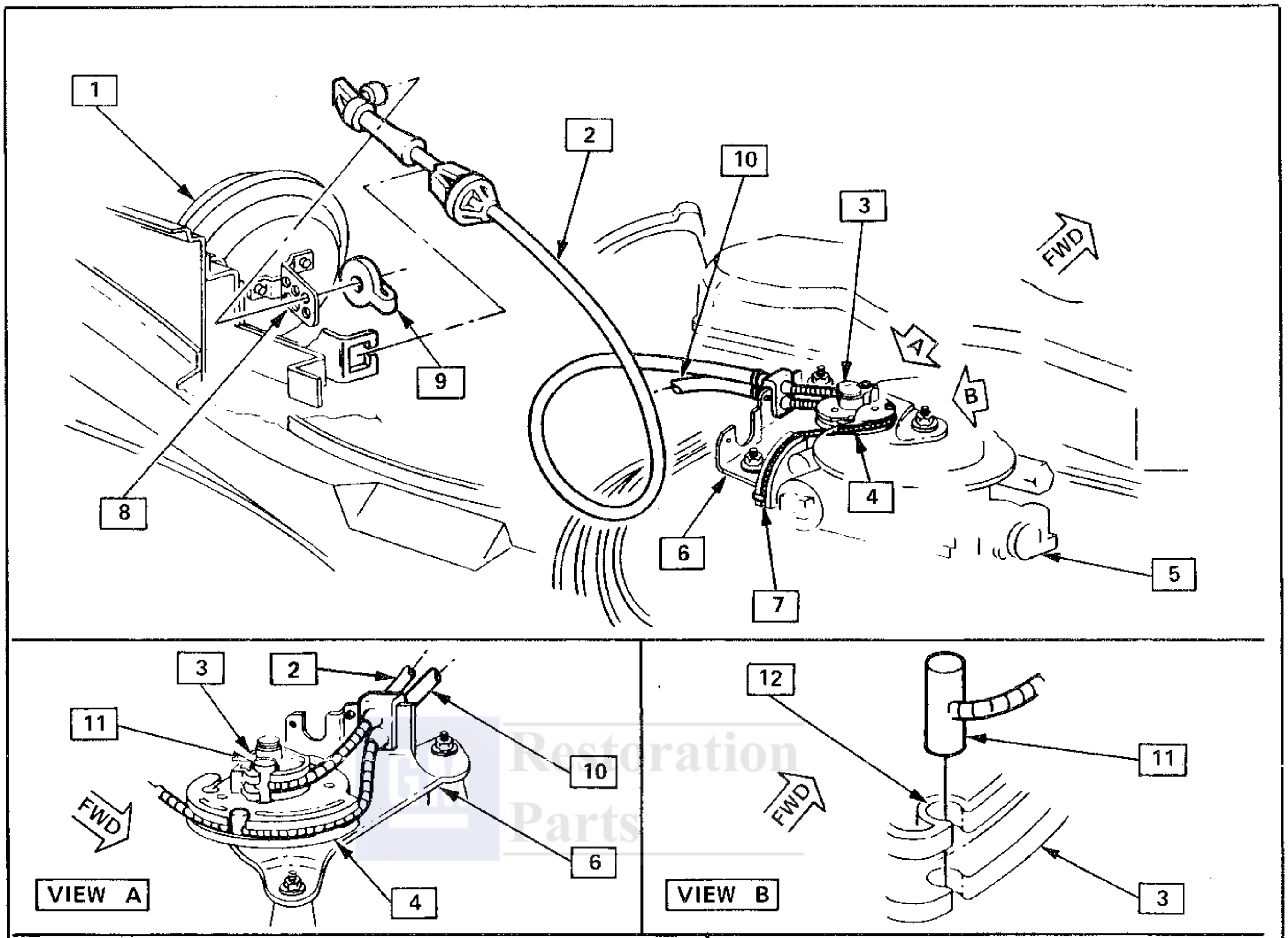
Fig. 801 Cruise Servo/Cable - V6



CRUISE CONTROL CABLE INSTALLATION AND ADJUSTMENT PROCEDURE

1 — ACCELERATOR CABLE MUST BE INSTALLED PRIOR TO CRUISE CONTROL CABLE INSTALLATION.

2 — WITH CRUISE CABLE ATTACHED AT ENGINE BRACKET. INSERT CABLE SLUG IN CRUISE PULLEY SLOT.

3 — INSERT CABLE IN SERVO BRACKET.

4 — PULL SERVO ASM. END OF CABLE TOWARD SERVO WITHOUT MOVING IDLER PULLEY.

5 — IF ONE OF THE SIX HOLES IN THE SERVO ASM. TAB LINES UP WITH CABLE PIN, PUSH PIN THRU HOLE AND CONNECT PIN TO TAB WITH RETAINER 9.

6 — 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 9.

CAUTION DO NOT STRETCH CABLE SO AS TO MAKE A PARTICULAR TAB HOLE CONNECT TO PIN. THIS COULD PREVENT ENGINE FROM RETURNING TO IDLE.

1 — CRUISE SERVO
2 — CRUISE CABLE; MUST BE INSTALLED IN DIRECTION SHOWN
3 — CRUISE PULLEY (BRACKET ASM.)
4 — IDLER PULLEY (BRACKET ASM.)
5 — TBI UNIT (ENGINE)
6 — BRACKET ASSEMBLY (ENGINE)
7 — TBI PULLEY (ENGINE)
8 — TAB (SERVO)
9 — RETAINER
10 — ACCELERATOR CABLE
11 — SLUG (CABLE ASM.)
12 — PULLEY SLOT

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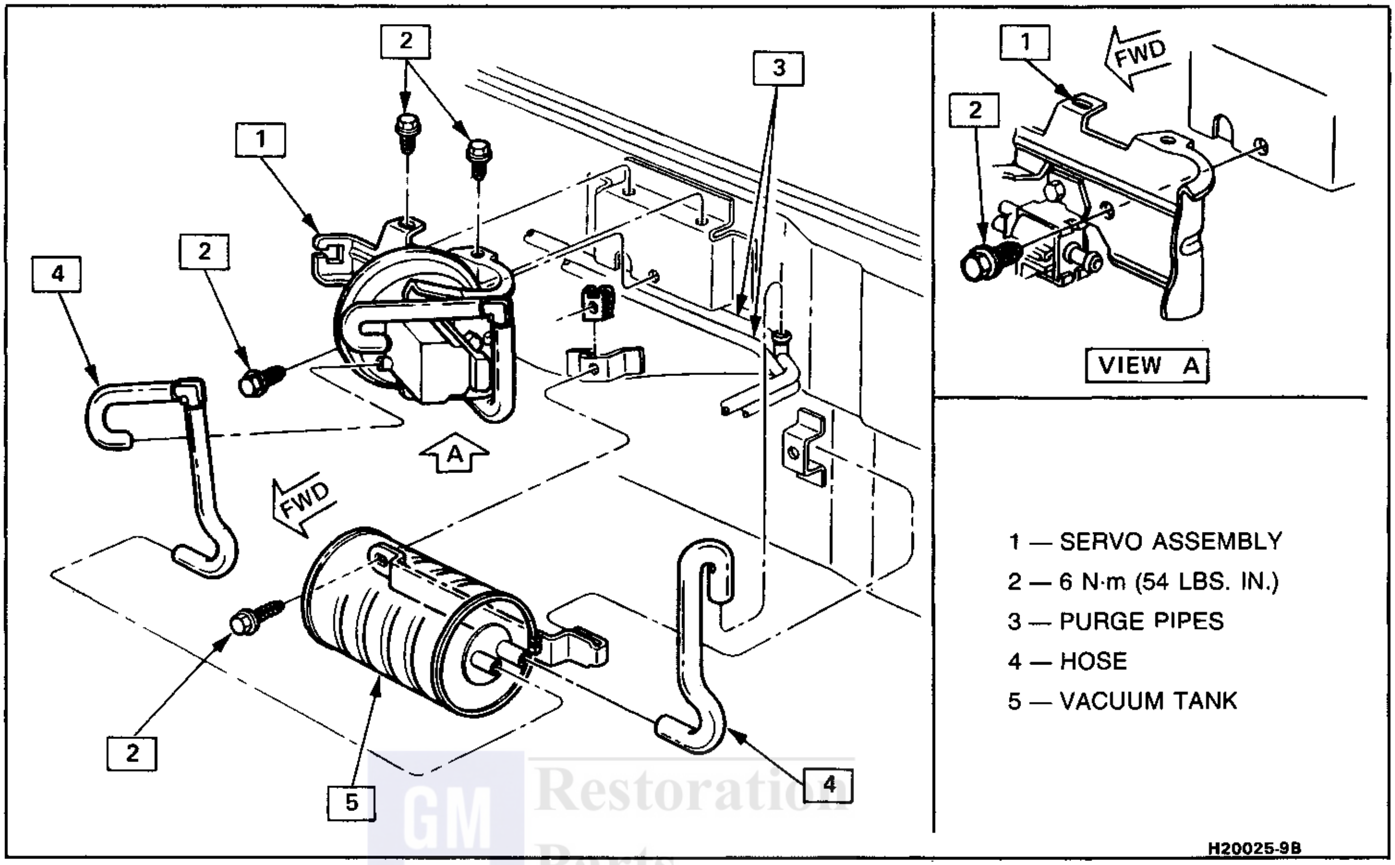
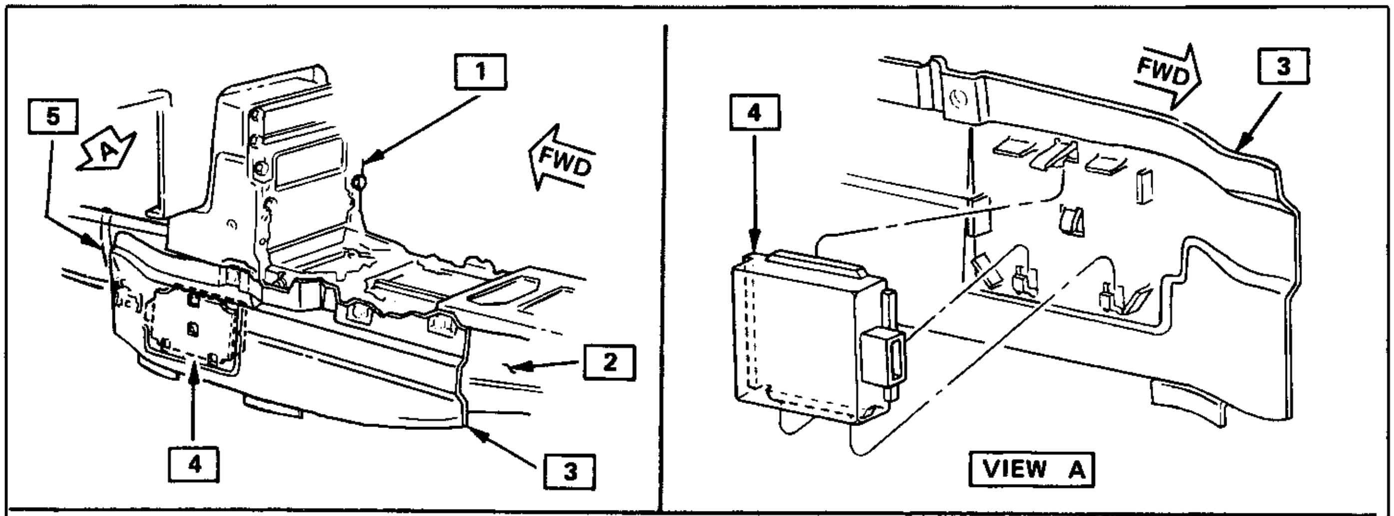
Fig. 802 Cruise Servo/Cable - L4



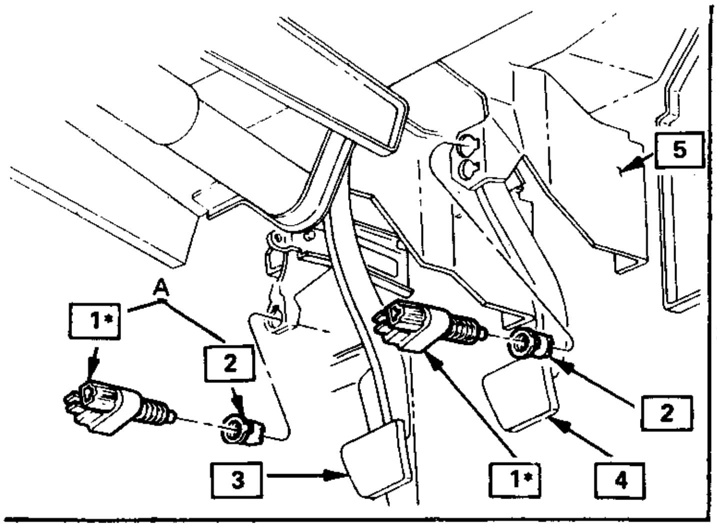
1 — SERVO ASSEMBLY
2 — 6 N·m (54 LBS. IN.)
3 — PURGE PIPES
4 — HOSE
5 — VACUUM TANK

Fig. 803 Vacuum Tank/Servo/Brackets/Hoses



1–SUPPORT ASM
2–UPPER FLOOR PAN
3–CARPET SUPT
4–MODULE ASM
5–HARNESS ASM

Fig. 804 Cruise Control Module - V6



***INSTALLATION OF SELF-ADJUSTING SWITCH ASM**

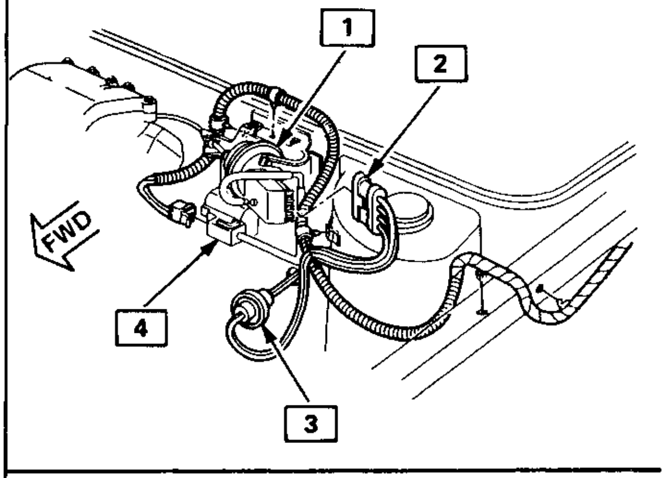
1. INSTALL RETAINER
2. WITH BRAKE PEDAL DEPRESSED, INSERT SWITCH ASM INTO RETAINER UNTIL SWITCH BODY SEATS ON RETAINER. NOTE THAT AUDIBLE "CLICKS" CAN BE HEARD AS THREADED PORTION OF SWITCH IS PUSHED THROUGH THE RETAINER TOWARD THE BRAKE PEDAL.
3. PULL BRAKE PEDAL FULLY REARWARD AGAINST PEDAL STOP UNTIL 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. 805 Cruise Release Switches



1 – CRUISE CONTROL SERVO

2 – SERVO CONNECTOR

3 – GROMMET

4 – SOLENOID CONNECTOR

H20014-9B

Fig. 806 Cruise Wiring - V6

SECTION 9E

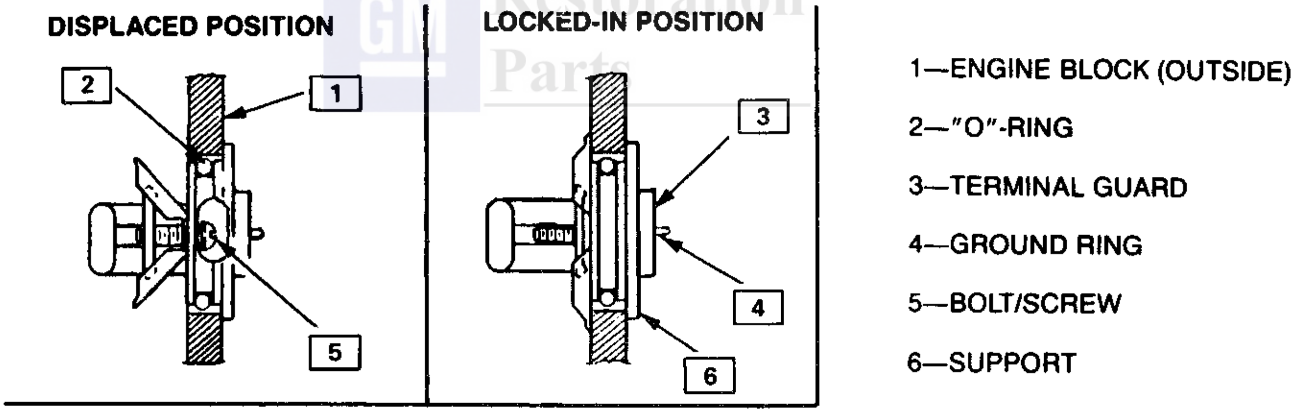
ENGINE BLOCK HEATER

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 to avoid having the element contact the side of the block.

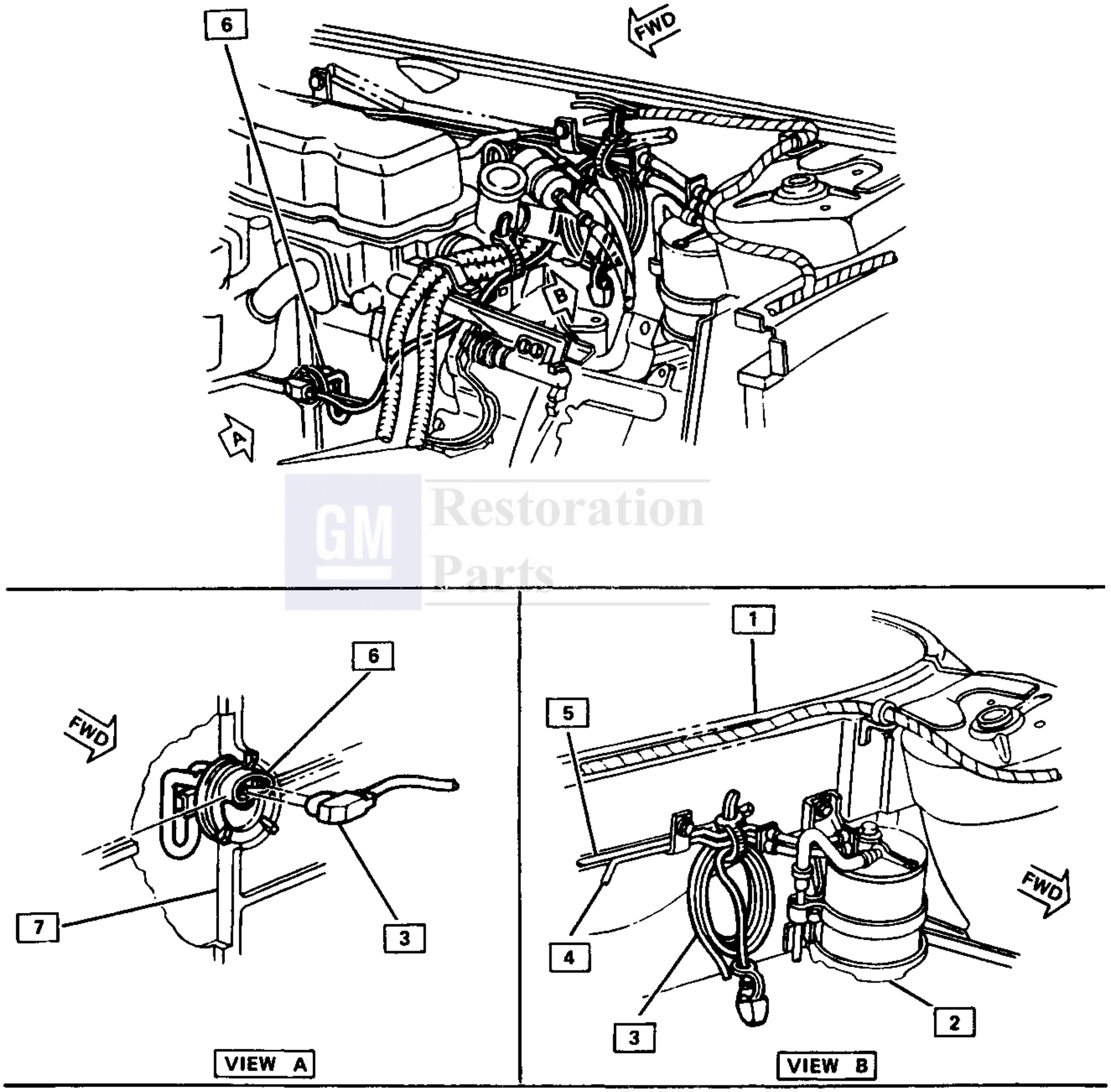
ON-CAR SERVICE



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 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

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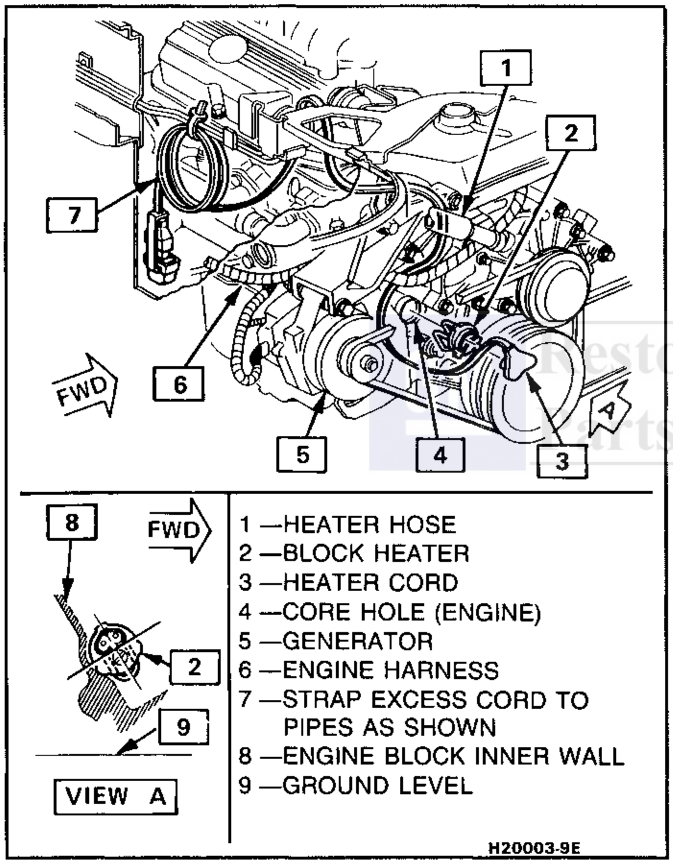
Fig. 802 Block Heater - L4



1 —HEATER HOSE
2 —BLOCK HEATER
3 —HEATER CORD
4 —CORE HOLE (ENGINE)
5 —GENERATOR
6 —ENGINE HARNESS
7 —STRAP EXCESS CORD TO PIPES AS SHOWN
8 —ENGINE BLOCK INNER WALL
9 —GROUND LEVEL

Fig. 803 Block Heater - V6

SECTION 9F

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, a voltmeter,and, in some applications, a tachometer.

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 on the engine. See Section 8C On-Car Service for specific locations. 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 bands can indicate improper voltage regulation, broken or slipping alternator belt, a shorted alternator diode or a defective battery. Readings in the low band are normal with the engine idling or for short periods after long engine cranking. However, continuous readings in the low band can indicate faulty operation.

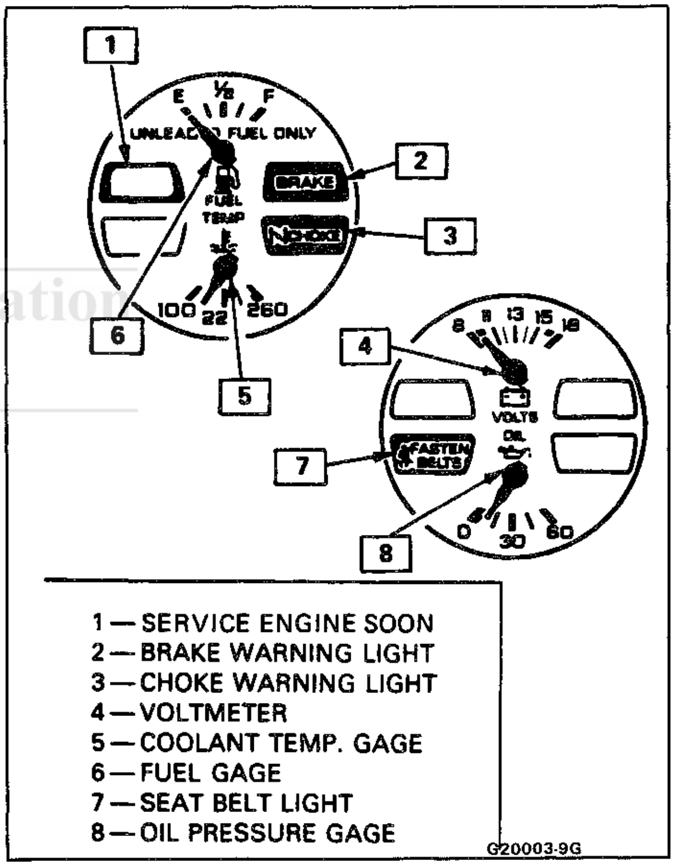


Fig. 1 Rally Gages - Typical

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 on clusters without an electronic digital odometer can be reset by **twice** fully depressing the reset pushbutton. 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. On clusters with an electronic digital odometer simply press the Reset button.

ELECTRIC REAR WINDOW DEFOGGER

The electric rear window defogger system incorporates an electrical grid fused to the inside surface of the rear glass. Current is applied to this grid through a control switch on the instrument panel to warm and defog the glass. A defogger timer, which is also activated when the system is on, 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

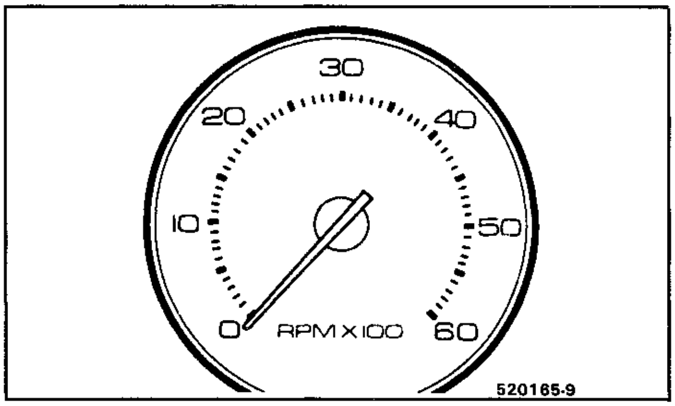


Fig. 2 Tachometer - Typical

any time by moving/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. It is suggested that only a side-to-side motion (in the same direction as the grid lines) be used when cleaning the rear glass to avoid grid damage. Damage to the grid could cause an open circuit. A monitor lamp indicates power being fed to the rear window grid to indicate 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. See Section 8C On-Car Service for specific location and service procedures.

DIAGNOSIS

RALLY GAGES/TACHOMETER

Diagnosis of individual rally gages is found in Section 8A-81 or 82, depending on the type of instrument cluster.

ELECTRIC REAR WINDOW DEFOGGER

Figure 3

Use the chart in Figure 3 to aid in diagnosis of problems with the rear defogger system. Testing and repair of the grid itself are covered in Section 10 of the Body Service Manual.

The electric defogger system wiring and troubleshooting are covered in Section 8A-61, 'Defogger'.

POWER REMOTE CONTROL OUTSIDE MIRROR

The repair and mounting of the mirror assemblies is covered in the Body Service Manual, Section 5. See Section 8A-141 'Power Remote Mirrors' for electrical diagnosis.

DASH AND CONSOLE MOUNTED ACCESSORY SWITCHES

Installation for various dash and console mounted accessory switches is shown in Section 8C. Diagnosis for the switches and the systems they control is in Section 8A.

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. 3 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 at time of publication approval.

TABLE OF CONTENTS

SECTION 1J

GENERAL INFORMATION

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

CONTENTS

Body 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 in the ignition lock cylinder.
- Oval headed key is used in all other lock cylinders.

Key identification is obtained from the four character key code stamped on the knockout portion of the key head and an identification letter stamped on the key shank. After the code number has been recorded by the owner, the plugs should be knocked out of the key head. From these numbers, the lock combination can be determined by use of a code list (available to owners of key cutting equipment from equipment suppliers). If key code numbers are not available from records or from the knockout plug, the lock combination (tumbler numbers and position) can be determined by laying key on diagram in Figure 1.

CUTTING KEYS

- Determine special code from the code list or the key code diagram (Fig. 1).
- Cut a blank key to the proper level for each of six tumbler positions.
- Check key operation in the lock cylinder.

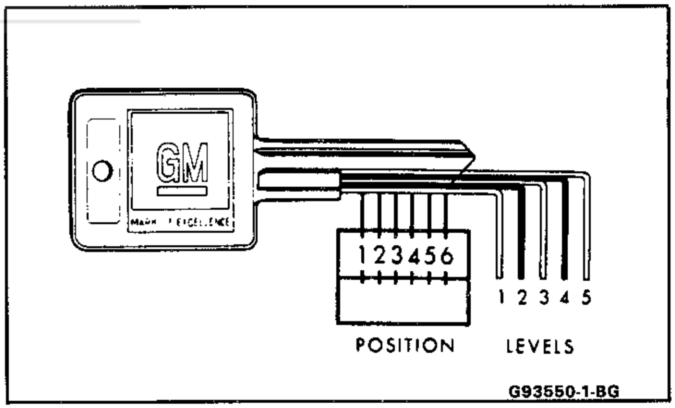


Fig. 1 - Key Code Diagram

REPLACEMENT LOCK CYLINDERS

Lock cylinders are available from service parts warehouses. The new cylinder has a locking bar staked in place. Tumblers are also available and must be assembled into the cylinder.

ASSEMBLING AND CODING LOCK CYLINDERS

Tumblers for all locks are shaped exactly alike with the exception of the notch position on one side. As the key is inserted in the lock cylinder, tumblers are lowered to the correct height so that notches on each tumbler are at the same level. When the notches on all six tumblers line up, the side bar is pushed into the notches by two small springs. This allows the cylinder to turn in its bore. Five types of tumblers are used to make the various lock combinations. Each tumbler is coded according to a number, 1 through 5, stamped on its side.

Assemble (Figs. 2 and 3)

1. Determine tumbler numbers and arrangement.
   a. With numerical key code, use code list provided by key cutting equipment supplier.
   b. Without numerical key code or without code list, refer to Figure 1.
      - Lay key on key code diagram. Be sure key is outlined by diagram.
      - Start with position number one. Find and record lowest level (tumbler number) that is visible. Repeat for each of the remaining five positions.
2. Starting with position one (open end or head of cylinder), insert tumblers in their proper slots in the order called for by the code (Fig. 2).
3. Pull side bar out with fingers so that tumblers will drop completely into place.
4. Insert one tumbler spring above each tumbler.
5. Insert spring retainer so that end prongs slide into the slots at each end of cylinder. Press retainer down.

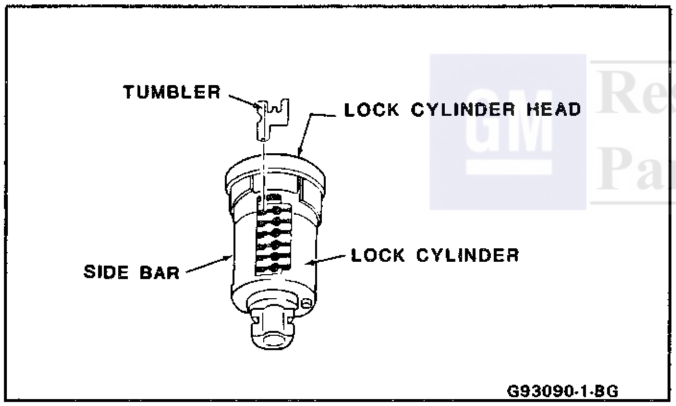


Fig. 2 - Installing Tumblers

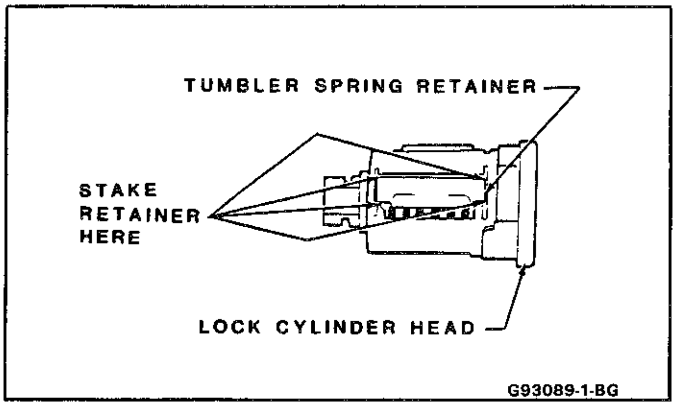


Fig. 3 - Installing Spring Retainer

6. Insert key into lock cylinder to check for proper installation.

Inspect

Side bar will drop down if tumblers are installed properly, If incorrectly assembled, disassemble and reassemble correctly.

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.

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 surfaces 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.
- All weatherstrips should be periodically lubricated with a silicone paste lubricant, part no. 1052363, or equivalent. A thin film of lubricant should be applied using a clean cloth.

WATERLEAK DIAGNOSIS AND REPAIR

GM vehicles are designed to operate under normal environmental conditions. The design criteria for sealing materials and components takes into consideration the sealing forces required to withstand the natural elements. These specifications do not, and cannot, take into consideration all artificial conditions such as may be encountered in some high pressure car washes.

The watertest procedure has been correlated to the natural elements and will determine the ability of a car to perform under normal operating conditions.

Repairing body waterleaks is a problem of proper testing, diagnosis and repair through adjustment of misaligned components and/or application of proven repair materials. The first step in waterleak diagnosis is finding the conditions under which the leak occurs. For example, leak noticed only when parked on an inclined drive or water in spare tire compartment.

If the general leak area can be found, the exact entry point can be quickly isolated by use of a localized test such as a water hose or air hose. If the leak source is not obvious, the generalized testing method using watertest equipment such as the watertest stands shown in Figures 4 and 5 should be used. It may be necessary to remove some interior trim panels or components to locate and confirm repairs.

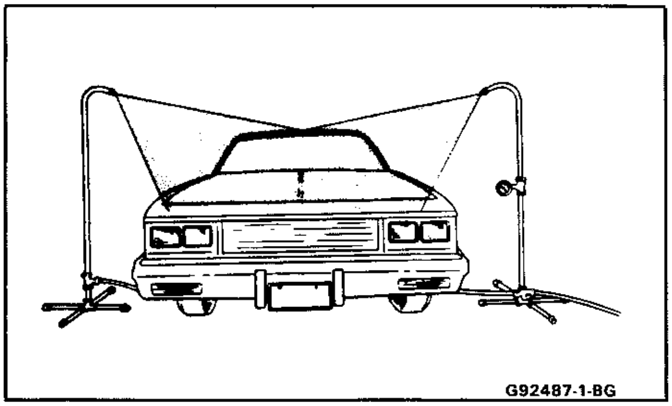


Fig. 4-Watertest Stands Positioned for Front End Watertest

GENERALIZED TESTING

Specifications for construction of the watertest stand are shown in Figure 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

- Have a helper inside the car to detect the actual leak point (Figs. 7 and 8).
- Use unrestricted water flow (no nozzle).
- Begin at base of suspected leak area and move upward slowly.

AIR HOSE TEST

- Apply bubble solution (liquid soap) to suspected area (Fig. 9).
- Apply air pressure with an air hose from inside vehicle. Do not exceed 205 kPa (30 psi)
- Observe for bubbles on outside at suspected leak area.

WATERLEAK REPAIR

To locate the exact leak point, or to repair the leak, 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 2J.
- 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.

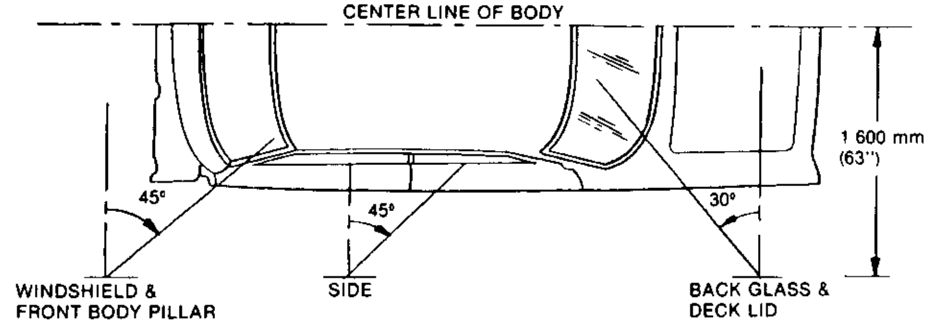


Fig. 5-Watertest Stand Specifications

should be corrected by resealing. Attaching points of new replacement panels should be resealed (Fig. 10).

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 control the general noise level inside the passenger area of the car. When deadeners are disturbed because of damage, removed during repair operations, or a new replacement panel is installed, the deadener material must be replaced by a service equivalent material. The application pattern and location of deadener materials can be determined by observing the original production installation.

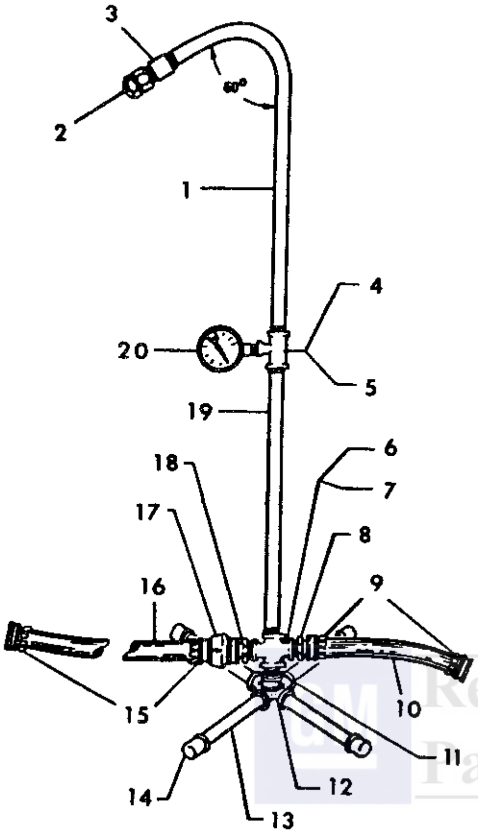
Anticorrosion compounds are light-bodied materials designed to penetrate between metal-to-metal surfaces, such as pinch-weld joints, hem flanges, and integral panel attaching points where metal surfaces are difficult to coat with conventional undercoating materials, and are inaccessible for painting. Materials suited for this type application are 3M Rust Fighter-1 (part no. 08892) or equivalent.

Conventional undercoating is recommended to coat large areas such as 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 (at all previously sealed joints).
4. Apply color in areas where color is required, such as hem flanges, exposed joints and underbody components.
5. Apply deadeners (as indicated by original application pattern).
6. Apply anticorrosion compounds.
7. Apply underbody rustproofing material.

Cleaning of interior and underbody panel surfaces is necessary when original galvanized or other anticorrosion materials have been burned off during welding or heating operations. Removal of the residue left from burning will require additional care in such areas as interior surfaces of box-type construction and when configurations of the metal panels limit access to



1. 1/2" x 36" Pipe
2. Full-Jet Spray Nozzle #1/2GG-25 or Equivalent Nozzle Height - 64" to Floor
3. 1/2" Coupling
4. 1/2" x 1/2" x 1/4" Reducing Tee (Right Only)
5. 1/2" Coupling (Left Only)
6. 1/2" Cross (Right Only)
7. 1/2" Tee (Left Only)
8. 1/2" Pipe to Hose Nipple (Right Only)
9. 5/8" Female Hose Coupling
10. 2' Input Hose (5/8" Dia.) Right Only
11. 1/2" Close Nipple
12. 1/2" Cross with Weld-On 1/2" Cap
13. 1/2" x 12" Nipple
14. 1/2" Cap
15. 5/8" Female Hose Coupling
16. 12' Cross Hose (5/8" Dia.)
17. Hose Quick Connect
18. 1/2" Pipe to Hose Nipple
19. 1/2" x 30" Pipe (Straight)
20. Water Pressure Gage (Right Side)

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Fig. 6-Watertest Stand

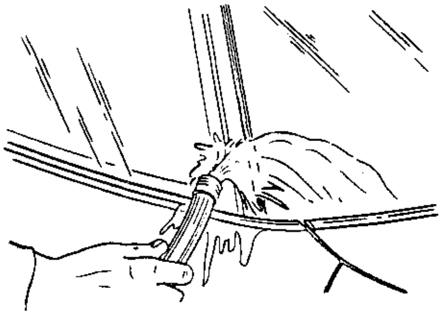


Fig. 7-Water Hose Test of Windshield Pillar

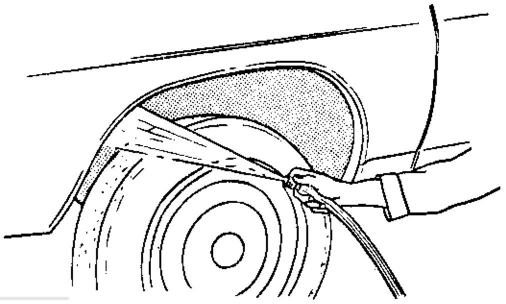


Fig. 8-Pressure Test of Wheelhouse

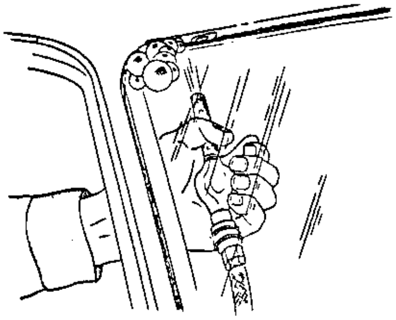
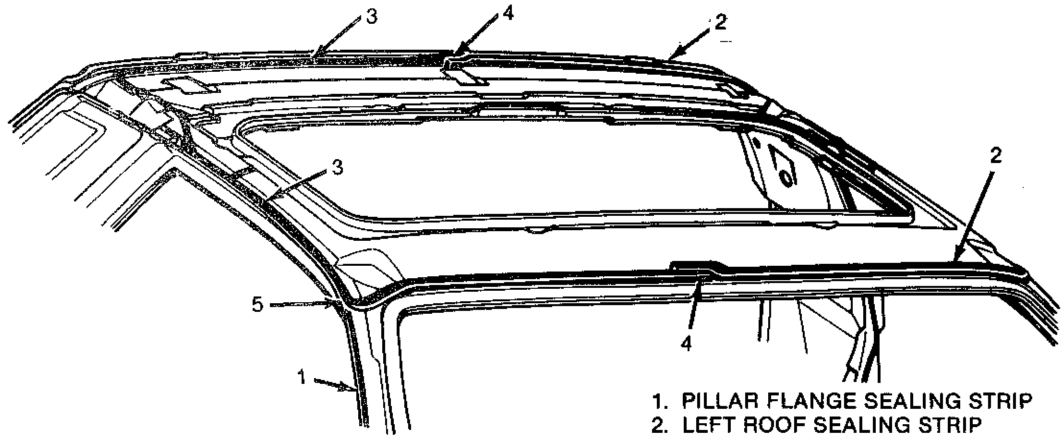


Fig. 9-Air Hose and Bubble Solution Test of Windshield Glass Sealant

interior surfaces. One or more of the following methods will remove the residue.

CAUTION: Standard shop practices, particularly eye protection, should be followed during these operations to avoid personal injury.

- Where access is possible, scraping can be used. If a standard putty knife or scraper will not fit into the affected area, consider fabricating a small, flexible scraper from a narrow piece of sheet metal.
- A jet of compressed air will remove most residue and could be most effective in limited-access areas. Eye protection is absolutely necessary in an operation of this type.
- Sandblasting is most effective and should be used when the equipment is available and access to the



1. PILLAR FLANGE SEALING STRIP
2. LEFT ROOF SEALING STRIP
3. RIGHT ROOF SEALING STRIP
4. OVERLAP OF SEALING STRIPS, FRONT AND REAR
5. BUTT JOINT PILLAR FLANGE TO ROOF SEALING STRIPS

Fig. 10-Sealing Locations

area is good. Sandblasting is an excellent method for cleanup and preparation of open joints, underbody components and hem flange areas.

- Wire brushing (power and by hand).
- When access is good, sandpaper and steel wool can be used.

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 #4051 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 has 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.

Preparation of the back and face sides of the part and the use of structural adhesive will be the same as the procedure for RIM and RRIM.

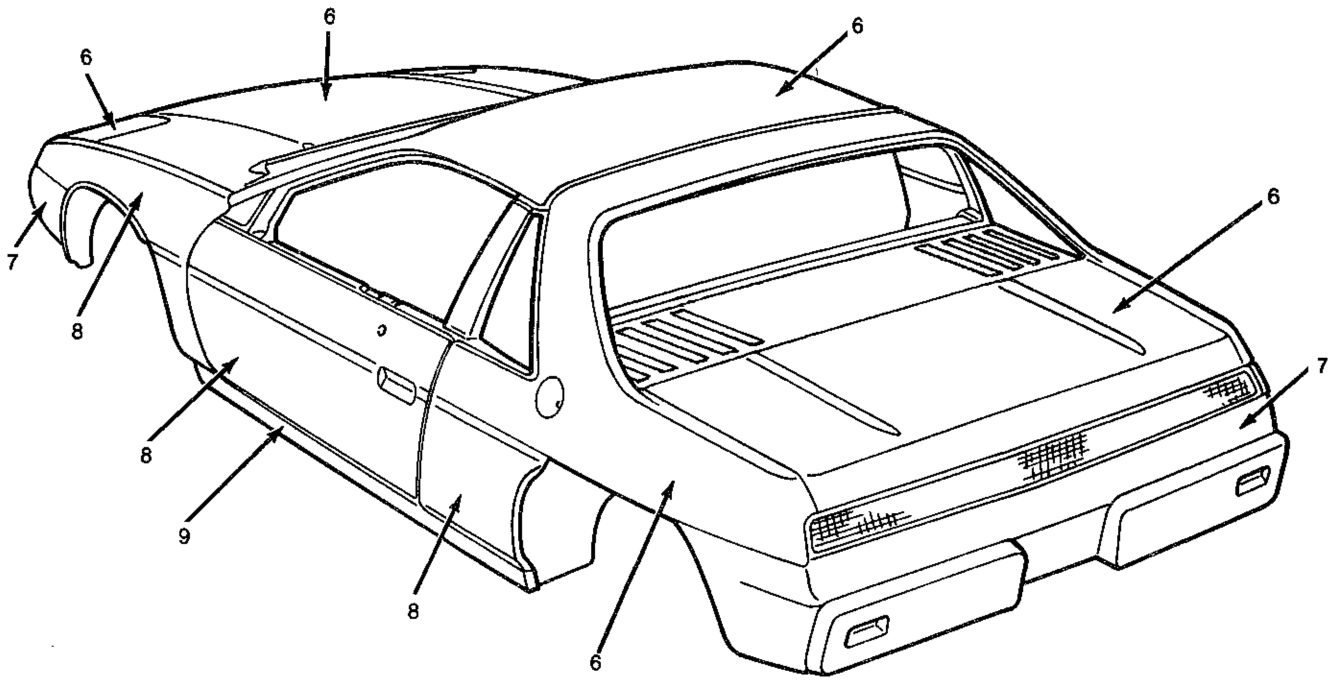
REACTION INJECTION MOLDED (RIM) AND REINFORCED REACTION INJECTION MOLDED (RRIM) PARTS

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. 12).
   b. Use a clean 2″ or 3″ #50 grit disc to enlarge the gouge or puncture in order to ensure removal of grease, oil or dirt from the area to be contacted by the repair material. This action should also create at least a 25 mm (1″) taper around the damage for extended contact between the repair material and substrate. Remove all dust and loose particles from the repair area (Fig. 13).

      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. 14).
   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



6. SMC — SHEET MOLDED COMPOUND
7. RIM REACTION INJECTION MOLDED URETHANE
8. RRIM REINFORCED REACTION INJECTION MOLDED URETHANE
9. TPO — THERMO PLASTIC OLEFIN

Fig. 11-Exterior Panel Identification

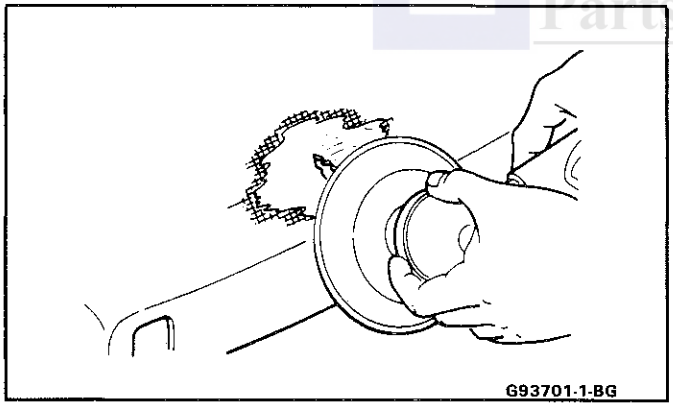


Fig. 12-Removing Paint Surrounding Damage

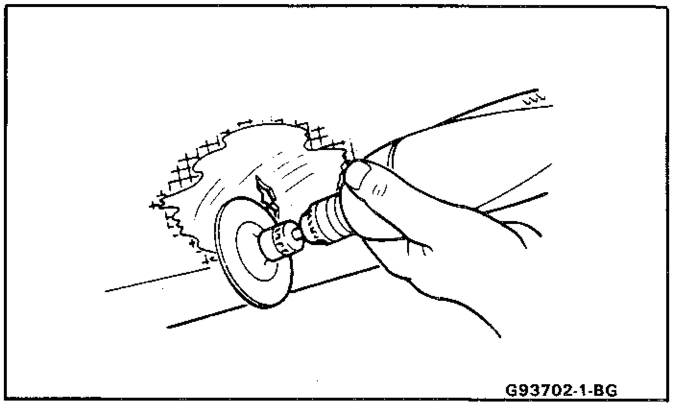


Fig. 13-Tapering Substrate Surrounding Damage

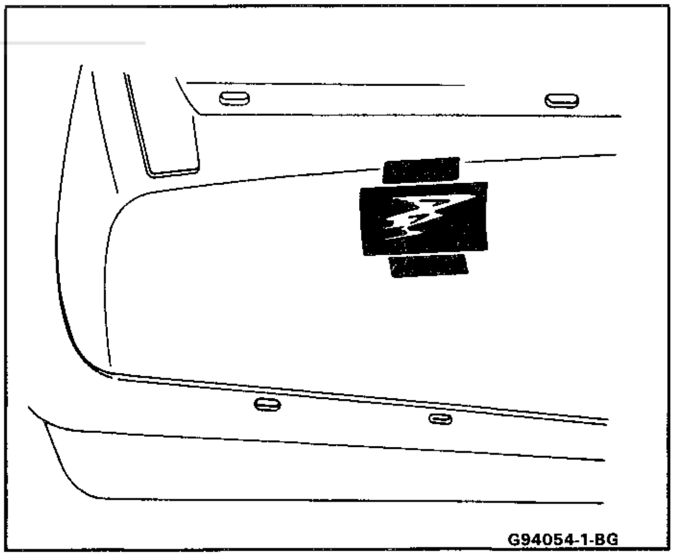


Fig. 14-Tape Support for Repair Material

until a uniform color and consistency is achieved (Fig. 15).

d. Apply the mixed repair material with a squeegee or plastic spreader. Apply a light coat over the entire area; then continue application to a level slightly above the surrounding contour. Allow the mixture to cure 20 to 30 minutes at 16°C to 27°C (60°F to 80°F). If low areas or pits remain, mix and spread additional adhesive or use 3M Flexible Parts Putty #05903 or equivalent (Fig. 16).

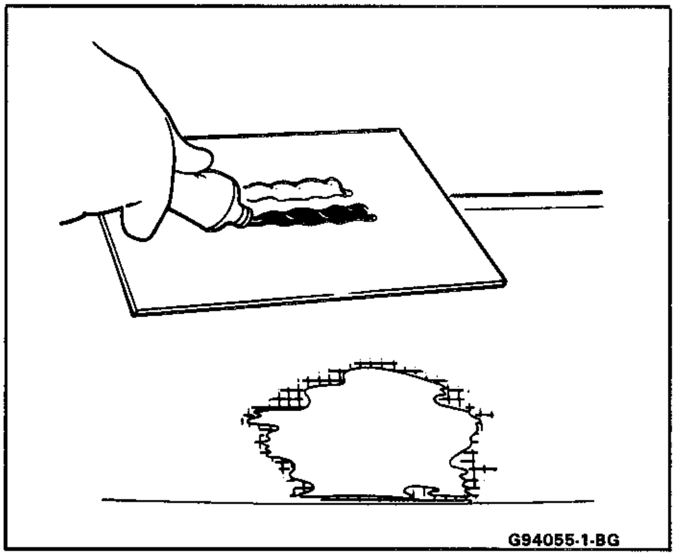


Fig. 15-Measuring Two-Component Repair Material

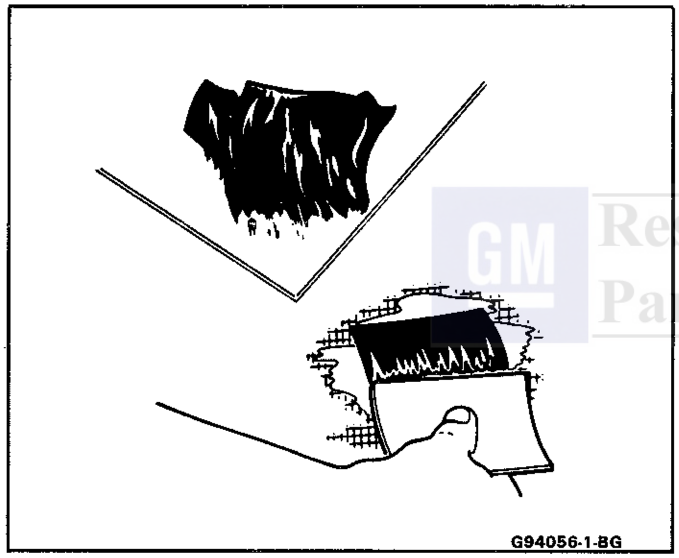


Fig. 16-Applying Mixed Repair Material

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. 17 and 18). For final feathering, use a random orbit sander with a #320 disc.

