SERVICE MANUAL

LIGHT DUTY TRUCKS

1986

A Truck You Can Live With!

FOREWORD

This service manual contains diagnosis, "On-Vehicle" maintenance, and light repair for Light Duty Truck Models ("C-K, P-Truck, and G-Van"). Procedures involving disassembly and assembly of major components for these vehicles are published in a separate "Truck Unit Repair Manual." Wiring diagrams for these models are also published in a separate "Truck Wiring Diagram" booklet.

This manual should be kept in a handy place for ready reference. If properly used, it will meet the needs of technicians and vehicle owners.

CAUTION:

These vehicles contain some parts dimensioned in the metric system as well as in the customary system. Some fasteners are metric and are very close in dimension to familiar customary fasteners in the inch system. It is important to note that, during any vehicle maintenance procedures, replacement fasteners must have the same measurements and strength as those removed, whether metric or customary. (Numbers on the heads of metric bolts and on surfaces of metric nuts indicate their strength. Customary bolts use radial lines for this purpose, while most customary nuts do not have strength markings.) Mismatched or incorrect fasteners can result in vehicle damage or malfunction, or possibly personal injury. Therefore, fasteners removed from the vehicle should be saved for re-use in the same location whenever possible. Where the fasteners are not satisfactory for re-use, care should be taken to select a replacement that matches the original. For information and assistance, see your authorized dealer.

GMC TRUCK & COACH OPERATION
TRUCK & BUS GROUP
General Motors Corporation
Pontiac, Michigan

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.

1986

LIGHT DUTY TRUCK SERVICE MANUAL

C-K, P-TRUCK AND G-VAN MODELS

The Table of Contents on this page indicates the sections covered in this manual. At the beginning of each individual section is a Table of Contents which gives the page number on which each major subject begins.

When reference is made in this manual to a brand name, number, or specific tool, an equivalent product may be used in place of the recommended item.

All information, illustrations, and specifications contained in this Manual are based on the latest product information available at the time of publication approval. The right is reserved to make changes at any time without notice.

Printed in Canada

November, 1985

Mr. Goodwrench

SECTION 0

GENERAL INFORMATION

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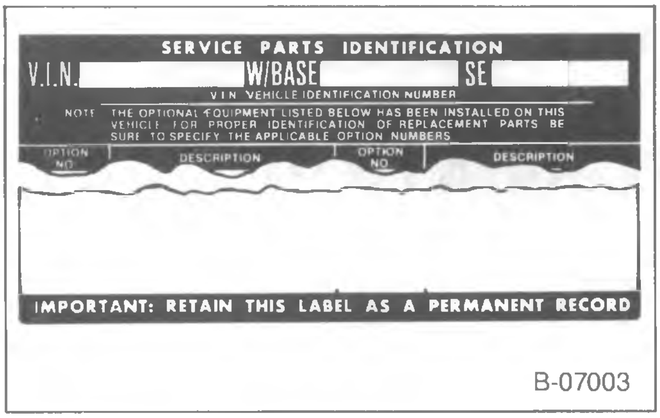
SUBJECT **PAGE**

SECTION 0A

GENERAL INFORMATION

CONTENTS

SUBJECT **PAGE**



SERVICE PARTS IDENTIFICATION

V.I.N. W/BASE SE

VIN VEHICLE IDENTIFICATION NUMBER

NOTE THE OPTIONAL EQUIPMENT LISTED BELOW HAS BEEN INSTALLED ON THIS VEHICLE FOR PROPER IDENTIFICATION OF REPLACEMENT PARTS BE SURE TO SPECIFY THE APPLICABLE OPTION NUMBERS

OPTION NO.	DESCRIPTION	OPTION NO.	DESCRIPTION

IMPORTANT: RETAIN THIS LABEL AS A PERMANENT RECORD

Figure 1—Service Parts Identification Label

SERVICE PARTS IDENTIFICATION LABEL

The Truck Service Parts Identification Label is provided on all models (figure 1). It is located on the inside of the glove box door (or on an inner body panel for Forward Control models). The Label lists the VIN (Vehicle Identification Number), wheelbase, paint information and all Production options or Special Equipment on the vehicle when it was shipped from the factory. ALWAYS REFER TO THIS INFORMATION WHEN ORDERING PARTS.

VEHICLE IDENTIFICATION NUMBER

The VIN is the legal identifier of the vehicle. On all models except Forward Control, it is located on a plate which is attached to the left top of the instrument panel and can be seen through the windshield from the outside of the vehicle (figure 2). On Forward Control models, the plate is on the dash and toe panel. To find out the manufacturer, model and chasis type, engine type, GVW range, model year, plant code, and sequential number, refer to figure 3.

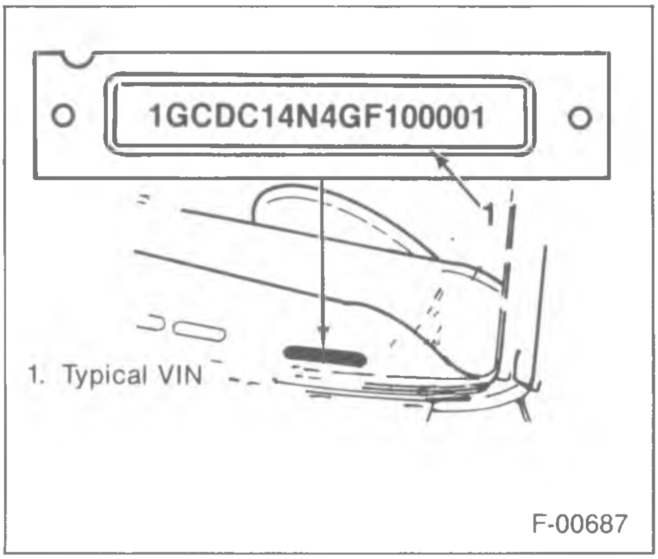


Figure 2—VIN Location

CERTIFICATION LABEL

The Certification Label shows the GVWR, and the front and rear GAWRs, and the Payload Rating for your vehicle (figure 4).

Gross Vehicle Weight (GVW) is the weight of the orginally equipped vehicle and all items added to it after it has left the factory. This would include bodies, winches, booms, etc.; the driver and all occupants; and the load the vehicle is carrying. The GVW must not exceed the GVWR. Also, the front and rear gross axle weights must not exceed the front and rear GAWRs.

The Payload Rating shown on the label is the maximum allowable cargo load (including the weight of the driver and all occupants) that the vehicle can carry based on all factory installed equipment on the vehicle. The Payload Rating is reduced if any accessories or other equipment is added to the vehicle after final date of manufacture. The weight of these items should be determined and deducted from the Payload Rating.

The vehicle may also have a GCWR (Gross Combination Weight Rating). The GCW (Gross Combination Weight) is the total weight of the loaded tow vehicle (including passengers) and a loaded trailer.

The tires on the vehicle must be the proper size and properly inflated for the load which you are carrying. The vehicle Certification Label shows the originally equipped tire size and recommended inflation pressures. For more information on tires, refer to WHEELS AND TIRES (Sec.3E).

MODEL REFERENCE

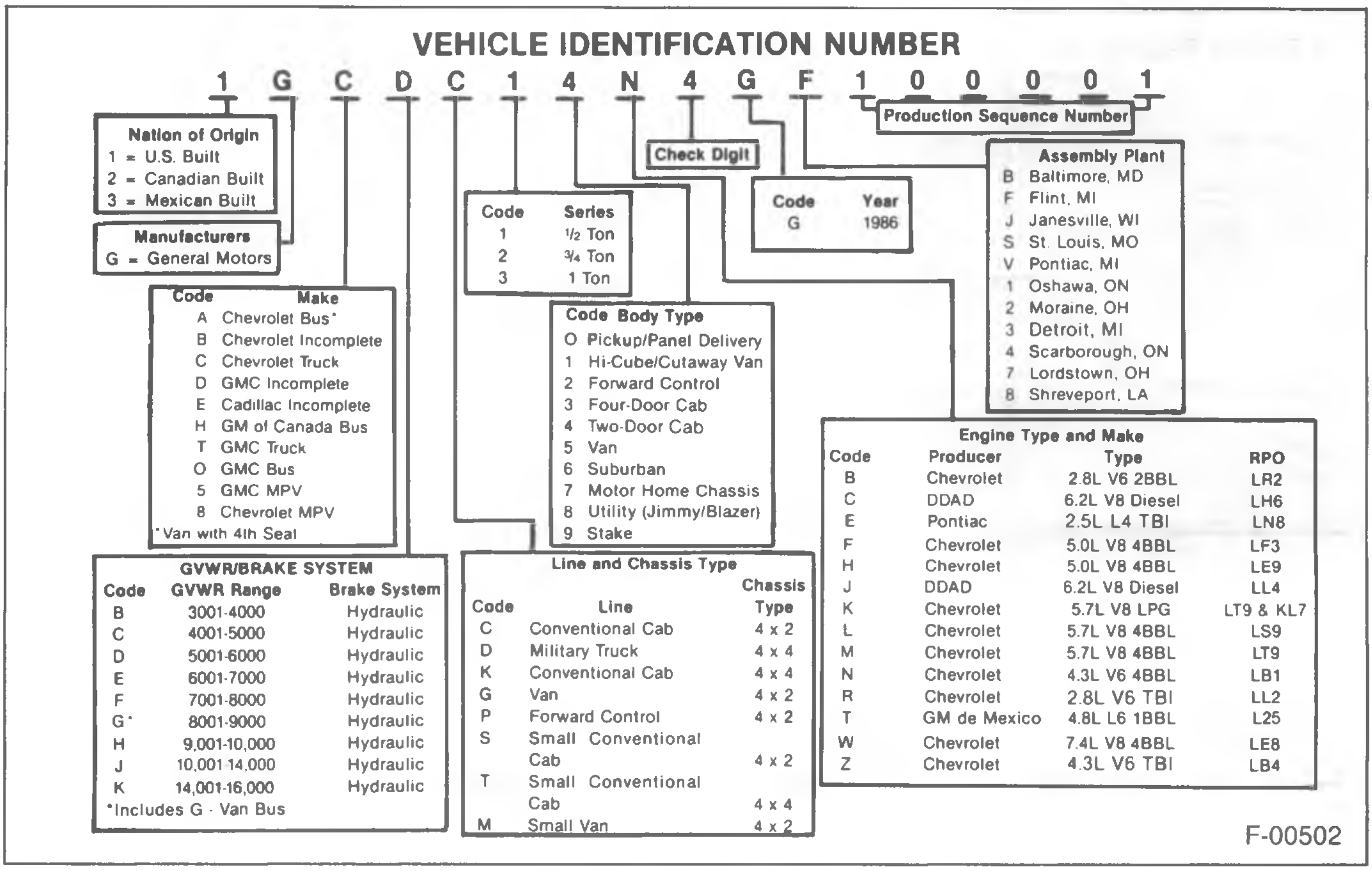
Refer to figures 5 and 6 to determine the vehicle model. For C/K models, a "C" is a two-wheel drive vehicle and a "K" is a four-wheel drive vehicle.

ENGINE IDENTIFICATION NUMBER

Refer to figure 7 to determine the location of the engine I.D. number.

EMERGENCY STARTING YOUR VEHICLE DUE TO A DISCHARGED BATTERY

If your vehicle will not start due to a discharged battery, it can often be started by using energy from another battery - a procedure called "jump starting."



VEHICLE IDENTIFICATION NUMBER

1 G C D C 1 4 N 4 G F 1 0 0 0 0 1

Nation of Origin
1 = U.S. Built
2 = Canadian Built
3 = Mexican Built

Manufacturers
G = General Motors

Code	Make
A	Chevrolet Bus*
B	Chevrolet Incomplete
C	Chevrolet Truck
D	GMC Incomplete
E	Cadillac Incomplete
H	GM of Canada Bus
T	GMC Truck
O	GMC Bus
5	GMC MPV
8	Chevrolet MPV

*Van with 4th Seat

GVWR/BRAKE SYSTEM

Code	GVWR Range	Brake System
B	3001-4000	Hydraulic
C	4001-5000	Hydraulic
D	5001-6000	Hydraulic
E	6001-7000	Hydraulic
F	7001-8000	Hydraulic
G*	8001-9000	Hydraulic
H	9,001-10,000	Hydraulic
J	10,001-14,000	Hydraulic
K	14,001-16,000	Hydraulic

*Includes G - Van Bus

Code	Series
1	½ Ton
2	¾ Ton
3	1 Ton

Code	Body Type
O	Pickup/Panel Delivery
1	Hi-Cube/Cutaway Van
2	Forward Control
3	Four-Door Cab
4	Two-Door Cab
5	Van
6	Suburban
7	Motor Home Chassis
8	Utility (Jimmy/Blazer)
9	Stake

Line and Chassis Type

Code	Line	Chassis Type
C	Conventional Cab	4 x 2
D	Military Truck	4 x 4
K	Conventional Cab	4 x 4
G	Van	4 x 2
P	Forward Control	4 x 2
S	Small Conventional Cab	4 x 2
T	Small Conventional Cab	4 x 4
M	Small Van	4 x 2

Check Digit

Code	Year
G	1986

Assembly Plant

B	Baltimore, MD
F	Flint, MI
J	Janesville, WI
S	St. Louis, MO
V	Pontiac, MI
1	Oshawa, ON
2	Moraine, OH
3	Detroit, MI
4	Scarborough, ON
7	Lordstown, OH
8	Shreveport, LA

Production Sequence Number

Engine Type and Make

Code	Producer	Type	RPO
B	Chevrolet	2.8L V6 2BBL	LR2
C	DDAD	6.2L V8 Diesel	LH6
E	Pontiac	2.5L L4 TBI	LN8
F	Chevrolet	5.0L V8 4BBL	LF3
H	Chevrolet	5.0L V8 4BBL	LE9
J	DDAD	6.2L V8 Diesel	LL4
K	Chevrolet	5.7L V8 LPG	LT9 & KL7
L	Chevrolet	5.7L V8 4BBL	LS9
M	Chevrolet	5.7L V8 4BBL	LT9
N	Chevrolet	4.3L V6 4BBL	LB1
R	Chevrolet	2.8L V6 TBI	LL2
T	GM de Mexico	4.8L L6 1BBL	L25
W	Chevrolet	7.4L V8 4BBL	LE8
Z	Chevrolet	4.3L V6 TBI	LB4

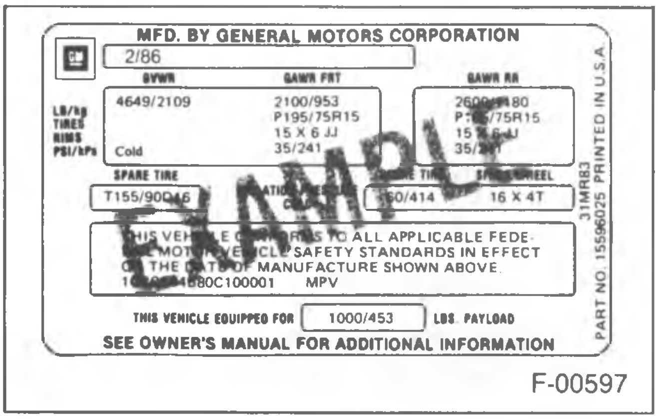
F-00502

Figure 3—Vehicle Identification Number (VIN)

Should your vehicle have an optional diesel engine with two batteries:

- P models and G Van models — use only the battery on the driver's side when jump starting.
- C/K models — use only the battery on the passenger's side when jump starting.

These battery locations are closer to the starter, thus reducing electrical resistance. Ignore the second battery.



MFD. BY GENERAL MOTORS CORPORATION

2/86

	GVWR	GAWR FRT	GAWR RR
LB/kg	4649/2109	2100/953	2600/[illegible]80
TIRES		P195/75R15	P[illegible]/75R15
RIMS		15 X 6 JJ	15 X 6 JJ
PSI/kPa Cold		35/241	35/241

SPARE TIRE T155/90D16 — INFLATION PRESSURE COLD [illegible]0/414 — SPARE WHEEL 16 X 4T

THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR VEHICLE SAFETY STANDARDS IN EFFECT ON THE DATE OF MANUFACTURE SHOWN ABOVE.
1[illegible]80C100001 MPV

THIS VEHICLE EQUIPPED FOR 1000/453 LBS. PAYLOAD

SEE OWNER'S MANUAL FOR ADDITIONAL INFORMATION

PART NO. 15596025 PRINTED IN U.S.A. 31MR83

EXAMPLE

F-00597

Figure 4—Certification Label

NOTICE: Do not push or tow this vehicle to start it. Under some conditions this may damage the catalytic converter or other parts of the vehicle. Also, since this vehicle has a 12 volt battery, be sure the vehicle or equipment used to jump start your engine is also 12 volt. Use of any other type system may damage the vehicle's electrical components.

At low temperatures, it may not be possible to start your diesel engine from a single battery in another vehicle. However, you can use your vehicle to jump start another vehicle.

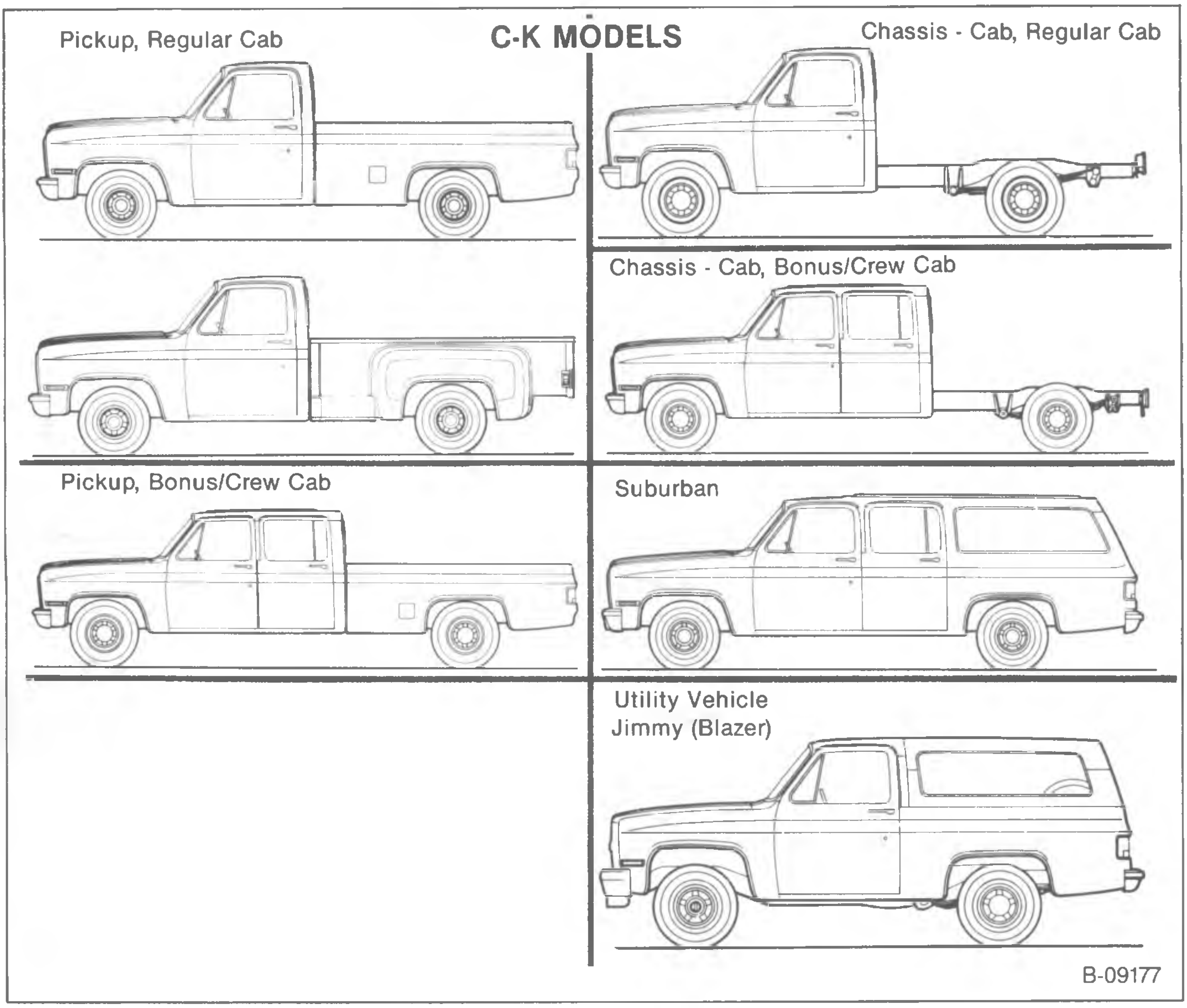


Figure 5 C-K Models

JUMP STARTING INSTRUCTIONS

> **CAUTION: Batteries produce explosive gases, contain corrosive acid, and supply levels of electrical current high enough to cause burns. Therefore, to reduce the risk of personal injury when working near a battery:**
>
> - **Always shield your eyes and avoid leaning over the battery whenever possible.**
> - **Do not expose the battery to open flames or sparks.**
> - **Be sure any batteries that have filler caps are properly filled with fluid.**
> - **Do not allow battery acid to contact eyes of skin. Flush any contacted area with water immediately and throughly, and get medical help.**
> - **Follow each step in the jump starting instructions.**

1. Position the vehicle with the good (charged) battery so that the booster (jumper) cables will reach, but never let the vehicles touch. Also, be sure booster cables do not have loose or missing insulation.

2. In both vehicles:

   - Turn off the ignition and all lights and accessories except the hazard flasher or any lights needed for the work area.

   - Apply the parking brake firmly, and shift the automatic transmission to Park (or manual transmission to Neutral).

3. Making sure the cable clamps do not touch any other metal parts, clamp one end of the first booster cable to the positive (+) terminal on one battery, and the other end to the positive terminal on the other battery (figure 8). Never connect (+) to (-).

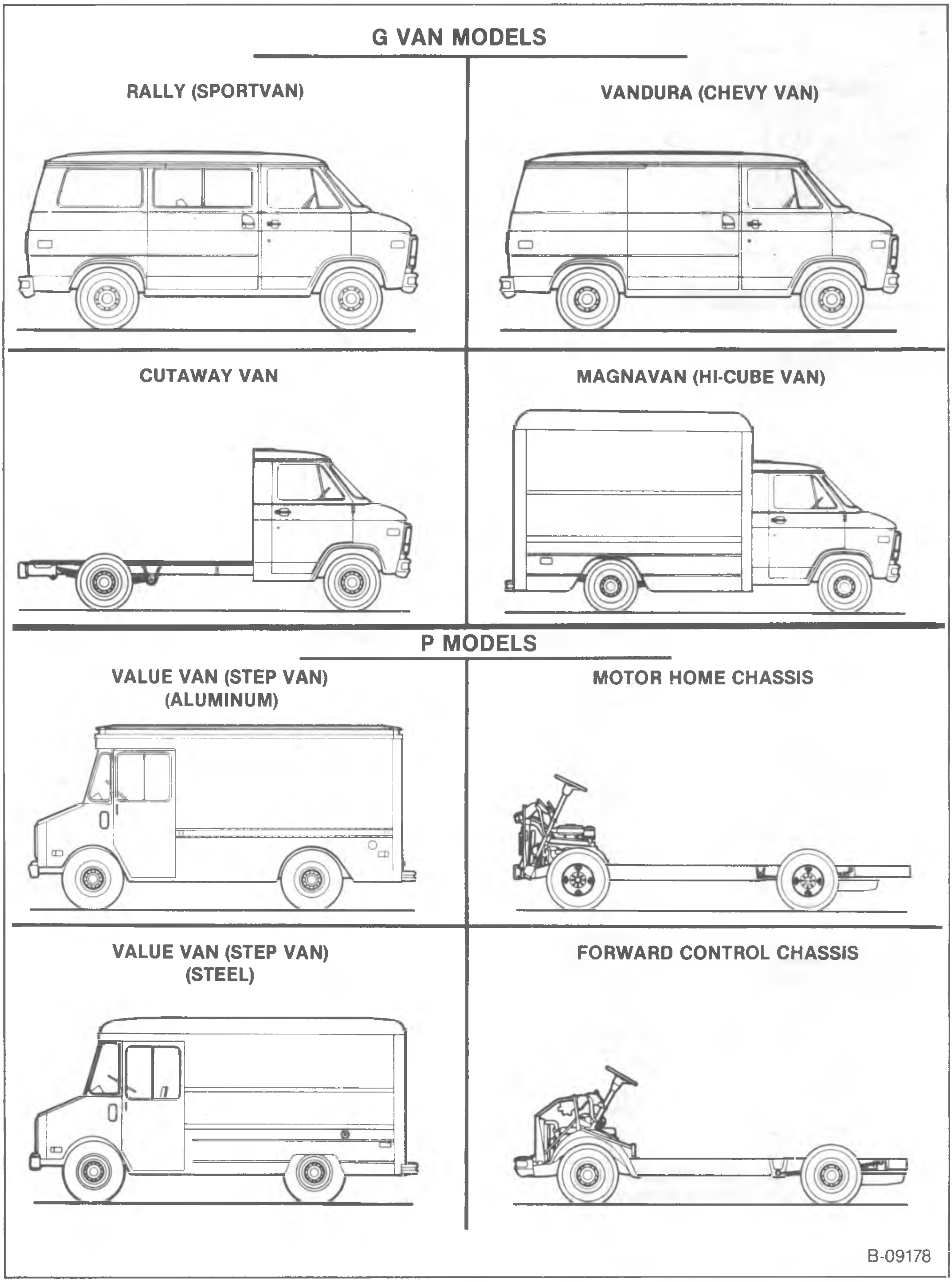
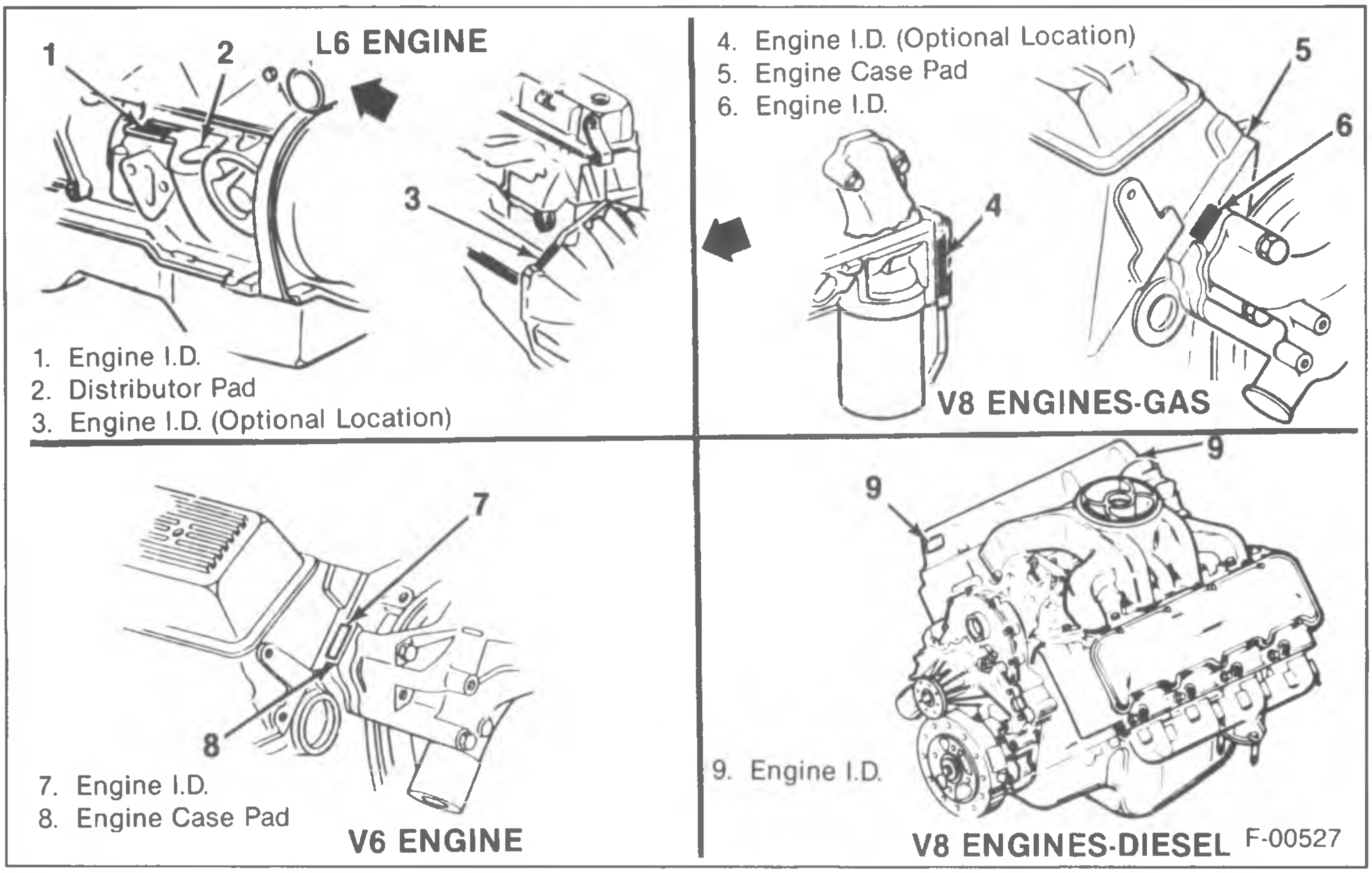


Figure 6—G Van and P Models



1. Engine I.D.
2. Distributor Pad
3. Engine I.D. (Optional Location)
4. Engine I.D. (Optional Location)
5. Engine Case Pad
6. Engine I.D.
7. Engine I.D.
8. Engine Case Pad
9. Engine I.D.

Figure 7—Engine I.D. Number Location

4. Clamp one end of the second cable to the negative (-) terminal of the good (charged) battery and make the final connection to a heavy metal bracket (such as the mounting bracket for the generator or air conditioner compressor if so equipped) on the engine about 450 millimeters (18 inches) from the discharged battery. Make sure the cables are not on or near pulleys, fans, or other parts that will move when the engine is started.

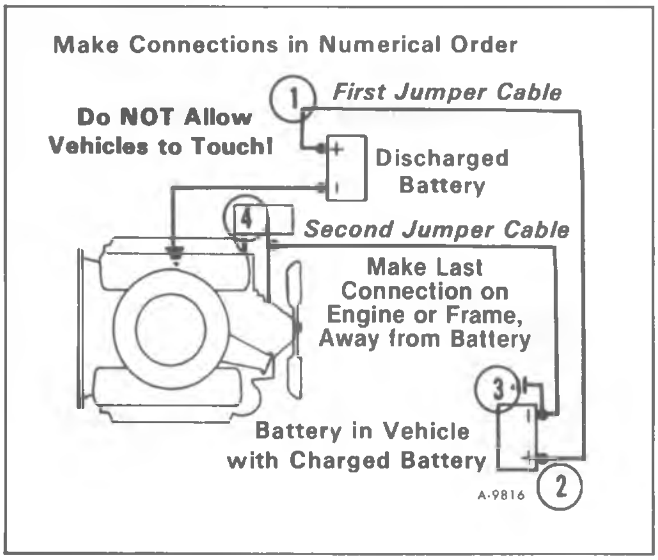


Figure 8—Jump Starting Connections

5. Start the engine of the vehicle with the good (charged) battery and run the engine at a moderate speed for several minutes. Then, start the engine of the vehicle that has the discharged battery.
6. Remove the booster cables by reversing the above installation sequence exactly. While removing each clamp, take care it does not touch any other metal while the other end remains attached.

GRAPHIC SYMBOLS

Graphic symbols are used on some controls and displays on the vehicle (figure 9). Many of these symbols are used internationally.

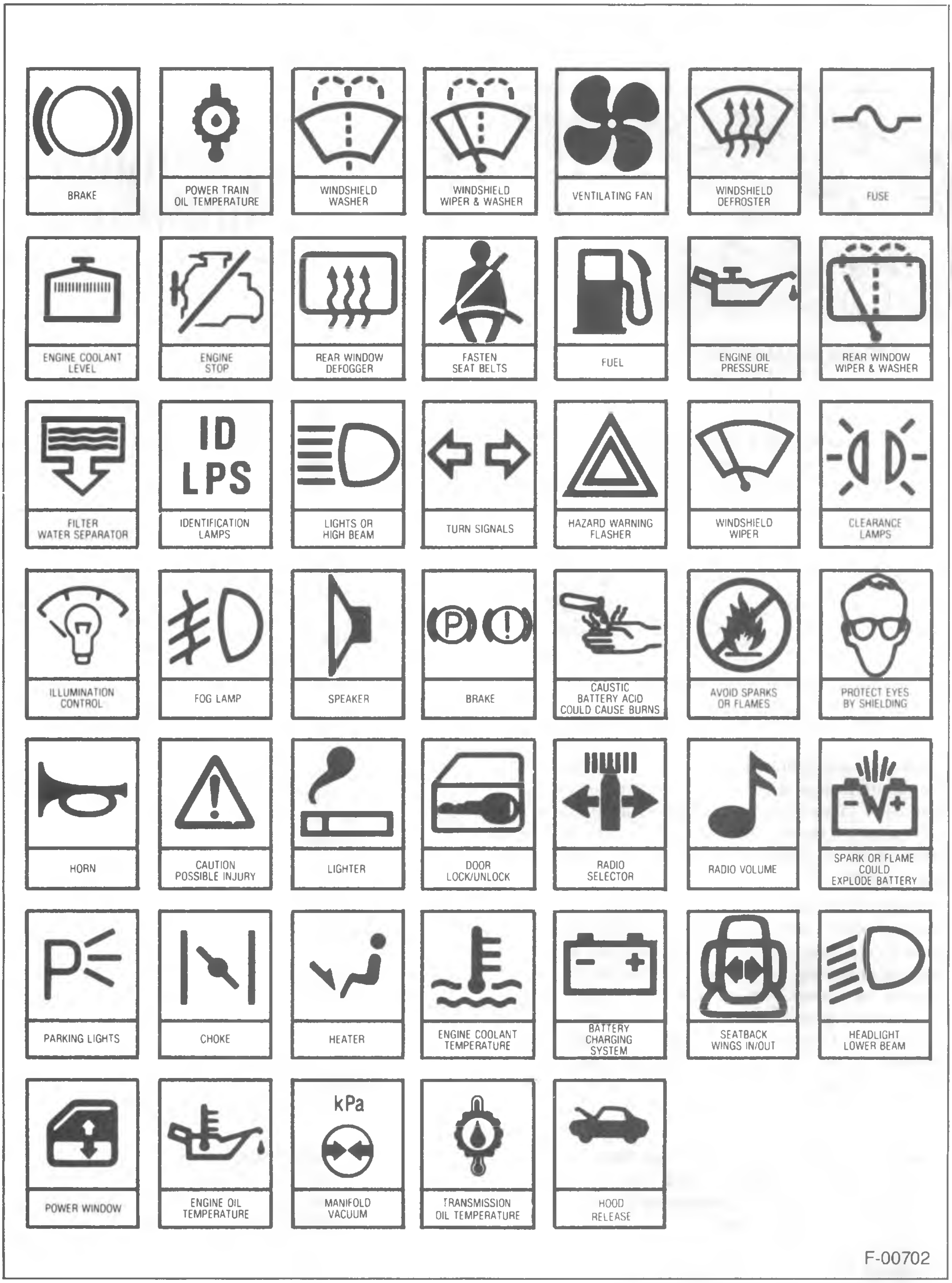
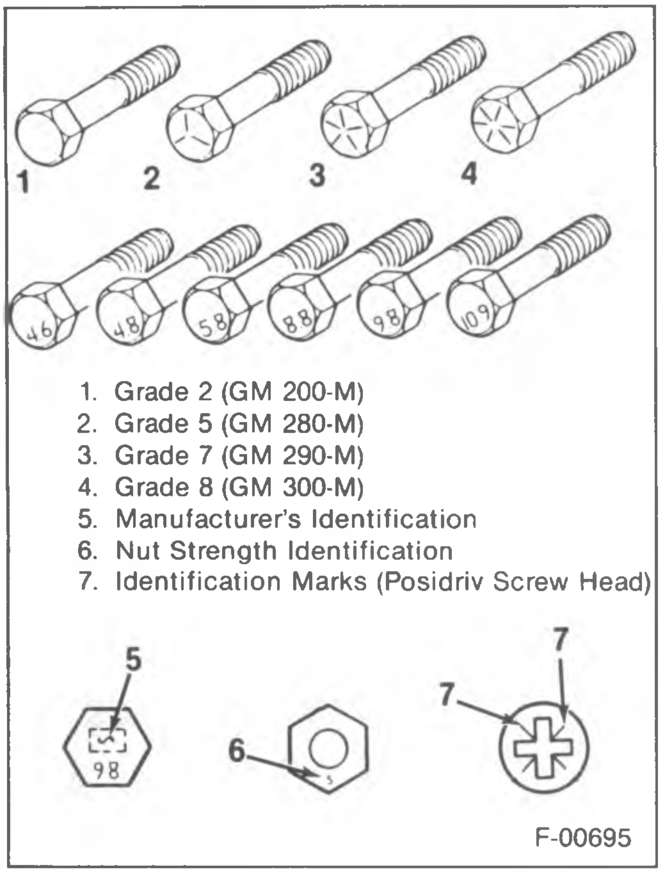


Figure 9—Graphic Symbols

METRIC FASTENERS



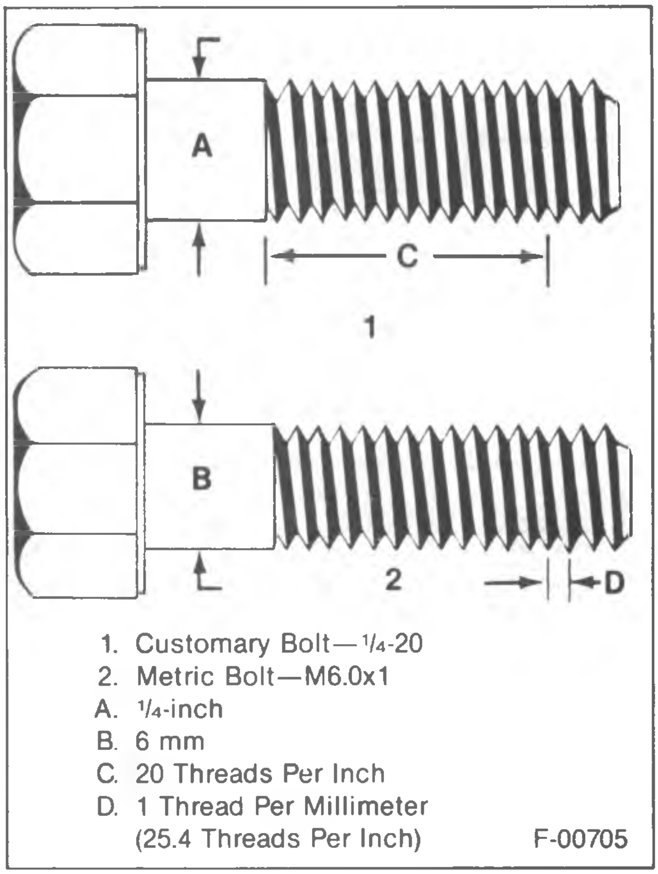
1. Grade 2 (GM 200-M)
2. Grade 5 (GM 280-M)
3. Grade 7 (GM 290-M)
4. Grade 8 (GM 300-M)
5. Manufacturer's Identification
6. Nut Strength Identification
7. Identification Marks (Posidriv Screw Head)

Figure 10—Bolt and Nut Identification

Models are primarily dimensioned in the metric system. Many 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 marking indicating the strength of the material in the fastener as outlined later. Metric cross recess screws are identified by a Posidriv or Type 1A shown in figure 10. 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 positive identification as some fasteners are not color coated.



1. Customary Bolt—1/4-20
2. Metric Bolt—M6.0x1

A. 1/4-inch
B. 6 mm
C. 20 Threads Per Inch
D. 1 Thread Per Millimeter (25.4 Threads Per Inch)

Figure 11—Thread Notation

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 M6.0X1 screw which has nearly the same diameter and has 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 11.

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. Markings correspond to two lines less than the actual grade (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 likewise important to select replacement fasteners of the correct size. Correct replacement bolts metric fasteners available in the aftermarket parts channels were designed to metric standards of countries other than the United States, and may be of a lower strength, may not have the numbered head marking system, and may be of a different thread pitch. The metric fasteners used on GM products are designed to new, international standards that may not yet be manufactured by some non-domestic bolt and nut suppliers. In general, except for special applicaitons, the common sizes and pitches are:

M6.0 x 1
M 8 x 1.25
M 10 x 1.5
M 12 x 1.75

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 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 (figure 12).

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 (figure 12).

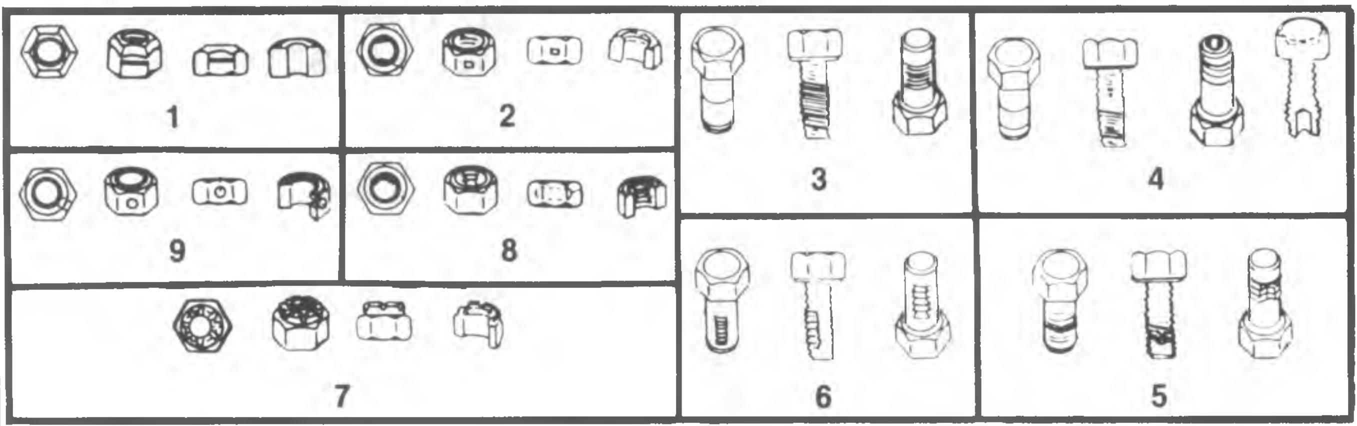
RECOMMENDATIONS FOR REUSE:

1. Clean, unrusted prevailing torque nuts and bolts may be reused as follows:
    a. Clean dirt and other foreign material off the nut or bolt.
    b. Inspect the 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 or equal or greater strength).
    c. Assemble the parts and hand start the 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 the fastener to the torque specified in the appropriate section of this manual.
2. Bolts and nuts which are rusty or damaged should be replaced with new parts or equal or greater strength.

SIX LOBED SOCKET HEAD FASTENERS

Six lobed socket head (Torx) fasteners are used in some applications on vehicles covered in this manual (figure 13). The door striker bolt is of this design.

Tools designed for these fasteners are available commercially. However, in some cases, if the correct tool is not available, a hex socket head wrench may be used.



A							
		6 & 6.3	8	10	12	14	16	20
4, 5	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
1, 2, 3, 6, 7, 8, 9	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

B									
		.250	.312	.375	.437	.500	.562	.625	.750
4, 5	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
1, 2, 3, 6, 8, 9	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

A. Metric Sizes
B. Inch Sizes

1. Top Lock Type
2. Center Lock
3. Dry Adhesive Coating
4. Out Of Round Thread
5. Deformed Thread Profile
6. Nylon Strip Or Patch
7. Nylon Washer Insert
8. Nylon Patch
9. Nylon Insert

B-02406

Figure 12—Torque Nuts and Bolts Chart

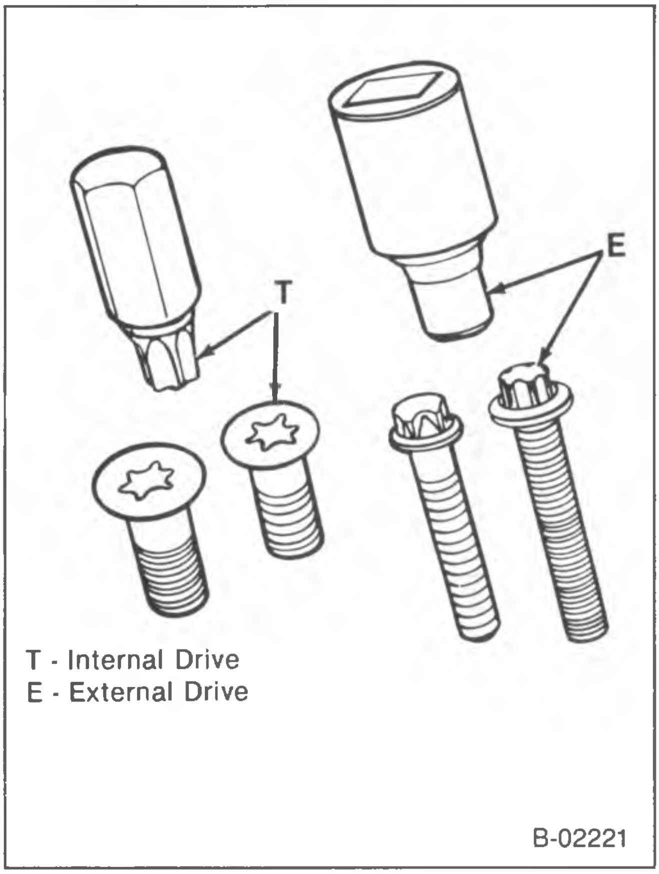


Figure 13—Six Lobed Socket Head (Torx) Fasteners

CONVERSION TABLE

Multiply	by	to get equivalent number of:
	LENGTH	
Inch	25.4	millimeters (mm)
Foot	0.304 8	meters (m)
Yard	0.914 4	meters
Mile	1.609	kilometers (km)
	AREA	
Inch^2	645.2	millimeters^2 (mm^2)
	6.45	centimeters^2 (cm^2)
Foot^2	0.092 9	meters^2 (m^2)
Yard^2	0.836 1	meters^2
	VOLUME	
Inch^3	16.387	mm^3
	16.387	cm^3
	0.016 4	liters (l)
Quart 0.946 4	liters	
Gallon	3.785 4	liters
Yard^3	0.764 6	meters^3 (m^3)
	MASS	
Pound	0.453 6	kilograms (kg)
Ton	907.18	kilograms (kg)
Ton	0.907	tonne (t)
	FORCE	
Kilogram	9.807	newtons (N)
Ounce	0.278 0	newtons
Pound	4.448	newtons
	TEMPERATURE	
Degree Fahrenheit	(†°F-32) ÷ 1.8	degree Celsius (C)

Multiply	by	to get equivalent number of:
	ACCELERATION	
Foot/sec^2	0.304 8	meter/sec^2 (m/s^2)
Inch/sec^2	0.025 4	meter/sec^2
	TORQUE	
Pound-inch	0.112 98	newton-meters (N·m)
Pound-foot	1.355 8	newton-meters
	POWER	
Horsepower	0.746	kilowatts (kW)
	PRESSURE OR STRESS	
Inches of water	0.249 1	kilopascals (kPa)
Pounds/sq. in.	6.895	kilopascals
	ENERGY OR WORK	
BTU	1 055	joules (J)
Foot-pound	1.355 8	joules
Kilowatt-hour	3 600 000 or 3.6 x 10^6	joules (J \$ one W)
	LIGHT	
Foot candle	1.076 4	lumens/meter^2 (lm/m^2)
	FUEL PERFORMANCE	
Miles/gal	0.425 1	kilometers/liter (km/l)
Gal/mile	2.352 7	liter/kilometer (l/km)
	VELOCITY	
Miles/hour	1.609 3	kilometers/hr. (km/h)

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	6.3500	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

B-05496

Decimal and Metric Equivalents

RPO LISTING (REGULAR PRODUCTION OPTION)

The RPO list contains RPOs used on C-K Models, G Vans, and Forward Control Chassis Models. Refer to the Service Parts Identification Label for a list of the RPOs used on each specific vehicle.

AA3 Windows - Deep Tint, Side Windows Only
AC2 Window - Sliding, Right Front Door
AD5 Window - Right Rear, Side, Sliding
AD8 Door Check
AJ1 Window - Deep Tint, Except Windshield and Doors
AM7 Seat - Right Rear Folding
AP7 Partition - Sliding Plywood
AQ3 Seat - Rear Center
AQ4 Seat - Rear
AS1 Seat - Front Bucket, High Back, Driver
AS2 Seat - Front Bucket, High Back, Passenger
AS3 Seat - Right Rear, Suburban
AT5 Seat - Center Folding, Suburban
AU2 Lock - Cargo Door
AU3 Power Lock - Side Door
AU6 Power Lock - Tailgate Remote Control
AV5 Seat - High Back, Bucket
AW4 Door - Sliding Side Extension
AX5 Partition - Expanded Metal, Left Side
AX6 Partition - Expanded Metal w/Sliding Door
AX7 Partition - Expanded Metal w/Center Sliding Door
AX8 Seat - Front Bucket, Pedestal, Driver
AX9 Latch - Rear Cargo Door
A01 Window - Tinted, All Shaded Windshield
A02 Windshield - Tinted, Shaded Upper
A07 Window - Body
A08 Window - Body, Right Side
A12 Window - Stationary, Back Door
A13 Window - Stationary, Side Rear Door
A17 Window - Left Side Swing-Out
A18 Window - Rear Door, Swing-Out
A19 Glass - Side Rear Door, Swing-Out
A28 Window - Right Rear, Full Width, Sliding
A31 Window - Side, Power
A33 Window - Tailgate, Power
A51 Seat - Front Bucket
A52 Seat - Front Bench
A57 Seat - Auxillary, One Passenger, Folding
A82 Head Restraints
A95 Seat - Front Bucket, High Back, Reclining
BA8 Compartment - Front Seat Storage
BB5 Ornamentation
BF3 Floor Covering - Step Well Mat
BW2 Ornamentation - Deluxe Body Side Molding
B3D School Bus Equipment
B3J Diesel Equipment
B3M School Bus Equipment - Deluxe
B30 Floor Carpet
B32 Floor Mats - Front
B33 Floor Mats - Rear
B84 Extra Molding - Body Side
B85 Extra Molding - Belt Reveal
B93 Extra Molding - Door Edge Guard
B96 Extra Molding - Wheel Opening
CD4 Wiper System - Pulse
C36 Heater - Auxillary
C42 Heater - Deluxe Outside Air
C49 Defogger - Rear Window, Electric
C55 Vent - Roof
C56 Vent - Forced Air, Right Side
C60 Air Conditioning - Front Manual Controls
C69 Air Conditioner - Roof Mounted
C91 Lamp - Interior Courtesy
DF1 Mirror - Camper Type, Painted
DF2 Mirror - Camper Type, SST
DG5 Mirror - West Coast Type
D20 Sunshade - Windshield, Passenger Side
D31 Mirror - Tilt
D34 Mirror - Visor Vanity
D44 Mirror - Outside, Painted
D45 Mirror - Outside, SST
D46 Mirror - West Coast Type with Clearance Lights
D49 Mirror - Chrome
D73 Pickup Box Hand Rail
D77 Mirror - Dual, Wide Angle, SST
D92 Stripe - Lower Decor
E24 Door - Cargo Side, Hinged
E31 Body - Steel ,10 ft.
E32 Body - Forward Control, Var. 3
E33 Body - Forward Control, Var. 4
E34 Body - Steel, 10 ft. Standard Width
E36 Body - Aluminum, 10 ft.
E38 Body - Steel, 12 ft. x 8 ft.
E39 Body - Aluminum, 12 ft. x 8 ft.
E46 Door - 66 in., Overhead Sliding w/Window
E52 Door - 83 in., Wrap-Around
E53 Door - 87 in., Wrap-Around
E71 Cargo Floor - Steel
E76 Door - 60 in., Rear
E79 Door - 74 in., Rear, Strap Hinges
E62 Pickup Box - Stepside (Fenderside)
E94 Rally (Beauville) Equipment
E63 Pickup Box - Fleetside (Wideside)
E89 Panel - Driver Door w/Window
FS3 Axle - Front I-Beam
F51 Shock Absorbers - Front and Rear, Heavy Duty
F58 Stabilizer Shaft - Front, Heavy Duty
F59 Stabilizer Shaft - Front
F60 Spring - Front, Heavy Duty
F66 Suspension System - Front
G50 Spring - Rear, Heavy Duty

G51	Spring - Rear, Special Heavy
G52	Spring - Rear 15000 lbs.
G60	Spring - Rear Auxiliary
G80	Axle - Rear, Limited Slip
KC4	Engine Oil Cooler System
KL7	Gas Conversion - LP
K05	Engine Block Heater
K09	Generator - 120 Amp
K22	Generator - 94 Amp
K34	Cruise Control
K46	Air Cleaner - Heavy Duty, Pre-Cleaner
K81	Generator - 66 Amp
LB1	Engine - 4.3L V6 4BBL
LE8	Engine -4.7L V8 4BBL
LE9	Engine - 5.0L V8 4BBL, Hi Compression
LF3	Engine - 5.0 V8 4BBL, Regular Compression
LH6	Engine - 6.2L V8, Diesel
LL4	Engine - 6.2L V8, Heavy Duty Diesel
LS9	Engine - 5.7L V8 4BBL
LT9	Engine - 5.7L V8 4BBL, Heavy Duty
L25	Engine - 4.8L V6 1BBL
MV4	Transmission - Auto. 3-Speed Clutch Converter
MY6	Transmission - Manual 4-Speed w/Overdrive
NA5	Emission System - Federal Requirements
NA6	Emission System - High Altitude Requirements
NE2	Fuel Tank - 40 gal.
NK7	Fuel Tank - 31 gal.
NL2	Fuel Tank - Auxiliary
NL7	Fuel Tank - 33 gal.
NM5	Emission system - Canadian Requirement
NN4	Fuel Tank - 60 gal.
NY1	Fuel Tank Shield
N05	Fuel Filler Cap Lock
N31	Steering Wheel - Custom
N33	Steering Column - Tilt
N40	Steering - Non-Variable
N41	Steering - Power
N51	Steering - Manual
N67	Wheel - Rally Type
N90	Wheel - Aluminum Cast
PA1	Wheel - Trim Discs, Var. 5
PA6	Wheel - Styled, Painted
P01	Wheel - Trim Discs, Var. 1
P10	Carrier - Spare Tire
P11	Carrier - Spare Tire, Glide Out
P13	Carrier - Spare Tire, Side-Mounted
P14	Carrier - Inside Mounted Spare Tire, Left Side
P15	Carrier - Inside Mounted Spare Tire, Right Side
P17	Cover - Spare Wheel/Tire
R05	Wheel Conversion - Dual Rear
TP2	Battery - Auxiliary Camper
TR9	Lamp Group
TT4	Headlamps - Halogen, Pencil Beam
TT5	Headlamps - Halogen
TVR	Lamp - Rear Dome and Reading
T63	Headlamps - Warning System
T84	Headlamps - Right Rule
T85	Headlamps - Left Rule
UA1	Battery - High Capacity
UB4	Lamps - Rear Side Marker
UD4	Alarm - Vehicle Speed
UF2	Lamp - Cargo
UJ1	Indicator System, Brake Warning
UM6	Radio - AM/FM Stereo, Seek/Scan, Cassette, Clock
UN3	Radio - AM/FM Stereo, Cassette
UY7	Wiring Harness - Truck Trailer, Heavy Duty
U01	Lamp - Roof Marker
U18	Speedometer - Kilometer
U35	Electric Clock
U37	Cigarette Lighter
U58	Radio - AM/FM Stereo
U63	Radio - AM
U66	Speaker System - Dual Front, Dual Rear
U69	Radio - AM/FM
U76	Antenna - Windshield
VE5	Bumper - Front and Rear Impact Strip
VF1	Bumper - Rear Chrome
VR2	Trailer Hitch
VR4	Trailer Hitch - Weight Distributing
V01	Radiator - Heavy Duty
V02	Radiator - Heavy Duty w/Trans. Oil Cooler
V05	Increased Cooling
V22	Radiator Grille - Chrome
V31	Bumper Guards - Front, Chrome
V35	Bumper, Rear w/Recessed Lighting
V37	Bumper - Front and Rear Chrome
V42	Bumper - Rear Step, Chrome
V43	Bumper - Rear Step, Painted
V46	Bumper - Front, Chrome
V76	Front Hook Towing Device
X6W	Hub - Locking
YE9	Equipment Package, Level 3
YG1	Molding, Body Side and Wheel Opening
YJ6	Decor Package - Econo
ZM2	Trim Package, Bonaventure
ZW9	Base Body or Chassis
ZY1	Color Combination - Solid
ZY2	Color Combination - Two Tone
ZY4	Color Combination - Deluxe Two Tone
Z53	Guage Package - Voltmeter, Oil Press. and Temp.
Z62	Equipment Package - Level 1
Z72	Trailering Package - L.D. Ball-Type Hitch
Z73	Trim - Special Interior
Z75	Shock Absorbers - Four Front
Z76	Special Chassis - Camper Package
Z80	Trim - Special Exterior
Z81	Camper - Special
Z82	Trailer Hitch - Special Reese Type
12A	Stripe Accent - White
12K	Color Combination - White (Auxiliary Top)
12L	Secondary Color - White
12U	Primary Color - White
18C	Trim Combination - Charcoal, Stnd. Cloth
18D	Trim Combination - Charcoal, Velour Cloth
18I	Interior Trim - Charcoal

18V	Trim Combination - Charcoal, Vinyl Striped
18W	Trim Combination - Charcoal, Dual Grain Vinyl
19A	Stripe Accent - Black and Grey Two Tone
19I	Interior Trim - Black
19K	Color Combination - Black (Auxiliary Top)
19L	Secondary Color - Black
19U	Primary Color - Black
19W	Trim Combination - Black, Dual Grain Vinyl
21L	Secondary Color - Lt. Blue Metallic
21U	Primary Color - Lt. Blue Metallic
23D	Trim Combination - Blue, Velour Cloth
23G	Trim Combination - Blue Cloth
23I	Interior Trim - Blue Vinyl
23V	Trim Combination - Blue Vinyl, Striped
23W	Trim Combination - Blue Dual Grain Vinyl
28L	Secondary Color - Dk. Blue Metallic
28U	Primary Color - Dk. Blue Metallic
29A	Stripe Accent - Dk. and Lt. Blue
29K	Color Combination - Dk. Blue (Auxiliary Top)
29L	Secondary Color - Dk. Blue
29U	Primary Color - Dk. Blue
55L	Second Color - Russet Metallic
55U	Primary Color - Russet Metallic
61K	Color Combination - Tan (Auxiliary Top)
61L	Secondary Color - Tan
61U	Primary Color - Tan
62C	Trim Combination - Lt. Saddle, Stnd. Cloth
62D	Trim Combination - Lt. Saddle, Velour Cloth
62G	Trim Combination - Saddle Cloth
62I	Interior Trim - Lt. Saddle
62V	Trim Combination - Lt. Saddle Vinyl, Striped
62W	Trim Combination - Lt. Saddle, Dual Grain Vinyl
66K	Color Combination - Dk. Brown
66L	Secondary Color - Dk. Brown Metallic
66U	Primary Color - Dk. Brown Metallic
67L	Secondary Color - Lt. Saddle Metallic
67U	Primary Color - Lt. Saddle Metallic
72A	Stripe Accent - Bright Red
72L	Secondary Color - Bright Red
72U	Primary Color - Bright Red
76C	Trim Combination - Bronze, Stnd. Cloth
76D	Trim Combination - Bronze, Velour Cloth
76G	Trim Combination - Dk. Claret and Gold, Garnet Red
76I	Interior Trim - Bronze
76V	Trim Combination - Bronze, Striped Vinyl
76W	Trim Combination - Bronze, Dual Grain Vinyl
77C	Trim Combination - Dk. Maple, Stnd. Cloth
77D	Trim Combination - Dk. Maple, Velour Cloth
77G	Trim Combination - Dk. Maple Cloth
77I	Interior Trim - Dk. Maple
77V	Trim Combination - Dk. Maple, Striped Vinyl
77W	Trim Combination - Dk. Maple, Dual Grain Vinyl
78U	Primary Color - Med. Rosewood Metallic
82D	Trim Combination - Med. Dk. Grey Velour Cloth
82G	Trim Combination - Med. Dk. Grey Cloth
82I	Interior Trim - Med. Dk. Grey
82W	Trim Combination - Dk. Grey, Dual Grain Vinyl
90K	Color Combination - Med. Grey (Auxiliary Top)
90L	Secondary Color - Grey Metallic
90U	Primary Color - Grey Metallic
93U	Primary Color - Lt. Driftwood Pearlmist
9V8	Color Combination - Cardinal Red

SECTION 0B

MAINTENANCE AND LUBRICATION

CONTENTS

SUBJECT **PAGE**

CAPACITIES

Figures 2 through 6 show the approximate capacities of the differential gear, the transmission, the cooling system, the crankcase, the fuel tank, the front axle and the transfer case. Engine code letters are used in the charts. Refer to figure 1 for an explanation of the code.

VIN	ENGINE DESCRIPTION			Produced
Engine Code	Liter Displacement	Type	Fuel System	in GM Plant Operated By:
N	4.3	V6	4 BBL	Chevrolet Motor
F	5.0	V8	4 BBL	Chevrolet Motor
H	5.0	V8	4 BBL	Chevrolet Motor*
L	5.7	V8	4 BBL	Chevrolet Motor
M	5.7	V8	4 BBL	Chevrolet Motor
W	7.4	V8	4 BBL	Chevrolet Motor
T	4.8	L6	1 BBL	†
C	6.2	V8	F.I. @	Det. Diesel Allison
J	6.2	V8	F.I. @	Det. Diesel Allison

* or General Motors of Canada
† Produced in Mexico by General Motors de Mexico
@ Diesel

Figure 1-1986 Engine Code Identification

Items	Metric Measure	U.S. Measure
Differential		
8½" Ring Gear	2.0 L	4.2 pts.
9½" Ring Gear	3.1 L	6.5 pts.
10½" Ring Gear (Chev.)	3.1 L	6½ pts.
9¾" Ring Gear (Dana)	2.8 L	6.0 pts.
12 Ring Gear (Rockwell)	5.9 L	12.5 pts.
Transmission		
Automatic		
350C — Pan Removal	3.3 L	6.3 pts.
Overhaul	9.5 L	20.0 pts.
400 — Pan Removal	4.0 L	9.0 pts.
Overhaul	10.0 L	22.0 pts.
700-R4 — Pan Removal	4.7 L	10.0 pts.
Overhaul	10.9 L	23.0 pts.
Manual		
4 Speed 117 mm	4.0 L	4.2 qts.
4 Speed 89 mm	4.0 L	4.2 qts.
3 Speed 76 mm	1.5 L	1.6 qts.

Figure 2—Approximate Capacities - All Models

Items	Metric Measure	U.S. Measure
Cooling System (Approx.)▲		
Code: H, L, M		
Without A/C	16.5 Liters	17.5 Quarts
With A/C	17 Liters	18 Quarts
Code: W		
Without A/C	22 Liters	23 Quarts
With A/C	23 Liters	24.5 Quarts
Diesel Engines		
Code: C, J		
With or Without A/C	23 Liters	25 Quarts
Crankcase•		
Gasoline Engines		
Code: H, L and M		
Without Filter	3.8 Liters	4 Quarts
With Filter	4.8 Liters	5 Quarts
Code: W +		
Without Filter	5.7 Liters	6 Quarts
With Filter	6.5 Liters	7 Quarts
Diesel Engines†		
Code: C, J With Filter	6.5 Liters	7 Quarts
Fuel Tank		
Standard, All — Gas	95 Liters	25 Gallons
— Diesel	102 Liters	27 Gallons
NK7 Option, All — Gas	117 Liters	31 Gallons
— Diesel	121 Liters	32 Gallons
NE2 Option, Suburban Only		
— Gas	151 Liters	40 Gallons
— Diesel	155 Liters	41 Gallons
Front Axle		
K15/10-K25/20	1.9 Liters	2 Quarts
K35/30	2.8 Liters	3 Quarts
Transfer Case	4.8 Liters	5.0 Quarts

• After refill, fluid level must be checked as outlined under "Service and Maintenance" in Section 5 of the owner's manual.

\+ K35/30 Models — 5 U.S. quarts (4.8 Liters) Without Filter.
6 U.S. Quarts (5.7 Liters) With Filter.

† Oil filter should be changed at EVERY oil change.

▲ Equipped with Auxiliary Heater add 2.68L/2.84 Qts.

Figure 3—Approximate Capacities - Blazer, Suburban

Items	Metric Measure	U.S. Measure
Cooling System (approx.)		
4.8L (L6) Engine Code (T)		
P30042 Models	13.1 Liters	13.8 Quarts
With or Without A/C		
5.7L (V8) Engine Code (M)		
P30042 Models	14.6 Liters	15.5 Quarts
With or Without A/C		
7.4 L (V8) Engine Code (W)		
P30032 Models	21.2 Liters	22.5 Quarts
Without A/C		
6.2L (V8) Diesel Engine Code (J)		
P30042 Models	23.5 Liters	25 Quarts
With or Without A/C		
P30032 Models	23.4 Liters	24.7 Quarts
Without A/C		
Crankcase (approx.)*		
Engine Code: M		
Without Filter	3.8 Liters	4 Quarts
With Filter	4.8 Liters	5 Quarts
Engine Code: T		
Without Filter	4.8 Liters	5 Quarts
With Filter	5.7 Liters	6 Quarts
Engine Code: W		
Without Filter	5.7 Liters	6 Quarts
With Filter	6.5 Liters	7 Quarts
Engine Code: J (Diesel)†		
With Filter	6.5 Liters	7 Quarts
Fuel Tank Data		
P25-35	114 Liters	30 Gallons
P30042 (School Bus)	114 Liters	30 Gallons
P30032 (Motor Home)•	114 Liters	30 Gallons

* After refill, fluid level should be checked as outlined under "Service and Maintenance" Section 5 of the owner's manual.

† Oil Filter should be changed at EVERY oil change.

• Optional 60 gallon fuel tank available.

Figure 4—Approximate Capacities - Forward Control

ITEMS	Metric Measure	U.S. Measure
Cooling System (Approx.)		
Code N-V6		
With or Without A/C	10.3 Liters	10.9 Quarts
Code T-L-6		
Without A/C	14.7 Liters	15.5 Quarts
With A/C	15.1 Liters	16 Quarts
Code F, H, L & M — V-8		
Without A/C	16.6 Liters	17.5 Quarts
With A/C	17 Liters	18 Quarts
Code W — V-8		
Without A/C	22 Liters	23 Quarts
With A/C	23 Liters	24.5 Quarts
Diesel		
With or Without A/C	23 Liters	25 Quarts
Crankcase▲		
Gasoline Engines		
Codes: N, F, H, L, M		
Without Filter	3.8 Liters	4 Quarts
With Filter	4.8 Liters	5 Quarts
Code: T		
Without Filter	4.8 Liters	5 Quarts
With Filter	5.7 Liters	6 Quarts
Code: W +		
Without Filter	5.7 Liters	6 Quarts
With Filter	6.5 Liters	7 Quarts
Diesel Engines Code C, J †	6.5 Liters	7 Quarts
Fuel Tank (Approx.)		
Short Bed —		
Single Tank, Gas, Diesel	61 Liters	16 Gallons
*Dual Tanks, Gas, Diesel	61 Liters	16 Gallons
Long Bed —		
Single Tank, Gas	76 Liters	20 Gallons
@*Dual Tanks, Gas	61 Liters	16 Gallons
Single Tank, Diesel	76 Liters	20 Gallons
*Dual Tanks, Diesel	76 Liters	20 Gallons
Front Axle		
K15/10-K25/20	1.9 Liters	2 Quarts
K35/30	2.8 Liters	3 Quarts
Transfer Case		
K15/10-K25/20	4.8 Liters	5 Quarts
K35/30	2.4 Liters	2.5 Quarts

▲After refill, fluid level must be checked as outlined under "Service and Maintenance" in Section 5 of the owner's manual.

\+ K30/35 Models — 5 U.S. Quarts (4.8 Liters) Without Filter.
6 U.S. Quarts (5.7 Liters) With Filter.

† Oil Filter should be changed at EVERY oil change.

* Listed quantity is for each tank.

@ Above 8600 GVWR — Both tanks 20 gallons (76 Liters)

Figure 5—Approximate Capacities - Pickup Models

ITEMS	METRIC MEASURE	U.S. MEASURE
Cooling System (Approx.)▲		
4.3 L (N) V6 All	10.5 Liters	11.1 Quarts
V8's Except Diesel		
Without A/C	16 Liters	17 Quarts
With A/C	16 Liters	17 Quarts
6.2 L (C) Diesel		
With Automatic or Manual Transmission With or w/0 A/C	23 Liters	24 Quarts
6.2 L (J) Diesel		
With Automatic or Manual Transmission With or w/o A/C	24.2 Liters	25.6 Quarts
Crankcase (Approx.)*		
All Engines Except Diesel		
Without Filter	3.8 Liters	4 Quarts
With Filter	4.8 Liters	5 Quarts
Diesel Engines		
With Filter†	6.5 Liters	7 Quarts
Fuel Tank (Approx.)		
Gasoline and Diesel Engines		
Standard	83 Liters	22 Gallons
Optional	125 Liters	33 Gallons

* After refill, fluid level should be checked as outlined under "Service and Maintenance" Section 5 of the owner's manual.

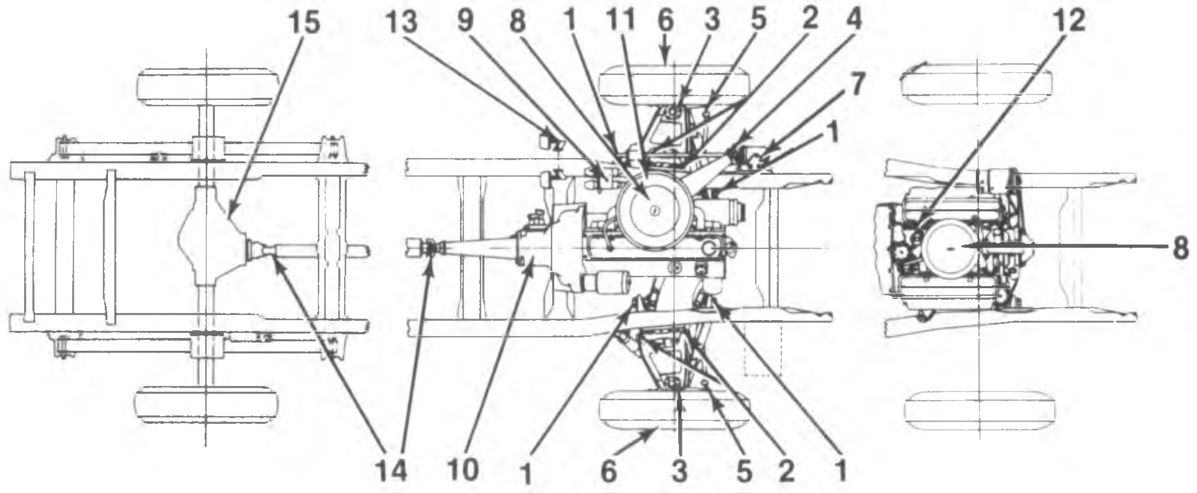
▲ If equipped with Auxiliary Heater add 2.68L/2.84 Qts.

† Oil Filter should be changed at EVERY oil change.

Figure 6—Approximate Capacities - G Van

LUBRICATION

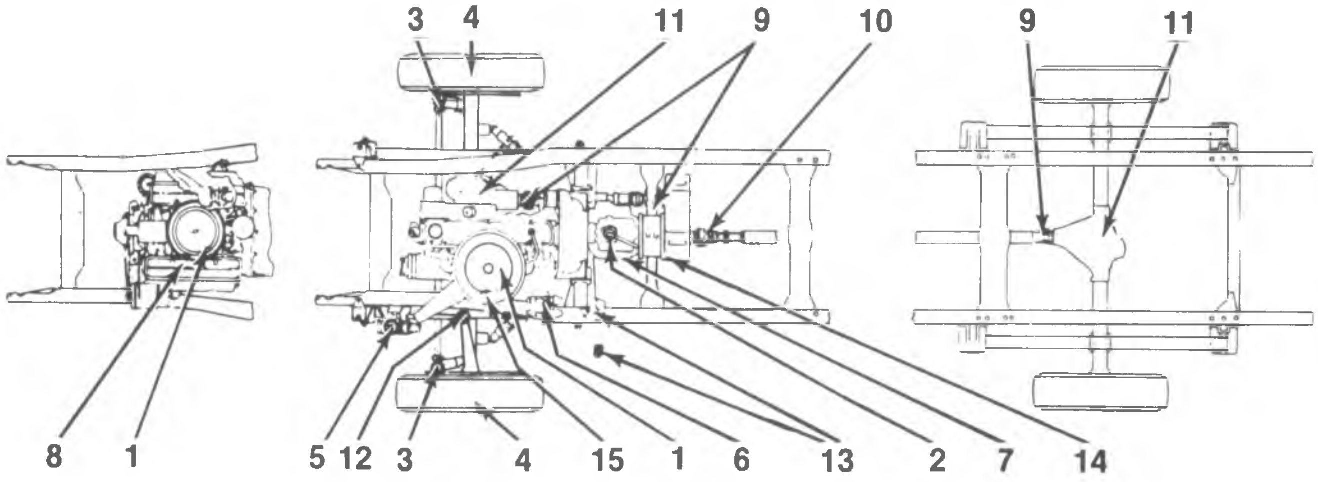
Figures 7, 8 and 9 show chassis lubrication points for the C, K, G and P chassis.



1. Lower Control Arms
2. Upper Control Arms
3. Upper and Lower Control Arm Ball Joints
4. Intermediate Steering Shaft (PA10)
5. Tie Rod Ends
6. Wheel Bearings
7. Steering Gear
8. Air Cleaner - Element
9. Master Cylinder
10. Transmission - Manual
    - Automatic
11. Throttle Bell Crank - L6
12. Carburetor Linkage - V8
13. Brake and Clutch Pedal Springs
14. Universal Joints
15. Rear Axle

F-00433

Figure 7—Lubrication Points For The Conventional And Forward Control Models



1. Air Cleaner
2. Control Linkage Points
3. Tie Rod Ends
4. Wheel Bearings
5. Steering Gear
6. Master Cylinder
7. Transmission - Manual
    - Automatic
8. Carburetor Linkage - V8
9. Universal Joints
10. Propeller Shaft Slip Joints
11. Front and Rear Axle
12. Drag Link
13. Brake and Clutch Pedal Springs
14. Transfer Case
15. Throttle Bell Crank - L6

F-00434

Figure 8—Lubrication Points For The CK Four Wheel Drive Models

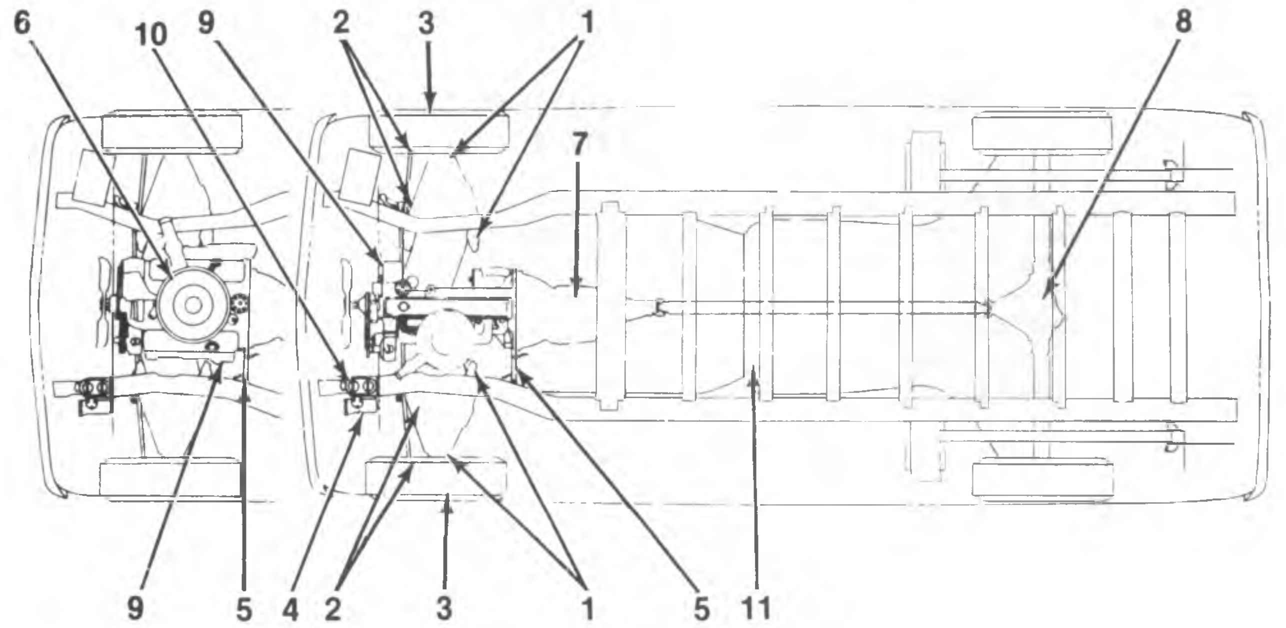


Figure 9—Lubrication Points For The G Van

MAINTENANCE SCHEDULE AND LOG

The information shown on pages 0B-7 through 0B-18 is the same as shown in the 1986 Light Duty Maintenance Schedule and Log.

1986 GENERAL MOTORS LIGHT DUTY TRUCK MAINTENANCE SCHEDULES

This booklet covers the maintenance required for your General Motors vehicle. It is essential that your vehicle receive this maintenance to retain the safety, dependability, and emission control performance originally built into your vehicle.

Maintenance service should be done by your General Motors truck dealer or any other qualified automotive service or repair establishment which is able to provide such services and which can be relied upon to use proper parts and practices.

In addition to the in-shop type services shown in Sections A and B, this booklet also includes owner inspections and services in Section C which you or a qualified technician should perform periodically.

Always keep this booklet in your vehicle, and leave it with the vehicle when sold. The maintenance record, plus maintenance receipts, may be needed for warranty repairs. It is suggested that receipts be kept with this booklet.

SELECTING YOUR VEHICLES MAINTENANCE

DETERMINING GVWR AND EMISSIONS CLASSIFICATION

To determine the emissions classification for gasoline engine equipped vehicles, refer to the certification label located on the edge of the driver's door. If the Gross Vehicle Weight Rating (GVWR) in the upper left corner of the certification label is less than 8600 lbs./3 900 kg, your vehicle is equipped with "Light Duty Emissions"; if 8600 lbs./3 900 kg or more, your vehicle is equipped with "Heavy Duty Emissions".

SELECTING THE PROPER MAINTENANCE CHART

Select the proper maintenance from pages 4 through 11 depending on your vehicle's engine (gas or diesel) and engine emissions classification.

SELECTING THE PROPER MAINTENANCE SCHEDULE

Select and follow either Maintenance Schedule 1 or Maintenance Schedule 2 based on how you use your vehicle.

MAINTENANCE SCHEDULE 1

Follow Maintenance Schedule 1 denoted by a white ○ if you mainly operate your vehicle under one or more of the following conditions:

- When most trips are less than 4 miles (6 kilometers).
- When most trips are less than 10 miles (16 kilometers) and outside temperatures remain below freezing.
- Idling for extended periods and/or low-speed operations such as found in delivery, police, rental or taxi operation.
- Towing a trailer.
- Operating in dusty areas.

MAINTENANCE SCHEDULE 2

Follow Maintenance Schedule 2 denoted by a black ● **only** if none of the driving conditions specified in Maintenance Schedule 1 apply.

SECTION A—SCHEDULED MAINTENANCE SERVICES FOR YOUR 1986 VEHICLE WITH LIGHT DUTY EMISSIONS - UNDER 8600 GVWR

The services shown in this schedule up to 60,000 miles (100 000 km) are to be performed after 60,000 miles (100 000 km) at the same intervals.

○ **Maintenance Schedule 1**
● **Maintenance Schedule 2**

Item No.	Service / Miles (000)	3	6	7.5	9	12	15	18	21	22.5	24	27	30	33	36	37.5	39	42	45	48	51	52.5	54	57	60
	Kilometers (000)	5	10	12.5	15	20	25	30	35	37.5	40	45	50	55	60	62.5	65	70	75	80	85	87.5	90	95	100
1	Engine Oil Change *	○	○	●	○	○	○●	○	○	●	○	○	○●	○	○	●	○	○	○●	○	○	●	○	○	○●
	Oil Filter Change *	○	○	●	○	○	○	○	○	●	○	○	○	○	○	●	○	○	○	○	○	●	○	○	○
2	Chassis Lubrication *	○	○	●	○	○	○●	○	○	●	○	○	○●	○	○	●	○	○	○●	○	○	●	○	○	○●
3	Engine Idle Speed Adjustment * [1] – At 6 Months or		○[2]	●[2]									○[1]												●[1]
4	Cooling System Service * — Every 24 Months or												○●												○●
5	Air Cleaner Element and PCV Filter Replacement *												○●[2]												○●
6	Front Wheel Bearing Repack						○						○●						○						○●
7	Transmission Service - See Explanation for Service Intervals in Section B																								
8	PCV System Inspection *												○●												○●
9	Fuel Filter Replacement *						○[1]						○●[1]						○[1]						○●
10	Carburetor Choke and Hoses Inspection * [1] – At 6 Months or		○	●									○●[2]						○						●
11	Carburetor or Throttle Body Mounting Bolt Torque Check * – At 6 Months or		○[2]	●[2]									○[1]												●[1]
12	Vacuum Advance System Inspection * – At 6 Months or		○	●									○●						○●						●
13	Spark Plugs *												○●[2]												○●
14	Wire Service *												○●												○●
15	EGR System Check *												○●												○●
16	Engine Timing Check *												○●												○●
17	Fuel Tank, Cap and Lines Inspection *						○[1]						○●						○[1]						○●
18	Early Fuel Evaporation System Inspection * [1]		○	●									○●												○●
19	Thermostatically Controlled Air Cleaner Inspection *												○●												○●
20	Engine Accessory Drive Belts Inspection *						○						○●[2]						○						○●
21	Evaporative Control System Inspection * [1]												○●												○●

FOOTNOTES:

1. All engines EXCEPT 2.5 L (VIN Engine Code E), 2.8 L (VIN Engine Code R), 4.3 L (VIN Engine Code Z)
2. In California, these are the minimum Emission Control Maintenance Services an owner must perform according to the California Air Resources Board. General Motors, however, urges that all Emission Control Maintenance Services shown be performed. To maintain your other new vehicle warranties, all services shown in this booklet should be performed.

* An Emission Control Service

NOTE: To determine the engine code, refer to the "Specifications" section of your Owner's Manual.

The maintenance services contained in Maintenance Schedule 1 and 2 are based on the assumption that your vehicle will be used as designed:

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

SECTION A—SCHEDULED MAINTENANCE SERVICES FOR YOUR 1986 VEHICLE WITH HEAVY DUTY EMISSIONS - OVER 8600 GVWR (EXCEPT CALIFORNIA)

The services shown in this schedule up to 60,000 miles (100 000 km) are to be performed after 60,000 miles (100 000 km) at the same intervals.

○ **Maintenance Schedule 1**
● **Maintenance Schedule 2**

Item No.	Service																				
	Miles (000)	**3**	**6**	**9**	**12**	**15**	**18**	**21**	**24**	**27**	**30**	**33**	**36**	**39**	**42**	**45**	**48**	**51**	**54**	**57**	**60**
	Kilometers (000)	**5**	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**	**65**	**70**	**75**	**80**	**85**	**90**	**95**	**100**
1	Engine Oil Change *	○	○ ●	○	○ ●	○	○ ●	○	○ ●	○	○ ●	○	○ ●	○	○ ●	○	○ ●	○	○ ●	○	○ ●
	Oil Filter Change *	○	○ ●	○	○	○	○ ●	○	○	○	○ ●	○	○	○	○ ●	○	○	○	○ ●	○	○
2	Chassis Lubrication	○	○ ●	○	○ ●	○	○ ●	○	○ ●	○	○ ●	○	○ ●	○	○ ●	○	○ ●	○	○ ●	○	○ ●
3	Engine Idle Speed Adjustment * — At 6 Months or		○ ●		○				○ ●				○				○ ●				○
4	Cooling System Service*—Every 24 Months or								○ ●								○ ●				
5	Air Cleaner, A.I.R. and PCV Filter Replacement * ▲								●								●				
6	Front Wheel Bearing Repack				○				○ ●				○				○ ●				○
7	Transmission Service - See Explanation for Service Intervals in Section B																				
8	PCV System Inspection *								○ ●								○ ●				
9	Fuel Filter Replacement *				○				○ ●				○				○ ●				○
10	Carburetor Choke and Hoses Inspection * — At 6 Months or		○ ●						○ ●								○ ●				
11	Carburetor or Throttle Body Mounting Bolt Torque Check * — At 6 Months or		○ ●		○				○ ●				○				○ ●				○
12	Vacuum Advance System Inspection * — At 6 Months or		○ ●						○ ●								○ ●				
13	Spark Plugs *				○ ●				○ ●				○ ●				○ ●				○ ●
14	Wire Service *																				○ ●
15	EGR System Check *								○ ●								○ ●				
16	Engine Timing Check * ▲								○ ●								○ ●				
17	Fuel Tank, Cap and Lines Inspection *								○ ●								○ ●				
18	Early Fuel Evaporation System Inspection *	○			○				○ ●				○				○ ●				○
19	Thermostatically Controlled Air Cleaner Inspection * ▲								○ ●								○ ●				
20	Engine Accessory Drive Belts Inspection * — Every 12 Months or				○ ●				○ ●				○ ●				○ ●				○ ●
21	Evaporative Control System Inspection *								○ ●												
22	Shields and Underhood Insulation Inspection ▲ ■				○ ●				○ ●				○ ●				○ ●				○ ●
23	Air Intake System Inspection ▲ ■								○ ●								○ ●				
24	Thermostatically Controlled Engine Cooling Fan Check ▲ ■ — Every 12 Months or				○ ●				○ ●				○ ●				○ ●				○ ●
25	Manifold Heat Valve Check ▲ *				○ ●				○ ●				○ ●				○ ●				○ ●

FOOTNOTES:
* An Emission Control Service
▲ Also a Noise Emission Control Service
■ Applicable only to vehicles sold in the United States

The maintenance services contained in Maintenance Schedule 1 and 2 are based on the assumption that your vehicle will be used as designed:

- To carry passengers and cargo within the limits shown on the tire placard located on the edge of the driver's door.
- On reasonable road surfaces within legal driving limits. • On leaded gasoline.

SECTION A—SCHEDULED MAINTENANCE SERVICES FOR YOUR 1986 VEHICLE WITH HEAVY DUTY EMISSIONS - OVER 8600 GVWR (CALIFORNIA ONLY)

The services shown in this schedule up to 60,000 miles (100 000 km) are to be performed after 60,000 miles (100 000 km) at the same intervals.

○ **Maintenance Schedule 1**
● **Maintenance Schedule 2**

Item No.	Service	Miles (000)	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
		Kilometers (000)	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
1	Engine Oil Change *		○	○●	○	○●	○	○●	○	○●	○	○●	○	○●	○	○●	○	○●	○	○●	○	○●
	Oil Filter Change *		○	○●	○	○	○	○●	○	○	○	○●	○	○	○	○●	○	○	○	○●	○	○
2	Chassis Lubrication - Every 4 Months or			○●		○●		○●		○●		○●		○●		○●		○●		○●		○●
3	Engine Idle Speed Adjustment * - At First 4 Months or, Then Every 12 Months or			○●		○●				○●				○●				○●				○●
4	Cooling System Service *					○●				○●				○●				○●				○●
5	Air Cleaner Element Replacement ▲*					○●				○●				○●				○●				○●
6	Front Wheel Bearing Repack					○●				○●				○●				○●				○●
7	Transmission Service - See Explanation for Service Intervals in Section B																					
8	PCV System Inspection * - Every 12 Months or					○●				○●				○●				○●				○●
9	Fuel Filter Replacement * - Every 12 Months or					○●				○●				○●				○●				○●
10	Carburetor Choke and Hoses Inspection * - Every 24 Months or									○●								○●				
11	Carburetor or Throttle Body Mounting Bolt Torque Check * — Every 12 Months or					○●				○●				○●				○●				○●
12	Vacuum Advance System Inspection * - Every 24 Months or									○								○				
13	Spark Plugs *					○●				○●				○●				○●				○●
14	Wire Service *					○●				○●				○●				○●				○●
15	EGR System Check * - Every 36 Months or													○●								
16	Engine Timing Check and Distributor Check * ▲					○●				○●				○●				○●				○●
17	Fuel Tank, Cap and Lines Inspection * - Every 24 Months or									○●								○●				
18	Early Fuel Evaporation System Inspection * - Every 24 Months or									○●								○●				
19	Thermostatically Controlled Air Cleaner Inspection * ▲ - Every 12 Months or					○●				○●				○●				○●				○●
20	Engine Accessory Drive Belts Inspection *					○●				○●				○●				○●				○●
21	Evaporative Control System Inspection * - Every 24 Months or									○●								○●				
22	Shields and Underhood Insulation Inspection ▲■					○●				○●				○●				○●				○●
23	Air Intake System Inspection ▲					○●				○●				○●				○●				○●
24	Thermostatically Controlled Engine Cooling Fan Check ▲■ - Every 12 Months or					○●				○●				○●				○●				○●
25	Manifold Heat Valve Check ▲ * — Every 12 Months or					○●				○●				○●				○●				○●
26	Idle Stop Solenoid Check * - At First 4 Months or Then Every 12 Months or			○●		○●				○●				○●				○●				○●
27	Throttle Return Control Check * — Every 12 Months or					○●				○●				○●				○●				○●
28	Engine Idle Mixture Adjustment (4.8 L only) * — Every 24 Months or									○●								○●				
29	Governor Check ▲■ - Every 48 Months or																	○●				

FOOTNOTES:
* An Emission Control Service
▲ Also a Noise Emission Control Service
■ Applicable only to vehicles sold in the United States

The maintenance services contained in Maintenance Schedule 1 and 2 are based on the assumption that your vehicle will be used as designed:

- To carry passengers and cargo within the limits shown on the tire placard located on the edge of the driver's door.
- On reasonable road surfaces within legal driving limits. • On leaded gasoline

SECTION A—SCHEDULED MAINTENANCE SERVICES FOR YOUR 1986 VEHICLE WITH A 6.2 L DIESEL ENGINE

The services shown in this schedule up to 47,500 miles (76 000 km) are to be performed after 47,500 miles (76 000 km) at the same intervals.

○ **Maintenance Schedule 1**
● **Maintenance Schedule 2**

Item No.	Service	Miles (000)	2.5	5	7.5	10	12.5	15	18	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5
		Kilometers (000)	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76
1	Engine Oil Change *		○	○ ●	○	○ ●	○	○ ●	○	○ ●	○	○ ●	○	○ ●	○	○ ●	○	○ ●	○	○ ●	○
	Oil Filter Change *		○	○ ●	○	○ ●	○	○ ●	○	○ ●	○	○ ●	○	○ ●	○	○ ●	○	○ ●	○	○ ●	○
2	Chassis Lubrication *		○	○ ●	○	○ ●	○	○ ●	○	○ ●	○	○ ●	○	○ ●	○	○ ●	○	○ ●	○	○ ●	○
3	Engine Idle Speed Adjustment *			○ ●[1]										○ ●[1]							
4	Cooling System Service * — Every 24 Months or													○ ●							
5	Air Cleaner Element Replacement*[2]													○ ●[1]							
6	Front Wheel Bearing Repack							○						○ ●						○	
7	Transmission Service - See Explanation for Service Intervals in Section B																				
8	PCV System Inspection * — Every 12 Months or							○ ●						○ ●						○ ●	
22	Shields and Underhood Insulation Inspection ▲ ■					○ ●				○ ●				○ ●				○ ●			
23	Air Intake System Inspection ▲ ■					○ ●				○ ●				○ ●				○ ●			
24	Thermostatically Controlled Engine Cooling Fan Check ▲ ■ —Every 12 Months or					○ ●				○ ●				○ ●				○ ●			
30	Exhaust Pressure Regulator Valve Inspection *			○ ●				○ ●						○ ●						○ ●	

FOOTNOTES:

1. In California, these are the minimum Emission Control Maintenance Services an owner must perform according to the California Air Resources Board. General Motors, however, urges that all Emission Control Maintenance Services shown be performed. To maintain your other new vehicle warranties, all services shown in this booklet should be performed.
2. For engines with Engine Family GGM06.2DABX, replace element every 15,000 miles (24 000 km).

* An Emission Control Service

▲ Also a Noise Emission Control Service (applicable only to vehicles with Engine Family GGM06.2DABX).

■ Applicable only to trucks sold in the United States

NOTE: To determine engine family refer to the Vehicle Emission Control Information label located in the engine compartment.

The maintenance services contained in Maintenance Schedule 1 and 2 are based on the assumption that your vehicle will be used as designed:

- To carry passengers and cargo within the limits shown on the tire placard located on the edge of the driver's door.
- On No. 1, blend or No. 2 grade diesel fuel.
- On reasonable road surfaces within legal driving limits.

SECTION B — EXPLANATION OF SCHEDULED MAINTENANCE SERVICES

The services listed in the preceding Maintenance Schedules are further explained below. After services are completed, fill in the Maintenance Record at the end of this booklet. When the following maintenance services are performed, make sure all parts are replaced and all necessary repairs are done before operating you vehicle. Be sure to use the proper fluids and lubricants as shown in Section E.

Item No.

1. **ENGINE OIL AND OIL FILTER CHANGE** * — ALWAYS USE SF/CC or SF/CD QUALITY, ENERGY CONSERVING OILS OF THE PROPER VISCOSITY. Also always change oil and filter as soon as possible after driving in a dust storm. If following Maintenance Schedule 1, change oil and filter every 6 months or recommended mileage; otherwise, change the oil and filter every 12 months or recommended mileage. See your Owner's Manual for further details.
2. **CHASSIS LUBRICATION** — Lubricate the front suspension, steering linkage, constant velocity universal joint, transmission, clutch, transfer case shift linkage, parking brake cable guides, propshaft, universal joints, brake pedal springs, and clutch pedal springs. Lubricate clutch cross shaft every 30,000 miles (50 000 km).
3. **ENGINE IDLE SPEED ADJUSTMENT** * — Adjust to the specifications shown on the underhood label. You must use calibrated test equipment. Check that idle stop solenoid or dashpot work properly (if so equipped).
4. **COOLING SYSTEM SERVICE** * — Drain, flush and refill system with new coolant. See your Owner's Manual for further details.
5. **AIR CLEANER ELEMENT REPLACEMENT, A.I.R. AND PCV FILTER REPLACEMENT (SOME MODELS)** * — Replace at specified intervals. Replace more often under dusty conditions. Ask your dealer for the proper replacement intervals for your driving conditions.
6. **FRONT WHEEL BEARING REPACK** — Clean and repack the front wheel bearings at each brake relining, or at the specified interval, whichever comes first.

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* An Emission Control Service

7. **TRANSMISSION SERVICE**

Automatic Transmission — Change the transmission fluid and filter every 15,000 miles (25 000 km) for vehicles under 8600 GVWR or every 12,000 miles (20 000 km) for vehicles over 8600 GVWR if the vehicle is mainly driven under one or more of these conditions:

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

If the vehicle is not used mainly under any of these conditions, change the fluid and filter every 30,000 miles (50 000 km) for vehicles under 8600 GVWR or every 24,000 miles (40 000 km) for vehicles over 8600 GVWR. See your Owner's Manual for further details.

Manual Transmission (S-Truck 4-Speed, 4-Speed O/D, and 5-Speed) — Change transmission fluid at 7,500 miles (12 500 km), then every 30,000 miles (50 000 km).

Manual Transmission (Except S-Truck 4-Speed, 4-Speed O/D, and 5-Speed) — Manual transmission fluid does not require periodic changing.

8. **PCV SYSTEM INSPECTION** * — Check that PCV (Positive Crankcase Ventilation) system works properly. Replace the valve as necessary and any worn, plugged or collapsed hoses.
9. **FUEL FILTER REPLACEMENT** * — Replace the fuel filter at the specified interval or sooner if clogged.
10. **CARBURETOR CHOKE AND HOSES INSPECTION** * — Verify that choke and vacuum break work properly and within specifications. Correct any binding caused by damage or gum on the choke shaft. Inspect hoses for proper hookup, cracks, chafing, or decay. Correct as necessary.
11. **CARBURETOR OR THROTTLE BODY MOUNTING BOLT TORQUE CHECK** * — Check torque of mounting bolts and/or nuts.
12. **VACUUM ADVANCE SYSTEM INSPECTION** * — Check that the system works properly. Check hoses for proper hookup, cracks, chafing or decay. Replace parts as needed.

An Emission Control Service

13. **SPARK PLUGS** * — Replace spark plugs with the type listed in your Owner's Manual.
14. **WIRE SERVICE** * — Clean wires and inspect for burns, cracks or other damage. Check the wire boot fit at the distributor and at the spark plugs. Replace wires as needed.
15. **EGR SYSTEM CHECK** * — Conduct EGR SYSTEM CHECK. Refer to DRIVEABILITY AND EMISSIONS (SEC. 6E8).
16. **ENGINE TIMING CHECK AND DISTRIBUTOR CHECK (SOME MODELS)*** — Adjust timing to underhood label specifications. Inspect the inside and outside of the distributor cap and rotor for cracks, carbon tracking and corrosion. Clean or replace as needed.
17. **FUEL TANK, CAP AND LINES INSPECTION** * — Inspect the fuel tank, cap and lines for damage or leaks. Remove fuel cap, inspect gasket for an even filler neck imprint, and any damage. Replace parts as needed.
18. **EARLY FUEL EVAPORATION (EFE) SYSTEM INSPECTION** * — Check that valve works properly; correct any binding. Check that thermal vacuum switch works properly. Check hoses for cracks, chafing, or decay. Replace parts as needed.
19. **THERMOSTATICALLY CONTROLLED AIR CLEANER INSPECTION** * ▲ — Inspect all hoses and ducts for proper hookup. Make sure valve works properly.
20. **ENGINE ACCESSORY DRIVE BELTS INSPECTION** * — Inspect belts. Look for cracks, fraying, wear, and proper tension. Adjust or replace as needed.
21. **EVAPORATE CONTROL SYSTEM (ECS) INSPECTION** * — Check all fuel and vapor lines and hoses for proper hookup, routing, and condition. Check that bowl vent and purge valves work properly, if equipped. Remove canister, and check for cracks or damage. Replace as needed.
22. **SHIELDS AND UNDERHOOD INSULATION INSPECTION ▲■** — Inspect shields and underhood insulation for damage or looseness. Adjust or replace as required.
23. **AIR INTAKE SYSTEM INSPECTION ▲■** — Check the air intake system installation to see that gaskets are seated properly and all hose connections, fasteners, and other components are tight. Also check to be sure that the air cleaner housing is properly seated on the carburetor, that the cover fits tightly, and the wingnut is tight. Tighten connections and fasteners or replace damaged parts as required.
24. **THERMOSTATICALLY CONTROLLED ENGINE COOLING FAN CHECK ▲■** — (If so equipped.) With the **engine off** and below normal operating temperature, check to see that the fan can be rotated by hand on fluid coupling or viscous drives. Replace as necessary.
25. **MANIFOLD HEAT VALVE CHECK▲■** — Some engines are equipped with a manifold heat valve which should be inspected and repaired as necessary to insure free operation.
26. **IDLE STOP SOLENOID AND/OR DASHPOT CHECK** * — Check that parts work properly. Replace them as needed.
27. **THROTTLE RETURN CONTROL (TRC) SYSTEM CHECK** * — Check hoses for proper connections, cracking, abrasion, or deterioration and replace as necessary. Check for proper operation of system. Check for shorted or broken wires and ensure electrical connectors are fully engaged at distributor, speed switch and vacuum solenoid.
28. **ENGINE IDLE MIXTURE ADJUSTMENT (4.8 L ONLY)** * — At designated intervals or in case of a major carburetor overhaul, or when poor idle quality exists, adjust mixture by a mechanical method (lean drop), following the specifications shown on the label under the hood.
29. **GOVERNOR CHECK ▲■** — (If so equipped). Check the engine no-load governed speed and reset to specifications as required.
30. **EXHAUST PRESSURE REGULATOR VALVE INSPECTION** * — Check that valve works properly. Correct any binding. Check hoses for cracks, chafing or decay. Replace parts as needed.

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* An Emission Control Service
▲Also a Noise Emission Control Service
■ Applicable only to vehicles sold in the United States

* An Emission Control Service
▲Also a Noise Emission Control Service
■ Applicable only to vehicles sold in the United States

SECTION C — 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 vehicle. 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, and all needed repairs should be done before operating your vehicle. Be sure to use the proper fluids and lubricants as shown in Section E.

WHILE OPERATING YOUR VEHICLE

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

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

Brake system operation — Be alert to abnormal sounds, increased brake pedal travel or repeated pulling to one side when braking. Also, if a brake warning light goes on, something may be wrong with part of the brake system.

Exhaust system — 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 — 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 abnormal sounds are noted when turning or parking.

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

AT EACH FUEL FILL

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

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

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

Hood latch operation — When opening hood, 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 services are performed.

AT LEAST MONTHLY

Tire pressure check — Keep pressures as shown on Tire Placard on the driver's door (including spare). Pressure should be checked when tires are cold.

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

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

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

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

Brake master cylinder reservoir fluid level check † — Check fluid level in accordance with your Owner's Manual, and keep at

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† A large loss in these systems may indicate a problem. Have them inspected and repaired at once.

proper level. A low fluid level can indicate worn disc brake pads may need to be serviced.

Clutch pedal free travel — Note the clutch pedal free travel. It should be about 1". Adjust linkage whenever there is little or no free travel.

EACH TIME OIL IS CHANGED

Automatic or manual transmission fluid level check † — Check transmission fluid level and add as required. See your Owner's Manual for further details.

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 the tires be rotated at the first oil change, then at every other oil change thereafter. See "Tires" in your Owner's Manual for further information. For dual wheels, whenever the truck, wheels, or fasteners are new, have the wheel fastener torque set at the first 100, 1,000 and 6,000 miles (160, 1 600 and 10 000 km).

Steering and suspension — Inspect front and rear suspension and steering system for damage, 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 vehicles equipped with manual steering gear, check for seal leakage.) Inspect final drive axle output shaft seals for leaking. †

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.**

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

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

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

Axle rear/front, transfer case (four-wheel drive) — Check fluid level and add if needed.

- **Locking differential - under 8600-lbs. GVWR** — Drain fluid at first oil change and refill. Check fluid level and add as needed at subsequent oil changes. In dusty areas, or trailer towing applications drain fluid at every oil change and refill. †
- **Locking differential - over 8600-lbs. GVWR** — Drain fluid at first oil change and refill. Change fluid at every other oil change and check and add fluid at subsequent oil changes. In dusty areas, or trailer towing applications, drain fluid at every oil change and refill as specified. †
- **Standard differential - under 8600-lbs. GVWR** — Check fluid level and add as needed at every oil change. In dusty areas, or trailer towing applications, drain fluid every oil change and refill. †
- **Standard differential - over 8600-lbs. GVWR** — Drain fluid every fourth oil change and refill. Check fluid level and add as needed at every oil change. In dusty areas, or trailer towing applications, drain fluid at every oil change and refill. †
- **Transfer case (four-wheel drive)** — Every 12 months or at oil change intervals, check front axle and transfer case and add lubricant when necessary. Lubricate propeller shaft slip joint, constant velocity universal joint and steering linkage. Oil the control lever pivot point and all exposed control linkage. Check vent hose at transfer case for kinks and proper installation. More frequent lubrication may be required on heavy-duty off-road use. †

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† A large loss in these systems may indicate a problem. Have them inspected and repaired at once.

* An Emission Control Service

† A large loss in these systems may indicate a problem. Have them inspected and repaired at once.

AT LEAST ONCE A YEAR

Starter safety switch operation —

CAUTION: Before performing the following safety switch check, be sure to have enough room around the vehicle. 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 vehicle could move without warning and possibly cause personal injury or property damage.

On automatic transmission vehicles, try to start the engine in each gear. The starter should crank only in "Park" or "Neutral."

On manual transmission vehicles place the shift lever in "Neutral," push the clutch halfway and try to start. The starter should crank only when the clutch is fully depressed.

Steering column lock operation — While parked, try to turn 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. On vehicles with a key release lever, try to turn the 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 "Park" mechanism operation—

CAUTION: Before checking the holding ability of the parking brake and automatic transmission "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 vehicle begins to move.

To check the parking brake with the engine running and transmission shift lever in "Neutral," slowly remove foot pressure from the regular brake pedal until the vehicle is held by only the parking brake.

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

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 vehicles with movable head restraints, make sure restraints stay in the desired position. (See adjustment instructions in your Owner's Manual.)

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

Spare tire and jack storage — Be alert to rattles in the rear of the vehicle. Make sure the spare tire, all jacking equipment, 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 condenser. Wash radiator filler cap and neck. To help ensure proper operation, a pressure test of both the cooling system and cap is also recommended. See maintenance schedule charts in Section A for the recommended coolant change interval.

Key Lock Service — Lubricate key lock cylinder at least annually.

Body Lubrication Service — Lubricate all body door hinges including the tailgate (if equipped) also lubricate the body hood, fuel door and rear compartment hinges and latches including interior glove box and console doors, and any folding seat hardware.

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* An Emission Control Service

† A large loss in these systems may indicate a problem. Have them inspected and repaired at once.

SECTION D — MAINTENANCE RECORD

After each of the preceding Scheduled Maintenance Services is performed, record the date, odometer reading, services performed (list item numbers) and who performed the services in the appropriate column. In addition, retain copies of your receipts. It is suggested that receipts be kept with this booklet.

SECTION E — RECOMMENDED FLUIDS & LUBRICANTS

NOTE: Fluids and lubricants identified below by name, part number or specification may be obtained from your GM Truck 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 a good quality ethylene glycol base antifreeze conforming to GM-1825-M (GM Part No. 1052753)
Brake and Hydraulic Clutch Systems	Delco Supreme 11 fluid (GM Part No. 1052535) or DOT-3
Parking Brake Cables	Chassis grease meeting requirements of GM-6031-M (GM Part No. 1052497)
Power Steering System	GM Power Steering Fluid (GM Part No. 1050017) or equivalent
Manual Steering Gear	GM Lubricant Part No. 1052182 or equivalent
Automatic Transmission, 4-Spd O/D Manual Transmission, 5-Spd Manual Transmission, S-Truck 4-Spd Manual Transmission, Transfer Case (Except K30/35 Series)	DEXRON ® II Automatic Transmission Fluid (GM Part No. 1051855)
Differential—Standard, K30/35 Series Transfer Case, Manual Transmission (Except S-Truck 4-Spd, 4-Spd O/D, and 5-Spd)	SAE-80W, or SAE-80W-90 GL-5 gear lubricant (SAE-80W GL-5 in Canada) (GM Part No. 1052271).
Differential — Locking	Some models require a special gear lubricant additive in addition to (GM Part No. 1052271).*
Manual Transmission Shift Linkage, Column Shift, Propeller Shaft Slip Joint	Chassis grease meeting requirements of GM-6031-M (GM Part No. 1052497)
Key Lock Cylinders	Light oil or general-purpose silicone lubricant (GM Part No. 1052276)

SECTION E — RECOMMENDED FLUIDS & LUBRICANTS

Chassis Lubrication	Chassis grease meeting requirements of GM-6031-M (GM Part No. 1052497)
Winshield Washer Solvent	GM Optikleen washer solvent (GM Part No. 1051515) or equivalent
Hood Latch Assembly a. Pivots and spring anchor b. Release pawl	a. Engine oil or GM Part No. 1050109 b. Chassis Grease meeting requirements of GM-6031-M (GM Part No. 1052497)
Front Wheel Bearings	GM Lubricant Part No. 1051344 or equivalent
Constant Velocity Universal Joint	GM Lubricant Part No. 1052497 or equivalent.
Automatic Transmission Shift Linkage, Floor Shift Linkage, Hood and Door Hinges, Body Door Hinge Pins, Tailgate Hinge and Linkage, Folding Seat, Fuel Door Hinge	Engine oil
Clutch Linkage (Manual Transmission only) a. Pivot points b. Pushrod to clutch fork joint, and shaft pressure fitting	a. Engine oil b. Chassis grease meeting requirements of GM-6031-M (GM No. 1051344)

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

SECTION 1

HEATING AND AIR CONDITIONING

CONTENTS

SECTION 1A

HEATING

CONTENTS

C-K AND G SERIES HEATERS — GENERAL DESCRIPTION

Heating components are attached to the right side of the cowl. The blower and air inlet assembly and water hoses are located on the forward side of the cowl panel while the heater core and distributor duct are on the passenger side.

The heater system is an air-mix type system in which outside air is heated and then mixed in varying amounts with cooler outside air to attain the desired air temperature. The system consists of (1) a blower and air inlet assembly, (2) a heater distributor assembly and (3) a heater control assembly.

BLOWER AND AIR INLET ASSEMBLY

The blower and air inlet assembly draws outside air through the outside air inlet grille located forward of the windshield reveal molding and channels the air into the heater distributor assembly. The operation of the blower motor is controlled by the fan switch on the heater control. The motor is connected in series with the fan switch and the blower resistor assembly.

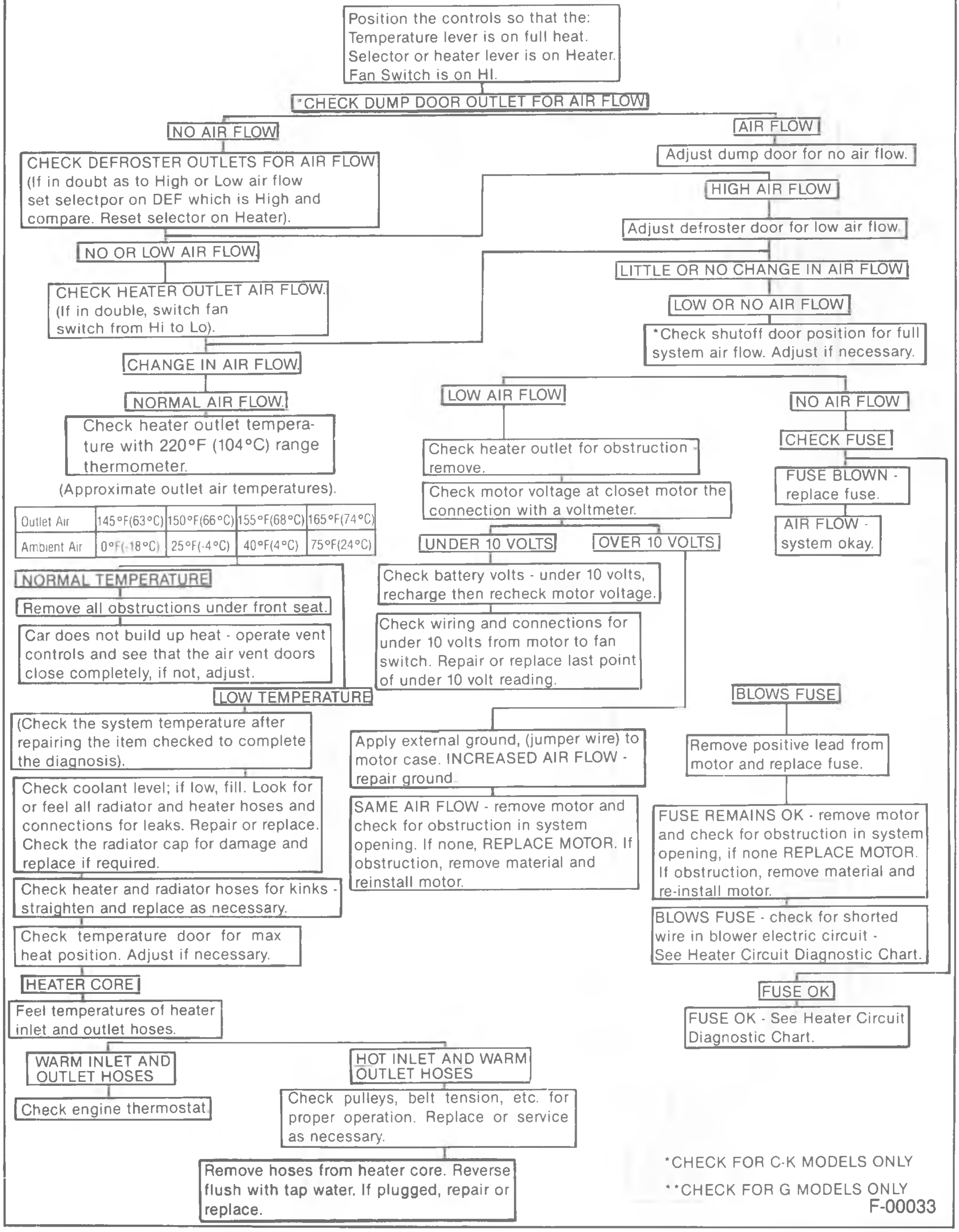
HEATER DISTRIBUTOR ASSEMBLY

The heater distributor assembly houses the heater core and the doors necessary to control mixing and channeling of the air. Since the unit has no water valve, water circulation keeps the core hot at all times. That portion of the air passing through the core receives maximum heat from the core. Air entering the distributor assembly is channeled as follows:

C-K AND G MODELS

Air entering the distributor can be directed out the purge door opening on the right end of the distributor assembly by the temperature door. If the temperature door is closed, air is directed through and/or around the heater core by the temperature door. Air is then directed into the passenger compartment through the heater (floor) outlets and/or the defroster (dash) outlets by the defroster door. The temperature of the outlet air is dependent on the ratio of heated to unheated air (controlled by the temperature door).

INSUFFICIENT HEAT DIAGNOSIS



Position the controls so that the:
Temperature lever is on full heat.
Selector or heater lever is on Heater.
Fan Switch is on HI.

*CHECK DUMP DOOR OUTLET FOR AIR FLOW

AIR FLOW

Adjust dump door for no air flow.

NO AIR FLOW

CHECK DEFROSTER OUTLETS FOR AIR FLOW (If in doubt as to High or Low air flow set selectpor on DEF which is High and compare. Reset selector on Heater).

HIGH AIR FLOW

Adjust defroster door for low air flow.

NO OR LOW AIR FLOW

CHECK HEATER OUTLET AIR FLOW. (If in double, switch fan switch from Hi to Lo).

LITTLE OR NO CHANGE IN AIR FLOW

LOW OR NO AIR FLOW

*Check shutoff door position for full system air flow. Adjust if necessary.

CHANGE IN AIR FLOW

NORMAL AIR FLOW.

Check heater outlet temperature with 220°F (104°C) range thermometer.

(Approximate outlet air temperatures).

Outlet Air	145°F(63°C)	150°F(66°C)	155°F(68°C)	165°F(74°C)
Ambient Air	0°F(-18°C)	25°F(-4°C)	40°F(4°C)	75°F(24°C)

NORMAL TEMPERATURE

Remove all obstructions under front seat.

Car does not build up heat - operate vent controls and see that the air vent doors close completely, if not, adjust.

LOW TEMPERATURE

(Check the system temperature after repairing the item checked to complete the diagnosis).

Check coolant level; if low, fill. Look for or feel all radiator and heater hoses and connections for leaks. Repair or replace. Check the radiator cap for damage and replace if required.

Check heater and radiator hoses for kinks - straighten and replace as necessary.

Check temperature door for max heat position. Adjust if necessary.

HEATER CORE

Feel temperatures of heater inlet and outlet hoses.

WARM INLET AND OUTLET HOSES

Check engine thermostat

HOT INLET AND WARM OUTLET HOSES

Check pulleys, belt tension, etc. for proper operation. Replace or service as necessary.

Remove hoses from heater core. Reverse flush with tap water. If plugged, repair or replace.

LOW AIR FLOW

Check heater outlet for obstruction - remove.

Check motor voltage at closet motor the connection with a voltmeter.

UNDER 10 VOLTS

Check battery volts - under 10 volts, recharge then recheck motor voltage.

Check wiring and connections for under 10 volts from motor to fan switch. Repair or replace last point of under 10 volt reading.

OVER 10 VOLTS

Apply external ground, (jumper wire) to motor case. INCREASED AIR FLOW - repair ground

SAME AIR FLOW - remove motor and check for obstruction in system opening. If none, REPLACE MOTOR. If obstruction, remove material and reinstall motor.

NO AIR FLOW

CHECK FUSE

FUSE BLOWN - replace fuse.

AIR FLOW - system okay.

BLOWS FUSE

Remove positive lead from motor and replace fuse.

FUSE REMAINS OK - remove motor and check for obstruction in system opening, if none REPLACE MOTOR. If obstruction, remove material and re-install motor.

BLOWS FUSE - check for shorted wire in blower electric circuit - See Heater Circuit Diagnostic Chart.

FUSE OK

FUSE OK - See Heater Circuit Diagnostic Chart.

*CHECK FOR C-K MODELS ONLY

**CHECK FOR G MODELS ONLY

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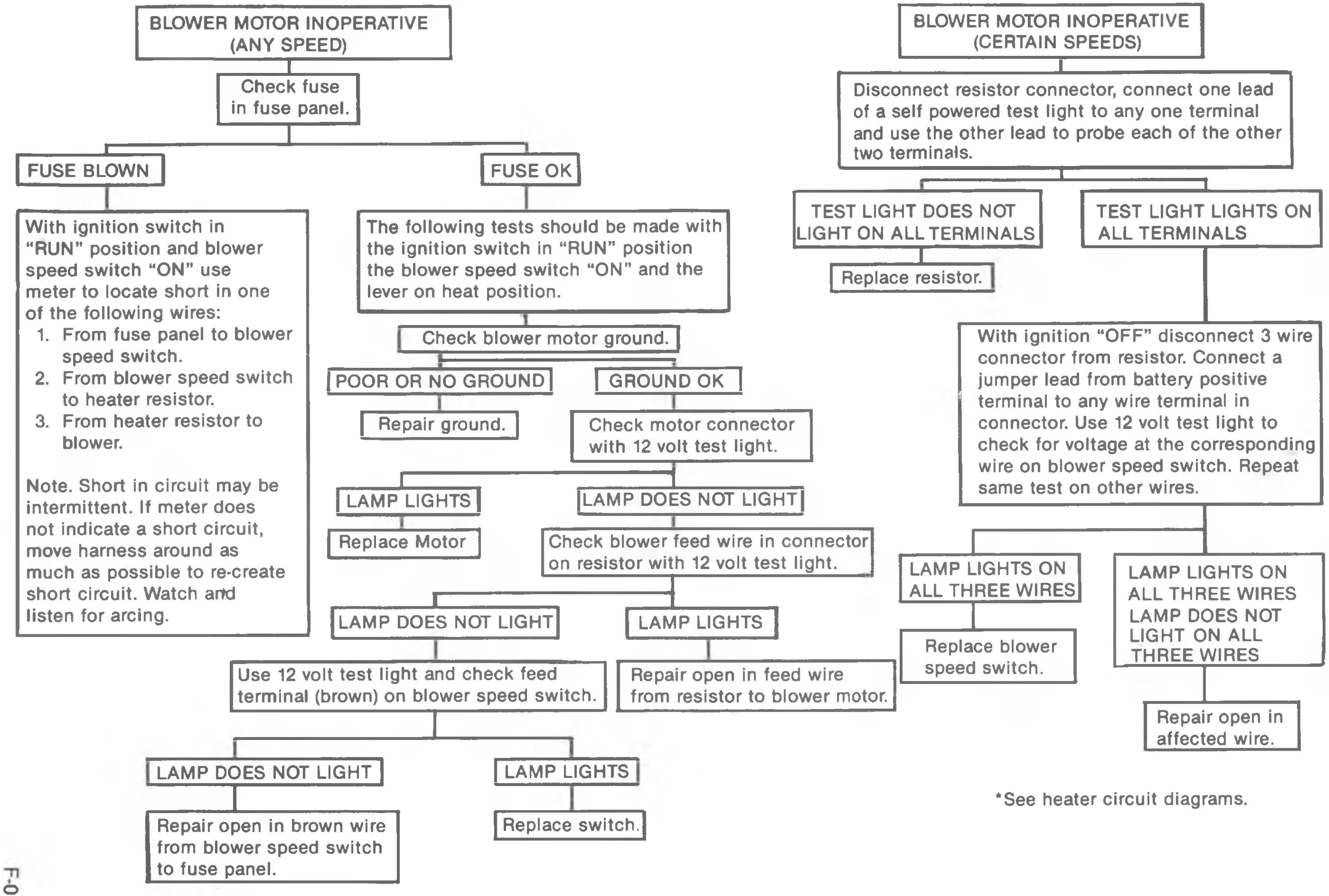
Figure 1—Insufficient Heat Diagnosis

HEATER CIRCUIT DIAGNOSIS*



- BLOWER MOTOR INOPERATIVE (ANY SPEED)
  - Check fuse in fuse panel.
    - FUSE BLOWN
      - With ignition switch in "RUN" position and blower speed switch "ON" use meter to locate short in one of the following wires:
        1. From fuse panel to blower speed switch.
        2. From blower speed switch to heater resistor.
        3. From heater resistor to blower.

        Note. Short in circuit may be intermittent. If meter does not indicate a short circuit, move harness around as much as possible to re-create short circuit. Watch and listen for arcing.
    - FUSE OK
      - The following tests should be made with the ignition switch in "RUN" position the blower speed switch "ON" and the lever on heat position.
        - Check blower motor ground.
          - POOR OR NO GROUND
            - Repair ground.
          - GROUND OK
            - Check motor connector with 12 volt test light.
              - LAMP LIGHTS
                - Replace Motor
              - LAMP DOES NOT LIGHT
                - Check blower feed wire in connector on resistor with 12 volt test light.
                  - LAMP DOES NOT LIGHT
                    - Use 12 volt test light and check feed terminal (brown) on blower speed switch.
                      - LAMP DOES NOT LIGHT
                        - Repair open in brown wire from blower speed switch to fuse panel.
                      - LAMP LIGHTS
                        - Replace switch.
                  - LAMP LIGHTS
                    - Repair open in feed wire from resistor to blower motor.
- BLOWER MOTOR INOPERATIVE (CERTAIN SPEEDS)
  - Disconnect resistor connector, connect one lead of a self powered test light to any one terminal and use the other lead to probe each of the other two terminals.
    - TEST LIGHT DOES NOT LIGHT ON ALL TERMINALS
      - Replace resistor.
    - TEST LIGHT LIGHTS ON ALL TERMINALS
      - With ignition "OFF" disconnect 3 wire connector from resistor. Connect a jumper lead from battery positive terminal to any wire terminal in connector. Use 12 volt test light to check for voltage at the corresponding wire on blower speed switch. Repeat same test on other wires.
        - LAMP LIGHTS ON ALL THREE WIRES
          - Replace blower speed switch.
        - LAMP LIGHTS ON ALL THREE WIRES LAMP DOES NOT LIGHT ON ALL THREE WIRES
          - Repair open in affected wire.

*See heater circuit diagrams.

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Figure 2—Heater Circuit Diagnosis

DIAGNOSIS OF HEATER SYSTEM

PROBLEM	POSSIBLE CAUSE	CORRECTION
Temperature Of Heater Air At The Outlets Is Too Low To Heat Up Passenger Compartment	1. Refer to "Insufficient Heat Diagnostic Chart."	1. Refer to "Insufficient Heat Diagnostic Chart."
Temperature Of Heater Air At The Outlets Is Adequate But The Vehicle Will Not Build Up Sufficient Heat	1. Floor side kick pad ventilators partially open. 2. Leaking grommets in dash. 3. Leaking welded seams along the rocker panel and windshield. 4. Leaks through the access holes and screw holes. 5. Leaking rubber molding around the door and windows. 6. Leaks between the sealing edge of blower and the air inlet assembly and cowl, and between the sealing edge of the heater distributor assembly and cowl.	1. Check and adjust. 2. Reseal or replace. 3. Clean and rewash. 4. Reseal or replace. 5. Reseal or replace. 6. Reseal or replace.
Inadequate Defrosting Action	1. Check that the DEFROST lever completely opens the defroster door in the DEF position. 2. Insure that the temperature and air doors open fully. 3. Look for obstructions in the defroster ducts. 4. Check for air leak in the ducting between the defroster outlet on heater assembly and the defroster duct under the instrument panel. 5. Check the position of the bottom of the nozzle to the heater locating tab. 6. Check the position of the defroster nozzle openings relative to instrument panel openings. Mounting tabs provide positive position if properly installed.	1. Adjust if necessary. 2. Adjust. 3. Remove any obstructions. 4. Seal area as necessary. 5. Adjust. 6. Adjust the defroster nozzle openings.
Inadequate Circulation Of Heated Air Through The Vehicle	1. Check the heater outlet for correct installation. 2. Inspect the floor carpet to insure that the carpet lies flat under the front seat and does not obstruct air flow. Also inspect around the outlet ducts to insure that the carpet is well fastened to floor to prevent cupping of the air flow.	1. Remove and install. 2. Correct as necessary.

DIAGNOSIS OF HEATER SYSTEM (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Erratic Heater Operation	1. Check the coolant level. 2. Check for kinked heater hoses. 3. Check the operation of all bowden cables and doors. 4. Sediment in the heater lines and radiator causing the engine thermostat to stick open. 5. Partially plugged heater core.	1. Fill to the proper level. 2. Relieve kinks or replace hoses. 3. Adjust as necessary. 4. Flush the system and clean or replace thermostat as necessary. 5. Backflush core as necessary.
Hard Operating Or Broken Controls	1. Check for loose bowden cable tab screws or mis-adjusted bowden cables. 2. Check for sticking heater system door(s).	1. Correct as required. 2. Lubricate as required using a silicone spray.

C-K SERIES HEATER — ON-VEHICLE SERVICE

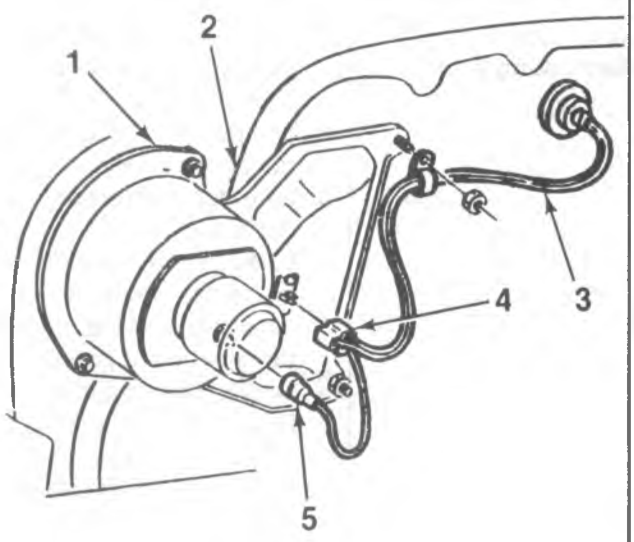
BLOWER MOTOR REPLACEMENT

Remove or Disconnect (Figures 3 and 4)

1. Battery ground cable.
2. Blower motor lead cable (figure 3).
3. Motor and wheel assembly (figure 4).
   - — Five mounting screws.
   - — Gently pry on the blower flange if the sealer acts like an adhesive.
4. Blower wheel to motor shaft nut.
5. Blower wheel from the motor.

Install or Connect (Figures 3 and 4)

1. Blower wheel to the motor.
   - Locate the open end of the wheel away from the blower motor.
2. Motor shaft nut.
3. Motor and wheel assembly.
4. New bead of sealer to the mounting flange.
5. Blower motor lead wire.
6. Battery ground wire.
7. Test the blower.

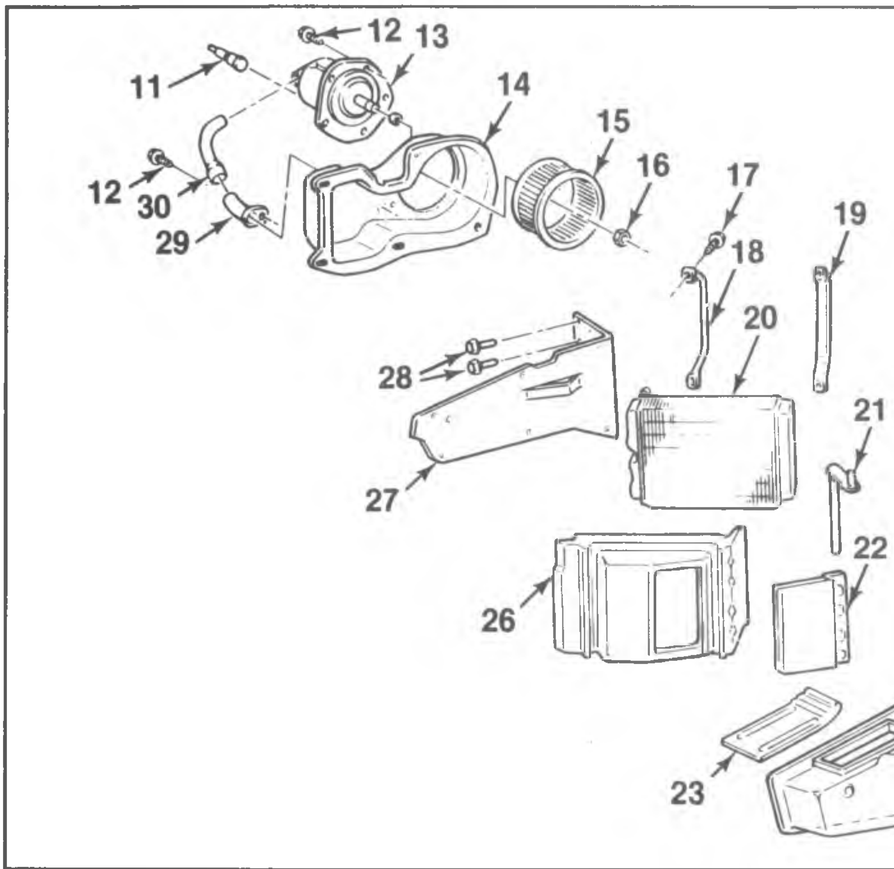


1. Heater/Blower Assembly
2. Dash
3. Blower Wiring
4. Resistor Connector
5. Motor Connector

Figure 3—Blower Motor Assembly Wiring—CK

HEATER HOSES — ROUTING

Heater hoses are routed from the thermostat housing or inlet manifold and water pump (radiator on some automatic transmission vehicles) to the core inlet and outlet pipes (figure 5). Hoses are attached at each end with screw-type clamps.



11.	Connector	21.	Shaft
12.	Screw	22.	Valve
13.	Motor	23.	Valve
14.	Case	24.	Case
15.	Fan	25.	Shaft
16.	Nut	26.	Shroud
17.	Bolt	27.	Plate
18.	Clamp	28.	Bolt
19.	Clamp	29.	Elbow
20.	Core	30.	Tube

Figure 4—Blower Motor Assembly — Component View

REPLACEMENT

The heater core can be damaged near the tube attachment seams if force is applied on them. If the heater hoses do not come off, cut the hoses forward of the core tubes. Cut the hose on core tubes to remove.

Important

- Draw hoses tight to prevent sagging or rubbing against other components. Route hoses through all clamps as installed originally.

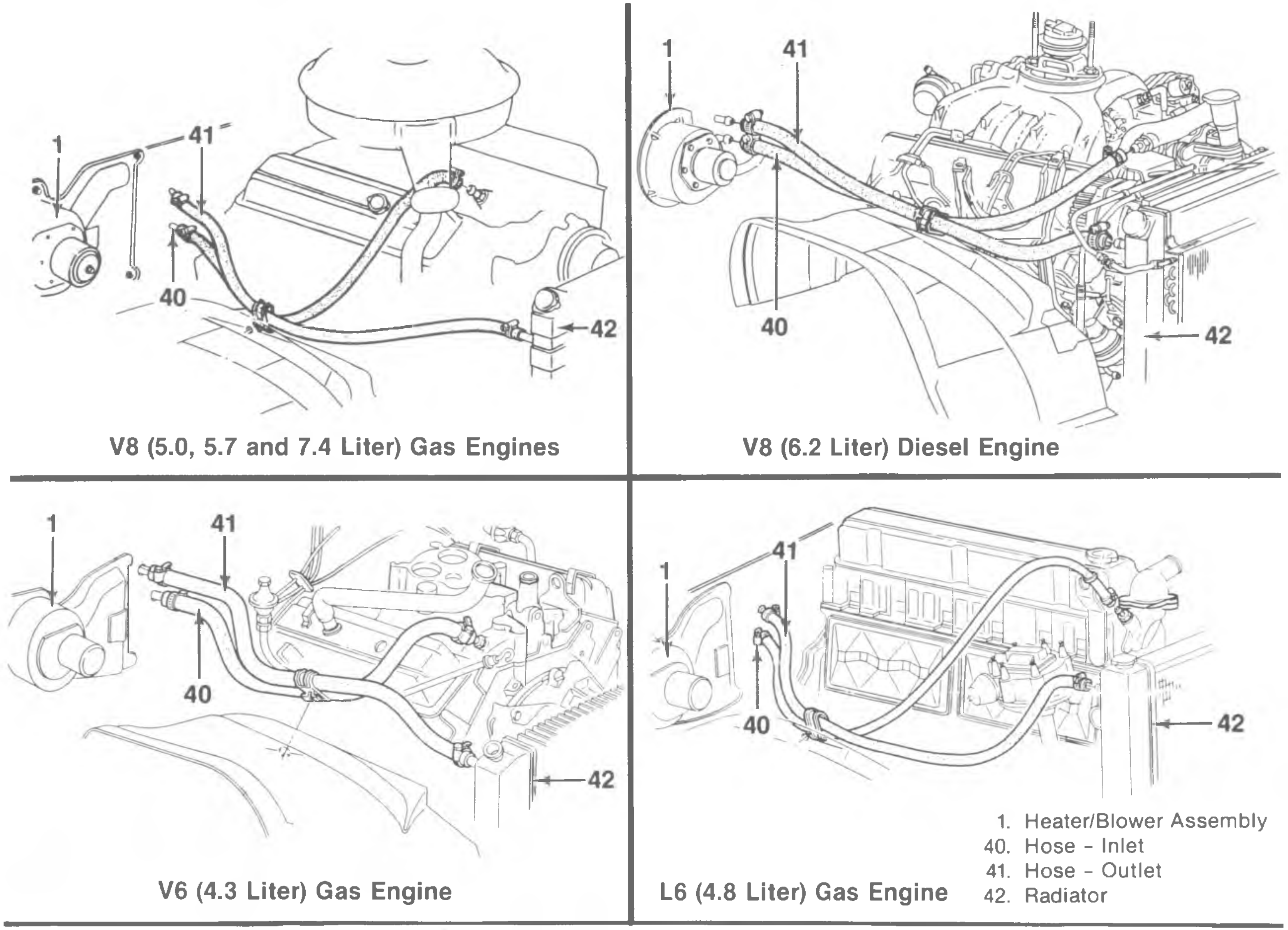
HEATER DISTRIBUTOR AND CORE ASSEMBLY

Remove or Disconnect (Figures 4, 5, 6, 7 and 8)

1. Battery ground cable.
2. Heater hoses at the core tubes (figure 6).
   - — Drain engine coolant into a clean pan.
   - — Plug the core tubes to prevent spillage.
3. Nuts from the distributor duct studs that project into the engine compartment (figure 6).
4. Instrument panel compartment assembly.
5. Air defroster and temperature cables (figure 7).
6. Floor outlet (figure 8).
7. Screw that holds the defroster duct to the heater distributor (figure 8).
8. Screws that hold the heater distributor to the dash panel.
   - Pull the assembly rearward to reach the wiring harness.
9. Wiring harness.
10. Heater distributor.
11. Core retaining clamps (figure 4).
12. Core (figure 5).

Install or Connect (Figures 4, 5, 6, 7, and 8)

1. Core (figure 5).
2. Core retaining clamps (figure 4).
3. Heater distributor.
4. Wiring harness.
5. Defrost duct to heater distributor (figure 5).
6. Floor outlet (figure 4).
7. Air-defroster and temperature cables (figure 6).
8. Instrument panel compartment.
9. Heater hoses to the core tubes (figure 4).
   - Unplug the hoses.
10. Replace coolant.
11. Battery ground wire.



V8 (5.0, 5.7 and 7.4 Liter) Gas Engines

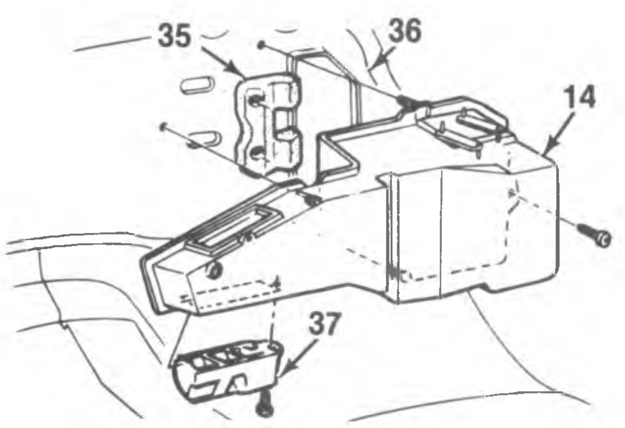
V8 (6.2 Liter) Diesel Engine

V6 (4.3 Liter) Gas Engine

L6 (4.8 Liter) Gas Engine

1. Heater/Blower Assembly
40. Hose - Inlet
41. Hose - Outlet
42. Radiator

Figure 5—Heater Hoses Routing Diagram



14. Case
35. Seal
36. Dash
37. Floor Outlet

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Figure 6—Heater Distributor Assembly

CONTROL ASSEMBLY REPLACEMENT

Remove or Disconnect (Figures 7 and 9)

1. Battery ground cable.
2. Instrument panel bezel.
3. Bowden cables (figure 7).
4. Blower switch wiring harness (figure 9).
5. Assembly through the opening above the control.

Install or Connect (Figures 7 and 9)

- If a new unit is being installed, transfer the blower switch to the new unit.

1. Assembly through the opening above the control.
2. Blower switch wiring harness.
3. Bowden cables.
4. Instrument panel bezel.
5. Battery ground cable.

CONTROL CABLES

Remove or Disconnect (Figure 7)

1. Battery ground cable.
2. Instrument panel bezel.
3. Control to instrument panel screws.
4. Cable push nuts and tab attaching screws.
   - Raise or lower the control as necessary.
5. Instrument panel compartment.
6. Cable push nut and tab attaching screws at the door end of the cable.
7. Cable from the retaining clip.
8. Cable assembly.

Install or Connect (Figure 7)

1. Cable assembly.

Important

- Do not kink the cable. Route the cable as removed. Check adjustment.

2. Cable to retaining clip.
3. Cable push nut and the tabe attaching the screw at the door.
4. Instrument panel compartment.
5. New cable push nuts and the tab attaching screws.
6. Instrument panel to control screws.
7. Instrument panel bezel.
8. Battery ground cable.

CABLE ADJUSTMENT

Remove or Disconnect (Figure 7)

1. Battery ground cable.
2. Instrument panel compartment.
3. Eyelet clip.
4. Cable from the door.

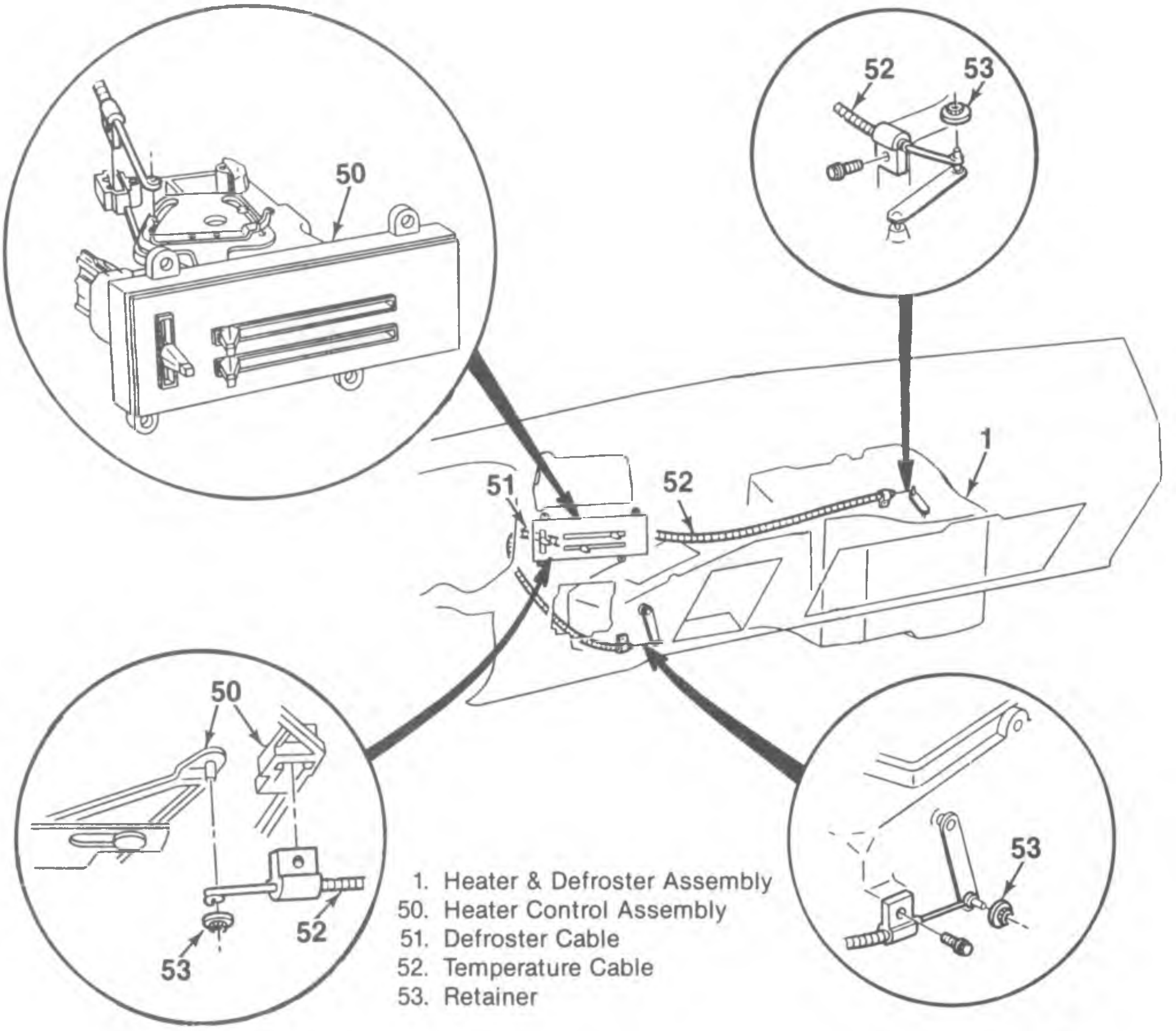
Adjust

- With pliers, hold the cable and rotate the mounting tab to lengthen or shorten the cable.

NOTICE: Do not pinch the cable.

Install or Connect (Figure 7)

1. Cable to the door.
2. Eyelet clip.
3. Instrument panel compartment.
4. Battery ground cable.



1. Heater & Defroster Assembly
50. Heater Control Assembly
51. Defroster Cable
52. Temperature Cable
53. Retainer

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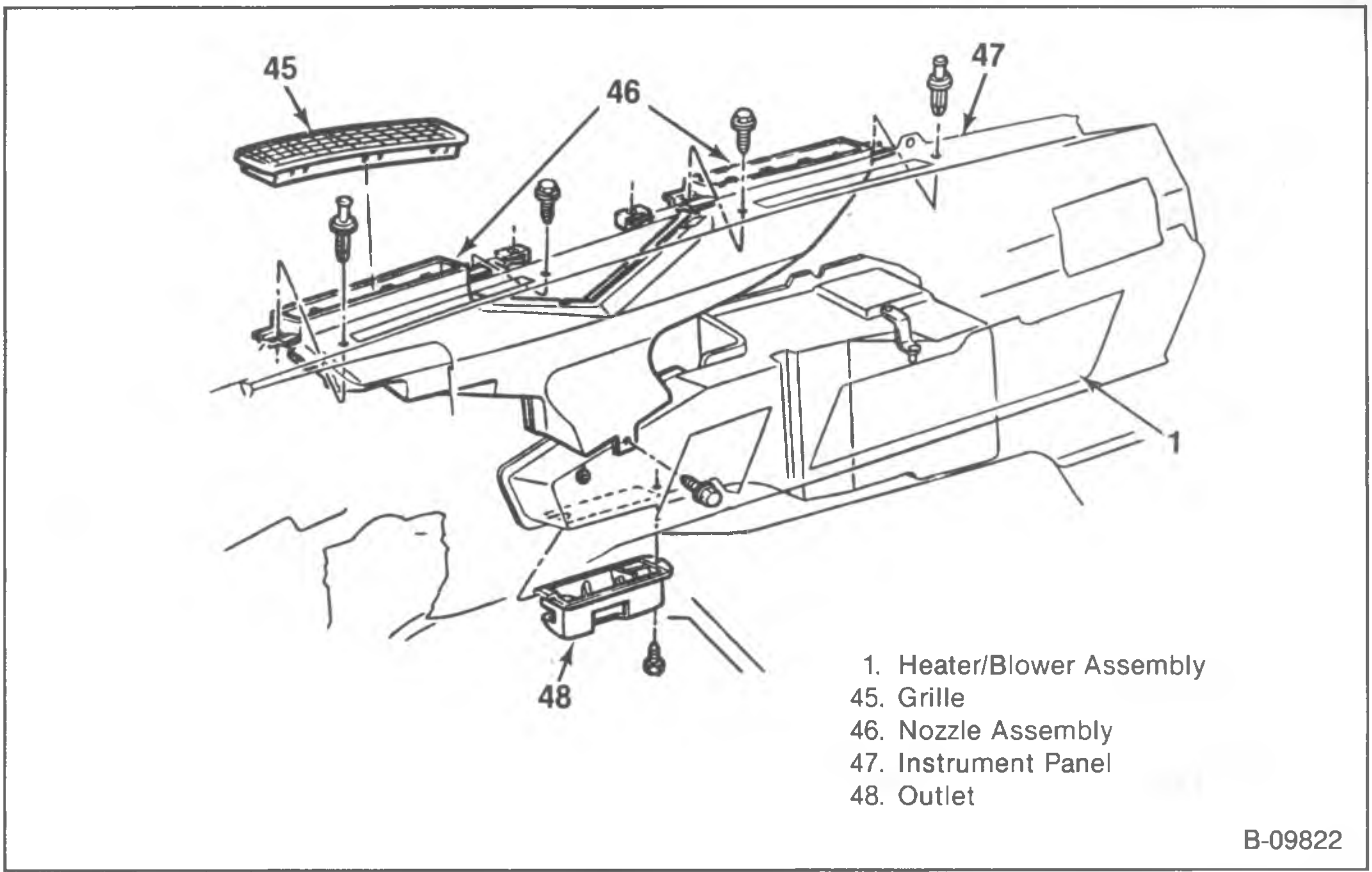
Figure 7—Control Assembly And Cables



1. Heater/Blower Assembly
45. Grille
46. Nozzle Assembly
47. Instrument Panel
48. Outlet

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Figure 8—Defroster Vents

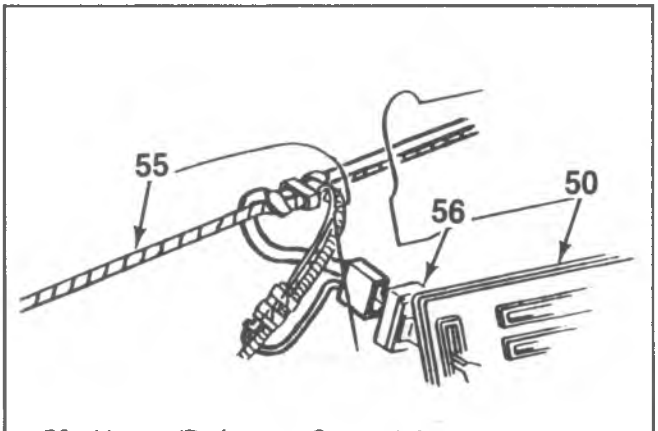
BLOWER SWITCH REPLACEMENT

↔ Remove or Disconnect (Figure 9)

1. Battery ground cable.
2. Instrument panel bezel.
3. Control to instrument panel screws.
4. Control.
   - Lower control onto the radio.
4. Switch wiring harness.
5. Switch.

→← Install or Connect (Figure 9)

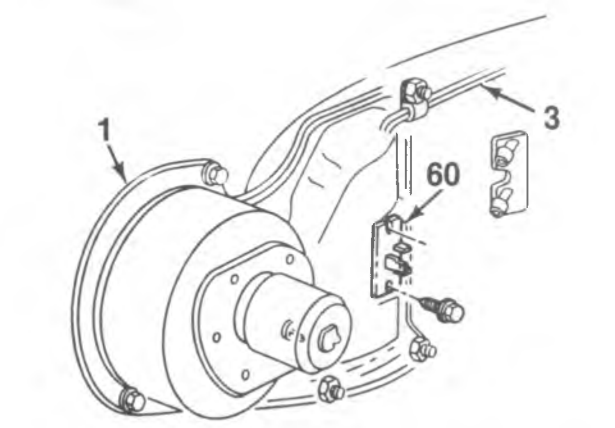
1. Switch.
2. Wiring harness.
3. Control to instrument panel.



50. Heater/Defroster Control Assembly
55. Instrument Panel Wiring Harness
56. Blower Switch

B-09811

Figure 9—Blower Switch



1. Heater and Blower Assembly
3. Blower Wiring
60. Resistor

B-09812

Figure 10—Blower Motor Resistor

65. Bezel
66. Valve Assembly
67. Instrument Panel Garnish
68. Kickpanel
69. Control Cable

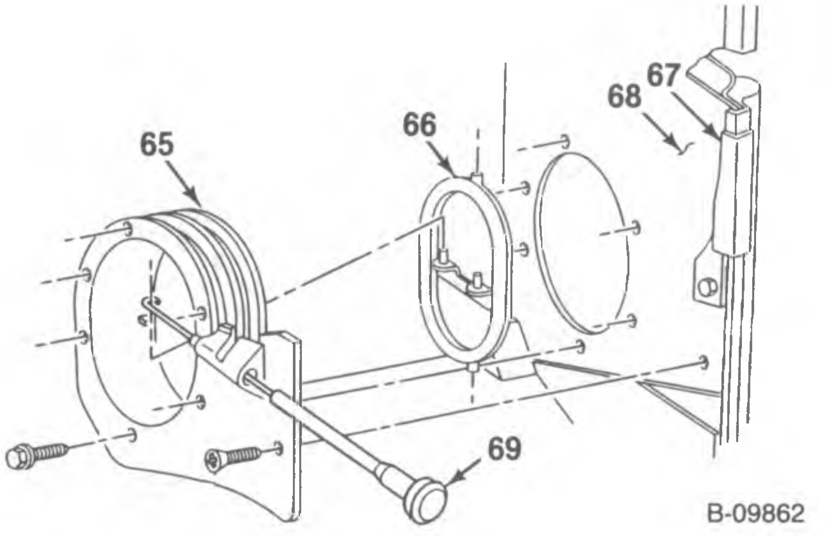


Figure 11—Vent Assembly — CK

4. Instrument panel bezel.
5. Battery ground cable.

RESISTOR REPLACEMENT

Remove or Disconnect (Figure 10)

1. Battery ground cable.
2. Wiring harness.
3. Two resistor mounting screws.
4. Resistor (figure 10).

Install or Connect

1. Resistor.
2. Mounting screws.
3. Wiring harness.
4. Battery ground cable.

VENT

Right and left vents are installed in the kick panels under the instrument panel. Replace the vents by removing the attaching screws (figure 11).

C-K SERIES AUXILIARY HEATER

GENERAL DESCRIPTION

An auxiliary heater provides additional heating capacity for the rear of the Suburban model.

This unit operates independently of the standard heater, and is regulated through its own controls at the instrument panel.

This system consists of a separate core and fan unit mounted in the rear of the vehicle.

Heater hoses extend from the unit to the front of the vehicle where they are connected to the standard heater hoses with "tees." An "on-off" vacuum operated water valve is installed in the heater core inlet line in the engine compartment. This valve cuts off coolant flow to the auxiliary core during warm weather and eliminates radiant heat (figure 12).

Two control methods are used:

WATER VALVE

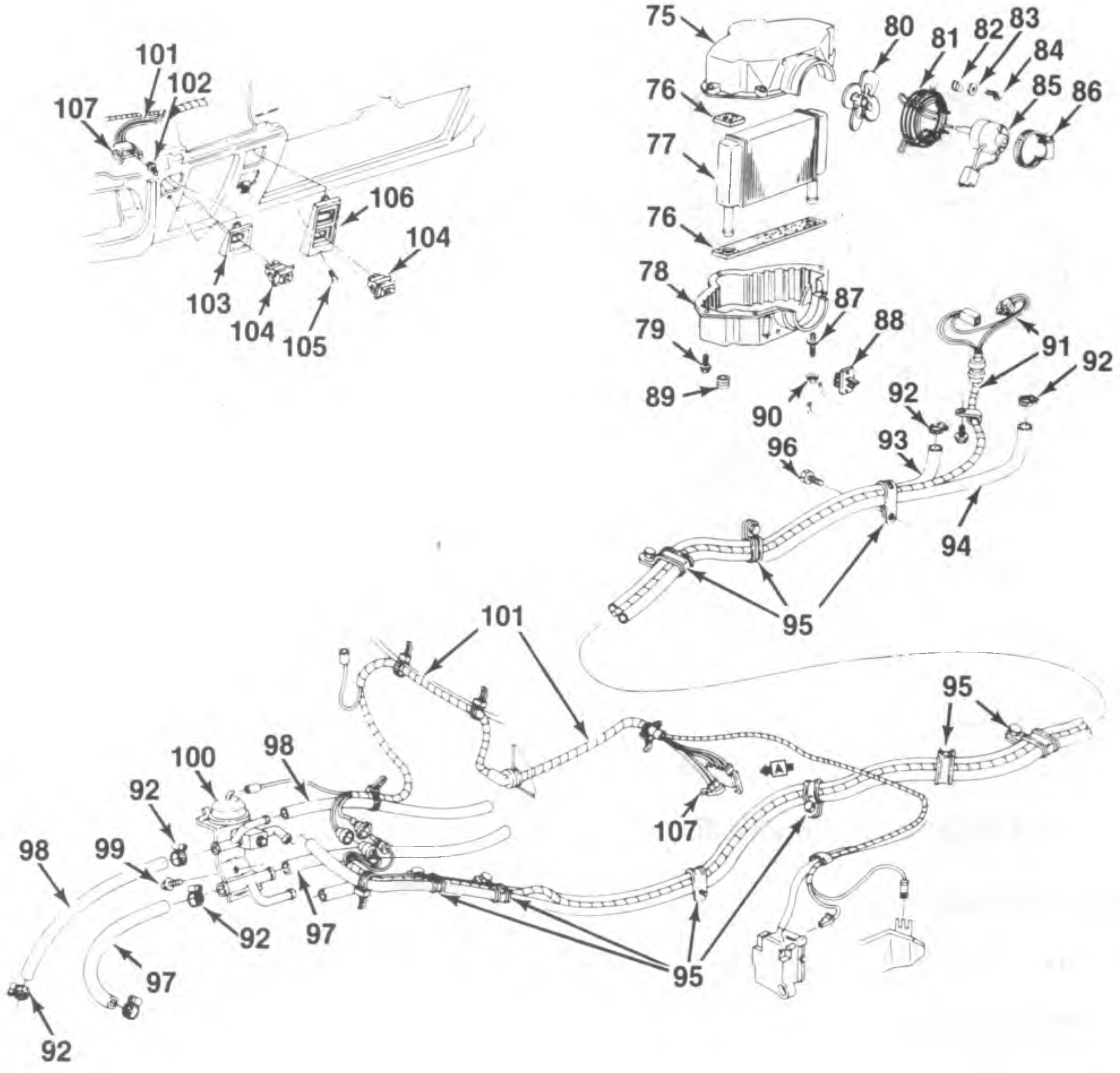
When heat is desired, and the fan switch is any position except off, a vacuum operated water valve controlled by the switch, opens the water line to permit hot water circulation through the heater core. In the OFF position the valve is closed to prevent unwanted heat.

FAN SWITCH

The three speed fan switch is located in the instrument panel to the right of the steering column.

DIAGNOSIS

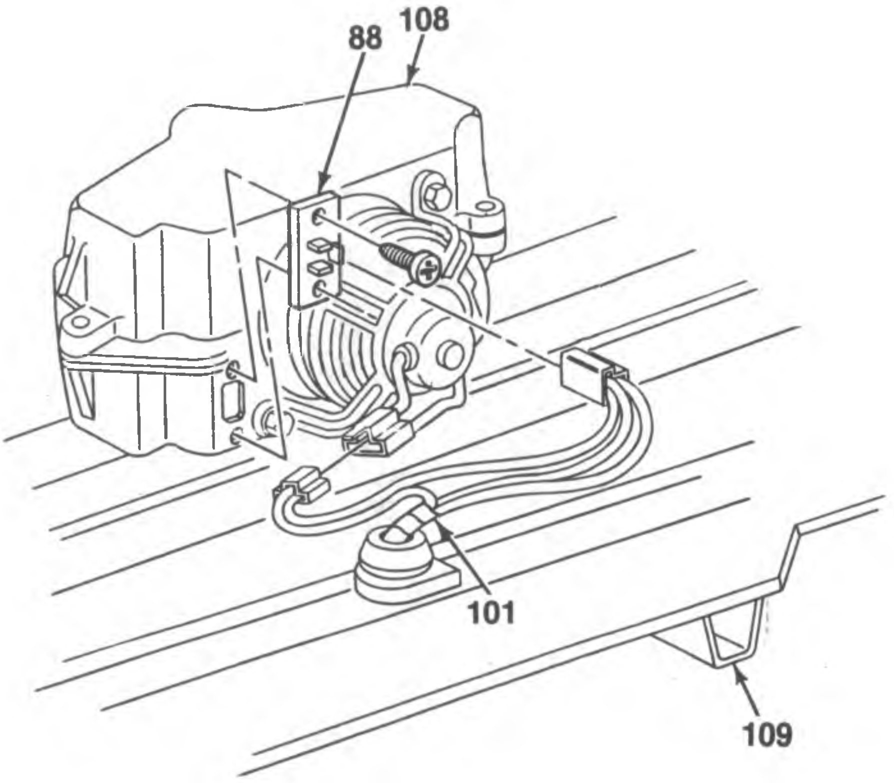
Refer to "C-K and G Model Heaters."



75. Upper Case
76. Seal
77. Core
78. Lower Case
79. Screw
80. Fan
81. Support
82. Grommet
83. Washer
84. Screw
85. Motor
86. Clamp
87. Stud
88. Resistor
89. Seal
90. Nut
91. Harness
92. Clamp
93. Auxiliary Heater Inlet Rear Hose
94. Auxiliary Heater Outlet Rear
95. Clip
96. Screw
97. Water Heater Outlet Hose
98. Water Heater Inlet Hose
99. Screw
100. Valve
101. Harness
102. Screw
103. Auxiliary Heater Switch (Single Function) Bezel
104. Auxiliary Heater Control Switch
105. Screw
106. Auxiliary Heater/Rear Air Conditioning Control Switch (Dual Function)
107. Connector

B-09813

Figure 12—Auxiliary Heater—Suburban



88. Resistor
101. Wiring Harness
108. Auxiliary Heater
109. Platform

Figure 13—Resistor Location

ON-VEHICLE SERVICE

RESISTOR PRELACEMENT

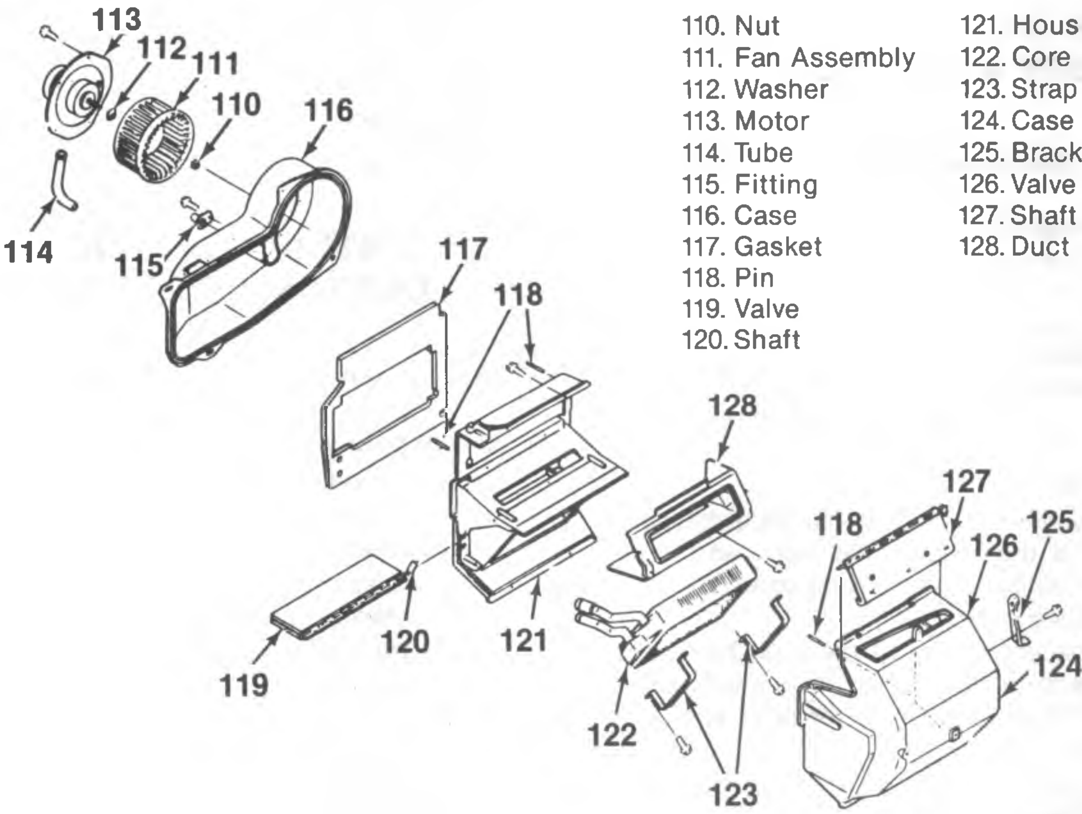
Remove or Disconnect (Figure 13)

1. Battery ground cable.
2. Wiring connector.
3. Screws.
4. Resistor (88).

Install or Connect (Figure 13)

1. Resistor.
2. Screws.
3. Wiring connector.
4. Battery ground cable.

G SERIES HEATER—ON-VEHICLE SERVICE



110. Nut
111. Fan Assembly
112. Washer
113. Motor
114. Tube
115. Fitting
116. Case
117. Gasket
118. Pin
119. Valve
120. Shaft
121. Housing
122. Core
123. Strap
124. Case
125. Bracket
126. Valve
127. Shaft Assembly
128. Duct

Figure 14—G-Model Component View

BLOWER MOTOR REPLACEMENT

Remove or Disconnect (Figure 14)

1. Battery ground cable.
2. Coolant overflow hose from the recovery bottle.
3. Fasteners.
4. Bottle from the vehicle.
5. Blower motor lead wire.
6. Motor and wheel assembly (113).
    - Five mounting screws.
    - Gently pry on the blower flange if the sealer acts like an adhesive.
7. Blower sheel shaft nut (112).
8. Blower wheel from the motor (111).

Install or Connect

1. Blower wheel to the motor shaft.
    - Locate the open end of the wheel away from the blower motor.
2. Blower wheel shaft nut.
3. Motor and wheel assembly.
4. Bead of sealer to the mounting flange.
5. Blower motor lead wire.
6. Coolant bottle to the vehicle.
7. Fasteners.
8. Coolant hose.
9. Battery ground cable.
10. Test the blower.

HEATER HOSES—ROUTING

Heater hoses are routed from the thermostat housing or inlet manifold and water pump (radiator on some automatic transmission vehicles) to the core inlet and outlet pipes (figure 15). Hoses are attached at each end with screw-type clamps.

REPLACEMENT

When replacing heater hoses, maintain a 13 mm (1/2-inch) minimum clearance between the hose clip and the upper control arm, a 38 mm (1 1/2-inch) minimum clearance between the hoses and the propshaft, and a 32 mm (1 1/4-inch) minimum clearance between the auxiliary heater core lines and the exhaust pipe. Refer to figure 15.

1¼-inch (32 mm) minimum clearance between the auxiliary heater core lines and the exhaust pipe. Refer to figure 15.

HEATER DISTRIBUTOR AND CORE ASSEMBLY

←→ Remove or Disconnect (Figures 15, 16 and 17)

1. Battery ground cable.
2. Coolant recovery tank.
3. Heater core hoses (figure 15).
   - — Place a clean pan under the vehicle to catch any coolant spillage.
   - — Plug the hoses.
   - — Allow coolant in the core to drain into the pan.
4. Heater distributor duct (figure 16).
   - — Remove the screws that hold the distributor duct to the distributor case and the distributor duct to the engine cover.
5. Engine housing cover.
   - — Remove the screws at the windshield, all lower screws and the right instrument panel support bracket at the door pillar and the engine housing.
6. Instrument panel.
7. Lower the steering column.
   - Raise and support the right side of the instrument panel.
8. Defroster duct to distributor case attaching screws.
9. Distributor to heater case (2) screws.
10. Temperature door cable (figure 17).
    - — Fold the cable back for access.
11. Heater case and core.
    - — Three nuts at the engine compartment side of the distributor case and one screw on the passenger side.
    - — Tilt the case assembly rearward at the top while lifting up until the core tubes clear the dash openings.
12. Core retaining strap screws (figure 15).
13. Core.

→← Install or Connect (Figures 15, 16 and 17)

1. Core to the heater case.
2. Sealer between the core and case.
3. Core retaining strap screws.
4. Apply new sealer between the heater case and the opening in the vehicle.
5. Heater core and case to the vehicle.
   - Tilt the case until the core tubes clear the cowl opening.
6. Temperature door cable.
7. Distributor duct to the heater case.
8. Defroster duct to the distributor case.
9. Instrument panel.
10. Steering column.
11. Engine housing cover.
12. Heater distributor duct.
13. Heater core hoses.
14. Coolant recovery tank.
15. Battery ground cable.

DISTRIBUTOR AND DEFROSTER DUCTS

←→ Remove or Disconnect (Figure 16)

1. Battery ground cable.
2. Raise the instrument panel at the right side. Refer to "Heater Distributor and Core Assembly."
3. Engine cover.
   - — Unsnap the engine cover front latches and remove the two cover-to-floor pan screws.
4. Screws that hold the heater distributor duct to the heater case.
5. Screw at the left center of the distributor duct.
6. Distributor duct.
   - Pull the center distributor duct to the right.
7. Defroster duct.
   - Screws that hold the defroster duct to the instrument panel.

→← Install or Connect (Figure 16)

1. Defroster duct.
2. Distributor duct.
3. Engine cover.
4. Instrument panel.
5. Battery ground cable.

CONTROL ASSEMBLY REPLACEMENT

←→ Remove or Disconnect (Figure 17)

1. Battery ground cable.
2. Instrument panel bezel.
3. Control out of the instrument panel (figure 17).
   - Pull the control out to reach the bowden cable.
4. Bowden cables.
5. Control illumination bulb.
6. Blower switch connector.
7. Control from the vehicle.
8. Blower switch.

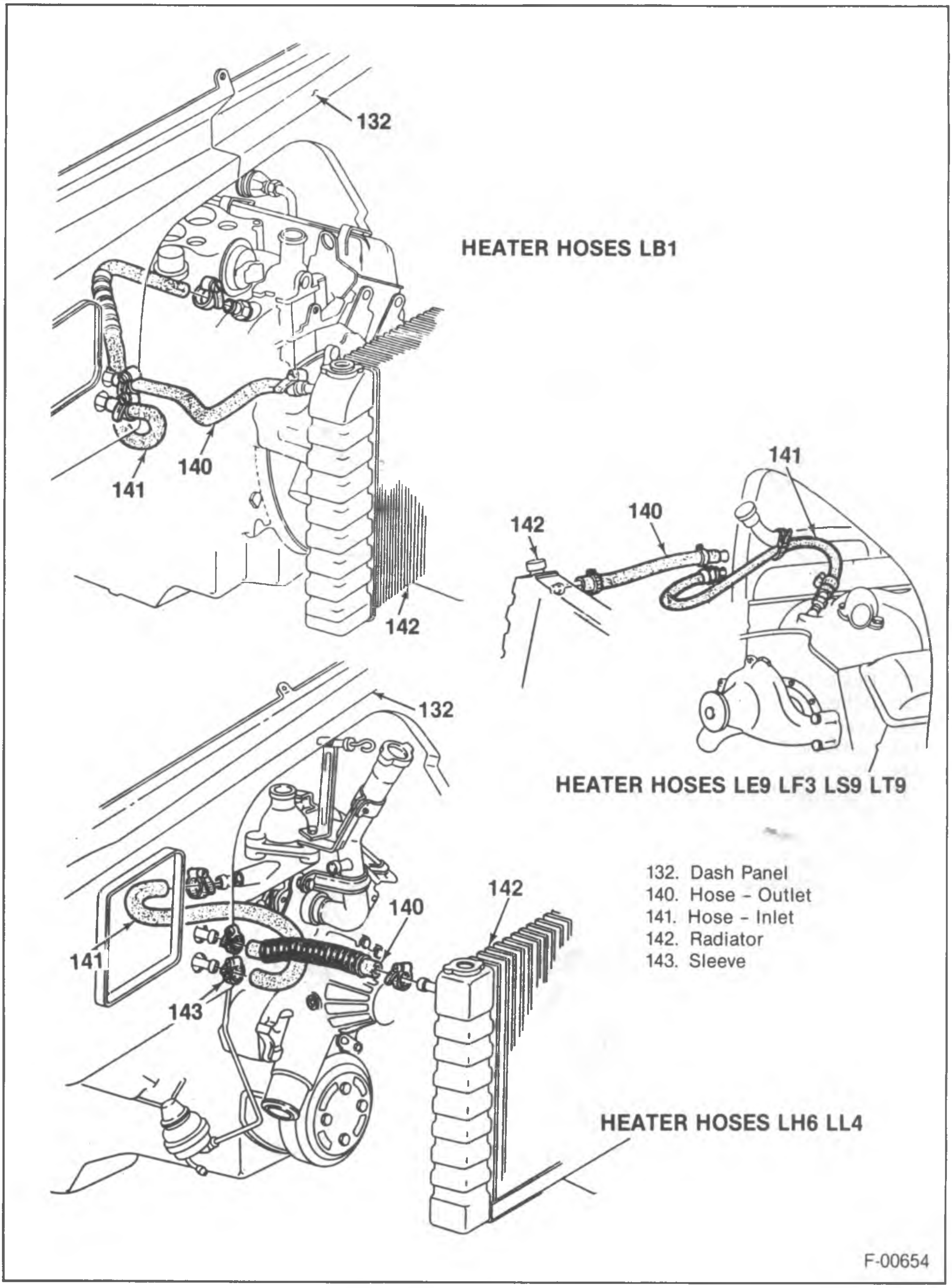
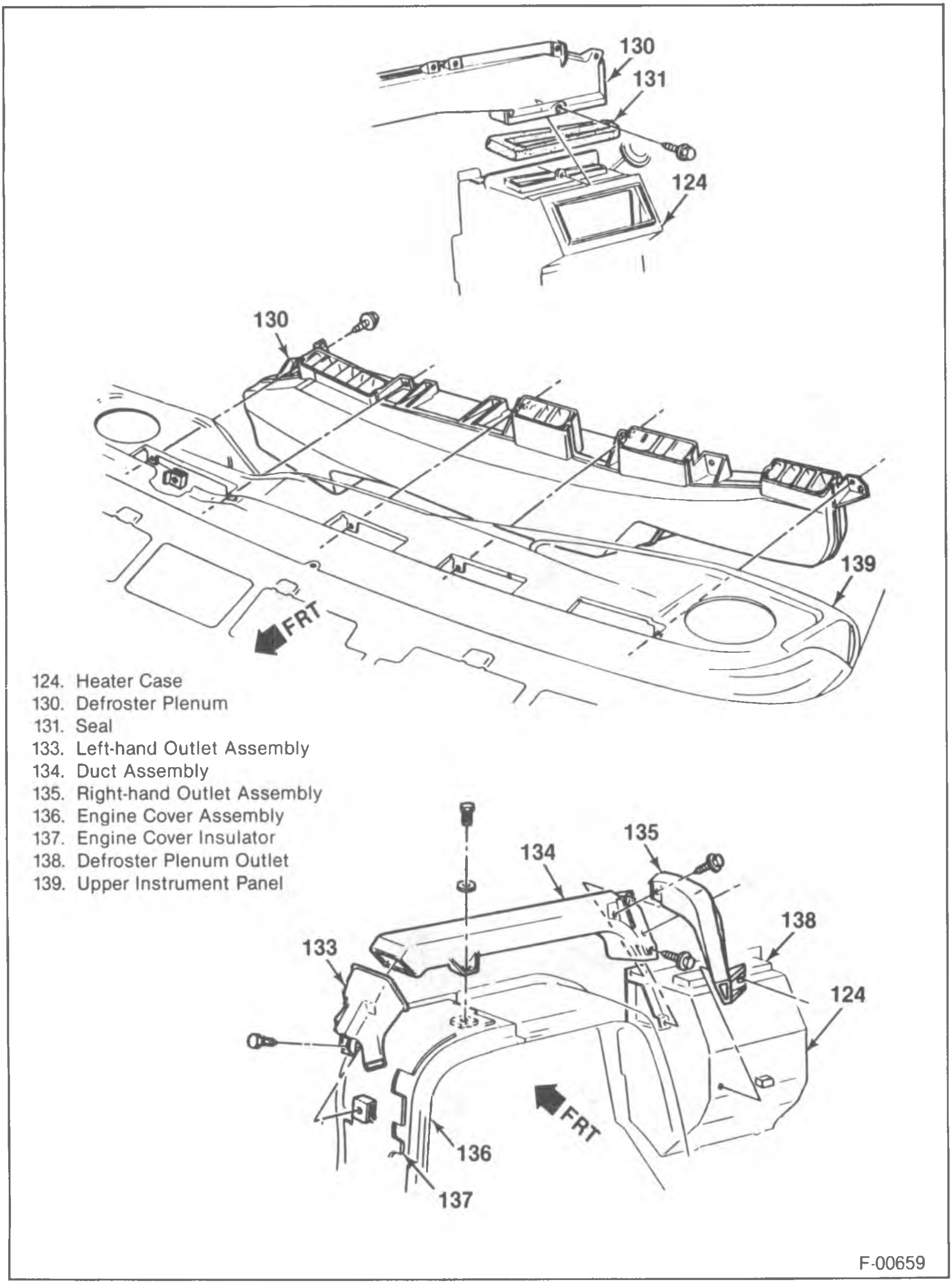
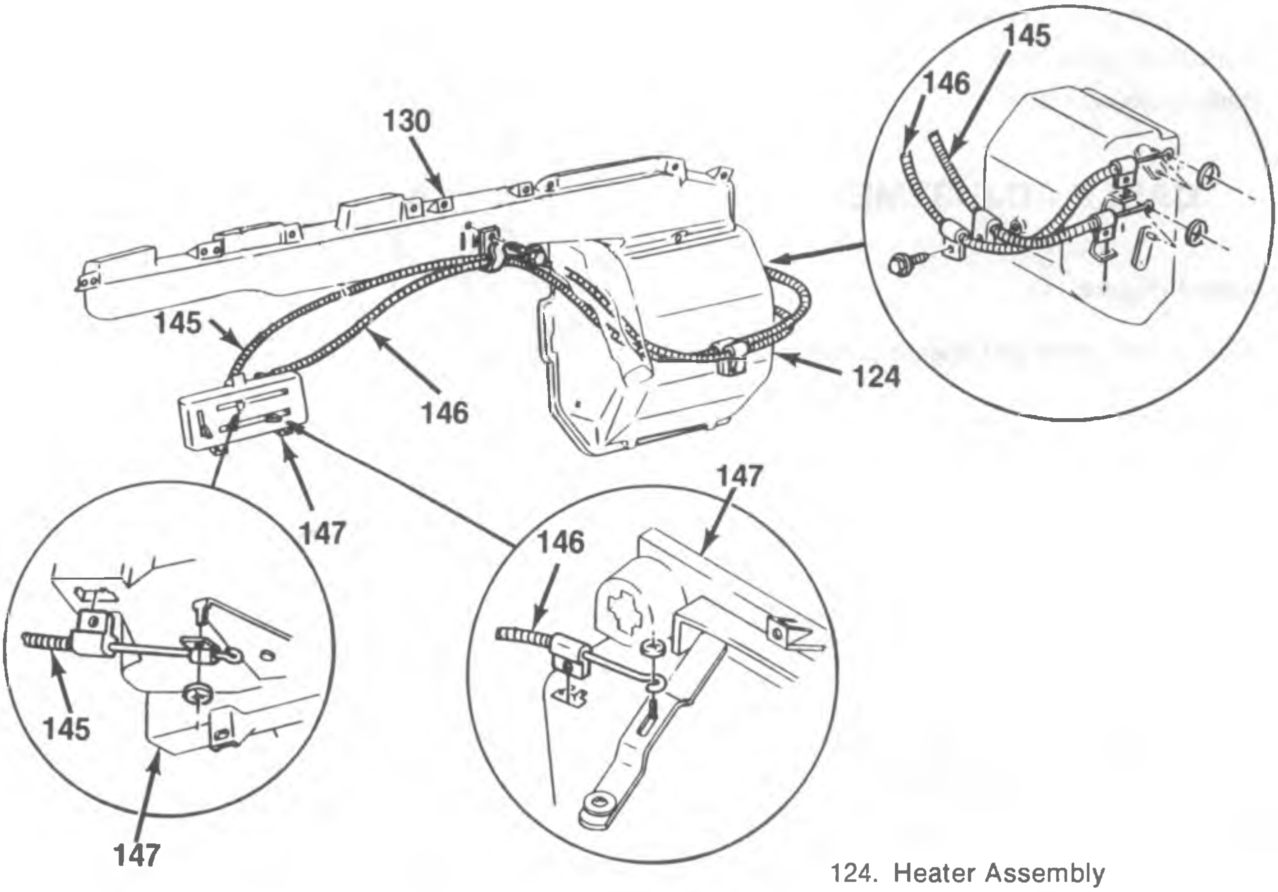


Figure 15—Heater Hose Distribution



124. Heater Case
130. Defroster Plenum
131. Seal
133. Left-hand Outlet Assembly
134. Duct Assembly
135. Right-hand Outlet Assembly
136. Engine Cover Assembly
137. Engine Cover Insulator
138. Defroster Plenum Outlet
139. Upper Instrument Panel

Figure 16—Distributor Ducts



124. Heater Assembly
130. Defroster Plenum
145. Temperature Cable
146. Defroster Cable
147. Control Assembly

F-00658

Figure 17—Control Assembly And Cables

→← Install or Connect (Figure 17)

1. Blower switch to control assembly (147).
2. Blower switch connector.
3. Control illumination bulb.
4. Bowden cables.
5. Control to the instrument panel.
6. Instrument panel bezel.
7. Battery ground cable.

CONTROL CABLES REPLACEMENT

←→ Remove or Disconnect (Figure 14)

1. Battery ground cable.
2. Instrument panel bezel.
    - Place transmission lever in "low."
3. Control to instrument panel screws.
4. Cable push nuts and tab attaching screws.
    - Raise or lower control as necessary.
5. Instrument panel compartment.
6. Cable push nut and tab attaching screws at the door end of the cable.
7. Cable from the retaining clip.
8. Cable assembly.

→← Install or Connect (Figure 14)

1. Cable assembly.

! Important

— Do not kink cable. Route the cable as removed.
— Check adjustment.

2. Cable to retaining clip.
3. Cable push nut and the tab attaching the screw at the door.

4. Instrument panel compartment.
5. Cable push nuts and the tab attaching screws.
6. Instrument panel to control assembly screws.
7. Instrument panel bezel.
8. Battery ground cable.

CABLE ADJUSTMENT

Adjust (Figure 14)

1. Attach inner cable and sheath to the instrument panel control.
2. Move the temperature cable to cold.
3. Attach the loop on the inner cable to the temperature door on the heater case.
4. Attach the cable sheath to the heater case.
5. Move the temperature lever to full heat. This will require force to slide the inner cable clip to its proper position.

BLOWER SWITCH REPLACEMENT

Remove or Disconnect (Figure 14)

1. Battery ground cable.
2. Blower switch wiring harness connector at the switch.
3. Switch attaching screws.
4. Switch assembly.

Install or Connect (Figure 14)

1. Switch.
2. Switch attaching screws.
3. Blower switch wiring harness.
4. Battery ground cable.

RESISTOR REPLACEMENT

Remove or Disconnect (Figure 18)

1. Screws.
2. Resistor (171).

Install or Connect (Figure 18)

1. Resistor.
2. Screws.

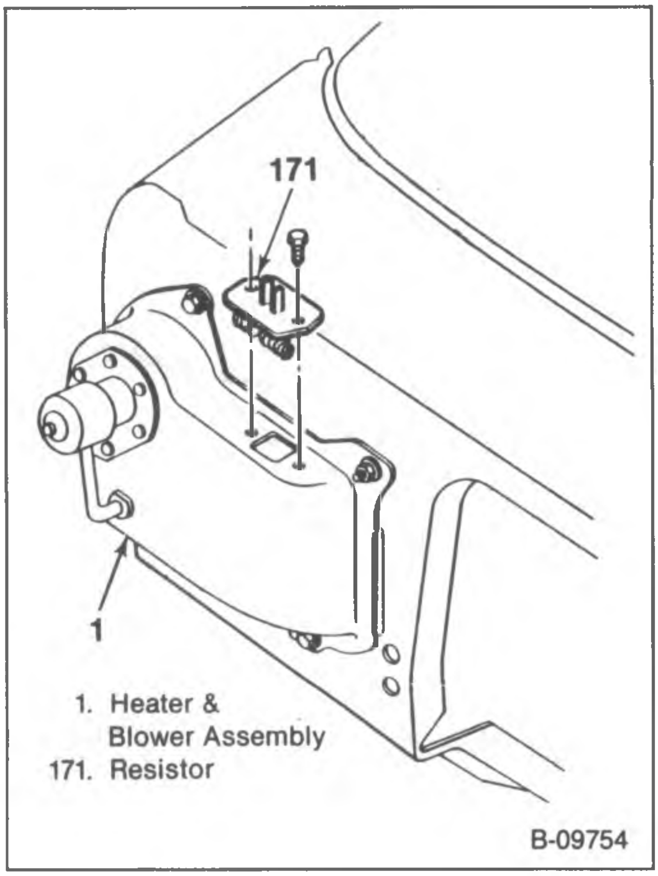


Figure 18—Resistor Replacement

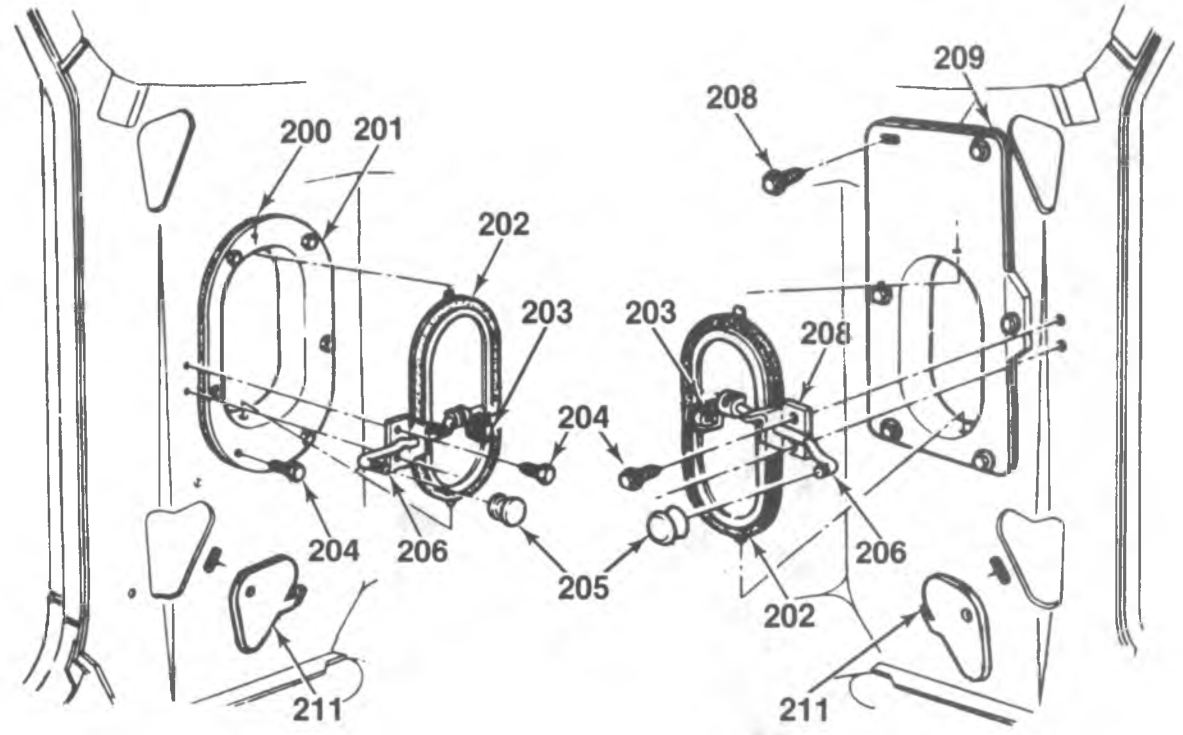
VENT REPLACEMENT

Remove or Disconnect (Figure 19)

1. Screws (5).
2. Valve assembly (202).

Install or Connect (Figure 19)

1. Valve assembly (202).
2. Screws (5).



200. Seal
201. Outlet
202. Valve Assembly
203. Clip
204. Screw
205. Knob
206. Rod
207. Guide
208. Outlet
209. Seal
210. Inlet Assembly
211. Cover

F-00657

Figure 19—Vents

G SERIES AUXILIARY HEATER

GENERAL DESCRIPTION

An auxiliary heater provides additional heating for the rear area on some models.

It operates independently of the standard heater, and is regulated through its own control at the instrument panel.

This system consists of a separate core fan vent.

Heater hoses extend from the unit to the front of the vehicle where they are connected to the standard heater hoses with "tees" (figure 21).

DIAGNOSIS

Refer to "C-K and G Series Heaters."

WATER VALVE

An "on-off" vacuum-operated water valve, installed in the heater core inlet in the engine compartment, controls coolant flow to the auxiliary core and eliminates radiant heat during warm weather.

FAN SWITCH

For heating, the fan switch is placed in any position except off. The switch opens the water valve which permits hot water to enter the heater core. In the OFF position, the valve is closed to prevent unwanted heat during warm weather.

ON-VEHICLE SERVICE

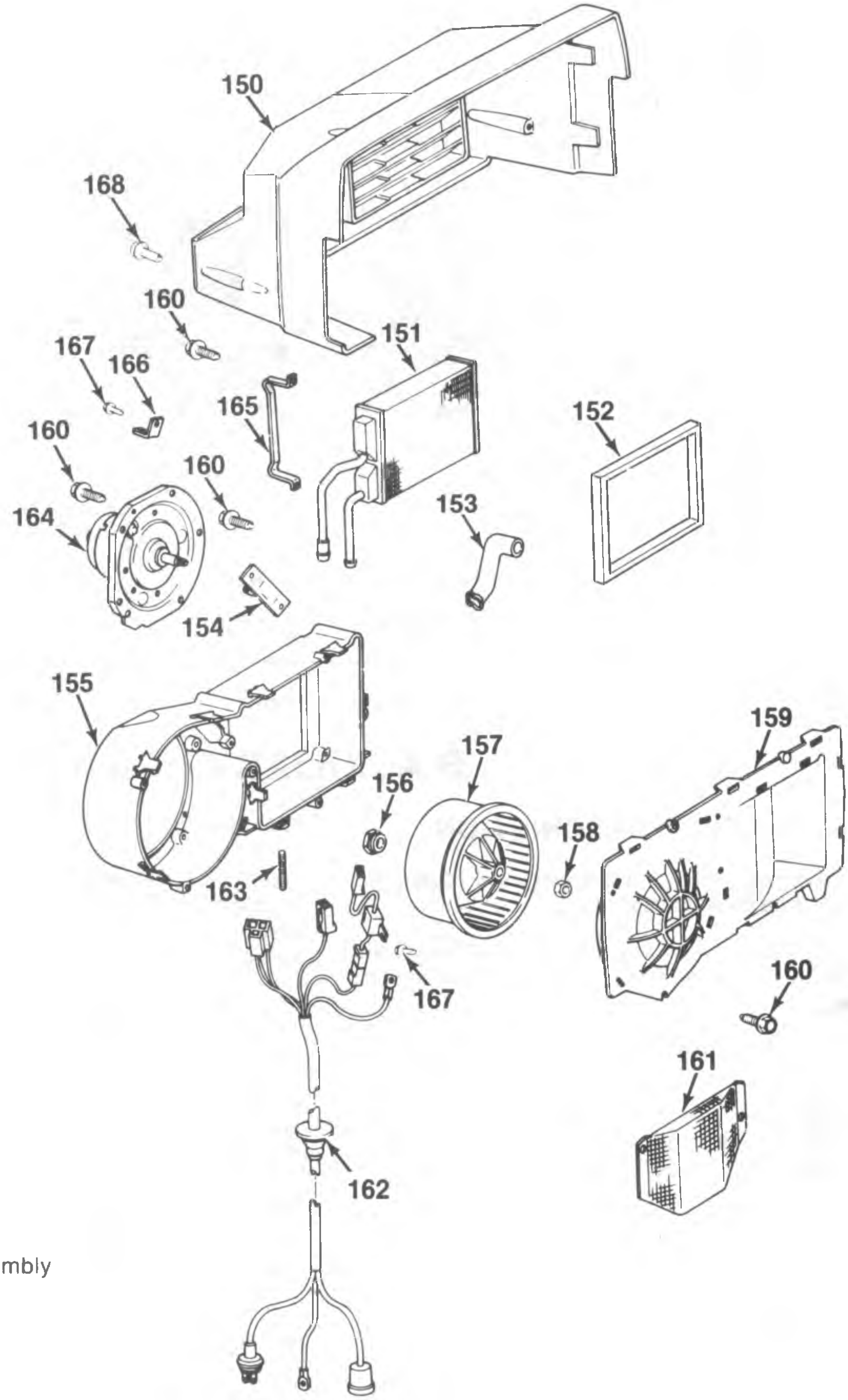
RESISTOR REPLACEMENT

Remove or Disconnect (Figure 18)

1. Battery ground cable.
2. Wiring harness at the resistor connector.
3. Resistor mounting screws.
4. Resistor.

Install or Connect (Figure 18)

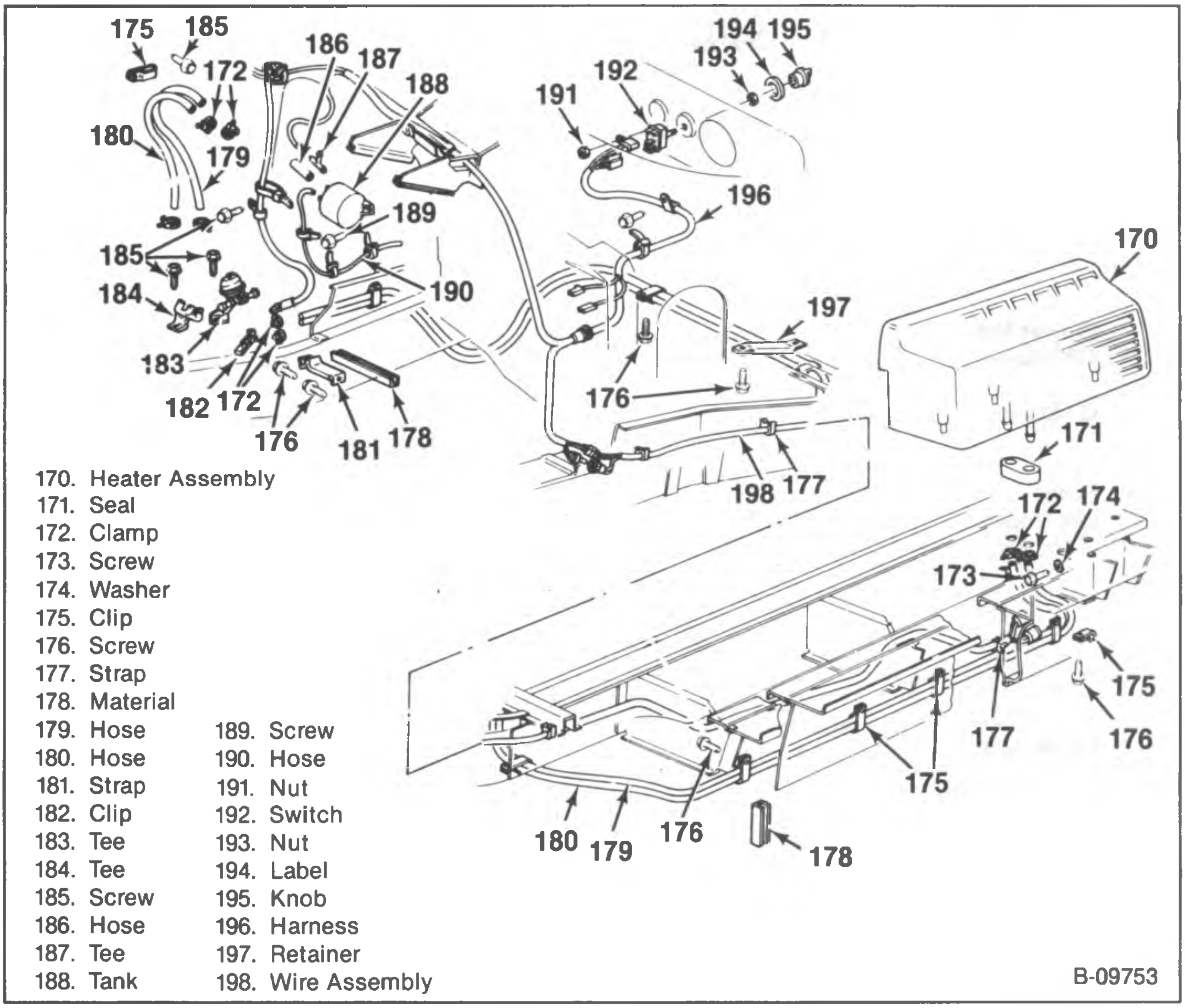
1. Resistor.
2. Mounting screws.
3. Wiring harness.
4. Battery ground cable.



150. Case
151. Core
152. Seal
153. Tube
154. Resistor
155. Case
156. Washer
157. Fan
158. Nut
159. Plate
160. Screw
161. Screen
162. Harness Assembly
163. Stud
164. Motor
165. Strap
166. Terminal
167. Screw
168. Screw

B-09752

Figure 20—Auxiliary Heater Component View



170.	Heater Assembly
171.	Seal
172.	Clamp
173.	Screw
174.	Washer
175.	Clip
176.	Screw
177.	Strap
178.	Material
179.	Hose
180.	Hose
181.	Strap
182.	Clip
183.	Tee
184.	Tee
185.	Screw
186.	Hose
187.	Tee
188.	Tank
189.	Screw
190.	Hose
191.	Nut
192.	Switch
193.	Nut
194.	Label
195.	Knob
196.	Harness
197.	Retainer
198.	Wire Assembly

Figure 21—Auxiliary Heater Plumbing Component View

SPECIFICATIONS

C-K AND G SERIES

HEATER

	Volts	Amps. (Cold)	RPM (Cold)
Blower Motor			
C-K Models	13.5	6.25 Max.	2550 Min. 2950 Max.
G Models	13.5	7.1 Max.	2850 Min. 3250 Max.

Fuses

C-K Models	20 Amp.
G Models	20 Amp.

AUXILIARY HEATER

	Volts	Amps. (Cold)	RPM (Cold)
Blower Motors	13.5	9.6 Max.	2700 Min.

SECTION 1B

AIR CONDITIONING

CONTENTS

SUBJECT **PAGE**

CONTENTS (CONTINUED)

CONTENTS (CONTINUED)

DESCRIPTION

CCOT A/C SYSTEM

The CCOT (Cycling Clutch Orifice Tube) A/C system performs heating and cooling. Air enters the vehicle and passes through the cooling unit (evaporator) and through (or around) the heating unit. The system is called a "reheat" system. The evaporator cools the air passing through the core when the air conditioning system is in the cooling mode.

On C-K and G series, a pressure sensing switch, located near the top of the accumulator, controls compressor operation. The switch responds to pressure changes to turn the compressor ON or OFF.

System operation:

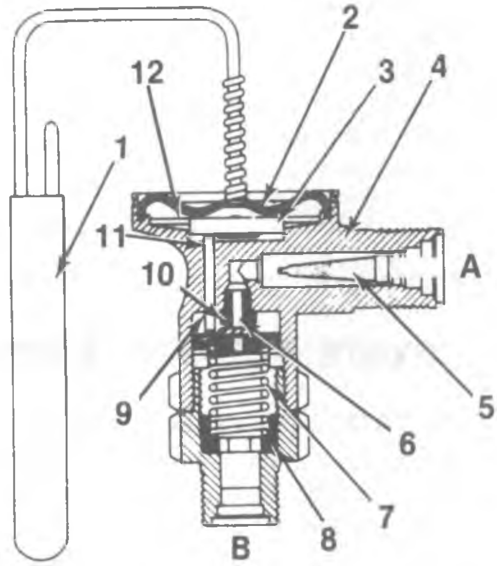
Outside air or recirculated air enters the system and is forced through the system by the blower. As the air passes through the evaporator core, it receives maximum cooling if the air conditioning controls are positioned for cooling.

From the evaporator, the air enters the heater and air conditioner selector duct assembly where, by means of diverter doors, it passes through or bypasses the heater core in proportions necessary to provide the desired outlet temperature. The air enters the vehicle through either the floor distributor duct or the dash outlets.

During cooling, the air is cooled by the evaporator to below comfort level then warmed by the heater to the desired temperature. During "heating only" the evaporator does not operate, and ambient air is warmed to the desired level in the same manner.

REAR INTERIOR ROOF MOUNTED SYSTEMS (SUBURBAN & G SERIES)

These systems operate with the front system - they do not operate independently. However, control of the rear blower motor speed is possible when the front system at OFF. Rear air circulation without the refrigerant function is possible by operating the rear blower control switch.



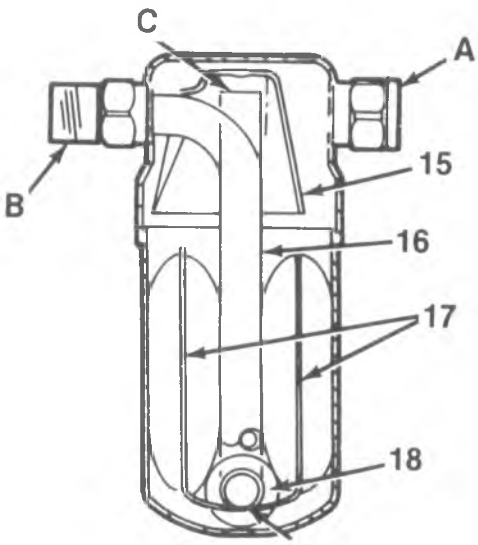
1. Power Element Thermobulb
2. Cover
3. Diaphragm Back-up Plate
4. Body
5. Screen
6. Orifice
7. Carriage Spring
8. Spring Seat
9. Carriage Seat
10. Seat
11. Actuating Pin
12. Diaphragm

A. Inlet
B. Outlet

F-00190

Figure 1—Thermostatic Expansion Valve

These self-contained units operate on inside (recirculated) air. Air enters the unit and passes through the evaporator core into the passenger compartment through the air distributor duct. The front system controls the rear system. A three-speed blower switch controls the rear interior roof mounted system.



A. Inlet
B. Outlet
C. Refrigerant Vapor Outlet
15. Baffle
16. Internal Tube
17. Desiccant Bag Assembly
18. Filter Assembly
19. Oil Bleed Hole

F-00191

Figure 2—Accumulator C-K & G Series

SYSTEM COMPONENTS

THERMOSTATIC EXPANSION VALVE

Suburban and G rear interior roof mounted and motor home chassis systems use a thermostatic expansion valve (figure 1).

The valve consists of the power element, body, actuating pins, seat and orifice. At the high pressure liquid inlet, a fine mesh screen prevents dirt, filings or other foreign matter from entering the valve orifice.

When the valve is connected in the system, high pressure liquid refrigerant enters the valve through the screen from the receiver-dehydrator or condenser and passes on to the seat and orifice where it changes into a low pressure liquid.

The low pressure liquid leaves the valve and flows into the evaporator core where it absorbs heat from the evaporator core and changes to a low pressure vapor and leaves the evaporator core. The power element bulb is clamped to the low pressure vapor line just beyond the outlet of the evaporator.

ACCUMULATOR C-K & G SERIES

The accumulator is located at the evaporator outlet. It separates liquid retained from vapor, retains the liquid and releases the vapor to the compressor (figure 2).

Flow from the accumulator to the compressor consists of vapor, entrained liquid and liquid flow through the oil bleed hole.

A bag of desiccant (dehydrating agent), located in the accumulator, collects moisture.

There is no sight glass in the accumulator with the CCOT system.

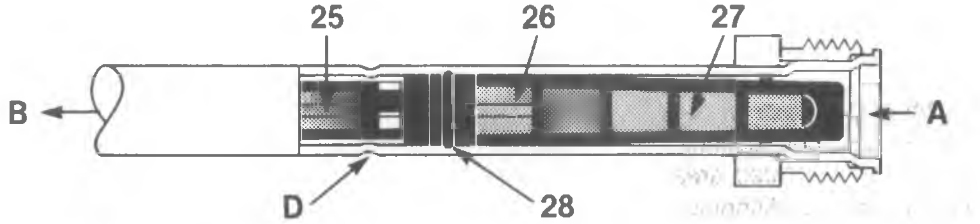
ORIFICE (EXPANSION TUBE) C-K & G SERIES

Pressure differences and sub-cooling determines expansion tube flow. The orifice is located in the evaporator inlet line (figure 3).

PRESSURE CYCLING SWITCH

This switch controls evaporator temperature. It cycles the compressor clutch off when the evaporator temperature gets too low. It cycles the compressor back on after evaporator temperature has increased (figure 4).

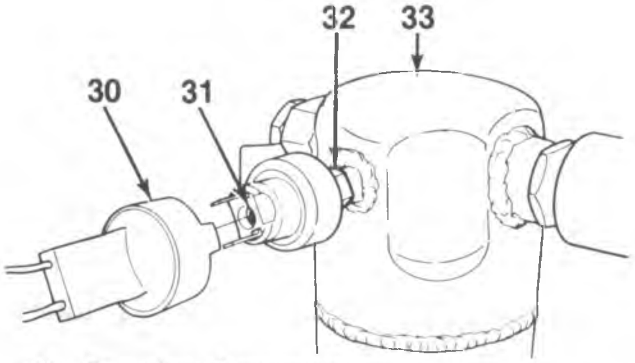
The cycling pressure switch provides inherent compressor protection so a separate low pressure switch is not necessary. The switch also acts as an ambient switch since at ambient freezing temperatures it will not allow the compressor to engage. Adjusting the set screw one-half turn left or right will rise or lower the settings 20.7 kPa (3 psi) (figure 5).



A. Inlet (R-12 From Condenser)
B. Outlet (To Evaporator)
D. Dent In Tube (Retains The Expansion Tube)
25. Outlet Screen
26. Expansion Tube
27. Inlet Screen
28. Seal (O Ring)

F-00192

Figure 3—Orifice (Expansion Tube)



30. Electrical Connector
31. Adjusting Screw
32. "Schrader" Type Valve
33. Accumulator

F-00338

Figure 4—Pressure Cycling Switch

CYCLING PRESSURE SWITCH SETTING (ACCUMULATOR READINGS)

COMPRESSOR CUT OUT PRESSURE RANGE	COMPRESSOR CUT IN PRESSURE RANGE
21-24	43-49

F-00333

Figure 5—Cycling Pressure Switch Settings (Accumulator Readings)

REFRIGERANT-12 OPERATING CHARACTERISTICS

CCOT SYSTEM COMPONENTS, TEMPERATURE AND PRESSURE RELATIONSHIPS

To review system components and Refrigerant-12 flow, refer to figure 6.

To find the pressure and temperature relationship between Refrigerant-12 and atmospheric pressure, refer to figure 7.

To find the relationship between relative humidity, air temperature, evaporator pressure, engine speed (2000 rpm), discharge air temperature and high pressure, refer to figure 8.

To determine the refrigerant charge for Suburban and G Series front and rear interior roof mounted systems, refer to figure 9.

HANDLING REFRIGERANT-12

Air conditioning systems contain Refrigerant-12, a chemical which requires special handling to avoid personal injury.

Always wear goggles and wrap a clean cloth around fittings, valves and connections when opening the system. Work in a ventilated area and do not weld or steam clean near air conditioning lines or components.

Refrigerant-12 drums are shipped with a metal screw cap that protects the valve and safety plug from damage. Replace the cap after each use.

Do not carry a container of Refrigerant-12 in the passenger compartment of a vehicle. Never subject any container to high temperatures. Do not breathe the smoke or fumes produced by burning Refrigerant-12.

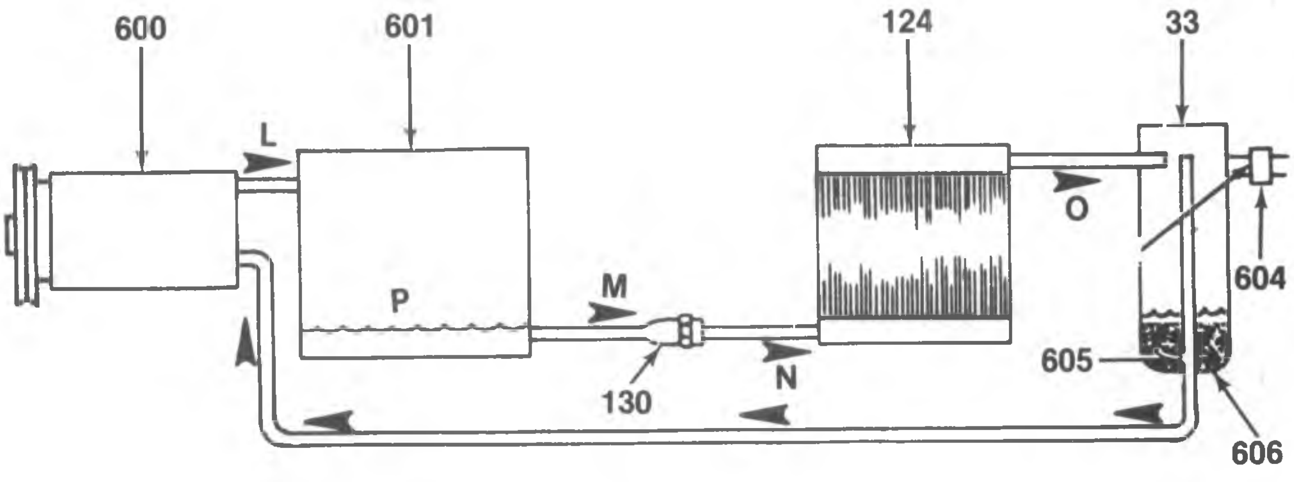
If Refrigerant-12 touches exposed flesh do the following:

- Treat the area as if it were frost bitten or frozen.
- Call a doctor or eye specialist and obtain treatment.
- DO NOT RUB THE EYE. Splash the area with cold water to raise temperature above the freezing point.
- Use an antiseptic oil to provide a protective film over the eyeball to reduce the possibility of infection.

HANDLING OF REFRIGERANT LINES AND FITTINGS

Tighten tubing connections to the specified torque (figure 10). Insufficient or excessive torque causes loose joints or deformed joint parts. Either condition can cause refrigerant leakage.

- All metal tubing lines should be free of dents or kinks to prevent loss of system capacity due to line restriction.
- Never bend a flexible hose line to a radius of less than 4 times the diameter of the hose.
- Never place a flexible hose line closer than 65 mm (2½-inch) to the exhaust manifold.
- Inspect flexible hose lines regularly for leaks or brittleness and replace if necessary.
- When disconnecting any fitting in the refrigeration system discharge the system. However, proceed with caution. Open slowly. Keep face and hands away to prevent injury if there is liquid Refrigerant-12 in the line.



33. Accumulator
130. Exapansion Tube (Orifice)
124. Evaporator
600. Compressor
601. Condenser
604. Pressure Cycling Switch
605. Oil Bleed Hole
606. Dessicant Bag

L. "HPV" - High pressure vapor leaving compressor.
M. "HPL" - Vapor is cooled down by condenser air flow and leaves as high pressure liquid.
N. "LPL" - Orifice meters the liquid R-12 into evaporator, reducing its pressure and warm blower air across evaporator core causes boiling off of liquid into vapor.
O. "LPV" - Leaves evaporator as low pressure vapor and returns with the small amount of . . .
P. "LPV/lpi" - Low pressure liquid that didn't boil off completely back to the compressor to be compressed again.

F-00075

Figure 6—CCOT A/C System Components

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 26.6°C (80°F) will have a pressure of 579.9 kPa (84.1 psi). If it is heated to 51.6°C (125°F), the pressure will increase to 1 154.9 kPa (167.5 psi). It also can be used conversely to determine the temperature at which Refrigerant - 12 boils under various pressures. For example, at a pressure of 207.5 kPa (30.1 psi), Refrigerant - 12 boils at 0°C (32°F).

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

F-00177

Figure 7—Pressure Temperature Relationship of Refrigerant-12

In Front Of Condenser								
Relative Humidity (%)	Air Temp.		Evaporator Pressure	Engine Speed (rpm)	Discharge Air Temp.		High Pressure	
	C°	F°			C°	F°	kPa	psi
20	21	70	29.5	2000	4	40	1034.25	150
	27	80	29.5		7	44	1310.05	190
	32	90	30.0		9	48	1689.27	245
	38	100	31.0		14	57	2102.97	305
30	21	70	29.5	2000	6	42	1034.25	150
	27	80	30.0		8	47	1413.47	205
	32	90	31.0		11	51	1827.17	265
	38	100	32.0		16	61	2240.87	325
40	21	70	29.5	2000	7	45	1137.67	165
	27	80	30.0		9	49	1432.42	215
	32	90	32.0		13	55	1930.60	280
	38	100	39.0		18	65	2378.77	345
50	21	70	30.0	2000	8	47	1241.10	180
	27	80	32.0		12	53	1620.32	235
	32	90	34.0		15	59	2034.02	295
	38	100	40.0		21	69	2413.25	350
60	21	70	30.0	2000	9	48	1241.10	180
	27	80	33.0		13	56	1654.80	240
	32	90	36.0		17	63	2068.50	300
	38	100	43.0		23	73	2482.20	360
70	21	70	30.0	2000	10	50	1275.57	185
	27	80	34.0		14	58	1689.27	245
	32	90	38.0		18	65	2102.97	305
	38	100	44.0		24	75	2516.67	365
80	21	70	30.0	2000	10	50	1310.05	190
	27	80	34.0		15	59	1723.75	250
	32	90	39.0		19	67	2137.45	310
90	21	70	30.0	2000	10	50	1379.00	200
	27	80	36.0		17	62	1827.17	265
	32	90	42.0		22	71	2275.35	330

F-00337

Figure 8—Relative Humidity, Temperature and Pressure Relationships of Refrigerant—12

REFRIGERANT CHARGE

	C60 System
C-K Models	3 lbs. 8 ozs.
G Models	3 lbs. 8 ozs.
	Overhead System
C-K Models	5 lbs. 4 ozs.
G Models	4 lbs. 8 ozs.

F-00652

Figure 9—CCOT A/C System Refrigerant Capacities

Allow any pressure to bleed off as described under "Discharging, Evacuating, Adding Oil And Charging And Discharging The CCOT A/C System."

- Cap or tape any line open to atmosphere to prevent dirt and moisture from entering the system.
- Use proper wrenches when making connections on seal (o-ring) fittings. Use two wrenches to prevent distorting the lines or components.
- When connecting the flexible hose connections, hold the swaged fitting, the flare nut and the coupling at the same time using three different wrenches to prevent turning the fitting and damaging the ground seat.
- Use seals (o-rings) in good condition. A burr or piece of dirt may cause a leak.
- Replace the seal when a connection has been broken. When replacing the seal first dip it in clean 525 viscosity refrigeration oil.
- When making steel to aluminum connections, use torque for aluminum tubing. (Refer to figure 10).

MAINTAINING CHEMICAL STABILITY

The efficient operation of the air conditioning refrigeration system is dependent upon the chemical stability of Refrigerant-12.

Foreign matter can change the stability of Refrigerant-12, cause corrosion and wear. Do the following:

1. Before disconnecting a refrigerant connection, remove dirt or oil at and near the connection. Cap or plug both sides of the connection.
2. Keep tools clean and dry.
3. When adding 525 viscosity refrigerant oil (refer to ADDING OIL in the Discharging, Evacuating, Adding Oil and Charging Procedures for CCOT A/C systems), the transfer device and container should be clean and dry.
4. Have everything ready before opening a line. Do not leave the A/C system open longer than necessary.
5. After opening, evacuate before recharging with Refrigerant-12 according to the "Discharging, Evacuating, Adding Oil, Charging And Discharging The CCOT A/C System."
6. Service parts are dehydrated and seated before shipping. Open just before making connections. Keep at room temperature before uncapping (this prevents moisture from entering the system). If the connections are not made, reseal the parts.

Metal Tube Outside Diameter	Thread and Fitting Size	Steel Tubing Torque		Aluminum or Copper Tubing Torque		Nominal Torque Wrench Span
		N·m	LB. FT.	N·m	LB. FT.	
1/4	7/16	14-20	10-15	7-8	5-7	5/8
3/8	5/8	41-48	30-36	15-18	11-13	3/4
1/2	3/4	41-48	30-36	20-27	15-20	7/8
5/8	7/8	41-48	30-36	28-37	21-22	11/16
3/4	11/16	41-48	30-36	36-45	28-33	1 1/4

F-00161

Figure 10—Pipe and Hose Connections Torque

DIAGNOSIS

NOTICE: When performing air conditioning diagnosis on vehicles equipped with a catalytic converter, warm the engine to a normal operating temperature before attempting to idle the engine for periods greater than five (5) minutes. Make adjustments after the choke is open and fast idle speed is reduced to a normal idle.

TESTING THE REFRIGERANT SYSTEM

If a malfuction is suspected due to abnormal system pressures, check the following:

1. Outer radiator and condensor cores for plugging. Check between the condenser and radiator.
2. Restrictions or kinks in evaporator core or condensor core, hoses, tubes, etc.
3. Refrigerant leaks.
4. Air ducts for leaks or restrictions. Air restriction may indicate a plugged (or partially plugged) evaporator core.
5. Compressor clutch slippage.
6. Improper drive belt tension.
7. Plugged accumulator, orifice (expansion tube) or plugged suction inlet screen (A6 compressor).
8. Moisture in the refrigerant system.

LEAK TESTING THE REFRIGERANT SYSTEM

Liquid Leak Detectors

Check for leaks at fittings and valves with the swab attached to the bottle cap. Bubbles will form if there is a leak.

For restricted areas, use a leak detector, J-6084 or equivalent.

J-6085 LEAK DETECTOR

Tool J-6084 is a propane gas-burning torch used to locate refrigerant leaks. Refrigerant gas drawn into the sampling tube attached to the torch will cause the torch flame to change color in proportion to the size of the leak. Propane gas fuel cylinders used with the torch are available commercially.

CAUTION: Do not use a lighted detector where combustible or explosive gasses, dusts or vapors may be present.

Operating Detector

1. Determine if there is sufficient refrigerant in the sytem for leak testing.

CAUTION: Do not breathe the fumes that are produced by the burning of Refrigerant-12 gas in the detector flame. These fumes can be toxic in large concentrations.

2. Open control valve until a low hiss of gas is heard; then light gas at opening in chimney.
3. Adjust until the blue flame is about 10mm (3/8-inch) above the reactor plate. The reaction plate will heat to a cherry red.
4. Explore for leaks by moving the end of the sampling hose around possible leak points in the system. Do not pinch or kink hose. Since Refrigerant-12 is heavier than air, place open end of sampling tube below point being tested.
5. Watch for color changes. Small leaks will turn the flame to green or yellow-green; large leaks will turn the flame a brilliant blue or purple. After passing through a leak the flame will turn to a colorless pale blue. Make tests in a semi-darkened area. If the flame remains yellow after removing it from a leak, the reaction plate is dirty or the flame is drawing insufficient air.

To check a leak in the high pressure side of the system, operate the system for a minute, shut down and check. To check a leak on the low pressure, operate the system and check several minutes after turning off the system. This will equalize both sides.

PRESSURE SENSING SWITCH

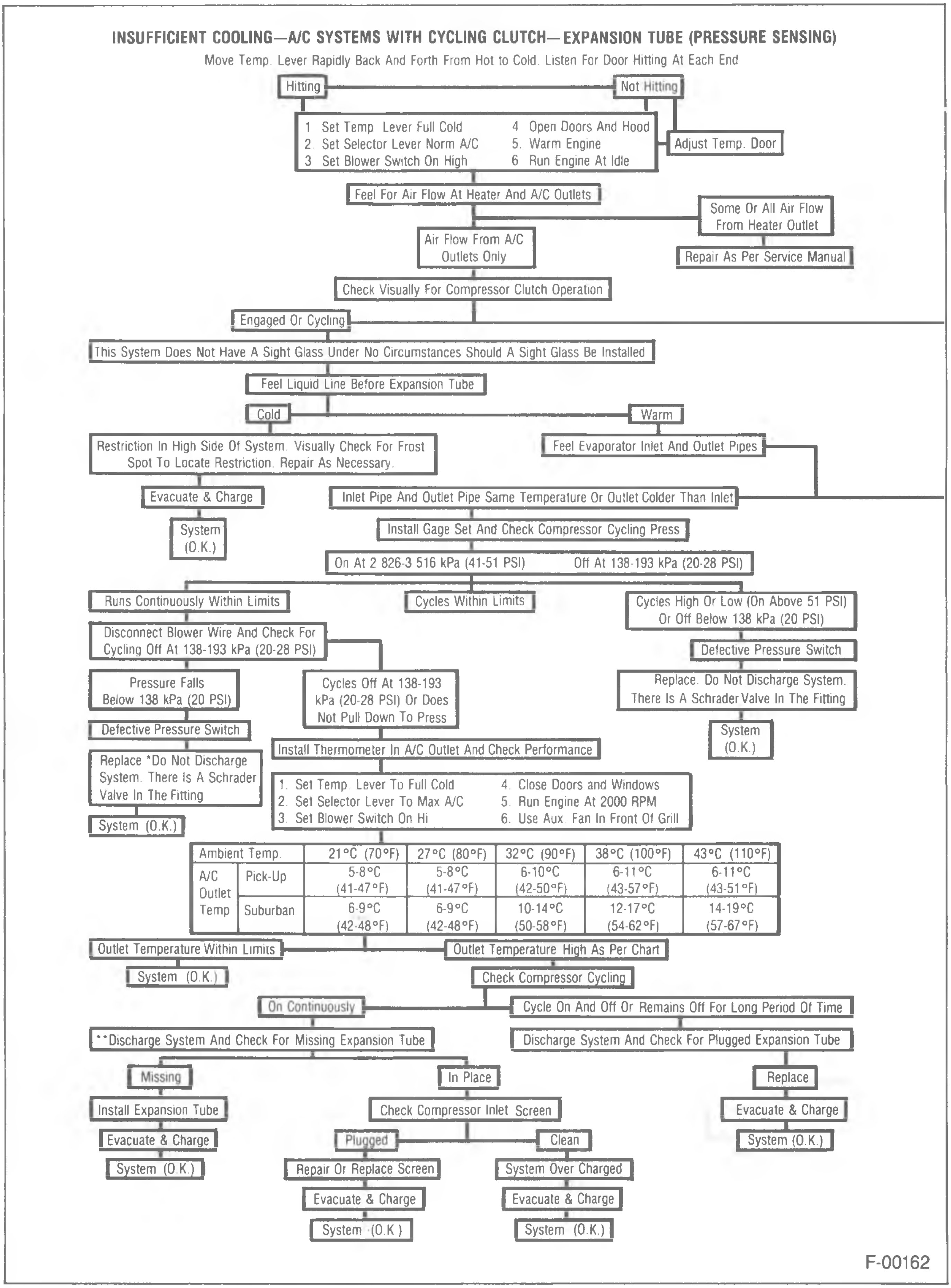
A pressure sensing switch located near the top of the accumulator, cycles the compressor clutch on C-K and G series CCOT A/C systems. The switch also shuts off the compressor clutch when there is a low refrigerant charge.

The A/C system does not have to be discharged to replace the switch. The pressure switch fitting is equipped with a schrader-type valve.

When replacing the switch, use a new oiled seal (o-ring), and torque to 10 N·m (90 in. lbs.).

Refer to the following trouble shooting charts:

1. Pressure Cycling CCOT System Diagnosis (figures 11 and 12).
2. System Diagnosis (Dash Mounted Unit) (figures 13, 14 and 15).
3. Compressor Diagnosis (figure 16).



INSUFFICIENT COOLING—A/C SYSTEMS WITH CYCLING CLUTCH—EXPANSION TUBE (PRESSURE SENSING)

Move Temp. Lever Rapidly Back And Forth From Hot to Cold. Listen For Door Hitting At Each End

Ambient Temp.		21°C (70°F)	27°C (80°F)	32°C (90°F)	38°C (100°F)	43°C (110°F)
A/C Outlet Temp	Pick-Up	5-8°C (41-47°F)	5-8°C (41-47°F)	6-10°C (42-50°F)	6-11°C (43-57°F)	6-11°C (43-51°F)
	Suburban	6-9°C (42-48°F)	6-9°C (42-48°F)	10-14°C (50-58°F)	12-17°C (54-62°F)	14-19°C (57-67°F)

Figure 11—Pressure Cycling CCOT System Diagnosis

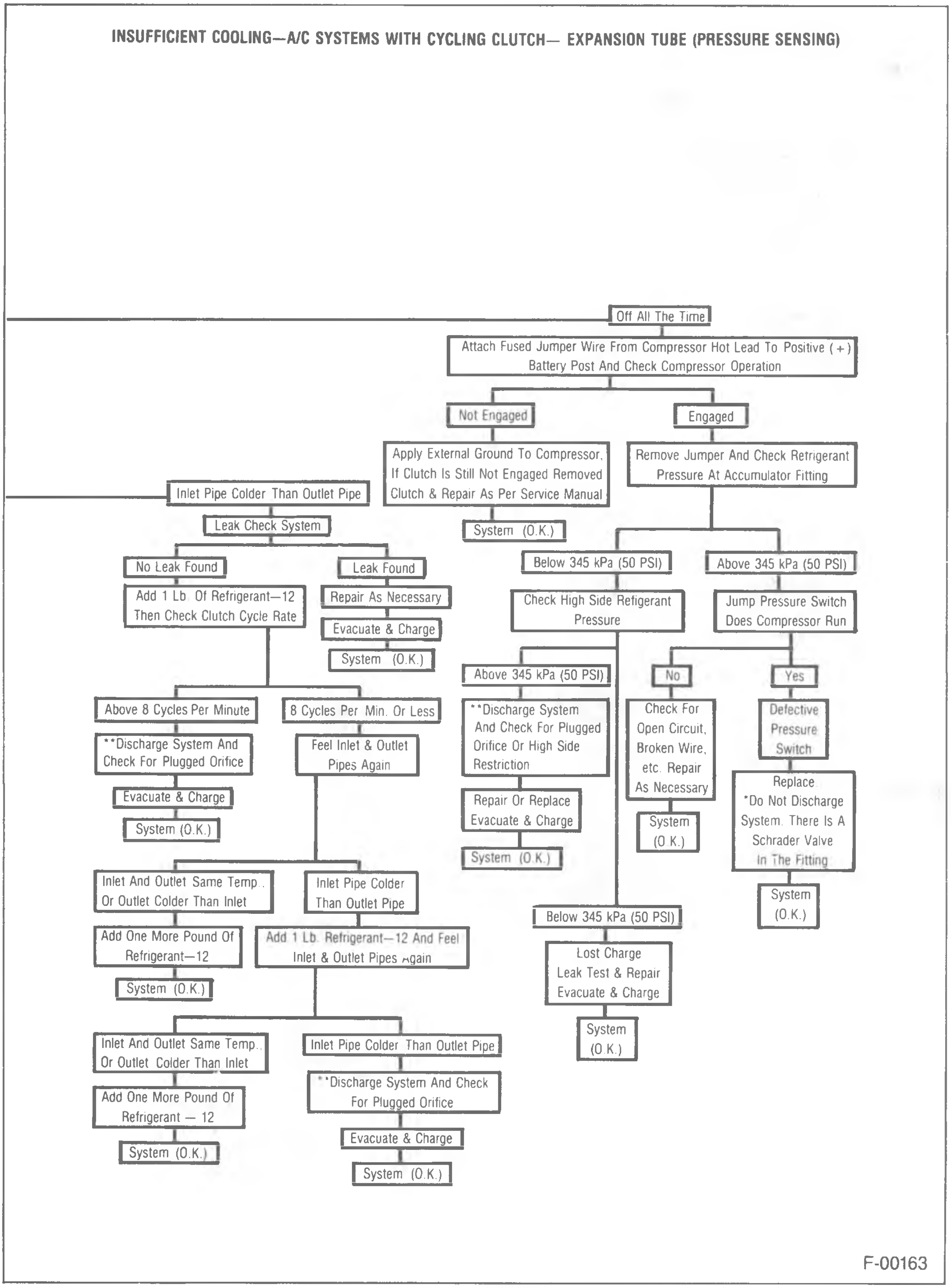


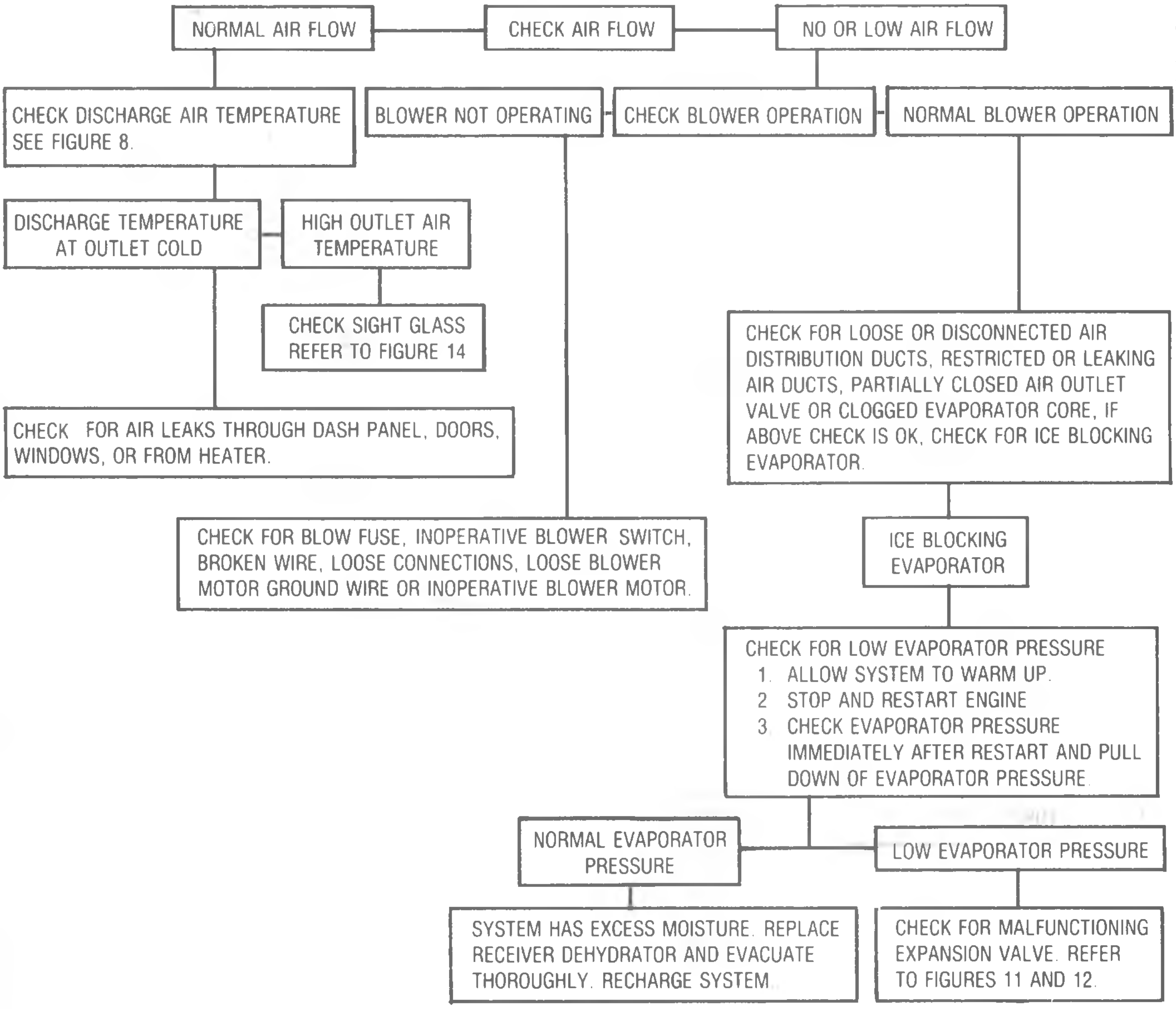
Figure 12—Pressure Cycling System Diagnosis (Cont.)

INSUFFICIENT COOLING DIAGNOSIS CHART

DASH MOUNTED UNIT (MOTOR HOME CHASSIS UNITS)

THE FOLLOWING PROCEDURES SHOULD BE APPLIED BEFORE PERFORMANCE TESTING AN A/C SYSTEM.

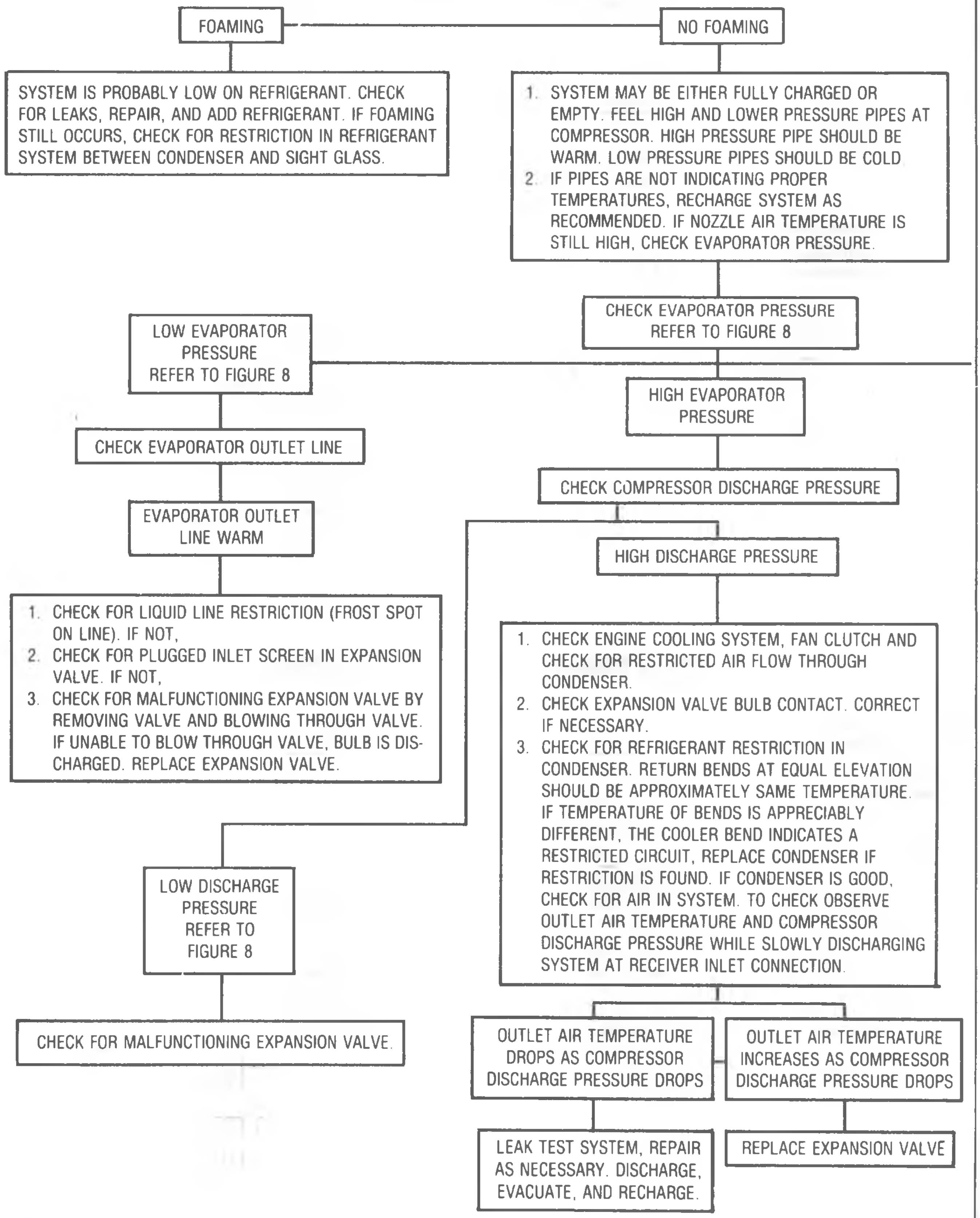
1. CHECK FOR PROPER BELT INSTALLATION AND TENSION WITH J-23600.
2. CHECK FOR PROPER CLUTCH COIL TERMINAL CONNECTOR INSTALLATION.
3. CHECK FOR CLUTCH AIR GAP (0.022-0.057) (.56-1.45 mm).
4. CHECK FOR BROKEN, BURST, OR CUT HOSES. ALSO CHECK FOR LOOSE FITTINGS ON ALL COMPONENTS.
5. CHECK FOR CONDENSOR AIR BLOCKAGE DUE TO FOREIGN MATERIAL.
6. CHECK FOR PROPER AIR DUCTING HOSE CONNECTIONS.
7. CHECK HEATER TEMPERATURE DOOR ADJUSTMENT, ADJUST IF INCORRECT.
8. CHECK EVAPORATOR SEALING FOR AIR LEAK, REPAIR IF LEAKING.
9. INSTALL PRESSURE GAGES AND THERMOMETER AND MAKE PERFORMANCE TEST.



F-00164

Figure 13—Insufficient Cooling Diagnosis Chart

INSUFFICIENT COOLING DIAGNOSIS CHART (CONTINUED)
DASH MOUNTED UNIT (MOTOR HOME CHASSIS UNITS)



FOAMING

SYSTEM IS PROBABLY LOW ON REFRIGERANT. CHECK FOR LEAKS, REPAIR, AND ADD REFRIGERANT. IF FOAMING STILL OCCURS, CHECK FOR RESTRICTION IN REFRIGERANT SYSTEM BETWEEN CONDENSER AND SIGHT GLASS.

NO FOAMING

1. SYSTEM MAY BE EITHER FULLY CHARGED OR EMPTY. FEEL HIGH AND LOWER PRESSURE PIPES AT COMPRESSOR. HIGH PRESSURE PIPE SHOULD BE WARM. LOW PRESSURE PIPES SHOULD BE COLD.
2. IF PIPES ARE NOT INDICATING PROPER TEMPERATURES, RECHARGE SYSTEM AS RECOMMENDED. IF NOZZLE AIR TEMPERATURE IS STILL HIGH, CHECK EVAPORATOR PRESSURE.

CHECK EVAPORATOR PRESSURE REFER TO FIGURE 8

LOW EVAPORATOR PRESSURE REFER TO FIGURE 8

CHECK EVAPORATOR OUTLET LINE

EVAPORATOR OUTLET LINE WARM

1. CHECK FOR LIQUID LINE RESTRICTION (FROST SPOT ON LINE). IF NOT,
2. CHECK FOR PLUGGED INLET SCREEN IN EXPANSION VALVE. IF NOT,
3. CHECK FOR MALFUNCTIONING EXPANSION VALVE BY REMOVING VALVE AND BLOWING THROUGH VALVE. IF UNABLE TO BLOW THROUGH VALVE, BULB IS DISCHARGED. REPLACE EXPANSION VALVE.

HIGH EVAPORATOR PRESSURE

CHECK COMPRESSOR DISCHARGE PRESSURE

HIGH DISCHARGE PRESSURE

1. CHECK ENGINE COOLING SYSTEM, FAN CLUTCH AND CHECK FOR RESTRICTED AIR FLOW THROUGH CONDENSER.
2. CHECK EXPANSION VALVE BULB CONTACT. CORRECT IF NECESSARY.
3. CHECK FOR REFRIGERANT RESTRICTION IN CONDENSER. RETURN BENDS AT EQUAL ELEVATION SHOULD BE APPROXIMATELY SAME TEMPERATURE. IF TEMPERATURE OF BENDS IS APPRECIABLY DIFFERENT, THE COOLER BEND INDICATES A RESTRICTED CIRCUIT, REPLACE CONDENSER IF RESTRICTION IS FOUND. IF CONDENSER IS GOOD, CHECK FOR AIR IN SYSTEM. TO CHECK OBSERVE OUTLET AIR TEMPERATURE AND COMPRESSOR DISCHARGE PRESSURE WHILE SLOWLY DISCHARGING SYSTEM AT RECEIVER INLET CONNECTION.

LOW DISCHARGE PRESSURE REFER TO FIGURE 8

CHECK FOR MALFUNCTIONING EXPANSION VALVE.

OUTLET AIR TEMPERATURE DROPS AS COMPRESSOR DISCHARGE PRESSURE DROPS

LEAK TEST SYSTEM, REPAIR AS NECESSARY. DISCHARGE, EVACUATE, AND RECHARGE.

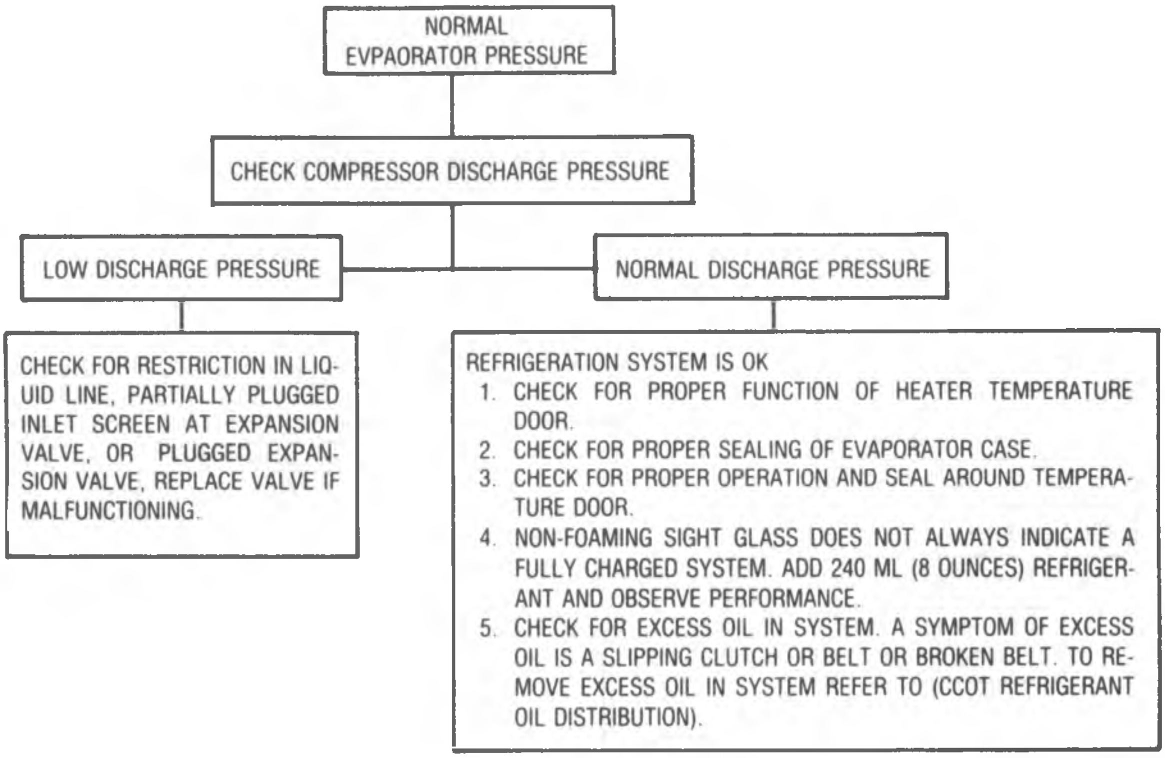
OUTLET AIR TEMPERATURE INCREASES AS COMPRESSOR DISCHARGE PRESSURE DROPS

REPLACE EXPANSION VALVE

F-00165

Figure 14—Insufficient Cooling Diagnosis Chart (Cont.)

INSUFFICIENT COOLING DIAGNOSIS CHART (Cont.) DASH MOUNTED UNIT (MOTOR HOME CHASSIS UNITS)



CHECK FOR RESTRICTION IN LIQUID LINE, PARTIALLY PLUGGED INLET SCREEN AT EXPANSION VALVE, OR PLUGGED EXPANSION VALVE, REPLACE VALVE IF MALFUNCTIONING.

REFRIGERATION SYSTEM IS OK

1. CHECK FOR PROPER FUNCTION OF HEATER TEMPERATURE DOOR.
2. CHECK FOR PROPER SEALING OF EVAPORATOR CASE.
3. CHECK FOR PROPER OPERATION AND SEAL AROUND TEMPERATURE DOOR.
4. NON-FOAMING SIGHT GLASS DOES NOT ALWAYS INDICATE A FULLY CHARGED SYSTEM. ADD 240 ML (8 OUNCES) REFRIGERANT AND OBSERVE PERFORMANCE.
5. CHECK FOR EXCESS OIL IN SYSTEM. A SYMPTOM OF EXCESS OIL IS A SLIPPING CLUTCH OR BELT OR BROKEN BELT. TO REMOVE EXCESS OIL IN SYSTEM REFER TO (CCOT REFRIGERANT OIL DISTRIBUTION).

DASH MOUNTED UNIT (MOTOR HOME CHASSIS)

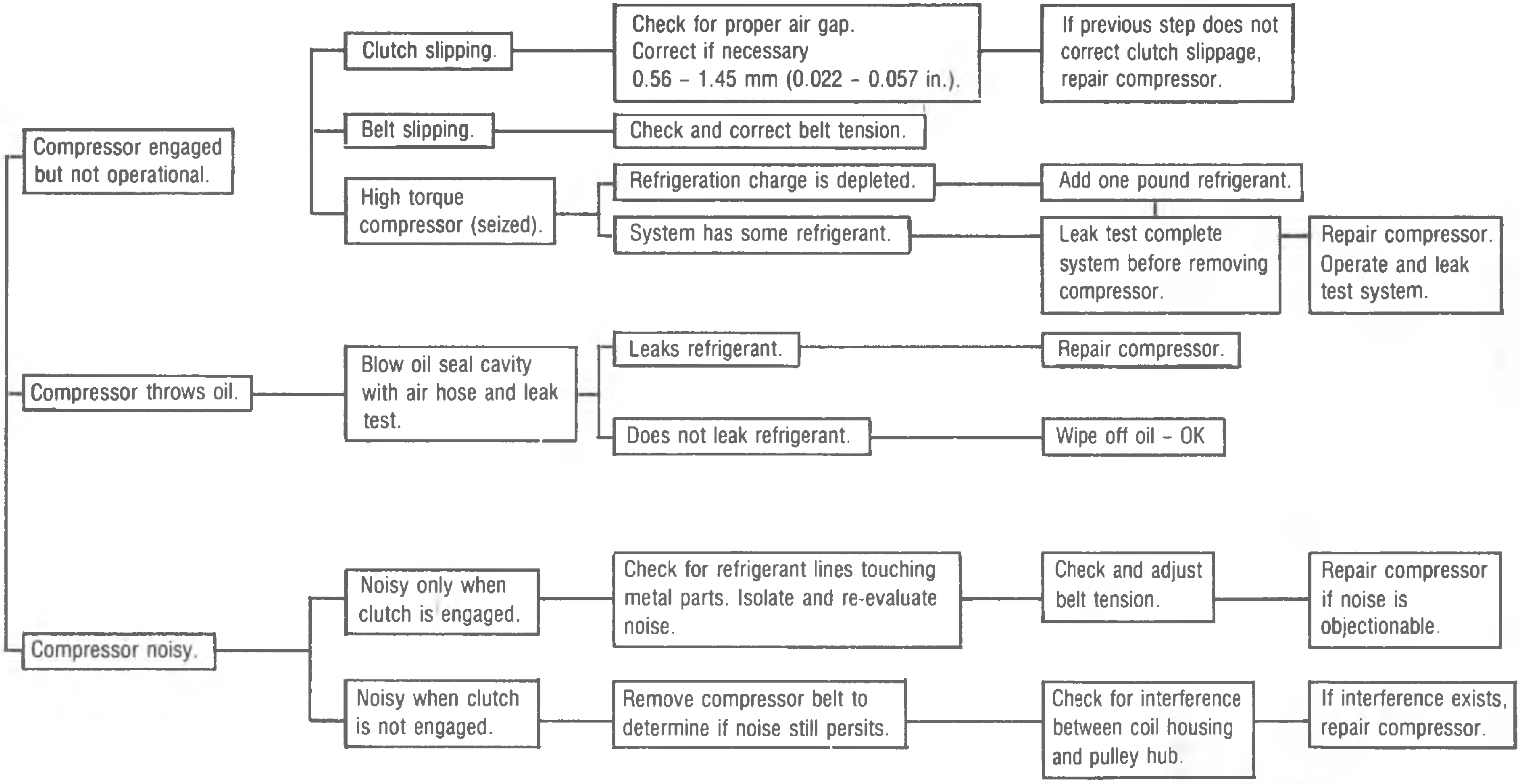
Refrigerant Charge 1.474 kg (3 lbs., 4 oz.)						
Temperature of Air Entering Condenser	21°C - (70° F)	27° C - (80° F)	32° C - (90° F)	38° C - (100° F)	43° C (110° F)	48° C - (120° F)
Engine rpm	2000					
Compressor Head Pressure*	758 kPa (110 psi)	931 Kpa (135 psi)	1 1031 kPa (160 psi)	1 310 kPa (190 psi)	1 517 kPa (220 psi)	1 792 kPa (260 psi)
	827 kPa (120 psi)	1 000 kPa (145 psi)	1 172 kPa (170 psi)	1 379 kPa (200 psi)	1 586 kPa (230 psi)	1 862 kPa (200 psi)
Suction Pressure psi*	43 kPa (6 psi)	48 kPa (7 psi)	62 kPa (9 psi)	69 kPa (10 psi)	69 kPa (10 psi)	90 kPa (13 psi)
Discharge Air Temperature*	14° C - (40° F)	16° C - (41° F)	16° C - (41° F)	18° C - (42° F)	22° C - (44° F)	22° C - (44° F)
	23° C - (45° F)	25° C - (46° F)	25° C - (46° F)	27° C - (47° F)	31° C - (49° F)	31° C - (49° F)

* Just before compressor clutch disengagement.

F-00468

Figure 15—Insufficient Cooling Diagnosis Chart (Cont.)

COMPRESSOR DIAGNOSIS



NOTE: A/C system noise is to be evaluated in the vehicle with doors and windows closed and low blower on.

F-00166

Figure 16—Compressor Diagnosis

ELECTRICAL/VACUUM TROUBLE DIAGNOSIS

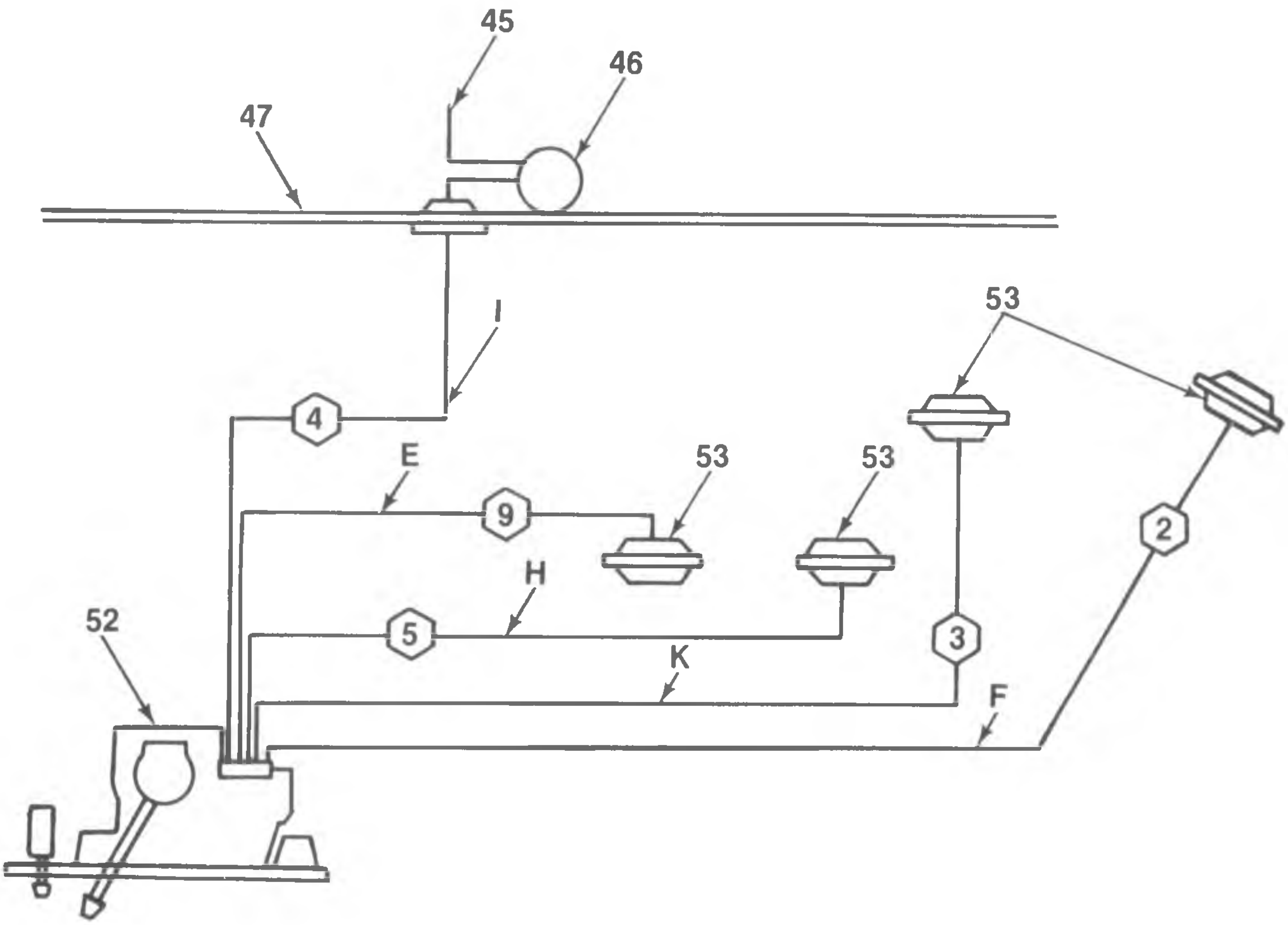
When diagnosing problems in the electrical and vacuum systems consult electrical wiring diagrams and vacuum diagrams (figures 17, 18, 19, and 20).

Ports on rotary vacuum valves are illustrated to provide simplicity in following vacuum schematic lines but are numbered in consecutive order on the actual valve. (Refer to figures 17 and 20).

OPERATIONAL TEST

To determine if the electrical, vacuum and refrigeration systems are operating efficiently, do the following:

1. Operate the blower at four speeds and check the compressor clutch engagement. This indicates that the electrical circuits are working.
2. Check the hand felt temperature of the evaporator inlet pipe and accumulator surface. The same temperature indicates a properly charged system.
3. Operate the A/C control selector (mode) lever to distribute air from the outlets. This will check the vacuum and diaphragm function.



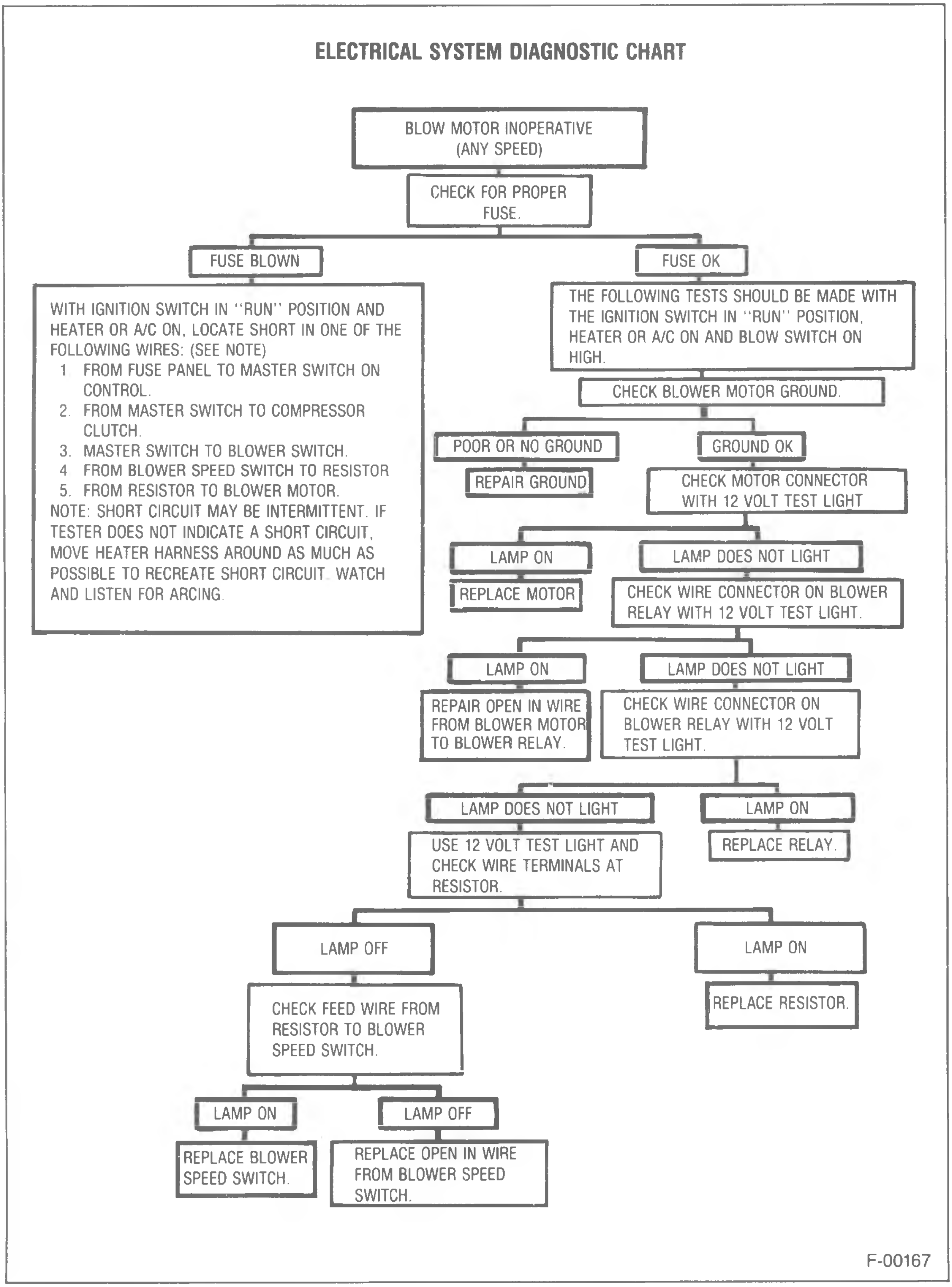
Connection	Port No.	Select Lever Valve Operation Chart						
		Off	Max A/C	Norm A/C	Bi-Level	Vent	Heat	Defrost
Source	4	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum
Bi Level	9	Vent	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum	Vent
Heat/Defrost	3	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum	Vacuum	Vent
OSA/REC	2	Vent	Vacuum	Vent	Vent	Vent	Vent	Vent
AC Mode	5	Vent	Vacuum	Vacuum	Vent	Vent	Vent	Vent
Ports 1,6,7 & 8 Not Used (Sealed On Vacuum Hose Assembly)								

45. Vacuum Source - Engine
46. Vacuum Tank - Gas
47. Cowl
52. Control
53. Actuator

I. Vacuum Line - Tan (Source)
E. Vacuum Line - Gray (Bi Level)
H. Vacuum Line - Dark Blue (A/C)
K. Vacuum Line - Red (Heat/Defrost)
F. Vacuum Line - Orange (Recirculate)

B-06944

Figure 17—G A/C Vacuum Schematic



ELECTRICAL SYSTEM DIAGNOSTIC CHART

BLOW MOTOR INOPERATIVE (ANY SPEED)

CHECK FOR PROPER FUSE.

FUSE BLOWN

WITH IGNITION SWITCH IN "RUN" POSITION AND HEATER OR A/C ON, LOCATE SHORT IN ONE OF THE FOLLOWING WIRES: (SEE NOTE)

1. FROM FUSE PANEL TO MASTER SWITCH ON CONTROL.
2. FROM MASTER SWITCH TO COMPRESSOR CLUTCH.
3. MASTER SWITCH TO BLOWER SWITCH.
4. FROM BLOWER SPEED SWITCH TO RESISTOR
5. FROM RESISTOR TO BLOWER MOTOR.

NOTE: SHORT CIRCUIT MAY BE INTERMITTENT. IF TESTER DOES NOT INDICATE A SHORT CIRCUIT, MOVE HEATER HARNESS AROUND AS MUCH AS POSSIBLE TO RECREATE SHORT CIRCUIT. WATCH AND LISTEN FOR ARCING.

FUSE OK

THE FOLLOWING TESTS SHOULD BE MADE WITH THE IGNITION SWITCH IN "RUN" POSITION, HEATER OR A/C ON AND BLOW SWITCH ON HIGH.

CHECK BLOWER MOTOR GROUND.

POOR OR NO GROUND

REPAIR GROUND

GROUND OK

CHECK MOTOR CONNECTOR WITH 12 VOLT TEST LIGHT

LAMP ON

REPLACE MOTOR

LAMP DOES NOT LIGHT

CHECK WIRE CONNECTOR ON BLOWER RELAY WITH 12 VOLT TEST LIGHT.

LAMP ON

REPAIR OPEN IN WIRE FROM BLOWER MOTOR TO BLOWER RELAY.

LAMP DOES NOT LIGHT

CHECK WIRE CONNECTOR ON BLOWER RELAY WITH 12 VOLT TEST LIGHT.

LAMP DOES NOT LIGHT

USE 12 VOLT TEST LIGHT AND CHECK WIRE TERMINALS AT RESISTOR.

LAMP ON

REPLACE RELAY.

LAMP OFF

CHECK FEED WIRE FROM RESISTOR TO BLOWER SPEED SWITCH.

LAMP ON

REPLACE BLOWER SPEED SWITCH.

LAMP OFF

REPLACE OPEN IN WIRE FROM BLOWER SPEED SWITCH.

LAMP ON

REPLACE RESISTOR.

F-00167

Figure 18—Electrical System Diagnostic Chart

ELECTRICAL SYSTEM DIAGNOSTIC CHART (CONTINUED)

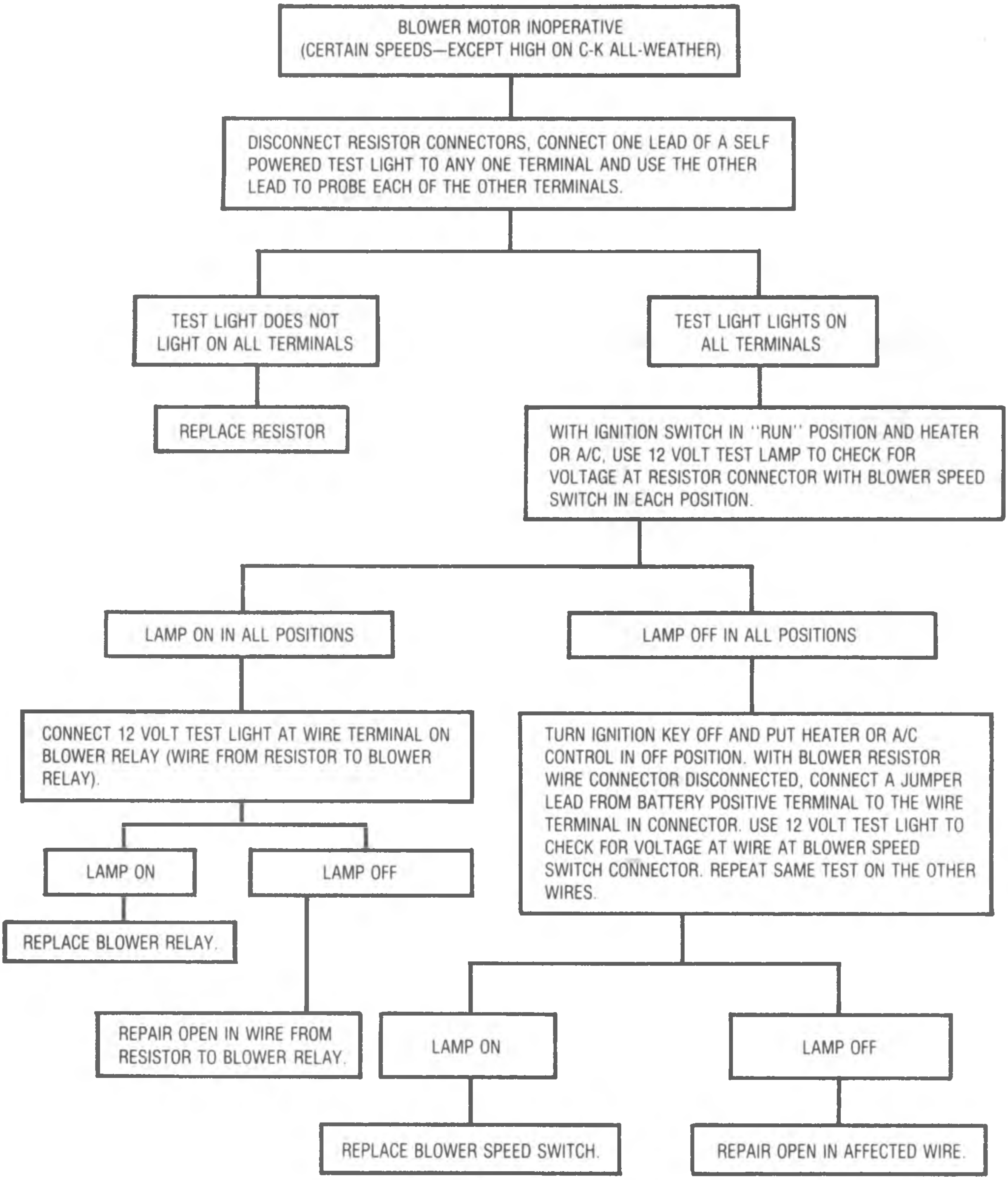


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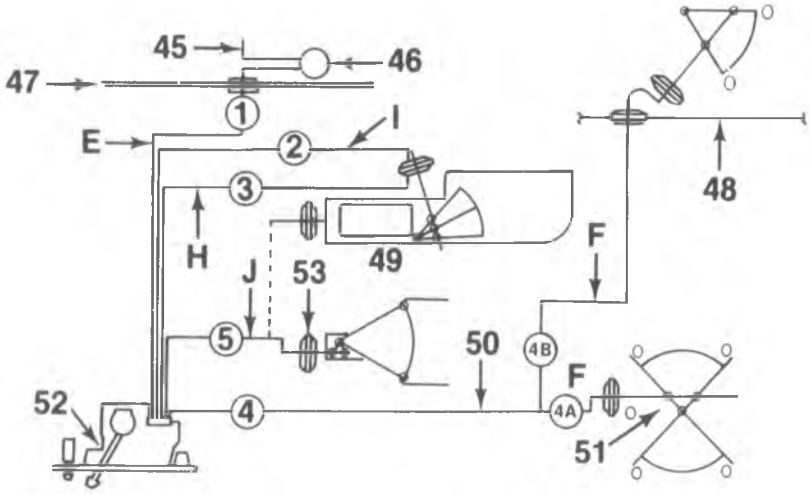
Figure 19—Electrical System Diagnostic Chart (Cont.)



Connection	Port No.	Select Lever Valve Operation Chart						
		Off	Max A/C	Norm A/C	Bi-Level	Vent	Heat	Defrost
Source	1	← Vac →						
A/C Mode	2	Vent	Vacuum	← Vent →				
Heater/Mode	3	Vent	Optional	Optional	Vent	Optional	Vent	Vacuum
OSA/REC	4	Vacuum	Vent	Vent	Vent	Vent	Vacuum	Vacuum
Defroster	5	Vent	Vacuum	Vacuum	Vent	Vacuum	Vent	Vent
Ports 6,7,8 and 9 not used (sealed on vacuum hose assembly)								

45. Vacuum Source - Engine
46. Vacuum Tank (Gas)
47. Cowl
48. Plenum Valve

49. Mode Door
50. Defroster Door
51. Recirculator Door
53. Actuator

E. Vacuum Line - Gary (Source)
F. Vacuum Line - Orange (Defroster)
H. Vacuum Line - Dark Blue (Heat)
I. Vacuum Line - Tan (A/C)
J. Vacuum Line - Black (Defroster)

F-00182

Figure 20—C-K A/C Vacuum Schematic

VACUUM SYSTEM DIAGNOSIS

C-K AND G SERIES

Start the engine and allow it to idle. Move the selector lever to each position and refer to the vacuum diagrams and operational charts for airflow, air door functioning and vacuum circuits. If air flow is not out of the proper outlet at each selector lever position do the following:

Inspect

1. The hose connections at the vacuum actuators, control head valve and vacuum tank.
2. The vacuum source circuit:
    - Install a vacuum tee and gage (with restrictor) at the vacuum tank outlet. Idle the engine and read the vacuum (a normal vacuum is equivalent to manifold vacuum) at all selector lever positions.
    - Vacuum less than normal at all positions. Remove the tee and connect the vacuum gage line to the tank - read the vacuum. If still low, then the problem lies in the feed circuit, the feed circuit to the tank or in the tank itself. If vacuum is now normal, then the problem lies downstream.
    - Vacuum less than normal at some positions. If vacuum was low at one or several of the selector lever positions, a leak is indicated in these circuits.
    - Vacuum normal at all positions. If vacuum was normal and even at all positions, then the malfunction may be caused by improperly connected or plugged lines or a malfunctioning vacuum valve or valves.
3. Specific vacuum circuit check:
    - Place the selector lever in the malfunctioning position and check for vacuum at the pertinent vacuum actuators.
    - If vacuum exists at the actuator but the door does not move, then the actuator is defective or the door is jammed.
    - If low or no vacuum exits at the actuator determine whether the cause is the vacuum harness or the vacuum valve.
    - Check the vacuum harness first.
4. Vacuum harness circuit check:
    - Disconnect the vacuum harness at the control head.
    - The black line should show engine vacuum; if not, trace back through connector to vacuum tank.
    - To check any individual circuit, place the selector lever at the involved circuit position and check for vacuum presence.

A/C REFRIGERANT SYSTEM DIAGNOSIS

INSUFFICIENT COOLING "QUICK-CHECK" PROCEDURE

Use the following CCOT "Hand-Feel" procedure if the A/C system has the proper charge of Refrigerant-12 (providing ambient temperature is above 21°C (70°F).

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

— BOTH THE SAME TEMPERATURE AND SOME DEGREE COOLER THAN AMBIENT—Proper condition: check for other problems (Refer to A/C System Diagnostic Procedure).

— INLET PIPE COOLER than accumulator surface indicates a low refrigerant charge.

- Add amounts 120 ml (4 ounces) of refrigerant UNTIL BOTH feel the same temperature. Allow stabilization time between additions.
- Then add 420 ml (14 oz.) one can additional refrigerant. (The 420 ml (14 oz.) disposable can of Refrigerant-12 is the equivalent to .88 lbs.).

A/C EVACUATING AND CHARGING PROCEDURES

EVACUATION AND CHARGING PROCEDURES

Before opening any refrigerant hose or component, read the information furnished in:

- Refrigerant-12 Operating Characteristics.
- Discharging, Evacuating, Adding Oil and Charging.

Remove sealing caps from subassemblies before making connections for final assembly. Use a small amount of clean 525 viscosity refrigerant oil on all tube and hose joints.

Use new seal (o-ring) 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 the stationary part of the connection.

Tighten all tubing connections (figure 10). Insufficient or excessive torque can cause loose joints or deformed joint parts. Either condition can cause leakage.

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

Discharge, evacuate and charge using J-23500-01 air conditioning service Charging Station or the J-5725-04 Manifold Gage Set, and 420 ml (14 oz.) disposable cans of Refrigerant-12 (figures 21 and 22).

Use gage adapters to connect the charging lines from the charging station or manifold and gage set to system service fittings. A straight gage Adapter J-5420 and a 90° angle gage Adapter J-9459 is available.

Wear goggles and wrap a clean cloth around fittings and connections.

- Discharge the system before removing and replacing refrigeration lines or components.
- Use the service valve and pressure gage sets during evacuation and charging procedures.
- Do not charge while the compressor system is hot.
- Always discharge the system at the low side service fitting and perform the entire evacuation and charging procedure through the low side service fitting.
- Do not connect the high pressure line or any line to the high side service fitting during discharging and charging procedures.

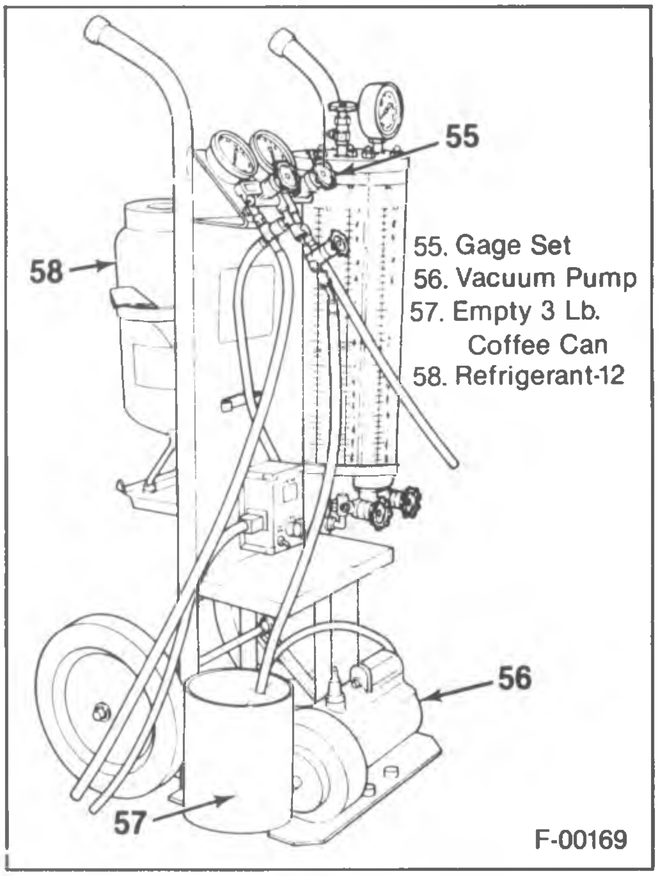


Figure 21—J-23500-01 Charging System

CAUTION: Never remove a gage line from its adapter when the line is connected to the 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 discharge the system due to the depressed schrader valve in service low side fitting and may cause personal injury due to escaping Refrigerant-12.

DISCHARGING THE CCOT A/C SYSTEM

Before replacing any component, discharge the system.

1. Discharge at the low side service fitting.
2. With the ignition turned OFF, remove the protective cap from LOW SIDE service fitting and connect Charging Station J-23500-01 Gage Set. (Refer to figure 22).

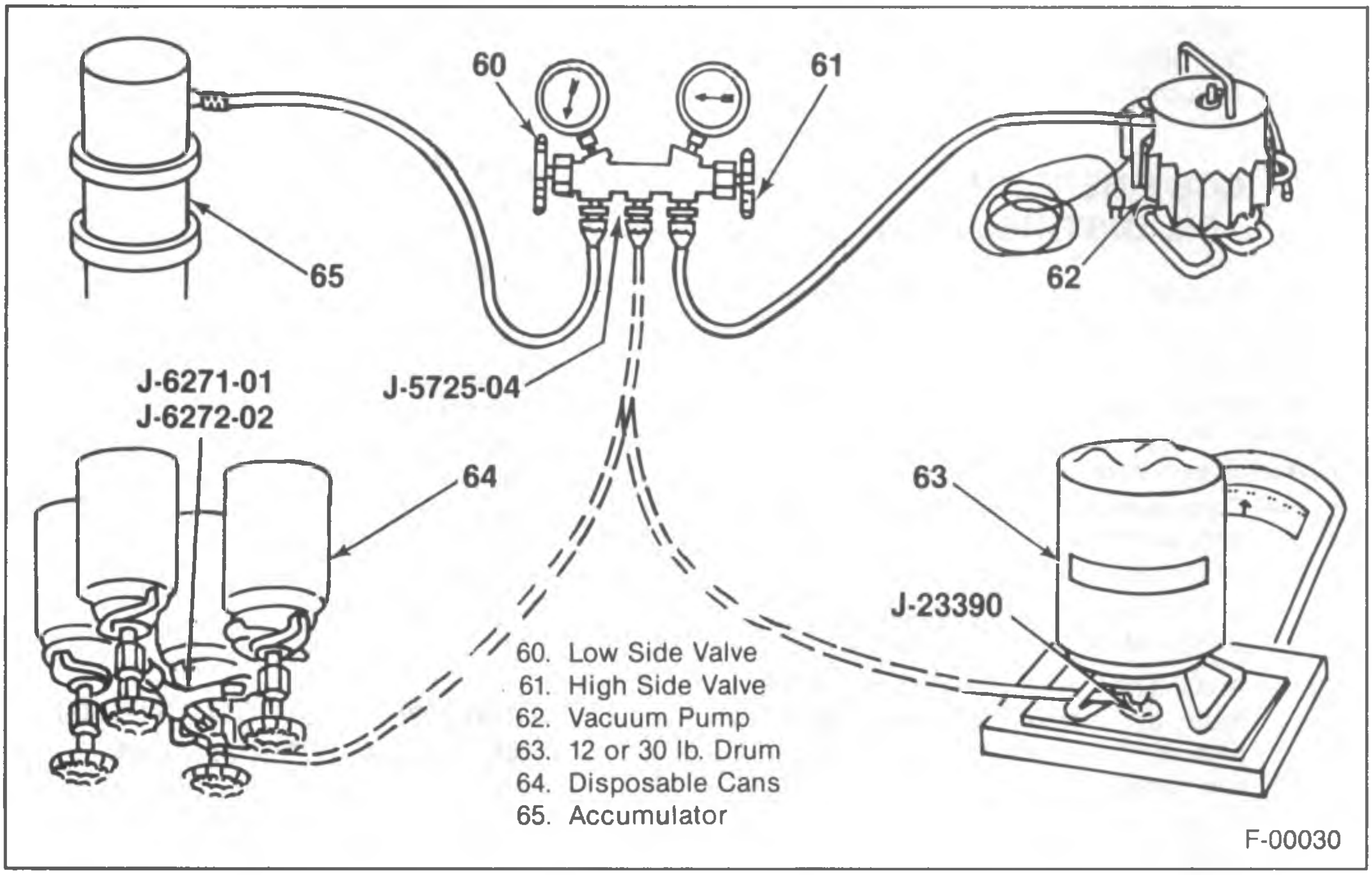


Figure 22—Charging The System With A Disposable Can Or Drum

a. If charging station J-23500-01 is not being used, discharge the system by slowly connecting a gage hose to the low side service fitting on the accumulator and discharge into a bottle (figure 23).

b. As the hose is SLOWLY tightened down onto the schrader valve, Refrigerant-12 will discharge from the system into the container. If no discharge occurs, check for missing or defective schrader depressor in the hose fitting.

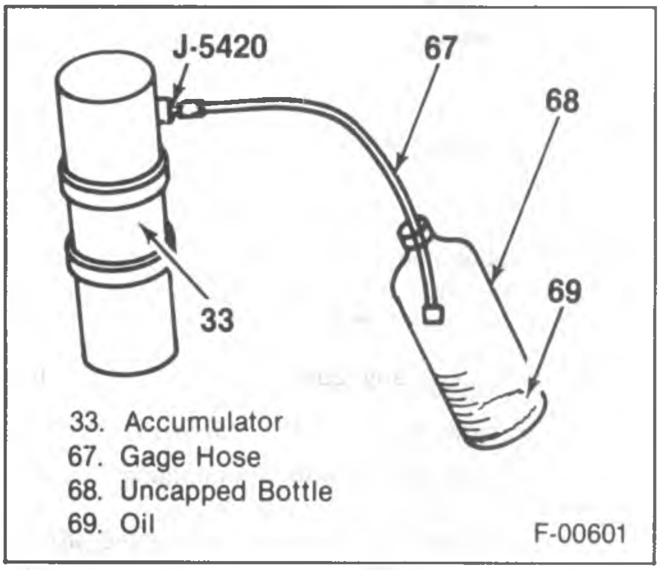


Figure 23—Discharging The CCOT A/C System Without Charging Station J-23500-10

3. With the low side of the system discharged, check the high side system fitting (on the liquid line or muffler) for remaining pressure.

4. If pressure is found, attempt to discharge the high side using the same procedure as used for the low side. (This condition indicates a restriction on the high side. Diagnose and correct before evacuating and charging).

5. After discharging, (no vapor escaping with the hose fully-tightened down), measure and record the amount. If 15 ml (.05 ounce) or more, add this amount of new 525 viscosity refrigerant oil plus any quantity in removed parts before evacuation and charging with Refrigerant-12 (refer to CCOT Refrigerant Oil Distribution for the quantity of oil normally retained in removed parts).

6. If adding oil is necessary, remove the suction hose at the accumulator outlet pipe connection and pour the correct quantity of refrigerant oil into the hose or pipe and then reconnect hose or pipe. (Refer to step

number 4 and CCOT Refrigerant Oil Distribution for specific quantity instructions).

CCOT REFRIGERANT OIL DISTRIBUTION

- A-6 COMPRESSOR—300 ml (10 ounces) of 525 viscosity refrigerant oil.
- R-4 COMPRESSOR 180 ml (6 ounces). Add new oil during the following component replacement and conditions:

1. With no excessive oil leakage, add;
   - Compressor - Remove, drain oil, measure replace the same amount of new oil plus 30 ml (1 ounce).
   - Evaporator—Add 90 ml (3 ounces).
   - Condenser—Add 30 ml (1 ounce).
   - Accumulator - R-4 Compressor - Remove drain oil, measure, replace the same amount of new oil plus 60 ml (2 ounces) to compensate for that retained by the original accumulator dessicant.
   - DA-6 Compressor - Remove, drain oil, measure, replace same amount of new oil plus 90 ml (3 ounces) to compensate for that retained by the original accumulator dessicant. If no oil can be drained from old accumulator, add 60 ml (2 ounces) new oil to the new accumulator.
2. With signs of excessive oil leakage;

A-6 COMPRESSOR

Remove Compressor and Accumulator. Drain measure and record total oil from both components. Use new oil.

- If less than 180 ml (6 ounces), add 180 ml (6 ounces) of new oil to system.
- If more than 180 ml (6 ounces), add same amount of new oil as drained.
- If a new accumulator is installed to A-6 system, add 60 ml (2 ounces) additional oil to compensate for that held/absorbed by the original accumulator dessicant.

DA-6 COMPRESSOR

Remove the accumulator. Drain, measure and record quantity of oil in accumulator. It is not necessary to remove and drain the DA-6 compressor because the compressor only retaines a minimum quantity of oil, it doesn't have an oil sump area.

- If less than 90 ml (3 ounces) add 90 ml (3 ounces) of new oil to the system.
- If more than 90 ml (3 ounces) add the same amount of new oil as drained.
- If a new accumulator is installed add 90 ml (3 ounces) additional oil to compensate for that absorbed by the original accumulator dessicant.

R-4 COMPRESSOR

Remove the accumulator. Drain, measure and record quantity of oil in accumulator. It is not necessary to remove and drain the R-4 compressor because the compressor only retains a minumum quantity of oil.

- If less than 90 ml (3 ounces), add 90 ml (3 ounces) of new oil to system.
- If more than 90 ml (3 ounces), add the same amount of new oil as drained.
- If a new accumulator is installed to system, add 60 ml (2 ounces) additional oil to compensate for that retained by the original accumulator dessicant.

EVACUATING AND CHARGING THE CCOT A/C SYSTEM

Before charging, evacuate the system if Refrigerant-12 is lost or if the system has been opened.

Evacuation and charging is a combined procedure. Purge all gage lines with Refrigerant-12 before charging.

There are three standard Refrigerant-12 evacuate and charge procedures:

- J-23500-01 Charging Station Method
- Disposable Can Method
- Drum Method

NOTICE: Do not use alcohol to remove moisture from the system. Alcohol can damage components.

GAGE CALIBRATION

Before evacuation, check the low pressure gage for proper calibration and vacuum system for proper operation. With the gage disconnected from the refrigeration system, be sure that the pointer indicates to the center of "0." Tap the gage to be sure pointer is not sticking. If necessary, calibrate as follows:

- Remove the cover from the gage.
- Holding the gage pointer adjusting screw with one hand, carefully force the pointer in the proper direction to position the pointer at the "0" position. Tap the gage to be sure the pointer is not sticking. Replace the gage cover.

VACUUM SYSTEM CHECK

Before connecting the vacuum pump to the A/C system run the pump connected to the low pressure gage to determine the vacuum pump capability. If the vacuum system is unable to reach 711.2 - 736.6 mm (28 to 29 inches) or more vacuum check for leaks. If no leaks are found, check the vacuum pump.

CHARGING STATION METHOD

Follow the J-23500-01 Charging Station instructions. 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.
3. Perform the evacuate and charge procedure through the accumulator low side pressure service fitting.
4. Following these procedures will prevent high side pressure from damaging the charging station if an error is made during the sequence.

DISPOSABLE CAN OR MULTI-CAN METHOD

Tools Required:
J-6271-01 Single Can Refrigerant Dispensing Valve
J-6272-02 Four Can Refrigerant Dispensing Valve

1. Use tool J-6271-01 for single can or multi-can dispensing unit.
2. Use tool J-6272-02 multi-can open valve. When using disposable cans, close the tapping valve and then attach the can(s) following the instructions included with the tapping valve or tapping manifold adapter.

REFRIGERANT DRUM METHOD

Tool required:
J-23390 Refrigerant Dispensing Valve

1. Use tool J-23390 for a 12 lb. can.
2. A 30 lb. can has a built in opener-valve. Place the drum on a scale and note weight before charging. During charging, watch the scale to determine the amount used.

Important

- Close the outlet valve on the opener (clockwise) before installing the opener to the R-12 container.

2. To evacuate the A/C system install Manifold Gage Set and Vacuum Pump.
   - SLOWLY open high and low side gage valves and begin vacuum pump operation. Pump the system until the low side gage reaches 459 - 475 mm (28 to 29 inches of mercury [vacuum]) or more.

   The evacuation procedure will specify 459 - 475 mm (28 to 29 inches) of mercury at sea level. For each 304.8 mm (1,000 ft.) above sea level, lower the specification by one inch of vacuum. At 1524 mm (5,000) feet elevation only 376.9 mm (23 to 24 inches) of mercury (vacuum) is required.

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

3. When the gage reaches the prescribed vacuum, the system is evacuated. Close the high side gage set valve and turn OFF the vacuum pump.
4. Watch the low side gage to be sure vacuum holds for five minutes. If the vacuum holds, disconnect the vacuum hose at the gage set and then proceed to charging.
5. If the vacuum does not hold for five minutes, charge the system with 420 ml (8 ounces) Refrigerant-12 and leak check. Discharge the system again and repair any leaks. Repeat the evacuation procedure.

CHARGING OF THE CCOT A/C SYSTEM

1. Start the engine, run with the choke open and the fast idle speed reduced to normal idle, set the A/C control lever on OFF.
2. With the drum or 420 ml (14 ounces) can(s) inverted, open source valve(s) and allow 0.454 Kg (one (1) pound) or more 420 ml (14 ounces) can of liquid Refrigerant-12 to enter the system through low side service fitting on accumulator.
3. When one 0.454 Kg (1 pound) or one 420 ml (14 ounces) can of liquid Refrigerant-12 enters the system, engage the compressor by setting the A/C control lever to NORM and blower speed on HI to draw in the remainder of the charge.

To speed up the operation, use a fan to pass air over the condenser. If the condenser temperature remains below the charging cylinder temperature, Refrigerant-12 will enter the system faster.

4. Shut off the source valve and run the 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 prevent Refrigerant-12 from escaping.

CAUTION: Never remove a gage line from its adapter when the line is connected to the A/C system. Always remove the line adapter from the service fitting to disconnect a line. Do NOT remove the charging hose at the gage set while it is attached to the accumulator. This will discharge the system because of the depressed schrader valve in service low side fitting. Also, the escaping Refrigerant-12 may cause personal injury.

6. Replace the protective cap on the accumulator fitting.
7. Turn the engine off.
8. Leak the check system with a J-6084 Leak Detector.
9. Start the engine.
10. With the system charged and leak-checked, operate the system and test for pressures. as outlined under Relative Humidity, Temperature and Pressure Relationship of Refrigerant-12 (figure 8).

ACCUMULATOR ASSEMBLY

The accumulator assembly has a service replacement which includes two seals (o-rings for the inlet and outlet connections). The desiccant is NOT serviced separately - it is part of the sealed accumulator assembly. Refer to CCOT Refrigerant Oil and Distribution for presence of refrigerant oil and service conditions when removing the accumulator from the vehicle to measure the oil.

Replace the accumulator assembly when:

1. A physical perforation prduces a leak.
2. The (orifice) screen experiences continued or repeated plugging.
3. An evaporator fails because of inside-out internal corrosion.

   DO NOT REPLACE the accumulator assembly where:

   1. A dent is found in the outer shell of the accumulator.
   2. A vehicle is involved in a collision and there is no perforation to the accumulator. Cap or place a plastic bag around an open refrigerant line.

SPECIFIC COMPONENT DIAGNOSIS

COMPRESSOR

Compressor defects can appear as noise, seizures, leakage or low discharge pressures.

NOTICE: Resonant compressor noises are normal; however, irregular noise or rattles may indicate broken parts or wear. To check seizure, de-energize the magnetic clutch and rotate the drive plate. If rotation is impossible the compressor is seized.

To check for a leak, refer to "Leak Testing The Refrigerant System." A faulty internal seal, a restriction or an insufficient refrigerant charge can cause a low discharge pressure. Check before servicing.

CONDENSER

A condenser may leak or be restricted. A restriction will cause excessive compressor discharge pressure. If a partial restriction is present, ice or frost will form after the restriction as the refrigerant expands after passing through the restriction.

Air flow restrictions through the condenser or radiator can cause high discharge pressures. During normal condenser operation, the outlet pipe will be cooler than the inlet pipe.

RECEIVER-DEHYDRATOR (MOTOR HOME CHASSIS)

An inlet restriction can cause high head pressure and an outlet restriction can cause low head pressure, or little or no cooling. A restricted outlet can cause a cold receiver-dehydrator.

EXPANSION VALVE

There are five expansion valve malfunctions: valve stuck open, valve stuck closed, broken power element, a restricted screen or an improperly located or installed power element bulb. To correct the first three conditions, replace the valve; to correct the last two, replace the valve inlet screen and properly install a power element bulb.

Operating the system will indicate valve trouble.

1. Valve stuck open.
   - Noisy compressor.
   - No cooling - freeze up.
2. Valve stuck closed, broken power element or plugged screen.
   - Very low suction pressure.
   - No cooling.
3. Poorly located power element bulb.
   - Normal pressure.
   - Poor cooling.

DIAGNOSIS FOR MALFUNCTIONING VALVE

Use the following procedure to determine a malfunctioning valve.

1. Operate the system at normal idle. If the valve is malfunctioning, the low pressure readings (evaporator pressure) will be above specifications (figure 8).
2. The loss of system performance is not as evident when the compressor head pressure is below 1379 kPa (200 psi). Increase the system head pressure by partially blocking the condenser. Disconnect the blower lead wire and operate the system to determine if the evaporator pressure can be obtained.
3. Bubbles in the sight glass will indicate a low refrigerant charge (Motor Home Chassis Systems).

EVAPORATOR

An inadequate supply of cool air can cause the evaporator to malfunction. Check for a plugged core, a cracked case or a leaking seal.

REFRIGERANT LINE RESTRICTIONS

There are three refrigerant line restrictions:

1. Suction Line - A restriction will cause low suction pressure at the compressor, low discharge pressure and little or no cooling.
2. Discharge Line—A restriction will cause the pressure relief valve to open.
3. Liquid Line—A restriction will be caused by low discharge and suction pressure, and insufficient cooling.

SIGHT GLASS DIAGNOSIS (MOTOR HOME CHASSIS UNITS)

At temperatures above 21° C (70° F), the sight glass can indicate if the refrigerant charge is sufficient.

After operating five minutes, slow-moving bubbles (vapor) or a broken column of refrigerant under the glass may indicate a shortage of liquid refrigerant. On a cool day, continuous bubbles will indicate a properly charged system. If the sight glass is clear and performance is satisfactory, occasional bubbles do not indicate a refrigerant shortage.

If the sight glass shows foaming or a broken liquid column, observe after partially blocking the air to the condenser. If the sight glass clears and the performance is satisfactory, the charge is adequate. If the refrigerant shortage continues, add refrigerant in 120 ml (4 ounces) increments until the sight glass is clear. Add an additional charge of 240 ml (8 ounces) as a reserve after the glass clears. Do not overcharge the system.

ON VEHICLE SERVICE

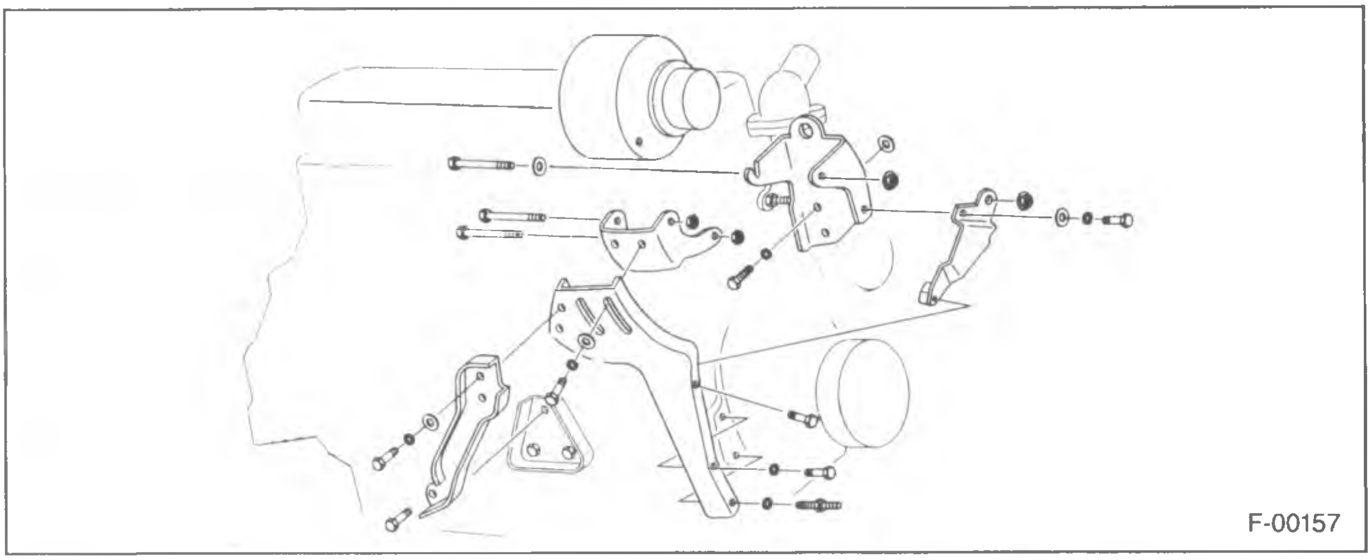


Figure 24—C-K Compressor Mounting Component View L6 (4.8 Liter) Gas Engine

COMPRESSOR REPLACEMENT (C-K)

Remove or Disconnect (Figures 24, 25, 26 and 27)

1. Discharge the system.
2. Connector attaching bolt.
3. Connector.
   - Cap or plug open connections.
4. Electrical lead to the clutch acutuating coil.
5. Bolt.
   - Loosen the bracket and pivot bolts.
6. Compressor.
   - Drain and measure the oil.
   - Check for contamination.

Install or Connect (Figures 24, 25, 26 and 27)

1. Oil to the compressor.

Important

- Replace with fresh oil. If the system was serviced, install a full, fresh charge of refrigeration oil.

2. Compressor.
   - Position to the mounting bracket.
3. Nuts, bolts and spring washer.
4. Connector assembly to the rear of the compressor.

Important

- Use new seals (o-rings) coated with clean refrigeration oil.

5. Electrical lead to the coil.
6. Compressor belt.

Adjust

- Belt. Refer to Specifications.

7. Evacuate, charge and check the system.

COMPRESSOR REPLACEMENT (G AND MOTOR HOME CHASSIS MODELS)

Remove or Disconnect (Figures 28 and 29)

1. Battery ground cable.
2. Compressor clutch connector.
3. Purge the system of refrigerant.
4. Belt.

Important

— Release the belt tension at the idle pulley to remove.

— On some vehicles remove the crankshaft pulley.

5. Engine cover - G Series.
6. Air cleaner.
7. Fitting and muffler assembly.
   - Cap or plug all open connections.
8. Compressor bracket.

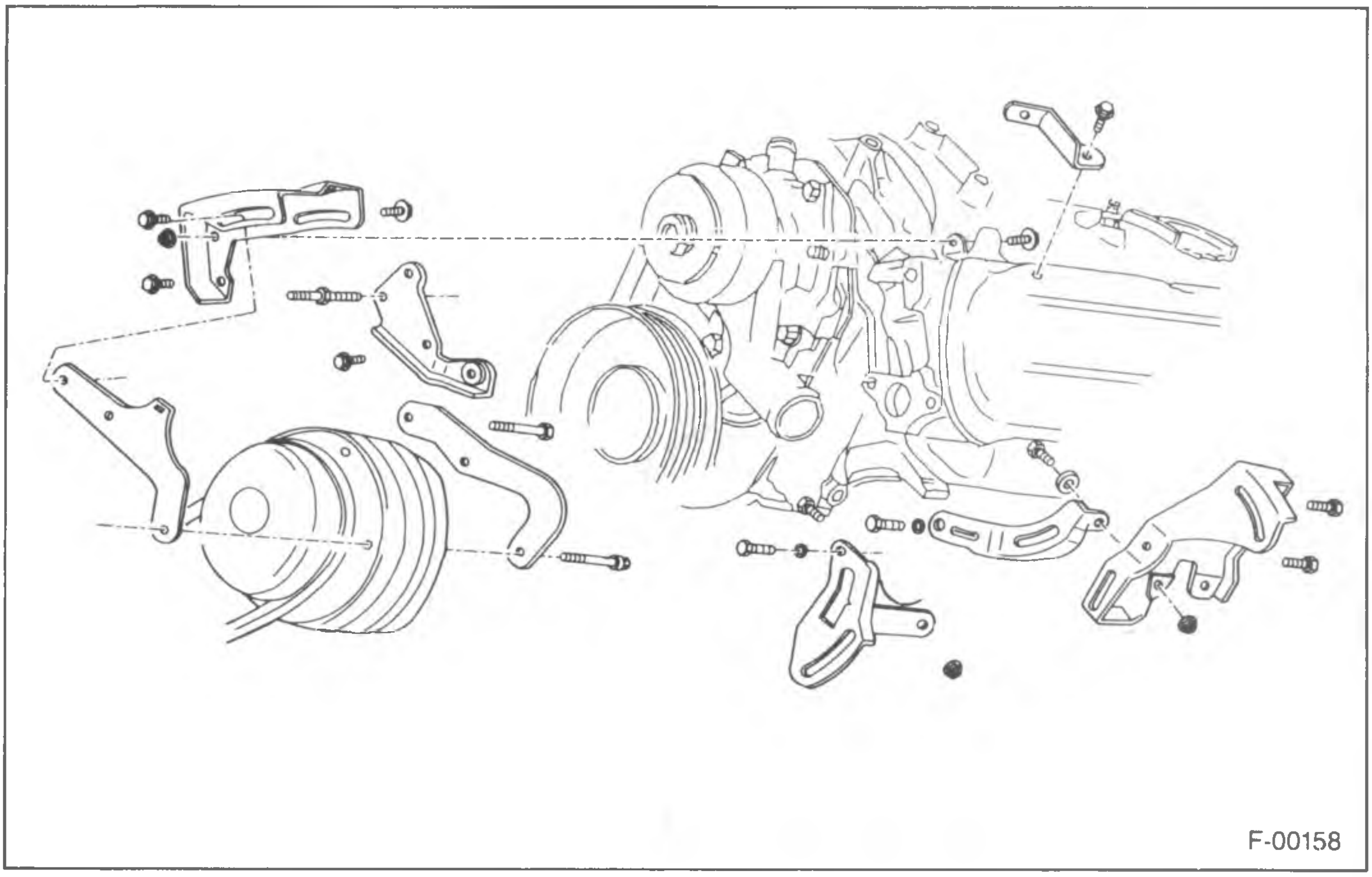


Figure 25—C-K Compressor Mounting Component V6 and V8 (4.3 and 5.0 Liter) Gas Engines

9. Engine oil tube support bracket bolt and nut.
10. Clutch ground lead.
11. Compressor.

Important

- Drain and measure the oil. Check for contamination.

Install or Connect (Figures 28 and 29)

1. Oil to the compressor.

Important

- Replace with fresh oil. If the system was serviced, install a full, fresh charge of refrigeration oil.

2. Compressor.
   - Position to the mounting bracket.
3. Nuts, bolts and spring washer.
4. Connector assembly to the rear of the compressor.

Important

- Use new seals (o-rings) coated with clean refrigerant oil.

5. Electrical lead to the coil.
6. Compressor belt.

Adjust

- Refer to COOLING (SEC. 6B)

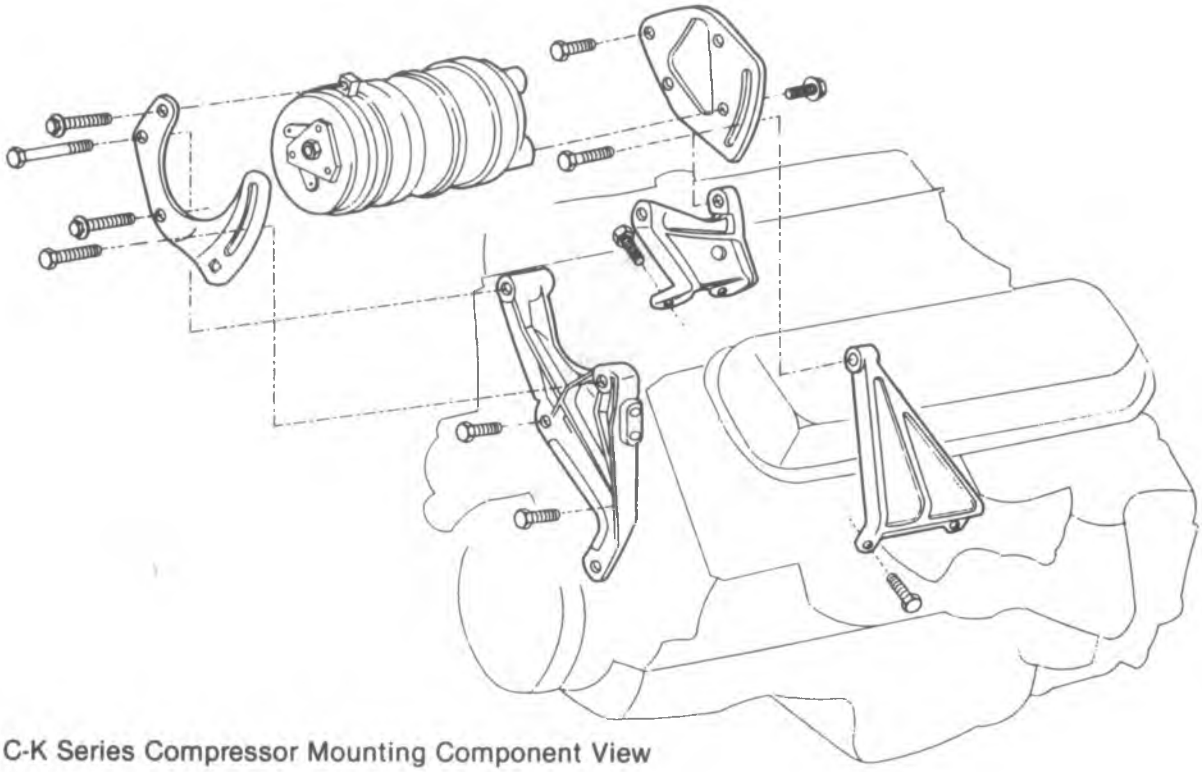
COMPRESSOR BELT TENSION ADJUSTMENT (G AND MOTOR HOME CHASSIS MODELS)

Adjust the compressor belt to the specifications shown in the COOLING (SEC. 6B). On some units increase idler pulley slack adjustment.

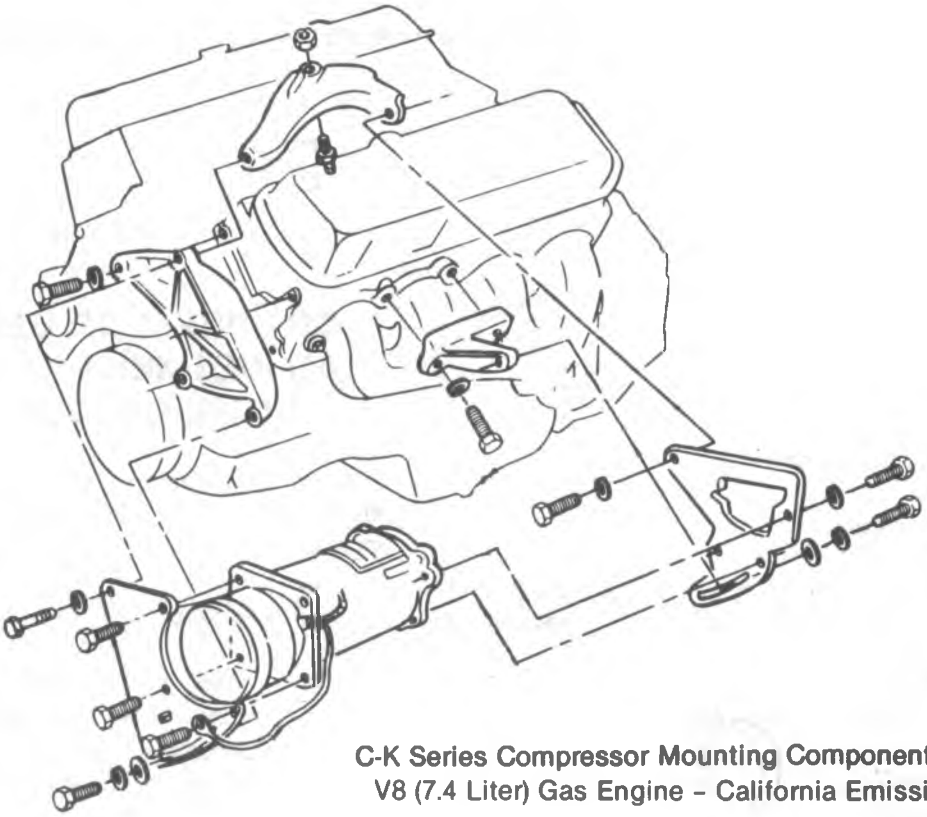
Adjust

1. Remove idler adjustment bolt.
2. Remove idler backing plate.
3. Lengthen adjusting slots 13 mm (1/2-inch) inboard or outboard as required.
4. Install backing plate.
5. Install assembly.

If the belt is being replaced it may be necessary to remove and replace the throttle cable during the belt replacement. Adjust the throttle cable upon completion. It may be necessary to remove the crankshaft pulley to install a new compressor belt.



C-K Series Compressor Mounting Component View
V8 (7.4 Liter) Gas Engine - Federal Emissions



C-K Series Compressor Mounting Component View
V8 (7.4 Liter) Gas Engine - California Emissions

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Figure 26—C-K Compressor Mounting Component View V8 (7.4 Liter) Gas Engine

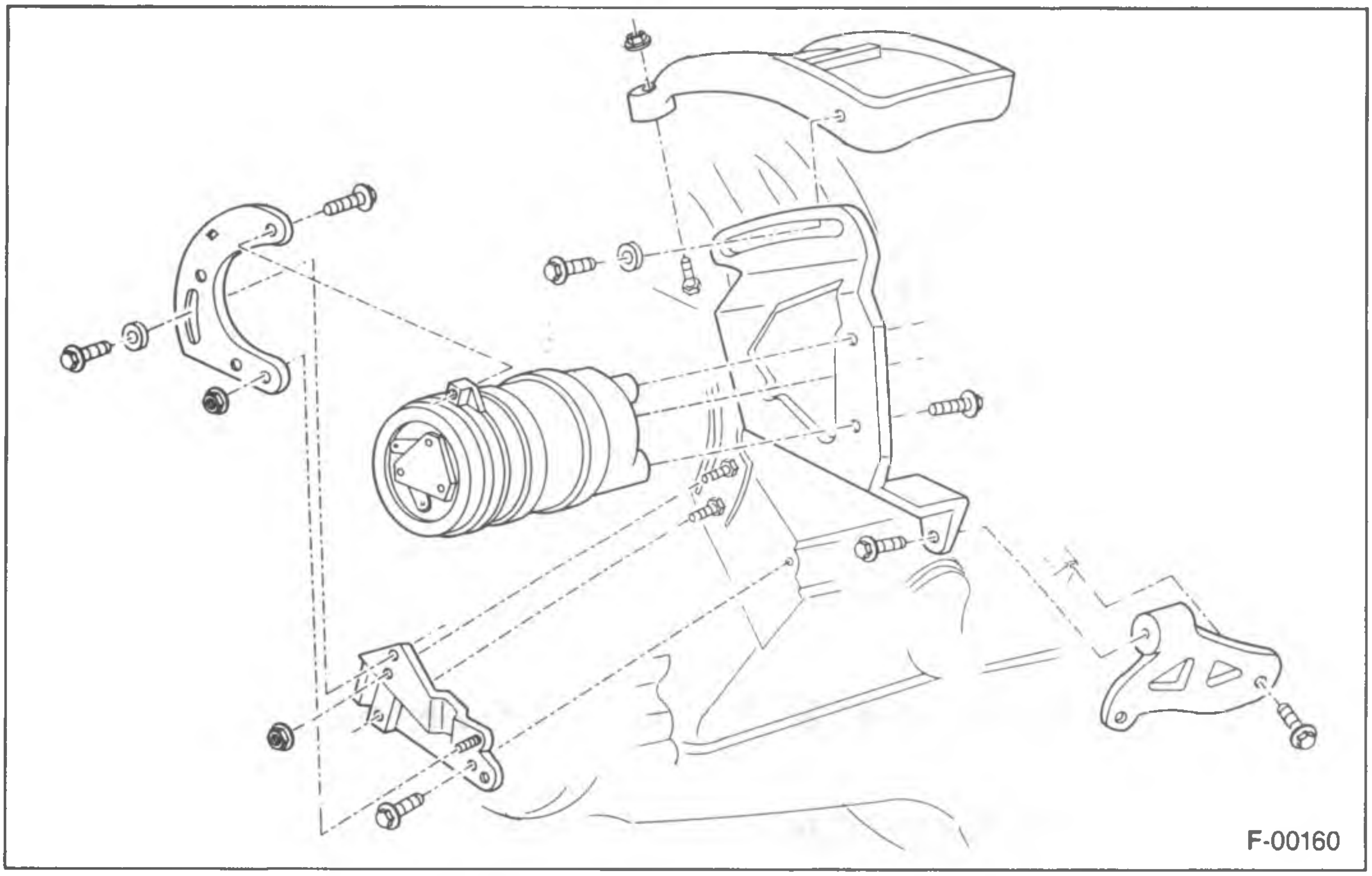


Figure 27—C-K Compressor Mounting Component View V8 (6.2 Liter) Diesel Engine

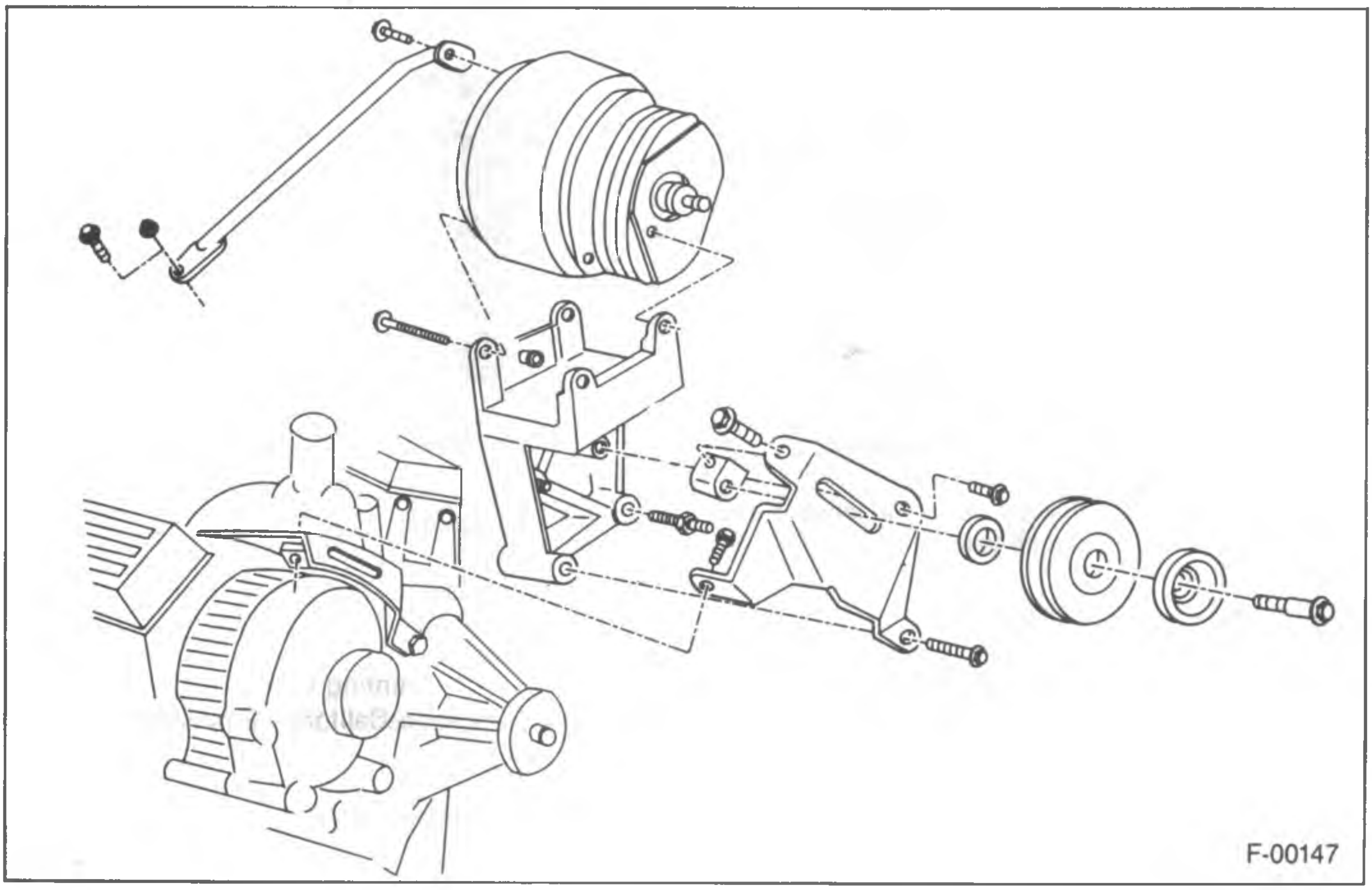


Figure 28—G Compressor Mounting Component View V8 (5.7 Liter) Gas Engine

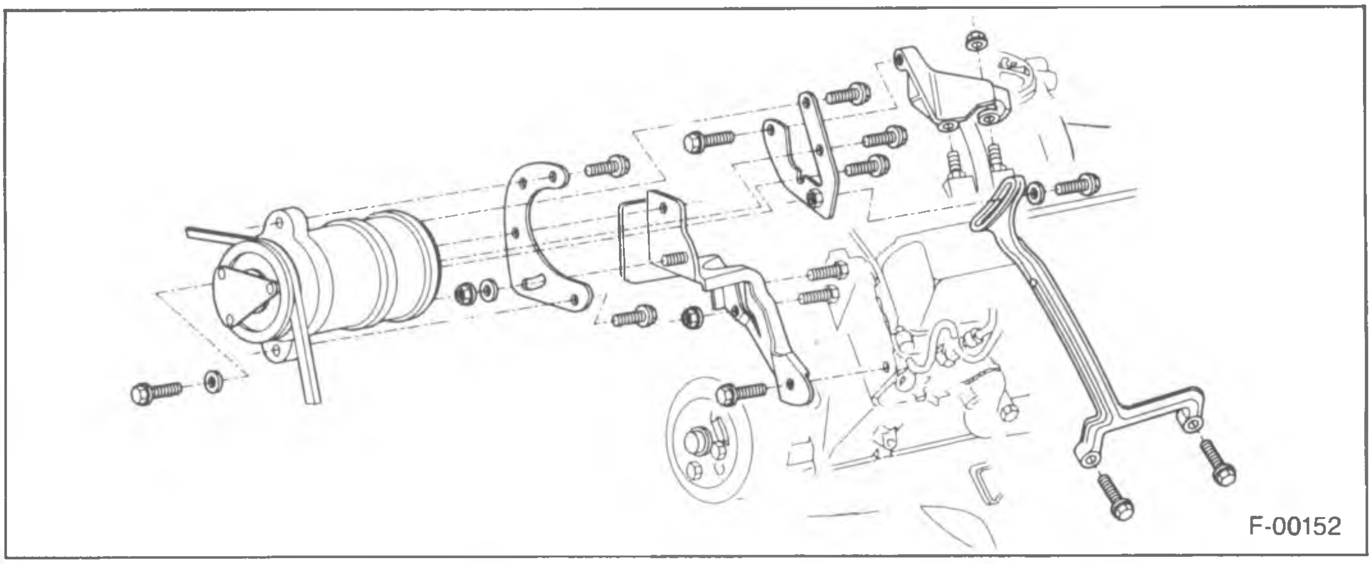


Figure 29—G Compressor Mounting Component View V8 (6.2 Liter) Diesel Engine

CCOT A/C SYSTEM—C-K SERIES

CONDENSER REPLACEMENT

Remove or Disconnect (Figure 30)

1. Battery ground cable.
2. Discharge the system.
3. Grille assembly.
4. Radiator grille center support.
5. Left grille support to upper fender support (2) screws.
6. Condenser inlet and outlet lines, and the outlet tube at the right end of the condenser (figure 30).

Important

- Cap or plug all open connections.

7. Condenser to radiator support screws.
8. Bend the left grille support outboard to gain clearance for condenser removal.
9. Condenser assembly by pulling it forward and then lowering it from the vehicle.

Install or Connect (Figure 30)

1. New condenser.

Important

- Add 30 ml (1 ounce) of clean refrigeration oil to a new condenser.

2. Left grille support.
3. Radiator support screws.
4. Condenser inlet and outlet lines.

70. Condenser
71. Insulator
72. Insulator

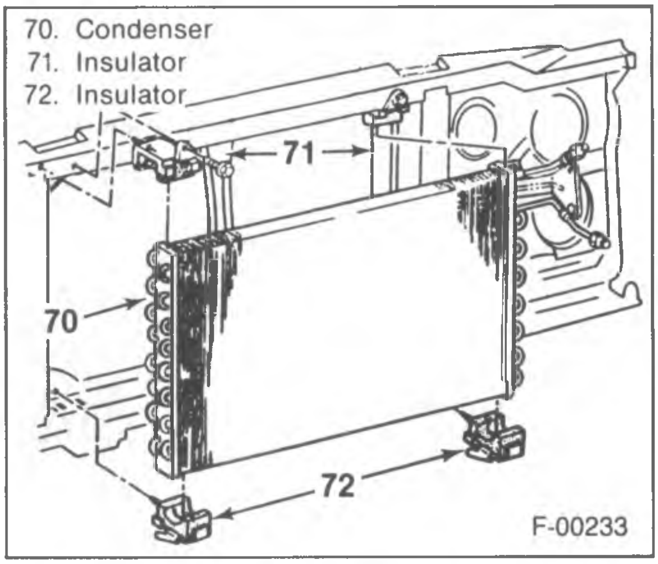
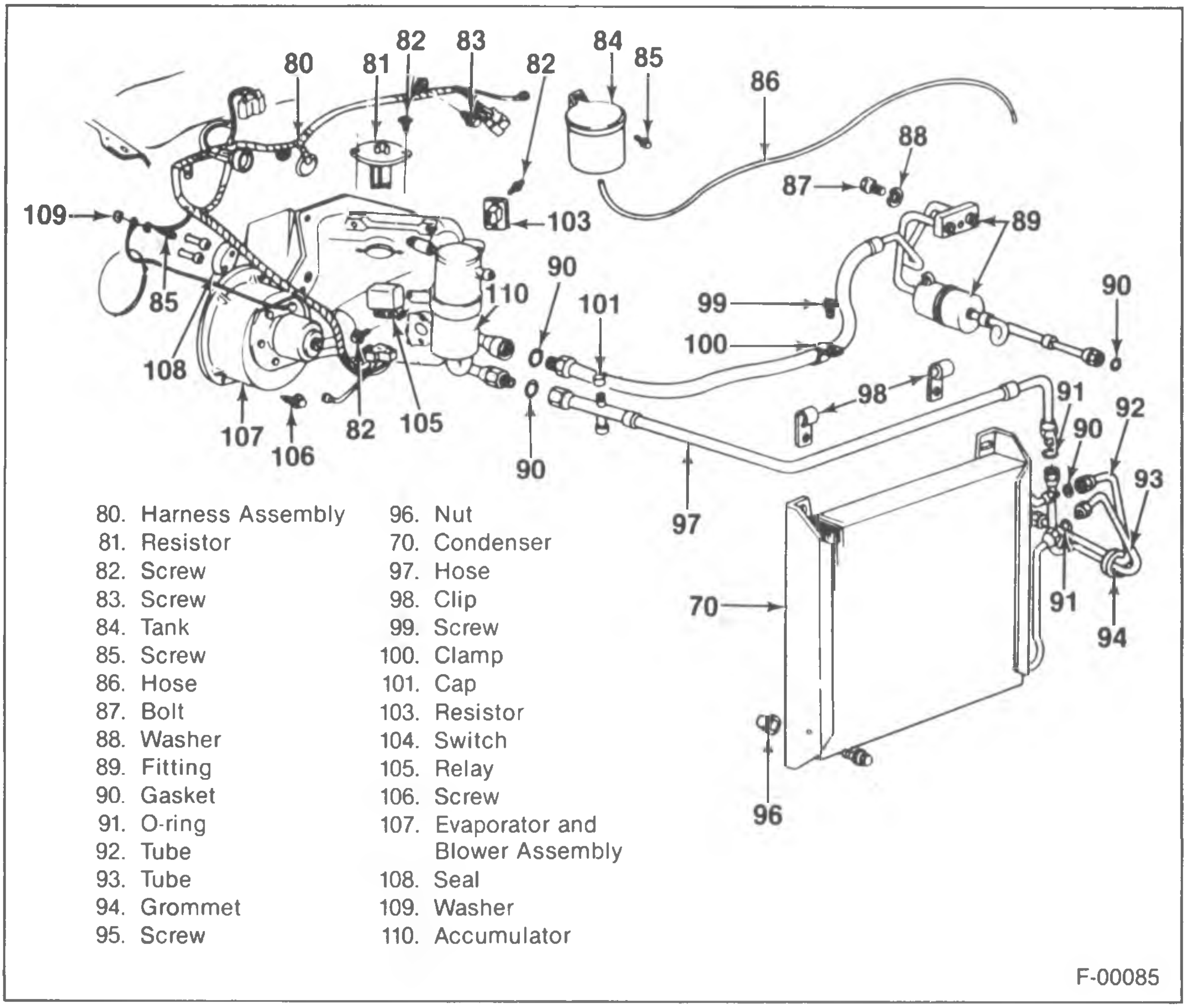


Figure 30—C-K Condenser Assembly

Important

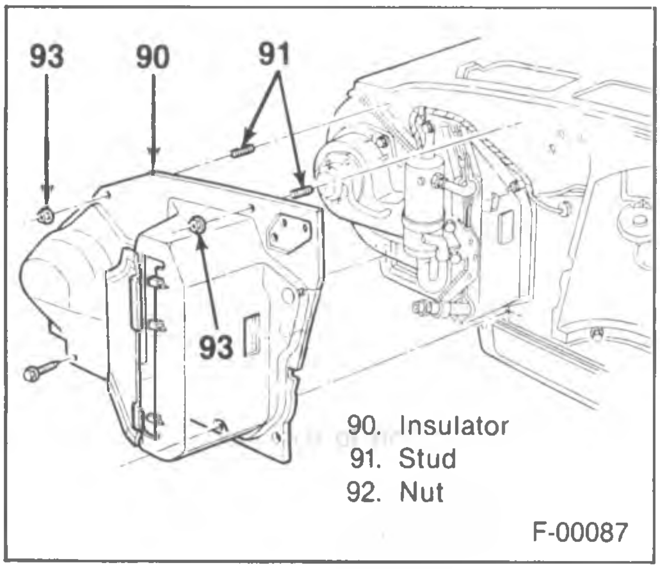
- Use new seals (o-rings) coated with clear refrigeration when connecting refrigerant lines.

5. Left grille support to the upper fender support screws.
6. Radiator center support.
7. Grille assembly.
8. Battery ground cable.



80. Harness Assembly
81. Resistor
82. Screw
83. Screw
84. Tank
85. Screw
86. Hose
87. Bolt
88. Washer
89. Fitting
90. Gasket
91. O-ring
92. Tube
93. Tube
94. Grommet
95. Screw
96. Nut
70. Condenser
97. Hose
98. Clip
99. Screw
100. Clamp
101. Cap
103. Resistor
104. Switch
105. Relay
106. Screw
107. Evaporator and Blower Assembly
108. Seal
109. Washer
110. Accumulator

Figure 31—C-K Evaporator and Condenser Component View (Engine Compartment)



90. Insulator
91. Stud
92. Nut

Figure 32—Dash Panel Insulator Assembly (Engine Compartment - Diesel)

ACCUMULATOR REPLACEMENT

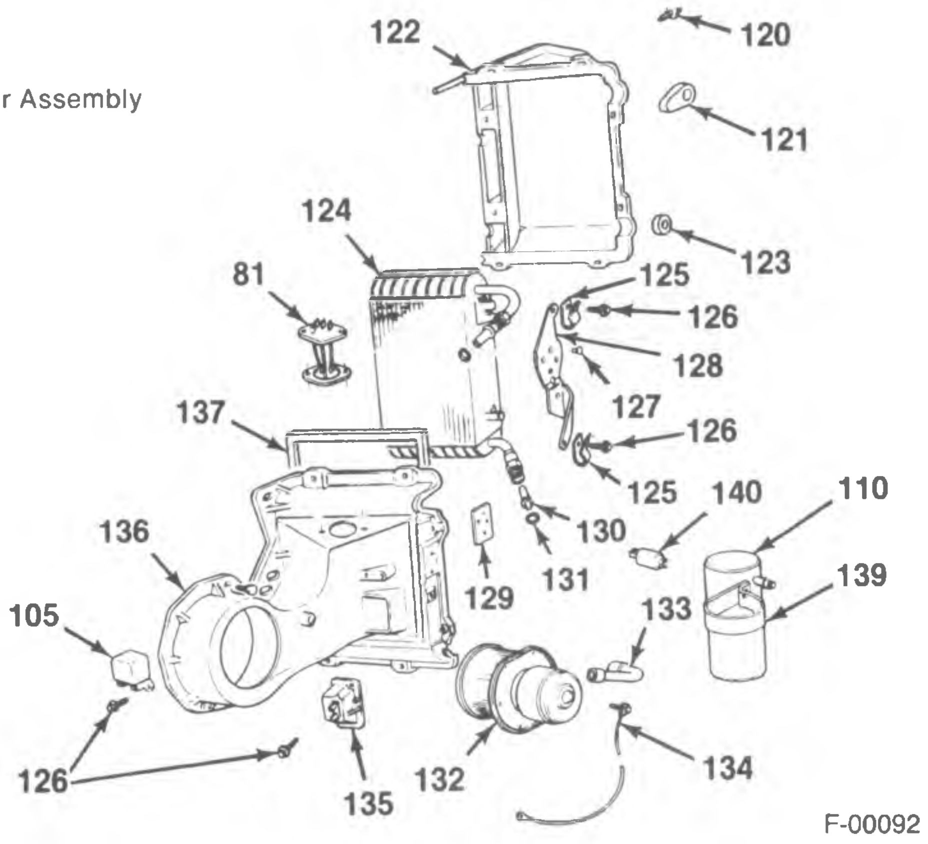
↔ Remove or Disconnect (Figures 31 and 33)

1. Battery ground cable.
2. Compressor clutch connector.
3. Discharge the system.
4. Inlet and outlet lines (97).

? Important

- Cap or plug open connections.

5. Bracket screws.
6. Accumulator (110).



105. Relay
110. Accumulator Dehydrator Assembly
120. Screw
121. Grommet
122. Case
123. Grommet
124. Core
125. Clamp
126. Screw
127. Rivet
128. Bracket
129. Plate
130. Orifice
131. Gasket
132. Motor Assembly
133. Hose
134. Wire Assembly
135. Switch Assembly
136. Case
137. Seal
81. Resistor
139. Clamp
140. Switch

Figure 33—C-K Evaporator and Blower Compartment (Engine Compartment)

Important

- Drain excess refrigerant oil into a clean container. Measure and add new oil.

Install or Connect (Figures 31 and 33)

1. New accumulator.

Important

- Add 30 ml (one ounce) of clean refrigerant oil. PLUS an amount equal to that drained.

2. Bracket screws.
3. Inlet and outlet lines.
4. Compressor clutch connector.
5. Battery ground cable.
6. Evacuate, charge and check the system.

BLOWER ASSEMBLY REPLACEMENT

Remove or Disconnect (Figures 32 and 33)

1. Battery ground cable.
2. Insulator—Diesel Engine.
3. Blower motor lead and ground wires (134).
4. Blower motor cooling tube.
5. Blower assembly.
   - Case attaching screws.
   - Carefully pry the blower flange away from the case if the sealer acts as an adhesive.
6. Blower wheel from motor shaft.
   - Remove shaft nut.

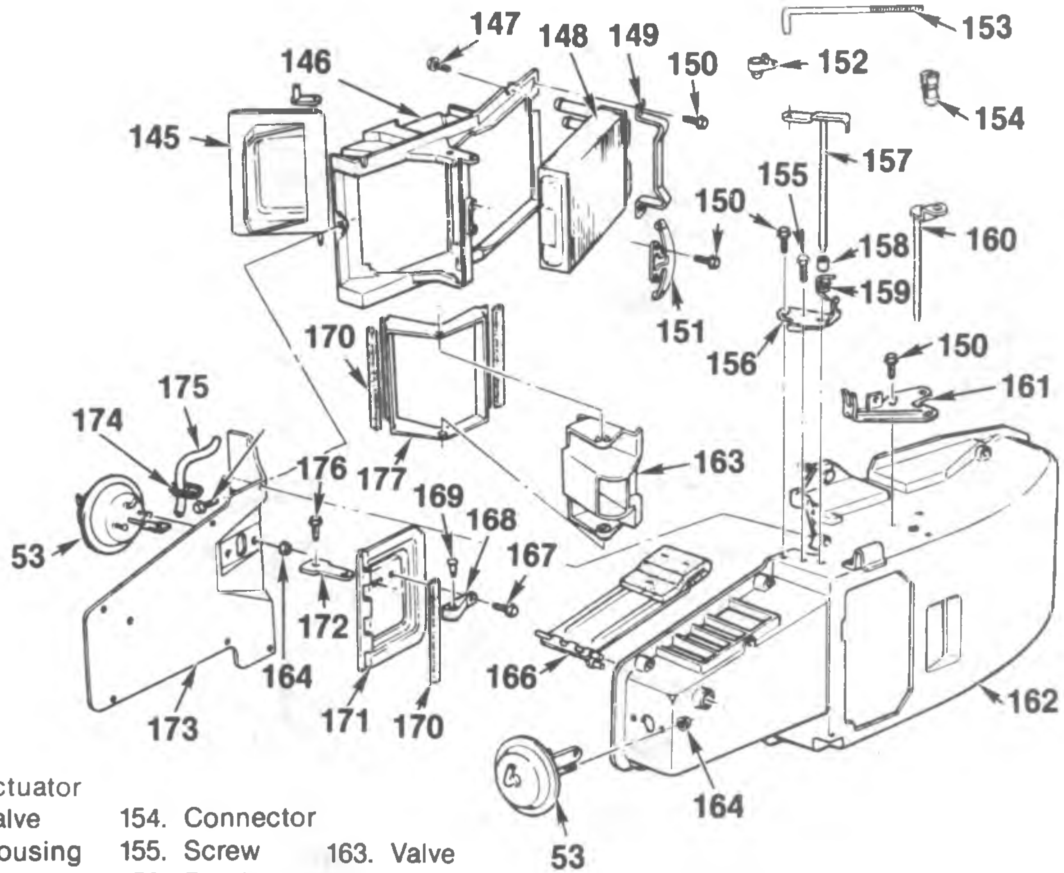
Install or Connect (Figures 32 and 33)

1. Blower wheel to the motor shaft.
2. Blower assembly.
   - Use a new bead of sealer on the flange.
3. Blower assembly.
4. Blower motor cooling tube.
5. Blower motor lead and ground wires.
6. Battery ground cable.

EVAPORATOR CORE REPLACEMENT

Remove or Disconnect (Figure 33)

1. Battery ground cable.
2. Discharge the system.
3. Nuts from the selector duct studs projecting through the dash panel.
4. Evaporator case cover (122).
5. Inlet and outlet lines.



53. Actuator
145. Valve
146. Housing
147. Screw
148. Core
149. Strap
150. Screw
151. Clamp
152. Connector
153. Link
154. Connector
155. Screw
156. Bracket
157. Shaft
158. Spacer
159. Spring
160. Shaft
161. Bracket
162. Case
163. Valve
164. Nut
166. Valve
167. Screw
168. Link
169. Pin
170. Seal
171. Vaive
172. Connector
173. Plate
174. Grommet
175. Hose
176. Screw
177. Yoke

F-00093

Figure 34—C-K A/C and Heater Component View

- Cap or inlet open connections.

6. Expansion tube. Refer to "Orifice (Expansion Tube) Replacement".
7. Evaporator core assembly.

Install or Connect (Figure 33)

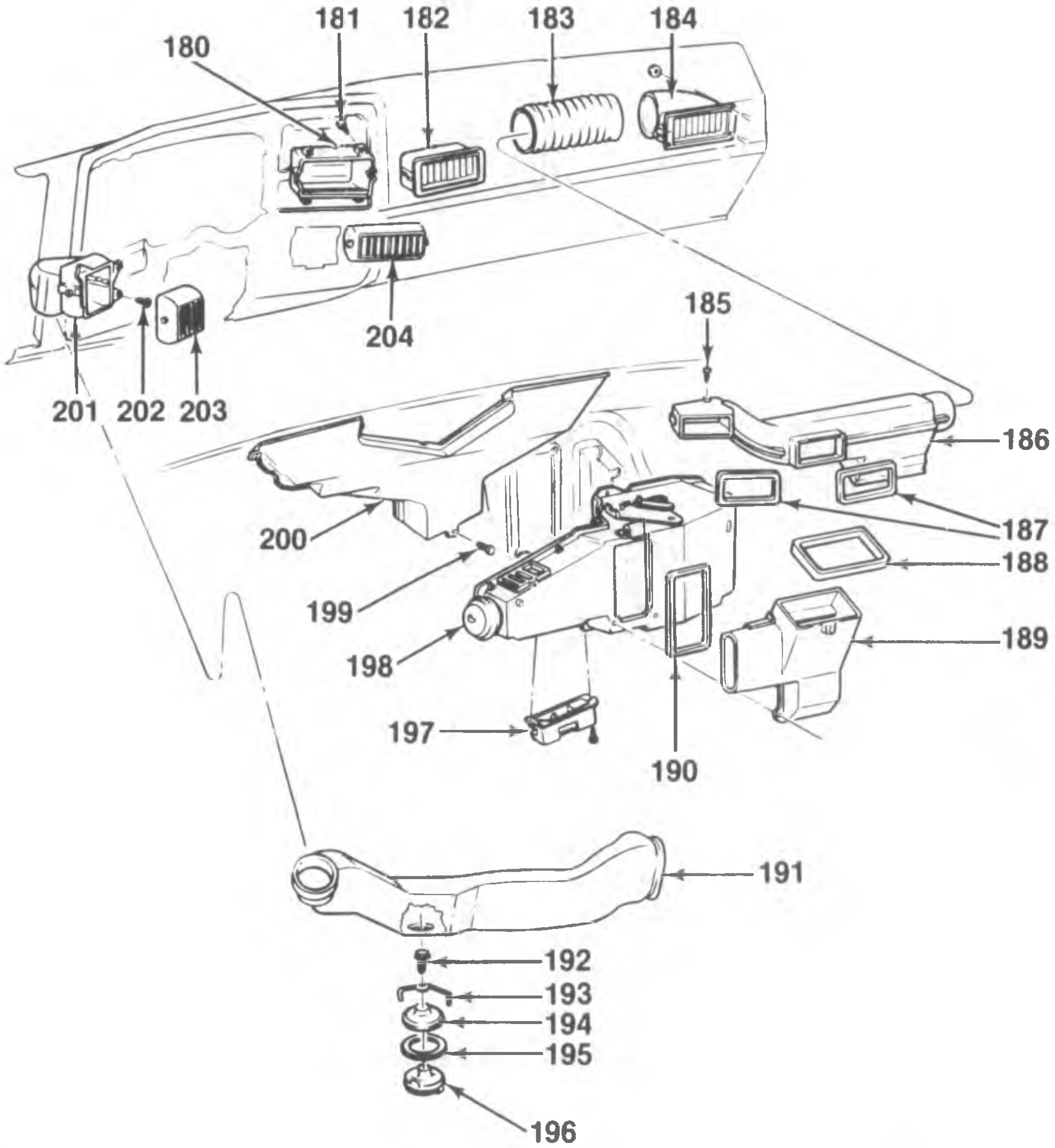
1. New core.
   - Add 90 ml (3 ounces) of clean refrigeration oil.
2. Expansion tube.
3. Inlet and outlet lines.
   - Use new seals (o-rings) coated with clean refrigeration oil.
4. Bead of sealer to cover.
   - Remove old sealer before applying new bead of sealer.
5. Evaporator case cover.
6. Nuts to the studs that project into the dash panel.
6. Battery ground cable.
7. Evacuate, charge and check the system.

ORIFICE (EXPANSION TUBE) REPLACEMENT

The expansion tube is located in the evaporator core inlet line.

Remove or Disconnect (Figures 4 and 33)

1. Discharge the system.
2. Condenser to the evaporator line at the evaporator inlet (figure 35.)
   - Cap or plug the open line.
3. Expansion tube from the evaporator core inlet line.
   - Use needle-nose pliers to remove the core.
4. Expansion tube seal (o-ring) from the core inlet line.



180. Adapter
181. Screw
182. Adapter
183. Hose
184. Duct Assembly
185. Screw
186. Duct Assembly
187. Seal
188. Seal
189. Duct Assembly
190. Gasket
191. Duct Assembly
192. Screw
193. Retainer
194. Adapter
195. Felt
196. Deflector
197. Outlet
198. Air Conditioning Assembly
199. Bolt
200. Outlet Assembly
201. Outlet Assembly
202. Screw
203. Deflector
204. Deflector

F-00080

Figure 35—C-K A/C and Heater Outlets and Ducts Component View (Passenger Compartment)

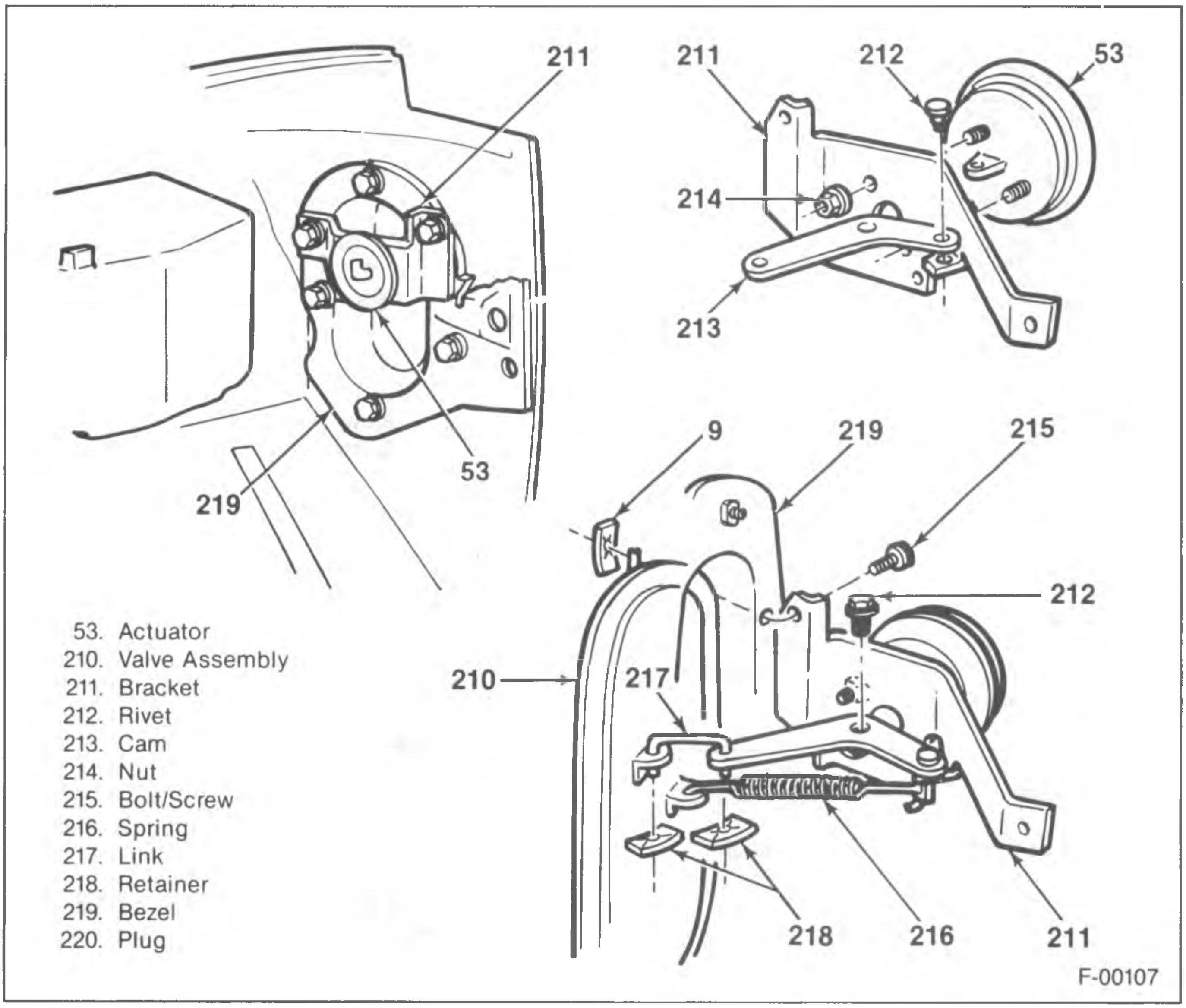


Figure 36—Actuator-Plenum Side Vent

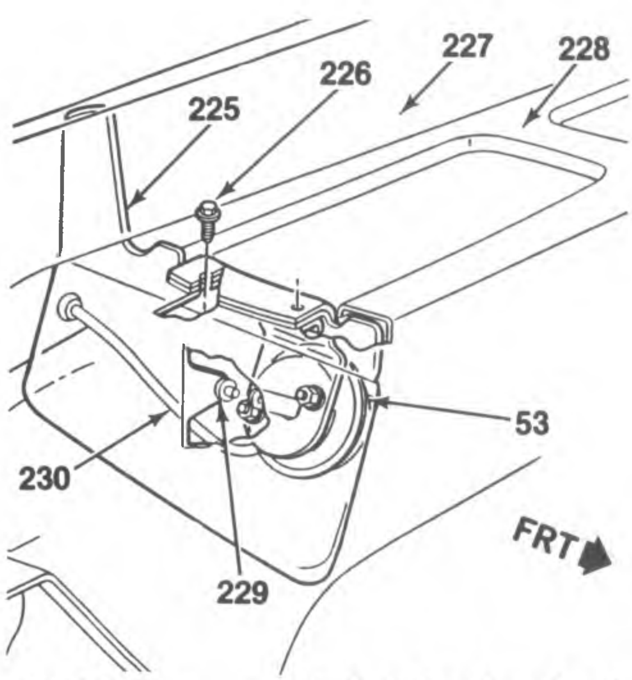
Install or Connect (Figures 4 and 33)

1. Expansion tube seal (o-ring) to the core inlet line.
   - Use new seal (o-ring) coated with clean refrieration oil.
   - Insert the short screen and end of the orifice into the evaporator inlet line.
2. Expansion tube to the evaporator core inlet line.
3. Condenser to the evaporator line at the evaporator inlet.
4. Evacuate, charge and check the system.

SELECTOR DUCT AND HEATER CORE REPLACEMENT

Remove or Disconnect (Figures 34 and 35)

1. Battery ground cable.
2. Drain the radiator.
3. Heater hoses from the core tubes (148).
   - Plug the core tubes to prevent spillage.
4. Instrument panel compartment and door.
5. Center duct to the selector duct (200).
6. Center lower and center upper ducts.
7. Temperature door cable.
8. Nuts from the three selector duct studs that project into the dash panel.
9. Selector duct to dash panel screw (inside the vehicle).
10. Selector duct assembly.
    - Pull rearward until the core tubes clear the dash panel.
    - Lower the selector assembly to reach the vacuum and electrical harness.
11. Vacuum and electrical harness.
12. Selector duct assembly.
13. Core mounting strap screws.
14. Core.



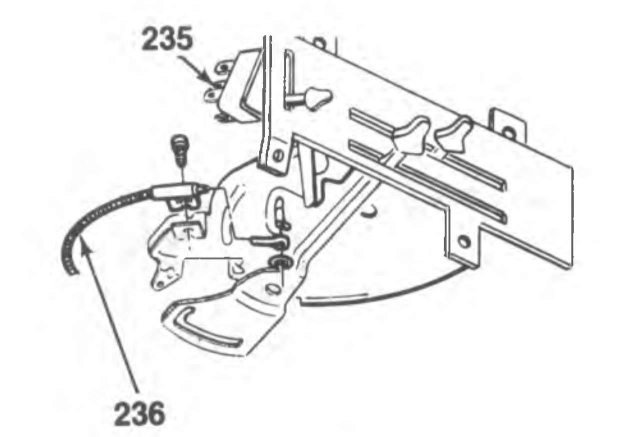
53. Actuator
225. Valve Assembly
226. Bolt/Screw
227. Windshield Frame
228. Dash And Cowl Panel
229. Retainer And Pin
230. Vacuum Control Hose

F-00153

Figure 37—Plenum Air Inlet Door

Install or Connect (Figures 34 and 35)

1. Core.
2. Core mounting strap screws.
3. Selector duct assembly.
4. Vacuum and electrical harnesses.
5. Selector duct assembly.
6. Temperature door cable.
7. Center lower and center upper ducts.



235. Blower Switch
236. Temperature Cable

F-00225

Figure 39—C-K Control Assembly

8. Center duct to selector duct.
9. Instrument panel bar and door.
10. Heater hoses.
11. Coolant to the radiator.
12. Battery ground cable.

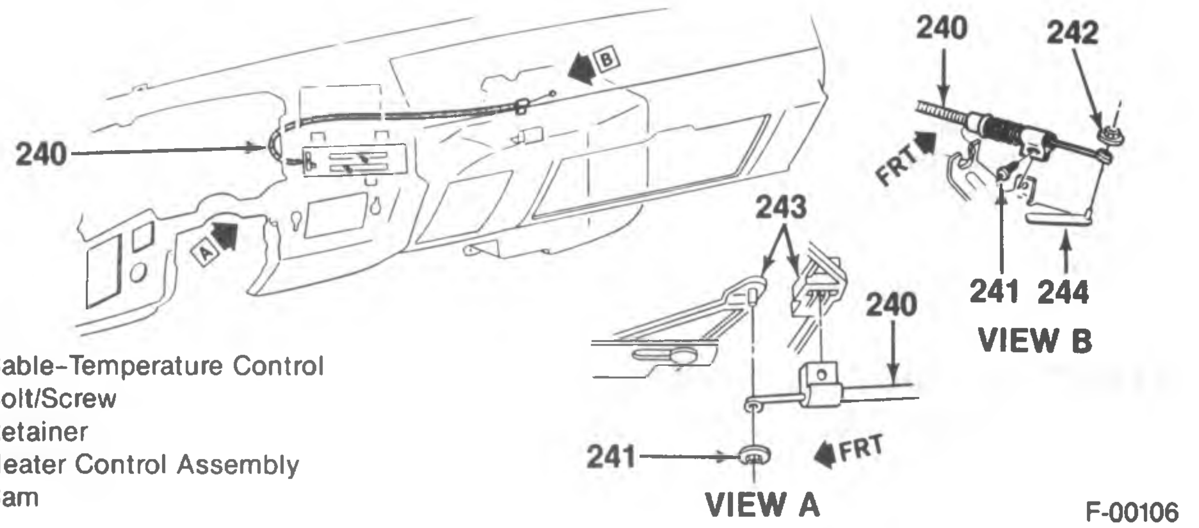
Adjust

Temperature door cable. Refer to "Temperature Door Cable Adjustment."

ACTUATOR-PLENUM SIDE VENT REPLACEMENT

Remove or Disconnect (Figure 36)

1. Vacuum hose at the actuator.
2. Valve return spring at the actuator end (216).



240. Cable-Temperature Control
241. Bolt/Screw
242. Retainer
243. Heater Control Assembly
244. Cam

F-00106

Figure 38—Temperature Door Cable Adjustment

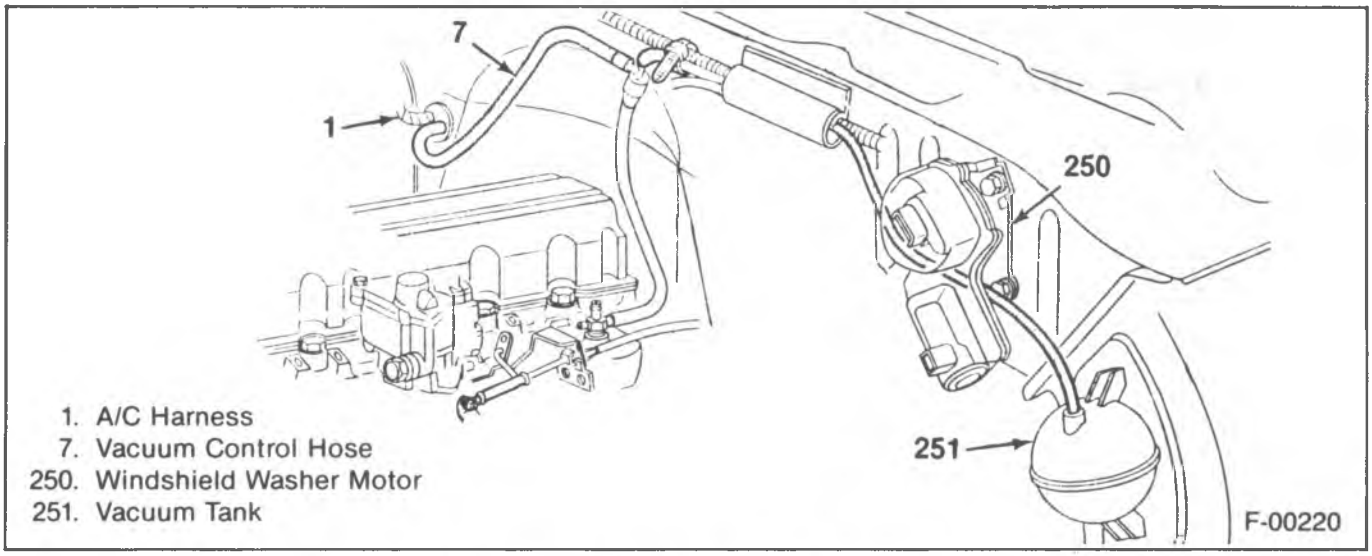


Figure 40—Vacuum Tank Location - L6 Vacuum Hose

3. Actuator bracket mounting screws.
4. Cam to actuator arm screw (213).
5. Actuator and bracket from the cam.
6. Actuator to bracket nuts.
7. Actuator from the bracket (53).

→← Install or Connect (Figure 36)

1. Actuator to the bracket (53).
2. Bracket nuts.
3. Actuator and bracket to the cam (211).
4. Cam to the actuator arm screw.
5. Actuator bracket mounting screws.
6. Valve return spring at the actuator end (216).
7. Vacuum hose to the actuator.

PLENUM VALVE REPLACEMENT

←→ Remove or Disconnect (Figure 37)

1. Raise the hood.
2. Cowl plastic grille.
3. Three cowl to valve assembly screws.
    - Valve assembly from the vehicle.
4. Actuator arm pushnut.
5. Actuator to valve nuts.
    - Separate the valve and actuator.

→← Install or Connect (Figure 37)

1. Actuator to valve nuts.
2. Actuator arm push nut (53).
3. Valve assembly to the vehicle.
4. Cowl plastic grille.
5. Close the hood.

CONTROL ASSEMBLY REPLACEMENT

←→ Remove or Disconnect

1. Battery ground cable.
2. Radio. Refer to RADIO (SEC. 9A).
3. Instrument panel bezel.
4. Control from the dash.
    - Lower the control to gain access to the control assembly.

! Important

- Do not kink the cable.

5. Cable.
6. Vacuum harness.
7. Electrical harness.
8. Control.

→← Install or Connect

1. Blower switches to the new control.
2. Electrical harness.
3. Vacuum harness.
4. Cable.
5. Control to the dash.
6. Instrument panel bezel.
7. Radio. Refer to RADIO (SEC. 9A).
8. Battery ground cable.

TEMPERATURE DOOR CABLE ADJUSTMENT

Adjust (Figure 38)

1. Remove instrument panel compartment and door.
2. Loosen the cable attaching screw at the selector duct assembly.
   - Make sure the cable is installed in the bracket on the selelctor duct assembly.
3. Place the temperature lever in full COLD position and hold while tightening the cable attaching screw.
4. Install instrument panel compartment and door.

BLOWER SWITCH REPLACEMENT

The blower switch is located on the rear of the control assembly.

Remove or Disconnect (Figure 39)

1. Battery ground cable.
2. Instrument panel bezel.
3. Control to instrument panel screws.
   - Reset the control on top of the radio.
4. Switch to control screws.
5. Electrical harness.
6. Vacuum harness at the master switch.
7. Switch assembly (235).

Install or Connect (Figure 39)

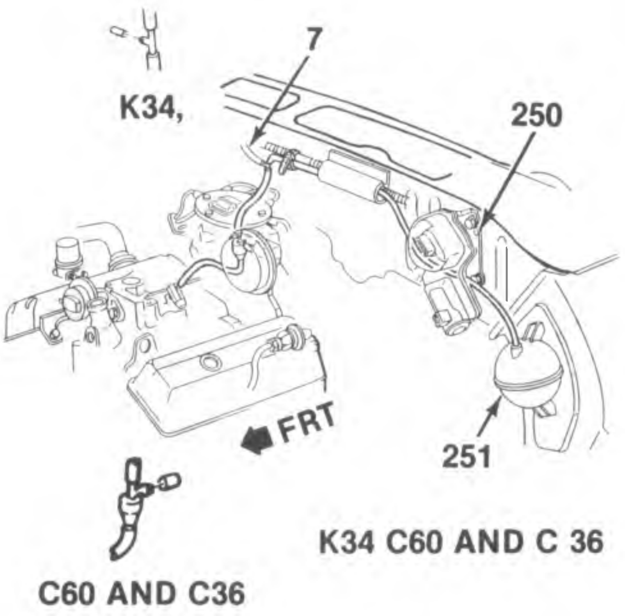
1. Switch.
2. Vacuum harness.
3. Electrical harness.
4. Switch to control screws.
5. Control to the instrument panel.
6. Instrument panel bezel.
7. Battery ground cable.

VACUUM TANK REPLACEMENT

The vacuum tank is mounted to the cowl behind the left front fender.

Remove or Disconnect (Figure 40)

1. Vacuum lines at the tank.
2. Tank to dash panel screws.
3. Tank (251).



7. Vacuum Control Hose
250. Windshield Washer Motor
251. Vacuum Tank

F-00221

Figure 41—C-K Vacuum Hose - V6 Gas Engine

Install or Connect (Figure 40)

1. Tank (251).
2. Vacuum lines.

VACUUM LINES ENGINE COMPARTMENT

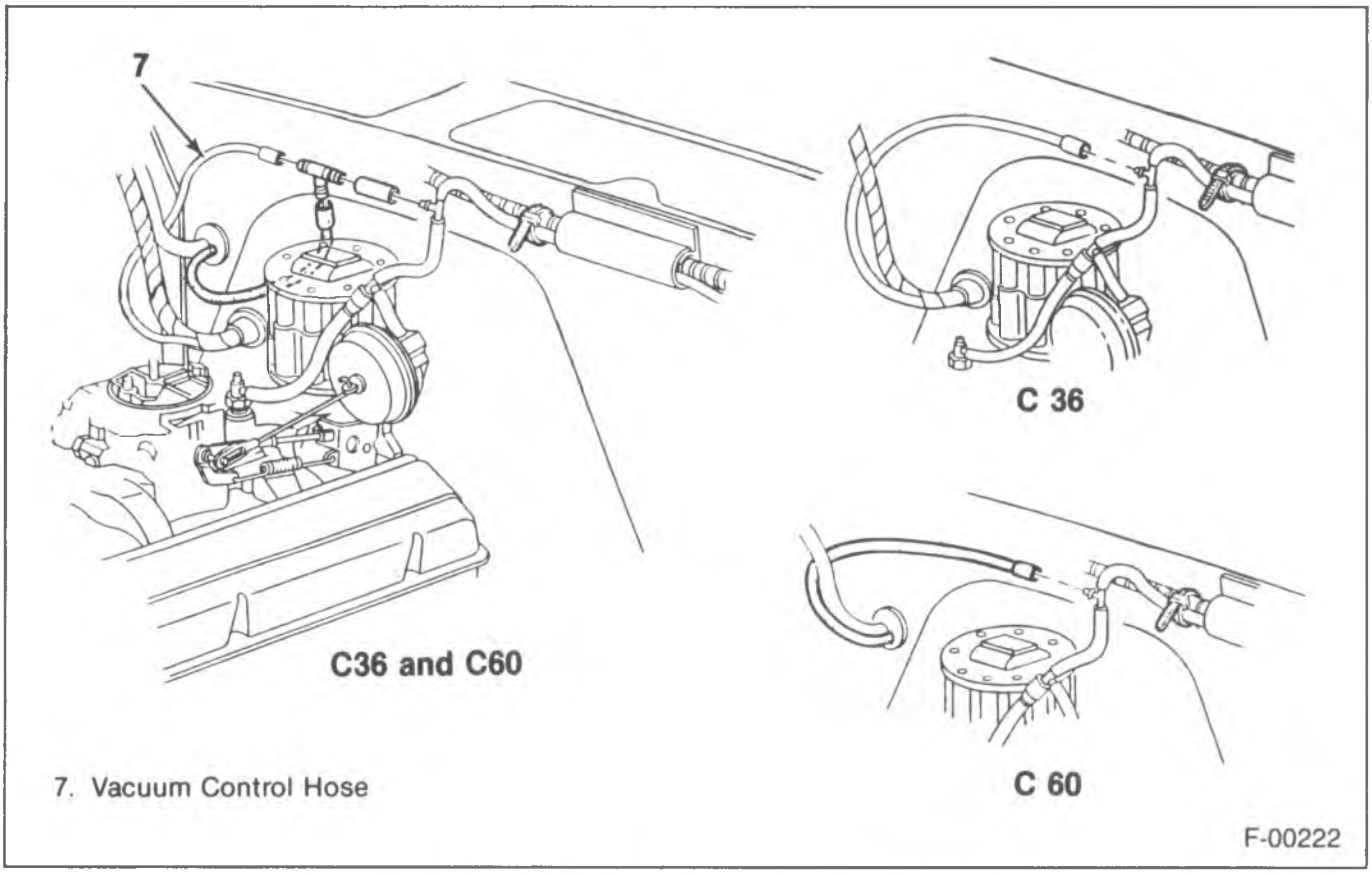
For vacuum line routing refer to figures 40-43.
1. L6 Engine (4.8 Liter) (figure 40).
2. V6 Engine (4.3 Liter) (figure 41).
3. V8 Engines (5.0, 5.7 and 7.4 Liter) (figure 42).
4. V8 Engine (6.2 Liter, Diesel) (figure 43).

VACUUM LINE HARNESS - DASH

Figure 44 presents the dash vacuum harness and activator installation.

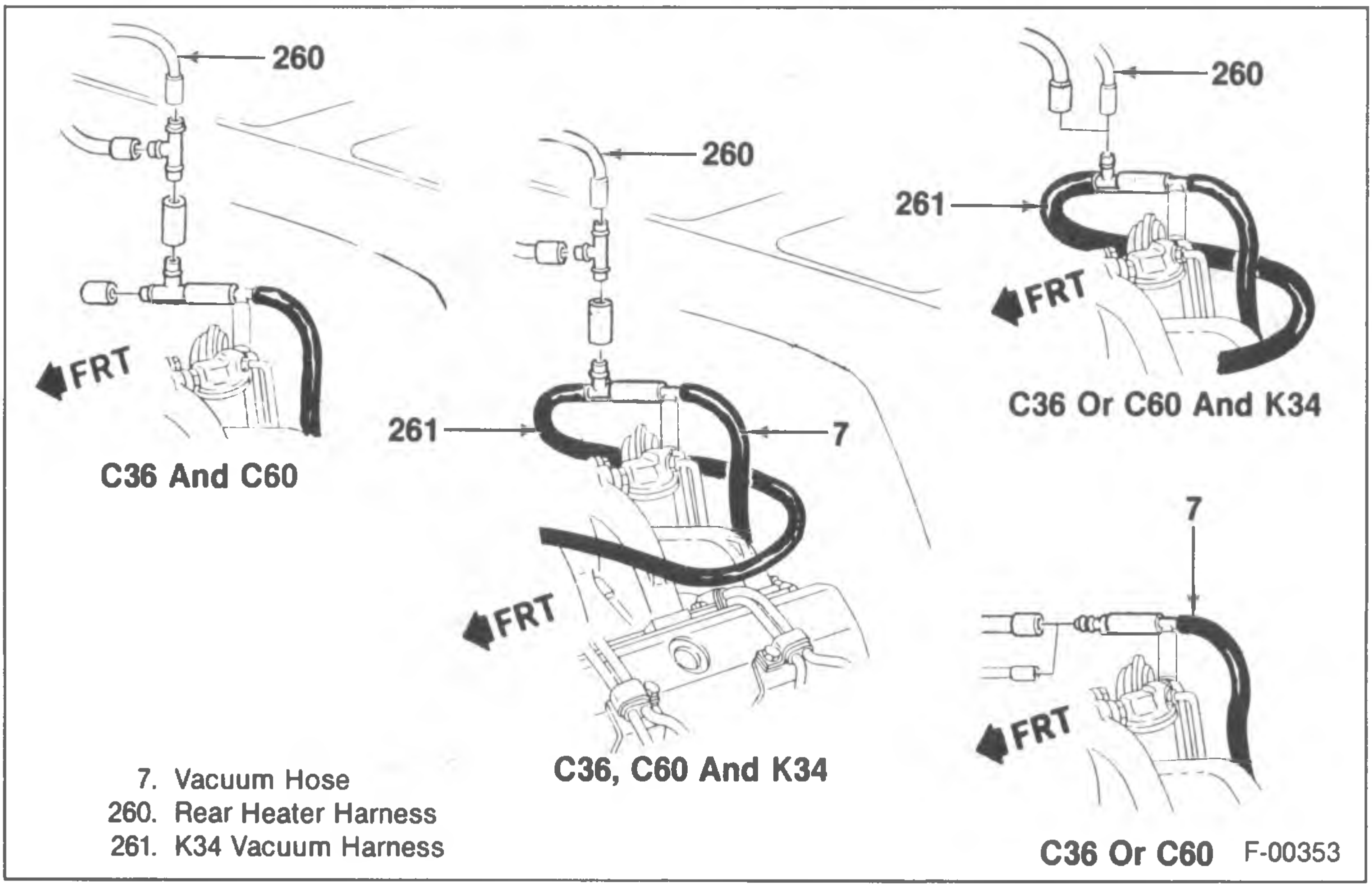
REFRIGERANT-12 HOSE ROUTING

For Refrigerant-12 hose assemblies, refer to figures 45–49.
1. L6 Engine (4.8 Liter) (figure 45).
2. V6 Engine (4.3 Liter) (figure 46).



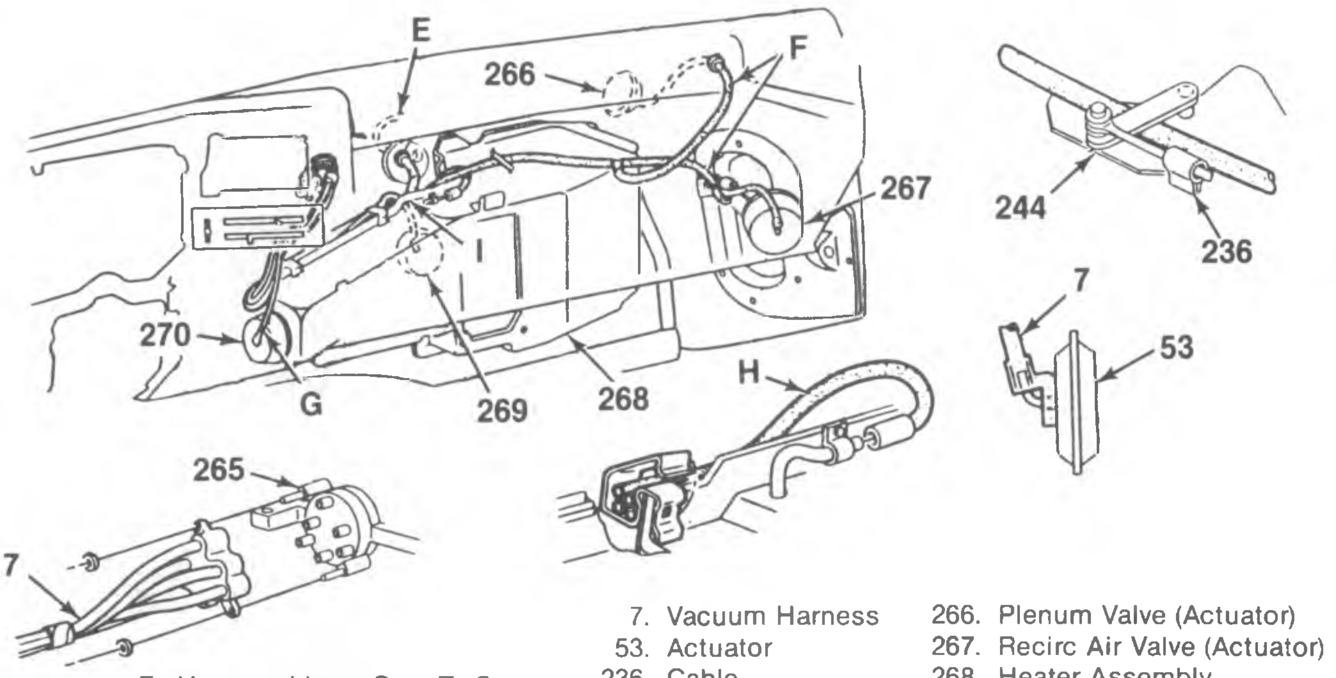
7. Vacuum Control Hose

Figure 42—C-K Vacuum Hose — V8 Gas Engine



7. Vacuum Hose
260. Rear Heater Harness
261. K34 Vacuum Harness

Figure 43—C-K Vacuum Hose - Diesel Engine



7. Vacuum Harness
53. Actuator
236. Cable
244. Cam
265. Control Assembly
266. Plenum Valve (Actuator)
267. Recirc Air Valve (Actuator)
268. Heater Assembly
269. Air Cond. Valve (Actuator)
270. Defrost (Actuator)

E. Vacuum Line—Gray To Source
F. Vacuum Line—Orange
G. Vacuum Line—Stripe
H. Vacuum Line—Dark Blue
I. Vacuum Line—Tan

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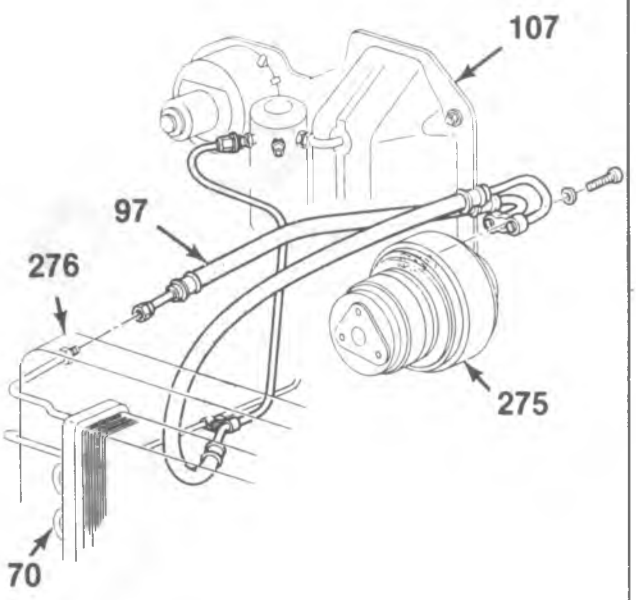
Figure 44—C-K Vacuum Control Hose - Dash



70. Condenser
97. Refrigerant Hose
107. Evaporator And Blower Assembly
275. Compressor
276. Radiator

F-00280

Figure 45—C-K L6 (4.8 Liter) Refrigerant Hose Assembly

3. V8 Engines (5.0 and 5.7 Liter) (figure 47).
4. V8 Engine (7.4 Liter) (figure 48).
5. V8 Engine (6.2 Liter) (figure 49).

BLOWER MOTOR RESISTOR REPLACEMENT

The blower motor resistor is located in the blower side of the blower-evaporator case.

↔ Remove or Disconnect (Figure 33)

1. Wiring harness at the resistor.
2. Resistor to case attaching screws.
3. Resistor (81).

→← Install or Connect (Figure 33)

1. Resistor (81).
2. Screws.
3. Wiring harness.

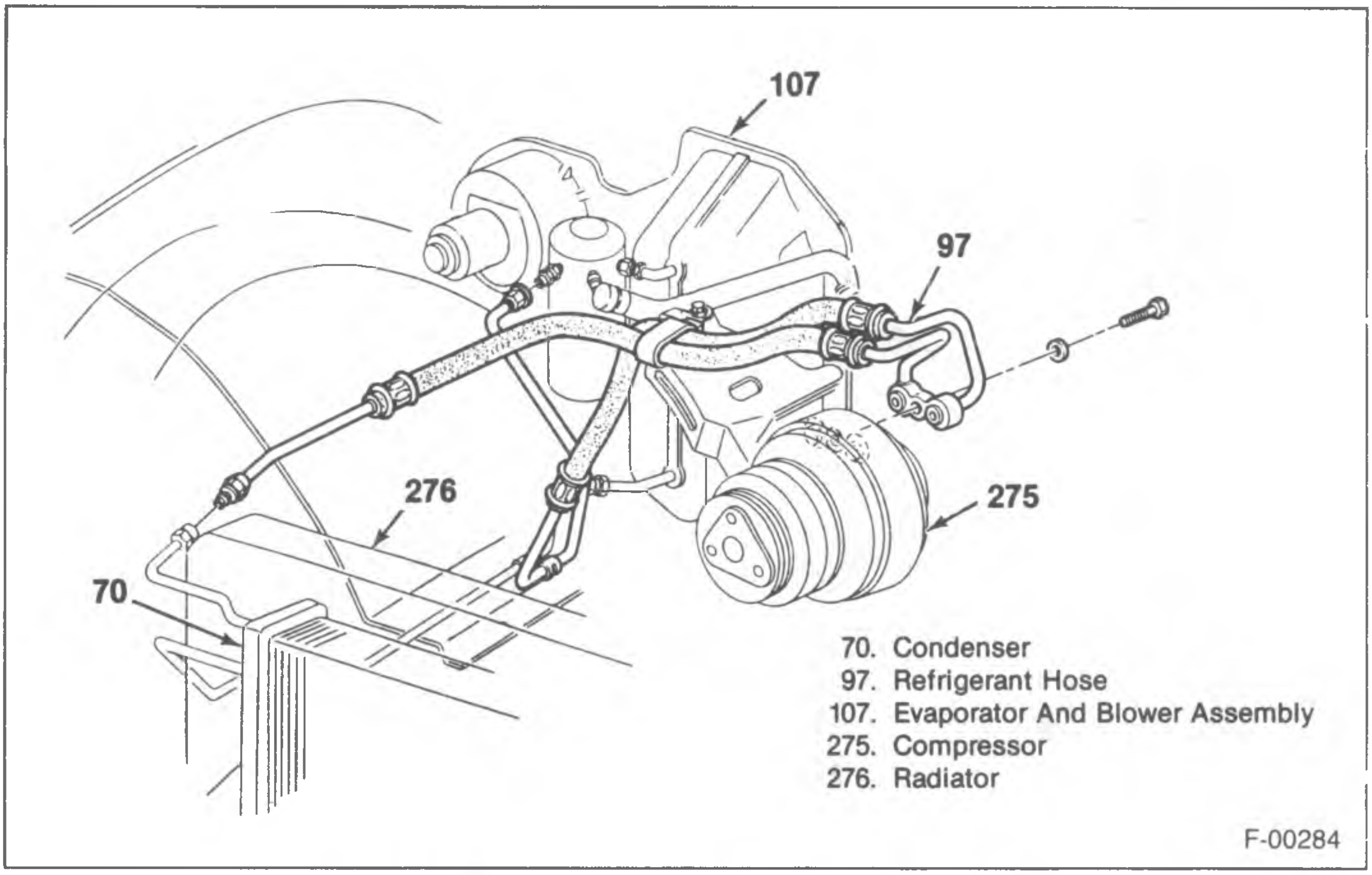


Figure 46—C-K (4.3 Liter) Refrigerant Hose Assembly

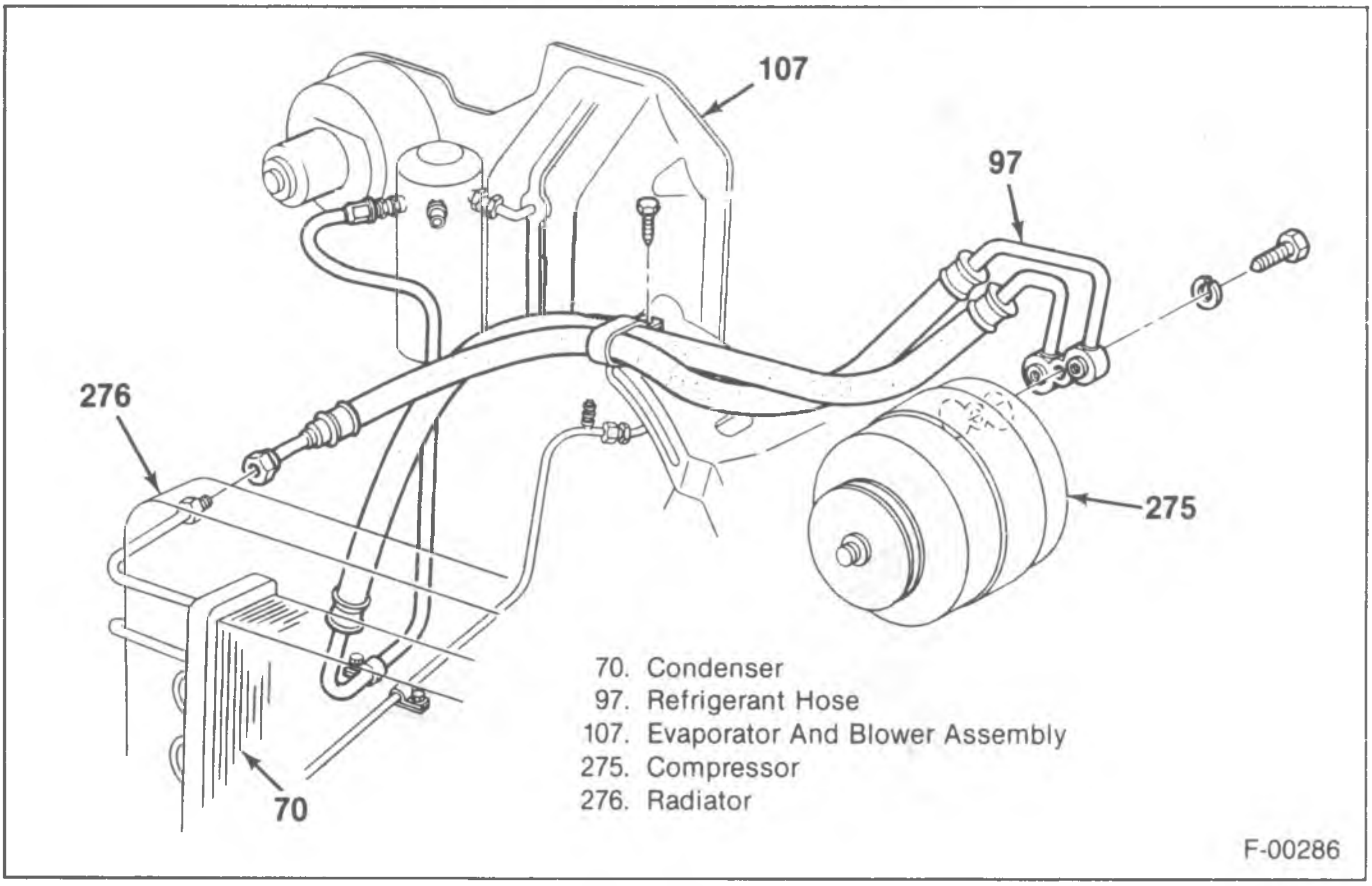


Figure 47—C-K V8 (5.0 Liter and 5.7 Liter) Refrigerant Hose Assembly

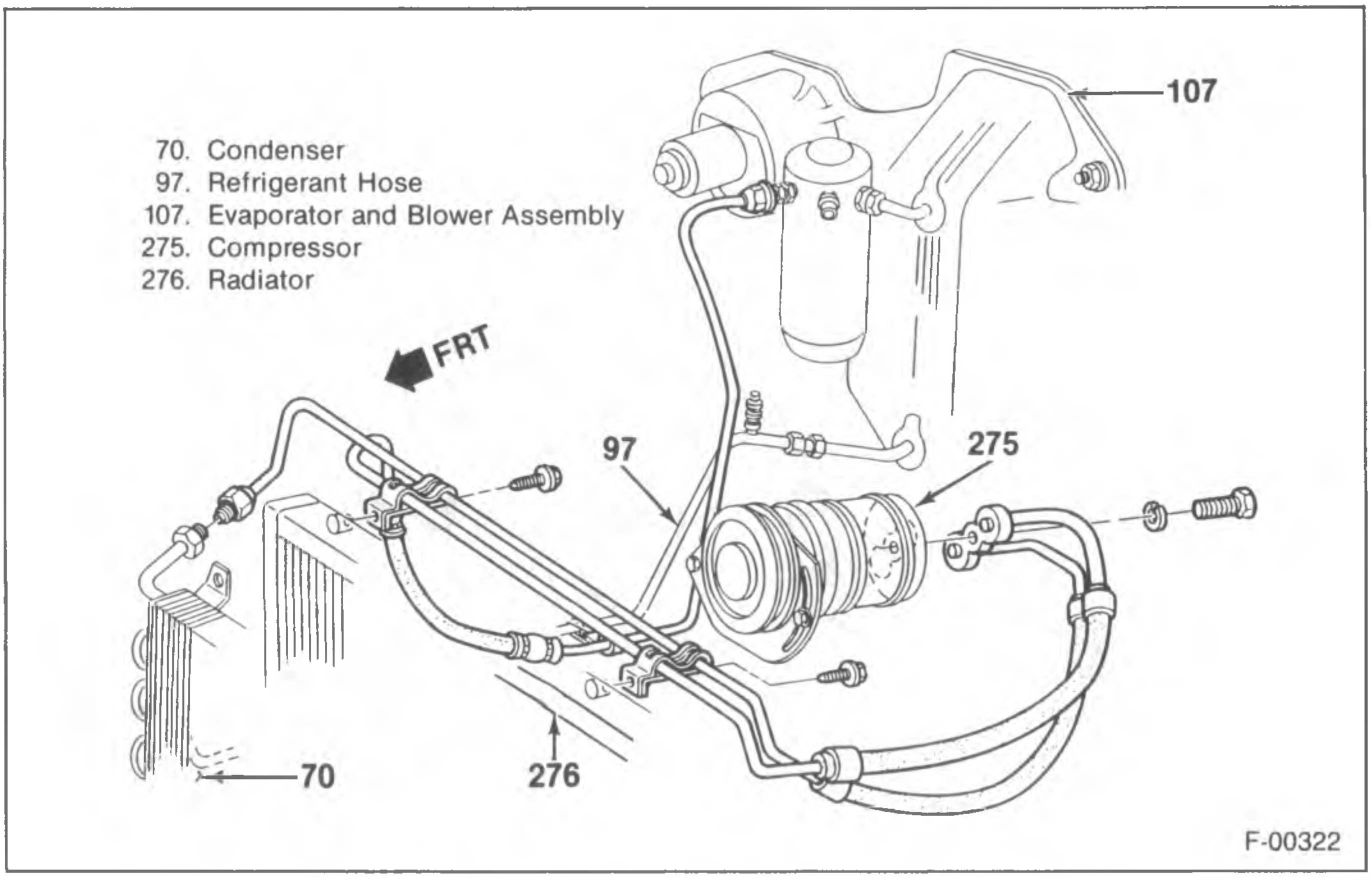


Figure 48—C-K V8 (7.4 Liter) Refrigerant Hose Assembly

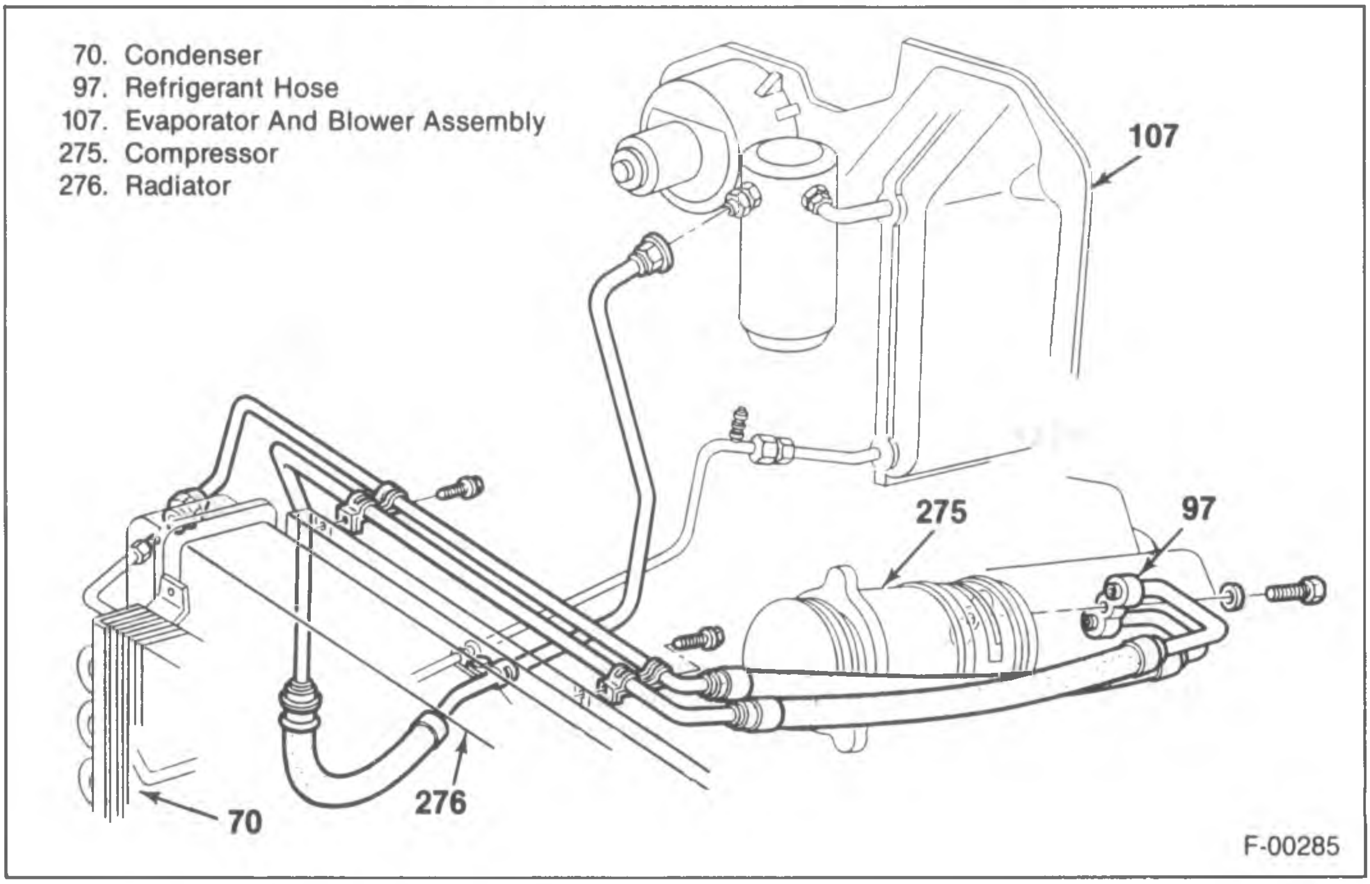


Figure 49—C-K V8 (6.2 Liter - Diesel) Refrigerant Hose Assembly

BLOWER MOTOR RELAY REPLACEMENT

The blower motor relay is located on the blower side of the blower-evaporator case.

Remove or Disconnect (Figure 31)

1. Wiring harness at the relay.
2. Attaching screws.
3. Relay (105).

Install or Connect (Figure 31)

1. Relay (105).
2. Mounting screws.
3. Wiring harness.

FUSE REPLACEMENT

A 25-amp fuse, located in the junction block, projects the system except for the blower circuit. The fuse for the blower circuit is located in the electrical wiring between the junction block and the blower relay.

REAR INTERIOR ROOF MOUNTED SYSTEM—SUBURBAN

The rear interior roof mounted system is used with the front air conditioning system.

REAR DUCT REPLACEMENT

This duct covers the blower-evaporator assembly located at the rear of the vehicle. It has four adjustable air outlets (figure 50).

Remove or Disconnect (Figure 50)

1. Drain tube from the rear duct.
2. Screws securing the duct to the roof panel and rear header brackets.
3. Duct (303).

Install or Connect (Figure 50)

1. Duct (303).
2. Screws and brackets.
3. Drain tube.

BLOWER MOTOR RESISTOR REPLACEMENT

The blower motor resistor is located on the cover side of the blower-evaporator. To remove, refer to "Blower Motor Resistor, CCOT A/C System (C-K Series)."

BLOWER MOTOR ASSEMBLY REPLACEMENT

Remove or Disconnect (Figures 50 and 51)

1. Battery ground cable.
2. Rear duct (303).
3. Blower motor ground strap.
4. Blower motor lead wire.
5. Lower to upper blower-evaporator case screws.
6. Case and motor assembly (326) (336).

Important

- Before removing the case screws, support the lower case to prevent damage to the case or motor assembly.

7. Motor retaining strap.
8. Motor and wheels (330).
9. Wheel from the motor shaft.

Install or Connect (Figures 50 and 51)

1. Wheels to the motor shaft (330).
   - Place the tension springs on the wheel hubs.
2. Motor and wheels to the case.
   - Align the wheels to prevent contact with the case.
3. Motor retaining strap and foam.
4. Lower case and blower motor assembly in the vehicle (336).
5. Lower to upper case screws.
   - Turn the blower wheels to prevent rubbing against the case.
6. Center ground strap.
7. Blower lead wire.
8. Rear duct.
9. Battery ground cable.

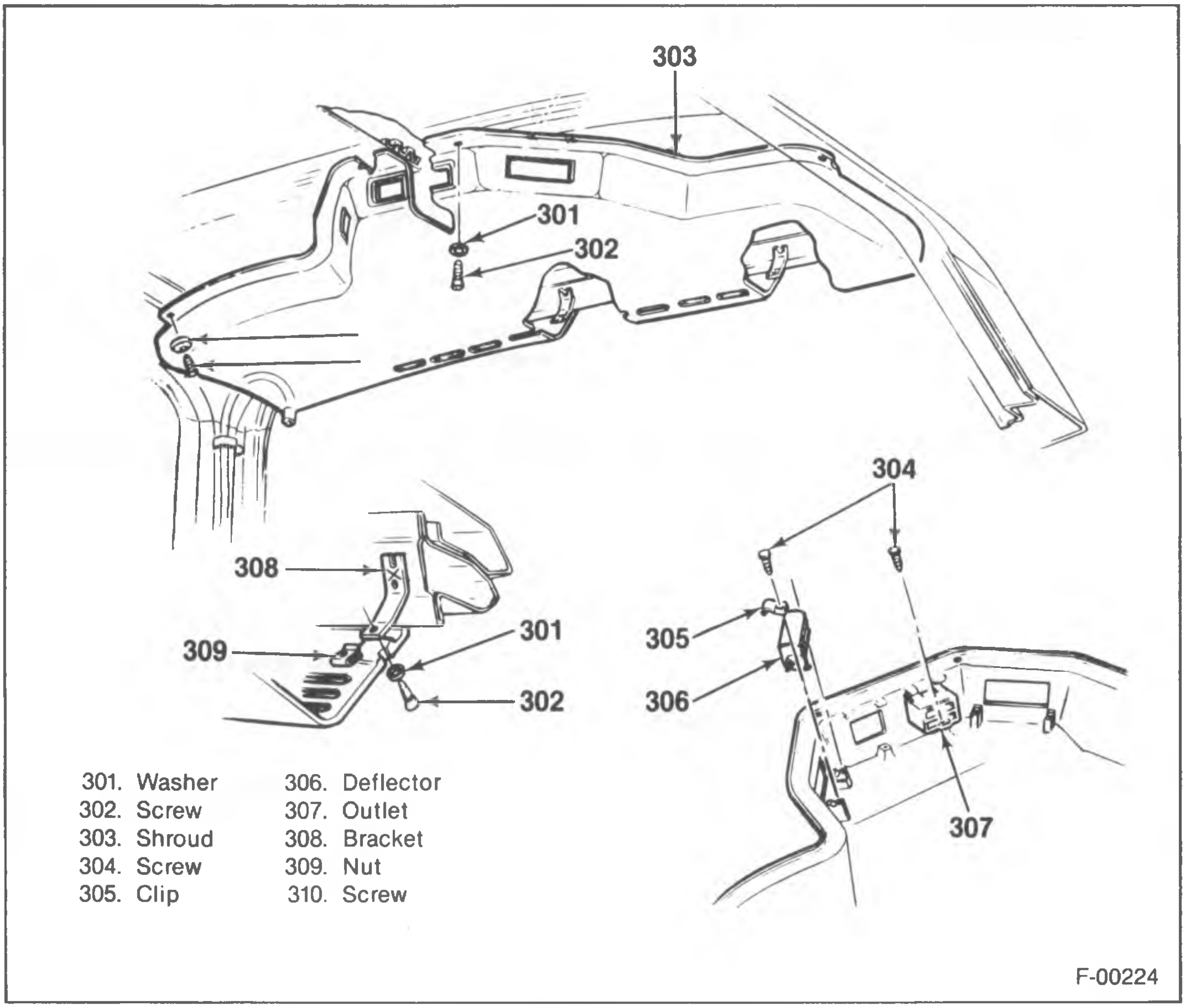


Figure 50—C-K Rear Interior Roof Mounted A/C Shroud

EXPANSION VALVE REPLACEMENT

This system incorporates an expansion valve which does not utilize and external equalizer line.

Remove or Disconnect (Figure 51)

1. Battery ground cable.
2. Purge the system of refrigerant.
3. Rear duct.
4. Blower motor lead.
5. Ground wire.
6. Lower to upper blower-evaporator case screws.

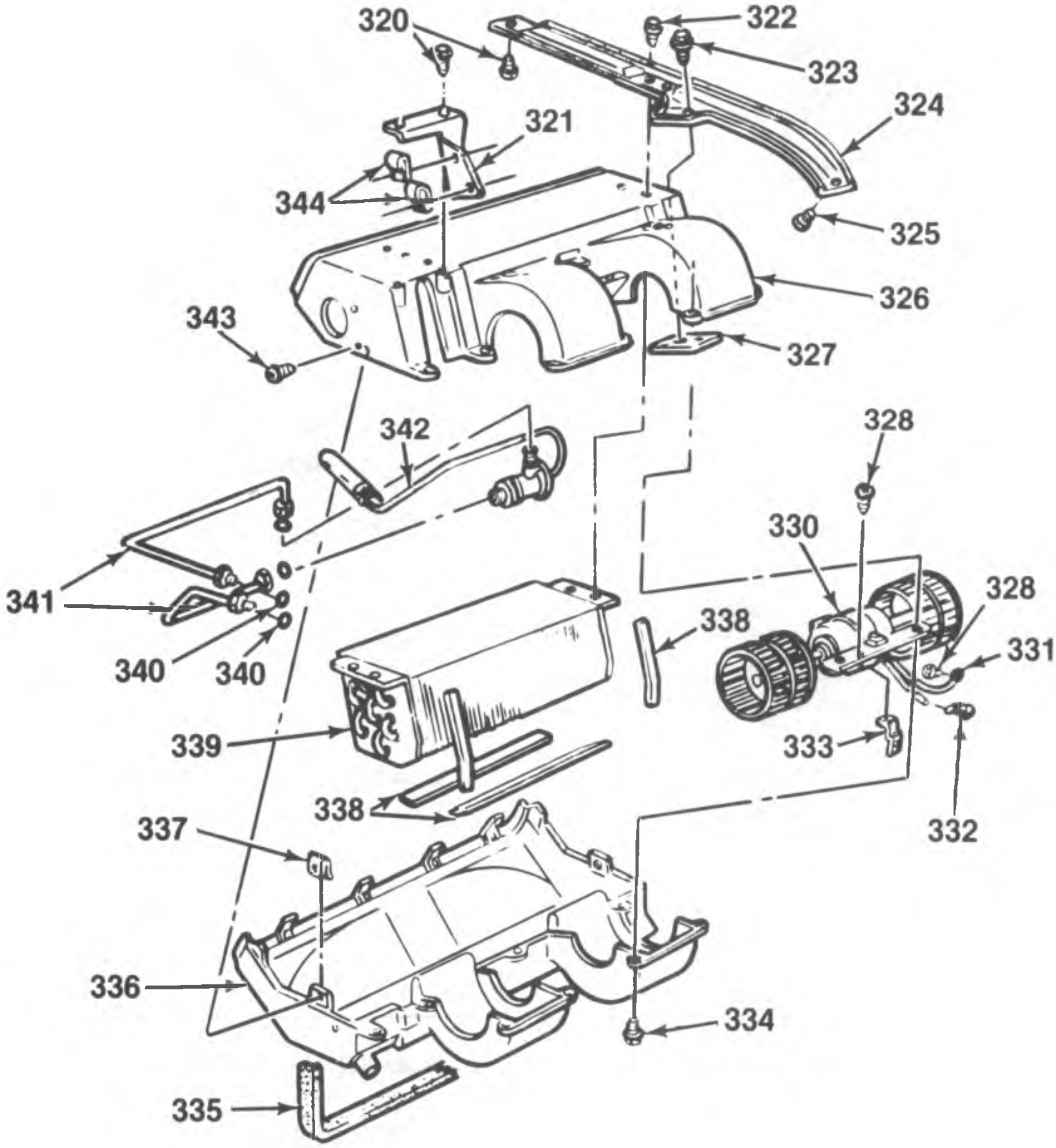
Important

- Before removing the case screws, support the lower case and motor assemblies to prevent damage to the case or motor assembly.

7. Lower case and motor assembly (336).
8. Expansion valve sensing bulb clamps.
9. Valve inlet and outlet lines.
    - Cap or plug open lines.
10. Expansion valve assembly (342).

Install or Connect (Figure 51).

1. New expansion valve assembly (342).
    - Remove caps or plug.
    - Use new seals (o-rings) coated with clean refrigeration oil.
2. Sensing bulb.
3. Lower case and blower motor assembly.



320. Screw
321. Bracket
322. Screw
323. Screw
324. Support
325. Screw
326. Case
327. Plate
328. Screw
329. Seal
330. Motor Asm.
331. Eyelet
332. Terminal
333. Bracket
334. Screw
335. Seal
336. Case
337. Clip
338. Seal
339. Core Asm.
340. Seal (O-ring)
341. Refrigerant Lines
342. Valve Asm.
343. Screw
344. Clamps

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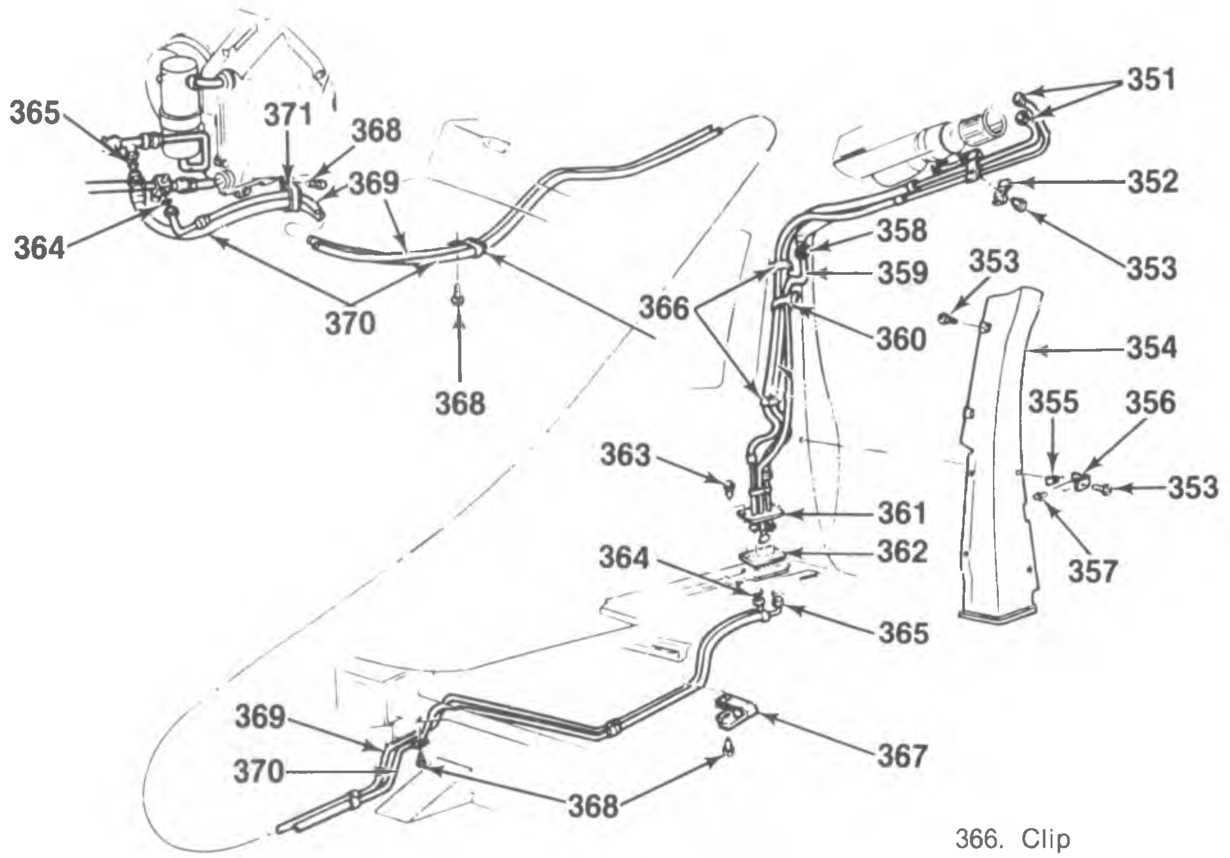
Figure 51—C-K Rear Interior Roof Mounted A/C Evaporator and Blower Component View



351. Fittings
352. Clip
353. Screw
354. Cover
355. Nut
356. Bracket
357. Screw
358. Clamp
359. Hose
360. Strap
361. Hose Assembly
362. Seal
363. Screw
364. O-ring
365. O-ring
366. Clip
367. Clip
368. Screw
369. Hose Assembly
370. Hose Assembly
371. Clip

B-06946

Figure 52—C-K Rear Interior Roof Mounted A/C Hoses and Cover Component View

4. Blower motor lead.
5. Ground wires.
6. Rear duct.
7. Battery ground cable.
8. Evacuate, charge and check the system.

EVAPORATOR CORE REPLACEMENT

↔ Remove or Disconnect (Figures 51 and 52)

1. Battery ground cable.
2. Purge the system of refrigerant.
3. Rear duct.
4. Blower motor lead.
5. Ground wire.
6. Refrigerant lines at the rear of the blower-evaporator assembly (351).
   - Cap or plug the open connections.
7. Blower-evaporator support to roof rail screws.
8. Blower-evaporator (339).
   - Place the blower-evaporator upside down on a work bench.
9. Lower case assembly.
10. Upper case from the evaporator core.
11. Expansion valve inlet and outlet lines.
    - Cap or plug open connections.
12. Expansion valve capillary bulb from the evaporator oulet line.
13. Valve.
14. Plastic pins that hold the screen to the core.
15. Screen.

→← Install or Connect (Figures 51 and 52)

1. Wire screen to the front of the core.
2. Plastic pins.
3. Expansion valve inlet and outlet lines (341).

   - Use new seals (o-rings) coated with clean rerfrigeration oil.
4. Sensing bulb to the evaporator outlet line (342).
   - Bulb must make good contact with the line.
   - Add 30 ml (3 ounces) of clean refrigeration oil to new core.
5. Upper case and supports to the core.
6. Lower core case and blower assembly.
7. Blower-evaporator assembly to the roof.
8. Support to roof rail screws.
9. Refrigerant lines to the blower-evaporator unit.
   - Use new seals (o-rings) with clean refrigeration oil.
10. Blower lead wire.
11. Ground wire.
12. Rear duct.
13. Battery ground cable.
14. Evacuate, charge and check the system.

BLOWER MOTOR SWITCH REPLACEMENT

The three-speed (LO-MED-HI) blower motor switch is located in the instrument panel to the left of the ash tray.

←→ Remove or Disconnect

1. Battery ground cable.
2. Switch retaining screws.
3. Wiring harness.
4. Switch.

→← Install or Connect

1. Switch.
2. Wiring harness.
3. Switch retaining screws.
4. Battery ground cable.

FUSE REPLACEMENT

A-25 amp fuse at the junction box protects this system. A 20-amp fuse, located between the junction block and the rear blower motor switch, protects the rear blower high speed circuit.

CCOT A/C SYSTEM — G SERIES

CONDENSER REPLACEMENT

←→ Remove or Disconnect (Figure 53)

1. Battery ground cable.
2. Purge the system of refrigerant.
3. Grille, hood lock, and center hood lock support.
4. Condenser inlet and outlet lines at the condenser (70).
5. Screws attaching the left side condenser bracket to the radiator.
6. Screws attaching the right side condenser bracket to the condenser.
7. Condenser.
8. Left bracket from the condenser.

→← Install or Connect (Figure 53)

1. Left bracket to condenser.
2. Condenser (70).
   - Add 30 ml (1 ounce) of clean refrigeration oil to a new condenser.
3. Screws attaching the left side of the condenser bracket to the condenser.
4. Screws attaching the right side of the condenser bracket to the condenser.
5. Condenser inlet and outlet lines at the condenser (70).
6. Grille, hood lock and center hood lock support.
7. Refrigerant.
8. Evacuate, charge and test the system.

ACCUMULATOR REPLACEMENT

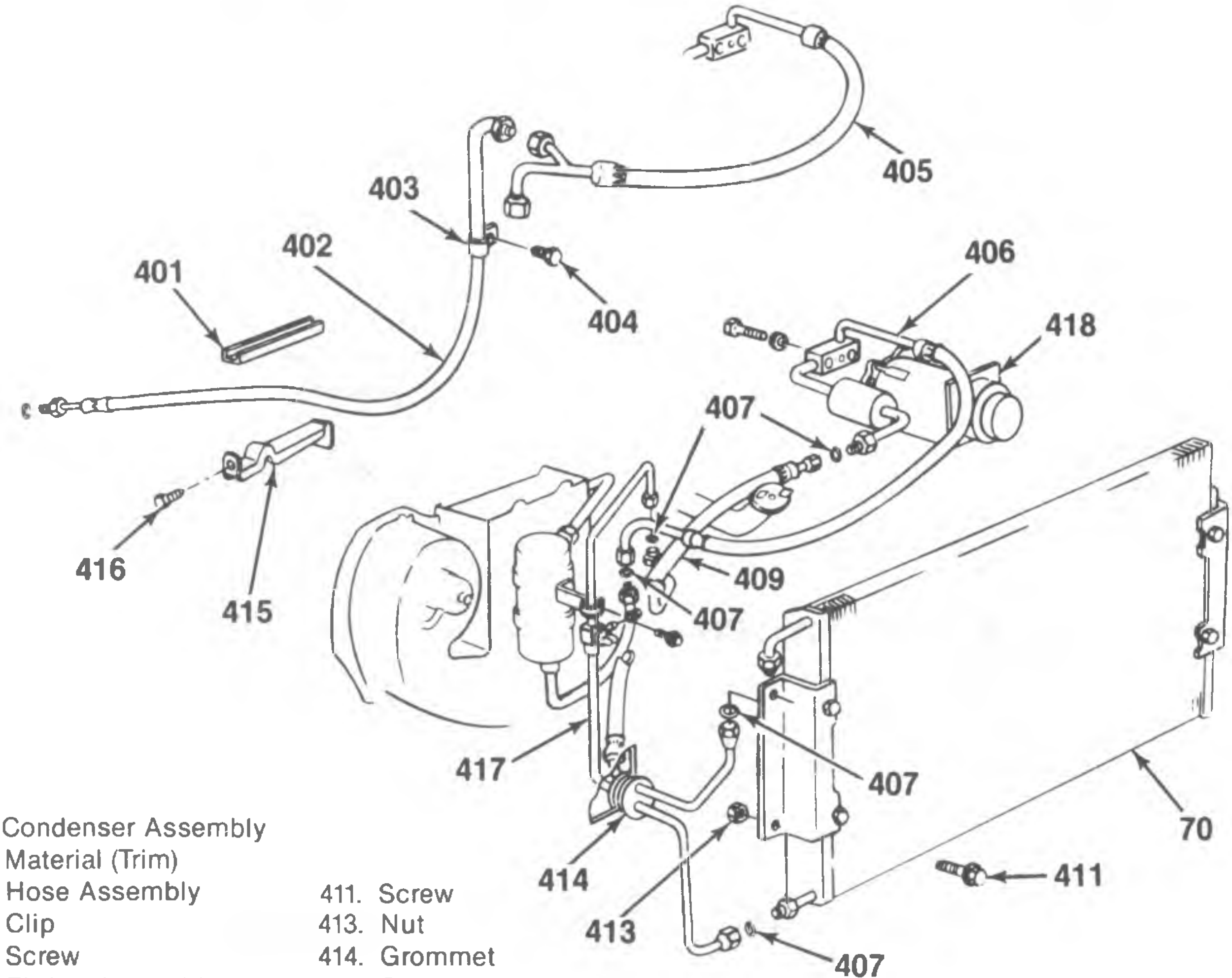
←→ Remove or Disconnect (Figure 53 and 54)

1. Battery ground cable.
2. Compressor clutch cable.
3. Discharge the system.
4. Inlet and outlet lines.

! Important

- Cap or plug open connections.

5. Bracket screws.
6. Accumulator.



70. Condenser Assembly
401. Material (Trim)
402. Hose Assembly
403. Clip
404. Screw
405. Fitting Assembly
406. Fitting Assembly
407. Seal (O-ring)
409. Hose Assembly
411. Screw
413. Nut
414. Grommet
415. Strap
416. Screw
417. Hose
418. Compressor

F-00086

Figure 53—G Condenser and Related Parts Component View

Important

- Drain excess refrigerant oil into a clean container. Measure and record amount. Use fresh oil.

Install or Connect (Figure 53 and 54)

1. New accumulator.

Important

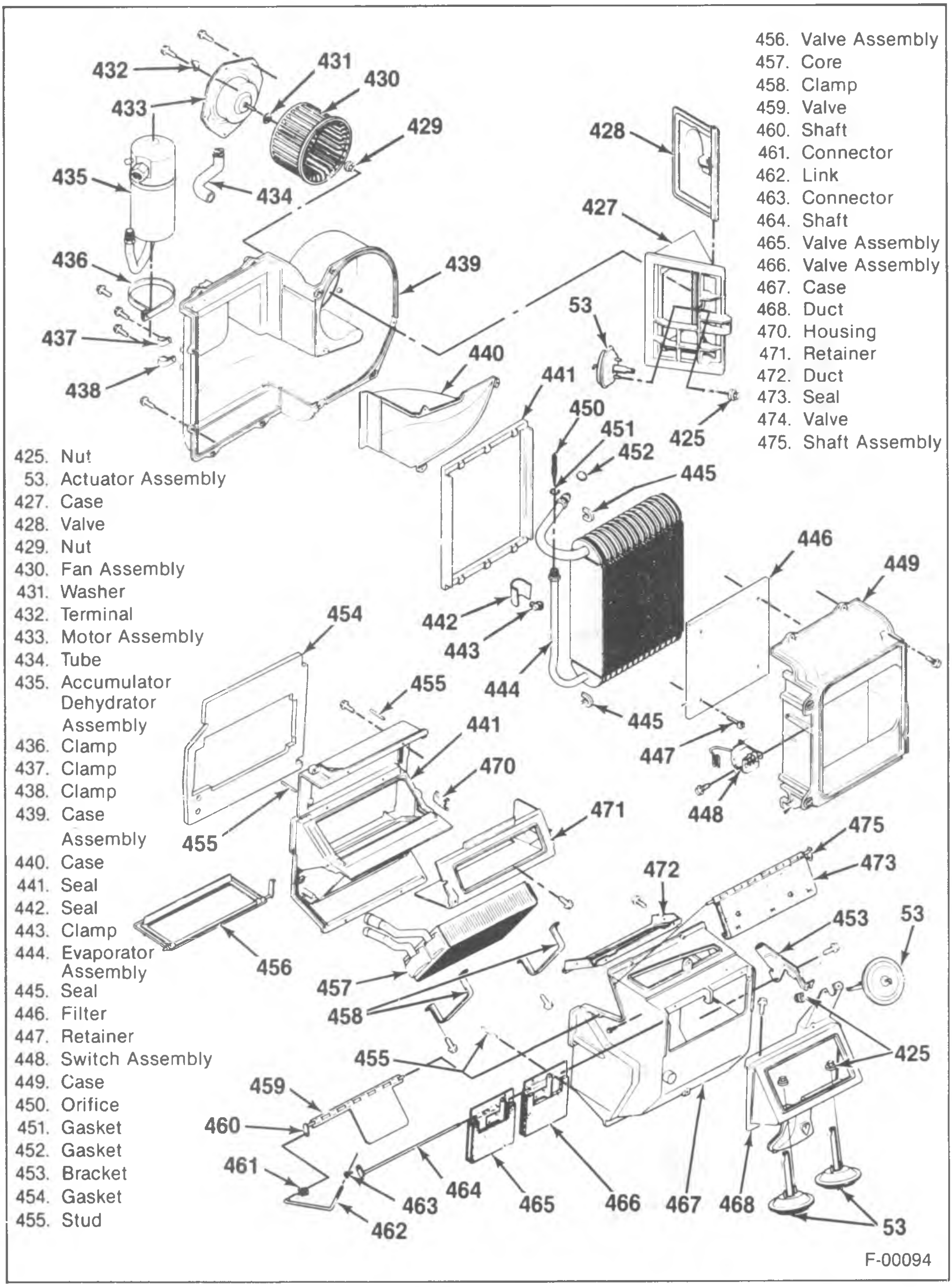
- Add 30 ml (1 ounce) of clean refrigerant oil **PLUS** an amount equal to that drained.

2. Bracket screws.
3. Inlet and outlet lines.
4. Compressor clutch connector.
5. Battery ground cable.
6. Evacuate, charge and check the system.

HEATER CORE REPLACEMENT

Remove or Disconnect (Figure 54)

1. Battery ground cable.
2. Engine cover.
3. Steering column to instrument panel.
   - Lower column.
4. Upper and lower instrument panel attaching screws and radio support bracket attaching screw.
5. Raise and support right side of the instrument panel.
6. Right lower instrument panel support bracket.
7. Recirculating air door vacuum actuator.
8. Temperature cable and vacuum hoses at the distributor case.



425.	Nut
53.	Actuator Assembly
427.	Case
428.	Valve
429.	Nut
430.	Fan Assembly
431.	Washer
432.	Terminal
433.	Motor Assembly
434.	Tube
435.	Accumulator Dehydrator Assembly
436.	Clamp
437.	Clamp
438.	Clamp
439.	Case Assembly
440.	Case
441.	Seal
442.	Seal
443.	Clamp
444.	Evaporator Assembly
445.	Seal
446.	Filter
447.	Retainer
448.	Switch Assembly
449.	Case
450.	Orifice
451.	Gasket
452.	Gasket
453.	Bracket
454.	Gasket
455.	Stud
456.	Valve Assembly
457.	Core
458.	Clamp
459.	Valve
460.	Shaft
461.	Connector
462.	Link
463.	Connector
464.	Shaft
465.	Valve Assembly
466.	Valve Assembly
467.	Case
468.	Duct
470.	Housing
471.	Retainer
472.	Duct
473.	Seal
474.	Valve
475.	Shaft Assembly

Figure 54—G A/C Heater and Evaporator-Blower Component View

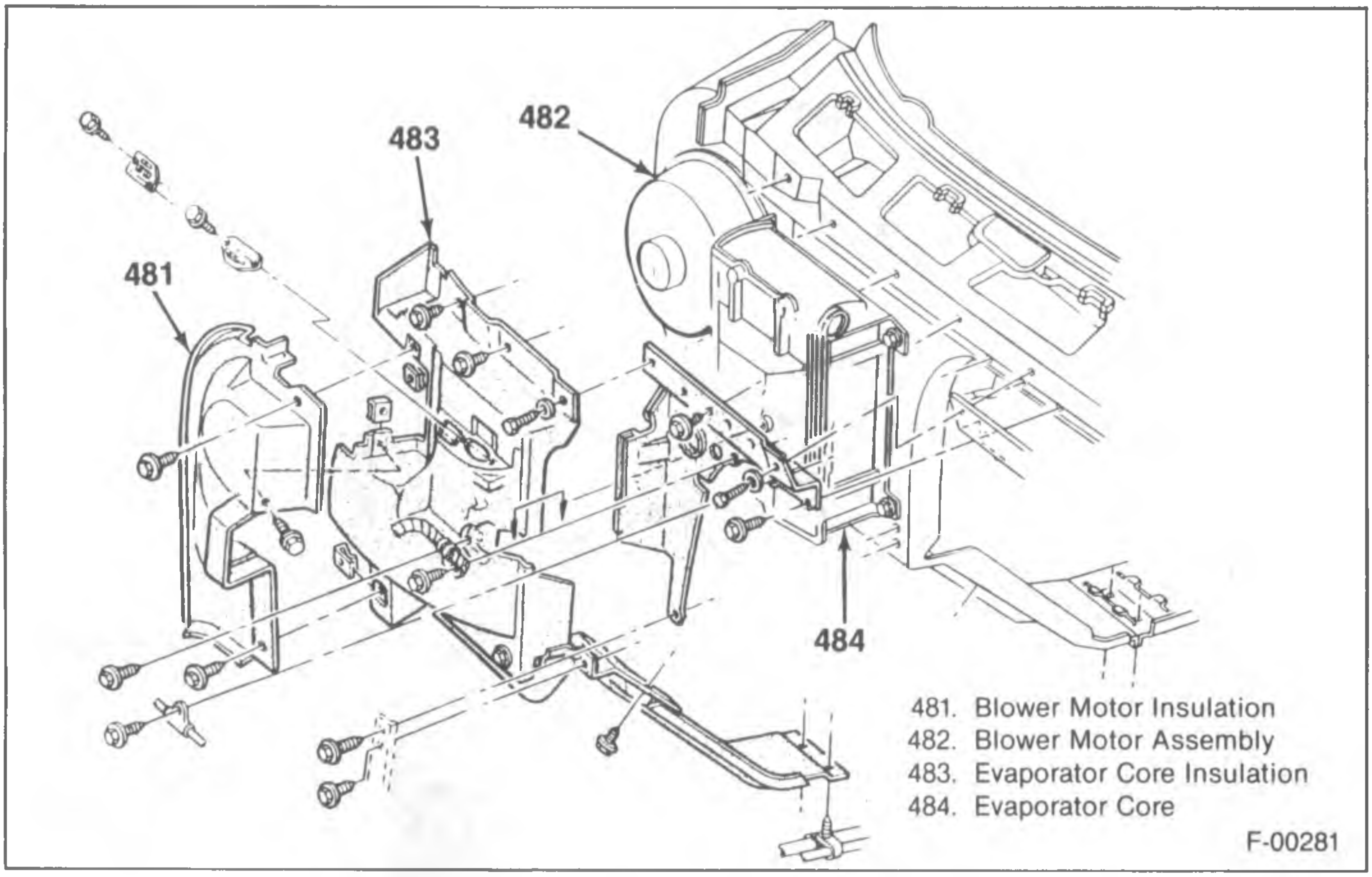


Figure 55—G Blower Motor Cover (Diesel)

9. Heater distributor duct.
10. Defroster duct to dash panel attaching screws (below the windshield).
11. Heater hoses (457).
    - Plug to prevent spillage.
12. Three nuts from the bolts that hold the heater core case to the dash panel and one screw at the lower right corner (inside).
13. Distributor assembly from the vehicle.
14. Gasket to expose the screws attaching the case sections together.
15. Temperature cable support bracket.
16. Case attaching screws and separate the case.
17. Heater core (457).

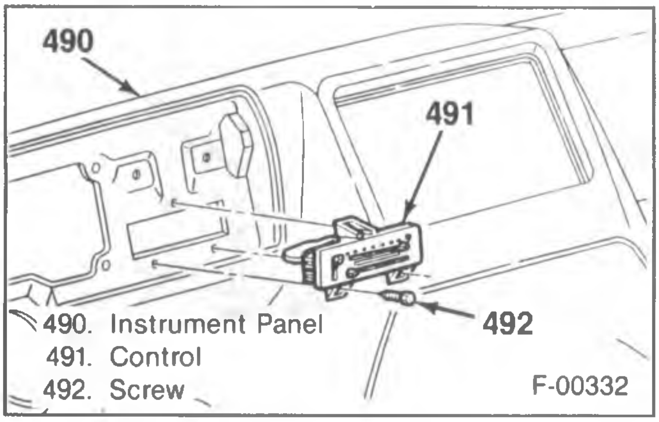
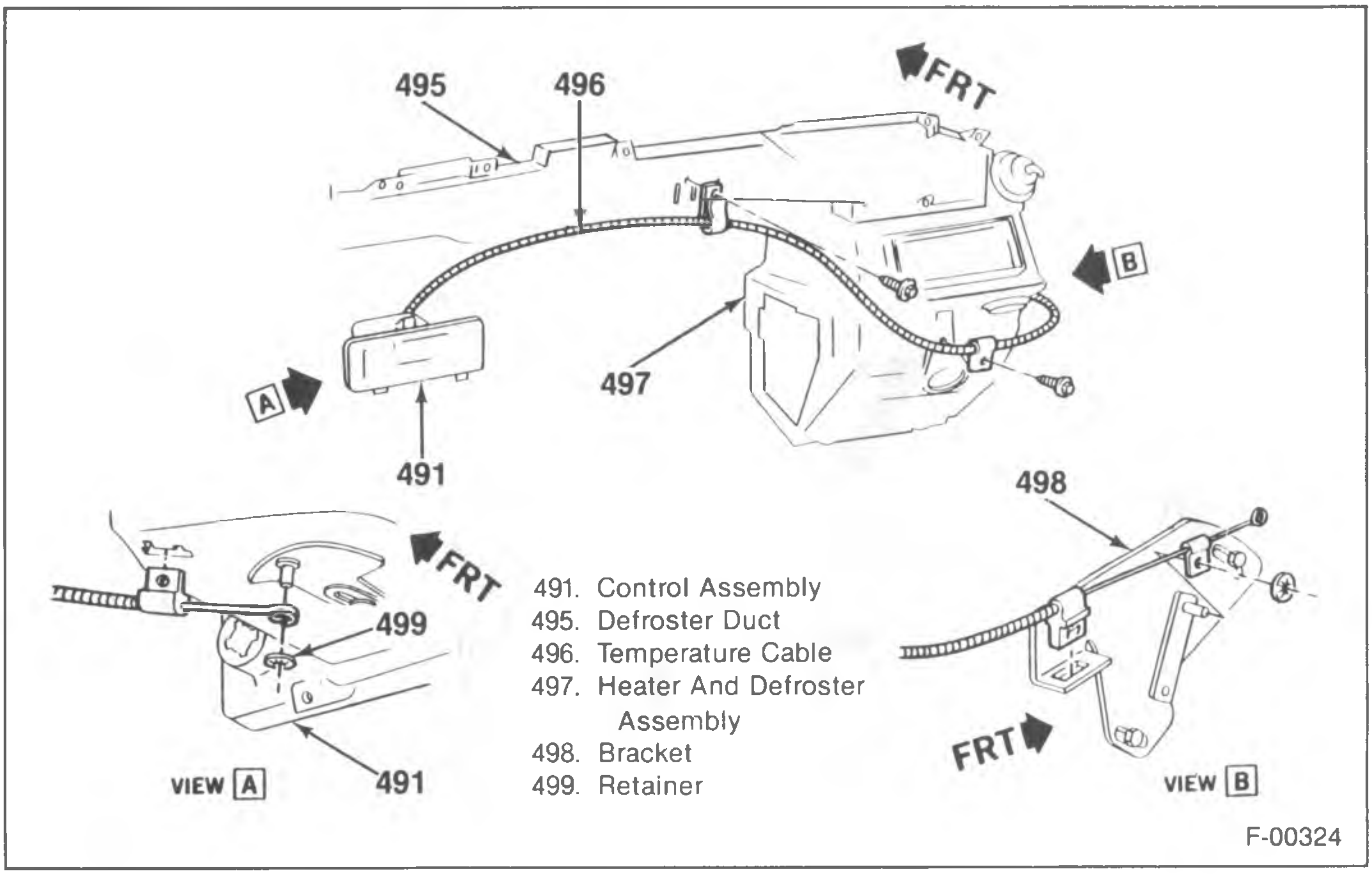


Figure 56—Control Assembly - A/C and Heater

Install or Connect (Figure 54)

1. New heater core.
2. Screws and case.
3. Temperature cable support bracket.
4. Gasket.
5. Distributor assembly.
6. Heater core nuts to bolts.
7. Heater hoses.
8. Defroster duct to dash panel screws.
9. Heater distributor duct.
10. Temperature cable and vacuum hoses at the distributor.
11. Right lower instrument panel support bracket.
12. Right side of the instrument panel.
13. Upper and lower instrument panel screws.
14. Radio support bracket screw.
15. Steering column to instrument panel attaching bolts and raise the column.
16. Engine cover.
17. Battery ground cable.



491. Control Assembly
495. Defroster Duct
496. Temperature Cable
497. Heater And Defroster Assembly
498. Bracket
499. Retainer

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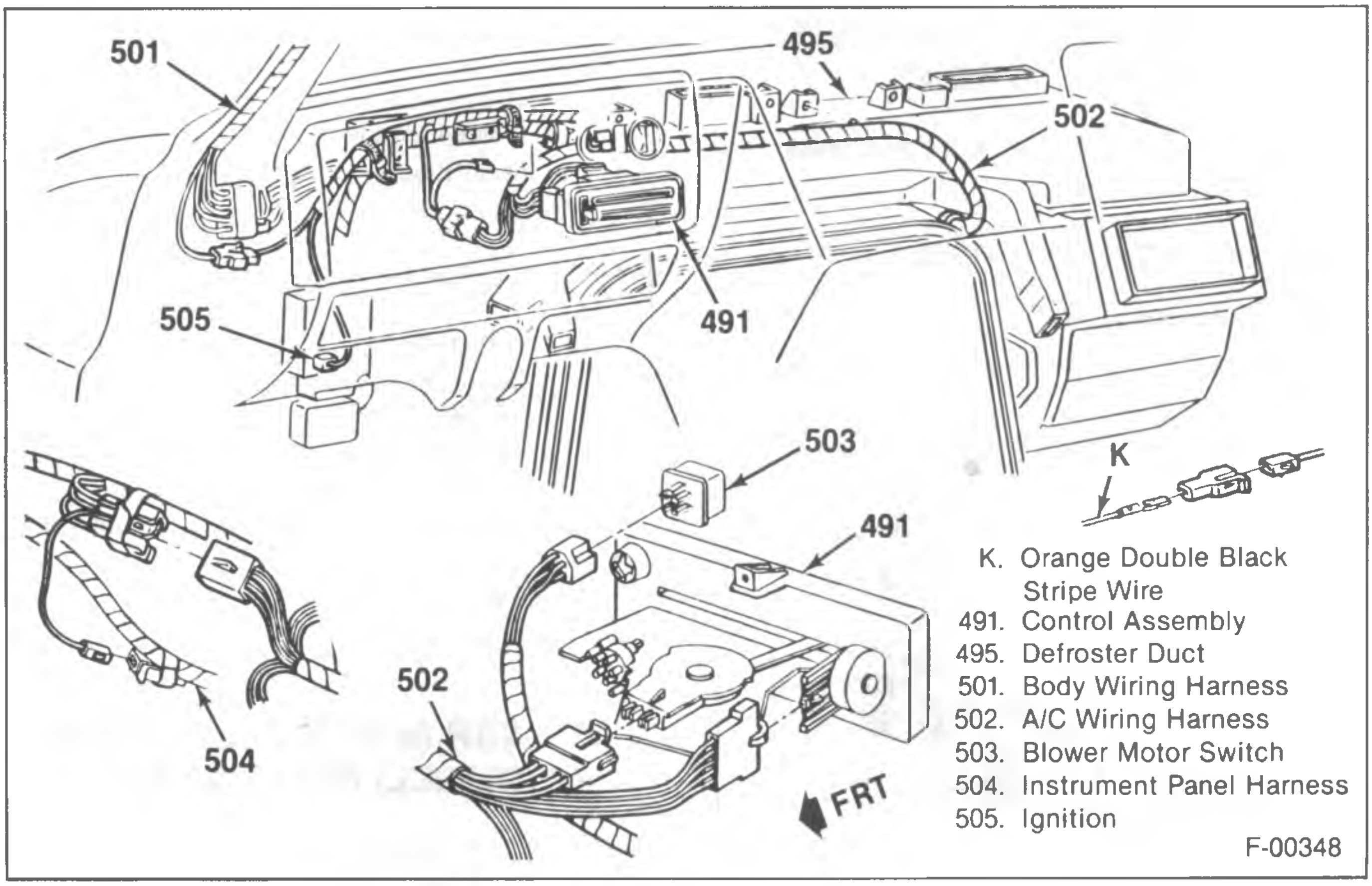
Figure 57—Temperature Control Cable



K. Orange Double Black Stripe Wire
491. Control Assembly
495. Defroster Duct
501. Body Wiring Harness
502. A/C Wiring Harness
503. Blower Motor Switch
504. Instrument Panel Harness
505. Ignition

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Figure 58—Instrument Panel Wiring Harness

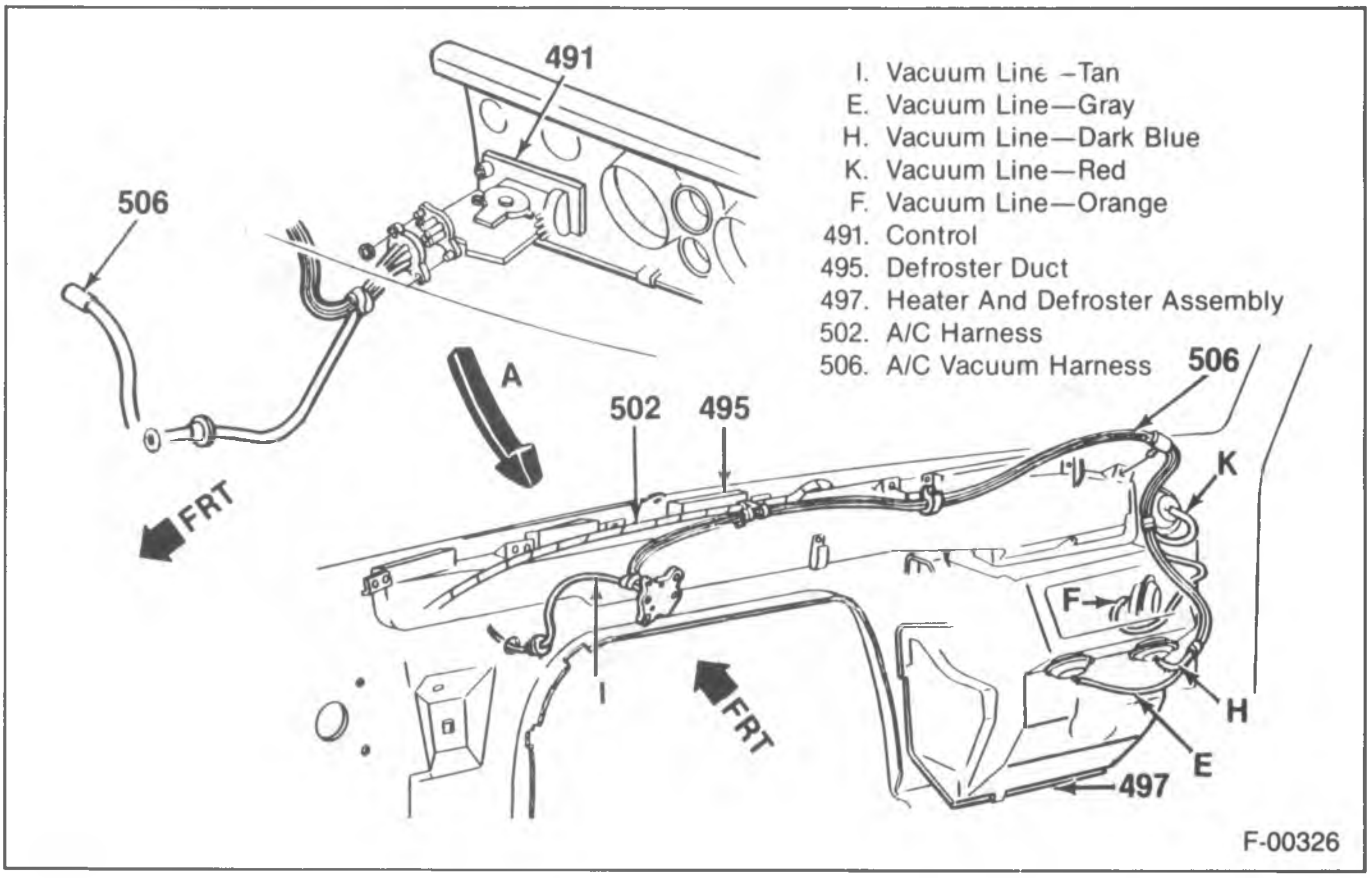


Figure 59—Vacuum Harness Assembly

ORIFICE (EXPANSION TUBE) REPLACEMENT

The orifice tube is located in the evaporator core inlet line.

Remove or Disconnect (Figure 4)

1. Discharge the system.
2. Condenser to the evaporator line at the evaporator inlet.
   - Cap or plug the open line.
3. Expansion tube from the evaporator core inlet line.
   - Use a needle nose pliers to remove the orifice from the tube.
4. Expansion tube seal (o-ring) frim the core inlet line.

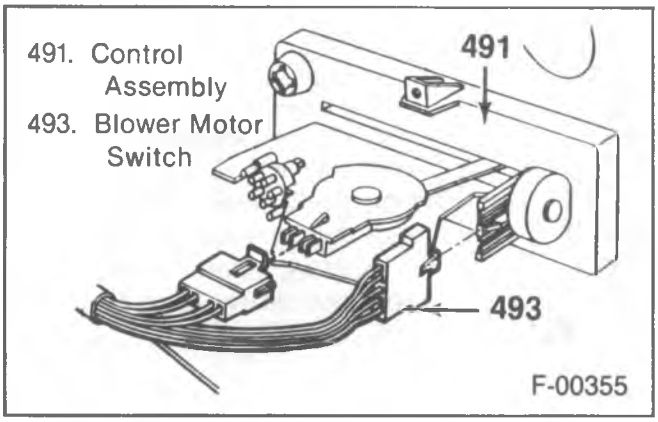


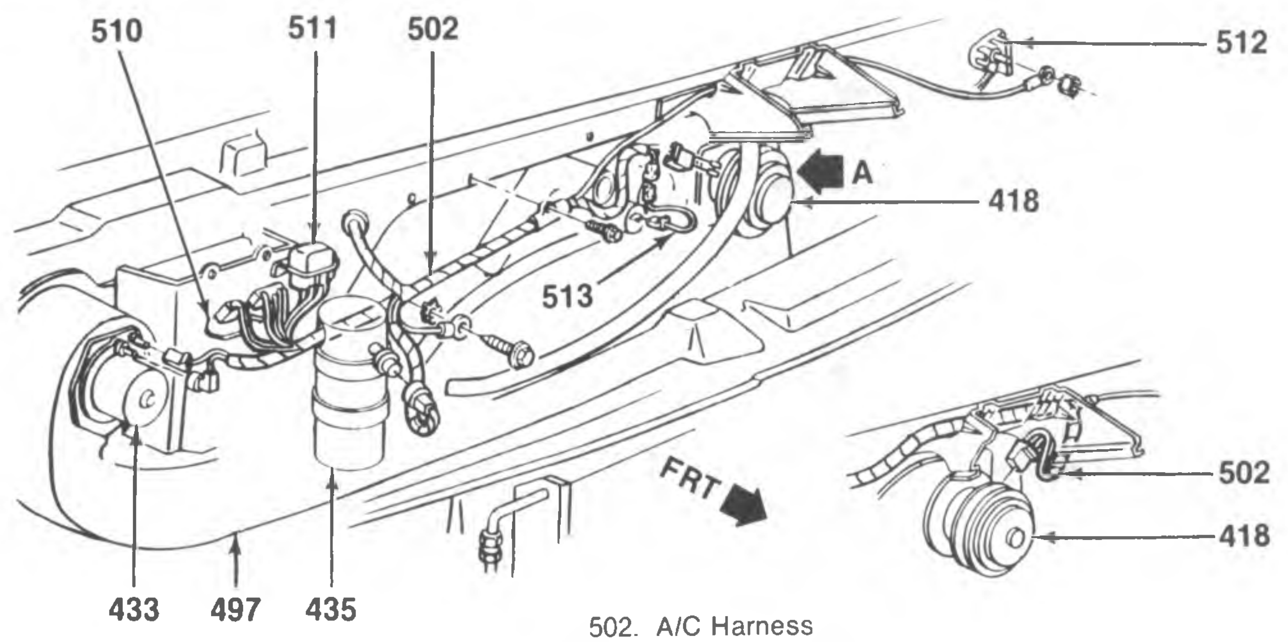
Figure 60—Blower Switch

Install or Connect (Figure 4)

1. Expansion tube seal (o-ring) to the core inlet line.
   - Use a new seal (o-ring) coated with clean refrigeration oil.
   - Insert the short screen end of the orifice into the evaporator inlet line.
2. Expansion tube to the evaporator core inlet line.
3. Condenser to the evaporator line at the evaporator inlet.
4. Evacuate, charge and check the system.

BLOWER MOTOR INSULATION (W/DIESEL) REPLACEMENT

The 6.2 Liter Diesel Engine has extra insulation around the blower motor on vehicles without air conditioning and around the blower motor and evaporator core with air conditioning option (figure 55).



418. Compressor
433. Motor
435. Accumulator/Dehydrator Assembly
497. Evaporator Blower Motor Assembly
502. A/C Harness
510. Resistor Assembly
511. Relay Assembly
512. Junction Block
513. Throttle Solenoid

Figure 61—A/C Wiring - Engine Compartment

Remove or Disconnect (Figure 55)

1. Parking lamp assembly.
2. Radiator overflow tank.
3. Blower motor insulation (481).
   - Insulation through the hood opening.
4. Blower motor (482).

Install or Connect (Figure 55)

1. Blower motor (482).
2. Insulation (481).
3. Radiator overflow tank.
4. Parking lamp assembly.

EVAPORATOR CORE (W/DIESEL) REPLACEMENT

Remove or Disconnect (Figures 54 and 55)

1. Cold air intake.
2. Hood latch assembly and cable retainer and place it out of the way.
3. Windshield solvent tank.
4. Discharge the A/C system.

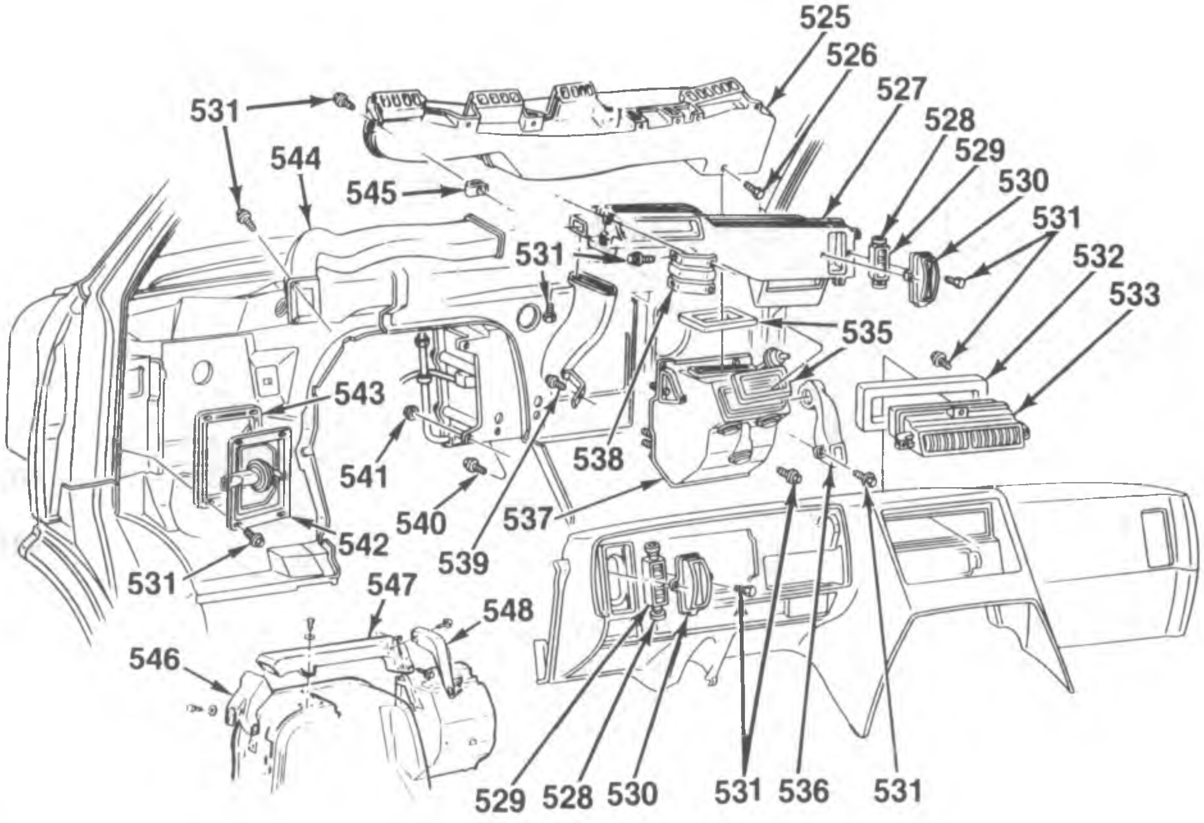
important

- When removing A/C components, cap the lines and openings to prevent contamination.

5. Low pressure vapor line and move it out of the way.
6. Accumulator.
7. High pressure line inlet to the evaporator and the connecting bracket.
8. Wiring harness going to the blower motor relay and resistor.
9. Blower motor relay and resistor.
10. Fan shroud upper half.
11. Radiator.
12. Heater valve assembly bracket and move it out of the way.
13. Upper screws of the lower section.
    - Push it down and out of the way.
14. Insulation mounting screws.
15. Insulation through the hood opening.
16. Proceed with the A/C evaporator procedure.

Install or Connect (Figures 54 and 55)

1. A/C evaporator core procedure.
2. Insulation (481).
3. Insulation mounting screws.
4. Lower section.



525. Duct Assembly
526. Screw
527. Duct Assembly
528. Washer
529. Deflector Assembly
530. Bezel
531. Screw
532. Seal
533. Outlet Assembly
534. Gasket
535. Gasket
536. Duct
537. Heater Assembly
538. Support
539. Outlet Assembly
540. Screw
541. Nut
542. Inlet Assembly
543. Seal
544. Duct
545. Nut
546. Duct
547. Duct
548. Duct

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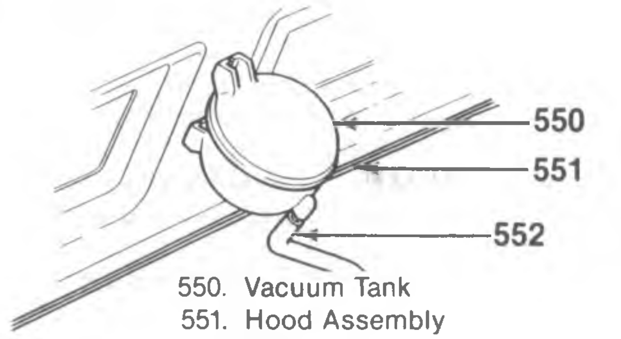
Figure 62—A/C Outlets and Ducts

5. Heater valve assembly bracket.
6. Radiator.
7. Fan shroud upper half.
8. Blower motor relay and resistor.



550. Vacuum Tank
551. Hood Assembly
552. Vacuum Line

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Figure 63—Vacuum Tank Location

9. Wiring harness.
10. High pressure line inlet and bracket.
11. Accumulator.
12. Low pressure vapor line.
13. Charge the A/C system.
14. Windshield solvent tank.
15. Hood latch assembly and cable retainer.
16. Cold air intake.

EVAPORATOR CORE REPLACEMENT

↔ **Remove or Disconnect (Figure 54)**

1. Battery ground cable.
2. Purge the system of refrigerant.
3. Coolant recovery tank and bracket.
4. Electrical connectors from the core case assembly.

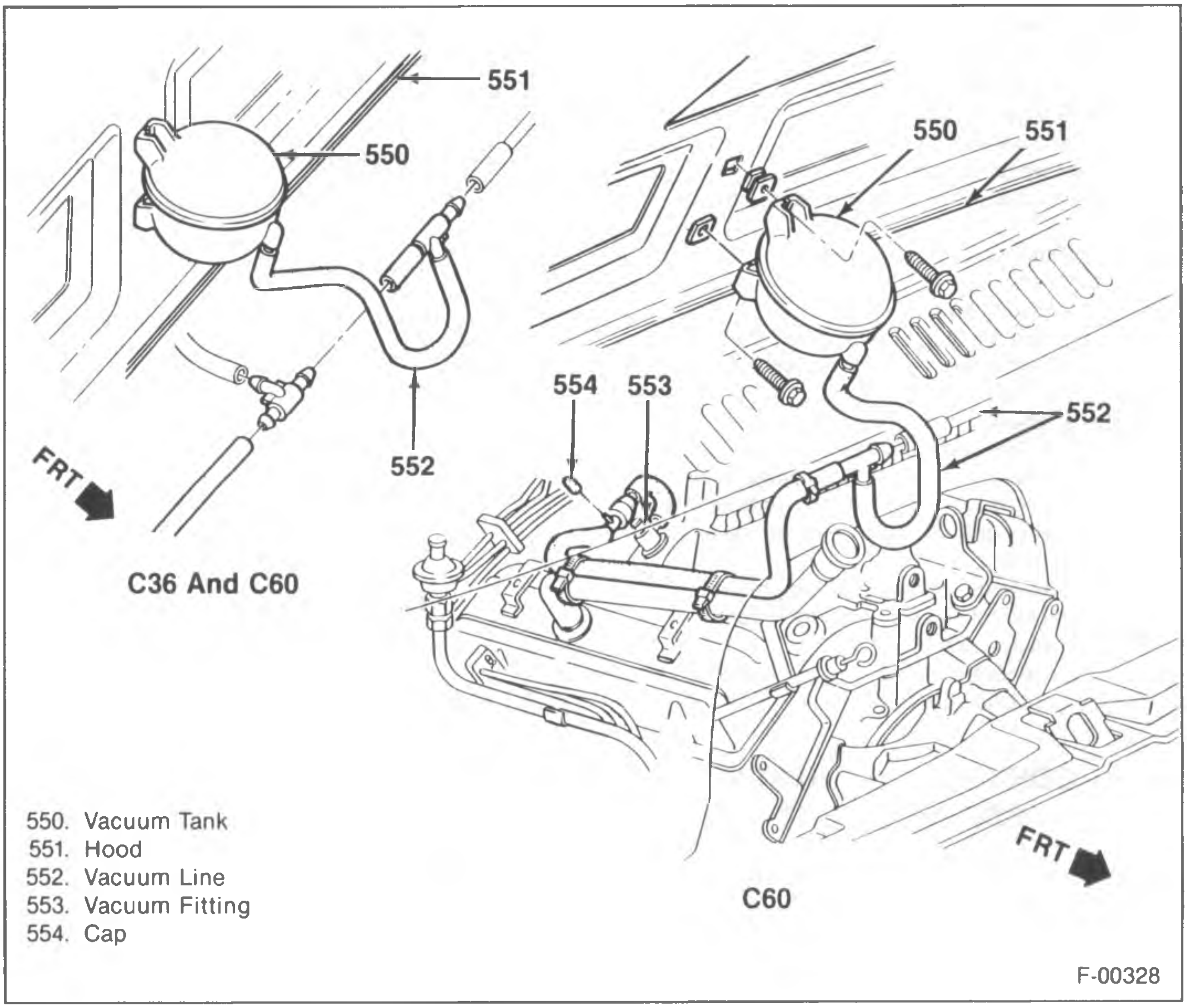


Figure 64—G - V6 (4.3 Liter) Vacuum Tank Assembly

5. Bracket at the evaporator case.
6. Right marker lamp for access.
7. Accumulator inlet and outlet lines, and the two brackets that attach the accumulator to the case.
8. Evaporator inlet line.
9. Three (3) nuts and one (1) screw attaching module to the dash panel.
10. Core case assembly from the vehicle.
11. Screws and separate the case sections.
12. Evaporator core.

Install or Connect (Figure 54)

1. New core.
   - Add 90 ml (3 ounces) or 525 viscosity refrigeration oil to a new condenser.
2. Screws and the case sections.
3. Core case assembly to the vehicle.
4. Module to the dash panel.
5. Evaporator inlet line.
6. Accumulator inlet and outlet lines.
7. Two brackets that hold the accumulator to the case.
8. Right marker lamp.
9. Bracket to the evaporator case.
10. Electrical connectors.
11. Coolant recovery tank and bracket.
12. Evacuate, charge and check the system.
13. Battery ground cable.

BLOWER MOTOR REPLACEMENT

Remove or Disconnect (Figure 54)

1. Battery ground cable.
2. Coolant recovery tank.
3. Power antenna.

4. Blower motor lead wire.
5. Motor and wheel assembly (433).
    - Five blower motor mounting screws.
    - Pry gently on the blower flange if the sealer acts as an adhesive.
6. Blower wheel to motor shaft nut.
7. Separate the wheel and motor assemblies.

Install or Connect (figure 54)

1. Wheel to the blower motor.
    - Assemble the blower wheel to the motor with the open end of the wheel away from the blower motor.
2. Blower wheel to the motor shaft nut.
3. Blower wheel and motor assembly to the vehicle.
    - If the motor mounting flange sealer has hardened or is not intact, remove the old sealer and apply a bead of sealer to the mounting flange.
    - Check blower operations: blower wheel should rotate with no interference.
4. Blower motor lead wire.
5. Coolant recovery tank and power antenna.
6. Battery ground cable.

CONTROL ASSEMBLY REPLACEMENT

Remove or Disconnect (Figures 56, 57, 58 and 59)

1. Battery ground cable.
2. Headlamp switch control knob.
3. Instrument panel bezel.
4. Control.
    - Screws.
    - Temperature cable eyelet clip and retainer (499).
    - Control lower right mounting tab through dash opening.
    - Upper tab.
    - Lower right tab.
5. Electrical harness.
6. Vacuum harness (506).
7. Control assembly.

Install or Connect (Figures 56, 57, 58 and 59)

1. Electrical and vacuum connection to the control.
2. Control into the opening in the dash panel.
3. Temperature cable.

Adjust

- Temperature door operation. Refer to "Temperature Door Cable Adjustment."

4. Instrument panel bezel.
5. Headlmap switch control knob.
6. Battery ground cable.

TEMPERATURE DOOR CABLE ADJUSTMENT

Adjust (Figure 57)

1. Remove instrument panel compartment and door.
2. Loosen the cable attaching screw at the selector duct assembly.
    - Make sure the cable is installed in the bracket on the selector duct assembly.
3. Place the temperature lever in full HOT position and hold while tightening the cable attaching screw.
4. Install instrument panel compartment and door.

BLOWER SWITCH REPLACEMENT

Remove or Disconnect (Figure 60)

1. Battery ground cable.
2. Left-foot cooler outlet assembly at the instrument panel attachment.
3. Electrical harness.
4. Mounting screws.
5. Control assembly (491).
6. Switch (493).

Install or Connect (Figure 60)

1. New switch.
    - Mounting screws.
2. Electrical harness.
3. Control Assembly (491).
4. Left-foot cooler outlet assembly.
5. Battery ground cable.

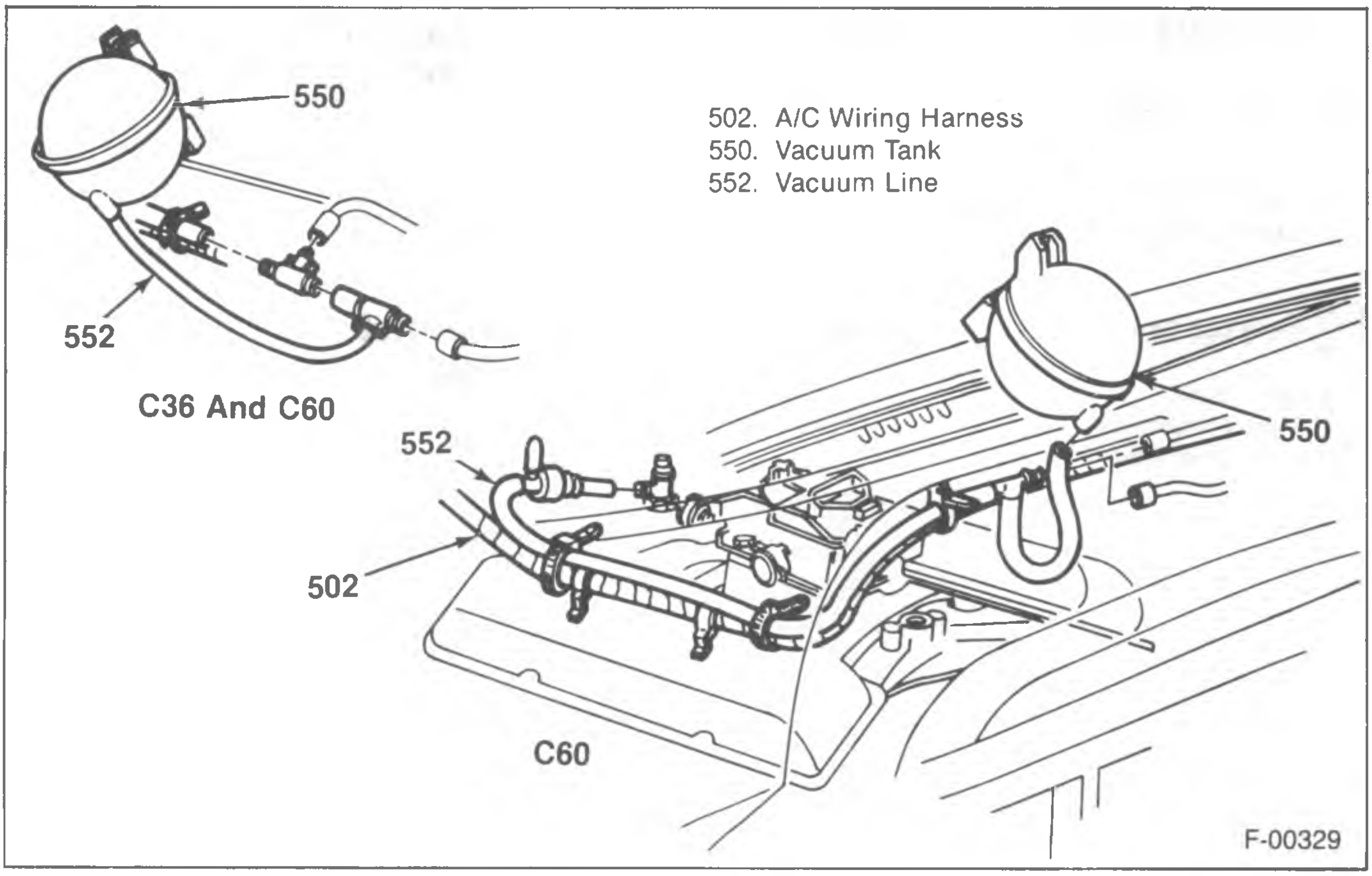
RESISTOR REPLACEMENT

Remove or Disconnect (Figure 61)

1. Electrical harness.
2. Resistor mounting screws.
3. Resistor (510).

install or Connect (Figure 61)

1. Resistor (510).
    - Screws.
2. Electrical harness.



502. A/C Wiring Harness
550. Vacuum Tank
552. Vacuum Line

Figure 65—G - V8 (5.0 and 5.7 Liter) Vacuum Tank

BLOWER MOTOR RELAY REPLACEMENT

↔ Remove or Disconnect (Figure 61)

1. Electrical harness.
2. Relay mounting screw.
3. Relay (511).

→← Install or Connect (Figure 61)

1. Relay (511).
    - Screws.
2. Electrical harness.

A/C DUCT WORK REPLACEMENT

↔ Remove or Disconnect (Figure 62)

1. Battery ground cable.
2. Engine cover.
3. Steering column to the instrument panel attaching screws.
4. Radio support bracket screw.
    - Pull the right side of the instrument panel rearward.
7. Duct (distributor) attaching screws.
8. Center deflector (527).

→← Install or Connect (Figure 62)

1. Center deflector (527).
2. Instrument panel.
3. Radio support bracket.
4. Steering column.
5. Engine cover.
6. Battery ground cable.

DEFROSTER DUCT REPLACEMENT

To remove the defroster duct mounting, refer to figure 64.

TEMPERATURE DOOR CABLE REPLACEMENT

To remove the temperature door cable, refer to "Control Assembly Replacement" and figure 57.

VACUUM TANK REPLACMENT

↔ Remove or Disconnect (Figures 63 and 65)

1. Raise the hood.
2. Vacuum harness at the tank (552).
3. Tank attaching screws.
4. Tank (551).

→← Install or Connect (Figures 63 and 65)

1. Tank (551).
2. Vacuum harness.
3. Lower the hood.

VACUUM LINES ENGINE COMPARTMENT

For vacuum line assemblies, refer to figures:
1. L6 Engine (4.6 Liter) (figure 64).
2. V6 - V8 Engine (4.3, 5.0 and 5.7 Liter) (figure 65).
3. V8 Engine (6.2 Liter, Diesel) (figure 66).

REFRIGERANT-12 HOSE ROUTING

For Refrigerant-12 hose assemblies refer to figures:
1. L6 Engine (4.8 Liter) (figure 67).
2. V8 Engine (5.0 and 5.7 Liters) (figure 68).
3. V8 Engine (6.2 Liter Diesel) (figure 69).

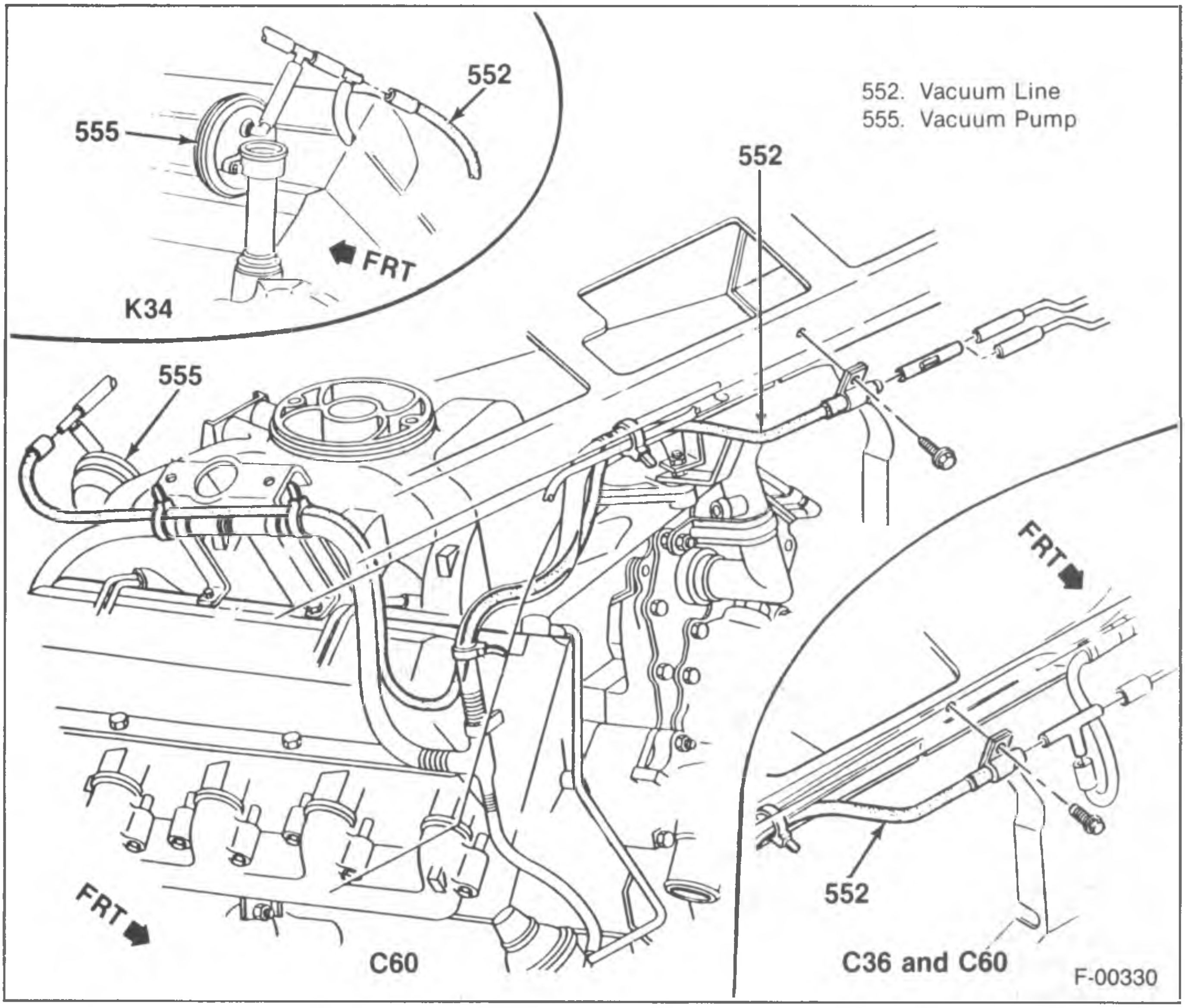


Figure 66—G - V8 (6.2 Liter - Diesel) Vacuum Hose Assembly

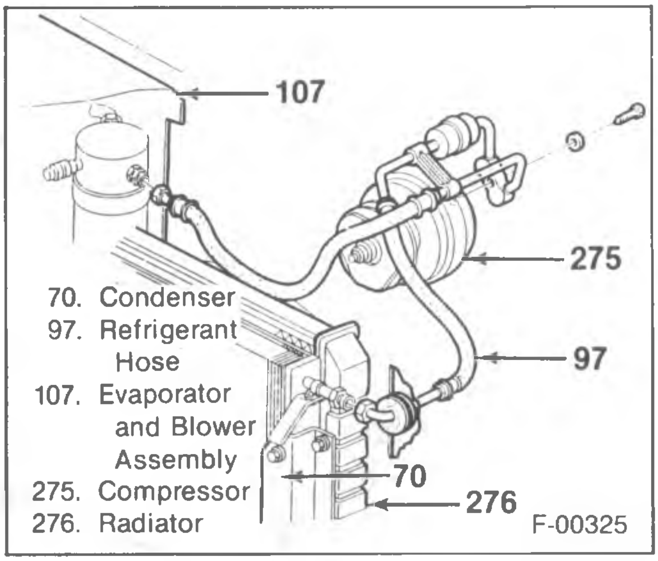


Figure 67— - L6 (4.8 Liter) Refrigerant Hose Assembly

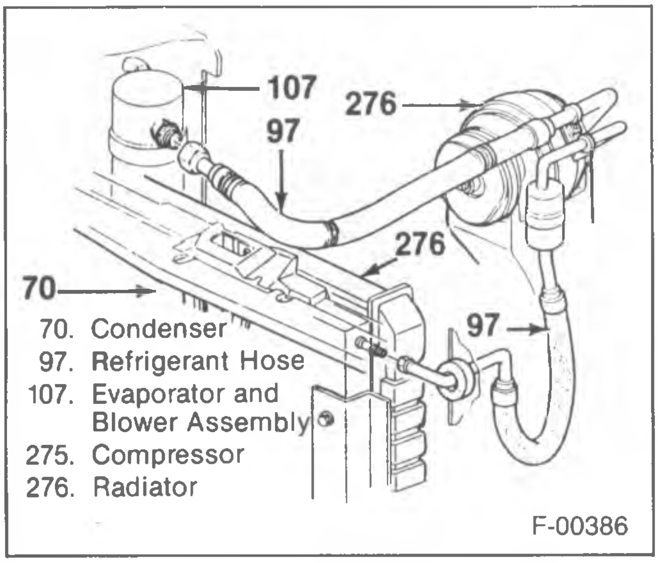


Figure 68—G - V8 (5.0 and 5.7 Liter) Refrigerant Hose Assembly

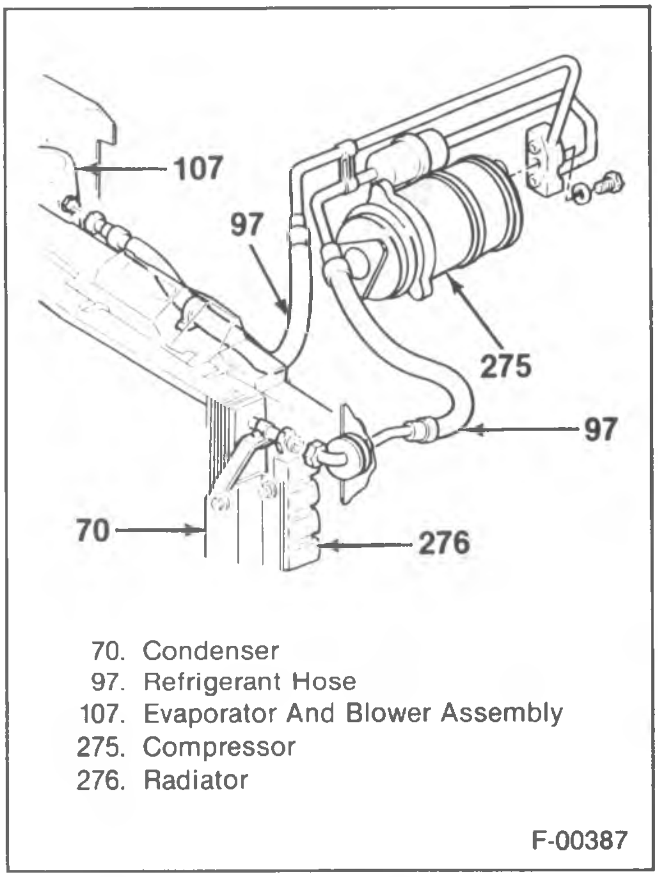


Figure 69—G - V8 (6.2 Liter - Diesel) Refrigerant Hose

REAR INTERIOR ROOF MOUNTED SYSTEM—G SERIES

This system is used in conjunction with the front mounted air conditioning system, and is almost identical to the C-K rear interior roof mounted system. For servicing, refer to figure 70 for plumbing and figure 71 for unit component view.

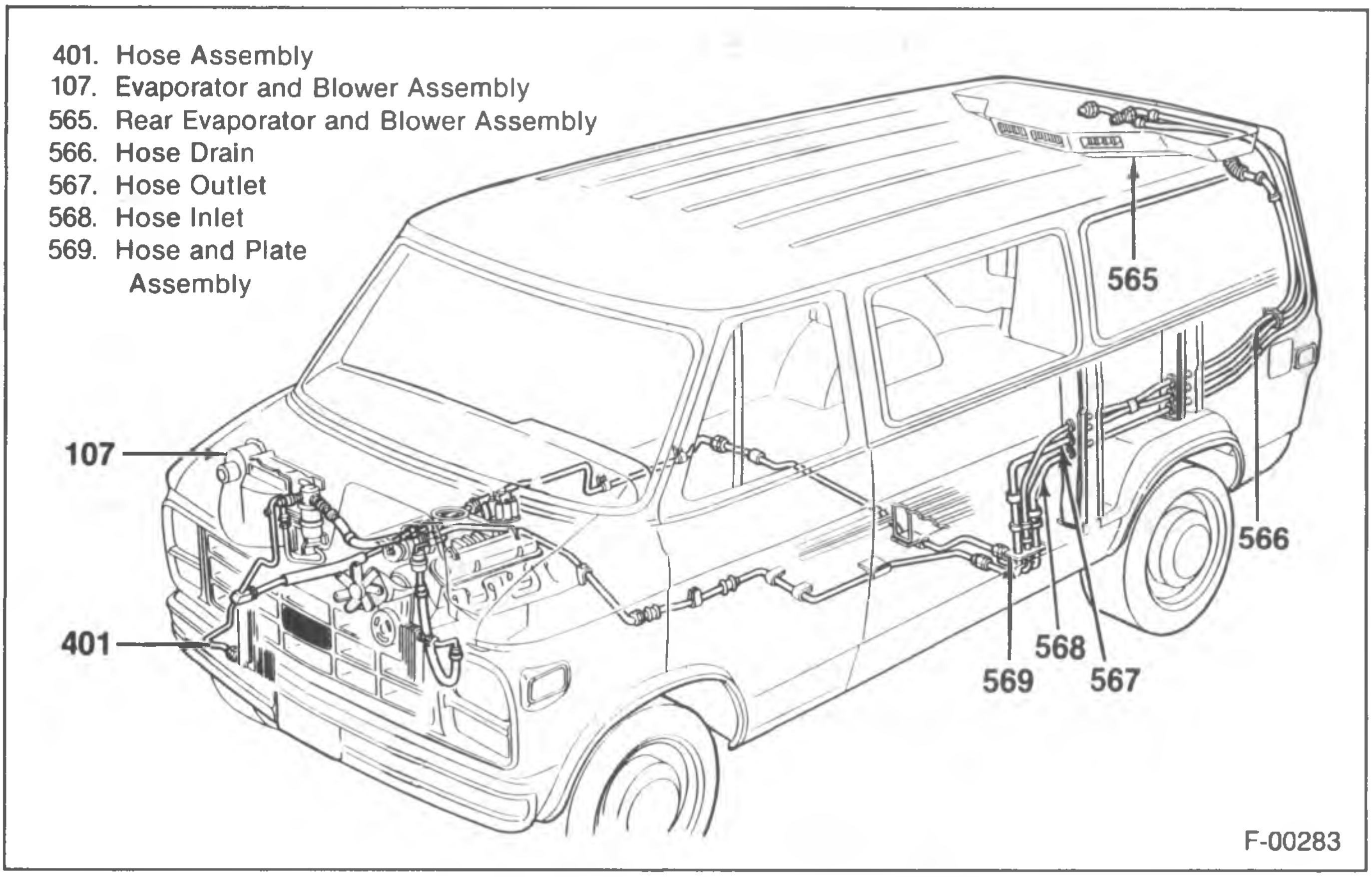


Figure 70—G Rear Interior Roof Mounted A/C Hoses and Drain Component View

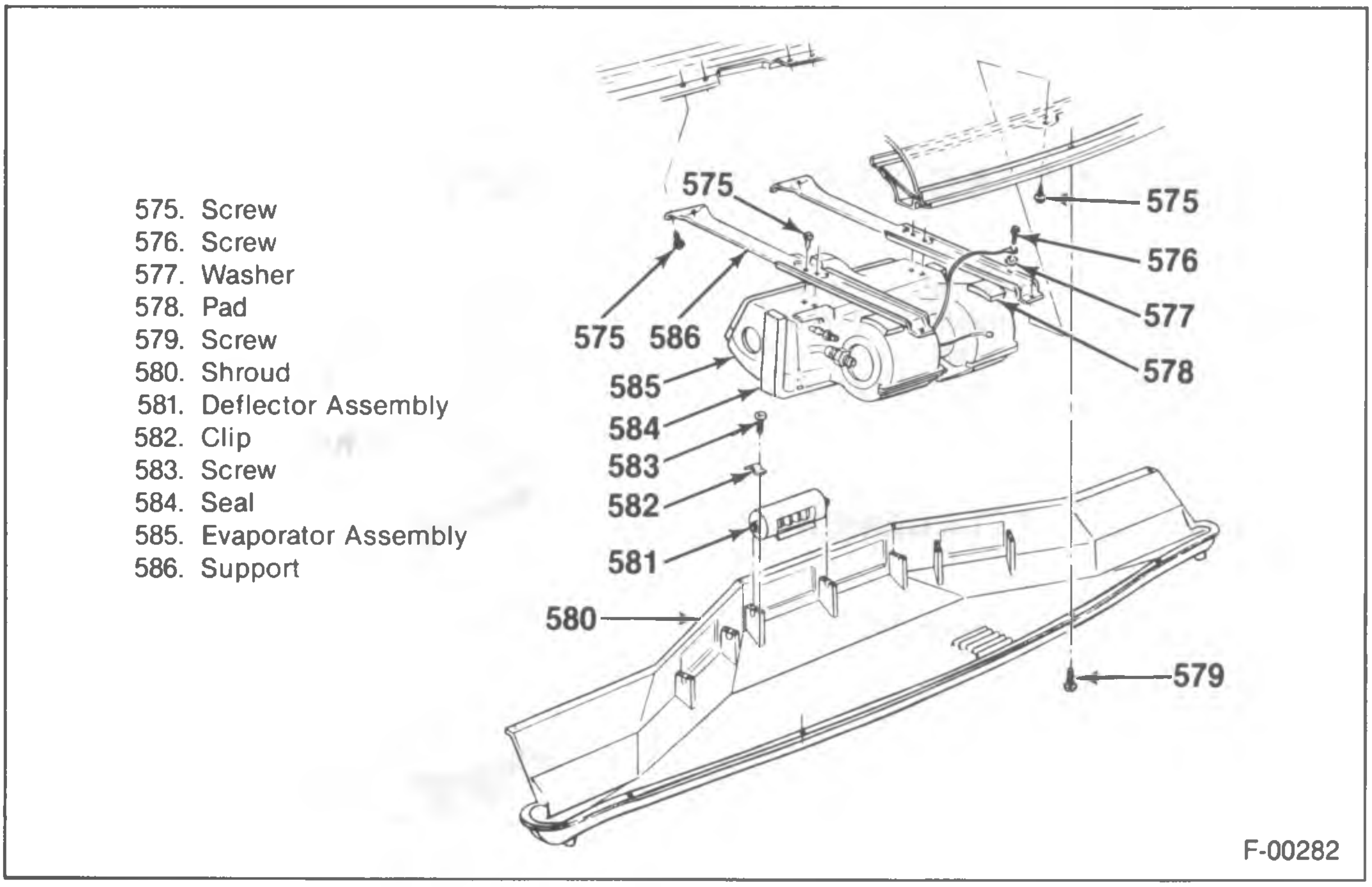


Figure 71—G Rear Interior Roof Mounted A/C Evaporator Mounting and Shroud

CCOT A/C SYSTEM — P SERIES

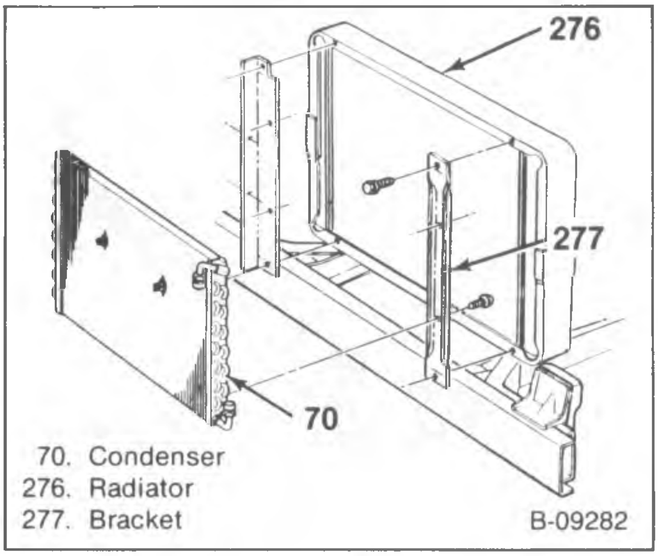


Figure 72—P Truck Condenser Installation V8 (5.7 Liter) Engine

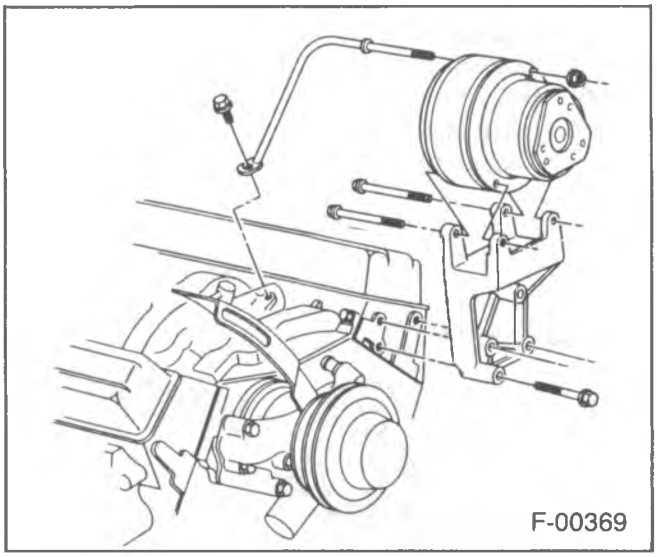


Figure 73—P Truck Compressor Installation

The compressor and condenser are installed on the vehicle during assembly. They are removed and shipped separately.

For reference refer to the following figures:

1. Condenser Mounting - refer to figure 72.
2. Compressor Installation - refer to figure 73.

DASH MOUNTED SYSTEM — MOTOR HOME CHASSIS

This system is installed on the vehicle and checked at assembly. The blower-evaporator is then disconnected and shipped with the chassis unit to the body supplier. For this reason, it will only be possible to give basic replacement procedures on some components.

CONDENSER REPLACEMENT

↔ Remove or Disconnect (Figure 74)

1. Battery ground cable.
2. Purge the system of refrigerant.
3. Condenser inlet and outlet lines.
   - Cap or plug all open connections.
4. Condenser to radiator support screws.
5. Condenser (70).

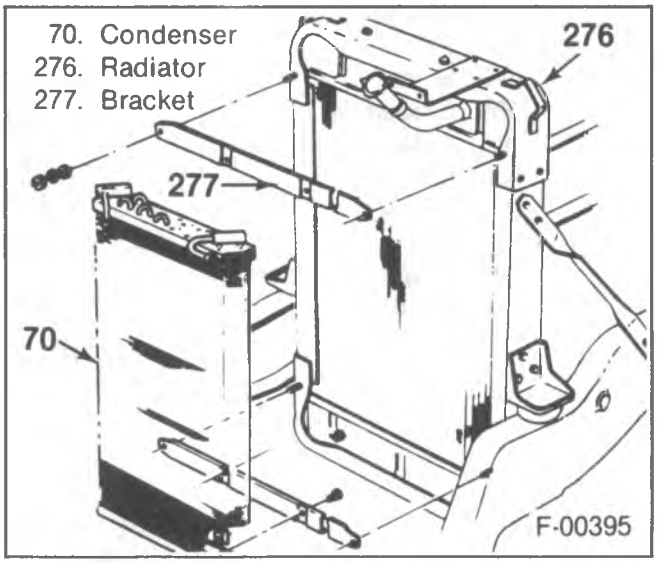
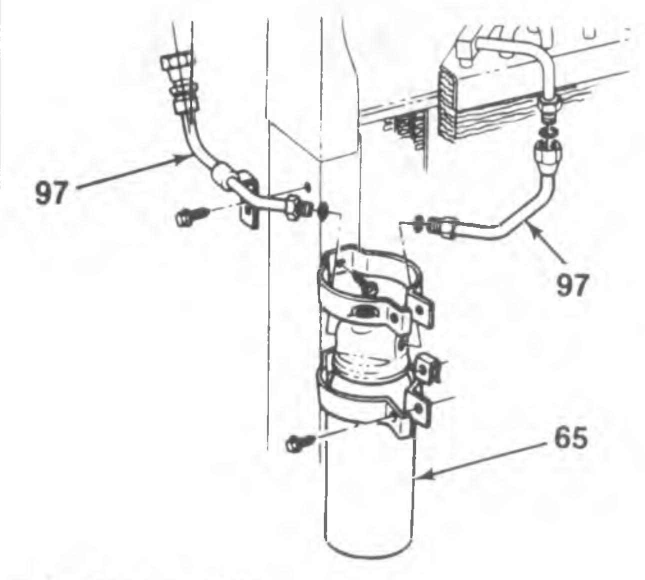


Figure 74—Condenser



65. Accumulator
97. Refrigerant Hose

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Figure 75—Receiver - Dehydrator

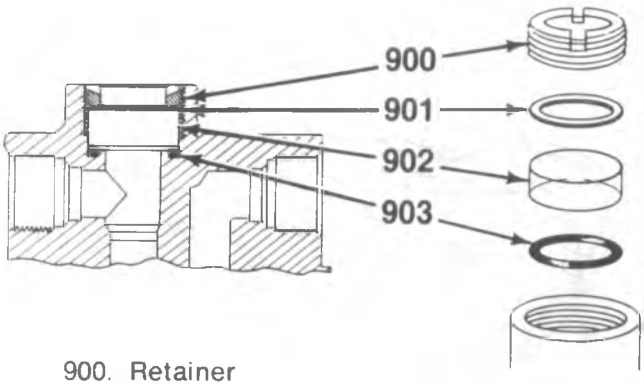
Install or Connect (Figure 74)

1. Condenser.
2. Screws.
3. Condenser inlet and outlet lines.
    - Add 30 ml (1 ounce) of clean refrigeration oil to new condenser.
    - Use new seals (o-rings) coated with clean refrigeration oil when connecting refrigerant lines.
4. Evacuate, charge and check the system.

RECEIVER-DEHYDRATOR REPLACEMENT

Remove or Disconnect (Figure 75)

1. Battery ground cable.
2. Purge the system of refrigerant.
3. Inlet and outlet lines at the receiver-dehydrator.
    - Cap or plug the open lines.
4. Receiver-dehydrator bracket attaching screws.
5. Bracket and receiver-dehydrator (65).



900. Retainer
901. Washer
902. Glass
903. Seal

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Figure 76—Sight Glass Replacement

Install or Connect (Figure 75)

1. Bracket and receiver-dehydrator.
2. Screws.
3. Inlet and outlet lines at the receiver-dehydrator.
    - Use new seals (o-rings) coated with clean refrigeration oil when connecting all refrigerant lines.
4. Evacuate, charge and check the system.

SIGHT GLASS REPLACEMENT

If the sight glass is damaged, install a new sight glass kit. The kit contains the sight glass, seal and retainer.

Remove or Disconnect (Figure 76)

1. Purge the system.
2. Sight glass retainer nut using a screwdriver (900).
3. Old glass and seal (o-ring) (902 and 903).

Install or Connect (Figure 76)

1. New glass and seal and retainer nut.

Important

- Do not turn the nut past the face of the housing. This may damage the seal (o-ring).

2. Evacuate, charge and check the system.

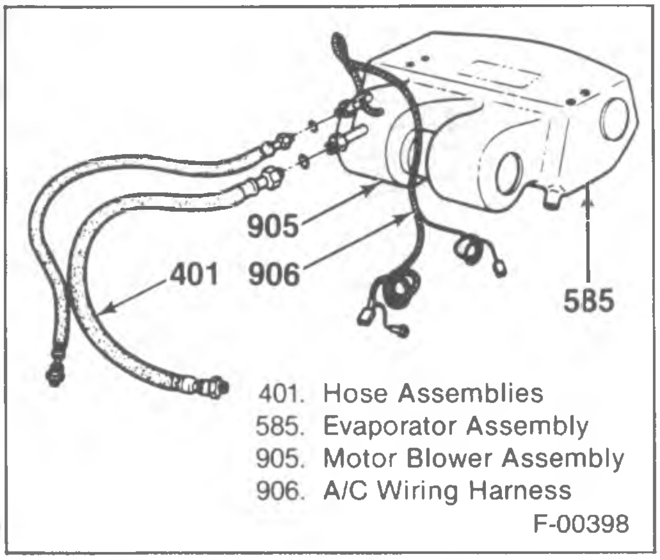
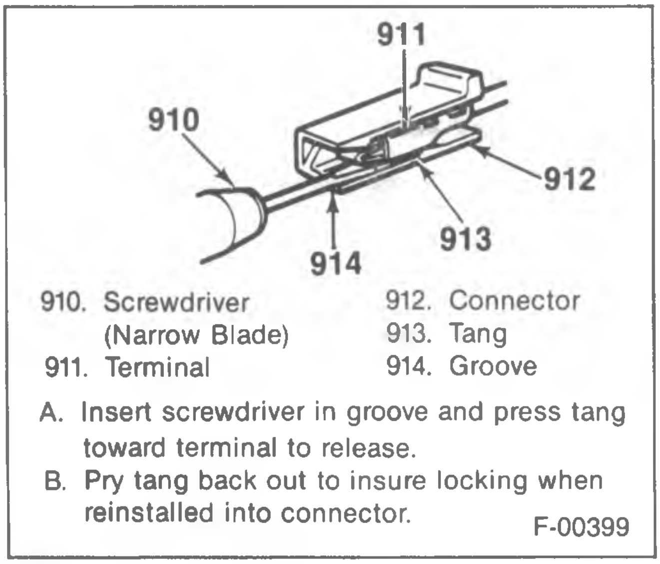


Figure 77—Blower - Evaporator Assembly

BLOWER-EVAPORATOR ASSEMBLY REPLACEMENT

Remove or Disconnect (Figures 77 and 78)

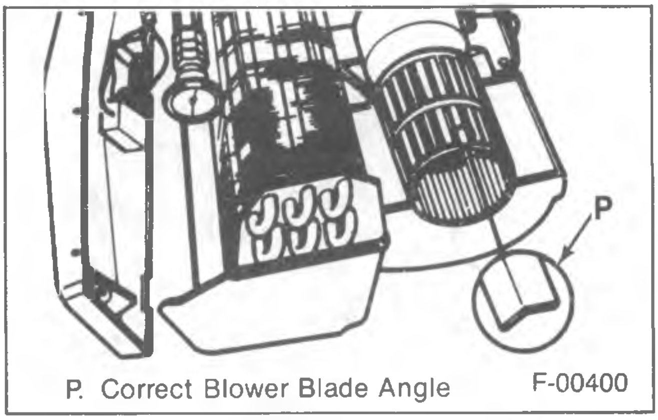
1. Battery ground cable.
2. Purge system of refrigerant.
3. Inlet and outlet refrigerant lines.
   - Cap or plug all open connections (401).
4. Drain tube from evaporator case.
5. Electrical connector from the compressor.
6. Terminal (910).
   — Allow connector to hang on the ground wire.
7. Screws securing the grommet retainer to the dash panel.
8. Wire from the grommet through the slit.
9. Electrical lead at the connector.



A. Insert screwdriver in groove and press tang toward terminal to release.

B. Pry tang back out to insure locking when reinstalled into connector.

Figure 78—Terminal Removal



P. Correct Blower Blade Angle

Figure 79—Blower Assembly

10. Unit mounting bolts.
11. Unit from the vehicle carefully pulling the compressor electrical lead through the dash.

Install or Connect (Figures 77 and 78)

1. Unit to the vehicle.
2. Mounting bolts.
3. Electrical lead to the connector.
4. Wire from grommet through the slit.
5. Screws that secure the grommet retainer to the dash.
6. Terminal.
7. Ground wire.
8. Electrical connector from the compressor.
9. Drain tube.
10. Refrigerant lines.
11. Battery ground cable.
12. Evacuate, charge and check the system.

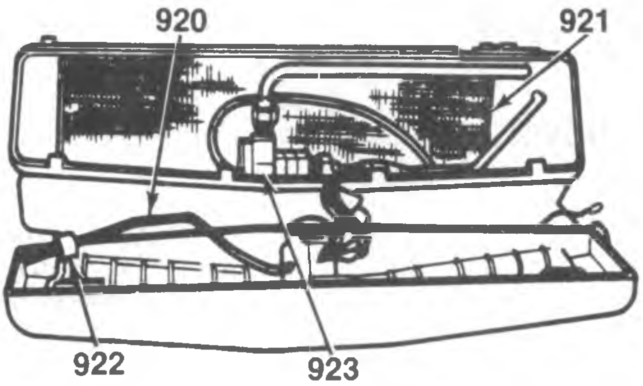
BLOWER ASSEMBLY REPLACEMENT

Remove or Disconnect (Figure 79)

1. Cover plate.
   - Separate the upper and lower case halves.
2. Blower motor mounting strap screw.
3. Blower assembly.
4. Wheels from the motor shaft.

Install or Connect (Figure 79)

1. Wheels to the motor shaft.
   - Place the wheels with the lower blades curved toward the dash panel side of the unit when the motor is placed in the case (P).
2. Mounting strap.



920. Thermostatic Switch Capillary Tube
921. Screen Mesh
922. Bumper
923. Expansion Valve

F-00410

Figure 80—Thermostatic and Blower Switches

- Place the motor in the bracket with the electrical connector side of the motor to the right side of the bracket.
- Align the blower wheels so they do not touch the case.

3. Assemble the case halves and attach the cover plate.

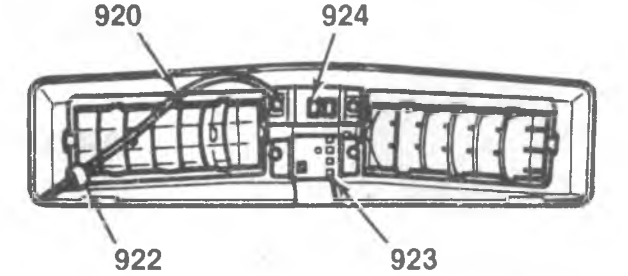
EXPANSION VALVE, EVAPORATOR AND/OR EVAPORATOR CASE REPLACEMENT

Remove or Disconnect (Figure 80)

1. Cover plate.
   - Separate the upper and lower case halves.
2. Inlet and outlet lines from the expansion valve (923).
3. Sensing bulb from the evaporator outlet manifold.
   - Cap or plug open connections.
5. Core.
6. Blower motor and harness assembly.

Install or Connect (Figure 80)

1. Blower motor and harness assembly.
2. Core.
3. Expansion valve (923).
4. Sensing bulb.
5. Inlet and outlet lines.
   - Use new seals (o-rings) coated with clean refrigeration oil when connecting lines.
   - Add 90 ml (3 ounces) of new refrigeration oil to a new core.



920. Thermostatic Switch Capillary Tube
922. Bumper
923. Blower Switch
924. Thermostatic Switch

F-00411

Figure 81—Thermostatic and Blower Switches

THERMOSTATIC AND/OR BLOWER SWITCHES REPLACEMENT

Remove or Disconnect (Figure 81)

1. Cover plate assembly from the evaporator case.
2. Switch (923 or 924).

Install or Connect (Figure 81)

1. Switch (923 or 924).
   - Place the sensing capillary in the same position before it was removed.
2. Cover plate.

BLOWER MOTOR RESISTOR REPLACEMENT

The resistor is located on the top of the unit. Remove the unit to replace.

FUSE REPLACEMENT

This unit does not have an in-line fuse. The lead wire is connected to the heater wiring harness and operates off the 20 amp heater fuse.

SPECIFICATIONS

A-6 COMPRESSOR

Type	6 Cylinder Axial
Displacement	12.6 Cu. In.
Rotation	Clockwise
SYSTEM CAPACITIES	
Refrigerant	1 587 6 kg (3 lbs. 8 ounces)
525 Viscosity Compressor Oil	330 ml (11 ounces)
TORQUE SPECIFICATIONS	
Compressor Suction and Discharge Connector Bolt	24 N·m (18 ft. lb.s)
Oil Drain Screw	17 N·m (13 ft. lbs.)
Cycling Pressure Switch	10 N·m (7.5 ft. lbs.)
All Compressor Mounting Bolts	34 N·m (25 ft. lbs.)

DA-6 COMPRESSOR

Type	6 Cylinder Axial
Displacement	10.0 Cu. In.
Rotation	Clockwise
SYSTEM CAPACITIES	
Refrigerant	1 587 kg (3 lbs. 8 ounces)
525 Viscosity Compressor Oil	240 ml (8 ounces)
TORQUE SPECIFICATIONS	
Compressor Suction and Discharge Connector Bolt	24 N·m (18 ft. lbs.)
Shaft Nut	16 N·m (12 ft. lbs.)
Cycling Pressure Switch	10 N·m (7.5 ft. lbs.)
Front Compressor Mounting Bolts	43 N·m (32 ft. lbs.)
Rear Compressor Mounting Bolts	30 N·m (22 ft. lbs.)

R-4 COMPRESSOR

Type	4 Cylinder Radial
Displacement	10.0 Cu. In.
Rotation	Clockwise
SYSTEM CAPACITIES	
Refrigerant	1 587 6 kg (3 lbs. 8 ounces)
525 Viscosity Compressor Oil	330 ml (11 ounces)
TORQUE SPECIFICATIONS	
Compressor Suction and Discharge Connector Bolt	24 N·m (18 ft. lb.s)
Oil Drain Screw	17 N·m (13 ft. lbs.)
Cycling Pressure Switch	10 N·m (7.5 ft. lbs.)
All Compressor Mounting Bolts	34 N·m (25 ft. lbs.)

SPECIFICATIONS (CONT.)

	Volts	Amps (Cold)	RPM (Cold)
Blower Motor			
C-K All Weather	12.0	12.8 Maximum	3400 Minimum
C-K-G Rear Interior Roof Mounted G Floor and Motor Home Units	12.0	13.7 Maximum	3400 Minimum

Compressor Clutch Coil	
Ohms (at 80° F)	3.70
Amps (at 80° F)	3.33 @ 12 Volts
Belt Tension	See Tune-Up Chart
Fuse Block	
C-K Systems	25 Amps
Motor Home Chassis Unit	20 Amps
In Line	
C-K Systems	25 Amps
Motor Home Chassis Unit	None
Circuit Breaker	
G Systems	45 Amps

SPECIAL TOOL LIST

J-5420	Across Valve Quick Fitting
J-5725-04	Mainifold and Gage Set
J-6084	Leak Detector
J-6271-01	Refrigerant Can "Taps-All" Valve
J-6272-02	Multi-Can Dispensing Valve
J-9459	Access Valve Quick Fitting
J-23390	12 Lb. Disposable Can Control Valve
J-23500-01	Portable Air Conditioning Evacuation and Recharging Station
J-23600	Belt Tension Gage

SECTION 2

FRAME AND CHASSIS SHEET METAL

CONTENTS

SECTION 2A

FRAME

CONTENTS

C/K AND P MODEL FRAMES

DESCRIPTION

The models covered under this part of the section include C/K, and P. The service information for the G model will be found in the underbody portion of this section.

Proper frame alignment is important to assure normal life and functioning of many other parts of the vehicle. If the vehicle has been involved in a fire, collision, or has been overloaded, there is cause to check the frame alignment. If, for any other reason, alignment is suspected it should be checked. A procedure for this is described later in this section under "Checking Frame Alignment."

It is possible that certain conditions make the frame appear to be out of alignment when, in fact, it is not. These conditions are also described under "Checking Frame Alignment."

Terms used later in this section are briefly defined below:

1. SECTION MODULUS—This is a measure of the strength of a frame, based on height, width, thickness and shape of the side rails. It does not account for the strength of the material used in the frame.
2. YIELD STRENGTH—This is a measure of the strength of the material from which the frame is made. It is the maximum load [kPa (psi)] that can be placed on a material and still have it return to its original shape.
3. RESISTANCE TO BENDING MOMENT (RBM)—This is a single measure of frame strength that accounts for both the section modulus and the strength of the material used. (It is the product of section modulus and yield strength.)
4. SAG—This refers to a frame or side rail that is bent down from where it should be.
5. BUCKLE—This refers to a frame or side rail that is bent up from where it should be.

6. DIAMOND—This refers to the condition where one entire frame rail is moved forward from, or to the rear of, its correct alignment with the other rail.
7. TWIST—This refers to the condition where the entire frame has been twisted. One rail will basically slope up while the other rail will basically slope down.
8. SIDESWAY—This refers to a side rail that is bent to the side of where it should be.
9. TRACKING—This refers to the alignment of the vehicle axles with each other. A misaligned frame can cause improper tracking. If the vehicle is tracking correctly, all axles will be parallel to each other and perpendicular to the center line of frame.
10. WEB—The vertical part of a channel-type frame rail.

DIAGNOSIS OF THE FRAME

PROBLEM	POSSIBLE CAUSE	CORRECTION
Sag	1. Loads greater than the frame is designed to carry. 2. Uneven load distribution. 3. Abrupt changes in section modulus. (For a brief definition of section modulus, see the "Description" at the beginning of this section. 4. Improper body, or accessory, mounting: — Holes drilled in the flange of the frame rail. — Too many holes in the web section of the rail. — Holes in the web section which are too close to each other. — Four or more holes in the same vertical line of the rail web. — Welds on the flange, particularly across the flange or along its edge. — Cutting holes in the rail with a torch. — Cutting notches anywhere on the rails. 5. A fire involving the vehicle. 6. A collision involving the vehicle. 7. The use of equipment for which the frame has not been designed or reinforced.	1-7. Straighten and reinforce the frame as described later in this section. See "Straightening Frames" and "Reinforcements."
Buckle	1. The use of equipmient such as snow plows for which the frame was not designed. 2. A collision involving the vehicle. 3. A fire involving the vehicle. 4. In addition to these causes, refer to possible causes 3 and 4 under "Sag." These may contribute to "Buckle."	1-4. Straighten and reinforce the frame as described later in this section. See "Straightening Frames" and "Reinforcements."

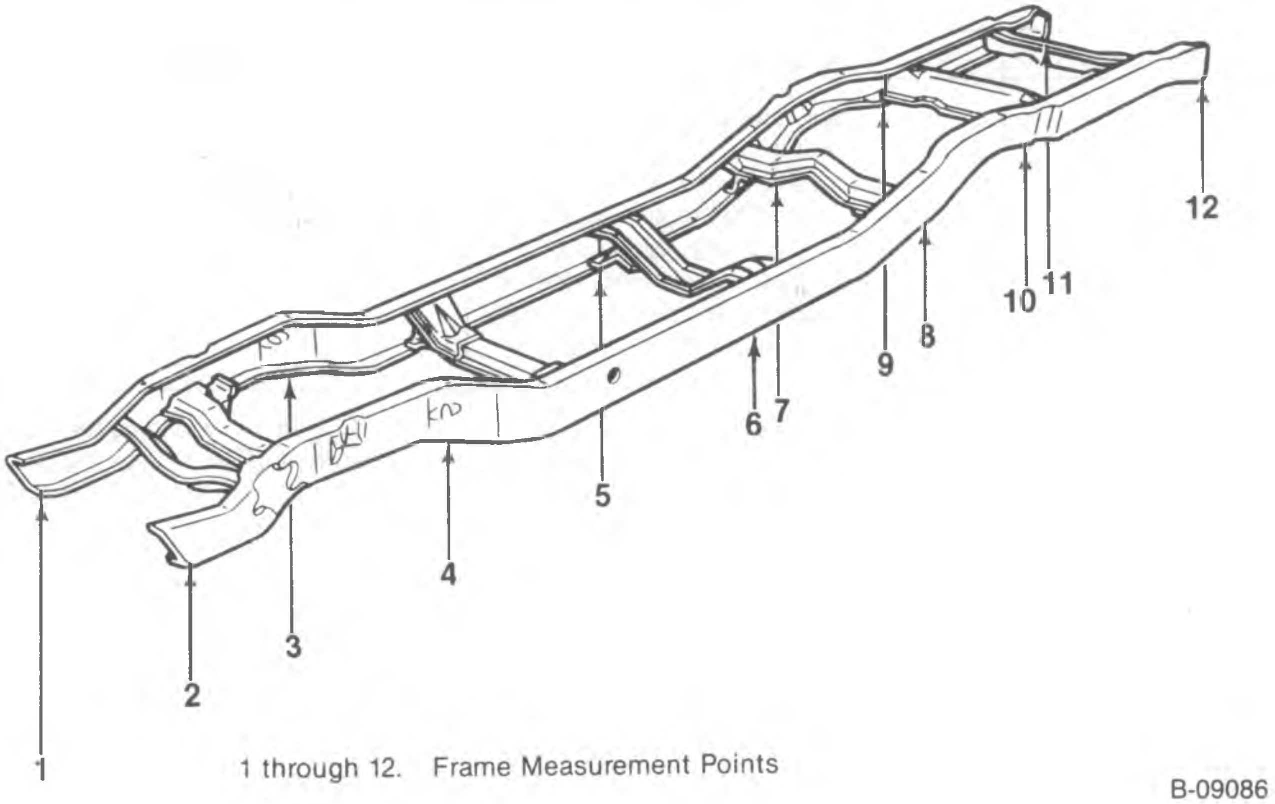
DIAGNOSIS OF THE FRAME (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Sidesway	1. A collision involving the vehicle. 2. A fire involving the vehicle. 3. The use of equipment such as snow plows for which the frame was neither designed nor properly reinforced. 4. In addition to these causes, refer to possible causes 3 and 4 under "Sag." These may be contributing factors.	1-4. Straighten and reinforce the frame as described later in this section. See "Straightening Frames" and "Reinforcements."
Diamond	1. A collision involving the vehicle. 2. Towing another vehicle with a chain attached to one corner of the frame.	1-2. Straighten and reinforce the frame as described later in this section. See "Straightening Frames" and "Reinforcements."
Twist	1. An accident or collision involving the vehicle. 2. Operating the vehicle in very rough terrain.	1-2. Straighten and reinforce the frame as described later in this section. See "Straightening Frames" and "Reinforcements."
Improper Tracking	1. Frame is out of alignment. 2. Front or rear axle has shifted. 3. Incorrect wheel alignment may make the vehicle appear to be tracking incorrectly.	1. Straighten and reinforce the frame as described later in this section. 2. Realign and secure the axle. 3. Align the wheels. Refer to FRONT END ALIGNMENT (SEC. 3A) of this manual.
Cracks In The Web Of The Rails	1. Loose crossmember attaching bolts. 2. Concentration of stress that may result from many different factors. (See "Sag" under "Diagnosis" previously described in this chart. Also see "Minimizing Frame Damage" and "Reinforcements" (later in this section.)	1. Replace, or weld and reinforce rail. Ream bolt holes and replace with larger bolts if necessary. Retighten bolts. 2. Replace, or weld and reinforce the rail. See the appropriate heading, later in this section.

MINIMIZING FRAME SERVICE

Generally, frame service can be minimized or eliminated by minimizing the concentration of stress in small areas of the frame.

1. Vehicles should be used only for those purposes for which they were designed.
   - They should not be overloaded.
   - They should be loaded evenly; localized loads should be avoided.
   - Do not operate the vehicle on extremely rough terrain.
   - Take into account the forces that will be placed on a frame from the operation of equipment such as snow plows when picking a frame for a new vehicle or reinforcing a frame.
2. Follow recommended practices when repairing a frame or when mounting a body or equipment on a frame.
   - Avoid sudden changes in the section modulus.
   - Do not drill holes in the frame rail flanges.
   - Space holes in the web section of a rail at least 13 mm (1/2-inch) from one another.
   - Use existing holes whenever possible.



1 through 12. Frame Measurement Points

Figure 1—C/K And P Model Frames

- Do not cut holes with a torch.
- Do not overheat the frame rails.
- Avoid welding on the flanges.
- Do not allow four or more holes to exist on the same vertical line of the web.
- Holes made in a reinforcement should be placed a distance of at least two times the material thickness from the edge of the reinforcement.

CHECKING FRAME ALIGNMENT

The main parts of a frame are the side rails and crossmembers. The rails carry the load and the crossmembers stabilize the rails.

Types of frame misalignment can be divided into five groups. The five groups are sag, buckle, diamond, sidesways, and twist. For a brief definition of these terms, refer to "Description" at the beginning of this section.

A misaligned frame rail may have moved forward from, up or down from, or to the side of where it should be. These possibilities must be checked.

The easiest way to check frame alignment is with gages made for this purpose. Detailed instructions are normally supplied with gages at the time of purchase. Therefore, instructions for gage use are not given in this manual.

It is possible to check certain portions of frame alignment without the proper gages. The procedure is described later in this section.

Whether alignment is checked with or without gages, the vehicle must be parked on a level section of floor.

Certain conditions call for preliminary checks before actually checking the frame. Suspension or axle problems may make it appear that the vehicle frame is out of alignment. If an axle has shifted, "Diamond" or "Sidesway" may appear to exist when, in fact, they do not. A weak spring may make the vehicle appear to have a twisted frame.

A visual inspection of the top and bottom flanges of each rail may reveal the specific area where sag or buckle exists. In the case of sag, wrinkles may appear on the top of the upper flange; such wrinkles are definite evidence of sag. Wrinkles on the bottom of the lower flange are definite evidence of buckle.

DETERMINING THE FRAME CENTERLINE (Figure 1)

1. Move the vehicle to a level, well-lighted section of the floor.
2. Make a diagram of the frame on the floor beneath the vehicle as follows:
   a. Using a plumb bob, transfer points 1, 2, 11, 12 from the inside of the web to the floor. Mark the points (figure 1).

   b. Using a plumb bob, transfer the remaining points from the outside of the web to the floor. Mark the points. The actual placement of these points is not so important as is the fact that the points must be taken from the same place on both the right and left frame rail.
3. Move the vehicle away from the points on the floor.
4. Measure the distance between points 1 and 2. This distance should be 704.85 mm (27.75-inch) for the standard front axle, and 847.25 mm (33.75-inch) if equipped with a 5000# I-Beam Front Axle.
5. Measure the distance between points 11 and 12. This distance should be 847.25 mm (33.75-inch). If both the measurements in steps 4 and 5 were correct, continue the procedure. If the measurements are not correct, refer to "Horizontal Check" step 2, and mark the centerline through the intersection of two sets of diagonals that have equal measurements.
6. Make a mark on the floor exactly halfway between points 1 and 2. Make a similar mark between points 11 and 12.
7. Use a chalk line to mark a line through the points. This is the centerline of the frame.

HORIZONTAL CHECK

1. Measure the distance between the frame rails, and the centerline at points 3-10. Each pair of corresponding points should be an equal distance from the centerline within 3 mm (1/8-inch). Example: Points 3 and 4 should measure equally from the centerline as should points 5 and 6, 7 and 8, and points 9 and 10.
2. Measure diagonally from point 1 to point 6, and from point 2 to point 5. Mark the floor where the diagonals pass the centerline. The diagonals should measure the same distance within 5 mm (3/16-inch), and should cross at the centerline. If the frame is within specifications, the frame within these points is properly aligned.
3. Repeat step 2 on other pairs of diagonals until the entire frame has been checked. Example: Point 3 to point 10 and point 4 to point 9 or point 5 to point 12 and point 6 to point 11, etc.
4. Refer to "Straightening Frames" to repair any damage that is found.

STRAIGHTENING FRAMES

Frame straightening can be complicated and usually requires special equipment. It should be attempted by competent personnel only.

A complete analysis of the condition of the frame should be made before any steps are taken to straighten it. Analyzing the cause of failure will help determine the correct sequence of steps in the repair. (See "Possible Causes" under "Diagnosis" and "Minimizing Frame Service" previously outlined in this section.) Corrective procedures should be set up to reverse the flow of the damaging forces. In many instances, to reverse the flow of forces, pressure must be applied from different directions at the same time.

Careful use of controlled heat is important. Too much or too little heat, or the improper application of heat, is a major source of trouble. Frame heating should be done with a large sized tip (multi-hole heating tip) and a neutral flame should be used (oxygen adjust opened just enough to remove the feathers or stringers from the blue center at tip of torch). Heat the area that will be stretched as frame is straightened. Heat the area AFTER SUFFICIENT PRESSURE HAS BEEN EXERTED to cause a slight checking, or silvery cracks, to appear on the surface of the metal. Gradually increase the pressure while heating. Do not heat beyond 606°C (1200°F). A red glow indicates that the material is overheated. Overheating will cause distortion and stretching, as well as a change in the characteristics of the metal.

REPAIRING CRACKS

Two common types of cracks are shown in figure 2. The straight crack will normally start from the edge of a flange. It will go across the flange and through the web section of a rail. Finally, it will continue through the other flange. This type of crack may result from high concentrations of stress in small areas of the frame, excessive bending moment, and torsional loading. (See "Minimizing Frame Service," previously outlined in this section).

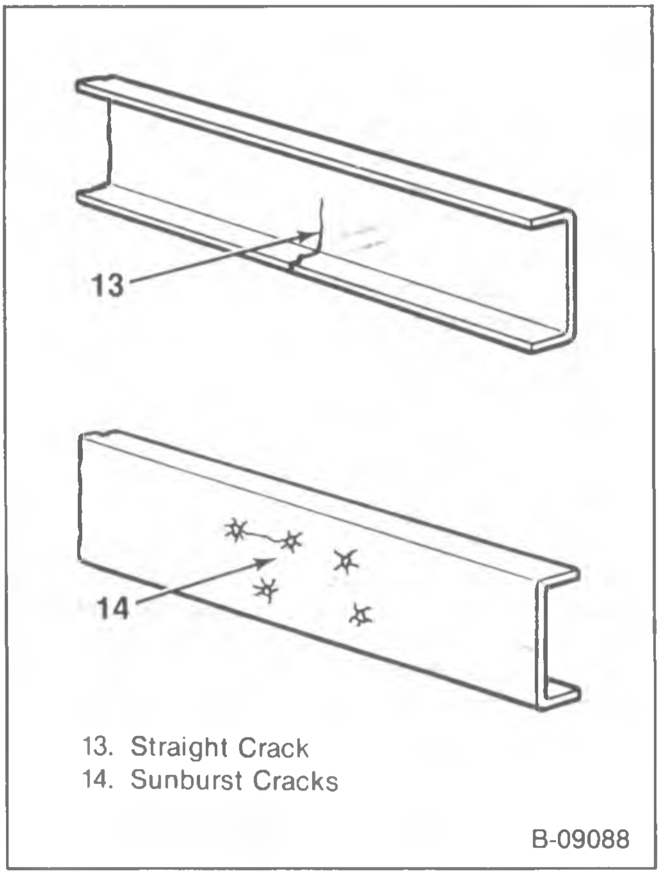
Sunburst crack(s) will radiate out from a hole in the web section of a rail or crossmember. They are caused by high loads being applied at a mounting bracket or crossmember which is not securely or properly attached to the rail.

If cracks occur to both the rail and reinforcement at a particular area of the frame, they must be repaired separately. The flanges must react independently to prevent localized stress concentration. Use a copper spacer between the flanges of cracked base rail flanges and reinforcement flanges.

Crossmember mounting flange cracks may be repaired in the same manner as side rail cracks. However, weld bead should be built up to provide a good smooth radius. If a crossmember is greatly damaged it should be replaced.

It may be necessary to align the frame and level the rails before repairing the frame.

1. Remove any equipment that will interfere with access to the crack.
2. Locate the extreme end of the crack and drill a 6 mm (0.25-inch) hole.



13. Straight Crack
14. Sunburst Cracks

Figure 2—Types Of Frame Cracks

3. "V" grind the entire length of the crack from the starting point to the 6 mm (0.25-inch) hole at the extreme end.
4. The bottom of the crack should be opened up 2 mm (1/16-inch) to allow good penetration of the weld. (A hack-saw blade may be used for this).
5. Weld with proper electrode and proper welding techniques. See "Welding" outlined later in this section for tips on welding.
6. Grind the weld smooth on both the inside and the outside of the rail or crossmember. Be extremely careful to eliminate weld build-up or notches on the edge of the flange.

WELDING

Improper welding techniques are the cause of many weld and/or frame failures. The following information points out potential areas of difficulty and provides some general guidelines for successful frame welding.

Most weld failures occur at the end of the weld in areas of the frame that are under high stress. By eliminating the ends of a weld, failures can be reduced; this can be done by making a hole or slot in the part to be attached and then using a fillet weld around a slot or plug weld. Do not leave a notch at the end of a weld.

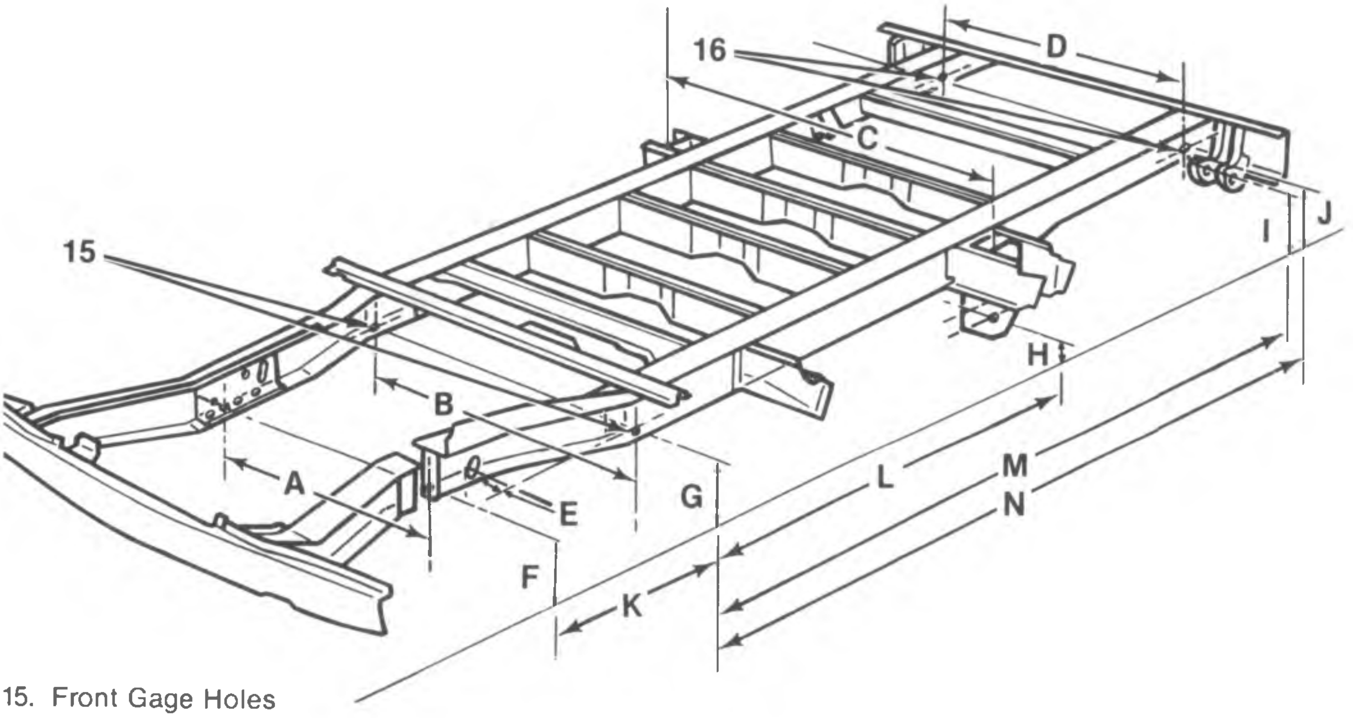
Over-welding can be harmful, especially if it is in an area of the frame that receives high concentrations of stress.

Small cracks in a crossmember may be welded (see "Repairing Cracks" previously outlined in this section).

When welding:

1. Do not use oxyacetylene welding equipment.
2. Whenever possible, use smaller diameter electrodes and make several passes; this is preferred to using a large diameter electrode and making fewer passes.
3. Do not use more heat than is necessary to give good penetration.
4. Do not run more passes than necessary.
5. Make sure the weld is free from craters and undercuts.
6. Make sure scale is removed from each successive pass.
7. If repairing a crack, grind the surface of the weld flush with the parent material.
8. When mounting accessories, do not weld across the flanges.
9. When mounting accessories, do not weld within 19 mm (3/4-inch) of a flange.
10. Do not weld up to the edge of a part being welded to a frame. Leave 6 mm (0.25-inch) between the end of the weld and the edge of the part.
11. Do not weld cast brackets to the frame.
12. Do not weld the flanges of cracked reinforcements and base rails together.
13. Connect the welding machine ground cables as close to the working area as possible.
14. Avoid direct contact between the welding cables and any part of the vehicle.
15. Do not get the welding cables near the vehicle wiring.

G MODEL UNDERBODY



15. Front Gage Holes
16. Rear Gage Holes
A. 789.4 mm (31.08-inch)
B. 1041.4 mm (41.0-inch)
C. 1340 mm (52.76-inch)
D. 1041.4 mm (41.0-inch)
E. 126 mm (4.96-inch)
F. 123 mm (4.8-inch)
G. 113.3 mm (4.46-inch)
H. 13 mm (0.51-inch)
I. 96 mm (3.78-inch)
J. 145.2 mm (5.72-inch)
K. 701 mm (27.6-inch)
L. 1465 mm (57.66-inch) 110-inch wheelbase
1845 mm (72.66-inch) 125-inch wheelbase
M. 2772 mm (109.17-inch) 110-inch wheelbase
3153 mm (124.17-inch) 125-inch wheelbase
N. 2833 mm (111.54-inch) 110-inch wheelbase
3442 mm (135.54-inch) 125-inch wheelbase

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Figure 3—G Model Underbody

DESCRIPTION

The G Model incorporates a unitized body design comprised of side rails, cross sills, and outriggers which are all part of the welded underbody.

A misaligned underbody can affect the opeartion of many vehicle components. It is essential that underbody alignment be exact to within 1.6 mm (1/16-inch).

UNDERBODY ALIGNMENT

To determine the alignment of the underbody it is necessary to use a good quality traming gage. This gage must be capable of measuring all points of the underbody up to three quarters of the body length.

Following the instructions given by the manufacturer of your gage, measure the horizontal and vertical points as shown in figure 3. Compare each measurement with the specifications given in the figure to determine the damaged areas and the extend of the damage. When repairing the underbody it will be necessary to return the underbody to these original specifications within 1.6 mm (1/16-inch).

Many different types and brands of unibody repair equipment are available; each system may be slightly different. A multiple pull system is most desirable in order to correct the damage in the same direction in which it was created. When making multiple pulls use the last in, first out procedure. This means that you correct the damage in the reverse sequence by which it was created. It is also important to correct the damage in the opposite direction in which the damage was created.

SECTION 2B

BUMPERS

CONTENTS

SUBJECT **PAGE**

C/K MODEL BUMPERS

FRONT BUMPER REPLACEMENT

Remove or Disconnect

1. Brace to bumper nuts (2) (figure 1).
2. Bracket to bumper nuts (3).
3. Bumper from the vehicle.
4. Guard assemblies (where used) (figure 2).
5. Rub strips from the bumper and guards (where used) (figure 3).
   - From the rear of the bumper, press the tangs of the rub strip together, and push the strip from the bumper and/or guard.
6. Bumper bolts (6 and/or 8).
7. Brace bolts and washers (17 and 18) (figure 4) from the inside of the frame rail.
   - Braces (4).
8. Bracket bolts, washers, and nuts (16, 15 and 14) from the frame.
9. Tow hooks (20) (where used).
10. Brackets (5).

Install or Connect (Figures 1-4)

1. Brackets and tow hooks (where used) to the frame rails.
   - On vehicles without tow hooks, install the bolts and washers through the brackets and through the outside of the frame rail.
   - On vehicles with tow hooks, install the tow hook bolts and washers from inside the frame rail, then through the brackets and the tow hooks. Install the top bracket bolts and washers through the bracket, and into the top rail flange.
2. Washers and nuts to the bolts.

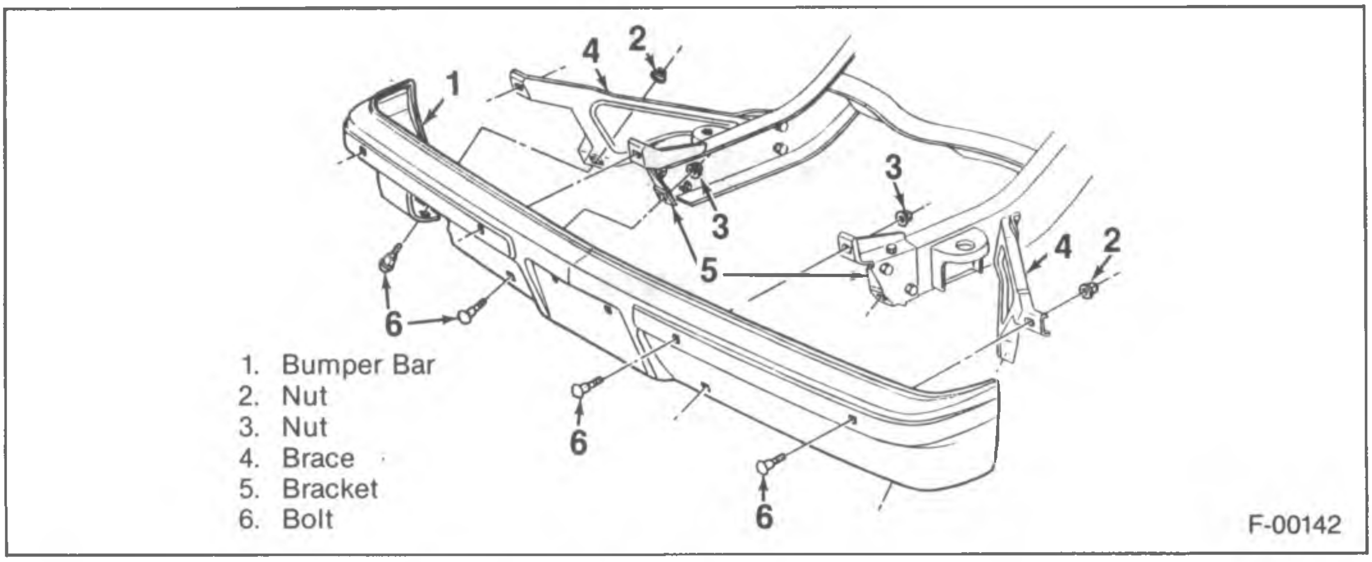


Figure 1—C/K Front Bumper Components

Tighten

- Nuts to 95 N·m (70 ft. lbs.).

3. Brace bolts and washers (17 and 18) through the frame rails and into the braces.

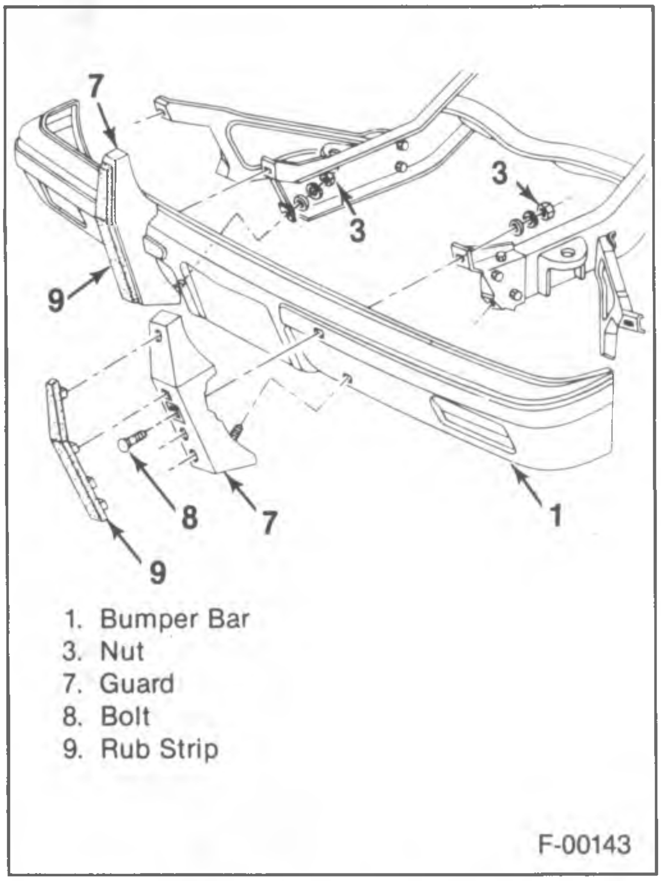


Figure 2—C/K Front Bumper Guards

Tighten

- Bolts to 50 N·m (37 ft. lbs.).

4. Bumper bolts (6) onto the bumper.
5. Rub strips to the bumper and guards (where used).
   - Place the tangs of the strips onto the slots in the bumper or guard. Using a rubber mallet, set the tangs in place starting at the center of the strip, and working toward each end.
6. Guard assemblies (where used).
7. Bumper to the vehicle.
   - Install the bumper with bolts through the right and left braces, and brackets.
8. Bracket to bumper nuts (3).

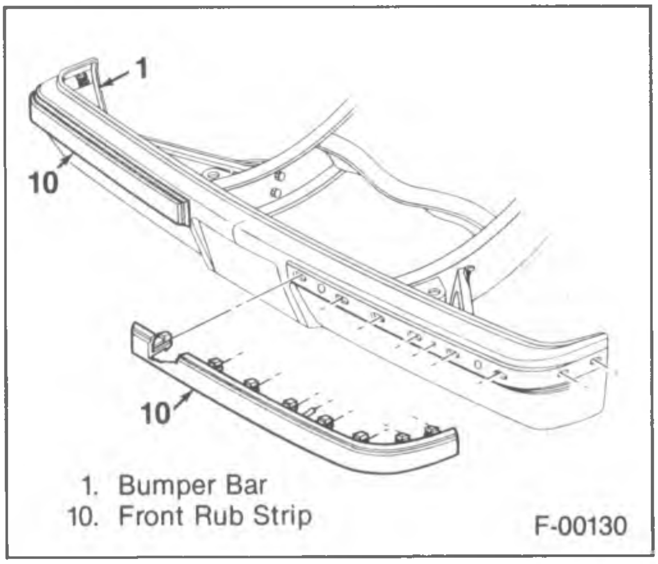
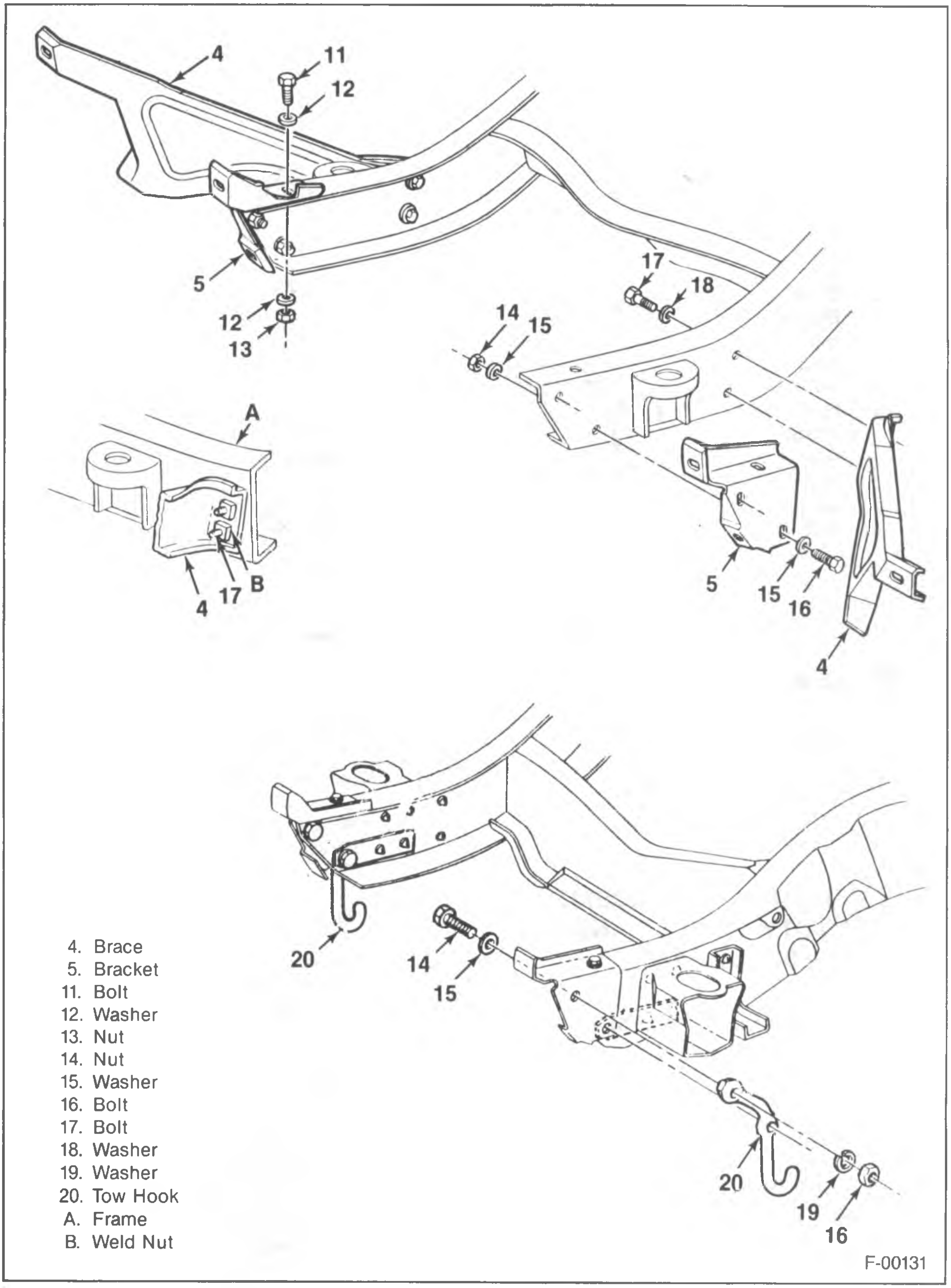
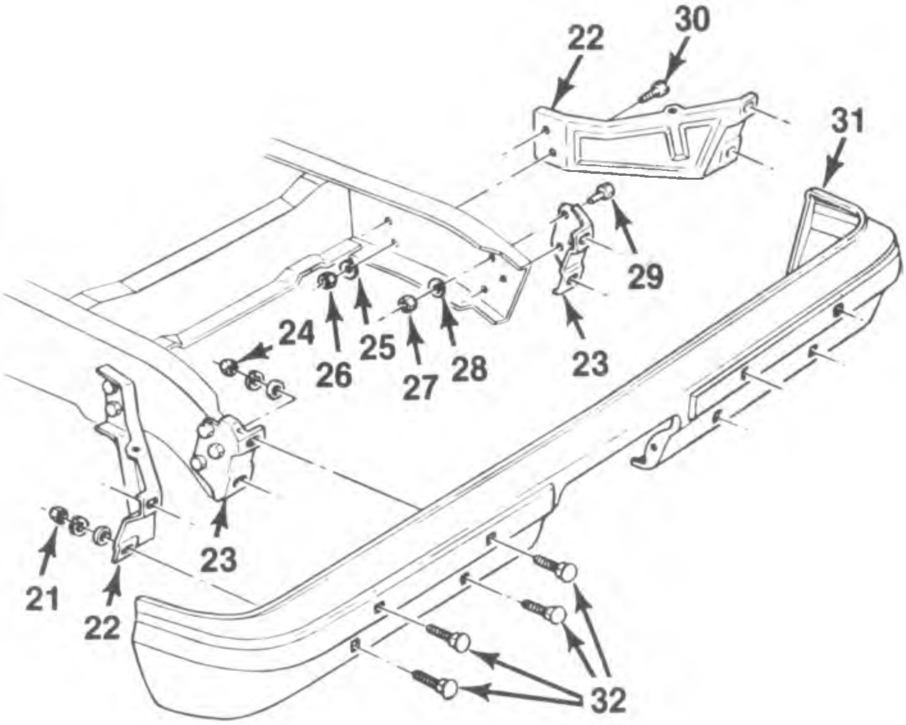


Figure 3—C/K Front Bumper Rub Strip



4. Brace
5. Bracket
11. Bolt
12. Washer
13. Nut
14. Nut
15. Washer
16. Bolt
17. Bolt
18. Washer
19. Washer
20. Tow Hook
A. Frame
B. Weld Nut

Figure 4—C/K Front Bumper Brackets, Braces, and Tow Hooks



21. Nut
22. Brace
23. Bracket
24. Nut
25. Washer
26. Nut
27. Nut
28. Washer
29. Bolt
30. Bolt
31. Bumper Bar
32. Bolt

Figure 5—Utility Vehicle and Suburban Rear Bumper Components

Tighten

- Nuts to 90 N·m (66 ft. lbs.).

9. Brace to bumper nuts (2).

Tighten

- Nuts to 90 N·m (66 ft. lbs.).

REAR BUMPER REPLACEMENT (UTILITY VEHICLE AND SUBURBAN)

Remove or Disconnect (Figure 5)

1. Brace to bumper nuts (21).
2. Bracket to bumper nuts (24).
3. Rear bumper.
4. Filler panel bolts (figures 6 and 7).
    - Filler panel.
5. Rub strips from the bumper (where used) (figure 8).
    - From the rear of the bumper, press the tangs of the bump strip together, and push the strip from the bumper.
6. Bumper bolts (32).
7. Brace nuts, washers, and bolts (26, 25 and 30).
    - Braces (22).
8. Bracket nuts, washers, and bolts (27, 28 and 29).
    - Brackets (22).

Install or Connect (Figures 5-8)

1. Brackets to the frame rails (22).
    - Bracket bolts, washers, and nuts (29, 28 and 27).

Tighten

- Nuts to 95 N·m (70 ft. lbs.).

2. Braces to the frame rails (22).
    - Brace bolts, washers, and nuts (30, 25 and 26).

Tighten

- Nuts to 95 N·m (70 ft. lbs.).

3. Bumper bolts to the bumper (32).
4. Rub strips to the bumper (where used).
    - Place the tangs of the strips onto the slots in the bumper guard. Using a rubber mallet, set the tangs in place starting at the center of the strip, working toward each end.
5. Filler panel supports (Utility vehicle only) (figure 6).

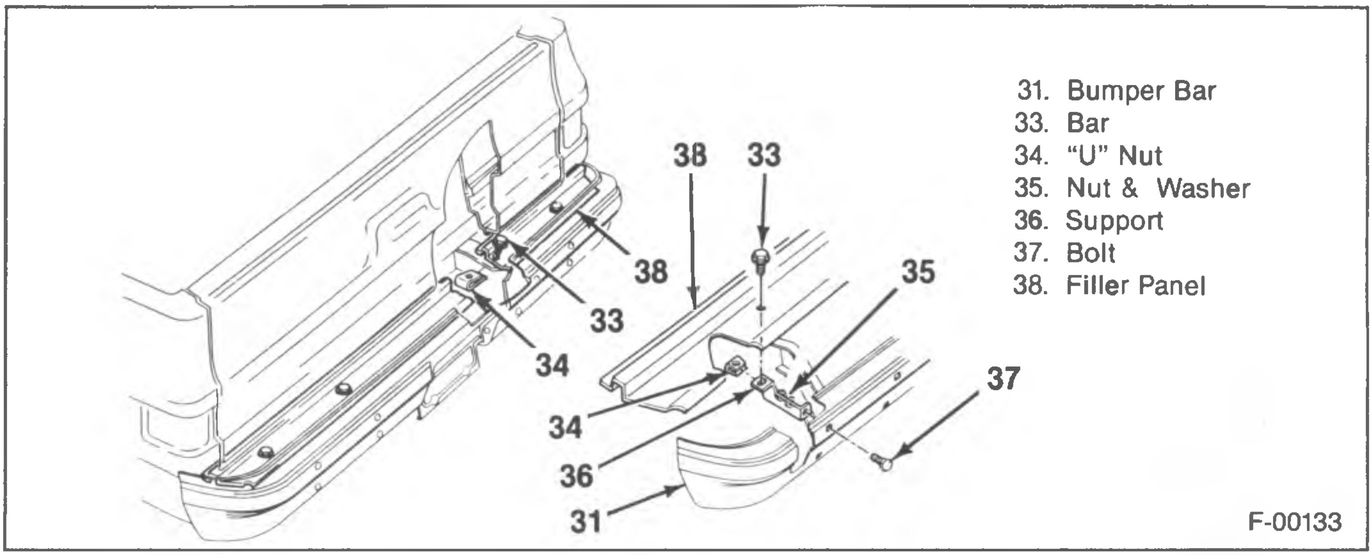


Figure 6—Rear Bumper Fiiler Strip

- Place the filler panel bolts through the panel and into the support "U"-nuts.

Tighten

- Bolts to 10 N·m (89 in. lbs.).

6. Filler panel (Suburban only) (figure 7).
   - Bolts through the filler panel, and into the platform.

Tighten

- Bolts to 2.8 N·m (25 in. lbs.).

7. Bumper to the vehicle.
   - Install the bumper bolts (32) into the braces, and brackets.
8. Filler Panel (Utility vehicles only).

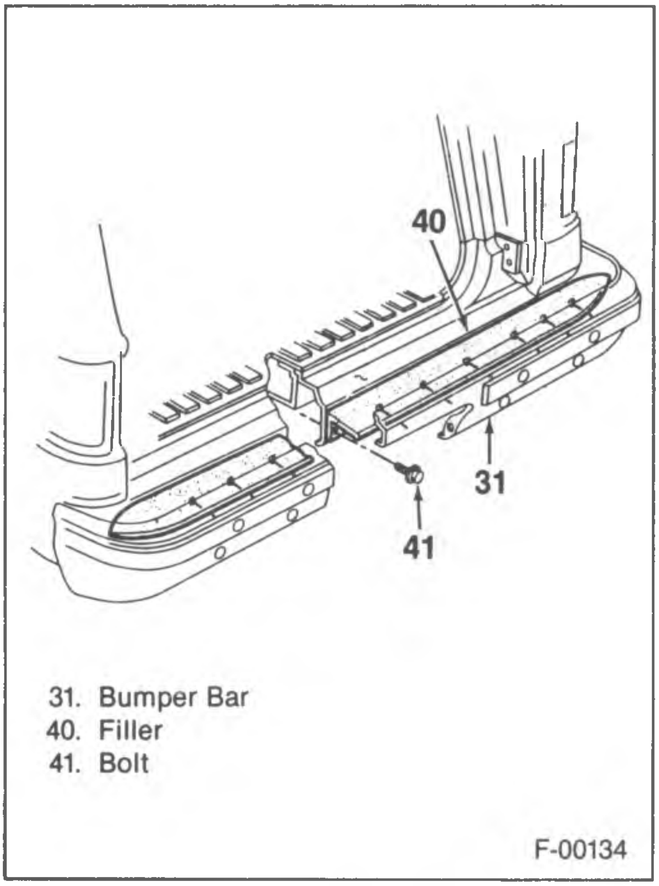


Figure 7—Rear Bumper Center Filler

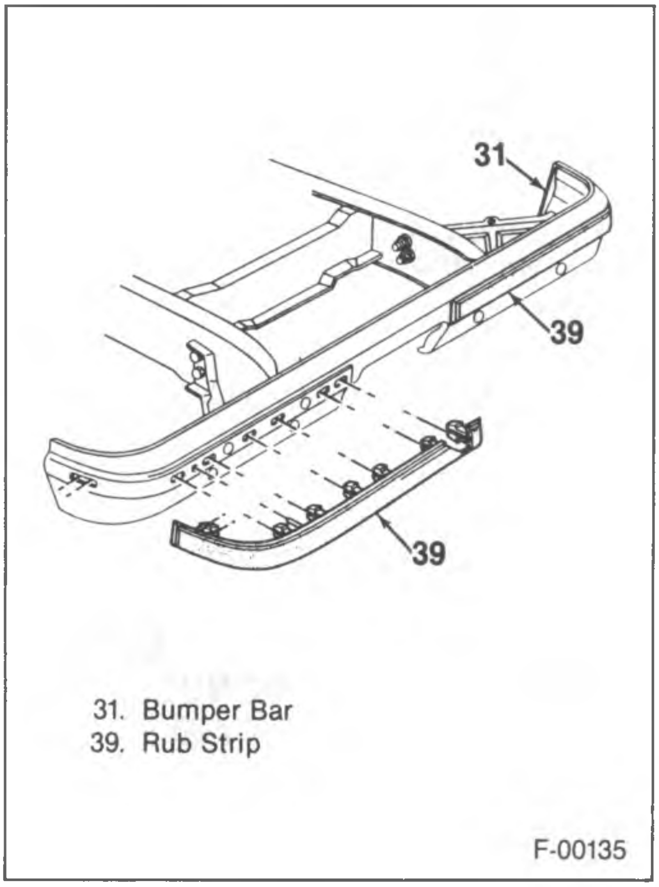
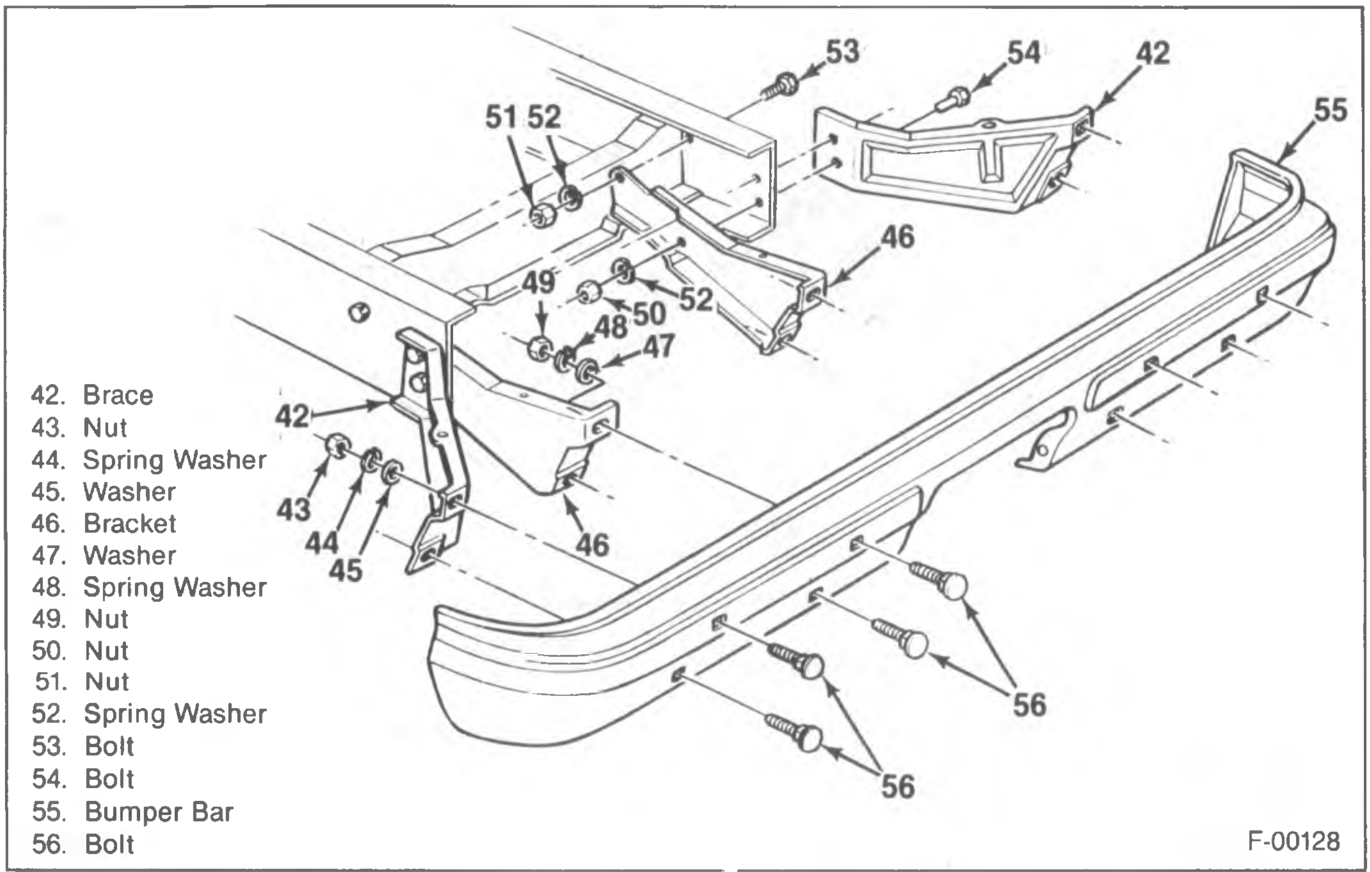


Figure 8—Rear Bumper Rub Strip



42. Brace
43. Nut
44. Spring Washer
45. Washer
46. Bracket
47. Washer
48. Spring Washer
49. Nut
50. Nut
51. Nut
52. Spring Washer
53. Bolt
54. Bolt
55. Bumper Bar
56. Bolt

Figure 9—Regular Cab, Bonus Cab, and Crew Cab Rear Bumper Components

- Place the filler panel behind the bumper, and place the supports onto the bumper bolts behind the braces.

9. Filler panel bracket bolts (Utility vehicle only).

Tighten

- Bolts to 10 N·m (89 in. lbs.).

10. Bracket nuts (24).

Tighten

- Nuts to 41 N·m (30 ft. lbs.).

11. Brace nuts (21).

Tighten

- Nuts to 41 N·m (30 ft. lbs.).

REAR BUMPER REPLACEMENT (REGULAR CAB, BONUS CAB, AND CREW CAB)

Remove or Disconnect (Figure 9)

1. Brace nuts (43), spring washers (44), and washers (45) at the bumper.
2. Bracket nuts (49), spring washers (48), and washers at the bumper.
3. Rear bumper from the vehicle.
4. Bumper bolts (56).
5. Gravel deflector nuts (59) and bolts (57) (where used) (figure 10).
   - Gravel deflectors (58).
6. Brace to frame nuts (50), spring washers (52), and bolts (54).
   - Braces (42).
7. Bracket to frame rail nuts (51), spring washers (52) and bolts (53).
   - Brackets (46).

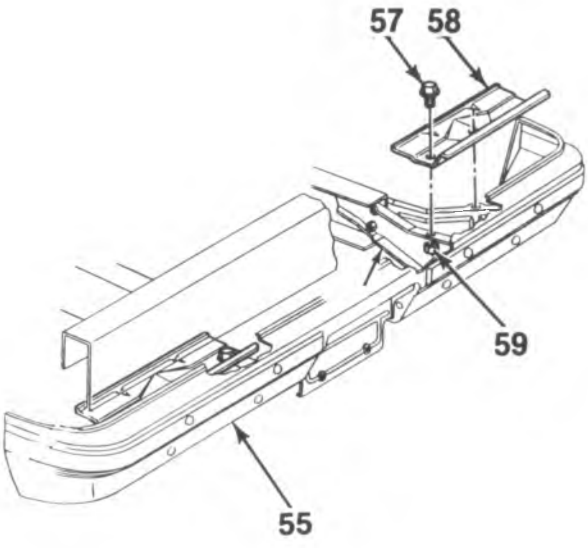
Install or Connect

1. Brackets to the frame rails.
   - Bolts (53), spring washers (52), and nuts (51).

Tighten

- Nuts to 95 N·m (70 ft. lbs.).

2. Braces to the frame rails.
   - Bolts (54), spring washers (52), and nuts (50).



55. Bumper Bar
57. Bolt
58. Gravel Deflector
59. Nut

F-00129

Figure 10—Rear Bumper Gravel Deflector

Tighten

- Nuts to 95 N·m (70 ft. lbs.).

3. Gravel deflectors (where used).
    - Nuts (59) and bolts (57).

Tighten

- Nuts to 10 N·m (89 in. lbs.).

4. Bumper bolts (56) onto the bumper.
5. Rear bumper.
    - Place the bumper bolts through the brackets and braces.
6. Bracket washers (47), spring washers (48), and nuts (49) to the bumper.

Tighten

- Nuts to 90 N·m (66 ft. lbs.).

7. Brace washers (45), spring washers (44), and nuts (43) to the bumper.

Tighten

- Nuts to 90 N·m (66 ft. lbs.).

REAR STEP BUMPER REPLACEMENT

↔ Remove or Disconnect (Figure 11)

1. Bracket to bumper nuts (63), and bolts (64).
2. Brace to bumper nuts (73), spring washers (72), washers (71), and bumper bolts.
3. Bumper from the vehicle.
4. Brace to frame nuts (60) and bolts (62).
    - Braces (70).
5. Bracket reinforcement nuts (68) and bolts (61) (and washers (67) where used).
    - Bracket reinforcements (66).
6. Bracket to frame nuts (60), and bolts (62).
    - Brackets (65).

Install or Connect (Figure 11)

1. Brackets (65) and braces (70) to the frame.
    - Bolts (62) and nuts (60) loosely.
2. Bracket reinforcements (66).
    - The reinforcements are marked as right or left on their inboard sides.
    - Bolts (61) and nuts (68), and washers (67) (where used).

Tighten

- Reinforcement nuts to 70 N·m (52 ft. lbs.).
- Bracket and brace nuts to 70 N·m (52 ft. lbs.).

3. Bumper to the vehicle.
4. Bumper to brace bolts (69), washers (71), spring washers (72), and nuts (73).

Tighten

- Nuts to 70 N·m (52 ft. lbs.).

5. Bumper to bracket bolts (64), and nuts (63).

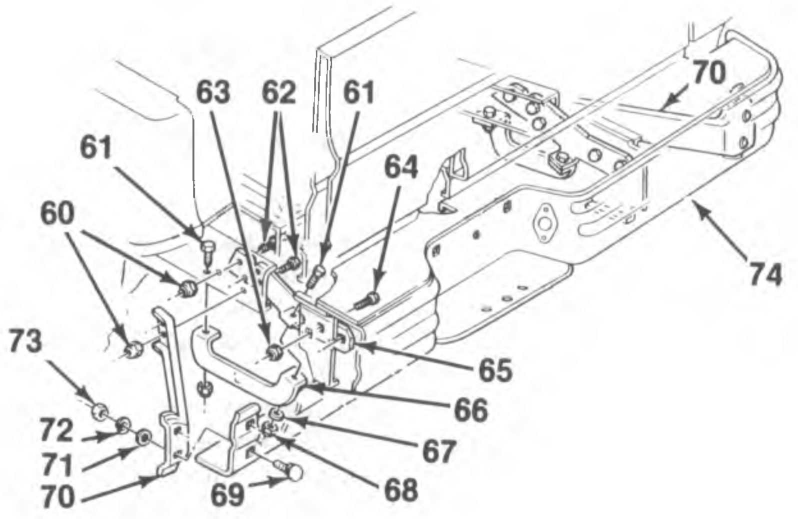
Tighten

- Nuts to 70 N·m (52 ft. lbs.).

REAR BUMPER LICENSE PLATE BRACKET REPLACEMENT

↔ Remove or Disconnect (Figure 12)

1. License plate bracket to bumper nuts (78), spring washers (77), washers (76), and bolts (76).
2. License plate bracket (75).



60. Nut
61. Bolt
62. Bolt
63. Bolt
64. Bolt
65. Bracket
66. Reinforcement
67. Washer
68. Nut
69. Bolt
70. Brace
71. Washer
72. Spring Washer
73. Nut
74. Bumper Bar

F-00118

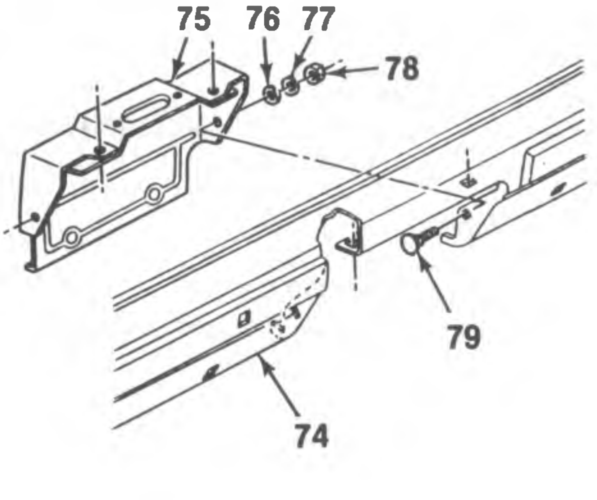
Figure 11—Rear Step Bumper Components

Install or Connect (Figure 12)

1. License plate bracket (75).
2. License plate bracket to the bumper bolts (76), washers (76), spring washers (77), and nuts (78).

Tighten

- Nuts to 29 N·m (21 ft. lbs.).



74. Bumper Bar
75. License Plate Bracket
76. Washer
77. Spring Washer
78. Nut
79. Bolt

F-00119

Figure 12—Rear License Plate Bracket

DEAD WEIGHT TRAILER HITCH REPLACEMENT (UTILITY VEHICLE AND SUBURBAN)

Remove or Disconnect (Figures 13 and 14)

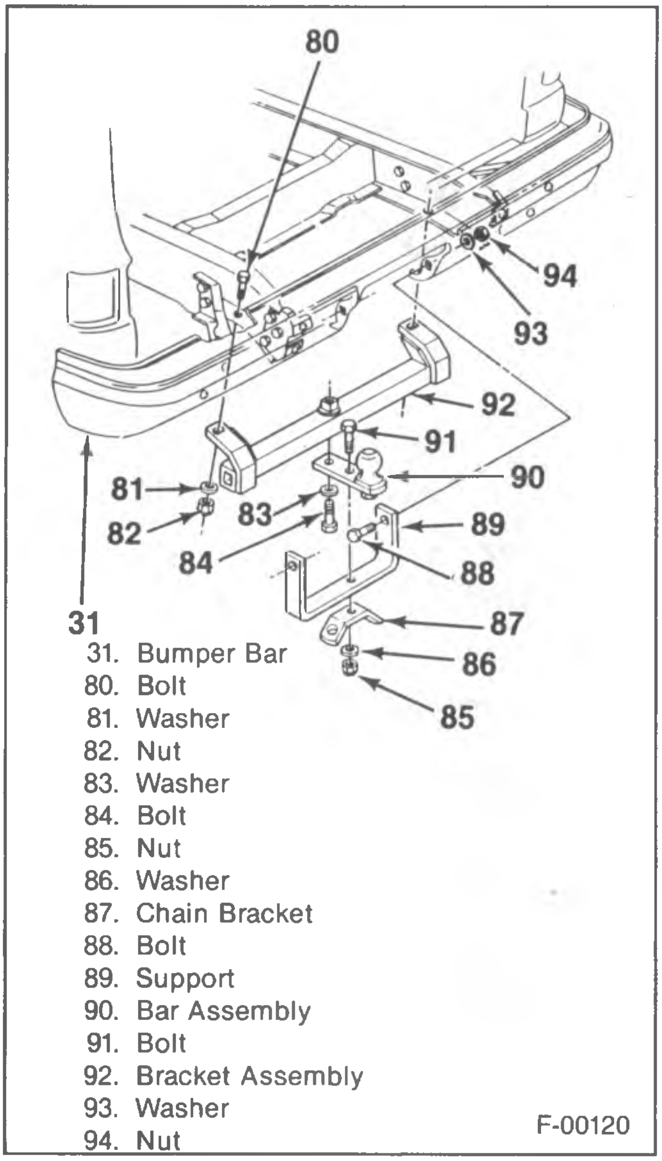
1. Bracket assembly nuts, washers, and bolts from the frame.
2. Support nuts, washers, and bolts from the bumper.
3. Hitch assembly.
4. Chain bracket nut, washer, and bolt.
    - Chain bracket.
    - Support.
5. Bar assembly bolt and washer from the bracket.
    - Bar assembly.

Install or Connect (Figures 13 and 14)

1. Bracket assembly to the frame with bolts, washers, and nuts.

    Tighten

    - Nuts to 70 N·m (52 ft. lbs.).
2. Bar assembly to the support.
    - Place the bolt through the bar assembly, support and the chain bracket. Install the washer and nut loosely.
3. Support assembly bolts through the support and the bumper.
    - Washers and nuts loosely.
4. Bar assembly bolt with washer through the bar and into the bracket assembly.



31. Bumper Bar
80. Bolt
81. Washer
82. Nut
83. Washer
84. Bolt
85. Nut
86. Washer
87. Chain Bracket
88. Bolt
89. Support
90. Bar Assembly
91. Bolt
92. Bracket Assembly
93. Washer
94. Nut

Figure 13—Suburban Dead Weight Trailer Hitch Components

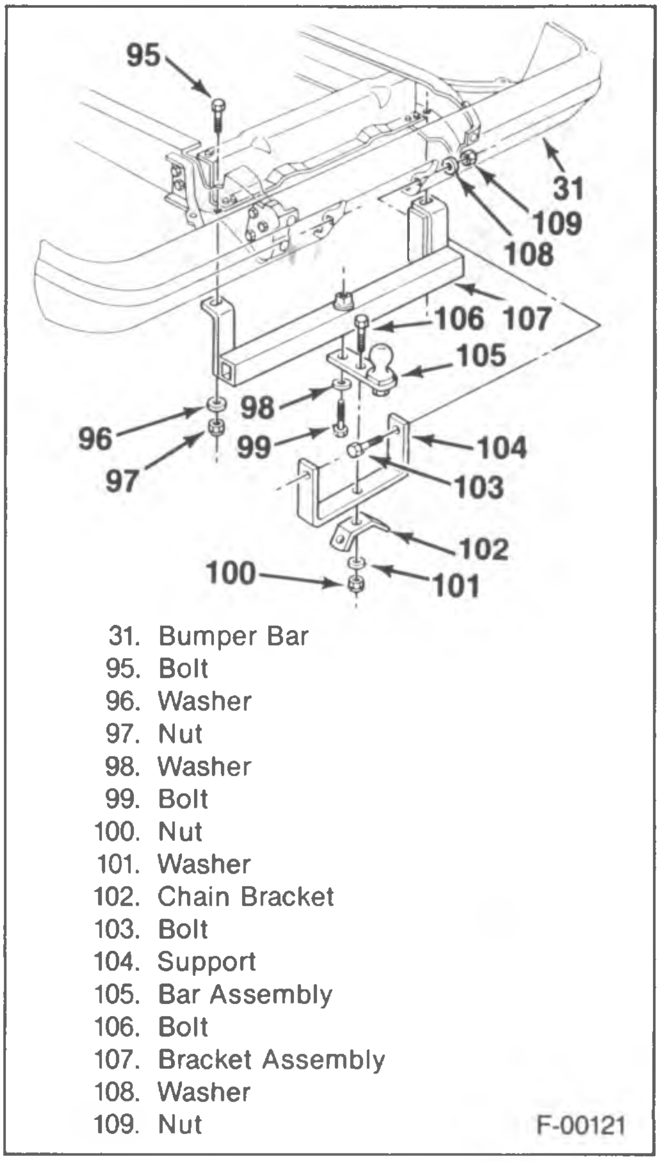
Tighten

- Bar to bracket bolt to 95 N·m (70 ft. lbs.).
- Bar to support nut to 70 N·m (52 ft. lbs.).
- Support to bumper nuts to 33 N·m (24 ft. lbs.).

WEIGHT DISTRIBUTION HITCH REPLACEMENT (SUBURBAN ONLY)

Remove or Disconnect (Figure 15)

1. Rear bolts, washers, and nuts from the hitch.
2. Front nuts, washers, and bolts from the hitch.
3. Hitch platform from the vehicle.



31. Bumper Bar
95. Bolt
96. Washer
97. Nut
98. Washer
99. Bolt
100. Nut
101. Washer
102. Chain Bracket
103. Bolt
104. Support
105. Bar Assembly
106. Bolt
107. Bracket Assembly
108. Washer
109. Nut

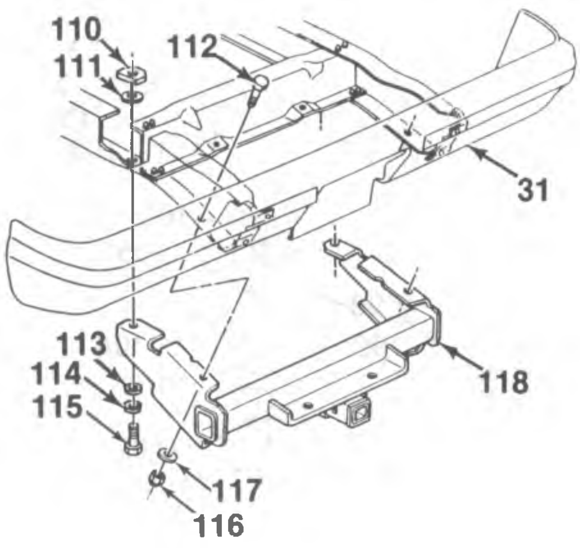
Figure 14—Utility Vehicle Dead Weight Trailer Hitch

Install or Connect (Figure 15)

1. Hitch platform to the vehicle.
    - There must be no contact between the platform and the rear bumper.
2. Front bolts, washers, and nuts to the hitch.
    - Assemble loosely.
3. Rear nuts, washers, and bolts to the hitch.
    - Install the nuts with the cut-off side outboard.

Tighten

- Rear bolts to 95 N·m (70 ft. lbs.).
- Front nuts to 70 N·m (52 ft. lbs.).



31. Bumper Bar
110. Nut
111. Washer
112. Bolt
113. Washer
114. Spring Washer
115. Bolt
116. Nut
117. Washer
118. Platform

F-00122

Figure 15—Suburban Weight Distribution Hitch Components

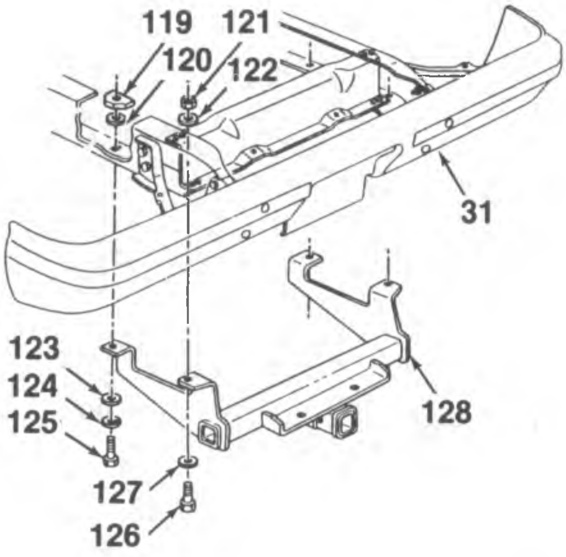
WEIGHT DISTRIBUTION HITCH REPLACEMENT (UTILITY VEHICLE ONLY)

Remove or Disconnect (Figure 16)

1. Rear bolts, washers, and nuts from the hitch.
2. Front bolts, washers, and nuts from the hitch.
3. Hitch platform from the vehicle.

Install or Connect (Figure 16)

1. Hitch platform to the vehicle.
2. Front bolts, washers, and nuts to the hitch.
   - Assemble loosely.
3. Rear bolts, washers, and nuts to the hitch.
   - Install nuts with the cut off side inboard.



31. Bumper Bar
119. Nut
120. Washer
121. Nut
122. Washer
123. Washer
124. Spring Washer
125. Bolt
126. Bolt
127. Washer
128. Platform

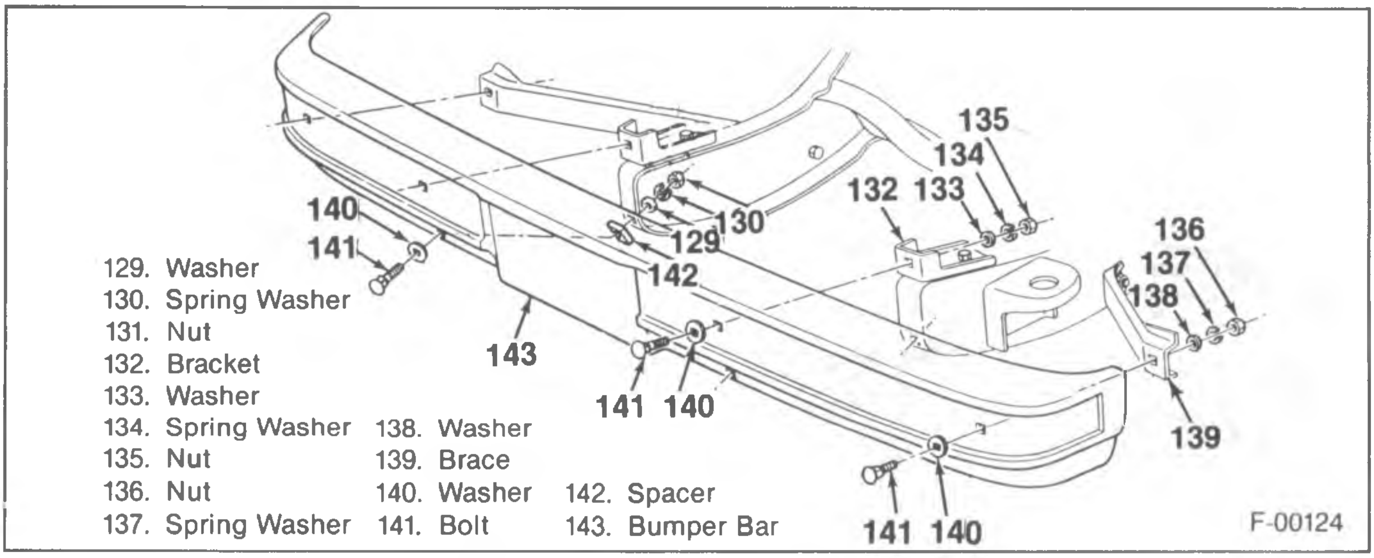
F-00123

Figure 16—Utility Vehicle Weight Distribution Hitch Components

Tighten

- Rear bolts to 73 N·m (54 ft. lbs.).
- Front bolts to 70 N·m (51 ft. lbs.).

P MODEL BUMPERS



129. Washer
130. Spring Washer
131. Nut
132. Bracket
133. Washer
134. Spring Washer
135. Nut
136. Nut
137. Spring Washer
138. Washer
139. Brace
140. Washer
141. Bolt
142. Spacer
143. Bumper Bar

Figure 17—P-Front Bumper Components

FRONT BUMPER REPLACEMENT

Remove or Disconnect (Figures 17 and 18)

1. Brace to frame nuts (149), spring washers (148), washers (147), and bolts (145).
2. Bracket to frame nuts (152), spring washers (151), washers (150), and bolts (144).
3. Bumper to frame nuts (131), spring washers (130), washers (129), spacers (142) (where used), and bolts (141).
4. Bumper from the vehicle.
5. Brace to bumper nuts (136), spring washers (137), washers (138), and bolts (141).
   - Braces (139).
6. Bracket to bumper nuts (135), spring washers (134), washers (133), and bolts (141).

Install or Connect (Figures 17 and 18)

1. Braces to the bumper with bolts (141), washers (138), spring washers (137), and nuts (136).
   - Assemble loosely.
2. Bracket to the bumper with bolts (141), washers (138), spring washers (137), and nuts (135).
   - Assemble loosely.
3. Bumper to vehicle.
4. Bumper to frame spacers (142) (where used), spring washers (130), washers (129), bolts (141), and nuts (131).

Tighten

- Nuts to 47 N·m (35 ft. lbs.).

5. Brackets to the frame rails with bolts (144), washers (150), spring washers (151), and nuts (152).

Tighten

- Bracket to frame nuts to 95 N·m (70 ft. lbs.).
- Bracket to bumper nuts to 47 N·m (35 ft. lbs.).

6. Braces to the frame rails with bolts (145), washers (147), spring washers (148), and nuts (149).

Tighten

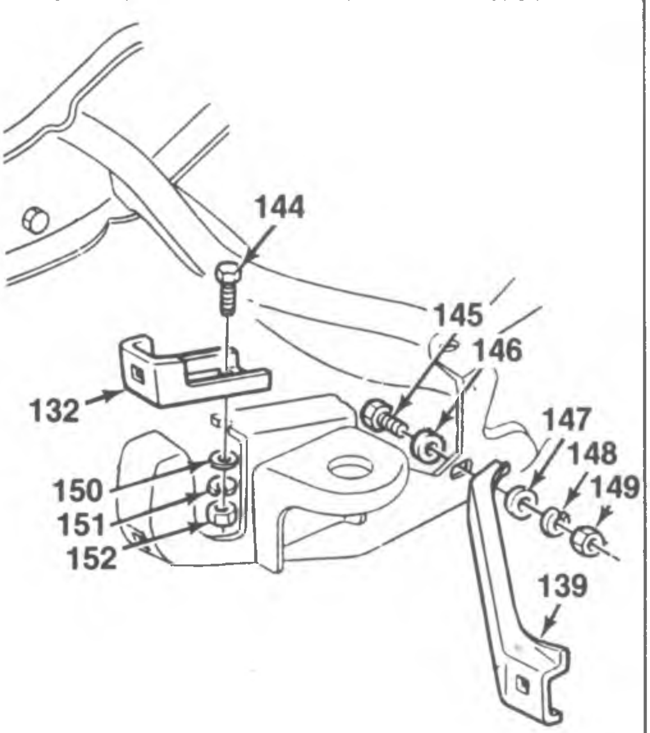
- Brace to frame nuts to 85 N·m (63 ft. lbs.).

2. Brace to bumper nuts to 47 N·m (35 ft. lbs.).

FRONT BUMPER REPLACEMENT (WITH RPO FS3 FRONT AXLE)

Remove or Disconnect (Figures 19 and 20)

1. Bracket to frame nuts (153) and washers (154).
2. Brace to frame nuts (170), washers (169), and bolts (167).
3. Front bumper from the vehicle.
4. Bracket to bumper nuts (166 and 171), spring washers (165 and 172), washers (164 and 173), spacers (174), and bolts (161).



132.	Bracket
139.	Brace
144.	Bolt
145.	Bolt
146.	Washer
147.	Washer
148.	Spring Washer
149.	Nut
150.	Washer
151.	Spring Washer
152.	Nut

Figure 18—P-Front Bumper Braces, and Brackets

- Brackets (162).

5. Brace to bumper nuts (155), spring washers (156), washers (157), and bolts (161).
   - Braces (158).

Install or Connect (Figures 19 and 20)

1. Braces to the bumper with bolts (161), washers (157), spring washers (156), and nuts (155).

Tighten

- Nuts to 47 N·m (35 ft. lbs.).

2. Brackets to the bumper with bolts (161), spacers (174), spring washers (165 and 172), washers (164 and 173), and nuts (166 and 171).

Tighten

- Nuts to 47 N·m (35 ft. lbs.).

3. Front bumper to the vehicle.
   - Place the bracket assembly studs into the frame crossmember.
4. Brace to frame bolts (167), washers (169), and nuts (170).

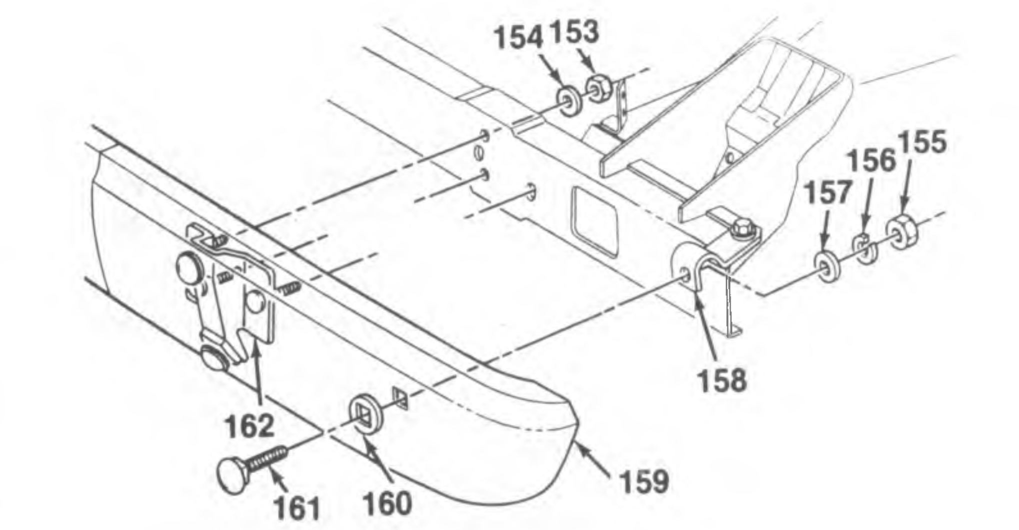
Tighten

- Nuts to 40 N·m (30 ft. lbs.).

5. Bracket to frame washers (154) and nuts (153).

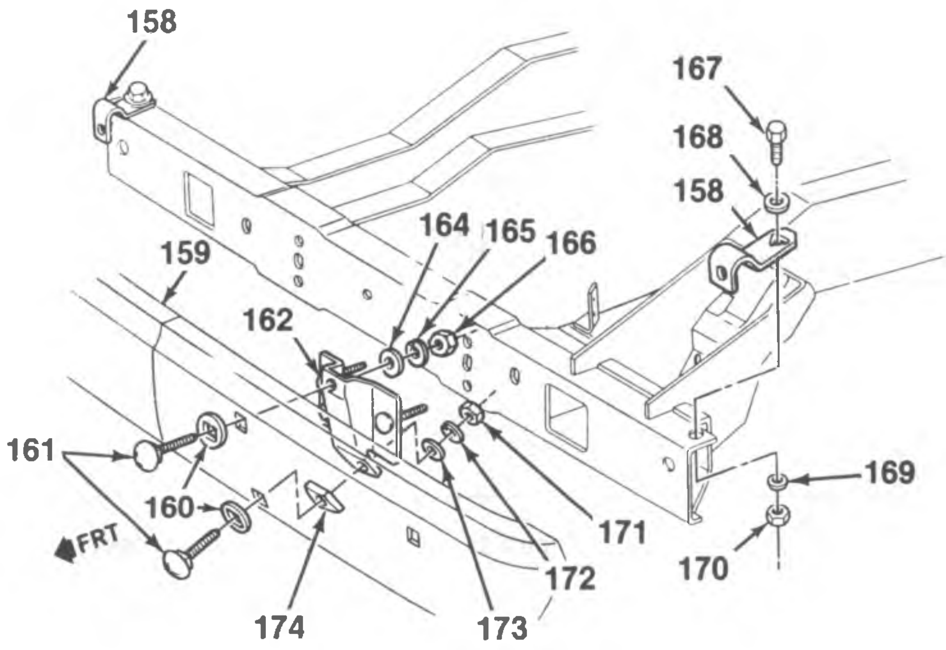
Tighten

- Nuts to 64 N·m (47 ft. lbs.).



153.	Nut
154.	Washer
155.	Nut
156.	Spring Washer
157.	Washer
158.	Brace
159.	Bumper Bar
160.	Washer
161.	Bolt
162.	Bracket

Figure 19—P-Front Bumper Components (RPO FS3 Front Axle)



158. Brace
159. Bumper Bar
160. Washer
161. Bolt
162. Bracket
164. Washer
165. Spring Washer
166. Nut
167. Bolt
168. Washer
169. Washer
170. Nut
171. Nut
172. Spring Washer
173. Washer
174. Spacer

F-00127

Figure 20—P-Front Bumper Braces, and Brackets (RPO FS3 Front Axle)

G MODEL BUMPERS

FRONT BUMPER REPLACEMENT

Remove or Disconnect (Figure 21)

1. Bracket to cross sill bolts (181).
2. Brace to bumper nuts (180) and bolts (182).
3. Bumper from the vehicle.
4. Bracket to bumper nuts (178), bolts (182), and guards (where used).
   - Brackets (177).
5. Rub strips from the guards (where used) (figure 22).
   - From the rear of the guard, press the tangs of the bump strip together, and push the strip from the guard.
6. Brace to frame bolts (179).
   - Braces (176).

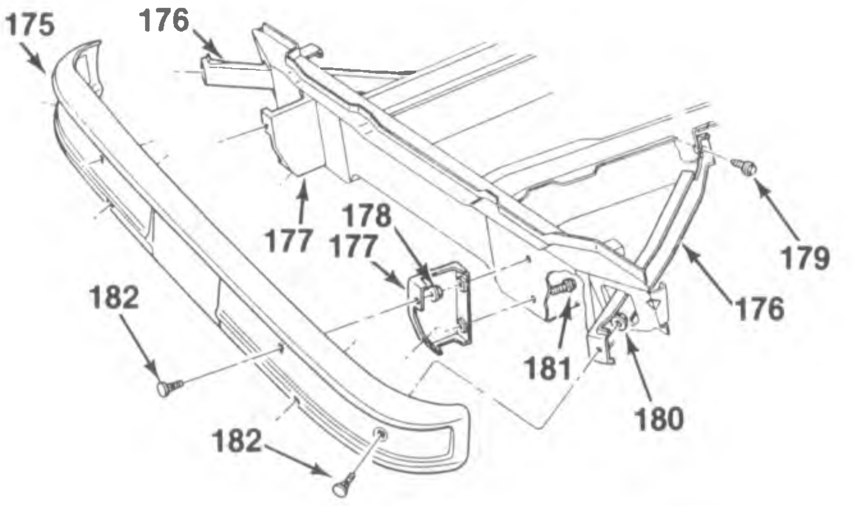
Install or Connect (Figures 21 and 22)

1. Braces to the frame.
   - Place braces through the holes in the cross sill, and install the bolts (179) loosely.
2. Bolts (184) into the guards (where used).
3. Rub strips to the guards (where used).
   - Place the tangs of the strips onto the slots in the guard. Using a rubber mallet, set the tangs in place starting at the center of the strip, and working toward each end.
4. Bracket to bumper bolts (182) or guards (where used), nuts (178), and guard lower bolts.

Tighten

- Nuts to 29 N·m (21 ft. lbs.).
- Guard lower bolts to 41 N·m (30 ft. lbs.).

5. Bumper to the vehicle.
6. Bracket to cross sill bolts (181).



175. Bumper Bar
176. Brace
177. Bracket
178. Nut
179. Bolt
180. Nut
181. Bolt
182. Bolt

Figure 21—G-Front Bumper Components

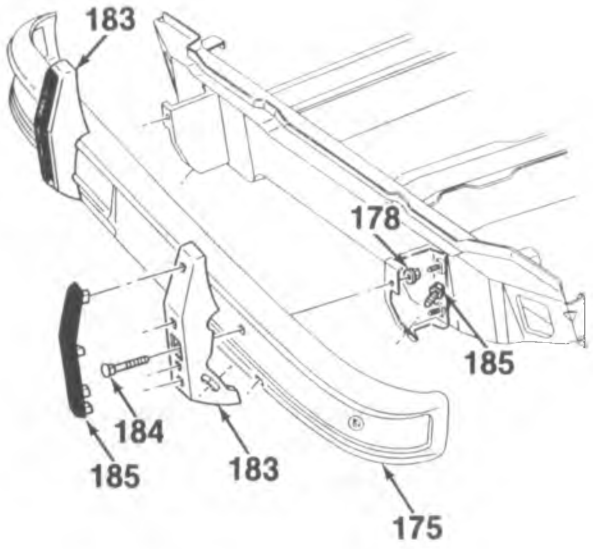
Tighten

- Bolts to 41 N·m (30 ft. lbs.).

7. Brace to bumper bolts (182) and nuts (180).

Tighten

- Brace to bumper nuts to 29 N·m (21 ft. lbs.).
- Brace to frame bolts to 41 N·m (30 ft. lbs.).



175. Bumper Bar
178. Nut
183. Guard
184. Bolt
185. Rub Strip

Figure 22—G-Front Bumper Guards

REAR BUMPER REPLACEMENT

Remove or Disconnect (Figure 23)

1. Outer brace to bumper nuts (192) and bolts (196).
2. Inner brace to cross sill bolts (194).
3. Bracket to frame bolts (188) and washers (187).
4. Bumper from the vehicle.
5. Outer brace to cross sill bolts (193).
   - Outer braces (186).
6. Bracket to bumper nuts and bolts (196).
   - Brackets (189).
7. Inner brace to bumper nuts (192) and bolts (196).
   - Inner braces (190).

Install or Connect (Figure 23)

1. Inner braces (190) to the bumper.
   - Assemble the top bolts (191) and nuts (192).

   Tighten

   - Nut to 30 N·m (22 ft. lbs.)
   - Assembly the lower bolts (196) and nuts (192).

   Tighten

   - Nut to 30 N·m (22 ft. lbs.).
2. Brackets to the frame with washers (187) and bolts (188).
   - Assemble loosely.
3. Outer braces (186) to the cross sill with bolts (193).

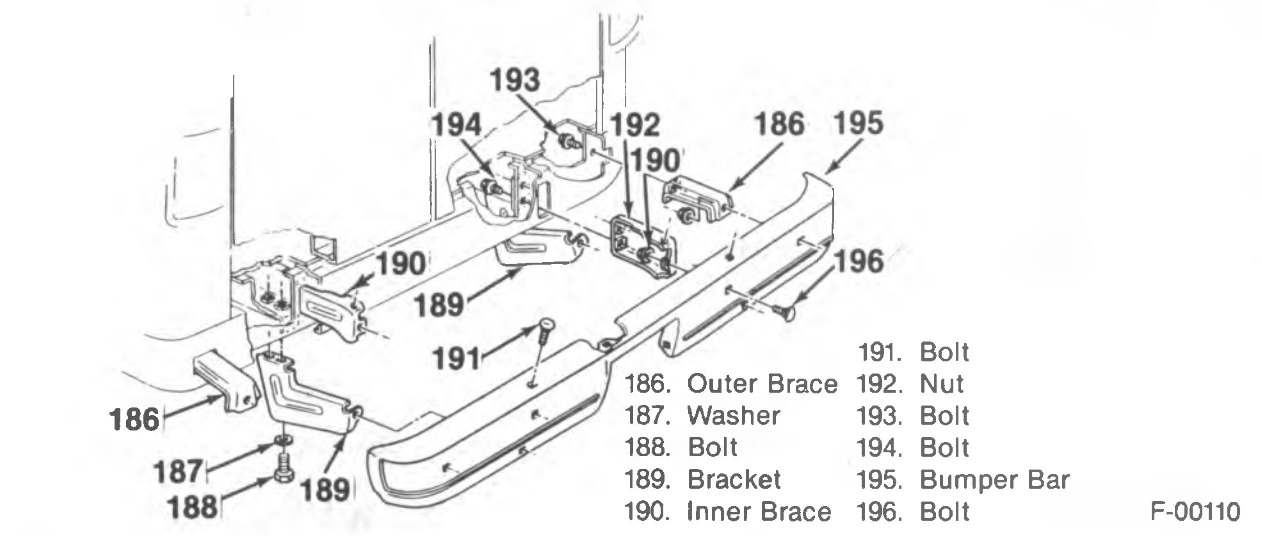


Figure 23—G-Rear Bumper Components

Tighten

- Bolts to 41 N·m (30 ft. lbs.).

4. Bumper to the vehicle.
   - Place the inner braces into the inner brace panel holes.
5. Inner braces to the cross sill with bolts (194).

Tighten

- Bolts to 41 N·m (30 ft. lbs.).

6. Bumper to bracket bolts (196) and nuts.

Tighten

- Nuts to 29 N·m (21 ft. lbs.).
- Bracket to frame bolts to 68 N·m (50 ft. lbs.).

7. Outer bracket to bumper bolts (196) and nuts (192).

Tighten

- Nuts to 68 N·m (50 ft. lbs.).

REAR LICENSE PLATE BRACKET REPLACEMENT

Remove or Disconnect (Figure 24)

1. License plate bracket nuts and bolts.
2. License plate bracket.

Install or Connect (Figure 24)

1. License plate bracket.
2. License plate bracket nuts and bolts.

Tighten

- Nuts to 29 N·m (21 ft. lbs.).

DEAD WEIGHT TRAILER HITCH REPLACEMENT

Remove or Disconnect (Figure 25)

1. Hitch bracket to bumper bracket nuts, washers, and bolts.
2. Support to bumper nuts and bolts.
3. Hitch from the vehicle.
4. Chain bracket to bar assembly nut and bolt.
   - Chain bracket.
   - Support.
   - Bar assembly.
5. Bar assembly to hitch bracket nut and bolt.
   - Bar assembly.
   - Shim(s).
   - Hitch bracket.

Install or Connect (Figure 25)

1. Hitch bracket to the bumper brackets with bolts, washers, and nuts.

Tighten

- Nuts to 24 N·m (18 ft. lbs.).

2. Bar assembly with shims (as required) to the hitch bracket with bolts and nuts.
   - Assemble loosely.
3. Support to the bumper with bolts and nuts.
   - Assemble loosely.
4. Bar assembly and chain bracket to the support with a bolt and nut.

195. Bumper Bar
197. Nut
198. Bolt
199. License Plate Bracket

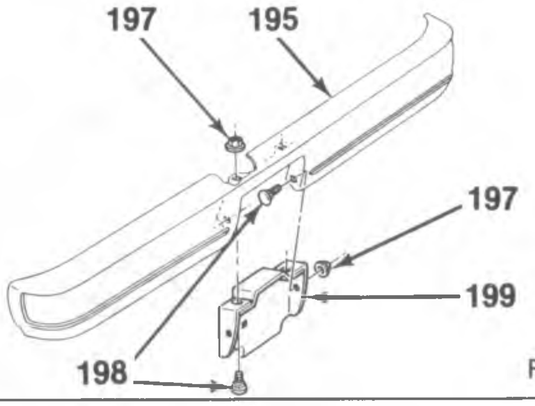


Figure 24—Rear License Plate Bracket Components

Tighten

- Bar assembly to chain bracket nut to 68 N·m (50 ft. lbs.).
- Bar assembly to hitch bracket bolt to 68 N·m (50 ft. lbs.).
- Support to bumper nuts to 29 N·m (21 ft. lbs.).

WEIGHT DISTRIBUTION HITCH REPLACEMENT

Remove or Disconnect (Figure 26)

1. Bumper nuts and bolts.
    - Bumper.
2. Rear hitch nuts and washers.

189. Bracket
195. Bumper Bar
200. Washer
201. Nut
202. Bolt
203. Bolt
204. Nut
205. Bracket Assembly
206. Bolt
207. Bar Assembly
208. Bolt
209. Nut
210. Chain Bracket
211. Support
212. Nut
213. Shim

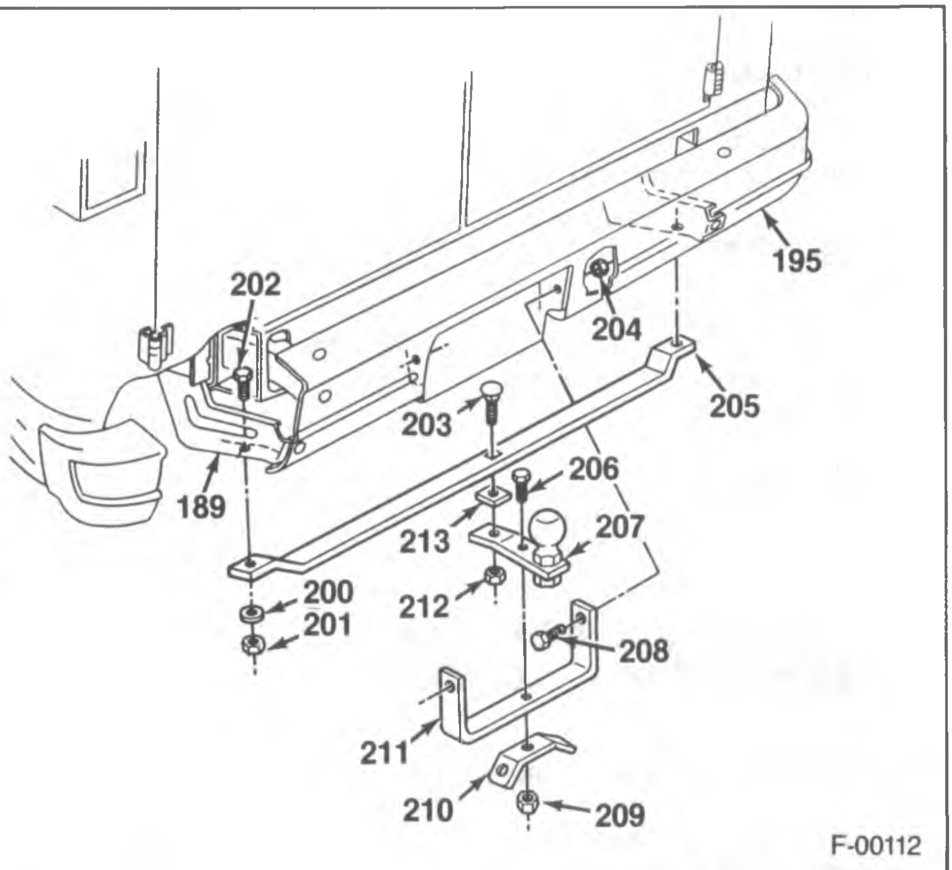
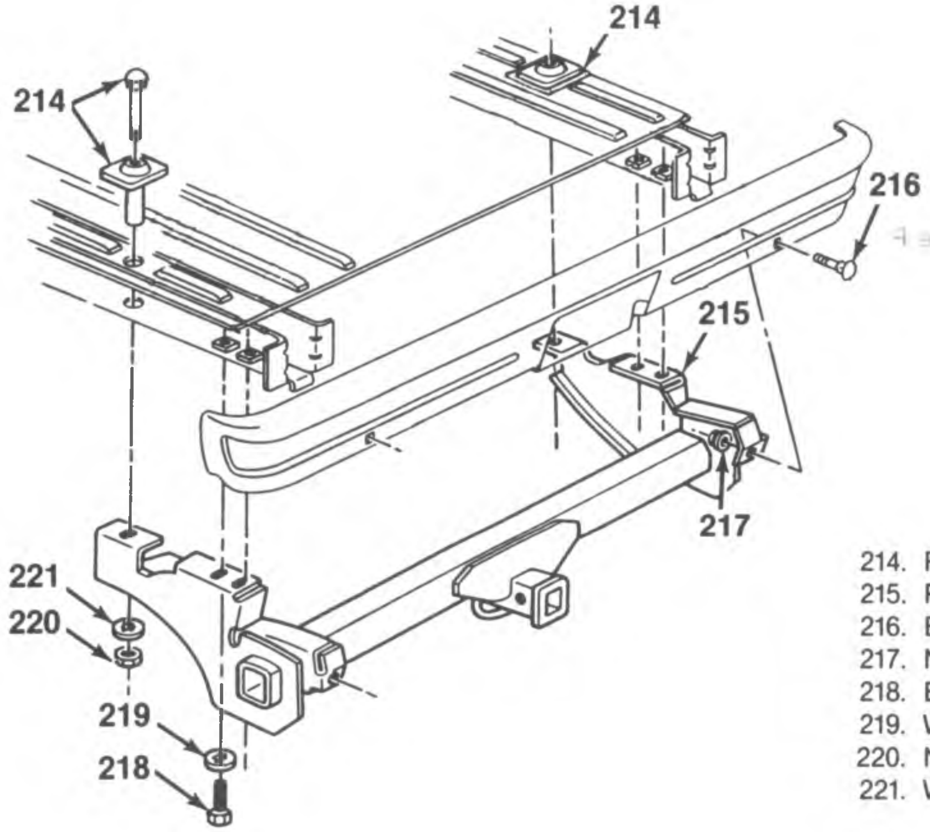


Figure 25—Dead Weight Trailer Hitch



214. Retainer Assembly
215. Platform
216. Bolt
217. Nut
218. Bolt
219. Washer
220. Nut
221. Washer

Figure 26—Weight Distribution Hitch

3. Front bolts and washers.
4. Hitch from the vehicle.

Install or Connect (Figure 26)

1. Hitch to the vehicle.
2. Front bolts and washers.

Tighten

- Bolts to 70 N·m (52 ft. lbs.).

3. Rear washers and nuts.

Tighten

- Nuts to 63 N·m (47 ft. lbs.).

4. Bumper to the vehicle with nuts and bolts.

Tighten

- Nuts to 29 N·m (21 ft. lbs.).

SECTION 2C

SHEET METAL

NOTICE: All hood latch 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 of with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of all parts.

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SUBJECT **PAGE**

C/K MODELS

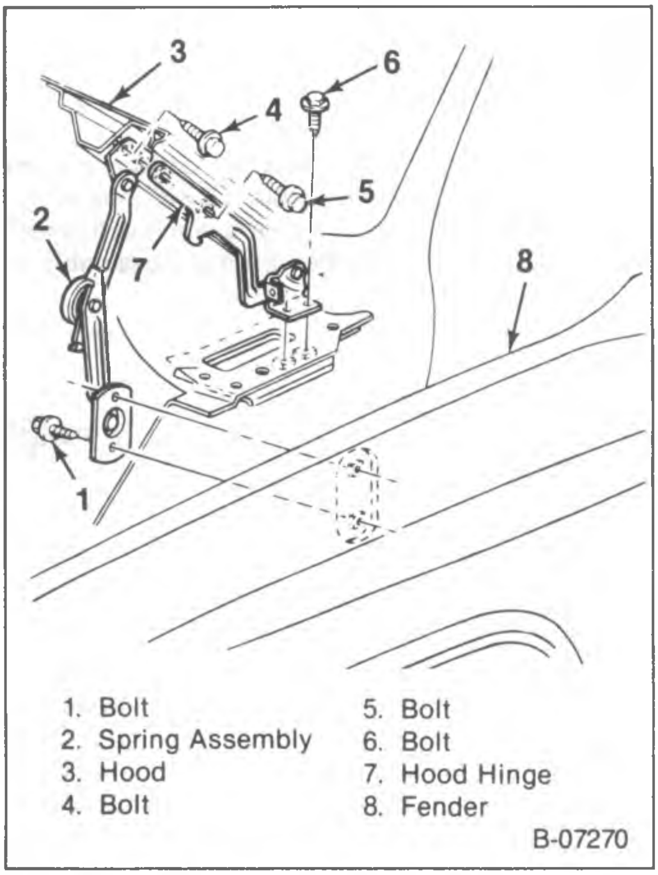


Figure 1—Hood Hinge Components

HOOD REPLACEMENT

Remove or Disconnect (Figure 1)

- Raise and support the hood at front and rear.
- Place protective coverings over the cowl and the fenders.
- Mark the position of the hinge on the hood.

1. Spring assembly to hood bolts (4).
2. Hood hinge to hood bolts (5).
3. Hood from the vehicle.

Install or Connect (Figure 1)

1. Hood to the vehicle.
   - Align the hood with the previously made marks.
2. Hood hinge to hood bolts (5).

Tighten

- Bolts to 25 N·m (18 ft. lbs.).

3. Spring assembly to hood bolts (4).

Tighten

- Bolts to 25 N·m (18 ft. lbs.).

SPRING ASSEMBLY REPLACEMENT

Remove or Disconnect (Figure 1)

- Raise and support the front of the hood.

1. Spring assembly to hood bolts (4).
2. Spring assembly to fender bolts (1).
3. Spring assembly from the vehicle.

Install or Connect (Figure 1)

1. Spring assembly to the vehicle.
2. Spring assembly to fender bolts (1).

Tighten

- Bolts to 25 N·m (18 ft. lbs.)

3. Spring assembly to hood bolts (4).

Tighten

- Bolts to 25 N·m (18 ft. lbs.).

HOOD HINGE REPLACEMENT

Remove or Disconnect (Figure 1)

- Raise and support the hood at front and rear.

1. Cowl vent grille. Refer to "Cowl Vent Grille Replacement."
2. Hinge to hood bolts (5).
3. Hinge to cowl bolts (6).
4. Hinge from the vehicle.

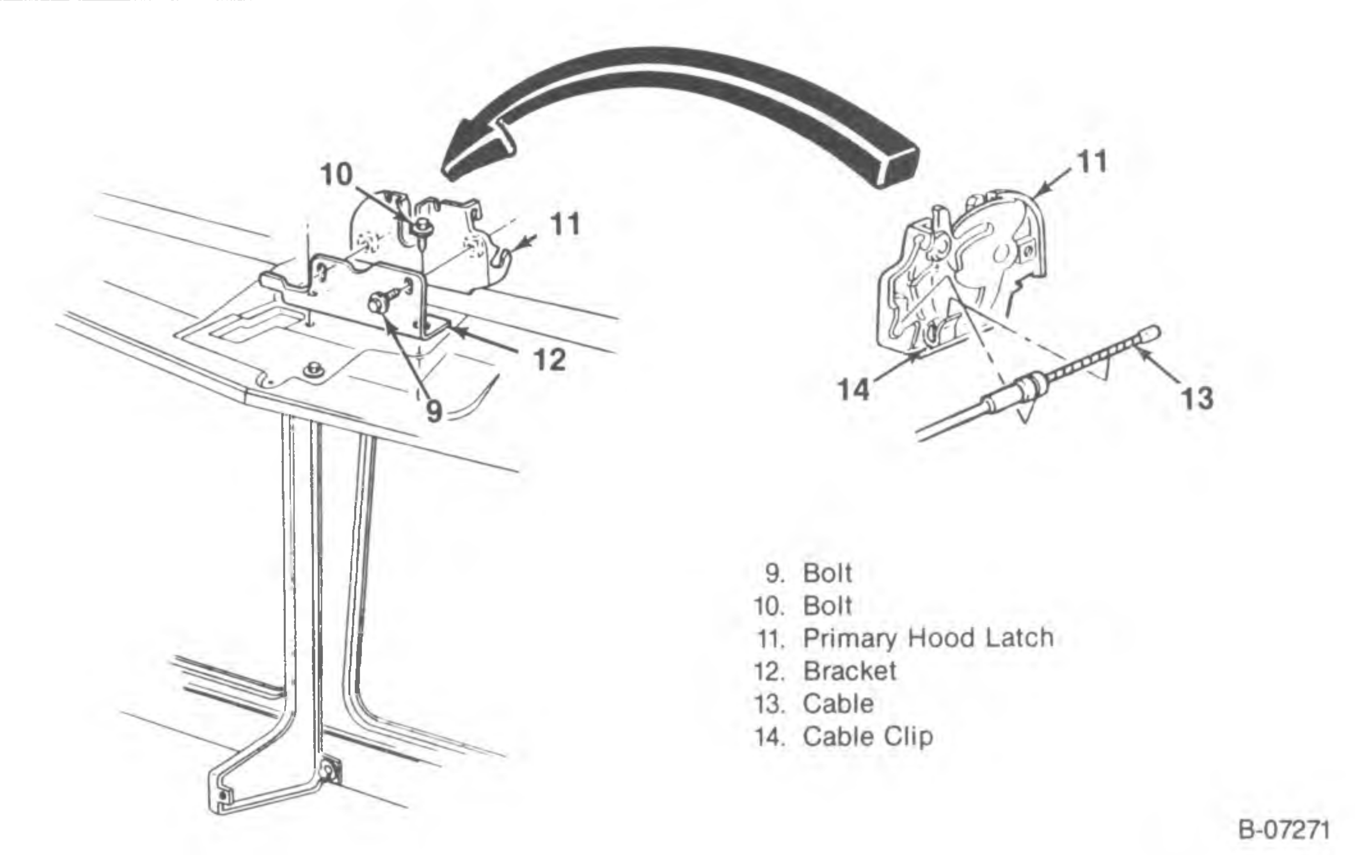
Install or Connect (Figure 1)

1. Hinge to the vehicle.
2. Hinge to cowl bolts (6).

Tighten

- Bolts to 43 N·m (32 ft. lbs.).

3. Hinge to hood bolts (5).



9. Bolt
10. Bolt
11. Primary Hood Latch
12. Bracket
13. Cable
14. Cable Clip

Figure 2—Hood Primary Latch Components

Tighten

- Bolts to 25 N·m (18 ft. lbs.).

4. Cowl vent grille. Refer to "Cowl Vent Grille Repacement."

PRIMARY HOOD LATCH REPLACEMENT

NOTICE: See "Notice" on page 2C-1 of this section.

Remove or Disconnect (Figure 2)

- Raise the hood.

1. Hood latch release cable from the latch. Refer to "Hood Release Cable Replacement."
2. Bracket to hood latch bolts (9).
3. Hood latch from the vehicle.
4. Bracket to radiator support bolts (10).
5. Bracket from the vehicle.

Adjust

- Front hood bumpers, so that the top of the hood is flush with the fenders.

Install or Connect (Figure 2)

1. Bracket to the radiator support.
2. Bracket to support bolts (10) loosely.
3. Primary hood latch to the bracket.
4. Latch to bracket bolts (9) loosely.
5. Hood latch release cable to the latch.

Adjust

1. Hood latch bracket left and right until the striker in the hood easily engages the primary latch.

- Raise the hood.

Tighten

- Bracket to radiator support bolts to 27 N·m (20 ft. lbs.).

2. Hood latch height so that when the hood is closed, the hood is held securely against the front hood bumpers. Mark this height.

- Raise the hood.

Tighten

- Bracket to hood latch bolts to 27 N·m (20 ft. lbs.).

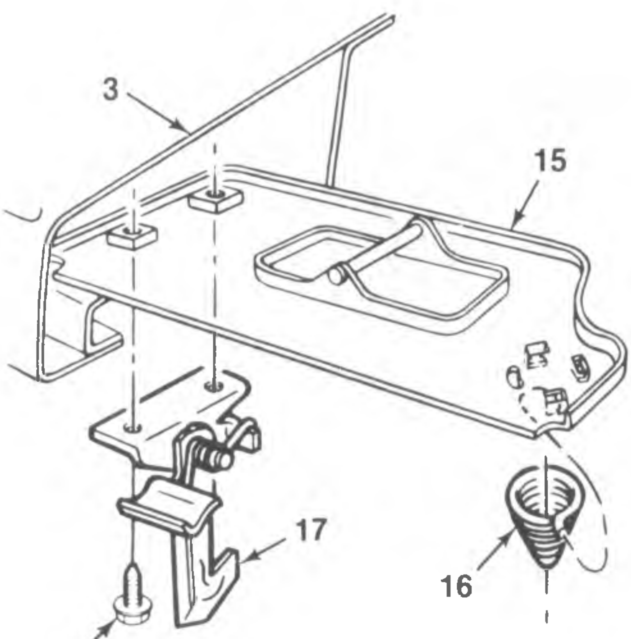


Figure 3—Hood Secondary Latch Components

SECONDARY HOOD LATCH AND SPRING REPLACEMENT

↔ Remove or Disconnect (Figure 3)

- Mark the position of the secondary hood latch on the hood.

1. Secondary hood latch to hood bolts (18).
2. Secondary hood latch from the vehicle.
3. Spring from the hood.
   - Twist the spring from the reinforcement.

→← Install or Connect (Figure 3)

1. Spring to the hood.
   - Twist the spring into the reinforcement.
2. Secondary hood latch to the vehicle.
3. Secondary hood latch to hood bolts (18).

Tighten

- Bolts to 27 N·m (20 ft. lbs.).

HOOD RELEASE CABLE REPLACEMENT

↔ Remove or Disconnect (Figure 4)

- If the cable is broken, release the hood by pressing the primary latch tab on the right side of the lock assembly. Use a rod to press the tab.
- Raise the hood.

1. Cable from the primary latch.
   - Insert a screwdriver into the clip, and lift the cable from the lock. Then, carefully pry the cable grommet from the lock flange.
2. Cable from the radiator support, and the wheelhouse retaining strap.
3. Grommet from the cowl.
   - Cut the grommet down to the cable casing on the engine side of the cowl.
   - Push the cable and grommet through the cowl.
4. Cable handle to air vent bezel bolts.
5. Cable from the vehicle.

→← Install or Connect (Figure 4)

1. New cable to the vehicle.
2. Cable through the drivers side of the cowl.
   - Push the grommet into the drivers side of the cowl.
3. Cable bolts through the cable handle, and into the air vent bezel.
4. Cable through the wheelhouse retaining strap, and the radiator support.
5. Cable to the primary latch.

HOOD ORNAMENT REPLACEMENT

↔ Remove or Disconnect (Figure 5)

- Raise hood.

1. Hood ornament nuts (21).
2. Hood ornament from the hood.
3. Seal from the hood.

→← Install or Connect (Figure 5)

1. Hood seal to the ornament.
2. Hood ornament to the hood.
3. Hood ornament nuts (21).

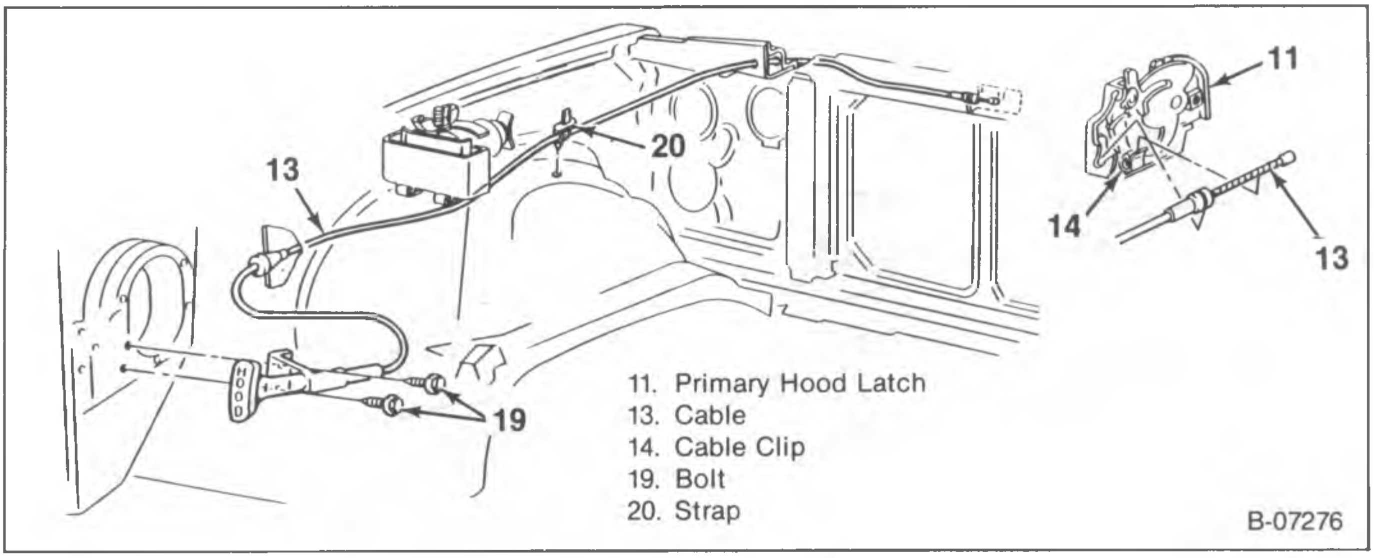


Figure 4—Hood Release Cable

COWL VENT GRILLE REPLACEMENT

Remove or Disconnect (Figure 6)

1. Wiper arms.
2. Cowl vent grille panel screws.
3. Cowl vent grille plastic fasteners from the windshield frame.
4. Cowl vent grille from the vehicle.

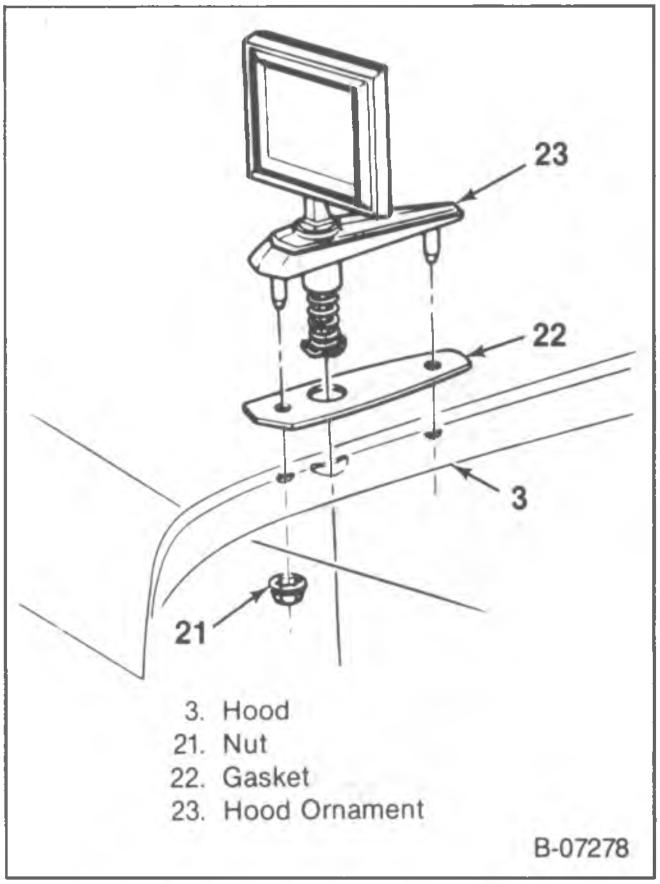


Figure 5—Hood Ornament Components

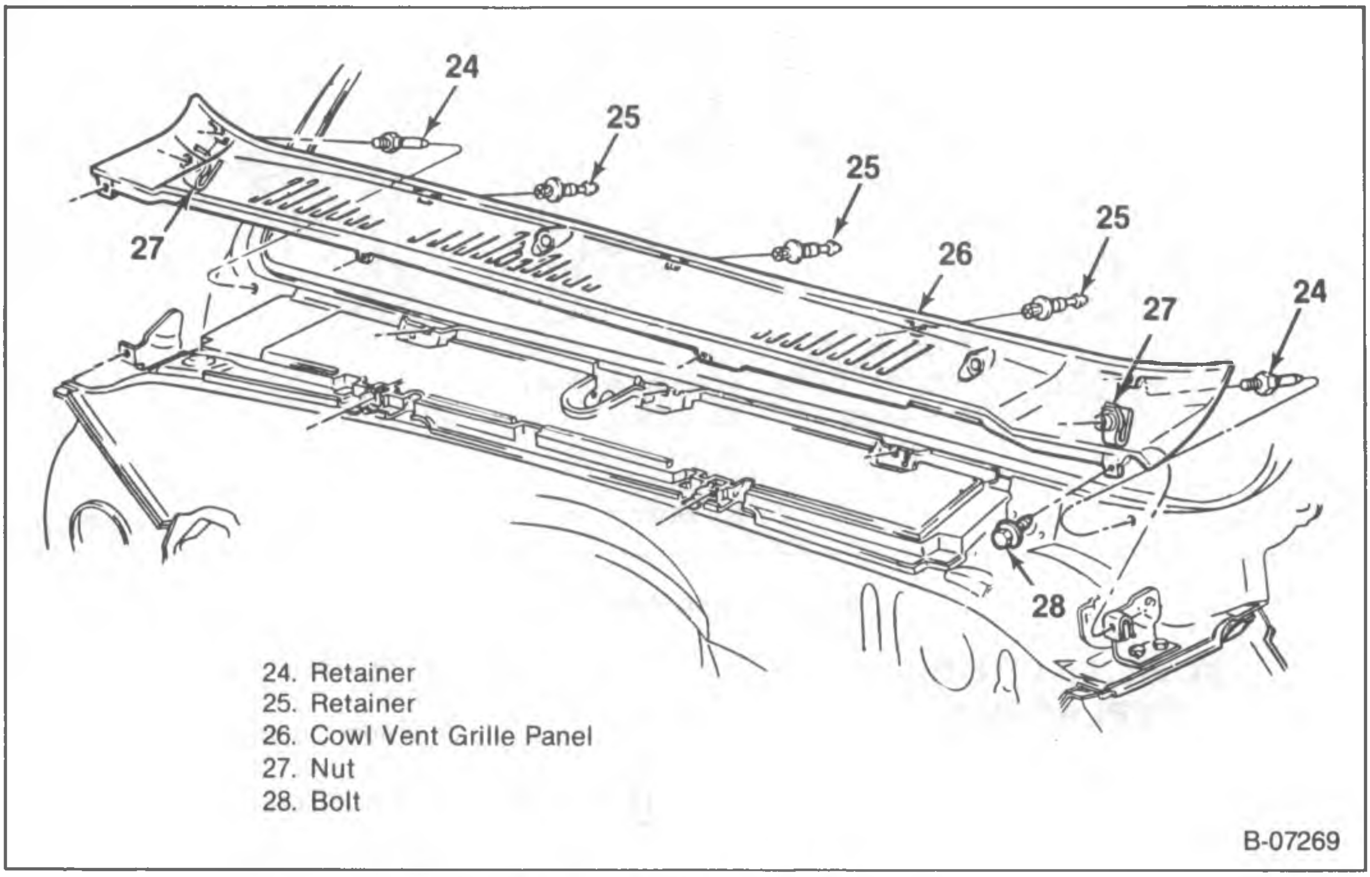
Install or Connect (Figure 6)

1. Cowl vent grille to the vehicle.
2. Cowl vent grille plastic fasteners to the windhsield frame.
3. Cowl vent grille panel screws.
4. Wiper arms.

GRILLE AND MOLDING REPLACEMENT

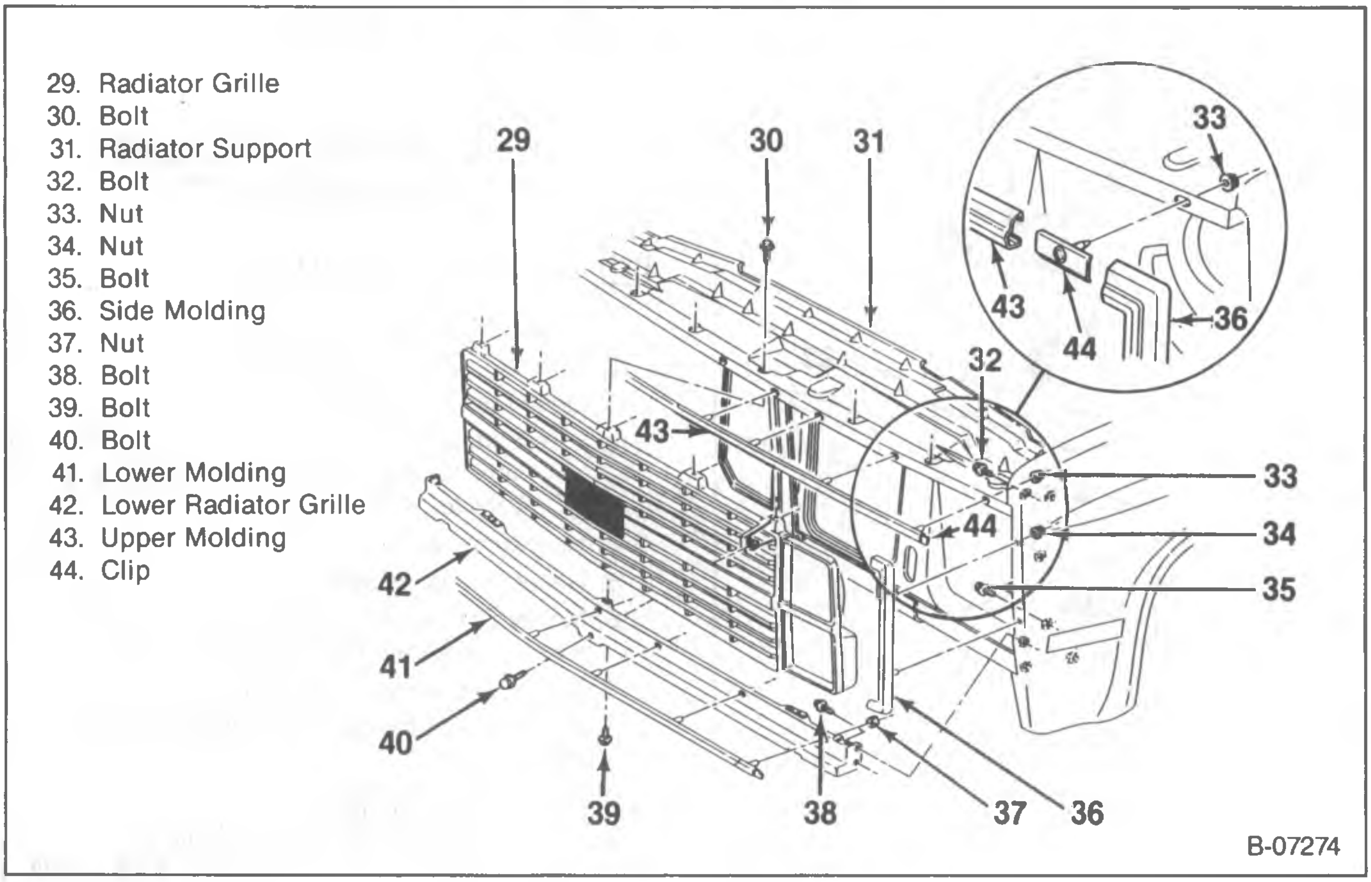
Remove or Disconnect (Figure 7)

1. Lower radiator grille to grille bolt (39).
2. Radiator support to grille bolts (30).
3. Grille from the vehicle.
    - Slide the bottom of the grille from the vehicle, and then lower the grille from the vehicle.
4. Headlamp bezels.
5. Headlamp assemblies.
6. Molding assembly to fender, radiator support, and lower grille panel nuts (33, 34 and 37).
7. Molding assembly from the vehicle.
8. Right and left moldings from the upper and lower moldings.
9. Clips from the moldings.
10. Lower radiator grille to fender bolts (38).
11. Lower radiator grille to the sheet metal support bolts (40).
12. Lower radiator grille from the vehicle.



24. Retainer
25. Retainer
26. Cowl Vent Grille Panel
27. Nut
28. Bolt

Figure 6—Cowl Vent Grille Components



29. Radiator Grille
30. Bolt
31. Radiator Support
32. Bolt
33. Nut
34. Nut
35. Bolt
36. Side Molding
37. Nut
38. Bolt
39. Bolt
40. Bolt
41. Lower Molding
42. Lower Radiator Grille
43. Upper Molding
44. Clip

Figure 7—Grille Components

Install or Connect (Figure 7)

1. Lower radiator grille to the vehicle.
2. Lower radiator grille to the sheet metal support bolts (40).
3. Lower radiator grille to fender bolts (38).
4. Upper molding to the radiator support with clips (44), and nuts (33).
   - Assemble loosely.
5. Lower molding to the radiator support with clips (44), and nuts (37).
   - Assemble loosely.
6. Right and left moldings to the fenders.
   - The moldings must butt against the upper and lower moldings, and be joined to those moldings by the clips.
7. Right and left molding nuts (34).
- Tighten upper and lower molding nuts (33 and 37).
8. Headlamp assemblies.
9. Headlamp bezels.
10. Grille to the vehicle.
    - Insert the top of the grille to the underside of the radiator support, and then slide the bottom of the grille into place.
11. Lower radiator grille to grille bolt (39).
12. Radiator support to grille bolts (30).

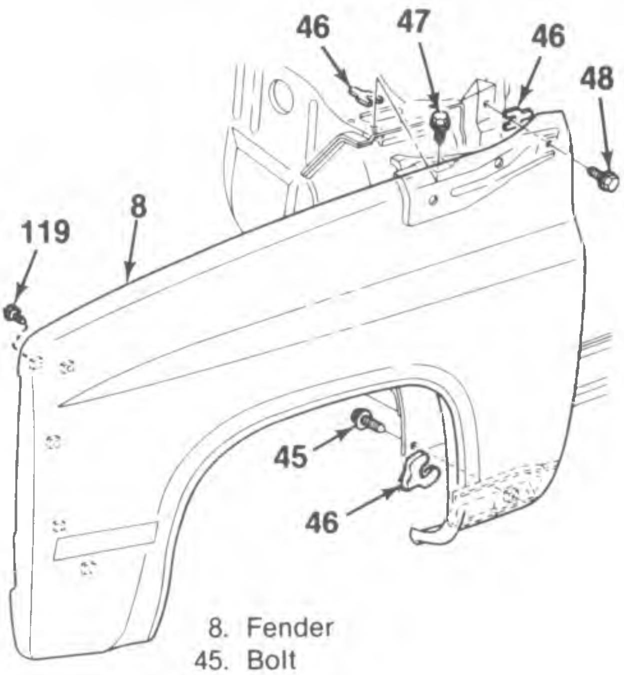
FRONT FENDER REPLACEMENT

Remove or Disconnect (Figures 8 and 9)

Tool Required:
J-24595-B Door Trim Pad Remover.

- Raise and support the hood.

1. Head lamp bezel.
2. Head lamp.
3. Right or left radiator grille molding nuts (34).
4. Upper and lower molding clip nuts (33 and 37).
5. Right or left radiator grille molding (36).
6. Lower radiator grille to fender bolts (38).
7. Cowl vent grille. Refer to "Cowl Vent Grille Replacement."
8. Hood spring assembly. Refer to "Spring Assembly Replacement."
9. Radiator support to fender bolts (119).
10. Wheelhouse panel to shield bolts.
11. Shield to underbody retainers using J-24595-B.
12. Shield from the vehicle.
13. Wheelhouse panel to fender bolts (50).
14. Lower door pillar to fender bolt (45) and shim(s) (46).
15. Fender to cowl bolt (47) and shim(s) (46).
- Open the front door.
16. Upper fender to door pillar bolt (48) and shim(s) (46).



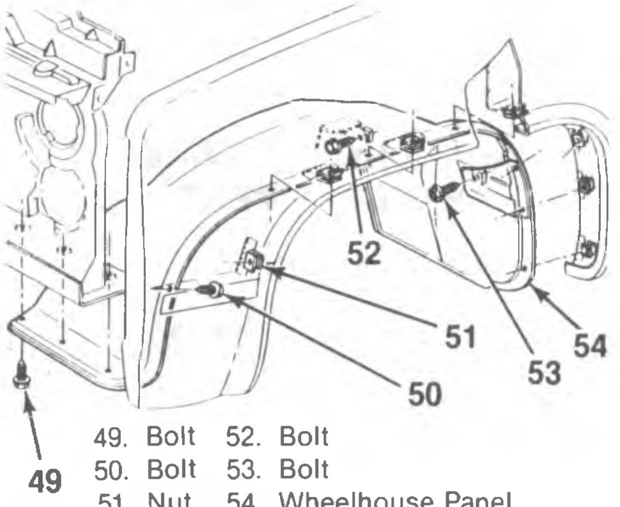
8. Fender
45. Bolt
46. Shim
47. Bolt
48. Bolt
119. Bolt

Figure 8—Front Fender Attachment

17. Fender from the vehicle.
18. Insulator from the fender.

Install or Connect (Figures 8 and 9).

1. Insulator to the fender.
2. Fender to the vehicle.



49. Bolt
50. Bolt
51. Nut
52. Bolt
53. Bolt
54. Wheelhouse Panel

Figure 9—Wheelhouse Panel Attachment

3. Upper fender to the door pillar bolt (48) and shim(s) (46) as required.
   - Assemble loosely.
4. Fender to cowl bolt (47) and shim(s) (46) as required.
   - Assemble loosely.
5. Lower door pillar to fender bolt (45) and shim(s) (46) as required.
   - Assemble loosely.
6. Radiator support to fender bolts (119).

Tighten

   - Bolts to 17 N·m (13 ft. lbs.).

7. Wheelhouse to fender bolts (50).

Tighten

   - Wheelhouse to fender bolts (50) to 17 N·m (13 ft. lbs.).
   - Lower door pillar to fender bolt to 43 N·m (31 ft. lbs.).

8. Shield to the vehicle.
9. Shield to underbody retainers.
10. Wheelhouse panel to shield bolts.

Tighten

   - Fender to cowl bolt (47) to 43 N·m (31 ft. lbs.).
   - Upper fender to door pillar bolt to 43 N·m (31 ft. lbs.).

11. Hood spring assembly. Refer to "Spring Assembly Replacement."
12. Cowl vent grille. Refer to "Cowl Vent Grille Replacement."
13. Lower radiator grille to fender bolts (38).
14. Right or left radiator grille molding (36).
15. Upper and lower molding clip nuts (33 and 37).
16. Right or left radiator grille molding nuts (34).
17. Head lamp.
18. Head lamp bezel.

WHEELHOUSE PANEL REPLACEMENT

RIGHT PANEL REPLACEMENT

Remove or Disconnect (Figure 9)

1. Jack handle.
2. Lug wrench.
3. Coolant recovery reservoir.
4. Air conditioning line retainers (if equipped).
- Raise and support the vehicle.
5. Right front wheel.
6. Wheelhouse panel to radiator support bolts (49).
7. Wheelhouse panel to underbody shield bolts.
8. Wheelhouse panel reinforcement to underbody bolts (52) and (53).
9. Wheelhouse panel to fender bolts (50).
10. Wheelhouse panel from the vehicle.
    - Slide the panel forward to clear the lower back side of the fender well.
    - Tilt the wheelhouse panel out of the vehicle.

Install or connect (Figure 9)

1. Wheelhouse panel to the vehicle.
   - Tilt the wheelhouse panel into the vehicle.
   - Slide the panel into position.
2. Wheelhouse panel to fender bolts (50).

Tighten

   - Bolts to 17 N·m (13 ft. lbs.).

3. Wheelhouse panel reinforcement to underbody bolts (52) and (53).

Tighten

   - Bolts (52) to 17 N·m (13 ft. lbs.).
   - Bolt (53) to 47 N·m (35 ft. lbs.).

4. Wheelhouse panel to underbody shield bolts.
5. Wheelhouse panel to radiator support bolts (49).

Tighten

   - Bolts to 17 N·m (13 ft. lbs.).

6. Right front wheel.
- Lower the vehicle.
7. Air conditioning line retainers (if equipped).
8. Coolant recovery reservoir.
9. Lug wrench.
10. Jack handle.

LEFT PANEL REPLACEMENT

Remove or Disconnect (Figure 9)

1. Jack.
2. Windshield washer fluid reservoir.
3. Wiring harness.
4. Hood release cable.
5. Air conditioning hose bracket (if equipped).
- Raise and support the vehicle.
6. Left front wheel.
7. Wheelhouse panel to radiator support bolts (49).
8. Wheelhouse panel to underbody shield bolts.
9. Wheelhouse panel reinforcement to underbody bolts (52) and (53).
10. Wheelhouse panel to fender bolts (50).

11. Wheelhouse panel from the vehicle.
    - Slide the panel forward to clear the lower back side of the fender well.
    - Tilt the wheelhouse panel out of the vehicle.

Install or Connect (Figure 9)

1. Wheelhouse panel to the vehicle.
    - Tilt the wheelhouse panel into the vehicle.
    - Slide the panel into position.
2. Wheelhouse panel to fender bolts (50).

Tighten

- Bolts to 17 N·m (13 ft. lbs.).

3. Wheelhouse panel reinforcement to underbody bolts (52) and (53).

Tighten

- Bolt (52) to 17 N·m (13 ft. lbs.).
- Bolt (53) to 47 N·m (35 ft. lbs.).

4. Wheelhouse panel to underbody shield bolts.
5. Wheelhouse panel to radiator support bolts (49).

Tighten

- Bolts to 17 N·m (13 ft. lbs.).

6. Left front wheel.
- Lower the vehicle.
7. Air conditioning hose bracket (if equipped).
8. Hood release cable.
9. Wiring harness.
10. Windshield washer fluid reservoir.
11. Jack.

REAR FENDER REPLACEMENT

FENDERSIDE MODEL FENDER REPLACEMENT

Remove or Disconnect (Figure 10)

1. Parking lamp wiring from the fender.
2. Brace to fender bolts (59).
3. Side panel to fender bolts (56).
4. Fender from the vehicle.
5. Side panel to brace bolt (56).
6. Brace (58).
7. Cross sill to brace bolt (63).
8. Brace (62).
9. Sealer from the fender and the side panel.

Install or Connect (Figure 10)

1. A medium bodied sealer onto the fender to side panel flange.
2. Brace (62).
3. Cross sill to brace bolt (63).
    - Assemble loosely.
4. Brace (58) to the vehicle.
5. Side panel to brace bolt (56).
    - Assemble loosely.
6. Fender to the vehicle.
7. Side panel to fender bolts (56).
    - Assemble loosely.
8. Brace to fender bolts (59).

Tighten

- Brace to fender bolts to 17 N·m (13 ft. lbs.).
- Side panel to fender bolts to 10 N·m (7 ft. lbs.).
- Cross sill to brace bolt to 17 N·m (13 ft. lbs.).

9. Parking lamp wiring to the fender.
- Clean excess sealant from the fender.

DUAL REAR WHEEL MODEL FENDER REPLACEMENT

Remove or Disconnect (Figure 11)

1. Parking lamp wiring from the fender.
2. Fender to brace bolts (71).
3. Fender to side panel bolts (72 and 69) and nuts (68).
4. Side panel to fender nuts (66).
5. Fender from the vehicle.
6. Sealer from the side panel and fender.

Install or Connect (Figure 11)

1. A medium bodied sealer onto the fender to side panel flange.
2. Fender to the vehicle.
3. Side panel to fender nuts (66).
    - Assemble loosely.
4. Fender to side panel bolts (72 and 69) and nuts (68).
    - Assemble loosely.
5. Fender to brace bolts (71).

Tighten

- All of the nuts and bolts to 17 N·m (13 ft. lbs.).

6. Parking lamp wiring to the fender.
- Clean excess sealant from the fender.

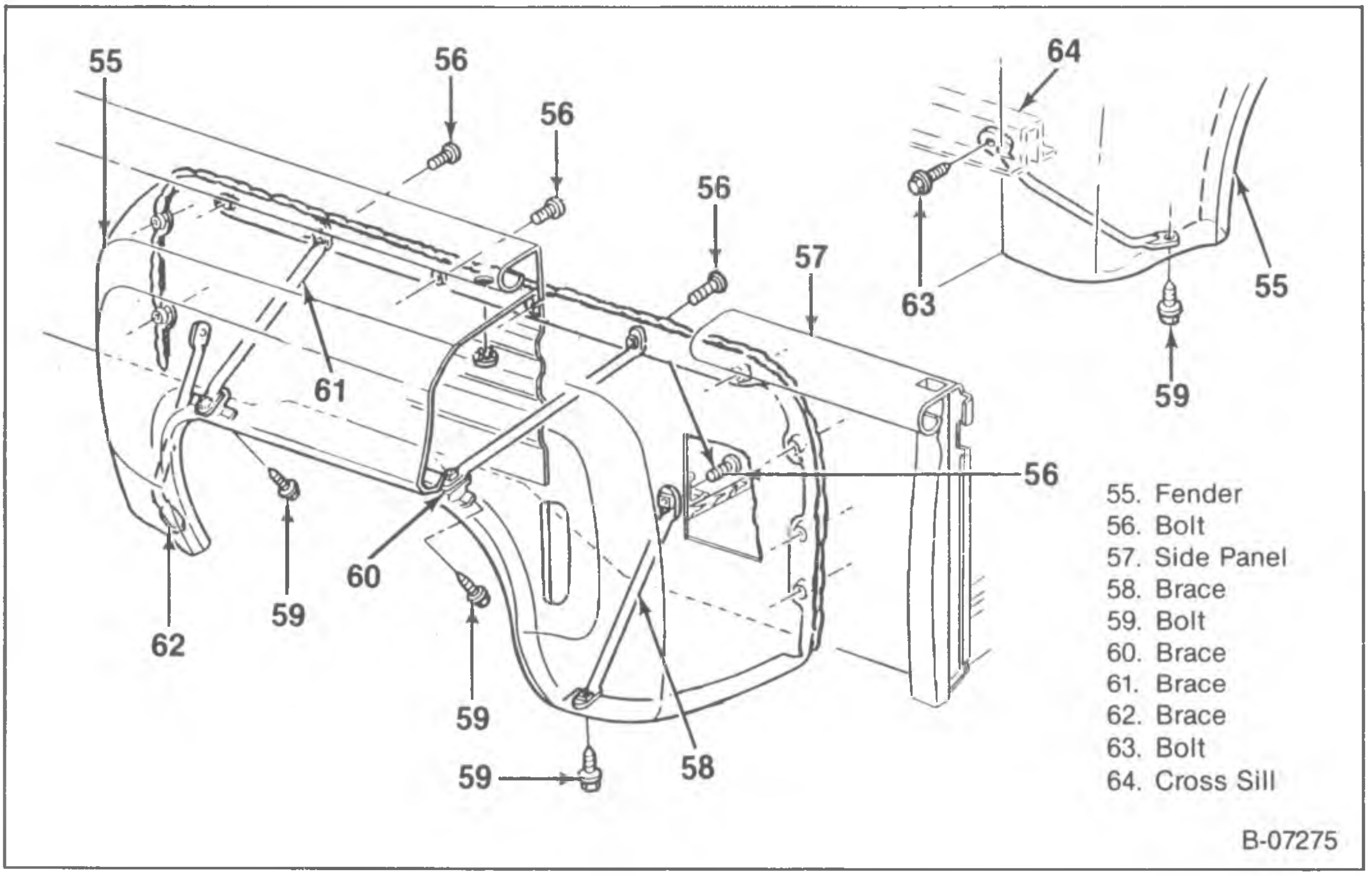


Figure 10—Fenderside Rear Fender Attachment

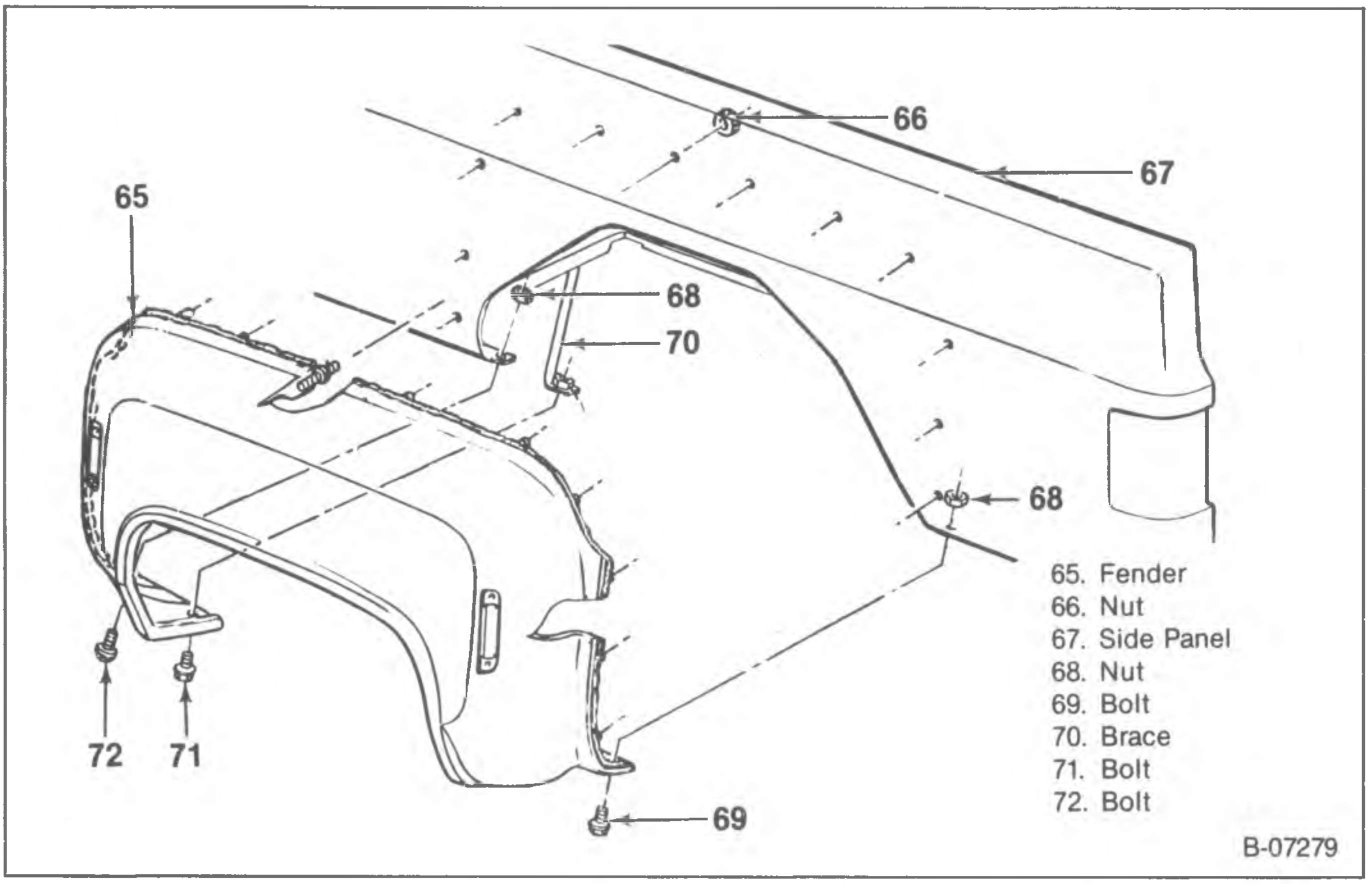


Figure 11—Dual Rear Wheel Rear Fender Attachment

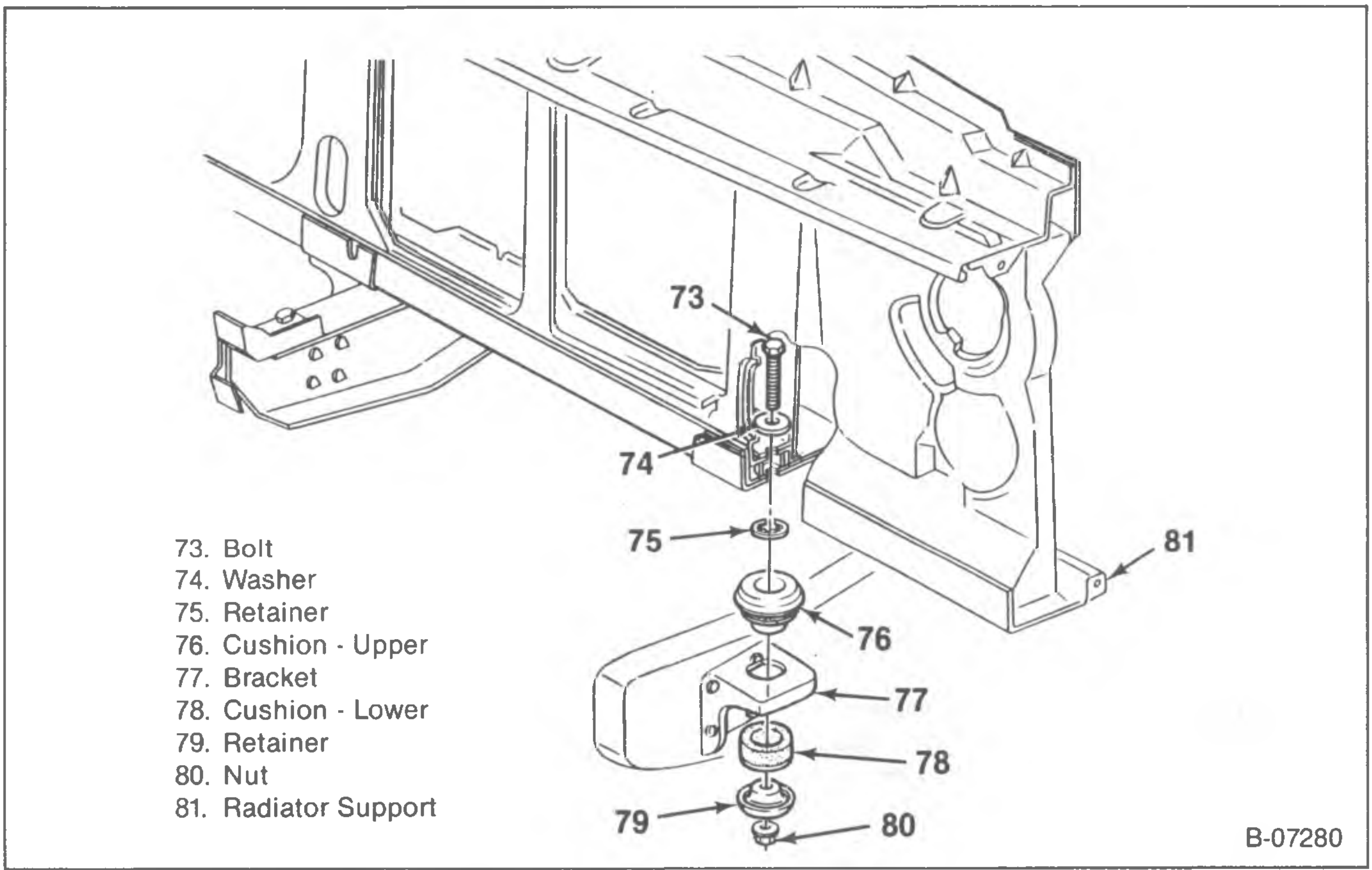


Figure 12—Radiator Support Mounting

RADIATOR SUPPORT REPLACEMENT

Remove or Disconnect (Figure 12)

1. Radiator from the vehicle. Refer to ENGINE COOLING (SEC. 6B).
2. Air conditioning condenser from the vehicle. Refer to AIR CONDITIONING (SEC. 1B).
3. Battery from the vehicle.
4. Headlamp and parking lamp wires from the lamps.
5. Headlamp and parking lamp wiring harness from the radiator support.
6. Headlamp bezels.
7. Headlamp assemblies.
8. Ground wires from the radiator support.
9. Fuel vapor canister from the radiator support.
10. Air cleaner inlet from the radiator support.
11. Primary hood latch bracket to the radiator support bolts.
12. Grille from the vehicle.
13. Lower radiator grille panel from the vehicle.
14. Sheet metal support to radiator support bolts.
15. Sheet metal support from the vehicle.
16. Radiator support to fender bolts (119).
17. Wheelhouse panel to radiator support bolts (49).
18. Radiator support to frame nuts (80), lower retainers (79), lower cushions (78), upper cushions (76), retainers (75), bolts (73), and washers (74).
19. Radiator support from the vehicle.
    - Tilt the radiator support to the rear, and lift it up and out of the vehicle.

Install or Connect (Figure 12)

1. Radiator support to the vehicle.
    - Lower the radiator support into the vehicle, and tilt it into position.
2. Radiator support to frame washers (74), bolts (73), retainers (75), upper cushions (76), lower cushions (78), lower retainers (79), and frame nuts (80).
    - Assemble loosely.
3. Wheelhouse panel to radiator support bolts (49).

    Tighten

    - Bolts to 17 N·m (13 ft. lbs.).
4. Radiator support to fender bolts (119).

    Tighten

    - Bolts to 17 N·m (13 ft. lbs.).
5. Sheet metal support to the vehicle.

6. Sheet metal support to radiator support bolts.

Tighten

- Bolts to 17 N·m (13 ft. lbs.).
- Radiator support to frame nuts (80) to 47 N·m (35 ft. lbs.).

7. Lower radiator grille panel to the vehicle.
8. Grille to the vehicle.
9. Primary hood latch bracket to the radiator support bolts.

Adjust

- Hood latch left or right so that the hood properly engages the hood latch.

Tighten

- Bracket to radiator support bolts to 27 N·m (20 ft. lbs.).

10. Air cleaner inlet to the radiator support.
11. Fuel vapor canister to the radiator support.
12. Ground wires to the radiator support.
13. Headlamp assemblies.
14. Headlamp bezels.
15. Headlamp and parking lamp wiring harness to the radiator support.
16. Headlamp and parking lamp wires to the lamps.
17. Battery to the vehicle.
18. Air conditioning condenser to the vehicle. Refer to AIR CONDITIONING (SEC. 1B).
19. Radiator to the vehicle. Refer to ENGINE COOLING (SEC. 6B).

SHEET METAL UNIT REPLACEMENT

Tool Required:
J-24595-B Door Trim Pad Remover.

Remove or Disconnect

1. Hood from the vehicle.
2. Battery from the vehicle.
3. Radiator from the vehicle. Refer to ENGINE COOLING (SEC. 6B).
4. Air conditioning condenser from the vehicle. Refer to AIR CONDITIONING (SEC. 1B).
5. Headlamp and parking lamp wires from the lamps.
6. Headlamp and parking lamp wiring harness from the radiator support.
7. Ground wires from the radiator support.
8. Fuel vapor canister from the radiator support.
9. Air cleaner inlet from the radiator support.
10. Bumper from the vehicle.
11. Wheelhouse panel to fender bolts (50).
12. Fender to cowl bolts (47).
13. Upper fender to door pillar bolt (48).
14. Wheelhouse panel to shield bolts.
15. Shield to underbody retainers using J-24595-B.
16. Shield from the vehicle.
17. Lower fender to door pillar bolt (45).
18. Radiator support to frame nuts (80), lower retainers (79), lower cushions (78), upper cushions (76), retainers (75), bolts (73), and washers (74).
19. Sheet metal assembly.
    - With the aid of a helper, lift the sheet metal from the chassis.

Install or Connect

1. Sheet metal assembly.
    - With the aid of a helper, lift the sheet metal onto the chassis.
2. Radiator support to frame washers (74), bolts (73), retainers (75), upper cushions (76), lower cushions (78), lower retainers (79), and nuts (80).
3. Lower fender to door pillar bolts (45).

Tighten

- Bolt to 43 N·m (31 ft. lbs.).

4. Shield to the vehicle.
5. Shield to underbody retainers.
6. Wheelhouse panel to shield bolts.
7. Upper fender to door pillar bolt (48).

Tighten

- Bolt to 43 N·m (31 ft. lbs.).

8. Fender to cowl bolts (47).

Tighten

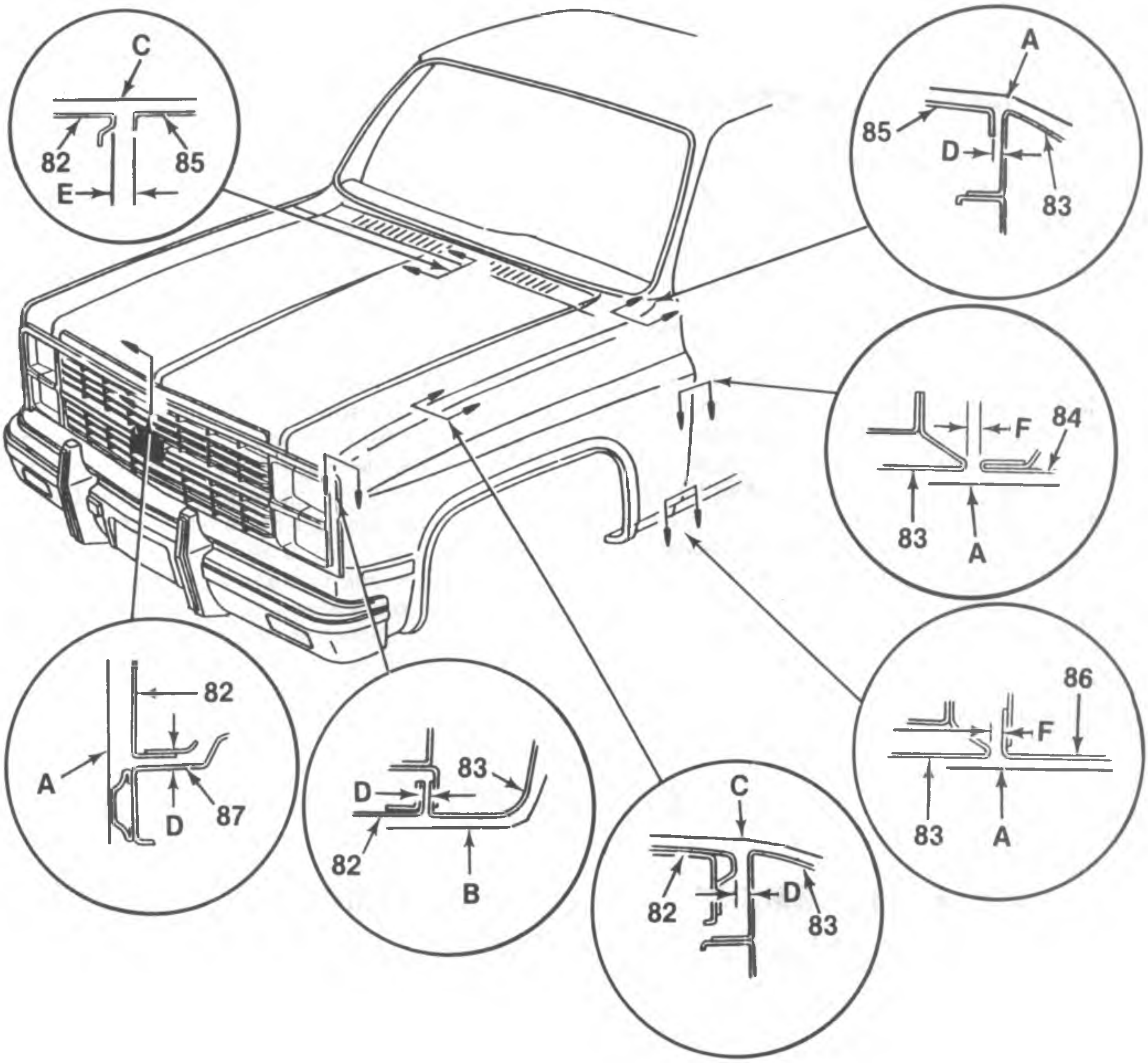
- Bolts to 43 N·m (31 ft. lbs.).

9. Wheelhouse panel to fender bolts (50).

Tighten

- Wheelhouse panel to fender bolts to 17 N·m (13 ft. lbs.).

10. Bumper to the vehicle.
11. Air cleaner inlet to the radiator support.
12. Fuel vapor canister to the radiator support.
13. Ground wires to the radiator support.
14. Headlamp and parking lamp wiring harness to the radiator support.
15. Head lamp and parking lamp wires to the lamps.
16. Air conditioning condenser to the vehicle. Refer to AIR CONDITIONING (SEC. 1B).



82. Hood
83. Fender
84. Door
85. Cowl Vent Grille
86. Rocker Panel
87. Radiator Support Upper Panel
A. Flush Fit
B. Flush + or - 1mm (0.03-inch)
C. Flush + 0.00 mm or - 1.5 mm (0.00-inch or -0.06-inch)
D. 4.6 mm ± 1 mm (0.18-inch ± 0.03-inch)
E. 8 mm ± 1 mm (0.31-inch ± 0.03-inch)
F. 5 mm ± 2.3 mm (0.19-inch ± 0.09-inch)

F-00183

Figure 13—Sheet Metal Gap Specifications

17. Radiator to the vehicle. Refer to ENGINE COOLING (SEC. 6B).
18. Battery to the vehicle.
19. Hood to the vehicle.

SHEET METAL ADJUSTEMENTS

In order to have the proper operation and appearance of sheet metal components, it is important that certain fits and gaps between components be maintained. The gaps given in this procedure are suggested as the best alignment for these components (figure 13).

In aligning sheet metal, it is best to start with the rearmost component, and work forward.

1. Starting with the fenders, align the rear edge of each fender to the rocker panel, and the door. The gap between these components should be 5 mm ± 2.3 mm (0.19-inch ± 0.09-inch). This adjustment should be accomplished by moving the fender forward or rearward. The surface of the fender should be flush with the rocker panel and the door. Add or remove shims to perform this adjustment.
2. Align the fender to the cowl vent grille to obtain a gap of 4.6 mm ± 1 mm (0.18-inch ± 0.03-inch). The surface of the cowl vent grille should be flush with the fender surface.
3. Align the hood with the cowl vent grille, so that there is a gap of 8 mm ± 1 mm (0.31-inch ± 0.03-inch) between the rear edge of the hood and the front edge of the cowl vent grille. The hood surface should be flush with the cowl vent grille surface within + 0.0 mm–1.5 mm (+0.00-inch-0.06-inch).
4. Align the left and right edges of the hood so that a gap of 4.6 mm ± 1 mm (0.18-inch ± 0.03-inch) exists between the hood and the fenders. The hood surface should be flush with the fender surface within + 0.0 mm, -1.5 mm (+0.00-inch, -0.06-inch). If this gap is difficult to obtain, and the hood appears to be cocked in between the fenders, the radiator support may need to be shifted. By shifting the radiator support, the entire front end sheet metal can be aligned as a unit. Loosen the support to the frame bolts, and shift the radiator support to obtain the proper gaps. Then, while holding the support in position, retighten the radiator support to frame bolts.
5. Align the front face of the hood to obtain a gap of 4.6 mm ± 1 mm (0.18-inch ± 0.03-inch) between the hood and the radiator support upper panel. The hood bumpers on the top of the radiator support should be adjusted to give the proper support to hood gap. The surface of the hood should be flush with the radiator support upper panel (not the grille molding).

G MODELS

HOOD REPLACEMENT

Remove or Disconnect (Figure 14)

- Raise and support the hood. Place a protective covering over the fenders, and the cowl vent grille.
- Mark the position of the hinges on the hood.

1. Hood hinge to hood bolts (89).
2. Hood from the vehicle.

Install or Connect (Figure 14)

1. Hood to the vehicle.
2. Hood hinge to hood bolts (89).

- Align the hood with the previously made marks.

Tighten

  - Bolts to 17 N·m (13 ft. lbs.).

- Remove the protective coverings, and lower the hood.

HOOD HINGE REPLACEMENT

Remove or Disconnect (Figure 14)

- Raise and support the hood. Also support the rear corner of the hood.
- Mark the position of the hinge on the hood and the cowl.

1. Hood hinge to hood bolts (89).
2. Hood hinge to cowl bolts (90).
3. Hood hinge from the vehicle.

Install or Connect (Figure 14)

1. Hood hinge to the vehicle.
2. Hood hinge to cowl bolts (90).
3. Hood hinge to hood bolts (89).

- Align the hinge with the previously made marks.

Tighten

  - Bolts to 17 N·m (13 ft. lbs.).

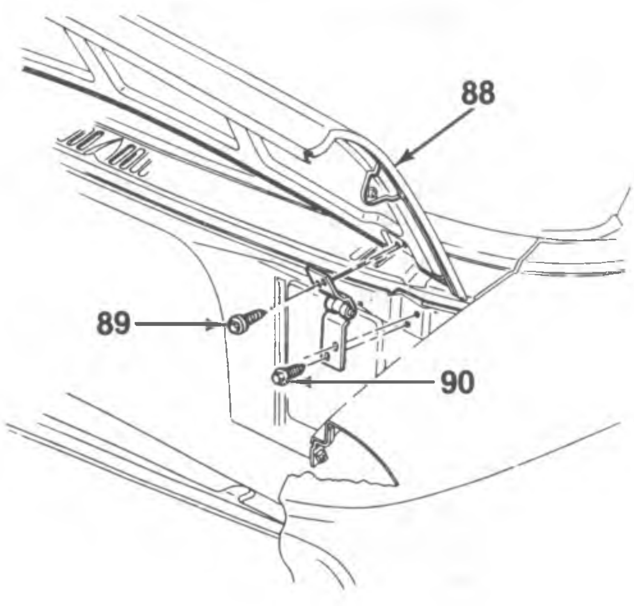


Figure 14—Hood Hinge Components

PRIMARY HOOD LATCH REPLACEMENT

NOTICE: See "Notice" on page 2C-1 of this section.

Remove or Disconnect (Figure 15)

- Raise and support the hood.

1. Hood latch release cable from the latch.
2. Bracket to hood latch bolts (94).
3. Hood latch from the vehicle.
4. Bracket to the sheet metal cross panel bolts (91).
5. Bracket from the vehicle.

Adjust

- Front hood bumpers, so that the top of the hood is flush with the fenders.

Install or Connect (Figure 15)

1. Bracket to the sheet metal cross panel.
2. Bracket to cross panel bolts (91) loosely.
3. Primary hood latch to the bracket.
4. Latch to bracket bolts (94) loosely.
5. Hood latch release cable to the latch.

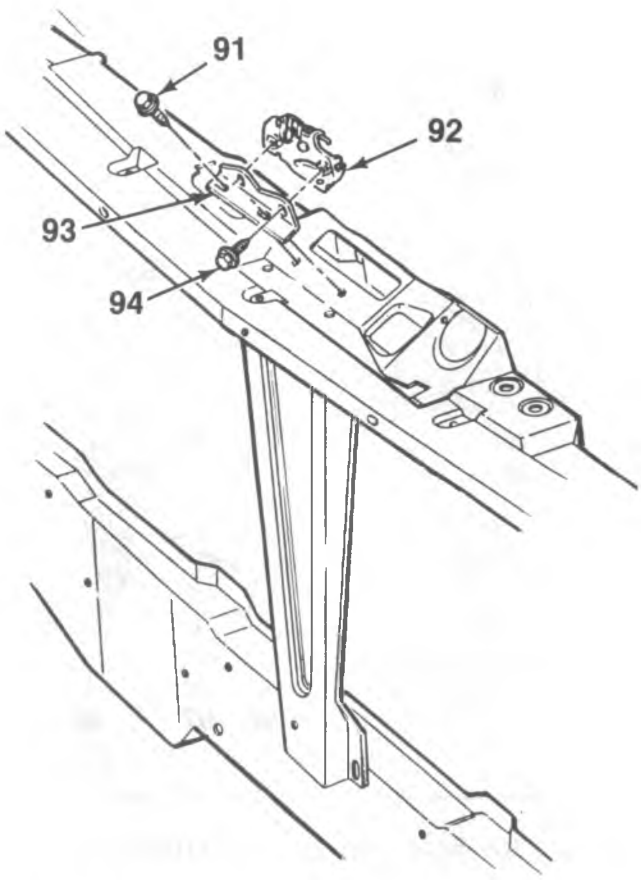


Figure 15—Primary Hood Latch Attachment

Adjust

1. Hood latch bracket left and right until the striker in the hood easily engages the primary latch.

- Raise and support the hood.

Tighten

- Bracket to radiator support bolts to 27 N·m (20 ft. lbs.)

2. Hood latch height so that when the hood is closed, the hood is held securely against the front hood bumpers.

- Raise and support the hood.

Tighten

- Bracket to hood latch bolts to 27 N·m (20 ft. lbs.).

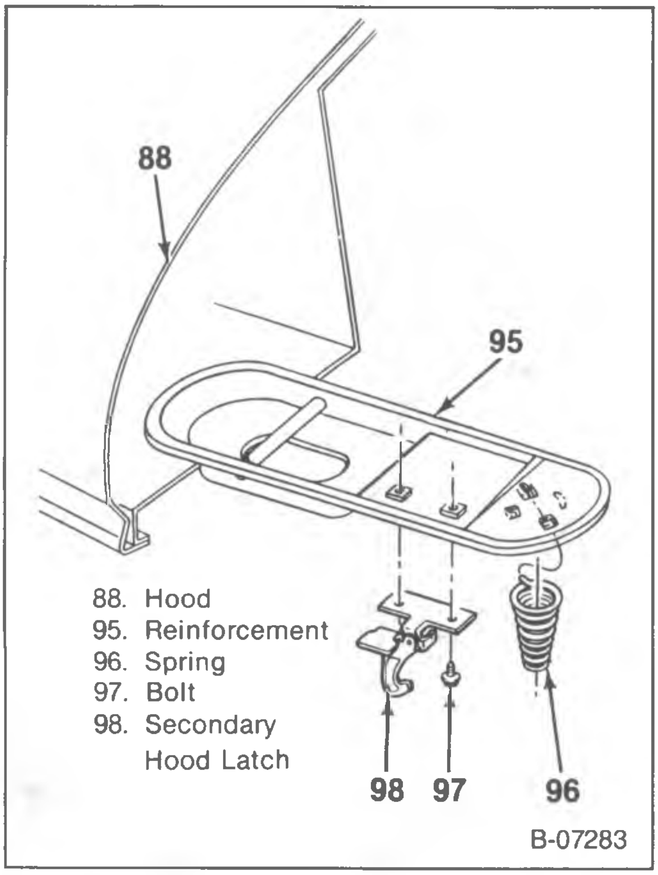


Figure 16—Secondary Hood Latch Attachment

SECONDARY HOOD LATCH AND SPRING REPLACEMENT

Remove or Disconnect (Figure 16)

- Mark the position of the secondary hood latch on the hood.

1. Secondary hood latch to hood bolts (97).
2. Secondary hood latch from the vehicle.
3. Spring from the hood.
    - Twist the spring from the reinforcement.

Install or Connect (Figure 16)

1. Spring to the hood.
    - Twist the spring into the reinforcement.
2. Secondary hood latch to the vehicle.
3. Secondary hood latch to hood bolts (97).

Tighten

- Bolts to 27 N·m (20 ft. lbs.).

HOOD RELEASE CABLE REPLACEMENT

Remove or Disconnect (Figure 17)

- If the cable is broken, release the hood by pressing the primary latch tab on the right side of the lock assembly. Use a rod to press the tab.
- Raise and support the hood.

1. Cable from the primary latch.
    - Insert a screwdriver into the clip, and lift the cable from the lock. Then, carefully pry the cable grommet from the lock flange.
2. Cable from the sheet metal cross panel clip.
3. Grommet from the cowl.
    - Cut the grommet down to the cable casing on the engine side of the cowl.
    - Push the cable and the grommet through the cowl.
4. Cable handle to dash screws.
5. Cable from the vehicle.

Install or Connect (Figure 17)

1. New cable to the vehicle.
2. Cable through the drivers side of the cowl.
    - Push the grommet into the drivers side of the cowl, and then push the insert into the grommet.
3. Cable handle to dash screws.
4. Cable into the sheet metal cross panel clip.
5. Cable to the primary latch.

COWL VENT GRILLE REPLACEMENT

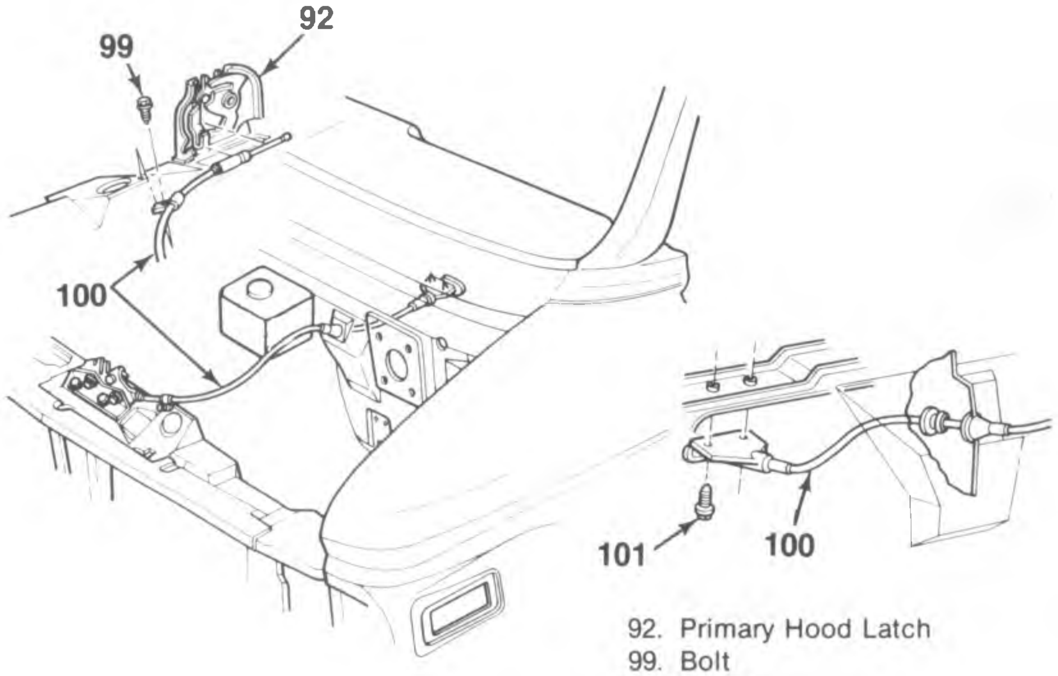
Remove or Disconnect (Figure 18)

- Raise and support the hood.

1. Windshield wiper arms.
2. Cowl vent grille to cowl bolts (104) and screws (103).
3. Cowl vent grille from the vehicle.
4. Cowl seal from the vehicle.

Install or Connect (Figure 18)

1. Cowl seal to the vehicle.
2. Cowl vent grille to the vehicle.
3. Cowl vent grille to cowl bolts (104) and screws (103).
4. Windshield wiper arms.



92. Primary Hood Latch
99. Bolt
100. Cable
101. Bolt

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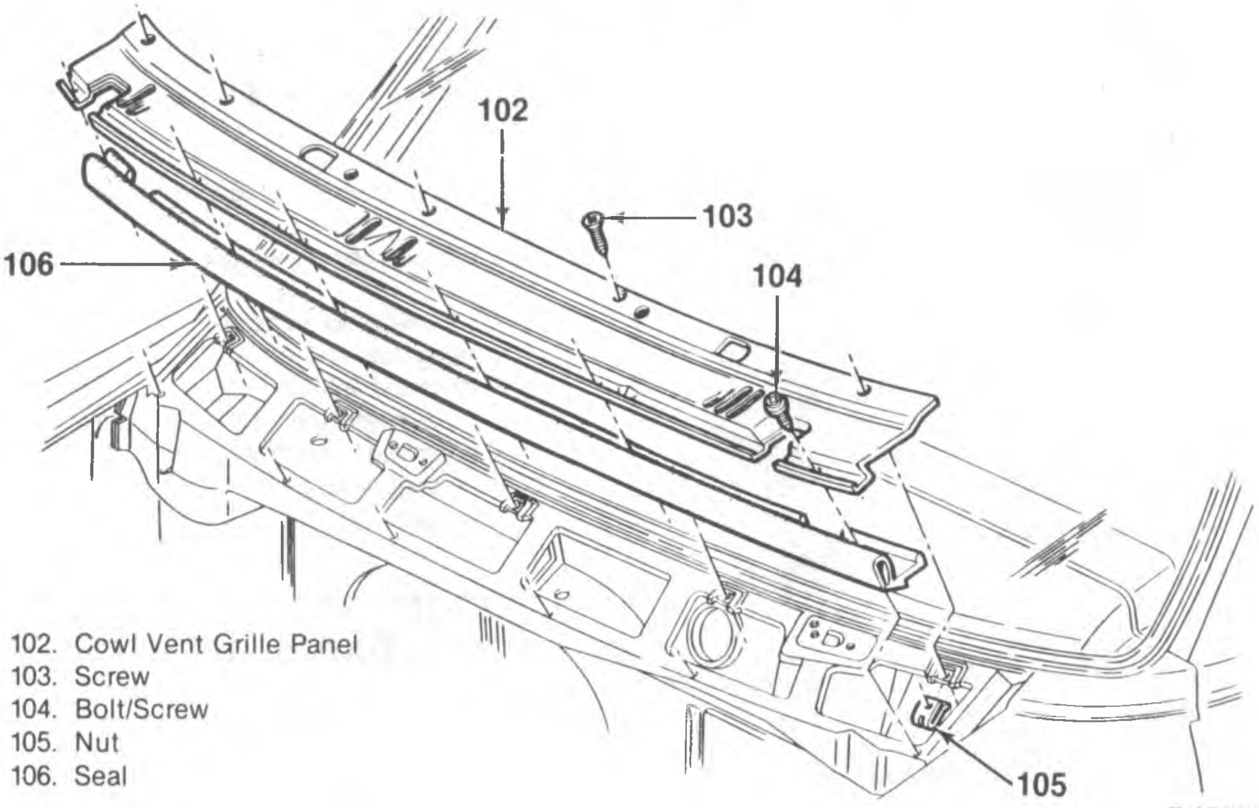
Figure 17—Hood Release Cable Attachment



102. Cowl Vent Grille Panel
103. Screw
104. Bolt/Screw
105. Nut
106. Seal

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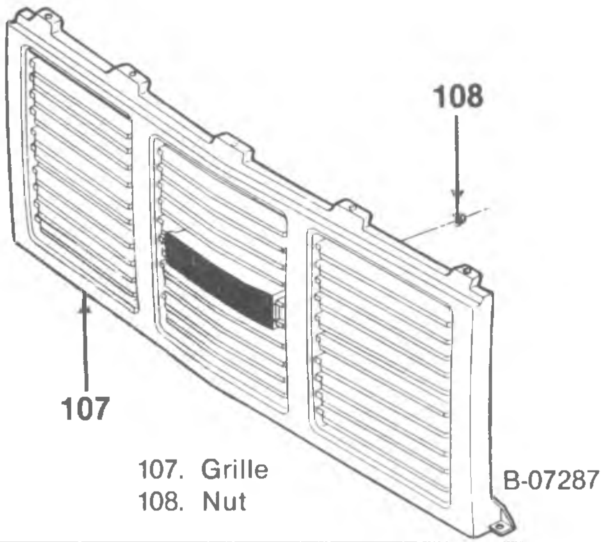
Figure 18—Cowl Vent Grille Components



107. Grille
108. Nut

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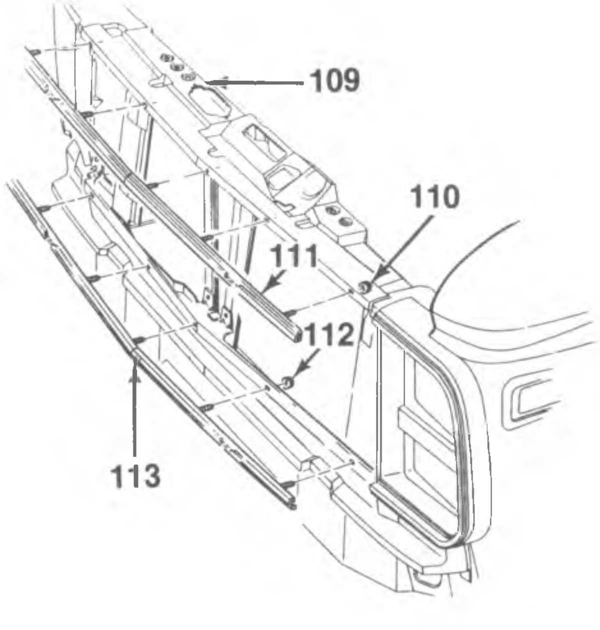
Figure 19—Radiator Grille

GRILLE REPLACEMENT

↔ Remove or Disconnect (Figures 19 and 20)

- Raise and support the hood.

1. Headlamp bezels.
2. Sheet metal cross panel to grille bolts.
3. Grille to lower front end panel bolts.
4. Grille from the vehicle.
5. Sheet metal to upper and lower radiator grille molding nuts (110 and 112).
6. Upper and lower radiator grille moldings from the vehicle.



109. Front End Sheet Metal Cross Panel
110. Nut
111. Upper Molding
112. Nut
113. Lower Molding

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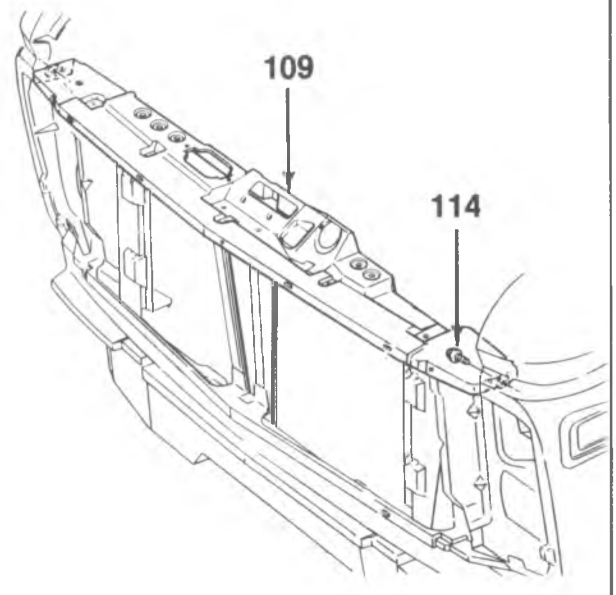
Figure 20—Radiator Grille Molding Attachment



109. Front End Sheet Metal Cross Panel
114. Bolt

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Figure 21—Front End Sheet Metal Cross Panel Attachment

→← Install or Connect (Figures 19 and 20)

1. Upper and lower radiator grille moldings to the vehicle.
2. Sheet metal to upper and lower radiator grille molding nuts (110 and 112).
3. Grille to the vehicle.
4. Grille to lower front end panel bolts.
5. Sheet metal cross panel to grille bolts.
6. Headlamp bezels.

- Lower the hood.

FRONT END SHEET METAL CROSS PANEL REPLACEMENT

↔ Remove or Disconnect (Figure 21)

- Raise and support the hood.

1. Headlamp bezels.
2. Grille. Refer to "Grille Replacement."
3. Primary hood latch. Refer to "Primary Hood Latch Replacement."

4. Air intake snorkel.
5. Upper radiator mount to sheet metal cross panel bolts.
6. Upper radiator mounts.
7. Sheet metal cross panel to fender bolts (114).
8. Sheet metal cross panel to the hood latch bracket bolts (91).
9. Sheet metal cross panel to radiator support baffle panel bolts.
10. Sheet metal cross panel to the headlamp bezel support bolts.
11. Sheet metal cross panel from the vehicle.

→← Install or Connect (Figure 21)

1. Sheet metal cross panel to the vehicle.
2. Sheet metal cross panel to the headlamp bezel support bolts.
    - Assemble loosely.
3. Sheet metal cross panel to the radiator support baffle panel bolts.
    - Assemble loosely.
4. Sheet metal cross panel to the hood latch bracket bolts (91).
    - Assemble loosely.
5. Sheet metal cross panel to the fender bolts (114).

    Tighten

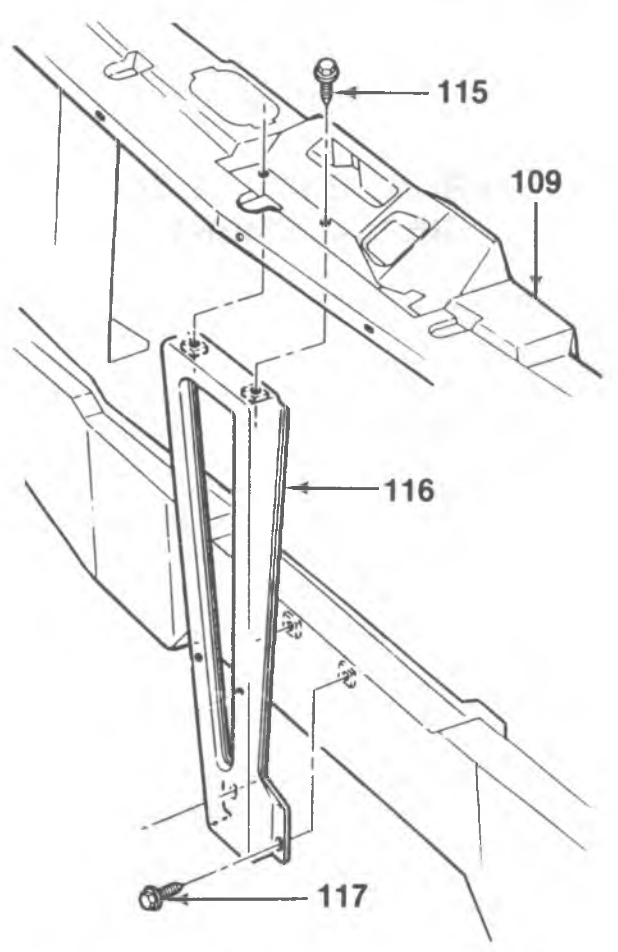
    - Bolts in steps 2 through 5 to 27 N·m (20 ft. lbs.).
6. Upper radiator mounts.
7. Upper radiator mount to sheet metal cross panel bolts.
8. Air intake snorkel.
9. Primary hood latch. Refer to "Primary Hood Latch Replacement."
10. Grille. Refer to "Grille Repalcement."
11. Headlamp bezels.

- Lower the hood.

SHEET METAL VERTICAL SUPPORT REPLACEMENT

←→ Remove or Disconnect (Figure 22)

1. Grille. Refer to "Grille Replacement."
2. Vertical support to sill bolts (17).
3. Front end panel to vertical support bolts (120).
4. Sheet metal cross panel to vertical support bolts (115).
5. Vertical support from the vehicle.



109. Front End Sheet Metal Cross Panel
115. Bolt
116. Sheet Metal Vertical Support
117. Bolt

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Figure 22—Front End Sheet Metal Vertical Support

→← Install or Connect (Figure 22)

1. Vertical support to the vehicle.
2. Sheet metal cross panel to vertical support bolts (115).

    Tighten

    - Bolts to 27 N·m (20 ft. lbs.).
3. Front end panel to vertical support bolts (120).

    Tighten

    - Bolts to 18 N·m (13 ft. lbs.).
4. Vertical support to sill bolts (117).

Tighten

- Bolt to 10 N·m (7 ft. lbs.).

5. Grille. Refer to "Grille Replacement."

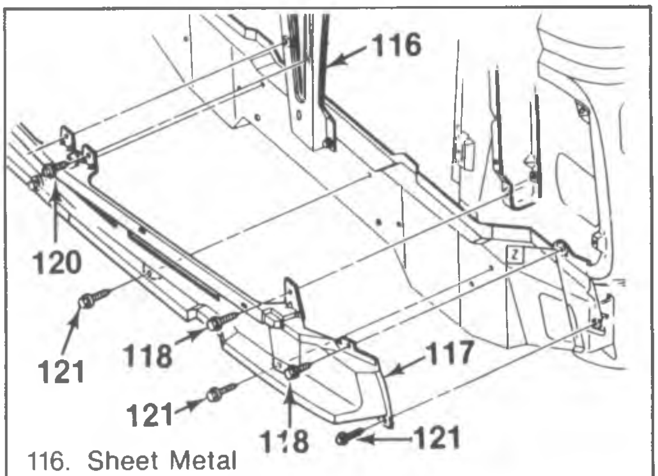
FRONT END PANEL REPLACEMENT

Remove or Disconnect (Figure 23)

1. Headlamp bezels.
2. Grille. Refer to "Grille Replacement."
3. Front end panel to headlamp bezel support bolts (118).
4. Front end panel to sill bolts (121).
5. Front end panel to vertical support bolts (120).
6. Front end panel from the vehicle.

Install or Connect (Figure 23)

1. Front end panel to the vehicle.
2. Front end panel to vertical support bolts (120).
   - Assemble loosely.
3. Front end panel to sill bolts (121).
4. Front end panel to headlamp bezel support bolts (118).
5. Grille. Refer to "Grille Replacement."
6. Headlamp bezels.



116. Sheet Metal Vertical Support
117. Front End Panel
118. Bolt
120. Bolt
121. Bolt

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Figure 23—Front End Panel Attachment

SPECIFICATIONS

	TORQUE	
	N·m	Ft. Lbs.
C/K Models		
Hood Hinge to Hood Bolts	25	18
Hood Hinge to Cowl Bolts	43	32
Spring Assembly to Hood Bolts	25	18
Spring Assembly to Fender Bolts	25	18
Primary Hood Latch Bracket to Radiator Support Bolts	27	20
Bracket to Primary Hood Latch Bolts	27	20
Secondary Hood Latch to Hood Bolts	27	20
Sheet Metal Support to Radiator Support Bolts	17	13
Radiator Support to Fender Bolts	17	13
Radiator Support to Frame Nuts	47	35
Wheelhouse to Fender Bolt	43	31
Fender to Cowl Bolt	43	31
Upper Fender to Door Pillar Bolt	43	31
Wheelhouse Panel Reinforcement to Underbody Bolts (52)	17	13
(53)	47	35
Wheelhouse to Radiator Support Bolts	17	13
Fenderside Models		
Brace to Rear Fender Bolts	17	13
Side Panel to Rear Fender Bolts	10	7
Side Panel to Brace Bolts	10	7
Fleetside Models		
All Rear Fender to Side Panel Bolts, and Nuts	17	13
G Models		
Hood Hinge to Hood Bolts	17	13
Primary Hood Latch Bracket to Radiator Support Bolts	27	20
Bracket to Primary Hood Latch Bolts	27	20
Secondary Hood Latch to Hood Bolts	27	20
Sheet Metal Cross Panel to Headlamp Bezel Support Bolts	27	20
Sheet Metal Cross Panel to Radiator Support Baffle Panel Bolts	27	20
Sheet Metal Cross Panel to Hood Latch Bracket Bolts	27	20
Sheet Metal Cross Panel to Fender Bolts	28	20
Sheet Metal Cross Panel to Vertical Support Bolts	27	20
Front End Panel to Vertical Support Bolts	18	13
Vertical Support to Sill Bolts	10	7

SPECIAL TOOLS

J-24595-B	Door Trim Pad Remover

SECTION 3

STEERING, SUSPENSION, WHEELS AND TIRES

CONTENTS

SECTION 3A

FRONT END ALIGNMENT

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: "NOTICE": See 'Notice' on page 3A-1 on this section."

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

CONTENTS

DESCRIPTION

"Front End Alignment" refers to the angular relationship between the front wheels, the front suspension attaching parts and the ground.

Proper front end alignment must be maintained in order to insure efficient steering, good directional stability and to prevent abnormal tire wear.

The most important factors of front end alignment are wheel toe-in, wheel camber, and axle caster (Figure 1).

DEFINITION OF TERMS

CAMBER

Camber is the inward or outward tilting of the front wheels from the vertical. When the wheels tilt outward at the top, the camber is positive (+). When the wheels tilt inward at the top, the camber is negative (—). The amount of tilt measured in degrees from the vertical is called the camber angle. Camber is designed into the front axle assembly of all four-wheel drive vehicles and is non-adjustable.

If camber is extreme or unequal between the wheels, improper steering and excessive tire wear will result. Negative camber causes wear on the inside tire, while positive camber causes wear to the outside.

CASTER (Figure 1)

Caster is the tilting of the wheel axis either forward or backward from the vertical (when viewed from the side of the vehicle). A backward tilt is positive (+) and a forward tilt is negative (—).

On the short and long arm type suspension you cannot see a caster angle without a special instrument, but if you look straight down from the top of the upper control arm to the ground, the ball joints do not line up (fore and aft) when a caster angle other than 0 degree is present. With a positive angle, the lower ball joint would be slightly ahead (toward the front of the vehicle) of the upper ball joint center line. Caster is designed into the front axle assembly on all four-wheel drive vehicles, and is non-adjustable.

TOE-IN

Toe-in is the turning of the front wheels. The actual amount of toe-in is normally a fraction of a degree. Toe-in is measured from the center of the tire treads or from the inside of the tires. The purpose of toe-in is to insure parallel rolling of the front wheels and to offset any small deflections of the wheel support system which occurs when the vehicle is rolling forward. Incorrect toe-in results in excessive toe-in and unstable steering. Toe-in is the last alignment to be set in the front end alignment procedure.

DIAGNOSIS OF FRONT END ALIGNMENT

PROBLEM	POSSIBLE CAUSE	CORRECTION
Noisy Front End	1. Worn tie rod ends.	1. Replace ends.
	2. Loose suspension bolts.	2. Refer to FRONT SUSPENSION (SEC. 3C).
	3. Lack of proper lubrication.	3. Refer to MAINTENANCE AND LUBRICATION (SEC. 0B).
	4. Loose shock absorbers or worn bushings.	4. Tighten bolts and/or replace the bushings.
	5. Loose stabilizer bar.	5. Tighten
Wheel Bounce	1. Tire and wheel out of balance.	1. Refer to WHEELS AND TIRES (SEC. 3E).
	2. Blister or bump on the tire.	2. Replace the tire.
	3. Improper shock absorber action.	3. Replace the shock absorber.
	4. Excessive wheel or tire run-out.	4. Refer to WHEELS AND TIRES (SEC. 3E).
	5. Tire "Lead."	5. Refer to WHEELS AND TIRES (SEC. 3E).
Excessive Tire Wear	1. Incorrect wheel alignment.	1. Align the wheels.
	2. Failure to rotate tires.	2. Refer to WHEELS AND TIRES (SEC. 3E).
	3. Faulty shock absorbers.	3. Replace shock absorber.
	4. Improper tire pressure.	4. Refer to WHEELS AND TIRES (SEC. 3E).
	5. Overloaded or improperly loaded vehicle.	5. Avoid overloading vehicle.
	6. Broken or sagging springs.	6. Replace springs.

ON-VEHICLE SERVICE

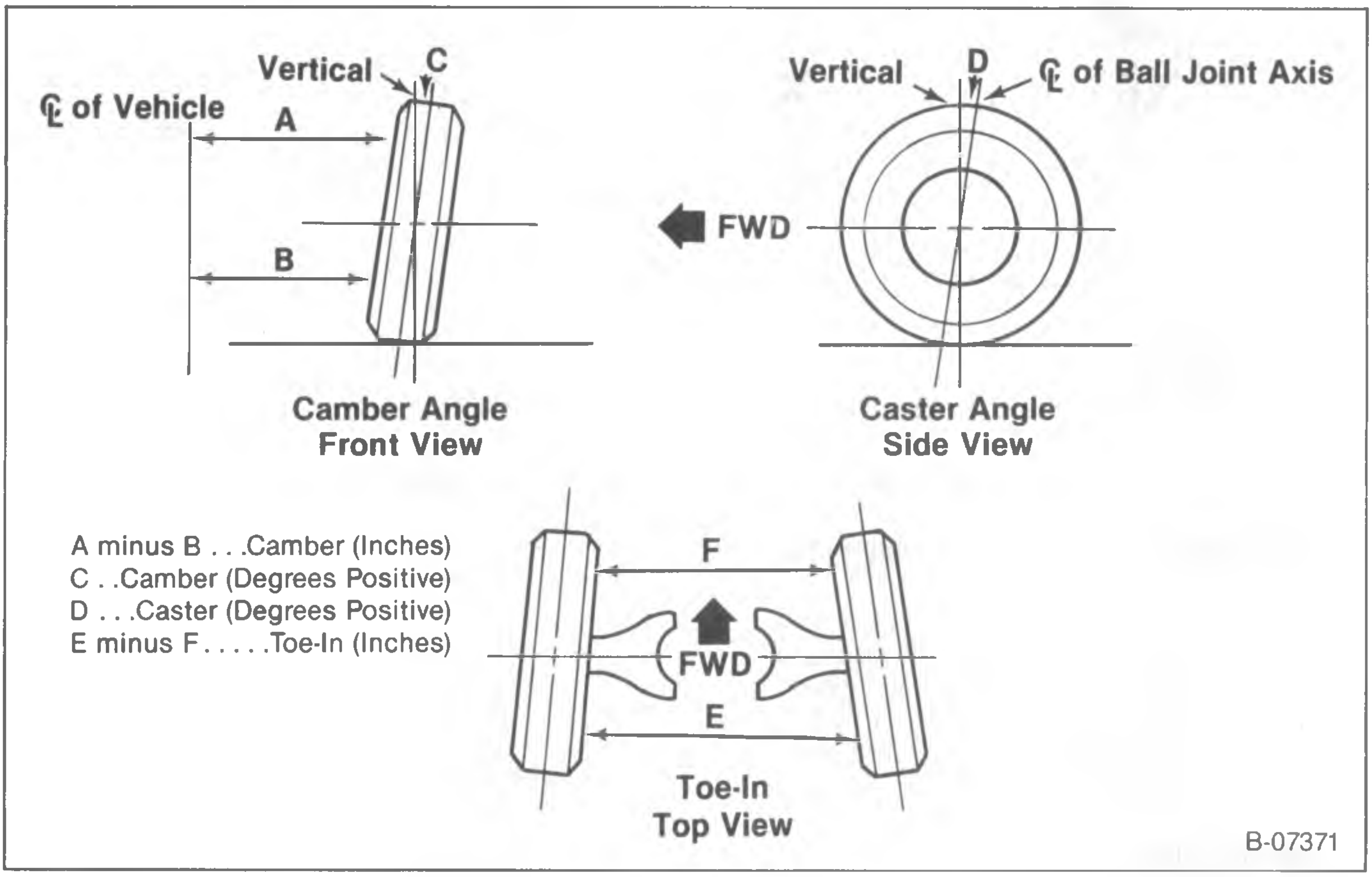


Figure 1—Caster - Camber - Toe-In

INSPECTION

Before making any adjustments affecting caster, camber or toe-in, the following front end inspection should be made:

Inspect

1. Tires for proper inflation pressure. Refer to WHEELS AND TIRES (SEC. 3E).
2. Front wheel bearing for proper adjustment. Refer to FRONT SUSPENSION (SEC. 3C.).
3. Ball joints, tie rod ends, and relay rods. If excessive looseness is noted, correct before adjusting. Refer to STEERING LINKAGE (SEC. 3B1).
4. Wheels and tires for run-out. Refer to WHEELS AND TIRES (SEC. 3E).
5. Dimension "BC" in (figure 3). If not within specifications, the correction must be made before adjusting caster.
6. Steering gear for looseness at the frame.
7. Shock absorbers for leaks or any noticeable noise. Refer to FRONT SUSPENSION (SEC. 3C).
8. Control arms or stabilizer bar attachments for looseness. Refer to FRONT SUSPENSION (SEC. 3C).
9. Alignment equipment. Follow the manufacturer's instructions.
10. Level of the vehicle. The vehicle must be on a level surface fore and aft and transversely.

FRONT END ALIGNMENT REQUIREMENTS

Satisfactory vehicle operation may occur over a wide range of front end alignment settings. If the settings vary beyond certain tolerances, adjustments are advisable. The "Specifications" at the back of this section is a guideline for vehicle diagnosis or for repairs.

Set the front end alignment to specifications while the vehicle is in its **normally loaded** condition. Vehicles which are **consistently operated with heavy loads should have toe-in adjusted with the vehicle under heavy load.** This procedure should result in longer tire life.

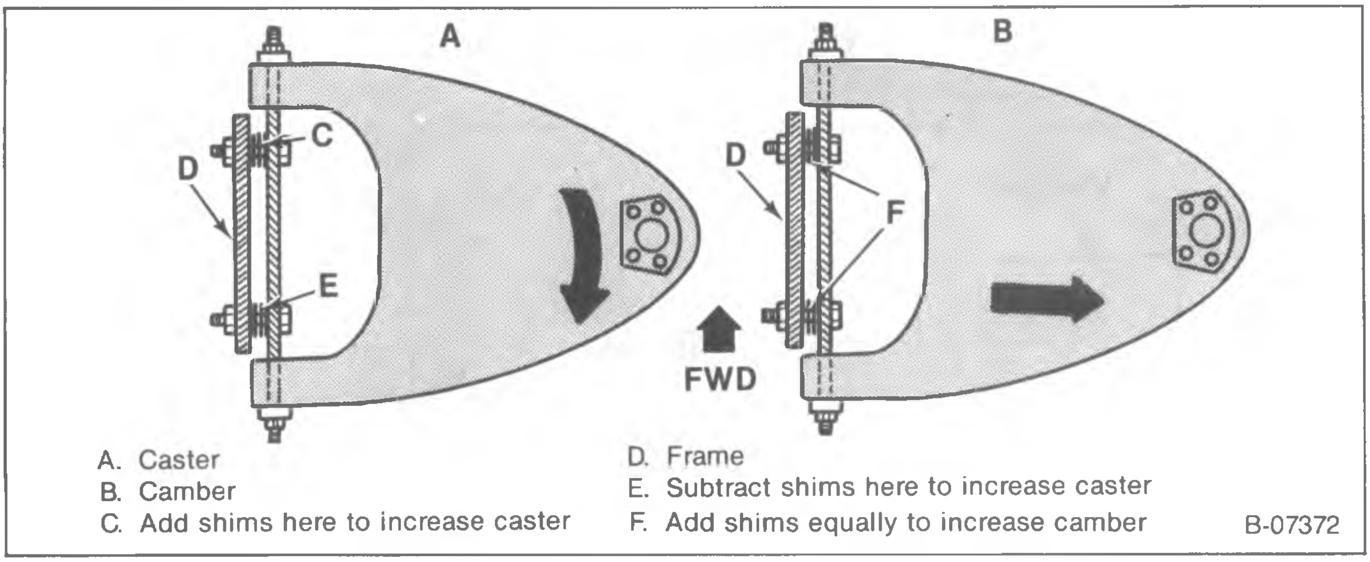


Figure 2—Caster - Camber Adjustment Pivot Shaft Outboard Of Frame

ALIGNMENT ADJUSTMENTS

A normal shim pack will leave at least two threads of the bolt exposed beyond the nut. If two threads cannot be obtained, check for control arms and related parts. The difference between front and rear shim packs must not exceed 7.62 mm (0.03 inch). Front shim pack must be at least 2.54 mm (0.10 inch).

ACESS TO SHIM PACKS

Models with $^{3}/_{4}$-Inch Nut

Jack up the frame to raise the wheel off the ground. This will allow the proper upper control arm to drop down far enough to use a socket on the nuts and permit shim adjustment. Torque to specifications, refer to FRONT SUSPENSION (SEC. 3C).

Models with $^{7}/_{8}$-Inch Nut

Remove the upper control arm bumper; then follow the same procedure as with $^{3}/_{4}$-inch Nut. Torque to specifications. Reinstall the upper control arm bumper when alignment is completed. Refer to FRONT SUSPENSION (SEC. 3C).

CASTER

All caster specifications are given with a frame angle of zero. Therefore, it will be necessary to know the angle of the frame (whether "up" in rear or "down" in rear) before a corrected caster reading can be determined. Camber and toe-in can be read "as is" from the alignment equipment.

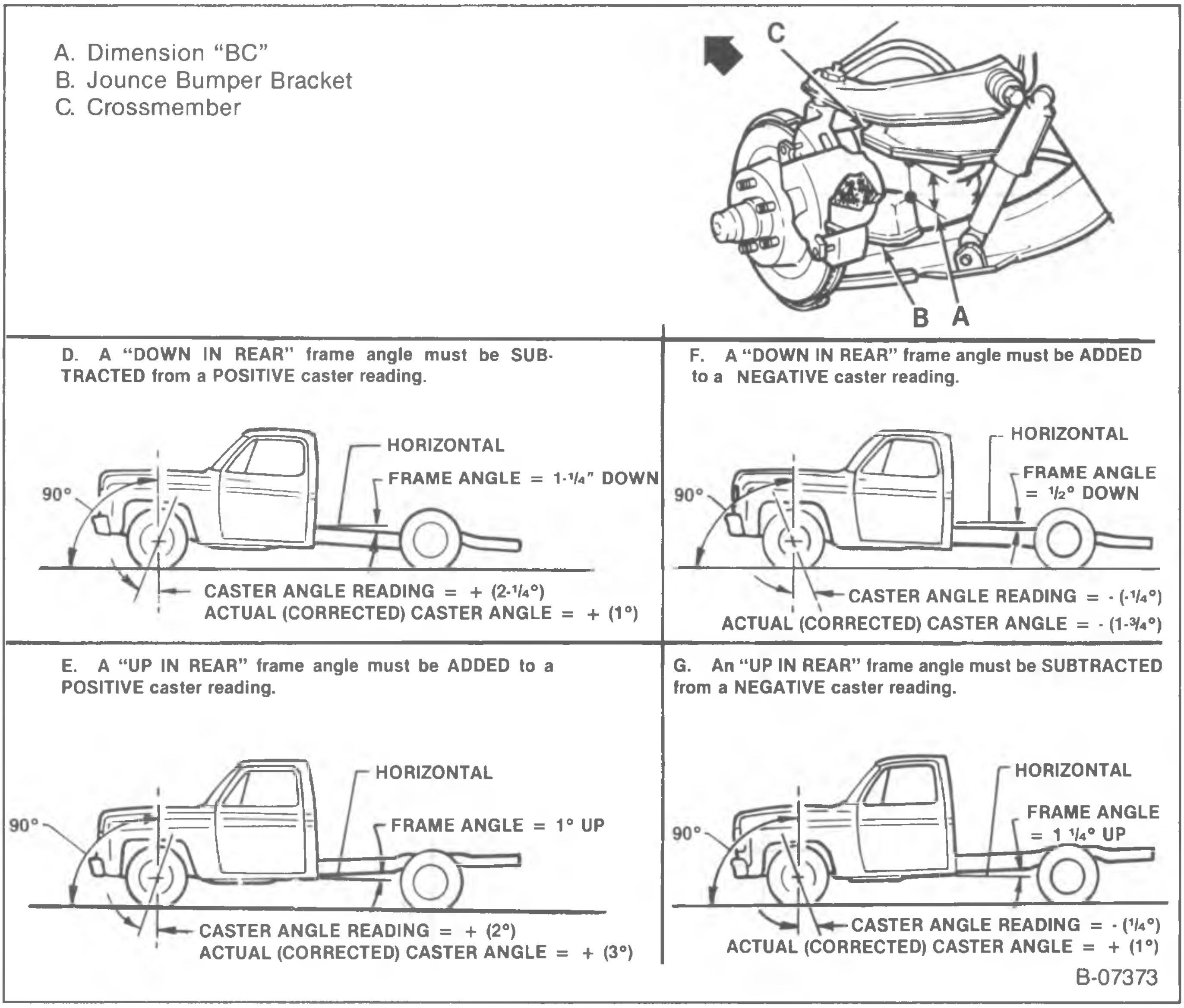
How To Determine Caster (Figure 2 and 3)

All caster specifications are given with vehicle frame angle of zero.

1. Position the vehicle on a smooth level surface.
2. Use a bubble protractor or inclinometer to measure the frame angle. Frame angle is the degree of tilt in the frame from the level position.
3. Determine whether the frame angle is "up in rear" or "down in rear."
4. Determine the caster angle reading from the alignment equipment.
5. Refer to figure 3. To determine an "actual (corrected) caster reading" with various frame angles and caster readings, one of the following rules apply:
   a. A **"DOWN IN REAR"** frame angle must be **SUBTRACTED** from a **POSITIVE** caster reading.
   b. An **"UP IN REAR" frame angle must be ADDED** to a **POSITIVE** caster reading.
   c. A **"DOWN IN REAR"** frame angle must be **ADDED** to a **NEGATIVE** caster reading.
   d. An **"UP IN REAR"** frame angle must be **SUBTRACTED** from a **NEGATIVE** caster reading.
6. Dimension "BC" measured 90 degrees from the lower surface of the crossmember (C) and to the inboard rear corner of the jounce bumper bracket (B).
7. Using dimension "BC" and the caster, camber, wheel toe-in chart sheet, find the recommended caster angle.
8. If the actual (corrected) caster cycle (Step 5) is not within the recommended caster angle (Step 7) make the necessary shim changes.

CAMBER

1. Determine the camber angle from the alignment equipment.
2. Add or subtract shims from both the front and rear bolts to affect a change.



A. Dimension “BC”
B. Jounce Bumper Bracket
C. Crossmember

D. A “DOWN IN REAR” frame angle must be SUBTRACTED from a POSITIVE caster reading.

F. A “DOWN IN REAR” frame angle must be ADDED to a NEGATIVE caster reading.

E. A “UP IN REAR” frame angle must be ADDED to a POSITIVE caster reading.

G. An “UP IN REAR” frame angle must be SUBTRACTED from a NEGATIVE caster reading.

Figure 3—Determining Caster

TOE-IN

1. Determine the toe-in from the alignment equipment.
2. Change the length of both tie rod sleeves to affect a toe change. Toe-in can be increased or decreased by changing the length of the tie rod ends. A threaded sleeve is provided for this purpose. When the tie rod ends are mounted ahead of the steering knuckle they must be decreased in length in order to increase toe-in. When the tie rod ends are mounted behind the steering kunckle they must be lenghtened in order to increase toe-in. Refer to STEERING LINKAGE (SEC. 3B1) for clamping instructions.

SPECIFICATIONS

CASTER CHART

Dimension "BC" MM	Dimension "BC" Inches	C100 (00)	C200 + 300 (00)	G100 + 200 (00)	G300 (00)	P200 + 300 (42) Except FS3, R05, JB8 or JB9	P200 + 300 (42) w/R05 Except FS3, JB8 or JB9	P300 w/JB8 or JB9 Except FS3	P300 (32) w/JB8 or JB9 Except FS3	P30/3500 (32,42) w/FS3	K100 + 200 + 300 (00)
38.1	1.50	—	—	3.4°	3.1°	—	—	—	—	+5° NOMINAL (References only,no means of adjustment provided).	+8° NOMINAL (References only, no means of adjustment provided).
44.5	1.75	—	—	3.2°	3.0°	—	—	—	—		
50.8	2.00	—	—	3.0°	2.7°	3.0°	2.5°	3.2°	—		
57.2	2.25	—	—	2.9°	2.4°	2.6°	2.2°	2.9°	—		
63.5	2.50	3.7°	1.5°	2.7°	2.1°	2.3°	1.9°	2.6°	5.5°		
70	2.75	3.5°	1.2°	2.5°	1.8°	2.0°	1.6°	2.4°	5.3°		
76.2	3.00	3.2°	0.9°	2.3°	1.5°	1.7°	1.3°	2.1°	5.0°		
82.5	3.25	2.9°	0.6°	2.2°	1.2°	1.4°	1.1°	1.8°	4.7°		
88.9	3.50	2.6°	0.3°	2.0°	1.0°	1.2°	0.8°	1.5°	4.4°		
95.3	3.75	2.4°	0.1°	1.8°	0.7°	0.9°	0.5°	1.2°	4.1°		
101.6	4.00	2.1°	-0.01°	1.7°	0.5°	0.6°	0.3°	1.0°	3.8°		
108	4.25	1.8°	-0.15°	1.5°	0.2°	0.4°	0.0°	0.7°	3.5°		
114.3	4.50	1.5°	-0.7°	1.4°	-0.03°	0.2°	-0.2°	0.5°	3.3°		
120.7	4.75	1.3°	-1.0°	—	—	-0.1°	-0.4°	0.2°	3.1°		
127	5.00	1.0°	-1.2°	—	—	—	—	-0.1°	2.9°		
133.4	5.25	0.8°	-1.4°	—	—	—	—	-0.3°	2.6°		
139.7	5.50	0.5°	-1.6°	—	—	—	—	-0.5	2.4°		
146	5.75	0.3°	-1.8°	—	—	—	—	-0.7°	2.2°		
152.4	6.00	0°	—	—	—	—	—	—	2.0°		

SPECIFICATIONS (CONTINUED)

CAMBER AND TOE-IN CHART

Model	Camber	Toe Angle	Total Toe-In
C100 (00)	0.70°	0.36°	4.5 mm (0.18 inch)
C200 + 300 (00)	0.25°		
K100 + 200 + 300 (00)	+ 1.5° Nominal (Reference only no means of adjustment provided).	0°	0 mm (0 inch)
G100 + 200 (00)	0.50°	0.36°	4.5 mm (0.18 inch)
G300 (00)	0.25°		
P200 + 300 (32, 42) Except FS3	0.25°	0.36°	4.5 mm (0.18 inch)
P30/3500 (32,42) with FS3	+ 1.5° Nominal (Reference only no means of adjustment provided).	0.1°	3.0 mm (0.12 inch)

CASTER, CAMBER, WHEEL TOE-IN ALIGNMENT SETTING TOLERANCES

	Check	Re-Set
Caster	± 1.00°	± 0.50°
Camber	± 0.75°	± 0.50°
Total Toe-In	± 3.0 mm (0.12 inch) ± 0.232°	± 1.5 mm (0.06 inch) ± 0.116°

SECTION 3B1

STEERING LINKAGE

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: "NOTICE: See 'Notice' on page 3B1-1 of this section."

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

CONTENTS

DESCRIPTION

The steering linkage for the C, G, and P20 + 30(42) model is composed of a pitman arm, idler arm, relay rod, two adjustable tie rods and a steering shock absorber (G-model). When the steering wheel is turned, the gear rotates the pitman arm which forces the relay rod to one side. The tie rods, which are connected to the relay rod by ball studs, transfers the steering force to the wheels. The tie rods are adjustable and are used for toe-in adjustments. The relay rod is supported by the pitman arm and idler arm. The idler arm pivots on a support attached to the frame rail. On the G-model the steering shock absorber is attached to a relay rod and a mounting bracket to the steering gear.

The P30(32) Motorhome model steering linkage has a similar adjustable tie rod assembly as described above. When the steering wheel is turned, the gear rotates the pitman arm which forces the nonadjustable connecting rod and relay arm to move the relay rod to one side. The relay arm and idler arm are attached to the frame by support assemblies. The support assemblies are adjustable for shaft end play. The steering shock absorber is attached to the frame and relay arm (figures 1 through 3).

The K model has a front driving axle assembly and the P30(00) with RPO-FS3 has an I-Beam axle assembly. The steering linkage consists of an adjustable connecting rod, steering shock absorber, pitman arm and a tie rod which connects the two steering knuckles together (figures 7 and 8).

The overall condition of the steering linkage affects steering performance. If parts are bent, damaged, worn or poorly lubricated, improper and possibly dangerous steering action will result.

Whenever any steering linkage components are repaired or replaced, check the steering geometry and front end alignment. Refer to FRONT END ALIGNMENT (SEC. 3A).

DIAGNOSIS OF STEERING LINKAGE

Refer to MANUAL STEERING (SEC. 3B2) or POWER STEERING (SEC. 3B3) in this manual, depending on vehicle equipment.

ON-VEHICLE SERVICE

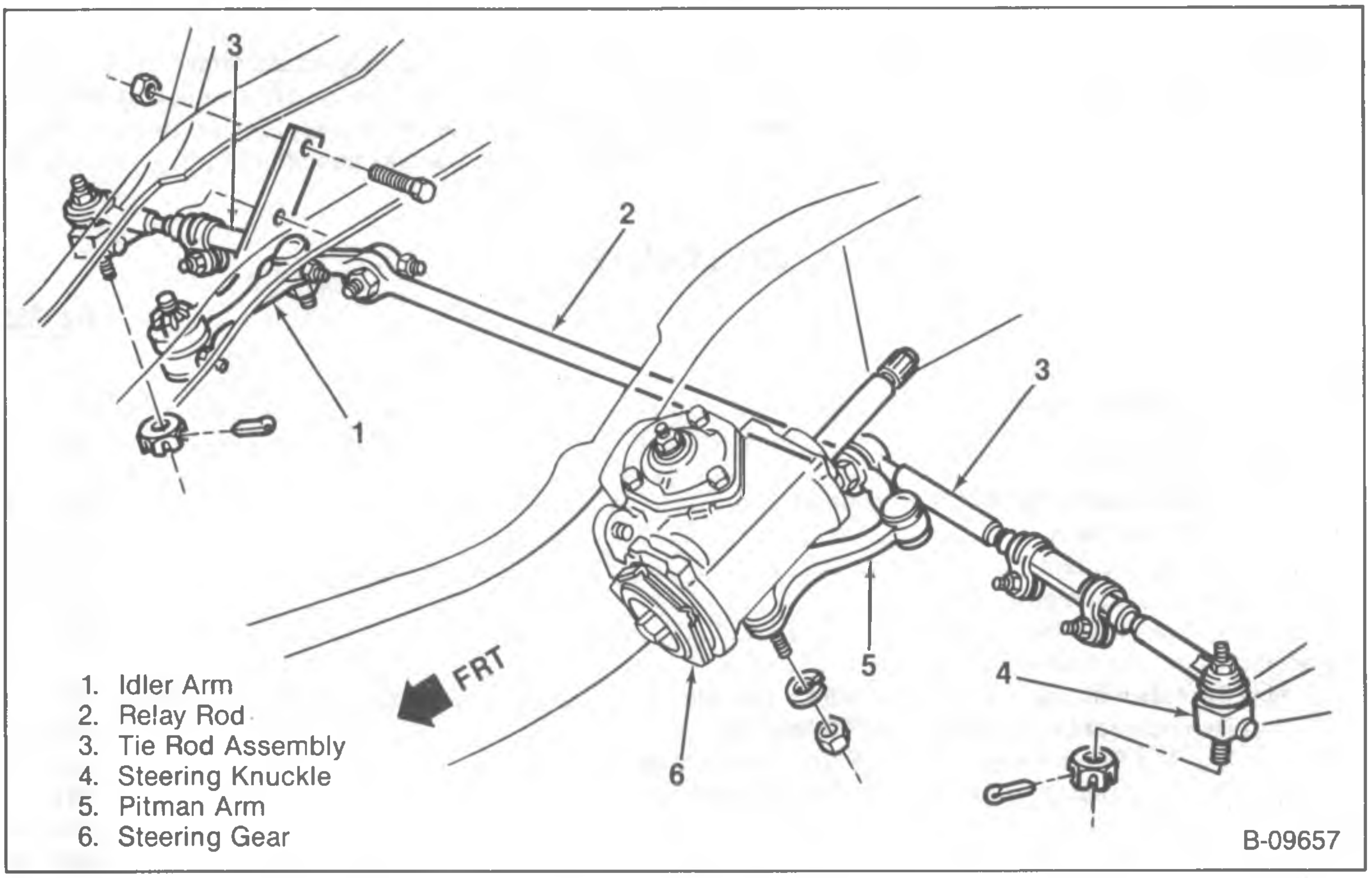


Figure 1—Steering Linkage (C and P20 + 30(42) Models)

IDLER ARM INSPECTION

Inspect (Figures 4 and 5)

1. Raise the vehicle. Allow the front wheels to rotate freely and the steering mechanism freedom to turn. Position the wheels in a straight ahead position.

2. Place a spring scale near the relay rod end of the idler arm. Exert a 110 N (25 lb.) force upward and then downward (G model the force is forward and rearward) while measuring the total distance the arm moves. The allowable deflection is ± 3.18mm (1/8 inch) for a total of 6.35mm (1/4 inch) (figures 4 and 5). Replace the idler arm if it fails this test with the exception of the P model motorhome. Refer to "Idler Arm Adjustment (P 30(32) Motorhome)" in this section.

Important

- Jerking the right wheel and tire assembly back and forth, causing an up and down movement of the idler arm, is NOT an acceptable testing procedure. There is no control on the amount of force being applied to the idler arm.

- Care should be used whenever shimmy complaints are suspected of being caused by loose idler arms. Before suspecting suspension or steering components, technicians should consider areas such as dynamic imbalance, runout or force variation of wheel and tire assemblies and road surface irregularities. Refer to WHEELS AND TIRES (SEC. 3E).

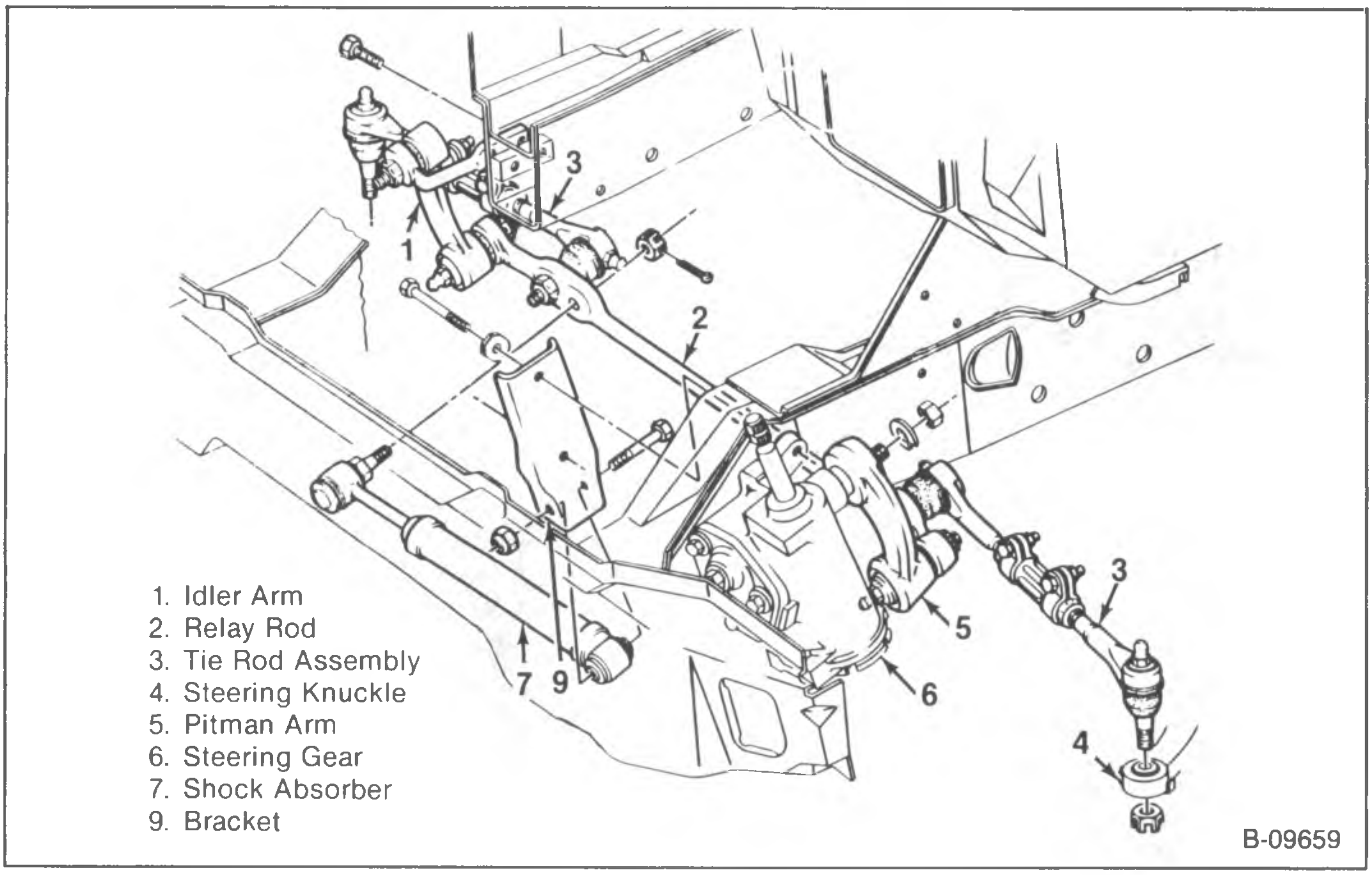


Figure 2—Steering Linkage (G Model)

IDLER ARM ADJUSTMENT (P30(32) MOTORHOME)

The frame mounted idler support assembly (10) is adjustable for support shaft end play. Check for idler arm movement as described in "Idler Arm Inspection." If the idler arm fails this test, adjust the support shaft end-play.

Adjust (Figure 3)

1. Loosen the support assembly jam nut.
2. Tighten the adjuster plug to metal-to-metal contact.
3. Back off the adjuster plug 1/8 of a turn (1/2 of a flat on the square nut).

Tighten

- Jam nut to 40 N·m (30 ft. lbs.). The adjusting plug should not rotate.

IDLER ARM REPLACEMENT

Important

- Do not attempt to free the ball stud by using a pickle fork or wedge type tool, because seal or bushing damage could result (figure 6). Use the proper tool to separate all ball joints.

Remove or Disconnect (Figures 1 and 2)

Tool Required:
J-24319-01 Steering Linkage Puller.

- Raise the vehicle.

1. Idler arm frame bolts.
2. Nut from the idler arm ball stud.
3. Idler arm (1) from the relay rod (2). Use J-24319-01.

Inspect

— Ball stud threads for damage.
— Ball stud seal for cuts or other damage.

Clean

- Threads on the ball stud and in the ball stud nut.

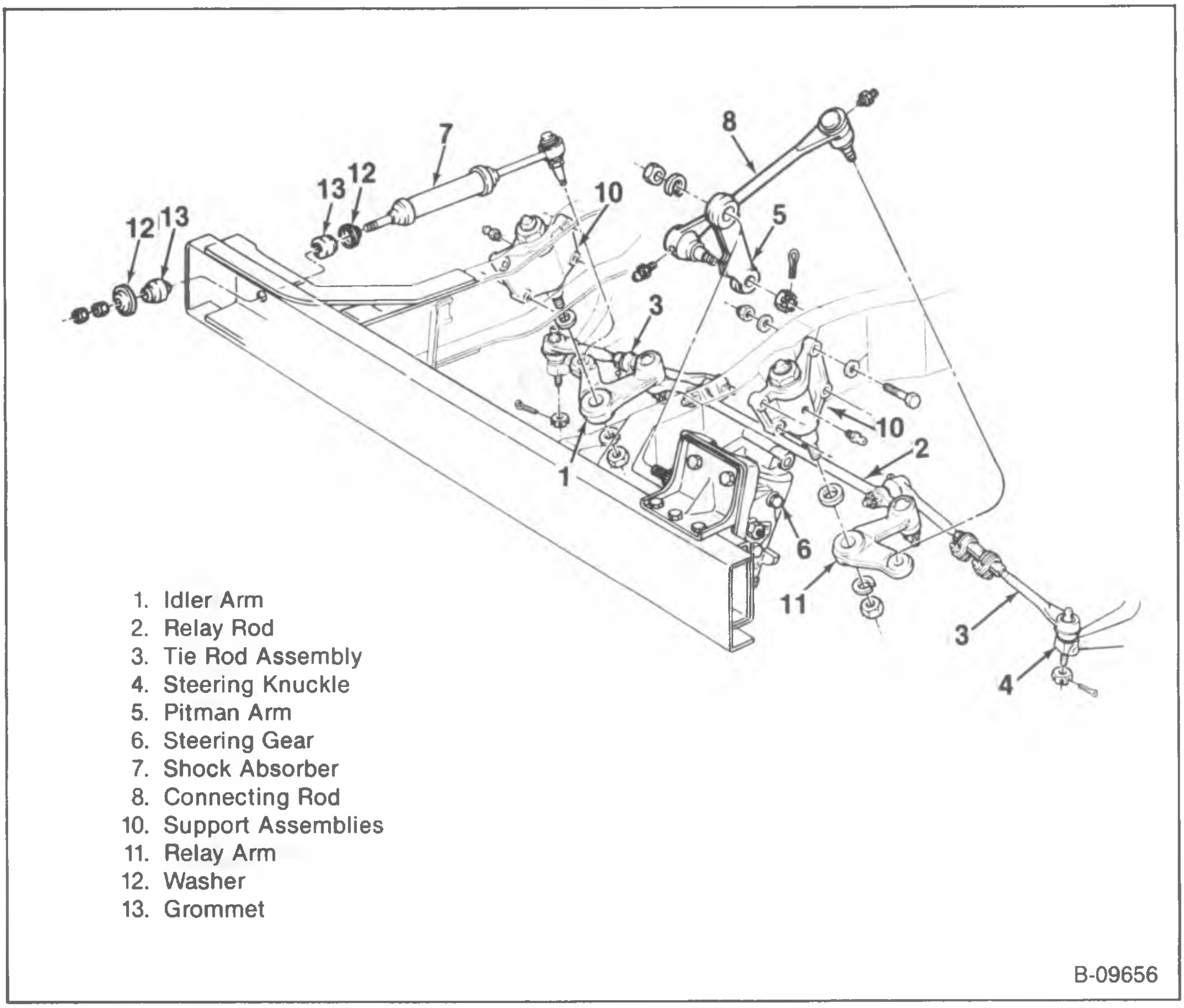


Figure 3—Steering Linkage (P30(32) Motorhome)

Install or Connect (Figures 1 and 2)

Tools Required:
J-29193 Steering Linkage Installer (12mm).
J-29194 Steering Linkage Installer (14mm).

NOTICE: For steps 1 and 3 see "Notice" on page 3B1-1 of this section.

- Position the idler arm (1) on the frame.

1. Frame bolts to the idler arm.

Tighten

- Bolts to "Specifications" at the end of this section.

2. Relay rod (2) to the idler arm ball stud. Make certain the seal is on the stud. Tighten tool J-29193 or J-29194 to 54 N·m (40 ft. lbs.) to seat the tapers. Remove the tool.
3. Prevailing torque nut to the idler arm ball stud.

Tighten

- Nut to "Specifications" at the end of this section.

- Lower the vehicle.

Adjust

- Toe-in if necessary. Refer to FRONT END ALIGNMENT (SEC. 3A) in this manual.

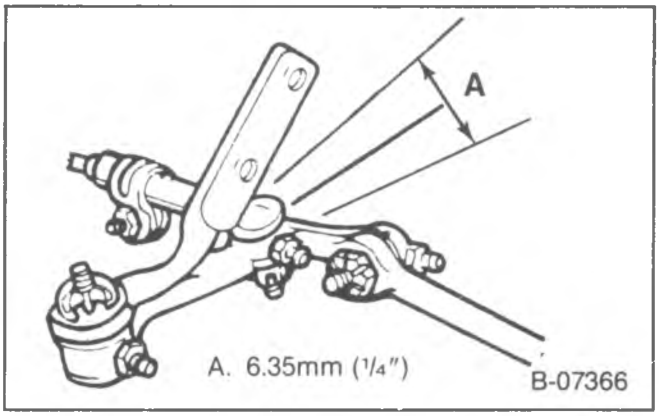


Figure 4—Checking Idler Arm Movement

RELAY ROD REPLACEMENT

Important

- Use the proper tool to separate all tie rod and ball joints.

Remove or Disconnect (Figures 1 through 3)

Tool Required:

J-24319-01 Steering Linkage Puller.

- Raise the vehicle.

1. Inner tie rod (3) from the relay rod (2). Refer to "Tie Rod Replacement" in this section.
2. Nuts from the idler arm (1) and pitman arm (5) or relay arm (11) ball studs at the relay rod (2).
3. Relay rod (2) from the idler arm (1). Use J-24319-01.
4. Relay rod (2) from the pitman arm (5) or relay arm (11). Use J-24319-01.

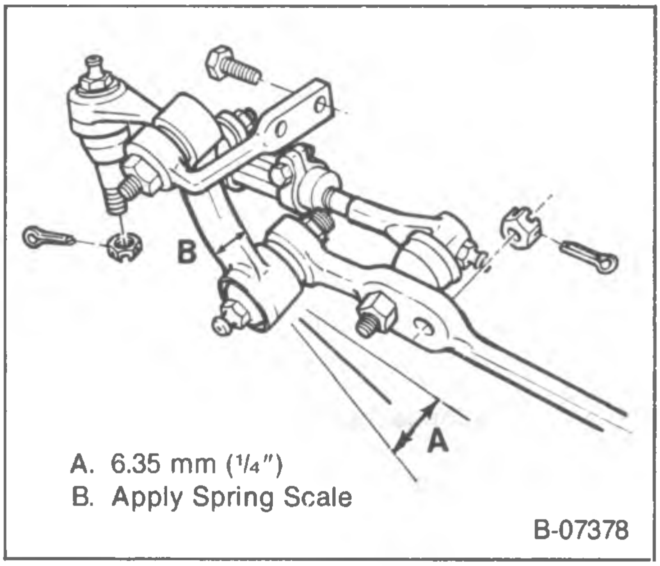


Figure 5—Checking Idler Arm Movement (G-Model)

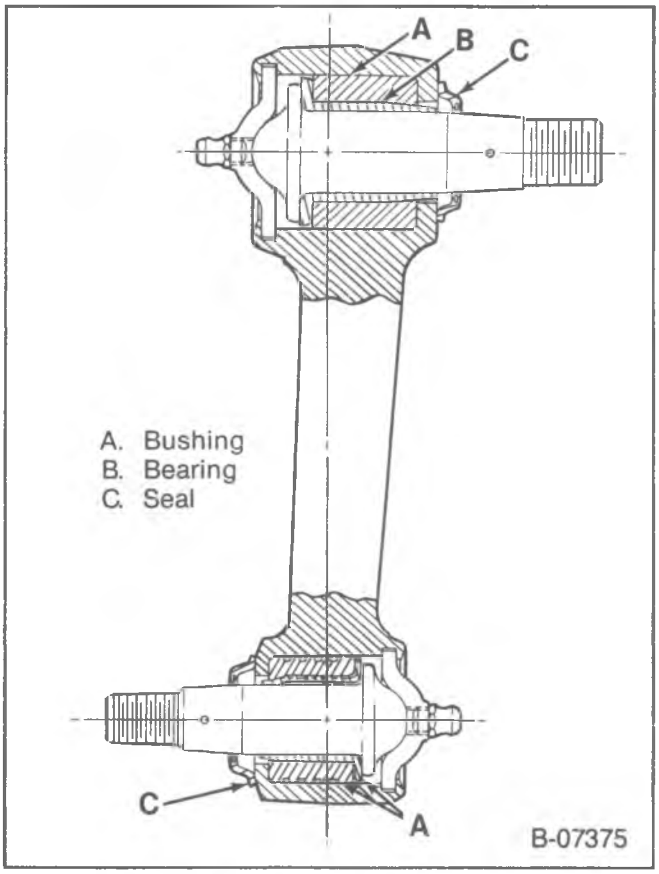


Figure 6—Idler Arm (Internal View)

Inspect

- Threads on the tie rod and the tie rod end for damage.
- Ball stud threads for damage.
- Ball stud seals for excessive wear.

Clean

- Threads on the ball stud and the ball stud nut.

Install or Connect (Figures 1 through 3)

Tools Required:

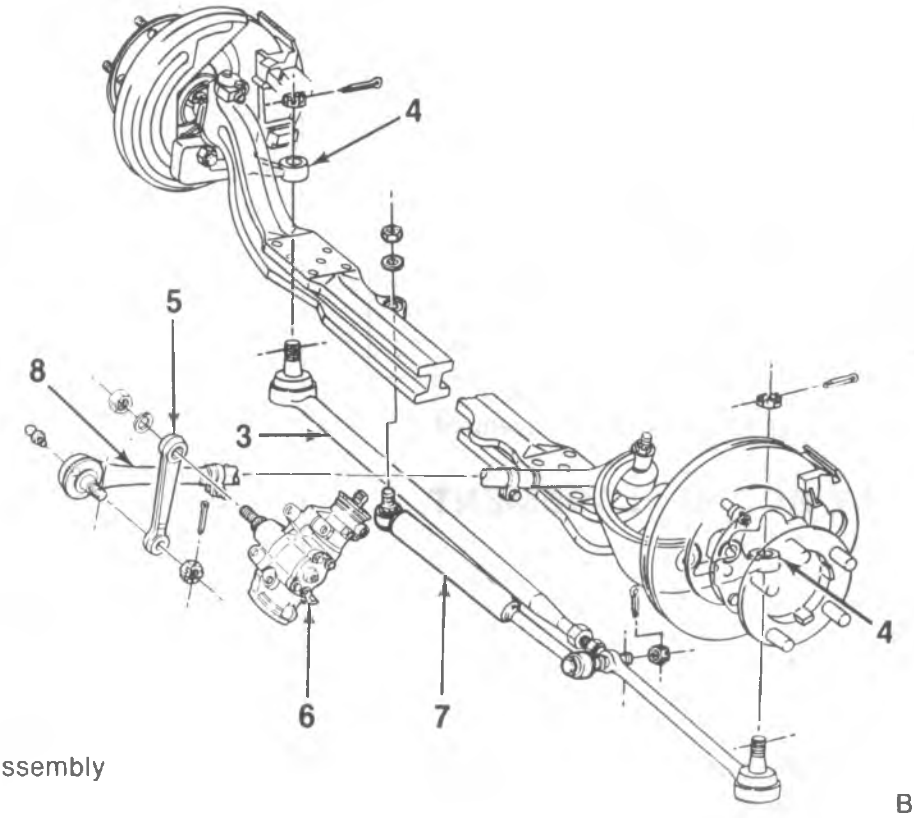
J-29193 Steering Linkage Installer (12mm).

J-29194 Steering Linkage Installer (14mm).

1. Relay rod (2) to the idler arm (1) and the pitman arm (5) or relay arm (11) ball stud. Make certain the seal is on the stud. Tighten J-29193 or J-29194 to 54 N·m (40 ft. lbs.) to seat the tapers. Remove the tool.

NOTICE: See "Notice" on page 3B1-1 of this section.

2. Nuts to the idler arm and the pitman arm or relay arm ball stud.



3. Tie Rod Assembly
4. Steering Knuckle
5. Pitman Arm
6. Steering Gear
7. Shock Absorber
8. Connecting Rod Assembly

Figure 7—Steering Linkage (P30(00)FS3)

Tighten

- Nuts to "Specifications" at the end of this section.

3. Inner tie rod (3) to the relay rod. Refer to "Tie Rod Replacement."

- Lower the vehicle.

PITMAN ARM REPLACEMENT

Important

- Use the proper tool to separate all ball joints.

Remove or Disconnect (Figures 1, 2, 3, 7 and 8)

Tools Required:
J-24319-01 Steering Linkage Puller.
J-29107 Pitman Arm Puller.
J-6632-01 Pitman Arm Remover.

- Raise the vehicle.

1. Relay rod nut or connecting rod nut and cotter pin from the pitman arm ball stud.
2. Relay rod (2) or connecting rod (8) from the pitman arm (5). Use J-24319-01.
3. Pitman arm nut and washer.

- Mark the pitman arm and the pitman shaft. This will permit proper alignment at assembly.

NOTICE: Do not hammer on pitman arm, pitman shaft, or puller. Damage to pitman arm or steering gear may result.

4. Pitman arm (5). Use J-6632-01 or J-29107.

Inspect

- Ball stud threads for damage.
- Ball stud seals for excessive wear.

Clean

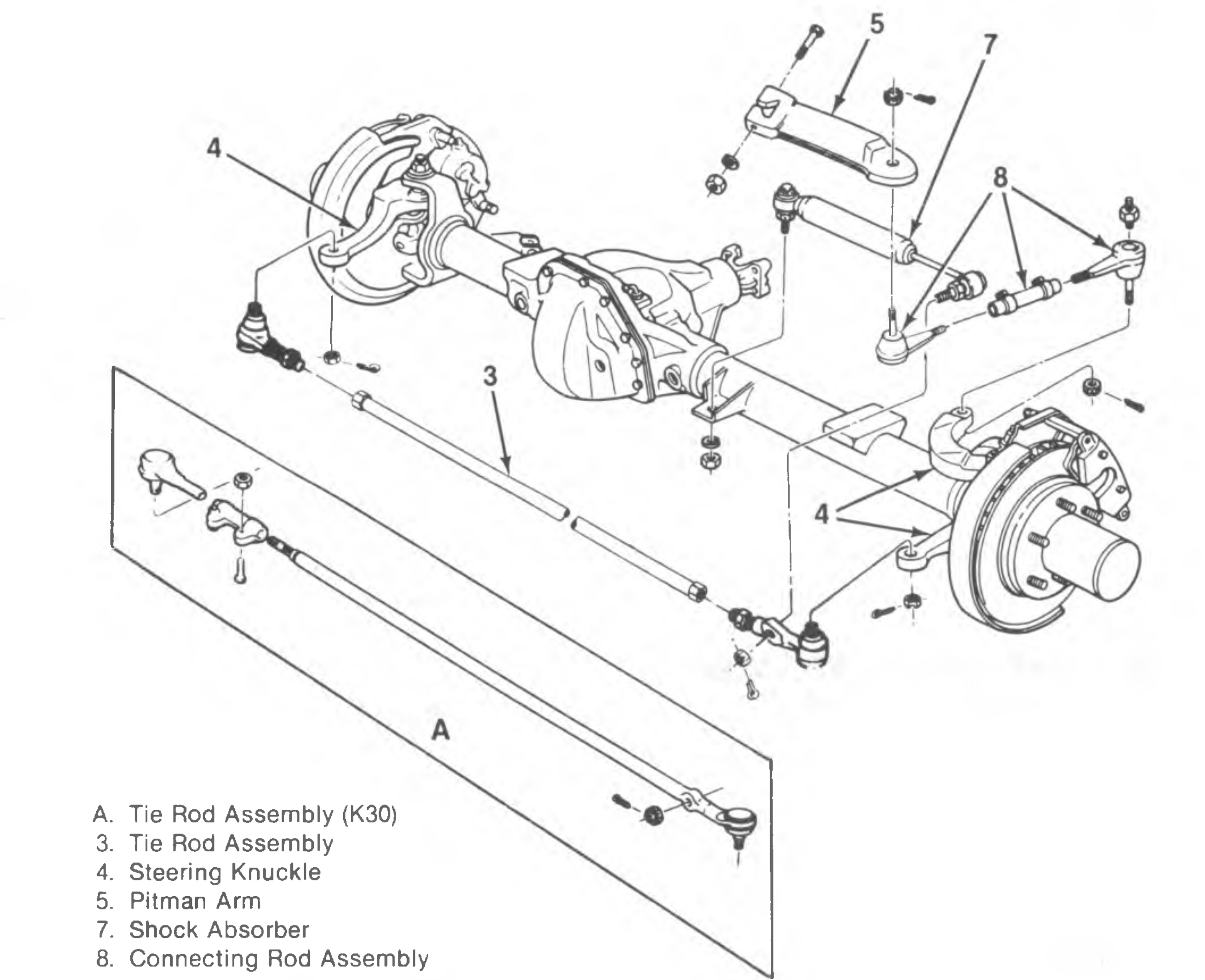
- Threads on the ball stud and ball stud nut.

Install or Connect (Figures 1, 2, 3, 7 and 8)

Tools Required:

J-29193 Steering Linkage Installer (12mm).

J-29194 Steering Linkage Installer (14mm).



A. Tie Rod Assembly (K30)
3. Tie Rod Assembly
4. Steering Knuckle
5. Pitman Arm
7. Shock Absorber
8. Connecting Rod Assembly

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Figure 8—Steering Linkage (K Model)

NOTICE: For steps 2 and 4 see "Notice" on page 3B1-1 of this section.

NOTICE: If a clamp type pitman arm is used, spread the pitman arm just enough, with a wedge, to slip the arm onto the pitman shaft. Do not spread the pitman arm more than required to slip over the pitman shaft with hand pressure. Do not hammer, or damage to the steering gear may result.

1. Pitman arm (5) on the pitman shaft. Line up the marks made at removal.
2. Pitman arm washer and nut.

Tighten

- Pitman arm nut to "Specifications" at the end of this section.

3. Relay rod (2) or connecting rod (8) to the pitman arm ball stud. Make certain the seal is on the stud. Tighten tool J-29193 or J-29194 to 54 N·m (40 ft. lbs.) to seat the tapers. Remove the tool.
4. Relay rod nut or the connecting rod castellated nut and cotter pin to the pitman arm ball stud.

Tighten

- Castellated nut to "Specifications" as instructed at the end of this section.

- Lower the vehicle.

STEERING SHOCK ABSORBER INSPECTION

Steering shock absorbers are a sealed assembly and are nonrepairable. Replace the complete assembly if damaged.

Inspect (Figures 2, 3, 7 and 8)

1. Shock absorber for fluid leakage. A slight film of fluid is allowable near the shaft seal. If there is excessive fluid leakage, be sure it's from the shock absorber and then replace the shock absorber.
2. Shock absorber bushing for excessive wear. Replace shock absorber if necessary.
3. Test the shock absorber.
   - Disconnect the shock absorber from the frame or axle end.
   - Extend and compress the shock absorber using as much travel as possible. Resistance should be smooth and constant for each stroking rate. Replace the shock absorber if any binding or unusual noises are present.
   - Install the end of the shock absorber. Torque to specifications.

STEERING SHOCK ABSORBER REPLACEMENT

Remove or Disconnect

1. Shock absorber mounting nuts and washers.
- Washer (12) and grommet (13) (P30(32) model).
2. Cotter pin and castellated nut.
3. Shock absorber (7).

Inspect

— Shock absorber for leaks and damage.
— Shock absorber bushings for wear and damage.
— Grommet (13) for wear.

Install or Connect

NOTICE: For steps 2 and 3 see "Notice" on page 3B1-1 of this section.

1. Shock absorber with bushings to the axle bracket.
- Washer (12) and grommet (13) (P30(32) model).
2. Shock absorber mounting nuts and washers.

Tighten

- Shock absorber nuts to "Specifications" at the end of this section.

3. Castellated nut and cotter pin.

Tighten

- Castellated nut to "Specifications" as instructed at the end of this section.

TIE ROD REPLACEMENT (C, G, P20 AND 30(42) MODELS)

There are two tie rod assemblies. Each assembly is of a five piece construction, consisting of an adjuster tube, two clamps and two tie rod ends. The ends are threaded into the sleeve and secured with the clamps. Right and left hand threads are used for toe-in adjustments and steering gear centering. The tie rod ends should be replaced when excessive up and down motion is present, or when excessive end play or loss of motion at the ball stud exists.

Before servicing, note the position of the tie rod adjuster tube and the direction the bolts are installed. The tie rod adjuster tube components may be rusted. If the torque required to remove the nut from bolt exceeds 9 N·m (7 ft. lbs.) discard the nuts and bolts. Apply penetrating oil between the clamp and tube and rotate the clamps until they move freely. Install all parts, with the correct part number, in the proper position.

Important

- Use the proper tool to separate all tie rod and ball joints.

Remove or Disconnect (Figures 1 through 3)

Tool Required:
J-6627-A Wheel Stud Remover and Tie Rod Remover.

- Raise the vehicle.

1. Cotter pins and castellated nuts from the outer tie rod ball stud.
2. Outer tie rod ball studs from the steering knuckle (4). Use J-6627-A (figure 9).
3. Inner tie rod ball stud from the relay rod (2). Use J-6627-A.
4. Tie rod ends from the adjuster tube. Loosen the clamp bolts and unscrew the end assemblies.

Inspect

— Tie rod end for damage.
— Tie rod end seals for excessive wear.
— Threads on the tie rod and tie rod end for damage.
— Ball stud threads for damage.
— Adjuster tube for bending or damaged threads.

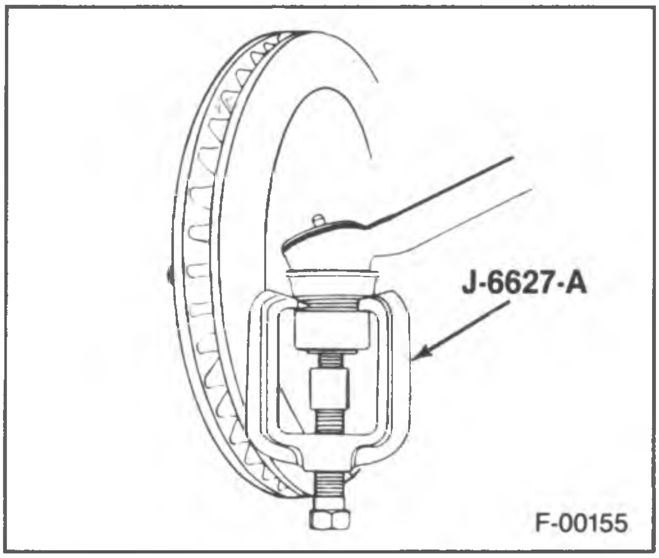


Figure 9—Freeing Ball Stud

Clean

— The tapered surfaces.
— Threads on the ball stud and in the ball stud nut.

Install or Connect (Figures 1 through 3)

Tools Required:
J-29193 Steering Linkage Installer (12mm).
J-29194 Steering Linkage Installer (14mm).

NOTICE: For steps 3 and 5 see "Notice" on page 3B1-1 of this section.

- If the rod ends were removed, lubricate the tie rod threads with chassis lubricant.

1. Tie rod ends to the adjuster tube. The number of threads on both the inner and outer rod ends must be equal within three threads.
2. Inner tie rod ball studs to the relay rod (2). The seal must be on the stud. Tighten J-29193 or J-29194 to 54 N·m (40 ft. lbs.) to seat the tapers. Remove the tool.
3. Prevailing torque nut to the inner tie rod ball stud.

Tighten

- Nut to "Specifications" at the end of this section.

4. Outer tie rod ball studs to the steering knuckle.
5. Castellated nuts and cotter pins to the outer rod ball studs.

Tighten

- Castellated nuts to "Specifications" as instructed at the end of this section.

Adjust

- Toe-in. Refer to FRONT END ALIGNMENT (SEC. 3A) in this manual.

6. Adjuster tube clamp bolts (figures 10, 11 and 12). Before tightening the clamp bolts, be sure the following conditions have been met:
   - The clamp must be positioned between the locating dimples at either end of the adjuster tube.
   - The clamps must be positioned within the angular travel shown in figures 10, 11 or 12.
   - Both inner and outer tie rod ends must rotate for their full travel. The position of each tie rod end must be maintained as the clamps are tightened to ensure free movement of each joint.
   - The clamp ends may touch when nuts are torqued to specification, but the gap next to the adjuster tube must NOT be less than the minimum dimension shown in figures 10, 11 or 12.

Tighten

- Adjuster tube clamp bolts to "Specifications" at the end of this section.

TIE ROD REPLACEMENT (K AND P30(00)FS3 MODELS)

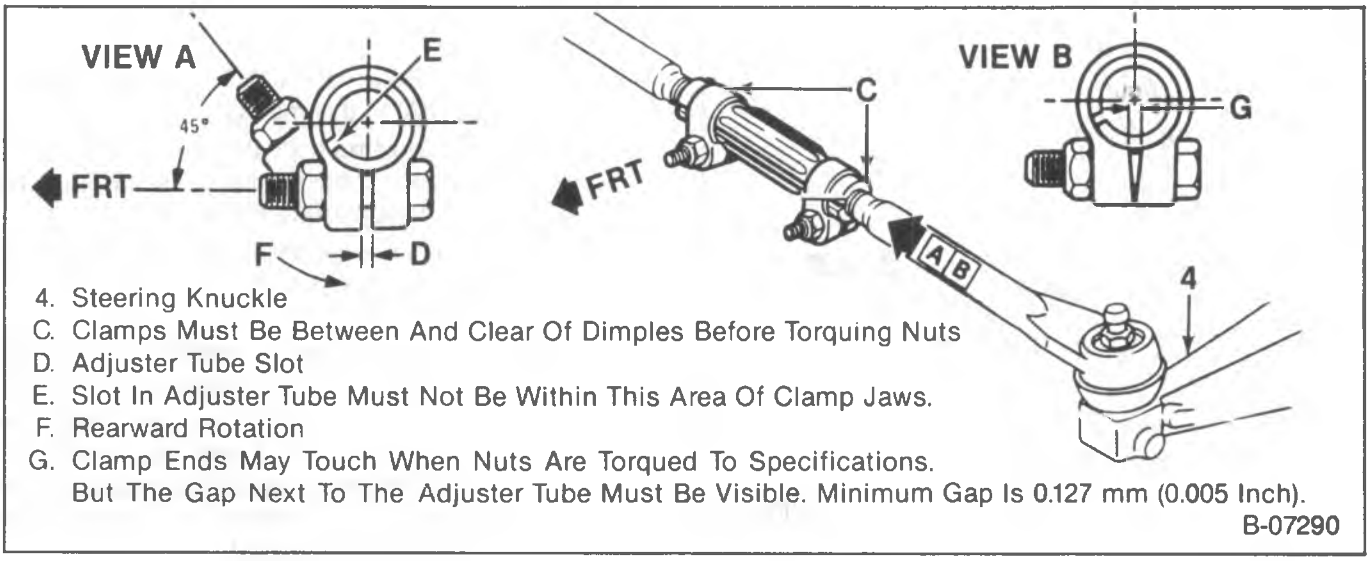
Remove or Disconnect (Figures 7 and 8)

Tool Required:
J-6627-A Wheel Stud Remover and Tie Rod Remover.

1. Cotter pins and castellated nuts from the rod assembly (3).
2. Shock absorber (7) from the tie rod assembly (3).
3. The rod ball studs from the steering knuckle (4). Use J-6627-A.
4. Tie rod end bodies. Count the number of turns needed to remove the tie rod end bodies.
5. Tie rod ends from the adjuster tube. On K30 models, note the position of the adjuster tube, and the direction from which the bolts are installed.

Inspect

— Tie rod for bending or damaged threads.
— Tie rod end seals for wear.
— Ball stud threads for damage.
— Adjuster tube for bending or damaged threads (K30).



4. Steering Knuckle
C. Clamps Must Be Between And Clear Of Dimples Before Torquing Nuts
D. Adjuster Tube Slot
E. Slot In Adjuster Tube Must Not Be Within This Area Of Clamp Jaws.
F. Rearward Rotation
G. Clamp Ends May Touch When Nuts Are Torqued To Specifications. But The Gap Next To The Adjuster Tube Must Be Visible. Minimum Gap Is 0.127 mm (0.005 Inch).

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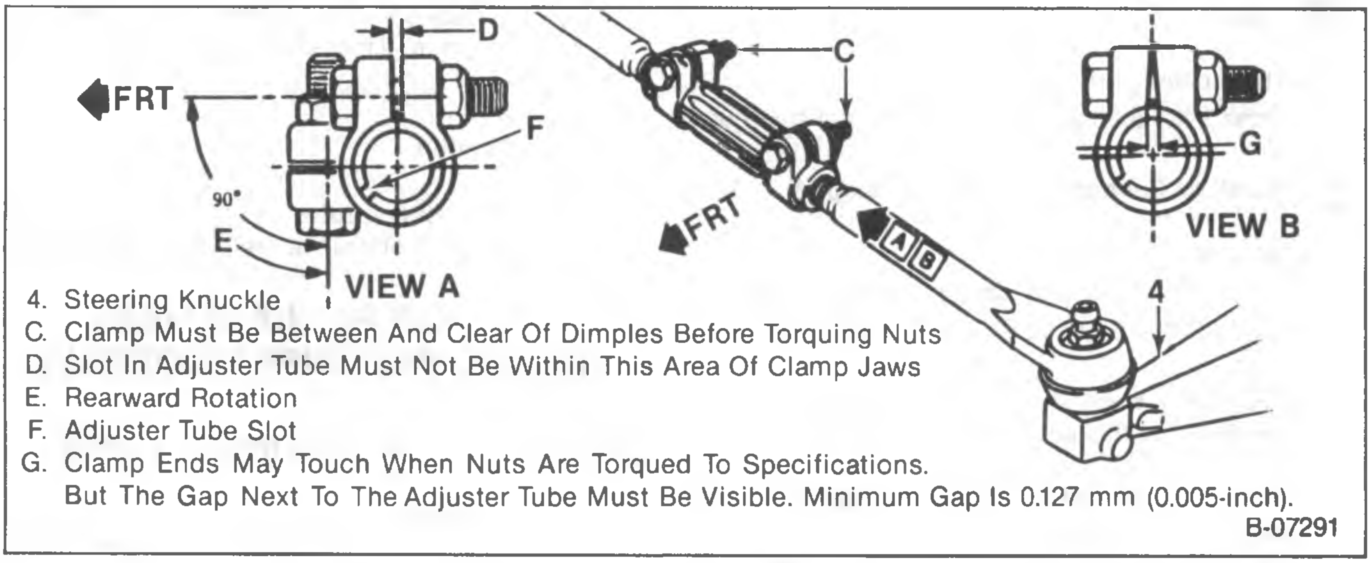
Figure 10—Tie Rod Clamp And Adjuster Tube Positioning (C Model)



4. Steering Knuckle
C. Clamp Must Be Between And Clear Of Dimples Before Torquing Nuts
D. Slot In Adjuster Tube Must Not Be Within This Area Of Clamp Jaws
E. Rearward Rotation
F. Adjuster Tube Slot
G. Clamp Ends May Touch When Nuts Are Torqued To Specifications. But The Gap Next To The Adjuster Tube Must Be Visible. Minimum Gap Is 0.127 mm (0.005-inch).

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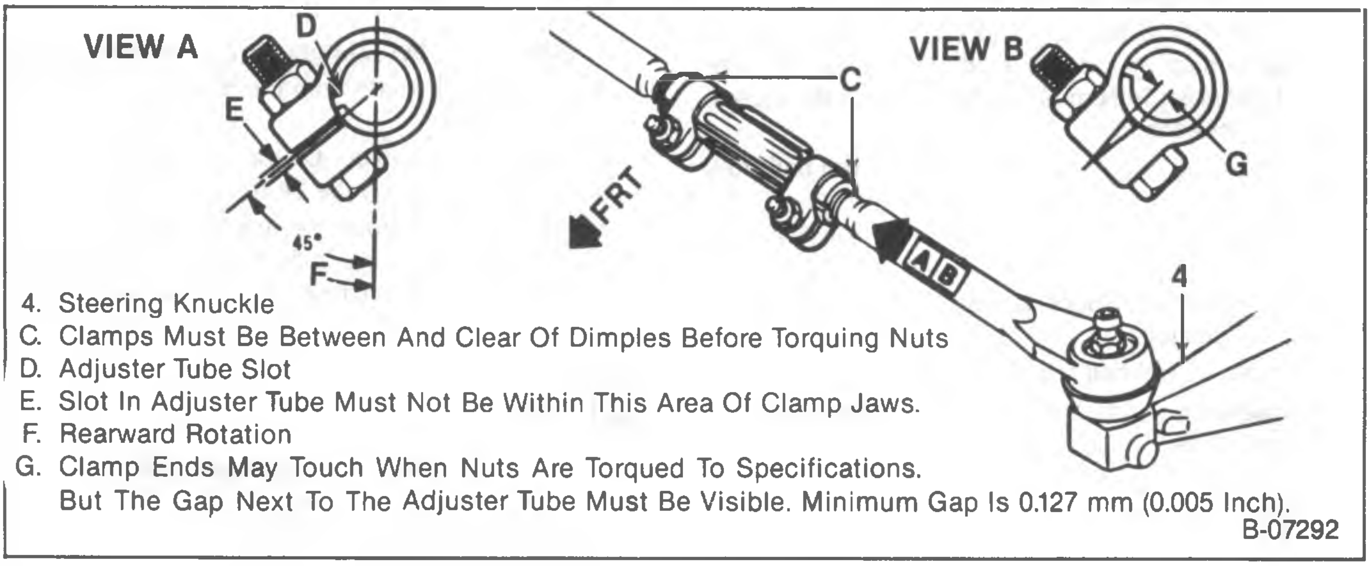
Figure 11—Tie Rod Clamp And Adjuster Tube Positioning (G Model)



4. Steering Knuckle
C. Clamps Must Be Between And Clear Of Dimples Before Torquing Nuts
D. Adjuster Tube Slot
E. Slot In Adjuster Tube Must Not Be Within This Area Of Clamp Jaws.
F. Rearward Rotation
G. Clamp Ends May Touch When Nuts Are Torqued To Specifications. But The Gap Next To The Adjuster Tube Must Be Visible. Minimum Gap Is 0.127 mm (0.005 Inch).

B-07292

Figure 12—Tie Rod Clamp And Adjuster Tube Positioning (All P Models Excluding FS3)

Clean

- — The tapered surfaces.
- — Threads on the ball stud and in the ball stud nut.

Install or Connect (Figures 7 and 8)

- If the tie rod ends were removed, lubricate the tie rod threads with chassis lubricant.

1. Tie rod end bodies to the tie rod (if removed). Screw the rod assembly on the same number of turns as when removed.

- Tie rod ends to the adjuster tube (K30).

2. Outer tie rod ball studs to the steering knuckle (4).
3. Shock absorber (7) to the tie rod assembly.

NOTICE: See "Notice" on page 3B1-1 of this section.

4. Castellated nuts and cotter pins to the tie rod assembly.

Tighten

- Castellated nuts to "Specifications" as instructed at the end of this section.

Adjust

- Toe-in. Refer to FRONT END ALIGNMENT (SEC. 3A) in this manual.

Tighten

- Jam nut at the tie rod end bodies to "Specifications" at the end of this section.
- Adjuster tube clamp bolts to "Specifications" at the end of this section (K30).

CONNECTING ROD REPLACEMENT (K AND P30(00)FS3 MODEL)

The adjustable connecting rod is used for centering the steering gear with the front axle. Replace the connecting rod if the rod is bent or if the ball stud is loose.

Important

- Use the proper tool to separate all ball joints.

Remove or Disconnect (Figures 7 and 8)

Tool Required:
J-24319-01 Steering Linkage Puller.

- Raise the vehicle.

1. Castellated nuts and cotter pins from the connecting rod (8).
2. Connecting rod (8) from the pitman arm (5). Use J-24319-01.
3. Connecting rod (8) from the steering knuckle (4). Use J-24319-01.

Important

- Before removing the connecting rod adjuster tube, note the position of the tube and the direction from which the bolts are installed.

4. Connecting rod ends from the adjuster tube. Loosen the clamp bolts and unscrew the end assemblies.
   - The connecting rod adjuster tube components may be rusted. If the torque required to remove the nut from the bolt exceeds 9 N·m (7 ft. lbs.) discard the nuts and bolts.
   - Apply penetrating oil between the clamps and the tube. Rotate the clamps until they move freely.

Inspect

- Ball stud threads for damage.
- Ball stud seals for wear.
- Adjuster tube for bending or damaged threads.

Clean

- Threads on the ball stud and ball stud nut.

Install or Connect (Figures 7 and 8)

NOTICE: For steps 3 and 5 see "Notice" on page 3B1-1 of this section.

- If the connecting rod ends were removed, lubricate the connecting rod threads with chassis lubrication.

1. Connecting rod ends to the adjuster tube. The number of threads on both the inner and outer connecting rod ends must be equal within three threads.
2. Inner connecting rod (8) ball stud to the pitman arm (5) (on K models install the short end). Make certain the seal is on the stud.
3. Castellated nut and cotter pin to the inner connecting rod ball stud.

Tighten

- Castellated nut to "Specifications" as instructed at the end of this section.

4. Outer connecting rod ball stud to the steering knuckle (4).
5. Castellated nut and cotter pin to the outer connecting rod ball stud.

Tighten

- Castellated nut to "Specifications" as instructed at the end of this section.

- The connecting rod ends to the pitman arm and steering knuckle must be in correct relationship to each other after adjustment within ± 2 degrees (K model).

Adjust

- Steering gear high point centering. Refer to POWER STEERING (SEC. 3B3) in this manual.

6. Adjuster tube clamp bolts (figures 13 and 14). Before tightening the clamp bolts, be sure the following conditions have been met.
   - The clamps must be positioned between the locating dimples at either end of the adjuster tube.
   - The clamps must be positioned within the angular travel shown in figures 13 and 14.
   - The clamp ends may touch when nuts are torqued to specification, but the gap adjacent to adjuster tube must NOT be less than minimum dimension shown in figures 13 and 14.
   - Both inner and outer connecting rod ends must rotate for their full travel. The position of each connecting rod end must be maintained as the clamps are tightened to ensure free movement of each joint.

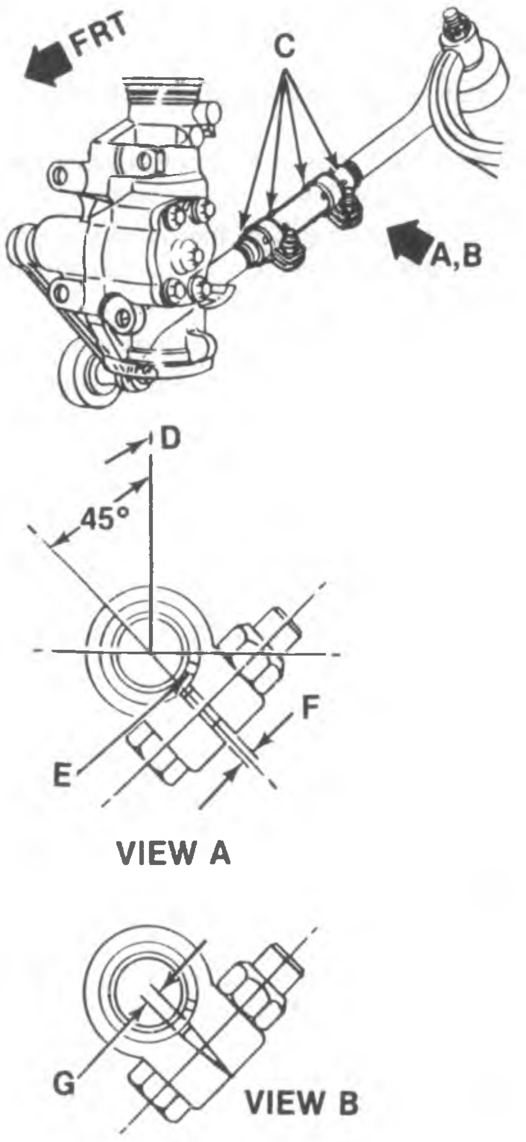
Tighten

- Adjuster tube bolts to "Specifications" at the end of this section.

- Lower the vehicle.

CONNECTING ROD REPLACEMENT (P30(32) MOTORHOME)

The non-adjustable connecting rod is used to connect the pitman arm to the relay arm. Replace the connecting rod if the rod is bent or the ball stud is loose.



C. Clamps must be between and clear of dimples before torquing nuts.
D. Outboard Rotation
E. Adjuster Tube Slot
F. Slot in adjuster tube must not be within this area of clamp jaws.
G. Clamp ends may touch when nuts are torqued to specifications. But the gap next to the adjuster tube must be visible. Minimum gap is 0.127 mm (0.005-inch).

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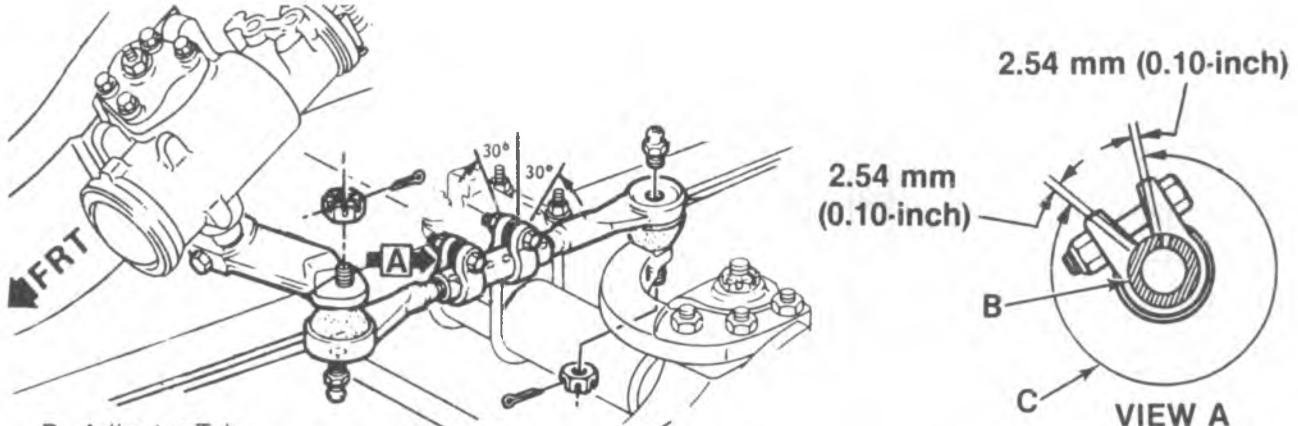
Figure 13—Connecting Rod Clamp And Adjuster Tube Positioning (P30(00)FS3)



B. Adjuster Tube
C. Slot Of Adjuster Tube May Be In Any Position On Arc Shown But Not Closer Than 2.54 mm (0.10 Inch) To The Edge Of Clamp Jaws Or Between.

B-07294

Figure 14—Connecting Rod Clamp And Adjuster Tube Positioning (K Model)

Important

- Use the proper tool to separate the ball joints.

Remove or Disconnect (Figure 3)

Tool Required:
J-24319-01 Steering Linkage Puller.

- Raise the vehicle.

1. Castellated nuts and cotter pins from the connecting rod (8).
2. Connecting rod (8) from the pitman arm (5). Use J-24319-01.
3. Connecting rod (8) from the relay arm (11). Use J-24319-01.

Inspect

— Ball stud threads for damage.
— Ball stud seals for excessive wear.

Clean

- Threads on the ball stud and ball stud nut.

Install or Connect (Figure 3)

1. Connecting rod (8) to the pitman arm (5) and relay arm (11).
2. Castellated nuts and cotter pins.

Tighten

- Castellated nuts to "Specifications" as instructed at the end of this section.
- Lower the vehicle.

SPECIFICATIONS

	C Model		G Model		P20 AND 30(42)		P30(32) Motorhome		P30(00)FS3		K Model	
	N·m	Ft. Lbs.	N·m	Ft. Lbs.	N·m	Ft. Lbs.	N·m	Ft. Lbs.	N·m	Ft. Lbs.	N·m	Ft. Lbs.
Tie Rod (3) End To Steering Knuckle (4)*	62	46	62	46	62	46	62	46	220	162	55	40
Tie Rod (3) Adjuster Tube Bolts	19	14	19	14	19	14	19	14	—	—	55	40
Tie Rod (3) To Relay Rod (2)	90	66	90	66	90	66	90	66	—	—	—	—
Idler Arm (1) To Relay Rod (2)	90	66	90	66	90	66	90	66	—	—	—	—
Idler Arm (1) To Frame	40	30	47	35	40	30	—	—	—	—	—	—
Pitman Arm (5) To Relay Rod (2)	90	66	90	66	90	66	—	—	—	—	—	—
Pitman Arm (5) To Steering Gear (6)	250	184	250	184	250	184	170	125	170	125	125	92
Bolt To Shock Absorber Bracket (9)	—	—	100	75	—	—	—	—	—	—	—	—
Shock Absorber (7) To Tie Rod (3)*	—	—	62	46	—	—	—	—	62	46	62	46
Shock Absorber (7) To Frame	—	—	62	46	—	—	11	8	47	35	110	81
Shock Asborber (7) To Idler Arm (1)*	—	—	—	—	—	—	62	46	—	—	—	—
Connecting Rod (8) To Adjuster Tube Bolts	—	—	—	—	—	—	—	—	68	50	54	40
Connecting Rod (8) To Pitman Arm (5)*	—	—	—	—	—	—	95	70	95	70	120	89
Connecting Rod (8) To Steering Knuckle (4)*	—	—	—	—	—	—	—	—	95	70	120	89
Connecting Rod (8) To Relay Arm (11)*	—	—	—	—	—	—	95	70	—	—	—	—
Support Assemblies (10) To Frame	—	—	—	—	—	—	65	48	—	—	—	—
Idler Arm (1) And Relay Arm (11) To Support Assemblies (10)	—	—	—	—	—	—	170	125	—	—	—	—
Relay Rod (2) To Relay Arm (11)	—	—	—	—	—	—	90	66	—	—	—	—
Tie Rod Jam Nut (K10, 20) & P30(00)FS3	—	—	—	—	—	—	—	—	375	277	125	92

* Tightening Procedure (Castellated Nuts)

1. Tighten to the specified torque.
2. Advance the nut to align the nut slot with the cotter pin hole. Never back the nut off to align the cotter pin hole.
3. Insert a new cotter pin of the correct size.

SPECIAL TOOLS

J-6627-A	Wheel Stud Remover & Tie Rod Remover
J-6632-01	Pitman Arm Remover
J-29107	Pitman Arm Puller
J-24319-01	Steering Linkage Puller
J-29193	Steering Linkage Installer (12mm)
J-29194	Steering Linkage Installer (14mm)

SECTION 3B2

MANUAL STEERING GEAR

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 "NOTICE: See 'Notice' on page 3B2-1 of this Section."

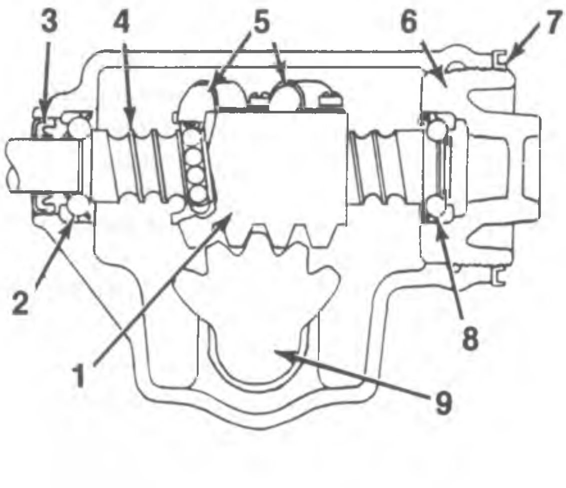
NOTICE: These fasteners are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use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

CONTENTS

DESCRIPTION

The steering gear is the recirculating ball nut and worm type. The worm is located on the lower end of the steering shaft. The ball nut is mounted on the worm and the steel balls act as a rolling thread between the worm and nut to provide a low friction drive between them.

Teeth on the ball nut engage teeth on the pitman shaft sector. The teeth on the ball nut are made so that a tighter fit exists between the ball nut and pitman shaft sector teeth when the front wheels are in the straight ahead position. The sector teeth are slightly tapered so that a proper preload may be obtained by moving the pitman shaft endways by means of a preload adjuster screw which extends through the gear housing side cover. The head of the preload adjuster and a selectively fitted shim fit snugly into a T-slot in the end of the pitman shaft, so that the screw also controls the end play of the shaft (figure 1).



1. Ball Nut
2. Worm Bearing
3. Seal
4. Wormshaft
5. Balls and Guides
6. Adjuster Plug
7. Nut
8. Worm Bearing (Lower)
9. Pitman Shaft Sector

B-07349

Figure 1—Manual Steering Gear

DIAGNOSIS OF MANUAL STEERING SYSTEM

PROBLEM	POSSIBLE CAUSE	CORRECTION
Rattle Or Chuckle In The Steering Gear	1. Insufficient or improper lubricant in the steering gear. 2. Pitman arm loose on the shaft or the steering gear mounting bolts loose. 3. Loose or worn steering shaft bearing. 4. Excessive over-center lash or worm thrust bearings adjusted too loose. On turns a slight rattle may occur, due to the increased lash between ball nut and pitman shaft as gear moves off the center of "high point" position. This is normal and lash must not be reduced to eliminate this slight rattle.	1. Add specified lube. 2. Tighten to specified torque. 3. Replace steering shaft bearing. 4. Adjust steering gear to specified preloads.
Poor Return Of The Steering Wheel	1. Steering column misaligned. 2. Insufficient or improper lubricant in the steering gear or front suspension. 3. Steering gear adjusted too tight. 4. Front wheel alignment incorrect (Caster).	1. Align the column. 2. Lubricate as specified. 3. Adjust over-center and thrust bearing preload to specifications. 4. Adjust to specifications.
Excessive Play Or Looseness In The Steering System	1. Front wheel bearings loosely adjusted. 2. Steering system out of alignment. 3. Worn upper ball joints. 4. Steering wheel loose on the shaft, loose pitman arm, tie rods, steering arms or steering linkage ball nuts. 5. Tires badly worn, edge of tires rounded off. 6. Excessive over-center lash. 7. Worm thrust bearings loosely adjusted.	1. Adjust bearings or replace with new parts as necessary. 2. Align caster, camber, and toe-in. 3. Check and replace ball joints if necessary. 4. Tighten to specification, replace if worn or damaged. 5. Install new tires, and check alignment. 6. Adjust over-center preload to specifications. 7. Adjust the worm thrust bearing preload to specifications.
Hard Steering — Excessive Effort Required At The Steering Wheel	1. Low or uneven tire pressure. 2. Insufficient or improper lubricant in the steering gear or front suspension. 3. Steering shaft flexible coupling misaligned. 4. Steering gear adjusted too tight. 5. Front wheel alignment incorrect.	1. Inflate to specified pressures. 2. Lubricate as specified. Relubricate at specified intervals. 3. Align the column and couplings. 4. Adjust over-center and thrust bearing preload to specifications. 5. Check the alignment and correct as necessary.

ON-VEHICLE SERVICE

MAINTENANCE

The steering gear is factory-filled with steering gear lubricant. Seasonal change of the lubricant should not be performed and the housing should not be drained. No additional lubrication is required for the life of the steering gear.

At intervals specified in MAINTENANCE AND LUBRICATION (SEC. 0B) of this manual, the gear should be inspected for seal leakage (actual solid grease — not just oily film). If a seal is replaced or the gear is overhauled, the gear housing should be refilled with Steering Gear Lubricant meeting GM specification 1051052 (or equivalent).

NOTICE: DO NOT USE EP Chassis Lube to lubricate the gear. DO NOT OVER-FILL the gear housing, or damage may occur.

STEERING GEAR REPLACEMENT

Remove or Disconnect

Tools Required:

J-6632-01 Pitman Arm Remover

J-5504-D Pitman Arm Puller

- Place the front wheels in a straight ahead position.

1. Flexible coupling to steering shaft bolts (C-Models).
2. Lower universal joint pinch bolt (G-Models). Mark the relationship of the universal yoke to the wormshaft.

- Mark the relationship of the pitman arm to the pitman shaft.

3. Pitman shaft nut and washer.
4. Pitman arm from the pitman shaft. Use J-6632-01 or J-5504-D (figure 2).
5. Frame bolts.
6. Pinch bolt, coupling, washers and nuts from the wormshaft (C-Models).
7. Gear assembly.

Install or Connect (Figure 3)

NOTICE: See "Notice" on page 3B2-1 of this section for steps 3, 5 and 8.

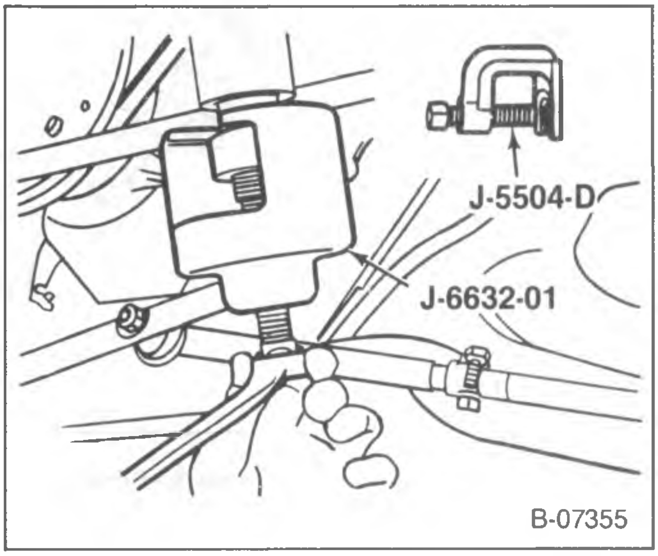


Figure 2—Removing Pitman Arm

C-Models

1. Flexible coupling onto the steering gear wormshaft.
    - Align the flat in the coupling with the flat on the shaft.
    - Push the coupling onto the shaft until the wormshaft bottoms on the coupling reinforcement.
2. Pinch bolt and torque to 41 N·m (30 ft. lbs.). The bolt must pass through the shaft undercut.

- Place the steering gear in position, guiding the coupling bolt into the shaft flange.

3. Steering gear to frame bolts and torque to 100 N·m (75 ft. lbs.).

Important

- If flexible coupling alignment pin plastic spacers were used, make sure they are bottomed on the pins.
- If flexible coupling alignment pin plastic spacers were not used, center the pins in the slots in the steeering shaft flange.

4. Washer and nut onto the coupling bolts.

Tighten

- Nut to 24 N·m (18 ft. lbs.).

G-Models (Figure 4)

- Place the steering gear in position, guiding the wormshaft into the universal joint assembly and lining up the marks made at removal. If a new gear was installed, line up the mark on the wormshaft with the slit in the universal joint yoke.

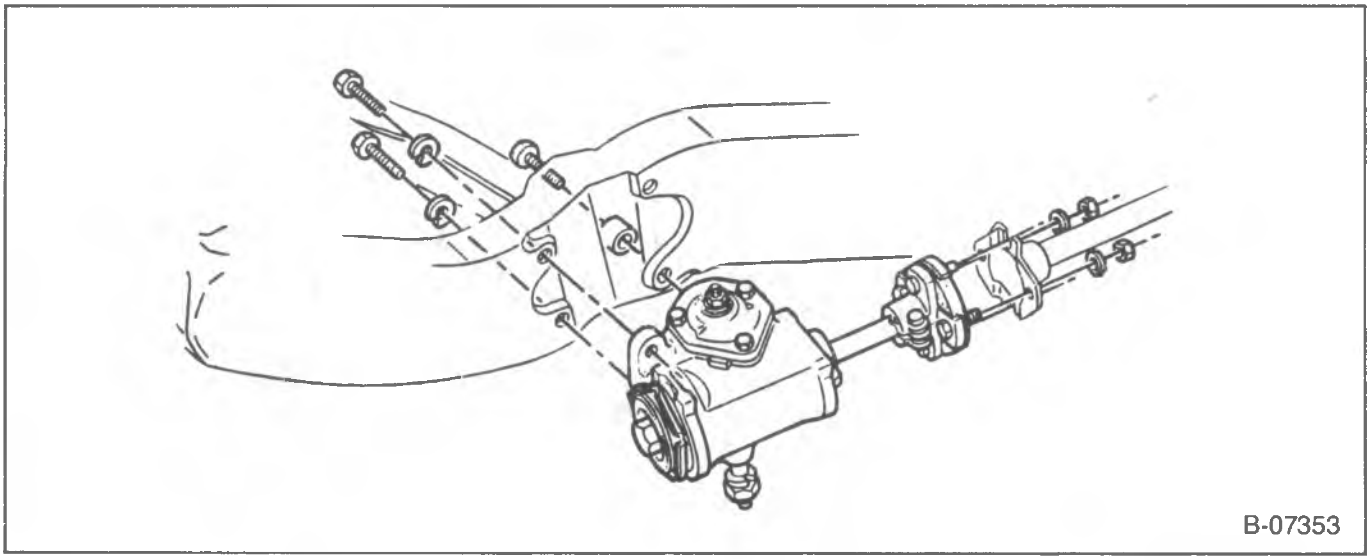


Figure 3—Steering Gear Attachment (C-Models)

5. Steering gear to frame bolts.

Tighten

- Bolts to 100 N·m (75 ft. lbs.).

6. Universal joint pinch bolt. The pinch bolt must pass through the shaft undercut. Torque to 60 N·m (44 ft. lbs.).

ALL MODELS

7. Pitman arm onto the pitman shaft. Line up the marks made at removal.
8. Washer and nut.

Tighten

- Nut to 250 N·m (185 ft. lbs.)

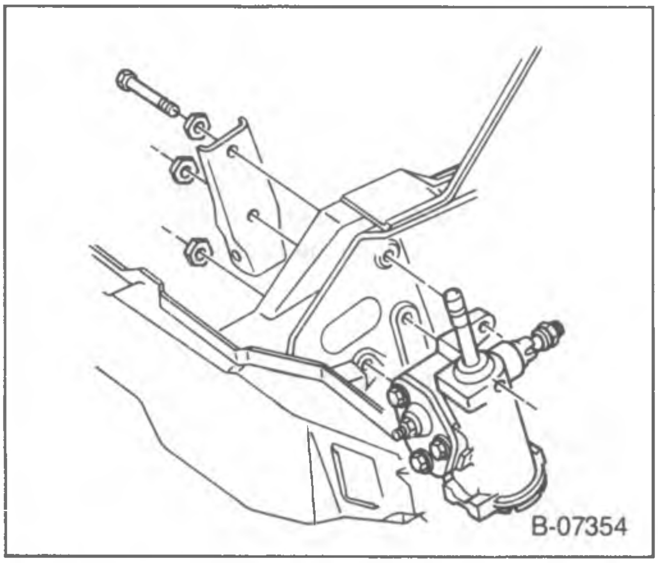


Figure 4—Steering Gear Attachment (G-Models)

PITMAN SHAFT SEAL REPLACEMENT

The pitman shaft seal may be replaced without removing the steering gear. Remove the pitman arm as outlined under "Steering Gear Replacement" or refer to STEERING LINKAGE (SEC. 3B1).

Remove or Disconnect

- Rotate the steering wheel from stop to stop, counting the total number of turns. Then turn back exactly halfway, placing the gear on center (the wormshaft flat should be at the 12 o'clock position).

1. Side cover bolts.
2. Pitman shaft and side cover assembly from the housing.
3. Pitman shaft seal from the gear housing using a screwdriver. Be careful not to damage the housing bore.
4. Jam nut (11).
5. Side cover from the pitman shaft assembly. Turn the adjuster screw (10) clockwise.

Inspect

- Gear lubricant for contamination. If contaminated, the gear must be removed and overhauled.

Install or Connect

- Lubricate the new pitman shaft seal with steering gear lubricant.

1. Pitman shaft seal. Position the seal in the pitman shaft bore and tap into position using a 25 mm (1 inch) pipe or socket (figure 5).

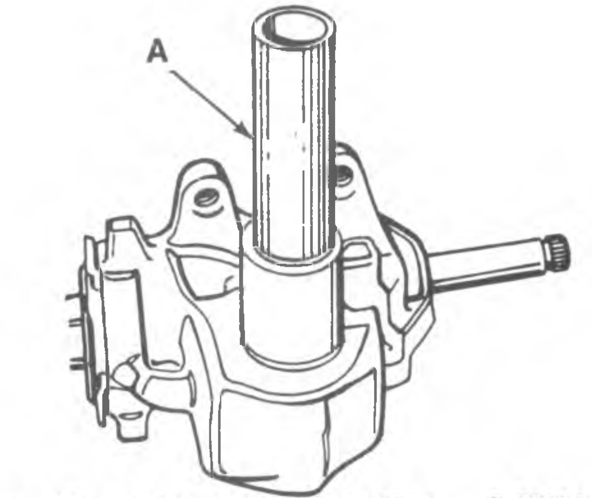


Figure 5—Pitman Shaft Seal Replacement

- Place the pitman shaft in the steering gear so that the center tooth of the pitman shaft sector enters the center tooth space of the ball nut.
- Fill the steering gear housing with Steering Gear Lubricant meeting GM Specification 1051052 (or equivalent).

2. New gasket onto the gear housing.
3. Side cover onto the adjuster screw (10). Reach through the threaded hole in the side cover with a small screwdriver and turn the adjuster screw counterclockwise until it bottoms and turns back in 1/4 turn.
4. Side cover bolts and torque to specifications.
5. Jam nut (11).

Adjust

- Steering gear as outlined under "Steering Gear Adjustments."

6. Pitman arm.

STEERING GEAR ADJUSTMENTS

Before any adjustments are made to the steering gear, in an attempt to correct such conditions as shimmy, loose or hard steering etc., a careful inspection should be made of the front end alignment, shock absorbers, wheel balance and tire pressure for the possible steering system problem.

Correct adjustment of the steering gear is very important. Perform adjustments following the sequence listed below.

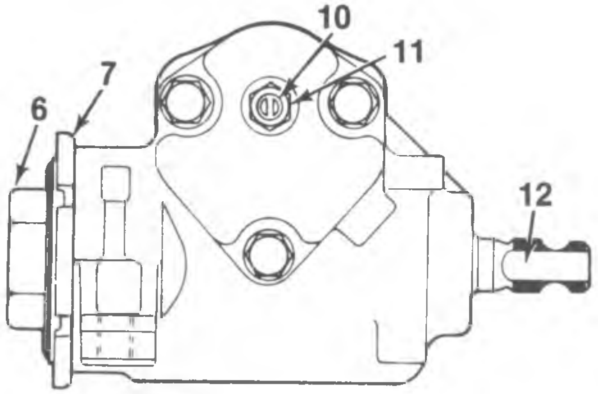


Figure 6—Steering Gear Adjustment Points

Remove or Disconnect

Tools Required:
J-6632-01 Pitman Arm Remover
J-5504-D Pitman Arm Puller

1. Battery ground cable.
   - Raise the vehicle.
2. Pitman arm nut and washer.
   - Mark the relationship of the pitman arm to the pitman shaft.
3. Pitman arm using J-6632-01 or J-5504-D (figure 2).
   - Loosen the adjuster nut (7) and then back the adjuster plug (6) off 1/4 turn (figure 6).
4. Horn cap or cover.
   - Turn the steering wheel gently in one direction until stopped by the gear; then turn back one-half turn.

NOTICE: Do not turn the steering wheel hard against the stops when the steering linkage is disconnected from the gear as damage to the ball guides could result.

Measure

- "Bearing drag" by applying a torque wrench with the socket on the steering wheel nut and rotate through a 90 degree arc. Do not use a torque wrench having a maximum torque reading of more than 6 N·m (50 in. lbs.) (figure 7).

Adjust

- Thrust bearing preload as follows:
  1. Tighten the adjuster plug (6) until the proper "loading preload" is 0.6-1 N·m (5-8 in. lbs.).

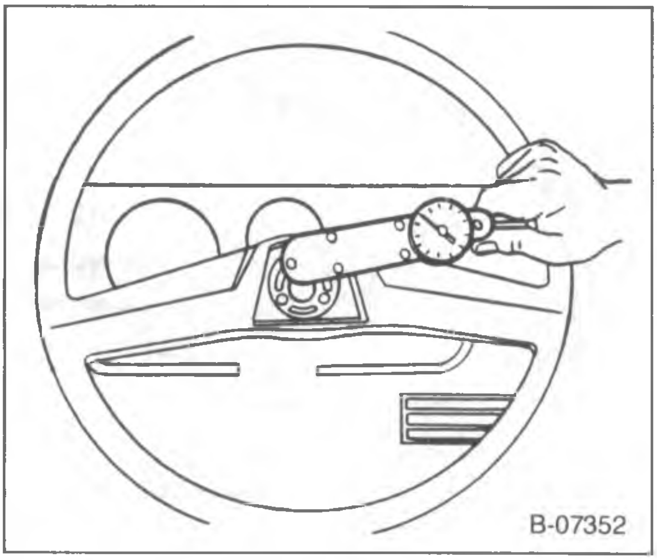


Figure 7—Checking Torque at Steering Wheel

NOTICE: See "Notice" on page 3B2-1 of this section.

2. Tighten the adjuster nut (7) to 115 N·m (85 ft. lbs.).
3. If the gear feels "lumpy" after adjustment, there is probably damage in the bearings due to severe impact or improper adjustment; the gear must be disassembled for replacement of damaged parts.

- Over-center preload as follows:
  1. Turn the steering wheel gently from one stop all the way to the other carefully counting the total number of turns. Turn the wheel back exactly half-way to the center position.
  2. Turn the over center adjuster screw (10) clockwise to take out all lash between the ball nut (1) and pitman shaft sector (9) teeth and then tighten the jam nut (11).

Tighten

- Jam nut (11) to 30 N·m (22 ft. lbs.).

3. Check the torque at the steering wheel, taking the highest reading as the wheel is turned through center position. Refer to "Specifications" for the proper over-center preload.
4. If necessary, loosen jam nut (11) and adjust over center adjuster screw to obtain proper torque. Tighten the jam nut and recheck torque reading through center of travel.

Important

- If maximum torque is exceeded, turn over center adjuster screw counter-clockwise, then come up on adjustment by turning the jam nut (11) in a clockwise motion.

Install or Connect

1. Pitman arm onto the pitman shaft. Line up the marks made during disassembly.

NOTICE: See "Notice" on page 3B2-1 of this section.

2. Washer and nut.

Tighten

- Nut to 250 N·m (185 ft. lbs.).

3. Horn cap or cover.
- Lower the vehicle to the floor.
4. Battery ground cable.

STEERING GEAR HIGH POINT CENTERING

1. Set the front wheels in the straight ahead position. This can be checked by driving the vehicle a short distance on a **flat** surface.
2. With the front wheels set straight ahead, check the position of the mark on the wormshaft designating the steering gear high point. This mark should be at the top side of the shaft at 12 o'clock position and lined up with the mark in the coupling lower clamp.
3. If the gear has been moved off high point when setting wheel in straight ahead position, loosen adjusting sleeve clamp on both left and right hand tie rods. Then turn both sleeves an equal number of turns in the same direction to bring gear back on high point.

Important

- Turning the sleeves an unequal number of turns or in different directions will disturb the toe-in setting of the wheels.

4. Adjust toe-in as outlined in FRONT END ALIGNMENT (SEC. 3A) (if necessary).
5. Orient sleeves and clamps when fastening and torqueing clamps to specifications. Refer to STEERING LINKAGE (SEC. 3B1).

SPECIFICATIONS

MANUAL STEERING GEAR

Manufacturer	Saginaw Steering Gear
Ratio	24 to 1
Type	Recirculating Ball

PRELOAD ADJUSTMENTS

	N·m	In. Lbs.
Worm Thrust Bearing Preload	0.6-1.0	5-8
Over Center Sector Preload	0.5-1.2*	4-10*
Total Steering Gear Preload	1.8 Max.	16 Max.

*In excess of worm bearing preload.

TORQUE SPECIFICATIONS

	N·m	Ft. Lbs.
Steering Gear to Frame Nuts	100	75
Pitman Shaft Nut	250	185
Side Cover Bolts	45	33
Adjuster Screw Jam Nut	30	22
Adjuster Plug Nut	115	85

SPECIAL TOOLS

J-6632-01	Pitman Arm Remover
J-5504-D	Pitman Arm Puller

SECTION 3B3

POWER STEERING

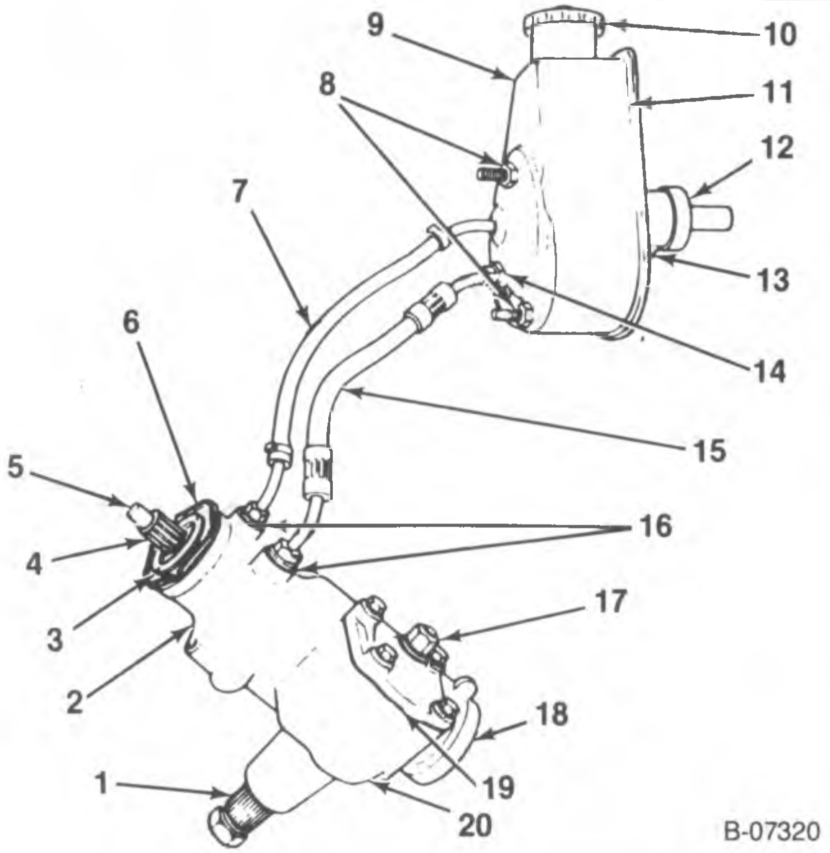
The following "Notice" applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations by the terminology: "NOTICE: See 'Notice' on page 3B3-1 of the section."

NOTICE: All steering 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 specific during reassembly to assure proper retention of all parts.

CONTENTS

SUBJECT **PAGE**

DESCRIPTION



1. Pitman Shaft
2. Housing Ball Plug
3. Adjuster Plug
4. Stub Shaft
5. Torsion Bar
6. Adjuster Plug Nut
7. Return Line
8. Stud Bolt O-ring Seals
9. Reservoir
10. Reservoir Cap
11. Reservoir O-ring Seal
12. Pump Shaft Seal
13. Pump Housing
14. Pressure Port Seat
15. Pressure Hose
16. Pressure And Return Port Seat
17. Adjusting Screw Jam Nut
18. End Cover O-ring Seal
19. Side Cover Seal
20. Gear Housing

Figure 1—Power Steering System — Typical

The hydraulic power steering system consists of a pump, an oil reservoir, a steering gear, a pressure hose, and a return hose (figure 1).

INTEGRAL POWER STEERING GEAR

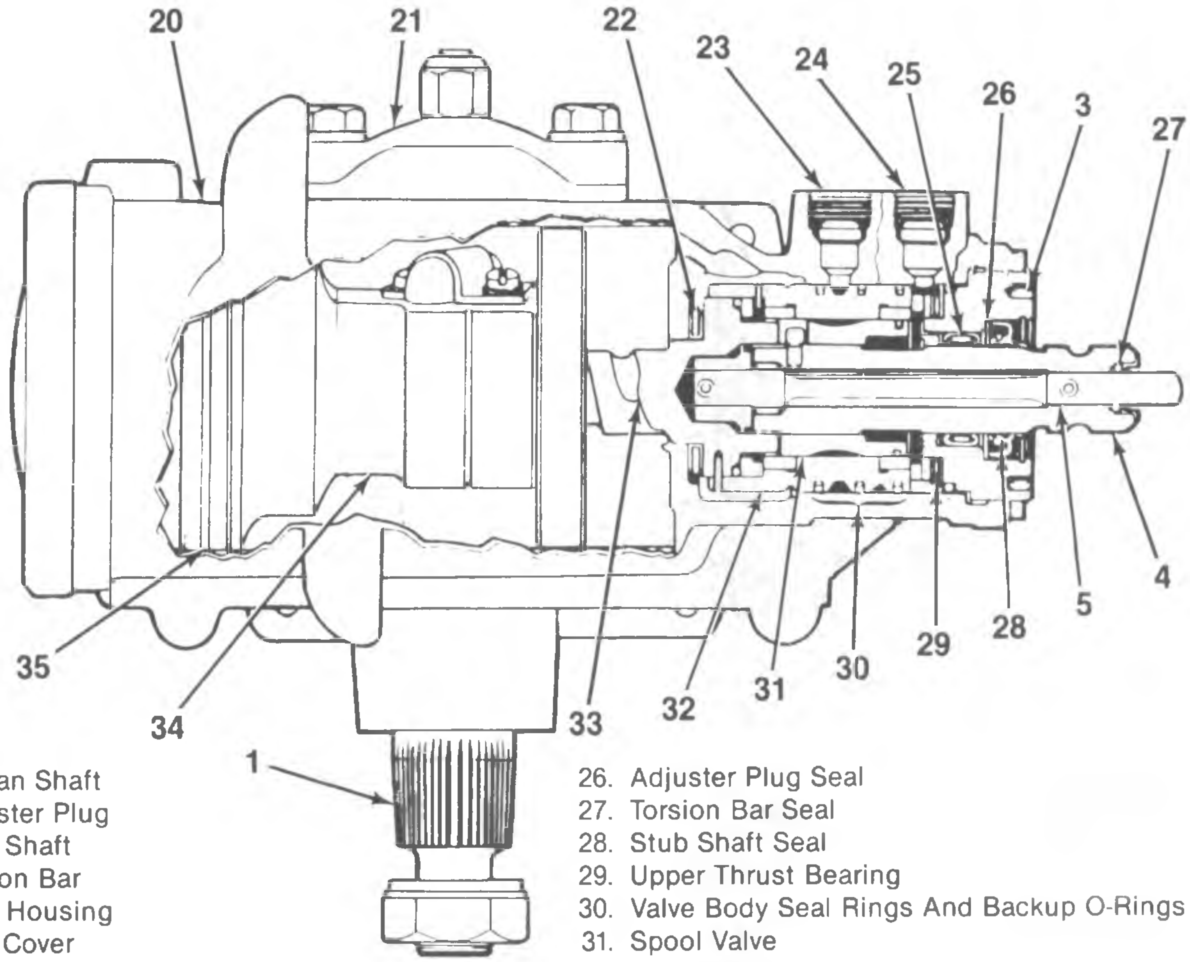
The power steering gear (figure 2) has a recirculating ball system which acts as a rolling thread between the worm shaft and the rack piston. The worm shaft is supported by a thrust bearing preload and two conical thrust races at the lower end, and a bearing assembly in the adjuster plug at the upper end. When the worm shaft is turned right, the rack piston moves up in gear. Turning the worm shaft left moves the rack piston down in gear. The rack piston teeth mesh with the sector, which is part of the pitman shaft. Turning the worm shaft turns the pitman shaft, which turns the wheels through the steering linkage.

The control valve in the steering gear directs the power steering fluid to either side of the rack piston. The rack piston converts the hydraulic pressure into a mechanical force. If the steering system becomes damaged and loses hydraulic pressure, the vehicle can be controlled manually.

HYDRAULIC PUMPS

The hydraulic pump is a vane-type design. There are two types, submerged and nonsubmerged. Submerged pump (P models) have a housing and internal parts that are inside the reservoir and operate submerged in oil. The nonsubmerged pump (TC models with or without reservoir) function the same as the submerged pump except that the reservoir is separate from the housing and internal parts (figure 3).

There are two bore openings at the rear of the pump housing. The larger opening contains the cam ring, pressure plate, thrust plate, rotor and vane assembly, and end plate. The smaller opening contains the pressure line union, flow control valve, and spring. The flow control orifice is part of the pressure line union. The pressure relief valve inside the flow control valve limits the pump pressure (figure 4).



1. Pitman Shaft
3. Adjuster Plug
4. Stub Shaft
5. Torsion Bar
20. Gear Housing
21. Side Cover
22. Lower Thrust Bearing And Races
23. Inlet Port
24. Outlet Port
25. Stub Shaft Bearing
26. Adjuster Plug Seal
27. Torsion Bar Seal
28. Stub Shaft Seal
29. Upper Thrust Bearing
30. Valve Body Seal Rings And Backup O-Rings
31. Spool Valve
32. Valve Body
33. Worm Shaft
34. Rack Piston
35. Rack Piston Seal Ring

Figure 2—Power Steering Gear

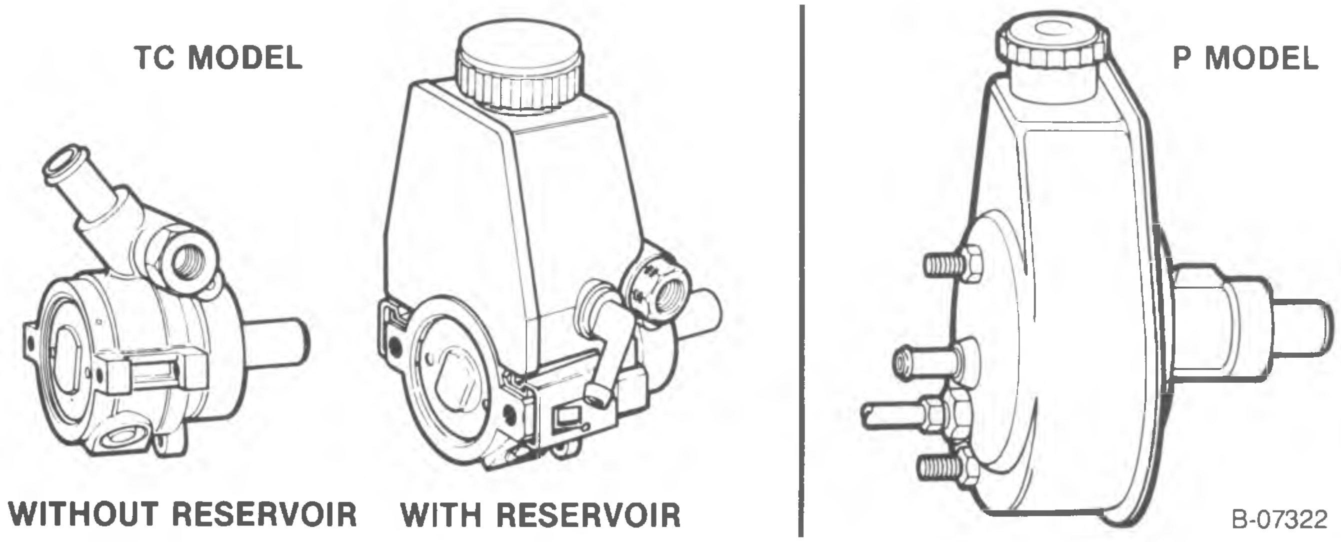
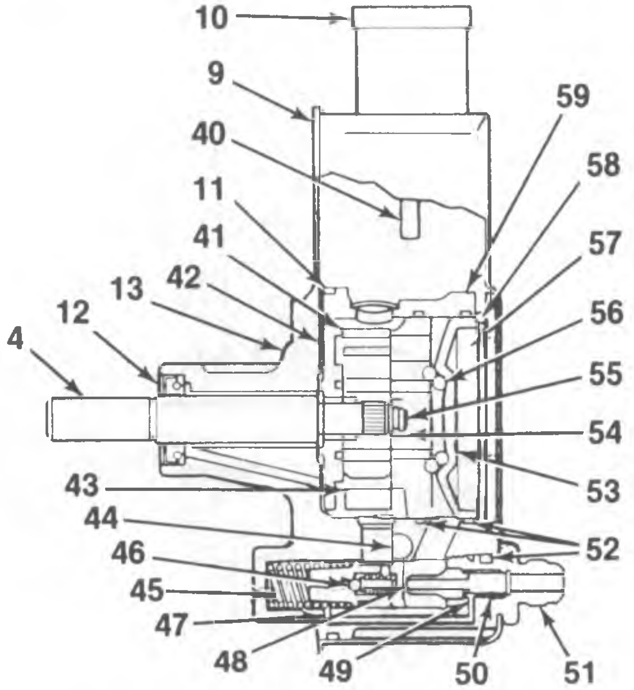


Figure 3—TC And P Pump Models



4. Stub Shaft
9. Reservoir
10. Reservoir Cap
11. Reservoir O-Ring Seal
12. Shaft Seal
13. Pump Housing
40. Dip Stick
41. Pump Ring
42. Thrust Plate
43. Vanes
44. Reservoir Hole
45. Spring
46. Pressure Relief Valve
47. Flow Control Valve
48. Exit Hole
49. Orifice
50. Filter
51. Pump Union
52. Seals
53. End Plate
54. Retaining Ring
55. Rotor
56. Spring
57. Discharge Cavity
58. Retaining Ring
59. Pressure Plate

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Figure 4—Power Steering Pump

DIAGNOSIS OF POWER STEERING SYSTEM

PROBLEM	POSSIBLE CAUSE	CORRECTION
Objectionable "Hiss"	1. Noisy relief valve in the hydraulic pump.	1. There is some noise in all power steering systems. One of the most common is a hissing sound most evident at standstill parking. Hiss is a high frequency noise. The noise is present in every valve and results from high velocity fluid passing valve orifice edges. There is no relationship between this noise and performance of the steering. "Hiss" may be expected when steering wheel is at end of travel or when slowly turning at standstill. Do not replace valve unless "hiss" is extremely objectionable. A replacement valve will also exhibit slight noise and is not always a cure for the objection.
	2. Any metal-to-metal contacts through flexible coupling.	2. Align the steering shaft and gear so the flexible coupling rotates in a flat plane and is not distorted as the shaft rotates.
Rattle Or Chuckle Noise In Steering Gear	1. Gear loose on the frame.	1. Check the gear mounting bolts. Torque the bolts to specifications.
	2. Steering linkage looseness.	2. Check linkage pivot points for wear. Replace if necessary.
	3. Pressure hose touching other parts of vehicle.	3. Adjust the hose position. Do not bend tubing by hand.
	4. Loose pitman arm.	4. Torque the pitman arm bolt.
	5. Improper over-center adjustment. A slight rattle may occur on turns because of increase clearance off the "high point." This is normal and clearance must not be reduced below specified limits to eliminate this slight rattle.	5. Adjust to specifications.
Excessive Wheel Kick-Back Or Loose Steering	1. Air in the system.	1. Add oil to the pump reservoir and bleed. Check hose connectors for proper torque.
	2. Steering gear mounting loose.	2. Tighten attaching bolts to specified torque.
	3. Steering linkage joints worn.	3. Replace loose parts.
	4. Front wheel bearings incorrectly adjusted or worn.	4. Adjust the bearings or replace with new parts as necessary.
	5. Steering gear improperly adjusted.	5. Adjust to specifications.
	6. Worn or missing poppet valve (steering gear).	6. Replace the poppet valve.
	7. Steering gear flexible coupling too loose on the shaft or the rubber disc mounting screws loose.	7. Tighten to specifications.
	8. Damaged or worn steering gear.	8. Disassemble and repair the steering gear as outlined in the unit repair manual.

DIAGNOSIS OF POWER STEERING SYSTEM (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Vehicle Leads To One Side Or The Other (Keep In Mind The Road And Wind Conditions). Test The Vehicle, Going In Both Directions, On A Flat Road.	1. Front end misaligned. 2. Unbalanced steering gear valve. If this is cause, steering effort will be very light in direction of lead and heavy in opposite direction. 3. Steering shaft rubbing the ID of the shaft tube. 4. Steering linkage not level.	1. Adjust to specifications. 2. Replace the gear valve. 3. Align the column. 4. Adjust as required.
Momentary Increase In Effort When Turning The Wheel Quickly To The Right Or Left	1. Low oil level in the pump. 2. Pump belt slipping (if used). 3. High internal linkage (steering gear or pump).	1. Add power steering fluid as required. 2. Tighten or replace belt. 3. Refer to "Power Steering System Test" in this section.
Poor Return Of Steering	1. Tires under-inflated. 2. Lower coupling flange rubbing against the steering gear adjuster plug. 3. Steering wheel rubbing against directional signal housing. 4. Tight or frozen steering shaft bearings. 5. Steering linkage or ball joints binding. 6. Steering gear to column misalignment. 7. Tie rod pivots not centralized. 8. Lack of lubricant in the suspension ball joints and the steering linkage. 9. Sticky or plugged valve spool. 10. Rubber spacer binding in the shift tube. 11. Improper front end alignment. 12. Tight steering shaft bearings. 13. Steering gear adjusted too tightly. 14. Kink in return hose.	1. Inflate to specified pressure. 2. Loosen the pinch bolt and assemble properly. 3. Adjust the steering jacket. 4. Replace the bearings. 5. Replace the affected parts. 6. Align the steering column. 7. Adjust tie rod ends as required to center pivots. 8. Lubricate. Refer to MAINTENANCE AND LUBRICATION (SEC. 0B). 9. Remove and clean or replace the valve. 10. Make certain the spacer is properly seated. Lubricate inside the diameter with silicone lubricant. 11. Check and adjust to specifications. 12. Replace the bearings. 13. Adjust over-center and thrust bearing preload to specifications. 14. Replace the hose.
Steering Wheel Surges Or Jerks When Turning With Engine Running Especially During Parking	1. Low oil level in pump. 2. Loose pump belt. 3. Sticky flow control valve. 4. Insufficient pump pressure. 5. Faulty gear relief valve.	1. Add power steering fluid as required. 2. Adjust tension to specification. 3. Replace or clean the control valve. 4. Refer to "Power Steering System Test" in this section. 5. Replace the gear relief valve.
Hard Steering Effort In Both Directions	1. Low tire pressure. 2. Lack of lubricant in suspension or ball joints. 3. Steering gear to column misalignment. 4. Loose pump belt.	1. Adjust the tire pressure. 2. Lubricate and relubricate at proper intervals. Refer to MAINTENANCE AND LUBRICATION (SEC. 0B). 3. Align the steering column. 4. Adjust belt tension to specifications.

DIAGNOSIS OF POWER STEERING SYSTEM (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Hard Steering Effort In Both Directions (Continued)	5. Low fluid level in reservoir.	5. Fill to proper level. Inspect lines and joints for external leakage.
	6. High internal leakage (steering gear or pump).	6. Refer to "Power Steering System Test" in this section.
	7. Sticky flow control valve.	7. Replace or clean the valve.
	8. Lower coupling flange rubbing against steering gear adjuster plug.	8. Loosen the pinch bolt and assemble properly.
	9. Steering gear adjusted too tight.	9. Adjust over-center and thrust bearing preload to specifications.
	10. Improper front end alignment.	10. Check and adjust to specifications.
Foaming Milky Power Steering Fluid, Low Level And Possible Low Pressure	Air in the fluid, and loss of fluid due to internal pump leakage causing overflow.	Check for leak and correct. Bleed system. Extremely cold temperatures will cause system aeriation should the oil level be low. If oil level is correct and pump still foams, remove pump from vehicle and separate reservoir from housing. Check welsh plug and housing for cracks. If plug is loose or housing is cracked, replace housing.
Low Oil Pressure Due To Restriction In The Hose	1. Check for kinks in the hose.	1. Remove the kinks or replace the hose.
	2. Foreign object stuck in the hose.	2. Remove the foreign object or replace the hose.
Low Oil Pressure Due To Steering Gear. Refer To "Power Steering System Test" In This Section.	1. Pressure loss in cylinder due to worn piston ring or scored housing bore.	1. Disassemble the steering gear as outlined in the unit repair manual. Inspect the ring and housing bore. Replace the affected parts.
	2. Leakage at the valve rings and valve body to the worm seal.	2. Disassemble steering gear and replace seals.
	3. Leakage at the valve body or a loose fitting spool.	3. Replace the valve.
	4. Damaged poppet valve.	4. Replace the poppet valve.
Low Oil Pressure Due To Steering Pump. Refer To "Power Steering System Test" In This Section.	1. Flow control valve stuck or inoperative.	1. Replace or clean the valve.
	2. Pressure plate not flat against the cam ring.	2. Replace the pressure plate.
	3. Extreme wear of cam ring.	3. Replace and flush the system.
	4. Scored pressure plate, thrust plate or rotor.	4. Replace parts. (If rotor, replace with rotating group), flush the system.
	5. Vanes sticking in rotor slots.	5. Free-up by removing burrs, varnish or dirt.
	6. Vanes not installed properly.	6. Install properly. Radius edge to the outside.
	7. Air in oil.	7. Locate source of leak and correct. Bleed the system.
	8. Low oil level.	8. Add power steering fluid as required.
	9. Loose belt.	9. Adjust tension to specifications.
	10. Damaged hoses or steering gear.	10. Replace as necessary.

DIAGNOSIS OF POWER STEERING SYSTEM (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Chirp Noise In Steering Pump	1. Loose belt.	1. Adjust belt tension.
Belt Squeal (Particularly Noticeable At Full Wheel Travel And Standstill Parking)	1. Loose belt.	1. Adjust belt tension.
Growl Noise In Steering Pump	1. Excessive back pressure in hoses or steering gear caused by restriction.	1. Locate restriction and correct. Replace part if necessary.
Growl Noise In Steering Pump (Particularly Noticeable At Standstill Parking)	1. Scored pressure plates, thrust plate or rotor. 2. Extreme wear of cam ring.	1. Replace parts and flush system. 2. Replace parts.
Groan Noise In Steering Pump	1. Low oil level. 2. Air in the oil. Poor pressure hose connection.	1. Add power steering fluid as required. 2. Torque the connector. Bleed the system.
Rattle Or Knock Noise In Steering Pump	1. Loose pump pulley nut. 2. Pump vanes sticking in rotor slots. 3. Pressure hose touching other parts of vehicle.	1. Torque nut. 2. Free up by removing burrs, varnish or dirt. 3. Adjust hose position.
Swish Noise In Steering Pump	1. Faulty flow control valve.	1. Replace part.
Whine Noise In Steering Pump	1. Pump shaft bearing scored.	1. Replace the housing and shaft. Flush the system.

OIL LEAK CHECK

1. With the vehicle's engine off, wipe the complete power steering system dry (gear, pump, hoses, and connections).
2. Check the oil level in the pump's reservoir and adjust as directed. Refer to "Fluid Level Adjustment" in this section.
3. Start the engine and turn the steering wheel from stop to stop several times. Do not hold the wheel against the stops as this may damage the pump.
4. Find the exact areas of leakage and use the recommended method of repair as shown in figure 5.

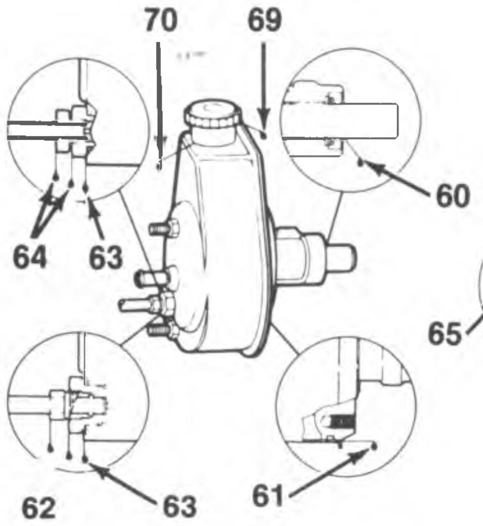
POWER STEERING SYSTEM TEST

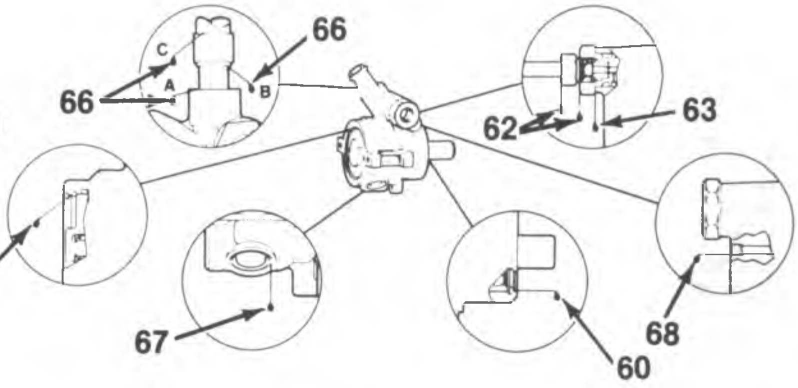
The power steering system may be tested using either J-5176-D, Power Steering Gage, or with J-25323, Power Steering Analyzer. J-25323 will measure the flow rate in addition to the pressure (figure 6).

The power steering system test is a method used to identify and isolate hydraulic circuit difficulties. Prior to performing this test the following inspection, and corrections if necessary, must be made.

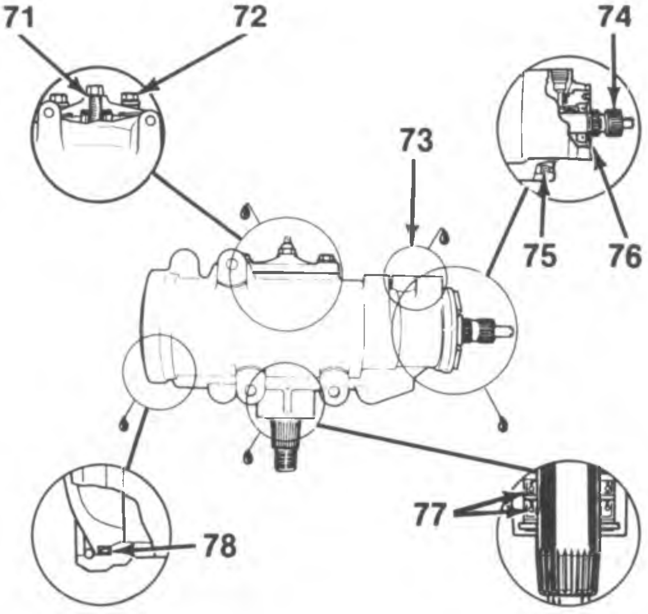
Inspect

- Pump reservoir for proper fluid level.
- Pump belt for proper tension.





60. Replace the drive shaft seal. Make certain that the drive shaft is clean and free of pitting in the seal area.
61. Replace the reservoir O-ring seal.
62. Torque hose fitting nut to 35 N·m (25 ft. lbs.). If leakage persists, replace the O-ring seal.
63. Torque fitting to 75 N·m (55 ft. lbs.). If leakage persists, replace the O-ring seal.
64. Torque hose fitting nut to 48 N·m (35 ft. lbs.). If leakage persists, replace the brass connector and reface the tube flare. If nut threads are damaged, replace the nut.
65. Replace the O-ring seal.
66. If leakage is observed at (A), following manufacturer's directions apply Loctite 75559 solvent and Loctite 290 adhesive, or equivalent, to tube-housing connection. If leakage is coming from (B), replace the return tube. If coming from (C), replace the hose or clamp.
67. Seat the plug in the housing. Following manufacturer's directions apply Loctite 75559 solvent and Loctite 290 adhesive, or equivalent, to plug-housing area.
68. Seat the ball in the housing with a blunt punch. Following manufacturer's directions apply Loctite 75559 solvent and Loctite 290 adhesive, or equivalent, to area.
69. Check the oil level; if leakage persists with the level correct and cap tight, replace the cap.
70. If a cracked or bent reservoir is detected, replace the reservoir.



71. Torque jam nut to 48 N·m (35 ft. lbs.). Replace the nut if leakage persists.
72. Torque side cover bolts to 60 N·m (45 ft. lbs.). Replace the side cover seal if leakage persists.
73. Torque hose fitting nut to 27 N·m (20 ft. lbs.). If leakage persists, replace the O-ring seal.
74. Check for seepage between the torsion bar and stub shaft. Replace the rotary valve assembly.
75. Seat the ball in the housing with a blunt punch. Apply Loctite 75559 solvent and Loctite 290 adhesive, or equivalent, to the ball area.
76. Replace the adjuster plug seals.
77. Replace both pitman shaft seals.
78. Replace end plug O-ring seal.

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Figure 5—Pump Leak Diagnosis

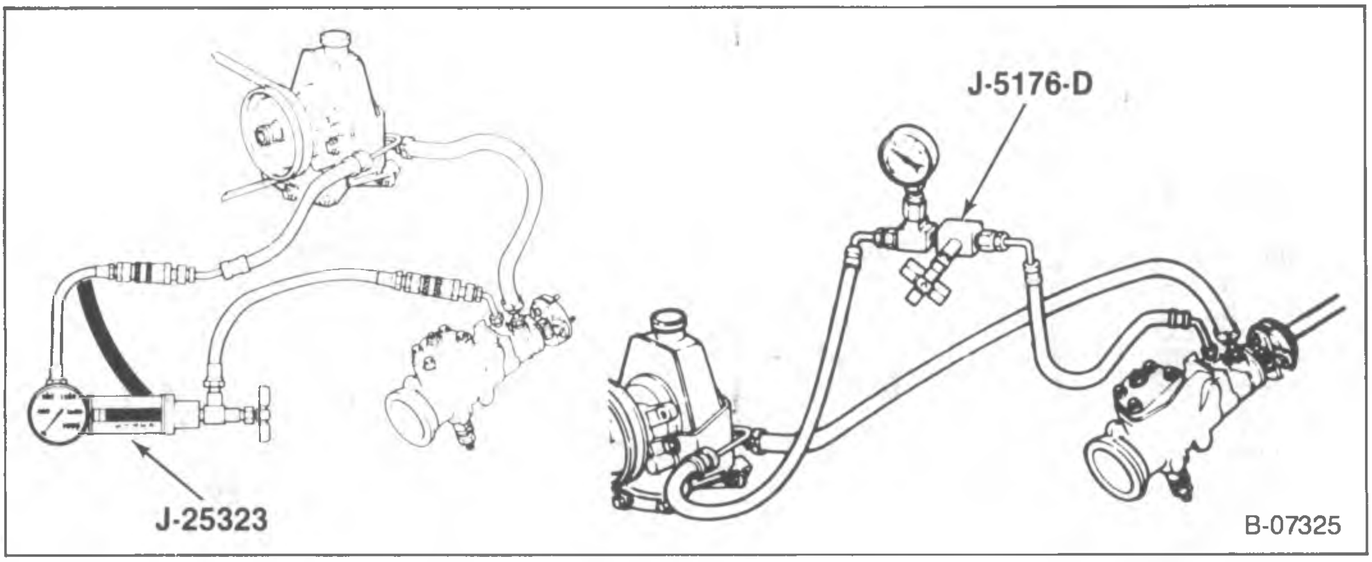


Figure 6—Tools For Power Steering System Test

- Tires for correct air pressure.
- Power steering system, replacing parts as necessary.

Important

- All tests are made with the engine idling at normal operating temperature. Check the idle adjustment and if necessary adjust the engine idle speed to the correct specification. Refer to FUEL SYSTEMS (SEC. 6C).

Test With J-5176-D

1. Place a container under the steering gear or pump to catch the fluid when disconnecting or connecting the hoses.
2. With the engine NOT running, disconnect the pressure hose at the steering gear or power steering pump and install J-5176-D to both hoses using adapter fitting J-5176-20. The gage must be between the shut-off valve and pump. Open the shut-off valve.
3. Remove the filler cap from the pump reservoir and check the fluid level. Fill the pump reservoir, with power steering fluid, to the full mark on the dipstick. Start the engine and, momentarily holding steering wheel against stop, check the connections at J-5176-D for leakage.
4. Bleed the system. Refer to "Bleeding the Power Steering System."
5. Insert thermometer J-5421-02 in the reservoir filler opening. Move the steering wheel from stop to stop several times until the thermometer indicates that the hydraulic fluid in the reservoir has reached a temperature of 65° to 77°C (150° to 170°F).

Important

- To prevent scrubbing flat spots on the tires, do not turn the steering wheel more than five times without rolling the vehicle to change the tire-to-floor contact area.

6. Start the engine and check the pumps fluid level. Add power steering fluid if required. When the engine is at normal operating temperature, the initial pressure read on the gage (valve open) should be in the 550-860 kPa (80-125 psi) range. Should this pressure be in excess of 1380 kPa (200 psi) — check the hoses for restrictions and the poppet valve for proper assembly.

NOTICE: Do not leave valve fully closed for more than 5 seconds as the pump could be damaged internally.

7. Close the gate valve fully 3 times. Record the highest pressures attained each time.
   - If the pressures recorded are within the specifications at the end of this section, and the range of readings is within 345 kPa (50 psi), the pump is functioning within its specifications.
   - If the pressures recorded are high, but do not repeat within 345 kPa (50 psi), the flow controlling valve is sticking. Remove the valve, clean it and remove any burrs using crocus cloth or fine hone. If the system contains some dirt, flush it. If it is exceptionally dirty, both the pump and gear must be completely disassembled, cleaned, flushed and reassembled before further usage.
   - If the pressures recorded are constant but more than 690 kPa (100 psi), below the minimum listed specification, replace the

flow control valve and recheck. If the pressures are still low, replace the rotating group in the pump.

8. If the pump checks within specifications, leave the valve open and turn (or have turned) the steering wheel into both corners. Record the highest pressures and compare with the maximum pump pressure recorded. If this pressure cannot be built in either (or one) side of the gear, the gear is leaking internally and must be disassembled and repaired.
9. Shut the engine off, remove the testing gage, reconnect the pressure hose, check the fluid level and/or make the needed repairs.
10. If the problem still exists, the steering and front suspension must be thoroughly examined. Refer to "Diagnosis of Power Steering System."

Test With J-25323

1. Place a container under the steering gear or pump to catch the fluid when disconnecting or connecting the hoses.
2. With the engine NOT running, disconnect the pressure hose at the steering gear or power steering pump. Thread J-29525 female adapter into the pressure hose and the male adapter into the gear or pump. Connect J-25323 analyzer hoses to the adapters.
3. If the analyzer has never been used, it will be necessary to bleed the power steering system to remove all the air. Refer to "Bleeding the Power Steering System" in this section. The analyzer gate must be open during this procedure.
4. Add power steering fluid to the pump if required.
5. Run the engine at idle speed **with the gate valve open** and record flow (A) and pressure (B).
   - If the flow is below 7.4 L/min. (2 gpm), the pump appears to be in need of repair, but continue the test.
   - If the pressure is above 1035 kPa (150 psi), check the hoses for restriction and check the steering gear.
6. Partially close the gate valve to build 4278 kPa (620 psi). Record the flow (C).
   - If the flow (C) drops more than 3.7 L/min. (1 gpm) under flow (A), disassemble the pump and replace the ring, rotor, and vanes. If the pressure plates are worn or cracked, replace them. Replace all O-ring seals when reassembling the pump. Continue the test.
7. Completely close and partially open the gate valve three times **(do not allow the valve to remain closed for more than 5 seconds).** Record the "gate closed" pressure (D).
8. Check the pressure specifications, at the end of this section for the correct pump model, and if the pump pressure recorded is 690 kPa (100 psi) lower than the minimum specification listed, replace the flow control valve in the pump. If the pressure recorded is above the maximum specification listed, the flow control valve in the pump should be removed and cleaned or replaced. If the system is exceptionally dirty, both the steering gear and pump must be completely disassembled and cleaned before reassembly.
9. Increase the engine speed from idle to about 1500 rpm. Record the flow (E).
   - If flow (E) varies more than 1 gpm from flow (A), then the flow control valve should be removed and cleaned or replaced, the same as in step 8.
10. Have the steering wheel turned into the left and then right corner lightly against the wheel stops. Record the pressure and flow (F).
    - Pressures developed in both corners should be nearly the same as the maximum pump output (D). At the same time the flow should drop below 1.85 L/min. (0.5 gpm).
    - If the pressure does not reach maximum output or the flow does not drop below the specified value, excessive internal leakage is occurring. Remove and disassemble the steering gear and remove the control valve. Repair the steering gear as outlined in the Unit Repair Manual.
11. Have the steering wheel turned slightly in both directions and release quickly while watching the pressure gage. The needle should move from the normal back pressure reading and snap back as the wheel is released. If it comes back slowly, or sticks, the rotary valve in the steering gear is sticking. Remove, disassemble and clean the rotary valve. If the system contains a lot of dirt and foreign material, disassemble the pump the gear, clean and reassemble.
12. If the problem still exists, the steering and front suspension must be thoroughly examined. Refer to "Diagnosis of Power Steering System" in this section.

POWER STEERING SYSTEM ON-VEHICLE SERVICE

MAINTENANCE

The hydraulic system should be kept clean and at regular intervals the pump steering fluid level in the reservoir should be checked and fluid added when required. Refer to MAINTENANCE AND LUBRICATION (SEC. 0B) of this manual for type of fluid to be used and intervals for filling.

If the system contains some dirt, flush it as detailed later in this section. If it is exceptionally dirty, both the pump and the gear must be completely disassembled before further usage.

All tubes, hoses, and fittings should be inspected for leakage at regular intervals. Fittings must be tight. Make sure the clips, clamps and supporting tubes and hoses are in place and properly secured.

Inspect the hoses with the wheels in the straight-ahead position, then turn the wheels fully to the left and right, while observing the movement of the hoses. Correct any hose contact with other parts of the vehicle that could cause chafing or wear.

Power steering hoses and lines must not be twisted, kinked or tightly bent. The hoses should have sufficient natural curvature in the routing to absorb movement and hose shortening during vehicle operation.

Air in the system will cause spongy action and noisy operation. When a hose is disconnected or when fluid is lost, for any reason, the system must be bled after refilling. Refer to "Bleeding the Power Steering System" in this section.

PUMP BELT TENSION ADJUSTMENT

When adjusting a power steering pump belt, never pry against the pump reservoir or pull against the filler neck. Two systems are used for belt adjustment. On some models, the pump is loosened from the bracket and moved outward to increase the tension. On other models, a half-inch square drive hole is located in the bracket, and this hole is used to rotate the pump-and-bracket assembly outward to increase belt tension.

Adjust

Tool Required:

J-23600-B Belt Tension Gage.

1. Place belt tension gage, J-23600-B or equivalent, midway between the pulleys on drive belts being checked.

- Power steering pump driven by a single belt.
  - Loosen the pump attaching bolts and adjust the belt to correct tension by moving the pump outward, away from the engine.
  - Tighten finger tight all pump mounting bolts and remove the pry bar.
  - Tighten all pump mounting bolts. Refer to "Power Steering Pump Replacement" in this section.
  - Inspect belt tension and remove the belt tension gage.

2. Loosen the pivot bolt and pump brace adjusting nuts.

NOTICE: Do not move the pump by prying against the reservoir or by pulling on the filler neck, or damage may occur.

3. Move the pump, with the belt in place until the belt is tensioned to specifications. Refer to ENGINE COOLING (SEC. 6B).
4. Tighten the pump bracket adjusting nut and the pivot bolt nut. Refer to "Power Steering Pump Replacement" in this section.
5. Inspect the belt tension and remove the belt tension gage.

FLUID LEVEL ADJUSTMENT

1. Run the engine until the power steering fluid reaches normal operating temperature, about 80°C (170°F), then shut the engine off.
2. Remove the reservoir cap and check the fluid level on the dipstick. On models equipped with a remote reservoir, the fluid level should be about 12.7 to 25.4 mm (1/2 to 1-inch) from the top when the wheels are in full left turn position.
3. If the fluid level is low, add power steering fluid (GM #1050017 or equivalent) to the proper level and install the reservoir cap.
4. When checking the fluid level after the steering system has been serviced, air must be bled from the system. Refer to "Bleeding the Power Steering System" in this section.

BLEEDING THE POWER STEERING SYSTEM

When a power steering pump or gear has been installed, or an oil line has been disconnected, the air that has entered the system must be bled out before the vehicle is operated. If air is allowed to remain in the power steering fluid system, nosiy and unsatisfactory operation of the system may result. Bleed air from the hydraulic system as follows:

- When bleeding the system, and any time fluid is added to the power steering system, be sure to use only power steering fluid as specified in MAINTENANCE AND LUBRICATION (SEC. 0B).

1. Fill the pump fluid reservoir to the proper level and let the fluid settle for at least two minutes.
2. Start the engine and let it run for a few seconds. Then turn the engine off.
3. Add fluid if necessary.
4. Repeat the above procedure until the fluid level remains constant after running the engine.
5. Raise the front end of the vehicle so that the wheels are off the ground.
6. Start the engine. Slowly turn the steering wheel right and left, lightly contacting the wheel stops.
7. Add power steering fluid if necessary.
8. Lower the vehicle and turn the steering wheel slowly from lock to lock.
9. Stop the engine. Check the fluid level and refill as required.
10. If the fluid is extremely foamy, allow the vehicle to stand a few minutes and repeat the above procedure.

Inspect

- Belt for tightness.
- Pulley for looseness or damage The pulley should not wobble with the engine running.
- Hoses so they are not touching any other parts of the vehicle.
- Fluid level and fill to the proper level.
- Fluid for air and if present attempt to bleed the system.

FLUSHING THE POWER STEERING SYSTEM

1. Raise the front end of the vehicle off the ground until the wheels are free to turn.
2. Remove the fluid return line at the pump inlet connector and plug the connector port on the pump. Position the line towards a large container to catch the draining fluid.
3. While an assistant is filling the reservoir with new power steering fluid, run the engine at idle. Turn the steering wheel from stop to stop. DO NOT contact wheel stops or hold the wheel in a corner or fluid will stop and the pump will be in pressure relief mode. A sudden overflow from the reservoir may develop if the wheel is held at a stop.
4. Install all the lines, hoses and components (if removed) on the vehicle. Fill the system with new power steering fluid and bleed the system as described in "Bleeding The Power Steering System." Operate the engine for about 15 minutes. Remove the pump return line at the pump inlet and plug the connection on the pump. While refilling the reservoir, check the draining fluid for contamination. If foreign material is still evident, replace all lines, disassemble and clean or replace the power steering system components. Do not re-use any drained power steering fluid.

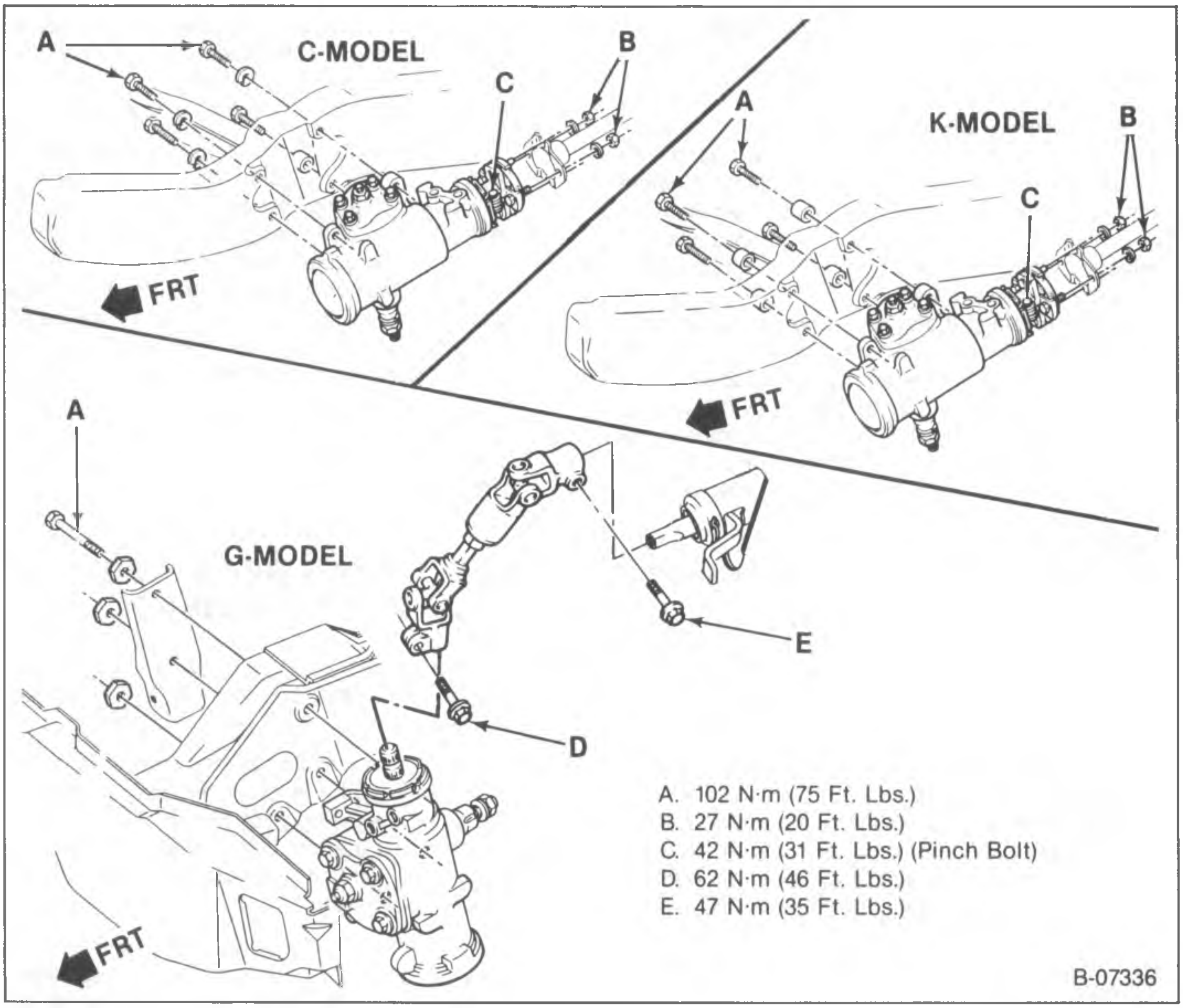
STEERING GEAR HIGH POINT CENTERING

1. Set the front wheels in the straight ahead position. This can be checked by driving the vehicle a short distance on a flat surface.
2. With the front wheels set straight ahead, check the position of the mark on the wormshaft designating steering gear high point. This mark should be at the top side of the shaft at the 12 o'clock position and lined up with the mark in the coupling lower clamp.
3. On C, G and P models except P30(00)FS3, if the steering gear has been moved off high point when setting the wheel in the straight ahead position, loosen the adjuster tube clamps on both the left and right hand tie rods. Then turn both adjuster tubes an equal number of turns in the same direction to bring the gear back on high point.

Important

- Turning the adjuster tubes an unequal number of turns or in different directions will disturb the toe-in setting of the wheels.

4. On K and P30(00)FS3 models, if the gear has been moved off high point when setting the wheels in the straight ahead position, loosen the adjuster tube clamps on the connecting rod. Then turn the adjuster tube to bring the gear back on high point.
5. Adjust toe-in. Refer to FRONT END ALIGNMENT (SEC. 3A).
6. Refer to STEERING LINKAGE (SEC. 3B1) for adjuster tube clamping instructions.



A. 102 N·m (75 Ft. Lbs.)
B. 27 N·m (20 Ft. Lbs.)
C. 42 N·m (31 Ft. Lbs.) (Pinch Bolt)
D. 62 N·m (46 Ft. Lbs.)
E. 47 N·m (35 Ft. Lbs.)

Figure 7—Steering Gear Installation

POWER STEERING GEAR REPLACEMENT

Remove or Disconnect (Figures 7 and 8)

- Place a drain pan below the steering gear.

1. Battery ground cable.
2. Hoses from the steering gear. Raise the hose up to prevent oil drainage. Cap or tape the ends of the hose and gear fittings to prevent the entrance of dirt.
   - Remove the flexible coupling to steering shaft flange bolts (C, K and P300(32) models).
   - Remove the lower universal joint pinch bolt. Mark the relationship of the universal yoke to the stub shaft (G and P models).
3. Pitman arm. Refer to STEERING LINKAGE (SEC. 3B1).
4. Steering gear frame bolts and the steering gear.
   - Tap lightly, using a soft mallet, on the flexible coupling to remove the coupling from the steering gear stub shaft (C, K and P300(32) models).

C, K And P300(32) Models

Install Or Connect (Figures 7 and 8)

NOTICE: For steps 2, 3 and 4 see "Notice" on page 3B3-1.

1. Flexible coupling onto the steering gear stub shaft.
   - Align the flat in the coupling with the flat on the shaft.
   - Push the coupling onto the stub shaft until the coupling reinforcement bottoms against the end of the shaft.

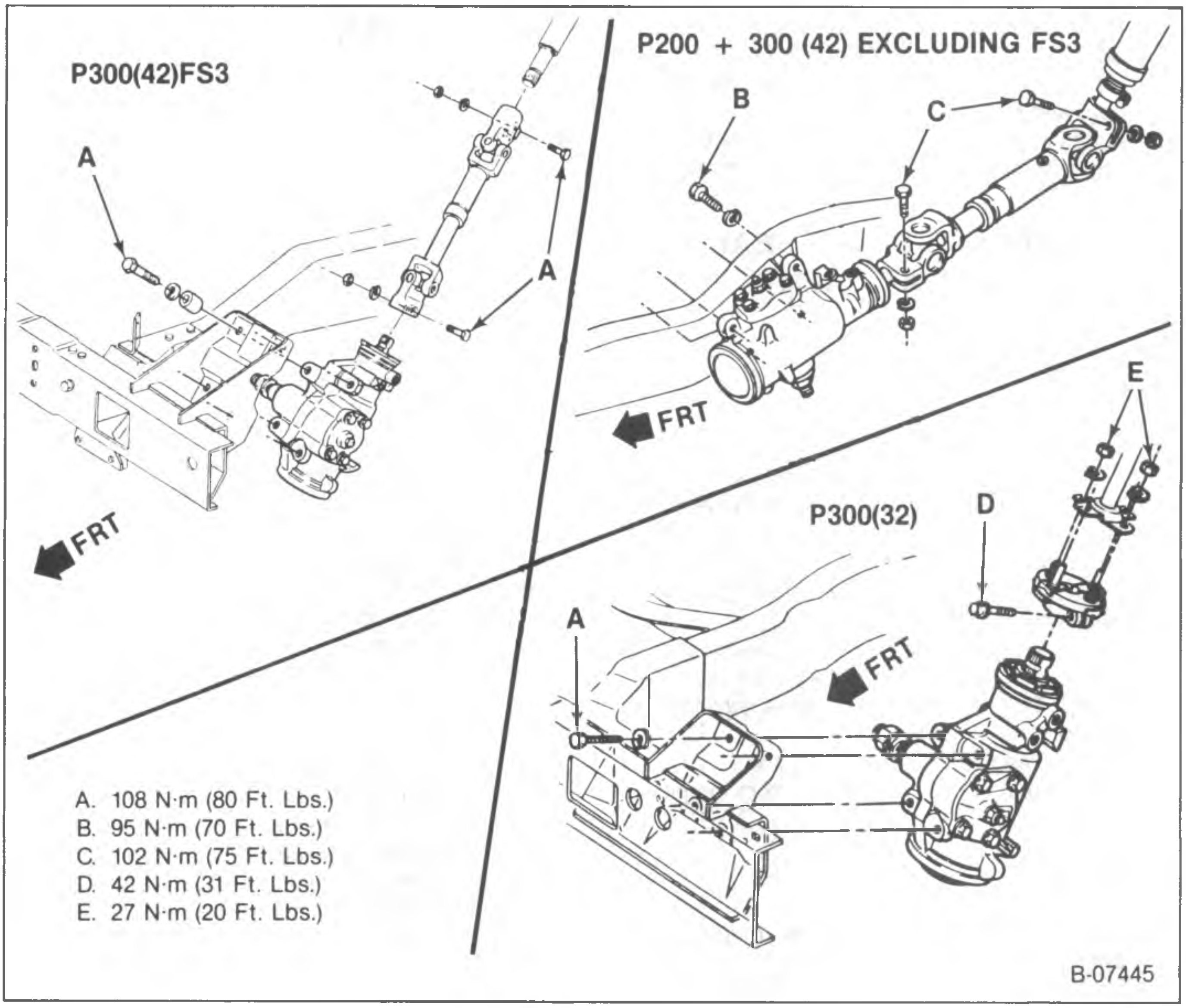


Figure 8—Steering Gear Installation

2. Pinch bolt into the split clamp. **The pinch bolt must pass through the shaft undercut.**

Tighten

  - Pinch bolt to 42 N·m (31 ft. lbs.).

- Place the steering gear into position, guiding the coupling bolts into the proper holes in the shaft flange.

3. Steering gear to frame bolts. Torque to "Specifications" at the end of this section.
4. Coupling flange nuts and washers. The coupling alignment pins should be centered in the flange slots.

Tighten

  - Coupling flange nuts to 27 N·m (20 ft. lbs.). Maintain a coupling to flange dimension of 6.4 to 9.5 mm (0.250 to 0.375-inch).

5. Pitman arm. Refer to STEERING LINKAGE (SEC. 3B1).

- Remove the plugs and caps from the steering gear and hoses.

6. Hoses to the steering gear. Torque hose fittings to "Specifications"at the end of this section.

G And P Models

Install or Connect (Figures 7 and 8)

- Place the steering gear in position. Guide the stub shaft into the universal joint assembly by lining up the marks made at removal.

1. Steering gear to the frame bolts. Torque to "Specifications" at the end of this section.
2. Intermediate shaft pinch bolt. Torque to "Specifications" at the end of this section. **The pinch bolt must pass through the shaft undercut.**

3. Pitman arm. Refer to STEERING LINKAGE (SEC. 3B1).
- Remove the plugs and caps from the steering gear and hoses.
4. Hoses to the steering gear. Torque hose fittings to "Specifications" at the end of this section.

PITMAN SHAFT SEAL REPLACEMENT

Remove or Disconnect

Tools Required:
J-29107 Pitman Arm Puller.
J-4245 Internal Snap Ring Pliers.

- Mark the position of the pitman arm to the pitman shaft. Remove the pitman arm using J-29107. Refer to STEERING LINKAGE (SEC. 3B1).
- Position a drain pan under the steering gear.
1. Retaining ring using J-4245.
- Start the engine and full turn the steering wheel to the left-turn position for one or two seconds at a time. This will force the pitman shaft seals and washers out of the housing.
- Stop the engine.
2. Pitman shaft seals and washers from the pitman shaft.

Inspect

- Pitman shaft seal surfaces for roughness or pitting. If pitted, replace the shaft.
- Housing for burrs. Remove the burrs before installing the new seals.

Clean

- Pitman shaft and seal areas using a crocus cloth.

Install or Connect

Tools Required:
J-6219 Steering Gear Pitman Shaft Oil Seal Installer.
J-4245 Internal Snap Ring Pliers.

- Lubricate the new seals with power steering fluid.
- Apply a single layer of tape to the pitman arm shaft to avoid damaging the seals.
1. Single lip seal and washer use J-6219. Install far enough to provide clearance for the remaining seal, washer and retaining ring. DO NOT allow the seal to bottom on the end of the counter bore.
2. Double lip seal and washer use J-21553.
3. Retaining ring use J-4245.
4. Pitman arm. Refer to STEERING LINKAGE (SEC. 3B1).

STEERING GEAR ADJUSTMENTS

Important

- Before any adjustments are made to the steering gear, refer to "Diagnosis of Power Steering System" for reviewing the possible steering system problems.

The steering gear adjustment is made only as a correction and not as a periodic adjustment. Adjusting the steering gear in the vehicle is NOT recommended for two reasons:

1. The complexity involved in adjusting the worm thrust bearing preload.
2. The friction effect provided by the hydraulic fluid in the steering gear.

For proper adjustment, remove the steering gear from the vehicle. Drain the power steering fluid from the gear. Mount the gear in a vise and make the following adjustments.

The steering gear requires two adjustments which are: the worm thrust bearing preload and the pitman shaft over-center preload adjustment.

The worm thrust bearing preload is controlled by the amount of compression force exerted on the conical worm bearing thrust races by the adjuster plug.

The pitman shaft over-center preload is controlled by the pitman shaft adjuster screw which determines the clearance between the rack piston and the pitman shaft sector teeth.

Important

- Adjust the worm thrust bearing preload first, then adjust the pitman shaft over-center preload.

Worm Bearing Preload

Adjust (Figures 1, 2, 9 through 13)

Tool Required:
J-7624 Adjustable Spanner Wrench.

1. Loosen and remove the adjuster plug nut (6) (figure 9).
2. Turn the adjuster plug (3) in (clockwise), using J-7624, until the plug and thrust bearing are firmly bottomed in the housing.

Tighten

- Adjuster plug to 27 N·m (20 ft. lbs.).

3. Place an index mark on the housing even with one of the holes in the adjust plug (figure 10).

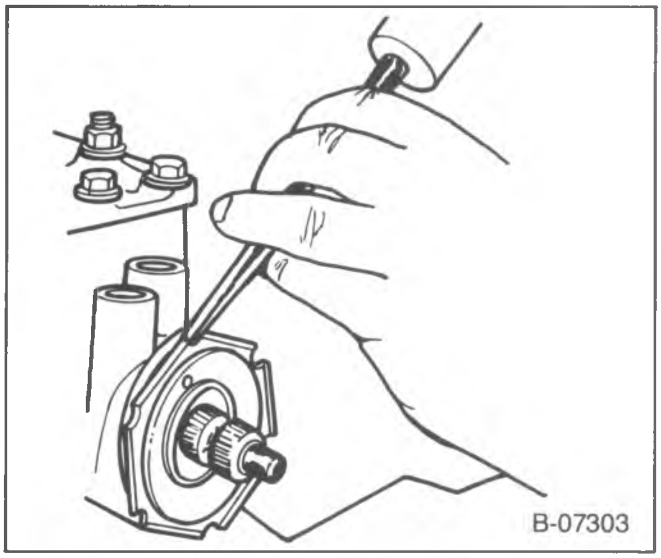


Figure 9—Loosening Adjuster Plug Nut

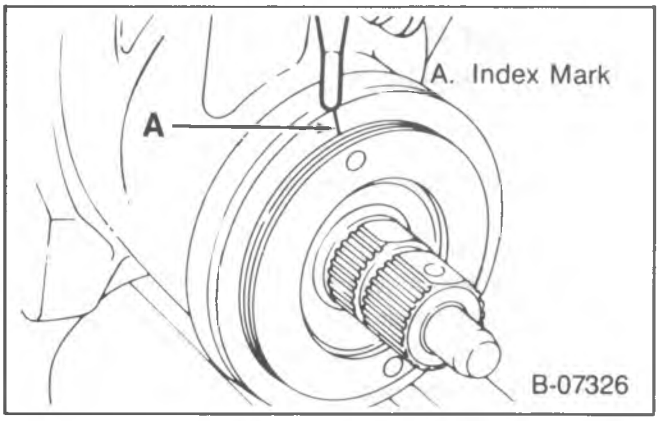


Figure 10—Marking Housing Even With Adjuster Plug

4. Measure back (counterclockwise) 4.7-6.3 mm ($^3/_{16}$-$^1/_4$-inch) from the index mark and mark the housing (figure 11).

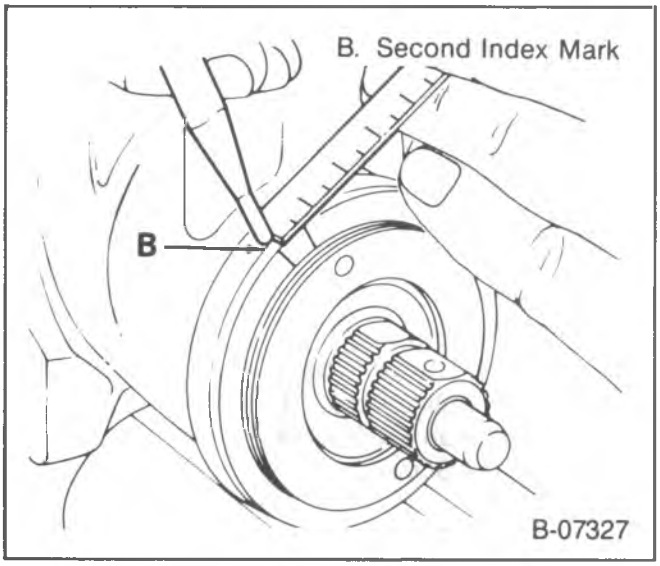


Figure 11—Remarking The Housing

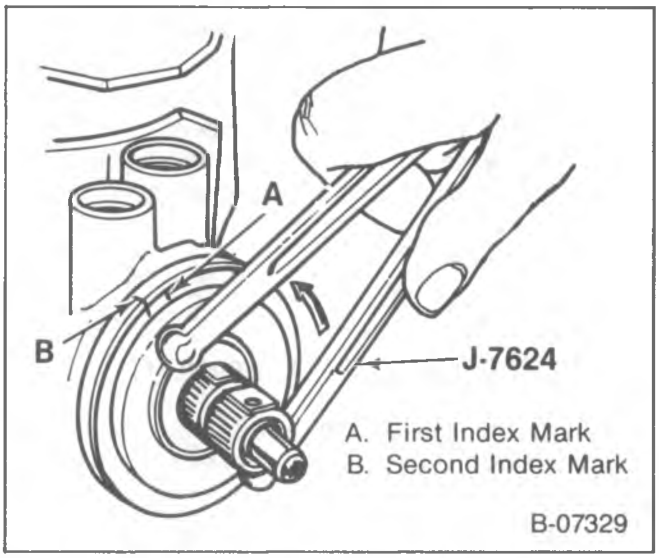


Figure 12—Aligning Adjuster Plug To Second Mark

5. Rotate the adjuster plug back (counterclockwise) until the hole in the plug is aligned with the second mark on the housing (figure 12).

6. Install the adjuster plug nut (6).

Tighten

- Nut to 110 N·m (81 ft. lbs.). Be sure the adjuster plug does not turn when tightening the nut.

7. Use a inch-pound torque wrench and a 12-point deep socket to measure the required torque to turn the stub shaft (4). Take the reading with the handle of the torque wrench near the vertical position. Turn the stub shaft to the right stop and then back (counterclockwise) $^1/_4$ turn at an even rate (figure 13). Record the torque reading.

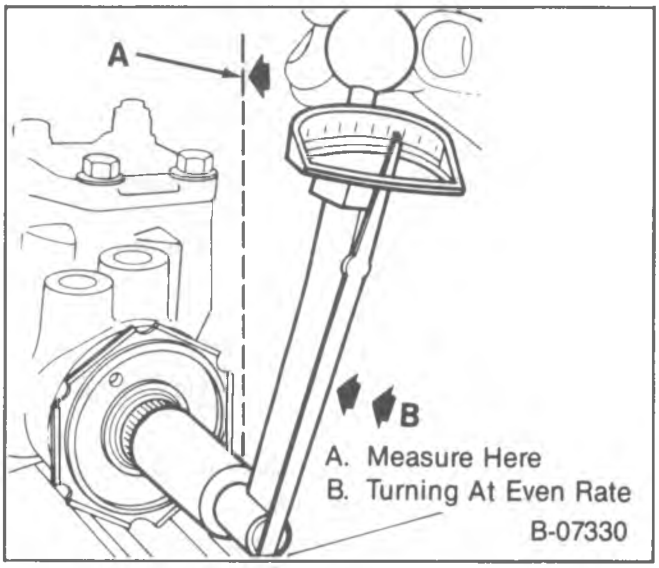


Figure 13—Checking Rotational Torque

8. The torque required to turn the stub shaft should be 0.45-1.13 N·m (4-10 in. lbs.). If the reading is above or below the specified torque; the adjuster plug may not be tightened properly or may have turned when the adjuster plug nut was tightened, or the thrust bearings and races (22) may be damaged.

Over Center Preload

Adjust (Figures 1, 2, 14 through 16)

1. Turn the pitman shaft adjuster screw (79) counterclockwise until fully extended, then turn back 1/2 turn clockwise.
2. Rotate the stub shaft (4) from stop to stop and count the number of turns.
3. Starting at either stop, turn the stub shaft back 1/2 the total number of turns. This is the "center" of the gear.
   - When the gear is centered, the flat on the stub shaft should face upward and be parallel with the side cover (21) (figure 14) and the master spline on the pitman shaft should be in line with the adjuster screw (79) (figure 15).
4. Place the torque wrench, in the vertical position, on the stub shaft. Rotate the torque wrench 45 degrees each side of the center and record the highest drag torque measured on or near center (figure 16).
5. Adjust over-center drag torque by loosening the adjuster screw jam nut (17) and turning the pitman shaft adjuster screw (79) clockwise until the correct drag torque is obtained.
   - On new steering gears (under 400 miles), add 0.6-1.2 N·m (6-10 in. lbs.) torque to the previously measured worm bearing preload torque but do not exceed a total steering gear preload of 2 N·m (18 in. lbs.).
   - On used steering gears (400 miles or more) add 0.5-0.6 N·m (4-5 in. lbs.) torque to the previously measured worm bearing preload torque but do not exceed a total steering gear preload of 1.5 N·m (14 in. lbs.).

Tighten

- Adjuster screw jam nut (17) to 47 N·m (35 ft. lbs.).

6. Install the steering gear. Refer to "Steering Gear Installation" in this section.
7. Fill the pump reservoir with power steering fluid and bleed the system. Refer to "Bleeding the Power Steering System" in this section.

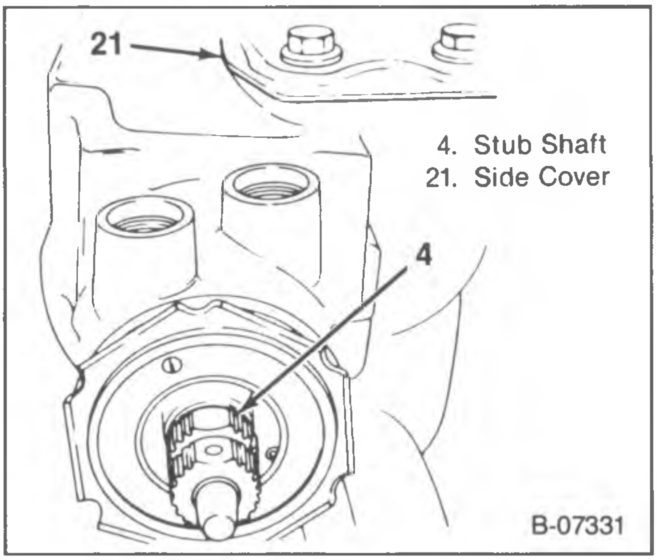


Figure 14—Aligning The Stub Shaft

POWER STEERING PUMP REPLACEMENT

Remove or Disconnect (Figures 17 through 20)

Tool Required:

J-29785-A Water Pump and Power Steering Pulley Remover.

- Place a drain pan below the pump.

1. Battery ground cable.
2. Hoses at the pump. Raise the hose up to prevent drainage of the oil. Cap or tape the ends of the hose and pump to prevent the entrance of dirt.
   - On models with remote reservoir, disconnect the reservoir hose at the pump. Cap the hose pump fittings.