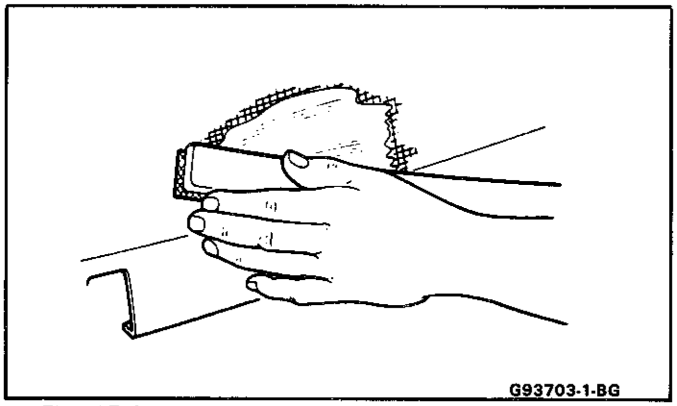


Fig. 17-Establishing Rough Contour with Body File

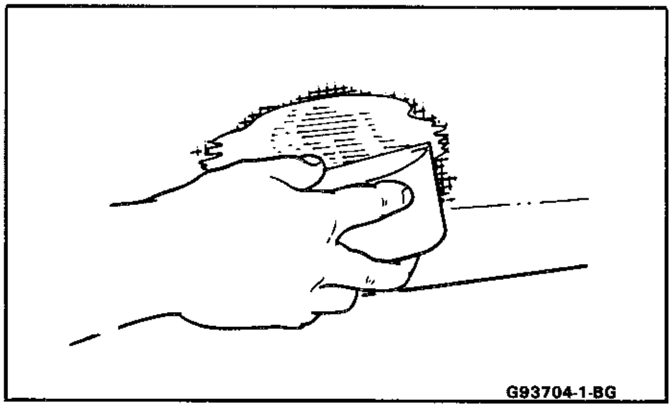


Fig. 18-Block Sanding for Accurate Contour

2. Structural type repair
   When a piece of attaching surface of a part is cracked or broken away as in Figure 19, structural strength may be restored as follows:
   a. Align and secure the piece on the face side with body tape and clamp (Fig. 20).

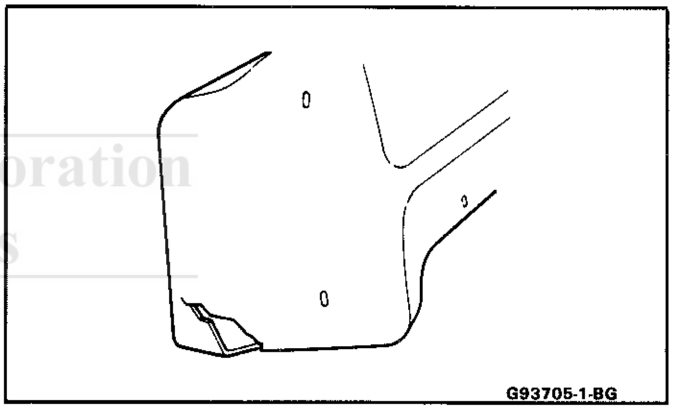


Fig. 19-Damaged Attaching Surface

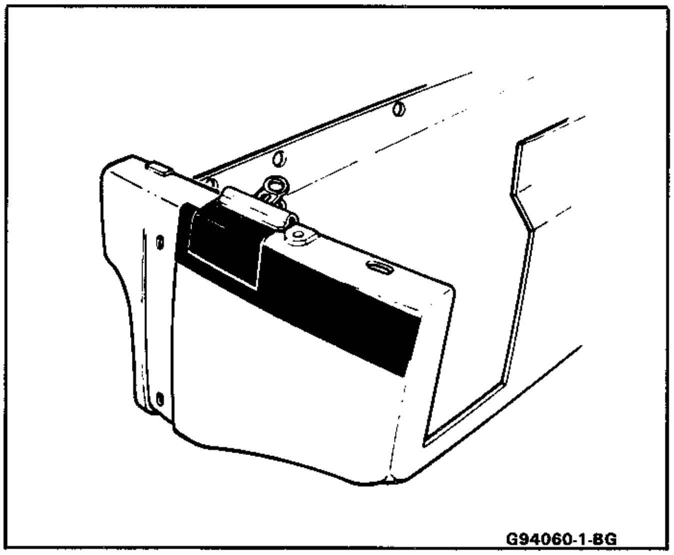


Fig. 20-Aligning Damage with Tape and Clamp

   b. Clean the underside of the repair area as in step 1a. Sand each side of the break with a #50 grit disc (Fig. 21).

c. Cut a piece of fiberglass cloth large enough to overlap the break 38 mm (1-1/2") (Fig. 22).

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 23.

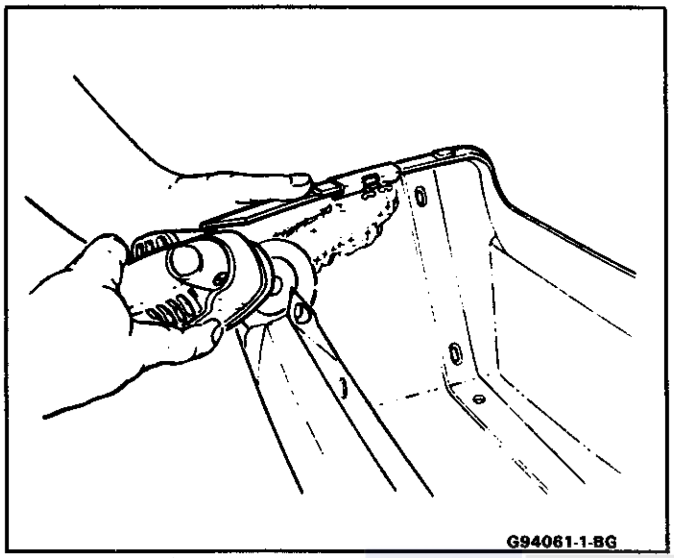


Fig. 21-Discing Back Side of Damage

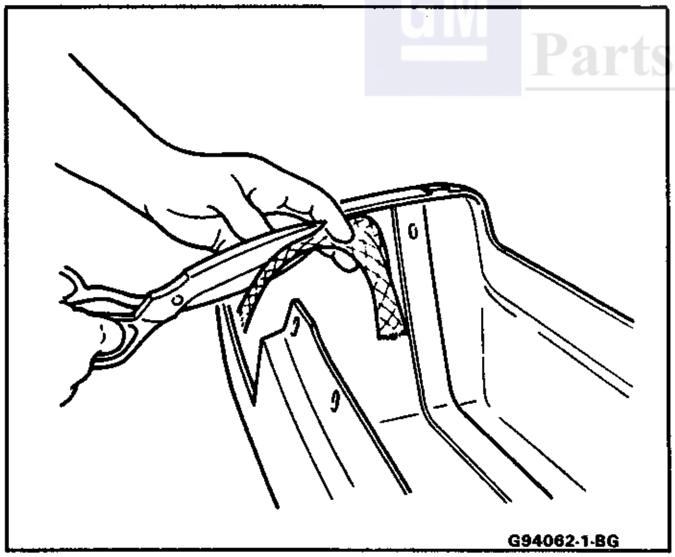


Fig. 22-Cutting Fiberglass Cloth to Size

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. 24 and 25).

f. Allow 20-30 minutes cure time at 16°C to 27°C (60°F to 80°F). Trim excess repair material at edge if necessary.

g. Repair the face side of the area following steps 1a through 1e.

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 manufacturer's recommendations for application.

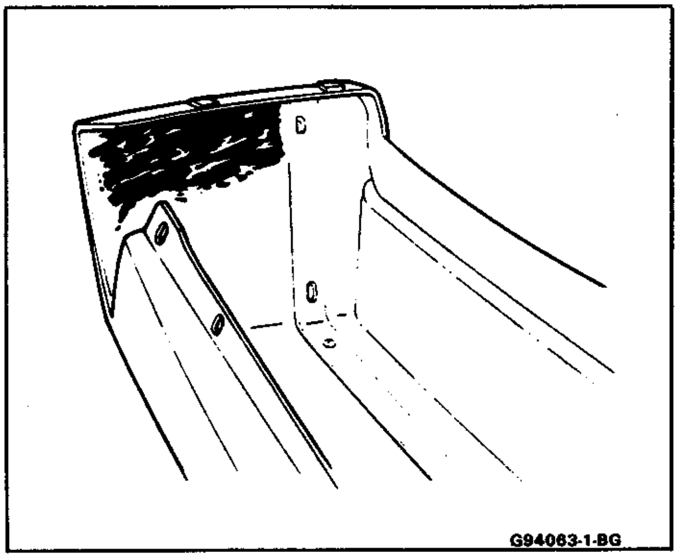


Fig. 23-Applying Repair Material - Back Side of Damage

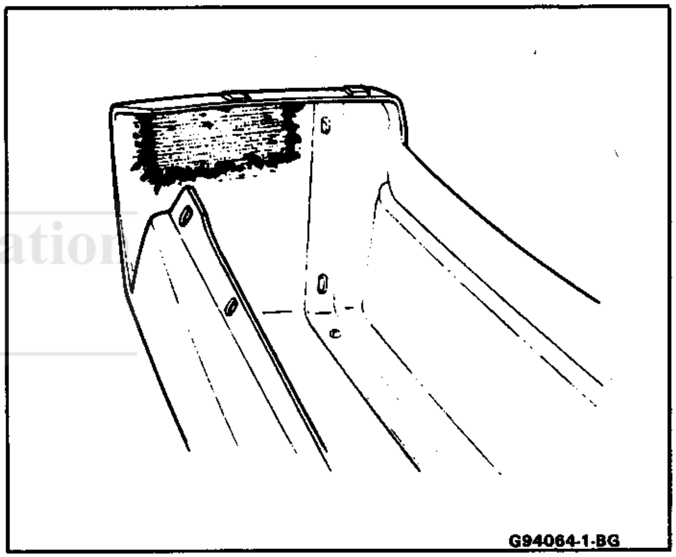


Fig. 24-Applying Fiberglass Cloth to Repair Material

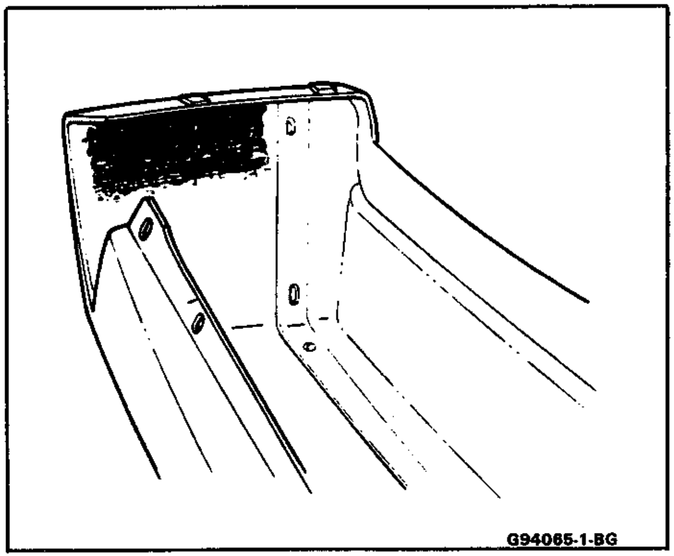


Fig. 25-Filling Fiberglass Cloth

When painting RIM panels (front or rear fascia) the paint **must** have elastomeric or flexible properties. There is a wide choice of flexible paint systems available for service use, however, many require additives containing isocyanates. Be certain to follow 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 adequate respiratory protection be worn. An exapmle of such protection is an air line respirator with a full hood or half mask. If not available, use a vapor/particulate respirator that the respirator supplier recommends as effective for isocyanate vapors and mists (unless local regulations prevail).**

When using a flexible paint system, color coat the entire panel. Spot repair is not recommended.

INTERIOR PLASTIC TRIM PARTS FINISHING

Paintable plastic interior trim components can be divided into three general types:

- Polypropylene Plastic
- ABS Plastic
- Vinyl Plastic

It is important for a painter to be able to identify each plastic in order to paint it satisfactorily. Painting of complete soft seat cushion and seatback trim cover assemblies of vinyl construction is not approved by the factory. Excluding the soft seat cushion and seat back trim cover assemblies, the plastic used most widely on the interior of bodies is polypropylene.

The purpose of the following tests is to determine the identity of a given plastic so that proper paint procedures and materials can be used.

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:
   a. Polypropylene burns with no readily visible smoke.
   b. ABS plastic burns with a readily visible black smoke residue which hangs temporarily in the air.

Test for Vinyl Plastic

To determine if a part to be painted is vinyl plastic (polyvinyl chloride), a copper wire test should be performed as follows:

1. Heat a copper wire in a suitable flame such as provided by a propane or equivalent torch until the wire glows (turns red).
2. Touch the heated wire to the backside or hidden surface of the part being tested in a manner so as to retain some of the plastic on the wire.
3. Return the wire (and retained plastic) to the flame and observe for a green, turquoise blue flame. A flame in this color range indicates that the plastic being tested is vinyl.
4. If black smoke residue, which hangs temporarily in the air, is readily visible when wire (with retained plastic residue) is returned to the flame, the part is made of flexible (soft) ABS plastic material.

PAINTING POLYPROPYLENE PLASTIC PARTS

The system for painting polypropylene parts involves the use of a special primer. Since polypropylene plastic is hard, it can be color coated after prime with conventional interior acrylic lacquer.

> **NOTICE:** Service part must be primed with a coating of special polypropylene primer according to factory recommendations. Failure to use the required primer as directed will result in color coat lifting and/or peeling problems. Use Polypropylene Primer, part no. 1052364, or equivalent.

1. Wash part with a solvent such as Acryli-Clean, Pre-Kleano, Prep-Sol or equivalent. Follow label directions.
2. Apply a thin, wet coat of polypropylene primer according to label directions. Wetness of primer is determined by observing gloss reflection of spray application in adequate lighting. Be sure primer application includes all edges. Allow primer to flash dry one minute minimum and ten minutes maximum.
3. During the above flash time period (1 to 10 minutes), apply conventional interior acrylic lacquer color as required and allow to dry before installing part. Application of color during above flash time range promotes best adhesion of color coats.

PAINTING RIGID OR HARD ABS PLASTIC PARTS

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

1. Wash part with a solvent such as Acryli-Clean, Pre-Kleano, Prep-Sol or equivalent.
2. Apply conventional interior acrylic lacquer color according to trim combination (see paint supplier color chart for trim and color code). Apply only

enough color for proper hiding to avoid washout of "grain" effect.

3. Allow to dry following label directions and then install part.

PAINTING VINYL AND FLEXIBLE (SOFT) ABS PLASTIC PARTS

The outer cover material of flexible instrument panel cover assemblies is made mostly of ABS plastic modified with PVC or vinyl. The same is true of many padded door trim assemblies. The soft cushion padding under ABS covers is urethane foam plastic.

The most widely used flexible vinyls (polyvinyl chloride) are coated fabrics as used in seat trim, some door trim assemblies, headlinings and sunshades. Most head restraints are covered with flexible vinyls. Examples of hard vinyls are door and front seatback assist handles, coat hooks and exterior molding inserts.

The paint system for vinyl and flexible ABS plastic involves the use of interior vinyl color and a clear vinyl top coat. No primer or primer-sealer is required.

1. Wash part with a vinyl cleaning and preparation solvent, such as Vinyl Prep, Vinyl Prep Conditioner or equivalent. Wipe off cleaner while still wet with clean, lint-free cloth.
2. As soon as the surface has been wiped dry, apply interior vinyl color in wet coats. Allow flash time between coats. Follow label directions. Use proper vinyl color as shown by interior trim code combination. Apply only enough color for proper hiding to avoid washout of grain effect.
3. Before color flashes completely, apply one wet double coat of vinyl clear top coat. Use top coat with appropriate gloss level to match adjacent similar components. The clear coat is necessary to control the gloss requirement and to prevent crocking (rubbing-off) of the color coat after drying.
4. Allow to dry according to label directions before installing part.

AVAILABILITY OF COLORS FOR PAINTING INTERIOR PLASTIC PARTS

Interior colors are color keyed to trim code combination numbers located on the body number plate or service parts identification label.

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

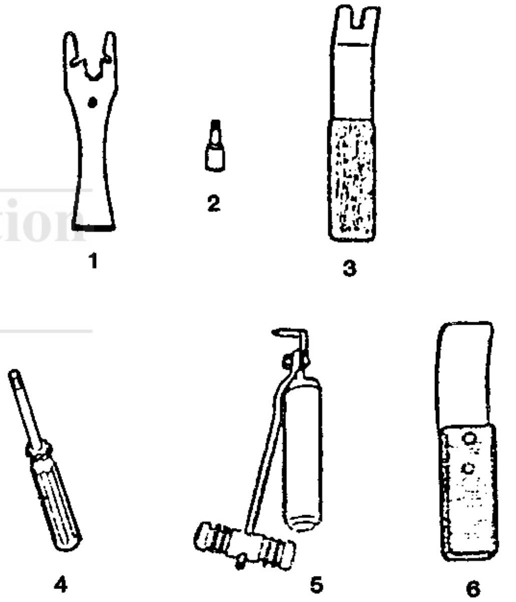
1. Steel parts (primer and/or sealer required on new service parts)
2. Hard ABS plastic (no primer necessary)
3. Hard polypropylene plastic (special primer required)

Each major paint supplier provides an interior color chart which identifies the stock number, color name, gloss factor and trim code combination number for each conventional interior color.

Vinyl interior colors are designed for soft trim parts such as instrument panel cover assemblies 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 26 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

H93802-1J-P

Fig. 26-Special Body Tools

SECTION 2J

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 scratches on opposite side of glass with a wax marking pencil or crayon. Draw other lines directly behind scratches to serve as guides in locating scratch during polishing (Fig. 1).
4. Use masking paper where needed to catch drippings or spattered polish.
5. Dip felt pad attached to polisher into mixture several times to insure that pad is well saturated. Do not submerge or allow pad to stay in mixture as it may loosen bond between pad and metal plate.

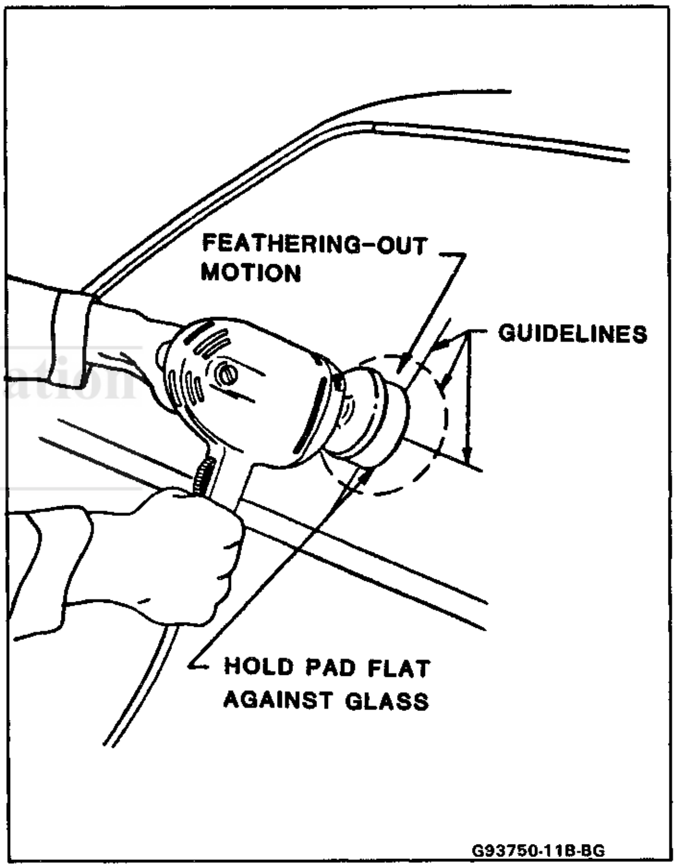


Fig. 1-Minor Glass Scratch Removal

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).

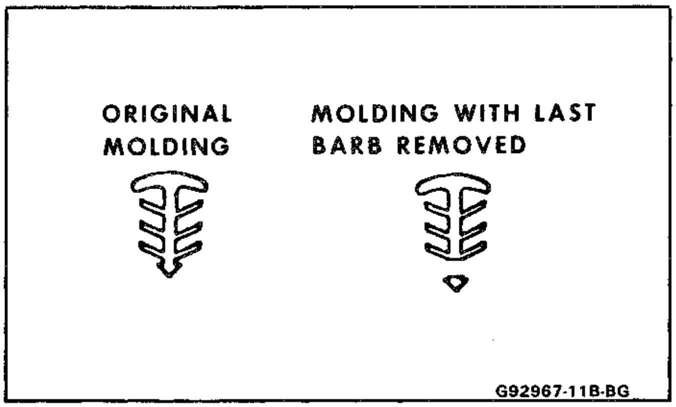


Fig. 2 - Removing Reveal Molding Barb

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

The short method can be used where original adhesive left on window opening pinch-weld 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.

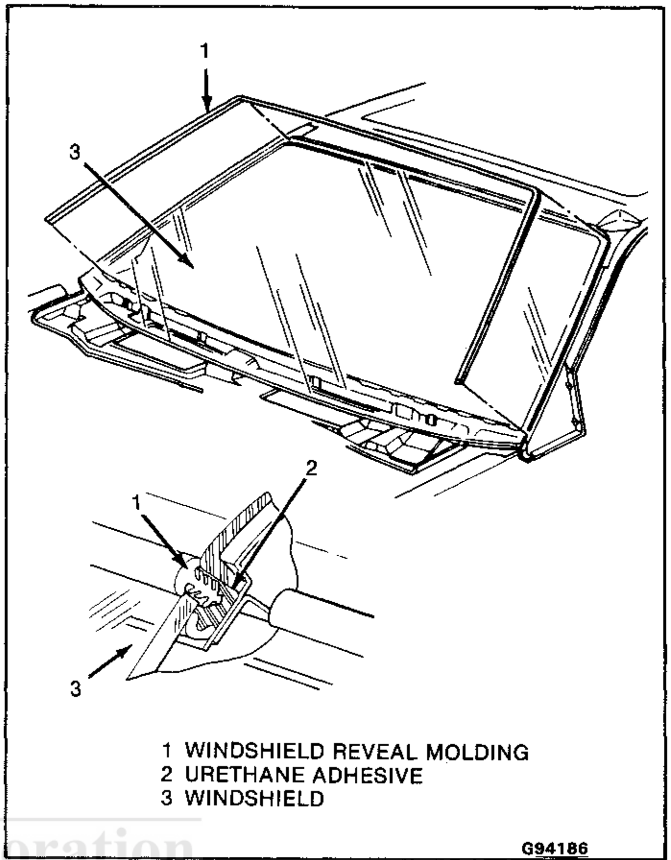


Fig. 3 - Installing Windshield Reveal Molding

The extended method is to be used when the original adhesive left in window opening after glass removal cannot serve as a base for new glass. This method would be used in cases needing metal work or paint repair in the opening. In these cases, original material is removed and replaced with new material during window installation.

ADHESIVE SERVICE KIT

Adhesive Kit No. 9636067 (urethane adhesive) or equivalent contains some of the items needed to replace a urethane adhesive installed glass using the short method or any adhesive installed glass using the extended method.

Additional items required:

- Solvent for cleaning edge of glass (preferably alcohol)
- Household cartridge type caulking gun
- Commercial type razor knife (for cutting around edge of glass)
- Cold knife No. J-24402-A or equivalent
- Black weatherstrip adhesive
- Spacers (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.

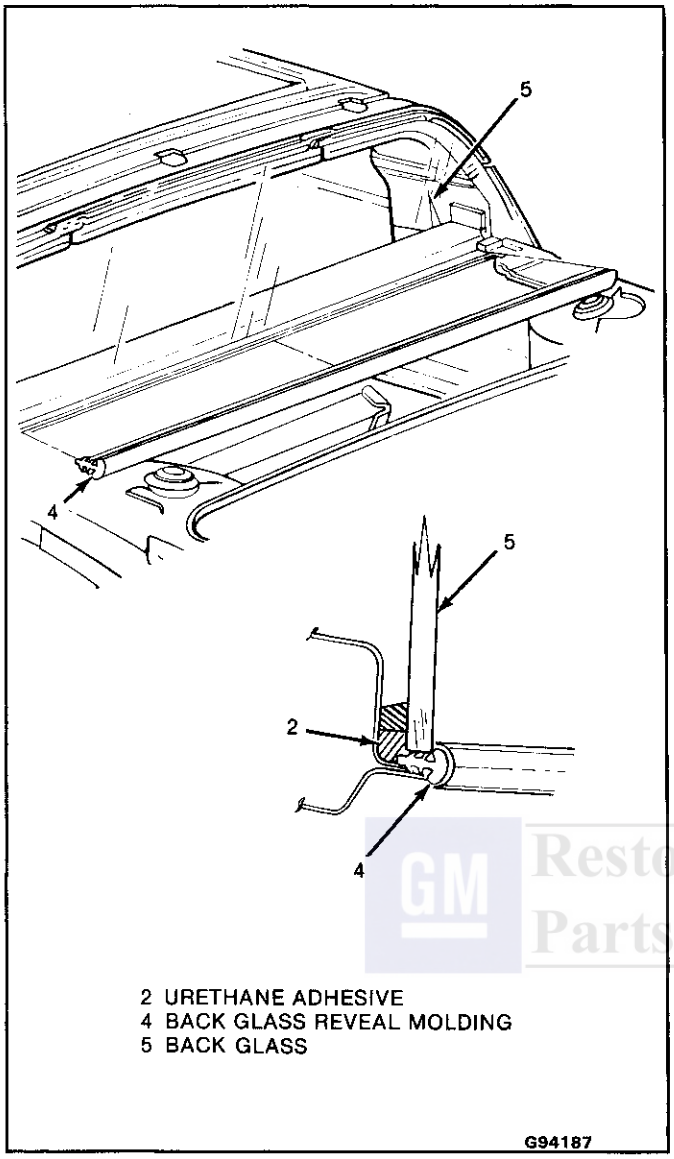


Fig. 4 - Installing Back Glass Reveal Molding

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 4J in the body portion of this manual).
3. Reveal molding
4. Two roof panel to cowl panel attaching screws (Section 8J)
5. Fender to side rail attaching bolts (Section 4J). 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)

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.

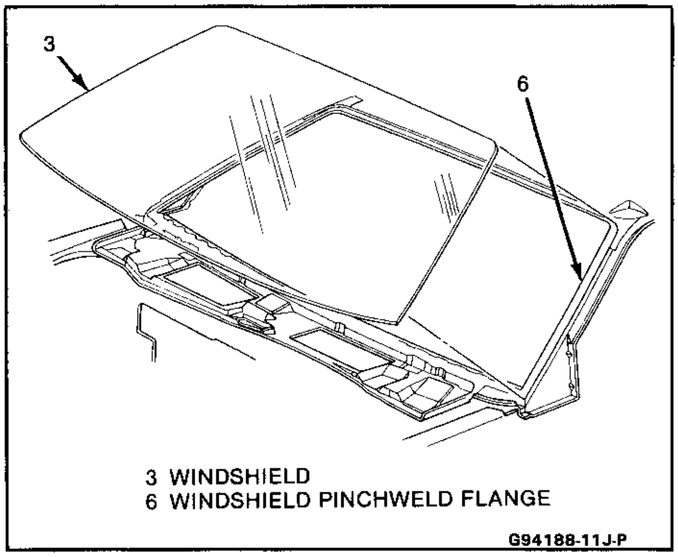


Fig. 5-Installing Windshield

2. Use suction cups on glass and with a helper prefit glass to maintain proper clearance between pinch-weld flanges (6) and glass edge.
3. Remove glass (3).
4. Refer to applicable installation method.
5. Position glass (3) and apply hand pressure to wet-out 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 4J 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 pinch-weld 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 sections for the following subassemblies.

Remove or Disconnect (Figure 6)

1. Rear compartment lid (Section 7J)
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 pinch-weld flanges and glass edge.

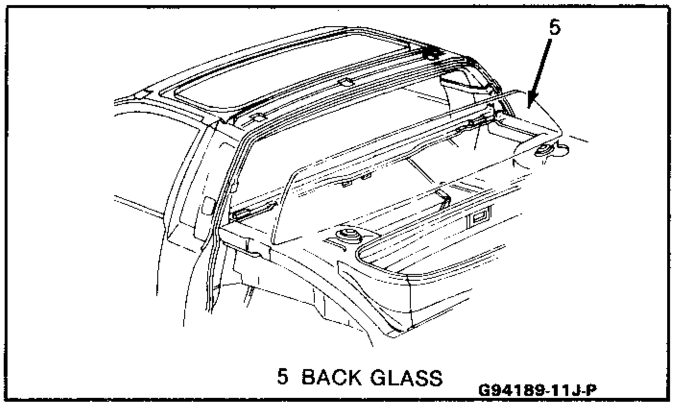


Fig. 6-Installing Back Glass

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.
6. Paddle adhesive around edge of glass with a 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. 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.

Quarter Window - 2PG97 Style

The quarter window is made of plastic and is retained to the body with double sided acrylic tape.

NOTICE: Strong solvent should not be used on quarter window, damage may occur. When cleaning window use household glass cleaner or equivalent.

Remove or Disconnect

1. Quarter vent grille.
2. Back window to quarter filler panel (Section 6).
3. Using a hooked blade tool, pull the monofilament line that's taped to the inside surface of quarter window at blackout loose (see Fig. 8)
4. Place line through wooden dowels (see Fig. 8)
5. Pull line across bottom first. When quarter window is loose at bottom, pull quarter window away from body. Reach between body and quarter window and pull upper line downward and remove quarter window

Clean

Body opening of any tape residue.

Install or Connect

1. Using a single edge razor blade as adapted in (Fig. 7), cut foam tape from quarter window.

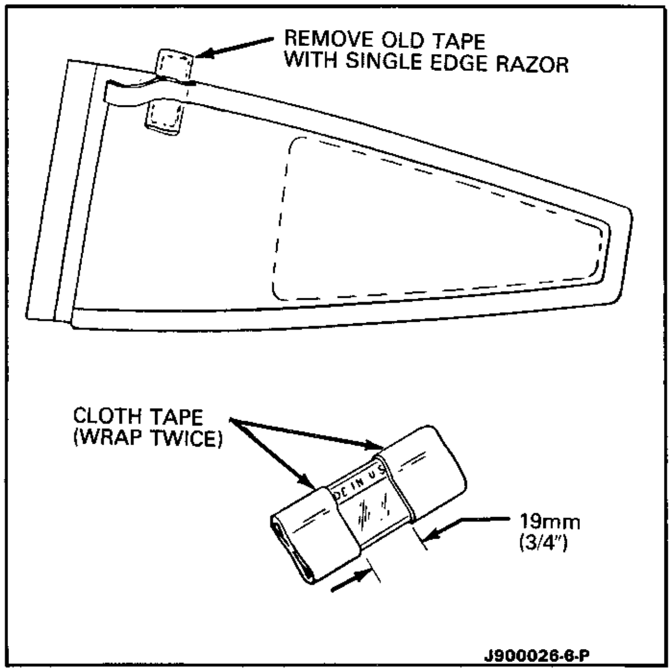


Fig. 7 - Removing Tape from Quarter Window

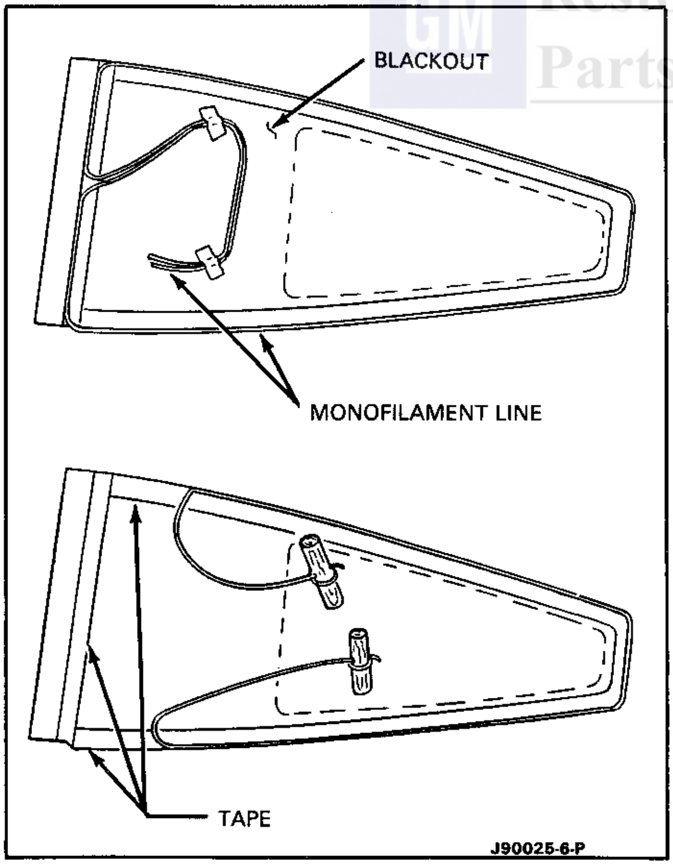


Fig. 8 - Location of Tape and Service Line on Quarter Window

2. Reactivate tape residue on quarter window by wiping with 3M General Purpose Cleaner No. 08984 or equivalent.
3. Apply a layer of 3M Scotch Mount Acrylic foam Tape, part no. Y-4225 or equivalent over existing tape residue rolling over tape to assure adhesion before removing orange release liner.
4. Apply 60 lb test monofilament line to outer edge of tape (see Fig. 8).
5. Quarter window to body opening, pressing firmly to assure adhesion to body.
6. Back window to quarter filler panel.
7. Quarter vent grille

WINDSHIELD AND BACK GLASS

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 9)

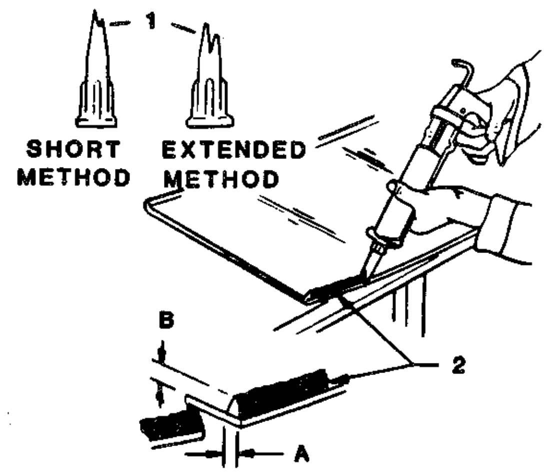
1. Clean around edge and inside surface of glass with alcohol. Allow to air dry.
2. Apply clear primer to perimeter of glass edge and 7 mm (9/32") inboard on inner surface.
3. Apply black primer over clear primer on glass. Allow five minutes to dry.
4. Apply smooth continuous bead of adhesive over inside edge of glass where primed (Fig. 9). Tip bead of adhesive slightly inboard.

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 9)

1. Scrape or chisel old adhesive or butyl tape from pinch-weld flanges. There should not be any mounds or loose pieces left.
2. Apply black primer to any exposed surface on pinch-weld flanges. Allow five minutes to dry.
3. Enlarge nozzle furnished in kit as shown in Figure 9.



1. CUT TIP AS SHOWN
2. ADHESIVE CAULKING MATERIAL

SHORT METHOD
A. 3 mm TO 5 mm (1/8" TO 3/16")
B. 3 mm TO 5 mm (1/8" TO 3/16")

EXTENDED METHOD
A. 5 mm (3/16")
B. 10 mm (3/8")

G94195-11K-T

Fig. 9-Applying Adhesive Material

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. 9). Tip bead of adhesive slightly inboard.

WATERLEAK CORRECTION

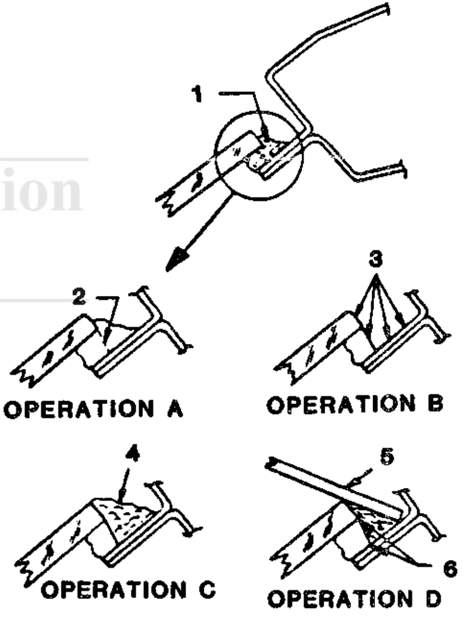
Where accessible, waterleaks can be corrected without removing and reinstalling the glass. This method applies only to urethane installed glass and the use of adhesive furnished in kit no. 9636067 or equivalent.

1. Remove reveal moldings in area of leak. In some cases, it may become necessary to remove garnish moldings or finishing lace to locate source of leak.
2. Mark location of leak(s). Carefully push outward on glass in area of leak to determine extent of leak. This operation should be performed while water is being applied to leak area. Mark extent of leak area.

Clean

From outside body, clean any dirt or foreign material from leak area with water; then dry area with air hose.

3. Using a sharp knife, trim off uneven edge of adhesive material (operation A, Fig. 10) at leak point and 75 mm (3") to 100 mm (4") on both sides of leak point or beyond limits of leak area.
4. Prime affected area, as shown in operation B, Figure 10, with black primer supplied in kit. Agitate primer prior to use. Allow primer to dry five minutes.
5. Apply adhesive material, as shown in operation C, Figure 10, at leak point and 75 mm (3") to 100 mm (4") on both sides of leak point or beyond limits of leak area.
6. Right after performing step 5, use a flat stick or other suitable flat-bladed tool to work adhesive material well into leak point and into joint of original material and body to effect watertight seal along entire length of material application (operation D, Fig. 10).
7. Using warm or hot water, spray test to assure that leak has been corrected. **Do not** run heavy stream of water directly on freshly applied adhesive.
8. Replace all previously removed parts.



1. ADHESIVE CAULKING MATERIAL
2. TRIM
3. PRIME
4. APPLY
5. FLAT STICK
6. WORK INTO JOINTS

G91294-11B-BG

Fig. 10 - Adhesive Glass Waterleak Correction

REARVIEW MIRROR

REARVIEW MIRROR SUPPORT

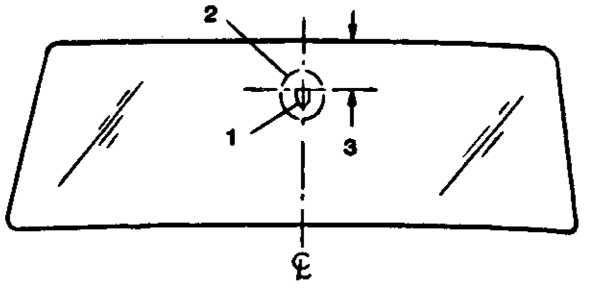
The rearview mirror is attached to a support which is secured to the windshield glass. This support is installed by the glass supplier using a plastic-polyvinyl butyral adhesive.

Service replacement windshield glass has the mirror support bonded to the glass assembly. To install a detached mirror support or install a new part, the following items are needed.

1. Part No. 1052369, Loctite Minute-Bond Adhesive 312 two component pack or equivalent
2. Original mirror support (prepared per steps 4 and 5 of installation procedure) or replacement rearview mirror support
3. Wax marking pencil or crayon
4. Rubbing alcohol
5. Clean paper towel
6. Fine grit emery cloth or sandpaper (no. 320 or no. 360)
7. Clean toothpick
8. Six-lobed socket bit

Install or Connect (Figure 11)

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

Fig. 11-Locating Rearview Mirror Support on Glass

REAR WINDOW DEFOGGER

The optional rear window defogger system consists of a tinted glass that has a number of horizontal ceramic silver compound element lines and two vertical bus bars baked into the inside surface during the glass forming operation. The feed wire or terminal is soldered to the bus bar on the side. The ground wire or terminal is soldered to the bus bar on the right side.

The system operates on 12 volts. Under some conditions, heat from the glass may not be detected by finger touch. The length of time required to remove interior fog from the back glass will vary with such conditions as car speed, outside glass temperature and atmospheric pressure and number of passengers.

This system uses an instrument panel mounted switch with an integral indicator lamp; and will operate for five to ten minutes and automatically turn off through the use of an automatic timer. The system can be turned off during this operating period by turning either the instrument panel mounted switch or ignition switch to off.

Testing Grid Lines

To locate inoperative grid lines, start engine and turn on the rear window defogger system. Ground one test lamp lead and lightly touch the other prod to each grid line. Figure 12 illustrates the pattern of test lamp brilliance to be expected with a properly functioning grid.

If test lamp bulb shows full brilliance at both ends of grid lines, check for loose ground wire contact to body metal.

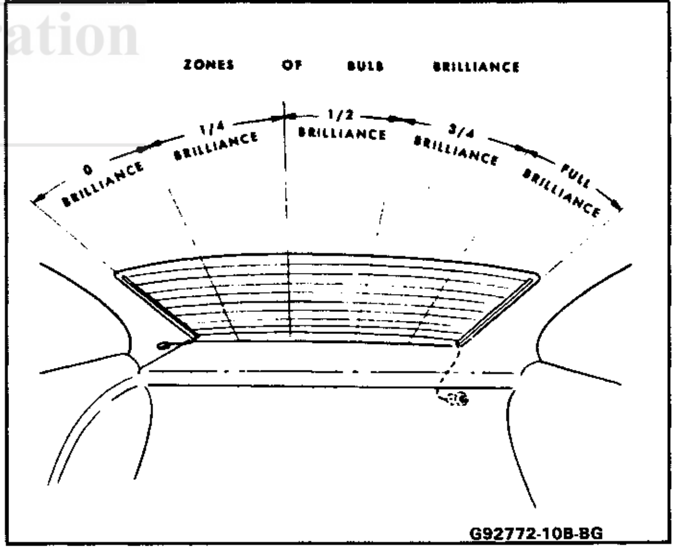


Fig. 12-Test Lamp Bulb Brilliance Zones - Normal Operating Rear Window Defogger

The range of zones in Figure 12 may vary slightly from one glass to another; however, the bulb brilliance will decrease proportionately to the increased resistance in the grid line as the prod is moved from the left bus bar to the right.

All grid lines must be tested in at least two places to eliminate the possibility of bridging a break. For best results, contact each grid line a few millimeters (inches) either side of the glass centerline. If an abnormal light reading is apparent on a specific grid line, place test lamp prod on that grid at the left bus bar and move prod toward the right bus bar until light goes out. This will indicate a break in the continuity of the grid line (Fig. 13).

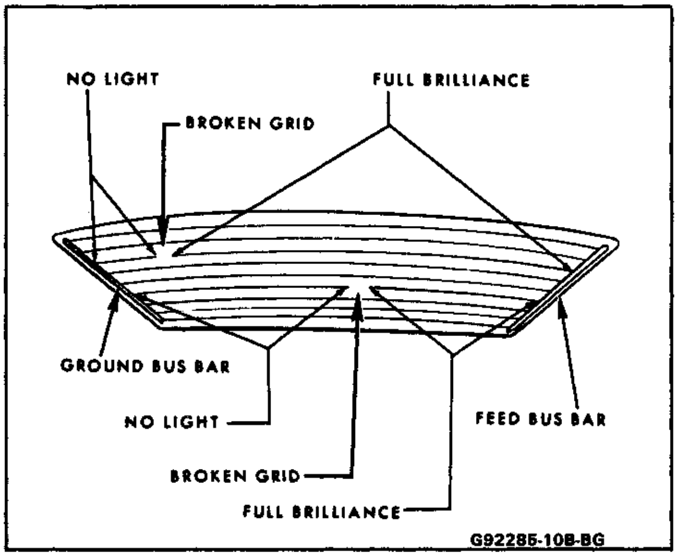


Fig. 13-Test Lamp Bulb Brilliance with Broken Grid Lines

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 a grease pencil.

Clean

Grid line area to be repaired. Buff with steel wool and wipe clean using cloth dampened with alcohol. Buff and clean about 6 mm (1/4") beyond each side of break in guide line.

Install or Connect (Figs. 14 and 15)

1. Grid line repair decal or two strips of tape positioned above and below repair area.
   - Repair decal or tape **must** be used to control width of repair area.
   - If decal is used, be sure the die-cut metering slot is the same width as the grid line.
2. Remove the clamp (separator) from the container of grid repair material.
   - Mix hardener and silver plastic thoroughly.
   - If hardener has crystalized, immerse packet in hot water until the hardener reliquifies.
3. At room temperature, apply grid repair material to repair area using a small wood stick or spatula.
4. Carefully remove the decal or tape.

NOTICE: The grid line repair material must be cured with heat. To avoid heat damage to interior trim, protect the trim near the repair area where heat is to be applied.

5. Apply heat to repair area for one to two minutes.
   - Hold heat gun nozzle 25 mm (1") from surface.
   - A minimum temperature of 149°C (300°F) is required.

Inspect

Grid line repair area. If repair appears discolored, apply a coating of tincture of iodine to repair area using a pipe cleaner or fine brush. Allow iodine to dry for about 30 seconds and carefully wipe off excess with lint free cloth.

6. Test rear defogger operation to verify grid line repair.

NOTICE: At least 24 hours are required for complete curing of repair materials. The unit should not be physically disturbed until after that time.

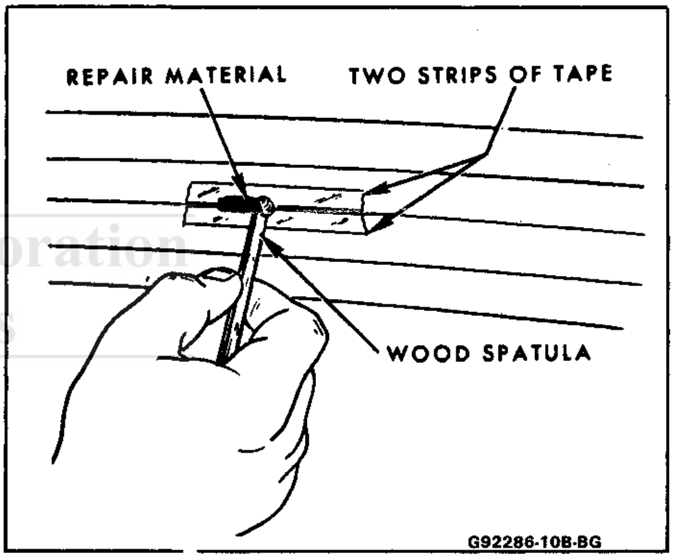


Fig. 14-Applying Repair Material to Broken Grid Line

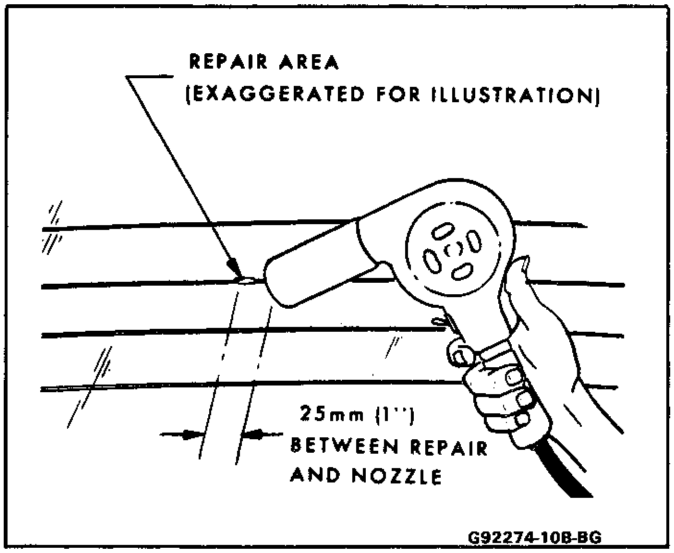


Fig. 15-Applying Heat to Grid Line Repair

Braided Lead Wire Repair

The rear defogger bus bar lead wire or terminal can be reattached by resoldering using a solder containing 3% silver and a rosin flux paste.

- Before soldering the bus bar, repair area should be buffed with fine steel wool. This removes the oxide coating formed during glass manufacture.
- Apply the paste-type rosin flux in small quantities to the wire lead and bus bar repair area using a brush.
- The soldering iron tip should be coated with solder beforehand. Use only enough heat to melt the solder and only enough solder to ensure a complete repair.
- Do not overheat the wire when resoldering it to the bus bar.

SECTION 3J

UNDERBODY

CONTENTS

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 5 and 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 4 through 9.

Dimensions to gage holes are measured to the 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 1)

1. Rear quarter trim panels. Refer to Section 6J.
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 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 6J.

LOWER GARNISH MOLDINGS

Remove or Disconnect (Figure 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 2)

1. Lower garnish molding (5)
2. Five garnish molding screws (6)
3. Five garnish molding plugs (7)

FLOOR CARPETS

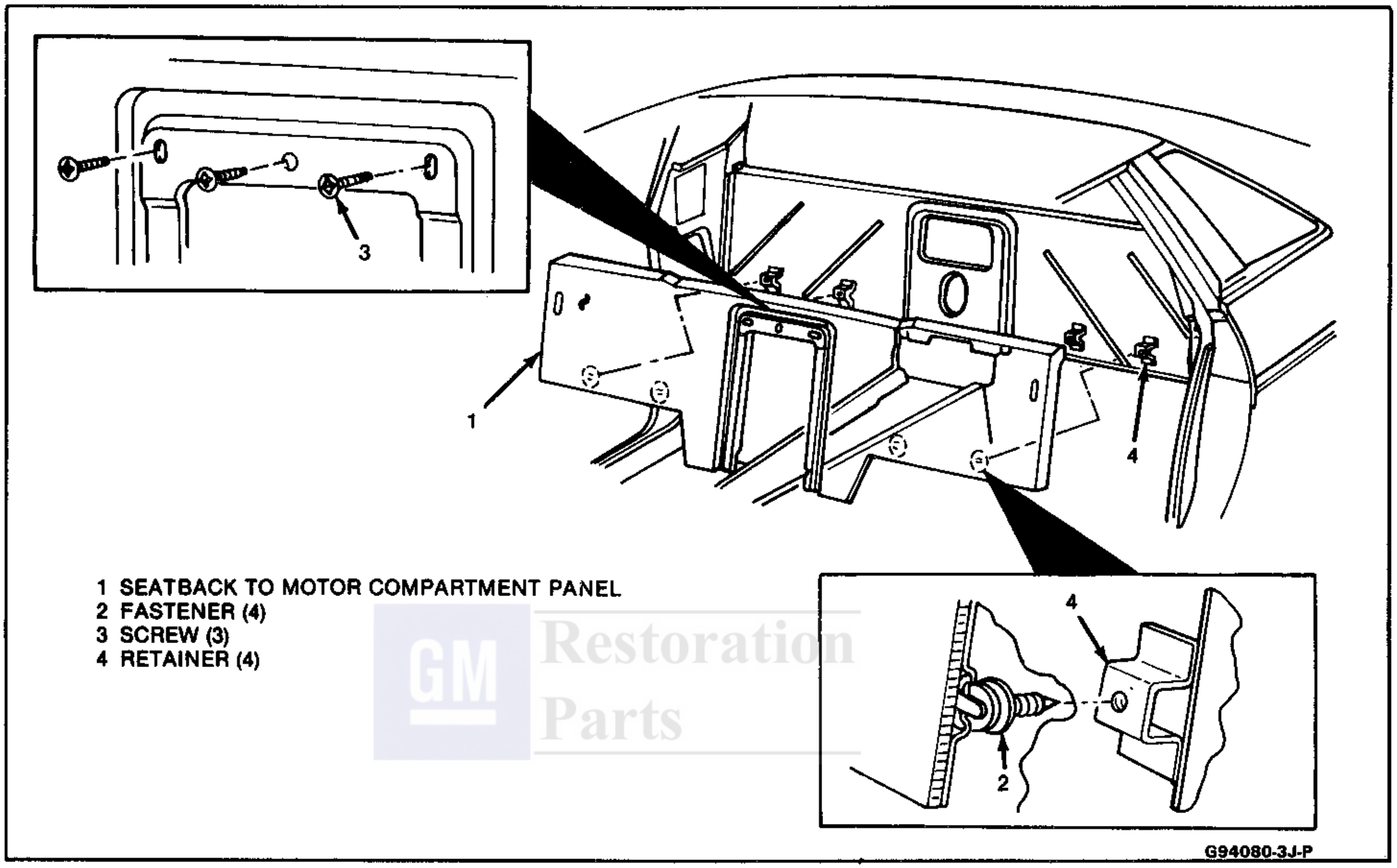
The floor carpet consists of molded right and left side carpet assemblies. Floor pan insulators are attached to the floor carpet assemblies. The right and left side floor carpets may be serviced separately.

Remove or Disconnect (Figures 1, 2 and 3)

1. Seats(s), refer to Section 9J.
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 9J.
6. Carpet(s) (9). Disengage carpet from retainers (10) in console (11). There are six retainers per side.