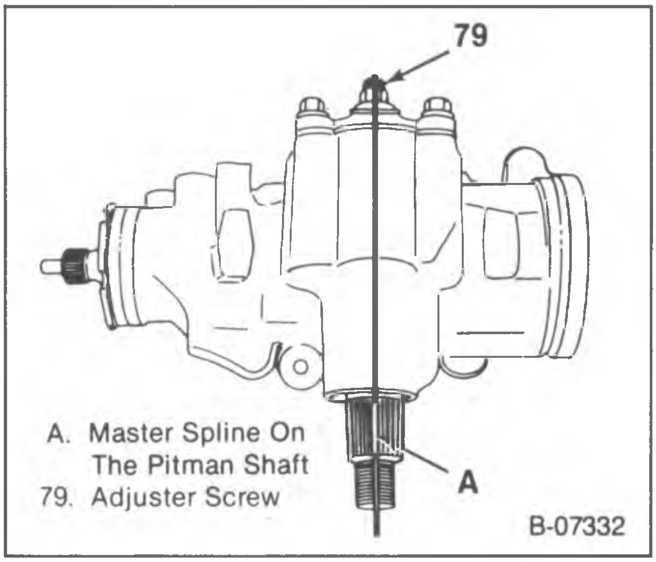


Figure 15—Aligning The Pitman Shaft Master Spline

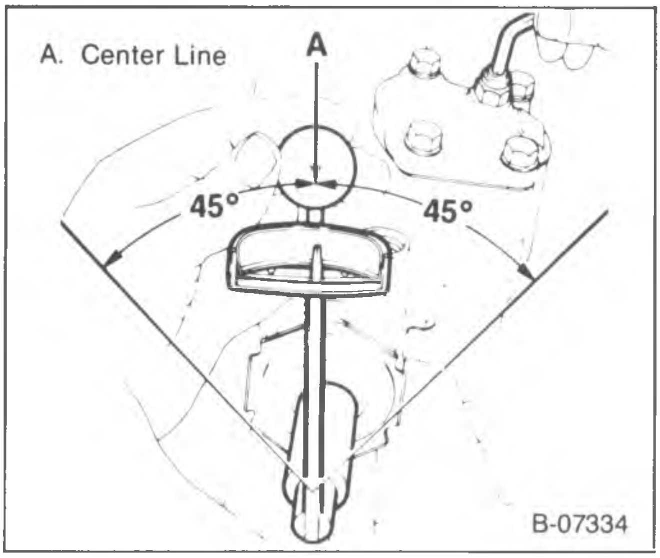


Figure 16—Checking Over-Center Rotational Torque

- Loosen the pump adjusting bolts and nuts.

3. Pump belt.
4. Pump adjusting bolts, nuts and brackets.
5. Pump assembly.
6. Pulley from the pump.
   - Install J-29785-A. Be sure the pilot bolt bottoms in the pump shaft by turning the nut to the top of the pilot bolt.
   - Hold the pilot bolt and turn the nut counterclockwise (figure 21).

Install or Connect (Figures 17 through 20)

Tool Required:

J-25033-B Power Steering Pump Pulley Installer.

1. Brackets to the pump.
2. Pulley to the pump.

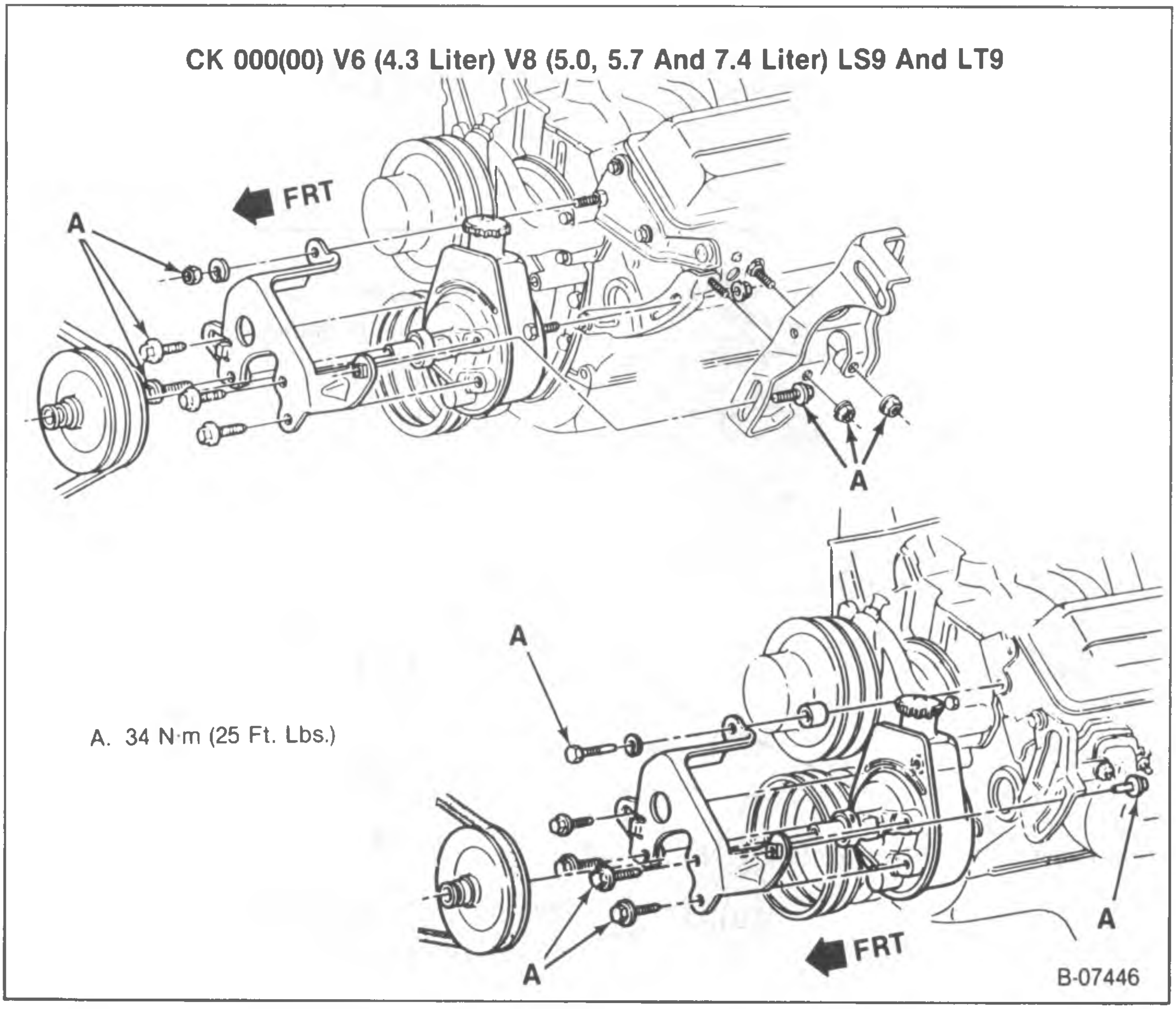
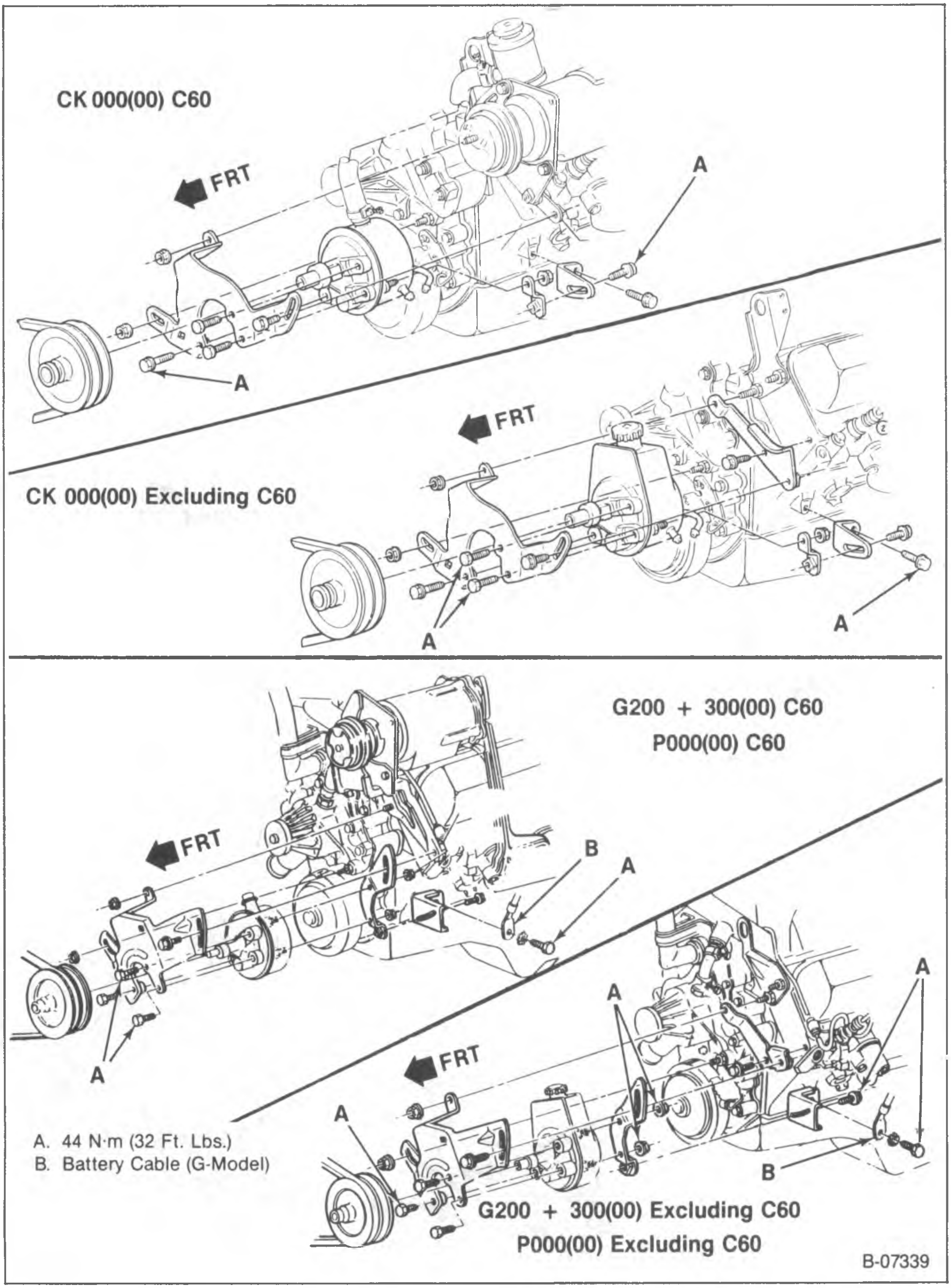


Figure 17—Power Steering Pump Mounting



CK 000(00) C60

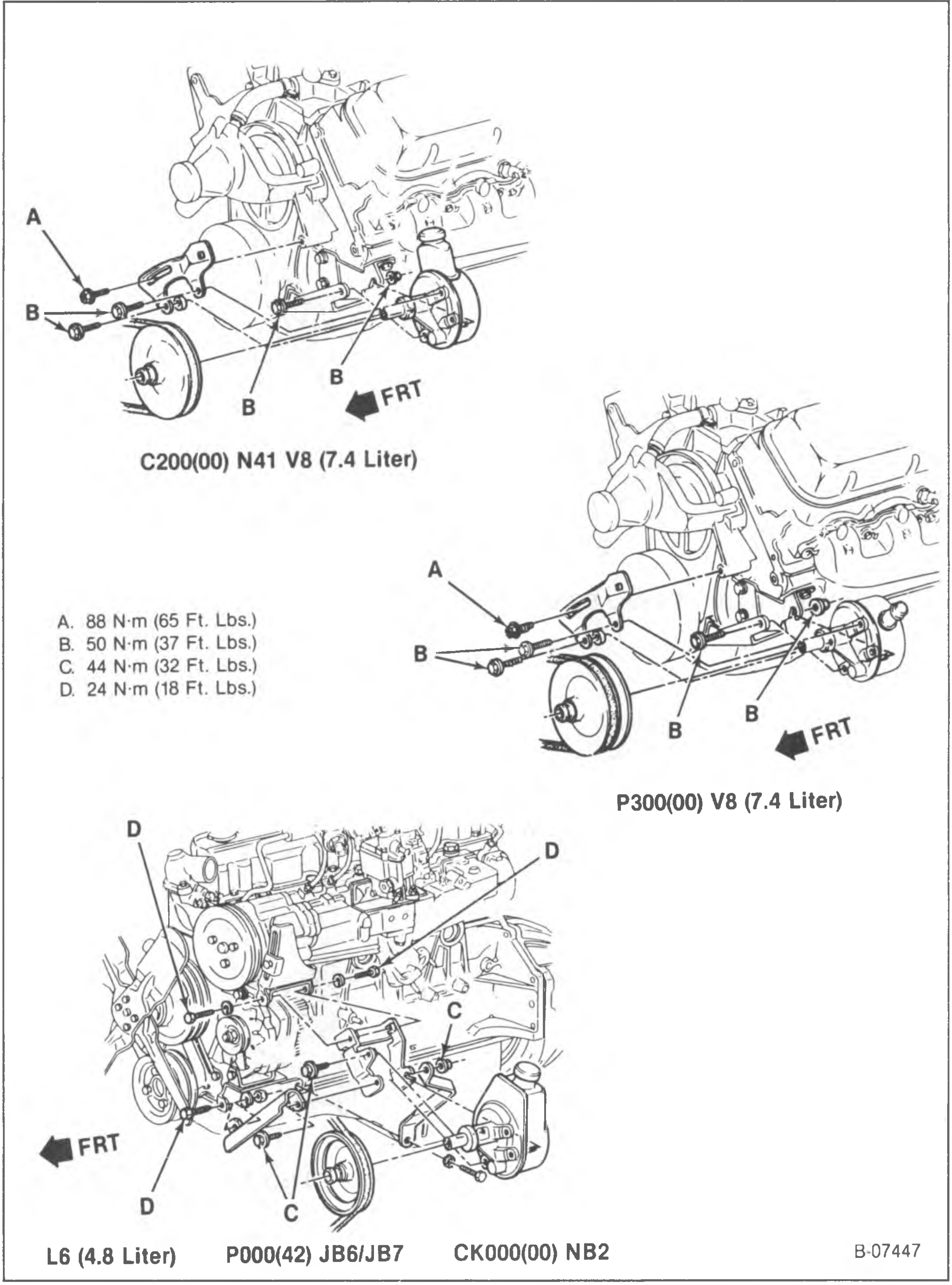
CK 000(00) Excluding C60

G200 + 300(00) C60
P000(00) C60

G200 + 300(00) Excluding C60
P000(00) Excluding C60

A. 44 N·m (32 Ft. Lbs.)
B. Battery Cable (G-Model)

Figure 18—Power Steering Pump Mounting V8 (6.2 Liter)



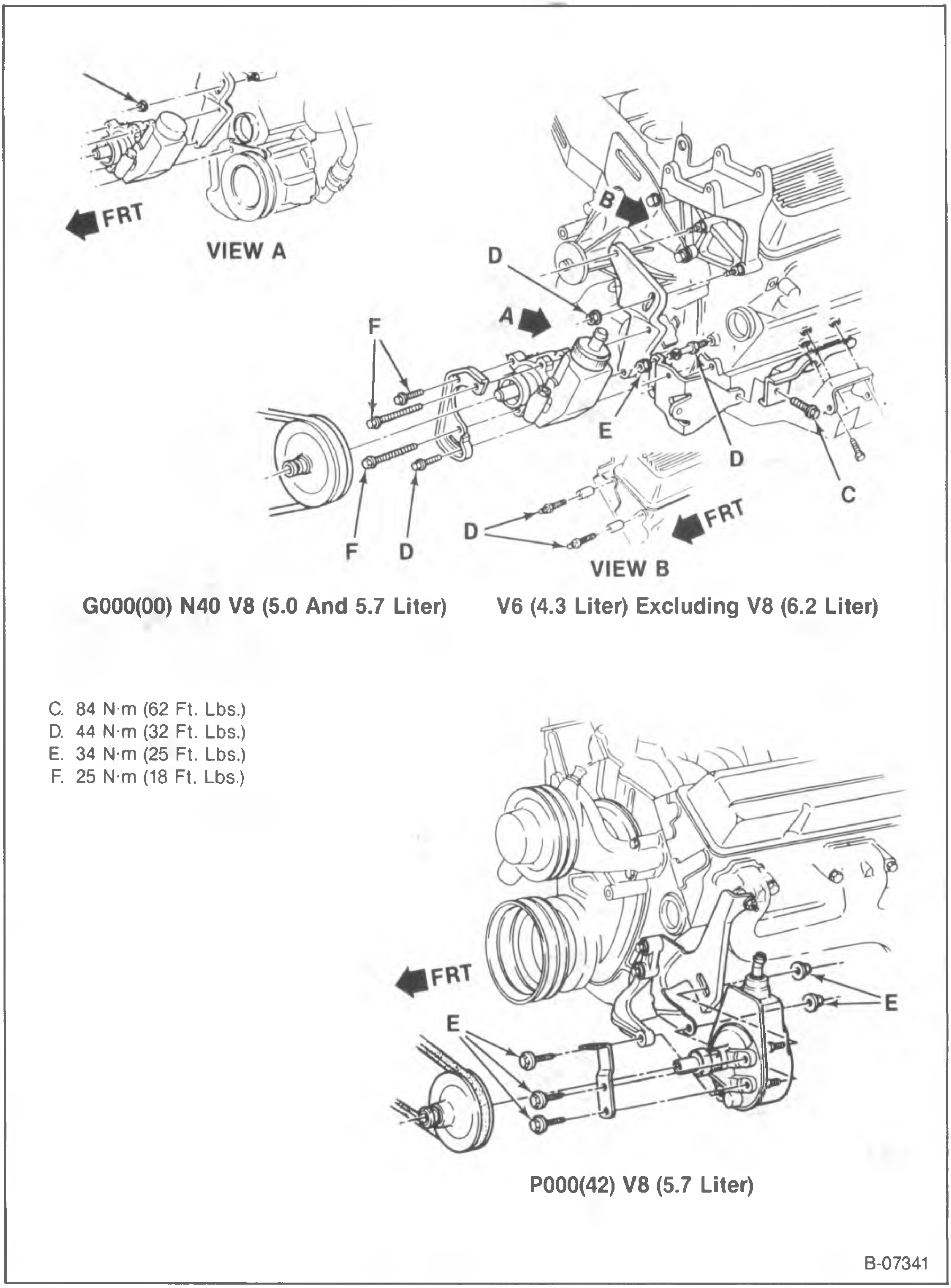
C200(00) N41 V8 (7.4 Liter)

A. 88 N·m (65 Ft. Lbs.)
B. 50 N·m (37 Ft. Lbs.)
C. 44 N·m (32 Ft. Lbs.)
D. 24 N·m (18 Ft. Lbs.)

P300(00) V8 (7.4 Liter)

L6 (4.8 Liter) P000(42) JB6/JB7 CK000(00) NB2

Figure 19—Power Steering Pump Mounting



G000(00) N40 V8 (5.0 And 5.7 Liter) **V6 (4.3 Liter) Excluding V8 (6.2 Liter)**

C. 84 N·m (62 Ft. Lbs.)
D. 44 N·m (32 Ft. Lbs.)
E. 34 N·m (25 Ft. Lbs.)
F. 25 N·m (18 Ft. Lbs.)

P000(42) V8 (5.7 Liter)

Figure 20—Power Steering Pump Mounting

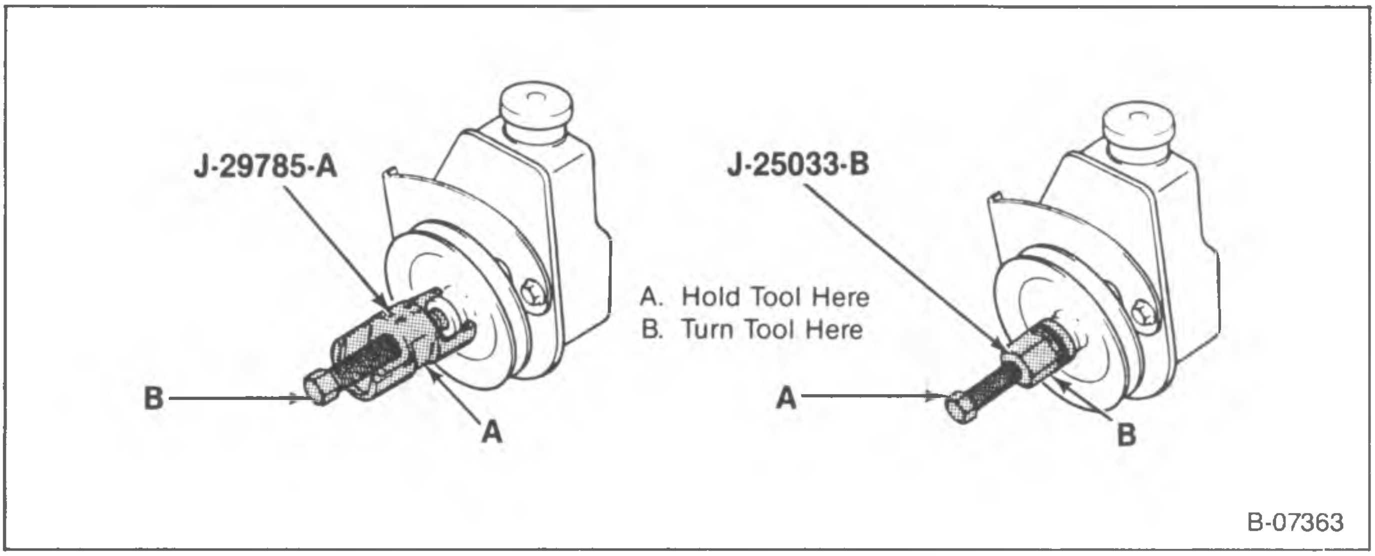


Figure 21—Installing And Removing Pulley

- Place pulley on the end of the pump shaft and install J-25033-B. Be sure the pilot bolt bottoms in the shaft by turning the nut to the top of the pilot bolt.
- Hold the pilot bolt and turn the nut clockwise (figure 21).

- On models equipped with a remote power steering pump reservoir fill the pump housing with as much fluid as possible before mounting.

3. Pump assembly and attaching parts loosely to the engine.
4. Power steering hoses to the pump. Hoses installed out of position may be subjected to chafing or other abuses during sharp turns. Refer to "Power Steering Hoses" in this section.

Important

- Do not start the engine with any power steering hose disconnected. After connecting the power steering hoses make sure there is clearance between the hoses and the drive belt, sheet metal or any other components where hose rub or interference could result.

- Fill the reservoir. Bleed the pump by turning the pulley backwards (counter-clockwise as viewed Internal Snap Ring Pliers
appear.

5. Pump belt over the pulley.

Adjust

- Belt tension. Refer to "Pump Belt Tension Adjustment" in this section.

- Fill and bleed the system. Refer to "Bleeding the Power Steering System" in this section.

POWER STEERING HOSES

When either a hose is reinstalled or replaced, the following points are essential:

- Route hoses in the same position they were in before removal (figures 22 through 29).
- Route hoses smoothly, avoid sharp bends and kinking.
- Tighten the pump end hose fitting, gear line fitting, and booster line fitting to specifications. Refer to "Specifications" at the end of this section.
- After hoses are installed, check for leaks while the system is being bled. Refer to "Bleeding the Power Steering System" in this section.

NOTICE: Do not start the engine with any power steering hose disconnected, or damage to the components could occur.

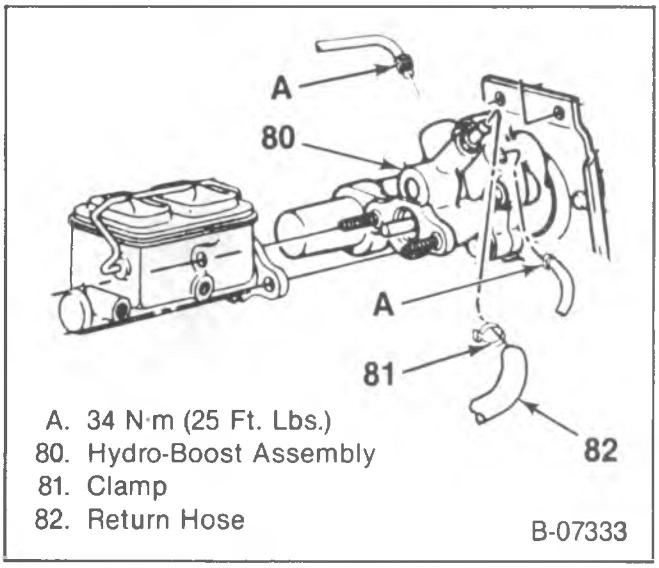


Figure 22—Hydro-Boost Lines

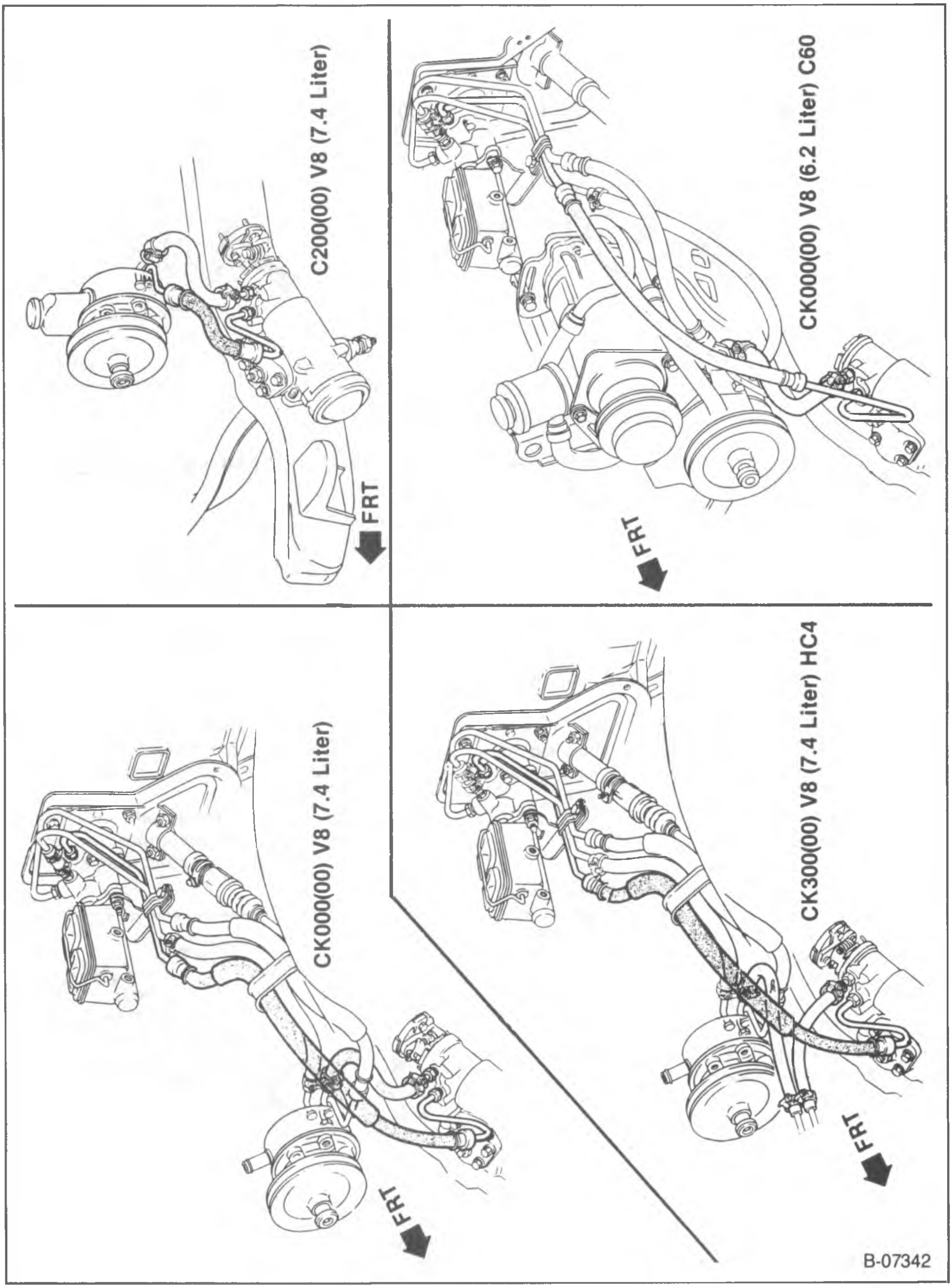


Figure 23—Power Steering Hoses

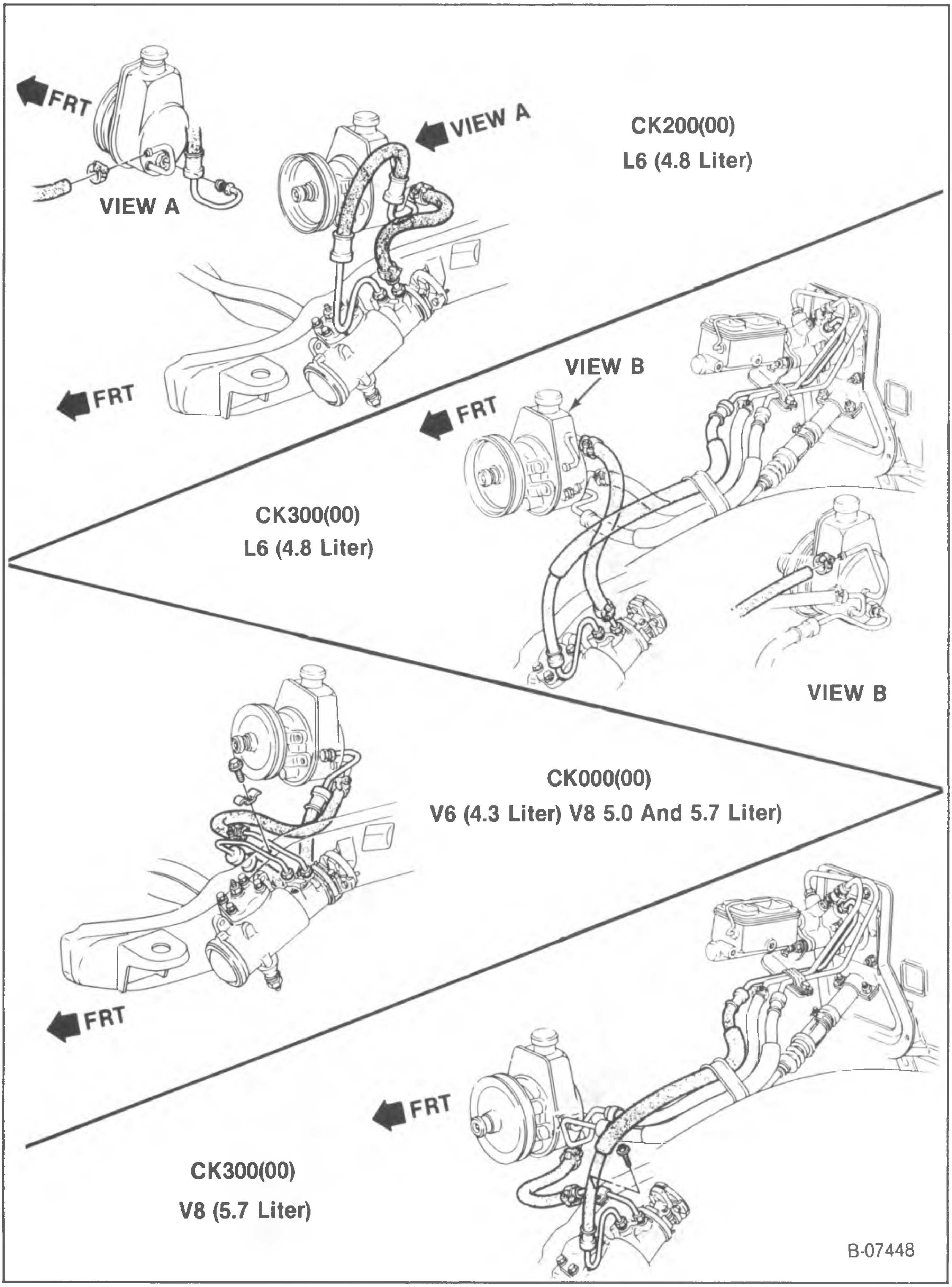


Figure 24—Power Steering Hoses

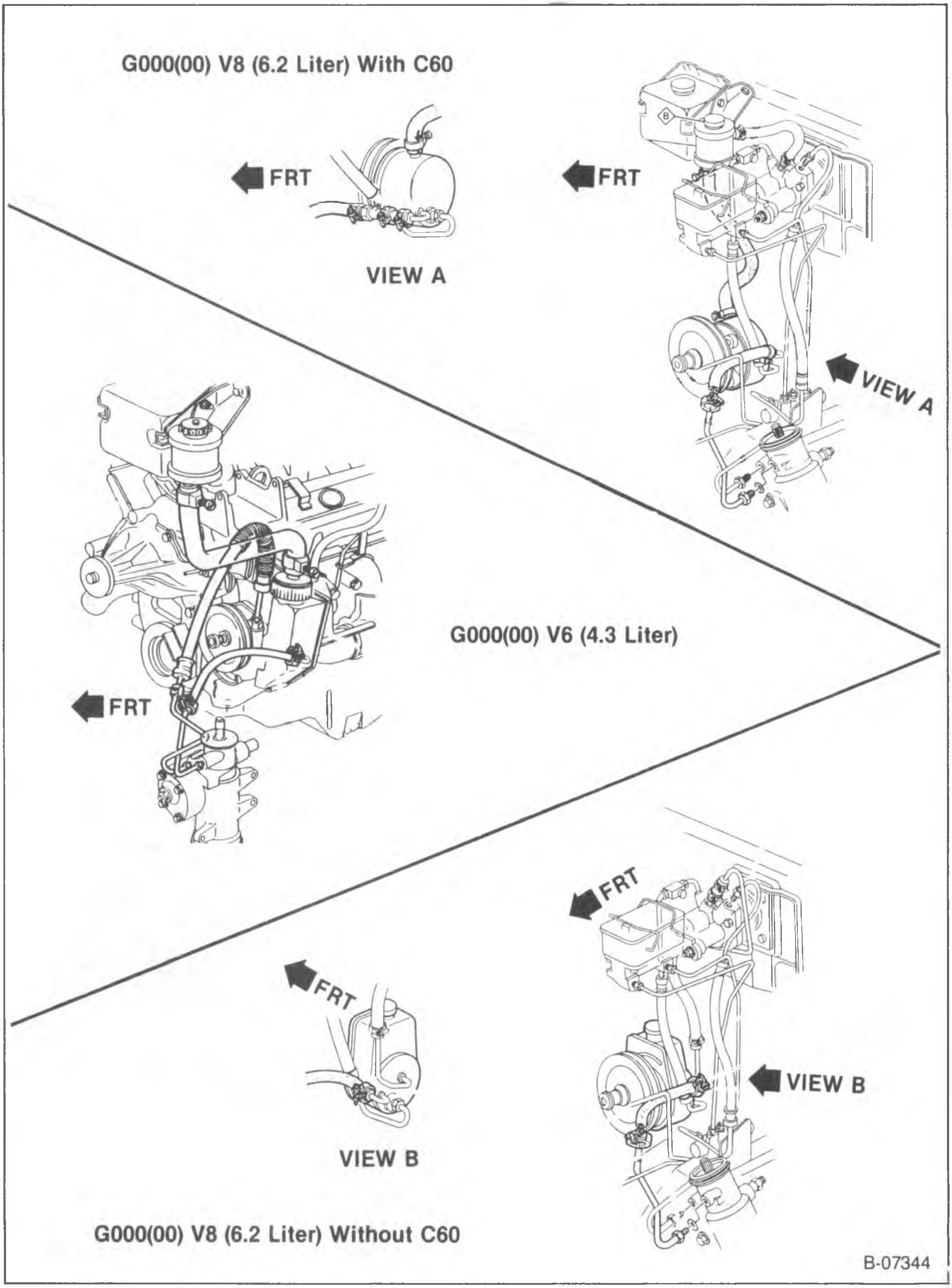
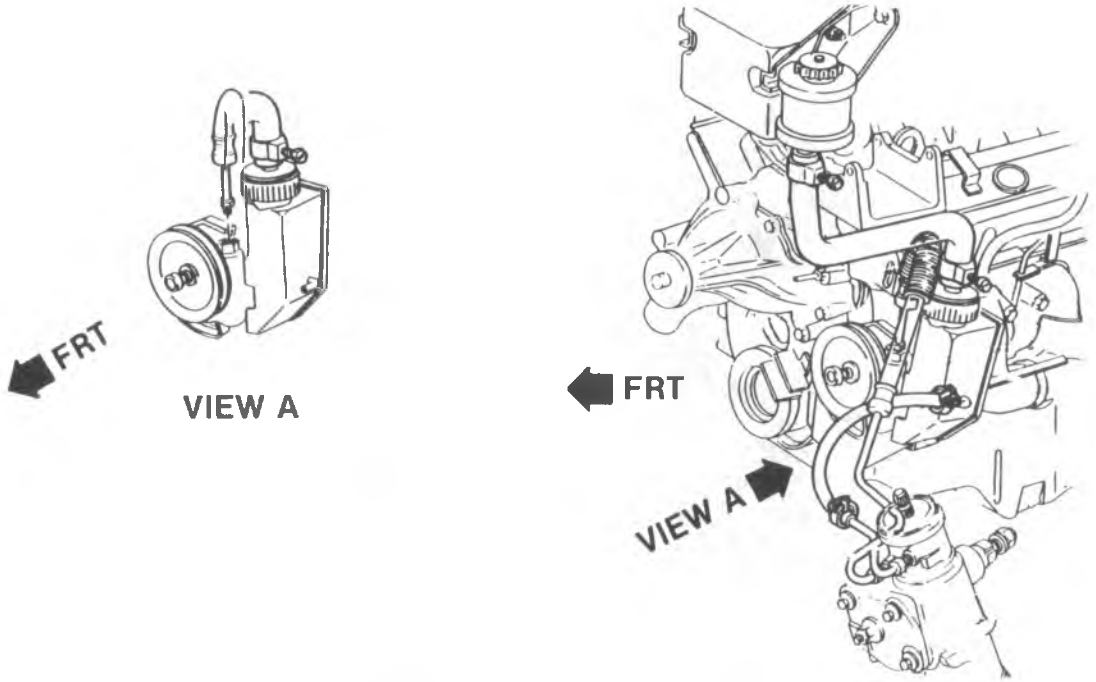
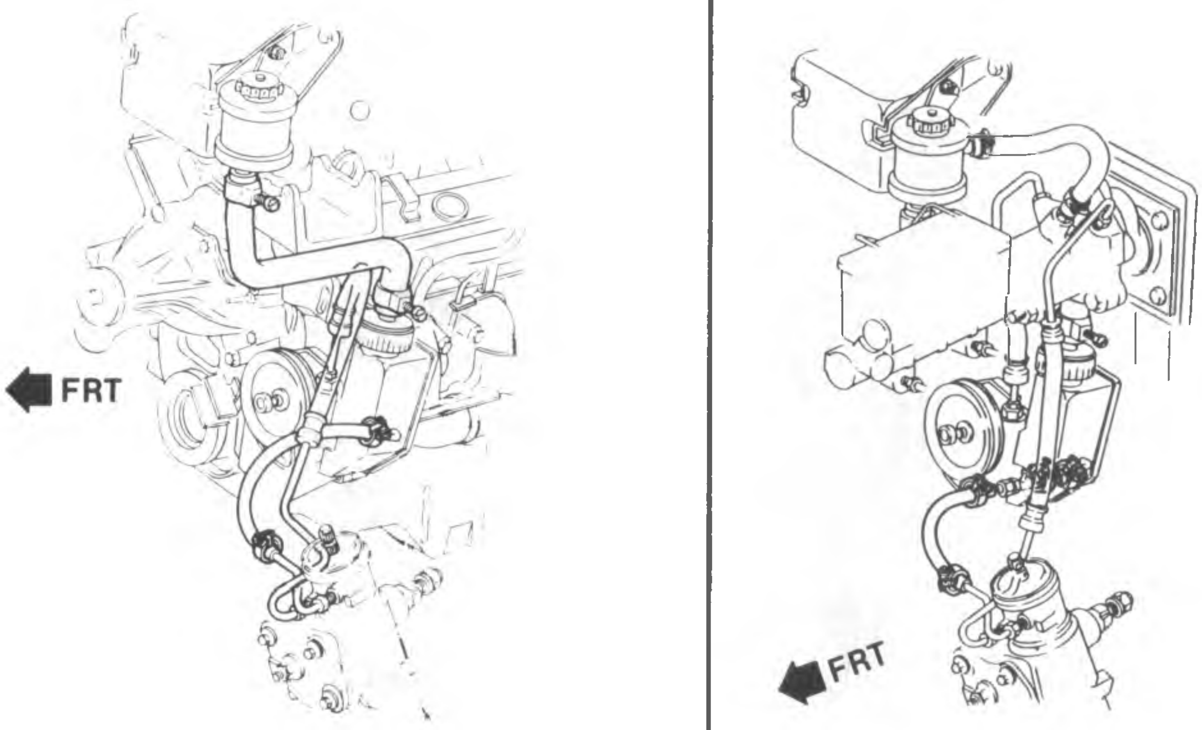


Figure 25—Power Steering Hoses



G100 + 200 V8 (5.0 And 5.7 Liter) G300 V8 (5.7 Liter) LS9 Or LT9 With JB7



G100 + 200 + 300 V8 (5.0 And 5.7 Liter)

G313(03) V8 (5.7 Liter)

B-07345

Figure 26—Power Steering Hoses

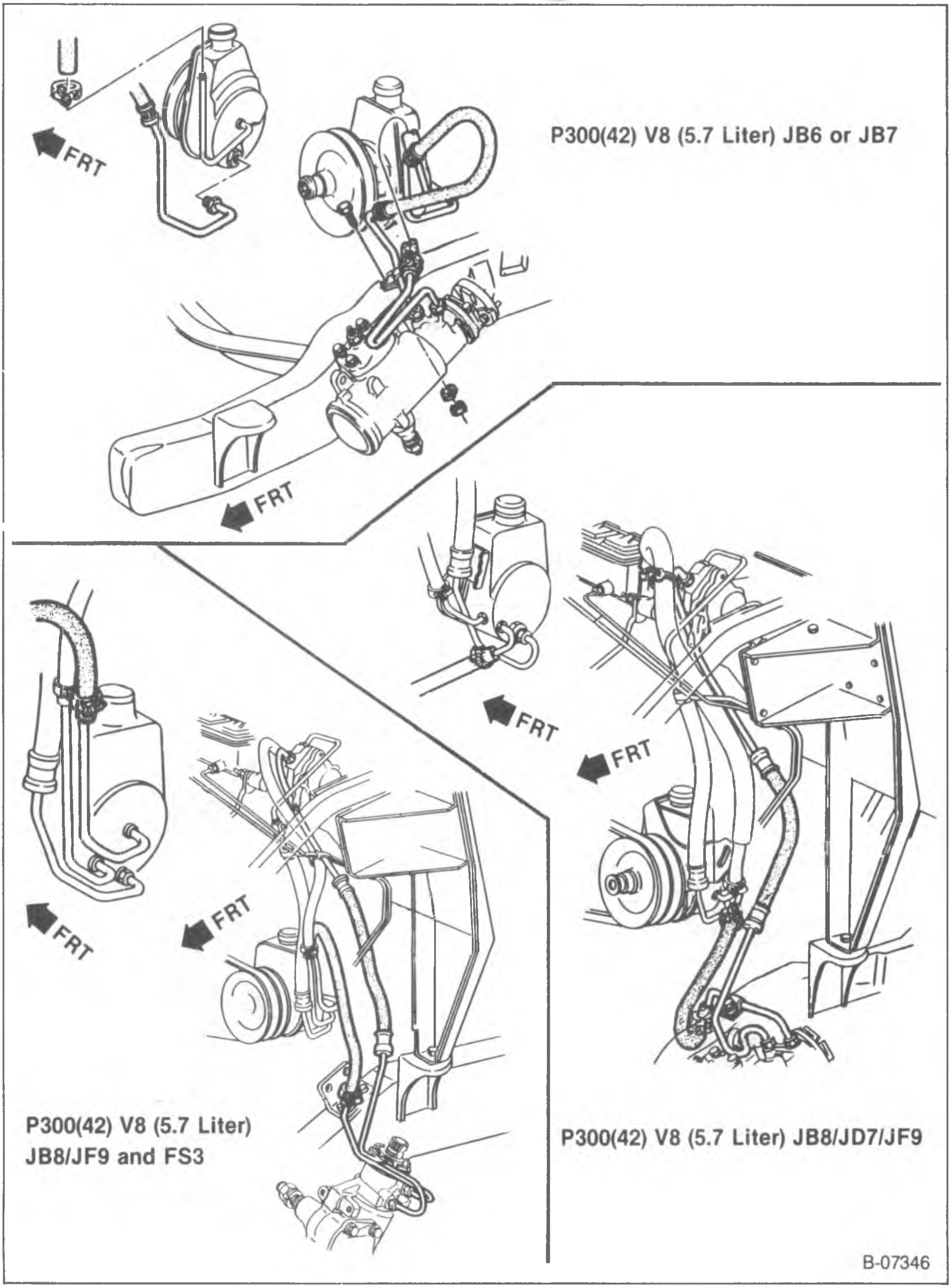
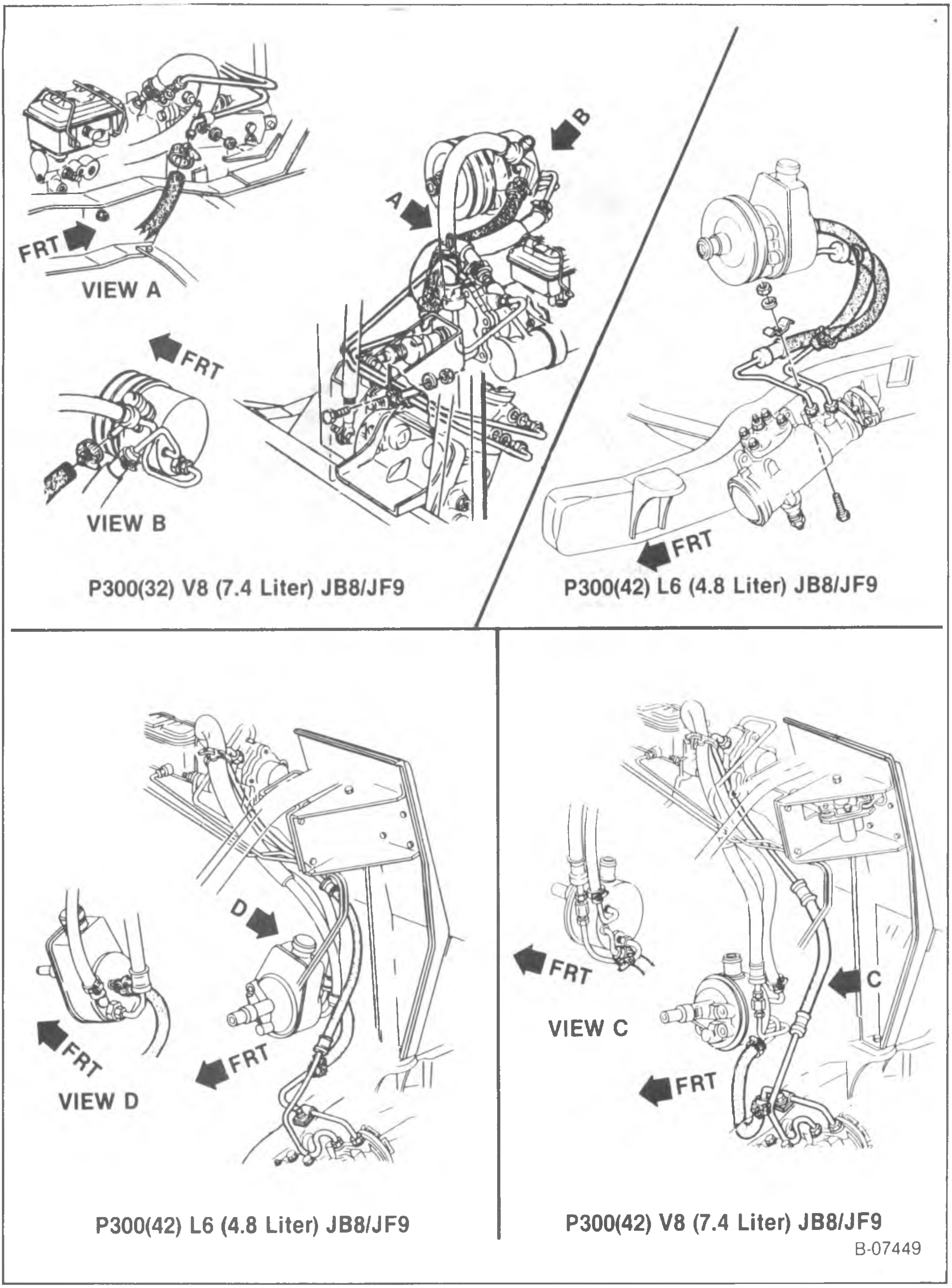


Figure 27—Power Steering Hoses



P300(32) V8 (7.4 Liter) JB8/JF9

P300(42) L6 (4.8 Liter) JB8/JF9

P300(42) L6 (4.8 Liter) JB8/JF9

P300(42) V8 (7.4 Liter) JB8/JF9

Figure 28—Power Steering Hoses

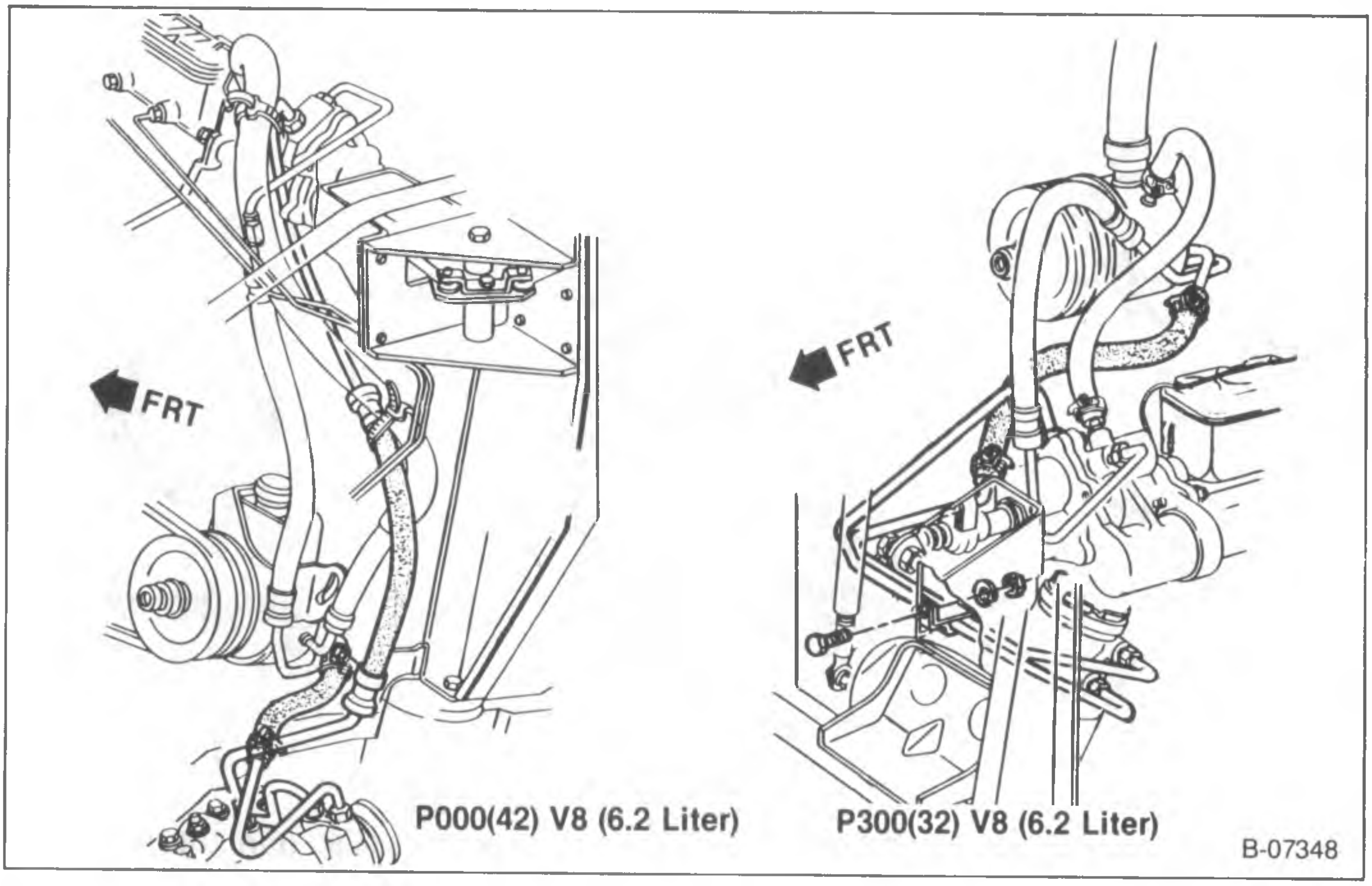


Figure 29—Power Steering Hoses

SPECIFICATIONS

STEERING GEAR ADJUSTMENTS

Valve Assembly And Seal Drag	0.1-0.4 N·m (1-4 in. lbs.)
Thrust Bearing Preload (In Excess Of Valve Assembly And Seal Drag)	0.3-0.4 N·m (3-4 in. lbs.)
Pitman Shaft Over Center Preload	
New Gear	0.6-1.2 N·m (6-10 in. lbs.)
Used Gear	0.4-0.5 N·m (4-5 in. lbs.)
Final Over Center Reading (Total-Maximum)	
New Gear	2 N·m (18 in. lbs.)
Used Gear	1.6 N·m (14 in. lbs.)

TORQUE SPECIFICATIONS

	TORQUE	
	N·m	Ft. Lbs.
Steering Gear To Frame Nuts (C, K, and G Models)	102	75
Steering Gear To Frame Nuts (P300(32) andP300(42)FS3)	108	80
Steering Gear To Frame Nuts (P200 + 300(42) Excluding FS3)	95	70
High Pressure Line Fitting (At Gear)	34	25
Oil Return Line Fitting (At Gear)	34	25
Pitman Shaft Adjuster Screw Jam Nut	47	35
Side Cover To Housing Bolt	60	45
Adjuster Plug Nut	110	81
Reservoir Bolt (At Pump)	48	35
Flow Control Fitting (At Pump)	48	35
Pressure Hose (At Pump)	27	20
Power Steering Pump To Booster Line	34	25
Booster To Gear Line	34	25
Return Line At Booster And Gear	34	25
Coupling Flange Nuts	27	20
Coupling Flange Pinch Bolt	42	31
Lower Intermediate Shaft Pinch Bolt (G Model)	62	46
Upper Intermediate Shaft Pinch Bolt (G Model)	47	35
Intermediate Shaft Pinch Bolts (P200 + 300(42) Excluding FS3)	102	75
Intermediate Shaft Pinch Bolts (P300(42)FS3)	108	80

SPECIFICATIONS (CONTINUED)

PUMP SPECIFICATIONS

Vehicle	Part Number	Model	Minimum Output (1)		Maximum Output (2)		Relief Valve Settings Minimum		Maximum	
			GPM	L/Min.	GPM	L/Min.	PSI	kPa	PSI	kPa
C K Model	7838933	132-P-122	1.32	5.00	3.1-3.5	11.7-13.2	1200	8274	1300	8964
	7838934	132-P-123	1.32	5.00	3.1-3.5	11.7-13.2	1350	9308	1450	9998
	7838935	132-P-124	1.32	5.00	3.1-3.5	11.7-13.2	1200	8274	1300	8964
	7838936	132-P-125	1.32	5.00	3.1-3.5	11.7-13.2	1350	9308	1450	9998
	7839797	132-P-143	1.32	5.00	3.1-3.5	11.7-13.2	1350	9308	1450	9998
	7839798	132-P-144	1.32	5.00	3.1-3.5	11.7-13.2	1350	9308	1450	9998
	7839799	132-P-145	1.32	5.00	3.1-3.5	11.7-13.2	1350	9308	1450	9998
	7839800	132-P-146	1.32	5.00	3.1-3.5	11.7-13.2	1200	8274	1300	8964
	7839801	132-P-147	1.32	5.00	3.1-3.5	11.7-13.2	1200	8274	1300	8964
	7839802	132-P-148	1.32	5.00	3.1-3.5	11.7-13.2	1200	8274	1300	8964
	7839804	132-P-150	1.32	5.00	3.1-3.5	11.7-13.2	1200	8274	1300	8964
	7839813	132-P-159	1.32	5.00	3.1-3.5	11.7-13.2	1350	9308	1450	9998
	7839816	132-P-161	1.32	5.00	3.1-3.5	11.7-13.2	1350	9308	1450	9998
	7839818	132-P-163	1.32	5.00	3.1-3.5	11.7-13.2	1200	8274	1300	8964
	26000518	132-P-260	1.32	5.00	3.1-3.5	11.7-13.2	1200	8274	1300	8964
G Model	7841731	132-P-222	1.32	5.00	3.1-3.5	11.7-13.2	1350	9308	1450	9998
	7842049	132-P-228	1.32	5.00	3.1-3.5	11.7-13.2	1350	9308	1450	9998
	7847616	T115-PT-003	1.15	4.35	3.1-3.5	11.7-13.2	1350	9308	1450	9998
	7849229	132-P-253	1.32	5.00	3.1-3.5	11.7-13.2	1350	9308	1450	9998
P Model	7839808	132-P-154	1.32	5.00	2.4-2.8	9.1-10.6	1200	8274	1300	8964
	7839809	132-P-155	1.32	5.00	2.4-2.8	9.1-10.6	1200	8274	1300	8964
	7839812	132-P-158	1.32	5.00	2.4-2.8	9.1-10.6	1350	9308	1450	9998
	7839817	132-P-162	1.32	5.00	2.4-2.8	9.1-10.6	1200	8274	1300	8964
	7842032	132-P-226	1.32	5.00	3.1-3.5	11.7-13.2	1200	8274	1300	8964
	7842033	132-P-227	1.32	5.00	3.1-3.5	11.7-13.2	1200	8274	1300	8964
	7842489	132-P-230	1.32	5.00	3.1-3.5	11.7-13.2	1200	8274	1300	8964
	7842490	132-P-231	1.32	5.00	2.4-2.8	9.1-10.6	1350	9308	1450	9998
	7842491	132-P-232	1.32	5.00	3.1-3.5	11.7-13.2	1200	8274	1300	8964

1 — Output of Power Steering Fluid at 32°C (90°F) temperature when operating pump at 465 rpm against 4585-5068 kPa (665-735 psi) pressure.

2 — Output of Power Steering Fluid at 32°C (90°F) temperature when operating pump at 1500 rpm against 345 kPa (50 psi) pressure.

SPECIAL TOOLS

J-5176-D	Power Steering Gage
J-5176-20	Power Steering Gage Adapter — 18 mm
J-5421-02	Pocket Thermometer (0°-220°F)
J-25323	Power Steering Analyzer
J-29525	Power Steering Analyzer Adapter
J-24600-B	Belt Tension Gage
J-29107	Pitman Arm Puller
J-4245	Internal Snap Ring Pliers
J-6219	Steering Gear Pitman Shaft Oil Seal Installer
J-7624	Adjustable Spanner Wrench
J-29785-A	Water Pump And Power Steering Pulley Remover
J-25033-B	Power Steering Pump Pulley Installer

SECTION 3B4

STEERING COLUMN

The following "Notice" applies to one or more steps in the assembly procedure of components in this portion of this manual as indicated at appropriate locations by the terminology "See NOTICE on page 3B4-1 of this section."

NOTICE: All steering column 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. Torque values must be used as specified during reassembly to assure proper retention of all parts.

CONTENTS

DESCRIPTION

The locking energy absorbing steering column includes three important features in addition to the steering function:

1. The column is energy absorbing, designed to compress in a front-end collision to minimize the possibility of injury to the driver of the vehicle.
2. The ignition switch and lock are mounted conveniently on the column.
3. With the column mounted lock, the ignition, steering and gearshifting operation can be locked to inhibit theft of the vehicle.

The column may be disassembled and reassembled. To insure the energy absorbing action, it is important that the specified screws, bolts and nuts be used only as designated and that they are tightened to the specified torque.

When the column is removed from the vehicle, such actions as a sharp blow on the end of the steering shaft or shift lever, leaning on the column assembly, or dropping of the assembly could shear or loosen the plastic fasteners that maintain column rigidity.

DIAGNOSIS OF THE STEERING COLUMN

PROBLEM	POSSIBLE CAUSE	CORRECTION
Lock System Will Not Unlock	1. Lock bolt damaged. 2. Faulty lock cylinder. 3. Damaged housing. 4. Damaged or collapsed sector. 5. Damaged rack.	1. Replace the lock bolt. 2. Replace or repair the lock cylinder. 3. Replace the housing. 4. Replace the sector. 5. Replace the rack.
Lock System Will Not Lock	1. Lock bolt spring is broken. 2. Damaged sector tooth. 3. Faulty lock cylinder. 4. Damaged housing. 5. Damaged rack. 6. Interference between the bowl and coupling. 7. Ignition switch stuck. 8. Actuator rod restricted or bent. 9. Transmission linkage adjustment is incorrect.	1. Replace the spring. 2. Replace the sector tooth. 3. Replace the lock cylinder. 4. Replace the housing. 5. Replace the rack. 6. Adjust or replace. 7. Adjust or replace. 8. Adjust or replace. 9. Adjust.
Lock System—High Lock Effort	1. Lock cylinder is faulty. 2. Ignition switch is faulty. 3. Rack preload spring is broken or weak. 4. Burrs on the sector, rack, housing, support, tang of the shift gate or actuator rod coupling. 5. Bent sector shaft. 6. Distorted rack. 7. Misalignment of the housing to the cover (tilt only). 8. Distorted coupling slot in the rack (tilt only). 9. Bent or restricted actuator rod. 10. Ignition switch mounting bracket is bent.	1. Replace the lock cylinder. 2. Replace the ignition switch. 3. Replace the spring. 4. Remove the burrs. 5. Replace the shaft. 6. Replace the rack. 7. Replace either or both. 8. Replace the rack. 9. Straighten or replace the rod. 10. Straighten or replace the bracket.

DIAGNOSIS OF THE STEERING COLUMN (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Lock Cylinder—High Effort Between The "Off" and "Off-Lock" Positions	1. Burr on tang of shift gate. 2. Distorted rack.	1. Remove the burr. 2. Replace the rack.
Sticks In "Start" Position	1. Actuator rod is deformed. 2. Any high effort condition.	1. Straighten or replace the rod. 2. See "correction" under the high effort diagnosis.
Key Cannot Be Removed In The "Off-Lock" Position	1. Ignition switch is not set correctly. 2. Faulty lock cylinder.	1. Adjust ignition switch. 2. Replace the lock cylinder.
The Lock Cylinder Can Be Removed Without Depressing The Retainer	1. Faulty retainer. 2. Burr over the retainer slot in the housing cover.	1. Replace the lock cylinder. 2. Remove the burr.
Lock Bolt Hits The Shaft Lock In The "Off" And "Park" Positions	Ignition switch is not set correctly.	Adjust the ignition switch.
Noise In The Column	1. Flexible coupling pulled apart. 2. Column not correctly aligned. 3. One click in Off-Unlock position and when the steering wheel is moved. 4. Horn contact ring not lubricated. 5. Lack of grease on the bearings or bearing surface. 6. Lower shaft bearing is tight or frozen. 7. Upper shaft bearing is tight or frozen. 8. Lock plate retaining ring is not seated. 9. Steering shaft snap ring is not seated. 10. Shroud or housing is loose. 11. Sheared intermediate shaft plastic joint.	1. Align the column and replace the flexible coupling. 2. Align the column. 3. Normal seating of the lock bolt. 4. Lubricate. 5. Lubricate the bearings. 6. Replace the bearing. Inspect the shaft and replace if scored. 7. Replace the housing assembly. 8. Replace the retaining ring. Inspect for proper seating in the groove. 9. Replace the snap ring. Inspect for proper seating in the groove. 10. Tighten mounting screws. 11. Repair or replace the steering shaft. Align the column.
High Steering Shaft Effort	1. Column assembly is misaligned in the vehicle. 2. Tight or frozen upper or lower bearings. 3. Binding intermediate shaft U-joints.	1. Align correctly. 2. Replace the bearings. 3. Repair or replace the intermediate shaft.

DIAGNOSIS OF THE STEERING COLUMN (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
High Shift Effort	1. Column assembly is misaligned in the vehicle. 2. Lower bowl bearing is not aligned correctly. 3. Lack of grease on the bearing or seal areas. 4. Shift tube is bent or broken.	1. Align correctly. 2. Align correctly. 3. Lubricate bearings and seals. 4. Replace the shift tubes.
Improper Transmission Shifter	1. Sheared shift tube joint. 2. Improper transmission linkage adjustment. 3. Loose lower shift lever. 4. Sheared lower shift lever weld.	1. Replace the shift tube assembly. 2. Adjust the linkage. 3. Replace the shift tube assembly. 4. Replace the shift tube assembly.
Lash In Mounted Column Assembly	1. Column mounting bracket bolts loose. 2. Broken weld nuts on the jacket. 3. Column bracket capsule sheared. 4. Loose shoes in the housing (tilt only). 5. Loose tilt head pivot pins (tilt only).	1. Tighten to specifications. 2. Replace the jacket assembly. 3. Replace the bracket assembly. 4. Replace the shoes. 5. Replace the pivot pins.
Driver Can Lock Steering In The Second Gear (Manual Transmission Columns)	1. Faulty upper shift lever. 2. Faulty shift lever gate. 3. Loose relay lever on the shift tube.	1. Replace the shift lever. 2. Replace the shift lever gate. 3. Replace the shift tube assembly.
Excessive Play In The Mounted Steering Column Assembly (Tilt Column)	1. Column mounting bracket bolts loose. 2. Loose support screws. 3. Loose tilt head pivot pins. 4. Loose lock shoe pin in the support.	1. Tighten to specifications. 2. Tighten to specifications. 3. Replace the pivot pins. 4. Replace the pin.
Housing Loose (Tilt Column)	1. Excessive clearance between the holes in the support or the housing and pivot pin diameter. 2. Faulty anti-lash spring in the centering spheres. 3. Upper bearing not seating in the bearing race. 4. Upper bearing inner race seat missing. 5. Bearing preload spring broken. 6. Loose support screws.	1. Replace either or both. 2. Replace the spring. 3. Replace both. 4. Install the seat. 5. Replace preload spring. 6. Tighten to specifications.
Housing Scraping On The Bowl (Tilt Column)	Bowl bent or not concentric with the hub.	Replace the bowl.

DIAGNOSIS OF THE STEERING COLUMN (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Steering Wheel Loose Every Other Tilt Position (Tilt Column)	Loose fit between the lock shoe and pivot pin.	Replace both.
Steering Column Will Not Lock In Any Tilt Position (Tilt Column)	1. Lock shoe grooves may have burrs or dirt. 2. Lock shoe spring is weak or broken. 3. Lock shoe seized on its pivot pin.	1. Replace lock shoes and clean the grooves. 2. Replace the spring. 3. Replace both lock shoes.
Noise When Tilting The Column (Tilt Column)	1. Tilt spring rubbing in the housing. 2. Tilt bumpers are worn.	1. Lubricate. 2. Replace the tilt bumpers.
Steering Wheel Fails To Return To The Top Tilt Position (Tilt Column)	1. Pivot pins are bound up. 2. Wheel tilt spring is faulty. 3. The turn signal switch wires are too tight.	1. Replace the pivot pins. 2. Replace the spring. 3. Reposition the wires.
Dimmer Switch Will Not Function	1. Loose connector at the dimmer switch. 2. Improper adjustment. 3. Internally damaged or worn switch.	1. Tighten or replace. 2. Readjust. 3. Replace.
Turn Signal Will Not Cancel	1. Loose switch mounting screws. 2. Switch or anchor bosses broken. 3. Broken, missing or out of position detent, return or cancelling spring. 4. Uneven or incorrect cancelling cam to cancelling spring interference.	1. Tighten screws to 2.8 N·m (25 in. lbs.). 2. Replace the switch. 3. Reposition or replace the springs as required. 4. Adjust the switch position. • If the interference is correct and switch will still not cancel, replace the switch. • If the interference cannot be corrected by the switch adjustment, replace the cancelling cam.
Turn Signal Difficult To Operate	1. Actuator rod loose. 2. Yoke broken or distorted. 3. Loose or misplaced springs. 4. Foreign parts and/or materials. 5. Switch mounted loosely.	1. Tighten mounting screw to 1.4 N·m (12 in. lbs.). 2. Replace the switch. 3. Reposition or replace the springs. 4. Remove the foreign parts and/or material. 5. Tighten mounting screws to 2.8 (25 in. lbs.).
Turn Signal Will Not Indicate Lane Change	1. Broken lane change pressure pad or spring hanger. 2. Broken, missing or misplaced lane change spring. 3. Jammed base or wires.	1. Replace the switch. 2. Replace or reposition as required. 3. Loosen mounting screws, reposition base or wires and tighten the screws to 2.8 N·m (25 in. lbs.).

DIAGNOSIS OF THE STEERING COLUMN (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Turn Signal Will Not Stay In Turn Position	1. Foreign material or loose parts impending movement of the yoke. 2. Broken or missing detent or cancelling springs. 3. None of the above.	1. Remove material and/or parts. 2. Replace the spring. 3. Replace the switch.
Hazard Switch Cannot Be Turned Off	Foreign material between hazard support cancelling leg and yoke.	Remove the foreign material. • No foreign material. Replace the turn signal switch.
Hazard Switch Will Not Stay On Or Difficult To Turn Off	1. Loose switch, mounting screws. 2. Interference with other components. 3. Foreign material. 4. None of the above.	1. Tighten mounting screws to 2.8 N.m (25 in. lbs.). 2. Remove the interference. 3. Remove the foreign material. 4. Replace the switch.
No Turn Signal Lights	1. Faulty or blown fuse. 2. Inoperative turn signal flasher. 3. Loose chassis to column connector. 4. Disconnect column to chassis connector. Connect new switch to chassis and operate switch by hand. If vehicle lights now operate normally, signal switch is inoperative. 5. If vehicle lights do not operate, check chassis wiring for opens, grounds, etc.	1. Replace fuse and check operation. 2. Replace the turn signal flasher. 3. Connect securely, check operation. 4. Replace the signal switch. 5. Repair the chassis wiring.
Turn Indicator Lights On, But Not Flashing	1. Inoperative turn flasher. 2. Loose chassis to column connection. 3. Inoperative turn signal switch. 4. To determine if turn signal switch is faulty, substitute a new switch into the circuit and operate the switch by hand. If the vehicle's lights operate normally, the signal switch is inoperative. 5. If the vehicle's lights do not operate, check light sockets for high resistance connections, the chassis wiring for opens, grounds, etc.	1. Replace the turn flasher. 2. Connect securely and check operation. 3. Replace the turn signal switch. 4. Replace the signal switch. 5. Repair the chassis wiring.
Front Or Rear Turn Signal Lights Are Not Flashing	1. Burned out fuse. 2. Burned out or damaged turn signal bulb. 3. High resistance connection to ground at the bulb socket. 4. Loose chassis to column connector.	1. Replace fuse and check operation. 2. Replace the bulb. 3. Remove or repair the faulty connection and check operation. 4. Connect securely and check operation.

DIAGNOSIS OF THE STEERING COLUMN (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Front Or Rear Turn Signal Lights Are Not Flashing (Cont.)	5. Disconnect column to the chassis connector. Connect a new switch into the system and operate the switch by hand. If turn signal lights are now on and flash, the turn signal switch is inoperative. 6. If vehicle lights do not operate, check the chassis wiring harness to light sockets for opens, grounds, etc.	5. Replace the turn signal switch. 6. Repair the chassis wiring.
Stop Light Not On When Turn Indicated	1. Burned out fuse. 2. Loose column to chassis connection. 3. Disconnect column to chassis connector. Connect new switch into system without removing old. Operate switch by hand. if brake lights work with switch in the turn position, signal switch is faulty. 4. If brake lights do not work, check connector to stop light, the sockets for grounds, opens, etc.	1. Replace fuse and check operation. 2. Connect securely and check operation. 3. Replace the signal switch. 4. Repair connector to stop lights circuits.
Turn Indicator Panel Lights Not Flashing	1. Burned out bulbs. 2. High resistance to ground at the bulb socket. 3. Opens, grounds in wiring harness from the front turn signal bulb socket to the indicator lights.	1. Replace the bulbs. 2. Replace the socket. 3. Locate and repair as required.
Turn Signal Lights Flash Very Slowly	1. Inoperative turn signal flasher. 2. System charging voltage low. 3. High resistance ground at light sockets. 4. Loose chassis to column connection. 5. Disconnect column to chassis connector. Connect new switch into system without removing old. Operate switch by hand. If flashing occurs at normal rate, the signal switch is faulty. 6. If the flashing rate is still extremely slow, check chassis wiring harness from the connector to the light sockets for high resistance.	1. Replace the turn signal flasher. 2. Increase voltage to specifications. Refer to (SEC. 6D ENGINE ELECTRICAL) in this manual. 3. Repair high resistance grounds at the light sockets. 4. Connect securely and check operation. 5. Replace signal switch. 6. Locate and repair as required. Refer to SEC. 8B (CHASSIS ELECTRICAL) in this manual.

DIAGNOSIS OF THE STEERING COLUMN (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Hazard Signal Lights Will Not Flash—Turn Signal Functions Normally	1. Blown fuse.	1. Replace fuse and check operation.
	2. Inoperative hazard warning flasher.	2. Replace the hazard warning flasher.
	3. Loose chassis to column connection.	3. Connect securely and check operation.
	4. Disconnect column to chassis connector. Connect new switch into system without removing old. Depress the hazard warning button and observe the hazard warning lights. If they now work normally, the turn signal switch is faulty.	4. Replace the turn signal switch.
	5. If the lights do not flash, check wiring harness "K" lead (brown) for open between hazard flasher and harmonica connector. If open, fuse block is faulty.	5. Replace fuse block. Refer to SEC. 8B (CHASSIS ELECTRICAL) in this manual.
Tone Alarm Does Not Sound With Key Fully Inserted In Lock Cylinder With Driver's Door Open	1. Loose connection at the tone alarm.	1. Connect securely.
	2. Voltage not available to the tone alarm.	2. Check the continuity of the chassis wiring and repair as required.
	3. Faulty tone alarm.	3. Replace the tone alarm.
	4. Door jamb switch on the driver's side is maladjusted or inoperative.	4. Adjust or replace as required.
	5. Short in the chassis wiring.	5. Check by separating chassis to column connector. Connect E and F female contacts on the chassis side (bent paper clip will work). If tone alarm sounds, continue diagnosis. If not, locate and repair chassis wiring.
	6. Short or fault in the signal switch wiring.	6. Connect male E and F contacts of connector with the jumper. Check buzzer switch pads with the ohmmeter. If contact is made, function is normal. If not, replace the signal switch.
	7. Chips, burrs, foreign material is preventing actuator tip function. NOTICE: Key must be removed or the cylinder in the "run" position before removing the lock cylinder.	7. Remove chips and burrs. Reassemble and check.
	8. Faulty lock cylinder.	8. With the lock cylinder out (refer to "Notice" under step 7), fully insert and remove the key. The actuator should extend and retract smoothly. Total expansion of tip should be 1.25 mm (0.050 inch). If not, replace the lock cylinder.
	9. Chips, foreign material affecting the tone alarm switch operation.	9. Remove and clean as required—reassemble and check.
	10. Damaged or broken tone alarm switch.	10. Replace the tone alarm switch.
	11. Inoperative tone alarm switch (switch appears good but will not make the tone alarm switch function check).	11. Connect the ohmmeter leads to the tone alarm switch probes. Press on the actuator pad until the interior points contact. If contact is not made, replace the tone alarm switch.
	12. Tone alarm switch contact gap is too large	12. Reset the contact gap.

DIAGNOSIS OF THE STEERING COLUMN (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Tone Alarm Does Not Sound With Key Fully Inserted In Lock Cylinder With Driver's Door Open (Cont.)	13. If the tone alarm fault has not yet been detected, connect a continuity meter (or light) to the male E and F connector contacts. Insert the key the full depth into the lock cylinder. If contact is made with the key in, and is not made with it out, the function is normal. Retrace the initial diagnostic steps. If contact is not established, the fault is in the column.	13. With the fault isolated in the column, disassemble the upper end of the column until the signal switch mounting screws have been removed. Lift the switch and check the probes of the tone alarm switch to ensure good contact with the pads in the signal switch. Bend the probes, if required, then reseat the signal switch and install the three screws. Check the function.
	14. If the fault has not yet been isolated and repaired, connect ohmmeter to the tone alarm switch probes. Fully insert and remove the key from the lock cylinder. If contact is made with the key in, and is broken with it out, the function is normal. Retrace the diagnostic steps. If contact is not made, the fault is in the lock cylinder or tone alarm switch.	14. Setting the contact gap. Press a 0.75 mm (0.030 inch) wire type spark plug gap wire with flat piece of stock on the actuator pad. If contact is not made, adjust switch until positive contact is made (use ohmmeter). With positive contact at 0.75 mm (0.030 inch) use a 0.65 mm (0.025 inch) plug gap wire beneath the flat stock. No contact should occur. Adjust. When the switch will make contact with the 0.75 mm (0.030 inch) wire and not with the 0.65 mm (0.025 inch) wire, the tone alarm switch is set at the low limit.
Tone Alarm Continues To Operate With Key In The Lock Cylinder With The Driver's Door Either Opened Or Closed And Ceases When Key Is Removed	1. Door jamb switch on driver's side maladjusted or inoperative.	1. Adjust or replace as required.
	2. Wire from signal switch to door jamb switch shorted.	2. If on signal switch side, replace signal switch. If on chassis side, find and repair. This condition indicates the lock cylinder or tone alarm switch is at fault. To verify, check for continuity at the E and F male connector contacts with the key removed from the cylinder. If continuity exists, the fault is in the column.
Tone Alarm Continues To Operate With Key Out, But Stops When Driver's Door Is Closed	1. Lock cylinder binding (turn lock toward start position. If tone alarm stops in the run position or when turned past run run towards the start, the problem is a sticky lock cylinder actuator).	1. Replace the lock cylinder.
	2. Chips, foreign material in lock cylinder bore.	2. Remove, assemble and recheck function.
	3. Sticky lock cylinder actuator tip.	3. Replace the lock cylinder.
	4. Damaged or broken tone alarm switch.	4. Replace the tone alarm switch.
	5. Tone alarm switch contact gap is too close.	5. Adjust as specified.

STEERING COLUMN ELECTRICAL COMPONENT ANALYZER

Use J-23980-B, the steering column electrical component analyzer, for C, K, G models, to analyze the steering column wiring harness for electrical problems.

To use J-23980-B, unfasten the harmonica connector on the column and plug the harness from J-23980-B into the vehicle chassis harness. Connect the single black jumper to a good ground and use the analyzer. The "A," "B," and "C" terminals on the tester will overhang the chassis connector. This does not affect the test results. These terminals are for vehicles with cornering lights.

Move the analyzer switch (with the key in the "on" position) to the various functions that may be checked. The switch positions are "OFF," "Horn," "Left Turn," "Right Turn," "Key Buzzer" and "Hazard" (some vehicles do not use a tone alarm switch). If the system functions properly while using the analyzer, then the problem has been narrowed to the column wiring or components. When this is determined the column may be serviced.

STEERING COLUMN ON-VEHICLE SERVICE (ALL MODELS)

INSPECTION

SHIFTER SHAFT

Separation of the shifter shaft sections will be internal and cannot be visually identified. Hold lower end of the "shifter shaft" and move the "shift lever" on the column through its ranges and up and down. If there is little or no movement of the "shifter shaft," the plastic joints are sheared.

STEERING SHAFT

If the steering shaft plastic pins have been sheared, the shaft will rattle when struck lihtly from the side and some lash may be felt when rotating the steering wheel while holding the rag joint. If the steering shaft pins are sheared due to minor collision without serious damage to other components, the vehicle can be safely steered; however, steering shaft replacement is recommended.

COLUMN JACKET

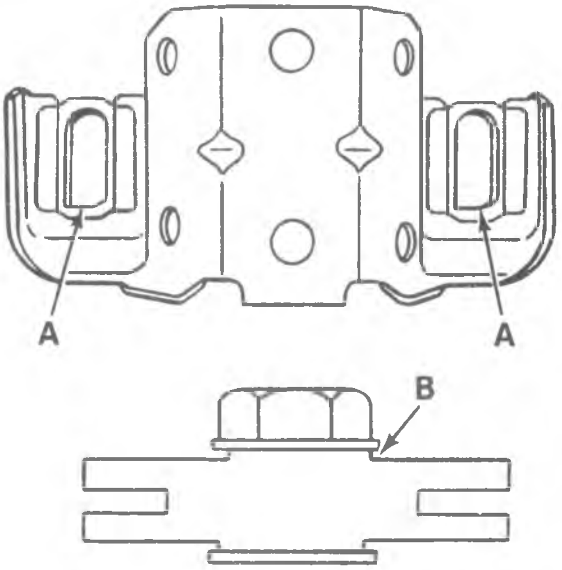
Inspect the jacket section of the column for looseness, and/or bends.

COLUMN SUPPORT BRACKET

Damage in this area will be indicated by separation of the mounting capsules from the bracket. The bracket will have moved forward toward the entire compartment and will usually result in collapsing of the jacket section of the steering column.

STEERING COLUMN FOR ACCIDENT DAMAGE

NOTICE: Vehicles involved in accidents resulting in frame damage, major body or sheet metal damage, or where the steering column has been impacted may also have a damaged or misaligned steering column.



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

B. The bolt head must not contact surface "B." If contact is made, the capsule shear load will be increased—Replace bracket.

B-07380

Figure 1—Inspecting The Steering Column For Collapse

Inspect (Figures 1 through 3)

1. Capsules on the steering column bracket assembly. The capsules must be within 1.59 (1/16 inch) from the bottom of the slots (figure 1). If not, the bracket should be replaced.
2. Contact surface (figure 1). The bolthead must not contact surface "B" or the shear load would be increased. If contact is made, replace the bracket.

3. Shift lever operation on vehicles with automatic transmission and column shift. If the shift lever is able to move to the "Park" position without raising the lever, the upper shift tube plastic bearing is broken.
4. Jacket collapse. Measure the jacket collapse dimensions, depending on the vehicle and steering column, in either of the following ways (figure 2):
    - Measure from the end of the bearing assembly to the lower edge of the upper jacket (C).
    - Measure from the collar on the toe plate flange to the lower edge of the upper jacket (E, G and H).
    - Measure from the edge of the back-up switch window to the lower edge of the upper jacket (D, F and J).

If the jacket dimensions are not within specifications, a new jacket must be installed.

- Visually inspect for sheared injected plastic in the shift tube, and the steering shaft (figure 3). If either one or both are sheared, replace with new parts.

5. Any frame damage that could cause a bent steering shaft must have the steering shaft runout checked in the following manner: Remove intermediate shaft. Hold a ruler against the lower end of steering shaft and have the steering wheel rotated. The runout must not exceed 1.59 mm ($^{1}/_{16}$ inch). A dial indicator may be used instead of a ruler.

STEERING WHEEL REPLACEMENT

Remove or Disconnect

Tools Required:
J-1859-03 Steering Wheel Puller

1. Battery ground cable.
2. Horn button cap.
3. Retainer and steering wheel nut.
4. Horn lead assembly (some models).
    - Mark the relationship of the steering wheel to the steering shaft.
5. Steering wheel. Use J-1859-03 (figure 4). Do not hammer on the puller, or damage could result to the steering column.

Install or Connect

NOTICE: For step 3 see "Notice" on page 3B4#1.

- The turn signal control assembly must be in the neutral position when assembling the steering wheel.

1. Steering wheel onto the steering shaft. Align the marks made at removal.

Important

- Do not misalign the steering wheel more than 25.4 mm (1 inch) from the horizontal centerline (figure 5).

2. Horn lead assembly (some models).
3. Steering wheel nut.

Tighten

- Nut to 40 N·m (30 ft. lbs.).

4. Retainer.
5. Horn button cap.
6. Battery ground cable.

FLEXIBLE COUPLING REPLACEMENT

Remove or Disconnect (Figure 6)

1. Coupling to flange bolt nuts and washers (2).
2. Clamp bolt (1).
3. Steering gear frame bolts. Lower the steering gear far enough to remove the flexible coupling.
4. Flexible coupling from the steering gear wormshaft. Tap lightly with a soft mallet.

Install or Connect (Figure 6)

NOTICE: For steps 2, 3 and 4 see "Notice" on page 3B4#1.

1. Flexible coupling onto the steering gear wormshaft. Align the flat on the shaft with the flat in the coupling.
    - Push the coupling onto the wormshaft until the coupling reinforcement bottoms against the end of the worm.
2. Clamp bolt (1) into the split clamp. The bolt must pass through the shaft undercut.

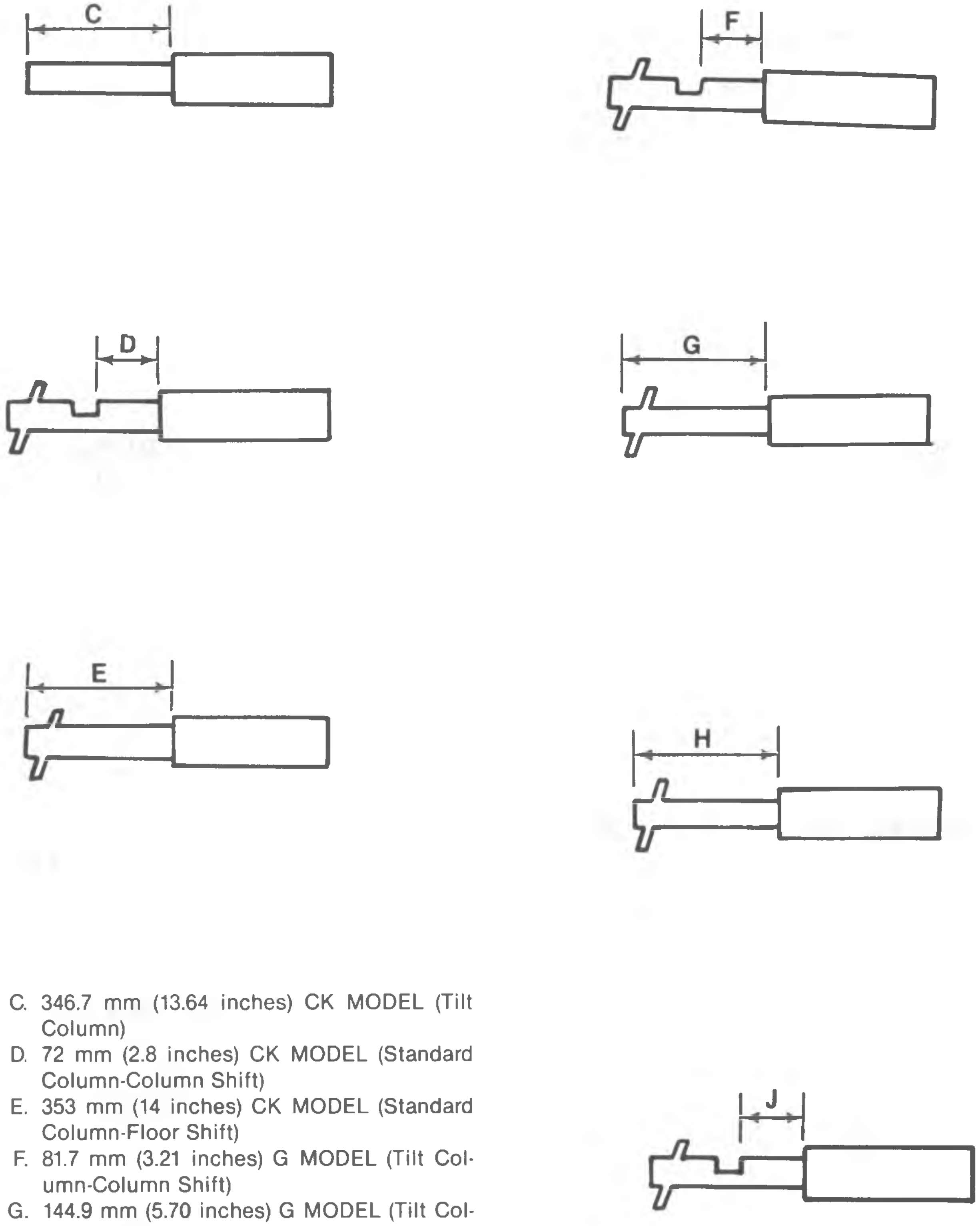
Tighten

- Bolt to 42 N·m (31 ft. lbs.).
- Place the steering gear into position, guiding the flexible coupling bolts into the proper holes in the steering shaft flange.

3. Steering gear and frame bolts.

Tighten

- Bolts to "Specifications" at the end of this section.



C. 346.7 mm (13.64 inches) CK MODEL (Tilt Column)

D. 72 mm (2.8 inches) CK MODEL (Standard Column-Column Shift)

E. 353 mm (14 inches) CK MODEL (Standard Column-Floor Shift)

F. 81.7 mm (3.21 inches) G MODEL (Tilt Column-Column Shift)

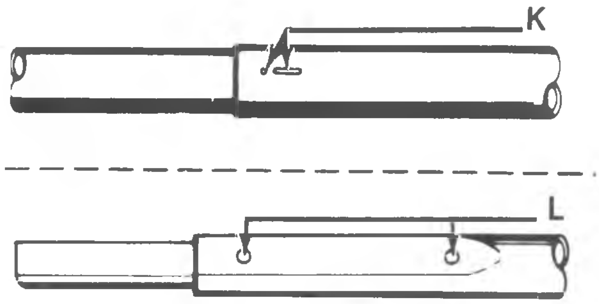
G. 144.9 mm (5.70 inches) G MODEL (Tilt Column-4 Speed)

H. 192 mm (7.5 inches) G MODEL (Standard Column-Column Shift)

J. 80 mm (3.1 inches) G MODEL (Tilt Column-Floor Shift)

B-07381

Figure 2—Inspecting The Steering Column For Collapse



K. Inspect for sheared injected plastic in the shift tube.
L. Inspect for sheared injected plastic in the steering shaft.

B-07382

Figure 3—Inspecting The Steering Column For Collapse

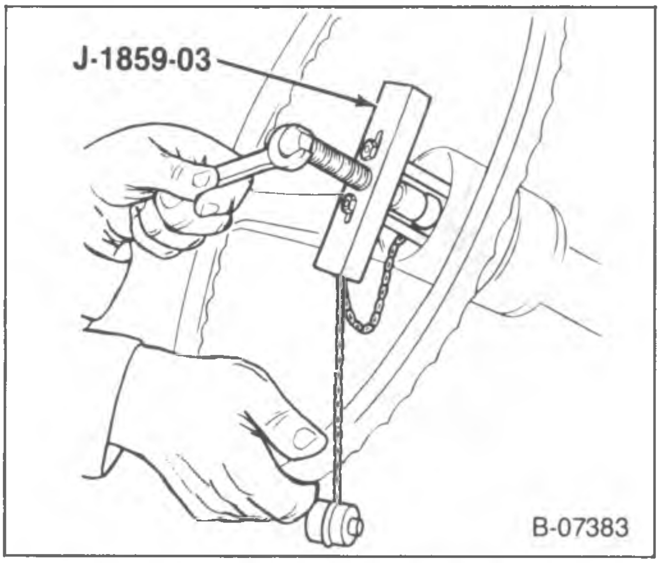


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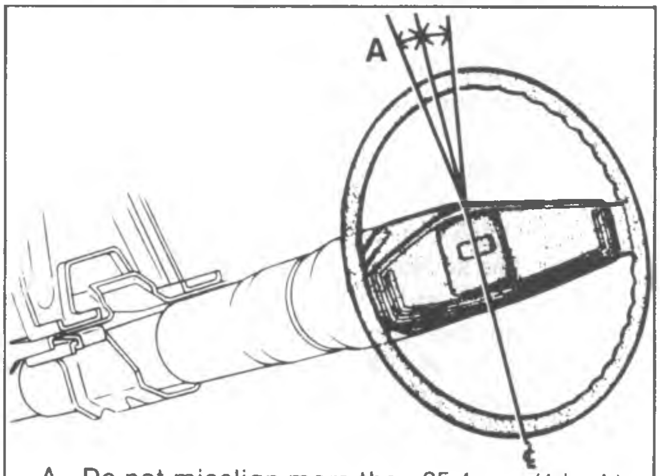
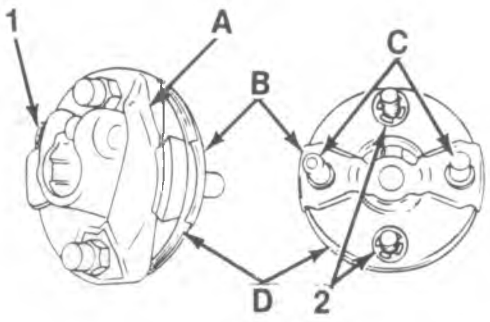
Figure 4—Removing The Steering Wheel



A. Do not misalign more than 25.4 mm (1 inch) from the horizontal centerline.

B-07384

Figure 5—Steering Wheel Alignment



1. Clamp Bolt
2. Nuts And Washers

A. Capturing Strap
B. Reinforcement
C. Alignment Pins
D. Wafer

B-07385

Figure 6—Flexible Type Steering Coupling

4. Coupling to flange bolt nuts and washers (2).
   - The coupling alignment pins should be centered in the flange slots.

Tighten

- Nuts to 27 N·m (20 ft. lbs.).

Measure

- Coupling to flange dimension. Maintain a 6.4 to 9.5 mm (0.250 to 0.375 inch) dimension.

INTERMEDIATE SHAFT REPLACEMENT

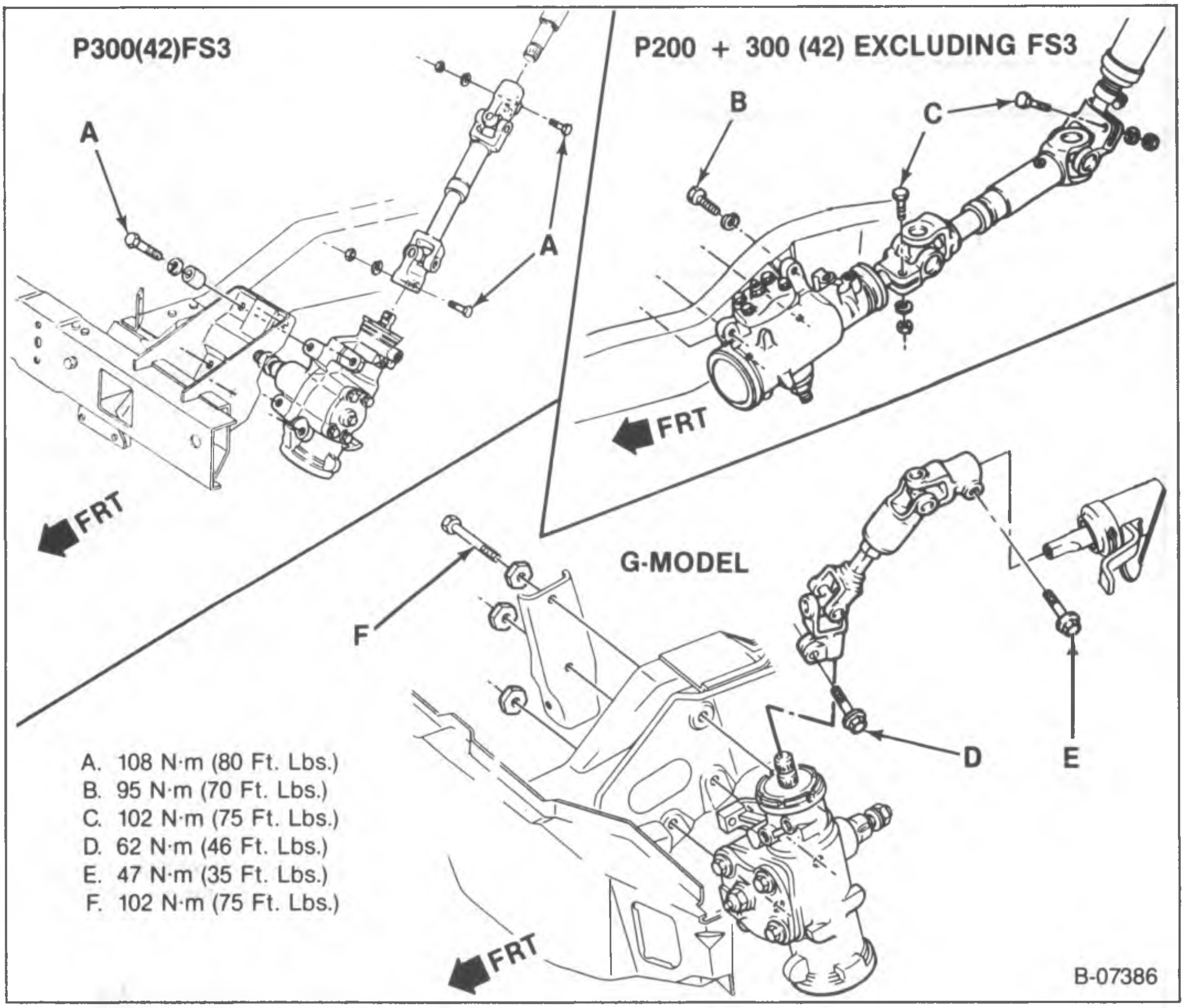
↔ Remove or Disconnect (Figure 7)

- Set front wheels in the straight ahead position.
- Mark the upper universal joint yoke to steering shaft and the lower yoke to steering gear wormshaft relationship.

1. Upper and lower universal yoke pinch bolt.
2. Steering gear frame bolts. Lower the steering gear.
   - It is not necessary to disconnect the pitman arm from the steering gear pitman shaft.
3. Intermediate steering shaft and universal joint assembly.

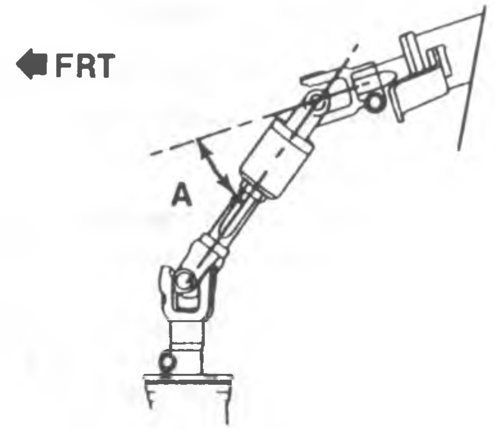
→← Install or Connect (Figure 7)

NOTICE: For steps 2, 3 and 4 see "Notice" on page 3B4#1.



A. 108 N·m (80 Ft. Lbs.)
B. 95 N·m (70 Ft. Lbs.)
C. 102 N·m (75 Ft. Lbs.)
D. 62 N·m (46 Ft. Lbs.)
E. 47 N·m (35 Ft. Lbs.)
F. 102 N·m (75 Ft. Lbs.)

Figure 7—Intermediate Shaft Installation



A. Angle must not exceed 39 degrees maximum or 34 degrees minimum.

Figure 8—Carden Joint Angle (G-Model)

1. Intermediate shaft lower yoke onto the steering gear wormshaft. Align the marks made at removal.
2. Pinch bolt. The pinch bolt must pass through the shaft undercut.

Tighten

- Pinch bolt to "Specifications" at the end of this section.

- Raise the steering gear into position while guiding the upper yoke assembly onto the steering shaft. The marks on the coupling and steering shaft must align.

3. Steering gear and frame bolts.

Tighten

- Bolt to "Specifications" at the end of this section.

4. Pinch bolt to the upper yoke assembly. The pinch bolt must pass through the shaft undercut.

Tighten

- Pinch bolt to "Specifications" at the end of this section.

Measure

- Carden joint operating angle (G-Model). The angle must not exceed 39 degrees maximum or 34 degrees minimum (figure 8).

STEERING COLUMN ON-VEHICLE SERVICE (C, K AND G MODELS)

CK MODEL STEERING COLUMN REPLACEMENT

Remove or Disconnect (Figure 9)

1. Battery ground cable.
2. Transmission control linkage from the column shift tube levers.
3. Nuts and washers (1) that secure the flanged end of the steering shaft to the flexible coupling.
4. Nuts (10) and clamp (11).
5. Steering wheel. Refer to "Steering Wheel Replacement" in this section.
6. Steering column harness at the connector.
   - Disconnect the neutral-start switch and back-up lamp switch connectors (some models). Refer to SEC. 8B (CHASSIS ELECTRICAL) in this manual.
7. Transmission indicator cable (some models).
8. Screws (6), upper cover (3), lower cover (5), and seal (4).
9. Screws (7), nuts (8) and bracket (9).
10. Steering column assembly. Rotate the column so the shift lever clears the dash opening.

Install or Connect (Figure 9)

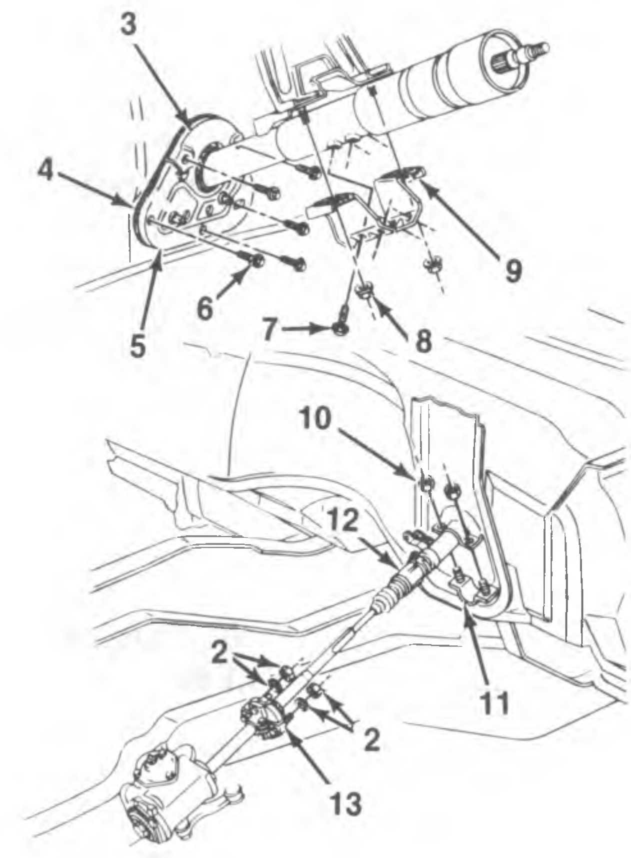
NOTICE: For steps 4 and 12 see "Notice" on page 3B4#1.

1. Plastic spacers onto the flexible coupling alignment pins.
2. Lower end of the steering column through the dash opening.
3. Lower steering shaft flange onto the flexible coupling (13).
4. Flange to coupling washers and nuts (1).

Tighten

- Nuts to 27 N·m (20 ft. lbs.).

- The flexible coupling (13) on manual steering must be installed prior to column installation.



2. Nuts And Washers
3. Upper Cover
4. Seal
5. Lower Cover
6. Screws
7. Screws
8. Nuts
9. Bracket
10. Nuts
11. Clamp
12. Pot Joint
13. Flexible Coupling

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Figure 9—Steering Column Installation (C-K Model)

5. Screws (7) and (8) and bracket (9) loosely. Tighten screws and nuts finger tight.

6. Clamp (11) and nuts (10).

Tighten

- Nuts (10) to 24 N·m (18 ft. lbs.).
- Screws (7) and nuts (8) to 30 N·m (22 ft. lbs.).

7. Seal (4) and covers (3, 5) to the dash.
8. Screws (6).
   - Remove plastic spacers from the flexible coupling pins.

Measure

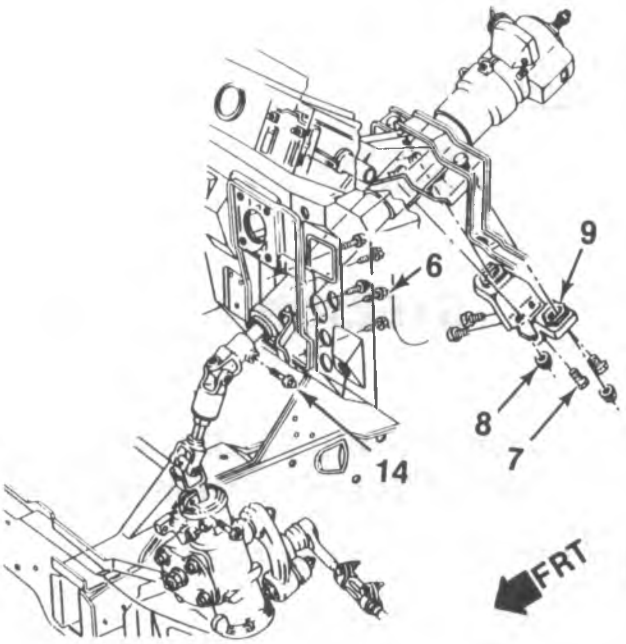
- Pot joint (12) operating angle must not exceed 12 degrees.
- Flexible coupling (13) must not be distorted greater than ± 1.5 mm (0.06 inch) due to pot joint bottoming, in either direction.

10. Transmission indicator cable (some models).
11. Connectors to the steering column harness.
    - Connect the neutral-start switch and back-up lamp switch connectors (some models). Refer to SEC. 8B (CHASSIS ELECTRICAL) in this manual.
12. Steering wheel. Refer to "Steering Wheel Replacement" in this section.
13. Transmission control linkage.
14. Battery ground cable.

G MODEL STEERING COLUMN REPLACEMENT

Remove or Disconnect (Figure 10)

1. Battery ground cable.
2. Transmission control linkage from the column shift tube levers.
3. Upper universal joint pinch bolt (14) from the intermediate shaft. Mark the relationship of the universal yoke to the steering shaft.
4. Screws (7), nuts (8) and bracket (9).
5. Screws (6) from the cover and seal.
6. Steering wheel. Refer to "Steering Wheel Replacement" in this section.
7. Steering column harness at the connectors.
   - Disconnect the neutral-start switch and back-up lamp switch connectors (some models). Refer to SEC. 8B (CHASSIS ELECTRICAL) in this manual.
8. Steering column assembly. Rotate the column so the shift lever clears the dash opening.



6. Screws
7. Screws
8. Nuts
9. Bracket
14. Pinch Bolt

Figure 10—Steering Column Installation (G Model)

Install or Connect (Figure 10)

NOTICE: For steps 3 and 5 see "Notice" on page 3B4#1.

1. Lower end of the steering column through the dash opening.
2. Bracket (9), screws (7) and nuts (8) loosely. Tighten screws and nuts finger tight.
   - Guide the steering shaft into the universal yoke, lining up the marks made at removal.
3. Upper universal joint pinch bolt (14). The pinch bolt must pass through the shaft undercut.

Tighten

- Pinch bolt to 47 N·m (35 ft. lbs.).

Measure

- Carden joint operating angle. The angle must not exceed 39 degrees maximum or 34 degrees minimum (figure 8).

Tighten

- Screws (7) and nuts (8) to 30 N·m (22 ft. lbs.).

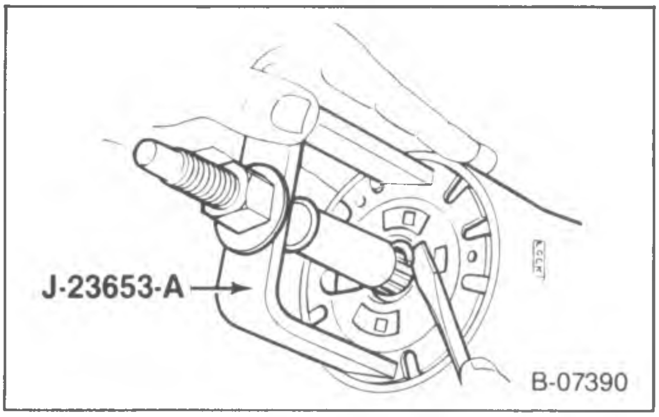


Figure 11—Removing The Retaining Ring

3. Screws (6) through the cover and seal to the dash panel.
4. Connectors to the steering column harness.
   - Connect the neutral-start switch and back-up lamp switch connectors (some models). Refer to SEC. 8B (CHASSIS ELECTRICAL) in this manual.
4. Steering wheel. Refer to "Steering Wheel Replacement" in this section.
6. Transmission control linkage.
7. Batter ground cable.

TURN SIGNAL SWITCH REPLACEMENT

↔ Remove or Disconnect (Figures 11 through 13)

Tools Required:
J-23653-A Lock Plate Compressor

1. Steering wheel. Refer to "Steering Wheel Replacement" in this section.
2. Instrument panel trim cover.

- Position a screwdriver blade into the steering shaft lock plate cover slot. Pry up and out to free the cover from the lock plate.
- Screw the center post of J-23653-A onto the steering shaft as far as it will go. Compress the lock plate by turning the center post nut clockwise. Pry the retaining ring out of the shaft (figure 11). Remove J-23653-A.

! Important

- If the column is being disassembled on a bench, the shaft could slide out of the end of the mast jacket when the snap ring is removed.

3. Lock plate.
4. Turn signal lever screw and lever.
6. Hazard warning knob. Press the knob inward and then unscrew.
7. Turn signal mounting screws.

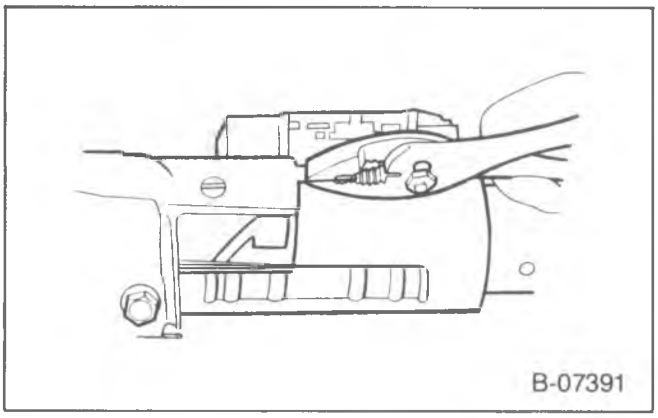


Figure 12—Removing The Turn Signal Wire Protector

- Pull the switch connector out of the bracket on the jacket and feed switch connector through column support bracket and pull switch straight up, guiding the wiring harness through the column housing and protector.

8. Wire protector. Pull downward out of the column with pliers using the tab provided (figure 12).

- Position the turn signal and shifter housing in the "low" position. Remove the harness cover by pulling toward the lower end of the column, be careful not to damage the wires (tilt column).

9. Turn signal switch. Pull the switch straight up, guiding the wiring harness and cover through the column housing (figure 13).

→← Install or Connect

Tools Required:
J-23653-A Lock Plate Compressor

! Important

- Use only the specified screws, bolts and nuts at assembly. The use of overlength screws could prevent a portion of the assembly from compressing under impact.

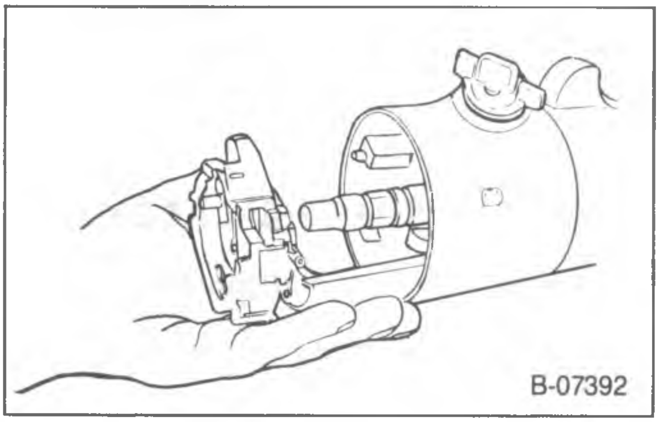


Figure 13—Removing The Turn Signal Switch Assembly

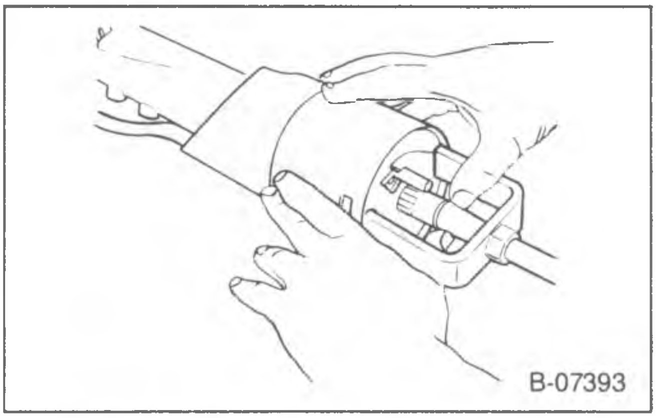


Figure 14—Installing The Retaining Ring

- On non-tilt columns, be sure the wiring harness is on the protector. Feed the connector and cover down through the housing and under the mounting bracket.
- On tilt columns, feed the connector down through the housing and under the mounting bracket. Install the cover on the harness.

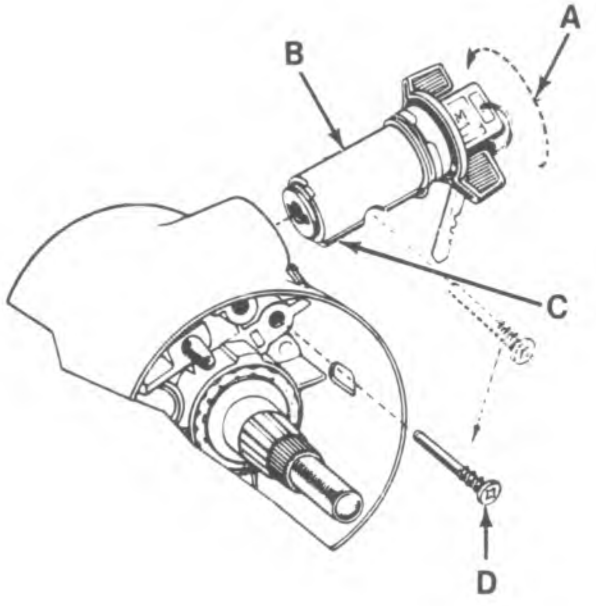
1. Turn signal mounting screws.
    - Clip the connector to the bracket on the jacket.
2. Instrument panel trim plate.
3. Hazard warning knob.
4. Turn signal lever and screws.
    - Put the turn signal switch in the "Neutral" position. Pull "out" on the hazard warning knob.
5. Washer, upper bearing preload spring and cancelling cam onto the upper end of the shaft.
6. Lock plate onto the end of the shaft.
    - Screw the center post of J-23653-A onto the steering shaft as far as it will go. Place a NEW retaining ring over the center post. Place the "C" bar over the center post and then compress the lock plate by turning the nut clockwise. Slide the new retaining ring down the tapered center post and into the shaft groove (figure 14). Remove J-23653-A.
7. Cover on the lock plate and snap into position.
8. Steering wheel. Refer to "Steering Wheel Replacement" in this section.

LOCK CYLINDER REPLACEMENT

Remove or Disconnect (Figure 15)

- Place the lock cylinder in the "Run" position.

1. Steering wheel. Refer to "Steering Wheel Replacement" in this section.
2. Turn signal switch. Refer to "Turn Signal Switch Replacement" in this section.
    - It is not necessary to completely remove the turn signal switch from the column. Pull the switch rearward far enough to slip it over the end of the shift. Do not pull the harness out of the column.
3. Retaining screw and the lock cylinder set.



A. Hold the lock cylinder sleeve and rotate the knob clockwise against the stop.
B. Lock Cylinder Set
C. Cylinder Key
D. Lock Retaining Screw

B-07394

Figure 15—Lock Cylinder Installation

Important

- If the retaining screw is dropped on removal, it could fall into the column, requiring a complete disassembly to retrieve the screw.

Install or Connect (Figure 15)

1. Lock cylinder set.
    - Align he cylinder key with the keyway in the housing. Rotate as shown in figure 15.
    - Push the lock all the way in.
2. Retaining screw.

Tighten

- Screw to 4.5 N m (40 in. lbs.) (Non-Tilt Columns).
- Screw to 2.5 N·m (22 in. lbs.) (Tilt Columns).

3. Turn signal switch. Refer to "Turn Signal Switch Replacement" in this section.

4. Steering wheel. Refer to "Steering Wheel Replacement" in this section.

TONE ALARM SWITCH REPLACEMENT

↔ Remove or Disconnect

1. Steering wheel. Refer to "Steering Wheel Replacement" in this section.
    - Pull the turn signal switch up far enough to allow access to the tone alarm switch. Refer to "Turn Signal Switch Replacement" in this section.
    - The tone alarm switch may be removed without removing the lock cylinder. The lock cylinder must be in the "Run" position.
2. Tone alarm switch assembly.
    - Pull the tone alarm switch straight out of the housing using a paper clip or similar tool. A flat spring wedges the switch toward the lock cylinder.

! Important

- Be careful not to let the flat spring fall down into the housing and do not pull on the switch contacts or plastic material of the switch when removing.

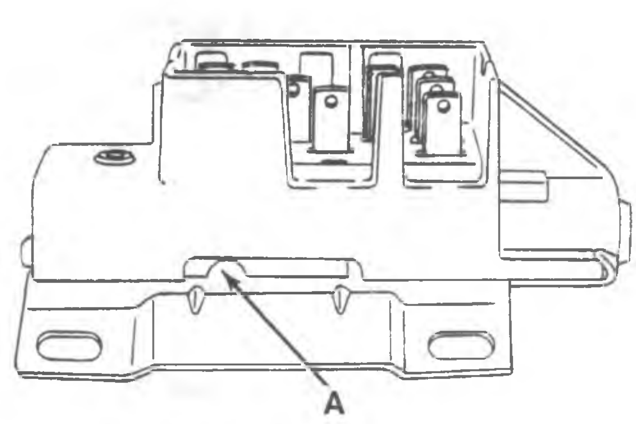
→← Install or Connect

1. Tone alarm switch to the spring clip with the formed end of the clip around the lower end of the switch. The spring is bowed away from the switch.
    - Lay the spring on the switch opposite the contacts.
2. Tone alarm switch and spring into the hole with the contacts toward the lock cylinder bore.
3. Turn signal switch. Refer to "Turn Signal Switch Replacement" in this section.
4. Steering Wheel. Refer to "Steering Wheel Replacement" in this section.

IGNITION SWITCH REPLACEMENT

The ignition switch is mounted on top of the column jacket near the front of the dash. For anti-theft reasons, the switch is located inside the channel section of the brake pedal support.

The switch is actuated by a rod and rack assembly. A portion of the rack is toothed and engages a gear on the end of the lock cylinder. This enables the rod and rack to be moved axially (with respect to the column) to actuate the switch when the lock cylinder is rotated.



A. Switch In The Lock Position

B-07395

Figure 16—Ignition Switch Assembly

↔ Remove or Disconnect

- Lower the steering column. Refer to "CK Model or G Model Steering Column Replacement" in this section. It is not necessary to remove the steering wheel.

! Important

- Properly support the steering column if it is not removed from the vehicle.
- Put the ignition switch in the "Lock" position.
    - If the lock cylinder was removed, the actuating rod to the switch should be pulled up until there is a definite stop, then moved down one detent, which is the "Lock" position.

1. Two ignition switch screws.
2. Ignition switch assembly.

→← Install or Connect (Figure 16)

- Put the ignition switch in the "Lock" position (figure 16).

1. Activating rod into the ignition switch.
2. Ignition switch and screws to the column
3. Steering column assembly. Refer to "Steering Column Replacement" in this section.

STANDARD STEERING COLUMN UNIT REPAIR (C, K AND G MODELS)

Remove or Disconnect

- Steering column assembly. Refer to "CK or G Model Steering Column Replacement" in this section.

Disassemble (Figures 17 through 25)

Tools Required:
J-23074 Steering Column Holding Fixture

1. Dash panel bracket and screws from the column.
- Install J-23074 onto the steering column and place the tool in a bench vise.

Important

- Clamping the steering column directly in a vise could result in a damaged column.

2. Steering wheel. Refer to "Steering Wheel Replacement" in this section.
3. Turn signal switch. Refer to "Turn Signal Switch Replacement" in this section.
4. Lock cylinder. Refer to "Lock Cylinder Replacement" in this section.
5. Tone alarm switch, if it needs to be serviced. Refer to "Tone Alarm Switch Replacement" in this section.

Important

- The buzzer switch does not have to be removed to remove the upper bearing housing.

6. Ignition switch. Refer to "Ignition Switch Replacement" in this section.
7. Shift lever pivot pin and lever. (Column Shift Models).
8. Upper bearing washer.
9. Screws attaching the turn signal and ignition lock housing.
10. Housing assembly (figure 23).
11. Bushing and retainer from the lower side of the housing.
12. Ignition switch actuating rod, rack assembly, rack preload spring, shaft lock bolt and spring assembly from the housing.
13. Shift lever detent plate.
14. Ignition switch actuator sector through the lock cylinder hole by pushing firmly on the block tooth of the sector with a blunt punch or screwdriver (figure 24).
15. Gear shift lever housing and shroud from the jacket assembly.
    - On floor shift models remove the transmission control lock tube housing and shroud.
16. Shift lever spring from the gear shift lever housing.
    - On floor shift models remove the lock tube spring.
17. Steering shaft from the lower end of the jacket assembly.
18. Back-up switch or neutral-safety switch. Refer to SEC. 8B (CHASSIS ELECTRICAL) in this manual.
19. Lower bearing retaining clip (figure 25).
    - On Automatic and Floorshift Columns.
        - Remove the lower bearing retainer, bearing adapter assembly, shift tube spring and washer. The lower bearing may be removed from the adapter by light pressure on the bearing outer race.
        - Slide out the shift tube assembly.
    - On Manual Transmission (Column Shift)
        - Remove the lower bearing adapter, bearing and the first reverse shift lever. The lower bearing may be removed from the adapter by light pressure on the bearing outer race.
        - Remove the three screws from the bearing at the lower and slide out the shift tube assembly.
        - Remove the gear shift housing lower bearing from the upper end of the mast jacket.

Assemble (Figures 17 through 22, 26 and 27)

- Apply a thin coat of lithium grease to all friction surfaces.

1. Sector into the turn signal and lock cylinder housing.
    - Install the sector in the lock cylinder hole over the sector shaft with the tang end to the outside of the hole.
    - Press the sector over the shaft with a blunt tool.
2. Shift lever detent plate onto the housing.
3. Rack preload spring into the housing from the bottom side. The long section should be toward the handwheel and hook onto the edge of the housing (figure 26).
4. Locking bolt onto the crossover arm on the rack and insert the rack and lock bolt assembly into the housing from the bottom with the teeth up (toward hand-wheel) and toward the centerline of the column.

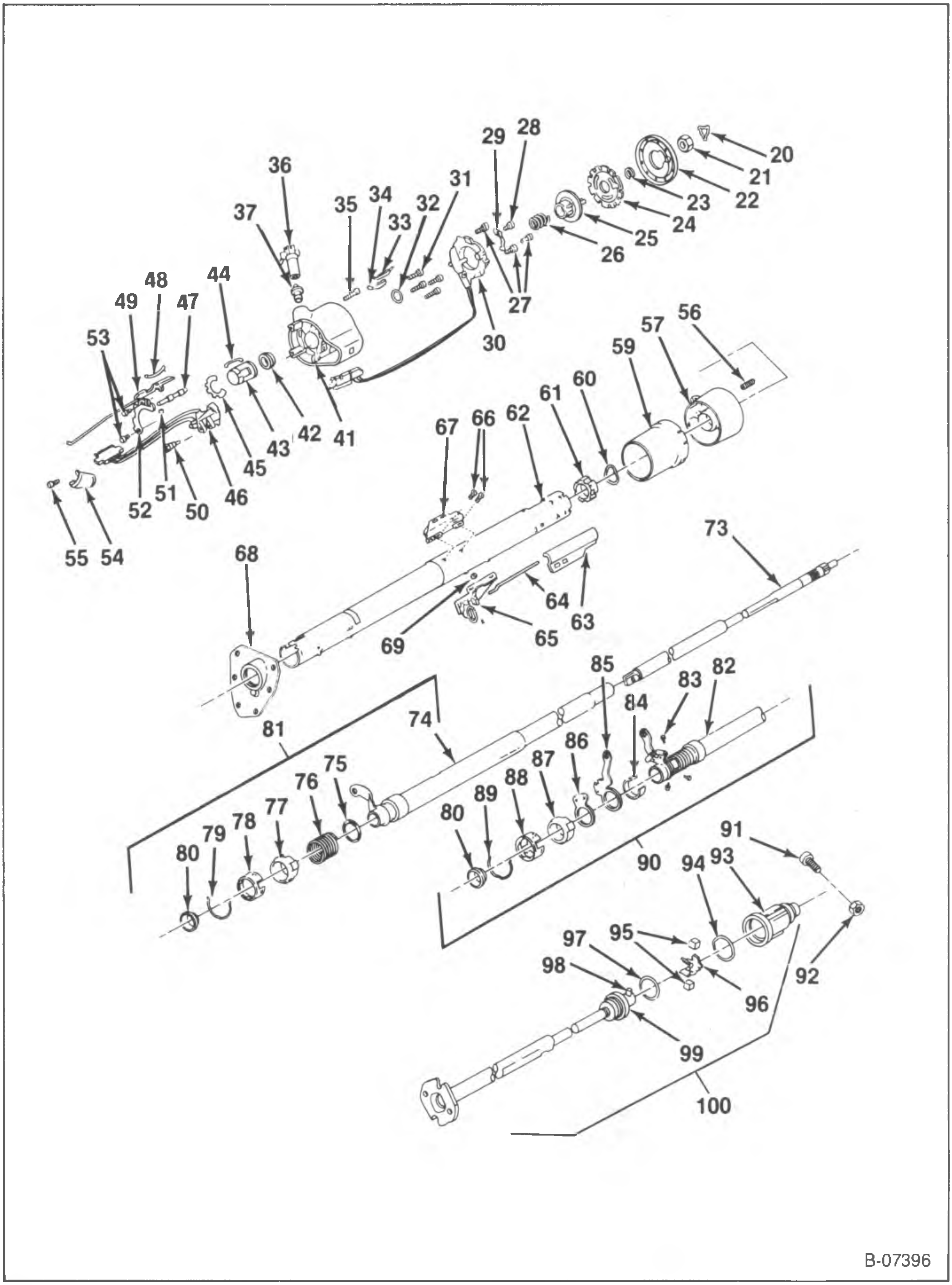


Figure 17—Standard Steering Column—Column Shift (CK-Model)

20. Retainer
21. Nut
22. Lock Plate Cover
23. Retainer
24. Lock Plate
25. Cancelling Cam
26. Bearing Preload Spring
27. Turn Signal Screws
28. Tap Screw
29. Actuator Arm
30. Turn Signal Switch
31. Turn Signal Housing Screws
32. Washer
33. Tone Alarm Switch
34. Retainer Clip
35. Retainer Screw
36. Ignition Lock
37. Actuator Sector
41. Housing Assembly
42. Bearing
43. Bushing
44. Horn Contact
45. Upper Bearing Retainer
46. Dimmer Pivot And Wiper Switch
47. Shaft Lock Bolt
48. Switch Rack Preload Spring
49. Actuator Rack
50. Actuator Pivot Pin
51. Washer
52. Shift Lever Gate
53. Shift Lever Screw
54. Housing Cover
55. Cover Screw
56. Shift Lever Spring
57. Gear Shift Housing
59. Gear Shift Shroud
60. Washer
61. Gear Shift Housing Bearing
62. Jacket
63. Wiring Protector
64. Actuator Rod
65. Dimmer Switch
66. Ignition Switch Screw
67. Ignition Switch
68. Dash Seal
73. Shaft
74. Shift Tube
75. Washer
76. Spring
77. Adapter
78. Reinforcement
79. Adapter Clip
80. Lower Bearing
81. Automatic Transmission
82. Shift Tube
83. Bolt
84. Spacer
85. Lower Shift Lever
86. Adapter Plate
87. Adapter
88. Retainer
89. Adapter Clip
90. Manual Transmission
91. Bolt
92. Nut
93. Coupling
94. Retainer
95. Bearing
96. Spring
97. Washer
98. Pin
99. Seal
100. Intermediate Shaft

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Figure 18—Standard Steering Column—Column Shift (CK-Model)

  - Align the first tooth on the sector with the first tooth on the rack; if aligned properly, the block teeth will line up when the rack assembly is pushed all the way in.

5. Retainer and bushing.
6. Gear shift housing lower bearing. Insert the bearing from the very end of the jacket.
    - Align the indentations in the bearing with the projections on the jacket (figure 27). If the bearing is not installed correctly, it will not rest on the stops provided.
7. Shift lever spring into the gear shift lever (or lock tube) housing.
8. Housing and shroud assembiles onto the upper end of the mast jacket.
    - Rotate the housing to be sure it is seated in the bearing.
9. Turn signal and lock cylinder housing onto the jacket.
    - The gear shift housing should be in the "Park" position and the rack pulled downward.
    - Seat the turn signal housing and install the four screws.
10. Lower bearing into the adapter assembly.
11. Shift tube assembly into the lower end of the jacket. Rotate until the upper shift tube key slides into the housing keyway.
    - On Automatic and Floor Shift Columns
        - Install the spring and lower bearing adapter assembly into the bottom of the jacket.
        - Hold the adapter in place and install the lower bearing reinforcement and retainer clip. The clip snaps into the jacket and reinforcement slots.
    - On Manual Transmission (Column Shift)
        - Loosely attach the three screws in the jacket and shift tube bearing.
        - Assemble the first reverse lever, lower bearing and adapter assembly into the bottom of the jacket.
        - Hold the adapter in place and install the bearing reinforcement and retaining clip. The clip snaps into the jacket and reinforcement slots.
        - Adjust the lower bearing. Refer to the "Manual Transmission (Column Shift) Lower Bearing Adjustment" in this section.
12. Back-up switch or neutral-safety switch. Refer to SEC. 8B (CHASSIS ELECTRICAL) in this manual.
13. Steering shaft into the column.
14. Upper bearing washer.
15. Ignition switch. Refer to "Ignition Switch Replacement" in this section.
16. Tone alarm switch, if removed. Refer to "Tone Alarm Switch Replacement" in this section.

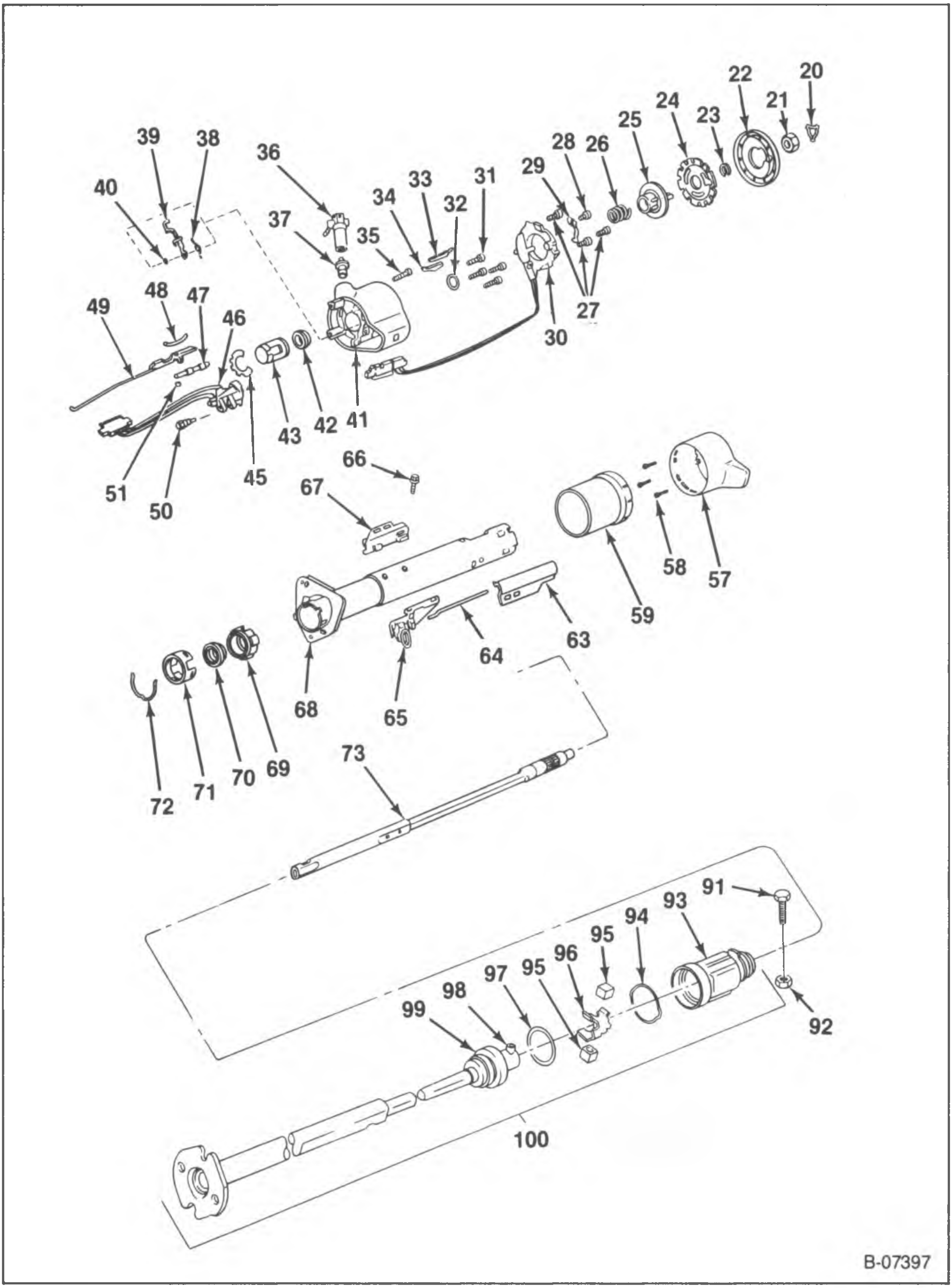

Figure 19—Standard Steering Column (CK-Model)

20. Retainer
21. Nut
22. Lock Plate Cover
23. Retainer
24. Lock Plate
25. Cancelling Cam
26. Bearing Preload Spring
27. Turn Signal Screws
28. Tap Screw
29. Actuator Arm
30. Turn Signal Switch
31. Turn Signal Housing Screws
32. Washer
33. Tone Alarm Switch
34. Retainer Clip
35. Retainer Screw
36. Ignition Lock
37. Actuator Sector
38. Key Release Spring
39. Key Release Lever
40. Key Release Washer
41. Housing Assembly
42. Bearing
43. Bushing
44. Horn Contact
45. Upper Bearing Retainer
46. Dimmer Pivot And Wiper Switch
47. Shaft Lock Bolt
48. Switch Rack Preload Spring
49. Actuator Rack
50. Actuator Pivot Pin
51. Washer
57. Gear Shift Housing
58. Signal Switch Mounting Screws
59. Gear Shift Housing
62. Jacket
63. Wiring Protector
64. Actuator Rod
65. Dimmer Switch
66. Ignition Switch Screw
67. Ignition Switch
68. Dash Seal
69. Adapter
70. Bearing
71. Reinforcement
72. Adapter Clip
73. Shaft
91. Bolt
92. Nut
93. Coupling
94. Retainer
95. Bearing
96. Spring
97. Washer
98. Pin
99. Seal
100. Intermediate Shaft

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Figure 20—Standard Steering Column (CK-Model)

17. Lock cylinder. Refer to "Lock Cylinder Replacement" in this section.
18. Turn signal switch. Refer to "Turn Signal Switch Replacement" in this section.
19. Steering wheel. Refer to "Steering Wheel Replacement" in this section.
20. Shift lever and pivot pin.
    - Remove the column from the vise and J-23074.
21. Dash panel bracket and screws to the column.

Install or Connect

- Steering column assembly. Refer to "CK or G Model Steering Column Replacement" in this section.

STANDARD STEERING COLUMN LOWER BEARING ADJUSTMENT

MANUAL TRANSMISSION (COLUMN SHIFT)

Adjust (Figure 28)

1. Put the transmission in neutral and disconnect the transmission rods.
2. Test for rotational drag by turning the shift lever through the 2–3 shift arc. The drag measured must not be more than 9N (2 lbs.).
3. Loosen the three clamping screws.
    - Increase clearance by sliding the clamping screws in the direction of arrow "B" until the first reverse lever is free of drag (figure 28).
    - Decrease clearance by sliding the clamping screws in the direction of arrow "A" until a slight drag is felt at the first reverse shift lever (figure 28).
4. Install a 0.13 mm (0.005 inch) thick shim between the space and either of the shift levers.
5. Slide the clamping screws in the direction of arrow "B" until the system is loose. Slide the screws in the opposite direction until a drag is felt at the first reverse shift lever.
6. Tighten the clamping screws.
7. Remove the shim.
8. Install the transmission rods.

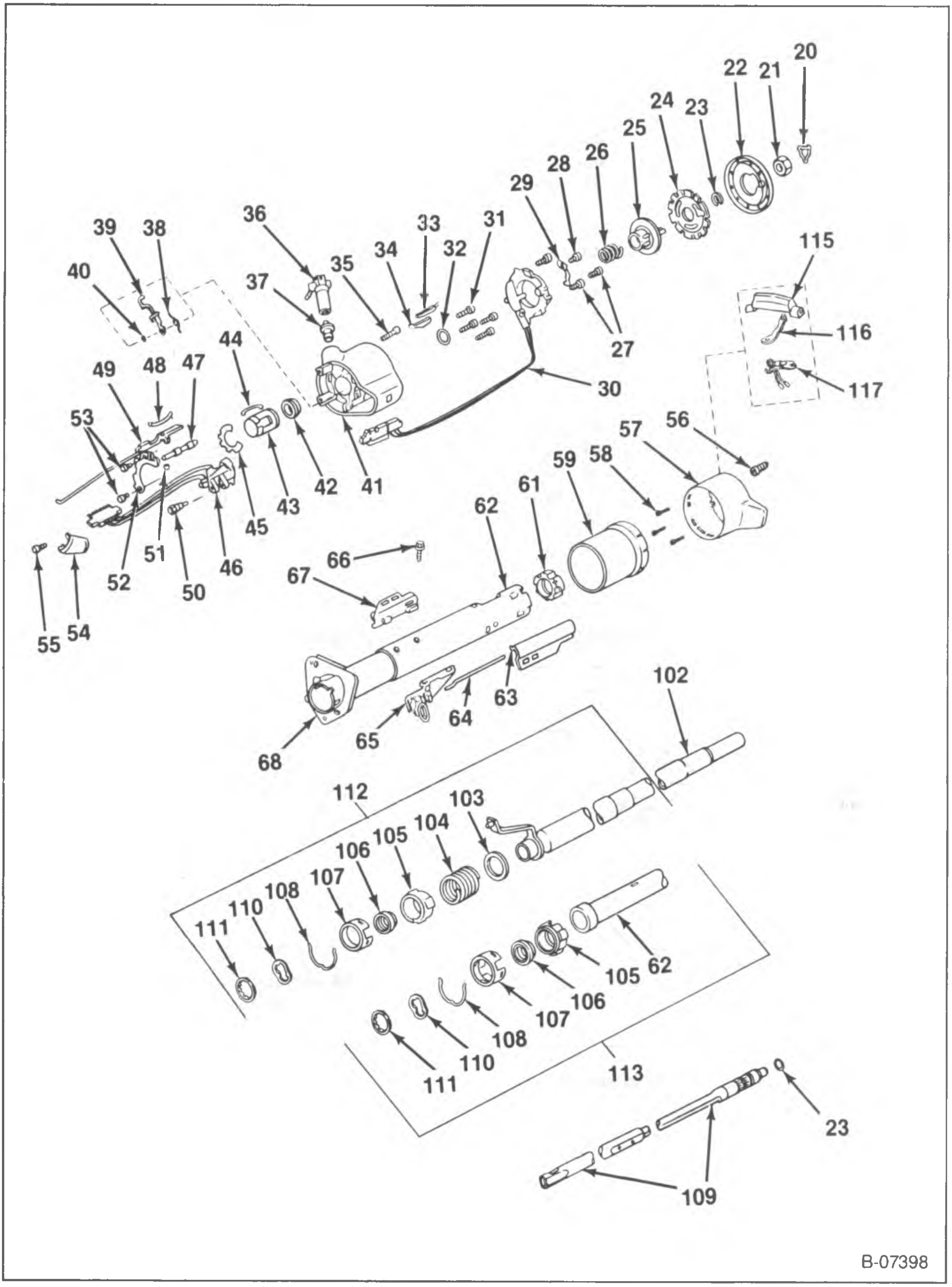

Figure 21—Standard Steering Column (G-Model)

20. Retainer
21. Nut
22. Lock Plate Cover
23. Retainer
24. Lock Plate
25. Cancelling Cam
26. Bearing Preload Spring
27. Turn Signal Screws
28. Tap Screw
29. Actuator Arm
30. Turn Signal Switch
31. Turn Signal Housing Screws
32. Washer
33. Tone Alarm Switch
34. Retainer Clip
35. Retainer Screw
36. Ignition Lock
37. Actuator Sector
38. Key Release Spring
39. Key Release Lever
40. Key Release Washer
41. Housing Assembly
42. Bearing
43. Bushing
44. Horn Contact
45. Upper Bearing Retainer
46. Dimmer Pivot And Wiper Switch
47. Shaft Lock Bolt
48. Switch Rack Preload Spring
49. Actuator Rack
50. Actuator Pivot Pin
51. Washer
52. Shift Lever Gate
53. Shift Lever Screw
54. Housing Cover
55. Cover Screw
56. Shift Lever Spring
57. Gear Shift Housing
58. Signal Switch Mounting Screws
59. Gear Shift Shroud
61. Gear Shift Housing Bearing
62. Jacket
63. Wiring Protector
64. Actuator Rod
65. Dimmer Switch
66. Ignition Switch Screw
67. Ignition Switch
68. Dash Seal
102. Shift Tube
103. Washer
104. Spring
105. Adapter
106. Bearing
107. Reinforcement
108. Adapter Clip
109. Shaft
110. Bearing Washer
111. Retainer
112. Automatic Transmission
113. Manual Transmission

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Figure 22—Standard Steering Column (G-Model)

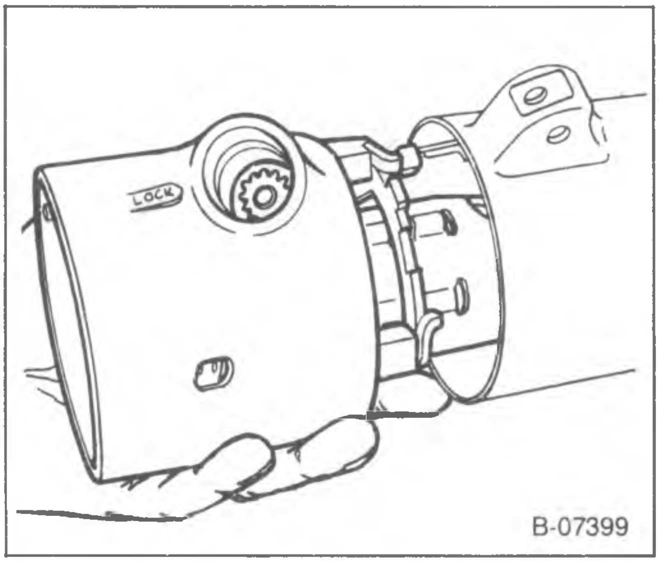

Figure 23—Removing The Turn Signal Housing

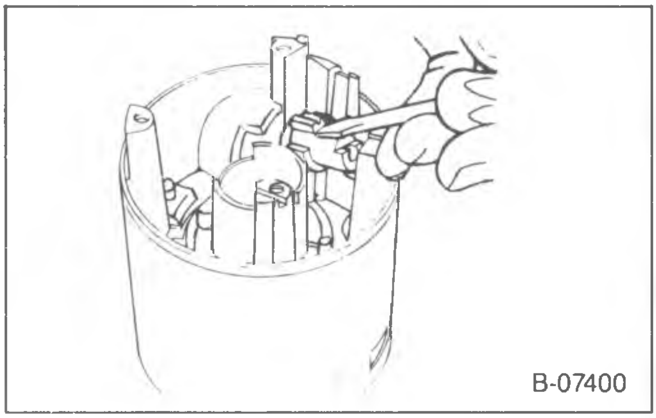

Figure 24—Removing The Ignition Switch Actuator Sector

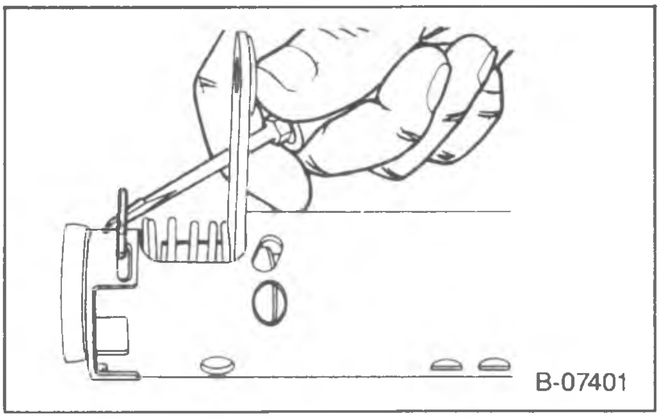

Figure 25—Removing The Lower Bearing Retainer

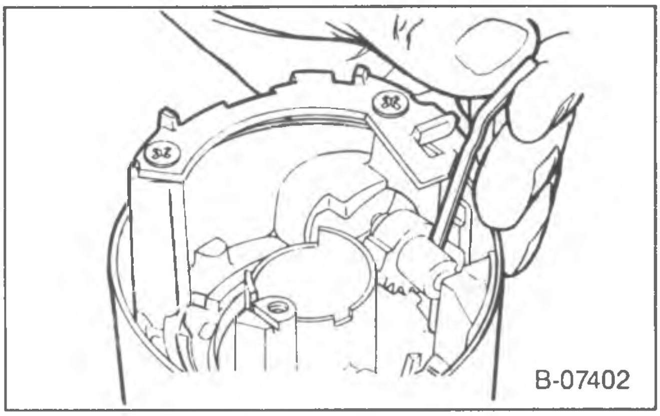

Figure 26—Installing The Rack Preload Spring

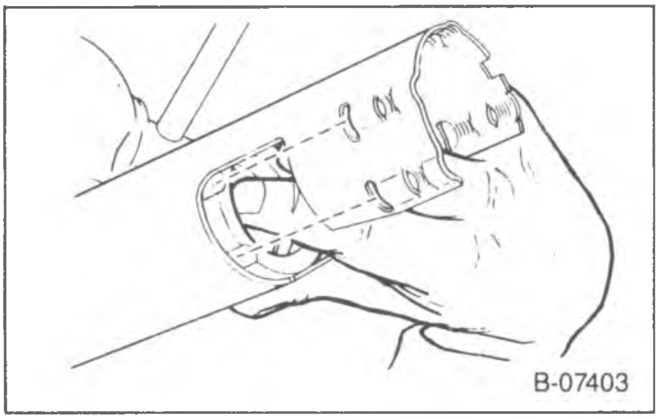

Figure 27—Installing The Gearshift Housing Lower Bearing

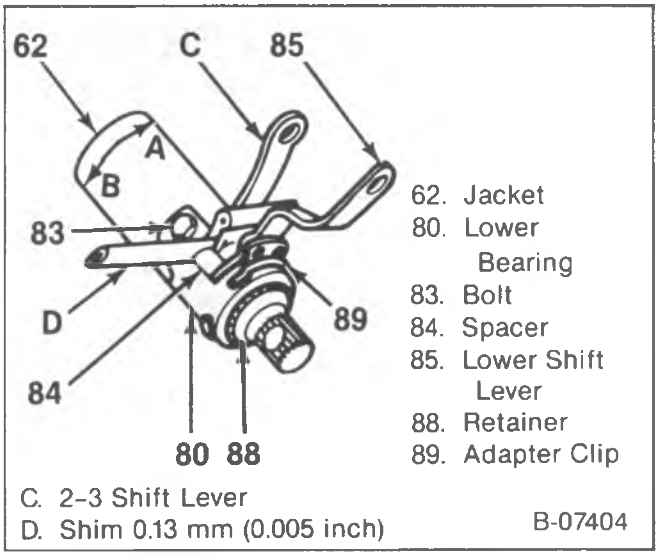

Figure 28—Adjusting The Lower Bearing

TILT STEERING COLUMN UNIT REPAIR (C, K AND G MODELS)

Remove or Disconnect

- Steering column assembly. Refer to "CK or G Model Steering Column Replacement" in this section.

Disassemble (Figures 29 through 36)

Tools Required:
J-22635 Lock Shoe and Release Lever Pin Remover and Installer
J-23074 Steering Column Holding Fixture
J-21854-01 Pivot Pin Remover
J-23072 Shift Tube Remover

1. Dash panel bracket and screws from the column.
- Install J-23074 onto the steering column and place the tool in a bench vise.

Important

- Clamping the steering column directly in a vise, could result in a damaged column.

2. Turn signal switch. Refer to "Turn Signal Switch Replacement" in this section.
3. Lock cylinder. Refer to "Lock Cylinder Replacement" in this section.
4. Tone alarm switch, if it needs to be serviced. Refer to "Tone Alarm Switch Replacement" in this section.

Important

- The tone alarm switch does not have to be removed to remove the upper bearing housing.

5. Ignition switch. Refer to "Ignition Switch Replacement" in this section.
6. Tilt release lever.
7. Shift lever pivot pin and lever.
8. Housing cover screws and housing cover.
- Install the tilt release lever and place the column in the "up" position.
9. Tilt lever spring retainer, spring and guide. Use a screwdriver to turn the retainer until it aligns with the grooves in the housing then remove the retainer.
10. Pot joint to steering shaft clamp bolt and remove the intermediate shaft and pot joint assembly (CK Model).
11. Upper bearing inner race and seat. Push the upper steering shaft in enough to remove the race and seat.
12. Lower bearing retainer clip.
13. Bearing reinforcement, bearing and bearing adapter assembly from the lower end of the mast jacket.
14. Upper bearing housing pivot pins. Use J-21854-01 (figure 33).
- Install the tilt release lever and disengage the lock shoes.
15. Bearing housing by pulling upward to extend the rack full down, and then moving the housing to the left to disengage the ignition switch rack from the actuator rod.
16. Steering shaft assembly from the upper end of the column.
17. Steering shaft by removing the centering spheres and the anti-lash spring.
18. Transmission indicator wire, if so equipped.
19. Bearing housing support to gearshift housing screws and remove the bearing housing support.
20. Ignition switch actuator rod.
21. Shift tube retaining ring and washer.

NOTICE: When removing the shift tube, be sure to guide the lower end through the slotted opening in the mast jacket. If the tube is allowed to interfere with the jacket in any way, damage to the tube and jacket could result.

- Install J-23072 into the lock plate, making sure that the tool screws have good thread engagement in the lock plate. Then, turning the center screw clockwise, force the shift tube from the housing (Figure 34). Remove the shift tube (transmission control lock tube on floor shift models) from the lower end of the mast jacket. Remove J-23072.

22. Lock plate and washer.
    - Slide the lock plate out of the jacket notches by tipping it down toward the housing hub and sliding it under the jacket opening.
    23. Shift lever housing from the mast jacket. (Transmission control lock tube housing on floor shift models).
    - Disassemble the bearing housing as follows:
    24. Tilt lever opening shield.
    25. Lock bolt spring. Remove the retaining screws and move the spring clockwise to remove it from the bolt (figure 35).
    26. Snap ring from the sector drive shaft.
    - With a small punch, lightly tap the drive shaft from the sector (figure 36).
27. Drive shaft, sector and lock bolt.
28. Rack and rack spring.

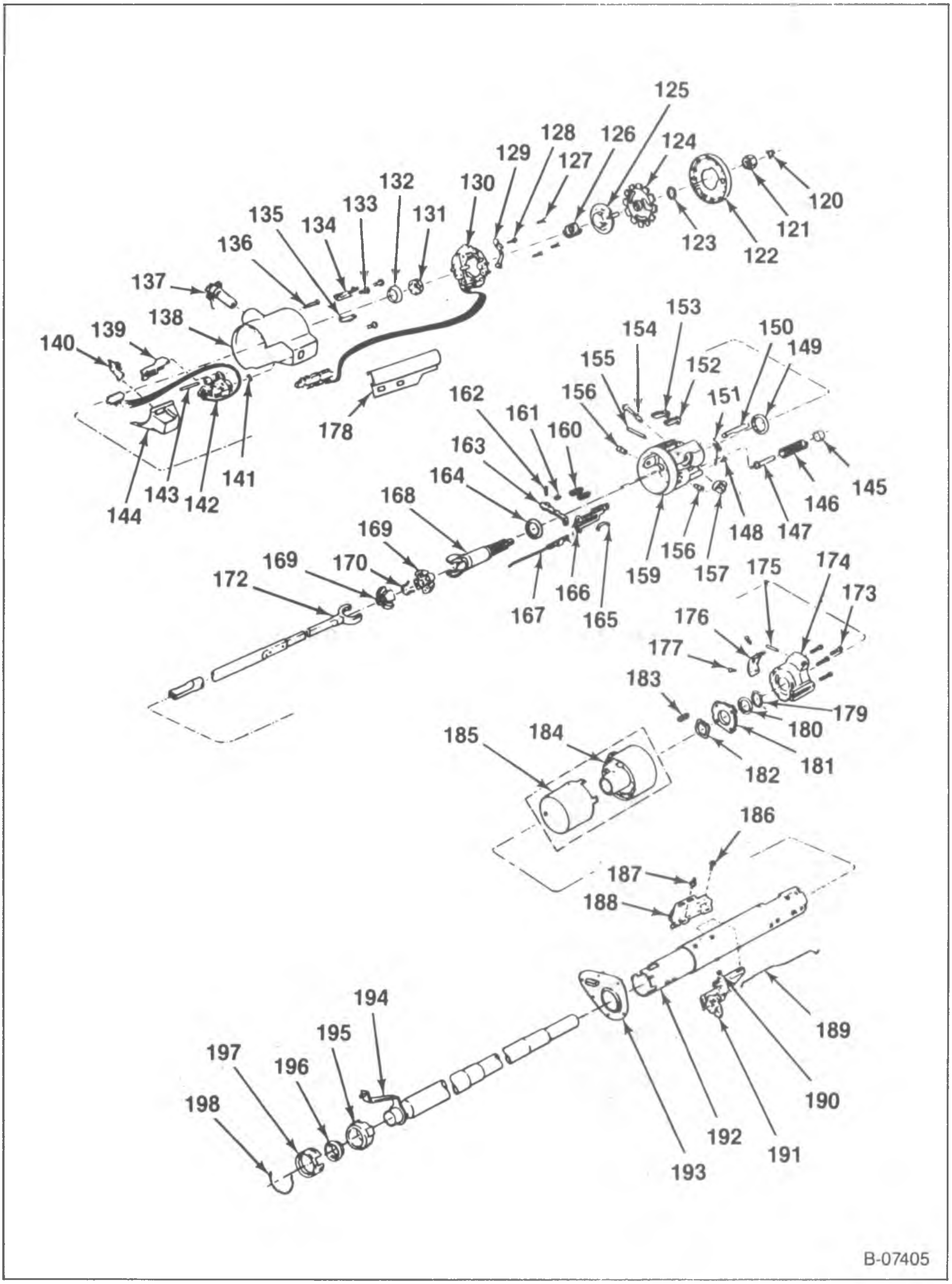

Figure 29—Tilt Steering Column (CK And G Models)

120. Retainer
121. Nut
122. Lock Plate Cover
123. Retainer
124. Lock Plate
125. Cancelling Cam
126. Bearing Preload Spring
127. Turn Signal Screws
128. Tap Screw
129. Actuator Arm
130. Turn Signal Switch
131. Inner Race Seat
132. Bearing Race
133. Screw
134. Tone Alarm Switch
135. Retainer Clip
136. Lock Retainer Screw
137. Ignition Lock
138. Housing Cover
139. Dimmer Switch Actuator
140. Shield
141. Pin Preload Spring
142. Pivot Switch
143. Actuator Pivot Pin
144. Cap
145. Retainer
146. Tilt Spring
147. Spring Guide
148. Screw
149. Bearing
150. Lock Bolt
151. Lock Bolt Spring
152. Lock Shoe
153. Lock Shoe
154. Sector Shaft
155. Lock Shoe Pin
156. Pivot Pin
157. Actuator Sector
159. Housing Assembly
160. Shoe Release Springs
161. Spring
162. Shoe Release Lever Pin
163. Shoe Release Lever
164. Lower Bearing
165. Rack Preload Spring
166. Actuator Rack
167. Ignition Switch Actuator
168. Sphere Spring
169. Centering Spheres
170. Spring
172. Lower Steering Shaft
173. Housing Support Screws
174. Housing Support
175. Pin
176. Shift Lever Gate
177. Detent Plate Screw
179. Retaining Ring
180. Washer
181. Lock Plate
182. Wave Washer
183. Gear Shift Lever Spring
184. Gear Shift Lever Bowl
185. Shroud
186. Screw
187. Stud
188. Switch
189. Dimmer Switch Rod
190. Nut
191. Dimmer Switch
192. Jacket
193. Dash Seal
194. Shift Tube
195. Adapter
196. Lower Bearing
197. Retainer
198. Adapter Clip

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Figure 30—Tilt Steering Column (CK And G Models)

29. Tilt release lever pin. Use J-22635.
30. Release lever and spring.

Important

- To relieve the load on the release lever, hold the shoes inward and wedge a block between the top of the shoes (over slots) and bearing housing.

31. Lock shoe retaining pin. Use J-22635.
32. Lock shoes and springs.
33. Bearings from the bearing housing only if they are to be replaced.
    - Remove the separator and balls from the bearings.
    - Place the housing on a work bench and with a pointed punch against the back surface of the race, carefully hammer the race out of the housing until a bearing puller can be used. Repeat for the other race.

Assemble (Figures 29 through 32)

Tools Required:

J-23073-01 Shift Tube Installer

J-22635 Lock Shoe and Release Lever Pin Remover and Installer

- If the bearing housing was disassembled, repeat steps 1–9.
- Apply a thin coat of lithium grease to all friction surfaces.

1. Bearings into the bearing housing, if removed.
2. Lock shoe springs, lock shoes and shoe pin in the bearing housing. Use J-22635 or a 4.5 mm (0.180 inch) diameter rod to line up the shoes for pin installation.
3. Release lever, spring and pin.

Important

- To relieve the load on the release lever, hold the shoes inward and wedge a block between the top of the shoes (over slots) and bearing housing.

4. Sector drive shaft into the housing.
    - Lightly tap the sector onto the shaft far enough to install the snap ring.
5. Snap ring.
6. Lock bolt. Engage the bolt with the sector cam surface.
7. Rack and spring. The block tooth on the rack should engage the block tooth on the sector (figure 37).
8. Tilt release lever.
9. Lock bolt spring and retaining screw.

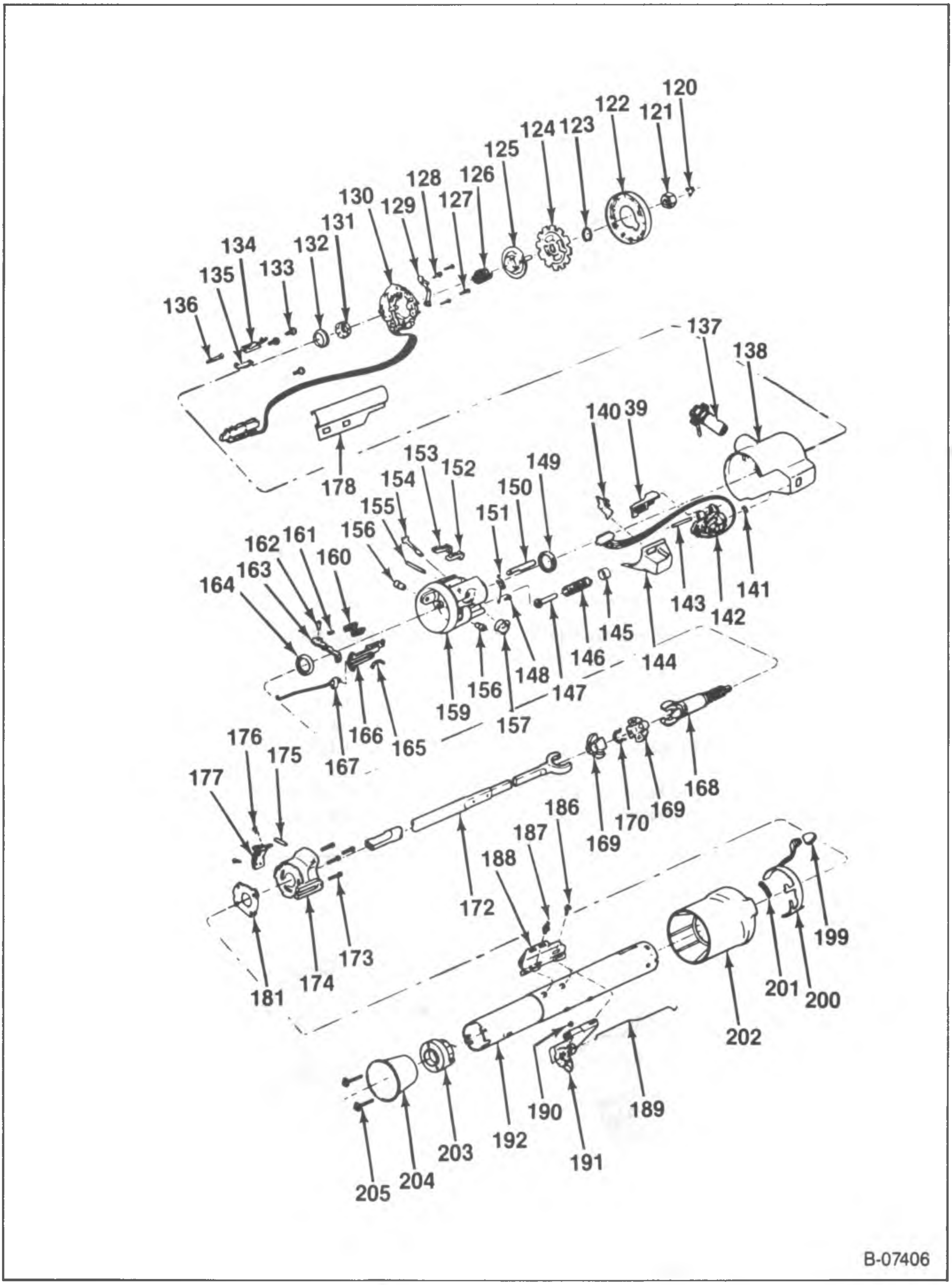

Figure 31—Tilt Steering Column—Floor Shift (CK And G Models)

120. Retainer
121. Nut
122. Lock Plate Cover
123. Retainer
124. Lock Plate
125. Cancelling Cam
126. Bearing Preload Spring
127. Turn Signal Screws
128. Tap Screw
129. Actuator Arm
130. Turn Signal Switch
131. Inner Race Seat
132. Bearing Race
133. Screw
134. Tone Alarm Switch
135. Retainer Clip
136. Lock Retainer Screw
137. Ignition Lock
138. Housing Cover
139. Dimmer Switch Actuator
140. Shield
141. Pin Preload Spring
142. Pivot Switch
143. Actuator Pivot Pin
144. Cap
145. Retainer
146. Tilt Spring
147. Spring Guide
148. Screw
149. Bearing
150. Lock Bolt
151. Lock Bolt Spring
152. Lock Shoe
153. Lock Shoe
154. Sector Shaft
155. Lock Shoe Pin
156. Pivot Pin
157. Actuator Sector
159. Housing Assembly
160. Shoe Release Springs
161. Spring
162. Shoe Release Lever Pin
163. Shoe Release Lever
164. Lower Bearing
165. Rack Preload Spring
166. Actuator Rack
167. Ignition Switch Actuator
168. Sphere Spring
169. Centering Spheres
170. Spring
172. Lower Steering Shaft
173. Housing Support Screws
174. Housing Support
175. Pin
176. Shift Lever Gate
177. Detent Plate Screw
181. Lock Plate
182. Screw
187. Stud
188. Switch
189. Dimmer Switch Rod
190. Nut
191. Dimmer Switch
199. Pad
200. Key Release Lever
201. Key Release Spring
202. Shroud
203. Lower Bearing
204. Retainer
205. Screws

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Figure 32—Tilt Steering Column—Floor Shift
(CK And G Models)

Tighten

- Screw to 4 N·m (35 in. lbs.).

10. Shift lever spring into the housing. Wind the spring up with pliers and push it into the housing.

- On floor shift models, install the plunger and slide the gearshift lever housing onto the mast jacket.

11. Washer and lock plate. Slide the lock plate into the notches in the jacket.

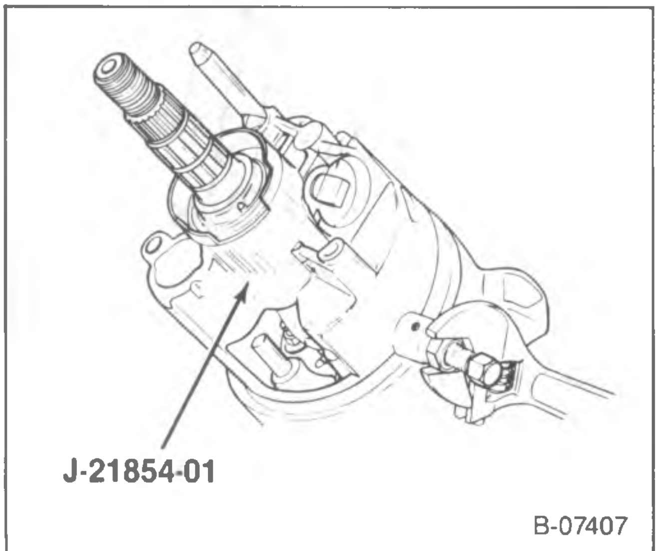


Figure 33—Removing The Bearing Housing Pivot Pins

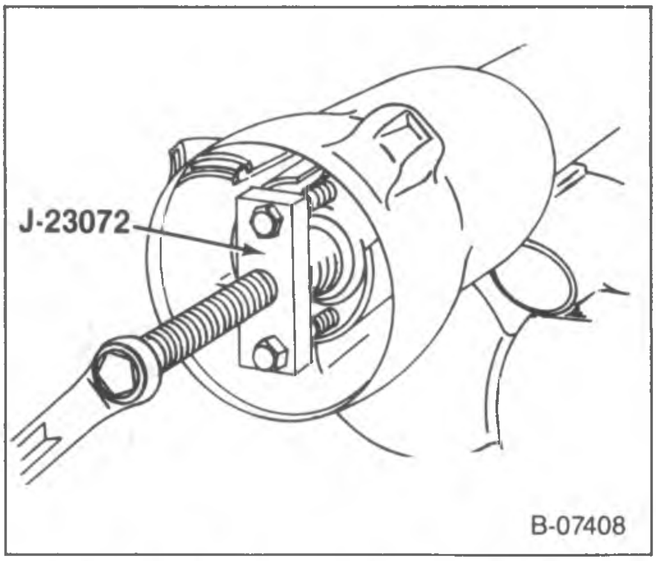
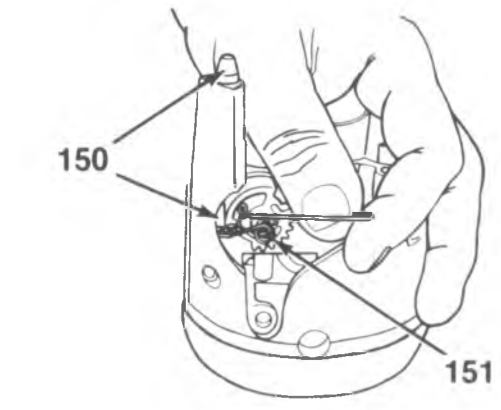


Figure 34—Removing The Shift Tube



150. Lock Bolt
151. Lock Bolt Spring

Figure 35—Replacing The Lock Bolt Spring

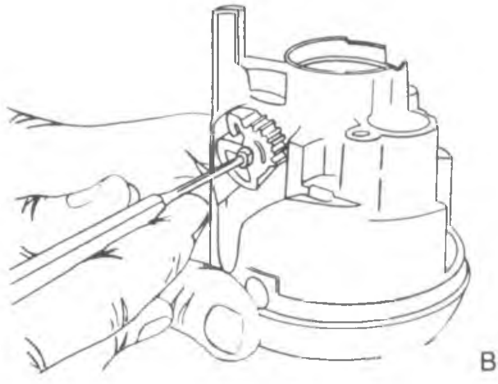
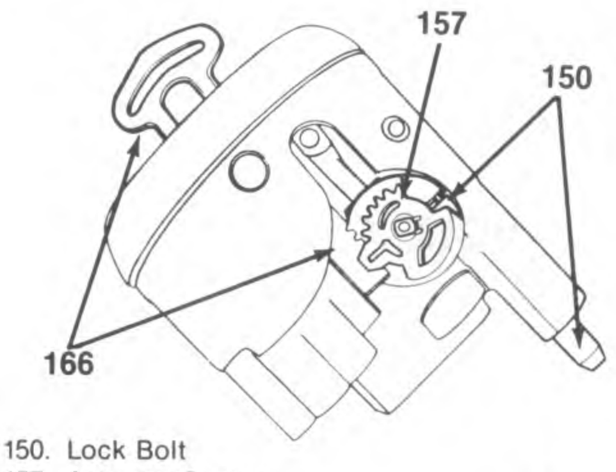


Figure 36—Removing The Sector Drive Shaft



150. Lock Bolt
157. Actuator Sector
166. Actuator Rack

Figure 37—Installing The Lock Bolt And Rack Assemblies

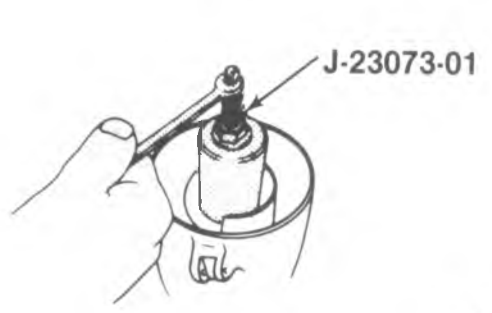


Figure 38—Installing The Shift Tube Assembly

NOTICE: Do not push or tap on the end of the shift tube. Be sure that teh shift tube lever is aligned with the slotted opening at the lower end of the mast jacket or damage to the shift tube and mast jacket could result.

12. Shift tube into the lower end of the mast jacket.
    - Align the keyway in the tube with the key in the shift lever housing.
    - Install the wobble plate end of J-23073-01 into the upper end of the shift tube far enough to reach the enlarged portion of the tube.
    - Install the adapter over the end of the tool, seating it against the lock plate.
    - Place the nut on the threaded end of the tool and pull the shift tube into the housing (figure 38).
    - Remove J-23073-01.
13. Bearing support washer and retaining ring. Pull the shift lever housing up far enough to compress the lock plate washer.
14. Bearing support. Align the "V" in the support with the "V" in the jacket.
15. Screws through the support and into the lock plate.
    - Screws to 6.8 N·m (60 in. lbs.).
    - Align the lower bearing adapter with the notches in the jacket.
16. Adapter into the lower end of the jacket.
17. Lower bearing, bearing reinforcement and retaining clip.
    - Align the retaining clip with the slots in the reinforcement, jacket and adapter.
18. Centering spheres and anti-lash spring in the upper shaft.
19. Lower shaft from the same side of the spheres that the spring ends protrude.
20. Steering shaft assembly into the shift tube from the upper end. Carefully guide the shaft through the shift tube and bearing.

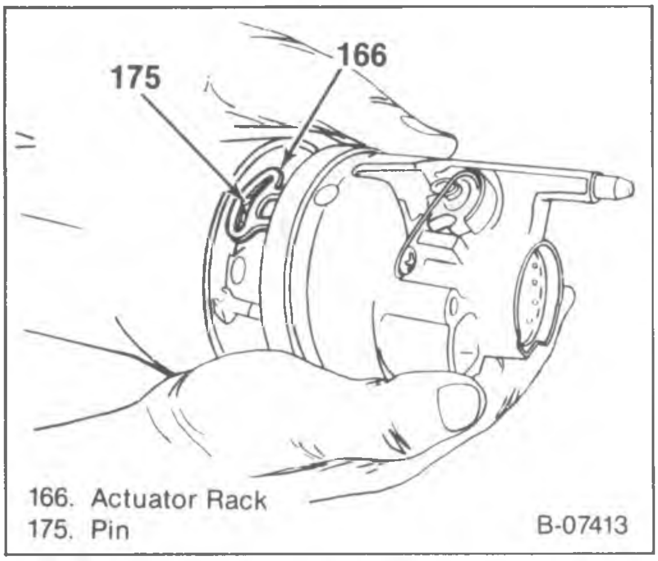


Figure 39—Installing The Bearing Housing

21. Ignition switch actuator rod through the shift lever housing and insert it in the slot in the bearing support.
    - Extend the rack downward from the bearing housing.
22. Bearing housing over the steering shaft.
    - Engage the rack over the end of the actuator rod (figure 39).
- With the release lever installed, hold the lock shoes in the disengaged positions.
23. Bearing housing over the steering shaft until the pivot pin holes line up.
24. Pivot pins.
    - Place the bearing in the full "up" position.
25. Tilt lever spring guide, spring and retainer.
    - With a suitable screwdriver, push the retainer in and turn clockwise to engage it in the housing.
26. Tilt lever opening shield.
    - Remove the tilt release lever.
27. Turn signal housing and retaining screws.

Tighten

- Screws to 5 N·m (45 in. lbs.).

28. Tilt release lever and shift lever.
29. Ignition switch. Refer to "Ignition Switch Replacement" in this section.
30. Tone alarm switch, if removed. Refer to "Tone Alarm Switch Replacement" in this section.
31. Lock cylinder. Refer to "Lock Cylinder Replacement" in this section.
32. Turn signal switch. Refer to "Turn Signal Switch Replacement" in this section.
    - Remove the column from the vise and J-23074.
    - Align the groove across the upper end of the pot joint with the flat on the steering shaft. Install the pot joint and intermediate shaft assembly to the upper shaft (CK Model).
        - Install the clamp, bolt and nut. The clamp bolt must pass through the shaft undercut.

Tighten

- Nut to 60 N·m (44 ft. lbs.).

33. Dash panel bracket and screws to the column.

Install or Connect

- Steering column. Refer to "CK or G Model Steering Column Replacement" in this section.

STEERING COLUMN ON-VEHICLE SERVICE P(32) MODELS

TURN SIGNAL SWITCH REPLACEMENT

Remove or Disconnect (Figures 40 and 41)

Tools Required:

J-22727 Electrical Terminal Remover
J-22708 Turn Signal Cover Remover

1. Steering wheel. Refer to "Steering Wheel Replacement" in this section.
2. Cancelling cam and spring (standard columns).
3. Instrument panel trim plate (some models).
4. Turn signal switch wiring harness at the half-moon connector.
    - Pry the wiring harness protector out of the column retaining slots.
    - Mark the location of each wire in the half-moon connector and then remove each individual wire from the connector. Use J-22727 (figure 40). Insert the tool into the lower end of the connector and push in until

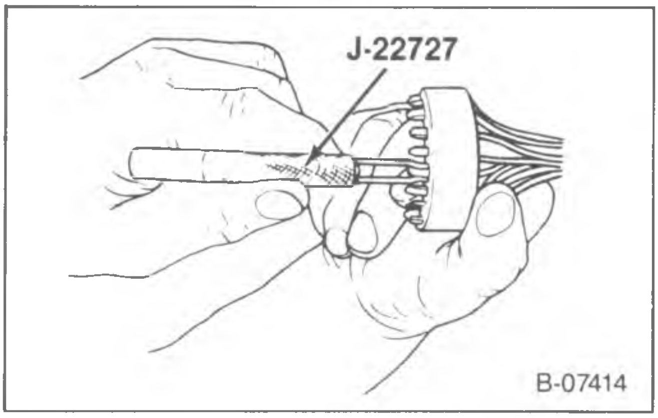


Figure 40—Removing The Wires From The Connector

the tool bottoms on the connector. Remove the tool and then pull the wire from the connector.

5. Turn signal lever screw and lever.
6. Hazard warning light knob. Press the knob inward and unscrew.

- On tilt columns.
  - Remove the PRNDL dial screws, dial and indicator needle. Remove the cap and dial illumination bulb from the housing cover (Automatic Transmission Model).
  - Unscrew and remove the tilt release lever.
  - Install J-22708 inside the turn signal housing cover and push in until the tangs lock inside the cover flange (figure 41). Turn the center screw on the tool clockwise to pull the cover from the housing.

7. Turn signal switch mounting screws.
8. Turn signal switch assembly from the column. Guide the wiring harness through the opening in the shift lever housing.

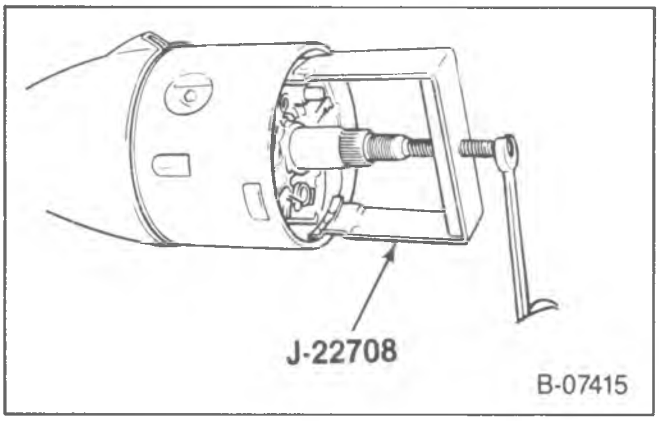


Figure 41—Removing The Turn Signal Housing Cover

→← Install or Connect

NOTICE: For step 8 see "Notice" on page 3B4#1.

- Wrap the ends of the turn signal switch wires with tape and then guide them through the opening at the lower left hand side of the bearing housing (tilt columns) out the lower end of the shift lever housing and under the dash seal.
- Place the turn signal switch in position.

1. Turn signal switch mounting screws.

Tighten

- Screws to 2.8 N m (25 in. lbs.).

- On tilt columns.
  - Align the openings in the turn signal switch cover with the proper lever positions. Tap the cover into place using a plastic hammer.
  - Install the tilt release lever.
  - Install the PRNDL dial, pointer, dial illumination bulb and cap (Automatic Transmission Models).

2. Turn signal switch lever and screws.
3. Hazard warning knob.

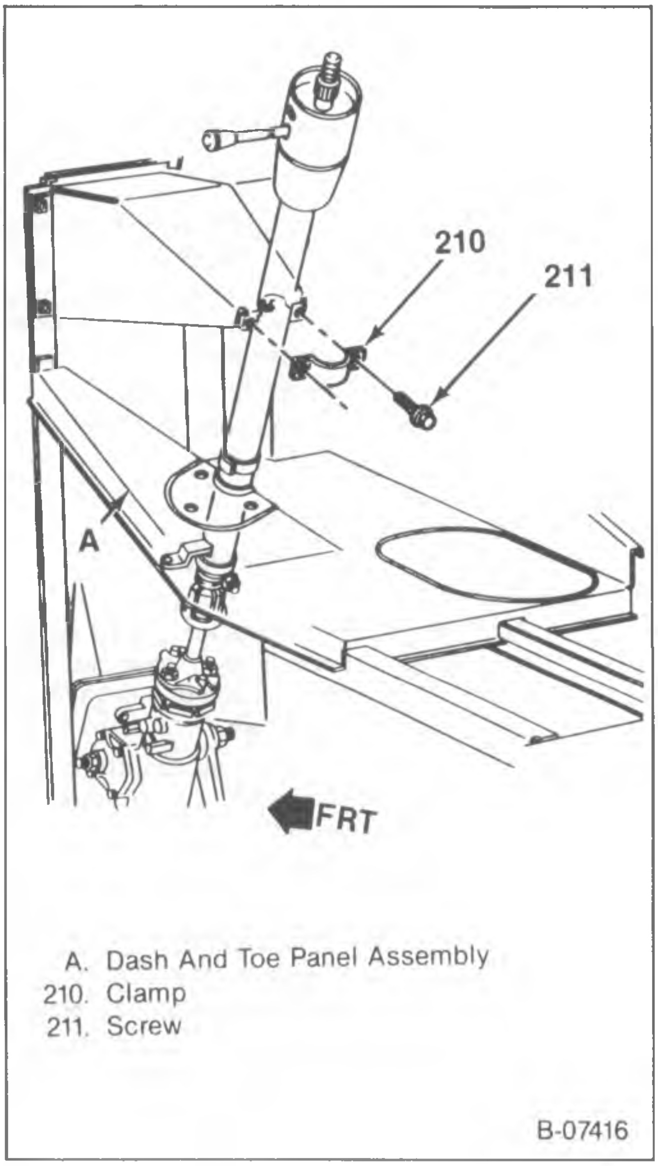
- Bend the wire retaining tabs, on each wire in the wiring harness, enough to provide proper retention of the wire in the half-moon connector.

4. Each wire in its marked location in the half-moon connector. Push in until the square part of the clip is flush with the bottom side of the connector.
5. Turn signal switch wiring harness.
6. Wiring harness protector into the column retaining slots.
7. Cancelling cam and spring (non-tilt column).
8. Steering wheel. Refer to "Steering Wheel Replacement" in this section.
9. Instrument panel trim plate (some models).

TILT STEERING COLUMN REPLACEMENT

←→ Remove or Disconnect (Figure 42)

1. Battery ground cable.
2. Transmission control linkage from the column shift tube levers.
3. Nuts and washers that secure the flanged end of the steering shaft to the flexible coupling.
4. Steering wheel. Refer to "Steering Wheel Replacement" in this section.
5. Turn signal wiring harness.



A. Dash And Toe Panel Assembly
210. Clamp
211. Screw

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Figure 42—Steering Column Installation P(32) Model

- On an automatic transmission, disconnect the single wire at the fuse block and unclip it from the parking brake bracket.

6. Screws from the cover of the dash and toe panel assembly.
7. Screws (211) and clamp (210) from the column support bracket.
8. Steering column assembly.
    - Lower and then withdraw the column assembly. Rotate the column so the shift lever clears the dash and toe panel assembly.

Install or Connect (Figures 42 and 43)

NOTICE: For steps 4 and 8 see "Notice" on page 3B4#1.

- Adjust the lower bearing preload. Refer to "Steering Column Lower Bearing Adjustment" in this section.

1. Plastic spacers onto the flexible coupling alignment pins.
2. Lower end of the steering column through the toe panel opening.
3. Lower steering shaft flange onto the flexible coupling.
4. Flange to coupling nuts.

Tighten

- Nuts to 27 N·m (20 ft. lbs.).
- Align the index slot in the steering column jacket with the protrusion on the column support bracket.

5. Clamp (210) and screws (211) to the column support bracket. Tighten bolts finger tight.

- Push the column down until the steering shaft flange bottoms on the plastic spacers on the flexible coupling.

Tighten

- Screws (211) to 25 N·m (18 ft. lbs.).
- Remove the plastic spacer from the alignment pins.

Measure

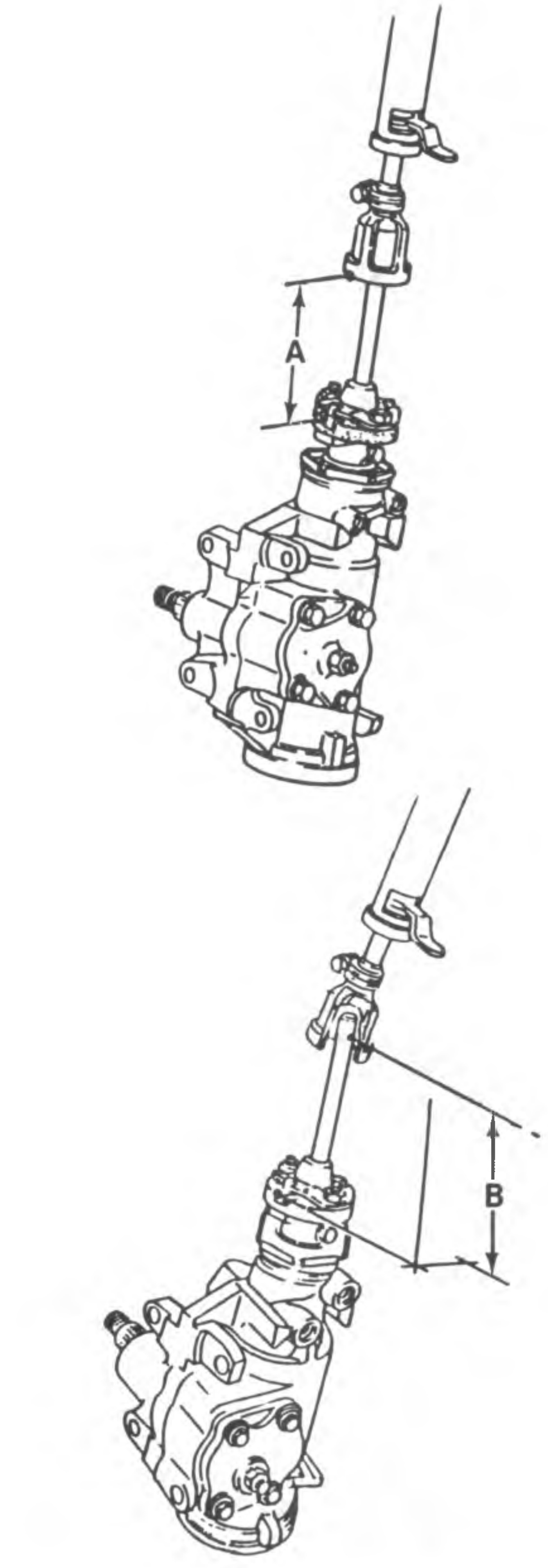
- Coupling assembly dimensions (figure 43). Raise or lower steering column if necessary.

6. Cover and mounting screws to the dash and toe panel assembly.
7. Turn signal switch wiring harness.
    - On an automatic transmission, connect the single wire to the fuse block and clip it to the parking brack bracket.
8. Steering wheel. Refer to "Steering Wheel Replacement" in this section.
9. Transmission control linkage.
10. Battery ground cable.

TILT STEERING COLUMN BEARING HOUSING REPLACEMENT

Remove or Disconnect (Figures 44 through 48)

Tools Required:
J-22635 Lock Shoe and Release Lever Pin Remover and Installer
J-22599 Locknut Wrench
J-21854-01 Pivot Pin Remover
J-5822 Steering Gear Shaft Main Bearing Cup Remover
J-2619-01 Slide Hammer



A. (4.89 ± 0.12 inch) Excluding FS3
B. (4.71 inch) with FS3

B-07417

Figure 43—Measuring The Coupling Assembly

1. Battery ground cable.
2. Steering wheel. Refer to "Steering Wheel Replacement" in this section.
3. Turn signal switch. Refer to "Turn Signal Switch Replacement" in this section.
   - On column shift models, use a suitable size punch to drive out the shift lever pivot and remove the shift lever.
   - Install the tilt release lever and place the column in the "up" position.
4. Retainer (230) and spring (232). Use a screwdriver to turn the retainer until it aligns with the grooves in the housing, then remove the retainer and spring.
5. Upper bearing nut (253). Use J-22599.
6. Seat (254) and race (255).
7. Housing pivot pins (221). Use J-21854-01 (figure 46).
8. Bearing housing (219). Pull up on the tilt release lever, this will disengage the shoes (224), and remove the housing.
9. Upper and lower bearings (218, 220).
   - Remove the bearing races using J-5822 and J-2619-01 (figure 47).
10. Tilt release lever.
11. Shoe release pivot pin (228). Use J-22635 or a suitable punch (figure 48).
12. Spring (227) and lever (229).
13. Shoe kit assembly (225).
    - If the upper steering shaft, lower steering shaft, or centering spheres are being removed, proceed as follows.
14. Steering shaft assembly through the upper end of the column. If it is necessary to disassemble the shaft, proceed as follows:
    - Disconnect the shaft at the pot joint coupling clamp and remove the lower steering shaft.
    - Turn the upper shaft 90 degrees to the lower shaft and slide the upper shaft and centering sphere from the lower shaft.
    - Rotate the centering spheres 90 degrees and remove the centering spheres and spring from the upper shaft.
    - If the bearing housing support is being replaced, proceed as follows:
15. Screws (231).
16. Support (233).

→← Install or Connect (Figures 44 and 45)

Tools Required:

J-22599 Locknut Wrench

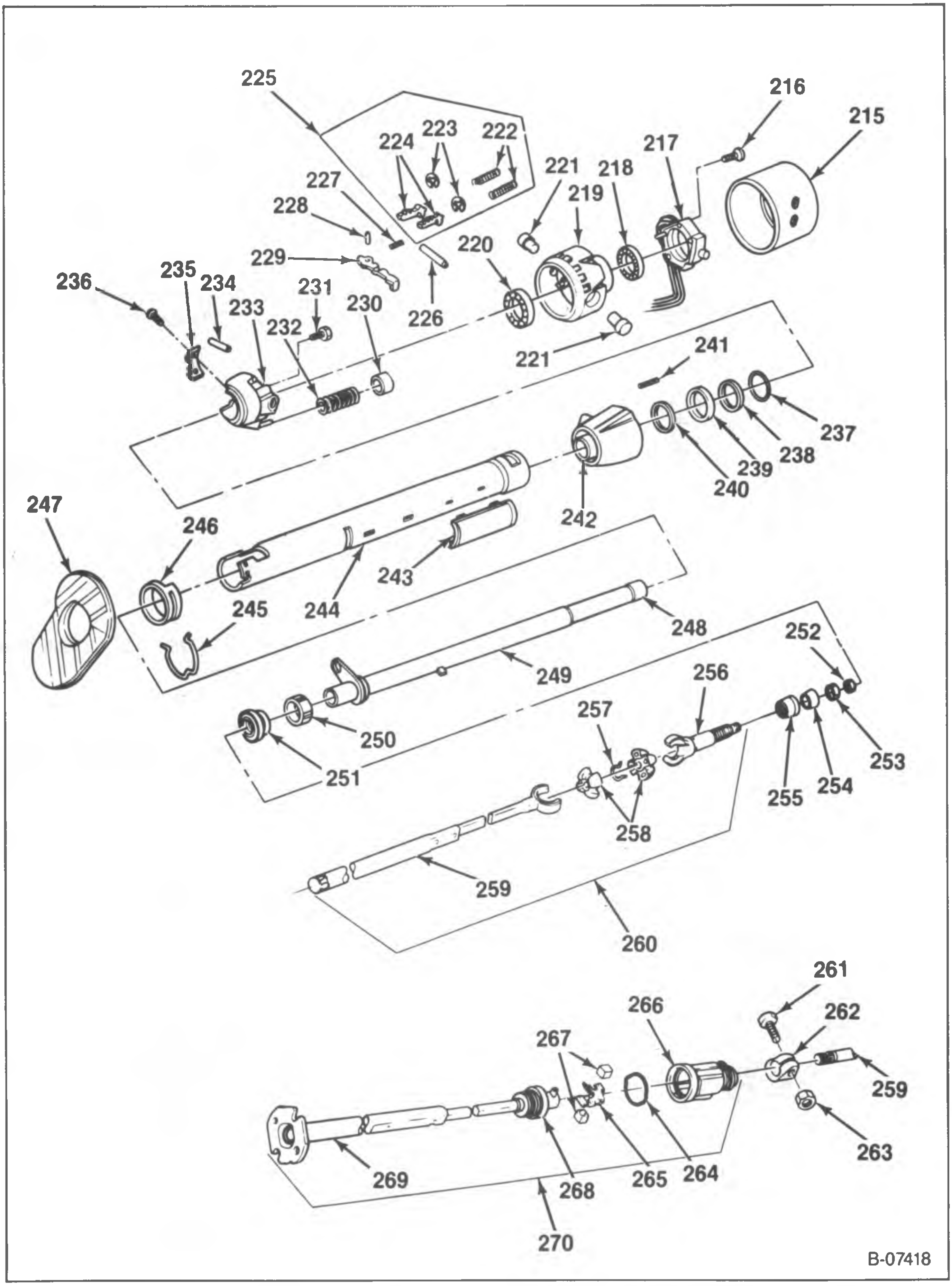


Figure 44—Tilt Steering Column P(32) Model

215. Housing Cover
216. Turn Signal Mounting Screw
217. Turn Signal Switch
218. Upper Bearing
219. Bearing Housing
220. Lower Bearing
221. Pivot Pins
222. Shoe Spring
223. Spacer
224. Shoes
225. Shoe Kit Assembly
226. Shoe Retaining Pin
227. Spring
228. Pivot Pin
229. Lever
230. Retainer
231. Screws
232. Spring
233. Support
234. Pin
235. Detent Plate
236. Screw
237. Retaining Ring
238. Washer
239. Lock Plate
240. Washer
241. Gear Shift Lever Spring
242. Gear Shift Housing
243. Guide
244. Jacket
245. Bearing Retainer Clip
246. Reinforcement
247. Dash Seal
248. Seal
249. Shift Tube
250. Adapter
251. Bearing
252. Nut
253. Nut
254. Seat
255. Race
256. Shaft
257. Spring
258. Sphere Assembly
259. Lower Shaft
260. Shaft Assembly
261. Bolt
262. Clamp
263. Nut
264. Retainer
265. Spring
266. Coupling Assembly
267. Bearings
268. Seal
269. Intermediate Shaft Assembly

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Figure 45—Tilt Steering Column P(32) Model

NOTICE: For steps 4 and 11 see "Notice" on page 3B4#1.

- Lubricate the ID of the bearing housing support and install the support and screws.

1. Steering shaft assembly.
   - Lubricate and assemble the centering spheres and spring.
   - Install the spheres into the upper (short) shaft and rotate 90 degrees.
   - Install the lower shaft 90 degrees to the upper shaft and over the centering spheres. Slowly straighten the shafts while compressing the spring.
2. Steering shaft assembly into the housing from the upper end.
3. Lower steering column shaft to the intermediate shaft (pot joint) assembly (269).
4. Clamp (262) bolt (261) and nut (263). The bolt must pass through the shaft undercut.

Tighten

   - Bolt to 60 N·m (44 ft. lbs.).
5. Bearing housing (219) assembly.
   - Press the new upper and lower bearing races into the bearing housing.

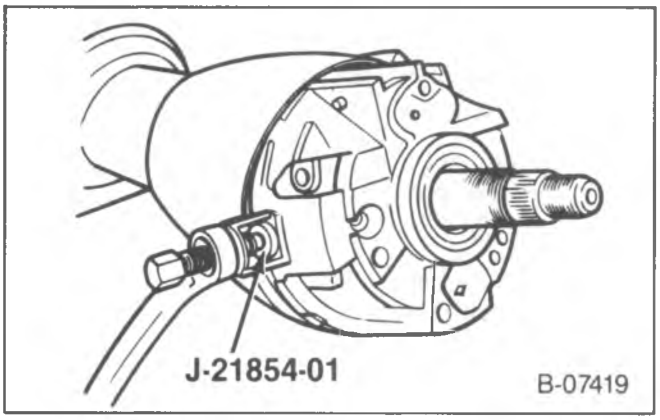


Figure 46—Removing The Bearing Housing Pivot Pin

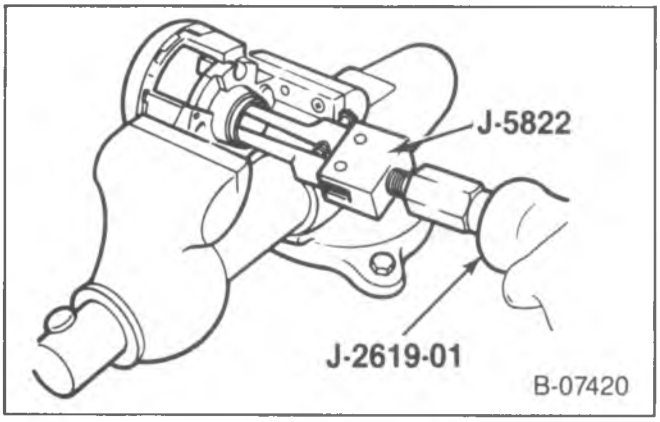


Figure 47—Removing The Bearing Race

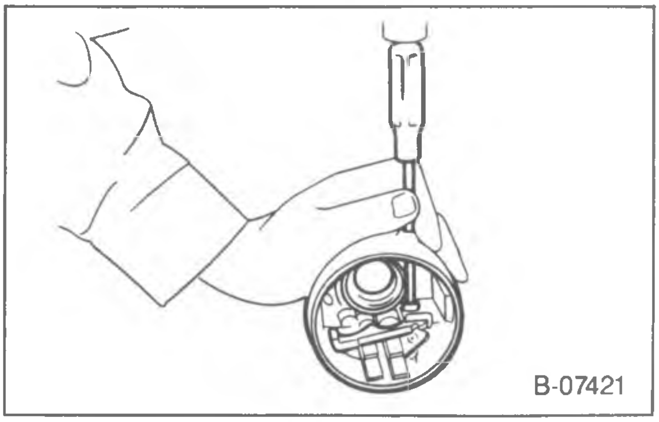


Figure 48—Removing The Release Lever Pivot Pin

  - Lubricate and install the bearings into the bearing races.
  - Place the shoe springs in position in the housing. Install each shoe in place and compress the spring in position. Once the shoes are in place, drive in the shoe retaining pin (226).
  - Install the shoe release lever (229), spring (227) and pivot pin (228).
  - Install the tilt release lever.
  - Lubricate the shoes and release lever.

6. Bearing housing assembly to the support (233).
   - Hold the tilt release lever in the "up" position until the shoes have fully engaged the support.
   - Lubricate and install the bearing housing pivot pins (221). Press the pins in flush with the housing.

- Place the housing in the "up" position.

7. Spring (232) and retainer (230). Push the retainer into the housing about 5 mm (3/16 inch) and rotate counterclockwise 1/8 turn.

- Lubricate the upper bearing race (255), seat (254) and nut (253).

8. Race (255), seat (254) and nut (253). Tighten the nut using J-22599.

- Remove the tilt release lever.

9. Turn signal switch. Refer to "Turn Signal Switch Replacement" in this section.
10. Shift lever and pivot pin. (Column Shift Models).
11. Steering Wheel. Refer to "Steering Wheel Replacement" in this section.
12. Tilt release lever.

Inspect

- Electrical and mechanical functioning of the steering column.

TILT STEERING COLUMN UNIT REPAIR
P(32) MODELS

Remove or Disconnect

- Steering column assembly. Refer to "Tilt Steering Column Replacement" in this section.

Disassemble (Figures 44 and 45)

Tools Required:
J-23074 Steering Column Holding Fixture
J-23072 Shift Tube Remover

- Install J-23074 onto the steering column and place the tool in a bench vise.

Important

  - Clamping the steering column directly in a vise could result in a damaged column.

1. Intermediate shaft assembly (270), with the universal joint (pot joint), from the steering column shaft.
2. Bearing retainer clip (245) and reinforcement (246).
3. Bearing (251) and adapter (250).
4. Bearing housing assembly and steering shaft assembly. Refer to "Tilt Steering Column Bearing Housing Replacement" in this section.

- If the shift tube index plate must be removed, remove the two retaining screws and plate. (Column Shift Models).

5. Shift tube retaining ring (237) and washer (238).
6. Neutral-safety or back-up lamp switch screws and switch. Refer to SEC. 8B (CHASSIS ELECTRICAL) in this manual.
7. Shift tube (249) assembly. Use J-23072. Do not hammer or pull on the shift tube during removal (figure 29).
   - Insert the hooked end of the tool into the notch in the shift tube just below the shift lever housing key. Pilot the sleeve over the threaded end of the tool and into the upper end of the shift tube. Force the shift tube out of the housing by turning the nut onto the tool. If the shift tube is not completely free when the nut is bottomed on the threads, complete the removal by hand.
   - On column shift models, guide the lower shift lever through the slotted opening in the column to prevent damage to the tube or column.
8. Lock plate (239) and washer (240). Tip the lock plate downward towards the housing, then remove.
9. Shift lever housing.

- Remove the shift lever spring by winding the spring up with pliers (Column Shift Models).

10. Dash panel seal from the column jacket.

Assemble (Figures 44 and 45)

Tools Required:
J-23073-01 Shift Tube Installer

- Apply a thin coat of lithium grease to all friction surfaces.

1. Dash panes seal.

- Press a new shift lever spring into the shift lever housing (Column Shift Models).

2. Shift lever housing. Slide the housing over the upper end of the column.
3. Washer (240) and lock plate (239).
   - Apply lithium grease to the lock plate and the upper end of the shift tube.
4. Shift tube (249) and seal (248) into the lower end of the column. Do not hammer or force the shift tube.
   - Align the keyway in the shift tube with the key in the shift lever housing and install the shift tube using J-23073-01 (figure 38).
   - The shift lever housing key must bottom in the shift tube slot.
5. Neutral-safety or back-up lamp switch and screws. Refer to SEC. 8B (CHASSIS ELECTRICAL) in this manual.
6. Washer (238) and retaining ring (237). Pull up on the shift lever housing when installing the washer and retaining ring.
   - Seat the retaining ring in both slots in the shift tube.
7. Steering shaft assembly and bearing housing assembly. Refer to "Tilt Steering Column Bearing Housing Replacement" in this section.

Install or Connect

- Steering column assembly. Refer to "Tilt Steering Column Replacement" in this section.

STEERING COLUMN ON-VEHICLE SERVICE P(42) MODELS

STANDARD STEERING COLUMN REPLACEMENT

Remove or Disconnect (Figure 40)

1. Battery ground cable.
2. Transmission control linkage from the column shift tube levers (Column Shift Models).
3. Upper universal joint pinch bolt from the intermediate shaft. Mark the relationship of the universal yoke to the steering shaft.
4. Nut (282), bolt (280) and clamp (281). Slide the clamp down the column.
5. Screws (277) from the cover (278) and seal (279). Slide the cover and seal up the column.
6. Steering wheel. Refer to "Steering Wheel Replacement" in this section.
7. Turn signal wiring harness.
   - On an automatic transmission, disconnect the conductor tube at the instrument panel.
8. Bolts (275) and clamp (276) from the column support bracket.
9. Bolt, nut and outer brace (283) from the column support bracket (P200 + 300 (42) models).
10. Steering column assembly.
    - Lower and then withdraw the column assembly. Rotate the column so the shift lever clears the dash and toe panel assembly.

Install or Connect (Figure 49)

NOTICE: For steps 2, 3, 4 and 9 see "Notice" on page 3B4#1.

1. Adjust the lower bearing preload. Refer to "Steering Column Lower Bearing Adjustment" in this section.
2. Lower end of the steering column through the toe panel opening.

- Guide the steering shaft into the universal yoke, lining up the marks made at removal.
- Upper universal pinch bolt. The pinch bolt must pass through the shaft undercut.

Tighten

- Pinch bolt to "Specifications" at the end of this section.
- Align the seal (279) and cover (278) with the floor and dash panel assembly.
- Align the column support bracket protrusion with the index slot in the steering column.

3. Clamp (281), bolt (280) and nut (282). Position the clamp as shown in figure 49.

Tighten

- Nut to 15 N·m (11 ft. lbs.).

4. Clamp (276) and bolt (275).

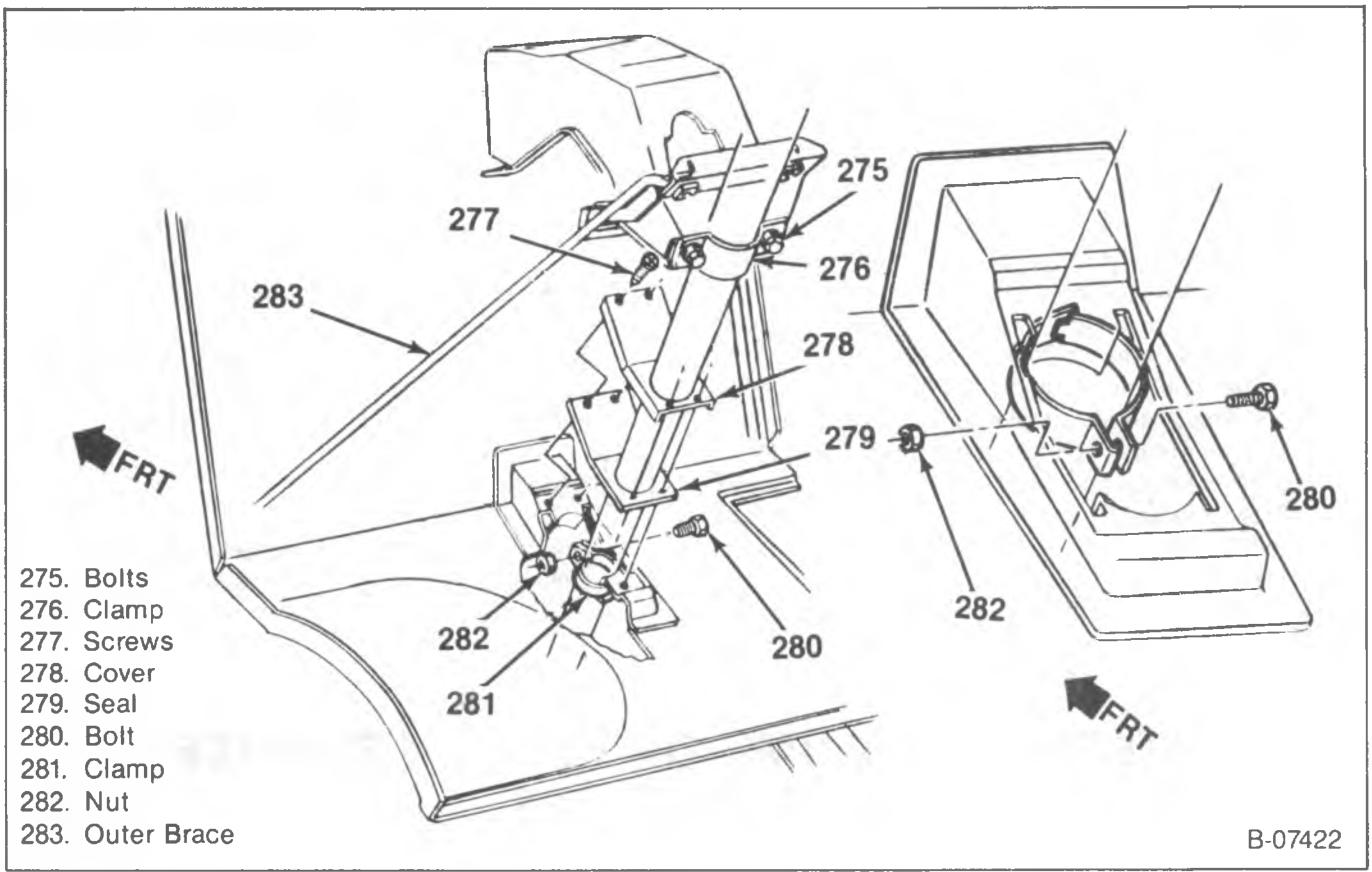


Figure 49—Steering Column Installation P(42) Model

Tighten

- Bolt to 25 N·m (18 ft. lbs.).

5. Seal (279), cover (278) and screws (277) to the dash panel assembly.
6. Outer brace (283), bolt and nut to the column support bracket (P200 + 300 (42) models).

Tighten

- Bolt to 25 N·m (18 ft. lbs.).

7. Transmission control linkage to the shift tube levers (Column Shift Models).
8. Turn signal wiring harness.
   - On a standard column with automatic transmission connect the conductor tube at the instrument panel.
9. Steering wheel. Refer to "Steering Wheel Replacement."
10. Battery ground cable.

UPPER BEARING REPLACEMENT

Remove or Disconnect (Figure 50)

1. Steering wheel. Refer to "Steering Wheel Replacement" in this section.
2. Cancelling cam (286).
3. Upper bearing (289).

Install or Connect (Figure 50).

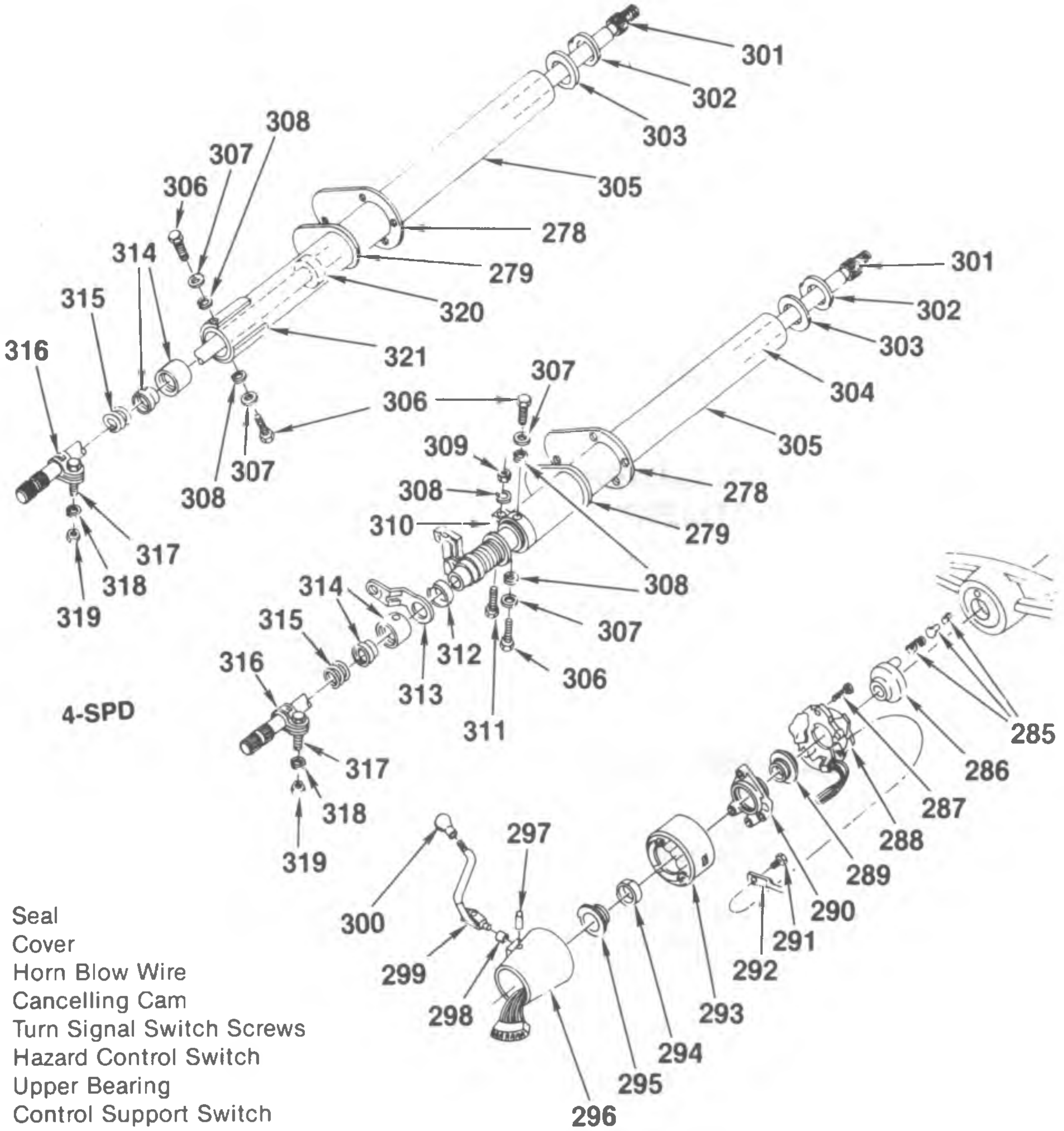
NOTICE: For step 3 see "Notice" on page 3B4#1.

1. New upper bearing (289).
2. Cancelling cam (286).
3. Steering wheel. Refer to "Steering Wheel Replacement" in this section.

LOWER BEARING REPLACEMENT

Remove or Disconnect (Figure 50)

1. Intermediate steering shaft. Refer to "Intermediate Shaft Replacement" in this section.
2. Nut (319), washer (318), bolt (317) and clamp (316).
3. Bearing assembly (315, 314).



278. Seal
279. Cover
285. Horn Blow Wire
286. Cancelling Cam
287. Turn Signal Switch Screws
288. Hazard Control Switch
289. Upper Bearing
290. Control Support Switch
291. Screw
292. Control Lever
293. Housing
294. Washer
295. Washer
296. Shift Lever Housing
297. Pivot Pin
298. Sleeve
299. Shift Lever
300. Knob
301. Shaft
302. Bushing
303. Seat
304. Shift Tube
305. Jacket
306. Bolts
307. Washer
308. Washer
309. Nut
310. Clamp
311. Bolt
312. Spacer
313. Lever
314. Adjusting Pin And Bearing Assembly
315. Spring
316. Clamp
317. Bolt
318. Washer
319. Nut
320. Seal
321. Cover

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Figure 50—Standard Steering Column P(42) Model

Install or Connect (Figures 50 and 51)

NOTICE: For steps 2 and 3 see "Notice" on page 3B4#1.

1. New adjusting ring and bearing assembly (314, 315).
2. Clamp (316), bolt (317), washer (318) and nut (319). Maintain the clearance dimension shown in figure 51.

Tighten

- Nut to 14 N·m (10 ft. lbs.).

3. Intermediate shaft. Refer to "Intermediate Shaft Replacement" in this section.

STEERING COLUMN LOWER BEARING ADJUSTMENT

1. Loosen clamp bolt (317).
2. Apply 222 N (50 lbs.) force to the steering wheel end of the steering shaft.
3. Adjust the clamp to obtain a clearance of 32 ± 0.5 mm (1.26 ± 0.02 inch) (figure 51).

SHIFT TUBE ADJUSTMENT

3-SPEED MANUAL TRANSMISSION

1. Loosen the adjusting ring bolts (306).
2. Loosen the clamp bolt (317).
3. Rotate the adjusting ring to give a 0.13 mm (0.005 inch) end play between the adjusting ring and first and reverse lever (figure 52).

Tighten

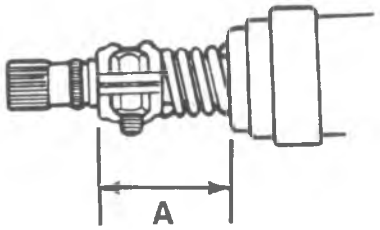
- Adjusting ring bolt (306) to 8 N·m (70 in. lbs.).
- Clamp bolt (317) to 14 N·m (10 ft. lbs.).

AUTOMATIC TRANSMISSION

1. Place the shift tube lever in "Neutral" or "Drive."
2. Loosen the adjusting ring bolt (306).
3. Rotate the shift tube adjusting ring to obtain a 8.4 to 9.1 mm (0.33 to 0.36 inch) clearance between the shift tube lever and adjusting ring (figure 53).

Tighten

- Adjusting ring bolt to 8 N·m (70 in. lbs.).



A. 32 ± 0.5 mm (1.26 ± 0.02 inch)

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Figure 51—Lower Bearing Adjustment

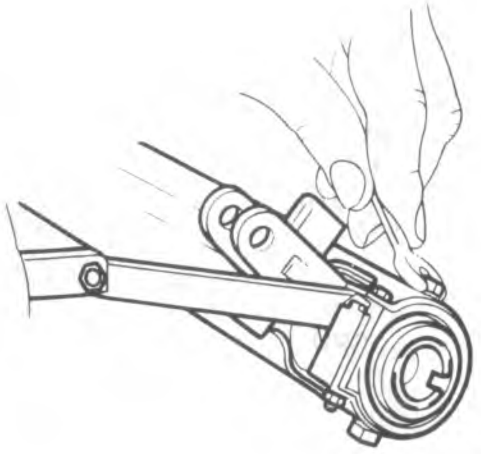

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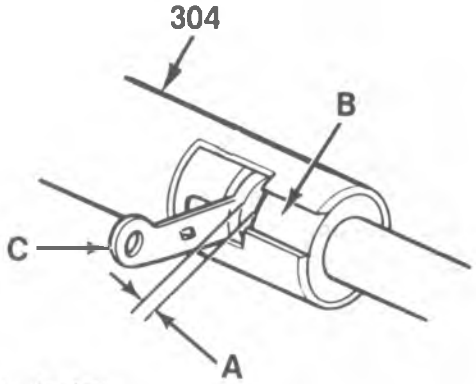
Figure 52—Shift Tube Adjustment—3-Speed Manual Transmission



304. Jacket
A. 8.4 to 9.1 mm (0.33 to 0.36 inch)
B. Adjusting Ring
C. Shift Lever

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Figure 53—Shift Tube Adjustment—Automatic Transmission

STANDARD STEERING COLUMN UNIT REPAIR P(42) MODELS

Remove or Disconnect

- Steering column assembly. Refer to "Standard Steering Column Replacement" (P42 Model) in this section.

Disassemble (Figure 50)

- Slide the steering shaft assembly from the lower end of the steering column.

1. Lower bearing bolt (317), washer (318), nut (319), clamp (316) and spring (315).
2. Back-up lamp switch.
3. Pivot pin (297) and shift lever (299).
4. Cancelling cam (286).
5. Conrol lever screw (291) and lever (292).
6. Column wiring harness cover.
7. Turn signal switch screws (287).
8. Housing (293). Rotate the housing counterclockwise.
   - The housing and switch cannot be completely removed from the column until the shift lever housing is removed.
9. Washer assembly (294, 295) and shift lever housing (296) (or extension housing) from the column.
   - Separate the turn signal switch, switch control support assembly, turn signal housing and shift lever housing (or housing extension) assemblies.
10. Upper bearing (289). Press the bearing out of the switch contact support (290).
11. Bushing (302) and seat (303).
12. Bolts (306), washers (307, 308) and adjusting ring clamp (310).
13. Adjusting ring and bearing (314) assembly.
    - Press the bearing out of the adjusing ring.
14. First-reverse shift lever and spacer (3-Speed Column).
15. Selector plate clamping screws (Automatic Columns).
    - Place the column upright on the floor, supporting it with two pieces of wood. Place a block of wood on the upper end of the shift tube. Press down on the shift lever with foot while tapping on the wood block to withdraw the tube from the column jacket.

NOTICE: In some tolerance stack-up cases it may be necessary to use a press. Be careful not to damage the tube or jacket.

16. Seal (320) and cover (321).
17. Cover (279), seal (278) and clamp from steering column jacket (305).

Assemble (Figure 50)

- Apply a thin coat of lithium grease to all friction surfaces.

1. Clamp, seal (278) and cover (279) over the end of the jacket (305).
   - Apply lithium grease to all bearing surfaces on the shift tube.
2. Seal (320) onto the shift tube and place the shift tube in the jacket.
   - Temporarily install the spacer, first-reverse shift lever and lower adjusting ring. Place a block of wood on top of the adjusting ring and tap until the shift tube bottoms. Remove the adjusting ring, shift lever and spacer (3-Speed Columns).
   - Align the three holes in the selector plate with the three holes in the jacket. Position the clamping ring and install the three screws. The shift tube spring retainer must bottom against the jacket stops (Automatic Columns).
   - Lubricate and install the spacer and first-reverse shift lever. The tang of the lever is toward the top of the column (3-Speed Column).
3. Bearing in the adjusting ring (314).
4. Adjusting ring and bearing (314) assembly, clamp (310), washers (308, 307) and bolts (306).
5. Seat (303) and bushing (302) to the upper end of the housing.
   - Thread the turn signal switch wiring harness through the switch and lever (or extension) housing.
   - Lubricate the inner diameter of the shift housing.
6. Shift lever (or extension) housing onto the upper end of the column.
7. Washer assembly (295, 294).
8. Upper bearing into the switch contact support.
9. Turn signal switch housing (293), contact support, bearing, switch and switch screws. Tighten screws to 2.8 N·m (25 in. lbs.).
10. Wiring harness cover and back-up lamp switch.
11. Control lever (292) and the gear shift lever (299).

Adjust

- Shift tube. Refer to "Shift Tube Adjustment" in this section.

12. Spring (315), clamp (316), bolt (317), washer (318) and nut (319). Tighten the bolt finger tight.
    - Slide the steering shaft assembly up through the column assembly.

Install or Connect

- Steering column assembly. Refer to "Standard Steering Column Replacement" in this section.

INTERMEDIATE SHAFT UNIT REPAIR P(42) MODELS

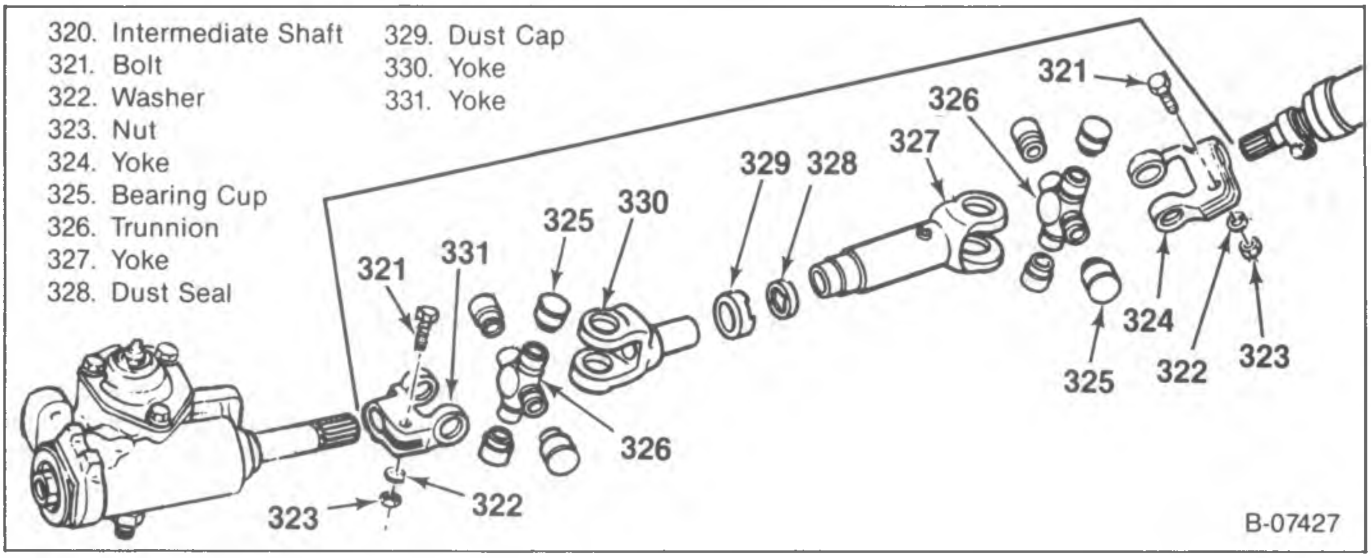


Figure 54—Intermediate Shaft P(42) Model

Remove or Disconnect

- Intermediate shaft. Refer to "Intermediate Shaft Replacement" in this section.

Disassembly (Figure 54)

- If the upper and lower half of the intermediate shaft is to be replaced, preceed as follows:
- Place the intermediate shaft (320) on a bench and straighten the tangs on the dust cap (329). Separate the upper and lower portions of the shaft assembly.

1. Dust cap (329) and dust seal (328).

- If the trunnion assembles are to be replaced, proceed as follows:

2. Bearing cups (325).
    - Support the yoke on a bench vise and drive out one bearing cup by tapping on the opposite bearing cup. Use a soft drift and hammer.
    - Support the other side of the yoke and drive out the remaining bearing cups, as described in the previous step.
3. Trunnion (326) from the yokes (324, 327).
4. Trunnion (326) from the yokes, (331, 330).

Assemble (Figure 54)

- If the yoke trunnions were removed, assemble as follows:

1. Trunnion (326) into the yokes (331, 330).
2. Trunnion (326) into the yokes (327, 321).
3. Bearing cups (325) into the yokes.

- Reassemble the intermediate shaft assembly as follows:

4. Dust cap (329) and dust seal (328) over the shaft of the lower yoke (330) assembly.

- Align the arrow on the lower yoke assembly shaft with the arrow on the upper yoke assembly tube and push the two assemblies together.
- Push the dust seal (328) and dust cap (329) into position on the lower end of the upper yoke assembly and bend the tangs of the dust cap down against the yoke tube.

Install or Connect

- Intermediate shaft. Refer to "Intermediate Shaft Replacement" in this section.

SPECIFICATIONS

	N·m	Ft. Lbs.	In. Lbs.
Turn Signal Switch Attaching Screws	4.0		35
Ignition Switch Attaching Screws	4.0		35
Dimmer Switch Attaching Screws	4.0		35
Steering Wheel Nut	40	30	
Flexible Coupling Clamp Bolt	42	31	
Flexible Coupling To Flange Bolt Nuts	27	20	
Steering Gear To Frame Bolts (C, K And G Models)	102	75	
Steering Gear To Frame Bolts P300 (32, 42) FS3	108	80	
Steering Gear To Frame Bolts P200 & 300(42) Excluding FS3	95	70	
Upper Intermediate Shaft Pinch Bolt (G Model)	47	35	
Lower Intermediate Shaft Pinch Bolt (G Model)	62	46	
Intermediate Shaft Pinch Bolt P300 (42) FS3	108	80	
Intermediate Shaft Pinch Bolt P200 & 300(42) Excluding FS3	102	75	
Steering Column Support Bracket Screws (C, K And G Models)	30	22	
Steering Column Support Bracket Clamp Nuts (P Models)	25	18	
Steering Column Shaft To Intermediate Shaft (Pot Joint) Assembly	60	44	

SPECIAL TOOLS

J-23980-B	Steering Column Electrical Component Analyzer
J-1859-03	Steering Wheel Puller
J-23653-A	Lock Plate Compressor
J-21854-01	Pivot Pin Remover
J-23072	Shift Tube Remover
J-22599	Locknut Wrench
J-5822	Steering Gear Shaft Main Bearing Cup Remover
J-2619-01	Slide Hammer
J-22635	Lock Shoe & Release Lever Pin Remover And Installer
J-22727	Electrical Terminal Remover
J-23072	Shift Tube Remover
J-23073-01	Shift Tube Installer
J-23074	Steering Column Holding Fixture
J-22708	Turn Signal Cover Remover

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 "NOTICE: Refer to 'Notice' on page 3C-1 of this section."

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

CONTENTS

SUBJECT **PAGE**

GENERAL DESCRIPTION

An independent suspension is standard on the C-G-P series vehicles. This suspension features unequal length control arms (the lower control arm is the load carrying member), coil springs and shock absorbers to reduce vibration and shock load, plus a stabilizer bar to control sway or roll. Air cylinders inside coil springs are available to minimize "crash through" on large road bumps. A special heavy duty front suspension is available on P series vehicles. This suspension (RPO FS3), centered around a solid I-beam axle, includes leaf springs, shock absorbers, and a stabilizer bar.

The K series (four wheel drive) suspension includes leaf springs, shock absorbers, and a stabilizer bar.

DIAGNOSIS OF FRONT SUSPENSION

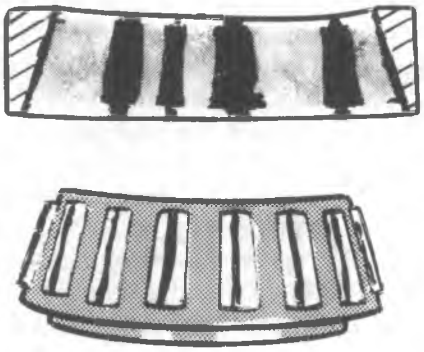
PROBLEM	POSSIBLE CAUSE	CORRECTION
Hard Steering	1. Ball joints and steering linkage need lubrication. 2. Low or uneven front tire pressure. 3. Incorrect front wheel alignment (manual steering).	1. Lubricate the ball joints and linkage. 2. Inflate tires to the recommended pressure. 3. Check and align the front suspension.
Poor Directional Stability	1. Ball joints and steering linkage need lubrication. 2. Low or uneven front or rear tire pressure. 3. Loose wheel bearings. 4. Incorrect front wheel alignment (caster). 5. Broken springs. 6. Malfunctioning shock absorber. 7. Broken stabilizer bar or a missing link.	1. Lubricate the ball joints and linkage. 2. Inflate tires to the recommended pressure. 3. Adjust the wheel bearings. 4. Check and align the front suspension. 5. Replace the springs. 6. Check and replace the shock absorber. 7. Replace the stabilizer bar or link.
Front Wheel Shimmy (Smooth Road Shake)	1. Tire and wheel are out of balance or out of round. 2. Worn or loose wheel bearings. 3. Worn ball joints. 4. Malfunctioning shock absorber.	1. Balance the tires, check run-out. 2. Adjust the wheel bearings. 3. Replace the ball joints. 4. Check and replace the shock absorber.
Vehicle Pulls To One Side (No Braking Action)	1. Low or uneven tire pressure. 2. Front or rear brakes dragging. 3. Broken or sagging front spring. 4. Incorrect front wheel alignment (camber).	1. Inflate the tires to the recommended pressure. 2. Adjust the brakes. 3. Replace the spring. 4. Check and align the front suspension.

DIAGNOSIS OF FRONT SUSPENSION (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Noise In The Front End	1. Ball joints and steering linkage need lubrication. 2. Loose shock absorber or worn bushings. 3. Worn control arm bushings. 4. Worn or loose wheel bearings. 5. Loose stabilizer bar. 6. Loose wheel nuts. 7. Spring is improperly positioned. 8. Loose suspension bolts.	1. Lubricate at the recommended intervals. 2. Tighten the bolts or replace the shock absorber. 3. Replace the bushings. 4. Adjust or replace the wheel bearings. 5. Tighten all the stabilizer bar attachments. 6. Tighten the wheel nuts. 7. Reposition the spring. 8. Tighten to specifications or replace.
Wheel Tramp	1. Tire and the wheel are out of balance. 2. Tire and the wheel are out of round. 3. Blister or bump on the tire. 4. Improper shock absorber action.	1. Balance the wheels. 2. Replace the tire. 3. Replace the tire. 4. Replace the shock absorber.
Excessive or Uneven Tire Wear	1. Underinflated or overinflated tires. 2. Improper toe-in. 3. Wheels are out of balance. 4. Hard driving. 5. Overloading the vehicle.	1. Inflate the tire to the recommended pressure. 2. Adjust toe-in setting. 3. Balance the wheels. 4. Follow proper driving techniques. 5. Do not exceed the maximum recommended payload rating.
Scuffed Tires	1. Toe-in is incorrect. 2. Excessive speed on turns. 3. Tires are improperly inflated. 4. Suspension arm is bent or twisted.	1. Adjust toe-in setting. 2. Follow proper driving techniques. 3. Inflate the tires to the recommended pressure. 4. Replace the suspension arm.
Cupped Tires	1. Front shock absorbers are defective. 2. Worn ball joints. 3. Wheel bearings are incorrectly adjusted or worn. 4. Wheel and tire is out of balance. 5. Excessive tire or wheel runout.	1. Replace the shock absorbers. 2. Replace the ball joints. 3. Adjust or replace the wheel bearings (also replace the races). 4. Balance the wheel and tire. 5. Check and compensate for runout.

DIAGNOSIS OF WHEEL BEARINGS

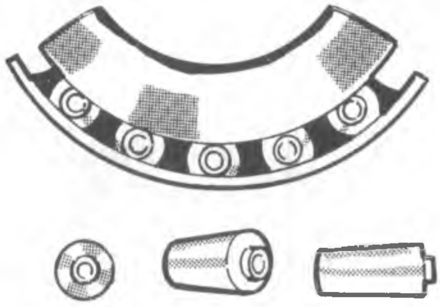
When diagnosing bearing condition, keep in mind the general condition of all parts during disassembly and inspection. Use Figures 1, 2, 3 and 4 to classify the failure, and follow the recommended repair procedures.



ABRASIVE ROLLER WEAR

Pattern on races and rollers caused by fine abrasives.

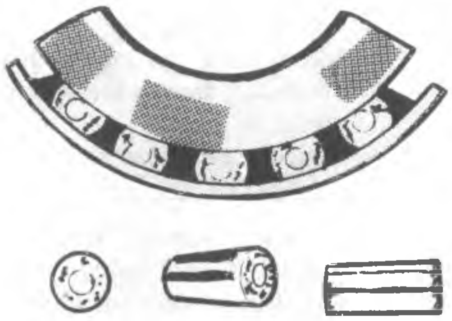
Clean all parts and housings, check seals and bearings and replace if leaking, rough or noisy.



ABRASIVE STEP WEAR

Pattern on roller ends caused by fine abrasives.

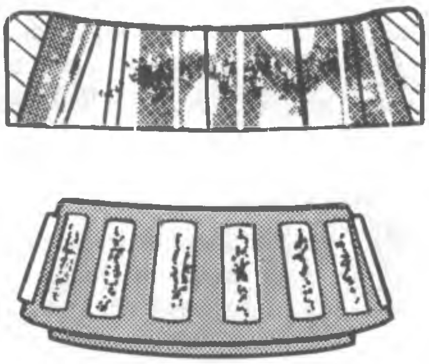
Clean all parts and housings, check seals and bearings and replace if leaking, rough or noisy.



GALLING

Metal smears on roller ends due to overheat, lubricant failure or overload.

Replace bearing, check seals and check for proper lubrication.



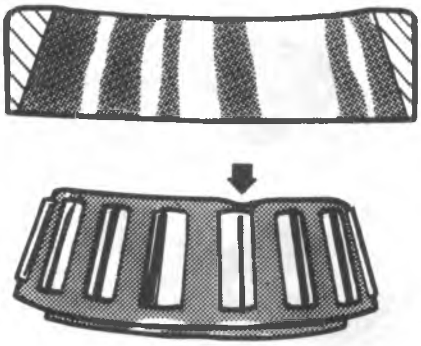
ETCHING

Bearing surfaces appear gray or grayish black in color with related etching away of material usually at roller spacing.

Replace bearings, check seals and check for proper lubrication.

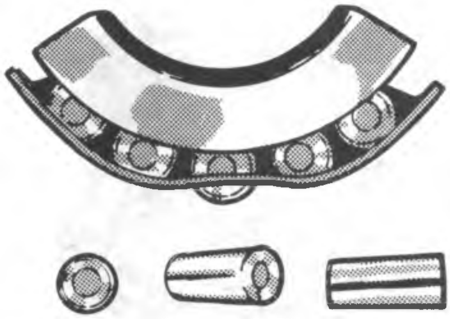
B-09194

Figure 1—Diagnosis Of Front Wheel Bearings



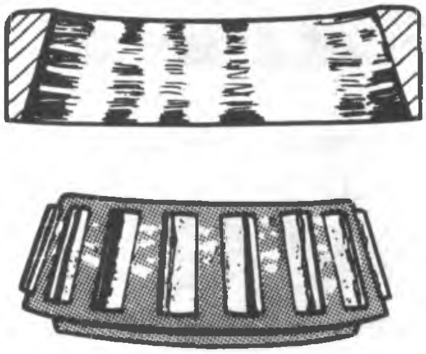
BENT CAGE

Cage damaged due to improper handling or tool usage.
Replace bearing.



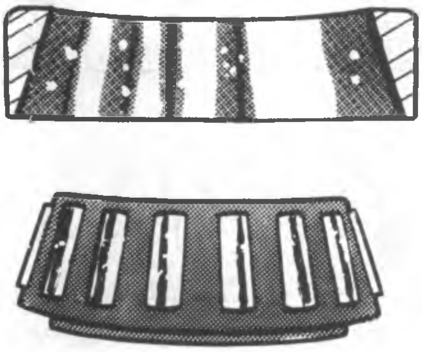
BENT CAGE

Cage damaged due to improper handling or tool usage.
Replace bearing.



CAGE WEAR

Wear around outside diameter of cage and roller pockets caused by abrasive material and inefficient lubrication.
Clean related parts and housings.
Check seals and replace bearings.

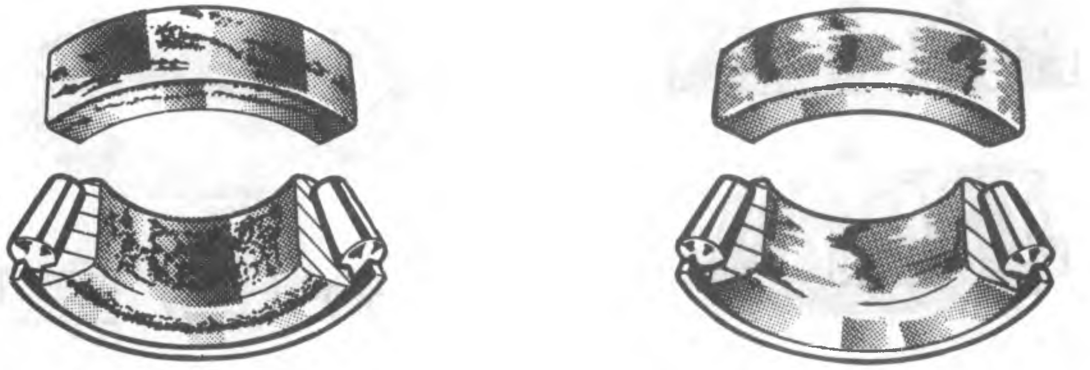


INDENTATIONS

Surface depressions on race and rollers caused by hard particles of foreign material.
Clean all parts and housings. Check seals and replace bearings if rough or noisy.

B-09195

Figure 2—Diagnosis Of Front Wheel Bearings



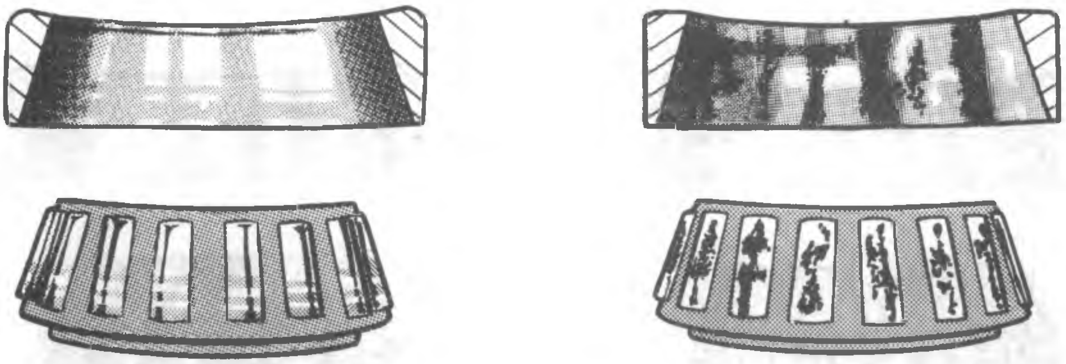
FRETTAGE

Corrosion set up by small relative movement of parts with no lubrication.

Replace bearing. Clean related parts. Check seals and check for proper lubrication.

SMEARS

Smearing of metal due to slippage. Slippage can be caused by poor fits, lubrication, overheating, overloads or handling damage. Replace bearings, clean related parts and check for proper fit and lubrication.



STAIN DISCOLORATION

Discoloration can range from light brown to black caused by incorrect lubricant or moisture.

Re-use bearings if stains can be removed by light polishing or if no evidence of overheating is observed.

Check seals and related parts for damage.

HEAT DISCOLORATION

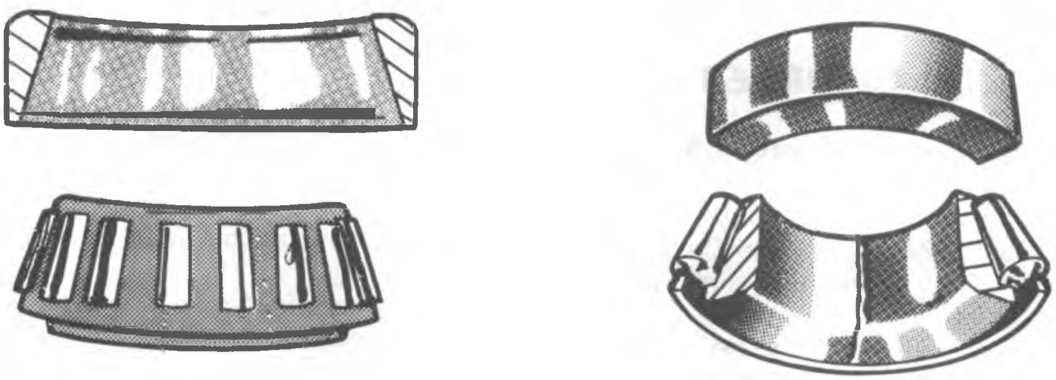
Heat discoloration can range from faint yellow to dark blue resulting from overload or incorrect lubricant.

Excessive heat can cause softening of races or rollers. To check for loss of temper on races or rollers a simple file test may be made. A file drawn over a tempered part will grab and cut metal, whereas, a file drawn over a hard part will glide readily with no metal cutting.

Replace bearings if over heating damage is indicated. Check seals and other parts.

F-00531

Figure 3—Diagnosis Of Front Wheel Bearings



MISALIGNMENT

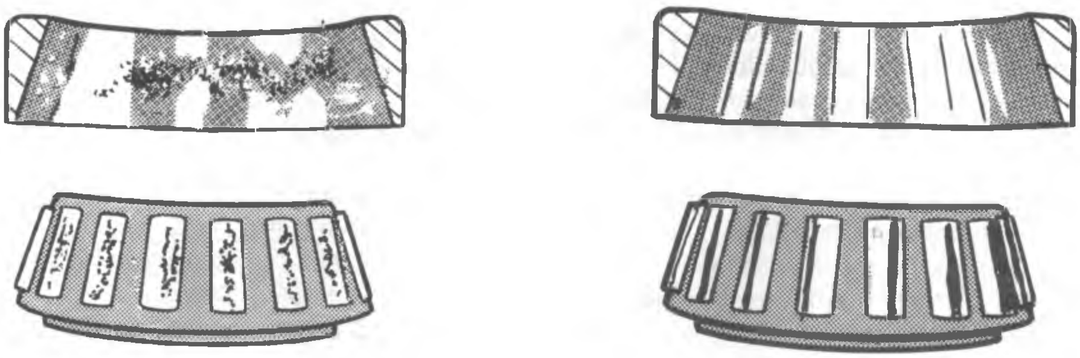
Outer race misalignment due to foreign object.

Clean related parts and replace bearing. Make sure races are properly seated.

CRACKED INNER RACE

Race cracked due to improper fit, cocking, or poor bearing seats.

Replace bearing and correct bearing seats.



FATIGUE SPALLING

Flaking of surface metal resulting from fatigue.

Replace bearing, clean all related parts.

BRINELLING

Surface indentations in raceway caused by rollers either under impact loading or vibration while the bearing is not rotating.

Replace bearing if rough or noisy.

B-09860

Figure 4—Diagnosis Of Front Wheel Bearings

ON-VEHICLE SERVICE: TWO WHEEL DRIVE INDEPENDENT FRONT SUSPENSION

SHOCK ABSORBER

Remove or Disconnect (Figures 5, 6, 7, 8, and 9)

- Raise the vehicle on a hoist.

1. Shock absorber (20) from the lower control arm.
    - Nuts (23), washers (22) and bolts (21) (Figure 9).
2. Shock absorber (20) from the frame.
    - Nuts (16), washers (17), and bolts (21) (Figure 9).

BENCH TEST: SPIRAL GROOVE SHOCK ABSORBERS

1. Purge the air from the pressure chamber.
    - Extend the shock vertically—top end up.
    - Turn the shock over and collapse it vertically—top end down.
    - Repeat the above step five times.
2. Place the shock absorber in a vise with the jaws clamped onto the shock's bottom mount.
    - — Shock absorber should be positioned vertically in the vise—top end up.
    - — Do not clamp the vise jaws on the shock's reservoir tube.
3. Pump the shock absorber at various rates of speed and observe the rebound force.
    - — Rebound force is normally stronger than the compression force (approximately two to one).
    - — Rebound force should be smooth and constant for each stroke rate.
4. Compare with a good shock absorber.
5. If one of the following are observed, replace the shock absorber.
    - — A skip or lag at reversal near mid-stroke.
    - — A seize (except at the extreme ends of travel).
    - — A noise (grunt or squeal) after completing one full stroke in both directions.
    - — A clicking noise at fast reversal.

BENCH TEST: NON-SPIRAL GROOVE RESERVOIR SHOCK ABSORBERS

- Purging air from non-spiral groove shock absorbers is not necessary. The shock absorbers have a gas filled cell in their reservoirs (as opposed to the air filled cell in the spiral groove shock absorber reservoirs).

1. Place the shock absorber in a vise with the jaws clamped on the shock absorber's top mount.
    - — Shock absorber should be held vertically in the vise with its bottom end up.
    - — Do not clamp the vise jaws on the shock's reservoir tube.
2. Pump the shock absorber at various rates of speed and observe the rebound force.
    - — Rebound force is normally stronger than the compression force (approximately two to one).
    - — Rebound force should be smooth and constant for each stroke rate.
3. Compare with a good shock absorber.
4. If one of the following are observed, replace the shock absorber.
    - — A skip or lag at reversal near mid-stroke.
    - — A seize (except at the extreme ends of travel).
    - — A noise (grunt or squeal) after completing one full stroke in both directions.
    - — A clicking noise at fast reversal.

Install or Connect (Figures 5 through 9)

NOTICE: Refer to "Notice" on page 3C#1 of this section.

1. Shock absorber (20) onto the vehicle.
    - Bolts (21), washers (17, 22), and nuts (16, 23) (figure 9).

    Tighten

    - C and P series upper mount nuts (16) to 190 N·m (140 ft. lbs.).
    - C and P series lower mount bolts (21) to 80 N·m (59 ft. lbs.).
    - G series upper and lower mount bolts (21) to 103 N·m (80 ft. lbs.).
2. Lower the vehicle.

STABILIZER BAR

Remove or Disconnect (Figures 5-8 and 10)

- Raise the vehicle and support with suitable safety stands. Remove the wheel and tire assembly.

1. Stabilizer bar (59) from the frame.
    - Bolts (54), nuts (58), washers (55, 57) and clamps (52).
2. Stabilizer bar (59) from the lower control arm (36).
    - Bolts (43), nuts (38), washers (39, 41) and clamps (42).
    - Stabilizer bar (59) drops down—remove the bushings (40, 53).

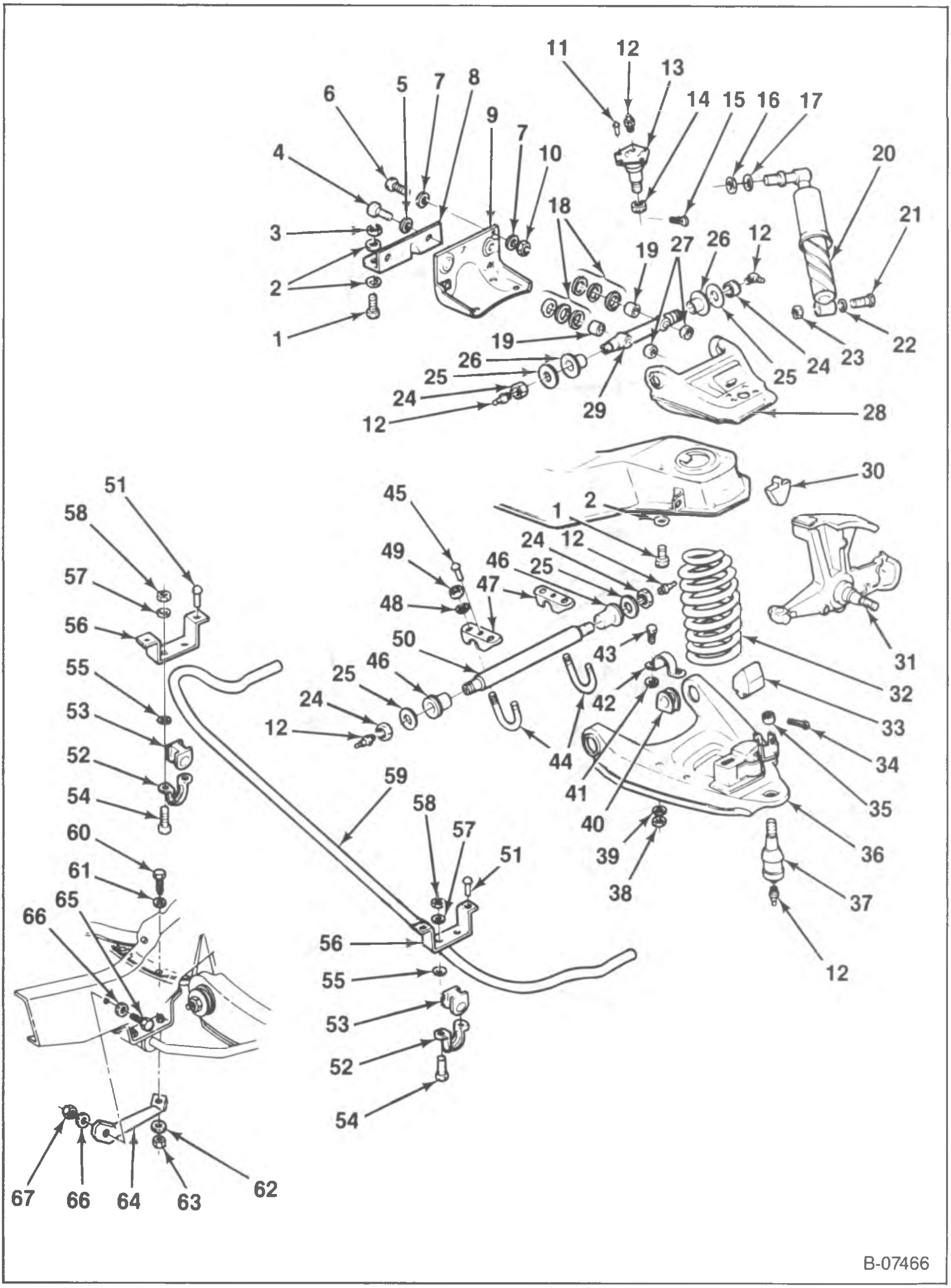


Figure 5—C Series Front Suspension

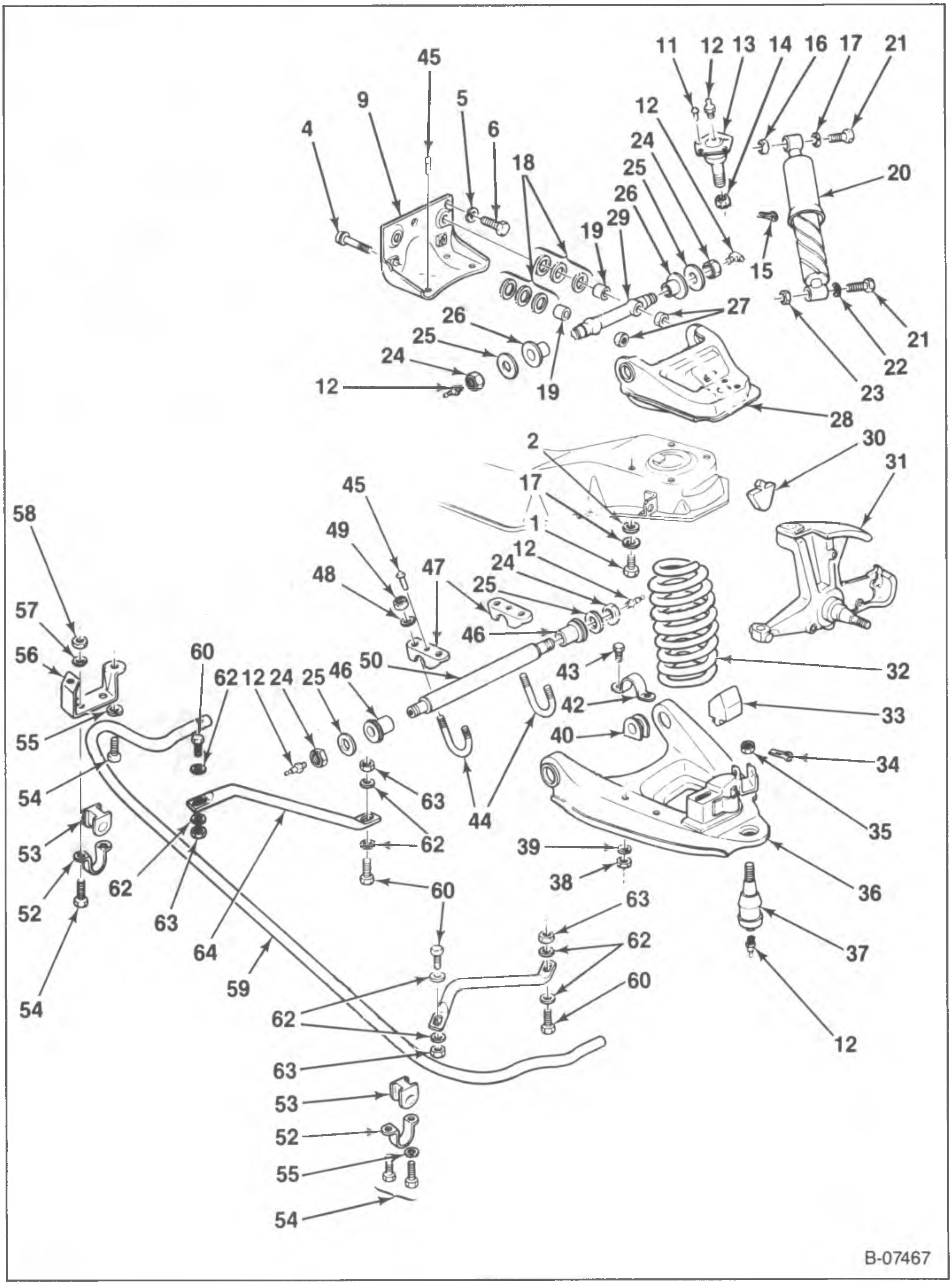


Figure 6—G Series Front Suspension

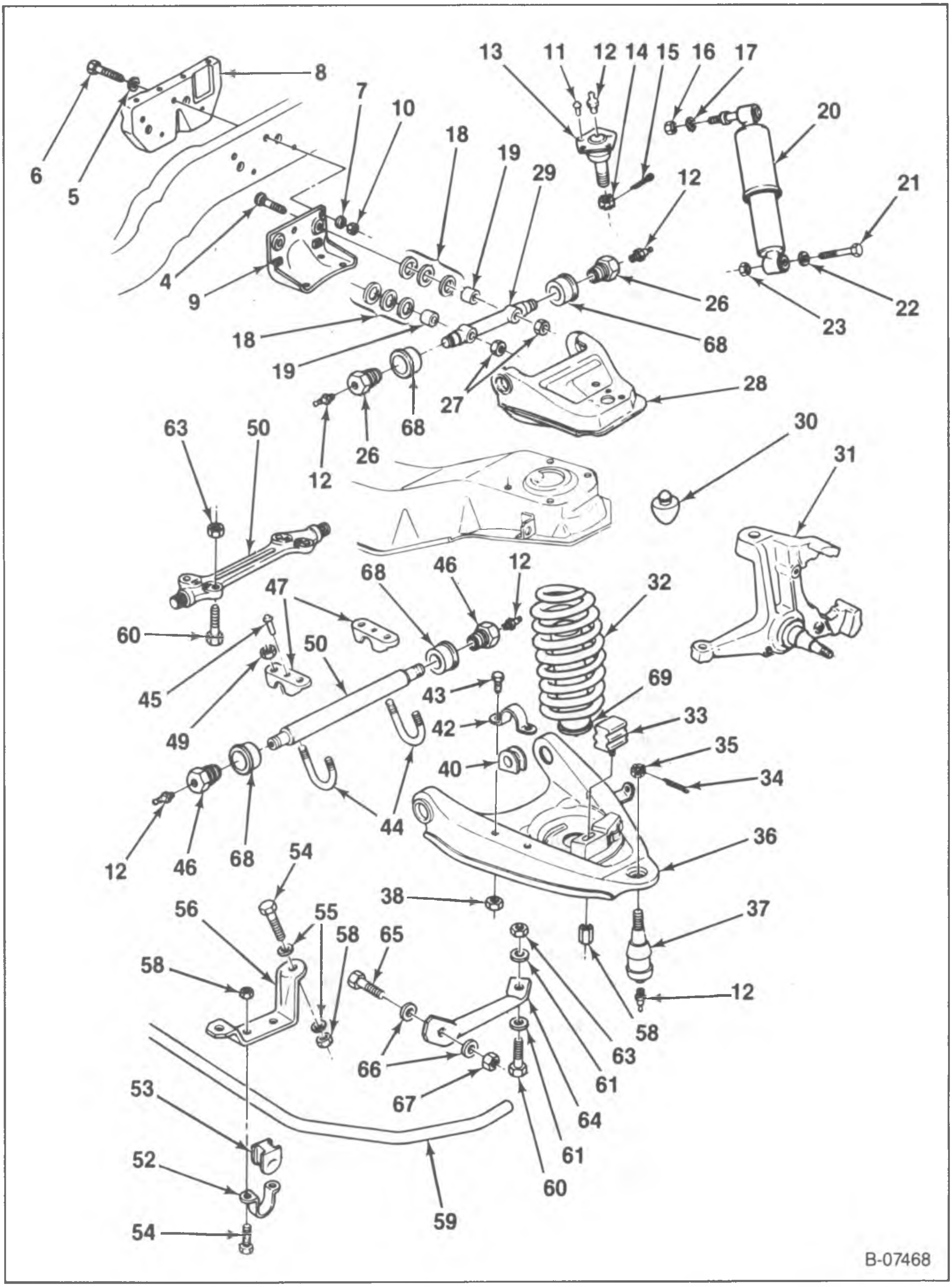


Figure 7—P Series Front Suspension

1. Bolt
2. Washer
3. Nut
4. Bolt
5. Washer
6. Bolt
7. Washer
8. Reinforcement
9. Bracket
10. Nut
11. Rivet
12. Fitting
13. Upper Ball Joint
14. Nut
15. Cotter Pin
16. Nut
17. Washer
18. Shim Pack
19. Spacer
20. Shock Absorber
21. Bolt
22. Washer
23. Nut
24. Nut
25. Retainer
26. Bushing
27. Nut
28. Upper Control Arm
29. Pivot Shaft
30. Bumper
31. Steering Knuckle
32. Coil Spring
33. Bumper
34. Cotter Pin
35. Nut
36. Lower Control Arm
37. Lower Ball Joint
38. Nut
39. Washer
40. Bushing
41. Washer
42. Bracket
43. Bolt
44. U-Bolt
45. Rivet
46. Bushing
47. Bracket
48. Washer
49. Nut
50. Pivot Shaft
51. Rivet
52. Bracket
53. Bushing
54. Bolt
55. Washer
56. Bracket
57. Washer
58. Nut
59. Stabilizer Bar
60. Bolt
61. Washer
62. Washer
63. Nut
64. Brace
65. Bolt
66. Washer
67. Nut
68. Seal
69. Air Cylinder

B-07469

Figure 8—C-G-P Series Front Suspension

Inspect

- Rubber bushings (40, 53) for excessive wear, aging, or other damage. Replace as necessary.

Install or Connect (Figures 5, 6, 7, 8 and 10)

1. Bushings (40, 53) to the stabilizer bar (59).
   - Slit on the insulator faces forward.
   - Use rubber lubricant to ease the installation.

NOTICE: Refer to "Notice" on page 3C#1 of this section.

2. Stabilizer bar (59) to the vehicle.
   - Position the stabilizer bar and attach the clamps (52), bolts (54), washers (55, 57) and nuts (58).
   - Clamps (42), bolts (43), washers (39, 41) and nuts (38).

Tighten

   - C and P series nuts (38, 58) to 33 N·m (24 ft. lbs.).
   - G series bolt (54) to 33 N·m (24 ft. lbs.).
   - G series nut (38) to 29 N·m (21 ft. lbs.).

3. Wheel and tire assembly. Lower the vehicle.

WHEEL HUB/ROTOR ASSEMBLY

Remove or Disconnect (Figures 5 through 8, and 11)

- Raise the vehicle and support it with suitable safety stands. Remove the wheel and tire assembly.

1. Caliper. Refer to BRAKES (SEC. 5).

NOTICE: Support the caliper with a piece of wire to prevent damage to the brake line.

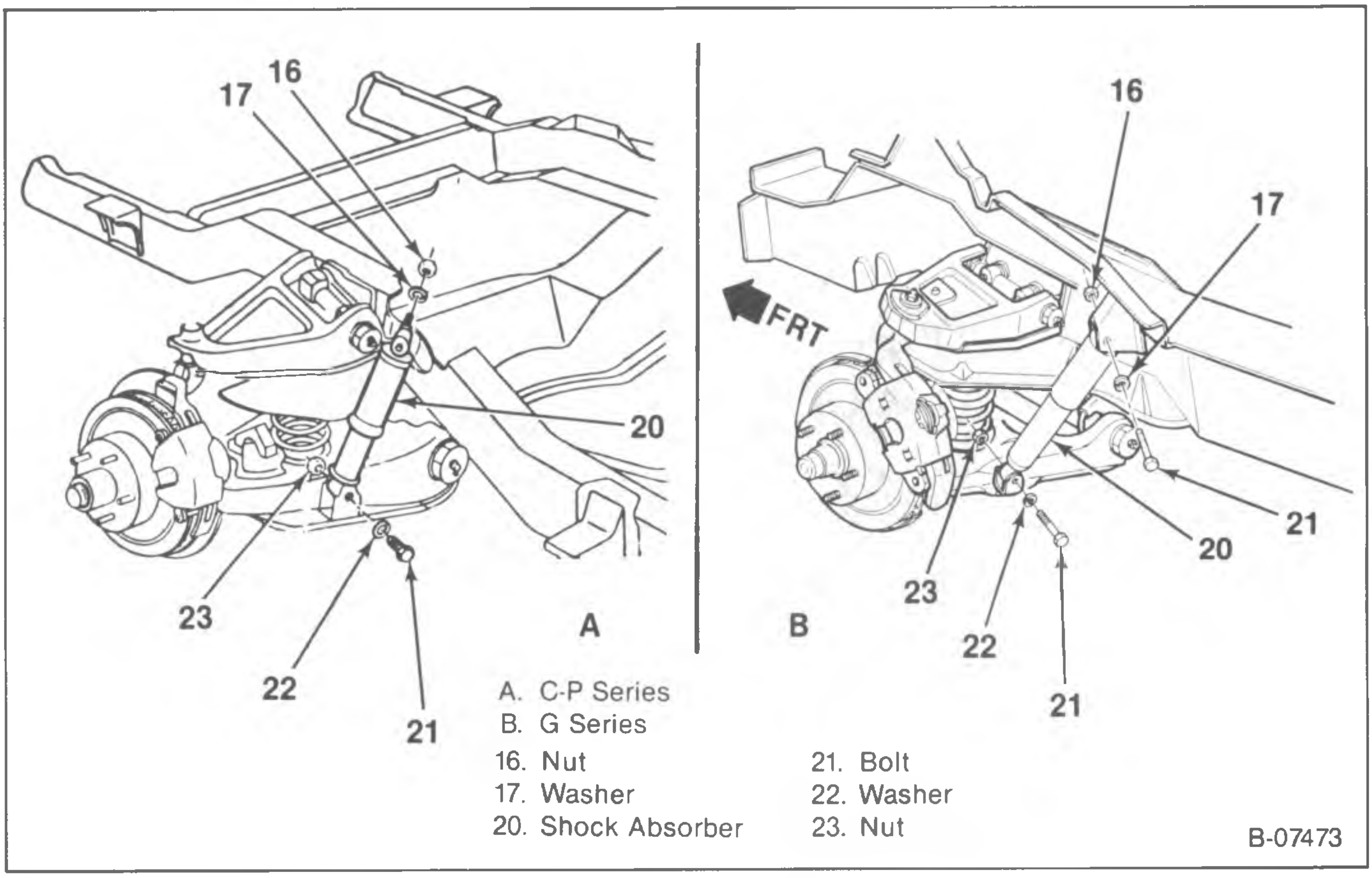
2. Wheel Hub/Rotor (81)
   - Dust cap (79).
   - Cotter pin (80), nut (78), and washer (77).
   - Pull the hub/rotor free, making sure the outer wheel bearing (76) comes free of the hub/rotor.
   - Do not damage the steering knuckle (70) spindle threads.
3. Inner wheel bearing (73).
   - Pry out the seal (72).
4. Races (75, 82).
   - Drive out each race using a brass drift inserted behind the race in notches in the hub.

Clean

1. Grease from the hub/rotor (81) and steering knuckle spindle.
   - Remove grease from inside the hub.
2. Grease from the wheel bearings (73, 76) and races (72, 75).
   - Use clean solvent and a small brush (no loose bristles).
   - Do not spin the wheel bearings with compressed air to dry them—the wheel bearings may be damaged.

Inspect

1. Wheel bearings (73, 76) and their races (72, 75) for damage or wear.
   - Refer to "Diagnosis of Wheel Bearings," in this section.



A. C-P Series
B. G Series
16. Nut
17. Washer
20. Shock Absorber
21. Bolt
22. Washer
23. Nut

Figure 9—Shock Absorber Attachments

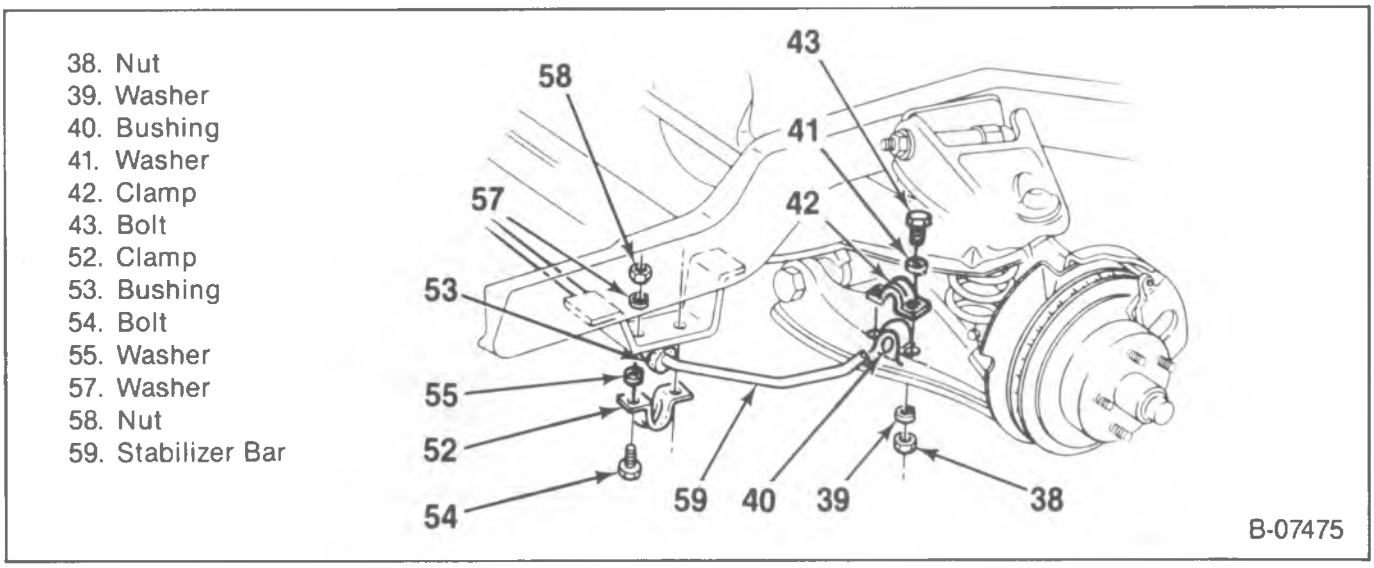
- If either a bearing or its race is damaged or worn, replace both.

2. Hub/rotor for damage.

   - Check for out-of-round or scored conditions.
   - Check for pitting or cracks.
   - Repair or replace as necessary.

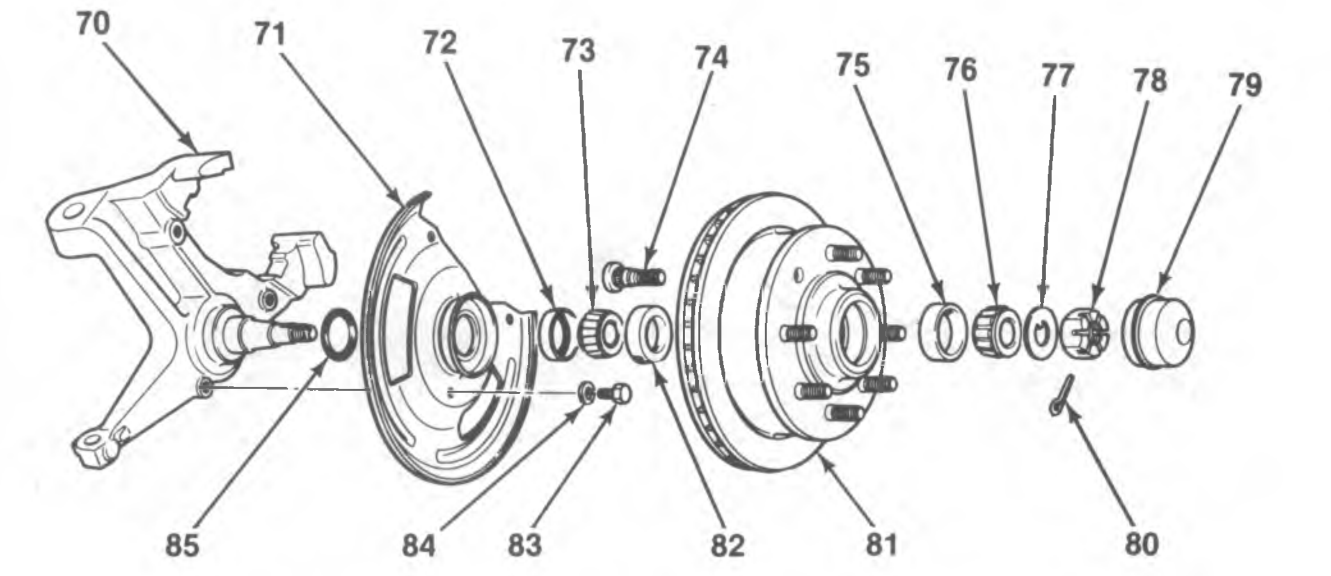
Install or Connect (Figures 5 through 8, 11 and 12)

Tools Required:
J-8092 Driver Handle
J-8457 Wheel Bearing Race Installer
J-8849 Wheel Bearing Race Installer
J-9746-02 Hub/Rotor Support



38. Nut
39. Washer
40. Bushing
41. Washer
42. Clamp
43. Bolt
52. Clamp
53. Bushing
54. Bolt
55. Washer
57. Washer
58. Nut
59. Stabilizer Bar

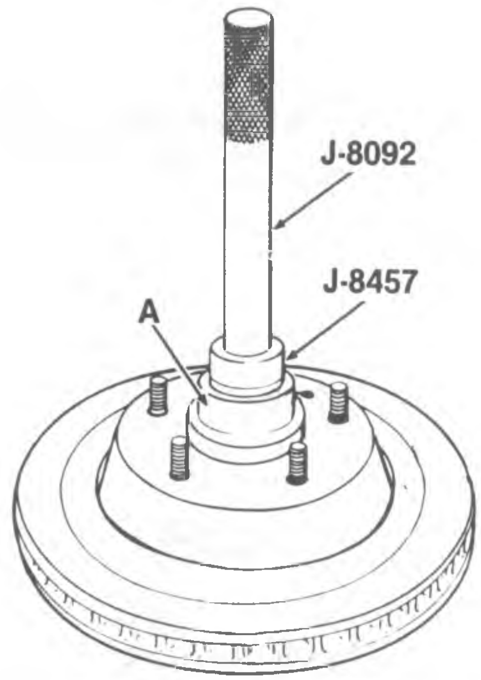
Figure 10—Stabilizer Bar Attachments



70. Steering Knuckle
71. Shield
72. Seal
73. Inner Wheel Bearing
74. Wheel Hub Bolt
75. Outer Race
76. Outer Wheel Bearing
77. Washer
78. Nut
79. Dust Cap
80. Cotter Pin
81. Wheel Hub/Rotor
82. Inner Race
83. Bolt
84. Washer
85. Gasket

B-07470

Figure 11—Steering Knuckle And Hub Assembly



A. Outer Wheel Bearing Race

B-06955

Figure 12—Installing The Outer Wheel Bearing Race

NOTICE: Start the races squarely inside the hub/rotor to avoid distortion and possible cracking.

1. Races (72, 75) into the hub/rotor (81).
   - Place the hub/rotor on J-9746-02 and rest this assembly on press bars.
   - Use J-8457 to drive the outer bearing outer race (75) into position (figure 12).
   - Turn over the hub/rotor, remove J-9746-02, and drive in the inner bearing outer race (82) with J-8449.

! Important

- Use an approved high-temperature front wheel bearing grease to lubricate the bearings. Refer to MAINTENANCE AND LUBRICATION (SEC. 0B).
- Do not mix different greases as mixing may change the grease's properties resulting in poor performance.

2. Apply a thin film of grease to the steering knuckle spindle at the outer wheel bearing seat and at the inner wheel bearing seat, shoulder, and seal seat.
3. Put a small quantity of grease inboard of each wheel bearing dust cap (79).

NOTICE: Failure to completely pack the wheel bearing (cones, rollers, and cage) with grease will result in premature wheel bearing damage and/or wear.

4. Fill each wheel bearing (cone and roller assembly) full of grease.
   - Use a cone-type grease machine that forces grease into the bearing.
   - If a cone-type grease machine is not available, pack the wheel bearing by hand.
   - When packing the wheel bearing by hand, work the grease into the bearings between the rollers, cones, and the cage.
5. Inner wheel bearing (73) into the hub/rotor (81).
   - Put an additional quantity of grease outboard of this bearing.
6. New seal (72).
   - Use a flat plate or block to install the seal to insure it is flush with the hub/rotor flange.
   - Lubricate the seal lip with a thin layer of grease.
7. Hub/rotor (81).
   - Do not damage the steering knuckle spindle threads.
8. Outer wheel bearing (76).
   - Slide it over the spindle until the wheel bearing (76) fully seats against the hub/rotor outer race (75).

NOTICE: Refer to "Notice" on page 3C#1 of this section.

9. Washer (77), nut (78), and cotter pin (80).
   - Do not place the cotter pin through the hole in the spindle until the wheel bearings are adjusted.

Tighten

- Nut (78) to 16 N·m (12 ft. lbs.) while turning the hub/rotor assembly in either direction.

10. Put an additional quantity of grease outboard of the wheel bearing (76).
11. Adjust the wheel bearings.
    - Refer to "Wheel Bearing Adjustment," in this section.
12. Dust cap (79) on the hub/rotor (81).
13. Caliper. Refer to BRAKES (SEC. 5).
14. Tire and wheel assembly and lower the vehicle.

WHEEL BEARING ADJUSTMENT

Important

- The proper functioning of the front suspension cannot be maintained unless the front wheel bearings are correctly adjusted. The bearings must be a slip fit on the spindle and the inside diameter of the wheel bearing must be lubricated to ensure the bearings will creep. The spindle nut (78) must have a free-running fit on the spindle threads.

NOTICE: Never preload the front wheel bearings. Damage can result by the steady thrust on the roller ends which comes from preloading.

Adjust

- Raise the vehicle and support it with suitable safety stands under the lower control arms.

1. Remove the dust cap (79) from the hub/rotor (81).
2. Remove the cotter pin (80).

Tighten

- Nut (78) to 16 N·m (12 ft. lbs.) while rotating the wheel and tire assembly (this will seat the bearings).

3. Back off the nut (78) to the "just loose" position.
4. Hand tighten the nut (78).
5. Back off the nut (78) until the hole in the spindle lines up with a slot on the nut.
   - Do not back off more than 1/2 of a flat.
6. New cotter pin (80).
   - Make sure the bent ends do not interfere with the dust cap (79).

Measure

- Endplay in the hub/rotor assembly (81).
- It should measure between 0.03 mm (0.0012 inches) and 0.13 mm (0.005 inches) when properly adjusted.

7. Install the dust cap (79) on the hub/rotor (81).
8. Install the wheel and tire assembly if removed and lower the vehicle.

WHEEL HUB BOLT

Remove or Disconnect (Figures 5 through 8, and 13)

Tools Required:
J-9746-02 Hub/Rotor Support

1. Hub/rotor from the vehicle.
   - Refer to "Wheel Hub, Bearing and Race" in this section.

NOTICE: Place J-9746-02 between the press bars and the hub/rotor to protect the rotor surfaces.

2. Wheel hub bolts (74) with a press.
   - Support the hub/rotor (81) using J-9746-02 and press bars (figure 13).
   - Do not damage the wheel mounting surface on the hub/rotor flange.

Install or connect (Figures 5 through 8, and 14)

NOTICE: Refer to the "Notice" on page 3C#1 of this section.

1. Wheel hub bolts (74) into the hub/rotor (81).
   - Place four washers onto the bolt, then fasten a nut onto the bolt until the nut bottoms on the washers (figure 14).
   - Tighten the nut until the bolt fully seats into the hub/rotor (81).
   - Remove the nut and washers.
2. Hub/rotor to the vehicle.
   - Refer to "Wheel Hub, Bearing and Race," in this section.
3. Wheel and tire assembly. Lower the vehicle.

STEERING KNUCKLE

Remove or Disconnect (Figures 5 through 8, 15 and 16)

Tools Required:
J-23742 Ball Joint Separator

Important

- It is recommended that the vehicle be raised and supported as on a twin-post hoist so that the front coil spring remains compressed, yet the wheel and steering knuckle assembly remain accessible. If a frame hoist is used, support the lower control arm with an adjustable jackstand to safely retain the spring in its curb height position.

1. Wheel and tire assembly.

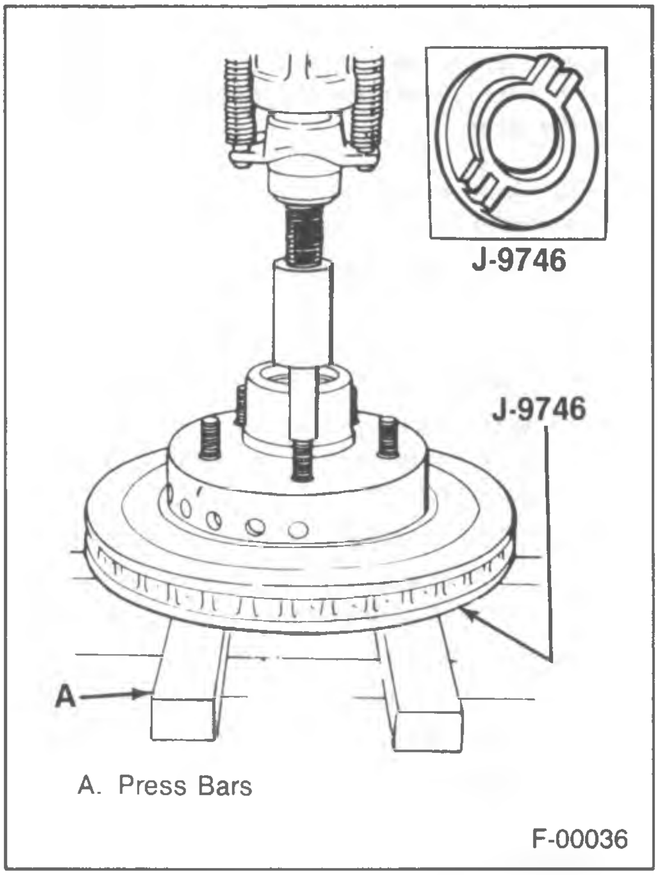


Figure 13—Pressing The Hub Bolt Out

2. Caliper.
   - Refer to BRAKES (SEC. 5).
3. Hub/Rotor (81).
   - Refer to "Wheel Hub, Bearing and Race," in this section.
4. Splash shield (71).
   - Bolts (83) and washers (84).
   - Gaskets (85).
5. Steering knuckle from the tie rod end.
   - Refer to STEERING LINKAGE (SEC. 3B1).
6. Steering knuckle (70) from the upper ball joint (13).

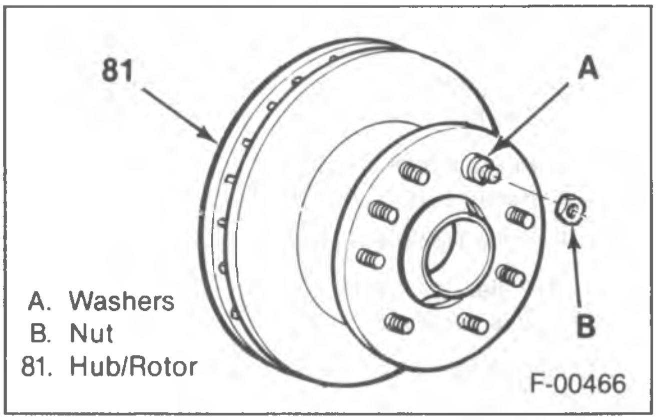


Figure 14—Installing The Wheel Hub Bolts

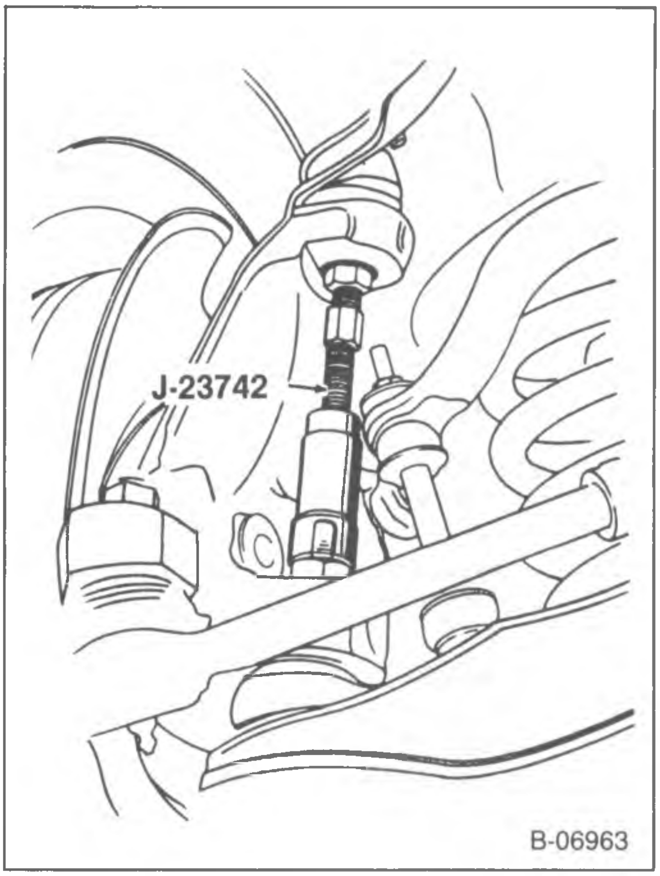


Figure 15—Disconnecting The Upper Ball Joint From The Steering Knuckle

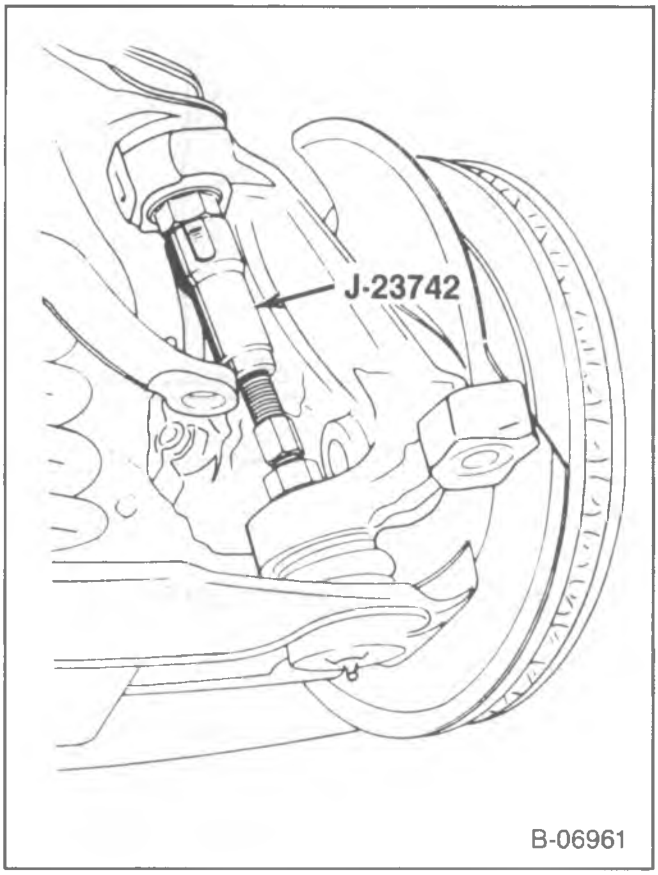


Figure 16—Disconnecting The Lower Ball Joint From The Steering Knuckle

- Position a floor jack under the lower control arm (36) near the spring seat.
- Raise the jack until it just supports the lower control arm.
- Use J-23742 to break the upper ball joint free of the steering knuckle (figure 15).
- Raise the upper control arm (28) to disengage the upper ball joint from the steering knuckle.

Important

- Floor jack must remain under the lower control arm spring seat during removal and installation to retain the spring and the lower control arm in position.

7. Steering knuckle (70) from the lower ball joint (37).
   - Use J-23742 to break the lower ball joint free from the steering knuckle (figure 16).
   - Lift the steering knuckle off the lower ball joint.

Inspect

1. Tapered holes in the steering knuckle that attach to the ball joints and the tie rod end.
   - Remove any dirt.
   - If any tapered hole is out of round, deformed, or damaged in any way, replace the steering knuckle (70).
2. Spindle for wear or damage.
   - The steering knuckle (70) must be replaced if the spindle is damaged or worn.

Install or Connect (Figures 5 through 8)

NOTICE: For steps 3 and 8, refer to the "Notice" on page 3C#1 of this section.

1. Steering knuckle (70) to the lower ball joint (37).
   - Press the steering knuckle onto the lower ball joint (37) until it is fully seated.
2. Steering knuckle (70) to the upper ball joint (13).
   - Lower the upper control arm (28) to seat the upper ball joint (13) into the steering knuckle.
3. Nuts (14, 35).

Tighten

- Nuts (14, 35) to "Specifications" at the end of this section.

4. Cotter pins (15, 34).
   - Tighten the nuts (14, 35), if needed, to install the cotter pins.

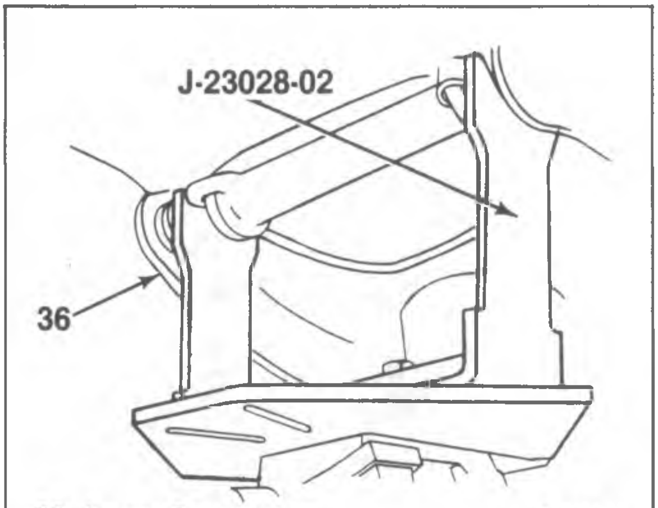


Figure 17—Removing The Coil Spring

5. Remove the floor jack.
6. Gasket.
7. Tie rod end to the steering knuckle (70).
   - Refer to STEERING LINKAGE (SEC. 3B1).
8. Splash shield (71).
   - Washers (84) and bolts (83) in position.

Tighten

- Bolts (83) to 13.5 N·m (120 in. lbs.).

4. Hub/rotor assembly.
   - Refer to "Wheel Hub, Bearing and Race" in this section.
5. Caliper.
   - Refer to BRAKES (SEC. 5).
6. Adjust the wheel bearings.
   - Refer to "Wheel Bearing Adjustment" in this section.
7. Check the front alignment and reset as required.
   - Refer to FRONT END ALIGNMENT (SEC. 3A).
8. Wheel and tire assembly, and lower the vehicle to the ground.

COIL SPRING

↔ Remove or Disconnect (Figures 5 through 8, and 17)

Tools Required:
J-23028-02 Spring Remover

- Raise the vehicle and support it with suitable safety stands, allowing the control arms to hang free. Remove the wheel and tire assembly.

1. Shock absorber (20) at the lower end and move it aside.
2. Stabilizer bar (59) from the lower control arm (36).
   - Nuts (38), bolts (43), washers (41) and clamp (42).

CAUTION: Failure to secure J-23028 to a suitable floor jack could result in personal injury.

3. J-23028-02 to a suitable jack.
4. Place J-23028-02 under the lower control arm shaft (50) as shown in figure 17.

Important

- Install a chain around the coil spring (32) and through the lower control arm (36) as a safety precaution.

5. Raise the jack to remove the tension from the lower control arm shaft (50) and remove the "U" bolts.
   - Nuts (49) and washers (48).
6. Lower the control arm by slowly releasing the jack until the spring can be removed.
   - Do not damage the ball joint (37) by applying too much force on it.
7. Spring (32) and safety chain only after all compression is removed from the spring.
   - Proper maneuvering of the spring will allow for easy removal.

→← Install or Connect (Figures 5 through 8 and 17)

Tools Required:
J-23028-02 Spring Remover

NOTICE: For steps 3, 5 and 6, refer to the "Notice" on page 3C#1 of this section.

1. Coil spring (32) into position on the lower control arm (36).

Important

- Install a chain around the coil spring and through the lower control arm as a safety precaution.

CAUTION: Failure to secure J-23028 to a suitable floor jack could result in personal injury.

2. Slowly lift the lower control arm into position.
   - Line up the front indexing hole in the shaft (50) with the crossmember attaching studs.
   - Do not damage the lower ball joint (37).
   - Use J-23028-02 bolted on a floor jack.
3. U-bolts (44), washers (48), and nuts (49).

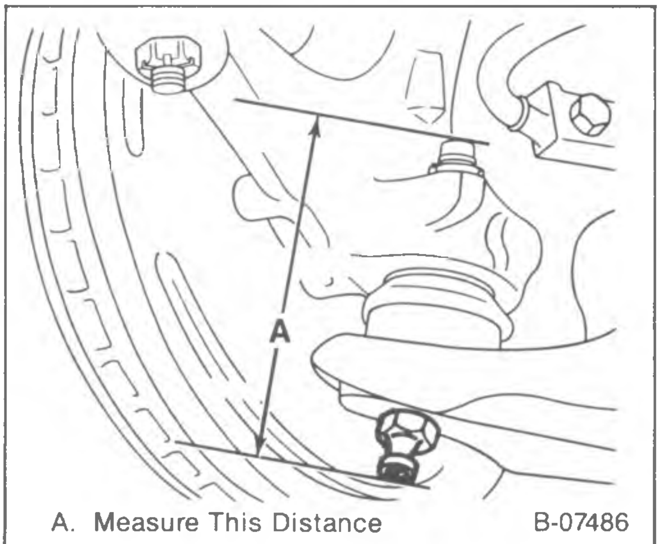


Figure 18—Inspecting The Lower Ball Joint

Tighten

- For G10/1500–20/2500 series vehicles, torque to 88 N·m (65 ft. lbs.).
- For all other series vehicles, torque to 115 N·m (85 ft. lbs.).

4. Lower the floor jack, and remove J-23028-02.
5. Stabilizer bar (59) to the lower control arm (36).
   - Clamp (42), washers (41), bolts (43) and nuts (38).

Tighten

- Nuts (38) to 33 N·m (24 ft. lbs.).

6. Shock absorber (20) to the lower control arm (36).
   - Washer (22), bolt (21), and nut (23).

Tighten

- Nut (23) to "Specifications" at the end of this section.

7. Check the front end alignment.
   - Refer to FRONT END ALIGNMENT (SEC. 3A).
8. Wheel and tire and lower the vehicle.

LOWER BALL JOINT

Inspect (Figures 5 through 8, and 18)

1. Raise the vehicle and remove the wheel and tire assembly. Support the weight of the control arms at the wheel hub and drum.
2. Measure the distance between the tip of the ball joint stud and the tip of the grease fitting below the ball joint (figure 18).
3. Move the support to underneath the control arm allowing the wheel hub and drum to hang free.

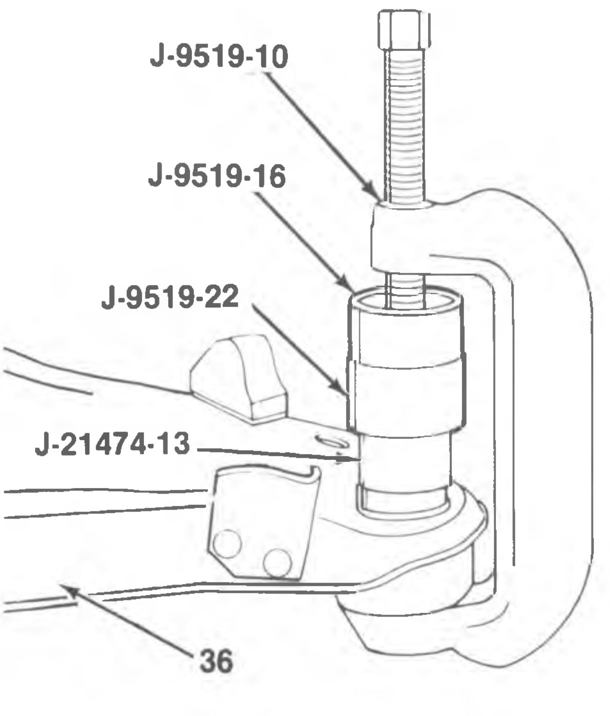


Figure 19—Removing The Lower Ball Joint

4. Measure the distance as in Step 2.
   - If the difference in measurements exceeds 2.38 mm ($^3/_{32}$ inches), for all models, the ball joint is worn and must be replaced.
5. If the ball joint seals are cracked, cut, or torn, replace them.

Remove or Disconnect (Figures 5 through 8, and 19)

Tools Required:
J-23742 Ball Joint Separator
J-9519-10 Ball Joint Fixture
J-9519-16 Ball Joint Installer
J-9519-22 Ball Joint Installer
J-21474-13 Ball Joint Installer

- Raise the vehicle on a hoist. If a frame hoist is used it will be necessary to support the lower control arm with a floor stand. Remove the tire and wheel assembly.

1. Cotter pin (34), nut (35), and lube fitting (12).
   - Loosen (two turns) but do not remove the nut (35).
2. Loosen the ball joint in the steering knuckle (31).
   - Use J-23742 between the ball joint studs (figure 16).
   - It may be necessary to remove the caliper and wire it to the frame to gain clearance for J-23742. Refer to BRAKES (SEC. 5).

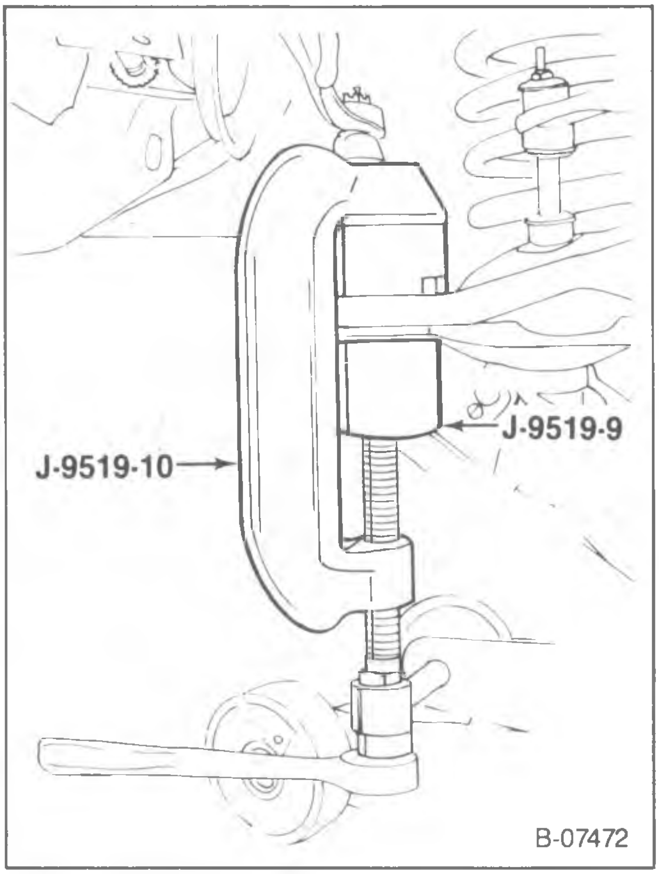


Figure 20—Installing The Lower Ball Joint

- Extend J-23742 until the lower ball joint (37) breaks free from the steering knuckle (31).
- Remove the nut (35) and J-23742.

3. Hub/rotor (70) and the knuckle assembly off the lower ball joint (37).
   - Support the upper control arm (28) with a block of wood to keep it clear of the work area.
4. Ball joint (37) from the lower control arm (36).
   - Install J-21474-13, J-9519-22, J-9519-16, and J-9519-10 (figure 19).
   - Turn the hex head screw until the ball joint is free of the lower control arm.
   - Remove the tools and the ball joint (37).

Install or Connect (Figures 5 through 8, and 20)

Tools Required:
J-9519-9 Ball Joint Installer
J-9519-10 Ball Joint Fixture

1. Ball joint (37) into the lower control arm (36).
   - Start the ball joint into the control arm and install J-9519-9 and J-9519-10 (Figure 20).
   - Position the bleed vent in the rubber boot facing inward.
   - Turn the hex head screw until the ball joint is seated in the lower control arm.
2. Ball joint into the steering knuckle (31).
   - Mate the steering knuckle (31) to the lower ball joint (37).
3. Caliper if it was removed.
   - Refer to BRAKES (SEC. 5).

NOTICE: Refer to "Notice" on page 3C#1 of this section.

4. Nut (35).

Tighten

- Nut (35) to 122 N·m (90 ft. lbs.).

5. Cotter pin (34).
   - Tighten the nut (35) until the hole in the stud lines up with the slot in the nut.
   - Do not tighten more than one flat or 175 N·m (130 ft. lbs.) maximum.
5. Fitting (12).
   - Lubricate the ball joint (37) with recommended lubricant.
6. Tire and wheel assembly and lower the vehicle to the floor.

UPPER BALL JOINT

Inspect

- The upper ball joint (13) is spring loaded in its socket. Replace the ball joint if there is any lateral shake or if it can be twisted in its socket with the fingers.
- The ball joint seals for cuts or tears. Replace the ball joint if any are found.

Remove or Disconnect (Figures 5 through 8, and 15)

Tools Required:
J-23742 Ball Joint Separator

- Raise the vehicle on a hoist. If a frame hoist is used, support the lower control arm with a floor jack.

1. Cotter pin (15) from the upper ball joint (13).
   - Loosen the nut (14) two turns, but do not remove the nut.
2. Caliper.
   - Refer to BRAKES (SEC. 5).
3. Upper ball joint (13) from the steering knuckle (31).
   - Use J-23742 to separate the upper ball joint from the steering knuckle (figure 15).
   - Nut (14), and lift the upper control arm (28) free of the ball joint.
4. Ball joint (13) from the upper control arm (28).
   - Drill 6.35 mm (1/4 inch) deep holes in the rivet heads using a 3.175 mm (1/8 inch) diameter drill bit.

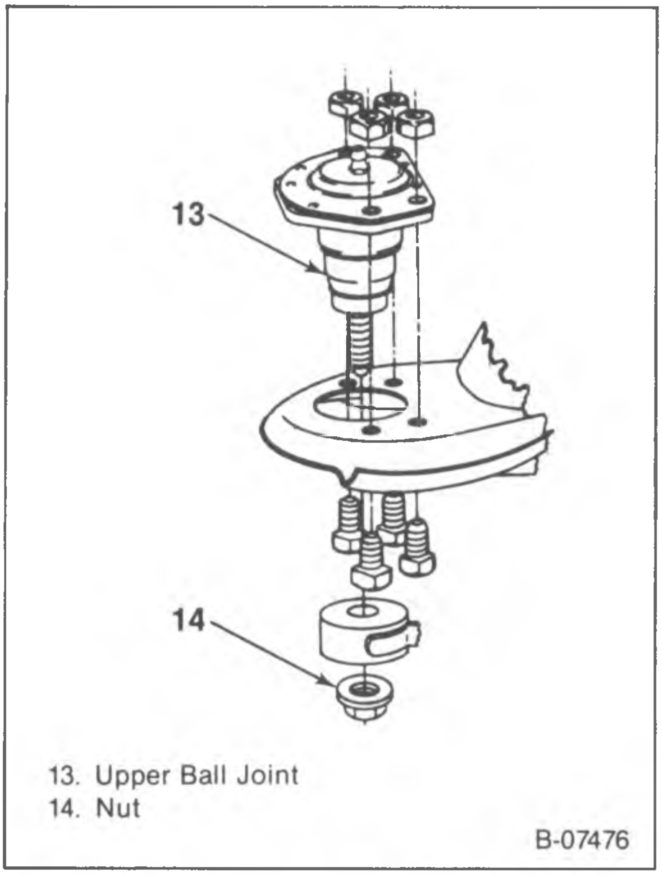


Figure 21—Installing The Upper Ball Joint

- Drill off the rivet heads using a 12.7 mm (1/2 inch) diameter drill bit.
- Punch out the rivets and remove the upper ball joint from the upper control arm.

Install or Connect (Figures 5 through 8, and 21)

NOTICE: For steps 1 and 2 refer to the "Notice" on page 3C#1 of this section.

1. Upper ball joint (13) into the upper control arm (28).
    - Position into the upper control arm and install four attaching bolts and nuts (figure 21).

    Tighten

    - Attaching nuts to 25 N·m (18 ft. lbs.).
2. Upper ball joint to the steering knuckle (31).
    - The upper ball joint must be fully seated into the steering knuckle.
    - Nut (14).

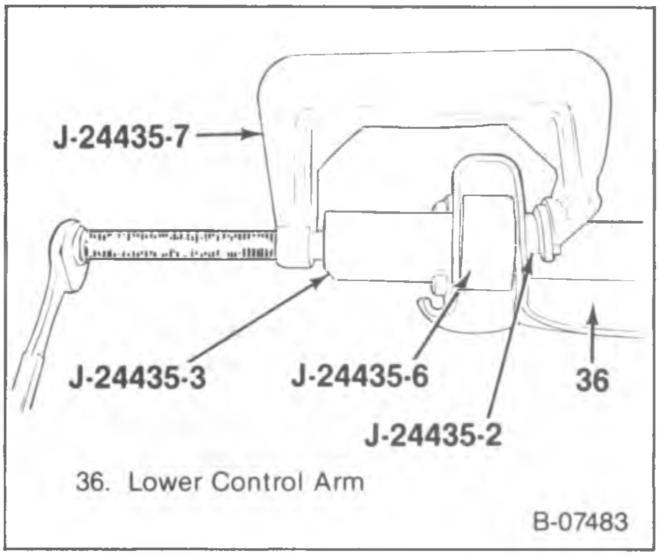


Figure 22—Removing The Lower Control Arm Bushings (C10/1500, G10/1500-20/2500 Series)

Tighten

- All 10/1500 series and G20/2500 series vehicle nuts (14) to 68 N·m (50 ft. lbs.).
- All 20/2500 and 30/3500 series (except G20/2500) vehicle's nuts (14) to 122 N·m (90 ft. lbs.).
- Apply additional torque to align the cotter pin (15), but do not exceed 120 N·m (90 ft. lbs.) for all 10 series and G20/2500 series or 175 N·m (130 ft. lbs.) for all other series.

3. Cotter pin (15).
4. Upper ball joint grease fitting (12).
5. Grease the upper ball joint (13).
    - Use a recommended lubricant.
6. Caliper.
    - Refer to BRAKES (SEC. 5).
7. Tire and wheel assembly.
8. Check the front end alignment.
    - Refer to FRONT END ALIGNMENT (SEC. 3A).

LOWER CONTROL ARM PIVOT SHAFT AND BUSHINGS

C10/1500 SERIES VEHICLES

Remove or Disconnect (Figures 5, 8, 17 and 22)

Tools Required:
J-23028-02 Coil Spring Remover
J-22717 Lower Control Arm Bushing Stake Remover
J-24435-2 Lower Control Arm Bushing Spacer

J-24435-3 Lower Control Arm Bushing Remover
J-24435-6 Lower Control Arm Bushing Spacer
J-24435-7 Lower Control Arm Bushing Fixture

If just the bushings (46) or the pivot shaft (50) need replacement, the lower control arm (36) does not have to be removed from the vehicle.

- Raise the vehicle on a hoist and support the frame so the lower control arms hang free.

CAUTION: Failure to install J-23028-02 to a suitable floor jack could result in personal injury.

1. J-23028-02 to a suitable floor jack and raise it into position [under the lower control arm (26)] inboard of the spring and into the depression of the lower control arm.

Important

- Install a chain over the upper control arm (28) inboard of the stabilizer bar (59) and outboard of the shock absorber (20).

2. Shock absorber (20) from the lower control arm (28).
   - Nut (23), washer (22), and bolt (21).
3. Stabilizer bar (59) from the lower control arm (28).
   - Nuts (38), washers (39, 41), clamp (42), and bolts (43).

42. Pivot shaft end nuts (24).
   - Loosen only, do not remove.

5. Lower control arm from the frame.
   - Nuts (49), washers (48), and U-bolts (44).
   - SLOWLY lower the floor jack until all compression is released from the spring (32).
6. Stakes on the front bushing.
   - Use J-22717 or an equivalent tool.
7. Bushings (46) and the pivot shaft (50) from the lower control arm (36).
   - Use J-24435-2, J-24435-3, J-24435-6, and J-24435-7 (figure 22).
   - Tighten the bolt on J-24435-7 to remove the bushing. Discard the old bushing.
   - The pivot shaft (50) will slide out of the lower control arm after one bushing is removed.
   - Leave the pivot shaft (50) inside the lower control arm (36) to remove the remaining bushing.

Install or Connect (Figure 5, 8 and 23)

Tools Required:
J-23028-02 Coil Spring Compressor

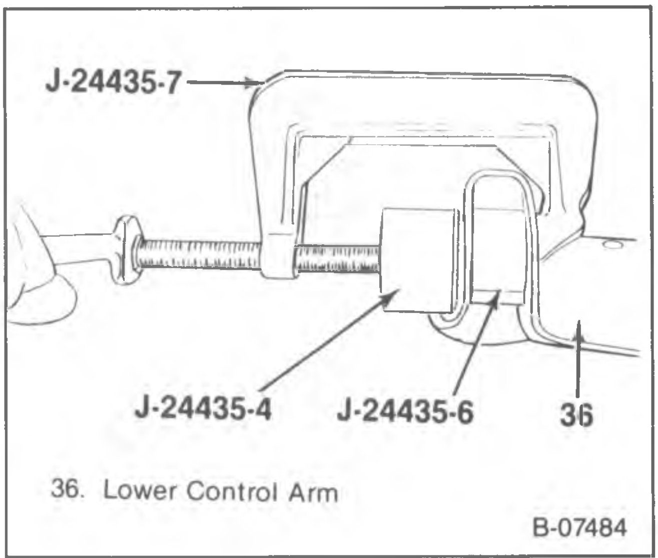


Figure 23—Installing The Lower Control Arm Bushings (C10/1500, G10/1500-20/2500 Series)

J-24435-4 Lower Control Arm Bushing Installer
J-24435-6 Lower Control Arm Bushing Spacer
J-24435-7 Lower Control Arm Bushing Fixture

NOTICE: For steps 3, 4, 5 and 6, refer to the "Notice" on page 3C#1 of this section.

1. Bushings (46) and the pivot shaft (50).
   - Use J-24435-4, J-24435-6, and J-24435-7 (figure 23).
   - Tighten the bolt on J-24435-7 to install the bushings.
   - Install one bushing, then insert the pivot shaft and install the remaining bushing.
   - Make sure J-24435-6 is in position to prevent collapsing the control arm.
2. Stake the front bushing in at least two places.

CAUTION: Failure to secure J-23028-02 to a suitable floor jack could result in personal injury.

3. Lower control arm (36) to the frame.
   - SLOWLY raise the floor jack until the front indexing hole in the pivot shaft (50) lines up with the crossmember attaching studs.
   - Do not damage the ball joint (37).
   - J-23028-02 is bolted to a suitable floor jack.
   - U-bolts (44), washers (48), and nuts (49).

Tighten

- U-bolt nuts (49) to 115 N·m (85 ft. lbs.).

4. Pivot shaft end nuts (24).

Tighten

- Nuts (24) to 95 N·m (70 ft. lbs.).

5. Stabilizer bar (59) to the lower control arm (28).
    - Washers (39, 41), clamp (42), bolts (43), and nuts (38).

Tighten

- Nuts (38) to 34 N·m (25 ft. lbs.).

6. Shock absorber (20) to the lower control arm (36).
    - Washers (22), bolt (21), and nut (23).

Tighten

- Nut (23) to 81 N·m (60 ft. lbs.).

7. Check the front end alignment.
    - Refer to FRONT END ALIGNMENT (SEC. 3A).
8. Wheel and tire and lower the vehicle.

G10/1500-20/2500 SERIES (EXCEPT 20/2500 SERIES W/6.2L DIESEL)

Remove or Disconnect (Figures 6, 8, and 22)

Tools Required:

J-22717 Lower Control Arm Bushing Stake Remover
J-24435-2 Lower Control Arm Bushing Spacer
J-24435-3 Lower Control Arm Bushing Remover
J-24435-6 Lower Control Arm Bushing Spacer
J-24435-7 Lower Control Arm Bushing Fixture

1. Lower control arm.
    - Refer to "Lower Control Arm," in this section.
2. Pivot shaft nuts (24) and washers (25).
3. Rear bushing (46).
    - Place the lower control arm in an arbor press.
    - Press the front end of the pivot shaft (50) to remove the rear bushing. Discard the old bushing.
    - The pivot shaft can be removed at this time.
4. Front bushing (46).
    - Stakes from the front bushing using J-22717 or an equivalent tool.
    - Use J-24435-7, J-24435-3, J-24435-2, and J-24435-6.
    - Tighten J-24435-7 until the bushing comes free. Discard the old bushing (figure 22).

Install or Connect (Figures 6, 8, 23 and 24)

Tools Required:

J-24435-4 Lower Control Arm Bushing Installer
J-24435-6 Lower Control Arm Bushing Spacer
J-24435-7 Lower Control Arm Bushing Fixture

1. New bushing (46) using J-24435-6, J-24435-4, and J-24435-7 (figure 23).
    - Tighten J-24435-7 until the bushing fully seats.
    - The outer tube hole must be lined up so it faces to the front or forward to the staked bushing.
2. Stake the front bushing in at least two places.
3. Pivot shaft (50) into installed bushing.
4. Remaining bushing (46) into the lower control arm.

NOTICE: Refer to "Notice" on page 3C#1 of this section.

5. Pivot shaft washers (25) and nuts (24).

Tighten

- Nuts (24) to 156 N·m (115 ft. lbs.).

6. Lower control arm (76).
    - Refer to "Lower Control Arm," in this section.
    - This results with the vehicle being completely assembled and lowered to the ground.

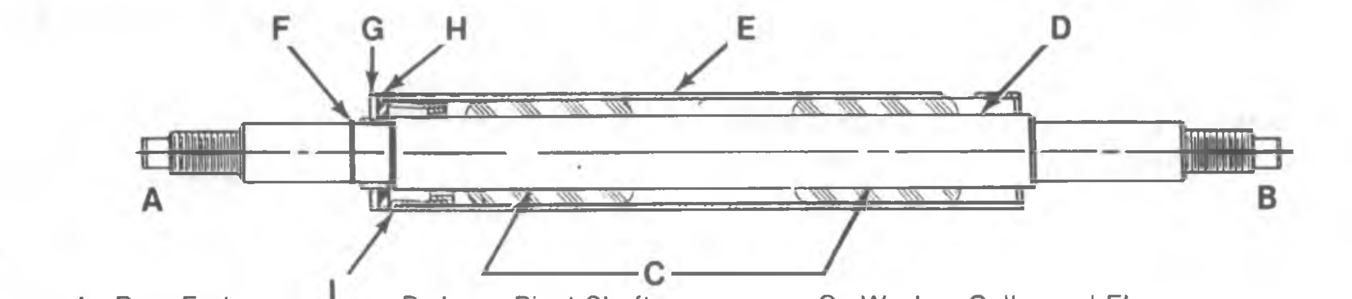
G20/2500 SERIES WITH RPO LH6/LL4 (6.2L DIESEL ENGINE)

Remove or Disconnect (Figures 5 through 8, and 25)

Tools Required:

J-24435-1 Lower Control Arm Bushing Remover
J-24435-3 Lower Control Arm Bushing Remover
J-24435-7 Lower Control Arm Bushing Fixture

1. Lower control arm (36).
    - Refer to "Lower Control Arm," in this section.
2. Bushings (46) and the pivot shaft (50) from the lower control arm (36).
    - Use J-24435-1, J-24435-3, and J-24435-7 (figure 25).
    - Tighten the clamp (J-24435-7) to remove the bushing (46).



A. Rear End
B. Front End
C. Insulators
D. Inner Pivot Shaft
E. Shaft Tube
F. O-Ring
G. Washer, Collar and Flange
H. Bumper
I. Shaft Restrictor

B-07514

Figure 24—Lower Control Arm Pivot Shaft (G10/1500-20/2500 W/O 6.2L Diesel)

- The pivot shaft can be slipped out at this time.
- Repeat the procedure on the remaining bushing (46) to remove it from the lower control arm (36).

Install or Connect (Figures 5 through 8, and 26)

Tools Required:
J-24435-4 Lower Control Arm Bushing Installer
J-24435-5 Lower Control Arm Bushing Installer
J-24435-7 Lower Control Arm Bushing Fixture

1. Bushings (46) and the pivot shaft (50) into the lower control arm (36).
   - Use J-24435-4, J-24435-5, and J-24435-7 (figure 26).
   - Tighten the clamp (J-24435-7) to install the bushing (26).
   - Slide the pivot shaft (50) into the lower control arm (36), then install the other bushing (36).
2. Lower control arm (36).
   - Refer to "Lower Control Arm," in this section.
   - This results with the vehicle being completely assembled and lowered to the ground.

CP20/2500-30/3500, G30/3500 SERIES VEHICLES

Remove or Disconnect (Figures 5 through 8)

- Raise the vehicle and support the frame so the control arms hang free. Remove the tire and wheel assembly.

1. Position an adjustable floor jack under the lower control arm (36) inboard of the spring and into the depression in the lower control arm.

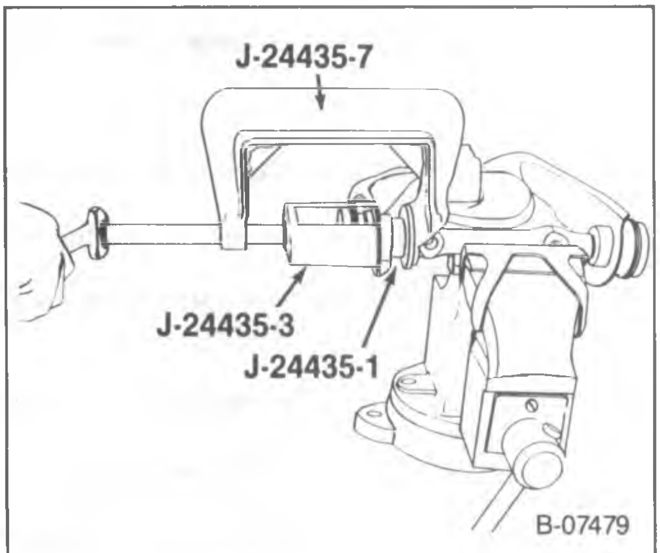


Figure 25—Removing The Lower Control Arm Bushing (G20/2500 W/6.2L Diesel)

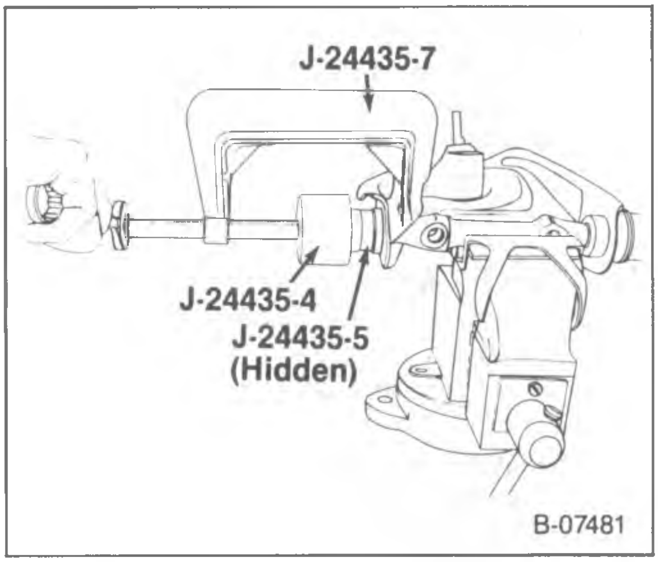
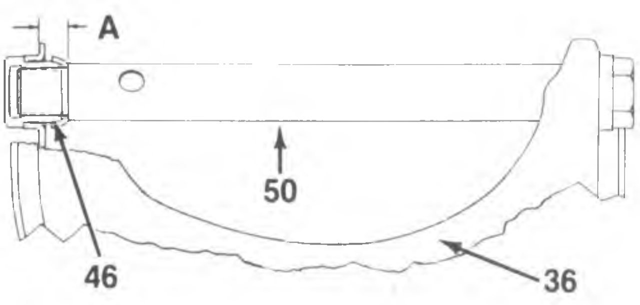


Figure 26—Installing The Lower Control Arm Bushing (G20/2500 W/6.2L Diesel)



A. 2.96 - 31.9 mm (1.16 - 1.25 inches) To Properly Center The Pivot Shaft
36. Lower Control Arm
46. Bushing
50. Pivot Shaft

B-07478

Figure 27—Centering The Lower Control Arm Shaft (CP20/2500-30/3500 And G30/3500 Series)

Important

- Install a chain over the upper control arm (28) inboard of the stabilizer bar (59) and outboard of the shock absorber (20).

2. Shock absorbers (20) from the lower control arm (36).
   - Nut (23), washer (22) and bolt (21).
3. Stabilizer bar (59) from the lower control arm (36).
   - Nuts (38), washers (39, 41), bolts (43) and clamp (42).
4. Lower control arm (36) from the frame crossmember.
   - Nuts (49), washer (48), and U-bolts (44).
   - SLOWLY lower the floor jack to access the pivot shaft (50).
5. Grease fittings (12).
6. Bushings (46) and bushing seals, and pivot shaft (50).
   - Unscrew the bushings.
   - Slide the pivot shaft out of the lower control arm.
   - Seals are mounted between the bushings and the pivot shaft. Discard the old seals.

Install or Connect (Figures 5 through 8, and 27)

NOTICE: For steps 1, 3, 4, and 5 refer to the "Notice" on page 3C#1 of this section.

1. Pivot shaft (50), seals, and bushings (46), to the lower control arm (36).
   - New seals onto the pivot shaft.
   - Pivot shaft into the lower control arm. Attach the bushings. Center the shaft in the lower control arm (figure 27).

Tighten

- Bushings (46) to 379 N·m (280 ft. lbs.).

Inspect

- Pivot shaft (50) for free rotation.

2. Grease fitting (12).
   - Lubricate the bushings with an approved grease.
   - Refer to MAINTENANCE AND LUBRICATION (SEC. 0B).
3. Lower control arm (36) to the frame crossmember.

- SLOWLY raise the floor jack until the lower control arm (36) is in position.

Important

- Be sure the hole in the pivot shaft mates with the bolt head in the frame crossmember saddle.

- U-bolts (44), washers (48), and nuts (49).

Tighten

- Nuts (49) to 115 N·m (85 ft. lbs.).

7. Stabilizer bar (59) to the lower control arm (36).
   - Nuts (38), washers (39, 41), bolts (43), and clamp (42).

Tighten

- Nuts (38) to 33 N·m (24 ft. lbs.).

5. Shock absorbers (20) to the lower control arm (36).
   - Bolt (21), washer (22), and nut (23).

Tighten

- Nut (23) to "Specifications" at the end of this section.

6. Remove the safety chain and the floor jack. Install the tire and wheel assembly and lower the vehicle to the ground.

UPPER CONTROL ARM PIVOT SHAFT AND BUSHINGS

C10/1500, G10/1500-20/2500 SERIES VEHICLES

Remove or Disconnect (Figures 5 through 8, and 28)

Tools Required:

J-24435-1 Lower Control Arm Bushing Remover

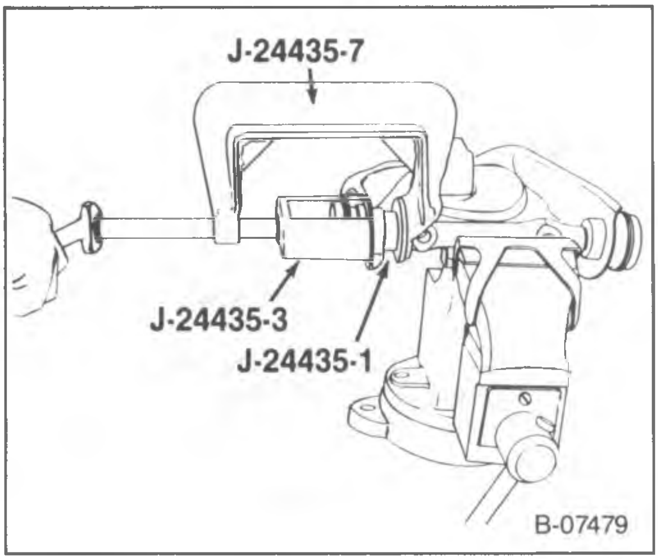


Figure 28—Removing The Upper Control Arm Bushings (C10/1500, G10/1500-20/2500 Series)

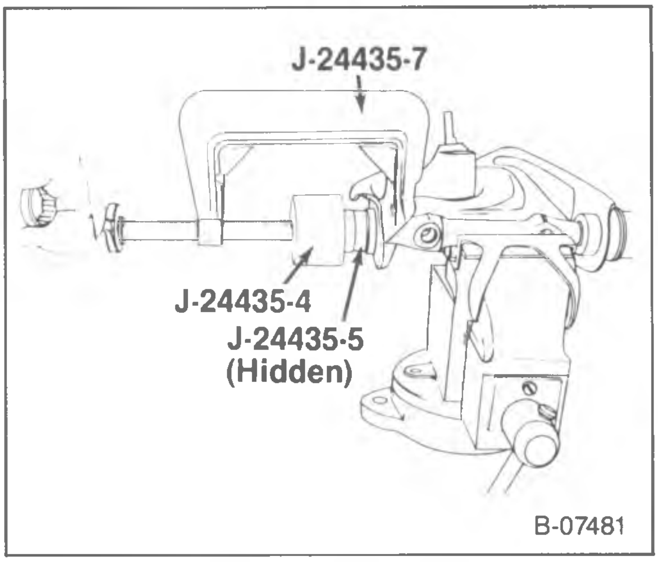


Figure 29—Installing The Upper Control Arm Bushings (C10/1500, G10/1500-20/2500 Series)

J-24435-3 Lower Control Arm Bushing Remover

J-24435-7 Lower Control Arm Bushing Fixture

1. Upper control arm (28).
   - Refer to "Upper Control Arm," in this section.
2. Nuts (24), bushings (26) and the pivot shaft (29) from the upper control arm (28).
   - Use J-24435-1, J-24435-3, and J-24435-7 (figure 28).
   - Tighten J-24435-7 to remove the bushing (26).
   - Pivot shaft (29) can be pulled free at this time.
   - Repeat this procedure on the remaining bushing (26). Discard the old bushings.

Install or Connect (Figures 5 through 8, and 29)

Tools Required:

J-24435-4 Lower Control Arm Bushing Installer

J-24435-5 Lower Control Arm Bushing Installer

J-24435-7 Lower Control Arm Bushing Fixture

NOTICE: Refer to the "Notice" on page 3C#1 of this section.

1. Bushings (26) and the pivot shaft (29) into the upper control arm (28).
   - Use J-24435-4, J-24435-5, and J-24435-7 (figure 29).
   - Tighten the clamp (J-24435-7) to install the bushing (26).
   - Slide the pivot shaft (29) into the upper control arm (28), then install the other bushing (26).
   - Nuts (24) in place.

Tighten

- Nuts (24) to 156 N·m (115 ft. lbs.).

2. Upper control arm (28) to the crossmember.
   - Refer to "Upper Control Arm," in this section.
3. Caliper if it was removed.
   - Refer to BRAKES (SEC. 5).
4. Check the front end alignment.
   - Refer to FRONT END ALIGNMENT (SEC. 3A).
5. Remove the supports and lower the vehicle to the ground.

CP20/2500-30/3500, G30/3500 SERIES VEHICLES

Remove or Disconnect (Figures 5 through 8)

- Raise the vehicle and support the lower control arms with a floor jack positioned under or near the ball joint assembly. Remove the wheel and tire assembly.

1. Loosen, but do not remove the pivot shaft to frame nuts (27).
2. Shim packs (18).
   - Tape each pack together and mark their position to assure exact replacement during installation.
3. Pivot shaft to frame nuts (27), bolts (4), and spacers (19).

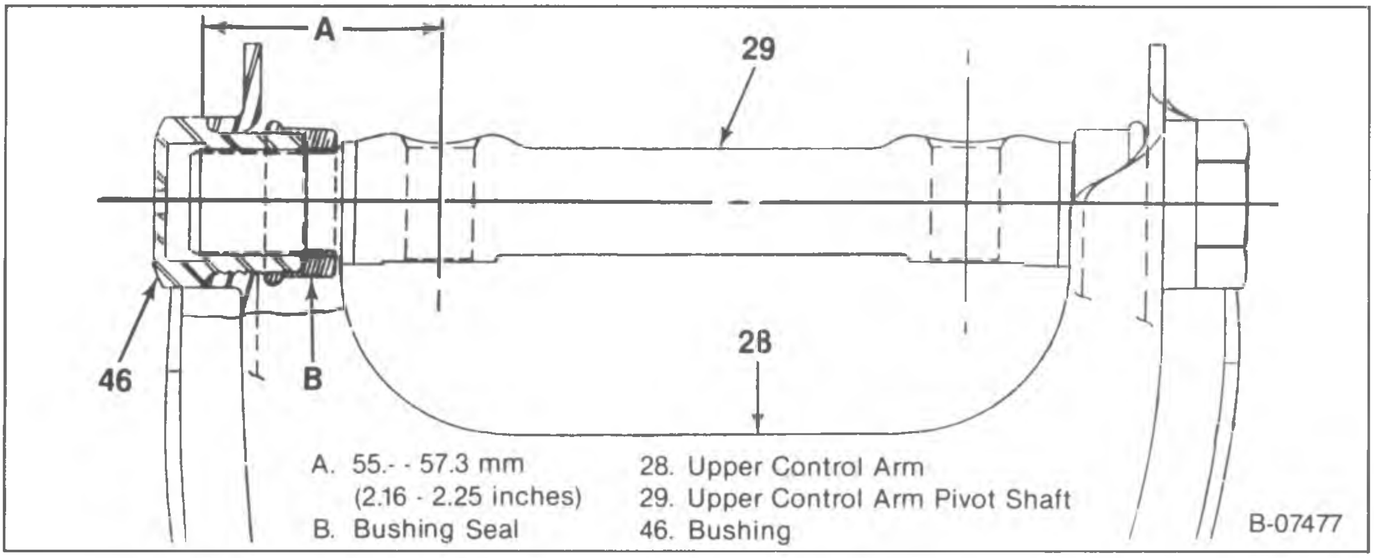


Figure 30—Centering The Upper Control Arm Shaft (CP20/2500-30/3500 G30/3500 Series)

- Do not allow the upper control arm (28) to swing too far from the frame crossmember.

Important

- Install a chain over the upper control arm (28) inboard of the stabilizer bar (59) and outboard of the shock absorber (20), to retain the upper control arm in a close relationship to the frame crossmember.

4. Pivot shaft (29) and bushings (26).
    - Grease fitting (12).
    - Unscrew the bushings (26).
    - Slide the pivot shaft out of the upper control arm. Remove and discard the inner seals (between the bushings and the pivot shaft).

Install or Connect (Figures 6 through 8, and 30)

1. Pivot shaft (29), seals, and bushings (26) onto the upper control arm (28).
    - New inner seals onto the pivot shaft.
    - Slide the pivot shaft into position inside the upper control arm. Screw on the new bushings. Do not tighten.

Important

- The pivot shaft (29) must be centered in the upper control arm (28) as shown in figure 30.

Tighten

- Bushings (26) to 257 N·m (190 ft. lbs.).

Inspect

- Pivot shaft for free rotation.

2. Grease fitting (12).
    - Grease the bushings (29). Refer to MAINTENANCE AND LUBRICATION (SEC. 0B).

NOTICE: Refer to the "Notice" on page 3C-1 of this section.

3. Pivot shaft (29) to the frame.
    - Bolts (4), shim packs (18), spacers (19), and nuts (27).
    - Shims are positioned into their original positions. Make sure the convex and concave sides of the shims are together.

Tighten

- Nuts (27) to 142 N·m (105 ft. lbs.).

4. Remove the safety chain and install the wheel and tire assembly.
5. Check the front end alignment.
    - Refer to FRONT END ALIGNMENT (SEC. 3A).
6. Lower the vehicle to the ground.

LOWER CONTROL ARM

Remove or Disconnect (Figures 5 through 8, and 16)

Tools Required:
J-23742 Ball Joint Separator

- Raise the vehicle and support it with suitable safety stands. Remove the wheel and tire assembly.

1. Caliper.
   - Refer to BRAKES (SEC. 5).
2. Coil spring (32).
   - Refer to "Coil Spring," in this section.
   - The lower control arm is separated from the frame.
3. Use a jack to support the inboard end of the lower control arm (36).
4. Lower control arm (36) from the steering knuckle (31).
   - Cotter pin (34), then loosen the nut (35) one turn.
   - Install J-23742, with the large cup end over the upper ball joint nut (14). Extend threaded end until the ball joint stud loosens from the steering knuckle. Remove J-23742 and the nut (35).

Install or Connect (Figures 5 through 8)

1. Lower control arm (36) to the steering knuckle (31).
   - Position the lower control arm ball joint stud (37) into the steering knuckle (31).
   - Nut (35) onto the stud. Do not tighten.
2. Coil spring (32).
   - Refer to "Coil Spring," in this section.
   - This step results with the lower control arm being attached to the frame.

NOTICE: Refer to "Notice" on page 3C-1 of this section.

3. Cotter pin (34).

Tighten

   - Nut (35) to 122 N·m (90 ft. lbs.).
   - Cotter pin. Tighten further to a maximum of 176 N·m (130 ft. lbs.) for cotter pin installation, if necessary.
4. Caliper.
   - Refer to BRAKES (SEC. 5).
5. Check the front end alignment.
   - Refer to FRONT END ALIGNMENT (SEC. 3A).
6. Tire and wheel assembly and lower the vehicle.

UPPER CONTROL ARM

Remove or Disconnect (Figures 5 through 8, and 15)

Tools Required:
J-23742 Ball Joint Separator

- Raise the vehicle and support it with suitable safety stands. Remove the wheel and tire assembly. Place an adjustable jackstand under the lower control arm for support.

1. Caliper.
   - Refer to BRAKES (SEC. 5).
2. Upper control arm (28) from the steering knuckle (31).
   - Cotter pin (15).
   - Loosen the nut (14). Do not remove it.
   - Install J-23742 with the large cupped end over the lower control arm ball joint stud nut (35). Expand J-23742 until the upper control arm separates.
   - Nut (14) from the upper ball joint stud and raise the upper control arm to clear the steering knuckle.
3. Upper control arm (28) from the frame bracket (9).
   - Nuts (27), spacers (19), shims (18), washers (5) and bolts (6).

Important

- Tape the shims together in their original positions and tag for proper relocation.

Install or Connect (Figures 5 through 8)

NOTICE: For steps 2 and 3, refer to "Notice" on page 3C-1 of this section.

1. Shims (18) into position on the upper control arm frame bracket (9).
   - Make sure the shims are positioned with concave and convex sides together.
2. Upper control arm (28) to the frame bracket (9).
   - Spacers (19) and nuts (27), washers (5), and bolts (6).

Important

- A normal shim pack will leave at least two threads of the bolt (6) exposed beyond the nut.
- If two threads cannot be obtained; check for damaged control arm or related parts. The difference between the front and rear shim

packs must not exceed 7.62 mm (0.30 inches). The front shim pack must be at least 6.09 mm (0.24 inches).
- Always tighten the thinner shim pack's nut (27) first for improved shaft to frame clamping force and torque retention.

Tighten

- Nuts (27) to "Specifications" at the end of this section.

3. Upper control arm (28) to the steering knuckle (31).
   - Insert the upper control arm ball joint stud (13) into the steering knuckle (31).
   - Nut (14) and cotter pin (15).

Tighten

- Nut (14) to the "Specifications" at the end of this section.

4. Caliper.
   - Refer to BRAKES (SEC. 5).
5. Check the front end alignment.
   - Refer to FRONT END ALIGNMENT (SEC. 3A).
6. Wheel and tire assembly. Lower the vehicle to the ground.

SUSPENSION UNIT

The front suspension and frame crossmember can be removed or installed as a unit if extensive service is required.

Remove or Disconnect (Figure 5 through 8, and 31)

- Raise the hood and disconnect the battery negative cable.
- Hoist the vehicle and support it with suitable safety stands placed at the frame side rails. Remove the tire and wheel assembly and then lower the hoist.

1. Front brake hose clip from each upper control arm.
2. Brake hoses from the calipers.
   - Clean the area adjacent to the brake hose fittings.
   - Discard the special washers (2 on each hose) and cover the disconnected ends of each hose with suitable material.
   - Refer to BRAKES (SEC. 5).
3. Tie rod ends from the steering knuckle (31).
   - Refer to STEERING LINKAGE (SEC. 3B1).
4. Front stabilizer from the lower control arms (36).
   - Nuts (38), washers (39, 41), bolts (43), and clamps (42).
5. Shock absorbers (20) from the lower control arms (36).
   - Nut (23), washer (22), and bolt (21).
6. Brake line clip bolts from the front suspension crossmember.
   - On C series models the clip is located under the right side engine mount support bracket.

NOTICE: Failure to disconnect these clips from the suspension unit will result in severe damage to the brake line when the unit is lowered from the vehicle.

7. Suspension crossmember from the engine mounts.
   - Refer to ENGINE (SEC. 6A).
8. Suspension crossmember from the frame rail (figure 31).
9. Raise the hoist to support the suspension crossmember.
10. Support the engine.
    - Must be done before the suspension unit is lowered from the vehicle.
11. Suspension unit and crossmember from the vehicle.
    - Upper control arm bracket to the frame side rail nuts (10), washer (7), and bolts (6).
    - Lower the suspension unit and the crossmember to bring the unit clear of the vehicle.

Install or Connect (Figures 5 through 8 and 31)

NOTICE: For steps 3, 7, and 8, refer to the "Notice" on page 3C-1 of this section.

1. Position the new suspension unit and crossmember and raise it with the hoist to align the suspension crossmember and frame holes.
2. Suspension crossmember to the frame rail bolts (figure 31).
3. Upper control arm (28) to the frame bracket bolts (6).
   - Washers (7) and nuts (10). Do not tighten.

Tighten

- Upper control arm to the frame bracket bolts (6) to "Specifications" at the end of this section.
- Suspension crossmember to the frame rail bolts to "Specifications" at the end of this section.

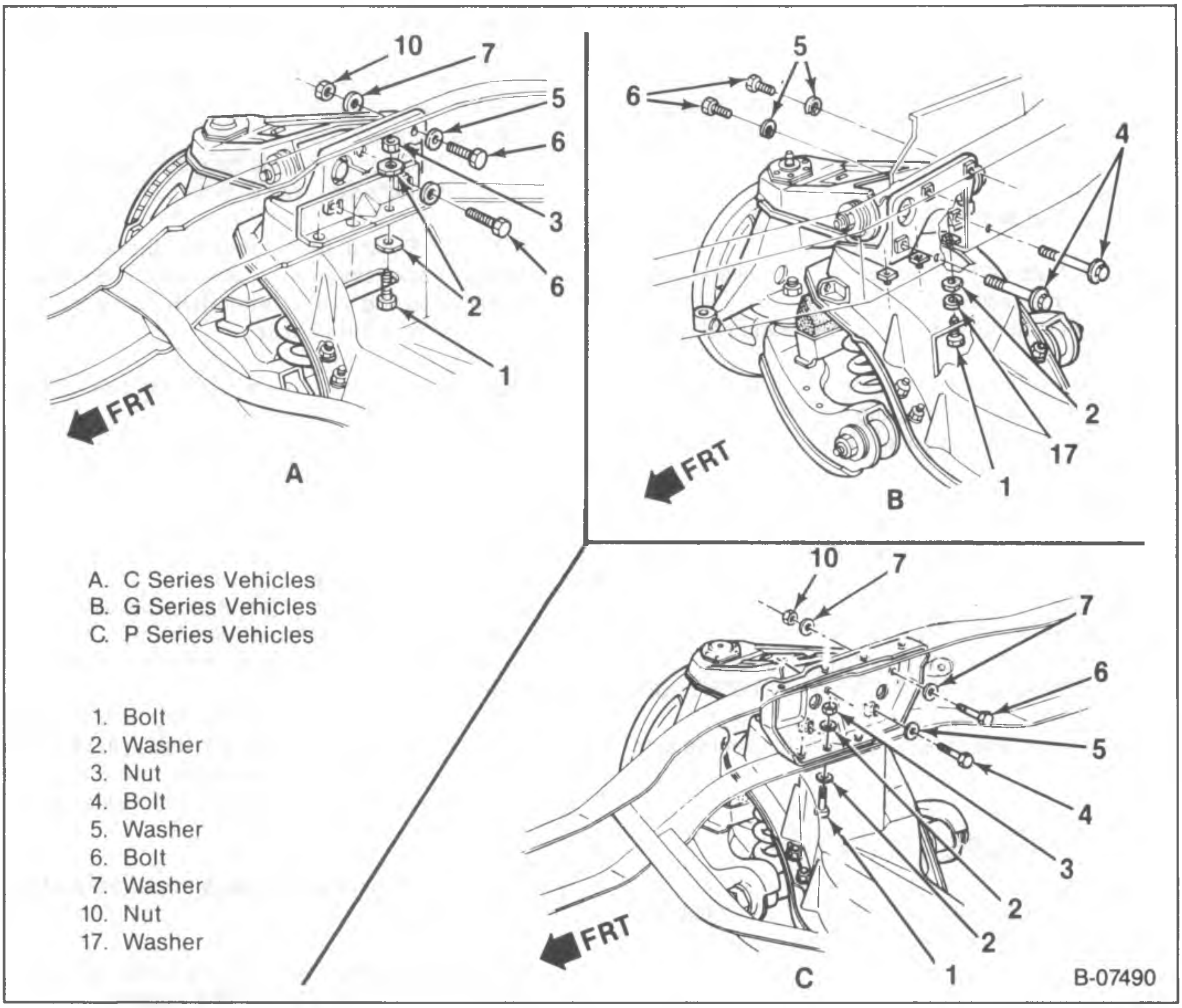


Figure 31—Suspension Unit Replacement

- The upper control arm to frame bracket bolts must be tightened first.
- The crossmember must be in contact with the frame side rails.

4. Remove the engine support and lower the hoist.
5. Engine mount support bracket to the suspension crossmember.
    - Refer to ENGINE (SEC. 6A).
6. Brake line clip to the crossmember.
    - Refer to BRAKES (SEC. 5).
7. Shock absorber to the lower control arm (28).
    - Washers (22), nuts (23), and bolts (21).

Tighten

- Nuts (23) to "Specifications" at the end of this section.

8. Stabilizer bar (59) to the lower control arm (28).
    - Clamps (42), bolts (43), washers (39) and nuts (38).

Tighten

- Nuts (38) to "Specifications" at the end of this section.

9. Tie rod ends to the steering knuckle (31).
    - Refer to STEERING LINKAGE (SEC. 3B1).
10. Brake hose to the caliper.
    - Refer to BRAKES (SEC. 5).
11. Brake hose clips to the upper control arms.
    - Refer to BRAKES (SEC. 5).
12. Bleed the brake system.
    - Refer to BRAKES (SEC. 5).
13. Tires and wheels and lower the vehicle.
14. Battery cable.

ON-VEHICLE SERVICE: TWO WHEEL DRIVE RPO FS3 (I-BEAM) FRONT SUSPENSION

SHOCK ABSORBER

Remove or Disconnect (Figures 32 through 34)

- Raise the vehicle and support it with suitable safety stands. Remove the wheel and tire assembly.

1. Shock absorber (113) from the leaf spring spacer (158).
    - Nut (109) and washer (111).
2. Shock absorber (113) from the frame.
    - Nut (109) and washer (111).
    - Pull the shock free from the vehicle.

BENCH TEST: SPIRAL GROOVE SHOCK ABSORBERS

1. Purge the air from the pressure chamber.
    - Extend the shock vertically—top end up.
    - Turn the shock over and collapse it vertically—top end down.
    - Repeat the above step five times.
2. Place the shock absorbers in a vise with the jaws clamped onto the shock's bottom mount.
    - — Shock absorber should be positioned vertically in the vise—top end up.
    - — Do not clamp the vise jaws on the shock's reservoir tube.
3. Pump the shock absorber at various rates of speed and observe the rebound force.
    - — Rebound force is normally stronger than the compression force (approximately two to one).
    - — Rebound force should be smooth and constant for each stroke rate.
4. Compare with a good shock absorber.
5. If one of the following are observed, replace the shock absorber.
    - — A skip or lag at reversal near mid-stroke.
    - — A seize (except at the extreme ends of travel).
    - — A noise (grunt or squeal) after completing one full stroke in both directions.
    - — A clicking noise at fast reversal.

BENCH TEST: NON-SPIRAL GROOVE RESERVOIR SHOCK ABSORBER

- Purging air from non-spiral groove shock absorbers is not necessary. The shock absorbers have a gas filled cell in their reservoirs (as opposed to the air filled cell in the spiral groove shock absorber reservoirs).

1. Place the shock absorber in a vise with the jaws clamped on the shock absorber's top mount.
    - — Shock absorber should be held vertically in the vise with its bottom end up.
    - — Do not clamp the vise jaws on the shock's reservoir tube.
2. Pump the shock absorber at various rates of speed and observe the rebound force.
    - — Rebound force is normally stronger than the compression force (approximately two to one).
    - — Rebound force should be smooth and constant for each stroke rate.
3. Compare with a good shock absorber.
4. If one of the following are observed, replace the shock absorber.
    - — A skip or lag at reversal near mid-stroke.
    - — A seize (except at the extreme ends of travel).
    - — A noise (grunt or squeal) after completing one full stroke in both directions.
    - — A clicking noise at fast reversal.

Install or Connect (Figures 32 through 34)

1. Shock absorber (113) to the frame (figure 34).
    - Insert the shock's upper stud into the hole in the frame.
    - Washer (111) and nut (109). Do not tighten.

NOTICE: Refer to the "Notice" on page 3C#1 of this section.

2. Shock absorber (113) to the leaf spring spacer (158) (figure 34).
    - Position the shock's lower mount onto the stud.
    - Washer (111) and nut (109).

Tighten

- Shock absorber upper nut to 185 N·m (136 ft. lbs.).
- Shock absorber lower nut to 50 N·m (37 ft. lbs.).

3. Wheel and tire on the vehicle. Lower the vehicle to the ground.

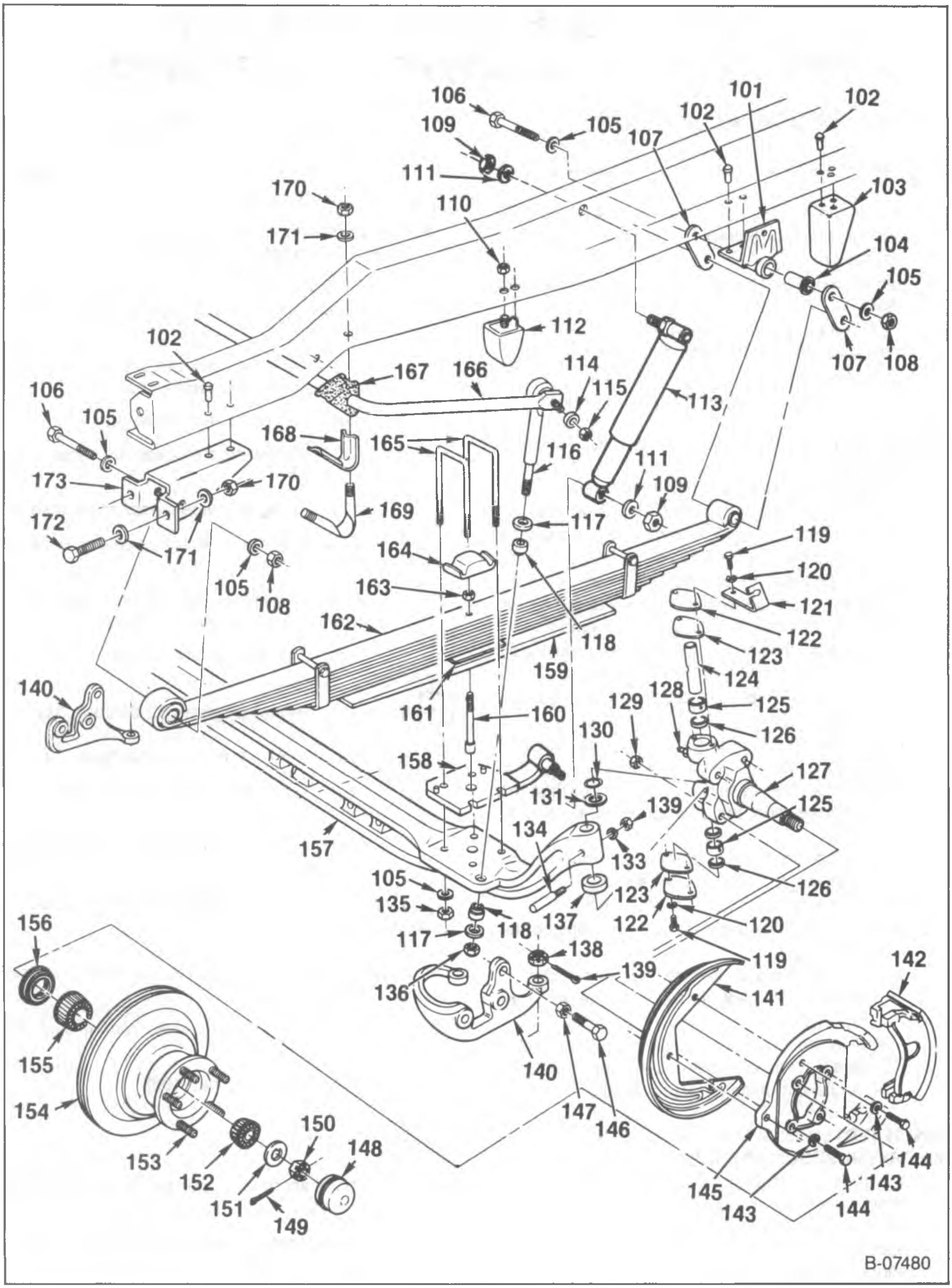


Figure 32—P Series Front Suspension (RPO FS3)

101. Spring Hanger
102. Rivet
103. Spring Stop
104. Hanger Bushing
105. Washer
106. Bolt
107. Shackle
108. Nut
109. Nut
110. Nut
111. Washer
112. Bumper
113. Shock Absorber
114. Spacer
115. Nut
116. Stabilizer Link
117. Retainer
118. Insulator
119. Bolt
120. Washer
121. Brake Hose Bracket
122. Cap
123. Gasket
124. King Pin
125. Bushing
126. Spacer
127. Steering Knuckle
128. Fitting
129. Nut
130. Dust Seal
131. Shim
132. Nut
133. Washer
134. Lock Pin
135. Nut
136. Nut
137. Thrust Bearing
138. Nut
139. Cotter Pin
140. Steering And Third Arm
141. Splash Shield
142. Brake Caliper
143. Washer
144. Bolt
145. Anchor Plate
146. Stop Bolt
147. Stop Nut
148. Retainer/Cap
149. Cotter Pin
150. Nut
151. Washer
152. Outer Wheel Bearing And Race
153. Wheel Hub Bolt
154. Hub/Rotor
155. Inner Wheel Bearing And Race
156. Bearing Seal
157. Front Axle
158. Spring Spacer
159. Spring Leaf
160. Bolt
161. Spacer
162. Front Spring
163. Nut
164. Spacer
165. U-Bolt
166. Stabilizer Bar
167. Insulator
168. Clamp
169. Bolt
170. Nut
171. Washer
172. Bolt
173. Spring Hanger

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Figure 33—P Series Front Suspension (RPO FS3)

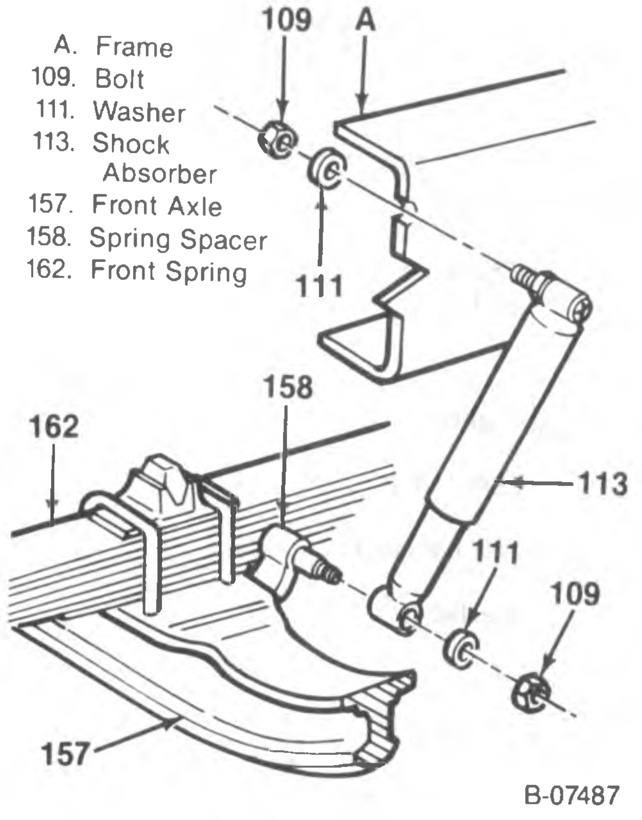


Figure 34—Shock Absorber Attachments

STABILIZER BAR

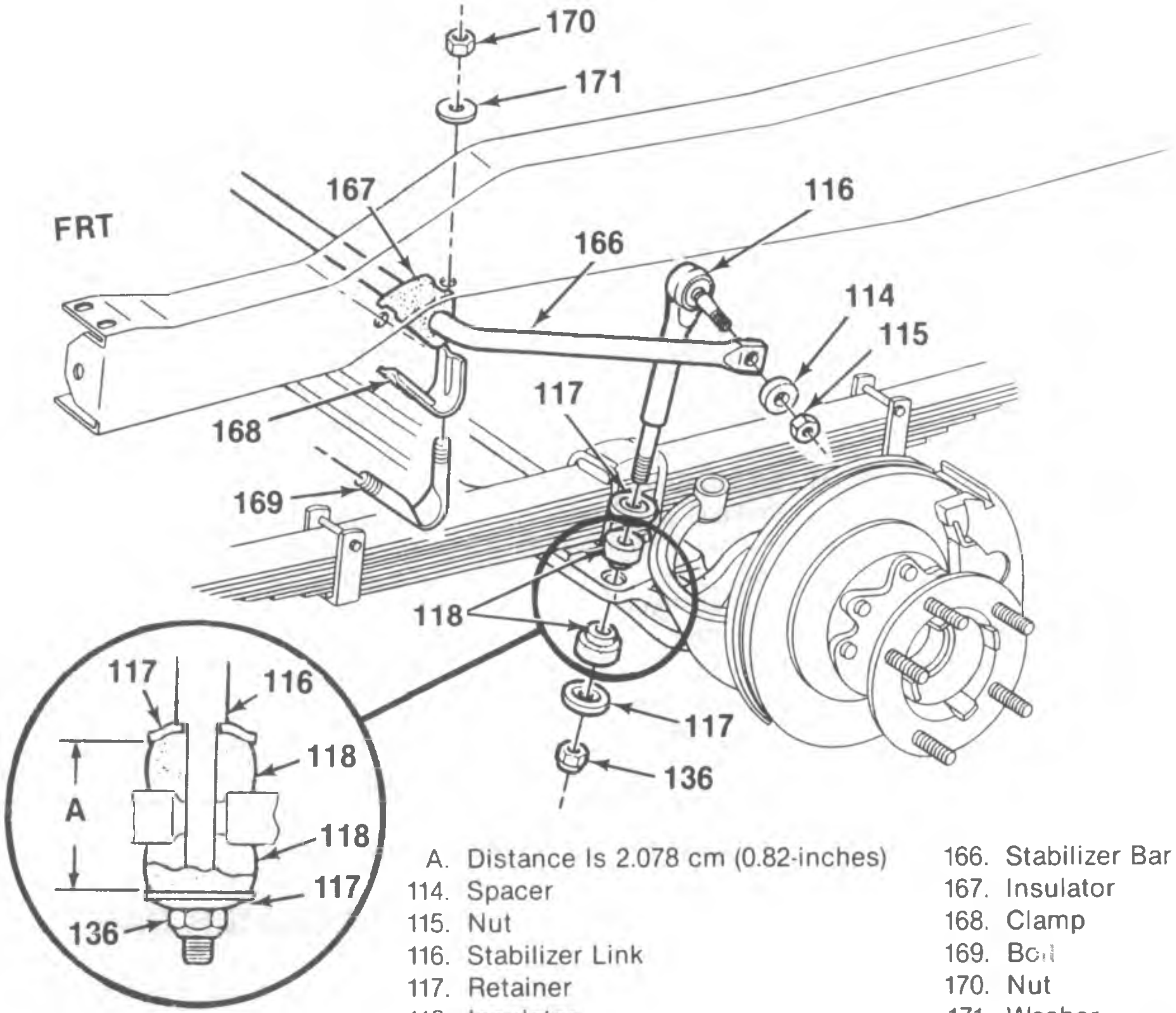
↔ **Remove or Disconnect (Figures 32, 33, and 35)**

Tools Required:

J-6627-A Wheel Stud and Tie Rod Remover

- Raise the vehicle and support it with suitable safety stands. Remove the tire and wheel assembly.

1. Stabilizer bar (166) from the stabilizer link (116).
    - Nut (115) and washer (114).
    - Use J-6627-A to separate the stabilizer link from the stabilizer end.
2. Stabilizer bar (166) from the frame (figure 35).
    - Nuts (170), washers (171), clamp bolts (169) and clamps (168).
    - Slide the insulator (167) from the stabilizer bar (166).
3. Stabilizer link (116) from the front axle (157) (figure 35).
    - Nut (136), retainer (117), insulator (118).
    - Pull the link from the axle. Another insulator (118) and retainer (117) will come off the link.



A. Distance Is 2.078 cm (0.82-inches)
114. Spacer
115. Nut
116. Stabilizer Link
117. Retainer
118. Insulator
136. Nut
166. Stabilizer Bar
167. Insulator
168. Clamp
169. Bolt
170. Nut
171. Washer

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Figure 35—Stabilizer Bar Attachments

Install or Connect (Figures 32, 33, and 35)

NOTICE: For steps 1, 2, and 3, refer to the "Notice" on page 3C#1 of this section.

1. Stabilizer link (116) to the front axle (157) (figure 35).
   - Slide a retainer (117) and an insulator (118) on to the link and insert the link into the proper hole in the front axle.
   - Insulator (118), retainer (117) and nut (136).

   Tighten

   - Nut (136) until the distance between each retainer (117) is 2.08 cm (0.82 inches) (figure 35).
2. Stabilizer bar (166) to the frame (figure 35).
   - Insulators (167) onto the stabilizer bar (166).
   - Clamps (168), clamp bolts (169), washers (171), and nuts (170).

   Tighten

   - Nuts (170) to 28 N·m (21 ft. lbs.).
3. Stabilizer bar (166) to the stabilizer link (116).
   - Washer (114) and nut (115).

   Tighten

   - Nuts (115) to 68 N·m (50 ft. lbs.).
4. Wheel and tire assembly. Lower the vehicle to the ground.

WHEEL HUB/ROTOR ASSEMBLY

↔ Remove or Disconnect (Figures 32 and 33)

- Raise the vehicle and support it with suitable safety stands. Remove the tire and wheel assembly.

1. Caliper (142).
    - Refer to BRAKES (SEC. 5).

NOTICE: Support the caliper with a piece of wire to prevent damage to the brake line.

2. Wheel hub/rotor (154) (figures 32, 33).
    - Retainer/cap (148).
    - Cotter pin (149), nut (150) and washer (151).
    - Pull the hub/rotor free from the spindle, making sure the outer wheel bearing (152) comes free.
    - Do not damage the steering knuckle spindle threads.
3. Inner wheel bearing (155).
    - Pry out the seal (156).
4. Races.
    - Drive out each race using a brass drift.

Clean

1. Grease from the hub/rotor (154) and steering knuckle spindle.
    - Grease from inside the hub.
2. Grease from the wheel bearings (152, 155) and races.
    - Use clean solvent and a small brush (no loose bristles).
    - Do not spin the wheel bearings with compressed air to dry them—the wheel bearings may be damaged.

Inspect

1. Wheel bearings (152, 155) and their races for damage or wear.
    - Refer to "Diagnosis of Wheel Bearings," in this section.
    - If either a bearing or its race is damaged or worn, replace both.
2. Hub/rotor (154) for damage or wear.
    - Check for out-of-round or scored conditions.
    - Check for pitting or cracks.
    - Repair or replace as necessary.

Install or Connect (Figures 32 and 33)

Tools Required:
J-8092 Driver Handle
J-29040 Outer Bearing Race Installer
J-9746-02 Hub/Rotor Support

NOTICE: Start the races squarely inside the hub/rotor (154) to avoid distortion and possible cracking.

1. Races into the hub/rotor (154).
    - Place the hub/rotor on J-9746-02 and rest this assembly on press bars.
    - Use J-29040 to drive the outer bearing race into position.
    - Remove J-9746-02 and use a 7.6 cm (3 inch) diameter bar, or equivalent tool to drive the inner bearing race into position. If the bar is larger than 7.6 cm (3 inches), it may damage the bearing seal seat.

Important

- Use an approved high temperature front wheel bearing grease to lubricate the bearings. Refer to MAINTENANCE AND LUBRICATION (SEC. 0B).
- Do not mix different greases as mixing may change the grease's properties resulting in poor performance.

2. Apply a thin film of grease to the steering knuckle spindle at the outer wheel bearing seat and at the inner wheel bearing seat, shoulder, and seal seat.
3. Put a small quantity of grease inboard of each wheel bearing retainer/cap (148).
4. Fill each wheel bearing (cone and roller assembly) full of grease.
    - Use a cone-type grease machine that forces grease into the bearing.
    - If a cone-type grease machine is not available, pack the wheel bearing by hand.
    - When packing the wheel bearing by hand, work the grease into the bearings between the rollers, cones, and the cage.

NOTICE: Failure to completely pack the wheel bearing (cones, rollers, and cage) with grease will result in premature wheel bearing damage and/or wear.

5. Inner wheel bearing (155) into the hub/rotor (154).
    - Put an additional quantity of grease outboard of this bearing.
6. New seal (156).
    - Use a flat plate or block to install the seal to insure it is flush with the hub/rotor flange.
    - Lubricate the seal lip with a thin layer of grease.
7. Hub/rotor (154).
    - Do not damage the steering knuckle spindle threads.
8. Outer wheel bearing (152).
    - Slide it over the spindle until the wheel bearing (152) fully seats against the hub/rotor outer race.

NOTICE: Refer to the "Notice" on page 3C#1 of this section.

9. Washer (151), nut (150) and cotter pin (149).
   - Do not place the cotter pin through the hole in the spindle until the wheel bearings are adjusted.

Tighten

   - Nut (150) to 16 N·m (12 ft. lbs.) while turning the hub/rotor assembly in either direction.
10. Put an additional amount of grease outboard of the wheel bearing (152).
11. Adjust the wheel bearings.
    - Refer to "Wheel Bearing Adjustment," in this section.
12. Retainer/cap (148) in place.
13. Caliper (142).
    - Refer to BRAKES (SEC. 5).
14. Tire and wheel assembly. Lower the vehicle to the ground.

WHEEL BEARING ADJUSTMENT

Important

- The proper functioning of the front suspension cannot be maintained unless the front wheel bearings are correctly adjusted. The bearings must be a slip fit on the spindle and the inside diameter of the wheel bearing must be lubricated to ensure the bearings will creep. The spindle nut (150) must have a free-running fit on the spindle threads.

NOTICE: Never preload the front wheel bearings. Damage can result by the steady thrust on the roller ends which comes from preloading.

Adjust

- Raise the vehicle and support it with suitable safety stands under the lower control arms.

1. Remove the retainer/cap (148).
2. Remove the cotter pin (149).

Tighten

   - Nut (150) to 16 N·m (12 ft. lbs.) while rotating the wheel and tire assembly (or the hub/rotor). This will seat the bearings.
3. Back off the nut (150) one flat.
   - If the hole in the spindle lines up with the slot in the nut, insert the cotter pin (149).
   - If they do not line up, back off the nut until they do—not more than one additional flat.

Measure

- Endplay in the hub/rotor should measure between 0.013–0.20 mm (0.0005–0.008 inches) when properly adjusted.

4. Install the retainer/cap (148).
5. Lower the vehicle to the ground.

WHEEL HUB BOLT

Remove or Disconnect

Tools Required:
J-9746-02 Hub/Rotor Support

1. Hub/rotor assembly from the vehicle.
   - Refer to "Wheel Hub/Rotor Assembly," in this section.

NOTICE: Place J-9746-02 between the press bars and the hub/rotor to protect the rotor surfaces.

2. Wheel hub bolts (153) with a press.
   - Support the hub/rotor (153) using J-9746-02 and the press bars.
   - Do not damage the wheel mounting surface on the hub/rotor flange.

Install or Connect

NOTICE: Refer to the "Notice" on page 3C#1 of this section.

1. Wheel hub bolts (153) into the hub/rotor (154).
   - Place four washers onto the bolt, then fasten a nut onto the bolt until the nut bottoms on the washers.
   - Tighten the nut until the bolt fully seats into the hub/rotor (154).
   - Remove the nut and washers.
2. Hub/rotor to the vehicle.
   - Refer to "Wheel Hub/Rotor Assembly," in this section.
3. Wheel and tire assembly. Lower the vehicle to the ground.

STEERING ARM, KNUCKLE AND SPINDLE

Remove or Disconnect (Figures 32 and 33)

- Raise the vehicle and support it with suitable safety stands. Remove the tire and wheel assembly.

1. Caliper (142).
   - Refer to BRAKES (SEC. 5).
2. Hub/rotor assembly (154).
   - Refer to "Wheel Hub/Rotor Assembly," in this section.
3. Anchor plate (145), splash shield (141), and the steering arm (140).
   - Bolts (146), washers (147) and nuts (129), and pull the anchor plate and splash shield off the knuckle. Steering arm hangs by tie rods.
   - Bolts (144) and washers (143) to separate the anchor plate from the splash shield.
   - Refer to STEERING LINKAGE (SEC. 3B1) to separate the steering arm from the tie rod and pitman arm.
4. Caps (122) from the steering knuckle (127).
   - Bolts (119) and washers (120).
   - Brake hose bracket (121).
   - Gaskets (123) come off.
5. Lock pin (134).
   - Nut (132) and washer (133).
6. King pin (124) from the steering knuckle (127).
   - Drive it out using a drift.
   - Spacers (126) and bushings (125) will also come out.
7. Steering knuckle (127) from the axle (157).
   - Dust seal (130), shim (131), and thrust bearing (137) will come free.

Install or Connect (Figures 32 and 33)

NOTICE: For steps 3, 4, and 5 refer to the "Notice" on page 3C#1 of this section.

1. Steering knuckle (127) to the axle (157).
   - Thrust bearing (137), shim (131), and dust seal (130) must be properly positioned. Knuckle to axle clearance must be between 0.025–0.25 mm (0.001–0.010 inches).
   - Prelube the thrust bearing (137). Refer to MAINTENANCE AND LUBRICATION (SEC. 0B).
   - Align lube hole in the bearing with the lube hole in the steering knuckle.
2. King pin (124) into the steering knuckle (127).
   - Insert bushings (125) and spacers (126) in their proper order.
   - Do not score the king pin surface. Use a proper lubricant if necessary.
3. Lock pin (134).
   - Washer (133) and nut (132).

   Tighten

   - Nut (132) to 40 N·m (29 ft. lbs.).
4. Caps (122) to the steering knuckle (127).
   - Gaskets (123) in place.
   - Brake hose bracket (121).
   - Washers (120) and bolts (119).

   Tighten

   - Bolts (119) to 7 N·m (5 ft. lbs.).
5. Steering arm (140), splash shield (141), and the anchor plate (145).
   - Bolts (144) and washers (143) to attach the splash shield to the anchor plate.
   - Bolts (146), washers (147) and nuts (129) to attach the anchor plate and steering arm to the steering knuckle.

   Tighten

   - Bolts (144) to 16 N·m (12 ft. lbs.).
   - Nuts (129) to 312 N·m (230 ft. lbs.).
6. Steering arm (140) to the steering linkage.
   - Refer to STEERING LINKAGE (SEC. 3B1).
7. Hub/Rotor assembly (154).
   - Refer to "Wheel Hub/Rotor Assembly," in this section.
8. Adjust the wheel bearings.
   - Refer to "Wheel Bearing Adjustment," in this section.
9. Caliper (142).
   - Refer to BRAKES (SEC. 5).
10. Wheel and tire assembly. Lower the vehicle to the ground.
11. Check the front end alignment.
    - Refer to FRONT END ALIGNMENT (SEC. 3A).

FRONT AXLE

Remove or Disconnect (Figures 32 through 36)

Tools Required:

J-6627-A Wheel Stud and Tie Rod Remover

- Raise the vehicle and support it with suitable safety stands on the frame. Remove the wheel and tire assembly. Support the axle with a floor jack to eliminate any load on the springs.

1. Steering arm, knuckle, and spindle.
   - Refer to "Steering Arm, Knuckle, and Spindle," in this section.

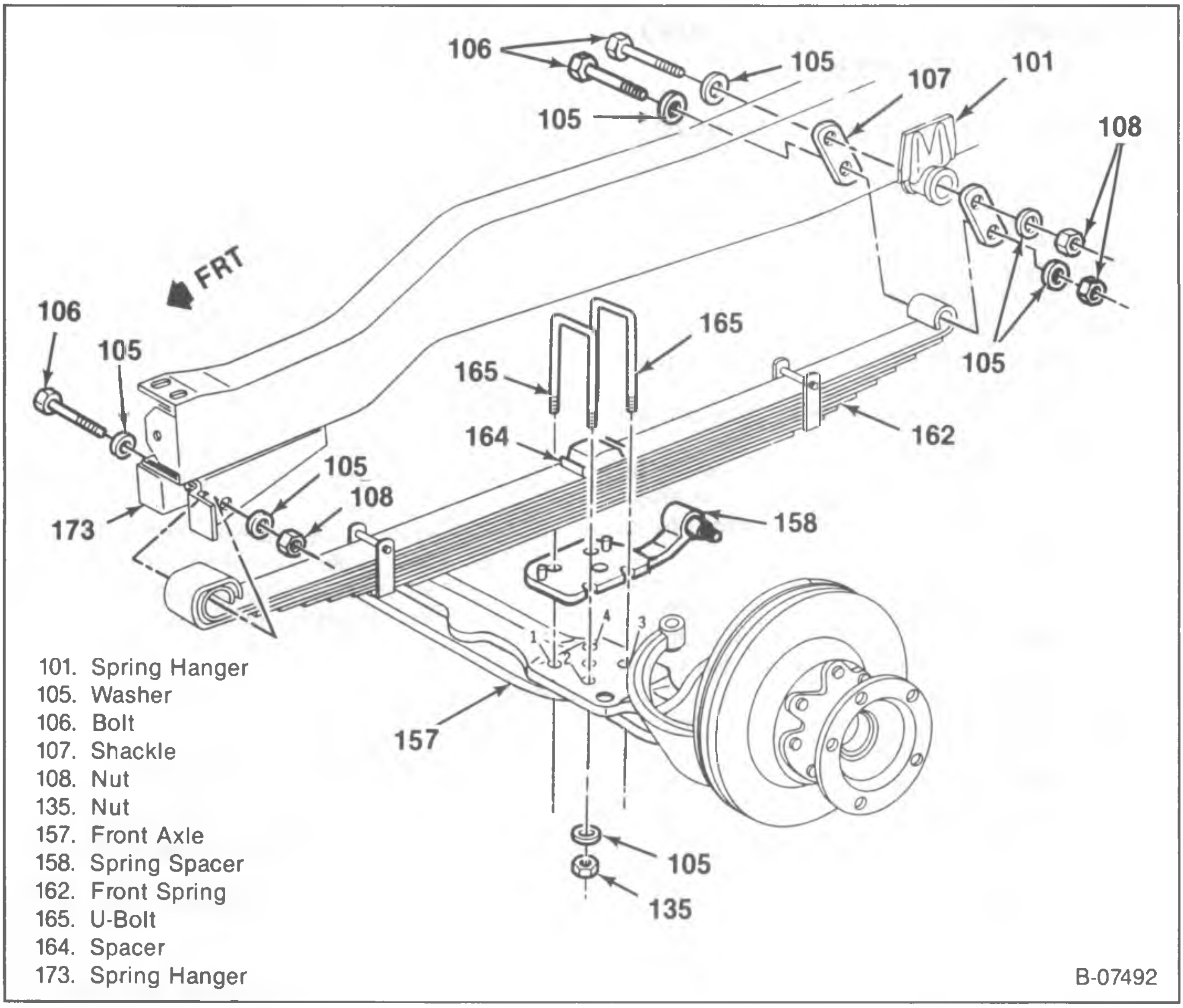

Figure 36—Axle And Leaf Spring Attachments

2. Shock absorber (113) from the axle (157) (figure 34).
   - Nut (109) and washer (111).
3. Stabilizer link (116) from the stabilizer bar (166) (figure 35).
   - Nut (115) and washer (114).
   - Use J-6627-A to separate the stabilizer bar from the stabilizer link.
4. Stabilizer link (116) from the axle (157) (figure 35).
   - Nut (136), retainer (117) and insulator (118).
   - Pull the link free from the axle, making sure not to loose the other insulator (118) and retainer (117).
5. Leaf spring (162) from the axle (157) (figure 36).
   - Nuts (135), washers (105) and U-bolts (165).
   - Spacer (164), and spring spacer (158).
6. Steering damper from the axle.
   - Refer to STEERING LINKAGE (SEC. 3B1).
7. Lower the floor jack and pull the axle clear of the vehicle.

Install or Connect (Figures 32 through 36)

NOTICE: For steps 4, 5, and 6, refer to the "Notice" on page 3C#1 of this section.

1. Line up the axle under the leaf springs.
   - Raise it into position using a floor jack.
2. Steering damper to the axle.
   - Refer to STEERING LINKAGE (SEC. 3B1).
3. Axle (157) to the leaf springs (162).
   - Refer to "Leaf Spring," in this section.
4. Stabilizer link (116) to the axle (157) (figure 35).
   - Link into the hole on the spring spacer (158) and axle.
   - Insulator (118), retainer (117), and nut (136).

Tighten

- Nut (136) until the distance between each retainer (117) is 2.08 cm (0.82 inches) (figure 35).

5. Stabilizer link to the stabilizer bar (166) (figure 35).
    - Washer (114) and nut (115).

Tighten

- Nut (115) to 68 N·m (50 ft. lbs.).

6. Shock absorber (113) to the axle (157) (figure 34).
    - Washer (111) and nut (109).

Tighten

- Nut (109) to 50 N·m (37 ft. lbs.).

7. Steering arm, knuckle, and spindle.
    - Refer to "Steering Arm, Knuckle, and Spindle," in this section.
8. Adjust the wheel bearings.
    - Refer to "Wheel Bearing Adjustment" in this section.
9. Wheel and tire assembly. Lower the vehicle to the ground.
10. Check the front end alignment.
    - Refer to FRONT END ALIGNMENT (SEC. 3B1).

LEAF SPRINGS

Remove or Disconnect (Figures 32 through 36)

Tools Required:
J-6627-A Wheel Stud and Tie Rod Remover

- Raise the vehicle and support it with suitable safety stands. Support the axle separately to eliminate any load on the springs. Remove the tire and wheel assembly.

1. Shock absorber (113) from the axle (157) (figure 34).
    - Nut (109) and washer (111).
2. Stabilizer link (116) from the stabilizer bar (166) (figure 35).
    - Nut (115) and washer (114).
    - Use J-6627-A to separate the stabilizer bar from the stabilizer link.
3. Stabilizer link (116) from the axle (157) (figure 35).
    - Nut (136), retainer (117), insulator (118).
    - Pull the link free from the axle, making sure not to loose the other insulator (118) and retainer (117).
4. Leaf spring (162) from the axle (157) (figure 36).
    - Nuts (135), washers (105) and U-bolts (165).
    - Spacer (164) and spring spacer (158).
5. Leaf spring (162) from the frame (figure 36).
    - Nut (108), washer (105), bolt (106) and washer (105) to separate the spring from the rear shackle (107).
    - Nut (108), washer (105), bolt (106), and washer (105) to separate the spring from the front hanger (173).
    - Pull the leaf spring backward and out.

Install or Connect (Figures 32 through 36).

NOTICE: For steps 1, 2, 3, 4 and 5, refer to the "Notice" on page 3C#1 of this section.

1. Leaf spring (162) to the frame (figure 36).
    - Line up the spring with the rear shackle (107) and the front hanger (173). Double wrap end is toward the front of the vehicle.
    - Washer (105), bolt (106), washer (105) and nut (108) to attach the spring to the front hanger (173).
    - Washer (105), bolt (106), washer (105) and nut (108) to attach the spring to the rear shackle (107).

Tighten

- Nut (108) to 125 N·m (92 ft. lbs.).

2. Leaf spring (162) to the axle (157) (figure 36).
    - Position the spring spacer (158) onto the axle. Either aligning pin can contact the edge of the leaf spring after the assembly is complete.
    - Spacer (164), U-bolts (165), washers (105) and nuts (135). Tighten nuts to 25 N·m (18 ft. lbs.) in a diagonal sequence (e.g., 1-3-4-2).

Tighten

- Nuts (135) in a diagonal sequence (e.g., 1-3-4-2) to 109 N·m (80 ft. lbs.).

3. Stabilizer link (116) to the axle (157) (figure 35).
    - Insert the link into the proper hole in the axle after the retainer (117) and insulator (118) are attached.
    - Insulator (118), retainer (117), and nut (136).

Tighten

- Nut (136) until the distance between each retainer (117) is 2.08 cm (0.82 inches) (figure 35).

4. Stabilizer link (116) to the stabilizer bar (166) (figure 35).
    - Washer (114) and nut (115).

Tighten

- Nut (115) to 68 N·m (50 ft. lbs.).

5. Shock absorber (113) to the axle (157) (figure 34).
   - Washer (111) and nut (109).

Tighten

- Nut (109) to 50 N·m (37 ft. lbs.).

6. Wheel and tire assembly. Lower the vehicle to the ground.
7. Check the front end alignment.
   - Refer to FRONT END ALIGNMENT (SEC. 3B1).

ON-VEHICLE SERVICE: FOUR WHEEL DRIVE FRONT SUSPENSION

SHOCK ABSORBER

Remove or Disconnect (Figures 37 through 39)

- Raise the vehicle on a hoist.

1. Shock absorber (220) from the frame.
   - Nut (212), washer (213) and bolt (219) (figure 36).
2. Shock absorber (220) from the axle.
   - Nut (212), washer (213) and bolt (225).
   - Quad shocks (RPO Z75) have a spacer (246) between them (figure 39).

BENCH TEST: SPIRAL GROOVE SHOCK ABSORBERS

1. Purge the air from the pressure chamber.
   - Extend the shock vertically—top end up.
   - Turn the shock over and collapse it vertically—top end down.
   - Repeat the above step five times.
2. Place the shock absorber in a vise with the jaws clamped onto the shock's bottom mount.
   — Shock absorber should be positioned vertically in the vise—top end up.
   — Do not clamp the vise jaws on the shock's reservoir tube.
3. Pump the shock absorber at various rates of speed and observe the rebound force.
   — Rebound force is normally stronger than the compression force (approximately two to one).
   — Rebound force should be smooth and constant for each stroke rate.
4. Compare with a good shock absorber.
5. If one of the following are observed, replace the shock absorber.
   — A skip or lag at reversal near mid-stroke.
   — A seize (except at the extreme ends of travel).
   — A noise (grunt or squeal) after completing one full stroke in both directions.
   — A clicking noise at fast reversal.

BENCH TEST: NON-SPIRAL GROOVE RESERVOIR SHOCK ABSORBERS

- Purging air from non-spiral groove shock absorbers is not necessary. The shock absorbers have a gas filled cell in their reservoirs (as opposed to the air filled cell in the spiral groove shock absorber reservoirs).

1. Place the shock absorber in a vise with the jaws clamped on the shock absorber's top mount.
   — Shock absorber should be held vertically in the vise with its bottom end up.
   — Do not clamp the vise jaws on the shock's reservoir tube.
2. Pump the shock absorber at various rates of speed and observe the rebound force.

— Rebound force is normally stronger than the compression force (approximately two to one).

— Rebound force should be smooth and constant for each stroke rate.

3. Compare with a good shock absorber.
4. If one of the following are observed, replace the shock absorber.
   — A skip or lag at reversal near mid-stroke.
   — A seize (except at the extreme ends of travel).
   — A noise (grunt or squeal) after completing one full stroke in both directions.
   — A clicking noise at fast reversal.

Install or Connect (Figures 37 and 38)

NOTICE: For steps 1 and 2, refer to the "Notice" on page 3C#1.

1. Shock absorber (220) to the axle.
   - Bolt (225), washer (213), and nut (212).
   - Spacer (246) must be positioned between the shock absorbers (220) on vehicles with quad shocks, RPO Z75 (figure 39).

Tighten

- Nut (212) to 88 N·m (65 ft. lbs.).
- Nut (212) to 120 N·m (89 ft. lbs.) on quad shocks (RPO Z75).

2. Shock absorber (220) to the frame.
    - Bolt (219), washer (213) and nut (212).

Tighten

- Nut (212) to 88 N·m (65 ft. lbs.).

3. Lower the vehicle to the floor.

STABILIZER BAR

Remove or Disconnect (Figures 37, 38 and 40)

- Raise the vehicle on a hoist.

1. Stabilizer bar (230) from the frame brackets (237).
    - Nuts (231), washers (232), brackets (233), and bolts (238) (figure 37).
2. Stabilizer bar (230) from the spring plate (224).
    - Bolts (229), and washers (228).
    - Stabilizer bar is free of the vehicle.
    - Bushings (234) can be removed from the stabilizer bar.

Install or Connect (Figures 37, 38 and 40)

1. Stabilizer bar (230) to the frame brackets (237).
    - Bushings (234) onto the stabilizer bar.
    - Use rubber lubricant when installing the bushings (slit faces forward) on the stabilizer bar.
    - Brackets (233), bolts (238), washers (232), and nuts (231) (figure 37). Do not tighten.

NOTICE: Refer to "Notice" on page 3C#1 of this section.

2. Stabilizer bar (230) to the spring plate (224).
    - Washers (228) and bolts (229) (figure 40).

Tighten

- Nuts (231) to 70 N·m (52 ft. lbs.).
- Bolts (229) to 180 N·m (133 ft. lbs.).

3. Lower the vehicle to the ground.

WHEEL HUB/ROTOR ASSEMBLY

Remove or Disconnect (Figures 37, 38, and 41 through 43)

Tools Required:
J-6893-D Wheel Bearing Nut Wrench (10/1500–20/2500 Series)
J-23446 Torque Wrench Adapter
J-26878-A Wheel Bearing Nut Wrench (30/3500 Series)

- Raise the vehicle and support it with suitable safety stands. Remove the tire and wheel assembly.

1. Caliper
    - Refer to BRAKES (SEC. 5).
2. Locking hub (249).
    - Refer to FRONT AXLE (SEC. 4C).
3. Locking nut (250), ring (251) and adjusting nut (252).
    - Use J-6893-D and J-23446 for 10/1500–20/2500 series vehicles.
    - Use J-26878-A for 30/3500 series vehicles.
4. Hub/Rotor Assembly (257).
    - Outer wheel bearing (253) will slide off the spindle (265) ahed of the hub/rotor (257).
    - Use a brass drift and hammer for the seal (260) and races (254, 258).
    - The inner bearing (259), race (258) are behind the seal (260).

Inspect

1. Rotor braking surfaces for scoring, pitting, or cracks.
    - Repair or replace as necessary.
2. Wheel bearings (253, 259) and races (254, 258).
    - Refer to "Diagnosis of Wheel Bearings," in this section.
    - If either a bearing or its race is damaged or worn, replace both.

Install or Connect (Figures 37, 38, and 41 through 43)

Tools Required:
J-8092 Driver Handle
J-6368 Bearing Race Installer (Outer)
J-23448 Bearing Race Installer (Inner)
J-6893-D Wheel Bearing Nut Wrench (10/1500–20/2500 series vehicles)
J-26878-A Wheel Bearing Nut Wrench (30/3500 series vehicles)
J-23446 Torque Wrench Adapter

1. Races (254, 258) into the rotor/hub (257).
    - Use J-8092 and J-6368 for installation of the outer bearing outer race (254).
    - Use J-8092 and J-23448 for installation of the inner bearing outer race (258).
    - Do not damage the hub/rotor during the race installations.

Clean

- Grease from the rotor/hub (257) and spindle (265).

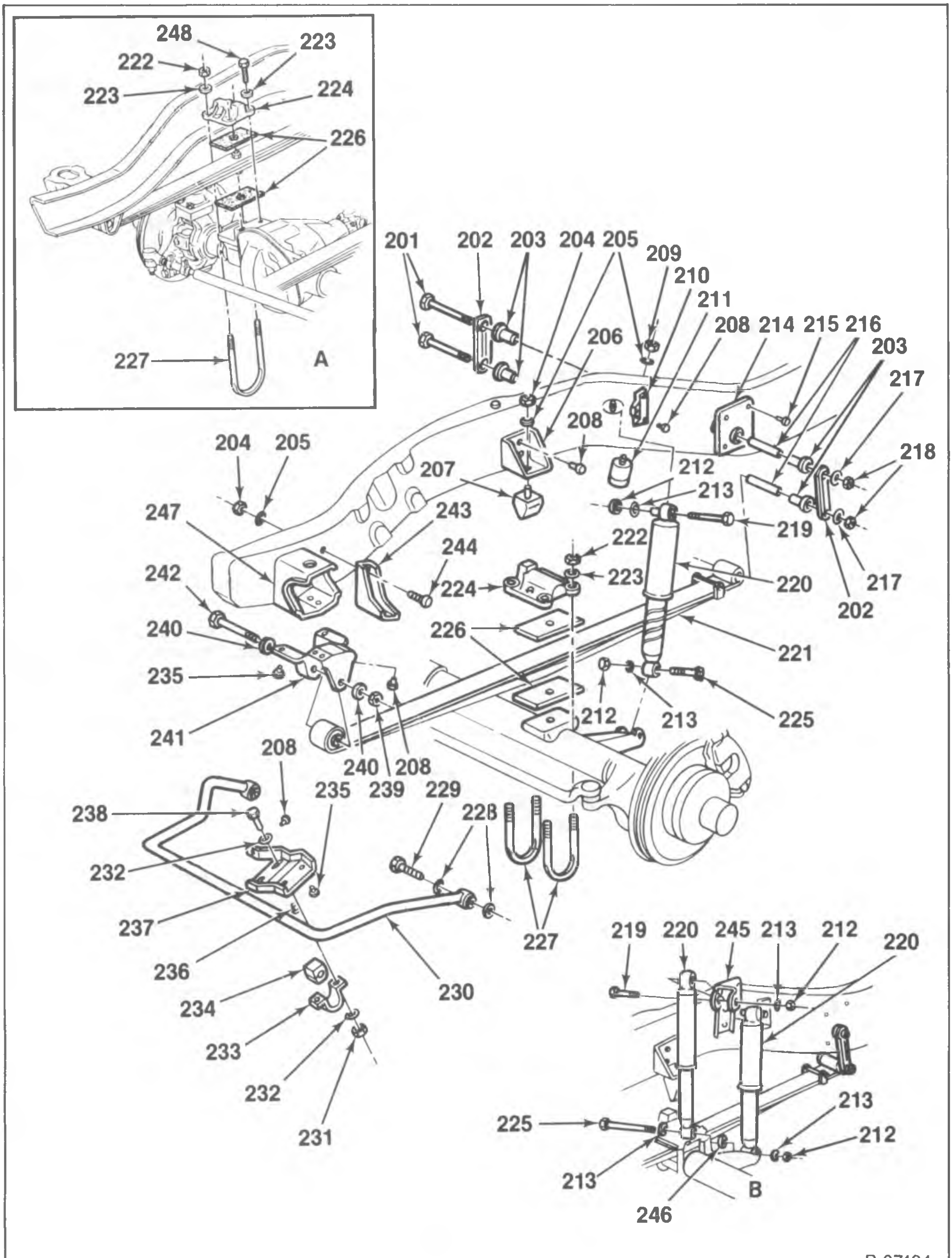

Figure 37—K Series (4 x 4) Front Suspension

201. Bolt
202. Shackle
203. Bushing
204. Nut
205. Washer
206. Bracket
207. Bumper
208. Rivet
209. Nut
210. Bracket
211. Bumper
212. Nut
213. Washer
214. Hanger
215. Rivet
216. Spacer
217. Washer
218. Nut
219. Bolt
220. Shock Absorber
221. Leaf Spring
222. Nut
223. Washer
224. Plate
225. Bolt
226. Spacer
227. Bolt
228. Washer
229. Bolt
230. Stabilizer Shaft
231. Nut
232. Washer
233. Bracket
234. Bushing
235. Rivet
236. Rivet
237. Bracket
238. Bolt
239. Nut
240. Washer
241. Hanger
242. Bolt
243. Reinforcement
245. Bracket
246. Spacer
247. Bracket
248. Bolt
A. K3500 Series Right Side
B. Quad Shock RPO Z75

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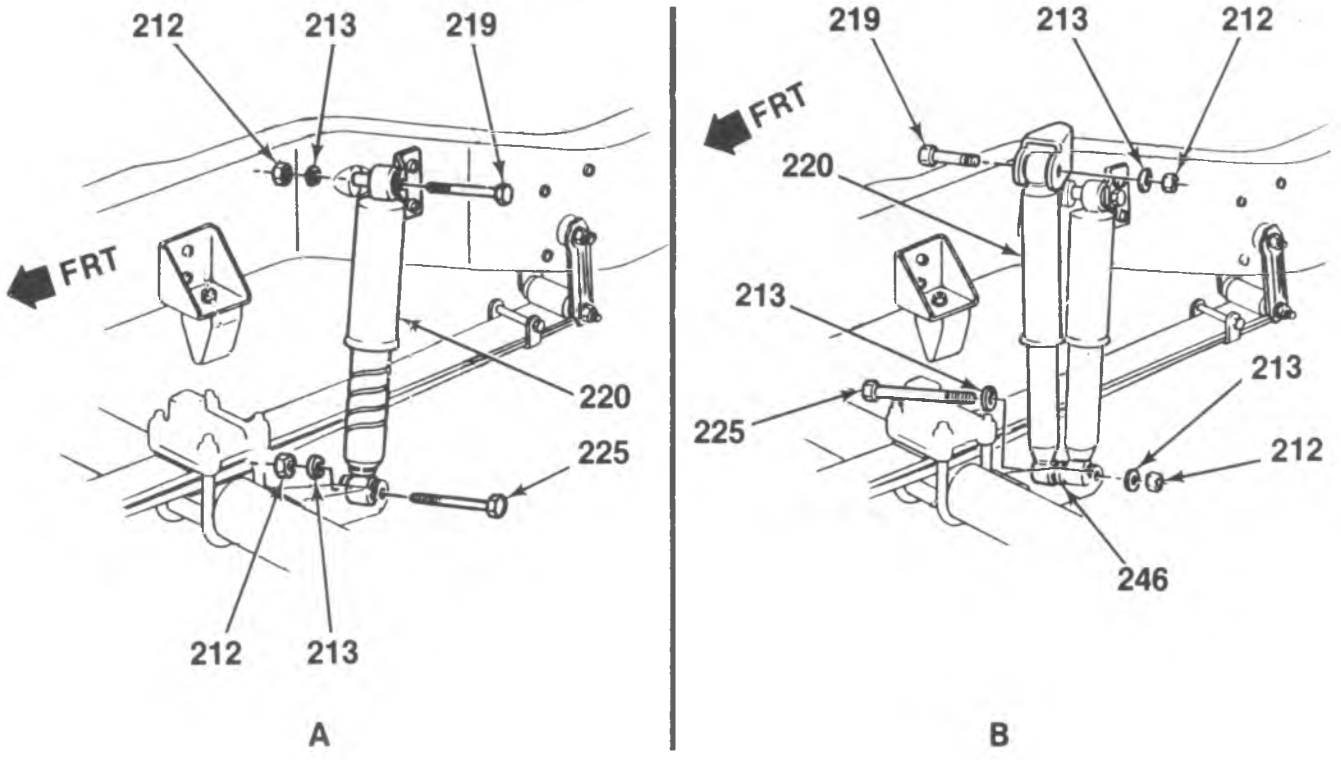
Figure 38—K Series (4 x 4) Front Suspension



A. K Series Standard Shock Absorber Mounting
B. K Series RPO Z75 Quad Shock Absorber Mounting
212. Nut
213. Washer
219. Bolt
220. Shock Absorber
225. Bolt
246. Spacer

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Figure 39—Shock Absorber Attachments

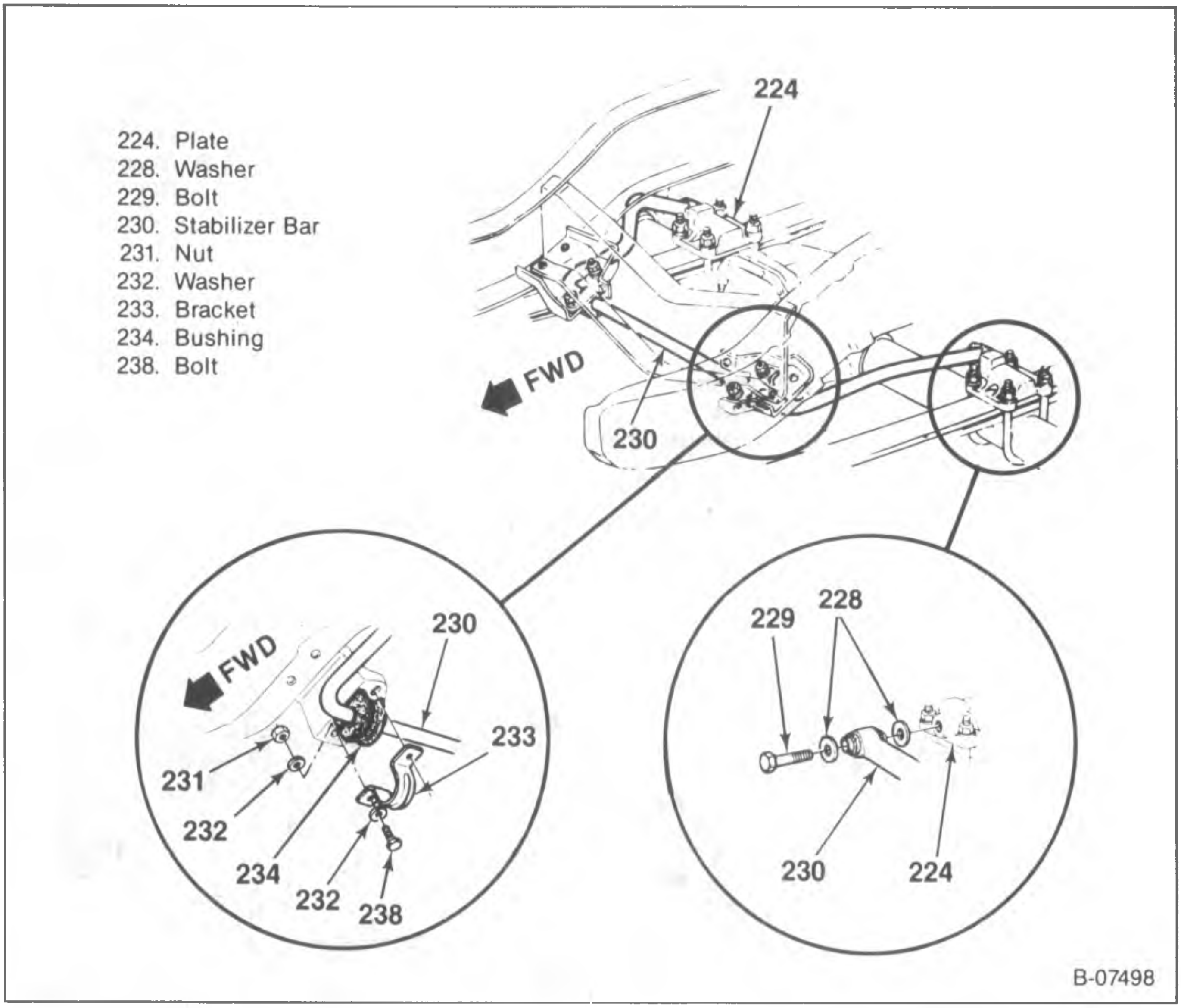

Figure 40—Stabilizer Bar Attachments

- Grease from the wheel bearings (253, 259).
- Use clean solvent and a small brush (no loose bristles).
- Do not spin the wheel bearings with compressed air to dry them—the wheel bearings may be damaged.

Important

- Use an approved high-temperature front wheel bearing grease. Refer to MAINTENANCE AND LUBRICATION (SEC. 0B).
- Do not mix greases as mixing may change the grease's properties resulting in poor performance.

2. Apply a thin film of grease to the spindle at the outer wheel bearing seat and at the inner wheel bearing seat, shoulder, and seal seat.
3. Put a small quantity of grease inboard of each wheel bearing cup, inside the rotor/hub (257).
4. Fill the wheel bearing (cone and roller assemblies) full of grease.
    - Use a cone-type grease packer that forces grease into the bearing.
    - If a cone-type grease packer is not available, pack the wheel bearings by hand.
    - If packing the wheel bearings by hand, work the grease into the bearings between the rollers, cones, and the cage.

NOTICE: Failure to completely pack the wheel bearings (cones, rollers, and cage) with grease will result in premature wheel bearing damage and/or wear.

5. Inner wheel bearing (259) into the rotor/hub (257).
    - Put an additional quantity of grease outboard of this wheel bearing.
6. New seal (260).

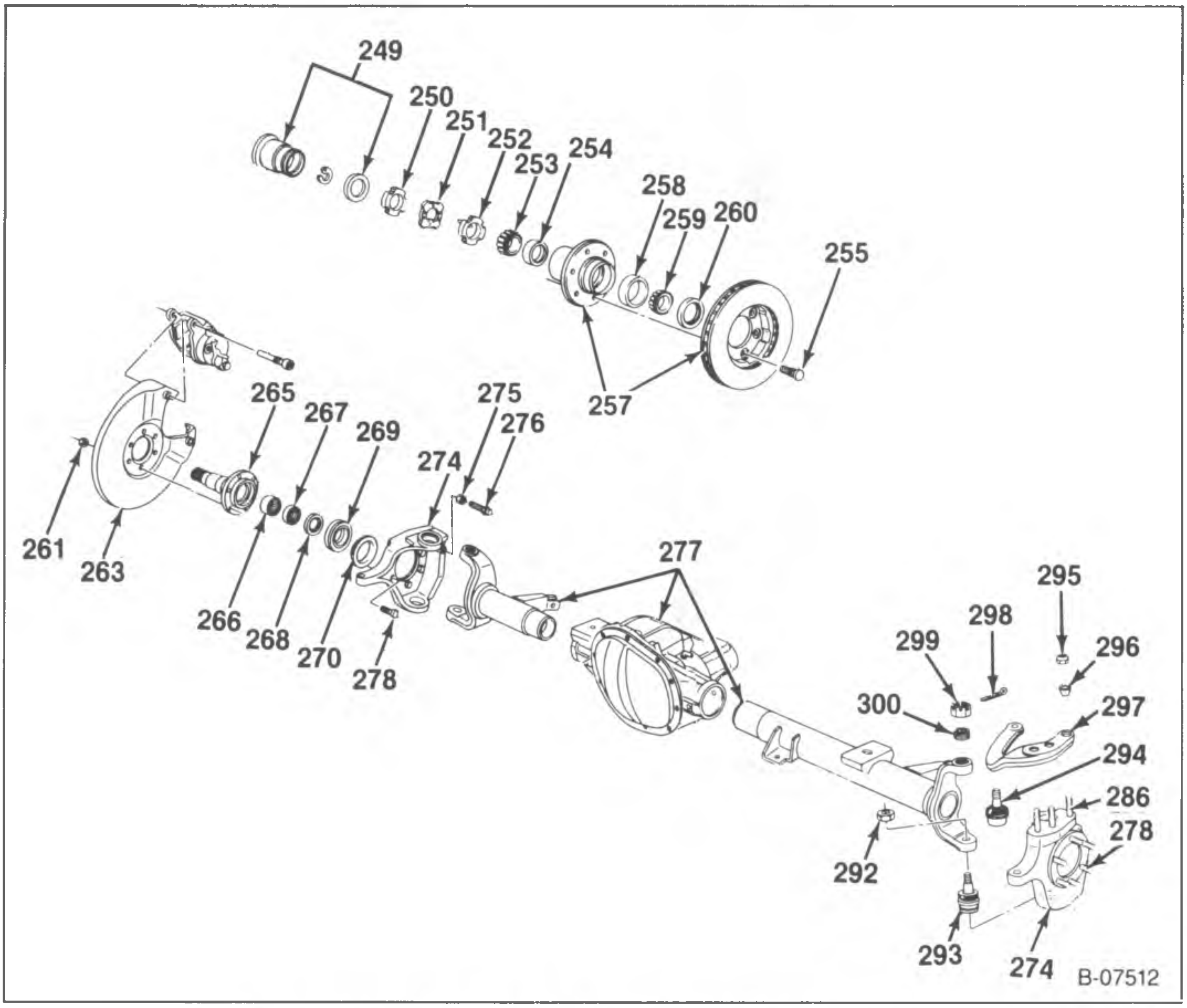

Figure 41—K10/1500-20/2500 Series Knuckle, Wheel Hub/Rotor Assembly

- Use a flat plate to install the seal so it is flush with the rotor/hub flange.
- Lubricate the seal lip with a thin layer of grease.

7. Rotor/hub (257).
   - Do not damage the spindle threads.
8. Outer wheel bearing (253).
   - Press on the spindle until the wheel bearing fully seats against the rotor/hub outer race.
9. Adjusting nut (252).
10. Adjust the wheel bearing.
    - Refer to "Wheel Bearing Adjustment," in this section.

NOTICE: Refer to the "Notice" on page 3C#1 of this section.

11. Ring (251) and locking nut (250).
    - Tang on the inside diameter of the ring must pass onto the slot on the spindle (265).
    - The hole in the ring must align with the pin on the lock nut (250). Move the adjustment nut (252) to align the pin.
    - Use J-6893-D or J-26878-A and J-23446.

Tighten

- Lock nut (250) to 217 N·m (160 ft. lbs.) minimum.

12. Locking hub (249).
    - Refer to FRONT AXLE (SEC. 4C).
13. Caliper.
    - Refer to BRAKES (SEC. 5).
14. Wheel and tire. Lower the vehicle to the ground.

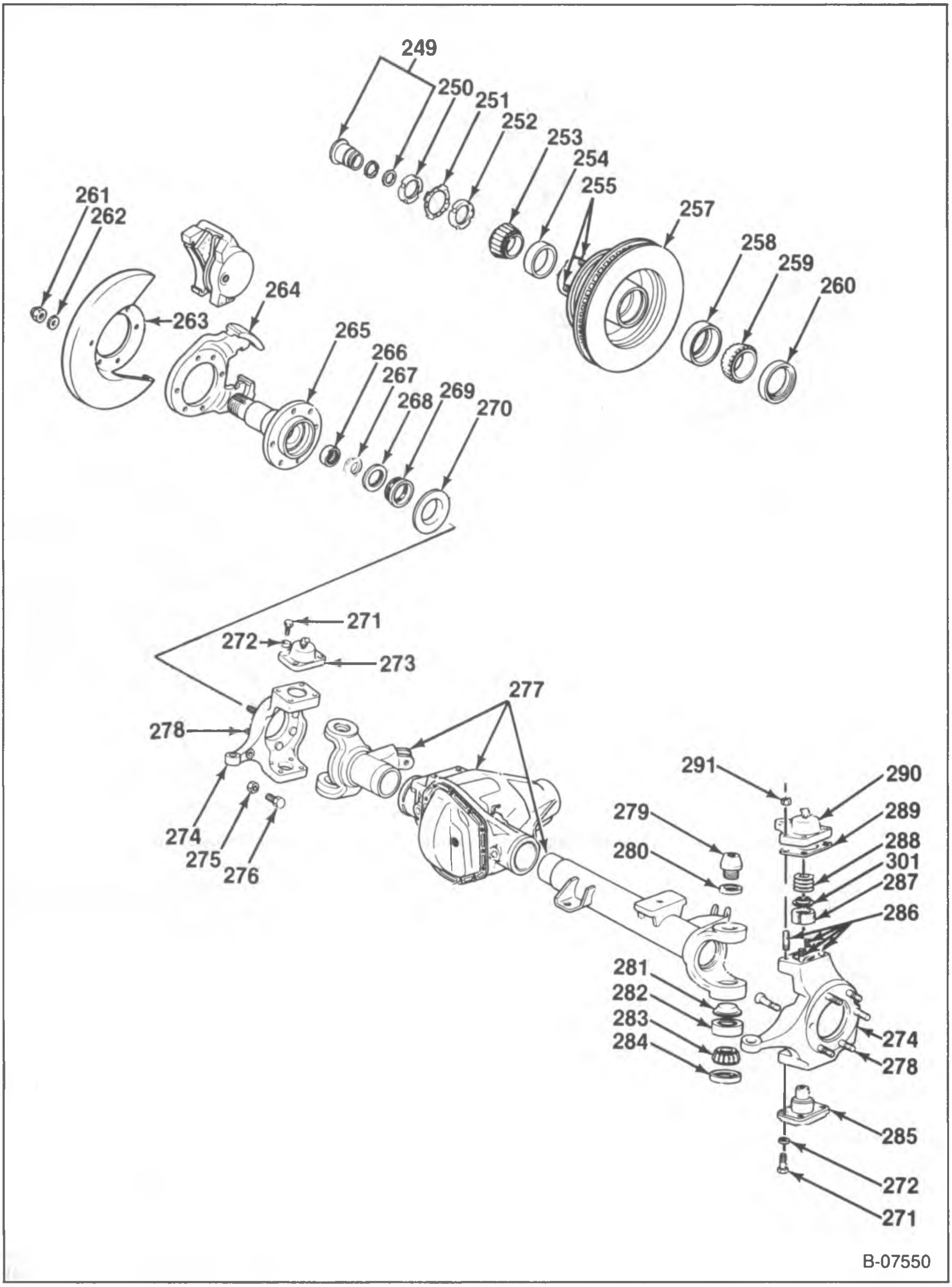

Figure 42—K30/3500 Series Knuckle, Wheel Hub/Rotor Assembly

249. Locking Hub Assembly
250. Locking Nut
251. Ring
252. Adjusting Nut
253. Outer Wheel Bearing
254. Outer Race
255. Wheel Hub Nut
257. Rotor/Hub
258. Inner Race
259. Inner Wheel Bearing
260. Seal
261. Nut
262. Washer
263. Plate
264. Bracket
265. Spindle
266. Shaft Bearing
267. Bearing Seal
268. Spacer
269. Seal
270. Oil Deflector
271. Bolt
272. Washer
273. Cap
274. Steering Knuckle
275. Nut
276. Bolt
278. Bolt
279. King Pin
280. Seal
281. Retainer
282. Race
283. Bearing
284. Seal
285. Bearing Cap and King Pin
286. Bolt
287. Bushing
288. Spring
289. Gasket
290. Steering Arm
291. Nut
292. Nut
293. Lower Ball Joint
294. Upper Ball Joint
295. Nut
296. Adapter
297. Steering Arm
298. Cotter Pin
299. Nut
300. Adjusting Ring
301. Retainer

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Figure 43—K Series Knuckle, Wheel Hub/Rotor Assembly

BEARING ADJUSTMENT

Important

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

Adjust

- Raise the vehicle and support it with safety stands.

1. Remove the locking hub assembly (249), lock nut (250), and the ring (251).

   Tighten

   - Adjusting nut (252) to 60 N·m (50 ft. lbs.) while rotating the hub/rotor in order to seat the bearings.

2. Back off the adjusting nut (252) and retighten.

   Tighten

   - For Automatic Hubs, torque the adjusting nut to 47 N·m (35 ft. lbs.) while rotating the wheel.
   - For Manual Hubs, torque the adjusting nut to 60 N·m (50 ft. lbs.) while rotating the wheel.

3. Back off the adjusting nut (252).
   - For Automatic hubs, back off 3/8 of a turn maximum.
   - For Manual hubs, back off enough to free the bearing.
4. Ring (251) and lock nut (252).
   - Tang on the inside diameter of the ring must pass onto the slot on the spindle (265).
   - The hole in the ring must align with the pin on the lock nut (250). Move the adjustment nut (252) to align the pin.

   Tighten

   - Lock nut (250) to 217 N·m (160 ft. lbs.) minimum.

Measure

- Endplay in the hub/rotor assembly. It should be set between 0.025 to 0.254 mm (0.001 to 0.010-inch).

5. Locking hub assembly (249).
   - Refer to FRONT AXLE (SEC. 4C).
6. Lower the vehicle to the ground.

WHEEL HUB BOLT

Remove or Disconnect (Figures 37, 38, and 44)

Tools Required:
J-9746-02 Hub/Rotor Support

1. Hub/rotor assembly from the vehicle.
   - Refer to "Wheel Hub/Rotor Assembly," in this section.
2. Wheel hub bolts (255) with a press.
   - Support the hub/rotor using J-9746-02 to prevent damage to the rotor face (figure 44).
   - Do not damage the wheel mounting surface on the hub/rotor flange.

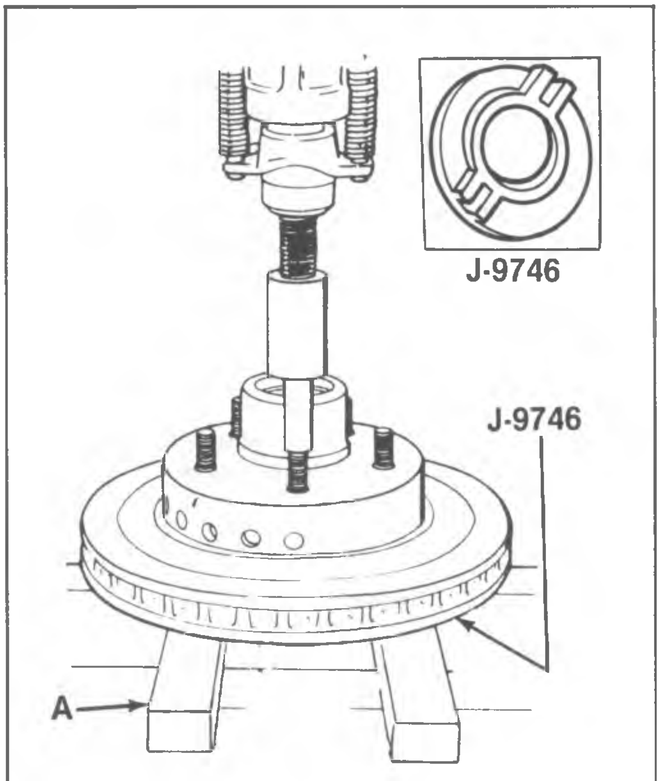


Figure 44—Pressing The Hub Bolt Out

Install or Connect (Figures 37, 38, and 45)

Tools Required:

J-9746-02 Hub/Rotor Support

NOTICE: Refer to "Notice" on page 3C#1 of this section.

1. New, serrated bolt (255) into the hole in the hub/rotor.
    - Place four washers onto the bolt, then fasten a nut onto the bolt until the nut bottoms on the washers (figure 45).

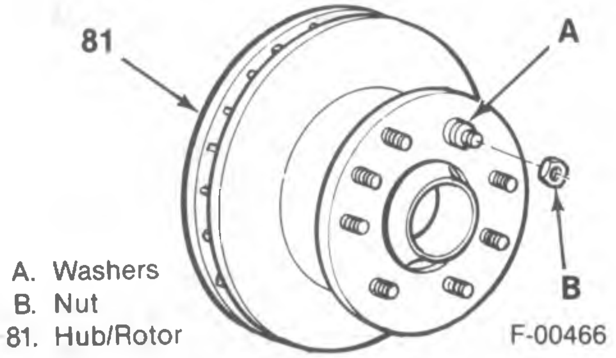


Figure 45—Installing The Wheel Hub Bolts

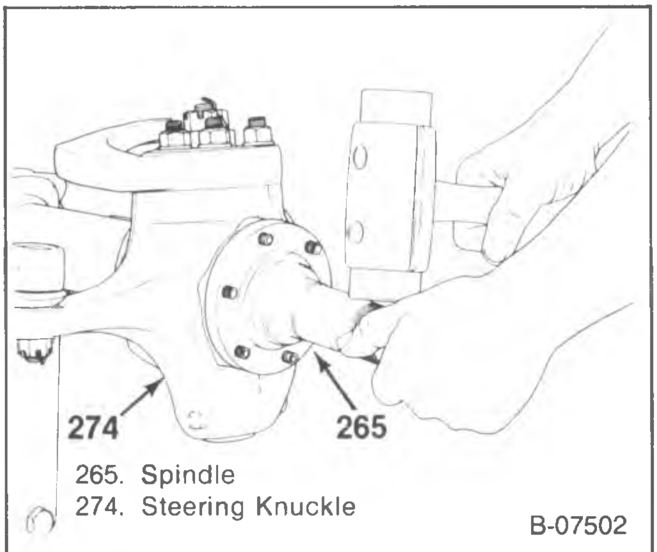


Figure 46—Removing The Spindle

- Tighten the nut until the bolt fully seats into the hub/rotor.
- Remove the nut and washers.

2. Hub/rotor to the vehicle.
    - Refer to "Wheel Hub/Rotor Assembly," in this section.
3. Wheel and tire assembly. Lower the vehicle.

SPINDLE

Remove or Disconnect (Figures 37, 38, 46 and 47)

- Raise the vehicle and support it with suitable safety stands. Remove the tire and wheel assembly.

1. Wheel hub/rotor assembly.
    - Refer to "Wheel Hub/Rotor Assembly," in this section.
2. Spindle (265) from the steering knuckle (274).
    - Nuts (261) and plate (263) for K10/1500–20/2500 series vehicles.
    - Nuts (261), washers (262), plate (263) and the bracket (264) for K30/3500 series vehicles.
    - Tap the end of the spindle with a plastic or rubber mallet to break it loose from the steering knuckle (274) (figure 46).

NOTICE: The machined surface of the spindle must not be damaged by vise jaws.

3. Spindle components.
    - Secure the spindle in a vise by locating on the high step diameter.
    - Bearing seal (267) and shaft bearing (266) (figure 47).

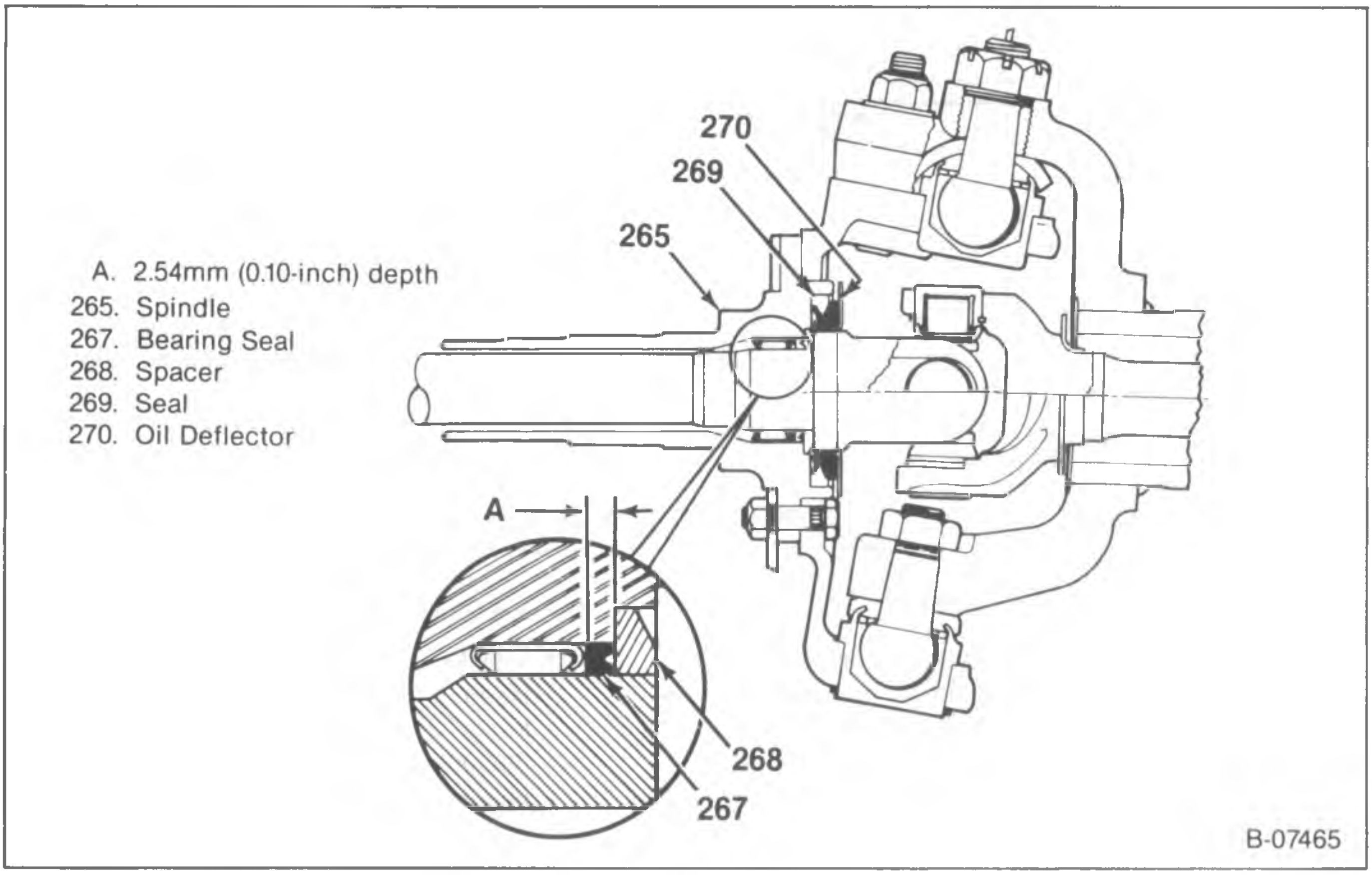

A. 2.54mm (0.10-inch) depth
265. Spindle
267. Bearing Seal
268. Spacer
269. Seal
270. Oil Deflector

Figure 47—Spindle Components

- Spacer (268), seal (269), and oil deflector (270) from the axle shaft (figure 47).

Inspect

- Spacer (268). Replace if it is worn.
- Spindle (265) for any heat burns, scoring, or wear. Replace if necessary.

Install or Connect (Figures 37, 38, 47 and 48)

Tools Required:
J-23445-A Needle Bearing Installer (K10/1500–20/2500 series)
J-8092 Driver Handle
J-21465-17 Bearing Installer (K30/3500 series)

- Relubricate the shaft bearing (266) and the spindle (265) with a high melting point type wheel bearing grease. Refer to MAINTENANCE AND LUBRICATION (SEC. 0B).

1. Shaft bearing (266) and bearing seal (267) into the spindle (265) (figure 47).
    - For K10/1500–20/2500 series vehicles, use J-8092 and J-23445-A.
    - For K30/3500 series vehicles, use J-8092 and J-21465-17.
2. Oil deflector (270) and seal (269) onto the axle shaft.
    - Seal (269) onto the oil deflector (270) with the deflector lip toward the spindle (265).
3. Spacer (268) onto the axle shaft.
    - The chamfer points toward the oil deflector (270) (figure 48).
4. Spindle (265) onto the steering knuckle (274).

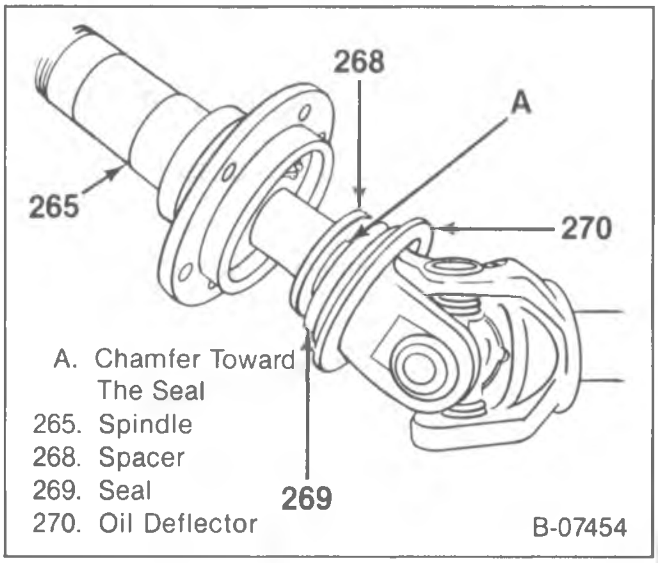

A. Chamfer Toward The Seal
265. Spindle
268. Spacer
269. Seal
270. Oil Deflector

Figure 48—Installing The Spindle Onto The Axle Shaft

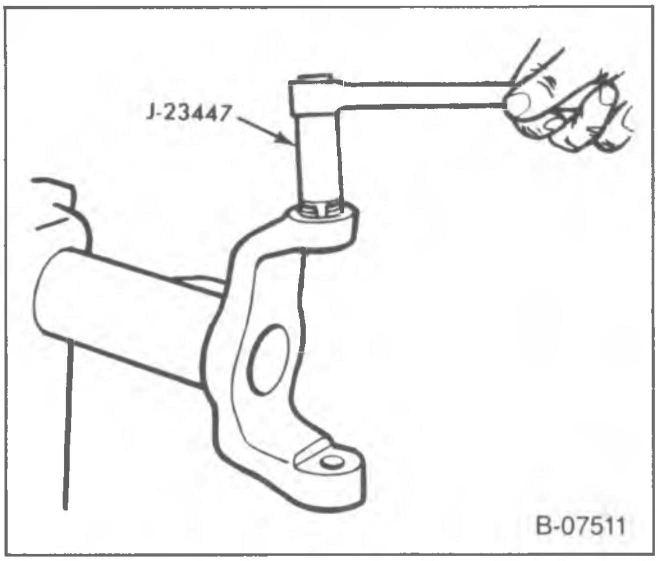


Figure 49—Tightening The Adjusting Ring

- Slide the spindle over the axle shaft until it seats on the steering knuckle. The bolts (278) must protrude through the spindle.

NOTICE: Refer to "Notice" on page 3C#1 of this section.

5. Bracket (264) and plate (263).
   - Only the K30/3500 series vehicles use a bracket (264).
   - Washers (262) (K30/3500 series only) and NEW nuts (261).

Tighten

   - Nuts (261) to 88 N·m (65 ft. lbs.).
6. Wheel hub/rotor assembly.
   - Refer to "Wheel Hub/Rotor Assembly," in this section.
7. Wheel and tire. Lower the vehicle to the ground.

STEERING KNUCKLE AND ARM

K10/1500-20/2500 SERIES VEHICLES (WITH BALL JOINTS)

Remove or Disconnect (Figures 37, 38, and 49)

- Raise the vehicle and support with suitable safety stands. Remove the tire and wheel assembly.

1. Locking hub assembly (249).
   - Refer to FRONT AXLE (SEC. 4C).
2. Wheel hub/rotor assembly.
   - Refer to "Wheel Hub/Rotor Assembly," in this section.
3. Spindle (265) from the steering knuckle (274).
   - Refer to "Spindle," in this section.
4. Tie rod from the steering arm (297).
   - Refer to STEERING LINKAGE (SEC. 3B1).
5. Steering arm (297) from the steering knuckle (274).
   - Nuts (295) and adapters (296).
   - Discard the nuts (295).

NOTICE: Do not remove the adjusting ring (300) unless new ball joints are being installed. If it is necessary to loosen the ring to remove the knuckle, do not loosen it more than two threads. Use J-23447 (figure 49). The nonhardened threads in the yoke can be easily damaged by the hardened threads in the adjusting ring if caution is not used during knuckle removal.

6. Steering knuckle (274) from the axle yoke.
   - Cotter pin (298), nuts (292, 299).
   - Insert a wedge-shaped tool between the lower ball joint (293) and the yoke. Tap on the tool to release the knuckle assembly.
   - Insert the wedge-shaped tool between the upper ball joint (294) and the yoke. Tap on the tool to release the knuckle assembly.

Install or Connect (Figure 37, 38 and 49)

Tools Required:

J-23447 Ball Stud Nut Wrench

NOTICE: For steps 2, 3, 4, 6 and 7, refer to "Notice" on page 3C#1 of this section.

1. Steering knuckle (274) to the axle yoke.
   - Ball joints (293, 294) into their respective sockets in the axle yoke.
   - Finger tighten the nuts (292, 299) onto the ball joints (293, 294). The nut with the cotter pin slot goes with the upper ball joint.
2. Push up on the steering knuckle [to keep the ball joint (293) from turning in the knuckle] and partially torque the lower ball joint nut (292).

Tighten

   - Nut (292) to 40 N·m (30 ft. lbs.).
3. Torque the adjusting ring (300).
   - Use J-23447 (figure 46).

Tighten

   - Adjusting ring (300) to 70 N·m (50 ft. lbs.).
4. Torque the upper ball joint nut (299).

Tighten

- Nut (299) to 135 N·m (100 ft. lbs.).

5. Cotter pin (298) into the nut (299).
    - Do not loosen the nut. Apply additional torque, if necessary, to line up the hole in the ball joint with the slot in the nut.
6. Apply the final torque to the lower ball joint nut (292).

Tighten

- Nut (292) to 95 N·m (70 ft. lbs.).

7. Steering arm (297) to the steering knuckle (274).
    - Adapters (296) and NEW nuts (295).

Tighten

- Nuts (295) to 120 N·m (90 ft. lbs.).

8. Tie rod to the steering arm (297).
    - Refer to STEERING LINKAGE (SEC. 3B1).
9. Spindle (265) to the steering knuckle (274).
    - Refer to "Spindle," in this section.
10. Wheel hub/rotor assembly.
    - Refer to "Wheel Hub/Rotor Assembly," in this section.
11. Adjust the wheel bearings.
    - Refer to "Wheel Bearing Adjustment," in this section.
12. Locking hub assembly (249).
    - Refer to FRONT AXLE (SEC. 4C).
13. Wheel and tire assembly.
14. Check the front end alignment.
    - Refer to FRONT END ALIGNMENT (SEC. 3A).
15. Lower the vehicle to the ground.

K30/3500 SERIES VEHICLES (WITH KING PINS)

Remove or Disconnect (Figures 37, 38, and 50 through 53)

Tools Required:
J-26871 King Pin Socket

- Raise the vehicle and support with suitable safety stands. Remove the tire and wheel assembly.

1. Locking hub (249).
    - Refer to FRONT AXLE (SEC. 4C).
2. Wheel hub/rotor assembly.
    - Refer to "Wheel Hub/Rotor Assembly," in this section.
3. Spindle (265).
    - Refer to "Spindle," in this section.
4. Upper cap (273) and/or steering arm (290).
    - For the cap, remove the bolts (271) and washers (272) alternately as the compression spring will force the cap up.
    - For the steering arm, remove the nuts (291) alternately as the compression spring will force the steering arm up (figure 50).
5. Gasket (289), and compression spring (288).
    - Discard the old gasket (289).
6. Lower bearing cap and king pin (285).
    - Bolts (271) and washers (272) (figure 51).
7. Upper king pin bushing (287).
    - Pull it out through the steering knuckle (274).
8. Steering knuckle (274) from the axle yoke.
    - Seal (301).
9. Upper king pin (279) from the axle yoke.
    - Use a large breaker bar and J-26871 (figure 49).
    - Apply 677–813 N·m (500–600 ft. lbs.) of torque to break the king pin free.

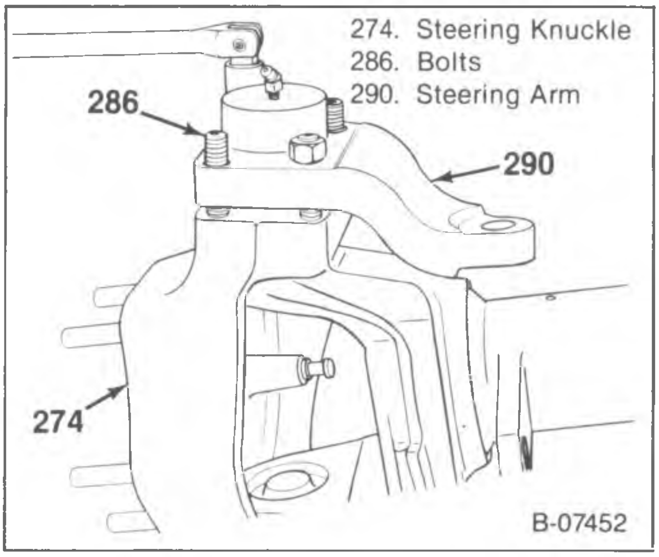


Figure 50—Removing The Cap And Steering Arm Fasteners

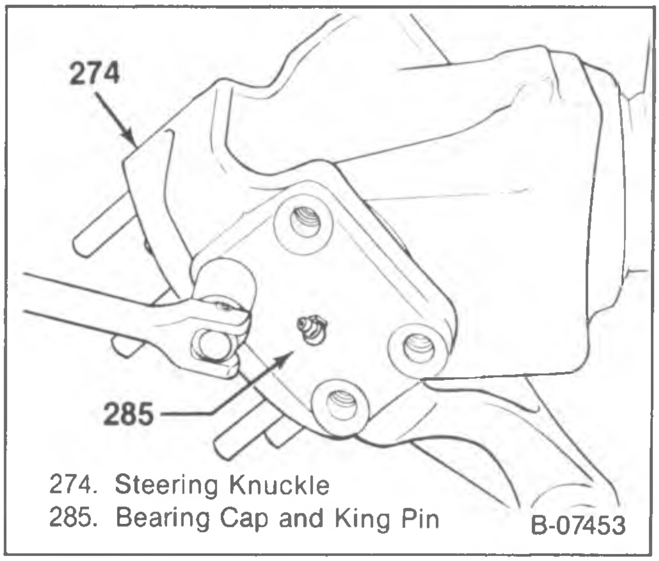


Figure 51—Removing The Lower Bearing Cap And King Pin

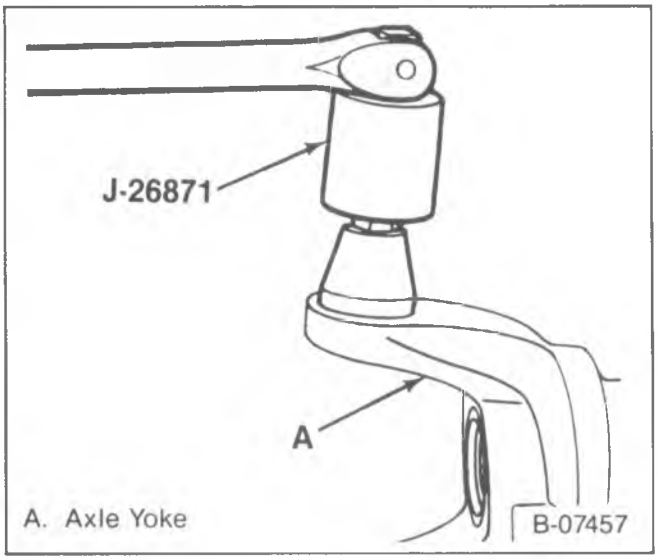


Figure 52—Removing The Upper King Pin

10. Retainer (281), race (282), bearing (283) and the seal (284) from the axle yoke.
    - Punch all the components out at once (figure 53).
    - Discard the old seal (284).
    - If the retainer (281) is damaged, discard it.

Install or connect (Figures 38, 39 and 54 through 56)

Tools Required:

J-7817 Front Pinion Bearing Installer

J-22301 King Pin Bearing Seal Installer

J-28871 King Pin Installer

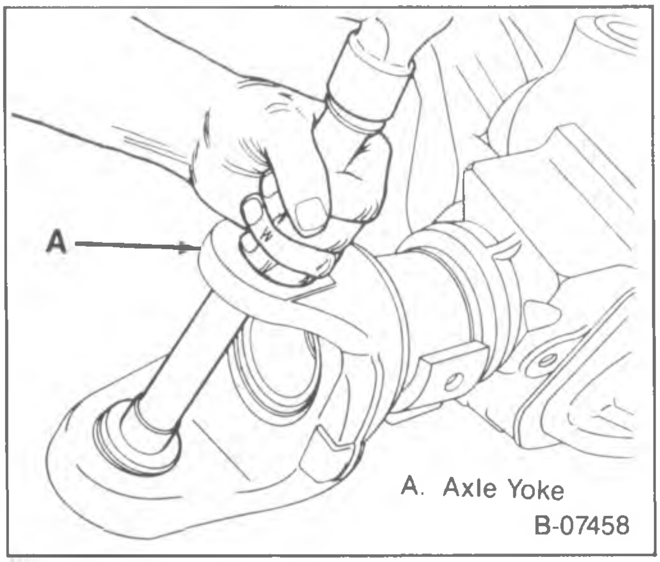


Figure 53—Removing The Retainer, Race, Bearing and Seal

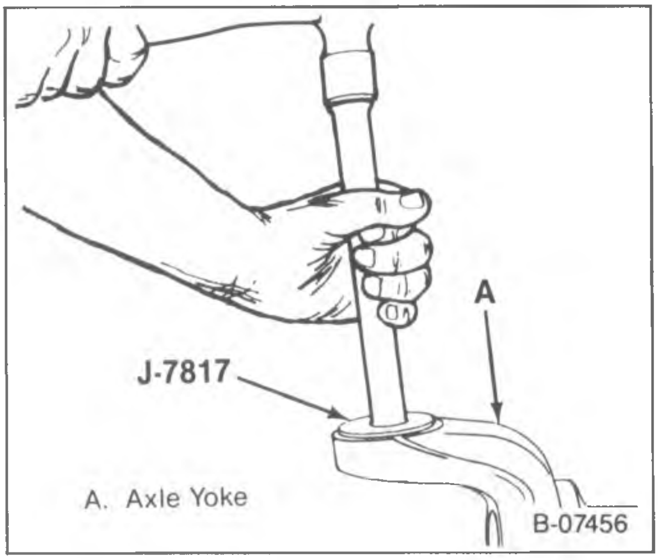


Figure 54—Installing The Retainer Into The Axle Yoke

NOTICE: For steps 4, 6, 7, refer to "Notice" on page 3C#1 of this section.

1. Retainer (281) and the race (282).
   - Use a new retainer.
   - Use J-7817 (figure 54).
2. Fill the area in the retainer (281) and race with an approved high temperature bearing lubricant. Grease the bearing (282).
   - Use a cone-type grease packer that forces grease into the bearing.
   - If a cone-type grease packer is not available, pack the bearing by hand. Work the grease between the rollers, cones, and cage.

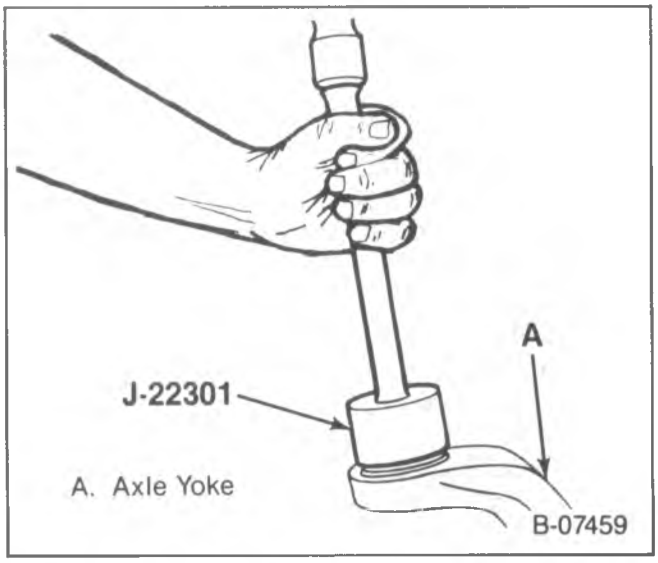
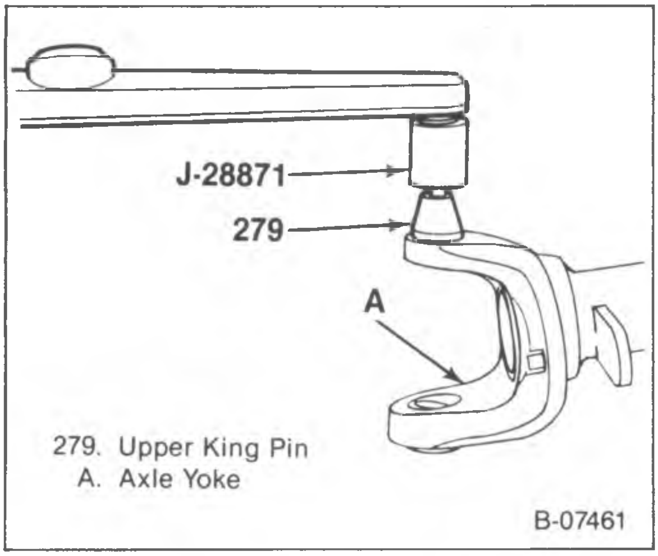


Figure 55—Installing The Seal Into The Axle Yoke



279. Upper King Pin
A. Axle Yoke

Figure 56—Installing The Upper King Pin

NOTICE: Failure to completely pack the bearing (cones, rollers, and cage) with grease will result in premature bearing damage and/or wear.

- Refer to MAINTENANCE AND LUBRICATION (SEC. 0B).

3. Bearing (283) and seal (284).
   - Use J-22301 to install the NEW seal (Figure 55).
   - Do not distort the seal. It will protrude slightly from the surface of the axle yoke flange when fully seated.
4. Upper king pin (279).
   - Use J-28871 (figure 56).

Tighten

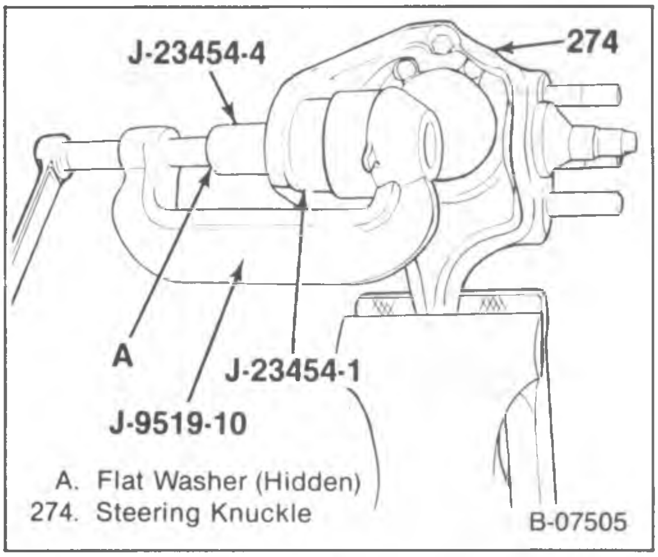
- King pin (279) to 745 N·m (550 ft. lbs.).

5. Steering knuckle (274) and bushing (287).
   - Felt seal (280) to the king pin (279) through the steering knuckle.
   - Knuckle onto the king pin (279).
   - Place the bushing (287) over the king pin (279).
6. Bearing cap and king pin (285) to the steering knuckle (278).
   - 4 bolts (271) and washers (272).

Tighten

- Bolts (271) alternately and evenly to 108 N·m (80 ft. lbs.).

7. Steering arm (290) to the steering knuckle (274).
   - Compression ring (288), gasket (289), and steering arm (290).
   - Nuts (291).



A. Flat Washer (Hidden)
274. Steering Knuckle

Figure 57—Removing The Lower Ball Joint

Tighten

- Nuts (291) alternately and evenly to 108 N·m (80 ft. lbs.).

8. Spindle (265).
   - Refer to "Spindle," in this section.
9. Wheel hub/rotor assembly.
   - Refer to "Wheel Hub/Rotor Assembly," in this section.
10. Adjust the wheel bearings.
    - Refer to "Wheel Bearing Adjustment" in this section.
11. Locking hub (249).
    - Refer to FRONT AXLE (SEC. 4C).
12. Wheel and tire assembly.
13. Check the front end alignment.
    - Refer to FRONT END ALIGNMENT (SEC. 3A).
14. Lower the vehicle to the ground.

BALL JOINTS (10/1500-20/2500 SERIES VEHICLES ONLY)

Remove or Disconnect (Figures 37, 38, 57 and 58)

Tools Required:
J-9519-10 Ball Joint Fixture
J-23454-1 Lower Ball Joint Spacer
J-23454-3 or
J-6382 Upper Ball Joint Spacer
J-23454-4 Upper and Lower Ball Joint Sleeve

- Raise the vehicle and support with suitable safety stands. Remove the wheel and tire assembly.

1. Wheel hub/rotor assembly.

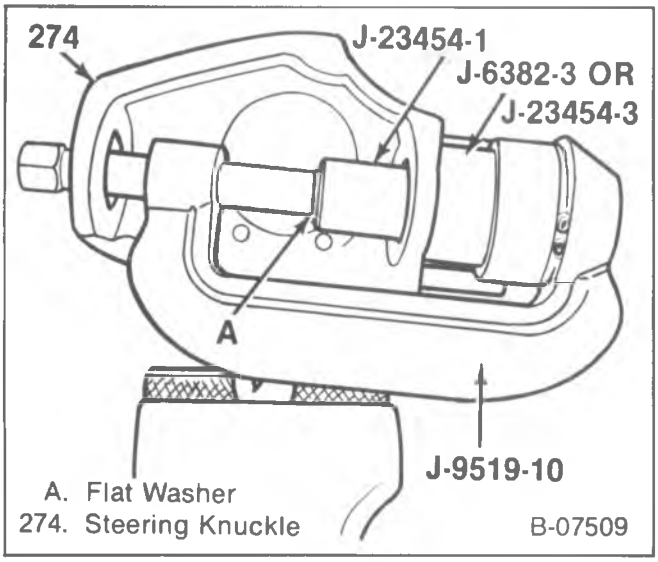


Figure 58—Removing The Upper Ball Joint

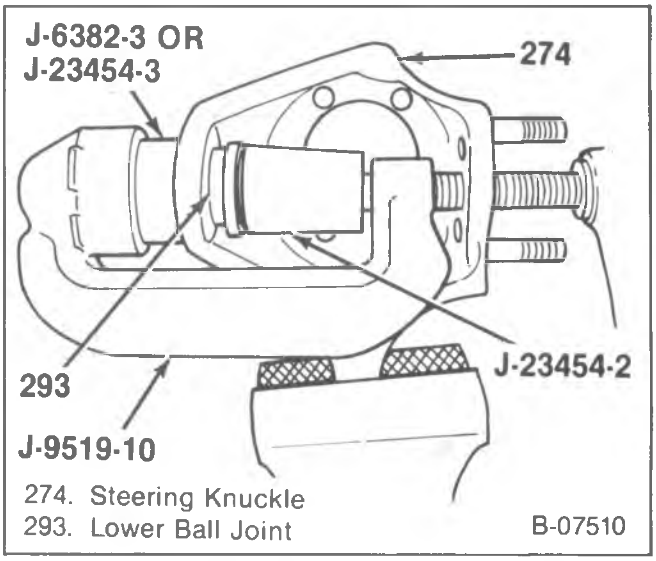


Figure 59—Installing The Lower Ball Joint

- Refer to "Wheel Hub/Rotor Assembly," in this section.

2. Spindle.
   - Refer to "Spindle," in this section.
3. Steering knuckle (274) and steering arm (290).
   - Remove the steering arm (290) only if removing the left axle yoke ball joints.
   - Refer to "Steering Knuckle and Arm," in this section."
   - Place the steering knuckle in a vise (figure 57).
4. Lower ball joint (293).
   - Must be removed before any service can be done to the upper ball joint (294).
   - Snap ring from the lower ball joint (293).
   - Use J-9519-10, J-23454-1, J-23454-4 or equivalent (figuer 57). Tighten until the ball joint breaks free of the steering knuckle.
5. Upper ball joint (294).
   - Use J-9519-10, J-23454-3 (or J-6382-3) and J-23454-4 (figure 58). Tighten until the ball joint breaks free of the steering knuckle.

Install or Connect (Figures 37, 38, 59 and 60)

Tools Required:

J-9519-10 Ball Joint Fixture
J-23454-2 Upper and Lower Ball Joint Sleeve
J-23454-3 or
J-6382-3 Upper and Lower Ball Joint Spacer

1. Lower ball joint (293) into the steering knuckle (274).
   - The ball joint (no cotter pin hole in the threaded end) must be positioned straight.
   - Use J-9519-10, J-23454-2, and J-23454-3 or J-6382-3 (figure 59). Tighten until the ball joint fully seats.
   - Snap ring in position.
2. Upper ball joint (294) into the steering knuckle (274).
   - Use J-9519-10, J-23454-2, and J-23454-3 or J-6382-3 (figure 60). Tighten until the ball joint fully seats.
3. Steering arm (290) and steering knuckle (274).
   - Steering arm only if removed.
   - Refer to "Steering Knuckle and Arm," in this section.
4. Spindle (265).
   - Refer to "Spindle," in this section.
5. Wheel hub/rotor assembly.
   - Refer to "Wheel Hub/Rotor Assembly," in this section.
6. Adjust the wheel bearings.
   - Refer to "Wheel Bearing Adjustment," in this section.
7. Wheel and tire assembly.
8. Check the front end alignment.

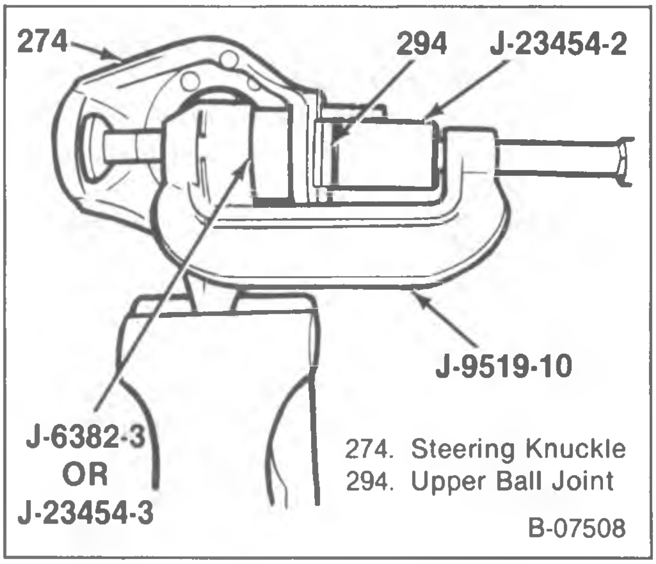


Figure 60—Installing The Upper Ball Joint

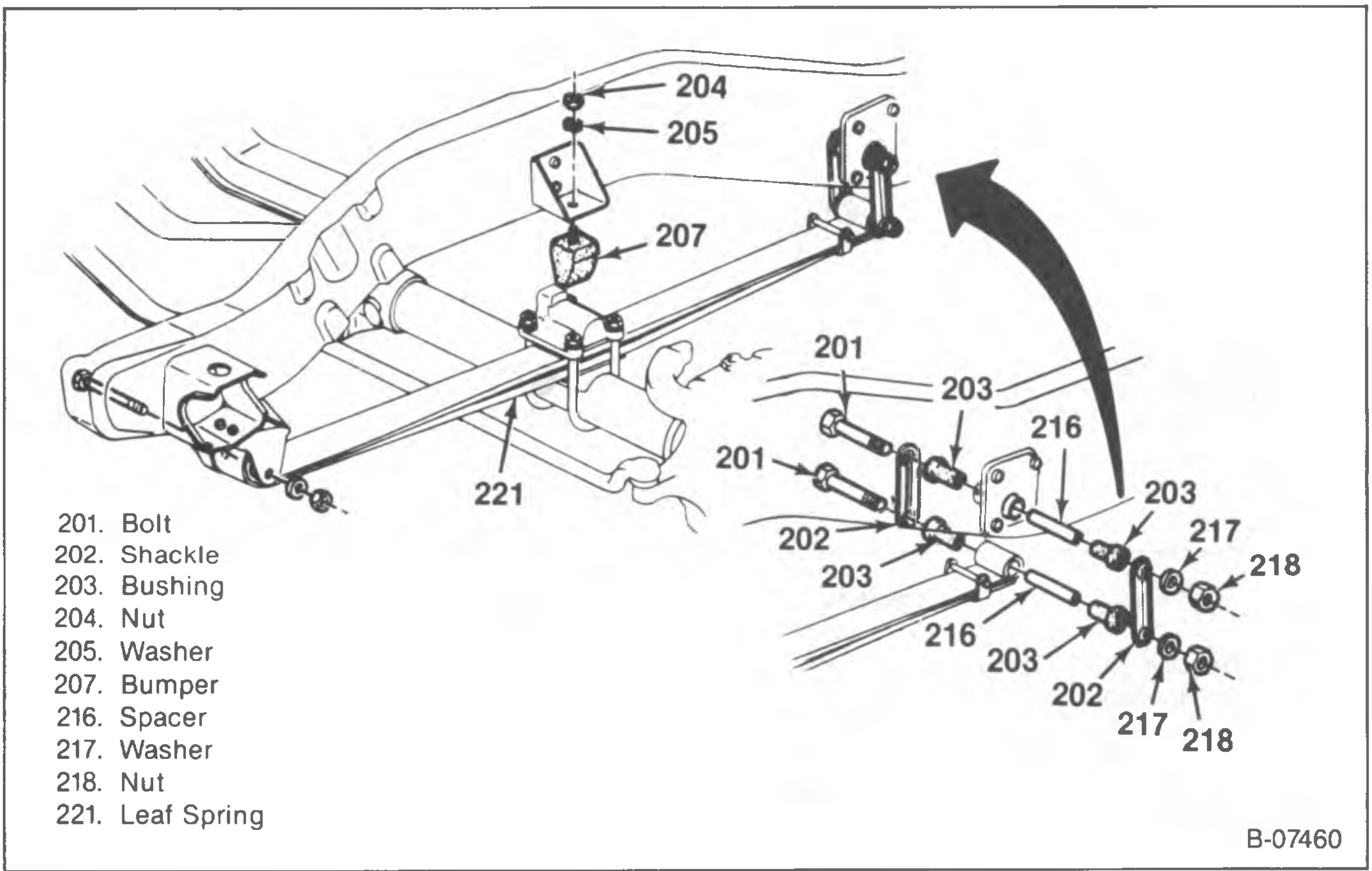


Figure 61—Leaf Spring Components

- Refer to FRONT END ALIGNMENT (SEC. 4C).

9. Lower the vehicle to the ground.

LEAF SPRING AND BUSHING

Remove or Disconnect (Figures 37, 38, and 61)

- Raise the vehicle on a hoist and support the front axle with a floor jack. Raise the floor jack until all tension is relieved from the springs.

1. Spring (221) from the frame.
   - Nut (218), washer (217), shackle (202), bolt (201), bushings (203) and spacer (216) (figure 61).
2. Spring (221) from the hanger (241).
   - Nut (239), washers (240), and bolt (242) (figure 61).
3. Spring (221) from the axle.
   - For K10/1500–20/2500 and the left side of K30/3500 series vehicles, remove nuts (222), washers (223), U-bolts (227), plate (224) and the spacers (226).
   - For the right side of K30/3500 series vehicles, remove the bolts (248), nuts (222), washers (223), U-bolt (227), plate (224) and the spacers (226) (figure 61).
4. Shackle (202) from the spring (221).
   - Nut (218), washer (217), bolt (201), bushings (203) and spacer (216) (figure 61).
5. Bushing from the spring eye.
   - Place the spring in a press and press out the bushing using a suitable rod, pipe, or tool.

Install or Connect (Figures 37, 38, 61 and 62)

1. Bushing into the spring eye.
   - Press in a new bushing, making sure the tool presses on the steel outer shell of the bushing.
   - Bushing must protrude an equal amount on either side of the spring eye when properly installed.
2. Shackle (202) into the spring (221).
   - Spacer (216), bushings (203), washers (217), bolt (201) and nut (218).
   - Do not tighten.
3. Upper spacer (226) onto the spring (221).
4. Spring into the hanger (241).
   - Bolt (242), washers (240) and nut (239).
   - Do not tighten.
5. Spring into the frame.
   - Bushings (203) and the spacer (216) into the frame.

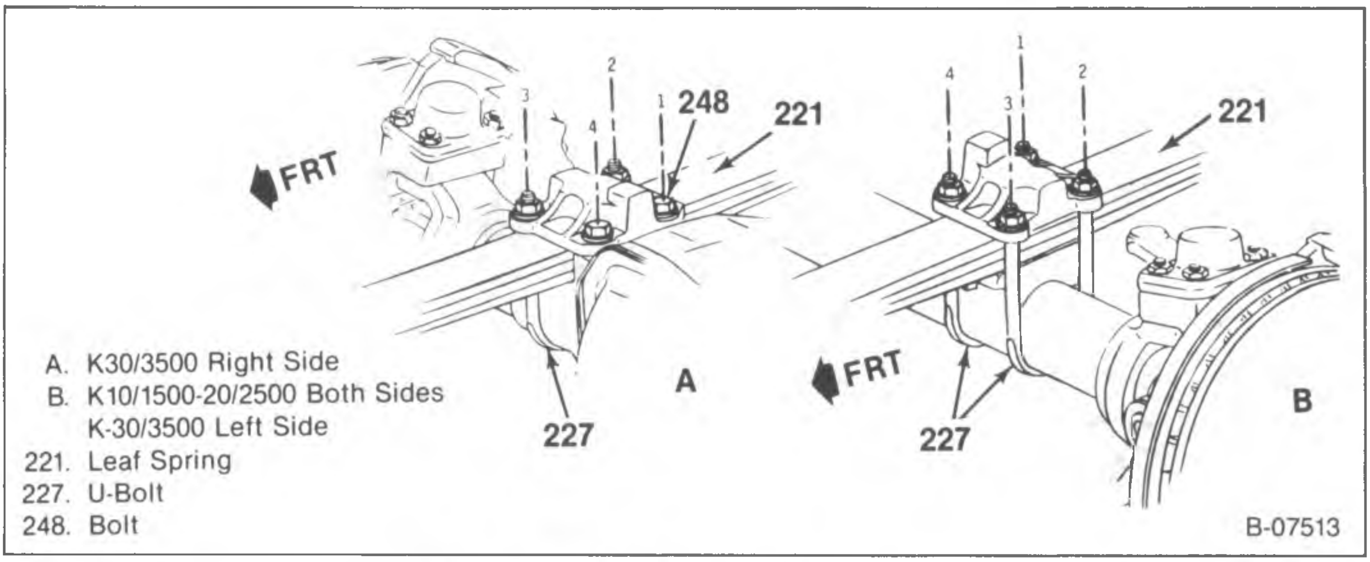


Figure 62—U-Bolt Tightening Sequence

- Shackle (202) into position and attach bolt (201), washer (217) and nut (218).
- Do not tighten.

NOTICE: Refer to the "Notice" on page 3C#1 of this section.

6. Spring to the axle.
    - For K10/1500–20/2500 series vehicles and the left side of K30/3500 series vehicles, attach the lower spacer (226), plate (224), U-bolts (227), washers (223) and nuts (222) (figure 61).
    - For the right side of K30/3500 series vehicles, attach the lower spacer (226), plate (224), U-bolt (227), washers (223), bolts (248) and nuts (222) (figure 61).

Tighten

- Nuts (222) and bolts (248) in sequence (2-4-1-3) to 203 N·m (150 ft. lbs.) (figure 62).

6. Torque the spring to frame and hanger fasteners.
    - Nuts (239) to 122 N·m (90 ft. lbs.).
    - Nuts (218) to 68 N·m (50 ft. lbs.).
7. Lower the floor jack, and lower the vehicle to the ground.

SPECIFICATIONS

FRONT SUSPENSION BOLT TORQUE—N·m (FT. LBS.)

	C10	K10	G10	C20	K20	G20	P20	C30	K30	G30	P30	P30 w/FS3
Shock Absorber To Frame	190 (140)	88 (65)	103 (80)	190 (140)	88 (65)	103 (80)	190 (140)	190 (140)	88 (65)	103 (80)	190 (140)	185 (136)
Shock Absorber To Lower Control Arm	80 (59)	—	103 (80)	80 (59)	—	103 (80)	80 (59)	80 (59)	—	103 (80)	80 (59)	—
Shock Absorber to Axle	—	88 (65)	—	—	88 (65)	—	—	—	88 (65)	—	—	50 (37)
Stabilizer To Frame	33 (24)	95 (70)	29 (21)	33 (24)	95 (70)	29 (21)	33 (24)	33 (24)	70 (52)	29 (21)	33 (24)	29 (21)
Stabilizer To Lower Control Arm	33 (24)	—	33 (24)	33 (24)	—	33 (24)	33 (24)	33 (24)	—	33 (24)	33 (24)	—
Stabilizer To Stabilizer Link	—	—	—	—	—	—	—	—	—	—	—	68 (50)
Stabilizer To Spring Plate	—	180 (133)	—	—	180 (133)	—	—	—	180 (133)	—	—	—
Steering Knuckle To Upper Ball Joint	* 68 (50)	** 135 (100)	* 68 (50)	*** 122 (90)	** 135 (100)	* 68 (50)	** 122 (90)	** 122 (90)	—	** 122 (90)	** 122 (90)	—
Steering Knuckle To Lower Ball Joint	** 122 (90)	*** 40 (30)	** 122 (90)	** 122 (90)	*** 40 (30)	** 122 (90)	** 122 (90)	** 122 (90)	—	** 122 (90)	** 122 (90)	—
Splash Shield To Knuckle	13 (10)	—	13 (10)	13 (10)	—	13 (10)	13 (10)	13 (10)	—	13 (10)	13 (10)	—
Splash Shield to Anchor Plate	—	—	—	—	—	—	—	—	—	—	—	16 (12)
Anchor Plate To Knuckle	—	88 (65)	—	—	88 (65)	—	—	—	88 (65)	—	—	—
Steering Arm To Knuckle	—	120 (90)	—	—	120 (90)	—	—	—	120 (90)	—	—	312 (230)
Caps To The Steering Knuckle	—	—	—	—	—	—	—	—	108 (80)	—	—	7 (5)
Lock Pin To Steering Knuckle	—	217 (160)	—	—	217 (160)	—	—	—	217 (160)	—	—	40 (29)
King Pin To Knuckle	—	—	—	—	—	—	—	—	745 (550)	—	—	—
Adjusting Ring To Spindle	—	70 (50)	—	—	70 (50)	—	—	—	—	—	—	—
Lower Control Arm Bushings	—	—	—	379 (280)	—	—	379 (280)	379 (280)	—	379 (280)	379 (280)	—
Lower Pivot Shaft End Nuts	95 (70)	—	156 (115)	—	—	156 (115)	—	—	—	—	—	—
Lower Pivot Shaft U-Bolt Nuts	115 (85)	—	88 (65)	115 (85)	—	88 (65)	115 (85)	115 (85)	—	115 (85)	115 (85)	—
Upper Control Arm Bushings	—	—	—	257 (190)	—	—	257 (190)	257 (190)	—	258 (190)	257 (190)	—
Upper Pivot Shaft End Nuts	156 (115)	—	156 (115)	—	—	156 (115)	—	—	—	—	—	—
Upper Pivot Shaft Thru Bolt Nuts	95 (70)	—	95 (76)	142 (105)	—	95 (70)	142 (105)	142 (105)	—	142 (105)	142 (105)	—
Upper Bolt Joint To Upper Control Arm	25 (18)	—	25 (18)	25 (18)	—	25 (18)	25 (18)	25 (18)	—	25 (18)	25 (18)	—
Crossmember To Bottom Frame Rail°	122 (90)	—	122 (90)	122 (90)	—	122 (90)	122 (90)	122 (90)	—	122 (90)	122 (90)	—

SPECIFICATIONS (CONT.)

FRONT SUSPENSION BOLT TORQUE—N·m (FT. LBS.)

	C10	K10	G10	C20	K20	G20	P20	C30	K30	G30	P30	P30 w/FS3
Crossmember To Side Frame Rail°°	88 (65)	—	88 (65)	88 (65)	—	88 (65)	88 (65)	88 (65)	—	88 (65)	88 (65)	—
Spring To Hanger Nuts	—	122 (90)	—	—	122 (90)	—	—	—	122 (90)	—	—	125 (92)
Spring To Shackle Nuts	—	68 (50)	—	—	68 (50)	—	—	—	68 (50)	—	—	125 (92)
Spring To Axle U-Bolt Nuts	—	203 (150)	—	—	203 (150)	—	—	—	203 (150)	—	—	109 (80)
Shackle To Frame Nuts	—	68 (50)	—	—	68 (50)	—	—	—	68 (50)	—	—	125 (92)
Suspension Bumper	20 (15)	20 (15)	20 (15)	26 (19)	20 (15)	20 (15)	26 (19)	26 (19)	20 (15)	20 (15)	26 (19)	34 (25)
Crossmember To Brake Support Struts	81 (60)	—	81 (60)	81 (60)	—	81 (60)	81 (60)	81 (60)	—	81 (60)	81 (60)	—

°P30 (32)—291 N·m (215 ft. lbs.); P30 (42) and JF9—176 N·m (130 ft. lbs.).

°°P30 (32), P30 (42) and JF9—135 N·m (100 ft. lbs.).

*Plus additional torque to align cotter pin. Not to exceed 122 N·m (90 ft. lbs.) maximum.

**Plus additional torque to align cotter pin. Not to exceed 176 N·m (130 ft. lbs.). maximum.

***Plus additional torque to align cotter pin.

ENDPLAY SPECIFICATIONS

C-G-P Series	0.03-0.13 mm (0.0012-0.005 inches)
K series	0.025-0.25 mm (0.001-0.010 inches)
P30 w/FS3	0.013-0.20 mm (0.0005-0.008)

SPECIAL TOOLS

Tool Number	Tool Name
J-8092	Driver Handle
J-8457	Wheel Bearing Race Installer
J-8849	Wheel Bearing Race Installer
J-29040	Outer Bearing Race Installer
J-6893-D	Wheel Bearing Nut Wrench (K10/1500–20/2500)
J-26878-A	Wheel Bearing Nut Wrench (K30/3500)
J-23446	Torque Wrench Adapter
J-6368	Outer Bearing Race Installer
J-23448	Inner Bearing Race Installer
J-24435-A	Needle Bearing Installer (K10/1500–20/2500)
J-21465-17	Bearing Installer (K30/3500)
J-23742	Ball Joint Separator
J-9519-9	Ball Joint Installer
J-9519-10	Ball Joint Fixture
J-9519-13	Ball Joint Installer
J-9519-16	Ball Joint Installer
J-9519-22	Ball Joint Installer
J-23454-1	Lower Ball Joint Separator
J-23454-2	Upper And Lower Ball Joint Sleeve
J-23454-3 or J-6382-3	Upper And Lower Ball Joint Spacer
J-9746-02	Hub/Rotor Support
J-23028-02	Spring Remover
J-6627-A	Wheel Stud And Tie Rod Remover
J-23447	Ball Stud Nut Wrench
J-7817	Front Pinion Bearing Installer
J-22301	King Pin Bearing Seal Installer
J-28871	King Pin Installer
J-22717	Lower Control Arm Bushing Stake Remover
J-24435-1	Upper And Lower Control Arm Bushing Remover
J-24435-2	Upper And Lower Control Arm Bushing Spacer
J-24435-3	Upper And Lower Control Arm Bushing Remover
J-24435-4	Upper And Lower Control Arm Bushing Installer
J-24435-5	Upper Control Arm Bushing Installer
J-24435-6	Upper And Lower Control Arm Bushing Spacer
J-24435-7	Upper And Lower Control Arm Bushing Fixture

SECTION 3D

REAR 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 "Notice: Refer to the 'Notice' on page 3D-1 of this section.

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

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GENERAL DESCRIPTION

All 10/1500 through 30/3500 series vehicles use a leaf spring and solid rear axle suspension system (figures 1 through 7).

The rear axle assembly is attached to multi-leaf springs by U-bolts. The front ends of the springs are attached to the frame at the front hangers, through rubber bushings. The rear ends of the springs are attached to the frame by the use of shackles which allow the springs to "change their length" while the vehicle is in motion.

Ride control is provided by two identical direct double acting shock absorbers angle-mounted between the frame and brackets attached to the axle tubes.

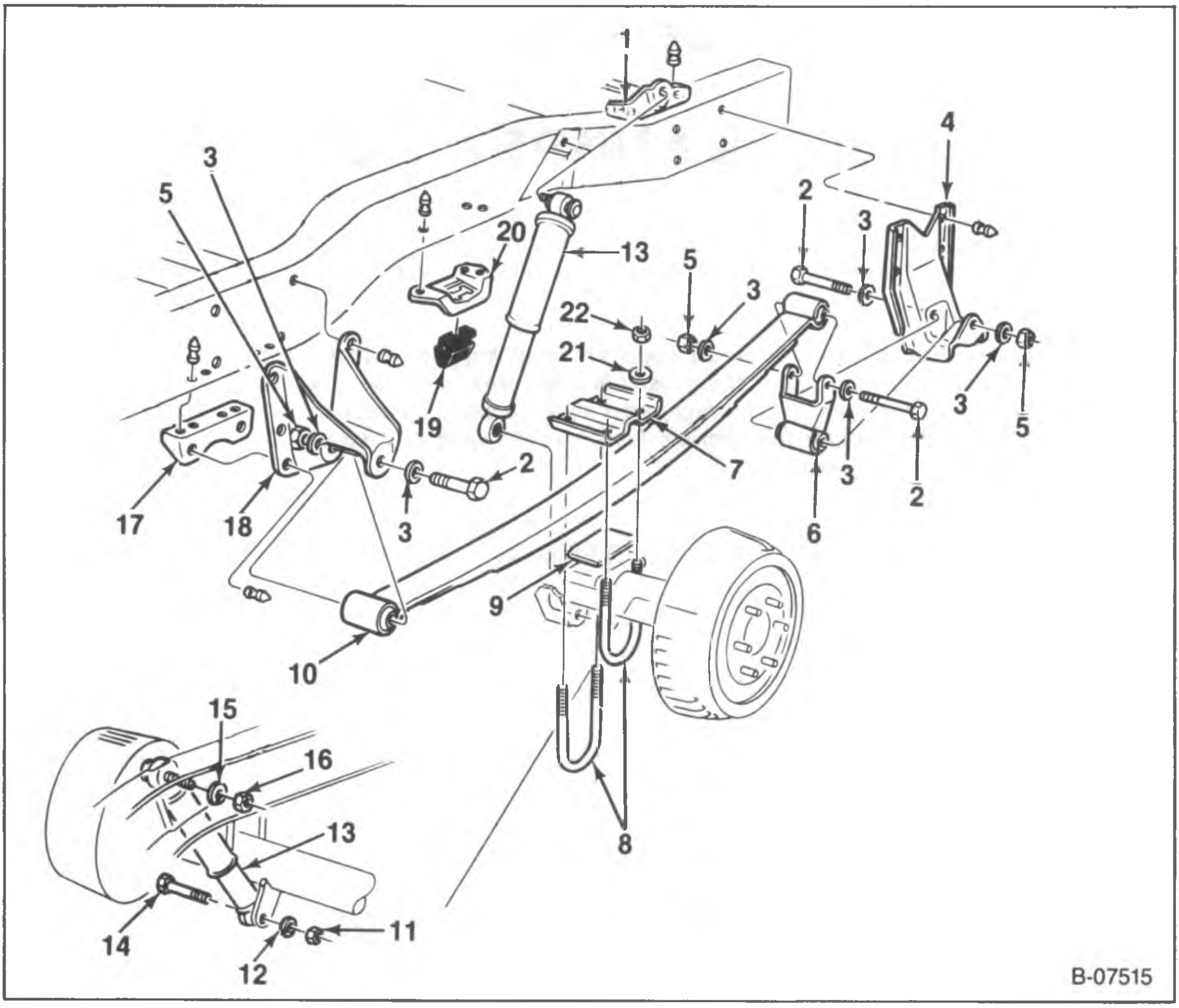

Figure 1—Rear Suspension (C-K 10/1500, 20/2500 Pickup, Suburban, And Blazer/Jimmy)

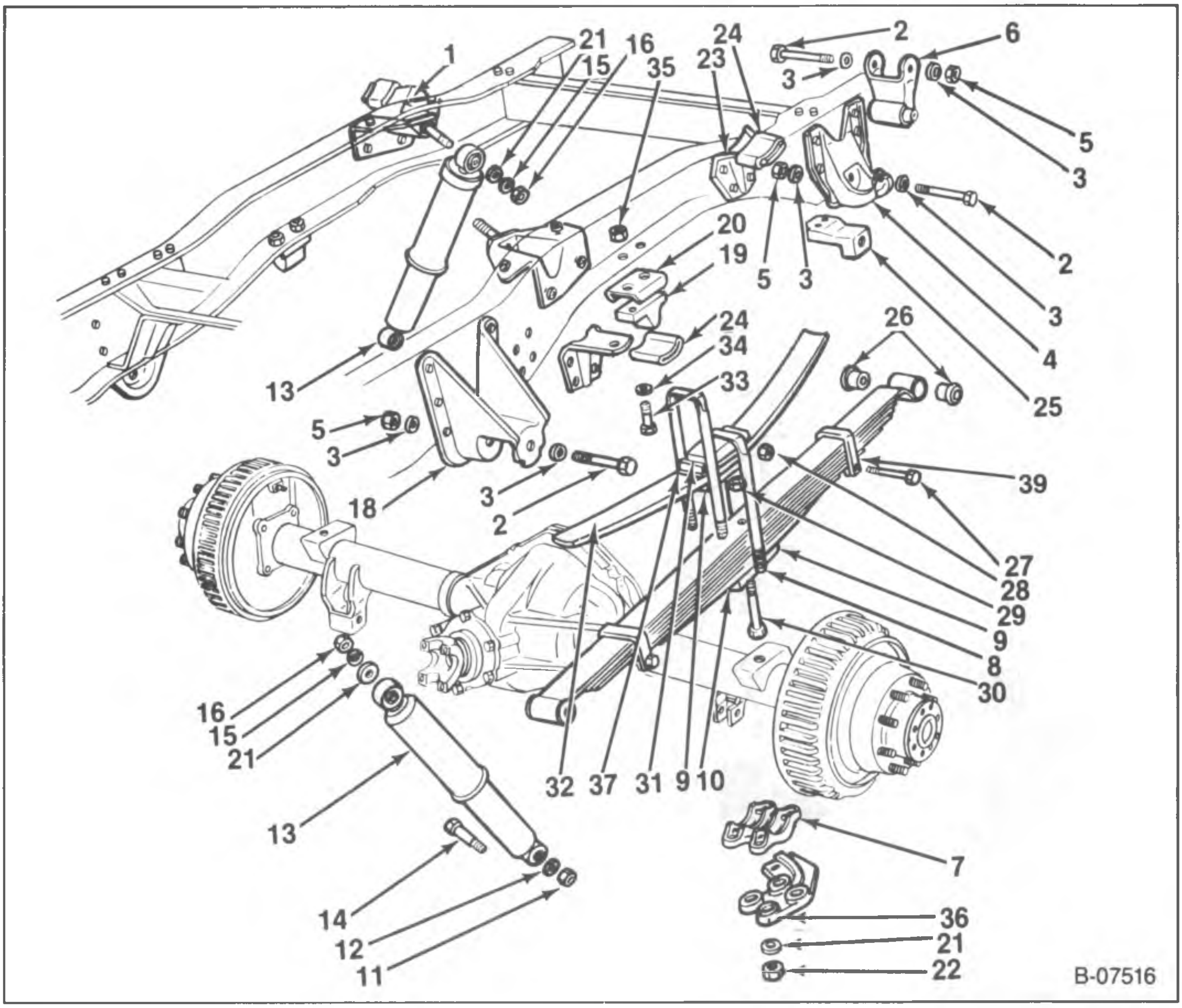

Figure 2—Rear Suspension (C-K 30/3500 Series Vehicles)

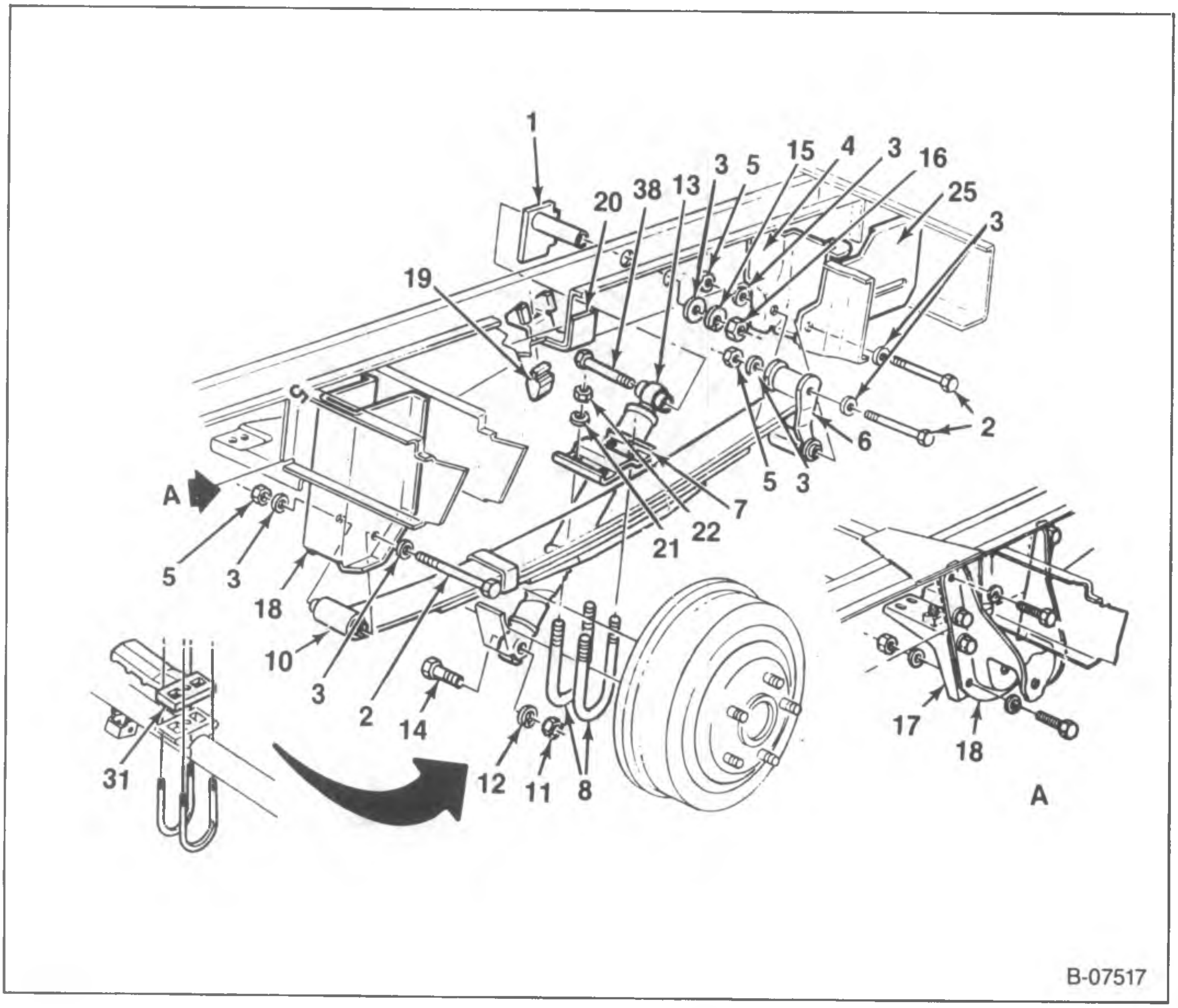

Figure 3—Rear Suspension (G 10/1500-30/3500 Series Vehicles)

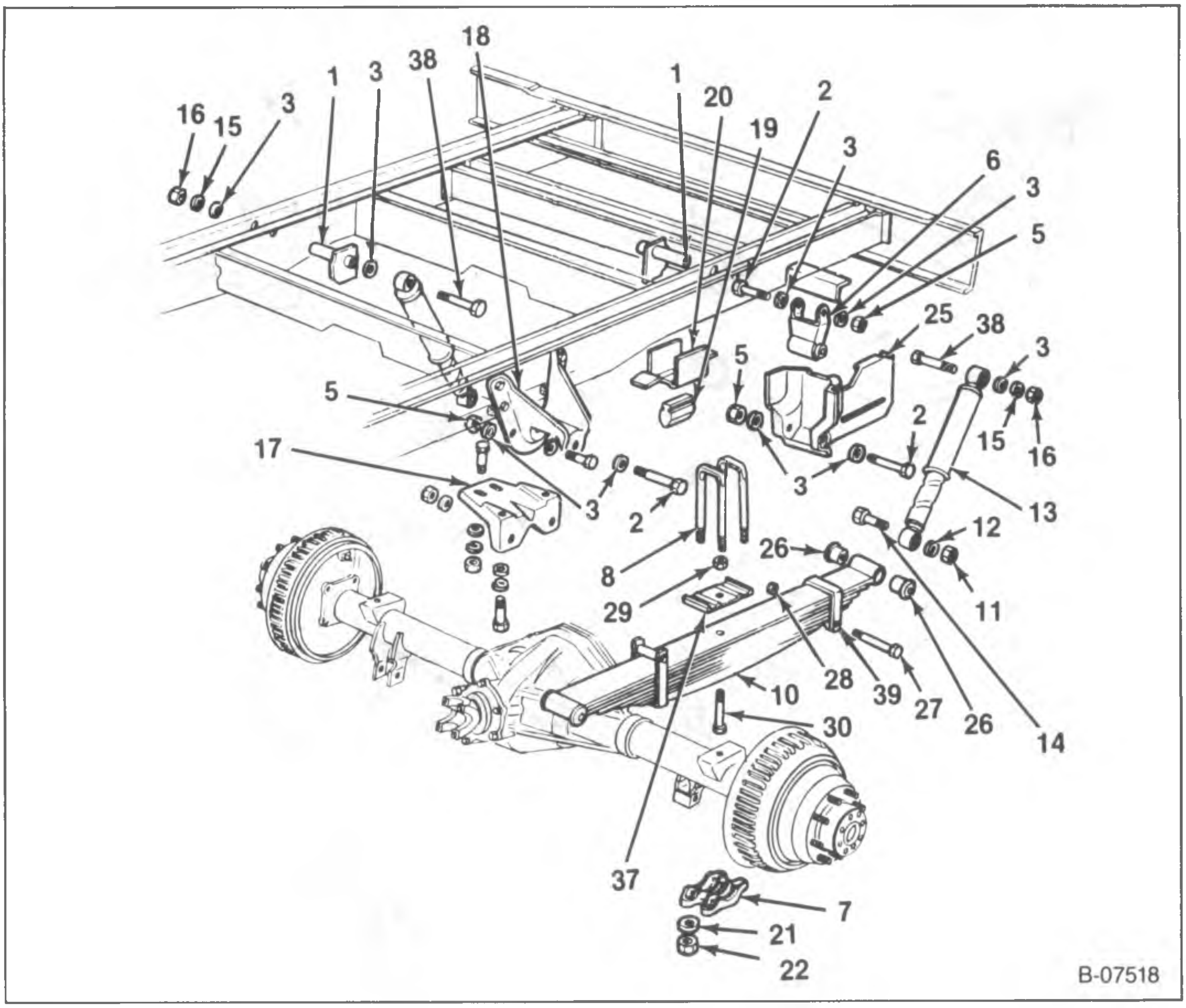

Figure 4—Rear Suspension (G30/3500 Series Cutaway Van With RPO M40)

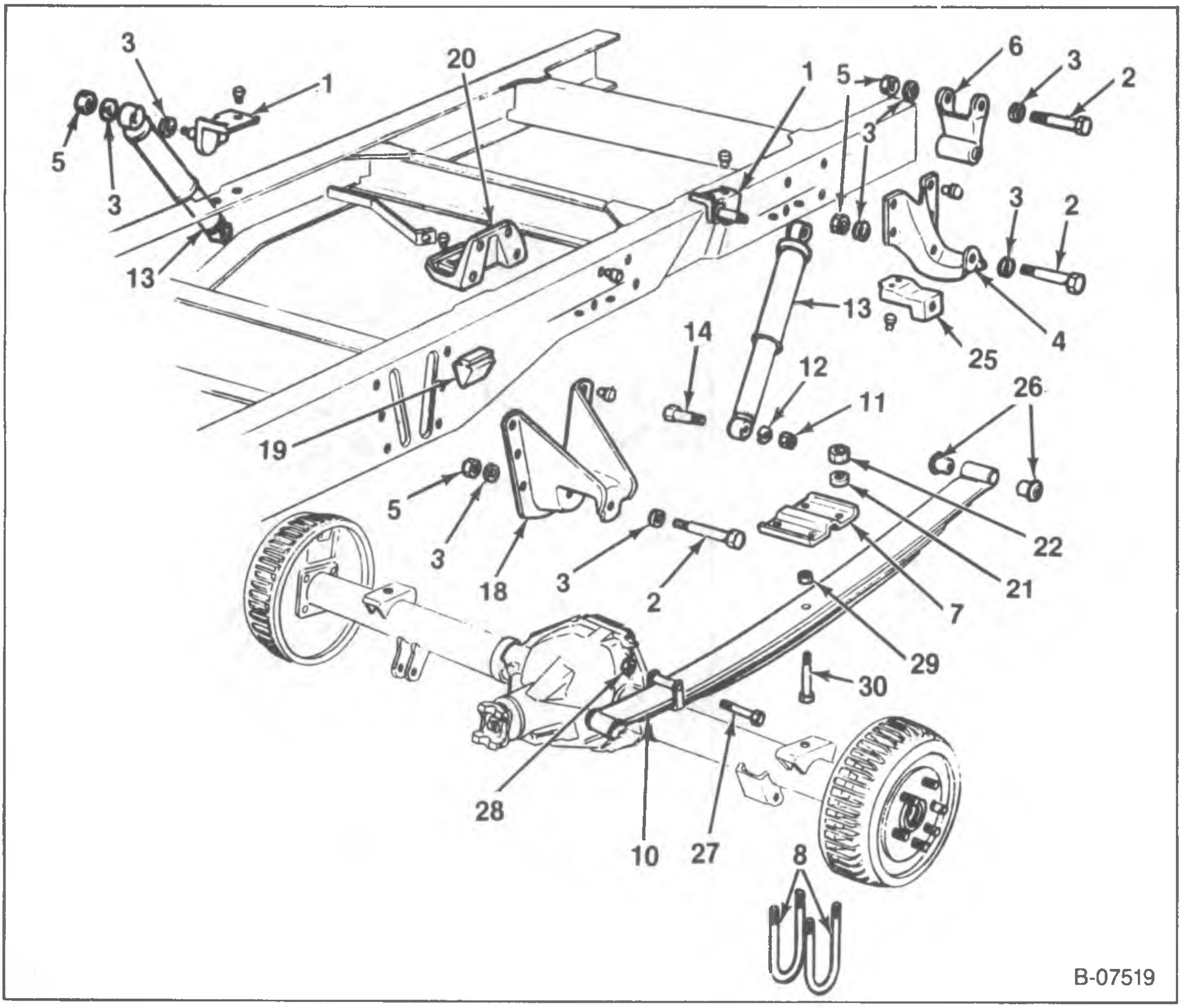

Figure 5—Rear Suspension (P20/2500 Series Vehicles)

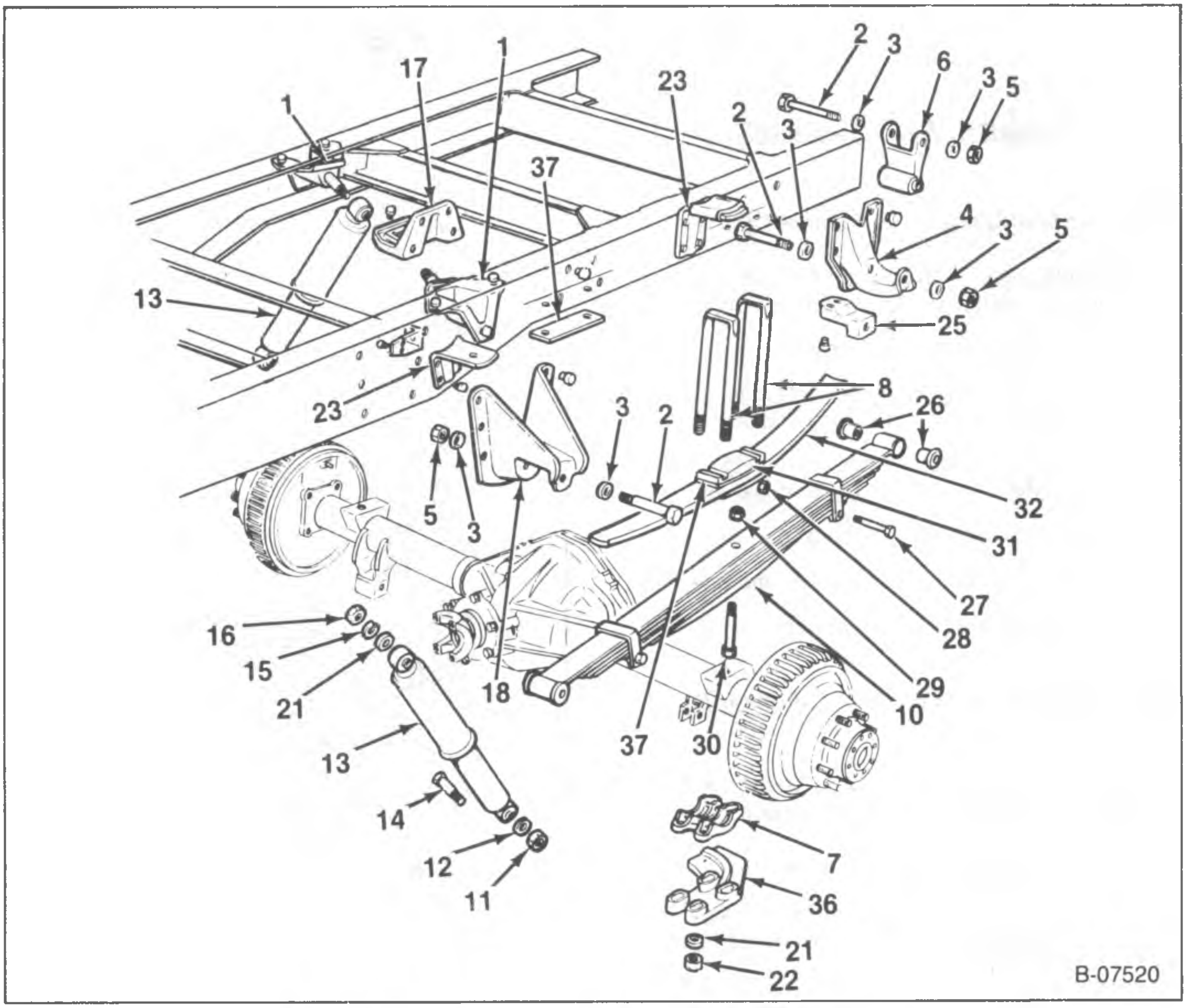

Figure 6—Rear Suspension (P30/3500 Series Vehicles)

1. Bracket
2. Bolt
3. Washer
4. Rear Hanger
5. Nut
6. Rear Shackle
7. Anchor Plate
8. U-bolt
9. Shim
10. Leaf Spring
11. Nut
12. Spring Lock Washer
13. Rear Shock Absorber
14. Bolt
15. Spring Lock Washer
16. Nut
17. Front Hanger Support
18. Front Hanger
19. Axle Bumper
20. Bumper Bracket
21. Washer
22. Nut
23. Bracket
24. Cushion
25. Rear Hanger Reinforcement
26. Leaf Spring Eye Bushing
27. Bolt
28. Nut
29. Nut
30. Bolt
31. Spacer
32. Optional Rear Auxiliary Spring
33. Bolt
34. Washer
35. Nut
36. Stabilizer Bar Anchor
37. Spacer
38. Bolt
39. Spring Clip

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Figure 7—Rear Suspension Legend

ON-VEHICLE SERVICE

SHOCK ABSORBERS

Remove or Disconnect (Figures 1 through 7)

- Raise the vehicle on a hoist and support the rear axle independently of the rest of the vehicle.

1. Shock absorber (13) from the frame.
    - For C-K and P series vehicles; nut (16), spring-washer (15), and/or washer (21).
    - For G series vehicles; nut (16), spring washer (15), washer (3), and bolt (38).
2. Shock absorber (13) from the axle.
    - Nut (11), spring-washer (12), and bolt (14).
    - Pull the shock absorber free.

Install or Connect (Figures 1 through 7)

NOTICE: For steps 1 and 2, refer to the "Notice" on page 3D-1 of this section.

1. Shock absorber (13) to the frame.
    - For C-K and P series vehicles; spring-washer (15) and/or washer (21), plus the nut (16).
    - For G series vehicles; bolt (38), washer (3), spring-washer (15), and nut (16).

Tighten

- Nuts (16) to "Specifications" at the end of this section.

2. Shock absorber (13) to the axle.
    - Line shock absorber up with the axle bracket.
    - Bolt (14), spring-washer (12), and nut (11).

Tighten

- For all C-K and P series vehicles; nut (11) to 155 N·m (114 ft. lbs.).
- For all G series vehicles; nut (11) to 102 N·m (75 ft. lbs.).

3. Lower the vehicle to the ground.

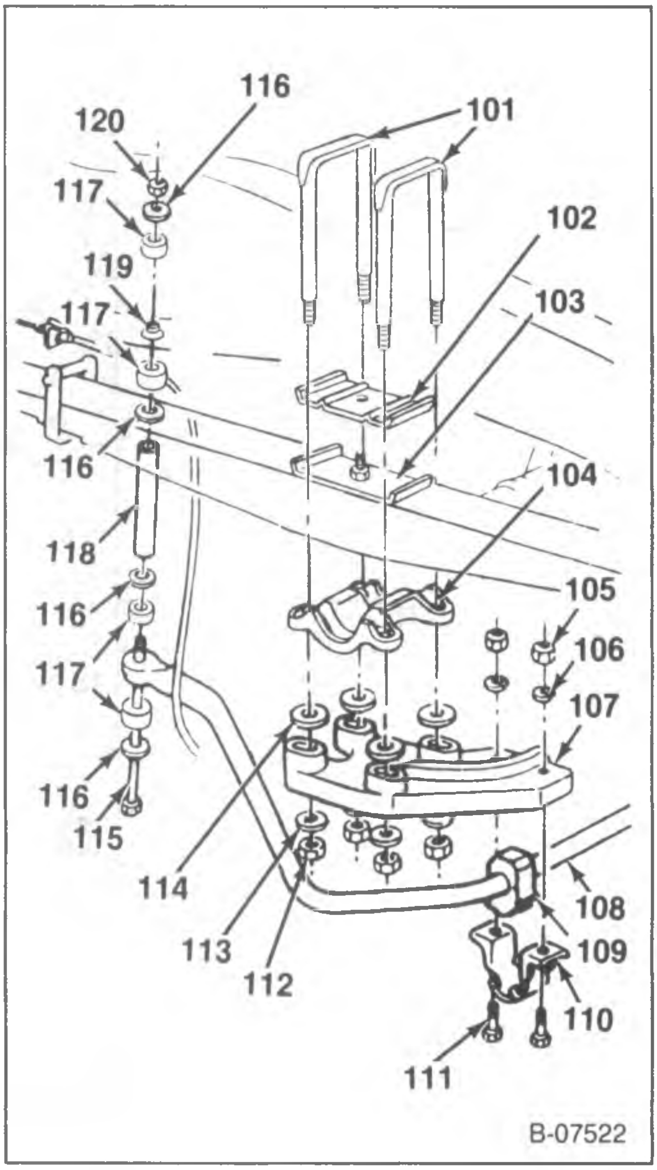

Figure 8—Rear Stabilizer Attachments (C30/3500 Series Vehicles)

STABILIZER BAR

Remove or Disconnect (Figures 8, 9, and 10)

- Raise the vehicle on a hoist. Support the rear axle independently of the rest of the vehicle.

1. Stabilizer bar (108) from the frame.
    - For C 30/3500 series vehicles; nut (120), and washer (116). Slide the link bolt (115) out along with the grommets (117), washers (116), and spacer (114).
    - For P 30/3500 (32) series vehicles; nuts (105), washers (106), bolts (111), and the clamp (110).

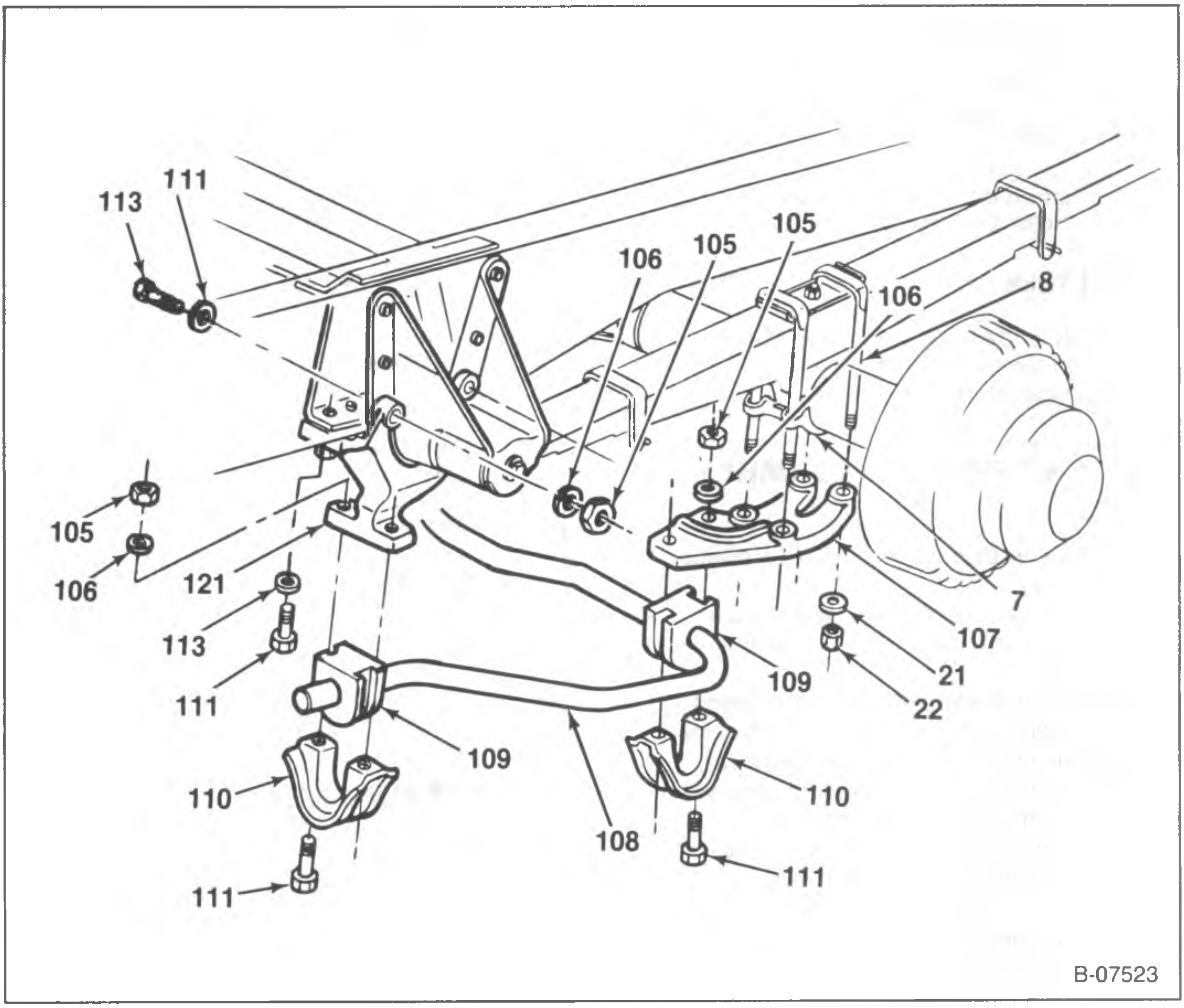

Figure 9—Rear Stabilizer Attachments (P(32) Series)

2. Stabilizer bar (108) from the anchor plates (107).
   - Nuts (105), washers (106), bolts (111), and the clamps (110).
3. Insulators (109) from the stabilizer bar (108).

101. U-bolt
102. Spacer
103. Spring Spacer
104. Anchor Plate
105. Nut
106. Spring Lock Washer
107. Stabilizer Bar Anchor
108. Stabilizer Bar
109. Bushing
110. Bracket
111. Bolt
112. Nut
113. Washer
114. Spacer
115. Bolt
116. Washer
117. Grommet
118. Link
119. Retainer
120. Nut
121. Bracket

B-07524

Figure 10—Rear Stabilizer Attachments Legend

Install or Connect (Figures 8, 9 and 10)

NOTICE: For steps 2 and 3, refer to the "Notice" on page 3D-1 of this section.

1. Insulators (109) to the stabilizer bar (108).
2. Stabilizer bar (108) to the anchor plates (107).
   - Clamps (110), bolts (111), washers (106), and nuts (105).

Tighten

- Refer to "Specifications" at the end of this section.

Important

- Route the parking brake cable over the stabilizer bar.

3. Stabilizer bar (108) to the frame.
   - For the C 30/3500 series vehicles; position the link bolt (115), washers (116), grommets (117), spacer (114), retainer (119) and nut (120).
   - For the P 30/3500 (32) series vehicles; attach the clamp (110), bolts (111), washers (106), and nuts (105) in position.

Tighten

- Nuts (120 and 105) to the "Specifications" at the end of this section.

4. Lower the vehicle to the ground.

LEAF SPRING ASSEMBLY

Remove or Disconnect (Figures 1 through 7)

- Raise the vehicle on a hoist and support the rear axle independently to relieve tension on the leaf springs.

1. Stabilizer bar from the vehicle if equipped.
   - Refer to "Stabilizer Bar," in this section.
2. Leaf spring (10) from the rear hanger (25).
   - Loosen, but do not remove, the spring-to-shackle nut and bolt.
   - Nut and the bolt securing the shackle to the rear hanger (25).
3. Leaf spring (10) from the front hanger (18).
   - Nut and the bolt securing the leaf spring (10) to the front hanger (18).
4. Shackle (6) from the leaf spring (10).
   - Nut and bolt securing the shackle to the leaf spring.
5. Leaf spring from the axle.
   - Nuts (22), and washers (21).
   - Rear stabilizer anchor (36) if equipped, the anchor plate, spacers, shims, and the auxiliary spring (32), if equipped.
   - U-bolts (8).
   - Leaf spring is free of the vehicle.

Install or Connect (Figures 1 through 7, and 11)

NOTICE: For steps 1 and 4, refer to the "Notice" on page 3D-1 of this section.

1. Leaf spring (10) to the rear axle.
   - Leaf spring into position.
   - Spacers, shims, the auxiliary spring (32) if equipped, and the anchor plate.
   - U-bolts (8), washers (21), and nuts (22).

Tighten

- Nuts (22), in a diagonal sequence 1-3-2-4 (figure 11), initially to 25 N·m (18 ft. lbs.). Then final torque in a diagonal sequence 1-3-2-4 (figure 11) to the "Specifications" at the end of this section.

2. Shackle (6) to the leaf spring (10).
   - Bolt (2), washers (3), and nuts (5), making sure the bolt is positioned correctly (figures 1 through 7).
   - Do not tighten.
3. Leaf spring to the front hanger (18).
   - Bolt (2), washers (3), and nut (5).
   - Do not tighten.
4. Leaf spring to the rear hanger (25).
   - Bolt (2), washers (3), and nut (5).

Tighten

- Nuts (5) and bolts (2), to the "Specifications" at the end of this section.

5. Stabilizer bar to the vehicle if equipped.
   - Refer to "Stabilizer Bar," in this section.
6. Lower the support on the rear axle. Lower the vehicle to the ground.

BUSHING REPLACEMENT

PRESS OUT TYPE BUSHINGS

Remove or Disconnect (Figures 1, 3, and 7)

1. Leaf spring (10) from the vehicle.
   - Refer to "Leaf Spring Assembly," in this section.
2. Bushing from the leaf spring (10).
   - Place the leaf spring in a press and press out the bushing.

Install or Connect (Figures 1, 3 and 7)

1. Bushing into the leaf spring (10).
   - Use a press to properly position the bushings.
2. Leaf spring (10) to the vehicle.
   - Refer to "Leaf Spring Assembly," in this section.

PRY OUT TYPE BUSHINGS

Remvoe or Disconnect (Figures 2 and 4 through 7)

1. Leaf spring (10) from the vehicle.
   - Refer to "Leaf Spring Assembly," in this section.

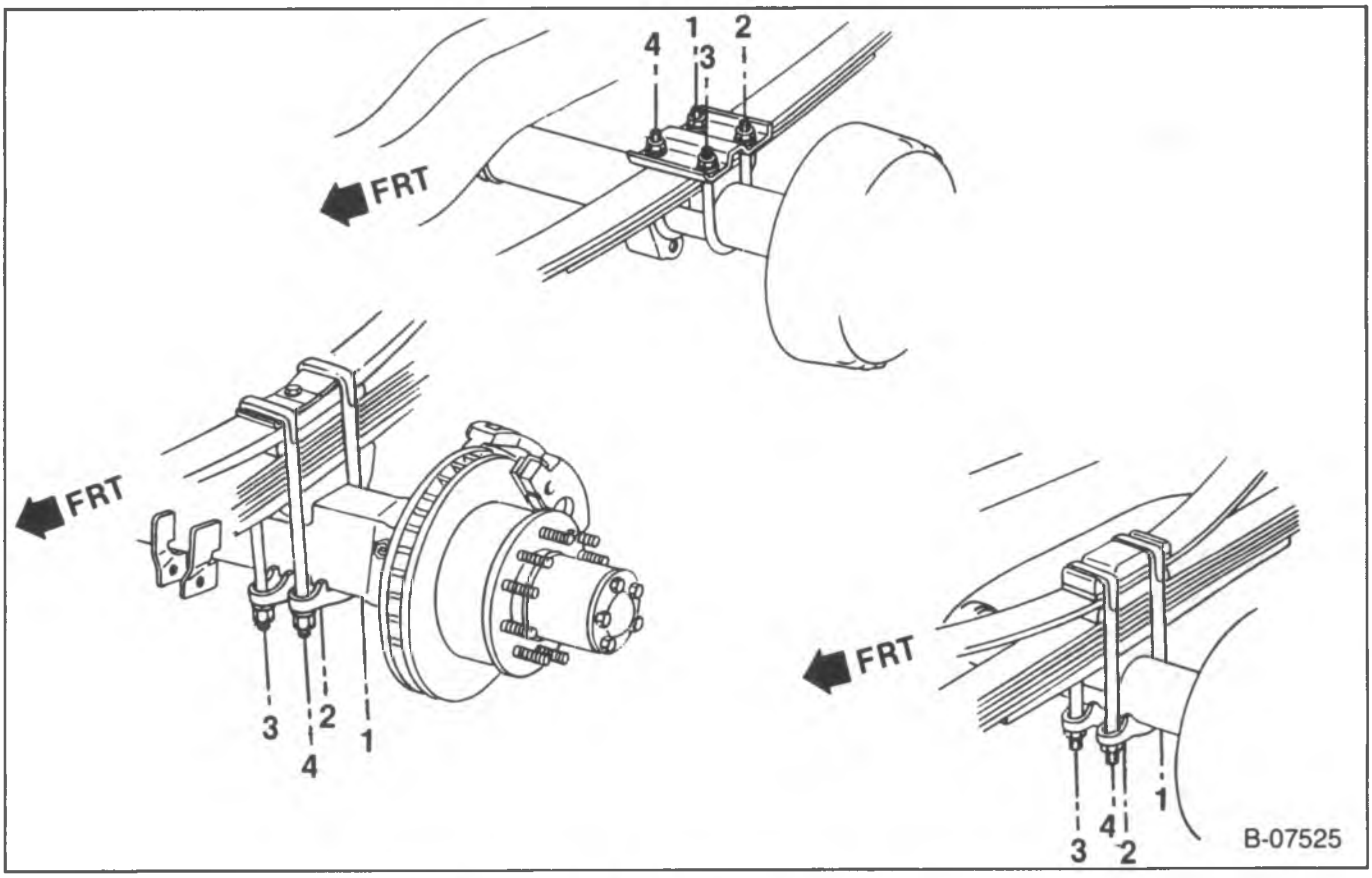

Figure 11—Spring To Axle Tightening Sequence

2. Bushings (26) from the leaf spring (10).
   - Pry the bushings out of each side of the spring eye.

Install or Connect (Figures 2 and 4 through 7)

1. Bushings (26) into the leaf spring (10).
   - Press each bushing (26) into its side of the spring eye.
2. Leaf srping (10) onto the vehicle.
   - Refer to "Leaf Spring Assembly," in this section.

SPECIFICATIONS

FASTENER NAME	TORQUE N·m (FT. LBS.)										
	C10/15	C20/25	C30/35	K10/15	K20/25	K30/35	G10/15	G20/25	G30/35	P20/25	P30/35
Shock Absorber To Frame Nut	190 (140)	*190 (140)	70 (52)	190 (140)	190 (140)	70 (52)	102 (75)	102 (75)	102 (75)	33 (24)	70 (52)
Shock Absorber To Axle Nut	155 (114)	*155 (114)	155 (114)	155 (114)	155 (114)	155 (114)	102 (75)	102 (75)	102 (75)	155 (114)	155 (114)
Stabilizer Bar To Frame Nut	—	—	**	—	—	—	—	—	—	—	29 (21)
Stabilizer Bar To Anchor Nut	—	—	33 (24)	—	—	—	—	—	—	—	29 (21)
Stabilizer Bar Bracket To Hanger	—	—	—	—	—	—	—	—	—	—	33 (24)
Stabilizer Bar Bracket To Frame	—	—	—	—	—	—	—	—	—	—	33 (24)
Anchor Plate To U-bolt Nut (U-bolts Facing Up)	170 (125)	170 (125)	170 (125)	170 (125)	170 (125)	170 (125)	155 (114)	155 (114)	205 (151)	170 (125)	—
Anchor Plate to U-bolt Nut (U-bolts Facing Down)	200 (147)	200 (147)	200 (147)	200 (147)	200 (147)	200 (147)	—	—	205 (151)	—	***200 (147)
Spring To Hanger Nut	125 (92)	125 (92)	125 (92)	125 (92)	125 (92)	125 (92)	125 (92)	125 (92)	125 (92)	125 (92)	N/A
Spring To Hanger Bolt	150 (110)	150 (110)	150 (110)	150 (110)	150 (110)	150 (110)	185 (136)	185 (136)	185 (136)	150 (110)	•150 (110)
Spring To Shackle Nut	125 (92)	125 (92)	125 (92)	125 (92)	125 (92)	125 (92)	125 (92)	125 (92)	125 (92)	125 (92)	•125 (92)
Spring To Shackle Bolt	150 (110)	150 (110)	150 (110)	150 (110)	150 (110)	150 (110)	185 (136)	185 (136)	185 (136)	150 (110)	•150 (110)
Shackle To Hanger Nut	125 (92)	125 (92)	125 (92)	125 (92)	125 (92)	125 (92)	N/A	N/A	N/A	125 (92)	•125 (92)
Shackle To Hanger Bolt	150 (110)	150 (110)	150 (110)	150 (110)	150 (110)	150 (110)	185 (136)	185 (136)	185 (136)	150 (110)	•150 (110)

• For Models with RPO JF9 or P318(32) Torque Spring to Hanger Bolt to 200 N·m (147 ft. lbs.) and Tighten Shcakle Fasteners to 135 N·m (99 ft. lbs.)

* Crew Cab Model Torque is 70 N·m (52 ft. lbs.) for Shock to Frame, and 155 N·m (114 ft. lbs.) for Shock to Axle.

** Tighten The Nut To The Unthreaded Portion Of The Link Bolt.

*** Torque Is 240 N·m (177 Ft. Lbs.) When Equipped With RPO JF9

SECTION 3E

WHEELS AND TIRES

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: "NOTICE: Refer to the 'Notice' on page 3E-1 of this section."

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

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GENERAL DESCRIPTION

This section details special service procedures that are not covered in the vehicle's Owner's Manual. For jacking instructions, basic tire changing and rotation instructions, and a detailed explanation of all other owner-oriented information, refer to the proper section in the vehicle's Owner's Manual.

CERTIFICATION LABEL

The certification label contains information used to determine which tire size and type the vehicle uses. For further information, refer to GENERAL INFORMATION (SEC. 0A).

TIRE LOAD LIMITS AND INFLATION PRESSURE

The factory installed wheels and tires are designed to handle loads up to and including their rated load capacity when inflated to the recommended inflation pressures. Refer to "Tire Load Limits And Inflation Pressure" at the end of this section.

Correct tire pressures and driving techniques influence tire life. Underinflated tires can cause handling problems, poor fuel economy, shortened tire life, and tire overloading. Heavy cornering, excessively rapid acceleration, and unnecessary braking also increase tire wear.

Important

- The use of wheels and/or tires with higher load capacity ratings than originally equipped on the vehicle will not increase the Gross Axle Weight Rating (GAWR) or Gross Vehicle Weight Rating (GVWR) of the vehicle.

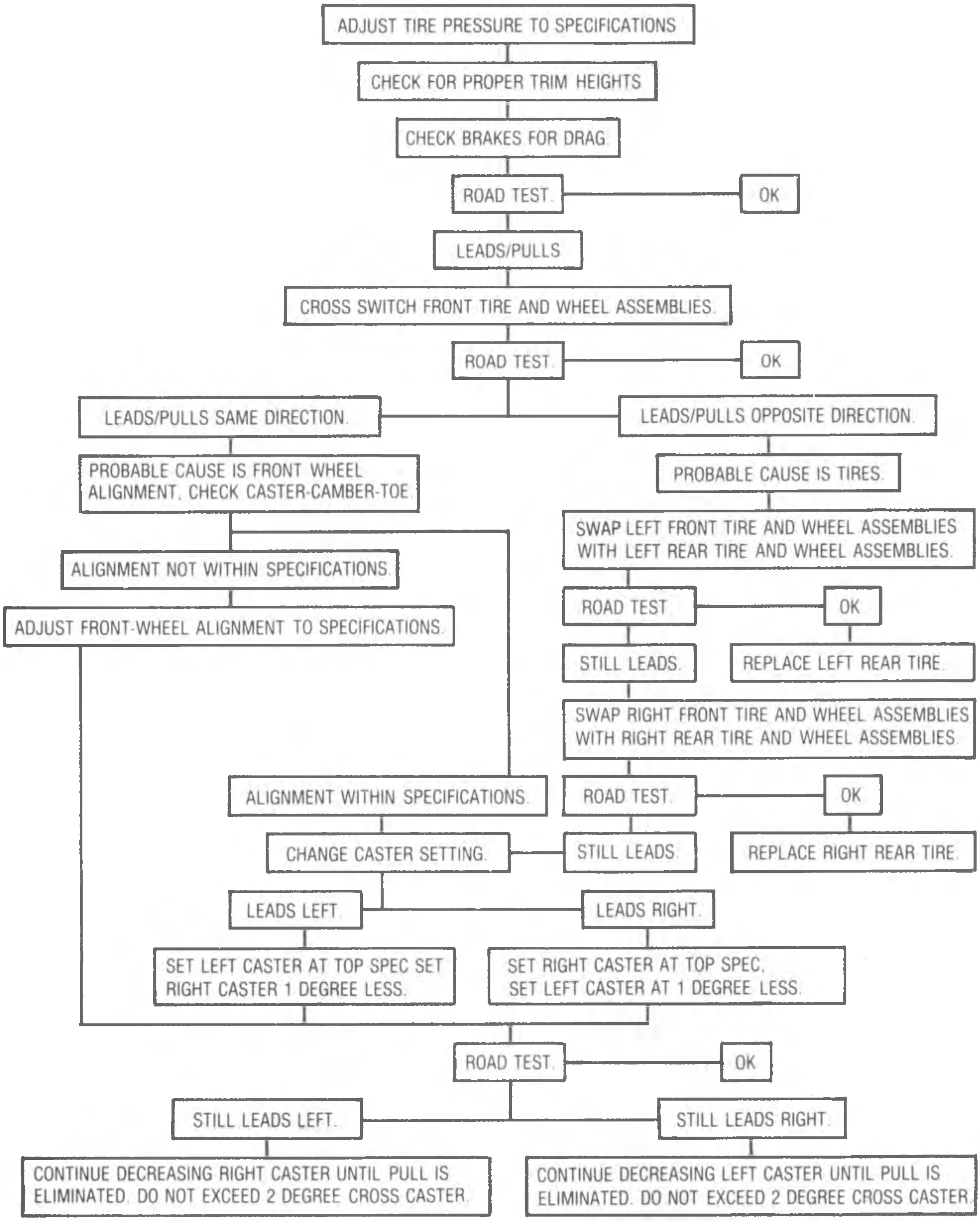


Figure 1—Radial Tire Lead/Pull Diagnosis Chart

DIAGNOSIS OF WHEELS AND TIRES

The following information (including figure 1) will help to identify certain tire-related durability and drivability problems.

PROBLEM	POSSIBLE CAUSE	CORRECTION
Excessive Heel And Toe Wear	High speed driving, excessive use of brakes.	Correct as required, rotate tires regularly.
Excessive Tire Edge(s) Wear	1. Underinflated tires. 2. Vehicle overloaded. 3. High speed cornering. 4. Incorrect toe setting.	1. Inflate to recommended pressure. 2. Correct as required—refer to certification label. 3. Correct as required. 4. Set to correct specifications.
Excessive Tire Wear (Center Of Tread)	Overinflated tires.	Deflate to recommended pressure.
Uneven Tire Wear	1. Improper tire pressure. 2. Incorrect tire and wheel usage. 3. Worn shock absorbers. 4. Front end out of alignment. 5. Loose, worn, or damaged steering linkage, joints, suspension components, bushings and/or ball joints. 6. Out of balance wheel/tire.	1. Inflate to recommended pressure. 2. Install correct tire-wheel combination. 3. Replace shock absorbers. 4. Align the front end. 5. Inspect, repair or replace as required. 6. Balance wheel/tire.
Radial Tire Waddle (Side To Side Movement At Speeds Between 5 and 15 MPH)	Worn tires.	Replace worn tires.
Vibration	1. Out of balance wheel/tire. 2. Tire runout. 3. Wheel runout. 4. Worn tire.	1. Balance wheel/tire. 2. Replace tire. 3. Replace wheel. 4. Replace tire.

CHECKING WHEEL AND TIRE RUNOUT

Some vehicles are sensitive to tire and wheel assembly runout. Tires that are satisfactory on one vehicle might be unsatisfactory on another. When analyzing vibration problems, it is important to keep this in mind. In addition, different wheel positions on a vehicle may have different sensitivity levels. You should check for wheel runout or total wheel and tire runout in the following cases:

- If the tire and wheel vibration occurs below 40 miles per hour.
- If all wheels are balanced well within one ounce of static balance and five ounces of dynamic balance, and a vibration occurs.
- If there appears to be a bulge in a tire or an out-of-round condition as a tire rotates on a balancer.
- If any wheel damage is noticed.
- If there is a poor wheel fit on the hub and the vehicle exhibits vibration.

ON-VEHICLE SERVICE

MEASURING WHEEL AND TIRE RUNOUT

Runout measurements of the wheel and tire assembly can be taken both on and off the vehicle. These measurements can be taken radially and laterally. A dial indicator equipped with a roller contact point, mounted on a heavy, solid base is the measurement device.

RADIAL RUNOUT

Radial runout is the egg-shaped difference from a perfect circle. Measure tire radial runout from the center tire tread rib although other tread ribs can be measured as well. The total runout is the reading from the gage, and the high spot is the location of the maximum runout. On a rim, if either flange is beyond specifications, replace the rim (figure 2).

LATERAL RUNOUT

Lateral runout is a sideways variation causing a twist or wobble and is measured on a side surface. On the tire and wheel assembly, measure the sidewall of the tire as close to the trend shoulder design edge as possible. The total runout is the reading from the gage, and the high spot is the location of the maximum runout. On a rim, if either flange is beyond guidelines, replace the rim (figure 3).

MEASUREMENT PROCEDURES

1. Inflate the tires to specifications.
2. Warm up the tires prior to taking measurements to eliminate flat spotting.
   - Newly installed tires usually do not require warming up.
3. Raise the vehicle on a lift.
   - If measurements will be taken off the vehicle, mount each tire and wheel assembly on a dynamic balance machine.
4. Mark the tire and wheel assemblies for exact replacement.
   - Mark a wheel hub bolt and its exact position on the wheel.
   - Mark each tire and wheel assembly for replacement on the exact hub/rotor assembly.
5. Take either a radial or lateral runout measurement.
   - Place the dial indicator in position.
   - Rotate the tire and wheel assembly (or just the wheel) to find its low spot. Adjust the dial indicator to read zero.
   - Rotate again to verify the low spot location—the dial indicator must return to zero.

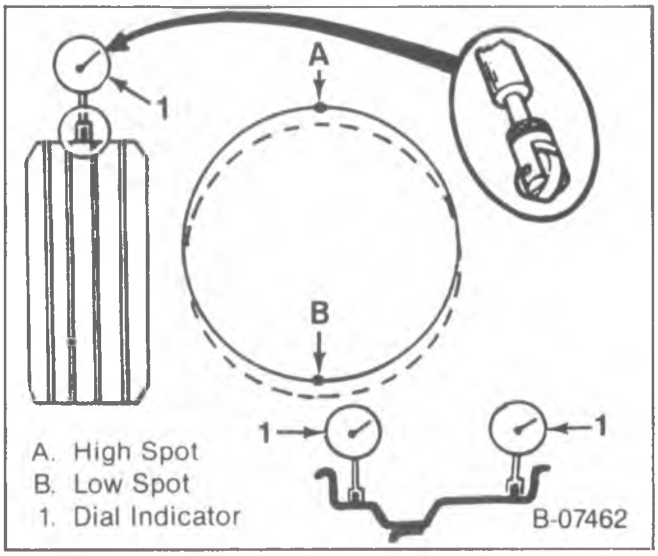


Figure 2—Measuring Radial Runout

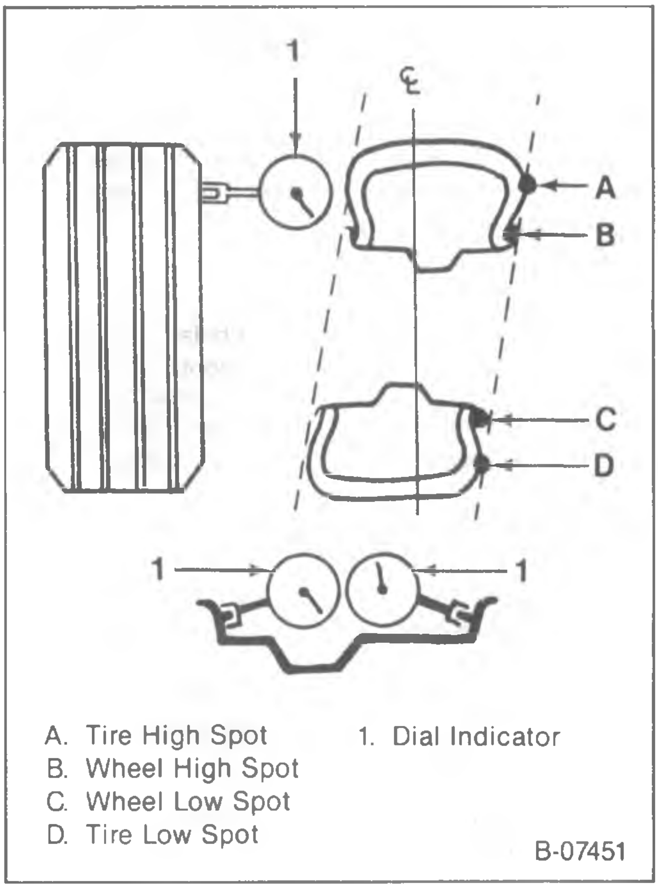
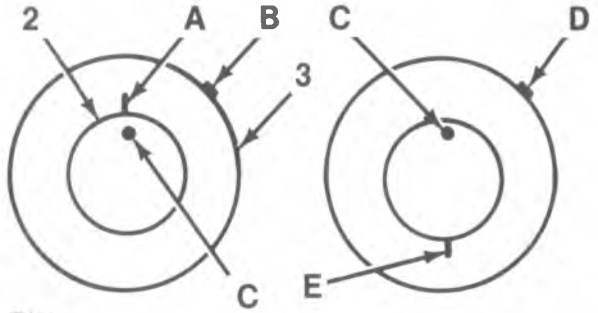


Figure 3—Measuring Lateral Runout



2. Rim
3. Tire
A. Tire Reference Mark At 12 O'clock
B. First Measurement (High Spot)
C. Valve Stem At 12 O'clock
D. Second Measurement (High Spot)
E. Tire Reference Mark At 6 O'clock

Figure 4—Checking Tire To Wheel Vectoring

- Disregard any instantaneous dial jumps due to welds, paint runs, scratches, etc. on the wheel.
- Rotate the tire and wheel assembly (or just the wheel) and note the amount of variance (runout) from zero. Locate and mark the high spot.

6. If there is a large difference in runout measurements from ON vehicle to OFF vehicle, the runout problem is likely due to excessive runout of the bolt circle or hub.
7. If measured runouts are not within the guidelines (located in "Wheel Runout Specifications" at the end of this section), proceed to "Vectoring" to correct the problem.

VECTORING

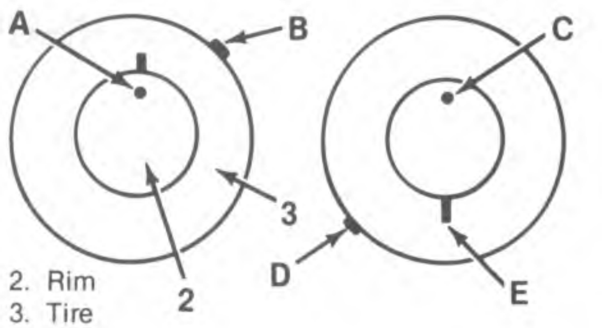
Vectoring is a technique used to reduce radial or lateral runout—and even dynamic balance on tire and wheel assemblies. Vectoring can be accomplished by positioning of the tire on the wheel and positioning of the tire and wheel assembly on the hub/rotor.

Important

- Always rebalance the tire and wheel assembly after vectoring.

Tire To Wheel Vectoring

1. Determine which runout needs to be minimized.
   - Determine visually.
2. If radial runout is the problem, take a measurement on the center tread rib.
   - If the trend is uneven, wrap tape tightly around the tire, record the runout magnitude, and mark the high spot location (figure 4).



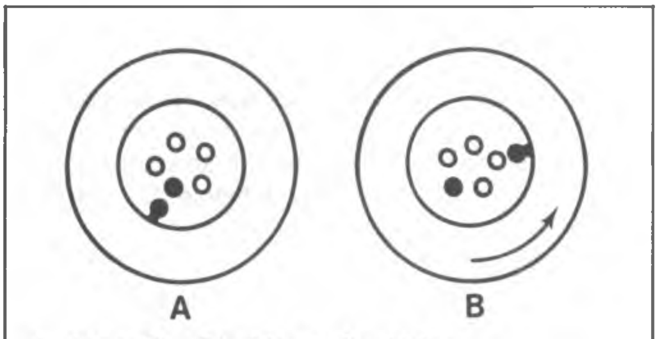
2. Rim
3. Tire
A. Valve Stem And Tire Reference Mark At 12 O'clock
B. First Measurement (High Spot)
C. Valve Stem At 12 O'clock
D. Second Measurement (High Spot)
E. Tire Reference Mark At 6 O'clock

Figure 5—Tire To Wheel Vectoring— Excessive Tire Runout

3. If lateral runout is the problem, take a measurement on the sidewall just below the edge of the tread shoulder.
   - Record the runout magnitude, and mark the high spot location.
4. Mark the tire sidewall at the valve location.
   - This is the 12 o'clock position.
   - The location of the high spot is always with respect to the clock location on the wheel.
5. Break the tire and wheel assembly down on a tire mounting machine and rotate the tire 6 hours (180°) on the rim (figure 4).
   - Reinflate the tire and measure the runout in question.
   - Record the magnitude and the location of the high spot. (Valve stem is 12 o'clock.)
6. If the clock location of the high spot remained at or near the clock location of the original high spot, the rim is the major contributor to the runout problem.
   - Confirm by removing the tire from the wheel and check the wheel rim runout.
   - If the wheel rim runout exceeds guidelines, replace the wheel.
7. If the clock position of the high spot is 6 hours from the original high spot, the tire is the major contributor to the runout problem (figure 5).
   - Replace the tire.
8. After correcting the tire to the wheel vectoring, rebalance the wheel and tire assembly.

Tire And Wheel Assembly To Hub/Rotor Vectoring

1. Mark the wheel hub bolt nearest the valve stem for reference (figure 6).
2. Rotate the assembly two wheel hub bolts and recheck the runout (figure 6).
   - Several positions may have to be tried to locate the optimum location.



A. Mark The Stud Near The Valve
B. Rotate The Wheel Two Bolt Holes B-07506

Figure 6—Tire And Wheel Assembly To Hub/Rotor Vectoring

  - This can be effective for both radial and lateral runouts.

3. If there is some looseness in the wheel hub bolt holes, radial runout can be reduced by loosening the hub bolt nuts slightly, moving the wheel position on the bolts and then retightening the nuts.
4. Balance the tire and wheel to hub/rotor assembly.
   - Compensates for any imbalance in the brake rotor, drum, or wheel cover.

EXCESSIVELY TIGHT WHEELS

Use this procedure to remove the wheel and tire assembly if it does not break free of the hub using a standard removal procedure.

1. Tighten all the lug nuts on the affected wheel.
   - Do not torque.
2. Raise the vehicle.
3. Loosen each nut two turns.
4. Lower the vehicle to the floor.
5. Rock the vehicle from side to side to loosen the wheel. Or rock the vehicle from forward to reverse allowing the vehicle to move several feet in each direction. Apply quick, hard jabs on the brake pedal to loosen the wheel.
6. Raise the vehicle and remove the lug nuts and the wheel.

SEPARATING THE TIRE FROM THE WHEEL

NOTICE: Use a tire changing machine to demount tires. Do not use hand tools or tire irons alone to remove the tire from the wheel. Damage to the tire beads or wheel rim could result.

- Follow the tire changing machine manufacturer's instructions to properly separate the tire from the wheel.

MOUNTING THE TIRE ON THE WHEEL

BIAS PLY TIRES

1. Clean the tire bead area.
2. Clean the rim bead seats with a wire brush or coarse steel wool to remove lubricants, old rubber, and light rust.
3. Apply an approved tire lubricant to the tire bead area.
4. Attach the tire to the wheel.
   - Use a tire changing machine. Follow the equipment manufacturer's instructions.

CAUTION: Do not stand over tire when inflating. The bead may break when it snaps over the safety hump, and cause serious personal injury. Do not exceed 275 kPa (40 psi) pressure when inflating. If 275 kPa (40 psi) pressure will not seat beads, deflate, re-lubricate and reinflate. Overinflation may cause the bead to break and result in personal injury.

5. Install a valve core and inflate to the specified pressure (figure 2).
   - The locating rings on each side of the tire must show above the rim flanges, positioned in direct relation to the wheel (not eccentric as compared with the rim).
6. Check the bead seating.
   - Tires must be mounted and inflated in accordance with the safety precautions included with the tire mounting equipment.

RADIAL PLY TIRES

NOTICE: Recommended vehicle tire mounting and inflation procedures are especially important with radial tires. Failure to follow these procedures can cause bead deformation in both tube type and tubeless tires due to incorrect bead seating. Bead deformation may lead to chafing, lower sidewall and bead area cracking, eccentric wear, ride vibration and nonretreadable castings.

Tube Type Tires

Important

- Only use rims approved for radial tire usage by the rim manufacturer.

1. Clean the rim parts.
    - Remove all rust and other foreign material.
    - Make sure the rim parts match and are not sprung or broken.
2. Lubricate the tire beads, the portion of the tube between the beads, and the flaps with an approved rubber lubricant.
    - Radial tubes are identifiable by the letter "R" in the size designation. A red band in the valve stem and an "R" in the flap size designation also identify radial parts.

NOTICE: Do not use silicone base lubricants—this could cause the tire to slip on the wheel.

3. Inflate to operating pressure, deflate completely, and reinflate to operating pressure.
    - Allows the tube, flap, and tire to fit together properly.
4. Check the bead seating.
    - Visually check the slot and side ring gap (on two piece rims) to make sure the bead is seated.
5. Check the spacing between the rim flange and one of the three lower sidewall rim line rings while the tire is laying flat to verify bead seating.
    - Measurements must be taken each 90 degrees around the circumference of the rim flange.
    - If the spacing is uneven around the bead from side to side, repeat steps 1 through 3, then recheck.

Installing Synthetic Tubes

NOTICE: When the tube and the flap are not properly lubricated, and mounted, they will stretch thin in the tire bead and rim region. This will cause premature wear.

1. Clean the inside of the casing.
2. Insert the tube in the tire and inflate until it is nearly rounded out.
3. Inspect the rim for rust scale and bent flanges.
    - Clean rust scale and straighten the flanges where necessary.
4. Apply a solution of neutral vegetable oil soap to the inside and outside of the tire beads, and also the rim side of the tube.
    - Use a brush or a cloth swab.
    - Do not allow the soap solution to run down into the tire.
5. Follow the standard procedure when mounting the tube and tire on a drop center rim. Be sure the tire is centered on the rim so the beads are out of the rim well before inflating. Do not allow the tire to hang loosely on the wheel while inflating.
6. Center the valve and pull it firmly against the rim. Hold in this position and inflate until the tire beads are firmly seated on the rim against the flanges.
7. Remove the valve core to completely deflate the tire.
8. Reinflate the tire to the recommended pressure.
    - Refer to "Tire Load Limits And Inflation Pressure" at the end of this section.

Tubeless Tires

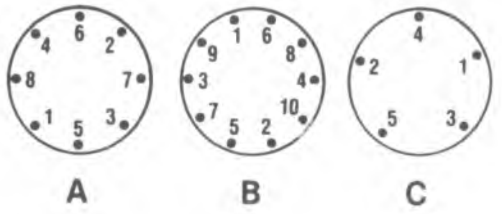
Important

- Only use rims approved for radial tire usage by the rim manufacturer.

1. Clean the rim.
    - Remove all rust and other foreign material.
2. Lubricate tire beads and rim bead seats with an approved rubber lubricant.

NOTICE: Do not use silicone base lubricants—this could cause the tire to slip on the wheel.

3. Inflate the tire to operating pressure.
    - Due to the construction of radial truck tires, particularly in the lower sidewall and bead area, it may be difficult to get the tire to take air.
    - An inflation aid may be necessary to help seat the bead of tubeless radial tires. Two types of inflation aids are commercially available—metal rings which use compressed air to seat beads, and rubber rings which seal between the tire bead and rim bead seat allowing the bead to move out and seat. Lubrication is necessary with both aids.
4. Check the spacing between the rim flange and one of the three lower sidewall rim line rings while the tire is laying flat to verify bead seating.
    - Measurements must be taken each 90 degrees around the circumference of the rim flange.
    - If the spacing is uneven around the bead from side to side, repeat steps 1 through 3, then recheck.



A. 8 Stud Wheel
B. 10 Stud Wheel
C. 5 Stud Wheel

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Figure 7—Wheel Tightening Sequence

Important

- This procedure must be followed to insure proper bead seating in order to prevent bead deformation.
- Radial tires, as well as bias tires, must be mounted and inflated in accordance with safety precautions noted in RMA Radial and Bias Truck Tire Service Manuals.

INSTALLING THE TIRE AND WHEEL ASSEMBLY

CAUTION: Before re-installing the wheels, remove any build up of corrosion on the wheel mounting surface and brake drum or disc mounting surface by scraping and wire brushing. Installing wheels with good metal-to-metal contact at the mounting surfaces can cause wheel nuts to loosen. This can lead to a wheel coming off while the vehicle is moving, possibly causing loss of control.

SINGLE WHEELS

Install or Connect (Figure 7)

1. Wheel and tire assembly in position on the hub/rotor, and lug nuts installed loosely.
2. Turn the wheel until one nut is at the top of the bolt circle. Tighten the nut just snug.
3. Snug up the remaining nuts criss-cross to minimize runout.

NOTICE: Refer to the "Notice" on page 3E-1 of this section.

Tighten

- Nuts to "Specifications" at the end of this section.
- Tighten evenly and alternately to avoid excessive runout (figure 7).

DUAL WHEELS

Install or Connect (Figure 7)

1. Inner and outer wheel and clamp ring on the rear wheel, or wheel and clamp ring on the front wheel.
   - Be sure the pins on the clamp ring face outward.
2. Lub nuts finger tight.

Tighten

- Nuts to "Specifications" at the end of this section.
- For P30 models, tighten to 210 N·m (155 ft. lbs.), then tighten again to 237 N·m (175 ft. lbs.).
- Tighten evenly and alternately to avoid excessive runout (figure 7).

Measure

- Lateral runout should not exceed 3.18 mm (0.125 inches) on the front wheel or 4.76 mm (0.187 inches) on the rear wheel.

ALUMINUM WHEEL REFINISHING

- Remove the tire and wheel assembly from the vehicle.
- Mark the position of the wheel weights on the tire for correct reinstallation after recoating the wheel. Remove the wheel weights and mask off the tire.

1. Remove the original clear coating.
   - Apply a chemical stripper such as 3M brand Troubleshooter to the wheel rim surface.
   - Wait 10 to 15 minutes, then wet scrub the surface using a 3M #98 Scotchbrite Cleaning Pad (3M part number 07445).
   - Rinse the surface thoroughly with clean water.

CAUTION: Use of eye goggles is necessary to prevent personal injury.

2. Remove surface oxidation.
   - Use 3M Superbuff Buffing Pad (3M part number 05701) and a medium type compound such as 3M part number 05955 or 05931.

   - Hose off the rim with water and scrub with a small brush to remove excess compound, then air blow dry.
3. Recoat the wheels.
   - Clean the surface of any contaminants using Prekleno.
   - Apply #801 Metal Conditioner, taking care to use rubber gloves and a clean cloth during the application. Keep the surface wet while applying.

Important

- Make sure #801 Metal Conditioner is reduced one part metal conditioner to three parts of water.
- Wipe off #801 Metal Conditioner carefully while the surface is still wet. Use a clean, dry cloth.

4. Apply the clear coat.
   - Apply R & M's 893 2K Clear with 894 Urethane Catalyst Hardener. Refer to the label for specific directions.
   - Wear proper respiratory protection such as a 3M Paint Respirator (part number 06984) or Easi-Air Respirator (part number 06986) or equivalent.
5. Allow the wheel to air dry overnight (minimum) before installing on the vehicle.
6. Attach balance weights and install the wheel and tire assembly on the vehicle.
   - Mount the weights in the marked positions and remove the masking from the tire.

WHEEL AND TIRE BALANCING

To insure successful, accurate balancing, the following precautions must be observed:

- The wheel and tire must be clean and free of all foreign matter.
- The tire should be in good condition and properly mounted using the balance mark on the tire, if any, or lined up with the inflation valve.
- Bent wheels that have a runout over 1.6 mm (1/6-inch) should be replaced.
- Inspect the wheel and tire assembly to determine if an out-of-round condition exists.

Important

- A severe out-of-round condition cannot be "balanced out." A wheel and tire assembly having an out-of-round condition exceeding 4.7 mm (3/16-inch) is not suitable for the front of the vehicle. Its use on the rear of the vehicle must be governed by its general condition and whether the roundness problem seriously detracts from overall ride quality.

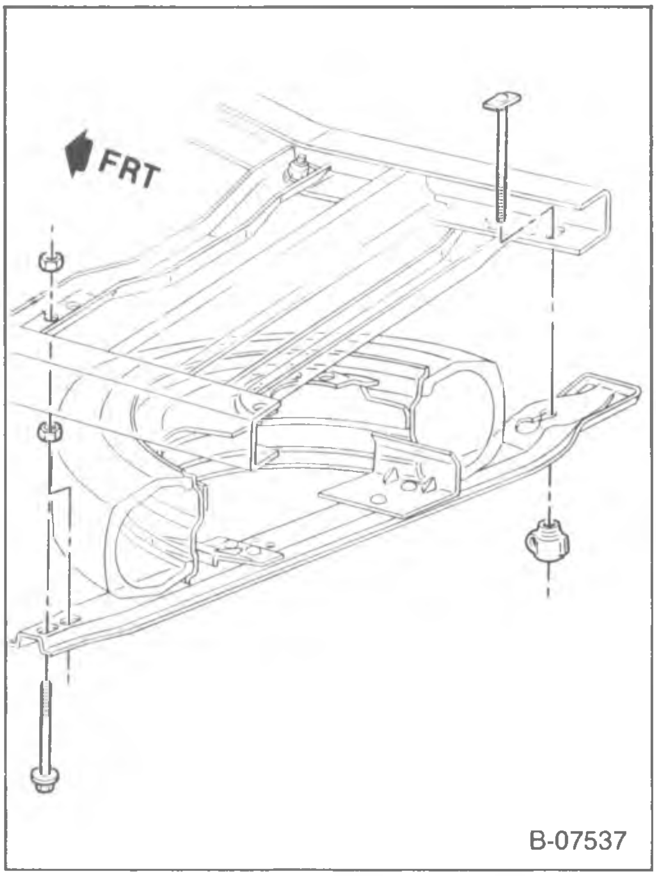


Figure 8—Underbody Swing Out Spare Tire Carrier (RPO P10)

- Follow the wheel balancer machine instructions while performing the balancing operation.

OPTIONAL SPARE TIRE CARRIERS

UNDERBODY SWING OUT SPARE TIRE CARRIER (RPO P10)

The underbody swing out spare tire carrier is standard equipment on C-K 10/1500 series pickups. It is available as an option (RPO P10) on C-K 20/2500 and 30/3500 series pickups (figure 8).

UNDERBODY GLIDE OUT SPARE TIRE CARRIER (RPO P11)

The underbody glide out spare tire carrier is available as an option (RPO P11) on all C-K series pickups (figure 9).

SIDE PANEL MOUNTED SPARE TIRE CARRIER (RPO P13)

The side panel mounted spare tire carrier is available as an option on all C-K series pickups (figure 10).

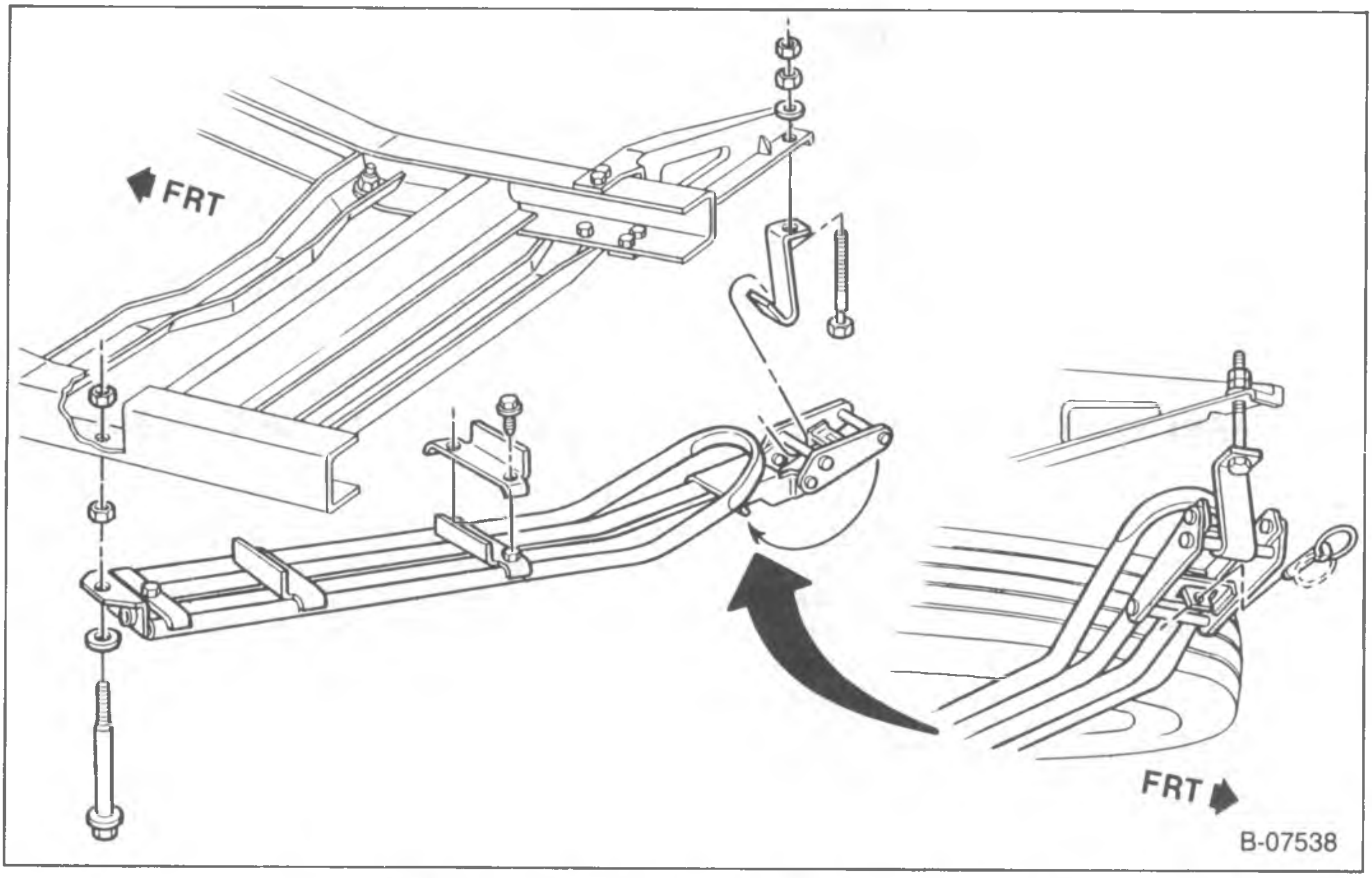


Figure 9—Underbody Glide Out Spare Tire Carrier (RPO P11)

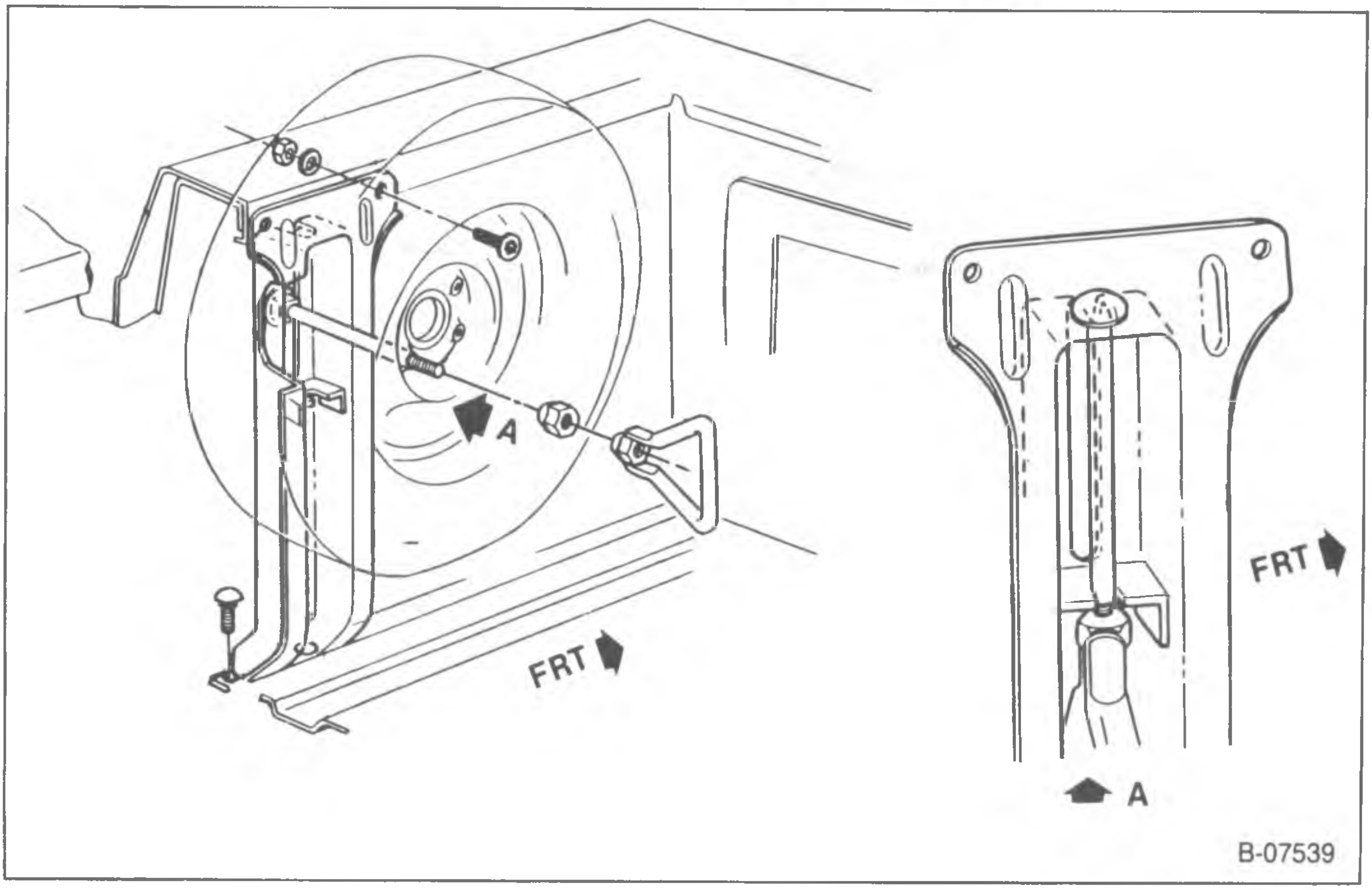


Figure 10—Side Panel Mounted Spare Tire Carrier (RPO P13)

SPECIFICATIONS

WHEEL RUNOUT SPECIFICATIONS

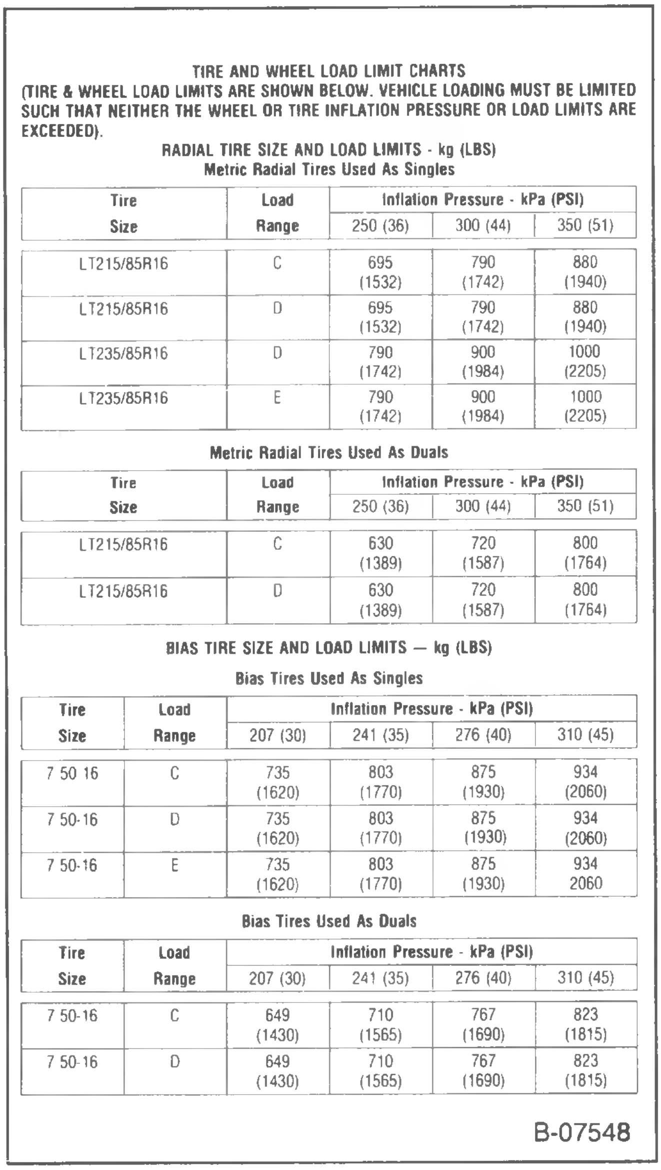
	Steel Wheels	Aluminum Wheels
Radial Runout	1.01 mm (0.04 inches)	0.76 mm (0.03 inches)
Lateral Runout	1.14 mm (0.045 inches)	0.76 mm (0.03 inches)

WHEEL STUD NUT TORQUE (SINGLE FRONT AND REAR WHEELS)

Series	Number Of Studs	Nut Torque
C10/1500	5 studs	140 N·m (100 ft. lbs.) (steel wheels)
K10/1500	6 studs	120 N·m (88 ft. lbs.) (steel wheels)
C 10/1500	5 studs	140 N·m (100 ft. lbs.) (aluminum wheels)
K 10/1500	6 studs	140 N·m (100 ft. lbs.) (aluminum wheels)
C-K 20/2500	8 studs	160 N·m (120 ft. lbs.) (all)
C-K 30/3500	8 studs	160 N·m (120 ft. lbs.) (all)
G10/1500–20/2500	5 studs	140 N·m (100 ft. lbs.) (steel wheels)
G10/1500–20/2500	5 studs	140 N·m (100 ft. lbs.) (aluminum wheels)
G30/3500	8 studs	160 N·m (120 ft. lbs.) (all)
P20/2500 & 30/3500	8 studs	160 N·m (120 ft. lbs.) (all)

WHEEL STUD NUT TORQUE (SINGLE FRONT AND DUAL REAR WHEELS)

Series	Number Of Studs	Nut Torque
C-K 30/3500	8 studs	190 N·m (140 ft. lbs.) (all)
G 30/3500	8 studs	190 N·m (140 ft. lbs.) (all)
P 30/3500	8 studs	190 N·m (140 ft. lbs.) (with RPO JB8)
P 30/3500	10 studs	210 N·m (155 ft. lbs.) (with RPO JF9)



TIRE AND WHEEL LOAD LIMIT CHARTS
(TIRE & WHEEL LOAD LIMITS ARE SHOWN BELOW. VEHICLE LOADING MUST BE LIMITED SUCH THAT NEITHER THE WHEEL OR TIRE INFLATION PRESSURE OR LOAD LIMITS ARE EXCEEDED).

RADIAL TIRE SIZE AND LOAD LIMITS - kg (LBS)

Metric Radial Tires Used As Singles

Tire Size	Load Range	Inflation Pressure - kPa (PSI)		
		250 (36)	300 (44)	350 (51)
LT215/85R16	C	695 (1532)	790 (1742)	880 (1940)
LT215/85R16	D	695 (1532)	790 (1742)	880 (1940)
LT235/85R16	D	790 (1742)	900 (1984)	1000 (2205)
LT235/85R16	E	790 (1742)	900 (1984)	1000 (2205)

Metric Radial Tires Used As Duals

Tire Size	Load Range	Inflation Pressure - kPa (PSI)		
		250 (36)	300 (44)	350 (51)
LT215/85R16	C	630 (1389)	720 (1587)	800 (1764)
LT215/85R16	D	630 (1389)	720 (1587)	800 (1764)

BIAS TIRE SIZE AND LOAD LIMITS — kg (LBS)

Bias Tires Used As Singles

Tire Size	Load Range	Inflation Pressure - kPa (PSI)			
		207 (30)	241 (35)	276 (40)	310 (45)
7 50 16	C	735 (1620)	803 (1770)	875 (1930)	934 (2060)
7 50-16	D	735 (1620)	803 (1770)	875 (1930)	934 (2060)
7 50-16	E	735 (1620)	803 (1770)	875 (1930)	934 2060

Bias Tires Used As Duals

Tire Size	Load Range	Inflation Pressure - kPa (PSI)			
		207 (30)	241 (35)	276 (40)	310 (45)
7 50-16	C	649 (1430)	710 (1565)	767 (1690)	823 (1815)
7 50-16	D	649 (1430)	710 (1565)	767 (1690)	823 (1815)

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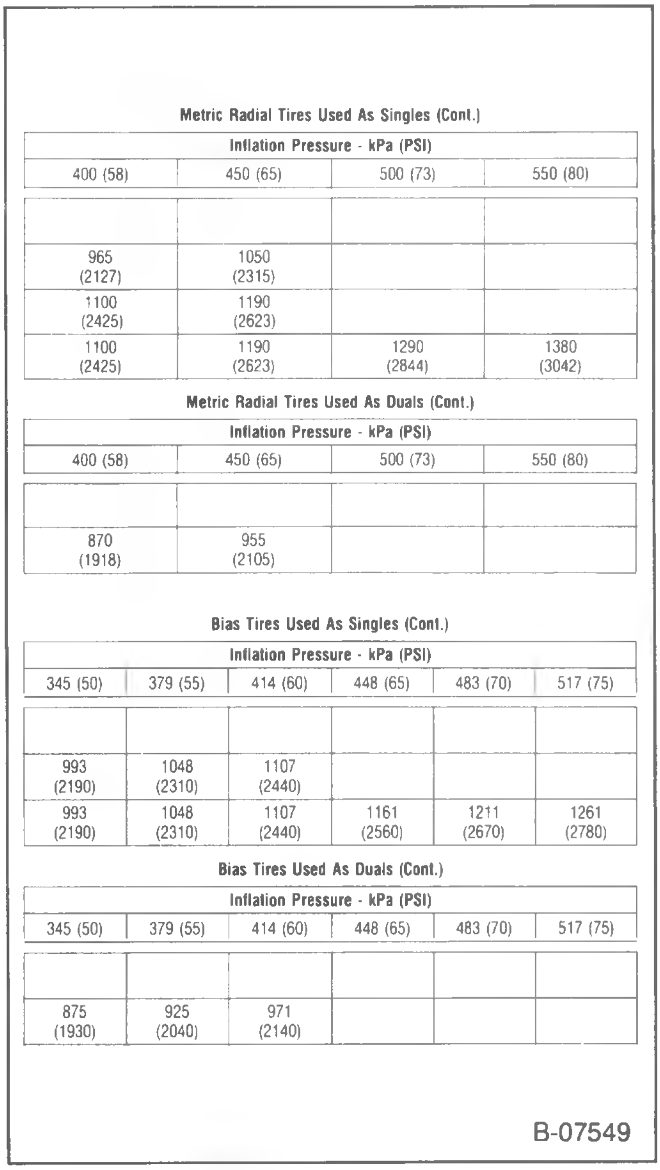
Figure 11—Tire Load Limits And Inflation Pressure (C-K)



Metric Radial Tires Used As Singles (Cont.)

Inflation Pressure - kPa (PSI)			
400 (58)	450 (65)	500 (73)	550 (80)
965 (2127)	1050 (2315)		
1100 (2425)	1190 (2623)		
1100 (2425)	1190 (2623)	1290 (2844)	1380 (3042)

Metric Radial Tires Used As Duals (Cont.)

Inflation Pressure - kPa (PSI)			
400 (58)	450 (65)	500 (73)	550 (80)
870 (1918)	955 (2105)		

Bias Tires Used As Singles (Cont.)

Inflation Pressure - kPa (PSI)					
345 (50)	379 (55)	414 (60)	448 (65)	483 (70)	517 (75)
993 (2190)	1048 (2310)	1107 (2440)			
993 (2190)	1048 (2310)	1107 (2440)	1161 (2560)	1211 (2670)	1261 (2780)

Bias Tires Used As Duals (Cont.)

Inflation Pressure - kPa (PSI)					
345 (50)	379 (55)	414 (60)	448 (65)	483 (70)	517 (75)
875 (1930)	925 (2040)	971 (2140)			

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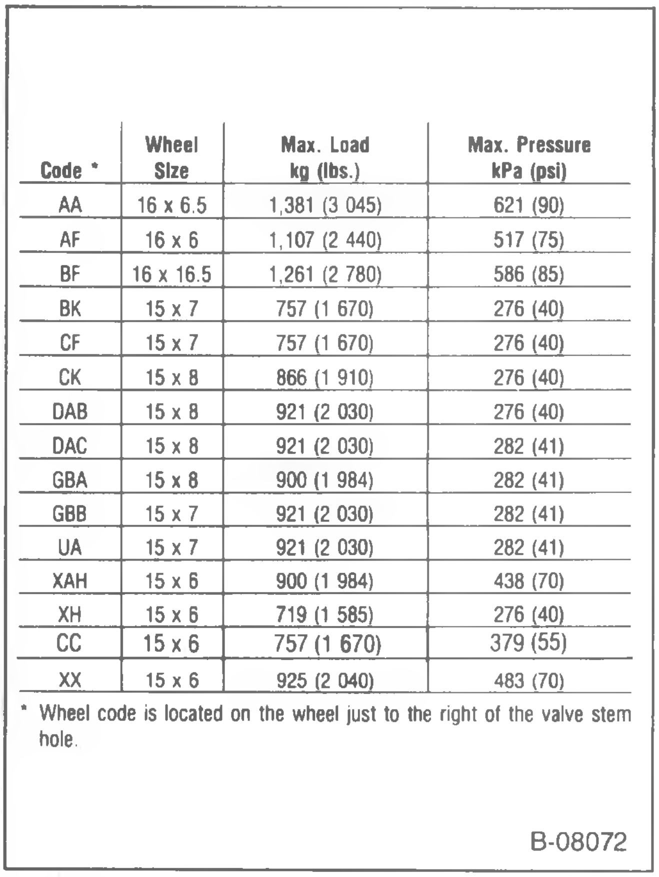
Figure 12—Tire Load Limits And Inflation Pressure (C-K)

TIRE LOAD LIMITS AND INFLATION PRESSURE

Refer to Figures 11, 12, 14, 15, 17, and 18 for tire load limits given an inflation pressure range.

WHEEL CODES AND LOAD LIMITS

Refer to Figures 13, 16, and 19 for wheel load limits for each wheel size (coded).



Code *	Wheel Size	Max. Load kg (lbs.)	Max. Pressure kPa (psi)
AA	16 x 6.5	1,381 (3 045)	621 (90)
AF	16 x 6	1,107 (2 440)	517 (75)
BF	16 x 16.5	1,261 (2 780)	586 (85)
BK	15 x 7	757 (1 670)	276 (40)
CF	15 x 7	757 (1 670)	276 (40)
CK	15 x 8	866 (1 910)	276 (40)
DAB	15 x 8	921 (2 030)	276 (40)
DAC	15 x 8	921 (2 030)	282 (41)
GBA	15 x 8	900 (1 984)	282 (41)
GBB	15 x 7	921 (2 030)	282 (41)
UA	15 x 7	921 (2 030)	282 (41)
XAH	15 x 6	900 (1 984)	438 (70)
XH	15 x 6	719 (1 585)	276 (40)
CC	15 x 6	757 (1 670)	379 (55)
XX	15 x 6	925 (2 040)	483 (70)

* Wheel code is located on the wheel just to the right of the valve stem hole.

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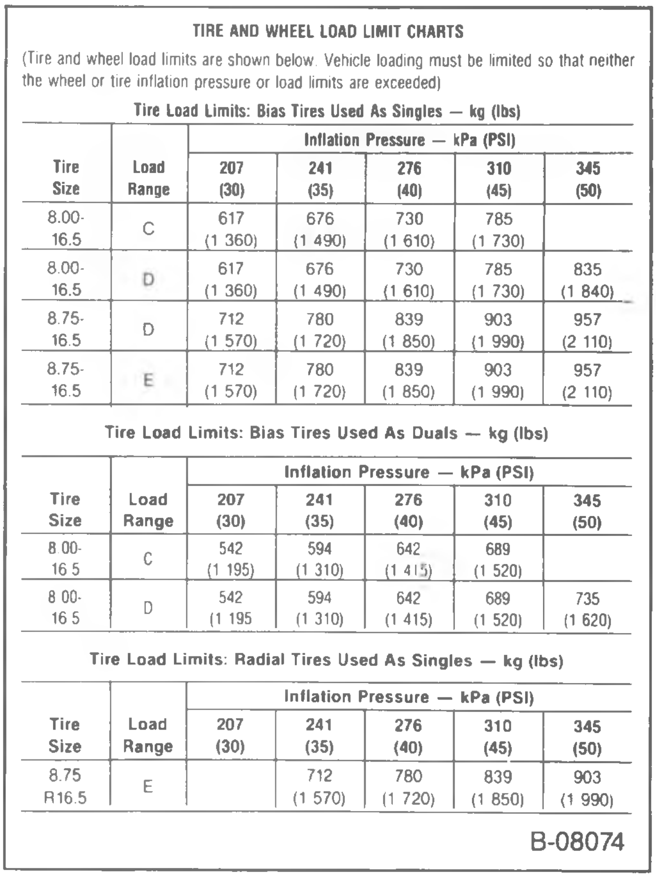
Figure 13—Wheel Codes And Load Limits (C-K)



TIRE AND WHEEL LOAD LIMIT CHARTS

(Tire and wheel load limits are shown below. Vehicle loading must be limited so that neither the wheel or tire inflation pressure or load limits are exceeded)

Tire Load Limits: Bias Tires Used As Singles — kg (lbs)

Tire Size	Load Range	Inflation Pressure — kPa (PSI) 207 (30)	241 (35)	276 (40)	310 (45)	345 (50)
8.00-16.5	C	617 (1 360)	676 (1 490)	730 (1 610)	785 (1 730)	
8.00-16.5	D	617 (1 360)	676 (1 490)	730 (1 610)	785 (1 730)	835 (1 840)
8.75-16.5	D	712 (1 570)	780 (1 720)	839 (1 850)	903 (1 990)	957 (2 110)
8.75-16.5	E	712 (1 570)	780 (1 720)	839 (1 850)	903 (1 990)	957 (2 110)

Tire Load Limits: Bias Tires Used As Duals — kg (lbs)

Tire Size	Load Range	Inflation Pressure — kPa (PSI) 207 (30)	241 (35)	276 (40)	310 (45)	345 (50)
8 00-16 5	C	542 (1 195)	594 (1 310)	642 (1 415)	689 (1 520)	
8 00-16 5	D	542 (1 195	594 (1 310)	642 (1 415)	689 (1 520)	735 (1 620)

Tire Load Limits: Radial Tires Used As Singles — kg (lbs)

Tire Size	Load Range	Inflation Pressure — kPa (PSI) 207 (30)	241 (35)	276 (40)	310 (45)	345 (50)
8.75 R16.5	E		712 (1 570)	780 (1 720)	839 (1 850)	903 (1 990)

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Figure 14—Tire Load Limits And Inflation Pressure (G)

Tire Load Limits: Bias Tire Used As Singles — kg (lbs.) (Cont.)

Inflation Pressure — kPa (PSI)					
379 (55)	414 (60)	448 (65)	483 (70)	517 (75)	552 (80)
882 (1 945)	928 (2 045)				
1016 (2 240)	1066 (2 350)				
1016 (2 240)	1066 (2 350)	1120 (2 470)	1166 (2 570)	1216 (2 680)	

Tire Load Limits: Bias Tires Used As Duals — kg (lbs.) (Cont.)

Inflation Pressure — kPa (PSI)					
379 (55)	414 (60)	448 (65)	483 (70)	517 (75)	552 (80)
776 (1 710)	816 (1 800)				

Tire Load Limits: Radial Tires Used As Singles — kg (lbs.) (Cont.)

Inflation Pressure — kPa (PSI)					
379 (55)	414 (60)	448 (65)	483 (70)	517 (75)	552 (80)
957 (2 110)	1016 (2 240)	1066 (2 350)	1120 (2 470)	1166 (2 570)	1216 (2 680)

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Figure 15—Tire Load Limits And Inflation Pressure (G)

Wheel Code and Load Limits

Code *	Wheel Size	Max. Load — kg (lbs.)	Max. Pressure — kPa (PSI)
DAS	15 x 6.5	835 (1 843)	282 (41)
GBC	15 x 6 5	835 (1 843)	282 (41)
XH	15 x 6	719 (1 585)	276 (40)
XAH	15 x 6	900 (1 984)	483 (70)
YH	16.5 x 6	1216 (2 680)	586 (85)
XJ	16 5 x 6 75	1216 (2 680)	586 (85)

*Wheel code is located on the wheel just to the right of the valve stem hole.

B-08076

Figure 16—Wheel Codes And Load Limits (G)

TIRE LOAD LIMIT CHARTS

(Tire load limits at different inflation pressures are shown below. Vehicle loading must be limited such that neither the tire inflation pressures or load limits are exceeded).

METRIC RADIAL TIRES — kg (LBS.)

Tire Size	Load Range	Single Dual	Inflation Pressure - kPa (PSI)		
			250 (36)	300 (44)	350 (51)
LT215/85R16	C	S	695 (1532)	790 (1742)	880 (1940)
		D	630 (1389)	720 (1587)	800 (1764)
LT215/85R16	D	S	695 (1532)	790 (1742)	880 (1940)
		D	630 (1389)	720 (1587)	800 (1764)
LT235/85R16	D	S	790 (1742)	900 (1984)	1000 (2205)
		—			
LT235/85R16	E	S	790 (1742)	900 (1984)	1000 (2205)
		—			

STANDARD RADIAL TIRES — kg (LBS.)

Tire Size	Load Range	Single Dual	Inflation Pressure - kPa (PSI)		
			310 (45)	345 (50)	379 (55)
8R19.5	D	S			
		D			

BIAS TIRES — kg (LBS.)

Tire Size	Load Range	Single Dual	Inflation Pressure — kPa (PSI)			
			207 (30)	241 (35)	276 (40)	310 (45)
7 50-16	C	S	735 (1630)	803 (1770)	875 (1930)	934 (2060)
		D	649 (1430)	710 (1565)	767 (1690)	823 (1815)
7.50-16	O	S	735 (1620)	803 (1770)	875 (1930)	934 (2060)
		D	649 (1430)	710 (1565)	767 (1690)	823 (1815)
7 50-16	E	S	735 (1620)	803 (1770)	875 (1930)	934 (2060)
		—				
8-19 5	D	S				
		D			839 (1850)	903 (1990)
8-19 5	E	S				
		D			839 (1850)	903 (1990)

B-08077

Figure 17—Tire Load Limits And Inflation Pressure (P)

TIRE LOAD LIMIT CHARTS (CONT.)

METRIC RADIAL TIRES (CONT.) — kg (LBS.)

Inflation Pressure - kPa (PSI)			
400 (58)	450 (65)	500 (73)	550 (80)
965 (2127)	1050(2315)		
870 (1918)	955 (2105)		
1100 (2425)	1190 (2623)		
1100 (2425)	1190 (2623)	1290 (2844)	1380 (3042)

STANDARD RADIAL TIRES (CONT.) — kg (LBS.)

Inflation Pressure — kPa (PSI)				
414 (60)	448 (65)	483 (70)	517 (75)	552 (80)
1030 (2270)	1093 (2410)	1152 (2540)	1216 (2680)	1270 (2800)
1012 (2230)	1066 (2350)	1116 (2460)		

BIAS TIRES (CONT.) — kg (LBS.)

Inflation Pressure — kPa (PSI)					
345 (50)	379 (55)	414 (60)	448 (65)	483 (70)	517 (75)
993 (2190)	1048 (2310)	1107 (2440)			
875 (1930)	925 (2040)	971 (2140)			
993 (2190)	1048 (2310)	1107 (2440)	1161 (2560)	1211 (2670)	1261 (2780)
957 (2110)	1030 (2270)	1093 (2410)	1152 (2540)	1216 (2680)	1270 (2800)
957 (2110)	1012 (2230)	1066 (2350)	1116 (2460)		
957 (2110)	1030 (2270)	1093 (2410)	1152 (2540)	1216 (2680)	1270 (2800)
957 (2110)	1012 (2230)	1066 (2350)	1116 (2460)	1166 (2570)	1216 (2680)

B-08078

Figure 18—Tire Load Limits And Inflation Pressure (P)

WHEEL CODE AND LIMITS

Code*	Wheel Size	Max Load kg (Lbs.)	Max Pressure kPa (PSI)
AA	16 x 6.5 L	1381 (3045)	621 (90)
AF	16 x 6 K	1107 (2440)	517 (75)
BF	16 x 6.5 L	1261 (2780)	586 (85)
ZT	19.5 x 6	1261 (2780)	655 (95)
ZY	19.5 x 6	1152 (2540)	552 (80)

*Wheel code is located on the wheel just to the right of the valve stem hole.

B-08079

Figure 19—Wheel Codes And Load Limits (P)

SECTION 4A

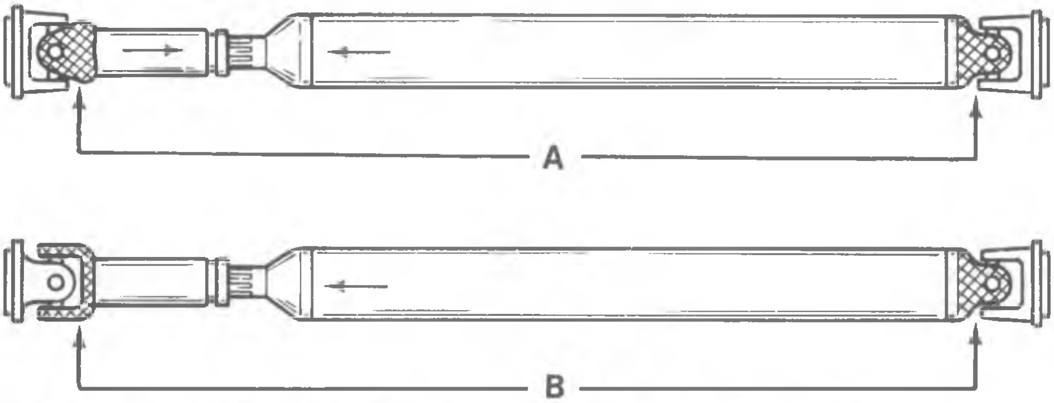
PROPELLER SHAFT

The following "Notice" applies to one or more steps in the assembly procedure of components in this portion of this manual as indicated at appropriate locations by the terminology "Notice: See 'NOTICE' on page 4A-1 of this section".

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

CONTENTS

DESCRIPTION



A. Correct Phasing - Yoke Lugs (Ears) and Alignment Marks Aligned
B. Incorrect Phasing - Yoke Lugs (Ears) and Alignment Marks not Aligned

B-06716

Figure 1—Propeller Shaft Assembly Phased

PROPELLER SHAFT

Torque is transmitted from the transmission to the rear axle through one or more propeller shafts and universal joint assemblies. The number of propeller shafts and universal joint assemblies vary with the vehicle wheel base, and the combination of transmission, transfer case (front drive) and rear axle equipment.

All propeller shafts are the balanced tubular type (figure 1). A splined slip joint is provided in some drivelines and others use a companion flange at the transmission end of the driveline. If two or more propeller shafts are used on a vehicle the slip joint is usually at the forward end of the rear propeller shaft.

Phasing

The propeller shaft is designed and built with the yoke lugs (ears) in line with each other (figure 1). This design produces the smoothest running shaft possible, and is called phasing.

Vibration can be caused by an out of phase propeller shaft. The propeller shaft will absorb vibrations from speeding up and slowing down each time the universal joint goes around. This vibration would be the same as a person snapping a rope and watching the "wave" reaction flow to the end. A propeller shaft working in phase would be similar to two persons snapping a rope at the same time, and watching the "waves" meet and cancel each other out. In comparison this would be the same as the universal joints on a propeller shaft. A total cancellation of vibration produces a smooth flow of power in the driveline. It is very important to reference mark the propeller shaft before removal, to assure phased installation alignment. Some propeller shafts have alignment marks or arrows stamped on the shaft at the time of production.

CENTER BEARING

Center bearings support the driveline when two or more propeller shafts are used. The center bearing is a ball type bearing mounted in a rubber cushion that is attached to a frame crossmember. The bearing is pre-lubricated and sealed by the manufacturer (figure 2).

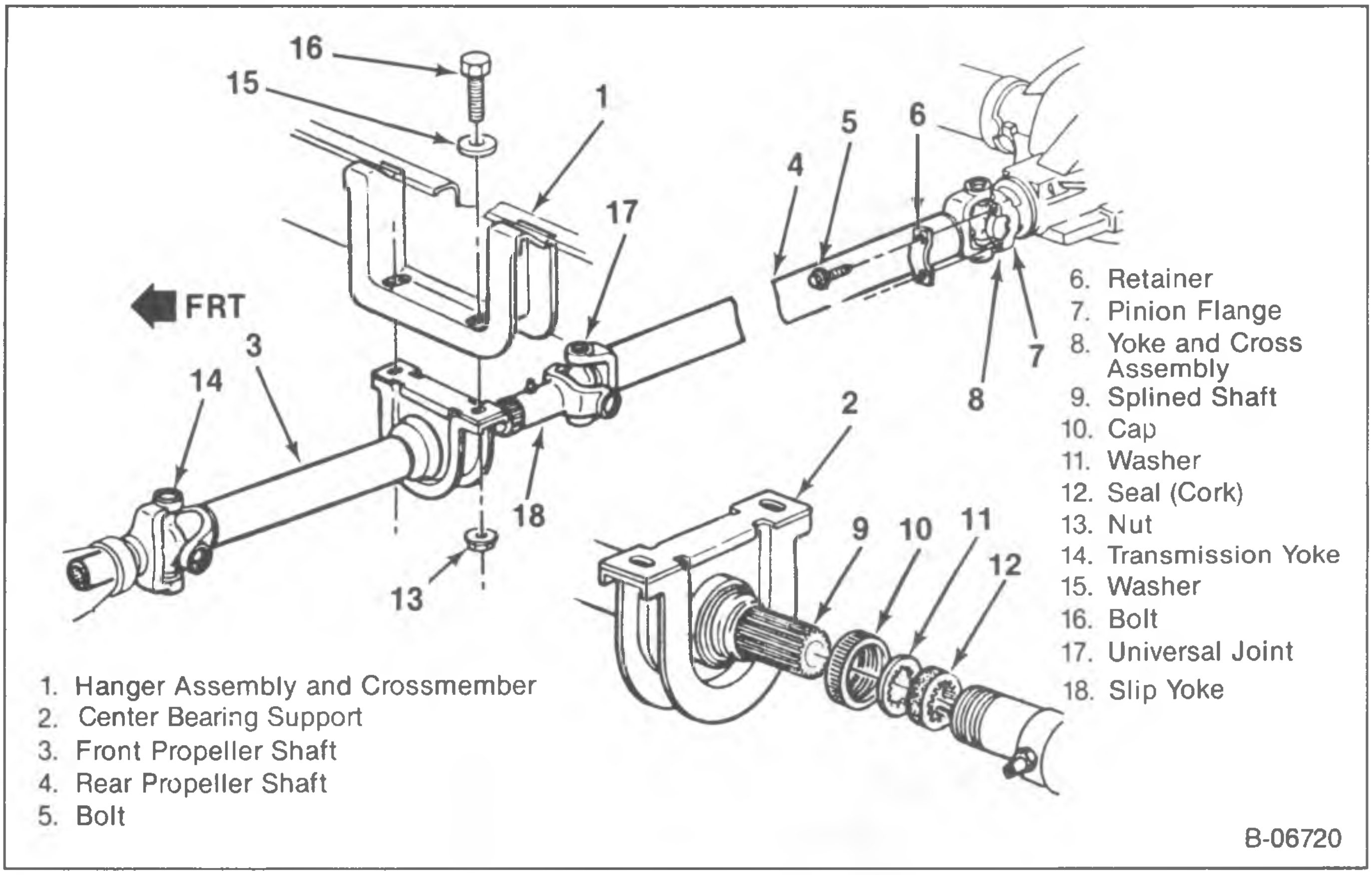
UNIVERSAL JOINT

A universal joint is two Y-shaped yokes connected by a crossmember called a spider. The spider is shaped like a cross having arms of equal length called trunnions (figure 3).

Universal joints are designed to handle the effects of various loadings and rear axle windup during acceleration. Within the designed angle variations the universal joint will operate efficiently and safely. When the design angle is changed or exceeded the operational life of the joint may decrease.

The trunnion bearings used in universal joints are the needle roller type. The needle rollers are held in place on the trunnions by round bearing cups. The bearing cups are held in the yokes by either (depending on the manufacturer) snap rings or injected plastic.

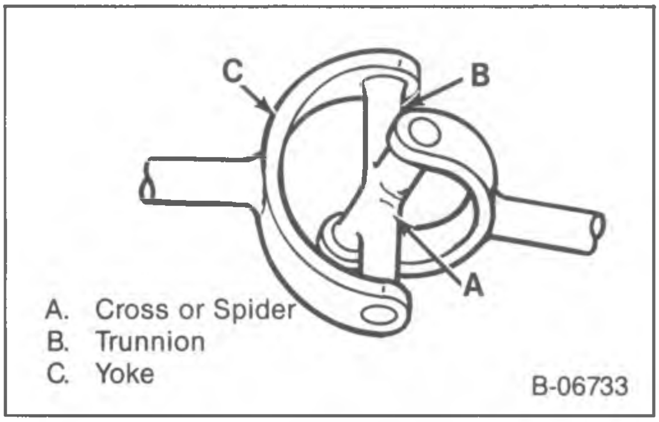
When a driveline has a large or deep angle a constant velocity joint is used. Essentially, the constant velocity joint is made of two universal joints coupled by a yoke and phased for constant velocity. A centering



1. Hanger Assembly and Crossmember
2. Center Bearing Support
3. Front Propeller Shaft
4. Rear Propeller Shaft
5. Bolt
6. Retainer
7. Pinion Flange
8. Yoke and Cross Assembly
9. Splined Shaft
10. Cap
11. Washer
12. Seal (Cork)
13. Nut
14. Transmission Yoke
15. Washer
16. Bolt
17. Universal Joint
18. Slip Yoke

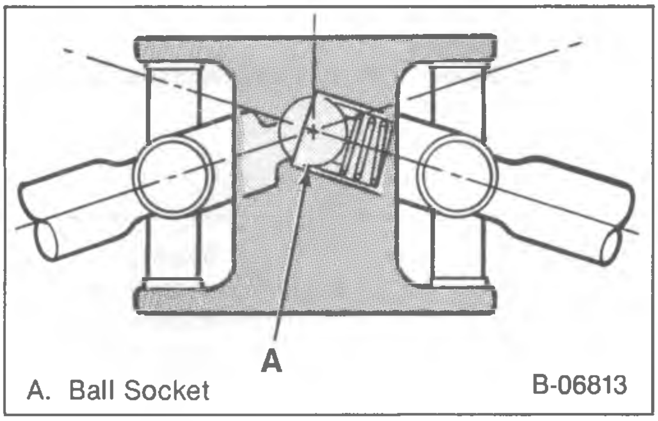
Figure 2—Center Bearing And Propeller Shaft Detail

ball socket between the joints keeps a relative position between the two joints. This centering device causes each of the two units to operate through one half of the complete angle between the propeller shaft and the differential carrier (figure 4). The ball socket on a constant velocity universal joint requires periodic lubrication through the fitting provided.



A. Cross or Spider
B. Trunnion
C. Yoke

Figure 3—Simple Universal Joint



A. Ball Socket

Figure 4—Constant Velocity Joint (Simplified)

DIAGNOSIS OF DRIVELINE VIBRATION (ROAD TEST)

Four major component groups are usually the cause of or are related to vibration. When a technician is road testing a vehicle for vibration he must remember the four major component groups:

1. Engine and mounts.
2. Clutch and transmission.
3. Tires, wheels and brake drums.
4. Propeller shaft and universal joints.

Before road testing a vehicle, check the following:

1. In or out of phase propeller shaft.
2. All fasteners for tightness at universal joints, wheel lugs and engine mounts.
3. Tire air pressure.
4. Load conditions.

ROAD TEST

A technician should road test the vehicle to diagnose exactly what the complaint is. Record the speed and rpm at which the greatest vibration occurs. The vibration is likely to be in two places, in the steering wheel or in the seat bottom. The road test can be helpful in locating the vibration source either forward or aft.

COAST TEST

Drive the vehicle past the vibration speed, shift into neutral and coast back through the vibration speed. In this test two kinds of vibration normally occur; a shaking or a buzzing. A shaking vibration is usually tires or a wheel and brake drum/disc assembly problem. A buzzing vibration is usually a driveline problem.

DIAGNOSIS OF THE PROPELLER SHAFT AND UNIVERSAL JOINT

PROBLEM	POSSIBLE CAUSE	CORRECTION
Leak At The Front Slip Yoke (An Occasional Drop Of Lubricant Leaking From The Splined Yoke Is Normal And Requires No Attention)	1. Rough surface on splined yoke; burred, nicked or worn. 2. Defective transmission rear oil seal.	1. Replace the seal. Minor burrs can be smoothed by careful use of crocus cloth or fine stone honing. Replace the yoke if badly burred. 2. Replace the transmission rear oil seal and replenish the transmission oil.
Universal Joint Noise	1. Center bearing. 2. Worn universal joint bearings. 3. Improper lubrication. 4. Loose flange bolts.	1. Replace the center bearing. 2. Replace. 3. Lubricate as directed. 4. Tighten to "Specifications".
Ping, Snap, Or Click In Drive Line (Usually Heard On Initial Load After The Transmission Is In Gear; Forward Or Reverse)	1. Loose bushing bolts on the rear springs or upper and lower control arms. 2. Loose or out of phase companion flange.	1. Tighten the bolts to specified torque. 2. Remove companion flange, turn 180 degrees from its original position, lubricate the splines and install. Tighten the bolts and pinion nut to specified torque.

DIAGNOSIS OF THE PROPELLER SHAFT AND UNIVERSAL JOINT (CONTINUED)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Knocking Or Clunking Noise In The Driveline When Operating The Vehicle In A Floating Condition In High Or Neutral Gear At 10 MPH (16 km/h)	1. Worn or damaged universal joint. 2. Side gear hub counterbore in the differential is worn oversize.	1. Replace the worn or damaged universal joint. 2. Replace the differential case and/or the sidegears.
Roughness Or Vibration	1. Bent or dented propeller shaft. 2. Undercoating on propeller shaft. 3. Tire unbalance, 30-80 mph (48-129 km/h). Not throttle conscious. 4. Tight universal joints. 5. Worn universal joints. 6. Burrs or gouges on companion flange. Check snap ring locating surfaces on flange yoke. 7. Propeller shaft, parking brake drum or companion flange is unbalanced. 8. Incorrect rear joint angle. The angle is usually too large when it is a factor. 9. Excessive looseness at the slip spline. 10. Distorted or damaged yokes or flanges. 11. Yokes out of phase. 12. Propeller shaft runout at 50 mph (80 km/h). Throttle conscious.	1. Replace propeller shaft. 2. Clean propeller shaft. 3. Balance or replace as required. 4. Impact yokes with a shaft hammer to free up. If unable to free up or if joint feels rough when rotated, replace. 5. Replace. 6. Rework or replace the companion flange. 7. Check for a missing balance weight on the propeller shaft. Rotate the companion flange 180 degrees. 8. Check and correct trim height at curb weight. Check and correct joint angle. 9. Replace necessary parts. 10. Install new yokes or flanges. 11. Remove companion flange, turn 180 degrees from the original position, lubricate the splines and install. Tighten bolts to specified torque. 12. Check propeller shaft runout at front and rear. Should be less than specified. If above, rotate propeller shaft 180 degrees and recheck. Replace the propeller shaft if runout is still over specification.
Scraping Noise	Slinger, companion flange, or end yoke rubbing on rear axle or center bearing.	Correct the interference.
Roughness Above 35 MPH (56 km/h) Felt And/Or Heard	Tires unbalanced or worn.	Balance or replace as required.
Squeak	1. Lack of lubricant. 2. Center bearing.	1. Lubricate joints and splines. Also check for worn or brinelled parts. 2. Replace or lubricate.

DIAGNOSIS OF THE PROPELLER SHAFT AND UNIVERSAL JOINT (CONTINUED)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Whine Or Whistle	Center support bearing.	Place the vehicle on a hoist with rear wheels free to rotate and diagnose for source of noise, replace.
Shudder On Acceleration, (Low Speed)	1. Loose or missing bolts at the center bearing or flanges. 2. Incorrectly set front joint angle. 3. Worn universal joint.	1. Replace or tighten bolts to specified torque. 2. Shim under the transmission support mount to change the front joint angle. 3. Replace.

ON-VEHICLE SERVICE

PROPELLER SHAFT BALANCE CHECK

- Raise the vehicle on a twin post hoist so the wheels can spin.

Remove or Disconnect

1. Tire and wheel assemblies and the brake drums.
    - **DO NOT APPLY THE BRAKE WITH THE DRUMS REMOVED.**

Inspect

- Propeller shaft, universal joints and attachments for mud, undercoating or loose fasteners.

Clean

- Propeller shaft, universal joints and attachments.

Tighten

- Any loose attachments or fasteners.

Important

- Run the vehicle in gear at the speed where the disturbance peaks; observe the intensity of the disturbance.
- Stop the engine.

2. Propeller shaft.
    - Rotate the propeller shaft 180 degrees from the original position.

Install or Connect

1. Propeller shaft.
    - Determine the position which gives the best balance.
2. Rear drums, wheel and tire assemblies.
    - Determine the position which gives the best driveline response by road testing the vehicle for a final check of the propeller shaft balance.
    - Unacceptable balance, replace the propeller shaft.

PROPELLER SHAFT RUNOUT CHECK

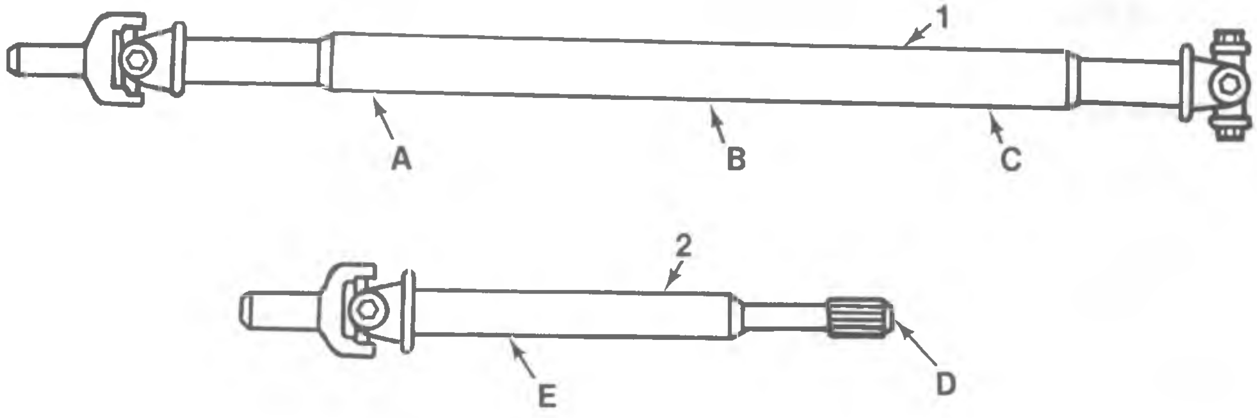
Noise or vibration at high speed could be caused by a bent propeller shaft. The propeller shaft could have been damaged by rough handling or a collision. Check for propeller shaft straightness.

1. Raise the vehicle on a twin post hoist so the wheels can spin.
2. Attach a dial indicator having a magnetic base to a smooth place on the vehicle underbody.
3. Take dial indicator readings at the propeller shaft check points shown in figure 5. For runout specifications, refer to figure 6.

Important

- Do not attach the dial indicator base at a weld.

4. With the transmission in neutral, hand rotate the axle pinion flange or the transmission yoke and take the necessary dial indicator readings on the propeller shaft. Record the readings. Models



A. Check Front Runout
B. Check Center Runout
C. Check Rear Runout
D. Check Splined Shaft Runout At Tapered Hole In Splined End
E. Check Front Runout
1. One Piece Propeller Shaft Or Rear Propeller Shaft In A Two-Piece Driveline
2. Front Propeller Shaft In A Two-Piece Driveline

B-07556

Figure 5—Checking Propeller Shaft Runout

PROPELLER SHAFT	FRONT CHECK	CENTER CHECK	REAR CHECK
ONE PIECE	0.040	0.050	0.055
TWO PIECE FRONT	0.020		0.008▲
TWO PIECE REAR	0.030*	0.030	0.035

▲NOTE: This measurement must be taken at the tapered hole on the splined shaft after the rear propeller shaft is removed.

* NOTE: This measurement must be taken with the rear propeller shaft mounted on the front shaft which is within specifications.

B-07557

Figure 6—Propeller Shaft Runout Specifications

having a two-piece driveline, measure the rear propeller shaft runout (figure 5). Reference mark the position of the rear propeller shaft yoke to the pinion flange, then remove the rear propeller shaft and measure the front propeller shaft runout on the tube and at the tapered hole on the splined shaft end (figure 5). If the runout exceeds specification, rotate the propeller shaft 180 degrees at the companion flange and install. Check the runout.

5. If the runout is still over specification at one or more check points, replace the propeller shaft after checking for vibration or noise. Check the runout on the replacement propeller shaft.

6. If the new propeller shaft runout is over specification, check for a bent companion flange.

Important

- The splined end of the front propeller shaft is critical to the smooth operation of a two-piece driveline. Be sure the dial indicator readings are accurate.

PROPELLER SHAFT REPLACEMENT (REAR DRIVE)

Remove or Disconnect (Figure 2)

Tool Required:
J-33051, Driveshaft Wrench.

- Raise the vehicle on a hoist.

1. Skid plate if used.
    - Reference mark the propeller shaft (4) to pinion flange (7) connection.
2. Bolts (5).
3. Retainers(6).

Important

- Do not pound on the original propeller shaft yoke ears. The injection joints may fracture. Never pry or place any tool between a yoke and a universal joint.

4. Yoke and cross assembly (8).
    - Tape bearing cups to prevent the loss of bearing rollers.
5. Propeller shaft (4).
    - Slide the propeller shaft (4) forward.
    - Lower the propeller shaft (4) and withdraw under the rear axle.
    - Do not allow the universal joint (17) to incline greatly; the joint may fracture.

Models with a two-piece propeller shaft

6. Nut (13).
7. Bolt (16) and washer (15).
8. Center bearing support (2).
    - Support the propeller shaft (3).
9. Cap (10).
10. Washer (11).
11. Seal (12).
12. Front propeller shaft (3).
    - Always support the propeller shaft (3).
    - Do not allow the universal joint (14) to bend deeply as the universal joint could fracture.
    - Withdraw the propeller shaft (3) with a rearward movement.

Clean

- All parts.

Inspect

1. Outer diameter of transmission yoke (14) for burrs. Any burring will damage the transmission seal.
2. For proper installation and uniform seating of bearing cups.
3. Slip yoke (18) splines for wear.
4. For twisted slip yoke splines or possibly the wrong universal joint.

Install or Connect (Figures 2 and 7)

One-Piece Propeller Shaft

1. Propeller shaft (4) into the transmission.
    - Lubricate slip joint.
2. Yoke and cross assembly (8) onto the pinion flange (7).
    - Align the reference marks on the pinion flange (7) and the propeller shaft rear yoke (8). Seat the yoke properly.
3. Retainer (6).
4. Bolt (5).

Tighten

- Bolt (5) to torque in "Specifications" at the end of this section.

Two-Piece Propeller Shaft

1. Propeller shaft (3) into the transmission.
    - Be sure joint is lubricated.
    - Bottom the propeller shaft (3) yoke in the transmission.
2. Center bearing support (2) onto hanger (1).
    - Align the center bearing support 90 degrees to the propeller shaft (3, 4) center lines. Refer to figure 7.
3. Bolt (16).
4. Washer (15).
5. Nut (13).

NOTICE: See "Notice" on page 4A-1 of this section.

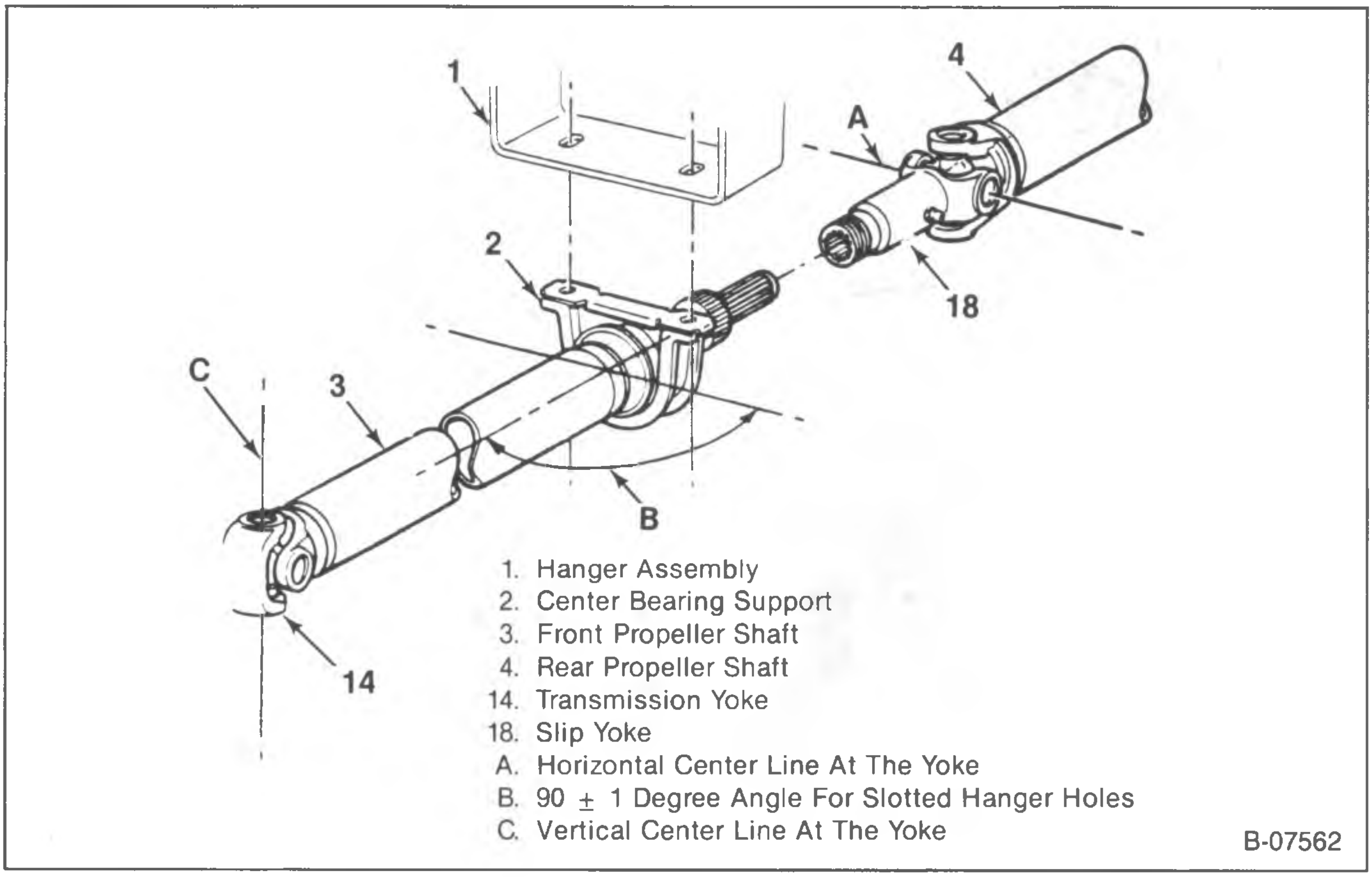
Tighten

- Nut (13) to torque specification later in this section. Maintain alignment (figure 7).

Important

- Set the transmission yoke (14) ears in a vertical position for proper phasing (figure 7).

6. Cap (10).
7. Washer (11).
8. Seal (12).
    - Locate the bridged tooth on the splined shaft (9).
9. Slip yoke (18) onto the splined shaft (9).
    - Mate the missing tooth in the yoke (18) with the bridged tooth on the splined shaft (9) figure 7. Support the propeller shaft (4).



1. Hanger Assembly
2. Center Bearing Support
3. Front Propeller Shaft
4. Rear Propeller Shaft
14. Transmission Yoke
18. Slip Yoke
A. Horizontal Center Line At The Yoke
B. 90 ± 1 Degree Angle For Slotted Hanger Holes
C. Vertical Center Line At The Yoke

Figure 7—Alignment For Two-Piece Propeller Shaft In Phase, G And K Models

- Be sure the slip yoke (18) ears are horizontal, figure 7.

10. Propeller shaft (4).
    - Align reference marks.
    - Check bearings for proper fit.
11. Retainer (6).
12. Bolt (5).
    - Check for proper joint fit.

Tighten

- Bolts (5) to specified torque. Refer to "Specifications" at the end of this section.
- Lubricate the slip yoke (18).

PROPELLER SHAFT REPLACEMENT (FRONT DRIVE)

Remove or Disconnect (Figure 8)

Tool Required:
J-22610, Keystone Clamp Pliers.

- Raise the vehicle on a hoist.
- Remove skid plate if used.
- Reference mark the relationship of the propeller shaft (14) to the front axle and the transfer case flange (17).

1. Slip yoke (13) from the front axle yoke (12).
   — Nut (10), washer (11) and U-bolt (15).
   — Bolt (20) and retainer (22).

Important

- Do not pound on the joint to disconnect.

2. Bolt (18) at the flange (17).
3. Boot (21) if used.
   - Release boot retainers using J-22610.
   - Slide the propeller shaft (14) forward, enough to disengage, then withdraw the propeller shaft (14) rearward.
   - Avoid dropping cap assemblies from the yoke ends.

Clean

- All parts.

Inspect

- Splines for damage, wear, burrs and twisting.
- Bearings for wear.
- Propeller shaft (14) for straightness.

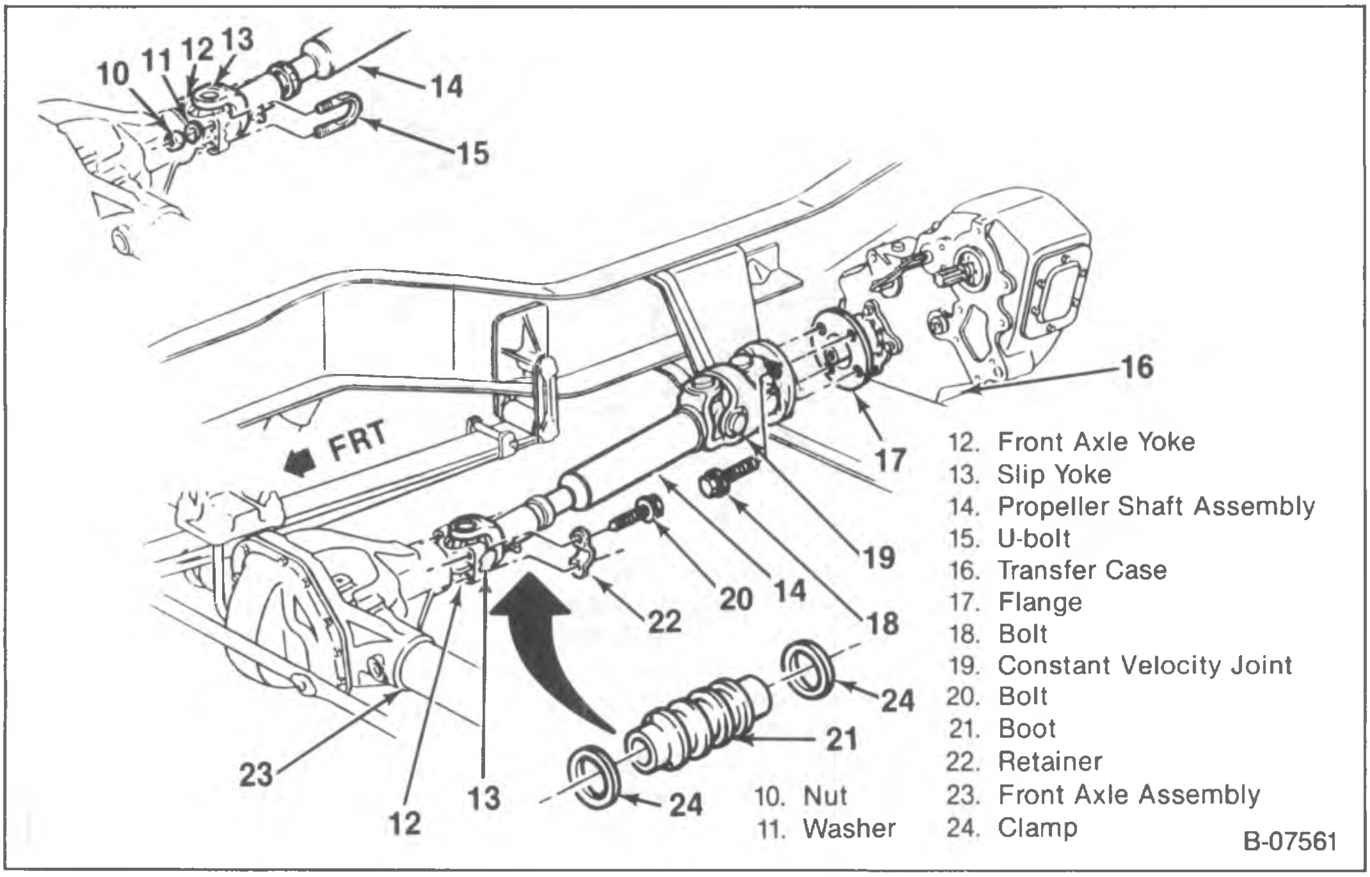


Figure 8—Front Propeller Shaft and Driveline Detail

Install or Connect (Figure 8)

Tools Required:

J-22610, Keystone Clamp Pliers.
J-25512, CV Propshaft Lube Gun (1/8-inch pipe).
J-25512-2, Needle point.

- Lubricate the slip yoke (13) before installing the boot (21). Refer to "Lubrication" later in this section.

1. Boot (21) if used.
   - Retainers (24) using J-22610.
2. Slip yoke (13) to the axle yoke (12).
   - Adjust propeller shaft (14) length.
   - Mate the joint using reference marks.
     - — U-bolt, washer (11) and nut (10).
     - — Retainer (22) and bolt (20).
   - Support the propeller shaft (14).

Tighten

- All fasteners to specified torque. Refer to "Specifications" at the end of this section.

3. Bolt (18) at the flange (17).
   - Mate the joint using reference marks.
   - Lubricate the Constant Velocity Joint (19). Refer to "Lubrication" later in this section.
4. Skid plate, if used.

Tighten

- All fasteners to specified torque. Refer to "Specifications" later in this section.

LUBRICATION

The front axle propeller shaft found on four-wheel drive vehicles requires a special lubricant at two locations: the constant velocity joint, and the slip yoke.

Constant Velocity Joint (C/V Joint)

The constant velocity (C/V) joint, located at the transfer case end of the front propeller shaft, must be lubricated periodically with a special lubricant, 1050679 or equivalent. If the lubrication fitting cannot be seen from beneath the vehicle refer to figure 9 which shows how the C/V joint may be lubricated from above, with a special adapter J-25512-2 on the end of a flex hose.

Slip Spline

Apply chassis lubricant at the slip spline grease fitting until the grease begins to leave through the vent hole.

If the slip spline is dry or corroded, it may be necessary to disconnect the propeller shaft from the vehicle, remove the slip yoke, and wire brush the affected area. Wipe clean before installation.

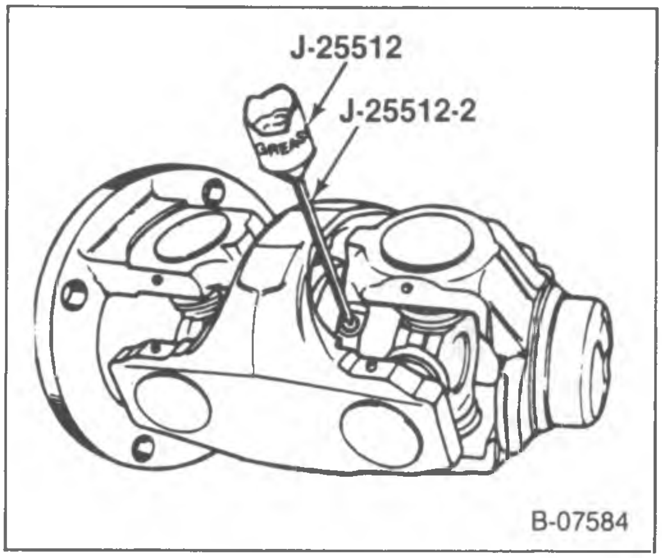


Figure 9—Lubricating The Constant Velocity Joint Fitting

SPECIFICATIONS

APPLICATION	MODEL	TORQUE N·m	TORQUE FT. LBS.
Propeller Shaft:			
To Rear Axle (Retainer or Strap)	C, G, P	20*	15*
To Rear Axle	C, K, G300, P	35	26
Two Piece Propeller Shaft–Front			
To Brake Hub Studs	P300	27	20
To Transmission Flange/Yoke	C, G, P	20	15
To Transfer Case Yoke (Nut)	K	27	20
Center Bearing Support:			
To Hanger (Nut)	P300	33	24
To Hanger	C	20	15
To Hanger (Nut)	P	35	26
To Hanger	K	27	20
To Hanger (Top of Crossmember)	C	33	24
To Hanger (Slotted Holes)	C, G	33	24
Two Piece Propeller Shaft–Rear:			
To Rear Axle (Nut)	P	27	20
To Rear Axle	C, G, P	20	15
To Rear Axle	C, K, G300, P300	33	24
Propeller Shaft:			
To Transfer Case (Front-Flange Bolt)	K	100	74
To Front Axle Assembly (Bolt)	K100, 200	20	15
To Front Axle Assembly (U-Bolt and Nut)	K300	20	15

*Torque Specification Is For Hex Head Bolt.

SPECIAL TOOLS

J-22610	Keystone Clamp Pliers
J-25512	CV Propshaft Lube Gun
J-25512-2	Needle Point
J-33051	Driveshaft Wrench

SECTION 4B

REAR AXLE

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: "NOTICE: See 'Notice' on page 4B-1 of this section."

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

CONTENTS

SUBJECT **PAGE**

DESCRIPTION

Light duty trucks use various rear axles, classed by ring gear diameter such as:

8½-INCH AND 9½-INCH RING GEAR AXLES —SEMI-FLOATING

These axles are of the fabricated constructed type consisting of a cast carrier, bossed at each end into which two welded steel tubes are fitted. An overhung hypoid pinion and the ring gear are housed in the carrier. The differential has a two pinion arrangement.

Two steel welded tubes pressed into the crossbore of the cast carrier make up the axle housing. Welded-on brackets provide attachment points for the suspension components such as leaf springs and shock absorbers. The brake flange plate is attached to a welded-on flange.

The overhung hypoid drive pinion is supported by two preloaded tapered roller bearings. The pinion shaft is sealed by means of a molded, spring loaded, rubber seal. The hypoid ring gear is bolted to a one-piece differential case supported by two preloaded tapered roller bearings.

The 9½-inch ring gear axles have the ring gear side bearing preload controlled by a side bearing adjusting nut threaded into the carrier near the axle tubes. Backlash is adjusted by increasing or decreasing the shim thickness.

CHEVROLET 10½-INCH RING GEAR AXLE

This axle is the full floating type with a hypoid ring gear and drive pinion. The full floating construction allows easy removal of the axle shafts. The differential carrier is heavily ribbed to provide rigid support for the differential assembly.

A straddle-mounted drive pinion is supported at the front by two opposed tapered roller bearings. The pinion straddle bearing is a roller bearing assembly having an outer race and roller assembly. A precision ground diameter on the pinion pilot functions as an inner race.

Side bearing preload and ring gear-to-pinion backlash are controlled by side bearing adjusting nuts threaded into the carrier near the axle tubes. Pinion depth is controlled by a shim located between the pinion bearing retainer assembly and the differential carrier.

DANA 10½-INCH RING GEAR AXLE

The axle is a Salisbury-type design similar to the 8½-inch ring gear axle. The axle shafts are full floating, and the carrier must be spread to remove the differential, and the drive pinion uses two shim packs. The inner pack controls pinion depth and the outer pack controls pinion bearing preload.

DANA 9¾-INCH RING GEAR AXLE

This Dana axle is similar to the Chevrolet 10½-inch ring gear axle however, the differential side bearing shims are located between the case and the side bearings.

ROCKWELL 12″ RING GEAR AXLE

This single-speed, hypoid axle has a straddle mounted drive pinion which is supported at the rear by a straight roller bearing. The pinion front bearing has a double row ball bearing.

The differential is a conventional four-pinion type using thrust washers between the side gears and case and also between the differential pinions and the differential case.

A thrust pad mounted on the end threaded into the carrier housing limits the deflection of the ring gear under high torque service.

Involute splines are used in the axle shaft flange and in the wheel hubs. This design gives driving torque transmission from the axle shaft to the hub through the mating splines.

REAR AXLE OPERATION

A basic differential has a set of four gears. Two are called differential side gears and the other two are differential pinion gears. Some differentials have more than two pinions. Each side gear is splined to an axle shaft, therefore each axle shaft must turn when its side gear rotates.

The differential pinion gears are mounted on a differential pinion shaft, and the gears are free to rotate on this shaft. The pinion shaft is fitted into a bore in the differential case and is at right angles to the axle shafts.

Power flow through the differential is as follows: the drive pinion rotates the ring gear. The ring gear, being bolted to the differential case, rotates the case. The differential pinion, as it rotates with the case, forces the pinion gears against the side gears. When both wheels have equal traction, the pinion gears do not rotate on the pinion shaft because the input force on the pinion gear is equally divided between the two side gears. Therefore, the pinion gears revolve with the pinion shaft, but do not rotate around the shaft itself. The side gears, being splined to the axle shafts and in mesh with the pinion gears, rotate the axle shafts.

If a vehicle were always driven in a straight line, the ring and pinion gears would be sufficient. The axle shaft could then be solidly attached to the ring gear and both driving wheels would turn at equal speed.

However, if it became necessary to turn a corner, the tires would scuff and slide because the outside wheel would travel further than the inside wheel. To prevent tire scuffing and sliding, the differential becomes effective and allows the axle shafts to rotate at different speeds.

When the vehicle turns a corner, the outer rear wheel must turn faster than the inner wheel. The inner wheel turns slower than the outer wheel and slows its rear axle side gear (as the axle shaft is splined to the side gear) and the rear axle pinion gears will roll around the slowed rear axle side gear, driving the other rear axle side gear and wheel faster.

LOCKING REAR AXLE

Eaton Locking Differential

The locking rear differential allows for normal differential function as indicated in the standard rear axle description. Additionally, the locking rear differential uses multi-disc clutch packs and a speed sensitive engagement mechanism that locks both wheels together if one wheel should spin excessively during slow vehicle operation.

Under light loads, the clutch plates alone tend to lock axle shafts to the differential case, and therefore, each other. This is due primarily to the gear separating load developed on the right side clutch pack. This induced clutch torque capacity resists motion between the side gear and the rear axle differential case. The axle shaft torques developed when turning a corner will overcome this capacity and allow differentiation. Also, heavier throttle application will cause differential, but this starts the full-lock feature of the unit.

Full locking is accomplished through the use of a heavyweight governor mechanism, cam system, and multi-disc clutch packs. The flyweights on the governor mechanism move outward to engage a latching bracket whenever the wheel-to-wheel speed varies by approximately 100 rpm or more. This action retards a cam which, in turn, compresses the multi-disc clutch packs locking both side gears to the case. The 100 rpm wheel-to-wheel speed allows for cornering without differential lock-up.

At vehicle speeds above approximately 32.2 km/h (20 mph), the latching bracket overcomes a spring preload and swings away from the flyweights. At this vehicle speed or greater, the differential will not lock, as the added traction is generally not required.

All gear axle parts of vehicles equipped with the locking rear axle are interchangeable with those equipped with the conventional rear axle, except for the case assembly.

DIAGNOSIS OF THE REAR AXLE

NOISE

The most essential part of rear axle service, as with any mechanical repair, is proper diagnosis of the problem, and, in axle work one of the most difficult areas to diagnose is noise. Locating a broken axle shaft, or broken differential gear, presents little or no problem, but, locating and isolating axle noise can be an entirely different matter.

Degree of Noise

Any gear driven unit, especially an automotive drive axle where engine torque multiplication occurs at a 90 degree turn in the drive line, produces a certain amount of noise. Therefore, an interpretation must be made for each vehicle to determine whether the noise is normal or if a problem actually exists. A normal amount of noise must be expected and cannot be eliminated by conventional repairs or adjustment.

Acceptable noise can be defined as a slight noise heard only at a certain speed or under unusual or remote conditions. For example, this noise tends to reach a "peak" at speeds from 40 to 60 miles per hour (60 to 100 km/h) depending on road and load conditions, or on gear ratio and tire size. This slight noise is in no way indicative of trouble in the axle assembly.

Drive line noises may baffle even the best diagnostician. Vehicle noises coming from tires, transmission, propeller shaft, universal joints, and front or rear wheel bearings, are often mistaken for axle noise. Such practices as: raising tire pressure to eliminate tire noise (although this will not silence tread noise of mud and snow tires), listening for the noise at varying speeds and road surfaces, on drive, float, and coast conditions will aid in locating the source of alleged axle noises. Thus, every effort should be made to isolate the noise to a specific drive line component instead of making a random guess that could be a costly waste of time.

DETERMINING TYPE OF NOISE

External Noise

When a rear axle is suspected of being noisy, it is advisable to make a thorough test to determine whether the noise originates in the tires, road surface, front wheel bearings, engine, transmission, or rear axle assembly. Noise which originates in other places cannot be corrected by adjustment or replacement of parts in the rear axle assembly.

Road Noise—Some road surfaces, such as brick or rough-surfaced concrete, cause noise which may be mistaken for tire or rear axle noise. Driving on a different type of road, such as smooth asphalt or dirt, will quickly show whether the road surface is the cause of noise. Road noise usually is the same on drive or coast.

Tire Noise—Tire noise may easily be mistaken for rear axle noise, even though the noisy tires may be located on the front wheels. Tires worn unevenly, or having surfaces on non-skid divisions worn in saw-tooth fashion, are usually noisy and may produce vibrations which seem to originate elsewhere in the vehicle. This is particularly true with low tire pressure.

Tire Noise Test—Tire noise changes with different road surfaces, but rear axle noise does not. Temporarily inflating all tires to 345 kilopascals (50 pounds per square inch) pressure, **for test purposes only** will materially alter noise caused by tires but will not affect noise caused by the rear axle. Rear axle noise usually stops when coasting at speeds under 30 miles per hour; however, tire noise continues but with lower tone as the vehicle speed is reduced. Rear axle noise usually changes when comparing "pull" and "coast" but tire noise remains about the same.

Engine and Transmission Noises—Sometimes a noise which seems to originate in the rear axle is actually caused by the engine or transmission. To determine which unit is actually causing the noise, observe approximate car speeds and conditions under which the noise is most pronounced; then stop the vehicle in a quiet place to avoid interfering noises. With the transmission in neutral, run the engine slowly up and down through the engine speeds corresponding to the vehicle speed at which the noise was most pronounced. If a similar noise is produced with the vehicle standing, it is caused by the engine or transmission and not the rear axle.

Front Wheel Bearing Noise—Loose or rough front wheel bearings will cause noise which may be confused with rear axle noise; however, front wheel bearing noise does not change when comparing "pull" and "coast." Light application of the brake, while holding the vehicle speed steady, will often cause the wheel bearing noise to diminish, as this takes some weight off of the bearing. Front wheel bearings may be easily checked for noise by jacking up the wheels and spinning them, and also by shaking the wheels to determine if the bearings are excessively loose.

Body Boom Noise or Vibration—Objectional "body boom" noise or vibration at 55–65 mph (90–100 km/h) can be caused by an unbalanced propeller shaft. Excessive looseness at the spline can contribute to this unbalance.

Other items that may also contribute to the noise problem are as follows:

1. Undercoating or mud on the shaft, causing unbalance.
2. Shaft or companion flange balance weights missing.
3. Shaft damage, such as bending, dents, or nicks.
4. Tire-type roughness. Switch tires from a known good vehicle to determine a tire fault.

If, after making a comprehensive check of the vehicle, all indications point to the rear axle, further diagnostic steps are necessary to determine the axle components at fault. True rear axle noise generally falls into two categories: gear noise and bearing noise.

Rear Axle Noises

If a careful test of the vehicle shows that the noise is not caused by external items, it is then reasonable to assume that noise is caused by the rear axle assembly. Test the rear axle on a smooth level road to avoid road noise. It is not advisable to test the rear axle for noise by running with the rear wheels jacked up.

Noise in the rear axle assembly may be caused by a faulty propeller shaft, faulty rear wheel bearings, faulty differential or pinion shaft bearings, misalignment between two U-joints, or worn differential side gears and pinions; noise may also be caused by a mismatched, improperly adjusted, or scored, ring and pinion gear set.

Rear Wheel Bearing Noise—A rough rear wheel bearing produces a vibration or growl which continues with the vehicle coasting and the transmission in neutral. A brinelled rear wheel bearing causes a knock or click approximately every two revolutions of the rear wheel, since the bearing rollers do not travel at the same speed as the rear axle and wheel. With the rear wheels jacked up, spin the rear wheels by hand while listening at the hubs for evidence of a rough or brinelled wheel bearing.

Differential Side Gear and Pinion Noise—Differential side gears and pinions seldom cause noise since their movement is relatively slight on straight ahead driving. Noise produced by these gears will be most pronounced on turns.

Pinion Bearing failures can be distinguished because they rotate at higher speeds than differential side bearings and axle shaft bearings. Rough or brinelled pinion bearings produce a continuous low pitched whirring or scraping noise starting at a low speed.

Side Bearings produce a constant rough noise pitched lower than pinion bearing noise. Side bearing noise may also fluctuate in the above rear wheel bearing test.

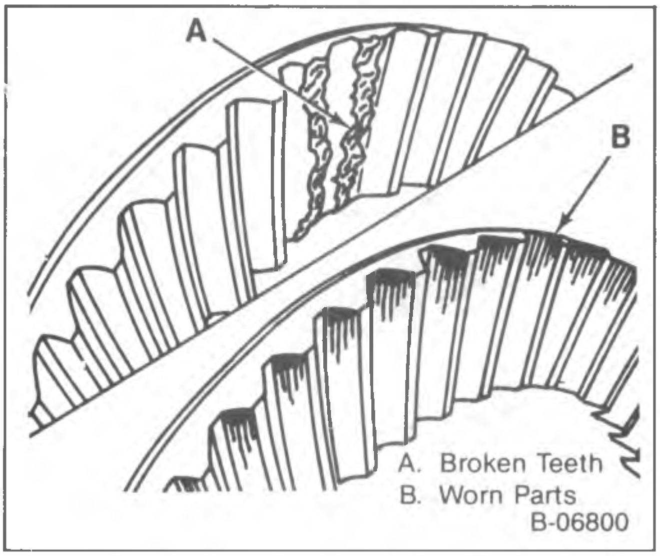


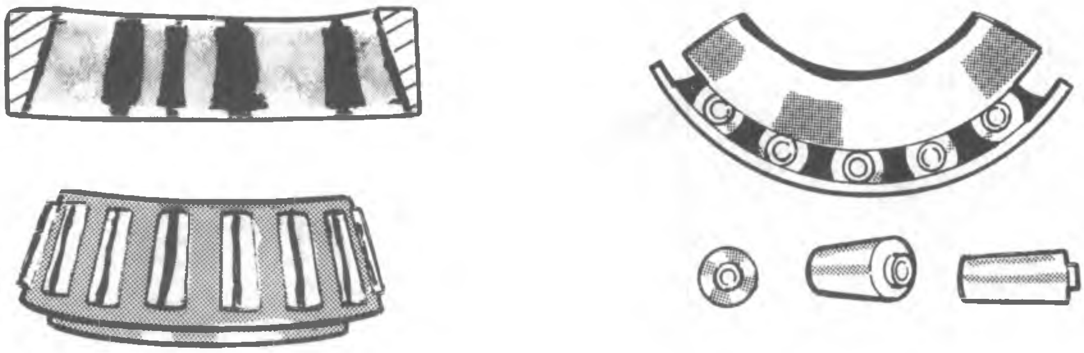
Figure 1—Causes Of Gear Noise

Gear Noise

There are two basic types of gear noise. The first type is produced by broken, bent, or forcibly damaged gear teeth and is usually quite audible over the entire speed range and presents no particular problem in diagnosis. For example, hypoid gear tooth scoring generally results from the following: insufficient lubricant, improper break-in, improper lubricant, insufficient gear backlash, improper ring and pinion gear alignment, or loss of drive pinion nut torque. The scoring will progressively lead to complete erosion of the gear tooth, or gear tooth pitting and then eventual fracture if the initial scoring condition is not corrected (figure 1). Another cause of hypoid tooth fracture is extended overloading of the gear set which will produce fatigue fracture, or shock loading which will result in sudden failure.

Differential pinion and side gears rarely give trouble. Common causes of differential failure are shock loading, extended overloading, and seizure of the differential pinions to the cross shaft resulting from excessive wheel spin and consequent lubrication breakdown. The second type of gear noise pertains to the mesh pattern of the gear teeth. This form of abnormal gear noise can be recognized because it produces a cycling pitch (whine) and will be very pronounced in the speed range at which it occurs, appearing under either "drive," or "float" or "coast" conditions. "Drive" is acceleration or heavy pull. "Coast" is with a closed throttle and the vehicle in gear and "float" is using just enough throttle to keep the vehicle from driving the engine; the vehicle slows down gradually but the engine still pulls slightly. Gear noise tends to peak in a narrow speed range or ranges, and will tend to remain constant in pitch. Bearing noise will vary in pitch with vehicle speeds.

Refer to figures 2 through 5 for bearing diagnosis.



ABRASIVE ROLLER WEAR

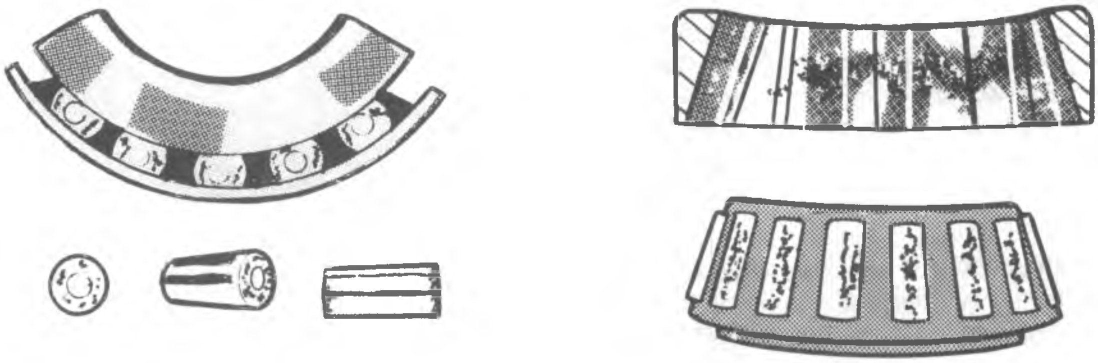
Pattern on races and rollers caused by fine abrasives.

Clean all parts and housings, check seals and bearings and replace if leaking, rough or noisy.

ABRASIVE STEP WEAR

Pattern on roller ends caused by fine abrasives.

Clean all parts and housings, check seals and bearings and replace if leaking, rough or noisy.



GALLING

Metal smears on roller ends due to overheat, lubricant failure or overload.

Replace bearing, check seals and check for proper lubrication.

ETCHING

Bearing surfaces appear gray or grayish black in color with related etching away of material usually at roller spacing.

Replace bearings, check seals and check for proper lubrication.

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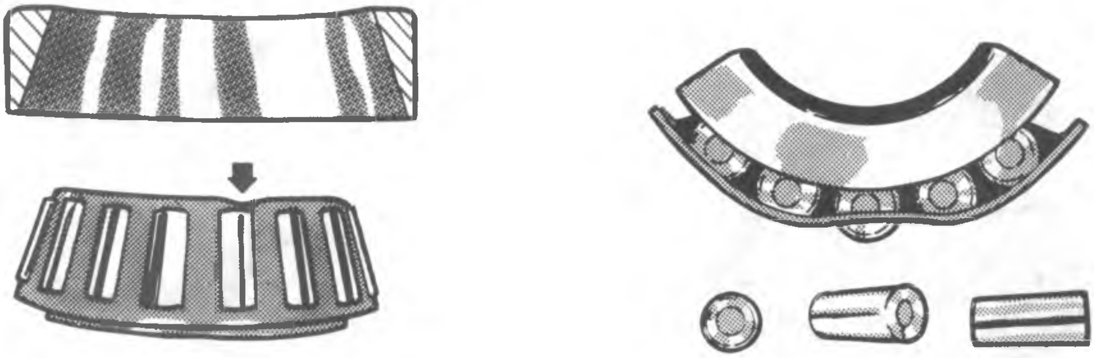
Figure 2—Diagnosis Of Tapered Roller Bearings

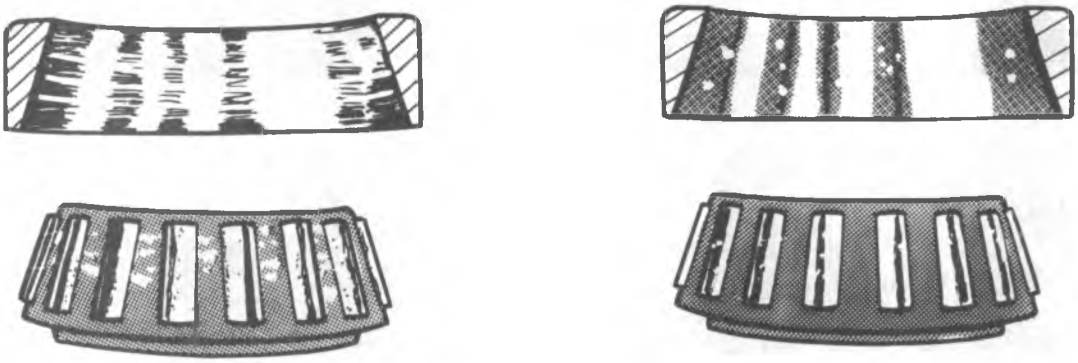


BENT CAGE

Cage damaged due to improper handling or tool usage.
Replace bearing.

BENT CAGE

Cage damaged due to improper handling or tool usage.
Replace bearing.



CAGE WEAR

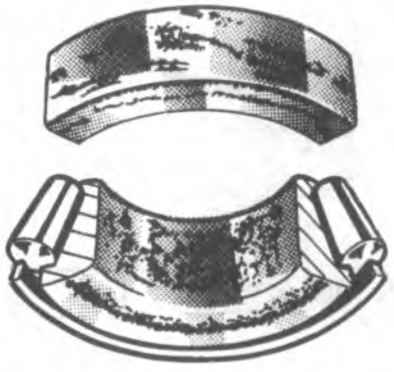
Wear around outside diameter of cage and roller pockets caused by abrasive material and inefficient lubrication.
Clean related parts and housings.
Check seals and replace bearings.

INDENTATIONS

Surface depressions on race and rollers caused by hard particles of foreign material.
Clean all parts and housings. Check seals and replace bearings if rough or noisy.

B-09195

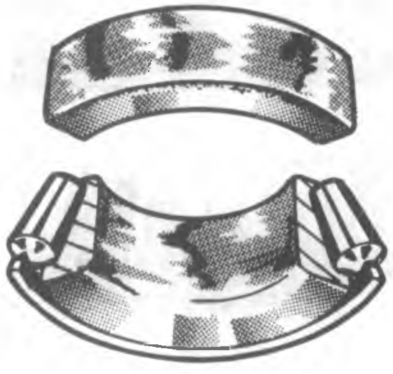
Figure 3—Diagnosis Of Tapered Roller Bearings



FRETTAGE

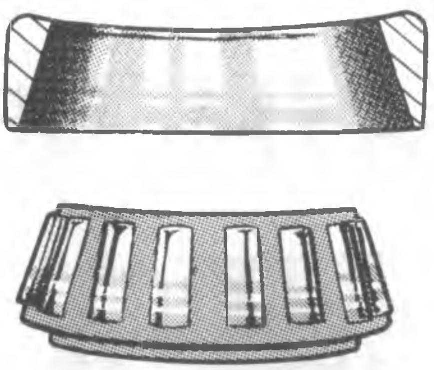
Corrosion set up by small relative movement of parts with no lubrication.

Replace bearing. Clean related parts. Check seals and check for proper lubrication.



SMEARS

Smearing of metal due to slippage. Slippage can be caused by poor fits, lubrication, overheating, overloads or handling damage. Replace bearings, clean related parts and check for proper fit and lubrication.

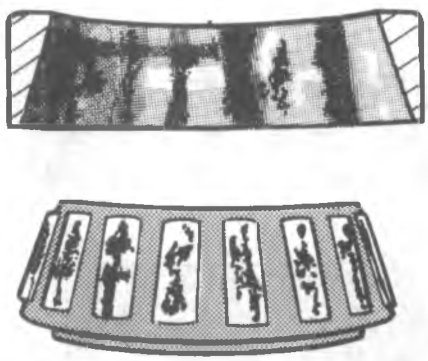


STAIN DISCOLORATION

Discoloration can range from light brown to black caused by incorrect lubricant or moisture.

Re-use bearings if stains can be removed by light polishing or if no evidence of overheating is observed.

Check seals and related parts for damage.



HEAT DISCOLORATION

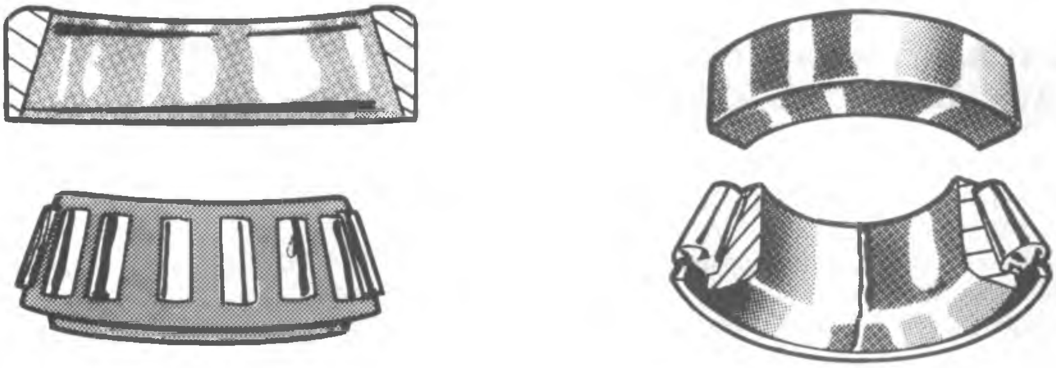
Heat discoloration can range from faint yellow to dark blue resulting from overload or incorrect lubricant.

Excessive heat can cause softening of races or rollers. To check for loss of temper on races or rollers a simple file test may be made. A file drawn over a tempered part will grab and cut metal, whereas, a file drawn over a hard part will glide readily with no metal cutting.

Replace bearings if over heating damage is indicated. Check seals and other parts.

F-00531

Figure 4—Diagnosis Of Tapered Roller Bearings

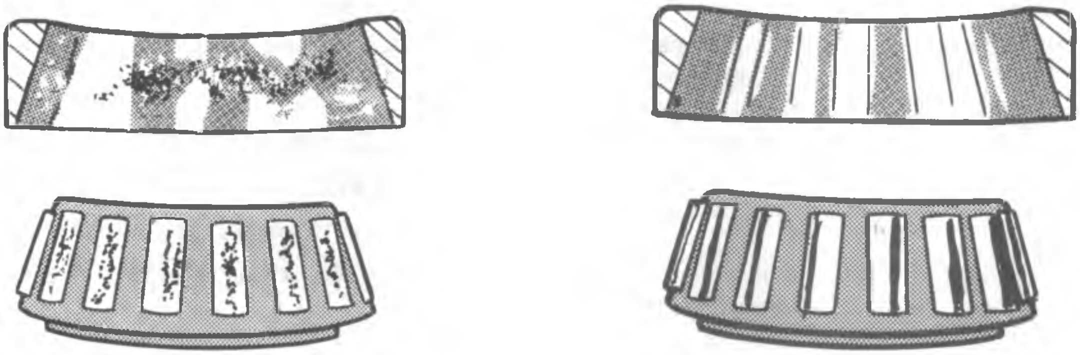


MISALIGNMENT

Outer race misalignment due to foreign object.
Clean related parts and replace bearing. Make sure races are properly seated.

CRACKED INNER RACE

Race cracked due to improper fit, cocking, or poor bearing seats.
Replace bearing and correct bearing seats.



FATIGUE SPALLING

Flaking of surface metal resulting from fatigue.
Replace bearing, clean all related parts.

BRINELLING

Surface indentations in raceway caused by rollers either under impact loading or vibration while the bearing is not rotating.
Replace bearing if rough or noisy.

B-09860

Figure 5—Diagnosis Of Tapered Roller Bearings

ON-VEHICLE SERVICE

REAR AXLE ASSEMBLY REPLACEMENT (ALL AXLES)

- Raise the vehicle on a hoist and support the axle assembly with a suitable lifting device.
- For $9\frac{3}{4}$-inch ring gear and $10\frac{1}{2}$-inch ring gear axles, raise the vehicle and place jack stands under the frame side rails for support.
- Drain the lubricant from the axle housing.

Remove or Disconnect

1. Propeller shaft. Refer to PROPELLER SHAFT (SEC. 4A).
   - Tie the propeller shaft to a side rail or crossmember.
   - Tape the bearing cups to prevent loss of the rollers.
2. Wheel and brake drum or hub and drum assembly.
3. Parking brake cable from the lever and at the brake flange plate. Refer to BRAKES (SEC. 5).
4. Hydraulic brake lines from the connectors. Refer to BRAKES (SEC. 5).
5. Shock absorbers from the axle brackets. Refer to REAR SUSPENSION (SEC. 3D).
6. Vent hose from the axle vent fitting if used.
7. Height sensing and brake proportional valve linkage if used. Refer to BRAKES (SEC. 5).
8. Stabilizer shaft if used. Refer to REAR SUSPENSION (SEC. 3D).
   - Support the assembly with a hydraulic floor jack.
9. Nuts and washers from the U-bolts.
10. U-bolts, spring plates and spacers from the axle assembly.
    - Lower the jack and the axle assembly.

Install or Connect

1. Axle assembly under the vehicle.
   - Align the axle assembly with the springs.
2. Spacers, spring plates and U-bolts to the axle assembly.
   - Raise the axle assembly.
3. Washers and nuts to the U-bolts.
   - Thread the nuts on firmly.
   - Adjust alignment of semi-float axles.
4. Stabilizer shaft if used.
5. Height sensing and brake proportional valve linkage if used. Refer to BRAKES (SEC. 5).
6. Vent hose to the axle vent fitting if used.
7. Shock absorbers to the axle brackets. Refer to REAR SUSPENSION (SEC. 3D).
8. Hydraulic brake lines to the connectors. Refer to BRAKES (SEC. 5).
9. Parking brake cable to the lever and the flange plate. Refer to BRAKES (SEC. 5).
10. Wheel and brakedrum or hub and drum assembly.
11. Propeller shaft. Refer to PROPELLER SHAFT (SEC. 4A).

NOTICE: See "Notice" on page 4B-1 of this section.

Tighten

- All fasteners to "Specifications" later in this section.

Important

- Check axle lubricant level at the filler plug hole. Lubricate as needed.
- Bleed the brake system, check operation and adjust if necessary. Refer to BRAKES (SEC. 5).
- Check axle and brake operation.
- Check for fluid leaks and road test the vehicle.

AXLE SHAFT, OIL SEAL AND BEARING REPLACEMENT ($8\frac{1}{2}$-$9\frac{1}{2}$-INCH RING GEAR SEMI-FLOATING AXLES)

- Raise the vehicle on a hoist.
- Clean dirt from around the carrier cover.

Remove or Disconnect (Figure 6)

Tools Required:

J-2619-01 Slide Hammer with Adapter

J-23689 Axle Shaft Bearing Remover (large shaft)

J-29712 Axle Shaft Bearing Remover ($9\frac{1}{2}$-inch ring gear)

1. Wheel and tire assembly. Refer to WHEELS AND TIRES (SEC. 3E).
2. Brake drum. Refer to BRAKES (SEC. 5).
3. Carrier cover (19).
   - Catch the oil in a drain pan.
   - Remove gasket material if used.

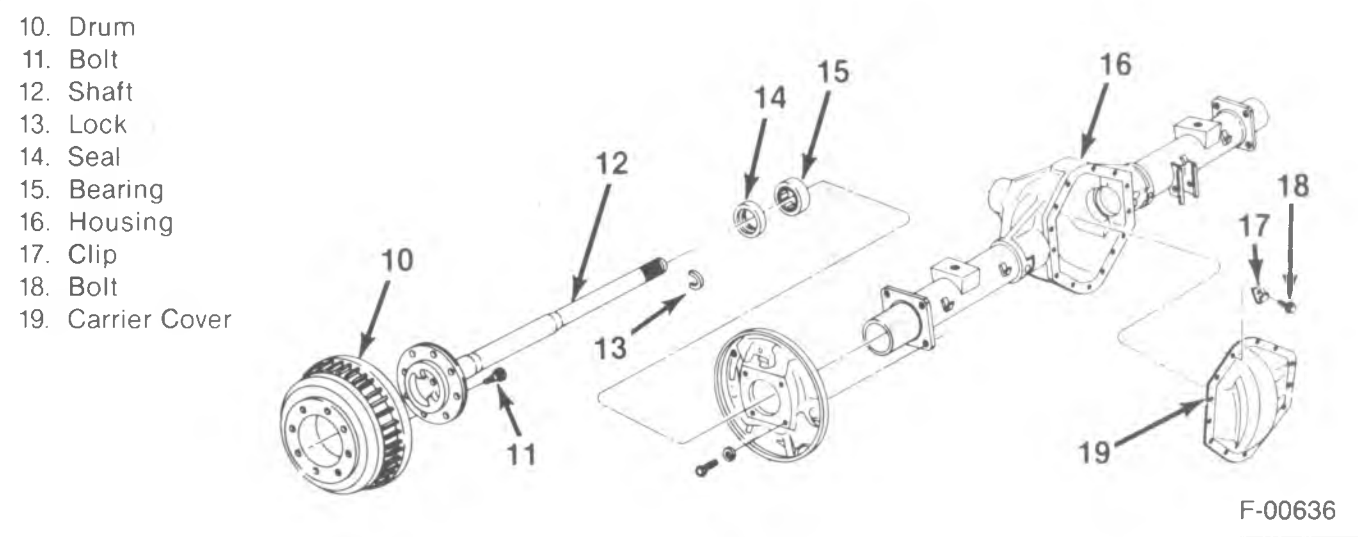


Figure 6—Axle Shaft And Housing Detail

WITHOUT LOCKING DIFFERENTIAL

4. Screw (A) (figure 7).
5. Pinion shaft (B) (figure 8).

Important

- Push the flanged axle shaft (12) toward the center of the vehicle.

6. Lock (13) from the button end of the axle shaft (12).
7. Axle shaft (12).
    - Withdraw the axle shaft (12) from the housing (16).
    - Be careful not to damage the oil seal (14).
    - Don't allow the thrust washer in the 9 1/2-inch ring gear axle to slide out when removing the axle shaft (12).

WITH LOCKING DIFFERENTIAL

4. Screw (A). Refer to figures 8, 9 and 10.
    - Hold the pinion shaft (B) when loosening the screw (A).
    - Withdraw the pinion shaft (B) part way and then position the differential case (C) for the best clearance (figure 9). Rotate the case (C) until the pinion shaft (B) touches the housing (D).
    - Use a screwdriver or similar tool to enter the case (D) and rotate the lock (13) until the open end points inward (figure 10).

Important

- Do not force or hammer the axle shaft (12) to gain removal clearance.

5. Lock (13). Refer to figures 10 and 11.
    - With the lock (13) correctly positioned, push the axle shaft (12) inward and remove the lock (13).

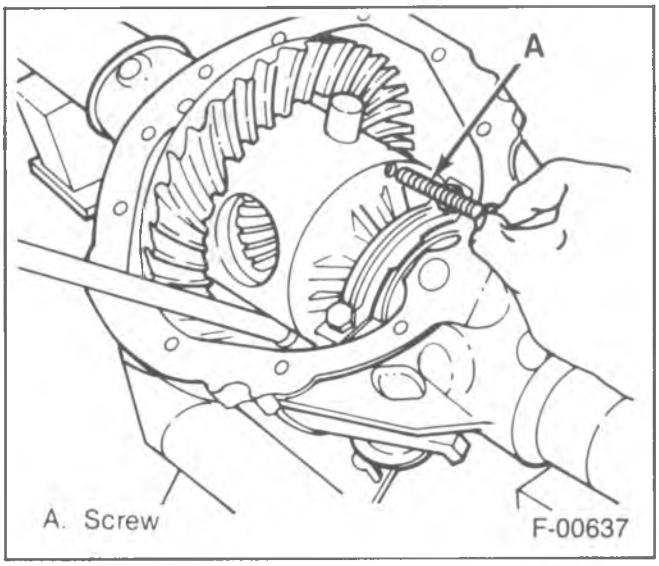


Figure 7—Removing The Lock Screw

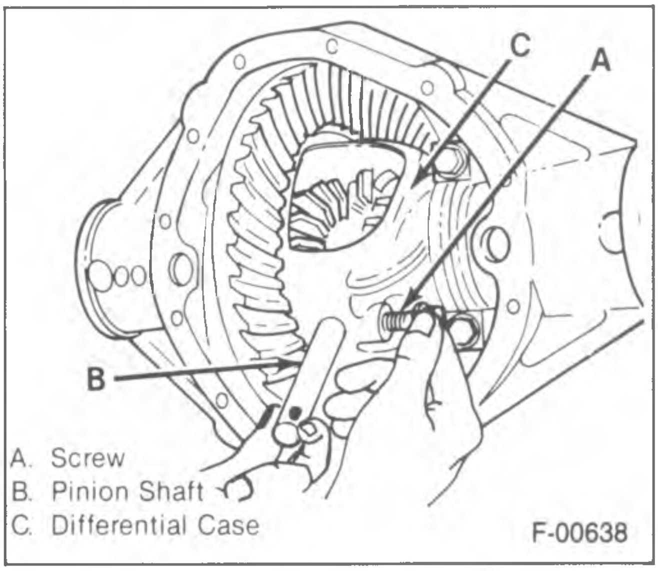


Figure 8—Removing The Differential Pinion Shaft

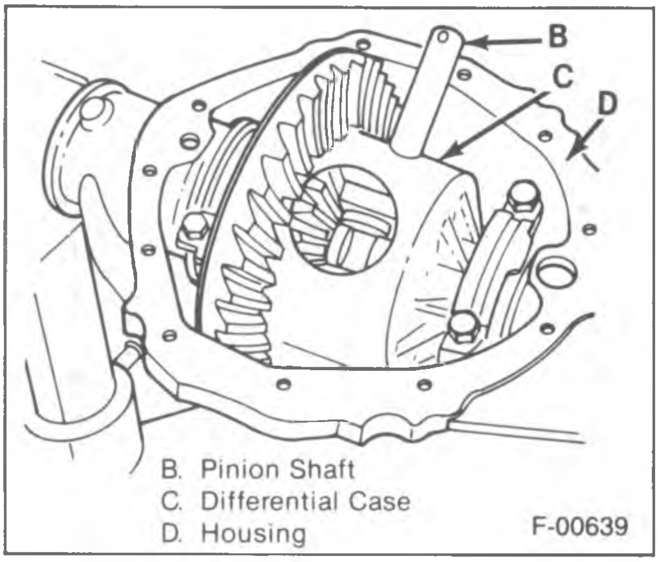


Figure 9—Positioning The Case For Best Clearance

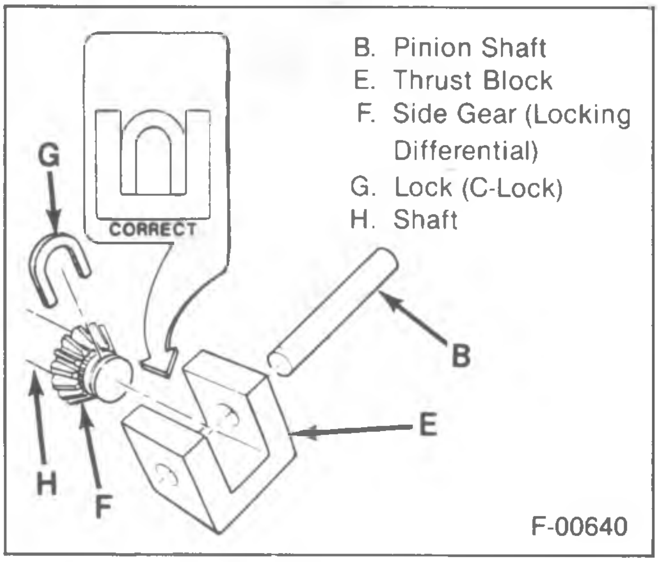


Figure 10—Aligning The C-Lock Correctly

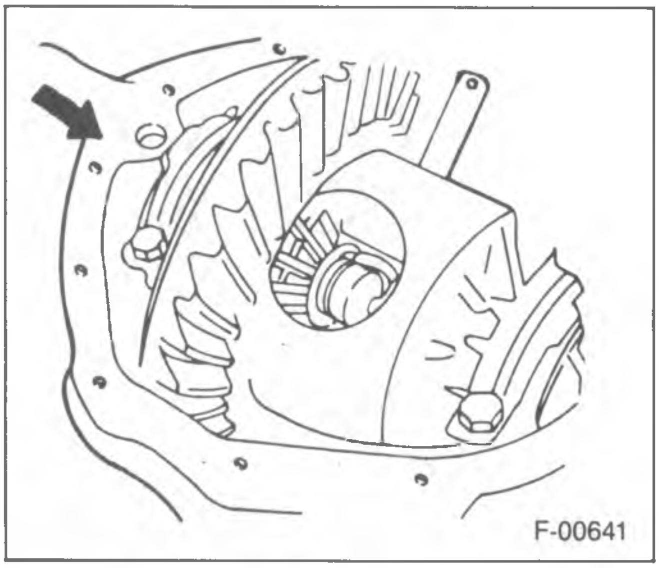


Figure 11—Push The Axle Shaft Inward

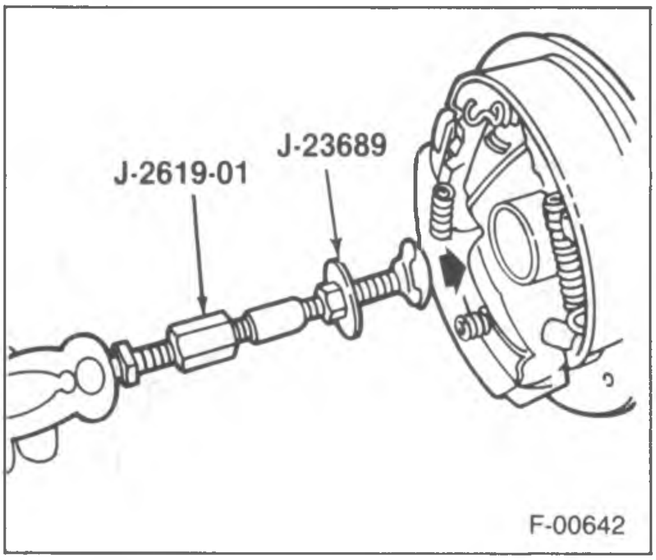


Figure 12—Removing The Bearing And Seal

6. Axle shaft (12).
   - Slide the axle shaft (12) out. Be careful not to damage the seal (14).
7. Seal (14).
   - Use the button end of the axle shaft (12) to pry the seal (14) out or use J-23689.
8. Bearing (15).
   - Use J-23689 for 8½-inch ring gear axle and J-29712 for 9½-inch ring gear axle. Attach J-2619-01 to J-23689.
   - Insert tool into the axle bore so that it grasps behind the bearing (15) (figure 12). Tighten nut and washer against the face of the bearing (15) or seal (14).

Inspect

- All parts. Replace as necessary.

Install or Connect (Figures 6 and 10)

Tools Required:

J-8092 Driver Handle

J-21128 Axle Shaft and Pinion Oil Seal Installer

J-23690 Axle Shaft Bearing Installer

J-29709 Axle Shaft Bearing Installer (9½-inch ring gear)

J-29713 Axle Shaft Seal Installer (9½-inch ring gear)

- Lubricate the axle cavity between the seal (14) lips and the bearing (15) with wheel bearing lubricant. Refer to MAINTENANCE AND LUBRICATION (SEC. 0B).

1. Bearing (15).
   - Use J-23690 for the 8½-inch gear axle and J-29709 for the 9½-inch ring gear axle.

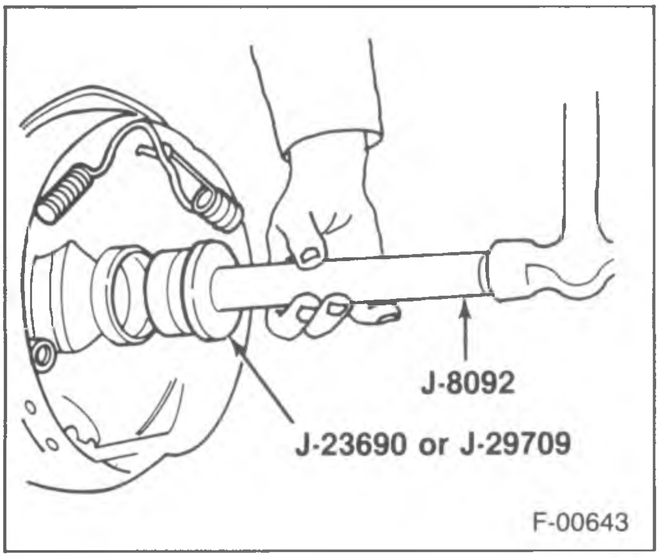


Figure 13—Installing The Wheel Bearing

- Bearing (15) into the axle (16) housing until the tool bottoms against the tube. Refer to figure 13.

2. Seal (14).
    - Use J-21128 for 8½-inch ring gear axle and J-29713 for the 9½-inch ring gear axle.
    - Drive the tool into the bore until the seal (14) bottoms flush with the end of the tube (figure 14).
3. Axle shaft (12).
    - Be careful not to damage the seal (14) when inserting the axle shaft (12).
    - Slide the axle shaft (12) into place allowing the splines to engage the differential side gear (F) figure 10.

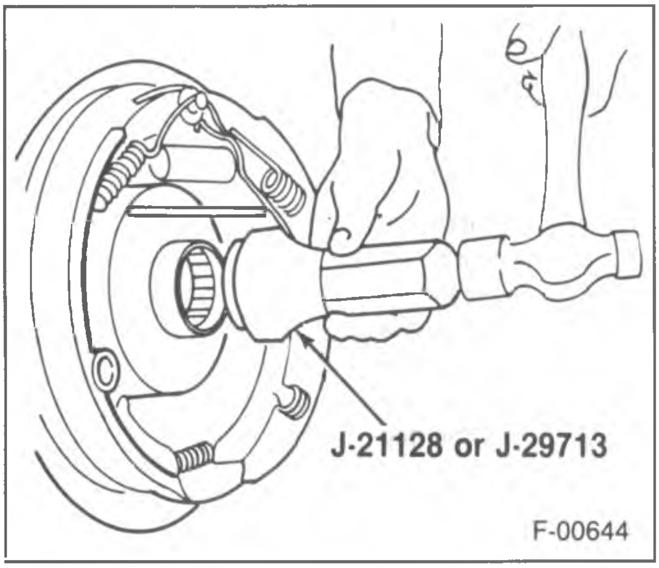


Figure 14—Installing The Seal

WITHOUT LOCKING DIFFERENTIAL

4. Lock (13).
    - Lock on the button end of the axle shaft (12), then push the shaft outward to seat the lock in the counterbore of the differential side gear.
5. Pinion shaft (B) figure 8.
    - Into the differential case (C) and pinion gears.
    - Align the hole in the pinion shaft (B) with the screw hole in the differential case (C). Thread the screw (A) in and tighten to 18 N·m (25 ft. lbs.).

WITH LOCKING DIFFERENTIAL

4. Lock (13).
    - Keep the pinion shaft (B) partially withdrawn (figure 9).
    - Place the lock (G) in the position shown in figure 10.
    - Carefully withdraw the axle shaft (12) until the lock (13) clears the thrust block.
    - Align the pinion shaft (B) hole with the screw hole in the differential case (C) figure 8.
5. Screw (A). Refer to figure 8.

Tighten

- Screw (A) to 18 N·m (25 ft. lbs.).

6. Gasket if used, otherwise RTV. Be sure sealing surface is clean.
7. Carrier cover (19).
8. Bolts (18) and clip (17).
    - Tighten bolts (18) in a crosswise pattern to assure uniform draw on the gasket if used.
    - Fill axle to filler plug hole level. Refer to MAINTENANCE AND LUBRICATION (SEC. 0B) for proper lubricant.
9. Brake drum. Refer to BRAKES (SEC. 5).
10. Wheel and tire assembly. Refer to WHEELS AND TIRES (SEC. 3E).
    - Lower the vehicle and road test.

BRAKE BACKING PLATE REPLACEMENT (8½- AND 9½-INCH RING GEAR— SEMI-FLOATING AXLES)

- Raise the vehicle on a hoist.

Remove or Disconnect

1. Wheel, tire and brake drum. Refer to BRAKES (SEC. 5).
2. Axle shaft. Refer to "Axle Shaft Replacement" earlier in this section.
3. Brake line from the cylinder inlet.

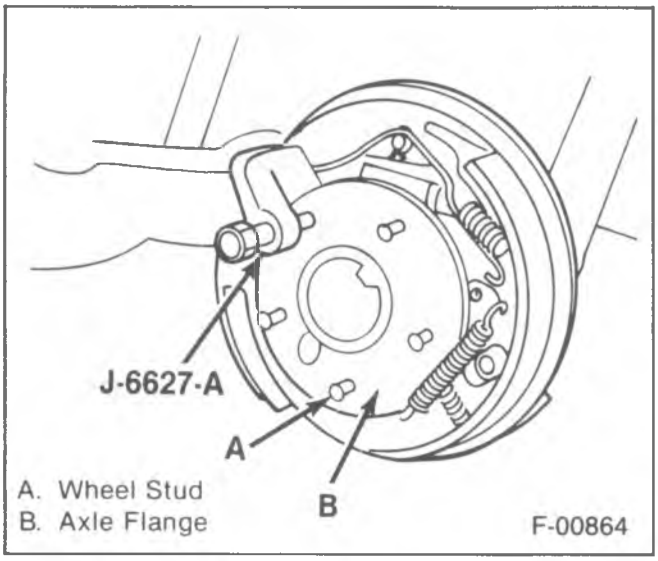


Figure 15—Pressing Out A Wheel Stud

- Brake components from the backing plate. Refer to BRAKES (SEC. 5).

4. Bolts and washers from the axle.
5. Backing plate.

Install or Connect

1. Backing plate to the axle.
2. Bolts and washers to the plate.
   - Attach components to the backing plate. Refer to BRAKES (SEC. 5).
3. Brake line to the cylinder inlet.
   - Refer to BRAKES (SEC. 5) for bleeding and adjustment procedure.
4. Axle shaft. Refer to "Axle Shaft Replacement" earlier in this section.
5. Wheel, tire and brake drum.

WHEEL STUD REPLACEMENT (8½-9½-INCH RING GEAR—SEMI-FLOATING AXLES)

- Raise the vehicle on a hoist and allow the axle to hang free.

Remove or Disconnect

Tool Required:

J-6627-A Wheel Stud Remover

1. Wheel, tire and brake drum.
2. Stud from the axle flange using J-6627-A (figure 15).

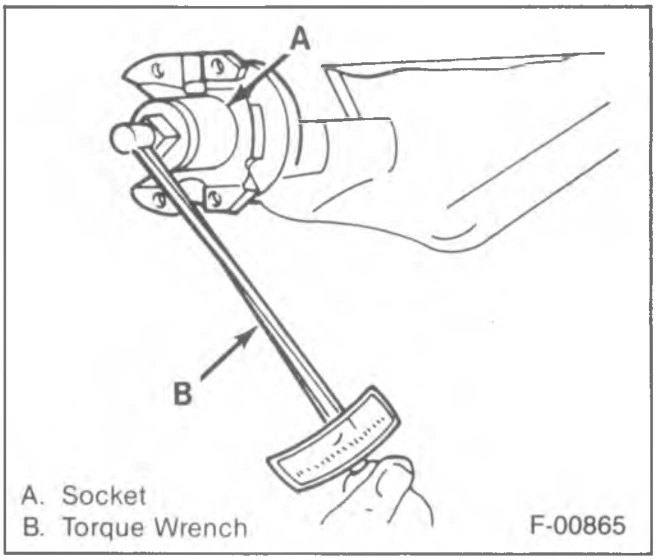


Figure 16—Measuring Pinion Rotating Torque

Install or Connect

1. Stud in the axle flange hole. Refer to figure 15.
   - Start the new stud into the axle flange hole by pressing firmly with your hand.
   - Thread on a lug nut with the flat side to the vehicle.
   - Tighten the lug nut and draw the stud head into the rear of the flange.
   - Thread the lug nut off.
2. Wheel, tire and brake drum.
   - Lower the vehicle.

PINION FLANGE, DUST DEFLECTOR/OIL SEAL REPLACEMENT (8½-9½-INCH RING GEAR SEMI-FLOATING AXLES)

- Raise the vehicle on a hoist.

Remove or Disconnect

Tool Required:

J-8614-01 Companion Flange Holder and Remover

1. Propeller shaft from the axle. Refer to PROPELLER SHAFT (SEC. 4A).
   - Tie the propeller shaft to a frame rail or crossmember.

Measure

- The torque required to rotate the pinion (figure 16). Record the torque value for later reference.

Important

- Scribe a line on the pinion stem, pinion nut and the companion flange and record the number of exposed threads on the pinion stem. Use the scribed reference and the exposed threads as a reinstallation guide (figure 17).

2. Nut using J-8614-01.
    - Position J-8614-01 on the flange so that the four notches on the tool face the flange (figure 18).
3. Flange using J-8614-01
    - Use the special nut and forcing screw to remove the flange (figure 19).
4. Oil seal. Use a screw driver to pry the seal out of the bore.

Inspect

- The pinion flange for a smooth oil seal surface, for worn drive splines, damaged ears and for smoothness of the bearing contact surface. Replace if necessary.

5. Dust deflector.
    - Tap the deflector from the flange if replacement is necessary.
    - Clean up the stake points on the flange.
    - Clean all foreign material from the contact area.

Install or Connect

Tools Required:

J-8614-01 Companion Flange Holder and Remover

J-22388 Pinion Oil Seal Installer (9½-inch ring gear)

J-22804-1 Pinion Oil Seal Spacer

J-22836 Pinion Seal Installer (8½-inch ring gear)

1. Dust deflector on the flange.
    - Stake new deflector at three new equally spaced positions. Staking must be such that the seal operating surface is not damaged.
2. Oil seal.
    - Pack the cavity between the lips of the oil seal with extreme pressure lithium-base lubricant.
    - Position the oil seal in the bore then place J-22804-1 over the oil seal and flat against the seal flange (figure 20).
    - Use J-22836 or J-22388 for the 9½-inch ring gear to press the oil seal into the bore (figure 20).
    - Turn J-22804-1 from installed position 180 degrees to assure proper installation against the pinion flange.

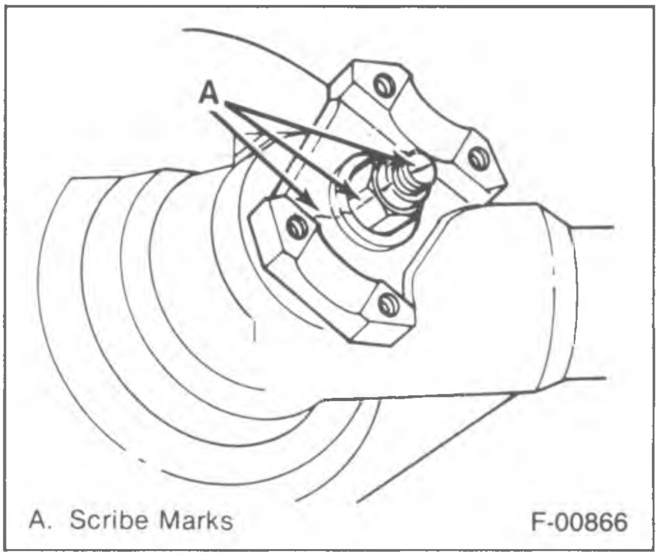


Figure 17—Scribed Marks

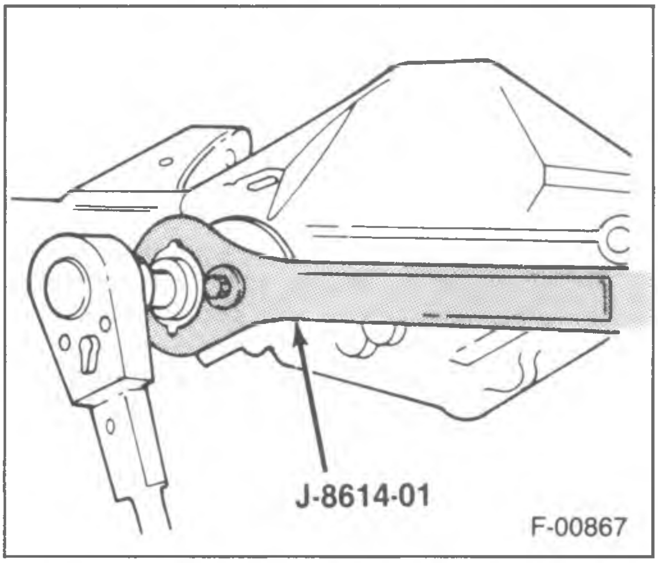


Figure 18—Removing The Drive Pinion Nut

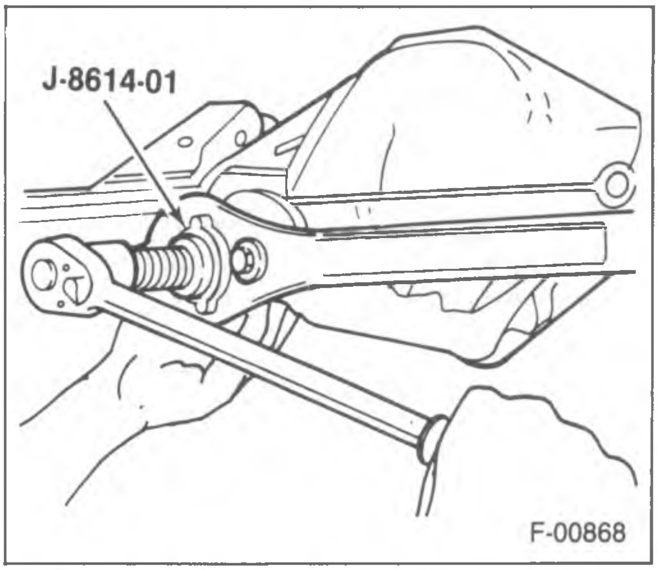


Figure 19—Removing The Drive Pinion Flange

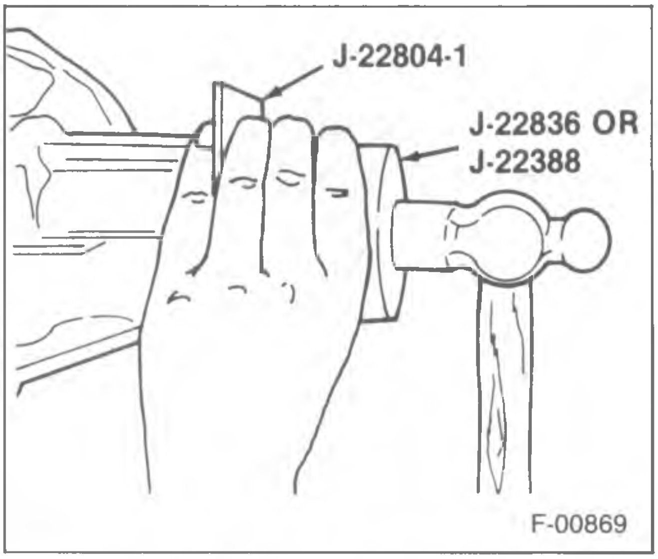


Figure 20—Installing The Pinion Seal

- Pack the cavity between the end of the pinion splines and the pinion flange with a non-hardening sealer such as PERMATEX TYPE A or equivalent.

3. Flange onto the pinion using J-8614-01.
    - Place washer and nut on the pinion threads and tighten the nut to the original scribed position using the scribe marks and exposed threads as a reference (figure 21). **DO NOT ATTEMPT TO HAMMER THE FLANGE ONTO THE PINION SHAFT.**

Measure

- The rotating torque of the pinion and compare with the torque recorded earlier (figure 16).

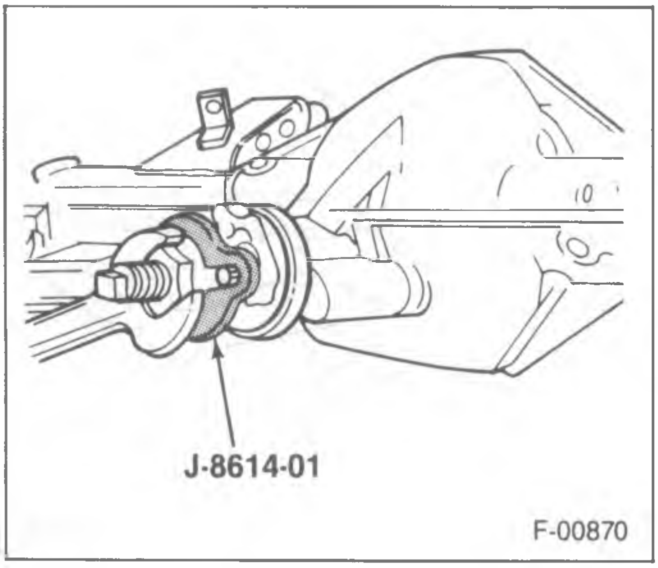


Figure 21—Installing The Pinion Flange

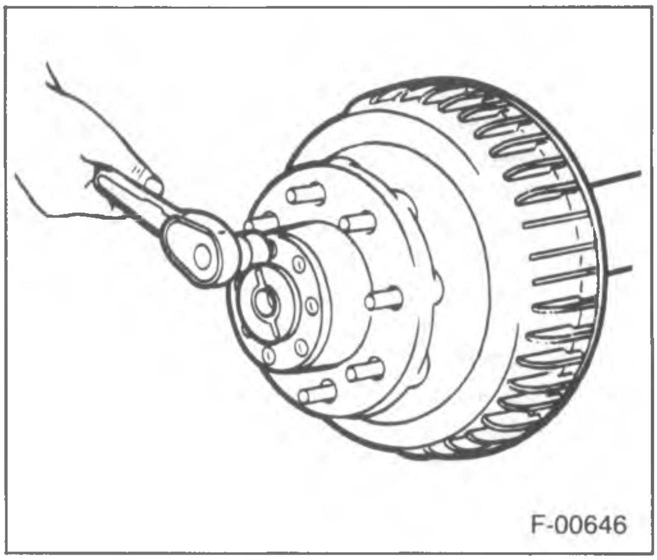


Figure 22—Installing Or Removing Flange-To-Hub Bolts

Tighten

- The pinion nut in additional small increments until the torque necessary to rotate the pinion exceeds the original recorded value by 0.35 N·m (3 in. lbs.).

4. Propeller shaft. Refer to PROPELLER SHAFT (SEC. 4A).
    - Lower the vehicle and road test.

AXLE SHAFT REPLACEMENT (9¾-10½-INCH RING GEAR—FULL FLOATING AXLES)

- This procedure covers the 9¾-inch and 10½-inch ring gear, full floating axles.

Remove or Disconnect (Figure 23)

1. Bolts (35) (figures 22 and 23).
    - Rap the axle shaft (34) flange with a soft faced hammer to loosen the shaft.
    - Grip the rib on the axle shaft (34) flange with a locking plier and twist, to start shaft removal.
2. Axle shaft (34) from the tube.

Clean (Figure 23)

- Axle shaft (34) flange. Remove old RTV or gasket (33).
- Outside face of the hub assembly (31). Lubricant in the area will loosen the shaft-to-hub bolts (35).

A. Chevrolet
B. Dana
40. Nut
41. Lock
42. Adjusting Nut
43. Washer
44. Outer Bearing
45. Retaining Ring
46. Inner Bearing
47. Oil Seal
48. Drum
49. Hub
50. Stud
51. Gasket
52. Shaft
53. Axle Shaft Flange
54. Washer
55. Bolt
56. Retaining Ring
57. Key
58. Adjusting Nut
59. Outer Bearing
60. Retaining Ring
61. Inner Bearing
62. Oil Seal

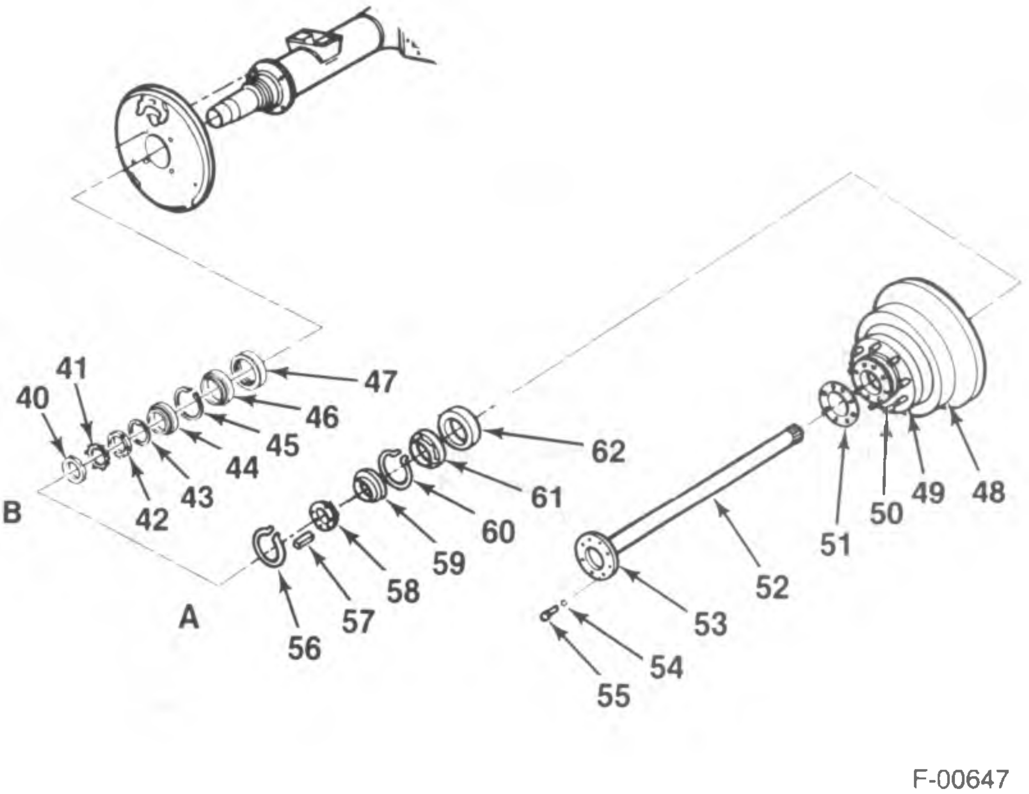


Figure 23—Full Floating Axle, Hub And Drum Assembly Detail

Inspect

- All parts and replace as necessary.

Install or Connect (Figure 23)

1. Axle shaft (34) with a gasket or RTV applied.
    - Be sure the shaft splines mesh into the differential side gear.
    - Align the axle shaft holes with the hub holes.
2. Bolts (35) figures 22 and 23.

Tighten

- Bolts (35) to specified torque later in this section.

HUB AND DRUM ASSEMBLY REPLACEMENT ($9^{3}/_{4}$-$10^{1}/_{2}$-INCH RING GEAR— FULL FLOATING AXLES)

Remove or Disconnect (Figure 23)

- Raise the vehicle until the wheel is free to rotate.
Tool Required:
J-2222-C Wheel Bearing Nut Wrench

1. Wheel and tire.
2. Axle shaft (52) as outlined earlier in this section.
3. Nut (40) use J-2222-C or retaining ring (56). Refer to figure 24.
4. Lock (41) or key (57).
5. Adjusting nut (42, 58). Refer to figure 24.
6. Washer (43).
7. Hub and Drum (48, 49).

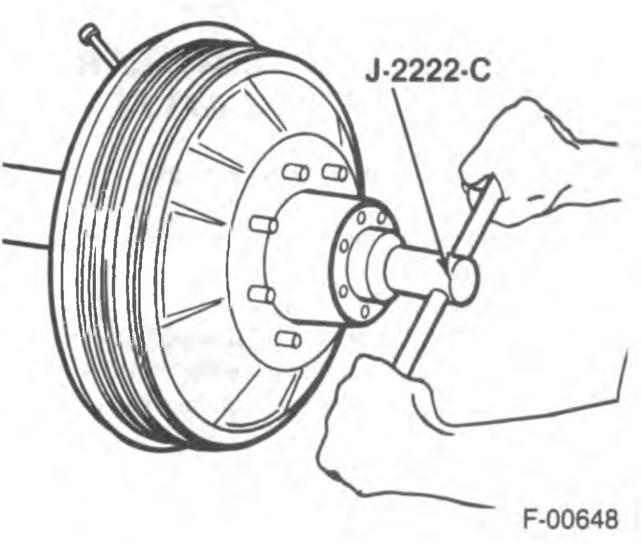


Figure 24—Removing Or Installing Nut

Inspect

- All parts and replace as necessary.

Install or Connect (Figure 23)

NOTICE: For steps 3, 4 and 5 see "Notice" on page 4B-1 of this section.

Tool Required:
J-2222-C Wheel Bearing Nut Wrench

1. Hub and drum (48, 49) to the tube.
   - Be sure the bearings and the oil seal are positioned properly.
   - Apply a light coat of high melting point EP bearing lubricant to the contact surfaces and the outside of the axle tube.
2. Washer (43). Tang into key way.
3. Adjusting nut (42, 58). Refer to figure 24.

   Tighten

   - Adjusting nut (42, 58) to specified torque later in this section.
4. Lock (41) or key (57).
   - Bend the tang to the flat of the adjusting nut (42) or insert the key (57).
5. Nut (40) or retaining ring (56). Refer to figure 24.

   Tighten

   - Nut (40) to specified torque later in this section.
6. Axle shaft (52) earlier in this section.
7. Wheel and tire.
   - Lower the vehicle.

WHEEL BEARING/CUP REPLACEMENT (9¾-10½-INCH RING GEAR— FULL FLOATING AXLES)

Remove or Disconnect (Figure 23)

- Raise the vehicle till the wheels are free to rotate.

Tools Required:
J-8092 Driver Handle
J-24426 Outer Wheel Bearing Cup Installer

1. Axle shaft (52) as outlined earlier in this section.
2. Hub and drum (48, 49) as outlined earlier in this section.
3. Oil seal (47) or (62). Use a drift.
4. Inner bearing (46) or (61). Use a drift to remove the bearing and cup.
5. Retaining ring (45) or (60).
   - Use snap ring pliers to remove the ring.

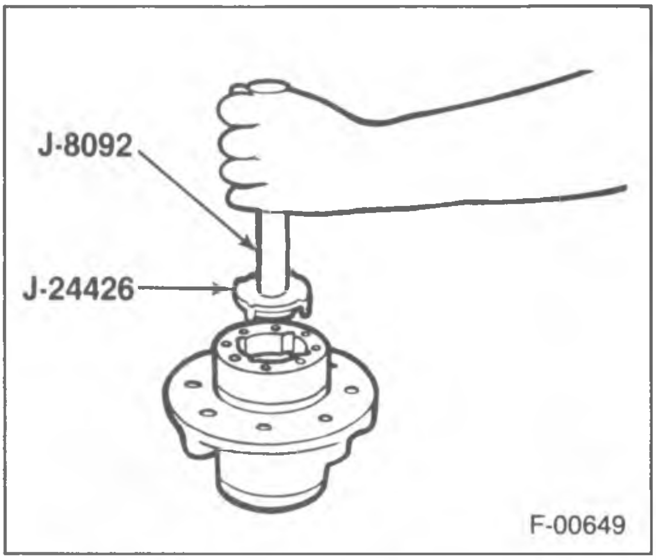


Figure 25—Removing Outer Bearing And Cup

6. Outer bearing (44) or (59) using J-8092 with J-24426 (figure 25).
   - Drive the bearing (44, 59) and cup from the hub (49).

Clean

- Old sealing compound from the oil seal (47, 62) bore in the hub (49).
- Bearing assemblies in a solvent using a stiff brush to remove the old lubricant. Dry the bearings with compressed air. **Do not spin them.**
- Lubricant from the axle housing and inside the hub (49).
- Gasket material from the hub (49), axle shaft (52).

Inspect

- Bearings for wear, chipped edges or other damage. Check for flat or rough spots on the rollers.
- Cups for pits and cracks.
- Oil seal for wear or roughness. Replace parts as necessary.

Install or Connect (Figure 23).

Tools Required:
J-8092 Driver Handle
J-8608 Pinion Bearing Cup Installer
J-24426 Outer Wheel Bearing Cup Installer
J-24427 Inner Wheel Bearing Cup Installer
J-24428 Axle Shaft Seal Installer

1. Outer bearing (44, 59) into the hub (49).
   - Outer cup into the hub (49) using J-8092 and J-8608. **Be sure J-8608 is installed upside down on the driver handle J-8092.**

  - Drive the outer cup beyond the retaining ring groove.
2. Retaining ring (45) or (60) into the groove.
    - Drive the outer bearing cup against the retaining ring (45) or (60) using J-8092 and J-24426 (figure 25).
3. Inner bearing (46) or (61).
    - Drive the inner bearing cup into place until seated against the shoulder of the hub (49) using J-8092 and J-24427.
4. Oil seal (47) or (62). Use J-24428 to install the new oil seal (47, 62).
5. Hub and drum (48, 49) as outlined earlier in this section.
6. Axle shaft (52) as outlined earlier in this section.

NON-DEMOUNTABLE TYPE DRUM REPLACEMENT

- Construction of the non-demountable type drum and hub assembly is such that replacement cannot be done with the hub assembly installed on the vehicle.

Remove or Disconnect

- Raise the vehicle.

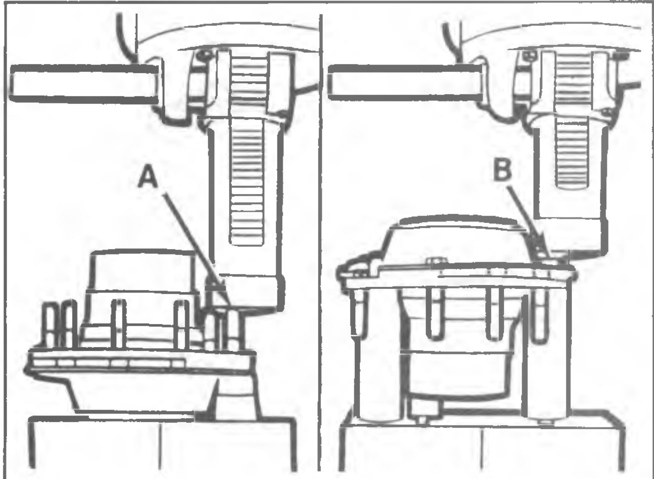
1. Hub and drum assembly. Refer to "Hub and Drum Assembly Replacement" earlier in this section.
2. Retaining bolts, stud nuts or wheel studs.
    - Separate the drum, hub and oil deflector.
    - Press the wheel studs out of the drum. Replace parts as necessary.

Install or Connect

1. Drum to the hub.
    - Make certain drain holes are in alignment.
2. Oil deflector to the drum.
    - Apply a light coating of sealing compound to the oil deflector contact surface.
3. Retaining bolts, stud nuts or wheel studs.
    - Press the wheel studs into the drum.

WHEEL BOLT REPLACEMENT

- Wheel bolts are serrated and may also be swaged in place; however, replacement procedure remains the same for both types of installation. Press the wheel bolts out of the hub flange, then press new wheel bolts into place, making sure of a tight fit. When replacing all of the wheel bolts be sure that the hub oil deflector is in position under the wheel bolt heads. Refer to figure 26.



A. Removing Wheel Bolt
B. Installing Wheel Bolt

Figure 26—Wheel Bolt Replacement

BEARING ADJUSTMENT

- Make sure the brakes are fully released and do not drag.
- Check the wheel bearing play by grasping the tire at the top and pulling and pushing back and forth, or by using a pry bar under the tire. If the wheel bearings are properly adjusted, movement of the brake drum in relation to the brake flange plate will be barely noticeable and the wheel will turn freely. If the movement is excessive, adjust the bearings.

Remove or Disconnect (Figure 23)

Tool Required:

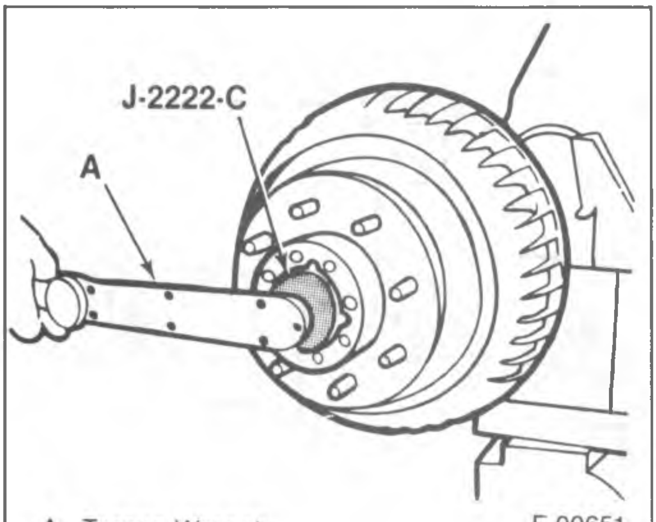
J-2222-C Wheel Bearing Nut Wrench

- Raise the vehicle until the wheel is free to spin.

1. Axle shaft (52). Refer to "Axle Shaft Replacement" earlier in this section.
    - Be sure the keyway, threads and adjusting nut (42, 58) are clean and free of chips, burrs and shavings.
2. Nut (40) if used or retaining ring (56).
    - Disengage the tang from the nut (40).
3. Lock (41) if used or key (57).

Tighten

- Adjusting nut (42, 58) to 70 N·m (50 ft. lbs.) using J-2222-C (figures 27 and 28).
- Be sure the bearings are seated and in contact with the spindle shoulder.



A. Torque Wrench F-00651

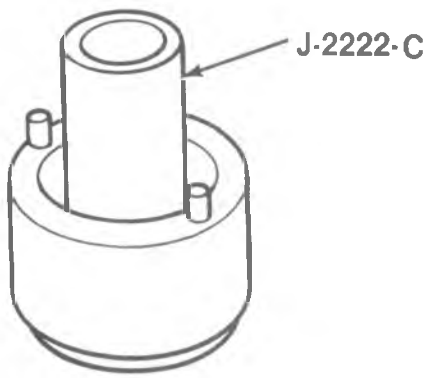
Figure 27—Tightening The Adjusting Nut

Adjust

- Nut (42, 58). Back the nut (42, 58) off until just loose using J-2222-C. Align the adjusting nut (58) slot with the keyway in the axle spindle. Do not back the adjusting nut (58) off more than one slot to gain alignment.

Install or Connect (Figure 23).

1. Key (57) if used or new lock (41).
    - Key (57) into the keyway and adjusting nut (58) slot.
    - Bend the lock (41) tang to the flat of the adjusting nut (42).
2. Retaining ring (56) or nut (40) if used.
    - Bend the lock (41) tang to the flat of the nut (40).
    - Be sure the retaining ring (56) is seated.



F-00863

Figure 28—Wheel Bearing Nut Wrench

3. Axle shaft (52). Refer to "Axle Shaft Replacement" earlier in this section.

PINION OIL SEAL/COMPANION FLANGE REPLACEMENT

- The pinion oil seal and the companion flange may be replaced with the carrier assembly installed in the vehicle.

Remove or Disconnect

Tools Required:

J-8614-01 Companion Flange Holder and Remover

J-22281 Pinion Oil Seal Installer (DANA 9¾-inch ring gear axle)

J-24384 Pinion Oil Seal Installer (DANA 10½-inch ring gear axle)

J-24434 Pinion Oil Seal Installer (CHEVROLET 10½-inch ring gear axle)

- Raise the vehicle.

1. Propeller shaft. Refer to PROPELLER SHAFT (SEC. 4A).
    - Tie the propeller shaft to a frame rail or crossmember.

Important

- Scribe a line on the pinion stem, pinion nut and companion flange to be used as a guide for reinstallation (figure 17).

2. Nut using J-8614-01 (figure 18).
3. Flange using J-8614-01.
    - Use the special nut and forcing screw to remove the flange (figure 19).
4. Oil seal.
    - Pry the oil seal from the bore. Do not damage the machined surfaces and then thoroughly clean foreign material from the contact area.
    - Replace parts as necessary.

Install or Connect

1. Oil seal into the bore.
    - Lubricate the cavity between the new seal lips with a high melting point bearing lubricant.
    - Use the proper seal installing tool listed under tools required.
2. Flange using J-8614-01.
    - Use scribed marks for reinstallation.
3. Nut, use J-8614-01 (figure 18).
    - Use scribe mark as an installation reference.

4. Propeller shaft. Refer to PROPELLER SHAFT (SEC. 4A).

AXLE VENT REPLACEMENT (12-INCH RING GEAR-FULL FLOATING AXLE)

- A threaded type axle vent is used on the Rockwell 12-inch ring gear axle and must be replaced if the vent cap is damaged or missing.

Clean

The area around the axle vent.

Remove or Disconnect

- Axle vent from the housing.

Install or Connect

- Axle vent to the housing.

AXLE SHAFT REPLACEMENT (12-INCH RING GEAR—FULL FLOATING AXLE)

- Raise the vehicle and place jack stands under the frame side rails.

Remove or Disconnect (Figure 29)

Tools Required:

J-2619-01 Slide Hammer
J-8117 Axle Shaft Puller Adapter

1. Bolts (70) and washers (71).
2. Hub cap (72).
   - Thread J-8117 into the tapped hole on the axle shaft (74) flange.
   - Attach J-2619-01 to J-8117.
3. Axle shaft (74) using J-2619-01.

Clean

- Old gasket material from the hub (86) and hub cap (72) and the axle shaft (74) flange and mating surface in the hub (86).

Install or Connect (Figure 29)

Tools Required:

J-2619-01 Slide Hammer
J-8117 Axle Shaft Puller Adapter

1. Axle shaft (74).
   - Tap the axle shaft (74) into position using J-8117 and J-2619-01.
   - Index the axle shaft (74) splines into the hub (86) splines.
2. Gasket (73).
3. Hub cap (72).
4. Washers (71) and bolts (70).

BEARING ADJUSTMENT (12-INCH GEAR—FULL FLOATING AXLE)

- Make sure the brakes are fully released and do not drag.
- Check the wheel bearing play by grasping the tire at the top and pulling and pushing back and forth, or by using a pry bar under the tire. If the wheel bearings are properly adjusted, movement of the hub or disc will be barely noticeable. If the movement is excessive, adjust the bearings.

Remove or Disconnect (Figure 29)

Tool Required:

J-25510 Wheel Bearing Nut Wrench

- Raise the vehicle until the wheel is free to spin.

1. Axle shaft (74). Refer to "Axle Shaft Replacement."
2. Nut (90) using J-25510.
   - Release the tang.
3. Lock washer (89).

Adjust

- Nut (88) using J-25510. Tighten the nut (88) while the hub is rotating to 68 N·m (50 ft. lbs.). Make sure the bearing surfaces are in contact and then back the nut (88) off 1/8 turn.

Install or Connect (Figure 29)

1. Lock washer (89).
   - Bend a tang over a flat of the adjusting nut (88).
2. Nut (90) using J-25510.
   - Tighten the nut (90) to 339 N·m (250 ft. lbs.).
   - Bend a long tang of the lock washer (89) over a flat of the nut (90).
3. Axle shaft (74). Refer to "Axle Shaft Replacement."
   - Lower the vehicle.

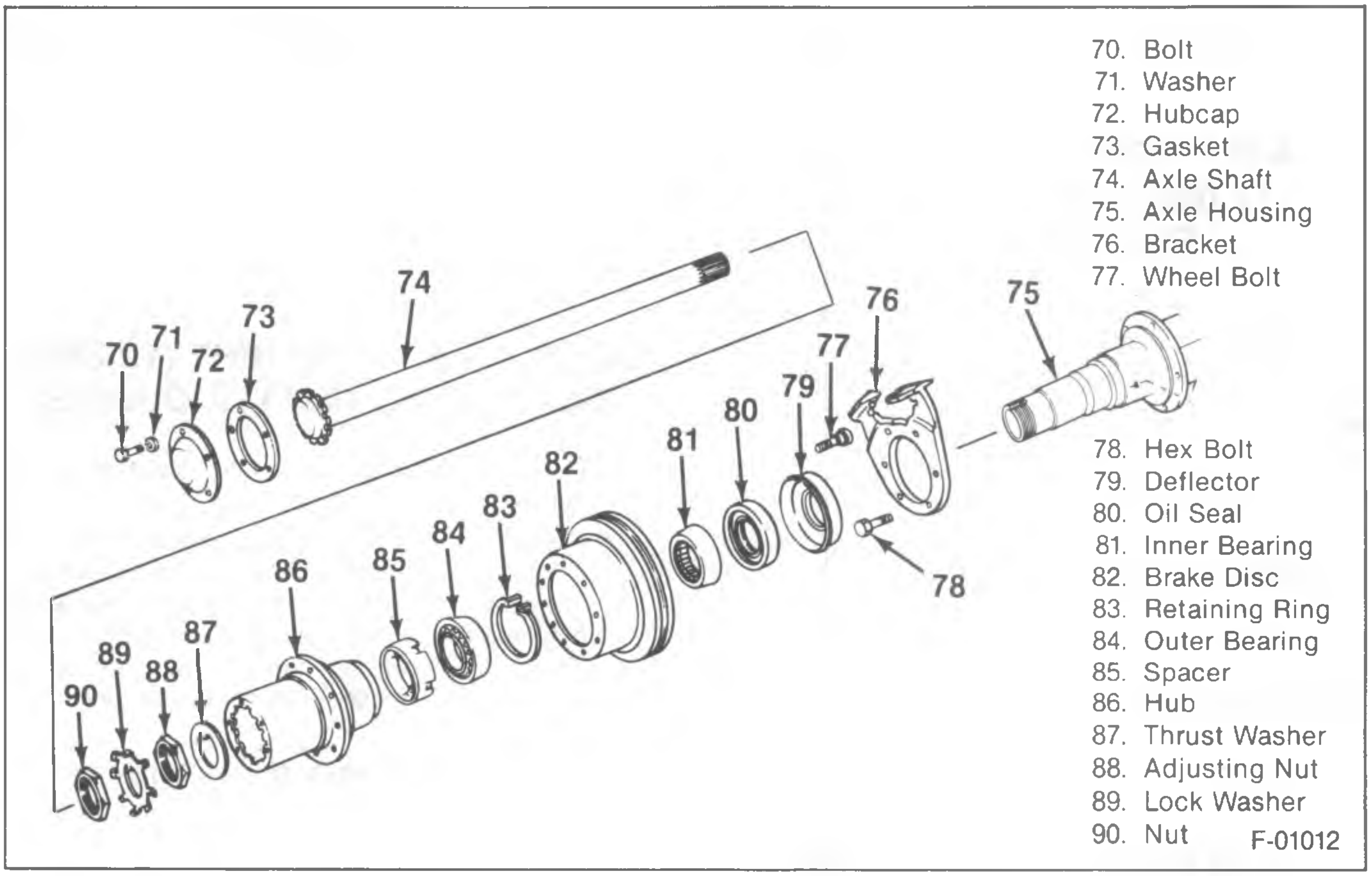


Figure 29—Rockwell Axle And Hub Detail

DRIVE PINION OIL SEAL REPLACEMENT (12-INCH RING GEAR— FULL FLOATING AXLE)

- A pinion oil seal may be replaced on the Rockwell 12-inch ring gear axle with the carrier assembly installed in the vehicle.

Remove or Disconnect (Figure 30)

Tools Required:

J-8614-01 Companion Flange Holder and Remover

J-22281 Pinion Oil Seal Installer

- Raise the vehicle.

1. Propeller shaft. Refer to PROPELLER SHAFT (SEC. 4A).

Important

- Scribe a reference line on the pinion stem, pinion nut and companion flange.

2. Cotter key (91) and nut (92) using J-8614-01.
3. Companion flange (94).
4. Bolts (97).
5. Oil seal retainer (95).

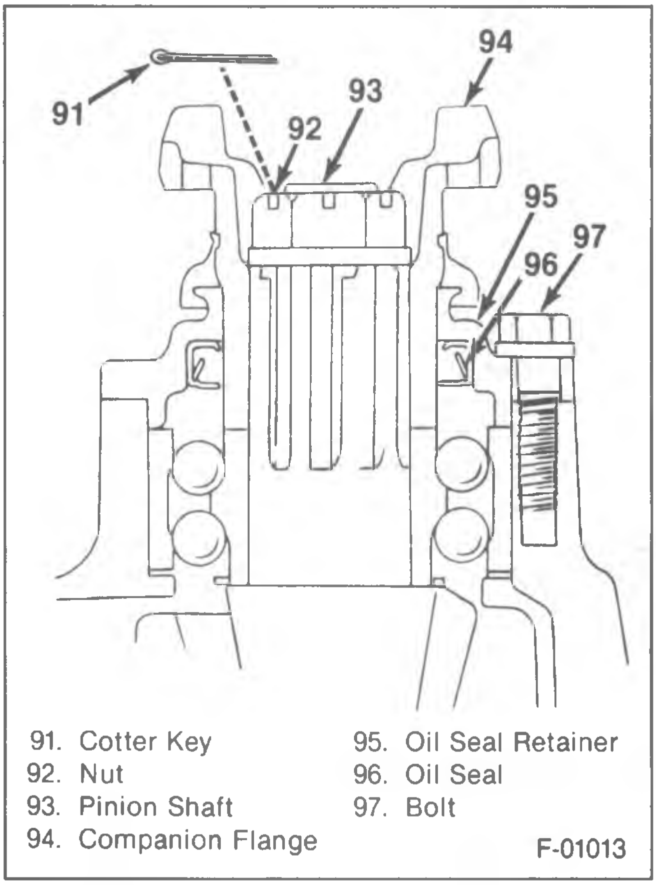


Figure 30-—Drive Pinion Oil Seal Detail

6. Oil seal (96).
   - Pry the oil seal (96) from the bore being careful not to damage the machined surfaces.

Clean

- The seal contact area.

Install or Connect (Figure 30)

- Lubricate the cavity between the new seal (96) lips with a high melting point bearing lubricant. Refer to MAINTENANCE AND LUBRICATION (SEC. 0B).

1. Oil seal (96) into the bore using J-22281.
   - Be sure the seal (96) bottoms against the bore shoulder.
2. Oil seal retainer (95).
3. Bolts to the retainer (97).
4. Companion flange (94) use the scribed reference mark.
5. Nut (92) using J-8614-01.

Tighten

- Nut (92). Align the castellated nut with the hole in the pinion shaft (93) stem and the reference mark.

6. Cotter key (91).
7. Propeller shaft. Refer to PROPELLER SHAFT (SEC. 4A).

SPECIFICATIONS

TORQUES

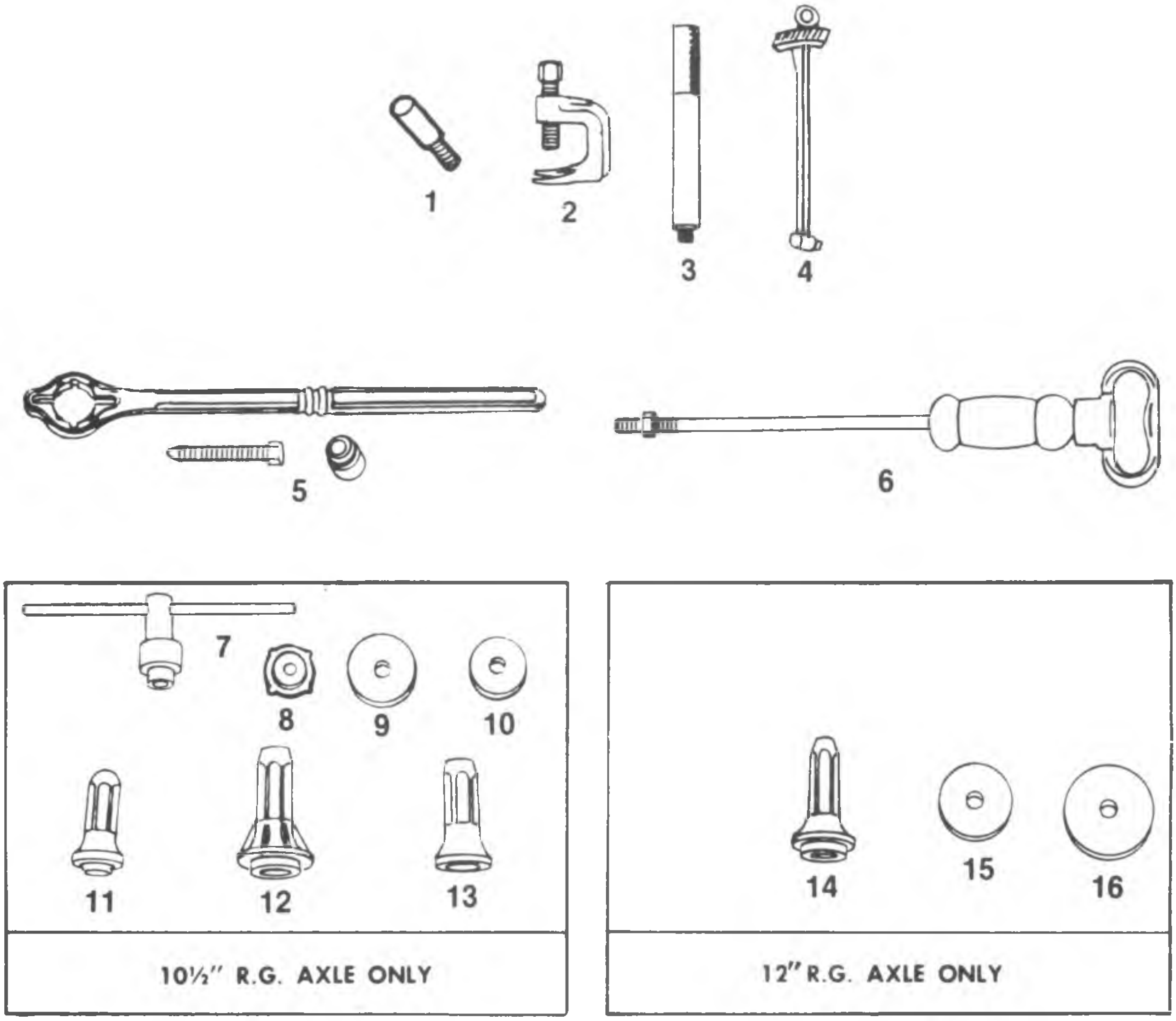
	8½″ RING GEAR—SEMI FLOATING AXLE		9½″ RING GEAR—SEMI FLOATING AXLE		DANA 9¾″-10½″ RING GEAR AXLE—FULL FLOATING		CHEVROLET 10½″ RING GEAR AXLE—FULL FLOATING		ROCKWELL 12″ RING GEAR AXLE—FULL FLOATING	
	N·m	FT. LBS.	N·m	FT. LBS.	N·m	FT. LBS.	N·m	FT. LBS.	N·m	FT. LBS.
Filler Plug	34	25	24	18	14	10	24	18	47	35
Lock Screw	34	25	34	25	—	—	—	—	—	—
Brake Backing Plate	47	35	142	105	142	105	142	105	—	—
Axle Shaft to Hub Bolts	—	—	—	—	156	115	156	115		
Carrier Cover	27	20	27	20	47	35	41	30	—	—
Axle Lubricant Capacity	Liters 2.0	Pints 4.2	Liters 2.6	Pints 5.5	Liters 2.6	Pints 5.5	Liters 3.4	Pints 7.2	Liters 6.6	Pints 14.0

WHEEL BEARING ADJUSTMENT VALUES

RING GEAR SIZE	BEARING ADJUSTING NUT TORQUE*	ADJUSTING NUT BACK-OFF*	OUTER LOCKNUT TORQUE	RESULTING BEARING ADJUSTMENT	TYPE OF BEARING
9¾″ Ring Gear	68.0 N·m 50 ft. lbs.	**	88.1 N·m 65 ft. lbs.	0.0254 to 0.254 mm .001 to .010 inch End Play	TAPERED ROLLER
10 ½″ Ring Gear	68.0 N·m 50 ft. lbs.	—	—		
12″ Ring Gear	68.0 N·m 50 ft. lbs.	⅛ Turn	339.0 N·m 250 ft. lbs.		

*With wheel rotating.

**Back-off the nut and retighten to 47 N·m (35 ft. lbs.). Then back the nut off ¼ turn



1.	J-8117	Axle Shaft Puller Adapter
2.	J-6627-A	Wheel Stud Remover
3.	J-8092	Driver Handle
4.	J-5853	Torque Wrench—Inch/Pound
5.	J-8614-01	Companion Flange Holder And Remover
6.	J-2619-01	Slide Hammer With Adapter
7.	J-2222-C	Wheel Bearing Nut Wrench
8.	J-24426	Outer Wheel Bearing Cup Installer
9.	J-24427	Inner Wheel Bearing Cup Installer
10.	J-8608	Outer Pinion Bearing Cup Installer
11.	J-24384	Pinion Oil Seal Installer
12.	J-24428	Axle Shaft Seal Installer
13.	J-24434	Pinion Oil Seal Installer
14.	J-22281	Pinion Oil Seal Installer
15.	J-8114	Wheel Bearing Outer Cup Installer
16.	J-8093	Wheel Bearing Inner Cup Installer

F-01014

Figure 31—Special Tools

SECTION 4C

FRONT AXLE

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: "NOTICE: See 'Notice' on page 4C-1 of this section."

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

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DESCRIPTION

The front axle is a hypoid gear axle unit equipped with steering knuckles and an automatic or manual locking hub. The K10 and 20 models use a Chevrolet front axle having an 8½-inch ring gear axle rated at 3600 pounds for the K-10 and 3800 pounds for the K-20. A Dana (60 Series) axle is used on the K-30 model and is rated at 4500 pound capacity. The Dana axle has a 9¾-inch ring gear. Automatic hub locks are used on all models to engage the hub whenever four-wheel drive is selected. A manual locking hub is used on the K-30 model only and must be engaged manually whenever four-wheel drive is selected.

DIAGNOSIS OF THE FRONT AXLE

ROAD TEST

- Check tires for irregular wear.
- Check tire pressure.
- Check axle lubricant level.
- Drive to warm up the front axle.
- Test at various speeds in drive, float, coast and while cornering.
- Verify that the hubs are locked.

TIRE NOISES

- Change the tire pressure to minimize noises.
- Drive over different road surfaces.
- Smooth black-top minimizes tire noise.
- Cross switch the tires, if necessary.
- Snow tire treads and studs cause added noises.

ENGINE OR EXHAUST NOISES

- Drive slightly above the speed where the noise occurs, place transmission in neutral.
- Let the engine speed drop to idle.
- Stop the vehicle.
- Run the engine at various speeds.

TEST FOR WHEEL BEARING NOISE

- Drive the vehicle at low speed on a smooth road.
- Turn the vehicle to develop left and right motions, traffic permitting.
- Noise should change due to cornering loads.
- Jack-up wheels to verify roughness at the wheels.

*TEST FOR DIFFERENTIAL BEARING NOISE

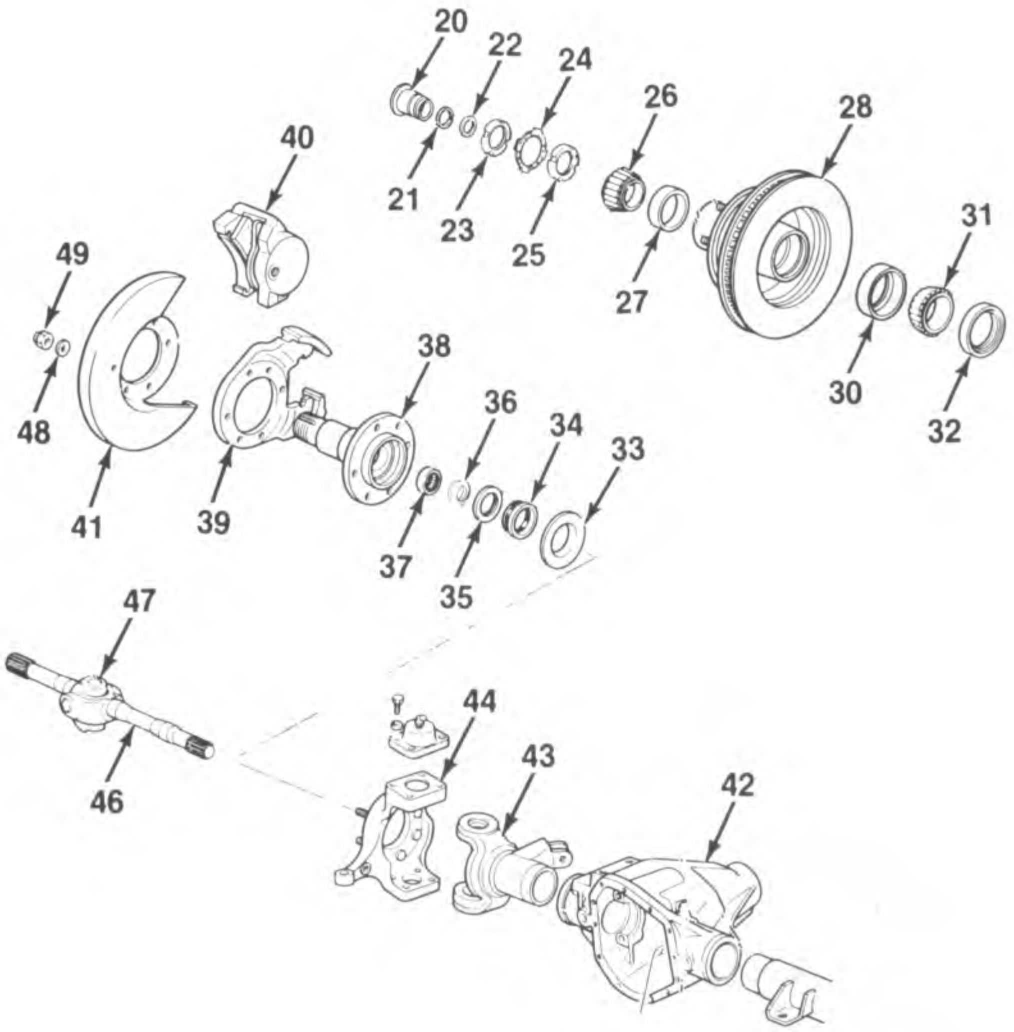
- Drive the vehicle at low speed on a smooth road.
- Constant low pitch bearing noise may be heard.
- Noise should not change in reversing turns.
- The noise pattern should vary with the wheel speed.

*TEST FOR PINION BEARING NOISE

- Rough running or a whine noise should increase with speed.
- Noise pitch should be higher than differential noise.
- Perform the test on a smooth road to minimize tire noises.
- Perform test at various speeds in drive, float, and coast.
- Rear pinion bearing noise may be louder on acceleration.
- Front pinion bearing noise may be louder on deceleration.
- Gear noise tends to peak in a narrow speed range.

*Bearing tests should be done in 2H (after 4H selection to lock hubs). This removes the transfer case whine.

ON-VEHICLE SERVICE



20. Hub Lock
21. Ring
22. Retainer
23. Nut
24. Ring
25. Nut
26. Outer Bearing
27. Cup
28. Hub And Disc
30. Cup
31. Inner Bearing
32. Inner Seal
33. Outer Deflector
34. Seal
35. Spacer
36. Seal
37. Bearing
38. Spindle
39. Brake Bracket
40. Brake Caliper
41. Splash Shield
42. Housing
43. Tube
44. Knuckle
46. Axle Shaft
47. U-Joint
48. Washer
49. Nut

F-01015

Figure 1—Front Axle Detail

AXLE SHAFT REPLACEMENT

Remove or Disconnect (Figure 1)

- Raise the vehicle.

1. Wheel and tire.
2. Brake caliper (40).

Important

- Support the brake caliper (40) so as not to stretch or damage the brake hose.

3. Hub lock mechanism (20).
4. Rotor and hub (28).
5. Inner bearing (31) and seal (32).
6. Splash shield (41), brake bracket (39) and spindle (38).
7. Axle shaft (46).

Clean

- Inner and outer wheel bearing (31, 26).
- Hub and disc (28), spindle (38).

Inspect

- All parts and replace as necessary.

Important

- Lube the spindle bearing (37) and spindle (38).

- Pack the inner and outer wheel bearing (31, 26).

NOTICE: For steps 3, 4 and 5, see "Notice" on page 4C#1 of this section.

Install or Connect (Figure 1)

1. Seal (36) and spacer (35) to the axle shaft (46).
2. Axle shaft (46) into the housing (42).
3. Spindle (38) to the knuckle (44). Be sure the seal (34) and outer deflector (33) are in place.
4. Brake bracket (39).
5. Splash shield (41).
    - New washers (48) and nuts (49) to the studs. Torque the nuts (49) to 88 N·m (65 ft. lbs.).
6. Hub and disc (28).
    - Adjust the wheel bearings (26, 31). Refer to FRONT SUSPENSION (SEC. 3C).
7. Retainer (22) and ring (21).
8. Hub lock mechanism (20).

NOTICE: See "Notice" on page 4C#1 of this section.

9. Brake caliper (40).
    - Do not stretch or damage the brake hose.
10. Wheel and tire.
    - Lower the vehicle and test.

FRONT AXLE ASSEMBLY REPLACEMENT

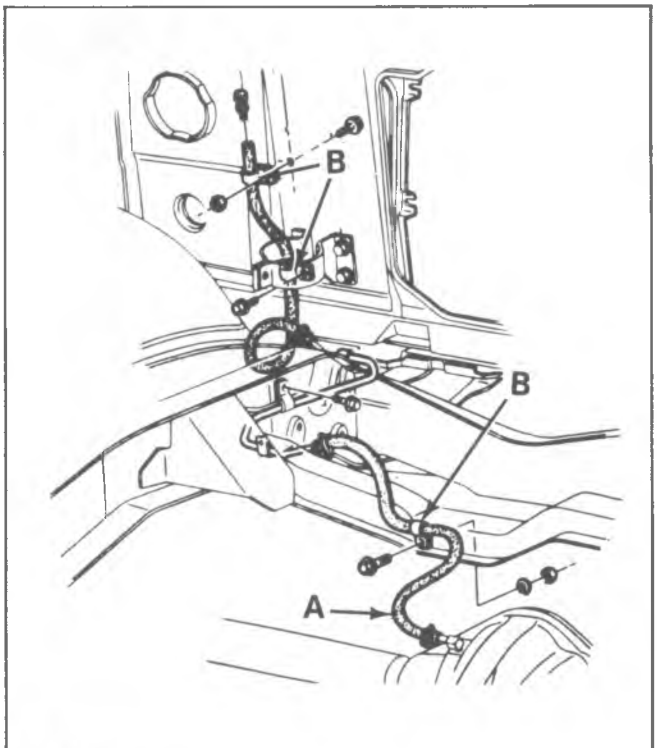
- Raise the vehicle until the weight is removed from the front springs. Support the vehicle with jack stands placed behind the front springs.

Remove or Disconnect (Figure 1)

1. Propeller shaft. Refer to "Propeller Shaft" (Sec. 4A).
2. Connecting rod from the steering arm. Refer to FRONT SUSPENSION (SEC. 3C).
3. Brake caliper (40).
    - Support the brake caliper (40) so as not to stretch or damage the brake hose.
4. Shock absorbers from the axle brackets.
5. Front stabilizer bar.
6. Axle vent tube and clips (figure 2).
7. Nuts, washers, U-bolts, spacers and plates.
    - Support the axle with a jack.
8. Axle assembly out from under the vehicle.

Clean

- Axle assembly.



A. Hose
B. Clips

F-01016

Figure 2—Axle Vent Hose Routing

Inspect

- The assembly and repair or replace as necessary.

NOTICE: For steps 1, 5, 6 and 7, see "Notice" on page 4C#1 of this section.

Install or Connect (Figure 1)

- Axle assembly positioned under the vehicle.

1. Plates, spacers, U-bolts, washers and nuts.
2. Axle vent tube and clips. Refer to figure 2.
3. Front stabilizer bar.
4. Shock absorbers to the axle brackets.
5. Brake caliper (40).
6. Connecting rod to the steering arm.
7. Propeller shaft.
    - Lower the vehicle.

AXLE JOINT COMPONENT REPLACEMENT

Remove or Disconnect

- Raise the vehicle.

1. Axle shaft. Refer to "Axle Shaft Replacement" earlier in this section.
   - Support the shaft yoke in a bench vise or on a short piece of pipe.
2. Trunnion
   - Using a brass drift and soft hammer drive on the end of a trunnion bearing enough to drive the opposite bearing from the yoke.
   - Support the other yoke and drive the trunnion bearing out in the same manner.

Clean

- The bearings and yokes.

Inspect

- The bearings and yokes. Replace parts as necessary.

Install or Connect

- Lubricate the new bearings with a high melting point type wheel bearing grease.

1. Bearing in a yoke ear.
2. Trunnion in the bearing.
3. Another bearing in the opposite yoke ear with the trunnion aligned.
4. Bearing in each ear of the companion yoke.
   - Press the bearings in beyond the lock ring grooves.
5. Lock ring at each bearing.
   - Tap the yoke lightly to seat the bearings against the lock rings.

LOCKING HUB COMPONENT REPLACEMENT

AUTOMATIC HUB COMPONENT REPLACEMENT

Remove or Disconnect (Figure 3)

1. Screws (50) and O-ring seals (52).
2. Cover (52).
3. Seal (53).
4. Keeper (60).
5. Spring (54).
6. Inner race (55).
7. Bearing (56).
8. Retainer (58).
9. Ring (57) using needle nose plier.
   - Pull the remaining components from the wheel.
10. Retaining ring (77) from the sleeve (67) groove.
    - Rotate the drag sleeve (75) until it drops into engagement with the gear (59).
    - Lift and cock the drag sleeve (75) to unlock the tangs of the brake band (74) from the "window" of the inner cage (72), then move the drag sleeve (75) and brake assembly away.

Important

- NEVER REMOVE THE BRAKE BAND (74) FROM THE DRAG SLEEVE (75). The spring tension of the brake band (74) can be changed if the coils are over expanded and the operation of the hub could be affected.

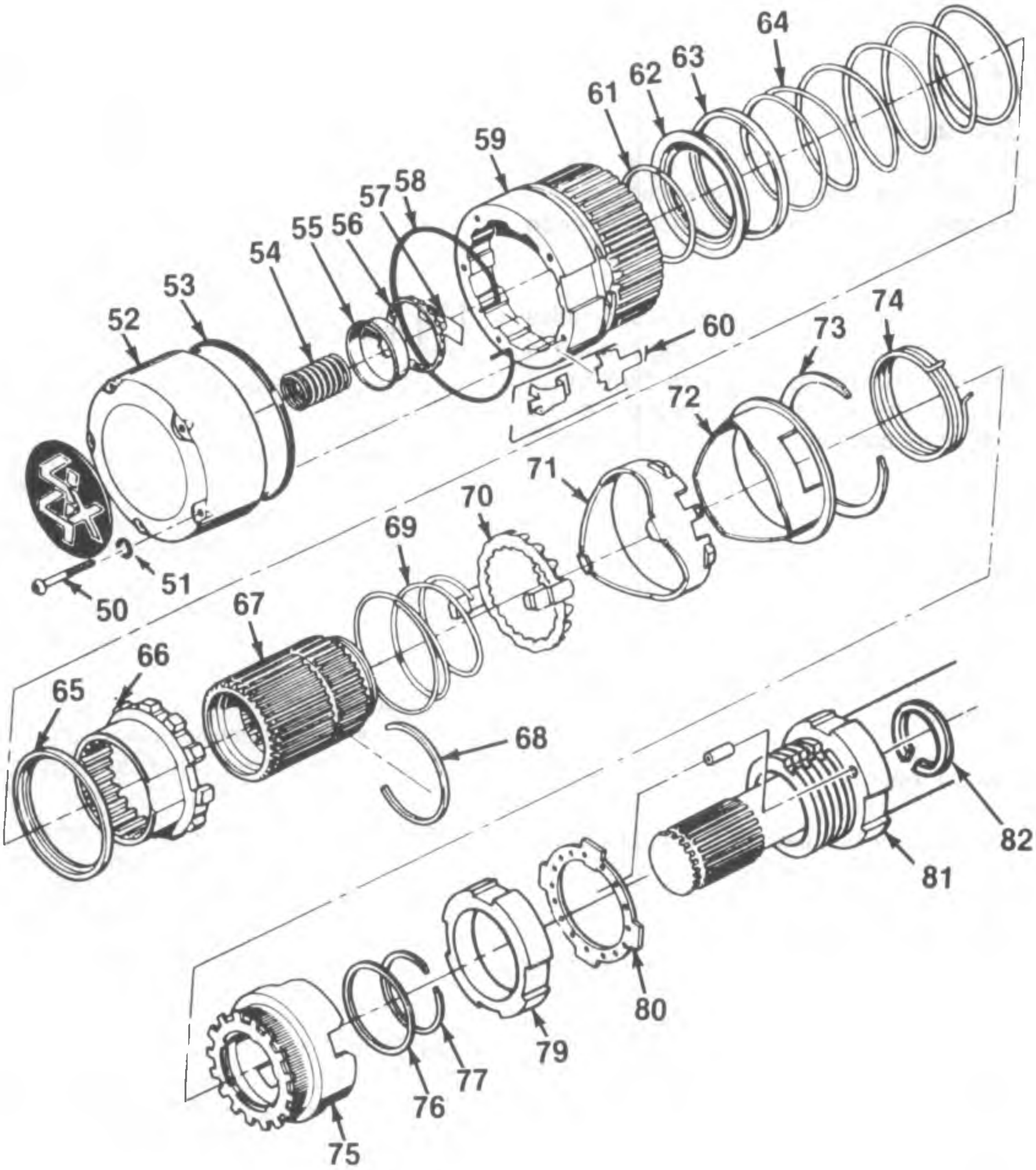
11. Ring (73) from the groove in the clutch gear (59).
12. Inner cage (72).
    - While removing the inner cage (72) use a small screw driver to pry the plastic outer cage (71) away.
13. Outer cage (71).
    - Pry the plastic outer cage (71) tabs free from the groove in the clutch gear (59) and move the outer cage (71) away.
14. Sleeve (67) from the clutch gear (59).
    - Compress the return spring (64) and hold the assembly in a compressed condition by using the clamps shown in figure 4.
    - Position the assembly with the clamps in place in a vice and hold both ends of the sleeve (67).
15. Ring (61).
    - While holding the sleeve (67) in the vise, remove the clamps holding the return spring (64) and then open the vise and release the return spring (64).
16. Retainer plate (62).
17. Retainer (63).
18. Stop ring (68).
    - Align the ends of the stop ring (68) with the legs of the cam (70) to allow removal.
19. Spring (69).
20. Cam (70) from the gear (66).

Inspect

- All parts and replace as necessary.

Install or Connect (Figure 3)

1. Cam (70) over the flats of the gear (66).
2. Spring (69).
   - Compress the spring (69) and slide the large diameter end against the gear (66).



50. Screw
51. O-Ring Seal
52. Cover
53. Seal
54. Spring
55. Inner Race
56. Bearing
57. Ring
58. Retainer
59. Clutch Gear
60. Keeper
61. Ring
62. Retainer Plate
63. Retainer
64. Return Spring
65. Retainer
66. Gear
67. Sleeve
68. Stop Ring
69. Spring
70. Cam
71. Outer Cage
72. Inner Cage
73. Ring
74. Brake Band
75. Drag Sleeve
76. Spacer
77. Retaining Ring
78. Washer-K10, K20
79. Adjusting Nut
80. Lock Ring
81. Nut With Pin
82. Ring-K30

F-01017

Figure 3—Automatic Hub-Detail K10, K20, K30

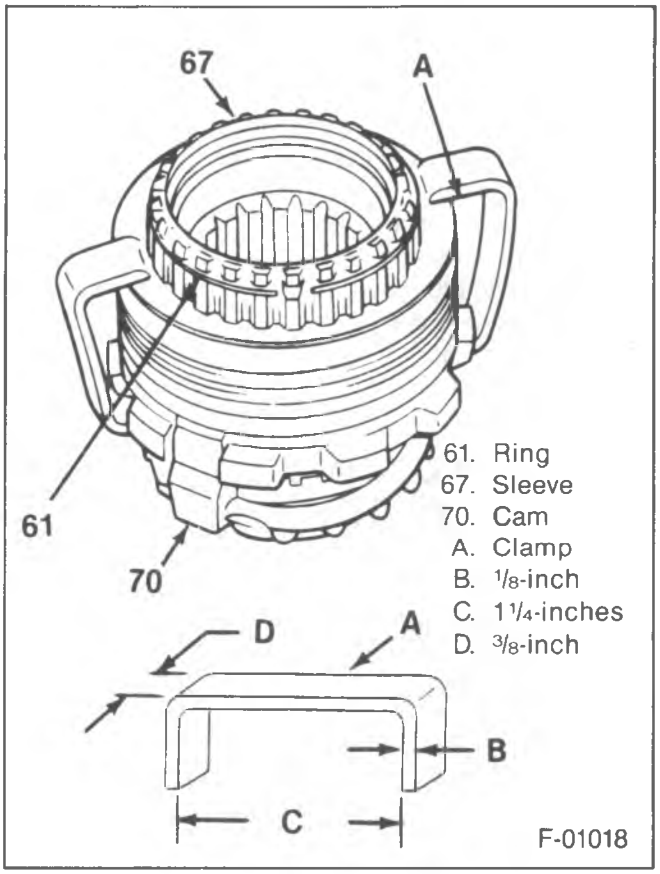


Figure 4—Compressing The Return Spring

3. Gear (66) over the splines of the sleeve (67).
   - Cam (70) should locate at the end of the sleeve (67) having no splines.

Important

   - The gear (66) and spring (69) should slide freely over the splines of the sleeve (67).

4. Stop ring (68) to the groove of the sleeve (67).
5. Retainers (63 and 65) to each end of the spring (64).
   - Retainer (65) to the shoulder of the gear (66).
6. Retainer plate (62) to the retainer (63).
   - Compress the return spring (64) and hold the assembly together with clamps (figure 4).
7. Ring (61) in the groove of the sleeve (67).
   - Place the assembly (steps 1 through 7) into the clutch gear (59) and support the clutch gear (59) above a flat surface allowing the assembly to drop down so that the tangs of the brake band (74) may be assembled later.
8. Outer cage (71) into the clutch gear (59).
   - The ramps of the outer cage (71) must face the cam (70).
   - Locate the outside tabs of the outer cage (71) into the wide grooves of the clutch gear (59).
9. Inner cage (72) into the outer cage (71).
   - Align the tab of the outer cage (71) with the "window" of the inner cage (72).
10. Ring (73).
    - Into the groove of the clutch gear (59) above the outer cage (71).

Important

   - Service the brake band (74) and drag sleeve (75) as an assembly and be sure the original lubricant has not been removed or contaminated. Lubricant number 1052750 or its equivalent **must be used** in this assembly.

11. Brake band (74) tangs.
    - Place the tangs of the brake band (74) on each side of the lug of the outer cage (71) located in the "window" of the steel inner cage (72). Cock these parts to engage the tangs in this position.
12. Spacer (76) and retaining ring (77).
    - To the sleeve (67) above the drag sleeve (75).
13. Hub assembly to the vehicle.
14. Ring (57) to the clutch gear (59) unsplined end.
    - Locate the tangs of the ring (57) pointing away from the vehicle.
15. Keeper (60).
    - Hold the tangs of the ring (57) together and attach the keeper (60). For K10 and K20 assemble the O-ring seal (53) in the clutch gear (59) groove and over the keeper (60).
16. Bearing (56) over the inner race (55).
    - Lubricate the bearing (56) with light wheel bearing grease.
    - Steel balls should be visible when bearing (56) is properly installed.
17. Retainer (58) into the outer race (55) hole.
    - Bearing (56) inner race (55) and retainer (58) into the sleeve (67).
18. Spring (54) into the cover (52) bore.
    - Align cover (52) screw holes with the screw thread holes in the clutch gear (59).
19. O-ring seals (51) and screws (50) in the cover (52).
    - The hub sleeve (67) and attached parts should turn freely after assembly.

Tighten

   - Screws (50) to 5.1 N·m (45 in. lbs.).

Important

   - The five cover screws (50) must be loosened (three or four turns) and then pushed inward to allow the retaining ring (57) to expand when assembling the automatic locking hub to the vehicle.

AUTOMATIC HUB TO THE WHEEL ADJUSTMENT

A lock ring (80) is supplied with each new automatic hub assembly. Assemble this lock ring (80) between the nut with pin (81) and the adjusting nut (79) as follows:

Use J-6893 to torque the nut with pin (81) to 68 N·m (50 ft. lbs.) to seat the wheel bearings; then back off the nut with pin (81) and torque to 47 N·m (35 ft. lbs.) while rotating the hub (figure 3).

Then back the nut with pin (81) off a maximum of 3/8 turn. Assemble the lock ring (80) over the axle shaft against the nut with pin (81) so that the inner tang enters the axle shaft keyway. One of the holes in the lock ring (80) must engage the pin on nut (81). Thread the adjusting nut (79) onto the axle shaft and tighten to 247 N·m (183 ft. lbs.).

Align the cut-outs on the drag sleeve (75) with the tabs on the lock ring (80) as the splines of the clutch gear (59) mesh with the splines of the wheel hub. Loosen the five cover screws (50) three or four turns and push in on the screws (50) to allow the ring (57) to expand into the groove in the wheel hub. Torque the screws (50) to 5.1 N·m (45 inch lbs.).

MANUAL LOCKING HUB REPLACEMENT

Remove or Disconnect (Figure 5)

1. Screws (91).
2. Outer hub locking assembly (92, 93, 94, 95, 96, 97, 98, and 99).
3. Snap ring (90) from the axle shaft end.
4. Internal snap ring (85) from hub.
5. Body assembly (86, 87, 88 and 89).

Inspect

- All parts and replace as necessary.

Install or Connect (Figure 5)

1. Body assembly (86, 87, 88 and 89).
2. Internal snap ring (85) to the hub.
3. Snap ring (90) onto the axle shaft end.
4. Outer hub locking assembly (92, 93, 94, 95, 96, 97, 98 and 99).
5. Screws (91).

MANUAL LOCKING HUB REBUILD PROCEDURE

- Outer hublock knob assembly should be replaced only as a unit, because timing relationships are difficult to restore if disassembly occurs. The inner body may be disassembled for cleaning and component replacement.

Remove or Disconnect (Figure 5)

1. Screws (91).
2. Hub body (86).
3. Spring (88).
4. Internal snap ring (85).
5. Inner drive gear (87) with thrust washers.
6. Plastic sleeve.

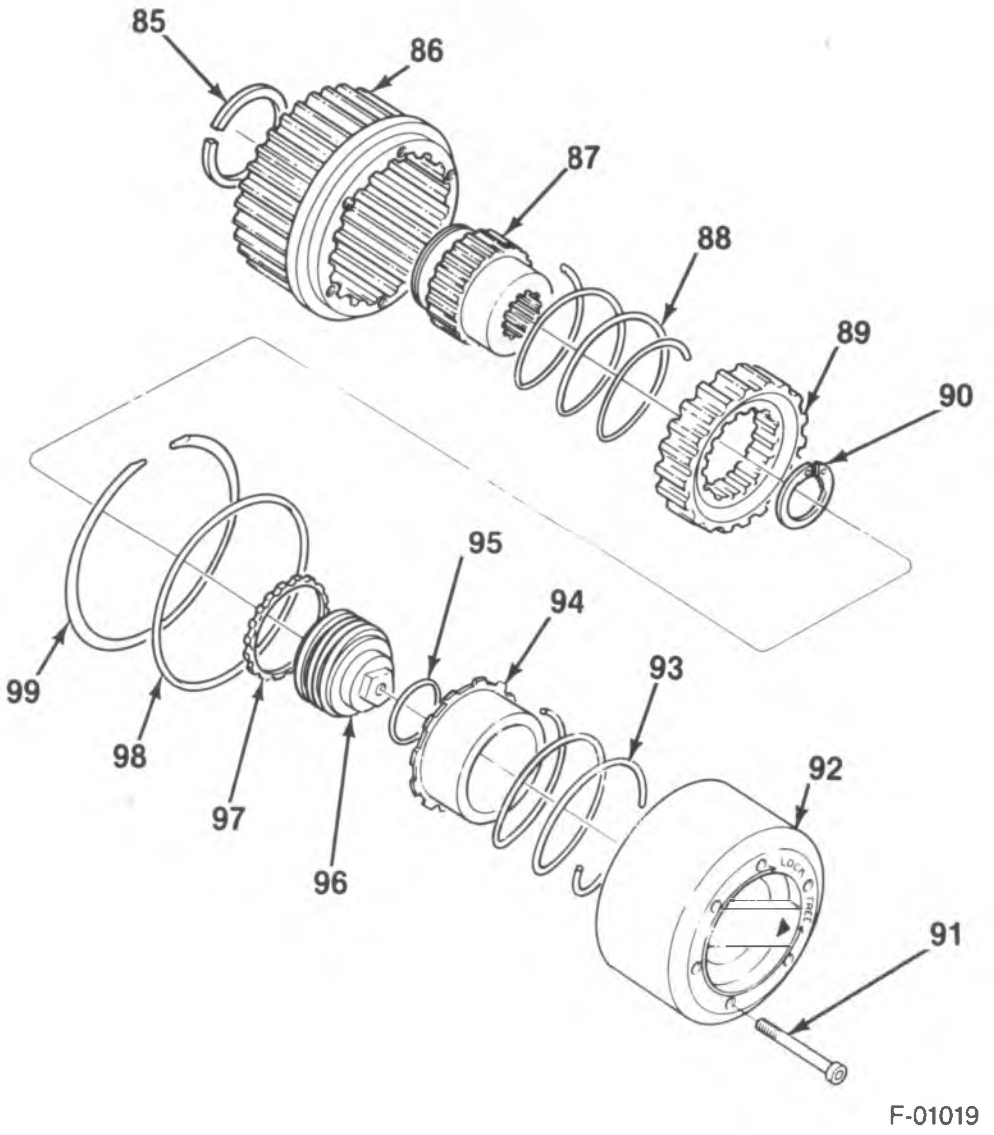
Inspect

- All parts and replace as necessary.

Install or Connect (Figure 5)

- Lubricate inner body parts with ATF or a light coat of wheel bearing grease.

1. Plastic sleeve.
2. Inner drive gear (87) with thrust washers.
3. Internal snap ring (85).
4. Spring (88).
5. Hub body (86).
6. Screws (91).



85. Internal Snap Ring
86. Hub Body
87. Inner Drive Gear
88. Spring
89. Clutch Ring
90. Axle Shaft Snap Ring
91. Screw
92. Hub Cap
93. Compression Spring
94. Clutch Cup
95. O-Ring Seal
96. Dial Screw
97. Clutch Nut
98. Seal
99. Lock Ring

Figure 5—Manual Locking Hub, K30

SPECIFICATIONS

Nut-Splash Shield Retaining		88 N·m	65 ft. lbs.
Nut With Pin	(Bearing Preload)	68 N·m	50 ft. lbs.
	(Final Torque)	47 N·m	35 ft. lbs.
Cover Screw-Automatic Hub		5.1 N·m	45 inch lbs.
Adjusting Nut-Axle Shaft		247 N·m	183 ft. lbs.

SPECIAL TOOLS

Snap Ring Plier
J-6893-D Wheel Bearing Nut Wrench

SECTION 5

BRAKES

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 NOTICE: See 'Notice' on page 5-1 of this section.

NOTICE: This fastener is an important attaching part in that it could affect the performance of vital components and system, 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.

CAUTION: When servicing wheel brake parts, do not create dust by grinding or sanding brake linings or by cleaning wheel brake parts with a dry brush or with compressed air. (A water dampened cloth should be used). Many wheel brake parts contain asbestos fibers which can become airborne if dust is created during servicing. Breathing dust containing asbestos fibers may cause serious bodily harm.

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BRAKE SYSTEM DIAGNOSIS

ROAD TESTING THE BRAKES

BRAKE TEST

The 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 the tires do not grip the road equally. The testing will be adversely affected if the roadway is crowned so as to throw the weight of the vehicle toward the wheels on one side or if the roadway is so rough that the wheels tend to bounce.

Test the brakes at different vehicle speeds with both light and heavy pressure; however, avoid locking the wheels and sliding the tires on the roadway. Locked wheels and sliding tires do not indicate brake efficiency since heavily braked turning wheels will stop the vehicle in less distance than locked wheels. More tire-to-road friction is present with a heavily braked turning tire than with a sliding tire.

EXTERNAL CONDITIONS THAT AFFECT BRAKE PERFORMANCE

1. **Tires**—Tires having unequal contact and grip on the road will cause unequal braking. The tires must be equally inflated and the tread pattern of the right and left tires must be about equal.
2. **Vehicle Loading**—When the vehicle has unequal loading, the most heavily loaded wheels require more braking power than the others.
3. **Front Wheel Bearings**—Loose front wheel bearings permit the disc to tilt and have spotty contact with the linings causing erratic action.
4. **Front End Alignment**—Misalignment of the front end, particularly in regard to limits on camber and caster, will cause the brakes to pull to one side.

HYDRO-BOOST SYSTEM TESTS

The Hydro-Boost system receives its source of power from the power steering system. Therefore a faulty power steering system may affect the operation of the booster, just as a problem in the booster may affect the steering system. Prior to performing any tests the following checks must be made.

1. Check all the power steering and brake pipe connections for leaks or restriction.

NOTICE: Power steering fluid and brake fluid cannot be mixed. If brake seals contact steering fluid or steering seals contact brake fluid, seal damage will result.

2. Check and fill the brake master cylinder with brake fluid.

3. Check and fill the power steering reservior with power steering fluid. If fluid contains air refer to POWER STEERING (Sec. 3B3) for further diagnosis.
4. Check power steering pump belt for wear and tension. Adjust if needed, refer to POWER STEERING (Sec. 3B3).
5. Check engine idle speed, refer to the vehicles Emission Control Information label for idle specifications.
6. Check steering pump pressure. Refer to POWER STEERING (Sec. 3B3).

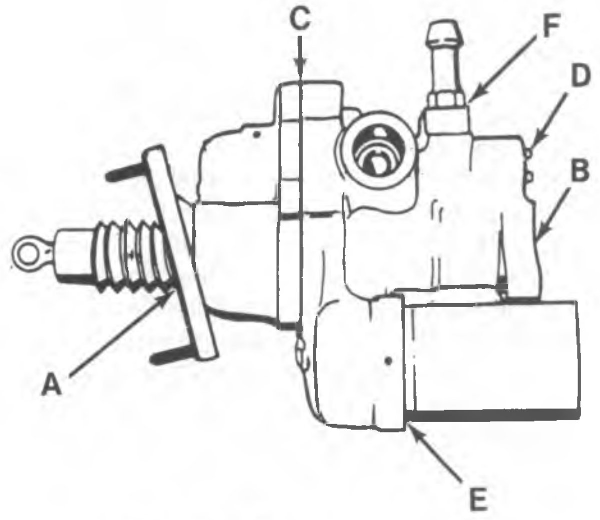
NOISE DIAGNOSIS

The following noises are associated with the Hydro-Boost and may or may not be cause for customer complaint. Some noises are normal and for the most part temporary in nature. Other noises may be a sign of excessive wear or the presence of air in either the booster or the steering system.

1. A moan or low frequency hum usually accompanied by a vibration in the pedal or steering column may be observed during parking maneuvers or other low speed maneuvers. This may be caused by a low fluid level in the power steering pump or by air in the fluid. Holding the pump at relief pressure (steering wheel held all the way in one direction) for more than five seconds will cause air to enter the system. Check the fluid level and fill if needed. The system must then sit for one hour to remove the air. If the condition persists, refer to POWER STEERING (Sec. 3B3).
2. A high speed fluid noise may be heard when the brake pedal is fully depressed, this condition is normal.
3. Whenever the accumulator pressure is used, a slight hiss may be noticed. It is the sound of the hydraulic fluid escaping through the accumulator valve, and is completely normal.
4. After the accumulator has been emptied, and the engine is started again, another hissing sound may be heard during the first brake application or the first steering maneuver. This is caused by the fluid rushing through the accumulator charging orifice. It is normal and will only be heard once after the accumulator is emptied. However, if this sound continues, even though no apparent accumulator pressure assist was made, it could be an indication that the accumulator is not holding pressure and should be checked using the procedure for the "Accumulator Leakdown Test" in this section.

BOOSTER FUNCTIONAL TEST

With the engine off, apply the brake pedal several times until the accumulator is completely depleted. Depress the brake pedal using 180 N (40 lbs.) of force and start the engine. The pedal will fall and then push back against your foot.



A. Input Rod Seal
B. Power Piston Seal
C. Housing Seal
D. Spool Valve Plug Seal
E. Accumulator Seal
F. Return Port Fitting

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Figure 1—Hydro-Boost Seal Leak Diagnosis

ACCUMULATOR LEAKDOWN TEST

1. Start the engine and charge the accumulator by applying the brake pedal or by turning the steering wheel from stop to stop. Turn off the engine and let the vehcile sit for one hour. After one hour there should be at least two power assisted applications with the engine off.
2. If the reserve system will not retain a charge for one hour, but functions normally immediately following charging, the accumulator valves are at fault and the booster must be disassembled and the accumulator valves replaced.
3. If the accumulator can be heard charging and discharging, but it does not hold a charge, disassemble the booster and replace the accumulator valves.
4. Deplete the accumulator by pressing the brake pedal several times. If the accumulator can has lost its gas charge, it is possible to rotate or wobble the accumulator can with respect to the housing. Replace the accumulator assembly.

SEAL LEAK DIAGNOSIS (FIGURE 1)

A. **INPUT ROD SEAL.** A damaged seal will show up as a fluid leak from the mounting bracket vent hole. The booster must be removed from the vehicle and disassembled. The input rod bore should be checked for any scratches that may cause the leak. If scratches are present, the housing cover must be replaced. If no excessive scratches are present, then the booster seal kit can be used to replace the appropriate seals.

B. **POWER PISTON SEAL.** Power piston seal damage will be noticed by fluid leaking out at the common master cylinder brake booster vent and possible reduction in power assist. The booster must be removed from the vehicle and disassembled. The piston should be checked for any scratches that may be the cause of the leak. If scratches are present, then the booster seal kit can be used to replace the appropriate seals.

C. **HOUSING SEAL.** If the housing seal is damaged, fluid will leak out from between the two housings. The booster must be removed from the vehicle and disassembled. The booster seal kit should be used to replace the housing and input rod and power piston seals.

D. **SPOOL VALVE PLUG SEAL.** Damage to this seal will be noticed by fluid leaking out past the plug. The booster need not be removed from the vehicle.

E. **ACCUMULATOR SEAL.** Damage to this seal will result in fluid leakage past the accumulator cap. The seal can be replaced while the booster is installed on the vehicle.

F. **RETURN PORT FITTING.** Tighten the fitting to 10 N·m (7 ft. lbs.). If the leak continues, replace the seal ring under the fitting.

DIAGNOSIS OF BRAKE SYSTEM

PROBLEM	POSSIBLE CAUSE	CORRECTION
Uneven Brake Action (Brakes Pull).	1. Incorrect tire pressure.	1. Inflate evenly on both sides to manufacturer's specifictions.
	2. Front end out of alignment.	2. Check and align to manufacturer's specifications.
	3. Loose suspension parts.	3. Check all suspension mountings.
	4. Worn out brake lining.	4. Replace with lining of correct material.
	5. Incorrect lining material.	5. Replace with linings of correct material.
	6. Malfunctioning caliper assembly.	6. Check for frozen or sluggish pistons and the lubrication of the retainer bolts. Caliper should slide.
	7. Loose calipers.	7. Check and torque.
	8. Contaminated brake linings.	8. Repair as necessary. Replace linings in complete axle sets.
	9. Malfunctioning rear brakes.	9. Check for inoperative self adjusters. Weak return springs. Leaking wheel cylinders.
	10. Leaking wheel or piston cylinder seal.	10. Repair as necessary.
	11. Restricted brake tubes or hoses.	11. Check for collapsed rubber hoses or damaged lines. Repair as necessary.
	12. Unmatched tires on the same axle.	12. Same style tires with about the same tread should be used on the same axle.

DIAGNOSIS OF BRAKE SYSTEM (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Brakes Squeak.	1. Worn out linings. 2. Glazed brake lining. 3. Heat spotted rotors or drums. 4. Weak or incorrect brake shoe retention springs. 5. Contaminated brake linings. 6. Incorrect lining material. 7. Brake assembly attachments missing or loose. 8. Excessive brake lining dust.	1. Replace linings. 2. Replace linings. 3. Check per instructions. If within specifications machine the rotor or drum. 4. Replace with new retention springs. 5. Repair as necessary. Replace linings in complete axle sets. 6. Replace with linings of correct material. 7. Repair as necessary. 8. Clean dust from brake assembly.
Brake Pedal Pulsates.	1. Excessive rotor lateral runout. 2. Rear drums out of round. 3. Heat spotted rotors or drums. 4. Incorrect wheel bearing adjustments. 5. Out of balance wheel assembly attachments missing or loose. 6. Brake assembly attachments missing or loose.	1. Check per instructions. If within specifications machine the rotor. 2. Check per instructions. If within specifications machine the drum. 3. Check per instructions. If within specifications machine the rotor or drum. 4. Repair as necessary. 5. Repair as necesary. 6. Repair as necessary.
Excessive Pedal Effort.	1. Leaking vacuum system. 2. Malfunctioning power brake unit. 3. Worn out linings. 4. Malfunctioning proportioning valve. 5. Incorrect lining material. 6. Incorrect wheel cylinder.	1. Repair as necessary. 2. Repair as necessary. 3. Replace linings. 4. Repair as necessary. 5. Replace with linings of correct materials. 6. Replace with corrrect size wheel cylinder.
Excessive Pedal Travel.	1. Insufficient fluid in master cylinder reservoir. 2. Air in brake system. 3. Malfunctioning self adjusters. 4. Master cylinder. 5. Incorrect wheel bearing adjustment. 6. Improperly adjusted master cylinder pushrod.	1. Fill reservoir with approved brake fluid. Check for leaks and air in the system. Check tell-tale light. 2. Check for leaks in lines, wheel cylinders, or master cylinder. Bleed the system. 3. Repair as necessary. 4. Replace or repair as necessary. 5. Repair as necessary. 6. Adjust master cylinder pushrod.

DIAGNOSIS OF BRAKE SYSTEM (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Brakes Drag.	1. Malfunctioning caliper assembly.	1. Check for frozen or sluggish pistons and the lubrication of the retainer bolts. Caliper should slide.
	2. Contaminated or improper brake fluid.	2. Repair as necessary.
	3. Improperly adjusted parking brakes.	3. Repair as necessary.
	4. Restricted brake tube or hoses.	4. Check for collapsed rubber hoses or damaged lines. Repair as necessary.
	5. Malfunctioning proportioning valve.	5. Replace or repair as necessary.
	6. Malfunctioning self adjusters.	6. Repair as necessary.
	7. Malfunctioning master cylinder.	7. Repair as necessary.
	8. Improperly adjusted master cylinder pushrod.	8. Adjust pushrod length.
Brake tell-tale light comes on.	1. Air in the brake system.	1. Check fluid level. Check for leaks in lines, wheel cylinders, or master cylinder. Bleed the system.
	2. Malfunctioning master cylinder.	2. Check for faulty metering valve, or leaking. Repair as necessary.
	3. Contaminated or improper brake fluid.	3. Repair as necessary.
	4. Parking brake on or not fully released.	4. Check parking brake. Repair as necessary.
	5. Worn out brake lining.	5. Replace linings.
	6. Incorrect wheel bearing adjustment.	6. Repair as necessary.
	7. Malfunctioning self adjusters.	7. Repair as necessary.
	8. Brake assembly attachments missing or loose.	8. Replace or repair as necessary.
	9. Improperly adjusted master cylinder pushrod.	9. Adjust pushrod length.
Excessive Brake Pedal Effort.	1. Loose or broken power steering pump belt.	1. Tighten or replace the belt.
	2. No fluid in the power steering reservoir.	2. Fill reservoir and check for external leaks.
	3. Leaks at Hydro-Boost tube fittings.	3. Tighten fittings or replace tube seats, if faulty.
	4. External leakage at the accumulator.	4. Replace seal and retainer.
	5. Faulty booster piston seal causing leakage at the booster flange vent.	5. Overhaul with new seal or input rod and piston assembly.
	6. Faulty booster input rod seal with leakage at the input rod end.	6. Overhaul with new seal kit.
	7. Fautly booster cover seal with leakage between the housing and cover.	7. Overhaul with new seal kit.
	8. Fautly booster spool plug seal.	8. Overhaul with spool plug seal kit.

DIAGNOSIS OF HYDRO-BOOST SYSTEM

PROBLEM	POSSIBLE CAUSE	CORRECTION
Slow Brake Pedal Return.	1. Excessive seal friction in booster. 2. Faulty spool action. 3. Restriction in return line from booster to pump reservoir. 4. Damaged input rod end.	1. Overhaul with new seal kit. 2. Flush steering system while pumping brake pedal. 3. Replace line. 4. Replace input rod and piston assembly.
Grabby Brakes. **Booster Chatters - Pedal Vibrates.**	1. Faulty spool action caused by contamination in system. 2. Power steering pump belt slips. 3. Low fluid level in power steering pump. 4. Faulty spool operation caused by contamination in system.	1. Flush steering system while pumping brake pedal. 2. Tighten belt. 3. Fill reservoir and check for external leaks. 4. Flush steering system while pumping brake pedal.
Accumulator Leak-down System does not hold charge.	1. Contamination in steering hydro-boost system. 2. Internal leakage in accumulator system.	1. Flush steering system while pumping brake pedal. 2. Overhaul unit using accumulator rebuild kit and seal kit.

ON VEHICLE SERVICE

BLEEDING THE BRAKE HYDRAULIC SYSTEM

A bleeding operation is necessary if air has been introduced into the hydraulic brake system.

It may be necessary to bleed the system at all four wheels if air has been introduced by a low fluid level condition in the master cylinder. Also if the brake pipes have been disconnected at either the master cylinder or the combination valve. If a pipe is disconnected at one wheel, then only bleed that particular wheel.

The time required to bleed the hydraulic system when the master cylinder is removed can be reduced if the master cylinder is filled with fluid and as much air as possible is bled from the cylinder before installing it on the vehicle.

MANUAL BLEEDING

If the vehicle is equipped with power brakes, deplete the vacuum reserve by applying the brakes several times with the engine off.

Use extreme care to prevent brake fluid from contacting any painted surface.

1. Fill the master cylinder reservoirs with brake fluid specified in MAINTENANCE AND LUBRICATION (Sec. OB).
    - Maintain the fluid level in the reservoir during the bleeding operation.
2. If the master cylinder is suspected to have air in the bore, it must be bled before any wheel cylinder or caliper.
    - Remove the forward brake pipe connection at the master cylinder.
    - Allow brake fluid to flow from the connector port.
    - Connect the brake pipe but do not tighten.
3. Slowly depress the brake pedal allowing the air to bleed from the loose fitting.
    - Tighten the fitting before releasing the pedal.
    - Wait 15 seconds, and repeat this sequence, including the 15 second wait until all the air is purged from the bore.
4. After all the air has been removed from the forward connection disconnect the rear pipe.
    - Allow brake fluid to flow from the connector port.
    - Connect the brake pipe but do not tighten.
5. Slowly depress the brake pedal allowing the air to bleed from the loose fitting.
    - Tighten the fitting before releasing the pedal.
    - Wait 15 seconds, and repeat this sequence, including the 15 second wait until all the air is purged from the bore.
6. If it is known that the calipers and wheel cylinders do not contain any air, then it will not be necessary to continue. Otherwise bleed each wheel in the following sequences.
    - Right rear
    - Left rear
    - Right front.
    - Left front
7. Attach a hose to the wheel cylinder/caliper bleeder screw.
    - Immerse the opposite end of the hose into a container partially filled with clean brake fluid.
8. Slowly depress the brake pedal one time and hold.
    - Loosen the bleeder screw to purge the air from the wheel cylinder/caliper.
    - Tighten the bleeder screw and slowly release the pedal.
    - Wait 15 seconds, then repeat this sequence, including the 15 second wait until all the air is purged from the wheel cylinder/caliper.
9. Continue steps 7 and 8 at each wheel until the entire brake system has been bled.
10. Check the brake pedal for "sponginess" and the brake warning lamp for an indication of an unbalanced pressure. Repeat the entire bleeding procedure to correct either of these two conditions.

PRESSURE BLEEDING

The pressure bleeding equipment must be of the diaphragm type. It must have a rubber diaphragm between the air supply and the brake fluid to prevent air, moisture, oil, and other contaminants from entering the hydraulic system. Also adapters are needed. depending on the type of master cylinder used.

Tools Required:

J-29567 Brake Bleeder Adapter (Plastic Reservoir)

J-23518-01 Brake Bleeder Adapter (Cast Iron Reservoir)

J-23709 Combination Valve Depressor

NOTICE: It is very important that the correct master cylinder bleeder adapter be used to avoid possible damage to the master cylinder reservoir.

1. Fill the pressure tank at least 1/3 full of brake fluid. The bleeder must be re-bled each time fluid is added.
    - Charge the bleeder to 140 - 170 kPa (20 to 25 psi).

2. Use J-23709 to depress and hold the valve stem on the combination valve during the bleeding operation (figure 2).
   - Install the correct bleeder adapter (figures 3 and 4).
3. Bleed each wheel in the following sequence.
   - Right rear
   - Left rear
   - Right front
   - Left front
4. Connect the hose from the bleeder to the adapter at the master cylinder.
   - Open the tank valve.
5. Attach a hose to a brake bleeder screw.
   - Immerse the opposite end of the hose into a container partially filled with clean brake fluid.
6. Open the bleeder screw at least 3/4 of a turn and allow the fluid to flow until no air is seen in the fluid.
   - Close the bleeder screw.
7. Repeat step six at all the wheels.
8. Check the brake pedal for "sponginess", repeat the entire bleeding procedure if this condition is found.
9. Remove J-23709.
   - Disconnect the line form the bleeder adapter.
   - Remove bleeder adapter.
10. Fill the master cylinder to the proper level with brake fluid.

FLUSHING THE BRAKE HYDRAULIC SYSTEM

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

Flushing is also recommended if there is any doubt as to the grade of fluid in the system or if fluid has been used which contains the slightest trace of mineral oil. Flush the system whenever there is any question of contamination.

Flushing is performed at each bleeder valve in the same manner as the bleeding operation, except that the bleeder valve is opened 1½ turns and the fluid is forced through the lines and bleeder valves until it emerges clear in color. Refer to "Bleeding the Brake Hydraulic System", in this section.

Check master cylinder fluid level after flushing at each valve and replenish if required. When flushing is completed at all bleeder valves, make certain the master cylinder reservoir is filled to proper level.

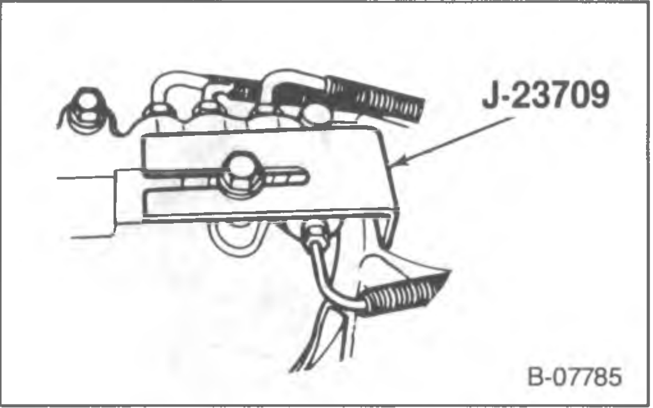


Figure 2—Installing Combination Valve Depressor

BRAKE PIPES AND HOSES

The hydraulic brake system components are interconnected by special steel piping and flexible hoses. Flexible hoses are used between the frame and the front calipers, and the frame and rear differential. When the hydraulic pipes have been disconnected for any reason, the brake system must be bled after reconnecting the pipe, refer to "Bleeding the Brake Hydraulic System" in this section.

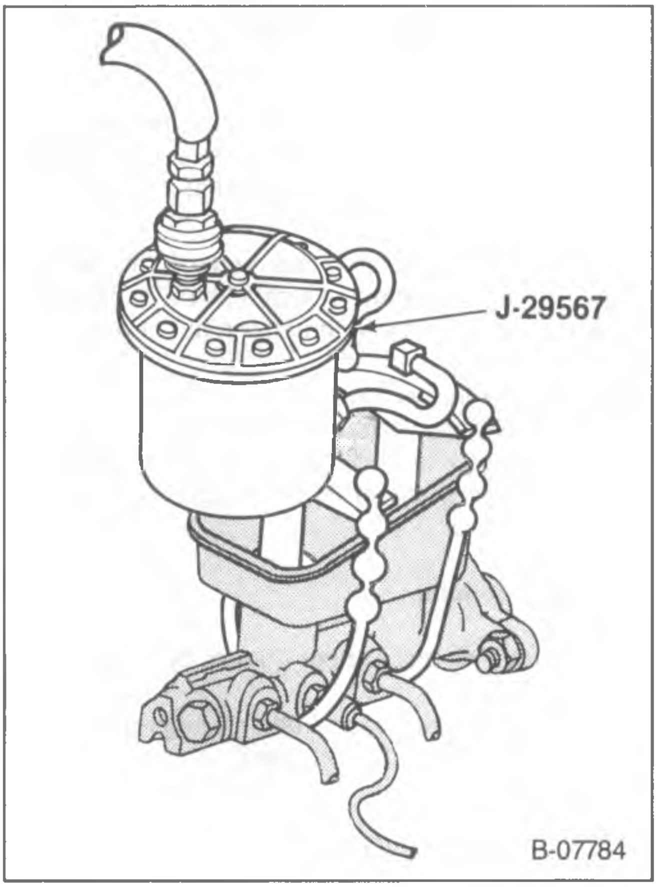


Figure 3—Plastic Reservoir Bleeder Adapter

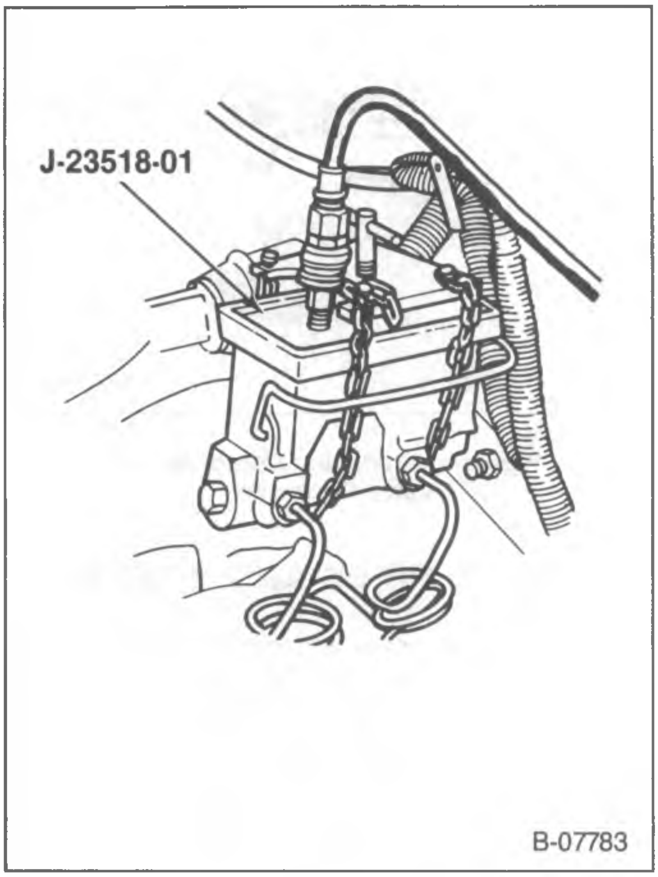


Figure 4—Cast Iron Reservoir Bleeder Adapter

FLEXIBLE HOSE

On the front brakes the hose is connected to the caliper with a bolt and copper washers. The fitting at the other end of the hose is secured at the frame with either a nut or a clip.

At the rear differential one end of the hose is connected to the differential with a bolt. The other end is secured at the frame with either a nut or a clip.

Flexible Hose Inspeciton

The flexible hoses should be inspected for any signs of road damage which will cause cracks and chafing of the other cover. If any of these conditions are visible, replace the hose.

Hose Replacement

←→ Remove or Disconnect (Figure 5)

- Clean dirt, grease, and other foreign material off the hose fittings at both ends.

1. Steel pipe.
    - Clip or nut (31).
2. Bolt (34).
    - Washers (33).
    - Hose (32).

→← Install or Connect (Figure 5)

- Use new copper washers when installing the hose.

1. Hose (32).
    - The hose must not be twisted.
2. Washers (33).
    - Bolt (34).
3. Clip or nut (31).
    - Steel pipe.
4. Bleed the brakes, refer to "Bleeding the Brake Hydraulic System" in this section.

! Important

- The hose installation must not contact any suspension components.

BRAKE PIPES

When replacing a steel brake pipe, always use steel piping which is designed to withstand high pressure and resist corrosion. The same size pipe must be used as the one removed.

NOTICE: Never use copper tubing for hydraulic brake lines because copper is subject to fatique cracking, and corrosion which could result in brake failure.

Brake pipes that run parallel to each other must maintain a 6 mm (1/4-inch) clearance.

Pipe Flaring (Figure 6)

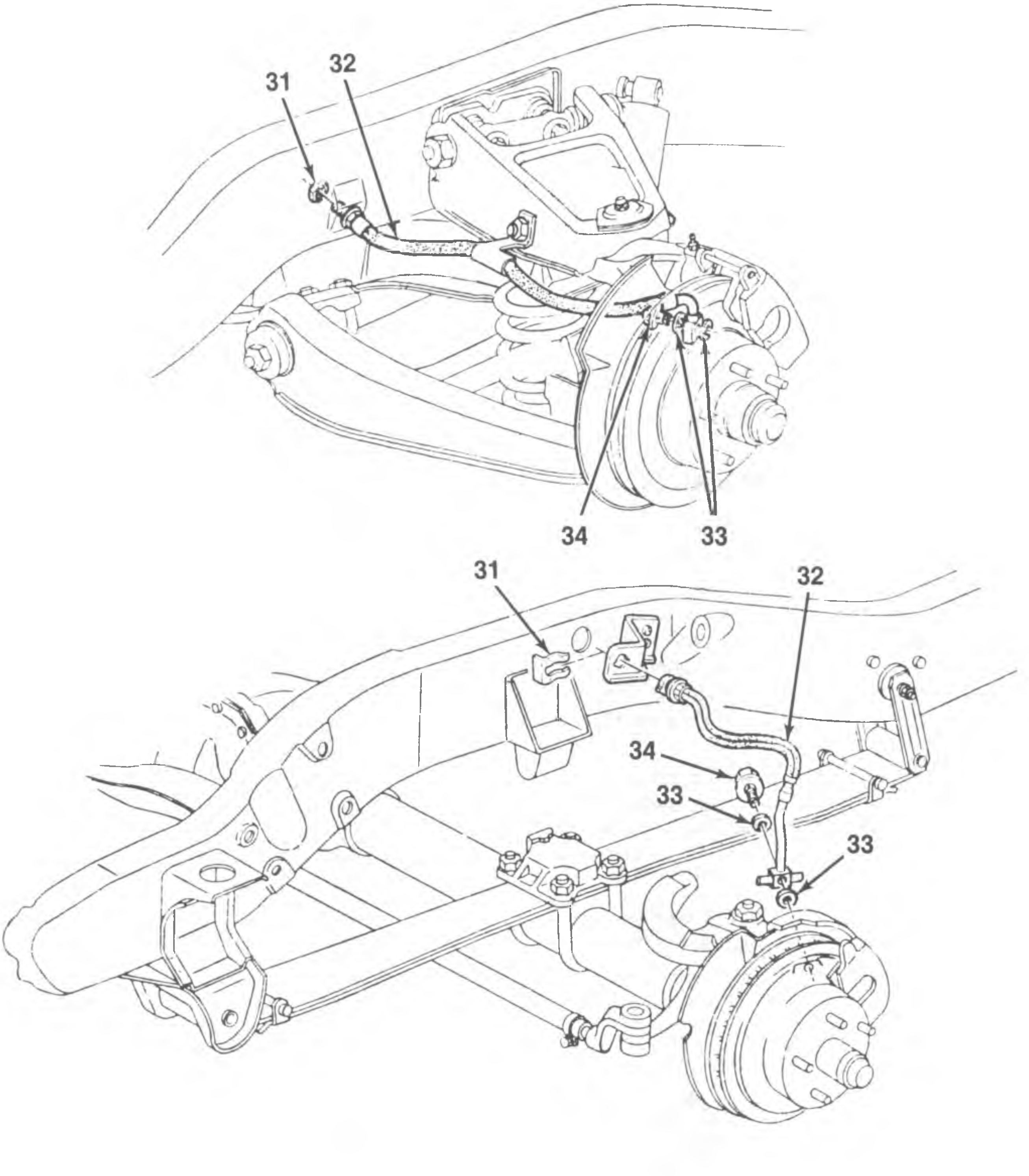
Tools Required:

J-23530 Flaring Tool.
J-23533-B Tube Cutter.

In order to ensure a proper flare, a special flaring tool must be used. When using the tool, instruction furnished by the tool manufacturer should be followed. Always inspect newly formed flares for cracks or malformations which might cause leaks. After flaring, blow out the brake pipe with compressed air before installing on the vehicle.

NOTICE: Double lap flaring tool must be used, as single flaring tools cannot produce a flare strong enough to hold the necessary pressure.

1. Use steel pipe and fittings of the correct size. The outside diameter of the pipe is used to specify the size.
2. Cut the pipe to length. Add 3 mm (1/8-inch) to the length for each flare.
3. Flare the pipe ends by following the instructions with the tool.
4. Bend the pipe to match the old pipe by using a pipe bender.



31. Nut or Clip
32. Flex Hose
33. Washer
34. Bolt

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Figure 5—Flexible Hoses

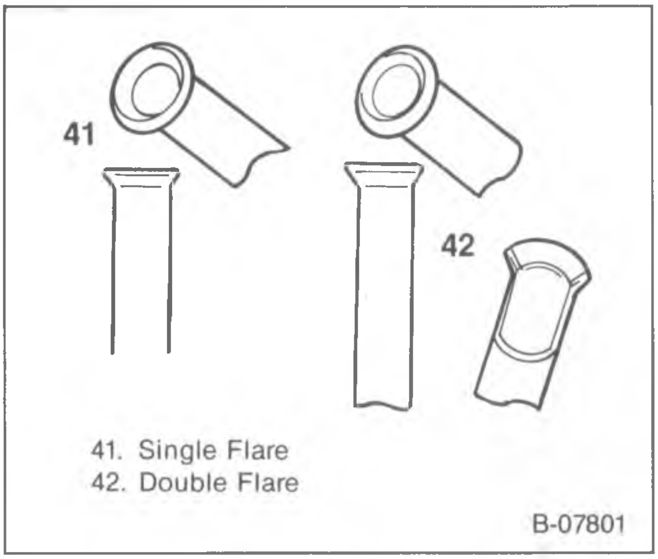


Figure 6—Double Flare

COMBINATION VALVE

The combination valve is comprised of three sections, each serving a different function (figure 7).

The metering or hold off section of the valve limits the pressure to the front disc brakes until a predetermined front input pressure is reached, enough to overcome the rear shoe retractor springs. There is no restriction to the inlet pressures below 20 kPa (3 psi) to allow for pressure equalization during the no apply periods.

The proportioning section of the combination valve proportions outlet pressure to the rear brakes after a predetermined rear input pressure has been reached. This is done to prevent rear wheel lock-up on the vehicles with light rear wheel loads.

The valve is designed to have a By-Pass feature which assures full system pressure to the rear brakes in the event of a front brake system malfunction, also full front pressure is retained in the event of rear malfunction.

The pressure differential warning switch is designed to constantly compare front and rear brake pressure from the master cylinder and energize the warning lamp on the dash in the event of a front or rear system malfunction. The valve and switch are so designed that the switch will latch in the "warning" position once a malfunction has occured. The only way the lamp can be turned off is to repair the malfunction and apply a pedal force as required to develop about 3102 kPa (450 psi) line pressure.

ELECTRICAL CIRCUIT TEST

1. Disconnect the wire from the switch on the valve.
   - Connect a jumper wire from the switch wire to ground.
2. Turn the ignition key to "ON".
   - The warning lamp should light.
   - If the lamp will not light check the bulb. If the bulb is good, refer to CHASSIS ELECTRICAL (Sec. 8B) for futher diagnosis.
3. Turn the ignition off.
   - Disconnect jumper wire and connect the wire to the switch terminal.

Valve Warning Switch Test

1. Raise the vehicle.
   - Support with suitable safety stands.
2. Attach a hose to a rear brake bleeder screw.
   - Immerse the opposite end of the hose into a container partially filled with clean brake fluid.

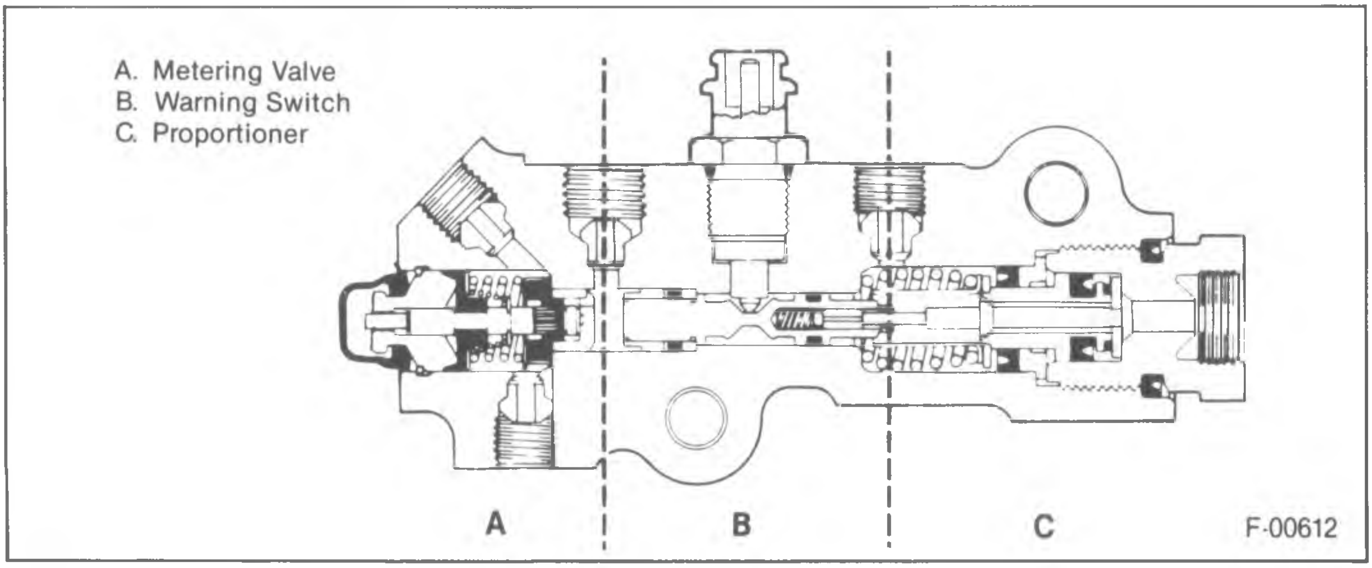


Figure 7—Combination Valve

  - Make sure the master cylinder reservoir is full.
3. Turn the ignition key to "ON".
   - Open the bleeder screw while a helper applies moderate pressure to the brake pedal.
   - The warning lamp should light.
   - Close the bleeder screw before the helper releases the brake pedal.
4. Reapply the brake pedal with moderate to heavy pressure.
   - The lamp should go out.
5. Attach a hose to a front brake bleeder screw.
   - Immerse the opposite end of the hose into a container partially filled with clean brake fluid.
   - Make sure the master cylinder reservoir is full.
6. Open the bleeder screw while a helper applies moderate pressure to the brake pedal.
   - The warning lamp should light.
   - Close the bleeder screw before the helper releases the brake pedal.
7. Reapply the brake pedal with moderate to heavy pressure.
   - The lamp should go out.
8. Turn the ignition key off.
   - If the warning lamp does not light during steps 3 and 6 but does light when a jumper is connected to ground, the warning switch portion of the valve is faulty. Do not disassemble any portion of the valve. It must be replaced.
9. Remove the safety stands.
   - Lower the vehicle.
   - Check and fill the master cylinder to the proper level.

VALVE REPLACEMENT

↔ Remove or Disconnect (Figure 8)

- The combination valve is not repairable and must be replaced as a complete assembly.
- Care must be taken to prevent brake fluid from contacting any painted surface.

1. Hydraulic pipes.
   - Plug the pipes to prevent the loss of fluid or the entrance of dirt.
2. Warning switch harness.
3. Bolts.
   - Combination valve.

→← Install or Connect (Figure 8)

1. Position valve on the bracket.
   - Bolts.
2. Warning switch harness.
3. Hydraulic pipes.
4. Bleed the brake system. Refer to "Bleeding The Brake Hydraulic System" in this section.

HEIGHT SENSING BRAKE PROPORTIONING VALVE

The height sensing brake proportioning valve is used on series 30 models (figure 9). This will provide optimum brake balance and efficiency. The vehicle braking force is distributed to the front and rear wheels as determined by either a light or heavy payload condition.

The valve is mounted on the frame, and a linkage connects the valve to a bracket that is mounted on the axle.

CAUTION: Adding any suspension accessories or other equipment (such as load leveling kits, air shocks, suspension lift kits, additional spring leafs, etc.), or making modification that will change the distance between the axle and the frame without changing the load, will provide a false reading to the brake proportioning valve. This could result in unsatisfactory brake performance which in turn could result in an accident and possibly personal injury.

VALVE REPLACEMENT

↔ Remove or Disconnect (Figure 10)

- Raise the vehicle.
- Support the frame with suitable safety stands. The axle must be allowed to hang free.
- Clean the exterior of the valve to prevent dirt from contaminating the hydraulic system.

1. Brake pipes (51).
2. Nut from the shaft (48).
   - Lever (49).
3. Bolts (46) and washers (47).
   - Valve (50).

→← Install or Connect (Figure 10).

1. Position the valve on the mounting bracket.
   - Washer (47) and bolts (46).
2. Lever (49).
   - Refer to "Proportioning Valve Adjustment" in this section.
3. Nut (48). Torque to 10 N·m (89 in. lbs.).
4. Brake pipes (51).
5. Bleed brakes. Refer to "Bleeding the Brake Hydraulic System", in this section.
6. Remove the safety stands.
   - Lower the vehicle.
   - Test the brakes.

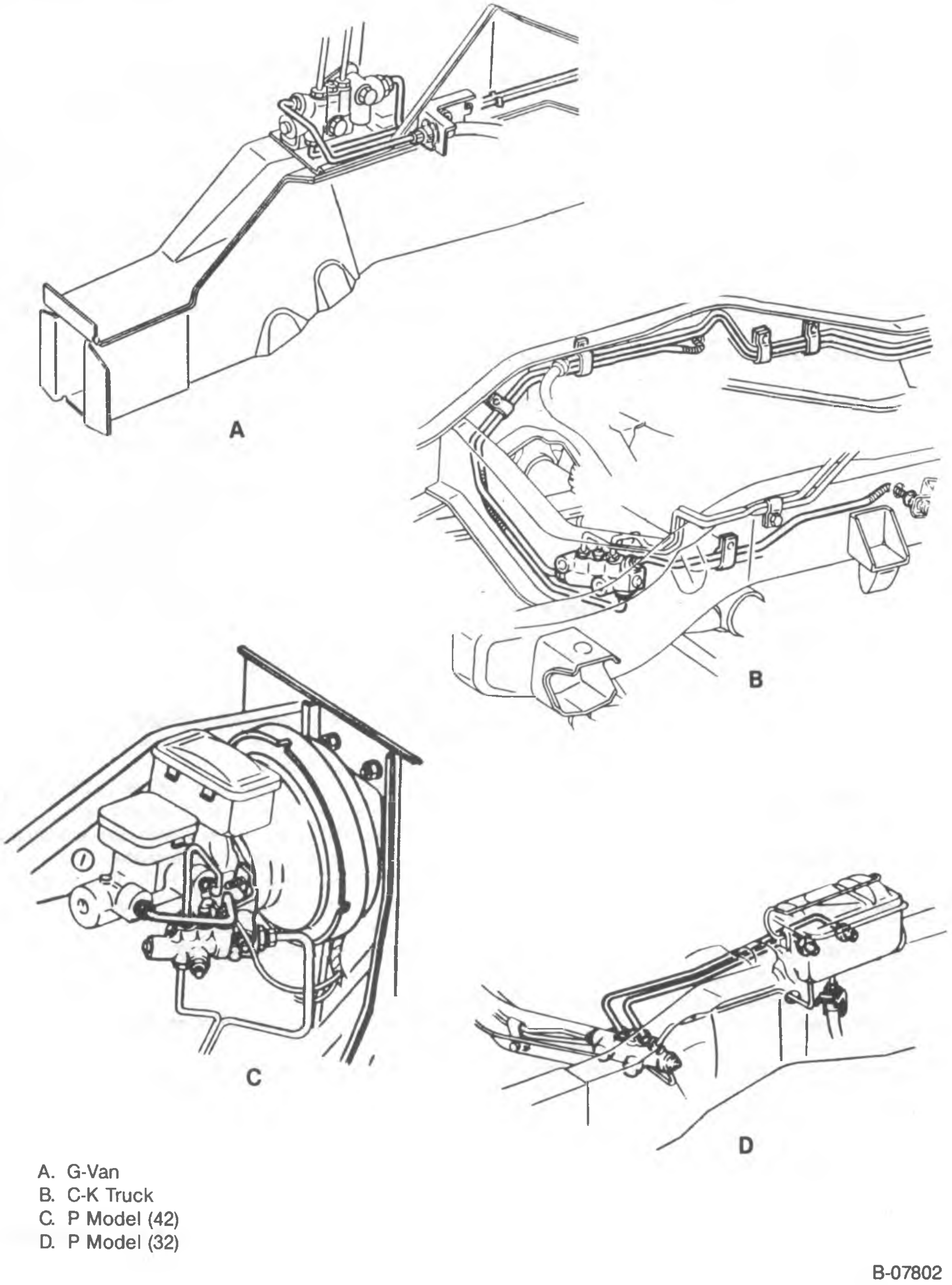


Figure 8—Combination Valves

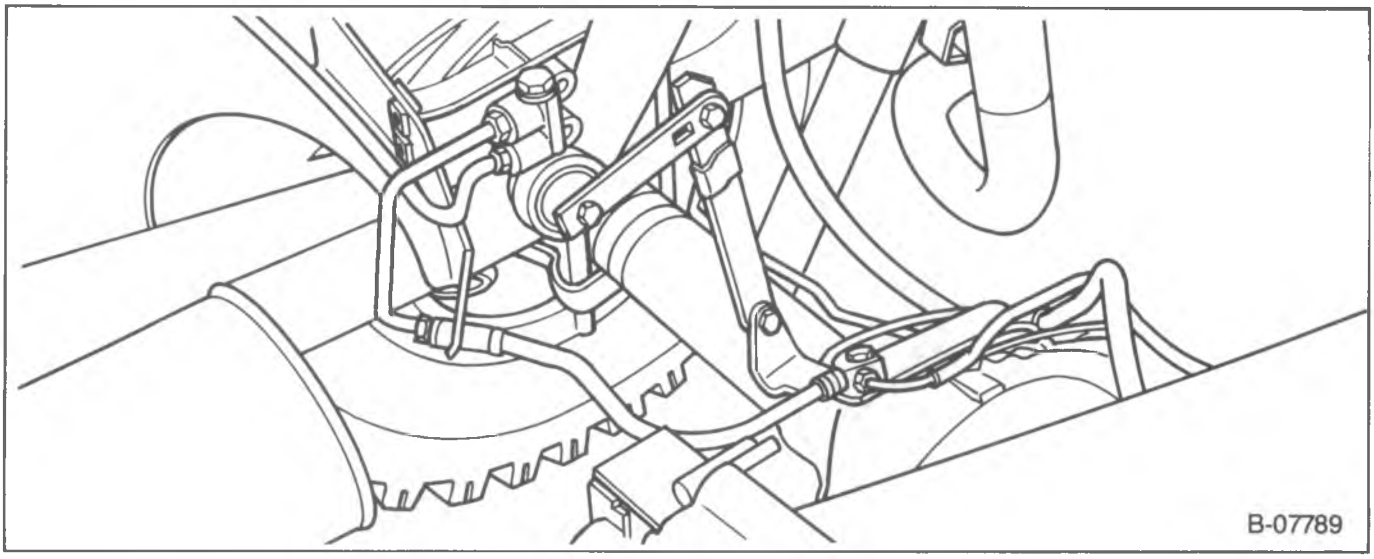


Figure 9—Height Sensing Proportioning Valve

PROPORTIONING VALVE ADJUSTMENT

If a front wheel lockup is experienced when the vehicle is being operated near the maximum GVWR with a lower than desired brake application, the valve adjustment should be checked. Use the following procedure to check the adjustment.

1. Raise the vehicle.
   - Support the frame with suitable safety stands. The axle must be allowed to hang free.
2. Remove the nut from the valve shaft.
   - Remove the lever.
3. Select the appropriate adjustment gage from the chart.

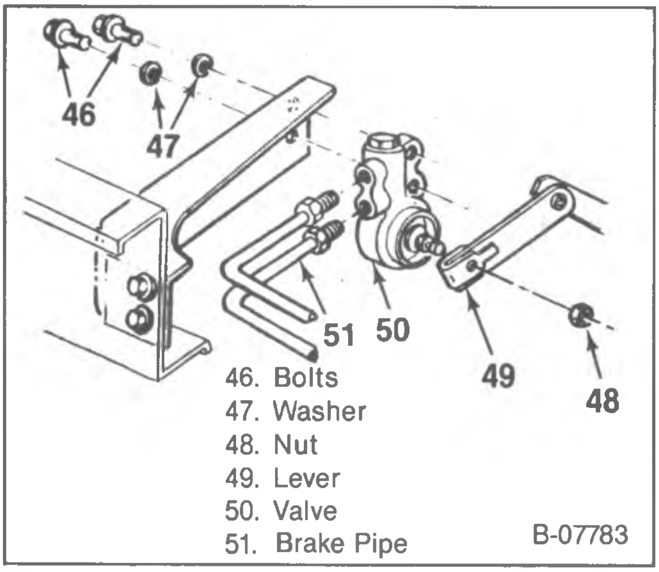


Figure 10—Removing Proportioning Valve

ADJUSTMENT GAGE CHART

Part Number	Code Color	Vehicle Combination
14061394	A Green	C/K 3500 with G52
14061395	B Black	C3500 Less G52 C2500 all K 20903 G31305/06 with LE3/LS9
14061396	C Blue	K3500 Less G52 K20906 G31305/06 with LLA/LT9

RPO G52: Extra Capacity Rear Spring
RPO LS9: 5.7 Liter (Cal. Only)
RPO LL4: 6.2 Liter
RPO LT9: 5.7 Liter

4. Rotate the valve shaft to permit the installation of the adjustment gage (figure 11).
   - The center hole of the adjustment gage must seat on the "D" shape of the valve shaft.
   - The gage tang must seat in the valve mounting hole.

NOTICE: Do not drive lever assembly on valve shaft by using nut or proper valve setting may be disturbed.

5. Install the nut on the shaft. Torque to 10 N·m (89 in. lbs.)
6. Sever the tang on the adjustment gage (figure 12).
7. Remove the safety stands.
   - Lower the vehicle.
   - Test the brakes.

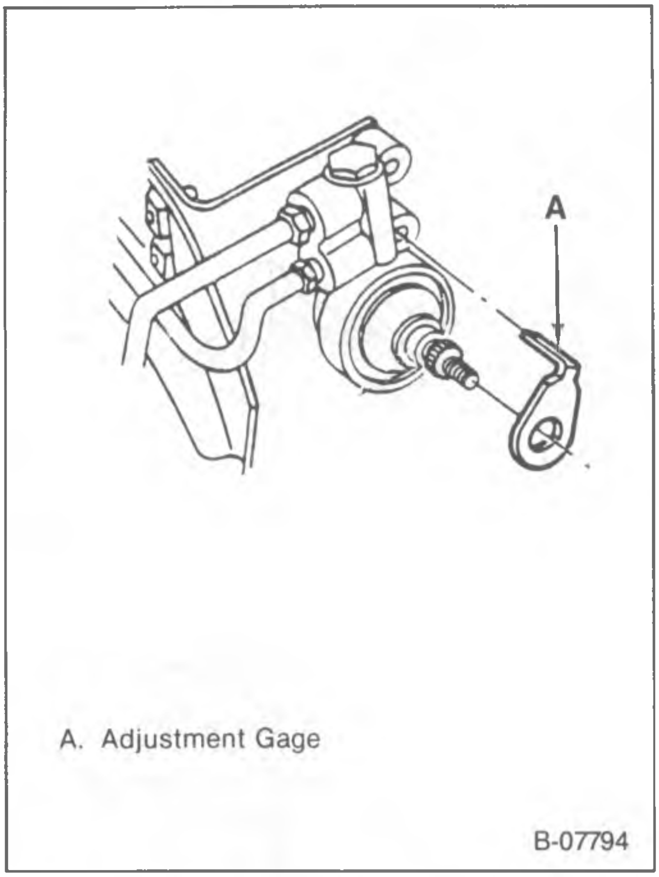


Figure 11—Installing Adjustment Gage

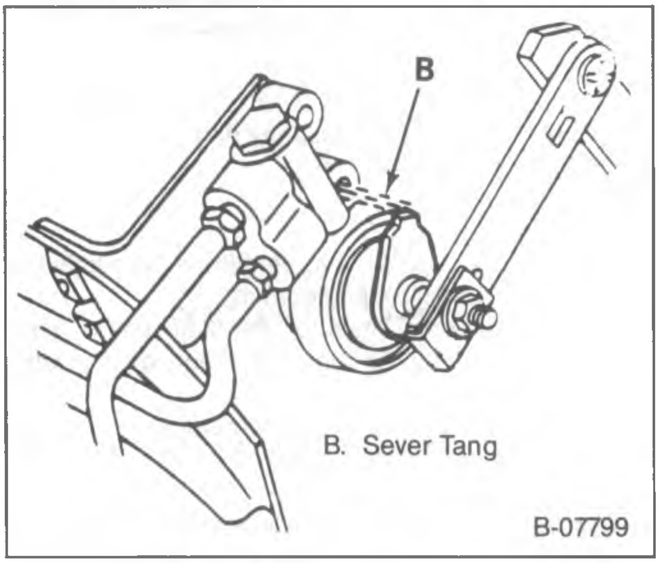


Figure 12—Severing The Adjustment Tang

BRAKE PEDAL ASSEMBLY

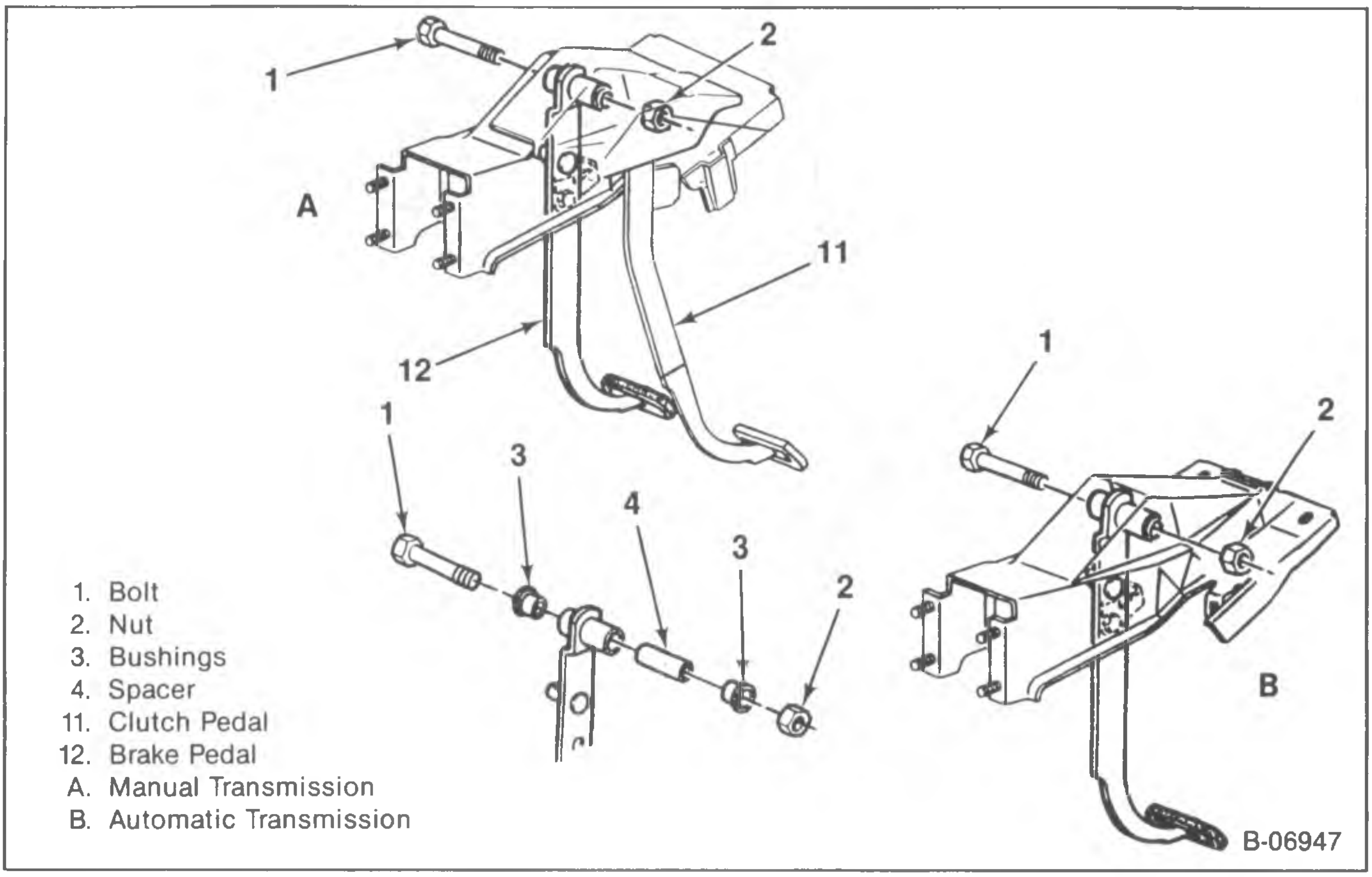


Figure 13—C-K Brake Pedal Components

CHECKING PEDAL TRAVEL

At frequent intervals the brake pedal should be checked for travel. Travel is the distance the pedal moves toward the floor from a full released position. This check should be made with the brakes cold and about 122 N (90 lbs.) of force on the pedal. On vehicles with power brakes the pedal must be pumped at least three times with the engine off before making the check. Follow the specifications below for the correct travel.

C-K-G Manual	115 mm (4.5-inches)
C-K-G Power	90 mm (3.5-inches)
P (Except JF9)	90 mm (3.5-inches)
P (JF9)	150 mm (6.0-inches)

BRAKE PEDAL REPLACEMENT

C-K AND P30 (32) MODELS

Remove or Disconnect (Figures 13 and 14)

1. Retainer (6).
    - Washer (7).
    - Pin (10) and washer (9).
    - Pushrod (8).
    - Return spring (5).
2. Nut (2) and bolt (1).
3. Brake pedal (12).
    - Clutch pedal (11) (if equipped).
    - Bushings (3).
    - Spacer (4).

Install or Connect (Figures 13 and 14)

1. Spacer (4).
    - Bushings (3).
    - Brake pedal (12).
    - Clutch pedal (11) (if equipped).

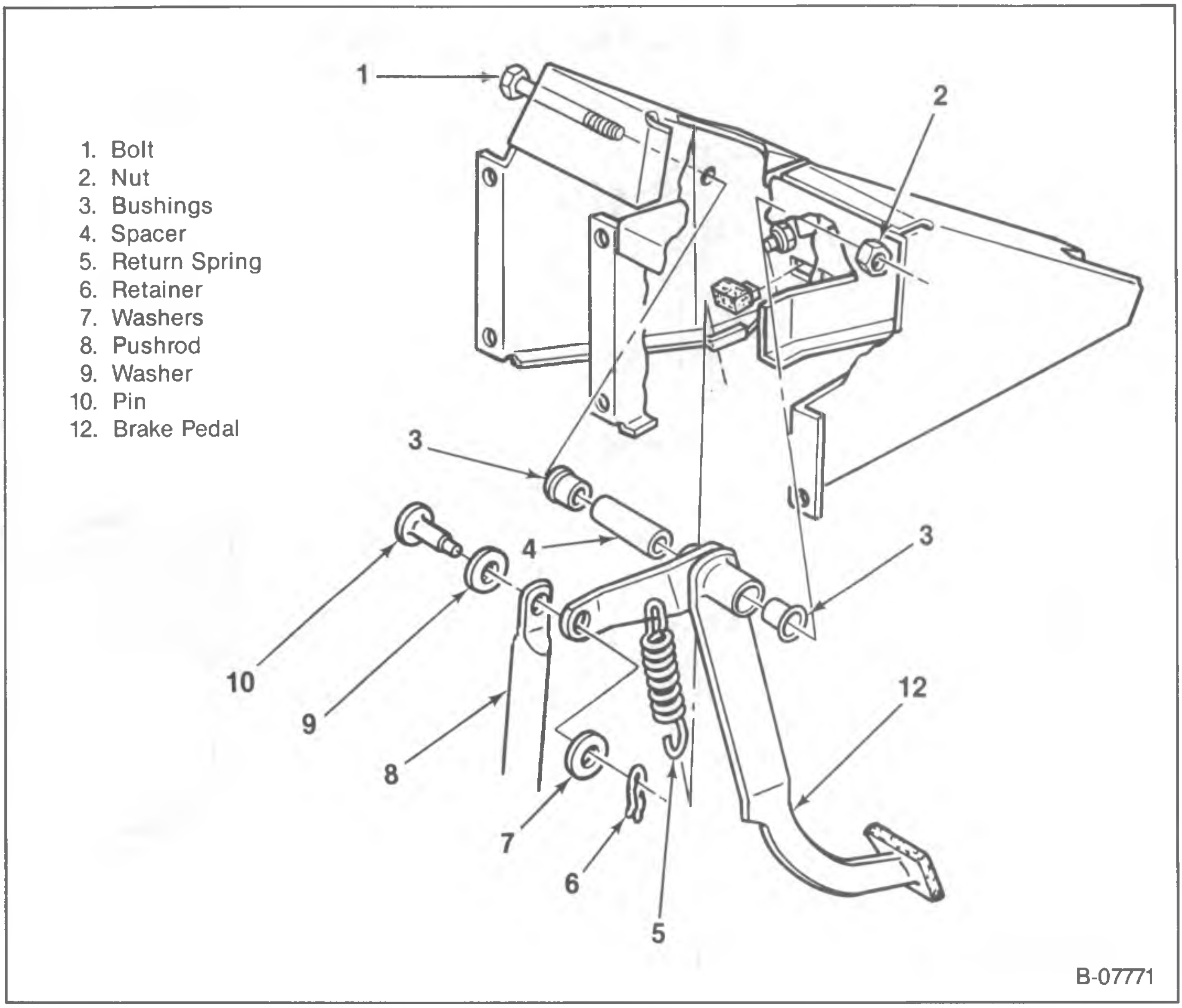
NOTICE: See "Notice" on page 5-1 of this section.

2. Bolt (1) and nut (2).

Tighten

- Nut to 34 N·m (25 ft. lbs.)

3. Return spring (5).



1. Bolt
2. Nut
3. Bushings
4. Spacer
5. Return Spring
6. Retainer
7. Washers
8. Pushrod
9. Washer
10. Pin
12. Brake Pedal

Figure 14—P30 (32) Brake Pedal Components

4. Washer (9) and pin (10).
    - Pushrod (8).
    - Washer (7) and retainer (6).
5. Check the stoplamp switch adjustment. Refer to "Stoplamp Switch."

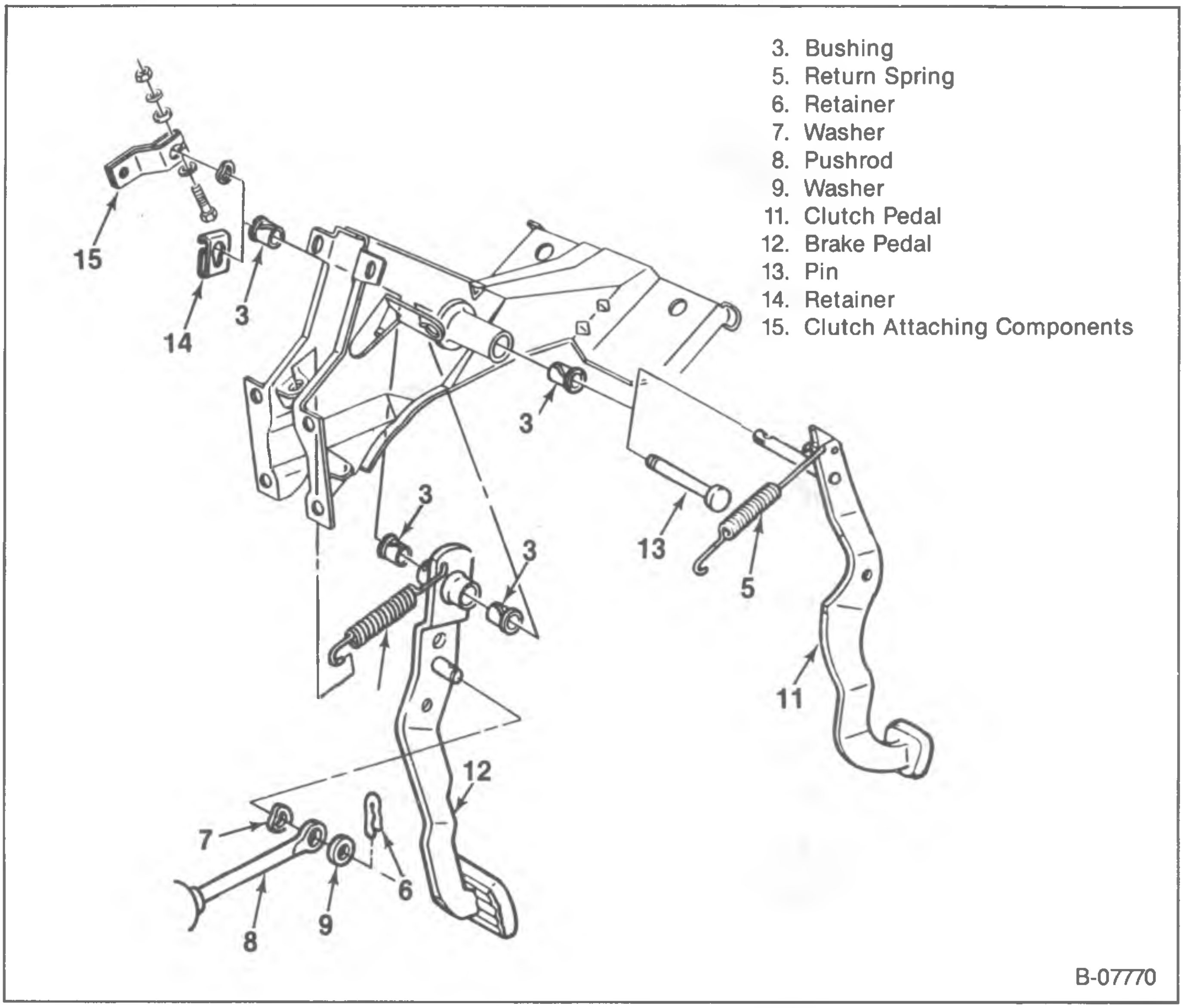
G-MODEL

Remove or Disconnect (Figure 15)

1. Retainer (6).
    - Washer (9).
    - Pushrod (8).
    - Washer (7).
2. Return spring. (5).
3. Retainer (14) or clutch attaching components (15) (if equipped).
4. Pin (13) or clutch pedal (11) (if equipped).
5. Brake pedal (12).
    - Bushings (3).

Install or Connect (Figure 15)

1. Bushings (3).
    - Brake pedal (12).
2. Pin (13) or clutch pedal (11) (if equipped).
3. Retainer (14) or clutch attaching components (15) (if equipped).
4. Return spring (5).
5. Washer (7).
    - Pushrod (8).
    - Washer (9).
    - Retainer (6).
6. Check the stoplamp switch adjustment. Refer to "Stoplamp Switch."



3. Bushing
5. Return Spring
6. Retainer
7. Washer
8. Pushrod
9. Washer
11. Clutch Pedal
12. Brake Pedal
13. Pin
14. Retainer
15. Clutch Attaching Components

Figure 15—G-Van Brake Pedal Components

P 30 (42) MODEL

Remove or Disconnect (Figure 16)

1. Retainer and washer.
   - Pushrod and washer.
2. Clutch attaching components (15) (if equipped).
3. Clutch pedal (11) (if equipped).
   - Return spring (5) (if equipped).
4. Nut (16) and bolt (18).
   - Shaft (17).
5. Brake pedal (12).
   - Bushings (3).

Install or Connect (Figure 16)

— Lubricate pivot points with Delco Brake Lube or equivalent.

1. Bushings (3).
   - Brake pedal (12).
2. Shaft (17).
   - Bolt (18) and nut (16).
3. Clutch pedal (11) (if equipped).
   - Return spring (5) (if equipped).
4. Clutch attaching components (15).
5. Washer and pushrod.
   - Washer and retainer.
6. Check the stoplamp switch adjustment, refer to "Stoplamp Switch."

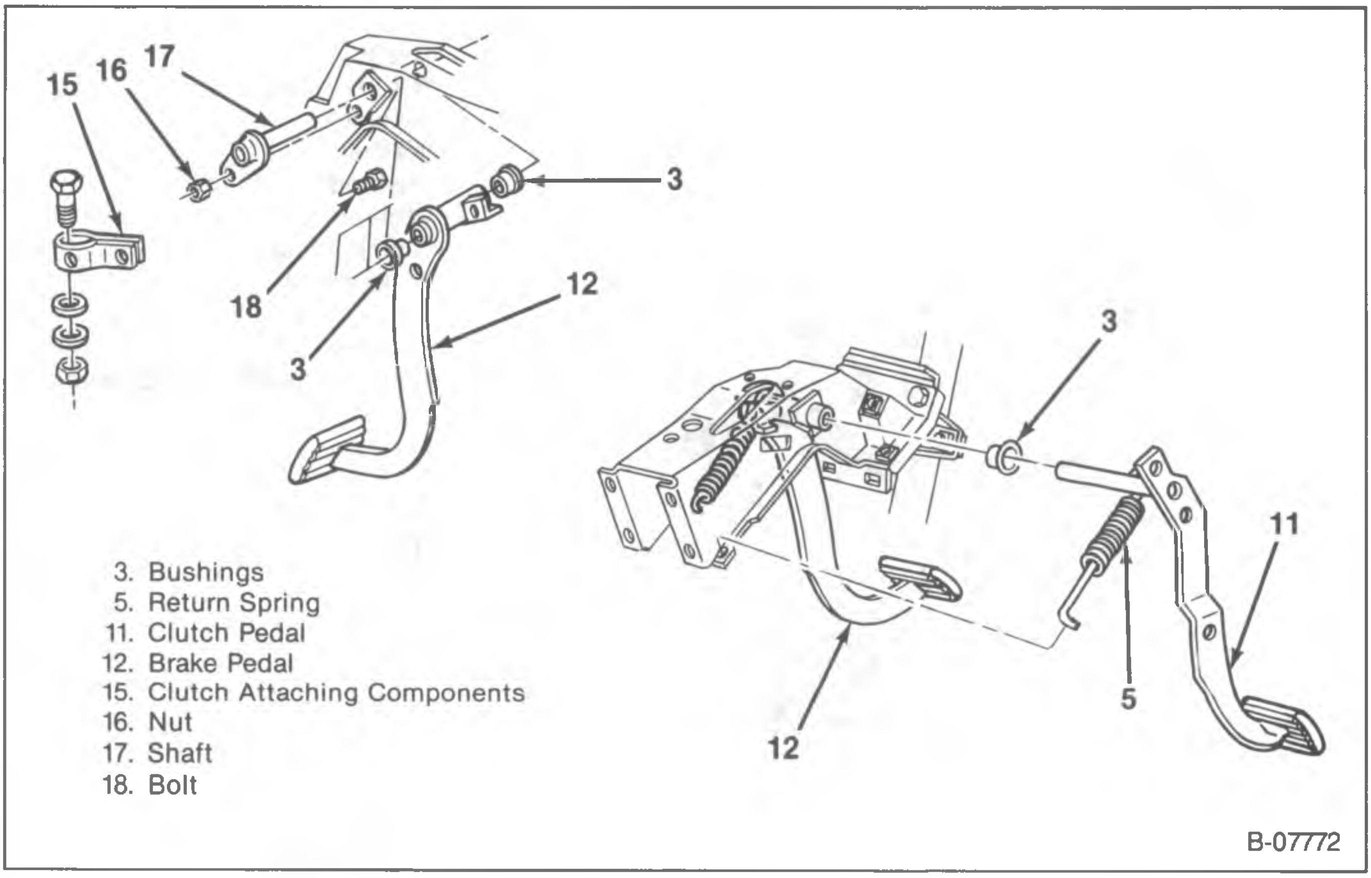


Figure 16—P 30 (42) Brake Pedal Components

BRAKE PEDAL ROD REPLACEMENT

P 30 (32) MODEL

Remove or Disconnect (Figure 17)

1. Retainer (6).
   - Nut (16).
   - Bolt (17) and washers (7 and 9).
2. Screws (18).
3. Raise the vehicle and support it with suitable safety stands.
4. Retainer (23).
   - Nut (22).
   - Bolt (19) and washers (20 and 21).
5. Brake rod (8).
   - Boot (24).

Install or Connect (Figure 17)

NOTICE: For steps 2 and 6 see "Notice" on page 5-1 of this section.

1. Boot (24).

Adjust

- Brake rod to 790 mm (31.00-inches) from the centers of the bolt holes.

2. Brake rod (8).
3. Bolt (19) and washers (20 and 21).
   - Nut (24) and retainer (23).

Tighten

- Nut to 35 N·m (26 ft. lbs.).

4. Lower the vehicle.
5. Screws (24).
6. Bolt (17) and washers (9 and 7).
   - Nut (16) and retainer (6).

Tighten

- Nut to 35 N·m (26 ft. lbs.).

STOPLAMP SWITCH

The design of the switch mounting provides for an automatic adjustment when the brake pedal is returned to its stop. There are two styles of switches, the determining factor is if the vehicle is equipped with cruise control. For electrical diagnosis of the stoplamp switch, refer to CHASSIS ELECTRICAL (Sec. 8B).

SWITCH REPLACEMENT

Remove or Disconnect

1. Remove the negative battery cable.
2. Electrical connectors.
3. Switch.

Install or Connect

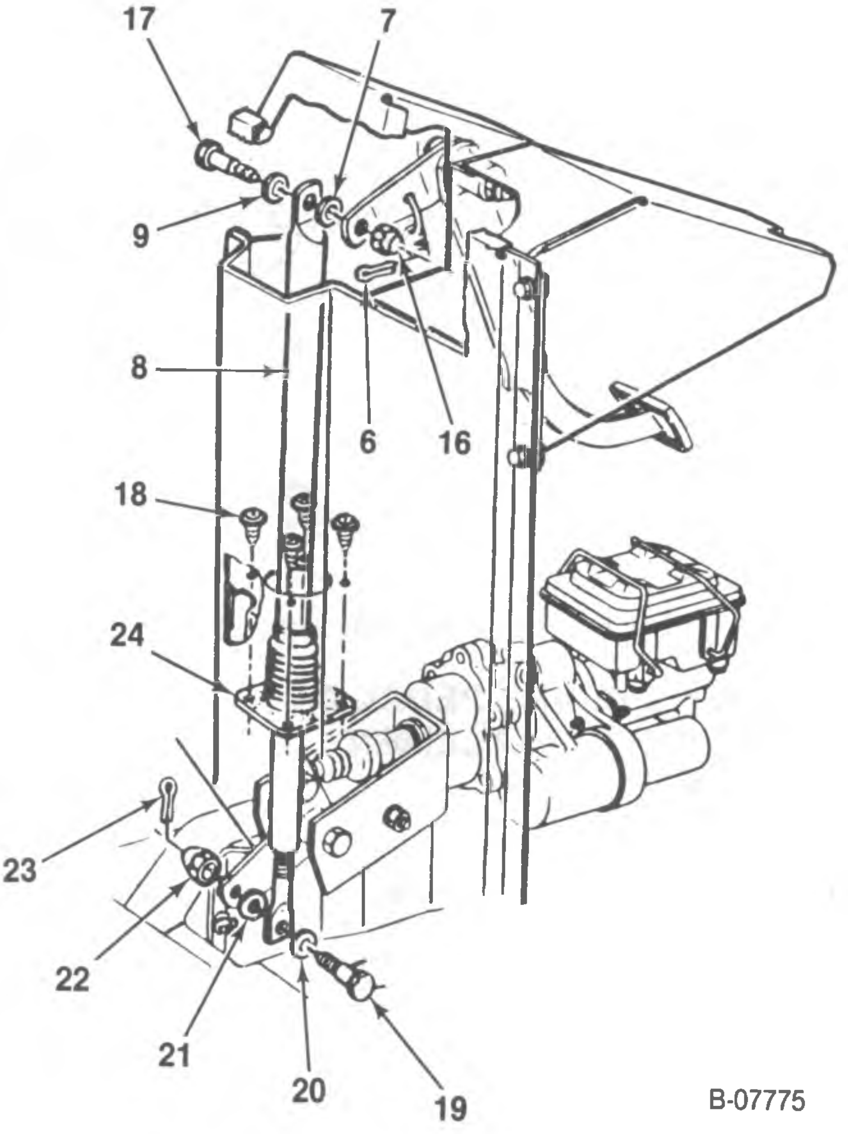
1. Switch.

   Adjust

   - Refer to "Switch Adjustment".
2. Electrical connectors.
3. Negative battery cable.

SWITCH ADJUSTMENT

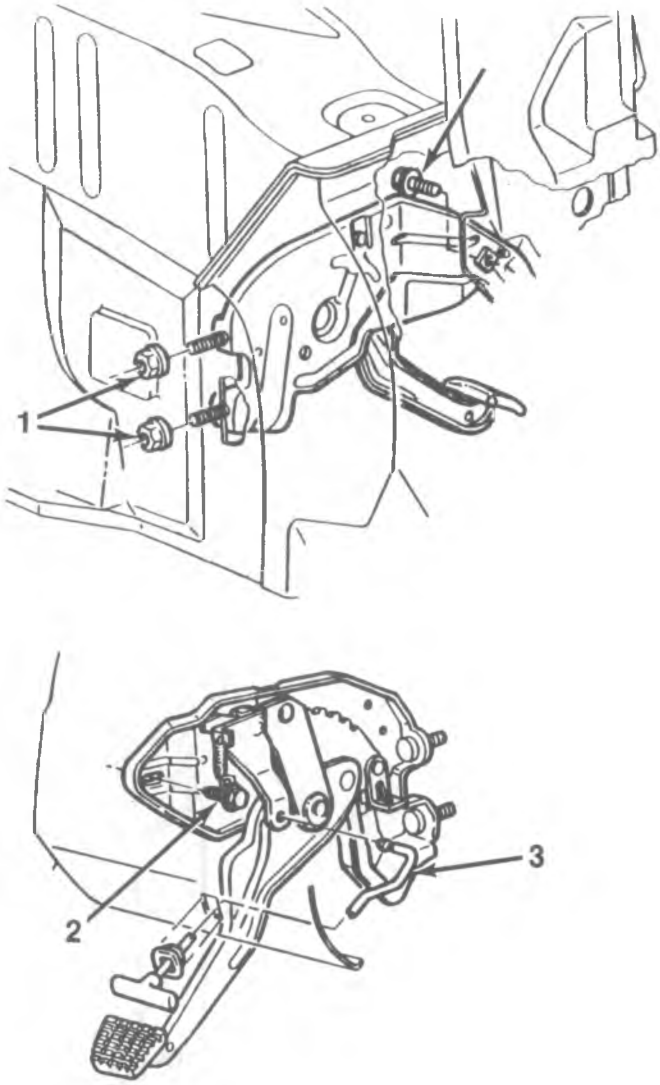
1. Depress the brake pedal and press the switch in until it is firmly seated in the clip.
   - Audible "clicks" can be heard as the threaded portion of the switch is pushed through the clip.
2. Pull the brake pedal against the pedal stop until the audible "click" can no longer be heard.
3. Electrical contact should be made when the brake pedal is depressed the specified distance.
   - C-K models 25 - 31 mm (1.0 - 1.24 inches)
   - G-P models 11 - 24 mm (0.45 - 0.95 inches)



6. Retainer
7. Washer
8. Brake Rod
9. Washer
16. Nut
17. Bolt
18. Screw
19. Bolt
20. Washer
21. Washer
22. Nut
23. Retainer
24. Boot

Figure 17 — P30 (32) Brake Pedal Rod Components

PARKING BRAKE SYSTEM



1. Nuts
2. Bolt
3. Release Rod

Figure 18—Removing Parking Brake Pedal on C-K, and G Models

PARKING BRAKE PEDAL OR HANDLE REPLACEMENT

C-K-G MODELS

Remove or Disconnect (Figure 18)

- The parking brake must be in the released position.

1. Nuts (1).
2. Release rod (3).
3. Bolt (2).
4. Brake assembly.
    - Parking brake cable.

Install or Connect (Figure 18)

NOTICE: See "Notice" on page 5-1 of this section for steps 2 and 4.

1. Parking brake cable.
2. Bolt.

Tighten

- Refer to "Torque Specifictions" in this section.

3. Release rod (3).
4. Nuts (1).

Tighten

- Refer to "Torque Specifications" in this section.

5. Check the parking brake adjustment, refer to "Parking Brake Adjustment" in this section.

P MODELS

Remove or Disconnect (Figure 19)

- The parking brake must be in the released position.

1. Nuts (10) and washers (11).
2. Bolts (12) and washers (13).
   - Spacers (14).
3. Cotter pin (15) and washer (16).
   - Clevis pin (17).
4. Nut (18) and washer (19).
5. Bolt (20).
   - Spacer (21).
   - Cable (22).
6. Handle assembly.

Install or Connect (Figure 19)

1. Cable (22).
   - Clevis pin (17).
   - Washer (16) and cotter pin (15).
2. Spacer (21).
   - Bolt (20).
   - Washer (19) and nut (18).
3. Spacer (14).

NOTICE: See "Notice" on page 5-1 of this section.

4. Washer (13) and bolts (12).
   - Washers (11) and nuts (10).

Tighten

- Nuts to 24 N·m (18 ft. lbs.)

5. Check the parking brake adjustment, refer to "Parking Brake Adjustment" in this section.

CABLE REPLACEMENT

FRONT CABLE REPLACEMENT (C-K MODELS)

Remove or Disconnect (Figures 20 and 21)

- Raise the vehicle and support with suitable safety stands.

1. Nut (31) from the equalizer (32).
2. Connector (33) from the front cable.
3. Bend retaining fingers (34) and (35).
   - Cable from the brake pedal assembly.
4. Cable assembly (36).
   - Attach a piece of wire to the cable to help in installation.

Install or Connect (Figure 20 and 21)

1. Cable assembly (36).
   - Make sure all the retaining fingers are completely through the holes.
2. Cable to the pedal assembly.
3. Connector (33).
4. Nut (31) onto the equalizer (32).

Adjust

- Refer to "Parking Brake Adjustment" in this section.

5. Lower the vehicle.

FRONT CABLE REPLACEMENT (G AND P MODELS)

Remove or Disconnect (Figures 20, 22 and 23)

- Raise the vehicle and support with suitable safety stands.

1. Nut (31) from the equalizer (32).
2. Connector (33) from the front cable.
3. Bolts (37) and clips (38).
4. Cable from the pedal/handle assembly.
5. Bend retaining fingers (34).
6. Cable assembly (36).
   - Attach a piece of wire to the cable to help in installation.

Install or Connect (Figures 20,22 and 23)

1. Cable assembly (36).
   - Make sure all the retaining fingers are completely through the holes.
2. Cable to the pedal/handle assembly.
3. Clips (38) and bolts (37).
4. Connector (33).
5. Nut (31) onto the equalizer (32).

Adjust

- Refer to "Parking Brake Adjustment", in this section.

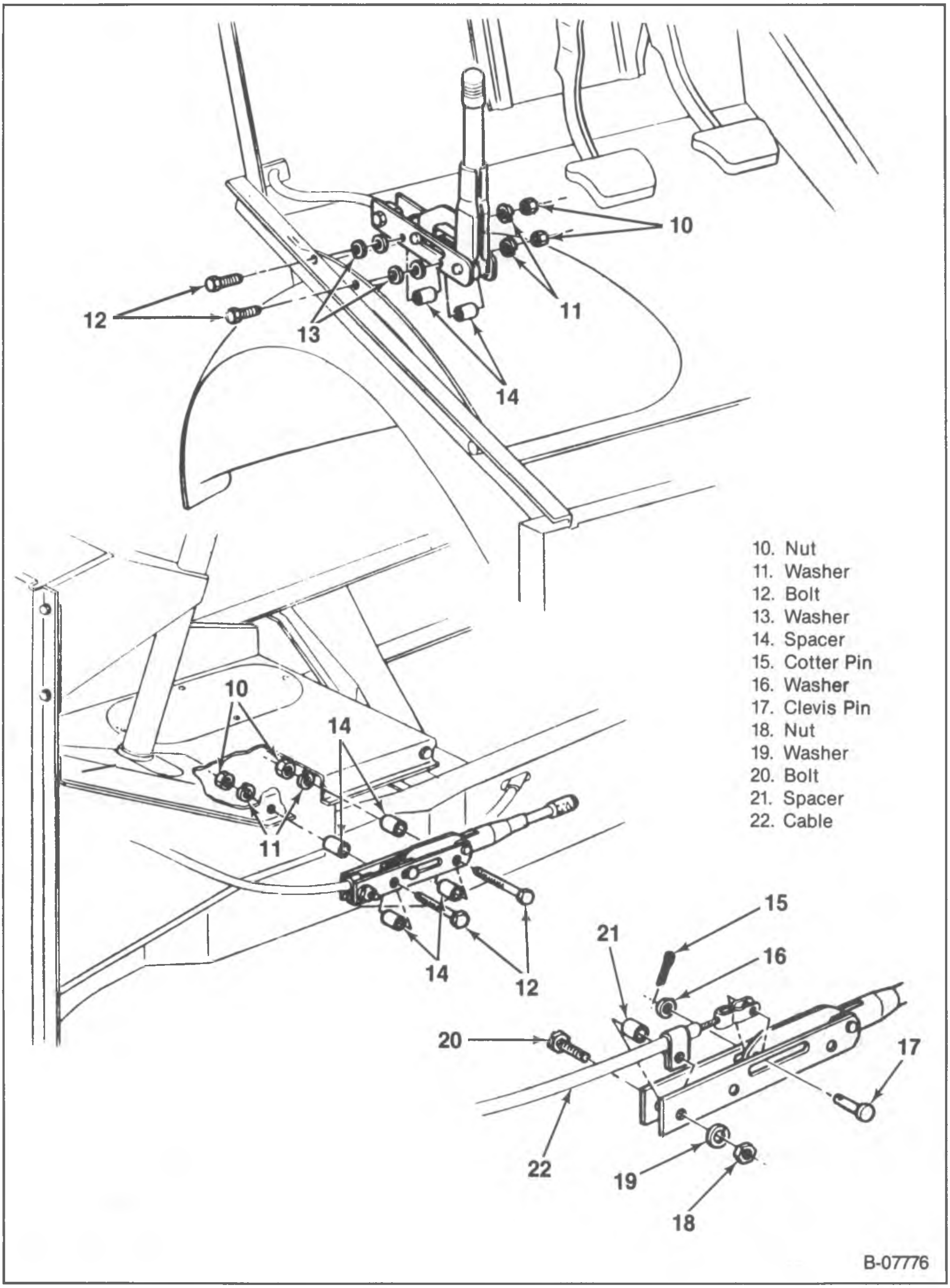
6. Lower the vehicle.

CENTER CABLE REPLACEMENT

Remove or Disconnect (Figure 20)

- Raise the vehicle and support with suitable safety stands.

1. Nut (31) from the equalizer (32).
2. Both front and rear connectors (33).



10. Nut
11. Washer
12. Bolt
13. Washer
14. Spacer
15. Cotter Pin
16. Washer
17. Clevis Pin
18. Nut
19. Washer
20. Bolt
21. Spacer
22. Cable

Figure 19—Removing Parking Brake Lever on P Models

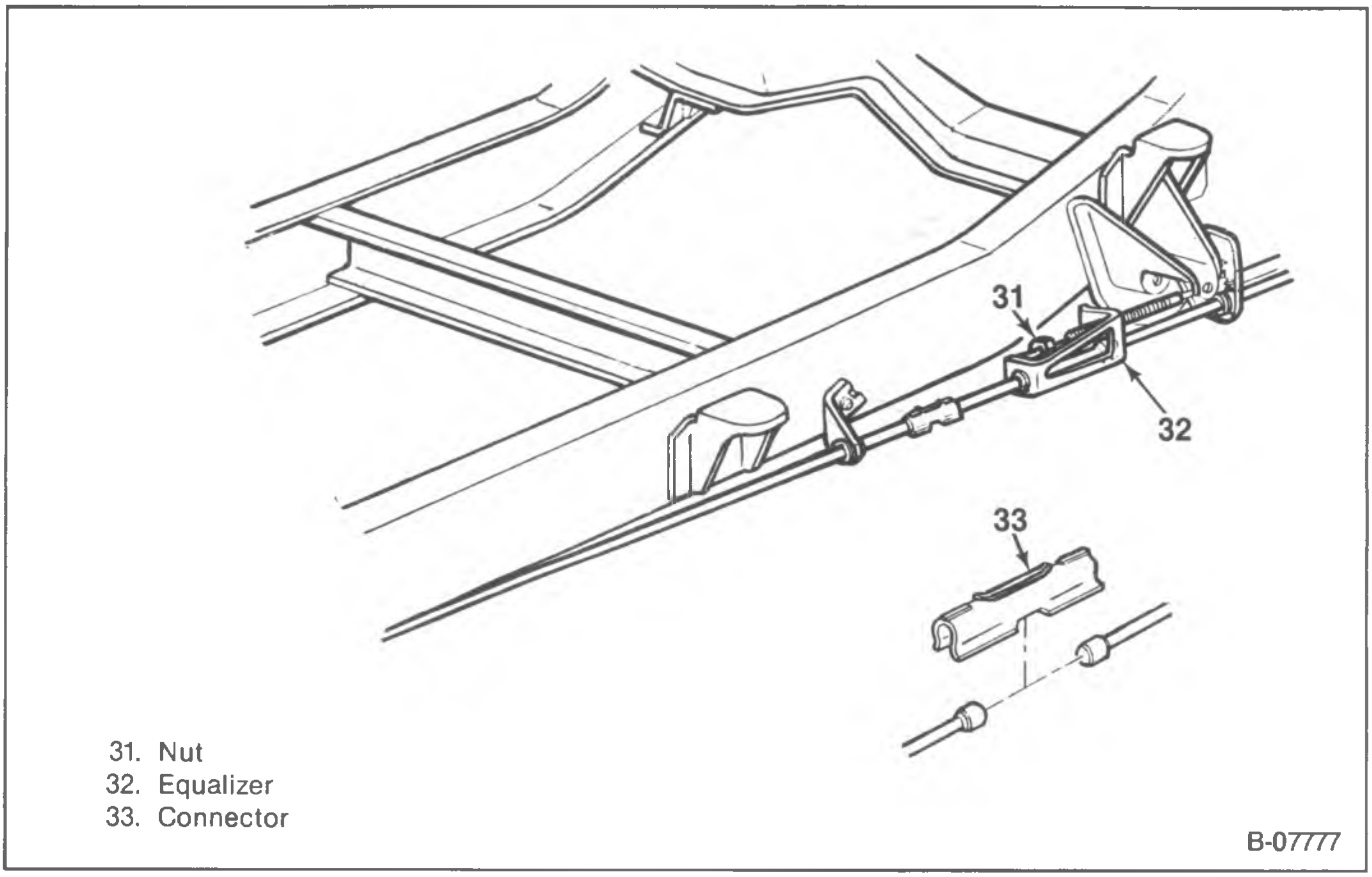


Figure 20—Equalizer Components

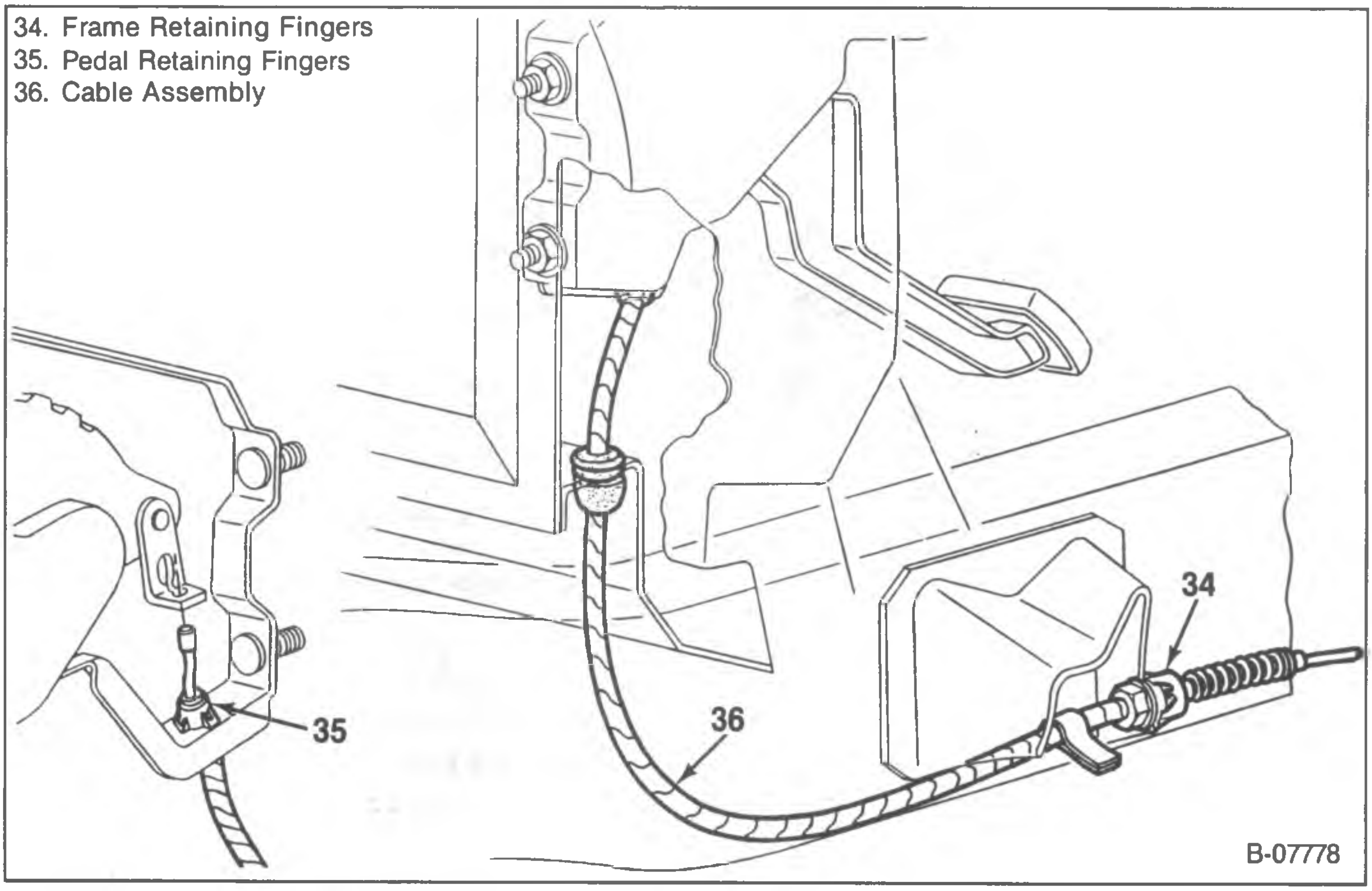
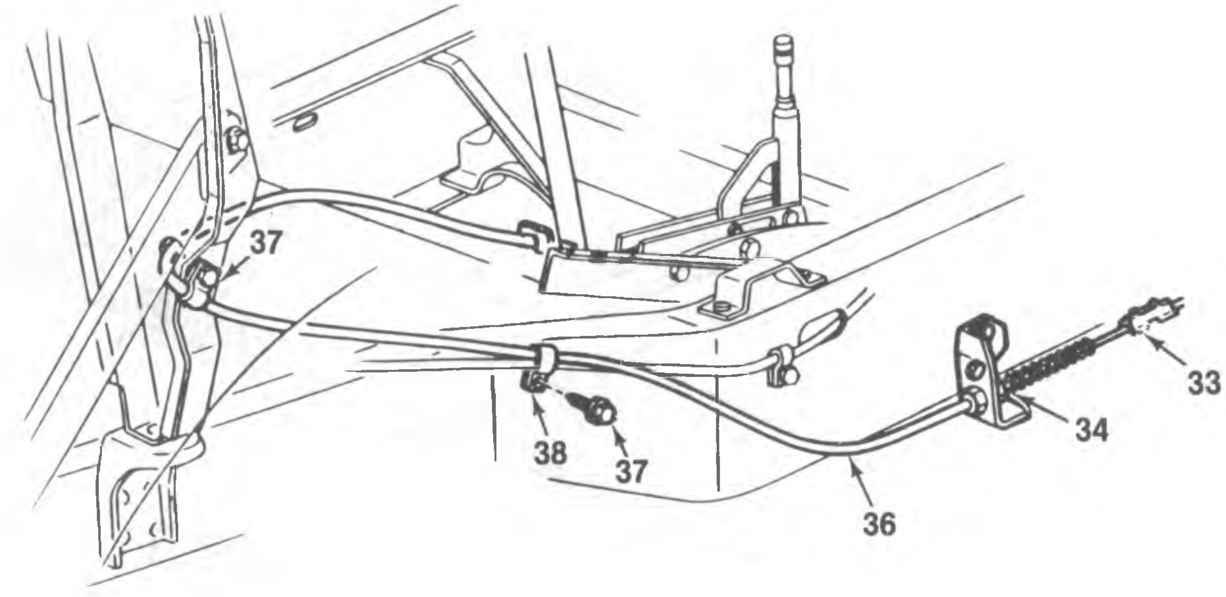


Figure 21—C-K Front Cable Components



33. Connector
34. Frame Retaining Fingers
36. Cable Assembly
37. Bolt
38. Clip

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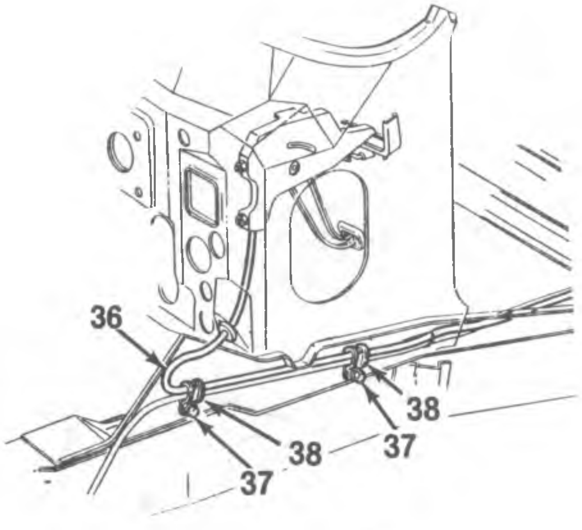
Figure 22—P Model Front Cable Components



36. Cable Assembly
37. Bolt
38. Clip

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Figure 23—G Model Front Cable Components

3. Cable.

Install or Connect (Figure 20)

1. Cable.
2. Connector (33).
3. Nut (31) onto the equalizer (32).

Adjust

- Refer to "Parking Brake Adjustment" in this section.

4. Lower the vehicle.

REAR CABLE REPLACEMENT

Remove or Disconnect (Figure 20)

- Raise the vehicle and support it with suitable safety stands.

1. Nut (31) from the equalizer (32).
2. Connector (33).
3. Brake drum and shoe assembly, refer to "Drum Brakes" in this section.
4. Bend in retaining fingers at the backing plate.
5. Retaining clip at the frame support.
   - Cable assembly.

Install or Connect (Figure 20)

1. Cable assembly.
- Make sure all the retaining fingers are completely through the backing plate.
2. Retaining clip at the frame support.
3. Brake shoes and drum assembly, refer to "Drum Brakes" in this section.
4. Connector (33).
5. Nut (31) onto the equalizer (32).

Adjust

- Refer to "Parking Brake Adjustment" in this section.

6. Lower the vehicle.

PROPELLER SHAFT BRAKE REPLACEMENT

Remove or Disconnect (Figure 24)

- Raise the vehicle and support with suitable safety stands.
1. Propeller shaft, refer to PROPELLER SHAFT (Sec. 4A) in this manual.

CAUTION: See "Caution" on page 5-1.

2. Drum (66).
- It may be necessary to back off the adjusting screw.
3. Return springs (56 and 71).
    - Return spring guide (72).
4. Hold down clips (65).
    - Hold down springs (64).
    - Washers (63).
5. Lever strut (55).
    - Strut spring (57).
6. Lever retaining ring (67).
7. Shoes (68).
8. Adjusting screw (60).
    - Adjusting screw spring (58).

Inspect

— All parts for discoloration due to heat, or stress. Replace if necessary.

— Brake drum for scoring and heat spots. Machine drum if needed.

Install or Connect (Figure 24)

— Lubricate the shoe pads and adjusting screw threads with a thin coat of white lithum grease.

1. Adjusting screw (60) and adjusting screw spring (58) to both shoes (68).
2. Shoe assembly (68).
    - Lever retaining ring (67).
3. Lever strut (55) and strut spring (57).
4. Washers (63).
    - Hold down springs (64).
    - Hold down clips (65).
5. Return spring guide (72).
    - Return springs (56 and 57)
6. Drum (66).
7. Propeller shaft, refer to PROPELLER SHAFT (Sec. 4A) in this manual.

Adjust

- Refer to "Parking Brake Adjustment" in this section.

8. Lower the vehicle.

PARKING BRAKE ADJUSTMENT

The parking brakes must be adjusted whenever the parking brake cables have been replaced or disconnected. Also if the brake holding ability is not adequate. Before adjusting the parking brakes check the condition of the service brakes. The service brakes must be adjusted properly before proceeding with the parking brake adjustment.

CABLE INSPECTION

Check the parking brake system for free operation. The brake lever must return to the released position without sticking or binding. If a problem is present check the cable routings for kinks or binding. Clean and lubricate the parking brake assembly and cables with Delco brake lube or equivalent.

FOOT PEDAL TYPE

1. Block the front wheels.
    - Raise and support the rear axle with suitable safety stands.
2. Loosen the equalizer nut.
3. Set the parking brake pedal to four clicks.

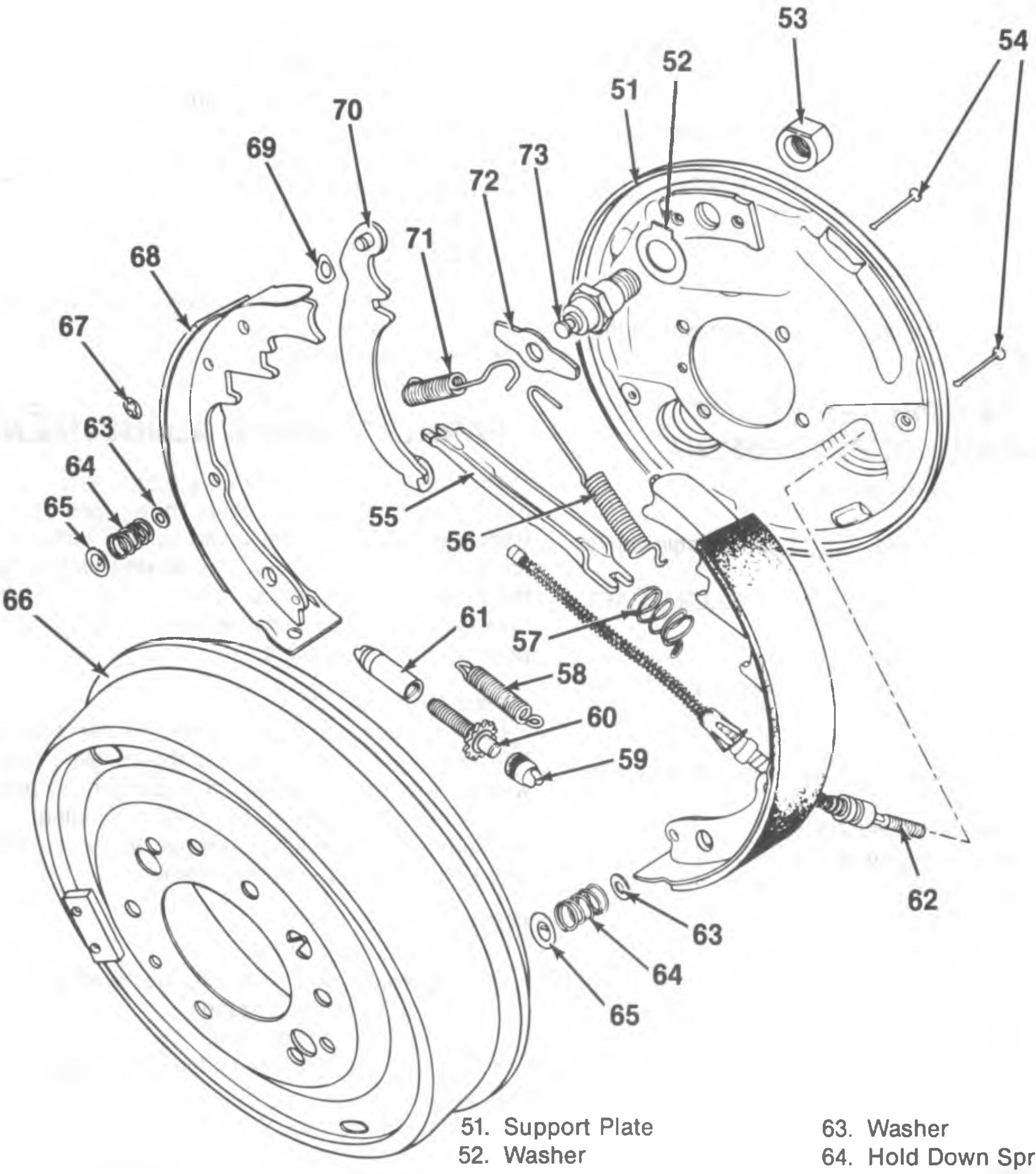
Adjust

- Equalizer nut until the wheels will not rotate forward without a moderate drag.

4. Release the parking brake and rotate the rear wheels.
    - There should be no brake drag.
5. Remove the safety stands and lower the vehicle.
    - Unblock the front wheels.

LEVER TYPE

1. Block the front wheels.
    - Raise and support the rear axle with suitable safety stands.
2. Turn the adjusting knob on the parking brake lever counterclockwise until it stops.
    - Apply parking brake.



51. Support Plate
52. Washer
53. Anchor Pin Nut
54. Hold Down Pin
55. Lever Strut
56. Return Spring
57. Strut Spring
58. Adjusting Screw Spring
59. Adjusting Screw Socket
60. Adjusting Screw
61. Adjusting Screw Nut
62. Cable
63. Washer
64. Hold Down Spring
65. Hold Down Clip
66. Drum
67. Lever Retaining Ring
68. Shoe
69. Washer
70. Operating Lever
71. Return Spring
72. Return Spring Guide
73. Anchor Pin

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Figure 24—Propeller Shaft Brake Components

3. Loosen the equalizer nut.

Adjust

- Equalizer nut until a light drag is felt while rotating the wheels forward.
- Knob on the parking brake lever until a definite snap over center is felt.

4. Release the parking brake and rotate the rear wheels.
   - There should be no brake drag.
5. Remove the safety stands and lower the vehicle.
   - Unblock the front wheels.

INTERNAL EXPANDING (PROPELLER SHAFT)

CAUTION: See "Caution" on page 5-1 of this section.

1. Block the front wheels.
   - Raise and support the rear axle with suitable safety stands.
2. Remove the clevis pin connecting the pull rod and relay lever.
3. Rotate the brake drum to align the access hole with the adjusting screw.
   - **Manual transmissions** - the adjusting screw is located at the bottom of the shoe.
   - **Automatic transmission** - the adjusting screw is located at the top of the shoe.
   - When adjusting the parking brake for the first time, it will be necessary to remove the lanced area from the drum. The drum must be removed to clean out all the metal shavings. Refer to PROPELLER SHAFTS (Sec. 4A).

Adjust

- Adjusting screw until the drum cannot be rotated by hand.
- Back off the adjusting screw ten notches. The drum should rotate freely.

4. Place parking brake lever in the full release position.
5. Take up the slack in the cable to overcome the spring tension.

Adjust

- The clevis of the pull rod to align with the hole in the relay lever.

6. Install the clevis pin.
   - Install new cover in the drum access hold.
7. Remove the safety stands and lower the vehicle.
   - Unblock the front wheels.

MASTER CYLINDERS

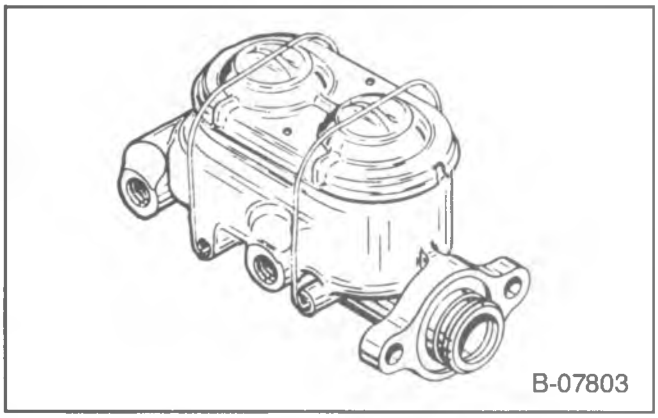


Figure 25—Cast Iron Master Cylinder

DESCRIPTION

There are two designs of master cylinders available depending on the brake option.

One is a full cast iron design incorporating a conventional front to rear brake split (figure 25). The primary piston provides the fluid pressure to the front brakes, while the secondary piston provides the fluid pressure to the rear brakes. If the pressure is lost from either system, the remaining system will function to stop the vehicle.

The second style master cylinder is designed for use with a system using the low drag calipers (figure 26). In addition to the standard master cylinder functions, a quick take-up feature is included. This provides a large volume of fluid to the wheels at low pressure with the initial brake application. This large volume of fluid is needed to overcome the clearance created by the seals retracting the pistons into the front calipers and the spring retraction of the rear drum brake shoes.

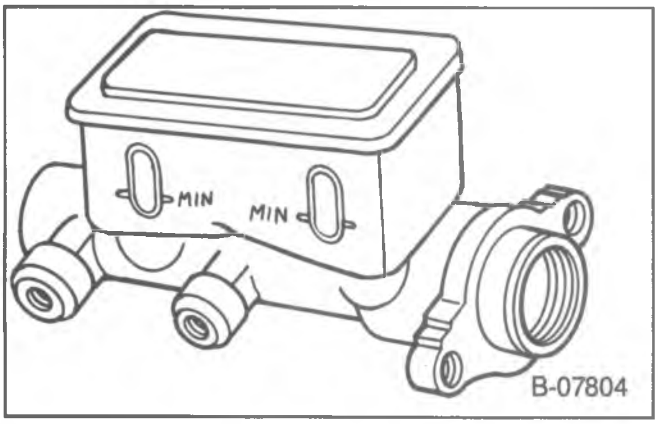


Figure 26—Composite Master Cylinder

MASTER CYLINDER REPLACEMENT

Remove or Disconnect (Figure 27)

- Apply the vehicles parking brakes.

1. Brake pipes.
   - Cover the ends of the pipes to prevent dirt from entering the system.
2. Mounting nuts.
3. Master cylinder.
   - If the vehicle is equipped with manual brakes, refer to "Brake Pedal Replacement" for the removal of the pushrod from the pedal.

Install or Connect (Figure 27)

- Prior to installation, refer to "Bench Bleeding" in this section.

1. Master cylinder.
   - If the vehicle is equipped with manual brakes, refer to "Brake Pedal Replacement" for the installation of the pushrod to the pedal.

NOTICE: See "Notice" on page 5-1 of this section.

2. Mounting nuts.

   Tighten

   - Nuts to 34 N·m (25 ft. lbs.), G and P models.
   - Nuts to 44 N·m (32 ft. lbs.), C and K models.
3. Brake pipes.
4. Bleed the brakes, refer to "Bleeding the Brake Hydraulic System" in this section.
5. Release the parking brakes.

BENCH BLEEDING

The purpose of bench bleeding is to remove the air from the master cylinder so when it is installed on the vehicle the brake system bleeding will be reduced.

1. Plug the outlet ports and mount the master cylinder in a vise with the front end tilted slightly down.
2. Fill the reservoir with clean brake fluid.

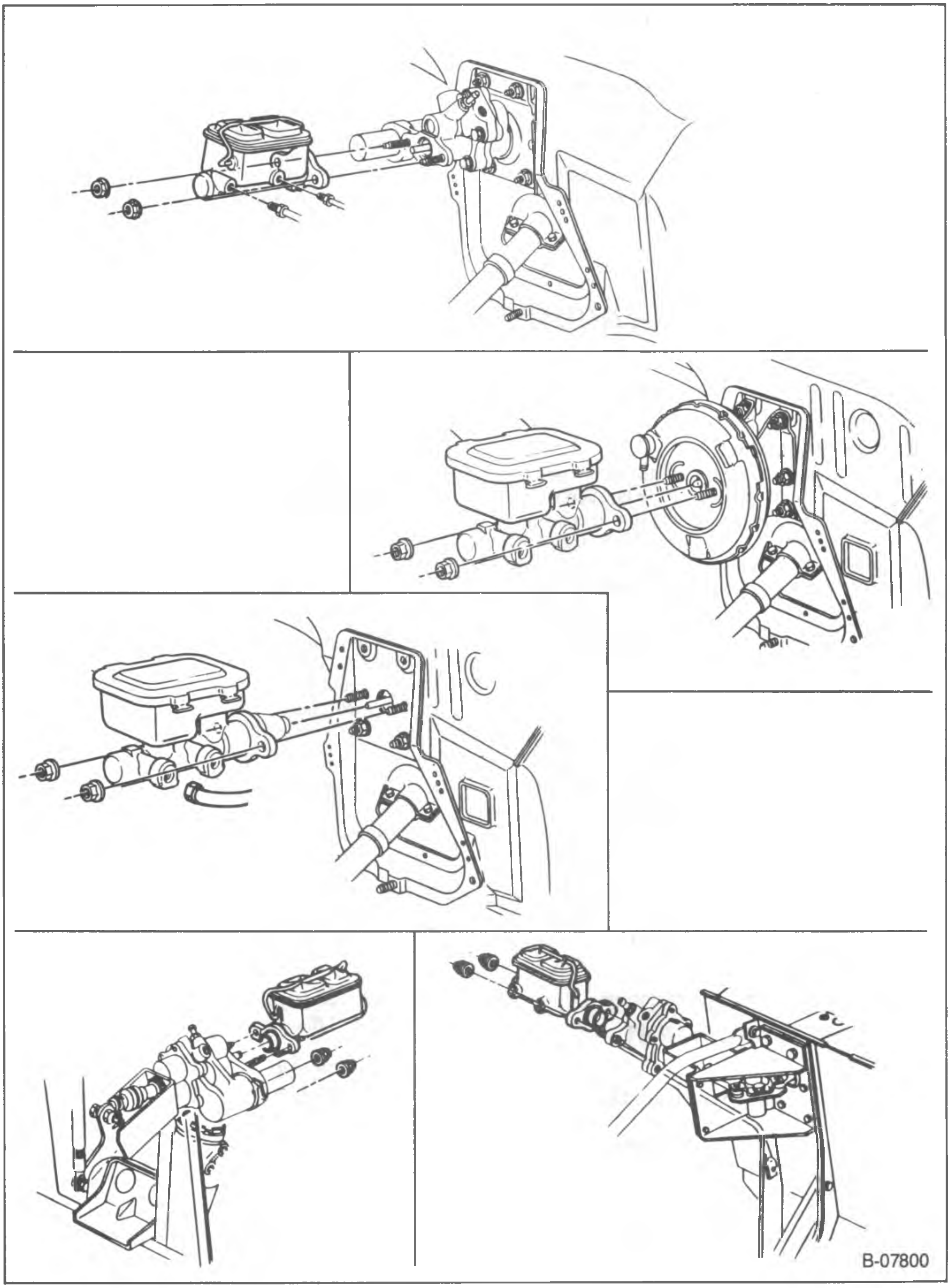


Figure 27—Master Cylinder Installations

Using a smooth rounded end tool, stroke the primary piston about 25 mm (1-inch) several times.

As air is bled from the master cylinder, with the outlets plugged, the resistance to the primary piston travel will not allow the full 25 mm (1-inch) stroke.

3. Reposition the master cylinder in the vise with the front end of the master cylinder tilted slightly up. Again stroke the primary piston about 25 mm (1-inch) several times.
4. Reposition the master cylinder in the vise to the level position. Loosen the plugs one at a time and push the piston into the bore to force the air from the cylinder. To prevent air from being sucked back into the cylinder, tighten the plug(s) before allowing the piston to return to its original position.
5. Fill the reservoir.

   Normal bleeding procedures should be followed after the master cylinder is installed.

VACUUM BOOSTERS

DESCRIPTION

SINGLE DIAPHRAGM MODEL

This booster is a single diaphragm vacuum suspended unit. It may have a single function vacuum switch to activate the brake warning light in case of low booster vacuum or vacuum pump malfunction. In a normal operating mode, with the service brakes in the released position, a vacuum suspended booster operates with vacuum on both sides of its diaphragm. When the brakes are applied, air at atmospheric pressure is admitted to one side of the diaphragm to provide the power assist.

TANDEM DIAPHRAGM MODEL

This booster is a tandem vacuum suspended unit. It may have a single dual function vacuum switch to activate the brake warning light in case of low booster vacuum or vacuum pump malfunction. In a normal operating mode, with the service brakes in the released position, a tandem vacuum suspended booster operates with vacuum on both sides of its diaphragms. When the brakes are applied, air at atmospheric pressure is admitted to one side of each diaphragm to provide the power assist.

VACUUM BOOSTER REPLACEMENT

Remove or Disconnect (Figure 28)

- Apply the vehicles parking brakes.
1. Mounting nuts.
2. Master cylinder.
- Support the master cylinder.
3. Vacuum hose from the check valve.
4. Booster pushrod, refer to "Brake Pedal Replacement" in this section.
5. Booster mounting nut.

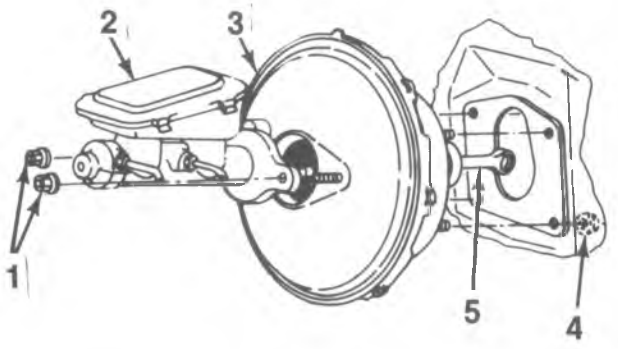


Figure 28—Removing Vacuum Boosters

- The mounting nuts must be removed from inside the vehicle.
  - Vacuum booster.