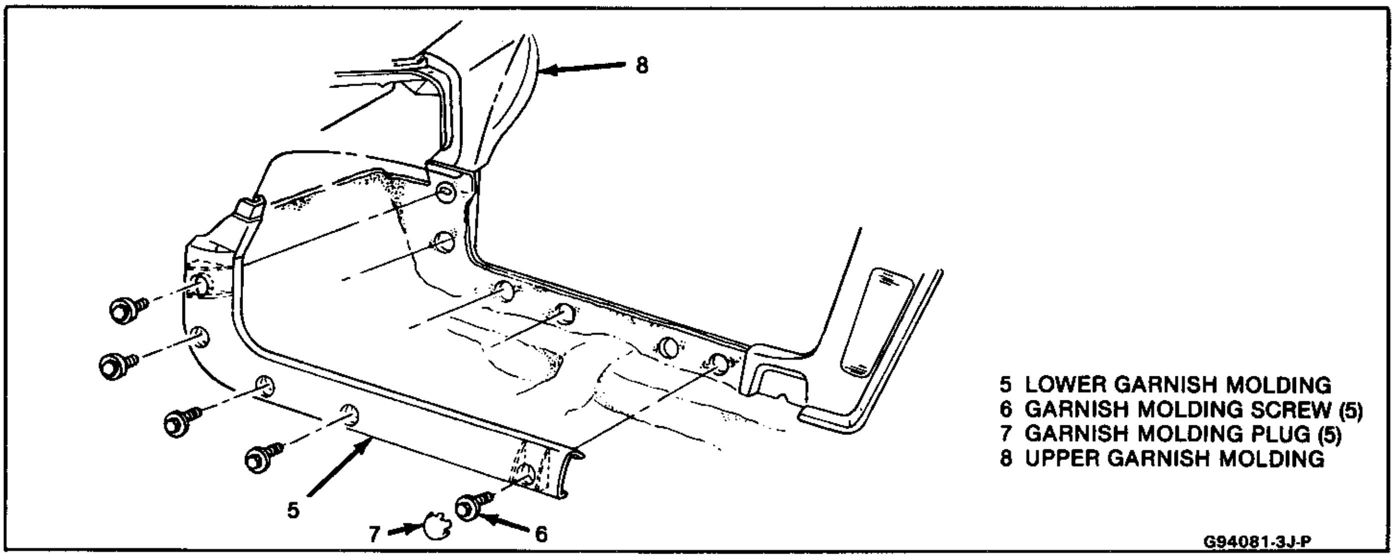
Install or Connect (Figures 1, 2 and 3)

1. Carpet(s) (9)
2. Inboard seat belt(s). Refer to Section 9J.
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 9J.



1 SEATBACK TO MOTOR COMPARTMENT PANEL
2 FASTENER (4)
3 SCREW (3)
4 RETAINER (4)

Fig. 1 - Seatback-to-Motor Compartment Panel



5 LOWER GARNISH MOLDING
6 GARNISH MOLDING SCREW (5)
7 GARNISH MOLDING PLUG (5)
8 UPPER GARNISH MOLDING

Fig. 2 - Installing Lower Garnish Molding

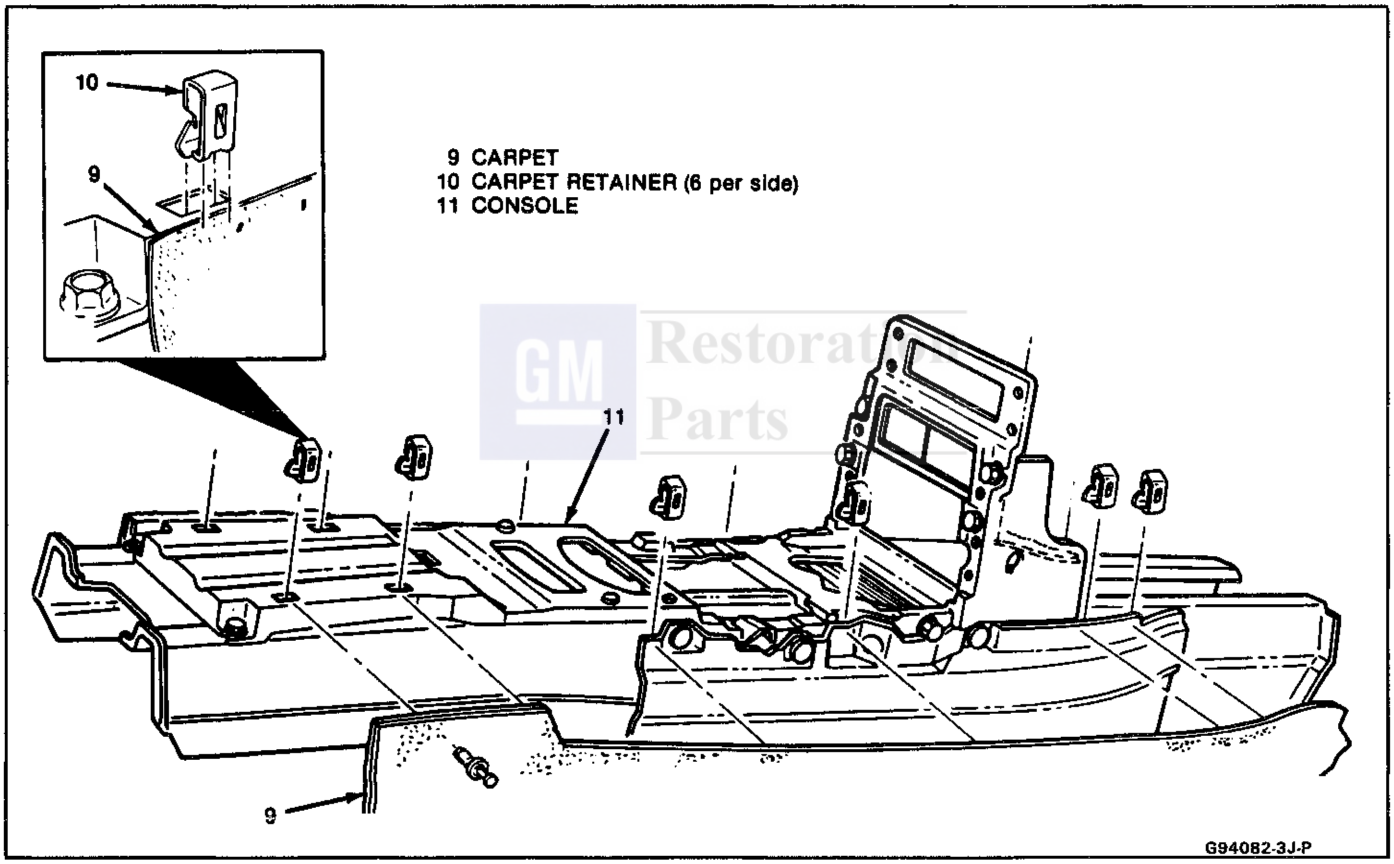
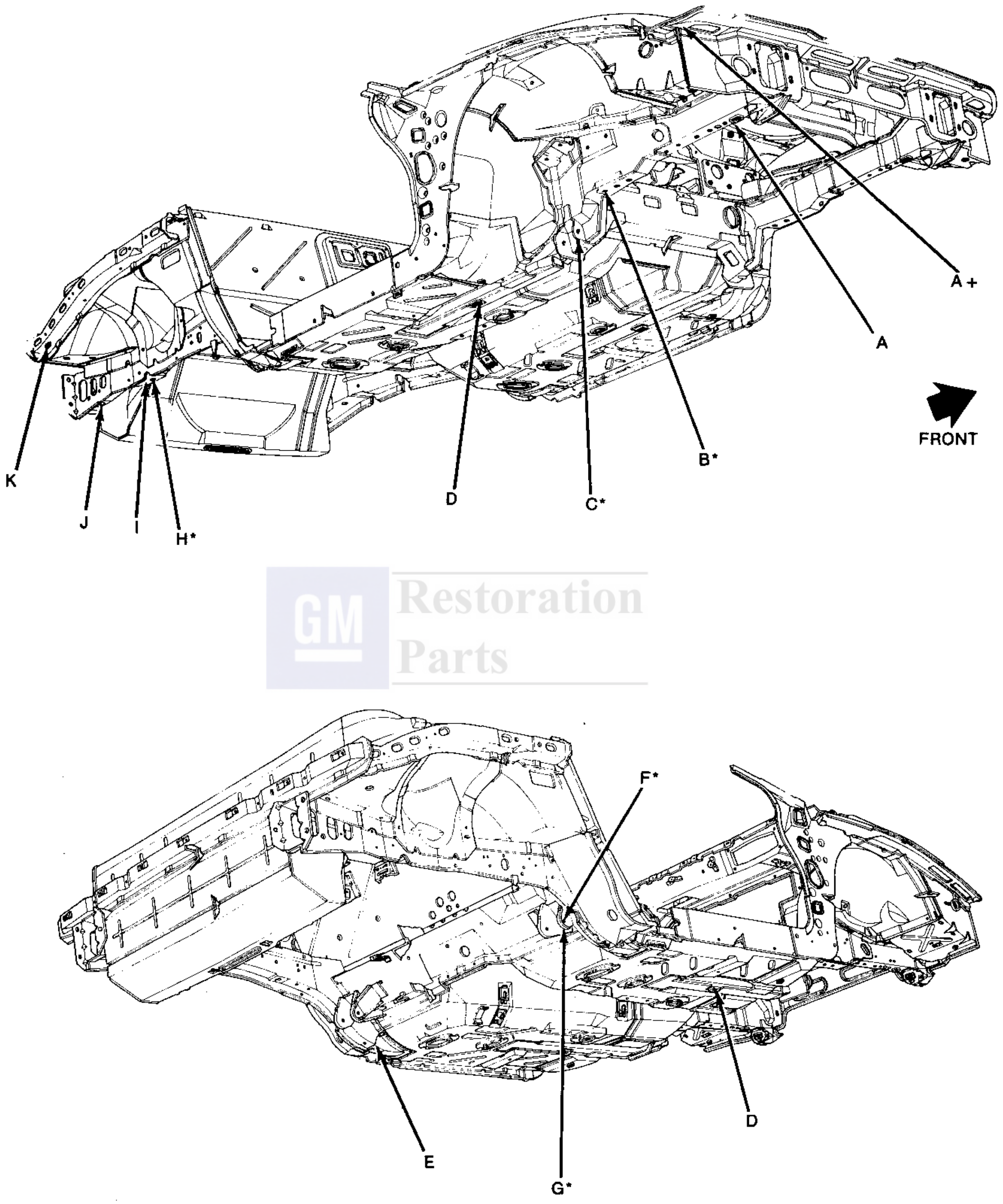


Fig. 3 - Installing Carpet to Console



*MEASURE WITH BOLT INSTALLED

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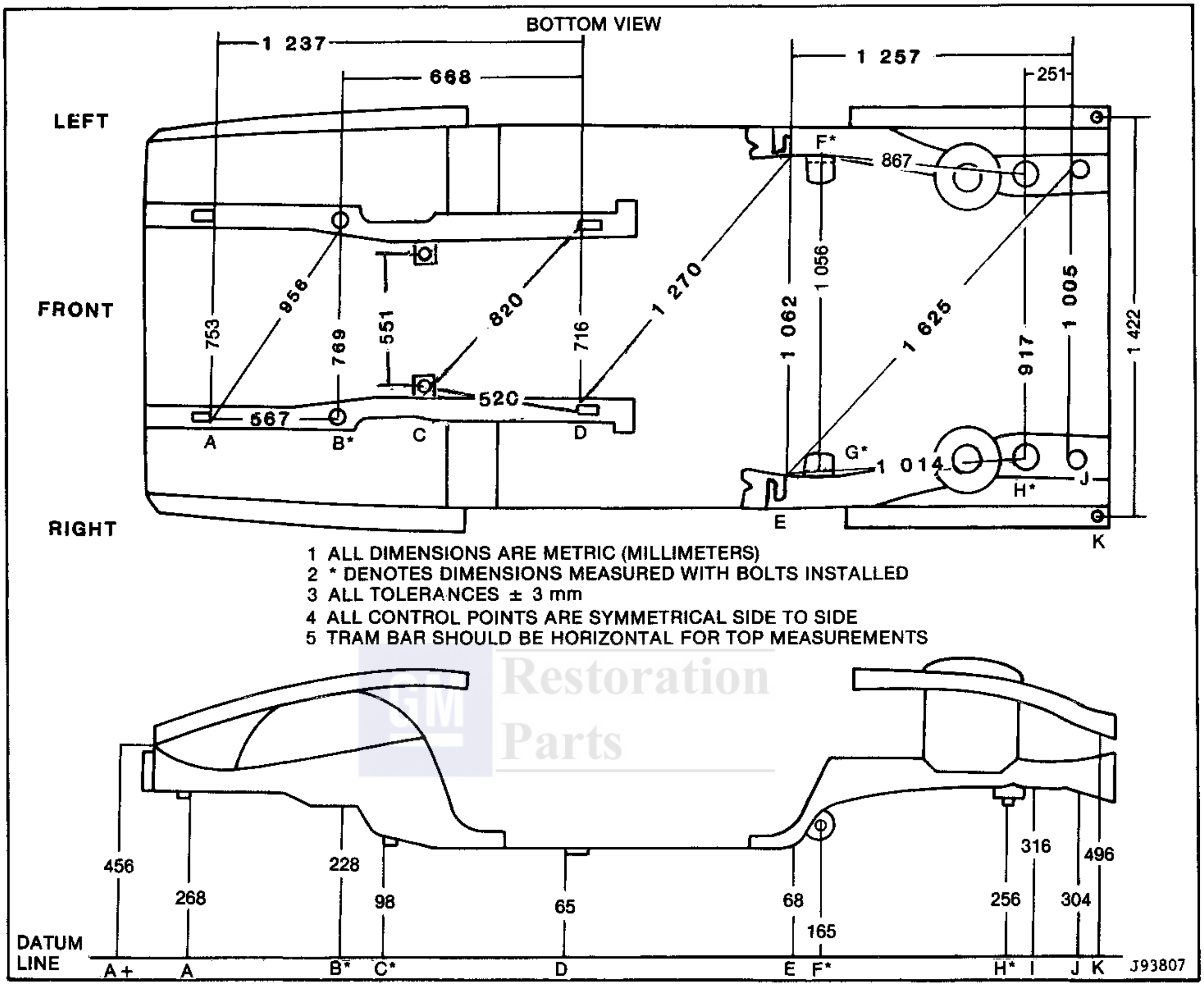
Fig. 4 - Underbody Reference Point Locations



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. 5 - Horizontal and Vertical Dimensions

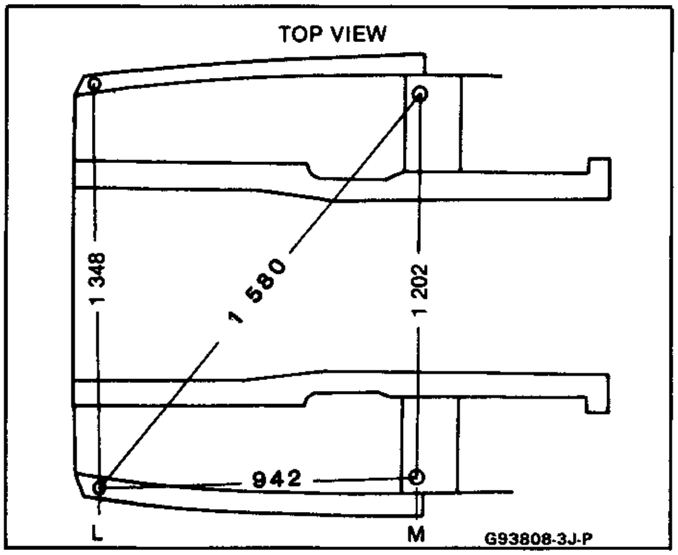


Fig. 6 - Front Compartment Upper Side Rail Dimensions

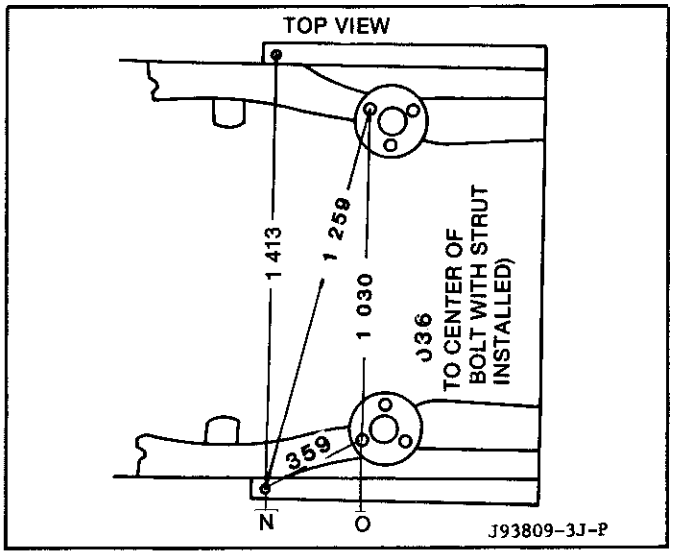


Fig. 7 - Rear Compartment Upper Side Rail and Suspension Strut Tower Dimensions

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	Center of lower hole in bracket	Lower surface of bracket	Support mounting bracket at front torque bar
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. 8 - 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	956	37-5/8
B to B	769	30-1/4
B to D	668	26-5/16
C to C	696	27-3/8
C to D	520	20-1/2
D to C	820	32-1/4
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	1 030	40-1/2
O to N	1 259	49-9/16
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. 9 - Metric-to-English Dimension Conversion Chart

SECTION 4J

FRONT END

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

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

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.

Shroud Vent Top 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)

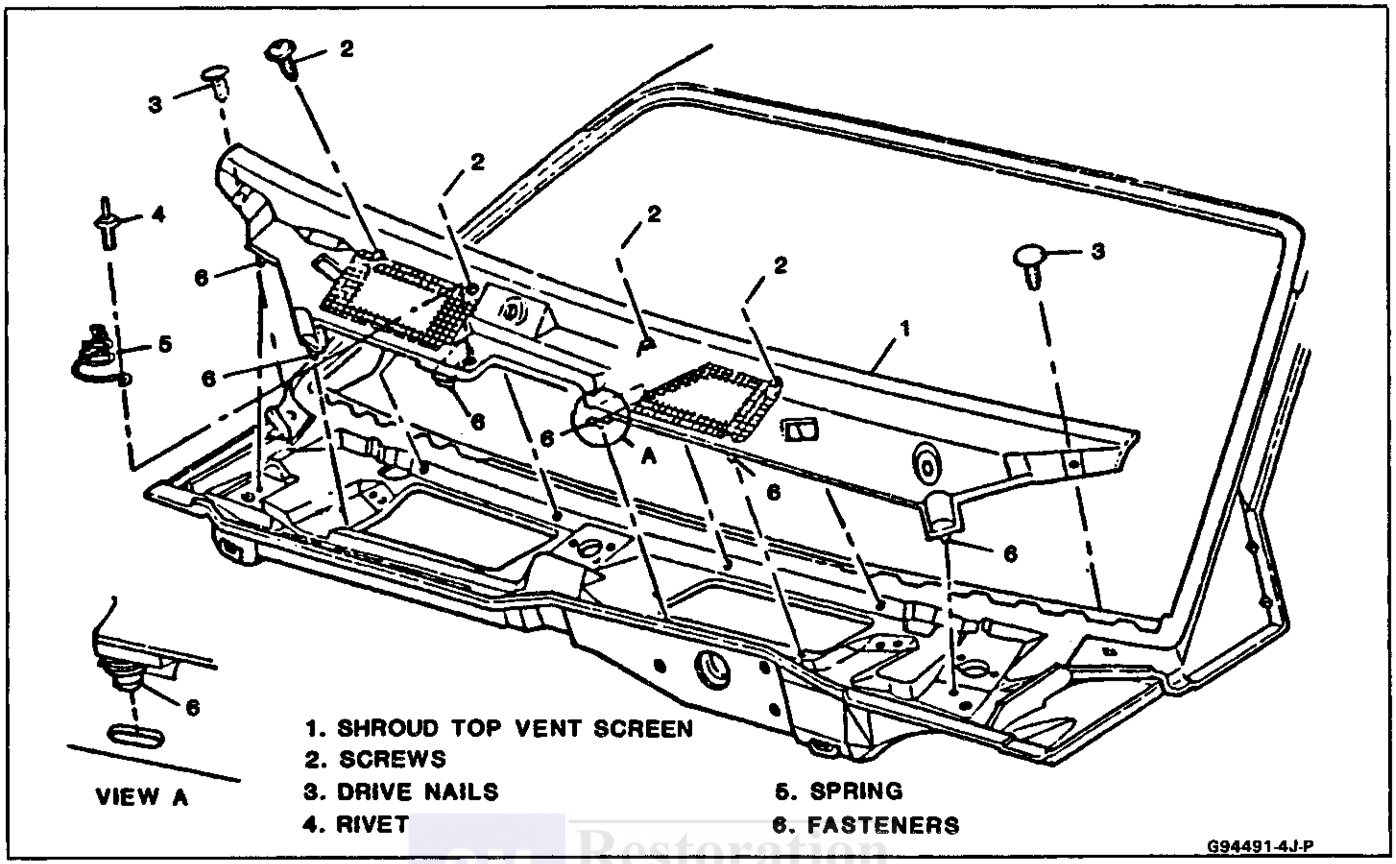


Fig. 1-Shroud Vent Top Screen

2. Retainer (16)

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

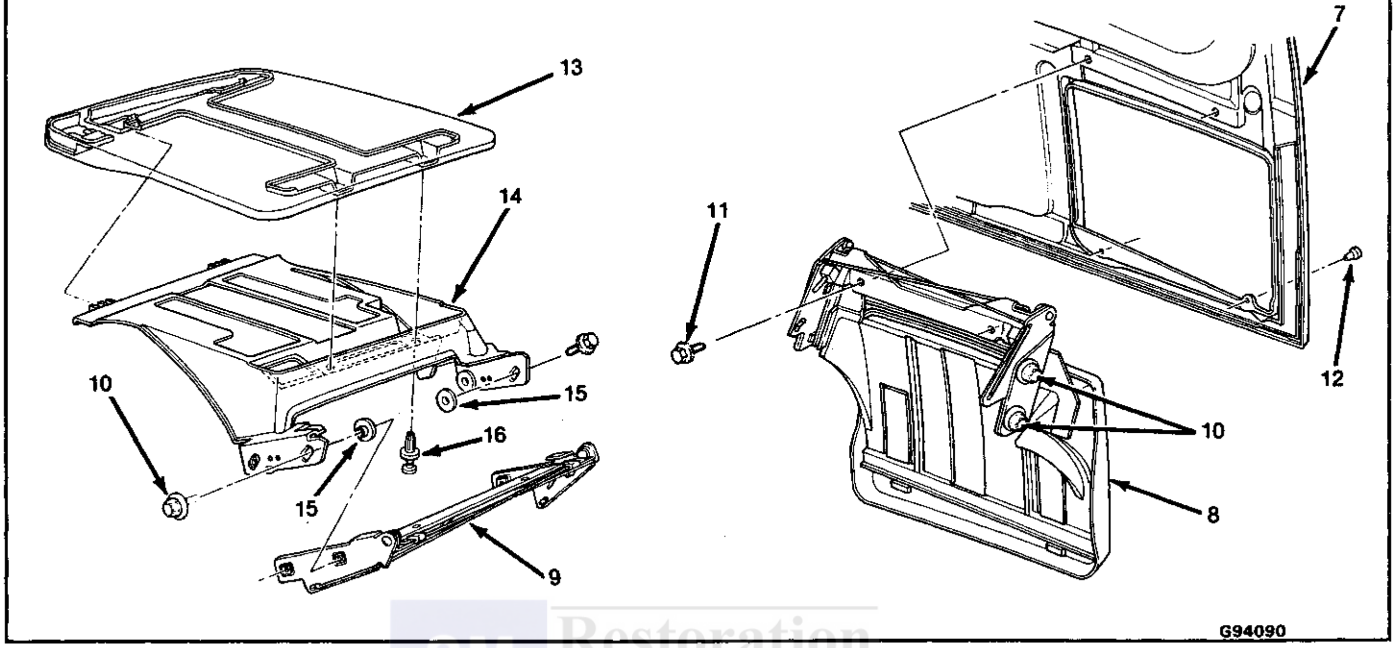


Fig. 2-Headlamp Door Assembly

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.

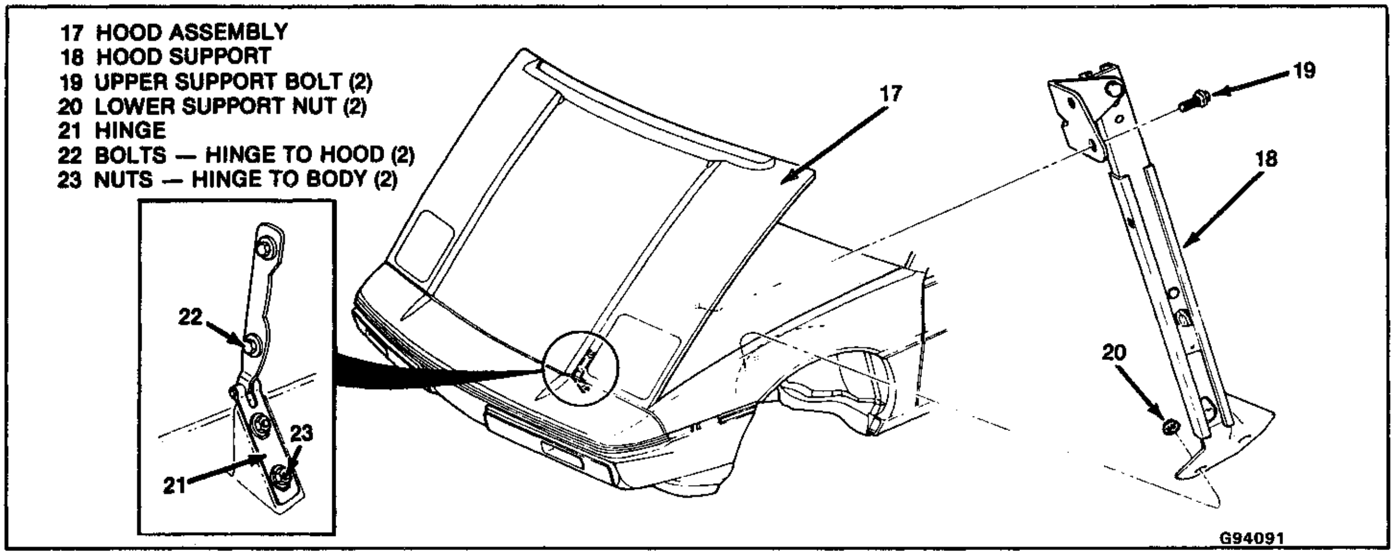


Fig. 3-Hood and Attaching Hardware

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.

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

1. Loosen switch from body
2. Electrical connector from switch

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

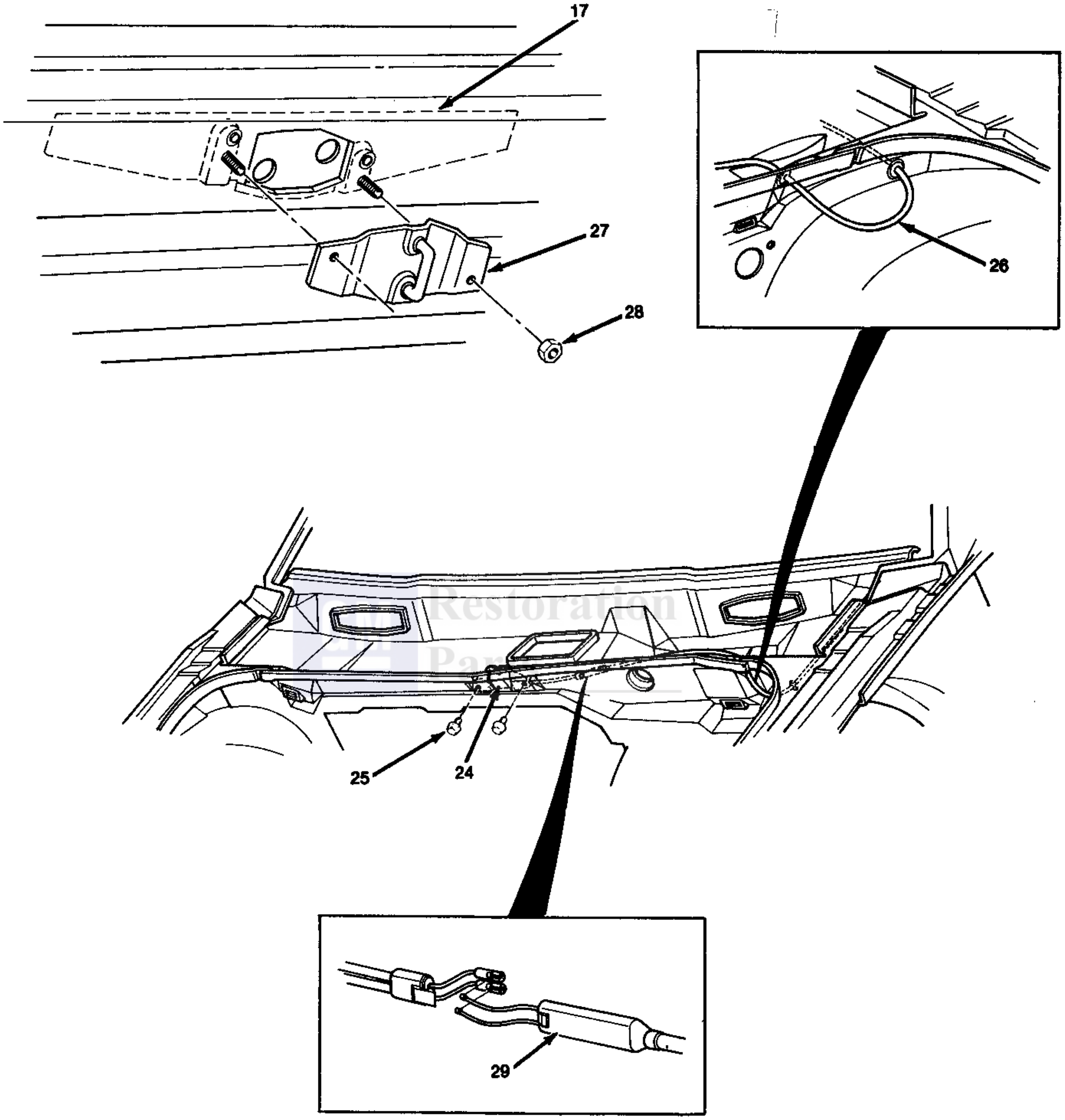
1. Cover (1)
2. Screws (2)

    Tighten

    Screws to 3 N·m (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.



24 HOOD LATCH
25 HOOD LATCH BOLT (2)
26 HOOD RELEASE CABLE
17 HOOD
27 STRIKER
28 STRIKER NUT (2)
29 CABLE CONNECTOR

G94092-4J-P

Fig. 4-Hood Latch and Striker

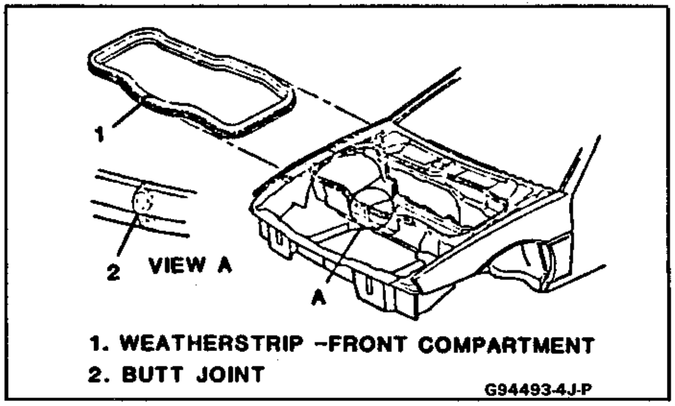


Fig. 5 - Installing Front Compartment Weatherstrip

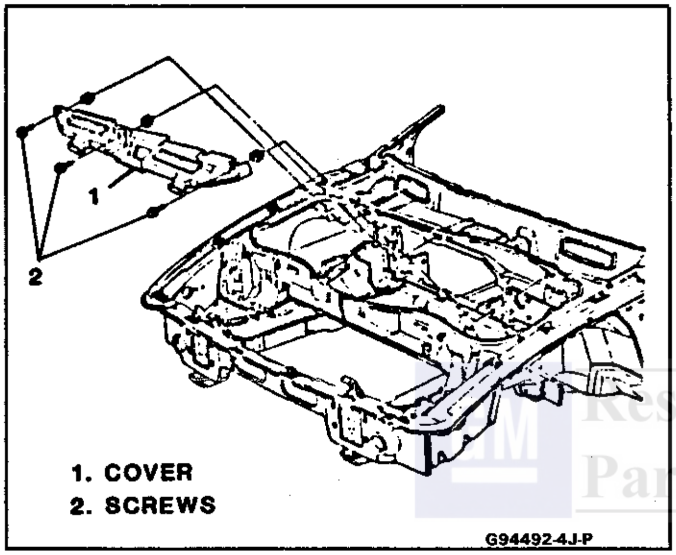


Fig. 6-Installing Optional Glass Roof Vent Storage Cover

Always use care when handling fenders to avoid marring the surfaces.

Remove or Disconnect (Figure 7)

1. Side marker lamp assembly (34)
2. Rocker panel (front portion)
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 (37)
3. Side marker lamp assembly (34)
4. Rocker panel

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)

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 9)

1. Wheelhousing panel (rear half)
2. Two nuts (47)
3. Molding (46)

Install or Connect (Figure 11)

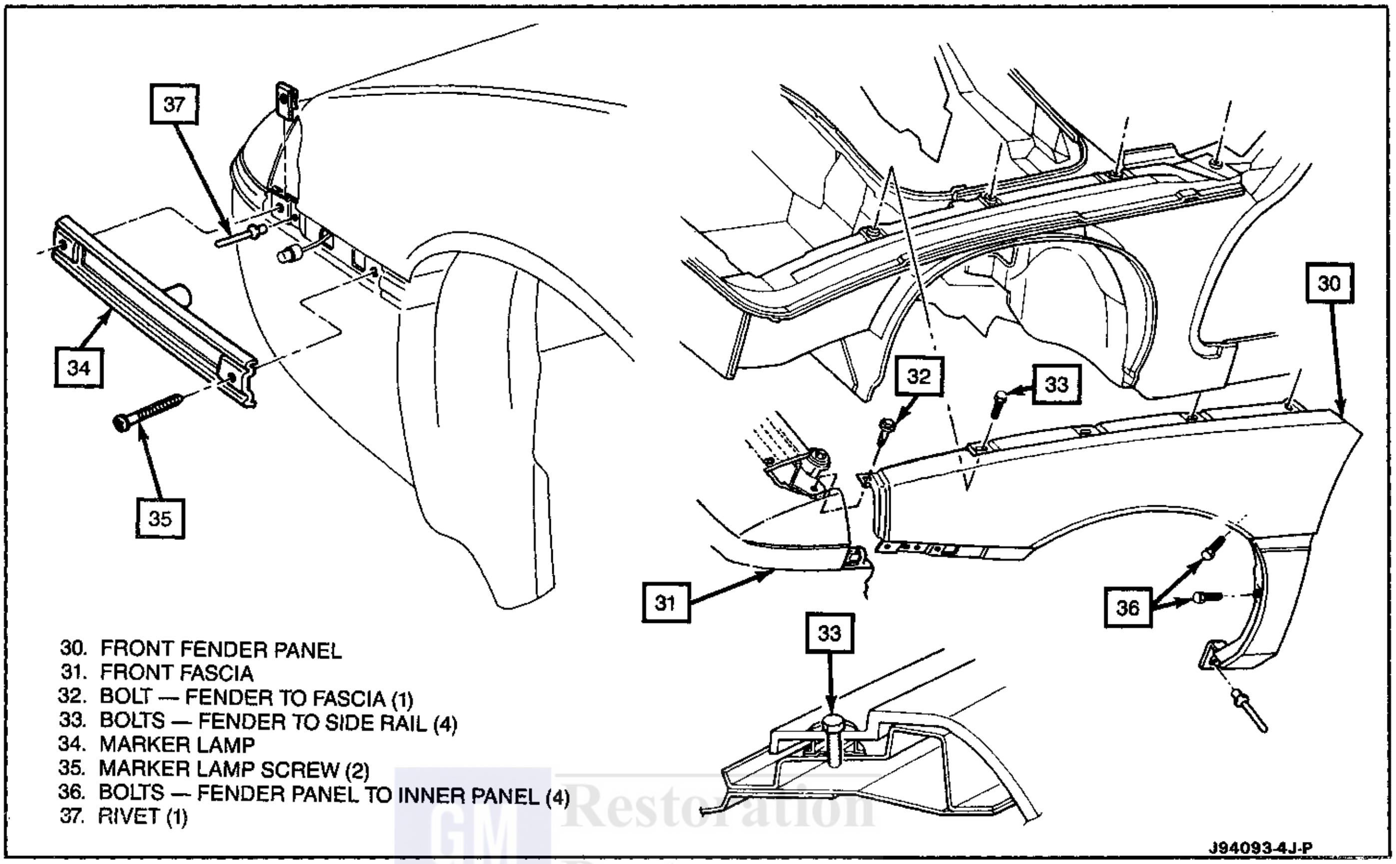
1. Molding (46)
2. Two nuts (47)
3. Wheelhousing panel (rear half)

Inspect

For proper alignment

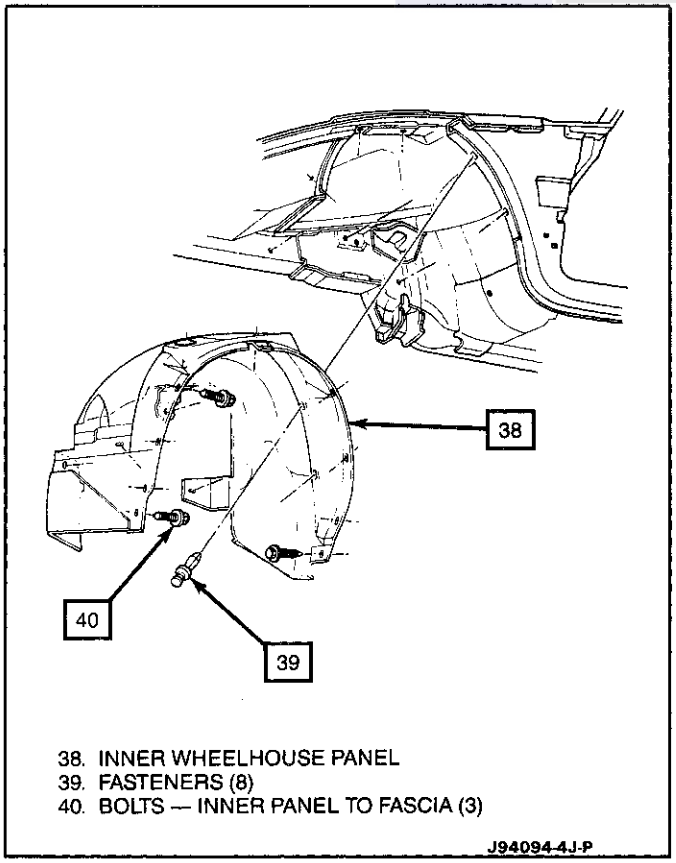
ROCKER PANEL COVER TO FRONT FENDER EXTENSION

See Section 6J in the body portion of this manual for removal and installation procedure.



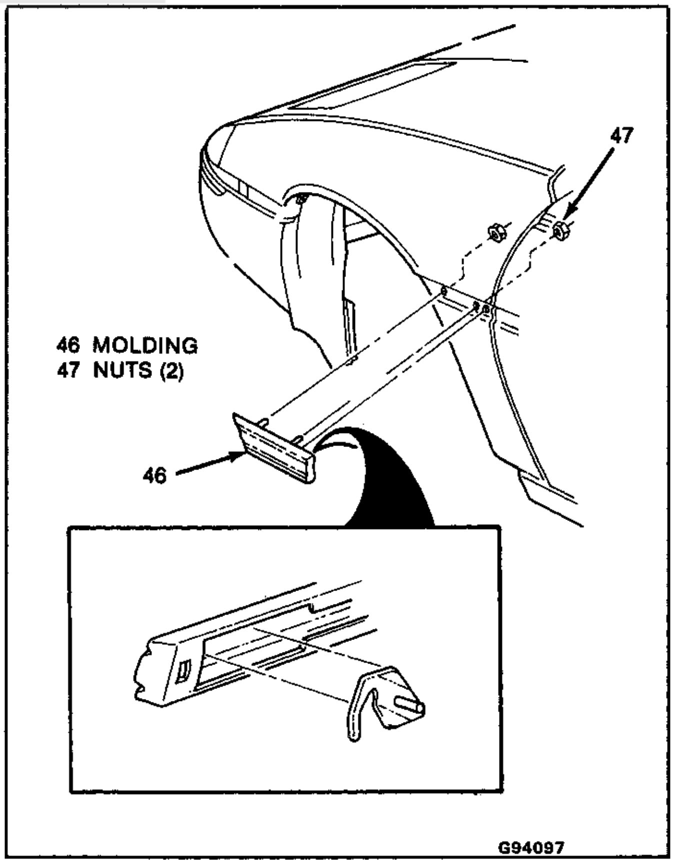
30. FRONT FENDER PANEL
31. FRONT FASCIA
32. BOLT — FENDER TO FASCIA (1)
33. BOLTS — FENDER TO SIDE RAIL (4)
34. MARKER LAMP
35. MARKER LAMP SCREW (2)
36. BOLTS — FENDER PANEL TO INNER PANEL (4)
37. RIVET (1)

Fig. 7-Front Fender Panel Attachment



38. INNER WHEELHOUSE PANEL
39. FASTENERS (8)
40. BOLTS — INNER PANEL TO FASCIA (3)

Fig. 8-Wheelhousing Panel Attachment



46 MOLDING
47 NUTS (2)

Fig. 9-Front Fender Molding

SECTION 5J

DOORS

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

CONTENTS

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 1)

1. Armrest plug (1)
2. Screws (2)
3. Armrest (3)

→← Install or Connect (Figure 1)

1. Armrest (3)
2. Screws (2)
3. Armrest plug (1)

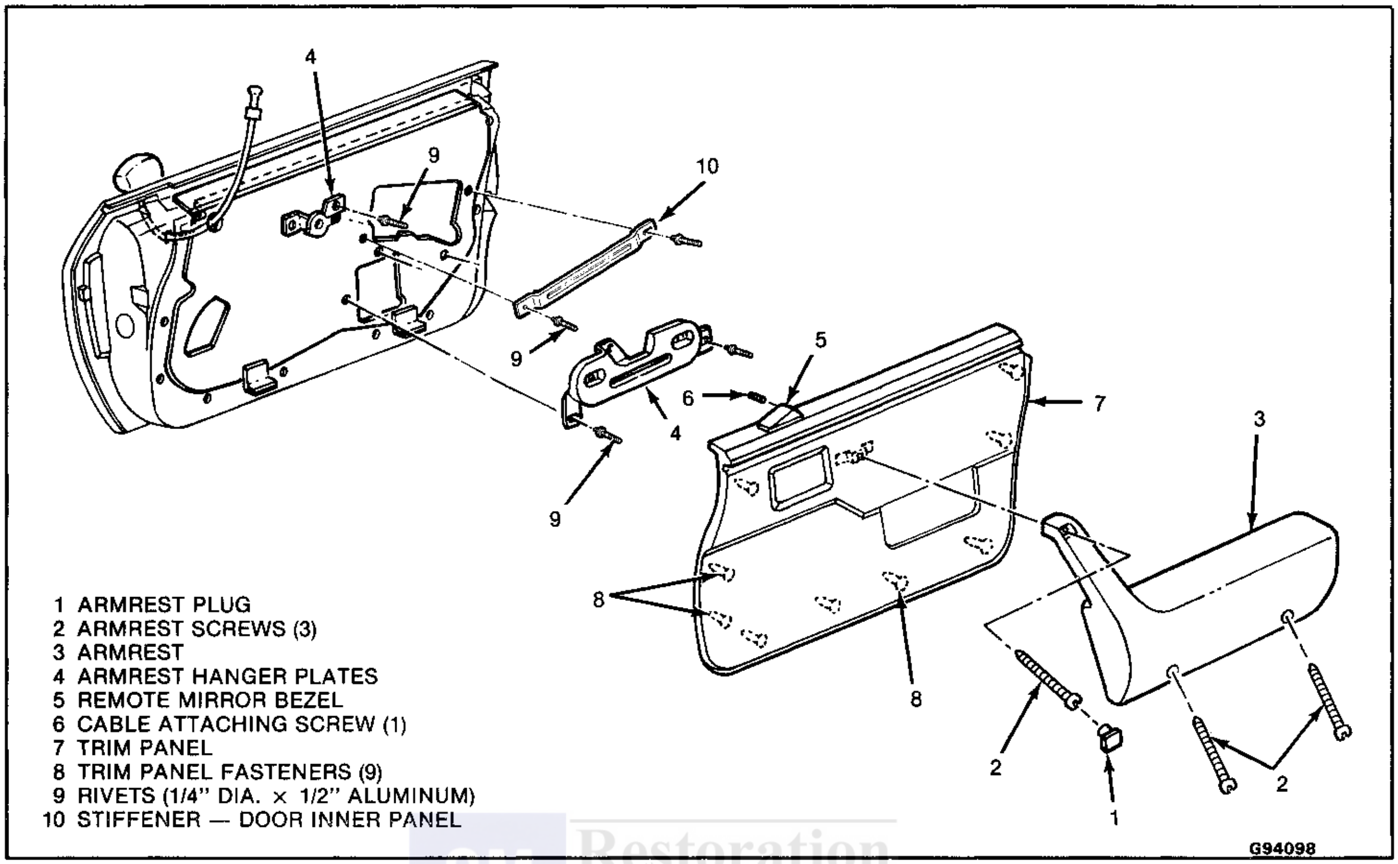


Fig. 1-Door Trim Panel and Armrest

WINDOW REGULATOR HANDLE

←→ Remove or Disconnect (Figures 2 and 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 2).
   - Push tool as indicated in Figure 3.
2. Handle (11)
3. Plate (13)

→← Install or Connect (Figures 2 and 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 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 4)

1. Remote handle bezel (15)
2. Lock knob (19)
   - Insert lock rod through hole in bezel.
   - Place end of knob on rod.
   - Slide knob rearward until end of rod goes into depression in end of knob.
   - Force knob against bezel until rod snaps into knob.
3. Screws (16)
4. Covers (17)

DOOR TRIM PANEL

←→ Remove or Disconnect (Figure 1)

Tools Required:

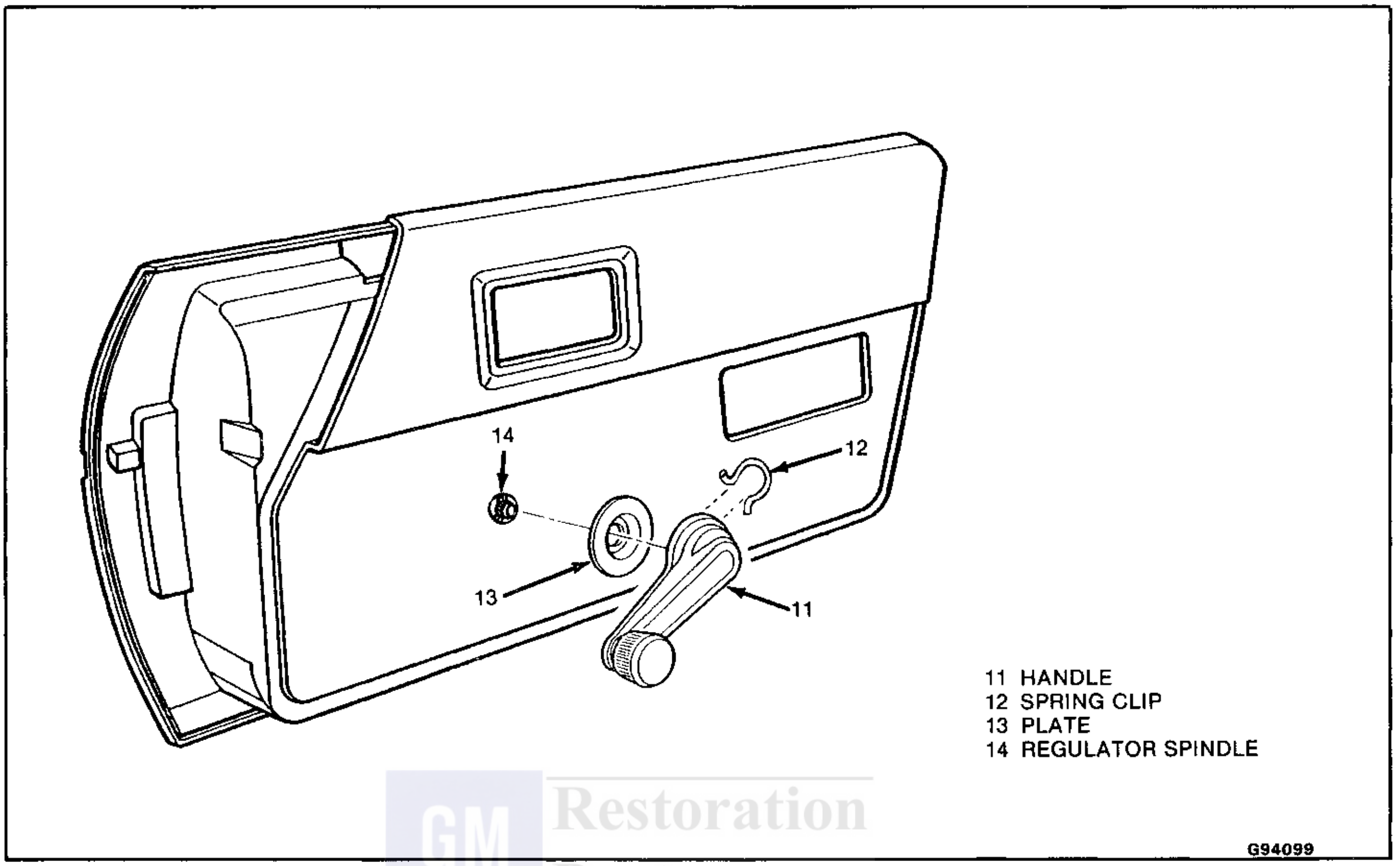


Fig. 2-Window Regulator Handle

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)

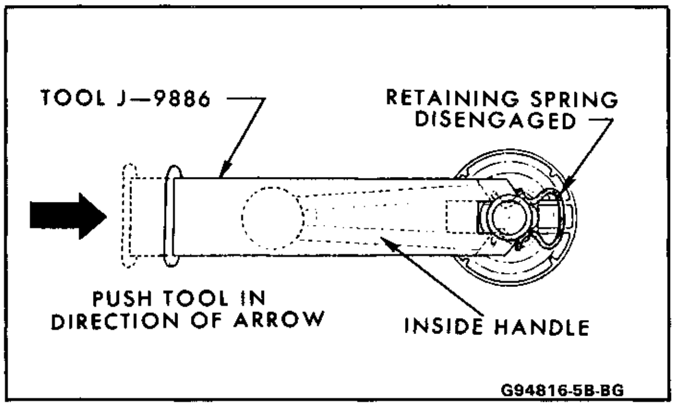


Fig. 3-Removing Window Regulator Handle

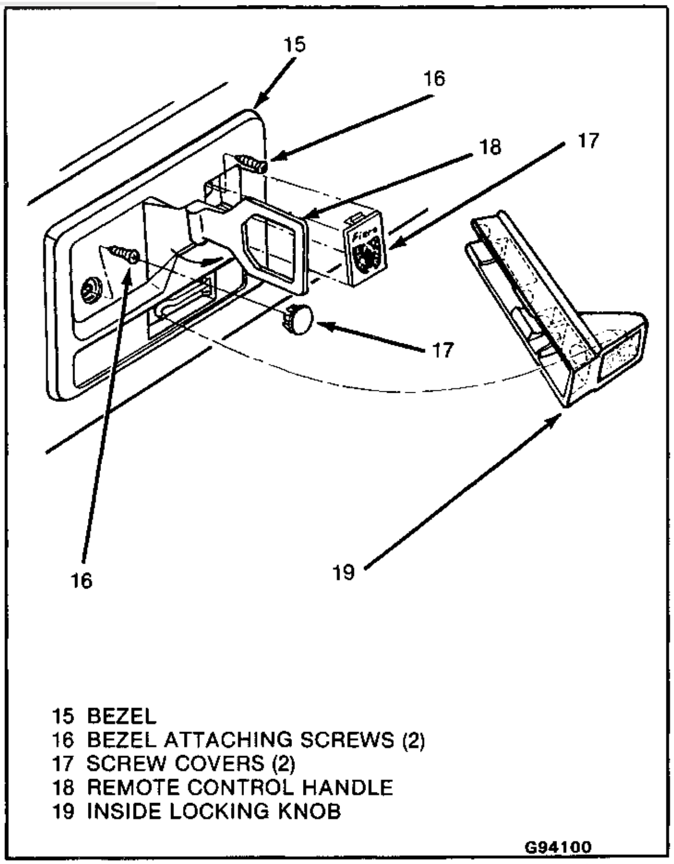


Fig. 4-Remote Control Handle and Lock Knob

Inspect

- Trim panel retainers (8) for damage and proper installation.

  Install or Connect

  1. Insert flange in hole
  2. Rotate retainer to engage flange

- Water deflector for proper installation

Install or Connect (Figure 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
   - 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)

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)

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)

1. Door trim panel
2. Door outside handle
3. Nut (24) from rear clip (25)
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)

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 PANEL COVER TO DOOR

See procedure in Section 6J 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 6)

1. Door trim panel
2. Retainer (31)
3. Sealing strip (30)

Install or Connect (Figure 6)

1. Sealing strip (30)
2. Retainer (31)
3. Door trim panel

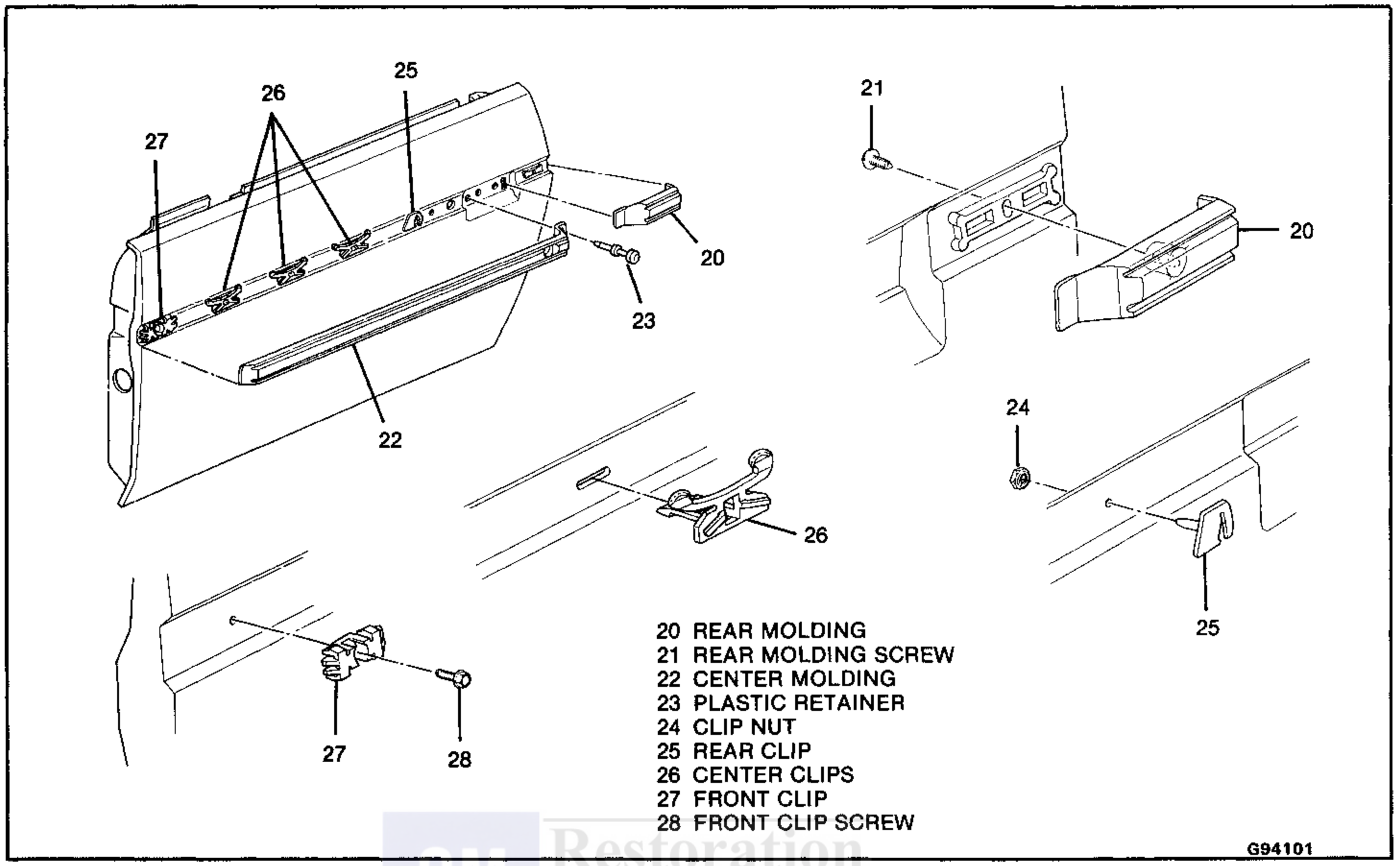


Fig. 5-Exterior Door Moldings

Outer Door Window Belt Sealing Strip

Remove or Disconnect (Figure 6)

1. Door trim panel
2. Water deflector (34)
3. Front filler sealing strip (32)
4. Mirror
5. Door glass
6. Sealing strip attaching screws
7. Sealing strip (29)

Install or Connect (Figure 6)

1. Sealing strip (29)
2. Screws
3. Door glass
4. Mirror
5. Front filler sealing strip (32)
6. Water deflector (34)
7. Door trim panel

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 1, 7 and 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 1, 7 and 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 pinch-weld flange around the door opening and are friction retained on pinch-weld around door opening and adhesive retained in the channels around the window glass opening. There are four screws at the beltline.

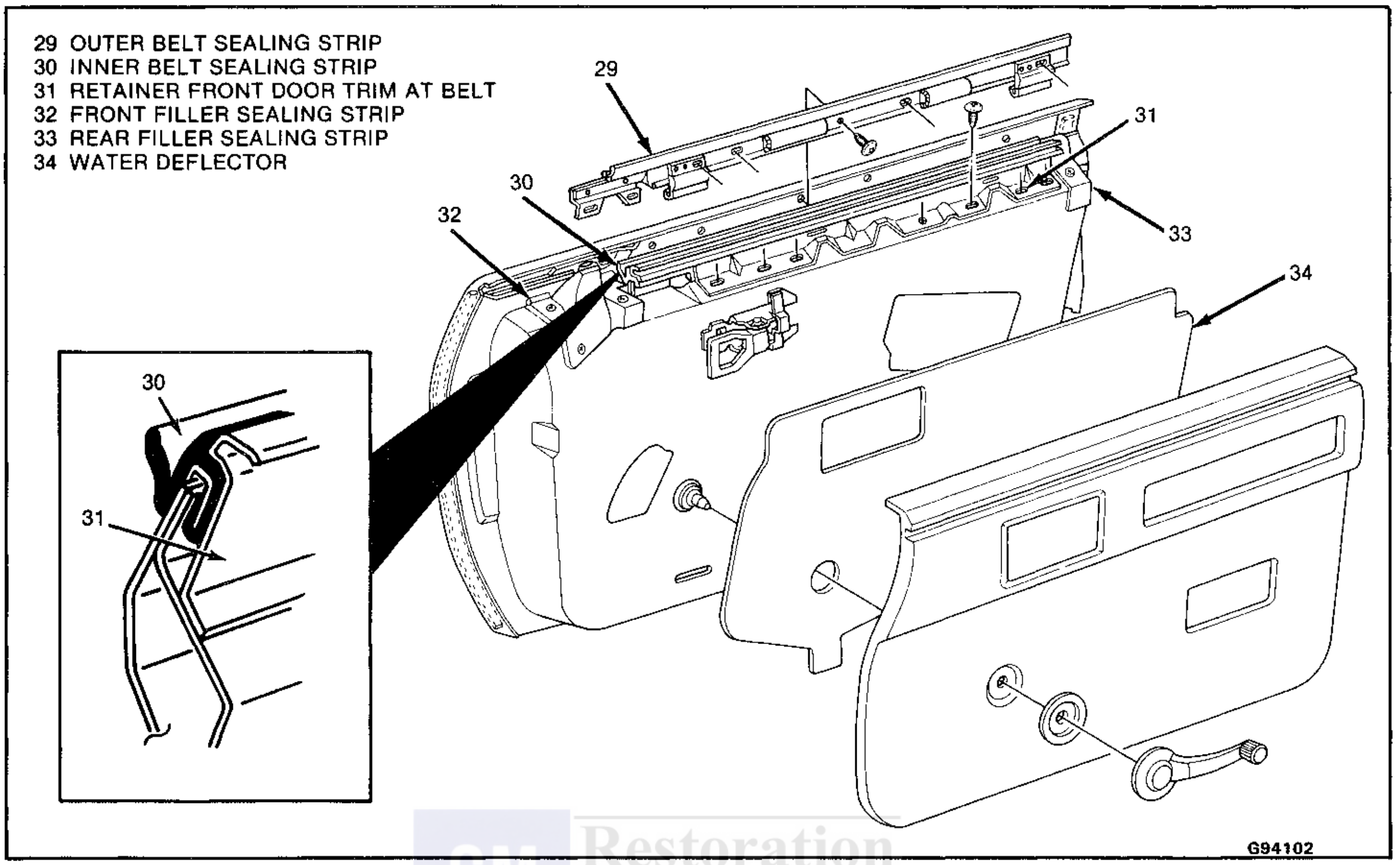


Fig. 6-Door Sealing Components

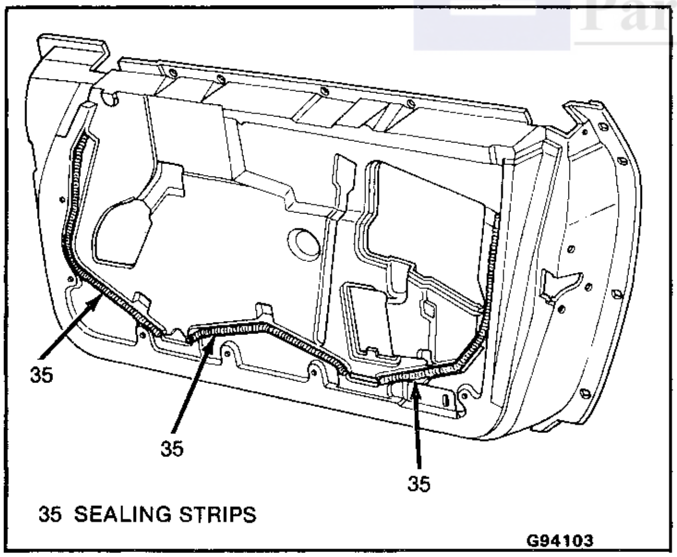


Fig. 7-Door Inner Panel Water Deflector Sealing Locations

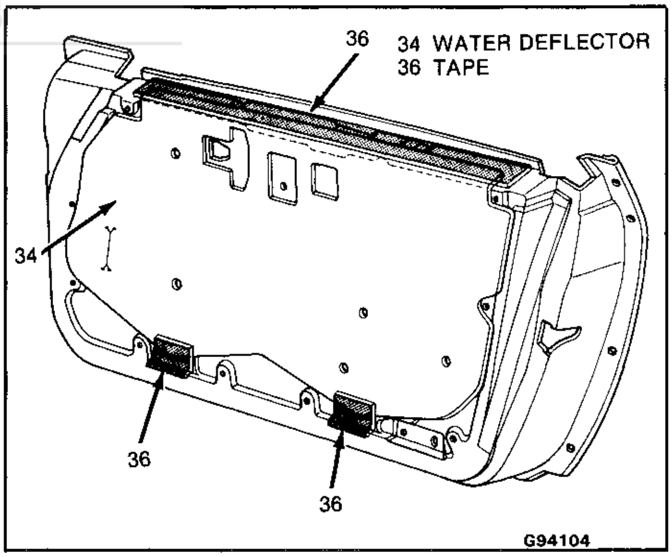


Fig. 8-Door Inner Panel Water Deflector Tape Locations

Door Opening Weatherstrip

Remove or Disconnect (Figure 9)

1. Lower garnish molding. Refer to Section 3J.
2. Loosen quarter trim panel
3. Screws (39)
4. Door opening weatherstrip (38)
   - Break bond between channel and weatherstrip with a putty knife or flat-bladed tool and a release agent.
   - Start at any convenient location, grasp the weatherstrip and pull from the pinch-weld flange and channel; continue around entire door opening.

Install or Connect (Figure 9)

1. Door opening weatherstrip (38)
   - Apply a medium-bodied sealer in cavity of weatherstrip
   - Apply black weatherstrip adhesive to the weatherstrip-to-channel stripping.

- Be certain to obtain full engagement on the pinch-weld flange and in the channels.

2. Screws (39)
3. Tighten quarter trim panel
4. Lower garnish molding

Weatherstrip Channels

Remove or Disconnect (Figure 9)

1. Weatherstrip (38)
2. Screws
3. Channels (37)

Inspect

Channel seal and repair or replace if damaged.

Install or Connect (Figure 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 mechanisms 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 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 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 11)

1. Door trim panel
2. Water deflector
3. Connecting rods and/or locking rods as required.

Install or Connect (Figure 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 12)

1. Door trim panel
2. Connecting rod clip (46)
3. Rivet at remote handle (44)
4. Remote handle (18)

Install or Connect (Figure 12)

1. Remote handle (18)
2. Rivet (44)
3. Connecting rod (47)
4. Door trim panel

OUTSIDE HANDLE

Remove or Disconnect (Figures 13 and 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 13 and 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, 6, and 14)

1. Door trim panel

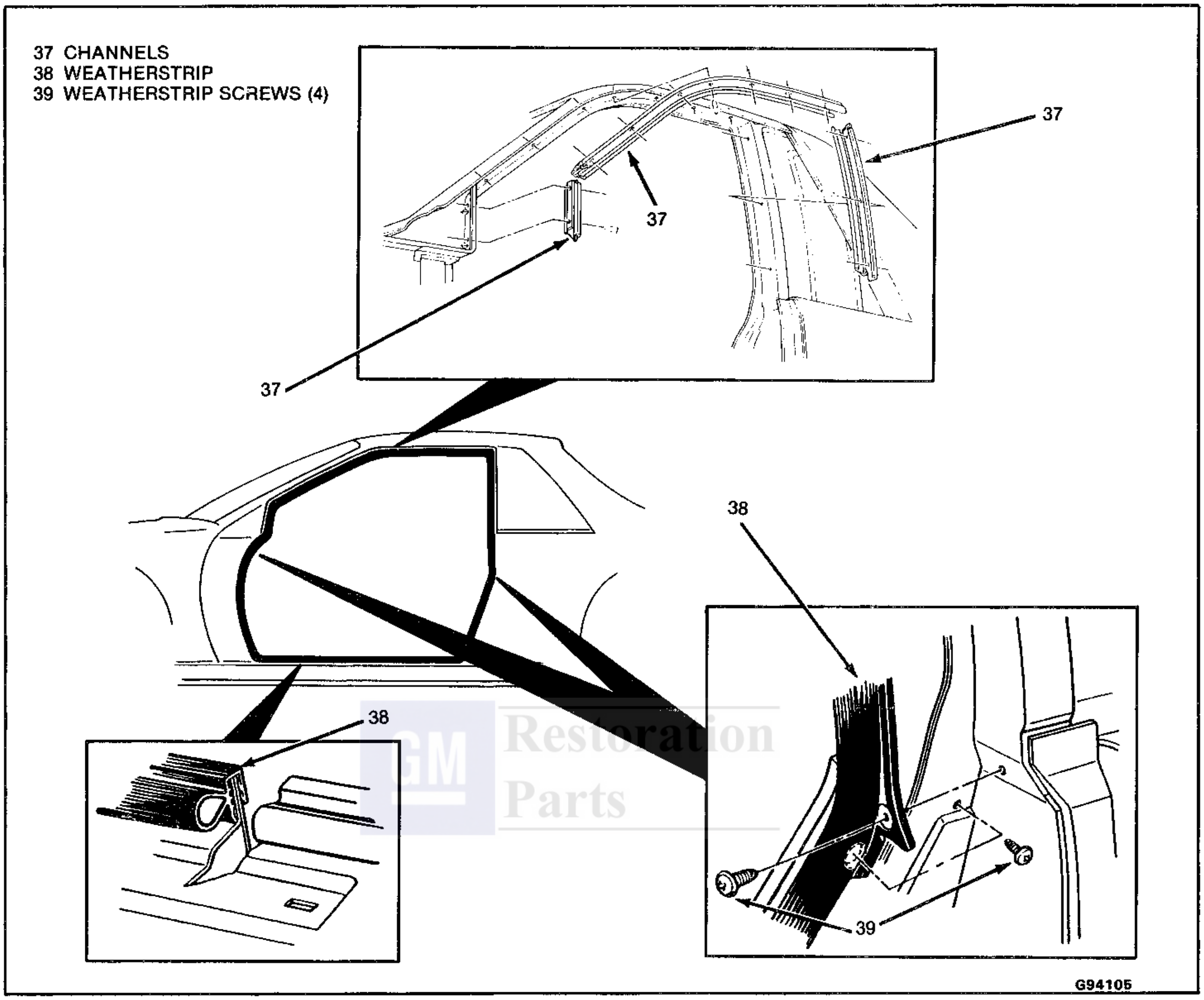


Fig. 9-Door Opening Weatherstrips and Channels

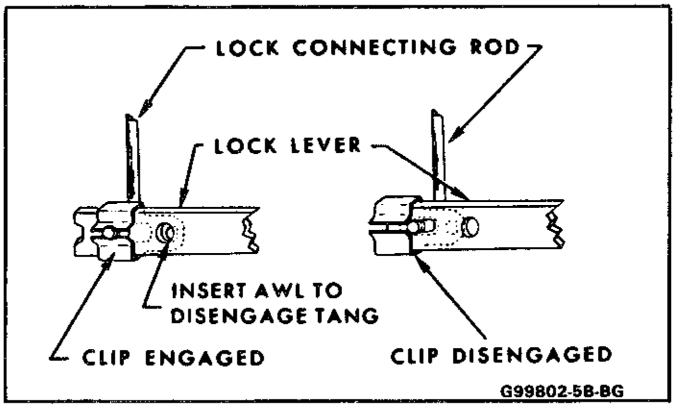


Fig. 10-Removing Spring Clip

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 panel.
5. Outside door handle
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, 6, and 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 bolts (28)

Inspect

Mechanical door parts for proper operation.

5. Four peel type rivets (60) at bottom of door

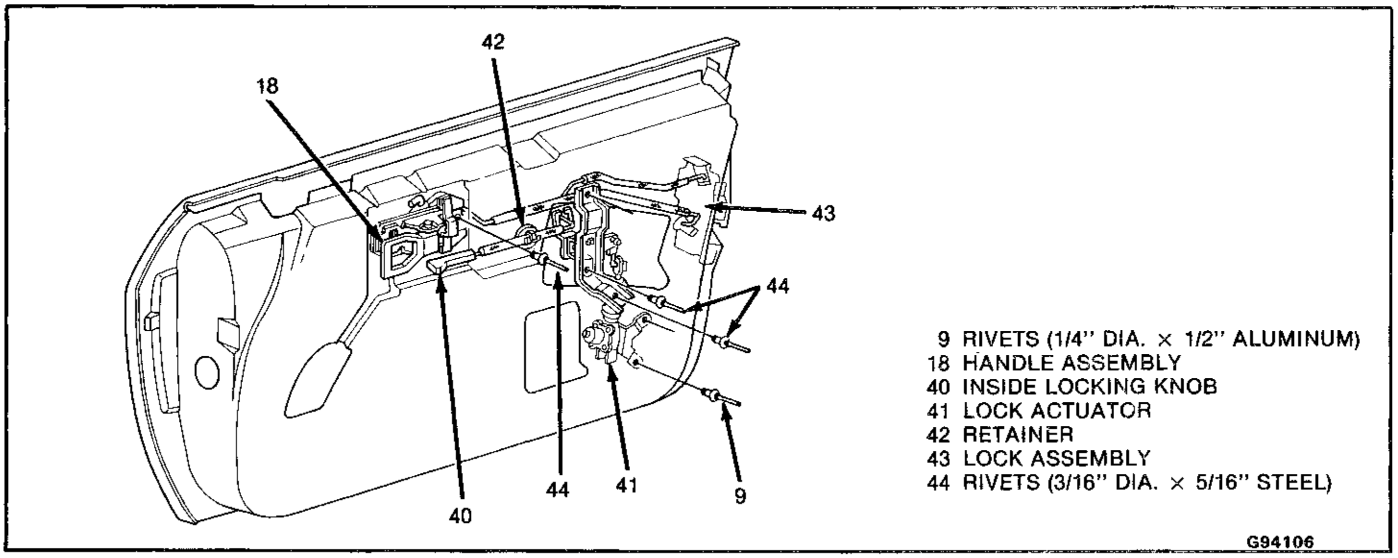


Fig. 11-Connecting Rods and Locking Rods

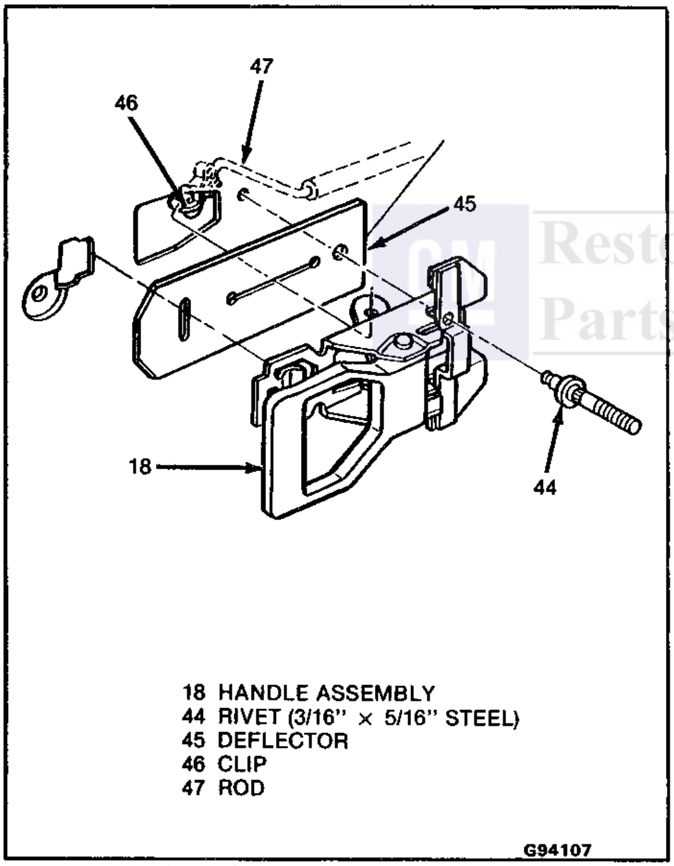


Fig. 12-Inside Remote Handle

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 15, 17)

- 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 (x in Figure 15).

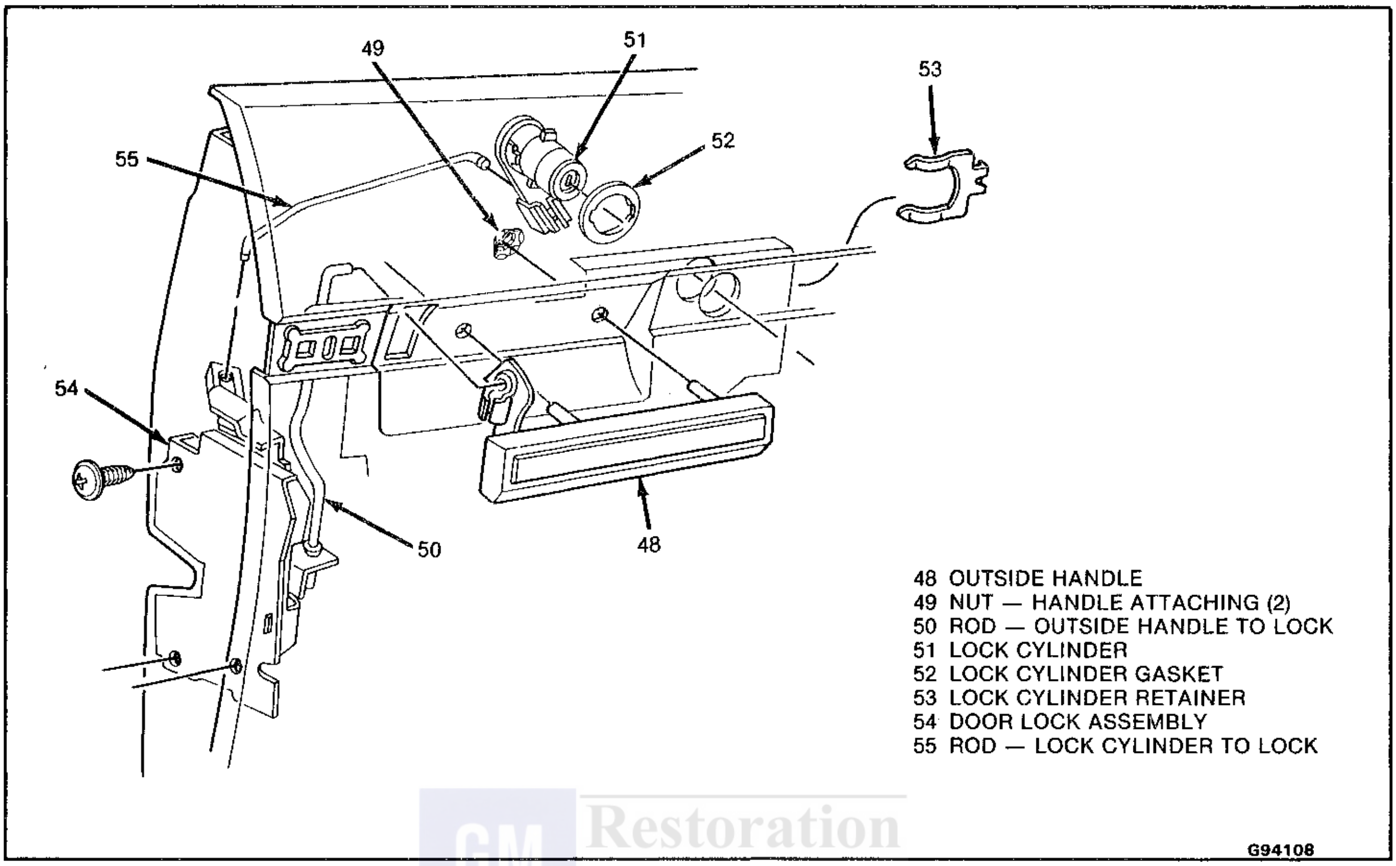
- Minimum allowable dimension 2 mm (3/32")
- Maximum allowable dimension 4 mm (5/32")

Adjust

Tools Required:

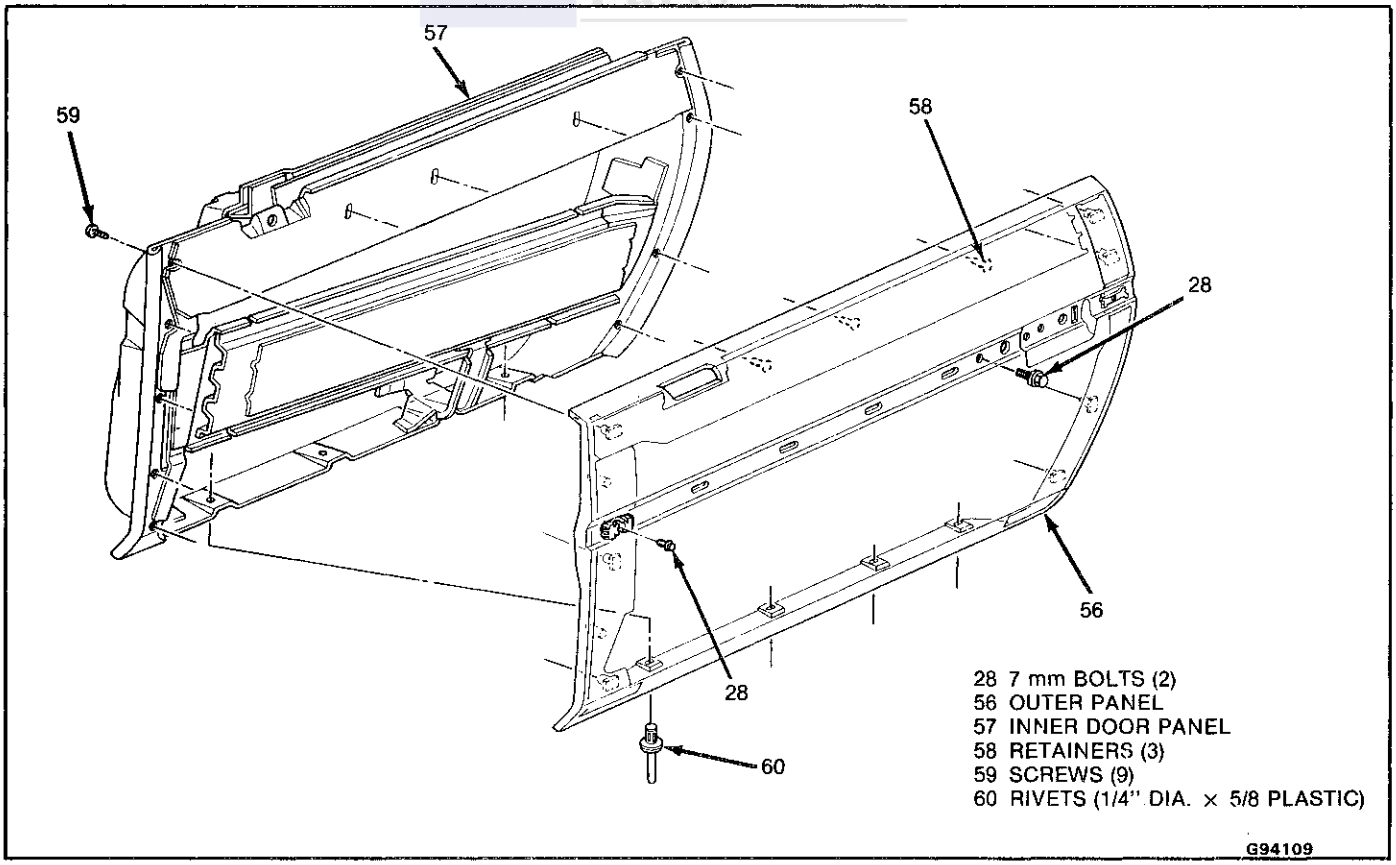
J-23457 Door lock striker wrench (or equivalent)

- Remove striker with J-23457.
- Install spacer or spacers as required to obtain correct alignment. A 2 mm (3/32") spacer, part no. 4469196, or equivalent, can be used to achieve the desired alignment.



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. 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. 14-Outer Door Panel

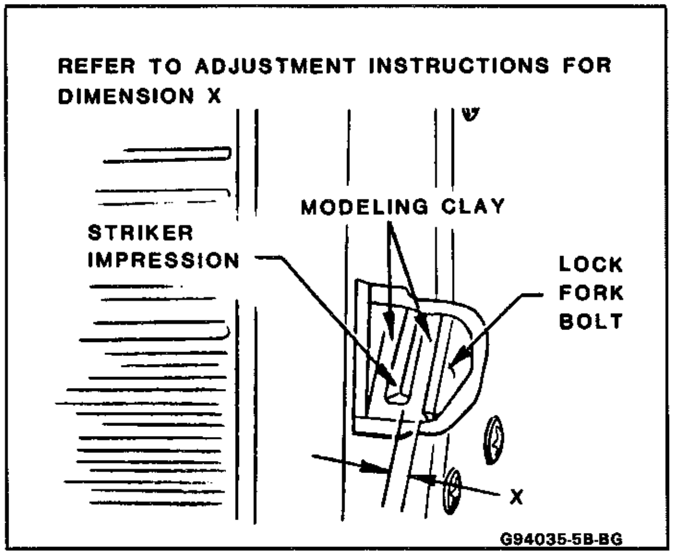


Fig. 15-Lock-to-Striker Engagement

- 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 16, 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. 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.

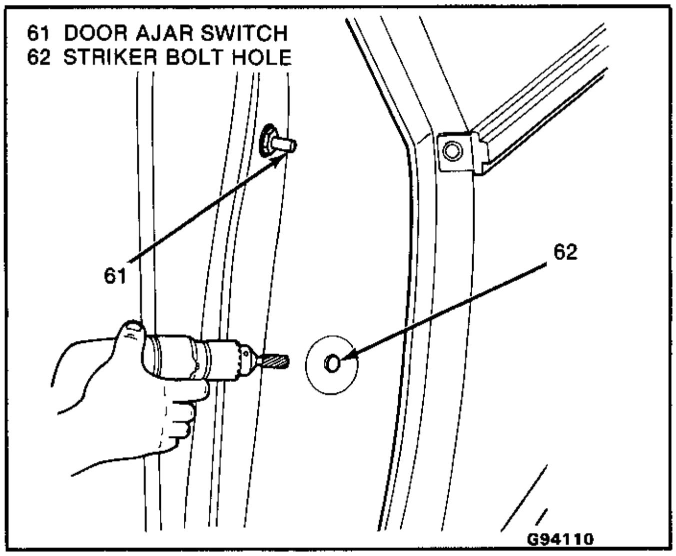


Fig. 16-Striker Bolt Hole Enlargement

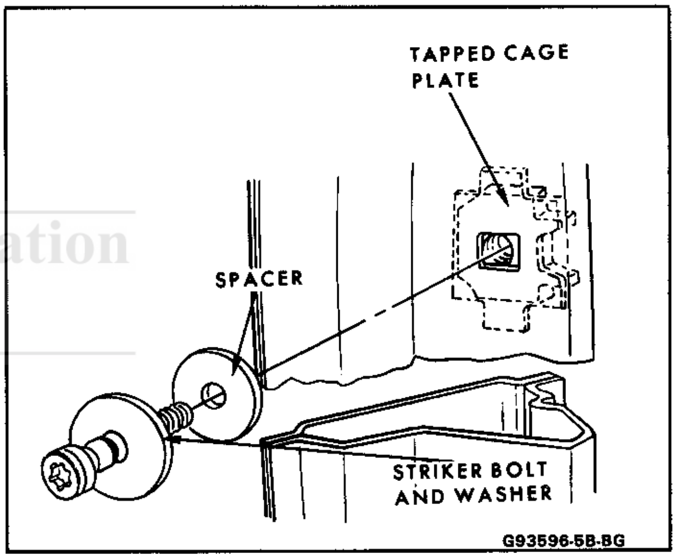


Fig. 17-Typical Door Lock Striker Mechanism

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 19)

1. Door trim panel
2. Front filler weatherstrip
3. Mirror attaching nuts (67)
4. Mirror (64)

Install or Connect (Figure 19)

1. Mirror (64)

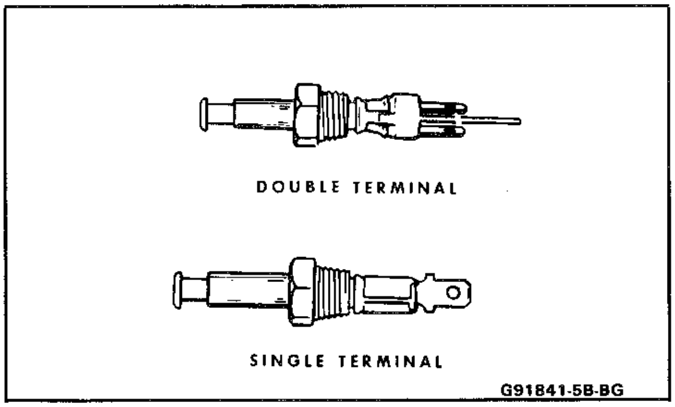


Fig. 18-Door Jamb Switches

2. Mirror attaching nuts (67)
3. Front filler weatherstrip
4. Door trim panel

Mirror Glass - Manual

Remove or Disconnect (Figure 19)

1. Upper screw by putting mirror glass (63) in full-down position for access
2. Lower screws by putting mirror glass (63) in full-up position for access
3. Mirror glass assembly (63)

Install or Connect (Figure 19)

1. Mirror glass assembly (63)
2. Lower screws by putting mirror glass (63) in full-up position for access
3. Upper screws by putting mirror glass (63) in full-down position for access

Remote Control Mirror - Manual

Remove or Disconnect (Figure 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 20)

1. Feed cable through door opening
2. Mirror (68)
3. Mirror attaching nuts (67)
4. Front filler weatherstrip
5. Remote control cable end
6. Door trim panel

Remote Control Mirror Glass - Manual

Remove or Disconnect (Figure 20)

1. Mirror (68)
2. Upper screws by putting mirror glass (69) in full-down position for access

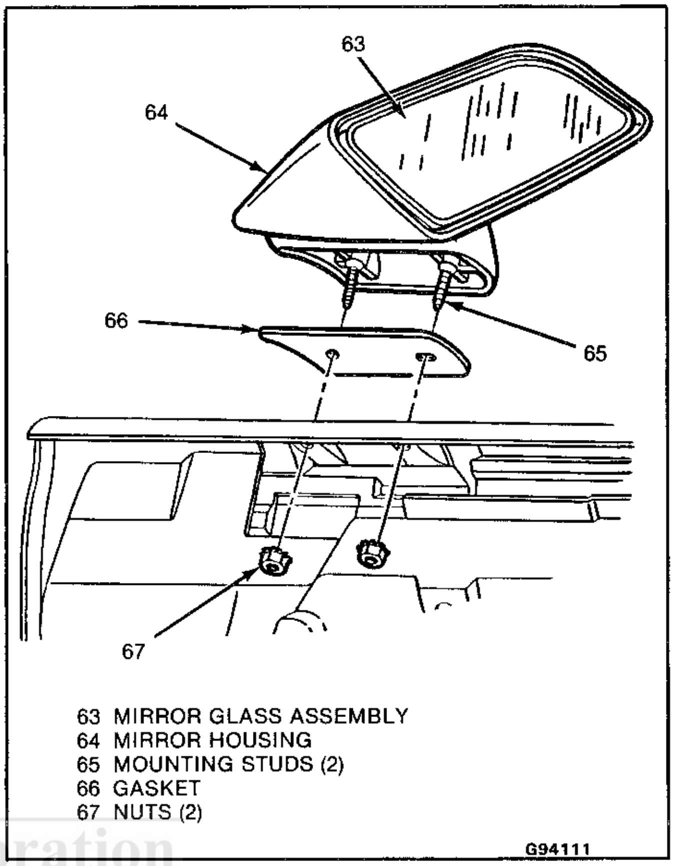


Fig. 19-Outside Mirror - Manual

3. Lower screws by putting 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 by putting mirror glass (69) in full-up position for access
3. Upper screws by putting 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 21)

- Grasp inboard and outboard edges of glass (71) with fingers
- Pull rearward to disengage glass from pivot (74)

Install or Connect (Figure 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

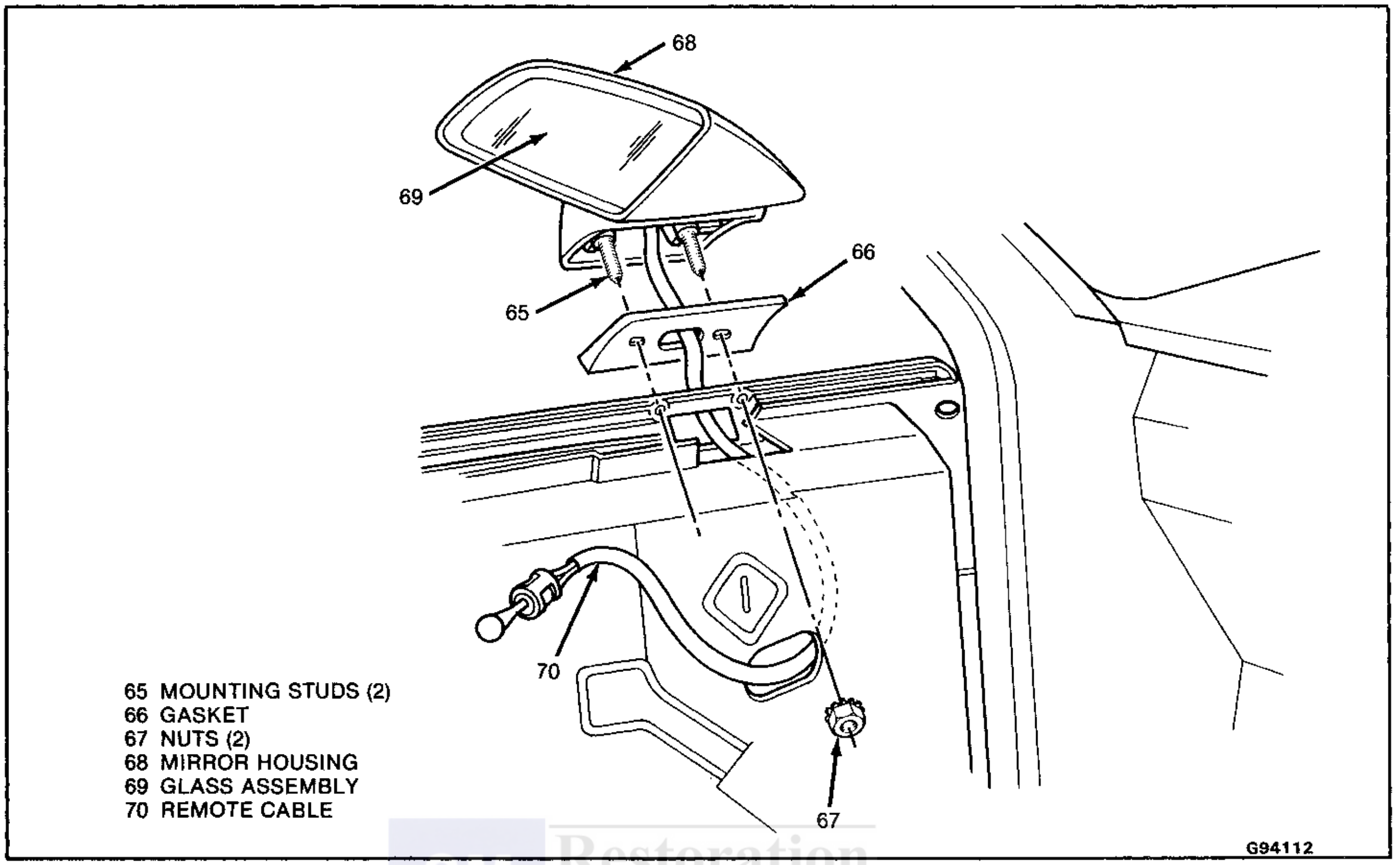


Fig. 20-Remote Control Mirror - Manual

Power Mirror Drive Unit

Remove or Disconnect (Figure 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 21)

1. Drive unit
2. Screws (73)
3. Electrical connector (76)
4. Mirror housing (72)
5. Nuts (67)
6. Mirror glass (71)
7. Battery – negative cable

Inspect

For proper operation

8. Front filler weatherstrip
9. Door trim panel

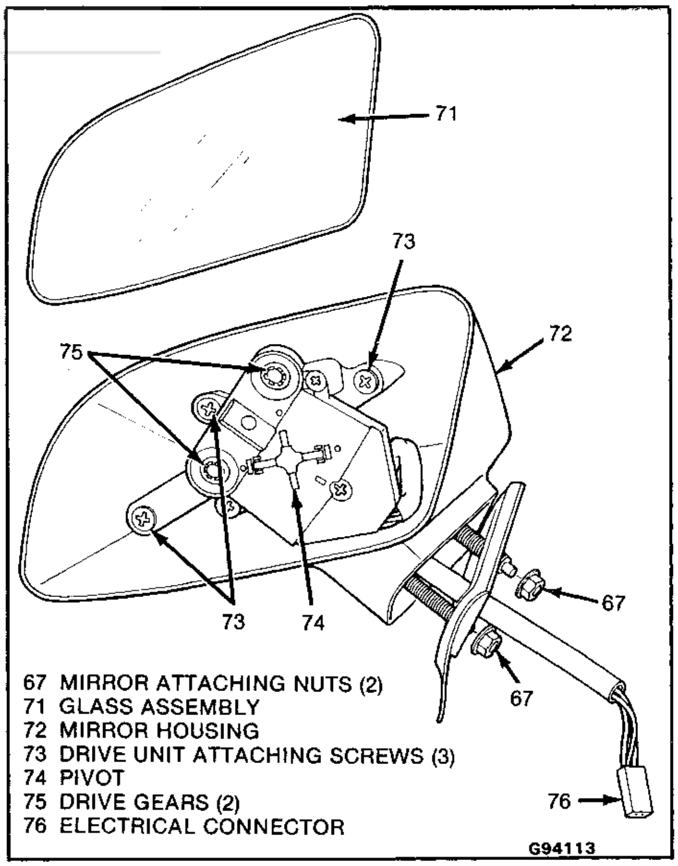


Fig. 21-Power Remote Outside Mirror Parts

DOOR GLASS ASSEMBLY

Remove or Disconnect (Figure 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 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 23)

Window rotated

- Loosen up-stop bolts (97 and 93)
- Adjust inner panel cam-bolts (98 and 99)
- Adjust window so that upper edge of glass is parallel with roof side rail weatherstrip.
- 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 22, 23)

1. Door trim panel
2. Water deflector
3. Lower glass halfway 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. 28)
9. Rivets – regulator to inner door (9, Fig. 28)
10. Regulator cam assembly (78)

Install or Connect (Figures 22, 23)

1. Regulator cam assembly (78)
2. Rivets – regulator to inner door (9, Fig. 28)
3. Plate (103, Fig. 28)
4. Window guide cam assembly bolts (90 and 91)
5. Remove blocks and lower glass
6. Glass to cam assembly (78)

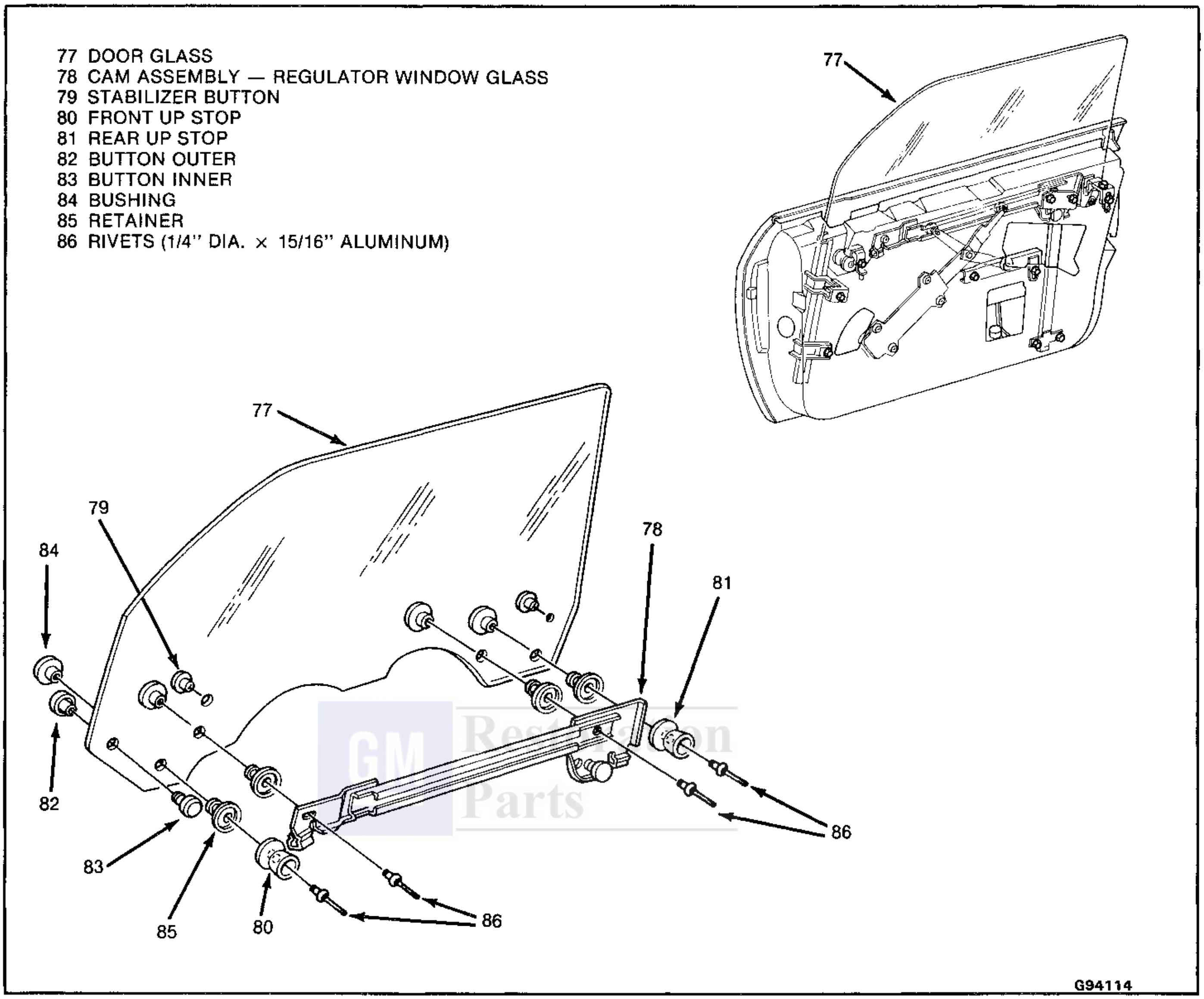


Fig. 22-Door Glass Assembly

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 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

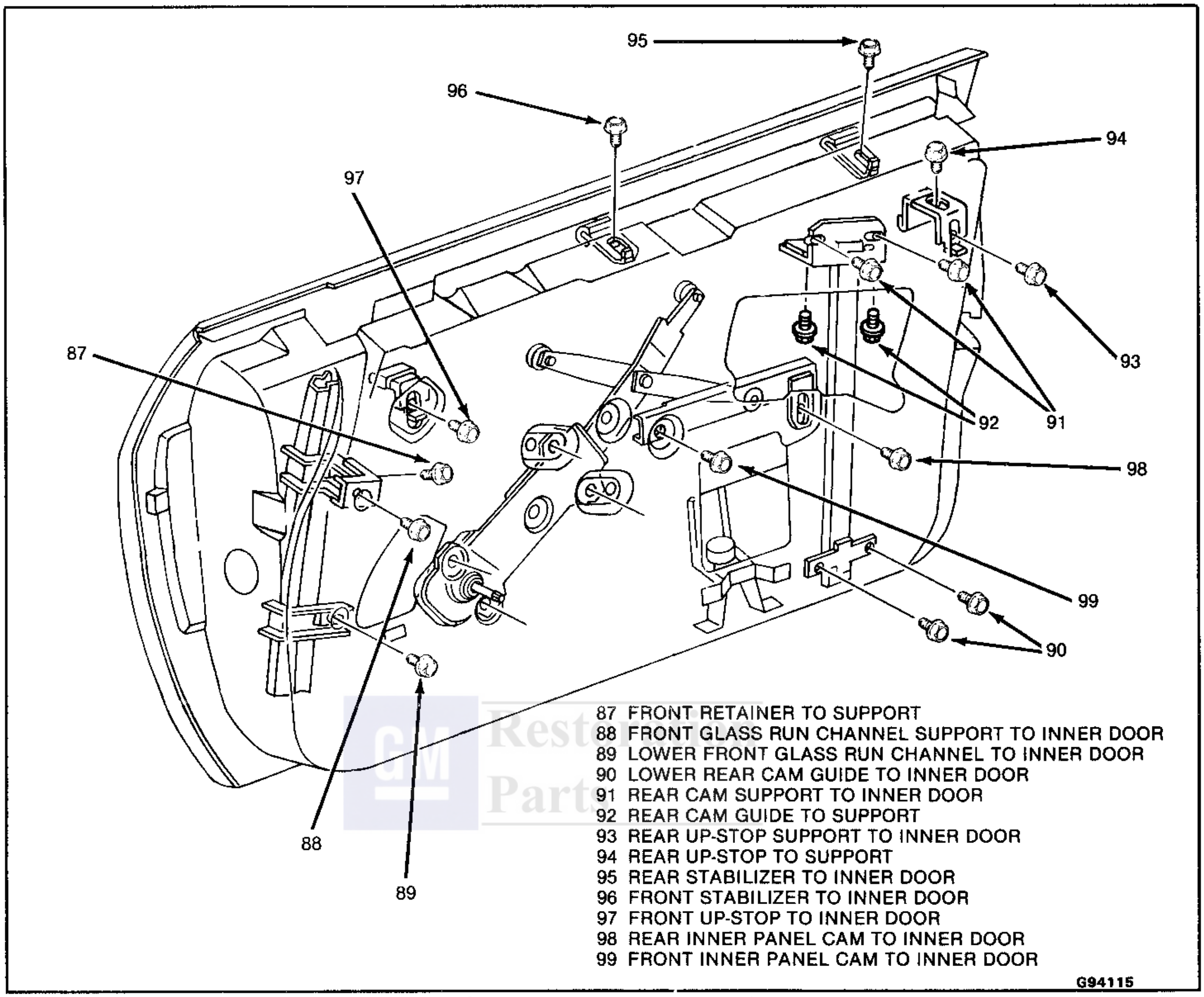
Install or Connect (Figure 24)

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

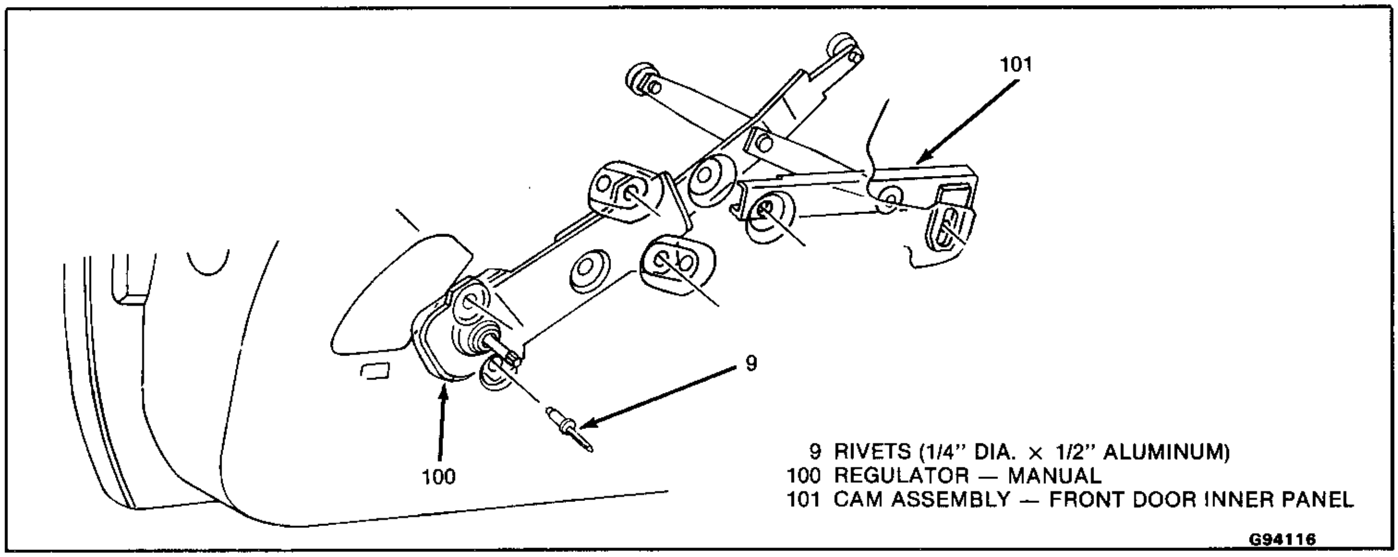
Remove or Disconnect (Figure 25)

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
6. Electrical connector
7. Regulator – electric (102) through rear access hole



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. 23-Door Hardware Attaching Bolts



9 RIVETS (1/4" DIA. × 1/2" ALUMINUM)
100 REGULATOR — MANUAL
101 CAM ASSEMBLY — FRONT DOOR INNER PANEL

Fig. 24-Window Regulator Assembly - Manual

→← Install or Connect (Figure 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 23)

1. Trim panel
2. Water deflector
3. Rear cam guide bolts (90, 91 and 92)
4. Rear cam guide

Install or Connect (Figure 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 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 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 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 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.