Install or Connect (Figure 28)

NOTICE: For steps 2 and 6 see "Notice" on page 5-1 of this section.

1. Vacuum booster.
2. Booster mounting nuts.

   Tighten

   - Nuts to 34 N·m (25 ft. lbs.).
3. Booster pushrod, refer to "Brake Pedal Replacement" in this section.
4. Vacuum hose.
5. Master cylinder.
6. Mounting nuts.

Tighten

- Mounting nuts to 34 N·m (25 ft. lbs.)

7. Release the parking brakes.

HYDRAULIC BRAKE BOOSTER (HYDRO-BOOST)

DESCRIPTION

This system uses a hydraulic pump to power the system and a pneumatic accumulator as a reserve system.

In this system no special fluids are used, however, care must be taken to use the correct fluids. The master cylinder and brake system operate on standard hydraulic brake fluid, while the hydraulic pump operates on power steering fluid. For diagnosis of the Hydro-Boost System, refer to "Hydro-Boost Systems Tests" and "Diagnosis of Hydro-Boost System" in this section.

HYDRO-BOOST REPLACEMENT

C-K AND G MODELS

Remove or Disconnect (Figure 29)

- Apply the vehicles parking brakes.

1. Hydraulic lines from the booster.
2. Nuts (1).
3. Master cylinder (2).
   - Support the master cylinder.
4. Booster pushrod, refer to "Brake Pedal Replacement" in this section.
5. Nuts (4) and (6).
6. Hydro-Boost unit (3).
   - Gasket (5).

Install or Connect (Figure 29)

NOTICE: For steps 2 and 5 see "Notice" on page 5-1 of this section.

1. Gasket (5).
   - Hydro-Boost unit (3).
2. Nuts (4) and (6).

Tighten

- Nuts to 34 N·m (25 ft. lbs.).

3. Booster pushrod, refer to "Brake Pedal Replacement" in this section.
4. Master cylinder. (2).
5. Nuts (1).

Tighten

- Nuts to 34 N·m (25 ft. lbs.).

6. Hydraulic lines.
7. Bleed the booster, refer to "Bleeding the Hydro-Boost System" in this section.
8. Release the parking brakes.

P 30 (42) MODEL

Remove or Disconnect (Figure 30 and 31)

- Apply the vehicles parking brakes.

1. Hydraulic lines from the booster.
2. Nuts (1) and washers (7).
3. Master cylinder (2).
   - Support the master cylinder.
4. Pushrod retainer (10).
5. Retaining clip and washer.
   - Booster pushrod (9).
6. Nuts (4) and washers (8).
7. Hydro-Boost unit (3).

Install or Connect (Figure 30 and 31)

NOTICE: For steps 2 and 6 see "Notice" on page 5-1 of this section.

1. Hydro-Boost unit (3).
2. Washers (8) and nuts (4).

Tighten

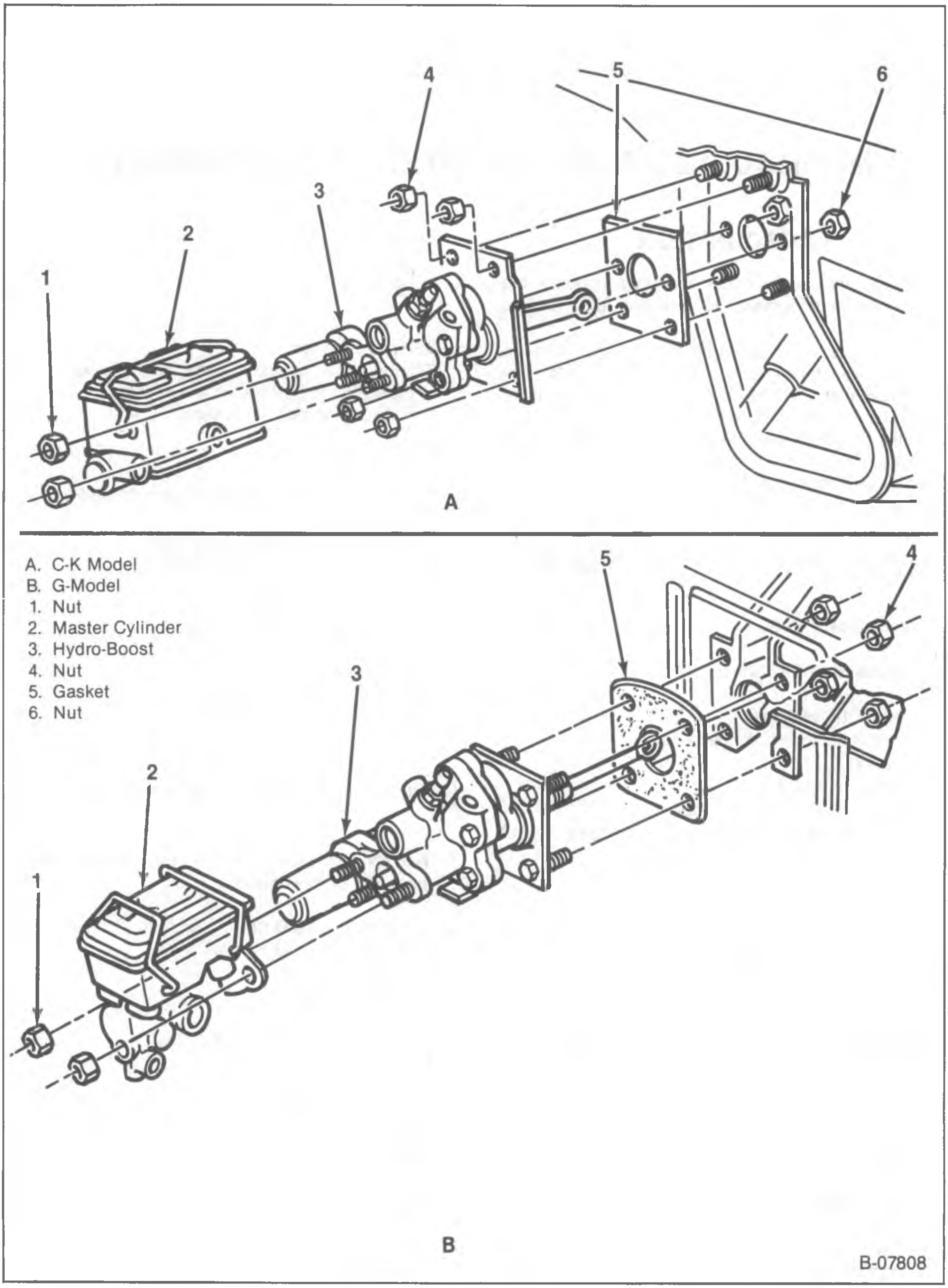
- Nuts to 34 N·m (25 ft. lbs.).

3. Booster pushrod (9).
   - Washer and retaining clip.
4. Pushrod retainer (10).
5. Master cylinder (2).
6. Washers (7) and nuts (1).

Tighten

- Nuts to 34 N·m (25 ft. lbs.)

7. Hydraulic lines.
8. Bleed the booster, refer to "Bleeding the Hydro-Boost System" in this section.



A. C-K Model
B. G-Model
1. Nut
2. Master Cylinder
3. Hydro-Boost
4. Nut
5. Gasket
6. Nut

Figure 29—C-K and G Model Hydro-Boost Replacement

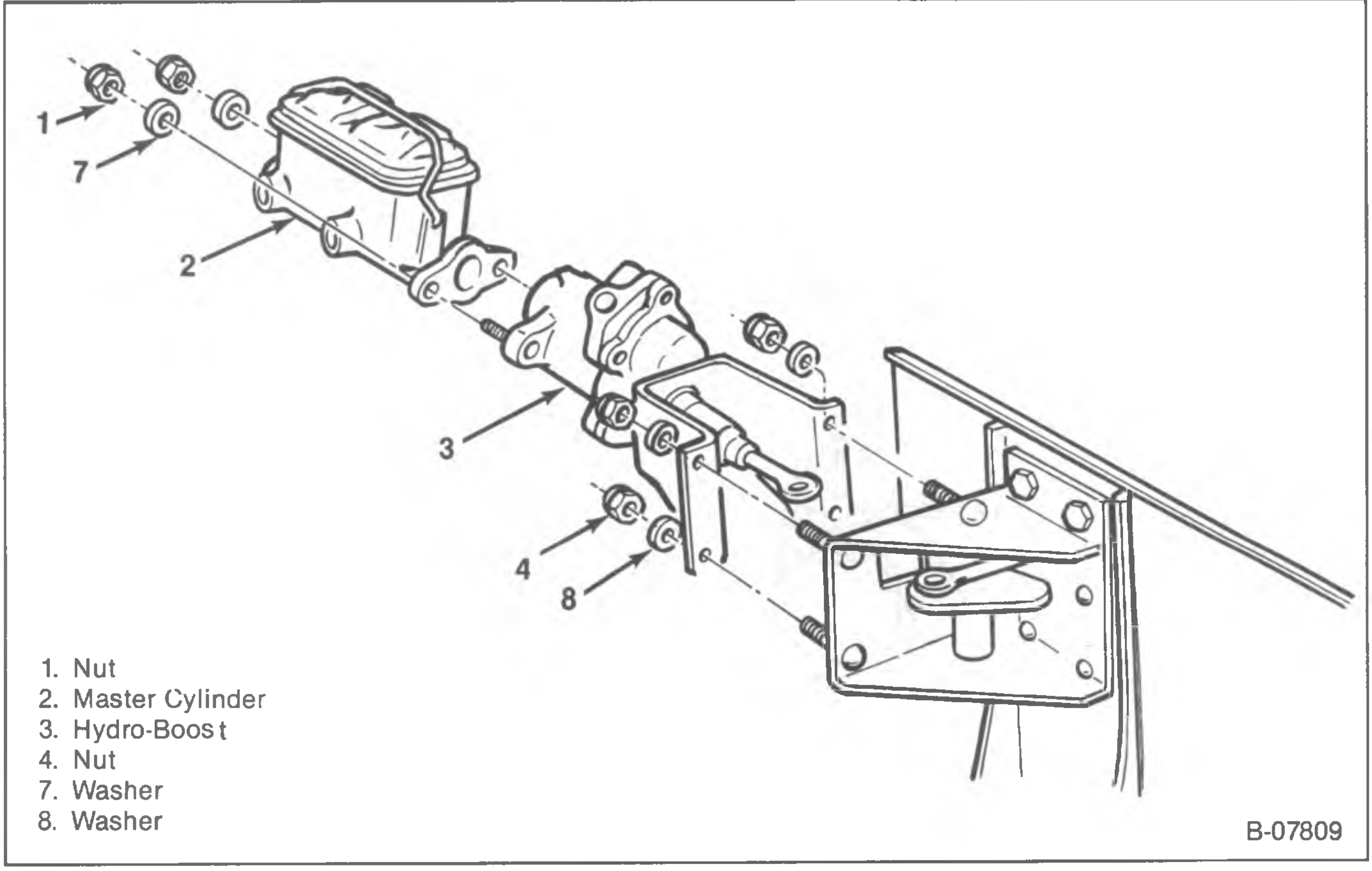


Figure 30—P 30 (42) Hydro-Boost Replacement

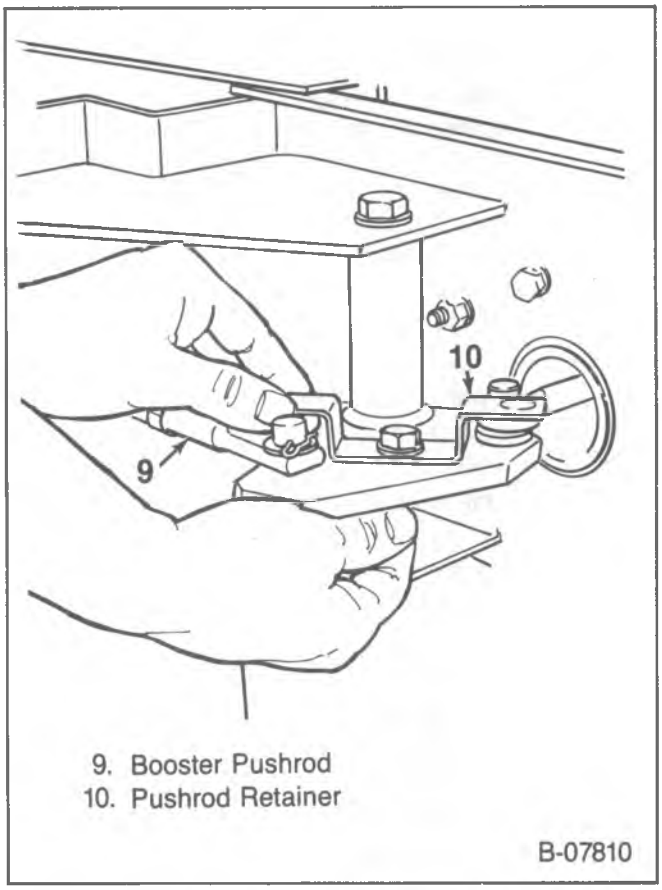


Figure 31—Removing Pushrod Retainer

9. Release the parking brakes.

P 30 (32) MODEL

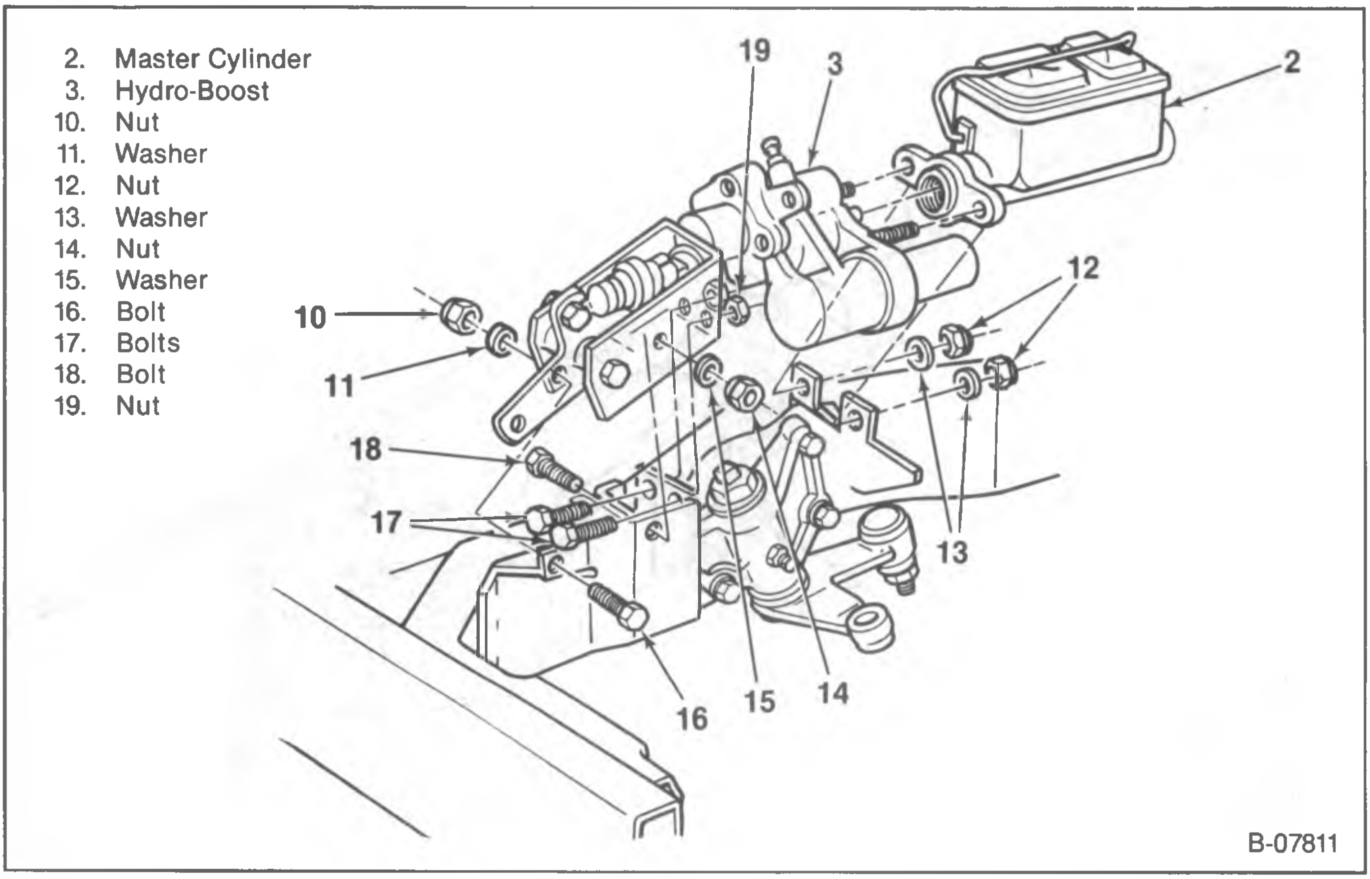
↔ Remove or Disconnect (Figure 32)

- Apply the vehicles parking brakes.
1. Hydraulic lines from the booster.
2. Nuts (12) and washers (13).
3. Master cylinder (2).
- Support the master cylinder.
4. Brake pedal rod, refer to "Brake Pedal Rod Replacement" in this section.
5. Nut (10) and washer (11).
   - Bolt (16).
6. Nut (14) and washers (15).
   - Bolt (18).
7. Nuts (12) and washer (13).
   - Bolts (17).
8. Hydro-Boost unit (3).

→← Install or Connect (Figure 32)

NOTICE: For steps 2, 3, 4, and 7 see "Notice" on page 5-1 of this section.

1. Hydro-Boost unit (3).
2. Bolts (17).



2. Master Cylinder
3. Hydro-Boost
10. Nut
11. Washer
12. Nut
13. Washer
14. Nut
15. Washer
16. Bolt
17. Bolts
18. Bolt
19. Nut

Figure 32—P 30 (32) Hydro-Boost Replacement

   - Washers (13) and nuts (12). Leave finger tight.
3. Bolt (18).
   - Washer (15) and nut (14). Leave finger tight.
4. Bolt (16).
   - Washer (11) and nut (10). Leave finger tight.

Tighten

   - Nuts (10, 14 and 12) to 34 N·m (25 ft. lbs.).
5. Brake pedal rod, refer to "Brake Pedal Rod Replacement" in this section.
6. Master cylinder (2).
7. Washers (13) and nuts (12).

Tighten

   - Nuts to 34 N·m (25 ft. lbs.)
8. Hydraulic lines.
9. Bleed the booster, refer to "Bleeding the Hydro-Boost System" in this section.
10. Release the parking brakes.

BLEEDING THE HYDRO-BOOST SYSTEM

Whenever the booster is removed and reinstalled, the steering system should be bled.

NOTICE: The power steering fluid and brake fluid cannot be mixed. If the brake seals contact steering fluid or the steering seals contact brake fluid, seal damage will result.

1. Fill the power steering pump reservoir to the proper level, let the fluid remain undisturbed for at least two minutes.
2. Start the engine and run momentarily.
   - Add fluid, if necessary.
3. Repeat steps 1 and 2 until the fluid level remains constant after running the engine.
4. Raise the front of the vehicle so the wheels are off the ground.
- Support the vehicle with suitable safety stands.
5. Turn the wheels from stop to stop, lightly contacting the stops.
   - Add fluid, if necessary.
6. Lower the vehicle.
7. Start the engine and depress the brake pedal serveral times while rotating the steering wheel from stop to stop.
8. Turn the engine off and then pump the brake pedal 4-5 times.
9. Check fluid level, add fluid if necessary.
10. If the fluid is extremely foamy, allow the vehicle to stand a few minutes with the engine off. Then repeat steps 7, 8 and 9.

11. Check for the presence of air in the oil. Air in the oil will have a milky appearance. Air in the system will also cause the fluid level in the pump to rise when the engine is turned off. If it becomes obvious that the pump will not bleed the air after a few attempts, refer to POWER STEERING (Sec. 3B3) for futher diagnosis.

DISC BRAKES

DESCRIPTION

The disc brake assembly consists of a caliper and piston assembly, rotor, linings, and an anchor plate. The caliper is mounted to the anchor plate, which allows the caliper to move laterally against the rotor. The caliper is a one-piece casting with the inboard side containing the piston bore. A square cut rubber seal is located in a groove in the piston bore which provides the hydraulic seal between the piston and the cylinder wall.

OPERATION

As the brake pedal is depressed, hydraulic pressure is applied against the piston. This pressure pushes the inboard brake lining against the inboard braking surface of the rotor. As the force increases against the rotor, the caliper assembly moves inboard thus providing a clamping action on the rotor.

When the brake pressure is released, the piston seal returns to its normal position, pulling the piston back into the caliper bore. This will create a running clearance between the inner brake lining and the rotor.

BRAKE LINING INSPECTION

Check the outer pad by looking at each end of the caliper (figure 33). Check the lining thickness on the inner pad by looking down through the inspection hole in the top of the caliper housing. Whenever the lining is worn to about the thickness of the pad, the lining should be removed for further measurements. The pad should be replaced anytime the lining is worn to within 0.08 mm ($^1/_{32}$-inch) of a rivet head or the pad itself.

The disc brake pads have a wear indicator that makes a noise when the linings wear to a degree where replacement is required (figure 34).

Also check the flatness of the brake pads. Place the inboard and outboard lining surfaces together and check for a gap between the lining surfaces. This gap should not exceed 0.13 mm (.005-inch) at the middle of the lining surfaces. This applies to new or used brake pads.

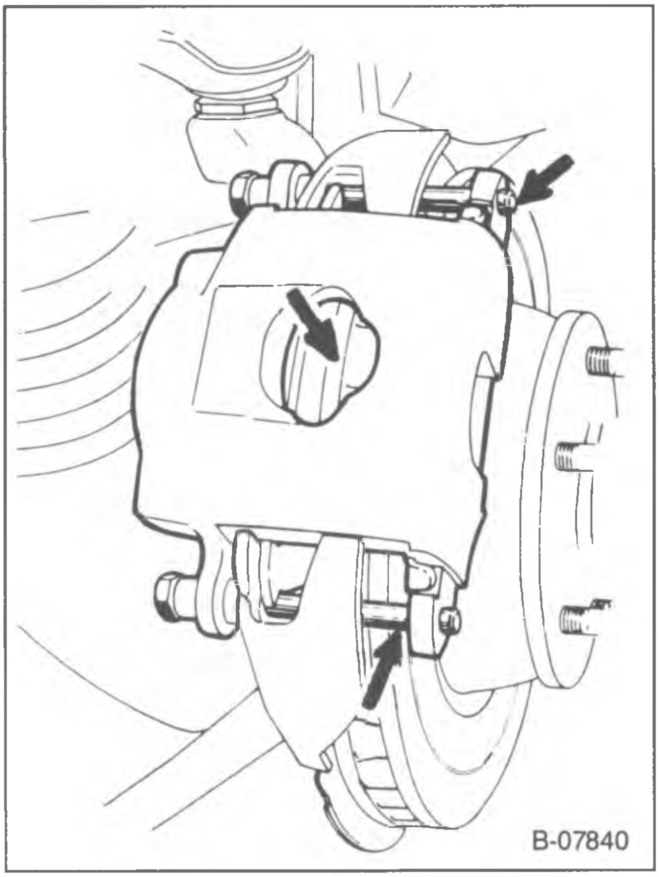


Figure 33—Lining Inspection Points

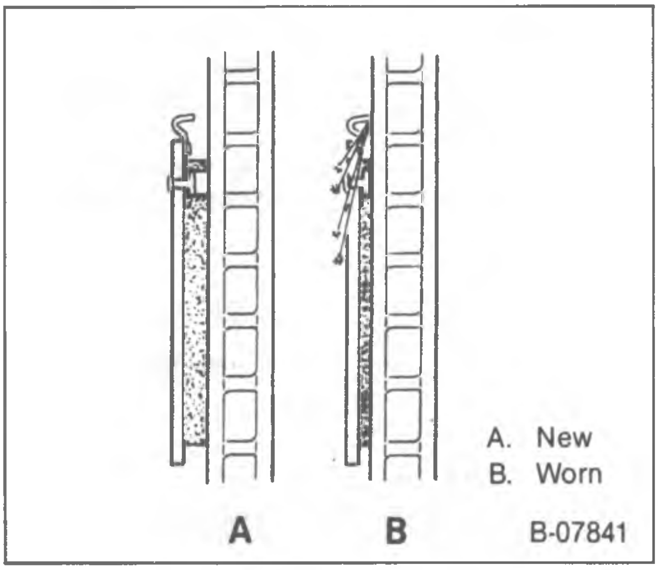


Figure 34—Warning Sensor

BRAKE LINING REPLACEMENT

3000/3100 MODELS

↔ Remove or Disconnect (Figure 35)

- 2/3 of the brake fluid from the master cylinder.
- Raise the vehicle and support it with suitable safety stands.
- Mark the relationship of the wheel to the hub.

1. Wheel and tire assembly, refer to WHEELS AND TIRES (Sec. 3E).

CAUTION: See "Caution" on page 5-1.

2. Position a C-clamp around the outer pad and caliper and tighten until the piston bottoms in its bore (figure 36).
   - C - clamp
3. Mounting bolts (1) (figure 37).
4. Caliper assembly.
   - Suspend the caliper from the suspension (figure 38).

   ! Important

   - Do not allow the brake components to hang from the flexible hoses as damage to the hoses may occur.
5. Inboard pad (6).
   - Retainer spring (5).
6. Outboard pad (7).
7. Sleeves (2).
8. Bushings (3 and 4).

Inspect

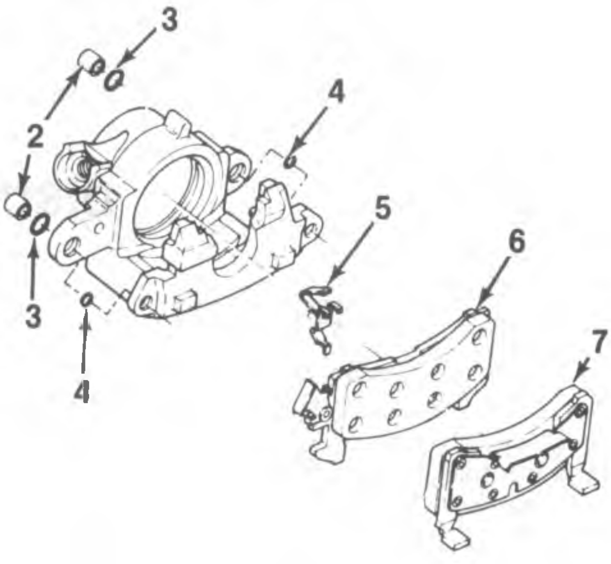
— The inside of the caliper assembly for signs of fluid leakage, if found, refer to "Rebuilding the Caliper" in this section.

— Mounting bolts and sleeves for corrosion. Do not attempt to polish away corrosion, replace the bolts.

→← Install or Connect (Figure 35)

- Lubricate the sleeves and bushings with Delco Silicone Lube or equivalent.

1. Bushings (3 and 4).
   - Sleeves (2).
2. Retainer spring (5) onto the inboard pad (6).
   - Inboard pad (6).
3. Outboard pad (7).
4. Caliper assembly.



2. Sleeves
3. Bushings
4. Bushings
5. Retainer Spring
6. Inboard Pad
7. Outboard Pad

B-07829

Figure 35—Replacing Disc Brake Linings (3000/3100 Models)

! Important

- Make sure that the brake hose is not twisted or kinked since damage to the hose could result.

NOTICE: See "Notice" on page 5-1.

5. Mounting bolts (1) (Figure 37).

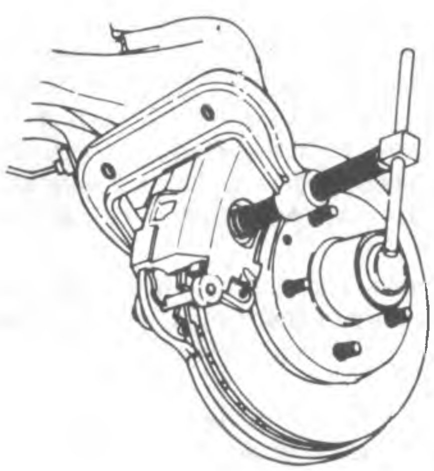


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Figure 36—Compressing The Caliper Piston

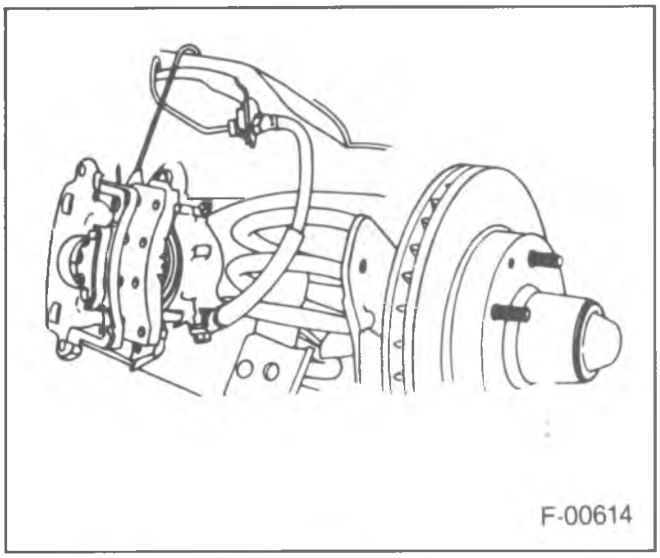


Figure 38—Suspending The Caliper

Tighten

- Bolts to 50 N·m (37 ft. lbs.)

6. Compress the pad ears to the caliper (figure 39).

Measure (Figure 40)

- The clearance between the caliper and the steering knuckle. The clearance at each end of the caliper should be measured individually and added together, this total should be between 0.26 - 0.60 mm (0.010 - 0.024-inches).

7. Wheel and tire assembly, refer to WHEELS AND TIRES (Sec. 3E).
8. Lower the vehicle.

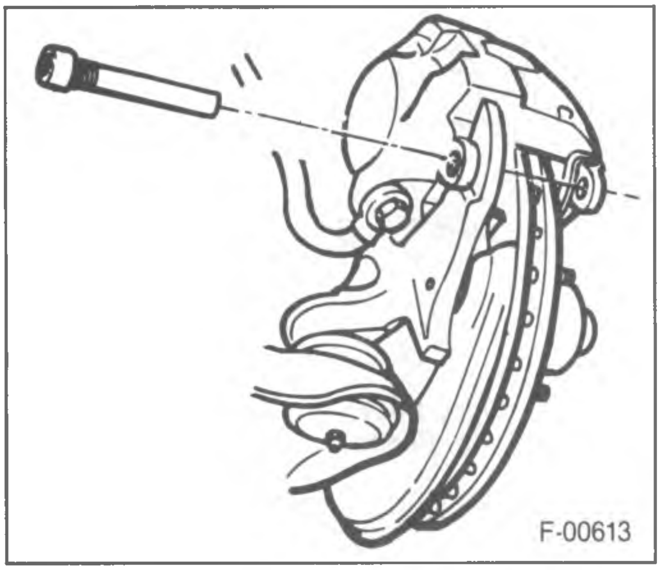


Figure 37—Removing The Mounting Bolts

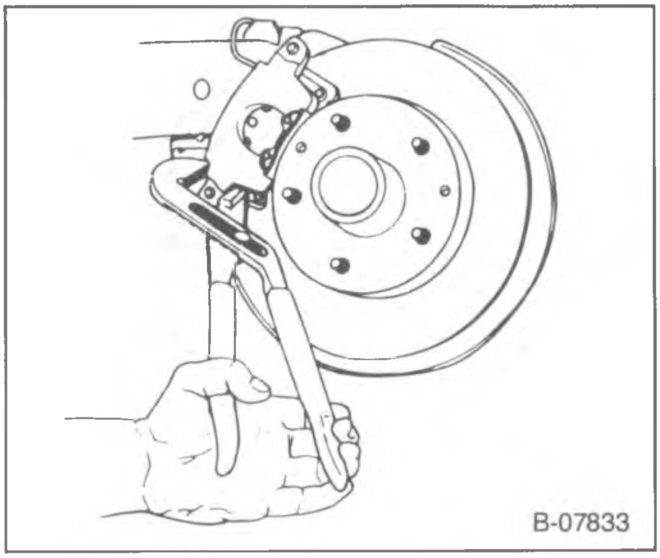


Figure 39—Compressing The Pad Ears

Important

- Before moving the vehicle, pump the brake pedal several times to make sure that the pedal is firm. Do not move the vehicle until a firm pedal is obtained. Check the brake fluid level in the master cylinder after pumping the brakes.

BENDIX MODEL

Remove or Disconnect (Figures 41 and 42)

- $^2/_3$ of the brake fluid from the master cylinder.
- Raise the vehicle and support it with suitable safety stands.
- Mark the relationship of the wheel to the hub.

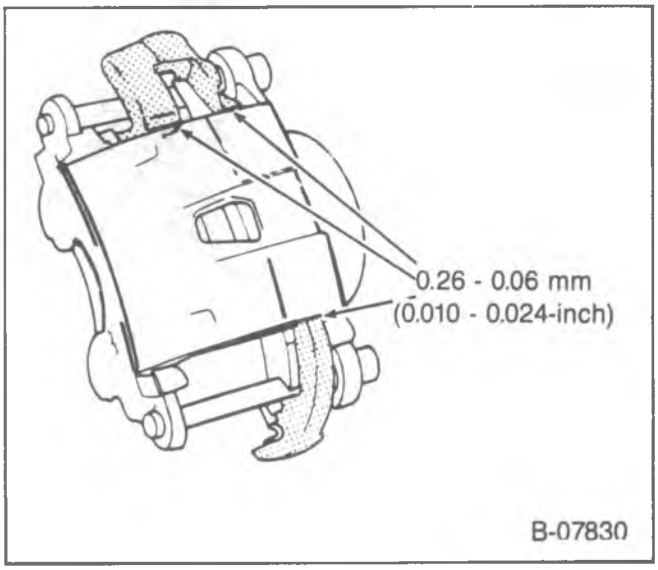


Figure 40—Caliper Clearances

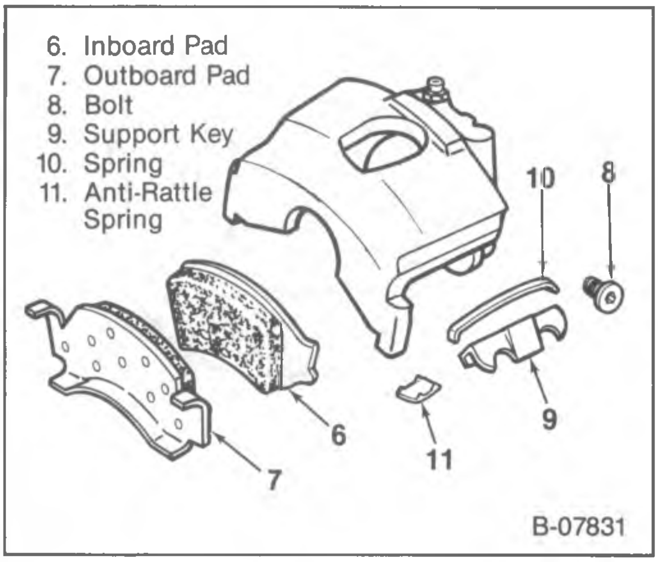


Figure 41—Replacing Disc Brake Linings (Bendix Models)

1. Wheel and tire assembly, refer to WHEELS AND TIRES (Sec. 3E).

CAUTION: See "Caution" on page 5-1.

2. Position C - clamp and tighten until the piston bottoms in its bore (figure 43).
    - C - clamp.

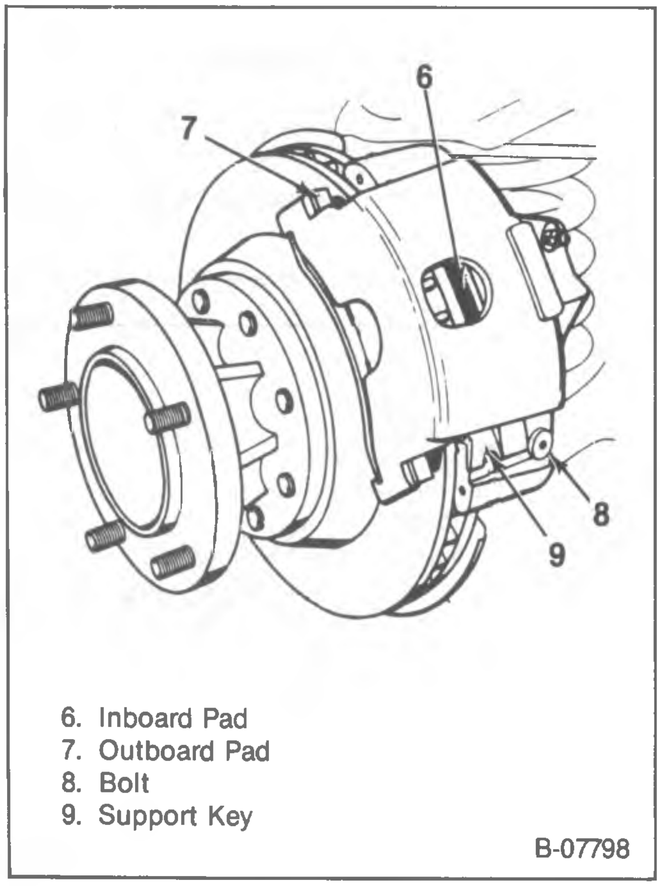


Figure 42—Bendix Disc Brake Assembly

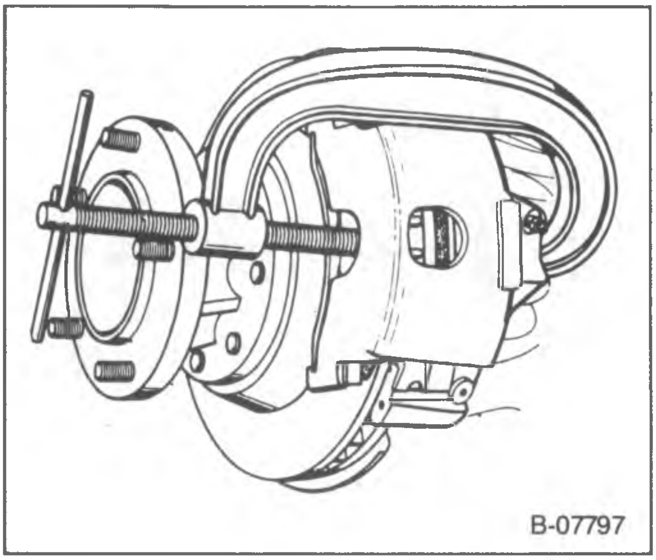


Figure 43—Compressing The Caliper Piston

3. Bolt (8).
4. Support key (9) and spring (10).
    - Use a brass punch and a hammer to drive the support key out (figure 44).
5. Caliper assembly.
    - Suspend the caliper from the suspension (figure 45).

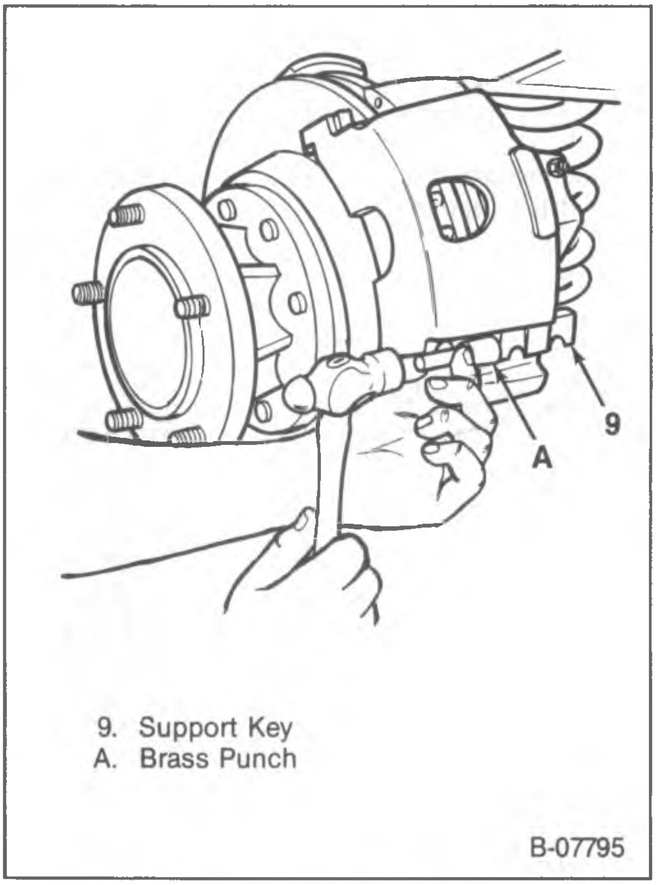


Figure 44—Removing The Support Key

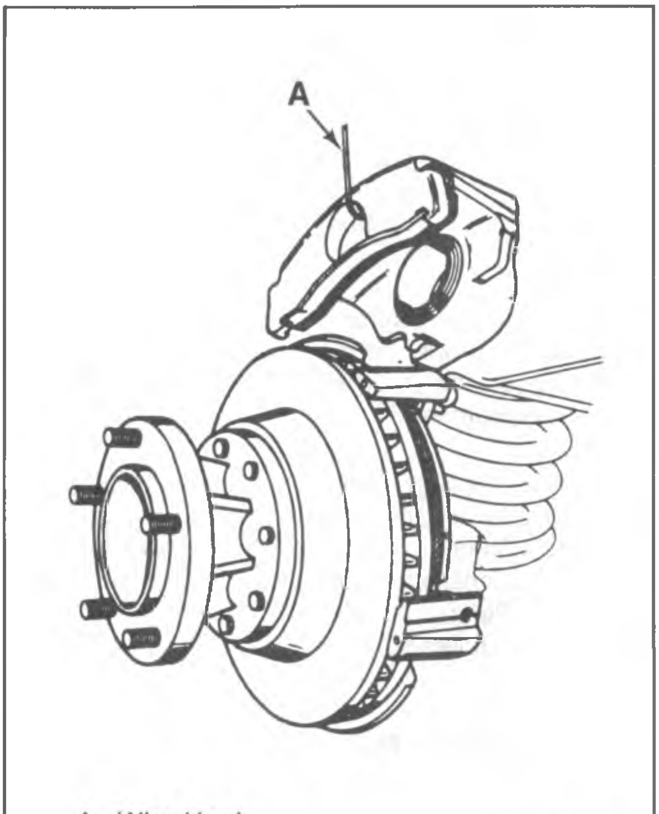


Figure 45—Suspending The Caliper

Important

— Do not allow the brake components to hang from the flexible hoses as damage to the hoses may occur.

6. Inboard pad (6) from the steering knuckle or rear caliper support.
   - Anti-rattle spring (11).
7. Outboard pad (7).

Inspect

– The inside of the caliper assembly for signs of fluid leakage, if found, refer to "Rebuilding the Caliper" in this section.

Clean

– Use a wire brush to remove any corrosion from the machined surfaces of the steering knuckle and caliper.

Install or Connect (Figures 41 and 42)

- Lubricate the caliper and steering knuckle (or support) sliding surfaces and spring with Delco Silicone Lube or equivalent.

1. Inboard pad (6) and anti-rattle spring (11).
2. Outboard pad (7) into the caliper assembly.

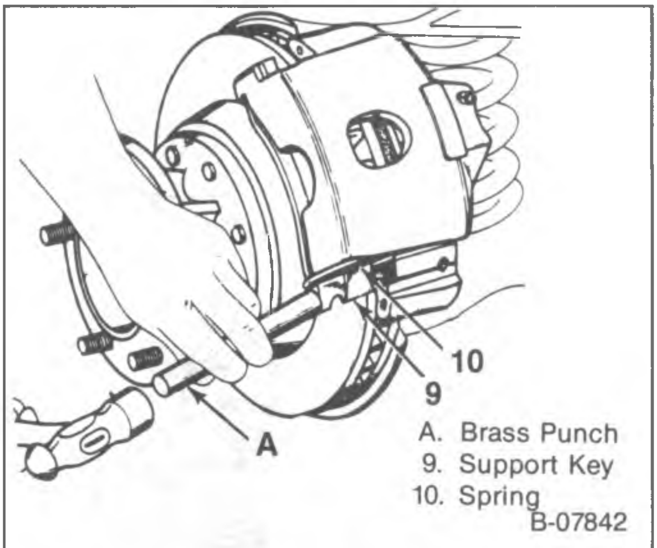


Figure 46—Installing The Support Key

3. Caliper assembly.

Important

- Make sure that the brake hose is not twisted or kinked since damage to the hose could result.

4. Spring (10) and support key (9).
   - Use a brass punch and a hammer to drive the support key in (figure 46).

NOTICE: See "Notice" on page 5-1.

5. Bolt (8).
   - The boss on the bolt must fully fit into the circular cutout in the key.

Tighten

- Bolt to 20 N·m (15 ft. lbs.).

6. Wheel and tire assembly, refer to WHEELS AND TIRES (Sec. 3E).
7. Lower the vehicle.

Important

- Before moving the vehicle, pump the brake pedal several times to make sure that the pedal is firm. Do not move the vehicle until a firm pedal is obtained. Check the brake fluid level in the master cylinder after pumping the brakes.

SERVICING THE ROTOR

In the manufacturing of the brake rotor all the tolerances regarding surface finish, parallelism, and lateral runout are held very closely. The maintenance

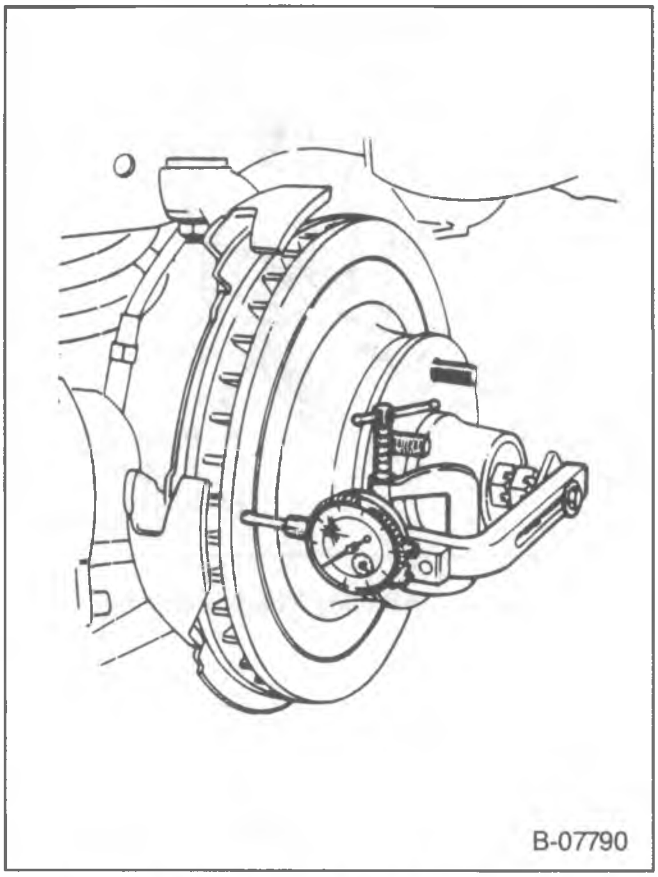


Figure 47—Checking For Lateral Runout

of these tolerances provide the surface necessary to prevent brake roughness.

Light scoring of the rotor surface not in excess of 0.38 mm (0.15-inch) in depth is normal. This condition does not affect the brake operation.

LATERAL RUNOUT

Lateral runout is the movement of the rotor from side to side as it rotates on the spindle. This could also be refered to as "rotor wobble".

This movement causes the brake pad and piston to be knocked back into it's bore. This results in additional pedal travel and a vibration during braking.

Checking Lateral Runout (Figure 47)

1. Tighten the wheel bearings to eliminate all freeplay.
2. Attach a dial indicator to some portion of the suspension.
   - The point of the styles must contact the rotor face about 25 mm (1-inch) from the rotor edge.
3. Move the rotor one complete rotation.
   - The lateral runout should not exceed 0.10 mm (0.004-inch).
4. Readjust the wheel bearings, refer to FRONT SUSPENSION (Sec. 3C).

PARALLELISM

Parallelism is the measurement of 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. The rotor thickness must not vary more than 0.013 mm (0.0005-inch) from point to point.

MACHINING

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.

All brake rotors have a minimum thickness dimension cast into them. This dimmension is the minimum wear dimension and not a refinish dimension. Do not use a brake rotor that will not meet the specifications, after refinishing. Replace with a new brake rotor. Refer to "Specification" in this section for final maching tolerances.

REBUILDING THE CALIPER

3000/3100 MODELS

Disassemble (Figure 48)

- Drain all the fluid from the caliper.
- Pad the interior of the caliper with clean shop towels.

CAUTION: Do not place your fingers in front of the piston in an attempt to catch or protect it when applying compressed air. This could result in serious injury.

NOTICE: Use just enough air to ease the piston out of the bore. If piston is blown out—even with padding provided, it may be damaged.

1. Piston (22) (figure 49)
2. Boot (23) (figure 50).
   - Use care not to scratch the housing bore.
3. Piston seal (21).
   - Do not use any type of metal tool.
4. Bleeder valve (20).

Clean

- Bleeder valve, caliper bore, caliper passages, and piston with denatured alcohol. Use dry, filtered compressed air to dry parts and blow out passages.

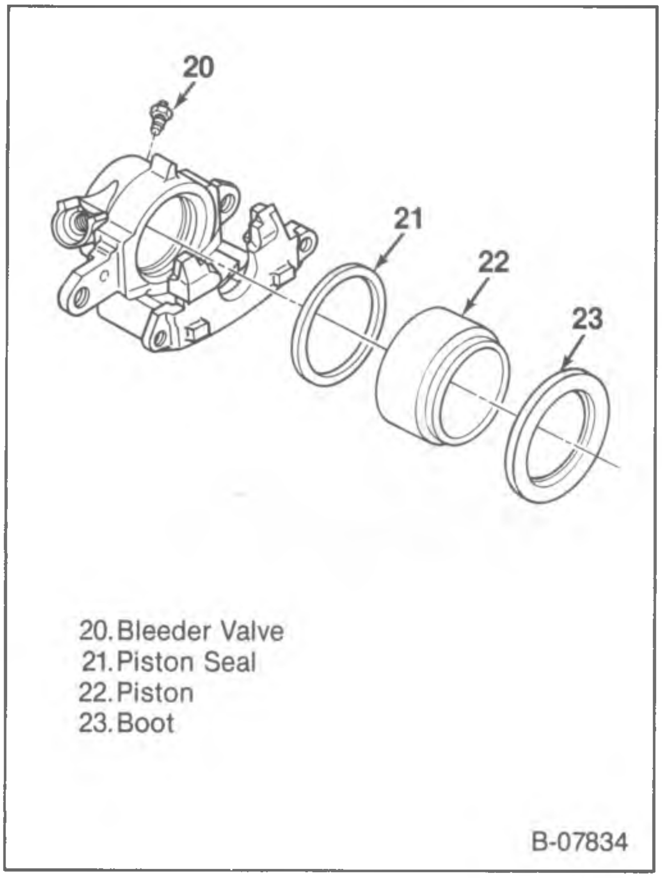


Figure 48—Models 3000/3100 Caliper Components

Inspect

- — Piston for scoring, corrosion and any damage to the chrome plating, replace if found.
- — Caliper bore for scoring, pitting, or corrosion. Use crocus cloth to polish out any light corrosion. Replace caliper if corrosion cannot be removed.

Assemble (Figure 48)

Tool required:

J-26267 Piston Seal Installer

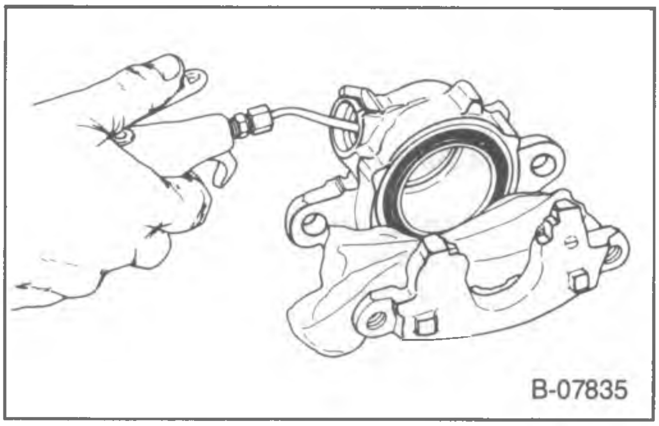


Figure 49—Removing The Piston

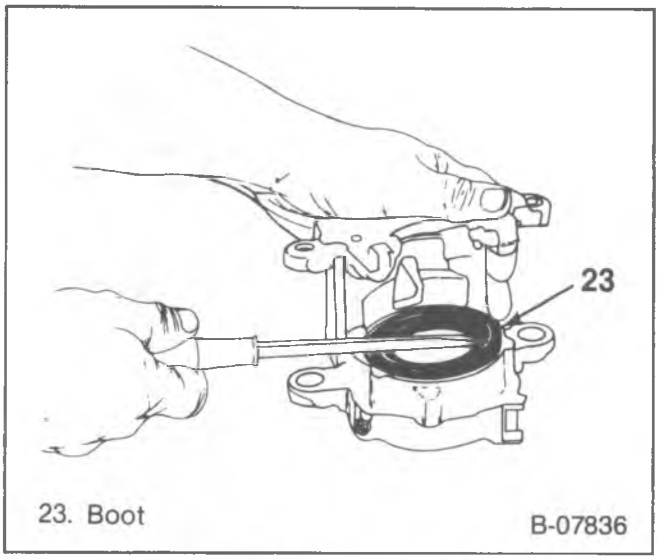


Figure 50—Removing The Boot

- Lubricate the new piston seal, caliper bore, and piston with clean brake fluid.

1. Piston seal (21).

- Make sure the seal is not twisted in the caliper bore groove.

2. Boot (23) onto the piston (22).
    - Piston (22).
3. Boot (23) into the caliper housing counterbore using tool J-26267 (figure 51).

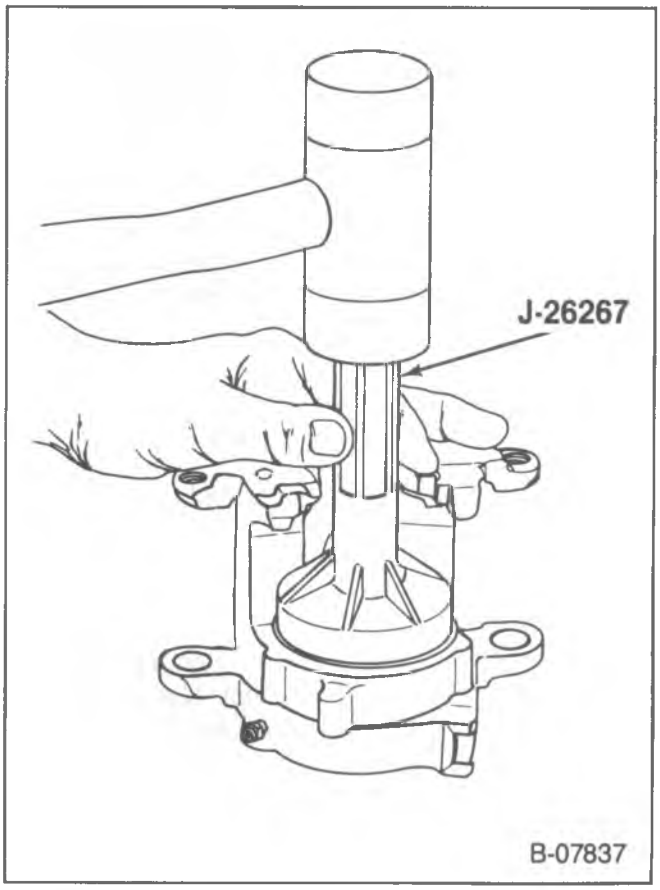


Figure 51—Installing The Caliper Boot

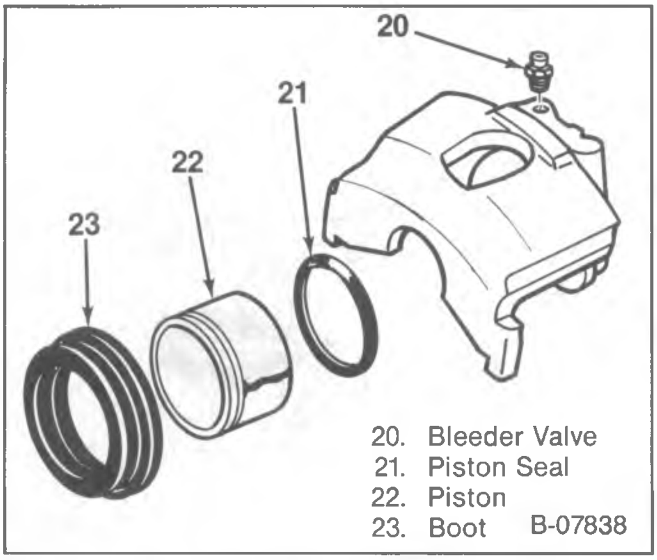


Figure 52—Bendix Model Caliper Components

4. Bleeder valve (20).

BENDIX MODEL

Disassemble (Figure 52)

- Drain all the fluid from the caliper.
- Pad the interior of the caliper with clean shop towels.

CAUTION: Do not place your fingers in front of the piston in an attempt to catch or protect it when applying compressed air. This could result in serious injury.

NOTICE: Use just enough air to ease the piston out of the bore. If piston is blown out—even with padding provided, it may be damaged.

1. Piston (22) (figure 49).
2. Boot (23).
3. Piston seal (21).
   - Do not use any type of metal tool.
4. Bleeder valve (20).

Clean

— Bleeder valve, caliper bore, caliper passages, and piston with denatured alcohol. Use dry, filtered compressed air to dry parts and blow out passages.

Inspect

— Piston for scoring, corrosion and any damage to the chrome plating, replace if found.

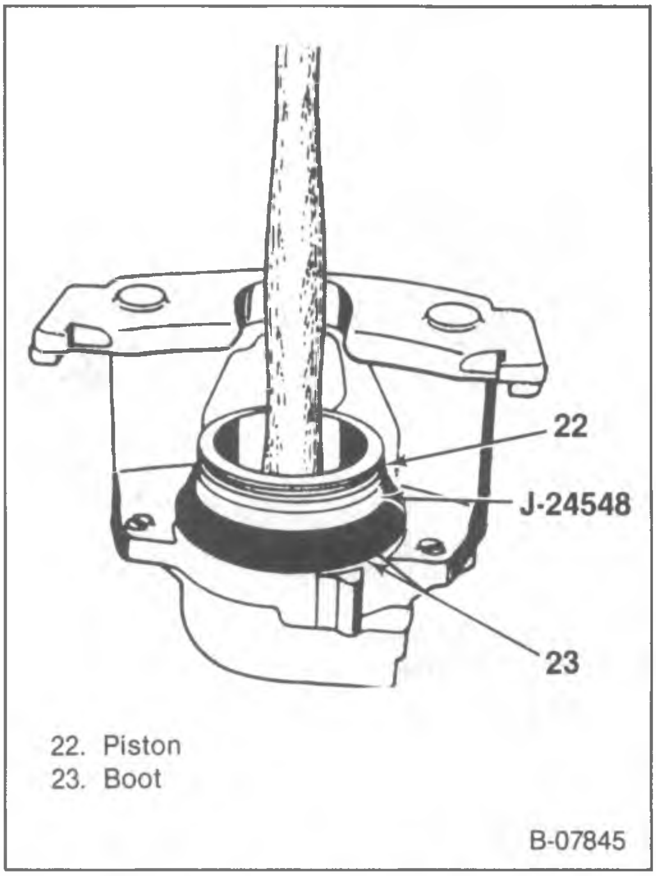


Figure 53—Installing The Piston

— Caliper bore for scoring, pitting, or corrosion. Use corcus cloth to polish out any light corrosion. Replace caliper if corrosion cannot be removed.

Assemble (Figure 52)

Tool required:
J-24548 Piston Seal Installer

- Lubricate the new piston seal, caliper bore, piston, and seal lips on boot with clean brake fluid.

1. Piston seal (21).
   - Make sure the seal is not twisted in the caliper bore groove.
2. Boot (23) on tool J-24548.
   - Place the large diameter of the boot over the tool first and ride the smaller diameter onto the tool.
   - The large diameter must then slide off the tool.
3. The large lip of the boot into the groove in the caliper bore.
   - The lip of the boot must be firmly slated in the groove.
4. Piston (22) inside tool J-24548 (figure 53).
   - Press the piston half way into its bore.
5. Remove tool J-24548.
   - Make sure the boot is firmly seated.
6. Bleeder valve (20).

DRUM BRAKES

DESCRIPTION

The drum brake assembly is a duo - servo design. With this particular design, the force which is applied by the wheel cylinder to the primary shoe is multiplied by the primary lining friction to provide a large applied force to the secondary shoe. The torque from the brake shoes is transferred to the anchor pin and through the backing plate, to the axle flange. Brake adjustments are automatic and are made during reverse brake applications.

BRAKE LINING REPLACEMENT

Remove or Disconnect (Figure 54)

- Raise the vehicle and support with suitable safety stands.
- Mark the relationship of the wheel to the hub.

1. Wheel and tire assembly, refer to WHEELS AND TIRES (Sec. 3E).

— Mark the relationship of the drum to the axle.

CAUTION: See "Caution" on page 5-1.

2. Drum
3. Return springs (12 and 13).
    - Shoe guide (7).
4. Hold down springs (14).
    - Hold down pins. (1).
5. Actuator lever (10) and lever pivot (15).
    - Lever return spring (16).
    - Actuator link (11).
6. Parking brake strut (8).
    - Strut spring (9).
7. Retaining ring (6).
    - Parking brake lever (4) and washer (4).
8. Shoes (5 and 19).
    - Adjusting screw assembly (17).
    - Adjusting screw spring (18).

Important

Do not interchange the right and left adjusting screws.

Inspect

— All parts for discoloration due to heat, or stress. Replace if necessary.

— All parts for signs of wear. Replace if necessary.

— Wheel cylinder for signs of leakage, refer to "Rebuilding The Wheel Cylinder."

— Brake drum for scoring, and machining tolerance, refer to "Servicing The Brake Drum."

Install or Connect (Figure 54)

— Lubricate the shoe pads and adjusting screw threads with a thin coat of white lithium grease.

1. Adjusting screw (17) and adjusting screw spring (18) to both shoes (19 and 5).

— The coils of the spring must not touch the adjusting screw.

2. Shoe assembly.
3. Parking brake lever (3) and washer (4) into the shoe.
    - Retaining ring (6).
4. Strut spring (9) onto the parking brake strut (8).
    - Parking brake strut (8).
5. Actuator lever (10) and lever pivot (15).
    - Actuator link (11).
    - Lever return spring (16).
6. Hold down pins (1).
    - Hold down springs (14).
7. Return springs (12 and 13).
8. Drum.

— Align the marks made during disassembly.

9. Wheel and tire assembly, refer to WHEELS AND TIRES (Sec. 3E).

— Align the marks made during disassembly.

10. Adjust the brakes, refer to "Brake Adjustment" in this section.

SERVCING THE BRAKE DRUM

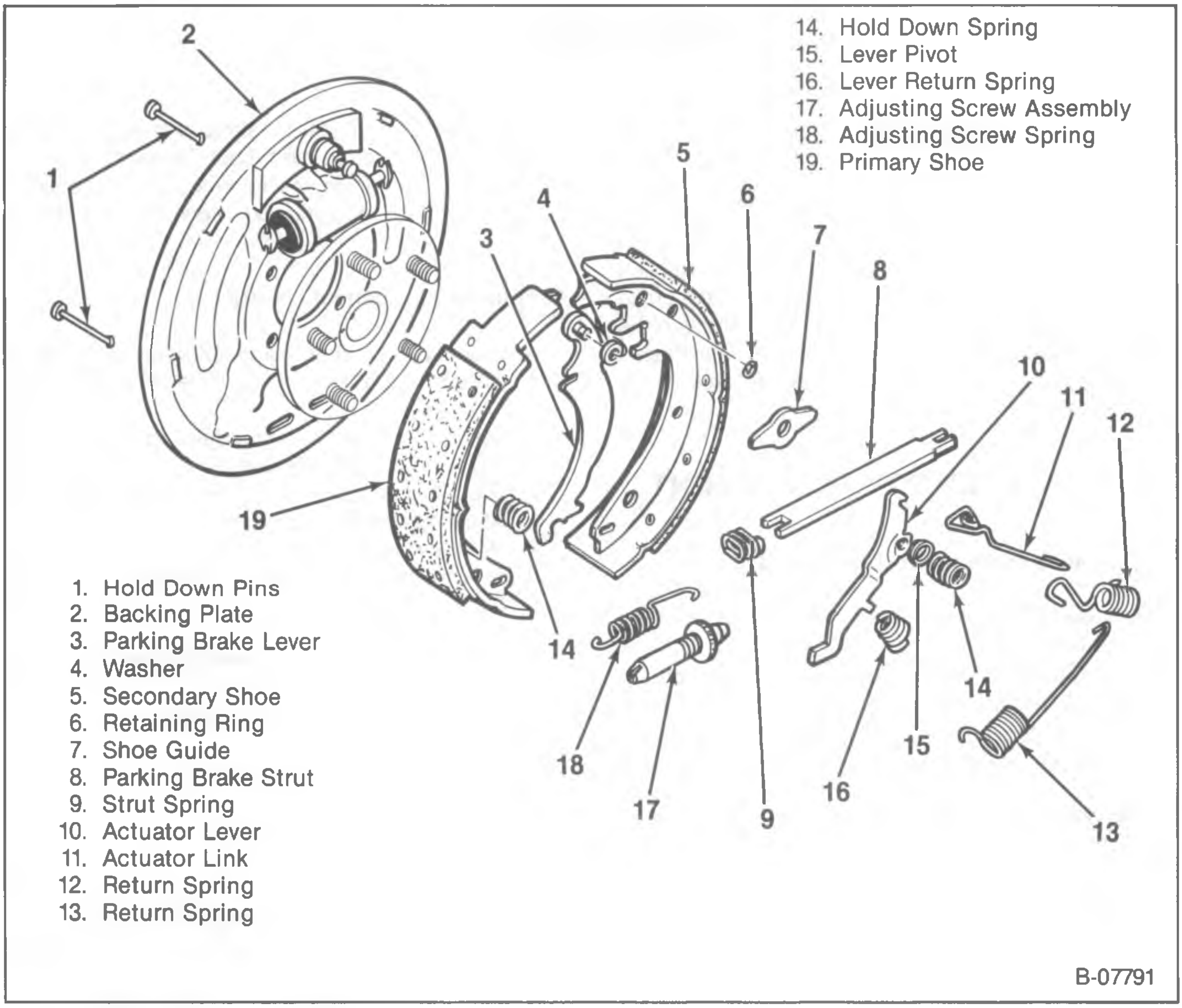
Whenever the brake drums are removed, they should be thoroughly cleaned and inspected for cracks, scores, deep grooves and out-of-round.

CRACKED, SCORED, OR GROOVED DRUM

A cracked drum is unsafe for further service and must be replaced. Do not attempt to weld a cracked drum.

Smooth up any slight scores. Heavy or extensive scoring will cause excessive brake lining wear, and it will probably be necessary to machine the drum braking surface.

If the brake linings are slightly worn and the drum is grooved, the drum should be polished with fine emery cloth but should not be machined. At this stage, eliminating all the grooves in the drum and smoothing



1. Hold Down Pins
2. Backing Plate
3. Parking Brake Lever
4. Washer
5. Secondary Shoe
6. Retaining Ring
7. Shoe Guide
8. Parking Brake Strut
9. Strut Spring
10. Actuator Lever
11. Actuator Link
12. Return Spring
13. Return Spring
14. Hold Down Spring
15. Lever Pivot
16. Lever Return Spring
17. Adjusting Screw Assembly
18. Adjusting Screw Spring
19. Primary Shoe

Figure 54—Drum Brake Components

the ridges on the lining would require the removal of too much metal and lining, while if left alone, the grooves and ridges match and satisfactory service can be obtained.

If brake linings are to be replaced, a grooved drum should be machined. A grooved drum, if used with new lining, will not only wear the lining, but will make it difficult, if not impossible to obtain efficient brake performance.

OUT-OF-ROUND OR TAPERED DRUM

An out-of-round drum makes accurate brake shoe adjustment impossible and is likely to cause excessive wear of other parts of brake mechanism due to its eccentric action. An out-of-round drum can also cause severe and irregular tire tread wear as well as a pulsing brake pedal. When the braking surface of a brake drum exceeds the specification limits in taper (and/or) out-of-round, the drum should be machined to true up the braking surface. Out-of-round as well as taper and wear can be accurately measured with an inside micrometer fitted with proper extension rods.

When measuring a drum for out-of-round, taper and wear, take measurments at the open and closed edges of machined surface and at right angles to each other.

MACHINING THE DRUM

If a drum is to be machined, only enough metal should be removed to obtain a true, smooth braking surface. If a drum does not clean-up when machined to a maximum diameter it must be replaced, refer to "Specifications" in this section. Removal of more metal will affect dissipation of heat and may cause distortion of the drum.

All brake drums have a maximum diameter cast into them. This diameter is the maximum wear diameter. Do not machine a brake drum that will not meet the specification, refer to "Specifications" in this section.

BRAKE ADJUSTMENT

A manual adjustment of the rear brakes is required after the rear linings have been replaced. The front disc brakes require not adjustment.

CAUTION: Refer to "Caution" on page 5-1.

1. Remove the lanced area in the brake backing plate.
    - The metal lanced area must be removed from the brake assembly.

Adjust

- Brake adjusting screw until the wheel can just be turned by hand.
- The brake drag should be equal at both wheels.
- Back off the adjusting screw 33 notches.

Important

- Brakes should have no drag after the screw has been backed off about 15 notches. If a heavy drag is present refer to "Parking Brake Adjustment."

2. Install an adjusting hole cover in the brake backing plate.
3. Check parking brake adjustment.

WHEEL CYLINDER REPLACEMENT

Remove or Disconnect (Figure 55)

CAUTION: See "Caution" on page 5-1.

1. Brake linings, refer to "Brake Lining Replacement."
2. Brake pipe.
3. Bolts.
4. Wheel cylinder.

Install or Connect (Figure 55)

1. Wheel cylinder.
2. Bolts.

Tighten

- Bolts to 18 N·m (160 in. lbs.).

3. Brake pipe.
4. Brake linings, refer to "Brake Lining Replacement."

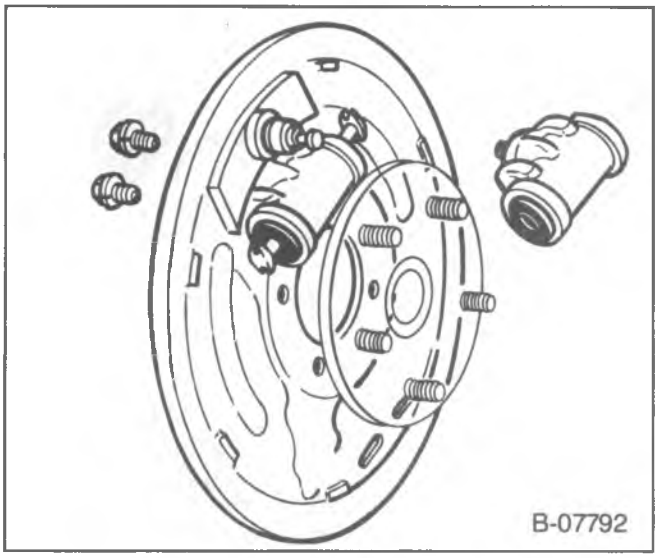


Figure 55—Removing The Wheel Cylinder

5. Bleed brake system, refer to "Bleeding the Brake Hydraulic System."

REBUILDING THE WHEEL CYLINDER

Disassemble (Figure 56)

1. Remove wheel cylinder, refer to "Wheel Cylinder Replacement."
2. Boots (54).
3. Pistons (53).
4. Seals (52).
5. Spring assembly (55).

Inspect

— Cylinder bore for scoring and corrosion.

— Spring assembly for signs of discoloration due to heat. Replace if necessary.

Clean

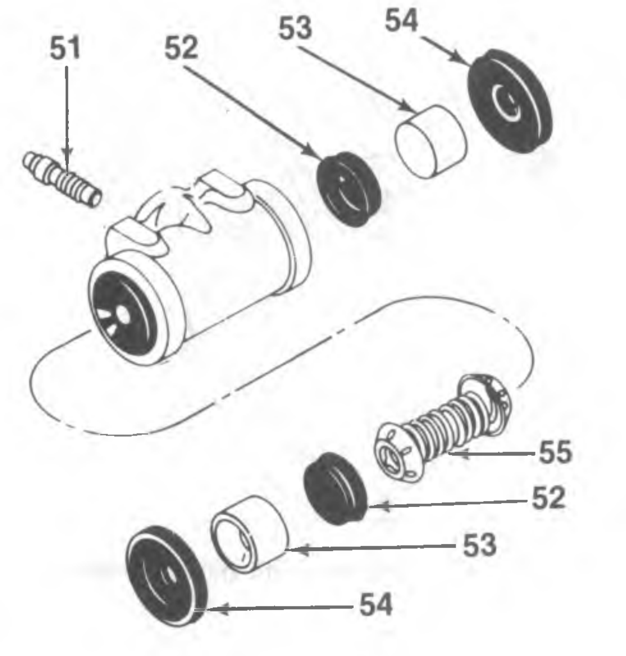
— Inside the cylinder bore with crocus cloth. If the bore is still scored replace the cylinder.

— Cylinder with clean brake fluid.

Assemble (Figure 56)

— Lubricate seals and cylinder bore with clean brake fluid.

1. Spring assembly (55).
2. Seals (52).
3. Pistons (53).



51. Bleeder Valve
52. Seal
53. Piston
54. Boot
55. Spring Assembly

B-07793

Figure 56—Wheel Cylinder Components

4. Boots (54).
5. Wheel cylinder, refer to "Wheel Cylinder Replacement."

SPECIFICATIONS

BRAKE SYSTEMS

SYSTEM	FRONT BRAKES	REAR BRAKES	BRAKE ASSIST
	GASOLINE ENGINE VEHICLES		
	C-MODELS		
JB1 Low Drag	Disc 11.86 x 1.04	Drum 11.0 x 2.00	None (Manual Brakes)
JB3 Low Drag	Disc 11.86 x 1.04	Drum 11.0 x 2.00	Vacuum—Single Diaphragm
	G-MODELS		
JB1 Low Drag	Disc 11.86 x 1.29	Drum 11.00 x 2.00	None (Manual Brakes)
JB3 Low Drag	Disc 11.86 x 1.29	Drum 11.00 x 2.00	Vacuum—Single Diaphragm
	ALL MODELS		
JB5 Low Drag	Disc 11.86 x 1.29	Drum 11.15 x 2.75	Vacuum—Dual Diaphragm
JB6 Low Drag	Disc 12.50 x 1.28	Drum 11.15 x 2.75	Vacuum—Dual Diaghragm
JB7 Conventional	Disc 12.50 x 1.28	Drum 13.00 x 2.50	Vacuum—Dual Diaphragm
JB8 Conventional	Disc 12.50 x 1.54	Drum 13.00 x 3.50	Hydraulic—Hydro-Boost
JF9 Conventional	Disc 14.25 x.1.54	Disc 13.75 x 1.54	Hydraulic—Hydro-Boost
	DIESEL ENGINE VEHICLES		
JD3 Low Drag	Disc 11.86 x 1.29	Drum 11.00 x 2.00	Hydraulic—Hydro-Boost
JD5 Low Drag	Disc 11.86 x 1.29	Drum 11.15 x 2.75	Hydraulic—Hydro-Boost
JD6 Conventional	Disc. 12.50 x 1.28	Drum 11.15 x 2.75	Hydraulic-Hydro-Boost
JD7 Conventional	Disc 12.50 x 1.28	Drum 13.00 x 2.50	Hydraulic—Hydro-Boost

DRUM DIAMETERS

ORIGINAL	MAXIMUM REFINISH	REPLACEMENT (DISCARD)
11.000	11.060	11.090
11.150	11.210	11.240
12.000	12.060	12.090
13.000	13.060	13.090

ROTOR THICKNESS

MINIMUM AFTER REFININSHING	REPLACEMENT (DISCARD)
1.480	1.465
1.230	1.215
0.980	0.965

TORQUE SPECIFICATIONS

<table>
<tr><th></th><th>C</th><th>K</th><th>G</th><th>P</th></tr>
<tr><td>Master Cylinder—to Dash or Booster</td><td>44 N·m (32 ft. lbs.)</td><td>44 N·m (32 ft. lbs.)</td><td>34 N·m (25 ft. lbs.)</td><td>34 N·m (25 ft. lbs.)</td></tr>
<tr><td>Booster to Dash or Frame</td><td>44 N·m (32 ft. lbs.)</td><td>44 N·m (32 ft. lbs.)</td><td>34 N·m (25 ft. lbs.)</td><td>34 N·m (25 ft. lbs.)</td></tr>
<tr><td>Combination Valve —Mounting Bolts</td><td>17 N·m (150 in. lbs.)</td><td>17 N·m (150 in. lbs.)</td><td>23 N·m (17 ft. lbs.)</td><td>23 N·m (17 ft. lbs.)</td></tr>
<tr><td>—Bracket</td><td>—</td><td>—</td><td>34 N·m (25 ft. lbs.)</td><td>34 N·m (25 ft. lbs.)</td></tr>
<tr><td>Caliper—Mounting Bolt</td><td colspan="4">48 N·m (35 ft. lbs.)</td></tr>
<tr><td>—Support Plate to Knuckle</td><td colspan="4">16 N·m (140 in. lbs.)</td></tr>
<tr><td>Brake Pedal —Bracket to Dash</td><td>34 N·m (25 ft. lbs.)</td><td>34 N·m (25 ft. lbs.)</td><td>17 N·m (150 in. lbs.)</td><td>34 N·m (25 ft. lbs.)</td></tr>
<tr><td>—Bracket to I.P.</td><td>34 N·m (25 ft. lbs.)</td><td>34 N·m (25 ft. lbs.)</td><td>—</td><td>—</td></tr>
<tr><td>—Pivot Bolt Nut</td><td>34 N·m (25 ft. lbs.)</td><td>34 N·m (25 ft. lbs.)</td><td>—</td><td>—</td></tr>
<tr><td>—Sleeve to Bracket</td><td>—</td><td>—</td><td>—</td><td>9.5 N·m (85 in. lbs.)</td></tr>
<tr><td>—Stoplamp Switch Bracket</td><td>34 N·m (25 ft. lbs.)</td><td>34 N·m (25 ft. lbs.)</td><td>34 N·m (25 ft. lbs.)</td><td>—</td></tr>
<tr><td>—Push Rod to Pedal</td><td>—</td><td>—</td><td>—</td><td>34 N·m (25 ft. lbs.)</td></tr>
<tr><td>—Push Rod Adjusting Nut</td><td>—</td><td>—</td><td>—</td><td>30 N·m (22 ft. lbs.)</td></tr>
<tr><td>Parking Brake —to Dash</td><td>12 N·m (100 in lbs.)</td><td>12 N·m (100 in. lbs.)</td><td>12 N·m (100 in. lbs.)</td><td>—</td></tr>
<tr><td>—to I.P. Kick Panel or Floorpan</td><td>17 N·m (100 in. lbs.)</td><td>17 N·m (100 in. lbs.)</td><td>12 N·m (100 in. lbs.)</td><td>24 N·m (18 ft. lbs.)</td></tr>
<tr><td>—Cable Clips—Screws</td><td>17 N·m (150 in. lbs.)</td><td>—</td><td>12 N·m (100 in. lbs.)</td><td>17 N·m (150 in. lbs.)</td></tr>
<tr><td>—Bolts</td><td>17 N·m (150 in. lbs.)</td><td>—</td><td>24 N·m (18 ft. lbs.)</td><td>6 N·m (55 in. lbs.)</td></tr>
<tr><td>Propshaft Parking Brake —Adjusting Nut</td><td>—</td><td>—</td><td>—</td><td>40 N·m (30 ft. lbs.)</td></tr>
<tr><td>—Bracket to Trans.</td><td>—</td><td>—</td><td>—</td><td>27 N·m (20 ft. lbs.)</td></tr>
<tr><td>—Cable Clip to Frame</td><td>—</td><td>—</td><td>—</td><td>17 N·m (150 in. lbs.)</td></tr>
<tr><td>—Cable Clip to Dash</td><td>—</td><td>—</td><td>—</td><td>6 N·m (55 in. lbs.)</td></tr>
<tr><td>—Cable Clip to Trans. Brkt.</td><td>—</td><td>—</td><td>—</td><td>27 N·m (20 ft. lbs.)</td></tr>
<tr><td>—Flange Plate</td><td>—</td><td>—</td><td>—</td><td>40 N·m (30 ft. lbs.)</td></tr>
<tr><td>—Drum</td><td>—</td><td>—</td><td>—</td><td>110 N·m (80 ft. lbs.)</td></tr>
<tr><td>Wheel Cylinder to Flange Plate Bolt</td><td colspan="4">5.5 N·m (50 in. lbs.)/20 N·m (180 in. lbs.) on JB5, JB6, JB7, and JB8</td></tr>
<tr><td>Rear Brake Anchor Pin</td><td colspan="4">190 N·m (140 ft. lbs.)/312 N·m (230 ft. lbs.) JB7 and JB8</td></tr>
<tr><td>Front Brake Hose —to Caliper</td><td colspan="4">44 N·m (32 ft. lbs.)</td></tr>
<tr><td>—to Frame Nut</td><td colspan="4">7 N·m (58 in. lbs.)</td></tr>
<tr><td>—Bracket Bolt</td><td>17 N·m (150 in. lbs.)</td><td>—</td><td>17 N·m (150 in. lbs.)</td><td>17 N·m (150 in. lbs.)</td></tr>
<tr><td>Rear Brake Hose—to Axle Bracket</td><td>27 N·m (20 ft. lbs.)</td><td>27 N·m (20 ft. lbs.)</td><td>10 N·m (90 in. lbs.)</td><td>17 N·m (150 in. lbs.)</td></tr>
<tr><td>—Bracket to Axle</td><td>17 N·m (150 in. lbs.)</td><td>17 N·m (150 in. lbs.)</td><td>—</td><td>17 N·m (150 in. lbs.)</td></tr>
<tr><td>Brake Line —Attaching Nuts</td><td colspan="4">17 N·m (150 in. lbs.)</td></tr>
<tr><td>—Retaining Clips—Screws</td><td>17 N·m (150 in. lbs.)</td><td>17 N·m (150 in. lbs.)</td><td>12 N·m (100 in. lbs.)</td><td>17 N·m (150 in. lbs.)</td></tr>
<tr><td>—Bolts</td><td>—</td><td>—</td><td>17 N·m (150 in. lbs.)</td><td>24 N·m (18 ft. lbs.)</td></tr>
<tr><td>Brake Bleeder Valves</td><td colspan="4">7 N·m (60 in. lbs.)</td></tr>
<tr><td>Hydro—Boost— —Pedal Rod — P30 (32) Models</td><td>—</td><td>—</td><td>—</td><td>34 N·m (25 ft. lbs.)</td></tr>
<tr><td>—Pedal Rod Boot — P 30 (32) Models</td><td>—</td><td>—</td><td>—</td><td>20 N·m (15 ft. lbs.)</td></tr>
<tr><td>—Pivot Lever Rod Retainer</td><td>—</td><td>—</td><td>—</td><td>34 N·m (25 ft. lbs.)</td></tr>
<tr><td>—Pivot Lever Bolt</td><td>—</td><td>—</td><td>—</td><td>60 N·m (45 ft. lbs.)</td></tr>
<tr><td>—Booster Brackets</td><td>—</td><td>—</td><td>—</td><td>34 N·m (25 ft. lbs.)</td></tr>
<tr><td>—Booster Brace at Dash or Rad. Supt.</td><td>—</td><td>—</td><td>—</td><td>17 N·m (150 in. lbs.)</td></tr>
<tr><td>—Power Steering Pump to Booster Line</td><td colspan="4">34 N·m (25 ft. lbs.)</td></tr>
<tr><td>—Booster to Gear Line</td><td colspan="4">34 N·m (25 ft. lbs.)</td></tr>
<tr><td>—Return Line at Booster and Gear</td><td colspan="4">34 N·m (25 ft. lbs.)</td></tr>
<tr><td>—Return Line Clamp Screw</td><td colspan="4">1.6 N·m (15 in. lbs.)</td></tr>
<tr><td>—Line Clamp to Bracket Screw</td><td colspan="4">17 N·m (150 in. lbs.)</td></tr>
<tr><td>—Hose Clamp to Skirt Screw</td><td>4.5 N·m (40 in. lbs.)</td><td>—</td><td>—</td><td>—</td></tr>
<tr><td>—Line Clamp to Frame Bolt</td><td>17 N·m (150 in. lbs.)</td><td>—</td><td>—</td><td>17 N·m (150 in. lbs.)</td></tr>
</table>

SPECIAL TOOLS

J-29567	Brake Bleeder Adapter
J-23518-01	Brake Bleeder Adapter
J-23709	Combination Valve Depressor
J-23530	Flaring Tool
J-23533-B	Tube Cutter
J-26267	Piston Seal Installer
J-24548	Piston Seal Installer

SECTION 6

ENGINE

CONTENTS

SUBJECT **PAGE**

SECTION 6A

ENGINE

CONTENTS

SUBJECT **PAGE**

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.

GENERAL INFORMATION

STATEMENT ON CLEANLINESS AND CARE

- An engine is a combination of many machined, honed, polished and lapped surfaces with very fine tolerances.
- Whenever valve train components, cylinder head, cylinder, crankshaft, or connecting rod components are removed for service, they should be retained in order. At the time of installation, they should be installed in the same locations and with the same mating surfaces as when removed.
- Any time air cleaner, carburetor, or TBI unit is removed, the intake opening must be covered. If a diesel engine is being serviced, the recommended cover (J-29664-2 or J-26996-1) should be used. This will protect against the entrance of foreign material which could follow the intake passage into the cylinder and cause extensive damage when the engine is started.
- 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.
- On diesel engines, whenever the fuel injection pump or lines are removed or disconnected, care must be taken to prevent the entry of dirt into the pump, lines, and injectors. The entry of even small amount of dirt or other foreign material into the fuel injection system may cause serious damage.
- It should be kept in mind, while working on the engine, that the 12-volt electrical system is capable of violent and damaging 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.
- 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.
- Cover or otherwise protect exposed electrical connections to prevent damage from oil and fuel.
- 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 pickup unit.

TUNE-UP INFORMATION

All information required to tune up the vehicle's engine is given in the Engine Emission Control Label. This label is located in the engine compartment.

Information that can be found on the label includes:

- Spark plug type and gap.
- Ignition timing.
- Valve lash (if applicable).
- Idle, fast idle, and solenoid screw speeds, as applicable.
- The proper sequence for making the adjustments.
- Emission hose routing diagram (sometimes on a separate label).

USE OF RTV SEALER AND ANAEROBIC GASKET ELIMINATOR

Two types of sealer are commonly used in engines covered by this manual. These are RTV sealer and anaerobic "gasket eliminator" sealer.

It is important that these sealers be applied properly and in the proper place to prevent oil leaks. THE TWO TYPES OF SEALER ARE NOT INTERCHANGEABLE. Use the sealer recommended in the procedure.

- RTV (room temperature vulcanizing) sealer is used where a non-rigid part is assembled to a rigid part. Common examples are oil pans and rocker arm covers.
- Anaerobic gasket eliminator hardens in the absence of air. This sealer is used where two rigid parts (such as castings) are assembled together. When two rigid parts are disassembled and no sealer or gasket is readily noticeable, the parts were probably assembled using gasket eliminator.

USING RTV SEALER

1. Don't use RTV when extreme temperatures are expected, such as exhaust manifold, head gasket or where gasket eliminator is specified.
2. When separating components sealed with RTV, use a rubber mallet and "bump" the part sideways to shear the RTV sealer. "Bumping" should be done at bends or reinforced areas to prevent distortion of parts. RTV is weaker in

shear (lateral) strength than in tensile (vertical) strength.

Attempting to pry or pull components apart may result in damage to the part.

3. Surfaces to be resealed must be clean and dry. Remove all traces of oil and RTV. Clean with a chlorinated solvent such as carburetor spray cleaner. Don't use petroleum cleaners such as mineral spirits; they leave a film onto which RTV won't stick.
4. Apply RTV to one of the clean surfaces. Use a bead size as specified in the procedure. Run the bead to the inside of any bolt holes. Do not allow the sealer in any blind threaded holes, as it may prevent the bolt from seating properly or cause damage when the bolt is tightened.
5. Assemble while RTV is still wet (within 3 minutes). Don't wait for RTV to skin over.
6. Torque bolts to specifications. Don't over-torque.

USING ANAEROBIC GASKET ELIMINATOR

1. Clean surfaces to be resealed with a chlorinated solvent to remove all oil, grease and old material.
2. Apply a continuous bead of gasket eliminator to one flange.
3. Spread bead evenly with your finger to get a uniform coating on the complete flange.
4. Assemble parts in the normal manner and torque to specifications.

REPLACING ENGINE GASKETS

CAUTION: Composite type gaskets are used in some areas of the engine assembly. These gaskets have a thin metal core. Use caution when removing or handling composite gaskets to help avoid personal injury.

GASOLINE ENGINE MECHANICAL DIAGNOSIS

The following information pertains to the basic assembly only. For more diagnosis information, refer to the following:

- Overheating or other cooling system problems: Refer to COOLING (SEC. 6B).
- Cranking and ignition system problems: Refer to ENGINE ELECTRICAL (SEC. 6D).
- Starting, driveability, fuel economy, etc. problems: Refer to DRIVEABILITY AND EMISSIONS (SEC. 6E).

GASOLINE ENGINE MECHANICAL DIAGNOSIS (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Engine Will Not Turn Over	1. Battery, cranking system or other electrical problem. 2. Liquid in combustion chamber. 3. Seized engine.	1. Refer to ENGINE ELECTRICAL (SEC. 6D). 2. Remove with suction gun. 3. Repair.
Engine Cranks Normally But Does Not Start	1. Fuel or ignition system problem. 2. Restricted exhaust system. 3. Low compression due to stuck or burned valves, stuck rings, blown head gasket, etc.	1. Refer to DRIVEABILITY AND EMMISSIONS (SEC. 6E) and ENGINE ELECTRICAL (SEC. 6D). 2. Repair. 3. Perform a compression test, as outlined in this section. Repair engine as necessary.
Rough Idle	1. Fuel, ignition system or emissions system problem. 2. Uneven cylinder compression. 3. Bent pushrod or broken valve spring. 4. Faulty engine mount.	1. Refer to DRIVEABILITY AND EMISSIONS (SEC. 6E) and ENGINE ELECTRICAL (SEC. 6D). 2. Perform a compression test, as outlined in this section. Repair engine as necessary. 3. Repair. 4. Repair or replace.
White Smoke	Usually caused by water vapor, which is a normal byproduct of combustion. Usually seen on cold days.	None required.
Black Smoke	Usually caused by rich fuel mixture.	Refer to FUEL SYSTEM (SEC. 6C) and/or DRIVEABILITY AND EMISSIONS (SEC. 6E).
Blue Smoke	Usually caused by oil burning in the combustion chambers.	Refer to Excessive Oil Loss diagnosis.
Excessive Oil Loss	1. External oil leaks. 2. Improper reading of dipstick. 3. Improper oil viscosity. 4. Continuous high speed driving and/or severe usage. 5. Crankcase ventilation or PCV system malfunctioning. 6. Valve guides and/or valve stem seals worn, or seals missing. 7. Piston rings not seated. 8. Broken or worn piston rings. 9. Piston improperly installed.	1. Tighten bolts and/or replace gaskets and seals as necessary. 2. Check oil with vehicle on a level surface and allow adequate drain down time. 3. Use recommended viscosity for prevailing temperatures. 4. Continuous high speed operation and/or severe usage will normally cause decreased oil mileage. 5. Service as necessary. 6. Ream guides and install oversize service valves and/or new valve stem seals. 7. Allow adequate time for rings to seat. 8. Replace broken or worn rings as necessary. 9. Replace piston or repair as necessary.

GASOLINE ENGINE MECHANICAL DIAGNOSIS (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Low Oil Pressure	1. Slow idle speed. 2. Incorrect or faulty oil pressure switch or sensor. 3. Incorrect or faulty oil pressure gage. 4. Improper oil viscosity. 5. Diluted engine oil 6. Oil pump worn or dirty. 7. Plugged oil filter 8. Oil pickup screen loose or plugged. 9. Hole in oil pickup tube. 10. Excessive bearing clearance. 11. Cracked, porous or plugged oil galleys. 12. Galley plugs missing or mis-installed.	1. Set idle speed to specifications. 2. Replace with proper switch or sensor. 3. Replace with proper gage. 4. Replace with proper oil. 5. Change engine oil and filter. Repair cause of dilution (rich mixture, etc.) 6. Clean pump and replace worn parts as necessary. 7. Replace filter and oil. 8. Clean or replace screen as necessary. 9. Replace tube. 10. Replace as necessary. 11. Repair or replace block. 12. Install plugs or repair as necessary.
Valve Train Noise	1. Low oil pressure. 2. Loose rocker arm attachments. 3. Worn rocker arm and/or pushrod. 4. Broken valve spring. 5. Sticking valves. 6. Lifters worn, dirty or faulty. 7. Camshaft worn or faulty. 8. Worn valve guides.	1. Repair as necessary. (See diagnosis for low oil pressure). 2. Inspect and repair as necessary. 3. Replace as necessary. 4. Replace spring. 5. Free valves. 6. Refer to "Diagnosis of Hydraulic Lifters." 7. Replace camshaft. 8. Repair as necessary.
Engine Knocks Cold And Continues For Two To Three Minutes. Knock Increases With Torque.	1. EFE equipped engines may have valve knock. 2. Flywheel contacting splash shield. 3. Loose or broken torsional damper or drive pulleys. 4. Excessive piston to bore clearance. 5. Bent connecting rod.	1. Replace EFE valve. 2. Reposition splash shield. 3. Tighten or replace as necessary. 4. Replace piston. 5. Replace connecting rod.
Engine Has Heavy Knock Hot With Torque Applied.	1. Broken balancer or pulley hub. 2. Loose torque converter bolts. 3. Accessory belts too tight or nicked. 4. Exhaust system grounded. 5. Flywheel cracked or loose rivets on flywheel. 6. Excessive main bearing clearance. 7. Excessive rod bearing clearance.	1. Replace parts as necessary. 2. Tighten bolts. 3. Replace and/or tension to specs as necessary. 4. Reposition as necessary. 5. Replace flywheel. 6. Repair as necessary. 7. Repair as necessary.
Engine Has Light Knock Hot In Light Load Conditions.	1. Faulty EST or ESC system. 2. Improper timing. 3. Poor quality fuel. 4. Loose torque converter bolts. 5. Exhaust leak at manifold. 6. Excessive rod bearing clearance.	1. Refer to DRIVEABILITY AND EMISSIONS (SEC. 6E). 2. Adjust to specifications. 3. Use fuel of recommended grade. 4. Tighten bolts. 5. Tighten bolts and/or replace gaskets. 6. Replace bearings as necessary.

GASOLINE ENGINE MECHANICAL DIAGNOSIS (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Engine Knocks On Initial Start Up But Only Lasts A Few Seconds.	1. Fuel pump. 2. Improper oil viscosity. 3. Hydraulic lifter bleed down.	1. Replace pump. 2. Install proper oil viscosity for expected temperatures. 3. Refer to "Diagnosis of Hydraulic Lifters."
Engine Knocks At Idle Hot	1. Loose or worn drive belts. 2. Compressor generator bearing. 3. Fuel pump. 4. Valve train. 5. Improper oil viscosity. 6. Excessive piston pin clearance. 7. Connecting rod alignment. 8. Insufficient piston to bore clearance. (Cold engine piston knock usually disappears when the cylinder's spark plug is grounded out. Cold engine piston knock which disappears in 1.5 minutes should be considered acceptable.) 9. Loose torsional damper.	1. Tension and/or replace as necessary. 2. Replace as necessary. 3. Replace pump. 4. Refer to "Valve Train Noise." 5. Install proper viscosity oil for expected temperature. 6. Install new piston, pin and/or connecting rod as needed. 7. Check and replace rods as necessary. 8. Hone and fit new piston, if required. 9. Torque and or replace worn parts.

GASOLINE ENGINE COMPRESSION CHECK

GASOLINE ENGINE COMPRESSION CHECK

1. Disconnect the "Bat" or "B+" terminal from the distributor. Refer to ENGINE ELECTRICAL (SEC. 6D).
2. Remove all spark plugs.
3. Block the throttle plate and choke plate (if used) wide open.
4. Make sure the battery is fully charged.
5. Starting with the compression gage at zero, crank the engine through four compression strokes (four "puffs").
6. Make the compression check at each cylinder and record each reading.
7. If some cylinders have low compression, inject about 15 ml. (one tablespoon or about 3 squirts from a pump type oil can) of engine oil into the combustion chamber through the spark plug hole.
8. Minimum compression recorded in any one cylinder should not be less than 70 per cent of highest cylinder, and no cylinder should read less than 690 kPa (100 psi). For example, if the highest pressure in any one cylinder is 1035 kPa (150 psi), the lowest allowable pressure for any other cylinder would be 725 kPa (105 psi). (1035 x 70% = 725) (150 x 70% = 105).
   - Normal — Compression builds up quickly and evenly to specified compression on each cylinder.
   - Piston Rings Leaking — compression low on first stroke tends to build up on following strokes but does not reach normal. Improves considerably with addition of oil.
   - Valves Leaking — Low on first stroke. Does not tend to build up on following strokes. Does not improve much with addition of oil.
   - If two adjacent cylinders have lower than normal compression, and injecting oil into cylinders does not increase the compression, the cause may be a head gasket leak between the cylinders.

DIAGNOSIS OF HYDRAULIC LIFTERS

PROBLEM	POSSIBLE CAUSE	CORRECTION
Momentarily Noisy When Engine Is Started	This condition is normal. Oil drains from the lifters which are holding the valves open when the engine is not running. It will take a few seconds for the lifter to fill after the engine is started.	None needed.
Intermittently Noisy On Idle Only, Disappearing When Engine Speed Is Increased	1. Dirt in hydraulic lifter. 2. Pitted or damaged check ball.	1. Disassemble and clean. 2. Replace the hydraulic lifter.
Noisy At Slow Idle Or With Hot Oil; Quiet At Higher Engine Speeds Or With Cold Oil	High leak down rate.	Replace the hydraulic lifter.
Noisy At High Vehicle Speeds, Quiet At Low Speeds	1. 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. 2. Low oil level — Oil level below the "Add" mark allows the oil pump to pump air at high speeds which results in noisy lifters. 3. Oil pan bent against oil pump pickup screen. 4. Oil pump screen bent or loose.	1. Drain oil to proper level. 2. Add oil as needed. 3. Repair. 4. Repair.
Noisy At Idle, Becoming Louder As Engine Speed Is Increased To 1500 RPM	1. This noise is not connected with lifter malfunction. It becomes most noticeable in the vehicle 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: • Badly worn or scuffed valve tip and rocker arm pad. • Excessive valve stem to guide clearance. • Excessive valve seat runout. • Off square valve spring. • Excessive valve face runout. • Valve spring damper clicking on rotator.	1. Repair as necessary.

DIAGNOSIS OF HYDRAULIC LIFTERS (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Noisy At Idle, Becoming Louder As Engine Speed Is Increased To 1500 RPM (Continued)	2. Off square valve spring. 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.	2. If the valve spring is more than 1.6mm ($^1/_{16}$-inch) off square, it should be replaced.
Noisy Regardless Of Engine Speed	1. Incorrect valve adjustment (excessive lash) (engines with adjustable valve lash).	1. Adjust as specified.
	2. Excessive valve lash. Check for valve lash by turning the engine so the piston in that cylinder is on TDC of the firing sroke. If valve lash is present, the pushrod can be freely moved up and down a certain amount with rocker arm held against valve. Excessive lash can be caused by:	2. Repair engine as needed.
	a. Worn pushrod upper end ball.	a. Replace pushrod and rocker arm.
	b. Bent pushrod.	b. Replace pushrod.
	c. Improper lubrication of the pushrod.	c. Replace pushrod and rocker arm. Check lubrication system feed to the pushrod.
	d. Loose or damaged rocker arm.	d. Replace rocker arm.
	e. If pushrod and rocker arm are OK, trouble in the hydraulic lifter is indicated.	e. Replace hydraulic lifter.

DIAGNOSIS OF DIESEL ENGINE

MOST LIKELY/POSSIBLE CAUSES

X = LIKELIEST CAUSES
● = POSSIBLE CAUSES

SYMPTOMS	LOW/LOSS OF POWER	HARD TO START	WILL NOT START-HOT	WILL NOT START-COLD	ENGINE STARTS - THEN STALLS	ENGINE MISFIRES OR BACKFIRES	ROUGH/ERRATIC IDLE	ENGINE WON'T SHUT-OFF	POOR ACCELERATION	ENGINE SPEED FLUXUATES	EXCESSIVE WHITE SMOKE	BLACK SMOKE AT LOAD (HOT)	BLACK SMOKE AT IDLE	EXCESSIVE ACCELERATION SMOKE	GREY SMOKE	BLUE SMOKE	EXCESSIVE LUBE OIL CONSUMPTION	EXCESSIVE FUEL CONSUMPTION	EXCESSIVE COOLANT CONSUMPTION	FUEL OR LUBE OIL LEAKS	LUBE OIL CONTAMINATED	COOLANT CONTAMINATED	HIGH COOLANT TEMPERATURE	HIGH OIL SUMP TEMPERATURE	NO HEAT FROM HEATER	CRANKCASE SLUDGE	LOW OIL PRESSURE	HIGH OIL PRESSURE	HIGH CRANKCASE PRESSURE	HIGH INLET RESTRICTION	MECHANICAL KNOCKS	FUEL KNOCKS (COMBUSTION NOISE)	EXCESSIVE ENGINE VIBRATION	SEIZED ENGINE COMPONENT	LOW CYLINDER COMPRESSION	ALL (8) GLOW PLUGS FAILED	(1) OR MORE GLOW PLUGS FAILED - NOT (8)	RELAY WILL NOT CYCLE-GLOW PLUGS O.K.	GLOW PLUG SYSTEM AND LIGHT INOP	WATER IN FUEL LIGHT ON/BLINKS
MECHANICAL/MAINTENANCE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
GASKET BLOW-BY OR SEAL LEAKAGE	●								●		●				●		●	●	●		●	X	●		X				●				●		●					
FAULTY DAMPER/FLYWHEEL BALANCE																																	X							
VALVE LEAKAGE	●	●	●	●		●	●		●		●	●			●		●	●											●						X					
BROKEN, SCORED OR WORN PISTONS/RINGS	●	●	●	●			●		●		●	●	●		●	●		●			●			●		●			●		●			●	●					
INCORRECT MAIN OR ROD BEARING CLEARANCE																											●				●									
DAMAGED CRANKSHAFT OR MAIN/ROD BEARINGS						●																									X			X						
DAMAGED/WORN CAMSHAFT LOBES	●	●				●	●		●			●						●															●							
FAULTY LIFTER OR GUIDE PLATE	●					●	●				●																				●				●					
FAULTY PUSHROD OR ROCKER ARM	●					●	●											●													●									
WORN/MISALIGNED TIMING GEARS, CHAIN OR KEY(S)	●					●	●			●		●						●															●							
LOW CYLINDER COMPRESSION (380 PSI MIN.)	●	●	X	●		●	●		●		●	●			●			●															●							
OIL CHANGE INTERVAL																	●				●					X														
EXTERNAL INJECTION PUMP THROTTLE LINKAGE	●						●		●																															
TIMING RETARDED	●	●		●		●	●		●		X				●			●																						
TIMING ADVANCED	●	●		●		●	●					X	●	●				●														X					X			
STARTER CRANKING SPEED/BATTERIES (180 RPM MIN.)		●	X	●																																	●			
ENGINE MOUNTS/BOLTS OR FUEL LINE/OIL FILL TUBE CLAMPS																															●		●							
LONG IDLE PERIODS											●	●		●	●			●								●														
CRACKED CYLINDER HEAD OR WALL																			●															●	●					
MISSING PRECHAMBER(S)	●					●	●					●	●																				●		●					
ENGINE OVERLOADED/EXCESSIVE SPEED	●								●			●		●			X	X									●													
IMPROPER STARTING PROCEDURES		●		●																																				
DEBRIS/FLUID IN CYLINDER(S)																															●			●						
ELECTRICAL/EMISSIONS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
INOPERATIVE GLOW PLUGS		●		X			●				●																													
FAULTY GLOW PLUG CONTROLLER/IP WIRE GROUNDS																																				X	●		X	
FAULTY ALTERNATOR DIODE/STARTER MOTOR WIRE CONNECTIONS																																				●		●	●	
INOPERATIVE GLOW PLUG CONTROLLER/RELAY		●		●																																●		●	●	
SHORTED OR OPEN GLOW PLUG INHIBITOR SWITCH																																				X		X	X	
NO VOLTAGE TO CONTROLLER (KEY ON)																																							●	
EGR VALVE STUCK OPEN	●											●		●				●																						
EPR VALVE STUCK CLOSED	●											●		●				●																						
FAULTY EGR/EPR SOLENOIDS	●											●		●				●																						
MISADJUSTED OR FAULTY THROTTLE POSITION SWITCH	●									●		●		●				●																						
HOUSING PRESSURE COLD ADVANCE SOLENOID OR SWITCH				●	●		●			●	X							●																						
FAULTY CRANKCASE DEPRESSION REGULATOR (CDR) VALVE																	●			●									●											
CRANKCASE DEPRESSION SYSTEM HOSE CONNECTIONS																	X			X	●								X											
MISADJUSTED OR FAULTY VACUUM REGULATOR VALVE																		●																						
TRANSMISSION CONVERTOR DOES NOT APPLY																		●																						
FAULTY VACUUM PUMP (21" HG MIN.)									●			●	●	●				●																						
FAULTY ENGINE SPEED SENSOR	●								●		●	●	●	●				●																						
AIR SYSTEM	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
RESTRICTED AIR INTAKE DUCTING OR MANIFOLD	X	●			●				●			●	●	●	●			●												●										
HIGH EXHAUST BACK PRESSURE	●				●				●			●		●	●			●											●											
THIN AIR IN HOT WEATHER OR HIGH ALTITUDE	●								●		●	●		●	●			●																						
PLUGGED AIR FILTER	X	●			●				●			X	●	●	●			●												X										
LOW AMBIENT TEMPERATURE				●							●															●		●												
HIGH AMBIENT TEMPERATURE	●																						●	●			●													

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DIAGNOSIS OF DIESEL ENGINES (CONT.)

MOST LIKELY/POSSIBLE CAUSES

X = LIKELIEST CAUSES
● = POSSIBLE CAUSES

SYMPTOMS

	LOW/LOSS OF POWER	HARD TO START	WILL NOT START-HOT	WILL NOT START-COLD	ENGINE STARTS - THEN STALLS	ENGINE MISFIRES OR BACKFIRES	ROUGH/ERRATIC IDLE	ENGINE WON'T SHUT OFF	POOR ACCELERATION	ENGINE SPEED FLUXUATES	EXCESSIVE WHITE SMOKE	BLACK SMOKE AT LOAD (HOT)	BLACK SMOKE AT IDLE	EXCESSIVE ACCELERATION SMOKE	GREY SMOKE	BLUE SMOKE	EXCESSIVE LUBE OIL CONSUMPTION	EXCESSIVE FUEL CONSUMPTION	EXCESSIVE COOLANT CONSUMPTION	FUEL OR LUBE OIL LEAKS	LUBE OIL CONTAMINATED	COOLANT CONTAMINATED	HIGH COOLANT TEMPERATURE	HIGH OIL SUMP TEMPERATURE	NO HEAT FROM HEATER	CRANKCASE SLUDGE	LOW OIL PRESSURE	HIGH OIL PRESSURE	HIGH CRANKCASE PRESSURE	HIGH INLET RESTRICTION	MECHANICAL KNOCKS	FUEL KNOCKS (COMBUSTION NOISE)	EXCESSIVE ENGINE VIBRATION	SEIZED ENGINE COMPONENT	LOW CYLINDER COMPRESSION	ALL (8) GLOW PLUGS FAILED	(1) OR MORE GLOW PLUGS FAILED - NOT (8)	RELAY WILL NOT CYCLE-GLOW PLUGS O.K.	GLOW PLUG SYSTEM AND LIGHT INOP	WATER IN FUEL LIGHT ON/BLINKS
FUEL SYSTEM	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
PLUGGED, WAXED OR FAULTY FUEL FILTER(S)/ASSEMBLY	X	●	●	●	●	●			X	X	●	●	●		●			●		X																				●
FAULTY WATER IN FUEL (WIF) OR VACUUM SENSOR(S)																																								●
QUALITY/GRADE OR INCORRECT FUEL (GASOLINE)	●	●	X	X		●	●		●	●	X	X		X	X			●														●								
AIR LEAKS IN FUEL SUCTION LINES	X	X	X	●	X	X	X		X	X	●																					●								
RESTRICTED FUEL RETURN LINE	X	X	●	●	●		X		●		●	●			●			●																						
FUEL TANK CAP NOT VENTED	●	●	●	●	●		●		●		●				●																									
HIGH FUEL TEMPERATURE (ABOVE 90°F)	●						●		●		●																													
FAULTY INJECTION PUMP OR SHAFT 180° OUT	●	●	●	●	●	●	●		●	●	●									●	●											●								
FUEL INLET RESTRICTION HIGH AT SUPPLY PUMP	●	●	●	●	●	●			●		●																													
FUEL PRESSURE BELOW (2) PSI AT INJECTION PUMP	●	●	●	●	●	●	●		●		●	●			●			●																						
FAULTY FUEL SUPPLY PUMP (5½ PSI MIN.)	●	●	●	●	●	●	●		●									●		●	●																			
NOZZLES, LINES OR HOSES	●	●				●	●		●		●	●	●	●				●		X												X	●							
LOW IDLE RPM ADJUSTMENT			●		●	●	●				●																													
FAST IDLE RPM ADJUSTMENT/FAULTY SOLENOID					●	●	●				●																													
WATER/DEBRIS IN FUEL TANK OR FILTER(S)	●			●	●																													●						X
EXTERNAL FUEL LEAKS	●	●	●	●	●	●	●				●							●																						
FAULTY ENGINE SHUTOFF SOLENOID (ESO)		●	●	●	●			X																																
FAULTY INJECTION PUMP BALL CHECK REG. VALVE	●	●			●							●			●																									
WORN OR STUCK INJECTION PUMP ADVANCE PISTON	X	●				●	●				●	●	●	●				●																						
FAULTY INJECTION PUMP WEIGHT RETAINER RING	●				●	●	●																																	
STICKING INTERNAL GOVERNOR LINKAGE/METERING VALVE	●				●		●	●		●																														
INOPERATIVE FUEL LINE OR FILTER HEATER	●			●	●					●																														
NO FUEL DELIVERY		●	●	●	●																																			
INJECTION PUMP HOUSING PRESSURE (8-12 PSI)	●				●	●	●			●	●							●														●	●							
LUBRICATION SYSTEM	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
INTERNAL OIL LEAKS (BLOCK GALLERY/CUP PLUGS)																						●					●													
LOW OIL LEVEL																								●			●													
HIGH OIL LEVEL (OVER-FILLED)	●						●		●								●							●					●											
FAULTY REGULATOR OR BY-PASS VALVE																					●			●			●	●												
CONTAMINATED LUBE OIL																										●	●													
HIGH LUBE OIL TEMPERATURE																										●	●													
QUALITY/GRADE OF LUBE OIL		●		●												●	●									●	X	X			●									
INACCURATE GAGE OR SENSOR																											●	●												
FAULTY OIL COOLER CORE																						●		●																
FAULTY OIL PUMP DRIVE GEAR/SHAFT																											X													
OIL PICKUP TUBE RESTRICTED/CRACK																											●													
EXTERNAL OIL LEAKS (PLUGS, SEALS OR GASKETS)																●	●				●																			
FAULTY OIL PUMP																											●	●												
COOLING SYSTEM	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
QUALITY/GRADE OF COOLANT																							●																	
LOW COOLANT LEVEL																							●		●															
FAULTY OR INCORRECT PRESSURE CAP																			X				●																	
INACCURATE TEMPERATURE GAGE/SENSOR																							●																	
OBSTRUCTED RADIATOR AIR FLOW																							X																	
INOPERATIVE WATER PUMP																							●		●															
FAULTY OPERATION OF FAN, VISCOUS CLUTCH/BELTS	●																	●					●																	
FAULTY THERMOSTAT																							●		●															
FAULTY COOLANT RECOVERY SYSTEM																			●				●																	
RESTRICTED COOLANT FLOW																							●		●															
AIR RECIRCULATION OR FAULTY FAN SHROUD																							●																	
FAULTY OR INADEQUATE DEAERATION SYSTEM/VENTS																							●		●															
HIGH COOLANT TEMPERATURE																								●																
LOW COOLANT TEMPERATURE																	●	●							●	●														

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COMPRESSION CHECK
(6.2 DIESEL ENGINE)

Tools Required:
J-29664-2 or J-26996-1 Intake Manifold Cover
J-26999-10 Compression gage.

1. Remove the air cleaner. Install J-29664-2 or J-26996-1 over the mouth of the intake manifold.
2. Disconnect the wire from the fuel solenoid terminal of the injection pump.
3. Disconnect wires from glow plugs then remove all glow plugs.
4. Screw J-26999-10 into the glow plug hole of the cylinder that is being checked.
5. Make sure the batteries are fully charged, and the engine is fully warmed up (engine oil hot).
6. Crank the engine. Allow six "puffs" per cylinder.
7. Make the compression check at each cylinder and record the readings.

NOTICE: Do not add oil to any cylinder during a compression test as extensive engine damage can result.

8. The lowest reading cylinder should not be less than 80 percent of the highest reading cylinder. No cylinder should read less than 2625 kPa (380 psi).
   - Normal: Compression builds up quickly and evenly to specified compression on each cylinder. Reading should be in the 2625-2760 kPa (380-400 psi) range.
   - Leaking: Compression low on first stroke tends to build up on following strokes but does not reach normal.

CRANKING SPEED CHECK
(6.2L DIESEL ENGINE)

Tool Required:
J-26999-10 Compression Gage

Cranking speed is critical for a diesel to start, either hot or cold. Some tachometers are not accurate at cranking speed. An alternate method of checking cranking speed or determining the accuracy of a tachometer follows:

1. Connect J-26999-10 to any cylinder.
2. Disconnect the injection pump fuel solenoid lead on the top of the injection pump.
3. Install the digital tachometer to be checked (if desired).
4. Depress the pressure release valve on the compression gage.
5. With the aid of an assistant, crank the engine for 2 or 3 seconds to allow the starter to reach full speed, then without stopping, count the number of "puffs" at the compression gage that occur in the next 10 seconds. Multiply the number of "puffs" in the 10 second period by 12 and the resulting number will be the cranking speed in revolutions per minute (RPM).
   Example:
   10 seconds = 1/6 of a minute
   1 puff = 2 RPM
   RPM = No. of puffs x 2 x 6 or
   RPM = No. of puffs x 12

Minimum cranking speed on the 6.2L diesel engine is 100 RPM cold and 180 RPM hot. The actual cranking speed needed will vary depending on the condition of the engine (compression) and nozzles.

SPECIAL TOOLS

J-29664-2 or J-26996-1	Intake Manifold Cover
J-26999-10	Compression Gage

SECTION 6A3

4.3 LITER V6

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 "NOTICE: See 'Notice' on page 6A3-1 of this section."

NOTICE: All engine 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 this part.

CONTENTS

SUBJECT **PAGE**

DESCRIPTION

4.3L engines are 90-degree V6 type, overhead valve, water cooled, with cast iron block and heads.

The crankshaft is supported by four precision insert main bearings, with crankshaft thrust taken at the number four (rear) bearing.

The camshaft is supported by four plain type bearings and is chain driven. Motion from the camshaft is transmitted to the valves by hydraulic lifters, pushrods, and ball type rocker arms. The valve guides are integral in the cylinder head.

The connecting rods are forged steel, with precision insert type crankpin bearings. The piston pins are a press fit in the connecting rods.

The pistons are cast aluminum alloy. The piston pins are a floating fit in the piston.

ENGINE LUBRICATION

Lubrication schematics are shown in figures 1 and 2. The gear type oil pump is driven from the distributor shaft, which is gear driven from the camshaft. Oil is drawn into the oil pump through a pickup screen and pipe.

Pressurized oil is routed to the oil filter. In case of excessive oil pressure, a bypass valve is provided. Filtered oil flows into the main gallery and then to the camshaft and crankshaft bearings. The valve lifter oil gallery supplies oil to the valve lifters. Oil flows from the hydraulic lifters through the hollow pushrods to the rocker arms. Oil from the overhead drains back to the crankcase through oil drain holes.

The timing chain is drip fed from the front camshaft bearing. The pistons and piston pins are lubricated by oil splash.

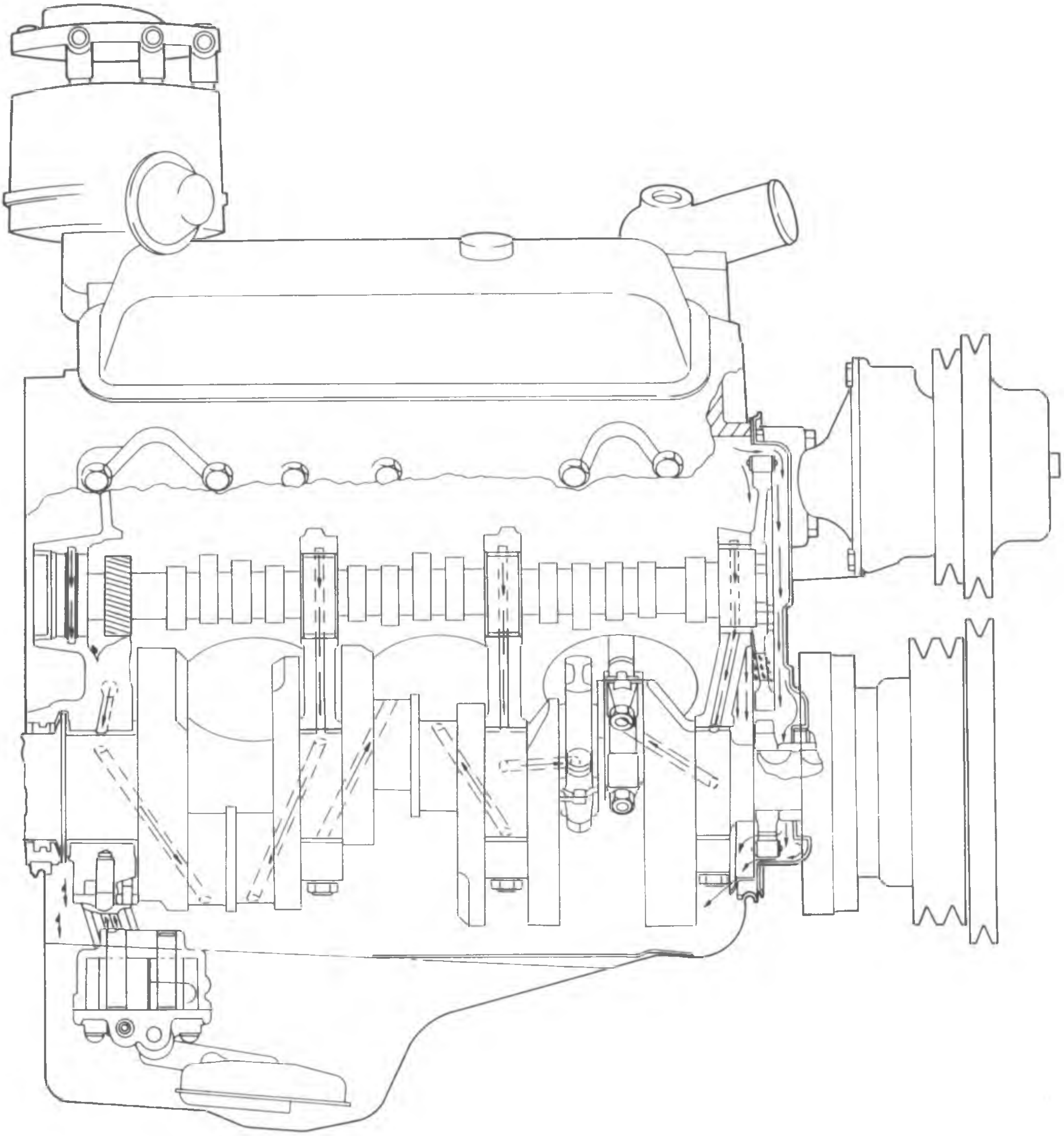
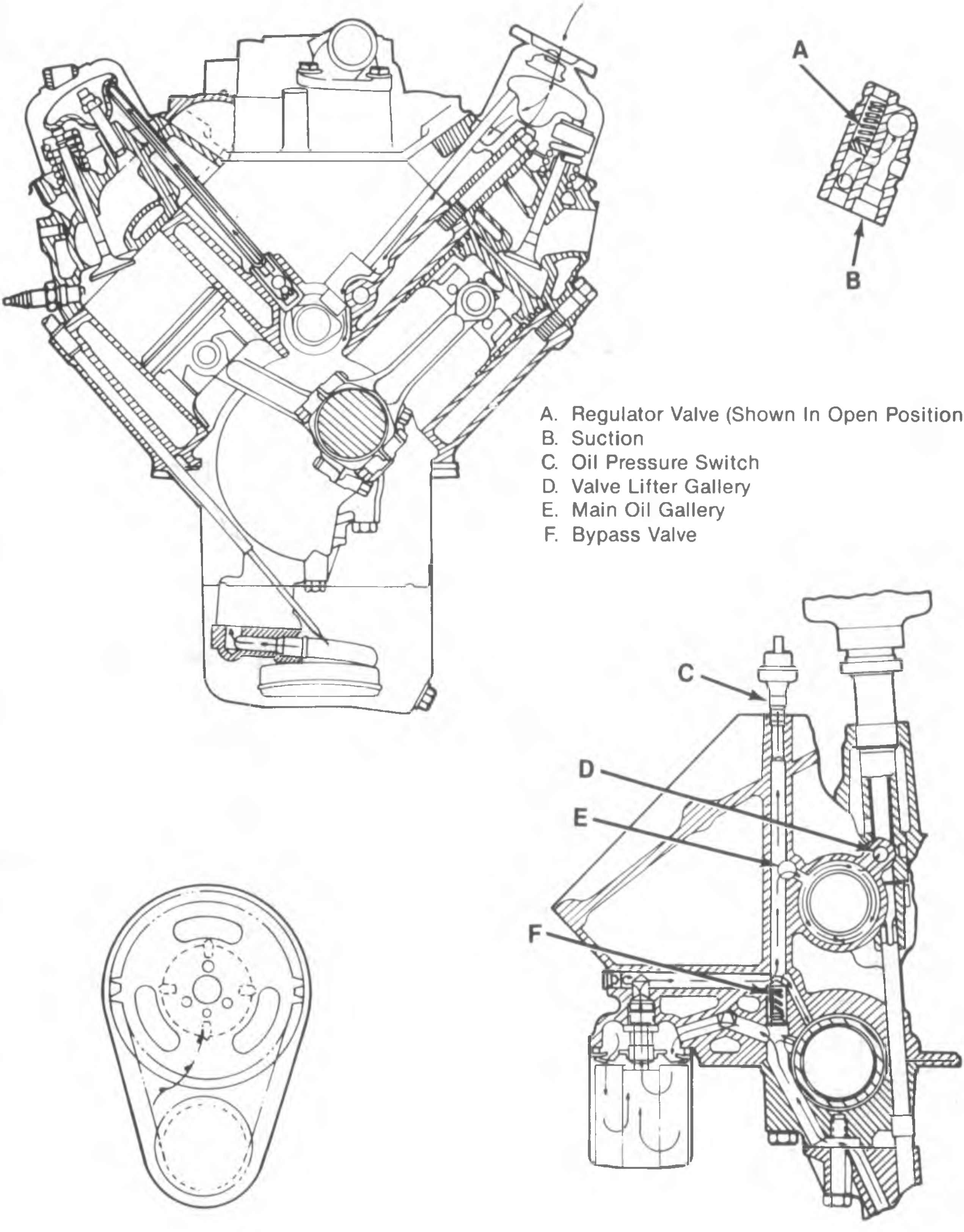


Figure 1—Engine Lubrication Diagram



A. Regulator Valve (Shown In Open Position)
B. Suction
C. Oil Pressure Switch
D. Valve Lifter Gallery
E. Main Oil Gallery
F. Bypass Valve

Front View
Showing Path Of Oil To Timing Chain.

Rear View
Showing Main Gallery, Oil Filter And Crankshaft Oil Feed.

B-07860

Figure 2—Engine Lubrication Diagram

ON-VEHICLE SERVICE

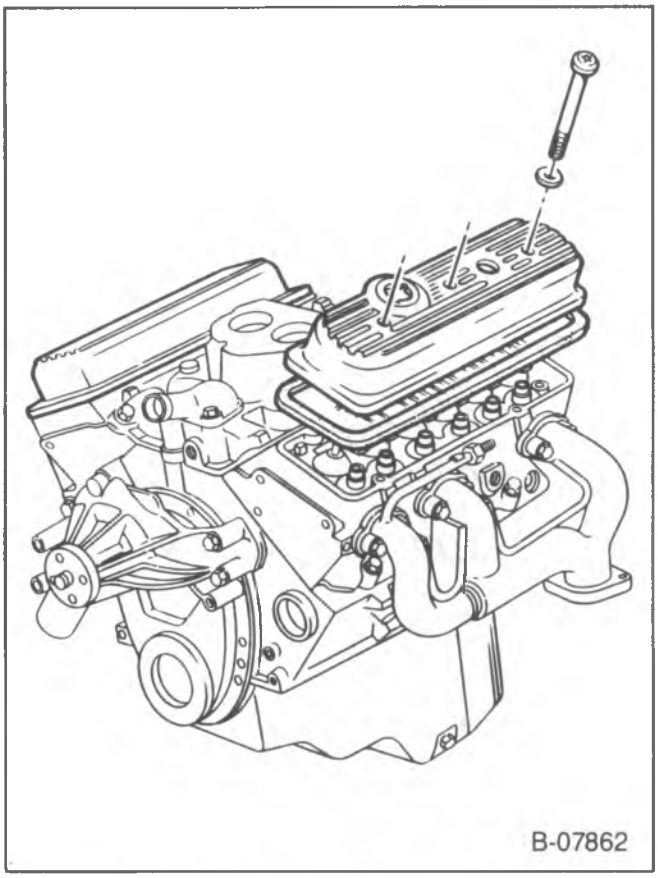


Figure 3—Rocker Arm Cover Installation

ROCKER ARM COVER REPLACEMENT

RIGHT SIDE ROCKER ARM COVER

Remove or Disconnect (Figure 3)

1. Battery negative cable.
2. Engine cover (G models).
3. Air cleaner.
4. Diverter valve.
5. Engine oil filler tube.
6. PCV valve at the rocker arm cover.
7. AIR pipe retaining bolts at the left and right cylinder heads.
8. Wires at the choke and rocker arm cover.
9. Rocker arm cover bolts.
10. Rocker arm cover and gasket.

Clean

- All traces of old gasket from the rocker arm cover and cylinder head.

Inspect

- Rocker arm cover sealing surfaces for distortion. Replace if necessary.

Install or Connect

1. Rocker arm cover and new gasket.
2. Rocker arm cover bolts and washers.

Tighten

- Rocker arm cover bolts to 9.9 N·m (88 in. lbs.).

3. Wires at choke.
4. AIR pipe retaining screws.
5. PCV valve.
6. Engine oil filler tube.
7. Diverter valve.
8. Air cleaner.
9. Engine cover (G models).
10. Battery negative cable.

LEFT SIDE ROCKER ARM COVER

Remove or Disconnect (Figure 3)

1. Battery negative cable.
2. Engine cover (G models).
3. Air cleaner.
4. Air conditioning compressor brace (if used).
5. Accelerator and TVS cable bracket at the intake manifold.
6. Rocker arm cover bolts.
7. Rocker arm cover gasket.

Clean

- All trackes of old gasket from the rocker arm cover and cylinder head.

Inspect

- Rocker arm cover sealing surface for distortion and damage. Replace if necessary.

Install or Connect (Figure 3)

1. Rocker arm cover and new gasket.
2. Rocker arm cover bolts and washers.

Tighten

- Rocker arm cover bolts to 9.9 N·m (88 in lbs.).

3. Accelerator and TVS cable bracket.
4. Air conditioning compressor brace (if used).
5. Air cleaner.
6. Engine cover (G models).
7. Battery negative cable.

ROCKER ARM AND PUSHROD REPLACEMENT

Remove or Disconnect

1. Rocker arm cover, as outlined previously.
2. Rocker arm nut.
    - If only the pushrod is to be replaced, back the rocker arm nut off until the rocker arm can be swung away from the pushrod. Then pull the pushrod out.
3. Rocker arm with ball.
4. Pushrod.

Important

- Store used components in order so they can be reassembled in the same location.

Inspect

— Rocker arms and balls at their mating surfaces. These surfaces should be smooth and free from scoring or other damage.

— Rocker arm areas which contact the valve stems and the sockets which contact the pushrods. These areas should be smooth and free of damage and wear.

— Pushrods for bending. Roll the pushrod on a flat surface to determine if it is bent. Replace if necessary.

— Ends of the pushrods for scoring or roughness.

Install or Connect

1. Pushrod. Make sure the pushrod seats properly in the hydraulic lifter.
2. Rocker arm with ball.

    Important

    - When new rocker arms and/or balls are installed, coat their bearing surfaces with "Molykote" or equivalent.
3. Rocker arm nuts.

    Adjust

    - Valves as outlined later.
4. Rocker arm cover, as outlined previously.

Figure 4—Adjusting The Valves

VALVE ADJUSTMENT

1. Remove the rocker arm cover as outlined previously.
2. Crank the engine until the mark on the torsional damper lines up with the "O" mark on the timing tab and the engine in the number one firing position. This may be determined by placing fingers on the number one valve as the mark on the damper comes near the "O" mark on the timing tab. If the rocker arms are not moving, the engine is in the number one firing position. If the rocker arms move as the mark comes up to the timing tab, the engine is in the number four firing position and should be turned over one more time to reach the number one position.
3. With the engine in the number one firing position as determined above, the following valves may be adjusted:

    — Exhaust: 1, 5, 6.

    — Intake: 1, 2, 3.

    (Even numbered cylinders are in the right bank; odd numbered cylinders are in the left bank, when viewed from the rear of the engine).
4. Back out the adjusting nut until lash is felt at the pushrod then turn in the adjusting nut until all lash is removed. This can be determined by rotating the pushrod while turning the adjusting nut (figure 4). When the play has been removed, turn the adjusting nut in one full additional turn (to center the lifter plunger).
5. Crank the engine one revolution until the timing tab "O" mark and vibration damper mark are again in alignment. This is the number four firing position. The following valves may be adjusted:

    — Exhaust: 2, 3, 4.

    — Intake: 4, 5, 6.

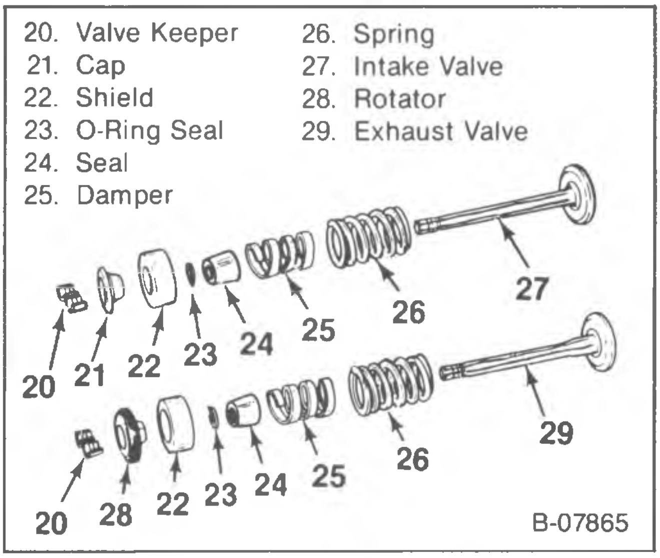


Figure 5—Valves And Components

6. Install the rocker arm cover as outlined previously.

VALVE STEM SEAL AND VALVE SPRING REPLACEMENT

Remove or Disconnect (Figures 5 and 6)

Tools Required:

J-23590 Air Adapter.
J-5892-A Spring Compressor.

1. Rocker arm cover, as outlined previously.
2. Rocker arms, as outlined previously.
3. Spark plugs.
4. Valve keepers (20).
   - Install J-23590 into the spark plug hole.

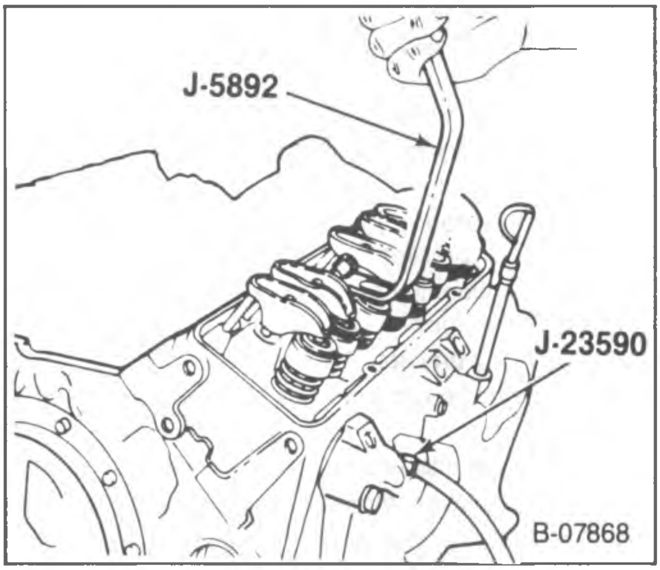


Figure 6—Compressing The Valve Springs

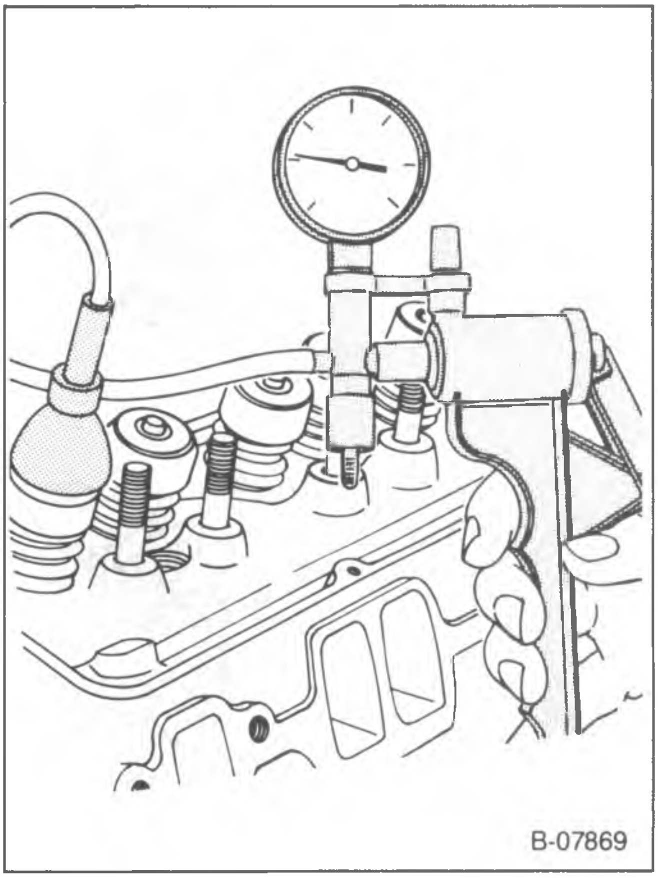


Figure 7—Testing The Valve Seals

   - Apply compressed air to hold the valves in place.
   - Install a rocker arm nut (figure 6).
   - Use J-5892-A to compress the valve spring (figure 6).
   - Remove the valve keepers.
   - Carefully release the spring tension. Remove J-5892-A.
5. Cap (21) and/or rotator (28), shield (22) and spring (26) with damper (25).
6. O-ring seal (23), and seal (24) (intake valve only).

Install or Connect (Figures 5, 6, and 7)

Tools Required:

J-23590 Air Adapter.
J-5892-A Spring Compressor.
J-23738-A Vacuum Pump

1. New seal (24). Install the seal over the intake valve stem and seat it against the head.
2. Spring (26) with damper (25), sheild (22) and cap (21) and/or rotator (28).
3. New o-ring seal (23) and valve keepers (20).
   - With air pressure applied to the cylinder with J-23590, compress the spring with J-5892-A (figure 6).

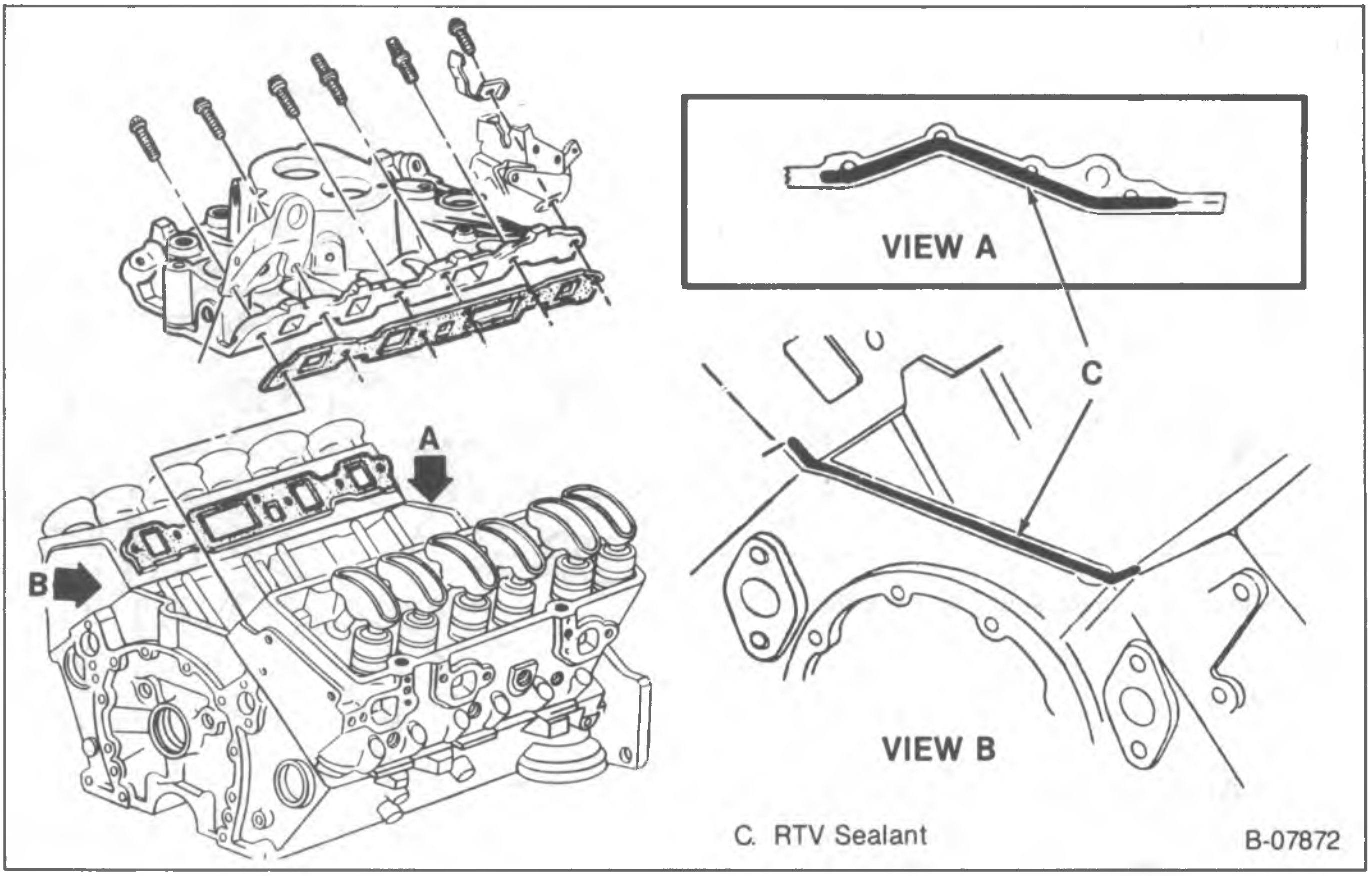


Figure 8—Intake Manifold Installation

- Lubricate the o-ring seal with engine oil. Install the seal on the valve stem. Make sure the seal is not twisted.
- Install the valve keepers. Use grease to hold them in place.
- Carefully release spring pressure. Make sure the valve keepers stay in place.
- Remove J-5892-A and J-23590.
- Check each o-ring seal for leakage (figure 7).
    - Place the suction cup furnished with J-23738-A over the shield.
    - Connect J-23738-A to the suction cup and apply a vacuum. Watch the vacuum pump gage. No air should be able to leak past the seal. If the seal will not hold a vacuum, it may have been damaged or improperly installed.

4. Spark plugs.
5. Rocker arms, as outlined previously.

Adjust

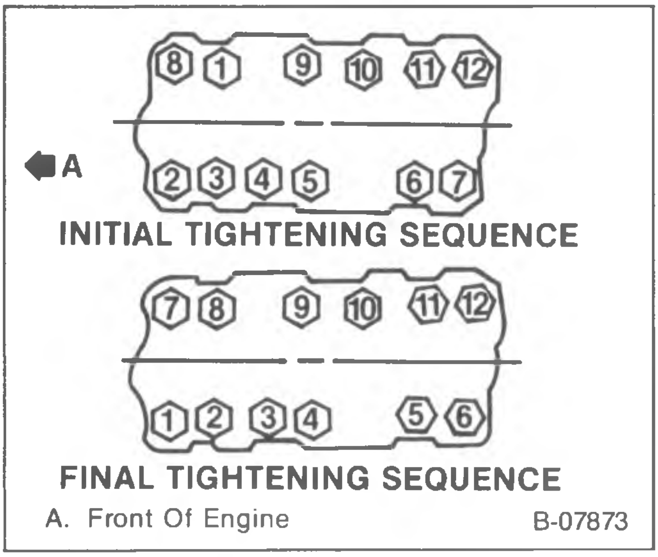
- Valves, as outlined previously.

6. Rocker arm cover, as outlined previously.

INTAKE MANIFOLD REPLACEMENT

↔ Remove or Disconnect

1. Battery negative cable.
2. Engine cover (G models).
3. Air cleaner.
   - Drain the cooling system.
4. ESC connector.
5. Distributor. Refer to ENGINE ELECTRICAL (SEC. 6D).
6. TVS and accelerator cables.
7. Air conditioning compressor rear brace.
8. Engine oil filler tube at the generator bracket.
9. Transmission dipstick tube (if used) at the generator bracket.
10. Air conditioning compressor belt idler (if used) at the generator bracket.
11. Generator bracket.
12. Fuel and vacuum lines and electrical wiring at the carburetor.
13. AIR hoses and brackets.
14. Heater hose at the intake manifold.
15. Carburetor (if required).
16. Intake manifold bolts.
17. Intake manifold.



A. Front Of Engine

Figure 9—Intake Manifold Bolt Tightening Sequence

Clean

— Old gasket and RTV from the block, heads, and intake manifold. Remove all RTV that is loose or will cause interference at assembly.

— Excessive carbon deposits from the exhaust and EGR passages.

— Excessive scale and deposits from the coolant passages.

Inspect

- Manifold for cracks and gasket surface damage.

Install or Connect (Figures 8 and 9)

1. Gaskets to the cylinder head.
2. RTV to the front and rear sealing surfaces on the block (figure 8). Apply a 5 mm (3/16-inch) bead of RTV (part number 1052366 or equivalent) to the front and rear of the block as shown. Extend the bead 13 mm (1/2-inch) up each cylinder head to seal and retain the gaskets.
3. Intake manifold to the engine.
4. Intake manifold bolts.

Tighten

- Intake manifold bolts to 48 N·m (36 ft. lbs.). Use the tightening sequence shown in figure 9.

5. Carburetor (if removed).
6. Heater hose.
7. AIR hoses and brackets.
8. Fuel and vacuum lines and electrical wiring at the carburetor.
9. Generator bracket.
10. Air conditioning compressor belt idler (if used).

Figure 10—Removing The Hydraulic Lifter

11. Transmission dipstick tube (if used).
12. Engine oil filler tube.
13. Air conditioning compressor rear brace.
14. TVS and accelerator cables.
15. Distributor. Refer to ENGINE ELECTRICAL (SEC. 6D).
16. ESC connector.
17. Air cleaner.
18. Proper grade and quantity of engine coolant.
19. Engine cover (G models).
20. Battery negative cable.

HYDRAULIC LIFTER REPLACEMENT

Remove or Disconnect (Figures 10 and 11)

Tools Required:

J-3049 Hydraulic Lifter Remover (Plier Type) or

J-9290-01 Hydraulic Lifter Remover (Slide Hammer Type)

1. Rocker arm cover, intake manifold, and pushrod, as outlined previously.
2. Hydraulic lifters.
   — Remove the hydraulic lifters one at a time and place them in an organizer rack. The lifters must be installed in the same bore from which they were removed.
   — A stuck hydraulic lifter can be removed using J-3049 (figure 10) or J-9290-01 (figure 11).

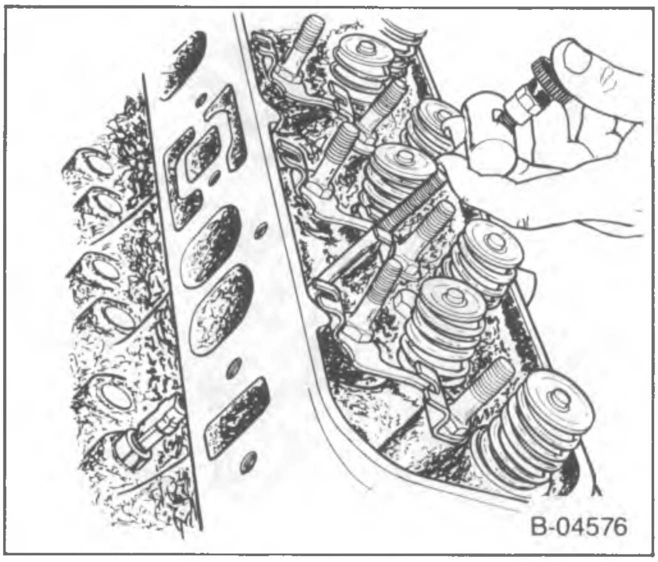


Figure 11—Removing The Hydraulic Lifter (Typical)

Inspect

- — Hydraulic lifter body for scuffing or scoring. If the lifter body wall is worn or damaged, the mating bore in the block should also be checked.
- — Check the fit of each hydraulic lifter in its mating bore in the block. If the clearance is excessive, try a new lifter.
- — The hydraulic lifter foot must be smooth and slightly convex. If worn, pitted, or damaged, the mating camshaft lobe should also be checked.

Hydraulic Lifter Repair

- Refer to the proper unit repair manual.

Install or Connect

1. Hydraulic lifters to the block. Lubricate the lifter foot and body with Engine Oil Supplement or equivalent.

   Important

   - When any new hydraulic lifters or a new camshaft is installed, Engine Oil Supplement (or equivalent) should be added to the crankcase oil.
   - Replace all hydraulic lifters when a new camshaft is installed.
2. Intake manifold, as outlined previously.
3. Pushrod, as outlined previously.

   Adjust

   - Valves, as outlined previously.
4. Rocker arm cover, as outlined previously.

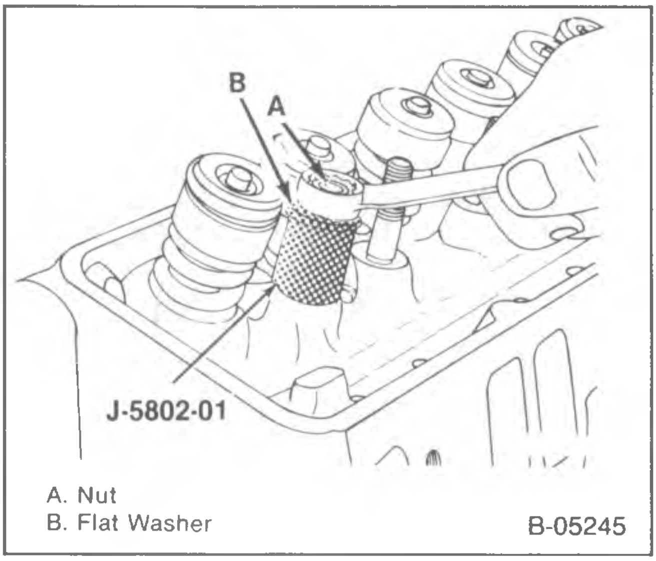


Figure 12—Removing The Rocker Arm Stud

ROCKER ARM STUD REPLACEMENT

Remove or Disconnect (Figure 12)

Tool Required:

J-5802-01 Rocker Arm Stud Remover.

1. Rocker arm cover and rocker arm, as outlined previously.
2. Rocker arm stud.
   - Place J-5802-01 over the rocker arm stud.
   - Install a nut and flat washer.
   - Turn the nut to remove the stud (figure 12).

Install or Connect (Figures 13 and 14)

Tools Required:

J-5715 Reamer (0.003-inch oversize) or

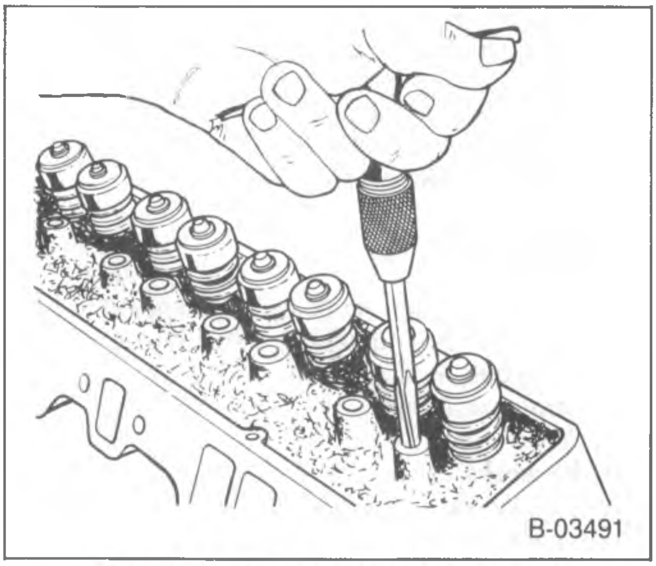


Figure 13—Reaming The Rocker Arm Stud Bore (Typical)

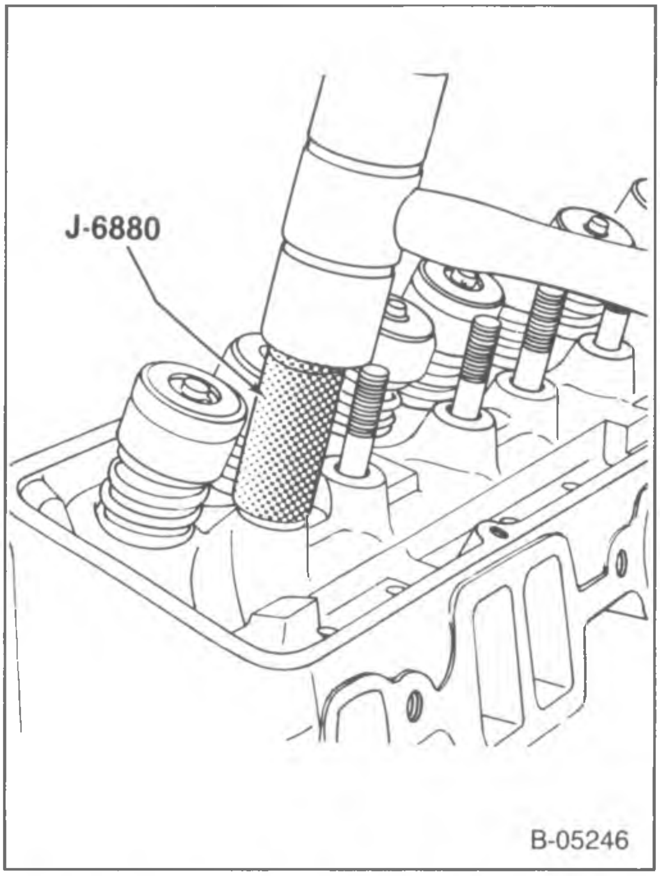


Figure 14—Installing The Rocker Arm Stud

J-6036 Reamer (0.013-inch oversize).

J-6880 Rocker Arm Stud Installer.

NOTICE: Do not attempt to install an oversize rocker arm stud without reaming the stud hole as this could damage the cylinder head.

- Ream the hole to the proper size for the replacement oversize rocker arm stud. Use J-5715 for 0.003-inch oversize studs; J-6036 for 0.013-inch oversize stud (figure 13).
- Coat the lower end (press-fit area) of the rocker arm stud with hypoid axle lubricant.

1. Rocker arm stud. Use J-6880 (figure 14). Stud is installed to proper depth when the tool bottoms on the cylinder head.
2. Rocker arm, as outlined previously.

Adjust

- Valves, as outlined previously.

3. Rocker arm cover, as outlined previously.

EXHAUST MANIFOLD REPLACEMENT

Remove or Disconnect

1. Battery negative cable.
2. Engine cover (G models).
- Raise the vehicle.
3. Exhaust pipe at the manifold.
- Lower the vehicle.
4. Oxygen sensor wire (left side manifold). Do not remove the oxygen sensor from the manifold unless the sensor is to be replaced.
5. AIR hose at the check valve.
6. AIR pipe at the diverter valve (right side manifold).
7. AIR pipe bracket at the head (left side manifold).
8. Exhaust manifold bolts, washers, and tab washers.
9. Exhaust manifold.

Clean

— Mating surfaces on the manifold and head.

— Threads on the exhaust manifold bolts.

Install or Connect

1. Exhaust manifold, bolts, washers, and tab washers.

Tighten

- Bolts on center exhaust tube to 36 N·m (26 ft. lbs.).
- Bolts on front and rear exhaust tubes to 28 N·m (20 ft. lbs.).
- Bend the tab washers over the heads of all bolts.

2. AIR bracket at the head (left side manifold).
3. AIR pipe at the diverter valve (right side manifold).
4. AIR hose at the check valve.
5. Oxygen sensor wire (left side manifold).
- Raise the vehicle.
6. Exhaust pipe to the manifold.
- Lower the vehicle.
7. Engine cover (G models).
8. Battery negative cable.

CYLINDER HEAD REPLACEMENT

Remove or Disconnect

1. Battery negative cable.
2. Engine cover (G models).
3. Intake manifold, as outlined previously.
4. Exhaust manifold, as described previously.
5. AIR pipe at the rear of the head (right cylinder head).
6. Generator mounting bolt at the cylinder head (right cylinder head).
7. Power steering pump and brackets from the cylinder head, and lay aside (left cylinder head).
8. Air conditioning compressor, and lay aside (left cylinder head).
9. Rocker arm cover, as outlined previously.
10. Spark plugs.
11. Pushrods, as outlined previously.
12. Cylinder head bolts.
13. Cylinder head.
14. Gasket.

Clean

- — Carbon deposits from combustion chambers.
- — All traces of old head gasket from cylinder head and block.
- — Cylinder head bolt threads and threads in the block.

Inspect

- Sealing surfaces of the block and cylinder head for nicks, heavy scratches, or other damage.

Cylinder Head Repair

- Refer to the proper Unit Repair Manual.

Install or Connect (Figure 15)

1. Head gasket.
   - If a steel gasket is used, coat both sides of the gasket with sealer. Spread the sealer thin and even.
   - Do not use sealer on composition steel-asbestos gaskets.
   - Place the gasket over the block dowel pins with the bead up.
2. Cylinder head. Carefully guide the cylinder head into place over the dowl pins and gasket.
3. Cylinder head bolts. Coat threads of the cylinder head bolts with sealing compound (GM part number 1052080 or equivalent) and install finger-tight.

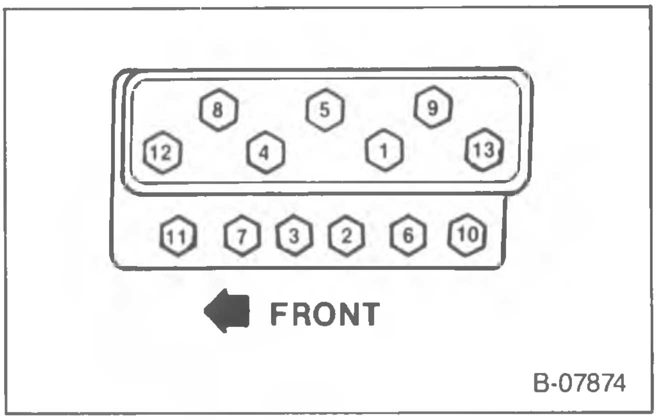


Figure 15—Cylinder Head Bolt Tightening Sequence

Tighten

- Cylinder head bolts, a little at a time, using the sequence shown in figure 15. Proper torque is 90 N·m (65 ft. lbs.).

4. Pushrods, as outlined previously.

Adjust

- Valves, as outlined previously.

5. Rocker arm cover, as outlined previously.
6. Spark plugs.
7. Rocker arm cover, as outlined previously.
8. Air conditioning compressor (if removed).
9. Power steering pump and brackets (if removed).
10. Generator mounting bolt (if removed).
11. AIR pipe (if removed).
12. Exhaust manifold, as outlined previously.
13. Intake manifold, as outlined previousy.
14. Engine cover (G models).
15. Battery negative cable.

TORSIONAL DAMPER AND FRONT CRANKSHAFT SEAL REPLACEMENT

Remove or Disconnect (Figure 16)

Tool Required:

J-23523-E Torsional Damper Puller and Installer.

1. Fan belts, fan, and pulley.
2. Fan shroud assembly.
3. Accessory drive pulley.
4. Torsional damper bolt.
5. Torsional damper. Use J-23523-E (figure 16).
6. Front crankshaft seal. Pry out with a large screwdriver. Take care not to distort the timing cover.
7. Crankshaft key, if necessary.

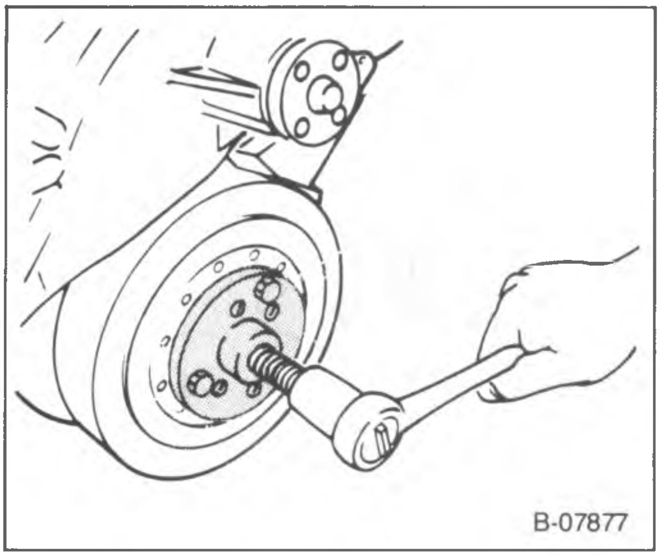


Figure 16—Removing The Torsional Damper

Inspect

- Oil seal contact area on the torsional damper shaft for grooving and roughness. Replace if necessary.

Install or Connect (Figures 17 and 18)

Tools Required:

J-23042-A Seal Installer.

J-23523-E Torsional Damper Puller and Installer.

1. Crankshaft key, if removed.
2. Front crankshaft seal. Use J-23042-A (figure 17). The open end of the seal faces inside the engine. Coat the seal lips with engine oil.

NOTICE: The inertia weight section of the torsional damper is assembled to the hub with a rubber type material. The correct installation procedures (with the proper tool) must be followed or movement of the inertia weight section of the hub will destroy the tuning of the torsional damper.

3. Stud (item A, figure 18) to the crankshaft. Thread the stud fully into the tapped hole in the crankshaft.
4. Torsional damper over the end of the stud. Align the keyway in the torsional damper shaft with the crankshaft key.
5. Bearing, washer and nut (figure 18).
   - Turn the nut to pull the vibration damper into place.
   - Remove the tool.
6. Torsional damper bolt and washer.

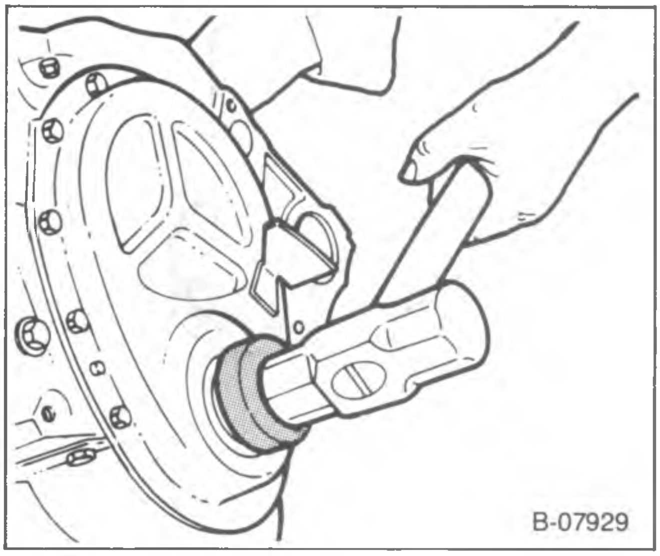


Figure 17—Installing The Front Crankshaft Oil Seal

Tighten

- Bolt to 95 N·m (70 ft. lbs.).

7. Accessory drive pulley.
8. Fan shroud assembly.
9. Fan pulley, fan, and fan belts.

FRONT COVER REPLACEMENT

Remove or Disconnect

1. Torsional damper, as outlined previously.
2. Water pump.
3. Front cover bolts.
4. Front cover.
5. Front cover to block gasket.

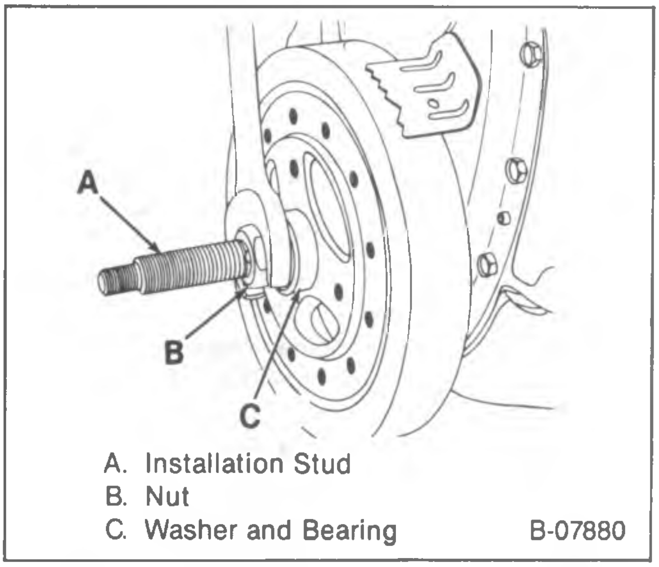


Figure 18—Installing The Torsional Damper

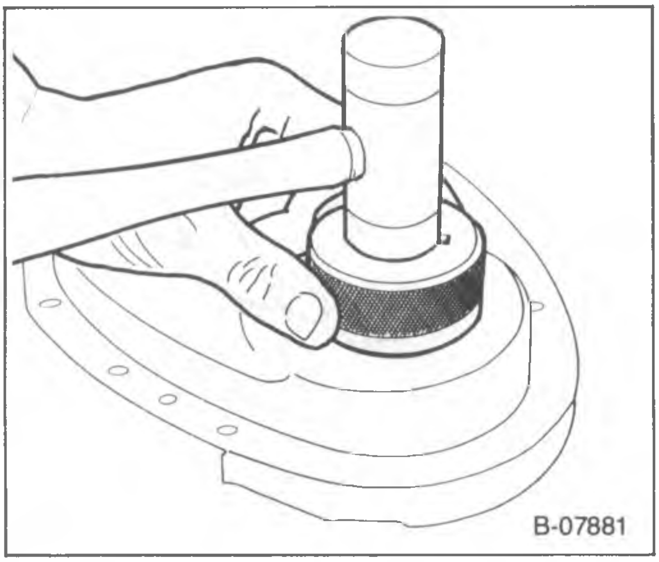


Figure 19—Installing The Front Crankshaft Oil Seal

6. Front crankshaft oil seal from the front cover. Pry out with a screwdriver. Take care not to distort the front cover.

Clean

- Old gasket from the front cover, and block.

Inspect

— Exposed portion of the one-piece oil pan gasket that contacts the front cover. Inspect for cracks, tears, heat checking, and deterioration. If the gasket is in good condition, it can be re-used. If it is unsuitable for reuse, the oil pan gasket must be replaced.

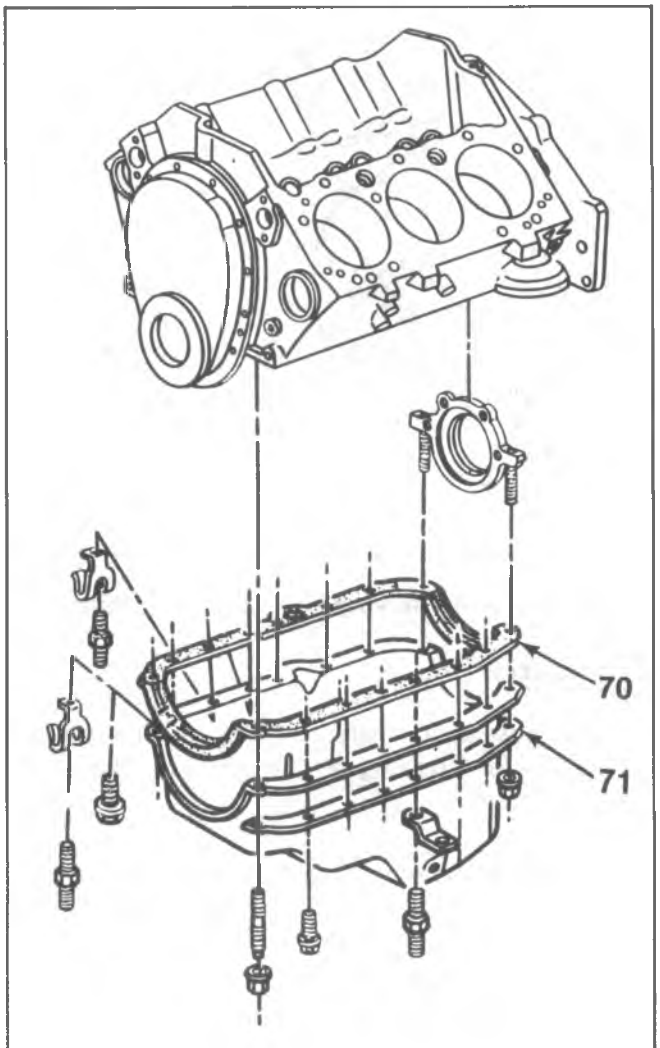
— Front cover for distortion and damage. Replace if necessary.

Install or Connect (Figure 19)

Tool Required:

J-23042-A Seal Installer.

1. Front crankshaft oil seal. Use J-23042-A (figure 19). The open end of the seal faces inside the engine. Coat the seal lips with engine oil.
2. Front cover gasket to the front cover. Use gasket cement to hold them in place.
3. Front cover to the engine. Press the cover down against the oil pan until the block dowel pins align with the holes in the cover. Position the cover against the block so that the dowels enter the cover holes without binding. Do not force the cover over the holes. Do not distort the cover flange or dowel pin holes. Hold the front cover in this position and install the front cover to block bolts.



70. Gasket
71. Reinforcement

Figure 20—Oil Pan Installation

Tighten

- Front cover to block bolts to 10.4 N·m (92 in. lbs.).

4. Water pump.
5. Torsional damper, as outlined previously.

OIL PAN REPLACEMENT

A one piece type oil pan gasket is used.

Remove or Disconnect (Figure 20)

1. Battery negative cable.
- Raise the vehicle.
- Drain the engine oil.
2. Exhaust crossover pipe.
3. Torque converter cover (models with automatic transmission).

4. Strut rods at flywheel cover.
5. Strut rod brackets at the front engine mountings.
6. Starter.
7. Strut rods at engine mounts (K models with automatic transmission).
8. Oil pan bolts, nuts, and reinforcements.
9. Oil pan and gasket.

Clean

- Gasket surfaces on the engine and oil pan.

Inspect

- Oil pan gasket for damage. Replace if necessary.

Install or Connect (Figure 20)

1. A small amount of RTV sealant (GM part number 1052751 or equivalent) to the front and rear corners of the oil pan.

   Important

   - Only a small amount of sealant is required. Excessive amounts of sealant may prevent proper sealing of the oil pan.
2. Oil pan gasket to the oil pan.
3. Oil pan to the engine.
4. Oil pan bolts, nuts, and reinforcements.

   Tighten

   — Oil pan bolts to 11.3 N·m (100 in. lbs.).

   — Oil pan nuts to 22.6 N·m (200 in. lbs.).
5. Strut rods at the engine mounts (K models with automatic transmission).
6. Starter.
7. Strut rod brackets at the front engine mountings.
8. Strut rods at the flywheel cover.
9. Converter housing under pan (models with automatic transmission).
10. Exhaust crossover pipe.
- Lower the vehicle.
11. Proper quantity and grade of engine oil.
12. Battery negative cable.

OIL PUMP REPLACEMENT

Remove or Disconnect

1. Oil pan, as outlined previously.
2. Oil pump to main bearing cap bolt.
3. Oil pump.

Inspect

- Oil pump pickup tube for looseness. If the tube is loose in the oil pump body, replace it, as outlined in the proper unit repair manual. A loose pickup tube can result in an air leak and loss of oil pressure.

Oil Pump Repair
- Refer to the proper unit repair manual.

Install or Connect

1. Oil pump to the engine. Align the slot in the oil pump shaft with the tang on the distributor shaft. The oil pump should slide easily into place. No gasket is used.
2. Oil pump to main bearing cap bolt.

   Tighten

   - Oil pump to main bearing cap bolt to 90 N·m (65 ft. lbs.).
3. Oil pan, as outlined previously.

REAR CRANKSHAFT OIL SEAL REPLACEMENT

Remove or Disconnect (Figure 21)

1. Transmission.
2. Clutch and flywheel or flexplate, as equipped.

NOTICE: Care should be taken when removing the rear crankshaft oil seal so as not to nick the crankshaft sealing surface.

3. Rear crankshaft oil seal. Insert a screwdriver into the notches provided in the seal retainer and pry the seal out (figure 21).

Install or Connect (Figure 22)

Tool Required:
J-35621 Seal Installer.

1. Rear crankshaft oil seal (figure 22).
   - Lubricate the inner and outer diameter of the seal with engine oil.
   - Install the seal on J-35621.

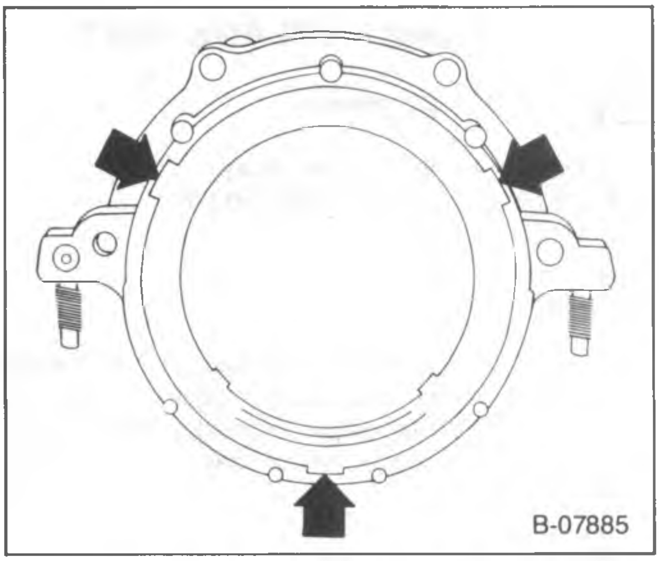


Figure 21—Seal Removal Notches

- Position J-35621 against the crankshaft. Thread the attaching screws into the tapped holes in the crankshaft.
- Tighten the screws securely with a screwdriver. This will ensure that the seal is installed squarely over the crankshaft.
- Turn the handle until it bottoms.
- Remove J-35621.

2. Clutch and flywheel or flexplate, as equipped.
3. Transmission.

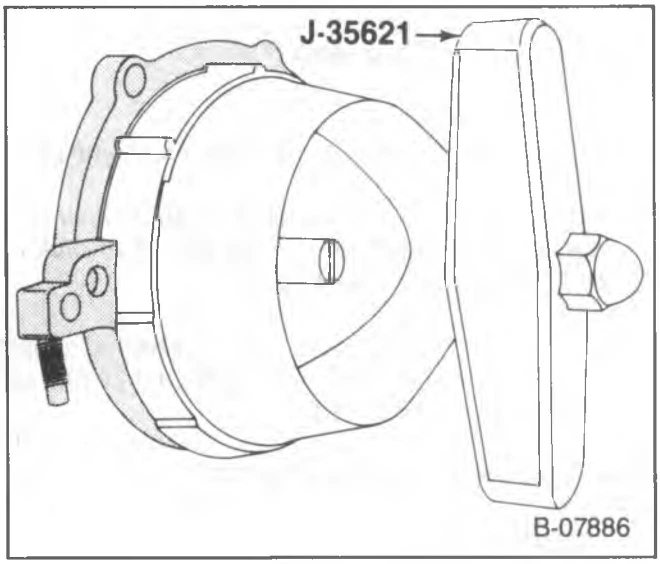


Figure 22—Installing The Rear Crankshaft Oil Seal

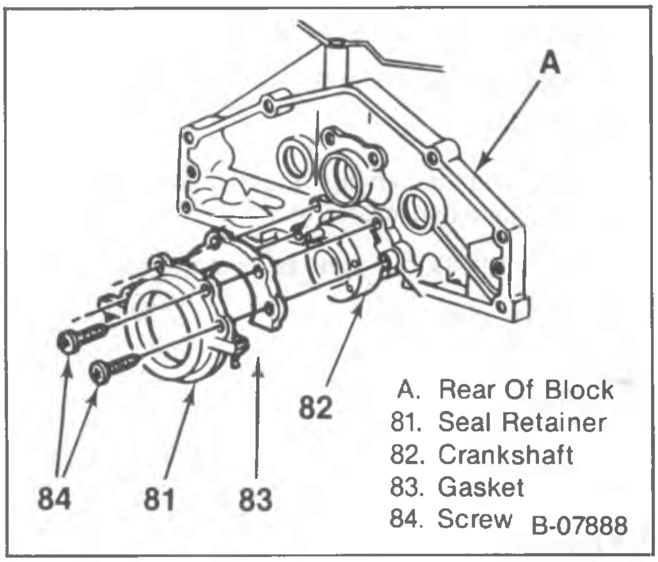


Figure 23—Rear Crankshaft Oil Seal Retainer Installation

REAR CRANKSHAFT OIL SEAL RETAINER REPLACEMENT

Remove or Disconnect (Figures 21 and 23)

1. Transmission.
2. Clutch and flywheel or flexplate, as equipped.
3. Oil pan, as outlined previously.
4. Screws (84).
5. Seal retainer (81).
6. Gasket (83).
7. Rear crankshaft oil seal. Insert a screwdriver into the notches provided in the seal retainer and pry the seal out (figure 21).

Clean

- Gasket surfaces on block and seal retainer.

Install or Connect (Figures 21 and 23)

- Whenever the seal retainer is removed, a new retainer gasket and rear crankshaft oil seal must be installed.

1. Gasket (83) to the block. It is not necessary to use sealant to hold the gasket in place.
2. Seal retainer (81).
3. Screws (84).

   Tighten

   - Screws (84) to 15.3 N·m (135 in. lbs.).

4. Oil pan, as outlined previously.
5. Rear crankshaft oil seal (80) as outlined previously.
6. Clutch and flywheel or flexplate, as equipped.

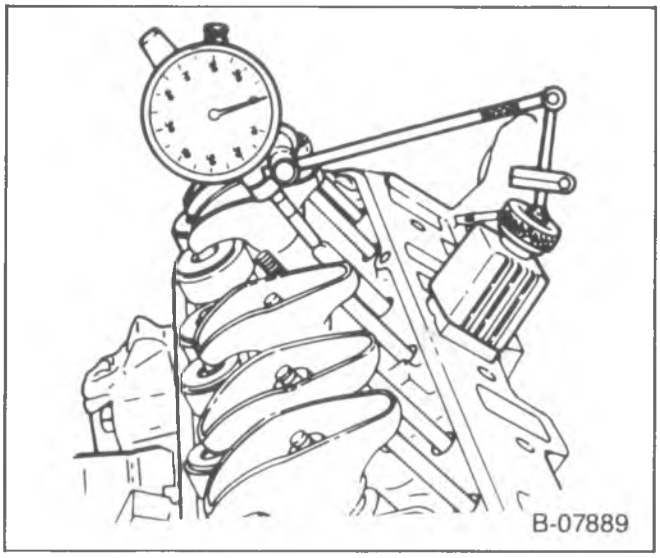


Figure 24—Measuring Camshaft Lobe Lift

7. Transmission.

MEASURING CAMSHAFT LOBE LIFT

Tool Required:

J-8520 Camshaft Lobe Lift Indicator.

1. Remove the rocker arm as outlined previously.
2. Refer to figure 24. Position the dial indicator (part of J-8520) so the plunger rests on the pushrod end, as shown. Make sure the pushrod is in the lifter socket.
3. Rotate the crankshaft slowly in the direction of rotation until the lifter is on the heel of the cam lobe. At this point, the pushrod will be in its lowest position.
4. Set dial indicator on zero, then rotate the crankshaft slowly, or attach an auxiliary starter switch and "bump" the engine over, until the pushrod is in fully raised position.

! **Important**

- Whenever the engine is cranked remotely at the starter, with a special jumper cable or other means, the distributor primary lead should be disconnected from the distributor (coil).

5. Compare the total lift recorded from the dial indicator with specifications.
6. If camshaft readings for all lobes are within specifications, remove dial indicator assembly.
7. Install the rocker arm and adjust the valves as previously outlined.

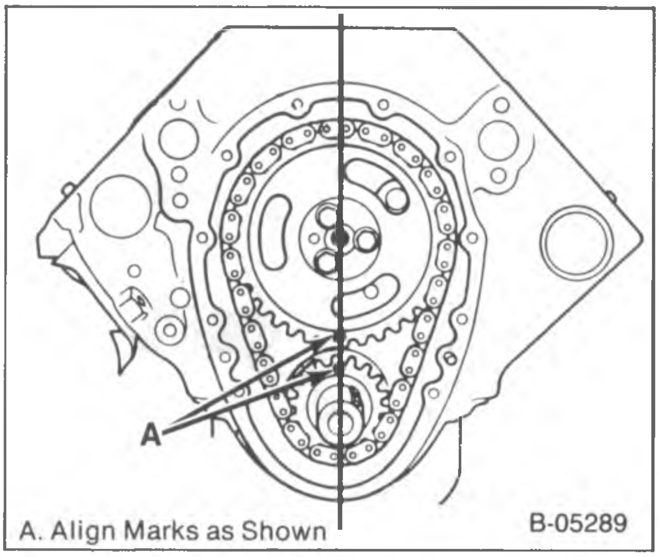


Figure 25—Timing Marks

CAMSHAFT REPLACEMENT

C AND K MODELS

↔ **Remove or Disconnect (Figures 25, 26, and 27)**

Tool Required:

J-5825 Crankshaft Sprocket Puller.

1. Battery negative cable.
2. Air cleaner.
3. Fan, shroud, and radiator. Refer to ENGINE COOLING (SEC. 6B).
4. Generator.
5. Rocker arm covers, as outlined previously.
6. Fuel line.
7. Water pump. Refer to ENGINE COOLING (SEC. 6B).
8. Torsional damper, as outlined previously.
9. Front cover, as outlined previously.
10. Distributor. Refer to ENGINE ELECTRICAL (SEC. 6D).
11. Intake manifold, as outlined previously.
12. Pushrods and hydraulic lifters, as outlined previously.
13. Fuel pump and pushrod.
    - Align the timing marks (figure 25).
14. Camshaft sprocket bolts.
15. Camshaft sprocket and timing chain. The sprocket is a light interference fit on the camshaft. Tap the sprocket on its lower edge to loosen it.
16. Crankshaft sprocket (if required). Use J-5825 (figure 26).
17. Engine mount through-bolts.
    - Raise the engine.
18. Camshaft.

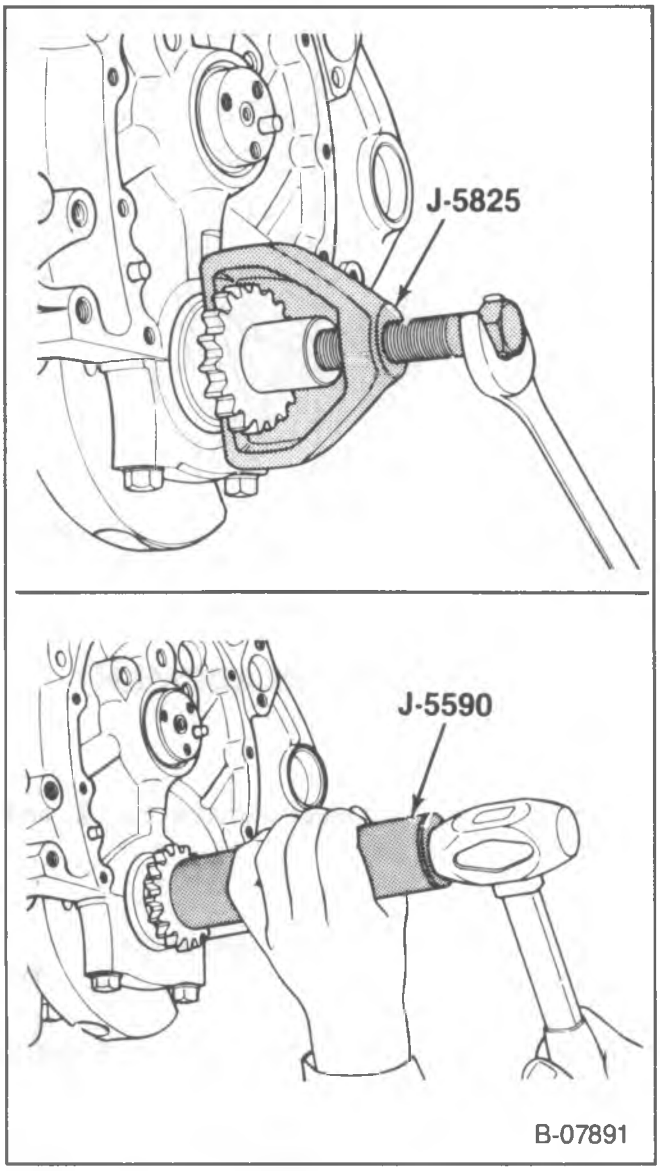


Figure 26—Replacing The Crankshaft Sprocket

- Install two or three $^{5}/_{16}$-18 bolts 100-125 mm (4-5 inches) long into the camshaft threaded holes. Use these bolts to handle the camshaft (figure 27).
- Pull the camshaft from the block. Use care to prevent damage to the camshaft bearings.

Cleaning, Inspection And Repair

Clean, inspect and repair or replace the camshaft and related components, as outlined in the proper unit repair manual.

The unit repair manual also describes camshaft bearing replacement.

Install or Connect (Figures 25 through 27, 35, and 36)

Tool Required:
J-5590 Crankshaft Sprocket Installer.

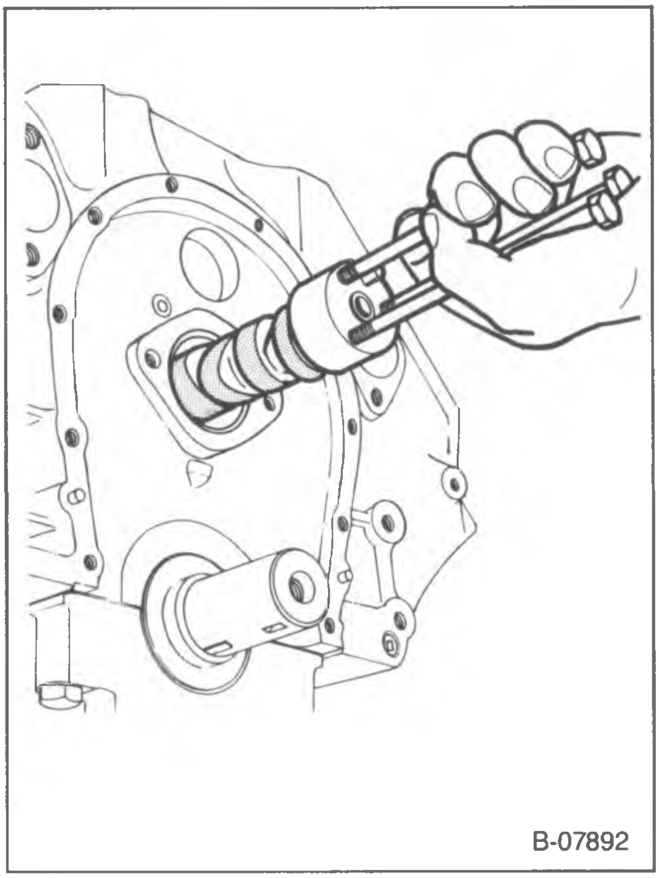


Figure 27—Replacing The Camshaft

- Coat the camshaft lobes and journals with a high quality engine oil supplement (GM Engine Oil Supplement or equivalent).

1. Two or three $^{5}/_{16}$-18 bolts 100-125 mm (4-5 inches) long into the camshaft threaded holes. Use these bolts to handle the camshaft.
2. Camshaft to the engine (figure 27). Handle the camshaft carefully to prevent damage to the camshaft bearings.

- Lower the engine.

3. Engine mount through-bolts.

Tighten

- Through-bolts or nuts to specifications. Refer to figures 35 and 36.

4. Crankshaft sprocket (if removed). Use J-5590 (figure 26). Make sure the timing mark faces outside.
5. Camshaft sprocket and timing chain.

Important

- Line up the timing marks on the camshaft sprocket and crankshaft sprocket (figure 25).

6. Camshaft sprocket bolts.

Tighten

- Bolts to 24 N·m (18 ft. lbs.).

7. Fuel pump and pushrod.
8. Hydraulic lifters and pushrods, as outlined previously.

Important

- Replace all hydraulic lifters and add GM Engine Oil Supplement (or equivalent) to the engine oil whenever a new camshaft is installed.

Adjust

- Valves, as outlined previously.

9. Intake manifold, as outlined previously.
10. Distributor. Refer to ENGINE ELECTRICAL (SEC. 6D).
11. Front cover, as outlined previously.
12. Torsional damper, as outlined previously.
13. Water pump. Refer to ENGINE COOLING (SEC. 6B).
14. Fuel line.
15. Rocker arm covers, as outlined previously.
16. Generator.
17. Fan, shroud, and radiator. Refer to ENGINE COOLING (SEC. 6B).
18. Air cleaner.
19. Battery negative cable.

G MODELS

Remove or Disconnect (Figures 25, 26, and 27)

Tool Required:
J-5825 Crankshaft Sprocket Puller.

1. Battery negative cable.
2. Intake manifold, as outlined previously.
3. Rocker arm covers, as outlined previously.
4. Hydraulic lifters and pushrods, as outlined previously.
5. Outside air duct.
6. Power steering reservoir.
7. Upper fan shroud bolts.
8. Radiator.
9. Hood release cable at the latch.
10. Upper fan shroud.
11. AIR pump, generator, air conditioning compressor, and power steering pump belts.
12. AIR pump and bracket.
13. Water pump.
14. Torsional damper, as outlined previously.
15. Front cover, as outlined previously.
16. Fuel pump and pushrod.
- Align the timing marks (figure 25).
17. Camshaft sprocket and timing chain. The sprocket is a lighter interference fit on the camshaft. Tap the sprocket on its lower edge to loosen it.
18. Crankshaft sprocket (if necessary). Use J-5825 (figure 26).
19. Camshaft.
    - Install two or three $^5/_{16}$-18 bolts 100-125 mm (4-5 inches) long into the camshaft tapped holes. Use these bolts to handle the camshaft (figure 27).
    - Pull the camshaft from the block. Use care to prevent damage to the camshaft bearings.

Cleaning, Inspection and Repair

Clean, inspect and repair or replace the camshaft and related components, as outlined in the proper unit repair manual.

The unit repair manual also describes camshaft bearing replacement.

Install or Connect (Figures 25, 26 and 27)

Tool Required:
J-5590 Crankshaft Sprocket Installer.

- Coat the camshaft lobes and journals with a high quality engine oil supplement (GM Engine Oil Supplement or equivalent).

1. Two or three $^5/_{16}$-18 bolts 100-125 mm (4-5 inches) long into the camshaft threaded holes. Use these bolts to handle the camshaft.
2. Camshaft to the engine (figure 27). Handle the camshaft carefully to prevent damage to the camshaft bearings.
3. Crankshaft sprocket. Use J-5590 (figure 26). Make sure the timing mark faces outside.
4. Camshaft sprocket and timing chain.

Important

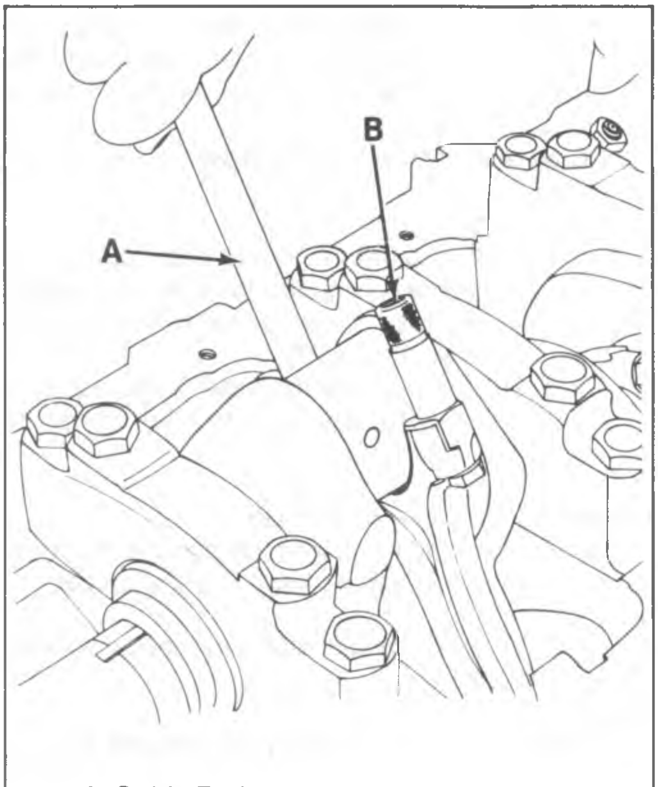
- Line up the timing marks on the camshaft sprocket and crankshaft sprocket (figure 25).

5. Camshaft sprocket bolts.

Tighten

- Bolts to 24 N·m (18 ft. lbs.).

6. Fuel pump and pushrod.
7. Front cover, as outlined previously.
8. Water pump.
9. AIR pump and bracket.
10. AIR pump, generator, air conditioning compressor, and power steering pump belts.
11. Torsional damper, as outlined previously.
12. Front cover, as outlined previously.
13. Upper fan shroud.



A. Guide Rod
B. Thread Protector
B-05269

Figure 28—Replacing The Piston And Connecting Rod (Typical)

14. Hood release cable.
15. Radiator.
16. Upper fan shroud bolts.
17. Power steering reservoir.
18. Outside air ducts.
19. Hydraulic lifters and pushrods, as outlined previously.

Adjust

- Valves, as outlined previously.

20. Rocker arm covers, as outlined previously.
21. Intake manifold, as outlined previously.
22. Battery negative cable.

CONNECTING ROD AND PISTON REPLACEMENT

Remove or Disconnect (Figure 28)

Tool Required:
J-5239 Guide Set.

1. Cylinder head, as outlined previously.
2. Oil pan, as outlined previously.
3. Oil pump, as outlined previously (if necessary).
4. Ridge or deposits from the upper end of the cylinder bores.
    - Turn the crankshaft until the piston is at BDC.
    - Place a cloth on top of the piston.
    - Perform the cutting operation with a ridge reamer.
    - Turn the crankshaft until the piston is at TDC.
    - Remove the cloth and cuttings.
5. Connecting rod cap. Check the connecting rod and cap for identification marks. Mark the parts if required. The connecting rod and cap must be kept together as mating parts.
6. Connecting rod and piston.
    - Attach J-5239 to the connecting rod bolts (figure 28).
    - Use the long guide rod of J-5239 to push the connecting rod and piston out of the bore.
7. Connecting rod bearing.

Cleaning, Inspection, And Repair

Clean, inspect and repair or replace the components as necessary. Measure connecting rod bearing clearance, piston clearance, ring clearances, etc. Refer to the proper unit repair manual.

The unit repair manual contains information on:

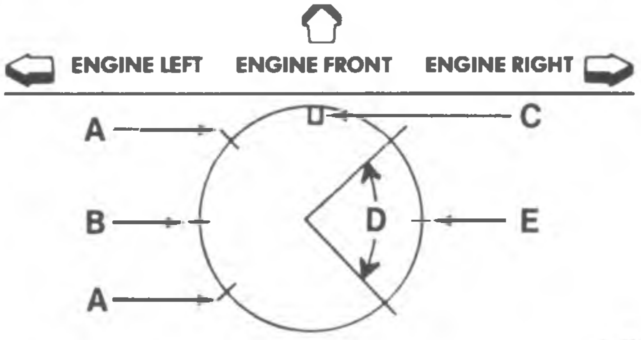
— Connecting rod and piston.
— Piston rings.
— Connecting rod and crankpin.
— Cylinder bores.

Install or Connect (Figures 28 through 31)

Tools Required:
J-5239 Connecting Rod Guide Set.
J-8037 Ring Compressor.

- Make sure the cylinder walls are clean. Lubricate the cylinder wall lightly with engine oil.
- Make sure the piston is installed in the matching cylinder.

1. Connecting rod bearings.
    - Be certain that the bearing inserts are of the proper size.
    - Install the bearing inserts in the connecting rod and connecting rod cap.
    - Lubricate the bearings with engine oil.
2. Piston and connecting rod to the proper bore.
    - With the connecting rod cap removed, install J-5239 onto the connecting rod studs.
    - Locate the piston ring end gaps as shown in figure 29. Lubricate the piston and rings with engine oil.
    - Without disturbing the ring end gap location, install J-8037 over the piston (figure 30).
    - The piston must be installed so that the notch in the piston faces the front of the engine (figure 29).



A. Oil Ring Rail Gaps
B. 2nd Compression Ring Gap
C. Notch In Piston
D. Oil Ring Spacer Gap
(Tang In Hole Or Slot With Arc)
E. Top Compression Ring Gap

Figure 29—Piston Ring End Gap Locations

- Place the piston in its matching bore. The connecting rod bearing tang slots must be on the side opposite the camshaft. Using light blows with a hammer handle, tap the piston down into its bore (figure 30). At the same time, from beneath the vehicle guide the connecting rod to the crankpin with J-5239 (figure 28). Hold the ring compressor against the block until all rings have entered the cylinder bore.

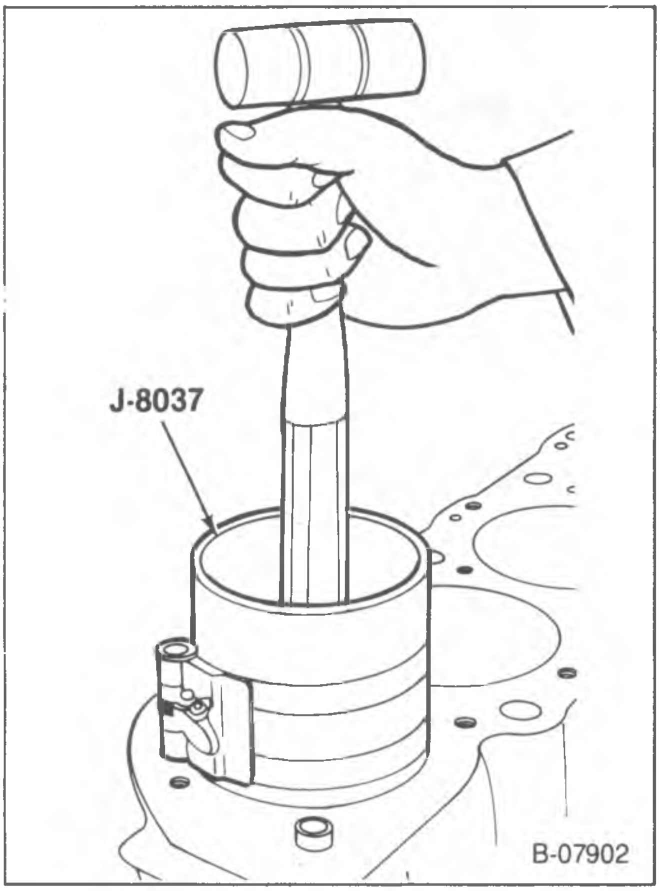


Figure 30—Installing The Piston

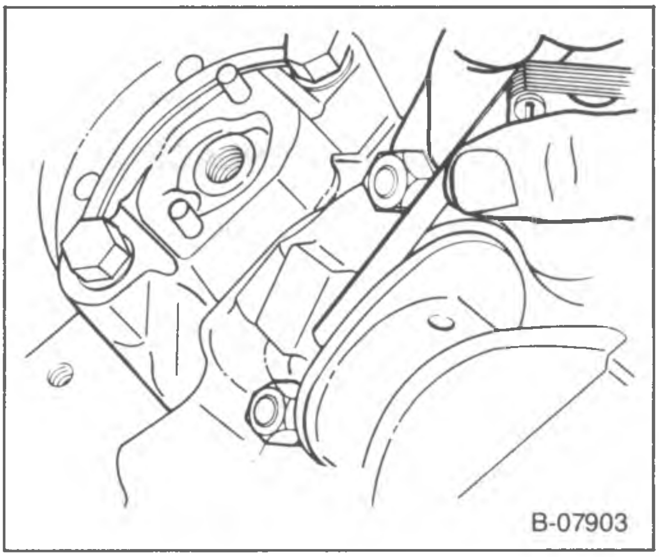


Figure 31—Measuring Connecting Rod Side Clearance

- Remove J-5239 from the connecting rod bolts.

Important

- Each connecting rod and bearing cap should be marked, beginning at the front of the engine. Cylinders 1, 3 and 5 are at the left bank and, 2, 4 and 6 are the right bank. The numbers on the connecting rod and bearing cap must be on the same side when installed in the cylinder bore. If a connecting rod is ever transposed from block or cylinder to another, new connecting rod bearings should be fitted and the connecting rod should be numbered to correspond with the new cylinder number.

Measure

- Connecting rod bearing clearance. Refer to the proper unit repair manual.

3. Connecting rod cap and bearing.
4. Connecting rod cap nuts.

Tighten

- Connecting rod cap nuts to 60 N·m (45 ft. lbs.).

Measure

- Connecting rod side clearance. Use a feeler gage between the connecting rod and crankshaft (figure 31). The correct clearance is 0.006-0.014-inch.

5. Oil pump (if removed), as outlined previously.
6. Oil pan and cylinder head, as outlined previously.

MAIN BEARING REPLACEMENT

Remove or Disconnect (Figure 32)

Tool Required:

J-8080 Main Bearing Remover/Installer.

1. Spark plugs.
2. Oil pan, as outlined previously.
3. Oil pump, as outlined previously.
4. Main bearing caps.
    - Check the main bearing caps for location markings. Mark the caps if necessary. The caps must be returned to their original locations during assembly.
5. Lower main bearing inserts from the main bearing caps.
6. Upper main bearing inserts.
    - Insert J-8080 into the crankshaft oil hole (figure 32).
    - Rotate the crankshaft to "turn" the bearing insert out of the block.

Cleaning, Inspection, And Repair

Clean, inspect, and repair or replace the components as required. Refer to the proper unit repair manual. The unit repair manual contains information on:

- Crankshaft.
- Main and connecting rod bearings.
- Main bearing cap replacement (shimming procedure).

Install or Connect (Figures 32 and 33)

Tool Required:

J-8080 Main Bearing Remover/Installer.

1. Upper main bearing inserts.
    - Insert J-8080 into a crankshaft main bearing oil hole (figure 32).
    - Apply engine oil to inserts of the proper size.
    - Insert the plain end (without the bearing tang) of the insert between the crankshaft and the notched side of the block.
    - Rotate the crankshaft to "roll" the insert into the block.
    - Remove the tool.
2. Lower main bearing inserts to the main bearing caps.
- Make sure the inserts are of the proper size.
- Apply engine oil to the inserts.

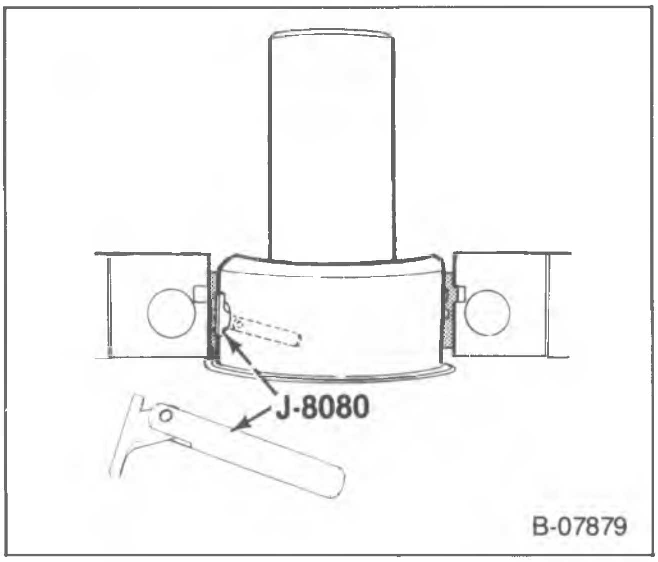


Figure 32—Removing The Main Bearing Insert

Measure

- Main bearing clearance. Refer to the proper unit repair manual. If the engine is 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.

3. Main bearing caps (except rear cap) and bolts to the block.

Tighten

- Main bearing cap bolts to 100 N·m (75 ft. lbs.).

4. Rear main bearing cap.
    - Apply engine oil to the bearing insert.

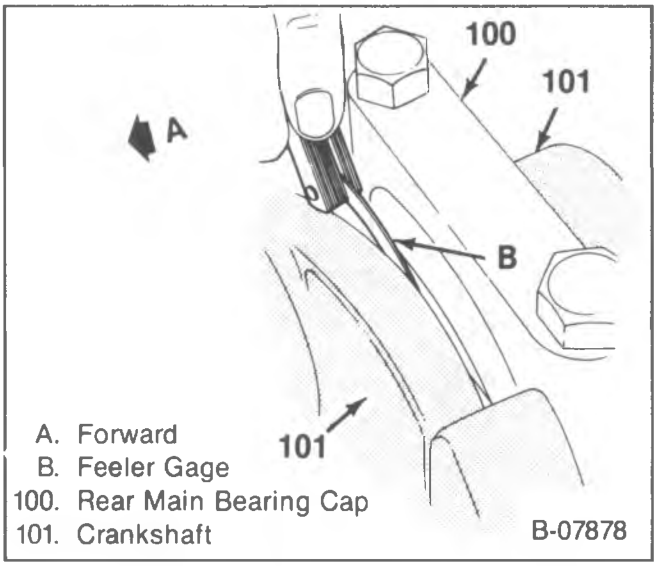


Figure 33—Measuring Crankshaft End Play

- Install the rear main bearing cap and bolts. Tighten the bolts temporarily to 14 N·m (10 ft. lbs.).

Measure

- Crankshaft end play, as follows:
    - Tap the end of the crankshaft first rearward then forward with a lead hammer. This will line up the rear main bearing and crankshaft thrust surfaces.
    - Tighten the rear main bearing cap bolts to 100 N·m (75 ft. lbs.).
    - With the crankshaft forced forward, measure at the front end of the rear main bearing with a feeler gage (figure 33). The proper clearance is 0.002-0.006-inch.
    - If correct end play cannot be obtained, be certain that the correct size rear main bearing has been installed. Production engines may have rear main bearings that are 0.008-inch wider across the thrust faces than standard. Refer to the proper unit repair manual for more information.

8. Oil pump, as outlined previously.
9. Oil pan, as outlined previously.
10. Spark plugs.

OIL FILTER ADAPTER AND OIL FILTER BYPASS VALVE REPLACEMENT (MODELS WITH ENGINE OIL COOLER)

Remove or Disconnect (Figure 34)

1. Oil filter.

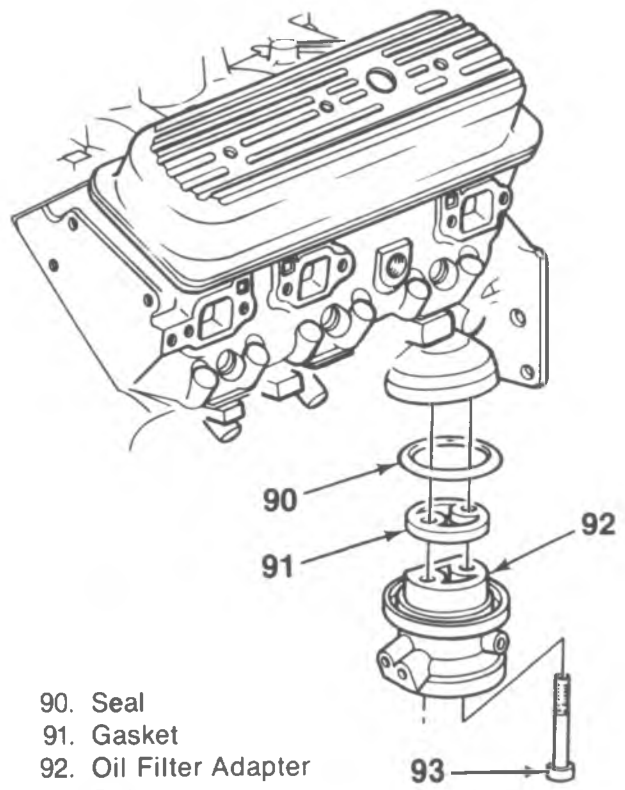
Inspect

- Bypass valve spring and fiber valve for proper operation, cracks, or other damage. If replacement is required, the bypass valve and oil filter adapter must be replaced as an assembly, as outlined following.

2. Oil cooler lines.
3. Bolts (93).
4. Oil filter adapter (92).
5. Gasket (91) and seal (90).

Install or Connect (Figure 33)

1. New gasket (91), new seal (90) and oil filter adapter (92) to the block.
2. Bolts (93).



90. Seal
91. Gasket
92. Oil Filter Adapter
93. Bolt

B-07904

Figure 34—Oil Filter Adapter Installation

Tighten

- Bolts (93) to 20 N·m (15 ft. lbs.).

3. Oil cooler lines.
4. Oil filter.

- Add engine oil as needed.

CRANKSHAFT REPLACEMENT

Remove or Disconnect (Figure 28)

Tool Required:
J-5239 Connecting Rod Guide Set.

1. Engine, as outlined later.
2. Flywheel (if used) as outlined later.
    - Mount the engine in a suitable engine stand.
3. Spark plugs.
4. Oil dipstick tube.
5. Oil pan and oil pump, as outlined previously.
6. Torsional damper, as outlined previously.
7. Front cover, as outlined previously.
8. Camshaft sprocket and timing chain.
9. Rear crankshaft oil seal retainer, as outlined previously.
10. Connecting rod caps. Check the connecting rod and cap for identification marks. Mark the parts if necessary. The connecting rod and cap are mating parts.

11. Connecting rods from the crankshaft.
    - Attach J-5239 to the connecting rod bolts (figure 28).
    - Use the long guide rod to push the pistons up in the bores.
12. Main bearing caps. Check the main bearing caps for location markings. Mark the parts if necessary. The main bearing caps must be returned to their original locations at assembly.
13. Crankshaft.
14. Main bearing inserts.

Cleaning, Inspection, And Repair

Clean, inspect, and repair or replace the parts as outiined in the proper unit repair manual. Refer to the unit repair manual for information on:

— Crankshaft.
— Main and connecting rod bearings.
— Procedures for measuring bearing clearances.

Install or Connect (Figures 25, 28, and 31)

Tool Required:
- J-5239 Guide Set.

1. Upper main bearing inserts to the block. Apply engine oil to the main bearings.
2. Crankshaft.
3. Lower main bearing inserts to the main bearing caps. Apply engine oil to the bearing inserts.

Measure

- Main bearing clearance. Refer to the proper unit repair manual.

4. Main bearing caps (except rear cap) and bolts to the block.

Tighten

- Main bearing cap bolts to 100 N·m (75 ft. lbs.).

5. Rear main bearing cap and bolts to the block.

Tighten

- Rear main bearing cap bolts temporarily to 14 N·m (10 ft. lbs.).

Measure

- Crankshaft end play, as follows:
    - Tap the end of the crankshaft first rearward then forward with a lead hammer. This will line up the rear main bearing and crankshaft thrust surfaces.
    - Tighten the rear main bearing cap bolts to 100 N·m (75 ft. lbs.).
    - With the crankshaft forced forward, measure at the front end of the rear main bearing with a feeler gage (figure 32). The proper clerance is 0.002-0.006-inch.
    - If correct end play cannot be obtained, be certain that the correct size rear main bearing has been installed. Production engines may have rear main bearings that are 0.008-inch wider across the thrust faces than standard. Refer to the proper unit repair manual for more information.

Inspect

- Crankshaft for binding. Try turning the crankshaft to check for binding. If the crankshaft does not turn freely, loosen the main bearing cap bolts, one pair at a time, until the tight bearing is located. Burrs on the bearing cap, foreign matter between the insert and the block or the bearing cap, or a faulty insert could cause a lack of clearance at the bearing.

6. Connecting rods to the crankshaft. Use J-5239 to pull the connecting rods down (figure 28). Make sure the connecting rod bearing insert stays in place.

Measure

- Connecting rod bearing clearance. Refer to the proper unit repair manual.

7. Connecting rod caps with bearing inserts to the connecting rods. Apply engine oil to the inserts.
8. Connecting rod cap nuts.

Tighten

- Connecting rod cap nuts to 60 N·m (45 ft. lbs.).

Measure

- Connecting rod side clearance. Use a feeler gage between the connecting rod and crankshft (figure 31) The correct clearance is 0.006-0.014-inch.

9. Rear crankshaft oil seal retainer wiht new crankshaft rear oil seal, as outlined previously.
10. Camshaft sprocket and timing chain.

Important

- Align the timing marks (figure 25).

11. Timing cover, as outlined previously.
12. Torsional damper, as outlined previously.

13. Oil pan and oil pump, as outlined previously.
14. Oil dipstick tube.
15. Spark plugs.
16. Flywheel (if used), as outlined later.
17. Engine, as outlined later.

FLYWHEEL REPLACEMENT

Remove or Disconnect

1. Transmission, flywheel housing, and clutch.
2. Flywheel bolts.
3. Flywheel.

Clean

- Mating surfaces of crankshaft and flywheel. Remove any burrs.

Inspect

— Flywheel for burning, scoring, warping, and wear. Replace the flywheel if necessary. Do not machine the flywheel.

— Flywheel ring gear for worn or broken teeth.

Flywheel Ring Gear Replacement

1. Use a torch to heat the gear around the entire circumference, then drive the gear off the flywheel, using care not to damage the flywheel.

NOTICE: Never heat starter gear to red heat as this will change metal structure.

2. Uniformly heat the flywheel gear to temperature which will expand the gear to permit installation. Temperature must not exceed 204°C (400°F).
3. As soon as the gear has been heated, install on the flywheel.

Install or Connect

1. Flywheel.
2. Flywheel bolts.

   Tighten

   - Flywheel bolts to 100 N·m (75 ft. lbs.).

3. Clutch, flywheel housing, and transmission.

ENGINE MOUNTINGS

NOTICE: Broken or deteriorated mountings can cause misaligned and eventual destruction of certain drive train components. When a single mounting breakage occurs, the remaining mountings are subjected to abnormally high stresses.

INSPECTING ENGINE MOUNTINGS

Front Engine Mountings

NOTICE: When raising or supporting the engine for any reason, do not use a jack under the oil pan, any sheet metal or crankshaft pulley. 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 pickup unit.

1. Raise the engine to remove weight from the mountings and to place a slight tension on the rubber cushion. Observe both mountings while raising the engine.
2. Replace the mounting if the following conditions exist:
   — Hard rubber surface covered with heat check cracks.
   — Rubber cushion separated from the metal palte of the mounting.
   — Rubber cushion split through the center.
3. If there is movement between a metal plate of the mounting and its attaching points, lower the engine and tighten the bolts or nuts attaching the mounting to the engine, frame, or bracket.

Rear Mountings

1. Push up and pull down on the transmission tailshaft. Observe the transmission mounting.
2. Replace the mounting if the following conditions exist:
   — Rubber cushion separated from the metal plate of the mounting.
   — Mounting bottomed out (tailshaft can be moved up but not down).
3. If there is relative movement between a metal plate of the mounting and its attaching point, tighten the bolts or nuts attaching the mounting to the transmission or crossmember.

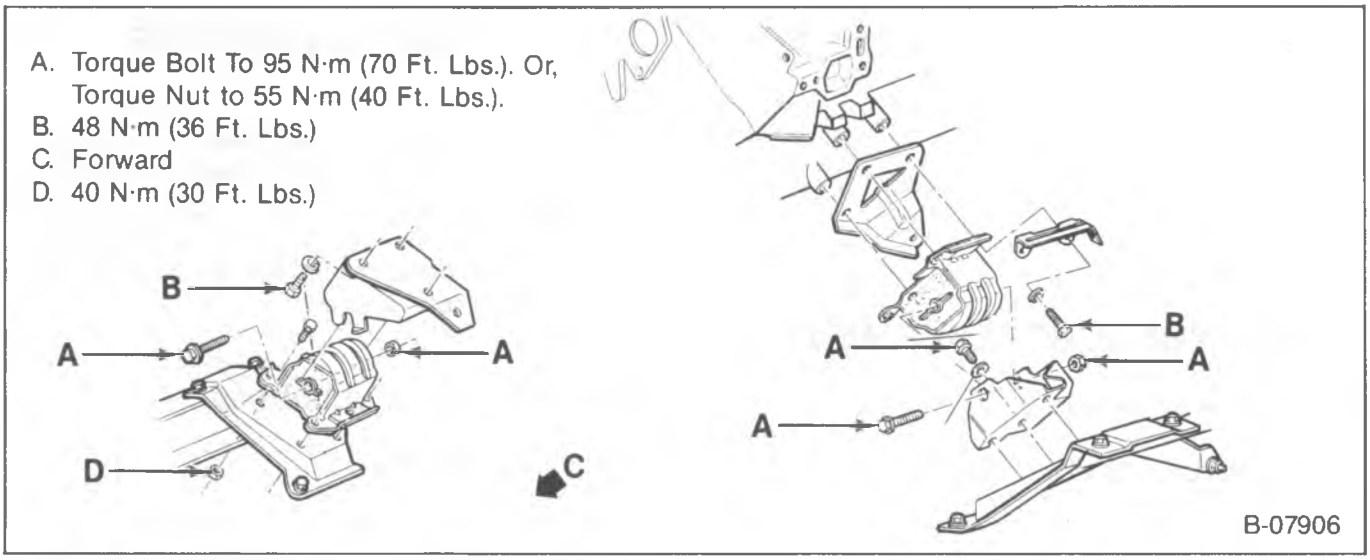


Figure 35—Front Engine Mounting (C And K Models)

FRONT MOUNTING REPLACEMENT

↔ Remove or Disconnect (Figures 35 and 36)

NOTICE: When raising or supporting the engine for any reason, do not use a jack under the oil pan, any sheet metal or crankshaft pulley. 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 pickup unit.

- Support the engine with a suitable jack. Do not load the engine mounting.

1. Engine mounting through-bolt and nut.

NOTICE: Raise the engine only enough for sufficient clearance. Check for interference between the rear of the engine and the dash panel which could cause distributor damage.

- Raise the engine only enough to permit removal of the engine mounting.

2. Mounting assembly bolts, nuts, and washers.
3. Mounting assembly.

→← Install or Connect (Figures 35 and 36)

1. Mounting assembly.

NOTICE: See "Notice" on page 6A3-1 of this section.

2. Mounting assembly bolts, nuts, and washers.

Tighten

- Fasteners to specifications. Refer to figures 35 and 36.

3. Engine mount through-bolt and nut. Lower the engine until the bolt can be inserted. Install the nut.

Tighten

- Through-bolt or nut to specifications. Refer to figures 35 and 36.

REAR MOUNTING RELACEMENT

↔ Remove or Disconnect (Figures 37 and 38)

NOTICE: When raising or supporting the engine for any reason, do not use a jack under the oil pan, any sheet metal or crankshaft pulley. 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 pickup unit.

- Support the rear of the engine to relieve the weight on the rear mountings.

1. Mounting to crossmember nut(s) and washer(s).
2. Mounting to transmission bolts and washers.

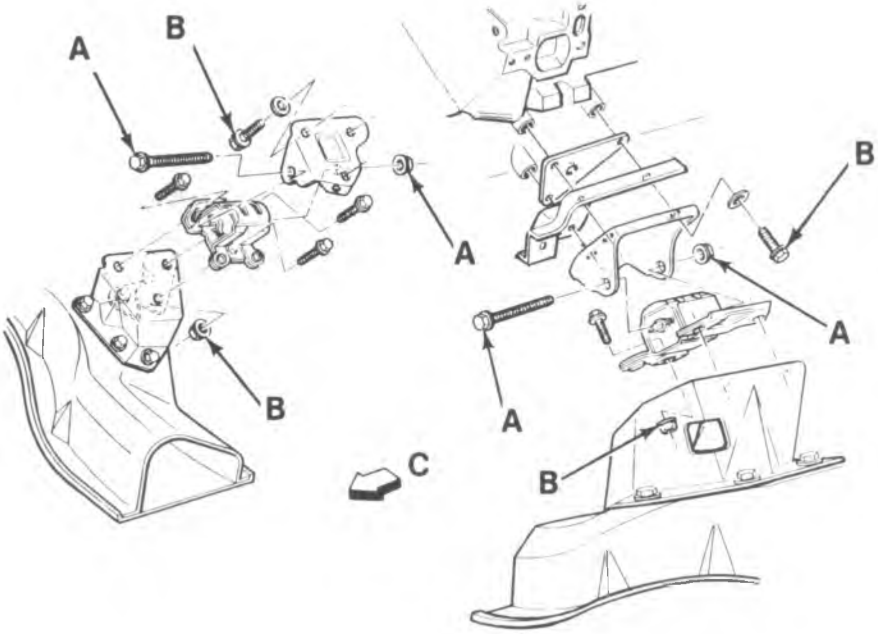
- Raise the rear of the engine only enough to permit removal of the mounting.

3. Mounting.

→← Install or Connect (Figures 37 and 38)

1. Mounting.

- Lower the rear of the engine.



A. Torque Bolt To 95 N·m (70 Ft. Lbs.). Or
   Torque Nut To 55 N·m (40 Ft. Lbs.).
B. 48 N·m (36 Ft. Lbs.)
C. Forward

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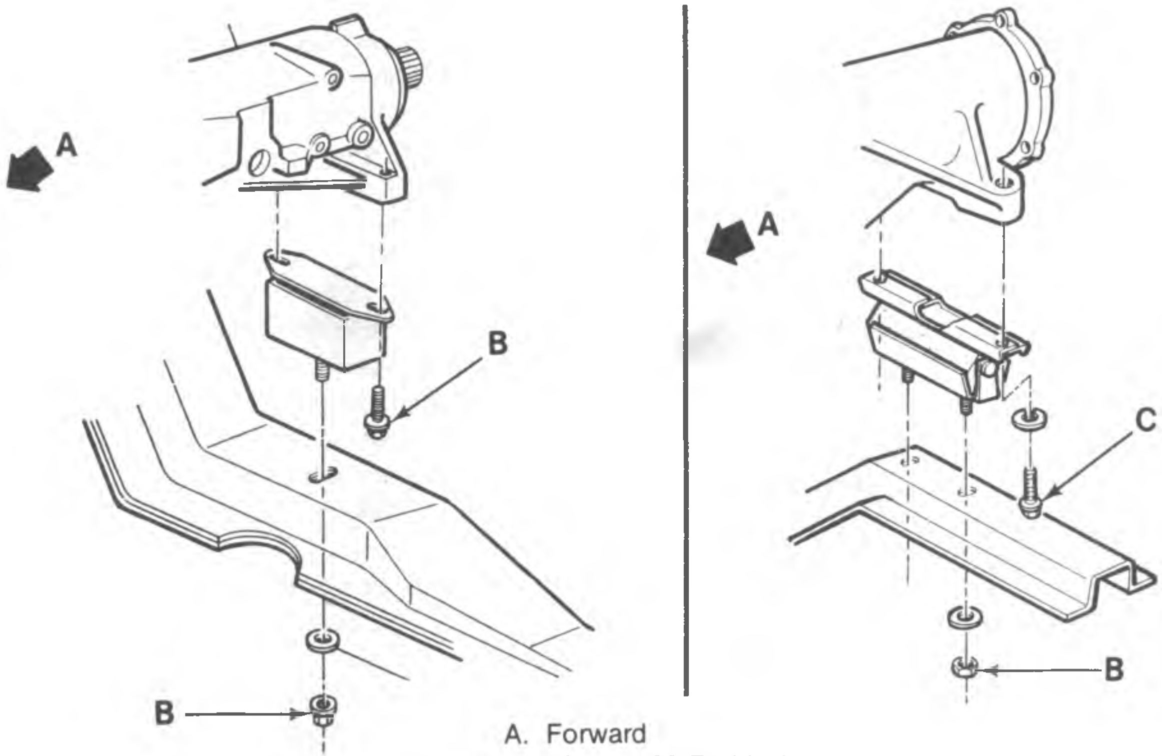
Figure 36—Front Engine Mounting (G Models)



A. Forward
B. 48 N·m (36 Ft. Lbs.)
C. 55 N·m (40 Ft. Lbs.)

"C" MODELS

"K" MODELS

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Figure 37—Rear Engine Mounting (C And K Models)

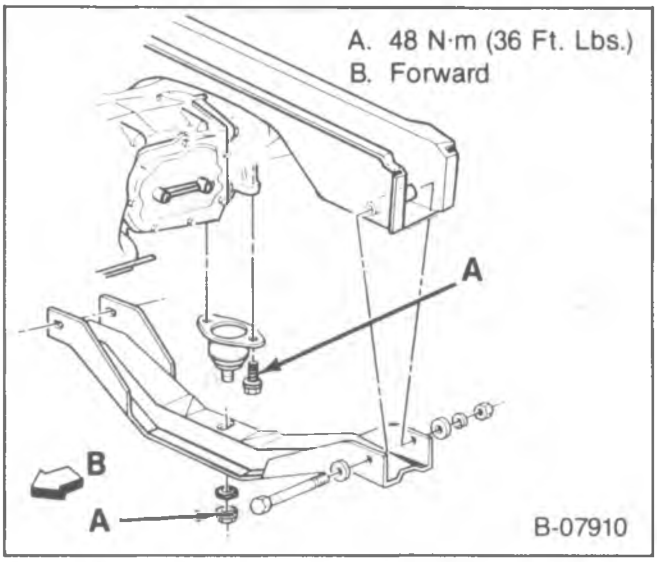

Figure 38—Rear Engine Mounting (G Models)

2. Mounting to transmission bolts and washers.

NOTICE: See "Notice" on page 6A3-1 of this section.

3. Mounting to crossmember nut(s) and washer(s).

Tighten

- Fasteners to specifications. Refer to figures 37 and 38.

ENGINE REPLACEMENT

"C" AND "K" MODELS

Remove or Disconnect

1. Battery negative cable.
2. Hood.
   - Drain the cooling system.
3. Air cleaner.
4. All accessory drive belts.
5. Fan and water pump pulley.
6. Radiator and shroud. Refer to ENGINE COOLING (SEC. 1B).
7. Heater hoses at the engine.
8. Accelerator cruise control, and detent linkage (if used) from the carburetor.
9. Air conditioning compressor (if used) and lay aside.
10. Power steering pump (if used) and lay aside.
11. Engine wiring harness from the engine.
12. Fuel line at the fuel pump.
13. Vacuum lines from the intake manifold.
    - Raise the vehicle.
    - Drain the crankcase oil.
14. Exhaust pipes from the manifolds.
15. Strut rods at the engine mountings ("K" models with automatic transmission).
16. Flywheel or torque converter cover.
17. Wiring along oil pan rail.
18. Starter.
19. Wiring for fuel gage.
20. Converter to flex plate bolts.
    - Lower the vehicle.
    - Support the transmission.
    - Attach a suitable lifting fixture.
21. Bell housing to engine bolts.
22. Engine mounting to frame bolts.
23. Hood.
24. Engine.

Install or Connect (Figure 35)

1. Engine to the vehicle.
   - Raise the vehicle.

NOTICE: See "Notice" on page 6A3-1 of this section.

2. Engine mounting to frame bolts.

Tighten

- Fasteners to specifications. Refer to figure 35.

3. Bell housing to engine bolts. Remove the transmission support.
4. Converter to flex plate bolts.
5. Fuel gage wiring.
6. Starter.
7. Wiring along oil pan rail.
8. Flywheel or torque converter cover.
9. Strut rods at the engine mountings (K models with automatic transmission).
10. Exhaust pipes to the manifolds.
    - Lower the vehicle.
11. Vacuum lines to the intake manifold.
12. Fuel line at the fuel pump.
13. Engine wiring harness.
14. Power steering pump (if used).
15. Air conditioning compressor (if used).
16. Accelerator, cruise control, and detent linkages.
17. Heater hoses.
18. Radiator and shroud.
19. Accessory drive belts.
20. Air cleaner.
21. Hood.
22. Proper quantity and grade of coolant and crankcase oil.
23. Battery negative cable.

"G" MODELS

Remove or Disconnect

1. Battery negative cable.
2. Glove box.
3. Engine cover.

- Drain the coolant.

4. Outside air duct.
5. Power steering fluid reservoir.
6. Hood release cable.
7. Upper fan shroud bolts.
8. Radiator. Refer to ENGINE COOLING (SEC. 6B).
9. Upper fan shroud.
10. Fan and pulley.
11. Air cleaner.
12. Cruise control servo.
13. Vacuum hoses at the intake manifold.
14. Accelerator, cruise control, and detent cables (if used).
15. Carburetor.
16. Distributor cap.
17. Diverter valve.
18. Coolant hose at the intake manifold.
19. PCV valve.
20. Other necessary vacuum hoses and wires.
21. Air conditioning compressor and brace. Refer to AIR CONDITIONING (SEC. 1B).
22. Upper half of engine dipstick tube.
23. Oil filler tube.
24. Transmission dipstick tube.
25. Accelerator cable at the dipstick tube.
26. Fuel hoses at the fuel pump.
27. Power steering pump.
28. Air conditioning idler pulley.
29. Headlamp bezels and grille.
30. Upper radiator support.
31. Lower fan shroud and filler panel.
32. Hood latch support.
33. Condenser.

- Raise the vehicle.
- Drain the crankcase.

34. Exhaust pipes at the manifolds.
35. Strut rods at the torque converter or flywheel underpan.
36. Torque convertor or flywheel cover.
37. Starter.
38. Flexplate to torque converter bolts (automatic transmissions).
39. Bell housing to engine bolts.
40. Engine mounting through bolts.

- Lower the vehicle and support the transmission.

41. Engine.

Install or Connect (Figure 36)

1. Engine to the vehicle.

- Raise the vehicle.

NOTICE: See "Notice" on page 6A3-1 of this section.

2. Engine mounting through-bolts.

Tighten

- Through-bolts or nuts to specifications. Refer to figure 36.

3. Bell housing to engine bolts.
4. Flex plate to torque converter bolts (automatic transmissions).
5. Starter.
6. Torque converter or flywheel cover.
7. Strut rods.
8. Exhaust pipes.

- Lower the vehicle.

9. Condenser.
10. Hood latch support.
11. Lower fan shroud and filler panel.
12. Upper radiator support.
13. Headlamp bezels and grille.
14. Air conditioning idler pulley.
15. Power steering pump.
16. Fuel hoses.
17. Accelerator cable at the dipstick tube.
18. Transmission dipstick tube.
19. Oil filler tube.
20. Upper half of engine dipstick tube.
21. Air conditioning compressor and brace. Refer to AIR CONDITIONING (SEC. 1B).
22. Vacuum hoses and wires.
23. PCV valve.
24. Coolant hose at the intake manifold.
25. Diverter valve.
26. Distributor cap.
27. Carburetor.
28. Accelerator, cruise control, and detent cables.
29. Vacuum hoses at the intake manifold.
30. Cruise control servo.
31. Air cleaner.
32. Fan and pulley.
33. Upper fan shroud.
34. Radiator. Refer to ENGINE COOLING (SEC. 6B).
35. Upper fan shroud bolts.
36. Hood release cable.
37. Power steering fluid reservoir.
38. Outside air duct.
39. Glove box.
40. Proper quantity and grade of coolant and crankcase oil.
41. Engine cover.
42. Battery negative cable.

- Evacuate and charge the air conditioning system. Refer to AIR CONDITIONING (SEC. 1B).

SPECIFICATIONS

ENGINE SPECIFICATIONS

All Specifications are in INCHES unless otherwise noted.

GENERAL DATA:				
Type				V6
Displacement				4.3L (262 Cu. In.)
RPO				LB1/LB4
Bore				4.00
Stroke				3.48
Compression Ratio				9.3:1
Firing Order				1 - 6 - 5 - 4 - 3 - 2
Oil Pressure				10 psi @ 500 RPM; 30-35 psi @ 2000 RPM
CYLINDER BORE:				
Diameter				3.9995-4.0025-
Out Of Round	Production			0.001 (Maximum)
	Service			0.002 (Maximum)
Taper	Production	Thrust Side		0.0005 (Maximum)
		Relief Side		0.001 (Maximum)
	Service			0.001 (Maximum)
PISTON:				
Clearance	Production			0.0007-0.0017
	Service Limit			0.0027 (Maximum)
PISTON RING:				
COMPRESSION	Groove Clearance	Production	Top	0.0012-0.0032
			2nd	
		Service Limit		Hi Limit Production + 0.001
	Gap	Production	Top	0.010-0.020
			2nd	0.010-0.025
		Service Limit		Hi Limit Production + 0.010
OIL	Groove Clearance	Production		0.002-0.007
		Service Limit		Hi Limit Production + 0.001
	Gap	Production		0.015-0.055
		Service Limit		Hi Production +0.010
PISTON PIN:				
Diameter				0.9270-0.09273
Clearance In Piston	Production			0.00025-0.00035
	Service Limit			0.001 (Maximum)
Fit In Rod				0.0008-0.0016 Interference

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SPECIFICATIONS

ENGINE SPECIFICATIONS (CONT.)

All specifications are in INCHES unless otherwise noted.

DISPLACEMENT:			4.3L
CRANKSHAFT:			
Main Journal	Diameter	#1	2.4484-2.4493
		#2, #3	2.4481-2.4490
		#4	2.4479-2.4488
	Taper	Production	0.0002 (Maximum)
		Service Limit	0.001 (Maximum)
	Out Of Round	Production	0.0002 (Maximum)
		Service Limit	0.001 (Maximum)
Main Bearing Clearance	Production	#1	0.0008-0.0020
		#2, #3	0.0011-0.0023
		#4	0.0017-0.0032
	Service Limit	#1	0.0010-0.0015
		#2, #3	0.0010-0.0025
		#4	0.0025-0.0035
Crankshaft End Play			0.002-0.006
Crankpin	Diameter		2.2487-2.2497
	Taper	Production	0.0005
		Service Limit	0.001 (Maximum)
	Out Round	Production	0.0005
		Service Limit	0.001 (Maximum)
Rod Bearing Clearance	Production		0.0013-0.0035
	Service Limit		0.0030
Rod Side Clearance			0.006-0.014
CAMSHAFT:			
Lobe Lift ± 0.002	Intake		0.357
	Exhaust		0.390
Journal Diameter			1.8682-1.8692
Camshaft End Play			0.004-0.012
VALVE SYSTEM:			
Lifter			Hydraulic
Rocker Arm Ratio			1.50:1
Valve Lash		Intake	One Turn Down From Zero Lash
		Exhaust	
Face Angle (Intake & Exhaust)			45°
Seat Angle (Intake & Exhaust)			46°
Seat Runout (Intake & Exhaust)			0.002 (Maximum)
Seat Width		Intake	1/32-1/16
		Exhaust	1/16-3/32
Stem Clearance	Production	Intake	0.0010-0.0027
		Exhaust	0.0010-0.0027
	Service	Intake	High Limit Production +0.001
		Exhaust	High Limit Production +0.002
Valve Spring (Outer)	Free Length		2.03
	Pressure lbs. @ in.	Closed	76-84 lbs. @ 1.70-in.
		Open	194-206 lbs. @ 1.25-in.
	Installed Height ± 1/32"		1 23/32
Valve Spring Damper	Free Length		1.86
	Approx. # of Coils		4

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SPECIFICATIONS (CONTINUED)

TORQUE SPECIFICATIONS

ITEM	N·m	FT. LBS.	IN. LBS.
Rocker Arm Cover Bolts	9.9	—	88
Intake Manifold Bolts	48	36	—
Exhaust Manifold Bolts			
Center Two Bolts	36	26	—
All Others	28	20	—
Cylinder Head Bolts	90	65	—
Torsional Damper Bolt	95	70	—
Front Cover Bolts	10.4	—	92
Oil Pan Nuts	22.6	—	200
Oil Pan Bolts	11.3	—	100
Oil Pump Bolt	90	65	—
Rear Crankshaft Oil Seal Retainer Screws	15.3	—	135
Camshaft Sprocket Bolts	24	18	—
Connecting Rod Cap Nuts	60	45	—
Oil Filter Adapter Bolts	20	15	—
Main Bearing Cap Bolts	100	75	—
Oil Pump Cover Bolts	9.0	—	80
Flywheel Bolts	100	75	—
Spark Plugs	30	22	—
Water Outlet Bolts	28	21	—
Water Pump Bolts	40	30	—
Flywheel Housing Bolts	44	32	—

SPECIAL TOOLS

J-23590	Air Adapter
J-5892-A	Spring Compressor
J-23738-A	Vacuum Pump
J-3049	Hydraulic Lifter Remover (Plier Type)
J-9290-1	Hydraulic Lifter Remover (Slide Hammer Type)
J-5802-01	Rocker Arm Stud Remover
J-5715	Reamer (0.003-inch oversize)
J-6036	Reamer (0.013-inch oversize)
J-6880	Rocker Arm Stud Installer
J-23523-E	Torsional Damper Remover and Installer
J-23042-A	Front Crankshaft Seal Installer
J-35621	Rear Crankshaft Seal Installer
J-8520	Camshaft Lobe Lift Indicator
J-5239	Guide Set
J-8037	Ring Compressor
J-8080	Main Bearing Remover/Installer
J-5825	Crankshaft Sprocket Puller
J-5590	Crankshaft Sprocket Installer

SECTION 6A4

4.8 LITER L6

The following "Notice" applies to one or more steps in the assembly procedure of components in this portion of this manual as indicated at appropriate locations by the terminology "See NOTICE on page 6A4-1 of this section."

NOTICE: All engine 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. Torque values must be used as specified during reassembly to assure proper retention of all parts.

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SUBJECT **PAGE**

DESCRIPTION

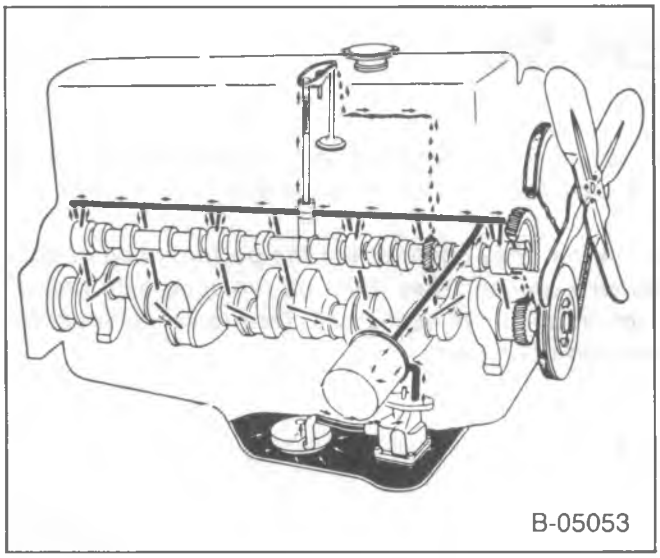


Figure 1—Lubrication Diagram (Side View)

4.8L engines are inline six cylinder type, overhead valve, water cooled, with cast iron block and head.

The crankshaft is supported by seven precision insert main bearings, with crankshaft thrust taken at the number seven (rear) bearing.

The camshaft is supported by four plain type bearings and is gear driven. Motion from the camshaft is transmitted to the valves by hydraulic lifters, pushrods, and ball-type rocker arms. The valve guides are integral in the cylinder head.

The connecting rods are forged steel, with precision insert type crankpin bearings. The piston pins are a press fit in the connecting rods.

The pistons are cast aluminum alloy. The piston pins are a floating fit in the pistons.

ENGINE LUBRICATION

Lubrication schematics are shown in figures 1 and 2. The gear type oil pump is driven through an extension shaft from the distributor drive shaft, which is gear driven from the camshaft. Oil is drawn into the oil pump through a pickup screen and pipe.

Pressurized oil is routed to the oil filter. In case of excessive backpressure at the oil filter, a bypass valve is provided. This valve will allow oil flow to the main oil gallery at the right side of the block. This gallery supplies oil to the camshaft bearings, hydraulic lifters, and main bearings. The connecting rods are supplied oil from the main bearings by means of drilled passages in the crankshaft. The valve train is supplied with oil by the hydraulic lifters. Oil is pumped from the lifters through the hollow pushrods to the rocker arms. Oil drains back to the crankcase through oil drain holes and the pushrod holes. The piston, piston pin, and timing gears are lubricated by oil splash.

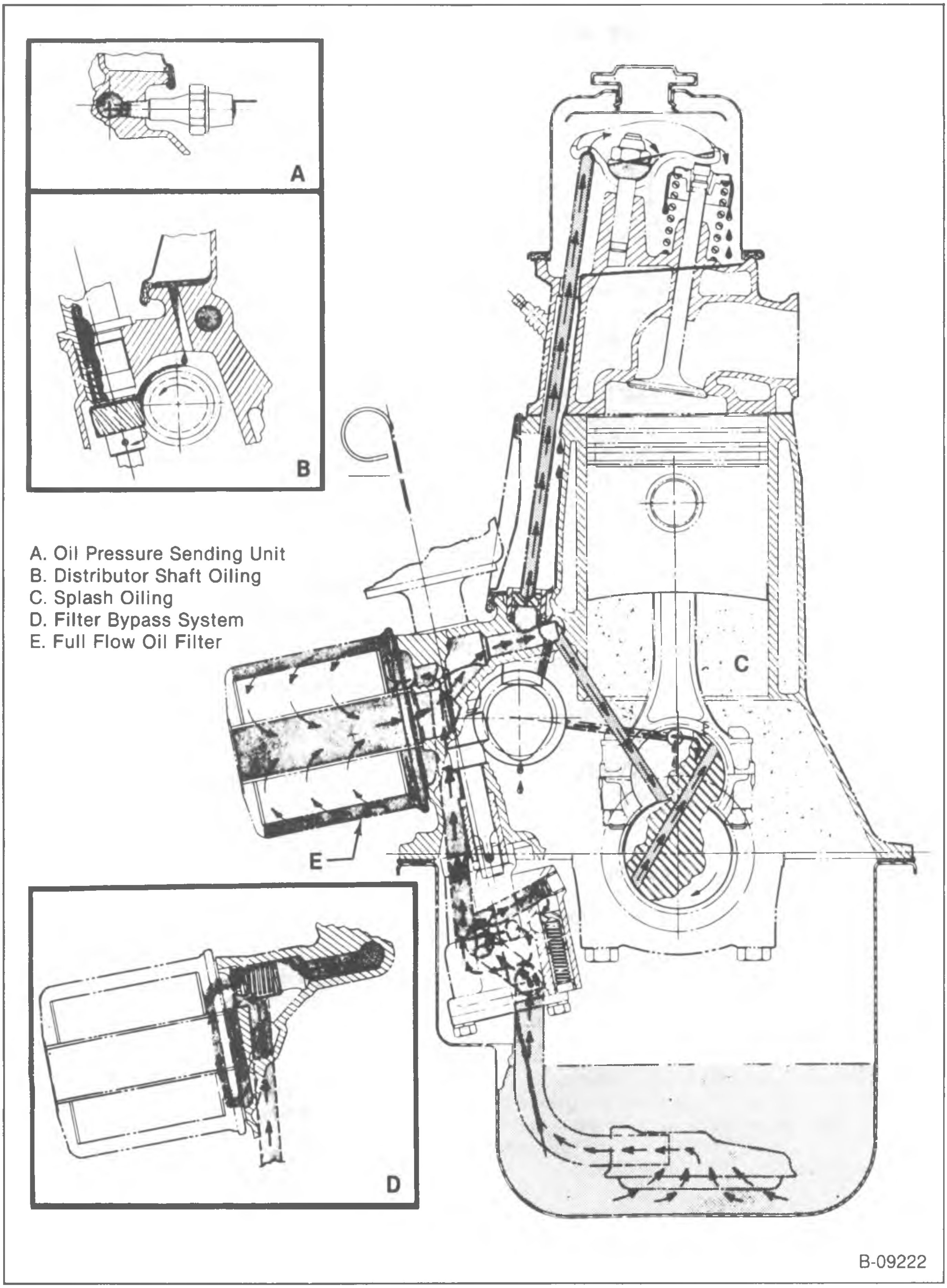
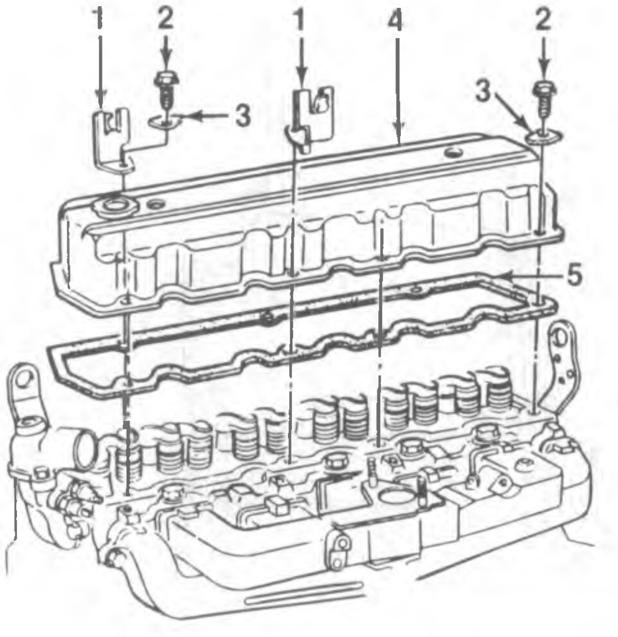


Figure 2—Lubrication Diagram (Front View)

ON-VEHICLE SERVICE



1. Clip
2. Bolt
3. Reinforcement
4. Rocker Arm Cover
5. Gasket

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Figure 3—Rocker Arm Cover Installation

ROCKER ARM COVER REPLACEMENT

Remove or Disconnect (Figure 3)

1. Crankcase ventilation hoses at the rocker arm cover.
2. Air cleaner.
3. Wiring, fuel and vacuum lines from the clips.
4. Bolts, reinforcements, and clips.
5. Rocker arm cover.
    - If the rocker arm cover adheres to the cylinder head, try to shear the gasket by bumping the end of the cover with a rubber mallet. DO NOT DISTORT THE SEALING FLANGE.
6. Gasket.

Clean

- All traces of old gasket from the rocker arm cover and cylinder head.

Inspect

- Rocker arm cover sealing surfaces for distortion. Straighten or replace as needed.

Install or Connect (Figure 3)

1. New gasket.
2. Rocker arm cover.
3. Bolts, clips, and reinforcements.

    Tighten

    - Bolts to specification.
        - — Rubber gasket – 4.3 N·m (38 in. lbs.).
        - — Cork gasket – 5.4 N·m (58 in. lbs.).
4. Wiring, fuel and vacuum lines to the clips.
5. Air cleaner.
6. Crankcase ventilation hoses to the rocker arm cover.

ROCKER ARM AND PUSHROD REPLACEMENT

Remove or Disconnect

1. Rocker arm cover, as outlined previously.
2. Rocker arm nut.
    - If only the pushrod is to be replaced, back the rocker arm nut off until the rocker arm can be swung away from the pushrod. Then pull the pushrod out.
3. Rocker arm with ball.
4. Pushrod.

Important

- Store used components in order so they can be reassembled in the same location.

Inspect

— Rocker arms and balls at their mating surfaces. These surfaces should be smooth and free from scoring or other damage.

— Rocker arm areas which contact the valve stems and the sockets which contact the pushrods. These areas should be smooth and free of damage and wear.

— Pushrods for bending. Roll the pushrod on a flat surface to determine if it is bent. Replace if necessary.

— Ends of the pushrods for scoring or roughness.

Install or Connect

1. Pushrod. Make sure the pushrod seats properly in the hydraulic lifter.
2. Rocker arm with ball.

Important

- When new rocker arms and/or balls are installed, coat their bearing surfaces with "Molykote" or equivalent.

3. Rocker arm nut.

Adjust

- Valves as outlined later.

4. Rocker arm cover, as outlined previously.

VALVE ADJUSTMENT

1. Remove the rocker arm cover as outlined previously.
2. Adjust the valves when the lifter is on the base circle of the camshaft lobe as follows:
   a. Mark the distributor housing with chalk, at #1 and #6 plug wire positions. Remove the distributor cap and lay aside.
   b. Crank the engine until the distributor rotor points to #1 cylinder position. The following valves can be adjusted with the engine in the #1 firing position:
      #1 cylinder–Exhaust and Intake
      #2 cylinder–Intake
      #3 cylinder–Exhaust
      #4 cylinder–Intake
      #5 cylinder–Exhaust
   c. Back out the adjusting nut until lash is felt at the pushrod, then turn in the adjusting nut until all lash is removed. This can be determined by rotating the pushrod while turning the adjusting nut (figure 4). When play has been removed, turn the adjusting nut in one full additional turn (to center the lifter plunger).
   d. Crank the engine until the distributor rotor points to #6 position. The following valves can be adjusted with the engine in #6 firing position:
      #2 cylinder–Exhaust
      #3 cylinder–Intake
      #4 cylinder–Exhaust
      #5 cylinder–Intake
      #6 cylinder–Intake and Exhaust
3. Install the distributor cap.
4. Install the rocker arm cover as outlined previously.

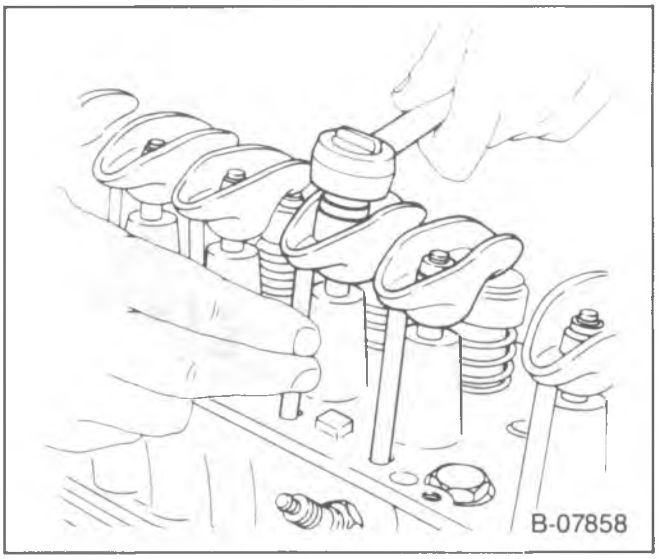


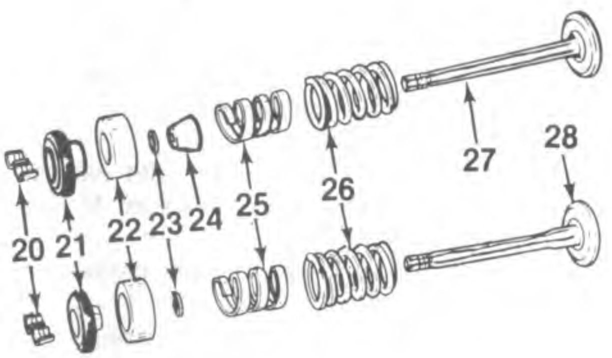
Figure 4—Adjusting The Valves

VALVE STEM SEAL AND VALVE SPRING REPLACEMENT

Remove or Disconnect (Figures 5 and 6)

Tools Required:
J-23590 Air Adapter.
J-5892-A Spring Compressor.

1. Rocker arm cover, as outlined previously.
2. Rocker arms, as outlined previously.
3. Spark plugs.
4. Valve keepers (20).
   - Install J-23590 into the spark plug hole.
   - Apply compressed air to hold the valves in place.
   - Install a rocker arm nut (figure 6).



20. Valve Keeper
21. Rotator
22. Shield
23. O-Ring Seal
24. Seal
25. Damper
26. Spring
27. Intake Valve
28. Exhaust Valve

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Figure 5—Valves And Components

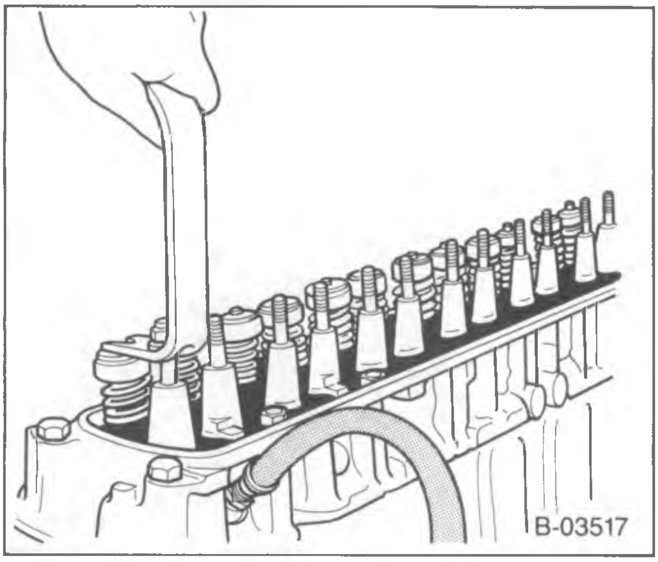


Figure 6—Compressing The Valve Springs

- Use J-5892-A to compress the valve spring (figure 6).
- Remove the valve keepers.
- Carefully release the spring tension. Remove J-5892-A.

5. Rotator (21), shield (22) and spring (26) with damper (25).
6. O-ring seal (23).
7. Seal (24) (intake valve only).

Install or Connect (Figures 5, 6, and 7)

Tools Required:

J-23590 Air Adapter.
J-5892-A Spring Compressor.
J-23994-01 Adapter Cup.
J-23738-A Vacuum Pump.

1. New seal (24) (intake valve only). Install the seal over the valve stem and seat it against the head.
2. Spring (26) with the damper (25), shield (22) and rotator (21).
3. New o-ring seal (23) and valve keepers (20).
    - With air pressure applied to the cylinder with J-23590, compress the spring with J-5892-A (figure 6).
    - Lubricate the o-ring seal with engine oil. Install the seal on the valve stem. Make sure the seal is not twisted.
    - Install the valve keepers. Use grease to hold them in place.
    - Carefully release spring pressure. Make sure the valve keepers stay in place.
    - Remove J-5892-A and J-23590.
    - Check each o-ring seal for leakage (figure 7).
        - Place the suction cup furnished with J-23738-A over the shield.
        - Connect J-23738-A to the suction cup and apply a vacuum. Watch the vacuum pump gage. No air should be able to leak past the seal. If the seal will not hold a vacuum, it may have been damaged or improperly installed.

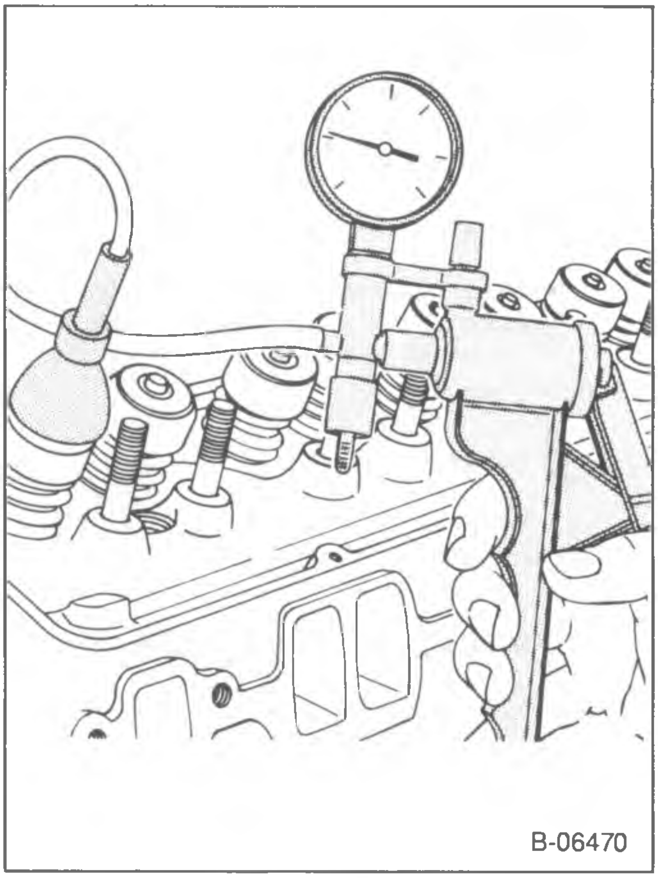


Figure 7—Testing The Valve Seals

4. Spark plugs.
5. Rocker arms, as outlined previously.

Adjust

- Valves, as outlined previously.

6. Rocker arm cover, as outlined previously.

PUSHROD COVER REPLACEMENT

Remove or Disconnect

1. Battery negative cable.
2. Dipstick tube (C-K models — if rear pushrod cover is to be removed).
3. Pushrod cover bolts.
4. Pushrod cover.
5. Gasket.

Clean

- Old gasket from pushrod cover and block.

Install or Connect

1. Pushrod cover and new gasket.
2. Pushrod cover bolts.

Tighten

- Pushrod cover bolts to 9.0 N·m (80 in. lbs.).

3. Dipstick tube (if removed).
4. Battery negative cable.

HYDRAULIC LIFTER REPLACEMENT

Remove or Disconnect (Figures 8 and 9)

Tools Required:
J-3049 Hydraulic Lifter Remover (Plier Type)
or
J-9290-01 Hydraulic Lifter Remover
(Slide Hammer Type)

1. Rocker arm cover, pushrod cover, and pushrod, as outlined previously.
2. Hydraulic lifters.
   - — Remove the hydraulic lifters one at a time and place them in an organizer rack. The lifters must be installed in the same bore from which they were removed.
   - — A stuck hydraulic lifter can be removed using J-3049 (figure 8) or J-9290-01 (figure 9).

Inspect

- — Hydraulic lifter body for scuffing and scoring. If the lifter body wall is worn or damaged, the mating bore in the block should also be checked.
- — Check the fit of each hydraulic lifter in its mating bore in the block. If the clearance is excessive, try a new lifter.
- — The hydraulic lifter foot must be smooth and slightly convex. If worn, pitted, or damaged, the mating camshaft lobe should also be checked.

Hydraulic Lifter Repair

- Refer to the proper unit repair manual.

Install or Connect

1. Hydraulic lifters to the block. Lubricate the lifter foot and body with Engine Oil Supplement or equivalent.
   - When any new hydraulic lifters or a new camshaft is installed, Engine Oil Supplement (or equivalent) should be added to the crankcase oil.

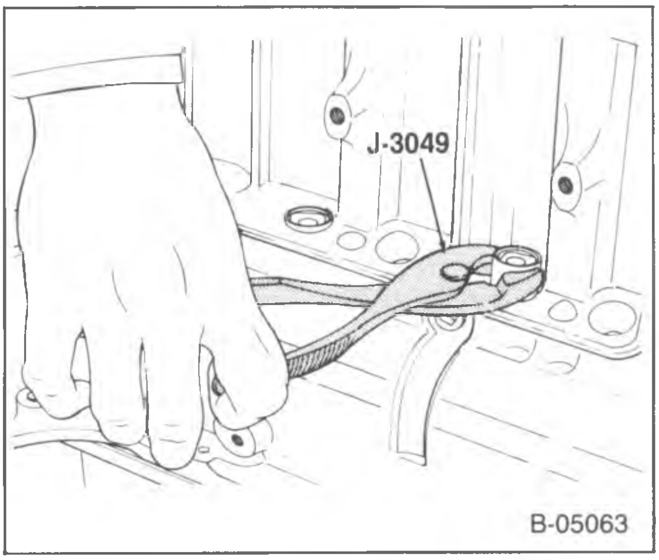


Figure 8—Removing The Hydraulic Lifter

- Replace all hydraulic lifters when a new camshaft is installed.

2. Pushrod cover, as outlined previously.
3. Pushrod, as outlined previously.

Adjust

- Valves, as outlined previously.

4. Rocker arm cover, as outlined previously.

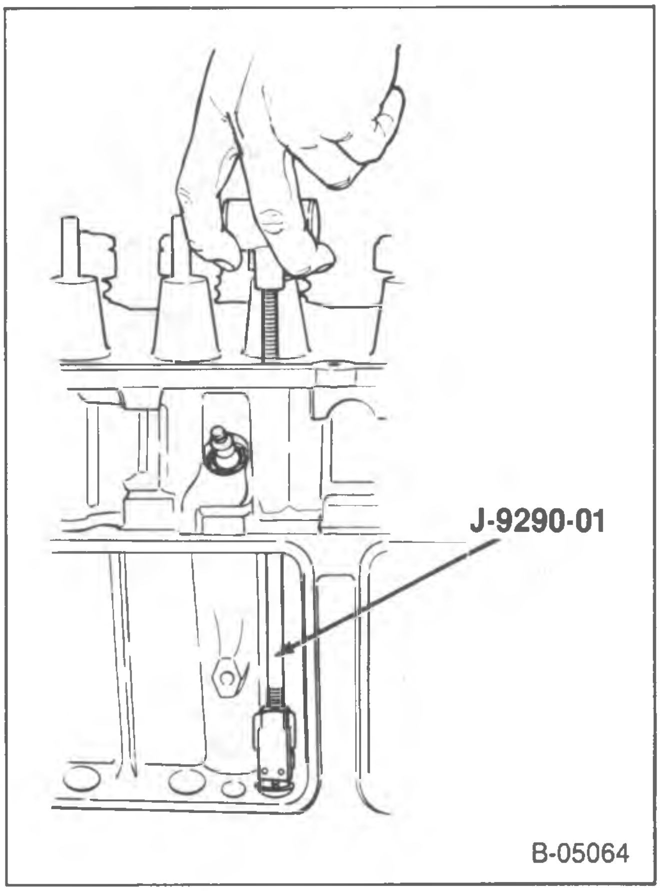
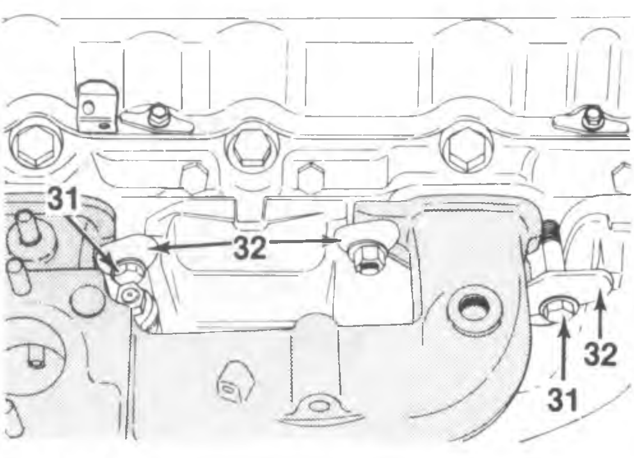


Figure 9—Removing The Hydraulic Lifter



31. Bolt 32. Clamp 33. Nut

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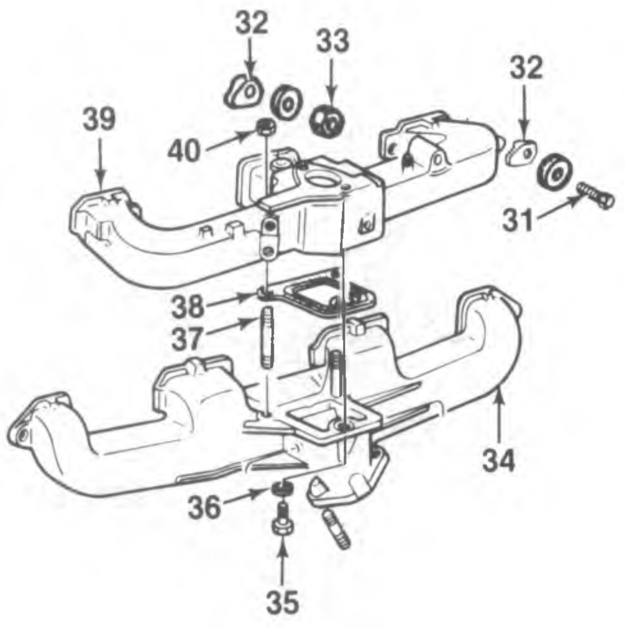
Figure 10—Manifold Installation

INTAKE AND EXHAUST MANIFOLD REPLACEMENT

Remove or Disconnect (Figures 10 and 11)

1. Battery negative cable.
2. Air cleaner.
3. Throttle controls at the bell crank.



31. Bolt
32. Clamp
33. Nut
34. Exhaust Manifold
35. Bolt
36. Washer
37. Stud
38. Gasket
39. Intake Manifold
40. Nut

B-07866

Figure 11—Manifolds And Components

4. Carburetor (if necessary).
5. Fuel and vacuum lines from the manifold, EGR valve (if used) and EFE valve.
6. AIR pump and bracket.
7. PCV hose.
8. Exhaust pipe.
9. Manifold heat stove.
10. Clamps (32), bolts (31), nuts (33) and washers.
11. Manifold assembly and gasket.

Disassemble (Figure 11)

1. Bolt (35) and nuts (40).
2. Manifolds (34 and 39).
3. Gasket (38).

Clean

- All manifold bolts and studs. Then apply engine oil to the threads.
- All traces of old gaskets from the cylinder head and manifolds.

Inspect

— Manifolds for cracks or damage to gasket surfaces.

— Operation of EFE or manifold heat valve (if used).

— Gaskets, if necessary to diagnose a leakage problem.

Measure

- Manifold distortion. Lay a straight edge along the full length of the manifold exhaust port faces and measure any gaps between the straight edge and the port faces. If at any point a gap of 0.80 mm (0.030-inch) or more exists, it is likely that the manifold has distorted to a point where it will not seal properly. If a good exhaust seal is to be expected, the exhaust manifold must be replaced.

Assemble (Figure 11)

1. Gasket (38) to the exhaust manifold (34).
2. Intake manifold (39) to the exhaust manifold.
3. Both (35), washers (36) and nuts (40). LEAVE FINGER TIGHT.

Install or Connect (Figures 10 and 11)

1. New gasket, over the manifold studs on the cylinder head.
2. Manifold assembly.
3. Clamps (32).
4. Bolts (31), and nuts (33).

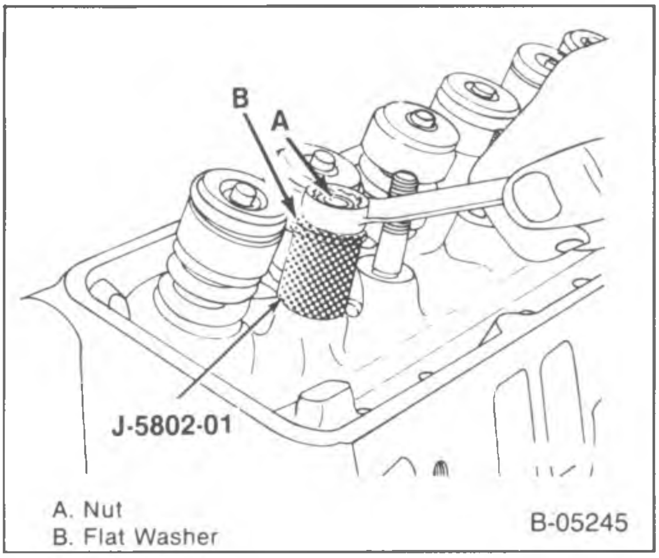


Figure 12—Removing The Rocker Arm Stud

Important

- Always tighten the manifold to cylinder head bolts and nuts (31 and 33) BEFORE tightening the manifold center bolt and nuts (35 and 40).

Tighten

- Bolts (31) and nuts (33) to 52 N·m (38 ft. lbs.).
- Bolts (35) and nuts (40) to 60 N·m (44 ft. lbs.).

5. Manifold heat stove.
6. Exhaust pipe.
7. PCV hose.
8. AIR pump and bracket.
9. Fuel and vacuum lines from the manifold, EGR valve (if used) and EFE valve (if used).
10. Carburetor (if removed).
11. Throttle controls.
12. Air cleaner.
13. Battery negative cable.

Adjust

- Engine idle speed, if necessary.

ROCKER ARM STUD REPLACEMENT

Remove or Disconnect (Figure 12)

Tool Required:
J-5802-01 Rocker Arm Stud Remover

1. Rocker arm cover and rocker arm, as outlined previously.

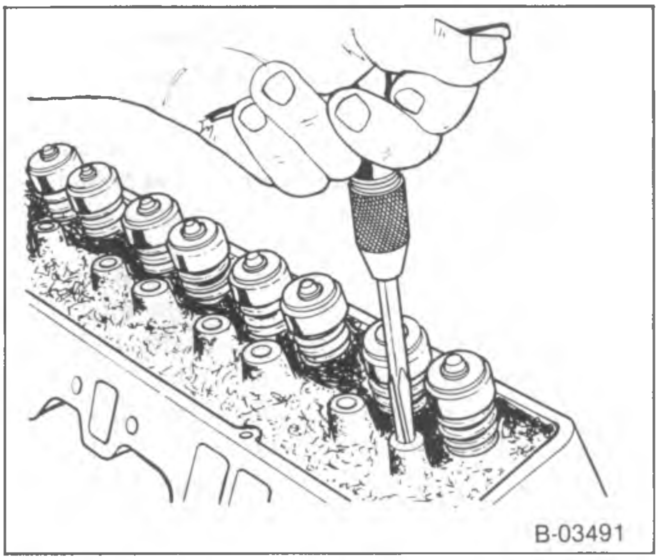


Figure 13—Reaming The Rocker Arm Stud Bore

2. Rocker arm stud.
   - Place J-5802-01 over the rocker arm stud.
   - Install a nut and flat washer.
   - Turn the nut to remove the stud (figure 12).

Install or Connect (Figures 13 and 14)

Tools Required:
J-5715 Reamer (0.003-inch oversize) or

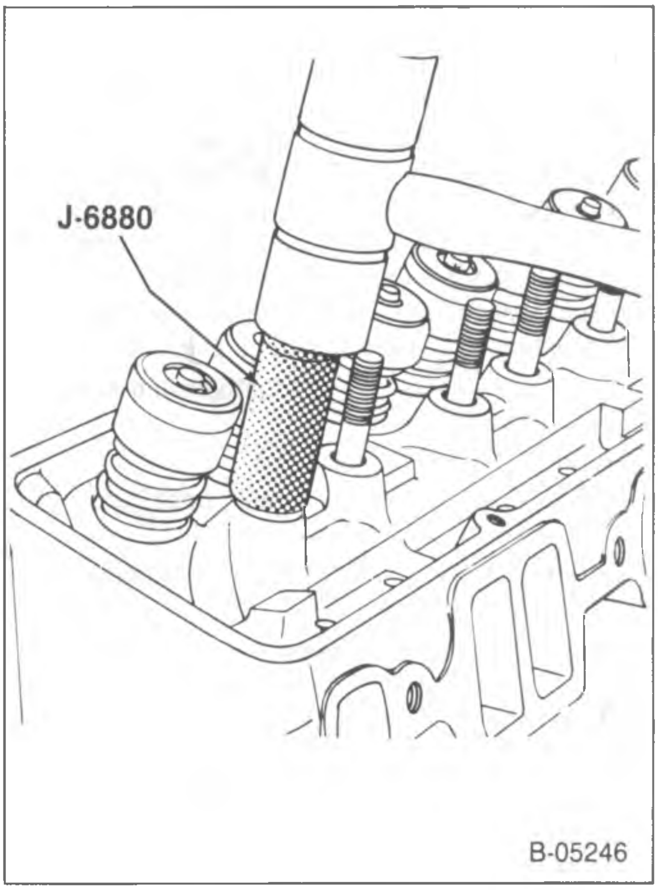


Figure 14—Installing The Rocker Arm Stud

J-6036 Reamer (0.013-inch oversize)
J-6880 Rocker Arm Stud Installer

NOTICE: Do not attempt to install an oversize rocker arm stud without reaming stud hole as this could damage the cylinder head.

- Ream the hole to the proper size for the replacement oversize rocker arm stud. Use J-5715 for 0.003-inch oversize studs; J-6036 for 0.013-inch oversize stud (figure 13).
- Coat lower end (press-fit area) of the rocker arm stud with hypoid axle lubricant.

1. Rocker arm stud. Use J-6880 (figure 14). Stud is installed to proper depth when the tool bottoms on the cylinder head.
2. Rocker arm, as outlined previously.

Adjust

- Valves, as outlined previously.

3. Rocker arm cover, as outlined previously.

CYLINDER HEAD REPLACEMENT

Remove or Disconnect

1. Battery ground cable.
2. Manifold assembly, as outlined previously.
3. AIR check valve.
4. Rocker arm cover, as outlined previously.
5. Pushrods. Back off the rocker arm nuts. Turn the rocker arms aside, then remove the pushrods. Place the pushrods in a rack so they can be returned to their original locations at assembly.
6. Spark plug wires at the spark plugs.
7. Vacuum lines at the thermal vacuum switch on the water outlet.
   - Drain the radiator and block.
8. Upper radiator hose, heater hose, and water pump bypass hose.
9. Battery ground strap at the cylinder head.
10. Cylinder head bolts.
11. Cylinder head and gasket.

Clean

- — Carbon deposits from combustion chambers.
- — All traces of old head gasket from cylinder head and block.
- — Cylinder head bolt threads and threads in the block.

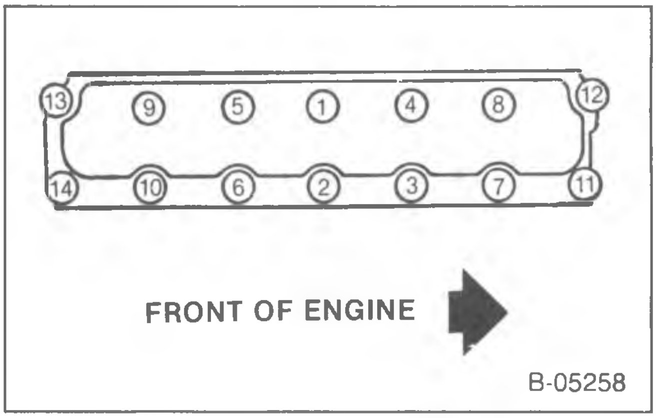


Figure 15—Cylinder Head Bolt Tightening Sequence

Inspect

- Sealing surfaces of the block and cylinder head for nicks, heavy scratches, or other damage.

Cylinder Head Repair

- Refer to the proper Unit Repair Manual.

Install or Connect (Figure 15)

1. Head gasket.
   - If a steel gasket is used, coat both sides of the gasket with sealer. Spread the sealer thin and even.
   - Do not use sealer on composition steel-asbestos gaskets.
   - Place the gasket over the block dowel pins with the bead up.
2. Cylinder head. Carefully guide the cylinder head into place over the dowel pins and gasket.
3. Cylinder head bolts. Coat threads of the cylinder head bolts with sealing compound and install finger tight.

   Tighten

   - Cylinder head bolts, a little at a time, using the sequence shown in figure 15, until the specified torque is reached.
     - — Left hand front bolt: 115 N·m (85 ft. lbs.).
     - — All other bolts: 130 N·m (95 ft. lbs.).
4. Battery ground strap at the cylinder head.
5. Upper radiator hose, heater hose, and water pump bypass hose. Fill the cooling system with the proper coolant.
6. Vacuum lines at the thermal vacuum switch.
7. Spark plug wires.
8. Pushrods. Be sure to install them in their original locations.
9. Rocker arms to the pushrods.

Adjust

- Valves, as outlined previously.

10. Rocker arm cover, as outlined previously.
11. AIR check valve.
12. Manifold assembly, as outlined previously.
13. Battery ground cable.

TORSIONAL DAMPER AND FRONT CRANKSHAFT SEAL REPLACEMENT

Remove or Disconnect (Figure 16)

Tool Required:
J-23523-E Torsional Damper Puller and Installer.

1. Battery negative cable.
2. Radiator. Refer to ENGINE COOLING (SEC. 6B).
3. Drive belts from the crankshaft pulley.
4. Torsional damper bolt and washer.
5. Torsional damper. Use J-23523-E (figure 16).
6. Front crankshaft seal. Pry out with a large screwdriver. Take care not to distort the timing gear cover.

Inspect

- Oil seal contact area on the torsional damper for grooving and roughness. Replace if necessary.

Install or Connect (Figures 17 and 18)

Tools Required:
J-23523-E Torsional Damper Puller and Installer
J-23042-A Centering Tool and Seal Installer

1. Front crankshaft seal. Use J-23042-A (figure 17). Coat the seal lips with engine oil. The open end of the seal faces inside the engine.

NOTICE: The inertia weight section of the torsional damper is assembled to the hub with a rubber type material. The correct installation procedures (with the proper tool) must be followed or movement of the inertia weight section of the hub will destroy the tuning of the torsional damper.

2. Crankshaft key (if removed).
3. Stud (item C, figure 18) to the crankshaft. Thread the stud fully into the tapped end of the crankshaft.
4. Torsional damper over the end of the stud. Align the keyway in the torsional damper shaft with the crankshaft key.
5. Bearing, washer, and nut (figure 18).

- Turn the nut to pull the torsional damper into place.
- Remove the tool.

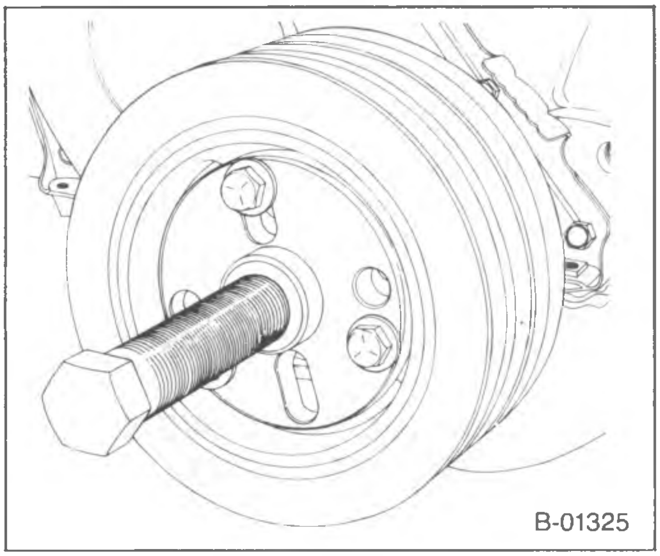


Figure 16—Removing The Torsional Damper

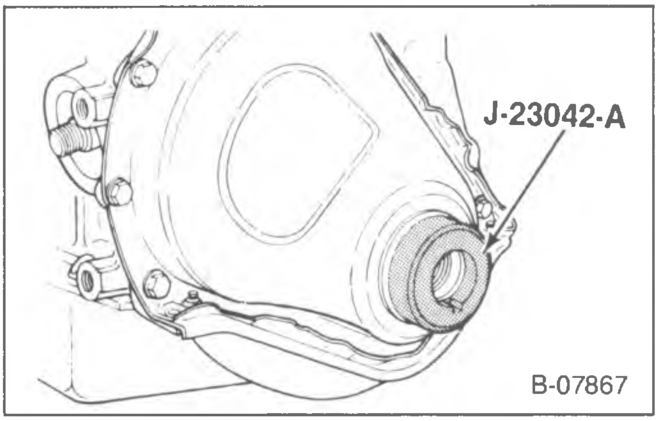


Figure 17—Installing The Timing Gear Cover And Seal

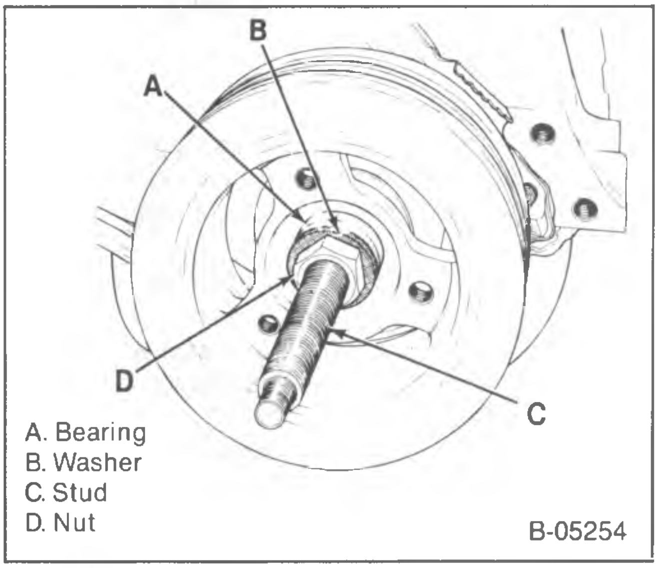


Figure 18—Installing The Torsional Damper

6. Torsional damper bolt and washer.

Tighten

- Torsional damper bolt to 70 N·m (50 ft. lbs.).

7. Drive belts to the crankshaft pulley, and tension to specifications.
8. Radiator. Refer to ENGINE COOLING (SEC. 6B).
9. Battery negative cable.

- Fill the cooling system with the proper coolant.

TIMING GEAR COVER REPLACEMENT

Remove or Disconnect

1. Battery negative cable.
2. Torsional damper, as described previously.
3. Oil pan to timing gear cover bolts.
4. Timing gear cover to block bolts.
5. Timing gear cover.
    - Pull the cover slightly forward only enough to permit cutting of the oil pan front seal.
    - Using a sharp knife or other suitable cutting tool, cut the oil pan front seal flush with the block at both sides of the oil pan.
    - Remove the cover and attached portion of the oil pan front seal.
6. Timing gear cover gasket.
7. Front crankshaft seal. Pry out with a screwdriver. Be careful not to distort the timing gear cover.

Clean

- Old gasket from the timing gear cover, block, and oil pan.

Install or Connect (Figures 17, 19, and 20)

Tool Required:

J-23042-A Centering Tool and Seal Installer

1. Front crankshaft seal to the timing gear cover.
    - Lubricate the seal lips with engine oil.
    - Use J-23042-A to press the seal into place (figure 19).
    - Leave the tool in position in the seal.
2. Timing gear cover to oil pan seal.
    - Cut the tabs from a new seal as shown in figure 20. Use a sharp cutting tool to help make a clean, straight cut.
    - Position the seal against the cover. Press the retaining tips into the holes in the cover.
3. Timing gear cover to block gasket to the timing gear cover. Use gasket sealer to hold it in place.

- Apply a 3 mm (1/8-inch) bead of RTV sealant to the joint formed at the oil pan and cylinder block.

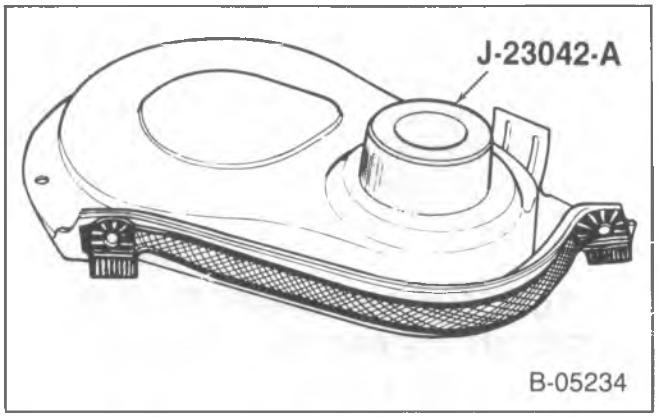


Figure 19—Installing The Front Crankshaft Seal

4. Timing gear cover, with J-23042-A in place, to the block (figure 17).

Important

- The tool is used to align the timing gear cover so that the front crankshaft seal is properly centered around the crankshaft. The seal must be centered to prevent damage during hub installation.

5. Oil pan to timing gear cover bolts. Partially tighten the bolts.
6. Timing gear cover to block bolts.

Tighten

- Timing gear cover to block bolts to 9.0 N·m (80 in. lbs.).
- Oil pan to timing gear cover bolts to 5.1 N·m (45 in. lbs.).

Remove or Disconnect

- J-23042-A from the timing gear cover.

7. Torsional damper, as outlined previously.
8. Battery negative cable.

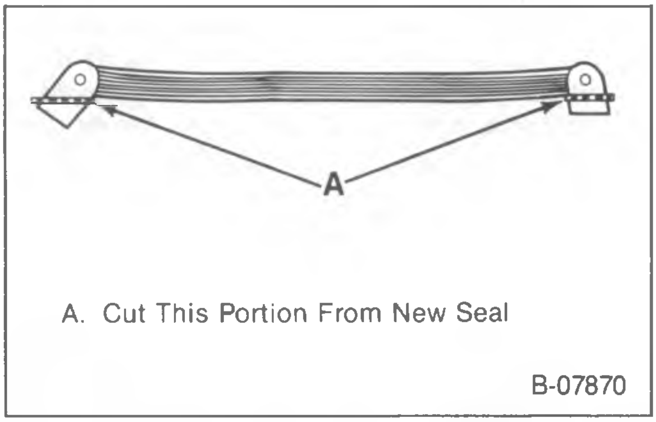


Figure 20—Front Oil Pan Seal Modification

OIL PAN REPLACEMENT

Remove or Disconnect

1. Battery negative cable.
- Drain the engine oil.
2. Starter.
3. Torque converter or flywheel cover.
4. Front engine mount through-bolts.
- Raise the engine and block in position.
5. Oil pan bolts.
6. Oil pan.
7. Old gaskets and seals.

Clean

- Old gasket and seals from the block and oil pan sealing surfaces.

Install or Connect

1. New rear oil pan seal to the rear main bearing cap.
2. New front oil pan seal to the timing gear cover. Press the retaining tips into the holes in the cover.
3. New oil pan to block gaskets to the block. Use gasket cement to hold them in place.
4. Oil pan bolts.

Tighten

- — 1/4-inch oil pan to block bolts to 9.0 N·m (80 in. lbs.).
- — 5/16-inch oil pan to block bolts to 18.6 N·m (165 in. lbs.).
- — Oil pan to timing gear cover to 5.1 N·m (45 in. lbs.).

- Lower the engine.
5. Front engine mount through-bolts.
6. Torque converter or flywheel cover.
7. Starter.
8. Proper quantity and grade of engine oil.
9. Battery negative cable.

OIL PUMP REPLACEMENT

Remove or Disconnect

1. Oil pan, as outlined previously.
2. Oil pump pickup tube bracket to main bearing cap nut.
3. Oil pump bolts.
4. Oil pump.

Inspect

- Oil pump pickup tube for looseness. If the tube is loose in the oil pump body, replace it, as outlined in the proper unit repair manual. A loose pickup tube can result in an air leak and loss of oil pressure.

Oil Pump Repair
- Refer to the proper unit repair manual.

Install or Connect

1. Oil pump to the engine. Align the slot in the oil pump shaft with the tang on the distributor shaft. The oil pump should slide easily into place. No gasket is used.
2. Oil pump bolts.

Tighten

- Oil pump bolts to 13.0 N·m (115 in. lbs.).

3. Oil pump pickup tube bracket to main bearing cap nut.

Tighten

- Nut to 34 N·m (25 ft. lbs.).

4. Oil pan, as outlined previously.

REAR CRANKSHAFT OIL SEAL REPLACEMENT

The rear main bearing oil seal can be replaced (both halves) without removal of the crankshaft. Always replace the upper and lower seal as a unit. Install the seal with the lip facing the front of the engine. Extreme care should be exercised when installing this seal to protect the sealing bead located in the channel on the outside diameter of the seal. An installation tool (figure 23) should be used to protect the seal bead when positioning the seal. (Some seal kits include the tool as part of the service kit).

Remove or Disconnect (Figures 21 and 22)

1. Oil pan, as outlined previously.
2. Rear main bearing cap.
3. Lower seal half (figure 21).
4. Upper seal half (figure 22).
   - Tap on the upper seal half, using a small drift and hammer.
   - Remove the upper seal half, using pliers.

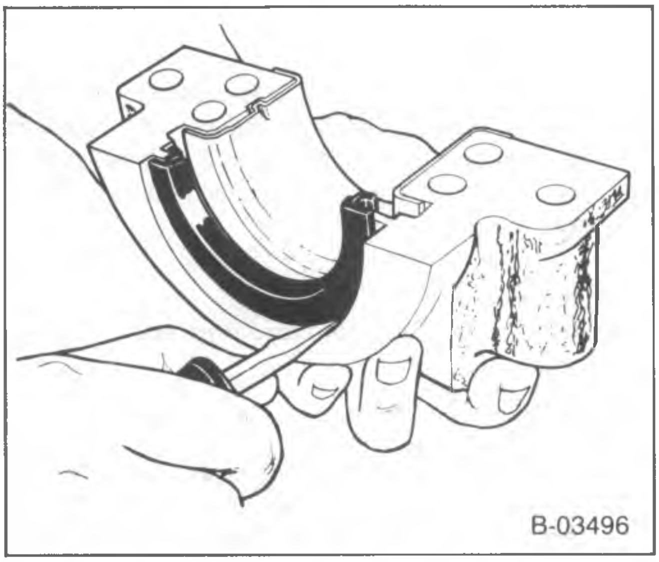


Figure 21—Removing The Lower Seal Half

Clean

- Sealing surfaces of the main bearing cap and block.

Inspect

- Crankshaft, seal channel, and sealing surfaces for nicks, scratches, etc.

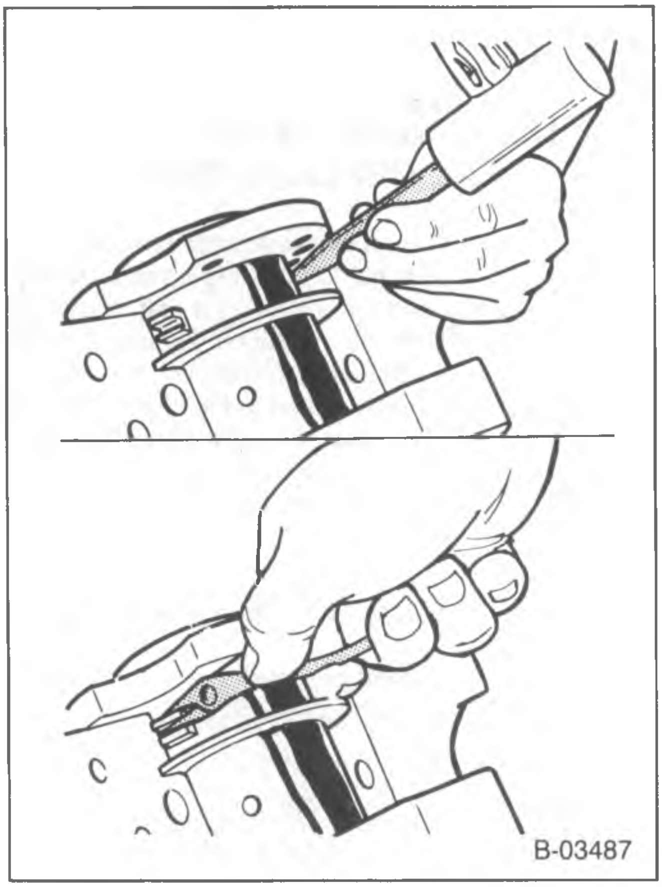
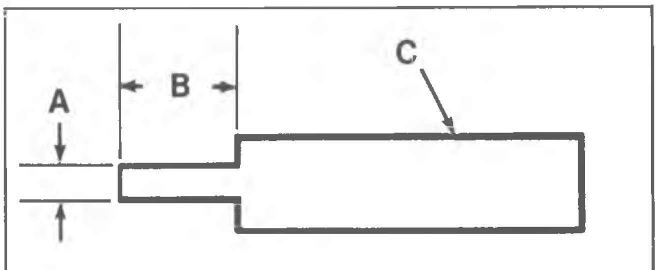


Figure 22—Removing The Upper Seal Half

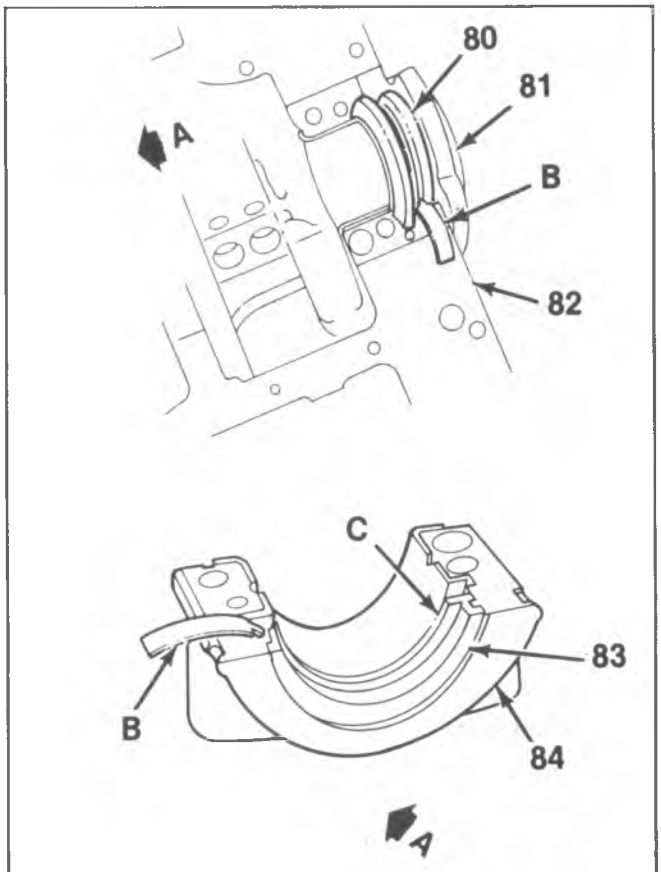


A. 4 mm (11/64-inch)
B. 13 mm (1/2-inch)
C. 0.10 mm (0.004-inch) shim stock

Figure 23—Oil Seal Installation Tool

Install or Connect (Figures 23, 24, and 25)

1. Upper seal half.



A. Forward
B. Fabricated Tool
C. Oil Seal Lip
80. Upper Seal Half
81. Crankshaft
82. Block
83. Lower Seal Half
84. Main Bearing Cap

Figure 24—Installing The Rear Crankshaft Oil Seal

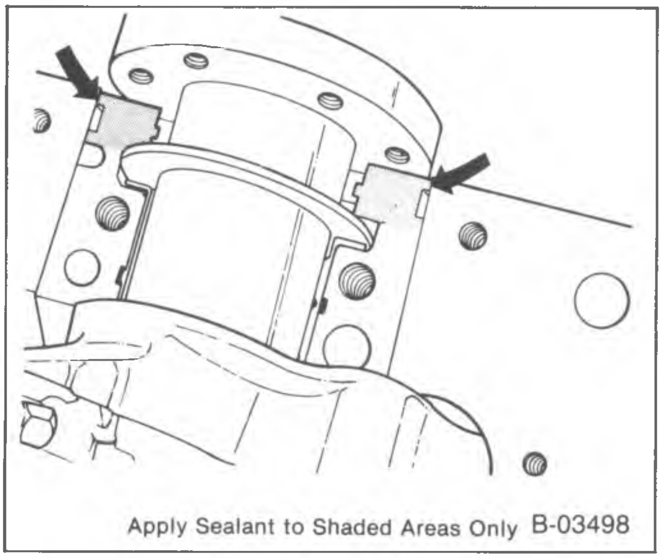


Figure 25—Applying Sealant To The Block

Important

  - An oil seal installation tool (figure 23) should be fabricated (if not provided in the seal kit) to prevent seal damage during installation. Extreme care should be taken when installing this seal to protect the sealing bead located in the channel on the outside diameter of the seal.
- Coat the seal lips lightly with engine oil. Keep the oil off of the seal mating ends.
- Position the tip of the tool between the crankshaft and the seal seat in the block (figure 24).
- Position the seal half between the crankshaft and the tip of the tool. Make sure that the oil seal lip is positioned toward the front of the engine.
- Roll the seal around the crankshaft using the tool as a "shoe-horn" to protect the seal bead from the sharp corner of the seal seat surface in the block. The installation tool must remain in position until the seal half is properly positioned with both ends flush with the block.
- Remove the tool, being careful not to withdraw the seal half.

2. Lower seal half.
   - Coat the seal lips lightly with engine oil. Keep the oil off of the seal mating ends.
   - Insert the seal half into the rear main bearing cap. Use the tool to protect the seal half from the sharp edge of the seal seat. Feed the seal half into the rear main bearing cap, using light finger pressure. Make sure the oil seal lip faces the front of the engine (figure 24).

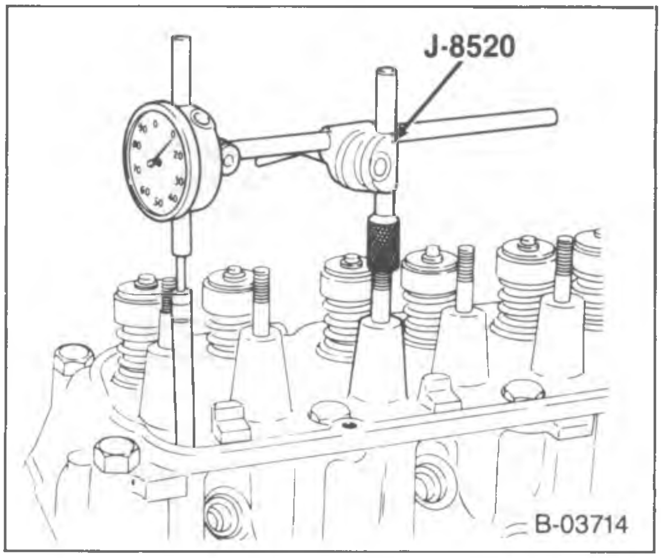


Figure 26—Checking Valve Timing Or Camshaft Lobe Lift

3. Rear main bearing cap with the lower main bearing.
   - Apply a brush-on type oil sealing compound to the mating surface of the block and cap (figure 25). Do not allow any sealant on either crankshaft or rear oil seal.
   - Apply engine oil to the lower main bearing.
   - Position the cap to the block. Install the cap bolts.

   Tighten

     - Rear main bearing cap bolts temporarily to 14 N·m (10 ft. lbs.).
   - Tap the end of the crankshaft first rearward then forward with a lead hammer. This will line up the rear main bearing and crankshaft thrust surfaces.

   Tighten

     - Rear main bearing cap bolts to 90 N·m (65 ft. lbs.).
4. Oil pan, as outlined previously.
5. The proper quantity and grade of engine oil.

CHECKING VALVE TIMING

Tool Required:
J-8520-Dial Indicator Adaptor

When it becomes necessary to make a check of valve timing, the procedure following may be used:

1. Loosen the nut at the #1 intake valve rocker arm, swing the rocker arm away from the pushrod, then remove the pushrod.
2. Install a dial indicator, along with J-8520 (figure 26). Turn the crankshaft until the #2 exhaust valve

opens and the notch on the damper is aligned with the "0" mark on the timing tab.

3. Position the dial indicator to measure lifter movement and set indicator at zero. Turn the crankshaft 360 degrees and read the indicator. On correctly timed engines the indicator will read 0.012-0.020-inch.
4. If the reading is not as shown, reset the indicator at zero and turn the crankshaft 360 degrees, then read the indicator again. If reading is now within specifications, the engine is timed properly.
5. The chart following shows indicator readings with gears properly indexed for 4.8L engines and the indicator readings resulting from improperly indexed gears.

Engine		**4.8L**
Camshaft Part Number		**3848000**
Valve Lift		**0.405"**
Dial	Gears Properly Indexed	0.012-0.020"
Indicator	One Tooth Advanced	0.038"
Readings	One Tooth Retarded	0.007"

MEASURING CAMSHAFT LOBE LIFT

Tool Required:

J-8520 Dial Indicator Adaptor

To check for worn camshaft lobes, use the following procedure:

1. Remove the rocker arm as outlined previously.
2. Install a dial indicator (part of J-8520) (figure 26). Position the dial indicator so the plunger rests on the pushrod end, as shown, Make sure the pushrod is in the lifter socket.
3. Rotate the crankshaft slowly in the direction of rotation until the hydraulic lifter is on the heel of the cam lobe. At this point, the pushrod will be in its lowest position. Set dial indicator on zero, then rotate the crankshaft slowly until the pushrod is in the fully raised position.
4. Compare the total lift recorded from the dial indicator with specifications.
5. Continue to rotate the crankshaft until the indicator reads zero. This will be a check on the accuracy of the original indicator reading.
6. Remove the dial indicator and adaptor.
7. Install the rocker arm and adjust the valves as previously outlined.

CAMSHAFT REPLACEMENT

To check for worn camshaft lobes without disassembling the engine, refer to "Measuring Camshaft Lobe Lift" in this section.

Remove or Disconnect (Figures 27 and 28)

1. Engine assembly, as outlined later.
- Mount the engine in a suitable engine stand.
2. Hydraulic lifters, as outlined previously.
3. Timing gear cover, as outlined previously.
4. Fuel pump. Refer to FUEL SYSTEM (SEC. 6C).
5. Distributor. Refer to ENGINE ELECTRICAL (SEC. 6D).
- Align the timing marks (figure 27).
6. Thrust plate bolts (93) (figure 28).
7. Camshaft. Support the camshaft carefully to avoid damage to the camshaft bearings.

Inspect

— Camshaft lobes and journals for scratches, pitting, and wear.

— Timing gear for damaged teeth.

Measure (Figure 29)

- Thrust plate to camshaft clearance. Use a feeler gage (figure 29). The proper clearance is 0.08-0.20mm (0.003-0.008-inch). If the clearance is excessive, replace the thrust plate. If the clearance is insufficient, replace the spacer ring. Refer to the proper unit repair manual.

Camshaft Gear And Thrust Plate Replacement

- Refer to the proper unit repair manual.

Camshaft Bearing Replacement

- Refer to the proper unit repair manual.

Install or Connect (Figure 27)

- Coat the camshaft lobes and journals with a high quality engine oil supplement (GM Engine Oil Supplement or equivalent).
1. Camshaft (90) to the engine. Handle the camshaft carefully to prevent damage to the camshaft bearings.

Important

- Line up the timing marks on the crankshaft gear and camshaft gear (figure 27).

2. Thrust plate bolts (94).

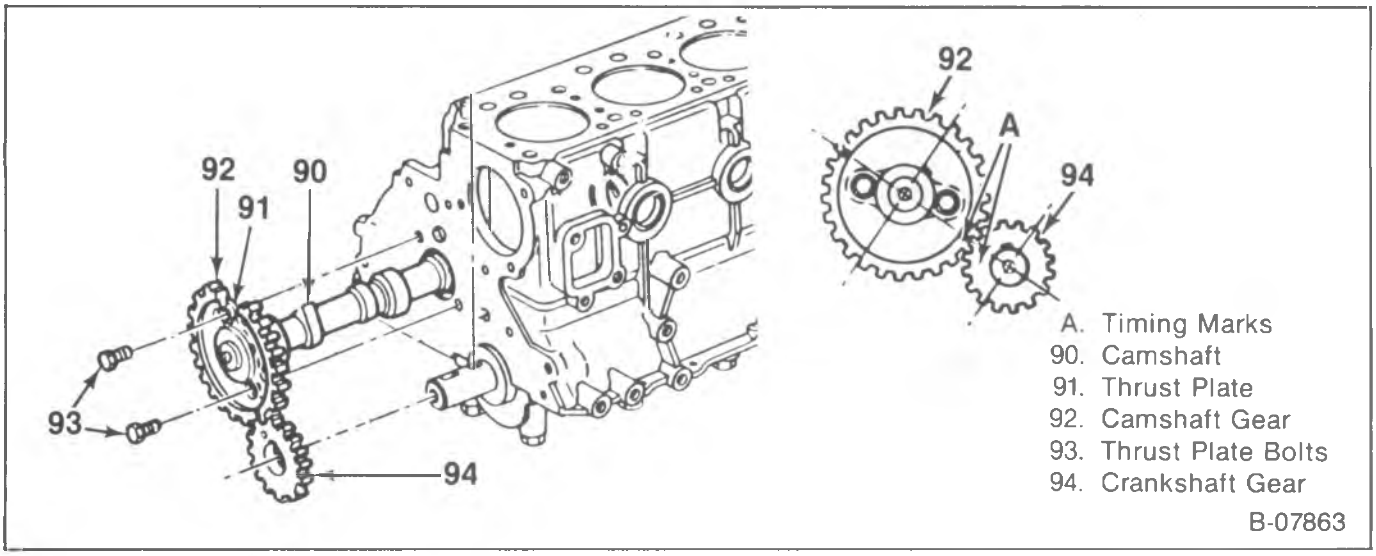


Figure 27—Camshaft And Components

Tighten

- Thrust plate bolts to 9.0 N·m (80 in. lbs.).

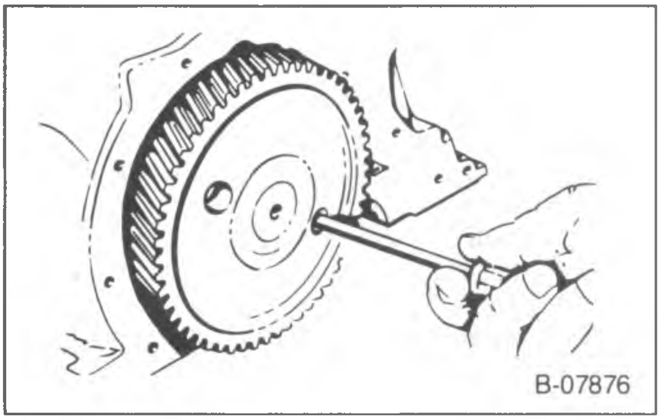


Figure 28—Removing The Camshaft Thrust Plate Bolts

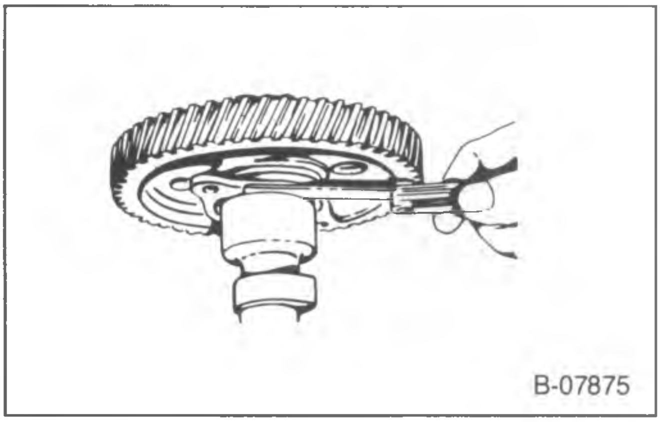


Figure 29—Measuring Camshaft To Thrust Plate Clearance

Measure

— Camshaft and crankshaft gear run-out. Use a dial indicator. Camshaft gear run-out should not exceed 0.10 mm (0.004-inch), crankshaft gear run-out should not exceed 0.08 mm (0.003-inch). If gear run out is excessive, the gear will have to be removed and any burrs cleaned from the shaft or the gear will have to be replaced.

— Timing gear backlash. Use a dial indicator. The correct backlash is 0.10-0.15 mm (0.004-0.006-inch) with new parts, 0.20 mm (0.008-inch) maximum with used parts.

4. Timing gear cover, as outlined previously.
5. Distributor. Refer to ENGINE ELECTRICAL (SEC. 6D).
6. Fuel pump. Refer to FUEL SYSTEM (SEC. 6C).
7. Hydraulic lifters, as outlined previously.

Important

- Replace all hydraulic lifters and add GM Engine Oil Supplement (or equivalent) to the engine oil whenever a new camshaft is installed.

8. Engine assembly in the vehicle, as outlined later.

CONNECTING ROD AND PISTON REPLACEMENT

Remove or Disconnect (Figure 30)

Tool Required:

J-5239 Guide Set.

1. Cylinder head, as outlined previously.
2. Oil pan, as outlined previously.
3. Oil pump, as outlined previously (if necessary).

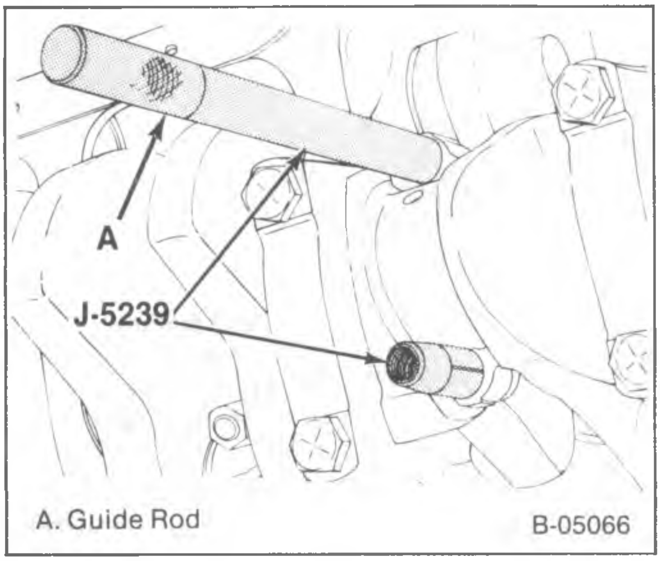


Figure 30—Removing Or Installing The Connecting Rod And Piston

4. Ridge or deposits from the upper end of the cylinder bores.
    - Turn the crankshaft until the piston is at BDC.
    - Place a cloth on top of the piston.
    - Perform the cutting operation with a ridge reamer.
    - Turn the crankshaft until the piston is at TDC.
    - Remove the cloth and cuttings.
5. Connecting rod cap. Check the connecting rod and cap for identification marks. Mark the parts if required. The connecting rod and cap must be kept together as mating parts.
6. Connecting rod and piston.
    - Attach J-5239 to the connecting rod bolts (figure 30).
    - Use the long guide rod of J-5239 to push the connecting rod and piston out of the bore.
7. Connecting rod bearing.

Cleaning, Inspection, And Repair

Clean, inspect and repair or replace the components as necessary. Measure connecting rod bearing clearance, piston clearance, ring clearances, etc. Refer to the proper unit repair manual.

The unit repair manual contains information on:

— Connecting rod and piston.
— Piston rings.
— Connecting rod and crankpin.
— Cylinder bores.

Install or Connect (Figures 30 through 34)

Tools Required:
J-5239 Connecting Rod Guide Set
J-8037 Ring Compressor

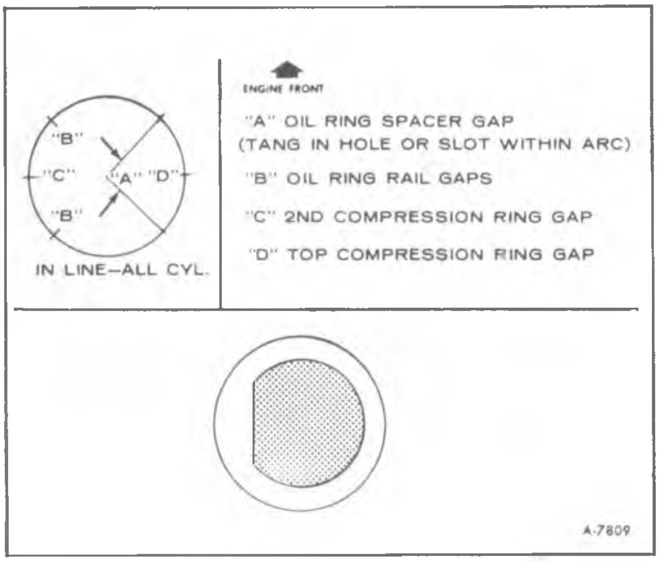


Figure 31—Piston Ring Gap Location

- Make sure the cylinder walls are clean. Lubricate the cylinder wall lightly with engine oil.
- Make sure the piston is installed in the matching cylinder.

1. Connecting rod bearings.
    - Be certain that the bearings are of the proper size.
    - Install the bearing inserts in the connecting rod and connecting rod cap.
    - Lubricate the bearings with engine oil.
2. Piston and connecting rod to the proper bore.
    - With the connecting rod cap removed, install J-5239 onto the connecting rod studs (figure 30).
    - Locate the piston ring end gaps as shown in figure 31. Lubricate the piston and rings with engine oil.
    - Without disturbing the ring end gap location, install J-8037 over the piston (figure 32).
    - The piston must be installed so that the piston crown depression's flat side faces to the engine's left side (figure 33).
    - Place the piston in its matching bore. Using light blows with a hammer handle, tap the piston down into its bore (figure 33). At the same time, from beneath the vehicle guide the connecting rod to the crankpin with J-5239 (figure 30). Hold the ring compressor against the block until all rings have entered the cylinder bore.
    - Remove J-5239 from the connecting rod bolts.

Measure

- Connecting rod bearing clearance. Refer to the proper unit repair manual.

3. Connecting rod cap and bearing.

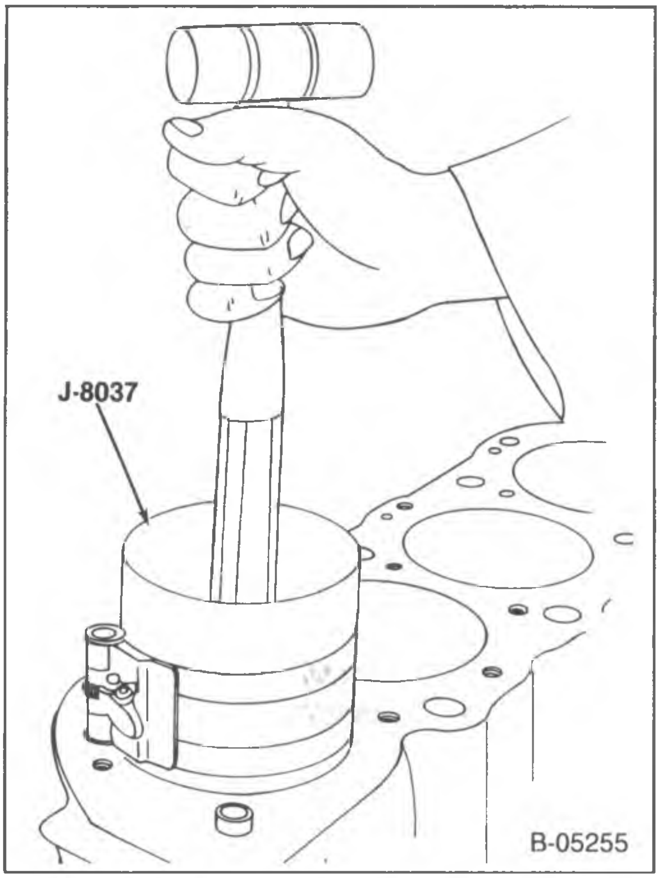


Figure 32—Installing The Piston

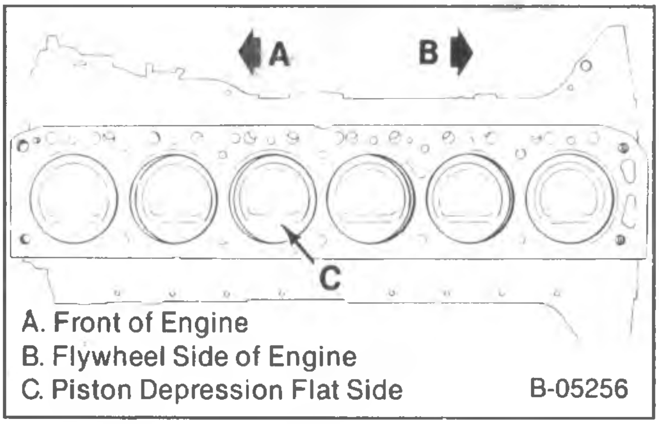
4. Connecting rod cap nuts.

Tighten

- Connecting rod cap nuts to 60 N·m (44 ft. lbs.).

Measure

- Connecting rod side clearance. Use a feeler gage between the connecting rod and crankshaft (figure 34). The correct clearance is 0.006-0.017-inch.



A. Front of Engine
B. Flywheel Side of Engine
C. Piston Depression Flat Side

Figure 33—Pistons Installed

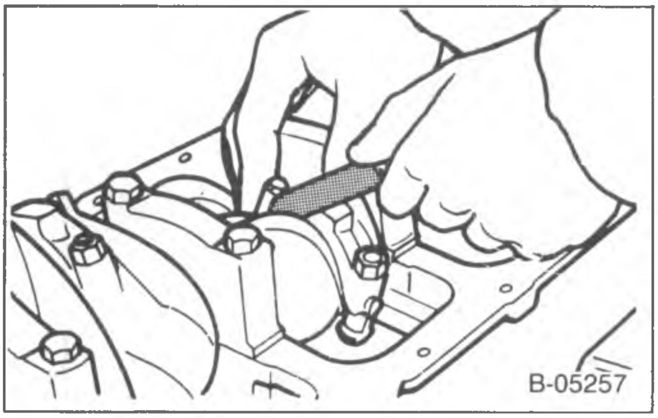


Figure 34—Measuring Connecting Rod Side Clearance

5. Oil pump (if removed), as outlined previously.
6 Oil pan and cylinder head, as outlined previously.

MAIN BEARING REPLACEMENT

Remove or Disconnect (Figures 35 and 36)

Tool Required:

J-8080 Main Bearing Remover/Installer

1. Spark plugs.
2. Oil pan, as outlined previously.
3. Oil pump, as outlined previously.
4. Main bearing caps.
   - Check the main bearing caps for location markings. Mark the caps if necessary. The caps must be returned to their original locations during assembly.
5. Lower main bearing inserts from the main bearing caps.
6. Rear crankshaft oil seal, if necessary, as outlined previously.
7. Upper rear main bearing insert.
   - Use a small brass drift and hammer. Tap on the insert, on the side opposite the bearing tang, until the insert rotates out of position (figure 35).
   - Use a pair of pliers with the jaws taped to prevent damage to the crankshaft. Clamp the insert to the crankshaft flange (figure 35). Rotate the crankshaft to remove the bearing insert.
8. Upper main bearing inserts.
   - Insert J-8080 into the crankshaft oil hole (figure 36).
   - Rotate the crankshaft to "turn" the bearing insert out of the block.

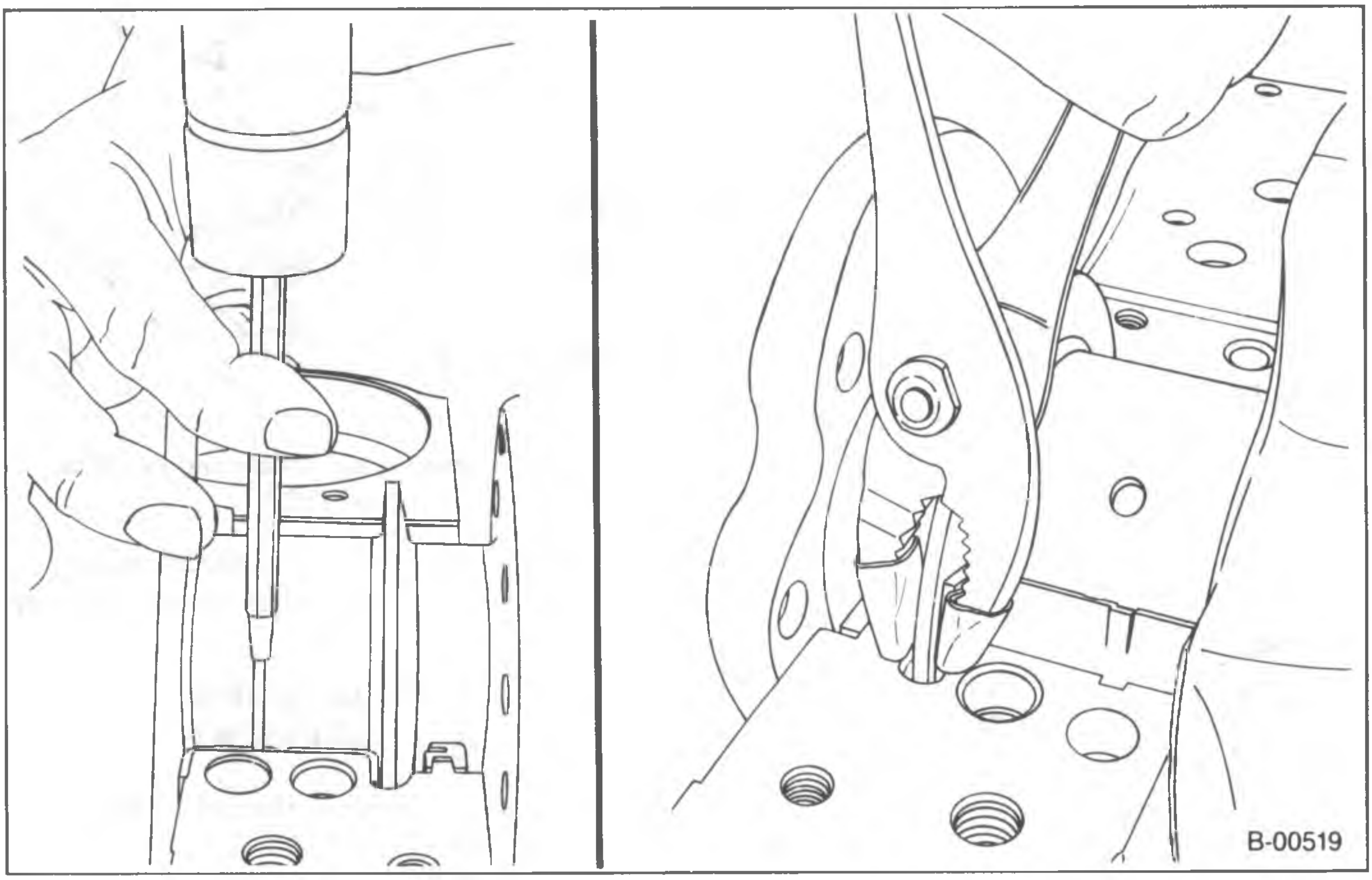


Figure 35—Removing The Upper Rear Main Bearing Insert

Cleaning, Inspection, And Repair

Clean, inspect, and repair or replace the components as required. Refer to the proper unit repair manual. The unit repair manual contains information on:

- Crankshaft.
- Main and connecting rod bearings.
- Main bearing cap replacement (shimming procedure).

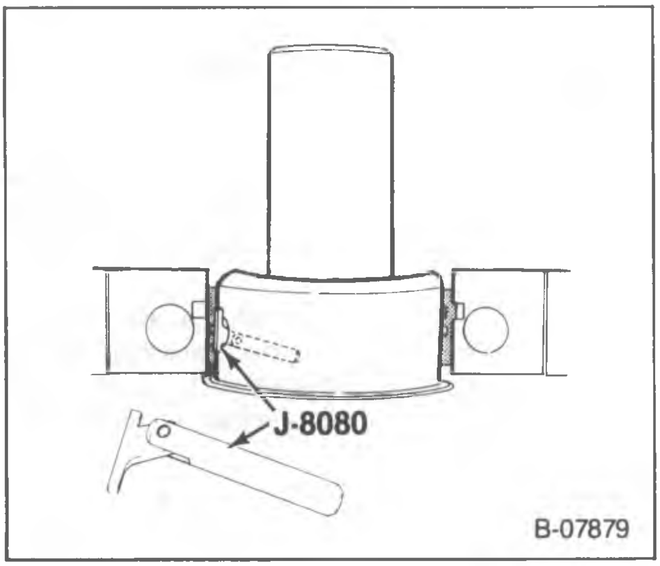


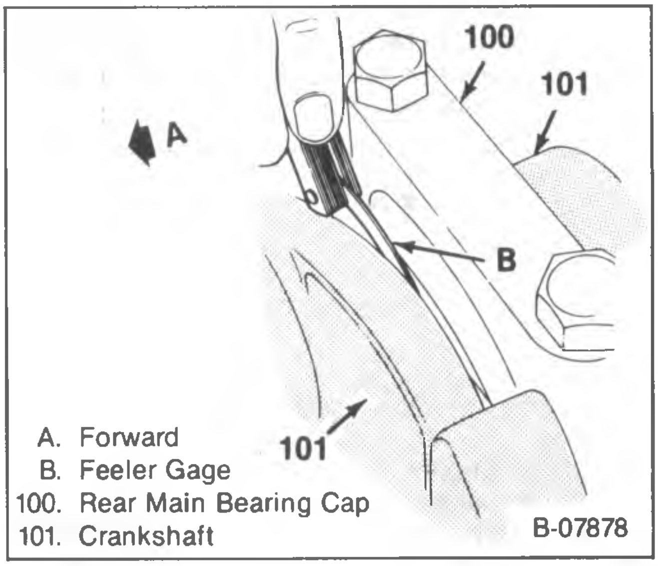
Figure 36—Removing The Upper Main Bearing Insert

→← Install or Connect (Figures 25, 35, 36, and 37)

Tool Required:

J-8080-Main Bearing Remover/Installer

1. Upper rear main bearing insert.



A. Forward
B. Feeler Gage
100. Rear Main Bearing Cap
101. Crankshaft

Figure 37—Measuring Crankshaft End Play

- Apply engine oil to an insert of the proper size.
- Insert the plain end (without the bearing tang) of the insert between the crankshaft journal and the notched side of the block.
- Use pliers with taped jaws to clamp the bearing to the crankshaft as shown in figure 35. Rotate the crankshaft to "roll" the insert into the block. Then seat the insert using a small drift and hammer.

2. Lower rear main bearing insert.
    - Apply engine oil to an insert of the proper size.
    - Press the insert into the rear main bearing cap.
3. Upper main bearing inserts.
    - Insert tool J-8080 into a crankshaft main bearing oil hole (figure 36).
    - Apply engine oil to inserts of the proper size.
    - Insert the plain end (without the bearing tang) of the insert between the crankshaft and the notched side of the block.
    - Rotate the crankshaft to "roll" the insert into the block.
    - Remove the tool.
4. Lower main bearing inserts to the main bearing caps.
    - Make sure the inserts are of the proper size.
    - Apply engine oil to the inserts.

Measure

- Main bearing clearance. Refer to the proper unit repair manual. If the engine is in the vehicle, the crankshaft must be supported upward to remove any clearance from the upper bearing. The total clerance can then be measured between the lower bearing and journal.

5. Main bearing caps (except rear cap) and bolts to the block. Make sure the special bolt which retains the oil pump screen bracket is installed in the proper position. (#5 main bearing cap, camshaft side hole.)

Tighten

- Main bearing cap bolts to 90 N·m (65 ft. lbs.).

6. Rear crankshaft oil seal to the block and main bearing cap, as outlined previously.
7. Rear main bearing cap to the block.
    - Apply a brush-on type oil sealing compound to the mating surface of the block and cap (figure 25). Do not allow any sealant on either crankshaft or rear oil seal.
    - Apply engine oil to the bearing insert.
    - Install the rear main bearing cap and bolts. Tighten the bolts temporarily to 14 N·m (10 ft. lbs.).

Measure

- Crankshaft end play, as follows:
    - Tap the end of the crankshaft first rearward then forward with a lead hammer. This will line up the rear main bearing and crankshaft thrust surfaces.
    - Tighten the rear main bearing cap bolts to 90 N·m (65 ft. lbs.).
    - With the crankshaft forced forward, measure at the front end of the rear main bearing with a feeler gage (figure 37). The proper clearance is 0.05-0.15 mm (0.002-0.006-inch).

8. Oil pump, as outlined previously.
9. Oil pan, as outlined previously.
10. Spark plugs.

CRANKSHAFT GEAR REPLACEMENT

Remove or Disconnect (Figure 38)

Tool Required:

J-24420-A Puller.

1. Timing gear cover, as outlined previously.
2. Crankshaft gear. Use J-24220-A (figure 38).

Install or Connect (Figures 27 and 38)

Tool Required:

J-5590 Crankshaft Gear Installer.

1. Crankshaft gear. Use J-5590 (figure 38). Make sure the timing mark faces out.

Important

- Align the timing marks (figure 27).

2. Timing gear cover, as outlined previously.

OIL FILTER BYPASS VALVE REPLACEMENT

Remove or Disconnect (Figure 39)

1. Oil filter.
2. Oil filter relief valve. Pry it from the block with a screwdriver (figure 39).

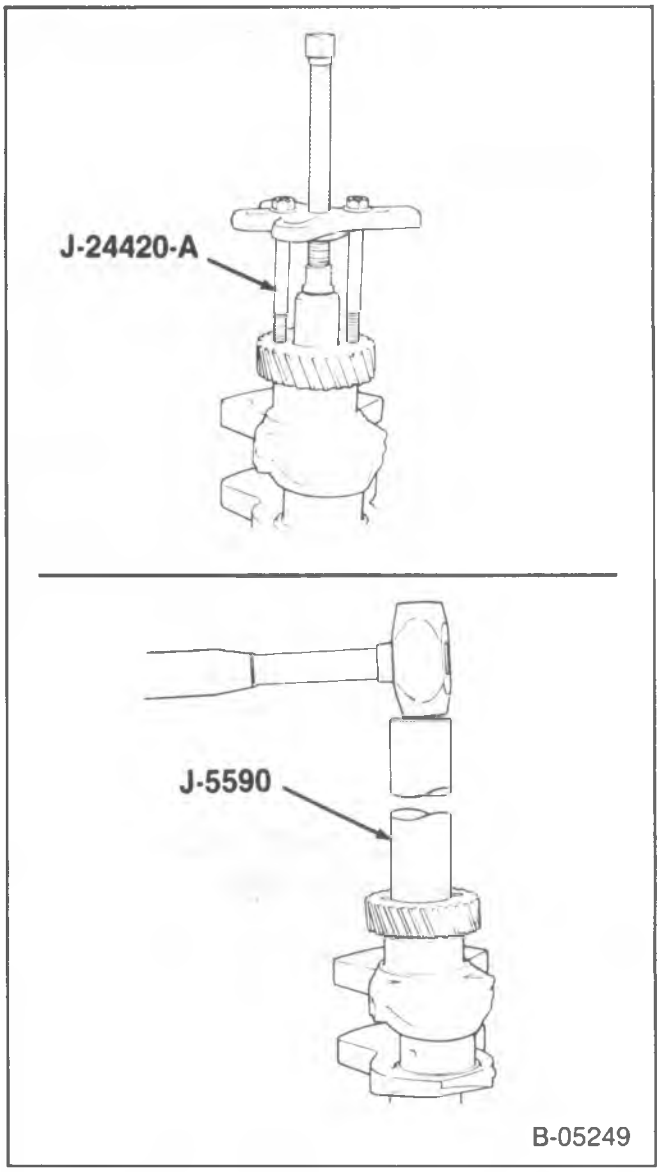


Figure 38—Replacing The Crankshaft Gear

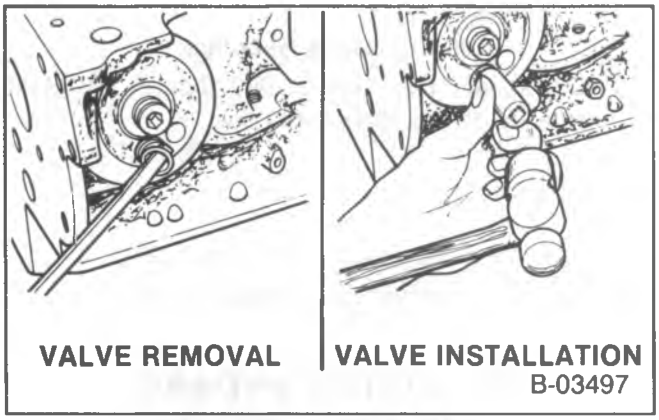


Figure 39—Replacing The Oil Filter Bypass Valve

Install or Connect (Figure 39)

1. Oil pressure relief valve. Tap into place. Use a 9/16-inch thin wall deep socket as a driver (figure 39).
2. Oil filter.
3. Engine oil, as necessary.

CRANKSHAFT REPLACEMENT

Remove or Disconnect (Figures 30 and 38)

Tools Required:

J-24420-A Puller.
J-5239 Guide Set.

1. Engine, as outlined later.
2. Flywheel (if necessary), as outlined later.
    - The crankshaft can be removed from the block without removing the flywheel. If the flywheel is removed, the dowel holes must be reamed oversize and oversized dowel pins installed, as outlined later.

- Mount the engine in a suitable engine stand.

3. Spark plugs.
4. Dipstick and tube.
5. Timing gear cover, as outlined previously.
6. Oil pan and oil pump, as outlined previously.
7. Crankshaft timing gear (if required). Use J-24420-A (figure 38).
8. Connecting rod caps. Check the connecting rod and cap for identification marks. Mark the parts if necessary. The connecting rod and cap are mating parts.
9. Connecting rods from the crankshaft.
    - Attach J-5239 to the connecting rod bolts (figure 30).
    - Use the long guide rod to push the pistons up in the bores.
10. Main bearing caps. Check the main bearing caps for location markings. Mark the parts if necessary. The main bearing caps must be returned to their original locations at assembly.
11. Crankshaft.
12. Main bearing inserts.
13. Rear crankshaft seal, as outlined previously.

Cleaning, Inspection, And Repair

- Clean, inspect, and repair or replace the parts as outlined in the proper unit repair manual. Refer to the unit repair manual for information on:
    — Crankshaft.
    — Main and connecting rod bearings.
    — Procedures for measuring bearing clearances.

Install or Connect (Figures 25, 27, 30, 34, 37, and 38)

Tools Required:
J-5239 Guide Set.
J-5590 Crankshaft Gear Installer.

1. Upper main bearing inserts to the block. Apply engine oil to the bearing inserts.
2. Crankshaft.
3. Lower main bearing inserts to the main bearing caps. Apply engine oil to the bearing inserts.

Measure

- Main bearing clearance. Refer to the proper unit repair manual.

4. Main bearing caps (except rear cap) and bolts to the block. Make sure the special bolt which retains the oil pump screen bracket is installed in the proper position. (#5 main bearing cap, camshaft side hole.)

Tighten

- Main bearing cap bolts to 90 N·m (65 ft. lbs.).

5. Rear crankshaft oil seal to the block and main bearing cap, as outlined previously.
6. Rear main bearing capto the block.
   - Apply a brush-on type oil sealing compound to the mating surface of the block and cap (figure 25). Do not allow any sealant on either crankshaft or rear oil seal.
   - Install the rear main bearing cap and bolts. Tighten the bolts temporarily to 14 N·m (10 ft. lbs.).

Measure

- Crankshaft end play, as follows:
  - Tap the end of the crankshaft first rearward then forward with a lead hammer. This will line up the rear main bearing and crankshaft thrust surfaces.
  - Tighten the rear main bearing cap bolts to 90 N·m (65 ft. lbs.).
  - With the crankshaft forced forward, measure at the front end of the rear main bearing with a feeler gage (figure 37). The proper clearance is 0.05-0.15 mm (0.002-0.006-inch).

Inspect

- Crankshaft for binding. Try turning the crankshaft to check for binding. If the crankshaft does not turn freely, loosen the main bearing cap bolts, one pair at a time, until the tight bearing is located. Burrs on the bearing cap, foreign matter between the insert and the block or the bearing cap, or a faulty insert could cause a lack of clearance at the bearing.

7. Connecting rods to the crankshaft. Use J-5239 to pull the connecting rods down (figure 30). Make sure the connecting rod bearing insert stays in place.

Measure

- Connecting rod bearing clearance. Refer to the proper unit repair manual.

8. Connecting rod caps with bearing inserts to the connecting rods. Apply engine oil to the inserts.
9. Connecting rod cap nuts.

Tighten

- Connecting rod cap nuts to 60 N·m (44 ft. lbs.).

Measure

- Connecting rod side clearance. Use a feeler gage between the connecting rod and crankshaft (figure 34). The correct clearance is 0.006-0.017-inch.

10. Crankshaft timing gear (if removed). Use J-5590 (figure 38). Make sure the timing mark faces out.

Important

- Align the timing marks (figure 27).

11. Oil pan and oil pump, as outlined previously.
12. Timing gear cover, as outlined previously.
13. Spark plugs.
14. Flywheel (if used), as outlined later.
15. Engine, as outlined previously.

FLYWHEEL REPLACEMENT

Remove or Disconnect (Figure 40)

1. Transmission, clutch housing, and clutch.
2. Rear main bearing cap. Refer to "Rear Crankshaft Oil Seal Replacement" in this section.
   - Mark the flywheel and crankshaft so the dowel pin holes can be aligned in their original positions at assembly (figure 40).
   - Loosen the flywheel bolts a few turns.
3. Flywheel dowel pins.
   - Turn the crankshaft so that a dowel pin is at the 6 o'clock position.
   - Drive the dowel pin out, using a hammer and drift.

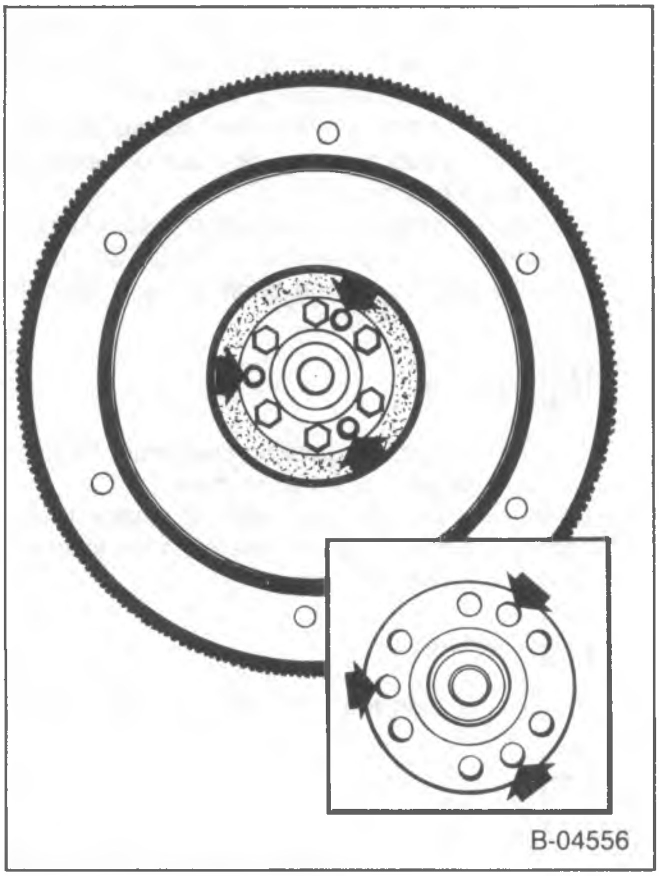


Figure 40—Flywheel Dowel Pin Hole Locations

- Repeat the preceding steps to drive out the remaining dowel pins. The crankshaft must be turned each time so that the pin can be driven out without contacting the block.

4. Flywheel bolts.
5. Flywheel.

Clean

- Mating surfaces of crankshaft and flywheel. Remove any burrs.

Inspect

— Flywheel for burning, scoring, warping, and wear. Replace the flywheel if necessary. Do not machine the flywheel.

— Flywheel ring gear for worn or broken teeth.

Flywheel Ring Gear Replacement

1. Use a torch to heat the gear around the entire circumference, then drive the gear off the flywheel, using care not to damage the flywheel.

NOTICE: Never heat starter gear to red heat as this will change metal structure.

2. Uniformly heat the flywheel gear to temperature which will expand the gear to permit installation. Temperature must not exceed 204°C (400°F).
3. As soon as the gear has been heated, install on the flywheel.

Install or Connect (Figure 40)

1. Flywheel to the crankshaft. Align the marks made at disassembly. Make sure the dowel holes in the crankshaft and flywheel are aligned.
2. Flywheel.

   Tighten

   - Bolts to 150 N·m (110 ft. lbs.).
3. Dowel pins.
   - The interference fit dowel pins must be replaced with an oversized dowel pin when installing the flywheel.
   - Ream the dowel pin holes to the proper size (0.4510-0.4517-inch).
   - Tap the dowl pins into place, flush with the flywheel retaining bolt surface.
4. Rear main bearing cap. Refer to "Rear Crankshaft Oil Seal Replacement" in this section.
5. Transmission, clutch housing, and clutch.

ENGINE MOUNTINGS

NOTICE: Broken or deteriorated mountings can cause misaligned and eventual destruction of certain drive train components. When a single mounting breakage occurs, the remaining mountings are subjected to abnormally high stresses.

INSPECTING ENGINE MOUNTINGS

Front Engine Mountings

1. Raise the engine to remove weight from the mountings and to place a slight tension on the rubber cushion. Observe both mountings while raising the engine.
2. Replace the mounting if the following conditions exist:
   — Hard rubber surface covered with heat check cracks.
   — Rubber cushion separated from the metal plate of the mounting.
   — Rubber cushion split through the center.

3. If there is movement between a metal plate of the mounting and its attaching points, lower the engine and tighten the bolts or nuts attaching the mounting to the engine, frame, or bracket.

Rear Mountings

1. Push up and pull down on the transmission tailshaft. Observe the transmission mounting.
2. Replace the mounting if the following conditions exist:
   - — Rubber cushion separated from the metal plate of the mounting.
   - — Mounting bottomed out (tailshaft can be moved up but not down).
3. If there is relative movement between a metal plate of the mounting and its attaching point, tighten the bolts or nuts attaching the mounting to the transmission or crossmember.

FRONT MOUNTING REPLACEMENT

Remove or Disconnect (Figures 41 through 44)

- Support the engine with a suitable lifting fixture. Do not load the engine mounting.

1. Engine mounting through-bolt and nut.

- Raise the engine only enough to permit removal of the engine mounting.

2. Mounting assembly bolts, nuts, and washers.
3. Mounting assembly.

Install or Connect (Figures 41 through 44)

NOTICE: See "Notice" on page 6A4-1 of this section for steps 2 and 3.

1. Mounting assembly.
2. Mounting assembly bolts, nuts, and washers.

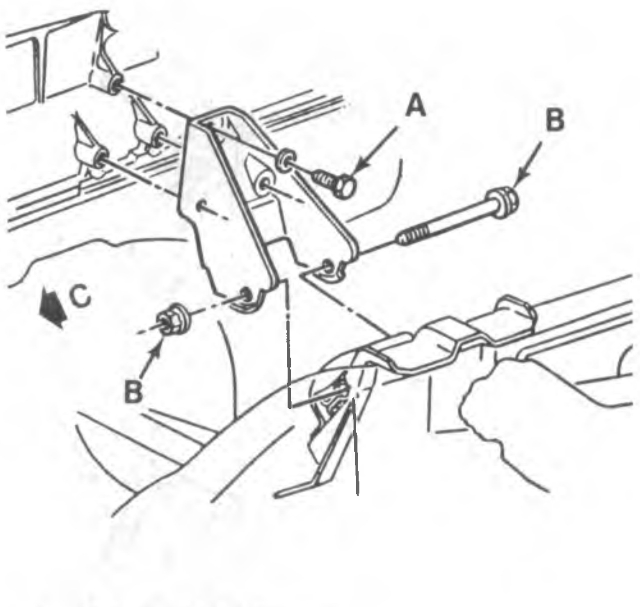
Tighten

- Fasteners to specifications. Refer to figures 41 through 44.

3. Engine mount through-bolt and nut. Lower the engine until the bolt can be inserted. Install the nut.

Tighten

- Through-bolt or nut to specifications. Refer to figure 41.



A. 48 N·m (36 ft. lbs.)
B. Torque Nut To 68 N·m (50 ft. lbs.) Or, Torque Bolt To 100 N·m (75 ft. lbs.)
C. Forward

B-07883

Figure 41—Front Engine Mounting Brackets All Models

REAR MOUNTING REPLACEMENT (EXCEPT P-MODELS WITH FLYWHEEL HOUSING MOUNTING)

Remove or Disconnect (Figures 45, 46, and 47)

- Support the rear of the engine to relieve the weight on the rear mountings.

1. Mounting to crossmember nut(s) and washer(s).
2. Mounting to transmission bolts and washers.

- Raise the rear of the engine only enough to permit removal of the mounting.

3. Mounting.

Install or Connect (Figures 45, 46, and 47)

1. Mounting.

- Lower the rear of the engine.

2. Mounting to transmission bolts and washers.

NOTICE: See "Notice" on page 6A4-1 of this section.

3. Mounting to crossmember nut(s) and washer(s).

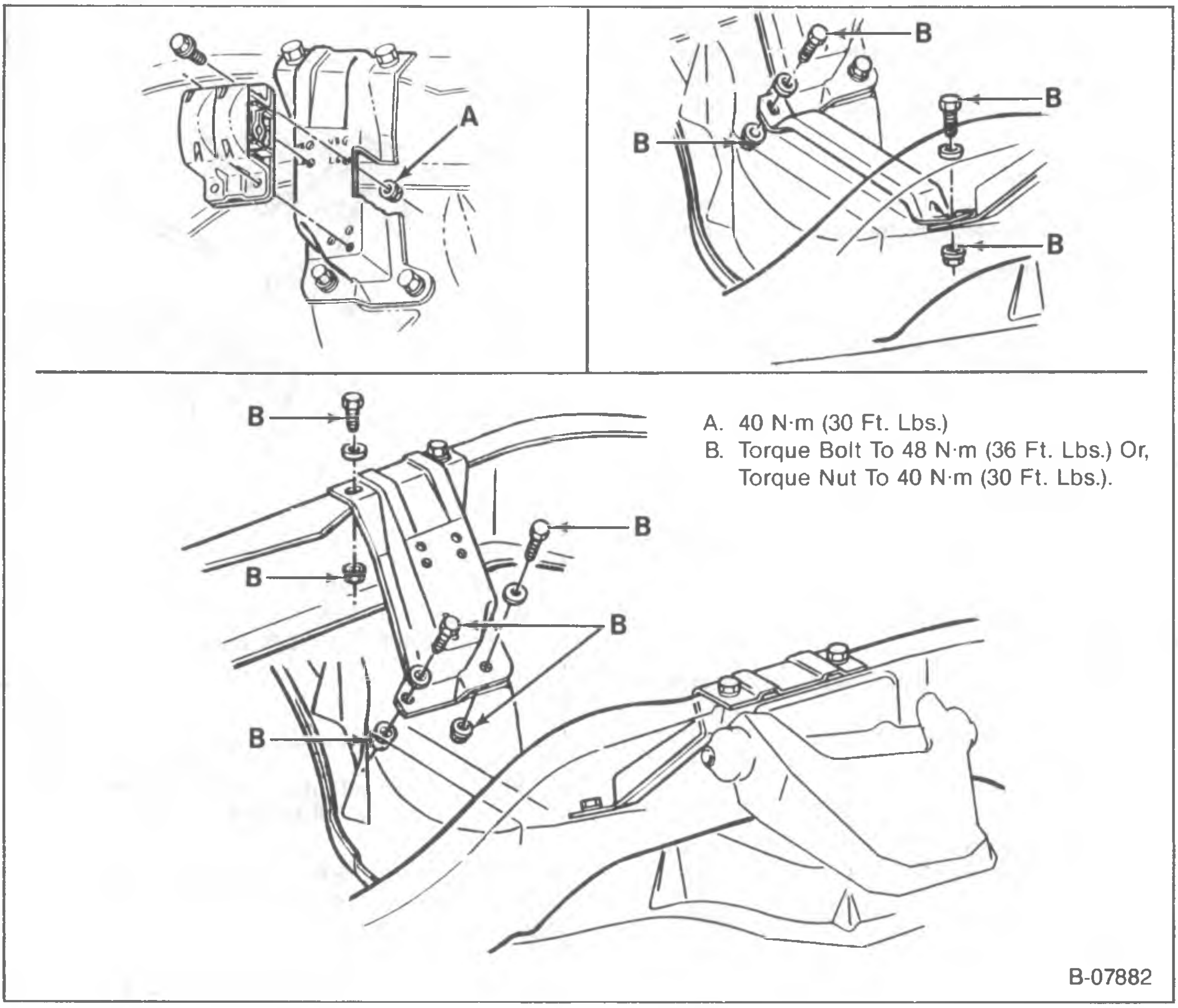


Figure 42—Front Engine Mountings (C Models)

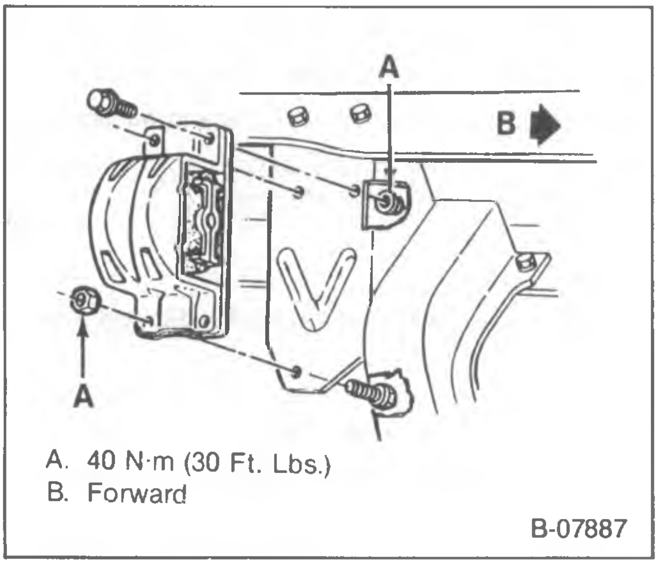


Figure 43—Front Engine Mountings (K Models)

Tighten

- Fasteners to specifications. Refer to figures 45, 46, and 47.

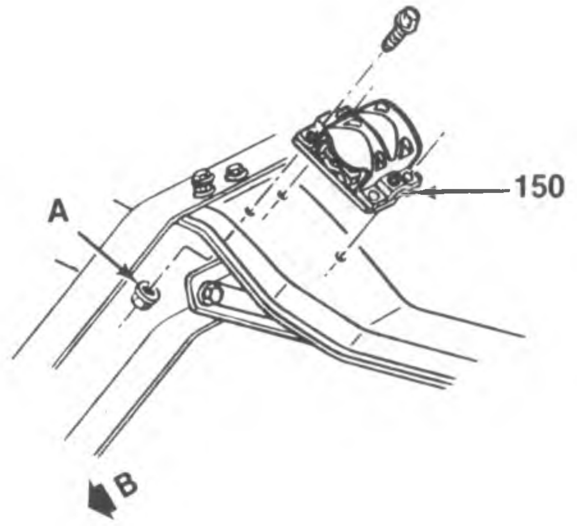
REAR MOUNTING REPLACEMENT (P-MODELS WITH FLYWHEEL HOUSING MOUNTING

Remove or Disconnect (Figure 48)

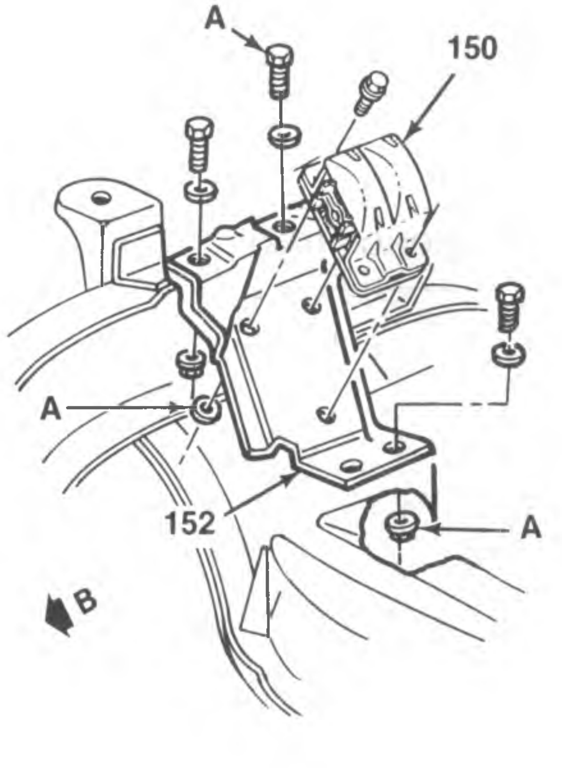
1. Bolt, cushion and spacer.
   - Raise the rear of the engine only enough to permit removal of the mounting.
2. Mounting.

Install or Connect (Figure 48)

1. Mounting. Align the hole in the mounting with the hole in the crossmember.
   - Lower the rear of the engine.



MODELS WITH I-BEAM AXLE (RPO-FS3)



MODELS WITHOUT I-BEAM AXLE

A. 40 N·m
B. Forward
150. Mounting Assembly
152. Frame Bracket

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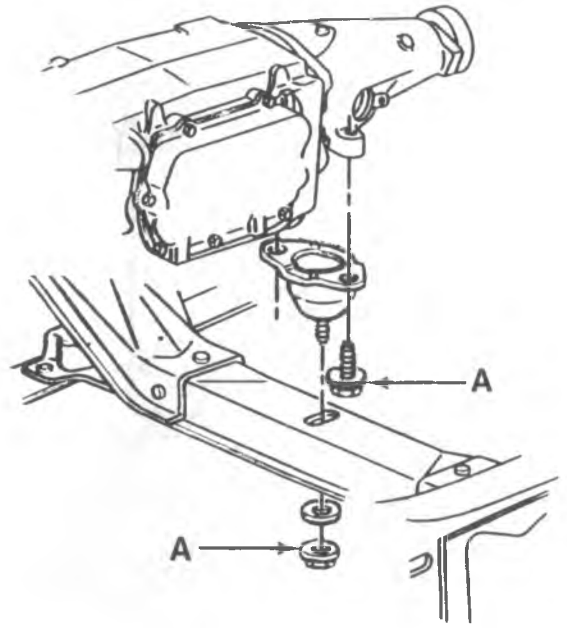
Figure 44—Front Engine Mountings (P Models)



A. 48 N·m (36 Ft. Lbs.)

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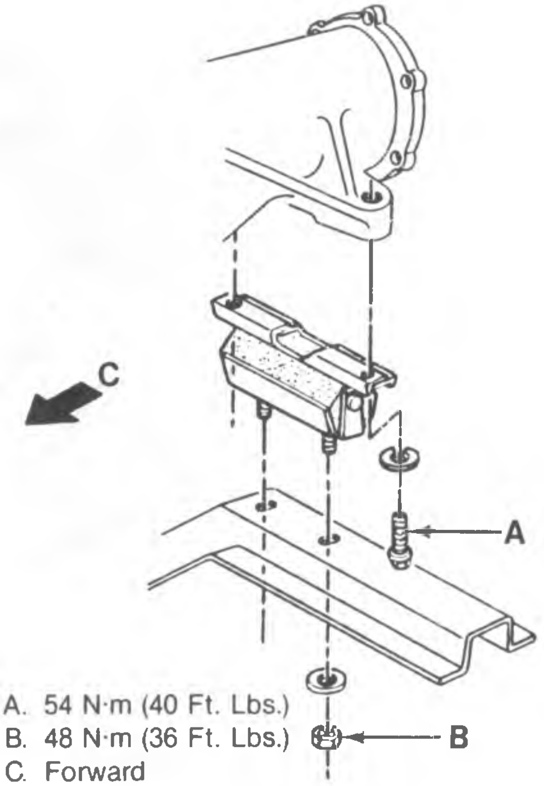
Figure 45—Rear Engine Mounting (C Models)



A. 54 N·m (40 Ft. Lbs.)
B. 48 N·m (36 Ft. Lbs.)
C. Forward

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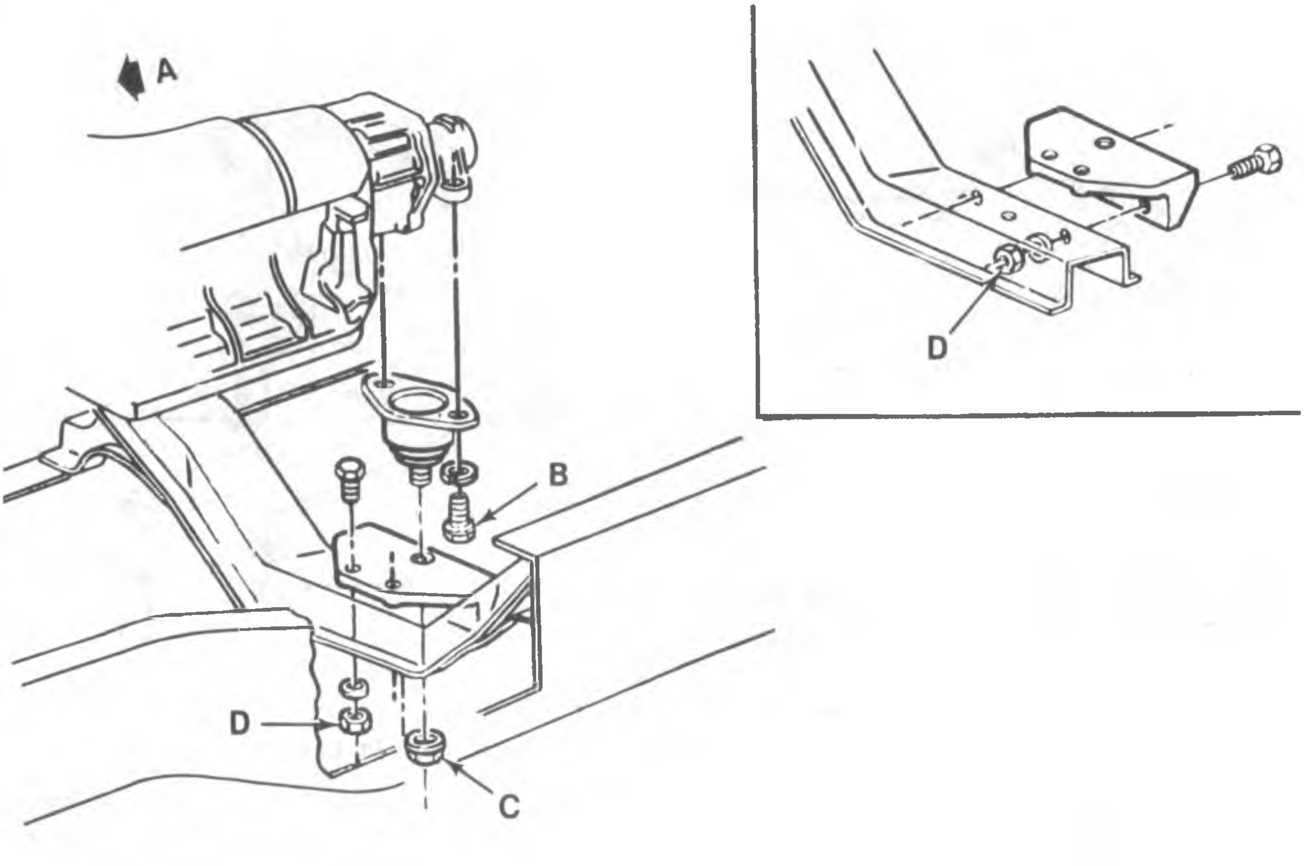
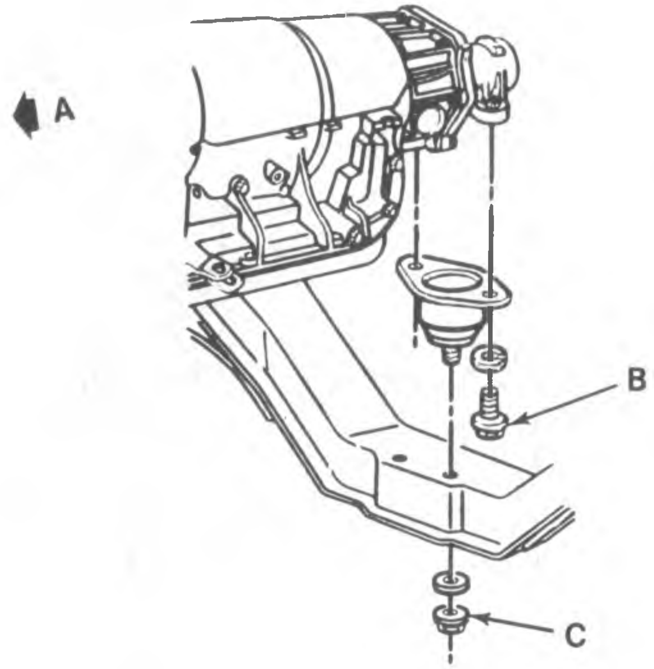
Figure 46—Rear Engine Mounting (K Models)



MODELS WITH PROPSHAFT PARKING BRAKE



A. Forward
B. 68 N·m (50 ft. lbs.)
C. 48 N·m (36 ft. lbs.)
D. 60 N·m (44 ft. lbs.)

MODELS WITHOUT PROPSHAFT PARKING BRAKE

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Figure 47—Rear Engine Mounting (P Models With Transmission Tail Type Mounting)

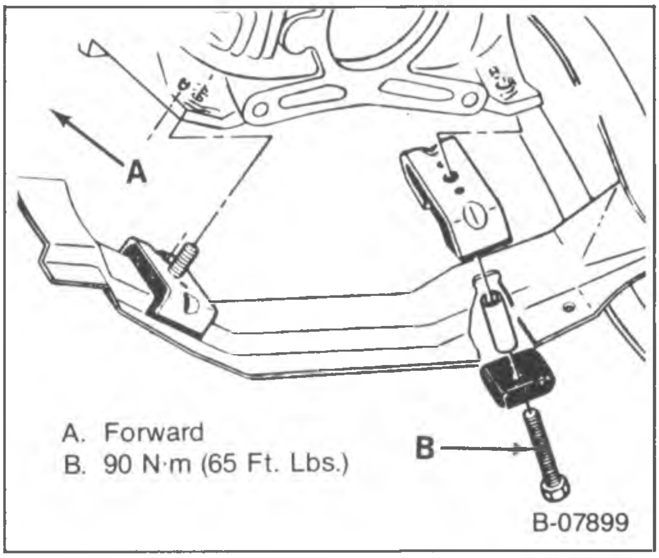

Figure 48—Rear Engine Mounting (P Models With Flywheel Housing Type Mounting)

NOTICE: See "Notice" on page 6A4-1 of this section.

2. Spacer, cushion and bolt.

Tighten

- Bolt to 90 N·m (65 ft. lbs.).

ENGINE REPLACEMENT

The procedure outlined applies specifically to "C" and "K" models. Additional steps may be necessary on "P" models depending on body design.

Remove or Disconnect

1. Battery negative cable.
2. Hood.
3. Air cleaner.
4. Radiator.
5. Heater hoses from the engine.
6. Accelerator cable.
7. Transmission detent cable (if used).
8. Fan and water pump pulley.
9. Fuel lines from the fuel pump.
10. Evaporate emission and other vacuum hoses.
11. Engine wiring.
12. Starter.
13. Exhaust pipe at the exhaust manifold. Wire the pipe out of the way.
14. Flywheel cover.
15. Flywheel to torque converter bolts (automatic transmission).
    - Attach a suitable lifting device to the engine. Remove the weight from the engine mountings.
16. Front engine mounting through-bolts.
17. Strut rods at engine mountings (4 wheel drive models).
    - Support the transmission with a chain or transmission jac.
18. Bell housing to engine bolts.
19. Engine. Move the engine forward to disengage the transmission and remove.

Install or Connect (Figure 41)

1. Engine. Move the engine rearward to engage the transmission.
2. Bell housing to engine bolts. Remove the transmission jack or support chain.
3. Front engine mounting through-bolts and nuts.

Tighten

- Fasteners to specifications. Refer to figure 41.

- Remove the lifting device.

4. Strut rods (4 wheel drive models).
5. Torque converter to flywheel bolts (automatic transmission).
6. Flywheel cover.
7. Exhaust pipe and new packing to the exhaust manifold.
8. Starter.
9. Engine wiring.
10. Vacuum hoses.
11. Fuel lines.
12. Fan and water pump pulley.
13. Transmission detent cable (if used).
14. Accelerator cable.
15. Heater hoses.
16. Radiator.
17. Air cleaner.
18. Hood.
19. Battery negative cable.
20. Proper quantity and grade of coolant.

SPECIFICATIONS

ENGINE SPECIFICATIONS

All Specifications are in INCHES unless otherwise noted.

GENERAL DATA:				
Type				In Line
Displacement				4.8L (292 Cu. In.)
No. Of Cylinders				6
Bore				3.876
Stroke				4.12
Compression Ratio				8.0:1
Firing Order				1 - 5 - 3 - 6 - 2 - 4
Oil Pressure				16 psi @ 700 RPM; 30-45 psi @ 1500 RPM
CYLINDER BORE:				
Diameter				3.8750-3.8780
Out Of Round	Production			0.0005 (Maximum)
	Service			0.002 (Maximum)
Taper	Production	Thrust Side		0.0005 (Maximum)
		Relief Side		0.0005 (Maximum)
	Service			0.001 (Maximum)
PISTON:				
Clearance	Production			0.0026-0.0036
	Service Limit			0.0045 (Maximum)
PISTON RING:				
COMPRESSION	Groove Clearance	Production	Top	0.0020-0.0040
			2nd	
		Service Limit		Hi Limit Production ± 0.001
	Gap	Production	Top	0.010-0.020
			2nd	0.010-0.020
		Service Limit		Hi Limit Production + 0.010
OIL	Groove Clearance	Production		0.005-0.0055
		Service Limit		Hi Limit Production + 0.001
	Gap	Production		0.015-0.055
		Service Limit		Hi Production + 0.010
PISTON PIN:				
Diameter				0.9270-0.09273
Clearance In Piston	Production			0.00015-0.00025
	Service Limit			0.001 (Maximum)
Fit In Rod				0.0008-0.0016 Interference

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SPECIFICATIONS

ENGINE SPECIFICATIONS (CONT.)

All specifications are in INCHES unless otherwise noted.

CRANKSHAFT:			
Main Journal	Diameter		All 2.2979-2.2994
	Taper	Production	0.0002 (Maximum)
		Service Limit	0.001 (Maximum)
	Out of Round	Production	0.0002 (Maximum)
		Service Limit	0.001 (Maximum)
Main Bearing Clearance	Production		#1-#6: 0.0010-0.0024 #7: 0.0016-0.0035
	Service Limit		#1-#6: 0.0010-0.0025 #7: 0.0015-0.0035
Crankshaft End Play			0.002-0.006
Crankpin	Diameter		2.099-2.100
	Taper	Production	0.0005 (Maximum)
		Service Limit	0.001 (Maximum)
	Out Round	Production	0.0005 (Maximum)
		Service Limit	0.001 (Maximum)
Rod Bearing Clearance	Production		0.0010-0.0026
	Service Limit		0.0030 (Maximum)
Rod Side Clearance			0.006-0.017
CAMSHAFT:			
Lobe Lift ± 0.002	Intake		0.2315
	Exhaust		0.2315
Journal Diameter			1.8677-1.8697
Camshaft Runout			0.020 (Maximum)
Camshaft End Play			0.003-0.008
VALVE SYSTEM:			
Lifter			Hydraulic
Rocker Arm Ratio			1.75:1
Valve Lash		Intake	One Turn Down From Zero Lash
		Exhaust	
Face Angle (Intake & Exhaust)			46°
Seat Angle (Intake & Exhaust)			46°
Seat Runout (Intake & Exhaust)			0.002 (Maximum)
Seat Width		Intake	0.035-0.060
		Exhaust	0.062-0.093
Stem Clearance	Production	Intake	0.0010-0.0027
		Exhaust	0.0015-0.0032
	Service	Intake	High Limit Production +0.001
		Exhaust	High Limit Production +0.002
Valve Spring (Outer)	Free Length		2.08
	Pressure lbs. @ in.	Closed	78-86 lbs. @ 1.66"
		Open	170-180 lbs. @ 1.26"
	Installed Height ± $\frac{1}{32}$"		$1\frac{21}{32}$
Valve Spring Damper	Free Length		1.94
	Approx. # of Coils		4

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SPECIFICATIONS (CONT.)

TORQUE SPECIFICATIONS

Item	N·m	Ft. Lbs.	In. Lbs.
Flywheel Bolts	150	110	—
Main Bearing Cap Bolts	90	65	—
Camshaft Thrust Plate Screws	9.0	—	80
Timing Gear Cover Bolts To Block	9.0	—	80
Torsional Damper Bolt	70	50	—
Connecting Rod Cap Nuts	60	44	—
Oil Pump Bolts	13.0	—	115
Oil Pump Pickup Tube Bracket Nut (To Main Bearing Cap Bolt)	34	26	—
Oil Pump Cover Bolts	7.9	—	70
Oil Pan Bolts (To Front Cover)	5.1	—	45
(To Block [1/4-20])	9.0	—	80
(To Block [5/16-18])	18.6	—	165
Cylinder Head Bolts (Left-Hand Front Bolt)	115	85	—
(All Others)	130	95	—
Rocker Arm Cover Bolts (Cork Gasket)	5.4	—	58
(Rubber Gasket)	4.3	—	38
Pushrod Cover Bolts	9.0	—	80
Water Pump Bolts	20	15	—
Thermostat Housing To Block Bolts	38	28	—
Water Outlet to Thermostat Housing Bolts	28	20	—
Intake Manifold To Exhaust Manifold Bolts And Nuts	60	44	—
Manifold To Cylinder Head Bolts And Nuts	52	38	—
Spark Plug	20	15	—

SPECIAL TOOLS

J-23590	Air Adapter
J-5892	Spring Compressor
J-23738-A	Vacuum Pump
J-3049	Hydraulic Lifter Remover (Plier Type)
J-9290-01	Hydraulic Lifter Remover (Slide Hammer Type)
J-5802-01	Rocker Arm Stud Remover
J-5715	Reamer (0.003-inch Oversize)
J-6036	Reamer (0.013-inch Oversize)
J-6880	Rocker Arm Stud Installer
J-23523-E	Torsional Damper Puller And Installer
J-8520	Dial Indicator Adaptor
J-5239	Guide Set
J-8037	Ring Compressor
J-8080	Main Bearing Remover/Installer
J-24420-A	Crankshaft Gear Puller
J-5590	Crankshaft Gear Installer

SECTION 6A5

SMALL BLOCK

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 "NOTICE: See 'Notice' on page 6A5-1 of this section."

NOTICE: All engine 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 this part.

CONTENTS

SUBJECT **PAGE**

DESCRIPTION

Small block engines covered by this manual are available in two displacements; 5.0L (305 cu. in.) and 5.7L (350 cu. in.).

Small block engines are 90-degree V8 type, overhead valve, water cooled, with cast iron block and heads.

The crankshaft is supported by five precision insert main bearings, with crankshaft thrust taken at the number five (rear) bearing.

The camshaft is supported by five plain type bearings and is chain driven. Motion from the camshaft is transmitted to the valves by hydraulic lifters, pushrods, and ball type rocker arms. The valve guides are integral in the cylinder head.

The connecting rods are forged steel, with precision insert type crankpin bearings. The piston pins are a press fit in the connecting rods.

The pistons are cast aluminum alloy. The piston pins are a floating fit in the piston.

ENGINE LUBRICATION

Lubrication schematics are shown in figures 1 and 2. The gear type oil pump is driven from the distributor shaft, which is gear driven from the camshaft. Oil is drawn into the oil pump through a pickup screen and pipe.

Pressurized oil is routed to the oil filter. In case of excessive oil pressure, a bypass valve is provided. Filtered oil flows into the main gallery and then to the camshaft and crankshaft bearings. The valve lifter oil gallery supplies oil to the valve lifters. Oil flows from the hydraulic lifters through the hollow pushrods to the rocker arms. Oil from the overhead drains back to the crankcase through oil drain holes.

The timing chain is drip fed from the front camshaft bearing. The pistons and piston pins are lubricated by oil splash.

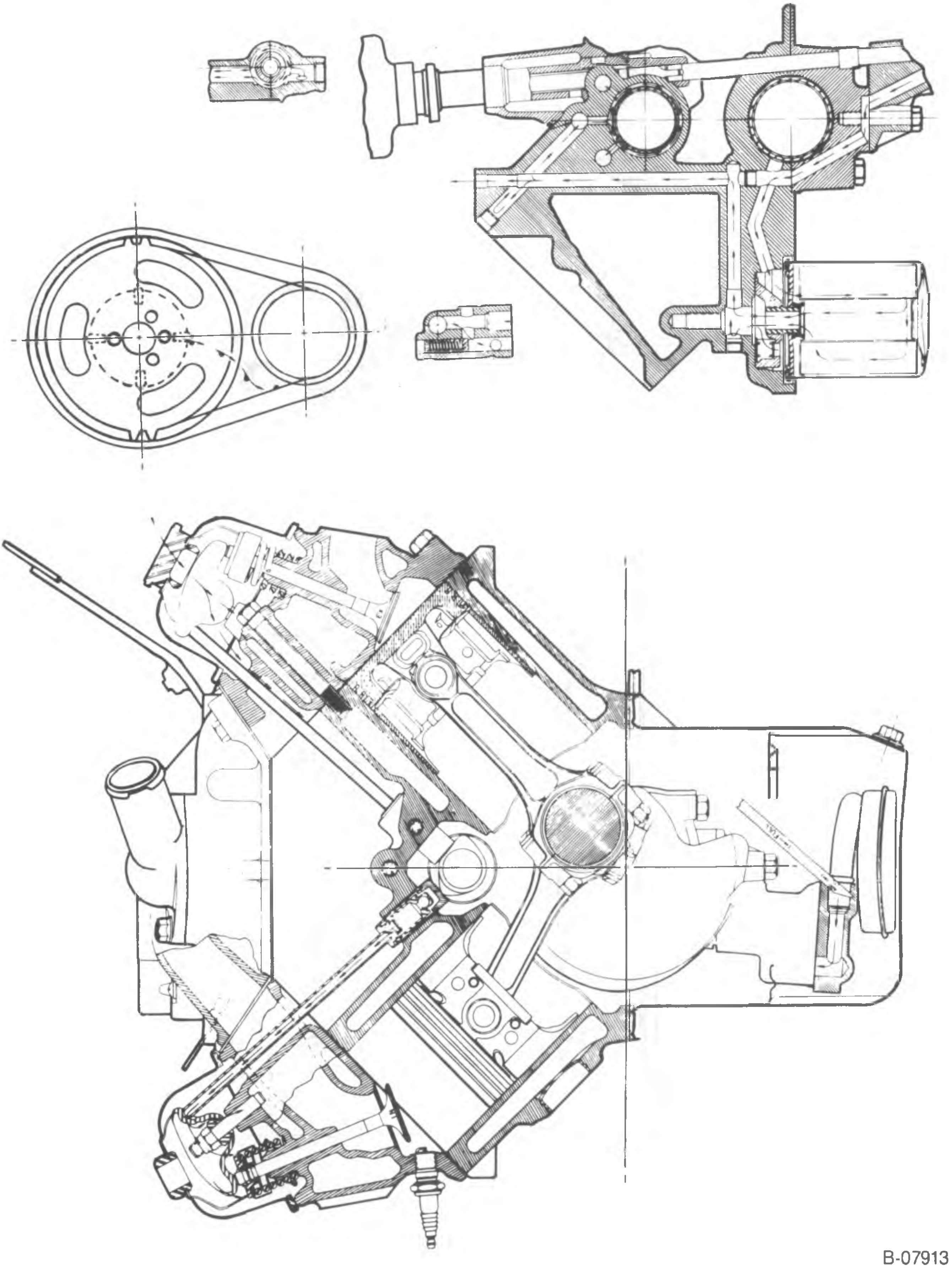


Figure 1—Engine Lubrication Diagram

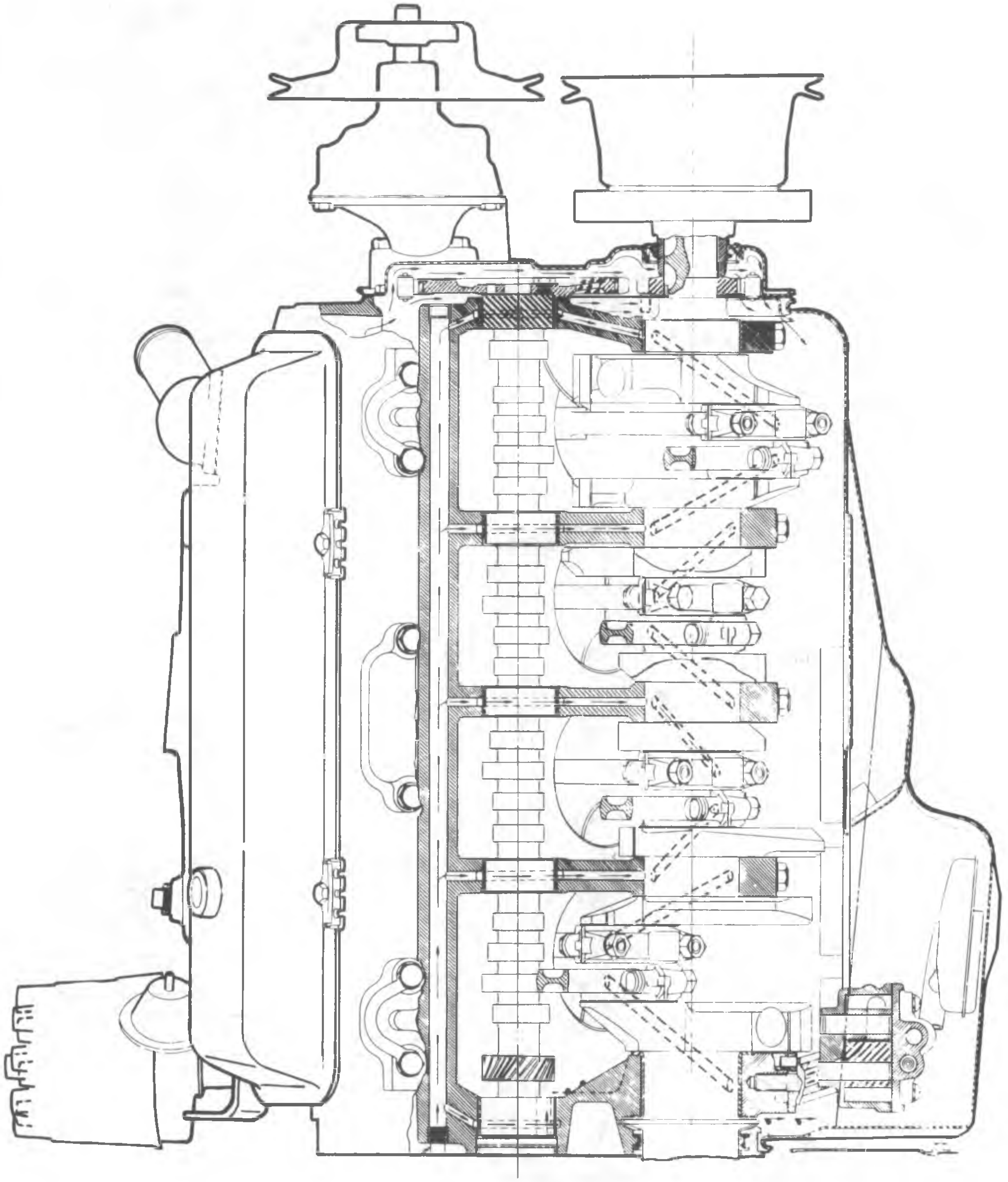


Figure 2—Engine Lubrication Diagram

ON-VEHICLE SERVICE

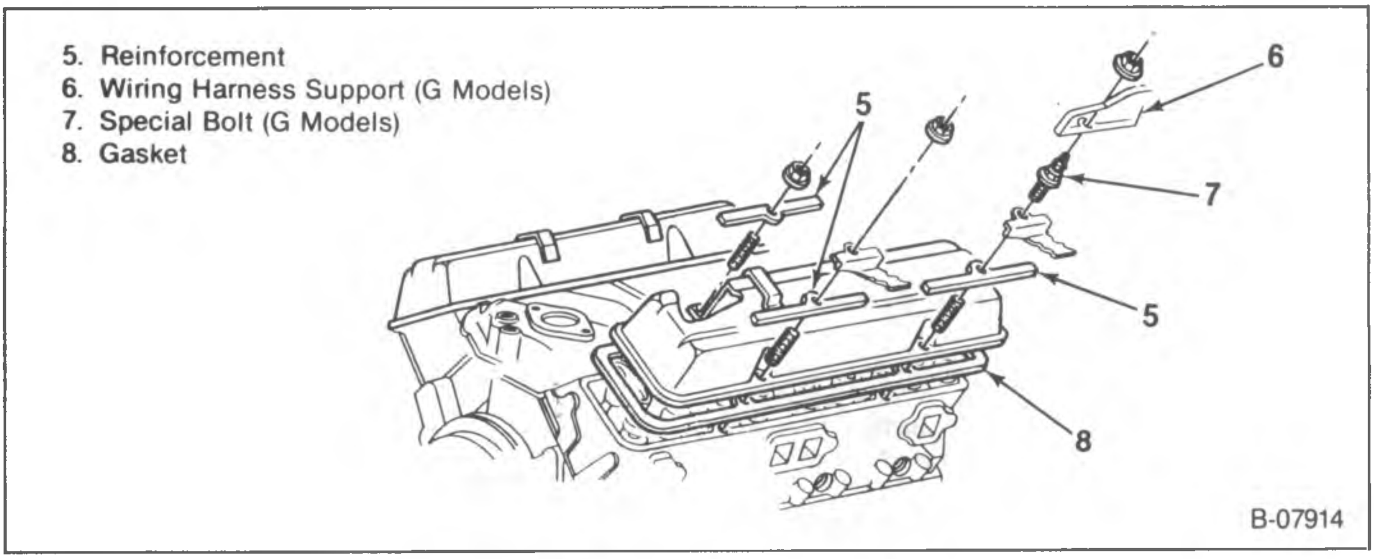


Figure 3—Rocker Arm Cover Installation

ROCKER ARM COVER REPLACEMENT

Remove or Disconnect (Figure 3)

1. Battery negative cable.
2. Engine cover (G models).
3. Air cleaner.
4. Crankcase ventilation hoses at the rocker arm covers.
5. Wiring harnesses from the rocker arm clips.
6. Wiring harness support (6) (G models—left rocker arm cover).
7. Heat stove pipe (right side rocker arm cover).
8. Air conditioning compressor rear brace (if equipped) (left side rocker arm cover).
9. Rocker arm cover nuts, special bolt (7) (if used), reinforcements, and wire clips.
10. Rocker arm cover and gasket.

Clean

- All traces of old gasket from the rocker arm cover and cylinder head.

Inspect

- Rocker arm cover sealing surface for distortion. Replace if necessary.

Install or Connect (Figure 3)

1. Rocker arm cover and new gasket.
2. Reinforcements, wire clips, nuts, and special bolt (7) (if used).

   Tighten

   — Nuts to 7.3 N·m (65 in. lbs.).
   — Special bolt (7) (if used) to 6.2 N·m (55 in. lbs.).
3. Air conditioning compressor rear brace (if necessary).
4. Heat stove pipe (if removed).
5. Wiring harness support (6) (if used).
6. Wiring harnesses to the rocker arm clips.
7. Crankcase ventilation hoses.
8. Air cleaner.
9. Engine cover (G models).
10. Battery negative cable.

ROCKER ARM AND PUSHROD REPLACEMENT

Remove or Disconnect

1. Rocker arm cover, as outlined previously.
2. Rocker arm nut.
   - If only the pushrod is to be replaced, back the rocker arm nut off until the rocker arm can be swung away from the pushrod. Then pull the pushrod out.
3. Rocker arm with ball.

4. Pushrod.

Important

- Store used components in order so they can be reassembled in the same location.

Inspect

— Rocker arms and balls at their mating surfaces. These surfaces should be smooth and free from scoring or other damage.
— Rocker arm areas which contact the valve stems and the sockets which contact the pushrods. These areas should be smooth and free of damage and wear.
— Pushrods for bending. Roll the pushrod on a flat surface to determine if it is bent. Replace if necessary.
— Ends of the pushrods for scoring or roughness.

Install or Connect

1. Pushrod. Make sure the pushrod seats properly in the hydraulic lifter.
2. Rocker arm with ball.

   Important

   - When new rocker arms and/or balls are installed, coat their bearing surfaces with "Molykote" or equivalent.
3. Rocker arm nut.

   Adjust

   - Valves as outlined later.
4. Rocker arm cover, as outlined previously.

VALVE ADJUSTMENT

1. Remove the rocker arm cover as outlined previously.
2. Crank the engine until the mark on the vibration damper lines up with the "O" mark on the timing tab and the engine in the number one firing position. This may be determined by placing fingers on the number one valve as the mark on the damper comes near the "O" mark on the timing tab. If the rocker arms are not moving, the engine is in the number one firing position. If the rocker arms move as the mark comes up to the timing tab, the engine is in the number six firing position and should be turned over one more time to reach the number one position.
3. With the engine in the number one firing position as determined above, the following valves may be adjusted:

Figure 4—Adjusting The Valves

   — Exhaust: 1, 3, 4, 8
   — Intake: 1, 2, 5, 7
   (Even numbered cylinders are in the right bank; odd numbered cylinders are in the left bank, when viewed from the rear of the engine).
4. Back out the adjusting nut until lash is felt at the pushrod then turn in the adjusting nut until all lash is removed. This can be determined by rotating the pushrod while turning the adjusting nut (figure 4). When the play has been removed, turn the adjusting nut in one full additional turn (to center the lifter plunger).
5. Crank the engine one revolution until the timing tab "O" mark and vibration damper mark are again in alignment. This is the number six firing position the following valves may be adjusted:
   — Exhaust: 2, 5, 6, 7
   — Intake: 3, 4, 6, 8
6. Install the rocker arm cover as outlined previously.

VALVE STEM SEAL AND VALVE SPRING REPLACEMENT

Remove or Disconnect (Figures 5 and 6)

Tools Required:
J-23590 Air Adapter.
J-5892-A Spring Compressor.

1. Rocker arm cover, as outlined previously.
2. Rocker arms, as outlined previously.
3. Spark plugs.
4. Valve keepers (20).
   - Install J-23590 into the spark plug hole.
   - Apply compressed air to hold the valves in place.

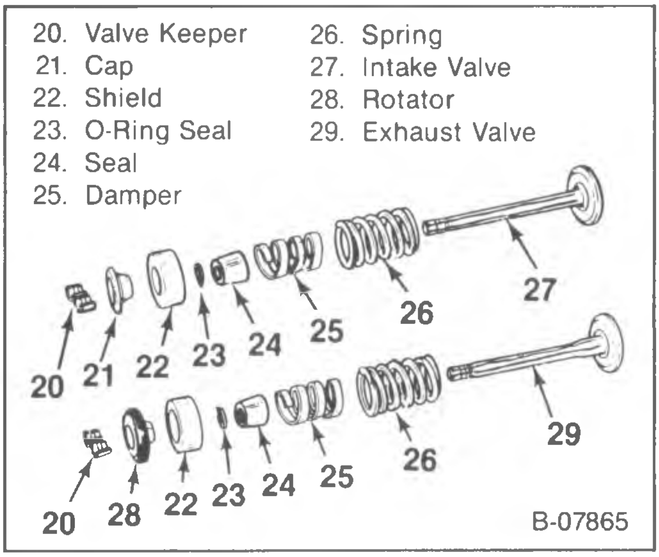


Figure 5—Valves And Components

- Install a rocker arm nut (figure 6).
- Use J-5892-A to compress the valve spring (figure 6).
- Remove the valve keepers.
- Carefully release the spring tension. Remove J-5892-A.

5. Cap (21) and/or rotator (28), shield (22) and spring (26) with damper (25).
6. O-ring seal (23), and seal (24).

Install or Connect (Figures 5, 6, and 7)

Tools Required:

J-23590 Air Adapter
J-5892-A Spring Compressor
J-23738-A Vacuum Pump

1. New seal (24). Install the seal over the valve stem and seat it against the head.

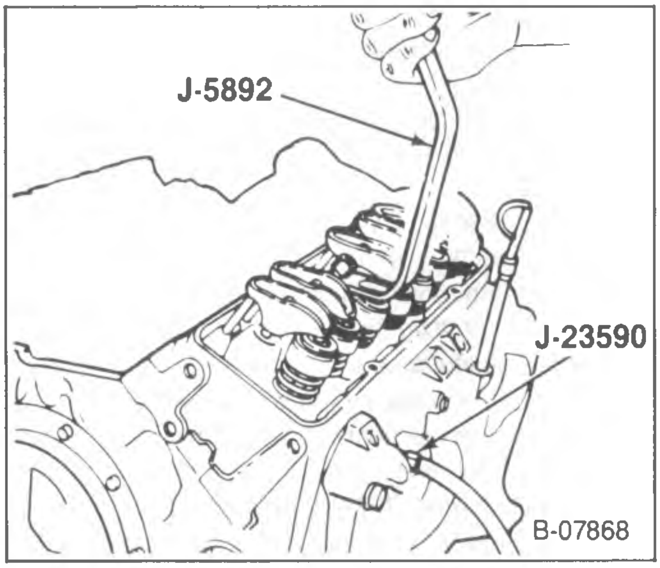


Figure 6—Compressing The Valve Springs

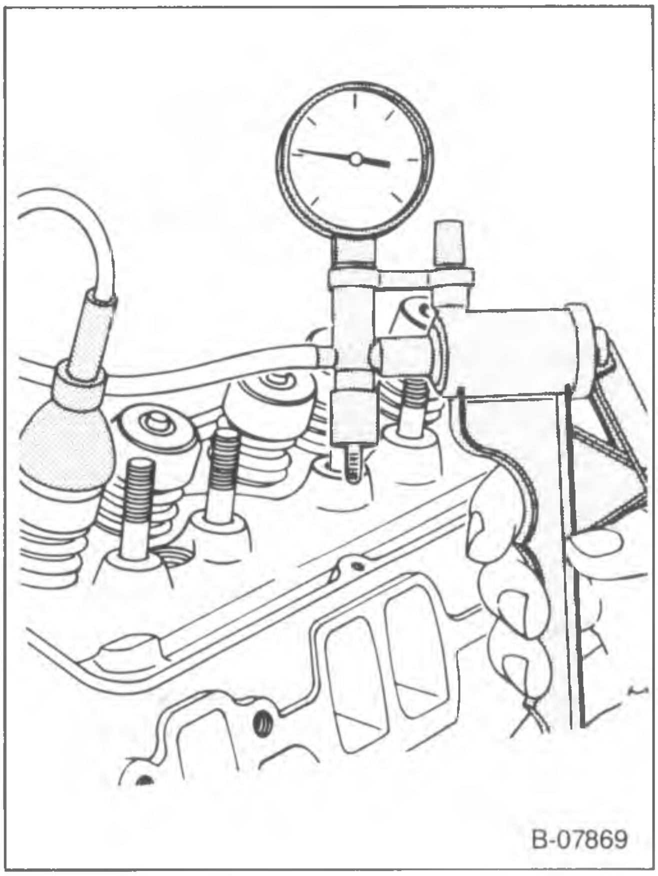


Figure 7—Testing The Valve Seals

2. Spring (26) with damper (25), shield (22) and cap (21) and/or rotator (28).
3. New o-ring seal (23) and valve keepers (20).
   - With air pressure applied to the cylinder with J-23590, compress the spring with J-5892-A (figure 6).
   - Lubricate the o-ring seal with engine oil. Install the seal on the valve stem. Make sure the seal is not twisted.
   - Install the valve keepers. Use grease to hold them in place.
   - Carefully release spring pressure. Make sure the valve keepers stay in place.
   - Remove J-5892-A and J-23590.
   - Check each o-ring seal for leakage (figure 7).
     - Place the suction cup furnished with J-23738-A over the shield.
     - Connect J-23738-A to the suction cup and apply a vacuum. Watch the vacuum pump gage. No air should be able to leak past the seal. If the seal will not hold a vacuum, it may have been damaged or improperly installed.
4. Spark plugs.
5. Rocker arms, as outlined previously.

Adjust

- Valves, as outlined previously.

6. Rocker arm cover, as outlined previously.

INTAKE MANIFOLD REPLACEMENT

Remove or Disconnect

1. Battery negative cable.
2. Engine cover (G models).
3. Air cleaner.
- Drain the cooling system.
4. AIR crossover hose.
5. Heater hose and upper radiator hose at the intake manifold.
6. Generator upper bracket.
7. Vacuum hoses at the intake manifold.
8. Electrical wiring at the carburetor and intake manifold.
9. Fuel line at the carburetor.
10. Accelerator, cruise control, and TV cables, as equipped.
11. Distributor. Refer to ENGINE ELECTRICAL (SEC. 6D).
12. Air conditioning compressor and bracket (if equipped). Refer to AIR CONDITIONING (SEC. 1B).
13. Brake booster vacuum pipe.
14. Carburetor.
15. Intake manifold bolts.
16. Intake manifold.
17. Gaskets.

Clean

— Old gasket and RTV from the block, heads, and intake manifold. Remove all RTV that is loose or will cause interference at assembly.

— Excessive carbon deposits from the exhaust and EGR passages.

— Excessive scale and deposits from the coolant passages.

Inspect

- Manifold for cracks and gasket surface damage.

Install or Connect (Figures 8 and 9)

1. Gaskets to the cylinder head.
2. RTV to the front and rear sealing surfaces on the block (figure 8). Apply a 5 mm ($^{3}/_{16}$-inch) bead of RTV (part number 1052366 or equivalent) to the front and rear of the block as shown. Extend the bead 13 mm ($^{1}/_{2}$-inch) up each cylinder head to seal and retain the gaskets.
3. Intake manifold to the engine.
4. Intake manifold bolts.

Tighten

- Intake manifold bolts to 48 N·m (36 ft. lbs.). Use the tightening sequence shown in figure 9.

5. Carburetor (if removed).
6. Brake booster vacuum pipe.
7. Air conditioning compressor and bracket (if equipped). Refer to AIR CONDITIONING (SEC. 1B).
8. Distributor. Refer to ENGINE ELECTRICAL (SEC. 6D).
9. Accelerator, cruise control, and TV cables, as equipped.
10. Fuel line to the carburetor.
11. Electrical wiring.
12. Vacuum hoses.
13. Generator upper bracket.
14. Heater hose and upper radiator hose.
15. AIR crossover hose.
16. Air cleaner.
17. Engine cover (G models).
18. Battery negative cable.
- Fill the cooling system with the proper quantity and grade of coolant.

HYDRAULIC LIFTER REPLACEMENT

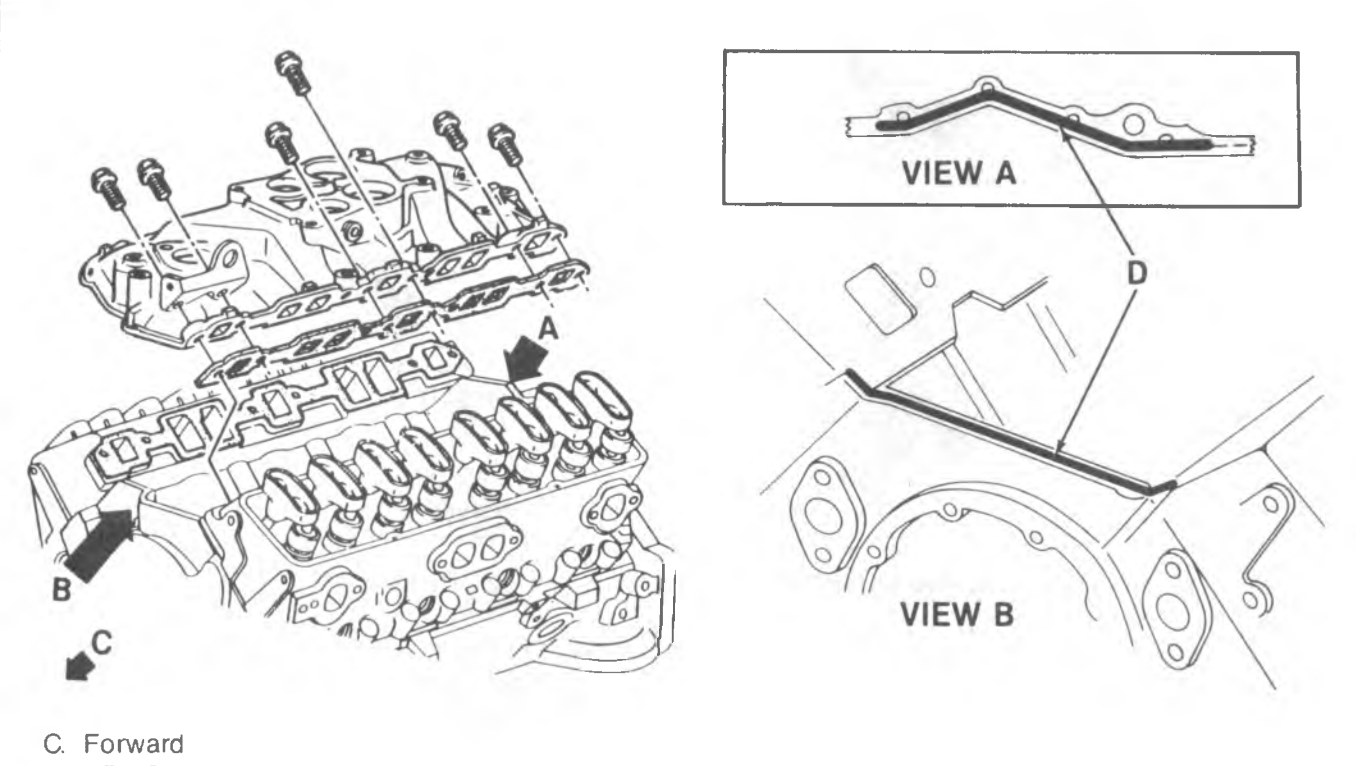
Remove or Disconnect (Figures 10 and 11)

Tools Required:

J-3049 Hydraulic Lifter Remover (Plier Type) or

J-9290-01 Hydraulic Lifter Remover (Slide Hammer Type)

1. Rocker arm cover, intake manifold, and pushrod, as outlined previously.
2. Hydraulic lifters.
   — Remove the hydraulic lifters one at a time and place them in an organizer rack. The lifters must be installed in the same bore from which they were removed.
   — A stuck hydraulic lifter can be removed using J-3049 (figure 10) or J-9290-01 (figure 11).



C. Forward
D. RTV Sealant

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Figure 8—Intake Manifold Installation

Inspect

- Hydraulic lifter body for scuffing and scoring. If the lifter body wall is worn or damaged, the mating bore in the block should also be checked.
- Check the fit of each hydraulic lifter in its mating bore in the block. If the clearance is excessive, try a new lifter.
- The hydraulic lifter foot must be smooth and slightly convex. If worn, pitted, or damaged, the mating camshaft lobe should also be checked.

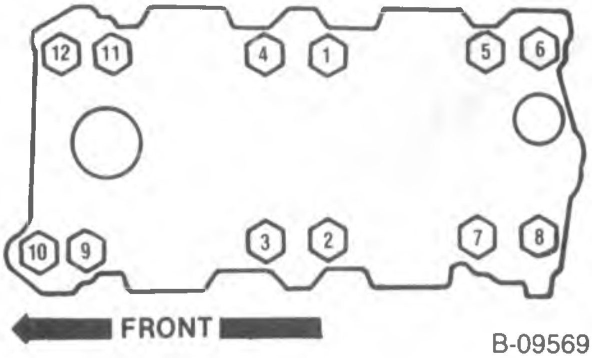

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Figure 9—Intake Manifold Bolt Tightening Sequence

Hydraulic Lifter Repair

- Refer to the proper unit repair manual.

Install or Connect

1. Hydraulic lifters to the block. Lubricate the lifter foot and body with Engine Oil Supplement or equivalent.

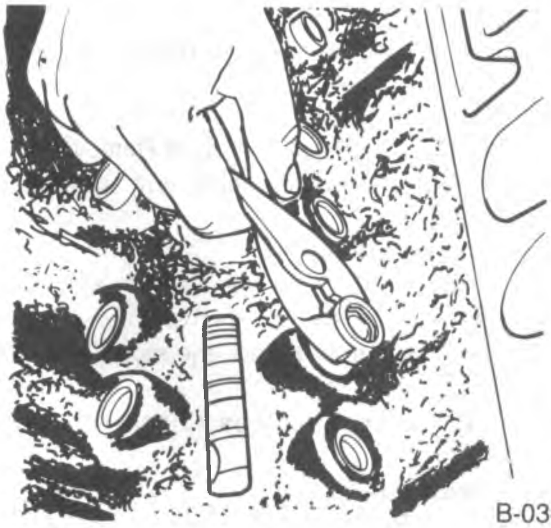

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Figure 10—Removing The Hydraulic Lifter

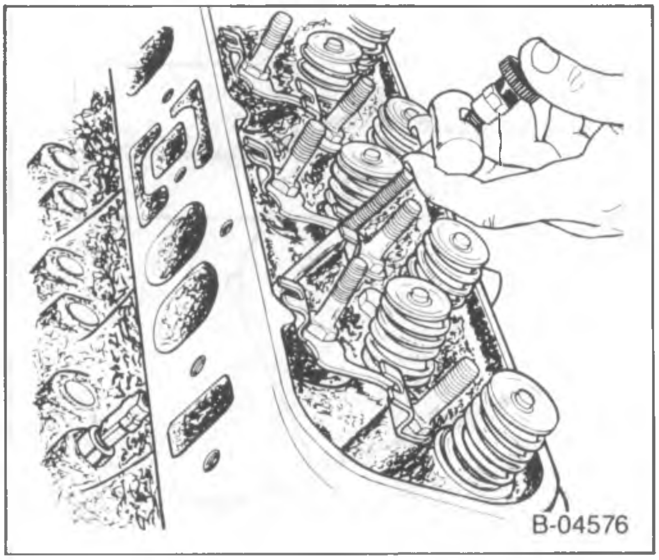


Figure 11—Removing The Hydraulic Lifter (Typical)

Important

- When only new hydraulic lifters or a new camshaft is installed, Engine Oil Supplement (or equivalent) should be added to the crankcase oil.
- Replace all hydraulic lifters when a new camshaft is installed.

2. Intake manifold, as outlined previously.
3. Pushrod, as outlined previously.

Adjust

- Valves, as outlined previously.

4. Rocker arm cover, as outlined previously.

ROCKER ARM STUD REPLACEMENT

Remove or Disconnect (Figure 12)

Tool Required:

J-5802-01 Rocker Arm Stud Remover

1. Rocker arm cover and rocker arm, as outlined previously.
2. Rocker arm stud.
   - Place J-5802-01 over the rocker arm stud.
   - Install a nut and flat washer.
   - Turn the nut to remove the stud (figure 12).

Install or Connect (Figures 13 and 14)

Tools Required:

J-5715 Reamer (0-003-inch oversize) or
J-6036 Reamer (0.013-inch oversize)
J-6880 Rocker Arm Stud Installer

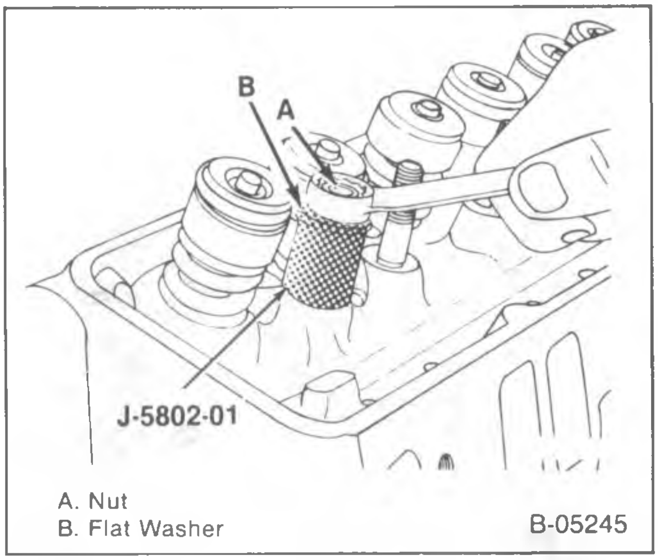


Figure 12—Removing The Rocker Arm Stud

NOTICE: Do not attempt to install an oversize rocker arm stud without reaming stud hole as this could damage the cylinder head.

- Ream the hole to the proper size for the replacement oversize rocker arm stud. Use J-5715 for 0.003-inch oversize studs; J-6036 for 0.013-inch oversize studs (figure 13).
- Coat lower end (press-fit area) of rocker arm stud with hypoid axle lubricant.

1. Rocker arm stud. Use J-6880 (figure 14). Stud is installed to proper depth when the tool bottoms on the cylinder head.
2. Rocker arm, as outlined previously.

Adjust

- Valves, as outlined previously.

3. Rocker arm cover, as outlined previously.

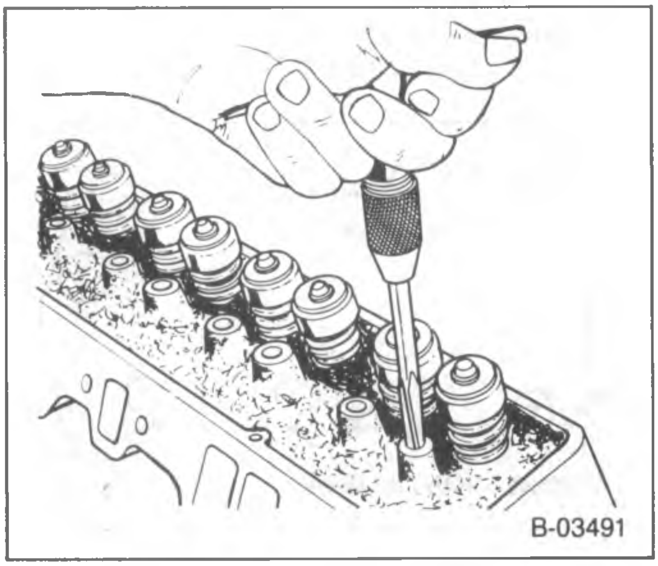


Figure 13—Reaming The Rocker Arm Stud Bore

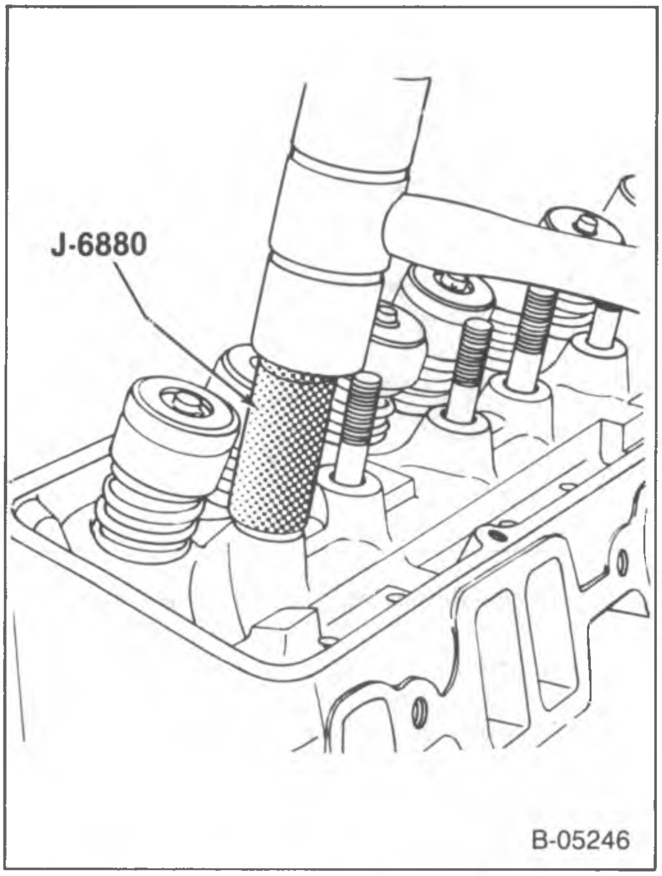


Figure 14—Installing The Rocker Arm Stud

EXHAUST MANIFOLD REPLACEMENT

↔ Remove or Disconnect

1. Battery negative cable.
2. Engine cover (G models).
- Raise the vehicle.
3. Exhaust pipe at the manifold.
- Lower the vehicle.
4. Oxygen sensor wire (if used) (left side manifold). Do not remove the oxygen sensor unless replacement is required.
5. AIR hose at the check valve.
6. AIR pipe bracket at the manifold stud (left side manifold).
7. Exhaust manifold bolts, washers, tab washers and spark plug heat shields, as equipped.
   - — Cast manifolds are retained by bolts, tab washers, and plain washers. Remove the outside bolts first, then the center bolts.
   - — Tubular (stainless steel) manifolds are retained by bolts and plain washers.
8. Exhaust manifold.

Clean

- — Mating surfaces on the manifold and head.
- — Threads on the exhaust manifold bolts.

→← Install or Connect

1. Exhaust manifold to the cylinder head.
2. Exhaust manifold fasteners and spark plug heat shields (where used).
   - — Cast manifolds: Install the flat washers against the manifold, then the tab washers and bolts.

     Tighten

     - Two center bolts to 36 N·m (26 ft. lbs.).
     - Outside bolts to 28 N·m (20 ft. lbs.).
     - Bend the tab washers against the bolt heads.
   - — Tubular (stainless steel) manifolds: Install the bolts and flat washers.

     Tighten

     - Bolts to 36 N·m (26 ft. lbs.).
3. AIR bracket at the manifold stud (left side manifold).
4. AIR hose at the check valve.
5. Oxygen sensor wire (if used).
- Raise the vehicle.
6. Exhaust pipe.
- Lower the vehicle.
7. Engine cover.
8. Battery negative cable.

CYLINDER HEAD REPLACEMENT

↔ Remove or Disconnect

1. Battery negative cable.
2. Engine cover (G models).
- Drain the cooling system.
3. Intake manifold, as outlined previously.
4. Generator, and lay aside.
5. Exhaust manifold, as outlined previously.
6. Air conditioning compressor and front bracket (if equipped). Lay the compressor aside.
7. Rocker arm cover, as outlined previously.
8. Spark plugs.
9. Pushrods, as outlined previously.
10. Cylinder head bolts.
11. Cylinder head.
12. Head gasket.

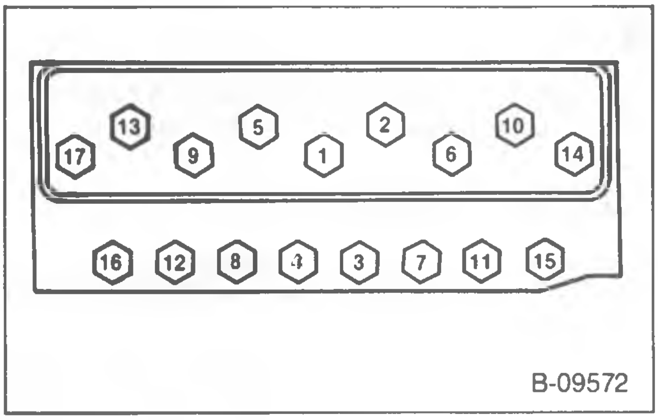


Figure 15—Cylinder Head Bolt Tightening Sequence

Clean

— Carbon deposits from combustion chambers.

— All traces of old head gasket from cylinder head and block.

— Cylinder head bolt threads and threads in the block.

Inspect

- Sealing surfaces of the block and cylinder head for nicks, heavy scratches, or other damage.

Cylinder Head Repair

- Refer to the proper Unit Repair Manual.

Install or Connect (Figure 15)

1. Head gasket.
    - If a steel gasket is used, coat both sides of the gasket with sealer. Spread the sealer thin and even.
    - Do not use sealer on composition seal-asbestos gaskets.
    - Place the gasket over the block dowel pins with the bead up.
2. Cylinder head. Carefully guide the cylinder head into place over the dowel pins and gasket.
3. Cylinder head bolts. Coat threads of the cylinder head bolts with sealing compound (GM part number 1052080 or equivalent) and install finger-tight.

Tighten

- Cylinder head bolts, a little at a time, using the sequence shown in figure 15. Proper torque is 90 N·m (65 ft. lbs.).

4. Pushrods, as outlined previously.

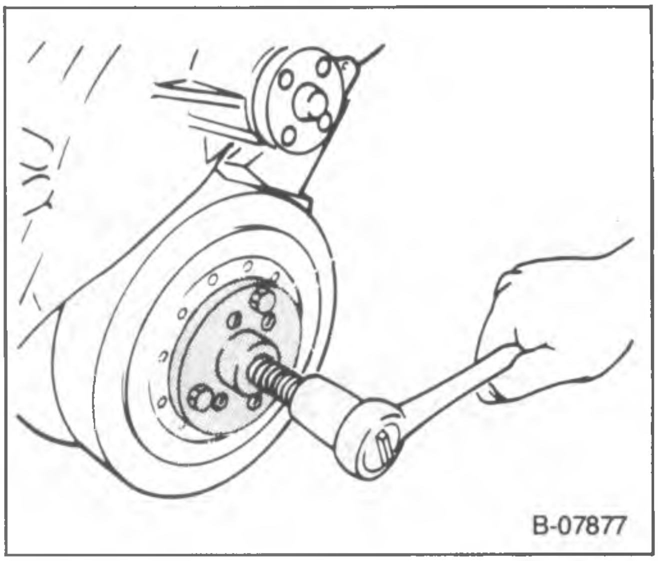


Figure 16—Removing The Torsional Damper

Adjust

- Valves, as outlined previously.

5. Rocker arm cover, as outlined previously.
6. Spark plugs.
7. Air conditioning compressor and front bracket (if equipped).
8. Exhaust manifold, as outlined previously.
9. Generator.
10. Intake manifold, as outlined previously.
11. Engine cover (G models).
12. Battery negative cable.

- Fill the cooling system with the proper quantity and grade of coolant.

TORSIONAL DAMPER AND FRONT CRANKSHAFT SEAL REPLACEMENT

Remove or Disconnect (Figure 16)

Tool Required:

J-23523-E Torsional Damper Puller and Installer

1. Fan belts, fan, and pulley.
2. Fan shroud assembly.
3. Accessory drive pulley.
4. Torsional damper bolt.
5. Torsional damper. Use J-23523-E (figure 16).
6. Front crankshaft seal. Pry out with a large screwdriver. Take care not to distort the timing cover.
7. Crankshaft key, if necessary.

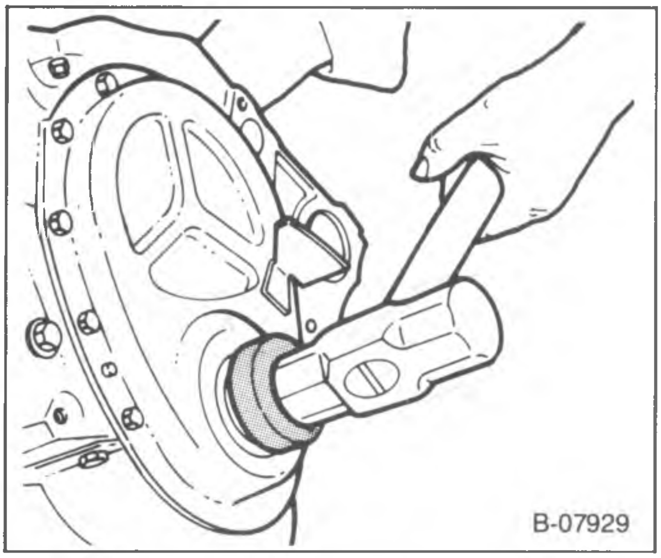


Figure 17—Installing The Front Crankshaft Oil Seal

Inspect

- Oil seal contact area on the torsional damper shaft for grooving and roughness. Replace if necessary.

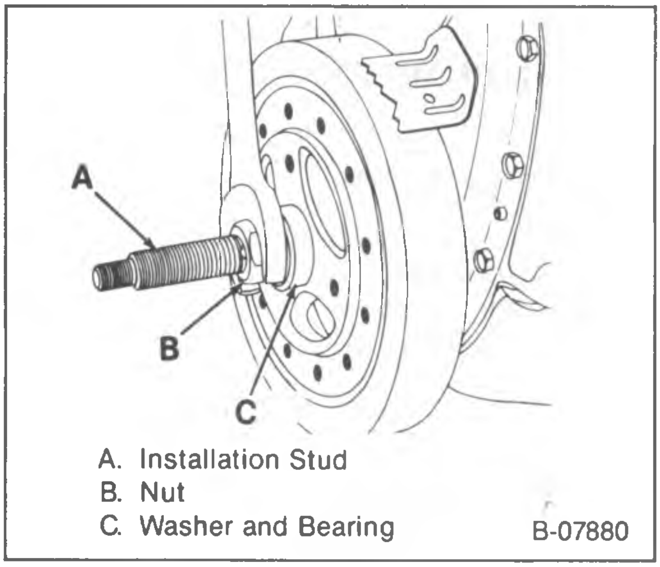
Install or Connect (Figures 17 and 18)

Tools Required:

J-23042-A Seal Installer

J-23523-E Torsional Damper Puller and Installer

1. Crankshaft key, if removed.
2. Front crankshaft seal. Use J-23042-A (figure 17). The open end of the seal faces inside the engine. Coat the seal lips with engine oil.



A. Installation Stud
B. Nut
C. Washer and Bearing

Figure 18—Installing The Torsional Damper

NOTICE: The inertia weight section of the torsional damper is assembled to the hub with a rubber type material. The correct installation procedures (with the proper tool) must be followed or movement of the inertia weight section of the hub will destroy the tuning of the torsional damper.

3. Stud (item A, figure 18) to the crankshaft. Thread the stud fully into the tapped hole in the crankshaft.
4. Torsional damper over the end of the stud. Align the keyway in the torsional damper shaft with the crankshaft key.
5. Bearing, washer and nut (figure 18).
   - Turn the nut to pull the vibration damper into place.
   - Remove the tool.
6. Torsional damper bolt and washer.

Tighten

- Bolt to 95 N·m (70 ft. lbs.).

7. Accessory drive pulley.
8. Fan shroud assembly.
9. Fan pulley, fan, and fan belts.

FRONT COVER REPLACEMENT

Remove or Disconnect

1. Torsional damper, as outlined previously.
2. Water pump.
3. Front cover bolts.
4. Front cover.
5. Front cover to block gasket.
6. Front crankshaft seal from the front cover. Pry out with a screwdriver. Take care not to distort the front cover.

Clean

- Old gasket from the front cover and block.

Inspect

— Exposed portion of the one-piece oil pan gasket that contacts the front cover. Inspect for cracks, tears, heat checking, and deterioration. If the gasket is in good condition, it can be re-used. If it is unsuitable for reuse, the oil pan gasket should be replaced.

— Front cover for distortion and damage. Replace if necessary.

Install or Connect (Figure 19)

Tool Required:

J-23042-A Seal Installer

1. Front crankshaft seal. Use J-23042-A (figure 19). The open end of the seal faces inside the engine. Coat the seal lips with engine oil.
2. Front cover gasket to the front cover. Use gasket cement to hold it in place.
3. Front cover to the engine. Press the cover down against the oil pan until the block dowel pins align with the holes in the cover. Position the cover against the block so that the dowels enter the cover holes without binding. Do not force the cover over the holes. Do not distort the cover flange or dowel pin holes. Hold the front cover in this position and install the front cover to block bolts.

Tighten

- Front cover to block bolts to 11.3 N·m (100 in. lbs.).

4. Water pump.
5. Torsional damper, as outlined previously.

OIL PAN REPLACEMENT

A one piece type oil pan gasket is used.

Remove or Disconnect (Figure 20)

1. Battery negative cable.
- Raise the vehicle.
- Drain the engine oil.
2. Exhaust crossover pipe.
3. Flywheel/torque converter cover.
4. Strut rods at the engine mountings (K models with automatic transmissions).
5. Oil pan bolts, nuts, and reinforcements.
6. Oil pan and gasket.

Clean

- Gasket surfaces on the engine and oil pan.

Inspect

- Oil pan gasket for damage. Replace if necessary.

Install or Connect (Figure 20)

1. A small amount of RTV sealant (GM part number 1052751 or equivalent) to the front and rear corners of the oil pan.

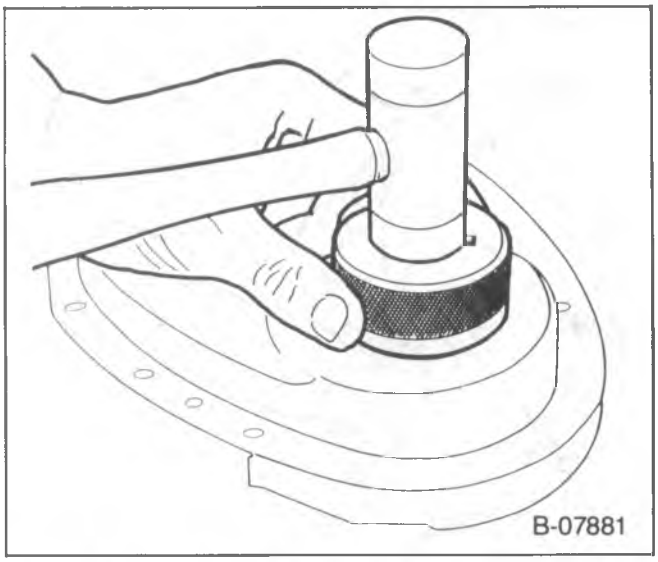


Figure 19—Installing The Front Crankshaft Oil Seal

Important

- Only a small amount of sealant is required. Excessive amounts of sealant may prevent proper sealing of the oil pan.

2. Oil pan gasket to the oil pan.
3. Oil pan to the engine.
4. Oil pan bolts, nuts, and reinforcements.

Tighten

— Oil pan bolts to 11.3 N·m (100 in. lbs.).
— Oil pan nuts to 22.6 N·m (200 in. lbs.).

5. Strut rods at the engine mount (K models with automatic transmissions).
6. Flywheel/torque converter cover.
7. Exhaust crossover pipe.
- Lower the vehicle.
8. Proper quantity and grade of engine oil.
9. Battery negative cable.

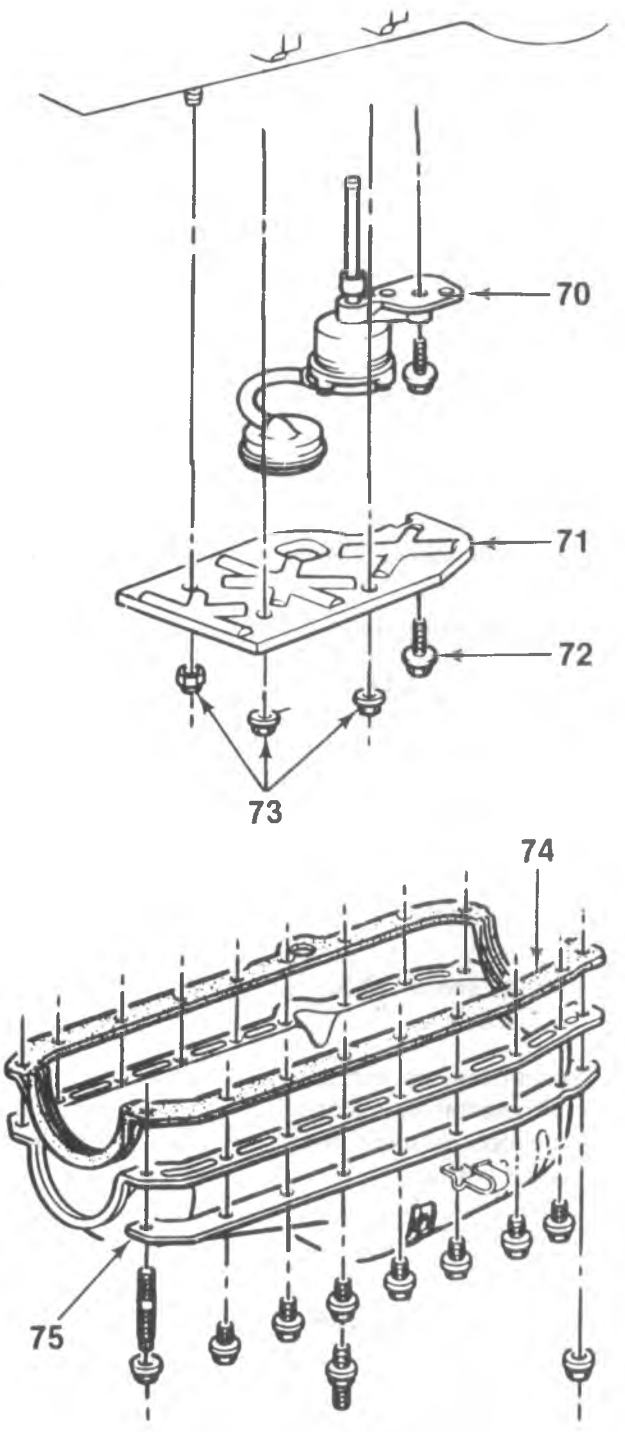
OIL PUMP REPLACEMENT

Remove or Disconnect (Figure 20)

1. Oil pan, as outlined previously.
2. Nuts (73) (if equipped).
3. Bolt (72).
4. Oil pump (70) and baffle (71) (if equipped).

Inspect

- Oil pump pickup tube for looseness. If the tube is loose in the oil pump body, replace it, as outlined in the proper unit repair manual. A loose pickup tube can result in an air leak and loss of oil pressure.



70. Oil Pump
71. Baffle (Some 5.7L Engines)
72. Bolt
73. Nut (Some 5.7L Engines)
74. Gasket
75. Reinforcement

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Figure 20—Oil Pan Installation

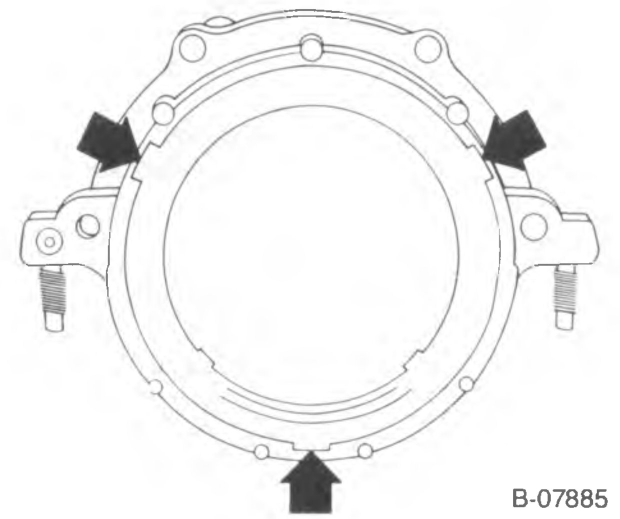


Figure 21—Seal Removal Notches

Oil Pump Repair

- Refer to the proper unit repair manual.

→← Install or Connect (Figure 20)

1. Oil pump to the engine. Align the slot in the oil pump shaft with the tang on the distributor shaft. The oil pump should slide easily into place. No gasket is used.
2. Baffle (71) (if equipped) and bolt (72).

Tighten

- Bolt (72) to 90 N·m (65 ft. lbs.).

3. Nuts (73) (if equipped).

Tighten

- Nuts (73) to 36 N·m (26 ft. lbs.).

4. Oil pan, as outlined previously.

REAR CRANKSHAFT OIL SEAL REPLACEMENT

←→ Remove or Disconnect (Figure 21)

1. Transmission.
2. Clutch and flywheel or flexplate, as equipped.

NOTICE: Care should be taken when removing the rear crankshaft oil seal so as not to nick the crankshaft sealing surface.

3. Rear crankshaft oil seal. Insert a screwdriver into the notches provided in the seal retainer and pry the seal out (Figure 21).

Install or Connect (Figure 22)

Tool Required:
J-35621 Seal Installer

1. Rear crankshaft oil seal (figure 22).
   - Lubricate the inner and outer diameter of the seal with engine oil.
   - Install the seal on J-35621.
   - Position J-35621 against the crankshaft. Thread the attaching screws into the tapped holes in the crankshaft.
   - Tighten the screws securely with a screwdriver. This will ensure that the seal is installed squarely over the crankshaft.
   - Turn the handle until it bottoms.
   - Remove J-35621.
2. Clutch and flywheel or flexplate, as equipped.
3. Transmission.

REAR CRANKSHAFT OIL SEAL RETAINER REPLACEMENT

Remove or Disconnect (Figures 21 and 23).

1. Transmission.
2. Clutch and flywheel or flexplate, as equipped.
3. Oil pan, as outlined previously.
4. Screws (84).
5. Seal retainer (81).
6. Gasket (83).
7. Rear crankshaft oil seal. Insert a screwdriver into the notches provided in the seal retainer and pry the seal out (figure 21).

Clean

- Gasket surfaces on block and seal retainer.

Install or Connect (Figure 23)

- Whenever the seal retainer is removed, a new retainer gasket and rear crankshaft oil seal must be installed.

1. Gasket (83) to the block. It is not necessary to use sealant to hold the gasket in place.
2. Seal retainer (81).
3. Screws (84).

Tighten

   - Screws (84) to 15.3 N·m (135 in. lbs.).

4. Oil pan, as outlined previously.
5. Rear crankshaft oil seal (80) as outlined previously.
6. Clutch and flywheel or flexplate, as equipped.
7. Transmission.

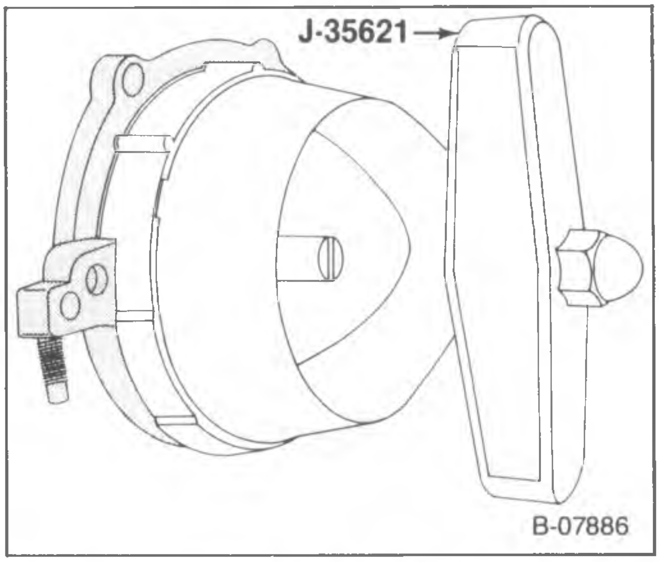


Figure 22—Installing The Rear Crankshaft Oil Seal

MEASURING CHAMSHAFT LOBE LIFT

Tool Required:

J-8520 Camshaft Lobe Lift Indicator

1. Remove the rocker arm as outlined previously.

2. Refer to figure 24. Position the dial indicator (part of J-8520) so the plunger rests on the pushrod end, as shown. Make sure the pushrod is in the lifter socket.

3. Rotate the crankshaft slowly in the direction of normal rotation until the lifter is on the heel of the cam lobe. At this point, the pushrod will be in its lowest position.

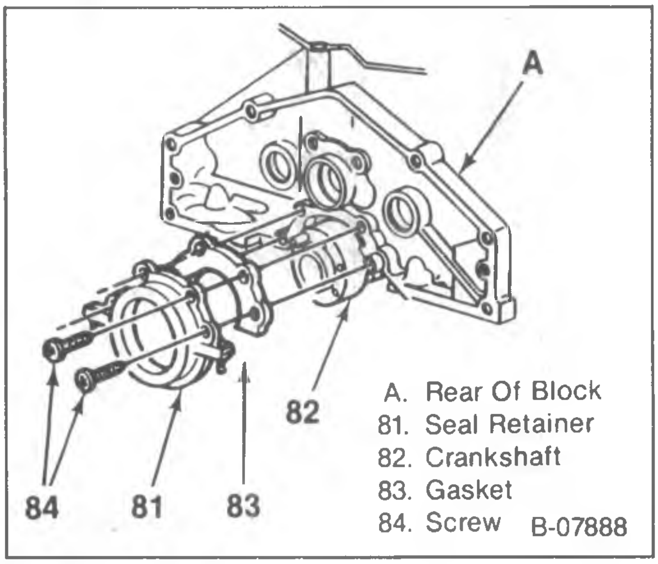


Figure 23—Rear Crankshaft Oil Seal Retainer Installation

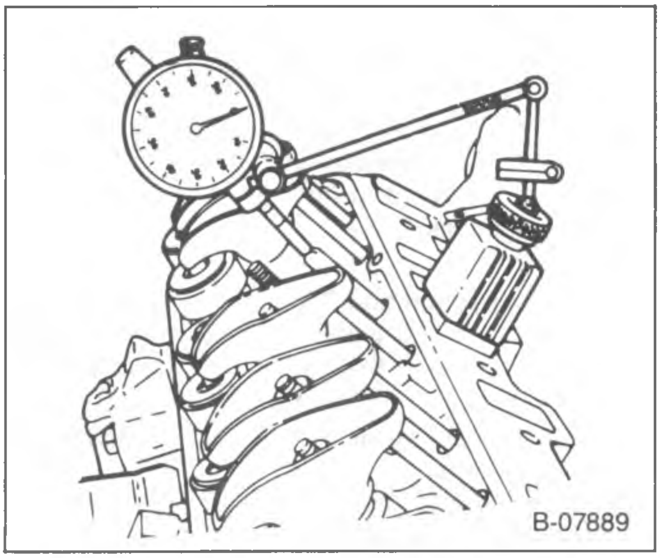


Figure 24—Measuring Camshaft Lobe Lift

4. Set dial indicator on zero, then rotate the crankshaft slowly, or attach an auxiliary starter switch and "bump" the engine over, until the pushrod is in fully raised position.

Important

- Whenever the engine is cranked remotely at the starter, with a special jumper cable or other means, the distributor primary lead should be disconnected from the distributor (coil).

5. Compare the total lift recorded from the dial indicator with specifications.
6. If camshaft readings for all lobes are within specifications, remove dial indicator assembly.
7. Install the rocker arm and adjust the valves as previously outlined.

CAMSHAFT REPLACEMENT

Remove or Disconnect (figures 25, 26, and 27)

Tool Required:

J-5825 Crankshaft Sprocket Puller

1. Battery negative cable.
2. Engine cover (G models).
3. Air cleaner.
4. Grille (G models).
5. Air conditioning condenser from its mounting and swing it forward (G models).
6. Fan, shroud, and radiator. Refer to ENGINE COOLING (SEC. 6B).
7. Generator.
8. Rocker arm covers, as outlined previously.
9. Fuel line.
10. Water pump. Refer to ENGINE COOLING (SEC. 6B).

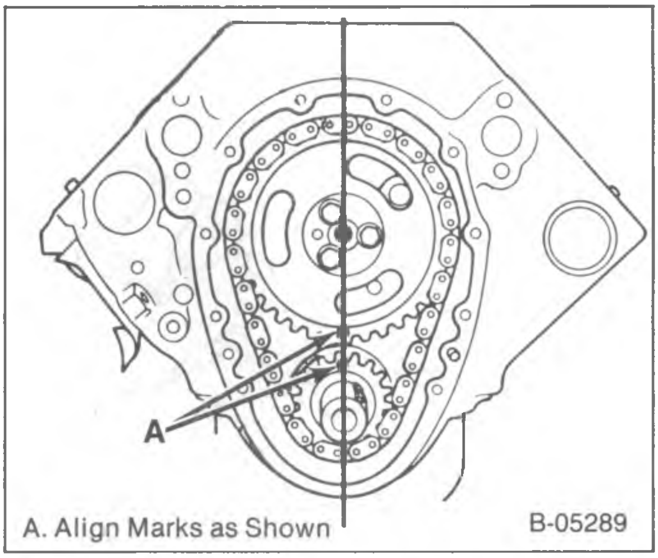


Figure 25—Timing Marks

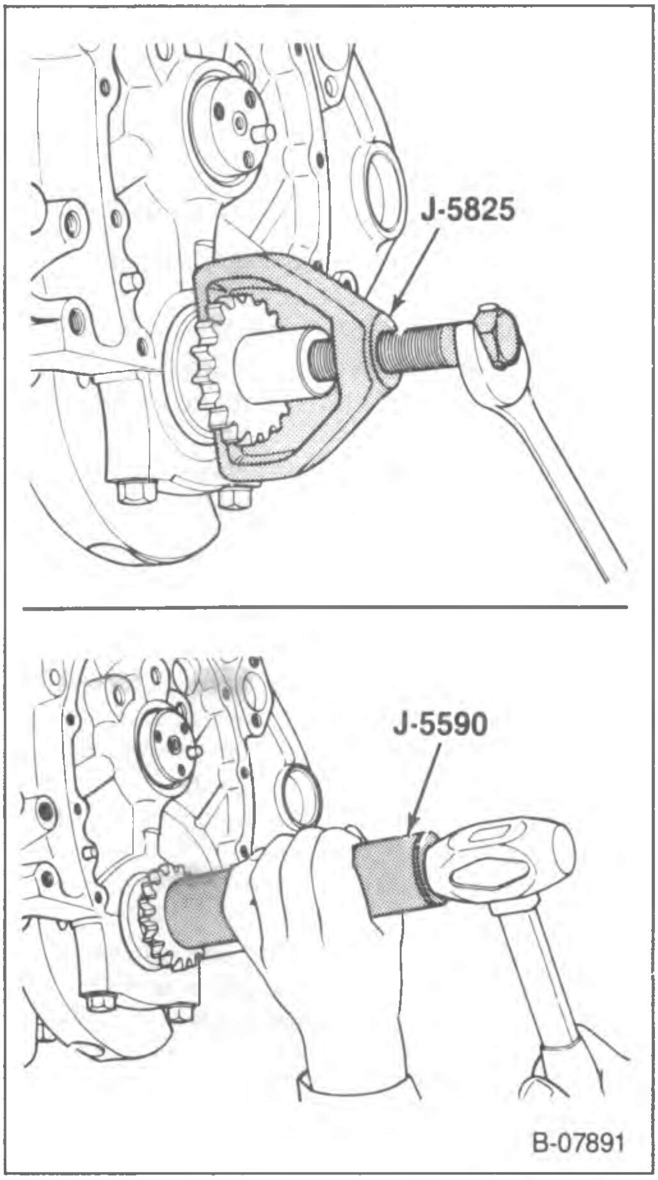


Figure 26—Replacing The Crankshaft Sprocket

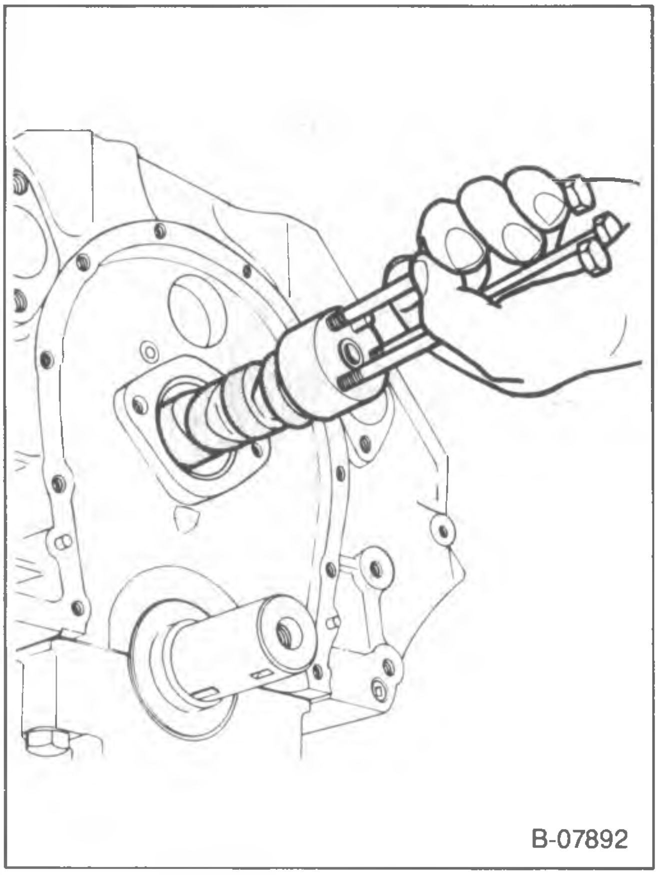


Figure 27—Replacing The Camshaft

11. Torsional damper, as outlined previously.
12. Front cover, as outlined previously.
13. Distributor. Refer to ENGINE ELECTRICAL (SEC. 6D).
14. Intake manifold, as outlined previously.
15. Pushrods and hydraulic lifters, as outlined previously.
16. Fuel pump and pushrod.
- Align the timing marks (figure 25).
17. Camshaft sprocket bolts.
18. Camshaft sprocket and timing chain. The sprocket is a light interference fit on the camshaft. Tap the sprocket on its lower edge to loosen it.
19. Crankshaft sprocket (if required). Use J-5825 (figure 26).
20. Front engine mounting through bolts.

NOTICE: When raising or supporting the engine for any reason, do not use a jack under the oil pan, any sheet metal or crankshaft pulley. 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 pickup unit.

21. Camshaft
    - Install two or three 5/16–18 bolts 100–125 mm (4–5 inches) long into the camshaft threaded holes. Use these bolts to handle the camshaft (figure 27).
    - Pull the camshaft from the block. Use care to prevent damage to the camshaft bearings.

Cleaning Inspection and Repair

Clean, inspect and repair or replace the camshaft and related components, as outlined in the proper unit repair manual.

The unit repair manual also describes camshaft bearing replacement.

Install or Connect (Figures 25 through 27 and 35 through 38)

Tool Required:

J-5590 Crankshaft Sprocket Installer

- Coat the camshaft lobes and journals with a high quality engine oil supplement (GM Engine Oil Supplement or equivalent).

1. Two or three 5/16–18 bolts 100–125 mm (4–5 inches) long into the camshaft threaded holes. Use these bolts to handle the camshaft.
2. Camshaft to the engine (figure 27). Handle the camshaft carefully to prevent damage to the camshaft bearings.
- Lower the engine.
3. Engine mount through-bolts.

Tighten

- Through-bolts to specifications. Refer to figures 35 through 38.

4. Crankshaft sprocket (if removed). Use J-5590 (figure 26). Make sure the timing mark faces outside.
5. Camshaft sprocket and timing chain.

Important

- Line up the timing marks on the camshaft sprocket and crankshaft sprocket (figure 25).

6. Camshaft sprocket bolts.

Tighten

- Bolts to 24 N·m (18 ft. lbs.).

7. Fuel pump and pushrod.
8. Hydraulic lifters and pushrods, as outlined previously.

Important

- Replace all hydraulic lifters and add GM Engine Oil Supplement (or equivalent) to the engine oil whenever a new camshaft is installed.

Adjust

- Valves, as outlined previously.

9. Intake manifold, as outlined previously.
10. Distributor. Refer to ENGINE ELECTRICAL (SEC. 6D).
11. Front cover, as outlined previously.
12. Torsional damper, as outlined previously.
13. Water pump. Refer to ENGINE COOLING (SEC. 6B).
14. Fuel line.
15. Rocker arm covers, as outlined previously.
16. Generator.
17. Fan, shroud, and radiator. Refer to ENGINE COOLING (SEC. 6B).
18. Air conditioning condenser (G models).
19. Grille (G models).
20. Air cleaner.
21. Engine cover (G models).
22. Battery negative cable.

- Fill the cooling system with the proper quantity and grade of coolant.

CONNECTING ROD AND PISTON REPLACEMENT

Remove or Disconnect (Figure 28)

Tool Required:
J-5239 Guide Set

1. Cylinder head, as outlined previously.
2. Oil pan, as outlined previously.
3. Oil pump, as outlined previously (if necessary).
4. Ridge or deposits from the upper end of the cylinder bores.
   - Turn the crankshaft until the piston is at BDC.
   - Place a cloth on top of the piston.
   - Perform the cutting operation with a ridge reamer.
   - Turn the crankshaft until the piston is at TDC.
   - Remove the cloth and cuttings.
5. Connecting rod cap. Check the connecting rod and cap for identification marks. Mark the parts if required. The connecting rod and cap must be kept together as mating parts.
6. Connecting rod and piston.

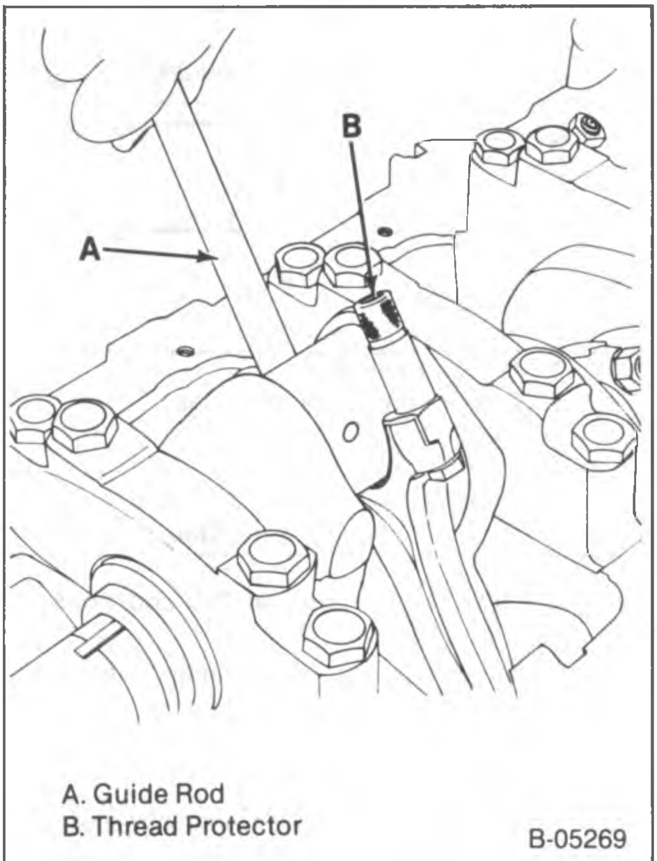


Figure 28—Replacing The Piston and Connecting Rod

- Attach J-5239 to the connecting rod bolts (figure 28).
- Use the long guide rod of J-5239 to push the connecting rod and piston out of the bore.

7. Connecting rod bearing.

Cleaning, Inspection, and Repair

Clean, inspect and repair or replace the components as necessary. Measure connecting rod bearing clearance, piston clearance, ring clearances, etc. Refer to the proper unit repair manual.

The unit repair manual contains information on:

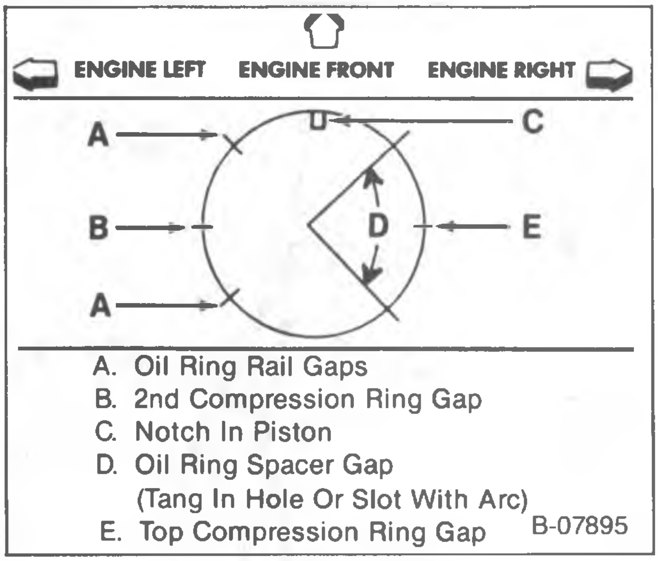
— Connecting rod and piston.
— Piston rings.
— Connecting rod and crankpin.
— Cylinder bores.

Install or Connect (Figures 28 through 31)

Tools Required:
J-5239 Connecting Rod Guide Set
J-8037 Ring Compressor

- Make sure the cylinder walls are clean. Lubricate the cylinder wall lightly with engine oil.
- Make sure the piston is installed in the matching cylinder.

1. Connecting rod bearings.



A. Oil Ring Rail Gaps
B. 2nd Compression Ring Gap
C. Notch In Piston
D. Oil Ring Spacer Gap
(Tang In Hole Or Slot With Arc)
E. Top Compression Ring Gap

Figure 29—Piston Ring End Gap Locations

- Be certain that the bearings are of the proper size.
- Install the bearings in the connecting rod and connecting rod cap.
- Lubricate the bearings with engine oil.

2. Piston and connecting rod to the proper bore.
   - With the connecting rod cap removed, install J-5239 onto the connecting rod studs.

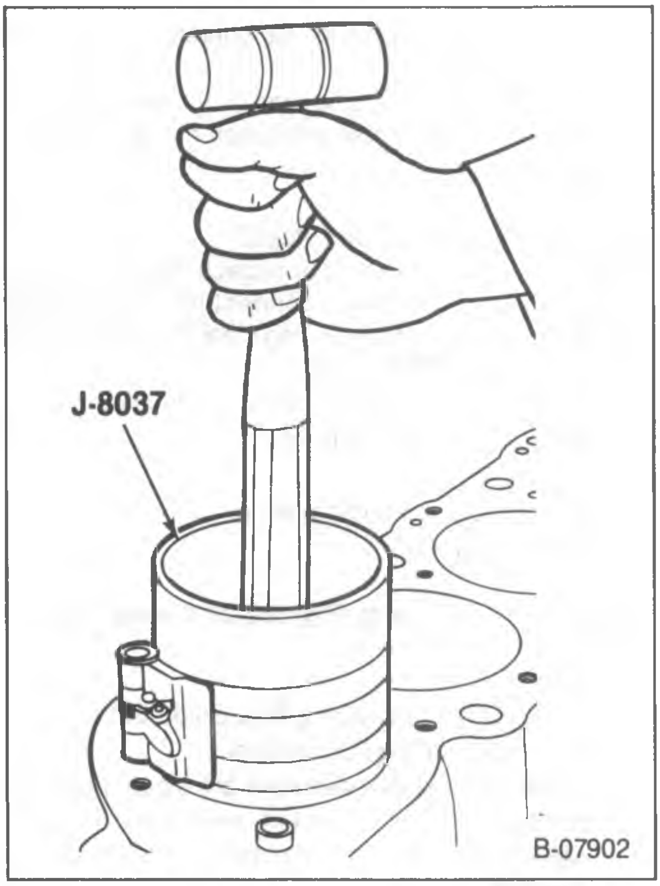


Figure 30—Installing The Piston

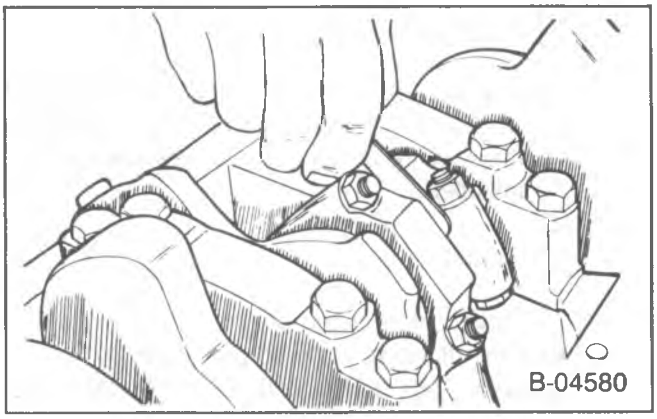


Figure 31—Measuring Connecting Rod Side Clearance

- Locate the piston ring end gaps as shown in figure 29. Lubricate the piston and rings.
- Without disturbing the ring end gap location, install J-8037 over the piston (figure 30).
- The piston must be installed so that the notch in the piston faces the front of the engine (figure 29).
- Place the piston in its matching bore. The connecting rod bearing tang slots must be on the side opposite the camshaft. Using light blows with a hammer handle, tap the piston down into its bore (figure 30). At the same time, from beneath the vehicle guide the connecting rod to the crankpin with J-5239 (figure 28). Hold the ring compressor against the block until all rings have entered the cylinder bore.
- Remove J-5239 from the connecting rod bolts.

Important

- Each connecting rod and bearing cap should be marked, beginning at the front of the engine. Cylinders 1, 3, 5 and 7 are the left bank and, 2, 4, 6, and 8 are the right bank. The numbers on the connecting rod and bearing cap must be on the same side when installed in the cylinder bore. If a connecting rod is ever transposed from one block or cylinder to another, new connecting rod bearings should be fitted and the connecting rod should be numbered to correspond with the new cylinder number.

Measure

- Connecting rod bearing clearance. Refer to the proper unit repair manual.

3. Connecting rod cap and bearing.
4. Connecting rod cap nuts.

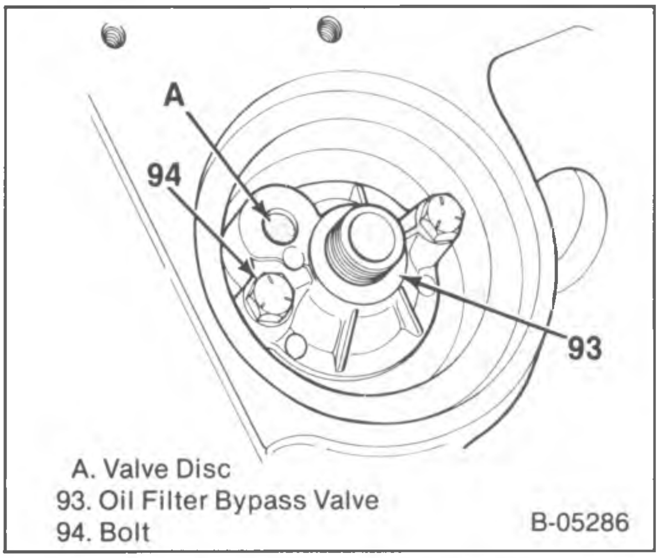


Figure 32—Oil Filter Bypass Valve

Tighten

- Connecting rod cap nuts to 60 N·m (45 ft. lbs.).

Measure

- Connecting rod side clearance. Use a feeler gage between the connecting rods (figure 31). The correct clearance is 0.006–0.014-inch.

5. Oil pump (if removed), as outlined previously.
6. Oil pan and cylinder head, as outlined previously.

OIL FILTER BYPASS VALVE

Remove or Disconnect (Figure 32)

1. Oil filter.

Inspect

- Bypass valve spring and valve disc for proper operation, cracks, and damage. If replacement is needed, the oil filter bypass valve (93) must be replaced, as follows:

2. Bolts (94).
3. Oil filter bypass valve.

Clean

- Valve chamber in the block.

Install or Connect (Figure 32)

1. Oil filter bypass valve (93).
2. Bolts (94).

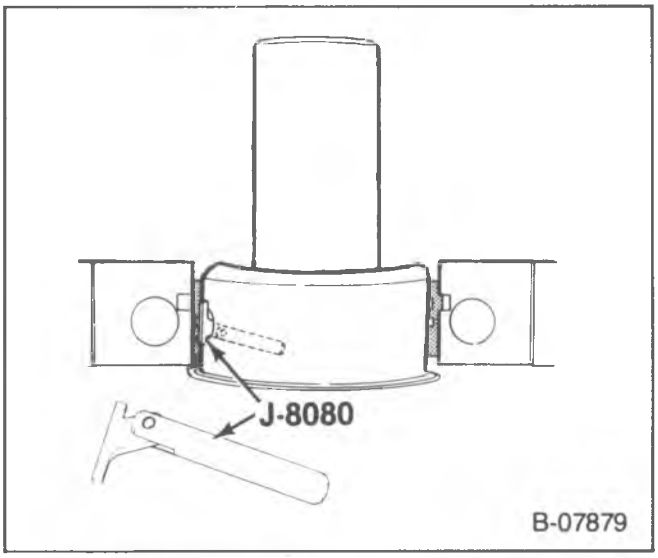


Figure 33—Removing The Main Bearing Insert

Tighten

- Bolts (94) to 26 N·m (20 ft. lbs.).

3. Oil filter.
4. Engine oil, as needed.

MAIN BEARING REPLACEMENT

Remove or Disconnect (Figure 33)

Tool Required:
J-8080 Main Bearing Remover/Installer

1. Spark plugs.
2. Oil pan, as outlined previously.
3. Oil pump, as outlined previously.
4. Main bearing caps.
    - Check the main bearing caps for location markings. Mark the caps if necessary. The caps must be returned to their original locations during assembly.
5. Lower main bearing inserts from the main bearing caps.
6. Upper main bearing inserts.
    - Insert J-8080 into the crankshaft oil hole (figure 33).
    - Rotate the crankshaft to "turn" the bearing insert out of the block.

Cleaning, Inspection, and Repair

Clean, inspect, and repair or replace the components as required. Refer to the proper unit repair manual. The unit repair manual contains information on

- Crankshaft.
- Main and connecting rod bearings.

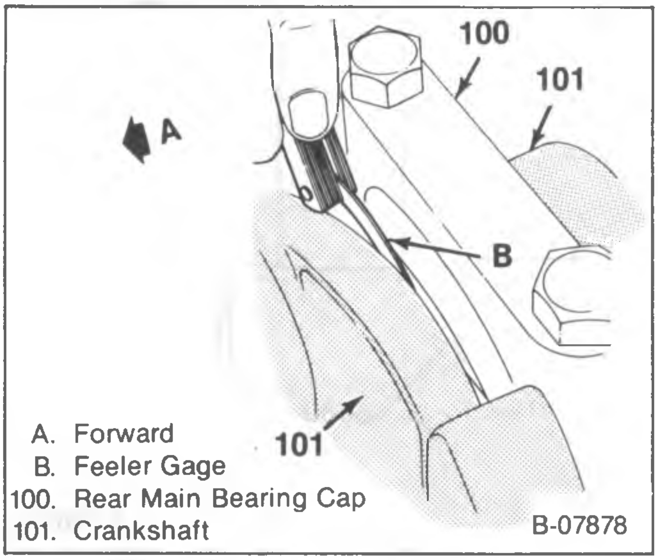


Figure 34—Measuring Crankshaft End Play

- Main bearing cap replacement (shimming procedure).

Install or Connect (Figures 33 and 34)

Tool Required:

J-8080 Main Bearing Remover/Installer

1. Upper main bearing inserts.
   - Insert tool J-8080 into a crankshaft main bearing oil hole (figure 33).
   - Apply engine oil to inserts of the proper size.
   - Insert the plain end (without the bearing tang) of the insert between the crankshaft and the notched side of the block.
   - Rotate the crankshaft to "roll" the insert into the block.
   - Remove the tool.
2. Lower main bearing inserts to the main bearing caps.
   - Make sure the inserts are of the proper size.
   - Apply engine oil to the inserts.

Measure

- Main bearing clearance. Refer to the proper unit repair manual. If the engine is 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.

3. Main bearing caps (except rear cap) and bolts to the block.

Tighten

- Main bearing cap bolts to specifications.
  - — Outer bolts on #2, #3, and #4 main bearing caps: 95 N·m (70 ft. lbs.).
  - — All others: 110 N·m (80 ft. lbs.).

4. Rear main bearing cap and bolts.

Tighten

- Rear main bearing cap bolts temporarily to 14 N·m (10 ft. lbs.).

Measure

- Crankshaft end play, as follows:
  - Tap the end of the crankshaft first rearward then forward with a lead hammer. This will line up the rear main bearing and crankshaft thrust surfaces.
  - Tighten the rear main bearing cap bolts to 110 N·m (80 ft. lbs.).
  - With the crankshaft forced forward, measure at the front end of the rear main bearing with a feeler gage (figure 34). The proper clearance is 0.002–0.006-inch.
  - If correct end play cannot be obtained, be certain that the correct size rear main bearing has been installed. Production engines may have rear main bearings that are 0.008-inch wider across the thrust faces than standard. Refer to the proper unit repair manual for more information.

8. Oil pump, as outlined previously.
9. Oil pan, as outlined previously.
10. Spark plugs.

CRANKSHAFT REPLACEMENT

Remove or Disconnect (Figure 28)

Tool Required:
J-5239 Guide Set

1. Engine, as outlined later.
2. Flywheel (if used) as outlined later.
   - Mount the engine in a suitable engine stand.
3. Spark plugs.
4. Torsional damper, as outlined previously.
5. Front cover, as outlined previously.
6. Camshaft sprocket and timing chain.
7. Oil pan and oil pump, as outlined previously.
8. Rear crankshaft oil seal retainer, as outlined previously.

9. Connecting rod caps. Check the connecting rod and cap for identification marks. Mark the parts if necessary. The connecting rod and cap are mating parts.
10. Connecting rods from the crankshaft.
    - Attach J-5239 to the connecting rod bolts (Figure 28).
    - Use the long guide rod to push the pistons up in the bores.
11. Main bearing caps. Check the main bearing caps for location markings. Mark the parts if necessary. The main bearing caps must be returned to their original locations at assembly.
12. Crankshaft.
13. Main bearing inserts.

Cleaning, Inspection, and Repair

- Clean, inspect, and repair or replace the parts as outlined in the proper unit repair manual. Refer to the unit repair manual for information on:
  - — Crankshaft.
  - — Main and connecting rod bearings.
  - — Procedures for measuring bearing clearances.

Install or Connect (Figures 25, 28, 31, and 34)

Tool Required:

J-5239 Guide Set

1. Upper main bearing inserts to the block. Apply engine oil to the main bearings.
2. Crankshaft.
3. Lower main bearing inserts to the main bearing caps. Apply engine oil to the bearing inserts.

Measure

- Main bearing clearance. Refer to the proper unit repair manual.

4. Main bearing caps (except rear cap) and bolts to the block.

Tighten

- Main bearing cap bolts to specifications.
  - — Outer bolts on #2, #3, and #4 main bearing caps: 95 N·m (70 ft. lbs.).
  - — All others: 110 N·m (80 ft. lbs.).

5. Rear main bearing cap and bolts to the block.

Tighten

- Rear main bearing cap bolts temporarily to 14 N·m (10 ft. lbs.).

Measure

- Crankshaft end play, as follows:
  - Tap the end of the crankshaft first rearward then forward with a lead hammer. This will line up the rear main bearing and crankshaft thrust surfaces.
  - Tighten the rear main bearing cap bolts to 110 N·m (80 ft. lbs.).
  - With the crankshaft forced forward, measure at the front end of the rear main bearing with a feeler gage (figure 34). The proper clearance is 0.002–0.006-inch.
  - If correct end play cannot be obtained, be certain that the correct size rear main bearing has been installed. Production engines may have rear main bearings that are 0.008-inch wider across the thrust faces than standard. Refer to the proper unit repair manual for more information.

Inspect

- Crankshaft for binding. Try turning the crankshaft to check for binding. If the crankshaft does not turn freely, loosen the main bearing cap bolts, one pair at a time, until the tight bearing is located. Burrs on the bearing cap, foreign matter between the insert and the block or the bearing cap, or a faulty insert could cause a lack of clearance at the bearing.

6. Connecting rods to the crankshaft. Use J-5239 to pull the connecting rods down (figure 28). Make sure the connecting rod bearing insert stays in place.

Measure

- Connecting rod bearing clearance. Refer to the proper unit repair manual.

7. Connecting rod caps with bearing inserts to the connecting rods. Apply engine oil to the inserts.
8. Connecting rod cap nuts.

Tighten

- Connecting rod cap nuts to 60 N·m (45 ft. lbs.).

Measure

- Connecting rod side clearance. Use a feeler gage between the connecting rods (figure 31). The correct clearance is 0.006–0.014-inch.

9. Rear oil seal retainer with new crankshaft rear oil seal, as outlined previously.
10. Camshaft sprocket and timing chain.

Important

- Align the timing marks (figure 25).

11. Front cover, as outlined previously.
12. Oil pan and oil pump, as outlined previously.
13. Torsional damper, as outlined previously.
14. Spark plugs.
15. Flywheel (if used), as outlined later.
16. Engine, as outlined later.

FLYWHEEL REPLACEMENT

Remove or Disconnect

1. Transmission, flywheel housing, and clutch.
2. Flywheel bolts.
3. Flywheel.

Clean

- Mating surfaces of crankshaft and flywheel. Remove any burrs.

Inspect

- — Flywheel for burning, scoring, warping, and wear. Replace the flywheel if necessary. Do not machine the flywheel.
- — Flywheel ring gear for worn or broken teeth.

Flywheel Ring Gear Replacement

1. Use a torch to heat the gear around the entire circumference, then drive the gear off the flywheel, using care not to damage the flywheel.

NOTICE: Never heat starter gear to red heat as this will change metal structure.

2. Uniformly heat the flywheel gear to temperature which will expand the gear to permit installation. Temperature must not exceed 204°C (400°F).
3. As soon as the gear has been heated, install on the flywheel.

Install or Connect

1. Flywheel.
2. Flywheel bolts.

Tighten

- Flywheel bolts to 100 N·m (75 ft. lbs.).

3. Clutch, flywheel housing, and transmission.

ENGINE MOUNTINGS

NOTICE: Broken or deteriorated mountings can cause misaligned and eventual destruction of certain drive train components. When a single mounting breakage occurs, the remaining mountings are subjected to abnormally high stresses.

INSPECTING ENGINE MOUNTINGS

Front Engine Mountings

NOTICE: When raising or supporting the engine for any reason, do not use a jack under the oil pan, any sheet metal or crankshaft pulley. 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 pickup unit.

1. Raise the engine to remove weight from the mountings and to place a slight tension on the rubber cushion. Observe both mountings while raising the engine.
2. Replace the mounting if the following conditions exist:
   - — Hard rubber surface covered with heat check cracks.
   - — Rubber cushion separated from the metal plate of the mounting.
   - — Rubber cushion split through the center.
3. If there is movement between a metal plate of the mounting and its attaching points, lower the engine and tighten the bolts or nuts attaching the mounting to the engine, frame, or bracket.

Rear Mountings

1. Push up and pull down on the transmission tailshaft. Observe the transmission mounting.
2. Replace the mounting if the following conditions exist:
   - — Rubber cushion separated from the metal plate of the mounting.

   - — Mounting bottomed out (tailshaft can be moved up but not down).

3. If there is relative movement between a metal plate of the mounting and its attaching point, tighten the bolts or nuts attaching the mounting to the transmission or crossmember.

FRONT MOUNTING REPLACEMENT

Remove or Disconnect (Figures 35 through 38)

NOTICE: When raising or supporting the engine for any reason, do not use a jack under the oil pan, any sheet metal or crankshaft pulley. 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 pickup unit.

- Support the engine with a suitable jack. Do not load the engine mounting.

1. Engine mounting through-bolt and nut.

NOTICE: Raise the engine only enough for sufficient clearance. Check for interference between the rear of the engine and the dash panel which could cause distributor housing damage.

- Raise the engine only enough to permit removal of the engine mounting.

2. Mounting assembly bolts, nuts, and washers.
3. Mounting assembly.

Install or Connect (Figures 35 through 38)

1. Mounting assembly.

NOTICE: See "Notice" on page 6A5-1 of this section.

2. Mounting assembly bolts, nuts, and washers.

Tighten

- Fasteners to specifications. Refer to figures 35 through 38.

3. Engine mount through-bolt and nut. Lower the engine until the bolt can be inserted. Install the nut.

Tighten

- Through-bolt nut to specifications. Refer to figures 35 through 38.

REAR MOUNTING REPLACEMENT (EXCEPT P-MODELS WITH FLYWHEEL HOUSING MOUNTING)

Remove or Disconnect (Figures 39 through 42)

NOTICE: When raising or supporting the engine for any reason, do not use a jack under the oil pan, any sheet metal or crankshaft pulley. 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 pickup unit.

- Support the rear of the engine to relieve the weight on the rear mountings.

1. Mounting to crossmember nut(s) and washer(s).
2. Mounting to transmission bolts and washers.

- Raise the rear of the engine only enough to permit removal of the mounting.

3. Mounting.

Install or Connect (Figures 39 through 42)

1. Mounting.

- Lower the rear of the engine.

2. Mounting to transmission bolts and washers.

NOTICE: See "Notice" on page 6A5-1 of this section.

3. Mounting to crossmember nut(s) and washer(s).

Tighten

- Fasteners to specifications. Refer to figures 39 through 42.

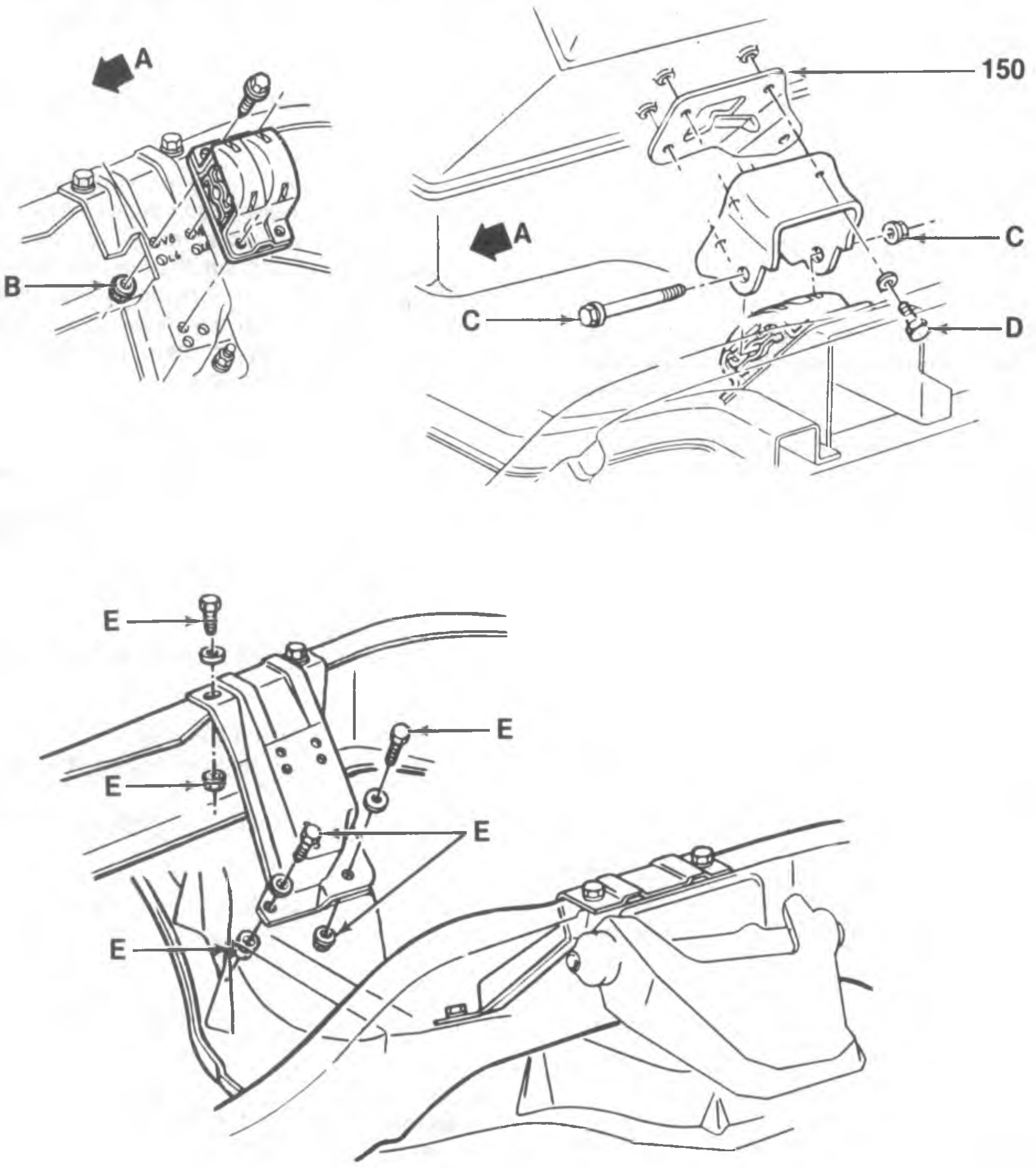
REAR MOUNTING REPLACEMENT (P MODELS WITH FLYWHEEL HOUSING MOUNTING)

Remove or Disconnect (Figure 43)

1. Bolt, cushion, and spacer.

NOTICE: When raising or supporting the engine for any reason, do not use a jack under the oil pan, any sheet metal or crankshaft pulley. 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 pickup unit.

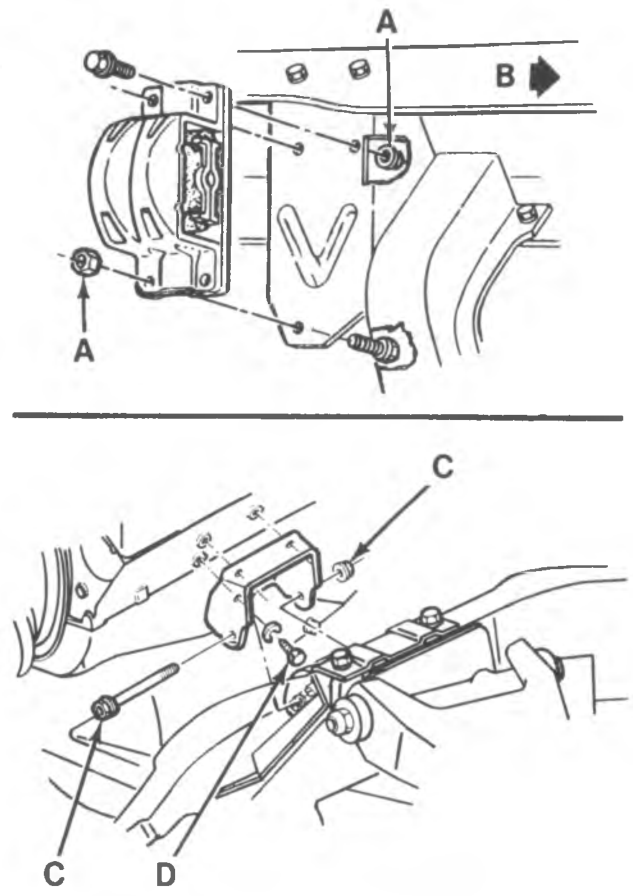
- Raise the rear of the engine only enough to permit removal of the mounting.



A. Forward
B. 40 N·m (30 Ft. Lbs.)
C. Torque Bolt To 115 N·m (85 Ft. Lbs.) Or, Torque Nut
To 75 N·m (55 Ft. Lbs.)
D. 48 N·m (36 Ft. Lbs.)
E. Torque Bolt To 48 N·m (36 Ft. Lbs.) Or, Torque Nut To 40 N·m (30 Ft. Lbs.)
150. Transmission Strut Bracket (Automatic Transmission) Or Spacer (Manual Transmission)

B-07917

Figure 35—Front Engine Mounting (C Models)



A. 40 N·m (30 Ft. Lbs.)
B. Forward
C. Torque Bolt To 115 N·m (85 Ft. Lbs.) Or, Torque Nut To 75 N·m (55 Ft. Lbs.)
D. 48 N·m (36 Ft. Lbs.)

B-07918

Figure 36—Front Engine Mounting (K Models)

2. Engine mounting.

Install or Connect (Figure 43)

1. Engine mounting. Align the hole in the mounting with the hole in the crossmember.

- Lower the engine.

NOTICE: See "Notice" on page 6A5-1 of this section.

2. Spacer, cushion, and bolt.

Tighten

- Bolt to 90 N·m (65 ft. lbs.).

ENGINE REPLACEMENT

"C" AND "K" MODELS

Remove or Disconnect

1. Battery negative cable.
2. Hood.
- Drain the cooling system.
3. Air cleaner.
4. All accessory drive belts.
5. Fan and water pump pulley.
6. Radiator and shroud. Refer to ENGINE COOLING (SEC. 1B).
7. Heater hoses at the engine.
8. Accelerator, cruise control, and detent linkage (if used) from carburetor.
9. Air conditioning compressor (if used) and lay aside.
10. Power steering pump (if used) and lay aside.
11. Engine wiring harness from the engine.
12. Fuel line at the fuel pump.
13. Vacuum lines from the intake manifold.
- Raise the vehicle.
- Drain the crankcase oil.
14. Exhaust pipes from the manifolds.
15. Strut rods at the engine mountings ("K" models with automatic transmission).
16. Flywheel or torque converter underpan.
17. Wiring along oil pan rail.
18. Starter.
19. Wiring for fuel gage.
20. Converter to flex plate bolts.
- Lower the vehicle.
- Support the transmission.
- Attach a suitable lifting fixture.
21. Bell housing to engine bolts.
22. Front engine mounting to frame bolts.
23. Engine.

Install or Connect (Figures 35 and 36)

1. Engine to the vehicle.
- Raise the vehicle.

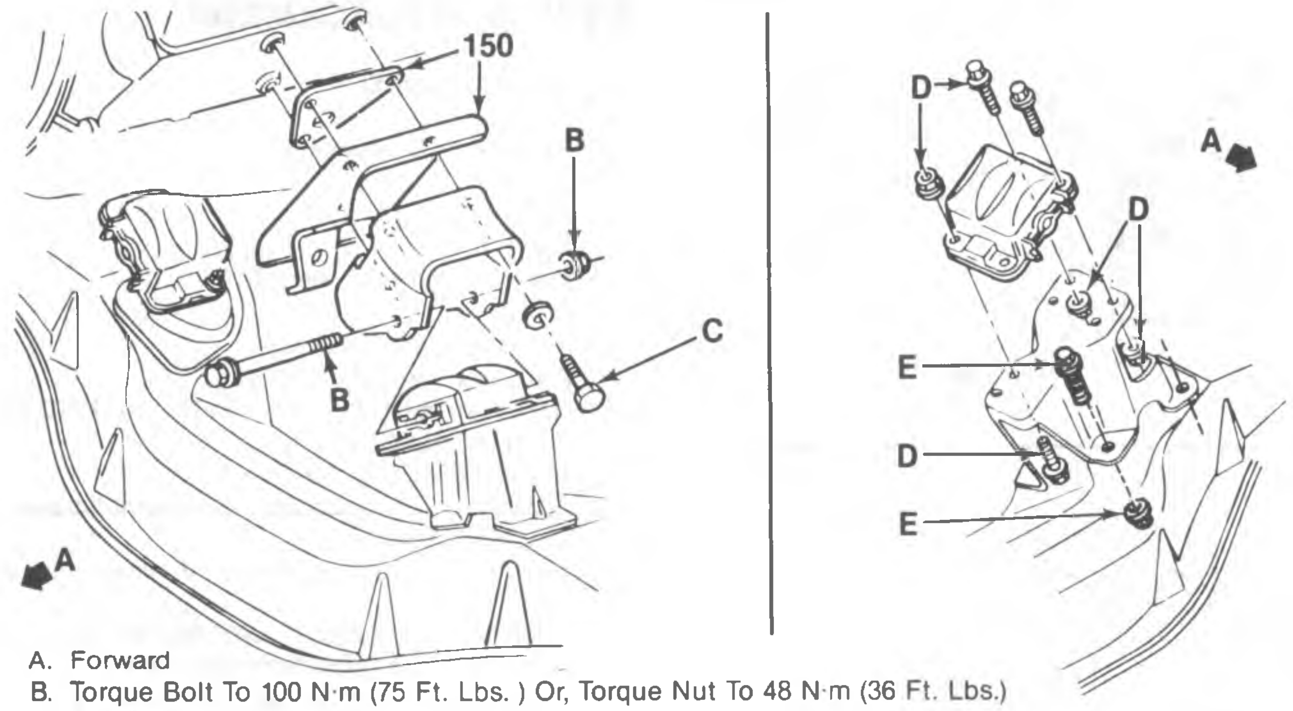
NOTICE: See "Notice" on page 6A5-1 of this section.

2. Front engine mounting to frame bolts.

Tighten

- Fasteners to specifications. Refer to figures 35 and 36.

3. Bell housing to engine bolts. Remove the transmission support.
4. Converter to flex plate bolts.
5. Fuel gage wiring.



A. Forward
B. Torque Bolt To 100 N·m (75 Ft. Lbs.) Or, Torque Nut To 48 N·m (36 Ft. Lbs.)
C. 48 N·m (36 Ft. Lbs.)
D. Torque Bolt To 52 N·m (38 Ft. Lbs.) Or, Torque Nut To 40 N·m (30 Ft. Lbs.)
E. Torque Bolt Or Nut to 40 N·m (30 Ft. Lbs.)
150. Spacer OR Power Steering Pump Bracket (Left Side Only)

B-07919

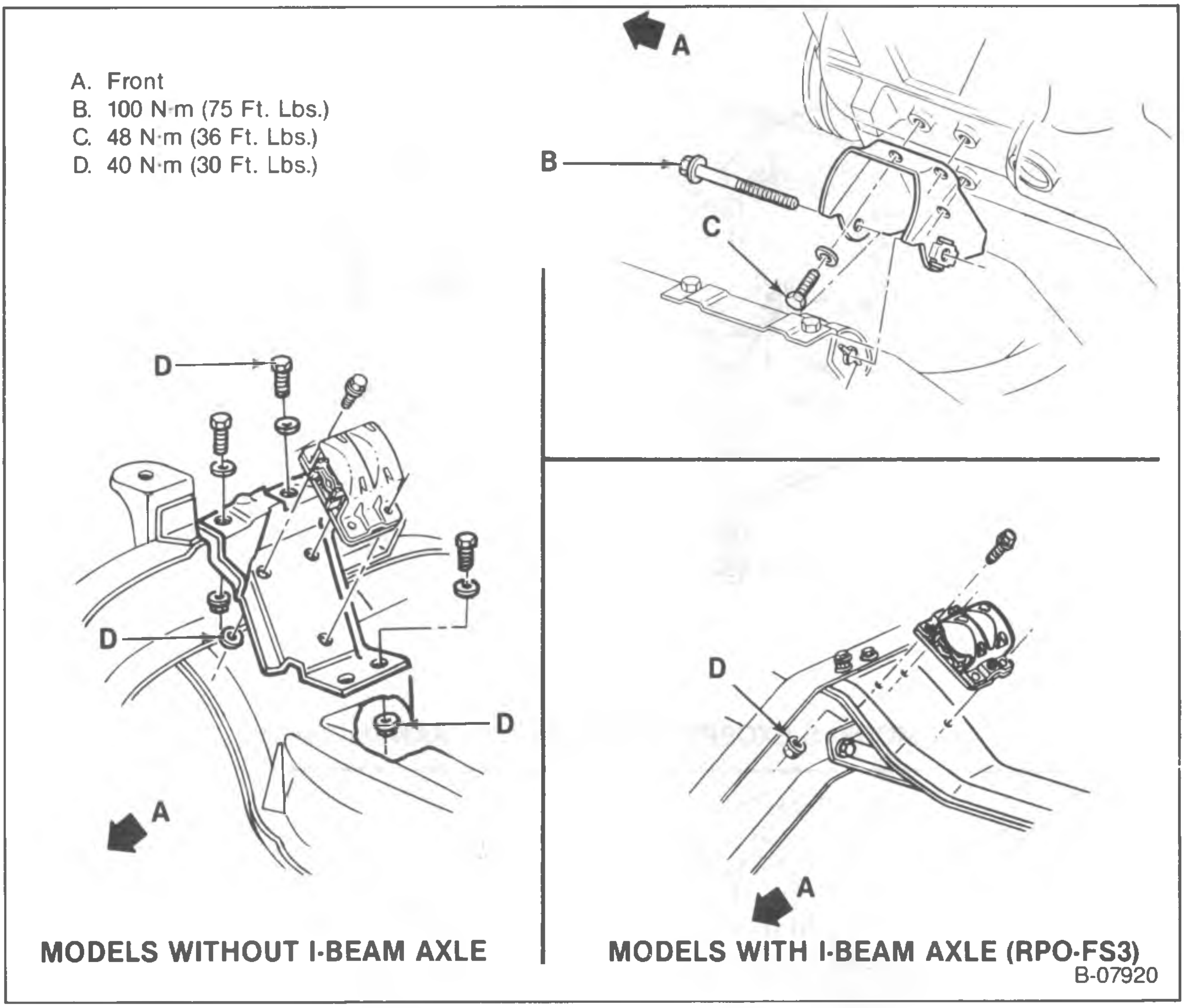
Figure 37—Front Engine Mounting (G Models)

6. Starter.
7. Wiring along oil pan rail.
8. Flywheel or torque converter underpan.
9. Strut rods at the engine mountings (K models with automatic transmission).
10. Exhaust pipes to the manifolds.
- Lower the vehicle.
11. Vacuum lines to the intake manifold.
12. Fuel line at the fuel pump.
13. Engine wiring harness.
14. Power steering pump (if used).
15. Air conditioning compressor (if used).
16. Accelerator, cruise control, and detent linkages.
17. Heater hoses.
18. Radiator and shroud. Refer to ENGINE COOLING (SEC. 1B).
19. Accessory drive belts.
20. Air cleaner.
21. Hood.
22. Proper quantity and grade of coolant and crankcase oil.
23. Battery negative cable.

G MODELS

↔ Remove or Disconnect

1. Battery negative cable.
- Drain the cooling system.
2. Coolant reservoir bottle.
3. Grille and lower grille valance.
4. Upper radiator support.
5. Air conditioning condenser. Refer to AIR CONDITIONING (SEC. 1B).
6. Radiator. Refer to ENGINE COOLING (SEC. 6B).
7. Power steering pump, and lay aside.
8. Engine cover.
9. Air cleaner.
10. Carburetor.
11. Engine wiring harness from the conductor on the dash panel.
12. Vacuum hoses and electrical wiring, as required.
13. Heater hoses at the engine.
14. Thermostat housing.
15. Oil filler tube.
16. Cruise control servo, bracket, and transducer (if equipped).
- Raise the vehicle.
17. Exhaust pipes at the exhaust manifolds.
18. Propeller shaft at the transmission. Plug the transmission end.



MODELS WITHOUT I-BEAM AXLE

MODELS WITH I-BEAM AXLE (RPO-FS3)

Figure 38—Front Engine Mounting (G Models)

19. Transmission shift linkage and speedometer cable.
20. Fuel and vapor return hoses at the engine.
   - Drain the engine oil.
21. Rear engine mounting bolts.

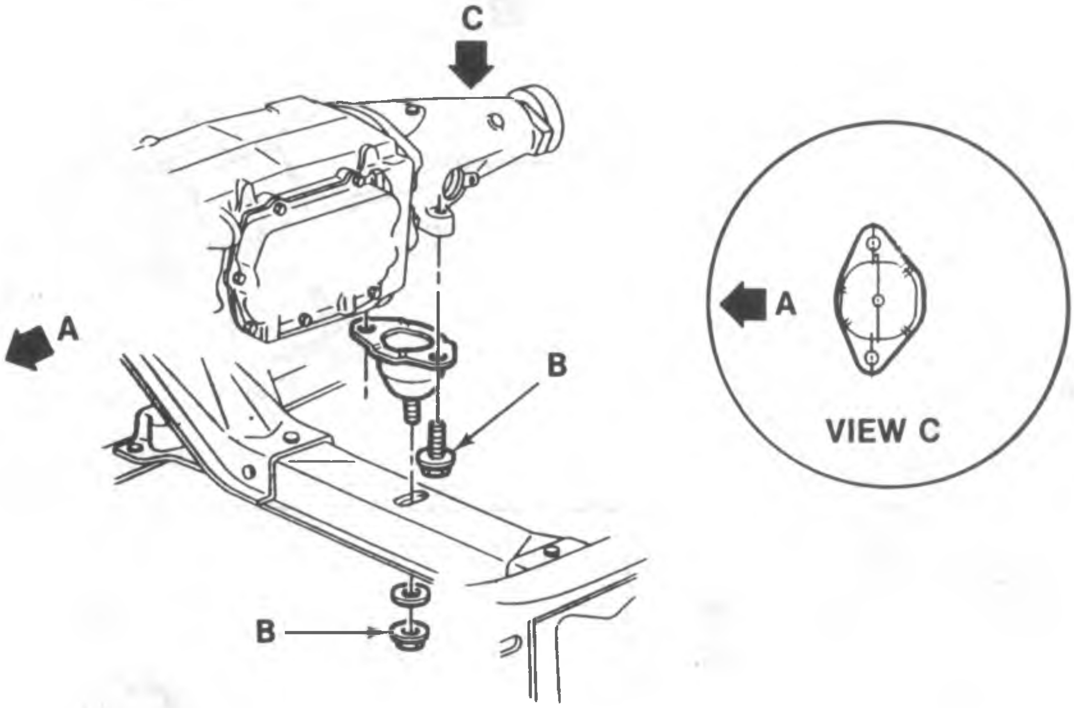
NOTICE: When raising or supporting the engine for any reason, do not use a jack under the oil pan, any sheet metal or crankshaft pulley. Due to the small clearance between the oil pan and the oil pump screen, jacking against the oil pan may cause it to be bent against the pump screen, resulting in a damaged oil pickup unit.

   - Support the engine with a suitable jack.
22. Front engine mounting bracket to frame bolts and nuts.
23. Front engine mounting through bolts.
24. Front engine mounting frame brackets. Raise the engine slightly to allow removal of the mounting bracket. Block the engine in place with wood blocks.

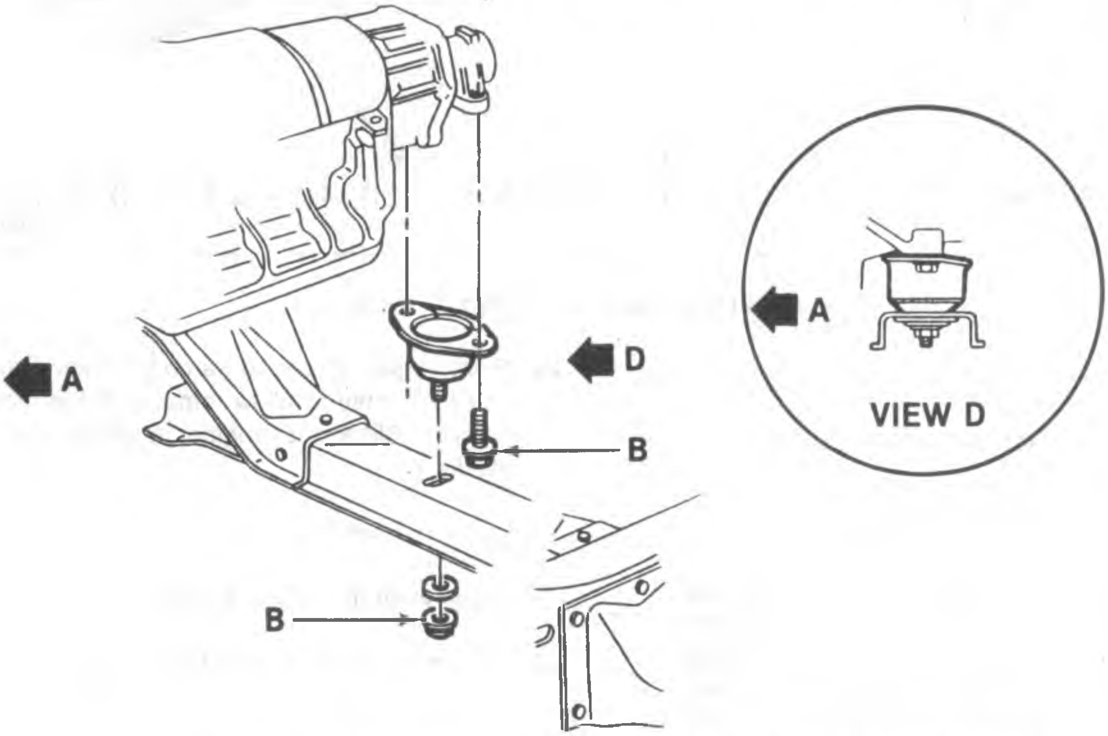
   - Lower the vehicle.

   - Install a suitable lifting fixture.

25. Engine and transmission from the vehicle.



ALL MODELS EXCEPT WITH THM 400 TRANSMISSION (RPO-M40)

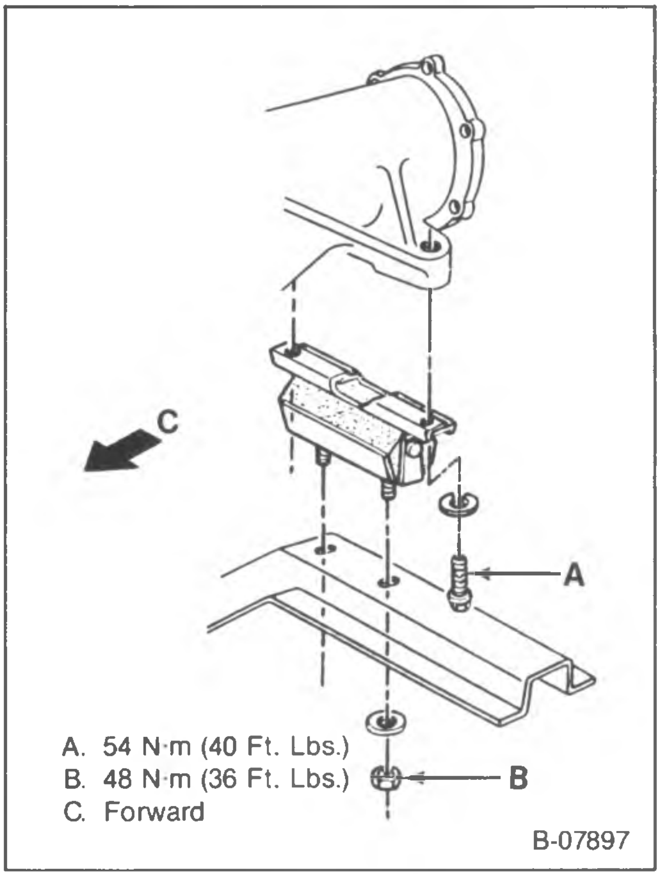


MODELS WITH THM 400 TRANSMISSION (RPO-M40)

A. Forward
B. 48 N·m (36 Ft. Lbs.)

B-07921

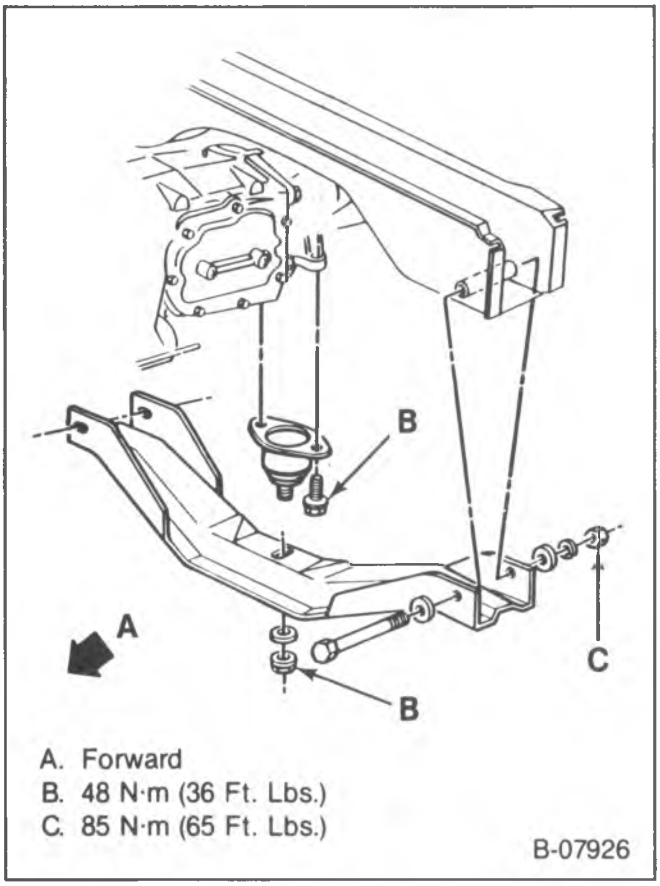
Figure 39—Rear Engine Mounting (C Models)



A. 54 N·m (40 Ft. Lbs.)
B. 48 N·m (36 Ft. Lbs.)
C. Forward

B-07897

Figure 40—Rear Engine Mounting (K Models)



A. Forward
B. 48 N·m (36 Ft. Lbs.)
C. 85 N·m (65 Ft. Lbs.)

B-07926

Figure 41—Rear Engine Mounting (G Models)

→← Install or Connect (Figure 37)

NOTICE: When raising or supporting the engine for any reason, do not use a jack under the oil pan, any sheet metal or crankshaft pulley. 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 pickup unit.

- Support the engine with a suitable jack.

NOTICE: See "Notice" on page 6A5-1 of this section.

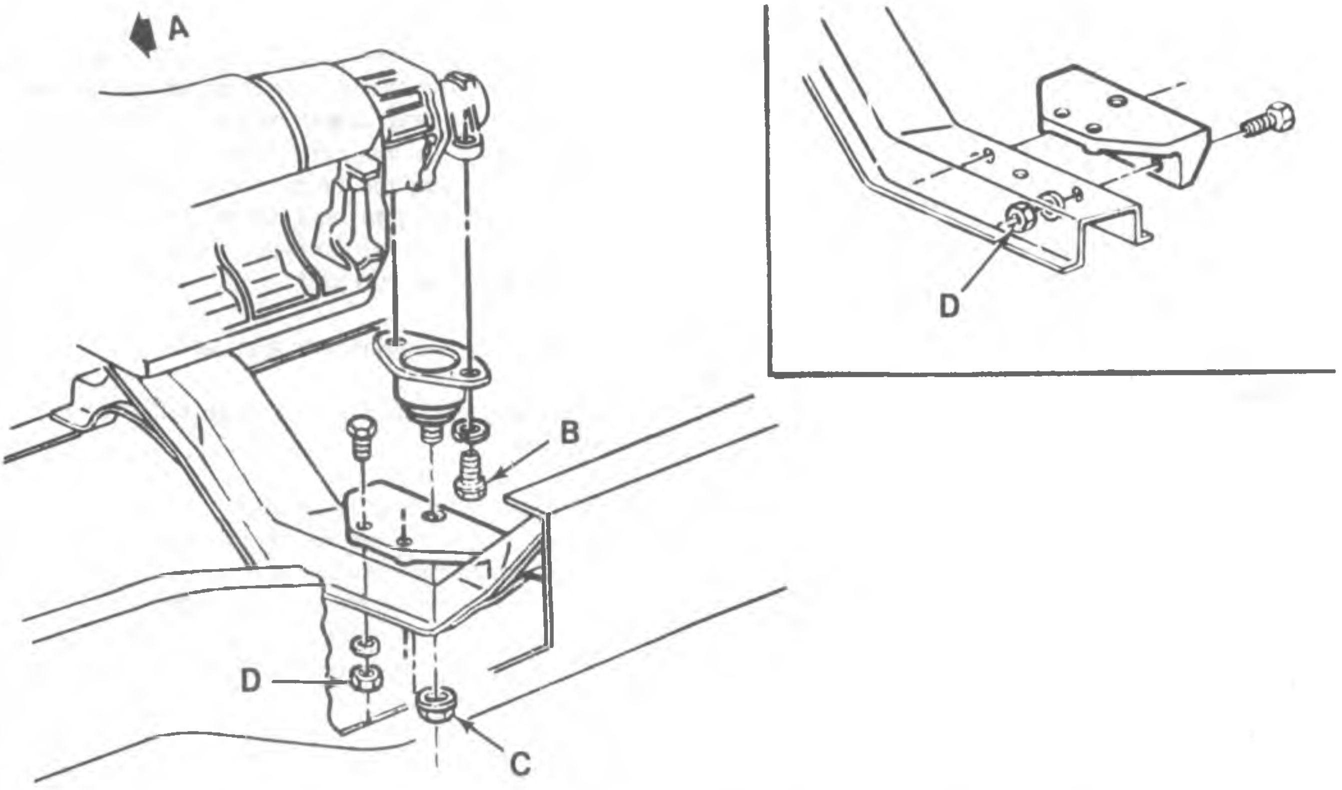
2. Engine mounting frame brackets.
    - Raise the engine slightly and position the brackets against the engine mountings.
    - Install the through-bolts finger tight.
    - Lower the engine.
    - Install the mounting bracket to frame bolts and nuts.

    Tighten

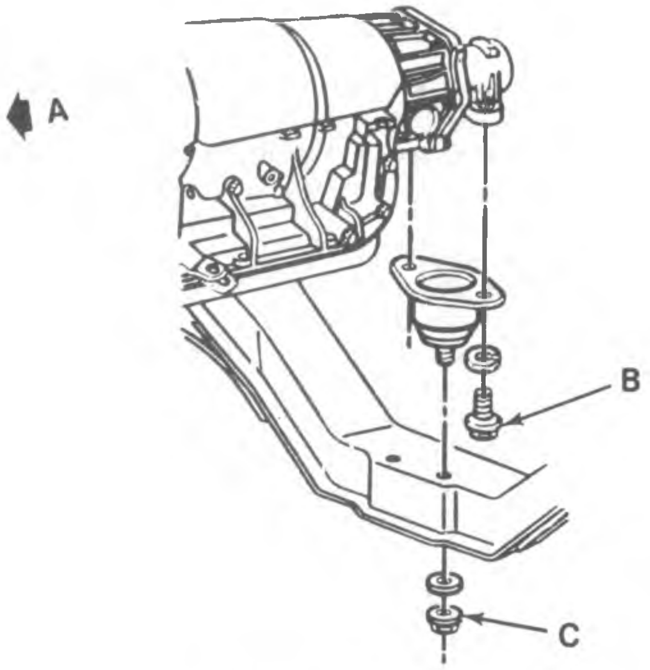
        - Engine mounting fasteners to specifications. Refer to figure 37.
    - Remove the jack.
3. Rear engine mounting bolts.

    Tighten

    - Engine mounting to transmission bolts to 48 N·m (36 ft. lbs.).
4. Fuel and vapor return lines.
5. Transmission shift linkage and speedometer cable.
6. Propeller shaft.
7. Exhaust pipes.
- Lower the vehicle.
8. Cruise control servo, bracket, and transducer (if equipped).
9. Oil filler tube.
10. Thermostat housing.
11. Heater hoses.
12. Vacuum hoses and electrical wiring.
13. Engine wiring harness connector.
14. Carburetor.
15. Air cleaner.
16. Power steering pump.
17. Radiator. Refer to ENGINE COOLING (SEC. 6B).
18. Air conditioning condenser (if equipped). Refer to AIR CONDITIONING (SEC. 1B).
19. Upper radiator support.
20. Grille and lower grille valance.
21. Coolant reservoir bottle.



MODELS WITH PROPSHAFT PARKING BRAKE



A. Forward
B. 68 N·m (50 ft. lbs.)
C. 48 N·m (36 ft. lbs.)
D. 60 N·m (44 ft. lbs.)

MODELS WITHOUT PROPSHAFT PARKING BRAKE

Figure 42—Rear Engine Mounting (P Models with Transmission Tail Type Mounting)

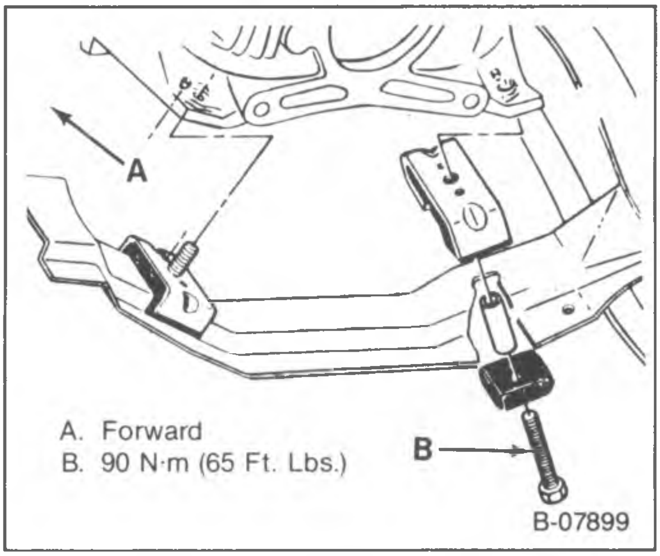


Figure 43—Rear Engine Mounting (P Models with Flywheel Housing Type Mounting)

22. Battery negative cable.
23. Proper quantities and grades of coolant and engine oil.
    - Evacuate and charge the air conditioning system. Refer to AIR CONDITIONING (SEC. 1B).

SPECIFICATIONS

ENGINE SPECIFICATIONS

All Specifications are in INCHES unless otherwise noted.

GENERAL DATA:							
Type				V8			
Displacement				5.0L (305 Cu. In.)		5.7L (350 Cu. In.)	
RPO (VIN Code)				LF3 (F)	LE9 (H)	LS9 (L)	LT9 (M)
Bore				3.736		4.00	
Stroke				3.480			
Compression Ratio				8.6:1	9.2:1	8.2:1	8.3:1
Firing Order				1 - 8 - 4 - 3 - 6 - 5 - 7 - 2			
Oil Pressure				10 psi @ 500 RPM; 30-55 psi @ 2000 RPM			
CYLINDER BORE:							
Diameter				3.7350-3.7385		3.9995-4.0025	
Out Of Round	Production			0.001 (Maximum)			
	Service			0.002 (Maximum)			
Taper	Production	Thrust Side		0.0005 (Maximum)			
		Relief Side		0.001 (Maximum)			
	Service			0.001 (Maximum)			
PISTON:							
Clearance	Production			0.0007-0.0017			
	Service Limit			0.0027 (Maximum)			
PISTON RING:							
COMPRESSION	Groove Clearance	Production	Top	0.0012-0.0032			
			2nd				
		Service Limit		Hi Limit Production +0.001			
	Gap	Production	Top	0.010-0.020			
			2nd	0.010-0.025			
		Service Limit		Hi Limit Production + 0.010			
OIL	Groove Clearance	Production		0.002-0.007			
		Service Limit		Hi Limit Production + 0.001			
	Gap	Production		0.015-0.055			
		Service Limit		Hi Production +0.010			
PISTON PIN:							
Diameter				0.9270-0.09273			
Clearance In Piston	Production			0.00025-0.00035			
	Service Limit			0.001 (Maximum)			
Fit In Rod				0.0008-0.0016 Interference			

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SPECIFICATIONS

ENGINE SPECIFICATIONS (CONT.)

All specifications are in INCHES unless otherwise noted.

DISPLACEMENT			5.0L (305 Cu. In.)	5.7L (350 Cu. In.)
CRANKSHAFT:				
Main Journal	Diameter	#1	2.4484-2.4493	
		#2, #3, #4	2.4481-2.4490	
		#5	2.4479-2.4488	
	Taper	Production	0.0002 (Maximum)	
		Service Limit	0.001 (Maximum)	
	Out Of Round	Production	0.0002 (Maximum)	
		Service Limit	0.001 (Maximum)	
Main Bearing Clearance	Production	#1	0.0008-0.0020	
		#2, #3, #4	0.0011-0.0023	
		#5	0.0017-0.0032	
	Service Limit	#1	0.0010-0.0015	
		#2, #3, #4	0.0010-0.0025	
		#5	0.0025-0.0035	
Crankshaft End Play			0.002-0.006	
Crankpin	Diameter		2.0988-2.0998	
	Taper	Production	0.0005 (Maximum)	
		Service Limit	0.001 (Maximum)	
	Out Round	Production	0.0005 (Maximum)	
		Service Limit	0.001 (Maximum)	
Rod Bearing Clearance	Production		0.0013-0.0035	
	Service Limit		0.003 (Maximum)	
Rod Side Clearance			0.006-0.014	
CAMSHAFT:				
Lobe Lift ± 0.002	Intake		0.2484	0.2600
	Exhaust		0.2667	0.2733
Journal Diameter			1.8682-1.8692	
Camshaft End Play			0.004-0.012	
VALVE SYSTEM:				
Lifter			Hydraulic	
Rocker Arm Ratio			1.50:1	
Valve Lash		Intake	One Turn Down From Zero Lash	
		Exhaust		
Face Angle (Intake & Exhaust)			45°	
Seat Angle (Intake & Exhaust)			46°	
Seat Runout (Intake & Exhaust)			0.002 (Maximum)	
Seat Width		Intake	1/32-1/16	
		Exhaust	1/16-3/32	
Stem Clearance	Production	Intake	0.0010-0.0027	
		Exhaust	0.0010-0.0027	
	Service	Intake	High Limit Production +0.001	
		Exhaust	High Limit Production +0.002	
Valve Spring (Outer)	Free Length		2.03	
	Pressure lbs. @ in.	Closed	76-84 lbs. @ 1.70"	
		Open	194-206 lbs. @ 1.25"	
	Installed Height ± 1/32"		1 23/32	
Valve Spring Damper	Free Length		1.86	
	Approx. # of Coils		4	

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SPECIFICATIONS (CONT.)

TORQUE SPECIFICATIONS

Item	N·m	Ft. Lbs.	In. Lbs.
Rocker Arm Cover Nuts	7.3	—	65
Rocker Arm Cover Bolt	6.2	—	55
Intake Manifold Bolts	48	36	—
Exhaust Manifold Bolts			
Cast Manifolds:			
Two Center Bolts:	36	26	—
All Others:	28	20	—
Tubular (Stainless Steel) Manifolds (All Bolts)	36	26	—
Cylinder Head Bolts	90	65	—
Torsional Damper Bolt	95	70	—
Front Cover Bolts	11.3	—	100
Oil Pan Nuts	22.6	—	200
Oil Pan Bolts	11.3	—	100
Oil Pump Bolt	90	65	—
Oil Pan Baffle Nuts (Some 5.7L Engines)	36	26	—
Rear Crankshaft Oil Seal Retainer Screws	15.3	—	135
Camshaft Sprocket Bolts	24	18	—
Connecting Rod Cap Nuts	60	45	—
Oil Filter Bypass Valve Bolts	26	20	—
Main Bearing Cap Bolts			
Outer Bolts on #2, #3, and #4 Caps	95	70	—
All Others	110	80	—
Oil Pump Cover Bolts	9.0	—	80
Flywheel Bolts	100	75	—
Spark Plugs	30	22	—
Water Outlet Bolts	28	21	—
Water Pump Bolts	40	30	—
Flywheel Housing Bolts	44	32	—

SPECIAL TOOLS

J-23590	Air Adapter
J-5892-A	Spring Compressor
J-23738-A	Vacuum Pump
J-3049	Hydraulic Lifter Remover (Plier Type)
J-9290-1	Hydraulic Lifter Remover (Slide Hammer Type)
J-5802-01	Rocker Arm Stud Remover
J-5715	Reamer (0.003-inch oversize)
J-6036	Reamer (0.013-inch oversize)
J-6880	Rocker Arm Stud Installer
J-23523-E	Torsional Damper Remover and Installer
J-23042-A	Front Crankshaft Seal Installer
J-35621	Rear Crankshaft Seal Installer
J-8520	Camshaft Lobe Lift Indicator
J-5239	Guide Set
J-8037	Ring Compressor
J-8080	Main Bearing Remover/Installer
J-5825	Crankshaft Sprocket Puller
J-5590	Crankshaft Sprocket Installer

SECTION 6A6

7.4 LITER V8

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 "NOTICE: See 'Notice' on page 6A6-1 of this section."

NOTICE: All engine 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 this part.

CONTENTS

DESCRIPTION

7.4L engines are 90-degree V8 type, overhead valve, water cooled, with cast iron block and heads.

The crankshaft is supported by five precision insert main bearings, with crankshaft thrust taken at the number five (rear) bearing.

The camshaft is supported by five plain type bearings and is chain driven. Motion from the camshaft is transmitted to the valves by hydraulic lifters, pushrods, and ball type rocker arms. The valve guides are integral in the cylinder head.

The connecting rods are forged steel, with precision insert type crankpin bearings. The piston pins are a press fit in the connecting rods.

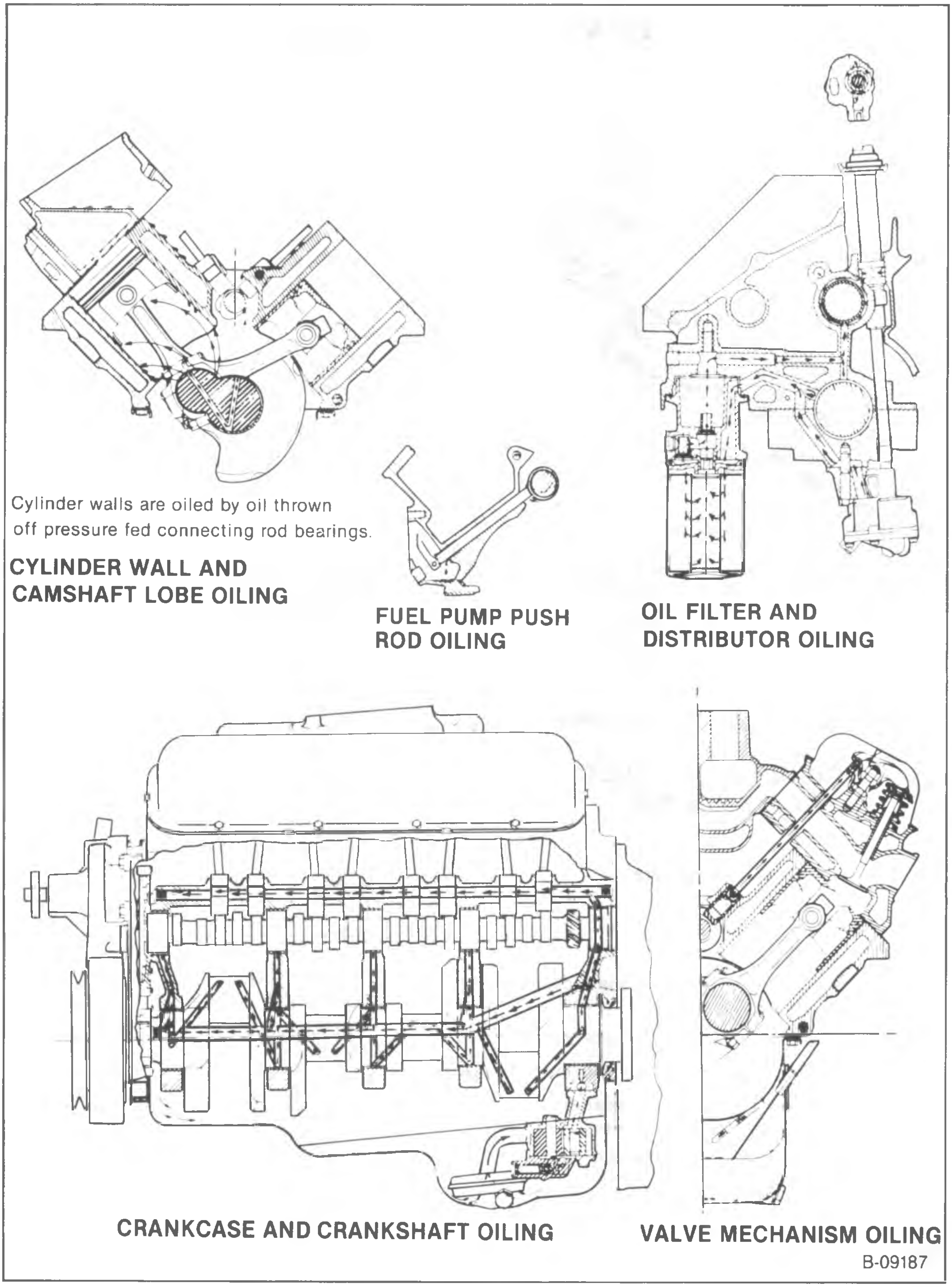
The pistons are cast aluminum alloy. The piston pins are a floating fit in the piston.

ENGINE LUBRICATION

Lubrication schematics are shown in Figure 1. The gear type oil pump is driven from the distributor shaft, which is gear driven from the camshaft. Oil is drawn into the oil pump through a pickup screen and pipe.

Pressurized oil is routed to the oil filter. In case of excessive oil pressure, a bypass valve is provided. Filtered oil flows into the main gallery and then to the camshaft and crankshaft bearings. The valve lifter oil gallery supplies oil to the valve lifters. Oil flows from the hydraulic lifters through the hollow pushrods to the rocker arms. Oil from the overhead drains back to the crankcase through oil drain holes.

The timing chain is drip fed from the front camshaft bearing. The pistons and piston pins are lubricated by oil splash.



Cylinder walls are oiled by oil thrown off pressure fed connecting rod bearings.

CYLINDER WALL AND CAMSHAFT LOBE OILING

FUEL PUMP PUSH ROD OILING

OIL FILTER AND DISTRIBUTOR OILING

CRANKCASE AND CRANKSHAFT OILING

VALVE MECHANISM OILING

Figure 1—Engine Lubrication Diagram

ON-VEHICLE SERVICE

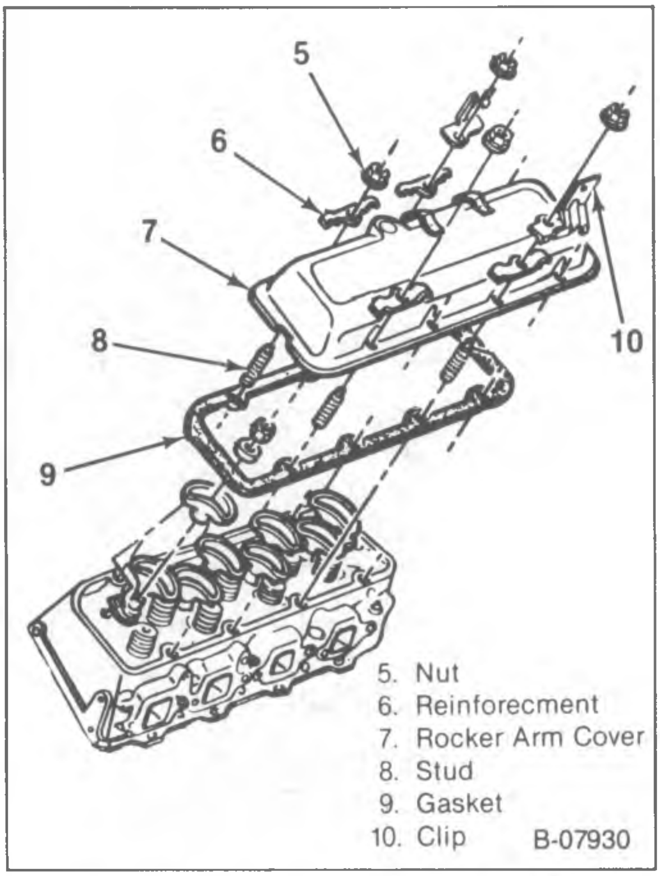


Figure 2—Rocker Arm Cover Installation

ROCKER ARM COVER REPLACEMENT

Remove or Disconnect (Figure 2)

1. Battery negative cable.
2. Air cleaner.
3. Crankcase ventilation hoses at the rocker arm cover.
4. Wiring harnesses from the rocker arm clips.
5. Heat stove pipe (right side rocker arm cover).
6. Air conditioning compressor rear brace (if equipped) (left side rocker arm cover).
7. Rocker arm cover nuts, reinforcements, and clips.
8. Rocker arm cover and gasket.

Clean

- All traces of old gasket from the rocker arm cover and cylinder head.

Inspect

- Rocker arm cover sealing surface for distortion. Replace if necessary.

Install or Connect (Figure 2)

1. Rocker arm cover and new gasket.
2. Reinforcements, clips, and nuts.

Tighten

- Nuts to 5.4 N·m (48 in. lbs.).

3. Air conditioning compressor rear brace (if removed).
4. Heat stove pipe (if removed).
5. Wiring harnesses.
6. Crankcase ventilation hoses.
7. Air cleaner.
8. Battery negative cable.

ROCKER ARM AND PUSHROD REPLACEMENT

Remove or Disconnect

1. Rocker arm cover, as outlined previously.
2. Rocker arm nut.
    - If only the pushrod is to be replaced, back the rocker arm nut off until the rocker arm can be swung away from the pushrod. Then pull the pushrod out.
3. Rocker arm with ball.
4. Pushrod.

Important

- Store used components in order so they can be reassembled in the same location.

Inspect

— Rocker arms and balls at their mating surfaces. These surfaces should be smooth and free from scoring or other damage.
— Rocker arm areas which contact the valve stems and the sockets which contact the pushrods. These areas should be smooth and free of damage and wear.
— Pushrods for bending. Roll the pushrod on a flat surface to determine if it is bent. Replace if necessary.
— Ends of the pushrods for scoring or roughness.

Install or Connect

1. Pushrod. Make sure the pushrod seats properly in the hydraulic lifter.
2. Rocker arm with ball.

Important

- When new rocker arms and/or balls are installed, coat their bearing surfaces with "Molykote" or equivalent.

3. Rocker arm nut.

Adjust

- Valves as outlined later.

4. Rocker arm cover, as outlined previously.

VALVE ADJUSTMENT

1. Remove the rocker arm cover as outlined previously.
2. Crank the engine until the mark on the vibration damper lines up with the "O" mark on the timing tab and the engine in the number one firing position. This may be determined by placing fingers on the number one valve as the mark on the damper comes near the "O" mark on the timing tab. If the rocker arms are not moving, the engine is in the number one firing position. If the rocker arms move as the mark comes up to the timing tab, the engine is in the number six firing position and should be turned over one more time to reach the number one position.
3. With the engine in the number one firing position as determined above, the following valves may be adjusted:
   — Exhaust: 1, 3, 4, 8
   — Intake: 1, 2, 5, 7
   (Even numbered cylinders are in the right bank; odd numbered cylinders are in the left bank, when viewed from the rear of the engine).
4. Back out the adjusting nut until lash is felt at the pushrod then turn in the adjusting nut until all lash is removed. This can be determined by rotating the pushrod while turning the adjusting nut (figure 3). When the play has been removed, turn the adjusting nut in 3/4 additional turn (to center the lifter plunger).
5. Crank the engine one revolution until the timing tab "O" mark and vibration damper mark are again in alignment. This is the number six firing position the following valves may be adjusted:
   — Exhaust: 2, 5, 6, 7
   — Intake: 3, 4, 6, 8
6. Install the rocker arm cover as outlined previously.

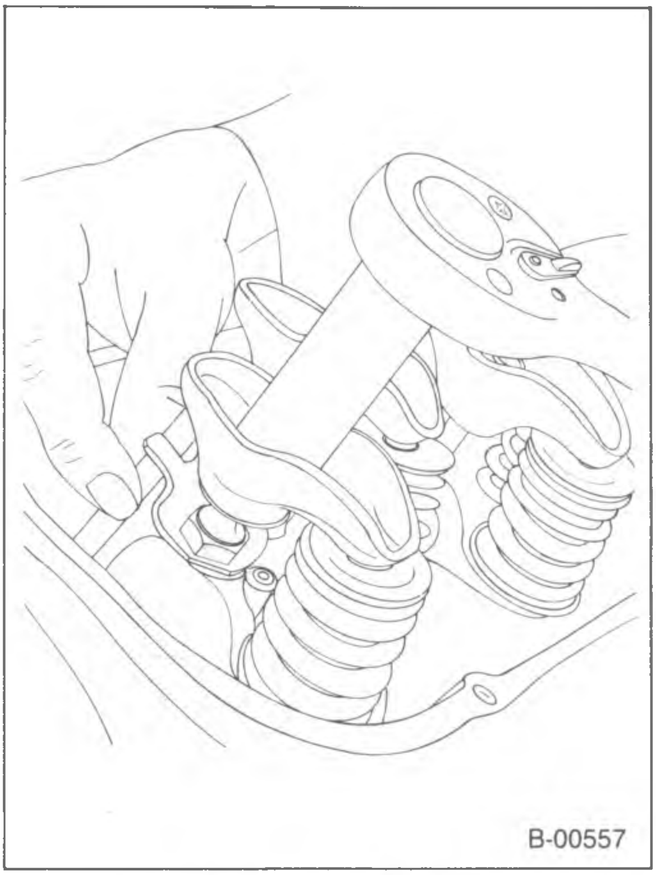
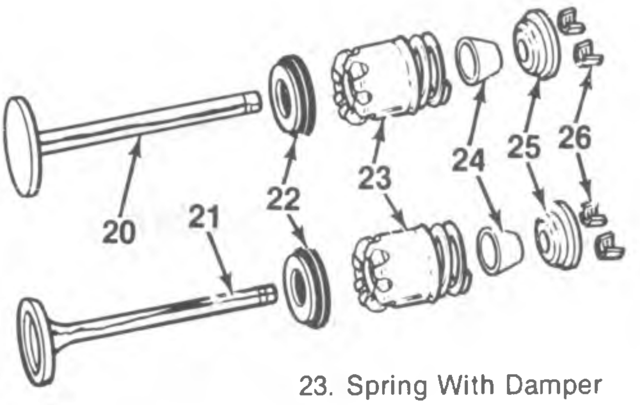


Figure 3—Adjusting The Valves

VALVE STEM SEAL AND VALVE SPRING REPLACEMENT

Remove or Disconnect (Figures 4 and 5)

Tools Required:
J-23590 Air Adapter
J-5892-A Spring Compressor



20. Intake Valve
21. Exhaust Valve
22. Rotator
23. Spring With Damper
24. Seal
25. Cap
26. Valve Keeper

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Figure 4—Valves And Components

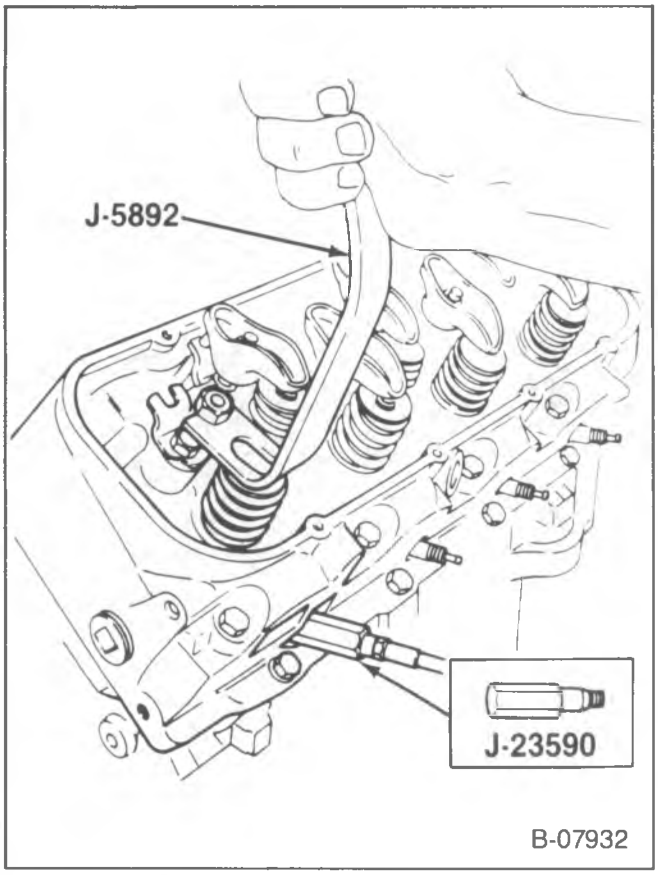


Figure 5—Compressing The Valve Spring

1. Rocker arm cover, as outlined previously.
2. Rocker arms, as outlined previously.
3. Spark plugs.
4. Valve keepers (26).
   - Install J-23590 into the spark plug hole.
   - Apply compressed air to hold the valves in place.
   - Install a rocker arm nut (figure 5).
   - Use J-5892-A to compress the valve spring (figure 5).
   - Remove the valve keepers.
   - Carefully release the spring tension. Remove J-5892-A.
5. Cap (25) and spring with damper (23).
6. Seal (24).

Install or Connect (Figures 4 and 5)

Tools Required:
J-23590 Air Adapter
J-5892-A Spring Compressor

1. New seal (24). Install the seal over the valve stem and seat it against the head.
2. Spring with damper (23), and cap (25).
3. Valve keepers (26).
   - With air pressure applied to the cylinder with J-23590, compress the spring with J-5892-A (figure 5).
   - Install the valve keepers. Use grease to hold them in place.
   - Carefully release spring pressure. Make sure the valve keepers stay in place.
   - Remove J-5892-A and J-23590.
4. Spark plugs.
5. Rocker arms, as outlined previously.

Adjust

- Valves, as outlined previously.

6. Rocker arm covers, as outlined previously.

INTAKE MANIFOLD REPLACEMENT

Remove or Disconnect

1. Battery negative cable.
2. Air cleaner.
- Drain the cooling system.
3. Upper radiator hose, heater hose, and water pump bypass hose.
4. Accelerator, cruise control, and TVS cables, as equipped.
5. Fuel line at the carburetor.
6. Crankcase ventilation hoses.
7. Vacuum hoses, as necessary.
8. Distributor. Refer to ENGINE ELECTRICAL (SEC. 6D).
9. Air conditioning compressor and bracket (if equipped) and lay aside.
10. Accelerator bellcrank, return spring, and bracket.
11. Upper generator bracket.
12. Intake manifold bolts.
13. Intake manifold.
14. Gaskets and seals.

Clean

— Old gaskets from the block, heads, and intake manifold.
— Excessive carbon deposits from the exhaust and EGR passages.
— Excessive scale and deposits from the coolant passages.

Inspect

- Manifold for cracks and gasket surface damage.

Install or Connect (Figure 6)

1. Front and rear intake manifold seals to the block.
2. Side gaskets to the cylinder heads.
3. Intake manifold and bolts.

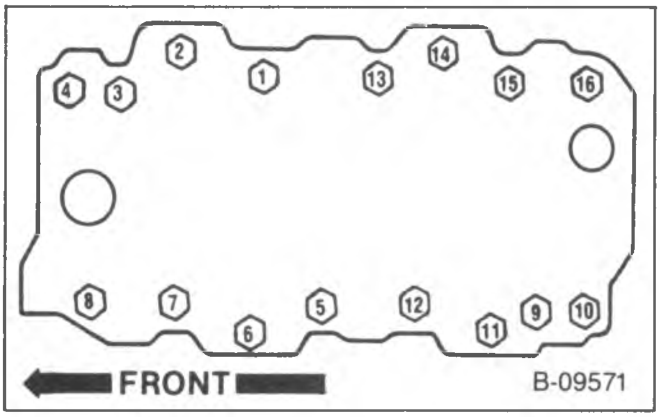


Figure 6—Intake Manifold Bolt Tightening Sequence

Tighten

- Bolts to 40 N·m (30 ft. lbs.). Use the tightening sequence shown in Figure 6.

4. Upper generator bracket.
5. Accelerator bellcrank, return spring, and bracket.
6. Air conditioning compressor and bracket (if equipped).
7. Distributor. Refer to ENGINE ELECTRICAL (SEC. 6D).
8. Vacuum hoses.
9. Crankcase ventilation hoses.
10. Fuel line.
11. Accelerator, cruise control, and TV cables.
12. Water pump bypass hose, heater hose, and upper radiator hose.
13. Air cleaner.
14. Battery negative cable.

- Fill the cooling system with the proper quantity and grade of coolant.

HYDRAULIC LIFTER REPLACEMENT

Remove or Disconnect (Figures 7 and 8)

Tools Required:

J-3049 Lifter Remover (Plier Type) or
J-9290-01 Lifter Remover (Slide Hammer Type)

1. Rocker arm cover, intake manifold, and pushrod, as outlined previously.
2. Hydraulic lifters.
   - Remove the hydraulic lifters one at a time and place them in an organizer rack. The lifters must be installed in the same bore from which they were removed.
   - A stuck hydraulic lifter can be removed using J-3049 (figure 7) or J-9290-01 (figure 8).

Figure 7—Removing The Valve Lifter

Inspect

- Hydraulic lifter body for scuffing and scoring. If the lifter body wall is worn or damaged, the mating bore in the block should also be checked.
- Check the fit of each hydraulic lifter in its mating bore in the block. If the clearance is excessive, try a new lifter.
- The hydraulic lifter foot must be smooth and slightly convex. If worn, pitted, or damaged, the mating camshaft lobe should also be checked.

Hydraulic Lifter Repair

- Refer to the proper unit repair manual.

Install or Connect

1. Hydraulic lifters to the block. Lubricate the lifter

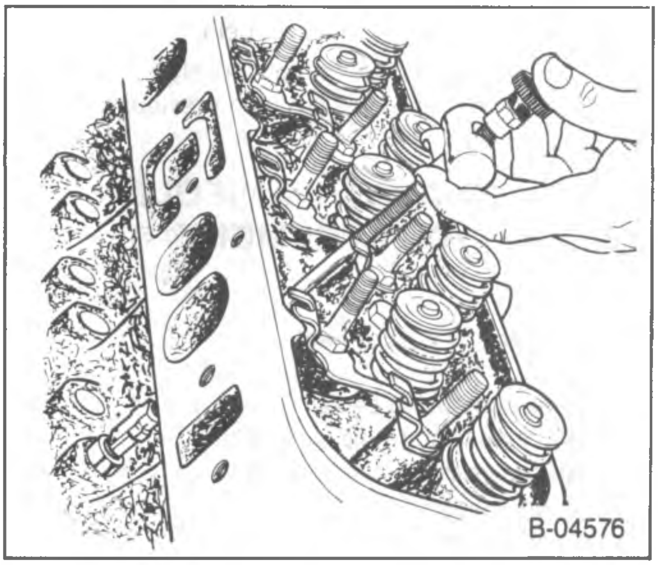


Figure 8—Removing The Valve Lifter

foot and body with Engine Oil Supplement or equivalent.

Important

- When any new hydraulic lifters or a new camshaft is installed, Engine Oil Supplement (or equivalent) should be added to the crankcase oil.
- Replace all hydraulic lifters when a new camshaft is installed.

2. Intake Manifold, as outlined previously.
3. Pushrod, as outlined previously.

Adjust

- Valves, as outlined previously.

4. Rocker arm cover, as outlined previously.

ROCKER ARM STUD REPLACEMENT

Remove or Disconnect

1. Rocker arm cover and rocker arm, as outlined previously.
2. Rocker arm stud. Use a deep socket.

Install or Connect

1. Rocker arm stud.

Tighten

- Rocker arm stud to 68 N·m (50 ft. lbs.).

2. Rocker arm, as outlined previously.

Adjust

- Valves, as outlined previously.

3. Rocker arm cover, as outlined previously.

EXHAUST MANIFOLD REPLACEMENT

Remove or Disconnect

1. Battery negative cable.
2. Air cleaner and heat stove pipe.
3. AIR hose at the check valve.
4. Spark plugs.
5. Exhaust pipe at the manifold.
6. Exhaust manifold bolts and spark plug heat shields (if used).
7. Exhaust manifold.

Clean

— Mating surface on the manifold and head.
— Threads on the exhaust manifold bolts.

Install or Connect

1. Exhaust manifold.
2. Exhaust manifold bolts and spark plug shields (if used).

Tighten

- Exhaust manifold bolts to specifications. Tighten the center bolts first, then continue outward each way.
  — Models with stainless steel manifolds (RPO-NA5): 54 N·m (40 ft. lbs.).
  — Models with cast iron manifolds (RPO-NB2): 24 N·m (18 ft. lbs.).

3. Exhaust pipe.
4. Spark plugs.
5. AIR hose.
6. Air cleaner and heat stove pipe.
7. Battery negative cable.

CYLINDER HEAD REPLACEMENT

Remove or Disconnect

1. Battery negative cable.
- Drain the cooling system.
2. Intake manifold, as outlined previously.
3. Generator, and lay aside.
4. Exhaust manifold, as outlined previously.
5. Air conditioning compressor and front bracket (if equipped). Lay the compressor aside.
6. Rocker arm cover, as outlined previously.
7. Spark plugs.
8. Pushrods, as outlined previously.
9. Cylinder head bolts.
10. Cylinder head.
11. Head gasket.

Clean

— Carbon deposits from combustion chambers.
— All traces of old head gasket from cylinder head and block.
— Cylinder head bolt threads and threads in the block.

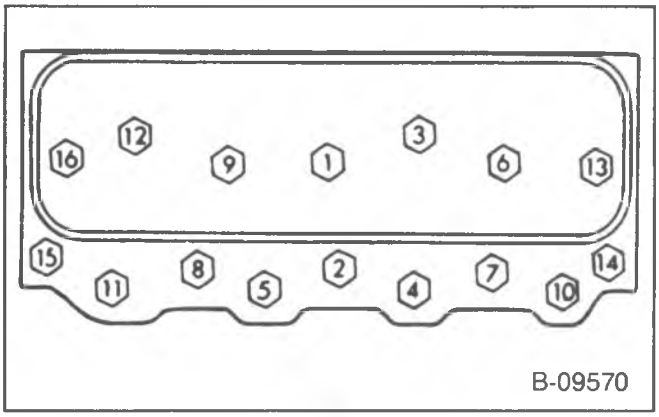


Figure 9—Cylinder Head Bolt Tightening Sequence

Inspect

- Sealing surfaces of the block and cylinder head for nicks, heavy scratches, or other damage.

Cylinder Head Repair

- Refer to the proper Unit Repair Manual.

Install or Connect (Figure 9)

1. Head gasket.
    - If a steel gasket is used, coat both sides of the gasket with sealer. Spread the sealer thin and even.
    - Do not use sealer on composition steel-asbestos gaskets.
    - Place the gasket over the block dowel pins with the bead up.
2. Cylinder head. Carefully guide the cylinder head into place over the dowel pins and gasket.
3. Cylinder head bolts. Coat threads of the cylinder head bolts with sealing compound (GM part number 1052080 or equivalent) and install finger-tight.

    Tighten

    - Cylinder head bolts, a little at a time, using the sequence shown in figure 9. Proper torque is 130 N·m (95 ft. lbs.).
4. Pushrods, as outlined previously.

    Adjust

    - Valves, as outlined previously.
5. Rocker arm cover, as outlined previously.
6. Spark plugs.
7. Air conditioning compressor and front bracket (if equipped).
8. Exhaust manifold, as outlined previously.
9. Generator.
10. Intake manifold, as outlined previously.
11. Battery negative cable.

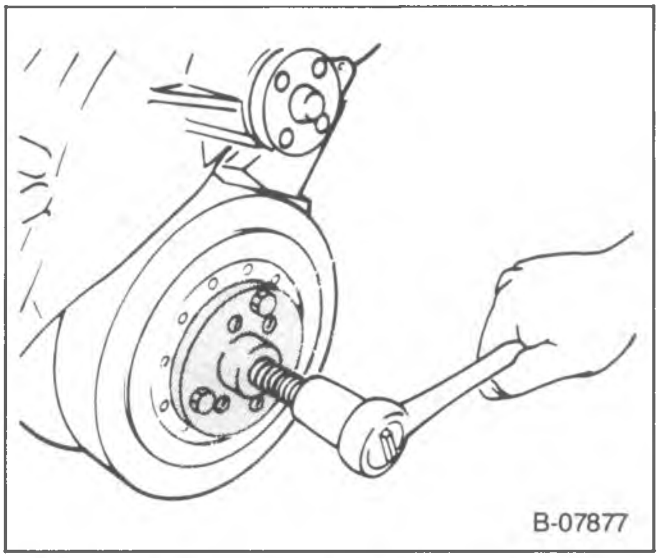


Figure 10—Removing The Torsional Damper

- Fill the cooling system with the proper quantity and grade of coolant.

TORSIONAL DAMPER AND FRONT CRANKSHAFT SEAL REPLACEMENT

Remove or Disconnect (Figure 10)

Tool Required:

J-23523-E Torsional Damper Puller and Installer

1. Fan belts, fan, and pulley.
2. Fan shroud assembly.
3. Accessory drive pulley.
4. Torsional damper bolt.
5. Torsional damper. Use J-23523-E (figure 10).
6. Front crankshaft seal. Pry out with a large screwdriver. Take care not to distort the front cover.
7. Crankshaft key, if necessary.

Inspect

- Oil seal contact area on the torsional damper shaft for grooving and roughness. Replace if necessary.

Install or Connect (Figures 11 and 12)

Tools Required:

J-22102 Seal Installer

J-23523-E Torsional Damper Puller and Installer

1. Crankshaft key, if removed.

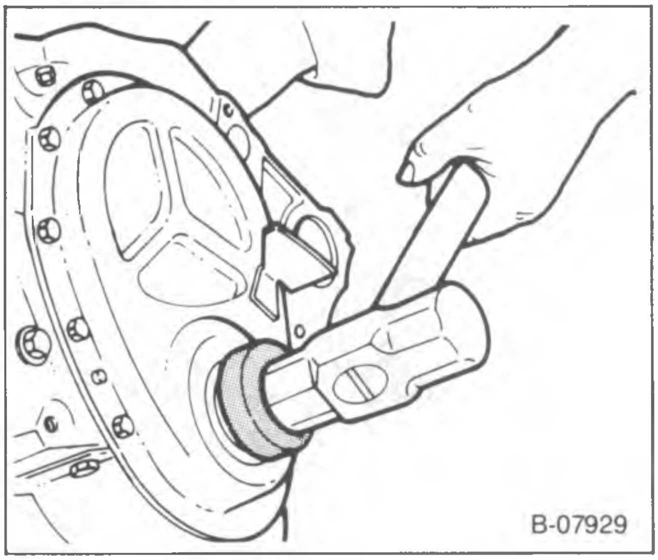


Figure 11—Installing The Front Crankshaft Seal (Typical)

2. Front crankshaft seal. Use J-22102 (figure 11). The open end of the seal faces inside the engine. Coat the seal lips with engine oil.

NOTICE: The inertia weight section of the torsional damper is assembled to the hub with a rubber type material. The correct installation procedures (with the proper tool) must be followed or movement of the inertia weight section of the hub will destroy the tuning of the torsional damper.

3. Stud (item A, figure 12) to the crankshaft. Thread the stud fully into the tapped hole in the crankshaft.
4. Torsional damper over the end of the stud. Align the keyway in the torsional damper shaft with the crankshaft key.

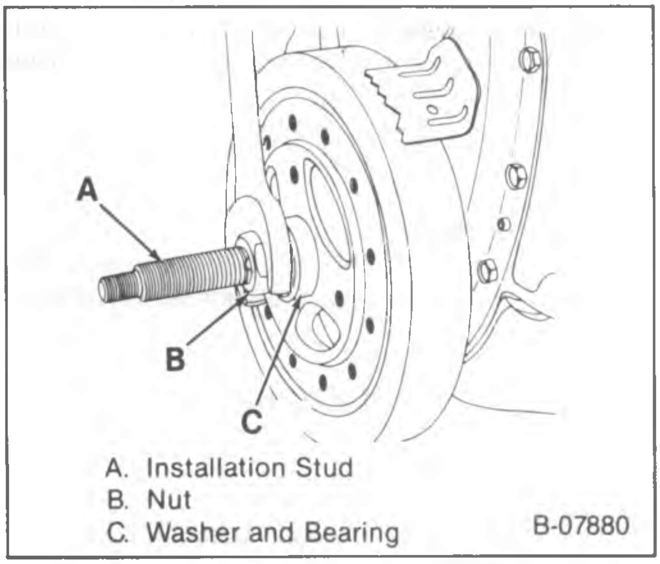


Figure 12—Installing The Torsional Damper

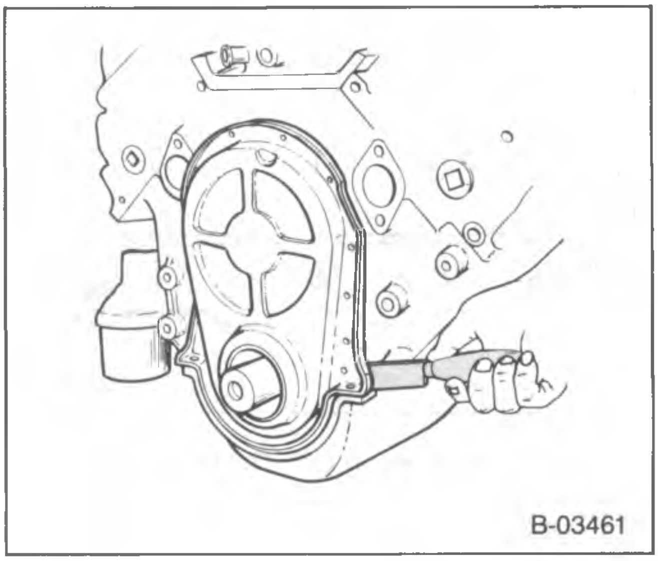


Figure 13—Cutting The Front Oil Pan Seal

5. Bearing, washer and nut (figure 12).
   - Turn the nut to pull the vibration damper into place.
   - Remove the tool.
6. Torsional damper bolt and washer.

Tighten

- Bolt to 115 N·m (85 ft. lbs.).

7. Accessory drive pulley.
8. Fan shroud assembly.
9. Fan pulley, fan, and fan belts.

FRONT COVER REPLACEMENT

↔ Remove or Disconnect (Figures 13 through 16)

1. Battery negative cable.
2. Water pump. Refer to ENGINE COOLING (SEC. 6B).
3. Torsional damper, as outlined previously.
4. Oil pan to front cover bolts.
5. Front cover to block bolts.
6. Front cover.
   - Pull the cover forward enough to permit cutting of the front oil pan seal (figure 13).
   - Cut the front oil pan seal flush with the block on both sides (figure 13). Use a sharp cutting tool to ensure a clean cut.
   - Pull off the front cover.
7. Gasket and front oil pan seal.
8. Front crankshaft oil seal from the front cover. Pry out with a screwdriver. Take care not to distort the front cover.

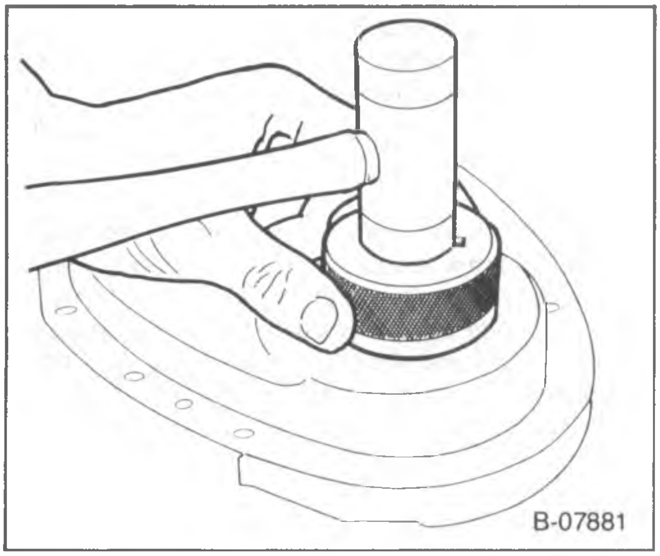


Figure 14—Installing The Front Crankshaft Seal (Typical)

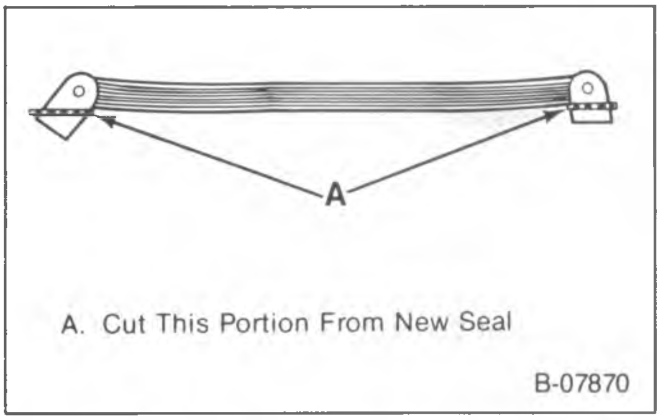


Figure 15—Front Oil Pan Seal Modification

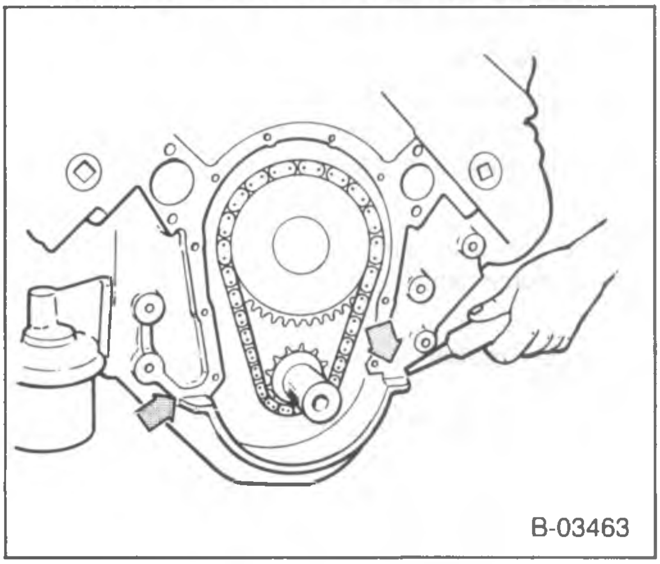


Figure 16—Applying Sealer

Clean

- Old gasket from the front cover, block, and oil pan.

Inspect

- Front cover for distortion and damage. Replace if necessary.

Install or Connect (Figures 14, 15, and 16)

Tool Required:

J-22102 Seal Installer

1. Front crankshaft seal. Use J-22102 (figure 14). The open end of the seal faces inside the engine. Coat the seal lips with engine oil.
2. Front oil pan seal.
   - Cut the tabs from a new seal (figure 15). Use a sharp cutting tool to ensure a clean cut.
   - Position the seal on the front cover. Push the seal locating tips into the holes in the front cover.
3. Front cover to block gasket to the front cover. Use gasket sealer to hold it in position.

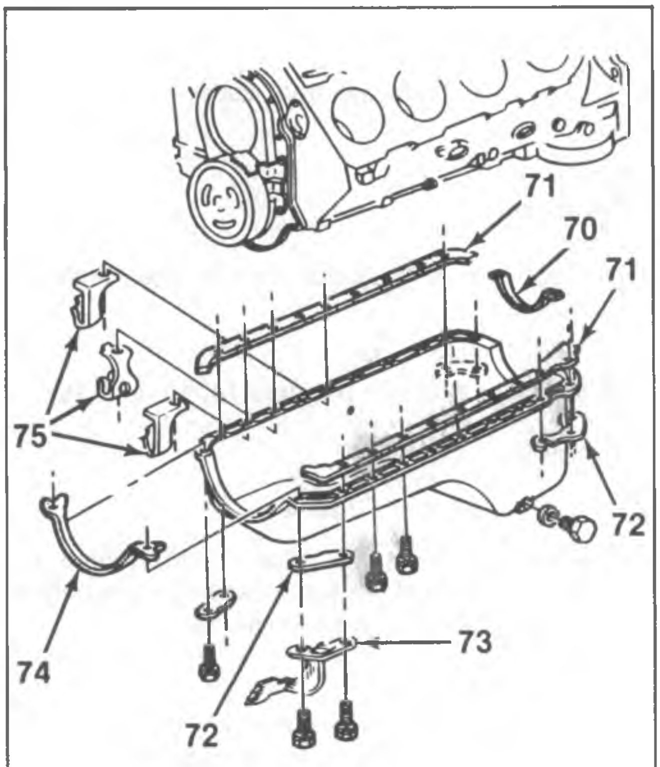
- Apply a 3 mm (1/8-inch) bead of RTV sealant (GM part number 1052366 or equivalent) to the front oil pan to block joint (figure 16).

4. Front cover to the engine. Press the cover down against the oil pan until the block dowel pins align with the holes in the cover. Position the cover against the block so that the dowels enter the cover holes without binding. Do not force the cover over the holes. Do not distort the cover flange or dowel pin holes. Hold the front cover in this position. Install and partially tighten the oil pan to front cover bolts.
5. Front cover to block bolts.

Tighten

- Front cover to block bolts to 10.8 N·m (96 in. lbs.).
- Oil pan to front cover bolts to 7.9 N·m (70 in. lbs.).

6. Torsional damper, as outlined previously.
7. Water pump. Refer to ENGINE COOLING (SEC. 6B).
8. Battery negative cable.



70. Rear Oil Pan Seal
71. Gasket
72. Reinforcement
73. Timing Marker (Some P Models)
74. Front Oil Pan Seal
75. Clip

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Figure 17—Oil Pan Installation

OIL PAN REPLACEMENT

Remove or Disconnect (Figure 17)

1. Battery negative cable.
2. Fan shroud from the radiator and push rearward.
3. Air cleaner.
4. Distributor cap.

- Raise the vehicle.
- Drain the engine oil.

5. Starter (vehicles with manual transmission).
6. Torque converter or clutch cover.
7. Oil filter.

NOTICE: Oil pressure line must be removed from the side of the block to prevent crushing of the line when the engine is raised.

8. Oil pressure line from the side of the block.

NOTICE: When raising or supporting the engine for any reason, do not use a jack under the oil pan, any sheet metal or crankshaft pulley. 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 pickup unit.

- Support the engine with a suitable lifting fixture.

9. Engine mounting through-bolts.

- Raise the engine only enough to permit oil pan removal.

10. Oil pan bolts, timing marker (if used), clips, and reinforcements.
11. Oil pan.
12. Gaskets and seals.

Clean

- Gasket surfaces on the engine and oil pan.

Install or Connect (Figure 17)

1. Gaskets (71) to the block. Use gasket sealer to hold them in place.
2. Rear oil pan seal (70) to the groove in the rear main bearing cap, with the ends mating against the gaskets (71).
3. Front oil pan seal (74). Press the locating tips into the holes in the front cover. The ends should mate against the gaskets (71).
4. Oil pan.
5. Oil pan bolts, timing marker (if used), clips, and reinforcements.

Tighten

- Oil pan to front cover bolts to 7.9 N·m (70 in. lbs.).
- Oil pan to block bolts to 15.3 N·m (135 in. lbs.).

- Lower the engine.

NOTICE: See "Notice" on page 6A6-1 of this section.

6. Engine mounting through bolts.

Tighten

- Through-bolts to specifications. Refer to figures 35, 36, and 37.

7. Oil pressure line.
8. Oil filter.
9. Torque converter or clutch cover.
10. Starter (if removed).
- Lower the vehicle.
11. Distributor cap.
12. Air cleaner.
13. Fan shroud.
14. Proper quantity and grade of engine oil.
15. Battery negative cable.

OIL PUMP REPLACEMENT

Remove or Disconnect

1. Oil pan, as outlined previously.
2. Oil pump to main bearing cup bolt.
3. Oil pump.

Inspect

- Oil pump pickup tube for damage and looseness. If the tube is loose or damaged, the entire oil pump must be replaced, because the tube is welded to the pump body.

Oil Pump Repair

- Refer to the proper unit repair manual.

Install or Connect

1. Oil pump to the engine. Align the slot in the oil pump shaft with the tang on the distributor shaft. The oil pump should slide easily into place. No gasket is used.
2. Oil pump to main bearing cap bolt.

Tighten

- Oil pump bolt to 90 N·m (65 ft. lbs.).

3. Oil pan, as outlined previously.

REAR CRANKSHAFT OIL SEAL REPLACEMENT

The rear main bearing oil seal can be replaced (both halves) without removal of the crankshaft. Always replace the upper and lower seal as a unit. Install the seal with the lip facing the front of the engine. Extreme care should be exercised when installing this seal to protect the sealing bead located in the channel on the outside diameter of the seal. An installation tool should be used to protect the seal bead when positioning the seal. (Some seal kits include the tool as part of the service kit).

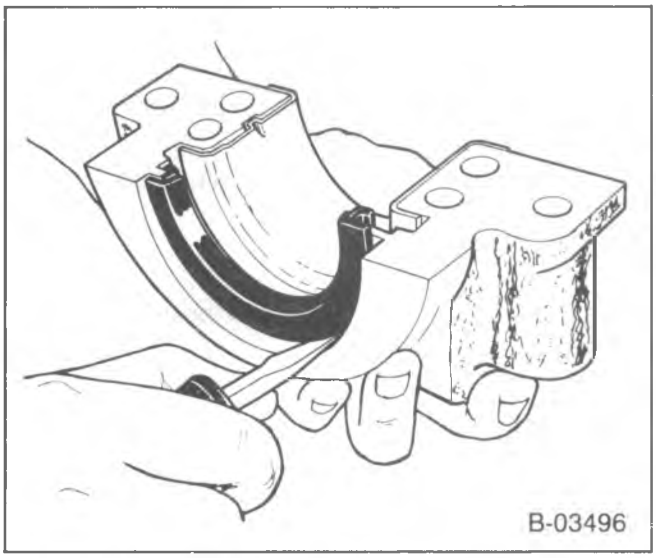


Figure 18—Removing The Lower Oil Seal Half

Remove or Disconnect (Figures 18 and 19)

1. Oil pan and oil pump, as outlined previously.
2. Rear main bearing cap.

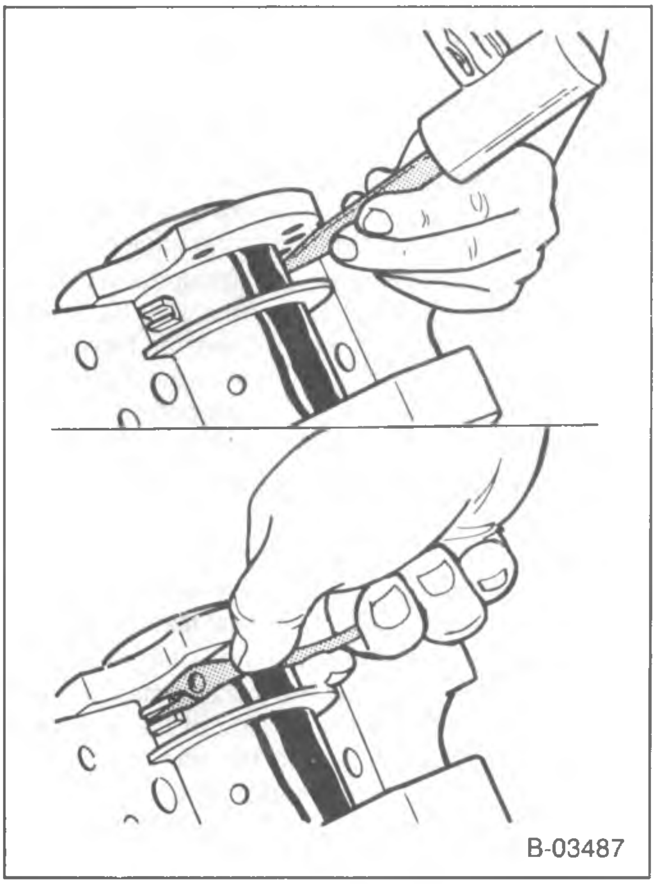


Figure 19—Removing The Upper Oil Seal Half

3. Lower seal half (figure 18).
4. Upper seal half (figure 19).
   - Tap on the upper seal half, using a small drift and hammer.
   - Remove the upper seal half, using pliers.

Clean

- Sealing surfaces of the main bearing cap and block.

Inspect

- Crankshaft, seal channel, and sealing surfaces for nicks, scratches, etc.

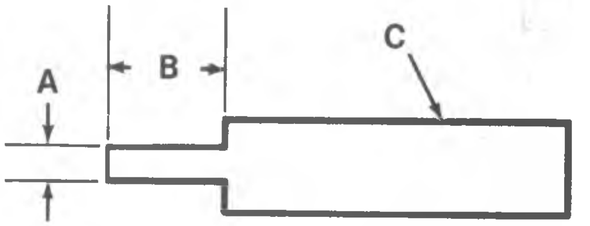
Install or Connect (Figures 20, 21, and 22)

1. Upper seal half.

Important

- An oil seal installation tool (figure 20) should be fabricated (if not provided in the seal kit) to prevent seal damage during installation. Extreme care should be taken when installing this seal to protect the sealing bead located in the channel on the outside diameter of the seal.
- Coat the seal lips lightly with engine oil. Keep the oil off of the seal mating ends.
- Position the tip of the tool between the crankshaft and the seal seat in the block (figure 21).
- Position the seal half between the crankshaft and the tip of the tool. Make sure that the oil seal lip is positioned toward the front of the engine.
- Roll the seal around the crankshaft using the tool as a "shoe-horn" to protect the seal bead from the sharp corner of the seal seat surface in the block. The installation tool must remain in position until the seal half is properly positioned with both ends flush with the block.
- Remove the tool, being careful not to withdraw the seal half.

2. Lower seal half.
   - Coat the seal lips lightly with engine oil. Keep the oil off of the seal mating ends.
   - Insert the seal half into the rear main bearing cap. Use the tool to protect the seal half from the sharp edge of the seal seat. Feed the seal half into the rear main bearing cap, using light finger pressure. Make sure the oil seal lip faces the front of the engine (figure 21).
3. Rear main bearing cap with the lower main bearing.



A. 4 mm (11/64-inch)
B. 13 mm (1/2-inch)
C. 0.10 mm (0.004-inch) shim stock

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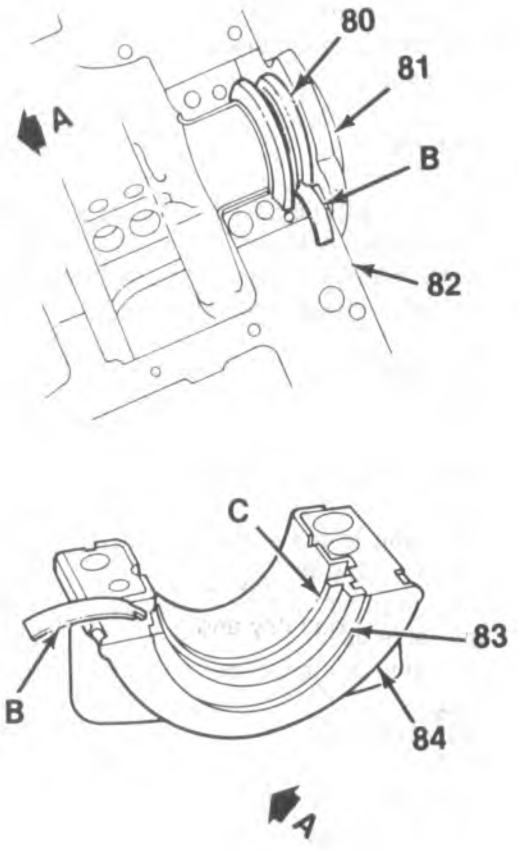
Figure 20—Oil Seal Installation Tool

- Apply a brush-on type oil sealing compound to the mating surface of the block and cap (figure 22). Do not allow any sealant on either crankshaft or rear oil seal.



A. Forward
B. Fabricated Tool
C. Oil Seal Lip
80. Upper Seal Half
81. Crankshaft
82. Block
83. Lower Seal Half
84. Main Bearing Cap

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Figure 21—Installing The Rear Crankshaft Oil Seal

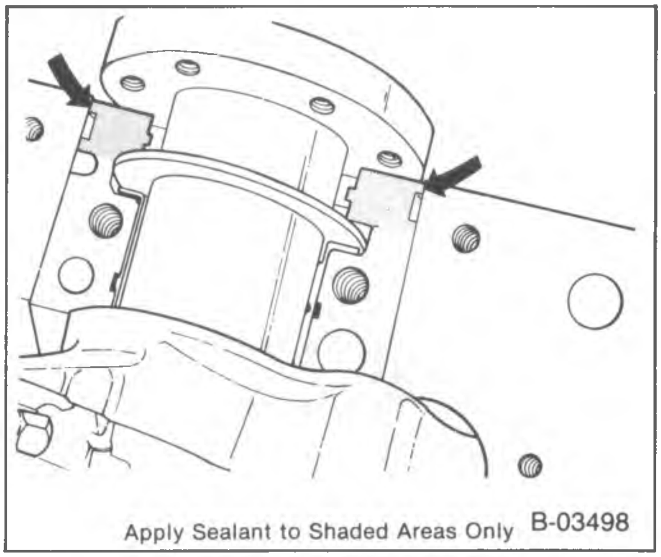


Figure 22—Applying Sealant To The Block

- Apply engine oil to the lower main bearing.
- Position the cap to the block. Install the cap bolts.

Tighten

  - Rear main bearing cap bolts temporarily to 14 N·m (10 ft. lbs.).

- Tap the end of the crankshaft first rearward then forward with a lead hammer. This will line up the rear main bearing and crankshaft thrust surfaces.

Tighten

  - Rear main bearing cap bolts to 150 N·m 110 ft. lbs.).

4. Oil pan and oil pump, as outlined previously.
5. The proper quantity and grade of engine oil.

MEASURING CAMSHAFT LOBE LIFT

Tools Required:

J-8520 Camshaft Lobe Lift Indicator

1. Remove the rocker arm as outlined previously.
2. Refer to figure 23. Position the dial indicator (part of J-8520) so the plunger rests on the pushrod end, as shown. Make sure the pushrod is in the lifter socket.
3. Rotate the crankshaft slowly in the direction of rotation until the lifter is on the heel of the cam lobe. At this point, the pushrod will be in its lowest position.

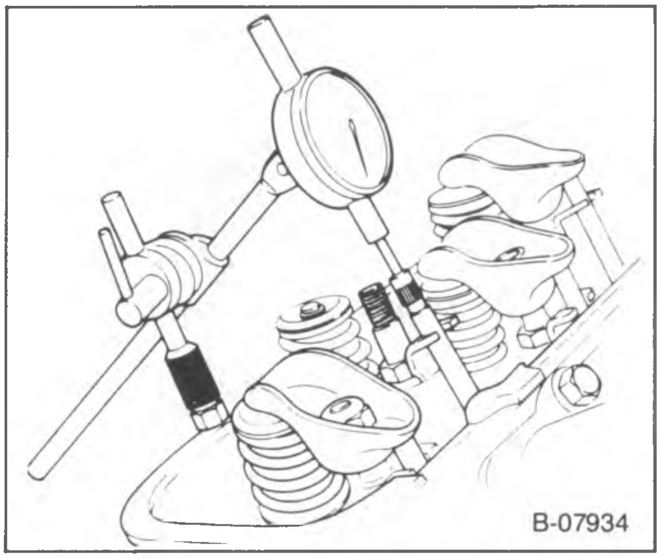


Figure 23—Measuring Camshaft Lobe Lift

4. Set dial indicator on zero, then rotate the crankshaft slowly, or attach an auxiliary starter switch and "bump" the engine over, until the pushrod is in fully raised position.

Important

- Whenever the engine is cranked remotely at the starter, with a special jumper cable or other means, the distributor primary lead should be disconnected from the distributor (coil).

5. Compare the total lift recorded from the dial indicator with specifications.
6. If camshaft readings for all lobes are within specifications, remove dial indicator assembly.
7. Install the rocker arm and adjust the valves as previously outlined.

CAMSHAFT REPLACEMENT

Remove or Disconnect (Figures 24, 25, and 26)

Tool Required:

J-1619 Crankshaft Sprocket Puller

1. Battery negative cable.
2. Air cleaner.
3. Grille.
4. Air conditioning condensor from its mounting and swing it forward.
5. Fan, shroud, and radiator. Refer to ENGINE COOLING (SEC. 6B).
6. Generator and bracket.
7. Rocker arm covers, as outlined previously.
8. Fuel line.

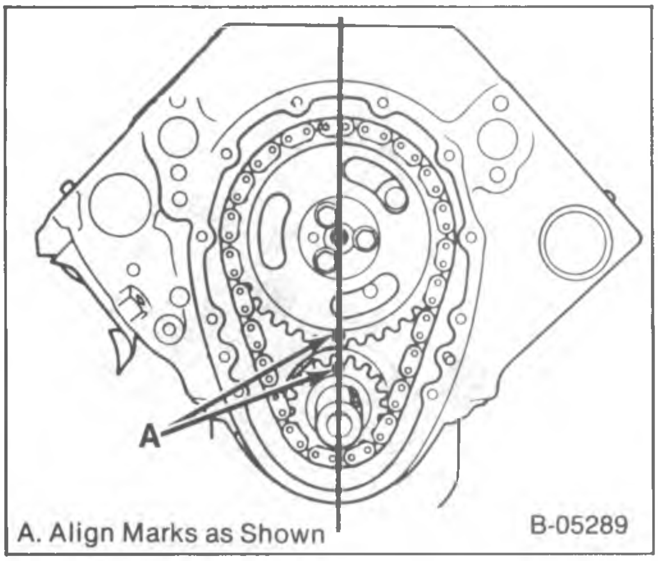


Figure 24—Timing Marks

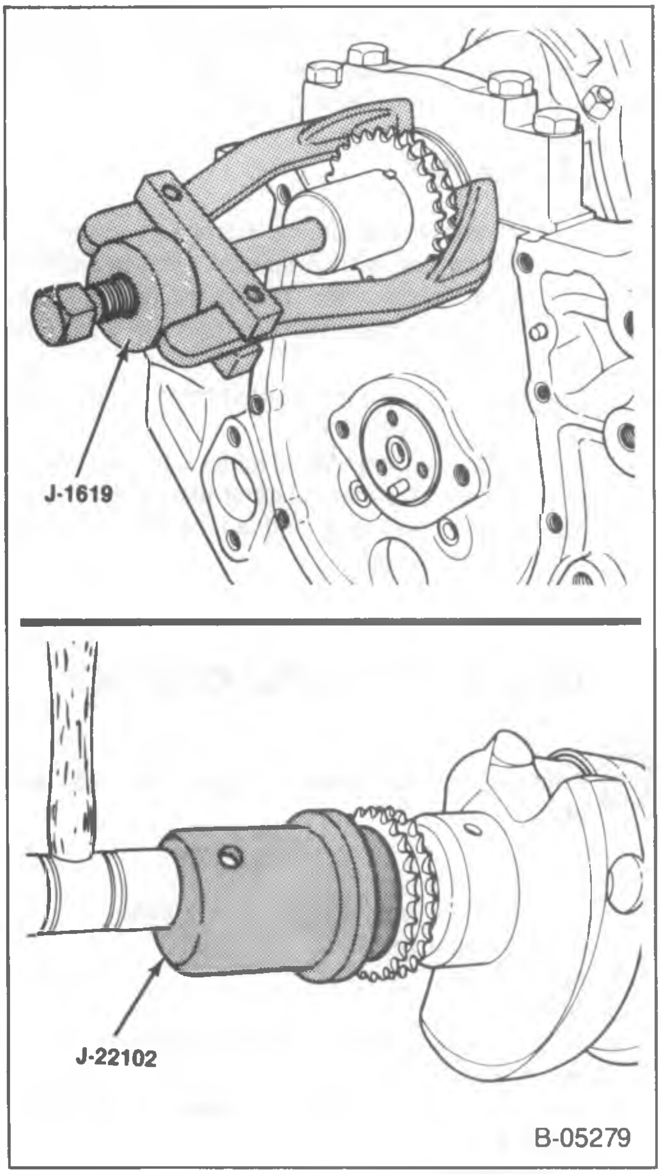


Figure 25—Replacing The Crankshaft Sprocket

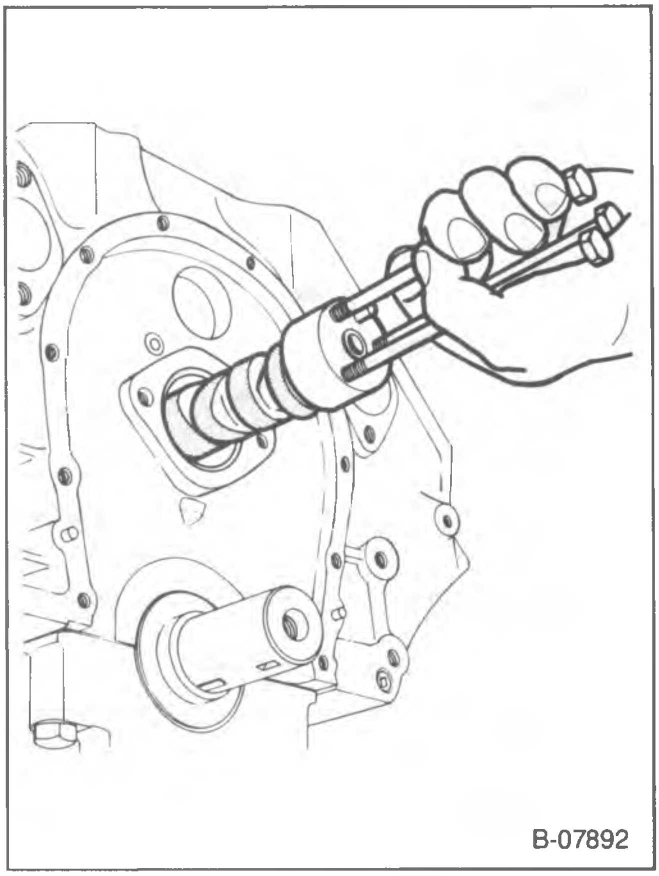


Figure 26—Replacing The Camshaft

9. Water pump. Refer to ENGINE COOLING (SEC. 6B).
10. Torsional damper, as outlined previously.
11. Front cover, as outlined previously.
12. Distributor. Refer to ENGINE ELECTRICAL (SEC. 6D).
13. Intake manifold, as outlined previously.
14. Pushrods and hydraulic lifters, as outlined previously.
15. Fuel pump and pushrod.
    - Align the timing marks (figure 24).
16. Camshaft sprocket bolts.
17. Camshaft sprocket and timing chain. The sprocket is a light interference fit on the camshaft. Tap the sprocket on its lower edge to loosen it.
18. Crankshaft sprocket (if required). Use J-1619 (figure 25).
19. Camshaft.
    - Install two or three 5/16–18 bolts 100–125 mm (4–5 inches) long into the camshaft threaded holes. Use these bolts to handle the camshaft (figure 26).
    - Pull the camshaft from the block. Use care to prevent damage to the camshaft bearings.

Cleaning Inspection and Repair

Clean, inspect and repair or replace the camshaft and related components, as outlined in the proper unit repair manual.

The unit repair manual also describes camshaft bearing replacement.

Install or Connect (Figures 24, 25, and 26)

Tool Required:
J-22102 Crankshaft Sprocket Installer

- Coat the camshaft lobes and journals with a high quality engine oil supplement (GM Engine Oil Supplement or equivalent).

1. Two or three 5/16-18 bolts 100-125 mm (4-5 inches) long into the camshaft threaded holes. Use these bolts to handle the camshaft.
2. Camshaft to the engine (figure 26). Handle the camshaft carefully to prevent damage to the camshaft bearings.
3. Crankshaft sprocket (if removed). Use J-22102 (figure 25). Make sure the timing mark faces outside.
4. Camshaft sprocket and timing chain.

Important

- Line up the timing marks on the camshaft sprocket and crankshaft sprocket (figure 24).

5. Camshaft sprocket bolts.

Tighten

- Bolts to 27 N·m (20 ft. lbs.).

6. Fuel pump and pushrod.
7. Hydraulic lifters and pushrods, as outlined previously.

Important

- Replace all hydraulic lifters and add GM Engine Oil Supplement (or equivalent) to the engine oil whenever a new camshaft is installed.

Adjust

- Valves, as outlined previously.

8. Intake manifold, as outlined previously.
9. Distributor. Refer to ENGINE ELECTRICAL (SEC. 6D).
10. Front cover, as outlined previously.
11. Torsional damper, as outlined previously.
12. Water pump. Refer to ENGINE COOLING (SEC. 6B).
13. Fuel line.
14. Rocker arm covers, as outlined previously.

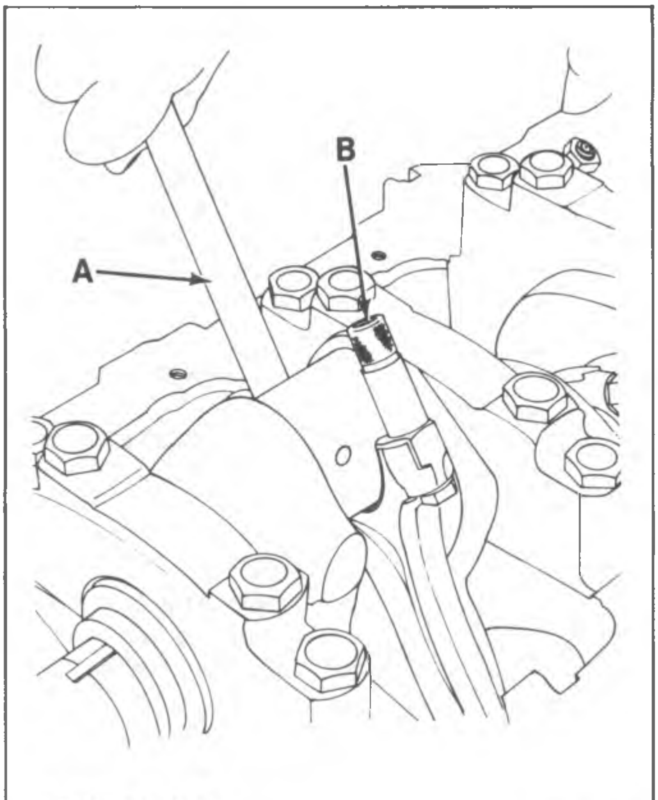


Figure 27—Replacing The Connecting Rod And Piston

15. Generator and bracket.
16. Fan, shroud, and radiator. Refer to ENGINE COOLING (SEC. 6B).
17. Air conditioning condensor.
18. Grille.
19. Air cleaner.
20. Battery negative cable.
    - Fill the cooling system with the proper quantity and grade of coolant.

CONNECTING ROD AND PISTON REPLACEMENT

Remove or Disconnect (Figure 27)

Tool Required:
J-5239 Guide Set

1. Cylinder head, as outlined previously.
2. Oil pan, as outlined previously.
3. Oil pump, as outlined previously (if necessary).
4. Ridge or deposits from the upper end of the cylinder bores.
    - Turn the crankshaft until the piston is at BDC.
    - Place a cloth on top of the piston.

- Perform the cutting operation with a ridge reamer.
- Turn the crankshaft until the piston is at TDC.
- Remove the cloth and cuttings.

5. Connecting rod cap. Check the connecting rod and cap for identification marks. Mark the parts if required. The connecting rod and cap must be kept together as mating parts.
6. Connecting rod and piston.
    - Attach J-5239 to the connecting rod bolts (figure 27).
    - Use the long guide rod of J-5239 to push the connecting rod and piston out of the bore.
7. Connecting rod bearing.

Cleaning, Inspection, and Repair

Clean, inspect and repair or replace the components as necessary. Measure connecting rod bearing clearance, piston clearance, ring clearances, etc. Refer to the proper unit repair manual.

The unit repair manual contains information on:

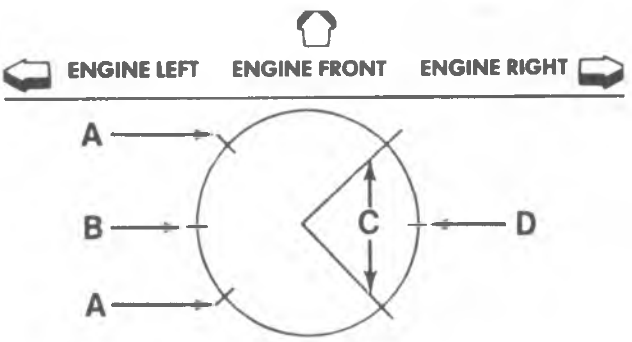
— Connecting rod and piston.
— Piston rings.
— Connecting rod and crankpin.
— Cylinder bores.

→← Install or Connect (Figures 27 through 31)

Tools Required:
J-5239 Connecting Rod Guide Set
J-8037 Ring Compressor

- Make sure the cylinder walls are clean. Lubricate the cylinder wall lightly with engine oil.
- Make sure the piston is installed in the matching cylinder for which it was fitted. Used pistons must be installed in the cylinder they were removed from.

1. Connecting rod bearings.
    - Be certain that the bearings are of the proper size.
    - Install the bearings in the connecting rod and connecting rod cap.
    - Lubricate the bearings with engine oil.
2. Piston and connecting rod to the proper bore.
    - With the connecting rod cap removed, install J-5239 onto the connecting rod studs.
    - Locate the piston ring end gaps as shown in figure 28. Lubricate the piston and rings with engine oil.
    - Without disturbing the ring end gap location, install J-8037 over the piston (figure 29).
    - The piston must be installed so that the valve clearance notches are towards the center of the engine (figure 30).



A. Oil Ring Rail Gaps
B. 2nd Compression Ring Gap
C. Oil Ring Spacer Gap
(Tang In Hole Or Slot With Arc)
D. Top Compression Ring Gap

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Figure 28—Ring End Gap Location

- Place the piston in its matching bore. Using light blows with a hammer handle, tap the piston down into its bore (figure 29). At the same time, from beneath the vehicle guide the connecting rod to the crankpin with J-5239 (figure 27). Hold the ring compressor against the block until all rings have entered the cylinder bore.

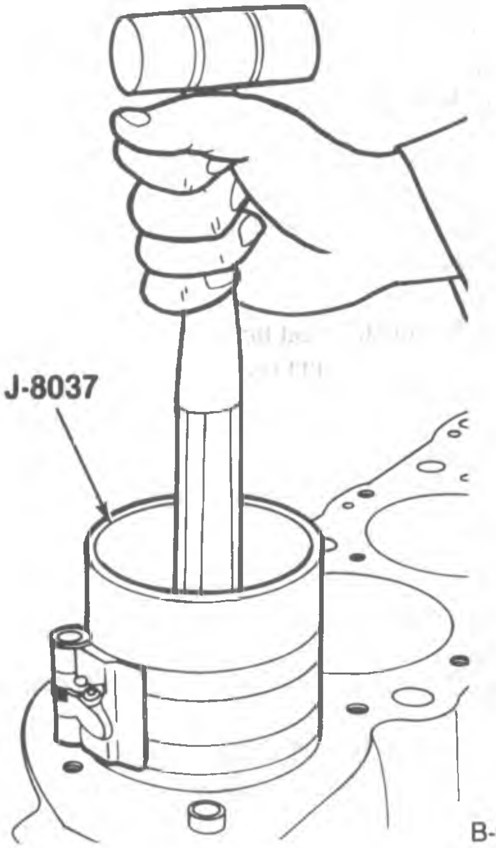

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Figure 29—Installing The Piston

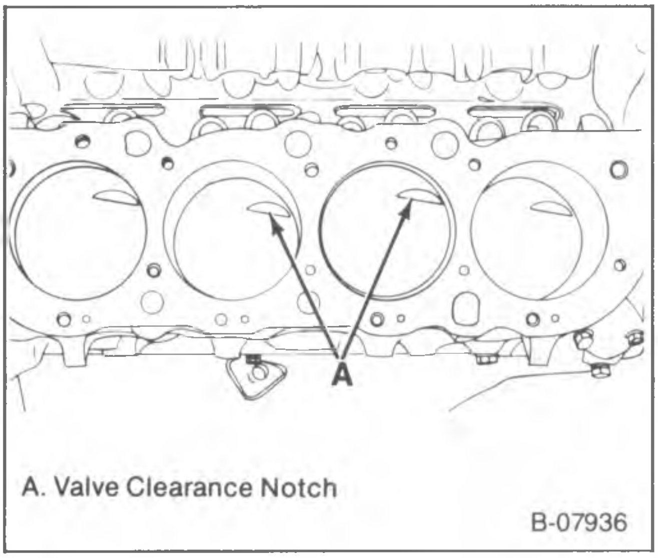


Figure 30—Pistons Installed

- Remove J-5239 from the connecting rod bolts.

Important

- Each connecting rod and bearing cap should be marked, beginning at the front of the engine. Cylinders 1, 3, 5 and 7 are the left bank and 2, 4, 6 and 8 are the right bank. The numbers on the connecting rod and bearing cap must be on the same side when installed in the cylinder bore. If a connecting rod is ever transposed from one block or cylinder to another, new connecting rod and bearings should be fitted and the connecting rod should be numbered to correspond with the new cylinder number.

Measure

- Connecting rod bearing clearance. Refer to the proper unit repair manual.

3. Connecting rod cap and bearing.
4. Connecting rod cap nuts.

Tighten

- Connecting rod cap nuts to 66 N·m (48 ft. lbs.).

Measure

- Connecting rod side clearance. Use a feeler gage between the connecting rod and crankshaft (figure 31). The correct clearance is 0.013–0.023-inch.

5. Oil pump (if removed), as outlined previously.
6. Oil pan and cylinder head, as outlined previously.

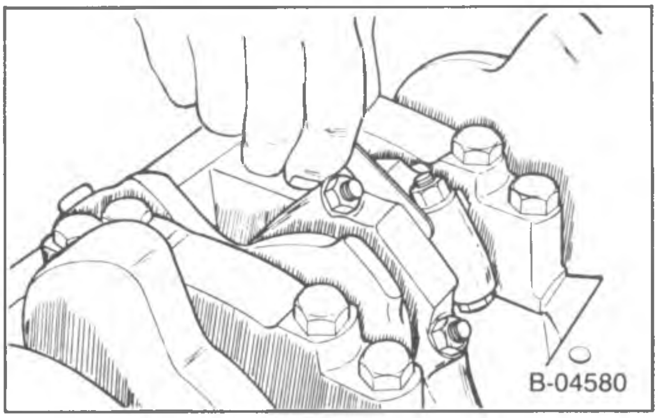


Figure 31—Measuring Connecting Rod Side Clearance

OIL FILTER BYPASS VALVE

Remove or Disconnect (Figure 32)

1. Oil filter.

Inspect

- Bypass valve spring and valve disc for proper operation, cracks, and damage. If replacement is needed, the oil filter bypass valve (93) must be replaced, as follows:

2. Bolts (94).
3. Oil filter bypass valve.

Clean

- Valve chamber in the block.

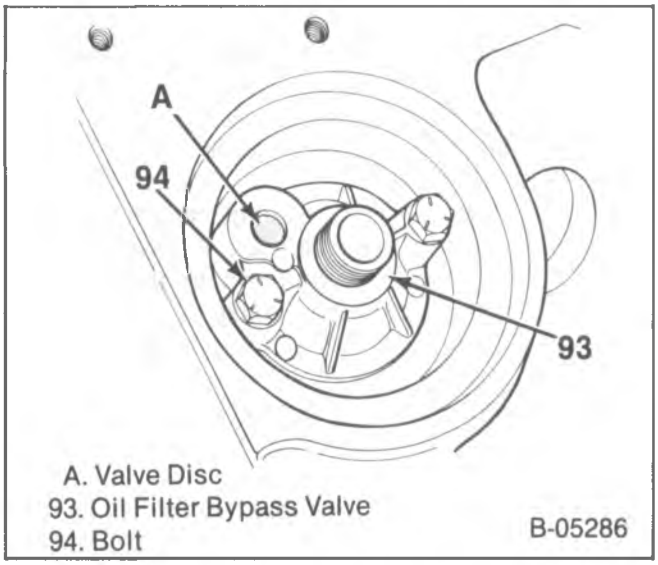


Figure 32—Oil Filter Bypass Valve

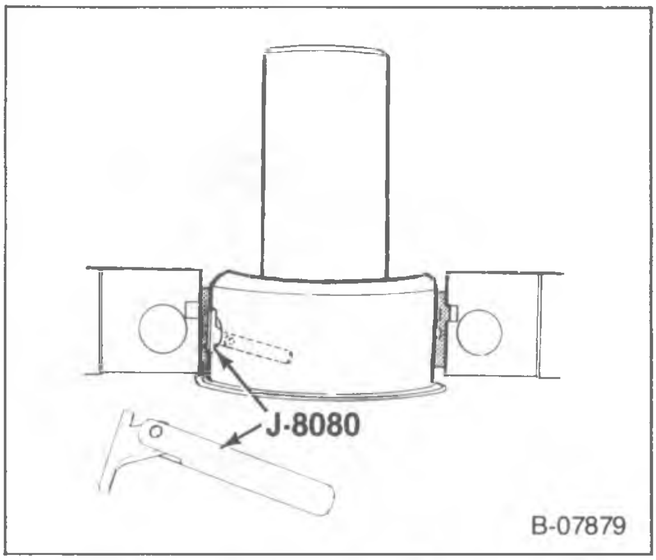


Figure 33—Removing The Main Bearing

Install or Connect (Figure 32)

1. Oil filter bypass valve (93).
2. Bolts (94).

Tighten

   - Bolts (94) to 26 N·m (20 ft. lbs.).
3. Oil filter.
4. Engine oil, as needed.
- Spark plugs.
- Flywheel (if used), as outlined later.
- Engine, as outlined later.

MAIN BEARING REPLACEMENT

Remove or Disconnect (Figure 33)

Tool Required:
J-8080 Main Bearing Remover/Installer

1. Spark plugs.
2. Oil pan, as outlined previously.
3. Oil pump, as outlined previously.
4. Main bearing caps.
   - Check the main bearing caps for location markings. Mark the caps if necessary. The caps must be returned to their original locations during assembly.
5. Lower main bearing inserts from the main bearing caps.
6. Rear crankshaft oil seal, if necessary, as outlined previously.
8. Upper main bearing inserts.
   - Insert J-8080 into the crankshaft oil hole (figure 33).
   - Rotate the crankshaft to "turn" the bearing insert out of the block.

Cleaning, Inspection, and Repair

Clean, inspect, and repair or replace the components as required. Refer to the proper unit repair manual. The unit repair manual contains information on:

- Crankshaft.
- Main and connecting rod bearings.
- Main bearing cap replacement (shimming procedure).

Install or Connect (Figures 22, 33, and 34)

Tool Required:
J-8080 Main Bearing Remover/Installer

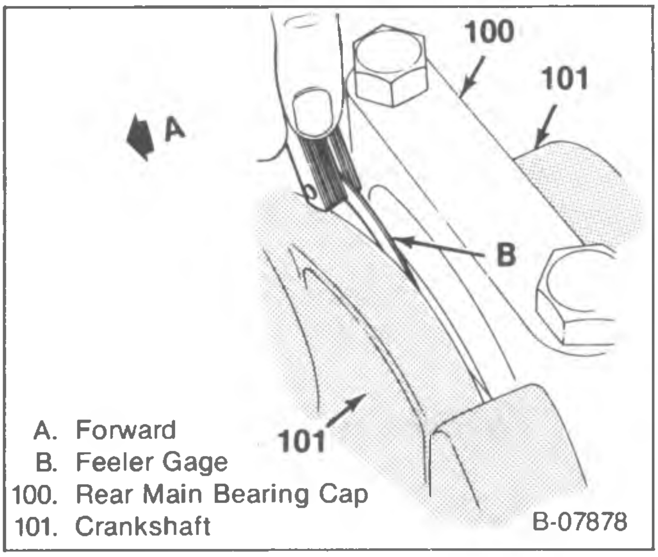
1. Upper main bearing inserts.
   - Insert tool J-8080 into a crankshaft main bearing oil hole (figure 33).
   - Apply engine oil to inserts of the proper size.
   - Insert the plain end (without the bearing tang) of the insert between the crankshaft and the notched side of the block.
   - Rotate the crankshaft to "roll" the insert into the block.
   - Remove the tool.
2. Lower main bearing inserts to the main bearing caps.
   - Make sure the inserts are of the proper size.
   - Apply engine oil to the inserts.

Measure

   - Main bearing clearance. Refer to the proper unit repair manual. If the engine is 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.
3. Main bearing caps (except rear cap) and bolts to the block.

Tighten

   - Main bearing cap bolts to 150 N·m (110 ft. lbs.).
4. Rear crankshaft oil seal to the block and main bearing cap, as outlined previously.
5. Rear main bearing cap.
   - Apply a brush-on type oil sealing compound to the mating surface of the block and cap (figure 27). Do not allow any sealant on either crankshaft or rear oil seal.
   - Apply engine oil to the bearing insert.
   - Install the rear main bearing cap and bolts. Tighten the bolts temporarily to 14 N·m (10 ft. lbs.).



A. Forward
B. Feeler Gage
100. Rear Main Bearing Cap
101. Crankshaft

Figure 34—Measuring Crankshaft End Play

Measure

- Crankshaft end play, as follows:
  - Tap the end of the crankshaft first rearward then forward with a lead hammer. This will line up the rear main bearing and crankshaft thrust surfaces.
  - Tighten the rear main bearing cap bolts to 150 N·m (110 ft. lbs.).
  - With the crankshaft forced forward, measure at the front end of the rear main bearing with a feeler gage (figure 34). The proper clearance is 0.006–0.010–inch.

6. Oil pump, as outlined previously.
7. Oil pan, as outlined previously.
8. Spark plugs.

CRANKSHAFT REPLACEMENT

Remove or Disconnect (Figure 27)

Tool Required:
J-5239 Guide Set

1. Engine, as outlined later.
2. Flywheel (if used) as outlined later.
- Mount the engine in a suitable engine stand.
3. Spark plugs.
4. Torsional damper, as outlined previously.
5. Front cover, as outlined previously.
6. Camshaft sprocket and timing chain, as outlined previously.
7. Oil pan and oil pump, as outlined previously.
8. Connecting rod caps. Check the connecting rod and cap for identification marks. Mark the parts if necessary. The connecting rod and cap are mating parts.
9. Connecting rods from the crankshaft.
   - Attach J-5239 to the connecting rod bolts (figure 27).
   - Use the long guide rod to push the pistons up in the bores.
10. Main bearing caps. Check the main bearing caps for location markings. Mark the parts if necessary. The main bearing caps must be returned to their original locations at assembly.
11. Crankshaft.
12. Main bearing inserts.
13. Rear crankshaft seal, as outlined previously.

Cleaning, Inspection, and Repair

- Clean, inspect, and repair or replace the parts as outlined in the proper unit repair manual. Refer to the unit repair manual for information on:
  - — Crankshaft.
  - — Main and connecting rod bearings.
  - — Procedures for measuring bearing clearances.

Install or Connect (Figures 22, 24, 27, 31, and 34)

Tool Required:
J-5239 Guide Set

1. Upper main bearing inserts to the block. Apply engine oil to the main bearings.
2. Crankshaft.
3. Lower main bearing inserts to the main bearing caps. Apply engine oil to the bearing inserts.

Measure

- Main bearing clearance. Refer to the proper unit repair manual.

4. Main bearing caps (except rear cap) and bolts to the block.

Tighten

- Main bearing cap bolts to 150 N·m (110 ft. lbs.).

5. Rear crankshaft oil seal to the block and main bearing cap, as outlined previously.
6. Rear main bearing cap to the block.
   - Apply a brush-on type oil sealing compound to the mating surface of the block and cap (figure 22). Do not allow any sealant on either crankshaft or rear oil seal.

- Install the rear main bearing cap and bolts. Tighten the bolts temporarily to 14 N·m (10 ft. lbs.).

Measure

- Crankshaft end play, as follows:
  - Tap the end of the crankshaft first rearward then forward with a lead hammer. This will line up the rear main bearing and crankshaft thrust surfaces.
  - Tighten the rear main bearing cap bolts to 150 N·m (110 ft. lbs.).
  - With the crankshaft forced forward, measure at the front end of the rear main bearing with a feeler gage (figure 34). The proper clearance is 0.006–0.010-inch.

Inspect

- Crankshaft for binding. Try turning the crankshaft to check for binding. If the crankshaft does not turn freely, loosen the main bearing cap bolts, one set at a time, until the tight bearing is located. Burrs on the bearing cap, foreign matter between the insert and the block for the bearing cap, or a faulty insert could cause a lack of clearance at the bearing.

7. Connecting rods to the crankshaft. Use J-5239 to pull the connecting rods down (figure 27). Make sure the connecting rod bearing insert stays in place.

Measure

- Connecting rod bearing clearance. Refer to the proper unit repair manual.

8. Connecting rod caps with bearing inserts to the connecting rods. Apply engine oil to the inserts.
9. Connecting rod cap nuts.

Tighten

- Connecting rod cap nuts to 66 N·m (48 ft. lbs.).

Measure

- Connecting rod side clearance. Use a feeler gage between the connecting rod and crankshaft (figure 31). The correct clearance is 0.013–0.023-inch.

10. Camshaft sprocket and timing gears, as outlined previously.

Important

- Align the timing marks (figure 24).

11. Front cover, as outlined previously.
12. Oil pan and oil pump, as outlined previously.
13. Torsional damper, as outlined previously.
14. Spark plugs.
15. Flywheel (if equipped) as outlined later.
16. Engine, as outlined later.

FLYWHEEL REPLACEMENT

Remove or Disconnect

1. Transmission, flywheel housing, and clutch.
2. Flywheel bolts.
3. Flywheel.

Clean

- Mating surfaces of crankshaft and flywheel. Remove any burrs.

Inspect

— Flywheel for burning, scoring, warping, and wear. Replace the flywheel if necessary. Do not machine the flywheel.

— Flywheel ring gear for worn or broken teeth.

Flywheel Ring Gear Replacement

1. Use a torch to heat the gear around the entire circumference, then drive the gear off the flywheel, using care not to damage the flywheel.

NOTICE: Never heat starter gear to red heat as this will change metal structure.

2. Uniformly heat the flywheel gear to temperature which will expand the gear to permit installation. Temperature must not exceed 200°C (400°F).
3. As soon as the gear has been heated, install on the flywheel.

Install or Connect

1. Flywheel.
2. Flywheel bolts.

Tighten

- Flywheel bolts to 90 N·m (65 ft. lbs.).

3. Clutch, flywheel housing, and transmission.

ENGINE MOUNTINGS

NOTICE: Broken or deteriorated mountings can cause misaligned and eventual destruction of certain drive train components. When a single mounting breakage occurs, the remaining mountings are subjected to abnormally high stresses.

INSPECTING ENGINE MOUNTINGS

Front Engine Mountings

NOTICE: When raising or supporting the engine for any reason, do not use a jack under the oil pan, any sheet metal or crankshaft pulley. 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 pickup unit.

1. Raise the engine to remove weight from the mountings and to place a slight tension on the rubber cushion. Observe both mountings while raising the engine.
2. Replace the mounting if the following conditions exist:
   - — Hard rubber surface covered with heat check cracks.
   - — Rubber cushion separated from the metal plate of the mounting.
   - — Rubber cushion split through the center.
3. If there is movement between a metal plate of the mounting and its attaching points, lower the engine and tighten the bolts or nuts attaching the mounting to the engine, frame, or bracket.

Rear Mountings

1. Push up and pull down on the transmission tailshaft. Observe the transmission mounting.
2. Replace the mounting if the following conditions exist:
   - — Rubber cushion separated from the metal plate of the mounting.
   - — Mounting bottomed out (tailshaft can be moved up but not down).
3. If there is relative movement between a metal plate of the mounting and its attaching point, tighten the bolts or nuts attaching the mounting to the transmission or crossmember.

FRONT MOUNTING REPLACEMENT

↔ Remove or Disconnect (Figures 35, 36, and 37)

NOTICE: When raising or supporting the engine for any reason, do not use a jack under the oil pan, any sheet metal or crankshaft pulley. 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 pickup unit.

- Support the engine with a suitable jack. Do not load the engine mounting.

1. Engine mounting through-bolt and nut.

NOTICE: Raise the engine only enough for sufficient clearance. Check for interference between the rear of the engine and the dash panel which could cause distributor damage.

- Raise the engine only enough to permit removal of the engine mounting.

2. Mounting assembly bolts, nuts, and washers.
3. Mounting assembly.

→← Install or Connect (Figures 35, 36, and 37)

1. Mounting assembly.

NOTICE: See "Notice" on page 6A6-1 of this section.

2. Mounting assembly bolts, nuts, and washers.

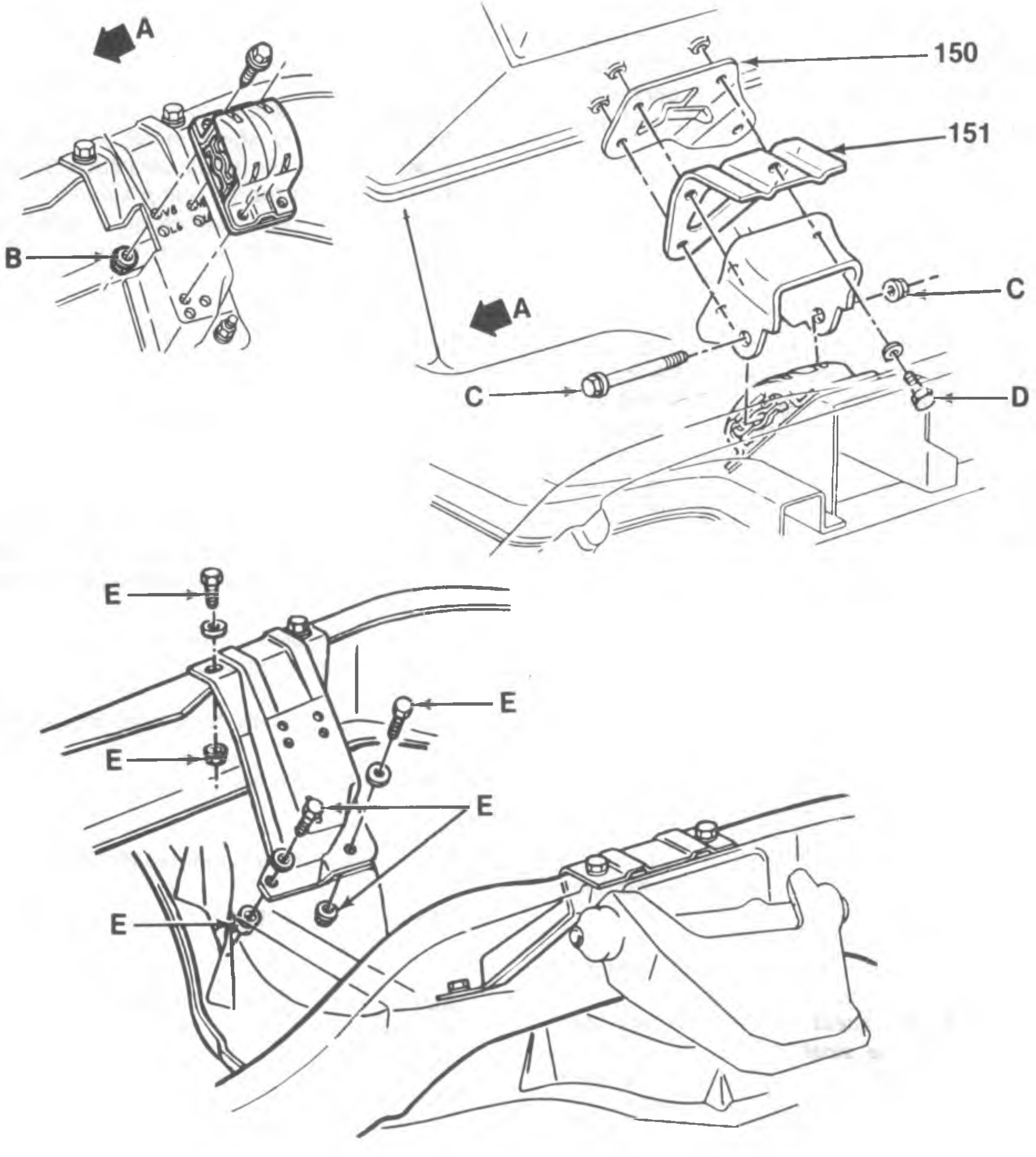
Tighten

- Fasteners to specifications. Refer to figures 35, 36, and 37.

3. Engine mount through-bolt and nut. Lower the engine until the bolt can be inserted. Install the nut.

Tighten

- Through-bolt nut to specifications. Refer to figures 35, 36, and 37.



A. Forward
B. 40 N·m (30 Ft. Lbs.)
C. Torque Bolt To 115 N·m (85 Ft. Lbs.) Or, Torque Nut To 75 N·m (55 Ft. Lbs.)
D. 48 N·m (36 Ft. Lbs.)
E. Torque Bolt To 48 N·m (36 Ft. Lbs.) Or, Torque Nut To 40 N·m (30 Ft. Lbs.)
150. Transmission Strut Bracket (Automatic Transmission) Or Spacer (Manual Transmission)
151. Heat Shield (Engines With Federal Emissions — Left Side Only)

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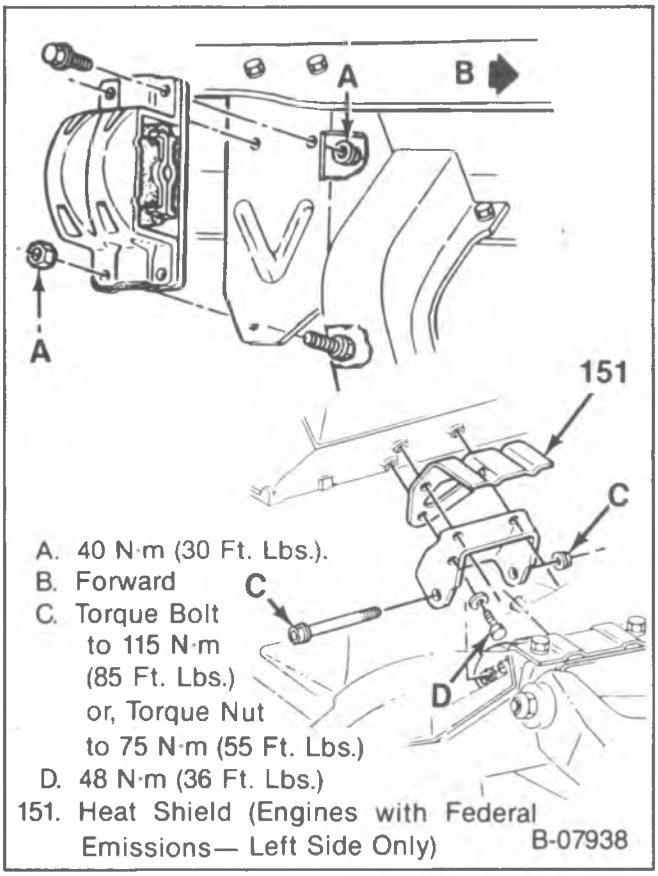
Figure 35—Front Engine Mounting (C Models)



A. 40 N·m (30 Ft. Lbs.).
B. Forward
C. Torque Bolt to 115 N·m (85 Ft. Lbs.) or, Torque Nut to 75 N·m (55 Ft. Lbs.)
D. 48 N·m (36 Ft. Lbs.)
151. Heat Shield (Engines with Federal Emissions— Left Side Only)

Figure 36—Front Engine Mounting (K Models)

REAR MOUNTING REPLACEMENT (EXCEPT P-MODELS WITH FLYWHEEL HOUSING MOUNTING)

Remove or Disconnect (Figures 38, 39, and 40)

NOTICE: When raising or supporting the engine for any reason, do not use a jack under the oil pan, any sheet metal or crankshaft pulley. 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 pickup unit.

- Support the rear of the engine to relieve the weight on the rear mountings.

1. Mounting to crossmember nut(s) and washer(s).
2. Mounting to transmission bolts and washers.
- Raise the rear of the engine only enough to permit removal of the mounting.
3. Mounting.

Install or Connect (Figures 38, 39, and 40)

1. Mounting.
- Lower the rear of the engine.
2. Mounting to transmission bolts and washers.

NOTICE: See "Notice" on page 6A6-1 of this section.

3. Mounting to crossmember nut(s) and washer(s).

Tighten

- Fasteners to specifications. Refer to figures 38, 39, and 40).

REAR MOUNTING REPLACEMENT (P-MODELS WITH FLYWHEEL HOUSING MOUNTING)

Remove or Disconnect (Figure 41)

1. Bolt, cushion, and spacer.

NOTICE: When raising or supporting the engine for any reason, do not use a jack under the oil pan, any sheet metal or crankshaft pulley. 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 pickup unit.

- Raise the rear of the engine only enough to permit removal of the mounting.
2. Engine mounting.

Install or Connect (Figure 41)

1. Engine mounting. Align the hole in the mounting with the hole in the crossmember.
- Lower the engine.

NOTICE: See "Notice" on page 6A6-1 of this section.

2. Spacer, cushion, and bolt.

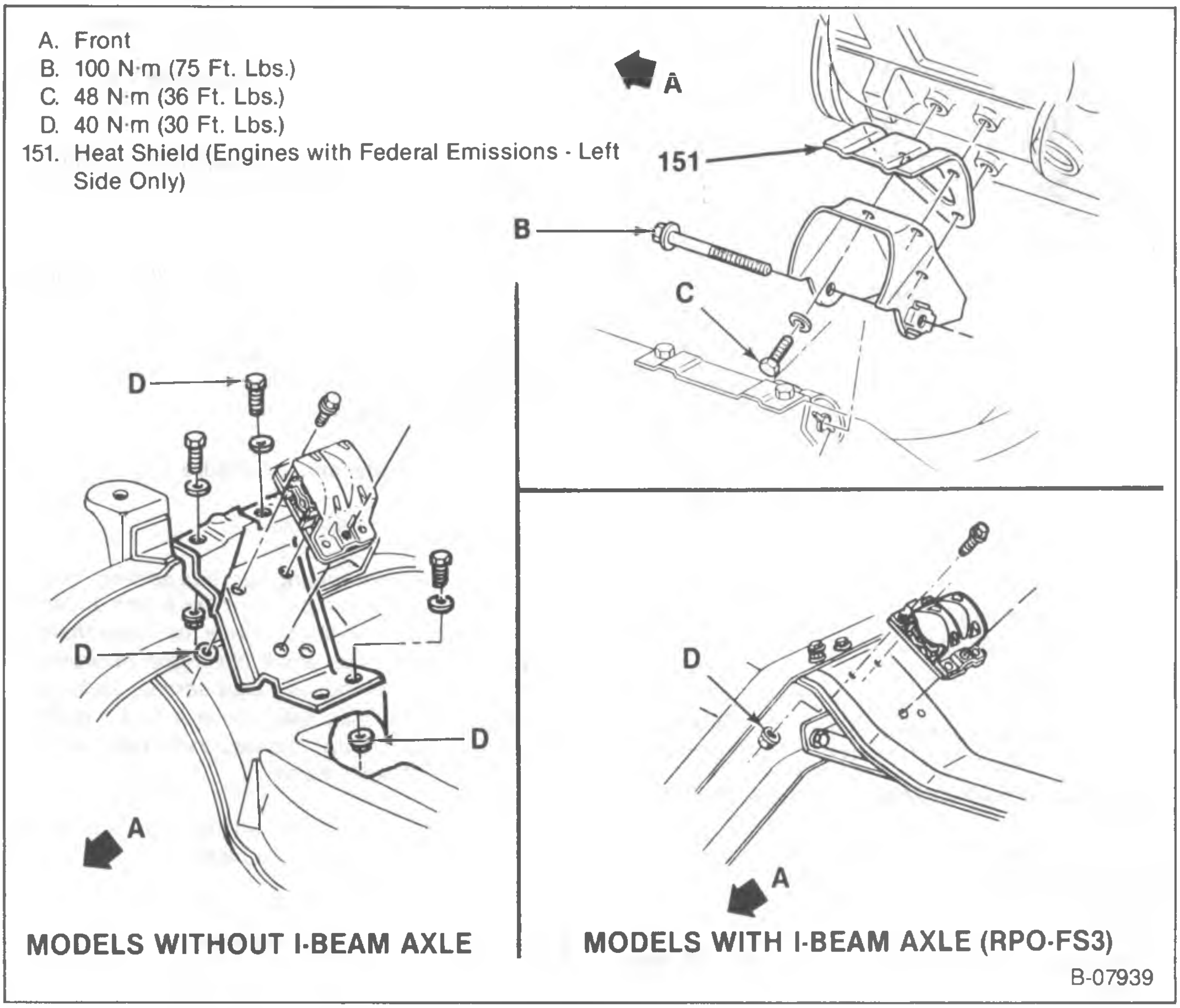
Tighten

- Bolt to 90 N·m (65 ft. lbs.).

ENGINE REPLACEMENT

Remove or Disconnect

1. Hood.
2. Battery negative cable.
3. Air cleaner.
4. Radiator and fan shroud. Refer to ENGINE COOLING (SEC. 6B).



A. Front
B. 100 N·m (75 Ft. Lbs.)
C. 48 N·m (36 Ft. Lbs.)
D. 40 N·m (30 Ft. Lbs.)
151. Heat Shield (Engines with Federal Emissions - Left Side Only)

Figure 37—Front Engine Mounting (P Models)

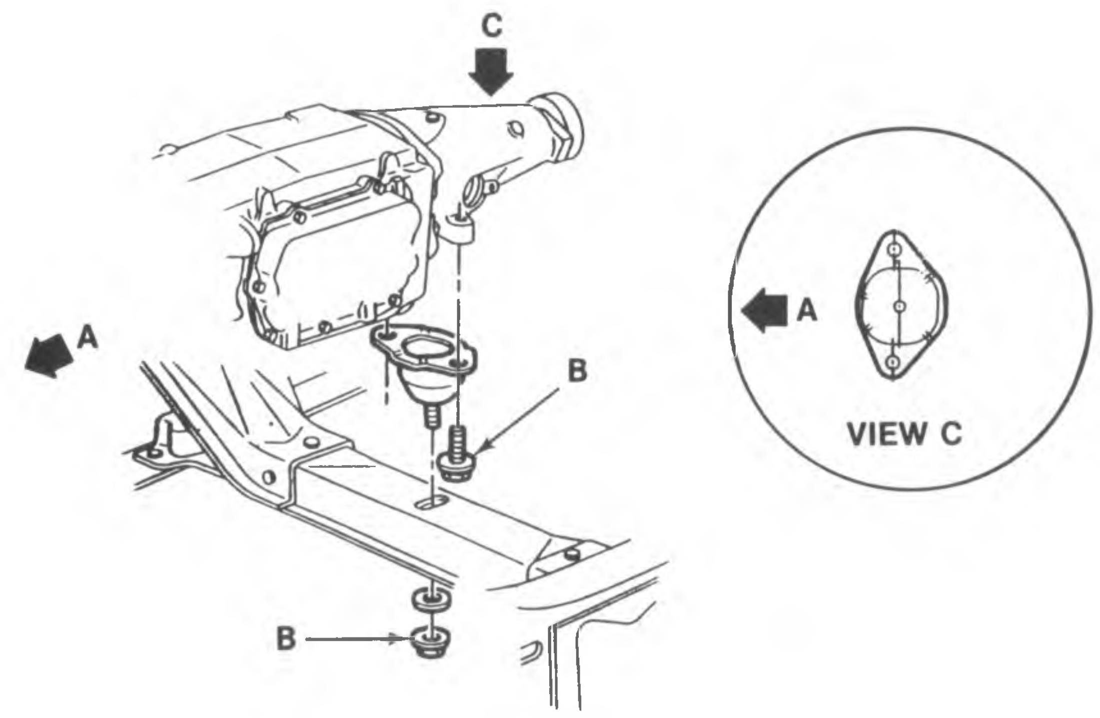
5. Necessary engine wiring:
   - — Starter and solenoid wires.
   - — Generator wires.
   - — TRC solenoid and switch (if used) wires.
   - — Temperature sensor wire.
   - — Oil pressure sender wire.
   - — Distributor wires.
   - — Any other necessary wiring.
6. Accelerator, cruise control and TVS linkages, as equipped.
7. Fuel supply line from fuel pump.
8. Necessary vacuum hoses:
   - — Evaporative emission hoses.
   - — Vacuum booster hose (if used).
   - — Cruise control hose (if used).
   - — Any other necessary vacuum hoses.
9. Power steering pump, and lay aside.
10. Air conditioning compressor, and lay aside.
   - Raise the vehicle.
11. Exhaust pipes at the manifolds.
12. Starter.
13. Flywheel or torque converter cover.
14. Flex plate to torque converter bolts (automatic transmission).
   - Lower the vehicle.
   - Support the transmission.
   - Attach a suitable lifting fixture.
15. Bell housing to engine bolts.
16. Front engine mounting through bolts.
17. Engine.

→← Install or Connect (Figures 36, 37, and 38)

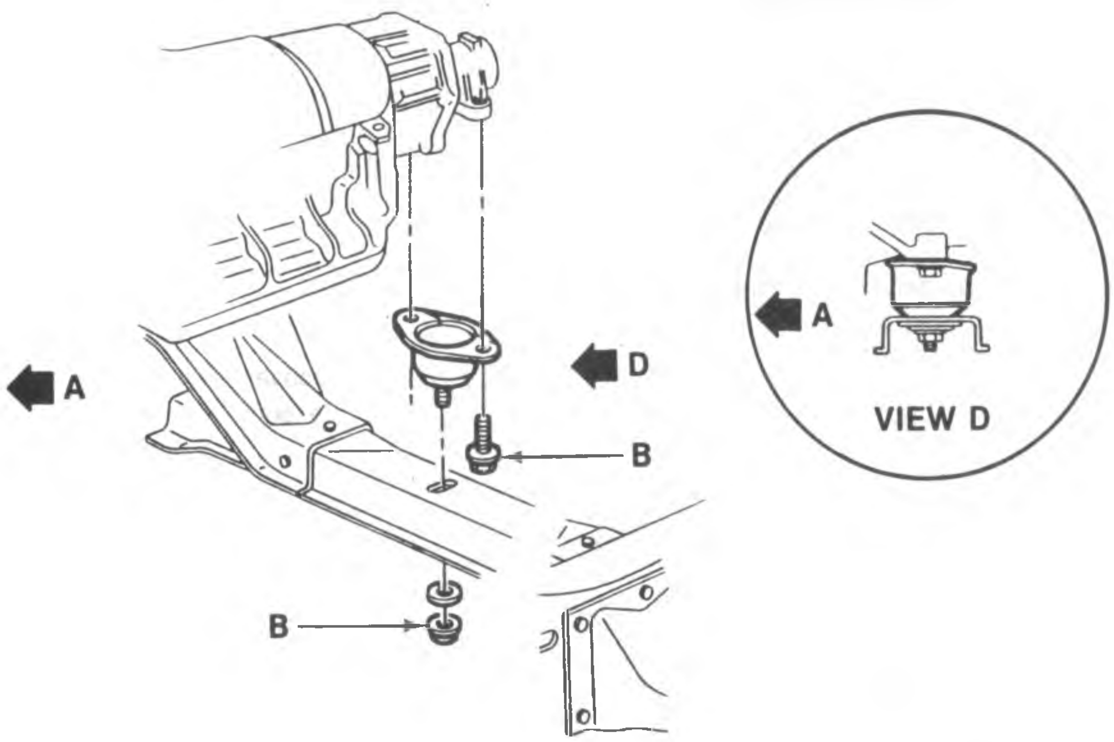
1. Engine in the vehicle.

NOTICE: See "Notice" on page 6A6-1 of this section.

2. Engine mounting through bolts and nuts.



ALL MODELS EXCEPT WITH THM 400 TRANSMISSION (RPO-M40)



MODELS WITH THM 400 TRANSMISSION (RPO-M40)

A. Forward
B. 48 N·m (36 Ft. Lbs.)

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Figure 38—Rear Engine Mounting (C Models)

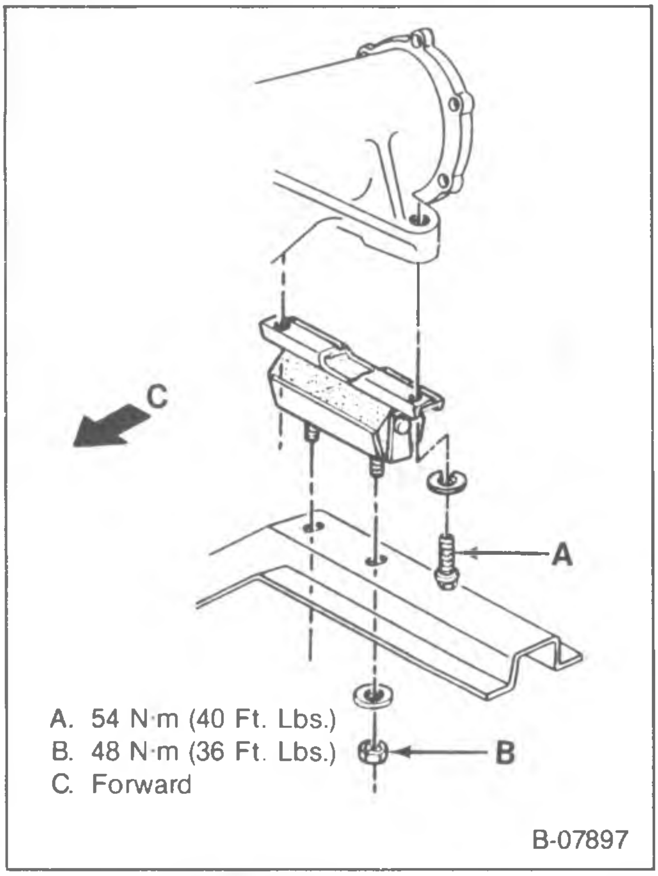
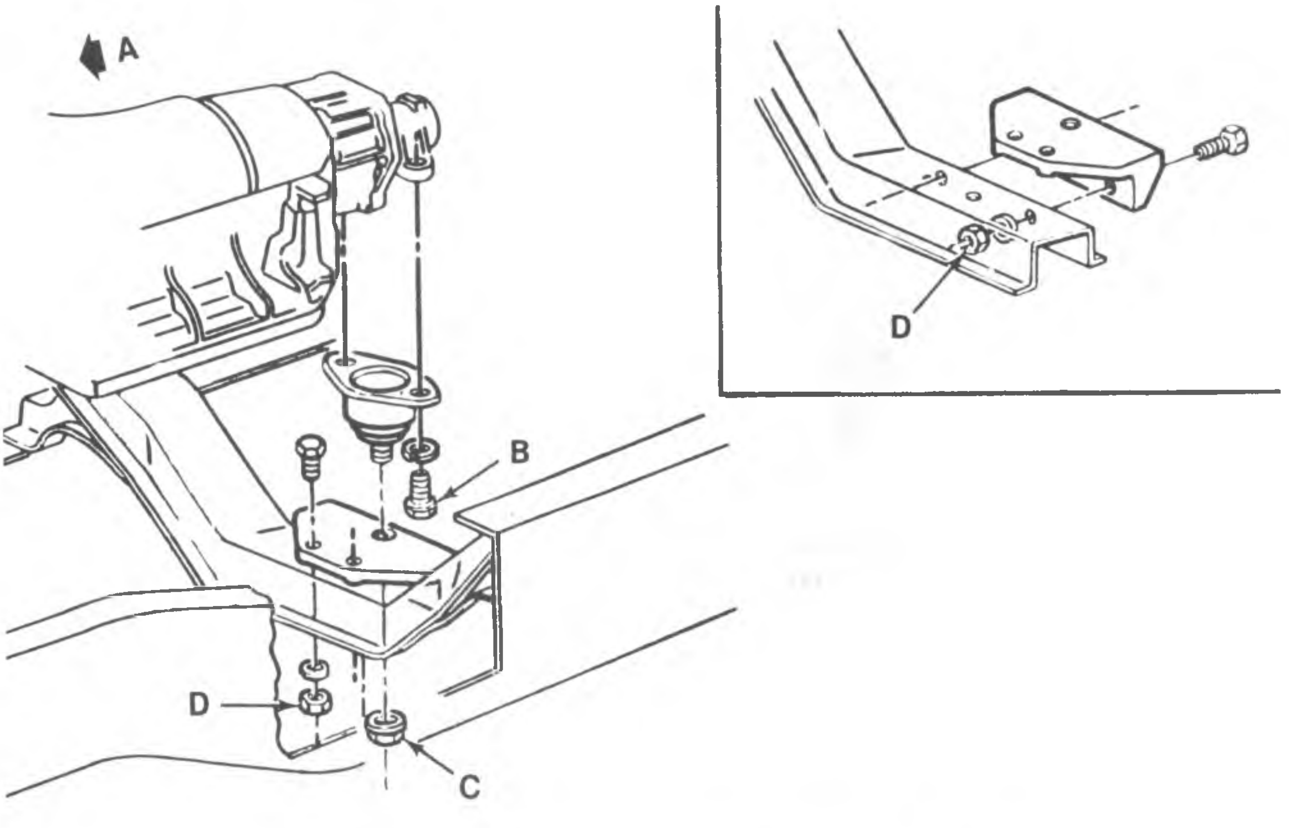


Figure 39—Rear Engine Mounting (K Models)

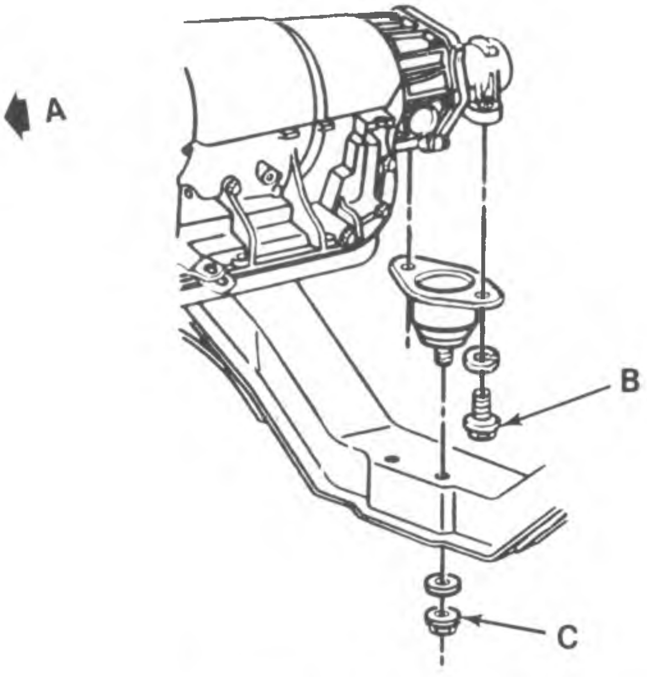
Tighten

- Fasteners to specifications. Refer to figures 36, 37, and 38.

3. Bell housing bolts.
- Remove the lifting fixture and transmission jack.
- Raise the vehicle.
4. Flex plate to torque converter bolts (automatic transmission).
5. Flywheel or torque converter cover.
6. Starter.
7. Exhaust pipes at the manifolds.
8. Air conditioning compressor.
9. Power steering pump.
10. Vacuum hoses.
11. Fuel supply line.
12. Accelerator, cruise control, and TVS linkages, as equipped.
13. Engine wiring.
14. Radiator and fan shroud: Refer to ENGINE COOLING (SEC. 6B).
15. Air cleaner.
16. Hood.
17. Battery negative cable.
18. Proper quantity and grade of coolant.



MODELS WITH PROPSHAFT PARKING BRAKE



A. Forward
B. 68 N·m (50 ft. lbs.)
C. 48 N·m (36 ft. lbs.)
D. 60 N·m (44 ft. lbs.)

MODELS WITHOUT PROPSHAFT PARKING BRAKE

Figure 40—Rear Engine Mounting (P Models with Transmission Tail Type Mounting)

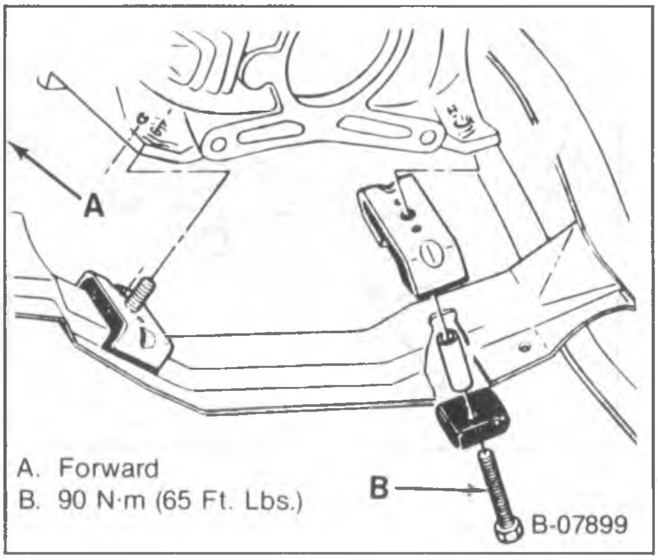


Figure 41—Rear Engine Mounting (P Models with Flywheel Housing Type Mounting)

SPECIFICATIONS

ENGINE SPECIFICATIONS

All Specifications are in INCHES unless otherwise noted.

GENERAL DATA:				
Type				V8
Displacement				7.4L (454 Cu. In.)
RPO				LE8
Bore				4.25
Stroke				4.00
Compression Ratio				8.0:1
Firing Order				1 - 8 - 4 - 3 - 6 - 5 - 7 - 2
Oil Pressure				10 psi @ 500 RPM Minimum; 40-60 psi @ 2000 RPM
CYLINDER BORE:				
Diameter				4.2495-4.2525
Out Of Round	Production			0.001 (Maximum)
	Service			0.002 (Maximum)
Taper	Production	Thrust Side		0.0005 (Maximum)
		Relief Side		0.001 (Maximum)
	Service			0.001 (Maximum)
PISTON:				
Clearance	Production			0.003-0.004
	Service Limit			0.005 (Maximum)
PISTON RING:				
COMPRESSION	Groove Clearance	Production	Top	0.0017-0.0032
			2nd	0.0017-0.0032
		Service Limit		Hi Limit Production +0.001
	Gap	Production	Top	0.010-0.018
			2nd	0.016-0.024
		Service Limit		Hi Limit Production + 0.010
OIL	Groove Clearance	Production		0.0050-0.0065
		Service Limit		Hi Limit Production + 0.001
	Gap	Production		0.015-0.055
		Service Limit		Hi Limit Production + 0.010
PISTON PIN:				
Diameter				0.9895-0.9898
Clearance In Piston	Production			0.00025-0.00035
	Service Limit			0.001 (Maximum)
Fit In Rod				0.0013-0.0021 Interference

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SPECIFICATIONS

ENGINE SPECIFICATIONS (CONT.)

All specifications are in INCHES unless otherwise noted.

DISPLACEMENT			7.4L
CRANKSHAFT:			
Main Journal	Diameter	#1, #2, #3, #4	2.7481-2.7490
		#5	2.7476-2.7486
	Taper	Production	0.0002 (Maximum)
		Service Limit	0.001 (Maximum)
	Out Of Round	Production	0.0002 (Maximum)
		Service Limit	0.001 (Maximum)
Main Bearing Clearance	Production	#1,#2, #3, #4	0.0013-0.0025
		#5	0.0024-0.0040
	Service Limit	#1, #2, #3, #4	0.0010-0.0025
		#5	0.0025-0.0035
Crankshaft End Play			0.002-0.006
Crankpin	Diameter		2.1990-2.200
	Taper	Production	0.0005
		Service Limit	0.001
	Out Round	Production	0.0005
		Service Limit	0.001
Rod Bearing Clearance	Production		0.0009-0.0025
	Service Limit		0.003 (Maximum)
Rod Side Clearance			0.0013-0.023
CAMSHAFT:			
Lobe Lift ± 0.002	Intake		0.2343
	Exhaust		0.2530
Journal Diameter			1.9482-1.9492
VALVE SYSTEM:			
Lifter			Hydraulic
Rocker Arm Ratio			1.70:1
Valve Lash		Intake	3/4 Turn Down From Zero Lash
		Exhaust	
Face Angle (Intake & Exhaust)			45°
Seat Angle (Intake & Exhaust)			46°
Seat Runout (Intake & Exhaust)			0.002 (Maximum)
Seat Width		Intake	1/32-1/16
		Exhaust	1/16-3/32
Stem Clearance	Production	Intake	0.0010-0.0027
		Exhaust	0.0012-0.0029
	Service	Intake	High Limit Production + 0.001
		Exhaust	High Limit Production + 0.002
Valve Spring	Free Length		2.12
	Pressure lbs. @ in.	Closed	74-86 lbs. @ 1.80 in.
		Open	195-215 lbs. @ 1.40 in.
	Installed Height ± 1/32″		1 51/64
	Valve Spring Fit In Damper		0.042-0.094 Interference

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SPECIFICATIONS (CONT.)

TORQUE SPECIFICATIONS

Item	N·m	Ft. Lbs.	In. Lbs.
Rocker Arm Cover Nuts	5.4	—	48
Intake Manifold Bolts	40	30	—
Rocker Arm Studs	68	50	—
Exhaust Manifold Bolts			
Models with stainless steel manifolds (RPO-NA5)	54	40	—
Models with cast iron manifolds (RPO-NB2)	24	18	—
Cylinder Head Bolts	130	95	—
Torsional Damper Bolts	115	85	—
Front Cover to Block Bolts	10.8	—	96
Oil Pan to Front Cover Bolts	7.9	—	70
Oil Pan to Block Bolts	15.3	—	135
Oil Pump Bolt	90	65	—
Main Bearing Caps	150	110	—
Camshaft Sprocket Bolts	26	20	—
Connecting Rod Cap Nuts	66	48	—
Oil Filter Bypass Valve Bolts	26	20	—
Flywheel Bolts	90	65	—
Oil Pump Cover Bolts	9.0	—	80
Flywheel Housing Bolts	40	30	—
Water Pump Bolts	40	30	—
Water Outlet Bolts	40	30	—
Spark Plugs	30	22	—

SPECIAL TOOLS

J-23590	Air Adapter
J-5892-A	Spring Compressor
J-3049	Hydraulic Lifter Remover (Plier Type)
J-9290-1	Hydraulic Lifter Remover (Slide Hammer Type)
J-1619	Crankshaft Sprocket Puller
J-22102	Front Crankshaft Seal and Crankshaft Sprocket Installer
J-23523-E	Torsional Damper Remover and Installer
J-8520	Camshaft Lobe Lift Indicator
J-5239	Guide Set
J-8037	Ring Compressor
J-8080	Main Bearing Remover/Installer

SECTION 6A7

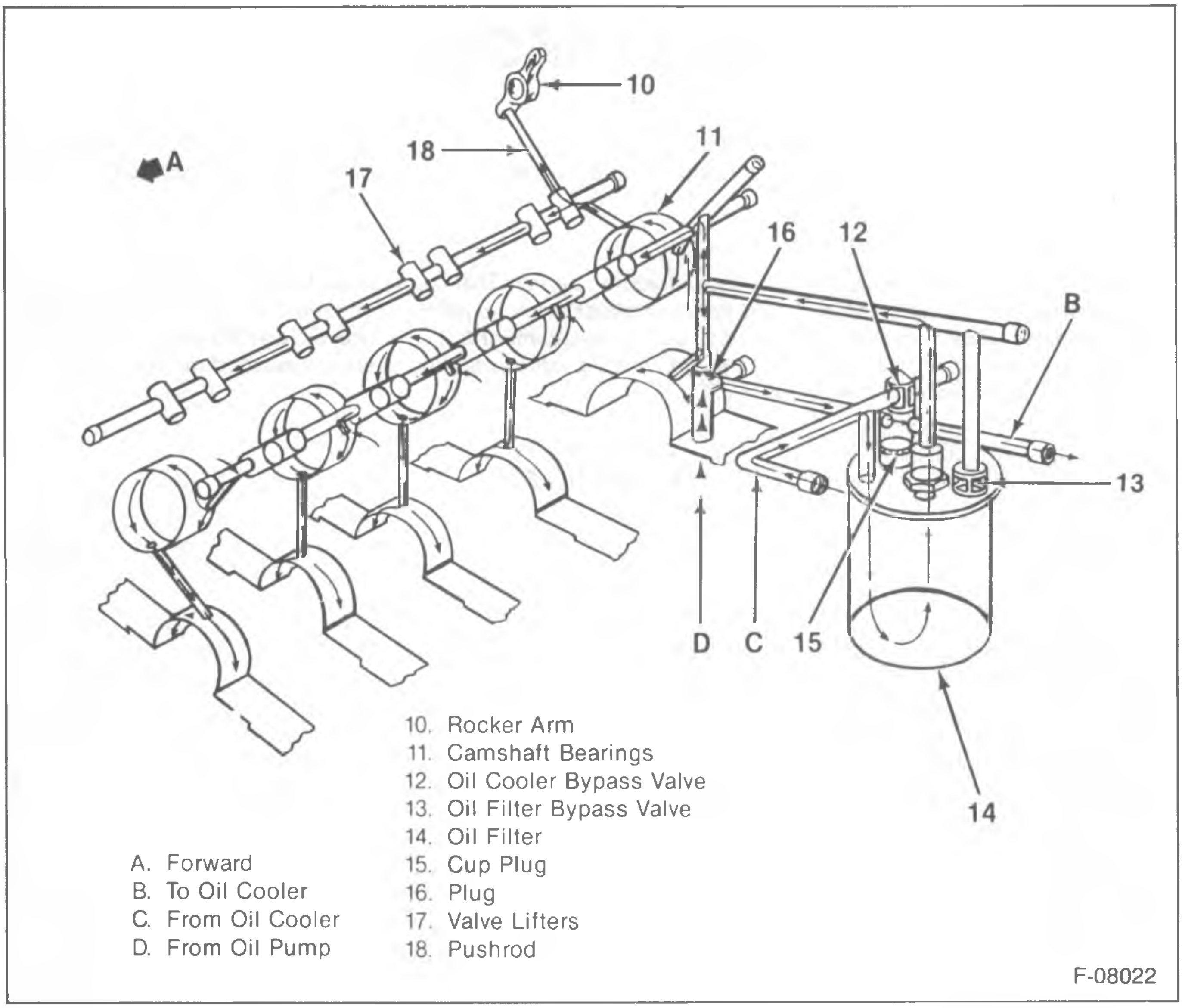
6.2L DIESEL

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 "NOTICE: See 'Notice' on page 6A7-1 of this section."

NOTICE: All engine 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 this part.

CONTENTS

DESCRIPTION



10. Rocker Arm
11. Camshaft Bearings
12. Oil Cooler Bypass Valve
13. Oil Filter Bypass Valve
14. Oil Filter
15. Cup Plug
16. Plug
17. Valve Lifters
18. Pushrod

A. Forward
B. To Oil Cooler
C. From Oil Cooler
D. From Oil Pump

F-08022

Figure 1—Lubrication Diagram

6.2L diesel engines are 90 degree V8 type, naturally aspirated, with indirect type combustion chambers.

The crankshaft is supported by five precision insert main bearings, with crankshaft thrust taken at the number three (center) main bearing.

The camshaft is supported by five plain type bearings and is chain driven. Motion from the camshaft is transmitted to the overhead valves by roller type hydraulic lifters, pushrods, and spindle mounted rocker arms. The valve guides are integral in the cylinder head.

The connecting rods are forged steel, with precision insert type crankpin bearings. The piston pins are retained by snap ring retainers.

ENGINE LUBRICATION

A lubrication schematic is shown in figure 1.

The gear type oil pump is driven from either the vacuum pump shaft or from a drive gear, depending on engine application. The vacuum pump or drive gear is driven by the camshaft. Oil is drawn into the pump through a pickup screen and pipe.

Pressurized oil is routed to the oil cooler, located in the radiator. A bypass valve is provided should the oil cooler become clogged. Oil flows from the cooler to a full flow oil filter. An oil filter bypass valve is provided should the oil filter become clogged.

Oil flows from the oil filter to the oil galleries, providing pressurized lubrication to various components.

The hydraulic valve lifters receive oil from the oil galleries. Oil flows from the hydraulic lifters through hollow pushrods to the rocker arms. Oil from the overhead drains back to the crankcase through oil drain holes.

The pistons, rings, piston rings, cylinder walls, and connecting rod small end bearing are lubricated by oil splash.

ON-VEHICLE SERVICE

INTAKE MANIFOLD REPLACEMENT

Remove or Disconnect

Tool Required:
J-29664-1 Intake Port Covers

1. Battery cables.
2. Engine cover (G models).
3. Air cleaner.
4. EGR/EPR solenoids with bracket from the intake manifold studs.
5. CDR valve (G models).
6. EGR and crankcase ventilation hoses.
7. Rear air conditioning compressor bracket (if equipped).
8. Fuel line bracket and ground strap.
9. Fuel filter bracket at the intake manifold (G models).
10. Intake manifold bolts and fuel line clips. On models with gear driven vacuum pumps, it may be necessary to loosen the vacuum pump clamp bolt and turn the pump to provide access to an intake manifold bolt.
11. Intake manifold and gasket.

Important

- If any further service work is to be done, cover the intake ports with J-29664-1.

Clean

- Gasket surfaces on intake manifold and cylinder heads.

Install or Connect (Figure 2)

1. New gaskets. Be sure to use the correct gasket. The gaskets for light duty emissions models have openings for the EGR, the gaskets for heavy duty emissions models do not. Be sure to remove J-29664-1 from the intake ports, if necessary.
2. Intake manifold.
3. Intake manifold bolts and fuel line clips.

Tighten

- Intake manifold bolts to 42 N·m (32 ft. lbs.). Use the tightening sequence shown in figure 2.

- Rotate the vacuum pump to the proper position and tighten the clamp bolt (gear driven vacuum pumps).

4. Fuel filter bracket (G models).
5. Fuel line bracket and ground strap.
6. Rear air conditioning compressor bracket (if equipped).
7. EGR and crankcase ventilation hoses.
8. CDR valve (G models).
9. EGR/EPR solenoids with bracket.
10. Air cleaner.
11. Engine cover (G models).
12. Battery cables.

EXHAUST MANIFOLD REPLACEMENT

C AND K MODELS (RIGHT SIDE)

Remove or Disconnect

1. Battery cables.
   - Raise the vehicle.
2. Exhaust pipe from the manifold.
   - Lower the vehicle.
3. Glow plug wires.
4. Air cleaner duct bracket.
5. Glow plugs.
6. Exhaust manifold bolts and exhaust manifold.

Clean

— Sealing surfaces on exhaust manifold and cylinder head.

— Threads on manifold bolts.

Install or Connect

1. Exhaust manifold and bolts.

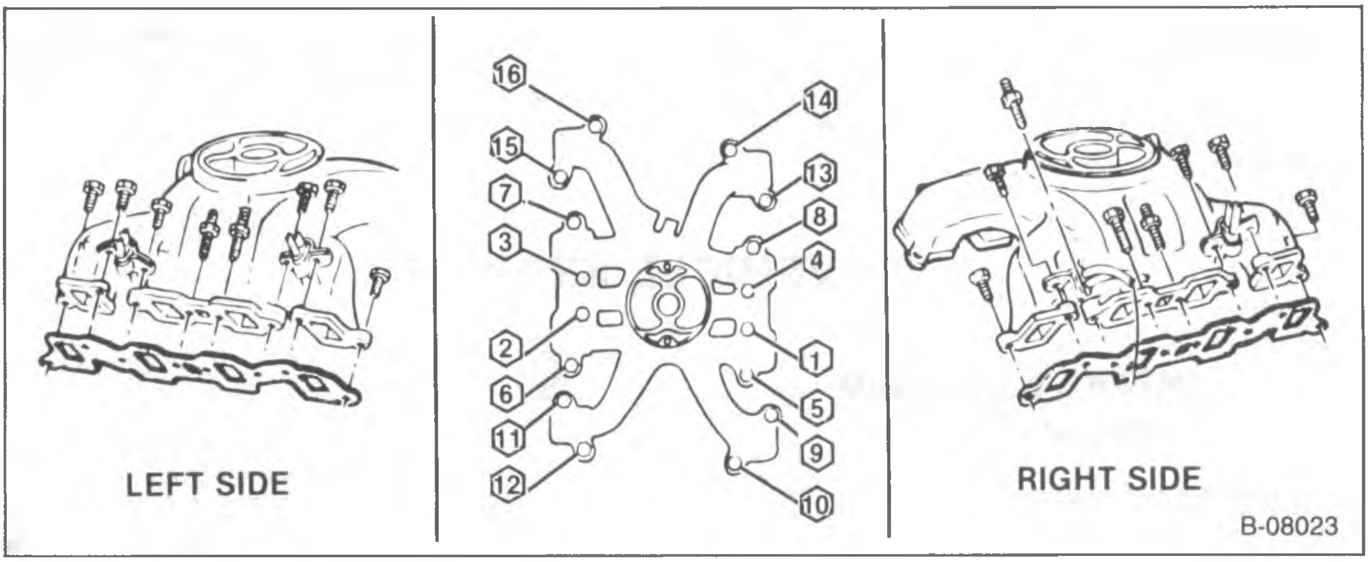


Figure 2—Intake Manifold Installation

Tighten

- Bolts to 35 N·m (26 ft. lbs.).

2. Glow plugs.
3. Air cleaner duct bracket.
4. Glow plug wires.
- Raise the vehicle.
5. Exhaust pipe to the manifold.
- Lower the vehicle.
6. Battery cables.

C AND K MODELS (LEFT SIDE)

Remove or Disconnect

1. Battery cables.
2. Dipstick tube.
3. Glow plugs.
4. Air conditioning compressor rear bracket (if equipped).
5. Exhaust manifold bolts.
- Raise the vehicle.
6. Exhaust pipe at the manifold.
7. Exhaust manifold, from below the vehicle.

Clean

— Sealing surfaces on the exhaust manifold and cylinder head.
— Threads on the exhaust manifold bolts.

Install or Connect

1. Exhaust manifold, from below the vehicle. Loosely install two or three bolts to hold the manifold in place.
2. Exhaust pipe to the manifold.
- Lower the vehicle.
3. Remaining exhaust manifold bolts and air conditioning compressor rear bracket (if used).

Tighten

- Bolts to 35 N·m (26 ft. lbs.).

4. Glow plugs.
5. Dipstick tube.
6. Battery cables.

G MODELS (BOTH SIDES)

Remove or Disconnect

1. Battery cables.
- Raise the vehicle.
2. Exhaust pipe at the manifold.
- Lower the vehicle.
3. Engine cover.
4. Glow plug wires.
5. Air conditioning compressor rear bracket (if equipped) (left side exhaust manifold).
6. Exhaust manifold bolts and exhaust manifold.

Clean

— Sealing surfaces on the exhaust manifold and cylinder head.
— Threads on the manifold bolts.

Install or Connect

1. Exhaust manifold.
2. Exhaust manifold bolts and air conditioning compressor rear bracket (if equipped) (left side exhaust manifold).

Tighten

- Bolts to 35 N·m (26 ft. lbs.).

3. Glow plug wires.
4. Engine cover.
- Raise the vehicle.
5. Exhaust pipe to the manifold.
- Lower the vehicle.
6. Battery cables.

ROCKER ARM COVER REPLACEMENT

C AND K MODELS (BOTH SIDES)
G MODELS (RIGHT SIDE)

Remove or Disconnect

1. Intake manifold, as outlined previously.
2. Fuel injection lines. Refer to DIESEL FUEL INJECTION (SEC. 6C2). (Injection lines for #5 and #7 cylinders do not have to be removed for right side rocker arm cover replacement).
3. Glow plug wires (G models).
4. Wiring harness from wiring harness clip.
5. Wiring harness bracket (left rocker arm cover).
6. Rocker arm cover bolts.

NOTICE: Do not pry on the rocker arm cover. Damage to sealing surfaces may result.

7. Rocker arm cover.

Clean

1. RTV from the rocker arm cover and cylinder head. All loose RTV, or pieces that will cause installation interference, must be removed.
2. Oil and grease from the sealing surfaces on the rocker arm cover and cylinder head. Use a suitable solvent.

Inspect

- Rocker arm cover sealing flanges for distortion. Replace as necessary.

Install or Connect (Figure 3)

NOTICE: Do not allow RTV sealant into the rocker arm cover bolt holes. This may cause a "hydraulic lock" condition when the bolts are tightened, damaging the cylinder head casting.

- Apply a 5 mm (3/16-inch) bead of RTV sealant (GM part number 1052915 or equivalent) to the cylinder head, inboard of the bolt holes. Refer to figure 3. The sealer must be wet to the touch when the bolts are torqued.

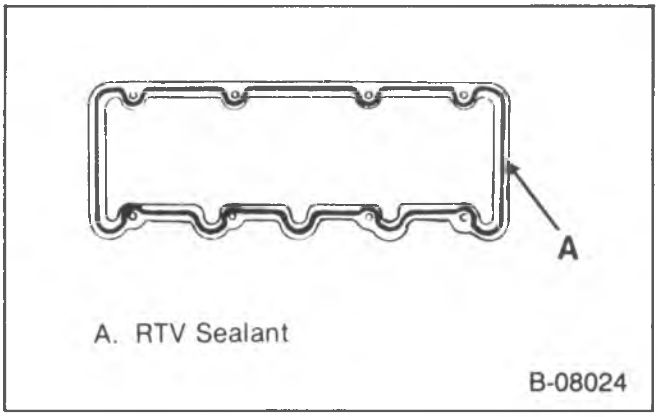


Figure 3—Apply Sealant To The Rocker Arm Cover

1. Rocker arm cover.
2. Rocker arm cover bolts.

Tighten

- Bolts to 22 N·m (16 ft. lbs.).

3. Wiring harness bracket.
4. Wiring harness to the wiring harness clip.
5. Glow plug wires (G models).
6. Fuel injection lines. Refer to DIESEL FUEL INJECTION (SEC. 6C2).
7. Intake manifold, as outlined previously.

G MODELS (LEFT SIDE)

Remove or Disconnect

1. Intake manifold, as outlined previously.
2. Fuel injection lines. Refer to DIESEL FUEL INJECTION (SEC. 6C2).
3. Upper fan shroud (vehicles with air conditioning).
4. Air conditioning compressor belt (if equipped).
5. Left exhaust manifold, as outlined previously (vehicles with air conditioning).
6. Air conditioning compressor (if equipped). Refer to AIR CONDITIONING (SEC. 1B).
7. Dipstick tube front bracket from stud.
8. Wiring harness brackets.
9. Rocker arm cover bolts and fuel return bracket.

NOTICE: Do not pry on the rocker arm cover. Damage to the sealing surfaces may result.

10. Rocker arm cover.

Clean

1. RTV from the rocker arm cover and cylinder head. All loose RTV, or pieces that will cause installation interference, must be removed.
2. Oil and grease from the sealing surfaces on the rocker arm cover and cylinder head. Use a suitable solvent.

Inspect

- Rocker arm cover sealing flanges for distortion. Replace as necessary.

Install or Connect (Figure 3)

NOTICE: Do not allow RTV sealant into the rocker arm cover bolt holes. This may cause a "hydraulic lock" condition when the bolts are tightened, damaging the cylinder head casting.

1. Rocker arm cover.
2. Rocker arm cover bolts and fuel return bracket.

   Tighten

   - Bolts to 22 N·m (16 ft. lbs.).
3. Wiring harness brackets.
4. Dipstick tube front bracket.
5. Air conditioning compressor (if equipped). Refer to AIR CONDITIONING (SEC. 1B).
6. Left exhaust manifold, as outlined previously (if removed).
7. Air conditioning compressor belt (if equipped).
8. Upper fan shroud (if removed).
9. Fuel injection lines. Refer to DIESEL FUEL INJECTION (SEC. 6C2).
10. Intake manifold, as outlined previously.

ROCKER ARM, SHAFT, AND PUSHROD REPLACEMENT

Remove or Disconnect (Figures 4 and 5)

1. Rocker arm cover, as outlined previously.
2. Rocker arm shaft nuts.
3. Rocker arm shaft with rocker arms. Mark the assemblies so they can be returned to the original location at assembly.
4. Pushrods.

   Important

   - The pushrods must be installed in the original direction at assembly. This is because the pushrods have a different degree of hardness at each end. A paint stripe identifies the upper end of the pushrod. If the paint stripe is not visible, mark the pushrods on the upper end as they are removed.
   - The pushrods should be installed in the same location at assembly.
5. Rocker arms, if required.
   - Insert a screwdriver into the rocker arm shaft bore, and break off the end of the nylon rocker arm retainers.
   - Remove the rocker arm retainers with pliers (figure 5).
   - Slide the rocker arms from the shaft.

Install or Connect (Figures 4 and 6)

1. Rocker arms to the rocker arm shaft. One type of rocker arm is used at all locations.

   Important

   - Lubricate the rocker arms with engine oil before installing.
2. Rocker arm retainers.
   - Center the rocker arms on the corresponding holes in the rocker arm shaft.
   - Install new retainers. Use a drift of at least 13 mm ($^{1}/_{2}$-inch) diameter.

NOTICE: The pushrods must be installed with the marked or painted end up. Failure to do so may result in damage or premature wear.

3. Pushrods, with the painted or marked end up.
4. Rocker arm shaft assembly. Make sure the ball ends of the pushrods seat in the rocker arms.

NOTICE: Improper installation of the rocker arm shaft bolts may cause rocker arm shaft breakage and/or piston to valve contact.

5. Rocker arm shaft bolts.
   - Rotate the engine until the mark on the torsional damper aligns with the "0" mark on the timing tab.
   - Rotate the engine counterclockwise 88 mm (3$^{1}/_{2}$-inches), measured at the torsional damper. This measurement can be estimated by aligning the torsional damper mark with the first lower water pump bolt (figure 6). This procedure will position the engine so no valves are close to a piston crown.
   - Install both bolts snug on the shaft.

17. Hydraulic Lifter
18. Pushrod
30. Bolt
31. Rocker Arm Assembly
32. Clamp
33. Guide Plate

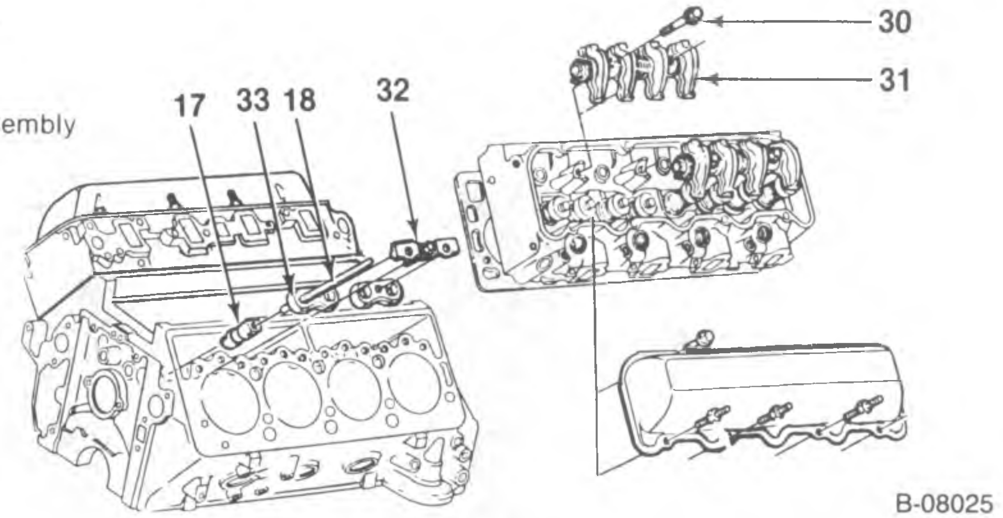


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Figure 4—Valve Train Components

Tighten

- Bolts alternately to 55 N·m (40 ft. lbs.).

6. Rocker arm cover, as outlined previously.

HYDRAULIC LIFTER REPLACEMENT

Remove or Disconnect (Figure 4)

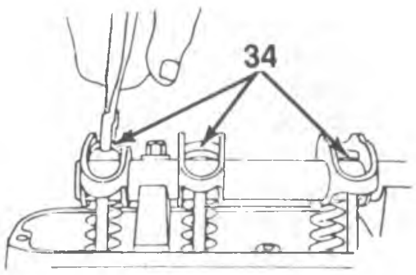
Tool Required:

J-29834 Hydraulic Lifter Remover (C and K Models)

1. Rocker arm covers, as outlined previously.
2. Rocker arm shaft with rocker arms and pushrods, as outlined previously.

Important

- Rocker arm assemblies and pushrods must be marked for proper assembly, as outlined previously.



34. Rocker Arm Retainers

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Figure 5—Removing The Rocker Arm Retainers

3. Cylinder head, as outlined later (G models).
4. Clamps (32).
5. Guide plates (33). Use mechanical fingers, if necessary.
6. Hydraulic lifters, through the access hole in the cylinder head. On C and K Models, use J-29834 and a magnet. Place the lifters in an organizer rack. The lifters must be installed in the same bore from which they were removed.

Inspect

- — Hydraulic lifter body for scuffing and scoring. Replace the lifter if present.
- — Roller for looseness and excessive play. Check for missing or broken needle bearings. Replace if necessary.
- — Roller surface for pits and roughness. If present, the mating camshaft lobe should also be checked. If the lobe is pitted or rough, replace both camshaft and lifter.

Hydraulic Lifter Repair

- Refer to the proper unit repair manual.

Important

- Some engines will have both standard and 0.010-inch oversize hydraulic lifters. The oversize lifter will have a "10" etched on the side. The block will be stamped "O.S." on the cast pad adjacent to the lifter bore and on the top rail of the cylinder case above the lifter bore.

Install or Connect (Figure 4)

NOTICE: New hydraulic lifters must be primed before installation. Damage to the lifters may result if dry when the engine is started.

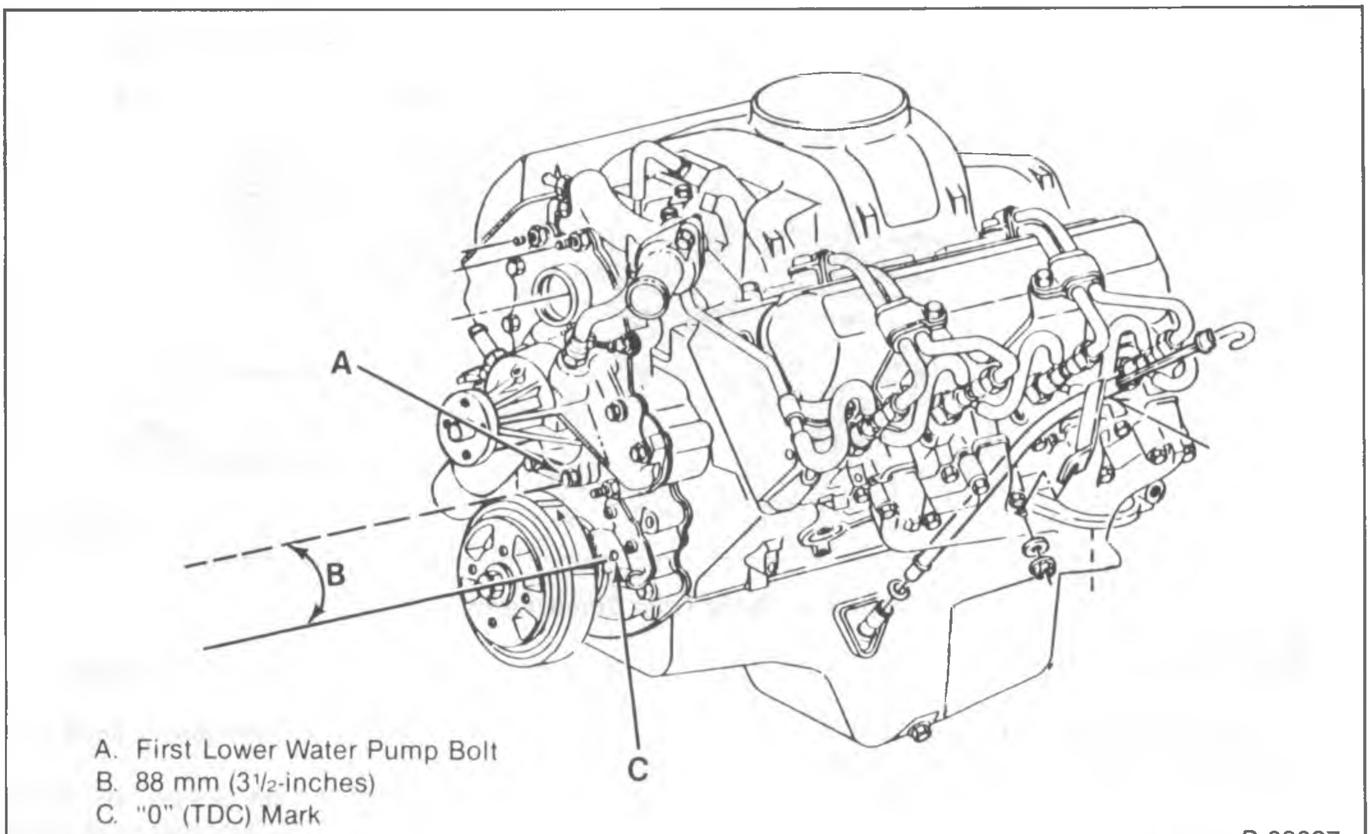


Figure 6—Aligning The Timing Mark

1. Hydraulic lifters to the engine. On C and K models, fabricate an installation tool from mechanic's wire.

Important

- Prime new hydraulic lifters before installation by working the lifter plunger while submerged in clean kerosene or diesel fuel.
- Coat the lifter roller and bearings with lubricant (GM part number 1052365 or equivalent).
- Lifters MUST be installed in their original locations.

2. Guide plates (33).
3. Clamps (32).

Tighten

- Clamp bolt to 26 N·m (18 ft. lbs.).

Important

- After all clamps are installed, turn the crankshaft by hand 720 degrees (two full turns), to insure free movement of the lifters in the guide plates. If the engine will not turn over by hand, one or more of the lifters may be binding in the guide plate.

4. Cylinder head, as outlined later (G models).
5. Rocker arm shaft with rocker arms and pushrods, in their original locations, as outlined previously. Hardened ends of the pushrods must face up.
6. Rocker arm covers, as outlined previously.

VALVE STEM SEAL AND VALVE SPRING REPLACEMENT

Remove or Disconnect (Figures 7 and 8)

Tools Required:
J-29666 Air Line Adapter
J-26513 Valve Spring Compressor Or
J-5892-A Valve Spring Compressor

1. Rocker arm covers, as outlined previously.
2. Rocker arm shaft with rocker arms, as outlined previously. Mark the assemblies so they can be returned to their original locations.
3. Glow plugs.
4. Valve keepers (42).
   - Rotate the engine until the piston for the cylinder being serviced is at TDC.
   - Install J-29666 into the glow plug hole.

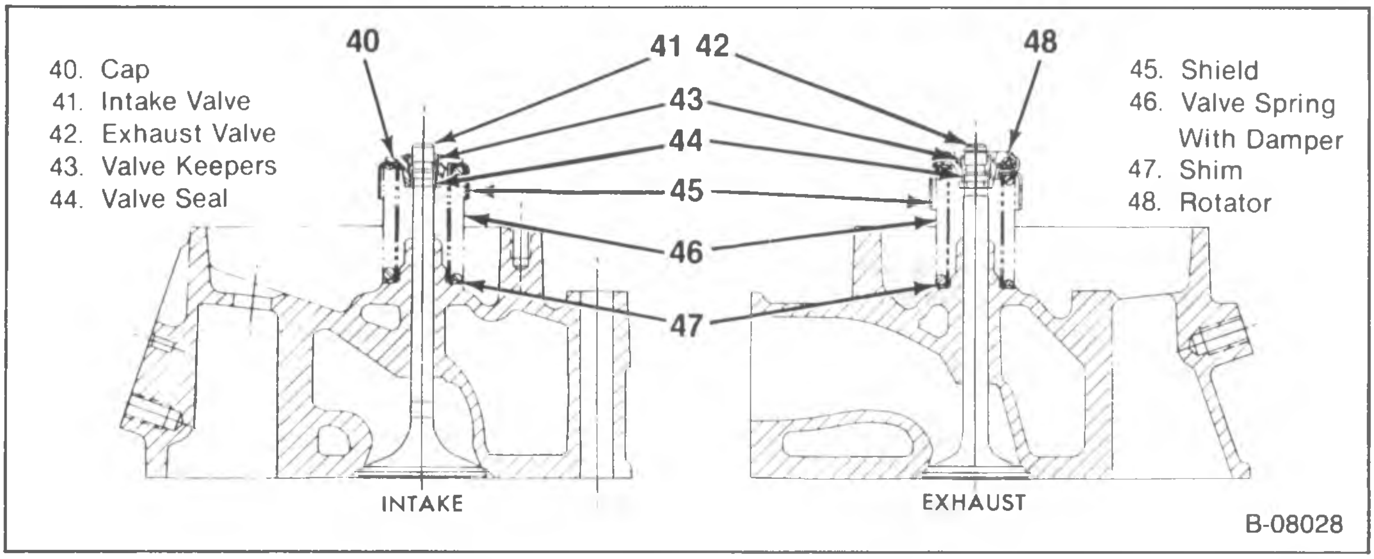


Figure 7—Valves And Components

- Apply compressed air to hold the valves in place.
- Use J-26513 (or J-5892-A) to compress the valve spring (figure 8). If the spring will not compress, tap on the tool lightly with a mallet to break the cap (40) or rotator (48) loose from the valve keepers.
- Remove the valve keepers.
- Carefully release spring tension. Remove J-29666 or J-5892-A.

5. Cap (40) or rotator (48), shield (45), and valve spring with damper (46).
6. Valve seal (44).

Install or Connect (Figures 7 and 8)

Tools Required:
J-29666 Air Line Adaptor
J-26513 Valve Spring Compressor Or
J-5892-A Valve Spring Compressor

1. New valve seal (44).
2. Valve spring with damper (46), shield (45) and cap (40) or rotator (48).

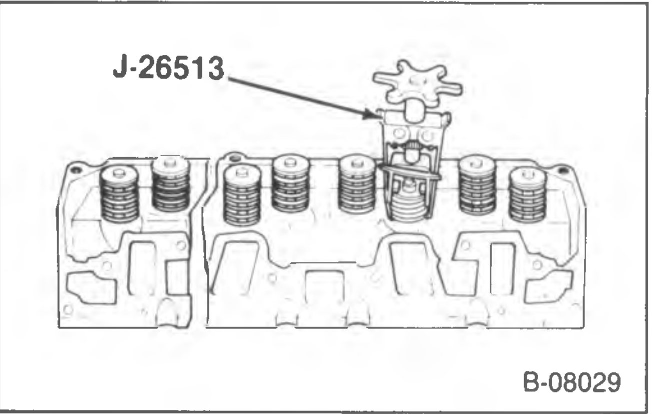


Figure 8—Compressing The Valve Spring

3. Valve keepers (42).
   - With air pressure applied to the cylinder with J-29666, compress the valve spring with J-26513 (or J-5892-A) (figure 8).
   - Install the valve keepers. Use grease to hold them in place.
   - Carefully release spring pressure. Make sure the valve keepers stay in place.
   - Remove J-26513 (or J-5892-A) and J-29666.
5. Glow plugs.
6. Rocker arm shaft with rocker arms, as outlined previously.
7. Rocker arm covers, as outlined previously.

CYLINDER HEAD REPLACEMENT

REMOVAL (C AND K MODELS) (BOTH SIDES)

Remove or Disconnect

1. Intake manifold, as outlined previously.
2. Injection lines. Refer to DIESEL FUEL INJECTION (SEC. 6C2).
3. Rocker arm covers, as outlined previously.
- Drain the cooling system.
4. Dipstick tube (left cylinder head).
5. Ground wire at the cowl (right cylinder head).
6. Glow plug relay (left cylinder head).
- Raise the vehicle.
7. Exhaust pipe from the manifold.
- Lower the vehicle.
8. Air conditioning compressor (if equipped) and lay aside (left cylinder head).
9. Generator, and lay aside (right cylinder head).
10. Glow plug wires.

11. Glow plug temperature inhibit switch wire (right cylinder head).
12. Rocker arm assemblies and pushrods, as outlined previously.

! Important

- Rocker arm assemblies and pushrods must be marked for proper assembly, as outlined previously.

13. Radiator, bypass and heater hoses.
14. Ground strap.
15. Water crossover pipe/thermostat housing assembly.
16. Cylinder head bolts. Rear bolt in left cylinder head may have to remain in the head during removal.
17. Cylinder head.

REMOVAL (G MODELS) (RIGHT SIDE)

↔ Remove or Disconnect

1. Intake manifold, as outlined previously.
2. Injection lines. Refer to DIESEL FUEL INJECTION (SEC. 6C2).
3. Transducer (cruise control equipped vehicles).
4. Upper fan shroud and air conditioning compressor belt (vehicles with air conditioning).

- Raise the vehicle.

5. Exhaust pipe at the manifold.
6. Rear air conditioning compressor bracket at the exhaust manifold (if equipped).
7. Glow plug wires.

- Lower the vehicle.

8. Air conditioning compressor (if equipped). Refer to AIR CONDITIONING (SEC. 1B).
9. Dipstick tube front bracket from the stud.
10. Oil fill tube upper bracket.
11. Rocker arm cover, as outlined previously.
12. Rocker arm assemblies and pushrods, as outlined previously.

! Important

- Rocker arm assemblies must be marked for proper assembly, as outlined previously.

- Drain the cooling system.

13. Air cleaner resonator and bracket.
14. Transmission dipstick tube.
15. Heater, radiator and bypass hoses at the engine.
16. Generator upper bracket.
17. Water crossover pipe/thermostat assembly.
18. Cylinder head bolts.
19. Cylinder head.

REMOVAL (G MODELS) (LEFT SIDE)

↔ Remove or Disconnect

1. Intake manifold, as outlined previously.
2. Injection lines at the injection pump. Refer to DIESEL FUEL INJECTION (SEC. 6C2).
3. Transducer (cruise control equipped vehicles).
4. Upper fan shroud and air conditioning compressor belt (vehicles with air conditioning).

- Raise the vehicle.

5. Left exhaust manifold, as outlined previously.
6. Power steering pump lower adjusting bolts.
7. Glow plug wires.
8. Glow plug temperature inhibit switch.
9. Injection lines. Refer to DIESEL FUEL INJECTION (SEC. 6C2).

- Lower the vehicle.

10. Air conditioning compressor (if equipped). Refer to AIR CONDITIONING (SEC. 1B).
11. Upper power steering pump brackets. Lay the pump aside.
12. Dipstick tube front bracket from the stud.
13. Transmission detent cable.
14. Glow plug controller, bracket, and relay.
15. Wiring harness bracket.
16. Vacuum line clip, at the cylinder head.
17. Fuel return line bracket.
18. Rocker arm cover, as outlined previously.
19. Rocker arm assemblies and pushrods, as outlined previously.

! Important

- Rocker arm assemblies must be marked for proper assembly, as outlined previously.

- Drain the cooling system.

20. Air cleaner resonator and bracket.
21. Transmission dipstick tube at the front attaching stud and lay aside.
22. Generator upper bracket.
23. Water crossover pipe/thermostat assembly.
24. Cylinder head bolts.
25. Cylinder head.

CLEANING AND INSPECTION

Clean

— Carbon deposits from combustion chambers.

— All traces of old head gasket from cylinder head and block. Use of a motorized wire brush is not recommended.

— Cylinder head bolt threads using a wire brush.

— Metal chips and dirt from the threads in the block.

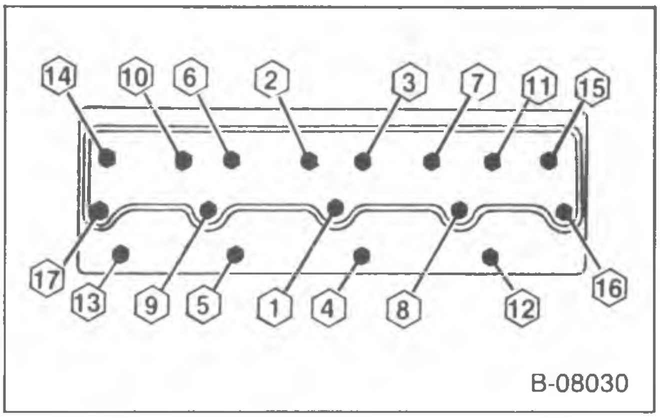


Figure 9—Head Bolt Tightening Sequence

Inspect

— Cylinder head for cracks between the intake and exhaust ports. Use the magnaflux or dye method if available.
— Sealing surfaces of the block and cylinder head for nicks, heavy scratches, or other damage.
— Block for missing or damaged dowel pins, or dowel pins in the wrong location.

Measure

— Cylinder head warpage. If warped more than 0.15 mm (0.006-inch) longitudinally or 0.08 mm (0.003-inch) transversely, replace the cylinder head. Resurfacing is not recommended.
— Pre-chamber installed depth. The pre-chamber should be flush to a maximum of 0.05 mm (0.002-inch) protrusion.
  - Make the measurement at two or more points on the pre-chamber where the prechamber seats on the head gasket shield and sealing ring.
  - Measure the difference between the flat of the pre-chamber and the flat surface of the cylinder head.
  - The pre-chamber must not protrude out of the cylinder head more than 0.05 mm (0.002-inch).
  - The pre-chamber must not be recessed into the cylinder head.

CYLINDER HEAD REPAIR

- Refer to the proper unit repair manual.

INSTALLATION (C AND K MODELS) (BOTH SIDES)

Install or Connect (Figure 9)

1. Head gasket to the block, over the dowel pins.

   Important

   - The block gasket surfaces must be clean.
   - If the engine has 0.030-inch oversize pistons, the oversize type head gasket must be used.
   - DO NOT use a sealer on the head gasket. The head gasket is manufactured with the proper amount of sealant "printed" on its surface. Additional sealer may cause leakage or malfunction. In addition, some sealers may attack the sealant already on the head gasket.
2. Rear cylinder head bolt to the cylinder head (left cylinder head). Apply sealant to the bolt as described in step 4. Due to clearances, the bolt must be installed at this time.
3. Cylinder head. Make sure the gasket surfaces are clean. Guide the head carefully into place over the dowel pins.
4. Cylinder head bolts.
   - Make sure the bolt threads are clean.
   - Apply sealant (GM part number 1052080 or equivalent) to the bolt threads and under the bolt heads.

   Tighten

   - Cylinder head bolts, as follows:
   - Using the sequence shown in Figure 9, tighten all bolts to 25 N·m (20 ft. lbs.).
   - In sequence, tighten all bolts to 65 N·m (50 ft. lbs.).
   - In sequence, tighten all bolts an additional 90 degrees (1/4 turn).
5. Water crossover pipe/thermostat assembly. Use new gaskets.

   Tighten

   - Bolts to 42 N·m (31 ft. lbs.).
6. Ground strap.
7. Radiator, bypass, and heater hoses.
8. Pushrods and rocker arm assemblies, in their original locations, as described previously. Hardened ends of the pushrods must face up.
9. Glow plug temperature inhibit switch wire (right cylinder head).
10. Glow plug wires.
11. Generator (right cylinder head).
12. Air conditioning compressor (left side cylinder head).
- Raise the vehicle.
13. Exhaust pipe to the manifold.
- Lower the vehicle.
14. Glow plug relay (left cylinder head).
15. Ground wire at the cowl (right cylinder head).
16. Dipstick tube (left cylinder head).
17. Rocker arm covers, as outlined previously.
18. Injection lines. Refer to DIESEL FUEL INJECTION (SEC. 6C2).

19. Intake manifold, as outlined previously.
    - Fill the cooling system with the proper quantity and grade of coolant.

INSTALLATION (G MODELS) (RIGHT SIDE)

Install or Connect (Figure 9)

1. Head gasket to the block, over the dowel pins.

   Important

   - The block gasket surfaces must be clean.
   - If the engine has 0.030-inch oversize pistons, the oversize type head gasket must be used.
   - DO NOT use a sealer on the head gasket. The head gasket is manufactured with the proper amount of sealant "printed" on its surface. Additional sealer may cause leakage or malfunction. In addition, some sealers may attack the sealant already on the head gasket.
2. Cylinder head. Make sure the gasket surfaces are clean. Guide the head carefully into place over the dowel pins.
3. Cylinder head bolts.
   - Make sure the bolt threads are clean.
   - Apply sealant (GM part number 1052080 or equivalent) to the bolt threads and under the bolt heads.

   Tighten

   - Cylinder head bolts, as follows:
     - Using the sequence shown in figure 9, tighten all bolts to 25 N·m (20 ft. lbs.).
     - In sequence, tighten all bolts to 65 N·m (50 ft. lbs.).
     - In sequence, tighten all bolts an additional 90 degrees (1/4 turn).
4. Water crossover pipe/thermostat assembly. Use new gaskets.

   Tighten

   - Bolts to 42 N·m (31 ft. lbs.).
5. Generator upper bracket.
6. Heater, radiator, and bypass hoses.
7. Transmission dipstick tube.
8. Air cleaner resonator and bracket.
9. Pushrods and rocker arm assemblies, in their original locations, as described previously. Hardened ends of the pushrods must face up.
10. Rocker arm cover, as outlined previously.
11. Oil fill tube upper bracket.
12. Dipstick tube front bracket.
13. Air conditioning compressor (if equipped). Refer to AIR CONDITIONING (SEC. 1B).
    - Raise the vehicle.
14. Glow plug wires.
15. Rear air conditioning compressor bracket (if equipped).
16. Exhaust pipe.
    - Lower the vehicle.
17. Upper fan shroud and air conditioning compressor belt (vehicles with air conditioning).
18. Transducer (if equipped).
19. Injection lines. Refer to DIESEL FUEL INJECTION (SEC. 6C2).
20. Intake manifold, as outlined previously.
    - Fill the cooling system with the proper quantity and grade of coolant.

INSTALLATION (G MODELS) (LEFT SIDE)

Install or Connect (Figure 9)

1. Head gasket to the block, over the dowel pins.

   Important

   - The block gasket surfaces must be clean.
   - If the engine has 0.030-inch oversize pistons, the oversize type head gasket must be used.
   - DO NOT use a sealer on the head gasket. The head gasket is manufactured with the proper amount of sealant "printed" on its surface. Additional sealer may cause leakage or malfunction. In addition, some sealers may attack the sealant already on the head gasket.
2. Cylinder head. Make sure the gasket surfaces are clean. Guide the head carefully into place over the dowel pins.
3. Cylinder head bolts.
   - Make sure the bolt threads are clean.
   - Apply sealant (GM part number 1052080 or equivalent) to the bolt threads and under the bolt heads.

   Tighten

   - Cylinder head bolts, as follows:
     - Using the sequence shown in figure 9, tighten all bolts to 25 N·m (20 ft. lbs.).
     - In sequence, tighten all bolts to 65 N·m (50 ft. lbs.).
     - In sequence, tighten all bolts an additional 90 degrees (1/4 turn).
4. Water crossover pipe/thermostat assembly. Use new gaskets.

Tighten

- Bolts to 42 N·m (31 ft. lbs.).

5. Generator upper bracket.
6. Transmission dipstick tube.
7. Air cleaner resonator and bracket.
8. Pushrods and rocker arm assemblies, in their original locations; as described previously. Hardened ends of the pushrods must face up.
9. Rocker arm cover, as outlined previously.
10. Fuel return line bracket.
11. Vacuum line clip.
12. Wiring harness bracket.
13. Glow plug controller, bracket, and relay.
14. Transmission detent cable.
15. Dipstick tube front bracket.
16. Power steering pump and brackets.
17. Air conditioning compressor (if equipped). Refer to AIR CONDITIONING (SEC. 1B).

- Raise the vehicle.

18. Injection lines. Refer to DIESEL FUEL INJECTION (SEC. 6C2).
19. Glow plug temperature inhibit switch.
20. Glow plug wires.
21. Power steering pump lower adjusting bolts.
22. Left exhaust manifold, as outlined previously.

- Lower the vehicle.

23. Upper fan shroud and air conditioning compressor belt (vehicles with air conditioning).
24. Transducer (if equipped).
25. Intake manifold, as outlined previously.

- Fill the cooling system with the proper quantity and grade of coolant.
- Evacuate and charge the air conditioning system. Refer to AIR CONDITIONING (SEC. 1B).

OIL PUMP DRIVE REPLACEMENT

For gear driven vacuum pump replacement, refer to VACUUM PUMP (SEC. 6H).

NOTICE: Do not run the engine without the gear driven vacuum pump or oil pump drive in place. This will cause extensive engine damage.

Remove or Disconnect (Figure 10)

1. Bolt and clamp.
2. Oil pump drive.
3. Gasket.

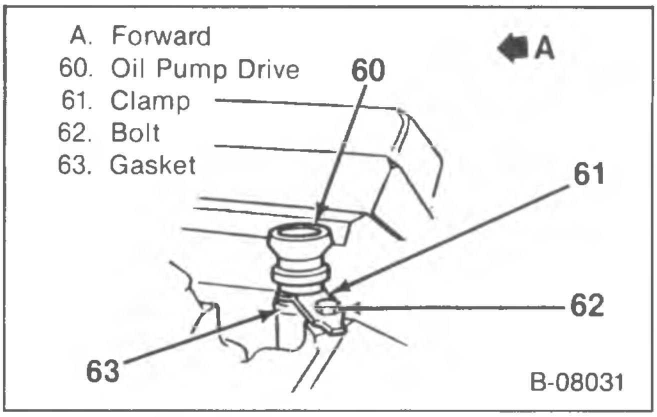


Figure 10—Oil Pump Drive Installed

Install or Connect (Figure 10)

1. New gasket to the oil pump drive.
2. Oil pump drive to the engine. Index the drive with the camshaft gear and oil pump drive shaft. Make sure the drive seats fully.
3. Clamp and bolt.

Tighten

- Bolt to 42 N·m (31 ft. lbs.).

TORSIONAL DAMPER AND FRONT CRANKSHAFT SEAL REPLACEMENT

Remove or Disconnect (Figure 11)

Tools Required:
J-23523-E Torsional Damper Puller
J-29788 Pilot

1. Battery cables.
2. Upper fan shroud (G models).
3. Accessory drive belts.

- Raise the vehicle (G models).

4. Bolts and crankshaft pulley.
5. Torsional damper bolt and washer.
6. Torsional damper. Use J-23523 and J-29788.
7. Front crankshaft seal. Pry out with a screwdriver.

Install or Connect (Figure 11)

Tool Required:
J-22102 Seal Installer

1. New front crankshaft seal. Use J-22102. Lubricate the seal lips with engine oil.

- Apply engine oil to the crankshaft stub.

2. Torsional damper. Tap into place with a mallet. Make sure the key is in place. Make sure the damper is all the way on the crankshaft.
3. Torsional damper bolt and washer.

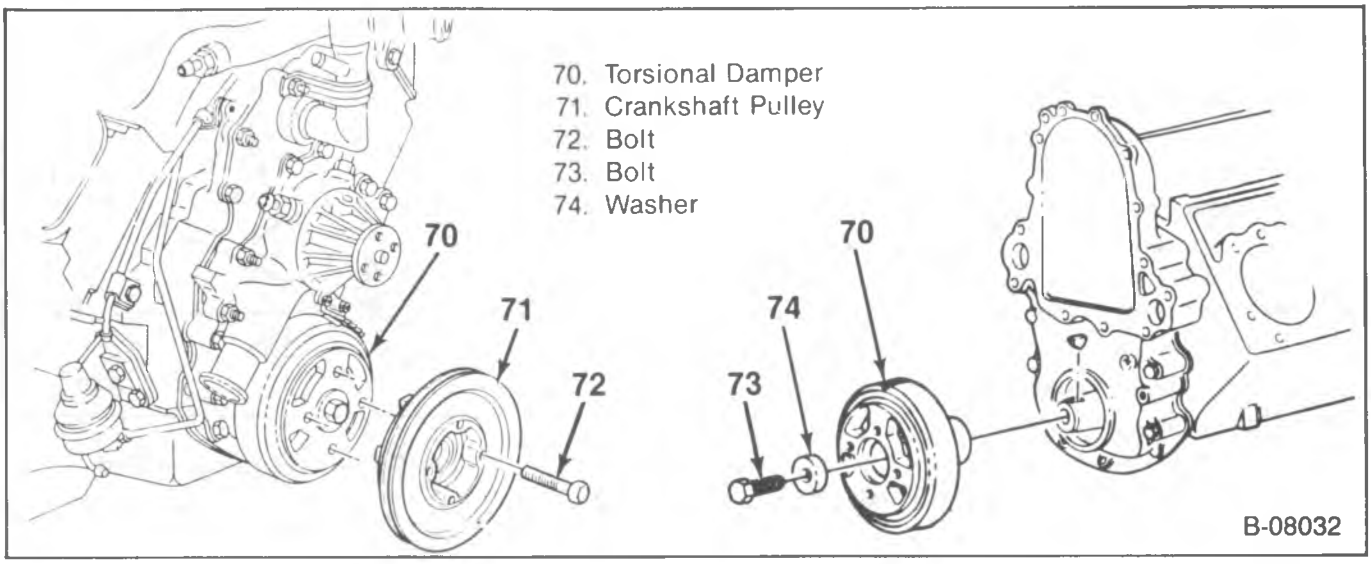


Figure 11—Torsional Damper And Crankshaft Pulley

Tighten

- Bolt to 270 N·m (200 ft. lbs.).

4. Crankshaft pulley and bolts.

Tighten

- Bolts to 40 N·m (30 ft. lbs.).
- Lower the vehicle, if necessary.

5. Accessory drive belts. Tension as outlined in ENGINE COOLING (SEC. 6B).
6. Upper fan shroud (G models).
7. Battey cables.

FRONT COVER REPLACEMENT

Remove or Disconnect (Figures 12 and 13)

- Drain the cooling system.

1. Water pump. Refer to ENGINE COOLING (SEC. 6B).

- Rotate the engine until the timing marks on the pump gear and camshaft gear are aligned (figure 13).
- Scribe a mark aligning the injection pump flange and front cover.

2. Torsional damper, as outlined previously.
3. Four front cover to oil pan bolts.
4. Two fuel return line clips.
5. Injection pump gear.
6. Injection pump retaining nuts at the front cover.
7. Baffle.
8. Front cover bolts.
9. Front cover.
10. Front crankshaft seal. Pry out with a screwdriver.

Clean

— RTV from oil pan sealing surface.
— Sealing surfaces on front cover.

Inspect

- Front cover for cracks or damage to sealing surfaces.

Install or Connect (Figures 12 and 13)

Tool Required:
J-22102 Seal Installer

1. New front crankshaft seal to the front cover. Use J-22102.

- Apply a 2 mm ($^3/_{32}$-inch) bead of anaerobic sealant (GM part number 1052357 or equivalent) to the front cover sealing area shown in Figure 12.

  Apply a 5 mm ($^3/_{16}$-inch) bead of RTV sealant to the front cover sealing surface that mates against the oil pan.

2. Front cover to the engine. Install the attaching bolts.

   Tighten

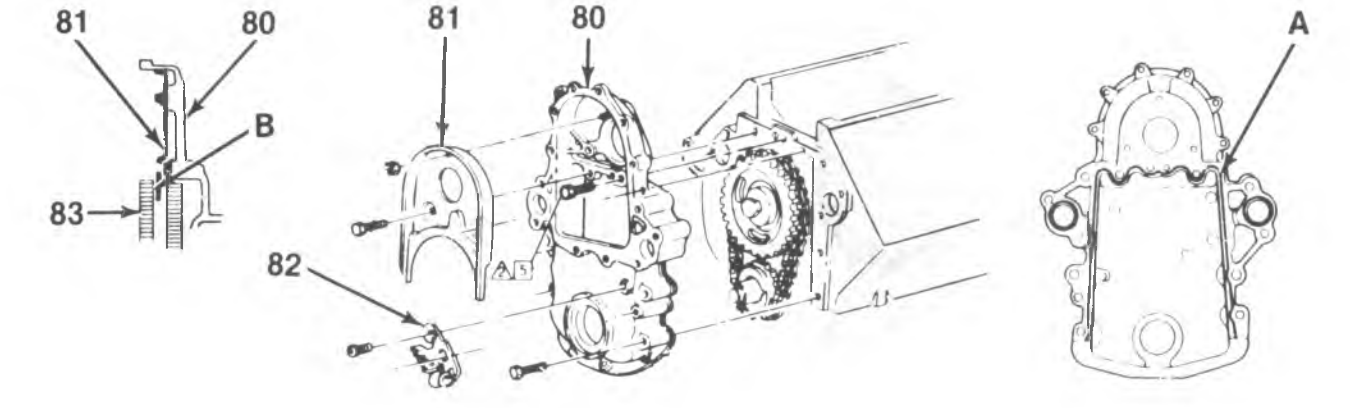
   - Front cover to block bolts to 45 N·m (33 ft. lbs.).
   - Oil pan to front cover bolts to 10.0 N·m (84 in. lbs.).

3. Baffle.

   Tighten

   - Baffle bolts and nut to 45 N·m (33 ft. lbs.).

- Align the scribe marks on the front cover and injection pump.



A. Apply Anaerobic Sealer
B. Minimum Clearance 1.0 mm (0.040-inch)
80. Front Cover
81. Baffle
82. Probe Holder
83. Camshaft Gear

B-08033

Figure 12—Front Cover And Components

4. Injection pump nuts.

Tighten

- Nuts to 42 N·m (31 ft. lbs.).

5. Injection pump gear and bolts. Align the timing marks (figure 13).

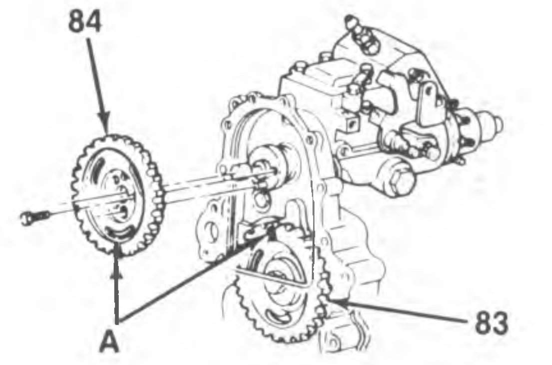
Tighten

- Injection pump gear bolts to 23 N·m (17 ft. lbs.).

Measure

- Clearance between injection pump gear and baffle (figure 12). It is necessary to maintain a minimum of 1.0 mm (0.040-inch) between the gear and baffle, or noise may result.

6. Fuel return line bolts.
7. Torsional damper, as outlined previously.
8. Water pump. Refer to ENGINE COOLING (SEC. 6B).
- Fill the cooling system with the proper quantity and grade of coolant.



A. Timing Marks
83. Camshaft Gear
84. Injection Pump Gear

B-08034

Figure 13—Injection Pump Gear And Timing Marks

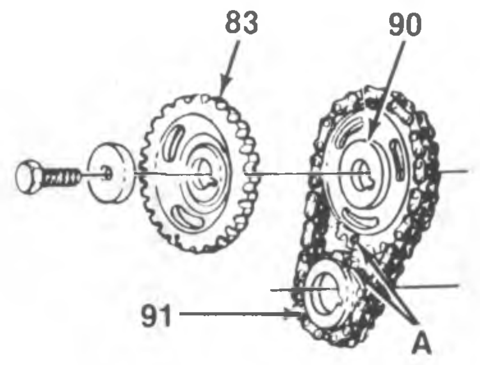
TIMING CHAIN AND SPROCKET REPLACEMENT

Remove or Disconnect (Figure 14)

1. Front cover, as outlined previously.

Measure

- Timing chain free play as follows:
  - Mount a dial indicator to the front of the block.
  - Position the dial indicator so that the plunger contacts the timing chain between the two gears.
  - Pull the chain outward (parallel to the front face of the block) the maximum amount with finger pressure on the inside of the chain.
  - Set the dial indicator to zero.
  - Move the chain inward (parallel to the front face of the block) the maximum amount with finger pressure on the outside of the chain.
  - The total indicator travel can be noted. With used parts, the deflection must not exceed 20.3 mm (0.800 inch). If the deflection exceeds this limit, the gears



A. Timing Marks
83. Camshaft Gear
90. Camshaft Sprocket
91. Crankshaft Sprocket

B-08035

Figure 14—Timing Chain And Sprockets

and timing chain must be inspected for wear and replaced as necessary. With new parts the maximum deflection must not exceed 12.7 mm (0.500 inch).

2. Injection pump gear.
3. Camshaft gear.
- Align the timing marks (figure 14).
4. Camshaft sprocket with timing chain.
5. Crankshaft sprocket.

Install or Connect (Figures 13 and 14)

1. Crankshaft sprocket.
2. Camshaft sprocket with timing chain.

Important

- Align the timing marks (figure 14).

3. Camshaft gear, bolt, and washer.

Tighten

- Bolt to 100 N·m (75 ft. lbs.).

4. Injection pump gear and bolts.

Important

- Align the timing marks (figure 13).

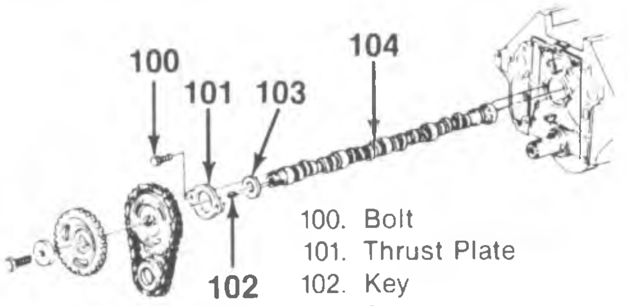
Tighten

- Bolts to 23 N·m (17 ft. lbs.).

5. Front cover, as outlined previously.

Adjust

- Injection pump timing, if new gears, sprockets, or timing chain were installed. Refer to DIESEL FUEL INJECTION (SEC. 6C2).



100. Bolt
101. Thrust Plate
102. Key
103. Spacer
104. Camshaft

B-08036

Figure 15—Camshaft And Components

CAMSHAFT REPLACEMENT

C AND K MODELS

Remove or Disconnect (Figure 15)

1. Battery cables.
- Drain the cooling system.
2. Radiator, shrouds, and fan. Refer to ENGINE COOLING (SEC. 6B).
3. Vacuum pump. Refer to VACUUM PUMP (SEC. 6H).
4. Power steering pump, generator, and air conditioning compressor and position aside.
5. Rocker arm covers, as outlined previously.
6. Rocker arm assemblies and pushrods, as outlined previously.

Important

- Rocker arm assemblies and pushrods must be marked for proper assembly, as outlined previously.

7. Hydraulic lifters, as outlined previously. Place the lifters in an organizer rack. The lifters must be installed in the same bore from which they were removed.
8. Front cover, as outlined previously.
9. Timing chain and camshaft sprocket, as outlined previously.
10. Fuel pump (lift pump).
11. Front engine mounting through bolts.

NOTICE: When raising or supporting the engine for any reason, do not use a jack under the oil pan, any sheet metal or crankshaft pulley. 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 pickup unit.

- Raise the engine and block in position.

12. Air conditioning condensor mounting bolts (if equipped). Lift the condensor with the aid of an assistant.
13. Bolts and thrust plate.
14. Camshaft. Pull the camshaft from the block carefully to avoid damage to the camshaft bearings.
15. Spacer (if necessary).

Cleaning, Inspection and Repair

Clean, inspect and repair or replace the camshaft and related components, as outlined in the proper unit repair manual.

The unit repair manual also describes camshaft bearing replacement.

→← Install or Connect (Figures 14, 15, 30, and 31).

- When a new camshaft is installed, replacement of all hydraulic lifters, engine oil, and oil filter is recommended.

1. Spacer, with the ID chamfer towards the camshaft.
2. Camshaft.
    - Coat the camshaft lobes with "Molykote" or equivalent.
    - Lubricate the camshaft bearing journals with engine oil.
    - Insert the camshaft carefully into the block to avoid damage to the camshaft bearings.
3. Thrust plate and bolts.

Tighten

- Bolts to 23 N·m (17 ft. lbs.).
- Lower the engine.

NOTICE: See "Notice" on page 6A7-1 of this section.

4. Engine mounting through bolts and nuts.

Tighten

- Fasteners to specifications. Refer to figures 30 and 31.

5. Timing chain and sprockets, as outlined previously.

Important

- Align the timing marks (figure 14).

6. Air conditioning condensor (if equipped).
7. Fuel pump (lift pump).
8. Front cover, as outlined previously.
9. Hydraulic lifters, as outlined previously. Used lifters must be installed in the same bore from which they were removed.
10. Rocker arm assemblies and pushrods, in their original locations, as outlined previously. Hardened ends of the pushrods must face up.
11. Rocker arm covers, as outlined previously.
12. Power steering pump, generator, and air conditioning compressor, as equipped.
13. Vacuum pump. Refer to VACUUM PUMP (SEC. 6H).
14. Fan, radiator, and radiator shrouds. Refer to ENGINE COOLING (SEC. 6B).
15. Battery cables.

- Fill the cooling system with the proper quantity and grade of coolant.

G MODELS

←→ Remove or Disconnect (Figure 15)

1. Battery cables.
2. Headlight bezels.
3. Grille, bumper, and lower valence panel.
4. Hood latch.
5. Coolant recovery bottle.
6. Upper tie bar.
7. Air conditioning compressor. Refer to AIR CONDITIONING (SEC. 1B).

- Drain the cooling system.

8. Radiator and fan. Refer to ENGINE COOLING (SEC. 6B).
9. Oil pump drive, as outlined previously.
10. Cylinder heads, as outlined previously.
11. Generator lower bracket.
12. Water pump. Refer to ENGINE COOLING (SEC. 6B).
13. Torsional damper, as outlined previously.
14. Front cover, as outlined previously.
15. Fuel pump (lift pump).
16. Rocker arm covers, as outlined previously.
17. Rocker arm assemblies and pushrods, as outlined previously.

Important

- Rocker arm assemblies and pushrods must be marked for proper assembly, as outlined previously.

18. Hydraulic lifters, as outlined previously. Place the lifters in an organizer rack. The lifters must be installed in the same bore from which they were removed.
19. Timing chain and camshaft sprocket, as outlined previously.
20. Bolts and thrust plate.
21. Camshaft. Pull the camshaft from the block carefully to avoid damage to the camshaft bearings.
22. Spacer, if necessary.

Cleaning, Inspection and Repair

Clean, inspect and repair or replace the camshaft and related components, as outlined in the proper unit repair manual.

The unit repair manual also describes camshaft bearing replacement.

Install or Connect (Figures 14 and 15).

- When a new camshaft is installed, replacement of all hydraulic lifters, engine oil, and oil filter is recommended.

1. Spacer, with the ID chamfer towards the camshaft.
2. Camshaft.
    - Coat the camshaft lobes with "Molykote" or equivalent.
    - Lubricate the camshaft bearing journals with engine oil.
    - Insert the camshaft carefully into the block to avoid damage to the camshaft bearings.
3. Thrust plate and bolts.

    Tighten

    - Bolts to 23 N·m (17 ft. lbs.).
4. Timing chain and camshaft sprocket, as outlined previously.
    - Align the timing marks (figure 14).
5. Hydraulic lifters, as outlined previously. Used lifters must be installed in the same bore from which they were removed.
6. Rocker arm assemblies and pushrods, in their original locations, as outlined previously. Hardened ends of the pushrods must face up.
7. Rocker arm covers, as outlined previously.
8. Fuel pump (lift pump).
9. Front cover, as outlined previously.
10. Torsional damper, as outlined previously.
11. Water pump. Refer to ENGINE COOLING (SEC. 6B).
12. Generator lower bracket.
13. Cylinder heads, as outlined previously.
14. Oil pump drive, as outlined previously.
15. Radiator and fan. Refer to ENGINE COOLING (SEC. 6B).
16. Air conditioning compressor. Refer to AIR CONDITIONING (SEC. 1B).
17. Upper tie bar.
18. Coolant recovery bottle.
19. Hood latch.
20. Grille, bumper, and lower valence panel.
21. Headlight bezels.
22. Battery cables.

- Fill the cooling system with the proper quantity and grade of coolant.

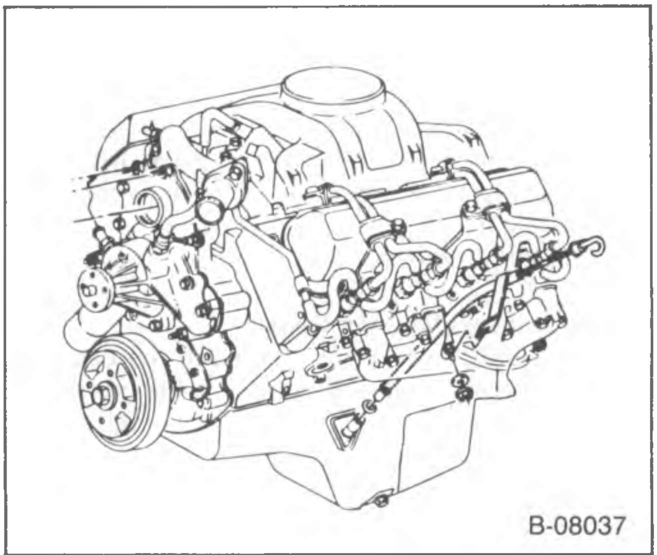


Figure 16—Oil Dipstick Tube (C and K Models)

- Evacuate and charge the air conditioning system (if equipped). Refer to AIR CONDITIONING (SEC. 1B).

DIPSTICK TUBE REPLACEMENT

C AND K MODELS

Remove or Disconnect (Figure 16)

1. Battery cables.
2. Dipstick tube bracket, nut and washer, at the exhaust manifold.
3. Dipstick tube.
4. O-ring from the dipstick tube.

Install or Connect (Figure 16)

1. New o-ring to the dipstick tube.
2. Dipstick tube to the engine.
3. Dipstick tube bracket nut and washer.
4. Battery cables.

G MODELS

Remove or Disconnect (Figure 17)

1. Battery cables.
2. Engine cover.
3. Air cleaner.
4. Dipstick tube bracket, at the thermostat housing.
5. Dipstick tube bracket, at the rocker arm cover bracket.
    - Raise the vehicle.
6. Left exhaust manifold, as outlined previously.
7. Dipstick tube from the oil pan.
    - Lower the vehicle.
8. Dipstick tube from the vehicle.

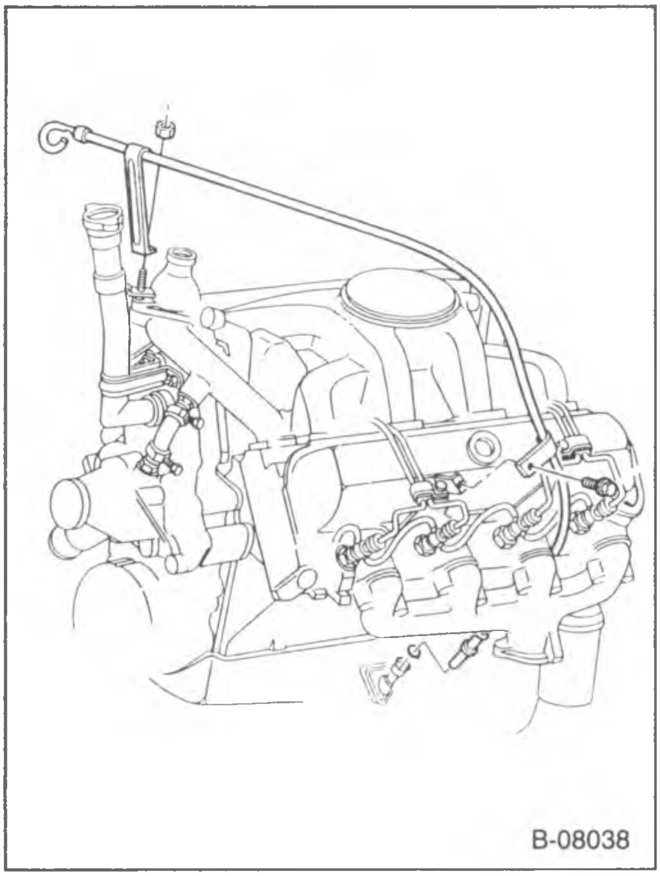


Figure 17—Oil Dipstick Tube (G Models)

9. O-ring.

Install or Connect (Figure 17)

1. New o-ring to the dipstick tube.
2. Dipstick tube to the vehicle.
- Raise the vehicle.
3. Dipstick tube to the oil pan.
4. Left exhaust manifold, as outlined previously.
- Lower the vehicle.
5. Dipstick tube bracket at the rocker arm cover.
6. Dipstick tube bracket at the thermostat housing.
7. Air cleaner.
8. Engine cover.
9. Battery cables.

OIL PAN REPLACEMENT (C AND K MODELS)

Remove or Disconnect

1. Battery cables.
- Raise the vehicle.
- Drain the engine oil.
2. Flywheel cover.
3. Left front engine mounting through-bolt.

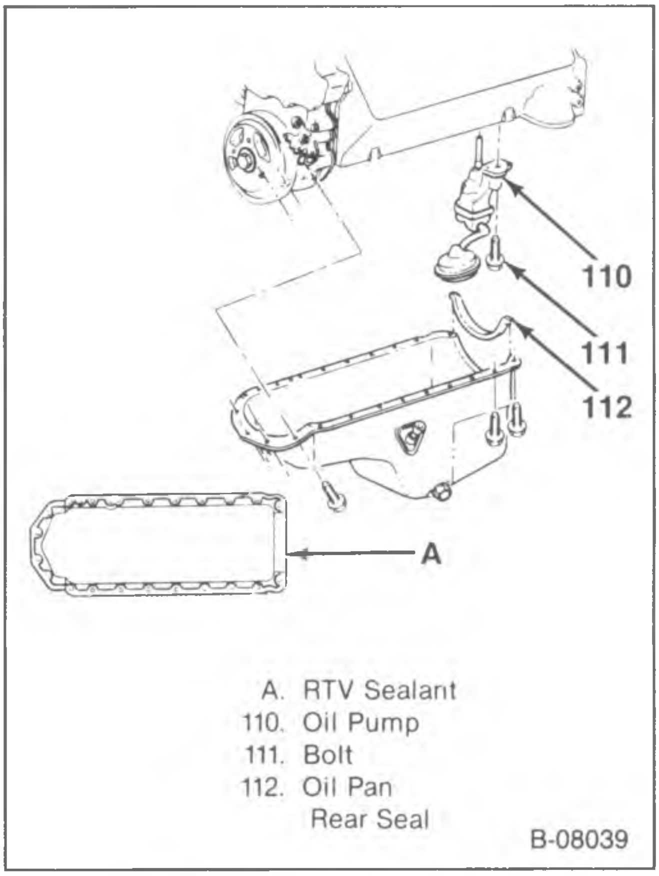


Figure 18—Oil Pan And Oil Pump

NOTICE: When raising or supporting the engine for any reason, do not use a jack under the oil pan, any sheet metal or crankshaft pulley. 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 pickup unit.

- Raise the engine.
4. Oil pan bolts.
5. Oil pan.
6. Oil pan rear seal.

Clean

1. Old RTV from the oil pan and block.
2. All oil and grease from the gasket surfaces.

Install or Connect (Figure 18, 30, and 31)

- Apply a 5 mm (3/16-inch) bead of RTV sealant (GM part number 1052915 or equivalent) to the oil pan sealing surface, inboard of the bolt holes (figure 18). The sealer must be wet to the touch when the oil pan is installed.
1. Oil pan rear seal.
2. Oil pan to the engine. Be sure to connect the oil dipstick.

3. Oil pan bolts.

Tighten

- — All except rear two bolts to 10.0 N·m (84 in. lbs.).
- — Rear two bolts to 23 N·m (17 ft. lbs.).
- Lower the engine.

NOTICE: See "Notice" on page 6A7-1 of this section.

4. Engine mounting through-bolt and nut.

Tighten

- Fasteners to specifications. Refer to figures 30 and 31.

5. Flywheel cover.

- Lower the vehicle.

6. Proper quantity and grade of engine oil.
7. Battery cables.

OIL PUMP REPLACEMENT (C AND K MODELS)

Remove or Disconnect

1. Oil pan, as outlined previously.
2. Oil pump to main bearing cap bolt.
3. Oil pump and extension shaft.

Inspect

- — Oil pump pick up tube and screen for damage.
- — Oil pump extension shaft bushing for cracks.

Oil Pump Repair

- Refer to the proper unit repair manual.

Install or Connect

1. Oil pump and extension shaft to the engine. Align the extension shaft hex with the drive hex on the oil pump drive or vacuum pump. The oil pump should push easily into place.
2. Oil pump bolt.

Tighten

- Oil pump bolt to 90 N·m (65 ft. lbs.).

3. Oil pan, as outlined previously.

OIL PAN AND OIL PUMP REPLACEMENT (G MODELS)

Remove or Disconnect

1. Battery cables.
2. Engine cover.
3. Engine oil dipstick.
4. Engine oil dipstick tube at the rocker arm cover.
5. Transmission. Refer to TRANSMISSION (SEC. 7).

- Drain the engine oil.

6. Engine oil cooler lines at the block.
7. Starter.
8. Oil pan bolts.
9. Oil pan and oil pump.
    - Lower the oil pan from the engine.
    - Rotate the crankshaft so that the forward crankshaft throw and numbers 1 and 2 connecting rod journals are up.
    - Oil pump to main bearing cap bolt.
    - Let the oil pump and extension shaft fall into the oil pan.
    - Remove the oil pan and oil pan rear seal.

Clean

1. Old RTV from the oil pan and block.
2. All oil and grease from the gasket surfaces.

Inspect

- — Oil pump pick up tube and screen for damage.
- — Oil pump extension shaft bushing for cracks.

Oil Pump Repair

- Refer to the proper unit repair manual.

Install or Connect (Figure 18)

- Apply a 5 mm (3/16-inch) bead of RTV sealant (GM part number 1052915 or equivalent) to the oil pan sealing surface, inboard of the bolt holes (figure 18). The sealer must be wet to the touch when the oil pan is installed.

1. Oil pan rear seal to the oil pan.
2. Oil pan and oil pump to the engine.
    - Lay the oil pump and extension shaft in the oil pan.
    - Hold the oil pan and position the oil pump to the main bearing cap.
    - Align the extension shaft hex with the drive hex on the oil pump drive or vacuum pump. The oil pump should push easily into place. Install the oil pump bolt and tighten.
    - Position the oil pan against the engine. Be sure to connect the dipstick tube.
3. Oil pan bolts.

Tighten

- All except rear two oil pan bolts to 10.0 N·m (84 in. lbs.).
- Rear two oil pan bolts to 23 N·m (17 ft. lbs.).

4. Starter.
5. Engine oil cooler lines.
6. Transmission. Refer to TRANSMISSION (SEC. 7).
7. Engine oil dipstick tube at the rocker arm cover.
8. Engine oil dipstick.
9. Engine cover.
10. Proper quantity and grade of engine oil.
11. Battery cables.

REAR CRANKSHAFT OIL SEAL REPLACEMENT

The production rear crankshaft oil seal is a "rope" type seal. The rope seal can be replaced with a two piece type seal, if desired. Repair procedures for both types of seal follow.

The CDR and crankcase ventilation system should be thoroughly inspected and crankcase pressure should be checked before a new seal is installed. Refer to DRIVEABILITY AND EMISSIONS—DIESEL (SEC. 6E9).

ROPE TYPE SEAL

Remove or Disconnect

1. Oil pan and oil pump, as outlined previously.
2. Rear main bearing cap.
3. Old rope seal from the main bearing cap. Do not discard.

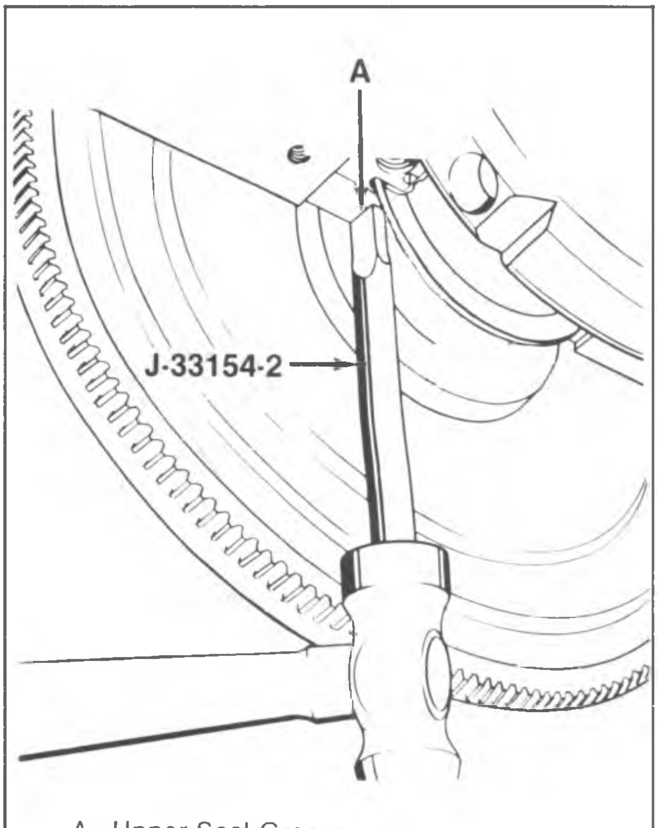
Clean

- Main bearing cap and block mating surfaces.
- Rope seal groove in the main bearing cap.

Install or Connect (Figures 19 through 22)

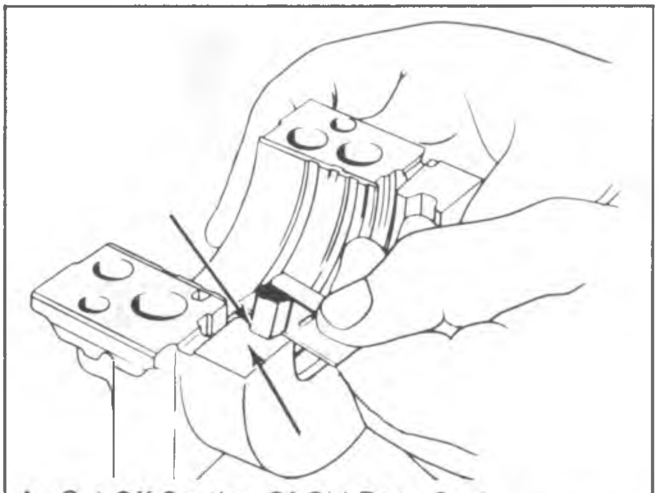
Tools Required:
J-33154 Rear Oil Seal Packer
J-33153 Rear Oil Seal Installer

1. Rope seal pieces to the upper seal groove.
   - Use J-33154-2 and gently drive the upper seal into the groove about 6 mm (1/4-inch). Do this on both sides. Refer to figure 19.
   - Measure the amount the seal was driven up on one side. Add 1.5 mm (1/16-inch). Cut this length from the old seal removed from the main bearing cap. Use the main bearing cap as a holding fixture when cutting the seal (figure 20). Use a sharp tool. Repeat this procedure for the other side.
   - Install J-33154-1 onto the cylinder block (figure 21).
   - Use J-33154-2 to work the short pieces of seal cut previously onto the guide tool and into the seal groove in the block (figure 21). It may help to use engine oil on the seal pieces. The tools have been machined to



A. Upper Seal Groove B-08040

Figure 19—Packing The Upper Rear Crankshaft Oil Seal



A. Cut Off Section Of Old Rope Seal
B. Use Bearing Cap As Holding Fixture B-08041

Figure 20—Cutting The Rope Seal

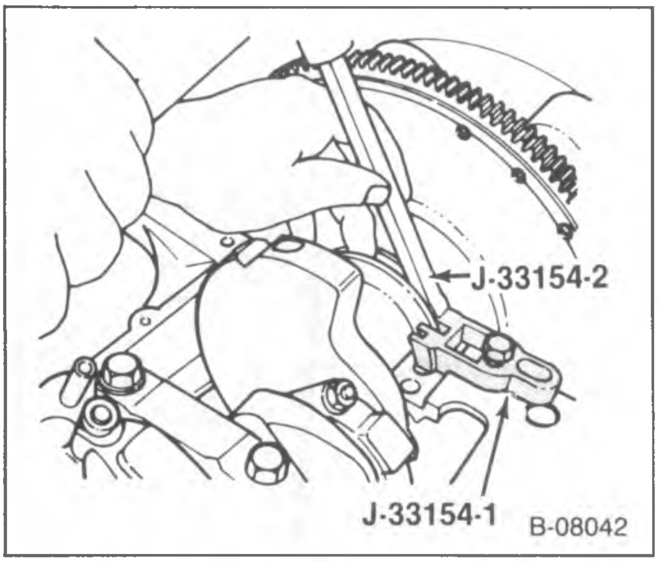


Figure 21—Installing The Rope Seal Pieces

provide a built-in stop. Use this procedure for both sides.

2. New rope seal to the main bearing cap.
   - Apply adhesive (GM part number 1052621 [Loctite 414] or equivalent) to the seal groove.
   - Position the rope seal on the bearing cap.
   - Use J-33153 to install the seal (figure 22).
   - After correctly positioning the seal, rotate J-33153 slightly and cut the seal ends flush with the bearing cap surface. Use a sharp tool. (figure 22).

Measure

- Rear main bearing clearance, using plastic gaging material. Refer to the proper unit repair manual. If the clearance is out of specification, check the ends of the seal for fraying that may prevent the main bearing cap from seating. Correct as necessary. Remove the gaging material from the bearing and journal.

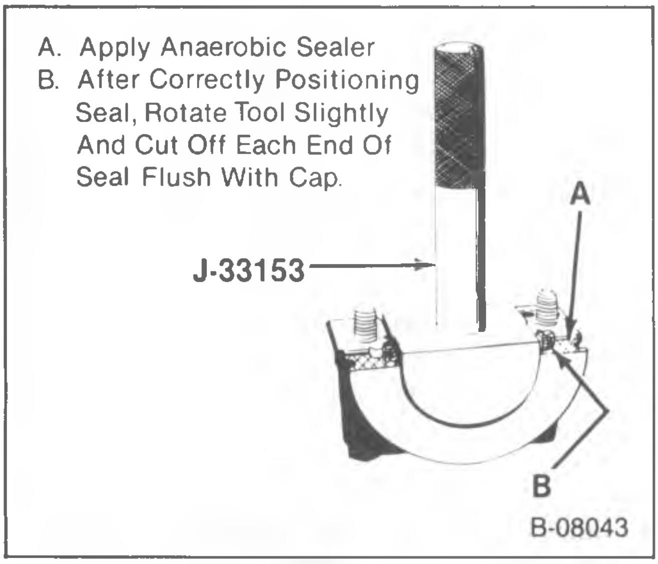


Figure 22—Installing The Lower Rear Crankshaft Oil Seal

NOTICE: The main bearing caps are to be tapped into place with a brass or leather mallet before the attaching bolts are installed. Do not use the attaching bolts to pull the main bearing caps into their seats, as this may damage the bearing cap and/or block.

3. Main bearing cap to the block.
   - Apply a thin film of anaerobic sealant (GM part number 1052756 or equivalent) to the bearing cap as shown in figure 22. Keep the sealant off the seal and bearing. Do not put sealant in the bearing cap oil relief slot.
   - Apply a light coat of engine oil to the crankshaft surface that will contact the seal.
   - Apply engine oil to the main bearing cap bolt threads.
   - Tap the main bearing cap into place with a brass or leather mallet. Then install the bolts.

Tighten

Bolts to specifications, in the following sequence:

- Inner bolts: 150 N·m (110 ft. lbs.).
- Outer bolts: 135 N·m (100 ft. lbs.).
- Re-tighten all bolts in the same sequence.

4. Oil pump and oil pan, as outlined previously.

TWO PIECE TYPE SEAL

Remove or Disconnect

1. Oil pan and oil pump, as outlined previously.
2. Rear main bearing cap.
3. Upper and lower rope seal.

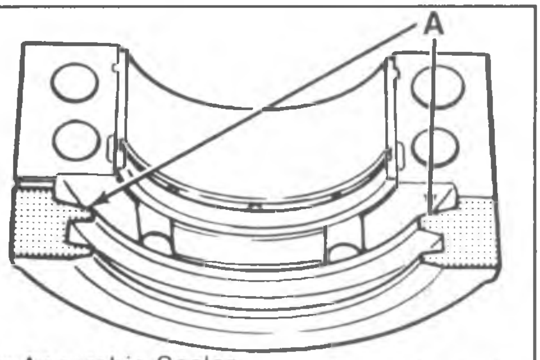
Clean

— Upper and lower seal grooves and bearing cap slot with a chlorinated solvent, such as carburetor spray cleaner.

— Main bearing cap and block mating surfaces.

Measure

- Rear main bearing clearance, using plastic gage material. Refer to the proper unit repair manual. If the clearance is outside specifications, correct as necessary.



A. Apply Anaerobic Sealer To Shaded Area

B-08044

Figure 23—Applying Sealer To The Rear Main Bearing Cap

Install or Connect (Figure 23)

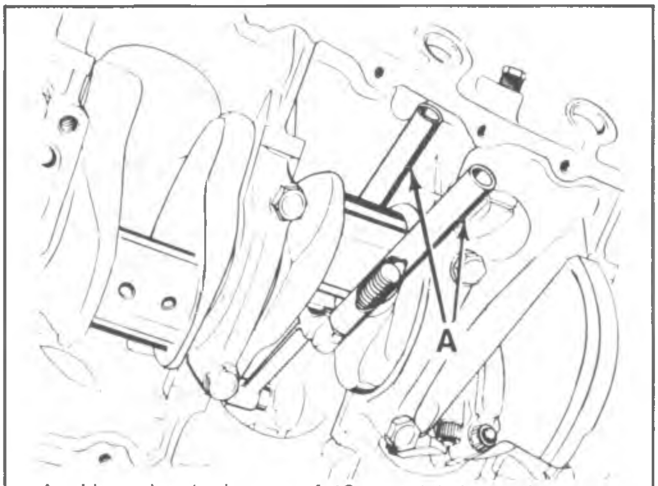
1. Seal halves to the block.
    - Apply a light coat of engine oil to the seal lips where they contact the crankshaft.
    - "Roll" one seal half into the block seal groove until 13 mm (1/2-inch) of the seal's one end is extending out of the block.
    - Insert the other seal half into the opposite side of the seal groove in the block.

Important

- The contact ends of the seal halves should now be at the four and ten o'clock positions, or at the eight and two o'clock positions. This is necessary to align the rear main bearing cap and seal lips.

NOTICE: To prevent damage to the main bearing caps, the caps are to be tapped into the block using a brass or leather hammer. The new seal is used as a guide. The cap must NOT be pulled into the block with the bolts.

2. Main bearing cap to the block.
    - Lightly coat the seal groove in the main bearing with adhesive (GM part number 1052621 [Loctite 414] or equivalent).
    - Apply a thin film of anaerobic sealant (GM part number 1052756 or equivalent) to the main bearing cap as shown in figure 23. Do not put sealant in the bearing cap oil relief slot.
    - Apply engine oil to the main bearing cap bolt threads.
    - Tap the main bearing cap into place with a brass or leather mallet. Then install the bolts.



A. Use short pieces of 10 mm (3/8-inch) hose to protect the crankshaft journal.

B-08045

Figure 24—Replacing The Connecting Rod And Piston

Tighten

- Main bearing cap bolts to specifications, in the following sequence:
    - Inner bolts: 150 N·m (110 ft. lbs.).
    - Outer bolts: 135 N·m (100 ft. lbs.).
    - Re-tighten all bolts using the same sequence.

3. Oil pump and oil pan, as outlined previously.

CONNECTING ROD AND PISTON REPLACEMENT

Remove or Disconnect (Figure 24)

1. Cylinder head, as outlined previously.
2. Oil pan, as outlined previously.
3. Oil pump, as outlined previously.
4. Ridge or deposits from the upper end of the cylinder bores.
    - Turn the crankshaft until the piston is at BDC.
    - Place a cloth on top of the piston.
    - Perform the cutting operation with a ridge reamer.
    - Turn the crankshaft until the piston is at TDC.
    - Remove the cloth and cuttings.
5. Connecting rod cap. Check the connecting rod and cap for identification makrs. Mark the parts if required. The connecting rod and cap must be kept together as mating parts.
6. Connecting rod and piston.

  - Attach two short pieces of 10 mm (3/8-inch) hose to the connecting rod bolts (figure 24). This will protect the crankshaft journal during removal.
  - Push the connecting rod and piston out of the bore.
7. Connecting rod bearings. Place the bearings in a rack if they are to be reused, so they can be returned to their original locations.

Cleaning, Inspection and Repair

Clean, inspect and repair or replace the components as necessary. Measure connecting rod bearing clearance, piston clearance, ring clearances, etc. Refer to the proper unit repair manual.

The unit repair manual contains information on:

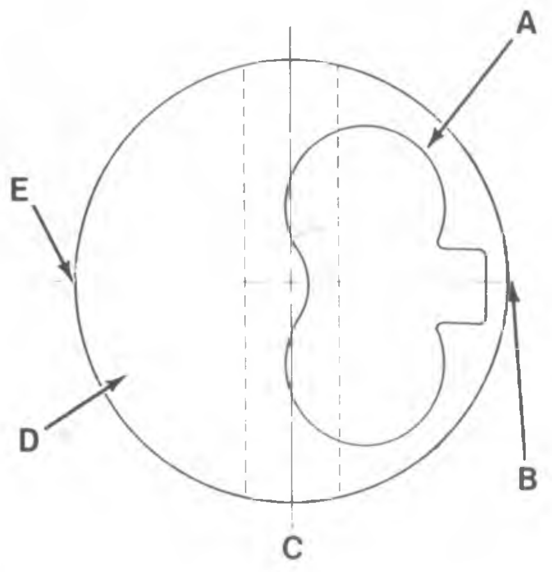
— Connecting rod and piston.
— Piston rings.
— Connecting rod and crankpin.
— Cylinder bores.

Install or Connect (Figures 24 through 27)

Tool Required:
J-8037 Ring Compressor

- Make sure the cylinder walls are clean. Lubricate the cylinder wall lightly with engine oil.
- Make sure the piston is installed in the matching cylinder. Install new pistons in the cylinders for which they were fitted. Install used pistons in the cylinder from which they were removed.

1. Connecting rod bearings.
   - Be certain that the bearings are the proper size.
   - Install the bearings in the connecting rod and connecting rod cap.
   - Lubricate the bearings with engine oil.
2. Piston and connecting rod to the proper bore.
   - With the connecting rod cap removed, install two short pieces of 10 mm (3/8-inch) hose onto the connecting rod studs.
   - Locate the piston ring end gaps as shown in figure 25. Lubricate the piston and rings with engine oil.
   - Without disturbing the ring end gap location, install J-8037 over the piston (figure 26).
   - The piston must be installed so that the depression in the piston crown is towards the outside of the engine. The connecting rod bearing tang slots must be opposite the camshaft.
   - Place the piston in its matching bore. Using light blows with a hammer handle, tap the piston down into its bore (figure 26). At the same time, from beneath the vehicle guide the connecting rod to the crankpin with the pieces of hose (figure 24). Hold the ring compressor against the block until all rings have entered the cylinder bore.



A. Oil Control Ring Expander Gap
B. Second Compression Ring Gap
C. Centerline Of Piston Pin
D. Oil Control Ring Gap
E. Top Compression Ring Gap

B-08046

Figure 25—Ring Gap Location

   - Remove the hoses from the connecting rod bolts.

Important

- Each connecting rod and bearing cap should be marked, beginning at the front of the engine. Cylinders and 1, 3, 5 and 7 are the left bank and, 2, 4, 6 and 8 are the right bank. The numbers on the connecting rod and bearing cap must be on the same side when installed in the cylinder bore. If a connecting rod is ever transposed from one block or cylinder to another, new connecting rod bearings should be fitted and the connecting rod should be numbered to correspond with the new cylinder number.

Measure

- Connecting rod bearing clearance. Refer to the proper unit repair manual.

3. Connecting rod cap and bearing.
4. Connecting rod cap nuts.

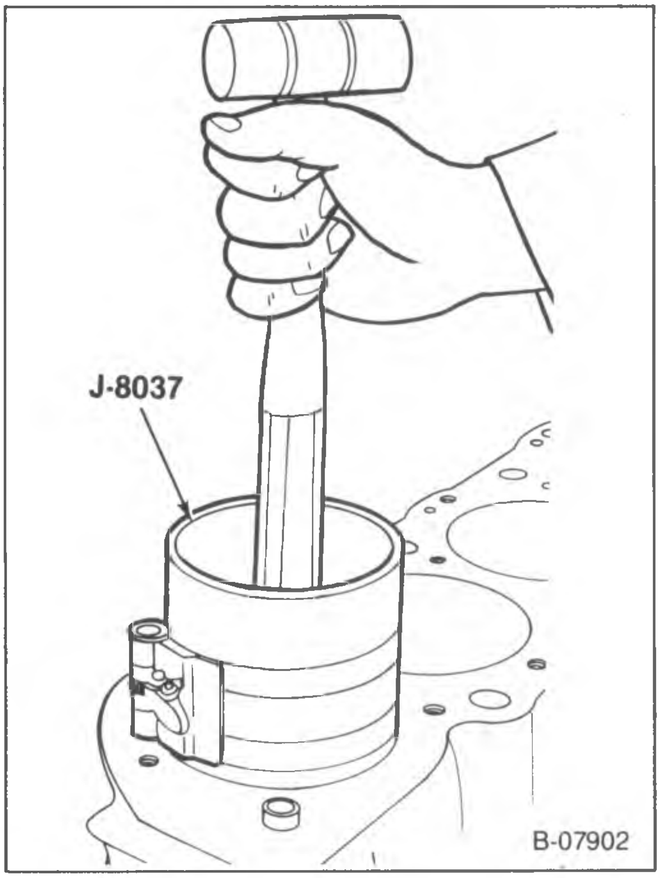


Figure 26—Installing The Piston And Connecting Rod

Tighten

- Connecting rod cap nuts to 65 N·m (48 ft. lbs.).

Measure

- Connecting rod side clearance. Use a feeler gage between the connecting rod and crankshaft (figure 27). The correct clearance is 0.17–0.63 mm.

5. Oil pump (if removed), as outlined previously.

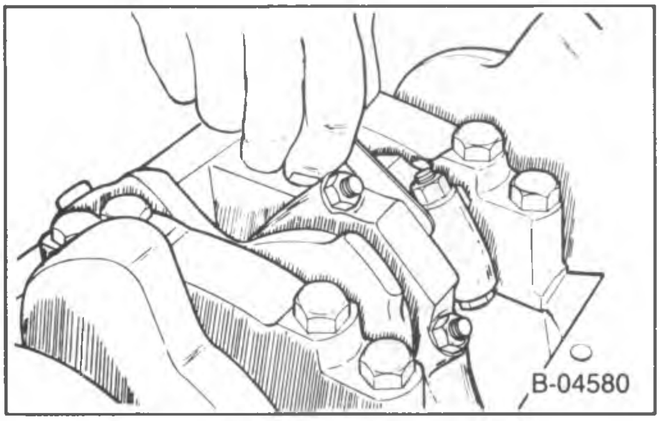


Figure 27—Checking Connecting Rod Side Clearance

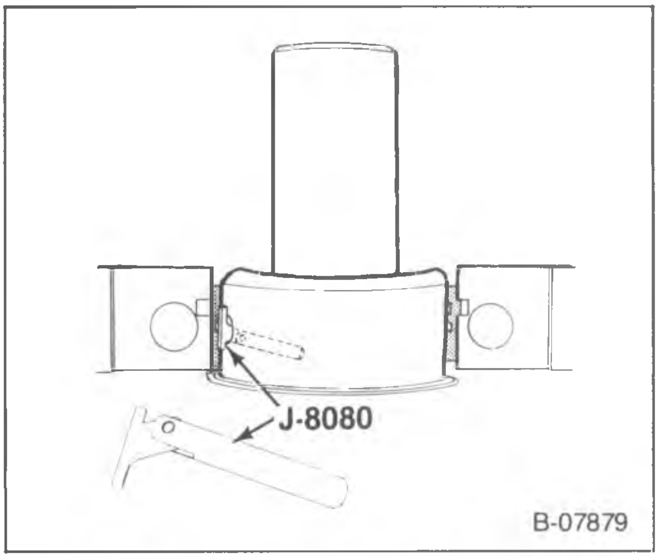


Figure 28—Removing The Main Bearings

6. Oil pan and cylinder head, as outlined previously.

MAIN BEARING REPLACEMENT

Remove or Disconnect (Figure 28)

Tool Required:

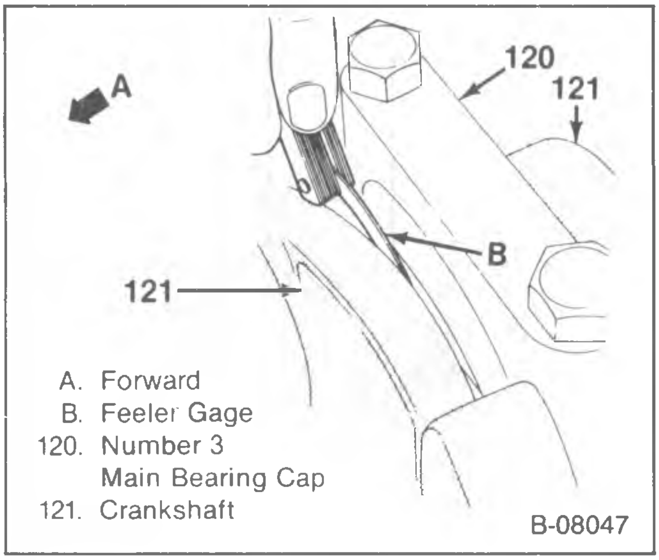
J-8080 Main Bearing Remover/Installer

1. Glow plugs.
2. Oil pan, as outlined previously.
3. Oil pump, as outlined previously.
4. Main bearing caps.
   - Check the main bearing caps for location markings. Mark the caps if necessary. The caps must be returned to their original locations during assembly.
5. Lower main bearing inserts from the main bearing caps.
6. Rear crankshaft oil seal, if necessary, as outlined previously.
7. Upper main bearing inserts.
   - Insert J-8080 into the crankshaft oil hole (figure 28).
   - Rotate the crankshaft to "turn" the bearing insert out of the block.

Cleaning, Inspection and Repair

Clean, inspect and repair or replace the components as required. Refer to the proper unit repair manual. The unit repair manual contains information on

- Crankshaft.
- Main and connecting rod bearings.



A. Forward
B. Feeler Gage
120. Number 3 Main Bearing Cap
121. Crankshaft

Figure 29—Measuring Crankshaft End Play

Install or Connect (Figures 23, 28, and 29)

Tool Required:

J-8080 Main Bearing Remover/Installer

1. Upper main bearing inserts.
   - Insert tool J-8080 into a crankshaft main bearing oil hole (figure 28).
   - Apply engine oil to inserts of the proper size.
   - Insert the plain end (without the bearing tang) of the insert between the crankshaft and the notched side of the block.
   - Rotate the crankshaft to "roll" the insert into the block.
   - Remove the tool.
2. Lower main bearing inserts to the main bearing caps.
   - Make sure the inserts are of the proper size.
   - Apply engine oil to the inserts.

   Measure

   - Main bearing clearance. Refer to the proper unit repair manual. If the engine is 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.
3. Rear crankshaft oil seal (if necessary) as outlined previously.

NOTICE: The main bearing caps are to be tapped into place with a brass or leather mallet before the attaching bolts are installed. Do not use the attaching bolts to pull the main bearing caps into their seats, as this may damage the bearing cap and/or block.

4. Number 5 (rear) main bearing cap.
   - Apply a thin film of anaerobic sealant (GM part number 1052756 or equivalent) to the bearing cap as shown in figure 23. Keep the sealant off the seal and bearing. Do not put sealant in the bearing cap oil relief slot.
   - Apply a light coat of engine oil to the crankshaft surface that will contact the seal.
   - Apply engine oil to the main bearing cap bolt threads.
   - Tap the main bearing cap into place with a brass or leather mallet. Then install the bolts.

   Tighten

   - Bolts to specifications, in the following sequence:
     - Inner bolts: 150 N·m (110 ft. lbs.).
     - Outer bolts: 135 N·m (100 ft. lbs.).
     - Re-tighten all bolts in the same sequence.
5. Numbers 1, 2, and 4 main bearing caps and bolts.

   Tighten

   - Bolts to specifications. Refer to step 4.
6. Number 3 (center) main bearing cap and bolts. Tighten the bolts temporarily to 14 N·m (10 ft. lbs.).

   Measure

   - Crankshaft end play, as follows:
     - Tap the end of the crankshaft first rearward then forward with a lead hammer. This will line up the rear main bearing and crankshaft thrust surfaces.
     - Tighten the rear main bearing cap bolts to specifications. Refer to step 4.
     - With the crankshaft forced forward, measure at the front end of the number 3 main bearing with a feeler gage (figure 29). The proper clearance is 0.10–0.25 mm.
7. Oil pump, as outlined previously.
8. Oil pan, as outlined previously.
9. Glow plugs.

CRANKSHAFT REPLACEMENT

↔ Remove or Disconnect (Figure 24)

1. Engine, as outlined later.
2. Flywheel as outlined later.
   - Mount the engine in a suitable engine stand.
3. Oil dipstick tube.
4. Glow plugs.
5. Torsional damper, as outlined previously.
6. Front cover, as outlined previously.
7. Timing chain, as outlined previously.
8. Oil pan and oil pump, as outlined previously.
9. Connecting rod caps. Check the connecting rod and cap for identification marks. Mark the parts if necessary. The connecting rod and cap are mating parts.
10. Connecting rods from the crankshaft.
    - Attach short pieces of 10 mm (3/8-inch) hose to the connecting rod bolts (figure 24).
    - Push the pistons up in the bores.
11. Connecting rods bearings. If the bearings are to be re-used, mark them so they can be re-installed in the original location.
12. Main bearing caps. Check the main bearing caps for location markings. Mark the parts if necessary. The main bearing caps must be returned to their original locations at assembly.
13. Crankshaft.
14. Main bearing inserts.
15. Rear crankshaft oil seal, from the block and main bearing cap.

Cleaning, Inspection and Repair

- Clean, inspect and repair or replace the parts as outlined in the proper unit repair manual. Refer to the unit repair manual for information on:
  - — Crankshaft.
  - — Main and connecting rod bearings.
  - — Procedures for measuring bearing clearances.

Install or Connect (Figures 14, 22, 27, and 29)

Tool Required:

J-33153 Rear Oil Seal Installer (for rope type seal)

1. New upper rope seal piece to the seal groove in the block (if a rope type seal is to be installed).
   - Apply a drop of adhesive (GM part number 1052621 [Loctite 414] or equivalent) to the seal groove in the block.
   - Install the new rope seal piece. The seal must be firmly installed in place, completely filling the groove.
   - Cut the seal clean and flush with the block surface. Use a sharp tool.
2. New rope seal to the main bearing cap (if a rope type seal is to be installed).
   - Apply adhesive (GM part number 1052621 [Loctite 414] or equivalent) to the seal groove.
   - Position the rope seal on the bearing cap.
   - Use J-33153 to install the seal (figure 22).
   - After correctly positioning the seal, rotate J-33153 slightly and cut the seal ends flush with the bearing cap surface. Use a sharp tool. (figure 22).
3. Upper main bearing inserts to the block. Apply engine oil to the main bearings.
4. Crankshaft.
5. Lower main bearing inserts to the main bearing caps. Apply engine oil to the bearing inserts.

Measure

- Main bearing clearance. Refer to the proper unit repair manual. If clearance is out of specification at the rear main bearing, and a rope type seal is being installed, check for fraying that may prevent the bearing cap from seating.

6. Rear crankshaft oil seal halves to the block and main bearing cap as outlined previously (if a two piece type seal is to be installed).

NOTICE: The main bearing caps are to be tapped into place with a brass or leather mallet before the attaching bolts are installed. Do not use the attaching bolts to pull the main bearing caps into their seats, as this may damage the bearing cap and/or block.

7. Number 5 (rear) main bearing cap.
   - Apply a thin film of anaerobic sealant (GM part number 1052756 or equivalent) to the bearing cap as shown in figure 22. Keep the sealant off the seal and bearing. Do not put sealant in the bearing cap oil relief slot.
   - Apply engine oil to the main bearing cap bolt threads.
   - Tap the main bearing cap into place with a brass or leather mallet. Then install the bolts.

Tighten

- Bolts to specifications, in the following sequence:
  - Inner bolts: 150 N·m (110 ft. lbs.).
  - Outer bolts: 135 N·m (100 ft. lbs.).
  - Re-tighten all bolts in the same sequence.

8. Numbers 1, 2, and 4 main bearing caps and bolts.

Tighten

- Bolts to specifications. Refer to step 7.

9. Number 3 (center) main bearing cap and bolts. Tighten the bolts temporarily to 14 N·m (10 ft. lbs.).

Measure

- Crankshaft end play, as follows:
  - Tap the end of the crankshaft first rearward then forward with a lead hammer. This will line up the rear main bearing and crankshaft thrust surfaces.
  - Tighten the rear main bearing cap bolts to specifications. Refer to step 7.
  - With the crankshaft forced forward, measure at the front end of the number 3 main bearing with a feeler gage (figure 29). The proper clearance is 0.10–0.25 mm.

Inspect

- Crankshaft for binding. Try turning the crankshaft to check for binding. If the crankshaft does not turn freely, loosen the main bearing cap bolts, one pair at a time, until the tight bearing is located. Burrs on the bearing cap, foreign matter between the insert and the block or the bearing cap, or a faulty insert could cause a lack of clearance at the bearing.

10. Connecting rod bearing inserts. Used inserts must be installed in their original locations.
11. Connecting rods to the crankshaft. Pull the connecting rods down. Make sure the connecting rod bearing insert stays in place. Remove the hose pieces.

Measure

- Connecting rod bearing clearance. Refer to the proper unit repair manual.

12. Connecting rod caps with bearing inserts to the connecting rods. Apply engine oil to the inserts.
13. Connecting rod cap nuts.

Tighten

- Connecting rod cap nuts to 65 N·m (48 in. lbs.).

Measure

- Connecting rod side clearance. Use a feeler gage between the connecting rod and crankshaft (figure 27). The correct clearance is 0.17–0.63 mm.

14. Oil pump and oil pan, as outlined previously.
15. Timing chain, as outlined previously.

Important

- Align the timing marks (figure 14).

16. Torsional damper, as outlined previously.
17. Glow plugs.
18. Oil dipstick tube.
19. Flywheel.
20. Engine.

ENGINE MOUNTINGS

NOTICE: Broken or deteriorated mountings can cause misaligned and eventual destruction of certain drive train components. When a single mounting breakage occurs, the remaining mountings are subjected to abnormally high stresses.

INSPECTING ENGINE MOUNTINGS

Front Engine Mountings

NOTICE: When raising or supporting the engine for any reason, do not use a jack under the oil pan, any sheet metal or crankshaft pulley. Due to the small clearance between the oil pan and the oil pump screen, jacking against the oil pan may cuase it to be bent against the pump screen, resulting in a damaged oil pickup unit.

1. Raise the engine to remove weight from the mountings and to place a slight tension on the rubber cushion. Observe both mountings while raising the engine.
2. Replace the mounting if the following conditions exist:
   - — Hard rubber surface covered with heat check cracks.
   - — Rubber cushion separated from the metal plate of the mounting.
   - — Rubber cushion split through the center.
3. If there is movement between a metal plate of the mounting and its attaching points, lower the engine and tighten the bolts or nuts attaching the mounting to the engine, frame, or bracket.

Rear Mountings

1. Push up and pull down on the transmission tailshaft. Observe the transmission mounting.
2. Replace the mounting if the following conditions exist:
    - — Rubber cushion separated from the metal plate of the mounting.
    - — Mounting bottomed out (tailshaft can be moved up but not down).
3. If there is relative movement between a metal plate of the mounting and its attaching point, tighten the bolts or nuts attaching the mounting to the transmission or crossmember.

FRONT MOUNTING REPLACEMENT

Remove or Disconnect (Figures 30 through 33)

> ***NOTICE: When raising or supporting the engine for any reason, do not use a jack under the oil pan, any sheet metal or crankshaft pulley. 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 pickup unit.***

- Support the engine with a suitable jack. Do not load the engine mounting.

1. Engine mounting through-bolt and nut.

- Raise the engine only enough to permit removal of the engine mounting.

2. Mounting assembly bolts, nuts, and washers.
3. Mounting assembly.

Install or Connect (Figures 30 through 33)

1. Engine mounting assembly to the vehicle.
    - On K, G, and P models, the through-bolt must be inserted from the rear of the right side mounting before the mounting is installed in the vehicle.

NOTICE: See "Notice" on page 6A7-1 of this section.

2. Mounting assembly bolts, nuts, and washers.

Tighten

- Fasteners to specifications. Refer to figures 30 through 33.
- On K, G, and P models (right side), make sure there is 25 mm (1 inch) clearance between the through bolt head and mounting assembly.
- Lower the engine until the through bolts can be inserted.

NOTICE: See "Notice" on page 6A7-1 of this section.

3. Through bolts and nuts.

Tighten

- Fasteners to specifications. Refer to figures 30 through 33.

REAR MOUNTING REPLACEMENT (EXCEPT P MODEL FLYWHEEL HOUSING MOUNTING)

Remove or Disconnect (Figures 34 through 37)

> ***NOTICE: When raising or supporting the engine for any reason, do not use a jack under the oil pan, any sheet metal or crankshaft pulley. Due to the small clearance between the oil pan and the oil pump screen, resulting in a damaged oil pickup unit.***

- Support the rear of the engine to relieve the weight on the rear mountings.

1. Mounting to crossmember nut(s) and washer(s).
2. Mounting to transmission bolts and washers.

- Raise the rear of the engine only enough to permit removal of the mounting.

3. Mounting.

Install or Connect (Figures 34 through 37)

1. Mounting.

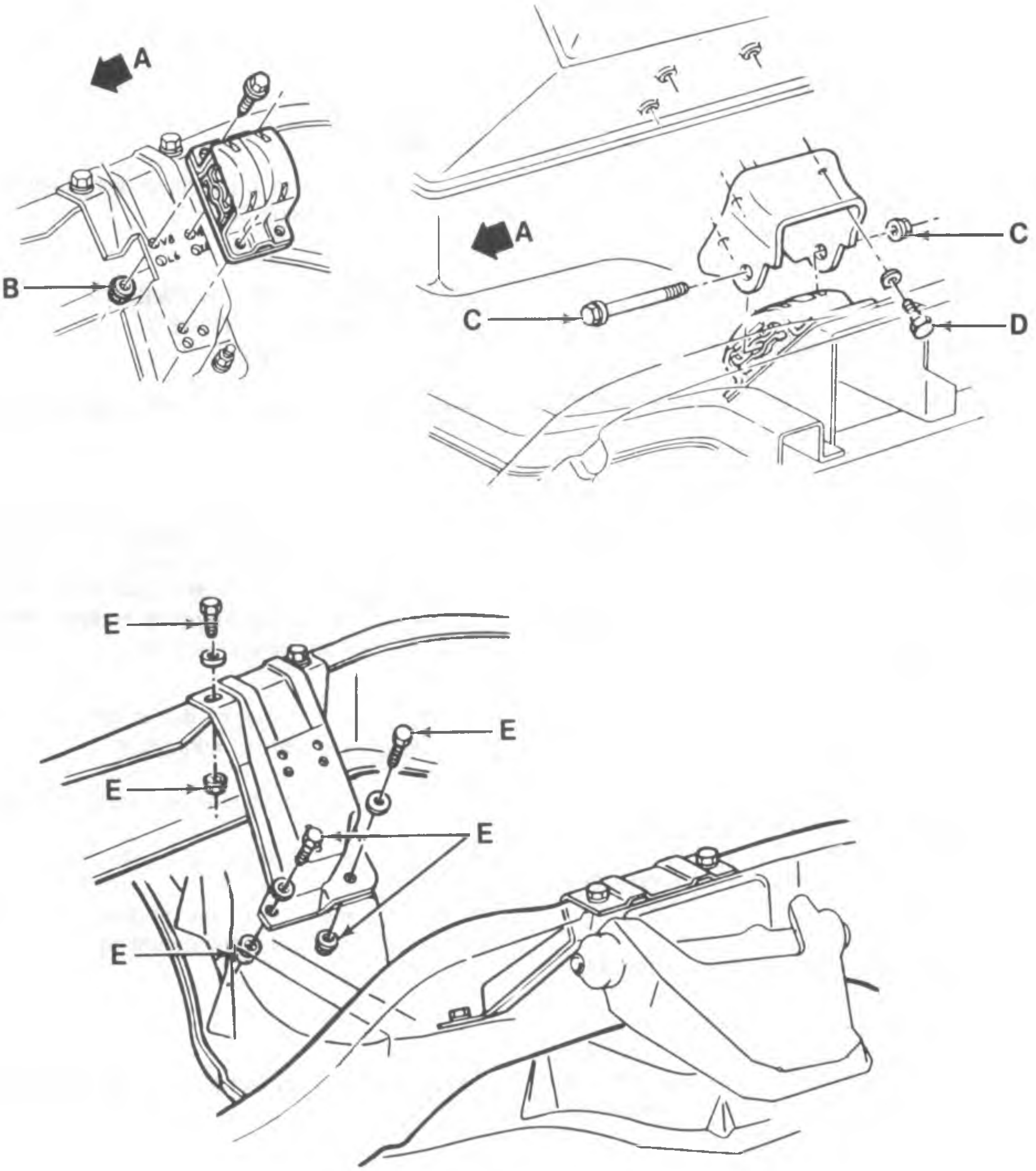
- Lower the rear of the engine.

2. Mounting to transmission bolts and washers.

NOTICE: See "Notice" on page 6A7-1 of this section.

Tighten

- Fasteners to specifications. Refer to figures 34 through 37.



A. Forward
B. 40 N·m (30 Ft. Lbs.)
C. Torque Bolt To 115 N·m (85 Ft. Lbs.) Or, Torque Nut To 75 N·m (55 Ft. Lbs.)
D. 48 N·m (36 Ft. Lbs.)
E. Torque Bolt To 48 N·m (36 Ft. Lbs.) Or, Torque Nut To 40 N·m (30 Ft. Lbs.)

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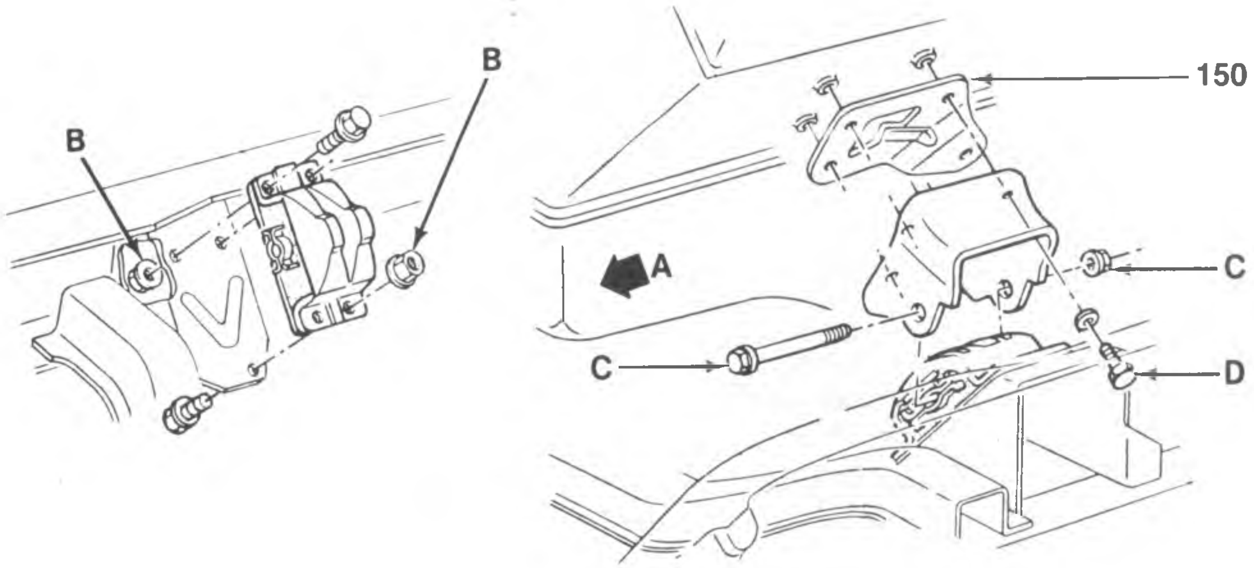
Figure 30—Front Engine Mountings (C Models)



A. Forward
B. 40 N·m (30 Ft. Lbs.)
C. Torque Bolt To 115 N·m (85 Ft. Lbs.) Or, Torque Nut To 75 N·m (55 Ft. Lbs.)
D. 48 N·m (36 Ft. Lbs.)
150. Transmission Strut Bracket (Automatic Transmission) Or Spacer (Manual Transmission)

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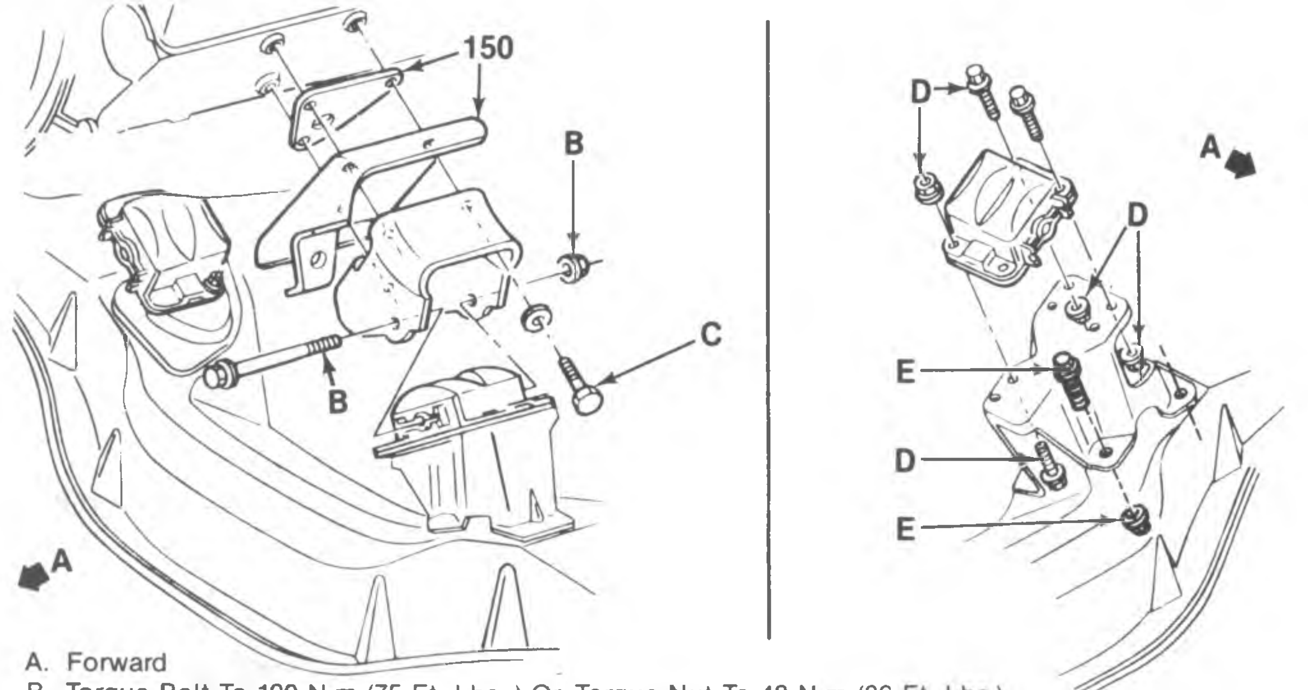
Figure 31—Front Engine Mountings (K Models)



A. Forward
B. Torque Bolt To 100 N·m (75 Ft. Lbs.) Or, Torque Nut To 48 N·m (36 Ft. Lbs.)
C. 48 N·m (36 Ft. Lbs.)
D. Torque Bolt To 52 N·m (38 Ft. Lbs.) Or, Torque Nut To 40 N·m (30 Ft. Lbs.)
E. Torque Bolt Or Nut to 40 N·m (30 Ft. Lbs.)
150. Spacer OR Power Steering Pump Bracket (Left Side Only)

B-07919

Figure 32—Front Engine Mountings (G Models)

REAR MOUNTING REPLACEMENT (P MODELS FLYWHEEL HOUSING MOUNTING)

Remove or Disconnect (Figure 38)

1. Bolt, cushion, and spacer.

NOTICE: When raising or supporting the engine for any reason, do not use a jack under the oil pan, any sheet metal or crankshaft pulley. 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 pickup unit.

- Raise the rear of the engine only enough to permit removal of the mounting.

2. Engine mounting.

Install or Connect (Figure 38)

1. Engine mounting. Align the hole in the mounting with the hole in the crossmember.

- Lower the engine.

NOTICE: See "Notice" on page 6A7-1 of this section.

2. Spacer, cushion, and bolt.

Tighten

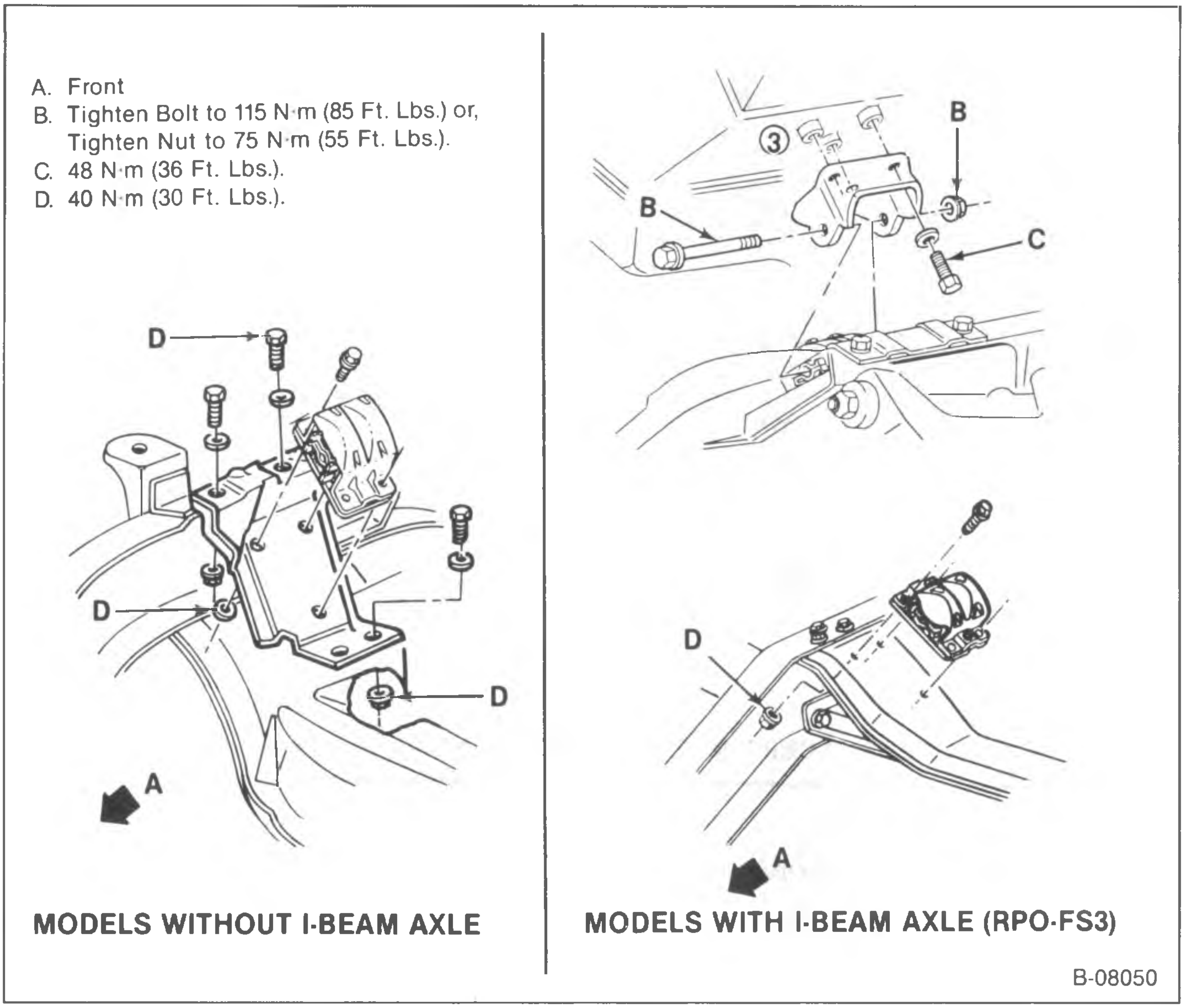
- Bolt to 90 N·m (65 ft. lbs.).

ENGINE REPLACEMENT

C AND K MODELS

Remove or Disconnect

1. Battery cables.
- Raise the vehicle.
2. Flywheel cover.
3. Flywheel to torque converter bolts (automatic transmission).
4. Exhaust pipes at the manifolds.
5. Starter.
6. Bell housing bolts.
7. Front engine mounting through-bolts.
8. Block heater.
9. Wiring harness, transmission cooler lines, and front battery cable clamp at the oil pan.
10. Fuel return lines at the engine.



A. Front
B. Tighten Bolt to 115 N·m (85 Ft. Lbs.) or, Tighten Nut to 75 N·m (55 Ft. Lbs.).
C. 48 N·m (36 Ft. Lbs.).
D. 40 N·m (30 Ft. Lbs.).

MODELS WITHOUT I-BEAM AXLE

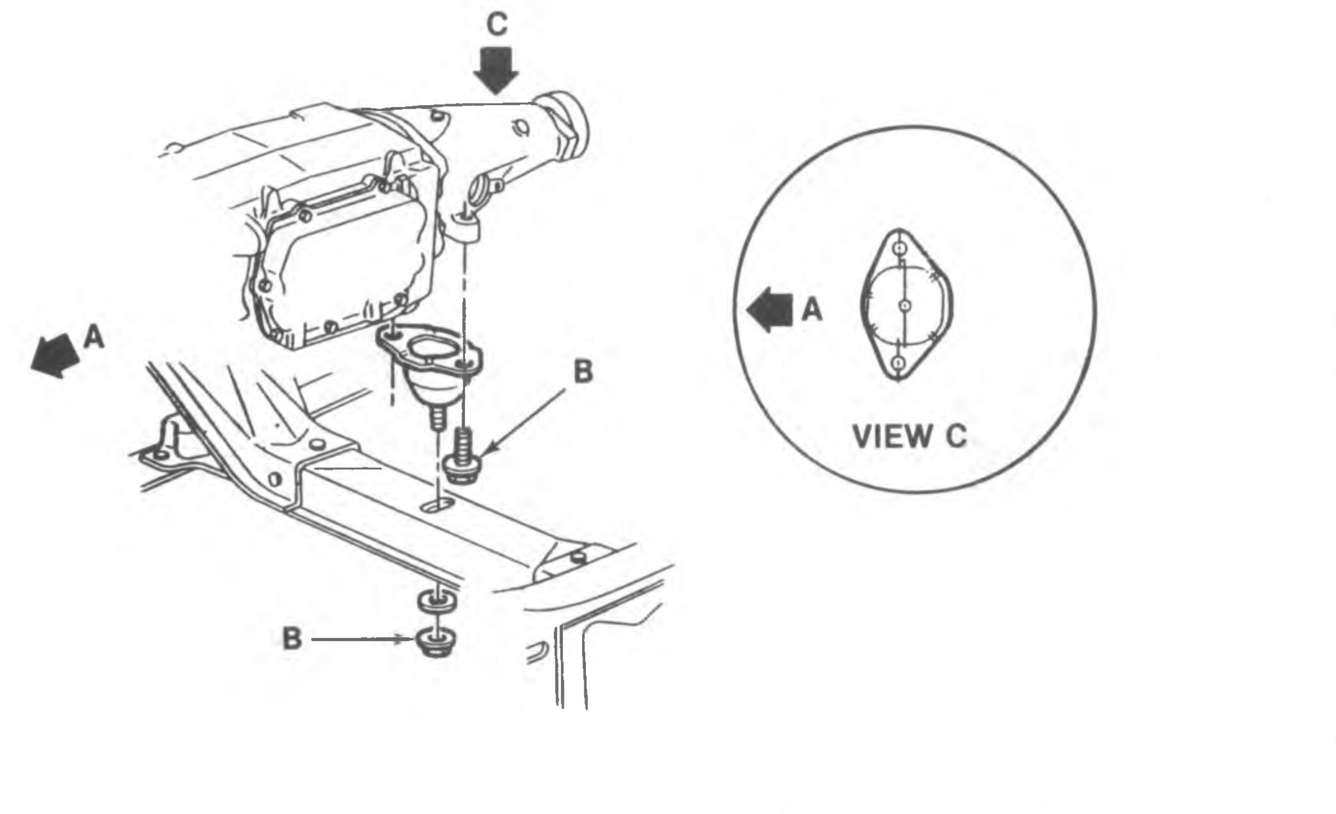
MODELS WITH I-BEAM AXLE (RPO-FS3)

Figure 33—Front Engine Mountings (P Models)

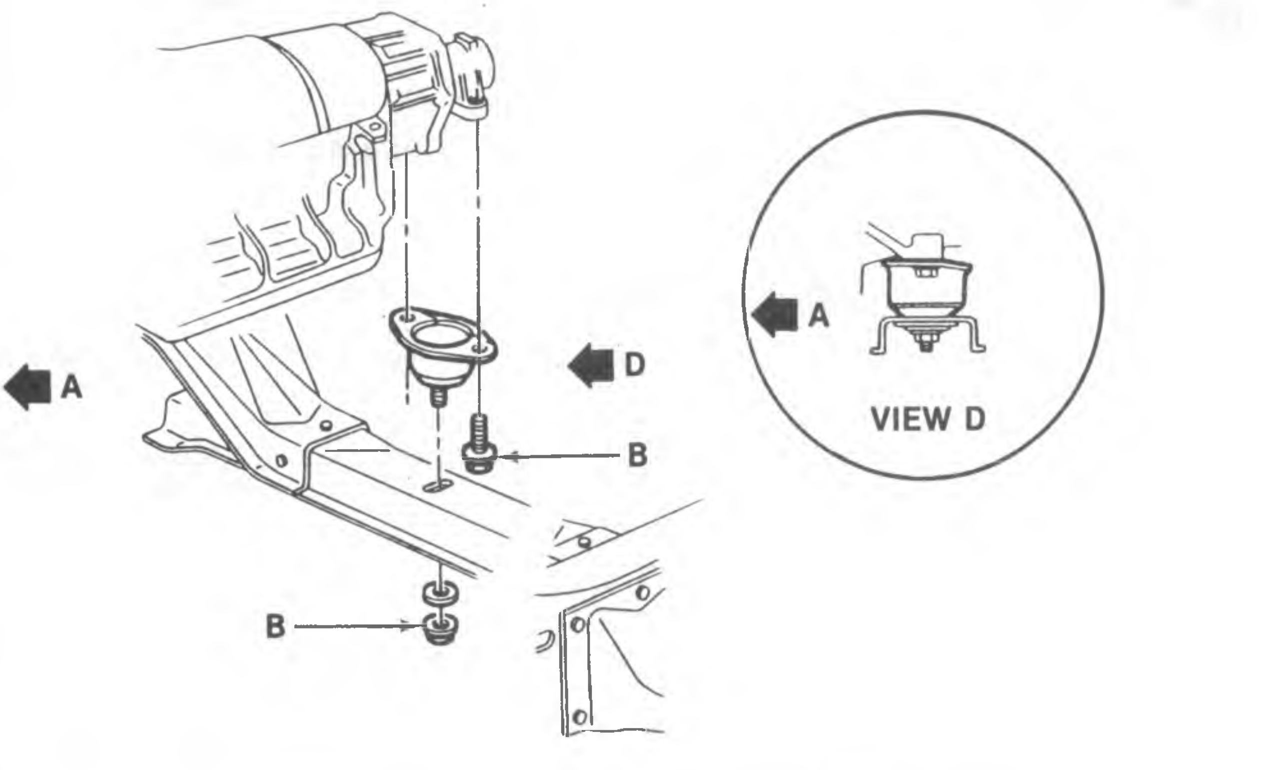
11. Oil cooler lines at the engine.
12. Lower fan shroud bolts.
    - Lower the vehicle.
13. Hood.
    - Drain the cooling system.
14. Air cleaner with resonator.
15. Fuel filter.
16. Ground cable at the generator bracket.
17. Generator wires and clips.
18. Wiring at the injection pump.
19. Wiring from rocker arm clips, including glow plug wires.
20. EGR-EPR solenoids, glow plug controller and temperature sensor. Move the harness aside.
21. Left side ground strap.
22. Fan.
23. Fan shroud.
24. Power steering pump and reservoir and lay aside.
25. Vacuum hose at the cruise control transducer (if equipped).
26. Accelerator, detent, and cruise control cables at the injection pump.
27. Heater hose at the engine.
28. Radiator. Refer to ENGINE COOLING (SEC. 6B).
    - Support the transmission with a suitable jack.
29. Engine.

Install or Connect (Figures 30 and 31)

1. Engine to the vehicle.
2. Radiator. Refer to ENGINE COOLING (SEC. 6B).
3. Heater hose.
4. Accelerator, detent, and cruise control cables.
5. Vacuum hose at the transducer.
6. Power steering pump and reservoir.
7. Fan shroud.
8. Fan.
9. Left side ground strap.
10. EGR-EPR, glow plug controller, and temperature sensor.



ALL MODELS EXCEPT WITH THM 400 TRANSMISSION (RPO-M40)



MODELS WITH THM 400 TRANSMISSION (RPO-M40)

A. Forward
B. 48 N·m (36 Ft. Lbs.)

B-07921

Figure 34—Rear Engine Mountings (C Models)

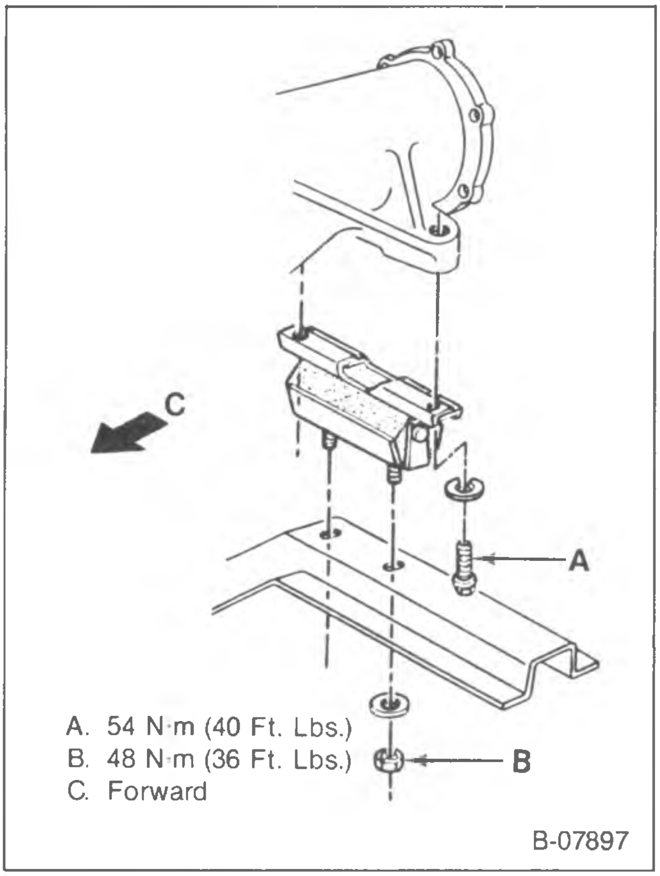


Figure 35—Rear Engine Mountings (K Models)

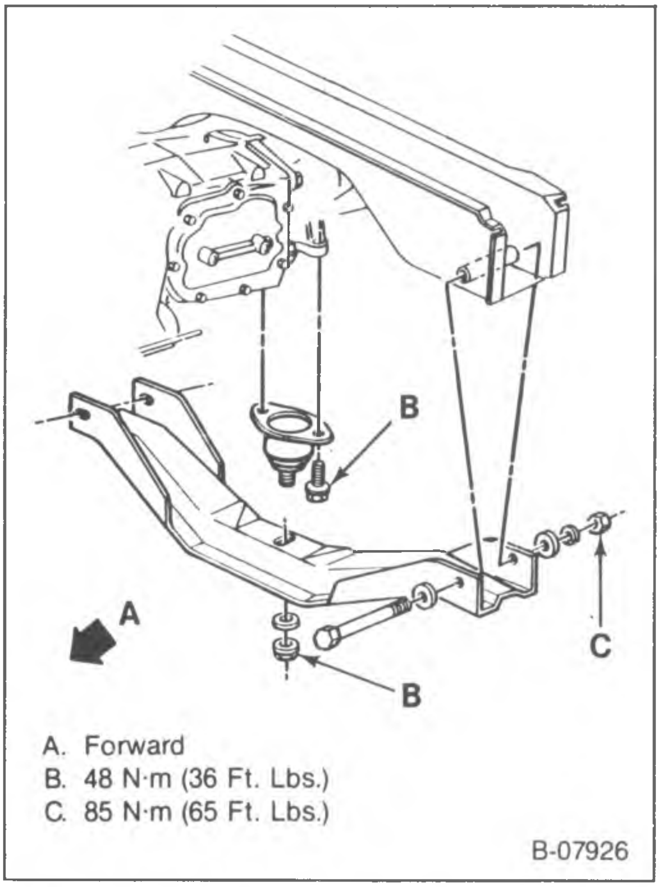


Figure 36—Rear Engine Mountings (G Models)

11. Wiring at the rocker arm clips, including glow plug wires.
12. Injection pump wiring.
13. Generator wires and clips.
14. Ground cable at the generator bracket.
15. Fuel filter.
16. Air cleaner and resonator.
17. Hood.
- Raise the vehicle.
18. Lower fan shroud bolts.
19. Oil cooler and fuel return lines.
20. Wiring harness, transmission cooler lines, and front battery cable clamp at the oil pan.
21. Block heater.

NOTICE: See "Notice" on page 6A7-1 of this section.

22. Engine mounting through bolts.

Tighten

- Fasteners to specifications. Refer to figures 30 and 31.

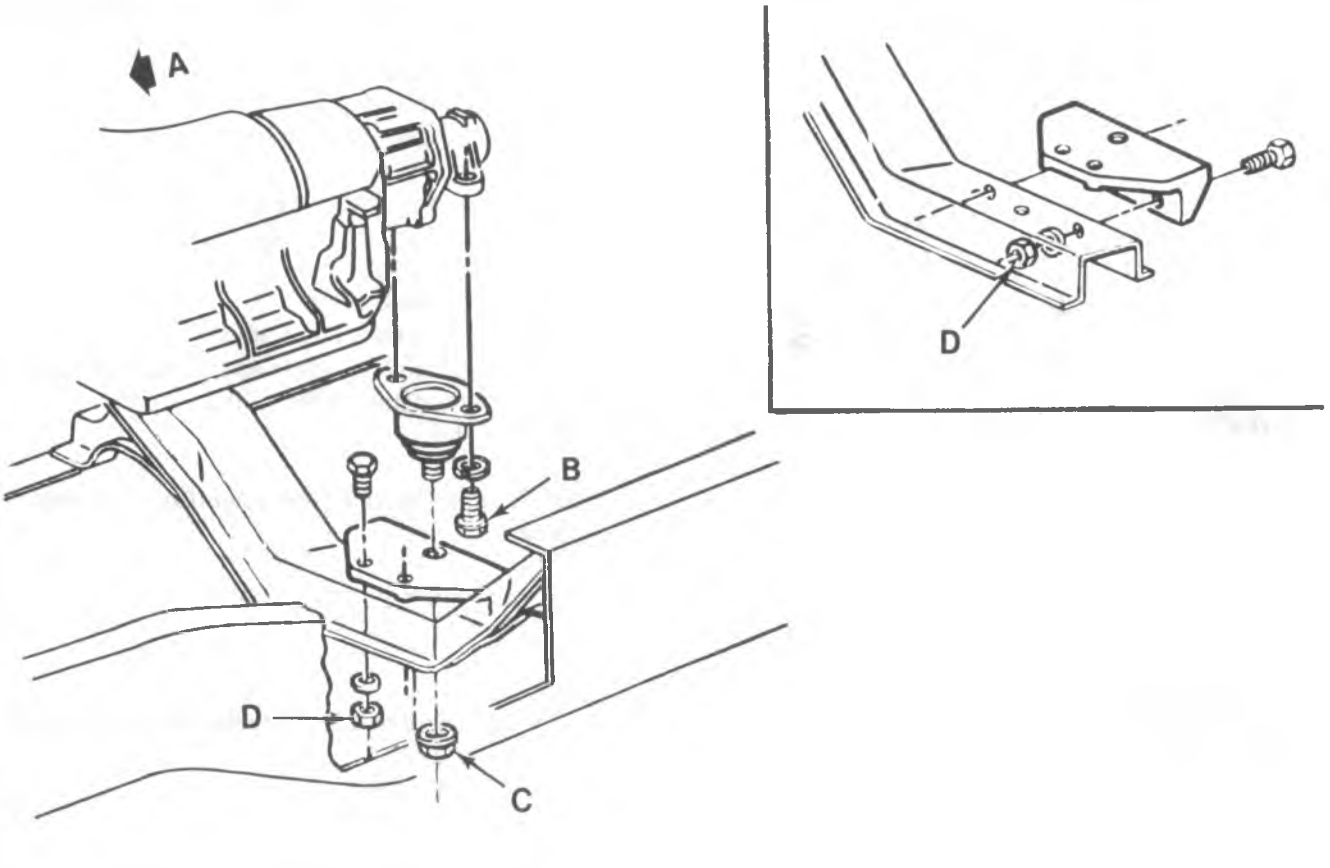
23. Bell housing bolts.
24. Starter.
25. Exhaust pipes.
26. Flywheel to torque converter bolts (automatic transmission).
27. Flywheel cover.
- Lower the vehicle.
28. Battery cables.
- Fill the cooling system with the proper quantity and grade of coolant.

G MODELS

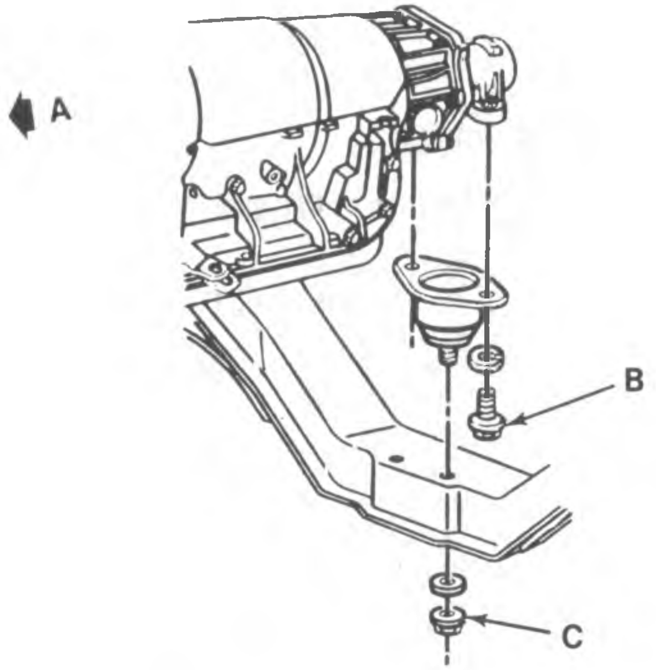
Remove or Disconnect

Tool Required:
J-33888 Lifting Fixture

1. Battery cables.
2. Headlight bezels, grille, bumper, and lower valence panel.
3. Hood latch.
4. Coolant recovery bottle.
5. Upper fan shroud.
6. Upper tie bar.
7. Engine cover.
8. Condenser (vehicles with air conditioning). Refer to AIR CONDITIONING (SEC. 1B).
9. Radiator and fan. Refer to ENGINE COOLING (SEC. 6B).
10. Injection pump. Refer to DIESEL FUEL INJECTION (SEC. 6C2).
- Raise the vehicle.
11. Exhaust pipes at the manifolds.
12. Flywheel cover.



MODELS WITH PROPSHAFT PARKING BRAKE



A. Forward
B. 68 N·m (50 ft. lbs.)
C. 48 N·m (36 ft. lbs.)
D. 60 N·m (44 ft. lbs.)

MODELS WITHOUT PROPSHAFT PARKING BRAKE

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Figure 37—Rear Engine Mountings (P Models—Transmission Tail Type Mountings)

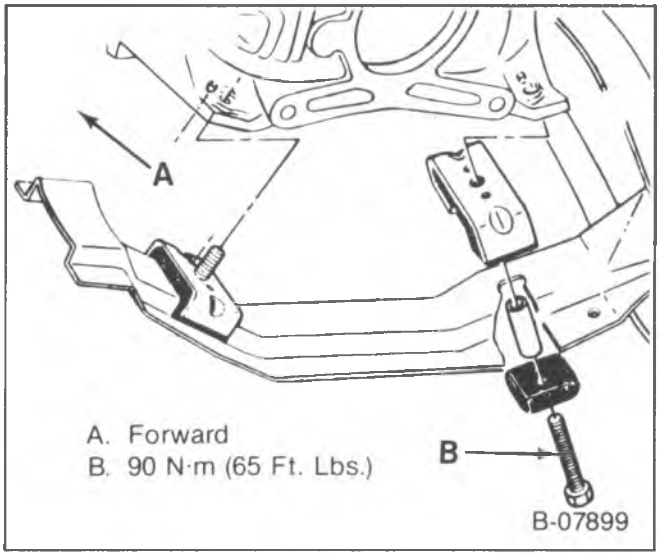

Figure 38—Rear Engine Mountings (P Models—Flywheel Housing Type Mounting)

13. Flywheel to torque converter bolts (automatic transmission).
14. Engine mounting through bolts.
15. Block heater wires.
16. Bellhousing bolts.
17. Starter.
- Lower the vehicle.
18. Cruise control transducer (if equipped).
19. Air conditioning compressor (if equipped). Refer to AIR CONDITIONING (SEC. 1B).
20. Power steering pump, and lay aside.
21. Oil fill tube upper bracket.
22. Glow plug relay.
23. Oil pressure sender harness.
24. Air cleaner resonator and bracket.
25. Transmission dipstick tube and move aside.
26. Heater hoses at the engine.
27. Generator upper bracket.
28. Water crossover/thermostat assembly.
29. Fuel lines at the fuel pump (lift pump).
30. Engine
    - Attach J-33888 to the center intake manifold bolt holes. The two pieces of the tool should extend down into the "valley" between the cylinders.
    - Support the transmission.
    - Use a suitable lifting device to remove the engines.

Install or Connect (Figure 32)

1. Engine to the vehicle.

    Remove or Disconnect

    - J-33888, and lifting device.
    - Transmission support.
2. Fuel lines to the fuel pump (lift pump).
3. Water crossover/thermostat assembly. Use new gaskets.

    Tighten

    - Bolts to 42 N·m (31 ft. lbs.).
4. Generator upper bracket.
5. Heater hoses.
6. Transmission dipstick tube.
7. Air cleaner resonator and bracket.
8. Oil pressure sender harness.
9. Glow plug relay.
10. Oil fill tube upper bracket.
11. Power steering pump.
12. Air conditioning compressor (if equipped). Refer to AIR CONDITIONING (SEC. 1B).
13. Cruise control transducer (if equipped).
- Raise the vehicle.
14. Starter.
15. Bellhousing bolts.
16. Block heater wires.

NOTICE: See "Notice" on page 6A7-1 of this section.

17. Engine mounting through bolts.

    Tighten

    - Fasteners to specifications. (Refer to figure 32).
18. Flywheel to torque converter bolts (automatic transmission).
19. Flywheel cover.
20. Exhaust pipes.
- Lower the vehicle.
21. Injection pump. Refer to DIESEL FUEL INJECTION (SEC. 6C2).
22. Radiator and fan. Refer to ENGINE COOLING (SEC. 6B).
23. Condenser (if equipped). Refer to AIR CONDITIONING (SEC. 1B).
26. Engine cover.
27. Upper tie bar.
28. Upper fan shroud.
29. Coolant recovery bottle.
30. Hood latch.
31. Lower valence panel, bumper, grille, and headlight bezels.
32. Battery cables.
- Fill the cooling system with the proper quantity and grade of coolant.
- Evacuate and charge the air conditioning system. Refer to AIR CONDITIONING (SEC. 1B).

SPECIFICATIONS

ENGINE SPECIFICATIONS

All Specifications are in millimeters (mm) unless otherwise noted.

GENERAL DATA:			
Type			90-degree V8 Diesel
Displacement			6.2L
RPO			LH6 LL4
Bore			101
Stroke			97
Compression Ratio			21.3:1
Firing Order			1-8-7-2-6-5-4-3
Oil Pressure			10 psi at idle (hot); 40–45 psi at 2000 RPM
CYLINDER BORE:			
Diameter			100.987–101.065
Diameter			0.02 (Maximum)
Taper (Thrust Side)			0.02 (Maximum)
PISTON:			
Clearance	Bohn Pistons	Bores 1 through 6	0.089–0.115
		Bores 7 and 8	0.102–0.128
	Zollner Pistons	Bores 1 through 6	0.112–0.138
		Bores 7 and 8	0.125–0.151
PISTON RING:			
Compression	Groove Clearance	Top	0.076–0.178
		2nd	0.039-0.080
	Gap	Top	0.30–0.55
		2nd	0.75–1.00
Oil	Groove Clearance		0.040–0.096
	Gap		0.25–0.51
PISTON PIN:			
Diameter			30.9961–31.0039
Clearance			0.0101-0.0153
Fit in Rod			0.0081–0.0309
CRANKSHAFT			
Main Journal	Diameter	#1, 2, 3, 4	74.917–74.941
		#5	74.912–74.936
	Taper		0.005 (Maximum)
	Out of Round		0.005 (Maximum)
Main Bearing Clearance	#1, 2, 3, 4		0.045–0.083
	#5		0.055–0.093
Crankshaft End Play			0.10–0.25
Crankpin	Diameter		60.913–60.939
	Taper		0.005 (Maximum)
	Out-of-Round		0.005 (Maximum)
Rod Bearing Clearance			0.045–0.100
Rod Side Clearance			0.17–0.63

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SPECIFICATIONS

ENGINE SPECIFICATIONS (CONT.)

All Specifications are in millimeters (mm) unless otherwise noted.

DISPLACEMENT			6.2 L
CAMSHAFT:			
Lobe Lift ± 0.05		Intake	7.133
		Exhaust	7.133
Journal Diameter		#1, 2, 3, 4	54.975-55.025
		#5	50.975-51.025
Journal Clearance			0.026-0.101
Camshaft End Play			0.051-0.305
VALVE SYSTEM:			
Lifter			Hydraulic Roller
Rocker Arm Ratio			1.5 : 1
Valve Lash		Intake	Not Adjustable
		Exhaust	
Face Angle (Intake & Exhaust)			45°
Seat Angle (Intake & Exhaust)			46°
Seat Runout (Intake & Exhaust			0.05
Seat Width		Intake	0.89-1.53
		Exhaust	1.57-2.36
Stem Clearance		Intake	0.026-0.069
		Exhaust	0.026-0.069
Valve Spring	Pressure Newtons @ mm	Closed	356 N @ 46.0 mm
		Open	1025 N @ 35.3 mm
	Installed Height		46
Timing Chain Free Play		New Chain	12.7 mm (0.500-inch)
		Used Chain	20.3 mm (0.800-inch)

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SPECIFICATIONS (CONT.)

TORQUE SPECIFICATIONS

Item	N·m	Ft. Lbs.	In. Lbs.
Intake Manifold Bolts	42	31	—
Exhaust Manifold Bolts	35	26	—
Rocker Arm Cover Bolts	22	16	—
Rocker Arm Shaft Bolts	55	40	—
Hydraulic Lifter Guide Plate Clamp Bolts	26	18	—
Cylinder Head Bolts—Refer to Procedure	—	—	—
Oil Pump Drive Clamp Bolt	42	31	—
Torsional Damper Bolt	270	200	—
Crankshaft Pulley Bolts	40	30	—
Front Cover to Block Bolts	45	33	—
Oil Pan Bolts (all except rear two bolts)	10.0	—	84
(rear two bolts)	23	17	—
Front Cover Baffle Bolts and Nut	45	33	—
Injection Pump Nuts	42	31	—
Injection Pump Gear Bolts	23	17	—
Camshaft Gear Bolt	100	75	—
Camshaft Thrust Plate	23	17	—
Oil Pump Bolt	90	65	—
Main Bearing Cap Bolts—Inner	150	110	—
Outer	135	100	—
Connecting Rod Cap Nuts	65	48	—
Glow Plugs	14	10	—
Water Crossover/Thermostat Housing Bolts	42	31	—
Fuel Pump to Block	34	25	—
Flywheel Bolts	40	30	—
Bell Housing Bolts	40	30	—

SPECIAL TOOLS

J-29834	Hydraulic Lifter Remover
J-29666	Air Line Adapter
J-26513	Valve Spring Compressor or
J-5892-A	Valve Spring Compressor
J-23523-E	Torsional Damper Puller
J-29788	Pilot
J-22102	Seal Installer
J-33154	Rear Oil Seal Packer
J-33153	Rear Oil Seal Installer
J-8037	Ring Compressor
J-8080	Main Bearing Remover/Installer
J-33888	Lifting Fixture
J-29664-1	Intake Port Covers

SECTION 6B

ENGINE COOLING

CONTENTS

GENERAL DESCRIPTION

All C-K, G, and P series vehicles have pressure type engine cooling systems with thermostatic control of the coolant circulation. The cooling system is sealed by a pressure type radiator cap that causes the system to operate at higher than atmospheric pressure. This higher pressure operation raises the boiling point of the coolant, thereby increasing the cooling efficiency of the radiator. The 105 kPa (15 psi) pressure cap raises the boiling point of the coolant to approximately 125°C (258°F) at seal level.

The pressure-vacuum valve radiator cap allows the coolant to expand through the pressure valve in the center of the cap without building unnecessary pressure. This expanding coolant flows into the coolant reservoir. The vent valve closes due to expansion and coolant flow (the nominal 105 kPa (15 psi) pressure will not be reached until the system is working at maximum capacity). Any air or vapor in the cooling system will be forced to the coolant reservoir and leave through the vent tube at the top of the reservoir. As the system cools, the extra coolant in the reservoir will be drawn back to the radiator through the vent valve. In this manner, the radiator will keep itself full at all times.

GENERAL DIAGNOSIS

SYSTEM CHECKS

EXHAUST LEAKS

To check for exhaust leaks into the cooling system, drain the system until the coolant level stands just above the top of the cylinder head(s), then disconnect the radiator upper hose and remove the thermostat and fan belt(s). Start the engine and quickly accelerate several times. At the same time note any appreciable coolant rise or the appearance of bubbles which are indicative of exhaust gases leaking into the cooling system.

> ***NOTICE: A worn head gasket may allow exhaust gases to leak into the cooling system. This is particularly damaging to the cooling system as the gases combine with the water to form acids which are harmful to the radiator and engine.***

WATER PUMP

Water pump operation may be checked by running the engine while squeezing the radiator upper hose. When the engine warms a pressure surge should be felt. Check for a plugged venthole in the pump.

RADIATOR

Test for restriction in the radiator by warming the engine up and then turning the engine off and feeling the radiator. The radiator should be hot along the left side and warm along the right side, with an even temperature rise from right to left. Cold spots in the radiator indicate clogged sections.

THERMOSTAT

An operational check of the thermostat can be made by hanging the thermostat on a hook in a 33% glycol solution, 25°C (4°F) above the temperature stamped on the thermostat valve. Submerge the valve completely and agitate the solution thoroughly. Under this condition the valve should open. Remove the thermostat and place in a 33% glycol solution, -12°C (10°F) below the temperature indicated on the valve. With the valve completely submerged and coolant agitated thoroughly, the valve should close completely.

OVERHEAT AND/OR NOISE

Engine overheat and/or cooling system noise may be caused by restrictions in the cooling system.

Components which may be prone to this condition are the cylinder head, water pump, block, thermostat housing and inlet manifold. Symptoms of this condition are:

- Engine may make snapping/cracking noises.
- Heater core may gurgle or surge.
- Radiator hoses may collapse and expand.
- Heater hoses may vibrate and thump.
- Overheat light may or may not come on.

Symptoms are the result of coolant boiling at some localized area and may be noticed after extending idling and/or while driving. Determine which side of the engine is involved and whether it is more at the front or rear of the engine.

Diagnosis/Inspection

1. Isolate the area from which the localized boiling is originating. This can be done by probing the engine with a sounding bar (large screwdriver).
2. With the radiator cap removed, observe the water being circulated in the radiator. Feel the front area of the radiator for cold spots which indicate blockage. Blocked radiators generally occur on units that have accrued miles and not on new vehicles.

CAUTION: The radiator cap should be removed from a cool engine only. If the radiator cap is removed from a hot cooling system, serious personal injury may result.

3. Inspect the thermostat to see if it opens completely.
4. Inspect the thermostat housing to make sure it is completely free of obstructions.
5. Remove water pump from the vehicle and remove the back cover on the pump. All internal passages can be inspected using a flash light.
6. Inspect the cross over at the front of the inlet manifold. This entire passage can be seen with only the thermostat removed.
7. Remove heads, but lay them aside for now and check the block first because the heads are the most complex pieces as far as coolant passages are concerned.
8. With the water pump and heads removed, ALL coolant passages CAN be inspected by using a pen light flash light. All water jacket areas can be seen directly and a block should never be replaced as being suspect unless the restricted area can be DIRECTLY SEEN.
9. If none of the above inspections reveal the problem area, the heads must be considered prime suspect. Heads with blocked coolant passages generally have more than one area that is blocked. Inspect the heads for signs of overheat discoloration (a dark blue or black area). If none are found, look in the coolant passages for blockage and probe all the passages that are accessible.

The head is very intricate and all the passages cannot be reached. Use a probe that is fairly substantial as a tag wire may go through or around a partially blocked area. If nothing is found by visual inspection and probing, inspect the passages for a rough, ragged appearance. The roughest internal passages are probably the ones that are blocked.

Replace a blocked or suspect head and inspect the replacement head in the same manner before installation.

FAN CLUTCH DIAGNOSIS

NOISE

Fan noise is sometimes evident under the following normal conditions.

- When the clutch is engaged for maximum cooling.
- During the first few minutes after start-up until the clutch can re-distribute the silicone fluid back to its normal disengaged operating condition (after overnight settling).

Fan noise or an excessive roar will generally occur continuously, however, under all high engine speed conditions (2500 rpm and up) if the clutch assembly is locked up due to an internal failure. If the fan cannot be rotated by hand or there is a rough grating feel as the fan is turned, the clutch should be replaced.

LOOSENESS

An excessively loose fan assembly must be checked for any wear and be replaced if necessary. Under various temperature conditions, there is a visible lateral movement that can be observed at the tip of the fan blade. This is a normal condition due to the type of bearing used. Approximately 6.5 mm (1/4-inch) maximum lateral movement measured at the fan tip is allowable. This is not cause for replacement.

SILICONE FLUID LEAKS

The fan clutch operation is generally not affected by small fluid leaks which may occur in the area around the bearing assembly. If leakage appears excessive, replace the fan clutch (see below).

ENGINE OVERHEATING

If the fan and clutch assembly free-wheel with no drag (revolves more than five times when spun by hand), the clutch should be replaced.

THERMOSTAT DIAGNOSIS

Refer to the thermostat diagnostic chart (figure 1) for detailed thermostat diagnosis procedures.

COOLANT LEVEL INDICATOR DIAGNOSIS

INDICATOR LAMP WILL NOT ILLUMINATE

1. Turn the ignition switch to the CRANK position.
   - If the lamp illuminates, the lamp is OK and the connector is properly installed on the module. Go to Step 2.
   - If the lamp does not illuminate, check the bulb, socket and wiring between the socket and the module connector and the connector on the module. Replace or repair as required.
2. Turn the ignition switch to the ON position and disconnect the electrical lead at the coolant level sensor on the radiator.
   - If the lamp fails to illuminate, check the wiring between the coolant level sensor connector and the module for a short circuit to ground. If the circuit is OK, replace the module.

INDICATOR LAMP REMAINS ILLUMINATED

1. Turn the ignition switch to ON.
   - Check the coolant level. Add coolant if necessary.
   - If the lamp remains illuminated, go to Step 2.
2. Disconnect the electrical lead at the coolant level sensor on the radiator (use a jumper wire and "G" type electrical connector).
   - If the lamp does not illuminate, replace the sensor.
   - If the lamp remains illuminated, connect the electrical lead and go to Step 3.
3. Check for an open circuit between the sensor and the module.
   - If an open circuit is found, repair it.
   - If no open circuit is found, replace the module.

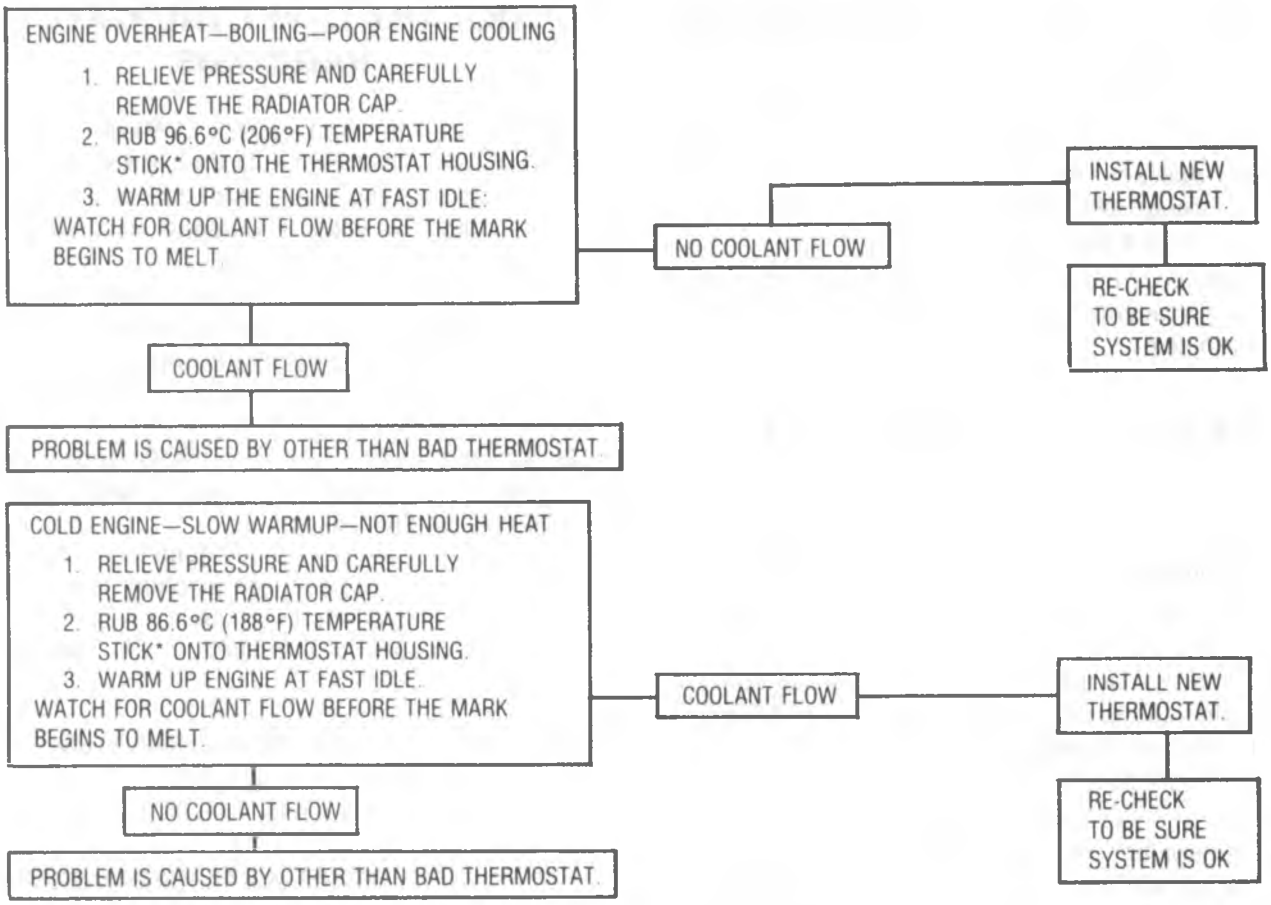
COOLING SYSTEM DIAGNOSIS

Refer to the cooling system diagnosis chart (figure 2) for detailed cooling system diagnostic procedures.

UNCOMMON COOLING SYSTEM PROBLEMS

PROBLEMS NOT REQUIRING DISASSEMBLY OF THE COOLING SYSTEM

1. Large obstructions blocking the radiator or condenser should be relocated or removed.
   - Auxiliary oil cooler.
   - License plates.
   - Spare tires.



*NOTE: THE TEMPERATURE STICK IS A PENCIL LIKE DEVICE WHICH HAS A WAX MATERIAL CONTAINING CERTAIN CHEMICALS WHICH MELT AT A GIVEN TEMPERATURE. TEMPERATURE STICKS CAN BE USED TO DETERMINE A THERMOSTAT'S OPERATING TEMPERATURE BY RUBBING 86.6°C (188°F) AND 96.6°C (206°F) STICKS ON THE THERMOSTAT HOUSING. THE MARKS MADE BY THE STICKS SHOULD MELT WHEN COOLANT TEMPERATURES OF 86.6°C (188°F) AND 96.6°C (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 WORN.

B-07540

Figure 1—Thermostat Diagnosis Chart

  - Ice, mud, or snow obstructing the grille.
2. Engine oil is overfilled.
3. Incorrect radiator for the application.
   - Check the part number.
4. Loose, damaged, or missing air seals.
5. Missing or damaged lower air baffle.
6. Incorrect ignition timing.

PROBLEMS REQUIRING DISASSEMBLY OF THE COOLING SYSTEM

1. Incorrect or damaged fan.
2. Worn or damaged emission system components.
   - Could cause overheating at idle.
   - Damaged PCV valve, TVS or TCS.
3. Pressure check the cooling system with the pressure cap installed.
   - Shows if the pressure cap leaks because of radiator filler neck damage.
4. Worn or damaged water pump.
   - Impeller vanes eroded or broken.
   - Worn or damaged bearing and/or seal-check for shaft or bearing play.
5. Plugged radiator tubes.
   - Perform a flow check.
6. Internal system leaks.
   - Head gasket.
   - Cracked block.
   - Timing chain cover.
   - Intake manifold gasket.
7. Plugged coolant passages in the cylinder heads.
   - Visual check.

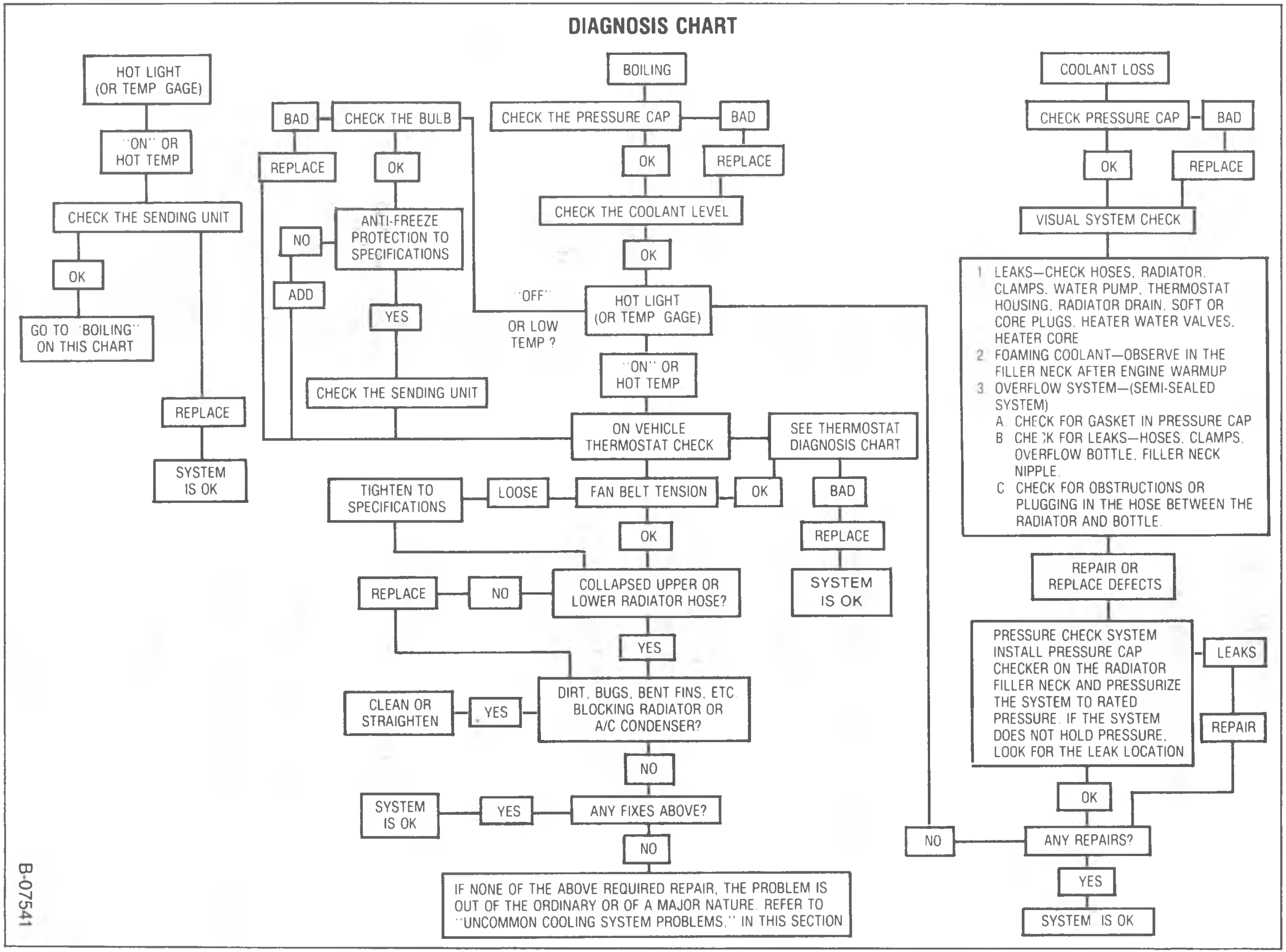


Figure 2—Cooling System Diagnosis Chart

ON VEHICLE SERVICE

FLUSHING THE COOLING SYSTEM

Various methods and equipment can be used to flush the cooling system. If special equipment such as a back flusher is used, follow the equipment manufacturer's instructions.

Important

- Remove the thermostat before flushing the cooling system.

COOLANT RECOVERY TANK

Remove or Disconnect (Figures 3, 4 and 5)

1. Battery negative cable.
2. Drain the coolant from the recovery tank (1).
3. Coolant overflow hose from the recovery tank (1).
4. Coolant recovery tank (1) from the vehicle.
    - Bolt/screw (2).

Install or Connect (Figures 3 and 4)

1. Coolant recovery tank (1), to the vehicle.
    - Bolt/screw (2).

    Tighten

    - Bolt/screw (2) to 2.0 N·m (1.5 ft. lbs.).
2. Coolant overflow hose to the recovery tank (1).
3. Coolant to the recovery tank (1).
4. Battery negative cable.

DEAERATION TANK

Remove or Disconnect (Figures 6, 7 and 8)

1. Battery negative cable.
2. Drain the coolant from the deaeration tank (10).
3. Overflow hose from the filler neck.
4. Return hose (12) from the deaeration tank (10).
5. Deaeration tank (10) from the vehicle.
    - For C-K and P series vehicles; bolts/screws (7), and the retaining straps (8) from the support brackets (9) (figures 6 and 8).
    - For G series vehicles; bolts/screws (7) and nut (6) (figure 7).
    - The deaeration tank (10) is free of the vehicle.

Install or Connect (Figures 6, 7 and 8)

1. Deareation tank (10) to the vehicle.
    - For C-K and P series vehicles; deaeration tank (10) onto the support brackets (9). Attach the retaining straps with bolts/screws around the tank and the lip on the support brackets (9).
    - For G series vehicles; deaeration tank (10) into position and attach with bolts/screws (7) and the nut (6).

    Tighten

    - Bolt/screws (7) and nut (6) to "Specifications" at the end of this section.
2. Return hose (12) to the deaeration tank (10).
3. Overflow hose to the filler neck.
4. Coolant into the deaeration tank (10).
5. Battery negative cable.

THERMOSTAT

ALL MODELS EXCEPT THOSE WITH 6.2L DIESEL ENGINES

Remove or Disconnect (Figures 9 through 12)

1. Battery negative cable.
2. Drain the cooling system until the radiator coolant level is below the thermostat.
3. Thermostat (23) from the vehicle.
    - Bolts (20) and the water outlet (21).
    - Thermostat from its housing.
    - Discard the old gasket.

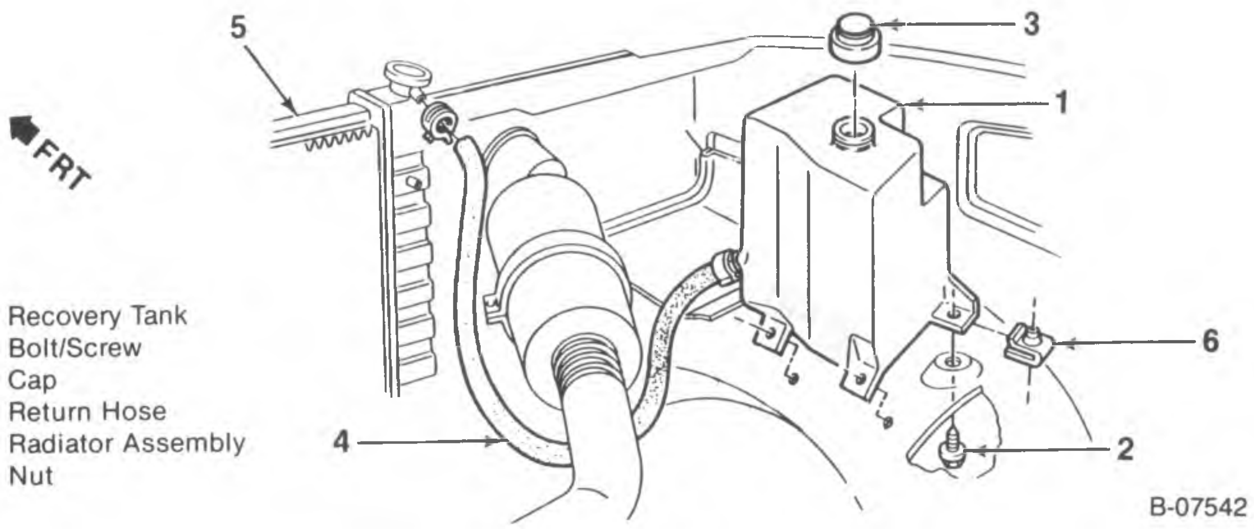
Install or Connect (Figures 9 through 12)

- Make sure the thermostat housing and water outlet sealing surfaces are clean.

1. Thermostat (23) in its housing.
2. New gasket (22) into position.
3. Water outlet (21).
    - Bolts (20).

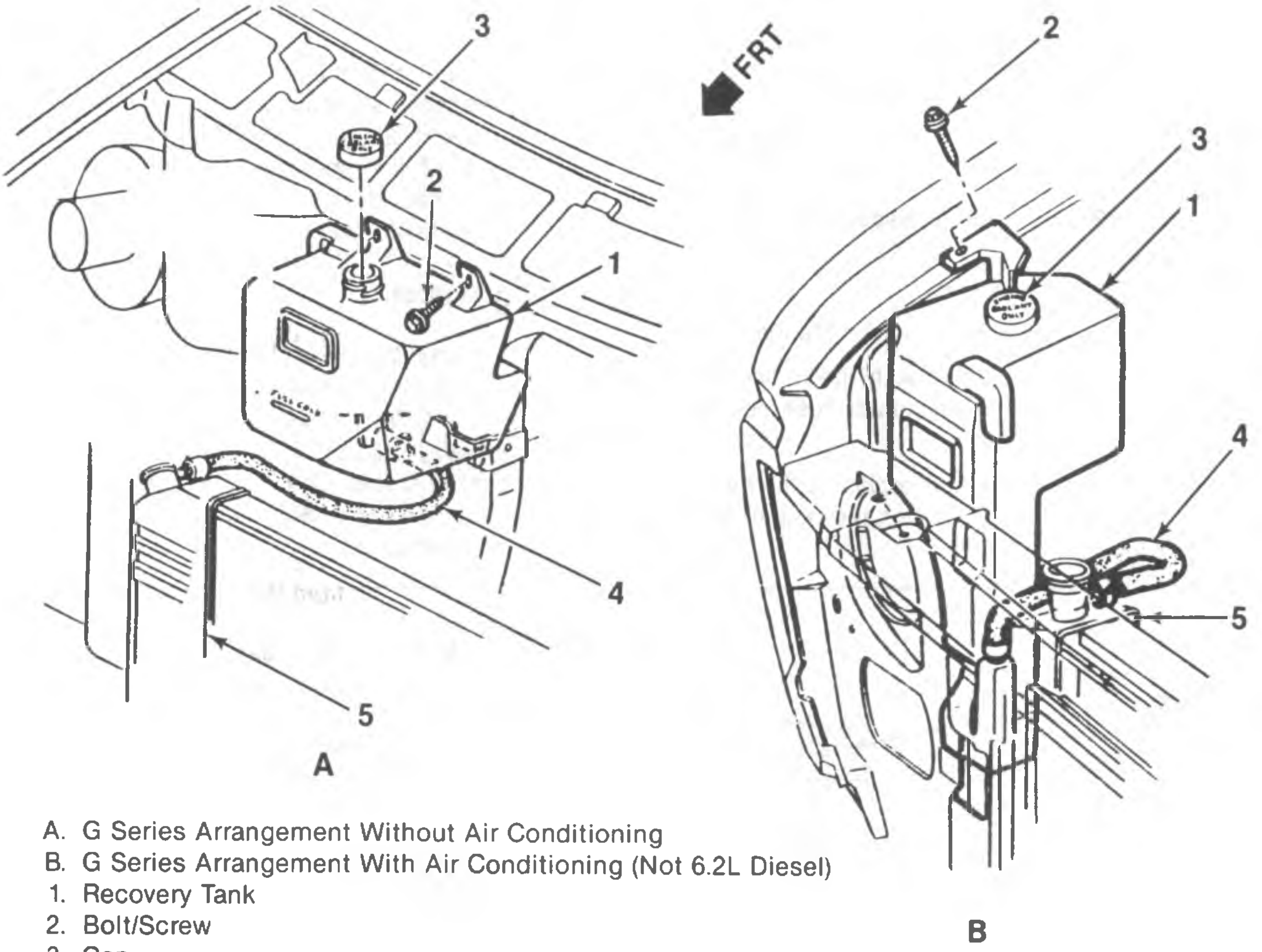
    Tighten

    - For bolts (20), refer to "Specifications" at the end of this section.
4. Battery negative cable.



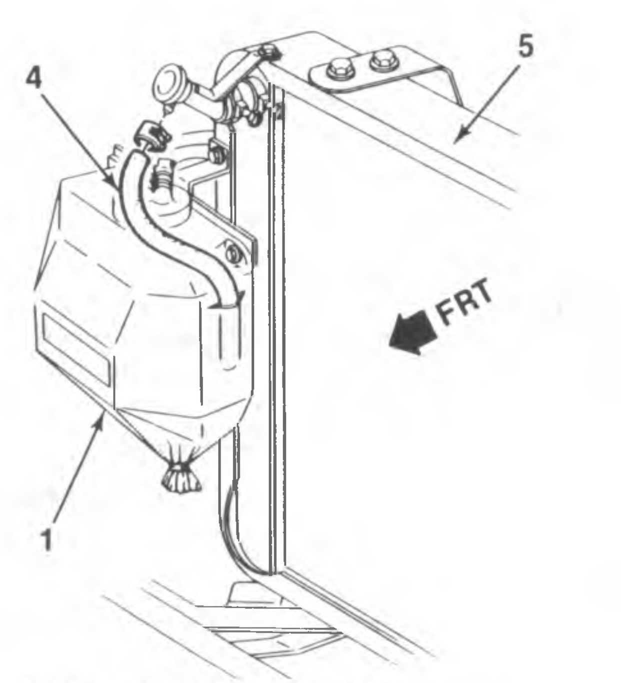
1. Recovery Tank
2. Bolt/Screw
3. Cap
4. Return Hose
5. Radiator Assembly
6. Nut

Figure 3—C-K Series Coolant Recovery Bottle



A. G Series Arrangement Without Air Conditioning
B. G Series Arrangement With Air Conditioning (Not 6.2L Diesel)
1. Recovery Tank
2. Bolt/Screw
3. Cap
4. Return Hose
5. Radiator Assembly

Figure 4—G Series Coolant Recovery Bottle



1. Coolant Recovery Container (Plastic Bag Covering The Fuel Jar)
4. Return Hose
5. Radiator Assembly

Figure 5—P Series Coolant Recovery System

5. Fill the cooling system.
   - Refer to the vehicle Owner's Manual.
6. Start the engine and run, with the radiator cap removed, until the radiator upper hose becomes hot (thermostat is open).
7. With the engine idling, add coolant to the radiator until the coolant level reaches the bottom of the filler neck.
8. Radiator cap to the radiator, making sure the arrows line up with the overflow tube.

MODELS WITH THE 6.2L DIESEL ENGINE

Remove or Disconnect (Figures 13 and 14)

1. Battery negative cable.
2. Upper fan shroud ONLY from G Van models.
   - Refer to "Fan Shroud" in this section.
3. Drain the cooling system until the radiator coolant level is below the thermostat.
4. Engine oil dipstick tube brace and the oil fill brace ONLY on G Van models.
   - Refer to 6.2L DIESEL (SEC. 6A7).
5. Thermostat (23) from the vehicle.
   - Studs (26) and the water outlet (21).
   - Upper radiator inlet hose.
   - Thermostat from its housing.
   - Discard the old gasket (22).

Install Or Connect (Figures 13 and 14)

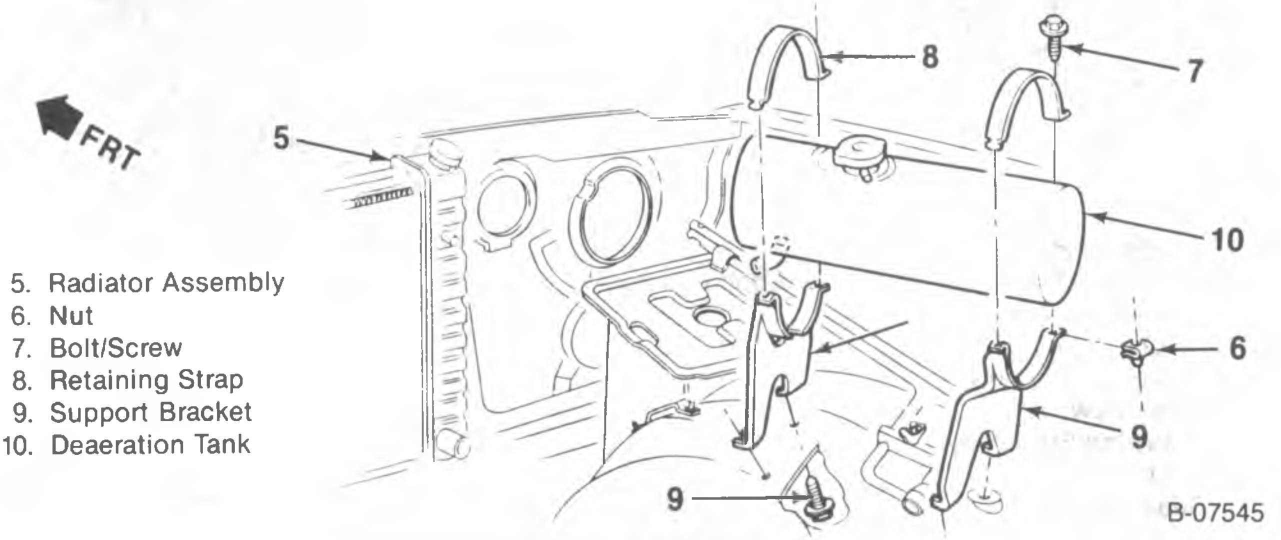
- Make sure the thermostat housing and water outlet sealing surfaces are clean.

1. Thermostat (23) into its housing.
2. Gasket (22) into position.
3. Water outlet (21).
   - Studs (26) and the upper radiator inlet hose.

Tighten

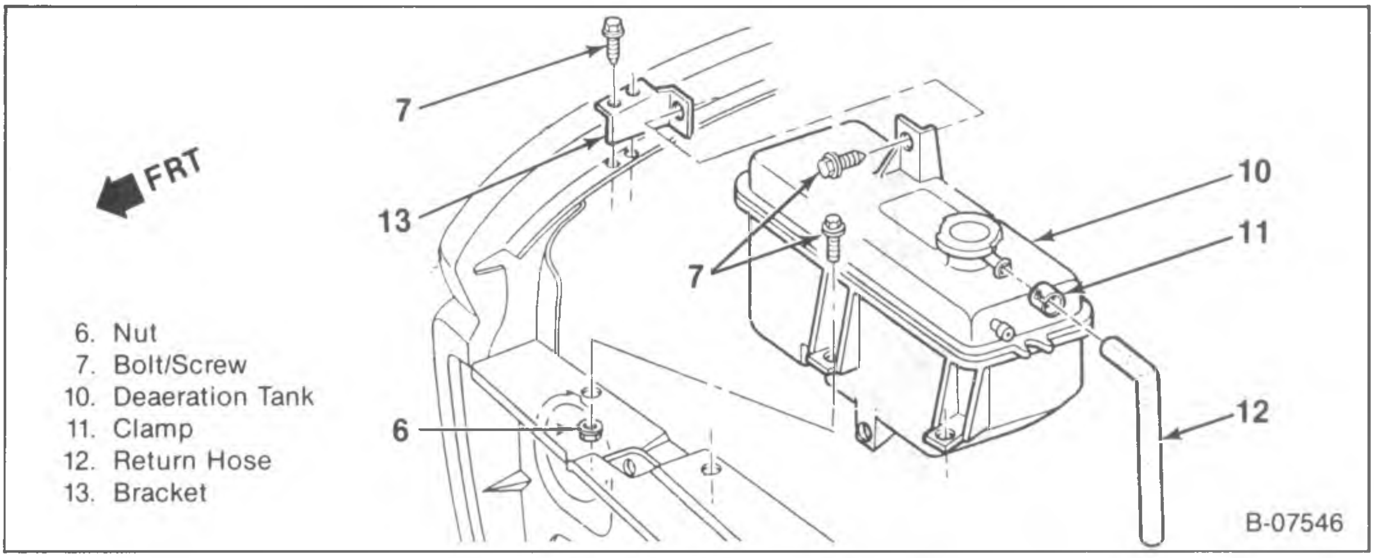
   - Studs (26) to 47 N·m (35 ft. lbs.).

4. Engine oil dipstick tube brace and the oil fill brace ONLY on G Van models.
   - Refer to 6.2L DIESEL (SEC. 6A7).
5. Upper fan shroud ONLY on G Van models.
   - Refer to "Fan Shroud," in this section.
6. Battery negative cable.



5. Radiator Assembly
6. Nut
7. Bolt/Screw
8. Retaining Strap
9. Support Bracket
10. Deaeration Tank

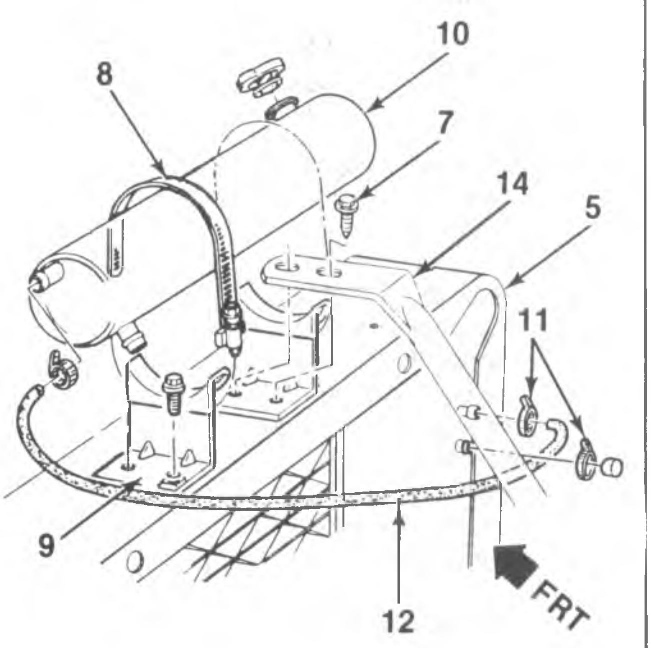
Figure 6—C-K Series Deaeration Tank



6. Nut
7. Bolt/Screw
10. Deaeration Tank
11. Clamp
12. Return Hose
13. Bracket

Figure 7—G Series Deaeration Tank

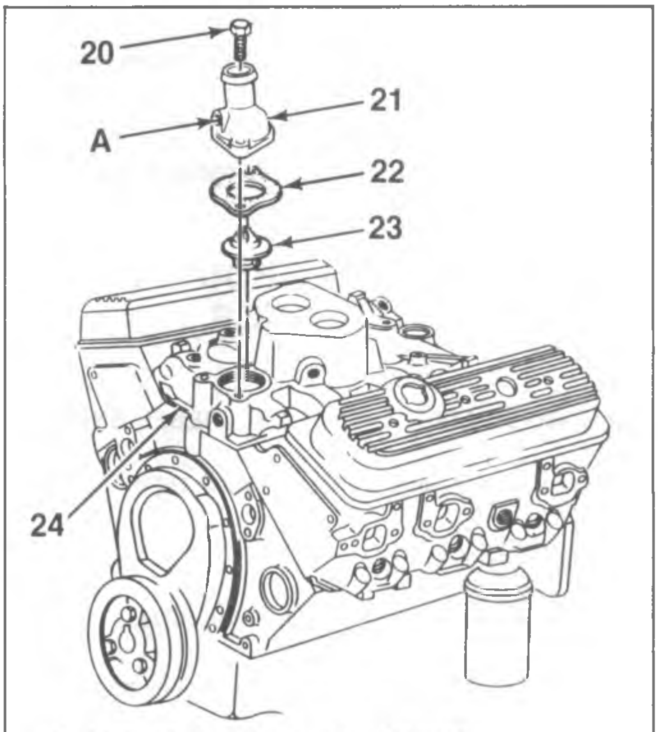
7. Fill the cooling system.
   - Refer to the vehicle Owner's Manual.
8. Start the engine and run, with the radiator cap removed, until the radiator upper hose becomes hot (thermostat is open).
9. With the engine idling, add coolant to the radiator until the coolant level reaches the bottom of the filler neck.



5. Radiator Assembly
7. Bolt/Screw
8. Retaining Strap
9. Support Bracket
10. Deaeration Tank
11. Clamp
12. Return Hose
14. Radiator Support Brace

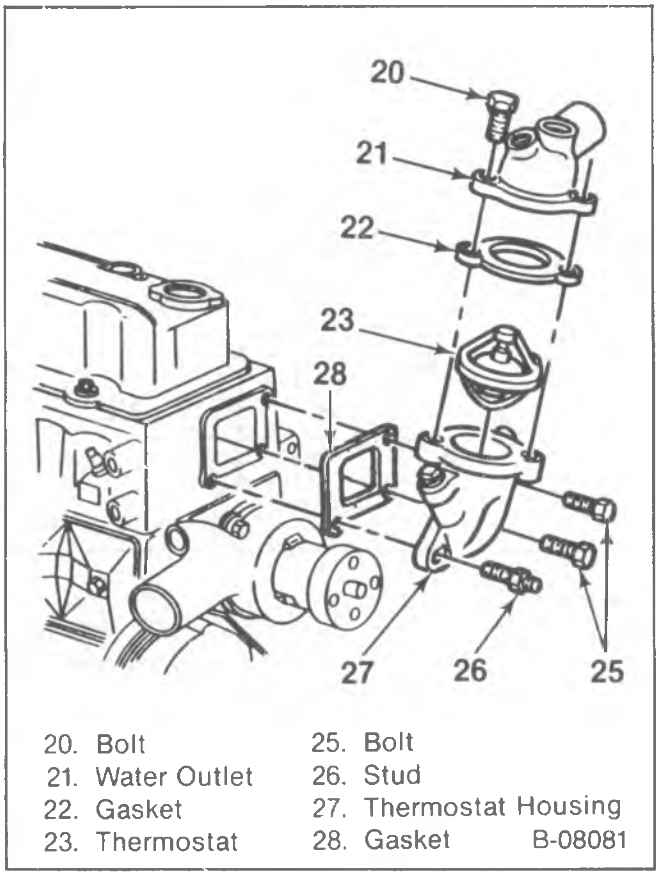
Figure 8—P Series Deaeration Tank

10. Radiator cap to the radiator, making sure the arrows line up with the overflow tube.



A. Hole Is Omitted On The M Van
20. Bolt
21. Water Outlet
22. Gasket
23. Thermostat
24. Inlet Manifold

Figure 9—C-K And G Series Vehicle Thermostat Replacement (4.3L V6)



20. Bolt
21. Water Outlet
22. Gasket
23. Thermostat
25. Bolt
26. Stud
27. Thermostat Housing
28. Gasket

Figure 10—C-K And P Series Vehicle Thermostat Replacement (4.8L L6)

THERMOSTAT HOUSING CROSSOVER

C-K SERIES VEHICLE WITH 6.2L DIESEL ENGINE

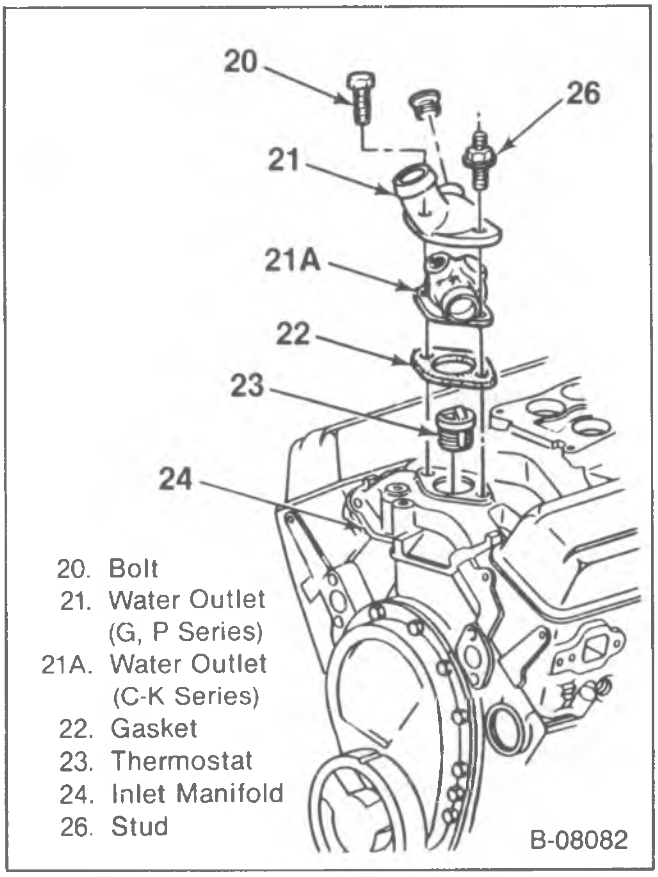
Remove or Disconnect (Figure 15)

1. Battery negative cable.
2. Drain the cooling system.
3. Crankcase depression regulator valve.
4. Generator upper bracket.
5. By pass hose, upper radiator hose, and heater hose.
6. Crossover (32) from the vehicle.
   - Bolts (27) from the vehicle.
   - Thermostat (23) and water outlet (21) are attached to the crossover along with the thermal bypass nipple.

Install or Connect (Figure 15)

- Make sure the crossover sealing surfaces are clean.

1. New gaskets (28) into position.
2. Crossover (32) to the vehicle.
   - Bolts (27).



20. Bolt
21. Water Outlet (G, P Series)
21A. Water Outlet (C-K Series)
22. Gasket
23. Thermostat
24. Inlet Manifold
26. Stud

Figure 11—C-K, G, And P Series Vehicle Thermostat Replacement (5.0L & 5.7L V8)

Tighten

- Bolts (27) to 47 N·m (35 ft. lbs.).

3. Heater hose, upper radiator hose, and bypass hose.
4. Generator upper bracket.
5. Crankcase depression regulator valve.
6. Battery negative cable.
7. Fill the cooling system.
   - Refer to the vehicle Owner's Manual.
8. Start the engine and run, with the radiator cap removed, until the radiator upper hose becomes hot (thermostat is open).
9. With the engine idling, add coolant to the radiator until the coolant level reaches the bottom of the filler neck.
10. Radiator cap to the radiator, making sure the arrows line up with the overflow tube.

G AND P SERIES VEHICLES WITH 6.2L DIESEL ENGINES

Remove or Disconnect (Figure 14)

1. Battery negative cable.
2. Drain the cooling system.
3. Engine cover from G Van models ONLY.
4. Air cleaner.

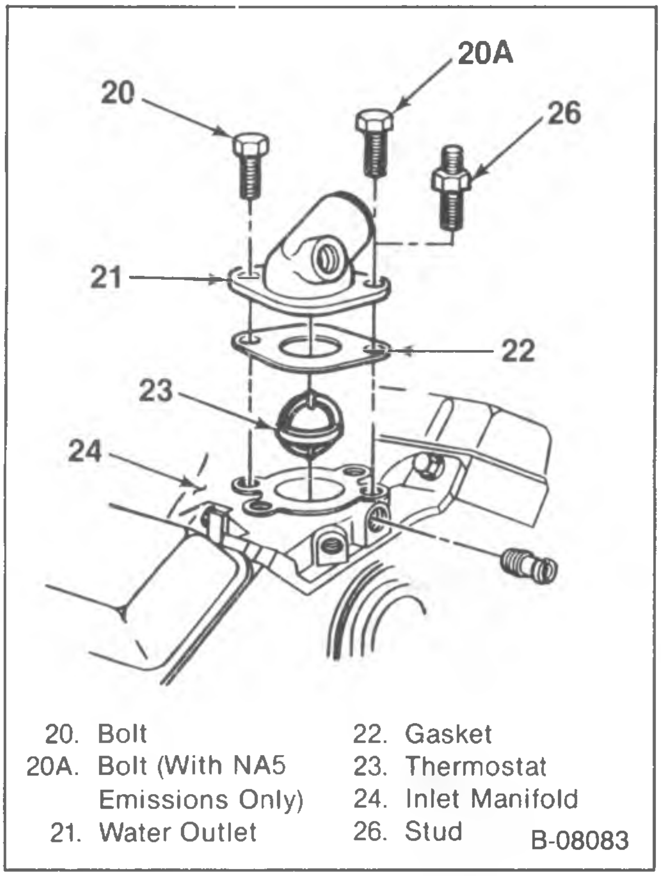


Figure 12—C-K And P Series Vehicle Thermostat Replacement (7.4L V8)

5. Air cleaner resonator and its bracket.
6. Upper fan shroud.
7. Generator upper bracket.
8. Bypass hose, upper radiator hose, and heater hose.
9. Crossover (32) from the vehicle.
    - Bolts (27), studs (26) and discard the old gaskets (28).
    - Thermostat (23) and the water outlet (21) are attached.

Install or Connect (Figure 14)

- Make sure the crossover sealing surfaces are clean.

1. New gaskets (28) into position.
2. Crossover (32) to the vehicle.
    - Bolts (27) and studs (26).

Tighten

- Bolts (27) to 47 N·m (35 ft. lbs.).
- Studs (26) to 47 N·m (35 ft. lbs.).

3. Heater hose, upper radiator hose, and the bypass hose.
4. Generator upper bracket.
5. Upper fan shroud.
6. Air cleaner resonator and its bracket.

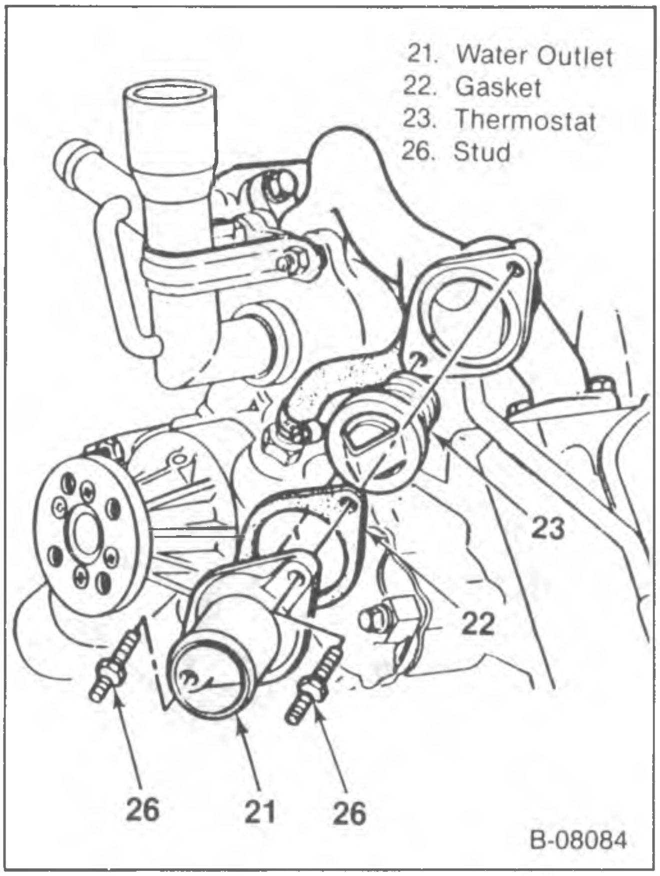


Figure 13—C-K Series Vehicle Thermostat Replacement (6.2L V8 Diesel)

7. Air cleaner.
8. Engine cover on G Van models ONLY.
9. Battery negative cable.
10. Fill the cooling system.
    - Refer to the vehicle Owner's Manual.
11. Start the engine and run, with the radiator cap removed, until the radiator upper hose becomes hot (thermostat is open).
12. With the engine idling, add coolant to the radiator until the coolant level reaches the bottom of the filler neck.
13. Radiator cap to the radiator, making sure the arrows line up with the overflow tube.

DRIVE BELTS

PULLEY INSPECTION

Examine the pulleys for chips, nicks, tool marks, cracks, bent sidewalls, corrosion, or other damage.

1. Place a straightedge or position a cord across the two pulleys so they touch at all points (figure 16).
2. Turn each pulley one half revolution and recheck with a straightedge or cord. Full contact at all points must be made. If contact is not made at all

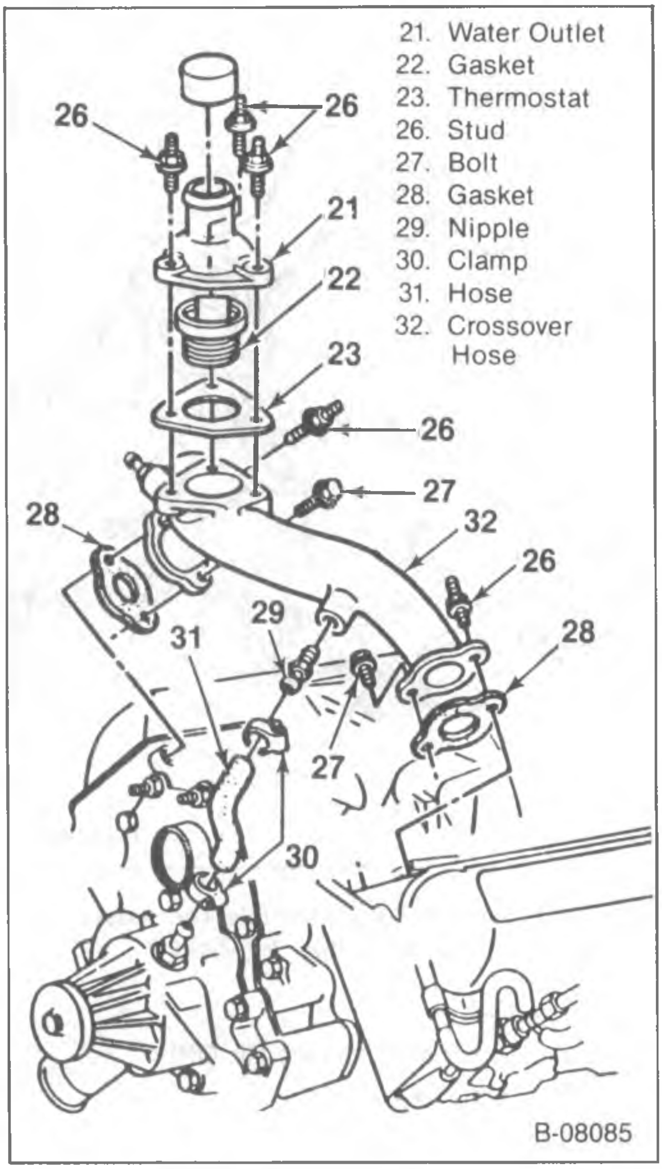


Figure 14—G, P Series Vehicle Thermostat & Crossover Replacement (6.2L V8 Diesel)

points, the pulley may be warped or its shaft could be bent. Replace any parts found to be damaged.

DRIVE BELT INSPECTION

Frayed or cracked belts must be replaced and tensioned to the proper specification. Do not use drive belt dressings to extend the belt life.

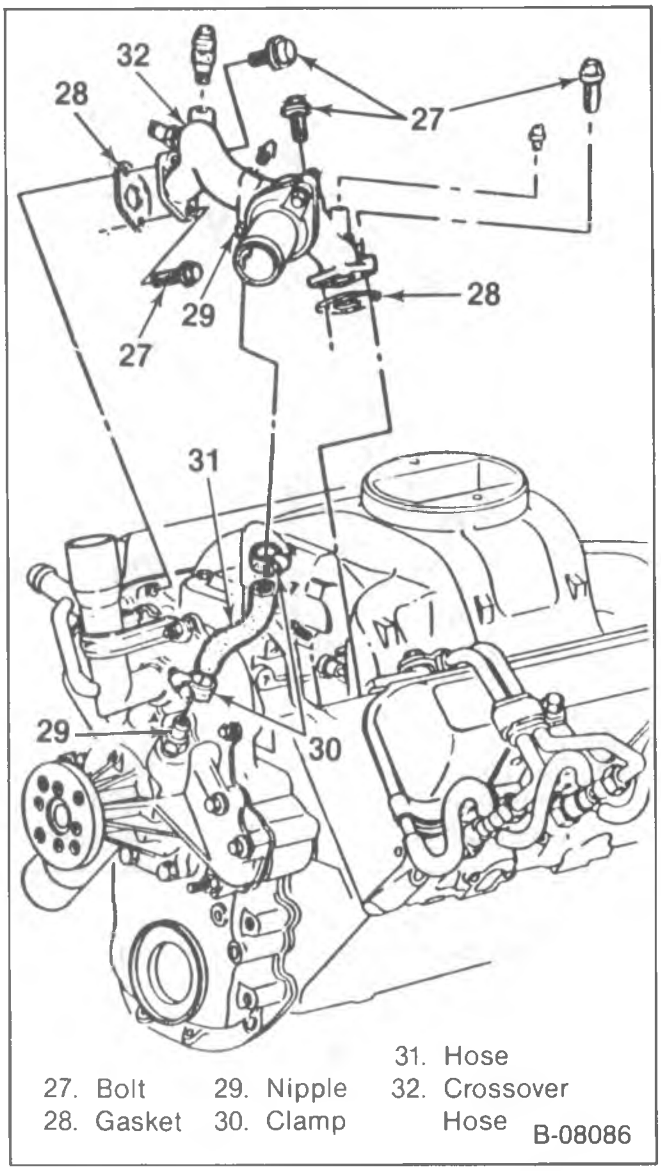


Figure 15—C-K Series Vehicle Crossover Replacement (6.2L V8 Diesel)

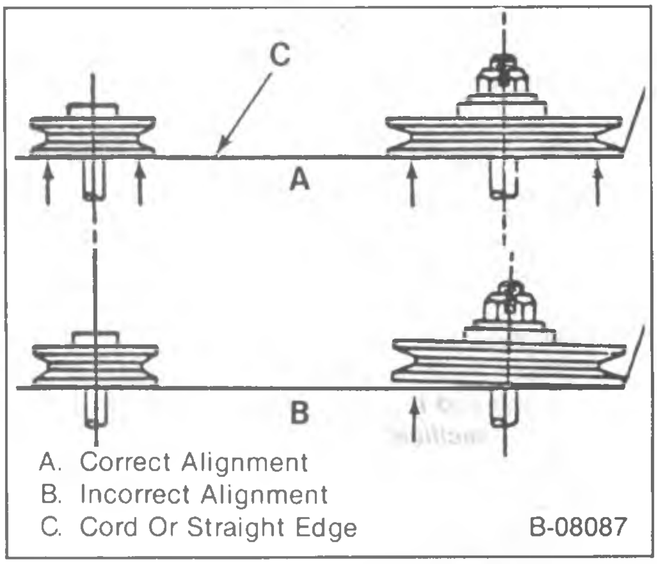


Figure 16—Inspecting Pulley Alignment

CAUTION: Avoid over or under-tightening drive belts. Loose belts result in slippage which can lead to belt and pulley "glazing" and inefficient component operation. Once a belt has become "glazed," it will be necessary to replace the belt. Loose belts can also place high impact loads on driven component bearings due to the whipping action of a loose belt. Over tightening belts can lead to bearing damage and early belt failure.

DRIVE BELT REPLACEMENT

1. Remove the old belt.
   - Loosen the component driven by the belt (figures 17 through 21).

NOTICE: Place the belts into the pulley grooves by hand. Do not force a belt into a pulley groove by prying with a screwdriver, crowbar, or other wedge type tool. Prying a belt into position can damage both the belt and the belt drive components.

2. Install the new belt.
   - Tension the new belt to the "Specifications" at the end of this section.
   - Use BT-33-95 ACBN to measure v-belt tension, and BT-33-97M to measure poly v-belt tension.
   - Place the gage at the center of the greatest span.

Tighten

- Component to mounting bracket fasteners to the specifications at the end of this section.

3. Run the engine at idle speed for a minimum of 15 minutes.
   - This allows the belt to seat itself in the pulleys, causing the belt fibers to relax, or stretch.
4. Allow the drive belt to cool until it is cool or at most, warm to the touch. Not hot.

NOTICE: A used belt is one that has been rotated at least one complete revolution on the engine pulleys. This begins the "seating" of the belt and it must never be tensioned to new belt specifications.

5. Check the belt tension.
   - Use BT-33-95 ACBN to measure v-belt tension, and BT-33-97M to measure poly v-belt tension.
   - Place the gage at the center of the greatest span.
   - The belt tension should be at the maximum used belt specifications from the chart in "Specifications," at the end of this section.

DRIVE BELT ADJUSTMENT

A used belt must never be tensioned to more than its specified tension limit.

1. Check the belt tension.
   - Belt should be cool or at least warm to the touch. Not hot.
   - Use BT-33-95 ACBN to measure v-belt tension, and BT-33-97M to measure poly v-belt tension.
   - Place the gage at the center of the greatest span.
   - If the belt is below the minimum "used belt" tension specification, adjust the belt.
2. Loosen the component in its mounting bracket (figures 17 through 21).
3. Tension the belt to the maximum used belt specification from the chart in "Specifications," at the end of this section.

Tighten

- Component to mounting bracket fasteners to the specifications at the end of this section.

4. Run the engine at idle for a minimum of 15 minutes.
   - This allows the belt to reseat itself in the pulleys.
5. Allow the drive belt to cool.
   - Should be at most warm to the touch. Not hot.
6. Check the belt tension.
   - Use BT-33-95 ACBN to measure v-belt tension, and BT-33-97M to measure poly v-belt tension.
   - Place the gage at the center of the greatest span.
   - If not within the used belt specifications from the chart in "Specifications," at the end of this section, re-adjust.

DRIVE BELT ROUTING

Refer to the drive belt routing diagrams (figures 22 through 31) if belt replacement becomes necessary.

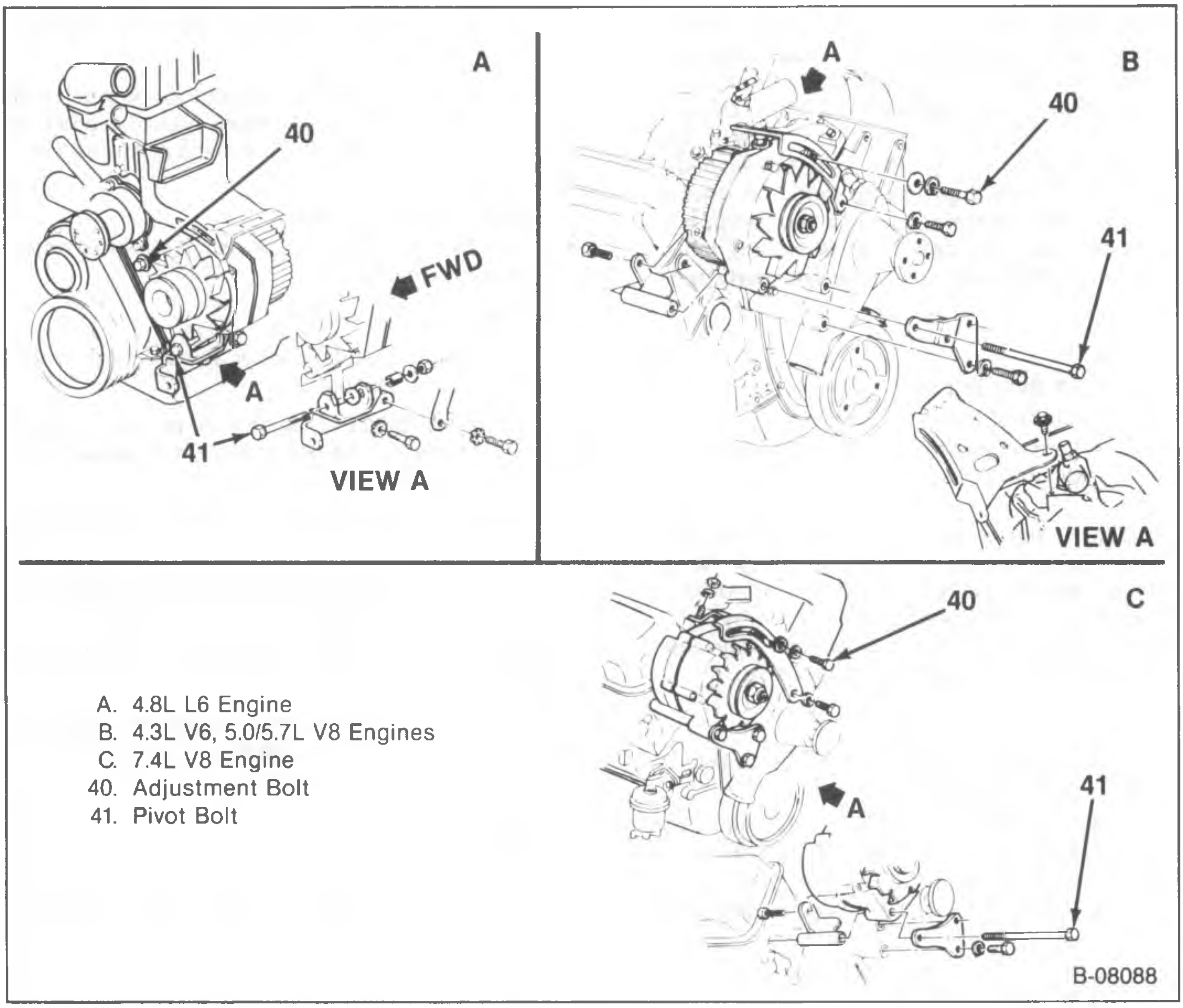


Figure 17—C-K, G, And P Series Vehicle Generator Adjustment

FAN SHROUD

C-K SERIES VEHICLE

Remove or Disconnect (Figures 32 and 33)

1. Battery negative cable.
2. Fan shroud to radiator retainer attaching bolts (60).
3. Fan clutch to water pump hub attachments.
   - Refer to "Fan And Fan Clutch," in this section.
4. Fan shroud assembly (61 and 64).
   - Pull up and out of the lower retaining clips.
   - The fan shroud and fan clutch assembly must be removed together.