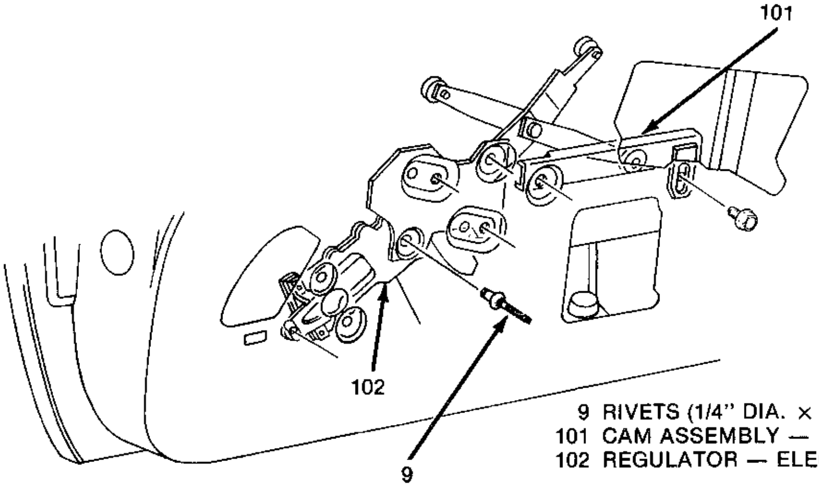
3. Water deflector
4. Trim panel

DOOR LOCK ASSEMBLY

Do not attempt to correct lock discrepancies. Make correction through the replacement of the lock assembly.

Remove or Disconnect (Figure 27)

1. Trim panel
2. Water deflector



9 RIVETS (1/4" DIA. × 1/2" ALUMINUM)
101 CAM ASSEMBLY — FRONT DOOR INNER PANEL
102 REGULATOR — ELECTRIC

Fig. 25-Window Regulator Assembly - Electric

3. Rods at lock assembly
4. Door ajar switch wire connector from main harness (54C, Fig. 26)
5. Lock assembly screws – lower assembly to disengage outside handle lock rod (50)
6. Lock assembly (54)

Install or Connect (Figure 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. 26)
6. Water deflector
7. Trim panel

DOOR AJAR SWITCH

Remove or Disconnect (Fig. 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 27)

1. Trim panel
2. Water deflector
3. Loosen top portion of outer door panel
4. Cylinder assembly retainer (53)
5. Lock cylinder assembly (51)

Install or Connect (Figure 27)

1. Lock cylinder assembly (51)
2. Cylinder assembly retainer (53)
3. Top portion of outer door panel
4. Water deflector
5. Trim panel

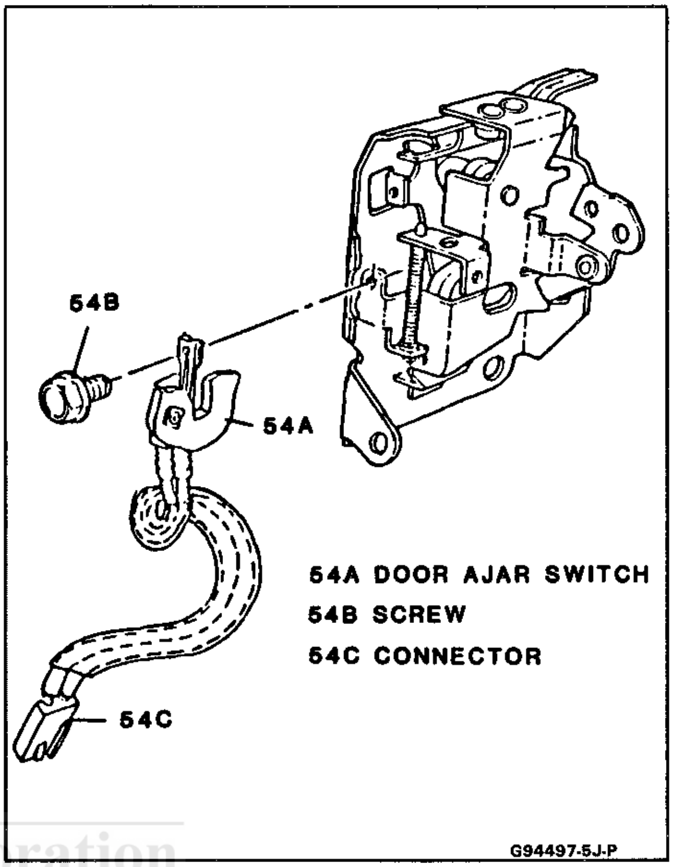


Fig. 26 - Installing Door Ajar Switch

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 28)

1. Trim panel
2. Water deflector
3. Electrical connector
4. Rivets (9)
5. Actuator rod at bell crank (104)
6. Actuator assembly (41)

Install or Connect (Figure 28)

1. Actuator assembly (41)
2. Actuator rod at bell crank (104)
3. Rivets (9)
4. Electrical connector

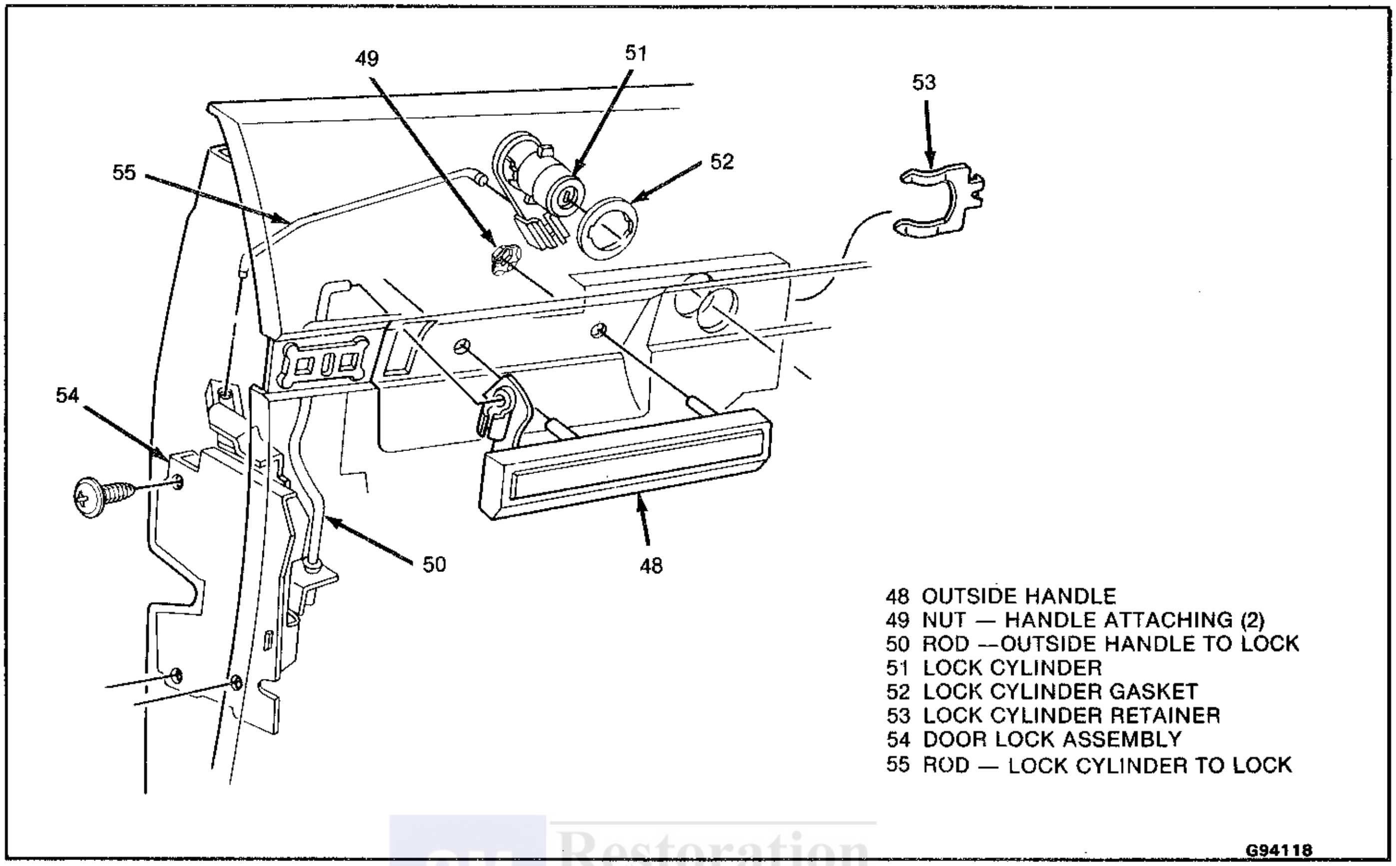


Fig. 27-Door Locking Mechanism

Inspect

For proper operation

5. Water deflector
6. Trim panel

DOOR BELL CRANK

Remove or Disconnect (Figures 11 and 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
5. Trim panel

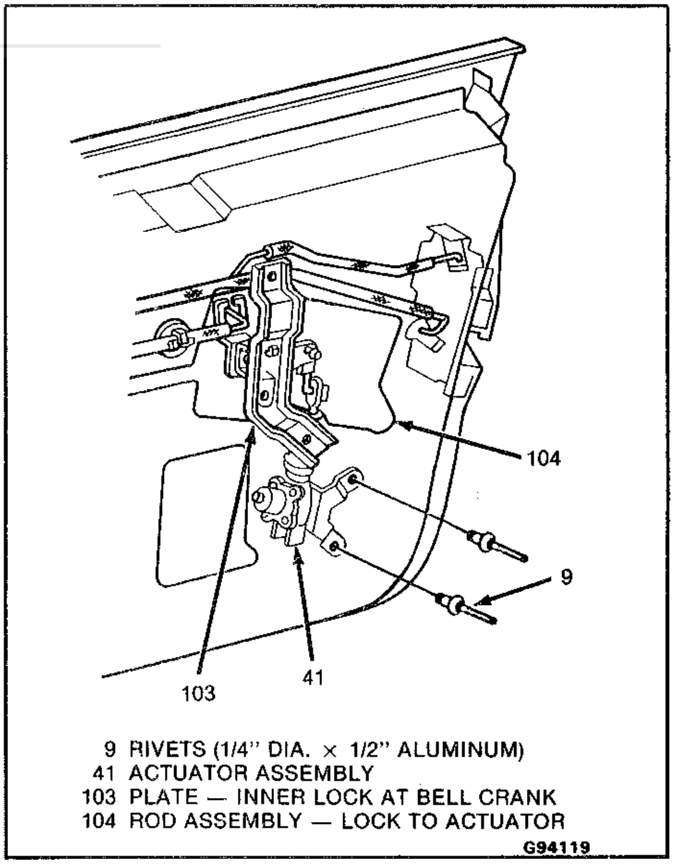


Fig. 28-Power Door Lock System

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 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 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

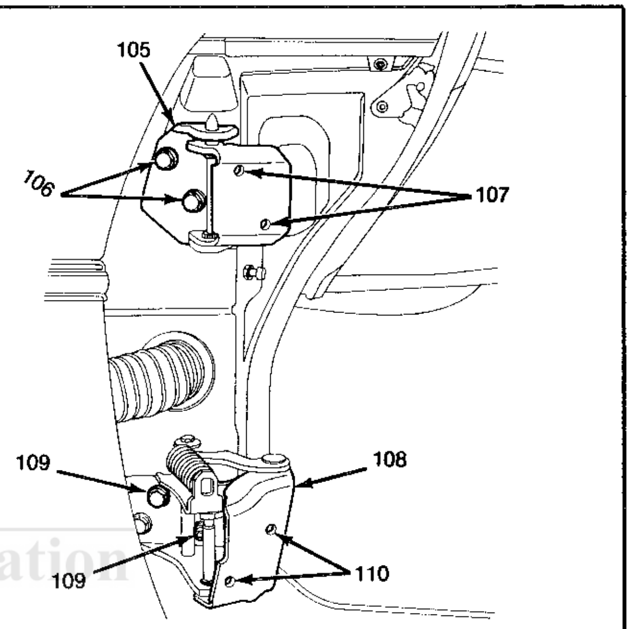
   - Door assembly for proper engagement
   - All electrical door devices for proper operation
6. Front run channel
7. Water deflector
8. Door trim panel

DOOR HINGE

Remove or Disconnect (Figure 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

G94120

Fig. 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 movement when installing the hinge.

Install or Connect (Figure 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 6J

REAR QUARTERS

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

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)

ROCKER PANEL COVER TO DOOR PANEL EXTENSION

←→ 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)

ROCKER PANEL COVER TO FRONT FENDER EXTENSION

←→ 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

ROCKER PANEL COVER TO QUARTER EXTENSION

←→ 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

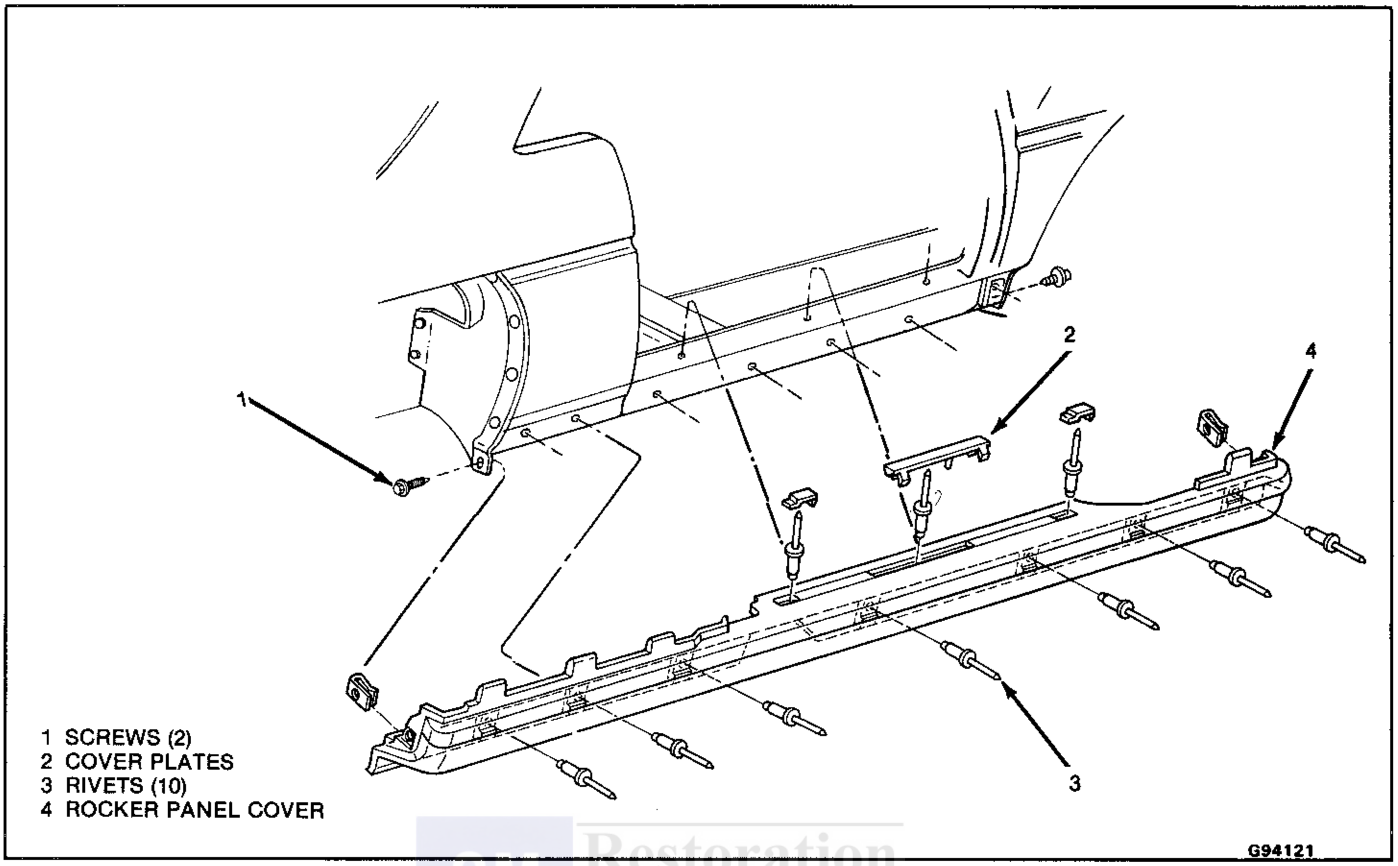


Fig. 1-Installing Rocker Panel Cover

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

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)
4. Rear compartment side panel cover

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

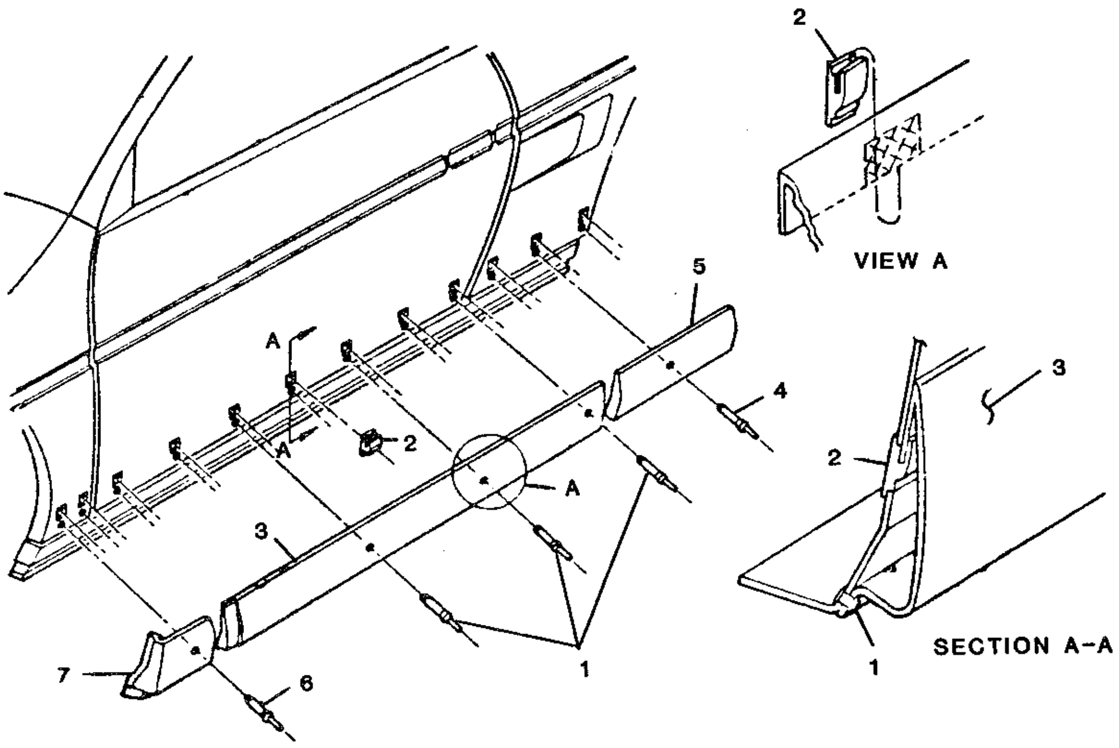
Install or Connect (Figure 5)

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



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 - Rocker Panel Cover Extensions

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. Make sure spacers (10B) are in proper location
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)

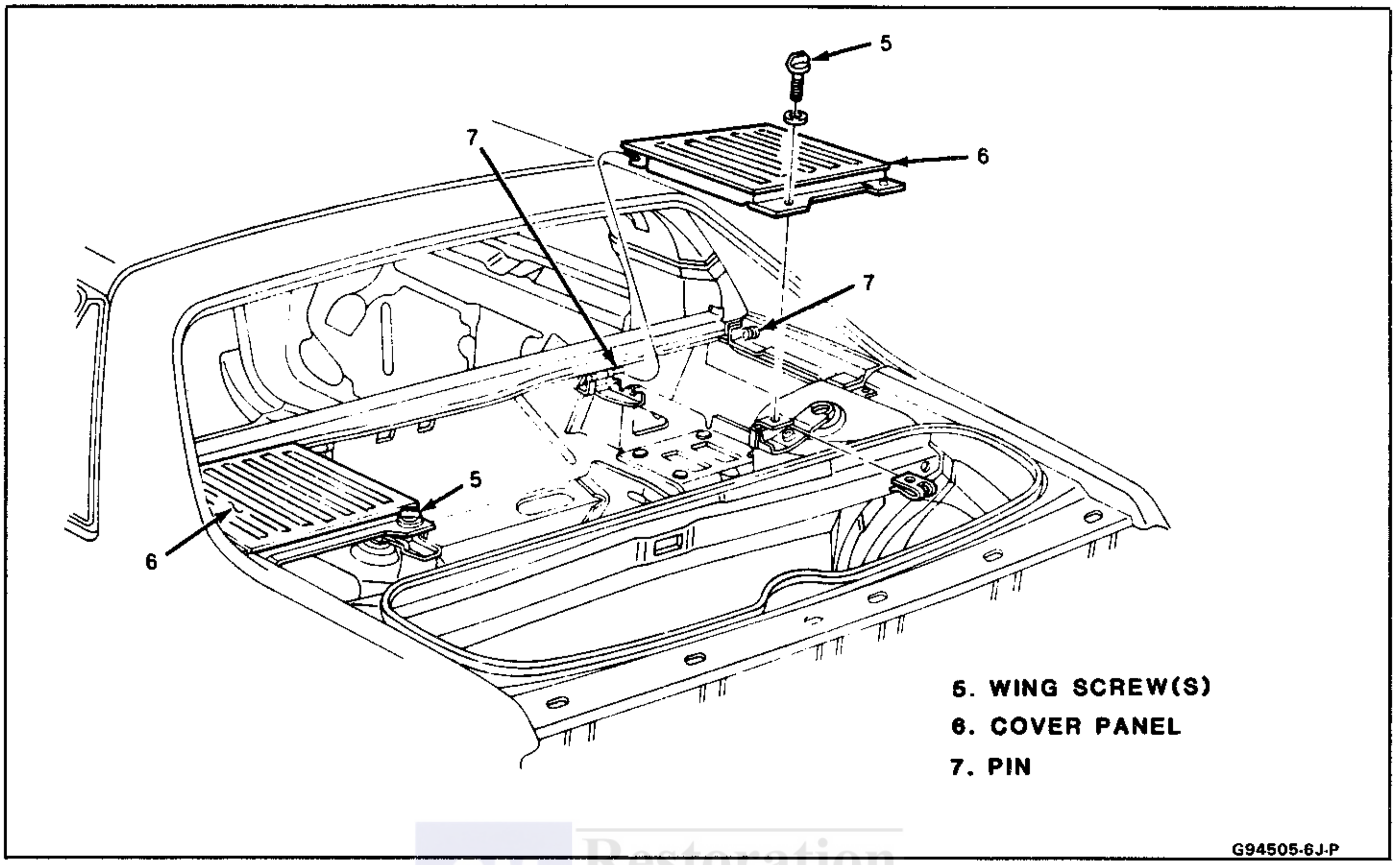


Fig. 3-Installing Rear Compartment Side Panel Cover - 37 Style Shown, 97 Style Similar

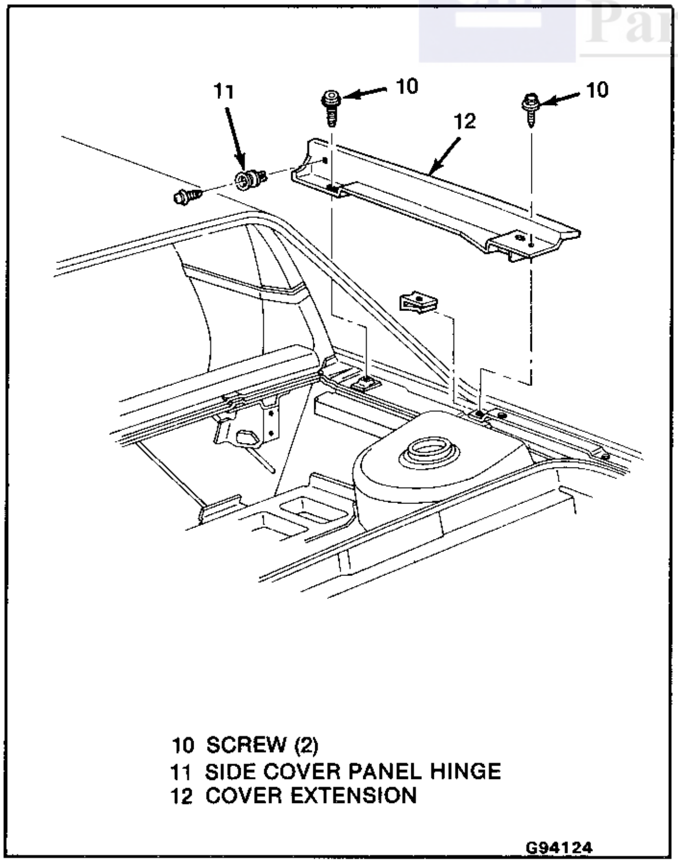


Fig. 4 - Rear Compartment Cover Extension - 37 Style

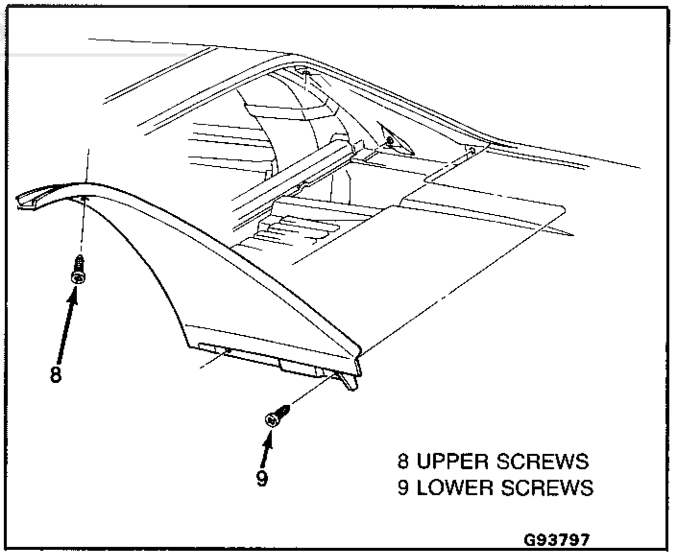


Fig. 5 - Back Window Side Filler Panel - 37 Style

2. Speaker assembly (14A)
3. Screws (12A)
4. Rear quarter trim panel

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

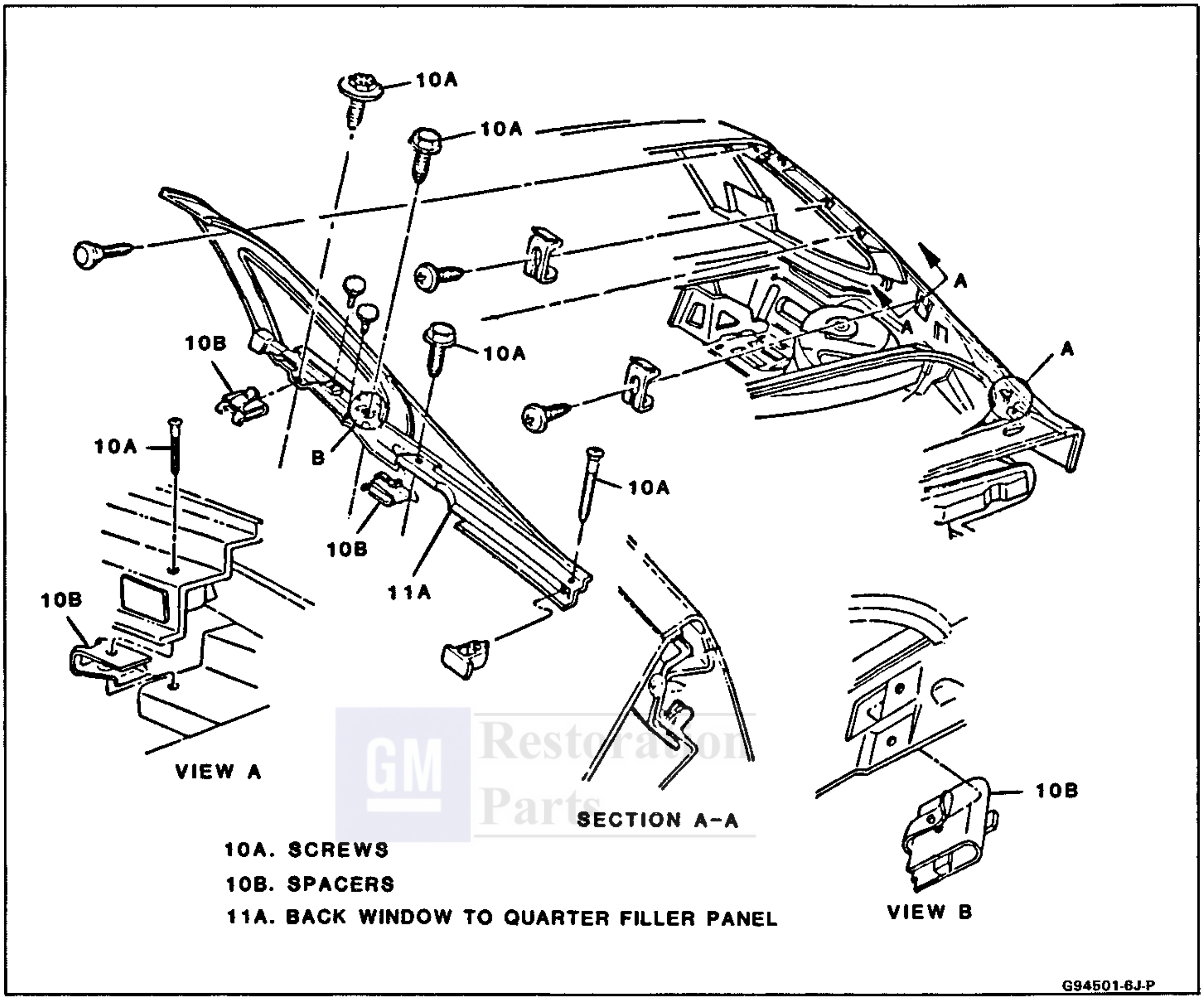


Fig. 6 - Installing Back Window to Quarter Filler Panel - 97 Style

Install or Connect

1. Speaker grille to trim panel
2. Rear quarter trim

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)

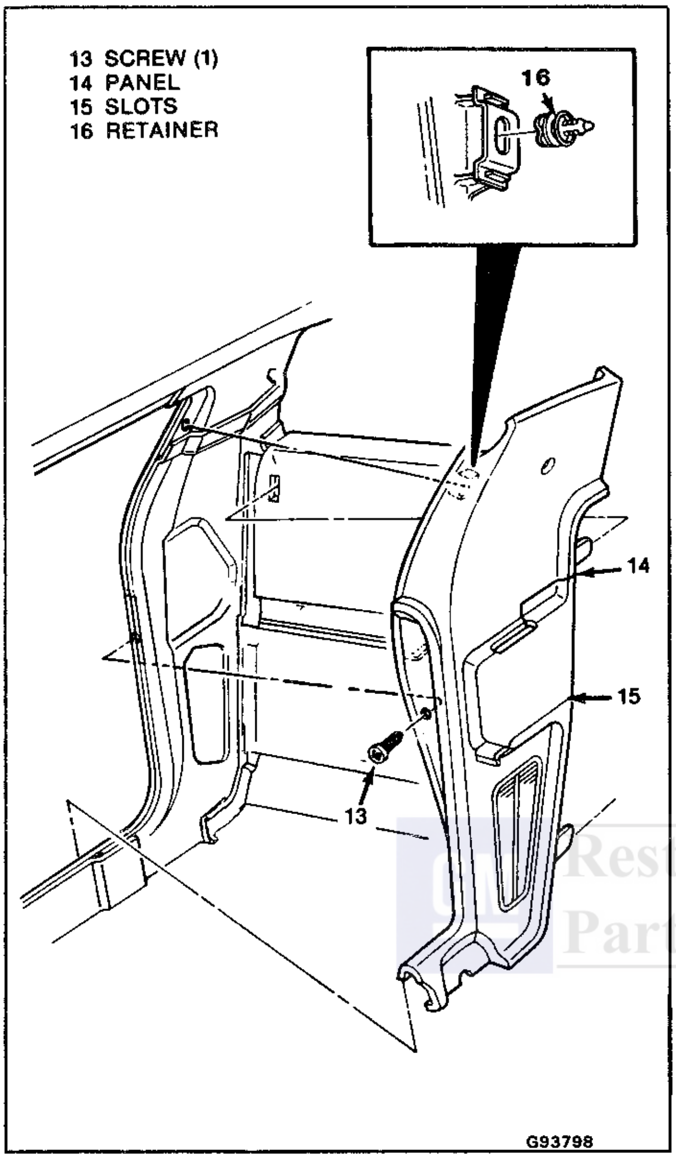


Fig. 7-Rear Quarter Trim Panel

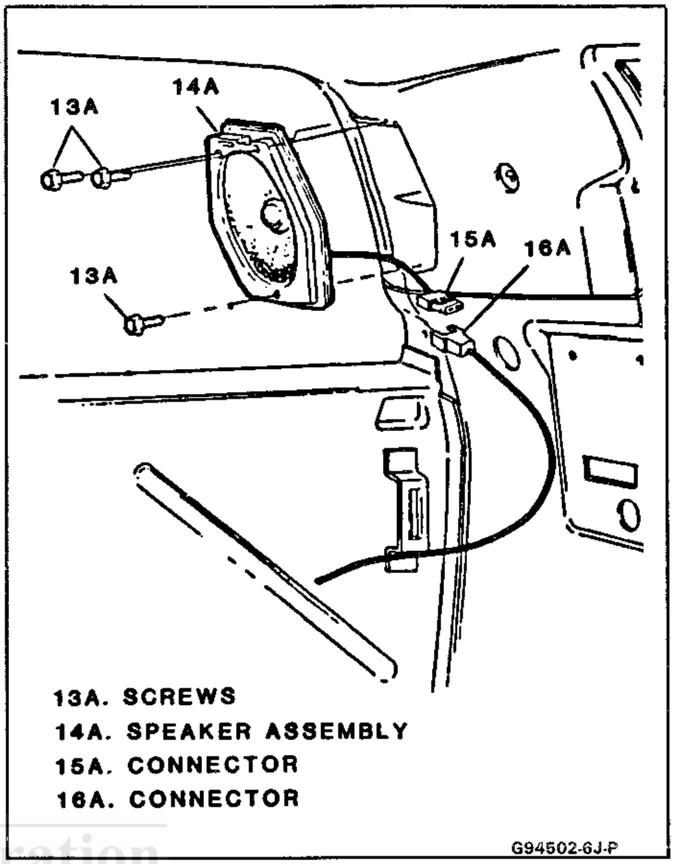


Fig. 8 - Installing Quarter Speaker Assembly

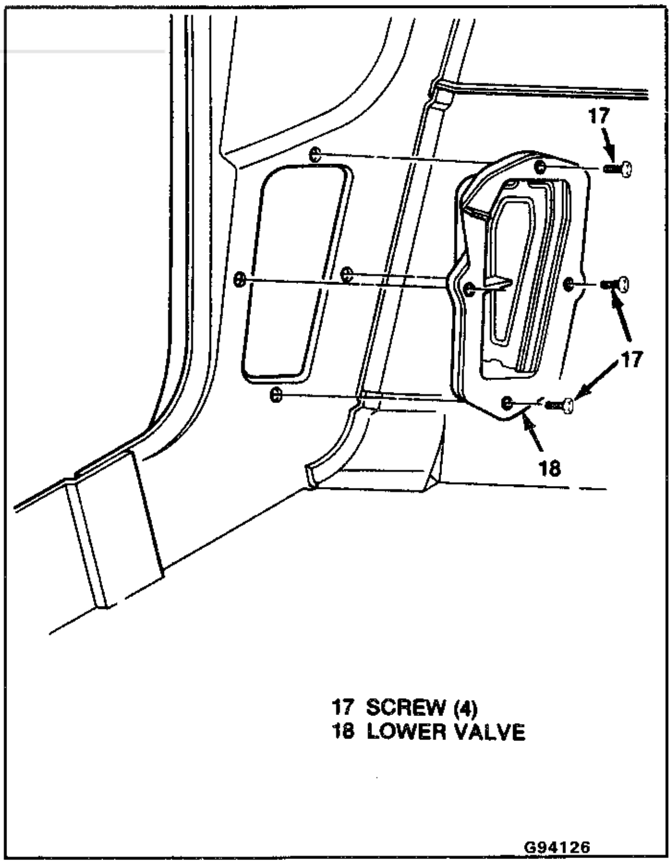


Fig. 9-Lower Pressure Relief Valve

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

Anchor bolt 35 to 48 N·m (26 to 35 ft-lb)

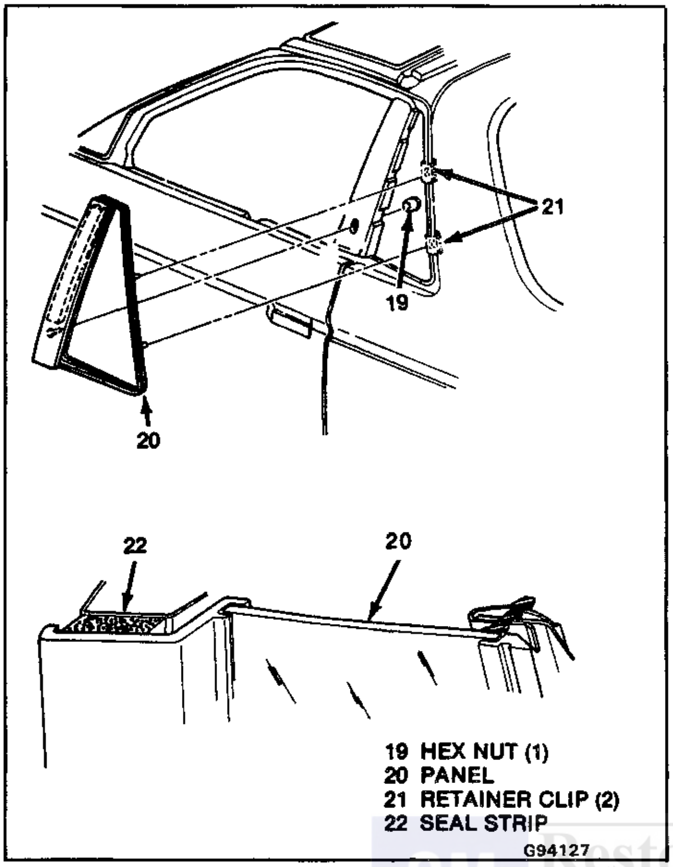


Fig. 10-Applique Panel Assembly

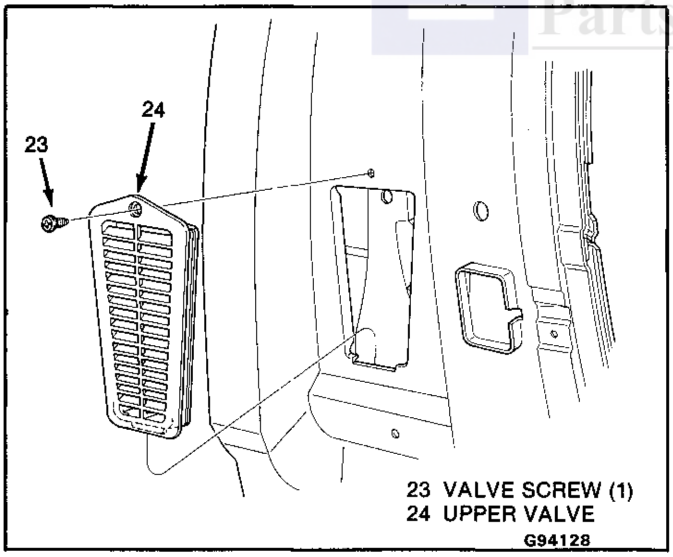


Fig. 11-Upper Pressure Relief Valve

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 (Figures 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)

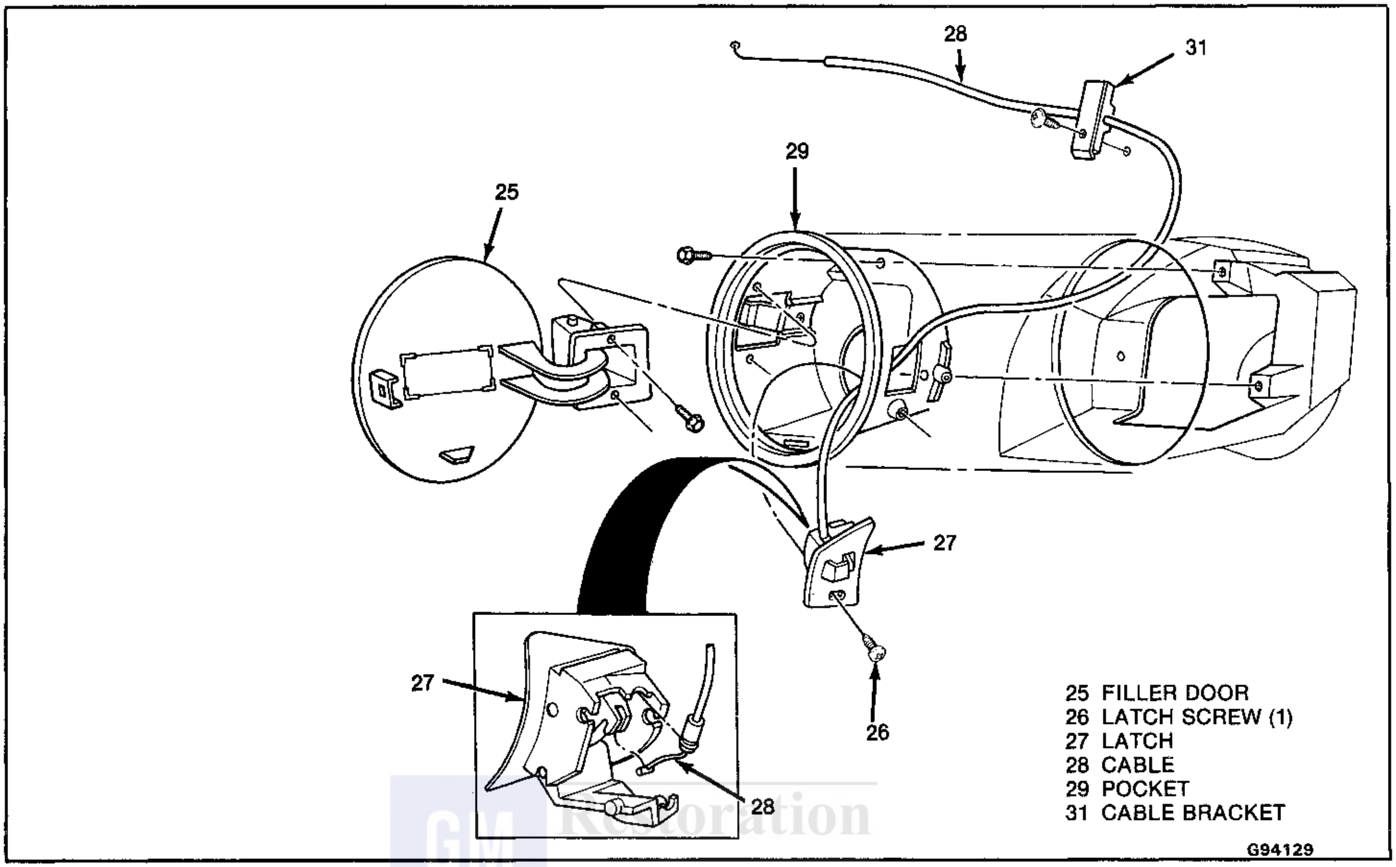


Fig. 12-Locking Fuel Door and Pocket Assembly

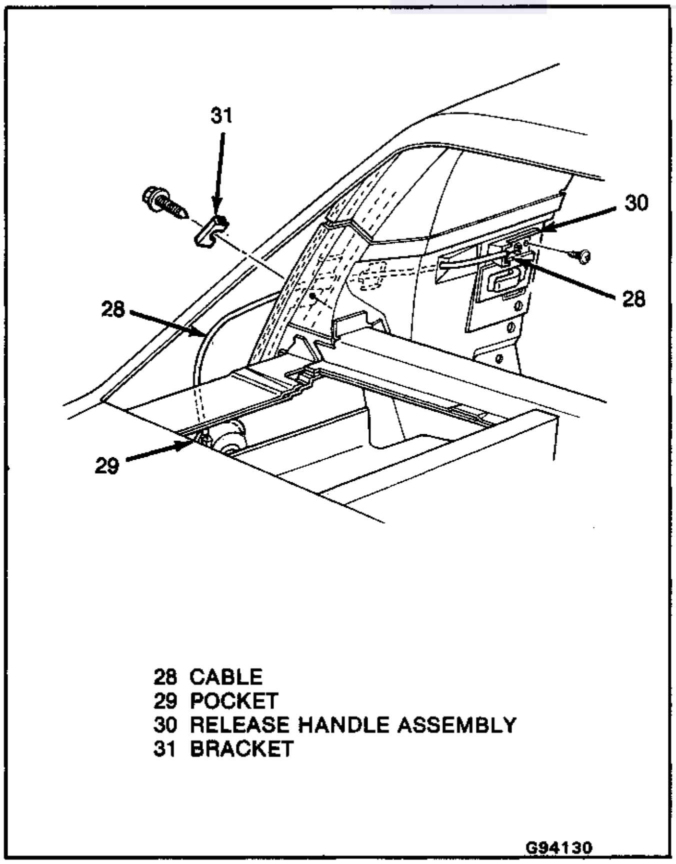


Fig. 13-Fuel Filler Door Remote Latch and Cable Assembly

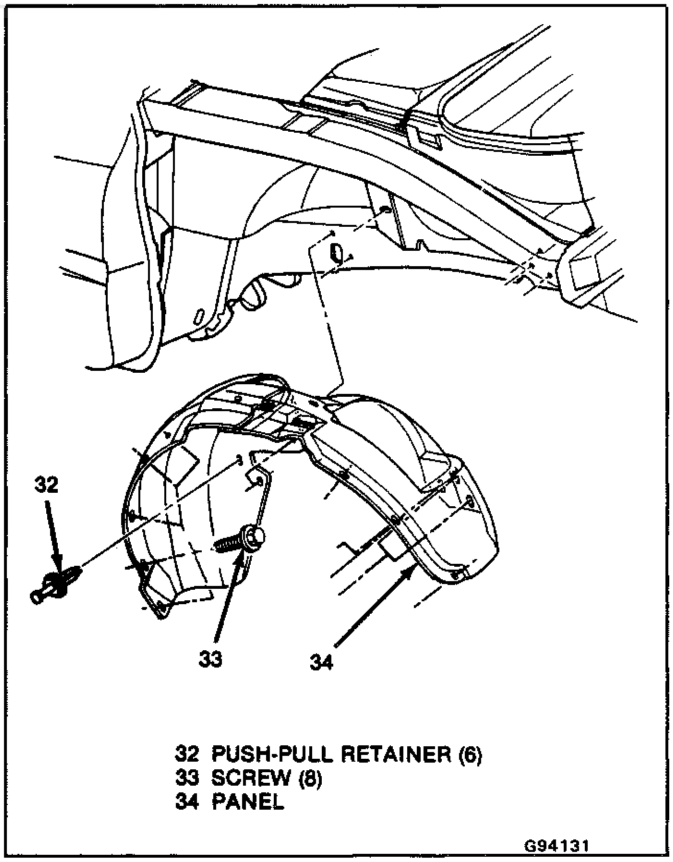


Fig. 14-Installing Rear Wheelhouse Panel

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 7J)
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 7J)
7. Six rear roof panel to frame bolts (47)
8. Rear fender finish moldings
9. Loosen upper portion of fender from top

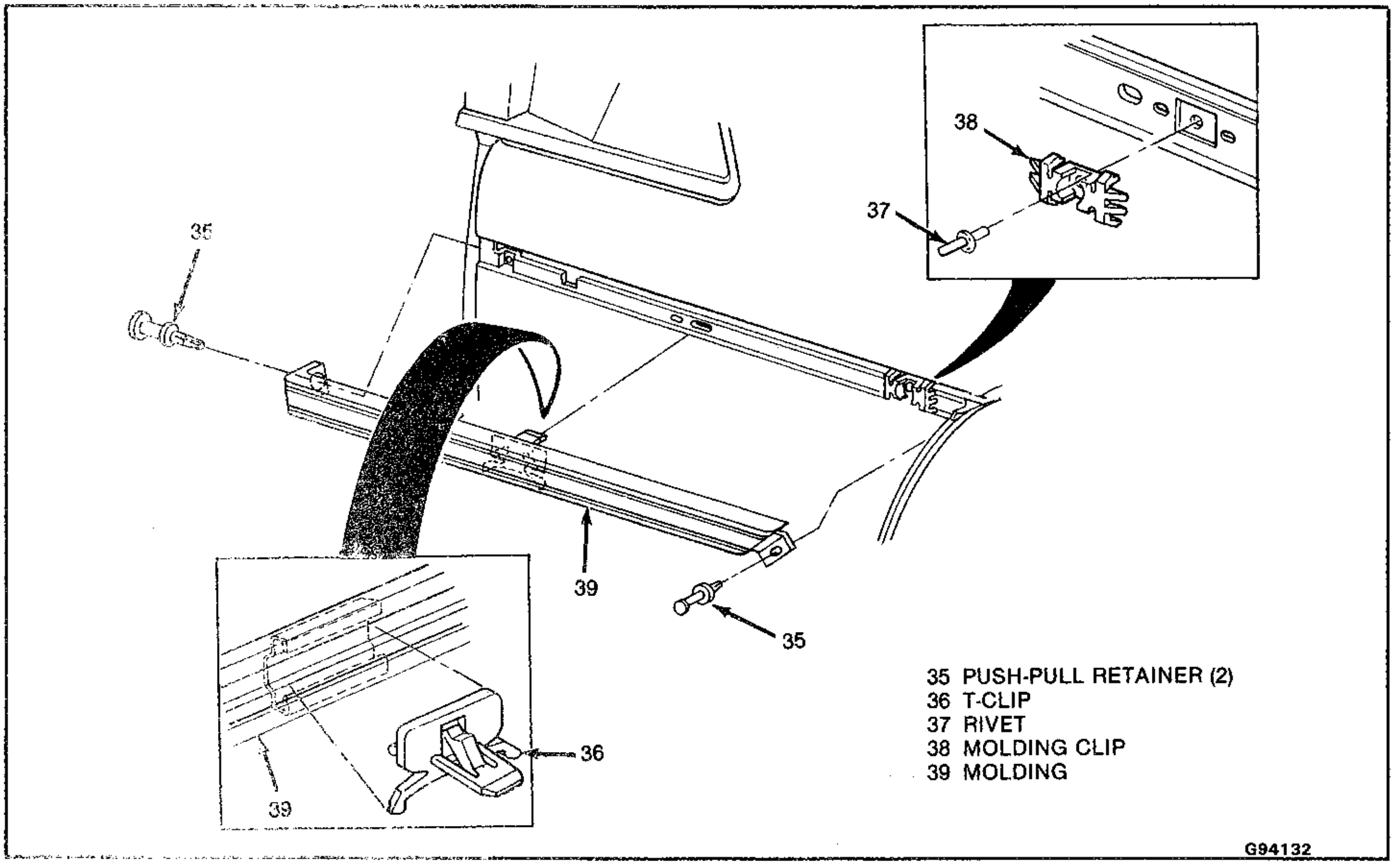


Fig. 15-Rear Fender Finish Molding

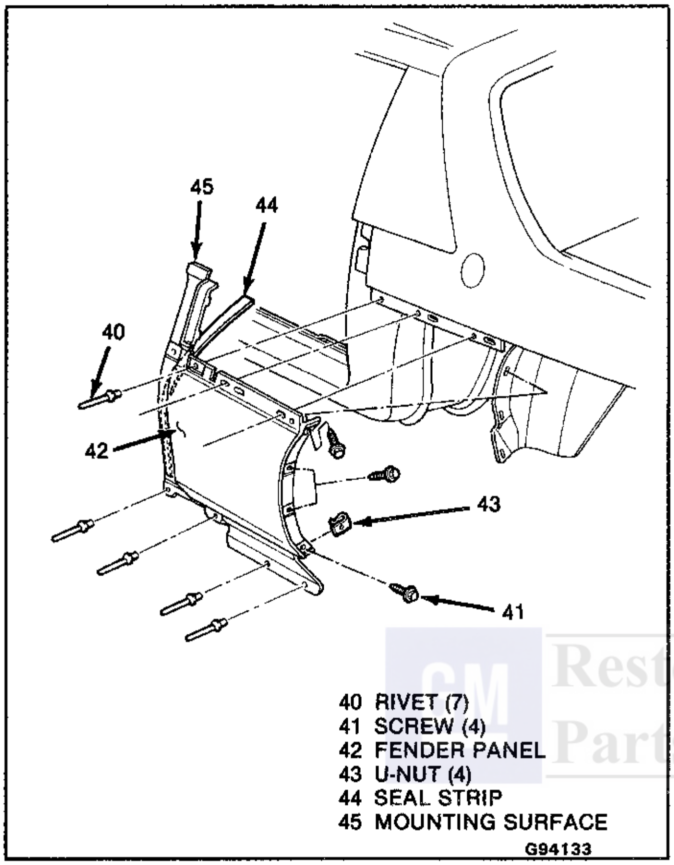


Fig.16-Rear Fender Panel Assembly

10. Rear wheelhouse to rear roof panel retainers
11. Rear markers and loosen upper portion of rear fascia from top (refer to Section 7J)
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 8J)
18. Headlining assembly (refer to Section 8J)
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