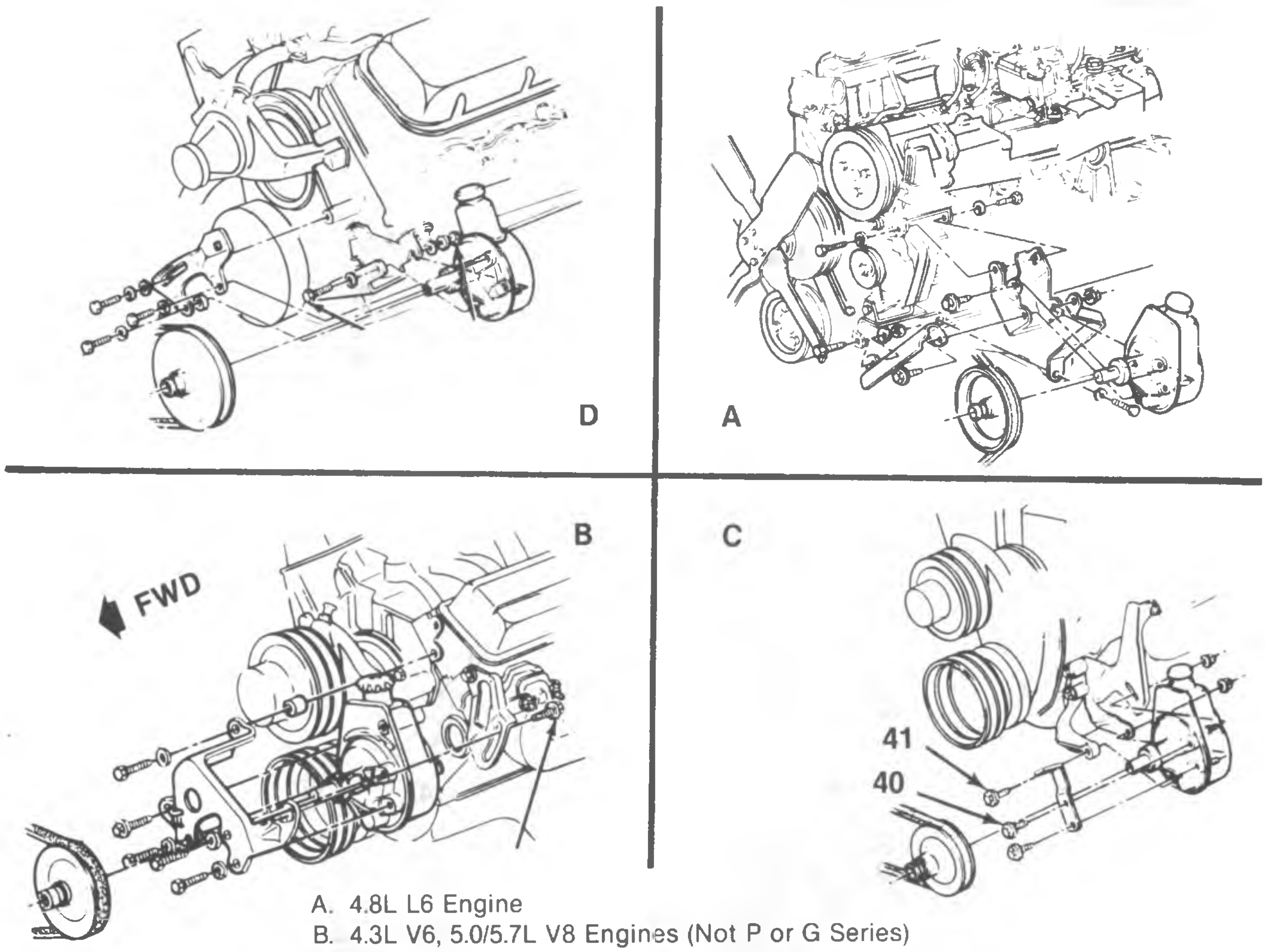
Install or Connect (Figures 32 and 33)

1. Lower fan shroud (64) and the fan clutch.
   - Position along the back of the radiator (63).
   - Make sure the lower edge fits into the lower retaining clips.
2. Fan clutch to water pump hub attachments.
   - Refer to "Fan And Fan Clutch," in this section.
3. Shroud (61) to the radiator retainer attaching bolts (60).

Tighten

- Bolts (60) to 6 N·m (53 in. lbs.)

4. Battery negative cable.



A. 4.8L L6 Engine
B. 4.3L V6, 5.0/5.7L V8 Engines (Not P or G Series)
C. 4.3L V6 5.0/5.7L V8 Engines (P and G Series)
D. 7.4L V8 Engine
40. Adjustment Bolt
41. Pivot Bolt

B-08089

Figure 18—C-K, G, And P Series Vehicle Power Steering Pump Adjustment

G, P SERIES VEHICLE WITH GASOLINE ENGINES

Remove or Disconnect (Figures 34 through 37)

1. Battery negative cable.
2. Vacuum reservoir, if equipped with air conditioning.
    - Refer to AIR CONDITIONING (SEC. 1B).
3. Windshield washer jar and its bracket.
4. Fan shroud retaining bolts (60).
5. Radiator support bracket (67).
6. Dipstick from the engine.
7. Dipstick from the automatic transmission, if equipped.
8. Radiator hose strap from the fan shroud (61).
9. Fan from the water pump.
    - Leave the pulley in place.
    - Refer to "Water Pump," in this section.
10. Fan and the fan shroud together.

Install or Connect (Figures 34 through 37)

1. Fan and the fan shroud together.
2. Fan to the water pump.
    - Refer to "Fan And Fan Clutch" in this section.
3. Radiator hose strap to the fan shroud.
4. Dipsticks into the engine, and transmission if applicable.
5. Radiator support bracket (67).
    - Bolts (60).

Tighten

- Bolts (60) to 6 N·m (53 in. lbs.).

6. Fan shroud retaining bolts (60).

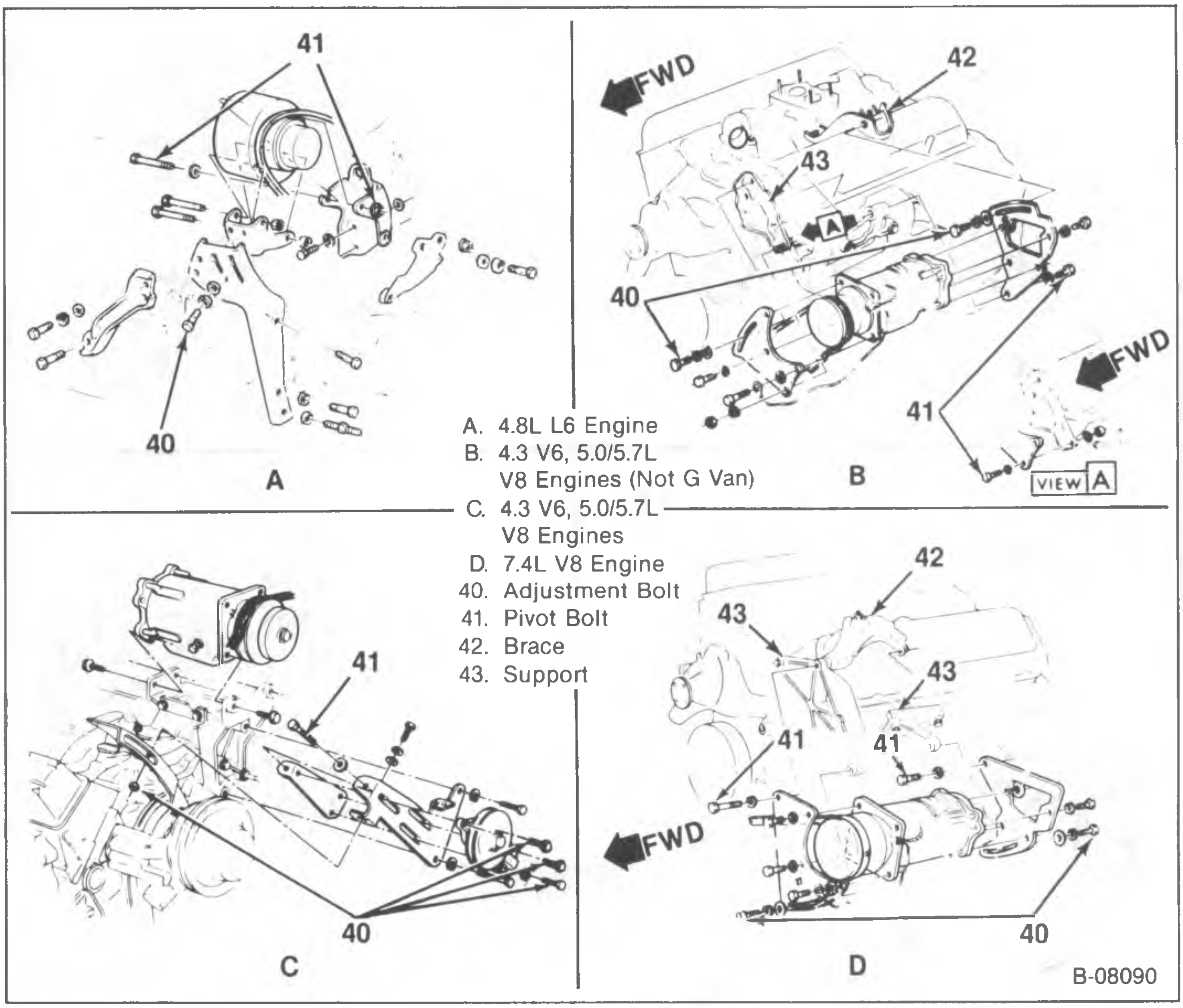


Figure 19—C-K, G, And P Series Vehicle Air Conditioning Compressor Adjustment

Tighten

- Bolts (60) to 6 N·m (53 in. lbs.).
- Bolts (60) for 4.3L V6 engines to 27 N·m (20 ft. lbs.).

7. Windshield washer jar and its bracket.
8. Vacuum reservoir, if equipped with air conditioning.
   - Refer to AIR CONDITIONING (SEC. 1B).
9. Battery negative cable.

G, P SERIES VEHICLE (DIESEL ENGINE EQUIPPED)

Remove or Disconnect (Figures 35 and 37)

1. Battery negative cable.
2. Air cleaner intake.
   - Rotate the snorkel up.
3. Fan shroud bolts (60).
4. Hood latch cable.
5. Windshield washer bottle.
6. Upper fan shroud (61).

Install or Connect (Figures 35 and 37)

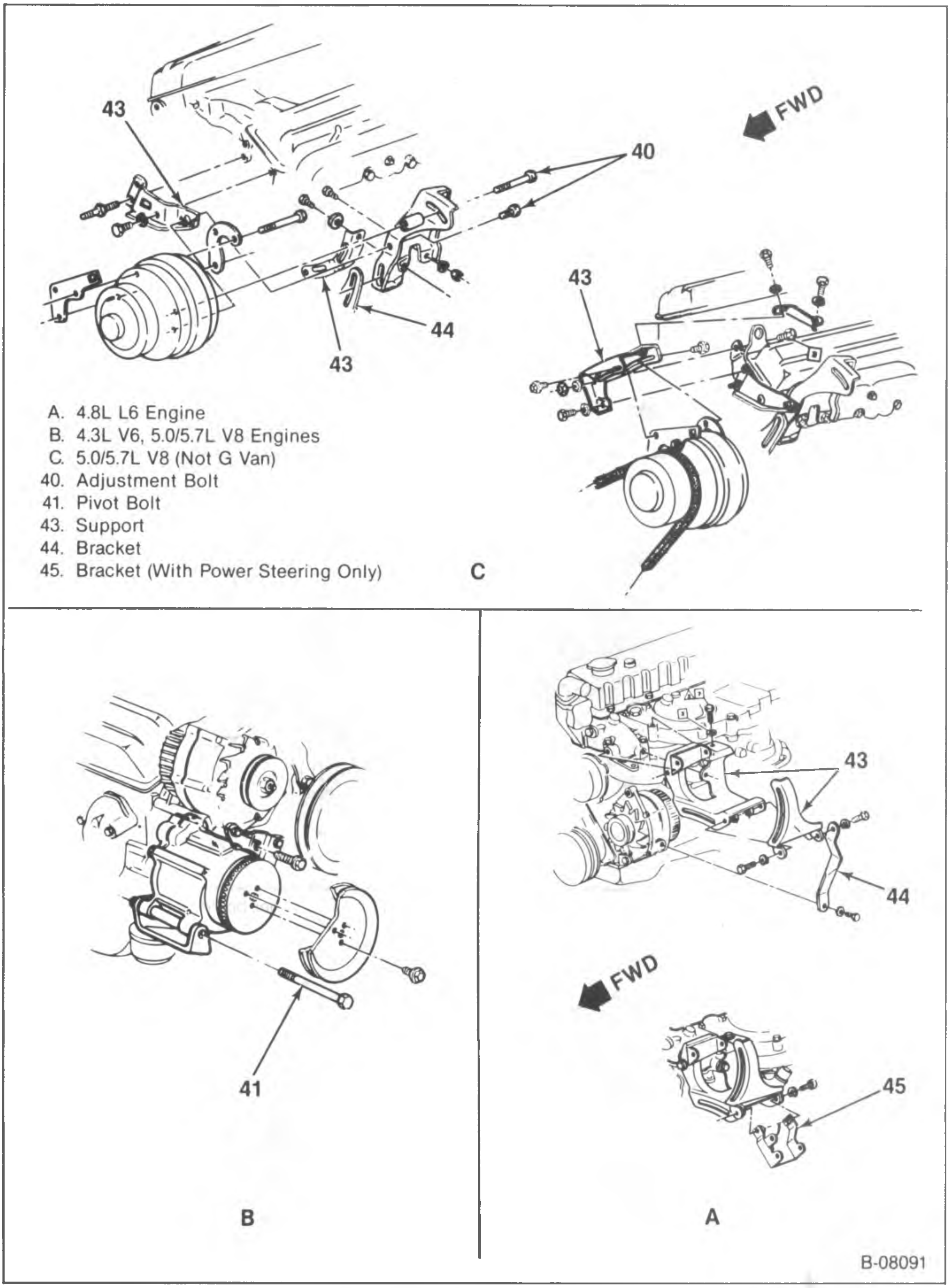
1. Upper fan shroud (61).
   - Bolts (60).

Tighten

   - Bolts (60) to 6 N·m (53 in. lbs.).
2. Windshield washer bottle.
3. Hood latch cable.
4. Fan shroud bolts (60).

Tighten

   - Bolts (60) to 6 N·m (53 in. lbs.).
5. Air cleaner intake.



A. 4.8L L6 Engine
B. 4.3L V6, 5.0/5.7L V8 Engines
C. 5.0/5.7L V8 (Not G Van)
40. Adjustment Bolt
41. Pivot Bolt
43. Support
44. Bracket
45. Bracket (With Power Steering Only)

Figure 20—C-K, G, And P Series Vehicle Air Conditioning And A.I.R. Adjustment

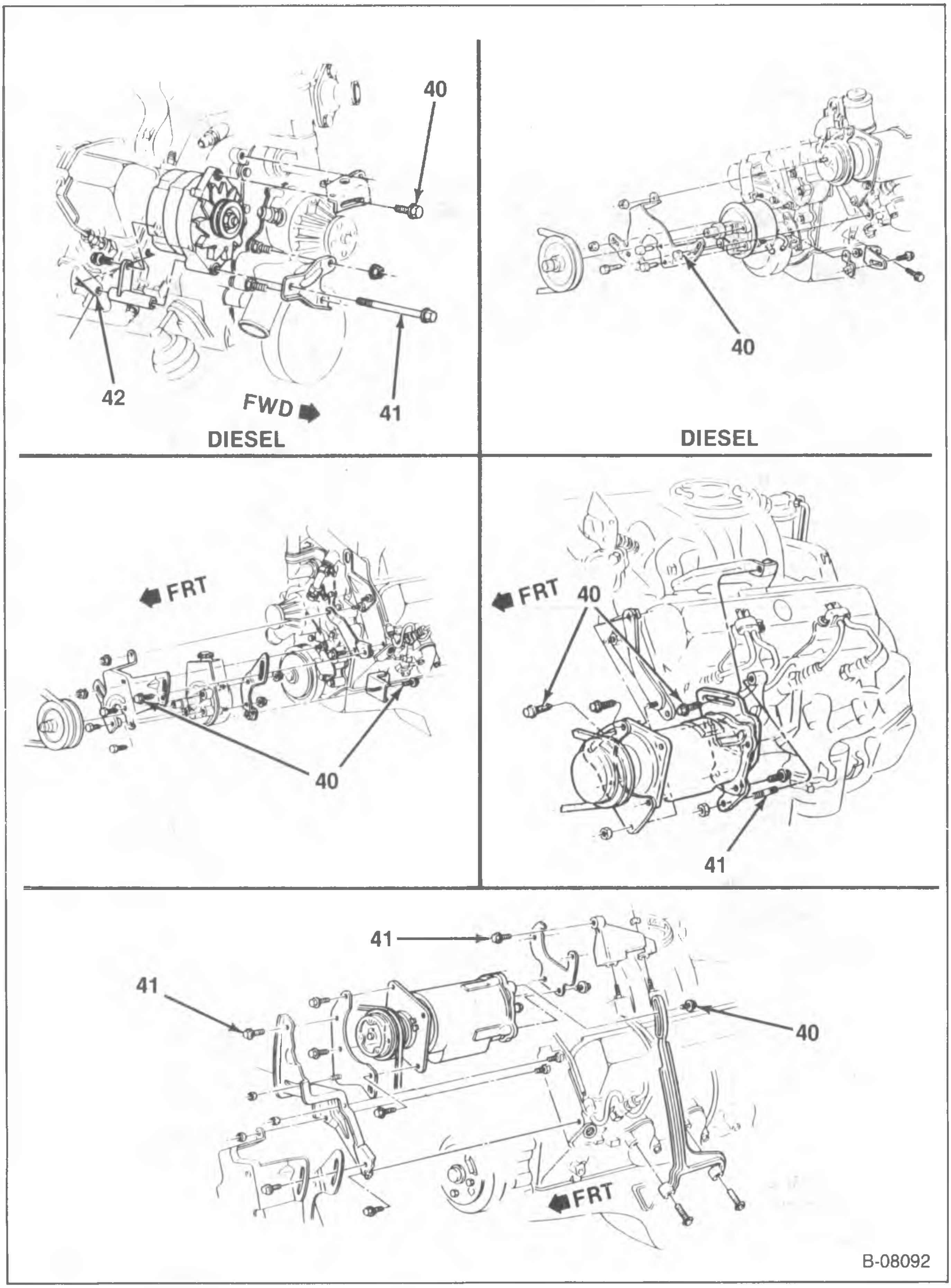


Figure 21—C-K, G, And P Series Vehicle 6.2L Diesel Drive Belt Adjustment

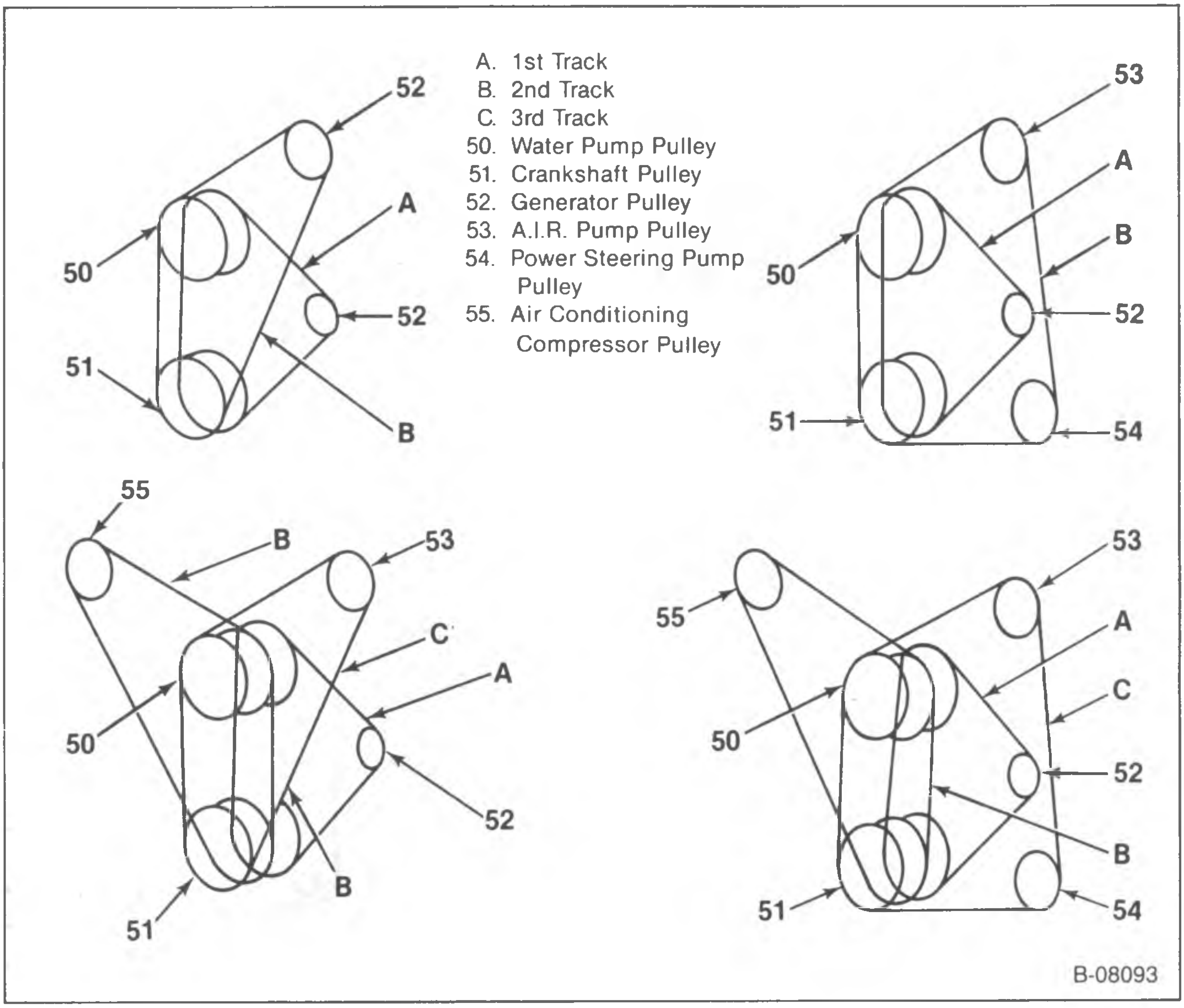


Figure 22—C-K Series 4.8L L6 Engine Accessory Drive

6. Battery negative cable.

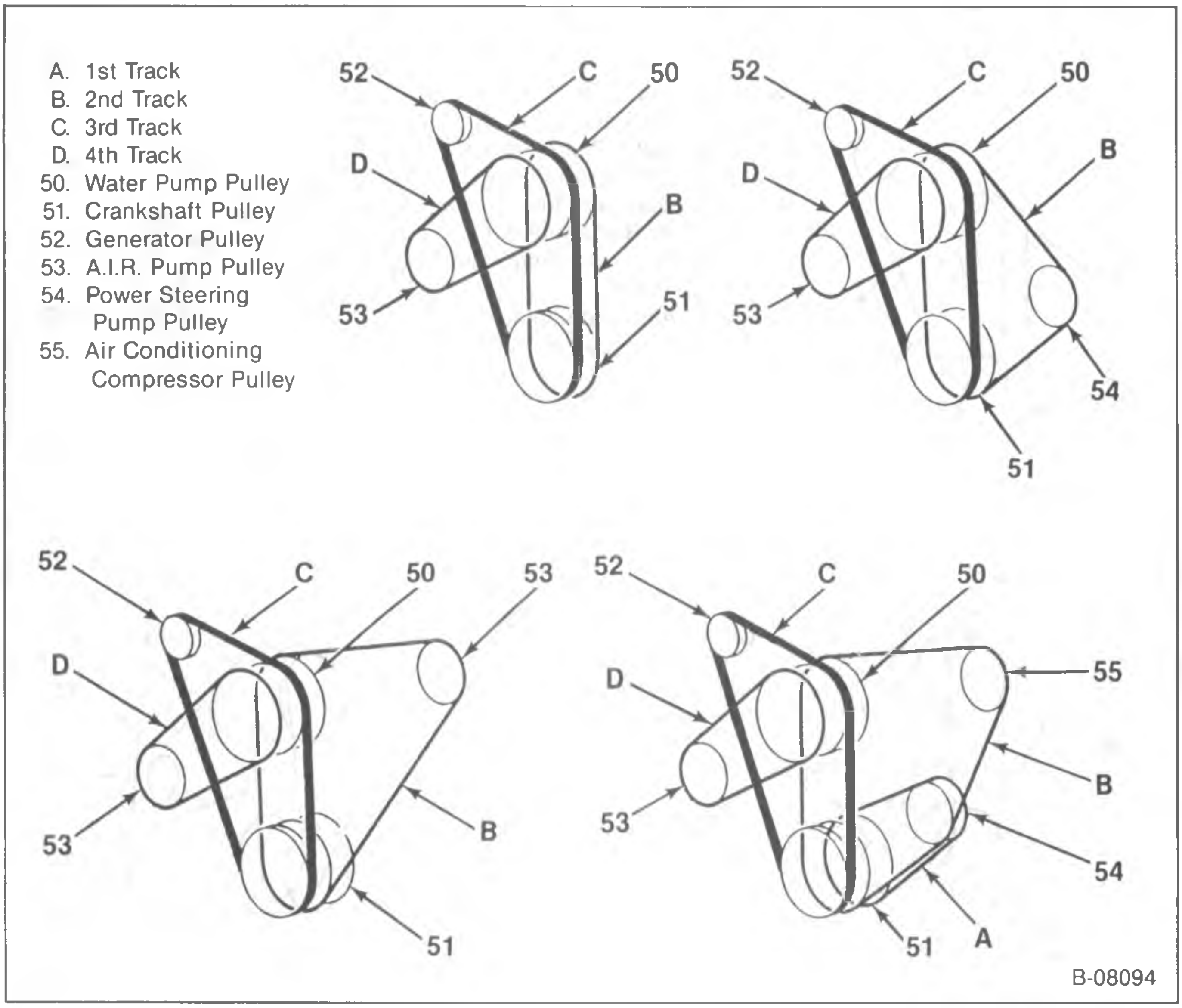
FAN AND FAN CLUTCH

Remove or Disconnect (Figure 38)

1. Battery negative cable.
2. Radiator fan shroud.
   - Refer to "Fan Shroud," in this section.
3. Fan (73) and fan clutch (74) from the water pump pulley (70).
   - Nuts (75).
4. Fan (73) from the fan clutch (74).
   - Bolts (72).

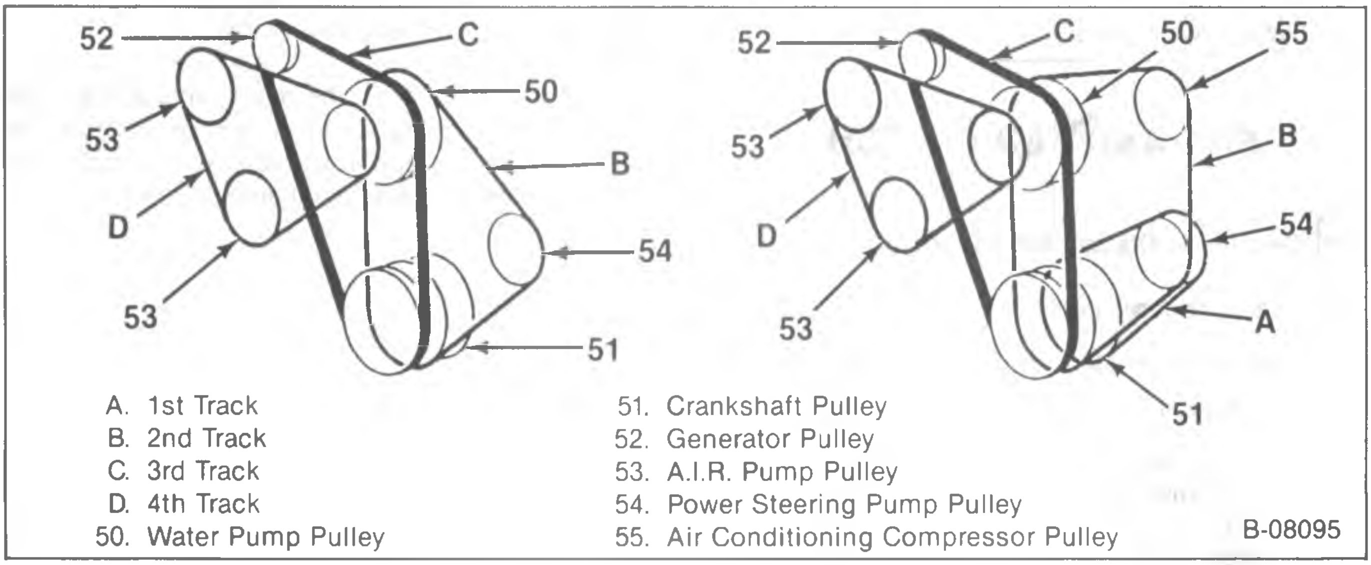
Install or Connect (Figure 38)

- All mating surfaces (the water pump hub and the fan clutch hub) must be inspected for smoothness and reworked as necessary to eliminate any burrs or other imperfections.



A. 1st Track
B. 2nd Track
C. 3rd Track
D. 4th Track
50. Water Pump Pulley
51. Crankshaft Pulley
52. Generator Pulley
53. A.I.R. Pump Pulley
54. Power Steering Pump Pulley
55. Air Conditioning Compressor Pulley

Figure 23—C-K Series V6 & V8 Engine Accessory Drive



A. 1st Track
B. 2nd Track
C. 3rd Track
D. 4th Track
50. Water Pump Pulley
51. Crankshaft Pulley
52. Generator Pulley
53. A.I.R. Pump Pulley
54. Power Steering Pump Pulley
55. Air Conditioning Compressor Pulley

Figure 24—C-K Series 5.7L V8 Engine (With Heavy Duty Emissions) Accessory Drive

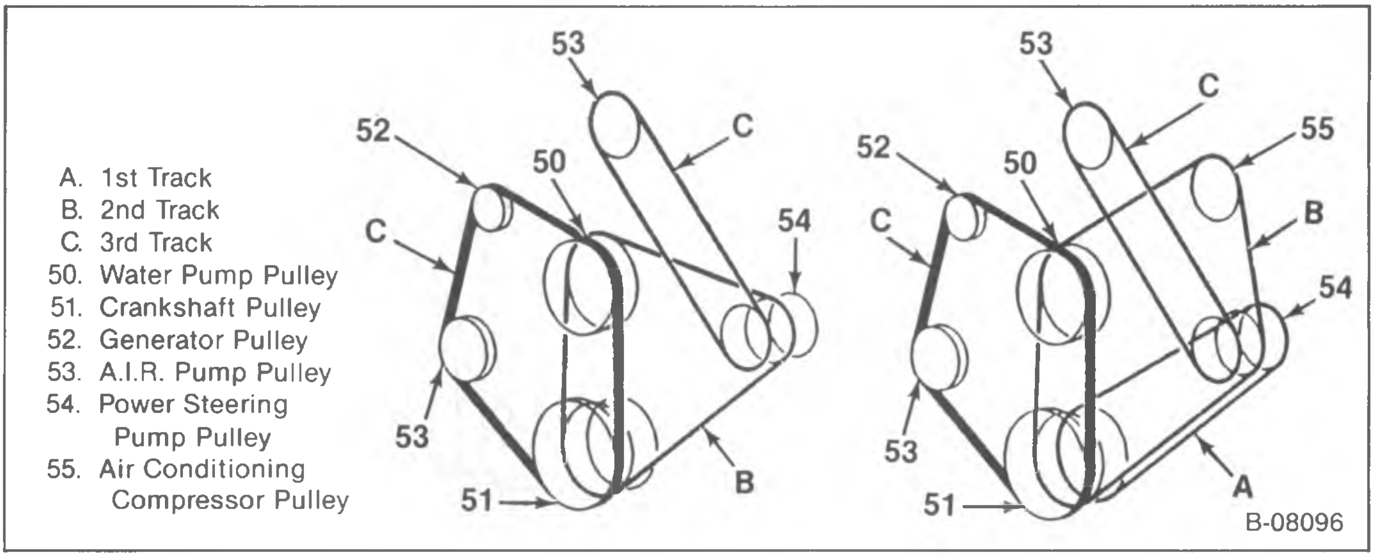


Figure 25—C-K Series 7.4L V8 Engine Accessory Drive (Federal Emissions)

CAUTION: If a fan blade is bent or damaged in any way, no attempt should be made to repair and/or reuse the damaged part. A bent or damaged fan assembly must be replaced with a new fan assembly.

It is essential that the fan assembly remain in proper balance. 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 use, creating a dangerous condition to both the vehicle and the owner.

1. Fan (73) to the fan clutch (74).

Tighten

- Bolts (72) to 25 N·m (18 ft. lbs.).

2. Fan and clutch assembly to the water pump pulley (70).
   - Nuts (75), making sure to align the yellow reference marks on the water pump hub and the fan clutch hub (figure 38).

Tighten

   - Nuts (75) to 25 N·m (18 ft. lbs.).
3. Radiator fan shroud.
   - Refer to "Fan Shroud" in this section.
4. Battery negative cable.

AUXILIARY COOLING FAN

The Auxiliary Cooling Fan is available only when a 7.4L V8 engine (RPO LE8) and Air Conditioning (C60, C69) are ordered. Its purpose is to provide additional cooling at low speed vehicle operations, extended idle,

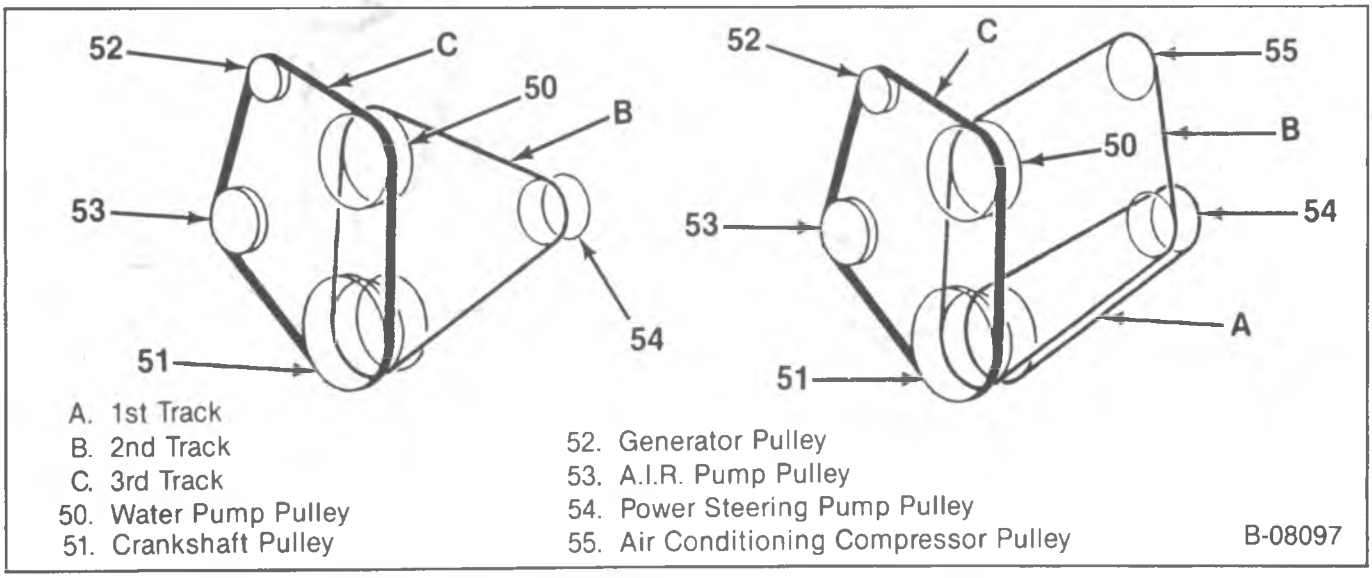


Figure 26—C-K Series 7.4L V8 Engine Accessory Drive (California Emissions)

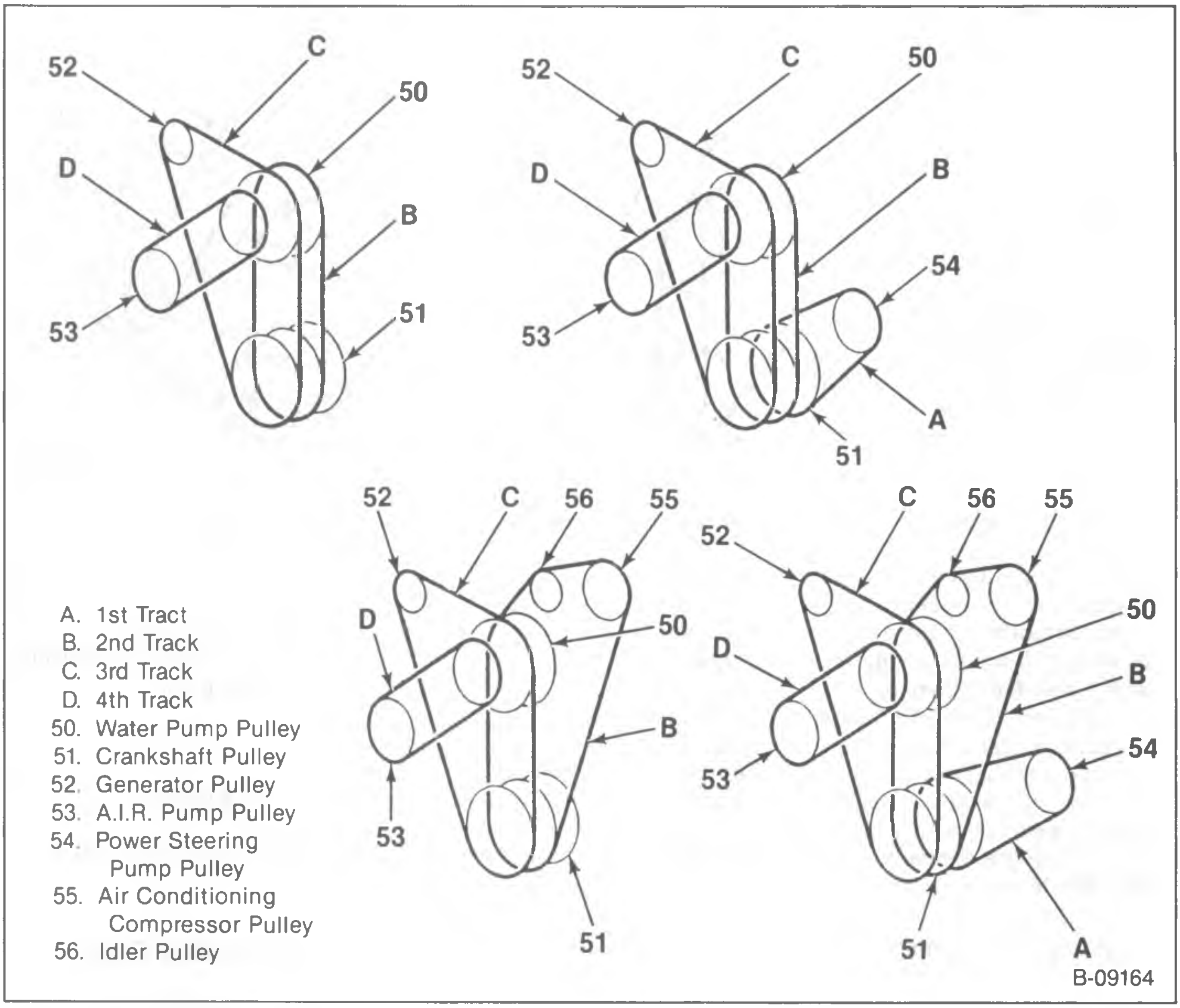


Figure 27—G Series V6 And V8 Engine Accessory Drive

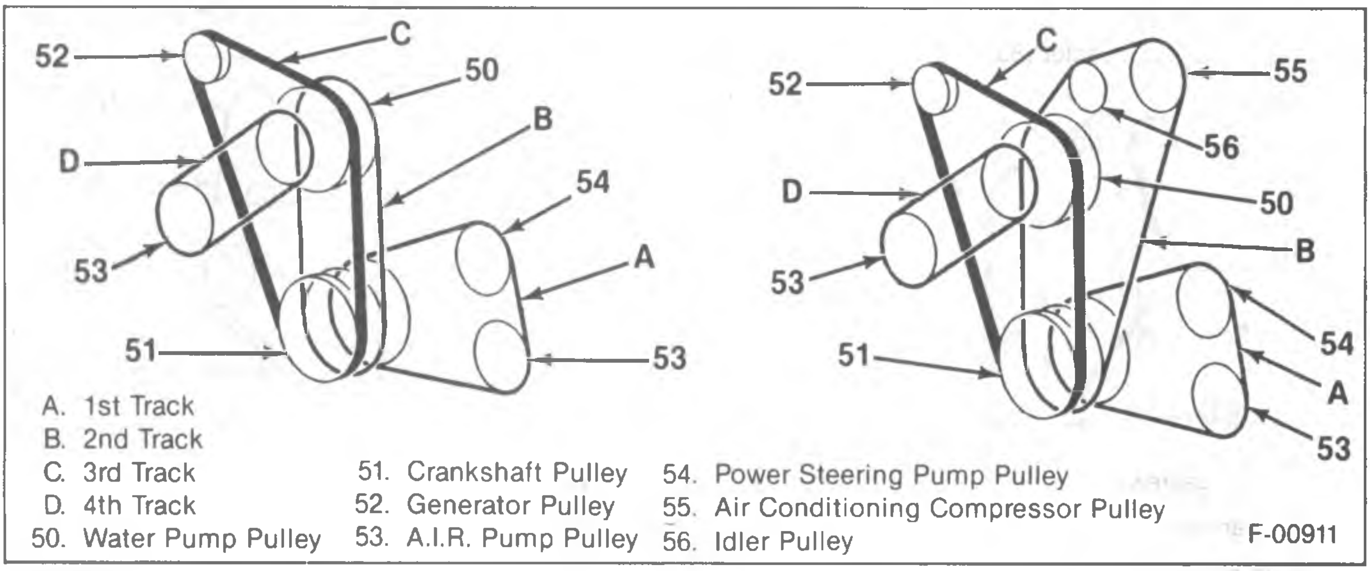


Figure 28—G Series 5.7L V8 Engine Accessory Drive (Heavy Duty Emissions)

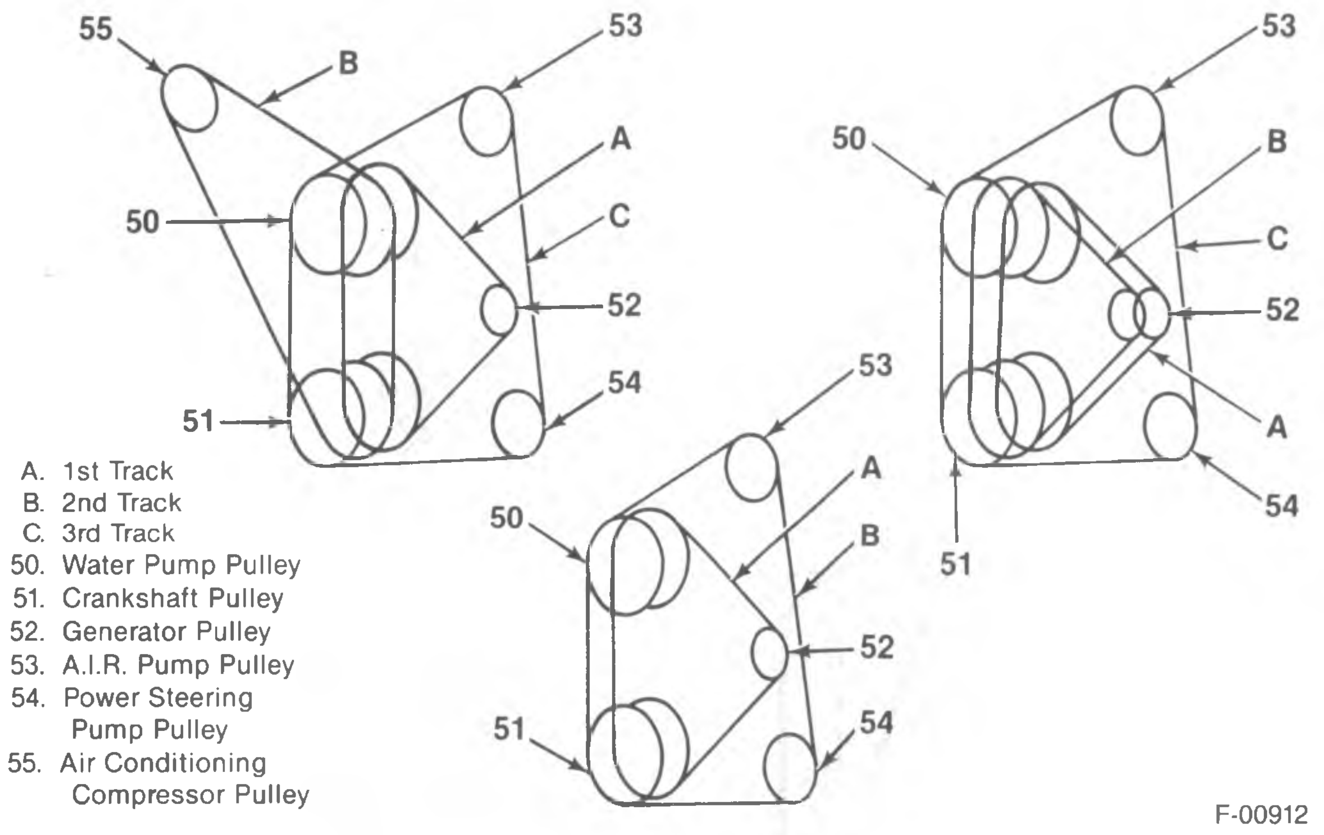


Figure 29—P Series 4.8L L6 Engine Accessory Drive

stop and go conditions, and when running the air conditioning system.

Remove or Disconnect (Figure 39)

1. Battery negative cable.
2. Grille assembly.
    - Refer to SHEET METAL (SEC. 2C).
3. Fan harness connector (83).
4. Fan assembly (81) from the radiator support (80).
    - Bolts/screws (82).

Install or Connect (Figure 39)

1. Fan assembly (81) to the radiator support (80).
    - Bolts/screws (82).

Tighten

- Bolt/screw (82) to 6 N·m (53 ft. lbs.).

2. Fan harness connector (83).
3. Grille assembly.
    - Refer to SHEET METAL (SEC. 2C).
4. Battery negative cable.

WATER PUMP

4.8L L6 ENGINE

Remove or Disconnect (Figures 38 and 40)

- Battery negative cable.
- Drain the cooling system.

1. Accessory drive belts.
    - Refer to "Drive Belts," in this section.
2. Fan (73) and fan clutch (74) (figure 38).
    - Nuts (75).
3. Water pump pulley (70).
    - Pulley off the water pump studs (71), but do not damage the threads.
4. Lower radiator hose and the heater hose from the water pump (91).
5. Water pump (91) from the engine block (figure 40).
    - Bolts (92, 93), and gasket (94).
    - Loosen the generator adjusting bolt to allow the brace to be moved away on vehicles where the brace will inhibit water pump removal.

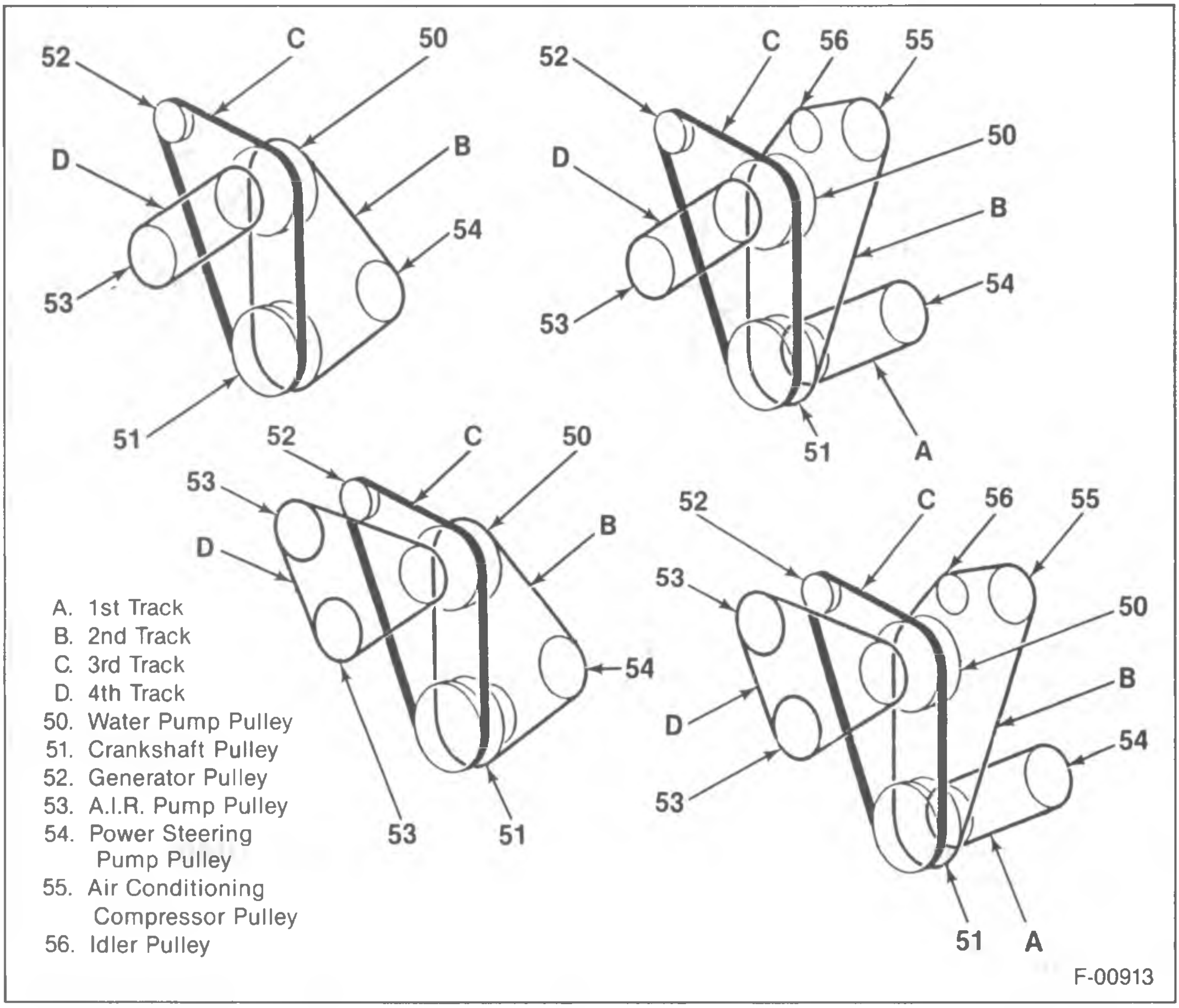


Figure 30—P Series 5.7L V8 Engine Accessory Drive (Heavy Duty Emissions)

Install or Connect (Figures 38 and 40)

- Clean the mating surfaces on the water pump and the engine block.

1. Water pump (91) to the engine block (figure 40).
   - New gasket (94) onto the water pump (91).
   - Place the generator adjusting brace back into position if moved.
   - Bolts (92 and 93).

Tighten

- Bolts (92 and 93) to the specifications at the end of this section.

2. Lower radiator hose and the heater hose to the water pump (91).
3. Water pump pulley (70), fan (73), and fan clutch (74) on the water pump hub (figure 38).

Tighten

- Nuts (75) to 25 N·m (18 ft. lbs.).

4. Drive belts and adjust.
   - Refer to "Drive Belts," in this section.
5. Battery negative cable.
6. Cooling system.
   - Refer to the Owner's Manual.
7. Start the engine and run, with the radiator cap removed, until the radiator upper hose (12) becomes hot (thermostat is open).
8. Add coolant to the radiator until the level reaches the bottom of the filler neck.
   - Engine must be running at idle speed.
9. Radiator cap, making sure the arrows line up with the overflow tube.

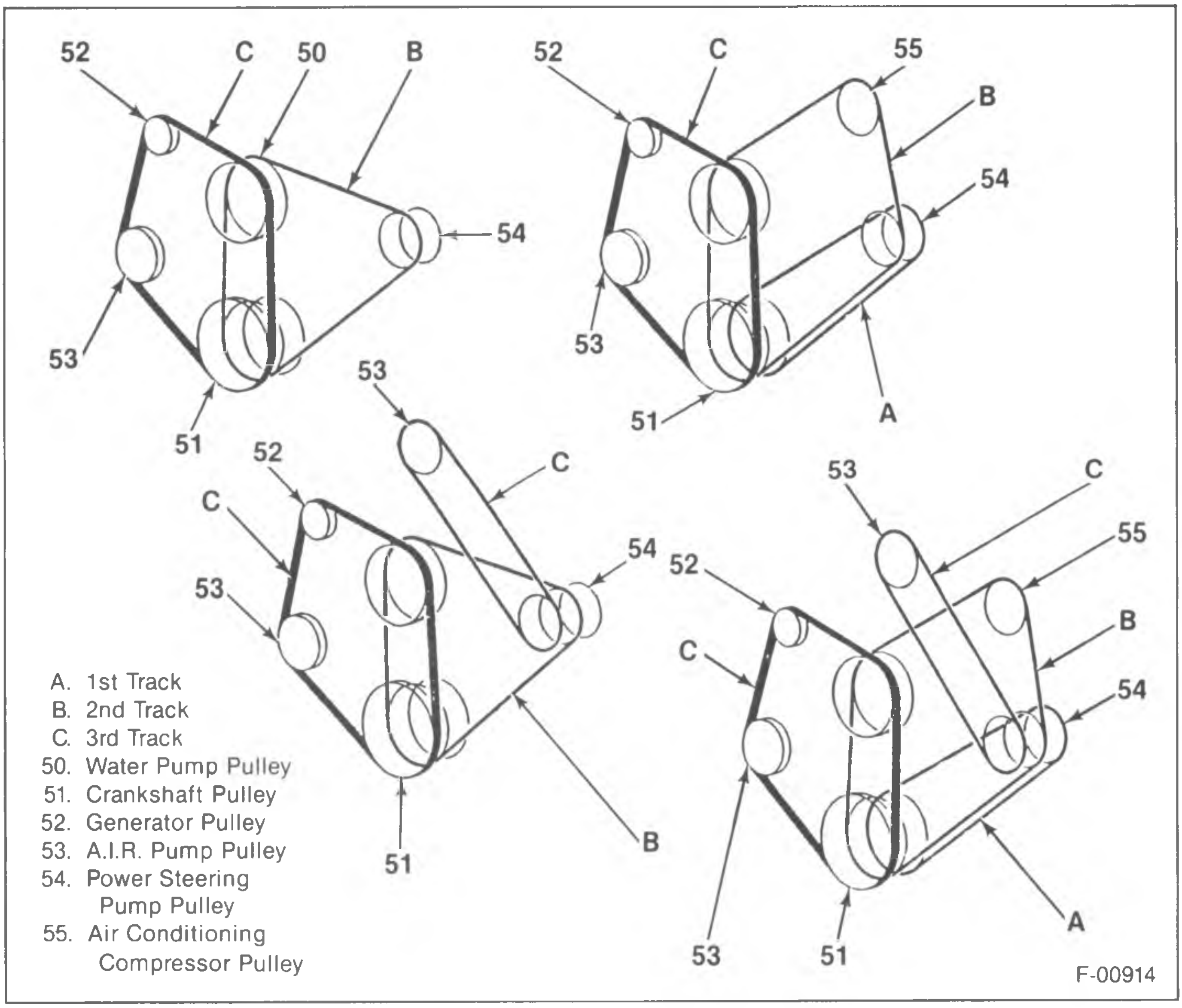


Figure 31—P Series 7.4L V8 Engine Accessory Drive

V6 AND V8 GASOLINE ENGINES

Remove or Disconnect (Figures 41, 42 and 43)

- Battery negative cable.
- Drain the cooling system.

1. Accessory drive belts.
   - Refer to "Drive Belts," in this section.
2. Fan (73), the fan clutch (74), and the pulley (70) from the water pump (91) (figure 38).
   - Nuts (75).
3. Generator lower brace attaching bolts and swing the brace down and out of the way.
4. Generator upper brace attaching bolts.
5. Lower radiator hose and heater hose from the water pump (91).
   - On the 7.4L engine, remove the bypass hose.
6. Water pump (91) from the engine block.
   - Bolts (92, 93) and studs (95).

Install or Connect (Figures 41, 42 and 43)

- Clean the mating surfaces on the water pump and the engine block.

1. Water pump (91) to the engine block.
   - New gaskets (94).
   - Place the pump against the block and retain it with bolts (92, 93 and 95).

Tighten

   - Bolts (92 and 93) and studs (95) to the "Specifications" at the end of this section.
2. Lower radiator hose and the heater hose to the water pump (91).
   - Bypass hose with 7.4L V8 engine.
3. Generator upper and lower braces to the water pump (91).
4. Water pump pulley (70), fan (73) and fan clutch (74) to the water pump hub (figure 38).

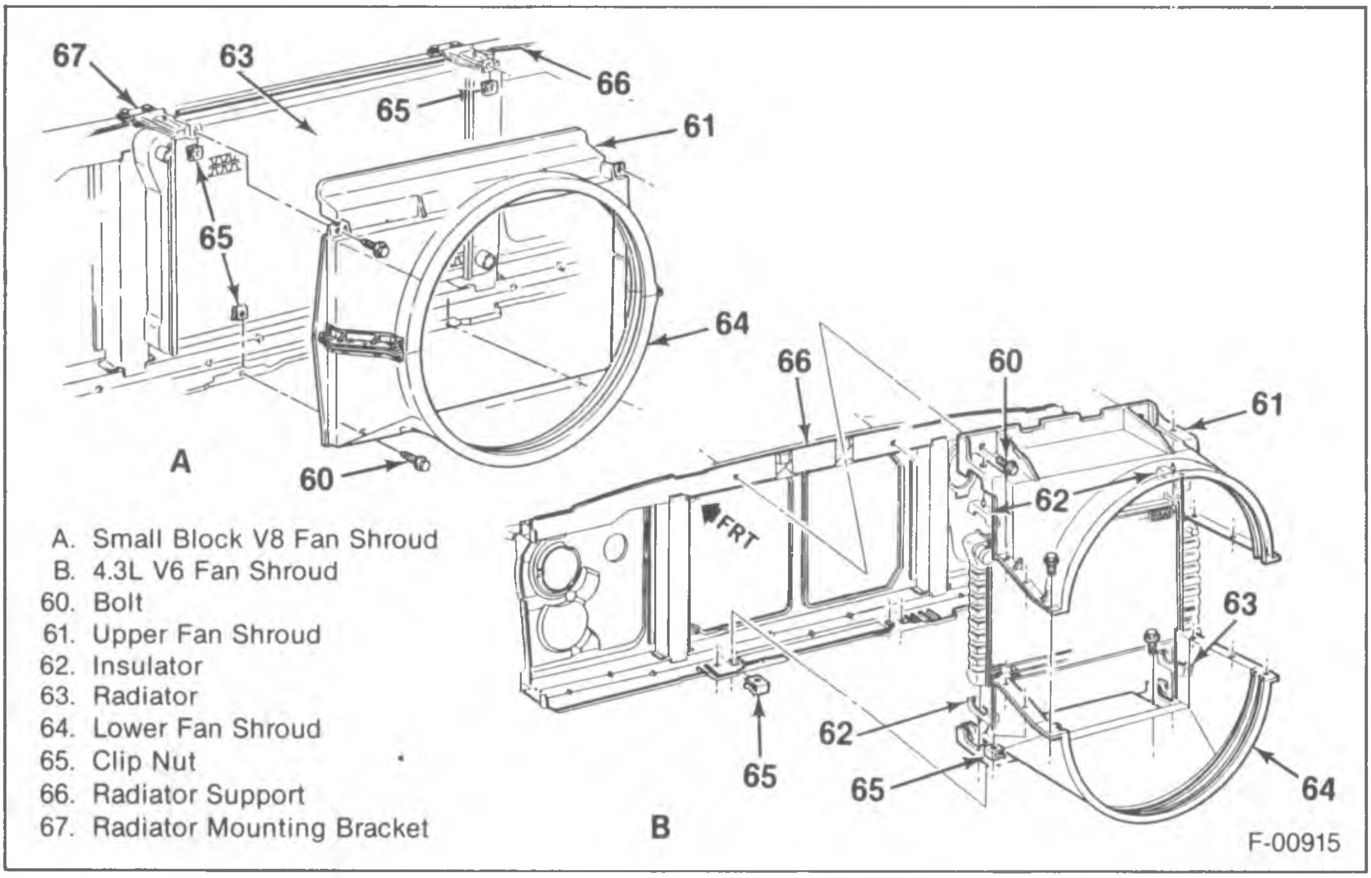


Figure 32—C-K Series V6, Small Block V8 Engine Fan Shrouds

- Nuts (75).

Tighten

- Nuts (75) to 25 N·m (18 ft. lbs.).

5. Accessory belt drive and adjust.
   - Refer to "Belt Drive" in this section.
6. Battery negative cable.
7. Fill the cooling system.
   - Refer to the Owner's Manual.
8. Start the engine and run, with the radiator cap removed, until the radiator upper hose (12) becomes hot (thermostat is open).
9. Add coolant to the radiator until the level reaches the bottom of the filler neck.
   - Engine must be running at idle speed.
10. Radiator cap, making sure the arrows line up with the overflow tube.

6.2L V8 DIESEL ENGINE

Remove or Disconnect (Figures 38 and 44)

- Battery negative cable.
- Drain the cooling system.

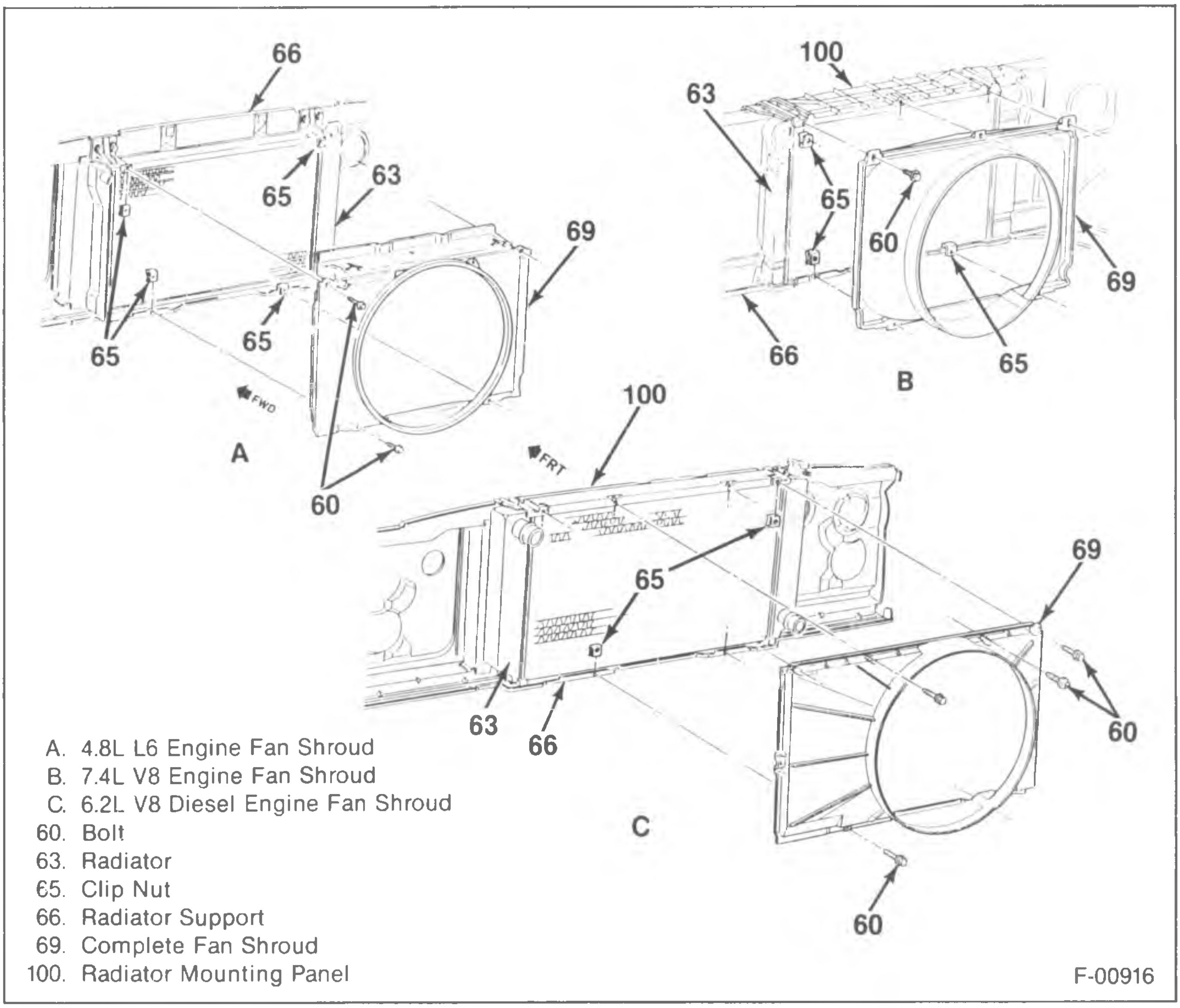
1. Fan.
   - Refer to "Fan And Fan Clutch," in this section.
2. Fan shroud.
   - Refer to "Fan Shroud," in this section.
3. Air conditioning hose bracket nuts.
4. Oil fill tube.
5. Generator drive belt.
   - Generator pivot bolt.
   - Refer to "Drive Belts," in this section.
6. Generator lower bracket.
7. Power steering belt.
   - Refer to "Drive Belts," in this section.
8. Power steering pump.
9. Air conditioning compressor belt, if equipped.
   - Refer to "Drive Belts," in this section.
10. Bypass hose and the lower radiator hose.
11. Water pump (91) (figure 44).
    - Bolts (96 and 97), water pump plate (99) and the water pump (91).
12. Water pump plate (99) from the water pump (91).
    - Bolts (92 and 93) and the gasket (94).

Install or Connect (Figure 44)

Important

- Flanges must be free of oil. Clean the mating surfaces on the water pump, both sides of the water pump plate, and the engine block.

1. Water pump (91) to the water pump plate (99).
   - Gasket (94) and bolts (92 and 93).



A. 4.8L L6 Engine Fan Shroud
B. 7.4L V8 Engine Fan Shroud
C. 6.2L V8 Diesel Engine Fan Shroud
60. Bolt
63. Radiator
65. Clip Nut
66. Radiator Support
69. Complete Fan Shroud
100. Radiator Mounting Panel

Figure 33—C-K Series L6, 6.2L Diesel, And 7.4L V8 Engine Fan Shrouds

Tighten

- Bolts (92 and 93) to "Specifications," at the end of this section.

2. Water pump (91) to the engine block.
   - Apply anerobic sealer #1052357 or equivalent as shown in figure 44.
   - The sealer must be wet to the touch when the bolts are tightened.
   - Bolts (96 and 97).

Tighten

- Bolts (96 and 97) to "Specifications," at the end of this section.

3. Bypass hose and lower radiator hose.
4. Power steering pump.
5. Generator in place.
   - Generator lower bracket.
6. Drive belts and adjust.
   - Refer to "Drive Belts," in this section.
7. Oil fill tube.
8. Fan shroud.
   - Refer to "Fan Shroud," in this section.
9. Fan (73) assembly.
   - Refer to "Fan And Fan Clutch," in this section.
10. Battery negative cable.
11. Fill the cooling system.
    - Refer to the Owner's Manual.
12. Start the engine and run, with the radiator cap removed, until the radiator upper hose (12) becomes hot (thermostat is open).
13. Add coolant to the radiator until the level reaches the bottom of the filler neck.
    - Engine must be running at idle speed.
14. Radiator cap, making sure the arrows line up with the overflow tube.

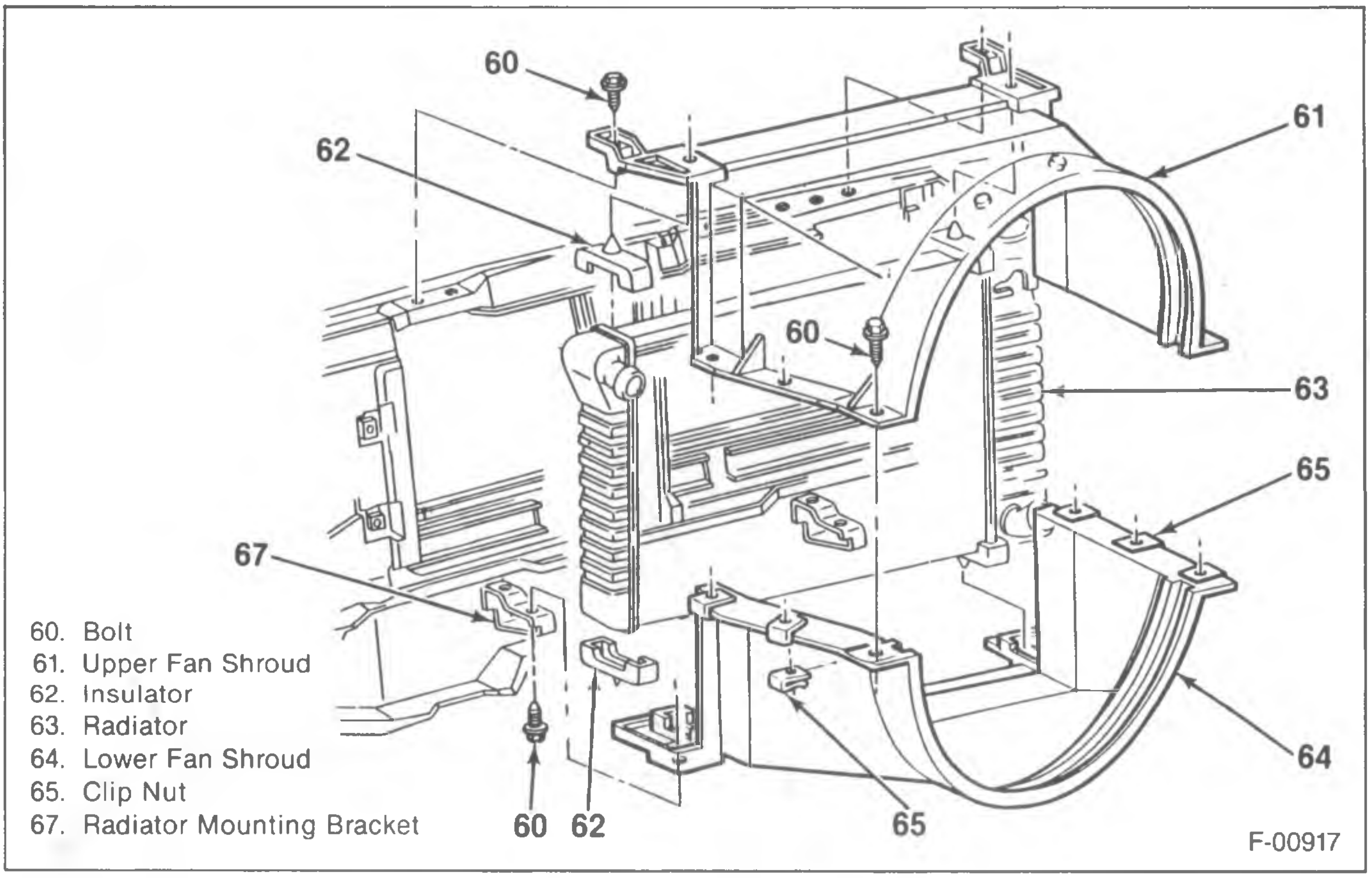


Figure 34—G Series 4.3L V6 Engine Fan Shroud

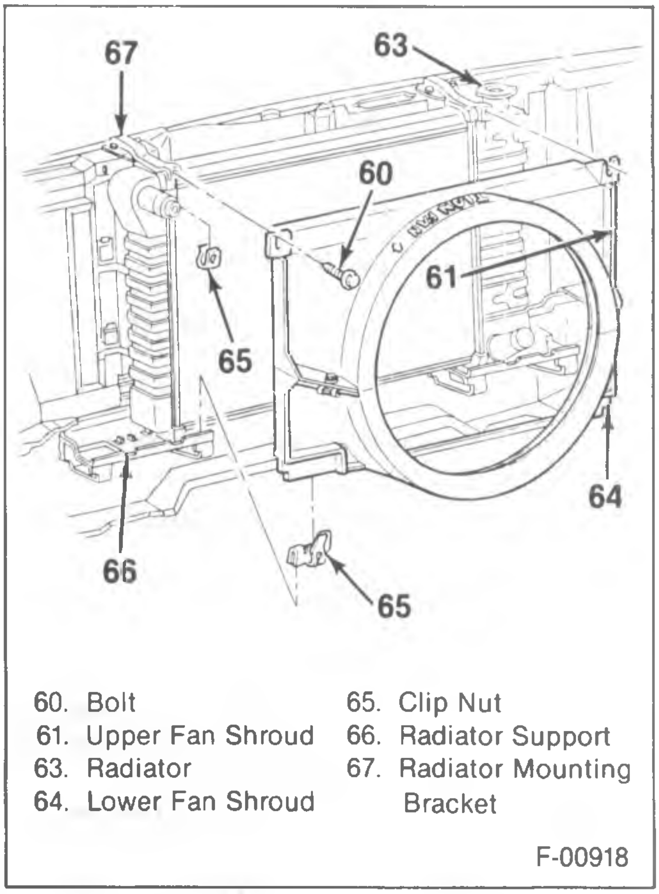


Figure 35—G Series Small Block V8 And 6.2L Diesel Engine Fan Shroud

RADIATOR

C-K, G, AND P SERIES VEHICLE (WITHOUT A 6.2L DIESEL ENGINE)

Remove or Disconnect (Figures 45, 46 and 47)

- Drain the cooling system.

1. Battery negative cable.
2. Radiator hoses from the radiator.
   - Radiator inlet hose and radiator outlet hose.
3. Overflow hose from the radiator.
4. Fan shroud.
   - Refer to "Fan Shroud," in this section.
5. Transmission cooler lines.
6. Radiator from the vehicle.
   - Retainers from the radiator support.
   - Retainers from the upper mounting panel on C-K series vehicle.

Install or Connect (Figures 45, 46 and 47)

1. Radiator on the vehicle.
   - Radiator support on the upper mounting panel.

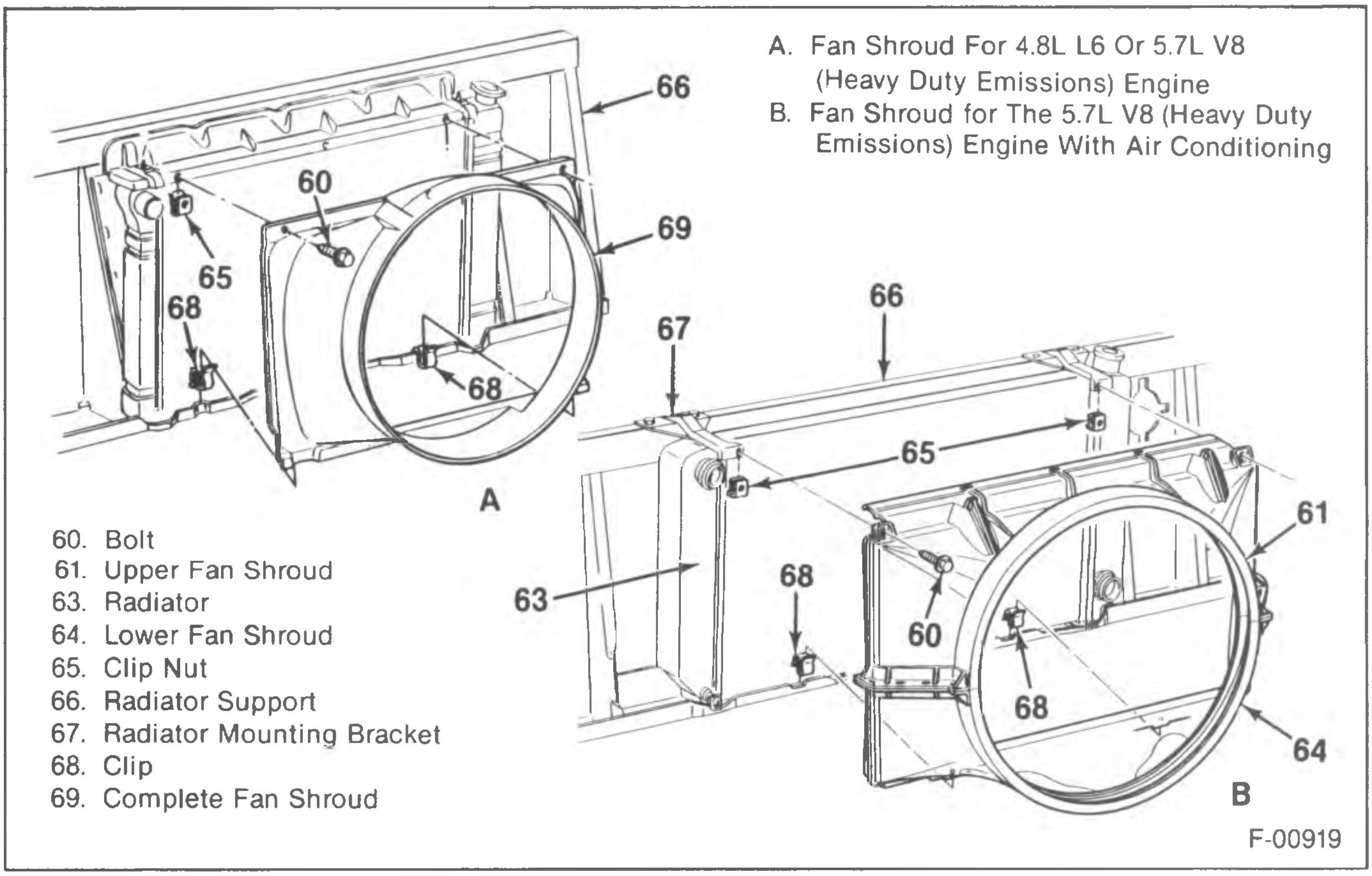


Figure 36—P Series (42) 4.8L L6 And 5.7L V8 Fan Shroud

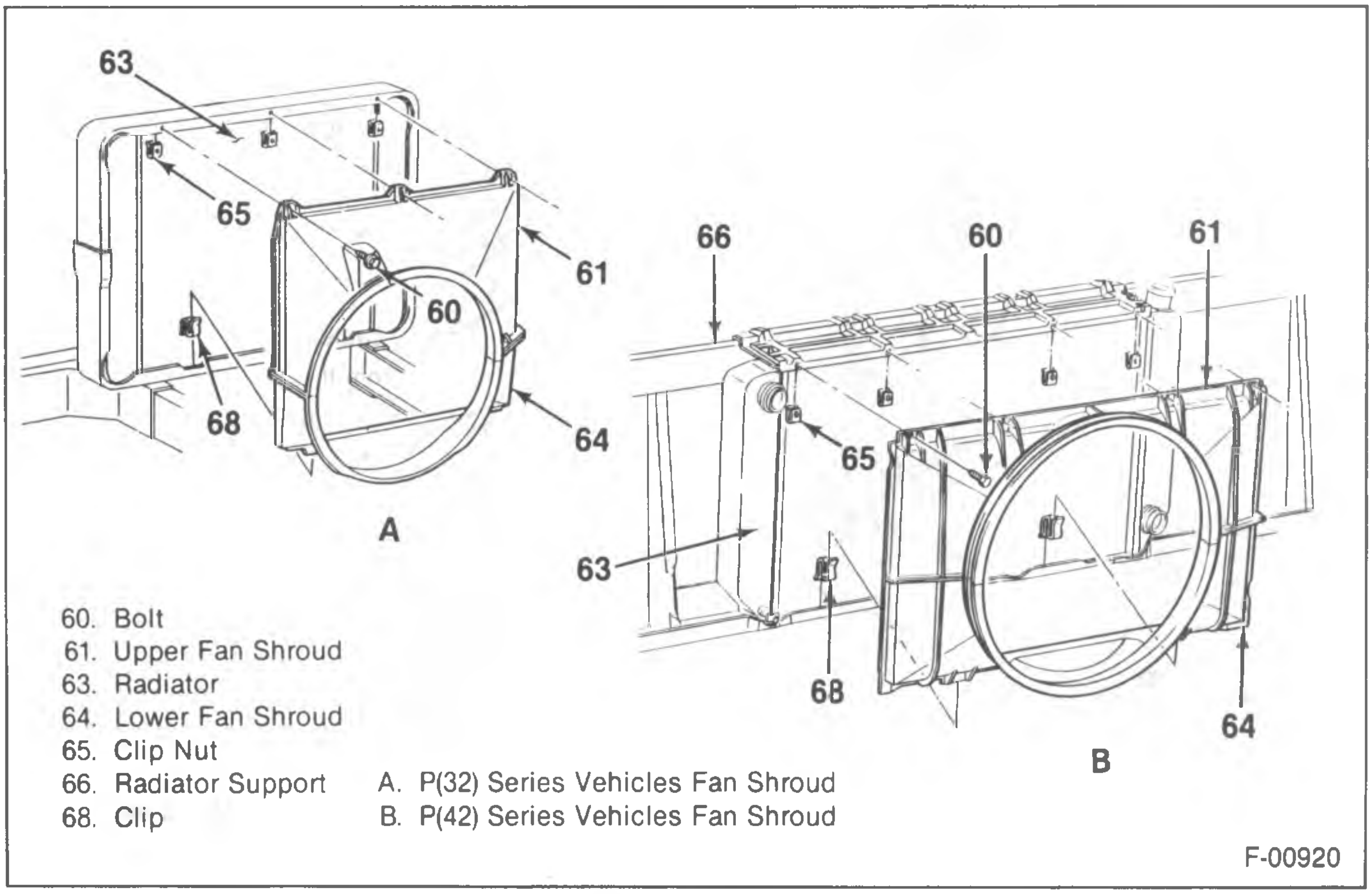
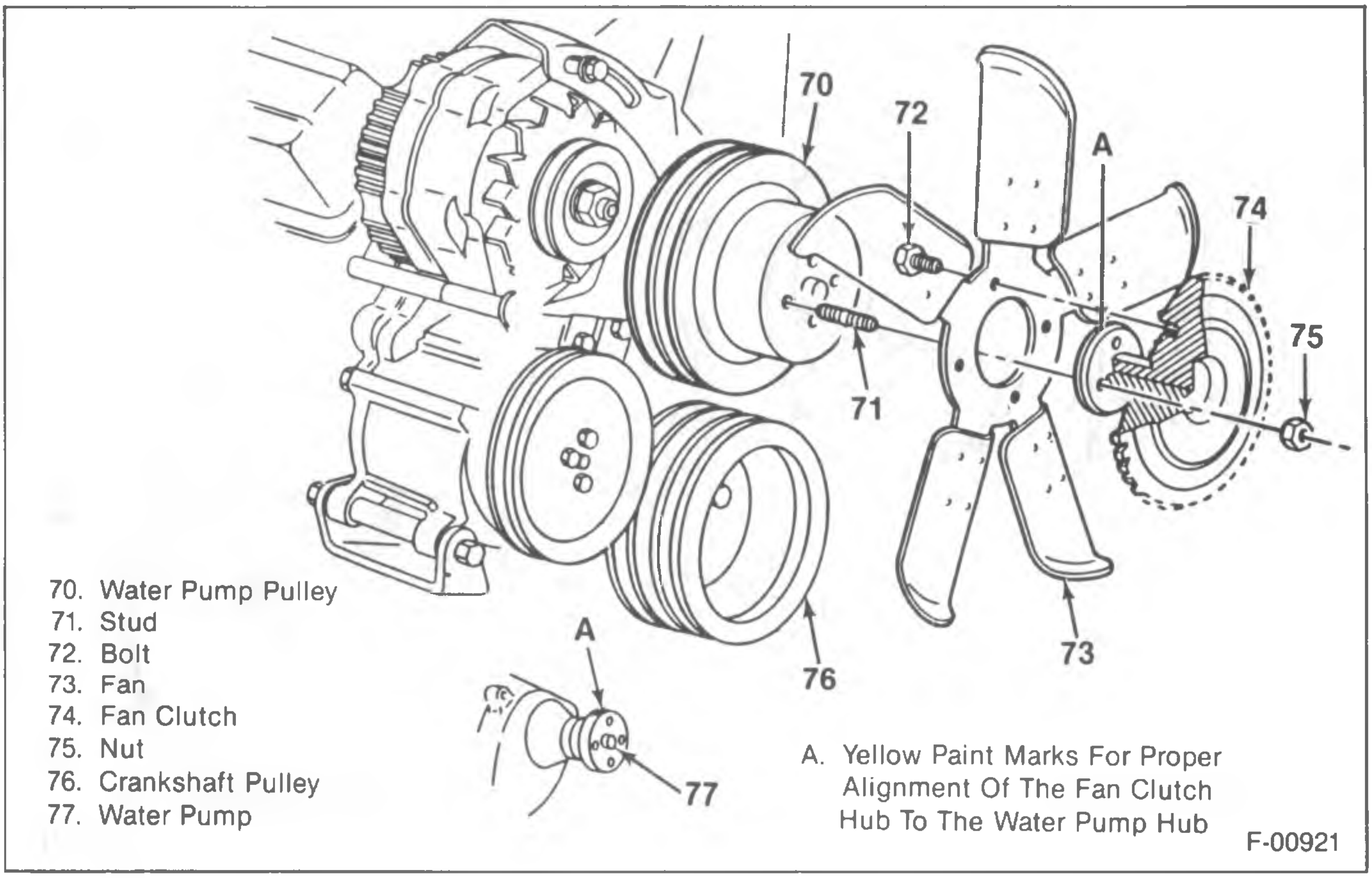


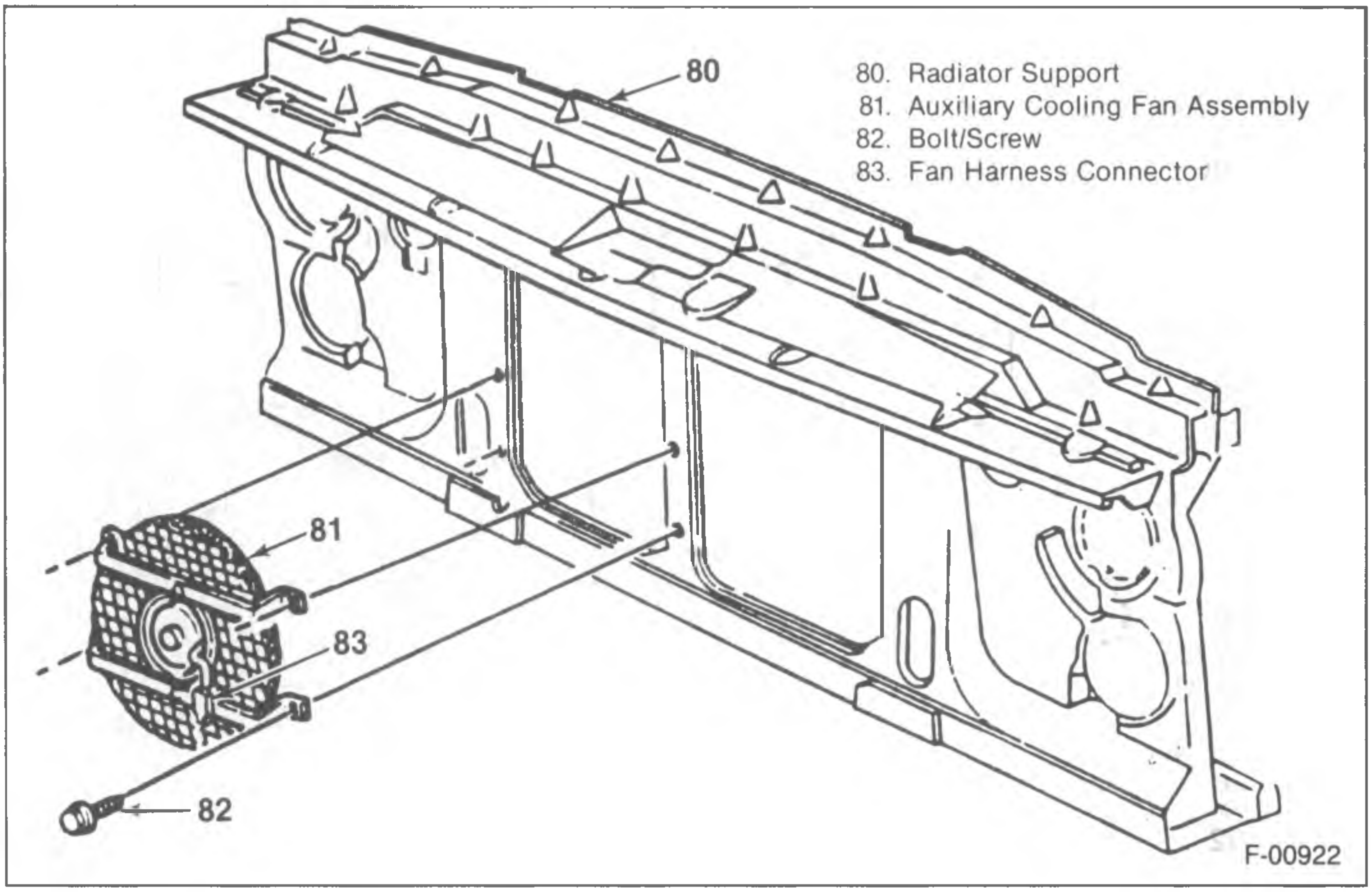
Figure 37—P Series (32 & 42) 6.2L Diesel And 7.4L V8 Fan Shroud



70. Water Pump Pulley
71. Stud
72. Bolt
73. Fan
74. Fan Clutch
75. Nut
76. Crankshaft Pulley
77. Water Pump

A. Yellow Paint Marks For Proper Alignment Of The Fan Clutch Hub To The Water Pump Hub

Figure 38—Fan And Fan Clutch Attachment



80. Radiator Support
81. Auxiliary Cooling Fan Assembly
82. Bolt/Screw
83. Fan Harness Connector

Figure 39—Auxiliary Cooling Fan Attachment

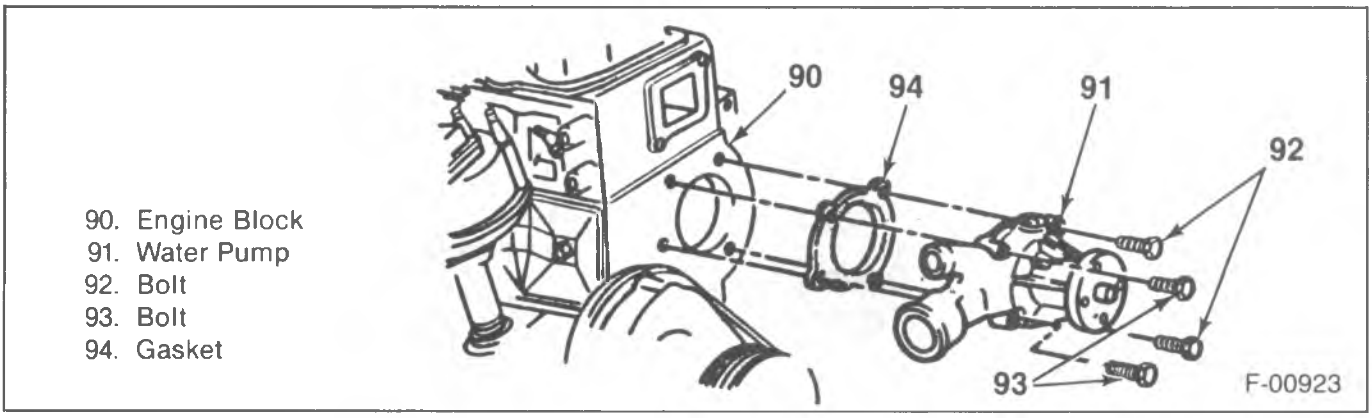


Figure 40—4.8L L6 Engine Water Pump Attachments

Tighten

- Fasteners to the "Specifications," at the end of this section.

2. Transmission cooler lines.
3. Fan shroud.
    - Refer to "Fan Shroud," in this section.
4. Overflow hose to the radiator.
5. Radiator hoses to the radiator.
    - Radiator inlet hose and radiator outlet hose.
6. Battery negative cable.
7. Fill the cooling system.
    - Refer to the vehicle Owner's Manual.
8. Remove the radiator pressure cap, start the engine, and let it run until the upper radiator hose becomes hot — thermostat is open.
9. Add coolant, with the engine running at idle speed, until the coolant level reaches the bottom of the filler neck.
10. Install the radiator pressure cap, making sure the arrows line up with the overflow tube.

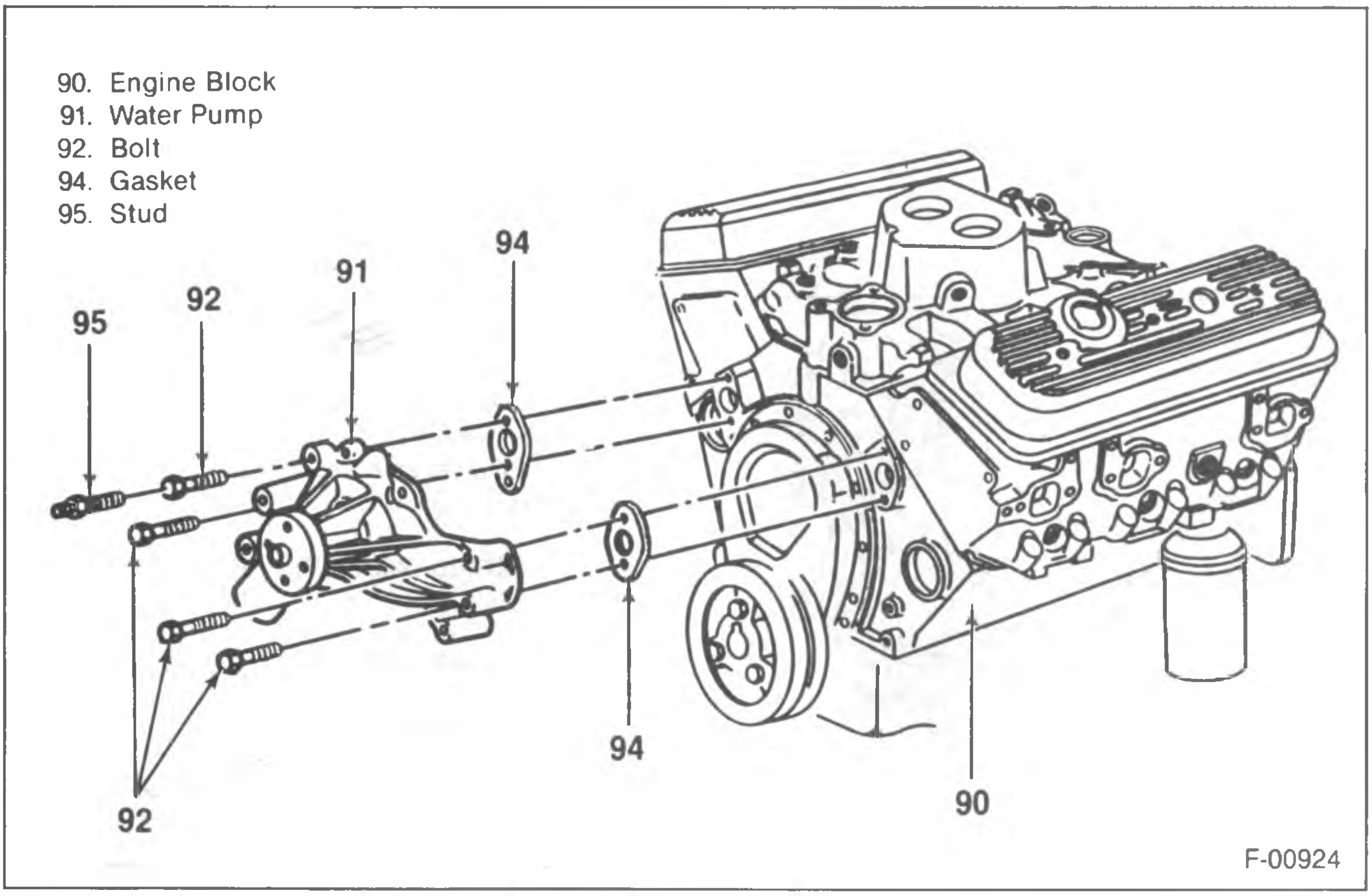


Figure 41—4.3L V6 Engine Water Pump Attachments

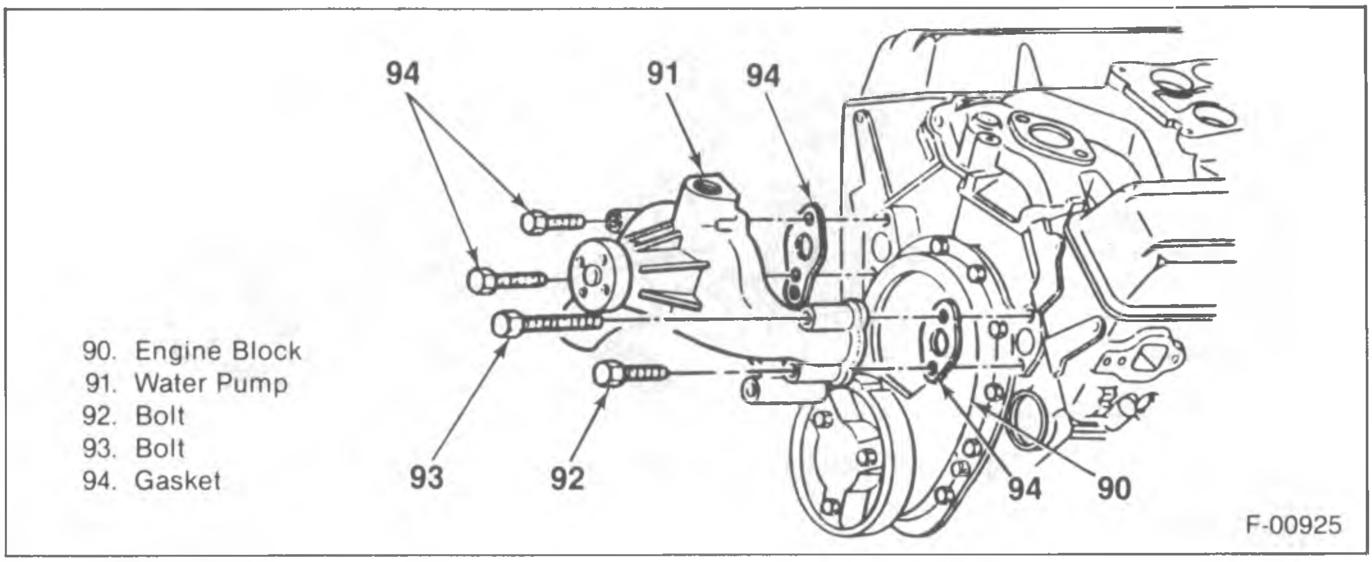


Figure 42—5.0L/5.,7L V8 Engine Water Pump Attachments

C-K SERIES VEHICLE WITH A 6.2L DIESEL ENGINE

Remove or Disconnect (Figures 45, 46 and 47)

- Drain the cooling system.

1. Battery negative cable.
2. Fan shroud.
    - Refer to "Fan Shroud," in this section.
3. Engine and transmission oil cooler lines.
4. Upper radiator hose and lower radiator hose from the radiator.
5. Overflow hose from the radiator.
6. Upper radiator supports.
7. Radiator from the vehicle.

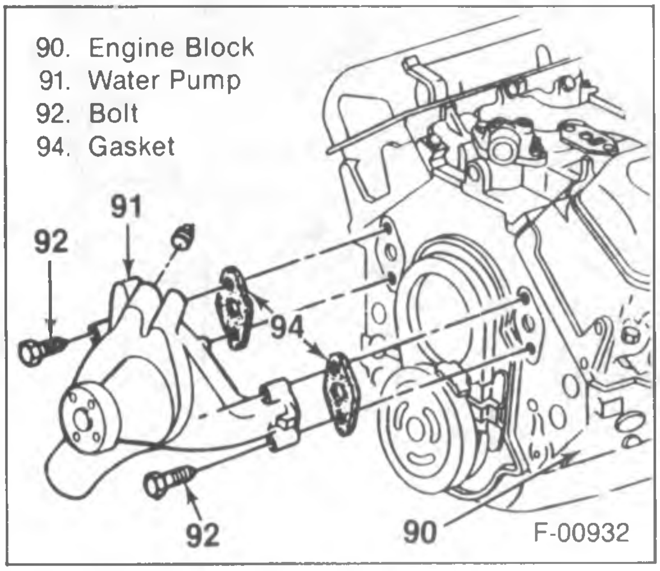


Figure 43—7.4L V8 Engine Water Pump Attachments

Install or Connect (Figures 45, 46 and 47)

1. Radiator to the vehicle.
2. Radiator supports and/or mounting panel.

Tighten

- Fasteners to the "Specifications" at the end of this section.

3. Overflow hose to the radiator.
4. Upper radiator hose and lower radiator hose to the radiator.
5. Engine and transmission oil cooler lines.
6. Fan shroud.
    - Refer to "Fan Shroud," in this section.
7. Battery negative cable.
8. Fill the cooling system.
    - Refer to the vehicle Owner's Manual.
9. Remove the radiator pressure cap, start the engine, and let it run until the upper radiator hose becomes hot — thermostat is open.
10. Add coolant, with the engine running at idle speed, until the coolant level reaches the bottom of the filler neck.
11. Install the radiator pressure cap, making sure the arrows line up with the overflow tube.

G AND SERIES VEHICLE WITH A 6.2L DIESEL ENGINE

Remove or Disconnect (Figures 45, 46 and 47)

- Drain the cooling system.

1. Battery negative cable.
2. Air intake snorkel.
3. Windshield washer bottle.
4. Hood release cable.
5. Upper fan shroud.
    - Refer to "Fan Shroud," in this section.

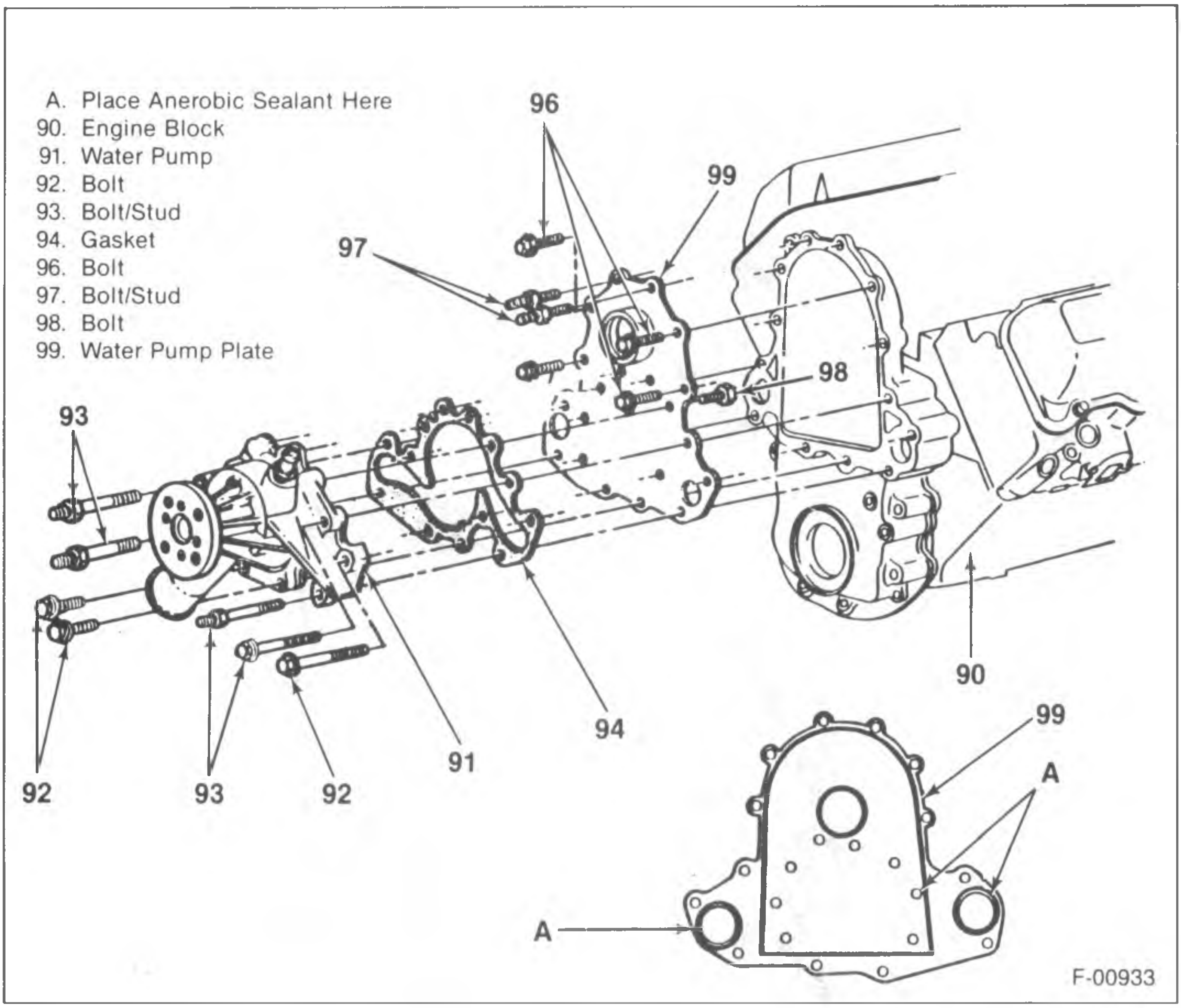


Figure 44—6.2L V8 Diesel Engine Water Pump Attachments

6. Upper radiator hose from the radiator.
7. Transmission cooler lines from the radiator.
8. Low coolant sensor.
9. Overflow hose from the radiator.
10. Engine oil cooler lines from the radiator.
11. Raise the vehicle.
12. Lower radiator hose from the radiator.
13. Lower the vehicle.
14. Master cylinder from the booster.
    - Refer to BRAKES (SEC. 5).
15. Radiator from the vehicle.

Install or Connect (Figures 45, 46, and 47)

1. Radiator into the vehicle.

Tighten

- Fasteners to the "Specifications," at the end of this section.

2. Master cylinder to the booster.
    - Refer to BRAKES (SEC. 5).
3. Raise the vehicle.
4. Lower radiator hose to the radiator.
5. Lower the vehicle.
6. Engine oil cooler lines to the radiator.
7. Overflow hose to the radiator.
8. Low coolant sensor.
9. Transmission oil cooler lines to the radiator.
10. Upper radiator hose to the radiator.
11. Upper fan shroud.
    - Refer to "Fan Shroud," in this section.
12. Hood release cable.
13. Windshield washer bottle.
14. Air intake snorkel.
15. Battery negative cable.
16. Fill the cooling system.
    - Refer to the vehicle Owner's Manual.

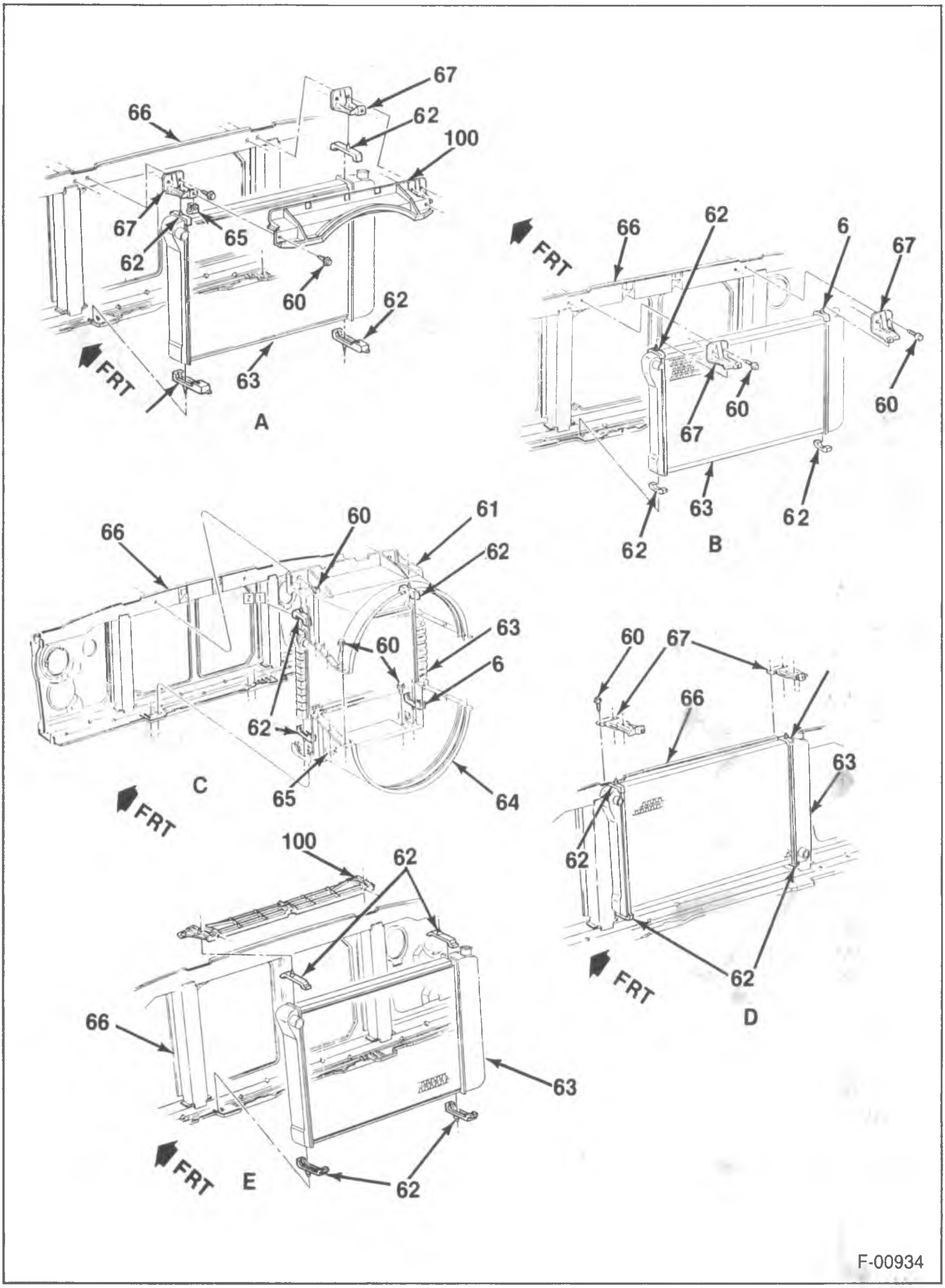


Figure 45—C-K, G, P(42) Series Vehicle Radiator Attachment

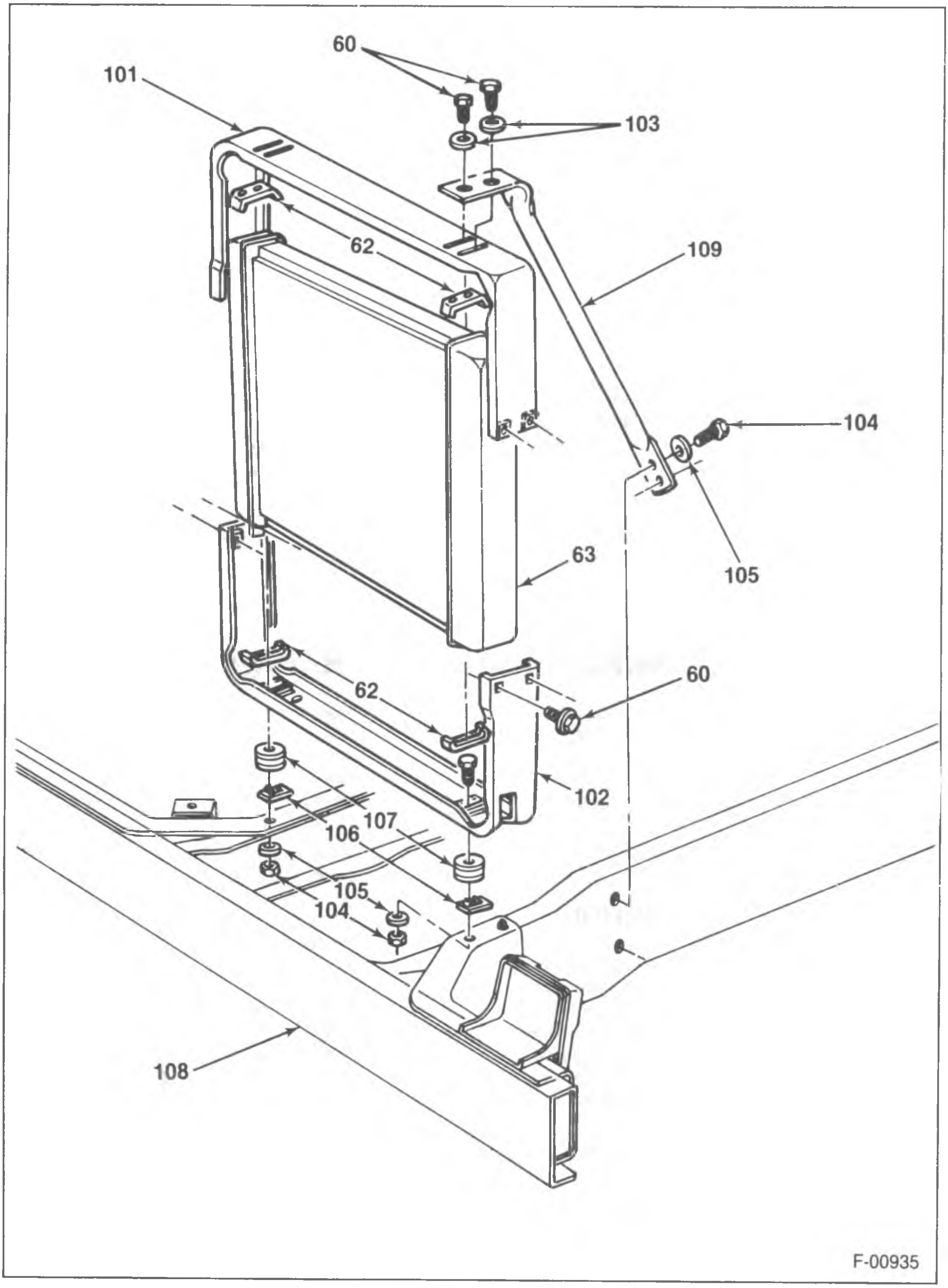


Figure 46—P(32) Series Vehicle Radiator Attachments

A. Radiator Mounting For C-K Series With 4.8L L6 (Exc. C60), P(42) Series With 4.8L L6 And 5.7L V8
B. Radiator Mounting For C-K Series With 4.8L L6 With C60
C. Radiator Mounting For C-K And G Series With 4.3L V6
D. Radiator Mounting For C-K Series With 5.0L, 5.7L; G Series (Exc. 4.3L V6); P(42) Series With 5.7L V8
E. Radiator Mounting For C-K Series With 7.4L V8, 6.2L Diesel; P(42) Series With 7.4L V8, 6.2L Diesel
60. Bolt
61. Upper Fan Shroud
62. Insulator
63. Radiator
64. Lower Fan Shroud
65. Clip Nut
66. Radiator Support
67. Radiator Mounting Bracket
68. Clip
69. Complete Fan Shroud
100. Radiator Mounting Panel
101. Radiator Upper Mounting Panel
102. Radiator Lower Mounting Panel
103. Washer
104. Nut
105. Washer
106. Nut
107. Insulator
108. Extension Assembly
109. Radiator Support Brace

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Figure 47—Radiator Attachment Legend

ALUMINUM RADIATOR REPAIR

17. Remove the radiator pressure cap, start the engine and let it run until the upper radiator hose (12) becomes hot — thermostat is open.
18. Add coolant, with the engine running at idle speed, until the coolant level reaches the bottom of the filler neck.
19. Install the radiator pressure cap, making sure the arrows line up with the overflow tube.

GENERAL DESCRIPTION

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 transmission oil cooler is located in one of the side tanks. The oil coolers 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 attached to the sides of the core. 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 (figure 48). The gasket must be replaced any time a tank is removed from the core.

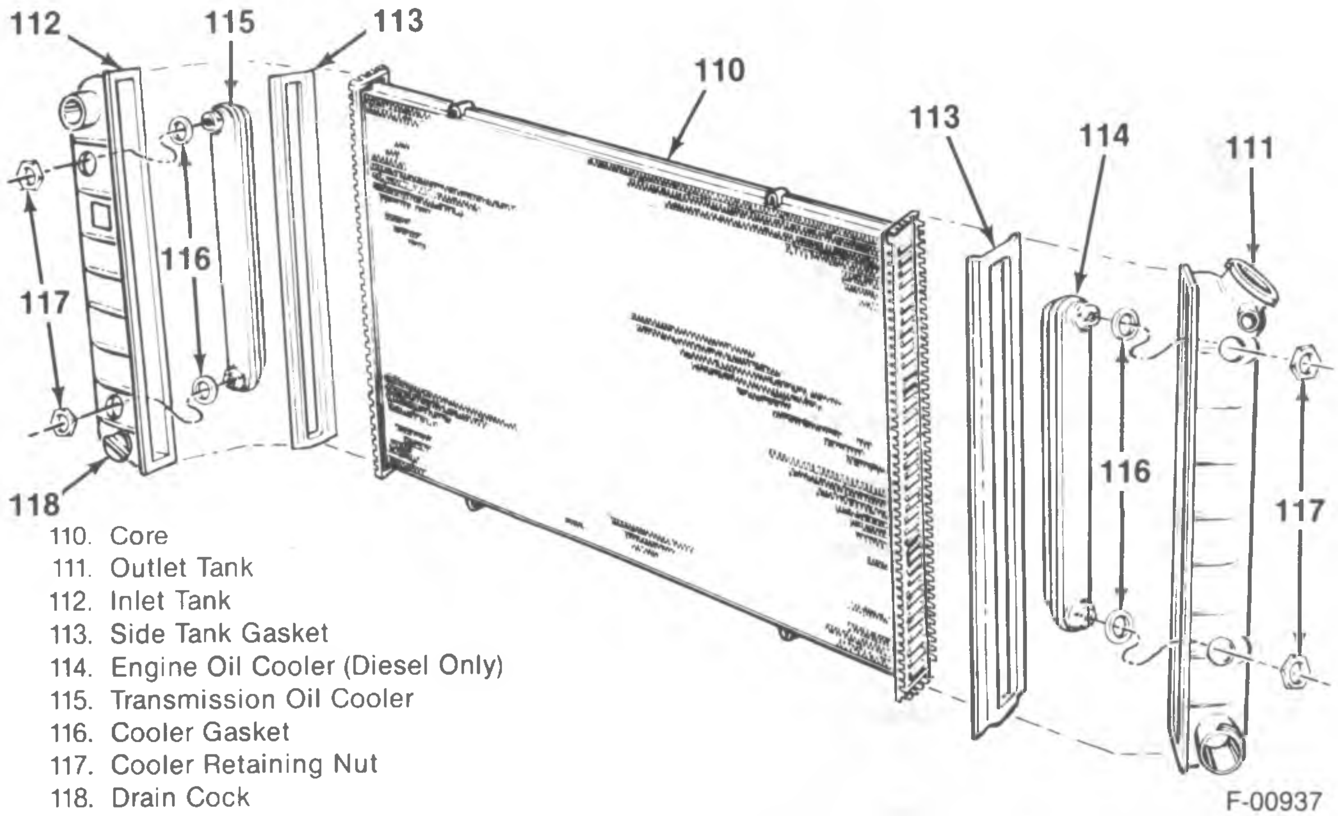
TRANSMISSION OIL COOLER

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.

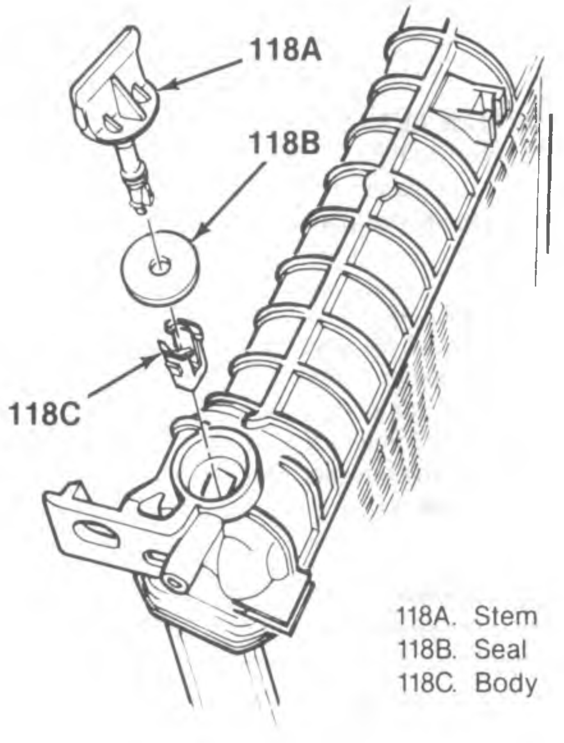
DRAIN COCK

The aluminum/plastic radiator utilizes a two piece plastic drain cock and a rubber seal. The drain cock is serviceable (figure 49).



110. Core
111. Outlet Tank
112. Inlet Tank
113. Side Tank Gasket
114. Engine Oil Cooler (Diesel Only)
115. Transmission Oil Cooler
116. Cooler Gasket
117. Cooler Retaining Nut
118. Drain Cock

Figure 48—Aluminum Radiator Assembly



118A. Stem
118B. Seal
118C. Body

Figure 49—Aluminum Radiator Drain Cock

ALUMINUM 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 50). With the system at a cool temperature, remove the radiator cap, connect the gage, and apply normal system operating pressure. Do not exceed 138 kPa (20 psi). 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 the radiator cap to ensure that it will maintain the correct pressure.

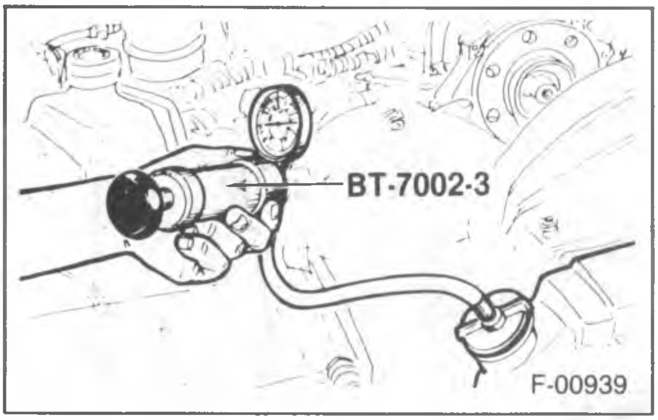


Figure 50—Pressure Testing The Radiator

If the radiator is found to be leaking during the pressure test, mark the leak area so that it is easily found once the radiator has been removed from the vehicle.

Off-Vehicle Leak Testing

NOTICE: Do not use boil-out tanks or vats or other tanks that have been used for copper and brass radiators. The flux, acid, and caustic cleaners remaining in these tanks will attack the aluminum and cause radiator failure. A separate test tank containing clean water is strongly recommended for servicing aluminum/plastic radiators.

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 51).
2. Attach the pressure tester and gradually apply air pressure until 138 kPa (20 psi) is attained. Do not exceed 138 kPa (20 psi). Check the 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).

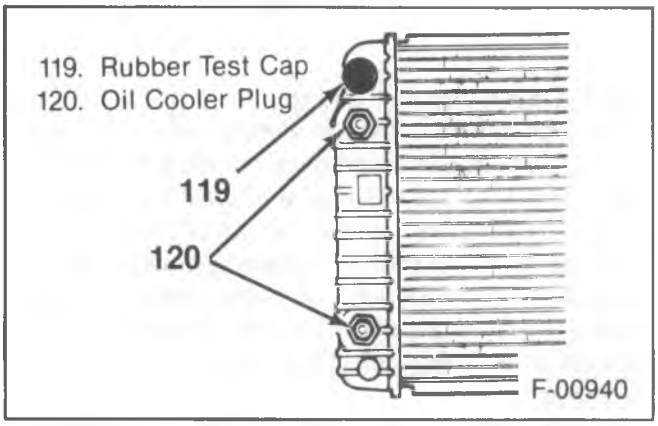
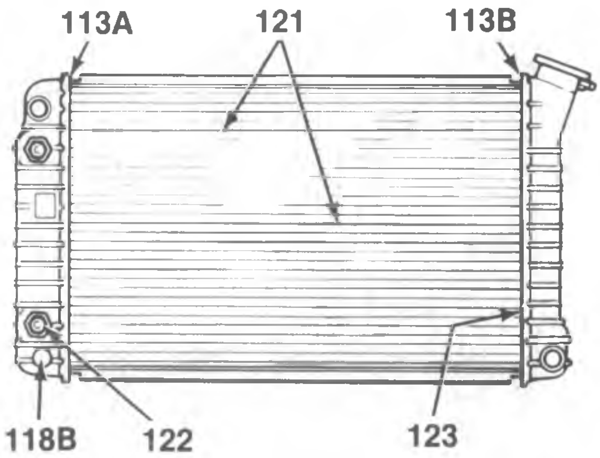

119. Rubber Test Cap
120. Oil Cooler Plug

Figure 51—Aluminum Radiator And Oil Cooler Plugs



113A. Inlet Tank Gasket
121. Core Tubes
113B. Outlet Tank Gasket
118B. Drain Cock Gasket
122. Oil Cooler Gaskets
123. Joint Between Tube And Header

Figure 52—Possible Leak Areas

If a large water tank is available, the radiator can be submerged, and a check for air bubbles can be made.

REPAIRABLE LEAKS

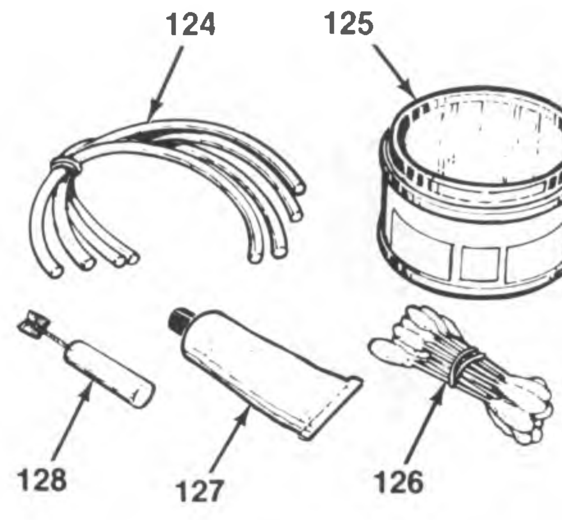
There are two types of leaks that can be repaired on the aluminum-plastic radiator: core leaks and gasket leaks. Leaks in the plastic tanks cannot be repaired (figure 52).

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 vehicle; however, it is usually best to remove the radiator.

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, a wire brush and the 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 53).



124. Adhesive Sticks
125. Kit Container
126. Cotton Swabs
127. Primer
128. Wire Brush

F-00942

Figure 53—Hot Melt Adhesive Repair Kit

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. USE CLEAN WATER ONLY WHEN SERVICING 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 the radiator feels warm.
- Do not remove the radiator cap or coolant recovery tank cap if the coolant in the recovery tank looks like it is boiling.
- Wear eye protection.
- Wear gloves to protect your hands against excessive heat or the effects of chemicals on your skin.
- Prevent dirt and water from entering the transmission oil cooler.
- Do not use boil-out tanks or vats or other tanks that have been used for copper and brass radiators. The flux, acid, and caustic cleaners remaining in these tanks will attack the aluminum and cause radiator failure. A separate test tank containing clean water is strongly recommended for servicing aluminum/plastic radiators.

NOTICE: Never use shop air to pressure test radiators that is not regulated at 138 kPa (20 psi). Pressures over 138 kPa (20 psi) will damage the radiator.

SPECIAL PREPARATION

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 6 mm (1/4-inch) beyond the leak or damage area is enough to make an effective repair (figure 54).

TUBE BLOCKING

If a tube is severely damaged, it can be blocked off (figure 55).

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 6 mm (1/4-inch) from the header and pinched shut before it is cleaned and sealed. Refer to "General Core Sealing."

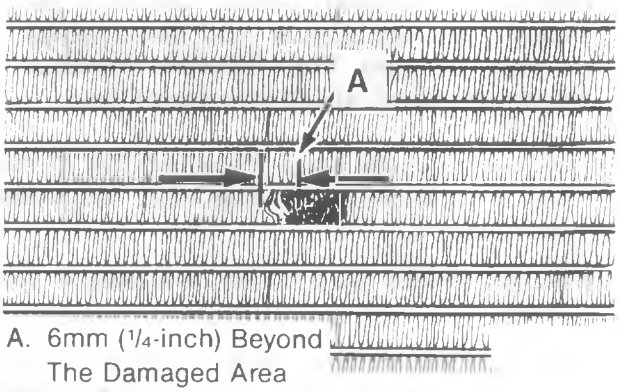


Figure 54—Removing Fins From Damaged Area

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 56). The side tank can also be submerged in a tank of water up to the header (figure 57).

NOTICE: ***One of these procedures have to be used when repairs are made on or near the header to prevent damage to the tank or gasket.***

GENERAL CORE REPAIR

Preparation of the surface in the repair area cannot be overemphasized. If the leak area surface is not clean, none of the repair materials will stick to the surface.

1. Position the core so the repair area is accessible.

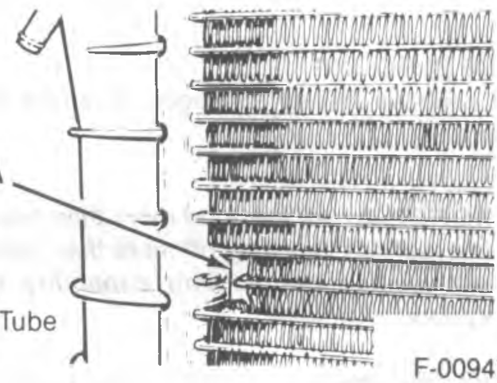


Figure 55—Tube Blocking

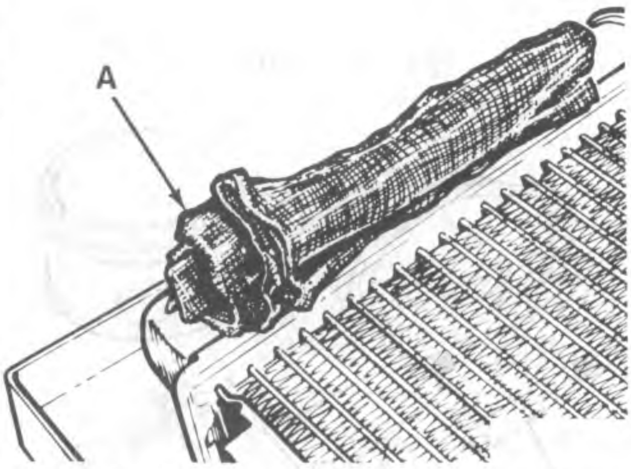


Figure 56—Using A Wet Cloth To Cool The Side Tank

2. Apply a wet cloth if you are working near the plastic tanks or the joints between the core tubes and header (figure 56); or submerge the tank in water (figure 57).

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 the repair area (figure 58).

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.**

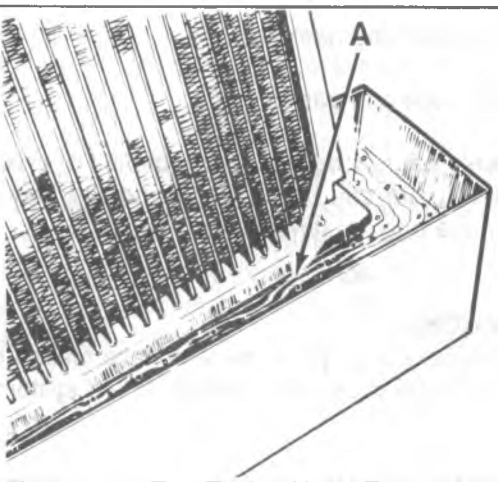


Figure 57—Submerging The Side Tank

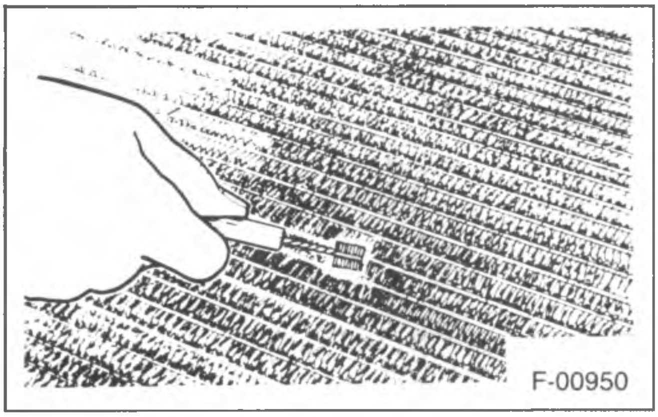


Figure 58—Cleaning The Repair Area With A Steel Brush

CAUTION: The primer contains trichlorethane.
- **It could be harful 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 59).
7. Heat the repair area with a heat gun or by moving the torch in a circular pattern (figure 60). Use a soft, small blue flame (like a gas stove flame).
8. Withdraw the torch and rub the adhesive stick on the repair area (figure 61). The adhesive will flow at a temperature of approximately 260°C (500°F). If the stick doesn't start to melt, remove it and reapply the heat. **Do not heat the stick directly with a flame. High heat will burn and char the adhesive.**
9. Continue heating until the adhesive flows and wets the entire repair area and fills the joint. If a hole is in the center of a tube, heat the tube and let the hot surface melt and pull in the adhesive. The force of the flame or heat gun will also tend to guide the adhesive toward the hole. For leaks between a tube and header, flow the adhesive completely around the tube and header joint with the tank installed.
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.

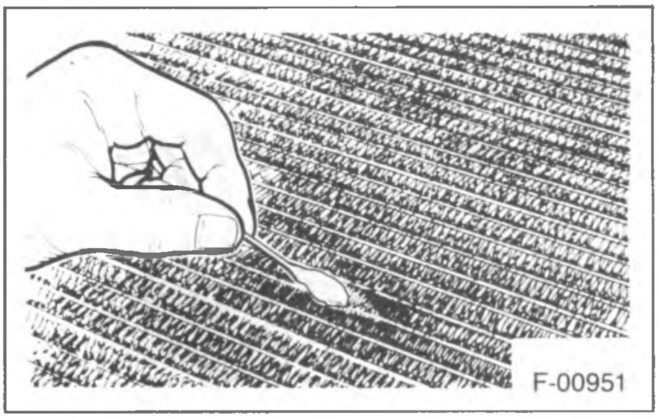


Figure 59—Scrubbing The Area With A Cotton Swab

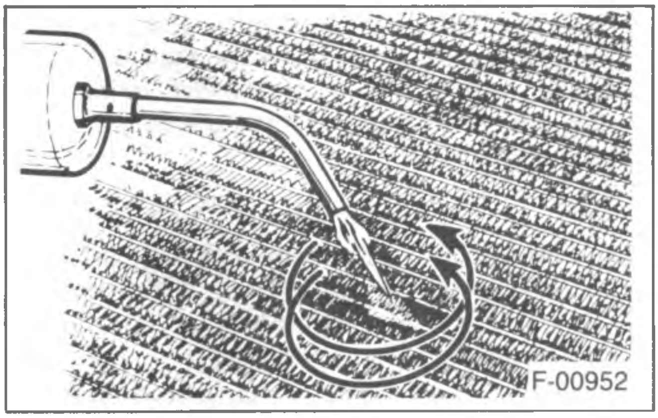


Figure 60—Heating The Repair Area

TANK GASKET LEAK REPAIR

Tank gasket leaks can easily be mistaken for tank or header leaks. If a plactic tank leaks from the header joint gasket, tighten the clinch tabs with locking-type pliers (figure 62). If this method doesn't seal the leak, remove the tank for further inspection.

1. Pry open the clinch tabs, except those under the inlet, outlet, and filler necks, using J-33419-1 or a screwdriver (figure 63). Lift the tabs only enough to allow removal.

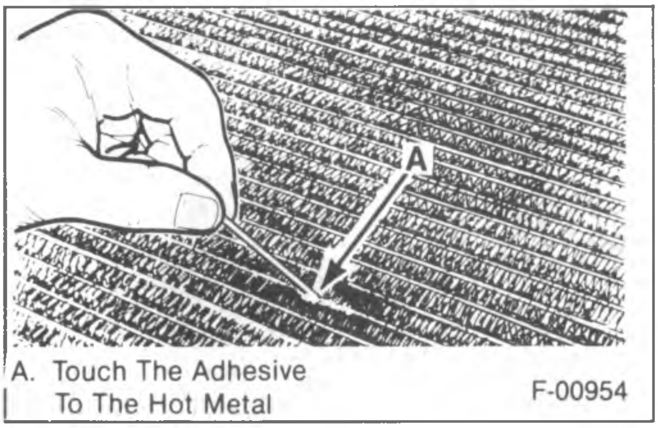


Figure 61—Apply Hot Melt Adhesive To The Repair Area

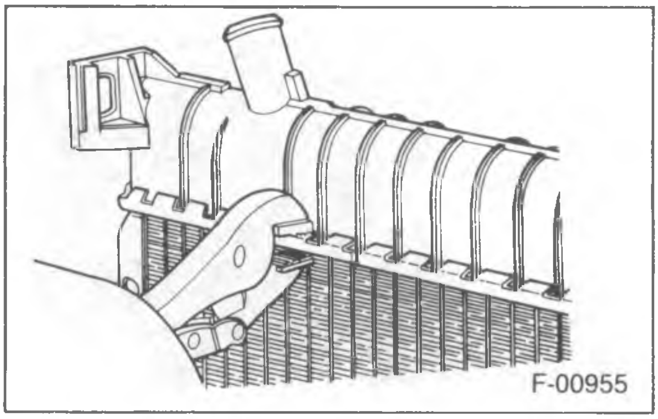


Figure 62—Tightening The Clinch Tabs

NOTICE: Care should be taken not to overbend the tabs. Overbending could result in breakage. If there are more than 3 tabs broken on one side of the header, or more than 2 adjacent tabs together, the core must be replaced.

2. Lift the tank and slide it out from under the remaining clinched tab. You may have to tap the tank with your hand to dislodge the gasket. Lift the remaining tab(s) with pliers.
3. Remove and discard the gasket.
4. Clean the header and gasket groove of all dirt and old rubber.
5. Clean the sealing edge of the plastic tank.
6. Examine the header gasket surface and tank flange for evidence of leakage, and clean or repair the surface to remove dirt, burrs, and bumps.
7. Remove the oil cooler, if equipped, and install it in the new tank, if used.
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 64.

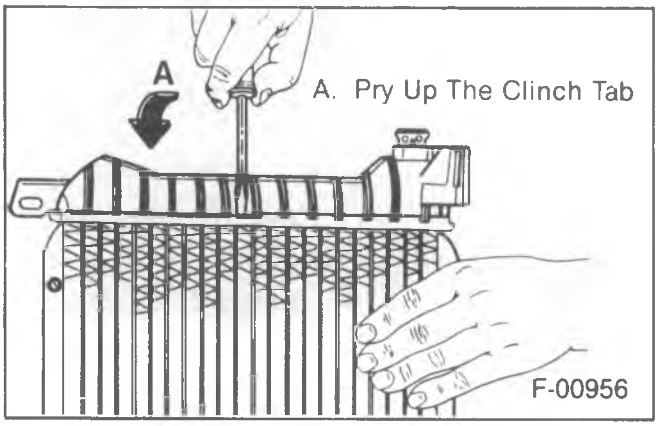


Figure 63—Opening The Clinch Tabs

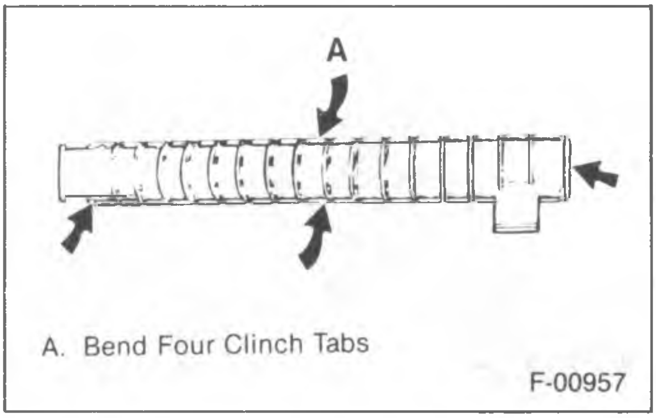


Figure 64—Sealing The Tank To The Radiator Core

10. Clamp remaining clinch tabs around the header using the clinching tool or pliers (figure 65).

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 66).
4. Flow-dry all surfaces on the tank and oil cooler.
5. Install a new gasket **without lubrication**. Be sure it is seated properly inside the tip of the fitting.
6. Reach into the oil cooler and push it into position against the tank.
7. Assemble the oil cooler nut loosely.

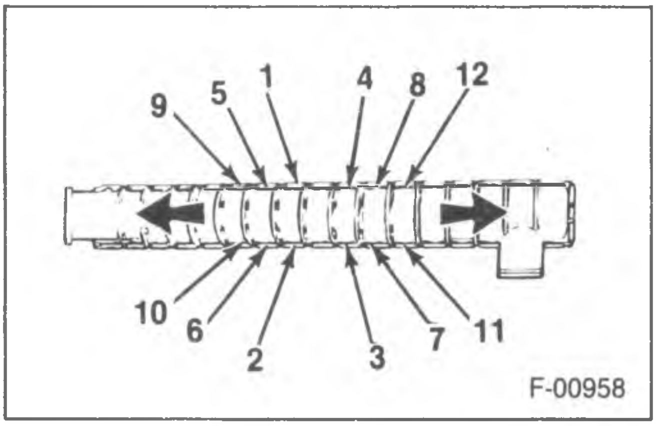


Figure 65—Clinching Sequence

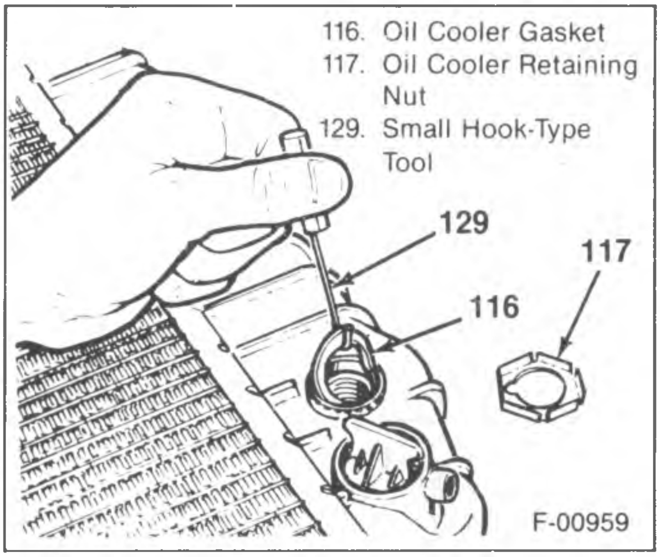


Figure 66—Removing The Oil Cooler Gasket

8. Replace the other gasket by following the same procedure.
9. Install the oil cooler nuts and torque to 20 N·m (15 ft. lbs.). 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 the oil cooler and gaskets from the tank.
4. Remove the old rubber gaskets, throw away, then clean and dry seal areas.
5. Place rubber gaskets on a new oil cooler and place onto the outlet tank fitting holes. Be careful not to loosen or misalign the gaskets. Gaskets must be installed dry and be free of dirt and oil.
6. Install and tighten nuts snugly onto the fittings.
7. Torque nuts to 20 N·m (15 ft. lbs.). Overtorquing could cut the rubber gaskets.
8. Replace the tank as previously described.
9. Test the 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, along with the new core and new gaskets.

SPECIFICATIONS

DRIVE BELT TENSION SPECIFICATIONS

Engine	Tension Requirement	Generator	Power Steering Pump	Air Conditioning Compressor	A.I.R. Pump
4.8L L6	Before Operating The Engine (New Belt)	750 N (169 lb.)	750 N (169 lb.)	750 N (169 lb.)	750 N (169 lb.)
	After Operating The Engine (Old Belt)	400 N (90 lb.)	400 N (90 lb.)	400 N (90 lb.)	400 N (90 lb.)
4.3L V6	Before Operating The Engine (New Belt)	600 (135 lb.)	650 N (146 lb.)	750 N (169 lb.)	650 N (146 lb.)
	After Operating The Engine (Old Belt)	400 N (90 lb.)	300 N (67 lb.)	400 N (90 lb.)	300 N (67 lb.)
5.0L V8	Before Operating The Engine (New Belt)	600 N (135 lb.)	650N (146 lb.)	750 N (169 lb.)	650 N (146 lb.)
	After Operating The Engine (Old Belt)	400 N (90 lb.)	300 N (67 lb.)	400 N (90 lb.)	300 N (67 lb.)
5.7L V8	Before Operating The Engine (New Belt)	600 N (135 lb.)	650 N (146 lb.)	750 N (169 lb.)	650 N (146 lb.)
	After Operating The Engine (Old Belt)	400 N (90 lb.)	300 N (67 lb.)	400 N (90 lb.)	300 N (67 lb.)
7.4L V8	Before Operating The Engine (New Belt)	600 N (135 lb.)	650 N (146 lb.)	650 N (146 lb.)	*650 N (146 lb.)
	After Operating The Engine (Old Belt)	400 N (90 lb.)	400 N (90 lb.)	400 N (90 lb.)	*400 N (90 lb.)
6.2L V8 (Diesel)	Before Operating The Engine (New Belt)	650 N (146 lb.)	650 N (146 lb.)	750 N (169 lb.)	—
	After Operating The Engine (Old Belt)	300 N (67 lb.)	300 N (67 lb.)	400 N (90 lb.)	—

* When equipped with a right hand mounted pump and/or Federal Emissions (NAS) ONLY.

DO NOT exceed the "New Belt" tension specification when tensioning any belt, especially a used belt.

RADIATOR MOUNTING TORQUE SPECIFICATIONS

Fastener Name	4.8L L6	4.3L V6	5.0L V8	5.7L V8	6.2L V8	7.4L V8
Complete Fan Shroud To The Radiator Support	6 N·m (4 ft. lbs.)	—	16 N·m (12 ft. lbs.)	16 N·m (12 ft. lbs.)	9 N·m (7 ft. lbs.)	6 N·m (4 ft. lbs.)
Upper Fan Shroud To The Radiator Support	*6 N·m (4 ft. lbs.)	27 N·m (20 ft. lbs.)	—	*16 N·m (12 ft. lbs.)	*6 N·m (4 ft. lbs.)	**10 N·m (8 ft. lbs.)
Lower Fan Shroud To The Radiator Support	—	6 N·m (4 ft. lbs.)	—	—	—	—
Upper Fan Shroud To The Lower Fan Shroud	—	6 N·m (4 ft. lbs.)	—	—	*6 N·m (4 ft. lbs.)	—
Radiator Mounting Panel To The Bracket	17 N·m (13 ft. lbs.)	—	—	—	—	—
Radiator Mounting Panel To The Radiator Support	—	—	—	—	17 N·m (13 ft. lbs.)	17 N·m (13 ft. lbs.)
Upper Mounting Panel To The Lower Mounting Panel	—	—	—	—	17 N·m (13 ft. lbs.)	17 N·m (13 ft. lbs.)
Lower Mounting Panel To The Frame	—	—	—	—	25 N·m (18 ft. lbs.)	25 N·m (18 ft. lbs.)
Radiator Bracket To The Support	—	—	17 N·m (13 ft. lbs.)	17 N·m (13 ft. lbs.)	—	—
Support Brace To The Upper Mounting Panel	—	—	—	—	17 N·m (13 ft. lbs.)	17 N·m (13 ft. lbs.)

* For G Series Vehicles ONLY

** For P Series Vehicles ONLY

SPECIFICATIONS (CONT.)

ACCESSORY DRIVE COMPONENT TORQUE SPECIFICATIONS

Fastener Name	**4.8L L6**	**4.3L V6**	**5.0L V8**	**5.7L V8**	**6.2L V8**	**7.4L V8**
Generator Adjustment Bolt	25 N·m (18 ft. lbs.)	25 N·m (18 ft. lbs.)	25 N·m (18 ft. lbs.)	25 N·m (18 ft. lbs.)	27 N·m (20 ft. lbs.)	*25 N·m (18 ft. lbs.)
Generator Pivot Bolt	23 N·m (17 ft. lbs.)	47 N·m (35 ft. lbs.)	47 N·m (35 ft. lbs.)	47 N·m (35 ft. lbs.)	43 N·m (32 ft. lbs.)	50 N·m (37 ft. lbs.)
Power Steering Pump Adjustment Bolt	43 N·m (32 ft. lbs.)	33 N·m (24 ft. lbs.)	33 N·m (24 ft. lbs.)	33 N·m (24 ft. lbs.)	43 N·m (32 ft. lbs.)	88 N·m (65 ft. lbs.)
Power Steering Pump Pivot Bolt	24 N·m (17 ft. lbs.)	33 N·m (24 ft. lbs.)	33 N·m (24 ft. lbs.)	33 N·m (24 ft. lbs.)	43 N·m (32 ft. lbs.)	50 N·m (37 ft. lbs.)
Air Conditioning Condenser Adjustment Bolt	34 N·m (25 ft. lbs.)	34 N·m (25 ft. lbs.)	34 N·m (25 ft. lbs.)	34 N·m (25 ft. lbs.)	34 N·m (25 ft. lbs.)	34 N·m (25 ft. lbs.)
Air Conditioning Condenser Pivot Bolt	34 N·m (25 ft. lbs.)	34 N·m (25 ft. lbs.)	34 N·m (25 ft. lbs.)	34 N·m (25 ft. lbs.)	34 N·m (25 ft. lbs.)	34 N·m (25 ft. lbs.)
Air Injection Reactor (A.I.R.) Pump Adjustment Bolt	25 N·m (18 ft. lbs.)	25 N·m (18 ft. lbs.)	25 N·m (18 ft. lbs.)	**25 N·m (18 ft. lbs.)	—	33 N·m (24 ft. lbs.)
Air Injection Reactor (A.I.R.) Pump Pivot Bolt	24 N·m (17 ft. lbs.)	24 N·m (17 ft. lbs.)	24 N·m (17 ft. lbs.)	**24 N·m (17 ft. lbs.)	—	33 N·m (24 ft. lbs.)

* For P series vehicles, torque is 64 N·m (47 ft. lbs.) with the K97 Generator.

** For the 5.7L V8 with Federal Emissions (RPO NA5), torque is 50 N·m (37 ft. lbs.)

THERMOSTAT AND RESERVOIR RELATED TORQUE SPECIFICATIONS

Fastener Name	**C-K 10/1500**	**C-K 20/2500**	**C-K 30/3500**	**G 10/1500**	**G 20/2500**	**G 30/3500**	**P 20/2500**	**P 30/3500**
Coolant Recovery Tank Bolt/Screw	2 N·m (18 in. lbs.)	2 N·m (18 in. lbs.)	2 N·m (18 in. lbs.)	2 N·m (18 in. lbs.)	2 N·m (18 in. lbs.)	2 N·m (18 in. lbs.)	— —	— —
Deaeration Tank Bolts/ Screws And Nuts	5 N·m (44 in. lbs.)	5 N·m (44 in. lbs.)	5 N·m (44 in. lbs.)	—	—	10 N·m (88 in. lbs.)	—	17 N·m (12 ft. lbs.)
Water Outlet To The Thermostat Housing Bolts	*•27 N·m (20 ft. lbs.)	*•27 N·m (20 ft. lbs.)	*•27 N·m (20 ft. lbs.)	*•27 N·m (20 ft. lbs.)	*•27 N·m (20 ft. lbs.)	*•27 N·m (20 ft. lbs.)	*•27 N·m (20 ft. lbs.)	*•27 N·m (20 ft. lbs.)
Thermostat Crossover To The Engine Bolts (6.2L Diesel ONLY)	47 N·m (35 ft. lbs.)	47 N·m (35 ft. lbs.)	47 N·m (35 ft. lbs.)	47 N·m (35 ft. lbs.)	47 N·m (35 ft. lbs.)	47 N·m (35 ft. lbs.)	47 N·m (35 ft. lbs.)	47 N·m (35 ft. lbs.)
Water Outlet To The Thermostat Housing Bolts (6.2L Diesel ONLY)	47 N·m (35 ft. lbs.)	47 N·m (35 ft. lbs.)	47 N·m (35 ft. lbs.)	47 N·m (35 ft. lbs.)	47 N·m (35 ft. lbs.)	47 N·m (35 ft. lbs.)	47 N·m (35 ft. lbs.)	47 N·m (35 ft. lbs.)

* On vehicles with a 6.2L Diesel, torque to 47 N·m (35 ft. lbs.)

• On vehicles with a 7.4L V8, torque to 41 N·m (30 ft. lbs.)

SECTION 6C

FUEL SYSTEM

CONTENTS

SUBJECT **PAGE**

All new GM 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, cap, 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.

AIR CLEANER

CAUTION: The air cleaner also functions as a flame arrestor in the event of engine backfire. The air cleaner should be installed at all times unless its removal is necessary for repair or maintenance. To help reduce the risk of personal injury and property damage, be sure that no one is near the engine compartment before starting the engine with the air cleaner removed. If engine backfire occurs with the air cleaner removed, there could be a burst of flame and possibly other fire in the engine compartment.

On vehicles with diesel engines, do not use starting fluids—immediate engine damage can result. Also take care not to let objects fall into the engine if the air cleaner is removed. If the engine is running, suction can pull loose objects into the engine. Objects pulled or dropped into the engine can cause costly engine damage.

When replacement of the air cleaner filter element is necessary, an AC air filter element is recommended.

Refer to "MAINTENANCE AND LUBRICATION" (SEC. 0B) for change intervals. Operation of the vehicle in dusty areas will necessitate more frequent replacement.

AIR FILTER ELEMENT REPLACEMENT

NOTICE: Extreme care should be taken when removing the filter element. Remove the filter element slowly to prevent dirt from falling into the engine.

Remove or Disconnect

1. Wing nut.
2. Air cleaner cover from the base.
3. Air filter element.
4. All accumulated dirt from the base.

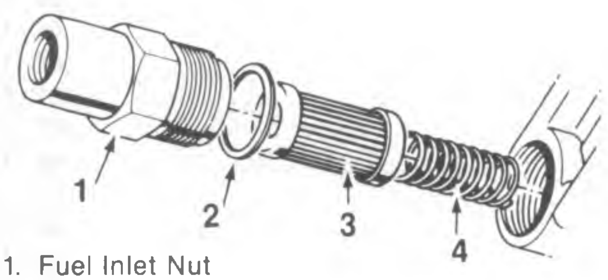
Inspect

- Filter element for damage or excessive dirt accumulation. Replace as necessary.
- Seals or gaskets for damage.

Install or Connect

1. Air filter element.
2. Air cleaner cover.
3. Wing nut.

GASOLINE ENGINE FUEL FILTERS



1. Fuel Inlet Nut
2. Gasket
3. Filter With Check Valve
4. Spring

Figure 1—Carburetor Fuel Filter

The fuel filter element should be replaced at the intervals shown in MAINTENANCE AND LUBRICATION (SEC. 0B). Fuel filter elements are of the throw away type and should be replaced, not cleaned.

Internal fuel filters are located in the inlet fitting of the carburetor (Figure 1). The filter element (3) is placed in the inlet hole with the gasket (2) surface outward. A spring (4) pushes out against the element and compresses the gasket (2) against the fuel inlet nut (1). A check valve is also built into the filter element.

FUEL FILTER REPLACEMENT

Remove or Disconnect

1. Fuel line connection at the fuel inlet nut (1).
2. Fuel inlet nut (1).
3. Filter element (3), gasket (2), and spring (4).

Install or Connect (Figure 1)

1. Spring (4).
2. Filter element (3).
    - The inlet check valve must be installed in the filter element to meet Motor Vehicle Safety Standards (M.V.S.S.) for roll-over.

- The new filter element must include the check valve.
- The check valve end of the filter element must face toward the fuel line.

3. Fuel inlet nut (1).

Tighten

- Fuel inlet nut to 24 N·m (18 ft. lbs.).

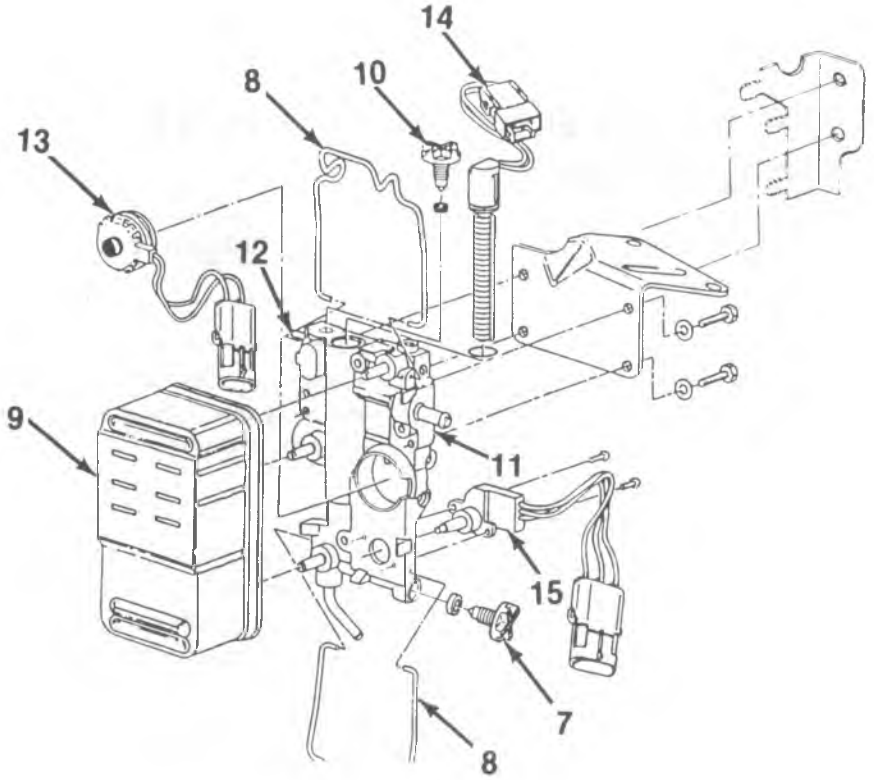
4. Fuel line.

- Start the engine and check for leaks.

DIAGNOSIS OF "WATER IN FUEL" LIGHT (DIESEL ENGINE ONLY)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Intermittent Light	• Water in fuel filter.	• Drain water from the fuel filter.
Light Stays On With Engine Running (Temperature Above Freezing)	• Fuel filter is clogged or contains water.	• Drain the fuel filter. If no water is drained and the light stays on, replace the filter element.
Light Stays On With Engine Running (Temperature Below Freezing)	• Fuel filter is clogged with ice.	• Drain the fuel filter. If no water is drained, open the air bleed and check for fuel pressure. Replace the filter element if there is no pressure.
Light Comes On At High Speed Or During Heavy Acceleration	• Plugged fuel filter.	• Replace the filter element.
Light Stays On Continuously And Engine Stalls And Will Not Restart (After Initial Start-Up).	• Fuel filter or lines plugged.	• Replace the filter element or check the lines.
Light Stays On Continuously And Engine Stalls And Will Not Restart (After Refueling).	• Large amounts of water pumped into the tank.	• Purge the fuel tank.

DIESEL ENGINE FUEL FILTERS



7. Water Drain Valve
8. Bail Wires
9. Fuel Filter Element
10. Air Bleed
11. Filter Adapter
12. Air Bleed Port
13. Restriction Switch
14. Fuel Heater
15. Water Sensor

F-00796

Figure 2—Diesel Fuel Filter

The diesel engine fuel filter is an inline type filter which combines several different functions. It acts as a filter, water separator, water detector, water drain, and a fuel heater (Figure 2).

The first stage of the filter element is a water coalesor. The coalesor element combines small droplets of water into larger drops. The water collects in the bottom of the filter element for draining. The fuel then passes through the second stage of the filter element which is a paper filter.

The filter acts as a water detector by turning on the "WATER IN FUEL" light on the instrument panel. The probe of the water detector will touch water when 65 ml. (2.2 fluid ounces) of water has collected in the filter. This completes a circuit through the water to the cover assembly which turns on the "WATER IN FUEL" light.

NOTICE: If the "WATER IN FUEL" light comes on and the fuel system is not purged of water, fuel injection system damage may result.

When the light comes on, the filter should be drained as soon as practical, but within one to two hours of engine operation.

A water drain is located in the bottom of the fuel filter assembly. By opening the water drain valve, water that has collected in the bottom of the filter element can be drained.

A fuel heater is located in the fuel filter assembly to help prevent fuel waxing. The heater thermostat turns the heater on at about 0°C (32°F) and off at about 30°C (80°F). The heater uses 7 to 13 amps depending on fuel temperature.

DRAINING THE FUEL FILTER

1. Turn off the engine and apply the parking brake.
2. Remove the fuel filler cap to release any pressure or vacuum in the fuel tank.
3. Place a suitable container under the filter drain hose.

CAUTION: The water/diesel fuel mixture is flammable, and could be hot. To help avoid personal injury and/or property damage, do not touch the fuel coming from the drain hose, and do not expose the fuel to open flames or sparks.

Be sure you do not overfill the container. Heat (such as from the engine) can cause the fuel to expand. If the container is too full, fuel could be forced out of the container. This could lead to a fire and the risk of personal injury and/or vehicle damage.

4. Open the drain valve (7) two to three turns (figure 2).
5. Start the engine and allow it to idle for one to two minutes or until clear fuel is observed.
6. Stop the engine and close the drain valve (7).
7. Install the fuel filler cap.
8. Dispose of the drained mixture in a proper manner.

DIESEL FUEL FILTER REPLACEMENT

Remove or Disconnect (Figure 2)

1. Fuel filler cap to release any pressure or vacuum in the fuel tank.
2. Both bail wires (8).
    - Drain fuel from the filter by opening the air bleed (10) and the water drain valve (7).
        - — Allow the fuel to drain into a suitable container.
3. Fuel filter element (9).

Clean

- Any dirt from the fuel sealing surfaces of the filter element and the filter adapter (11).

Install or Connect (Figure 2)

1. New filter element.
2. Bail wires.
- Close the drain valve (7).

3. A 3 mm ($^{1}/_{8}$-inch) inside diameter hose to the air bleed port (12).
4. The other end of the hose into a suitable container.
- Disconnect the fuel injection pump shut-off solenoid wire.

NOTICE: If the engine is to be cranked or started with the air cleaner removed, take care not to let objects fall into the engine. If the engine is running, suction can pull loose objects into the engine. Objects pulled or dropped into the engine can cause costly engine damage.

- Crank the engine for 10 to 15 seconds and then wait one minute for the starter motor to cool. Repeat until clear fuel is observed coming from the air bleed.
- Close the air bleed.

5. Injection pump solenoid wire.
6. Fuel filler cap.
- Start the engine and allow it to idle for five minutes.
- Check the fuel filter for leaks.

DIESEL FUEL FILTER ASSEMBLY COMPONENT REPLACEMENT

All component parts of the fuel filter assembly are serviceable. These components include the filter adapter, restriction switch, fuel heater, and the water sensor (figure 2).

Always replace any damaged or worn O-rings, gaskets, or seals. After replacing components, bleed air from the filter to save cranking time. Start the engine and check for leaks after replacing components.

FUEL PUMP

All engines use a mechanical fuel pump located on the front right side of the engine. The pump is a diaphragm type pump and is actuated by a rocker arm through a link and pull rod.

Some engines have a special fuel pump that has a metering outlet for a vapor return system. Any vapor that forms is returned to the fuel tank along with hot fuel. This reduces the chance of vapor lock because cool fuel from the tank is always circulated through the fuel pump.

The fuel pump rocker arm is moved back and forth by a rod which rides on an eccentric on the engine camshaft. The rocker arm pulls down on the pump diaphragm against spring pressure. This causes a vacuum in the pump chamber which draws fuel from the tank through the inlet valve. The camshaft rotates and releases pressure on the rocker arm. This allows the spring to act on the diaphragm and force fuel out of the pump chamber through the outlet valve and into the fuel line to the carburetor.

When the carburetor float rises and closes the needle valve, fuel cannot leave the pump chamber. The spring is held compressed by the fuel pressure in the pump chamber. The rocker arm idles on the cam eccentric and only moves enough to maintain pressure on the spring. A constant pressure is maintained on the fuel in the line to the carburetor. This pressure is proportional to the force of the spring.

FUEL PUMP TESTS (GASOLINE ENGINE)

If the fuel system is suspected of not delivering enough fuel, it should be inspected as follows.

Inspect

- Make certain that there is fuel in the tank.
- For leaks at all fuel connections from the fuel tank to the carburetor.
  - The engine should be running.
  - Tighten any loose connections.
- All hoses for flattening or kinks that would restrict the flow of fuel.
- Air leaks or restrictions on the suction side of the fuel pump will seriously affect pump output.

FUEL PUMP FLOW TEST

1. Remove the fuel supply line from the carburetor and insert it into a suitable container.
2. Crank the engine.
3. The fuel pump should supply 237 ml (1/2-pint) or more in 15 seconds.
4. If the flow is insufficient, check for a restriction.
5. If there are no restrictions, check fuel pump vacuum and/or pressure.

FUEL PUMP PRESSURE TEST

1. Disconnect the fuel inlet line at the carburetor.
2. Install a low pressure gage to the line.
3. Start the engine.
4. Fuel pump pressure should be 27.5 to 44.8 kPa (4 to 6 1/2 psi).
5. If the pressure is low, check for restrictions in the fuel tank sender unit filter, lines, and hoses.

NOTICE: Hold the carburetor fuel inlet nut while tightening the fuel line fitting to prevent carburetor damage.

6. Connect the fuel inlet line to the carburetor.

FUEL PUMP VACUUM TEST

1. Disconnect the inlet hose at the fuel pump and connect a vacuum gage.
2. Crank or run the engine until the maximum vacuum is reached.
3. If the vacuum is less than 50.6 kPa (15-inches Hg), replace the fuel pump.
4. If the vacuum is 50.6 kPa (15-inches Hg), check the fuel lines and hoses for leaks, kinks, or splits by disconnecting each section of line and connecting a vacuum gage. Crank or run the engine until the maximum vacuum is reached. The vacuum should be at least 50.6 kPa (15-inches Hg).

FUEL PUMP TESTS (DIESEL ENGINE)

If the fuel system is suspected of not delivering enough fuel, it should be inspected as follows.

Inspect

- Make certain that there is fuel in the tank.
- For leaks at all fuel connections from the fuel tank to the injection pump.
  - The engine should be running.
  - Tighten any loose connections.
- All hoses for flattening or kinks that would restrict the flow of fuel.
- Air leaks or restrictions on the suction side of the fuel pump will seriously affect pump output.

FUEL PUMP FLOW TEST

↔ Remove or Disconnect

1. Fuel line at the fuel filter inlet.
2. Fuel injection pump electric shut-off solenoid wire (pink wire).
- Place a suitable container at the end of the fuel filter inlet line.
- Crank the engine for 15 seconds.
- The fuel pump should supply 237 ml (1/2-pint) or more in 15 seconds.

FUEL PUMP PRESSURE TEST

1. Disconnect the fuel line at the inlet to the fuel filter assembly.
2. Install a low pressure gage to the line.
3. Crank or run the engine for 10 to 15 seconds.
4. Fuel pressure should be 38 to 45 kPa (5.5 to 6.5 psi).

FUEL PUMP VACUUM TEST

1. Disconnect the inlet line at the fuel pump.
    - Plug the hose or position it so fuel does not leak.
2. Connect a vacuum gage to the fuel pump inlet.
3. Start the engine.
    - The engine will use fuel from the filter assembly.
4. Vacuum should be 41 kPa (12-inches Hg) or greater.
5. Replace the pump if vacuum is less than 41 kPa (12-inches Hg).

FUEL PUMP REPLACEMENT

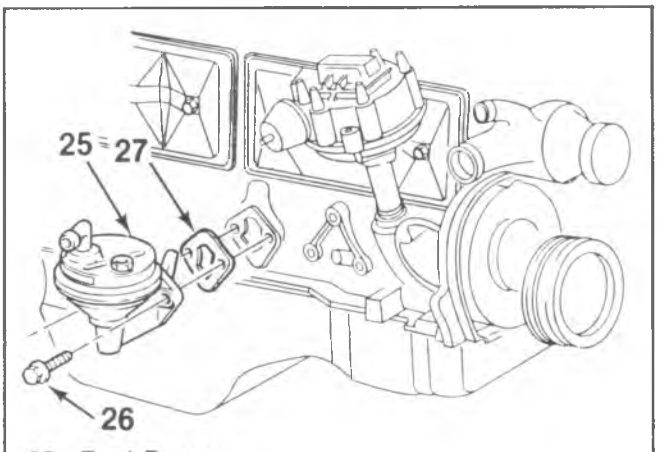
ALL ENGINES EXCEPT 7.4L

↔ Remove or Disconnect (Figures 3 through 6)

1. Fuel pipes and hoses from the fuel pump (25).
2. Bolts (26).
3. Fuel pump (25).
4. Gasket (27).
5. Bolts (28).
6. Mounting plate (29).
7. Gasket (30).
8. The push rod (31) (if necessary).

→← Install or Connect (Figures 3 through 6)

1. The push rod (if removed).
    - Apply some chassis grease to the rod to hold it up against the camshaft.
2. New gasket (30).
3. Mounting plate (29).
4. Bolts (28).



25. Fuel Pump
26. Bolt
27. Gasket

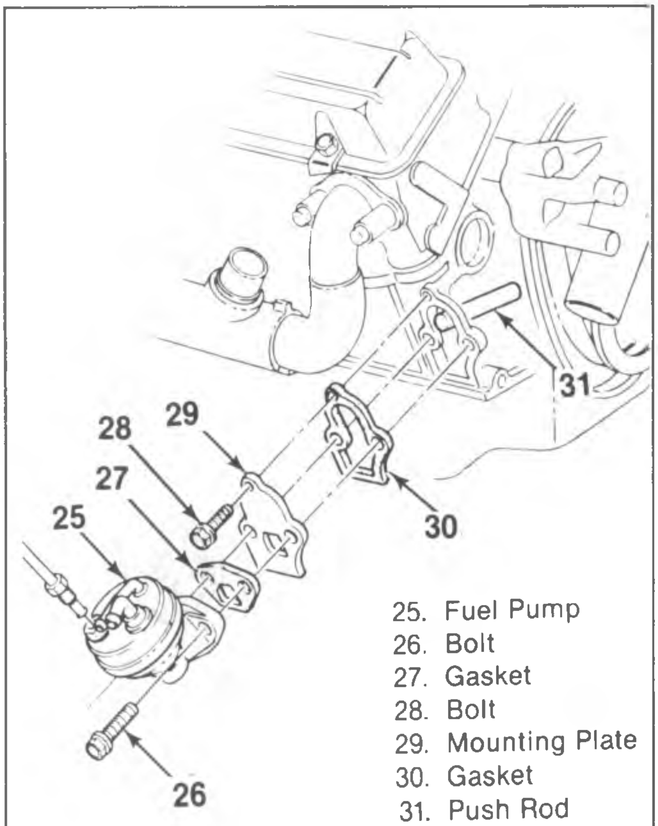
F-00797

Figure 3—Fuel Pump—4.8L Engine

Tighten

- Bolts to specification.

5. New gasket (27).
6. Fuel pump (25).
7. Bolts (26).



25. Fuel Pump
26. Bolt
27. Gasket
28. Bolt
29. Mounting Plate
30. Gasket
31. Push Rod

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Figure 4—Fuel Pump—4.3L Engine

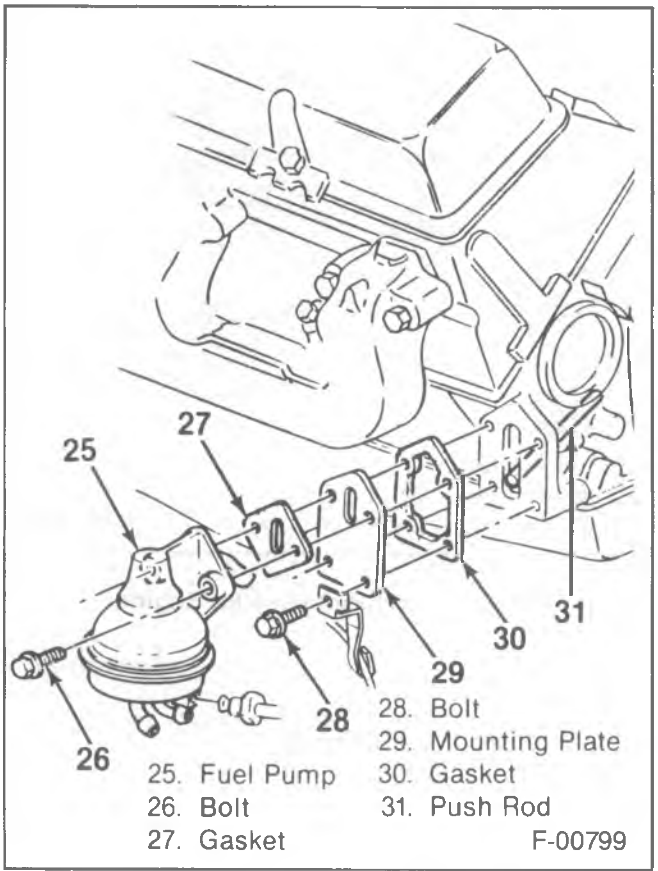


Figure 5—Fuel Pump—5.0L and 5.7L Engines

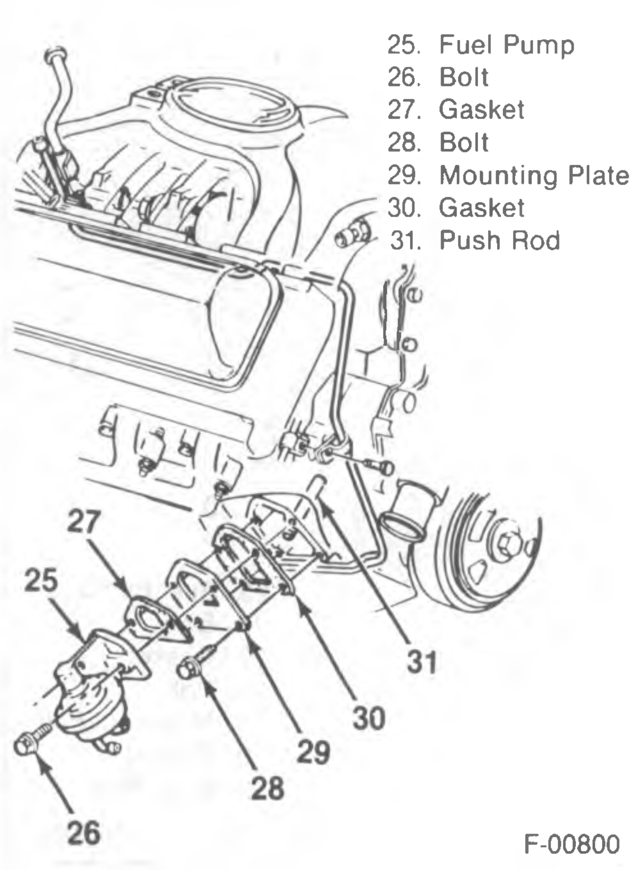


Figure 6—Fuel Pump—6.2L Engine

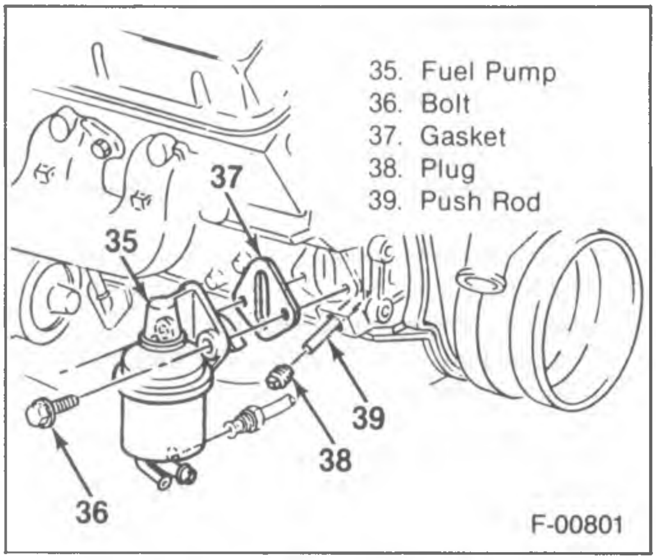


Figure 7—Fuel Pump—7.4L Engine

Tighten

- Bolts to specification.

8. Fuel pipes and hoses to the fuel pump.
    - If it is difficult to start the outlet fitting, disconnect the line at the carburetor.
    - Start the engine and check for leaks.

7.4L ENGINE

Remove or Disconnect (Figure 7)

1. Fuel pipes and hoses from the fuel pump (35).
2. Bolts (36).
3. Fuel pump (35).
4. Gasket (37).
5. Plug (38).
6. The push rod (39).

Install or Connect (Figure 7)

1. The push rod (39).
    - Apply some chassis grease to the rod and hold it up against the camshaft.
2. Gasket sealer to the threads on the plug (38).
3. Plug (38).
4. Gasket (37).
5. Fuel pump (35).
6. Bolts (36).

Tighten

- Bolts alternately and evenly to 37 N·m (27 ft. lbs.).

7. Fuel pipes and hoses to the fuel pump.
    - If it is difficult to start the outlet fitting, disconnect the line at the carburetor.

- Start the engine and check for leaks.

FUEL TANK

The fuel tank is located under the rear or the sides of the vehicle. The fuel tank is held in place by two metal straps that are attached to the underbody. Anti-squeak strips are used between the tanks and straps to reduce rattles and squeaks.

The fuel tank, filler cap, and fuel lines should be checked for damage which could cause leakage. Replace any damaged or worn parts.

Before servicing the fuel tank or lines:

- Disconnect the negative battery cable from the battery.
- Place "NO SMOKING" signs near work areas.
- Have a CO_2 fire extinguisher nearby.
- Wear safety glasses.
- Siphon or pump fuel into an explosion proof container.

DRAINING THE FUEL TANK

Remove or Disconnect

1. Negative battery cable.
    - There are two batteries in diesel engine vehicles.
    - Have a dry chemical (Class B) fire extinguisher in the work area.
2. Fuel filler cap.

CAUTION: Never drain or store gasoline or diesel fuel in an open container due to the possibility of fire or explosion.

3. Fuel through the filler tube using a hand operated pump.
    - If a hand operated pump cannot be used to complete the draining, use a siphon at the main (not return) fuel pipe at the fuel pump or the fuel gage sending unit.

Install or Connect

1. Any lines or hoses.
2. Fuel filler cap.
3. Negative battery cable.

FUEL SYSTEM CLEANING (GASOLINE ENGINE)

CAUTION: This procedure will not remove all fuel vapor. Do not attempt any repair on the tank or filler neck where heat or flame is required, as an explosion resulting in personal injury could occur.

Contaminated fuel or other foreign material in the tank can usually be removed by cleaning; however, if the fuel tank is rusted internally, it should be replaced.

Remove or Disconnect

Tool Required:

J-24187 Fuel Gage Sending Unit Tool

1. Negative battery cable.
2. Engine harness connector at the distributor.
    - Have a dry chemical (Class B) fire extinguisher near the work area.
3. Fuel from the fuel tank.
    - Refer to "Draining the Fuel Tank."
4. Fuel tank.
    - Refer to "Fuel Tank Removal."
5. Fuel filter. Replace the filter if it is plugged.
6. Fuel gage sending unit using J-24187.
    - Locate the tank away from heat, flame, or other sources of ignition.
    - If the strainer is contaminated or clogged, a new strainer should be installed upon reassembly.
7. Remaining fuel from the tank by rocking the tank.
- Flush the fuel tank with hot running water for at least five minutes.
8. Water from the fuel tank by rocking the tank.
    - Make sure that the water is completely removed.
9. Fuel feed pipe at the fuel pump.

Clean

- Fuel lines by applying air pressure in the opposite direction of fuel flow in the line.

Install or Connect

Tool Required:

J-24187 Fuel Gage Sending Unit Tool

1. Lines and pipes.

Tighten

- Fittings to 30 N·m (22 ft. lbs.).

2. New strainer on the fuel gage sending unit (if necessary).
   - Use low air pressure to clean the pipes of the fuel gage sending unit.
3. New fuel gage sending unit gasket.

NOTICE: Take care not to fold or twist the strainer when installing the sending unit as this will restrict fuel flow.

4. Fuel gage sending unit.
5. Fuel tank.
6. Fuel gage wire harness to the body harness.
7. All fuel lines.
8. A hose to the carburetor inlet line.
   - Disconnect the inlet line from the carburetor.
9. The other end of the hose into a four liter (one gallon) fuel can.
10. Battery cable.
11. Six gallons of clean gasoline into the fuel tank.
   - Crank the engine until the fuel can is about one-half full. This will purge the fuel pump.
   — Do not overheat the starter.
12. Carburetor inlet line to the carburetor.
   - Check all connections for leaks and tighten all hose clamps.
13. Engine harness connector to the distributor.

DIESEL FUEL SYSTEM CONTAMINATION

Fungi and other micro-organisms can survive and multiply in diesel fuel if water is present. The fungi can be present in any part of the fuel handling system. These fungi grow into long strings and will form into large globules. The growths appear slimy and are usually black, green, or brown. The fungi may grow anywhere in the fuel but are most plentiful where diesel fuel and water meet. As the fuel is agitated (when service station tanks are being filled), fungi are distributed throughout the tank and may be pumped into a vehicle.

Fungi use the fuel as their main energy supply and need only trace amounts of water and minerals. As they grow and multiply, they change fuel into water, sludge, acids, and products of metabolism. The most common symptom is fuel filter plugging; however, various metal components (fuel tank, lines, and injection pump) can corrode.

CAUTION: To avoid personal injury, do not come into physical contact with biocides.

If fungi have caused fuel system problems, use a diesel fuel biocide to sterilize the fuel system. Do not exceed the dosage recommended on the label. Discontinue the use of a biocide when towing a trailer. It is permissible to have biocide in the fuel when starting to tow, but do not add any biocide while towing.

Steam cleaning may be necessary if most of the fungus growth cannot be removed with biocides.

FUEL SYSTEM CLEANING (DIESEL ENGINE)

CAUTION: Never drain or store diesel fuel in an open container due to the possibility of fire or explosion.

WATER IN THE FUEL SYSTEM

Remove or Disconnect

1. Fuel from the tank.
   - Refer to "Draining the Fuel Tank."
2. Fuel tank.
3. Fuel gage sending unit.

Clean

- Fuel tank.
  — The tank should be replaced if it is rusted internally.
- The pick-up filter or replace if necessary.
- The check valve assembly.

4. Main fuel hose at the fuel pump.
5. Fuel return line at the injection pump.
   - Use low air pressure to blow out the lines toward the rear of the vehicle.
     — Replace the pipes if they are rusted internally.
6. Fuel filter.

Install or Connect

1. Fuel gage sending unit.
2. Fuel tank.
3. Fuel lines to the tank.
4. Clean diesel fuel into the tank until it is 1/4 full.
5. Fuel tank cap.
6. Fuel hoses to the fuel pump.
7. Battery cables.
   - Crank the engine for 15 seconds with one minute cooling periods until clean fuel is pumped out.
     — Use a suitable container to catch the fuel.
8. New fuel filter.
9. A hose from the return line at the fuel injection pump to a closed metal container with a capacity of at least 8L (2-gallons).

- If the engine temperature is above 52°C (125°F), activate the HPCA (Housing Pressure Cold Advance) on the injection pump. This can be done by disconnecting the two lead connectors at the Engine Temperature Switch and bridging the connector with a jumper wire.
- Crank the engine for 15 seconds with one minute cooling periods until clean fuel appears at the return line.

10. Two lead connectors to the Engine Temperature Switch.
    - Remove the jumper wire.

- Disconnect the lead to the HPCA solenoid (on the injection pump).
- Crack open each injection line at the nozzle. Use two wrenches to prevent nozzle damage.
- Crank the engine for 15 seconds with one minute cooling periods until clean fuel appears from each nozzle.

11. HPCA lead to the injection pump.

Tighten

- Injection line to nozzle fitting to 25 N·m (20 ft. lbs.).
  - — Use two wrenches to prevent nozzle damage.
- Start the engine and allow it to idle for 15 minutes.
  - — Make sure the fuel return line is in the metal container and that the container does not overflow.
- Remove the hose from the metal container.

12. Fuel return line to the injection pump.

- Check for leaks.

GASOLINE IN THE FUEL SYSTEM

Engine Will Run Or Start

1. Drain the fuel tank.
2. Fill the tank with diesel fuel.
3. Run the engine for 15 minutes.

Engine Will Not Run

1. Drain the fuel tank.
2. Fill the tank with diesel fuel.
3. Remove the fuel line between the fuel filter and the injection pump.
4. Connect a hose to the fuel filter outlet and run it to a closed metal container.
5. Crank the engine for 15 seconds with one minute cooling periods to purge gasoline from the system.
6. Install the fuel line between the fuel filter and the injection pump.
7. If the engine temperature is above 52°C (125°F), activate the HPCA (Housing Pressure Cold Advance) on the injection pump. This can be done by disconnecting the two lead connectors at the Engine Temperature Switch and bridging the connector with a jumper wire.
8. Start the engine and remove the jumper wire.
9. Connect the two lead connector.
10. Run the engine for 15 minutes.

FUEL TANK PURGING

The fuel tank should be purged before being repaired.

Remove or Disconnect

1. Fuel tank from the vehicle.
2. Fuel gage sending unit.
3. All remaining fuel from the tank.

Inspect

- Fuel tank for any remaining fuel.

Install or Connect

1. Tap water into the tank until it is full.
   - Move the tank to the flushing area (wash rack).

- Agitate the water vigorously and then drain it.

2. Gasoline emulsifying agent into the tank.
   - Use an available emulsifying agent such as Product-Sol No. 913 or equivalent.
3. Water to the fuel tank.
   - Refer to the emulsifying agent specifications for the mixture ratio.

- Agitate the mixture for ten minutes.
- Drain the tank completely.
- Fill the tank with water until it overflows.
- Completely flush out any remaining mixture.
- Drain the fuel tank.
- Use an explosion meter (if available) to check for a negative reading.
- Perform the required service work.

FUEL TANK LEAK TEST

If fuel is leaking from the tank, the tank should be replaced. Make sure that the fuel lines are not leaking onto the tank.

1. Remove the fuel tank.
2. Drain the tank.
3. Plug all of the outlets.
4. Apply 7 to 10 kPa (1 to 1 1/2 psi) air pressure through the vent tube.
5. Test for leaks with a soap solution or by submersion.
6. Replace the tank if a leak is found.

FUEL TANK REPLACEMENT

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

Remove or Disconnect (Figures 8 through 10)

1. Fuel from the tank.
2. Fuel tank retaining straps.
   - Support the fuel tank.
3. Sending unit wire, hoses, and ground straps.
   - Lower the tank.
4. Fuel tank from the vehicle.

Install or Connect (Figures 8 through 10)

1. Fuel tank into the vehicle.
   - Support the tank.
2. Sending unit wire, hoses, and ground straps.
3. Fuel tank retaining straps with the anti-squeak pieces.
   - Cement the anti-squeak material securely to the tank with 25 mm (1-inch) wide coverage for 10 cm (4-inches) on each end.

Tighten

- Retaining strap bolts or nuts to specifications.

FUEL TANK FILLER NECK

A restrictor and deflector is built into the fuel filler neck on gasoline engine vehicles to help prevent refueling with leaded gasoline. The opening in the restrictor will only admit the smaller unleaded gas nozzle spout. The nozzle must be fully inserted to bypass the deflector (figure 11 through 13).

FUEL FILLER CAP

The fuel tank filler neck is equipped with a screw type cap. The cap requires several turns counterclockwise to remove. The long threaded area allows fuel tank pressure to escape while the cap is being removed. A torque limiting device prevents overtightening. To install, turn the cap clockwise until a clicking noise is heard.

NOTICE: If a fuel filler cap requires replacement, use only a cap with the same features. Failure to use the correct cap can result in a serious malfunction of the system.

FUEL LINES

NOTICE: Fuel and vapor hoses and pipes are specially manufactured. It is important to use replacement hose or pipe meeting GM Specifications. Hoses and pipes not meeting GM Specification could cause early failure or failure to meet emission standards.

When replacing fuel feed and return pipes, always use welded steel tubing meeting GM Specification 124 M or its equivalent. The replacement pipe must have the same type fittings as the original pipes to ensure integrity of the connection.

— Never replace fuel pipe with copper or aluminum tubing.
— Check and replace any damaged O-rings or washers.
— Fuel pipes should be inspected occasionally for leaks, dents, or kinks.
— Follow the same routing as the original pipe.
— Pipes must be properly secured to the frame to prevent chafing. A minimum clearance of 6 mm (1/4-inch) must be maintained to prevent contact and chafing.

FUEL AND VAPOR HOSES

NOTICE: Fuel and vapor hoses are specially manufactured. It is important to use replacement hoses that meet GM Specification 6163-M. These hoses are identified by the word "Fluoroelastomer" marked on them. Hoses not so marked could cause early failure or failure to meet emission standards.

Do not use rubber hose within 10 cm (4-inches) of any part of the exhaust system or within 25 cm (10-inches) of the catalytic converter.

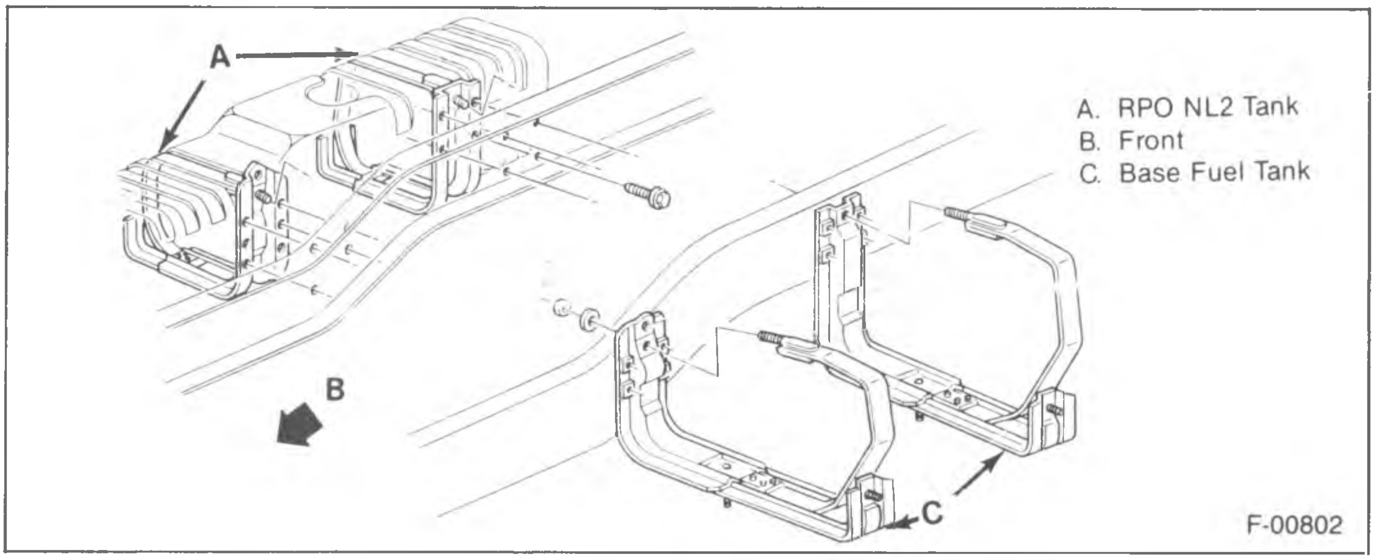


Figure 8—Fuel Tank Mounting—C/K Pickup

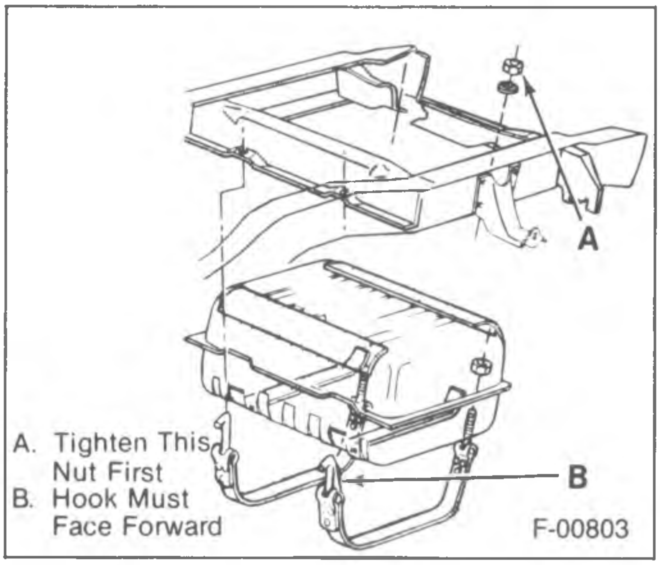


Figure 9—Fuel Tank Mounting— Utility Vehicle and Suburban

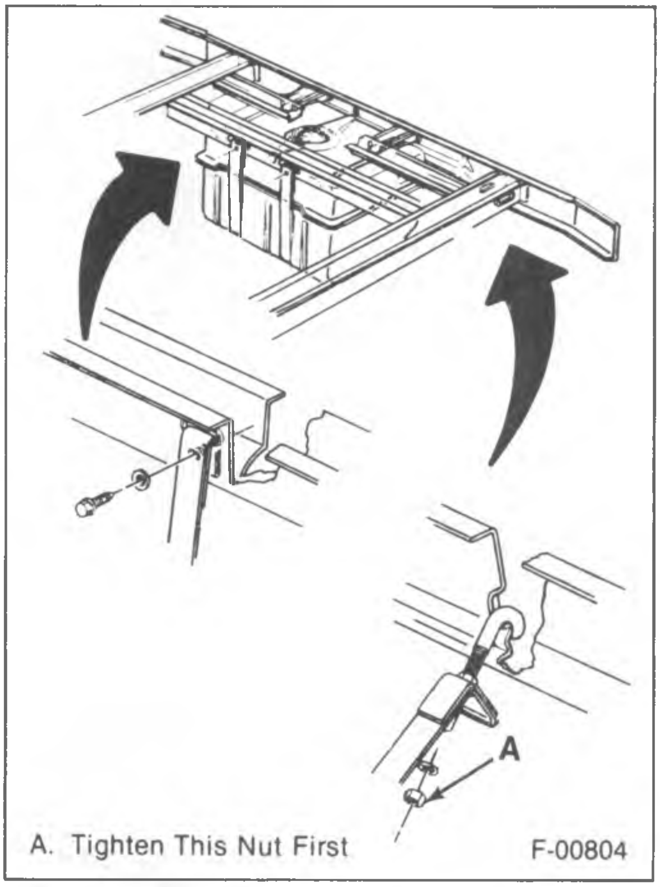


Figure 10—Fuel Tank Mounting—G-Van

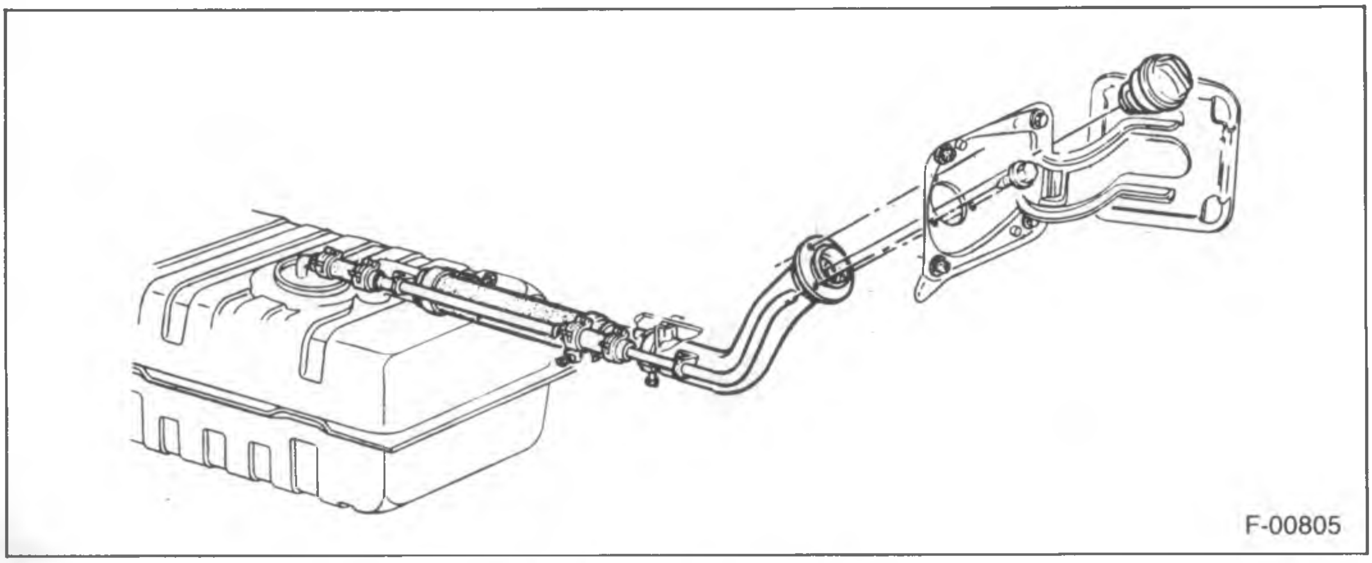


Figure 11—C/K Filler Neck

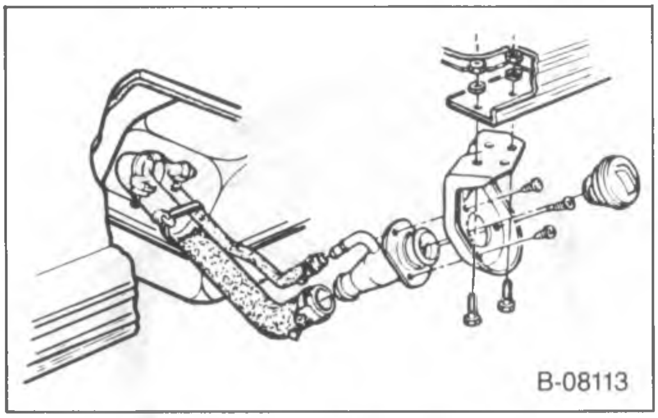


Figure 12—Chassis Cab Filler Neck

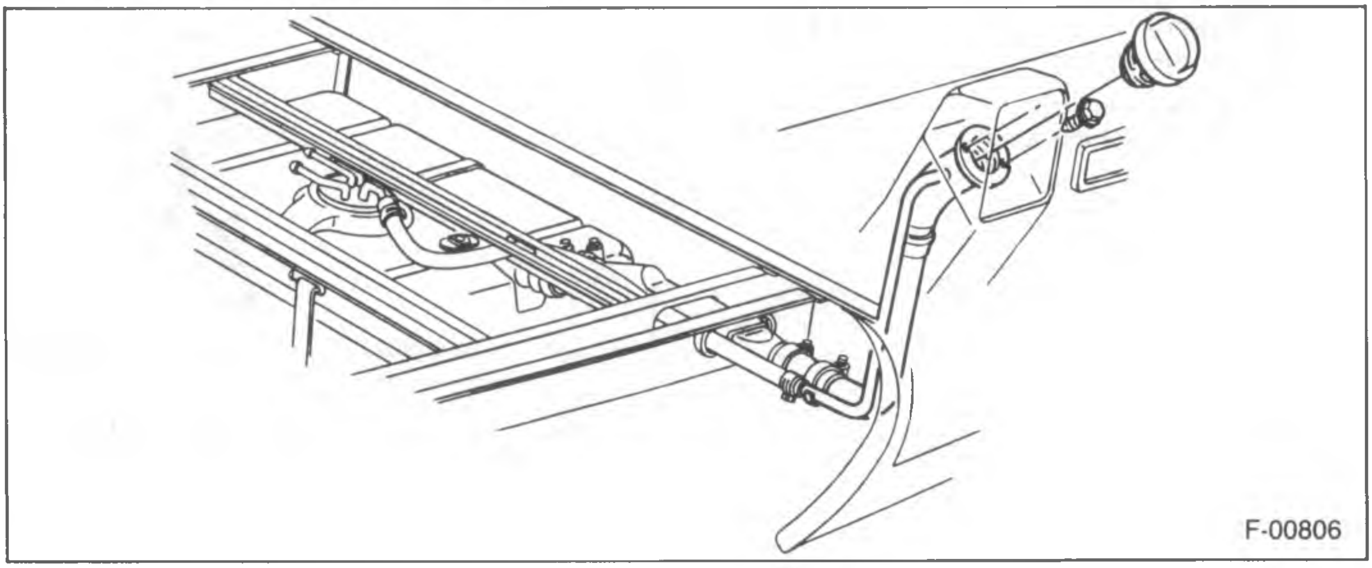


Figure 13—G-Van Filler Neck

FUEL GAGE SENDING UNIT

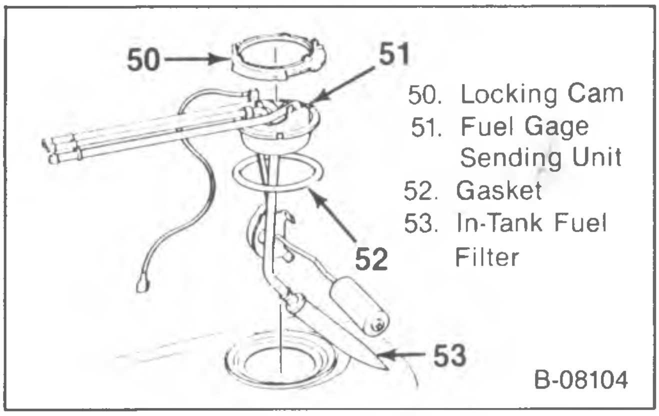


Figure 14—Fuel Gage Sending Unit

The fuel gage sending unit is mounted in the top of the fuel tank. It is held in place by a cam lock ring. A gasket is used between the tank and the sending unit.

Sending units have either two or three nipples to attach hoses. These hoses are the fuel feed, fuel return, and vapor hoses.

On some sending units a wire is attached to the unit; while on other sending units, connectors attach directly to the sender.

IN TANK FUEL FILTER

A woven plastic filter is located on the lower end of the fuel pickup tube in the fuel tank (figure 14). This filter prevents dirt and water from entering into the fuel line unless it becomes completely submerged in water. The filter is self cleaning and normally requires no maintenance. Fuel stoppage at this point indicates that the fuel tank contains an abnormal amount of sediment or water and should be thoroughly cleaned.

Diesel engine vehicles have a check valve that will permit fuel to pass if the tank filter becomes plugged with paraffin during cold weather operation.

When this plugging occurs, the last four gallons of fuel will not be used due to the location of the check valve. Therefore it is important to keep the fuel tank above the 1/4 mark at temperatures below -6°C (-20°F) when using number two diesel fuel.

FUEL GAGE SENDING UNIT REPLACEMENT

←→ **Remove or Disconnect (Figure 14)**

Tool Required:
J-24187 Fuel Gage Sending Unit Tool

1. Fuel from the tank.
2. Fuel tank from the vehicle.
3. Locking cam (50) using J-24187.
4. Fuel gage sending unit (51).
5. Gasket (52).

→← **Install or Connect (Figure 14)**

Tool Required:
J-24187 Fuel Gage Sending Unit Tool

1. New gasket.
2. Fuel gage sending unit.
    - Take care not to fold or twist the strainer or fuel flow will be restricted.
3. Locking cam using J-24187.
4. Fuel tank into the vehicle.

FUEL TANK SELECTOR VALVE

The fuel tank selector valve is operated by a switch on the instrument panel. The switch controls fuel tank switching and fuel gage indication in a single operation.

A simple check can be made to determine if the fuel tank selector valve is working by listening for selector valve motor operation when the switch is pressed.

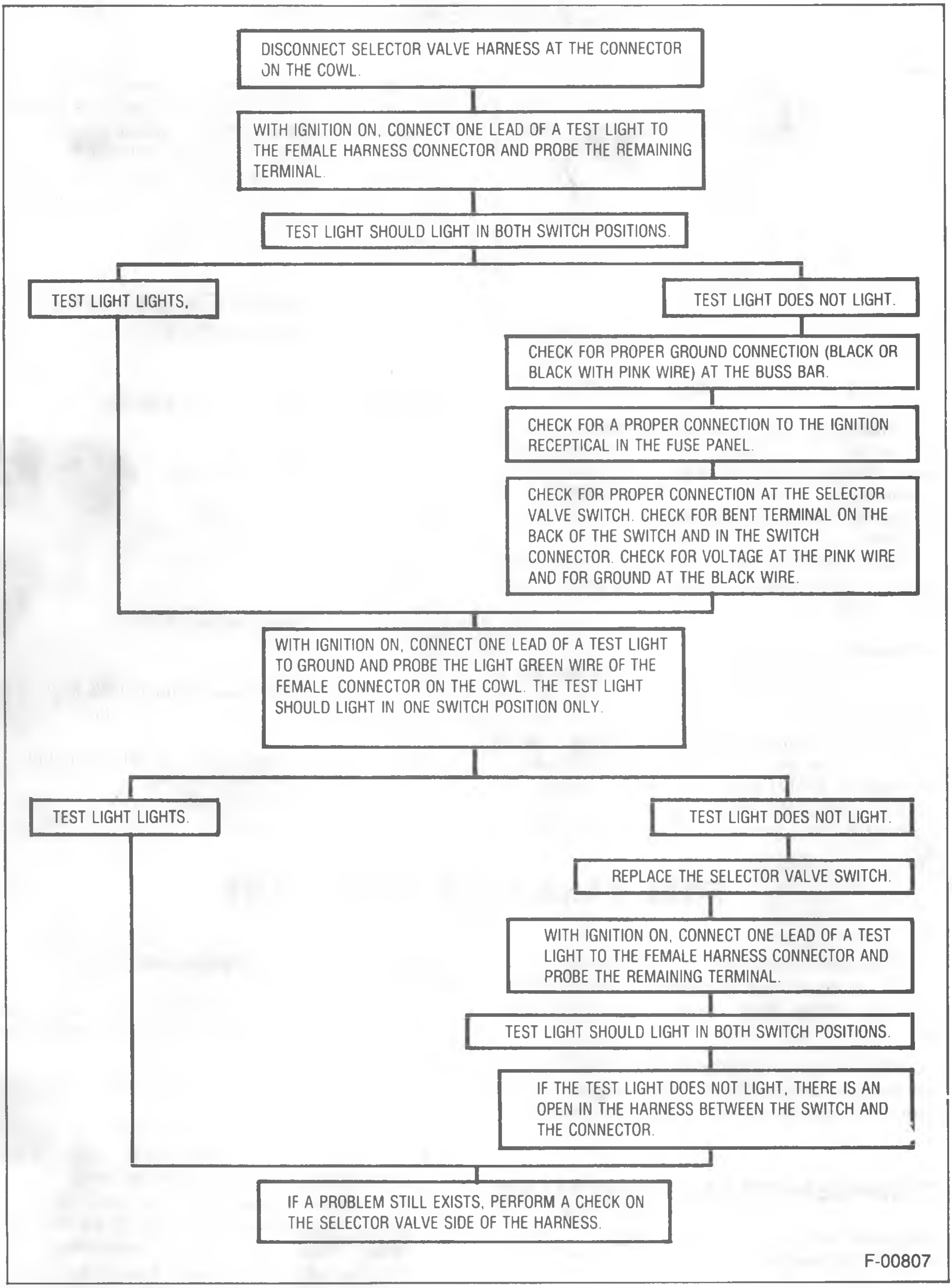
DIAGNOSIS OF SELECTOR VALVE

CHECKING THE INSTRUMENT PANEL SIDE OF THE HARNESS

Refer to figures 15 through 17 to diagnose the instrument panel side of the selector valve harness.

CHECKING THE SELECTOR VALVE SIDE OF THE HARNESS

1. Make sure there is about 40 liters (10 gallons) of fuel in one tank and about 20 liters (5 gallons) in the other tank.
2. Remove the harness connector from the fuel tank selector valve.
3. Install a known good selector valve.
4. Activate the fuel tank selector switch and note the gage readings of the right and left tanks.
5. The system is operating properly if a change is indicated between the tanks. Therefore, the original selector valve was the problem.
6. If a change is not indicated, there is an open in the harness between the connector on the cowl and the selector valve.



DISCONNECT SELECTOR VALVE HARNESS AT THE CONNECTOR ON THE COWL.

WITH IGNITION ON, CONNECT ONE LEAD OF A TEST LIGHT TO THE FEMALE HARNESS CONNECTOR AND PROBE THE REMAINING TERMINAL.

TEST LIGHT SHOULD LIGHT IN BOTH SWITCH POSITIONS.

TEST LIGHT LIGHTS.

TEST LIGHT DOES NOT LIGHT.

CHECK FOR PROPER GROUND CONNECTION (BLACK OR BLACK WITH PINK WIRE) AT THE BUSS BAR.

CHECK FOR A PROPER CONNECTION TO THE IGNITION RECEPTICAL IN THE FUSE PANEL.

CHECK FOR PROPER CONNECTION AT THE SELECTOR VALVE SWITCH. CHECK FOR BENT TERMINAL ON THE BACK OF THE SWITCH AND IN THE SWITCH CONNECTOR. CHECK FOR VOLTAGE AT THE PINK WIRE AND FOR GROUND AT THE BLACK WIRE.

WITH IGNITION ON, CONNECT ONE LEAD OF A TEST LIGHT TO GROUND AND PROBE THE LIGHT GREEN WIRE OF THE FEMALE CONNECTOR ON THE COWL. THE TEST LIGHT SHOULD LIGHT IN ONE SWITCH POSITION ONLY.

TEST LIGHT LIGHTS.

TEST LIGHT DOES NOT LIGHT.

REPLACE THE SELECTOR VALVE SWITCH.

WITH IGNITION ON, CONNECT ONE LEAD OF A TEST LIGHT TO THE FEMALE HARNESS CONNECTOR AND PROBE THE REMAINING TERMINAL.

TEST LIGHT SHOULD LIGHT IN BOTH SWITCH POSITIONS.

IF THE TEST LIGHT DOES NOT LIGHT, THERE IS AN OPEN IN THE HARNESS BETWEEN THE SWITCH AND THE CONNECTOR.

IF A PROBLEM STILL EXISTS, PERFORM A CHECK ON THE SELECTOR VALVE SIDE OF THE HARNESS.

Figure 15—Diagnosis Of The Instrument Panel Side Of The Selector Valve Harness

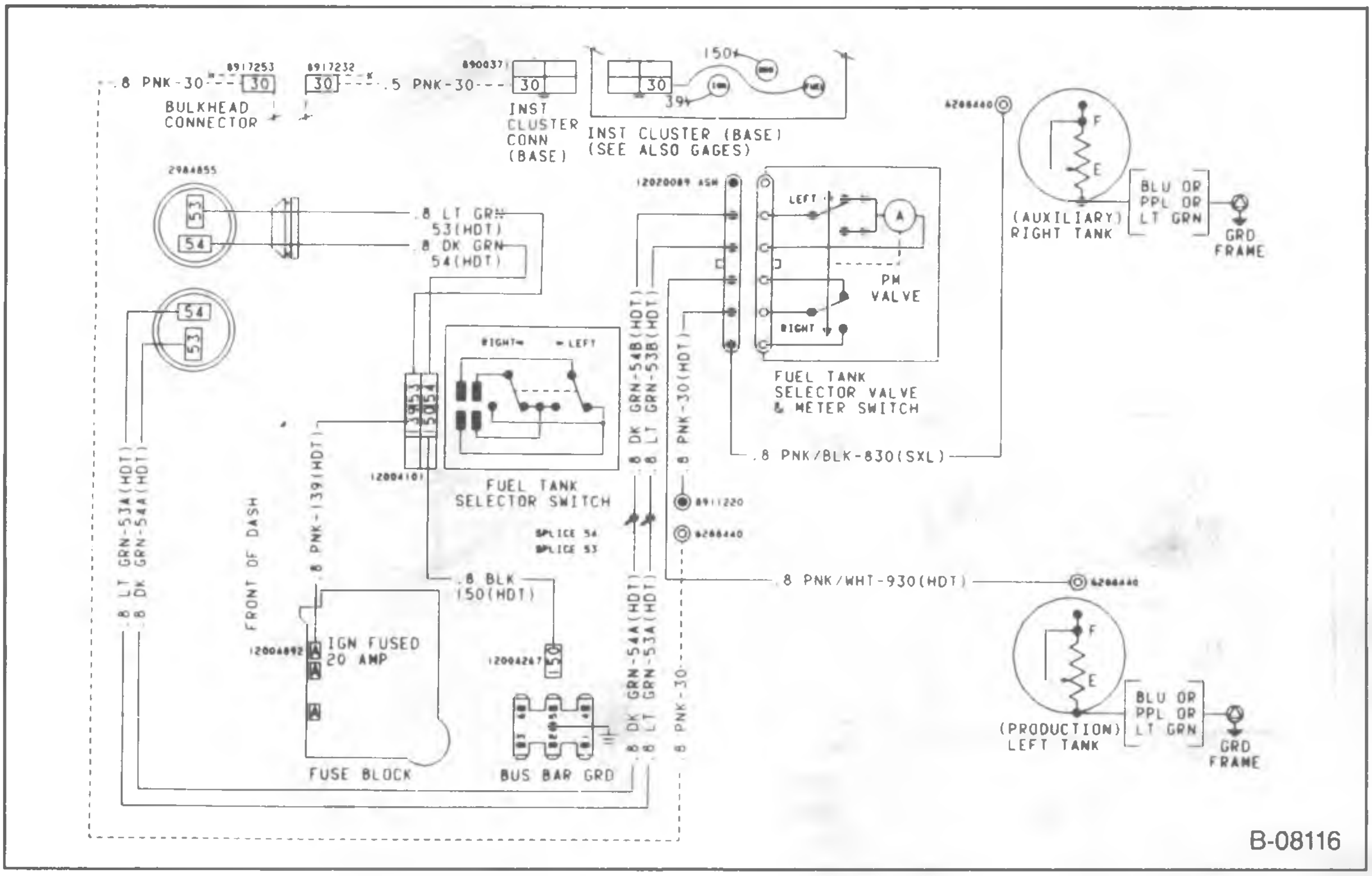
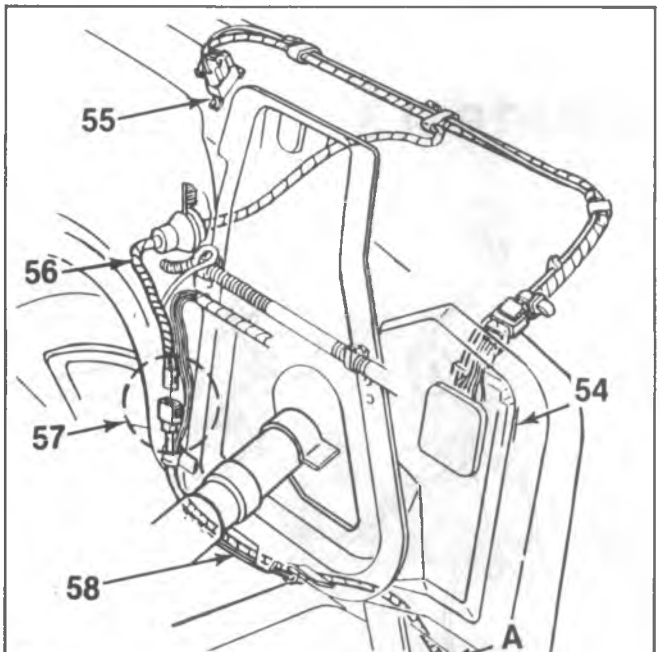


Figure 16—Auxiliary Fuel Tank Wiring



A. To Fuel Tank Selector Valve And Sending Unit
54. Fuse Panel
55. Selector Valve Switch
56. Instrument Panel Side Of Harness
57. Connector
58. Selector Valve Side Of Harness

Figure 17—Auxiliary Fuel Tank Instrument Panel Wiring

7. Refer to INSTRUMENT PANEL (SEC. 8C) if the fuel gage does not register accurately.

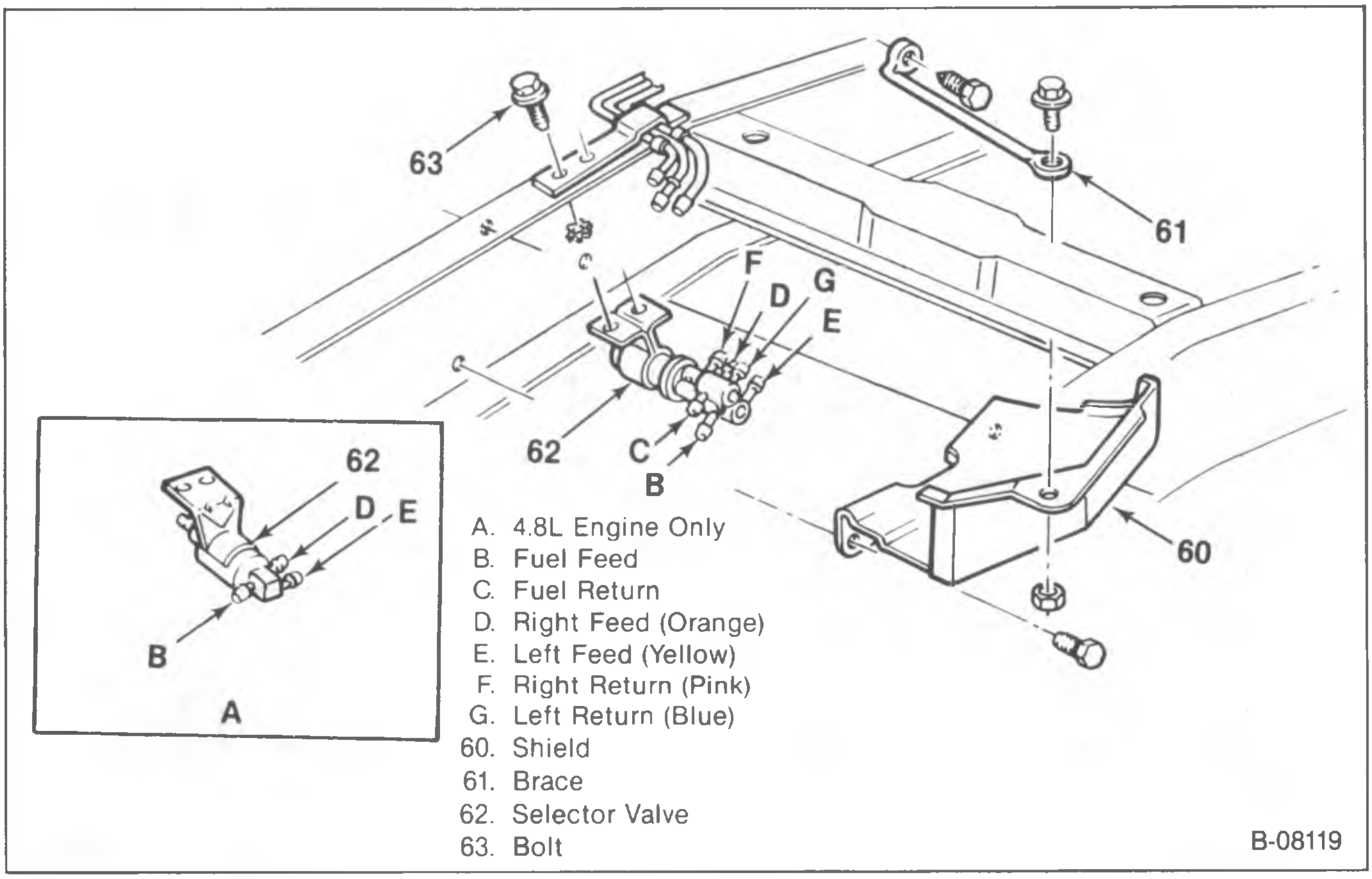
FUEL TANK SELECTOR VALVE REPLACEMENT

↔ Remove or Disconnect (Figure 18)

1. Battery negative cable.
2. Hose shield (60) and brace (61).
3. Electrical connector from the selector valve (62).
4. Fuel and vapor hoses.
   - Note the position of the hoses for installation.
5. Screws (63).
6. Valve (62).

→← Install or Connect (Figure 18)

1. Valve (62).
2. Screws (63).
3. Fuel and vapor hoses in the correct position.
4. Electrical connector.
5. Brace (61) and hose shield (60).
6. Battery negative cable.



A. 4.8L Engine Only
B. Fuel Feed
C. Fuel Return
D. Right Feed (Orange)
E. Left Feed (Yellow)
F. Right Return (Pink)
G. Left Return (Blue)
60. Shield
61. Brace
62. Selector Valve
63. Bolt

Figure 18—Selector Valve

ACCELERATOR CONTROLS

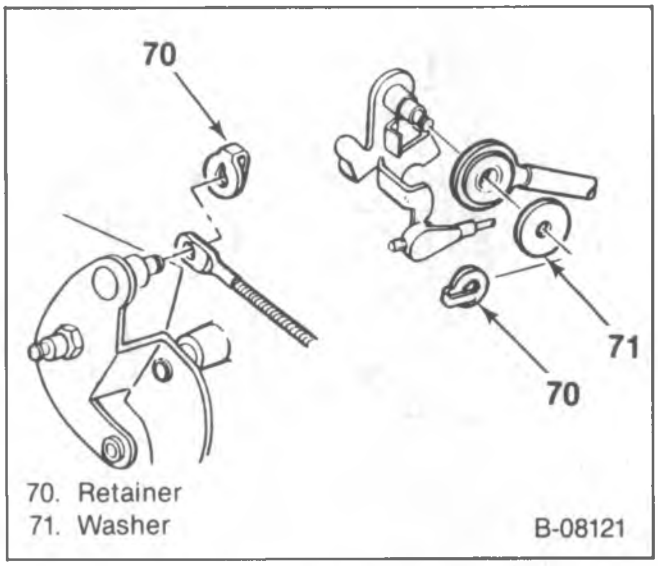
The accelerator pedal controls the throttle through a cable. There are no linkage adjustments. The throttle cable must be replaced with an identical replacement part.

All linkages and cables must be checked to assure free movement with no rubbing, chafing, or binding. The throttle must operate freely without binding between full closed and wide open throttle.

ACCELERATOR CONTROL CABLE

Observe the following when performing service on the accelerator control cable.

- The retainer must be installed with the tangs secured over the head of the stud (figure 19).
- The conduit fitting at both ends of the cable must have the locking tangs expanded and locked into the attaching holes.
- The braided portion of the cable must not come into contact with the front of dash sealer during replacement.



70. Retainer
71. Washer

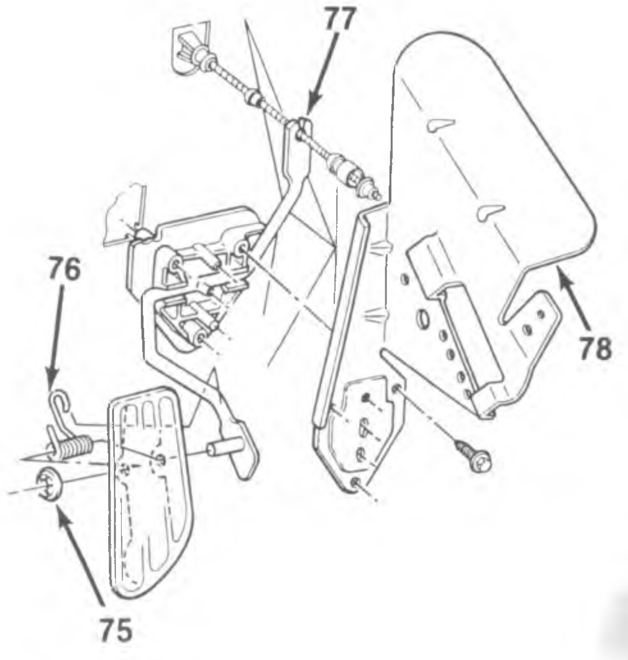
Figure 19—Control Cable Attachment

- Flexible components (hoses, wires, conduit, etc.) must not be routed within 50 mm (2-inches) of the moving parts of the accelerator linkage unless routing is positively controlled.
- Lube all pivot points with Accelerator Linkage Lubricant (1052541 or equivalent).

ACCELERATOR PEDAL

Observe the following when performing service on the accelerator pedal.

- The mounting surface between the support and the dash panel must be free of insulation. The carpet and padding in the pedal and tunnel area must be positioned to lay flat and be free of wrinkles and bunches.
- Slip the accelerator control cable through the slot in the rod before installing the retainer in the rod. Make sure it is seated properly. Use care in pressing the retainer into the hole so the cable is not kinked or damaged (figure 20).
- The linkage must operate freely without binding between closed throttle and full throttle.
- Wire, hoses, cable, and other flexible components must not be placed within 13 mm (0.52-inch) of the cable or rod at any point in their travel.



75. Retainer (Must Bear Against Pedal Rib)
76. Spring
77. Rod
78. Reinforcement

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Figure 20—Accelerator Pedal Assembly

SPECIFICATIONS

FUEL PUMP BOLT TORQUE

4.8L Engine	23 N·m (17 ft. lbs.)
4.3L Engine (Top Bolt)	4 N·m (3 ft. lbs.)
4.3L Engine (Bottom Bolts)	22 N·m (16 ft. lbs.)
5.0L and 5.7L Engines (Top Bolts)	37 N·m (27 ft. lbs.)
5.0L and 5.7L Engines (Bottom Bolts)	4 N·m (3 ft. lbs.)
6.2L Engine (Top Bolts)	33 N·m (24 ft. lbs.)
6.2L Engine (Bottom Bolts)	8 N·m (6 ft. lbs.)
7.4L Engine	(37 N·m (27 ft. lbs.)

FUEL TANK MOUNTING STRAP FASTENERS

C/K Model With Base Tank Nuts	6 N·m (4 ft. lbs.)
C/K Model With RPO NL2 Bolts	33 N·m (24 ft. lbs.)
Utility Vehicle And Suburban Nuts	16 N·m (12 ft. lbs.)
G-Van With Base Tank Bolts	5 N·m (45 in. lbs.)
G-Van With RPO NL7 Bolts	11 N·m (95 in. lbs.)
G-Van Nuts	13 N·m (10 ft. lbs.)

SPECIAL TOOLS

J-24187 Fuel Gage Sending Unit Tool

SECTION 6C1

CARBURETORS

CONTENTS

SUBJECT **PAGE**

CONTENTS (CONT.)

All new GM 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 in accessible to prevent indiscriminate or routine adjustment in the field. For this reason, the factory procedure for temporarily removing plugs, cap, 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.

CARBURETOR MODEL 1MEF

DESCRIPTION

Model 1MEF carburetors are single bore downdraft carburetors using a triple venturi along with a discharge tube nozzle (figure 1).

A power valve piston assembly and metering rod control the fuel flow in the main metering and power systems of the carburetor. The tapered metering rod is attached to the power piston and moves in a fixed metering jet to provide the fuel flow for varying engine demands. On 1MEF carburetors, a factory set metering rod adjusting screw controls the position of the metering rod in the jet. This screw is located in the air horn and should not be turned as this could result in engine damage or increased exhaust emissions.

Model 1MEF incorporates an integral automatic choke system which uses an electrically heated choke coil. The vacuum diaphragm unit is mounted externally on the air horn and connects to the thermostatic coil lever through a connecting link.

The electric choke coil is contained in a choke housing, which is mounted on a bracket attached to the float bowl. Special rivets are installed to retain the factory setting of the choke coil and provide a non-adjustable design.

An integral, pleated-paper fuel inlet filter is mounted in the fuel bowl behind the fuel inlet nut to give maximum filtration of incoming fuel. A check valve is used in the filter inlet to prevent fuel draining from the fuel system after rollover.

To improve hot engine starting and meet evaporative emission requirements, fuel vapors from the carburetor bowl are vented to a vapor canister on some models. A tube (location F) is added to the air horn to connect the air horn and canister.

Other features of the carburetors include an aluminum throttle body for decreased weight and improved heat distribution. A thick throttle body to bowl insulator gasket keeps excessive engine heat from the float bowl.

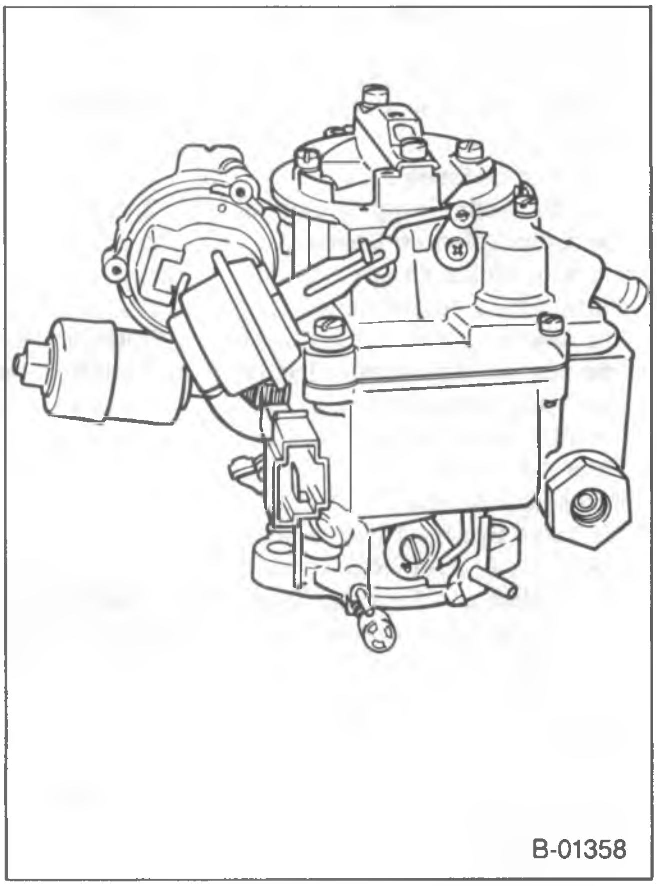
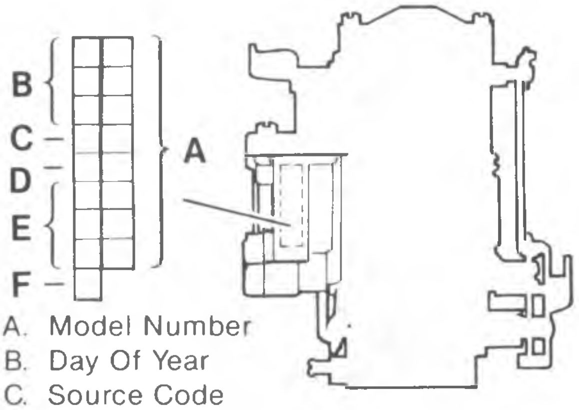


Figure 1—1 MEF Carburetor

All 1MEF models have seals added in the float bowl to seal the power piston drive rod and the pump lever. This prevents fuel vapors from escaping to atmosphere. During unit repair, the seals and retainer, where used, must be removed prior to immersion of the float bowl in carburetor cleaner.



A. Model Number
B. Day Of Year
C. Source Code
D. Year
E. Assembly Plant Code
F. Shift Identification

B-06647

Figure 2—Carburetor Identification

The carburetor model identification is stamped on a vertical portion of the foat bowl, adjacent to the fuel inlet nut (figure 2).

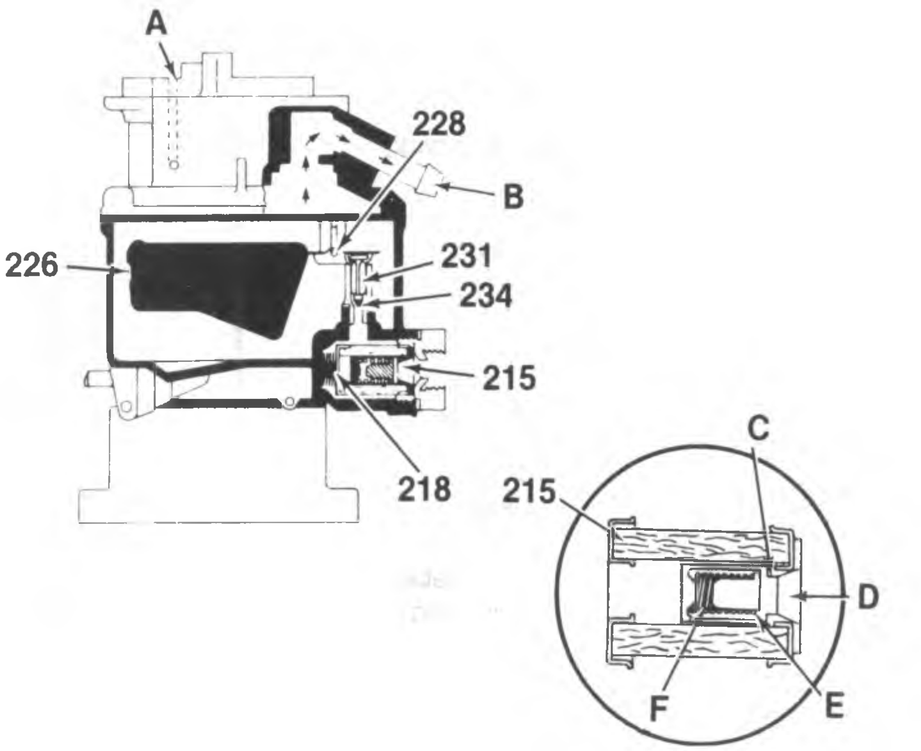
If replacing the float bowl, follow the manufacturer's instructions contained in the service package so that the identification number can be transferred to the new float bowl.

An electrically operated idle stop solenoid and dual throttle return springs are used on all carburetors.

The throttle lever has a spun-in plastic bushing which is used as a bearing surface. The bushing will withstand normal cleaning time in an approved cold immersion type carburetor cleaner. The bushing is not serviced separately and should not be removed from the carburetor throttle lever.

Six basic systems of operation are used (figures 3 through 8).

- Float
- Idle
- Main Metering
- Power
- Pump
- Choke



226. Float
228. Float Hinge Pin
231. Float Needle
234. Needle Seat
215. Fuel Inlet Filter
218. Filter Spring
A. Internal Vent
B. Vent Tube to Canister
C. Check Valve Seat
D. Fuel In
E. Check Valve
F. Valve Closing Spring

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Figure 3—Float System

240. Rod - Pump
247. Cup - Pump Plunger
248. Spring - Pump Plunger
252. Spring - Pump Return
256. Guide - Pump Discharge Spring
258. Spring - Pump Discharge Ball
260. Ball - Pump Discharge
310. Lever - Pump and Power Rod
317. Link - Pump
A. Pump Plunger Head
B. Pump Duration Spring
C. Pump Discharge Channel
D. Pump Jet

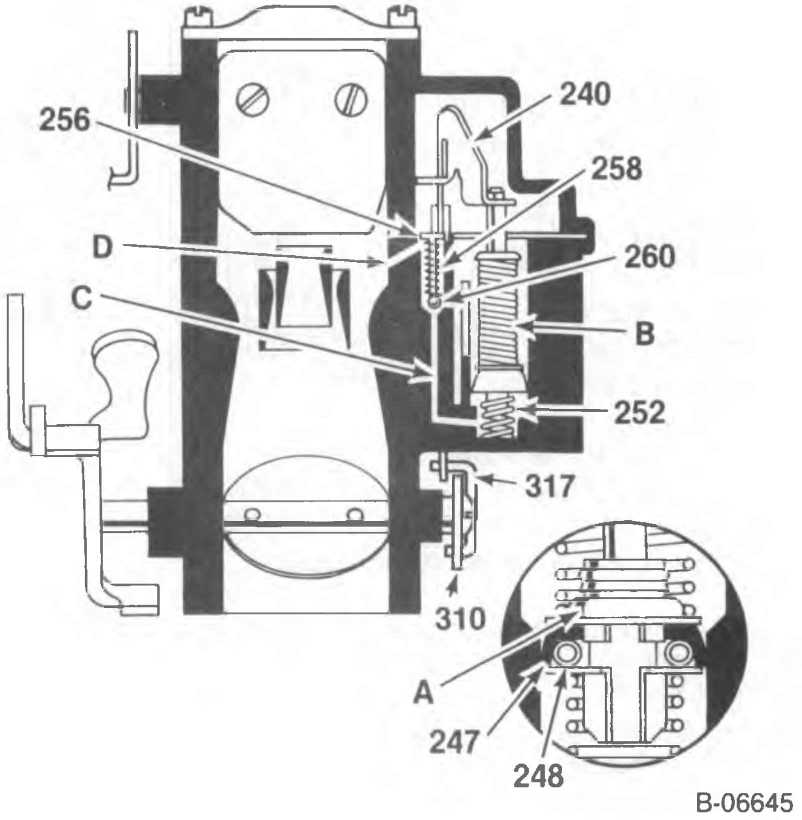

Figure 4—Pump System

266. Rod - Power Piston
274. Power Valve Piston Assembly
276. Spring - Power Piston
279. Metering Rod and Spring Assembly
282. Jet - Main Metering
A. Throttle Valve
B. Vacuum Channel
C. Main Venturi
D. Boost Venturi
E. Main Discharge Nozzle
F. Lower Idle Air Bleed
G. Main Well
H. Fuel Feed Orifice
I. Part Throttle Adjusting Screw
J. Main Well to Aspirator Bleed

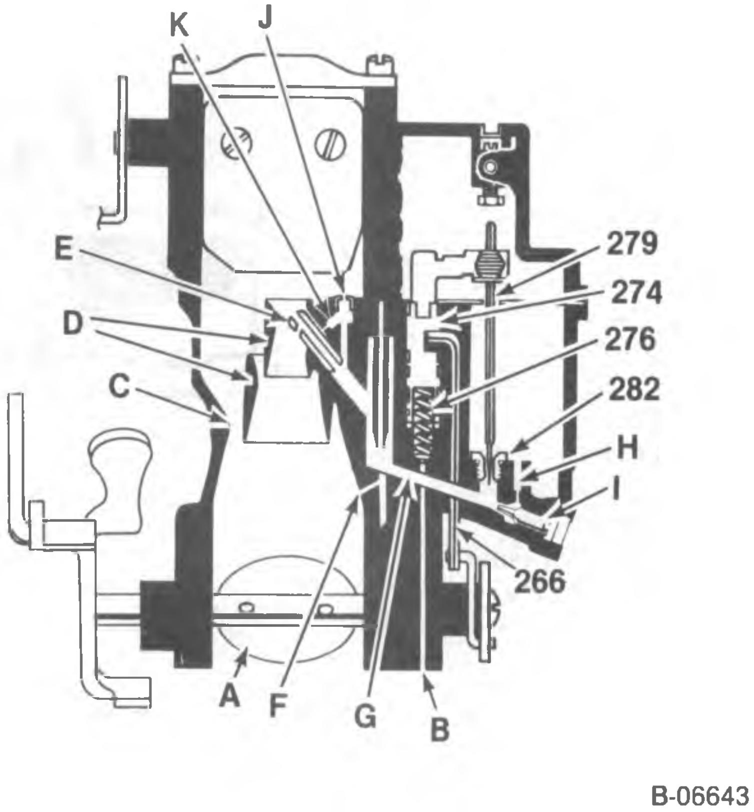

Figure 5—Main Metering System — 1 MEF

266. Rod - Power Piston
274. Power Valve Piston Assembly
276. Spring - Power Piston
279. Metering Rod and Spring Assembly
282. Jet - Main Metering
310. Lever - Pump and Power Rod
314. Link - Power Rod
A. Throttle Valve
B. Vacuum Channel
C. Main Discharge Nozzle
D. Lower Idle Air Bleed
E. Main Well
F. Metering Rod Adjusting Screw
G. Setscrew
H. Metering Rod Adjusting Screw Plug
I. Top Main Well Air Bleed
J. Main Well to Aspirator Bleed

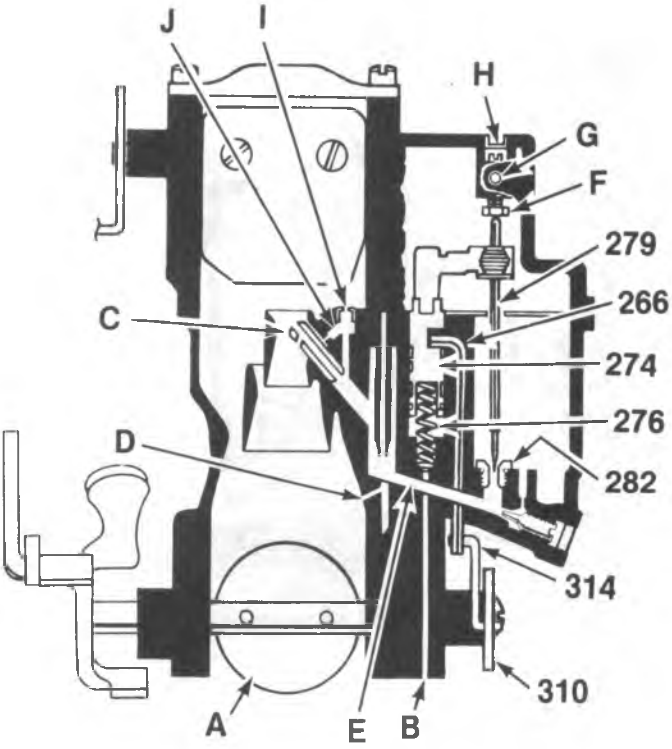

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Figure 6—Power System — 1 MEF

10. Cam - Fast Idle
15. Link - Fast Idle Cam
20. Choke Shaft, Lever and Link Assembly
40. Choke Shaft and Lever Assembly
43. Lever - Choke Stat
65. Vacuum Break Assembly - Bowl Side
69. Vacuum Break Lever and Link Assembly
A. Choke Valve
B. Thermostatic Coil

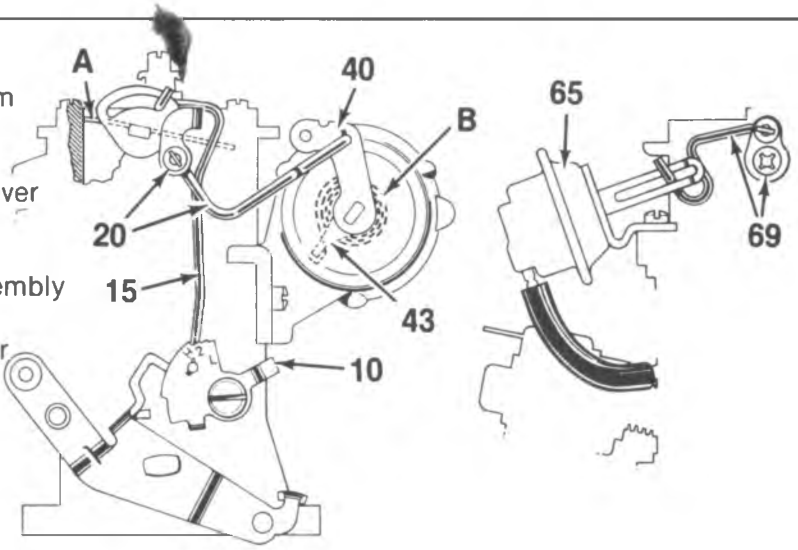

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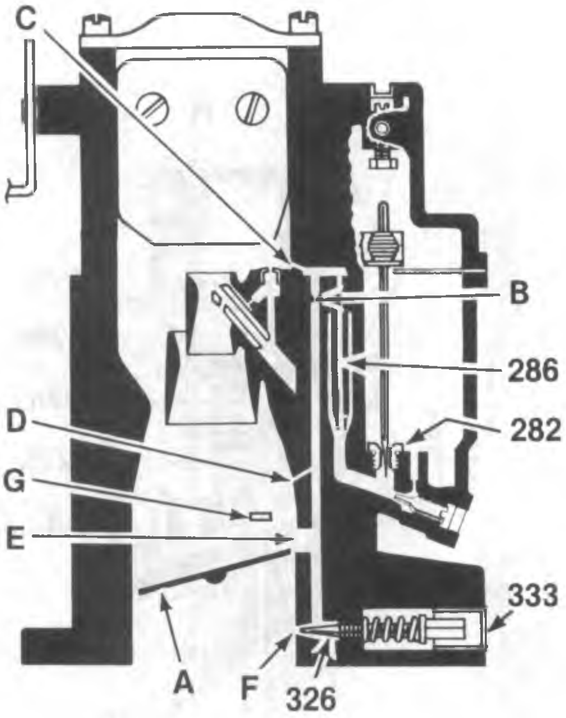
Figure 7—Choke System



282. Jet-Main Metering
286. Idle Tube Assembly
326. Needle-Idle Mixture
333. Plug-Idle Mixture Needle
A. Throttle Valve
B. Idle Channel Restriction
C. Top Idle Air Bleed
D. Lower Idle Air Bleed
E. Off-Idle Port
F. Idle Discharge Orifice
G. Timed Vacuum Port

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Figure 8—Idle System — 1 MEF

DIAGNOSIS OF 1MEF ROCHESTER CARBURETOR

The following diagnostic procedures are for carburetor related problems and their effects on vehicle performance. Other systems of the vehicle can also cause problems and should be checked when listed on the chart.

PROBLEM	POSSIBLE CAUSE	CORRECTION
Engine Cranks Normally — Will Not Start	1. Improper starting procedure used.	1. Check with the customer to determine if proper starting procedure is used, as outlined in the "Owner's and Driver's Manual."
	2. Choke valve not operating properly.	2. Check the choke valve and/or linkage as necessary. Replace parts if faulty. If caused by foreign material and gum, clean with suitable solvent.
	3. No fuel in carburetor.	3. Remove fuel line at carburetor. Connect hose to fuel line and run into metal container. Remove the wire from the "BAT" terminal of the distributor. Crank over engine—if there is not fuel discharge from the fuel line, test fuel pump as outlined in FUEL SYSTEM (SEC. 6C). If fuel supply is okay, check the following: a. Inspect fuel inlet filter. If plugged, replace. b. If fuel filter is okay, remove air horn and check for a bind in the float mechanism or a sticking inlet needle. If okay, adjust float as specified.
	4. Engine flooded. To check for flooding, remove the air cleaner with the engine immediately shut off and look into the carburetor bore. Fuel will be dripping off nozzle.	4. Remove the air horn. Check fuel inlet needle and seat for proper seal. If a needle and seat tester is not available, apply vacuum to the needle seat with needle installed. If the needle is leaking, replace. Check float for free movement. If foreign material is in fuel system, clean the system and replace fuel filters as necessary. If excessive foreign material is found, completely disassemble and clean.
Engine Starts — Will Not Keep Running	1. Fuel pump.	1. Check fuel pump pressure and volume, replace as necessary.
	2. Idle speed.	2. Adjust idle to specifications.
	3. Electric choke system malfunctioning (may cause loading).	3. Check choke for proper operation.

DIAGNOSIS OF 1MEF ROCHESTER CARBURETOR (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Engine Starts — Will Not Keep Running (Cont.)	4. Loose, broken or incorrect vacuum hose routing.	4. Check condition and routing of all vacuum hoses — correct as necessary.
	5. Engine does not have correct fast idle speed when cold.	5. Check for free movement of fast idle cam. Clean and/or realign as necessary. Adjust fast idle.
	6. Choke vacuum break units are not adjusted to specification or are faulty.	6. Adjust vacuum break assembly to specification. If adjusted okay, check the vacuum break unit as outlined under "Electric Choke" later in this section.
	7. Choke valve sticking and/or binding.	7. Clean and align linkage or replace if necessary. Readjust all choke settings, if part replacement or realignment is necessary.
	8. Not enough fuel in carburetor.	8. Check fuel pump pressure and volume. Check for partially plugged fuel inlet filter. Replace if plugged. Check the float level adjustment.
Engine Starts Hard (Cranks Normally)	1. Loose, broken or incorrect vacuum hose routing.	1. Check condition and routing of vacuum hoses — correct as necessary.
	2. Incorrect starting procedure.	2. Check to be sure customer is using the starting procedure outlined in "Owner's and Driver's Manual."
	3. Malfunction in accelerator pump system.	3. Check accelerator pump operation. Check pump discharge ball for sticking or leakage.
	4. Choke valve not closing.	4. Check choke valve and linkage for binds and alignment. Clean and repair or replace as necessary.
	5. Vacuum break misadjusted or malfunctioning.	5. Check for adjustment and function of vacuum break as outlined under "Electric Choke" later in this section. Correct as necessary.
	6. Not enough fuel in carburetor.	6. Check fuel pump pressure and volume. Check for partially plugged fuel inlet filter. Replace if dirty. Check float level. Adjust as specified.
	7. Flooding.	7. Check float and needle and seat for proper operation.
	8. Slow engine cranking speed.	8 Refer to starting circuit diagnosis.

DIAGNOSIS OF 1MEF ROCHESTER CARBURETOR (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Engine Idles Abnormally (Too Fast Or Too Slow)	1. Incorrect idle speed.	1. Reset idle speed.
	2. Air leaks into carburetor bores beneath throttle valve, manifold leaks, or vacuum hoses disconnected or installed improperly.	2. Check all vacuum hoses and restrictors leading into the manifold or carburetor base for leaks or being disconnected. Install or replace as necessary. Torque carburetor to manifold bolts to specifications. Using a pressure oil can, spray light oil or kerosene around manifold to head surfaces and carburetor throttle body. Do not spray at throttle shaft ends. If engine RPM changes, tighten or replace the carburetor or manifold gaskets as necessary.
	3. PCV system not working.	3. Check PCV system. Clean and/or replace as necessary.
	4. Carburetor flooding.	4. Remove air horn and check float adjustment. Check float needle and seat for proper seal. If a needle and seat tester is not available, apply vacuum to the needle seat with needle installed. If the needle is leaking or damaged, replace. Check float for free movement. If foreign material is found in the carburetor, clean the fuel system and carburetor. Replace fuel filter as necessary.
	5. Restricted air cleaner element.	5. Replace as necessary.
	6. Idle system plugged or restricted.	6. Clean carburetor.
	7. Incorrect idle mixture adjustment.	7. Readjust per specified procedure.
	8. Misadjusted idle solenoid. Faulty idle solenoid or wiring.	8. Check solenoid and wiring.
	9. Throttle valve or linkage sticking and/or binding.	9. Check throttle linkage and throttle valve for smooth and free operation. Correct problem areas.
Engine Diesels (After Run) Upon Shut Off	1. Loose, broken or improperly routed vacuum hoses.	1. Check condition and routing of all vacuum hoses. Correct as necessary.
	2. Incorrect idle speed.	2. Reset idle speed.
	3. Faulty or misadjusted idle solenoid.	3. Check for correct adjustment and operation of idle solenoid. Check for sticky or binding solenoid.
	4. Fast idle cam not fully off.	4. Check fast idle cam for freedom of operation. Clean, repair, or adjust as required. Check choke linkage for binding. Clean and correct as necessary.

DIAGNOSIS OF 1MEF ROCHESTER CARBURETOR (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Engine Diesels (After Run) Upon Shut Off (Continued)	5. Excessively lean condition caused by misadjustment of carburetor idle mixture. 6. Ignition timing retarded.	5. Adjust carburetor idle mixture. 6. Set to specifications.
Engine Hesitates On Acceleration	1. Loose, broken or incorrect vacuum hose routing. 2. Inoperative accelerator pump system. A quick check of the pump system can be made as follows: With the engine off, look into the carburetor bores and observe pump nozzle while quickly opening throttle lever. A full stream of fuel should emit from pump jet. 3. Foreign matter in pump passages. 4. Float level too low. 5. Vacuum break diaphragm not functioning properly. 6. Power enrichment system not operating correctly. 7. Inoperative Thermac system. 8. Fuel filter dirty or plugged. 9. Distributor vacuum or mechanical advance malfunctioning. 10. Timing not to specifications. 11. Incorrect metering rod adjustment.	1. Check condition and routing of all vacuum hoses — correct or replace. 2. Remove air horn and check pump cup. If cracked, scored or distorted, replace the pump plunger cup and spring. Check the pump discharge ball for proper seating and location. 3. Clean and blow out with compressed air. 4. Check and reset float level to specification. 5. Check adjustment and operation of vacuum break diaphragm. 6. Check for sticking power piston — correct as necessary. 7. Check operation. Repair as needed. 8. Replace filter and clean fuel system as necessary. 9. Check for proper operation. 10. Adjust to specifications. 11. Adjust to specifications.
Engine Has Less Than Normal Power At Normal Accelerations	1. Loose, broken or incorrect vacuum hose routing. 2. Clogged or faulty PCV system. 3. Choke sticking. 4. Clogged or inoperative power system. 5. Air cleaner temperature regulation improper. 6. Transmission malfunction. 7. Ignition system malfunction. 8. Exhaust system restricted.	1. Check condition and routing of all vacuum hoses. 2. Clean or replace as necessary. 3. Check complete choke system for sticking or binding. Clean and realign as necessary. Check jet and channels for plugging; clean and blow out passages. 4. Remove air horn and check for free operation of power piston. 5. Check regulation and operation of Thermac system. 6. Refer to transmission diagnosis. 7. Check ignition system. Refer to HEI diagnosis. 8. Check for restrictions. Correct as required.

DIAGNOSIS OF 1MEF ROCHESTER CARBURETOR (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Less Than Normal Power On Heavy Acceleration Or At High Speed (Continued)	1. Carburetor throttle valve not going wide open.	1. Correct throttle linkage to obtain wide open throttle in carburetor. Check for free movement of fast idle cam.
	2. Spark plugs fouled, incorrect gap.	2. Clean, regap, or replace plugs.
	3. Plugged air cleaner element.	3. Replace element.
	4. Plugged fuel inlet filter.	4. Replace with a new filter element.
	5. Insufficient fuel to carburetor.	5. Check fuel pump and system, run pressure and volume test.
	6. Power enrichment system not operating correctly.	6. Remove the air horn and check for free operation of power piston. Clean and correct as necessary.
	7. Choke closed or partially closed.	7. Free choke valve or linkage.
	8. Float level too low.	8. Check and reset float level to specification.
	9. Transmission malfunction.	9. Refer to transmission diagnosis.
	10. Ignition system malfunction.	10. Check ignition system.
	11. Fuel metering jets restricted or loose.	11. If the fuel metering jets are restricted and an excessive amount of foreign material is found in the fuel bowl, the carburetor should be completely disassembled and cleaned.
	12. Faulty fuel pump.	12. Check fuel pump pressure and volume, inspect lines or leaks and restrictions.
	13. Restricted exhaust system.	13. Check for restrictions. Correct as required.
Engine Surges	1. Loose, broken or incorrect vacuum hose routing.	1. Check condition and routing of all vacuum hoses. Correct as necessary.
	2. PCV system clogged or malfunctioning.	2. Check PCV system. Clean or replace as necessary.
	3. Loose carburetor or intake manifold bolts and/or leaking gaskets.	3. Torque carburetor to manifold bolts. Using a pressure oil can, spray light oil or kerosene around manifold to head mounting surface and carburetor base. If engine rpm changes, tighten or replace the carburetor or manifold gaskets as necessary.
	4. Low or erratic fuel pump pressure.	4. Check fuel delivery and pressure.
	5. Contaminated fuel.	5. Check for contaminants in fuel. Clean system if necessary.
	6. Fuel filter plugged.	6. Check and replace as necessary.
	7. Float level too low.	7. Check and reset float level to specification.
	8. Malfunctioning float and/or needle and seat.	8. Check operation of system. Repair or replace as necessary.
	9. Power piston sticking.	9. Check for free movement of power piston. Clean and correct as necessary.

DIAGNOSIS OF 1MEF ROCHESTER CARBURETOR (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Engine Surges (Continued)	10. Fuel jets or passages plugged or restricted. 11. Faulty ignition system. 12. Restricted exhaust system.	10. Clean and blow out with compressed air. 11. Check ignition system. 12. Check for restrictions. Correct as necessary.
Poor Gas Mileage *Black Smoke From Tail Pipe	1. Customer driving habits.	1. Run mileage test with customer driving if possible. Make sure vehicle has 2000-3000 miles (3 200-4 800 km) for the "break-in" period.
	2. Loose, broken or improperly routed vacuum hoses.	2. Check condition of all vacuum hose routings. Correct as necessary.
	3. Engine in need of service.	3. Check engine compression, examine spark plugs; if fouled or improperly gapped, clean and regap or replace. Check ignition wire condition and check and reset ignition timing. Replace air cleaner element if dirty. Check for restricted exhaust system and intake manifold for leakage. Check carburetor mounting bolt torque. Check vacuum and mechanical advance.
	4. Fuel leaks.	4. Check fuel tank, fuel lines and fuel pump for any fuel leakage.
	*5. Incorrect float setting.	5. Adjust.
	*6. Incorrect metering rod adjustment.	6. Adjust.
	*7. Loose main metering jet.	7. Tighten.
	*8. Faulty electric choke.	8. Refer to "Electric Choke" later in this section.
	9. Restricted exhaust system.	9. Repair.
	10. Low tire pressure or incorrect tire size.	10. Inflate tires to specifications and use correct size tires.
	11. Transmission malfunction or in wrong gear.	11. Refer to transmission diagnosis.
Gasoline Odor	1. Fuel feed or vapor return line leaking. 2. Leak in fuel tank. 3. Disconnected fuel tank vent lines or hoses. 4. Purge lines not connected, improperly routed, plugged or pinched. 5. Faulty fill cap.	1. Correct as required. 2. Purge tank and repair or replace tank as required. 3. Connect lines or hoses as required. 4. Check, connect and open lines as required. 5. Install new cap.
Fuel Starvation	1. Fuel line pinched, plugged or misrouted. 2. Fuel pump not operating.	1. Check open or reroute as required. 2. Test and replace if necessary.

ON-VEHICLE SERVICE (1MEF)

ELECTRIC CHOKE

Inspect

- Remove the air cleaner. With the engine off, hold the throttle half open. Open and close the choke several times. Watch linkage to be certain all links are connected and there are no signs of damage.
- If the choke or linkage binds, sticks, or works sluggishly, clean it with Choke Cleaner X-20-A or equivalent. Use cleaner as directed on the can. Refer to the disassembly instructions for additional direction if cleaning does not correct the problem. Do not lubricate the linkage.
- Visually inspect the carburetor to be certain all vacuum hoses are connected. Inspect hoses for cracks, abrasions, hardness or other signs of deterioration. Replace or correct as necessary.
- The vacuum break diaphragm shaft should be fully extended when the engine is off. If the shaft is not fully extended, replace the vacuum break assembly. Start engine — the vacuum break diaphragm shaft should fully retract within 10 seconds. If the unit fails to retract, replace the vacuum break assembly.
- Allow the choke to cool so that when the throttle is opened slightly, the choke blade fully closes. This check must be performed at an ambient temperature of about 21°C (70°F).
- Start the engine and determine the time required for the choke blade to reach its' full open position. (Start timing when the engine starts). If the choke plate fails to open fully within five minutes, proceed with the remaining steps.
- Check voltage at the choke heater connection with the engine running. If the voltage is approximately 12-15 volts, replace the electric choke unit. If the voltage is low or zero, check all wires and connections. If the connections at the oil pressure switch are dirty or corroded, the oil warning lamp will be off with the ignition switch "On" and the engine off. If the fuse is blown, the radio or turn signal indicator will be inoperative. Repair wires or replace fuses as necessary.
- If all wiring and fuses are good, replace the oil pressure switch.

Remove or Disconnect

1. Air cleaner.
2. The choke electrical connector.
3. Rivet heads and retainers.

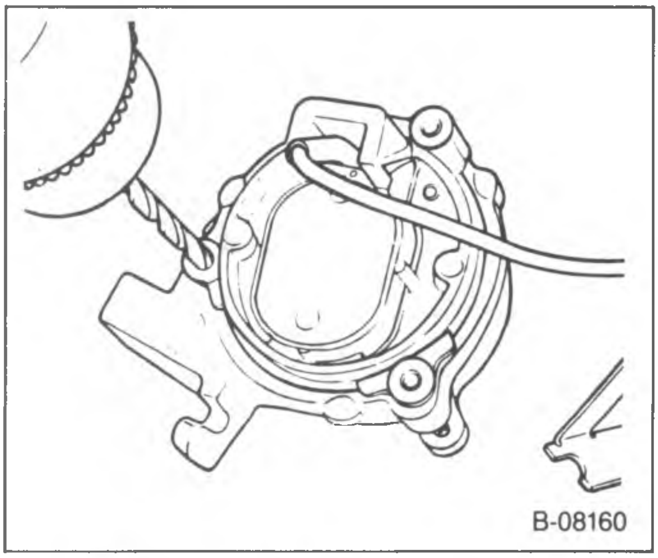


Figure 9—Drilling The Choke Coil Rivets

   - Align a #21 drill (0.156 inch) on the rivet head and drill only enough to remove the rivet head (figure 9).
   - Use a drift and a small hammer to drive the remainder of the rivets from the choke housing.
   - Use care in drilling to prevent damage to the choke cover or housing.
4. The choke cover assembly from the housing.
5. The choke coil from the housing.

Install or Connect

1. The choke cover and coil assembly in the choke housing.
   - Align the notch in the cover with the raised casting projection on the housing cover flange.
   - Make sure the coil pick-up tang engages the inside choke coil lever.
2. Retainers and rivets using a suitable blind rivet installing tool (figure 10).
3. Electrical connector.
- Start the engine and check the operation of the choke.
4. Air cleaner.

IDLE SOLENOID

Inspect

1. Turn on the engine control switch, but do not start the engine.

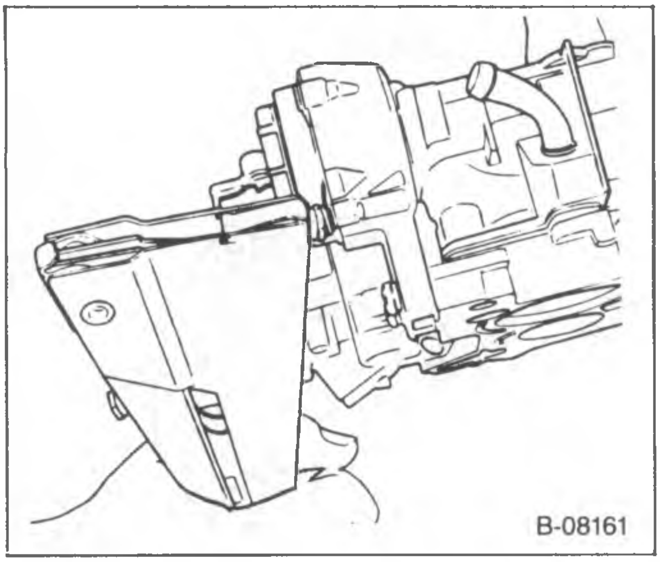


Figure 10—Installing The Choke Coil Rivets

2. Open the throttle to allow the solenoid plunger to extend.
3. Hold the throttle lever wide open, feel the end of the plunger and disconnect the wire at the solenoid.
4. Plunger should move. Some spring tension should be felt.
5. If the plunger did not move, back out 1/8 hex screw (counter clockwise) one full turn and repeat step 3 and 4.
6. If the plunger moves in step 5, connect the wire to the solenoid and adjust the idle speed.
7. If the plunger did not move in step 5, insert test light (1893 bulb or smaller) between the solenoid feed wire and ground.
8. If the light lights, replace the solenoid.
9. If the light does not light, locate the cause of the open circuit in the solenoid feed wire.

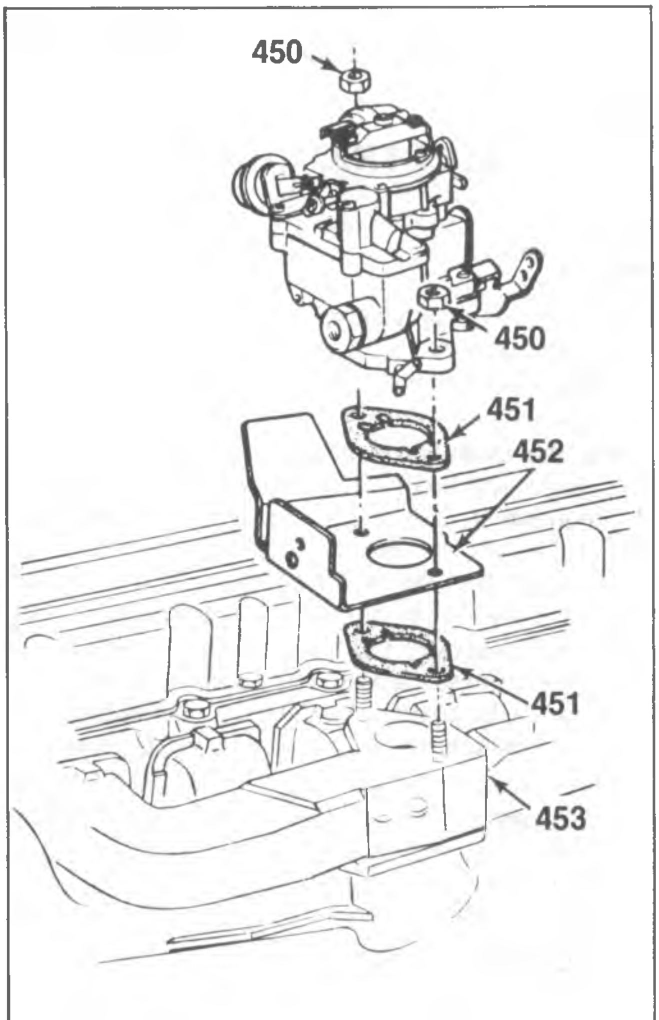
↔ Remove or Disconnect

1. Air cleaner.
2. Electrical connector from the solenoid.
3. Solenoid from the float bowl assembly.

→← Install or Connect

1. Solenoid.
    - Hold the choke valve wide open so the fast idle cam follower clears the fast idle cam.
    - Turn the solenoid until it contacts the lever tang.
2. Electrical connector.
3. Air cleaner.

- Check and adjust the idle speed.



450. Nut
451. Insulator Gasket
452. Heat Shield
453. Intake Manifold

Figure 11—Carburetor Installation

CARBURETOR REPLACEMENT

Flooding, stumble on acceleration and other performance complaints are, in many instances, caused by the presence of dirt, water or other foreign matter in the carburetor. To aid in diagnosing the cause, the carburetor should be removed carefully from the engine without draining fuel from the bowl. Contents of the fuel bowl may then be examined for foreign materials as the carburetor is disassembled.

↔ Remove or Disconnect (Figure 11)

1. Air cleaner assembly.
2. Fuel and vacuum lines from the carburetor.
    - Make note of the vacuum hose routing.
3. Electrical connectors for the choke and idle solenoid.
4. Accelerator linkage.
5. Carburetor attaching nuts.

6. Carburetor.
7. Insulator gaskets and heat shield.

Clean

- All traces of the old gasket from the carburetor flange and intake manifold.

Install or Connect (Figure 11)

1. Heat shield and insulator gaskets to the intake manifold.

CAUTION: Extinguish all open flames while filling and testing carburetor with gasoline to avoid personal injury.

2. Carburetor.
    - It is good shop practice to fill the carburetor float bowl before installing the carburetor. This reduces the strain on the starting motor and battery and reduces the possibility of backfiring while attempting to start the engine. Operate the throttle several times and check the discharge from pump jets before installing the carburetor.
3. Carburetor attaching nuts.

    Tighten

    - Both nuts to 4.1 N·m (36 in. lbs.) and then both nuts to 22 N·m (16 ft. lbs.).
4. Accelerator linkage.
5. Electrical connectors for the choke and idle solenoid.
6. Fuel and vacuum lines. Refer to the Emission Control Label, if necessary, for vacuum line routing information.
7. Air cleaner.

    Adjust

    - Idle speed, as outlined later.

CARBURETOR ADJUSTMENTS

A carburetor is designed to meet the particular requirements of the engine, transmission and vehicle and although they may look alike, they are not usually interchangeable. Refer to carburetor part number and/or specifications when making adjustments.

Before suspecting the carburetor as the cause of poor engine performance or rough idle; check the ignition system including distributor, timing, spark plugs and wires. Check the air cleaner, evaporative emission system, EFE System, PCV system, EGR valve and engine compression. Also inspect intake manifold, vacuum hoses and connections for leaks and check torques of carburetor mounting bolts/nuts.

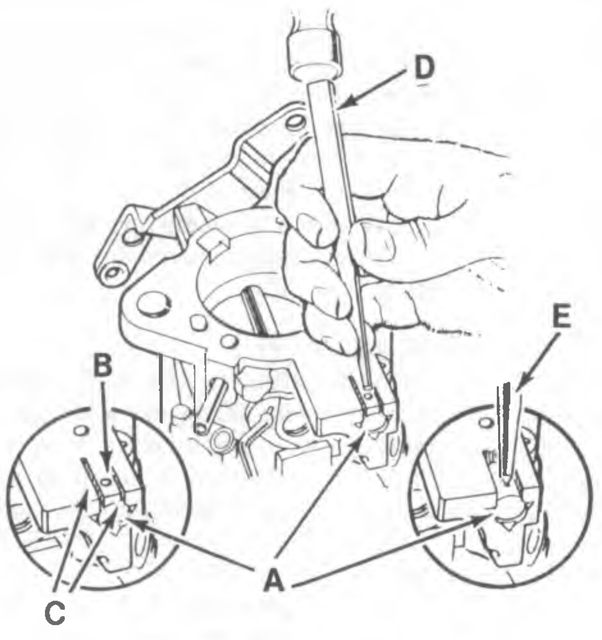
Make all adjustments with the engine at normal operating temperature, choke full open, and the air cleaner installed. Except as noted, air conditioning should be "off" and all vacuum lines and all electrical leads connected. Refer to "Specifications" at the end of this section for carburetor adjustment specifications. Gages and tools for making adjustments are included in the Universal Gage J-9789D.

IDLE MIXTURE ADJUSTMENT

In the case of a major carburetor overhaul, throttle body replacement, or high idle CO as indicated by an emissions inspection, the idle mixture may be adjusted. Adjusting the mixture by other than the following method may violate Federal and/or state laws.

Tool Required:
J-29030-B Idle Mixture Needle Socket

1. Set parking brake and block the drive wheels.
2. Remove the air cleaner.
3. Remove carburetor from the engine.
4. Invert the carburetor and drain fuel into a container. Dispose of the fuel in an approved container.
5. Place the carburetor on a suitable holding fixture with the manifold side up.
6. Make two parallel cuts in the throttle body, one on each side of the locator point with a hack saw. The cuts should reach down to the steel plug but should not extend more than 3 mm (1/8-inch) beyond the locator points (figure 12).
7. Place a small flat punch at a point near the ends of the saw marks in the throttle body. Holding the punch at a 45 degree angle, drive it into the throttle body until the casting breaks away, exposing the steel plug.
8. Hold a center punch vertically and drive it into the steel plug. Hold the punch at a 45 degree angle and drive the plug out of the casting. The plug will break rather than remain intact. It is not necessary to remove the plug completely, but remove all loose pieces.
9. Use J-29030-B to lightly seat the idle mixture needle, then back the needle out three turns.
10. Install the carburetor as outlined previously.
11. Disconnect and plug hoses, as directed on Vehicle Emission Control Information label under the hood.
12. Place the transmission in Neutral or Park.
13. Start the engine and bring it to normal operating temperature, choke open, air conditioning off.
14. Connect an ACCURATE tachometer to the engine.
15. Disconnect the vacuum advance and plug the hose. Check ignition timing. If necessary, adjust to the specification shown on Vehicle Emission



A. Idle Mixture Needle Plug
B. Locator Point
C. Hacksaw Slots
D. Flat Punch
E. Center Punch

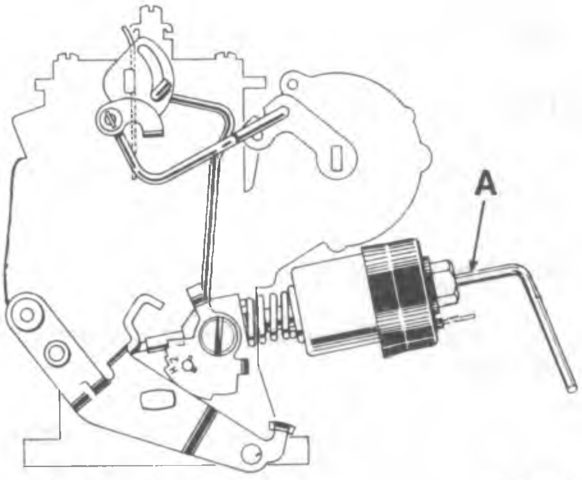
Figure 12—Removing The Idle Mixture Needle Plug

Control Information Label. Reconnect the vacuum advance.

16. Use J-29030-B to turn the mixture needle to obtain the highest RPM (best idle).
17. Adjust the idle stop screw to obtain the base idle speed specified on the Emission Control Information Label.
18. Readjust the mixture needle to obtain the highest idle RPM.
19. If necessary, readjust the idle stop screw to obtain the specified base idle speed.
20. If necessary, adjust the fast idle speed and the idle stop solenoid activated speed to the specification shown on the Emission Control Information Label.
21. Turn the engine off and reconnect the vacuum hoses.
22. Install the air cleaner.
23. Remove the block from the wheels.

IDLE SPEED ADJUSTMENT (Figure 13)

1. Engine must be warm with the choke wide open.
2. The fast idle cam follower must be off the steps of the cam.
   - See the Emission Control Information label.
3. Set the curb idle to specification. Turn the solenoid in or out to adjust RPM.
   - The solenoid should be energized.



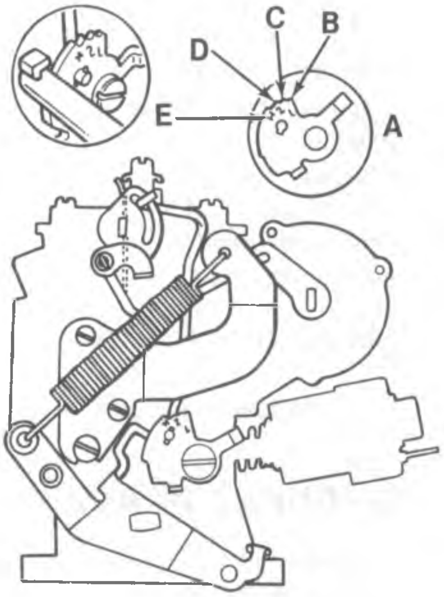
A. Hex Wrench

Figure 13—Idle Speed Adjustment

4. Turn a 1/8'' Hex screw to adjust the low idle speed to 450 RPM.
   - The solenoid should not be energized.

FAST IDLE ADJUSTMENT (Figure 14)

1. Prepare the vehicle for adjustments according to the Emission Control Information label.
   - Ignition timing must be set per label.



A. Fast Idle Cam Steps
B. Low
C. Third
D. Second
E. High

Figure 14—Fast Idle Adjustment

2. Adjust the curb idle speed with the idle stop solenoid.
3. Place the cam follower tang on the high step of the cam.
4. Support the lever with pliers and bend the tang in or out to obtain the specified fast idle RPM.

CHOKE COIL LEVER ADJUSTMENT (Figure 15)

1. Place the fast idle cam follower on the highest step of the fast idle cam.
2. Hold the choke valve completely closed.
3. Bend the link to adjust.
    - A 3 mm (0.120-inch) plug gage must pass through the hole in the lever and enter the hole in the casting.

CHOKE ROD (FAST IDLE CAM) ADJUSTMENT (Figure 16)

1. With the fast idle adjustment made, the fast idle cam follower must be held firmly on the second step of the fast idle cam and against the highest step.
2. Hold down on the choke valve so the rod is in the end of the slot.
3. Gage between the lower edge of the choke valve (at the center) and the inside air horn wall.
    - Refer to "Specifications."
4. Bend the rod at point A to adjust.

CHOKE UNLOADER ADJUSTMENT (Figure 17)

1. If the choke coil is warm, cool it down to the point where the choke valve will close fully.
2. Hold the throttle valve wide open.
3. Gage between the lower edge of the choke valve and the inside of the air horn.
4. Bend the tang to adjust.

VACUUM BREAK ADJUSTMENT (Figure 18)

1. Place the fast idle cam follower on the highest step of the cam.
2. Use an outside vacuum source to seat the vacuum break diaphragm.
    - On delay feature models, cover the plug and the purge bleed hole with a 1 inch square of masking tape. Remove the tape after adjustment.
3. Push down on the choke valve (compress the plunger bucking spring and seat the plunger stem on models so equipped).
4. Gage between the lower edge of the choke valve and the inside of the air horn wall.
    - Hold the gage vertical.
5. Bend the link at point "A" to adjust.

FLOAT ADJUSTMENT (Figure 19)

Tool Required:

J-34817 Float Positioning Tool Kit

1. Remove the air horn and gasket.
2. Attach J-34817-2 to the float bowl using an air horn attaching screw.

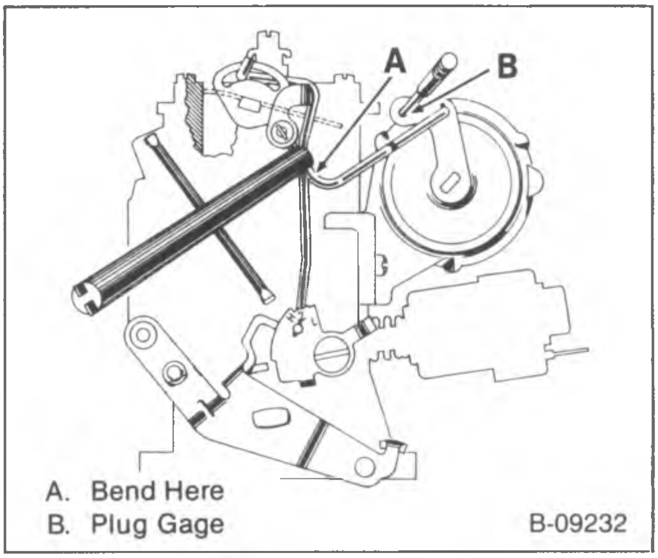


Figure 15—Choke Coil Lever Adjustment

3. Place J-34817-3 in the base with the contact pin resting on the edge of the float lever.
4. Measure the distance from the top of the casting to the top of the index at the toe of the float.
    - Use J-9789-90.
5. If more than ± 2/32" from specification, use J-34817-30 to bend the lever up or down. Remove J-34817-30 and measure, repeating until within specification.

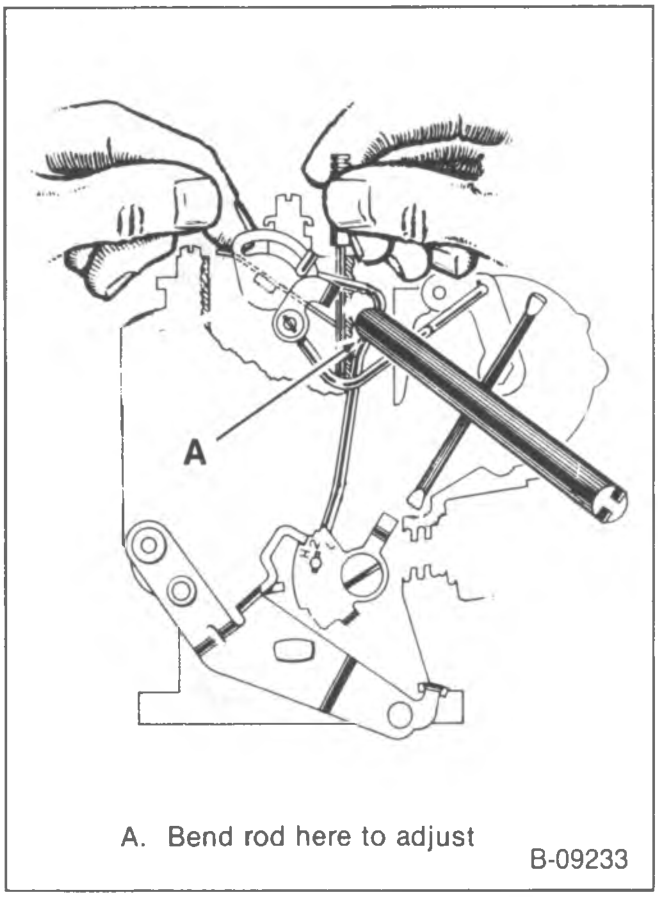


Figure 16—Choke Rod (Fast Idle Cam) Adjustment

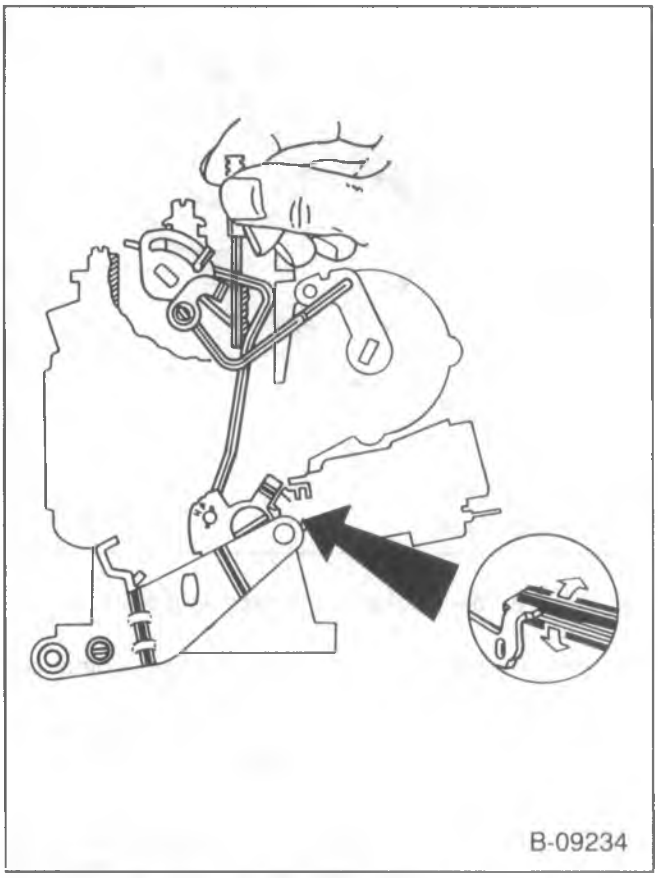
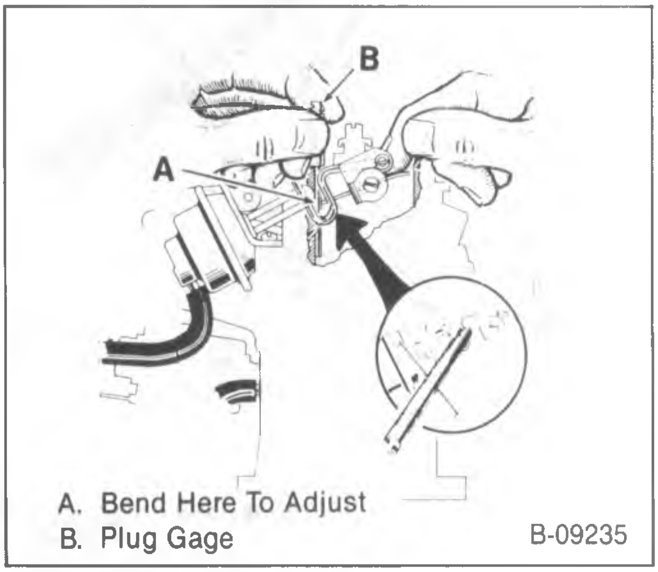


Figure 17—Choke Unloader Adjustment

6. Check float alignment.
7. Install the air horn and gasket.

METERING ROD ADJUSTMENT (Figure 20)

1. Remove the metering rod.
    - Hold the throttle valve wide open.
    - Push down on the metering rod against spring tension.



A. Bend Here To Adjust
B. Plug Gage

Figure 18—Vacuum Break Adjustment

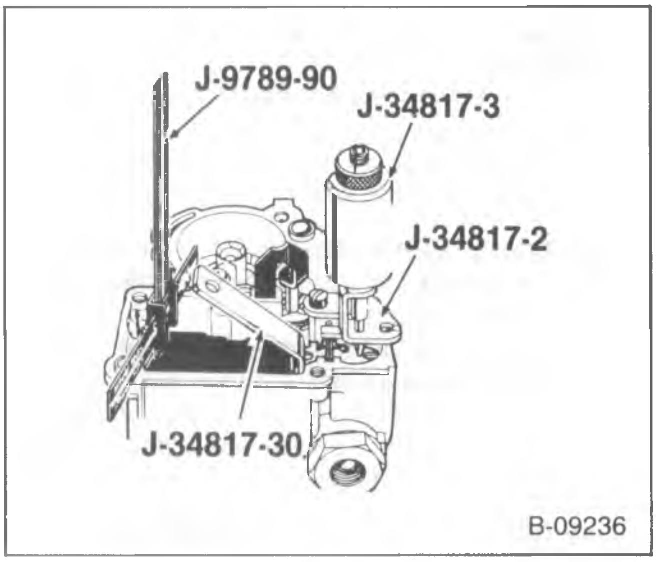
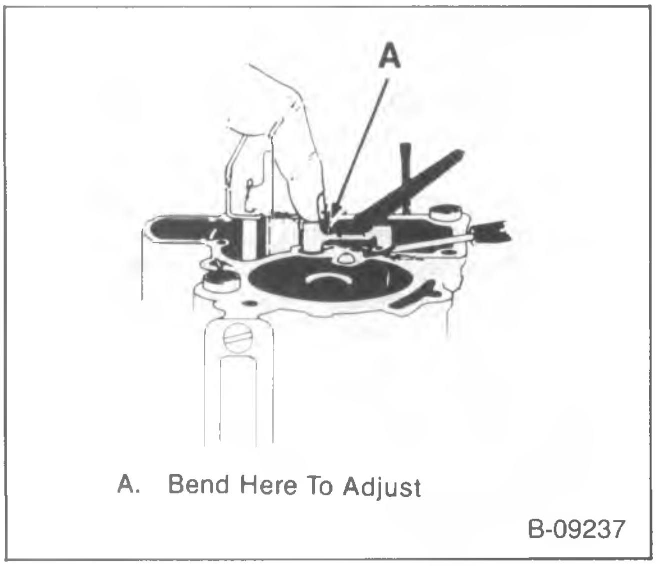


Figure 19—Float Adjustment

    - Slide the metering rod out of the slot in the holder.
2. Back out the idle stop solenoid.
    - Hold the throttle valve completely closed.
3. Hold the power piston down and swing the metering rod holder over the flat surface of the bowl casting next to the carburetor bore.
    - The gasket must be removed.
4. Gage between the end of the metering rod holder and the top of the casting.
    - Use the specified plug gage.
    - Gage should have a slide fit.
5. Bend at point "A" to adjust.



A. Bend Here To Adjust

Figure 20—Metering Rod Adjustment

CARBURETOR MODELS M4ME, M4MED AND M4MEF

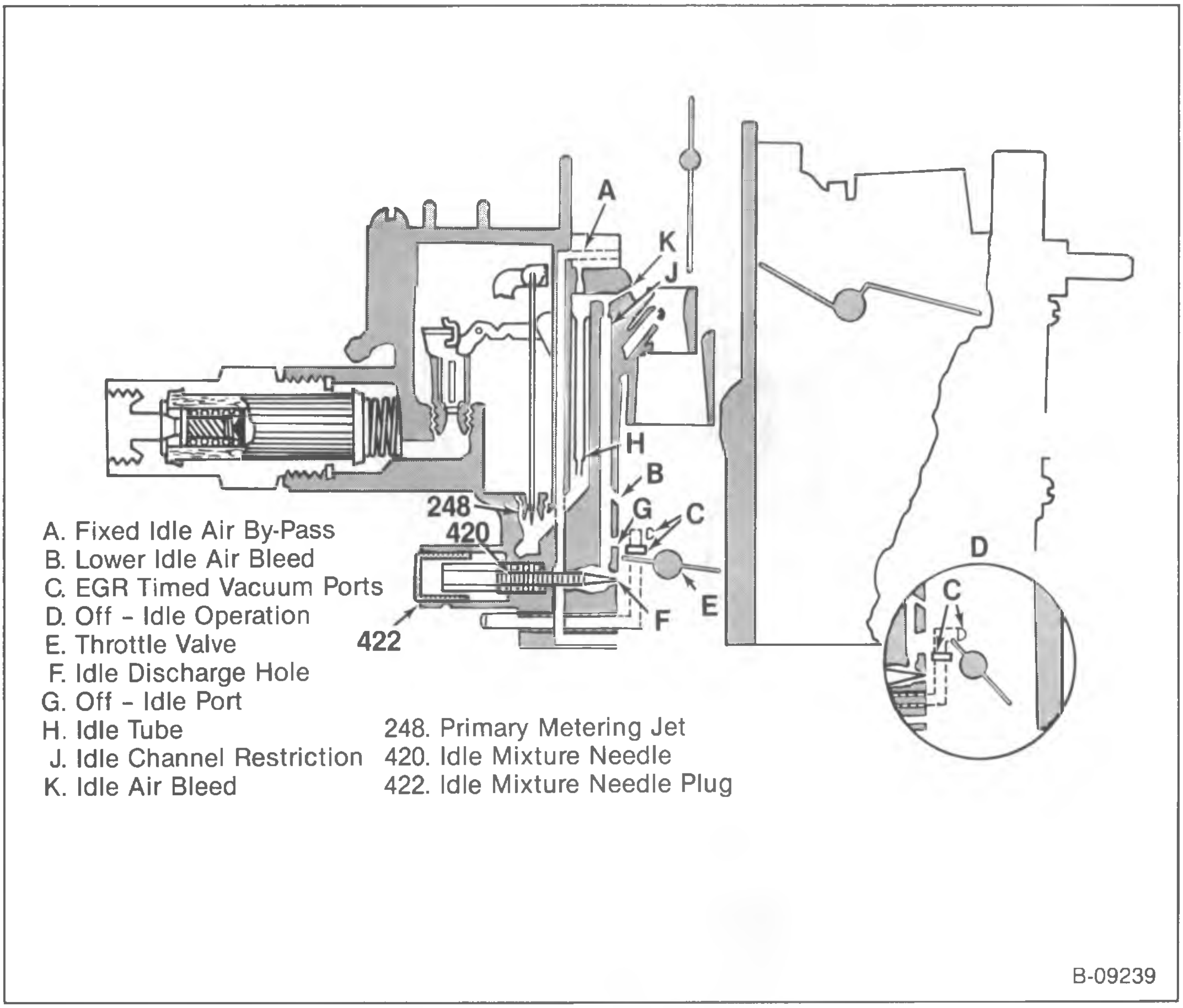


Figure 21—Idle System M4ME, And M4MED

DESCRIPTION

All these models are four barrel, two stage carburetors with three major assemblies: the air horn, float bowl, and throttle body. They have six basic operating systems (figures 21 through 33).

- Float
- Idle
- Main Metering
- Power
- Pump
- Choke

The first "M" indicates this carburetor is of a Modified primary metering "open loop" design.

The "4M" is the model designation, indicating it is a four barrel carburetor. The remaining letters designate specific features.

E — uses an electric choke.

D — has a dual capacity pump.

F — has an adjustable wide open throttle mixture control.

METERING SYSTEMS

A single float chamber supplies fuel to all carburetor bores. A float, float needle with pull clip, and a float needle seat, are used to control the level of fuel in the float chamber. A vacuum-operated power piston and metering rods control the air/fuel metering in the primary bores of the carburetor. Tapered metering rods are attached to the power valve piston assembly, and move in fixed metering jets, to provide the fuel flow for varying engine demands. A factory-set adjustable part throttle screw, used on all models, precisely positions the tapered portion of the metering rods in the jets. (On M4MEF models, the factory-set rich stop adjusting

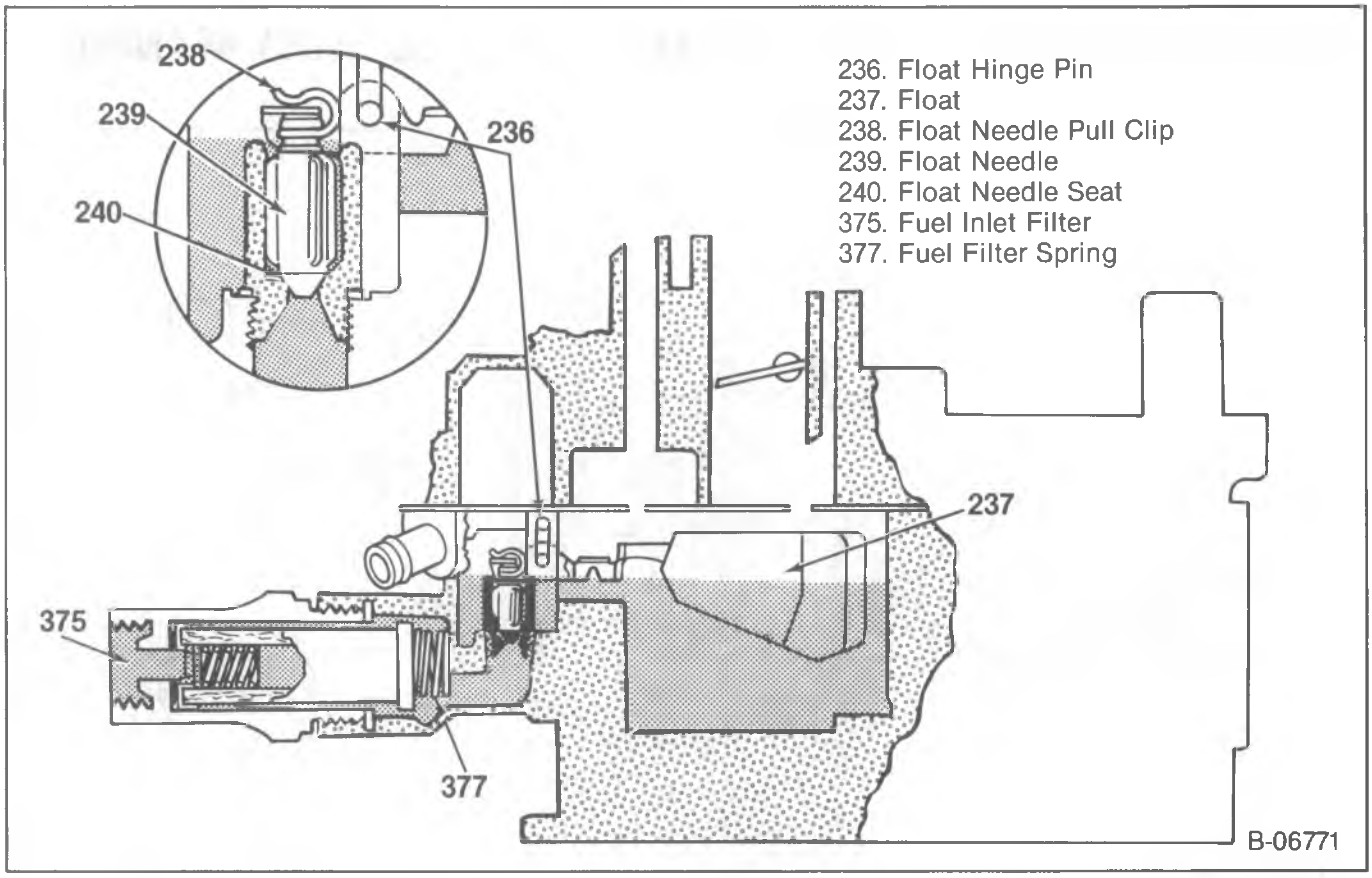


Figure 22—Float System

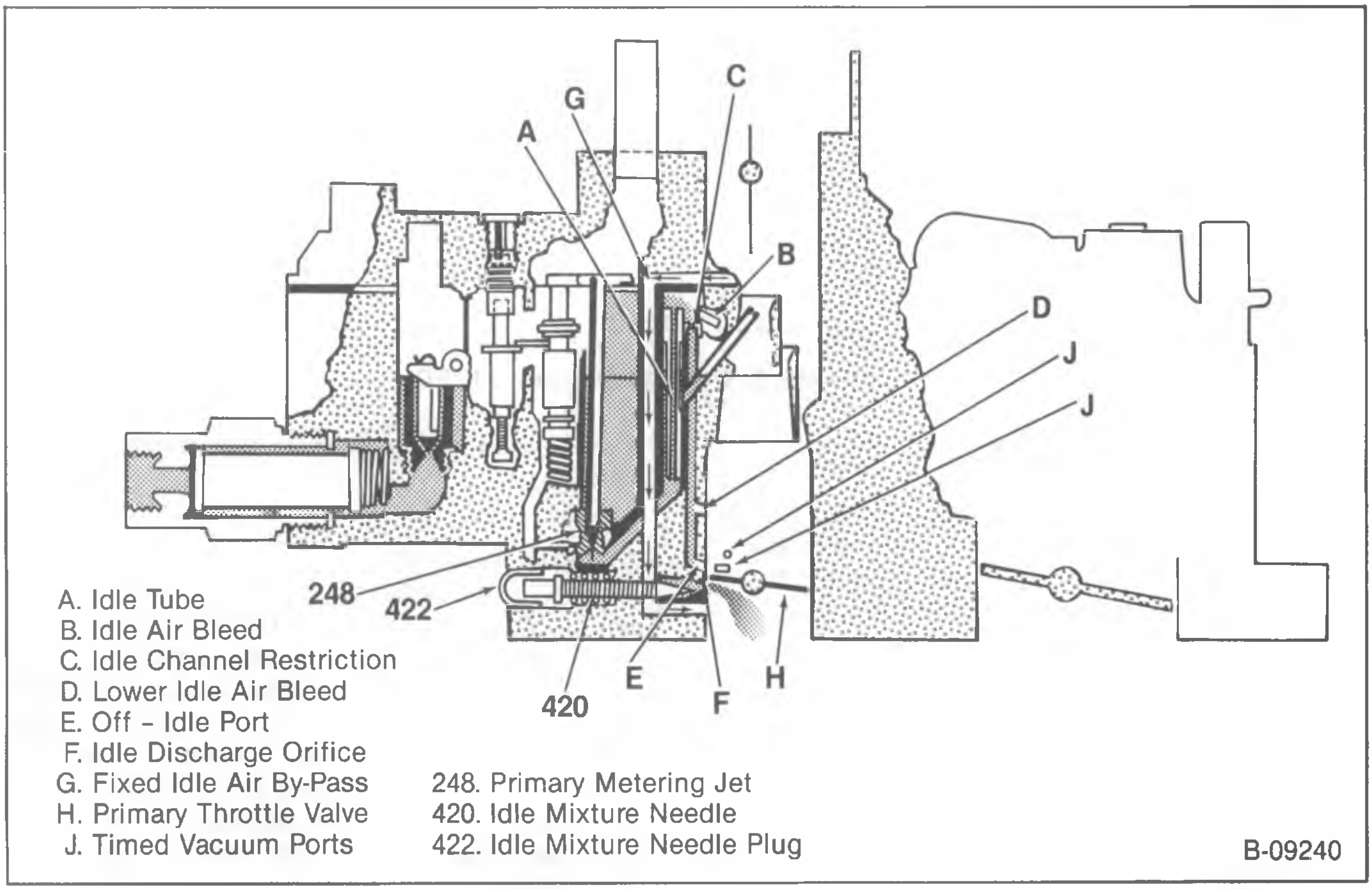
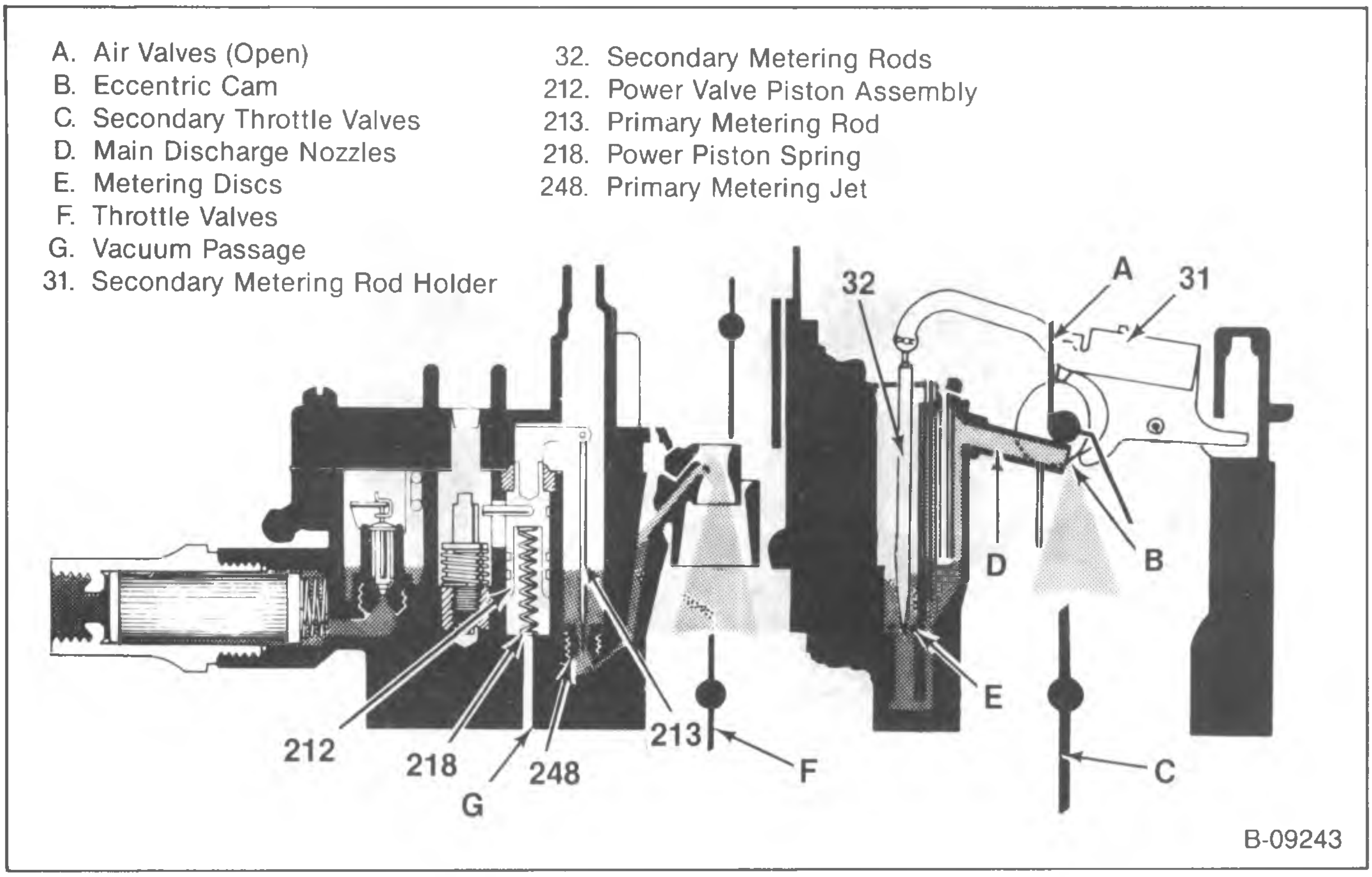
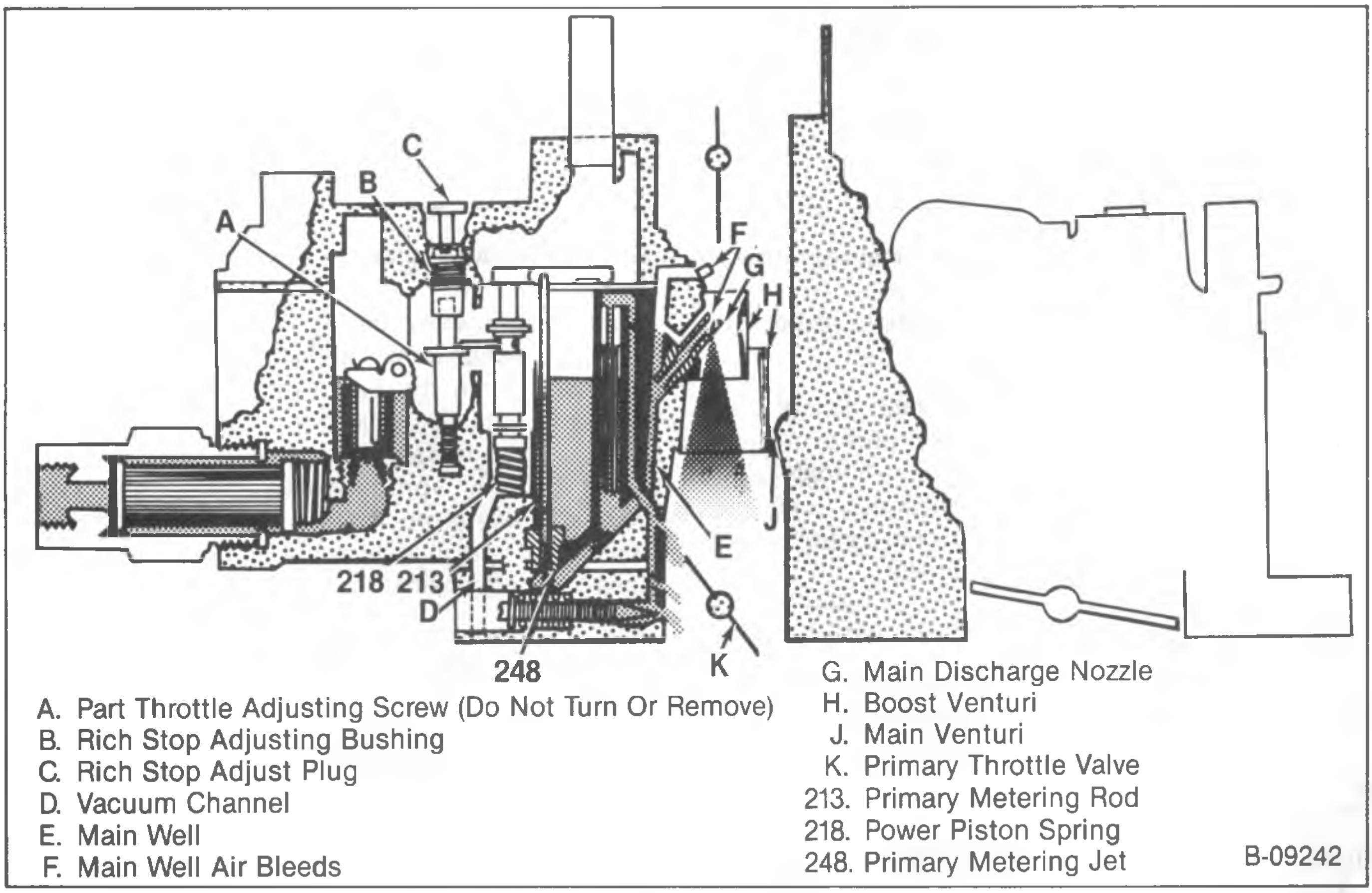


Figure 23—Idle System M4MEF



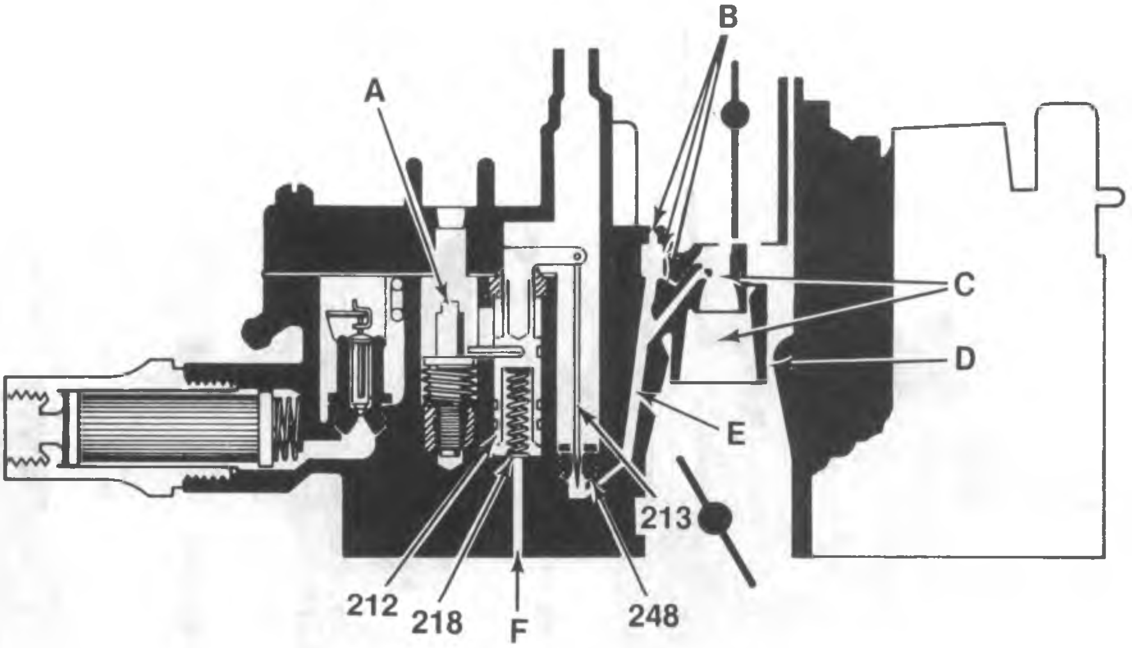
A. Air Valves (Open)
B. Eccentric Cam
C. Secondary Throttle Valves
D. Main Discharge Nozzles
E. Metering Discs
F. Throttle Valves
G. Vacuum Passage
31. Secondary Metering Rod Holder
32. Secondary Metering Rods
212. Power Valve Piston Assembly
213. Primary Metering Rod
218. Power Piston Spring
248. Primary Metering Jet

Figure 24—Power System M4ME And M4MED



A. Part Throttle Adjusting Screw (Do Not Turn Or Remove)
B. Rich Stop Adjusting Bushing
C. Rich Stop Adjust Plug
D. Vacuum Channel
E. Main Well
F. Main Well Air Bleeds
G. Main Discharge Nozzle
H. Boost Venturi
J. Main Venturi
K. Primary Throttle Valve
213. Primary Metering Rod
218. Power Piston Spring
248. Primary Metering Jet

Figure 25—Main Metering System — M4MEF



A. Metering Adjustment Screw (Factory Set)
B. Main Well Air Bleeds
C. Boost Venturi
D. Main Venturi
E. Main Fuel Wells
F. Vacuum Passage
212. Power Valve Piston Assembly
213. Primary Metering Rod
218. Power Piston Spring
248. Primary Metering Jet

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Figure 26—Main Metering System — M4ME And M4MED

bushing precisely positions the enrichment portion of the metering rods in the jets.)

Air valves and tapered metering rods control the air/fuel mixture in the secondary bores during increased engine air flow at wide open throttle. On M4MEF models, the factory-set secondary well air bleed adjusting screw provides additional control of the air/fuel mixture during wide open throttle.

PUMP SYSTEMS

The pump system on all models uses a throttle actuated pump plunger, operating in the pump well. The pump provides extra fuel during quick throttle openings.

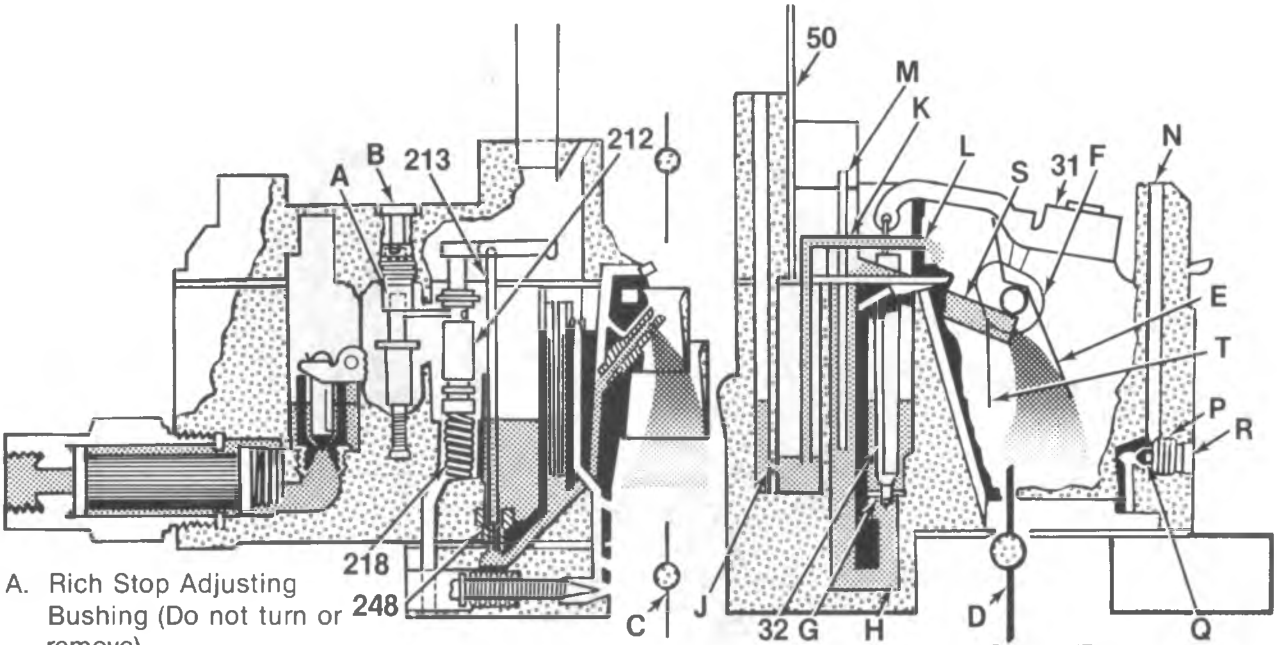
DUAL CAPACITY PUMP (M4MED ONLY)

M4MED carburetors have a float bowl-mounted dual capacity pump valve assembly and a dual capacity pump solenoid assembly.

When the engine is cold, more fuel is necessary to insure a smooth transition from idle to part throttle operation. When the engine is warm, less fuel is needed. The dual capacity pump solenoid is activated by a coolant temperature sensor. When coolant temperature is approximately 170°F, the pump solenoid is energized. The pump solenoid opens the dual capacity pump valve, reducing the capacity of the pump by about one-half.

CHOKE SYSTEMS

A choke coil is used to provide the choke valve closing force for cold startup and for correct opening timing during warmup. Vacuum break assemblies control initial choke valve openings at startup and during warmup. An unloader tang on the throttle lever forces the choke valve open to purge a flooded engine when the accelerator is pressed to the floor. The fast idle cam, following choke valve movement, acts as a



A. Rich Stop Adjusting Bushing (Do not turn or remove)
B. Rich Stop Adjusting Plug
C. Primary Throttle Valve
D. Secondary Throttle Valve
E. Air Valve
F. Eccentric Cam
G. Metering Disc
H. Secondary Fuel Well
J. Accelerator Well Inlet Orifice
K. Accelerator Well and Tube
L. Accelerator Well Discharge Orifice
M. Secondary Well Bleed Tube
N. Clean Air Inlet
P. Secondary Well Bleed Adjust Screw (Do not turn or remove)
Q. Secondary Well Bleed Adjust Spring
R. Secondary Well Bleed Adjust Plug
S. Secondary Discharge Nozzle
T. Baffle
31. Secondary Metering Rod Holder
32. Secondary Metering Rod
50. Air Horn Baffle
212. Power Valve Piston Assembly
213. Primary Metering Rod
218. Power Piston Spring
248. Primary Metering Jet

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Figure 27—Power System — M4MEF

graduated throttle stop to provide increased idle speed during warmup.

THROTTLE KICKER AND IDLE SPEED SOLENOID

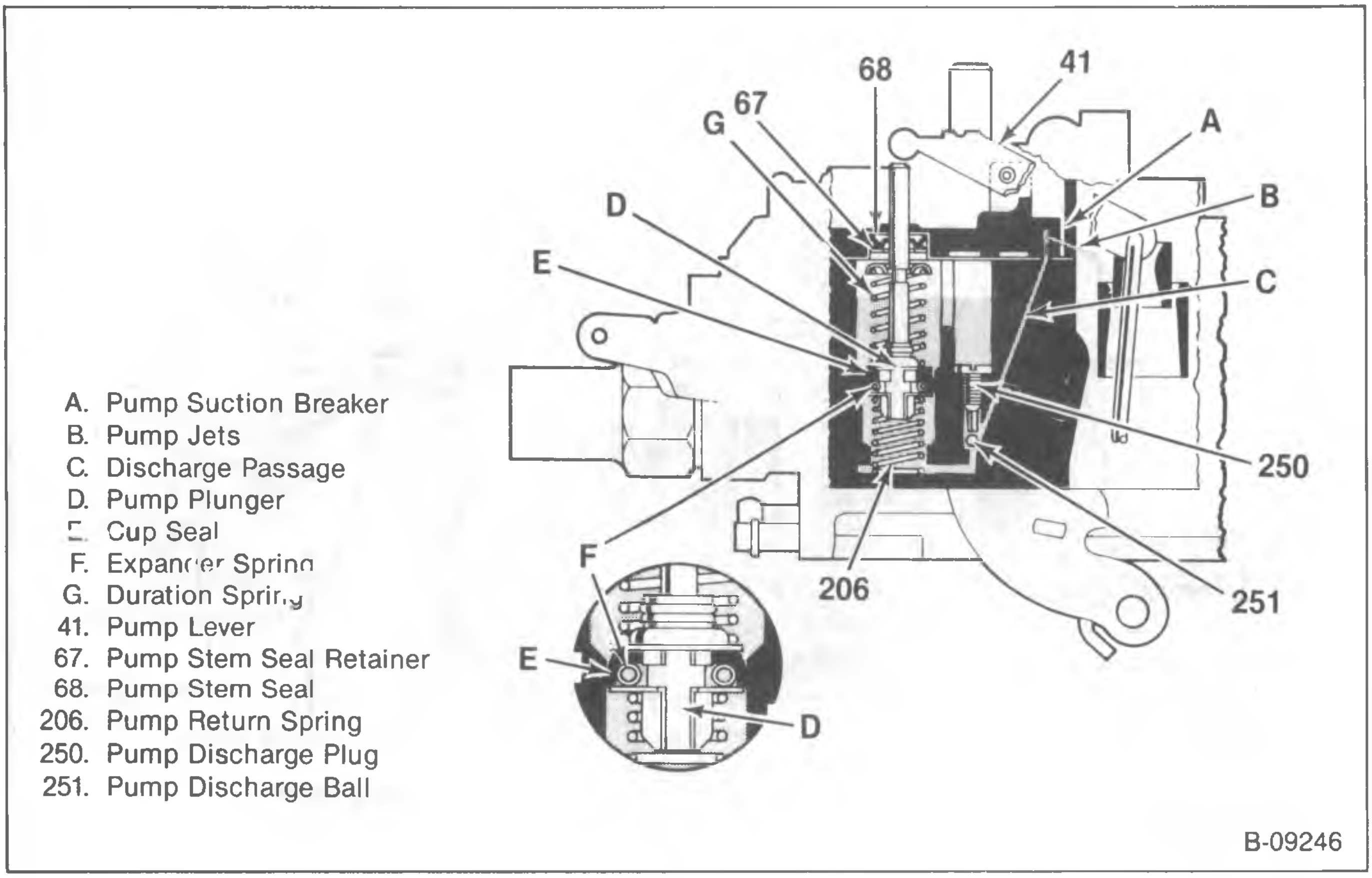
Depending on engine displacement and vehicle application, a throttle kicker assembly or an idle speed solenoid may be used.

On vehicles without air conditioning, the idle speed solenoid provides desired engine speed and prevents dieseling when the ignition is turned off. On vehicles with air conditioning, the idle speed solenoid maintains engine idle speed when the air conditioning compressor clutch is engaged. The solenoid is energized by the air conditioning switch.

The vacuum-operated throttle kicker holds the throttle open during deceleration, to reduce emissions. On the 4.3 liter engine, it is also used to increase engine idle speed based on accessory load.

CARBURETOR IDENTIFICATION

Refer to the carburetor identification before servicing the carburetor. The number is stamped vertically on the float bowl near the secondary throttle lever (figure 34). Follow the instructions in the service package when replacing the float bowl assembly. Stamp or engrave the identification number on the new float bowl.



A. Pump Suction Breaker
B. Pump Jets
C. Discharge Passage
D. Pump Plunger
E. Cup Seal
F. Expander Spring
G. Duration Spring
41. Pump Lever
67. Pump Stem Seal Retainer
68. Pump Stem Seal
206. Pump Return Spring
250. Pump Discharge Plug
251. Pump Discharge Ball

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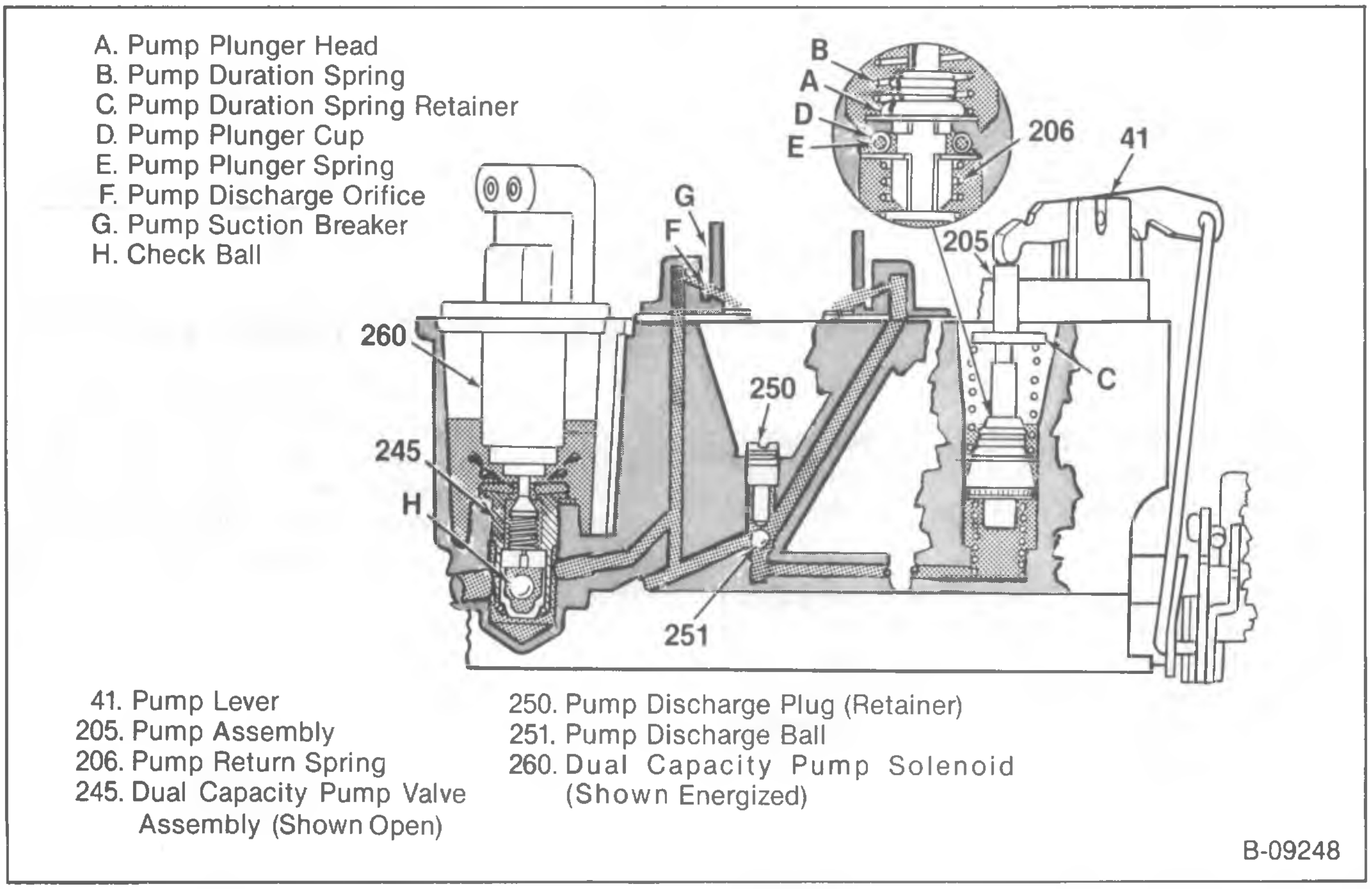
Figure 28—Pump System — M4ME And M4MEF



A. Pump Plunger Head
B. Pump Duration Spring
C. Pump Duration Spring Retainer
D. Pump Plunger Cup
E. Pump Plunger Spring
F. Pump Discharge Orifice
G. Pump Suction Breaker
H. Check Ball

41. Pump Lever
205. Pump Assembly
206. Pump Return Spring
245. Dual Capacity Pump Valve Assembly (Shown Open)
250. Pump Discharge Plug (Retainer)
251. Pump Discharge Ball
260. Dual Capacity Pump Solenoid (Shown Energized)

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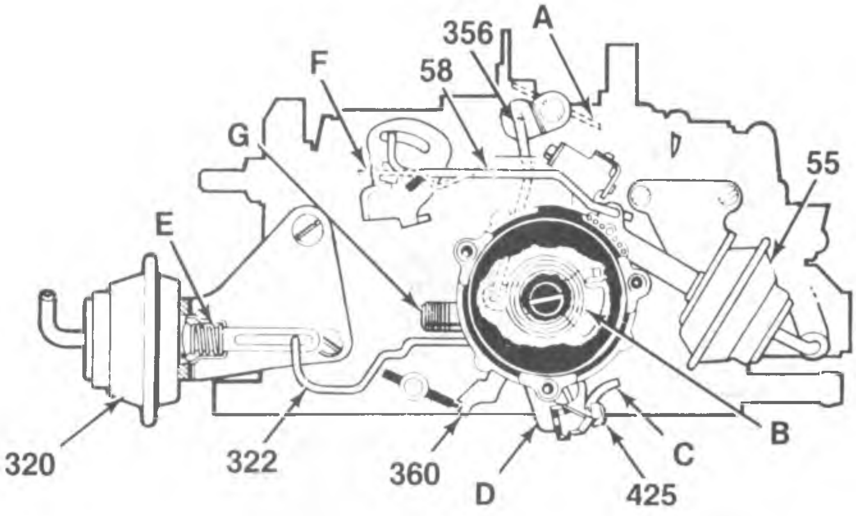
Figure 29—Dual Capacity Pump System — M4MED



A. Choke Valve
B. Thermostatic Coil
C. Unloader Tang
D. Fast Idle Cam Follower
E. Plunger Bucking Spring (Not Used On All Models)
F. Air Valve
G. Hot Air Inlet

55. Primary Side Vacuum Break Assembly
58. Primary Side Vacuum Break To Air Valve Link
320. Secondary Side Vacuum Break Assembly
322. Secondary Side Vacuum Break to Choke Link
356. Choke Link
360. Secondary Throttle Lockout Lever
425. Fast Idle Adjusting Screw

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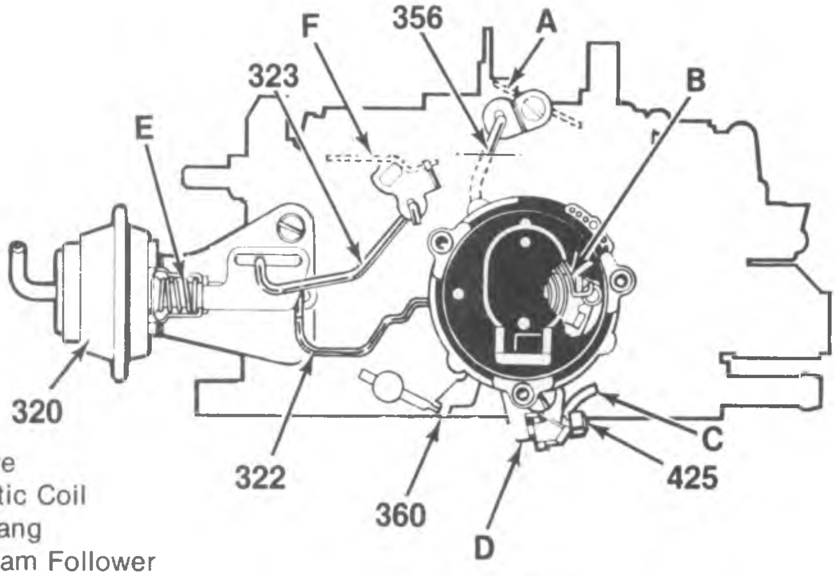
Figure 30—Hot Air Choke System With Front And Rear Vacuum Breaks



A. Choke Valve
B. Thermostatic Coil
C. Unloader Tang
D. Fast Idle Cam Follower
E. Plunger Bucking Spring (Not Used On All Models)
F. Air Valve
320. Secondary Side Vacuum Break Assembly
322. Secondary Side Vacuum Break To Choke Link
323. Secondary Side Vacuum Break to Air Valve Lever Link
360. Secondary Throttle Lockout Lever
425. Fast Idle Adjusting Screw

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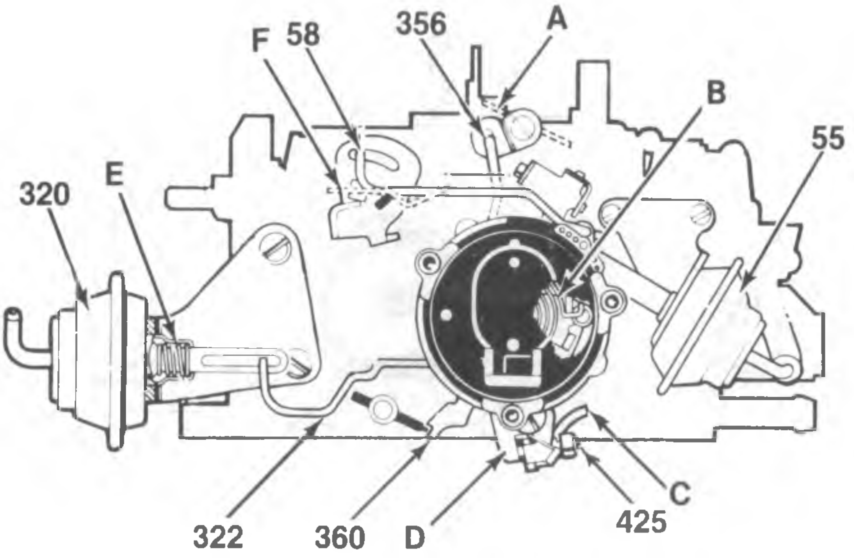
Figure 31—Electric Choke With Rear Vacuum Break

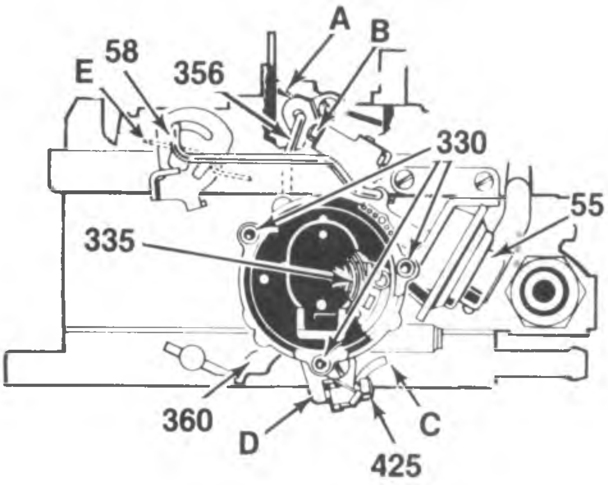


A. Choke Valve
B. Thermostatic Coil
C. Unloader Tang
D. Fast Idle Cam Follower
E. Plunger Bucking Spring (Not Used On All Models)
F. Air Valve

55. Primary Side Vacuum Break Assembly
58. Primary Side Vacuum Break To Air Valve Lever
320. Secondary Side Vacuum Break Assembly
322. Secondary Side Vacuum Break To Choke Link
356. Choke Link
360. Secondary Throttle Lockout Lever
425. Fast Idle Adjusting Screw

B-09252

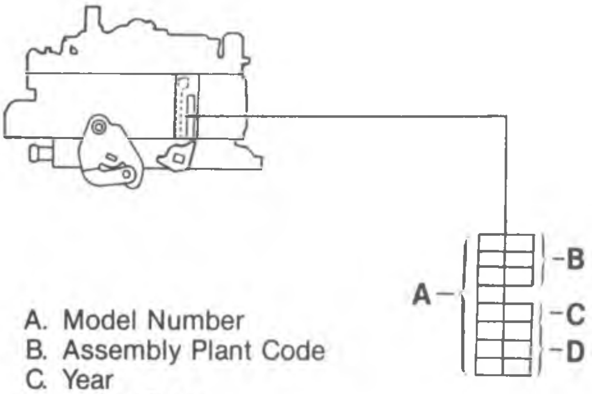
Figure 32—Electric Choke With Front And Rear Vacuum Breaks



A. Choke Valve
B. Adjustment Screw
C. Unloader Tang
D. Fast Idle Cam Follower
E. Air Valve
55. Primary Side Vacuum Break Assembly
58. Air Valve Link Rod
330. Choke Cover Attaching Rivet
335. Electric Choke Cover and Stat Assembly
356. Choke Link
360. Secondary Throttle Lockout Lever
425. Fast Idle Adjusting Screw

B-09250

Figure 33—Electric Choke System With Front Vacuum Break



A. Model Number
B. Assembly Plant Code
C. Year
D. Julian Date

B-09586

Figure 34—Carburetor Identification

ON-VEHICLE SERVICE (M4ME, M4MED AND M4MEF)

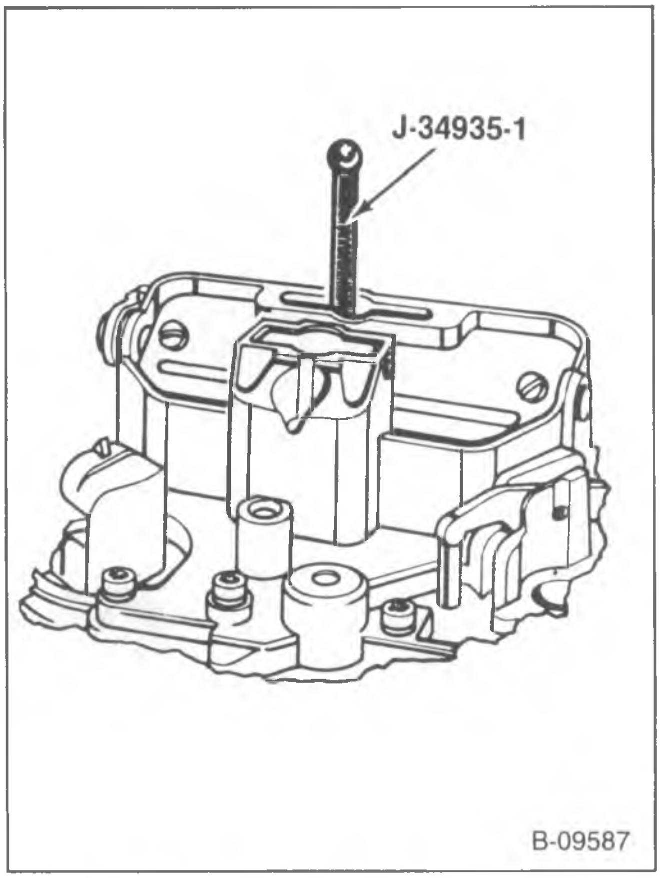


Figure 35—Checking The Float Level

FLOAT LEVEL CHECK

1. With the engine idling and the choke wide open, insert J-34935-1 in the vent slot or vent hole (figure 35).
   - Allow the gage to float freely.

NOTICE: Do not press down on the gage. Flooding or float damage could result.

2. Observe the mark on the gage that lines up with the top of the casting. The setting should be within 1.588 mm (2/32-inch) of the specified float level setting.
   - Incorrect fuel pressure will adversely affect the fuel level.
3. If not within specification, remove the air horn and adjust the float.

CHOKE AND HOSES

Check the choke mechanism and vacuum break(s) for proper operation at recommended maintenance intervals.

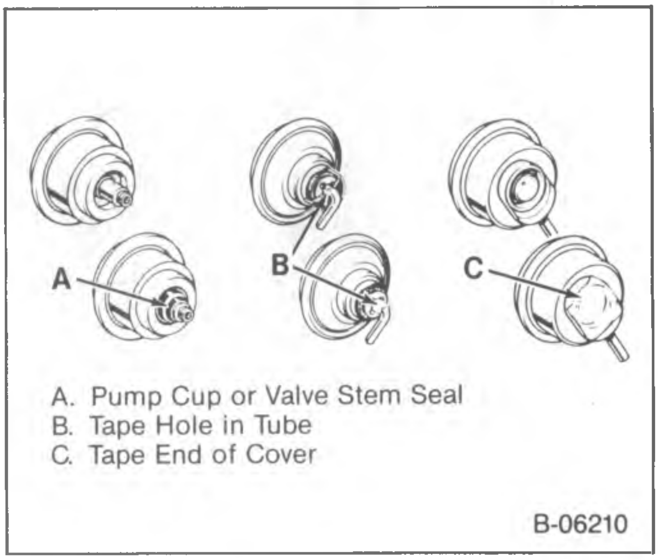


Figure 36—Plugging The Vacuum Break Air Bleed Holes

1. Remove the air cleaner. With the engine off, hold the throttle half open. Open and close the choke several times. Be sure all links are connected, and are not damaged.
2. If choke or linkage binds or is sluggish, clean them with choke cleaner X-20-A or equivalent. Refer to the "Light Duty Truck" Unit Repair Manual if cleaning does not correct the problem.
3. Inspect all carburetor vacuum hoses for proper connections, cracks, cuts, hardness, or other signs of deterioration. Replace or correct as necessary.

VACUUM BREAK CHECKING PROCEDURE

1. If the vacuum break has an air bleed hole, plug it during this checking procedure (figure 36).
2. Use hand held vacuum pump J-23738-A or equivalent, to apply -51 kPa (15 in. Hg.) vacuum to the vacuum break.
   - The vacuum break plunger should retract fully within ten seconds. Apply finger pressure to see if the plunger has moved through its' full travel. If it fails to retract within ten seconds, or if it fails to move through full travel, replace the vacuum break assembly.
   - The vacuum break diaphragm should hold vacuum for at least twenty seconds. If it does not, replace the vacuum break.

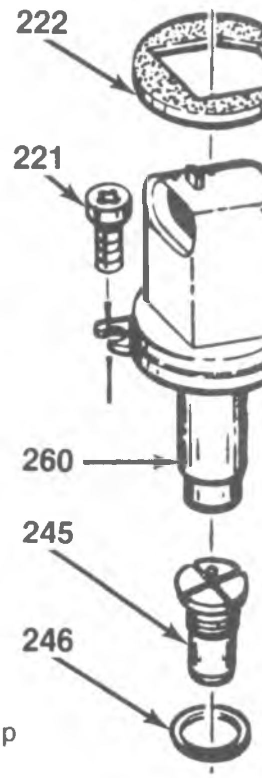
ELECTRIC CHOKE CHECKING PROCEDURE

1. Allow the choke to cool so that when the throttle is opened slightly, the choke valve closes fully.
   - Ambient temperature should be 15°-27°C (60°-80°F).

2. Start the engine and find the time that the choke valve takes to open fully.
   - Start timing when the engine starts.
3. If the choke fails to open fully within five minutes, check the voltage at the choke heater connection with the engine running.
   - If approximately 12-15 volts, replace the electric choke assembly.
   - If low or zero, check all connections and wires. Repair wires or replace fuses as required.

DUAL CAPACITY PUMP CHECK (M4MED ONLY)

1. Bring the engine to normal operating tempearture.
2. With the ignition off, actuate the throttle lever several times and observe the fuel stream. The stream should be strong and consistent.
3. Run the engine to refill the float bowl.
4. With the ignition on, actuate the throttle lever several times and observe the fuel stream. Less fuel should be coming from the pump because the solenoid is energized.
5. If the pump stream does not change and appears to be strong and consistent, fuel is not being bypassed by the pump circuit.
   - Disconnect the solenoid (260) (figure 37) coolant temperature switch connector and jump it to ground.
   - Repeat step 4.
     - If less fuel comes from the pump, check cooling system operation and the coolant temperature switch for opens.
     - If the pump stream remains the same, check wiring for opens or shorts.
   - Disconnect the dual capacity pump solenoid connector.
   - Remove the air horn assembly and gasket.
   - Remove the dual capacity solenoid from the float bowl and connect the solenoid connector.
   - With the ignition on and the coolant switch lead grounded, the solenoid should be energized and the solenoid plunger should extend. Replace the solenoid if it does not extend.
   - Check the pump valve (245) and passages for dirt or obstructions.
   - Check pump system operation.
6. If the pump stream does not change and appears to be weak or irregular, fuel is leaking in the pump circuit.
   - Disconnect the dual capacity pump solenoid (260) (figure 37) connector.



221. Screw
222. Gasket
245. Dual Capacity Pump Valve Assembly
246. Gasket
260. Dual Capacity Pump Solenoid

F-00861

Figure 37—Dual Capacity Pump

   - Remove the air horn assembly and the gasket.
   - Fill the float bowl and the pump well with clean fuel.
   - Seal the two pump discharge passages on the top surfaces of the float bowl with two fingers while pushing the pump assembly slowly into the pump well.
     - The pump assembly should not travel to the bottom of the well. The only movement should be the compressing of the duration spring.
     - If the pump assembly moves down in the well, the pump cup may be worn, hardened or damaged, the pump well may be worn or scored, the pump discharge plug may be leaking, the dual capacity pump solenoid plunger may be stuck, the pump valve may not be seating correctly, or the valve gasket may be leaking.
   - Connect the dual capacity pump solenoid connector.
   - Disconnect the dual pump solenoid coolant temperature switch connector and jump it to ground.
   - With the ignition on and the engine off, slowly move the pump assembly into the

pump well until fuel is visible at the top of the passages.

- Remove the pump assembly and continue to watch fuel in the passages. The fuel level should not go down.
  - If the level begins to drop, the discharge ball may be missing or not seating correctly, damaged, or needs to be restaked. It may also indicate that the check ball in the pump valve is not seating properly.
- Check dual capacity pump system operation.

IDLE STOP SOLENOID CHECK

A non-functioning idle stop solenoid (if equipped) could cause stalling or rough idle when the air conditioning (if equipped) is turned on.

1. Turn the ignition on but do not start the engine. Turn the air conditioning switch on.
2. Open the throttle momentarily to allow the solenoid plunger to extend.
3. Disconnect the wire at the solenoid. The plunger should pull back from the throttle lever.
4. Connect the solenoid wire. The plunger should move out and contact the throttle lever.
5. If the plunger does not move in and out, check for voltage across the feed wire.
   - If the voltage is 12 to 15 volts, replace the solenoid.
   - If the voltage is low, locate the cause of the open circuit in the solenoid feed wire.

THROTTLE KICKER CHECK

Tool Required:
J-23738-A, Hand Held Vacuum Pump.

1. Hold the throttle half way open to allow the plunger to extend fully.
2. Apply 68 kPa (20-inches Hg) vacuum to the throttle kicker.
3. Apply finger pressure to the plunger to see if it is fully extended. If not, replace the throttle kicker.
4. Observe the vacuum gage. The vacuum should hold for at least 20 seconds. If not, replace the throttle kicker.
5. Release the vacuum to the throttle kicker.
6. Apply finger pressure to the plunger to see if it has returned to its retracted position. If not, replace the throttle kicker.

CARBURETOR REPLACEMENT

Flooding, stumble on acceleration and other performance complaints are, in many instances, caused by the presence of dirt, water or other foreign matter in carburetor. To aid in diagnosing the cause, the carburetor should be removed carefully from the engine without draining fuel from the bowl. Contents of the fuel bowl may then be examined for foreign materials as carburetor is disassembled.

↔ Remove or Disconnect

1. Air cleaner and gasket.
2. Electrical connectors at the idle speed solenoid and dual capacity pump solenoid (if equipped).
3. Fuel line and vacuum hoses.
4. Choke system.
5. Accelerator linkage.
6. Downshift cable (automatic transmission only).
7. Cruise control linkage (if equipped).
8. Carburetor attaching bolts.
9. Carburetor and insulator.

→← Install or Connect

- Clean the sealing surfaces on the intake manifold and carburetor.

CAUTION: Extinguish all open flames while filling and testing carburetor with gasoline to avoid personal injury.

1. Carburetor and insulator.
   - It is good shop practice to fill the carburetor float bowl before installing the carburetor. This reduces the strain on starting motor and battery and reduces the possibility of backfiring while attempting to start the engine. Operate the throttle several times and check the discharge from pump jets before installing the carburetor.
2. Carburetor attaching bolts.

   Tighten

   - Bolts to 16 N·m (144 in. lbs.) in a criss-cross pattern.
3. Downshift cable (automatic transmission only).
4. Cruise control cable (if equipped).
5. Accelerator linkage.
6. Choke system.
7. Fuel line and vacuum hoses.
8. Electrical connectors at the idle speed solenoid and/or the dual capacity pump solenoid (if equipped).
9. Air cleaner.

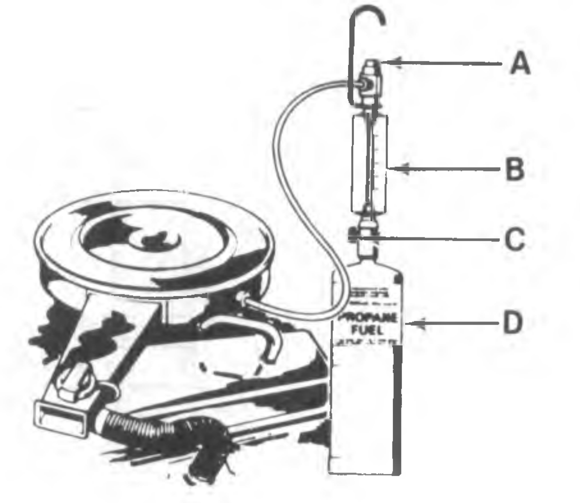
- Check and adjust the idle speed.

IDLE MIXTURE ADJUSTMENT (LIGHT-DUTY EMISSION VEHICLES ONLY)

Idle mixture needles were preset and sealed at the factory. Idle mixture should only be adjusted during major carburetor overhaul, throttle body replacement, or if high emissions are determined by official inspection.

Because of the sealed idle mixture needles, the idle mixture checking procedure requires artificial enrichment by adding propane. Adjusting mixture by other than the following method may violate government regulations.

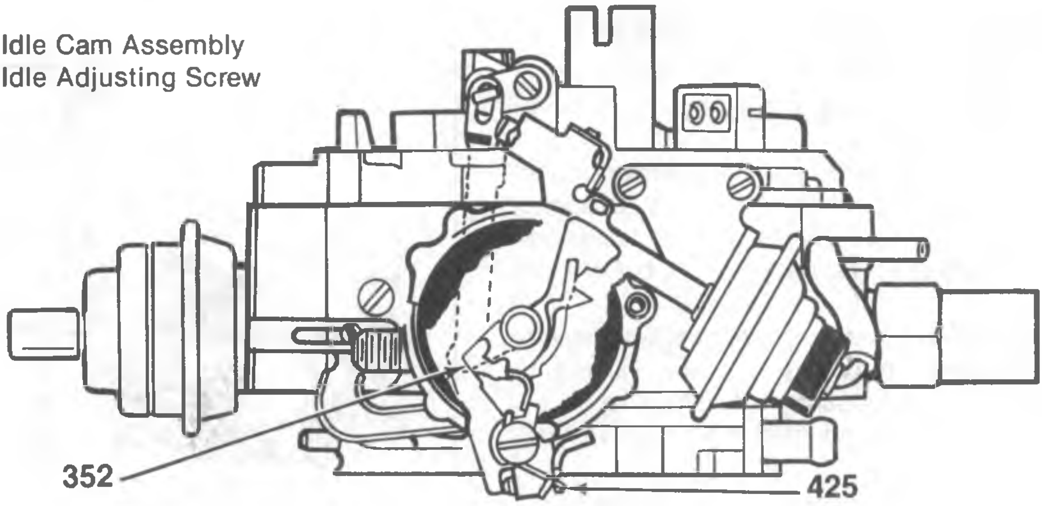
1. Set the parking brake and block the drive wheels. Engine must be at normal operating temperature with the air conditioning off.
2. Disconnect and plug hoses as directed on the Emission Control Information label under the hood.
3. Connect an accurate tachometer to the engine.
4. Disconnect the vacuum advance and set timing to the specification shown on the Vehicle Emission Control Information label. Reconnect the vacuum advance.
5. Set carburetor idle speed to the specification shown on the Vehicle Emission Control Information label.
6. Disconnect the crankcase ventilation tube from the air cleaner.
7. Insert the hose with the rubber stopper into the crankcase ventilation tube opening in the air cleaner using tool J-26911 or equivalent (figure 38).
    - The propane cartridge must be vertical.
8. With the engine idling in Drive (Neutral for manual transmissions), slowly open the propane control valve while pressing the button. Continue to add propane until the engine speed drops, due to over-richness. Note the maximum engine speed (enriched speed). If rich speed drop cannot be obtained, check for an empty propane cartridge or propane system leaks.
9. If the enriched idle speed is within the enriched idle specification, the mixture is correct. Go to Step 18.
10. If the enriched idle speed is not within specifications, remove the idle mixture needles:
    - Remove the carburetor from the engine using normal service procedures.
    - Invert the carburetor and drain the fuel into an approved container.
    - Place the carburetor on a holding fixture with the manifold side up.
        — Use care to avoid damaging the linkage, tubes, and parts protruding from the air horn.
    - Use a hacksaw to make two parallel cuts in the throttle body, one on each side of the locator point by each idle mixture needle plug. Cut down to the steel plug but not more than 3.1 mm (1/8-inch) beyond the locator point.
    - Place a flat punch at a point near the ends of the saw marks. Hold the punch at a 45 degree angle and drive it into the throttle body until the casting breaks away, exposing the steel plug.
    - Hold a center punch vertically and drive it into the steel plug.
    - Hold the punch at a 45 degree angle and drive the plug out of the casting.
    - Remove all loose pieces.
    - Repeat the procedure for the other plug.
11. Install the carburetor on the engine.
12. Use J-29030-B or equivalent to lightly seat the mixture needles, then back out equally, just enough so the engine will run.
13. Place the transmission in Drive (automatic) or Neutral (manual).
14. Back each needle out (richen 1/8 turn at a time), until the maximum idle speed is obtained. Set the idle speed to the enriched idle specification.



A. Push Valve
B. Flow Meter
C. Control Valve
D. Propane Cylinder

F-00401

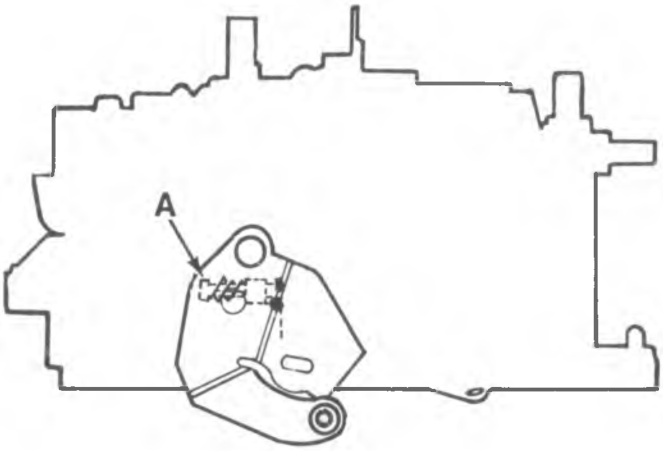
Figure 38—Idle Mixture Check With Propane Enrichment



352. Fast Idle Cam Assembly
425. Fast Idle Adjusting Screw

B-09590

Figure 39—Fast Idle Adjustment



A. Idle Speed Screw

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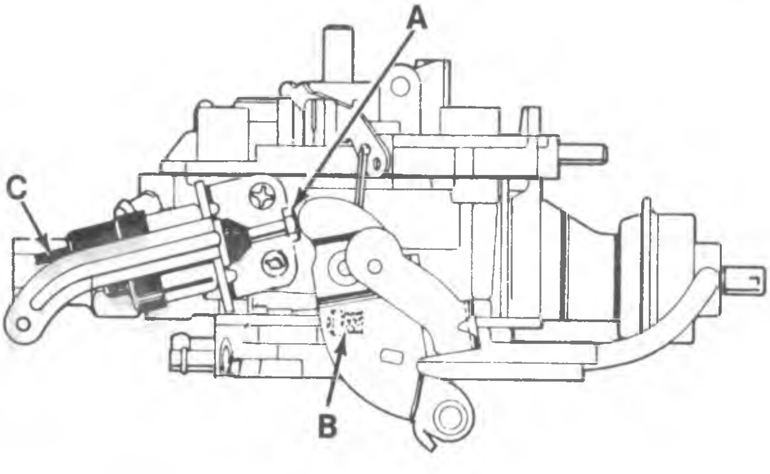
Figure 40—Idle Speed Adjustment — Without Idle Speed Solenoid



A. Solenoid Screw
B. Idle Speed Screw
C. Electrical Connection

B-09284

Figure 41—Idle Speed Adjustment — With Idle Speed Solenoid

15. Turn each mixture needle in (1/8 turn at a time), until the idle speed reaches the value given on the Emission Control Information label.
16. Re-check the enriched speed with propane. If not within specification, repeat the adjustment, starting at step 12.
17. After adjustments are made, seal the idle mixture needles with RTV rubber or equivalent. Sealing is required to retain the setting and to prevent loss of fuel vapors.
18. Check, and if necessary, adjust the fast idle as described on the Emission Control Information label.
19. Turn the engine off. Remove the propane tool and connect the crankcase ventilation tube. Unplug and reconnect the vacuum hoses. Install the air cleaner.
20. Remove the wheel blocks.

IDLE MIXTURE ADJUSTMENT (HEAVY DUTY EMISSION VEHICLES ONLY)

Idle mixture needles were preset at the factory and sealed. Idle mixture should be adjusted only during major carburetor overhaul, throttle body replacement, or if high emissions are determined by official inspection.

Perform this adjustment with the engine at operating temperature, parking brake applied, drive wheels blocked, and the transmission in Park or Neutral.

1. Remove the air cleaner.
2. Remove the idle mixture needle plugs (if equipped).
   - Remove the carburetor from the engine using normal service procedures.
   - Invert the carburetor and drain the fuel into an approved container.
   - Place the carburetor on a holding fixture with the manifold side up.
     — Use care to avoid damaging the linkage, tubes, and parts protruding from the air horn.
   - Use a hacksaw to make two parallel cuts in the throttle body, one on each side of the locator point by each idle mixture needle plug. Cut down to the steel plug but not more than 3.1 mm (1/8-inch) beyond the locator point.
   - Place a flat punch at a point near the ends of the saw marks. Hold the punch at a 45 degree angle and drive it into the throttle body until the casting breaks away, exposing the steel plug.
   - Hold a center punch vertically and drive it into the steel plug.
   - Hold the punch at a 45 degree angle and drive the plug out of the casting.
   - Remove all loose pieces.
   - Repeat the procedure for the other plug.
   - Replace the carburetor on the engine.
3. Connect a tachometer and a vacuum gage to the engine.
4. As a preliminary adjustment, lightly seat each mixture needle and back it out two turns.
5. Adjust the idle speed screw to the idle speed specified on the Vehicle Emission Control Information label.
   - Engine should be running with the choke wide open and the transmission in neutral.
6. Adjust each idle mixture needle to obtain the highest RPM.
7. Repeat steps 4 and 5 until "best" idle is obtained.
8. Reset the curb idle speed to specifications on the Vehicle Emission Control Information label (if necessary).
9. After adjustments are made, seal idle mixture needles with RTV rubber or equivalent. Sealing is required to retain the setting and to prevent loss of fuel vapors.
10. Check, and if necessary, adjust the throttle lever actuator.
11. Check, and if necessary, adjust the fast idle speed as described on the Emission Control Infomation label.
12. Turn off the engine, remove gages, unplug and reconnect vacuum hoses. Install the air cleaner.
13. Remove block from the drive wheels.

IDLE SPEED ADJUSTMENT

Refer to the Emission Control Information label to adjust idle speed and fast idle.

THROTTLE KICKER ADJUSTMENT

Refer to DRIVEABILITY AND EMISSIONS - CARBURETED (SEC. 6E8) to adjust the throttle kicker.

FLOAT ADJUSTMENT

Tools Required:
J-9789-90, Float Level "T" Scale
J-34817, Float Positioning Tool Kit

1. Remove the air horn, gasket, power piston and metering rod assembly, and the float bowl insert.
2. Attach J-34817-1 to the float bowl (figure 42).
3. Place J-34817-3 in J-34817-1 with the contact pin resting on the outer edge of the float lever.
4. Measure the distance from the top of the casting to the top of the float at a point 3/16-inch from the large end of the float.

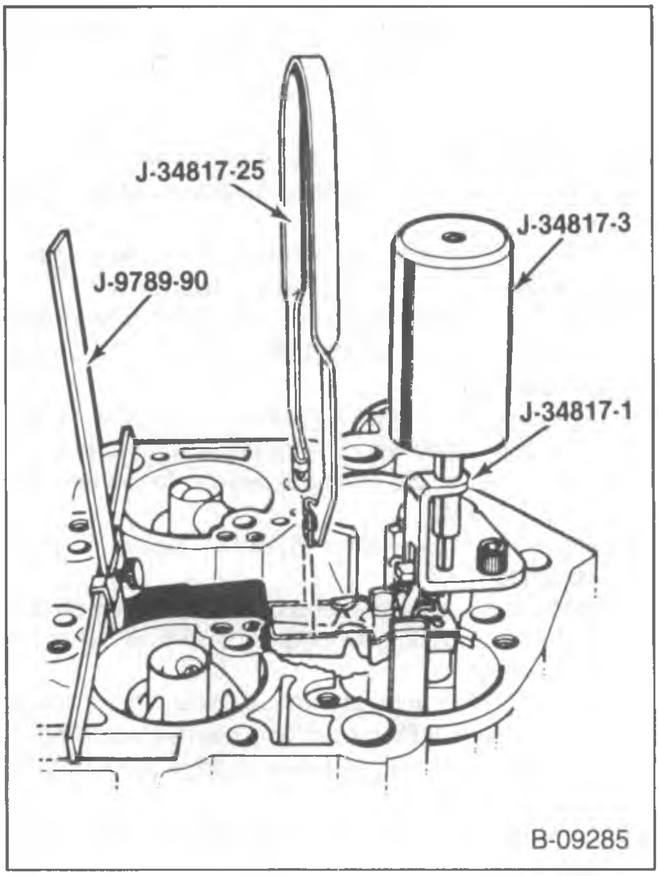


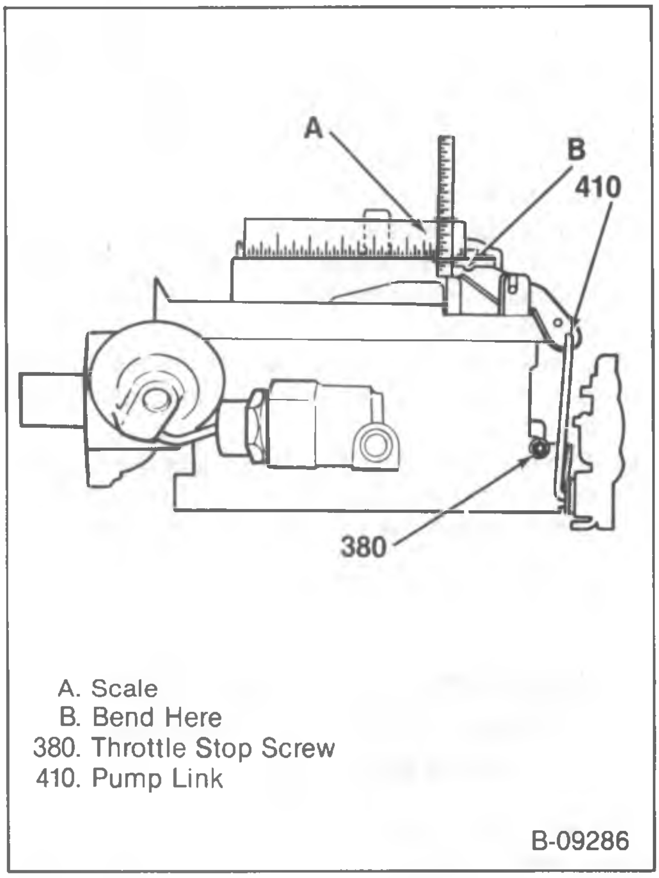
Figure 42—Float Adjustment

- Use J-9789-90.

5. If more than ± 2/32-inch from specification, use J-34817-25 to bend the lever up or down.
6. Remove J-34817-25 and measure, repeating until within specification.
7. Check the float alignment.
8. Reassemble the carburetor.

PUMP ADJUSTMENT

1. The pump link (410) must be in the specified hole (figure 43).
2. Be sure the fast idle cam follower lever is off the steps of the fast idle cam. Back off the throttle stop screw (380) from contact with the throttle lever.
3. Gage from the top of the choke valve wall next to the vent stack, to the top of the pump stem as specified.
4. Bend the pump lever (41) at the notch to adjust.
   - Support the lever with a screwdriver while bending it.



A. Scale
B. Bend Here
380. Throttle Stop Screw
410. Pump Link

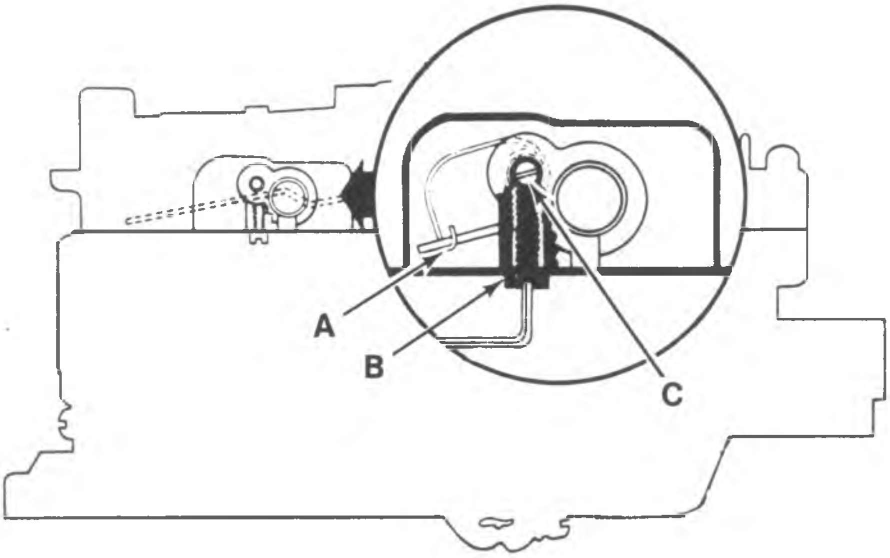
Figure 43—Pump Adjustment

AIR VALVE SPRING ADJUSTMENT

1. Loosen the lock screw using a 3/32-inch hex wrench (figure 44).
2. Turn the tension adjusting screw counterclockwise until the air valve opens part way.
3. Turn the tension adjusting screw clockwise until the air valve just closes. Then turn the adjusting screw clockwise the specified number of turns.
4. Tighten the lock screw.
5. Apply lithium base grease to lubricate the contact area.
6. Bend the choke rod to adjust.

CHOKE COIL LEVER ADJUSTMENT

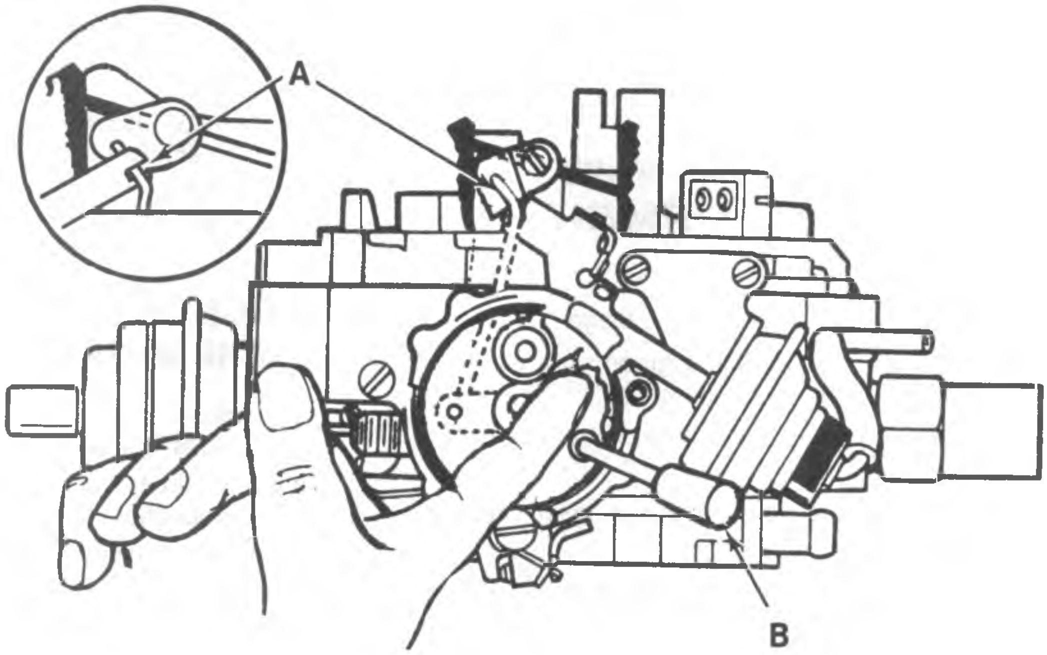
1. Drill out and remove rivets (if riveted). Remove the electric choke cover and stat assembly.
2. Place the fast idle cam follower on the high step of the fast idle cam.
3. Push up on the choke coil lever to close the choke valve.
4. Insert a 0.120-inch plug gage (figure 45).



A. Apply Lithium Base Grease Here
B. Lock Screw
C. Tension Adjusting Screw

B-09287

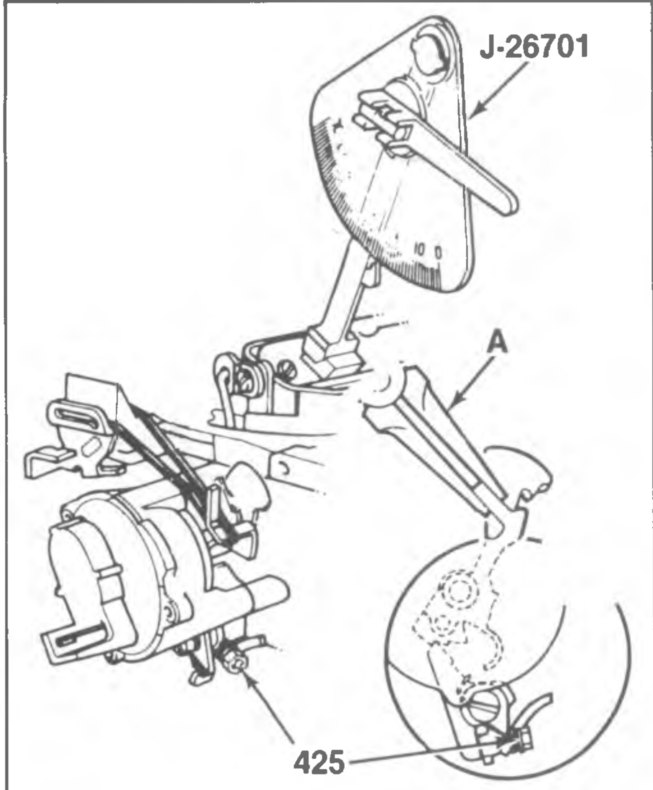
Figure 44—Air Valve Spring Adjustment



A. Bend Here to Adjust
B. 0.120 - Inch Plug Gage

B-09573

Figure 45—Choke Coil Lever Adjustment



A. Pliers on Tang
425.Fast Idle Adjusting Screw B-09574

Figure 46—Choke Rod And Fast Idle Cam Adjustment

5. The lower edge of the lever should just contact the gage.
6. Bend the choke rod to adjust.

CHOKE ROD AND FAST IDLE CAM ADJUSTMENT

Tool Required:

J-26701, Choke Valve Angle Gage

1. Attach a rubber band to the green tang of the intermediate choke shaft (figure 46).
2. Open the throttle to allow the choke valve to close.
3. Set up J-26701 and set the angle to specification (figure 47).
    - Rotate the degree scale until zero is opposite the pointer.
    - Center the leveling bubble.
    - Rotate the scale to the specified angle.
        — Refer to "Specifications."
4. Place the cam follower on the second step of the cam against the high step. If the cam follower does not contact the cam, turn in the fast idle speed screw additional turn(s).

NOTICE: Final Fast Idle Speed Adjustment must be performed according to the Underhood Emission Control Information Label.

5. Adjust by bending the tang of the fast idle cam until the bubble is centered.

PRIMARY SIDE VACUUM BREAK ADJUSTMENT

Tool Required:

J-26701, Choke Valve Angle Gage

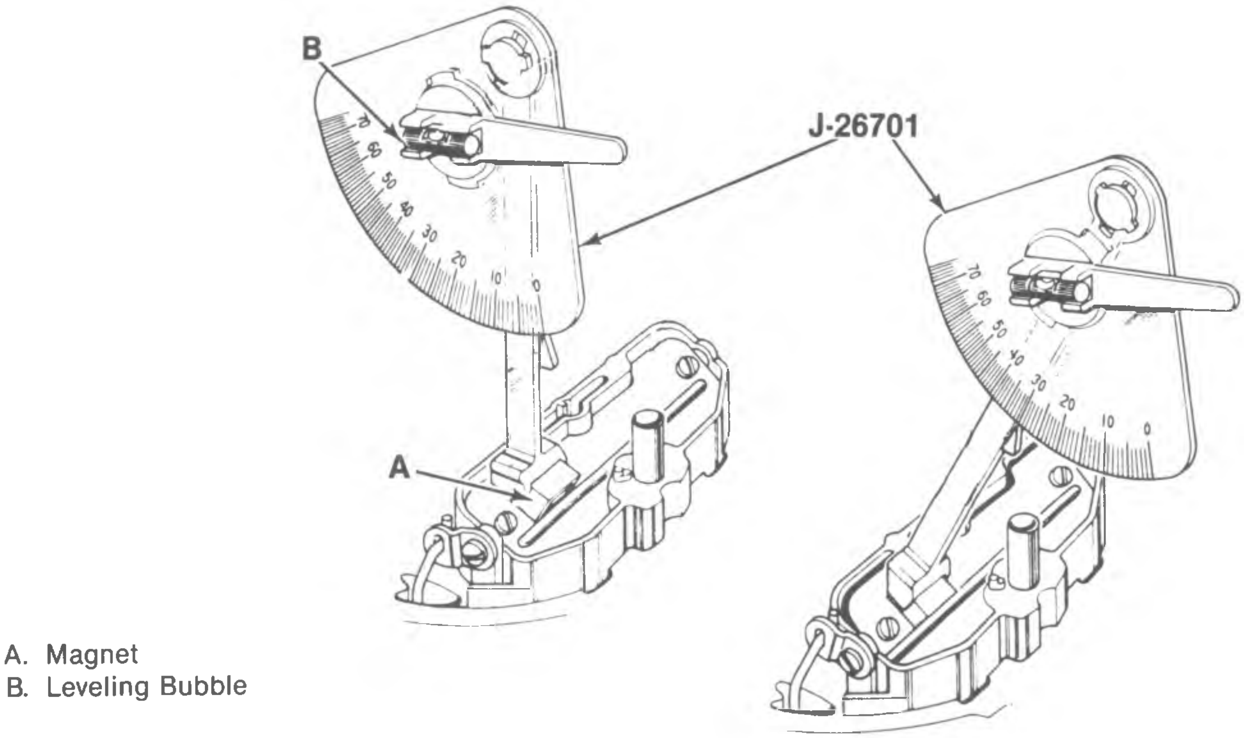
1. Attach rubber band to the green tang of the intermediate choke saft.
2. Open the throttle to allow the choke valve to close.
3. Set up J-26701 and set angle to specifications (figure 47).
    - Rotate the degree scale until zero is opposite the pointer.
    - Center the leveling bubble.
    - Rotate the scale to the specified angle.
        — Refer to "Specifications."
4. Retract the vacuum break plunger using a vacuum source of at least 61 kPa (18 in. Hg.). Plug the air bleed holes where applicable (figure 36).
    - The air valve rod must not restrict the plunger from retracting fully. If necessary, bend the rod to permit full plunger travel. Final rod clearance must be set after the vacuum break setting has been made.
5. With at least 61 kPa (18 in. Hg.) still applied, adjust the screw to center the bubble (figure 48).
    - Bucking spring must be seated against lever (if used).

SECONDARY SIDE VACUUM BREAK ADJUSTMENT

Tool Required:

J-26701, Choke Valve Angle Gage

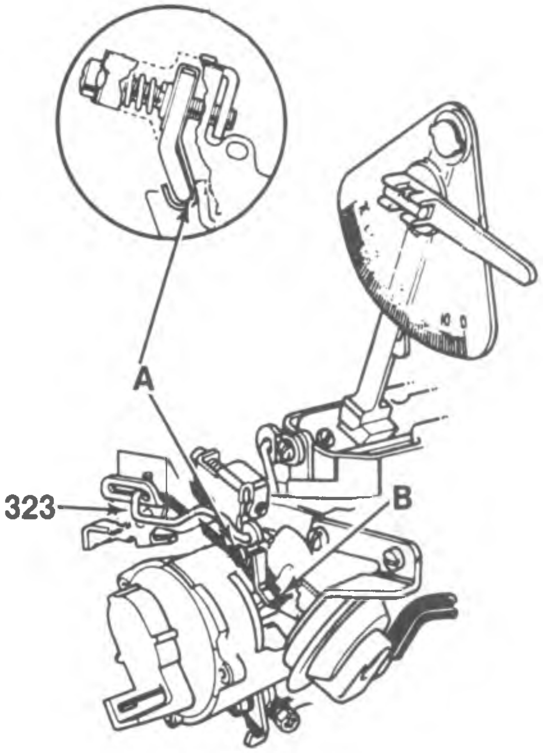
1. Attach a rubber band to the green tang of the intermediate choke shaft.
2. Open the throttle to allow the choke valve to close.
3. Set up J-26701 and set angle to specification (figure 47).
    - Rotate the degree scale until zero is opposite the pointer.
    - Center the leveling bubble.
    - Rotate the scale to the specified angle.
        — Refer to "Specifications."
4. Retract the vacuum break plunger using a vacuum source of at least 61 kPa (18 in. Hg.).



A. Magnet
B. Leveling Bubble

B-09575

Figure 47—Choke Valve Angle Gage



A. Bucking Spring (If Used)
B. Rubber Band
323.Air Valve Lever

B-09576

Figure 48—Primary Side Vacuum Break Adjustment

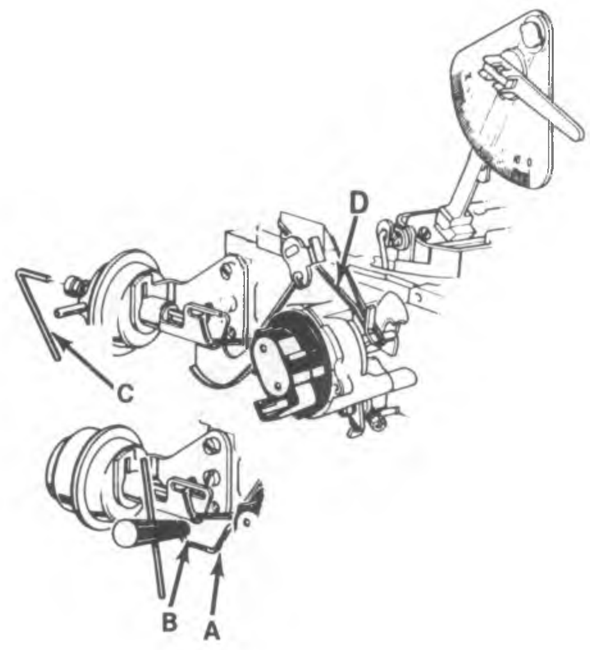
Plug the air bleed holes where applicable (figure 36).

- The air valve rod must not restrict the plunger from retracting fully. If necessary, bend the rod to permit full plunger travel. The plunger stem must be extended fully to compress the plunger bucking spring.

5. Center the bubble by adjusting with a 1/8 inch hex wrench (vacuum still applied) or support at point "A" and bend the vacuum break rod (vacuum still applied) (figure 49).

AIR VALVE ROD ADJUSTMENT

1. Use a vacuum source of at least 61 kPa (18 in. Hg.) to seat the vacuum break plunger.
   - Plug the air bleed holes where applicable (figure 36).
2. The air valve must be completely closed.
3. Use a 0.025-inch plug gage between the rod and the end of the slot (figures 50 and 51).
4. Bend the rod to adjust clearance to 0.025-inch.



A. Support Here
B. Bend Here
C. Hex Wrench
D. Rubber Band

B-09577

Figure 49—Secondary Side Vacuum Break Adjustment

UNLOADER ADJUSTMENT

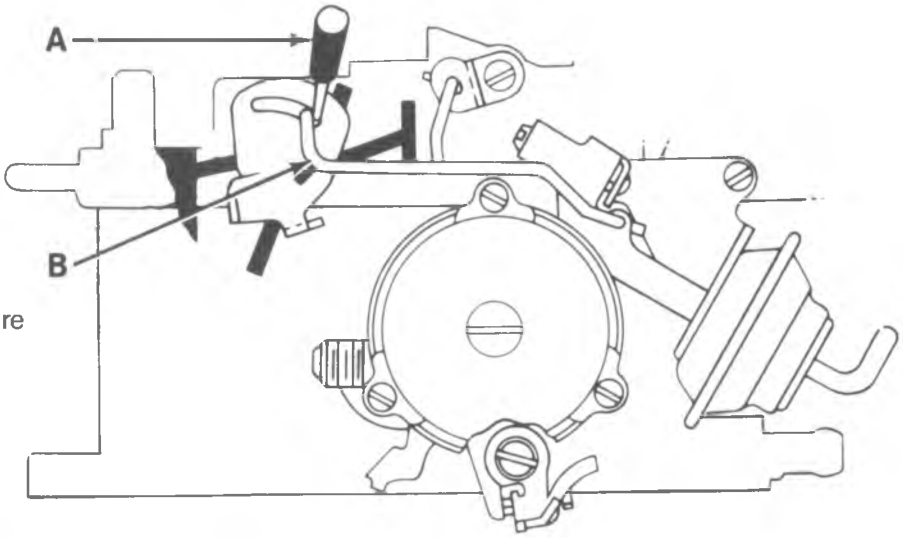
Tool Required:

J-26701, Choke Valve Angle Gage

1. Attach a rubber band to the green tang of the intermediate choke shaft (figure 52).
2. Open the throttle to allow the choke valve to close.
3. Set up J-26701 and set angle to specification (figure 47).
   - Rotate the degree scale until zero is opposite the pointer.
   - Center the leveling bubble.
   - Rotate the scale to the specified angle.
     — Refer to "Specifications."
4. Hold the secondary lockout lever away from the pin.
5. Hold the throttle lever wide open.
6. Adjust by bending the tang of the fast idle lever until the bubble is centered.

SECONDARY LOCKOUT ADJUSTMENT

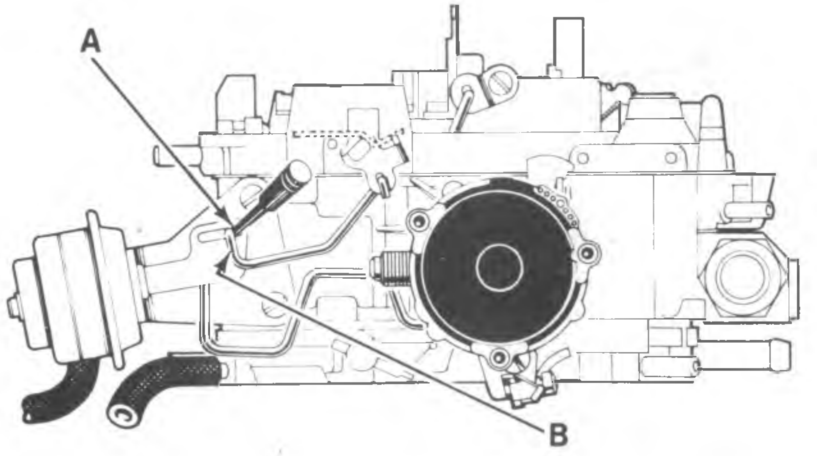
1. The choke valve and throttle valves must be closed.
2. Secondary lockout lever side clearance should be a maximum of 0.015-inch (figure 53).
3. Bend the pin to adjust.
4. Hold the choke valve wide open by pushing down on the tail of the fast idle cam.
5. Check the secondary lockout opening clearance with a 0.015-inch gage.
6. File the end of the pin for clearance.
   - Check for burrs after filing.



A. 0.025-inch Plug Gage
B. Bend Rod Here To Adjust

F-00402

Figure 50—Front Air Valve Adjustment



A. Plug Gage
B. Bend Here

Figure 51—Rear Air Valve Adjustment

A. Rubber Band
B. Bend Tang to Adjust
C. Lockout Lever
D. Pin
352. Fast Idle Cam

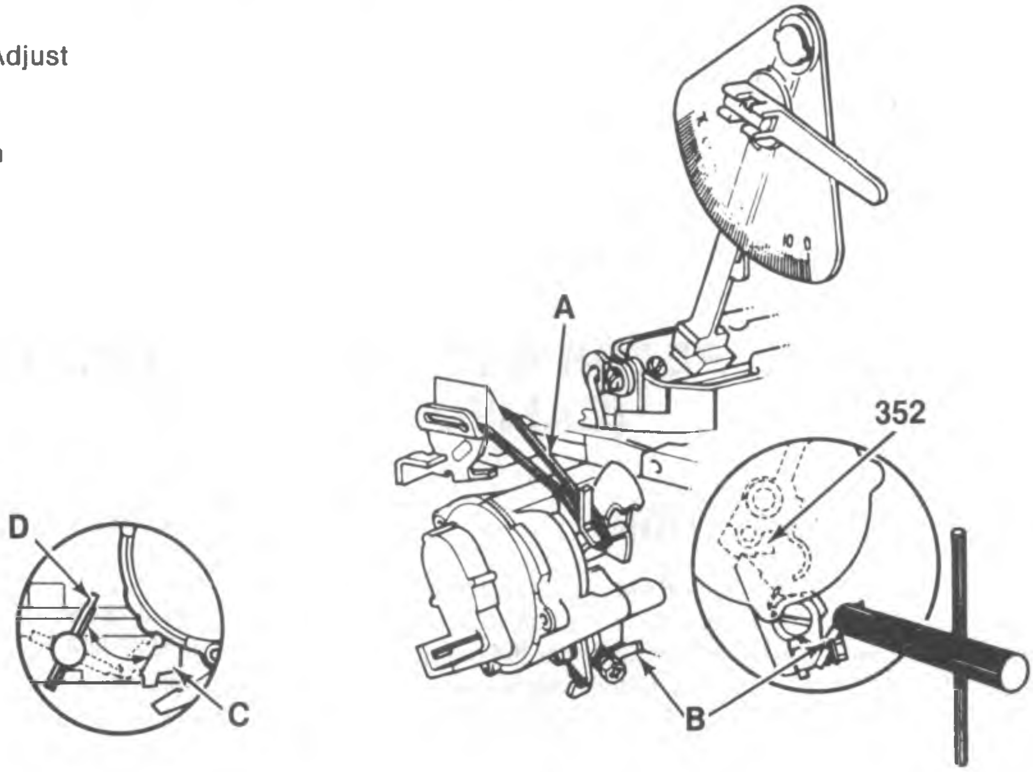
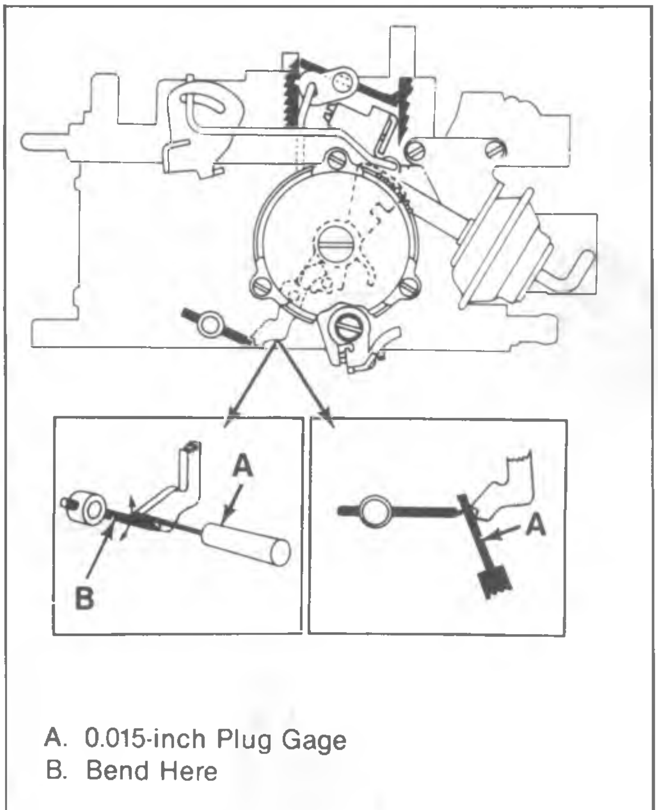


Figure 52—Unloader Adjustment



A. 0.015-inch Plug Gage
B. Bend Here

F-00404

Figure 53—Secondary Lockout Adjustment

CARBURETOR MODELS E4ME AND E4MED (CALIFORNIA ONLY)

DESCRIPTION

The Models E4ME and E4MED Quadrajet Carburetors are of the four barrel, two stage design. They are used with the Computer Command Control System of fuel control, which is further described in DRIVABILITY AND EMISSIONS — CARBURETED (SEC. 6E8).

The carburetor has three major assemblies: the air horn, the float bowl, and the throttle body. It has six basic operating systems (figures 54 through 60).

- Float
- Idle
- Main Metering
- Power
- Pump
- Choke

A single float chamber supplies fuel to the four carburetor bores. Fuel level is controlled by a closed cell rubber float, brass needle seat, and a rubber tipped float needle with pull clip.

Air/fuel mixture in the primary bores is controlled by an electrically operated mixture control solenoid. The solenoid is mounted in the float bowl. The plunger in the solenoid is controlled (or "pulsed") by electrical signals received frm the Electronic Control Module (ECM).

TWO POINT ADJUSTMENT

The two points of fuel control adjustment are:

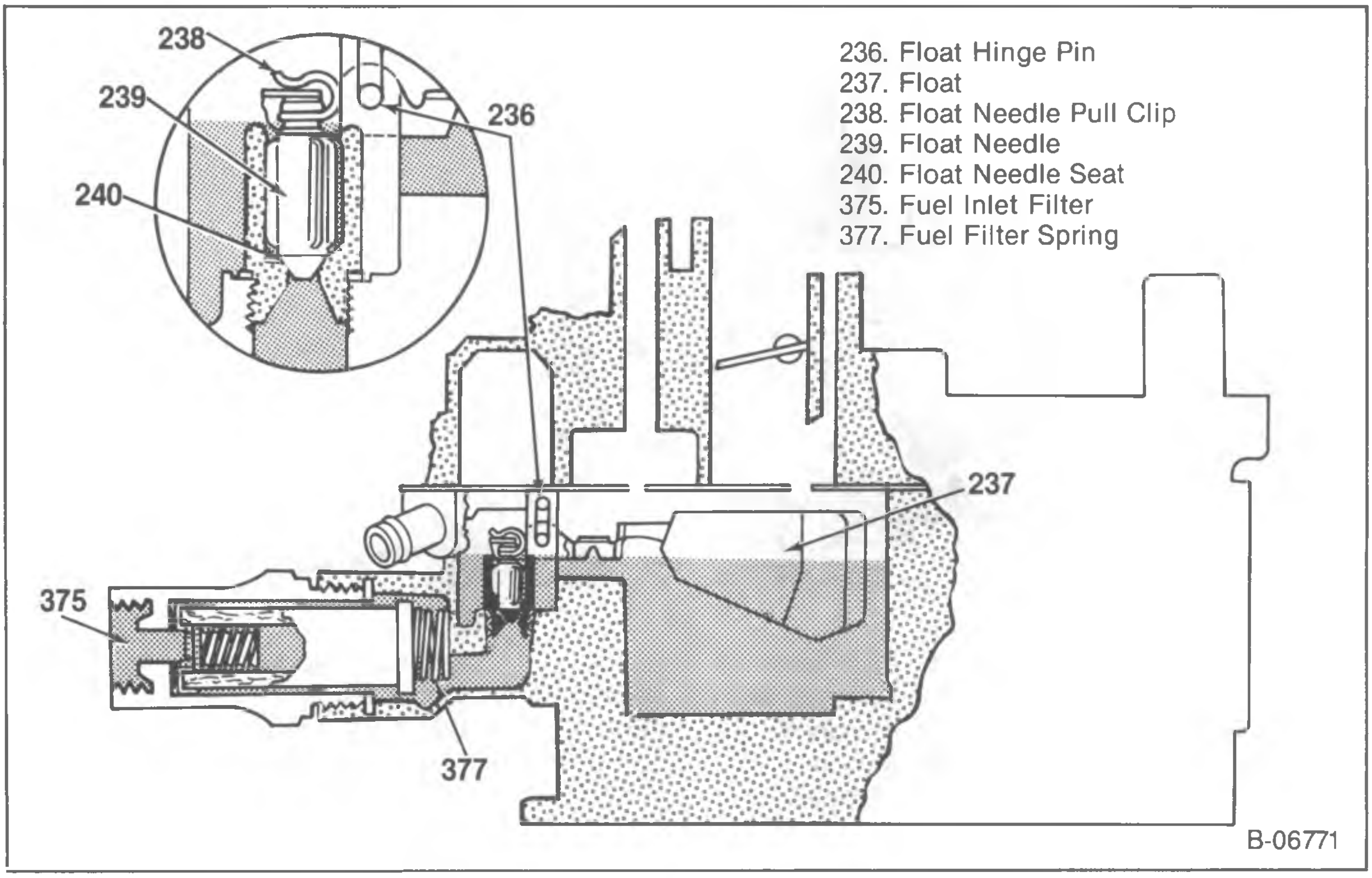
1. The mixture control solenoid adjusting screw.
2. The idle mixture needles.

A single mixture control solenoid adjusting screw replaces the separate rich stop and lean stop screws. The solenoid adjusting screw positions the solenoid in the float bowl. A rich limit stop is assembled with the adjusting screw to hold the solenoid plunger travel to a fixed limit.

DUAL CAPACITY PUMP (E4MED MODELS ONLY)

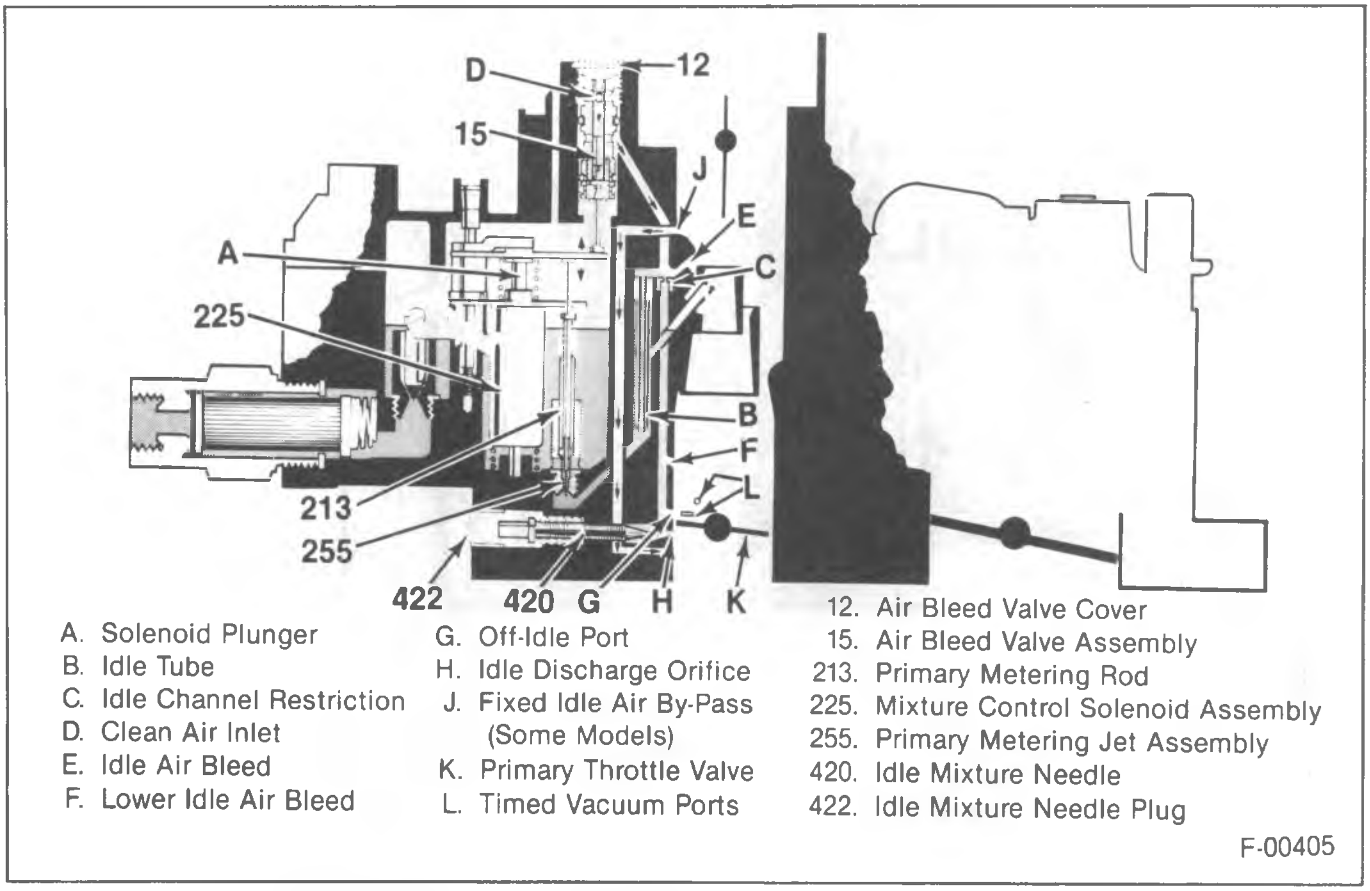
E4MED model carburetors have a dual capacity pump valve and a combined mixture control/dual capacity pump solenoid assembly mounted on the float bowl (figure 59).

When the engine is cold, more fuel is necessary to insure a smooth transition from idle to part throttle. When the engine is warm, less fuel is required. The dual capacity pump is controlled by the coolant



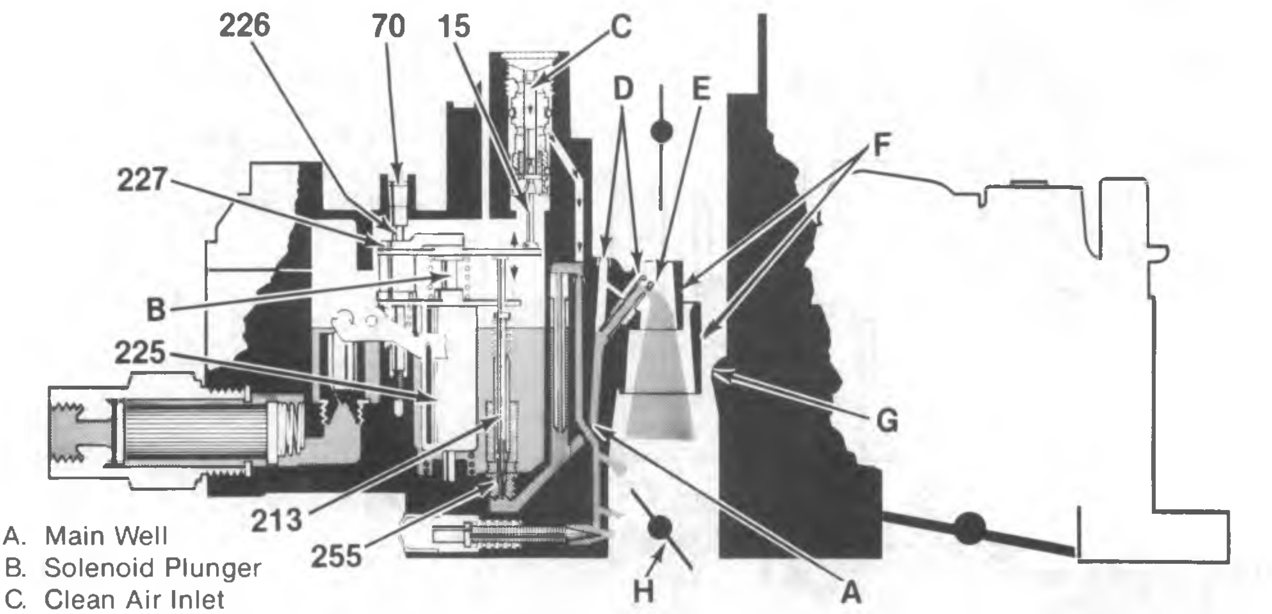
236. Float Hinge Pin
237. Float
238. Float Needle Pull Clip
239. Float Needle
240. Float Needle Seat
375. Fuel Inlet Filter
377. Fuel Filter Spring

Figure 54—Float System



A. Solenoid Plunger
B. Idle Tube
C. Idle Channel Restriction
D. Clean Air Inlet
E. Idle Air Bleed
F. Lower Idle Air Bleed
G. Off-Idle Port
H. Idle Discharge Orifice
J. Fixed Idle Air By-Pass (Some Models)
K. Primary Throttle Valve
L. Timed Vacuum Ports
12. Air Bleed Valve Cover
15. Air Bleed Valve Assembly
213. Primary Metering Rod
225. Mixture Control Solenoid Assembly
255. Primary Metering Jet Assembly
420. Idle Mixture Needle
422. Idle Mixture Needle Plug

Figure 55—Idle System



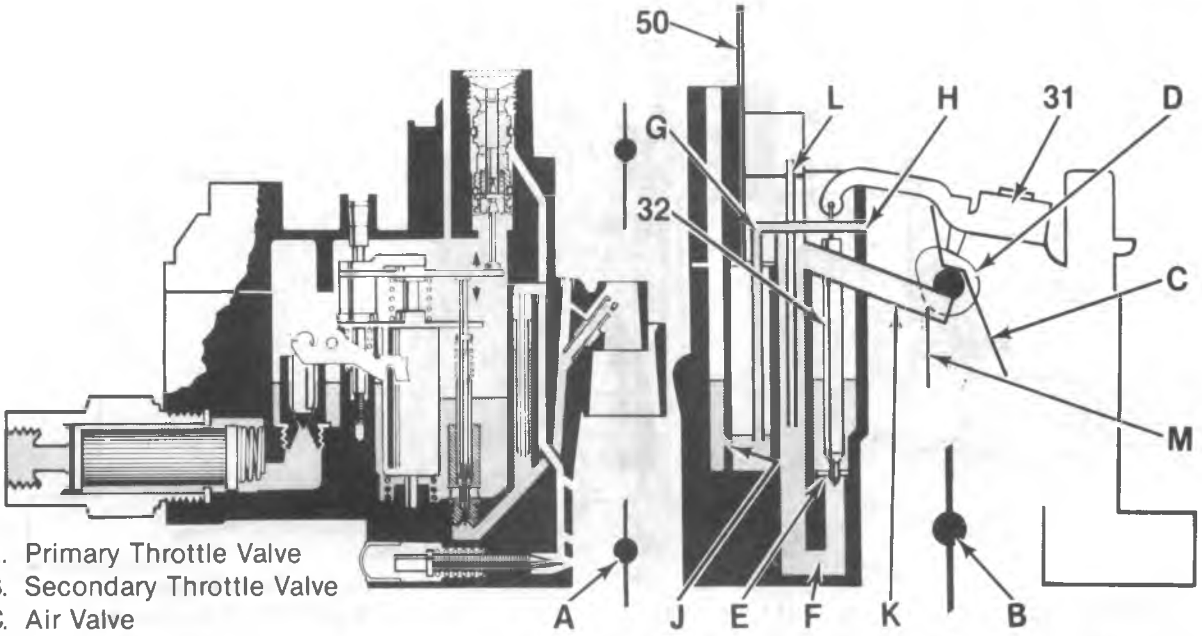
A. Main Well
B. Solenoid Plunger
C. Clean Air Inlet
D. Main Well Air Bleeds
E. Main Discharge Nozzle
F. Boost Venturi
G. Main Venturi
H. Primary Throttle Valve

15. Air Bleed Valve Assembly
70. Solenoid Adjusting Screw Plug
213. Primary Metering Rod
225. Mixture Control Solenoid Assembly

226. Solenoid Adjusting Screw (Lean Mixture)
227. Rich Limit Stop
255. Primary Metering Jet Assembly

F-00406

Figure 56—Main Metering System



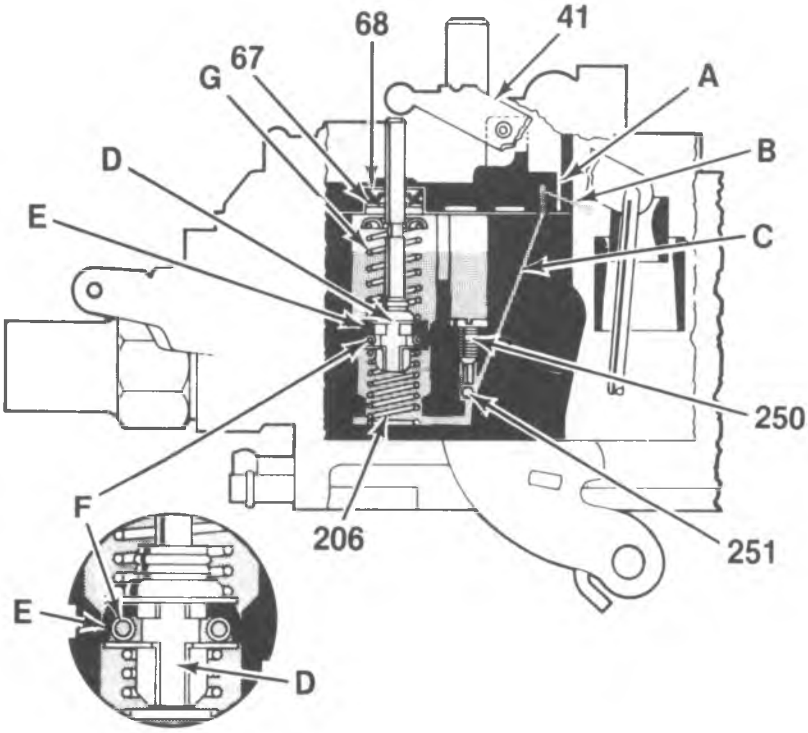
A. Primary Throttle Valve
B. Secondary Throttle Valve
C. Air Valve
D. Eccentric Cam
E. Metering Disc
F. Secondary Fuel Well
G. Accelerator Well & Tube
H. Accelerator Well Discharge Orifice

J. Accelerator Well Inlet Orifice
K. Secondary Discharge Nozzle
L. Secondary Well Bleed Tube
M. Baffle

31. Secondary Metering Rod Holder
32. Secondary Metering Rod
50. Air Horn Baffle

F-00407

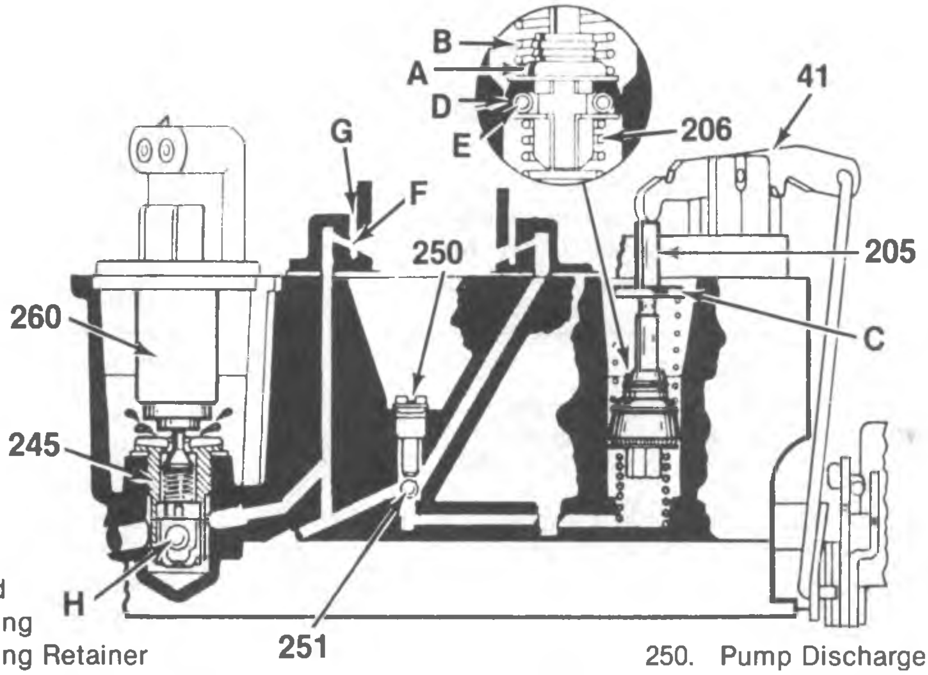
Figure 57—Power System



A. Pump Suction Breaker
B. Pump Jets
C. Discharge Passage
D. Pump Plunger
E. Cup Seal
F. Expander Spring
G. Duration Spring
41. Pump Lever
67. Pump Stem Seal Retainer
68. Pump Stem Seal
206. Pump Return Spring
250. Pump Discharge Plug
251. Pump Discharge Ball

B-09246

Figure 58—Pump System



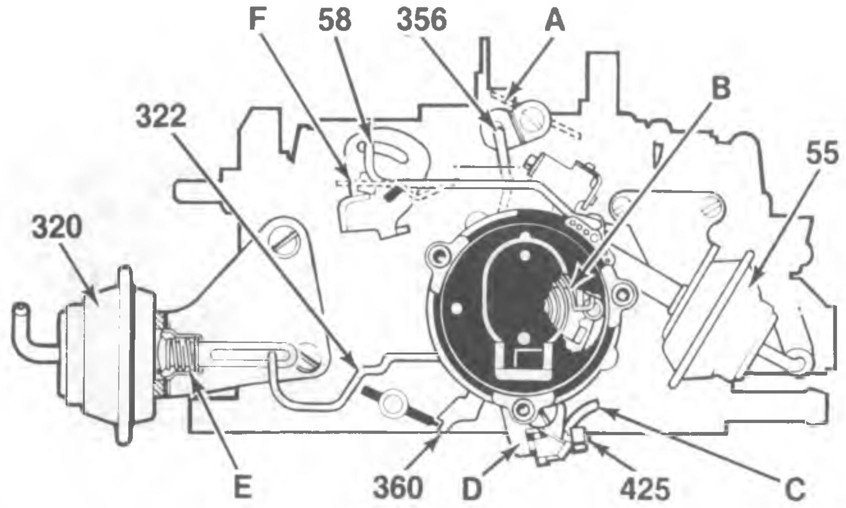
A. Pump Plunger Head
B. Pump Duration Spring
C. Pump Duration Spring Retainer
D. Pump Plunger Cup
E. Pump Plunger Spring
F. Pump Discharge Orifice
G. Pump Suction Breaker
H. Check Ball

41. Pump Lever
205. Pump Assembly
206. Pump Return Spring
245. Dual Capacity Pump Valve Assembly (Shown Open)

250. Pump Discharge Plug (Retainer)
251. Pump Discharge Ball
260. Dual Capacity Pump Solenoid (Shown Energized)

B-09595

Figure 59—Dual Capacity Pump System



A. Choke Valve
B. Thermostatic Coil
C. Unloader Tang
D. Fast Idle Cam Follower
E. Plunger Bucking Spring (Not Used On All Models)
F. Air Valve
55. Primary Side (Front) Vacuum Break Assembly
58. Primary Side Vacuum Break To Air Valve Lever Link
320. Secondary Side (Rear) Vacuum Break Assembly
322. Secondary Side Vacuum Break To Choke Link
356. Choke Link
360. Secondary Throttle Lockout Lever
425. Fast Idle Adjusting Screw

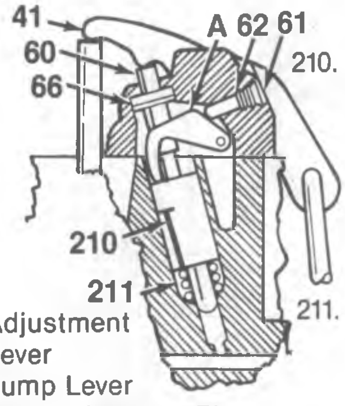
F-00408

Figure 60—Electric Choke System With Front And Rear Vacuum Breaks

temperature sensor. When coolant temperature is approximately 170°F (77°C), a solenoid within the carburetor is energized, opening a bypass valve. This lowers the capacity of the pump by about one-half.

THROTTLE POSITION SENSOR (TPS)

The float bowl mounted throttle position sensor is a pump lever actuated variable resistor (figure 61). It sends a varying voltage signal to the ECM in response to changes in throttle position. TPS input is used by the ECM to regulate the mixture control solenoid, EST, idle speed control, and TCC. The sensor is adjustable and the specific adjustment procedure must be followed.



A. Adjustment Lever
41. Pump Lever
60. Sensor Actuator Plunger
61. TPS Adjusting Screw Plug
62. TPS Adjusting Screw
66. TPS Plunger Seal
210. Throttle Position Sensor (TPS)
211. Sensor Adjusting Spring

B-09597

Figure 61—Throttle Position Sensor (TPS)

SECONDARY OPERATION

Air valves and metering rods control the air/fuel metering in the secondary bores.

Additional fuel flow during wide open throttle is provided by a pair of tapered metering rods. The metering rods are attached to a holder. The holder operates by cam action resulting from the air valve angle.

CHOKE

An electrically heated thermostatic coil provides the choke valve closing force for cold start-up and for correct opening time during warmup. Vacuum break units control initial choke valve opening at start and during warmup. An unloader tang on the fast idle lever forces the choke valve open to purge a flooded engine when the accelerator is pressed to the floor. A fast idle cam follows the choke valve movement. This acts as a graduated throttle stop and provides increased idle speed during warmup.

THROTTLE KICKER AND IDLE SPEED SOLENOID

Depending on engine displacement and vehicle application, either a throttle kicker assembly or an idle speed solenoid (ISS) is used.

A throttle kicker is vacuum operated and ECM controlled to maintain primary throttle position during deceleration above a specified rpm as an emission requirement.

On vehicles with V-8 engines and air conditioning, an idle speed solenoid is used to maintain curb idle speed whenever the air conditioning compressor clutch is engaged. The idle speed solenoid is energized by the air conditioning switch.

MODEL IDENTIFICATION

The carburetor model identification number (figure 62) is stamped vertically on the float bowl near the secondary throttle lever. Refer to this part number when servicing the carburetor. If replacing the float bowl assembly, follow instructions contained in the service package. Stamp or engrave the model number on the new float bowl.

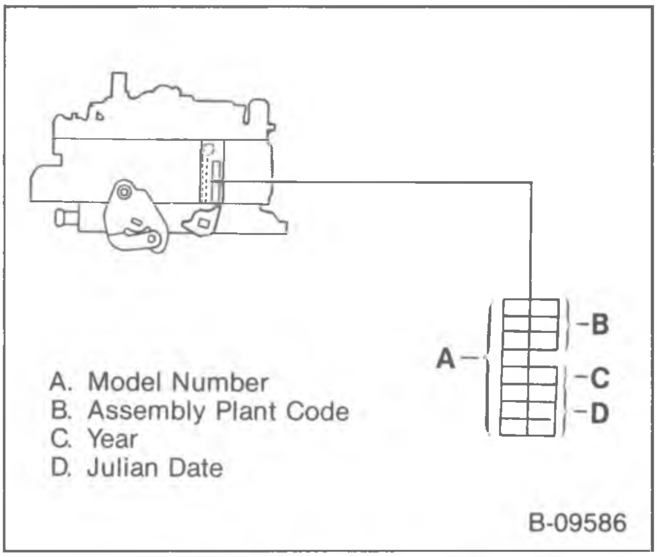


Figure 62—Carburetor Identification

ON-VEHICLE SERVICE

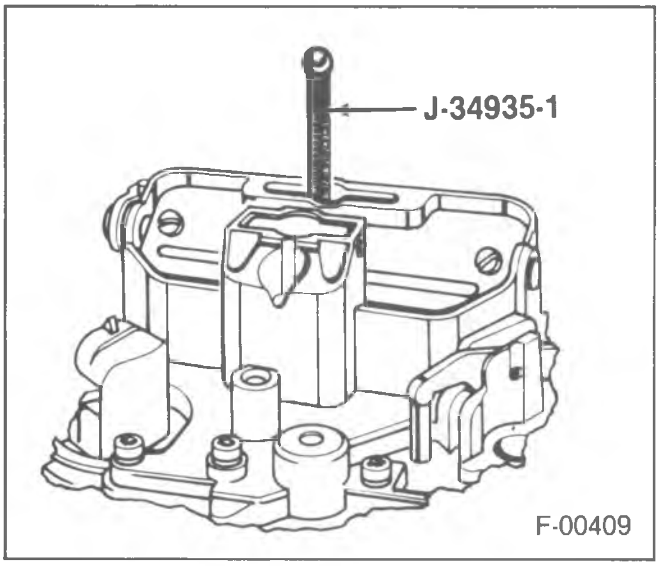


Figure 63—External Float Checking Gage

FLOAT LEVEL CHECK

Tool Required:

J-34935-1, Float Gage

1. With the engine idling and the choke wide open, insert J-34935-1 in the vent slot or vent hole. Allow the gage to float freely (figure 63).

NOTICE: DO NOT PRESS DOWN ON THE GAGE. FLOODING OR FLOAT DAMAGE COULD RESULT.

2. Observe the mark on the gage that lines up with the top of the casting. Setting should be within ± 2/32" (1.588 mm) of the specified float level.
   - Incorrect fuel pressure will adversely affect the fuel level.
3. If not within specifications, remove the air horn and adjust the float.

CHOKE CHECK

Check the unloader and idle setting adjustments. The choke linkage and fast idle cam must operate freely.

Bent, dirty or otherwise damaged linkage must be cleaned, repaired or replaced as necessary. Do not lubricate the linkage, since lubricant will collect dust and cause sticking.

Inspect

- This check should be performed at an ambient temperature of 15° to 27°C (60° to 80°F).
- Allow the choke to cool so that when the throttle is opened slightly, the choke valve closes fully.
- Start the engine and determine the time required for the choke valve to open fully.
  - — Start timing when the engine starts.
- Check the voltage at the choke heater connection with the engine running.
  - — If the voltage is approximately 12-15 volts, replace the electric choke unit.
  - — If the voltage is low or zero, check all wires and connections.

  - — The oil pressure warning lamp will be on with the engine running if there is a problem in the oil pressure switch circuitry or if the pressure switch is open.

5. If step 4 does not correct the problem, replace the oil pressure switch.

- No gasket is used between the choke cover and the choke housing due to grounding requirements.

DUAL CAPACITY PUMP CHECK (E4MED ONLY)

1. Bring the engine to normal operating temperature.
2. With the ignition off, actuate the throttle lever several times and observe the fuel stream. The stream should be strong and consistent.
3. Run the engine to refill the float bowl.
4. With the ignition on, actuate the throttle lever several times and observe the fuel stream. Less fuel should be coming from the pump because the solenoid is energized.
5. If the pump stream does not change and appears to be strong and consistent, fuel is not being bypassed by the pump circuit.
   - Disconnect the solenoid coolant temperature switch connector and jump it to ground.
   - Repeat step 4.
     - — If less fuel comes from the pump, check cooling system operation and the coolant temperature switch for opens.
     - — If the pump stream remains the same, check wiring for opens or shorts.
   - Disconnect the mixture control solenoid and the dual capacity pump solenoid connectors.
   - Remove the air horn assembly and gasket.
   - Remove the dual capacity solenoid from the float bowl and connect the solenoid connector.
   - With the ignition on and the coolant switch lead grounded, the solenoid should be energized and the solenoid plunger should extend. Replace the solenoid if it does not extend.
   - Check the pump valve and passages for dirt or obstructions.
   - Check pump system operation.
6. If the pump stream does not change and appears to be weak or irregular, fuel is leaking in the pump circuit.
   - Disconnect the mixture control solenoids and the dual capacity pump solenoid connectors.
   - Remove the air horn assembly and the gasket.
   - Fill the float bowl and the pump well with clean fuel.
   - Seal the two pump discharge passages on the top surfaces of the float bowl with two fingers while pushing the pump assembly slowly into the pump well.
     - — The pump assembly should not travel to the bottom of the well. The only movement should be the compressing of the duration spring.
     - — If the pump assembly moves down in the well, the pump cup may be worn, hardened or damaged, the pump well may be worn or scored, the pump discharge plug may be leaking, the dual capacity pump solenoid plunger may be stuck, the pump valve may not be seating correctly, or the valve gasket may be leaking.
   - Connect the dual capacity pump solenoid connector.
   - Disconnect the dual pump solenoid coolant temperature switch connector and jump it to ground.
   - With the ignition on and the engine off, slowly move the pump assembly into the pump well until fuel is visible at the top of the passages.
   - Remove the pump assembly and continue to watch fuel in the passages. The fuel level should not go down.
     - — If the level begins to drop, the discharge ball may be missing or not seating correctly, damaged, or needs to be restaked. It may also indicate that the check ball in the pump valve is not seating properly.
   - Check dual capacity pump system operation.

IDLE STOP SOLENOID CHECK

A non-functioning idle stop solenoid (if equipped) could cause stalling or rough idle when the air conditioning (if equipped) is turned on.

1. Turn the ignition on but do not start the engine. Turn the air conditioning switch on.
2. Open the throttle momentarily to allow the solenoid plunger to extend.
3. Disconnect the wire at the solenoid. The plunger should pull back from the throttle lever.
4. Connect the solenoid wire. The plunger should move out and contact the throttle lever.

5. If the plunger does not move in and out, check for voltage across the feed wire.
   - If the voltage is 12 to 15 volts, replace the solenoid.
   - If the voltage is low, locate the cause of the open circuit in the solenoid feed wire.

THROTTLE KICKER CHECK

Tool Required:
J-23738-A, Hand Held Vacuum Pump.

1. Hold the throttle half way open to allow the plunger to extend fully.
2. Apply 68 kPa (20-inches Hg) vacuum to the throttle kicker.
3. Apply finger pressure to the plunger to see if it is fully extended. If not, replace the throttle kicker.
4. Observe the vacuum gage. The vacuum should hold for at least 20 seconds. If not, replace the throttle kicker.
5. Release the vacuum to the throttle kicker.
6. Apply finger pressure to the plunger to see if it has returned to its retracted position. If not, replace the throttle kicker.

CARBURETOR ADJUSTMENTS

All on-vehicle adjustments are in DRIVEABILITY AND EMISSIONS — CARBURETED (SEC. 6E8).

CARBURETOR REPLACEMENT

Remove or Disconnect

- Raise the hood and cover the fenders.

1. Negative battery cable.
2. Air cleaner.
3. Accelerator linkage.
4. Transmission detent cable.
5. Cruise control linkage (if equipped).
6. All necessary vacuum hoses.
   - Make note of the hose routing.
7. Fuel line at the carburetor inlet.
8. All necessary electrical connectors.
9. Carburetor attaching bolts.
10. Carburetor from the engine.
11. Insulator gasket.

Install or Connect

1. Insulator gasket.
2. Carburetor on the engine.
3. Carburetor attaching bolts.

   Tighten

   - Long bolts to 9 N·m (7 ft. lbs.).
   - Short bolts to 15 N·m (11 ft. lbs.).
4. All necessary electrical connectors.
5. Fuel line to the carburetor inlet.
6. Vacuum hoses.
7. Cruise control linkage (if equipped).
8. Transmission detent cable.
9. Accelerator linkage.
10. Air cleaner.
11. Negative battery cable.