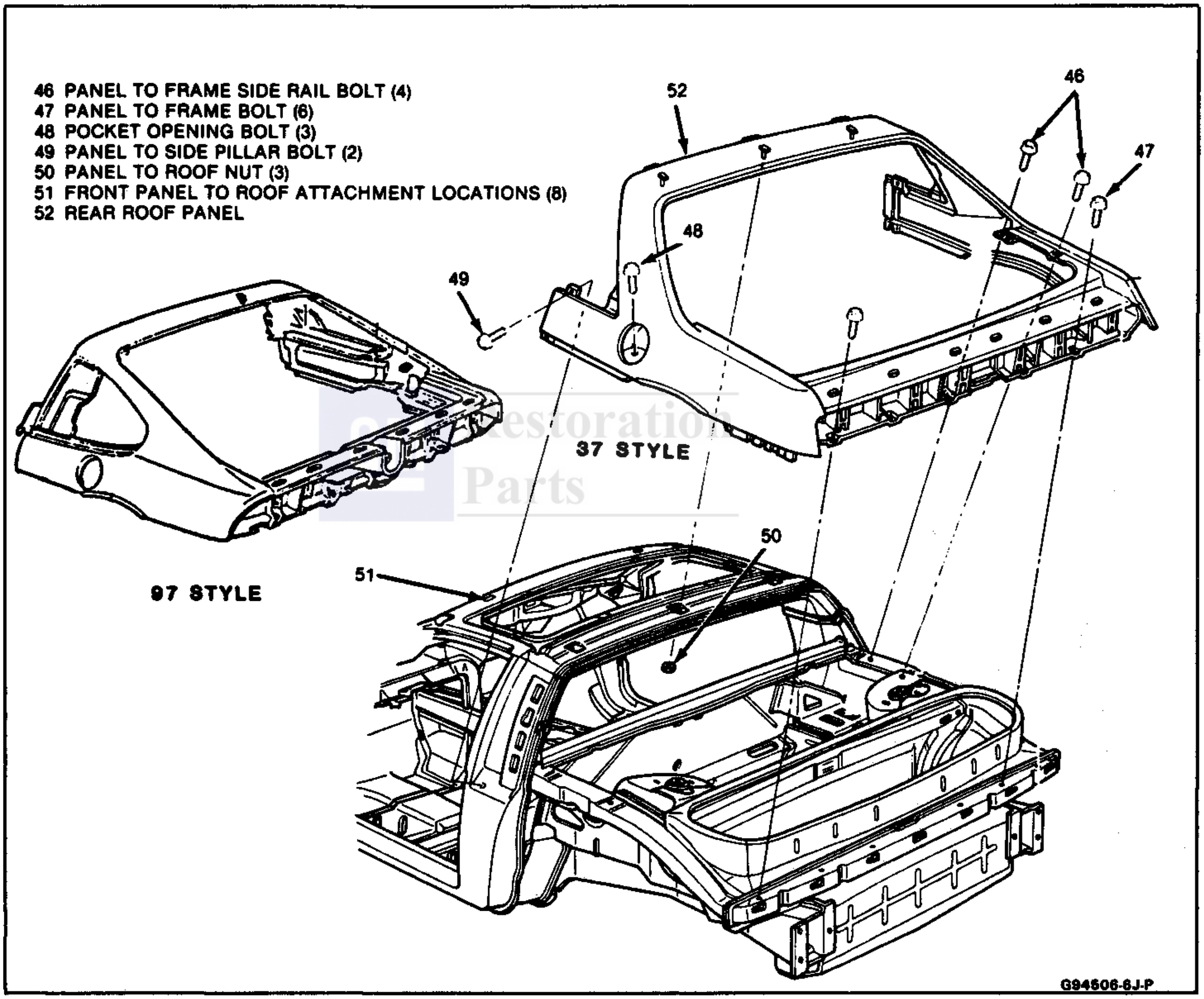
   Front roof panel fasteners to 10 N·m (7 ft-lb)
3. Three rear roof panel to rear roof nuts (50)

   Tighten

   Rear roof panel nuts to 10 N·m (7 ft-lb)
4. Roof drip molding
5. Headlining assembly (refer to Section 8J)
6. Upper garnish moldings (refer to Section 8J)
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 7J)
15. Six rear roof panel to frame bolts (47)
16. Tail lamp assemblies (refer to Secion 7J)
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 7J)



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 7J

REAR END

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

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

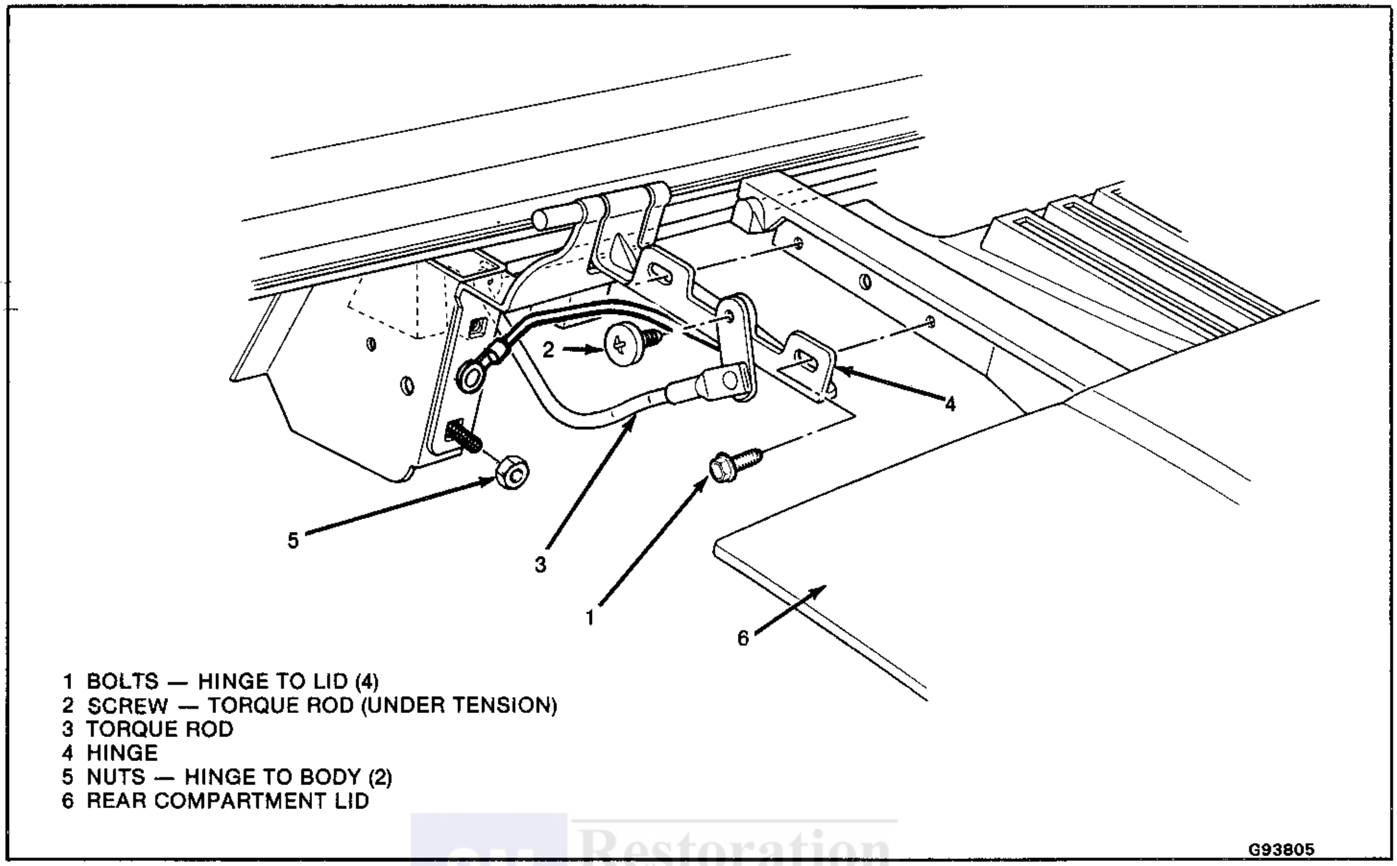


Fig. 1-Rear Compartment Lid Attachment

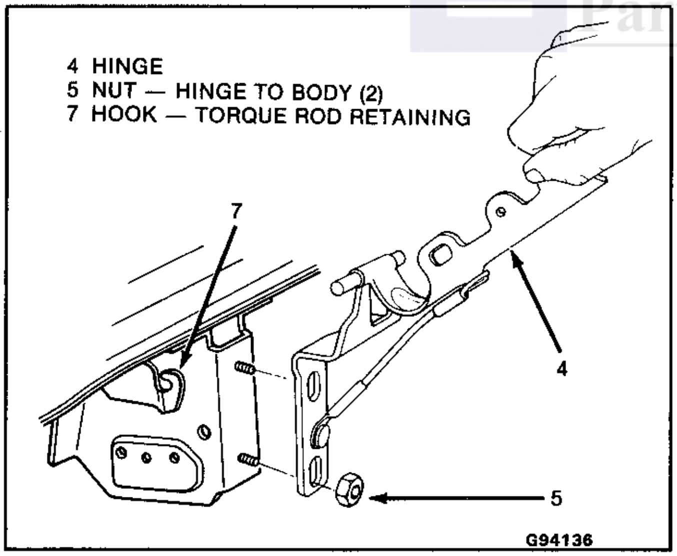


Fig. 2-Rear Compartment Lid Hinge

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.

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.
4. Rod (3) from hook (7)
5. Rod (3)

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.

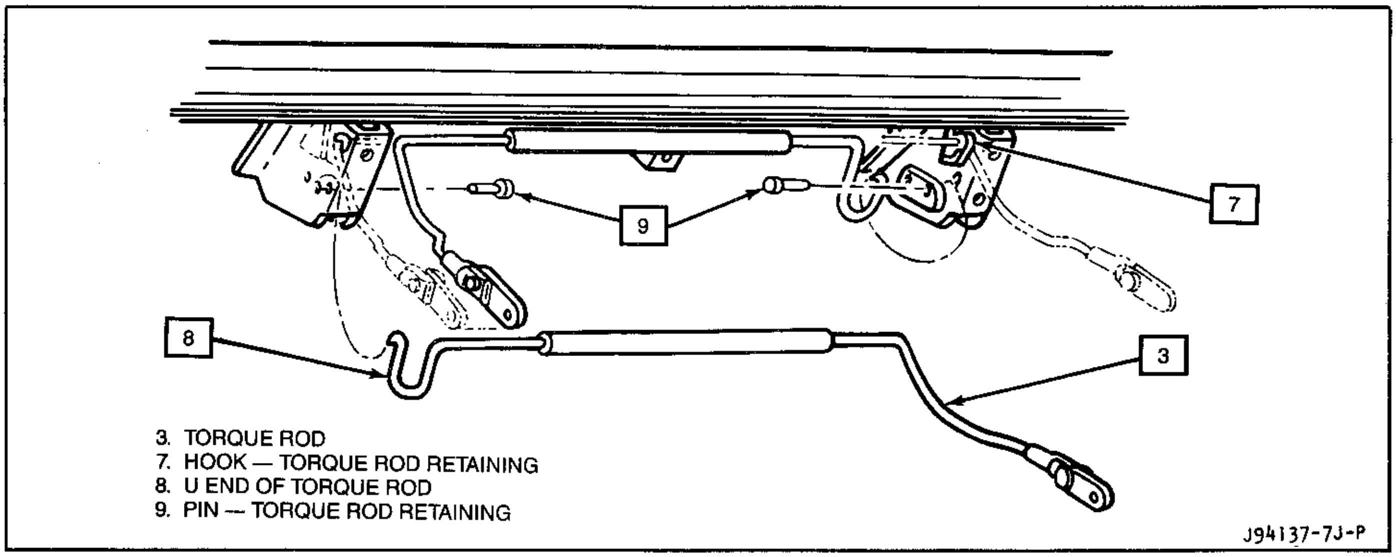


Fig. 3-Rear Compartment Lid Torque Rod

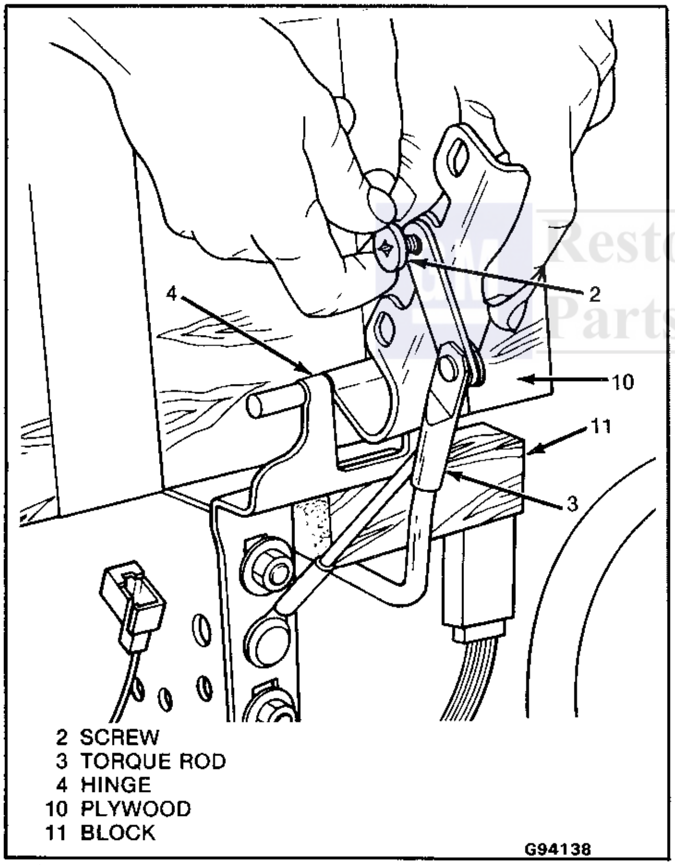


Fig. 4-Attaching Rear Compartment Lid Torque Rod

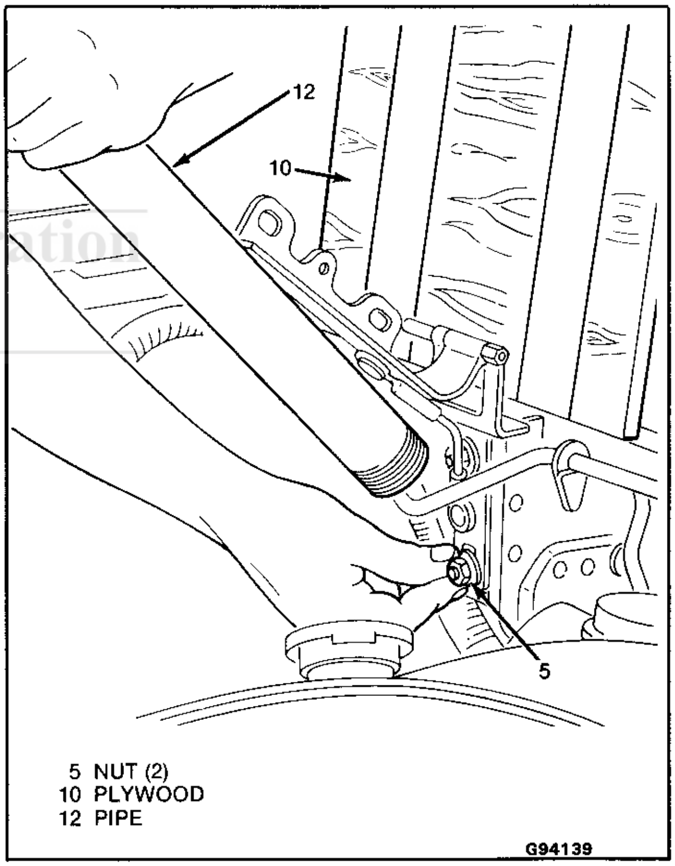


Fig. 5-Installing Rear Compartment Lid Hinge

REAR COMPARTMENT STRIKER

↔ Remove or Disconnect (Figure 7)

1. Bolts (16)
2. Striker (15)

→← Install or Connect (Figure 7)

1. Striker (15)
2. Bolts (16) – hand tighten bolts. Carefully close lid to align striker and then tighten bolts.

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)

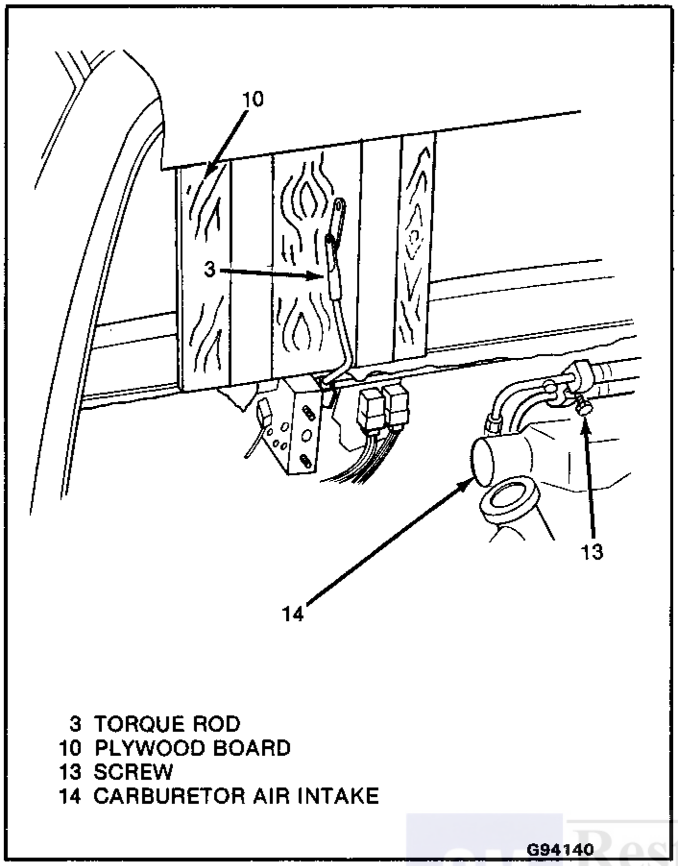


Fig. 6-Rear Compartment Lid Torque Rod Detached

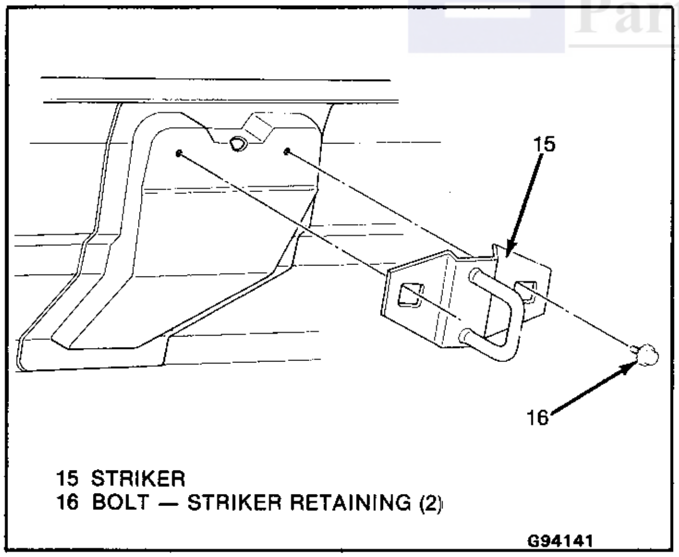


Fig. 7-Rear Compartment Lid Striker

REAR COMPARTMENT LOCK CYLINDER

37 Style

Remove or Disconnect (Figure 9)

1. Screw or rivet (22)
2. Retainer (21)
3. Cylinder (19) and gasket (20)

Install or Connect (Figure 9)

1. Cylinder (19) and gasket (20)
2. Retainer (21)
3. Screw or rivet (22)

97 Style

Remove or Disconnect (Fig. 10)

1. Screws (22A) four required
2. Cover (20A)
3. Retainer (21A)
4. Lock cylinder (19A) from support (23A)

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)

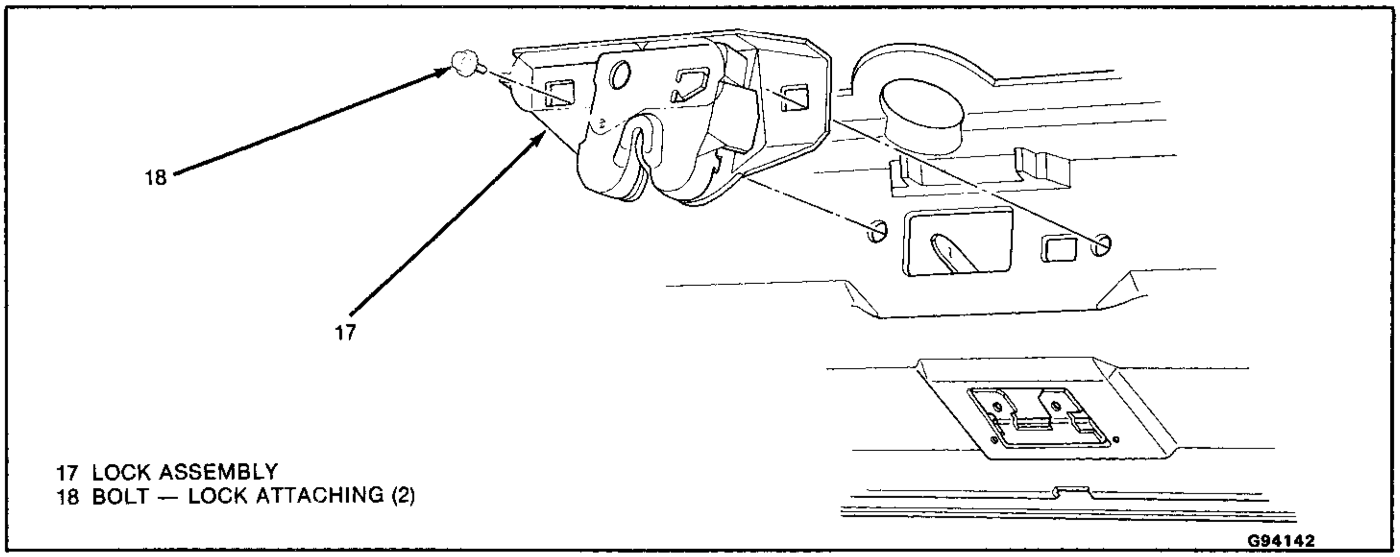


Fig. 8-Rear Compartment Lid Lock Assembly

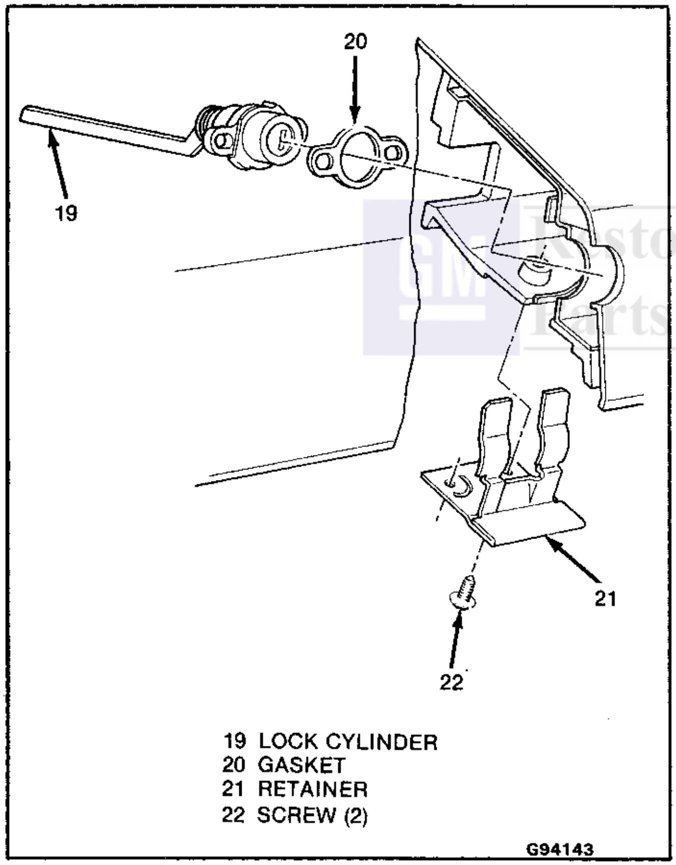


Fig. 9-Rear Compartment Lock Cylinder

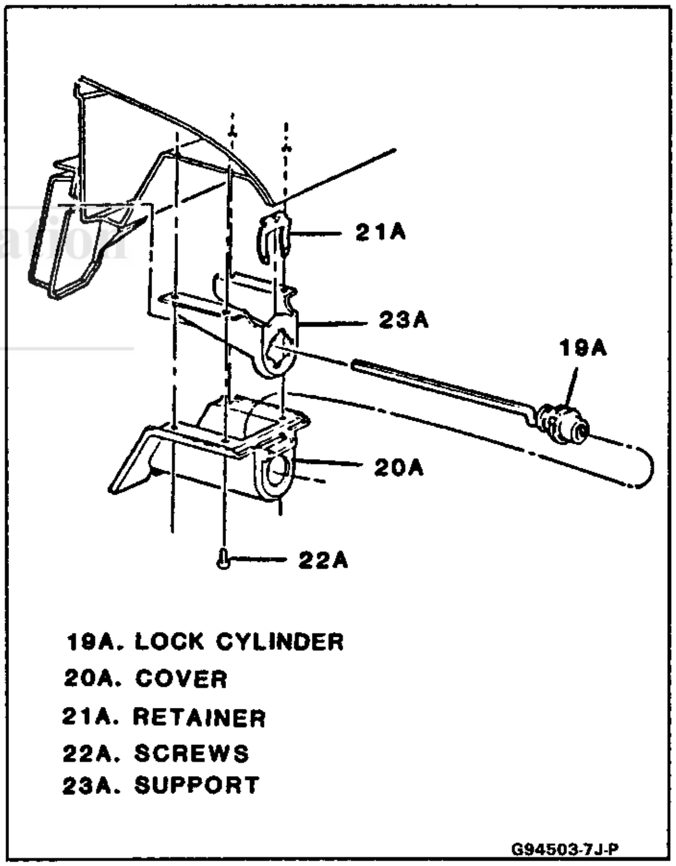


Fig. 10 - Installing Lock Cylinder - 97 Style

- 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) (both hinges)
- Move both hinges left or right as required
- Tighten nuts (5)

Lid too far left or right

- Loosen nuts (5) (both hinges)
- Move both hinges left or right as required
- 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

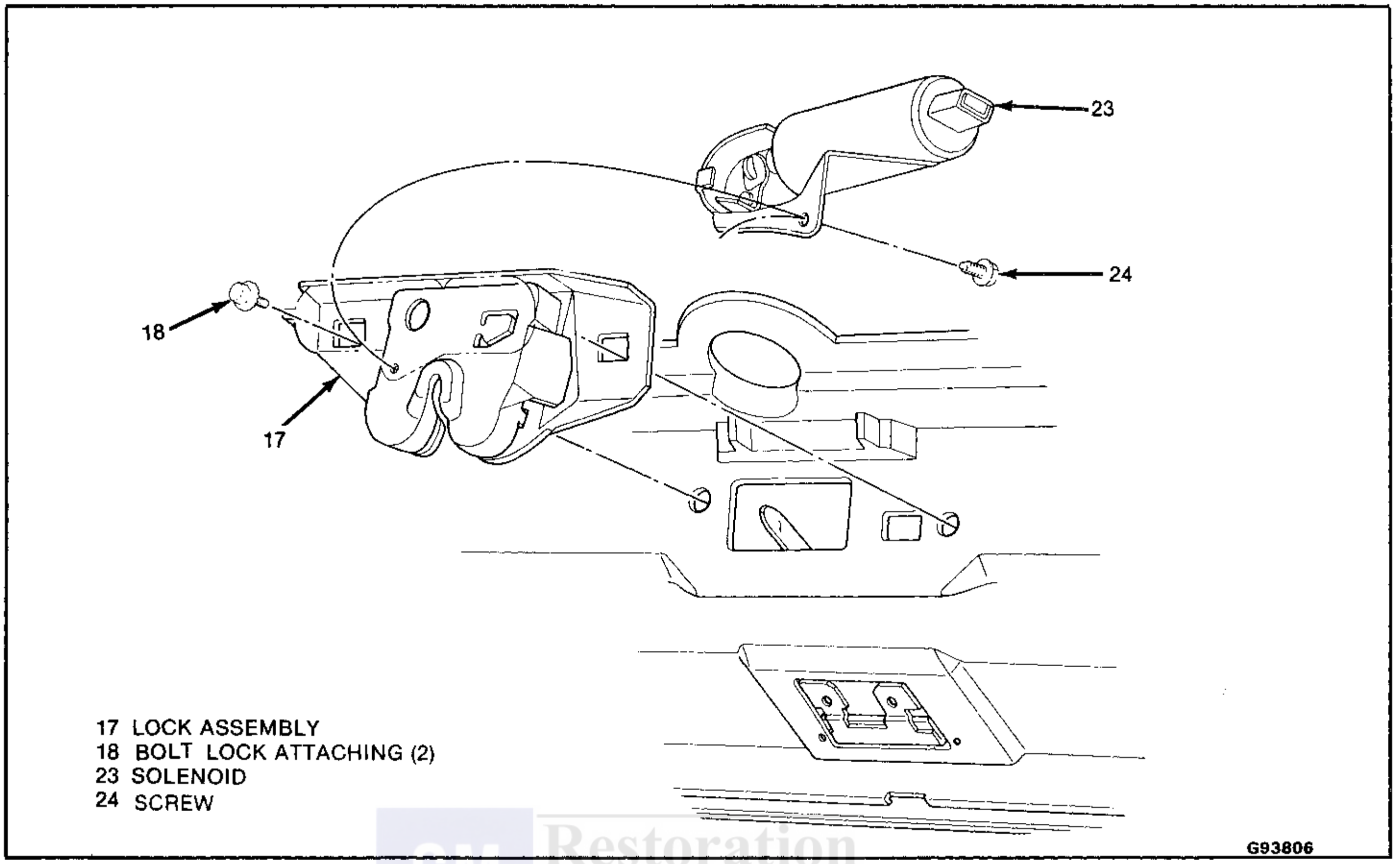


Fig. 11-Remote Control Rear Compartment Lid Release

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.

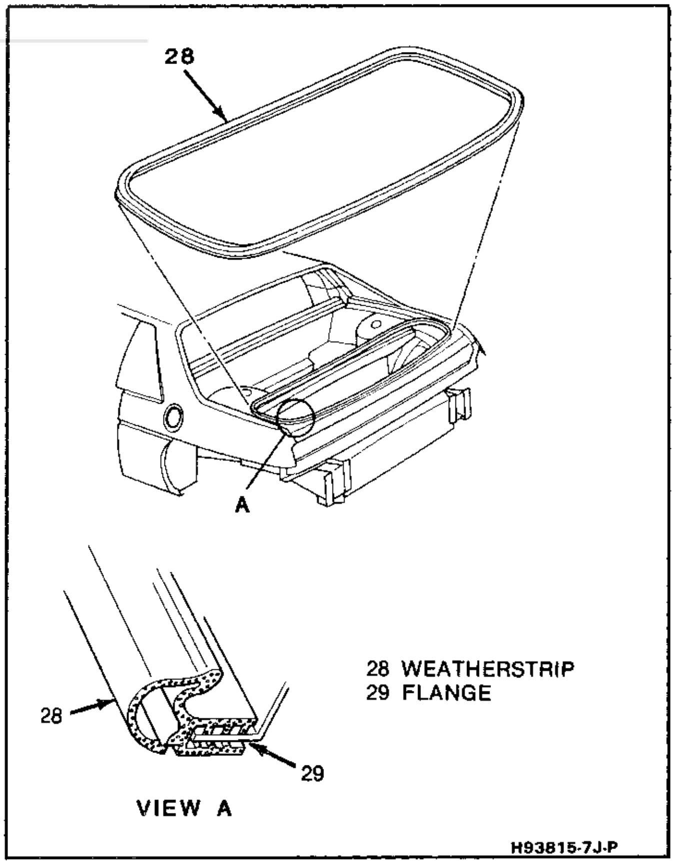


Fig. 12 - Rear Compartment Weatherstrip

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)

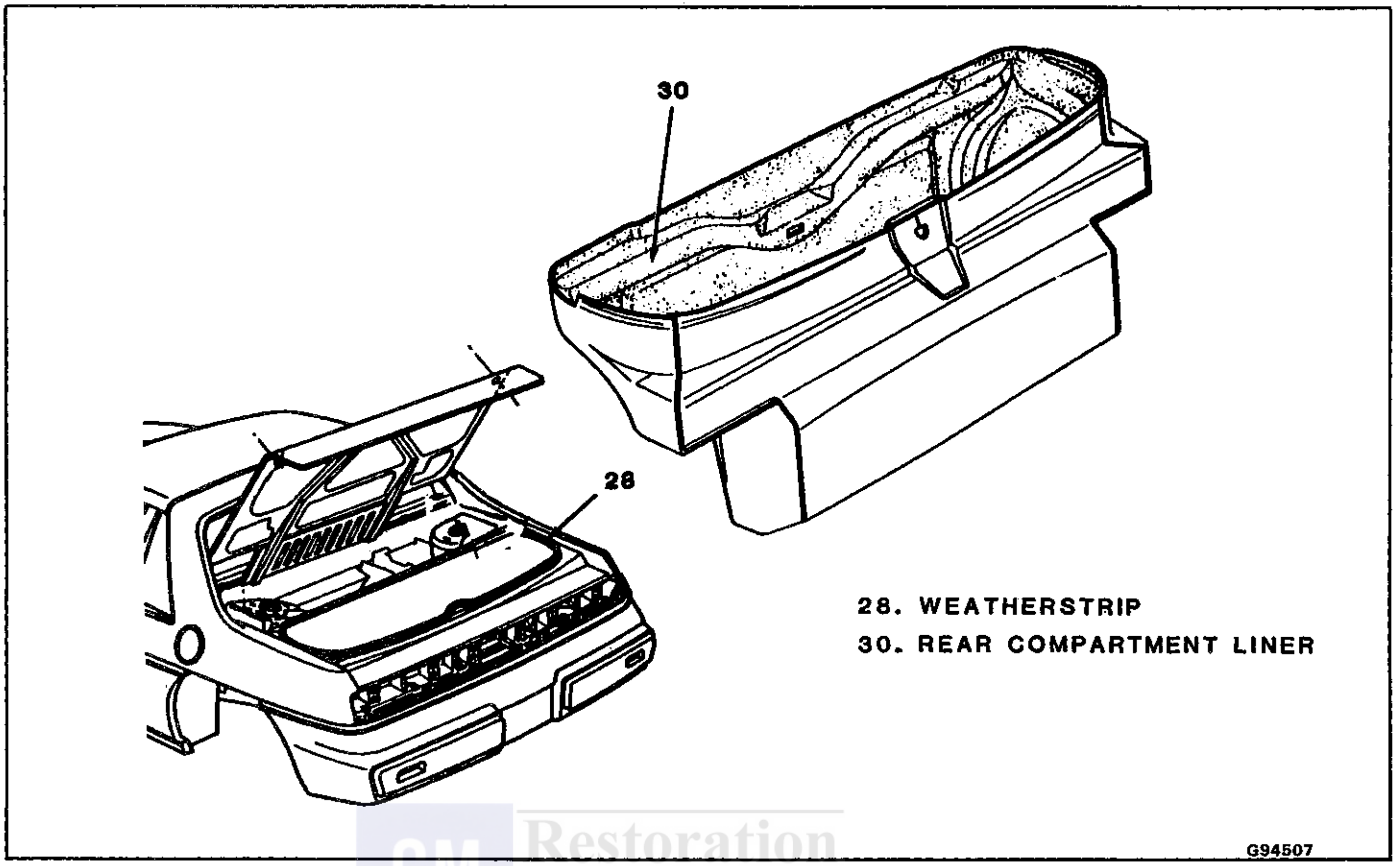


Fig. 13-Rear Compartment Liner

3. Tail lamp assembly (33)
4. Bulb assemblies (34)

Install or Connect (Figure 14)

1. Bulb assemblies (34)
2. Tail lamp assembly (33)
3. Six screws (32)
4. Plugs (31)

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.

SPOILER

Remove or Disconnect (Fig. 16)

1. Nuts (2) four required
2. Spoiler (4)

Install or Connect

1. Gasket (3) to spoiler (4)
2. Studs (1) on spoiler through holes in lid.
3. Nuts (2) tighten to 5-7 N·m (48-60 in-lb)

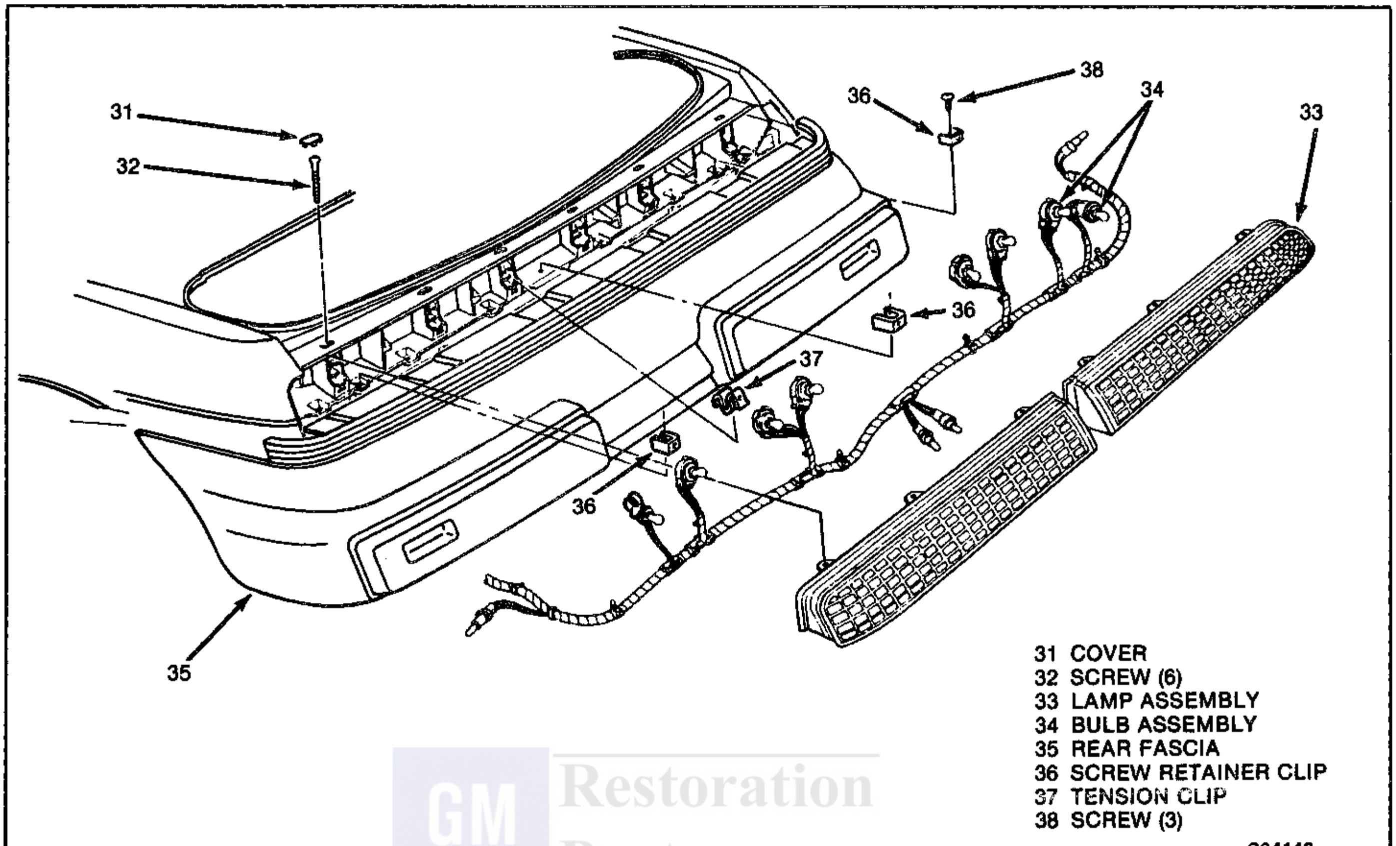
REAR FASCIA

Remove or Disconnect (Figure 17)

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)

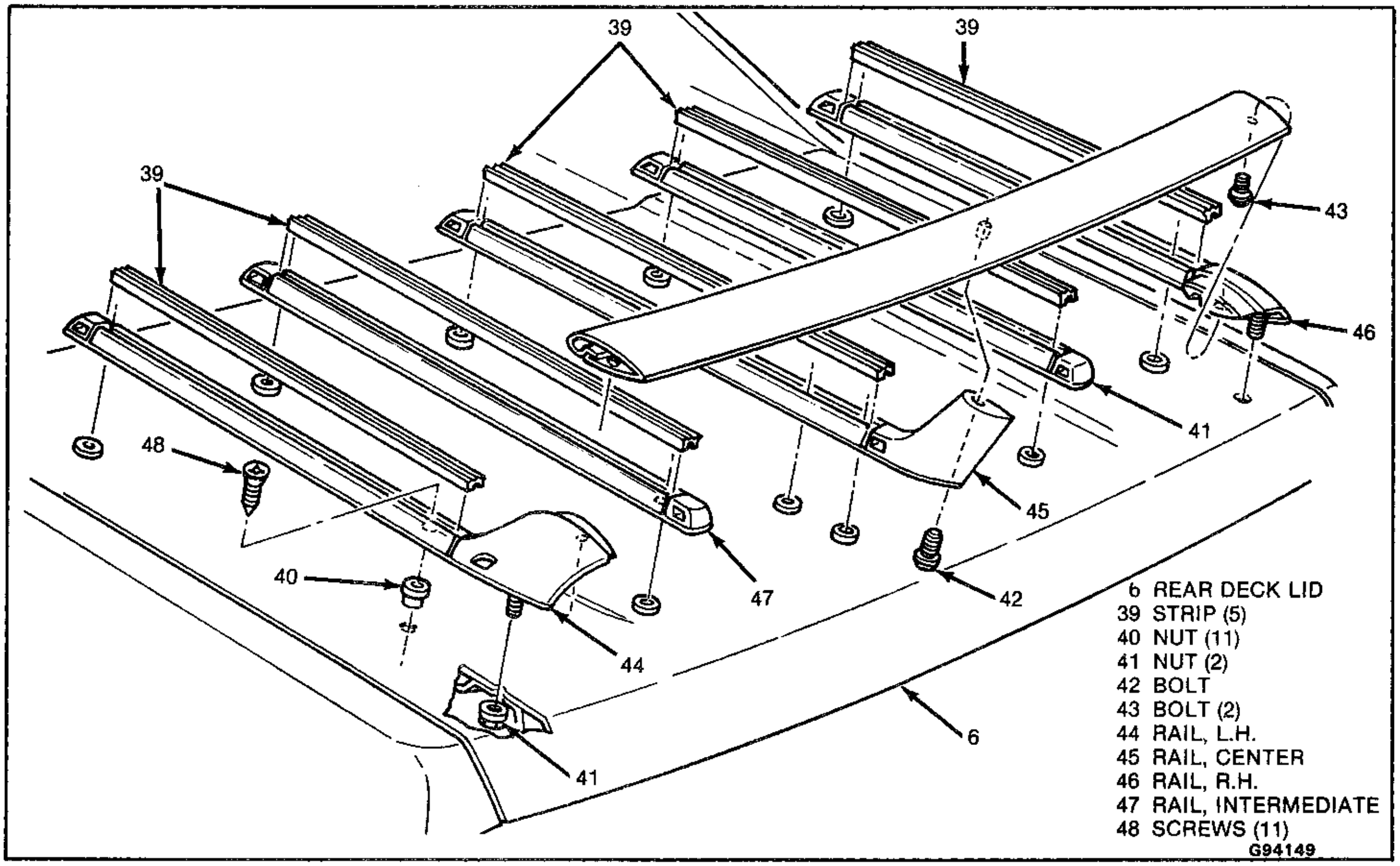
Install or Connect (Figure 17)

1. Seven retainers (53)
2. Seven retainers (49)
3. Bolts (50)



31 COVER
32 SCREW (6)
33 LAMP ASSEMBLY
34 BULB ASSEMBLY
35 REAR FASCIA
36 SCREW RETAINER CLIP
37 TENSION CLIP
38 SCREW (3)

Fig. 14-Tail Lamp Assembly - 37 Style Shown, 97 Style Similar



6 REAR DECK LID
39 STRIP (5)
40 NUT (11)
41 NUT (2)
42 BOLT
43 BOLT (2)
44 RAIL, L.H.
45 RAIL, CENTER
46 RAIL, R.H.
47 RAIL, INTERMEDIATE
48 SCREWS (11)

Fig. 15-Luggage Carrier Assembly

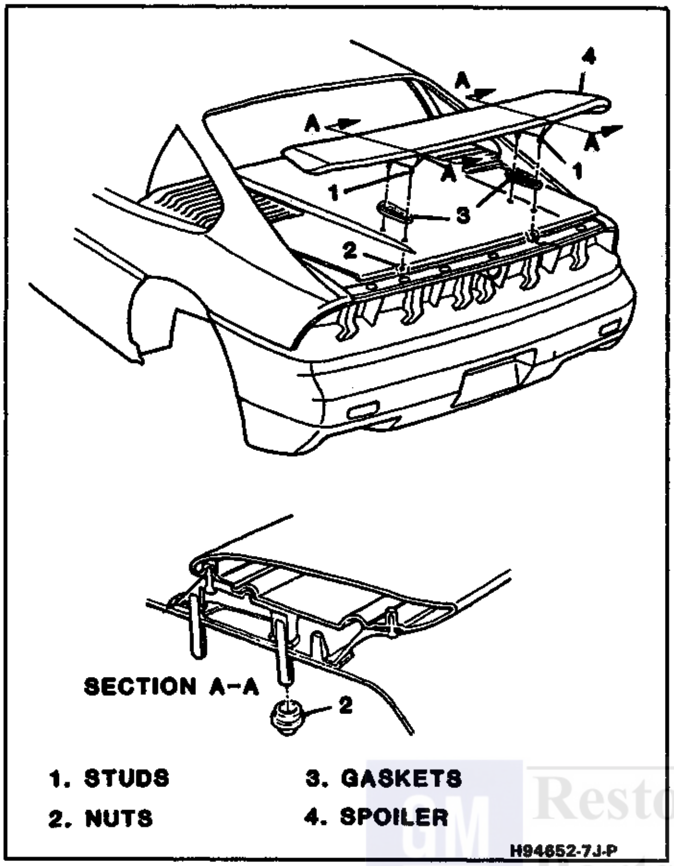


Fig. 16 - Installing Spoiler

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. 18)

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)
4. Cover (55)
5. Screws (54)

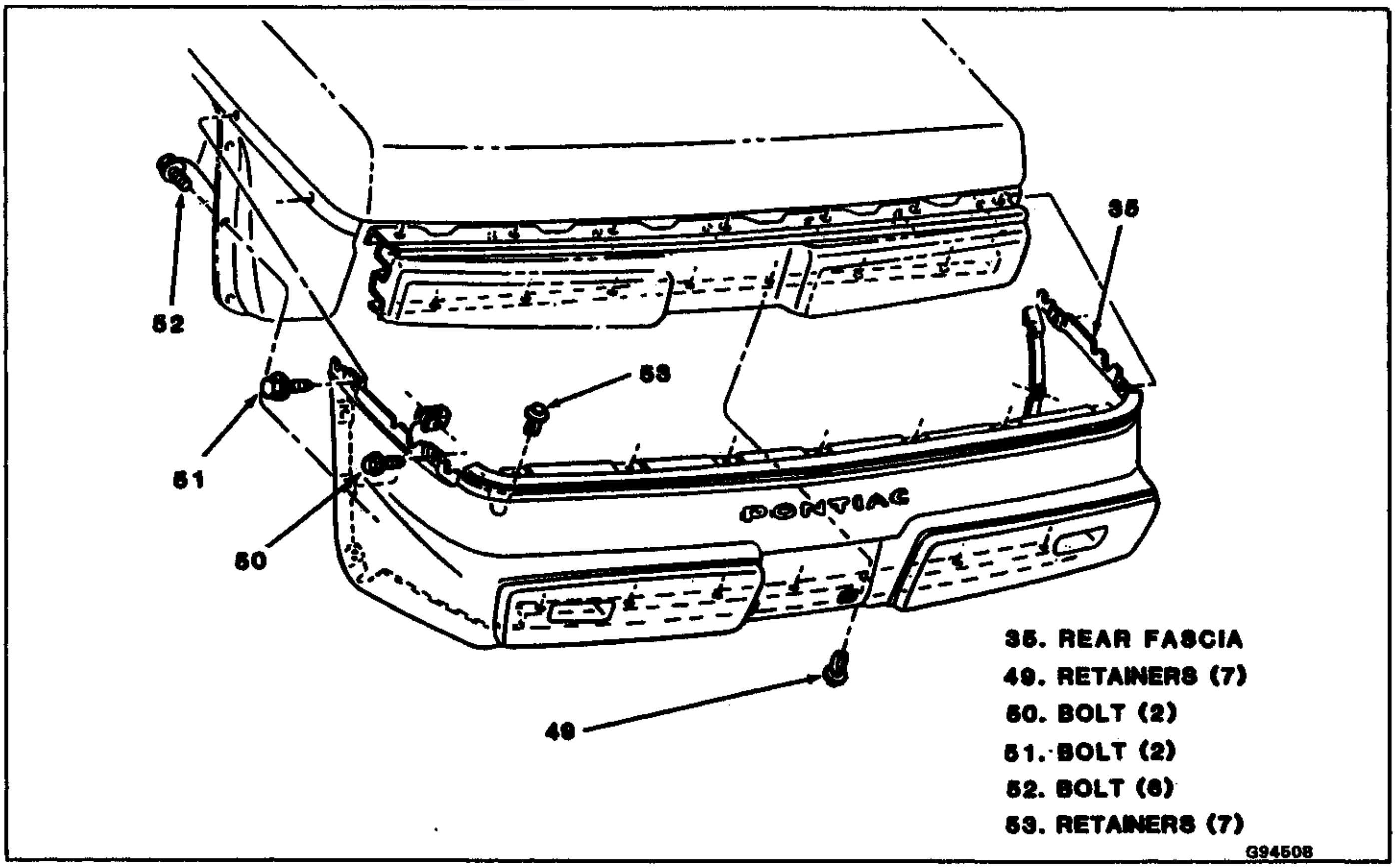
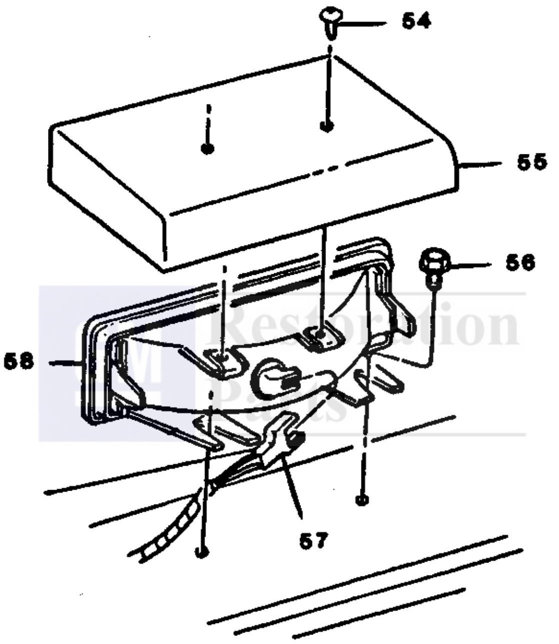


Fig. 17-Rear Fascia



54. SCREWS
55. COVER
56. SCREWS
57. CONNECTOR
58. CENTER HIGH-MOUNTED STOP LAMP

G94504-7J-P

Fig. 18 - Center High-Mounted Stop Lamp

SECTION 8J

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 1, 2, 3 and 4)

1. Wiper arms. Refer to Section 8E in the chassis portion of this manual.
2. Shroud top vent screen. Refer to Section 4J.
3. Windshield assembly. Refer to Section 2J.
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 filler – 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.

Install or Connect (Figures 1, 2, 3, and 4)

1. Sealing strips to windshield pillar flanges (5). Apply by moving from bottom of pillar flange (5) toward top of roof.

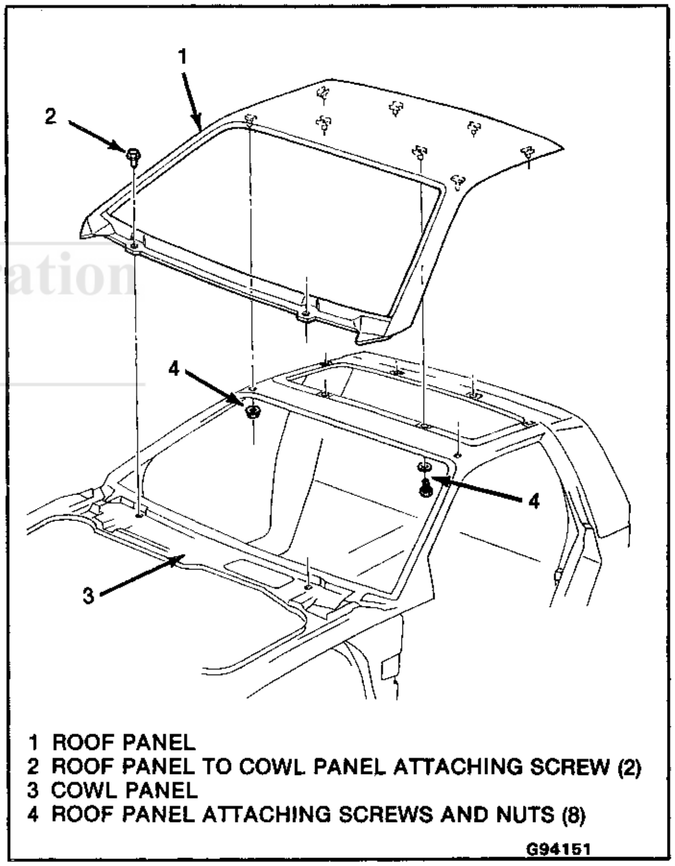


Fig. 1-Roof Panel Attachment

2. Right and left side fillers – windshield frame at belt (6)
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 along side of roof to rearmost rib (8) and turn toward rear center of roof.
   - Allow for a 25 mm (1") overlap (9) with the left side of roof sealing strip.
4. Roof sealing strips – left side

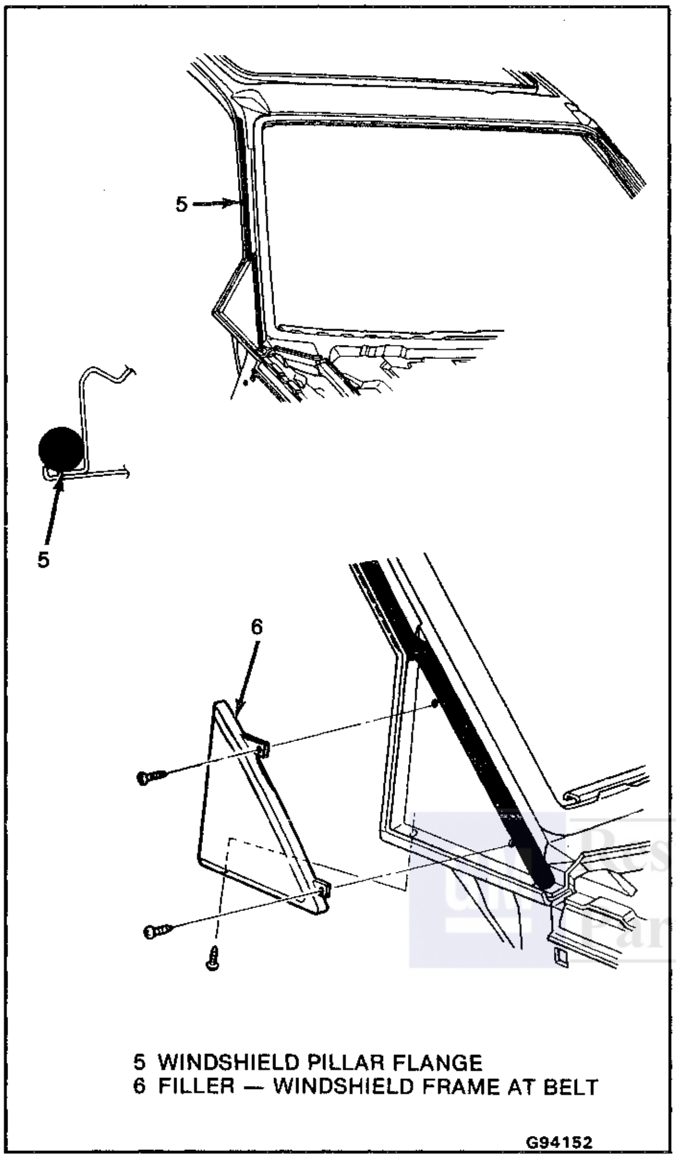


Fig. 2-Windshield Pillar Flange and Filler - Windshield Frame at Belt

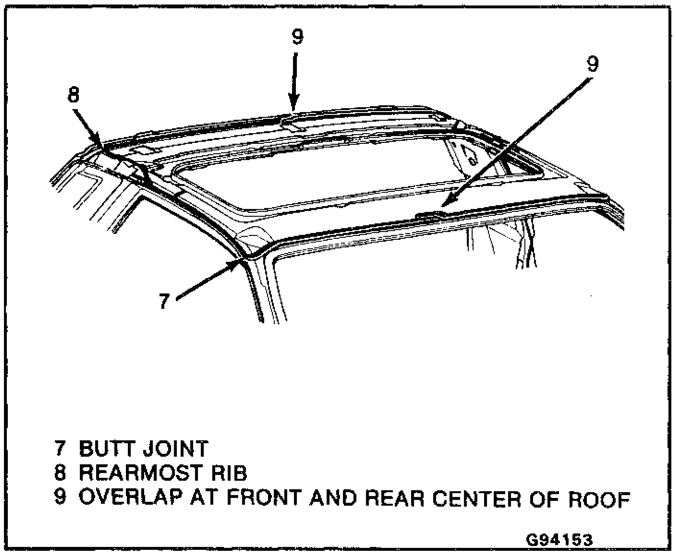


Fig. 3-Roof Sealing Strip Locations

- Begin at center of roof above windshield opening (9). Overlap adjacent sealing strip by 25 mm (1").

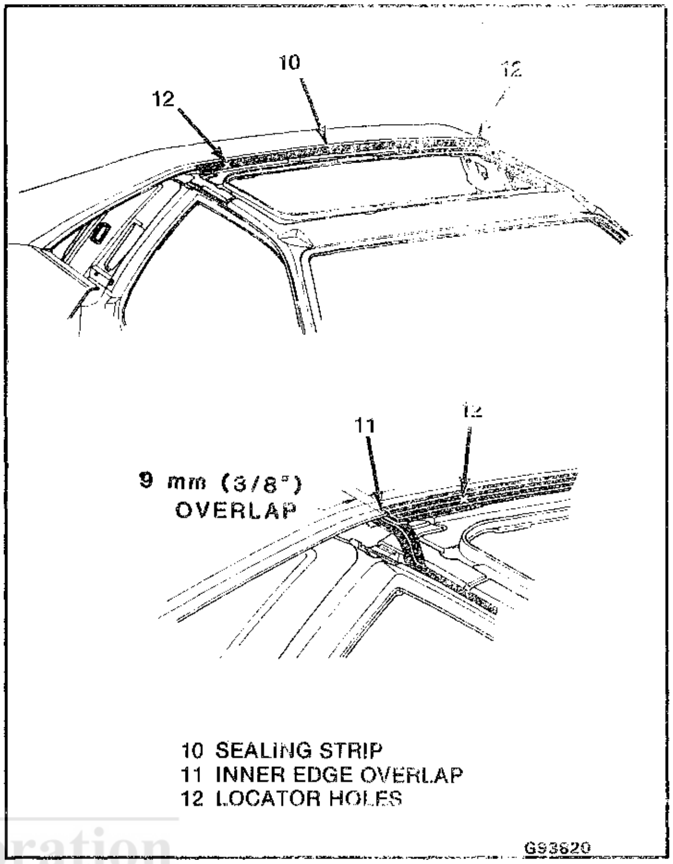


Fig. 4-Rear Roof Sealing Strip

- 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")

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

Ensure gap between quarter panel and roof is sealed at right and left sides (Fig. 4).

6. Cut rear roof sealing strip a locator holes (12)
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

Screws (4) to 10 N·m (7 ft-lb)

9. Two roof panel attaching nuts (4)

Tighten

Nuts (4) to 10 N·m (7 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 2J.
16. Shroud top vent screen. Refer to Section 4J.
17. Wiper arms. Refer to Section 8E in the chassis portion of this manual.
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 substrate 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 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 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

Tighten

Anchor bolts to 35 N·m (26 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.

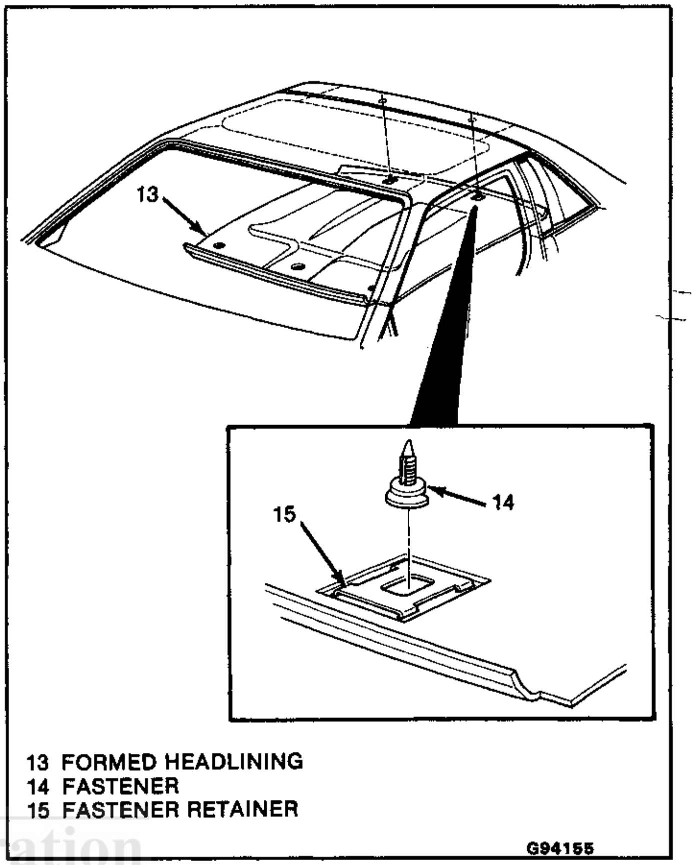


Fig. 5-Installing Formed Headlining

Remove or Disconnect (Figure 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 6)

As per illustration

SUNSHADE ASSEMBLY

The sunshade assemblies are attached to the roof panel with three attaching screws (Fig. 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)

1. Upper seat belt anchor assembly

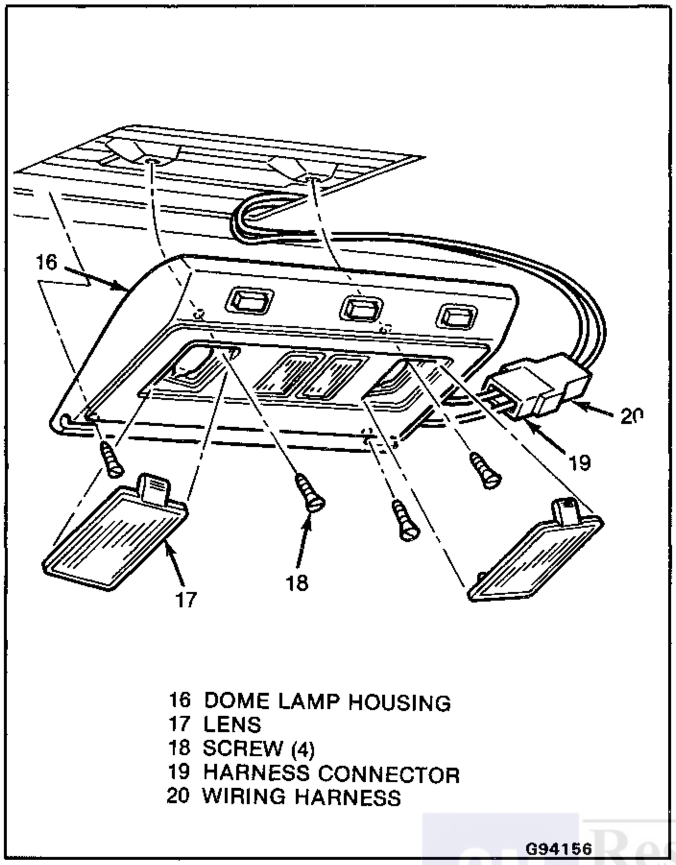


Fig. 6-Dome Lamp Assembly

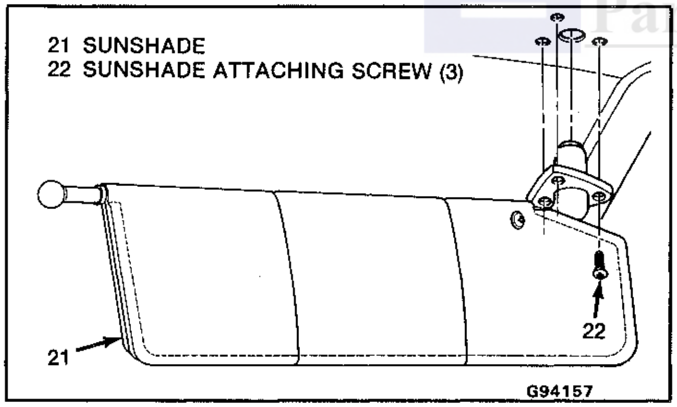


Fig. 7-Sunshade Assembly

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)

1. Garnish molding (23)
2. Rear quarter trim panel (26)
3. Upper seat belt anchor and bolt

Tighten

Seat belt anchor bolt to 35 N·m (26 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 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 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 which is cemented and sealed within the gutter of the roof opening. The finishing lace is positioned over the headlining and roof reinforcement flange.

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 10)

1. Vent glass (29)
2. Glass handle plate (30)
3. Hinge assemblies (31)

Install or Connect (Figure 10)

As per illustration

Tighten

- Hinge attaching screws to 5 N·m (44 in-lb).
- Glass handle plate attaching screws to 6 N·m (53 in-lb).

Adjust (Figure 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.

VISTA VENT HEADLINING RETAINER AND FINISHING LACE

Remove or Disconnect (Figures 12 and 13)

1. Vent glass
2. Escutcheon (36)
3. Button assembly (37)

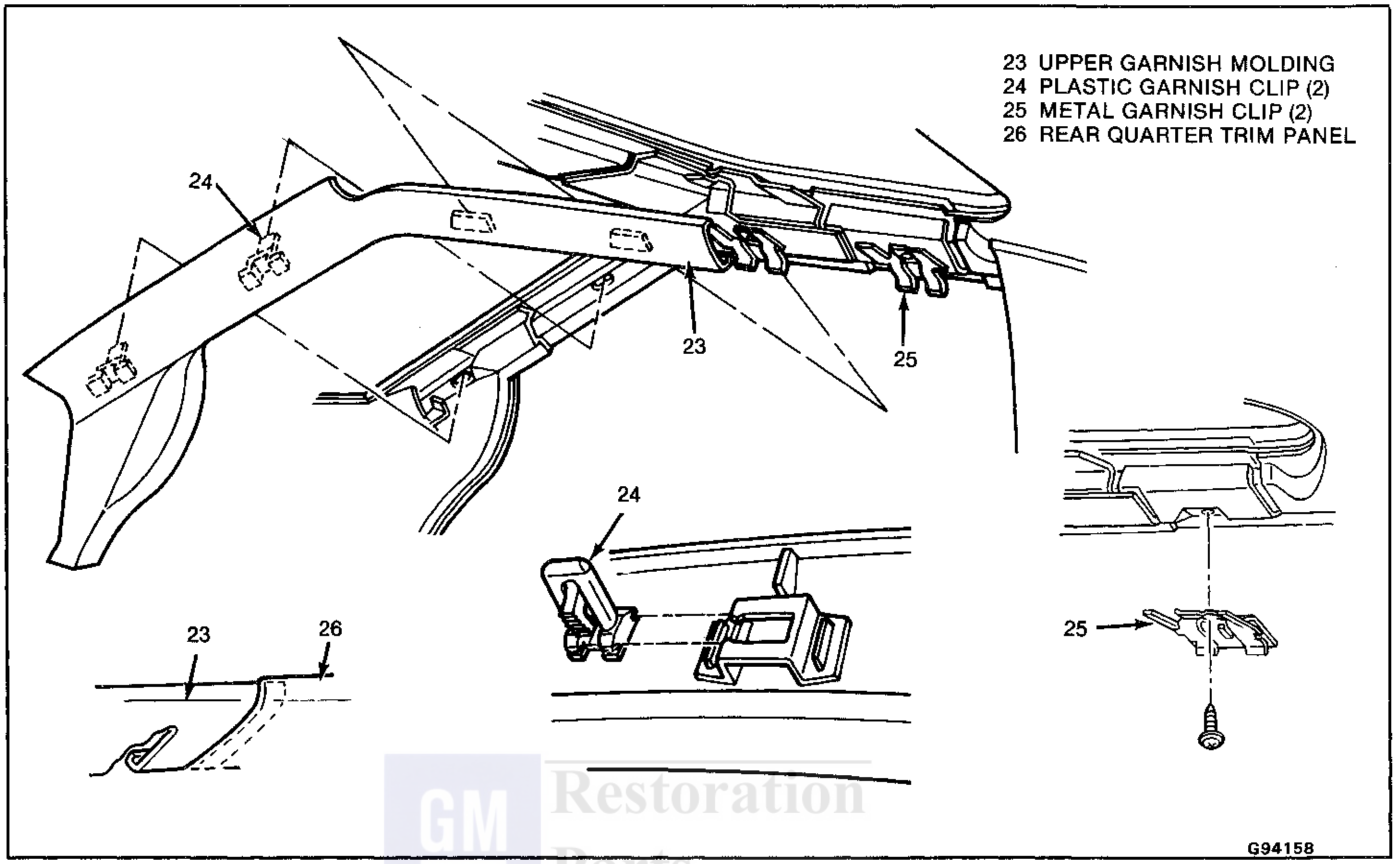


Fig. 8-Upper Garnish Molding

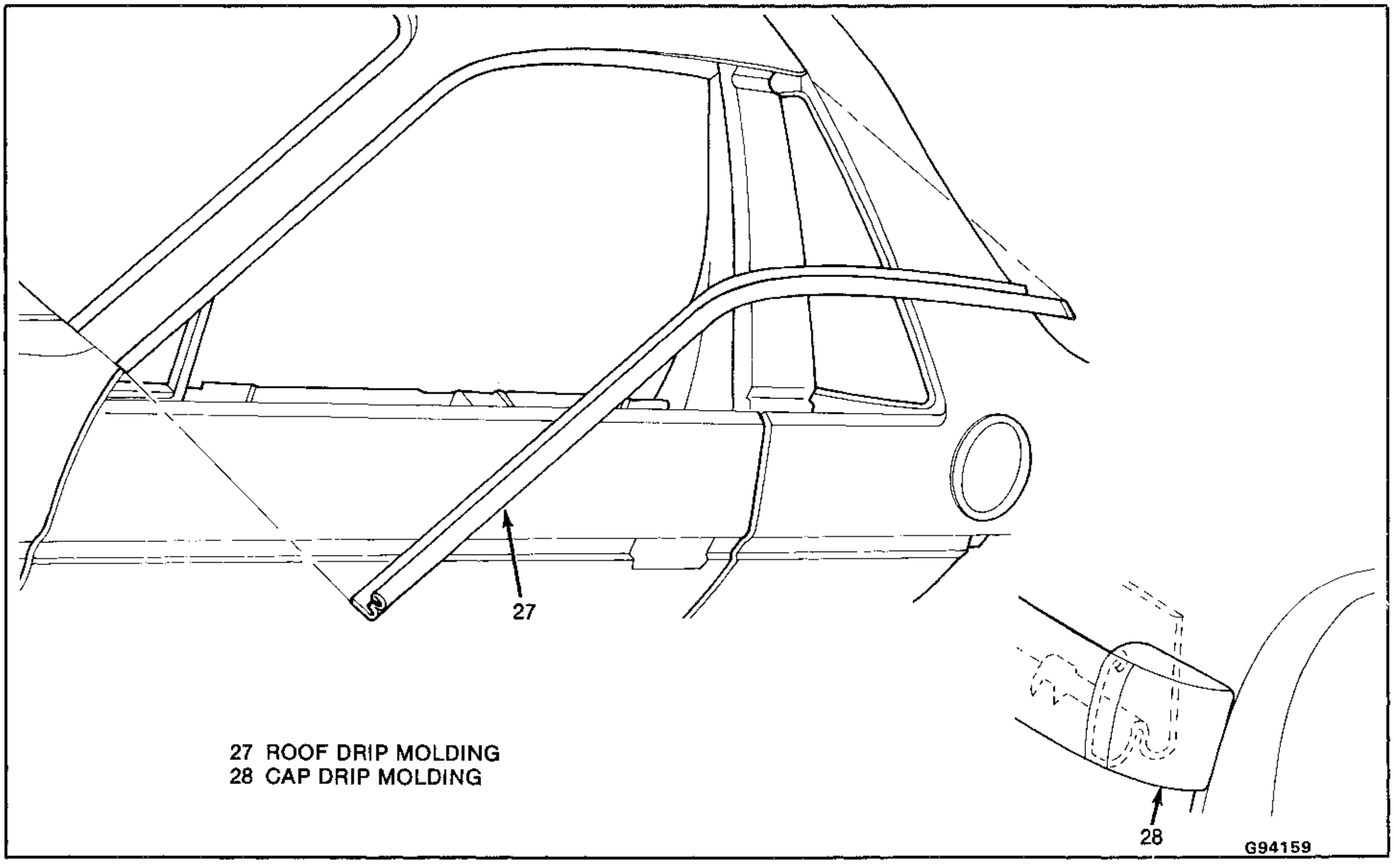


Fig. 9-Roof Drip Molding

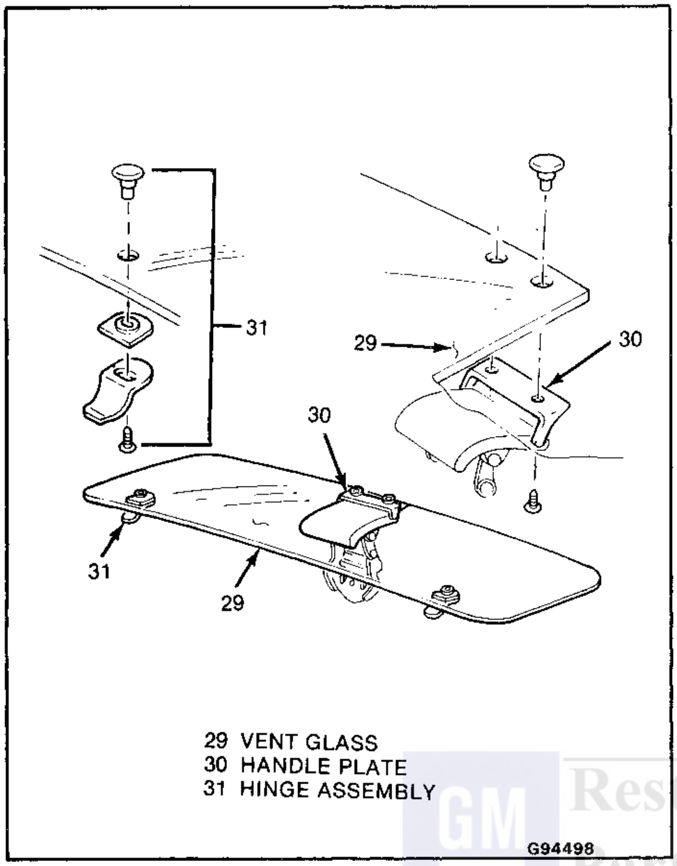


Fig. 10-Vent Glass and Hardware

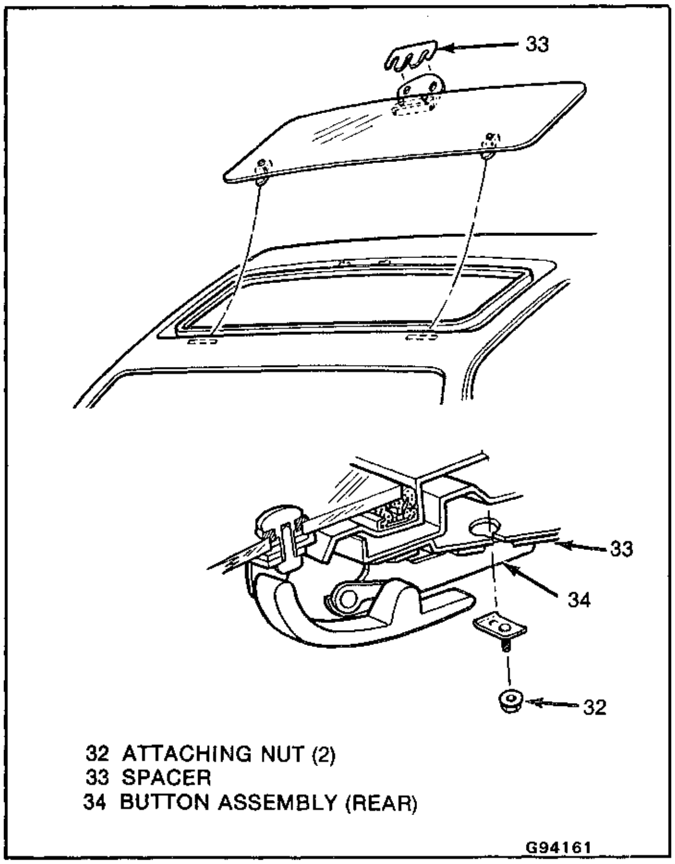


Fig. 11-Latch Adjustment

4. Finishing lace (38)
5. Retainer (39)

→← Install or Connect (Figures 12 and 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 14)

1. Vent glass
2. Weatherstrip (35) – a hot air gun or adhesive removing solvent can be used to help break the bond and clean out any remaining adhesive.

→← Install or Connect (Figure 14)

1. Adhesive to gutter (40)
2. Adhesive to weatherstrip (35)
3. Allow adhesive to become tacky before installing weatherstrip.
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.

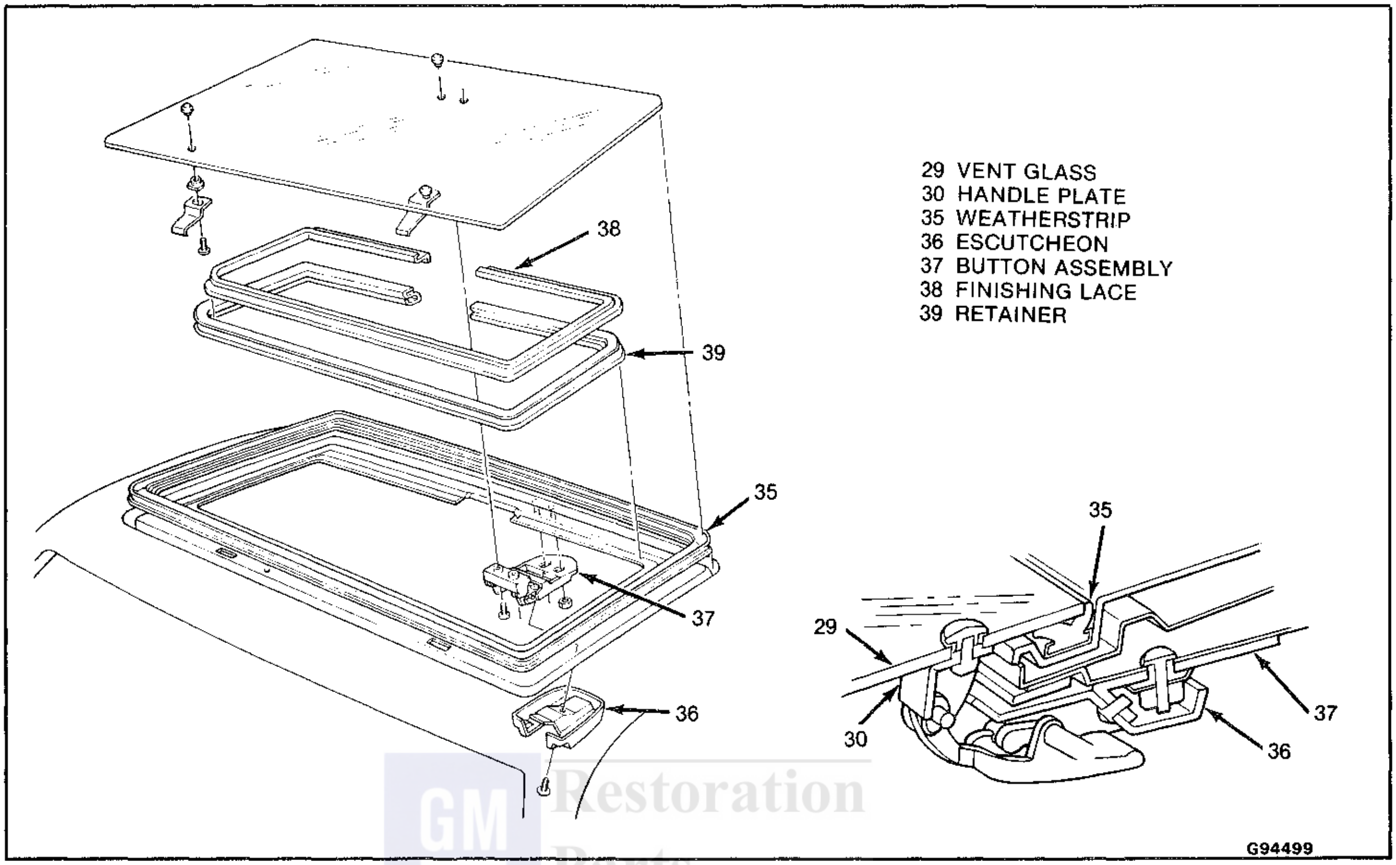


Fig. 12-Vista Vent Assembly

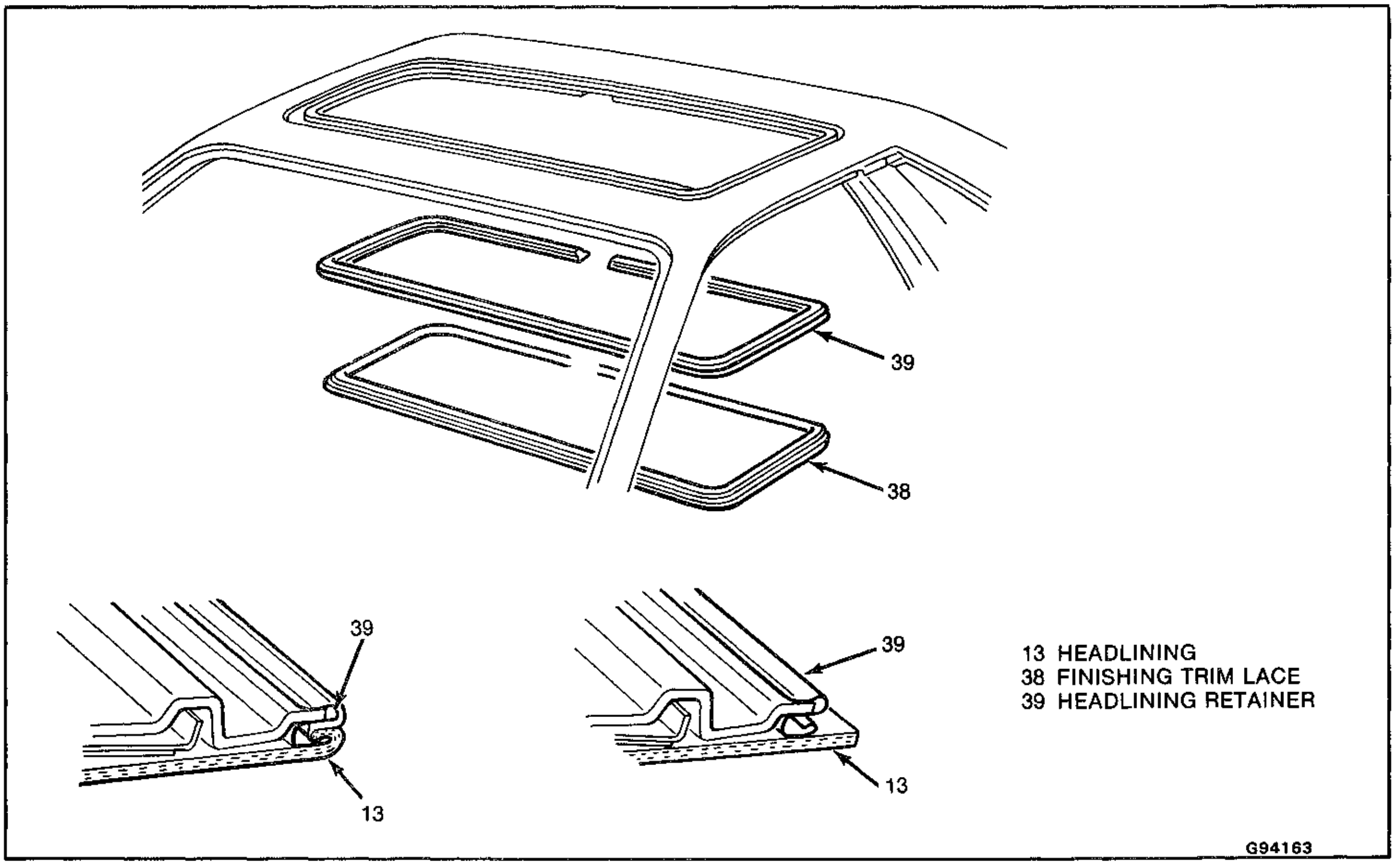


Fig. 13-Installing Vista Vent Headlining Retainer

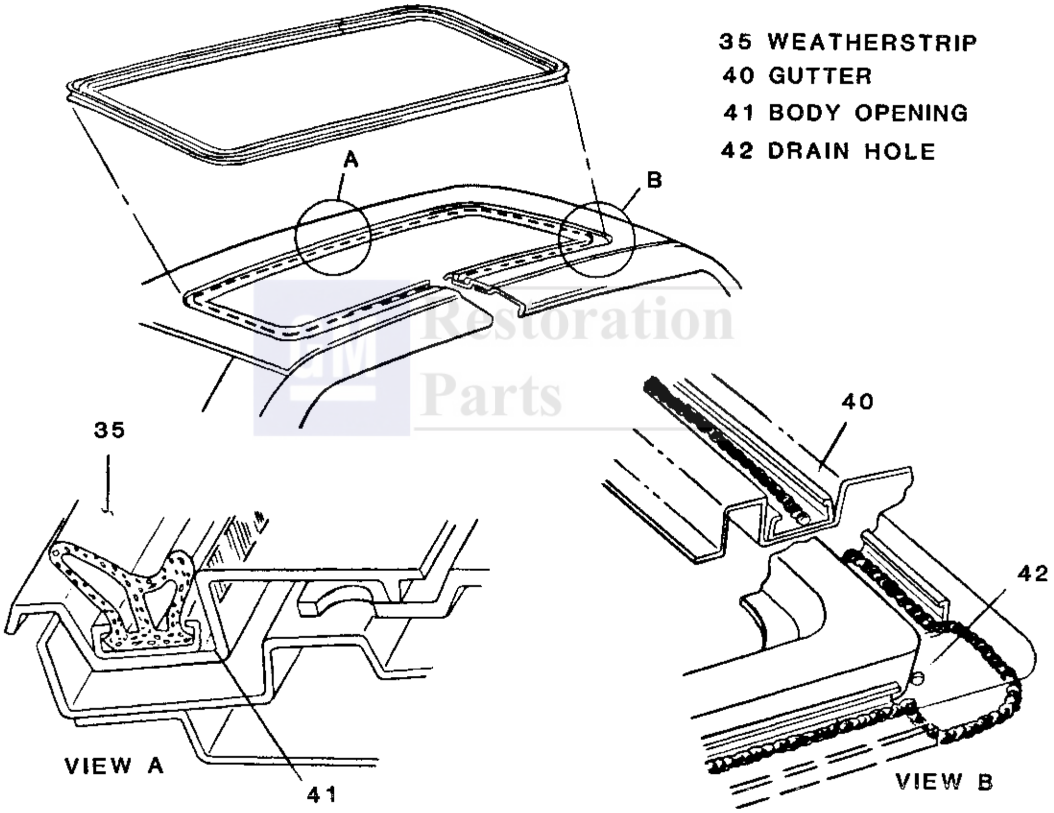


Fig. 14-Installing Vista Vent Weatherstrip

SECTION 9J

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. To diagnose a system failure, refer to Seat Belt Reminder Lamp/Alarm Diagnosis Chart (Fig. 1).

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:

1. Lap and shoulder belts will be serviced as follows:
   a Retractor portion of lap and shoulder belt for passenger and driver.
   b Buckle portion of seat lap belt for passenger and driver.
2. Keep sharp edges and damaging objects away from belts.
3. Avoid bending or damaging any portion of the belt buckle or latch plate.
4. Do not bleach or dye belt webbing (clean with mild soap solution and water).
5. When installing lap or shoulder belt anchor bolts, start bolt by hand to assure that bolt is threaded straight.

NOTICE: See NOTICE on page 9J-1 of this section.

6. Do not attempt repairs on lap or shoulder belt retractor mechanisms or belt retractor covers. Replace with new service replacement parts.

Refer to Figures 2 through 5 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.

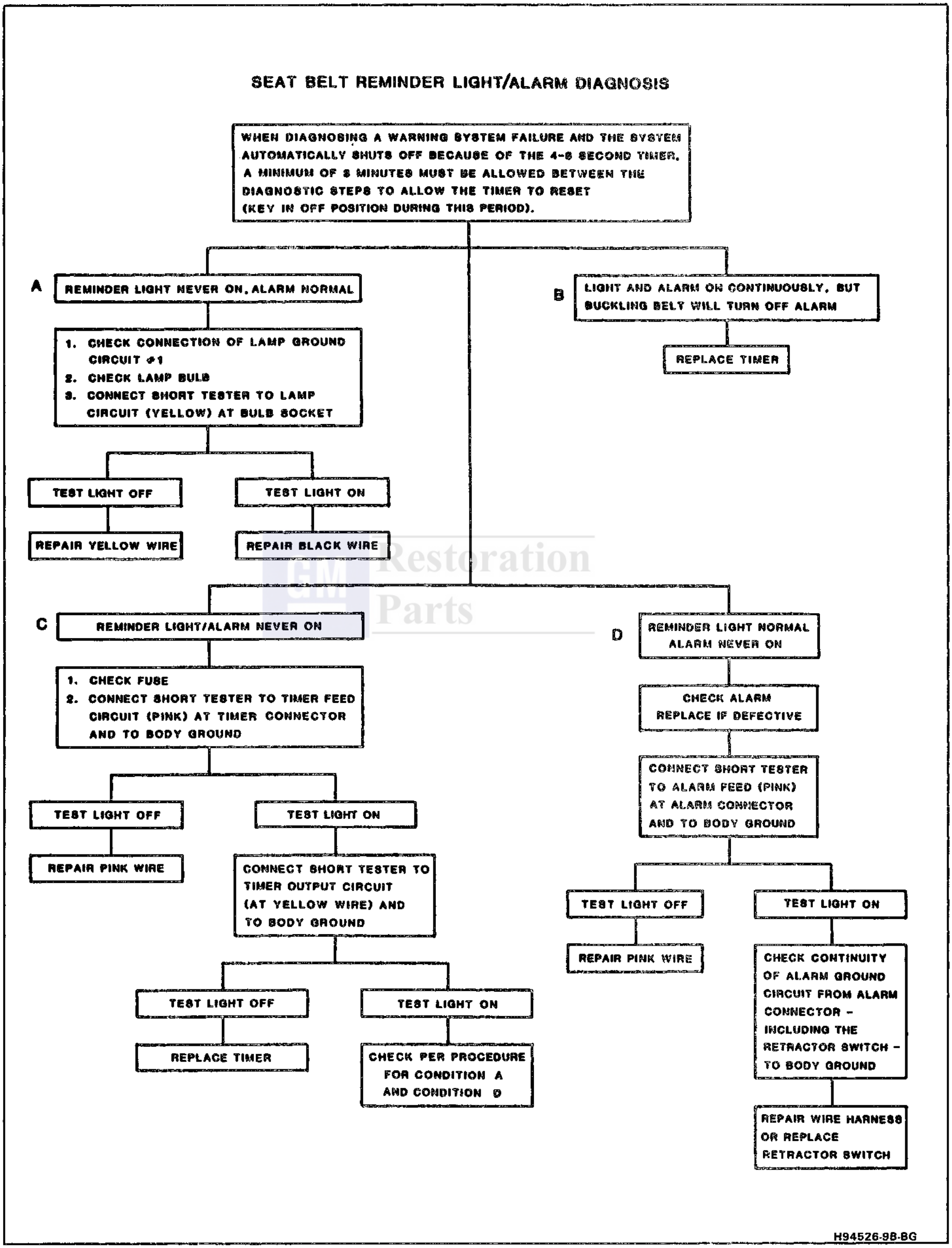


Fig. 1 - Seat Belt Reminder Lamp/Alarm Diagnosis Chart

- 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 2, 3)

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 (Figures 2, 3)

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

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

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 the manufacturer.

Install or Connect (Fig. 4)

1. Remove battery from engine compartment.
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.

To return the seatback to an upright or forward position, raise the recliner release handle.

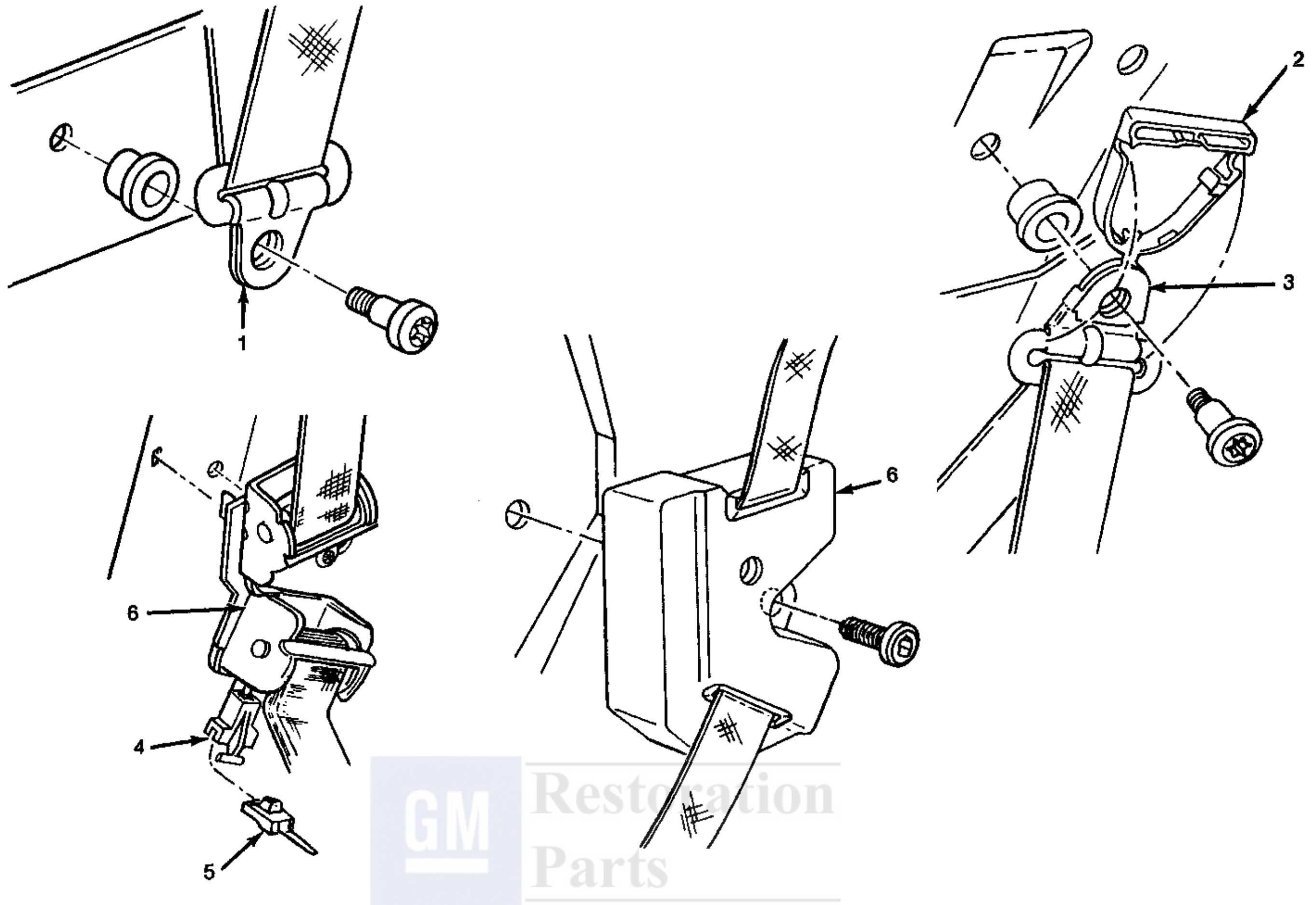


Fig. 2 Single Loop Belt System

RECLINER CONTROL MECHANISM

Remove or Disconnect (Figure 5)

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 5)

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 5)

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 5)

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.

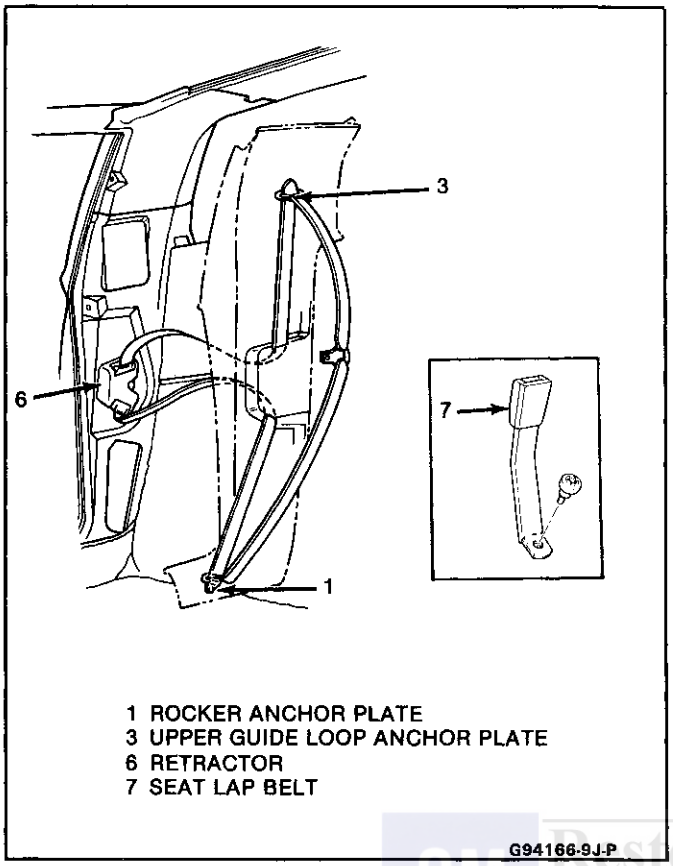


Fig. 3 Retractor Assembly

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. Apply sufficient straight-in pressure to start thread forming action of bolt into an unthreaded nut (Figure 6). Use of an appropriate tap will help in cutting initial threads

NOTICE: See Notice on page 9J-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
- Upper guide loop anchor plate to rear quarter trim panel 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 7)

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 8)

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 8)

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 to 21 ft-lb)
4. Move seat to full-forward position
5. Adjuster-to-floor pan rear attaching nuts

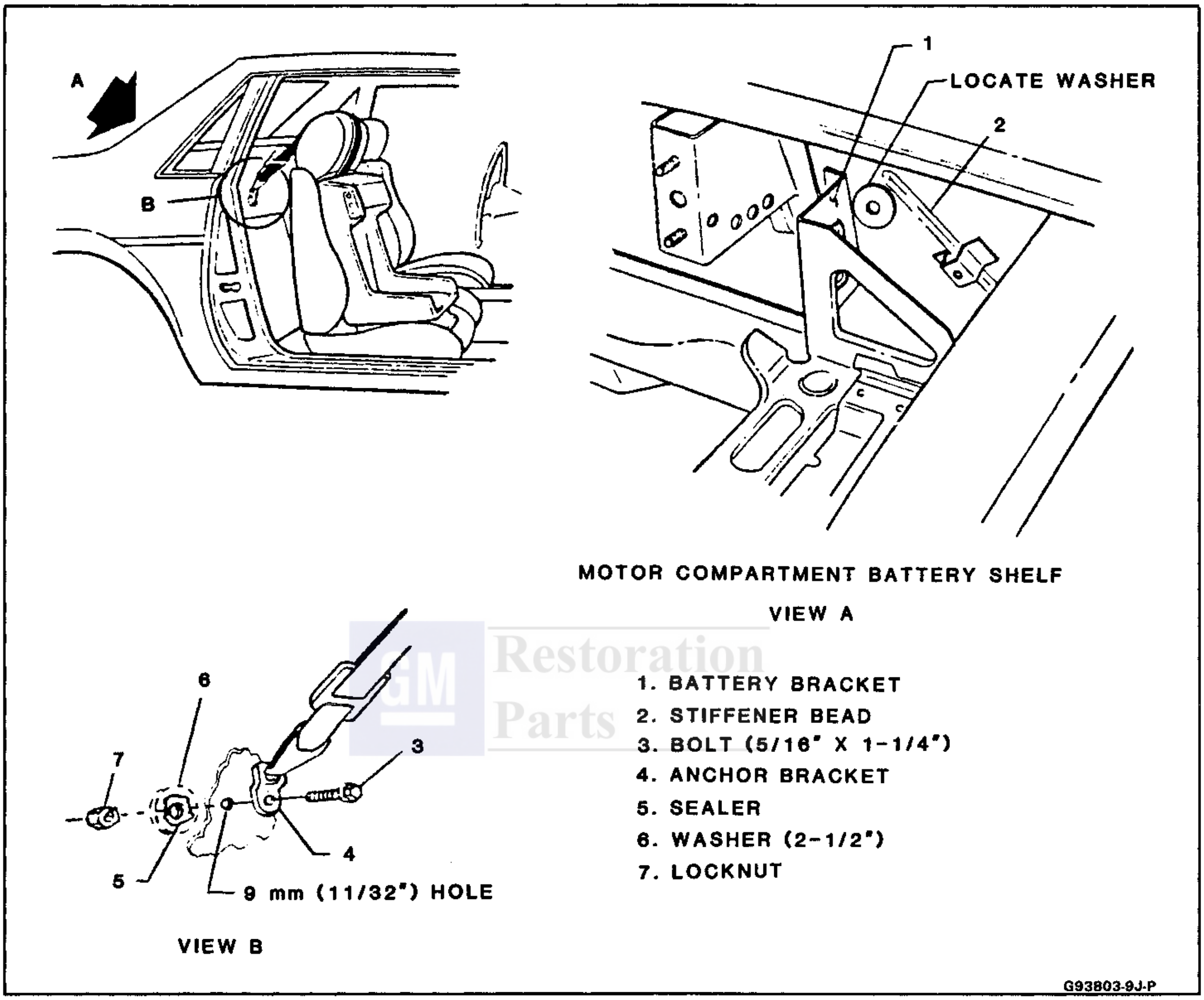


Fig. 4 Installing Top Strap Anchor

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 8)

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 8)

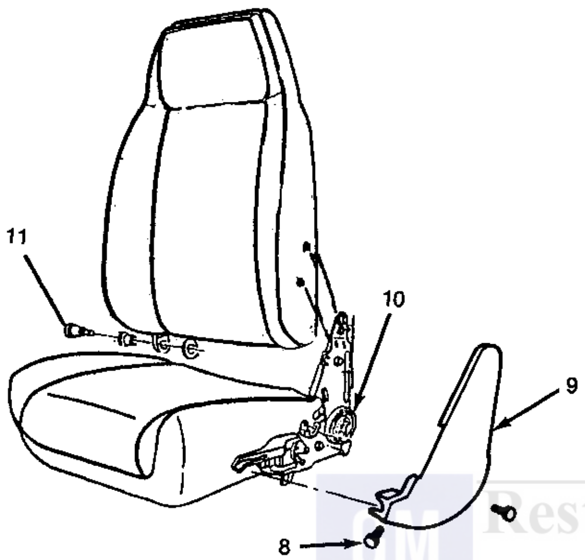
1. Seat adjuster (19) to seat
2. Adjuster-to-seat bottom frame, front and rear attaching bolts (18)

   Tighten

   Adjuster-to-seat bolts (18) from 20 to 28 N·m (15 to 21 ft-lb)
3. Seat assembly (17)

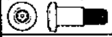
Inspect

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

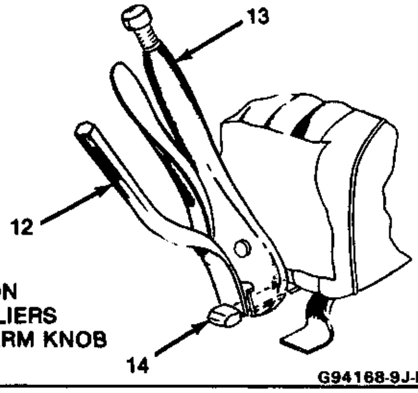
Fig. 5 Recliner Mechanism

	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 AT BEGINNING OF SECTION

Fig. 6 Seat Belt Fastener Chart



12 BODY SPOON
13 LOCKING PLIERS
14 CONTROL ARM KNOB

Fig. 7-Seat Adjuster Control Knob

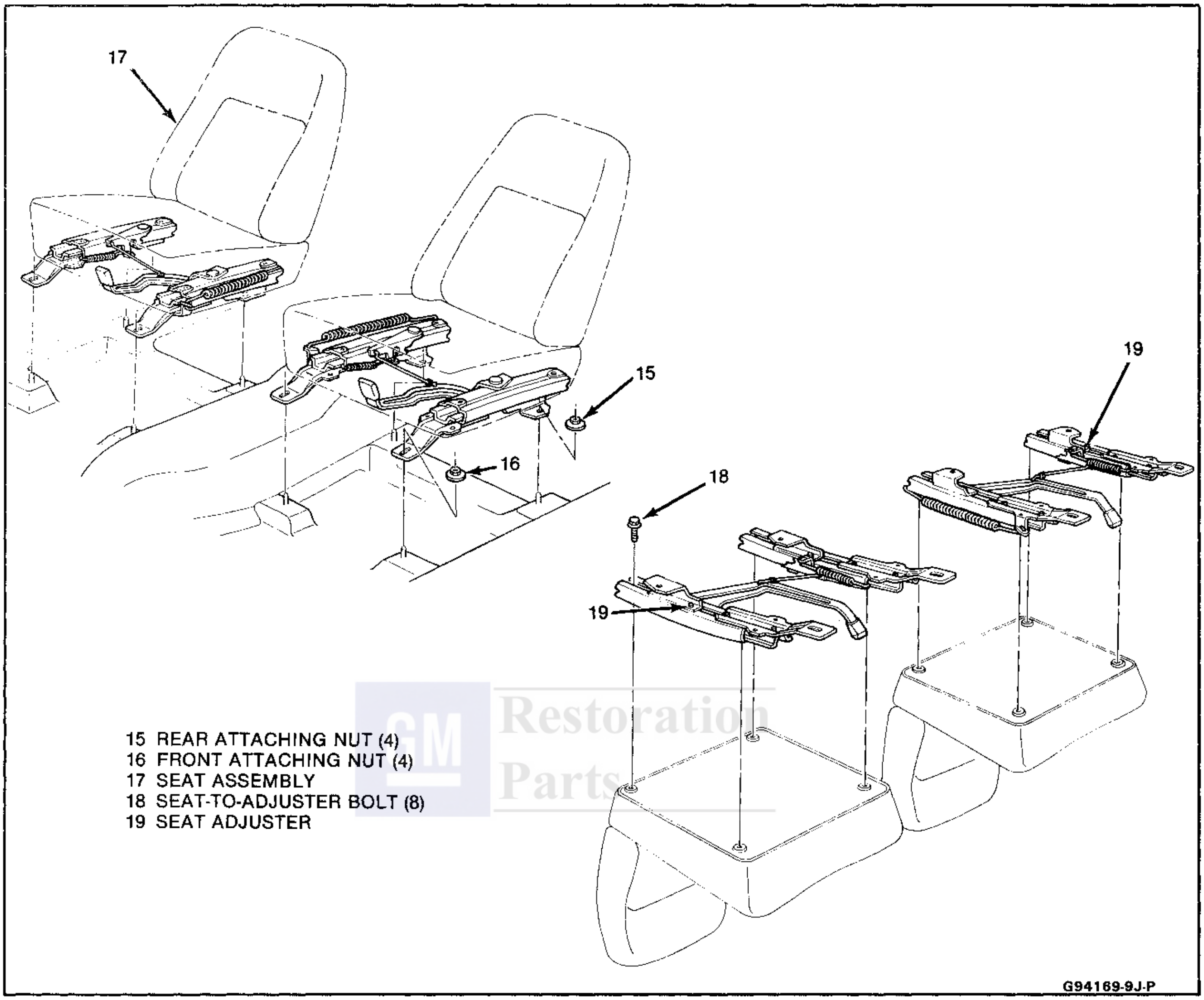


Fig. 8 Seat Assembly

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.

AF9 PNEUMATIC SEAT

SEATBACK ASSEMBLY, TRIM COVER AND BLADDER BAG

Remove or Disconnect (Fig. 9)

1. Seat assembly from vehicle.
2. Recliner cover attaching screws and slide cover (9) downward and rearward of the seat.
3. Unzip underside of backseat trim cover and remove hog rings from bottom corners of seatback cover.
4. Hog rings from trim curtain on underside of seat cushion.
5. Work tube harness connector (3) out from under inboard edge of foam on bottomside of seat cushion and disconnect.
6. Raise corner of seatback trim over upper portion of recliner. Mechanism to expose two recliner-to-seatback bolts. Remove bolts.
7. Inner hinge arm attaching bolt (11, Fig. 5).
8. Lift seatback and work seatback bladder bag tubes (4) out from under cushion.
9. Seatback assembly.
10. Hog rings from side rods and support wires securing trim cover to seatback frame.
11. Seatback trim cover
12. Hog rings securing upper and lower edges of bladder bag (4) to seatback.
13. Carefully peel cemented area of bladder bag away from foam. Avoiding tearing foam.
14. Bladder bag.

Install or Connect

Install reverse of removal procedure. During installation of bladder bag a nitril, nonstaining spray adhesive such as 3M Super Trim Adhesive 08090, or equivalent may be used. Apply a coat of adhesive to both the bladder bag and the area marked on the foam where the bag is located.

FRONT SEAT CUSHION ASSEMBLY, TRIM COVER, SWITCH AND TUBE HARNESS

Remove or Disconnect (Fig. 9)

1. Seat adjusters (Ref. Seat Adjuster Assembly procedure).
2. Recliner cover (9).
3. Escutcheon (1) from switch.
4. Inner hinge arm attaching bolt (11, Fig. 5).

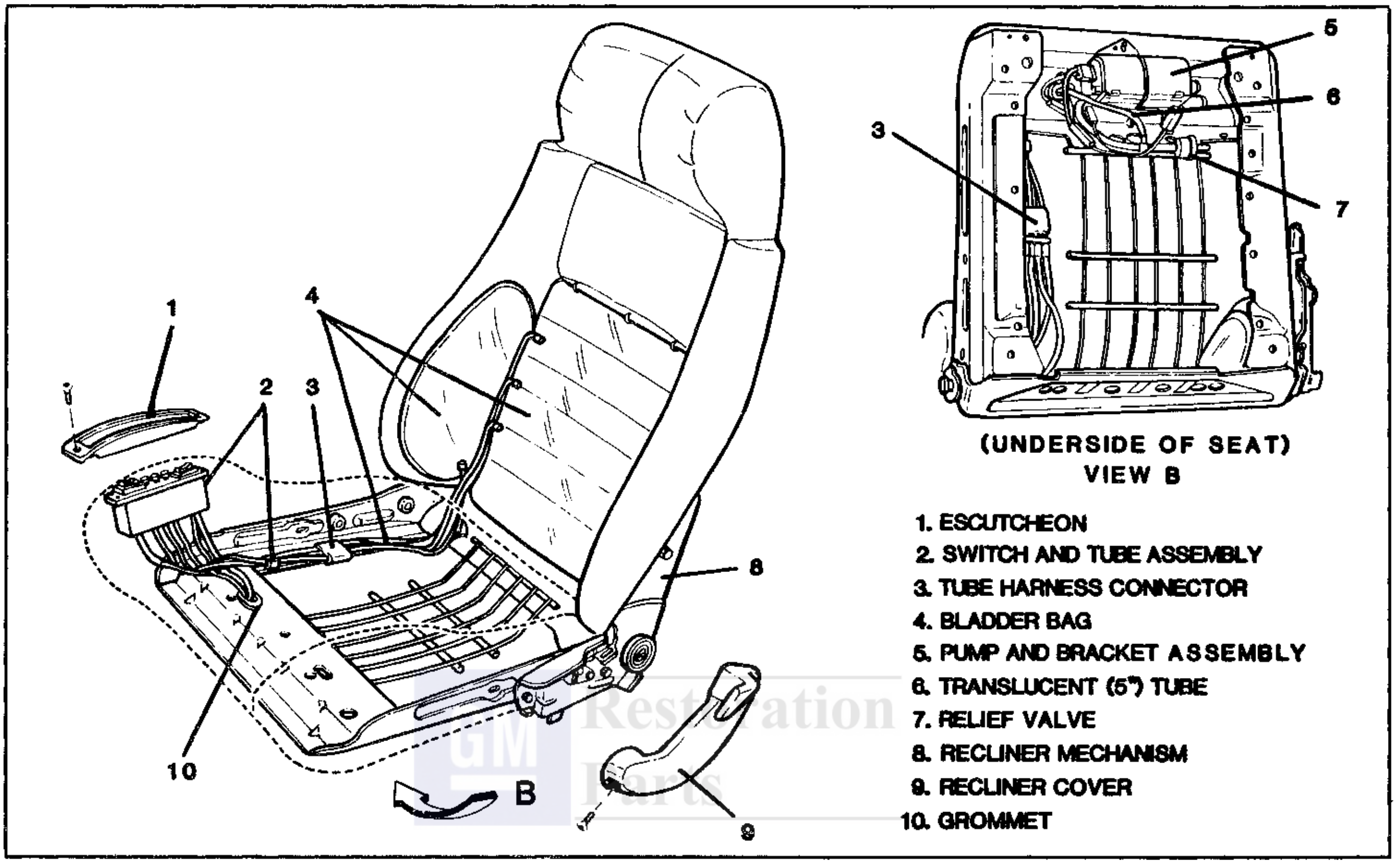


Fig. 9 - AF9 Pneumatic Seat Assembly

5. Two recliner-to-seatback cushion bolts.
6. Partially lift off seatback and withdraw bladder bag tubes (4) out from under cushion.
7. Complete removal of hog rings from underside of seat cushion trim.
8. Partially separate seat cushion trim and foam from seat frame.
9. Translucent tube (6) of switch and tube harness from "T" connector.
10. Label and disconnect electrical connectors from pump (5).
11. Work connector and hose through grommet (10) in seat frame and complete removal of seat cushion trim and foam. Complete separation of trim from foam as required.
12. Switch and tube harness (2) from underside of seat cushion foam.

→← Install or Connect

Install reverse of removal procedure. When cementing edges of trim cover around opening for switch in foam, brush on cement using a nitrile, nonstaining adhesive such as Hughes HC 4183, 3M 08046 or equivalent.

PUMP AND BRACKET ASSEMBLY

←→ Remove or Disconnect (Fig. 9)

1. Seat assembly from vehicle.
2. Hog rings from curtain on underside of seat cushion
3. Translucent tube (6) of switch and tube harness from "T" connector.
4. Label and disconnect electrical connectors from pump (5).
5. Pump and bracket assembly (5) from seat frame.

→← Install or Connect

Install reverse of removal procedure. A relief valve (7) is provided as part of the pumping system to control pressure buildup by the pump motor. Removal will be obvious upon inspection.

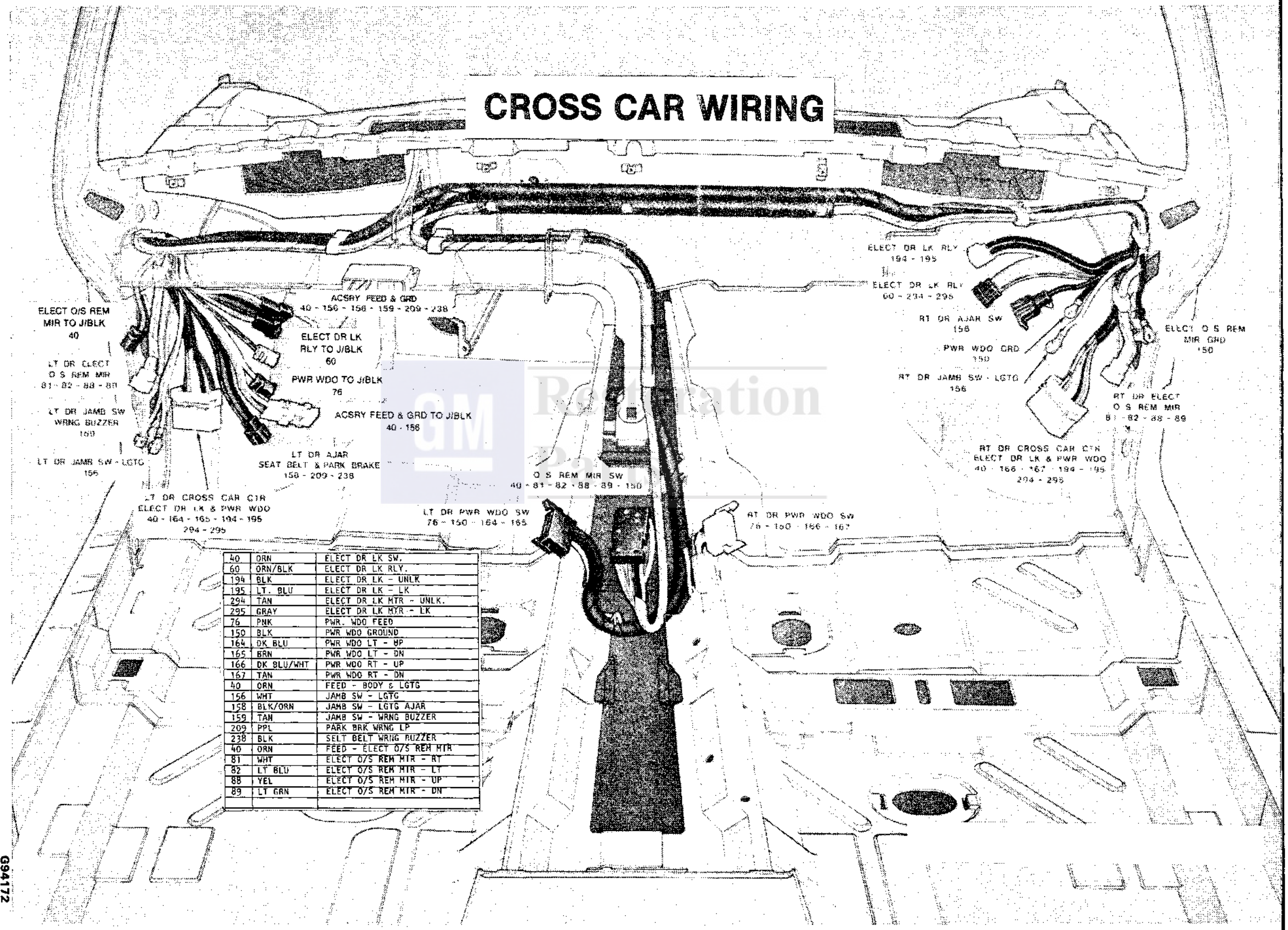
SECTION 10J

ELECTRICAL

CONTENTS

Wiring Harness Illustrations

See Section 8A in the chassis portion of this manual for detailed diagnostics.



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

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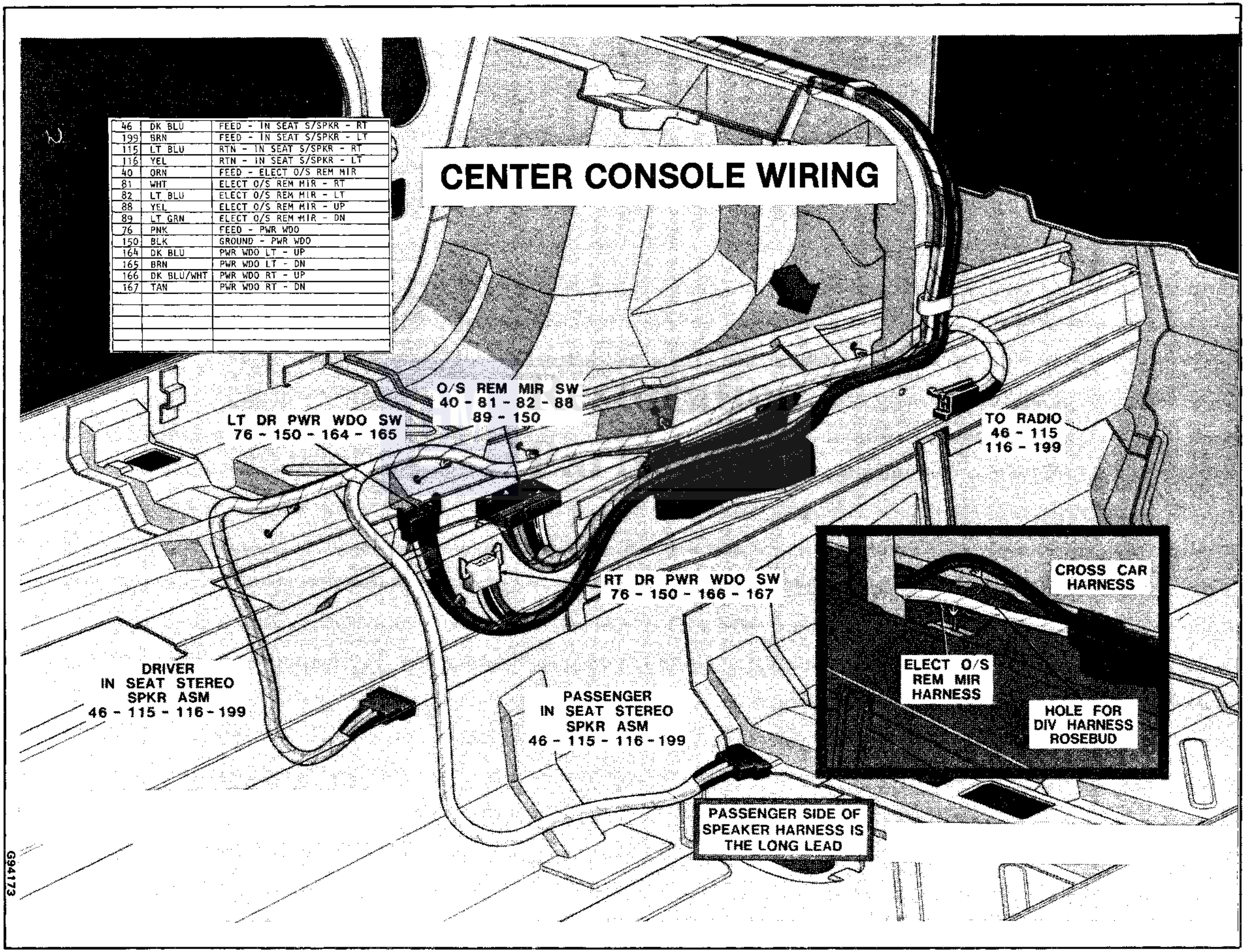
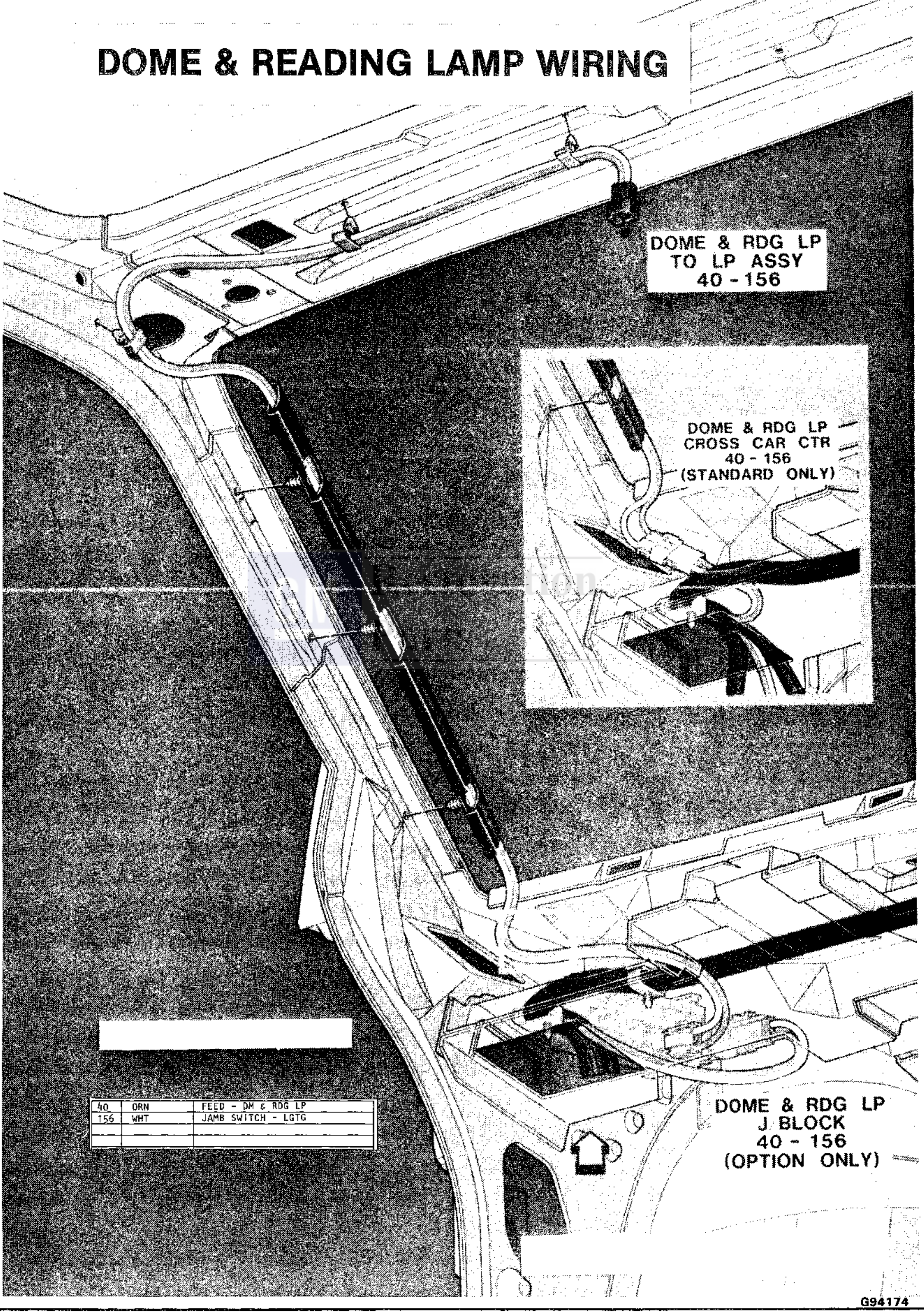
Fig. 1-Cross Car Wiring



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

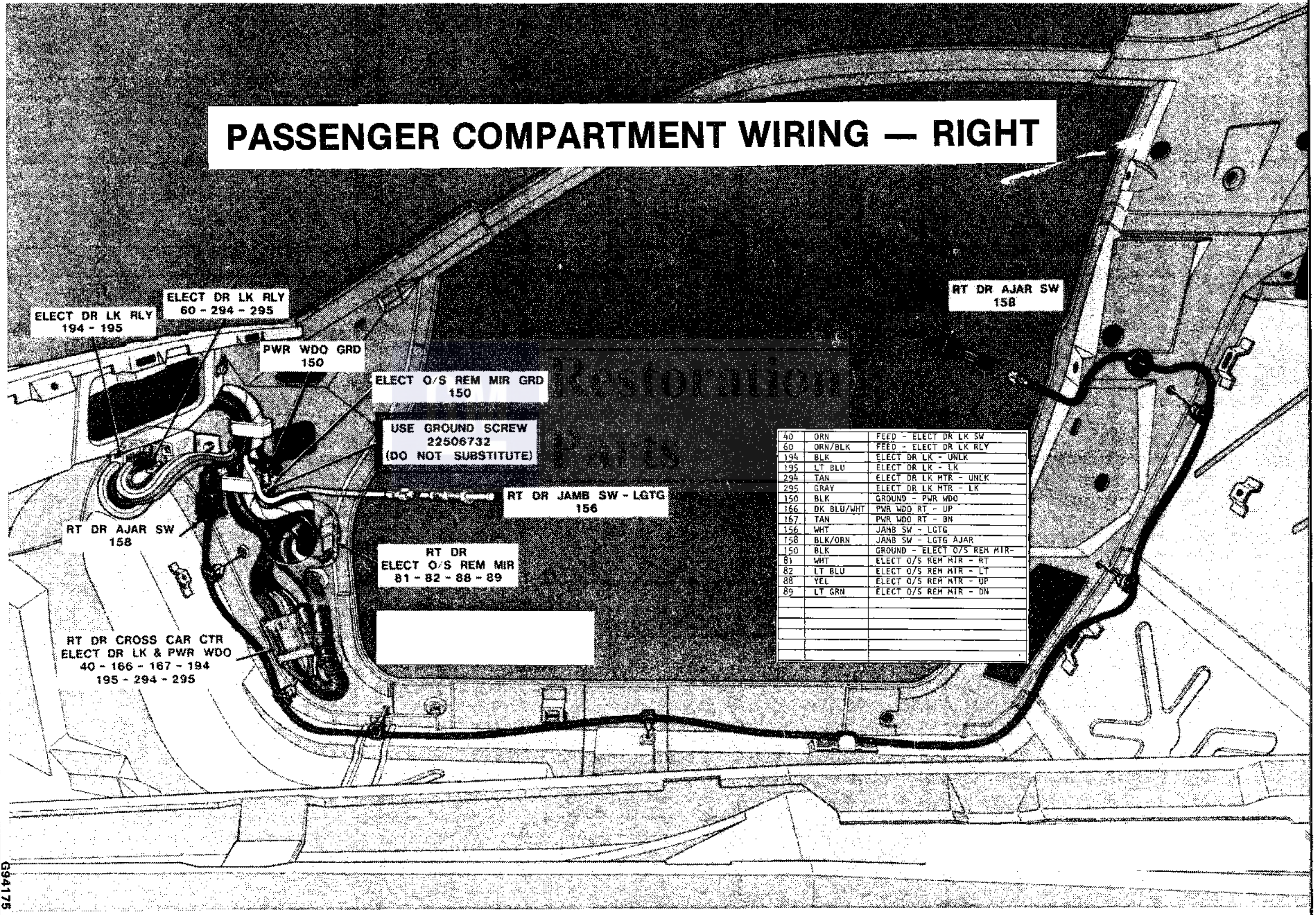
Fig. 2-Center Console Wiring



DOME & READING LAMP WIRING

40	ORN	FEED - DM & RDG LP
156	WHT	JAMB SWITCH - LGTG

Fig. 3-Dome and Reading Lamp Wiring



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

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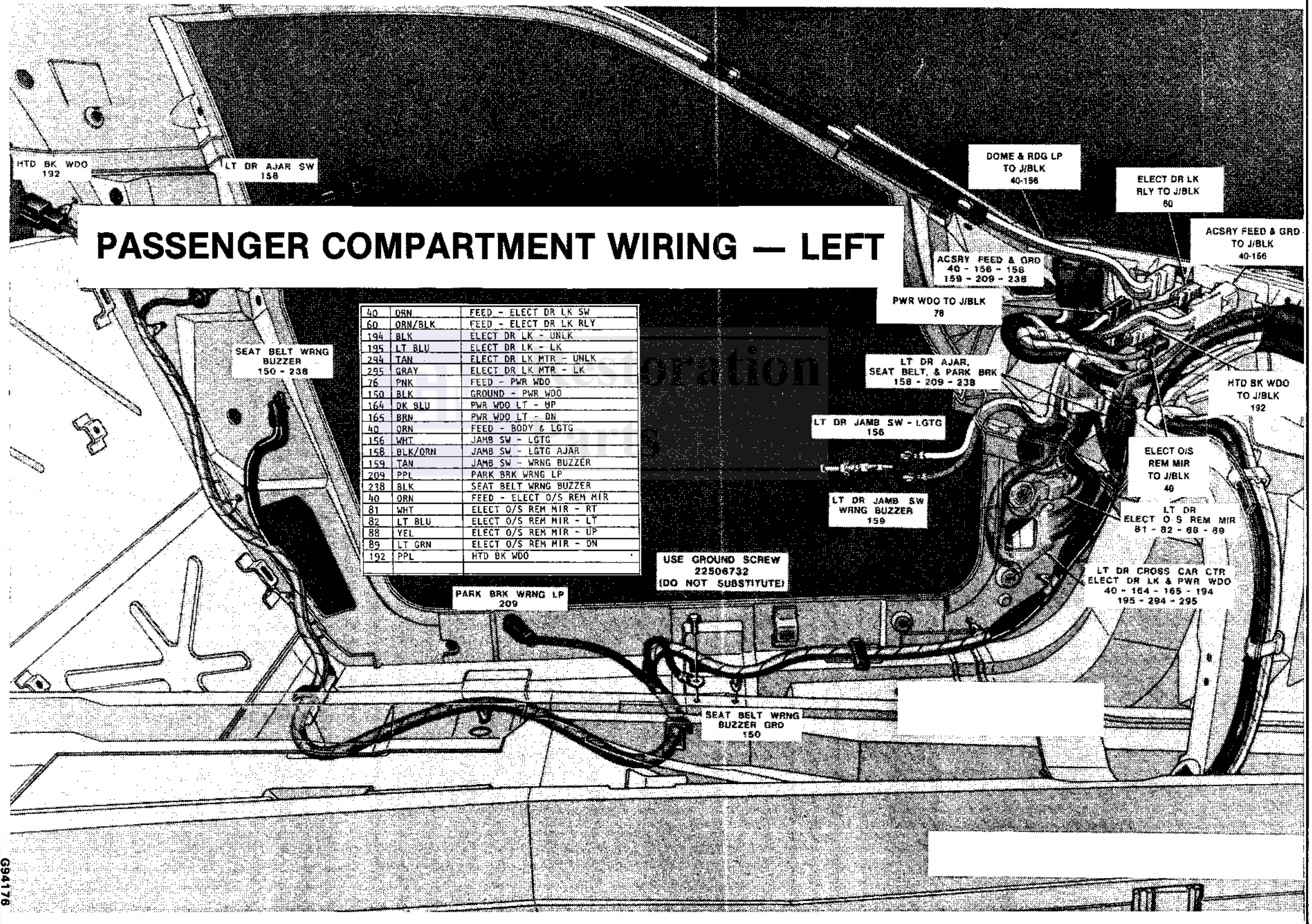
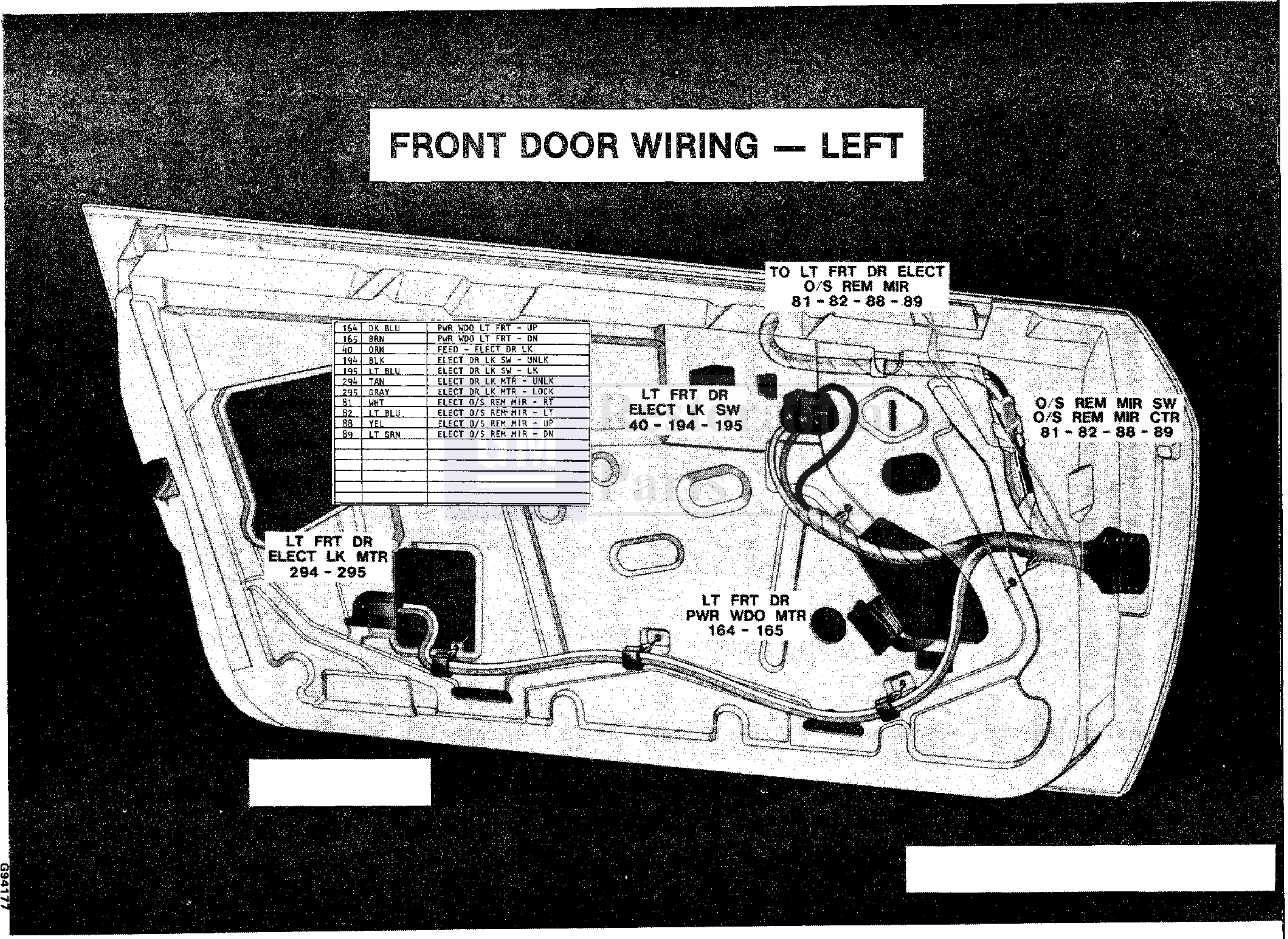
Fig. 4-Passenger Compartment Wiring - Right

PASSENGER COMPARTMENT WIRING — LEFT



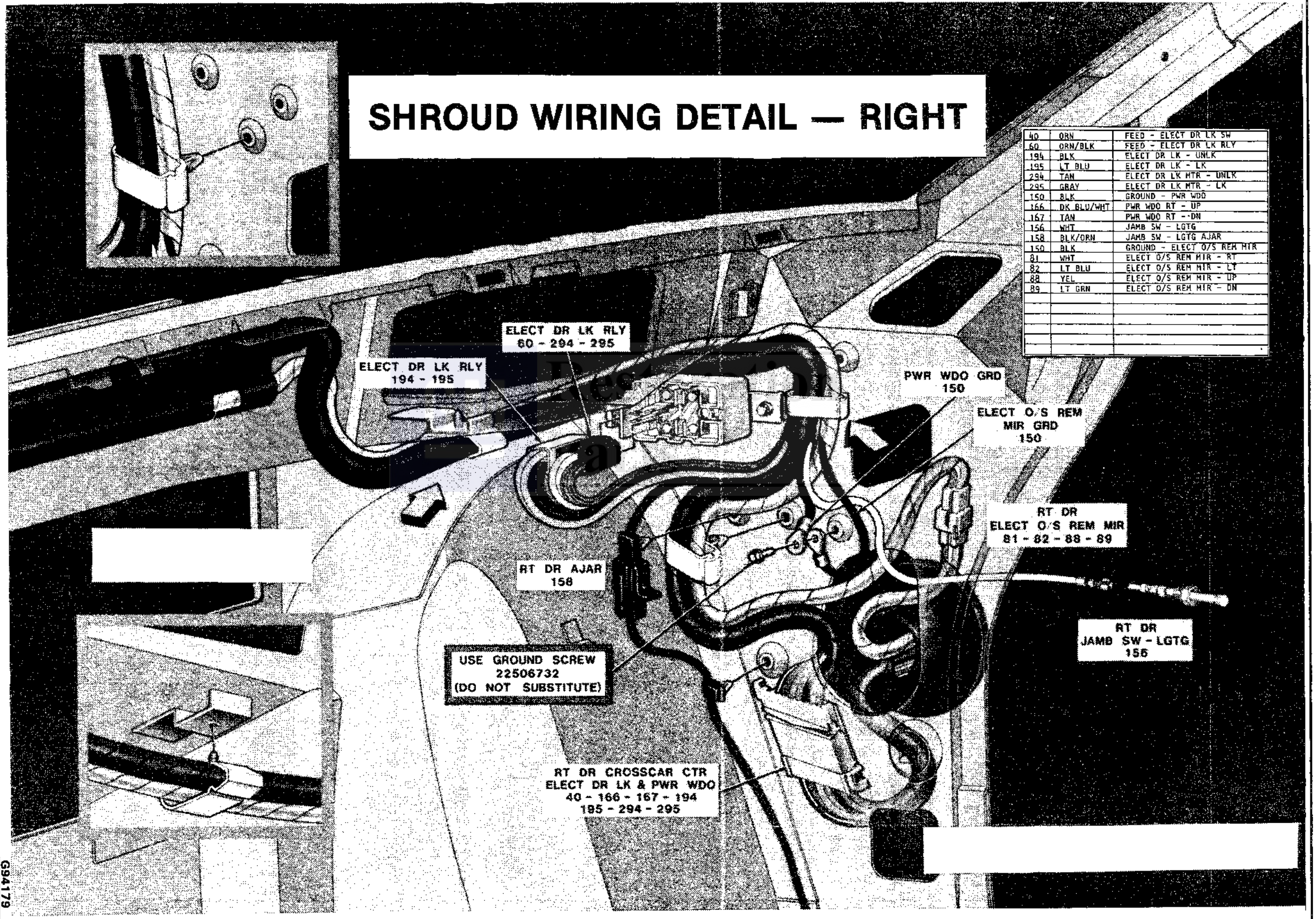
40	ORN	FEED - ELECT DR LK SW
60	ORN/BLK	FEED - ELECT DR LK RLY
194	BLK	ELECT DR LK - UNLK
195	LT BLU	ELECT DR LK - LK
294	TAN	ELECT DR LK MTR - UNLK
295	GRAY	ELECT DR LK MTR - LK
76	PNK	FEED - PWR WDO
150	BLK	GROUND - PWR WDO
164	DK BLU	PWR WDO LT - UP
165	BRN	PWR WDO LT - DN
40	ORN	FEED - BODY & LGTG
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. 5-Passenger Compartment Wiring - Left



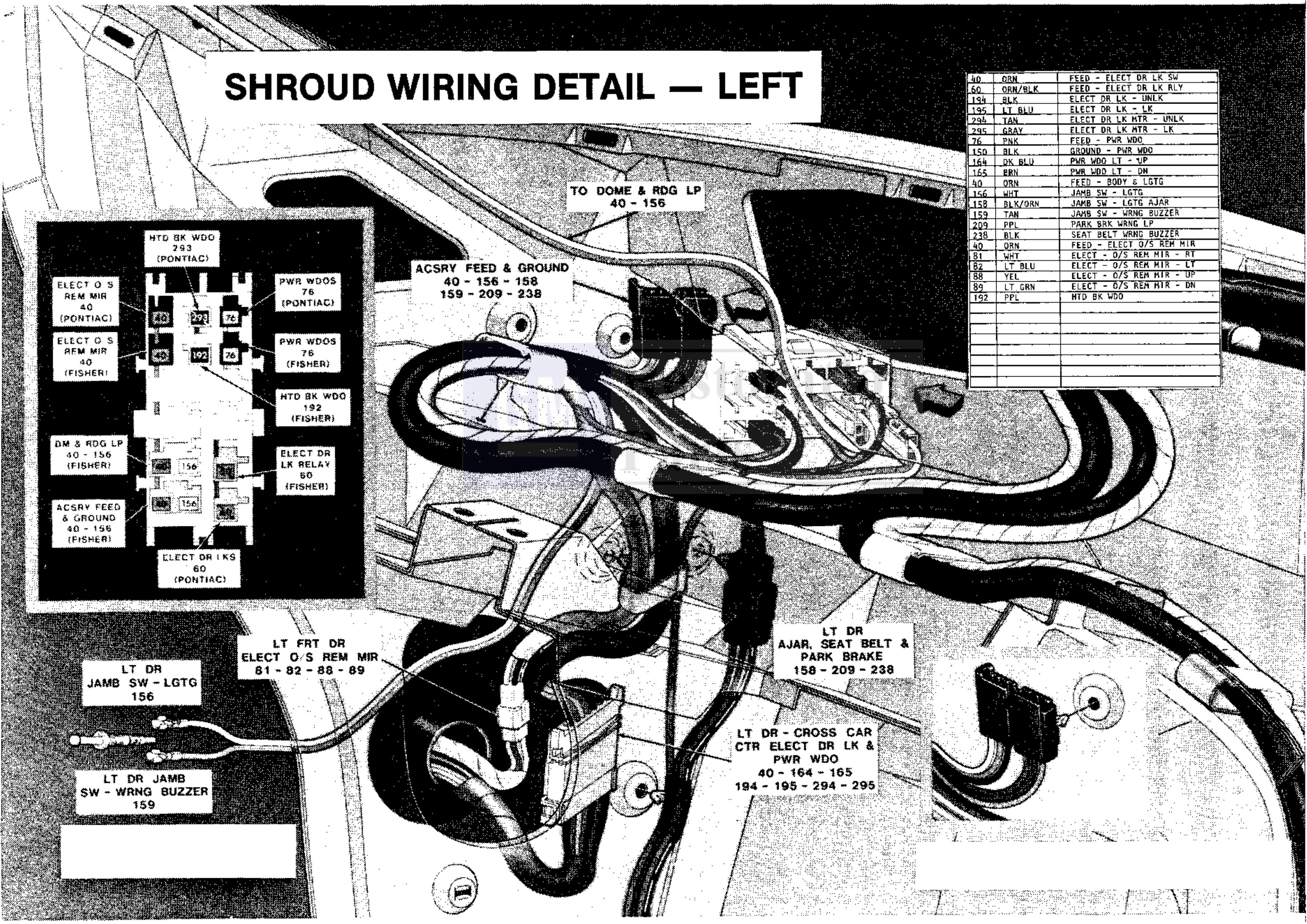
164	DK BLU	PWR WDO LT FRT - UP
165	BRN	PWR WDO LT FRT - DN
40	ORN	FEED - ELECT DR LK
194	BLK	ELECT DR LK SW - UNLK
195	LT BLU	ELECT DR LK SW - LK
294	TAN	ELECT DR LK MTR - UNLK
295	GRAY	ELECT DR LK MTR - LOCK
81	WHT	ELECT O/S REM MIR - RT
82	LT BLU	ELECT O/S REM MIR - LT
88	YEL	ELECT O/S REM MIR - UP
89	LT GRN	ELECT O/S REM MIR - DN

Fig. 6-Front Door Wiring - Left



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

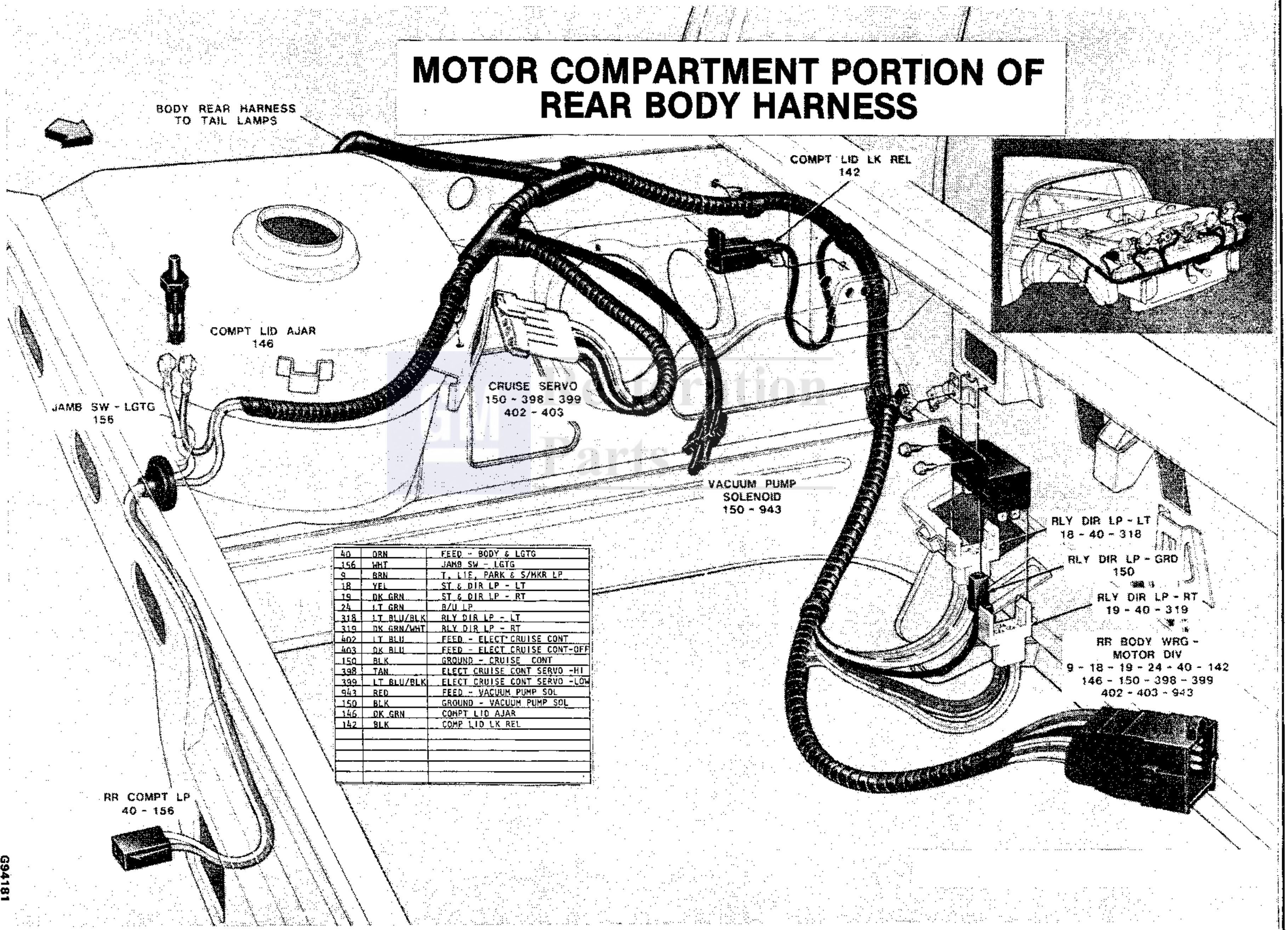
Fig. 7-Shroud Wiring - Right



SHROUD WIRING DETAIL — LEFT

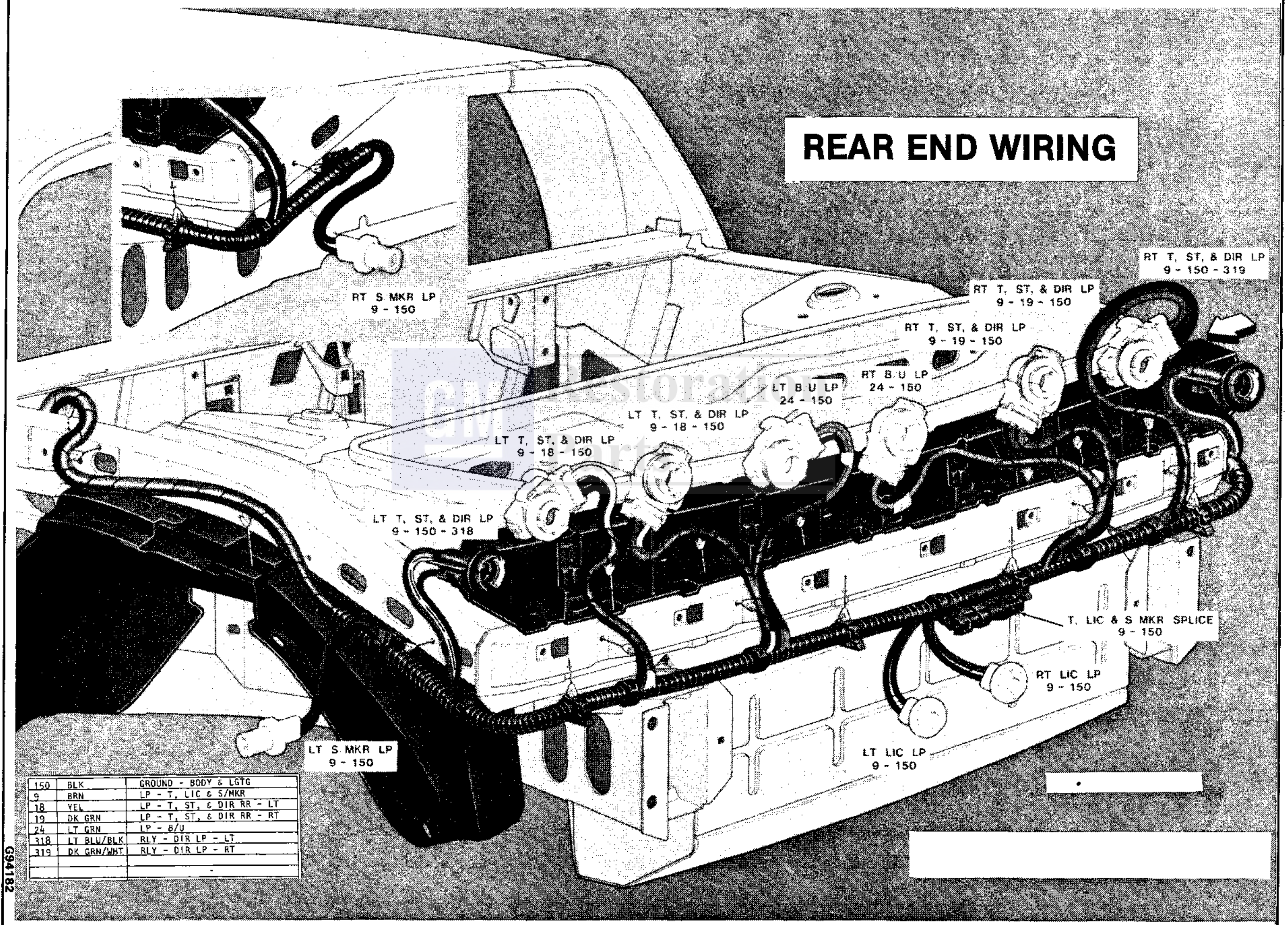
40	ORN	FEED - ELECT DR LK SW
60	ORN/BLK	FEED - ELECT DR LK RLY
194	BLK	ELECT DR LK - UNLK
195	LT BLU	ELECT DR LK - LK
294	TAN	ELECT DR LK MTR - UNLK
295	GRAY	ELECT DR LK MTR - LK
76	PNK	FEED - PWR WDO
150	BLK	GROUND - PWR WDO
164	DK BLU	PWR WDO LT - UP
165	BRN	PWR WDO LT - DN
40	ORN	FEED - BODY & LGTG
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. 8-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. 9-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-Rear End Wiring

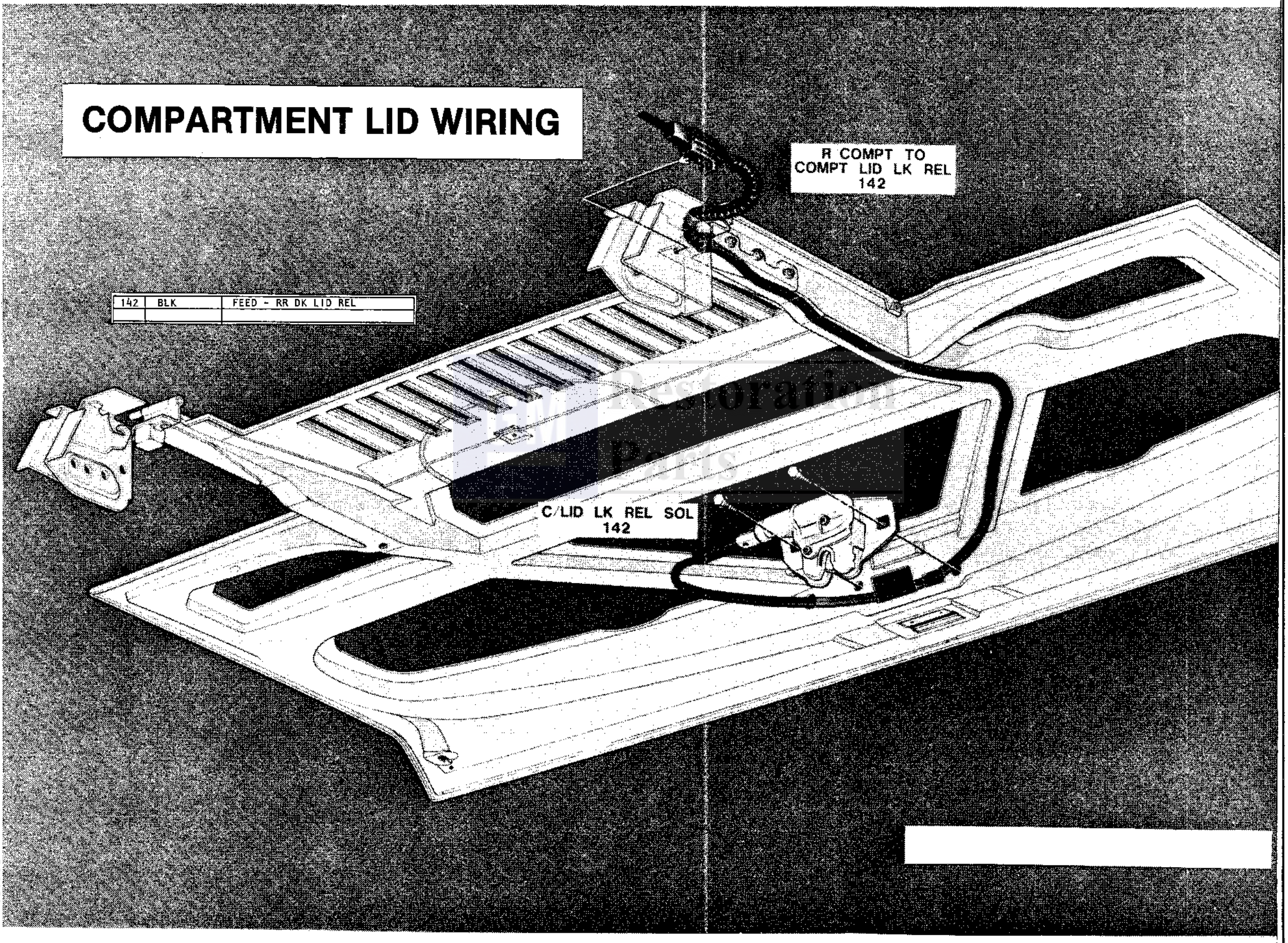


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Fig. 11-Compartment Lid Wiring

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

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Fig. 12-Glossary of Circuit Abbreviations

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PONTIAC

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