SPECIFICATIONS

CARBURETOR MODELS 1ME AND 1MEF					
CARBURETOR PART NUMBER	FLOAT LEVEL	METERING ROD	CHOKE ROD CAM ADJ	VACUUM BREAK	UNLOADER
	m/(Inches)	mm/(Inches)	mm/(Inches)	mm/(Inches)	mm/(Inches)
17081009	8.7/(11/32)	2.3/(.090)	7.0/(.275)	10.0/(.400)	13.2/(.520)
17084329	8.7/(11/32)	2.3/(.090)	7.0/(.275)	10.0/(.400)	13.2/(.520)
17085009	8.7/(11/32)	2.3/(.090)	7.0/(.275)	10.0/(.400)	13.2/(.520)
17085036	8.7/(11/32)	2.3/(.090)	7.0/(.275)	10.0/(.400)	13.2/(.520)
17085044	8.7/(11/32)	2.3/(.090)	7.0/(.275)	10.0/(.400)	13.2/(.520)

SPECIFICATIONS (CONTINUED)

MODEL M4MC/M4ME CARBURETORS

CARBU-RETOR PART NO.	FLOAT LEVEL mm (Inches) ± 2/32"	PUMP ROD SETTING mm (Inches)	PUMP ROD LOCA-TION	AIR VALVE SPRING (Turns)	CHOKE COIL LEVER	FAST IDLE CAM (CHOKE ROD) ± 2.5°	VACUUM BREAK FRONT ± 2.5°	VACUUM BREAK REAR ± 3.5°	AIR VALVE ROD mm (Inches)	UN-LOAD-ER ± 4°	PROPANE ENRICH-MENT SPEED
17085000	9.5 (12/32)	7.0 (9/32)	INNER	7/8	.120	46°	24°	30°	0.6 (.025)	40°	
17085001	9.5 (12/32)	7.0 (9/32)	INNER	1	.120	46°	23°	30°	0.6 (.025)	40°	
17085003	10.0 (13/32)	7.0 (9/32)	INNER	7/8	.120	46°	23°	—	0.6 (.025)	35°	
17085004	10.0 (13/32)	7.0 (9/32)	INNER	7/8	.120	46°	23°	—	0.6 (.025)	35°	
17085206	10.0 (13/32)	7.0 (9/32)	INNER	7/8	.120	46°	—	26°	0.6 (.025)	39°	20
17085208	10.0 (13/32)	7.0 (9/32)	INNER	7/8	.120	20°	26°	38°	0.6 (.025)	39°	10
17085209	10.0 (13/32)	9.5 (3/8)	OUTER	7/8	.120	20°	26°	36°	0.6 (.025)	39°	50
17085210	10.0 (13/32)	7.0 (9/32)	INNER	7/8	.120	20°	26°	38°	0.6 (.025)	39°	10
17085211	10.0 (13/32)	9.5 (3/8)	OUTER	7/8	.120	20°	26°	36°	0.6 (.025)	39°	50
17085212	10.0 (13/32)	7.0 (9/32)	INNER	7/8	.120	46°	23°	—	0.6 (.025)	35°	
17085213	10.0 (13/32)	7.0 (9/32)	INNER	7/8	.120	46°	23°	—	0.6 (.025)	35°	
17085215	10.0 (13/32)	7.0 (9/32)	INNER	7/8	.120	46°	—	26°	0.6 (.025)	32°	
17085216	10.0 (13/32)	7.0 (9/32)	INNER	7/8	.120	20°	26°	38°	0.6 (.025)	39°	
17085217	10.0 (13/32)	7.0 (9/32)	INNER	1/2	.120	20°	26°	36°	0.6 (.025)	39°	
17085219	10.0 (13/32)	7.0 (9/32)	INNER	1/2	.120	20°	26°	36°	0.6 (.025)	39°	
17085220	10.0 (13/32)	9.5 (3/8)	OUTER	7/8	.120	20°	—	26°	0.6 (.025)	32°	75
17085221	10.0 (13/32)	9.5 (3/8)	OUTER	7/8	.120	20°	—	26°	0.6 (.025)	32°	75
17085222	10.0 (13/32)	7.0 (9/32)	INNER	7/8	.120	20°	26°	36°	0.6 (.025)	39°	20

SPECIFICATIONS (CONTINUED)

MODEL M4MC/M4ME CARBURETORS

CARBU-RETOR PART NO.	FLOAT LEVEL mm (Inches) ± 2/32"	PUMP ROD SETTING mm (Inches)	PUMP ROD LOCA-TION	AIR VALVE SPRING (Turns)	CHOKE COIL LEVER	FAST IDLE CAM (CHOKE ROD) ± 2.5°	VACUUM BREAK FRONT ± 2.5°	VACUUM BREAK REAR ± 3.5°	AIR VALVE ROD mm (Inches)	UN-LOAD-ER ± 4°	PROPANE ENRICH-MENT SPEED
17085223	10.0 (13/32)	9.5 (3/8)	OUTER	1/2	.120	20°	26°	36°	0.6 (.025)	39°	50
17085224	10.0 (13/32)	7.0 (9/32)	INNER	1/2	.120	20°	26°	36°	0.6 (.025)	39°	20
17085225	10.0 (13/32)	9.5 (3/8)	OUTER	1/2	.120	20°	26°	36°	0.6 (.025)	39°	50
17085226	10.0 (13/32)	7.0 (9/32)	INNER	7/8	.120	20°	—	24°	0.6 (.025)	32°	20
17085227	10.0 (13/32)	7.0 (9/32)	INNER	7/8	.120	20°	—	24°	0.6 (.025)	32°	20
17085228	10.0 (13/32)	7.0 (9/32)	INNER	7/8	.120	46°	—	24°	0.6 (.025)	39°	30
17085229	10.0 (13/32)	7.0 (9/32)	INNER	7/8	.120	46°	—	24°	0.6 (.025)	39°	30
17085230	10.0 (13/32)	7.0 (9/32)	INNER	7/8	.120	20°	—	26°	0.6 (.025)	32°	20
17085231	10.0 (13/32)	7.0 (9/32)	INNER	7/8	.120	20°	—	26°	0.6 (.025)	32°	40
17085235	10.0 (13/32)	7.0 (9/32)	INNER	7/8	.120	46°	—	26°	0.6 (.025)	39°	80
17085238	10.0 (13/32)	9.5 (3/8)	OUTER	7/8	.120	20°	—	26°	0.6 (.025)	32°	75
17085239	10.0 (13/32)	9.5 (3/8)	OUTER	7/8	.120	20°	—	26°	0.6 (.025)	32°	75
17085283	10.0 (13/32)	7.0 (9/32)	INNER	7/8	.120	20°	—	24°	0.6 (.025)	32°	20
17085284	10.0 (13/32)	7.0 (9/32)	INNER	7/8	.120	20°	—	26°	0.6 (.025)	32°	20
17085285	10.0 (13/32)	7.0 (9/32)	INNER	7/8	.120	20°	—	24°	0.6 (.025)	32°	20
17085290	10.0 (13/32)	7.0 (9/32)	INNER	7/8	.120	46°	—	24°	0.6 (.025)	39°	30
17085291	10.0 (13/32)	9.5 (3/8)	OUTER	7/8	.120	46°	—	26°	0.6 (.025)	39°	100
17085292	10.0 (13/32)	7.0 (9/32)	INNER	7/8	.120	46°	—	24°	0.6 (.025)	39°	30
17085293	10.0 (13/32)	9.5 (3/8)	OUTER	7/8	.120	46°	—	26°	0.6 (.025)	39°	100
17085294	10.0 (13/32)	7.0 (9/32)	INNER	7/8	.120	46°	—	26°	0.6 (.025)	39°	
17085298	10.0 (13/32)	7.0 (9/32)	INNER	7/8	.120	46°	—	26°	0.6 (.025)	39°	

SPECIFICATIONS (CONTINUED)

MODEL E4ME CARBURETOR

CARBU-RETOR NUMBER	FLOAT LEVEL ± 2/32"	LEAN MIXTURE SCREW	IDLE MIXTURE NEEDLE (NO. OF TURNS)	IDLE AIR BLEED VALVE	AIR VALVE SPRING (NO. OF TURNS)	CHOKE STAT LEVER	CHOKE LINK CAM ± 2.5°	VACUUM BREAK FRONT ± 2.5°	VACUUM BREAK REAR ± 3.5°	AIR VALVE ROD	UN-LOADER ± 4°
17085502	14/32 (11.0 mm)	1.304 Gage	SEE NOTE	1.756 Gage	7/8	.120 Gage	20°	26°	36°	.025	39°
17085503	14/32 (11.0 mm)	1.304 Gage	SEE NOTE	1.756 Gage	7/8	.120 Gage	20°	26°	36°	.025	39°
17085506	14/32 (11.0 mm)	1.304 Gage	SEE NOTE	1.756 Gage	1	.120 Gage	20°	27°	36°	.025	36°
17085508	14/32 (11.0 mm)	1.304 Gage	SEE NOTE	1.756 Gage	1	.120 Gage	20°	27°	36°	.025	36°
17085524	14/32 (11.0 mm)	1.304 Gage	SEE NOTE	1.756 Gage	1	.120 Gage	20°	25°	36°	.025	36°
17085526	14/32 (11.0 mm)	1.304 Gage	SEE NOTE	1.756 Gage	1	.120 Gage	20°	25°	36°	.025	36°

NOTE: Preset 3 Turns, Final Adjustment On Vehicle

THROTTLE POSITION SENSOR (TPS)		
ENGINE	TPS VOLTAGE ± 0.1 VOLT	THROTTLE
F (LF3)	.41 Volts	Curb Idle
L (LS9)	.41 Volts	Curb Idle
N (LB1)	.25 Volts	Curb Idle

SPECIAL TOOLS

J-9789-D	Carburetor Gage Set
J-9789-90	Float Level "T" Scale
J-9789-111	Bending Tool
J-9789-118	Carburetor Stand
J-23738-A	Hand Held Vacuum Pump
J-26701-A	Carburetor Choke Angle Gage
J-26911	Propane Enrichment Device
J-29030-B	Idle Mixture Socket
J-34817	Float Positioning Tool Kit
J-34935-1	Float Level Gage

SECTION 6C2

DIESEL FUEL INJECTION

CONTENTS

SUBJECT **PAGE**

DESCRIPTION

The 6.2 L diesel engine fuel system is composed of:

- Fuel tank
- Mechanical fuel pump
- Fuel filter with water sensor and heater
- Fuel filter restriction switch
- Injection distributor pump
- High pressure lines
- Fuel injection nozzles

Fuel is drawn from the fuel tank by the mechanical pump which is located on the right side of the engine. The pump is driven by an eccentric lobe on the camshaft through a push rod. Fuel is then pumped through the filter/water separator. The filer/water separator is located on the engine side of the cowl (C-K models) or under the rear of the air cleaner (G-P models). The fuel is then transferred to the injection pump.

The injection pump is mounted on top of the engine under the intake manifold. The pump is driven by the camshaft through two gears, one attached to the front of the camshaft and the other attached to the end of the injection pump shaft. These gears are the same size and have the same number of teeth; therefore, the injection pump shaft turns at the same speed as the camshaft. The pump turns in the opposite direction of the camshaft and crankshaft.

The injection pump is a high pressure rotary type pump that meters, pressurizes, and distributes fuel to the eight injector nozzles. The eight high pressure lines are all the same length although their shape may be different. This prevents timing differences between cylinders. Injection lines should not be bent to ease removal.

ON-VEHICLE SERVICE

FUEL FILTER REPLACEMENT

The fuel filter on C-K models is located on the engine side of the cowl.

The fuel filter on G-P models is mounted on the rear of the inlet manifold under the air cleaner. It is accessible by removing the engine cover.

Remove or Disconnect (Figures 1 and 2)

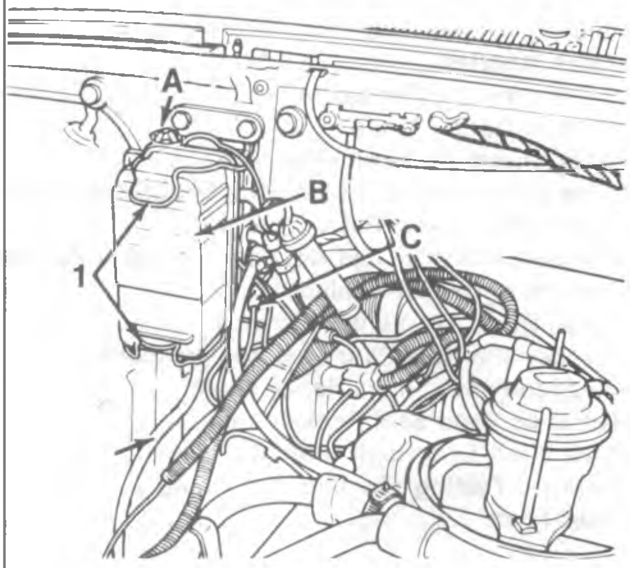
1. The fuel tank cap to release pressure or vacuum in the tank.
2. The bail wires (1) using a screwdriver.
   - Drain fuel from the filter by opening both the air bleed and water drain valves and allowing fuel to drain into an appropriate container.
3. Filter.

Clean

- Any dirt from the fuel port sealing surface of the filter adapter and the new filter.

Install or Connect (Figures 1 and 2)

1. New filter.
2. The bail wires.
   - Close the water drain valve and open the air bleed.
3. A 3.18 mm (1/8 inch) inside diameter hose to the air bleed port and the other end into a suitable container.
   - Disconnect the fuel injection pump shut off solenoid wire.

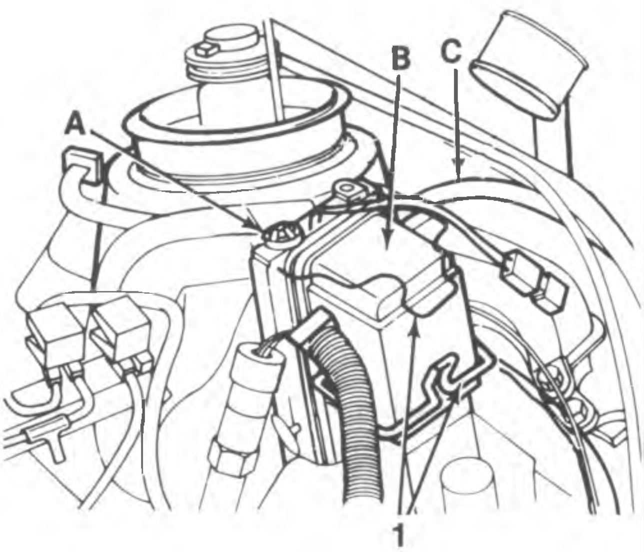


A. Air Bleed
B. Fuel Filter/Water Separator
C. Water Drain
1. Bail Wires

B-08123

Figure 1—Fuel Filter on C-K Truck

NOTICE: If the engine is to be cranked, or starting attempted with the air cleaner removed, care must be taken to prevent material from being pulled into the air inlet manifold which could result in engine damage.



A. Air Bleed
B. Fuel Filter/Water Separator
C. Filter Inlet Hose
1. Bail Wires

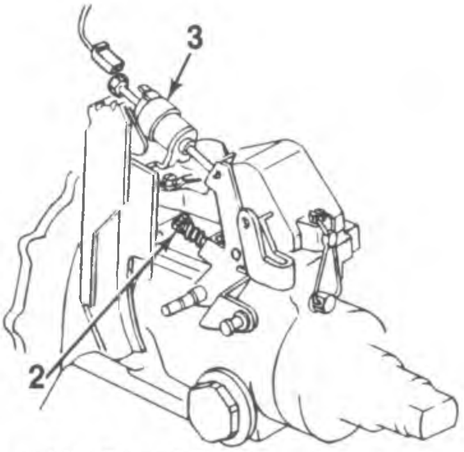
F-00598

Figure 2—Fuel Filter on G Van

- Crank the engine for 10-15 seconds and then wait one minute for the starter motor to cool. Repeat until clear fuel is observed coming from the air bleed.
- Close the air bleed.

4. Injection pump solenoid wire.
5. Fuel tank cap.

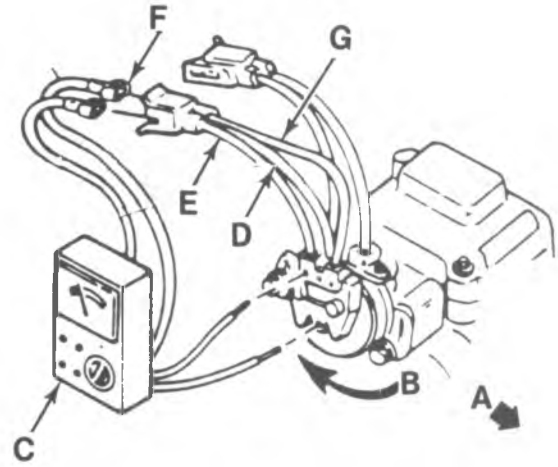
- Start the engine and allow it to idle for five minutes.



2. Low Idle Speed Screw
3. Fast Idle Solenoid Plunger

B-08125

Figure 3—Idle Speed Adjustment Location



A. Front
B. Clockwise Rotation
C. Power Test Light Or Ohmmeter
D. IGN (Pink Wire)
E. EGR (Yellow Wire)
F. Optional Test Location
G. EPR (Blue or Violet Wire)

F-0008

Figure 4—Testing The TPS For Continuity

Inspect

- Fuel filter for leaks.

IDLE SPEED ADJUSTMENT

CURB IDLE SPEED (Figure 3)

Tool Required: J-26925, Tachometer

1. Set the parking brake and block the drive wheels.
2. Engine must be at normal operating temperature with the air cleaner on and all accessories turned off.
3. Install J-26925 or equivalent per manufacturers instructions.
4. Adjust the low idle speed screw (2) on the fuel injection pump to obtain the curb idle speed shown on the Emission Control Information label.

FAST IDLE SPEED (Figure 3)

Tool Required: J-26925, Tachometer

1. Set the parking brake and block the drive wheels.
2. Engine must be at normal operating temperature with the air cleaner on and all accessories turned off.
3. Install J-26925 or equivalent per manufacturers instructions.
4. Remove the connector from the fast idle solenoid.

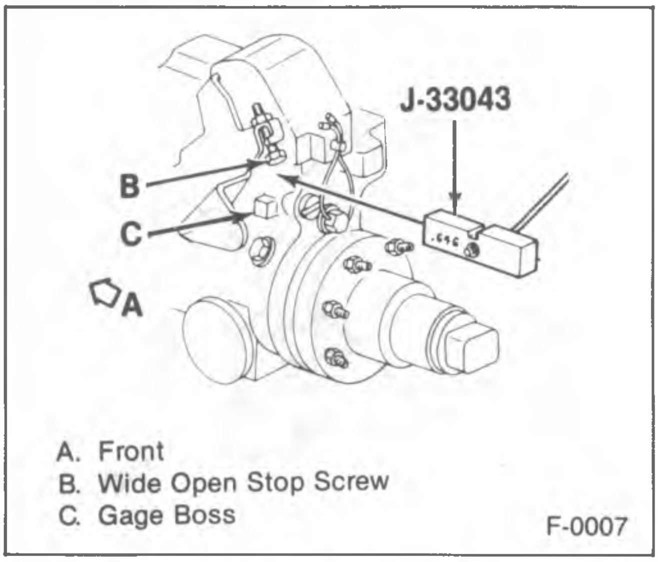


Figure 5—TPS Adjustment Block

5. Connect an insulated jumper wire from the positive battery terminal to the solenoid terminal. This will energize the solenoid.
6. Open the throttle momentarily to energize and fully extend the fast idle solenoid plunger.
7. Adjust the extended plunger (3) by turning the hex head to obtain the fast idle speed shown on the Emission Control Information label.
8. Remove the jumper wire and install the connector to the fast idle solenoid.

THROTTLE POSITION SWITCH ADJUSTMENT (LH6 ENGINE WITH 700 R4 TRANSMISSION)

Tool Required: J-33043, Gage Block

1. Disconnect the throttle position switch (TPS) connector.

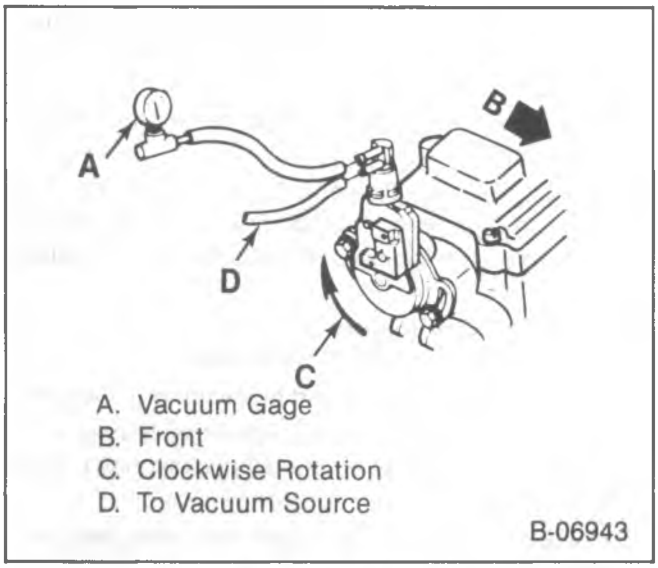


Figure 6—VRV Adjustment

2. Loosen the mounting screws that hold the TPS.
3. Connect an ohmmeter or test light to the IGN (pink) and EGR (yellow) terminals of the TPS (figure 4).
4. Insert the proper "switch closed" gage block between the gage boss on the injection pump and the wide open stop screw on the throttle shaft (figure 5).
   - Refer to the Emission Control Information label for correct gage block.
5. Rotate the throttle lever and hold the wide open stop screw against the gage block.
6. Rotate the TPS until there is continuity between the terminals.
7. Hold the TPS and tighten the mounting screws to 6 N·m (53 in. lbs.).
8. Return the throttle lever to the idle position and remove the gage block.
9. Insert the proper "switch open" gage block and rotate the throttle lever against the block. There should be no continuity. If there is continuity, repeat steps 1 through 9.
   - Refer to the Emission Control Information label for correct gage block size.
10. Remove the gage block and ohmmeter.
11. Connect the TPS connector.

VACUUM REGULATOR VALVE ADJUSTMENT (LL4 ENGINE WITH AUTOMATIC TRANSMISSION)

Tool Required: J-33043, Gage Block

1. Loosen the vacuum regulator valve (VRV) so it is free to rotate on the pump.
2. Attach a vacuum source of 67 ± 5 kPa (20 inches Hg ± 1.5 inch Hg) to the bottom vacuum port of the VRV.
3. Attach a vacuum gage to the top vacuum port (figure 6).
4. Insert the proper gage block between the gage boss on the injection pump and the wide open stop screw on the throttle lever (switch on position) (figure 5).
   - Refer to the Emission Control Information label for correct gage block size.
5. Rotate the throttle shaft and hold it against the gage block.

NOTICE: Valve must be set while rotating the valve body clockwise only.

6. Slowly rotate the vacuum regulator valve body clockwise (facing the valve) until the vacuum gage reads 27 ± 2 kPa (8 ± 0.6 inches Hg). Hold the valve body at this position and tighten the mounting screws to 6 N·m (54 in. lbs.).

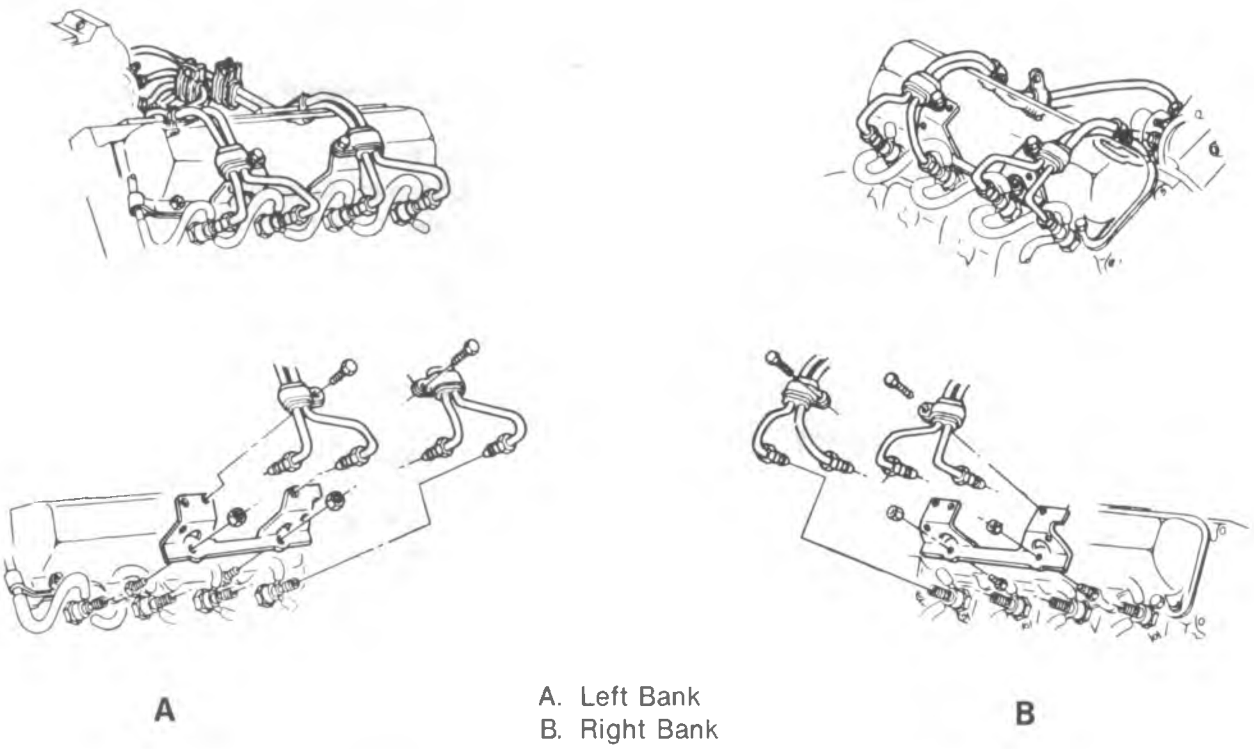


Figure 7—Fuel Injection Lines

7. Check by allowing the throttle shaft to return to the idle stop position. Then rotate the throttle shaft back against the gage block and read the vacuum gage. The gage should read 27 ± 2 kPa (8 ± 0.6 inches Hg). If vacuum is outside of limits, reset the valve.

HOUSING PRESSURE COLD ADVANCE

The Housing Pressure Cold Advance feature advances the injection timing about four degrees during cold operation. This provides better cold starts, improved cold idle, and emission control.

The circuit is actuated by a coolant temperature switch on the rear of the right cylinder head. The switch is calibrated to open the circuit at 35°C (95°F). Below the switching point, timing is advanced by decreasing housing pressure from 68.95 kPa (10 psi) to zero. Above the switching point, the housing pressure is returned to 68.95 kPa (10 psi). The fast idle solenoid is energized by the same switch.

INJECTION LINE REPLACEMENT

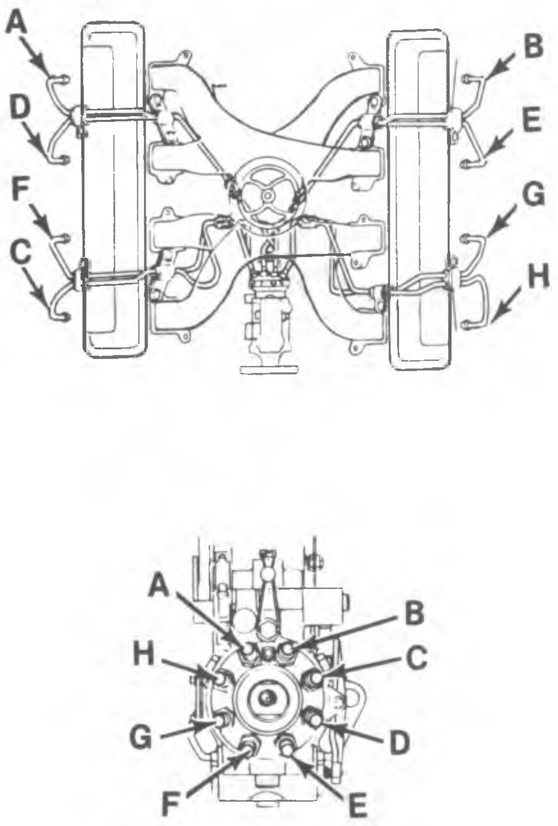
Clean

- All line fittings that will be loosened or removed.

Remove or Disconnect (Figures 7 and 8)

Tool Required: J-29664-1, Protective Covers

1. Battery negative cables.
2. Engine cover (G-Van only).
3. Air cleaner at the valve cover.
4. Crankcase ventilator bracket.
5. Intake manifold bolts.
    - It may be necessary to loosen the vacuum pump hold down clamp and rotate the pump to gain access to all intake manifold bolts.
6. Injection line clips.
7. Intake manifold.
    - Install J-29644-1 to the intake ports.
8. Injection line clips at the loom brackets.
    - Raise the vehicle (left bank of G-Van only).
9. Injection lines at the nozzles.
    - Cap the lines and nozzles immediately.
    - Do not bend injection lines.
10. Injection lines at the pump.



A. Cylinder Number 8
B. Cylinder Number 7
C. Cylinder Number 2
D. Cylinder Number 6
E. Cylinder Number 5
F. Cylinder Number 4
G. Cylinder Number 3
H. Cylinder Number 1

B-08131

Figure 8—Injection Line Routing

- Cap the lines and the pump fittings immediately.
- Tag the lines for installation.

Install or Connect (Figures 7 and 8)

1. Injection lines at the pump.
    - Uncap the lines and pump fittings.
    - Refer to the tags for correct installation.
- Raise the vehicle (left bank of G-Van only).
2. Injection lines at the nozzles.
    - Uncap the lines and nozzles.

Tighten

- Fittings to 25 N·m (19 ft. lbs.).
3. Injection line clips at the loom brackets.
4. Intake manifold.
    - Remove J-29664-1.
5. Injection line clips.
6. Intake manifold bolts.

Tighten

- Bolts to 40 N·m (30 ft. lbs.).
7. Crankcase ventilator bracket.
8. Air cleaner.
9. Engine cover (G-Van only).
10. Battery negative cables.

INJECTION PUMP REPLACEMENT

C-K TRUCK

Remove or Disconnect

Tool Required: J29664-1, Protective Covers

1. Battery negative cable.
2. Intake manifold.
    - Refer to 6.2 LITER DIESEL (SEC. 6A7).
3. Injection lines.
4. Accelerator cable at the injection pump (figure 9).
5. Detent cable (if equipped).
6. Fuel return line at the top of the injection pump.
7. Fuel inlet line from the injection pump.
8. All necessary wires and hoses from the injection pump.
9. Air conditioning hose retainer bracket (if equipped).
10. Oil fill tube (includes CDR valve vent hose).
11. Grommet.
    - Scribe or paint a mark on the front cover and the injection pump flange.
    - Rotate the engine to gain access to the bolts that hold the driven gear to the injection pump.

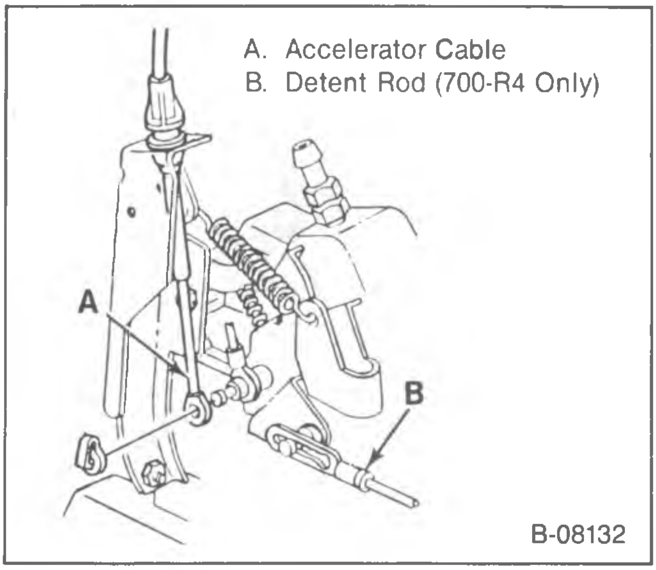


Figure 9—Accelerator Linkage

  - — Access is gained through the oil filler neck hole (figure 10).

12. Bolts (10).
13. Nuts (11) (figure 11).
14. Pump.
    - Cap all open lines and nozzles.
15. Gasket (12).

Install or Connect

1. New gasket (12).
2. Injection pump to the front cover.
    - Align the locating pin on the pump hub (14) with the slot in the injection pump driven gear (13) (figure 12).
    - Align the timing marks (figure 13).
3. Nuts (11) (figure 11).

Tighten

- Nuts to 40 N·m (30 ft. lbs.).
  - — Check the timing mark alignment before fully torquing the nuts.

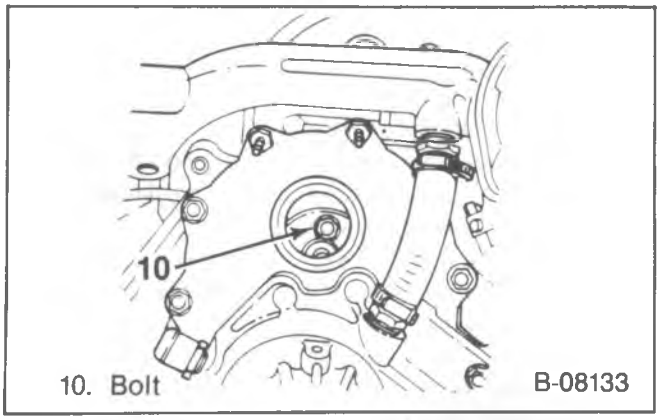


Figure 10—Pump Drive Gear Bolts

4. Drive gear to injection pump bolts (10) (figure 11).

Tighten

- Bolts to 25 N·m (20 ft. lbs.).

5. Grommet.
6. Oil fill tube including the CDR valve vent hose.
7. Air conditioning hose retainer bracket (if equipped).
8. Fuel feed line at the injection pump.

Tighten

- Fitting to 25 N·m (20 ft. lbs.).

9. Fuel return line to the top of the injection pump.
10. Detent cable (if equipped).
11. All necessary wires and hoses.
12. Accelerator cable.
13. Injection lines.
14. Intake manifold.
    - Refer to 6.2 LITER DIESEL (SEC. 6A7).
15. Battery negative cable.

G-VAN

Remove or Disconnect

Tool Required: J-29664-1, Protective Covers

1. Battery negative cable.
2. Engine cover.
3. Intake manifold.
    - Refer to 6.2 LITER DIESEL (SEC. 6A7).
4. Air cleaner inlet hose.
    - Rotate the snorkel up.
5. Hood latch.
6. Hood latch cable and move it aside.
7. Windshield washer bottle.
8. Fan shroud bolts.
9. Upper fan shroud.
10. Rubber hose from the oil fill tube.
11. The oil fill tube nuts.
12. The oil fill tube.
13. The oil fill tube grommet.
14. The drive gear to injection pump bolts (10) (figure 10).
    - Rotate the engine as necessary.
15. Fuel filter and bracket including the line to the injection pump.
16. Wire looms from the injection lines.
17. Injection lines from the brackets.
18. The oil pan dipstick tube at the left cylinder head.
19. Electrical connections at the injection pump.
20. Detent cable (if equipped).
21. Accelerator cable.
22. Injection lines.
23. Fuel return line.

- Scribe or paint a mark on the front cover and the injection pump flange.

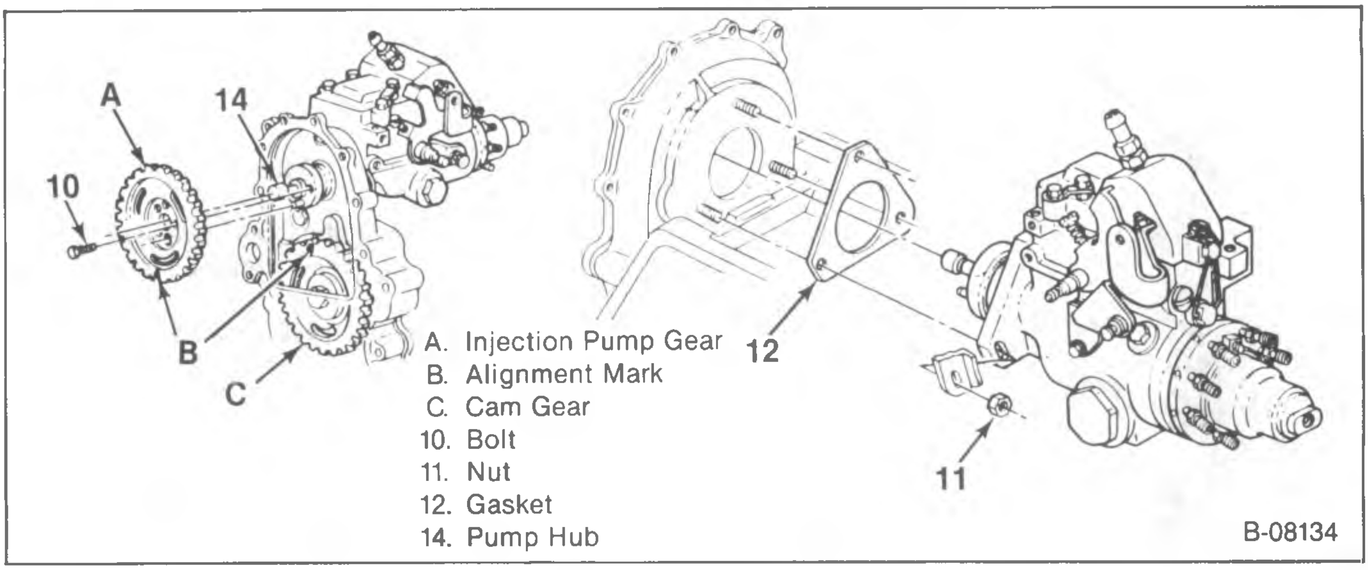


Figure 11—Injection Pump Installation

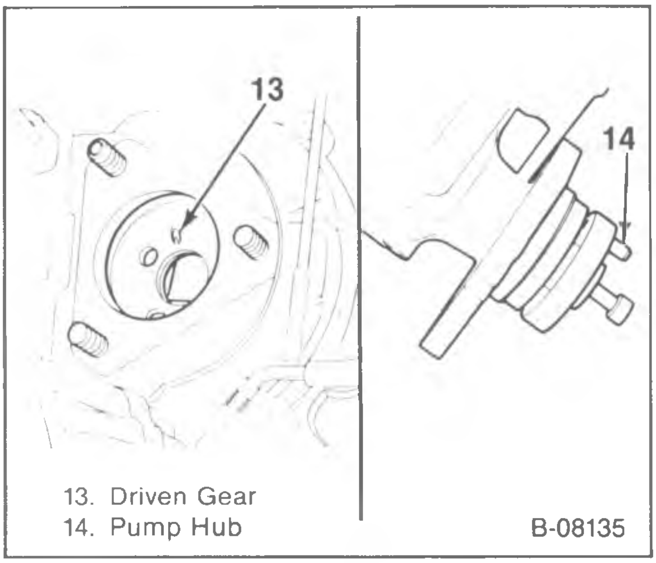


Figure 12—Injection Pump Locating Pin

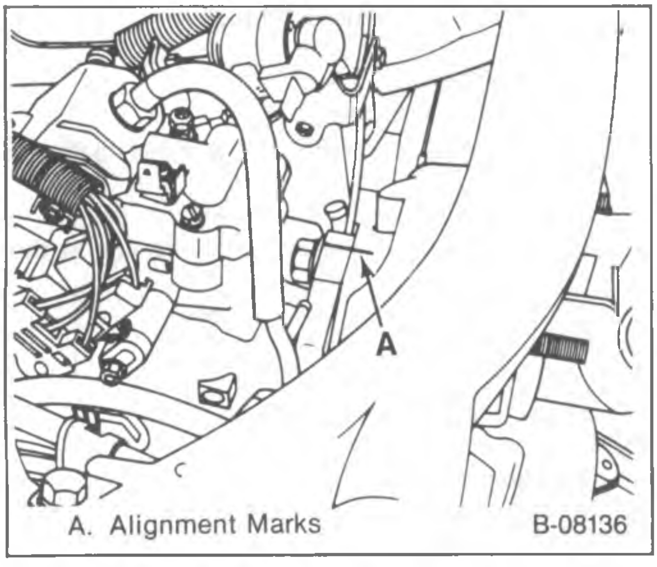


Figure 13—Timing Alignment Marks

24. Pump to front cover attaching nuts (11) (figure 11).
25. Injection pump.
    - Cap all open discharge fittings.
26. Gasket (12).

Install or Connect

1. New gasket.
2. Injection pump to the front cover.
    - Align the locating pin on the pump hub with the slot in the injection pump driven gear (figure 12).
    - Align the timing marks (figure 13).
3. Nuts (11).

Tighten

- Nuts to 40 N·m (30 ft. lbs.).
    — Check the timing mark alignment before fully torquing the nuts.

4. Drive gear to injection pump bolts (10).

Tighten

- Bolts to 25 N·m (20 ft. lbs.).

5. Fuel return line.
6. Injection lines.
7. Accelerator cable.
8. Detent cable (if equipped).
9. Electrical connections at the injection pump.
10. The oil pan dipstick tube at the left cylinder head.
11. Injection lines to the brackets.
12. Wire looms to the injection lines.
13. Fuel filter and bracket including the line to the injection pump.
14. The oil fill tube grommet.
15. The oil fill tube.
16. The oil fill tube nuts.
17. Rubber hose to the oil fill tube.

18. Upper fan shroud.
19. Fan shroud bolts.
20. Windshield washer bottle.
21. Hood latch cable.
22. Hood latch.
23. Air cleaner inlet hose.
24. Intake manifold.
    - Refer to 6.2 LITER DIESEL (SEC. 6A7).
25. Engine cover.
26. Battery negative cable.

INJECTION TIMING ADJUSTMENT

For the engine to be properly timed, the marks on the top of the engine front cover must be aligned with the marks on the injection pump flange (figure 13). The engine must be off when the timing is reset. On Federal models, align the scribe marks. On California models, align the half circles.

Adjust

1. Injection timing.
    - Loosen the three pump retaining nuts.
    - Align the mark on the injection pump with the mark on the front cover.

    Tighten

    - Pump retaining nuts to 40 N·m (30 ft. lbs.).
2. Throttle rod.

MARKING TDC ON THE FRONT HOUSING

Tool Required: J-33042, Timing Fixture

1. Set the engine so that number 1 cylinder is at TDC (firing).
2. Install J-33042 in the injection pump location.
    - Do not use the gasket.
3. The slot in the injection pump gear should be in the vertical 6 o'clock position (figure 14). If not, remove J-33042 and rotate the engine crankshaft 360 degrees. The timing marks on the gears will be aligned.
4. Fasten J-33042 to the gear and tighten.
5. Install one 10 mm nut to the upper housing stud to hold the tool flange.
    - The nut should be finger tight.
6. Tighten the large bolt (18 mm head) clockwise (looking at the front of the engine) to 48 N·m (35 ft. lbs.).
7. Tighten the 10 mm nut.
8. Check that the crankshaft has not rotated and that the tools did not bind.

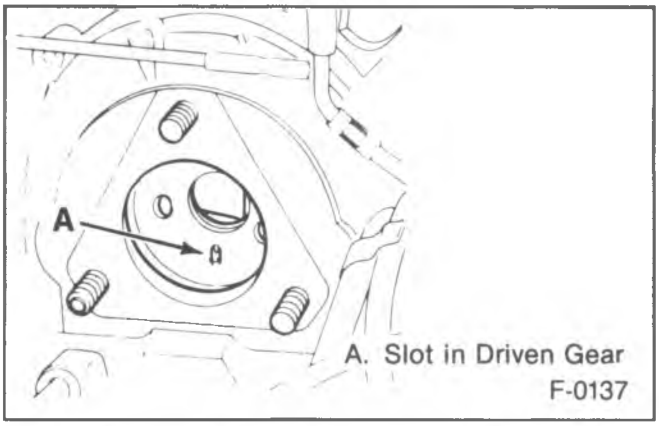


Figure 14—Slot In Injection Pump

9. Strike the scriber with a mallet to mark TDC on the front housing.
10. Remove J-33042.

Install or Connect

1. Gasket.
2. Injection pump.
3. Nuts (finger tight).
4. One 8 mm bolt to attach the gear to the pump hub.

    Tighten

    - Bolt to 25 N·m (20 ft. lbs.).
    - Injection pump nuts to 40 N·m (30 ft. lbs.).
        - — Align the timing mark on the injection pump flange with the mark on the front cover.
5. Remaining pump gear attaching bolts.
    - Rotate the engine to gain access to the bolts.

    Tighten

    - Bolts to 25 N·m (20 ft. lbs.).

INJECTION NOZZLES

Nozzles used in G models are shorter than nozzles used on C-K and P models. Attempts to use the incorrect nozzle will damage the cylinder heads. When replacing nozzles, reference should be made to the part number which is stamped on the side of the nozzle (figure 15).

INJECTION NOZZLE REPLACEMENT

↔ Remove or Disconnect(Figure 16)

Tool Required: J-29873, Nozzle Socket

1. Negative battery cable.
2. Fuel line clip.
3. Fuel return hose.
4. Fuel injection line.
   - Cap the nozzle and lines.

NOTICE: When removing an injection nozzle, use J-29873. Remove the nozzle using the 30 mm hex portion (figure 15). Failure to do so will result in damage to the injection nozzle.

5. Injection nozzle using J-29873.

→← Install or Connect (Figure 16)

Tool Required: J-29873, Nozzle Socket

NOTICE: When installing an injection nozzle, use J-29873. Install the nozzle using the 30 mm hex portion (figure 15). Failure to do so will result in damage to the injection nozzle.

1. Injection nozzle using J-29873.

   Tighten

   - Nozzle to 70 N·m (50 ft. lbs.).
2. Fuel injection line.

   Tighten

   - Nut to 25 N·m (20 ft. lbs.).
3. Fuel return hose.
4. Fuel line clip.
5. Negative battery cable.

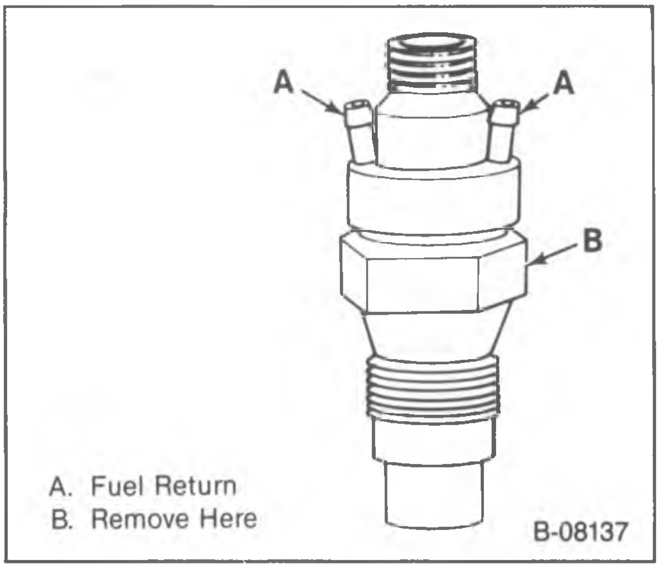


Figure 15—Injection Nozzle

INJECTION NOZZLE TESTS

Nozzle testing is comprised of the following checks:

- Nozzle opening pressure
- Leakage

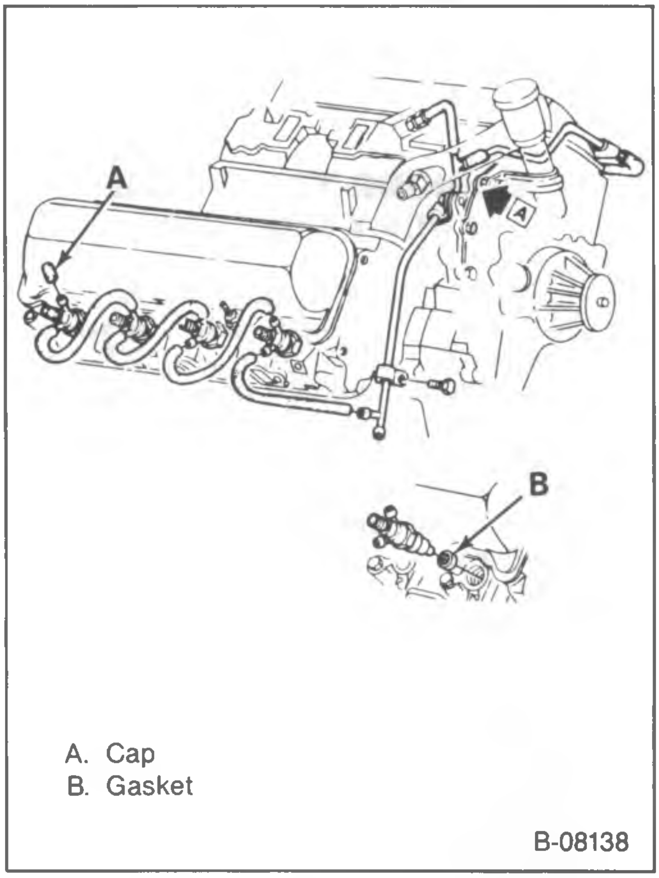


Figure 16—Injection Nozzles

- Chatter
- Spray pattern

Each test should be considered independent of the others (for example, when checking opening pressure, do not check for leakage).

If all of the above tests are satisfied, the nozzle holder assembly can be re-used. If any one of the tests is not satisfied, the complete nozzle holder assembly must be replaced. The nozzle holder will then be checked and repaired at a centralized location.

- Test Lines - 6 × 2 × 400 mm (1.5 mm bore).
- Test Fluid - per ISO 4113 (Example: Shell V 1399, Viscosity 1487C or equivalent).
- Kinetic Viscosity at 40° - per ISO 3104: 2,45 - 2.75 mm ²/second.
- Test oil temperature during test: 20 - 25°C (68°F - 77°F).
- Refer to the equipment manufacturers instructions for exact test procedures.

1. Connect the nozzle holder assembly to the test line.
2. Place clear plastic tubes on overflow connections to prevent leakoff from being confused with actual leak.
3. Close the shutoff valve to the pressure gage.

CAUTION: When testing nozzles, do not place your hands or arms near the tip of the nozzle. The high pressure atomized fuel spray from a nozzle has sufficient penetrating power to puncture flesh and destroy tissue and may result in blood poisoning. The nozzle tip should always be enclosed in a receptacle, preferably transparent, to contain the spray.

4. Fill and flush the nozzle holder assembly with test oil by activating the lever briskly and repeatedly. This will apply test oil to all functionally important areas of the nozzle and purge it of air.

OPENING PRESSURE TEST

1. Open the shutoff valve at the pressure gage one-quarter turn.

CAUTION: When testing nozzles, do not place your hands or arms near the top of the nozzle. The high pressure atomized fuel spray from a nozzle has sufficient penetrating power to puncture flesh and destroy tissue and may result in blood poisoning. The nozzle tip should always be enclosed in a receptacle preferably transparent, to contain the spray.

2. Depress the tester lever slowly. Note at what pressure the needle of the pressure gage stopped. The maximum observed pressure is the opening pressure.
   - Some nozzles may pop while other nozzles may drip down (this is not leakage).
3. The opening pressure should not fall below the lower limit of 105 bar (1500 psi) on used nozzles.
4. Replace nozzles which fall below the lower limit.

LEAKAGE TEST

1. Further open the shutoff valve at the pressure gage ½ to 1 ½ turns).
2. Blow-dry the nozzle tip.

CAUTION: When testing nozzles, do not place your hands or arms near the top of the nozzle. The high pressure atomized fuel spray from a nozzle has sufficient penetrating power to puncture flesh and destroy tissue and may result in blood poisoning. The nozzle tip should always be enclosed in a receptacle preferably transparent, to contain the spray.

3. Depress the lever of the manual test stand slowly until the gage reads a pressure of 95 bar (1400 psi). Observe the nozzle tip. A drop may form on the end of the nozzle but should not drop off within a period of 10 seconds.
4. Replace the nozzle assembly if a drop falls during the 10 seconds.

CHATTER TEST

When testing for chatter, it should be noted that the sound (chatter) for new and used nozzles may vary. This is due to carbonized fuel deposits on the pintle and nozzle tip of used nozzles. With some used nozzles, chatter is difficult to detect during slow actuation of the hand lever.

Some nozzles may chatter louder than others. As long as there is chatter, the nozzle is acceptable.

1. Close the shutoff lever at the pressure gage.

CAUTION: When testing nozzles, do not place your hands or arms near the top of the nozzle. The high pressure atomized fuel spray from a nozzle has sufficient penetrating power to puncture flesh and destroy tissue and may result in blood poisoning. The nozzle tip should always be enclosed in a receptacle preferably transparent, to contain the spray.

2. Depress the lever of the test stand slowly and note whether chatter noise can be heard.
3. If no chattter is heard, move the lever faster until it chatters. At fast lever movement, the nozzle may make a "hissing" or "squealing" sound rather than the normal chatter. This is acceptable.
4. These sounds indicate that the nozzle needle moves freely and that the nozzle seat, guide, and pintle are OK.
5. Replace nozzles that do not chatter.

SPRAY PATTERN

This nozzle features a longer nozzle overlap, greater pintle to body clearance, greater needle to body clearance, and an internal wave washer between the nozzle nut and the nozzle. These features make objective spray pattern testing difficult.

A pop tester will not deliver fuel fast enough for proper spray pattern analysis. Based on this, this type of nozzle should not be rejected for spray pattern.

INJECTION PUMP ON-VEHICLE SERVICE

Refer to figure 17 for injection pump components location.

PUMP COVER SEAL AND/OR GUIDE STUD SEAL REPLACEMENT

Remove or Disconnect

Tool Required: J-29664, Manifold Cover Set

1. Negative battery cables.
2. Air cleaner and intake manifold.
    - Install J-29664 in the cylinder heads.
3. Injection pump fuel solenoid wire.
4. Housing pressure cold advance wire.
5. Fuel return line.
6. Top attaching bolt and loosen the lower attaching bolt on the fast idle solenoid. Move the solenoid aside.
7. Injection pump cover screws.

Clean

- Injection pump cover.
- Upper portion of the pump.
- The guide stud area.
- Place several rags in the engine valley to catch fuel.

NOTICE: Extreme care must be used to keep foreign material out of the pump when the cover is off. If any objects are dropped into the pump, they must be removed before the engine is started or injection pump and engine damage could occur.

8. Injection pump cover.
9. The guide stud and washer.
    - Note location of parts prior to removal.
    - Observe the position of the metering valve spring over the top of the guide stud (figure 18). This position must be exactly duplicated during assembly.
10. Pump cover seal from the pump cover.

Install or Connect

1. The guide stud with a new washer.
    - Make sure that the upper extension of the metering valve spring rides on top of the guide studs.

Tighten

- The guide stud to 9.5 N·m (85 in. lbs.).
    - Overtightening the guide stud may strip the aluminum threads in the housing.

2. New pump cover seal in the pump cover.
3. The pump cover.
    - The screws should not be in the pump cover.
    - Position the cover about 6 mm ($^{1}/_{4}$-inch) forward (toward the shaft end) and about 3 mm ($^{1}/_{8}$-inch) above the pump (figure 19).
    - Move the cover rearward and downward into position, being careful not to cut the seal.
        - Hold throttle in the idle position.
4. The cover screws.
    - Be careful not to drop or lose the flat washer and spring washer on each screw.
    - The flat washer must be against the pump cover.

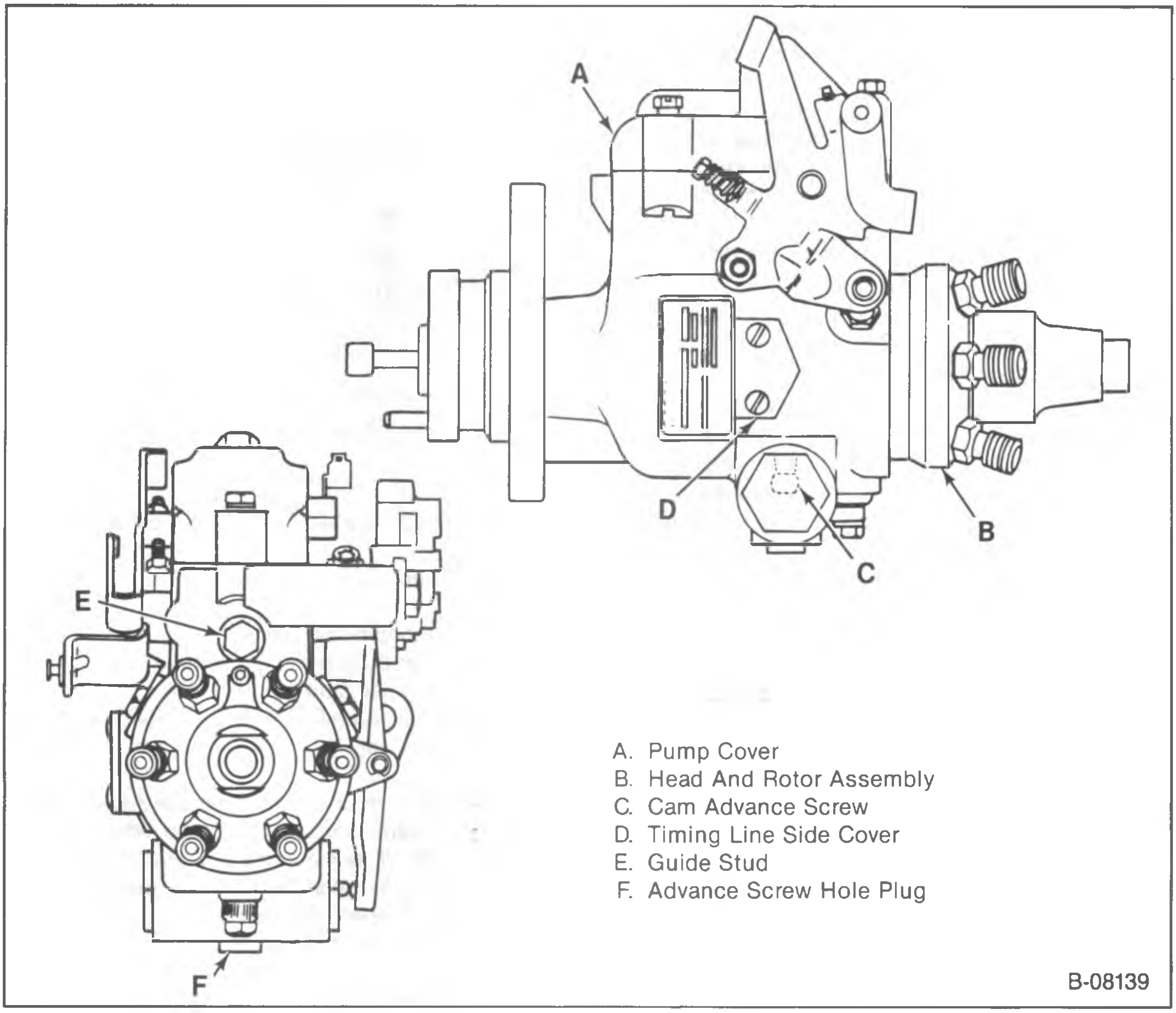
Tighten

- Screws to 3.7 N·m (33 in. lbs.).

5. Battery negative cables.

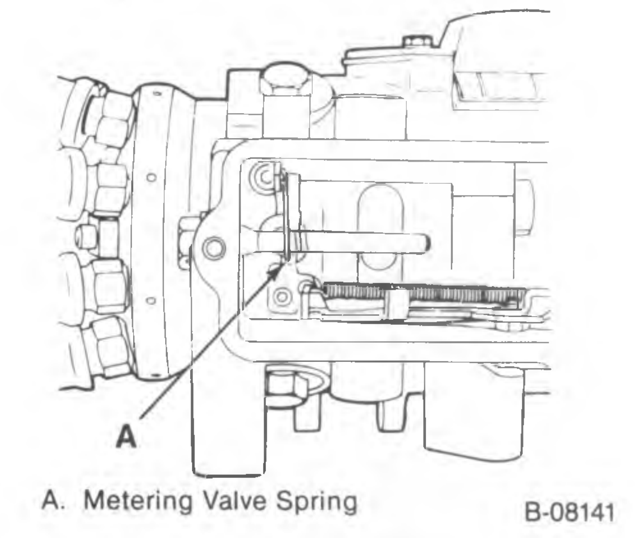
Inspect

- Turn the ignition switch to the run position and touch the pink wire to the solenoid connector. A clicking noise should be heard as the wire is connected and disconnected. If this clicking is not heard, the linkage may be jammed in the wide open throttle position and the engine **MUST NOT BE STARTED.** If clicking is not heard, remove the cover



- A. Pump Cover
- B. Head And Rotor Assembly
- C. Cam Advance Screw
- D. Timing Line Side Cover
- E. Guide Stud
- F. Advance Screw Hole Plug

Figure 17—Injection Pump Components Location



A. Metering Valve Spring

Figure 18—Metering Valve Spring Position

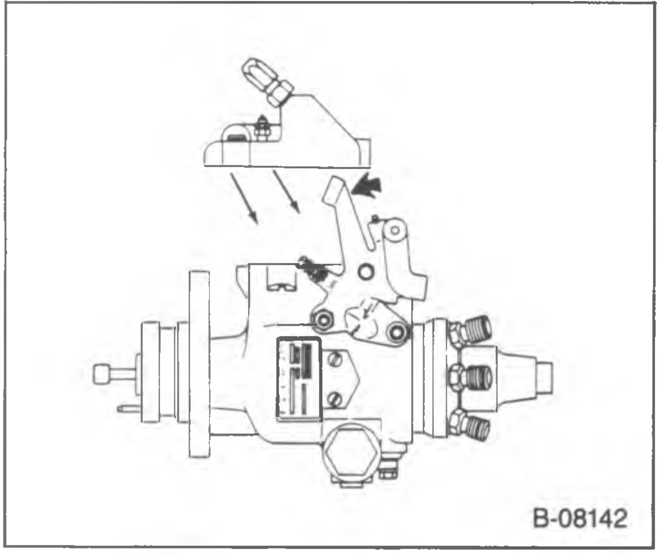


Figure 19—Installing The Injection Pump Cover

and ground the solenoid lead (opposite the hot lead) and connect the pink wire. With the ignition switch in the run position, the solenoid in the cover should move the linkage. If not, the solenoid must be replaced. Minimum voltage across the terminals must be 12.0. Install the cover and repeat the inspection.

6. Fuel return line, throttle cable, and the return springs.
7. Fast idle solenoid.
8. Housing pressure cold advance wire.
9. Injection pump fuel solenoid wire.

- Start the engine and check for leaks.
- Idle roughness may be observed due to air in the pump. Engine idling will allow the air to purge.
  - — It may be necessary to shut the engine down for several minutes to allow air bubbles to rise to the top of the pump.

10. Intake manifold and air cleaner.
    - Remover J-29664.

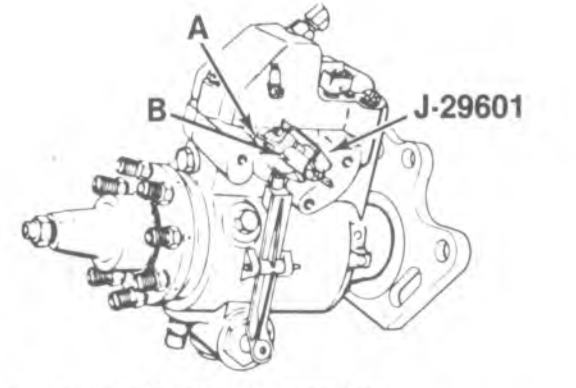
THROTTLE SHAFT SEAL REPLACEMENT

Remove or Disconnect

Tools Required:

J-29601, Injection Pump Timing Adapter
J-29664, Manifold Cover Set

1. Negative battery cables.
2. Air cleaner and intake manifold
   - Install J-29664 in the cylinder heads.
3. Injection pump fuel solenoid, housing pressure cold advance wires, and the fuel return line.
4. Throttle rod and the return springs.
   - Mark the position of the TPS switch or VRV for installation.
5. Top attaching bolt on the fast idle solenoid. Move the soleniod aside.
6. Throttle cable bracket.
7. Throttle shaft advance cam and fiber washer.
   - Install J-29601 over the throttle shaft with the slots on the tool engaging the pin (figure 20). Put the spring clip over the throttle shaft advance cam and tighten the wing nut. Pull the tool off of the shaft without loosening the wingnut This provides proper advance cam alignment for assembly.
   - Loosen the face cam screw.
   - Drive the pin from the throttle shaft.
8. Any burrs from the throttle shaft that may have resulted from pin removal.
9. Injection pump cover screws.



A. Throttle Shaft Advance Cam
B. Throttle Shaft Pin

B-08144

Figure 20—J-29601 Installed On Pump

Clean

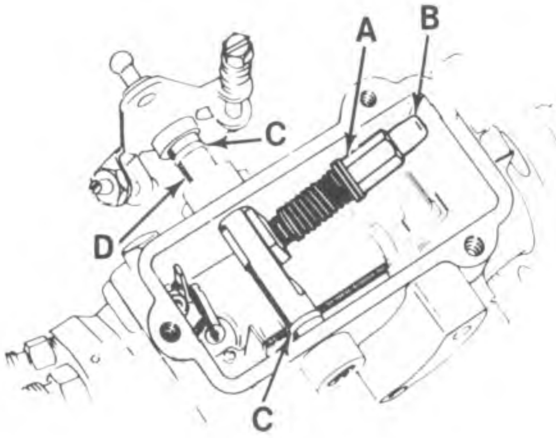
- Injection pump cover.
- Upper portion of the pump.
- The guide stud area.
- Place several rags in the engine valley to catch fuel.

NOTICE: Extreme care must be used to keep foreign material out fo the pump when the cover is off. If any objects are dropped into the pump, they must be removed before the engine is started or injection pump and engine damage could occur.

10. Injection pump cover.
11. The guide stud and washer.
    - Note location of parts prior to removal.
    - Observe the position of the metering valve spring over the top of the guide stud (figure 18). This position must be exactly duplicated during assembly.
12. Min - max governor assembly (figure 21).
    - Rotate the assembly up to provide clearance.
    - If the idle governor spring becomes disengaged from the throttle block, it must be reinstalled with the tightly wound coils toward the throttle block.
13. The throttle shaft assembly.

Inspect

- Throttle shaft for unusual wear or damage.
- Throttle shaft bushings for damage or unusual wear or leaks.
  - — Remove the pump and send it to the local Stanadyne dealer if bushing replacement is necessary.



A. Min - Max Governor Assembly
B. Min - Max Governor Sleeve
C. Seal
D. Throttle Shaft

B-08140

Figure 21—Injection Pump Cover Removed

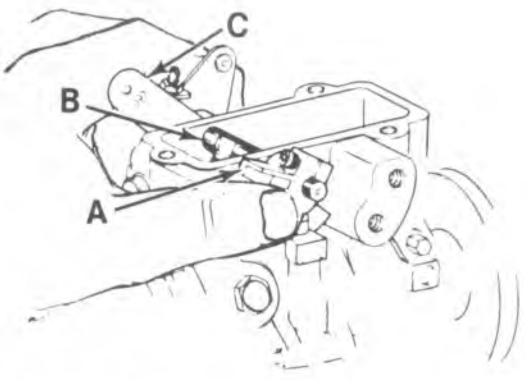
14. The throttle shaft seals.
    - Do not attempt to cut the seals, as nicks in the seal seat will cause leakage.

Install or Connect

Tools Required:

J-29601, Injection Pump Timing Adapter
J-33198, Synkut Oil Seal Lubricant

1. New throttle shaft seals.
    - Use care not to cut the seal on the sharp edges of the shaft.
    - Apply J-33198 or a light coating of clean chassis grease to the seals.
2. The throttle shaft to the point where the min - max governor assembly will slide back onto the shaft.
3. Throttle shaft and governor into position.
    - Rotate the min - max governor assembly downward (figure 21).
4. New mylar washer, the throttle shaft advance cam, and a new throttle shaft drive pin (figure 20).
    - Do not tighten the cam screw.
5. J-29601 over the throttle shaft with the pin in the slots and the spring clip over the advance cam.
6. A 0.005-inch feeler gage between the white washer on the throttle shaft and the pump housing (figure 22).



A. Advance Cam
B. Throttle Shaft
C. Feeler Gage

B-08145

Figure 22—Setting Advance Cam To Housing Clearance

Tighten

- Cam screw to 3.1 N·m (30 in. lbs.).
    - — Squeeze the throttle shaft.
    - — Secure the screw with Loctite 290 or equivalent.
- Remove J-29601.

7. The guide stud with a new washer.
    - Make sure that the upper extension of the metering valve spring rides on top of the guide stud.

Tighten

- The guide stud to 9.5 N·m (85 in. lbs.).
    - — Overtightening the guide stud may strip the aluminum threads in the housing.

8. New pump cover seal in the pump cover.
9. The pump cover.
    - The screws should not be in the pump cover.
    - Position the cover about 6 mm (1/4-inch) forward (toward the shaft end) and about 3 mm (1/8-inch) above the pump (figure 19).
    - Move the cover rearward and downward into position, being careful not to cut the seal.
10. The cover screws.
    - Be careful not to drop or lose the flat washer and spring washer on each screw.
    - The flat washer must be against the pump cover.

Tighten

- Screws to 3.7 N·m (33 in. lbs.).

11. TPS switch or VRV.
12. Battery negative cables.

Inspect

- Turn the ignition switch to the run position and touch the pink wire to the solenoid connector. A clicking noise should be heard as the wire is connected and disconnected. If this clicking is not heard, the linkage may be jammed in the wide open throttle position and the engine **MUST NOT BE STARTED.** If clicking is not heard, remove the cover and ground the solenoid lead (opposite the hot lead) and connect the pink wire. With the ignition switch in the run position, the solenoid in the cover should move the linkage. If not, the solenoid must be replaced. Minimum voltage across the terminals must be 12.0. Install the cover and repeat the inspection.

13. Fuel return line, throttle cable, and the return springs.
14. Fast idle solenoid.
15. Housing pressure cold advance wire.
16. Injection pump fuel solenoid wire.
    - Start the engine and check for leaks.
    - Idle roughness may be observed due to air in the pump. Engine idling will allow the air to purge.
      — It may be necessary to shut the engine down for several minutes to allow air bubbles to rise to the top of the pump.
17. Intake manifold and air cleaner.
    - Remove J-29664.

SHUTDOWN AND/OR COLD ADVANCE SOLENOID REPLACEMENT

Remove or Disconnect (Figure 23)

1. Pump cover.
   - Refer to "Pump Cover Seal And/Or Guide Stud Seal Replacement."
2. Terminal contact nuts.
3. Solenoid.
   - Note the positions of the insulating washers.

Install or Connect (Figure 23)

1. Solenoid in the pump cover.
   - On the shutdown solenoid, make sure that the linkage is free.
   - On the cold advance solenoid, make sure that the plunger is centered so that it will contact the check ball in the fitting.
2. Insulating washers on the terminal studs (where used).
3. Terminal nuts.

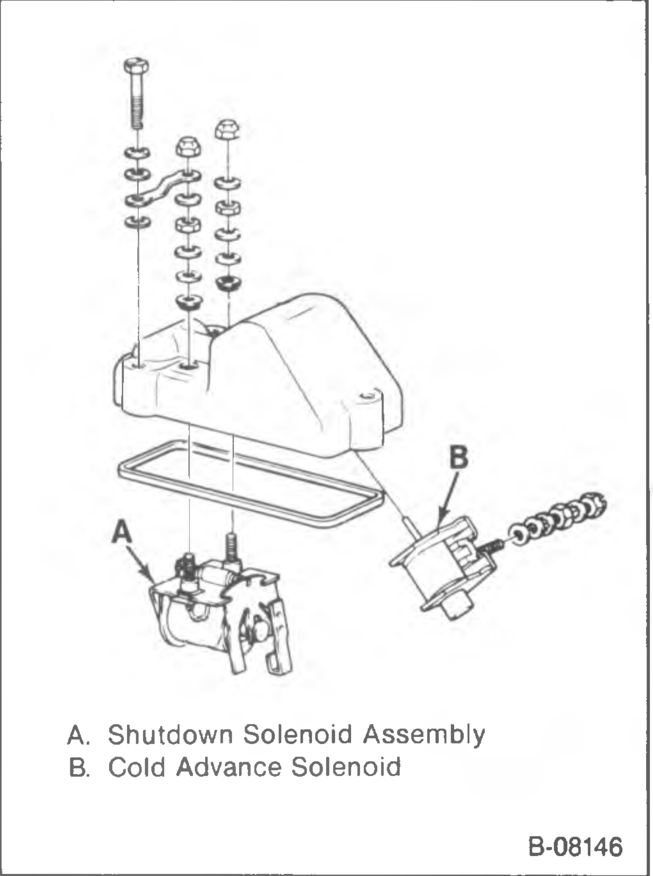


Figure 23—Cold Advance And Shutdown Solenoids

Tighten

- Nuts to 1.2 N·m (12 in. lbs.).

4. Pump cover.
   - Refer to "Pump Cover Seal And/Or Guide Stud Seal Replacement."

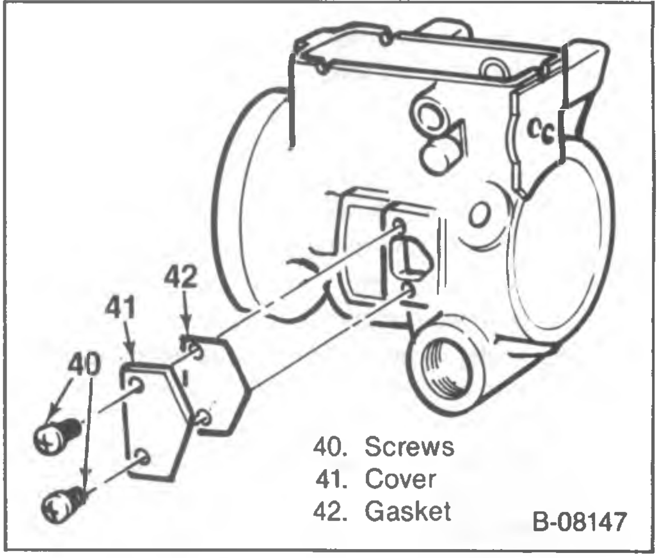


Figure 24—Side Housing and Drive Group

Inspect

- Solenoid operation prior to installing the pump cover. Use a 12V DC power source.

SIDE COVER GASKET REPLACEMENT

Remove or Disconnect (Figure 24)

1. The two screws (40).
2. Cover (41).
3. Gasket (42).

Install or Connect (Figure 24)

1. Gasket.
2. Cover.
3. Screws.

Tighten

- Screws to 2 N·m (18 in. lbs.).

INJECTION PUMP OFF-VEHICLE SERVICE

Refer to "Injection Pump Replacement." Off-vehicle service operations require a leak test after the repair has been made. Refer to "Pressure Testing The Injection Pump."

ADVANCE PIN HOLE PLUG SEAL REPLACEMENT

Remove or Disconnect (Figure 25)

1. Injection pump.
2. Plug (50).
    - Tap the plug lightly with a hammer to loosen it.
3. Seal (51).

Install or Connect (Figure 25)

1. New seal.
    - Lubricate the seal.
2. Plug.

Tighten

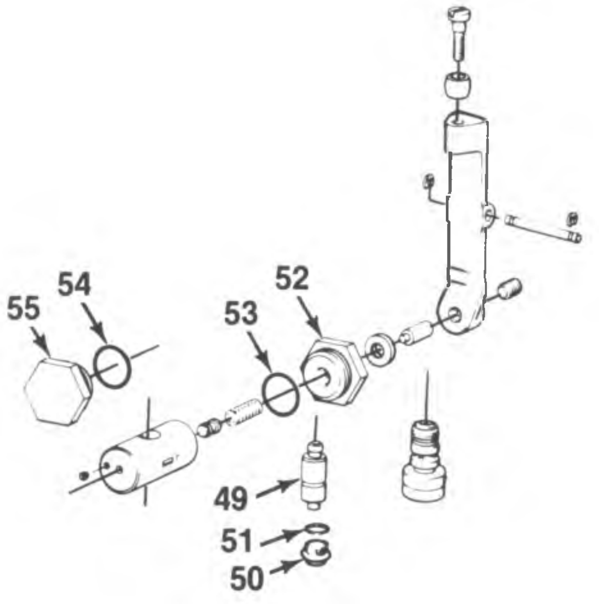
- Plug to 10 N·m (90 in. lbs.).

3. Injection pump.

ADVANCE PISTON SEALS REPLACEMENT

Remove or Disconnect (Figure 25)

1. Injection pump.
2. Spring side advance piston hold plug (52).
3. Seal (53).
4. Power side advance piston hold plug (55).
5. Seal (4).



49. Cam Advance Pin
50. Plug
51. Seal
52. Spring Side Plug
53. Seal
54. Seal
55. Power Side Plug

B-08148

Figure 25—Advance Piston Group

Install or Connect (Figure 25)

1. New seal (54).
    - Lubricate the seal.
2. Plug (55).
3. Seal (53).

4. Plug (52).
5. Injection pump.

HYDRAULIC HEAD SEAL REPLACEMENT

Remove or Disconnect

1. Injection pump.
2. Throttle shaft and seals.
    - Refer to "Throttle Shaft Seal Replacement."
3. Metering valve (figure 26)
4. Housing vent screw assembly (figure 27).
5. Cam advance pin hold plug (50) (figure 25).
6. Seal from the plug.
7. Cam advance pin (49) (figure 25).
8. Head locking screws (figure 28).
    - Locate the pump assembly so the rear of the pump is sloping down.
9. Head locating screw and seal (figure 29).
10. Hydraulic head assembly using a twisting motion.
11. O-ring seal.

Install or Connect

1. New o-ring seal to the hydraulic head.
    - Lubricate the seal.
2. Hydraulic head assembly into the pump housing.
3. Head locking screws loosly (figure 28).
    - Lubricate the screws.
4. New seal on the head locating screw.
5. Head locating screw (figure 29).
    - Turn the pump upside down.

Tighten

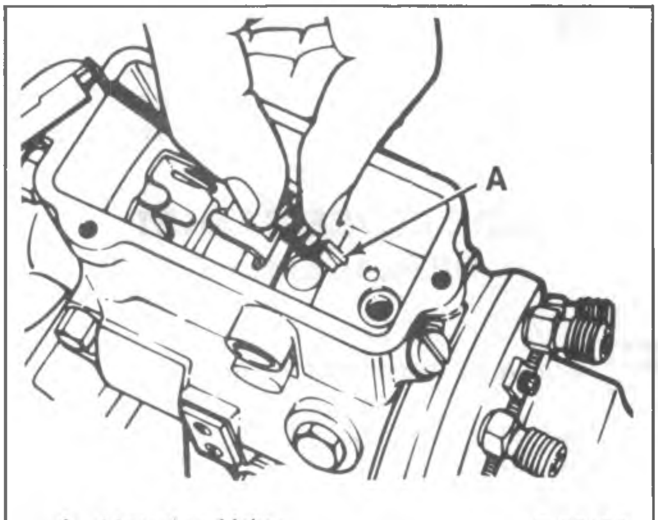
- Screw to 23 N·m (17 ft. lbs.).

6. The advance pin (49) (figure 25).
7. New seal on the advance pin hole plug.
    - Lubricate the seal.
8. The advance pin hold plug.

Tighten

- Plug to 10 N·m (90 in lbs.).

9. Housing vent screw assembly (figure 27).
10. Metering valve (figure 26).
11. Throttle shaft and seals.
    - Refer to "Throttle Shaft Seal Replacement."
12. Injection pump.



A. Metering Valve F-00138

Figure 26—Metering Valve

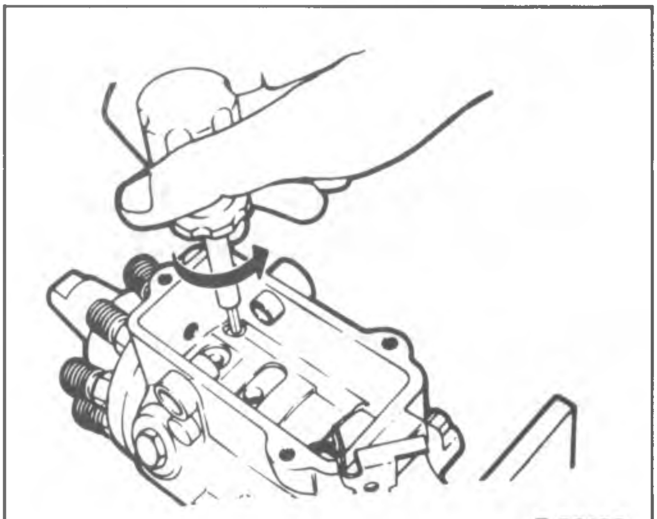


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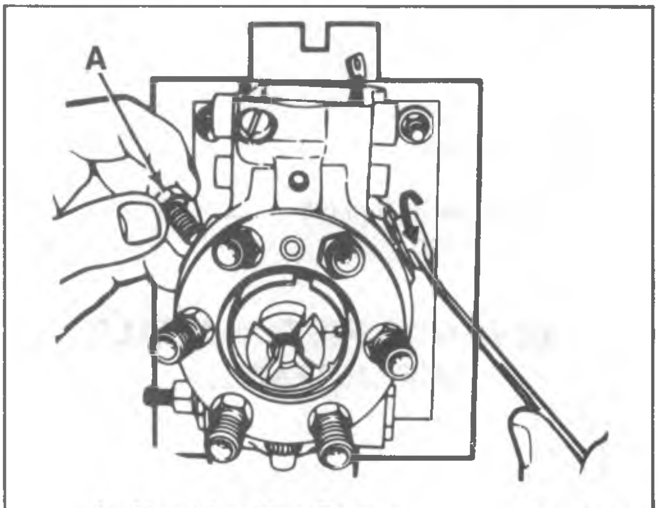
Figure 27—Vent Wire Assembly



A. Head Locking Screws F-00140

Figure 28—Head Locking Screws

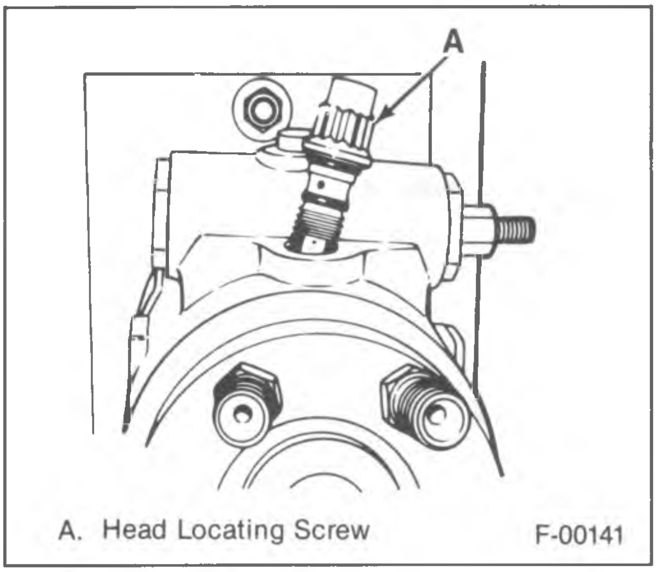


Figure 29—Head Locating Screw

DRIVE SHAFT SEAL REPLACEMENT

↔ Remove or Disconnect (Figure 30)

Tool Required: J-29692-B, Holding Fixture

1. Injection pump.
2. Fast idle solenoid bracket.
   - Mount the pump in J-29692-B and tilt it.
3. The drive shaft from the pump using a rotating motion (alignment pin at the top).
   - The shaft is retained by an o-ring.
   - Make sure that no pieces of the o-ring have broken off in the pump.
4. The drive shaft seals.

→← Install or Connect (Figure 30)

Tools Required:
J-29692-B, Holding Fixture
J-29745-A, Shaft Seal Protector
J-33198, Synkut Lubricating Oil

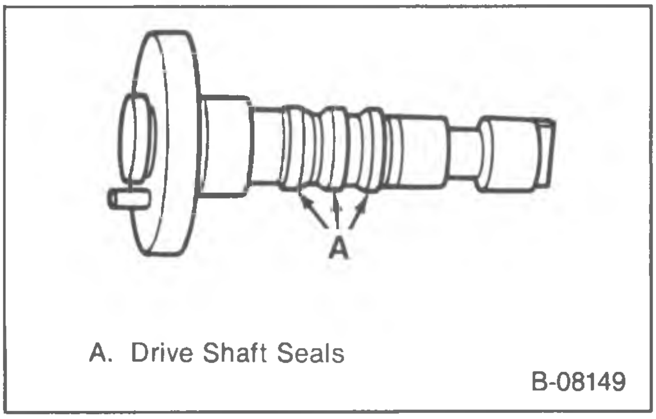


Figure 30—Drive Shaft Seals

1. One black seal on the shaft using J-29745-A.
   - Lubricate the seal protector with J-33198 or equivalent.
2. The red seal using J-29745-A.
   - Lubricate the seal protector with J-33198 or equivalent.
3. The other black seal using J-29745-A.
   - Lubricate the seal protector with J-33198 or equivalent.
4. New o-ring retaining clip on the shaft.
5. Drive shaft into the pump.
   - Make sure the drill points on the drive shaft end match up with the rotor.
6. Fast idle solenoid bracket.
7. Injection pump.

PRESSURE TESTING THE INJECTION PUMP

1. Drain all fuel from the pump.
2. Connect an air line to the pump inlet connection.
   - Make sure the air supply is clean and dry.
3. Completely immerse the pump in a bath of clean test oil.
   - Seal off the return line fitting.
4. Raise the air pressure in the pump to 137.9 kPa (20 psi). Keep the pump immersed in the oil for 10 minutes to allow any trapped air to escape.
5. Watch for leaks after the ten minutes. If the pump is not leaking, reduce the air pressure to 13.8 kPa (2 psi) for 30 seconds. If there is still no leakage, increase the pressure to 137.9 kPa (20 psi). If there are no leaks, the pump is ready for use.

SPECIAL TOOLS

J-26925	Tachometer
J-29601	Injection Pump Timing Adapter
J-29664-1	Protective Covers
J-29692-B	Holding Fixture
J-29745-A	Shaft Seal Protector
J-29873	Nozzle Socket
J-33042	Timing Fixture
J-33043	Gage Block
J-33198	Synkut Lubricating Oil

SECTION 6D

ENGINE ELECTRICAL

CONTENTS

CONTENTS (CONTINUED)

ELECTRICAL SYSTEM

Engine electrical system diagnosis includes the battery, charging system (generator and related wiring), cranking system (starter and related wiring), ignition system (distributor, spark plugs, and wiring), and glow plug system (diesel electrical).

Some vehicles are equipped with an electronic Computer Command Control system. These vehicles have a "Check Engine" or "Service Engine Soon" lamp on the instrument panel. Refer to the emissions material in Section 6E of this manual for a detailed description of the lamp's operation and use as a diagnostic indicator.

For vehicles sold in Canada and equipped with non-closed loop engine electrical systems, refer to the appropriate Canadian Service Manual Supplement.

ELECTRIC CHOKE HEATER-OIL PRESSURE SWITCH

DESCRIPTION

All carbureted engines without gage instrumentation have a 2-terminal oil pressure switch to control current to the electric choke heater. This switch also provides for the lighting of the "Oil" or "Choke" indicator lamp. No choke heater relay is used on these vehicles. Refer to the Body and Chassis Electrical Diagram for choke heater and associated indicator lamp circuitry.

CHOKE HEATER-OIL PRESSURE SWITCH CHECK

1. Allow the choke to cool so that when the throttle is opened slightly the choke blade fully closes. Do this with the engine not running and at an ambient temperature of 27° to 60° C (80° to 140° F).

2. Start the engine and determine the time for the choke blade to reach full open position. Start the timer when the engine starts.

3. If the choke blade fails to open fully within 3.5 minutes, proceed with steps 4-5-6 below.

4. Check the voltage at the choke heater connection with the engine running. If the voltage is approximately 12 to 15 volts, replace the electrical choke unit.
5. If the voltage is low or zero, check all wires and connections. No gasket is used between the choke cover and the choke housing because of grounding requirements. If any connections in the oil pressure switch circuitry are bad or if the oil pressure switch is stuck open, the oil warning lamp will be on with the engine running. Repair wires or connections as required.
6. If all wiring and connections are good, replace the oil pressure switch.

BATTERY

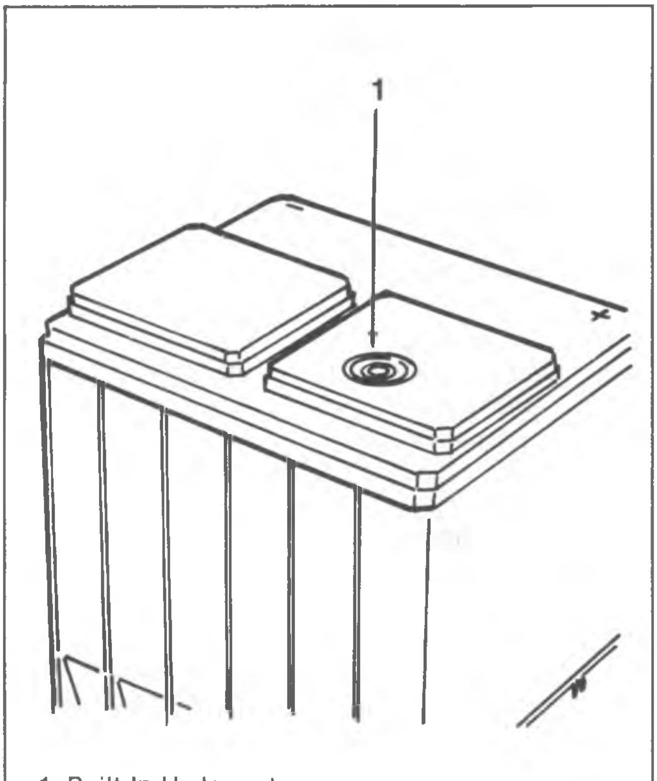


Figure 1—Sealed Battery with Side Terminals

DESCRIPTION

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.

The sealed battery as shown in figure 1 is standard. Refer to "Specifications" at the end of this section for specific application.

Water never needs to be added to the sealed battery. There are no filler caps in the cover. The battery is sealed, except for small vent holes in the cover. The vents allow what small amount of gasses that are produced in the battery to escape. The special chemical composition inside the battery reduces gassing to a very small amount at normal charging voltages. Besides reducing gassing, the special chemistry greatly reduces the possibility of overcharge damage.

Keep the battery in an upright position to prevent electrolyte leakage. Tipping the battery beyond a 45 degree angle in any direction can allow a small amount of electrolyte to leak out the vent hole.

Do not exceed this 45 degree angle when carrying or installing the battery.

Evidence of electrolyte leakage does not always mean the battery is defective.

RATINGS

Batteries are rated according to their reserve capacity in minutes and their cold cranking power in amperes. Both methods involve measuring the battery terminal voltage after a specified time period and discharge current.

The "reserve capacity" is defined as 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 12-volt battery, at a temperature of 27° C (80° F), being discharged at a constant current of 25 amperes, to reach a terminal voltage of 10.5 volts.

The "cold cranking ampere" (CCA) test measures the amperage delivered by the battery at –18° C (0° F) for 30 seconds.

Refer to the "Specifications" at the end of this section for battery ratings.

BUILT-IN HYDROMETER

The sealed battery has a special temperature compensated hydrometer built into the cover to show at a glance the battery's state-of-charge. The hydrometer has a green ball within a cage which is attached to a clear plastic rod. The green ball will float at a predetermined specific gravity of the electrolyte. When the green ball floats, it rises within the cage and positions itself under the rod. Visually a green dot then shows in the center of the hydrometer (figure 2). The built-in hydrometer provides a guide for battery testing and charging.

When looking at the hydrometer, make sure that the battery has a clean top. A lamp may be needed in some poorly-lit areas.

1. GREEN DOT VISIBLE: The state of charge is 65 percent or more of the full charge.
2. DARK; GREEN DOT NOT VISIBLE: The state of charge is below 65 percent. Charge the battery until the green dot appears. (Shake the battery slightly to make the green dot appear after charging).
3. CLEAR OR LIGHT YELLOW: The fluid level has dropped below the bottom of the hydrometer. This can be caused by a broken case, tipping of the battery, normal wearout, or overcharging because of a problem in the electrical system. Check the system and replace the battery.

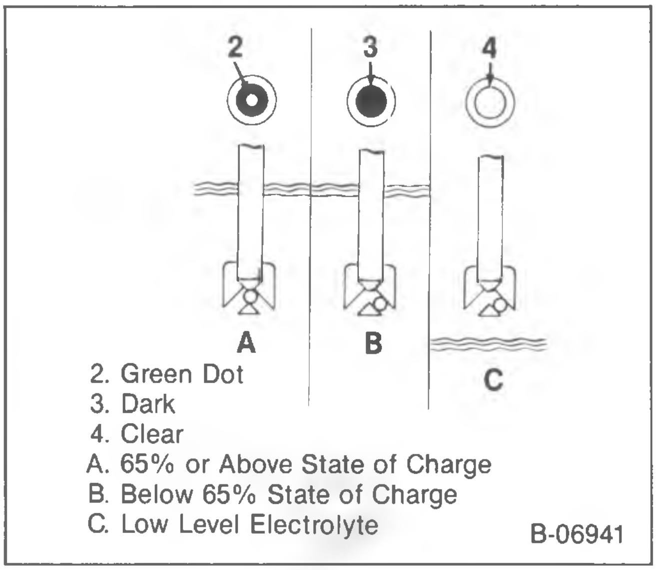


Figure 2—Built-In Hydrometer

GENERAL INFORMATION

COMMON CAUSES OF MALFUNCTION

If testing shows the battery to be in good condition but the battery doesn't perform satisfactorily, check for the following:

1. Vehicle accessories left on overnight.
2. Extended slow-speed driving with many accessories turned on.
3. The vehicle electrical load is more than the generator output, particularly with the addition of aftermarket equipment.
4. Problems in the charging system such as shorts, slipping fan belt, or worn generator or regulator parts.
5. Loose or poor battery cable-to-post connections, previous improper charging of a rundown battery, or loose hold-downs.
6. High-resistance connections in the cranking system.
7. Electronic devices draining the battery when the vehicle is parked for a long period of time. Disconnect the negative cable if the vehicle will be stored for more than 30 days.

Electrolyte Freezing

The freezing point of electrolyte depends on its specific gravity. Since freezing may ruin a battery, protect it against freezing by keeping it in a charged condition.

Carrier And Hold-Down

The carrier and hold-down should be clean and free from corrosion before battery installation.

The carrier should be in a sound mechanical condition so that it will support the battery securely and keep it level. Make certain there are no foreign objects in the carrier before installation.

To prevent the battery from shaking in its carrier, tighten the hold-down bolts. However, do not tighten the bolts to where the battery case or cover is placed under a severe strain.

DIAGNOSIS OF BATTERY

In a diesel-equipped vehicle, check and test each battery separately.

VISUAL INSPECTION

Check for obvious damage such as a cracked or broken case or cover that could permit loss of electrolyte. If damaged, replace the battery. Determine the cause of the damage and correct.

HYDROMETER TEST

GREEN DOT VISIBLE: If the hydrometer has a GREEN DOT visible the battery is ready for testing. Proceed to "Load Test".

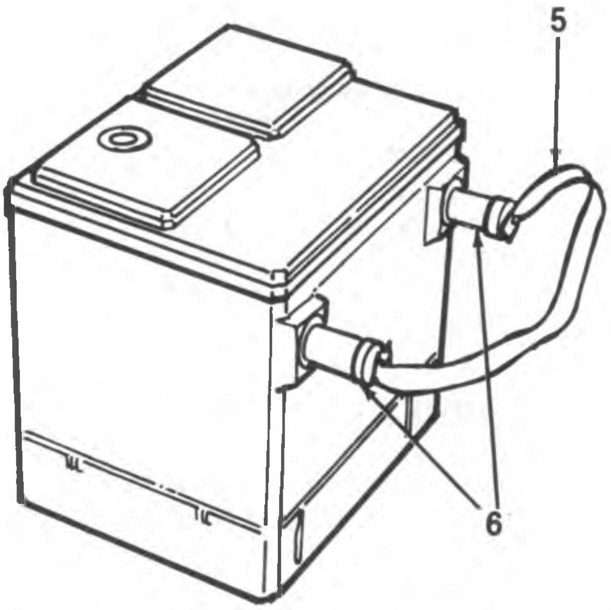
DARK; GREEN DOT NOT VISIBLE: Charge the battery as outlined under the heading "Battery Charging Procedure" later in this section.

LIGHT OR BRIGHT INDICATOR: Do not charge, test, or jump start the battery. Replace the battery.

LOAD TEST

If the battery is in the vehicle, make sure the engine control switch is off. If there is more than one battery, check each separately.

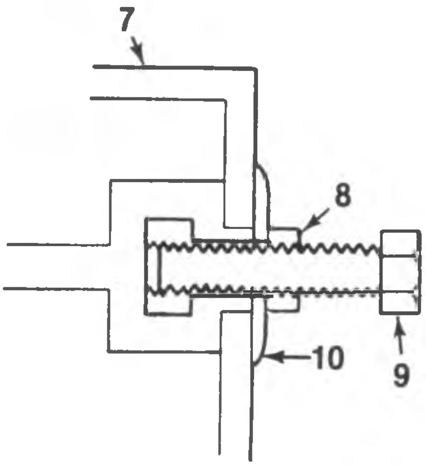
1. Disconnect the battery cables from the terminals.
2. Install adapter AC-Delco ST 1201 or equivalent (figure 3).
3. If adapters are not available, use a 3/8-inch 16 UNC bolt and stainless steel nut (figure 4). Finger tighten. Contact must be made through the lead pads at the face of the terminals, not through the threads of the bolt.
4. Install a voltmeter and battery load tester to the adapters.



5. Insulator strap prevents tool separation and loss when not in use.
6. Adapter charging tool attached to terminals.

B-09952

Figure 3—Testing and Charging Terminal Adapter



7. Case
8. 3/8-inch 16 UNC Nut
9. 3/8-inch 16 UNC Bolt
10. Electrical Contact

B-09715

Figure 4—Testing and Charging Using Bolt and Nut

5. Remove the surface charge from recently charged batteries by applying a 300-ampere load across the adapters for 15 seconds.
6. Do not remove the surface charge from batteries which have been in storage.
7. Turn the load off and wait 15 seconds for the battery to recover.
8. Apply the specified load selected from the chart in "Specifications". Observe the battery voltage after 15 seconds with the load connected, then turn off the load.
9. If the battery voltage does not drop below the minimum voltage as shown in the "Voltage and Temperature Chart" following, the battery is good and should be returned to service. (The battery temperature must be estimated by feel and by the temperature the battery has been exposed to for the preceeding few hours.) If the battery voltage drops below the minimum voltage listed, replace the battery.

Voltage And Temperature Chart

TEMPERATURE	MINIMUM VOLTAGE
21° C (70° F & Above)	9.6
10° C (50° F)	9.4
−1° C (30° F)	9.1
−10° C (15° F)	8.8
−18° C (0° F)	8.5

BATTERY ON-VEHICLE SERVICE

BATTERY CHARGING PROCEDURES

The following basic rules apply to any sealed battery charging situation:

1. Do not charge a battery if the hydrometer is clear or light yellow— replace the battery.
2. Charge rates between 3 and 50 amperes are satisfactory as long as spewing of electrolyte does not occur or the battery does not feel over 52° C, (125° F). If spewing occurs or temperature exceeds 52° C (125° F), the charging rate must be reduced or temporarily halted to permit cooling.

   Estimate battery temperature by touching or feeling the battery case.
3. The battery is sufficiently charged when the green dot in the built-in hydrometer is visible. No further charging is required. Shake or tilt the batter at hourly intervals during charging to mix the electrolyte and see if the green dot appears.
4. Battery charging consists of a charge current in amperes for a period of time in hours. Thus a 25-ampere charging rate for 2 hours would be 50 ampere-hour charge to the battery. In most cases, batteries whose load test values are less than 200 amperes will have the green dot visible after at least a 50 ampere-hour charge. Most batteries whose load test values are greater than 200 amperes will have the green dot visible after at least a 75 ampere-hour charge. In the event that the green dot does not appear after this amount of charging, continue charging for another 50 or 75 ampere-hours. If the green dot still does not appear, replace the battery.
5. The time required for a charge will vary according to:
   a. Size of battery — Example: A discharged large heavy-duty battery requires more than twice the recharging as a discharged small passenger car battery.
   b. Temperature — Example: A longer time will be needed to charge any battery at -18° C (0° F) than at 27° C (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, as the battery warms, it will accept a higher rate.
   c. State-of-charge — Example: A discharged battery requires more than twice as much charge as a one-half-charged battery. Because the electrolyte is nearly pure water and therefore a poor conductor, the current accepted is low at first. Later, as the charging current causes the electrolyte acid content to increase, the charging current will likewise increase.
   d. Charger Capacity — Example: A charger which can supply only 5 amperes will require a much longer period of charging than a charger that can supply 30 amperes or more.

CURRENT DRAIN TEST

If a battery needs recharging and no cause is evident, check the vehicle for excessive current drain.

←→ **Remove or Disconnect**

- Negative battery cable (both negative cables on diesels).

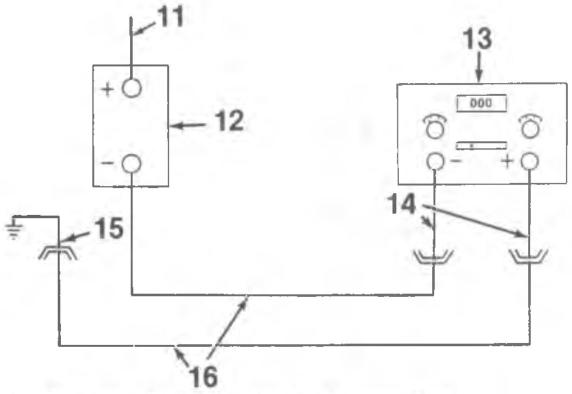
→← **Install or Connect**

Tool Required:
J-29125 Multimeter.

1. Battery side terminal adapter in the negative terminal or nut and bolt as described earlier in this section.
2. A $^{3}/_{8}$-inch 16 UNC nut on the negative battery cable terminal attaching screw.
3. Clip of a jumper wire to the negative battery terminal adapter (figure 5).
4. Clip at the other end of the jumper wire to digital multimeter J-29125 or equivalent.
5. Clip from the second jumper wire to the end of the negative battery cable.
6. Clip at the other end of the wire to the multimeter.
   - Set the multimeter on the DC, MA and 2000 scale.
   - Take the reading with the engine control switch and all accessories off.
7. If current draw is more than 50 milliamps, check the system for causes such as a shorted wire or a compartment lamp that does not shut off when it should.

BATTERY CABLES

Excessive resistance caused by poor terminal connections and partial short circuits through defective cable insulation will result in an abnormal voltage drop in the starter cable. Low voltage at the starter will prevent normal starter operation and cause hard starting.



11. Positive Battery Cable Connected
12. Battery (Disconnect Negative Cable From Other Battery On Diesel Vehicles)
13. Multimeter J-29125 Or Equivalent Set On DC, MA and 2000 Scale
14. Meter Test Leads
15. End of Negative Battery Cable
16. Jumper Wires

B-09979

Figure 5—Battery Drain Test Circuit

CAUTION: To prevent possible personal injury from a moving vehicle or operating engine do the following before performing the checks:

1. **Engage the parking brakes and block the wheels.**
2. **Place the manual transmission in the neutral position or the automatic transmission in park.**
3. **On gas engines disconnect the battery feed at the distributor. On diesel engines disconnect the battery feed at the engine shutoff (ESO) solenoid.**

1. Check the voltage drop between ground (negative battery terminal) and the vehicle frame. Place one prod of the test voltmeter on the grounded battery post (not on the cable clamp) and the other on the frame. Operate the starter and note the voltage reading.
2. Check the voltage drop between the positive battery terminal and starter terminal stud with starter operating.
3. Check the voltage drop between the starter housing and frame with the starter operating.
4. If the voltage drop in any of the above is more than 1.0 volt, there is excessive resistance in the circuit. To eliminate resistance, the cables should be disconnected and connections cleaned. If cables are frayed or the clamps corroded, the cables should be replaced. When selecting new cables, be sure they are at least as large as the ones being replaced.

BATTERY REPLACEMENT

When handling a battery, observe the following safety precautions.

1. Hydrogen gas is produced by the battery. A flame or spark near the battery may cause the gas to ignite.
2. Battery fluid is highly acidic. Avoid spilling on clothing or skin. Any spilled electrolyte should be flushed with large quantities of water and cleaned immediately.

↔ Remove or Disconnect

1. Negative cable from the negative battery terminal.
2. Positive cable from the positive battery terminal.
3. Battery hold-down clamp.
4. Battery.

Inspect

1. Battery for damage.
2. Cables and connectors.
3. Carrier for damage or foreign objects.
   - If damage is noted, find and correct the cause.

→← Install or Connect

1. Battery into cleaned carrier.
2. Hold-down retainer or top bar, as equipped.

Tighten

1. Retainer to 15 N·m (135 in. lbs.).
2. Top bar to 10 N·m (90 in. lbs.).

3. Positive cable to the positive terminal.
4. Negative cable to the negative terminal.

Tighten

- Terminals to 13 N·m (120 in. lbs.).

CHARGING SYSTEM

DESCRIPTION

The charging system consists of the battery, the generator, the regulator, and the charging system indicator lamp circuitry. The generator supplies electrical power for charging the battery and operating accessories.

The generators shown in figures 6 through 11 are of the "System Intergral" series (generator with built-in regulator).

The generator features a solid state regulator that is mounted inside the generator. All regulator components are enclosed into a solid mold, and this unit along with the brush holder assembly is attached to the slip ring end frame. The regulator voltage setting cannot be adjusted.

The generator rotor bearings contain enough grease to eliminate the need for periodic lubrication. Two brushes carry current through the two slip rings to the field coil mounted on the rotor, and under normal conditions will provide long periods of attention-free service.

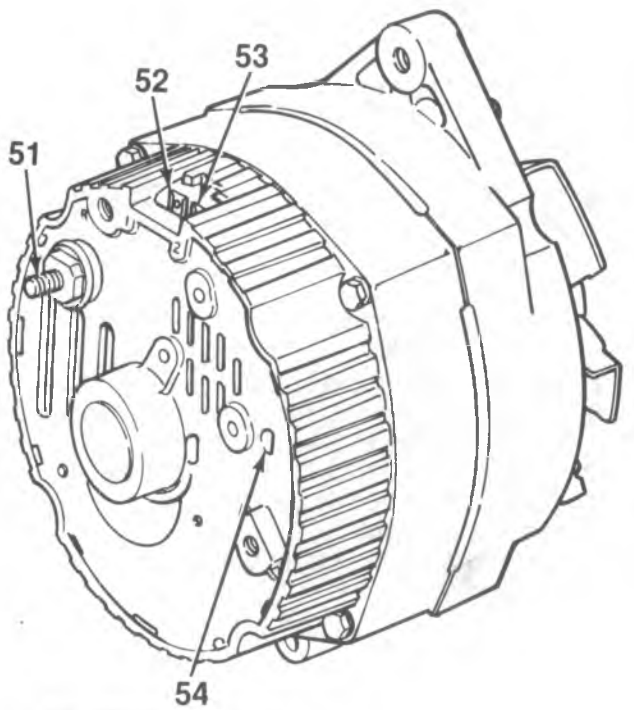
The stator windings are assembled on the inside of a laminated core that forms part of the generator frame. A rectifier bridge connected to the stator windings contains six diodes, and electrically changes the stator AC voltages to a DC voltage which appears at the generator output (BAT) terminal. The output varies from 37 to 80 amperes, depending on the model. Refer to "Specifications" at the end of this section. Generator field current is supplied thorugh a diode trio which also is connected to the stator windings. A capacitor or condenser, mounted in the end frame, protects the rectifier bridge and diode trio from high voltages, and suppresses radio noise.

No periodic adjustments or maintenance of any kind are required on the entire generator assembly.

CIRCUIT OPERATION

When the engine control switch is turned to "Run" or "Start", the switch closes and current from the battery flows through the charging system indicator lamp, the number 1 terminal, the regulator, ground, and back to the battery. Current also flows through the generator field coil and back to the battery. The charge indicator lamp then turns on.

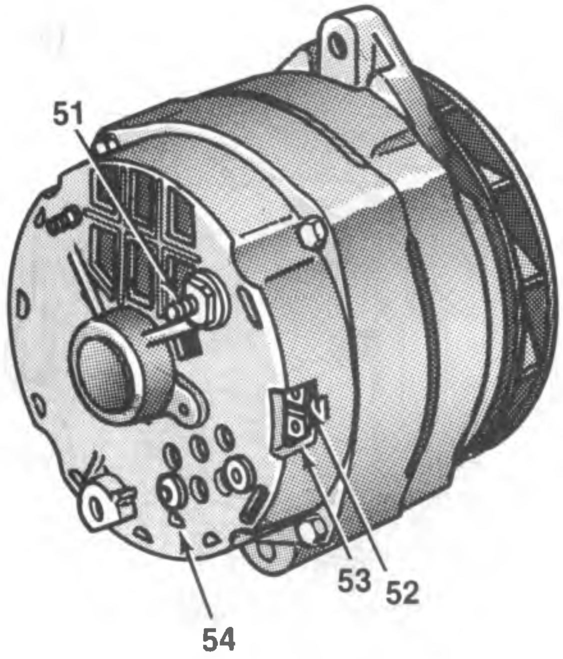
With the generator operating, direct current (DC) voltage is applied to the battery through the "BAT" terminal. Some of the output flows through the diode trio to the field coil, then through the brown wire at terminal number 1 to the charge indicator lamp. The lamp goes out since approximately the same voltage is present at both sides of the lamp. On vehicles with gages a voltmeter indicates voltage.



51. "BAT" Terminal
52. No. 1 Terminal
53. No. 2 Terminal
54. Field Ground Hole

F-00020

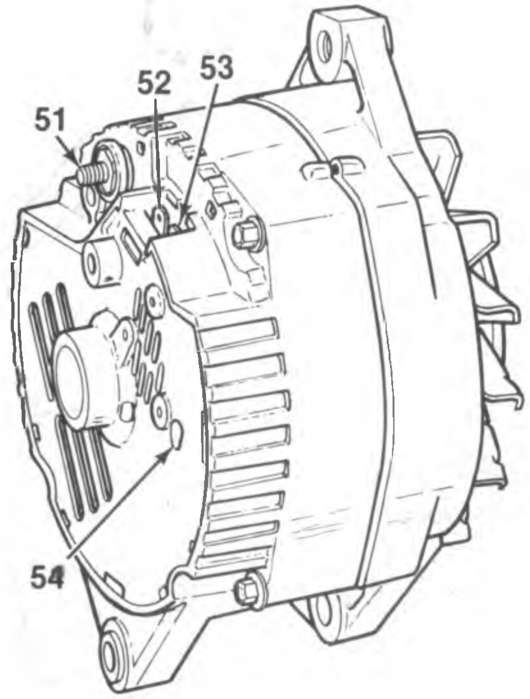
Figure 6—10-SI Series 100 Generator



51. BAT Terminal
52. No. 1 Terminal
53. No. 2 Terminal
54. Field Ground Hole

F-00013

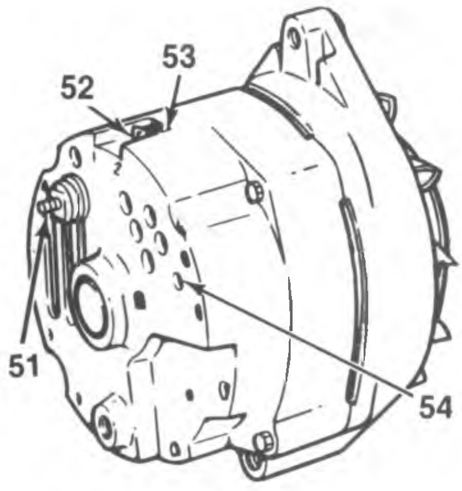
Figure 7—12-SI Series 100 Generator



51. BAT Terminal
52. No. 1 Terminal
53. No. 2 Terminal
54. Field Ground Hole

F-00015

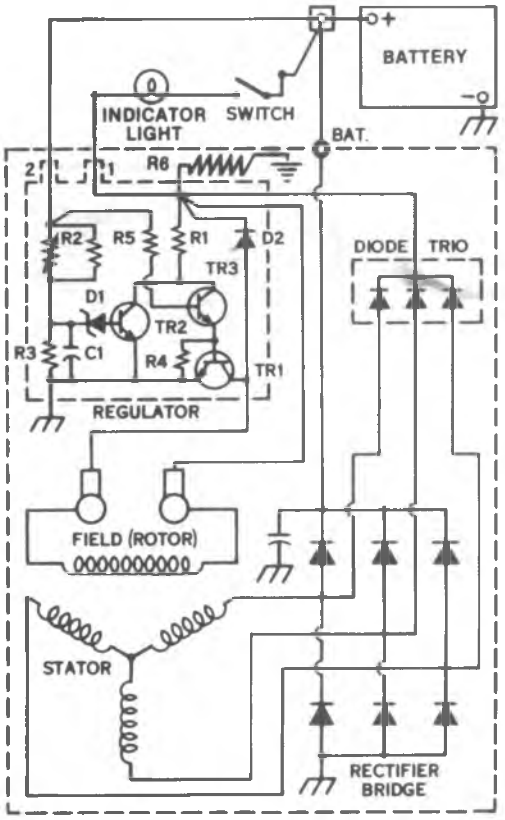
Figure 9—27-SI Series 100 Generator



51. "BAT" Terminal
52. No. 1 Terminal
53. No. 2 Terminal
54. Field Ground Hole

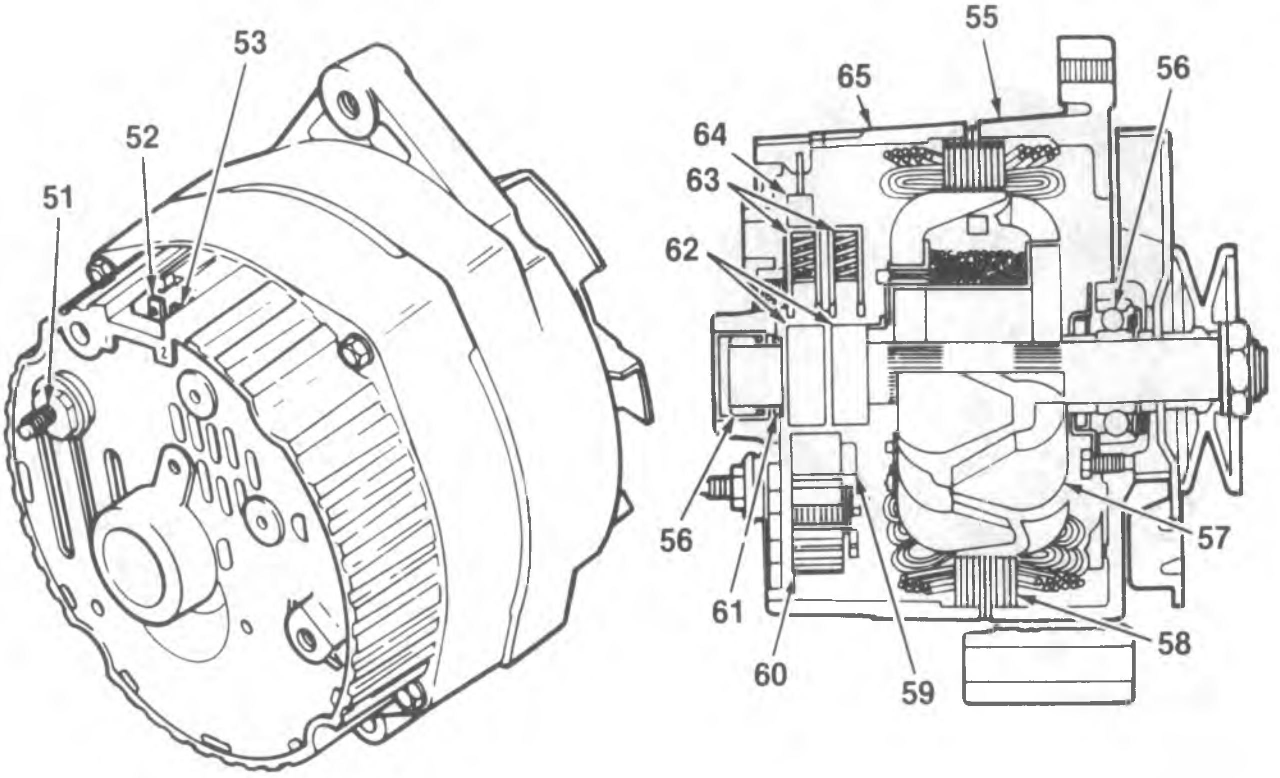
F-00014

Figure 8—15-SI Series 100 Generator



F-00660

Figure 10—Generator Schematic



51. "BAT" Terminal
52. No. 1 Terminal
53. No. 2 Terminal
55. Drive End Frame
56. Bearing
57. Rotor
58. Stator Assembly
59. Diode Trio
60. Rectifier Bridge
61. Seal
62. Slip Rings
63. Brushes
64. Regulator
65. Slip Ring End Frame

B-08205

Figure 11—SI Series Generator

DIAGNOSIS OF CHARGING SYSTEM

NOISY GENERATOR

Noise from a generator may be caused by a loose drive pulley, loose mounting bolts, worn or dirty bearings, worn diode or stator. If the pulley and mounting bolts are snug and the noise continues, remove the generator for inspection and repair. Refer to "Generator Replacement" later in this section.

ELECTRICAL TESTS

Before performing the diagnosis procedures on the vehicle, be certain that the system wiring is good and generator belts are not slipping. Also, the battery must be fully charged for a valid test of the charging system.

> ***NOTICE: To avoid damage to the vehicle electrical system, observe the following precautions:***
>
> - ***Do not polarize the generator.***
> - ***Do not short across or ground any of the terminals in the charging circuit except as specifically instructed herein.***
> - ***NEVER operate the generator with the output terminal open-circuited.***
> - ***Make sure the generator and battery have the same ground polarity.***
> - ***When connecting a charger or booster battery to the vehicle battery, connect negative to negative and positive to positive.***

Trouble in the charging system will show up as one or more of the following conditions:

1. On vehicles without gages, unusual operation of the charging indicator lamp.
2. An undercharged battery, indicated by slow cranking or a dark battery hydrometer.
3. An overcharged battery, indicated by spewing of electrolyte from the vents.

CHARGING SYSTEM INDICATOR LAMP OPERATION

Check the indicator lamp for normal operation (figure 12). If normal, proceed to "Undercharged Battery".

UNDERCHARGED BATTERY

Slow cranking or a dark battery hydrometer can be caused by one or more of the following conditions even though the indicator lamp may be operating normally. The following procedures also apply to vehicles equipped with a voltmeter.

1. Check that the undercharged condition has not been caused by accessories having been left on for extended periods.
2. Check the drive belt for proper tension. Refer to ENGINE COOLING (SEC. 6B) for belt specifications.
3. If the battery is suspected as defective, refer to "Battery" covered previously in this section.
4. Inspect the wiring for cracks or breaks. Check all circuit connections, cable clamps and battery terminals for tightness and cleanliness.
5. With the engine control switch on and all wiring harness leads connected, use a voltmeter for the following checks:

→← **Install or Connect (Figures 6 through 11)**

1. Voltmeter from the generator battery terminal to ground.
    - Should read 12 volts.
2. Voltmeter from the number 1 terminal to ground.
    - Should read one volt or more.
3. Voltmeter from the number 2 terminal to ground.
    - Should read 12 volts.

A zero reading on any of the above indicates an open between the voltmeter connection and the battery. If checks 1 through 5 are normal perform the generator output test.

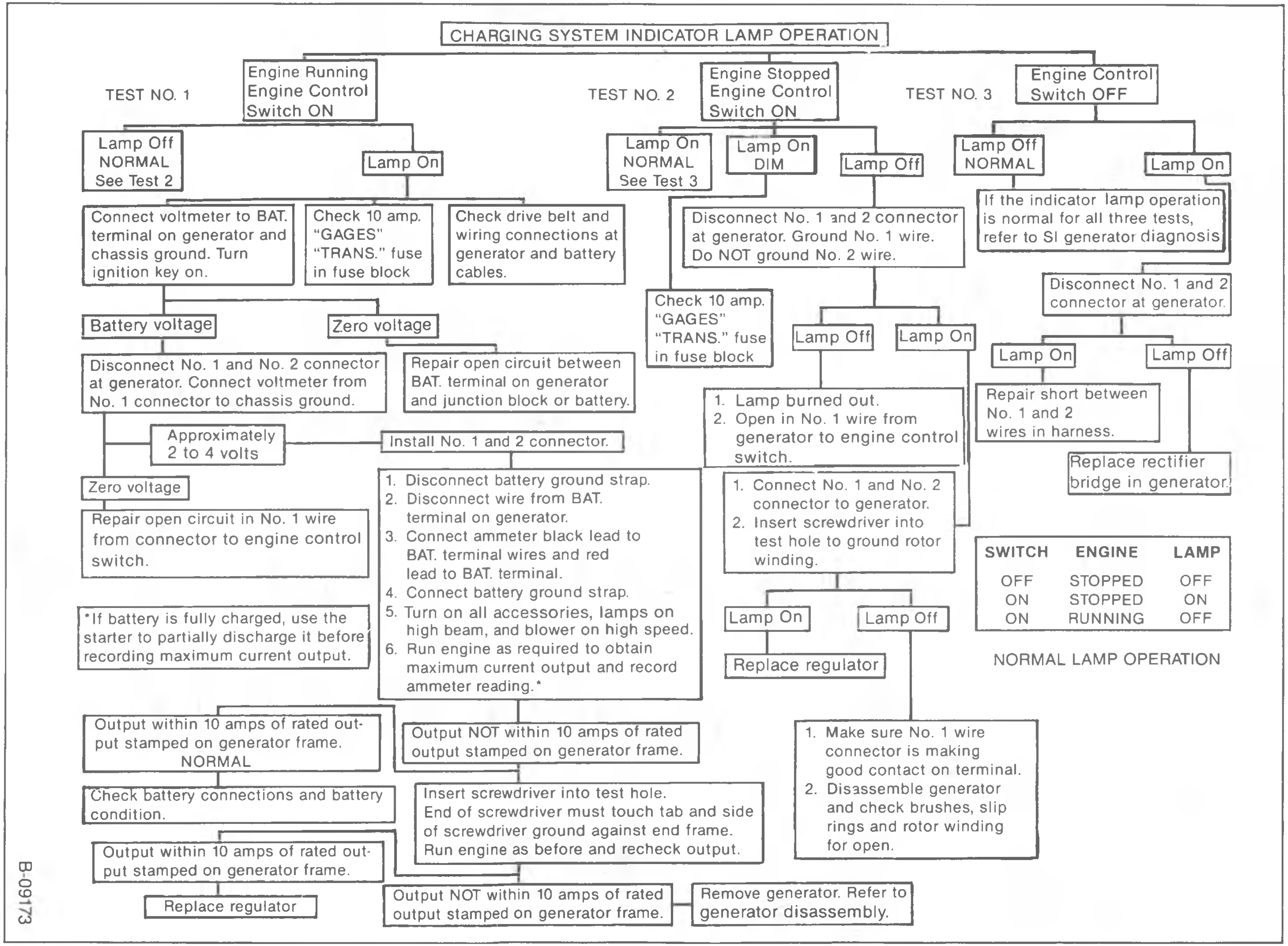
OVERCHARGED BATTERY

If the battery feels hot, is spewing electrolyte, or lamps seem too bright when turned on, an overcharged condition may exist.

To check the voltage, install a voltmeter across the battery. Run the engine at moderate speed with all accessories off. If the voltage reads 15.5 or more, remove the generator for repair.

GENERATOR OUTPUT TEST

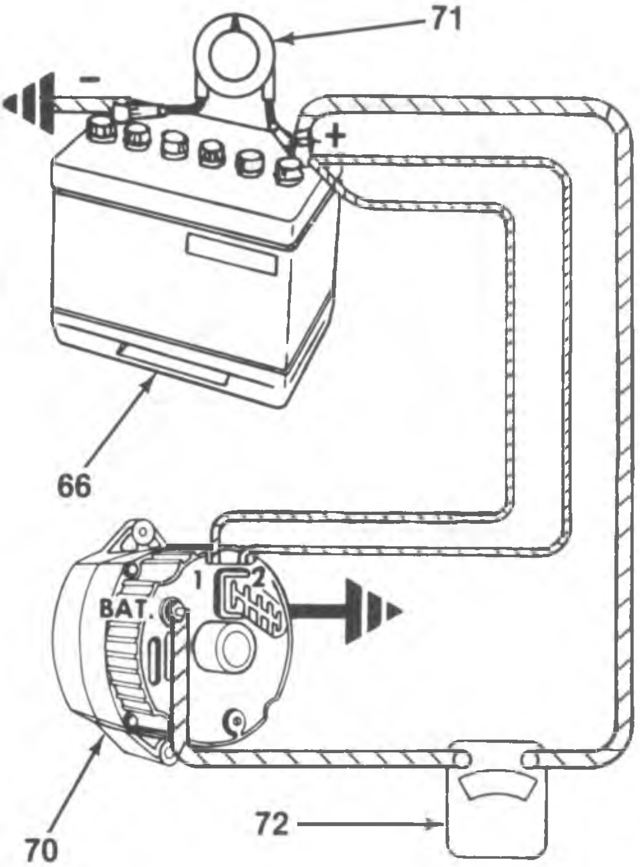
1. Disconnect the battery ground cable.
2. Connect an ammeter in the circuit at the battery terminal of the generator.
3. Reconnect battery ground cable.
4. Turn on the radio, windshield wipers, headlamps (high beam) and blower motor high speed.
5. Connect a carbon pile across the battery.
6. Run the engine at moderate speed (about 2,000 rpm) and adjust the carbon pile to obtain maximum current output.
7. If the ampere output is within 10 amperes of the rated ouput as stamped on the generator frame, the generator is probably all right.



SWITCH	ENGINE	LAMP
OFF	STOPPED	OFF
ON	STOPPED	ON
ON	RUNNING	OFF

NORMAL LAMP OPERATION

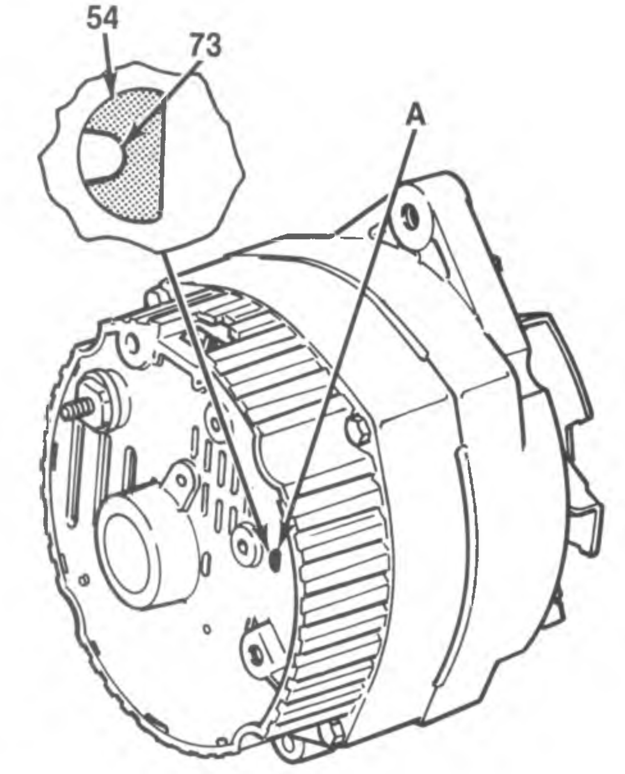
Figure 12—Charging System Diagnosis



66. Battery
70. Generator
71. Carbon Pile
72. Ammeter

F-00010

Figure 13—Connections For Generator Output Test



54. Field Ground
73. Tab
A. Insert screwdriver, ground tab to end frame.

F-00011

Figure 14—Generator Field Ground Tab

8. If the vehicle is equipped with a charging system indicator lamp, and the lamp remains on while the engine runs, and ampere output is normal, remove the generator for repair. Check the diode trio and rectifier bridge.
9. If the ampere output is not within 10 percent of the rated ouput in amperes, see if the test hole is accessible (figure 14). If it is not accessible go to step 14.
10. Ground the field winding by inserting a screwdriver into the test hole.

NOTICE: The tab is within 19 mm (3/4 inch) of the casting surface. Do not force the screwdriver deeper than 25 mm (1 inch) into the end frame or the generator may be damaged.

11. Run the engine at moderate speed and adjust the carbon pile to get maximum current ouput.
12. If the output is within 10 amperes of the rated ouput, remove the generator for repair. Refer to the Light Duty Truck Unit Repair Manual to check the field winding and regulator.
13. If the output is not within 10 amperes of rated output, remove the generator and check the field winding, diode trio, rectifier bridge and stator.
14. If the test hole is not accessible, remove the generator for repair.

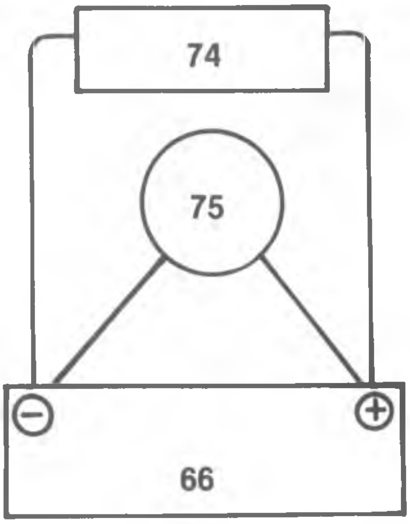
GENERATOR DIAGNOSTIC TESTER INDICATIONS

If a tester is available, check the generator following the tester manufacturer's instructions. It will indicate about 98 percent of the charging system problems.

TRANSISTORIZED VOLTAGE REGULATOR TEST

Connect a fast charger and a voltmeter to the battery as shown in figure 15. With the engine control switch on "run" and the engine off, slowly increase the charge rate. The charging system indicator lamp (on vehicles without gages) will dim at the voltage regulator setting. The setting should be at a minimum of 13.5 volts and a maximum of 16.0 volts.

This test works if the rotor circuit is good, even if the stator, rectifier bridge or diode trio is bad.



74. Fast Charger
75. Voltmeter
66. Battery

F-00012

Figure 15—On-Vehicle Regulator Test

GENERATOR ON-VEHICLE SERVICE

GENERATOR REPLACEMENT

The removal and installation instructions serve only as a guide. Additional operations may be required on some vehicles to remove other equipment to gain access to the generator, drive belts and brackets. However, specific instructions are given below for G vans equipped with air conditioning.

CAUTION: Failure to observe step 1 in this procedure may result in an injury from the hot battery lead at the generator.

↔ Remove or Disconnect

All Models

1. Negative battery cable at the battery.

G Van:

2. Air intake hoses on the bulkhead side.
3. Air intake and hoses.
4. Transmission fluid dipstick from the tube.

! Important

- Cover the tube opening to prevent dirt particles form entering the tube.

5. Engine oil dipstick.
6. Bolt through the bracket holding the dipstick tube to the engine oil fill tube.
7. Engine oil dipstick tube.
   - Cover the opening.
8. Bolt holding the oil fill tube to the generator bracket.
9. Oil fill tube from the rubber grommet in the valve cover.
   - Cover the opening.

All Models:

10. Terminal plug and battery lead from the back of the generator.
    - Loosen the adjusting bolt on the generator mounting.
11. Generator drive belt.
12. Lower mounting through-bolt from the generator flange.
13. Adjusting bolt and the generator.

→← Install or Connect

All Models

1. Generator to the mounting bracket with the bolt.
   - Do not tighten.
2. Lower mounting bolt through the generator flange, flange extension, emission hose bracket and into the cylinder head.
3. Generator drive belt.

Tighten

- Belt. Refer to ENGINE COOLING (SEC. 6B) for belt specifications.
- Adjusting bolt.

4. Terminal plug and battery lead to the back of the generator.

G Van:

5. Oil fill tube to the rubber grommet after removing the cover.
6. Oil fill tube to the generator bracket with the bolt.
7. Engine oil dispatch tube bracket to the oil fill tube with a bolt after removing the cover.
8. Dipstick.
9. Air intake hoses.
10. Air intake and bolt to core support.

All Models:

11. Negative battery cable to the battery.

Refer to the Light Duty Truck Unit Repair Manual for off-vehicle service.

DIESEL GLOW PLUG ELECTRICAL SYSTEM

DESCRIPTION

In the diesel engine, air alone is compressed in the cylinder; then after the air has been compressed a charge of fuel is sprayed into the cylinder and ignition occurs due to the heat of compression. Eight glow plugs are used to preheat the chamber as an aid to starting (figure 16).

The diesel glow plug system consists of an intergral-electronic control/glow plug relay assembly, 6-volt glow plugs, a glow plug inhibit temperature switch and a glow plug lamp.

GLOW PLUGS

These are 6-volt heaters (operated at 12 volts) that turn on when the engine control switch is turned to the run position prior to starting the engine. They remain pulsing a short time after starting, then automatically turn off.

INSTRUMENTATION

Vehicles with the diesel engine have special instrumentation indicators to permit the operator to properly apply the starting procedure. A glow plug lamp on the instrument panel provides this information on engine starting conditions.

Vehicles equipped with diesel engines have a water in fuel lamp and low engine coolant lamp. Refer to the engine fuel and engine cooling sections for information on these systems.

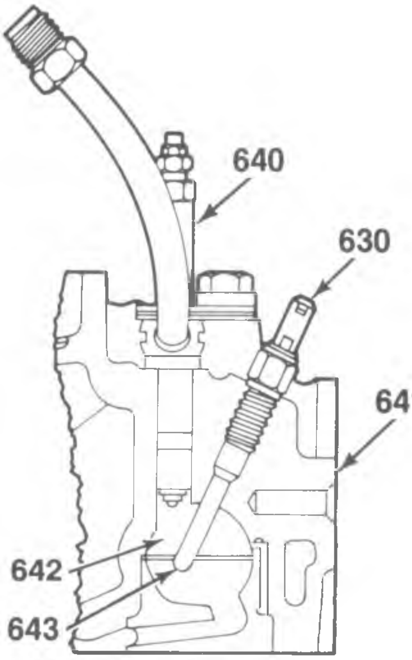


Figure 16—Diesel Engine Glow Plug Location

ELECTRONIC CONTROLLER/GLOW PLUG RELAY ASSEMBLY (FIGURES 17 AND 18)

The assembly contains the circuitry which monitors and controls glow plug relay operation. Information is received at pins B and C which is used by the controller to determine glow plug operating requirements. Pin B senses voltage at the starting

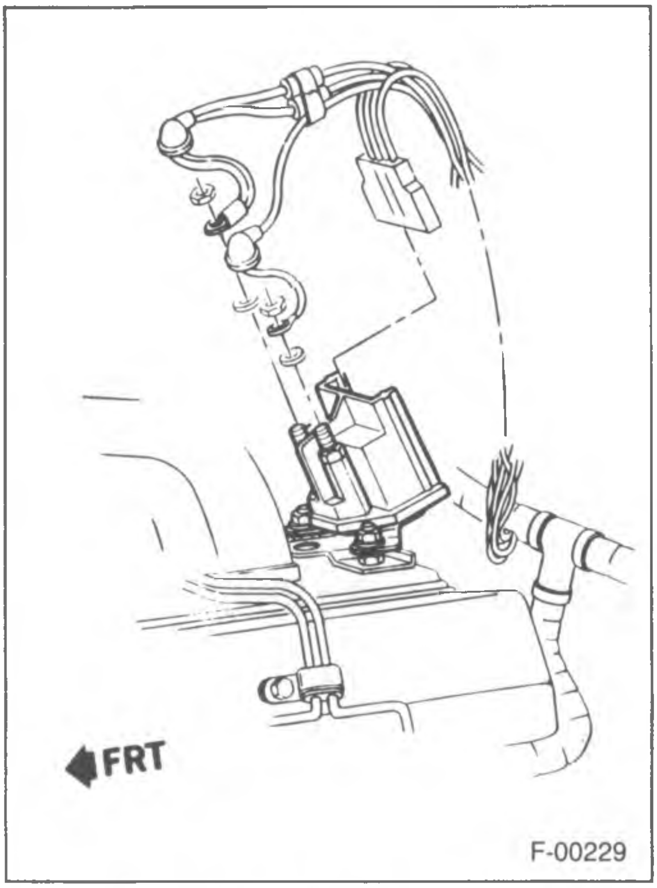


Figure 17—Glow Plug Controller

motor solenoid. Pin C senses glow plug voltage through the glow plug inhibit switch which is wired in series with the glow plug voltage sense lead to the glow plugs. The controller is mounted at the rear of the left cylinder head on two 10 mm studs.

GLOW PLUG INHIBIT SWITCH

The switch is temperature controlled and opens above 51.5° C (125° F) to prevent glow plug operation above this temperature. It is mounted at the rear of the right cylinder head.

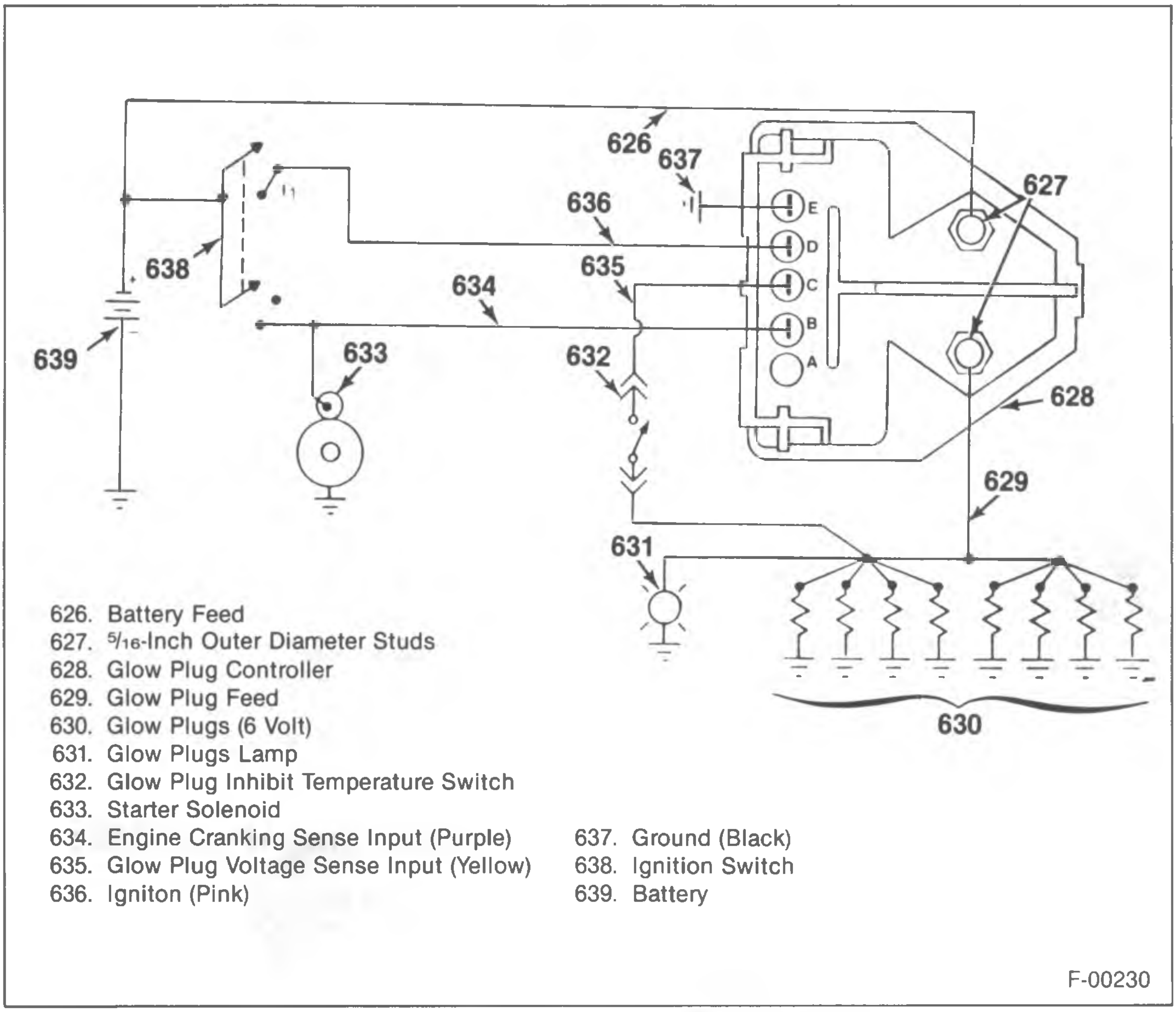
CIRCUIT OPERATION

A normal functioning system operates as follows:

A. Key on - Engine not running and at room temperature.
   1. Glow plugs ON for 4 to 6 seconds, then OFF for about 4.5 seconds.
   2. Then cycle; ON for about 1.5 seconds, OFF for about 4.5 seconds, and continue to cycle 1.5 ON/4.5 OFF, for a total duration (including the initial 4 to 6 seconds) of about 20 seconds.

B. If the engine is cranked during or after the above sequence, the glow plugs will cycle ON/OFF for a total duration of 25 seconds after the engine control switch is returned from the crank position, whether the engine starts or not. The engine does not have to be running to terminate the glow plug cycling.

All the times shown above are approximate because they vary with initial engine temperature. The initial ON time and cycling ON/OFF times vary also with system voltage and/or temperature. Lower temperatures cause longer duration of cycling.



626. Battery Feed
627. 5/16-Inch Outer Diameter Studs
628. Glow Plug Controller
629. Glow Plug Feed
630. Glow Plugs (6 Volt)
631. Glow Plugs Lamp
632. Glow Plug Inhibit Temperature Switch
633. Starter Solenoid
634. Engine Cranking Sense Input (Purple)
635. Glow Plug Voltage Sense Input (Yellow)
636. Igniton (Pink)
637. Ground (Black)
638. Ignition Switch
639. Battery

Figure 18—Electronic Glow Plug System

DIAGNOSIS OF GLOW PLUG ELECTRICAL SYSTEM

CIRCUIT CHECK

If the system does not operate as described, check the following:

Inspect

1. All connectors.
2. Engine harness ground connection to engine.

   Tighten

   - Nut to 11 N·m (8 ft. lbs.).
3. Four-wire connector at controller. It must be fully seated and latched.
4. Both controller copper stud upper nuts.

   Tighten

   - Nuts to 5 N·m (48 in. lbs.).
   - Do not tighten lower nuts.
5. Temperature switch connector at top rear right cylinder head.
6. Glow plug lamp on instrument panel for tight connection and operation.

GLOW PLUG INHIBIT SWITCH

Check the temperature-controlled switch to make sure it is closed at low temperatures and open at high temperatures.

1. Remove the connector from the inhibit switch when the engine temperature is below 38°C (100°F).
2. Set the ohmmeter on a low range or use a self-powered test lamp.
3. Test across the terminals.
4. The switch should be closed (test lamp on or a reading of less than 0.1 ohm on the meter).
5. Test terminals to ground with a test lamp or the ohmmeter on a high range. The lamp should be off or the meter show greater than 1.0 megohm.
6. Replace the switch if it tests open across the terminals or if either terminal is closed to ground.
7. Disconnect the plug from the switch terminals when the engine is above 52° C (125° F).
8. Set the ohmmeter on the highest scale or use a self-powered test light.
9. Test across the terminals.
10. Test from each teminal to ground.
11. Switch should be open (test light off or high ohm reading of greater than 1 megohm on the meter).
12. Replace the switch if it is closed.
13. When installing the switch, use a socket wrench.

    Tighten

    - Switch to 23 N·m (17 ft. lbs.).

GLOW PLUG SYSTEM

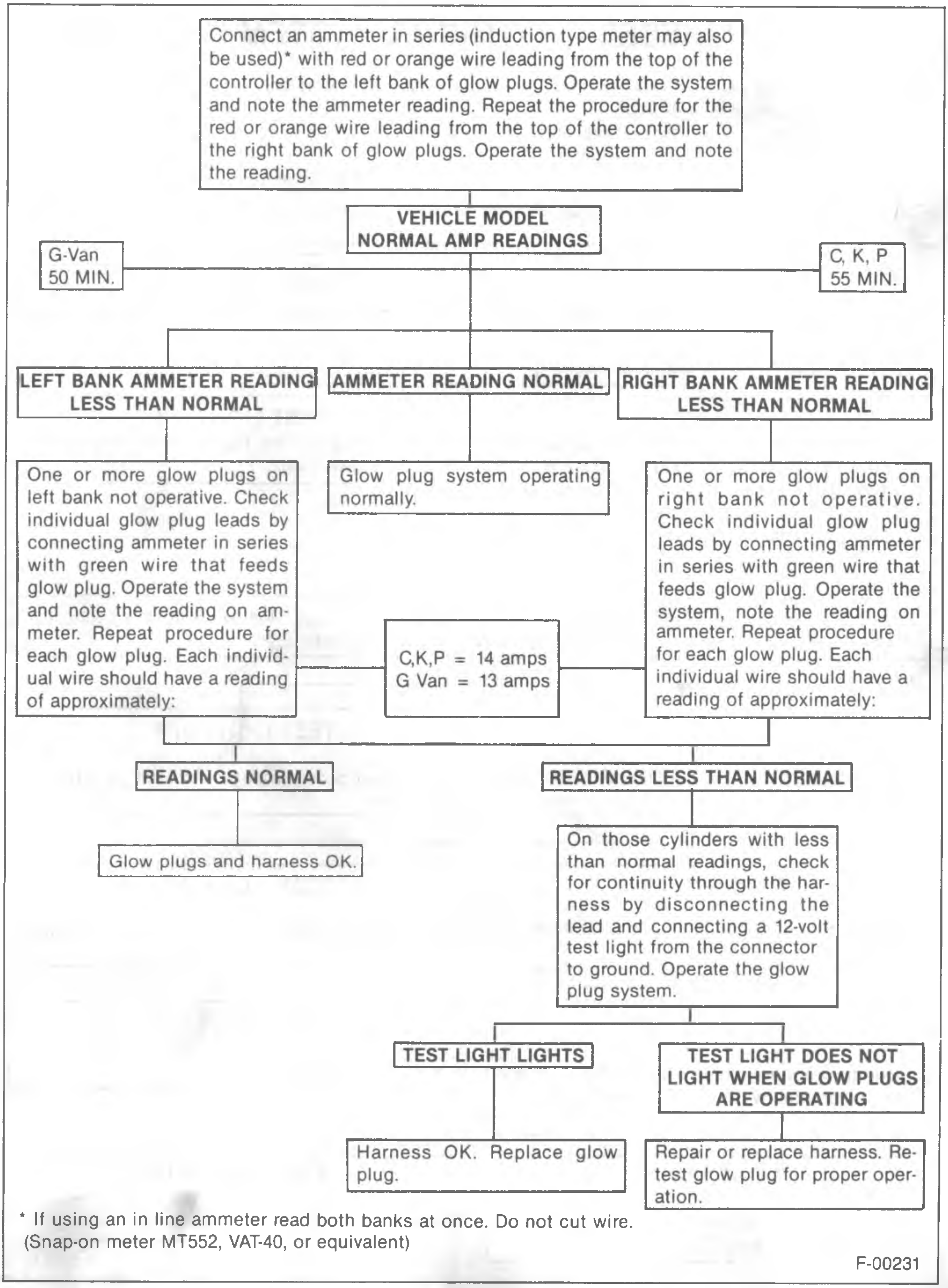
If all connections are intact, but the glow plug system does not operate as stated, do the system diagnosis shown in figure 19. It provides a fast way to find if the glow plug system is working properly. Use this procedure whenever there is doubt about correct system oepration. Then refer to the diagnostic chart in figure 20 to pinpoint the condition.

NOTICE: Do not manually bypass the relay in the glow plug controller. Do not jump start with more than a 12-volt system. The glow plugs could be damaged.

GLOW PLUG AFTERSTART

The glow plug controller provides glow plug operation after starting a cold engine. This after-start operation is initiated when the engine control switch is returned to "RUN" from the "START" position. While loss of this function may not cause a cold start complaint, it may result in excessive white smoking and/or poor idle quality after start. To check for proper operation of this circuit proceed as follows:

1. With the engine cold 27° C (80° F), turn the engine control switch to the RUN position and let the glow plugs cycle.
2. After 2 minutes crank the engine for 1 second. (It is not important that the engine starts.) Return the engine control switch to RUN. Glow plugs should cycle at least once after cranking.
3. If the plugs do not turn on, disconnect the controller connector, and check the connector harness terminal B with a grounded 12-volt test light. The light should be off with the engine control switch in RUN, and on when the engine is cranked.
4. If the light does not operate as just described, repair a short or open in the engine harness purple wire.
5. If the light works right, but the afterstart glow plug feature does not, replace the controller.



Connect an ammeter in series (induction type meter may also be used)* with red or orange wire leading from the top of the controller to the left bank of glow plugs. Operate the system and note the ammeter reading. Repeat the procedure for the red or orange wire leading from the top of the controller to the right bank of glow plugs. Operate the system and note the reading.

VEHICLE MODEL NORMAL AMP READINGS

G-Van 50 MIN.

C, K, P 55 MIN.

LEFT BANK AMMETER READING LESS THAN NORMAL

One or more glow plugs on left bank not operative. Check individual glow plug leads by connecting ammeter in series with green wire that feeds glow plug. Operate the system and note the reading on ammeter. Repeat procedure for each glow plug. Each individual wire should have a reading of approximately:

AMMETER READING NORMAL

Glow plug system operating normally.

RIGHT BANK AMMETER READING LESS THAN NORMAL

One or more glow plugs on right bank not operative. Check individual glow plug leads by connecting ammeter in series with green wire that feeds glow plug. Operate the system, note the reading on ammeter. Repeat procedure for each glow plug. Each individual wire should have a reading of approximately:

C,K,P = 14 amps
G Van = 13 amps

READINGS NORMAL

Glow plugs and harness OK.

READINGS LESS THAN NORMAL

On those cylinders with less than normal readings, check for continuity through the harness by disconnecting the lead and connecting a 12-volt test light from the connector to ground. Operate the glow plug system.

TEST LIGHT LIGHTS

Harness OK. Replace glow plug.

TEST LIGHT DOES NOT LIGHT WHEN GLOW PLUGS ARE OPERATING

Repair or replace harness. Retest glow plug for proper operation.

* If using an in line ammeter read both banks at once. Do not cut wire. (Snap-on meter MT552, VAT-40, or equivalent)

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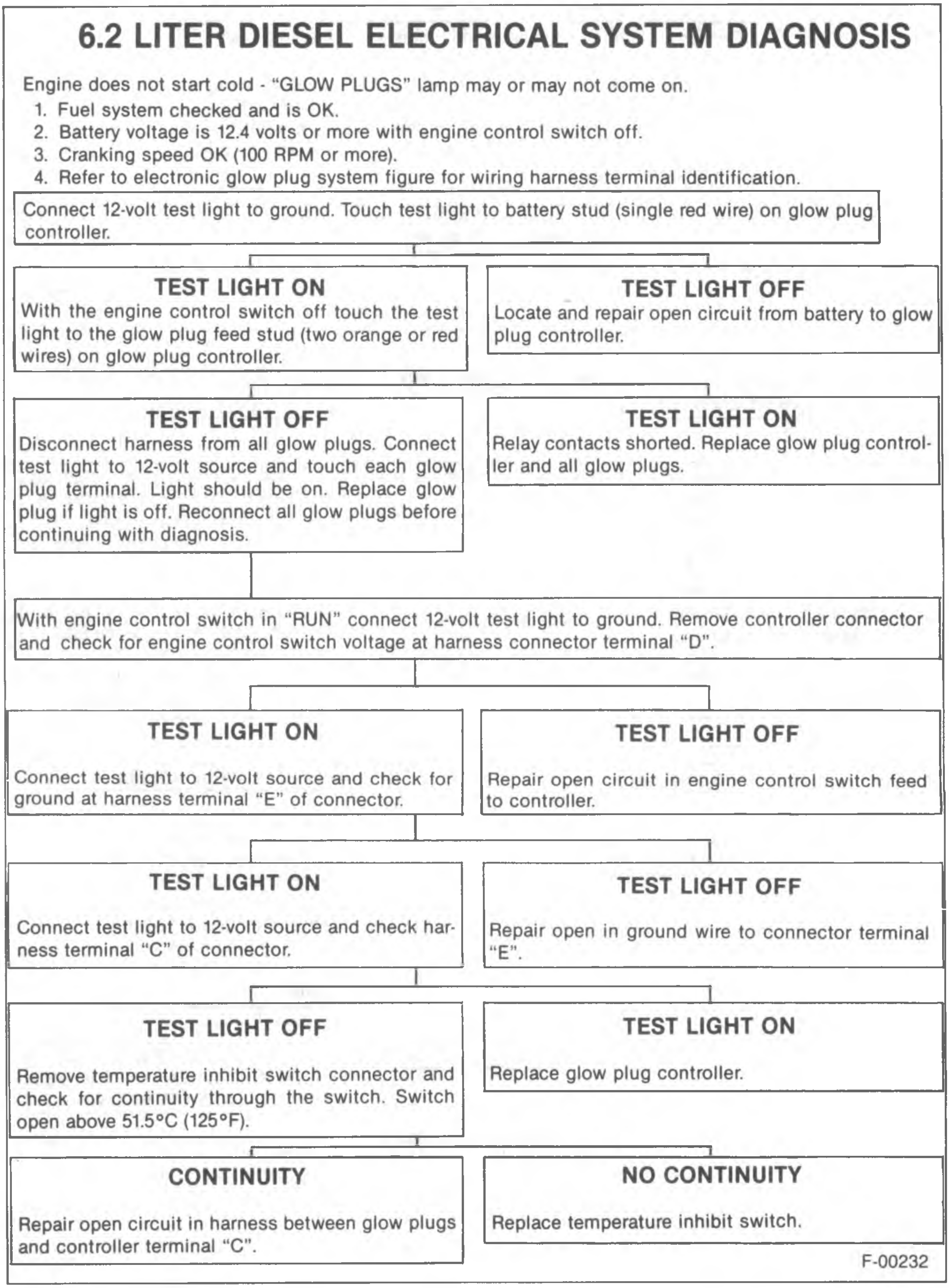
Figure 19—Preliminary Diagnosis With An Ammeter



6.2 LITER DIESEL ELECTRICAL SYSTEM DIAGNOSIS

Engine does not start cold - "GLOW PLUGS" lamp may or may not come on.

1. Fuel system checked and is OK.
2. Battery voltage is 12.4 volts or more with engine control switch off.
3. Cranking speed OK (100 RPM or more).
4. Refer to electronic glow plug system figure for wiring harness terminal identification.

Connect 12-volt test light to ground. Touch test light to battery stud (single red wire) on glow plug controller.

TEST LIGHT ON
With the engine control switch off touch the test light to the glow plug feed stud (two orange or red wires) on glow plug controller.

TEST LIGHT OFF
Locate and repair open circuit from battery to glow plug controller.

TEST LIGHT OFF
Disconnect harness from all glow plugs. Connect test light to 12-volt source and touch each glow plug terminal. Light should be on. Replace glow plug if light is off. Reconnect all glow plugs before continuing with diagnosis.

TEST LIGHT ON
Relay contacts shorted. Replace glow plug controller and all glow plugs.

With engine control switch in "RUN" connect 12-volt test light to ground. Remove controller connector and check for engine control switch voltage at harness connector terminal "D".

TEST LIGHT ON
Connect test light to 12-volt source and check for ground at harness terminal "E" of connector.

TEST LIGHT OFF
Repair open circuit in engine control switch feed to controller.

TEST LIGHT ON
Connect test light to 12-volt source and check harness terminal "C" of connector.

TEST LIGHT OFF
Repair open in ground wire to connector terminal "E".

TEST LIGHT OFF
Remove temperature inhibit switch connector and check for continuity through the switch. Switch open above 51.5°C (125°F).

TEST LIGHT ON
Replace glow plug controller.

CONTINUITY
Repair open circuit in harness between glow plugs and controller terminal "C".

NO CONTINUITY
Replace temperature inhibit switch.

F-00232

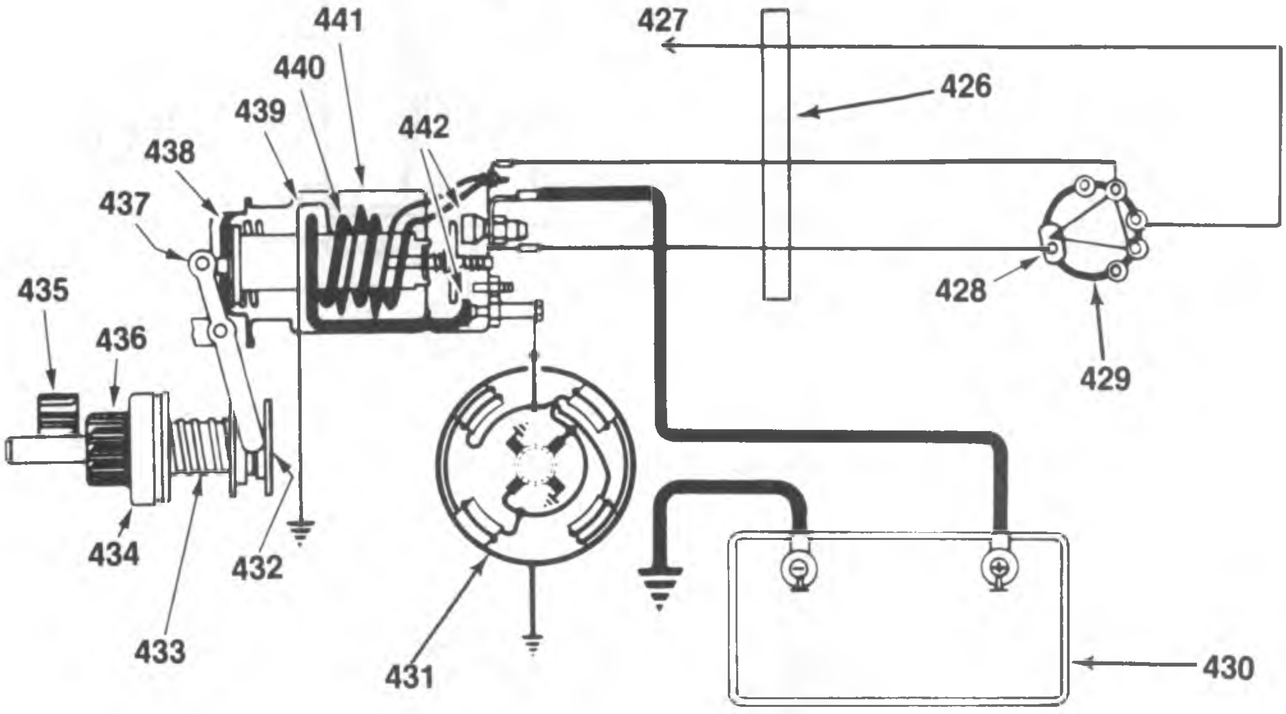
Figure 20—Diesel Electrical System Diagnosis

GLOW PLUG ON-VEHICLE SERVICE

Check the system and its components on the vehicle.

None of the components are serviceable. When installing new components and making connections, be sure that connections are tight and torque values are used. Torque the glow plugs to 17 N·m (12 ft. lbs.) when installed.

CRANKING SYSTEM



426. Bulkhead Connector
427. To Distributor "BAT" Terminal
428. BAT.
429. Engine Control Switch
430. Battery
431. Starter Motor
432. Shift Collar
433. Pinion Compression Spring
434. Clutch
435. Flywheel
436. Pinion
437. Shift Lever
438. Plunger
439. Hold In Coil
440. Pull In Coil
441. Solenoid
442. Solenoid Switch Contacts

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Figure 21—Cranking Circuit

DESCRIPTION

CRANKING CIRCUIT

The basic cranking circuit consists of the battery, starter motor, engine control switch, and related electrical wiring (figure 21).

STARTER MOTOR

Two types of starter motors are used in the vehicles covered in this manual (figures 22 and 23). Both have the shift lever mechanism and the solenoid plunger enclosed in the drive housing to protect them from exposure to dirt, icing conditions and splash.

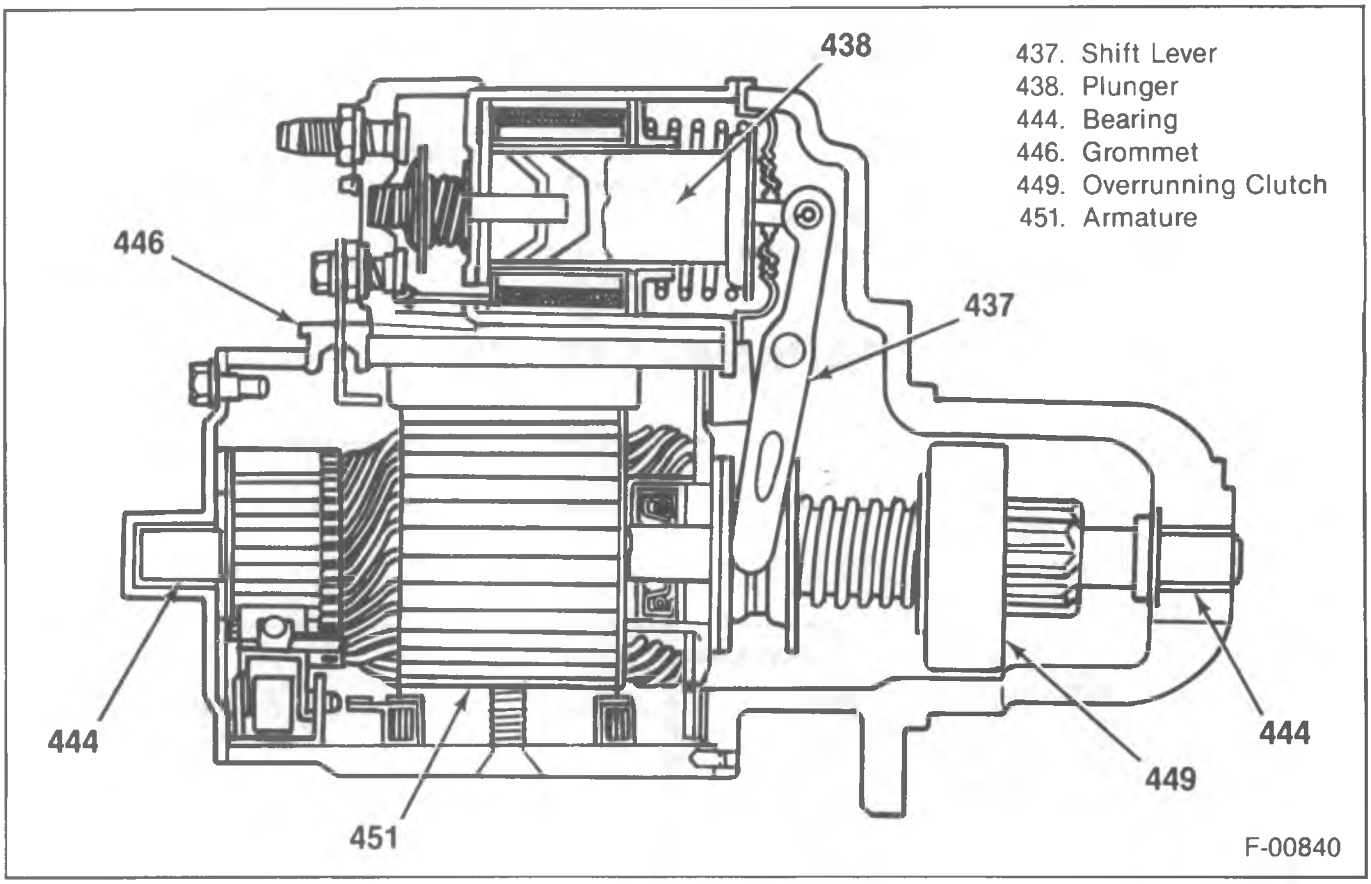


Figure 22—10MT Starting Motor

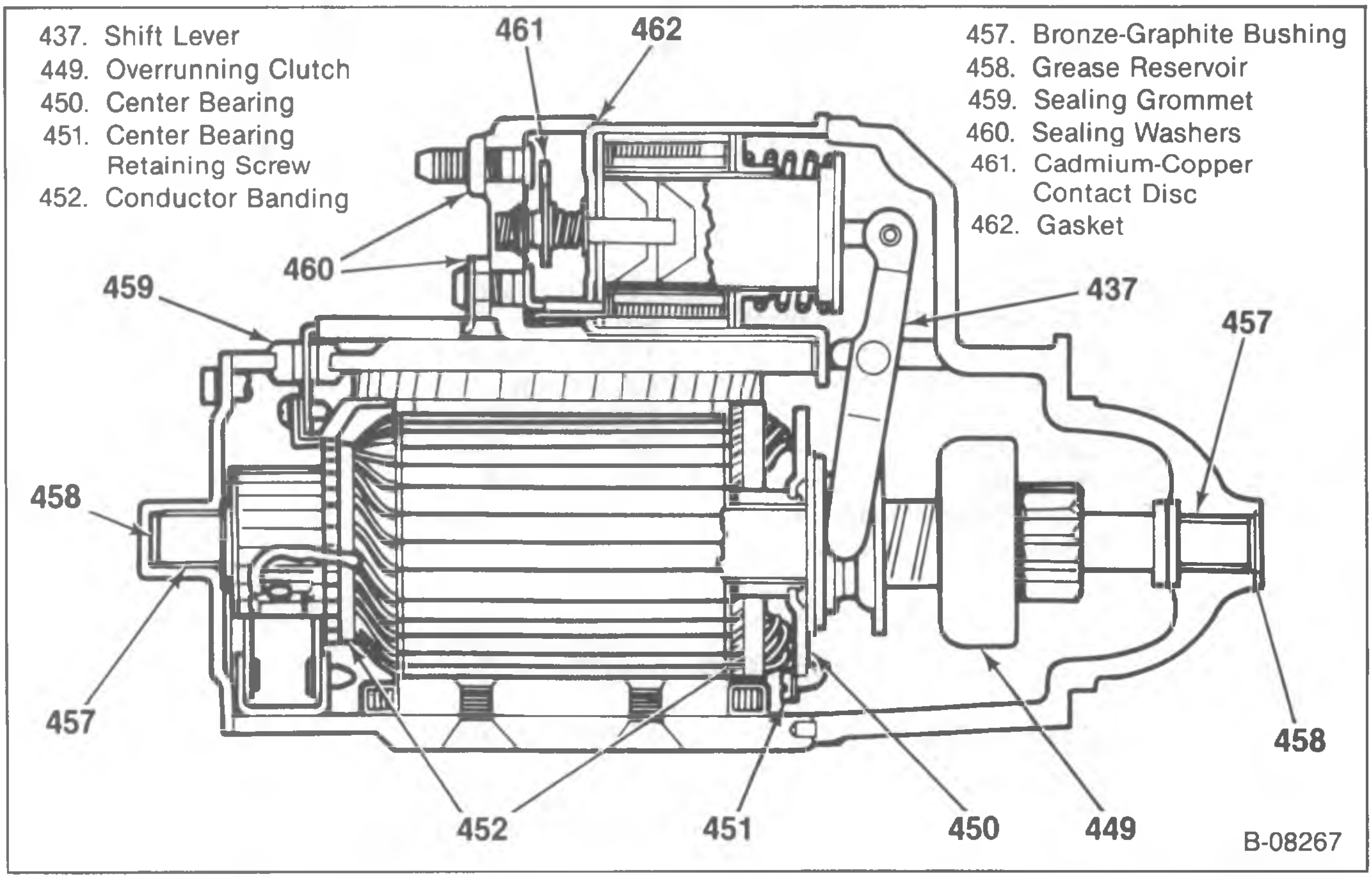


Figure 23—27MT Starting Motor

In the basic circuit (figure 21), the solenoid windings are energized when the switch is closed (in the "Start" position). The resulting plunger and shift lever movement causes the pinion to mesh with the engine flywheel ring gear and the solenoid main contacts to close, and engine 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, open the engine control switch (release from the "Start" position) immediately when the engine starts.

DIAGNOSIS OF CRANKING SYSTEM

Refer to figures 24, 25 and 26 for a diagnosis of the cranking system. Before removing any unit in the system for repair, make the following checks.

CRANKING CIRCUIT

BATTERY

Determine the condition of the battery. Refer to "Battery" earlier in this section for battery diagnosis and testing.

WIRING

Inspect the circuit wiring for damage. Inspect all connections to the starter motor, solenoid, engine control switch, and battery, including all ground connections. Clean and tighten all connections as required.

SOLENOID AND CONTROL SWITCHES

Check all switches to determine their condition. A vehicle equipped with an automatic transmission and a computerized ignition system (Electronic Control Module) has a neutral start switch which allows the vehicle to be started in Park or Neutral. It is located on the steering column near the floor. A vehicle with a manual transmission has a neutral start switch attached to the clutch.

STARTER MOTOR NOISE

Refer to the starter noise diagnostic chart.

PINION CLEARANCE

1. Remove the lower flywheel housing cover.
2. Inspect the flywheel for signs of unusual wear such as chipped or missing gear teeth or the flywheel being bent. If the flywheel needs replacing, refer to "Engine Mechanical" earlier in this manual.
3. Start the engine and gently touch the outside diameter of the rotating flywheel ring gear with chalk or crayon to show the high point of tooth runout after the engine is turned off. Turn the engine off and rotate the flywheel so that the marked teeth are in the area of the starter pinion gear.
4. Disconnect the negative battery cable to prevent accidental cranking of the engine.
5. Insert a screwdriver in the small hole in the bottom of the starter (shown by the arrow in figure 27) and move the starter pinion and clutch assembly so that the pinion teeth and flywheel teeth are meshed. If necessary, rotate the flywheel so that a pinion tooth is directly in the center of two flywheel teeth and on the centerline of the two gears (figure 28).
6. Measure the clearance between the top of the pinion tooth and the bottom of the flywheel tooth using the width of the wire gage (figure 28). Normal clearance is 0.5 to 1.5 mm (0.02 to 0.06 inch).
7. If the clearance is less than 0.5 mm (0.02 inch) and the starter whines after firing, shim the starter away from the flywheel.
   - Gas engines (figure 29):
     Add 1.0 mm (0.04 inch) shims, one at a time, to both long bolts between starter mounting pads and engine until noise problem is corrected. Do not use more than 2 shims total.
   - Diesel engine (figure 30):
     Add shims as required. Total shim stack must not exceed 4.0 mm (0.016 inch). If starter shims are not available, washers made of shim stock can be used.
8. If the pinion clearance is more than 1.5 mm (0.06 inch) and the starter whines during cranking, shim the starter towards the flywheel.
   - Gas engines (figure 29):
     Add 0.38 mm (0.015 inch) shims between the outboard starter mounting pad and engine mount until the noise stops. Do not add more than 4 shims total.

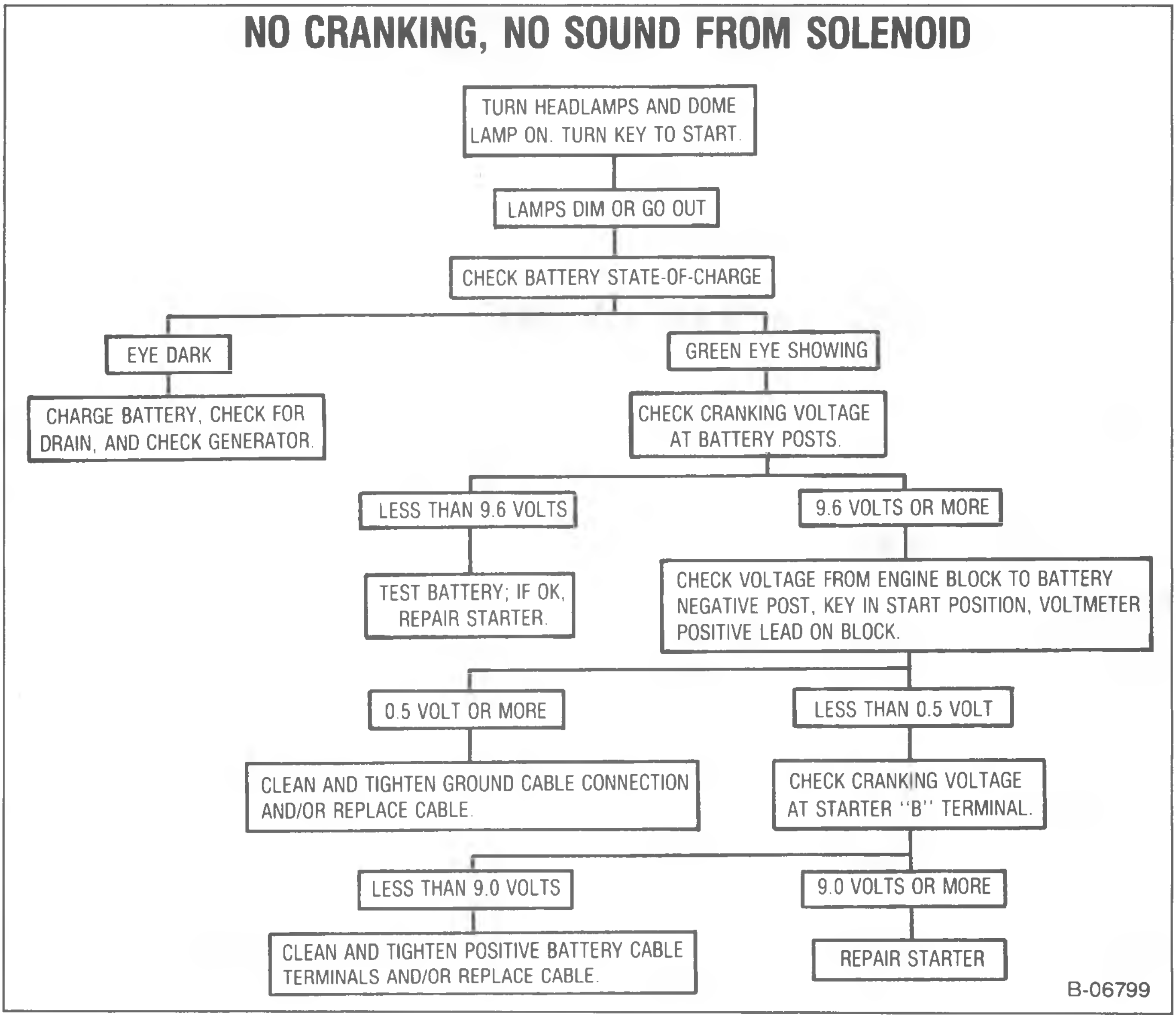


Figure 24—Cranking System Diagnosis

- Diesel engine (figure 30):
  Add a 1.0 mm (0.014 inch) shim at "A" between the starter motor mounting pad and the engine. If a starter shim is not available, a washer made of shim stock can be used.

9. When shimming is done, torque the mounting bolts.

Tighten

1. Gas engine starter motor mounting bolts to 38 N·m (28 ft. lbs.) (figure 29).
2. Diesel engine starter motor:
   - Through bolt to 38 N·m (28 ft. lbs.) (figure 30).
   - Nut to 10 N·m (7.4 ft. lbs.).
   - Bolt to 32 N·m (24 ft. lbs.).

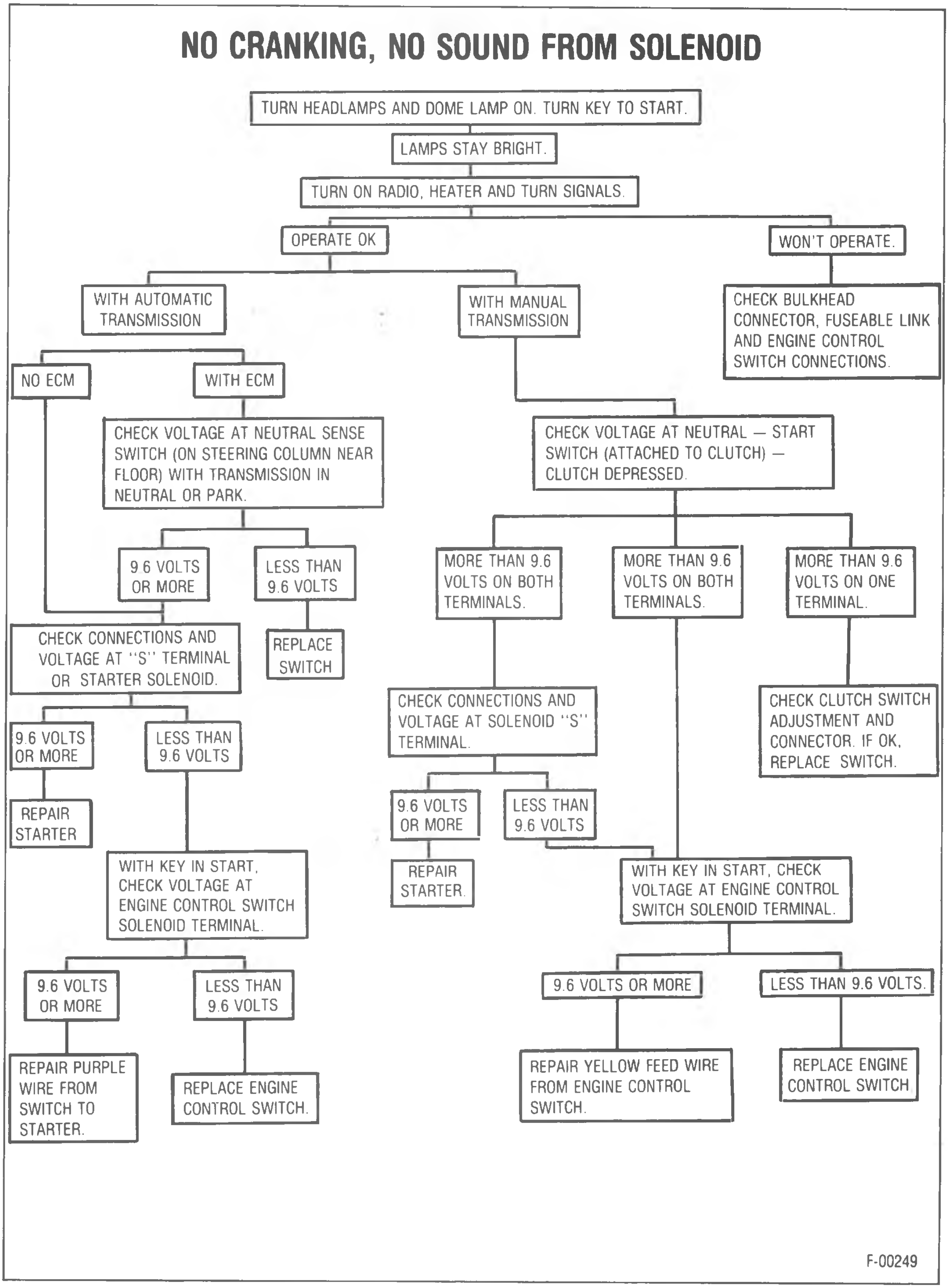
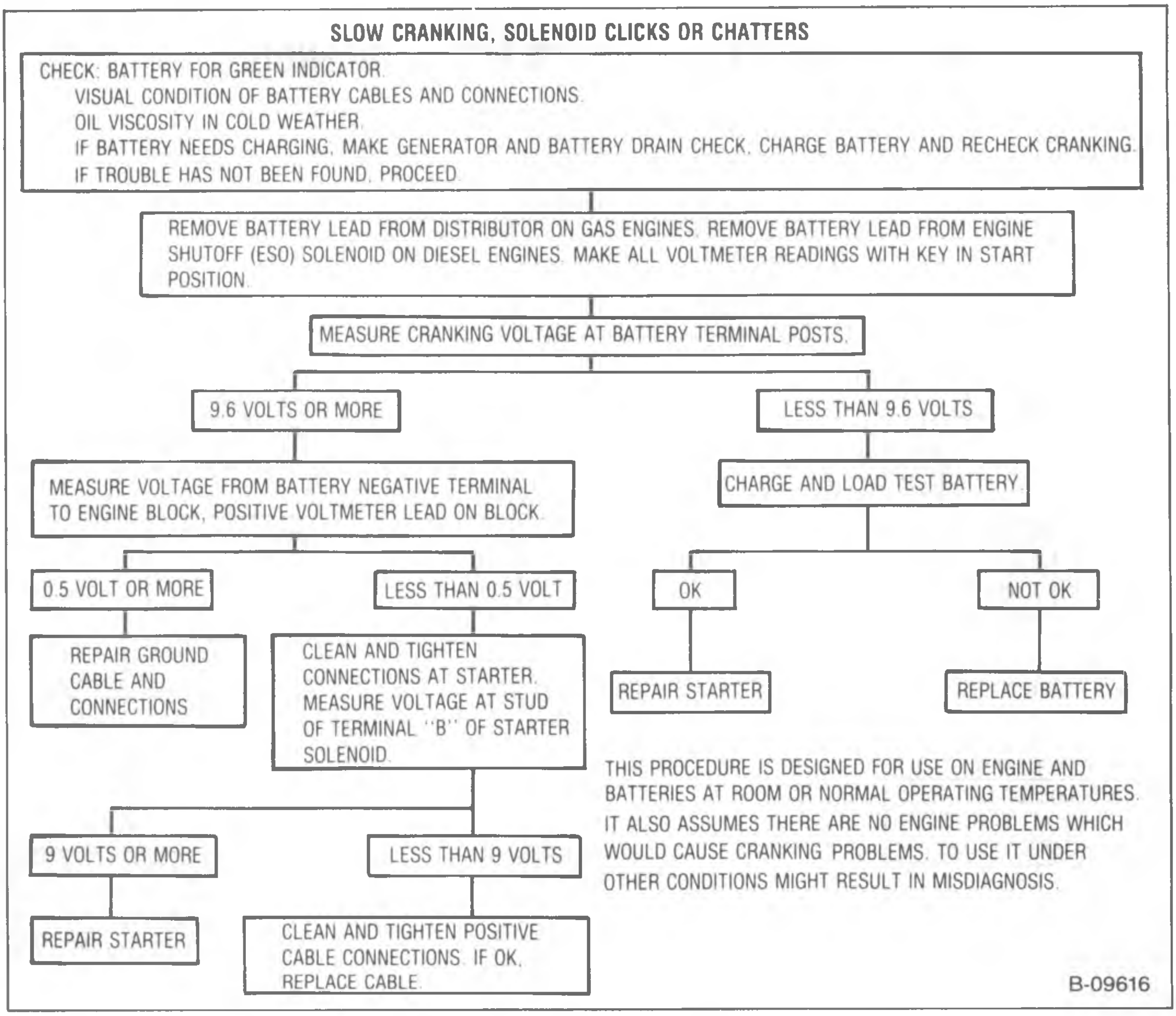


Figure 25—Cranking System Diagnosis



SLOW CRANKING, SOLENOID CLICKS OR CHATTERS

CHECK: BATTERY FOR GREEN INDICATOR.
VISUAL CONDITION OF BATTERY CABLES AND CONNECTIONS.
OIL VISCOSITY IN COLD WEATHER.
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 ON GAS ENGINES. REMOVE BATTERY LEAD FROM ENGINE SHUTOFF (ESO) SOLENOID ON DIESEL ENGINES. MAKE ALL VOLTMETER READINGS WITH KEY IN START POSITION.

MEASURE CRANKING VOLTAGE AT BATTERY TERMINAL POSTS.

9.6 VOLTS OR MORE

MEASURE VOLTAGE FROM BATTERY NEGATIVE TERMINAL TO ENGINE BLOCK, POSITIVE VOLTMETER LEAD ON BLOCK.

0.5 VOLT OR MORE

REPAIR GROUND CABLE AND CONNECTIONS

LESS THAN 0.5 VOLT

CLEAN AND TIGHTEN CONNECTIONS AT STARTER. MEASURE VOLTAGE AT STUD OF TERMINAL "B" OF STARTER SOLENOID.

9 VOLTS OR MORE

REPAIR STARTER

LESS THAN 9 VOLTS

CLEAN AND TIGHTEN POSITIVE CABLE CONNECTIONS. IF OK, REPLACE CABLE.

LESS THAN 9.6 VOLTS

CHARGE AND LOAD TEST BATTERY.

OK

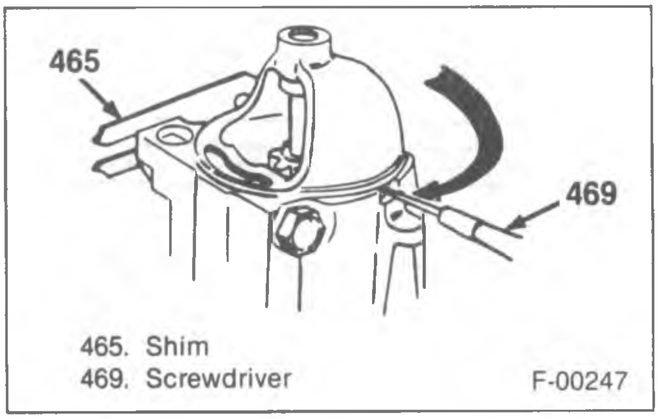
REPAIR STARTER

NOT OK

REPLACE BATTERY

THIS PROCEDURE IS DESIGNED FOR USE ON ENGINE AND BATTERIES AT ROOM OR NORMAL OPERATING TEMPERATURES. IT ALSO ASSUMES THERE ARE NO ENGINE PROBLEMS WHICH WOULD CAUSE CRANKING PROBLEMS. TO USE IT UNDER OTHER CONDITIONS MIGHT RESULT IN MISDIAGNOSIS.

Figure 26—Cranking System Diagnosis



465. Shim
469. Screwdriver

Figure 27—Meshing Starter and Flywheel Teeth

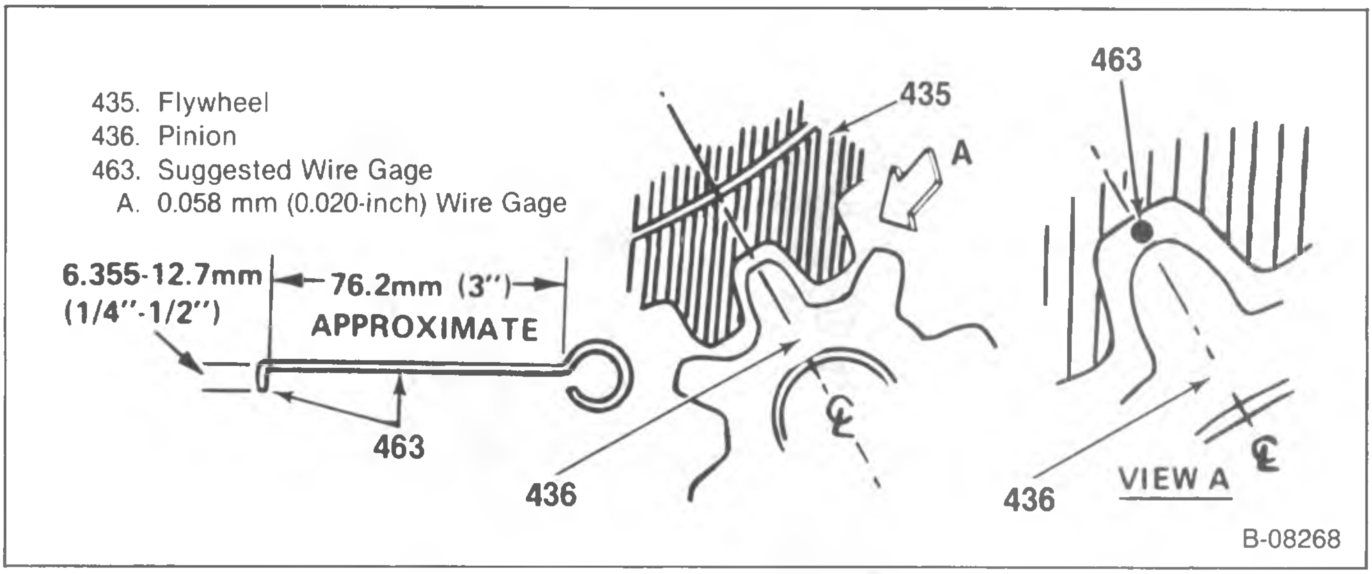


Figure 28—Flywheel To Pinion Clearance

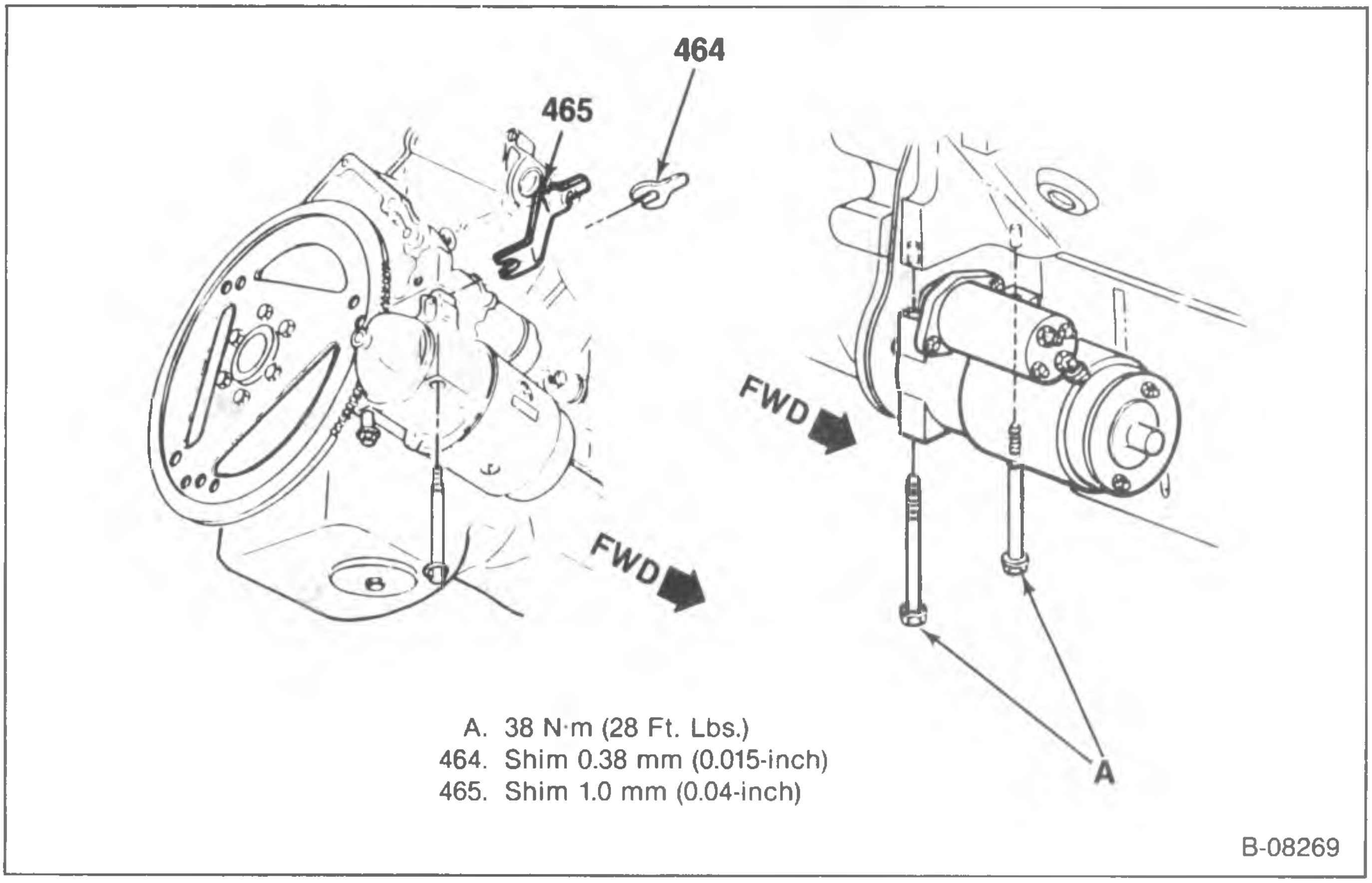
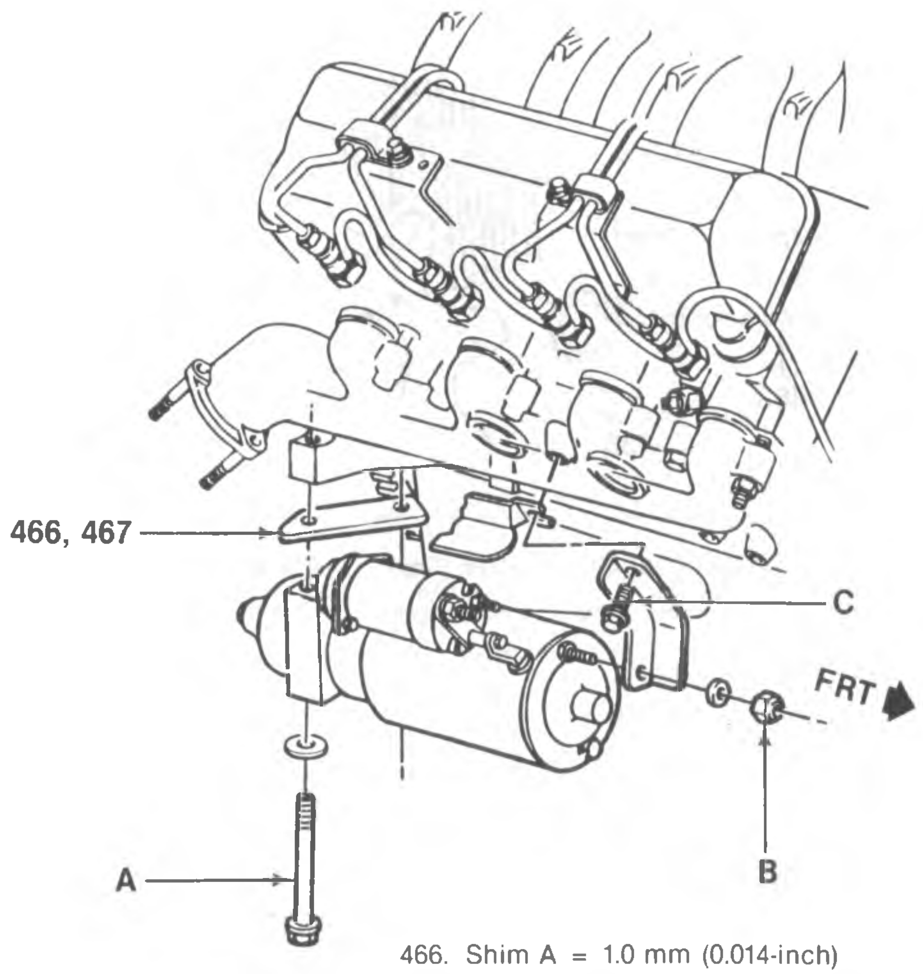


Figure 29—Shimming Gas Engine Starter Motors



466. Shim A = 1.0 mm (0.014-inch)
467. Shim B = 2.0 mm (0.08-inch)
A. 38 N·m (28 ft. lbs.)
B. 10 N·m (7.4 ft. lbs.)
C. 32 N·m (24 ft. lbs.)

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Figure 30—Shimming Diesel Engine Starter Motors

DIAGNOSIS OF STARTER MOTOR NOISE

PROBLEM	POSSIBLE CAUSE	CORRECTION
High-pitched whine during cranking (before engine fires) but engine cranks and fires normally.	Distance too great between starter pinion and flywheel.	Remove shims at starter mount. Refer to "Starter Motor Noise".
High-pitched whine after the engine fires as key is being released. The engine cranks and fires normally. This 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 of the problem.	Add shims at starter mount. Refer to "Starter Motor Noise".
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 the starter is engaged.	Usually due to a worn starter motor clutch.	Remove starter motor and check clutch. Refer to the Light Duty Truck Unit Repair Manual.
A "rumble" "growl" or (in severe cases) a "knock" as the starter is coasting down to a stop after starting the engine.	Usually due to a bent or unbalanced starter armature.	Remove starter motor and check the armature. Refer to the Light Duty Truck Unit Repair Manual.

CRANKING SYSTEM ON-VEHICLE SERVICE

MAINTENANCE

Keep starter terminals and all other terminals in the electrical system clean and tight. A loose or corroded connection or terminal will cause excessive resistance in the system which will result in hard starting.

At regular intervals, inspect the starting system to locate and correct potential causes of trouble before the system performance is affected.

Starting motors do not require lubrication except during overhaul.

STARTER MOTOR

If the battery, wiring and switches are in satisfactory condition, and the engine is functioning properly, remove the motor and refer to the Light Duty Truck Unit Repair Manual.

Never operate the starter motor more than 15 seconds at a time without pausing to allow it to cool for at least two minutes. Overheating, caused by excessive cranking, will damage the motor.

STARTER MOTOR REPLACEMENT

Remove or Disconnect

1. Negative battery cable.
2. Starter braces or shields if equipped.
3. Wires from the starter solenoid.
    - Raise the vehicle.
4. Two bolts, nuts, washers and shims holding the starter to the engine.
5. Starter from the engine.

Install or Connect

1. Two bolts, nuts, washer and shims through the starter to the engine.

    Tighten

    - Bolts to 38 N·m (28 ft. lbs.).
    - Lower the vehicle.
2. Wires to the solenoid terminals.
3. Negative battery terminal.

IGNITION SYSTEM

DESCRIPTION

All ignition systems include a battery, a distributor, an engine control switch, spark plugs, and the primary and secondary wiring. Information on the battery is located earlier in this section. Refer to CAB ELECTRICAL (SEC. 8A) for information on the engine control switch.

There are three ignition systems used on light duty vehicles: the High Energy Ignition (HEI) system, the HEI/ESC system, and the HEI/EST system.

HEI SYSTEM

The High Energy Ignition distributor used on these gasoline engines combines all ignition components in one unit (figures 31 and 32). The external electrical connections are the engine control switch feed wire, the tachometer pickup, and the six or eight spark plug leads. The engine control switch feed connector to the distributor has full battery voltage when the engine control switch is in the "RUN" and "START" positions. There is NO RESISTOR WIRE FROM THE ENGINE CONTROL SWITCH TO THE DISTRIBUTOR. The ignition coil is in the distributor cap and connects through a resistance brush to the rotor. The High Energy Ignition system is basically identical in operation to conventional ignition except the module and pick-up coil replace the contact points.

The High Energy Ignition is a magnetic pulse triggered, transistor controlled, inductive discharge ignition system. The magnetic pick-up assembly located inside the distributor 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 of up to 35,000 volts is induced in the ignition coil secondary winding which is directed through the rotor and secondary leads to fire the spark plugs. The capacitor in the distributor is for radio noise suppression.

The magnetic pick-up assembly is mounted over the main bearing on the distributor housing, and is made to rotate by the vacuum control unit, thus providing vacuum advance. The distributor shaft is mounted on the camshaft at the rear of the engine, and rotates at one-half the rpm of the engine. The force of rotation moves the advance weights against the springs, and provides cetrifugal advance to the timer core.

The module automatically controls the dwell period, stretching it with increasing engine speed.

The HEI system also features a longer spark duration, made possible by the higher amount of energy stored in the coil primary. This is desirable for firing lean mixtures.

When making compression checks, disconnect the engine control switch connector (pink wire) from HEI system.

No periodic lubrication is required. Engine oil lubricates the lower bushing and an oil-filled reservoir provides lubrication for the upper bushing.

ELECTRONIC SPARK CONTROL (HEI/ESC) SYSTEM (Figures 33, 34 and 35)

ESC is a closed loop system that controls engine knock by retarding spark timing. In addition to the components of the HEI system, it includes an electronic controller, a sensor, and switches. This system is used with LBI (4.3 L V6) and LE9 (5.0 L) engine equipped trucks.

Controller (Figures 36 and 37)

The controller is contained in a plastic box mounted behind the instrument panel compartment on the passenger side on CK models and under the driver's seat in the G van. It contains micro-electronic circuits which process signals from the sensor and switches and send a voltage signal to the distributor module to retard spark timing. The retard command is in proportion to the number and intensity of "knock" signals. It does not have memory storage.

Sensor (Figure 38)

The piezoelectric device is mounted in the engine block. It detects the presence and intensity of detonation by the vibration characteristics of the engine and sends a voltage signal to the controller.

ESC Vacuum Switch

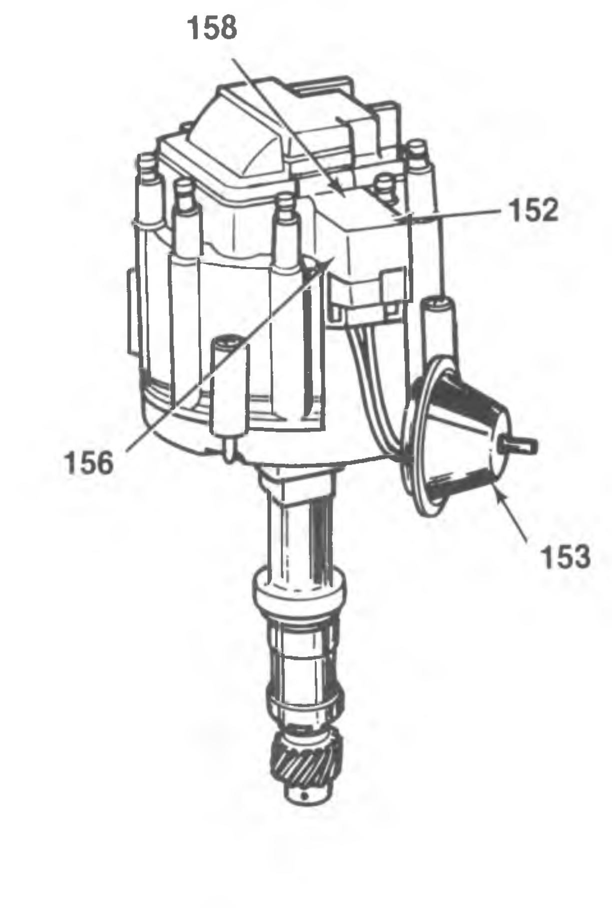
On LE9 and LB1 engine-equipped vehicles with automatic transmissions a "tip in" vacuum switch is used. It provides a brief contact closure (signal) to the controller to retard spark timing to minimize knock during a throttle "tip in" condition.

The switch contacts are normally open under steady engine vacuum conditions including no vacuum, and all brief increasing vacuum conditions. The switch closes during rapidly decreasing vacuum conditions such as those encountered on rapid throttle operation.

The switch is mounted on the right side of the cowl in the engine compartment (figure 39).

CARL Switch

HEI/ESC-equipped vehicles with manual transmissions (except the M20) use a Clutch Activated Retarded Limiting (CARL) switch (figures 40 and 41). It sends a signal to the controller to limit the retard command sent to the distributor in response to the "knock" sensor. Some detonation is then permitted during first gear acceleration to gain power.



152. Battery Terminal
(Connected to Ignition Switch)
153. Vacuum Unit
156. Tach Terminal
158. Ground Terminal

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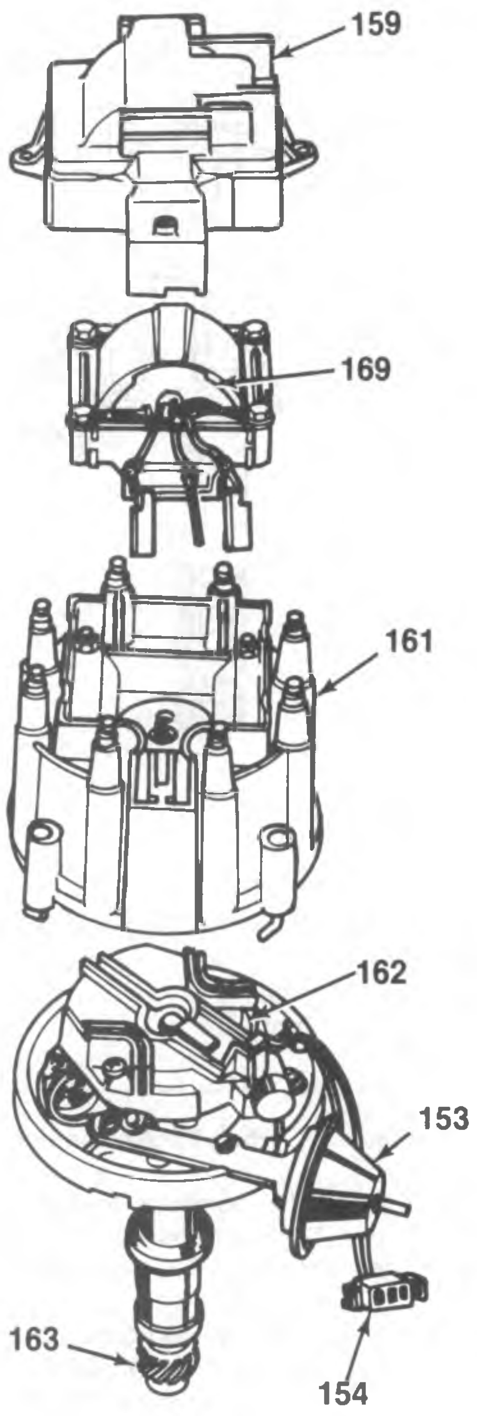
Figure 31—High Energy Ignition

ELECTRONIC SPARK TIMING (HEI/EST) SYSTEM

California vehicles use an HEI/EST distributor. All spark timing changes in the distributor are done electronically by the 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. No vacuum or mechanical advance is used. Further EST information is found in DRIVABILITY AND EMISSIONS (SEC. 6E).

IGNITION TIMING

Timing specifications for each engine are listed on the Vehicle Emissions Control Information label on the radiator support. When using a timing light, connect an adapter between the number 1 spark plug and the



153. Vacuum Unit
154. Connector
159. Cover
160. Coil
161. Cap
162. Rotor
163. Gear

B-09833

Figure 32—HEI System Components

number 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. The timing procedure remains the same as the conventional ignition system. Always follow Vehicle Emissions Control Information label procedures when adjusting timing.

SECONDARY WIRING

The spark plug wiring used with the HEI system is a carbon impregnated cord conductor encased in an 8 mm or 7 mm diameter silicone rubber jacket. The silicone wiring withstands high temperatures and provides an insulator for the higher voltage of the HEI system. The silicone spark plug boots form a tight seal on the plug and the boot should be twisted 1/2 turn before removing. Be cafeful when connecting a timing light or other pick-up equipment. Do not force contacts between the boot and wiring or through the silicone jacket. Make connections 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 gasoline engines. No gasket is used on these tapered seat plugs. Refer to figure 42 for an explanation of letter coding on spark plugs. Refer to the Vehicle Emissions Control Information label on the radiator support for correct gap information.

Normal or average service is assumed to be a mixture of idling, slow speed, and high speed operation with some of each making up the daily total driving. Occasional or intermittent high-speed driving is essential to good spark plug performance as it provides increased and sustained combustion heat that burns away any excess deposits of carbon or oxide that may have accumulated from frequent idling or continual stop-and-go or slow-speed 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 with resultant missing of engine, even though a film is allowed to accumulate on exposed portion of plug porcelains.

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.

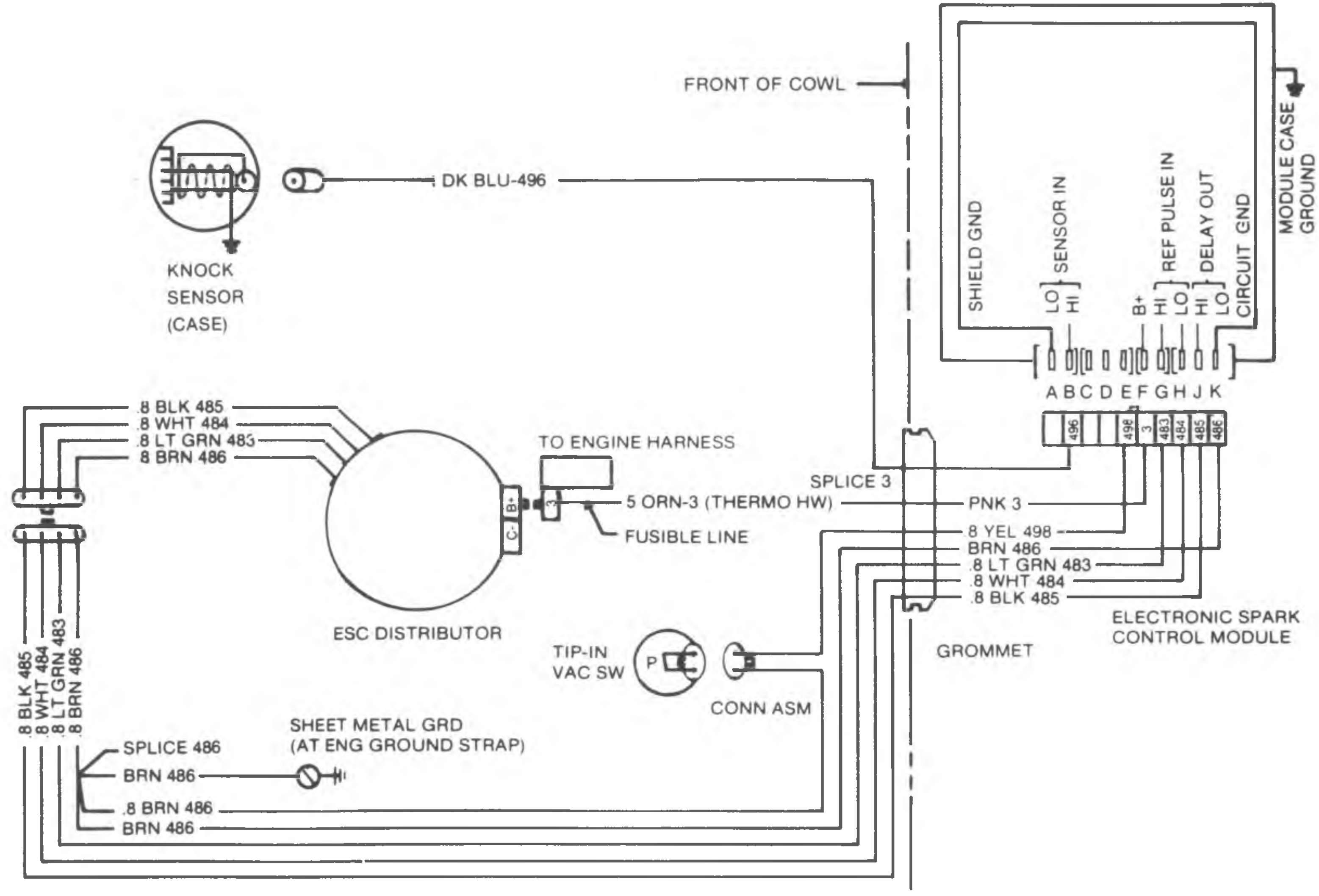


Figure 33—Electronic Spark Control Schematic - Automatic Transmission

B-09834

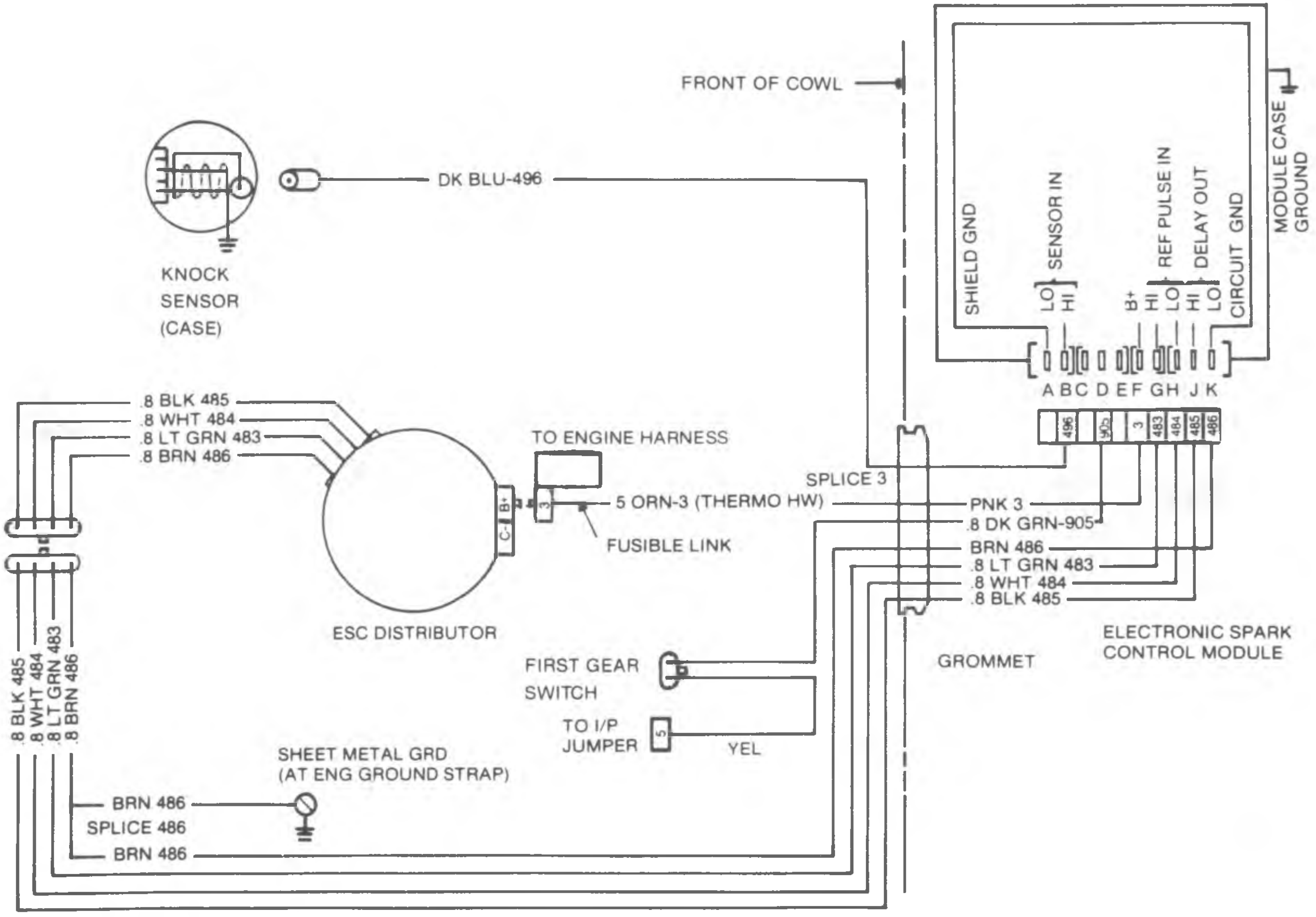
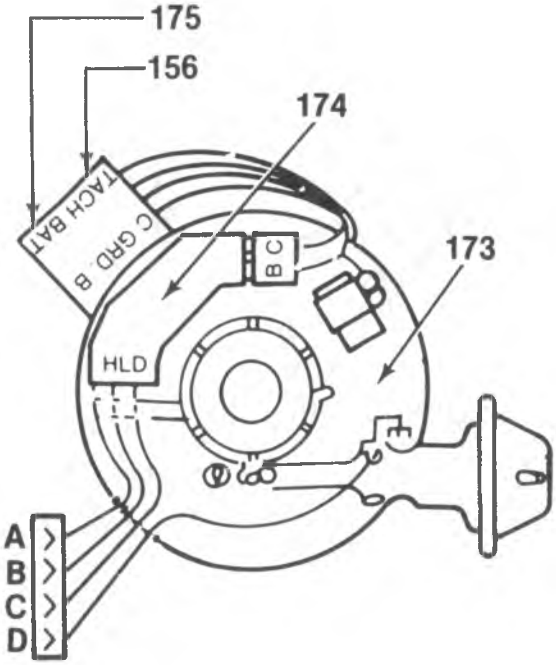


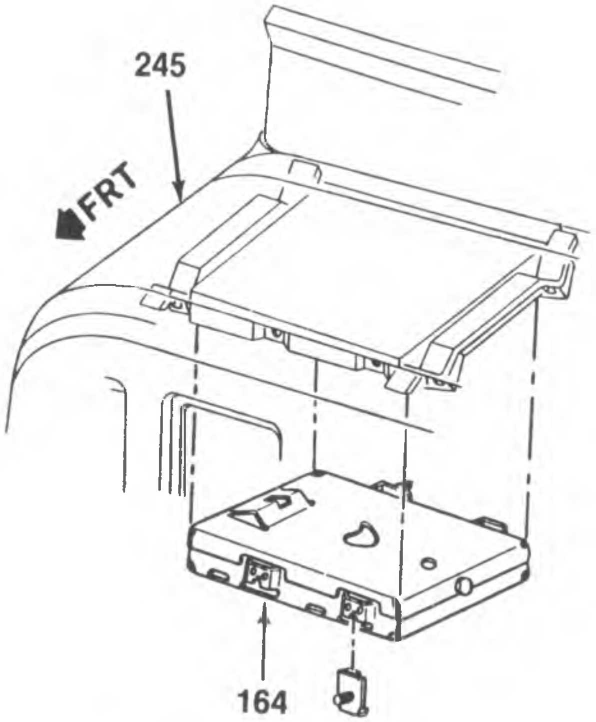
Figure 34—Electronic Spark Control Schematic - Manual Transmission (Except M20)



165.	Tachometer Terminal	A.	Black
173.	Pickup Coil	B.	White
174.	Module	C.	Green
175.	Ignition Switch Terminal	D.	Brown

B-09841

Figure 35—HEI/ESC Distributor



164. Controller
245. Cowl Panel

B-09842

Figure 36—Electronic Spark Control Controller (CK)

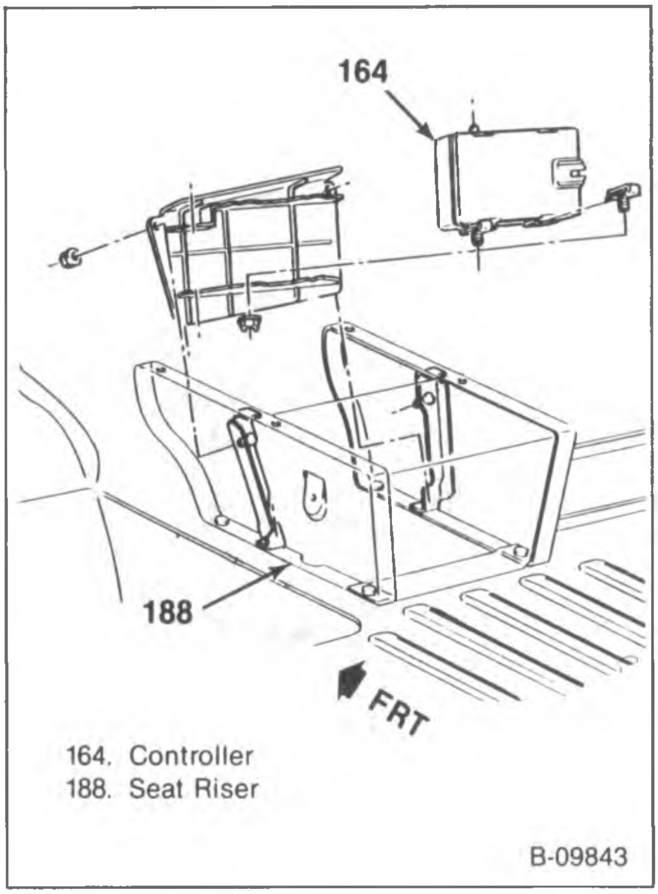


Figure 37—Electronic Spark Control Controller (G Van)

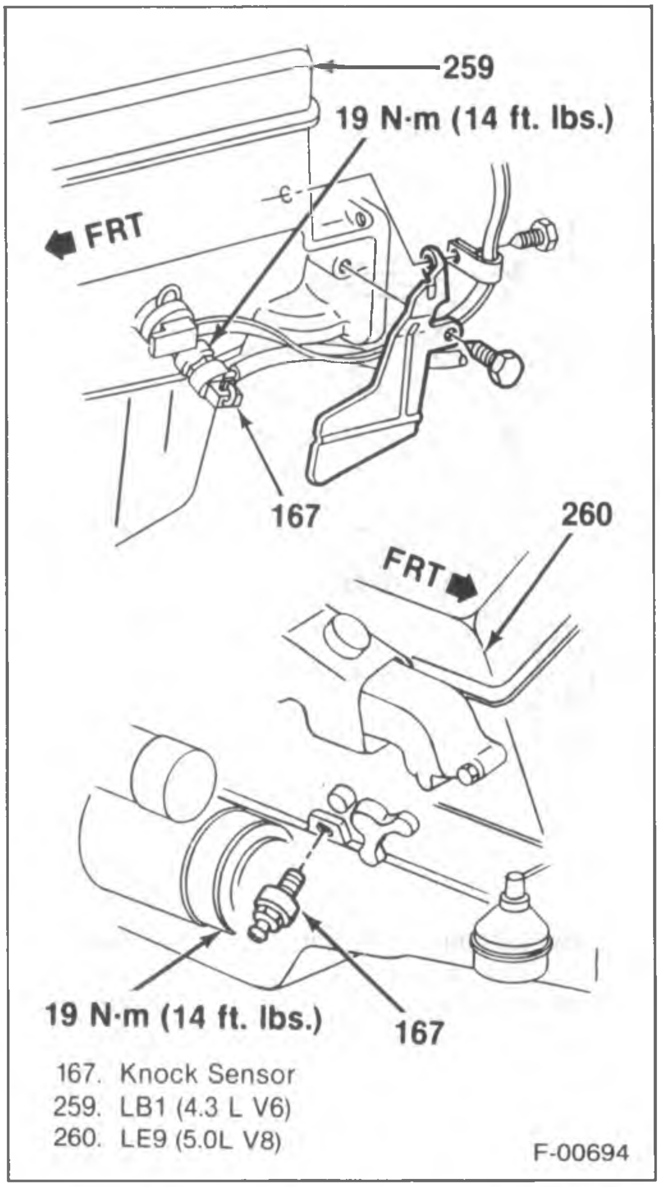


Figure 38—Knock Sensor On LB1 And LE9

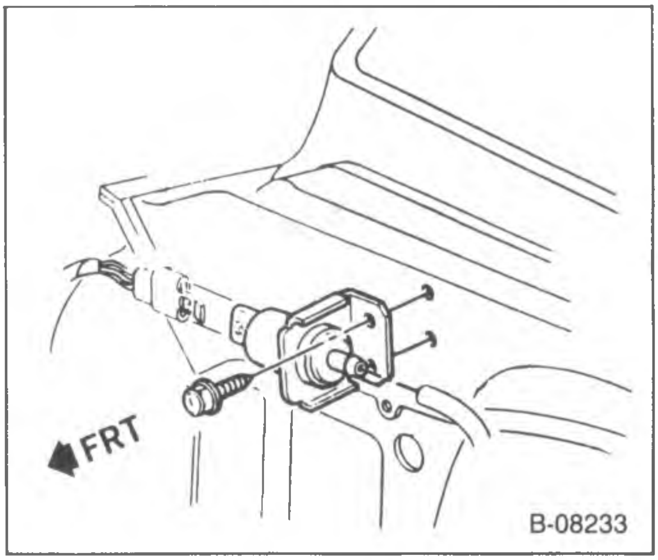
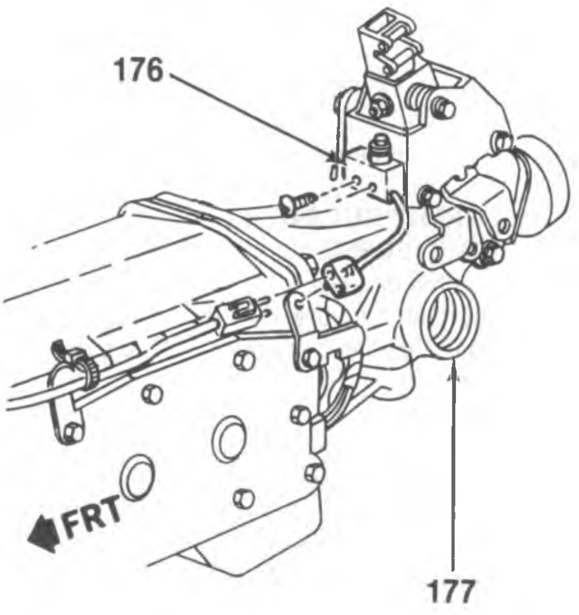
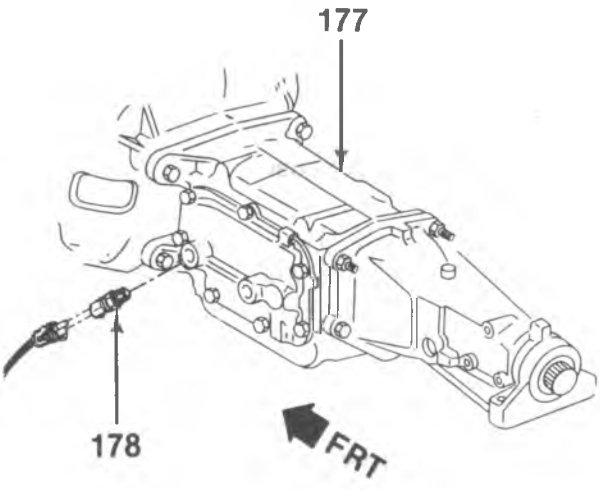


Figure 39—Tip In Vacuum Switch Mounting



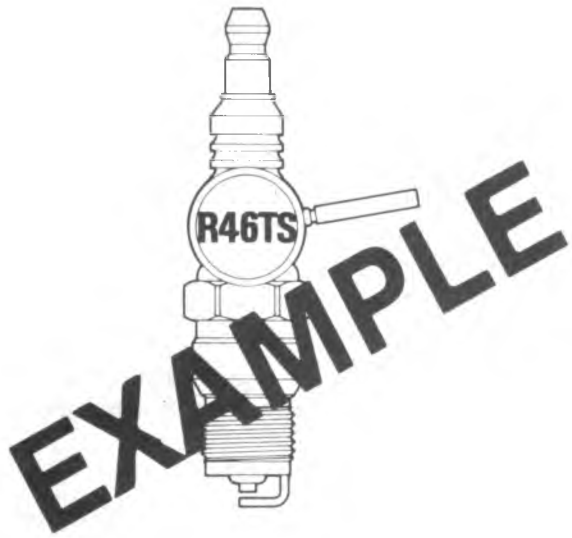
176. First Gear Switch
177. Transmission

Figure 40—CARL Switch On MY6 Transmission



177. Transmission
178. CARL Switch

Figure 41-CARL Switch on M62/M64 Transmissions



R = Resistor
4 = 14 mm Thread
6 = Heat Range
T = Taper Seat
S = Extended Tip

Figure 42—Spark Plug Coding

DIAGNOSIS OF IGNITION SYSTEM

HIGH ENERGY IGNITION (HEI) SYSTEM

1. Refer to figures 43, 44 and 45 for system diagnosis.
2. Refer to the Light Duty Truck Unit Repair Manual for distributor component checks.
3. Performance figures for centrifugal advance and vacuum advance are listed in "Specifications" at the end of this section.

NOTICE: If the module is removed from the distributor be sure to completely coat it with silicone grease or an equivalent heat transfer substance before reinstallation. Failure to do so could result in heat damage to the module.

CAUTION: To prevent possible personal injury from a moving vehicle or operating engine do the following before performing the checks:

1. **Engage the parking brake and block the wheels.**
2. **Place the automatic transmission in park or the manual transmission in neutral.**

ELECTRONIC SPARK TIMING (HEI/EST) SYSTEM

1. Refer to figures 43, 44 and 45 for system checks.
2. Refer to the Light Duty Truck Unit Repair Manual for distributor component checks.
3. Refer to DRIVEABILITY AND EMISSIONS (SEC. 6E) in this manual for further checks, including diagnostic use of the "Check Engine" or "Service Engine Soon" lamp.
4. Refer to the Notice and Caution given for the HEI System.

ELECTRONIC SPARK CONTROL (HEI/ESC) SYSTEM

Refer to the Notice and Caution given for the HEI System.

The charts and wiring diagrams in figures 46 through 50 show how to identify and correct no start, spark knock and poor engine performance conditions related to ESC. There can be a number of other causes for these conditions. Before replacing an ESC system component, check for other causes as listed below.

ENGINE CRANKS BUT DOES NOT START (FIGURES 46, 47 and 48)

Other possible causes:

1. A component in the electrical system (refer to Cranking System Diagnostic Charts earlier in this section).
2. Exhaust restriction or low compression. Refer to ENGINE (SEC. 6A).
3. Fuel system component. Refer to DRIVABILITY AND EMISSIONS (SEC. 6E).

POOR ENGINE PERFORMANCE (FIGURE 49)

Other possible causes:

1. Poor quality fuel.
2. Carburetor condition. Refer to FUEL SYSTEM (SEC. 6C).
3. Mechanical noises causing false spark retard.
   - Fuel pump noise. Refer to FUEL SYSTEM (SEC. 6C).
   - Abnormally loud valve lifters.
   - Loose accessory mounting brackets.
4. Ignition system.
   - Timing - Set timing to specifications.
   - Distributor - Check that centrifugal advance and vacuum advance meet the specifications given at the end of this section.
   - Spark Plugs - Inspect and replace if necessary. Be sure to use the recommended plugs.
   - Plug Wiring - Route plug wires and knock sensor wire away from the generator.
5. Mobile phone or radio (if equipped). Run separate power and ground wires directly to battery terminals.
6. CARL switch inoperative.

ENGINE DETONATION (FIGURE 50)

Other possible causes:

1. Low octane fuel.
2. High load on engine.
3. Exhaust Gas Recirculation (EGR) valve, Early Fuel Evaporation (EFE) valve, or THERMAC valve inoperative. Refer to DRIVABILITY AND EMISSIONS (SEC. 6E8).
4. Mechanical condition in engine. Refer to ENGINE (SEC. 6A).
5. Low coolant level. Refer to ENGINE COOLING (SEC. 6B).
6. Tip in switch inoperative.

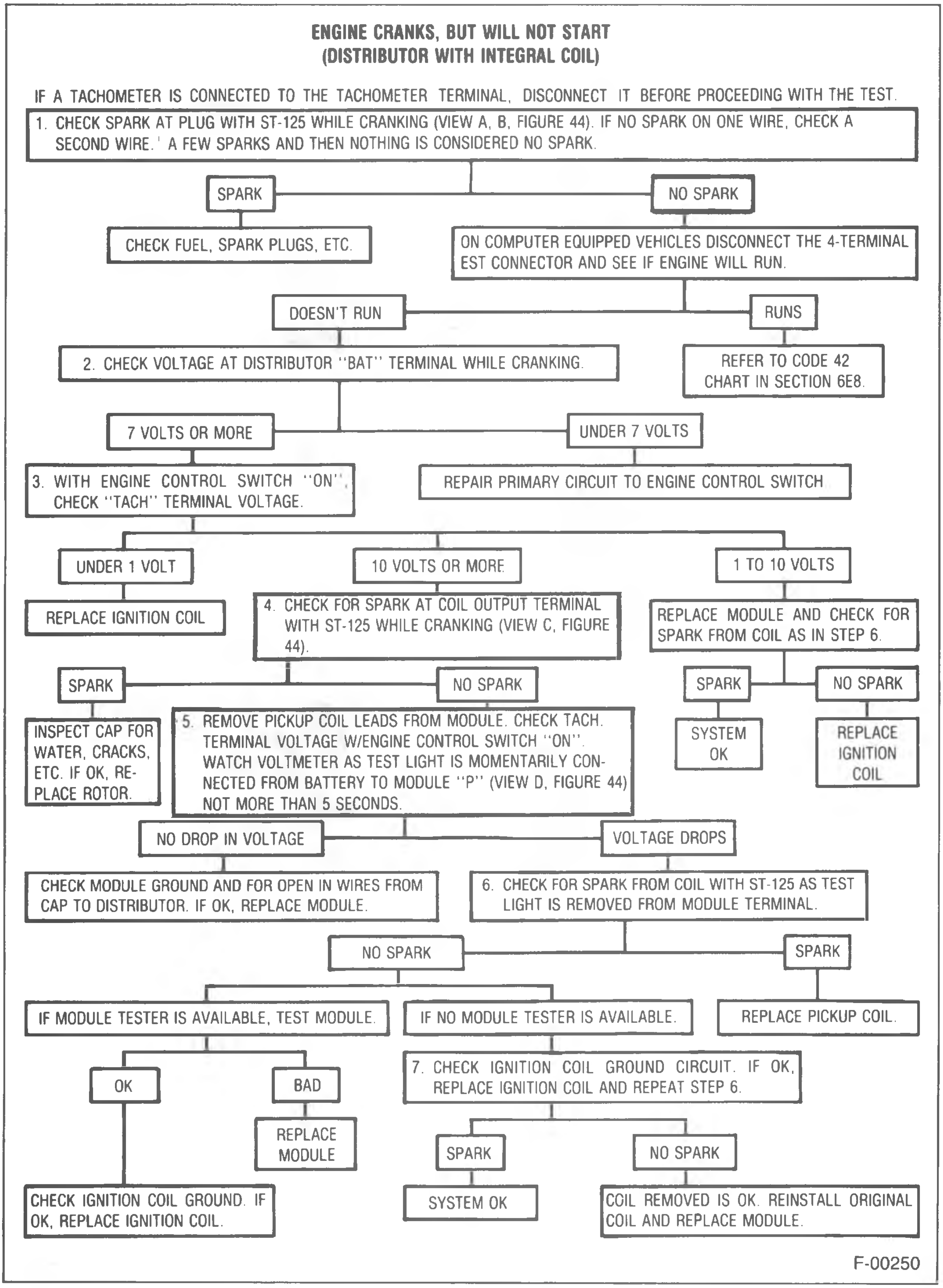
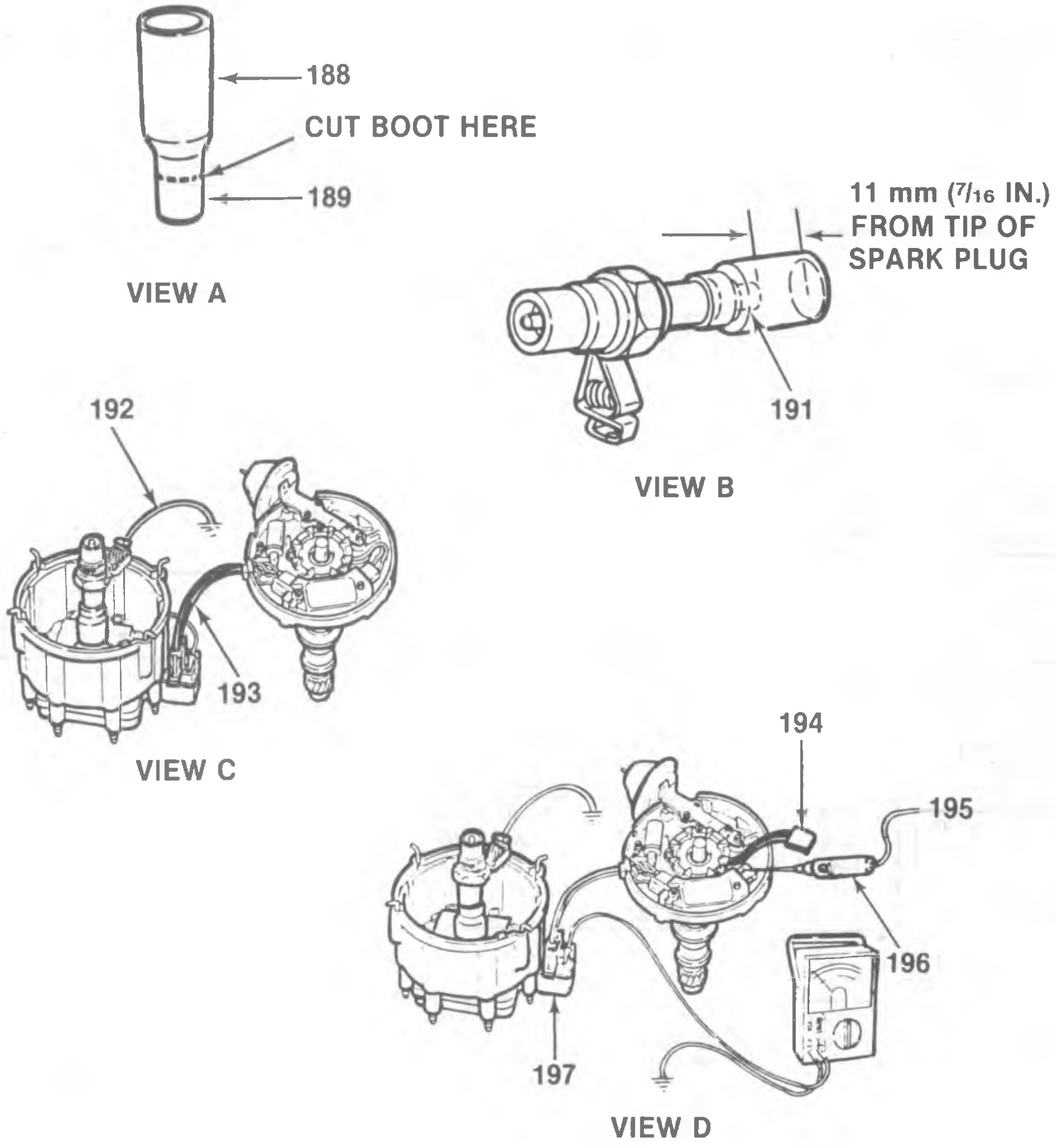


Figure 43—HEI System Diagnosis



188. Spark Plug Boot
189. Discard
191. Insert Boot Over Porcelain End Of ST-125
192. Connect To Ground
193. Leave Harness Connected
194. Remove Leads To Module
195. To BAT +
196. Test Light
197. Connect Voltmeter And Tach Terminal To Ground

F-00251

Figure 44—HEI System Diagnosis

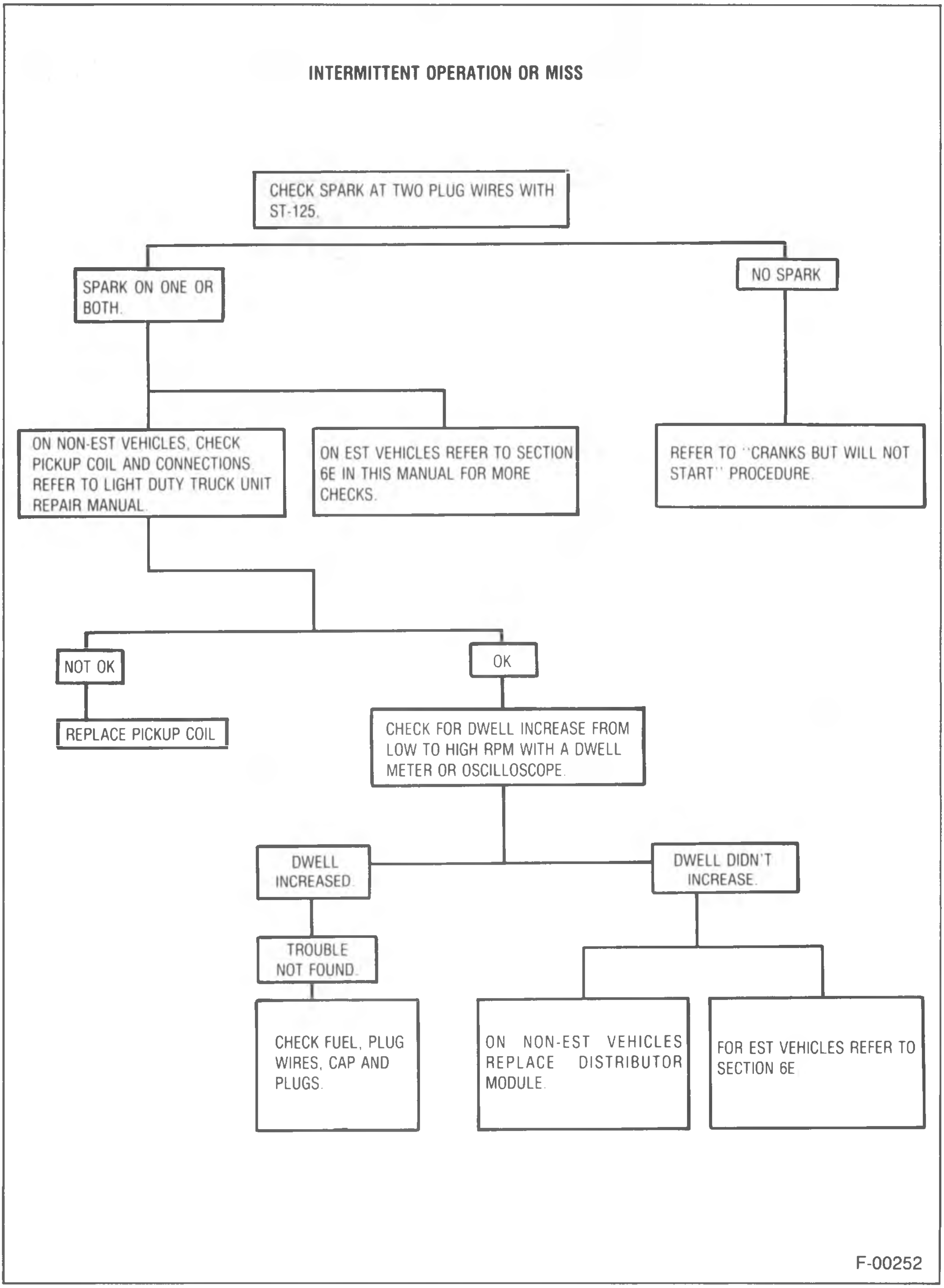


Figure 45—HEI System Diagnosis

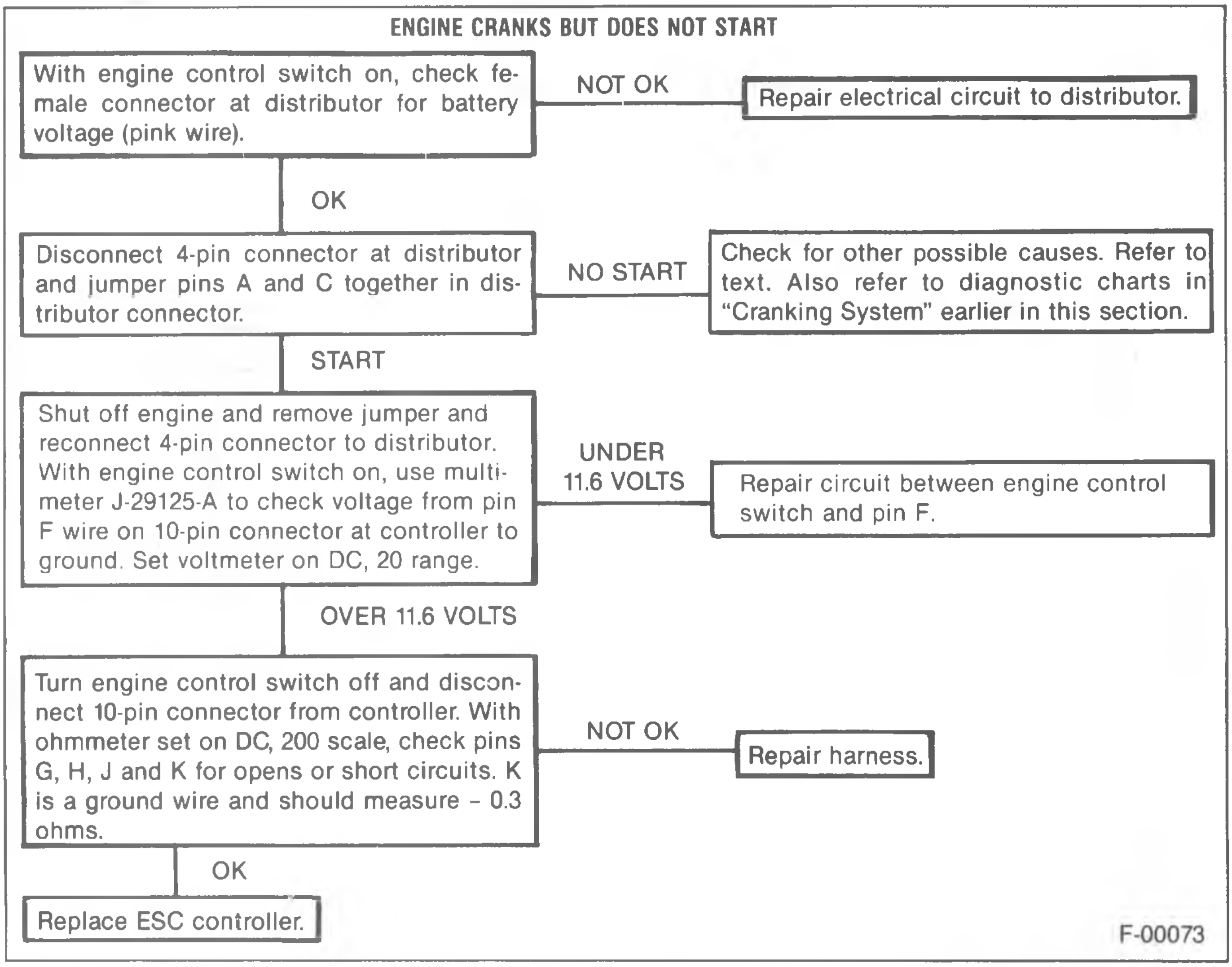


Figure 46—Electronic Spark Control System Diagnosis

SWITCHES

Vacuum Controlled Tip In Switch

1. Run the engine at idle speed.
2. Disconnect the vacuum line at the switch.
3. Connect a vacuum gage to the vacuum line. Vacuum should reach –57 kPa (17 in. Hg.).
4. With the gage still attached, depress the accelerator pedal rapidly. Vacuum should drop to approximately –10 kPa (3 in. Hg.).
5. With the engine again at idle speed, disconnect the vacuum gage. Depress the accelerator pedal rapidly. There should be noticeable engine knock.
6. With the engine again at idle speed, reconnect the vacuum line.
7. Depress the accelerator pedal rapidly. A slight amount of engine detonation may still be heard (a few "pings").
8. If engine detonation does not decrease with the vacuum line attached, replace the tip in switch.

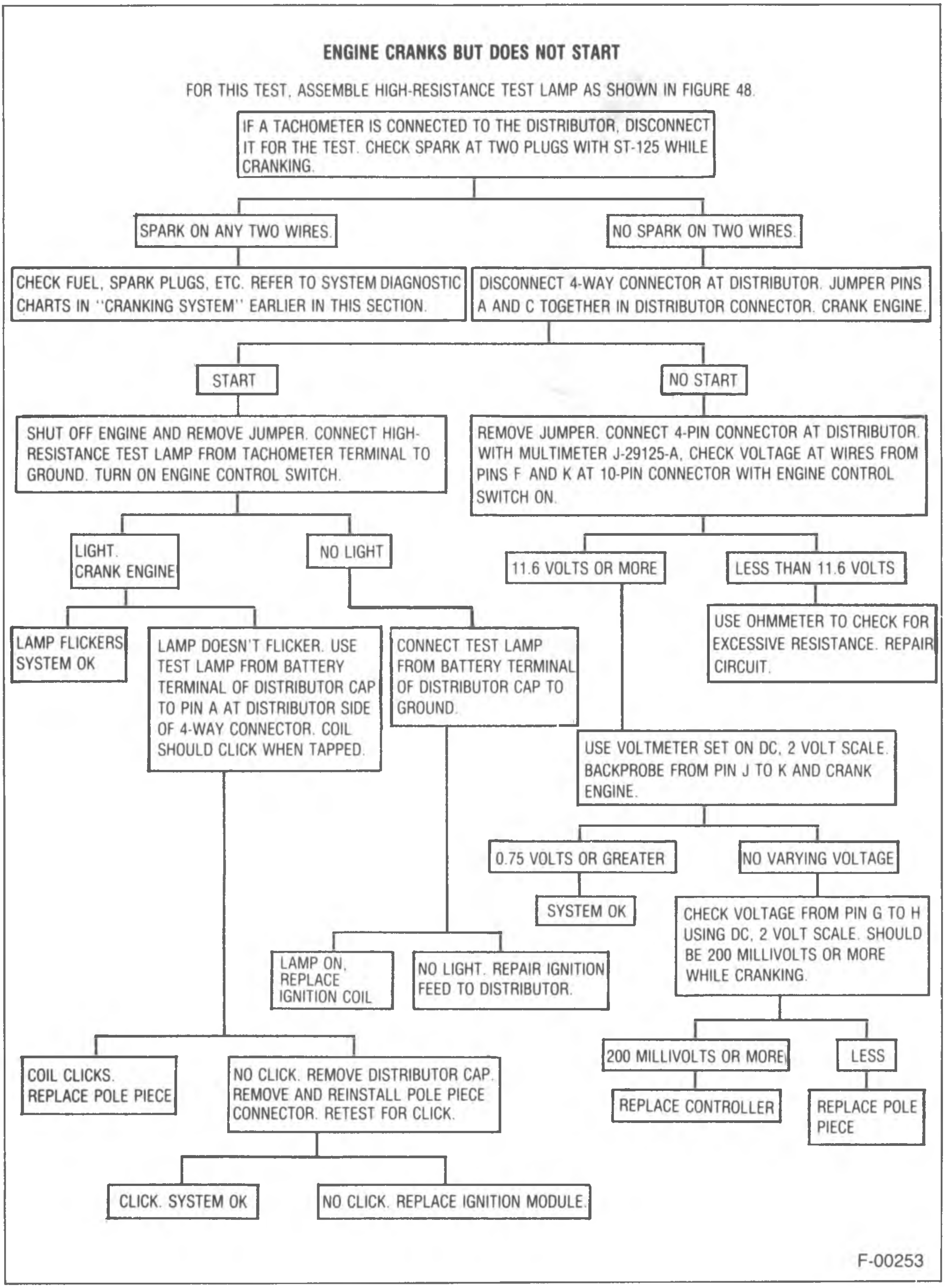
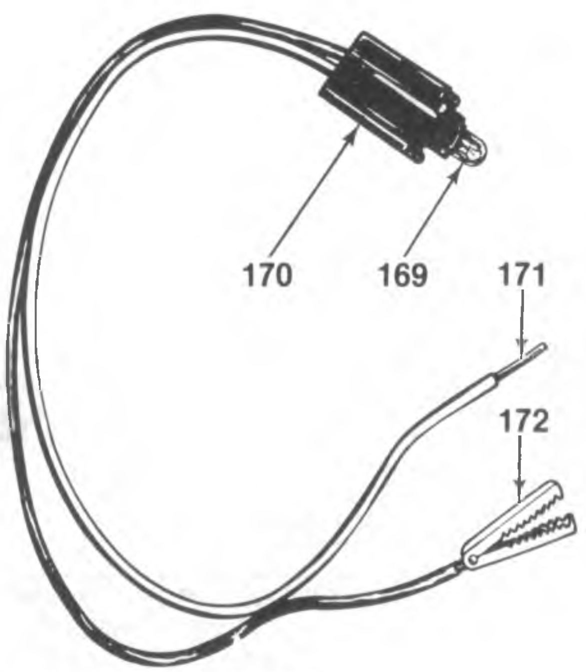


Figure 47—Electronic Spark Control System Diagnosis



169. Bulb PN 9436790
170. Socket PN 9436790
171. Probe
172. Alligator Clip

F-00254

Figure 48—High Resistance Test Light

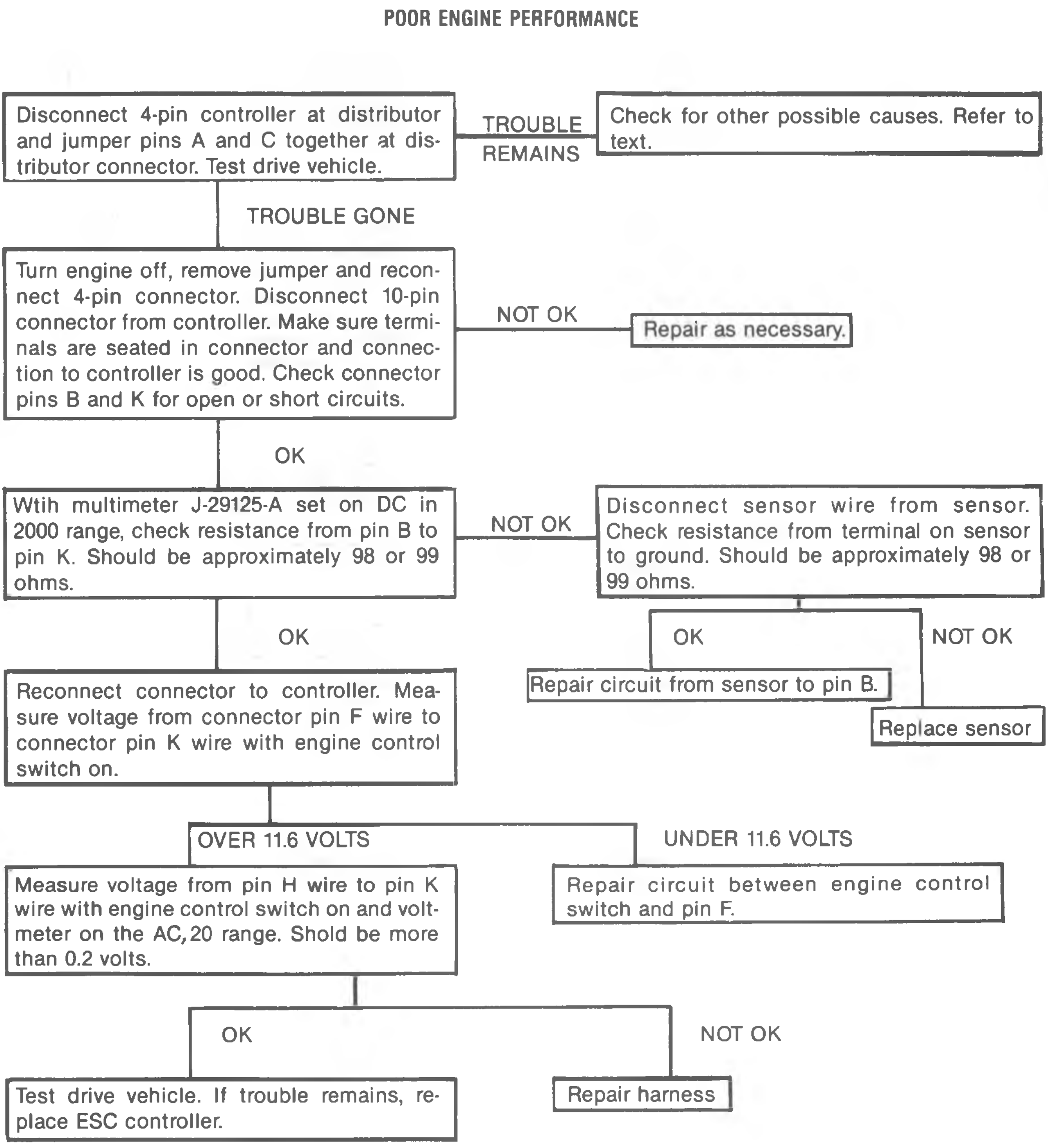


Figure 49—Electronic Spark Control System Diagnosis

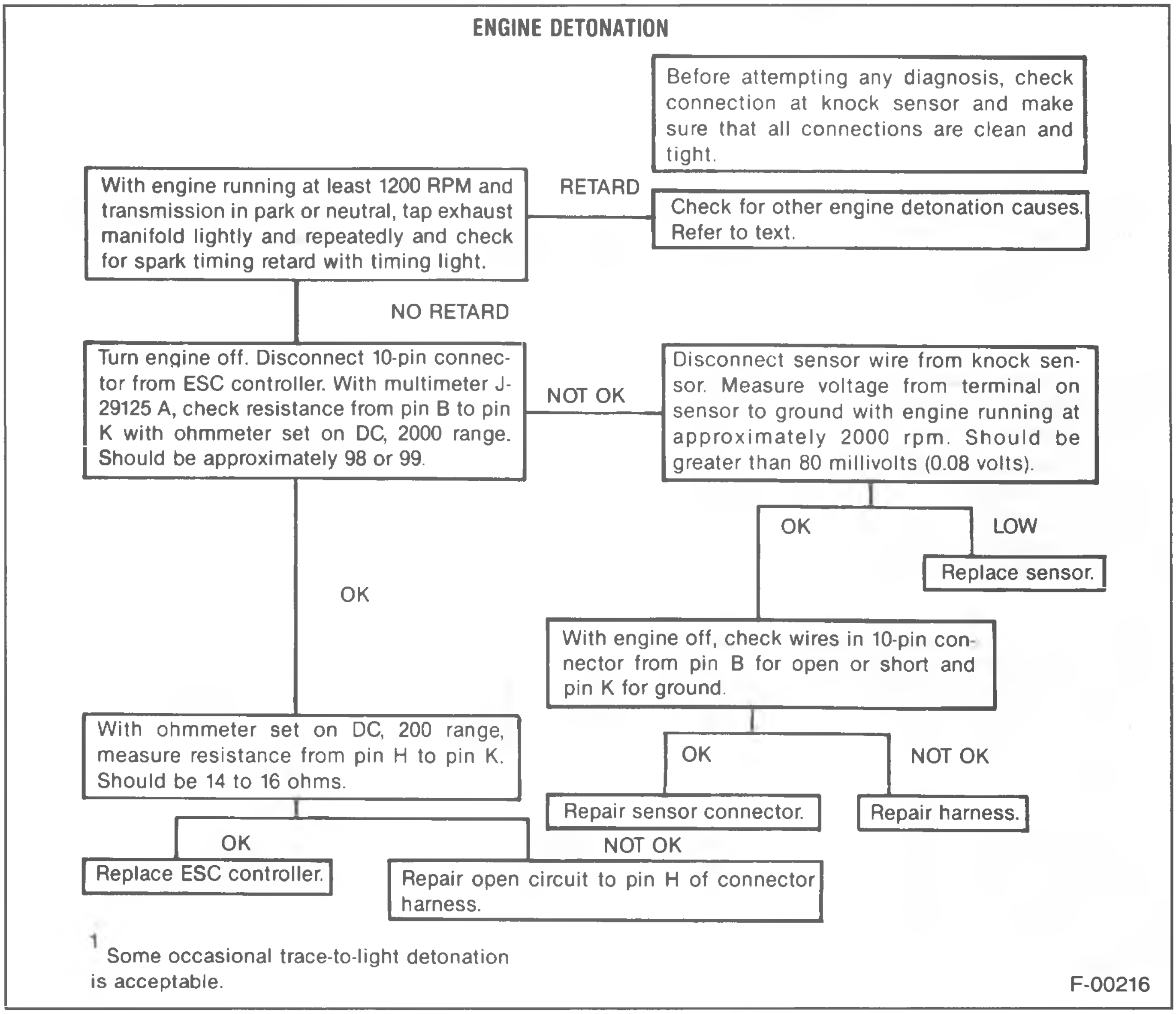


Figure 50—Electronic Spark Control System Diagnosis

DIAGNOSIS OF SPARK PLUGS

PROBLEM	POSSIBLE CAUSE	CORRECTION
Brown to grayish-tan deposits and slight electrode wear.	Normal wear.	Clean, regap, reinstall.
Dry, fluffy black carbon deposits.	1. Carburation is too rich. 2. Sticking EFE valve or manifold heat valve. 3. Sticking automatic choke. 4. Poor ignition output.	1. Check fuel mixture. Replace air cleaner if clogged. 2. Replace if necessary. 3. Refer to DRIVABILITY AND EMISSIONS (SEC. 6E). 4. Check distributor coil connections and cables (discussed in this section).
Wet, oily deposits with very little electrode wear.	1. "Break-in" of new or recently overhauled engine. 2. Excessive valve stem guide clearances. 3. Worn intake valve seals.	1. Degrease, clean and reinstall plugs. 2. Refer to ENGINE (SEC. 6A). 3. Replace seals.
Red, brown, yellow and white colored coatings on insulator. Engine misses intermittently under severe operating conditions.	By-products of combustion.	Clean, regap, and reinstall. If heavily coated, replace.
Colored coatings heavily deposited on portion of plug projecting into chamber and on side facing intake valve.	Leaking seals if condition is found in only one or two cylinders.	Check seals. Replace if necessary. Clean, regap, and reinstall plugs.
Shiny yellow glaze coating on insulator.	Melted by-products of combustion.	Avoid sudden acceleration with wide-open throttle after long periods of low speed driving. Replace plugs.
Burned or blistered insulator tips and badly eroded electrodes.	Excessive overheating.	1. Check cooling system. 2. Check for sticking heat riser valves. Refer to ENGINE (SEC. 6A). 3. Check air-fuel mixture. May be too lean. 4. Check heat range of plugs. May be too hot. 5. Check ignition timing. May be over-advanced. 6. Check torque value of plugs to ensure good plug-engine seat contact.

DIAGNOSIS OF SPARK PLUGS (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Broken or cracked insulator tips.	Heat shock from sudden rise in tip temperature under severe operating conditons. Improper gapping of plugs.	Replace plugs. Gap correctly.

IGNITION SYSTEM ON-VEHICLE SERVICE

SERVICE PRECAUTIONS

Some service tachometers and electronic diagnostic equipment may NOT be compatible with the High Energy Ignition system. Consult your representative of such equipment to update your equipment for compatibility with the HEI system.

1. When making compression checks, disconnect the engine control switch feed wire at the distributor. When disconnecting this connector release the locking tab while pulling downward on the connector body; do not use a screwdriver or tool to release the locking tab as it may break the tab.
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 engine control 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.

4. There is no dwell adjustment since this is controlled by the module.
5. The centrifugal advance and vacuum advance are similar to the conventional ignition.
6. The material used to construct the spark plug wires is very pliable and soft. This wire will withstand more heat and carry a higher voltage. Due to the more pliable wire, scuffing and cutting become easier. Route the spark plug wires correctly to prevent chaffing or cutting. 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.

DISTRIBUTOR REPLACEMENT

Remove or Disconnect

1. Engine cover (G-Van only).
2. Engine control switch battery feed wire from the distributor cap.
3. Tachometer lead (if equipped) from the cap.
4. Ignition coil connector from the cap.
    - Do not use a screwdriver or tool to release the locking tabs.
5. Distributor cap by pressing down on the four spring-loaded screws and turning the latches to the left.
6. Vacuum hose from the vacuum advance unit (if equipped).
7. Distributor clamp bolt and hold-down clamp from the engine.
    - Note the position of the rotor, then pull the distributor up until the rotor just stops turning to the left and again note the position of the rotor.
8. Distributor.

Install or Connect

To ensure correct timing of the distributor it must be installed with the rotor correctly positioned as noted in Step 7 of the removal procedure.

If the engine was accidentally cranked after the distributor was removed, the following procedure can be used for installation:

- Remove the number 1 spark plug.
- Place finger over the number 1 spark plug hole and crank the engine slowly until compression is felt.
- Align the timing mark on the pulley to "0" on the engine timing indicator.

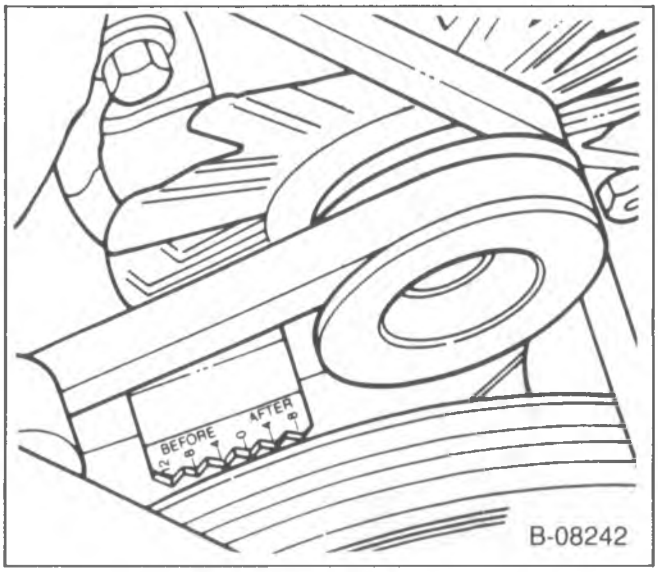


Figure 51—Typical Timing Mark

  - Turn the rotor to point between number 1 and number 8 spark plug towers on the distributor cap.
1. Distributor.
   - If the distributor shaft won't drop into the engine, first insert a screwdriver into the hole for the distributor and turn the oil pump drive shaft.
2. Distributor hold-down clamp and clamp bolt.
3. Vacuum hose to the vacuum unit (if equipped).
4. Cap on the distributor.
   - The aligning tab on the cap should engage with the notch in the housing.
5. Four hold-down spring latches.
6. Ignition coil connector to the cap.
7. Engine control switch battery feed wire.
8. Tachometer lead (if so equipped).
   - Set ignition timing as described later in this section.

IGNITION TIMING

1. Refer to the Vehicle Emissions Control Information label located on the radiator support. Follow all instructions on the label.
2. With the engine control switch off, connect the pick-up lead of a timing light to the number 1 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. Disconnect the vacuum hose from the distributor if so equipped.
4. Start the engine and aim the timing light at the timing mark (figure 51). 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, slowly rotate the distributor until the line indicates the correct timing. Tighten the hold-down bolt, and re-check the timing.
5. Turn off the engine and remove the timing light. Reconnect the number 1 spark plug wire, if removed.
6. Connect the vacuum hose to the distributor if so equipped.

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.

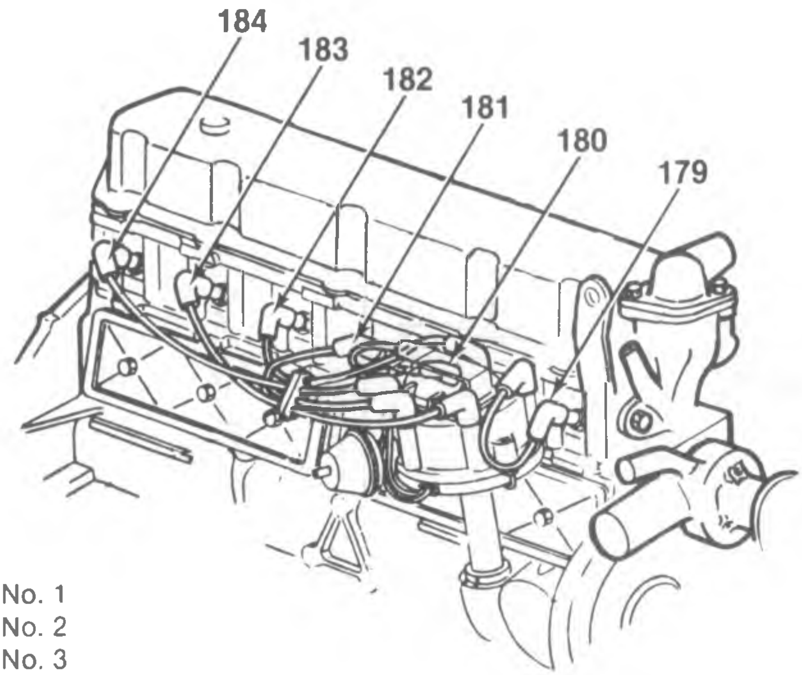
When replacing plug wires, route the wires correctly and through the proper retainers. Failure to route the wires properly can lead to radio ignition noise and crossfiring of the plugs, or shorting of the leads to ground.

SPARK PLUG WIRE REPLACEMENT

Wire routings must be kept intact during service, and followed exactly when wires have been disconnected, or when replacement of the wires is necessary. For the correct wiring routing for each engine, refer to figures 52 through 57.

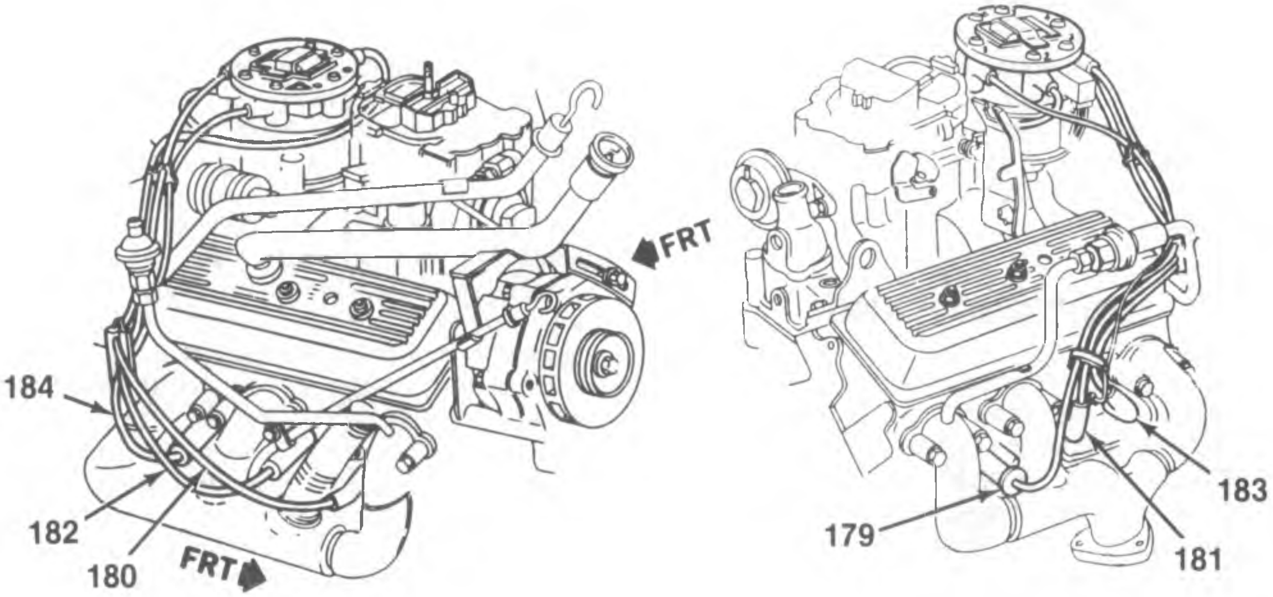
Some distributors have spark plug wire retainer harness assemblies with the engine firing order marked on them. If the firing order is not indicated, install the plug wires according to the firing order as shown in figures 58, 59 and 60. When the wiring is completed, the plug wire from cylinder number 1 should lead to the distributor tower at the front and on the same side of the engine as cylinder number 1. The plug wire from cylinder number 6 (in 6 cylinder engines) or from cylinder number 8 (in V8 engines) should lead to the distributor tower at the front of the engine next to the number 1 tower.

On the LE8 (7.4 L V8) engine, the spark plug harness assembly and a dielectric paper insulator are fitted to a shield which is installed over the spark plug (figure 61). The insulator grounds the shield to the engine block. If the assembly is removed from the shield, make sure that the insulator is present and undamaged before reinstallation.



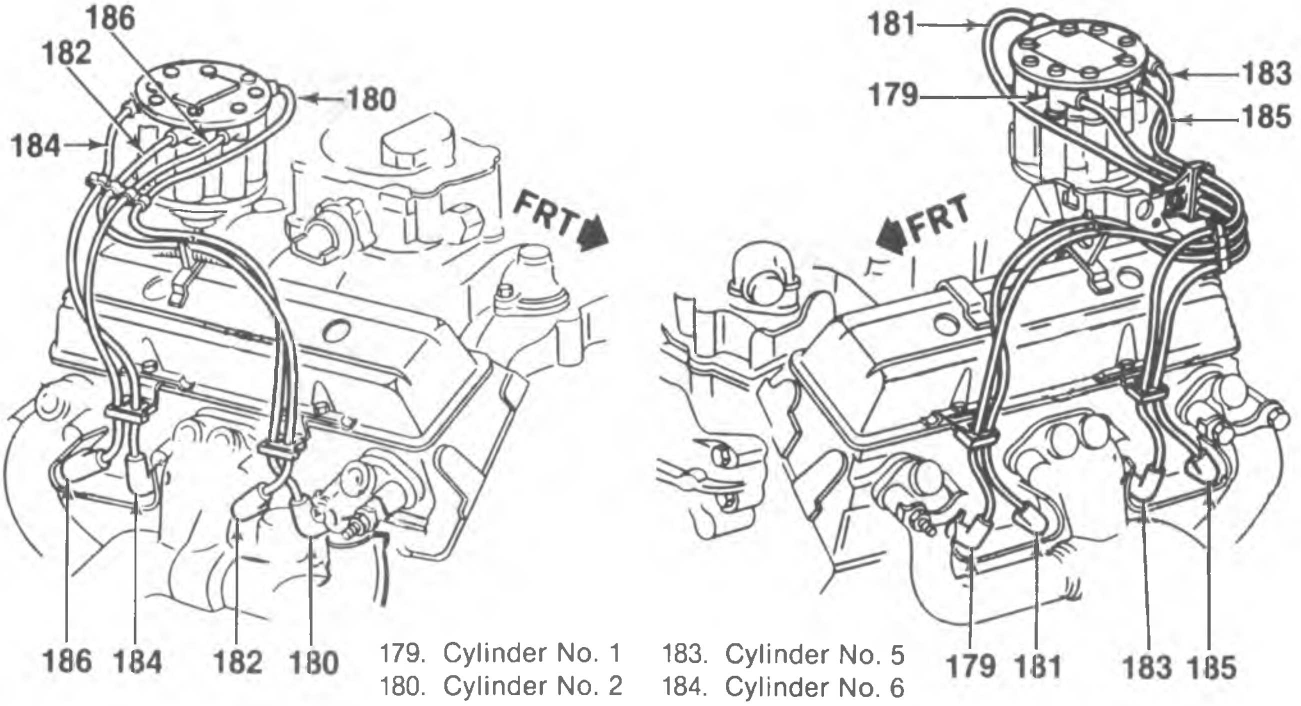
179. Cylinder No. 1
180. Cylinder No. 2
181. Cylinder No. 3
182. Cylinder No. 4
183. Cylinder No. 5
184. Cylinder No. 6

Figure 52—Spark Plug Wire Routing For Engine L25



179. Cylinder No. 1
180. Cylinder No. 2
181. Cylinder No. 3
182. Cylinder No. 4
183. Cylinder No. 5
184. Cylinder No. 6

Figure 53—Spark Plug Wire Routing For Engine LB1



179. Cylinder No. 1
180. Cylinder No. 2
181. Cylinder No. 3
182. Cylinder No. 4
183. Cylinder No. 5
184. Cylinder No. 6
185. Cylinder No. 7
186. Cylinder No. 8

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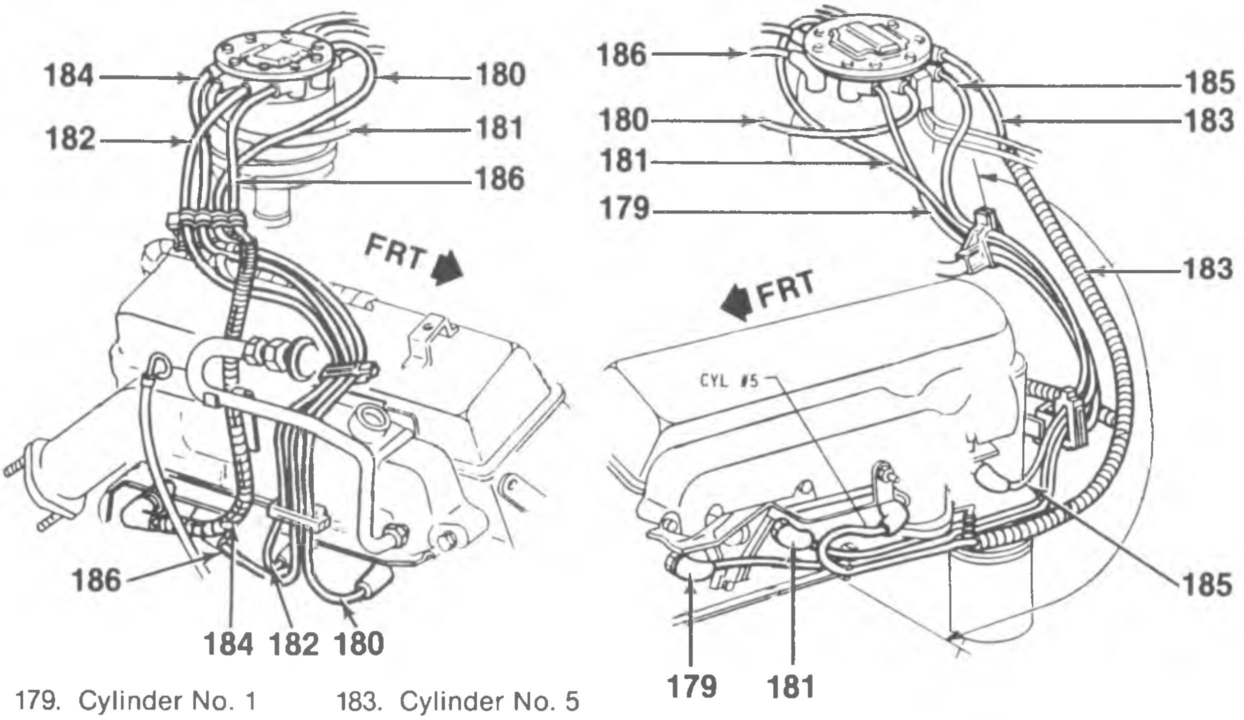
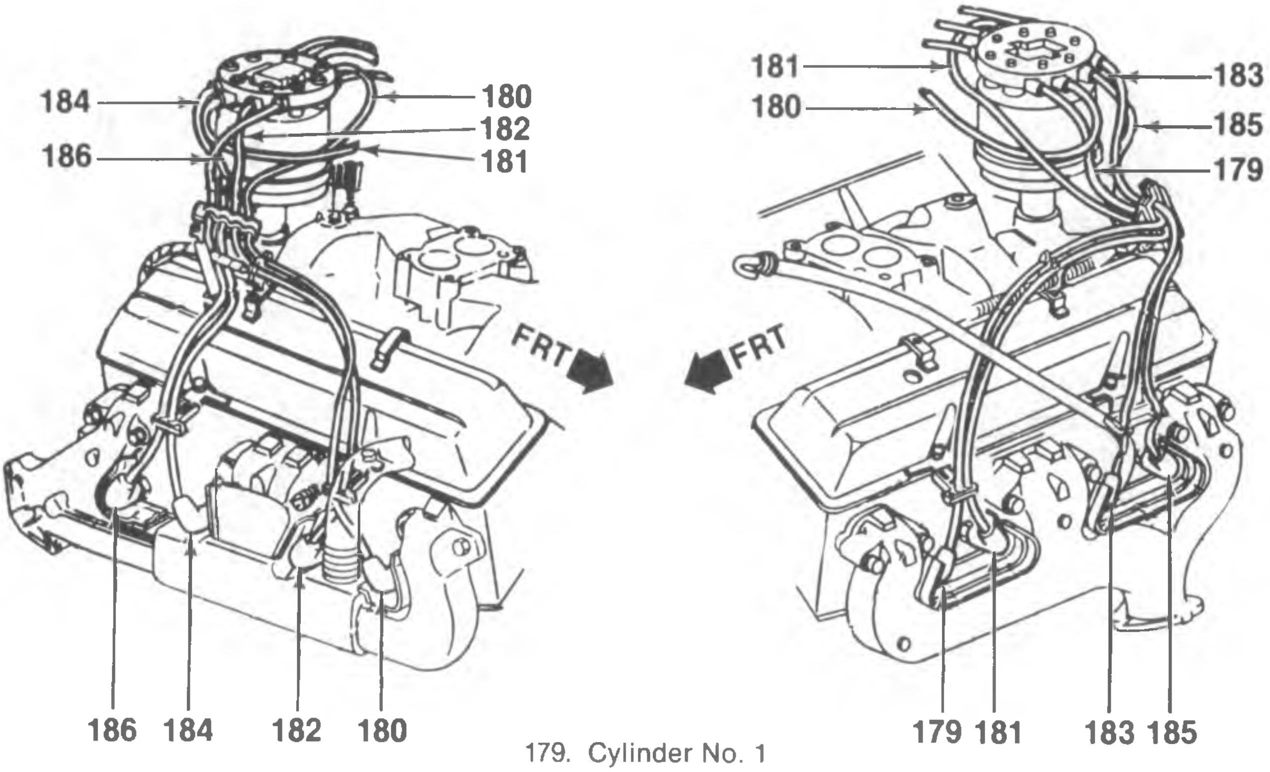
Figure 54—Spark Plug Wire Routing For Engine LT9



179. Cylinder No. 1
180. Cylinder No. 2
181. Cylinder No. 3
182. Cylinder No. 4
183. Cylinder No. 5
184. Cylinder No. 6
185. Cylinder No. 7
186. Cylinder No. 8

F-00258

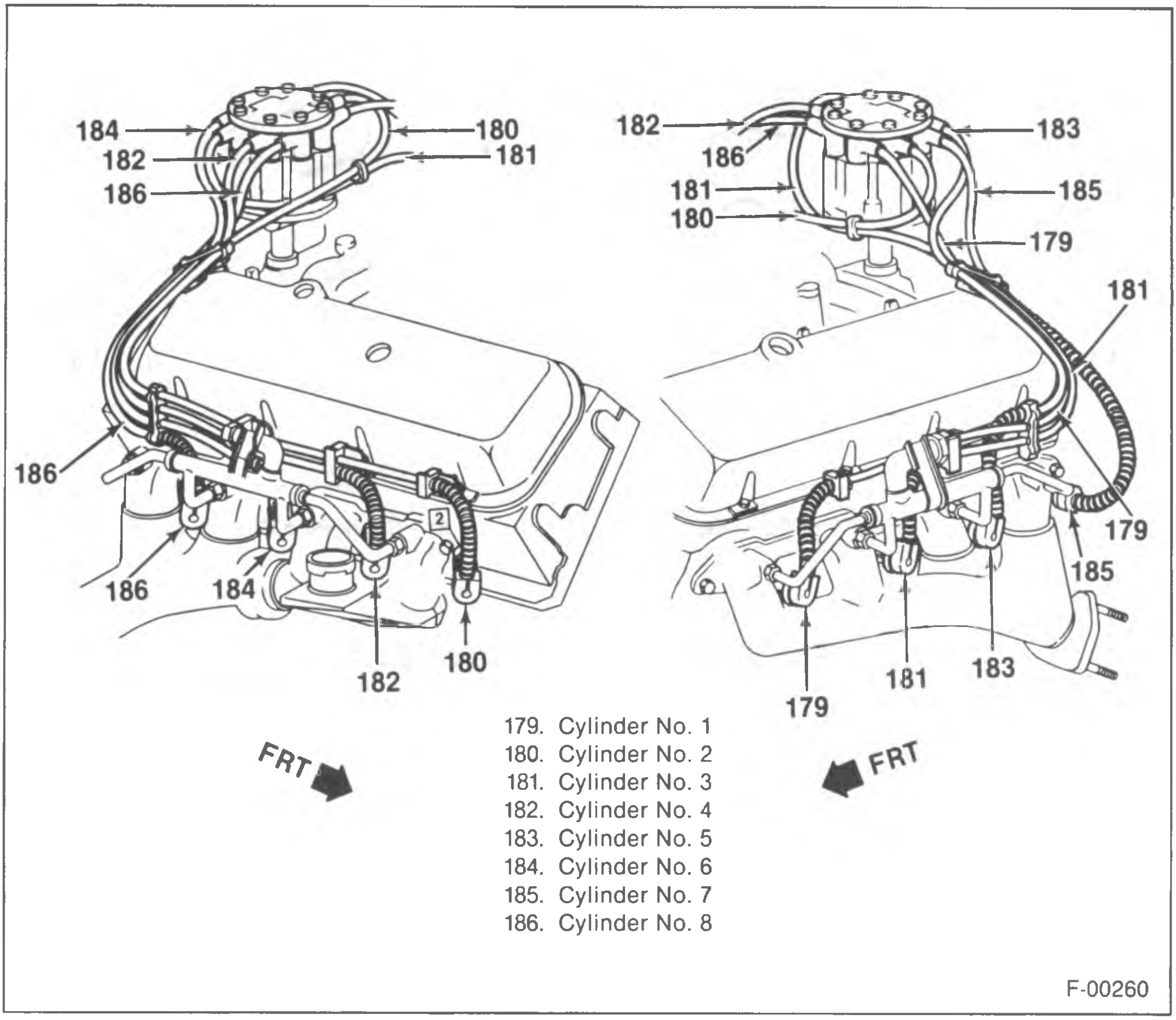
Figure 55—Spark Plug Wire Routing For Engines LE9, LF3, LS9 and LT9, CK



179. Cylinder No. 1
180. Cylinder No. 2
181. Cylinder No. 3
182. Cylinder No. 4
183. Cylinder No. 5
184. Cylinder No. 6
185. Cylinder No. 7
186. Cylinder No. 8

F-00259

Figure 56—Spark Plug Wire Routing For Engines LE9, LF3, LS9 and LT9, G Van



179. Cylinder No. 1
180. Cylinder No. 2
181. Cylinder No. 3
182. Cylinder No. 4
183. Cylinder No. 5
184. Cylinder No. 6
185. Cylinder No. 7
186. Cylinder No. 8

Figure 57—Spark Plug Wire Routing For Engine LE8

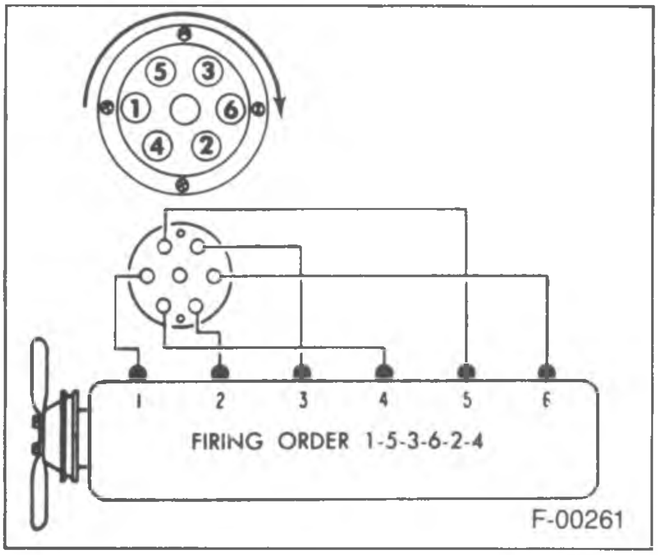


Figure 58—Spark Plug Wire Schematic (L6 Engines)

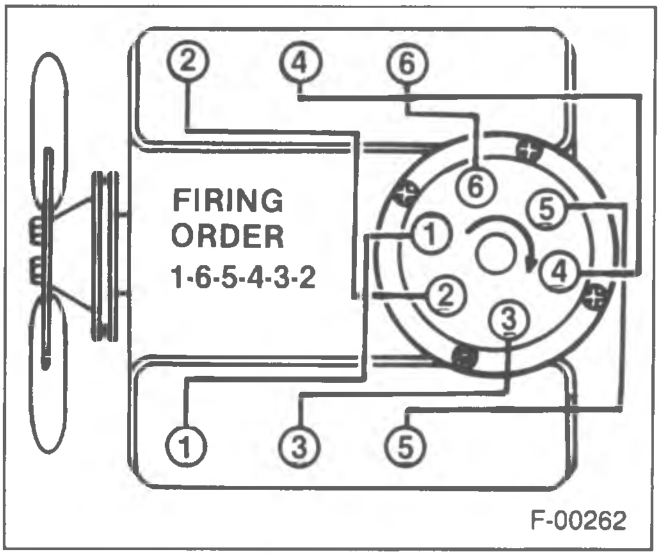


Figure 59—Spark Plug Wire Schematic (V6 Engines)

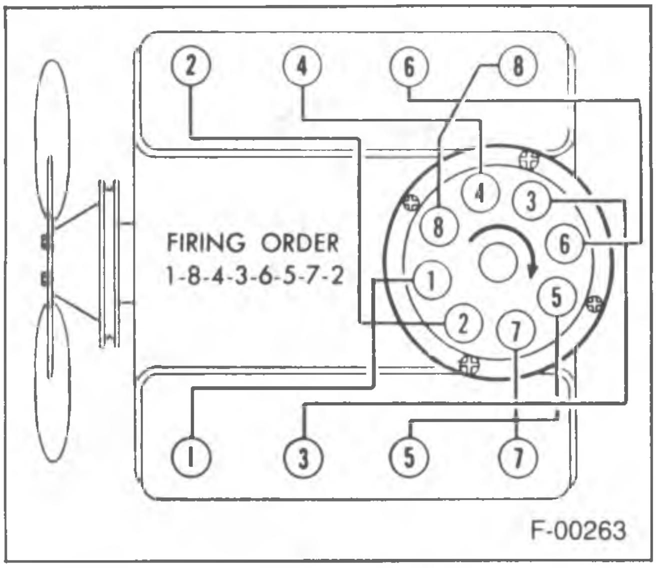
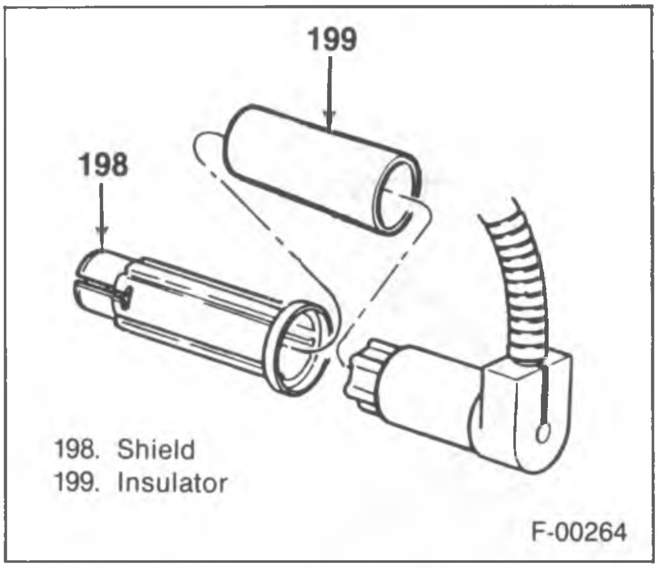


Figure 60—Spark Plug Wire Schematic (V8 Engines)

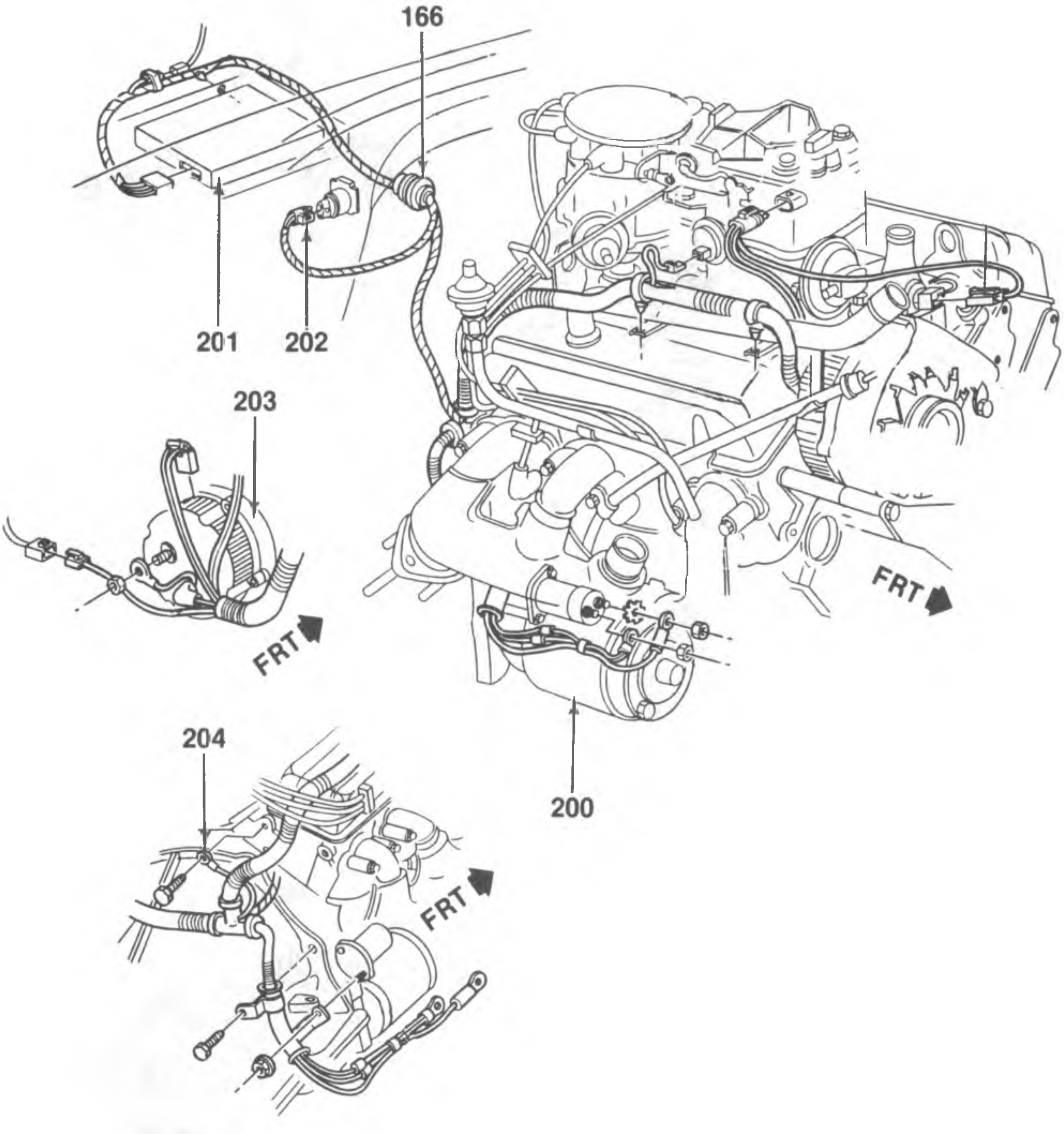


198. Shield
199. Insulator

Figure 61—Spark Plug Shield For LE8 Engine

ENGINE WIRE HARNESS

Refer to figures 62 through 71.



166.	Grommet
200.	Starter Motor
201.	ESC Module
202.	Tip In Switch
203.	Generator
204.	Engine Harness Ground

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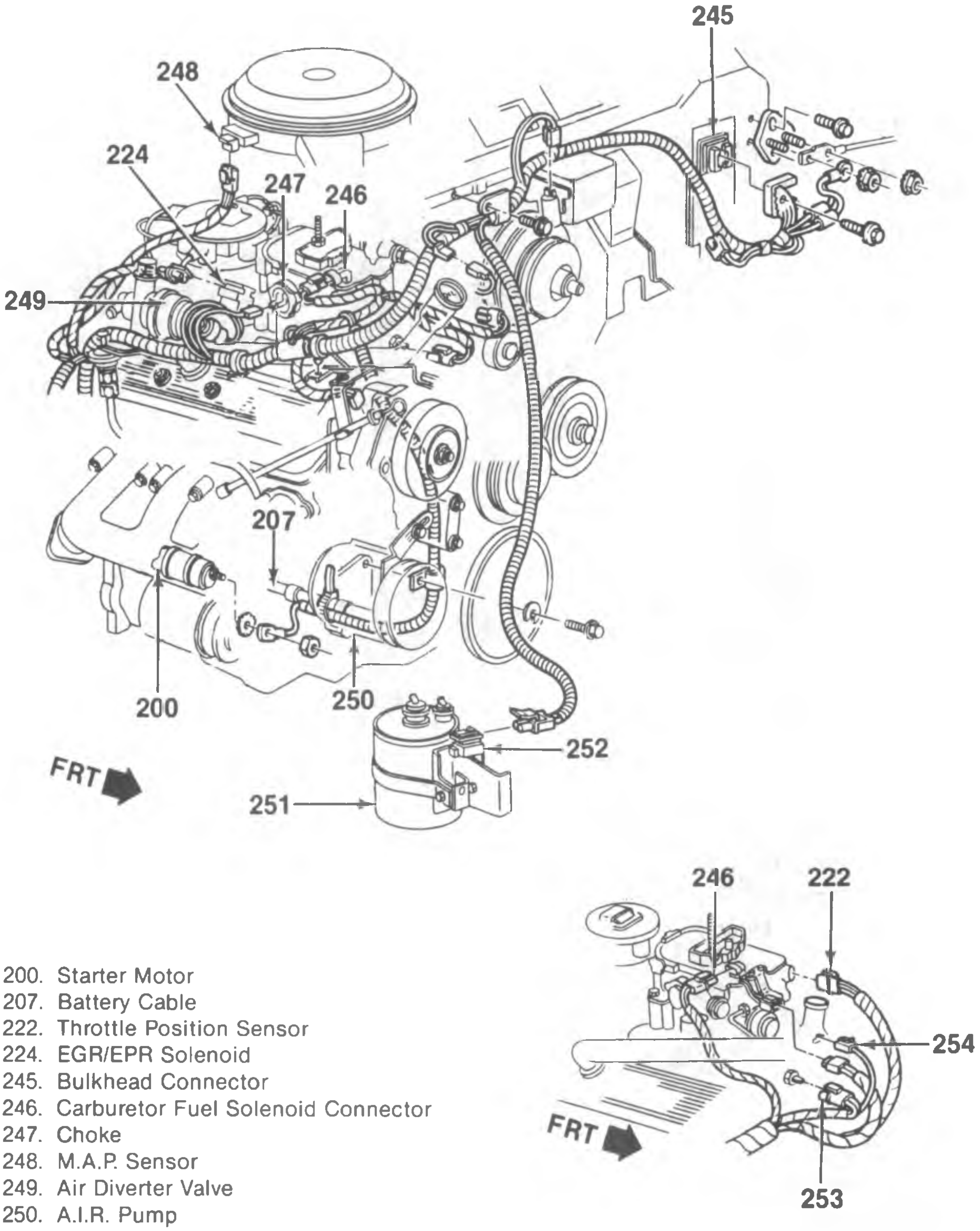
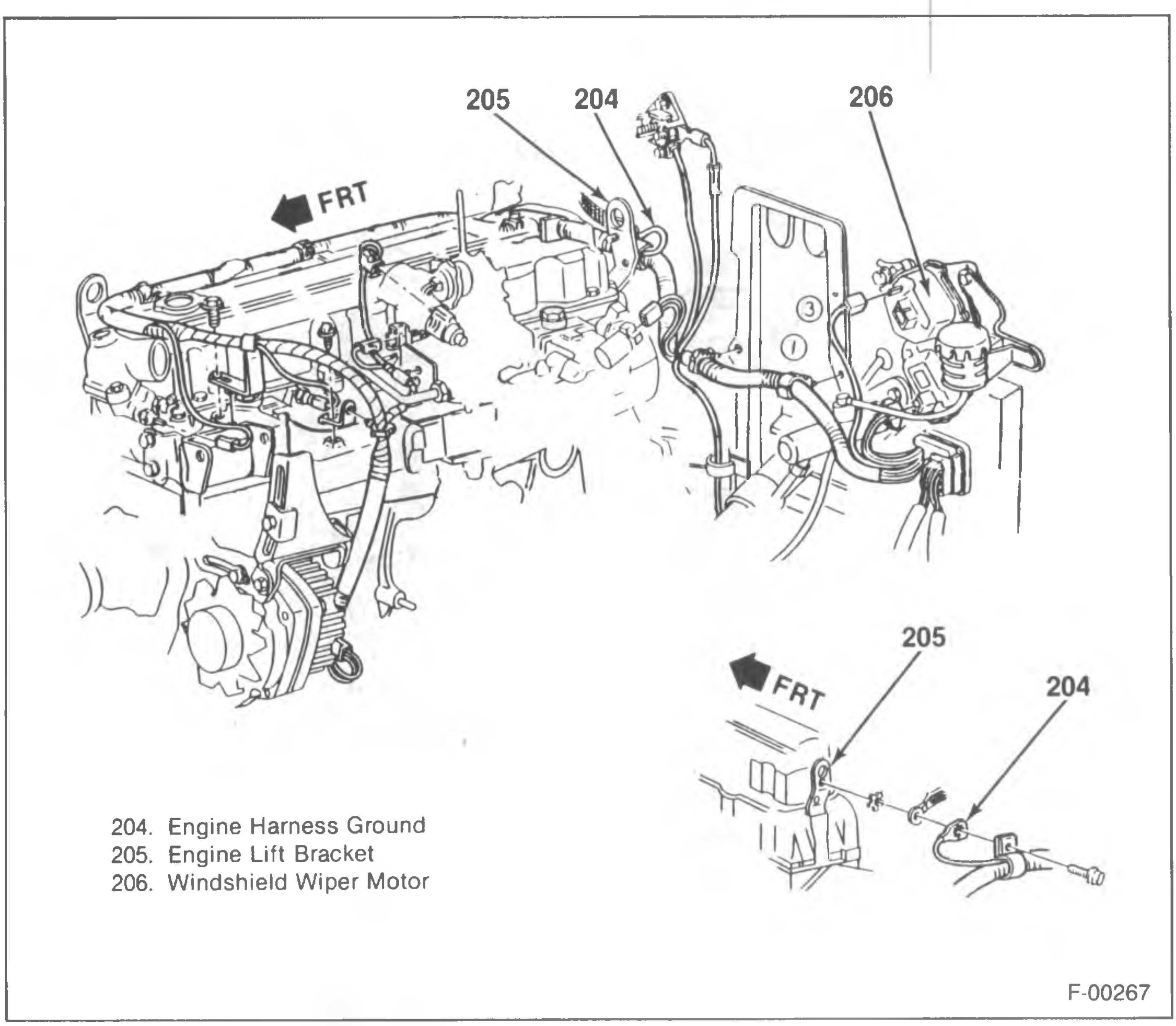
Figure 62—Engine Wiring, CK Series For LB1 (4.3 L V6)



200. Starter Motor
207. Battery Cable
222. Throttle Position Sensor
224. EGR/EPR Solenoid
245. Bulkhead Connector
246. Carburetor Fuel Solenoid Connector
247. Choke
248. M.A.P. Sensor
249. Air Diverter Valve
250. A.I.R. Pump
251. Fuel Vapor Cannister
252. Solenoid Cannister Purge
253. Coolant Temperature Sensor Connector
254. Accelerator Pump Temperature Switch Connector

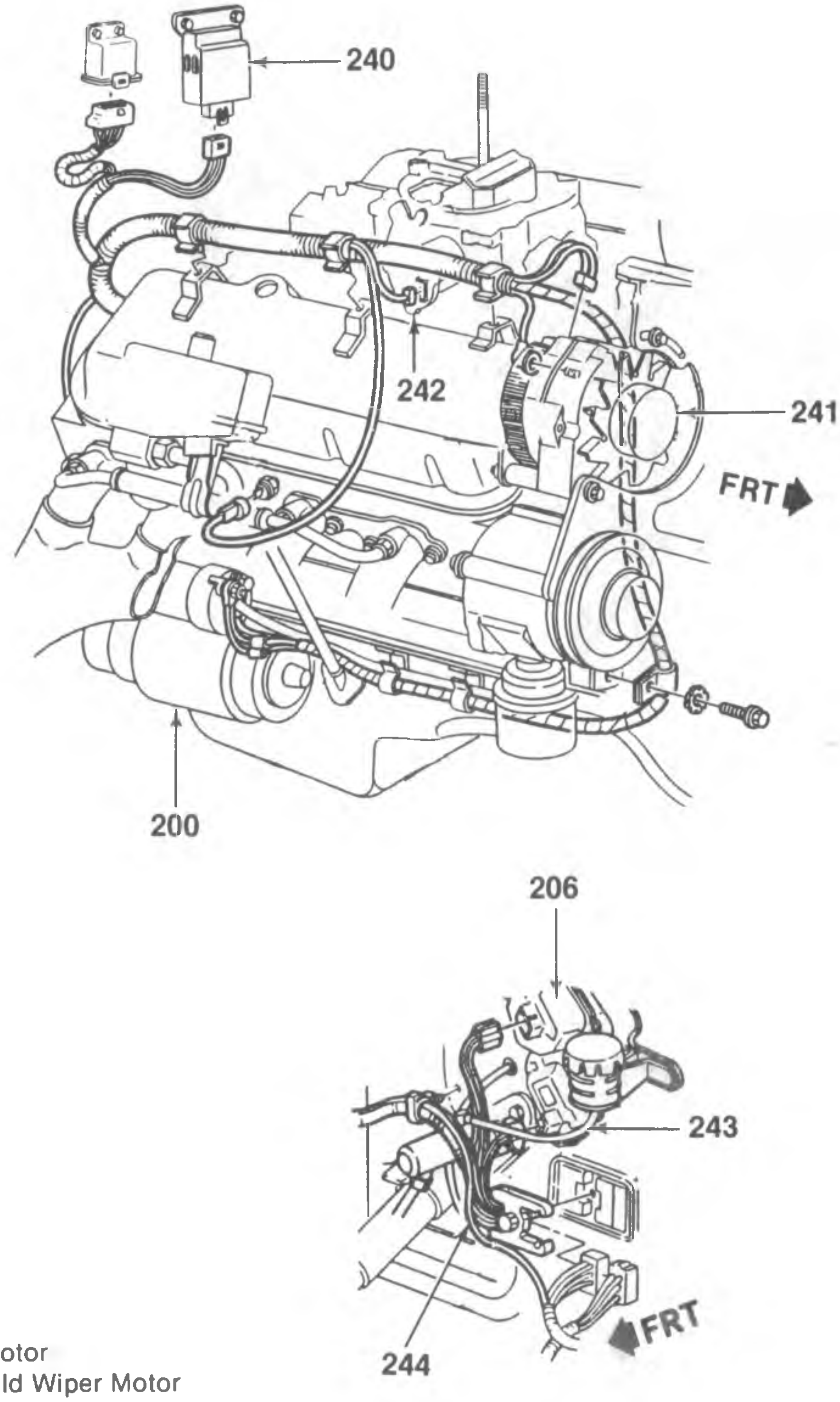
F-00266

Figure 63—Engine Wiring, G Series, For ECM-Equipped LB1 (4.3 L V6)



204. Engine Harness Ground
205. Engine Lift Bracket
206. Windshield Wiper Motor

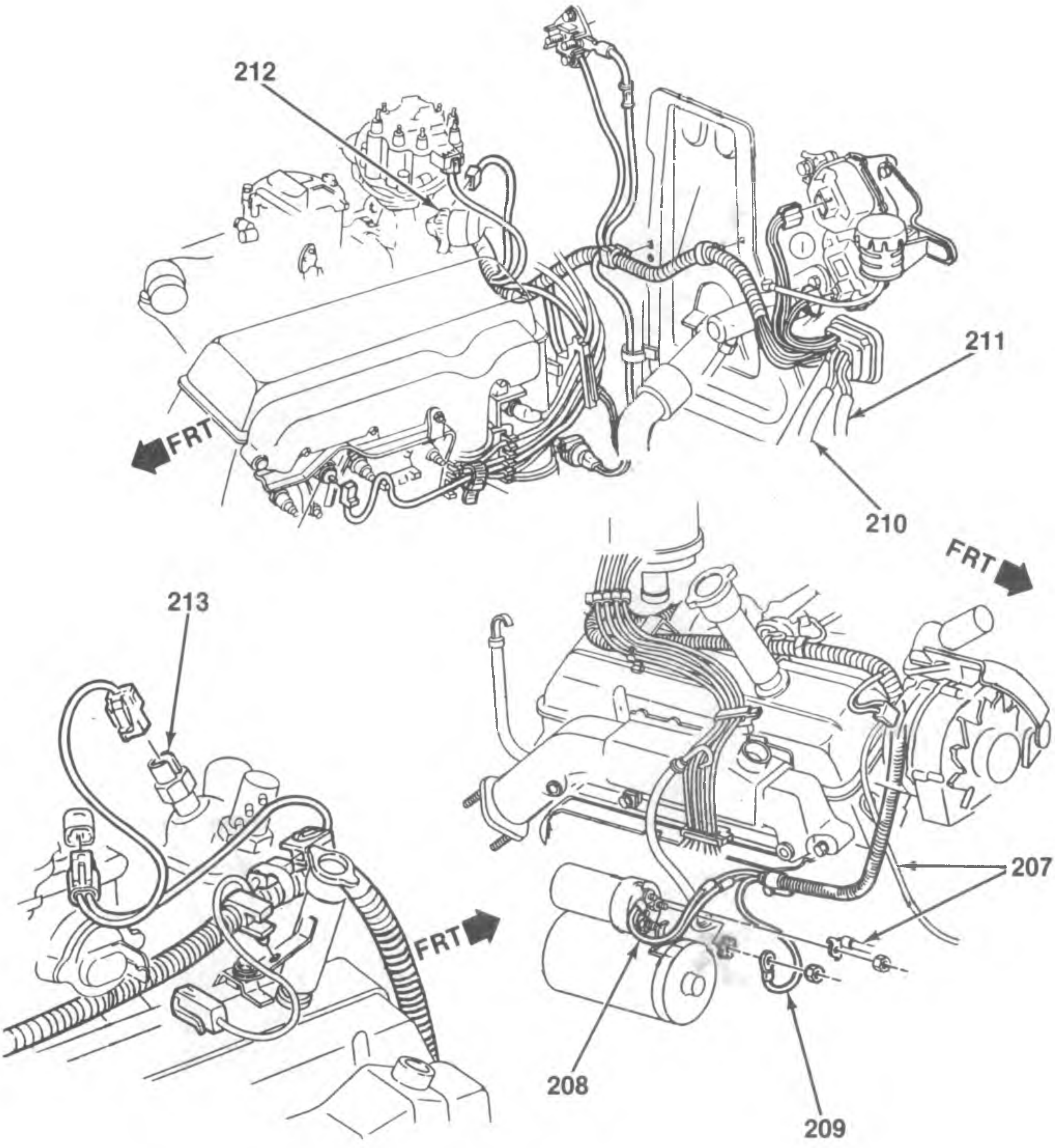
Figure 64—Engine Wiring, CK Series, For L25 (4.8 L L6)



200. Starter Motor
206. Windshield Wiper Motor
240. Air Divert Module
241. Generator
242. Electric Choke
243. Hydraulic Clutch Reservoir Hose
244. Speedometer Cable

F-00268

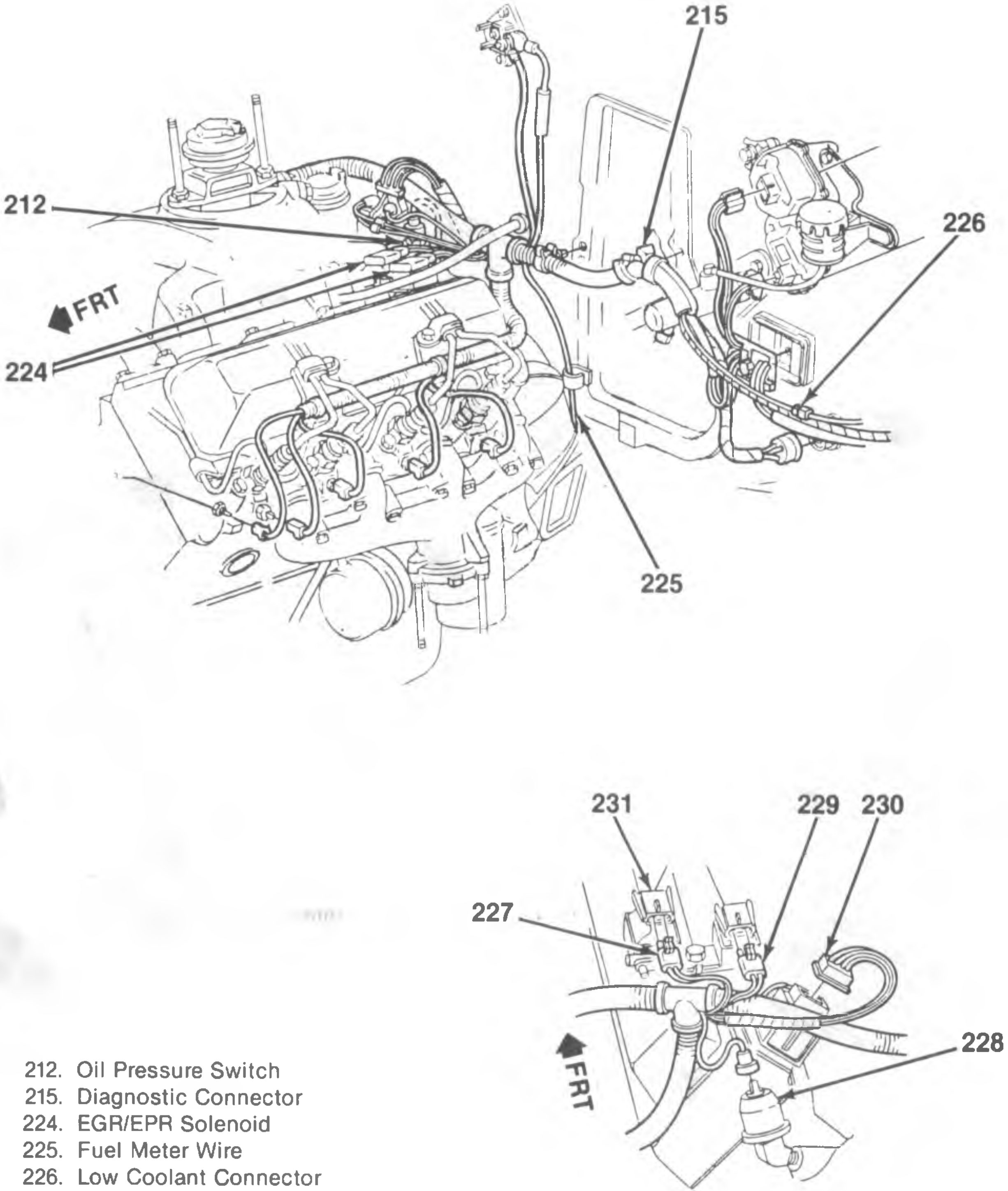
Figure 65—Engine Wiring, CK Series, For LE8 (7.4 L V8)



207. Battery Cable
208. Red
209. Purple
210. Headlamps
211. Taillamps
212. Oil Pressure Switch
213. Fuel Solenoid Temperature Switch

F-00269

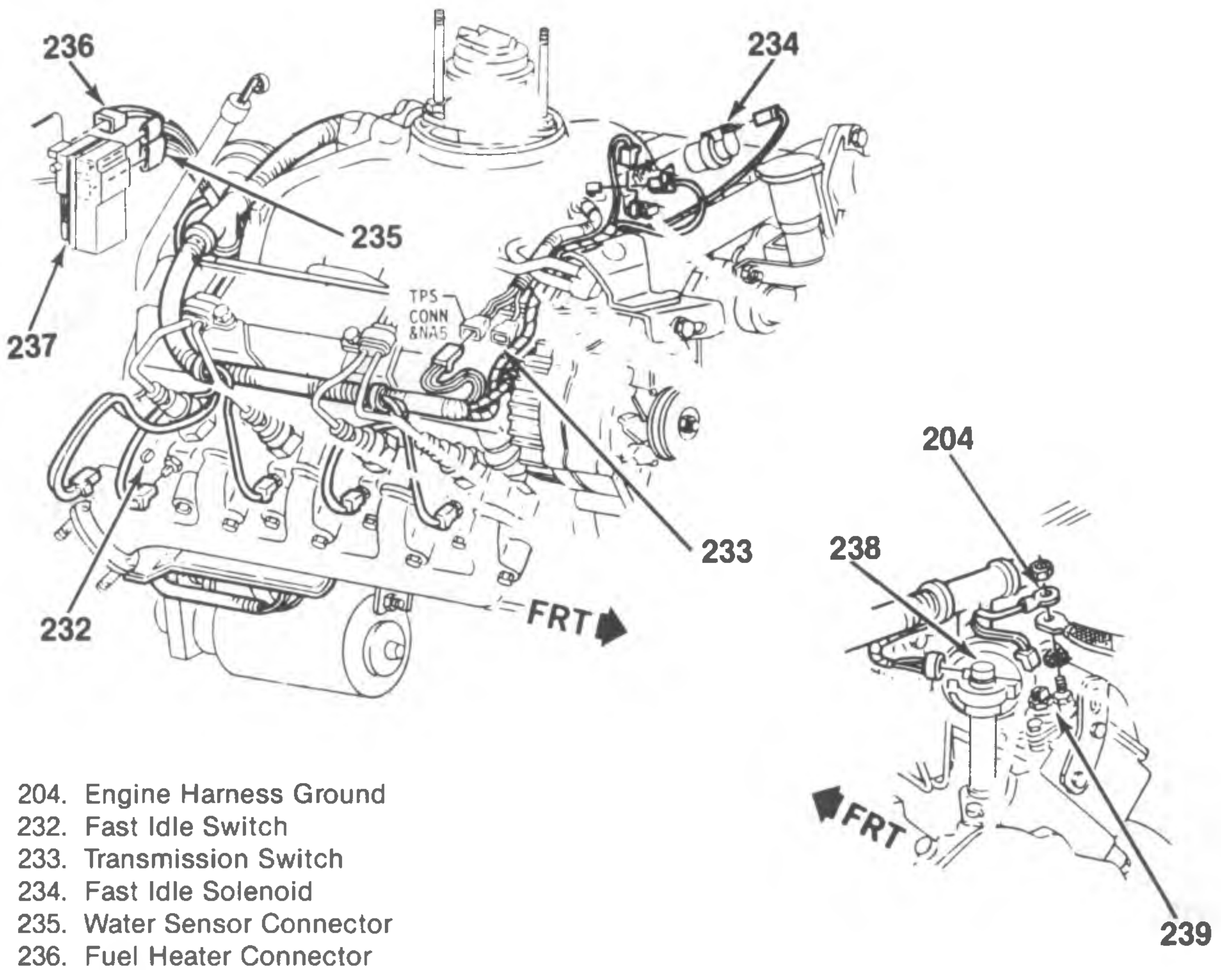
Figure 66—Engine Wiring, CK Series, for LE9 (5.0 L V8), LF3 (5.0 V8) and LS9 (5.7 L V8)



212. Oil Pressure Switch
215. Diagnostic Connector
224. EGR/EPR Solenoid
225. Fuel Meter Wire
226. Low Coolant Connector
227. EGR Solenoid Connector
229. EPR Solenoid Connector
230. Glow Plug Controller Connector
231. EPR/EGR Solenoid

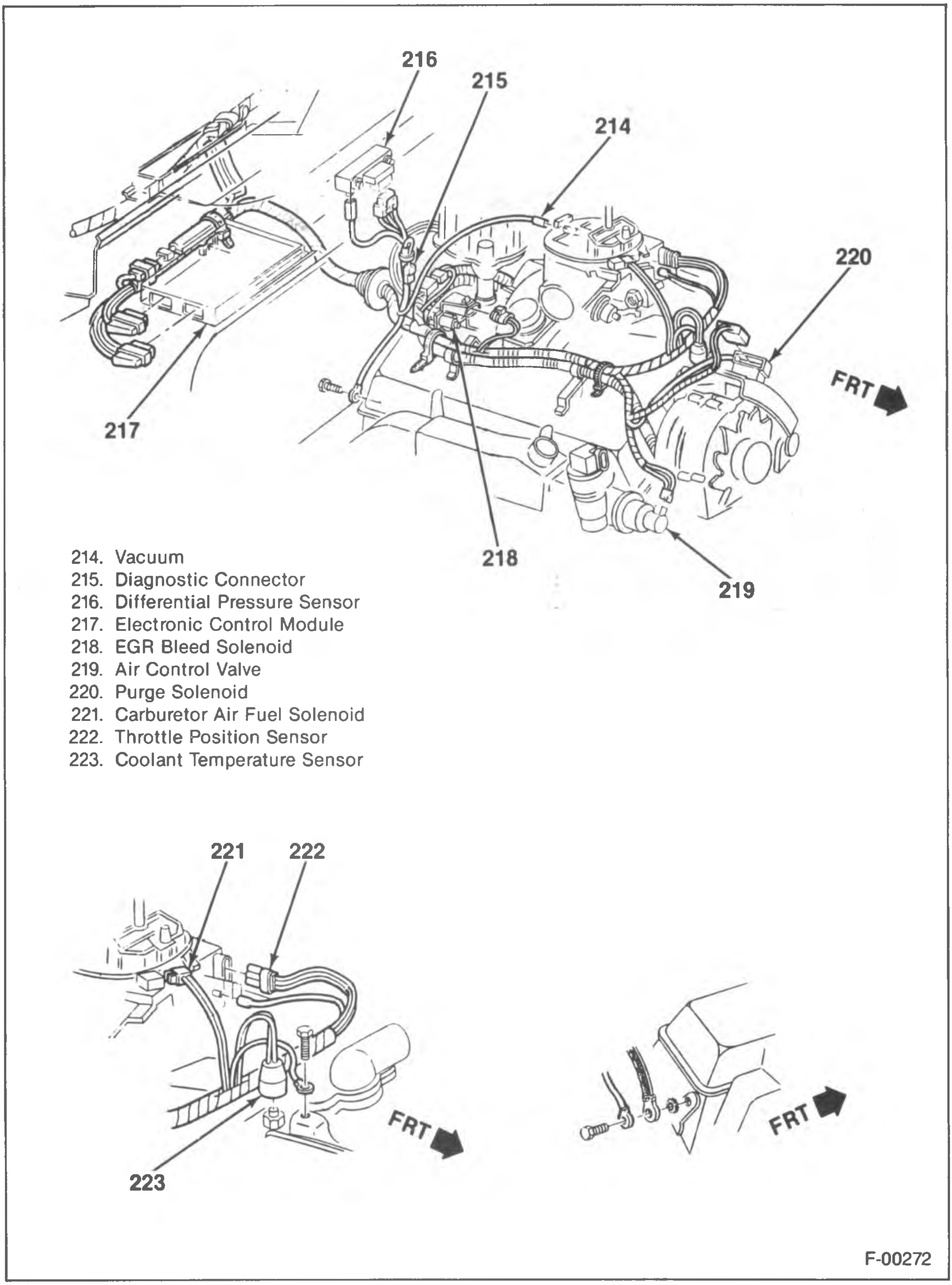
F-00270

Figure 67—Engine Wiring, CK Series For LH6, LL4 Engines (6.2 L Diesel)



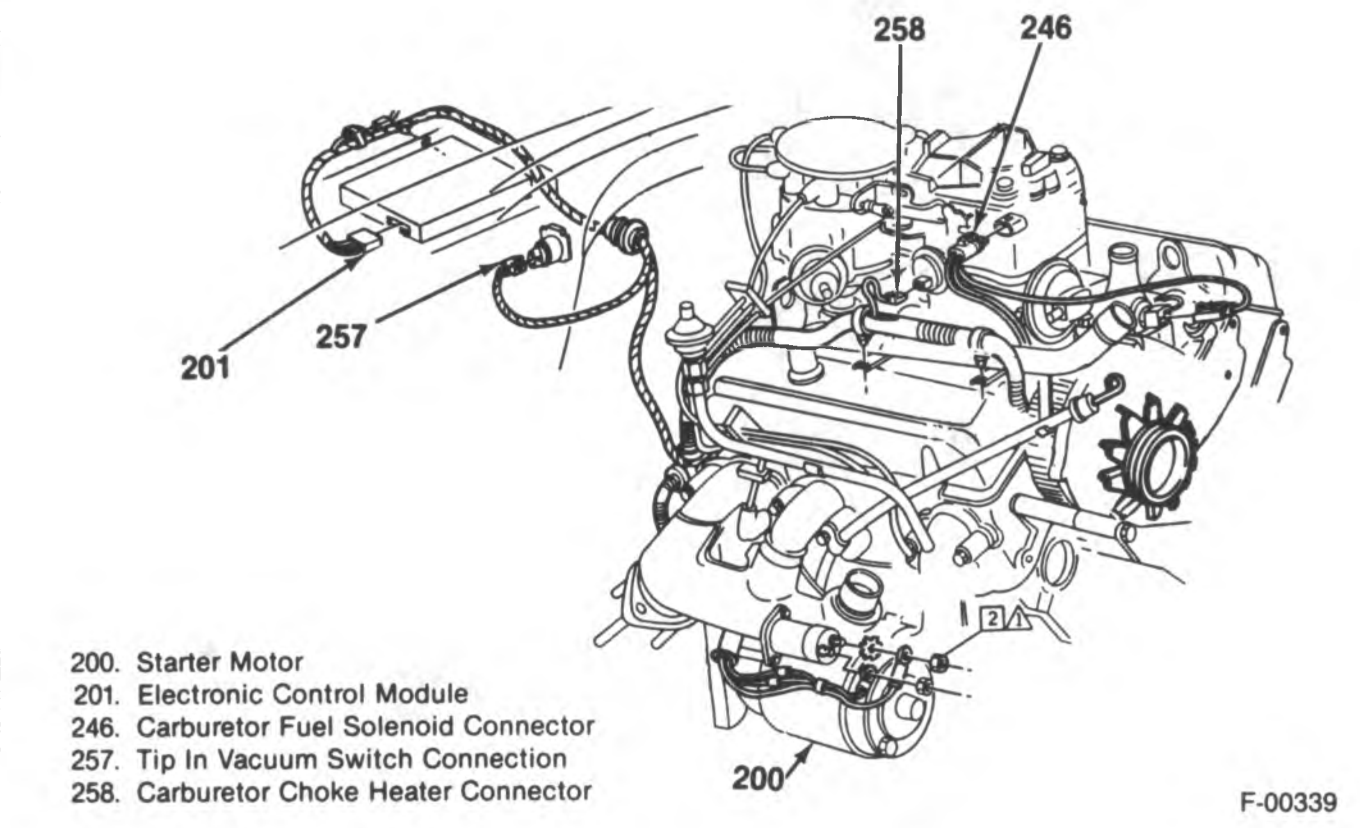
204. Engine Harness Ground
232. Fast Idle Switch
233. Transmission Switch
234. Fast Idle Solenoid
235. Water Sensor Connector
236. Fuel Heater Connector
237. Fuel Filter
238. Speed Sensor
239. Engine Temperature Switch

Figure 68—Engine Wiring, CK Series For LH6, LL4 Engines (6.2 L Diesel)



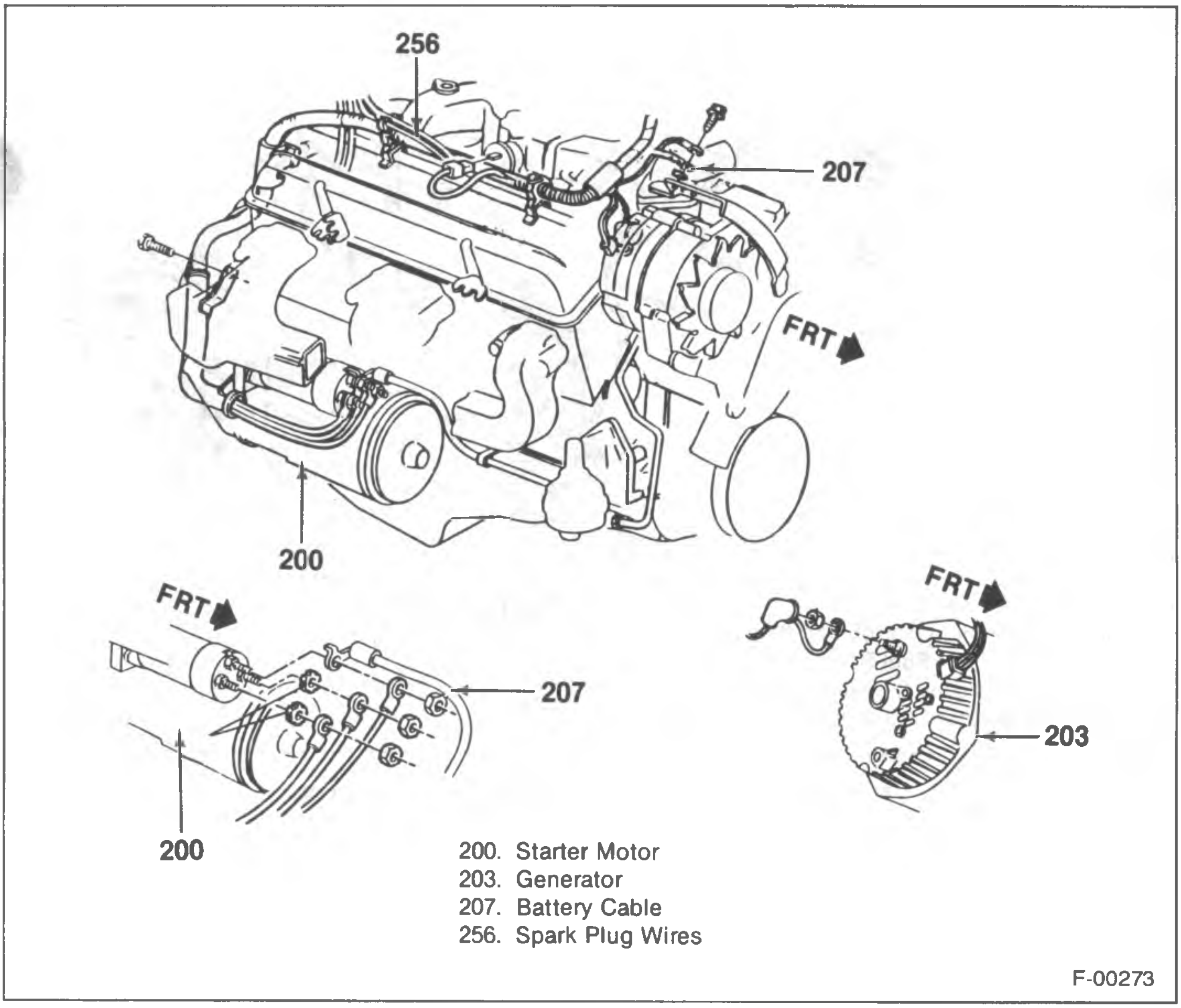
214. Vacuum
215. Diagnostic Connector
216. Differential Pressure Sensor
217. Electronic Control Module
218. EGR Bleed Solenoid
219. Air Control Valve
220. Purge Solenoid
221. Carburetor Air Fuel Solenoid
222. Throttle Position Sensor
223. Coolant Temperature Sensor

Figure 69—Engine Wiring, CK Series For ECM-Equipped LF3 (5.0 L V8) and LS9 (5.7 L V8)



200. Starter Motor
201. Electronic Control Module
246. Carburetor Fuel Solenoid Connector
257. Tip In Vacuum Switch Connection
258. Carburetor Choke Heater Connector

Figure 70—Engine Wiring, CK Series, For LB1 (4.3L V6)



200. Starter Motor
203. Generator
207. Battery Cable
256. Spark Plug Wires

Figure 71—Engine Wiring, P Series, For LT9 (5.7L V8)

SPECIFICATIONS

BATTERY SPECIFICATIONS

Part No.	Application	Description	Volts	Cold Cranking Amperes Rating @ −18 C (0° F)	Reserve Capacity (Minutes at 25 Amps)	Load Test (Amperes)
1981103	CK	Delco 103	12	405	75	200
1981104	CK, G	Delco 104	12	500	90	250
1981105	CK, G, P	Delco 105	12	540	115	250
1981610	G, P	Delco 610	12	430	90	210

GENERATOR APPLICATIONS

			Mounting Torque			
			Top Bracket Bolt		Bottom Bracket Bolt	
Engine	Generator	Part Number	N·m	Ft. Lbs.	N·m	Ft. Lbs.
CK						
LB1 4.3 L (262 cu. in.)	K81	1105706	25	18	47	35
	K85	1105703	25	18	47	35
LE9 5.0 L (305 cu. in.)	K64	1105708	25	18	47	35
	K81	1105707	25	18	47	35
	K85	1105704	25	18	47	35
LF3 5.0 L (305 cu. in.)	K81	1105707	25	18	47	35
	K85	1105704	25	18	47	35
LT9 5.7 L (350 cu. in.)	K64	1101155	25	18	47	35
	K64	1105708	25	18	47	35
	K81	1101156	25	18	47	35
	K81	1105707	25	18	47	35
	K85	1101155	25	18	47	35
	K85	1105704	25	18	47	35
L25 4.8 L (292 cu. in.)	K81	1100207	25	18	23	17
	K81	1100242	25	18	23	17
	K85	1100203	25	18	23	17
	K85	1100225	25	18	23	17
Diesel 6.2 L (379 cu. in.)	K64	1105628	27	20	43	32
	K81	1105632	27	20	43	32
LE8 7.4 L (454 cu. in.)	K22	1105629	25	18	50	37
	K85	1105691	25	18	50	37
LS9 5.7 L (350 cu. in.)	K64	1105708	25	18	47	35
	K81	1105707	25	18	47	35
	K85	1100704	25	18	47	35
G Van						
LB1 4.3 L (263 cu. in.)	K81	1105706	25	18	47	35
	K85	1105703	25	18	47	35
LE9 5.0 L (305 cu. in.)	K81	1105707	25	18	47	35
	K85	1105704	25	18	47	35
LF3 5.0 L (305 cu. in.)	K85	1105704	25	18	47	35
LS9 5.7 L (305 cu. in.)	K81	1105707	25	18	47	35
	K85	1105704	25	18	47	35
LT9 5.7 L (350 cu. in.)	K81	1105707				
	K85	1105704	25	18	47	35
Diesel 6.2 L (379 cu. in.)	K81	1105632	27	20	43	32
P Truck						
L25 4.8 L (292 cu. in.)	K79	1100229	25	18	24	17
	K81	1100207	25	18	24	17
	K97	1101064	33	44	33	44

GENERATOR APPLICATIONS (CONT.)

Engine	Generator	Part Number	Mounting Torque			
			Top Bracket Bolt		Bottom Bracket Bolt	
			N·m	Ft. Lbs.	N·m	Ft. Lbs.
P Truck (Cont.)						
LT9 5.7 L (350 cu. in.)	K79	1101159	25	18	47	35
	K81	1105707	25	18	47	35
	K81	1101156	25	18	47	35
	K97	1105709	26	19	47	35
LE8 7.4 L (454 cu. in.)	K81	1105692	25	18	47	35
	K97	1105693	64	47	50	37
LL4 6.2 L (379 cu. in.)	K81	1105632	27	20	43	32
	K09	1101215	27	20	43	32

GENERATOR SPECIFICATIONS

Part No.	Series (Type 100)	Rotation Viewing Dr. End	Field Current @ 12 Volts (27° C, 80° F) AMPS	Cold Ouput			Hot Output
				AMPS @ 2000 RPM	AMPS	RPM	AMPS
1100203	10SI	CW	4.0 - 5.0	22	33	5000	37
1100207	12SI	CW	4.5 - 5.0	38	70	7000	66
1100225	10SI	CW	4.0 - 5.0	22	33	5000	37
1100229	10SI	CW	4.0 - 5.0	25	38	5000	42
1100242	12SI	CW	4.5 - 5.0	38	70	7000	66
1101064	27SI	CW	4.4 - 4.9	55	76	5000	80
1101155	10SI	CW	4.0 - 5.0	22	33	5000	37
1101156	12SI	CW	4.5 - 5.0	38	70	7000	66
1101157	12SI	CW	4.5 - 5.0	51	81	7000	78
1101159	10SI	CW	4.0 - 5.0	25	38	5000	42
1105628	12SI	CW	4.5 - 5.0	51	81	7000	78
1105629	12SI	CW	4.5 - 5.0	56	103	7000	94
1105632	12SI	CW	4.5 - 5.0	38	70	7000	66
1105691	10SI	CW	4.0 - 5.0	22	33	5000	37
1105692	12SI	CW	4.5 - 5.0	38	70	7000	66
1105693	27SI	CW	4.4 - 4.9	55	76	5000	80
1105703	10SI	CW	4.0 - 5.0	22	33	5000	37
1105704	10SI	CW	4.0 - 5.0	22	33	5000	37
1105706	12SI	CW	4.5 - 5.0	38	70	7000	66
1105707	12SI	CW	4.5 - 5.0	38	70	7000	66
1105708	12SI	CW	4.5 - 5.0	51	81	7000	78
1105709	27SI	CW	4.4. - 4.9	55	76	5000	80

STARTER SPECIFICATIONS

					No Load Test @ 10 Volts			
Truck Model	Engine Application	Starter			AMPS		RPM	
		Part No.	Series	Type	Minimum	Maximum	Minimum	Maximum
C, G, P	LH6,LL4	1113589	27MT	136	120	210	9000	13400
K	LH6,LL4	1113590	27MT	136	120	210	9000	13400
C	L25	1998559	10MT	101	60	90	6500	10500
K	L25							
P	L25							
K	LE9, LS9,LT9, L25	1998560	10MT	101	70	110	6500	10700
C, G	LE9, LF3, LS9, LT9	1998561	10MT	101	70	110	6500	10700
K	LE9, LS9, LT9							
G	LE9, LF3							
P	LT9							
C	LB1, LE8	1998562	10MT	101	70	110	6500	11070
K	LB1, LE8							
G	LB1, L59, LT9							
P	LT9, LE8							
P	LT9	1998563	10MT	100	70	110	6500	10700
K	LB1, LE8	1998565	10MT	101	70	110	6500	10700

STARTER SHIMS

Gas Engines		Diesel Engines	
Shim	Part No.	Shim	Part No.
0.38 mm (0.015'')	1246249	1.0 mm (0.014'')	23500396
1.0 mm (0.04'')	14036090	2.0 mm (0.08'')	23500397

DISTRIBUTOR SPECIFICATIONS

The values given in these data are distributor rpm and distributor degrees of advance. The centrifugal automatic advance should be checked at each of the distributor speeds listed. NOTE: Distributor rpm and degrees of advance are one-half engine rpm and degrees of advance.

Advance curve information for the HEI/EST distributor is not given. The advance is provided by a separate electronic control device.

CENTRIFUGAL ADVANCE

		Start Distributor		Intermediate Distributor		Intermediate Distributor		Maximum Distributor		
Model No.	Ignition System	RPM	Degree	RPM	Degree	RPM	Degree	RPM	Degree	Vacuum Model
CK										
1103436	HEI	650	0-4			1200	7-9	2300	10-12	1973691
1103460	HEI/EST									
1103456	HEI/ESC	700	0-2			1000	3-5	2100	9-11	1973691
1103572	HEI	800	0-2	1200	4-6	1600	5-7	200	8-10	1973691
1103573	HEI/EST									
1103604	HEI	700	0-2			1000	3-5	2100	9-11	1973591
1103631	HEI/ESC	800	0-2	1200	4-6	1600	5-7	2000	8-10	1973644
1103641	HEI/ESC	700	0-2			1000	3-5	2100	9-11	1973644
G Van										
1103436	HEI	650	0-4			1200	7-9	2300	10-12	1973691
1103460	HEI/EST									
1103465	HEI/ESC	700	0-2			1000	3-5	2100	9-11	1973691
1103572	HEI	800	0-2	1200	4-6	1600	5-7	2000	8-10	1973626
1103573	HEI/EST									1973691
1103604	HEI	700	0-2	1000	3-5			2100	9-11	1973591
1103631	HEI/ESC	800	0-2	1200	4-6	1600	5-7	2000	8-10	1973644
1103641	HEI/ESC	700	0-2			1000	3-5	2100	9-11	1973644
P Truck										
1103376	HEI	700	0-3			1400	6-8	2100	9-11	1973682
1103384	HEI	500	0-4			800	5-8	2000	9-11	1973620
1103420	HEI	1000	0-3			800	5-8	2000	11-13	1973681
1103606	HEI	600	0-3			1850	4-6	1900	9-11	1973626
1103636	HEI	700	0-2			1000	3-5	2100	9-11	1973682

VACUUM ADVANCE SPECIFICATIONS

	Start		Maximum		Max. Dist.
Vacuum Model	Inches Hg.	-kPa	Inches Hg.	-kPa	(Deg.)
1973591	3-4	10-14	11-13	37-44	10
1973620	3-6	10-21	10-13	33-44	12
1973626	3-6	10-21	7-9	23-31	5
1973644	3-4	7-14	6-7	18-25	8
1978681	9-11	30-38	12-13	40-48	5
1973682	7-9	24-32	13-14	42-46	5
1973691	3-4	8-14	6-9	20-30	10

SPECIAL TOOLS

AC Delco ST 1201 Battery Terminal Adapters
AC ST-125 Spark Plug Tester
J 29125-A Multimeter

SECTION 6E
DRIVEABILITY AND EMISSIONS
CONTENTS

CONTENTS OF SECTION 6E

GENERAL INFORMATION

DRIVEABILITY

The driveability diagnosis procedures apply to various systems in current GM vehicles. The procedures assume that the vehicle worked right at one time and the problem is due to time, wear, dirt or other causes. Start with the introduction that follows. This will describe a systematic diagnostic procedure.

Any system disconnected during diagnosis should be reconnected. This includes wires, hoses, linkage, etc. When removing air cleaner, plug hose fittings that could cause an air leak.

Diesel Driveability

The driveability diagnosis information that applies to a vehicle with a diesel engine can be found in Section 6 of this Service Manual.

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.

Diesel Emissions

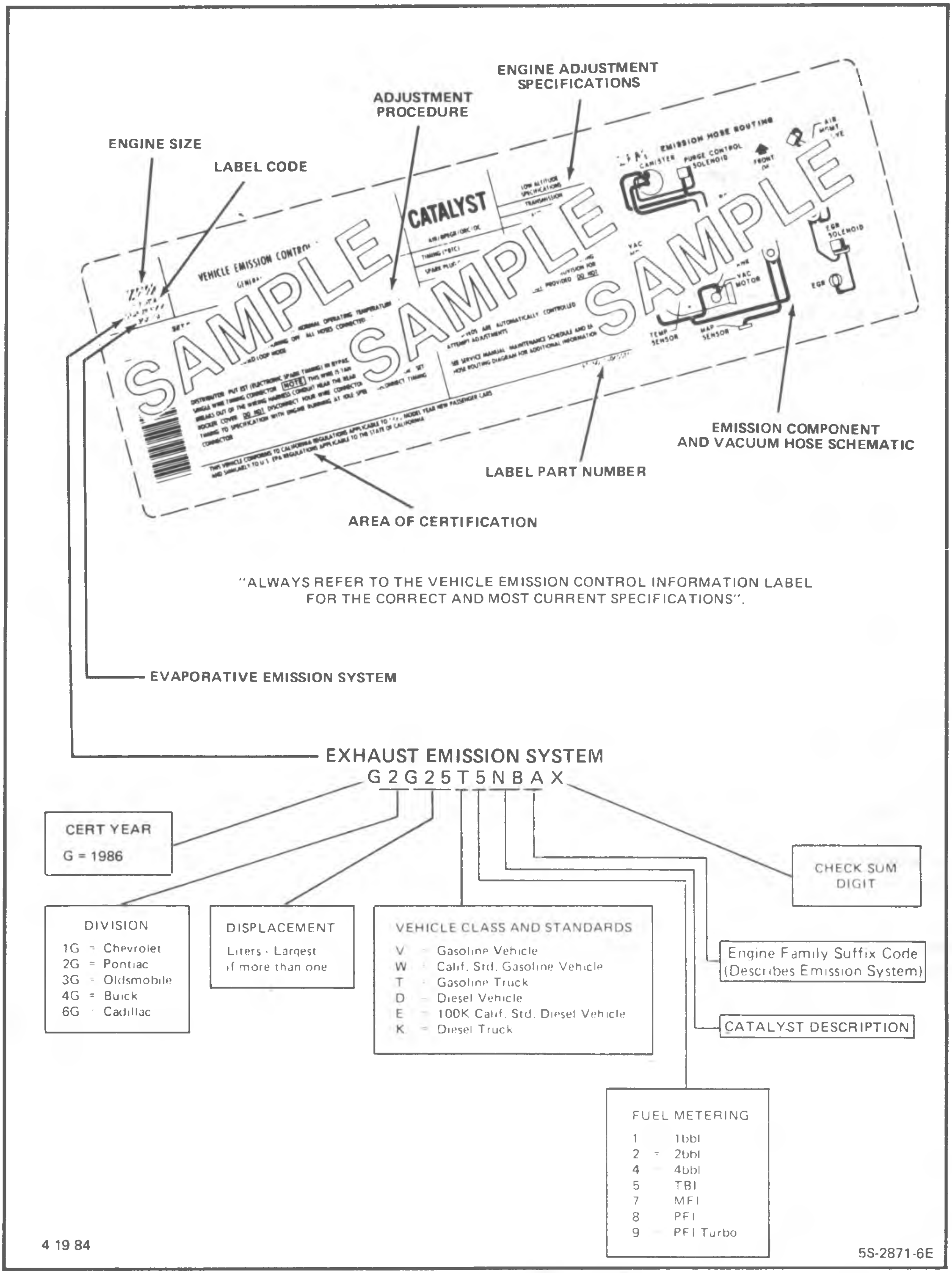
The system diagnosis and repair for emissions that apply to a diesel engine can be found in the applicable Diesel Emissions-Section 6E9.

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.

VEHICLE EMISSION CONTROL INFORMATION LABEL

The Vehicle Emission Control Information label (Fig.1) contains important emission specifications and setting procedures. In the upper left corner is exhaust emission information which identifies the year, the manufacturing division of the engine, the displacement in liters of the engine, the class of vehicle and type of fuel metering. Also there is an illustrated emission component and vacuum hose schematic. This label is located in the engine compartment of every General Motors Corporation vehicle. If the label has been removed, it can be ordered from the parts division. (WDDGM)



"ALWAYS REFER TO THE VEHICLE EMISSION CONTROL INFORMATION LABEL FOR THE CORRECT AND MOST CURRENT SPECIFICATIONS".

CERT YEAR
G = 1986

DIVISION
1G = Chevrolet
2G = Pontiac
3G = Oldsmobile
4G = Buick
6G = Cadillac

DISPLACEMENT
Liters - Largest if more than one

VEHICLE CLASS AND STANDARDS
V = Gasoline Vehicle
W = Calif. Std. Gasoline Vehicle
T = Gasoline Truck
D = Diesel Vehicle
E = 100K Calif. Std. Diesel Vehicle
K = Diesel Truck

FUEL METERING
1 = 1bbl
2 = 2bbl
4 = 4bbl
5 = TBI
7 = MFI
8 = PFI
9 = PFI Turbo

CATALYST DESCRIPTION

Engine Family Suffix Code (Describes Emission System)

CHECK SUM DIGIT

Figure 1 Vehicle Emission Control Information Label

INTRODUCTION

GENERAL

Each General Motors engine has system controls to reduce exhaust emissions while maintaining good driveability and fuel economy.

This Section explains how to use the Driveability and Emission Sections for gasoline engines. The procedure in Section A starts with checking the Computer Command Control for codes on California 4.3L, 5.0L, and 5.7L engines.

These engines have an Electronic Control Module (ECM) to control the fuel system. The ECM varies the air/fuel ratio. In addition, the ECM controls the ignition timing system as well as other systems such as exhaust gas recirculation and canister purge.

It is important to review the component sections and wiring diagrams for a specific engine to determine what is controlled by the ECM and what systems are non-ECM controlled.

This Section has a brief description of systems used to control fuel and emissions.

- Abbreviations that are used in Driveability and Emissions are listed in this Section.
- Wiring harness service information for harnesses used with the ECM is also provided in this Section.
- Special tools used to diagnosis and repair a system.

The Driveability and Emissions Sections are subdivided into three sub sections:

SECTION A - DIAGNOSTIC CHARTS

The Diagnostic Circuit Check in Section A is the starting point for the diagnostic procedure to be used on California 4.3L, 5.0L, or 5.7L engines with an Electronic Control Module (ECM). If an engine does not use an ECM, start the diagnosis with Driveability Symptoms in Section B.

The diagnostic charts are related to the ECM and will determine if the ECM is working properly. This section diagnosis the fuel system controlled by the ECM and has charts to diagnosis a circuit when the ECM has displayed a trouble code.

The way to approach a problem is to follow three basic steps (shown in Figure 2):

1. Are the On-Vehicle Diagnostics working? We find this out by performing the "Diagnostic Circuit Check". Since this is the starting point for the diagnostic procedure, always begin here.

If the On-Vehicle Diagnostics aren't working, the "Diagnostic Circuit Check" will lead you to a chart in Section A to correct the problem. If the vehicle will not start, see "Ignition System Check" in Chart C-4A or C-4E. 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, the third step is:
3. Is the Fuel System controlling correctly? We find this out in the "System Performance Check". If the fuel system is not controlling correctly, a chart in Section A will be used to correct the problem. If the fuel system goes closed loop and operates normally, go to the Driveability Symptoms in Section B. Section B lists various driveability symptoms which may be found, and suggests checks of related components, many of which are found in Section "C".

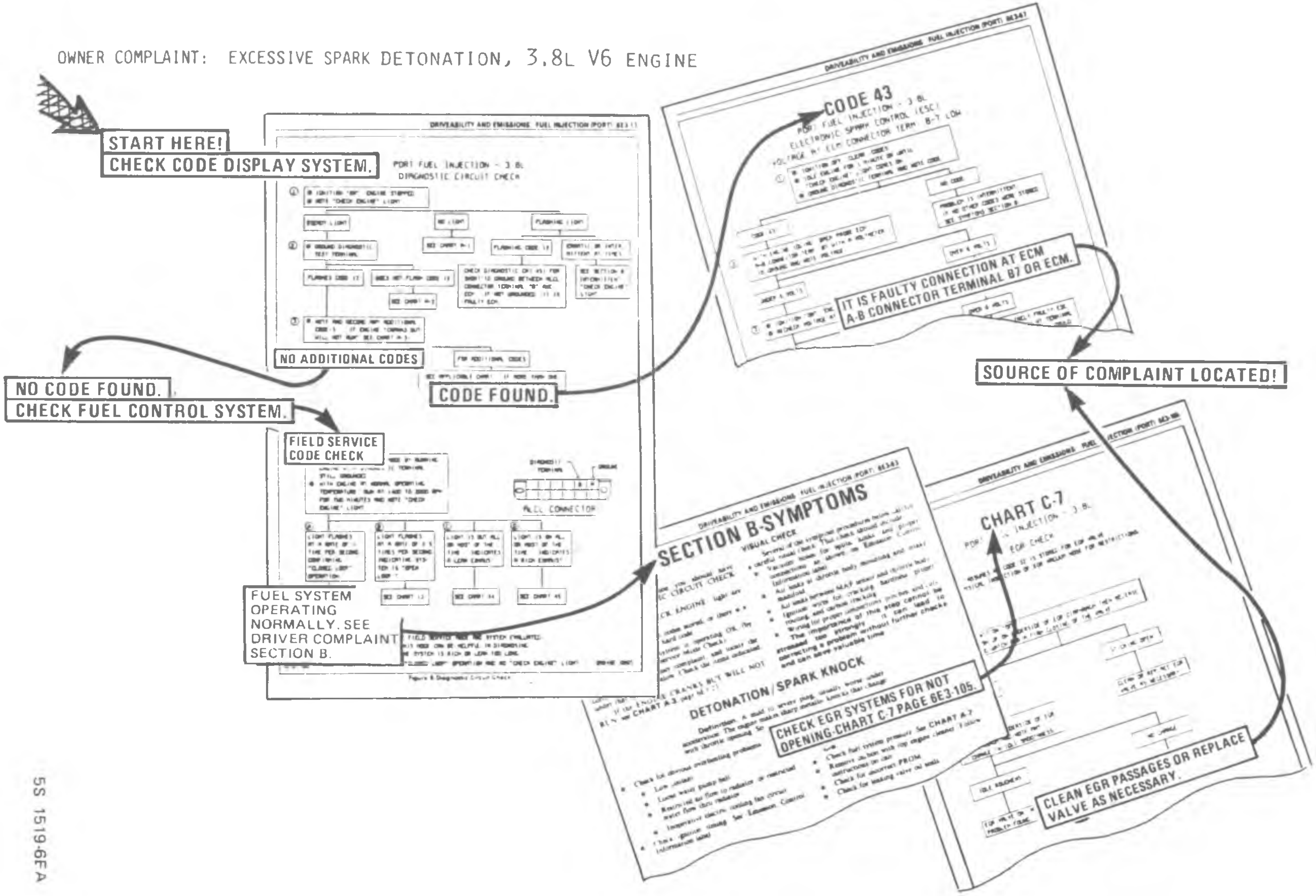
This procedure will help lead you to repair the problem in the least amount of time.

Before checking the system, observe the following information:

Blocking Drive Wheels

The vehicle drive wheels should always be blocked,and Parking Brake firmly set, while checking the system.

EASY-TO-FOLLOW TROUBLESHOOTING PATH



5S 1519-6FA

Figure 2 Diagnostic Procedure

VISUAL/PHYSICAL UNDERHOOD INSPECTION

One of the most important checks that must be done as part of any diagnostic procedure is a careful visual/physical underhood inspection. This can often lead to fixing a problem without further steps. Inspect all vacuum hoses for correct routing, pinches, cuts, or disconnects. Be sure to inspect hoses that are difficult to see beneath the air cleaner, compressor, generator, etc. Inspect all the wires in the engine compartment for correct and good connections, burned or chaffed spots, pinched wires, or contact with sharp edges or hot exhaust manifolds. This visual/physical inspection is very important. It must be done carefully and thoroughly.

BASIC KNOWLEDGE REQUIRED

Before using this section of the Service Manual, there are some areas that you should be familiar with. Without this basic knowledge, you will have trouble using the diagnostic procedures contained in this section.

Basic Electric Circuits

You should understand the basic theory of electricity, and know the meaning of voltage, amps, and ohms. You should understand what happens in a circuit with an open or a shorted wire. You should be able to read and understand a wiring diagram. A short to ground is referred to as a ground to distinguish it from a short between wires.

Use of Circuit Testing Tools

You should know how to use a test light, how to connect and use a tachometer, and how to use jumper wires to by-pass components to test circuits.

Use of Digital Volt-Ohm Meter (DVM)

You should be familiar with the Digital Volt-Ohm Meter, particularly essential tool J-29125-A, J34029A, or equivalent. You should be able to measure voltage, resistance, and current and know how to use the meter correctly.

The Digital Volt-Ohm Meter is covered in the "Special Tools" portion of this section.

DIAGNOSTIC INFORMATION

4.3L, 5.0L, or 5.7L in California

The Electronic Control Module (ECM) is equipped with a self- diagnosis system which detects system failure and aids the technician by identifying the fault via a trouble code. Below is information about the way the ECM displays a problem and how this corresponds to a trouble code in the ECM.

"CHECK ENGINE" or "SERVICE ENGINE SOON" LIGHT

Although this light may indicate either wording depending on the vehicle, it has the same function in either case. The terms are interchangeable. This light is on the instrument panel and has two functions:

- It is used to tell the driver that a problem has occured, and that the vehicle should be taken for service as soon as reasonably possible.
- It is used by the technician to read out "Trouble Codes" to help diagnosis system problems.

As a bulb and system check, the light will come "ON" with the key "ON" and the engine not running. When the engine is started, the light will turn off. If the light remains on, the self-diagnostic system has detected a problem. If the problem goes away, the light will go out in most cases after 10 seconds, but a Trouble Code will remain stored in the ECM.

INTERMITTENT "CHECK ENGINE" or "SERVICE ENGINE SOON" LIGHT

The Diagnostic Charts in Section A are set up to check whether or not a stored trouble code is "intermittent" or "hard".

An "intermittent" code is one which does not reset itself, and is not present while you are working on the vehicle. This is often caused by a loose connection. If a chart leads you to an intermittent condition, go to "INTERMITTENTS in Section B.

A "hard" code is one which is present when you are working on the vehicle and repeats itself in the Chart Procedures. The chart with the stored trouble code number will lead you to the cause of the problem.

Trouble Codes

The Electronic Control Module, (ECM), is really a computer. It uses sensors to look at many engine operating conditions. It has a memory and it knows what a certain sensor readings should be under certain conditions. These conditions are described on the facing page of each Trouble Code Chart. If a sensor reading is not what the ECM thinks it should be, the ECM will turn on the "CHECK ENGINE"/"SERVICE ENGINE SOON" light on the instrument panel, and will store a Trouble Code in the memory. The Trouble Code tells which CIRCUIT the trouble is in. A circuit consists of a sensor (such as coolant temperature), the wiring and connectors to it, and the ECM.

To get a Trouble Code out of the ECM, we use the Assembly Line Communication Link (ALCL) connector.

ALCL Connector

The Assembly Line Communication Link (ALCL) is a diagnostic connector located in the passenger compartment (Figure 3). It has terminals which are used in the assembly plant to check that the engine is operating properly before it leaves the plant. Terminal "B" is the Diagnostic terminal, and it can be connected to terminal "A", or ground, to enter the Diagnostic mode.

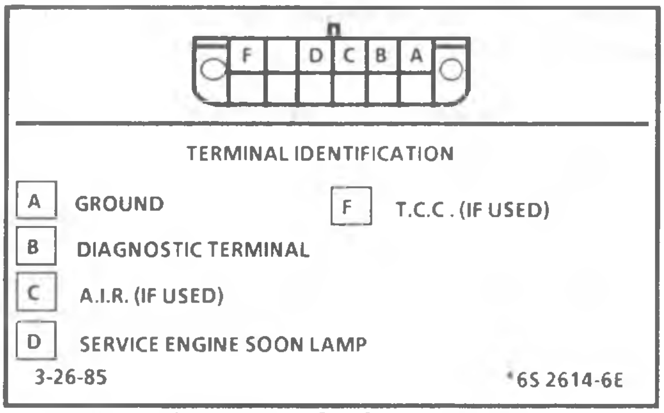


Figure 3 ALCL Connector

Diagnostic Mode

If the Diagnostic terminal is grounded with the ignition "ON" and the engine stopped, the system will enter the Diagnostic Mode. In this mode the ECM will:

1. Display a code "12" by flashing the "CHECK ENGINE"/"SERVICE ENGINE SOON" light (indicating the system is operating). A code "12" consists of one flash, followed by a short pause, then two flashes in quick succession. This code will be flashed three times. If no other codes are stored, code 12 will continue to flash until the Diagnostic terminal is ungrounded:

   The engine should not be started with the Diagnostic terminal grounded, because it may continue to flash a Code 12 with the engine running. Also, if the test terminal is grounded after the engine is running, any stored codes will flash, but Code 12 will flash only if there is a problem with the distributor reference signal.

2. Display any stored trouble codes by flashing the "CHECK ENGINE"/"SERVICE ENGINE SOON" light. Each code will be flashed three times, then code "12" will be flashed again.

   If a trouble code is displayed, the memory is cleared, then the engine is run to see if the code is a "hard" or "intermittent" failure. If it is a "hard" failure, a Diagnostic Code Chart is used to find the problem. If it is an intermittent failure, the charts are not used. A physical inspection of the applicable system is made.

3. Energize all ECM controlled relays and solenoids (with some exceptions, as noted in "Component Systems").

   The Mixture Control Solenoid is pulsed for 25 seconds or until the engine is started, whichever occurs first.

ALCL Mode

Tools are available from various suppliers for reading information from the ALCL connector. With a tool connected, the ECM will be in the ALCL mode. The information which can be obtained, and how it can be used in diagnosis, is found in "Special Tools".

Clearing Trouble Codes

When the ECM sets a trouble code, the "CHECK ENGINE"/"SERVICE ENGINE SOON" light will come "ON" and a trouble code will be stored in memory. If the problem is intermittent, the light will go out after 10 seconds, when the fault goes away. However, the trouble code will stay in the ECM memory until the battery voltage to the ECM is removed. Removing battery voltage for 10 seconds will clear all stored trouble codes.

Trouble Codes should be cleared after repairs have been completed. Also, some Diagnostic Charts will tell you to clear the codes before using the chart. This allows the ECM to set the code while going thru the chart, which will help to find the cause of the problem more quickly.

NOTICE: To prevent ECM damage, the key must be "OFF" when disconnecting or reconnecting power to ECM (for example battery cable, ECM pigtail, ECM fuse, jumper cables. etc.).

ECM Learning Ability

The ECM has a "learning" ability. If the battery is disconnected to clear diagnostic codes, or for repair, the "learning" process has to begin all over again. A change may be noted in the vehicle's performance. To "teach" the vehicle, make sure the vehicle is at operating temperature, and drive at part throttle, with moderate acceleration and idle conditions, until normal performance returns.

SECTION B - DRIVEABILITY SYMPTOMS

Always start with Section A "Diagnostic Circuit Check" on Computer Command Control vehicles before proceeding to the driveability symptoms. Section A checks the ECM which may be the driveability problem. On all other vehicles, start with Section B. A definition of each symptom is described for that condition. This will then lead to the most probable causes of the driveability problem.

SECTION C - COMPONENT SYSTEMS

There are many component systems that are used to control fuel and emissions. Section C introduces each component system or control with a general description. Included in each system is diagnosis and on- vehicle service.

Computer Command Control

This Section describes the Electronic Control Module (ECM) and the information sensors in the system.

Figure 4 shows the operating conditions which the ECM may sense and the systems that the ECM may control.

Fuel Control System

The ECM controls the air/fuel delivery to the combustion chamber.

Fuel delivery is controlled by a mixture control solenoid in the carburetor.

The ECM, on some engines, controls the idle speed.

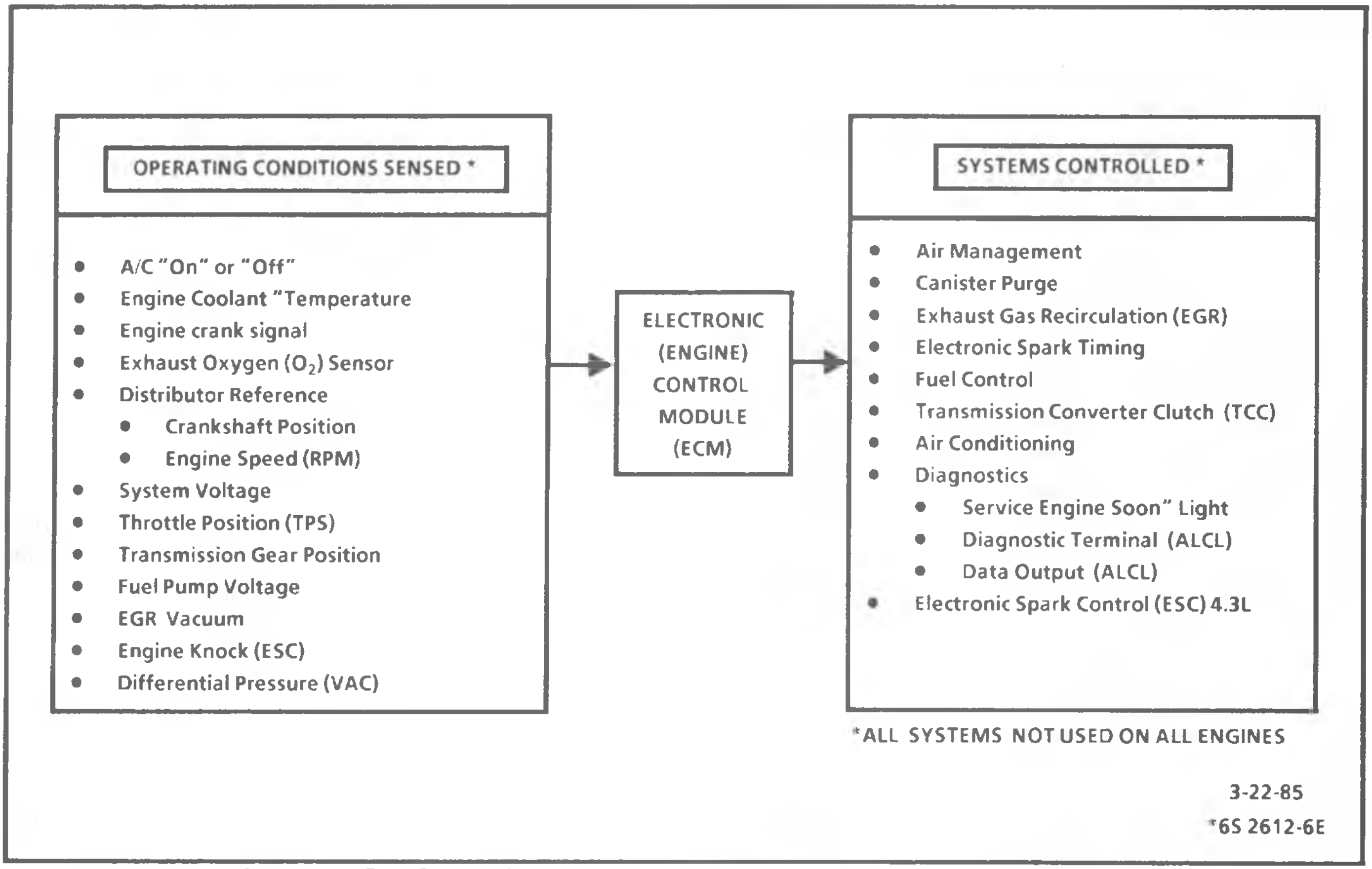


Figure 4 ECM Operating Conditions Sensed and Systems Controlled

Evaporative Emission Control

This system has a canister which stores fuel vapor from the fuel tank and the carburetor (if used). The fuel vapor is removed from the canister and consumed in the normal combustion process when the engine is running. This system is used on all engines and may or may not be controlled by the ECM.

Electronic Spark Timing (EST)

This system is controlled by the ECM which controls distributor spark advance (timing) and is used on all engines.

Air Injection Reaction (AIR)

The system provides additional oxygen to the exhaust gases to continue the combustion process. The A I R system is not on all engines and may or may not be controlled by the ECM.

Deceleration Control

The deceleration control uses a deceleration valve to control emissions and back-fire on deceleration. When deceleration causes a sudden rise in manifold vacuum, the deceleration valve will open to admit fresh air to the inlet manifold. After a calibrated time delay, the valve will close. The system is mainly used with manual transmission equipped vehicles.

Exhaust Gas Recirculation (EGR)

The EGR system uses a valve to feed a small amount of exhaust gas back into the intake manifold to control formation of NOx. This system is used on most engines and may or may not be controlled by the ECM.

Early Fuel Evaporation (EFE)

The EFE system heats the engine induction system or with exhaust gas during cold driveaway. This system is not controlled by the ECM.

Electronic Spark Control (ESC)

This system uses a a Knock Sensor in connection with the ECM to control spark timing on some engines to allow the engine to have maximum spark advance without spark knock. This improves driveability and fuel economy.

Transmission Converter Clutch (TCC)

The TCC is ECM controlled on California 4.3L, 5.0L, and 5.7L engines and is used on all engines with an automatic transmission. This system reduces slippage losses in the torque converter in an automatic transmission by coupling the engine flywheel to the output shaft of the transmission. Refer to Section 7A for TCC service information without ECM control.

A/C Clutch Control

The ECM may control the A/C clutch on the compressor to improve idle quality. This control is not on all engines.

A/C Wide Open Throttle (WOT) Control

The ECM controls the A/C compressor clutch to disengage clutch during hard acceleration. On some engines, the ECM disengages the clutch during engine start-up on a warm engine. This control is not on all engines.

A/C Constant Run Control

The ECM controls a relay to keep the A/C compressor clutch from cycling at idle for three minutes. This control is not on all engines.

Positive Crankcase Ventilation (PCV)

The PCV system passes crankcase vapors into the intake manifold. This system is not controlled by the ECM and is used on 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 and is used on all engines.

ABBREVIATIONS AND GLOSSARY OF TERMS

Abbreviations used in this Section are listed below in alphabetical order with an explanation of the abbreviation. There are some variations in the use of periods and in capitalization (as mph, m.p.h., Mph, and MPH) for abbreviations used in this Section but all types are acceptable.

A/F - Air/Fuel (A/F Ratio)

AIR - AIR INJECTOR REACTION SYSTEM - Air flow from pump is directed into engine exhaust manifold and/or converter to reduce exhaust.

ALCL - Assembly Line Communication Link - Used at assembly to evaluate Computer Command Control and for service to flash the "SERVICE ENGINE SOON" light if there are trouble codes.

ATS - Air Temperature Sensor. Measures temperature of ambient air.

BARO - BAROMETRIC ABSOLUTE PRESSURE SENSOR - Reads atmospheric pressure.

Bat + - Battery Positive Terminal (12 Volts)

CALPAK - A device used with fuel injection to allow fuel delivery in the event of a PROM or ECM malfunction.

CALIBRATOR - (PROM). An electronic component which can be specifically programmed to meet engine opperating requirements for each vehicle model. It plugs into the Engine Control Module (ECM).

CCC - COMPUTER COMMAND CONTROL - has an electronic control module to control air/fuel and emission systems.

C^{3}I - Computor 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.

CE - CHECK ENGINE - Lights when a malfunction occurs in Computer Command Control.

CID - Cubic Inch Displacement

C LOOP - Closed Loop

CLCC - CLOSED LOOP CARBURETOR CONTROL - Used to describe oxygen sensor to ECM to M/C solenoid circuit operation.

COOLANT TEMPERATURE SENSOR - Device that senses the engine coolant temperature, and passes that information to the electronic control module.

CONV.. - CATALYIC CONVERTER, THREE-WAY - EXHAUST CONVERTER. Containing platinum and palladium to speed up conversion of HC and CO, and rhodium to accelerate conversion of NOx.

CO - CARBON MONOXIDE - One of the pollutants found in engine exhaust.

DIS - Direct Ignition System. Produces the ignition spark without the aid of an ignition distributor.

DIAGNOSTIC CODE - Pair of numbers obtained from flashing "SERVICE ENGINE SOON" light. This code can be used to determine the system malfunction.

DIAGNOSTIC TERM. - Lead of ALCL Connector which is grounded to get a Trouble Code. On EFI it is grounded with the engine running to enter the "Field Service Mode".

DVM (10 Meg.) - Digital Voltmeter with 10 Million ohms resistance - used for measurement in electronic systems.

DWELL - The amount of time (recorded on a dwellmeter in degrees of crankshaft rotation) that current passes through a closed switch; for example, ignition contact points or internal switch in an electronic control module.

EAC - Electric Air Control - Used on AIR System to direct air flow to Air Switching valve or air cleaner.

EAS - Electric Air Switching - used to direct air flow to catalytic converter or exhaust ports of the engine.

ECM - ELECTRONC (ENGINE) CONTROL MODULE - A metal cased box (located in passenger compartment) containing electronic circuitry which electrically controls and monitors air/fuel and emission systems on Computer Command Control, and turns on the "SERVICE ENGINE SOON" light when a malfunction occurs in the system.

EFI - Electronic Fuel Injection is Computer Command Control using throttle body fuel injection.

EGR - EXHAUST GAS RECIRCULATION - Method of reducing NOx emission levels.

EECS - EVAPORATIVE EMISSIONS CONTROL SYSTEM - Used to prevent gasoline vapors in the fuel tank and carburetor from entering the atmosphere.

EFE - EARLY FUEL EVAPORATION (EFE) - Method of warming the intake manifold during cold engine operation. Provides efficient air/fuel mixing.

ENERGIZE/DE-ENERGIZE - When current is passed through a coil such as the M/C solenoid, the metering control armature is pulled into the solenoid (energized). When the voltage to the solenoid is turned off, a spring raises the metering control armature (de- energized).

ESC - Electronic Spark Control - Used to modify spark advance when detonation occurs.

EST - ELECTRONIC SPARK TIMING - ECM controlled timing of ignition spark.

EVRV - Electronic Vacuum Regulator Valve. Controls EGR vacuum.

FED - FEDERAL - Vehicle/Engine available in all states except California.

GROUND - A Wire shorted to ground.

HC - HYDROCARBONS (HC) - One of the pollutants found in engine exhaust.

HIGH IMPEDANCE VOLTMETER - Has high opposition to the flow of electrical current. Good for reading circuits with low current flow, such as found in electronic systems because it allows tests to be made without affecting the circuit.

HEI - HIGH ENERGY IGNITION - is a distributor that uses an electronic module and pick-up coil in place of contact points.

Hg - Mercury, a calibration material used as a standard for vacuum measurement.

IAC - IDLE AIR CONTROL - installed in the throttle body of fuel injected systems and controlled by the ECM to regulate idle speed.

IDEAL MIXTURE - The air/fuel ratio which provides the best performance, while maintaining maximum conversion of exhaust emissions, typically 14.7/1.

IDLE AIR BLEED VALVE - Controls the amount of air let into the idle fuel mixture prior to the mixture entering the carburetor idle system, when the M/C solenoid is energized.

IGN - IGNITION

ILC - IDLE LOAD COMPENSATOR - is used to control throttle angle during long deceleration such as coasting down a long grade and extends at wide open throttle position or to prevent engine stalls at idle.

INPUTS - Information from sources (coolant temperature sensors, exhaust oxygen sensor, etc.) that tells the ECM how the engine is performing.

INTERMITTENT - Occurs now and then; not continuously. In electrical circuits, refers to occasional open, short, or ground.

I.P. - INSTRUMENT PANEL

ISC - IDLE SPEED CONTROL - Regulates throttle valve position, is controlled by the ECM.

KM/HR - KILOMETER PER HOUR - A metric unit measuring distance (1000 meters) in one hour.

L - LITER - A metric unit of capacity.

L4 - Four Cylinder In-Line Engine

MALFUNCTION - A problem that causes the system to operate incorrectly. Typical malfunctions are; wiring harness opens or shorts, failed sensors, or circuit components.

MANIFOLD VACUUM SENSOR - Reads pressure changes in intake manifold in relation to barometric pressure. May be called a differential pressure sensor.

MAP - MANIFOLD ABSOLUTE PRESSURE SENSOR - Reads pressure changes in intake manifold with reference to zero or absolute vacuum.

MAF - MASS AIR FLOW

MAT - Manifold Air Temperature Sensor. Measures air temperature in the intake manifold.

M/C - MIXTURE CONTROL

MFI - MULTIPORT FUEL INJECTION. Individual injectors for each cylinder are mounted in the intake manifold. The injectors are fired in groups rather than individually.

MIXTURE CONTROL (M/C) SOLENOID - Device, installed in carburetor, which regulates the air/fuel ratio.

MODE - A particular state of operation.

MPH - MILES PER HOUR - A unit measuring distance (5280 feet) in one hour.

N.C. - NORMALLY CLOSED. State of relay contacts or solenoid plunger when no voltage is applied.

N•m - NEWTON METERS (Torque) - A metric unit which measures force.

N.O. - NORMALLY OPEN. State of relay contacts or solenoid plunger when no voltage is applied.

NOx - NITROGEN, OXIDES OF (NOx) - One of the pollutants found in engine exhaust.

O_2 - OXYGEN (Sensor) - Monitors the oxygen content of the exhaust system and generates a voltage signal to the ECM.

OPEN LOOP - Describes ECM fuel control without use of oxygen sensor information.

OUTPUT - Functions, typically solenoids, that are controlled by the ECM.

OXYGEN SENSOR, EXHAUST - Device that detects the amount of oxygen (O_2) in the exhaust stream.

PAIR - PULSE AIR INJECTION REACTOR system - pulsed air directed into engine to reduce exhaust emissions.

PCV - POSITIVE CRANKCASE VENTILATION - Prevent fumes in crankcase from passing into atmosphere.

PFI - PORT FUEL INJECTION

P/N - PARK/NEUTRAL

PORT - Exhaust 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. This code will indicate the area of the malfunction.

SERVICE ENGINE SOON Light - Lights when a malfunction occurs in Computer Command Control system. See "CHECK ENGINE".

TACH - TACHOMETER

TBI - THROTTLE BODY INJECTION (Unit) - is controlled by the ECM to supply precise air/fuel mixture into the intake manifold.

TCC - TRANSMISSION / TRANSAXLE CONVERTER CLUTCH - ECM controlled solenoid in transmission which positively couples the transmission to the engine.

THERMAC - THERMOSTATIC AIR CLEANER- provides preheated air to intake manifold to provide better driveability when engine is cold.

TPS - THROTTLE POSITION SENSOR - Device that tells the ECM the throttle position.

TVS - THERMAL VACUUM SWITCH. Used to control vacuum in relationship to engine temperature.

V - VOLT

V-6 - SIX CYLINDER ENGINE - Arranged in a "V"

V-8 - EIGHT CYLINDER ENGINE - Arranged in a "V"

VACUUM - Negative pressure; less than atmospheric pressure.

VACUUM, MANIFOLD - Vacuum source in manifold below throttle plate.

VACUUM, PORTED - A vacuum source above (atmospheric side) of closed throttle plate.

VAC SENSOR - Abbreviation for Differential Pressure Sensor which is a vacuum sensor.

VIN - VEHICLE IDENTIFICATION NUMBER.

VSS - VEHICLE SPEED SENSOR (VSS) - Sensor in speedometer cluster which sends vehicle speed information to the ECM.

WOT - WIDE OPEN THROTTLE.

WIRING HARNESS SERVICE

GENERAL DESCRIPTION

The ECM wire harness electrically connects the ECM to the various solenoids, switches, and sensors in vehicle engine compartment. The ECM is located inside the vehicle passenger compartment.

Most connectors in the engine compartment are protected against moisture and dirt which could create oxidation and deposits on the terminals. This protection is important because of the very low voltage and current levels found in the electronic system. As shown in Figure 5, the connectors have a lock which secures the male and female terminals together. A secondary lock holds the seal and terminal into the connector.

ON-VEHICLE SERVICE

GENERAL

Molded-on connectors (like metro pack) require complete replacement of the connector. This means splicing a new connector assembly into the harness. Figure 7 has instructions on splicing wires.

Use care when probing the connector or replacing terminals in them. It is possible to short between opposite terminals. If this happens to the wrong terminal pair, it is possible to damage certain components. Always use jumper wires between connectors for circuit checking. NEVER probe through the Weather-Pack seals.

When diagnosing, open circuits are often difficult to locate by sight because oxidation or terminal misalignment are hidden by the connectors. Merely wiggling a connector on a sensor or in the wiring harness may correct the open circuit condition. This should always be considered when an open circuit or failed sensor is indicated. Intermittent problems may also be caused by oxidized or loose connections.

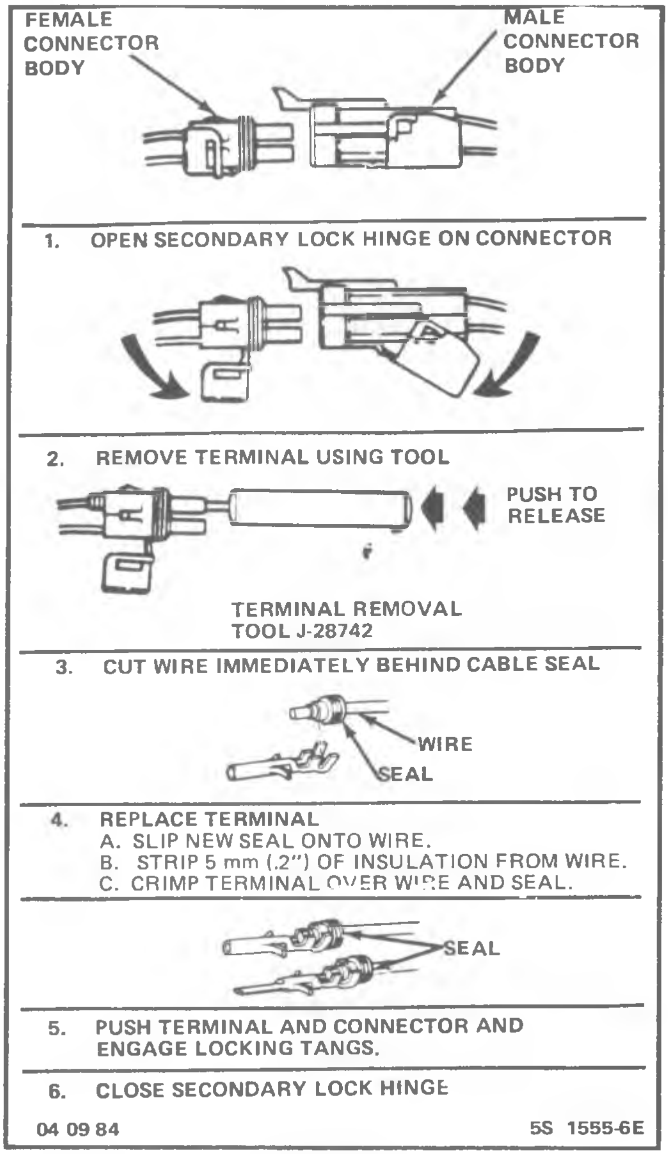
Before making a connector repair, be certain of the type of connector. Weather-Pack and Compact Three connectors look similar but are serviced differently.

Replacement connectors and terminals are listed in Group 8.965 of the Standard Parts Catalog.

CONNECTORS

WEATHER-PACK

Some connectors used with an ECM are called Weather-Pack. These connectors can be identified by the rubber seal at the rear of the connector. Figure 5 shows a Weather-Pack terminal and the tool (J-28742) required to service it. This tool is used to remove the pin and sleeve terminals. If removal is attempted with an ordinary pick, there is a good chance that the terminal will be bent or deformed. and, unlike standard blade type terminals, these terminals cannot be straightened once they are bent.

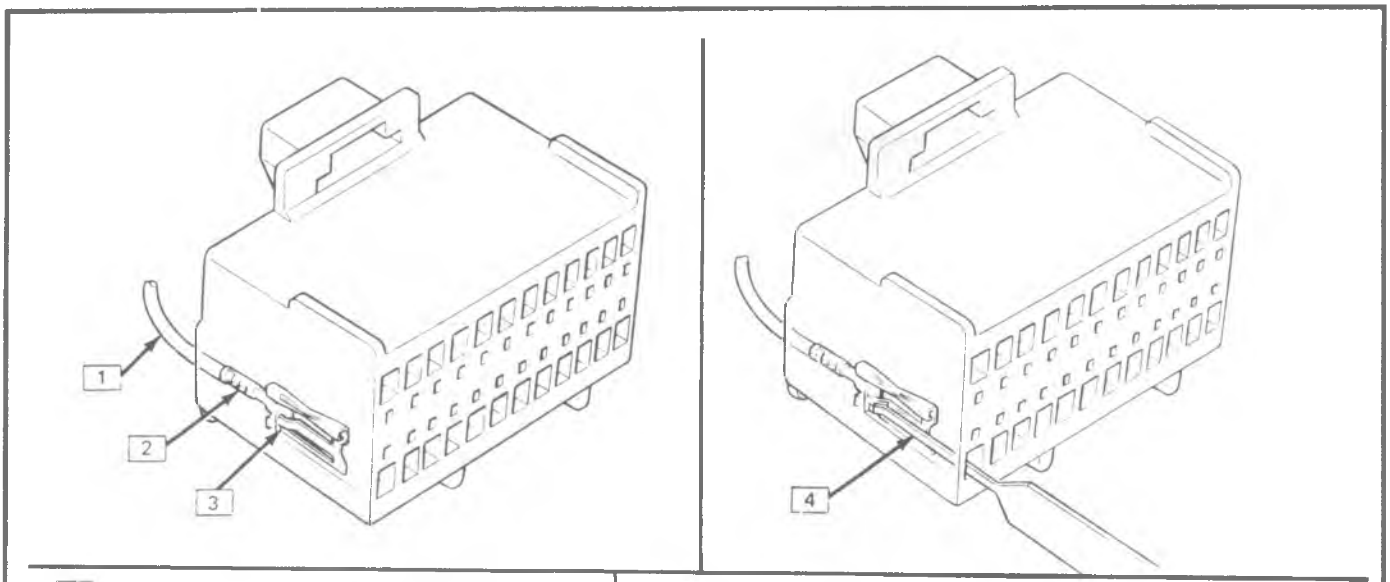


1. OPEN SECONDARY LOCK HINGE ON CONNECTOR
2. REMOVE TERMINAL USING TOOL
3. CUT WIRE IMMEDIATELY BEHIND CABLE SEAL
4. REPLACE TERMINAL
   A. SLIP NEW SEAL ONTO WIRE.
   B. STRIP 5 mm (.2") OF INSULATION FROM WIRE.
   C. CRIMP TERMINAL OVER WIRE AND SEAL.
5. PUSH TERMINAL AND CONNECTOR AND ENGAGE LOCKING TANGS.
6. CLOSE SECONDARY LOCK HINGE

Figure 5 Weather-Pack Terminal Repair

Make certain that the connectors are properly seated and all of the sealing rings in place when connecting leads. The hinge type flap provides a backup, or secondary locking feature for the connector. They are used to improve the connector reliability by retaining the terminals if the small terminal lock tangs are not positioned properly.

Weather-Pack connections cannot be replaced with standard connections. Instructions are provided with Weather-Pack connector and terminal packages.



1 CABLE
2 TERMINAL
3 LOCKING TANG
4 TOOL J33095

1. GRASP CABLE AND PUSH TERMINAL TO THE MOST FORWARD POSITION.
2. INSERT TOOL J33095 STRAIGHT INTO THE FRONT OF THE CONNECTOR CAVITY. DO NOT USE CONVENTIONAL PICK TO REMOVE TERMINAL.
3. WITH TOOL IN PLACE, GENTLY PULL ON THE CABLE TO REMOVE TERMINAL.
4. VISUALLY CHECK TERMINAL AND REPLACE IF TERMINAL CAVITY OR TANG IS DAMAGED.
5. INSTALL TERMINAL INTO CONNECTOR CAVITY UNTIL LOCKING TANG HAS SNAPPED INTO POSITION.

03 21 84

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Figure 6 Micro Pack Terminal Replacement

COMPACT THREE

The Compact Three connector which looks similar to a Weather-Pack connector not sealed and is used where resistance to the environment is not required. This type of connector most likely is used at the air control solenoid. Use the standard method when repairing a terminal. Do not use the Weather-Pack terminal tool J-28742.

MICRO-PACK

Some connectors used on harness to connect to the ECM are called Micro-Pack. Terminal replacement requires the use of a special tool. Refer to Figure 6 for Micro-Pack terminal replacement.

WIRE HARNESS

Wire harnesses should be replaced with proper part number harnesses. When signal wires are spliced into a harness, use wire with high temperature insulation only.

With the low current and voltage levels found in the system, it is important that the best possible bond at all wire splices be made by soldering the splices as shown in Figure 7.

SPECIAL TOOLS

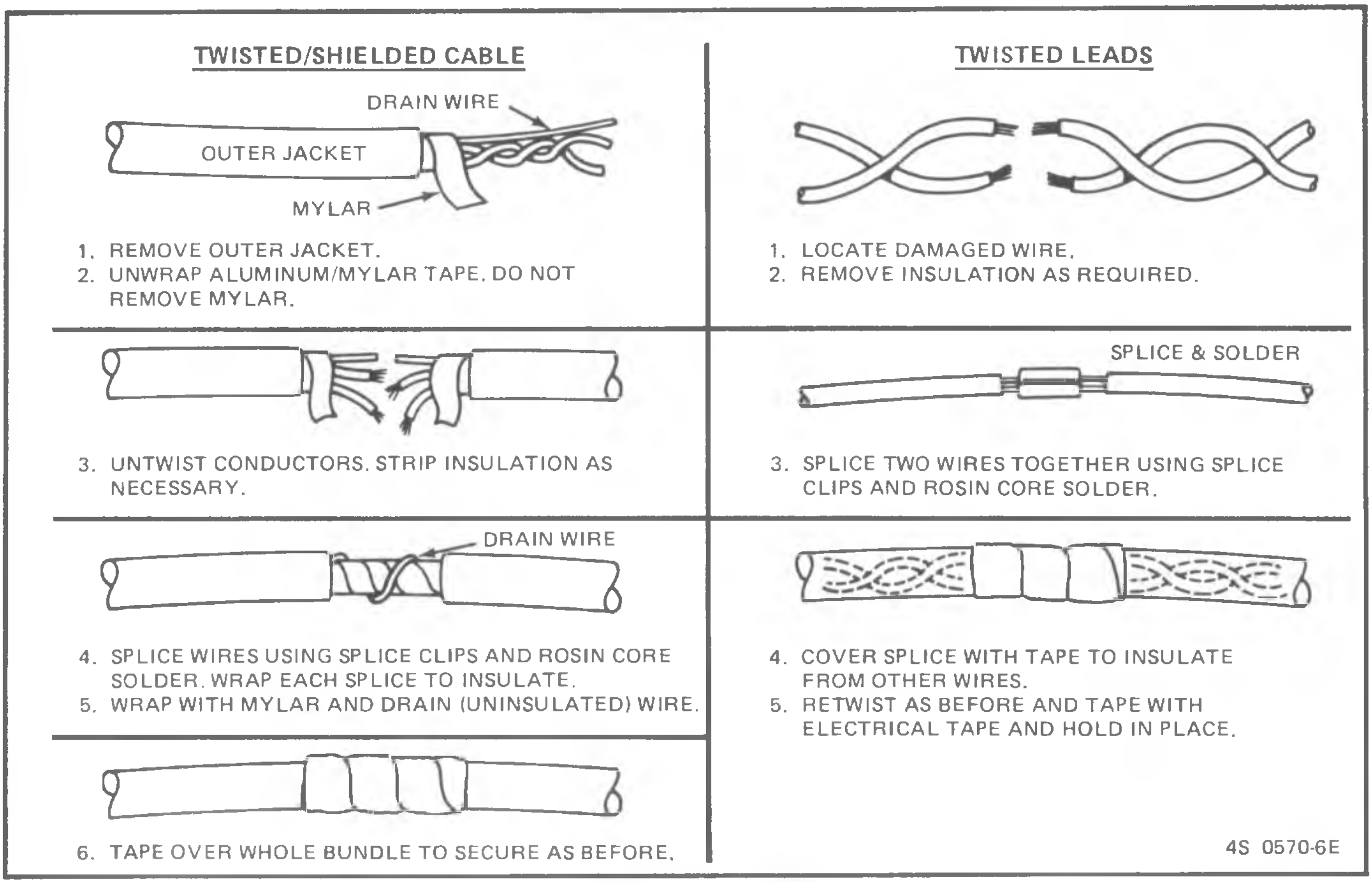
TOOLS NEEDED TO SERVICE THE SYSTEM

The system does not require special testers for diagnosis. A tachometer, test light, ohmmeter, digital voltmeter with 10 megohms impedance (J-29125A), vacuum gage and jumper wires are required for diagnosis. A test light or voltmeter must be used when specified in the procedures. They must NOT be interchanged. See Figures 8 through 11 for Special Tools needed to diagnosis or repair a system.

ALCL "SCAN" Tools

The ALCL connector under the dash has a variety of information available on terminal "D" (called Serial Data). There are several tools available 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.



TWISTED/SHIELDED CABLE

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.

TWISTED LEADS

1. LOCATE DAMAGED WIRE.
2. REMOVE INSULATION AS REQUIRED.
3. SPLICE TWO WIRES TOGETHER USING SPLICE CLIPS AND ROSIN CORE SOLDER.
4. COVER SPLICE WITH TAPE TO INSULATE FROM OTHER WIRES.
5. RETWIST AS BEFORE AND TAPE WITH ELECTRICAL TAPE AND HOLD IN PLACE.

Figure 7 Wire Harness Repair

In some cases, "SCAN" Tools will provide information that is either extremely difficult or impossible to get with other equipment.

When a chart calls for a sensor reading, the "SCAN" tool can be used to read the following directly:

- Throttle Position Sensor in volts
- Vacuum Sensor in volts
- Coolant Temperature Sensor in ° C
- Oxygen Sensor Voltage
- M/C Solenoid dwell.

When the "SCAN" tool is plugged in, the "CHECK ENGINE"/"SERVICE ENGINE SOON" light will flash rapidly on a carbureted engine. This indicates that information is being transmitted to the tool.

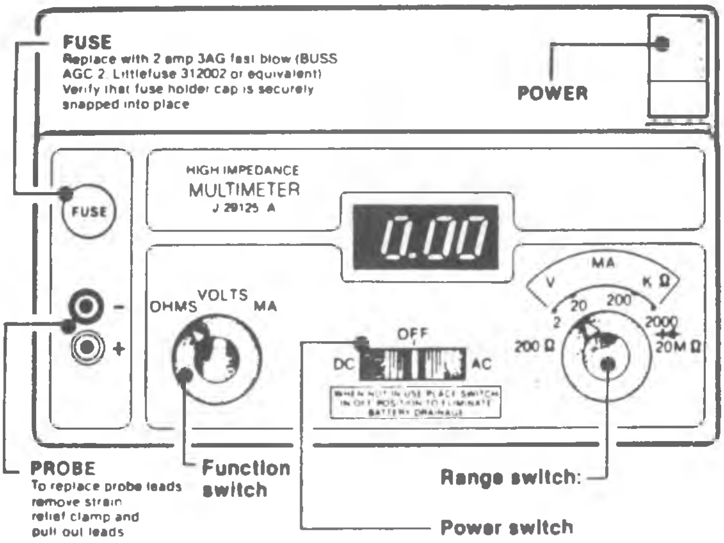
When the tool is plugged in on every system, it takes out the timer that keeps the system in open loop for a certain period of time. Therefore, it will go closed loop as soon as the vehicle is started, if all other closed loop conditions are met.On some vehicles with ESC, it will advance the spark 8 to 10 degrees.

Intermittent Conditions

The "SCAN" tool is helpful in cases of intermittent operation. The tool can be plugged in and observed while driving the vehicle under the condition where the light comes "ON" momentarily, or the engine driveability is poor momentarily. If the problem seems to be related to certain areas that can be checked on the "SCAN" tool, then those are the positions that should be checked while driving the vehicle. If there does not seem to be any correlation between the problem and any specific circuit, the "SCAN" tool can be checked on each position, watching for a period of time to see if there is any change in the readings that indicates intermittent operation.

For more complete information on the operation of these tools, see the manufacturer's instructions.

SPECIAL TOOLS



HIGH IMPEDANCE MULTIMETER
(DIGITAL VOLTMETER–DVM)
J29125-A or J34029

VOLTMETER–Voltage Position Measures amount of voltage. Connected parallel to exiting circuit. A digital voltmeter with a 10 meg ohm input impedence is used because some circuits require accurate low voltage readings, and some circuits have a very high resistance in the ECM. This meter also accurately measures extremely low current flow. Refer to meter for more information.

- Both function and range switch must be set properly, and the DC or AC position selected. DC is used for most measurements.

OHMMETER–Resistance Position Measures resistance of circuit directly in ohms. Refer to meter for more information.

- 1. display in all ranges indicates open circuit.
- Zero display in all ranges indicates a short circuit.
- Intermittent connection in circuit may be indicated by digital reading that will not stabilize on circuit.
- Range Switch.
  - 200Ω – Reads ohms directly
  - 2, 20, 200, 2,000Ω – Reads ohms in thousands
  - 20MΩ – Reads ohms in millions
  - Amps – Reads in thousandths of an amp.
  - Volts – Reads directly

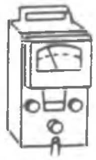
J23738

VACUUM PUMP (20 IN. HG. MINIMUM)

Use gage to monitor manifold engine vacuum. Check vacuum sensors, solenoids and valves with hand pump.

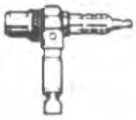
UNPOWERED TEST LIGHT

Used to check wiring for complete circuit. Connect lead wire to good ground. Probe with test prod to connector or component terminal. Bulb will light if voltage is present.



TACHOMETER

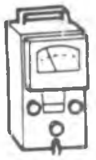
Use either a crankshaft harmonic balance pickup type or electronic coil trigger signal pickup type



J26792/BT7220-1

HEI SPARK TESTER

Use to check HEI spark voltage. Also called ST125.



DWELL METER (SET ON 6 CYL. SCALE)

Used to monitor the carburetor fuel control delivery determined by the ECM command.

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Figure 8 Special Tools (1 of 4)

SPECIAL TOOLS

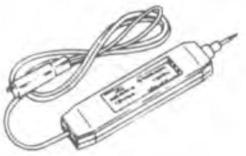
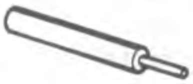
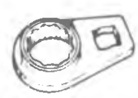
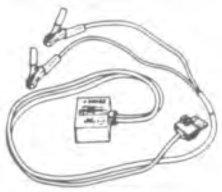
	JUMPER WIRES (#16, 18 OR 20 GAGE WIRE) - Clip jumper wire used to complete a circuit by bypassing an open. - Set of jumper wires used to insert between Weather Pack connectors to permit access to the connector terminals for circuit checking. Six wires approximately 6" long. Use terminals 12014836 and 12014837. One set - female terminals both ends, one set - male at both ends and four sets - male terminals at one end and female terminals at the opposite end.
 **J34636**	**CIRCUIT TESTER** Used to check all relays and solenoids before connecting them to a new ECM. Measures the circuit resistance and indicates pass or fail via green or red LED. Amber LED indicates current polarity. Can also be used as a non-powered continuity checker.
 **J28687-A/BT8220**	**OIL PRESSURE SWITCH WRENCH** Used to remove or install oil pressure gage switch on engine.
 **J28742/BT8234-A**	**WEATHER PACK TERMINAL REMOVER** Used to remove terminals from Weather Pack connectors. Refer to wiring harness service for removal procedure.
 **J22727/BT8234-A**	**ECM CONNECTOR TERMINAL REMOVER** Use to extract a terminal from edgeboard connectors at the ECM.
 **J33095/BT8234-A**	**ECM CONNECTOR TERMINAL REMOVER** Used to remove terminal from Micro-Pack connectors. Refer to wiring harness service for removal procedure.
 **J29533A/BT8127**	**OXYGEN SENSOR WRENCH** Used to remove or install the oxygen sensor.
 **J34025/BT8256A**	**ISC MOTOR TESTER** Used to test operation of ISC motor on carburetor in either direction and condition of the internal switch.
 **J29607/BT8022**	**ISC ADJUSTING WRENCH** Used to adjust ISC plunger on carburetor to obtain maximum specification RPM speed.

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Figure 9 Special Tools (2 of 4)

SPECIAL TOOLS

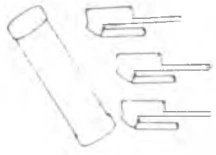
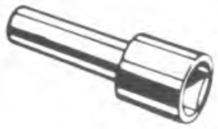
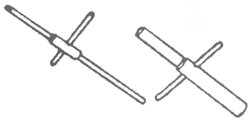
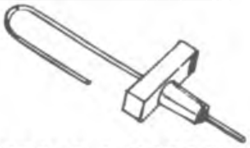
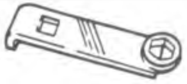
 **J9789-135/BT8104**	**FLOAT LEVEL GAGE SET** Used to check float level on 2SE or E2SE carburetor.
 **J34935/BT8420A**	**FLOAT LEVEL GAGE** Used to check float level or M/C solenoid plunger travel on E2ME or E4ME carburetor.
 **J29030-B/BT7610B**	**IDLE MIXTURE SOCKET** Used to adjust idle mixture needle on a E2SE carburetor.
 **J28696-B/BT7928**	**MIXTURE ADJUSTMENT TOOL** Used to adjust lean mixture and rich mixture stop screws on E2SE, E2ME or E4ME carburetor.
 **J22646-02**	**CARBURETOR ADJUSTMENT WRENCH** Used to remote adjust idle mixture needle on carburetor.
 **J33815-1/BT8253-A**	**M/C SOLENOID GAGING TOOL** Used to adjust the mixture control solenoid plunger on E2ME or E4ME carburetor.
 **J33815-2/BT8253-A**	**AIR BLEED VALVE GAGING TOOL** Used to adjust idle air bleed valve on E2ME or E4ME carburetor.
 **J25322/BT7523**	**PUMP LEVER PIN PUNCH** Used to drive pump lever pin inward to allow removal of the pump lever on E2ME carburetor.
 **J34062**	**BANJO BOLT WRENCH** Used to disconnect or connect fuel inlet on 2.0L TBI engine.

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Figure 10 Special Tools (3 of 4)

SPECIAL TOOLS

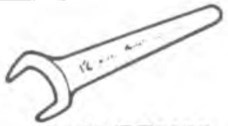
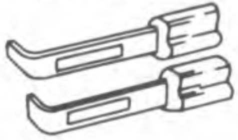
 J29698-A/BT8251	**FUEL LINE WRENCH** Used to connect or disconnect fuel lines at TBI unit by holding fuel nut at throttle body.
 J33031/BT8130	**IDLE AIR CONTROL WRENCH** Used to remove or install IAC valve on throttle body.
 J33047/BT8207-A	**IDLE AIR PASSAGE PLUGS** Used to block idle air passages when adjusting minimum idle speed on TBI unit. Also may be used to check ECM idle control.
 J33179-20	**MINIMUM AIR RATE ADJUSTING WRENCH** Used to adjust throttle stop screw on TBI unit.
 J29658/BT8205	**FUEL PRESSURE GAGE** Used to check fuel pressure on TBI engines.
 J34730-A	**PORT FUEL INJECTION DIAGNOSTIC KIT** Used to diagnosis and service port fuel injection systems. The kit includes: ● Fuel Pressure Gage — to check fuel pump pressure and compare injectors for equal fuel distribution. ● Test Light — to check electrical impulses to an injector. ● Injector Tester — to evaluate an injector.
 J34730-1	**FUEL PRESSURE GAGE** Used to check and monitor fuel line pressure of port fuel system.
 J34730-2	**INJECTOR TEST LIGHT** Used to check port fuel injector signal from ECM.
 J34730-3	**INJECTOR TESTER** Used to perform injector balance test in CHART C-2A.

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Figure 11 Special Tools (4 of 4)

GENERAL SPECIFICATIONS

Many of the specifications used in this section are located on the Vehicle Emission Control Information label under the hood.

Listed on the chart below are locations of specifications used in this Section.

Carburetor specifications can be found in the appropriate 6C Section of this Service Manual.

SPECIFICATION	LOCATION OF INFORMATION
Engine Timing	Vehicle Emission Control information label.
Idle Speed, ECM Controlled	Not adjustable. ECM controls idle.
Idle Speed, Non-ECM Controlled-Carbureted	Vehicle Emission Control Information label.
Idle Speed, Minimum-Carbureted	Vehicle Emission Control Information Label.
Fast Idle Speed-Carbureted	Vehicle Emission Control Information label.
Spark Plug Type	See Owner's Manual, Section 7.
Spark Plug Gap	Vehicle Emission Control Information Label.
Engine Code	8th digit of VIN number. See Section 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 6E8
DRIVEABILITY AND EMISSIONS

CARBURETED VEHICLE

LIGHT DUTY EMISSIONS

4.3L ENG. CODE N (RPO LB1)
5.0L ENG. CODE F (RPO LF3)
5.0L ENG. CODE H (RPO LE9)
5.7L ENG. CODE L (RPO LS9)

HEAVY DUTY EMISSIONS

4.8L ENG. CODE T (RPO L25)
5.7L ENG. CODE M (RPO LT9)
7.4L ENG. CODE W (RPO LE8)

Note: All 5.7L (LS9) engines, in K 10/15 Pick-Ups, K 10/15 Blazers/Jimmys and C 20/25 Pick-Ups, are California engines with Computer Command Control.

CONTENTS

INTRODUCTION

SECTION A - DIAGNOSTIC - CHARTS

SECTION B - DRIVEABILITY SYMPTOMS

SECTION C - COMPONENT SYSTEMS

Diagnosis Chart Summary

ALL NEW GENERAL MOTORS VEHICLES ARE CERTIFIED BY THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY AS CONFORMING TO THE REQUIREMENTS OF THE REGULATIONS FOR THE CONTROL OF AIR POLLUTION FROM NEW MOTOR VEHICLES. THIS CERTIFICATION IS CONTINGENT ON CERTAIN ADJUSTMENTS BEING SET TO FACTORY STANDARDS. IN MOST CASES, THESE ADJUSTMENT POINTS EITHER HAVE BEEN PERMANENTLY SEALED AND/OR MADE INACCESSIBLE TO PREVENT INDISCRIMINATE OR ROUTINE ADJUSTMENT IN THE FIELD. FOR THIS REASON, THE FACTORY PROCEDURE FOR TEMPORARILY REMOVING PLUGS, CAPS, ETC., FOR PURPOSES OF SERVICING THE PRODUCT, MUST BE STRICTLY FOLLOWED AND, WHEREVER PRACTICABLE, RETURNED TO THE ORIGINAL INTENT OF THE DESIGN.

INTRODUCTION

GENERAL DESCRIPTION

The engine has controls to reduce exhaust emissions while maintaining good driveability and fuel economy.

Refer to Section 6E for information to diagnosis and repair systems in this section.

The following emission controls are on all engines:

- Positive Crankcase Ventilation (PCV)
- Exhaust Gas Recirculation (EGR)
- Thermostatic Air Cleaner (THERMAC)
- Air Injection Reaction (AIR)
- Early Fuel Evaporation (EFE) (except 4.8L)

All engines in California have an Evaporative Emission Control System. The 4.3L, 5.0L and 5.7L (LS9) engines outside of California have an Evaporative Emission Control System.

A Throttle Return Control (TRC) system is used on heavy duty emissions - 4.8L, and 5.7L (LT9) vehicles.

COMPUTER COMMAND CONTROL

California Only

The 4.3L, 5.0L (RPO LF3) and 5.7L (RPO LS9) engines in California have a Computer Command Control system which controls:

- Fuel Control System
- Air Injection Reaction (AIR)
- Exhaust Gas Recirculation (EGR)
- Evaporative Emission Control System (EECS)
- Electronic Spark Timing (EST)
- Electronic Spark Control (ESC) (4.3L Cal.)
- Transmission Converter Clutch (TCC)

An Electronic Control Module (ECM) is the heart of the Computer Command Control system. The ECM uses sensors to get information about engine operation which the ECM uses to vary systems it controls. Details of basic operation, diagnosis, and service are covered in Section C - Component Systems.

The ECM has the ability to do some diagnosis of itself. When it recognizes a problem, it lights a "SERVICE ENGINE SOON" lamp on the instrument panel. 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.

Under the instrument panel on a CK truck or under the driver's seat on a G-Truck, is an Assembly Line Communication Link (ALCL) connector that is used by the assembly plant for a computerized check-out of the system. This connector is used in service to help diagnose the system (see "Diagnostic Procedure Terms").

ENGINE COMPONENTS

ENGINE EMISSION COMPONENTS

California Only

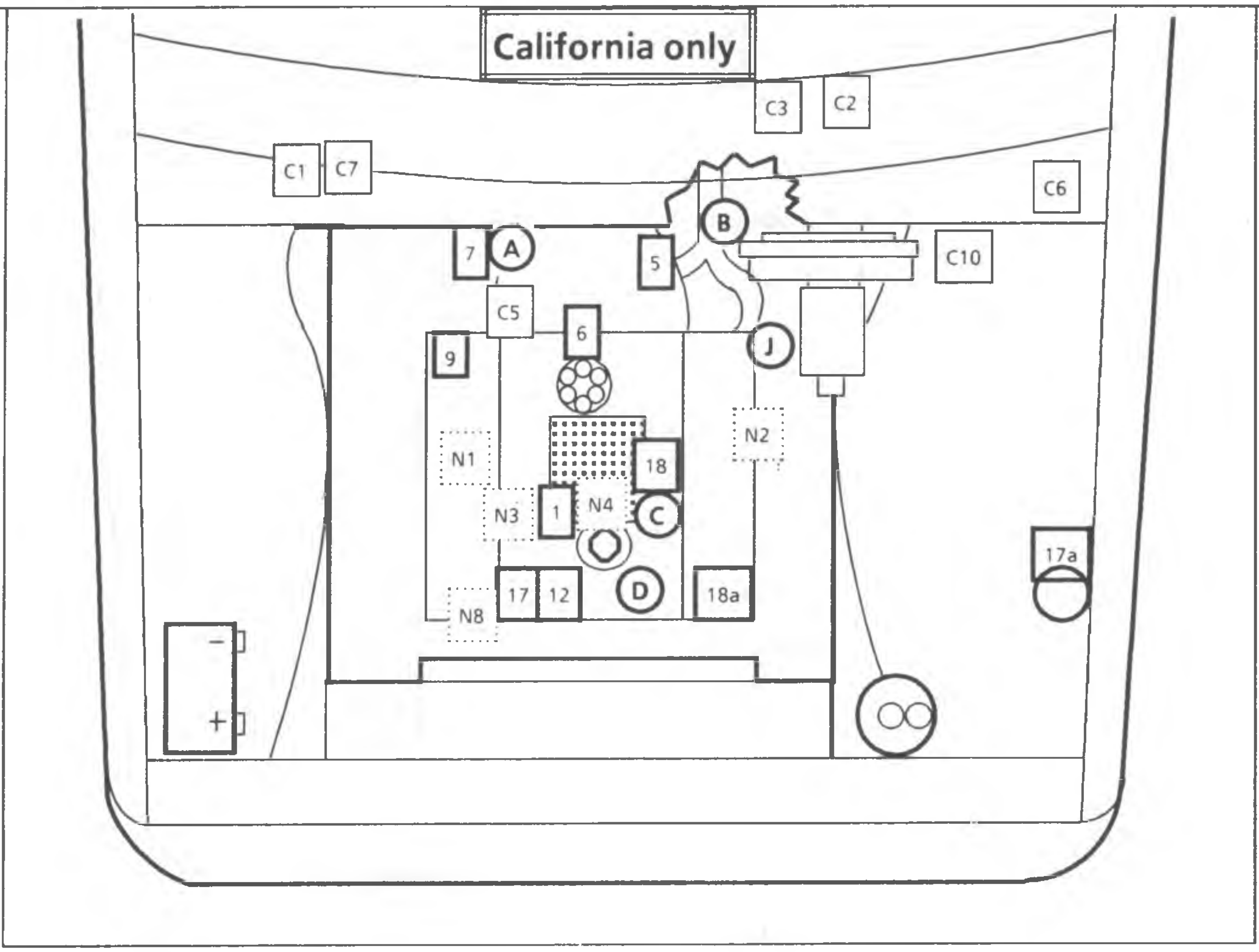
A top view location of emission components for each engine are shown in the following illustrations:

- Component Locations - 4.3L (CK Series) - Figures 1 and 2
- Component Locations - 4.3L (G Series) - Figures 3 and 4
- Component Locations - 4.8L (CK Series) - Figure 5
- Component Locations - 4.8L (P Series) - Figure 6
- Component Locations - 5.0L/5.7L (CK Series)- Figures 7, 8, and 11
- Component Locations - 5.0L/5.7L (G Series)- Figures 9, 10, and 12
- Component Locations - - 5.7L (P Series) - Figure 13
- Component Locations - 7.4L (CK Series) - Figure 14
- Component Locations - 7.4L (P Series) - Figure 15

Refer to Figure 16 and 18 for Computer Command Control wiring schematic diagrams.

Refer to Figures 17 and 19 for Computer Command Control (ECM) connector terminal end wires. Voltage values that are taken at the ECM should be very close to the chart. There may be a slight variation due to low battery.

'C/K' SERIES RPO: LB1 VIN CODE: N 4.3L V6 4BBL



☐ COMPUTER HARNESS

C1	Electronic Control Module (ECM)
C2	ALCL diagnostic connector
C3	"SERVICE ENGINE SOON" light
C5	ECM harness ground
C6	Fuse panel
C7	Lamp driver
C10	Diagnostic dwell connector

⬚ EMISSION SYSTEMS (NOT ECM CONTROLLED)

N1	Crankcase vent valve (PCV)
N2	EFE valve
N3	Deceleration valve
N4	Accelerator pump solenoid
N8	Air injection pump

☐ ECM CONTROLLED

1	Mixture control solenoid
5	Trans. Conv. Clutch connector
6	Electronic Spark Timing
7	Electronic Spark Control module
9	Air injection divert valve
12	Exhaust Gas Recirculation solenoid
17	Fuel vapor canister solenoid
17a	Auxiliary fuel vapor canister
18	Throttle kicker
18a	Throttle kicker solenoid

◎ Exhaust Gas Recirculation valve

○ INFORMATION SENSORS

A	Manifold differential pressure
B	Exhaust oxygen
C	Throttle position
D	Coolant temperature
J	ESC knock

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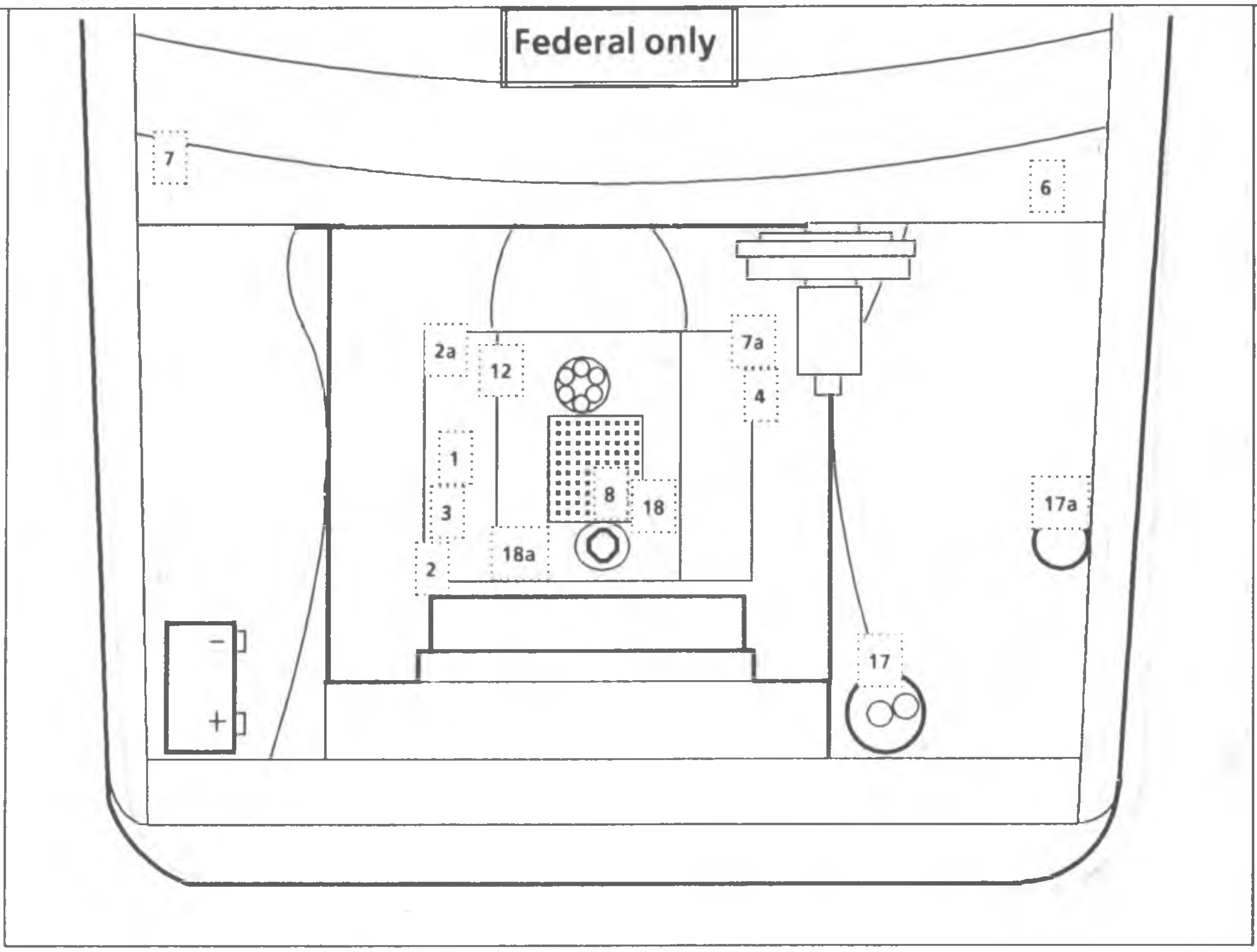
*5S 2133-6E

Figure 1 Component Locations - 4.3L (CK Series) - Calif

'C/K' SERIES RPO: LB1 VIN CODE: N 4.3L V6 4BBL



⬚ **EMISSIONS DEVICES**

1	Crankcase vent valve (PCV)
2	Air injection pump
2a	Air injection divert valve
3	Deceleration valve
4	EFE valve
6	Fuse panel
7	Electronic Spark Control module
7a	ESC knock sensor
8	Accelerator pump solenoid
12	EGR control valve solenoid
17	Fuel vapor canister solenoid
17a	Auxiliary fuel vapor canister
18	Throttle kicker
18a	Throttle kicker solenoid

◎ Exhaust Gas Recirculation valve

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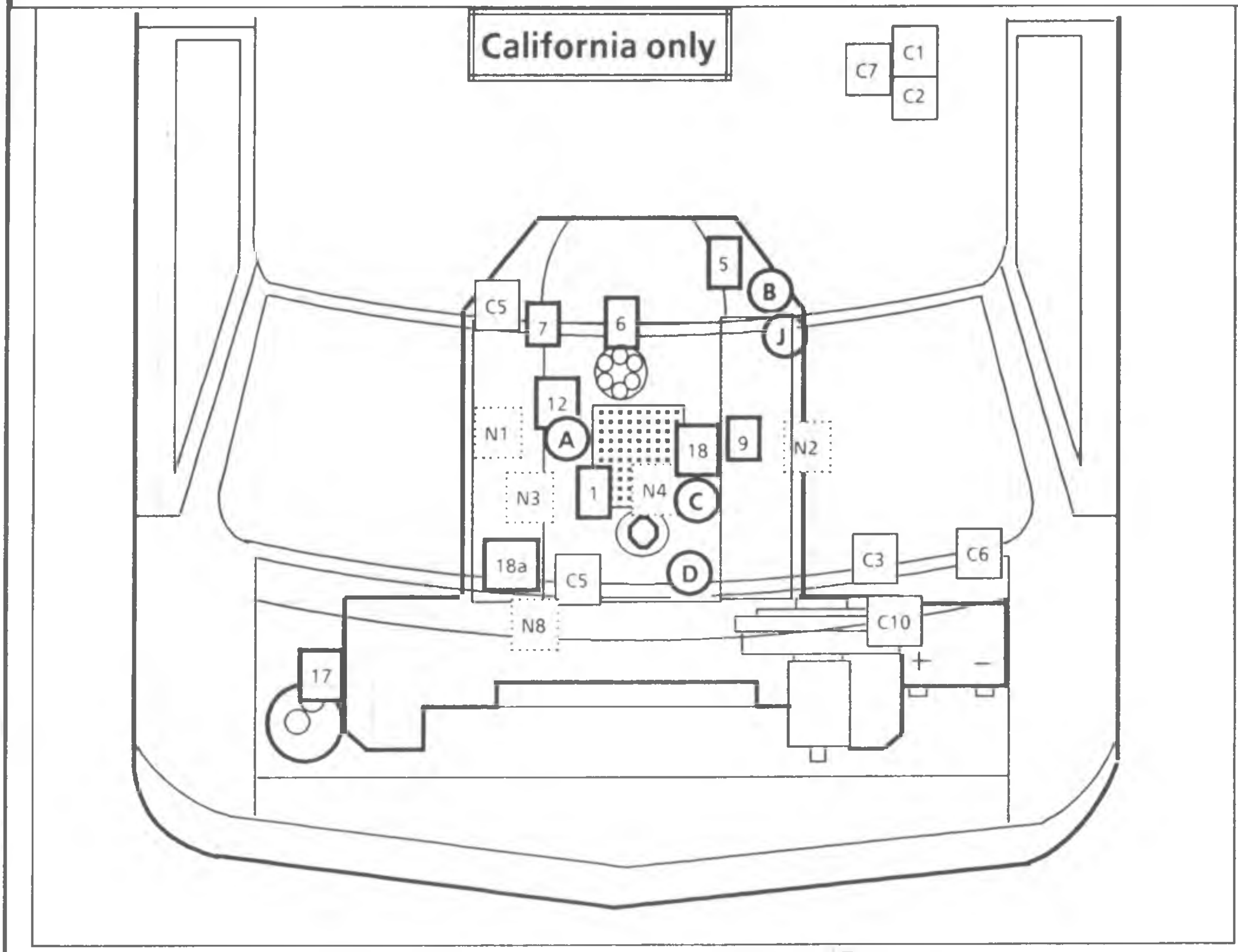
*5S 2134-6E

Figure 2 Component Locations - 4.3L (CK Series) - Fed

'G' SERIES RPO: LB1 VIN CODE: N 4.3L V6 4BBL



□ COMPUTER HARNESS

C1	Electronic Control Module (ECM)
C2	ALCL connector (Data Access)
C3	"SERVICE ENGINE SOON" light
C5	ECM harness ground
C6	Fuse panel
C7	Lamp driver
C10	Diagnostic dwell connector

☐ ECM CONTROLLED

1	Mixture control solenoid
5	Trans. Conv. Clutch connector
6	Electronic Spark Timing
7	Electronic Spark Control module
9	Air injection divert solenoid
12	Exhaust Gas Recirculation solenoid
17	Fuel vapor canister solenoid
18	Throttle kicker
18a	Throttle kicker solenoid

◎ Exhaust Gas Recirculation valve

○ INFORMATION SENSORS

A	Manifold differential pressure
B	Exhaust oxygen
C	Throttle position
D	Coolant temperature
J	ESC knock

⬚ EMISSION SYSTEMS (NOT ECM CONTROLLED)

N1	Crankcase vent valve (PCV)
N2	EFE valve
N3	Deceleration valve
N4	Accelerator pump solenoid
N8	Air injection pump

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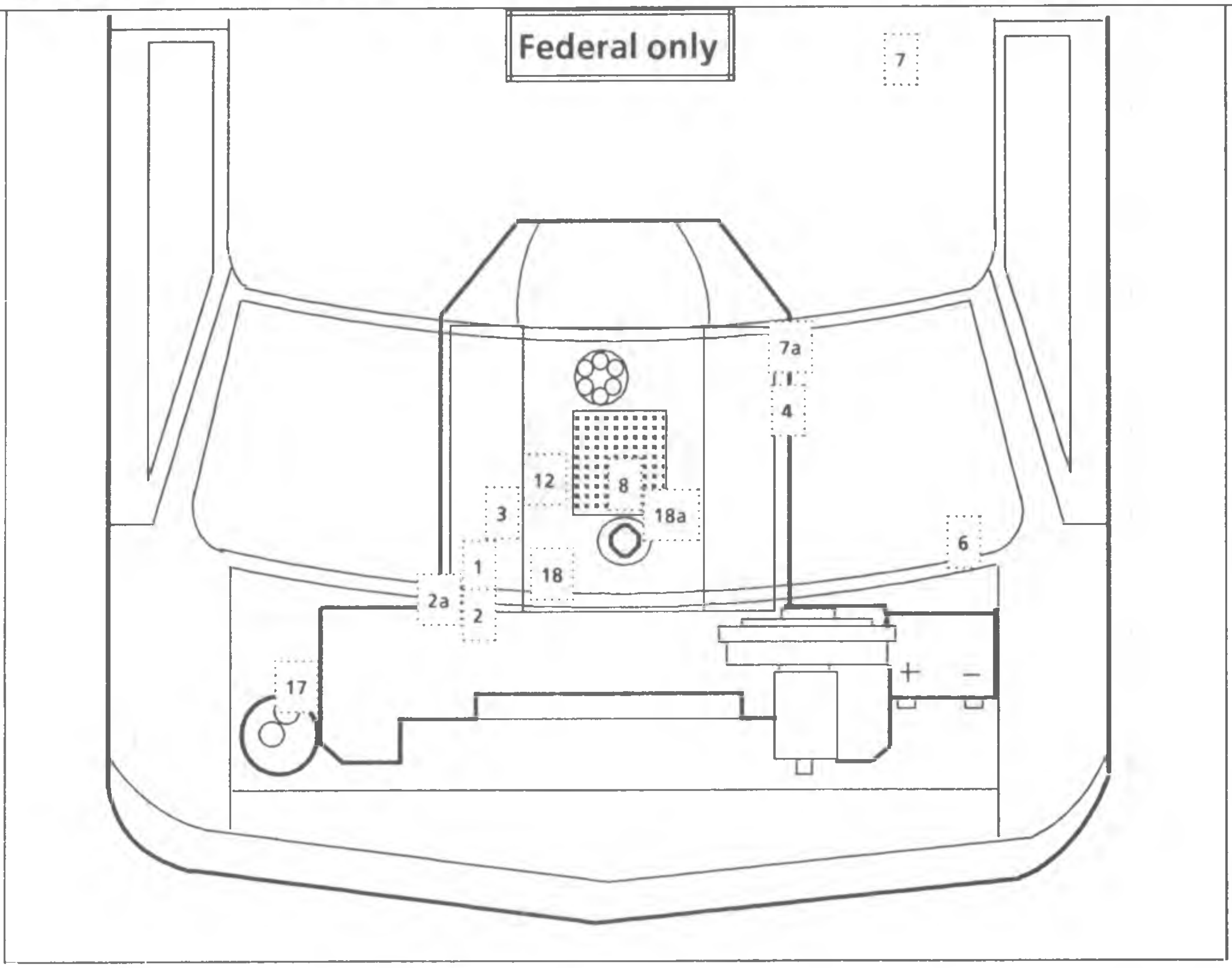
*5S 2146-6E

Figure 3 - Component Locations - 4.3L (G Series) - Calif.

'G' SERIES RPO: LB1 VIN CODE: N 4.3L V6 4BBL



⬚ **EMISSIONS DEVICES**

1	Crankcase vent valve (PCV)
2	Air injection pump
2a	Air injection divert valve
3	Deceleration valve
4	EFE valve
6	Fuse panel
7	Electronic Spark Contol module
7a	ESC knock sensor
8	Accelerator pump solenoid
12	EGR solenoid
17	Fuel vapor canister
18	Throttle kicker
18a	Throttle kicker solenoid

⬡ Exhaust Gas Recirculation valve

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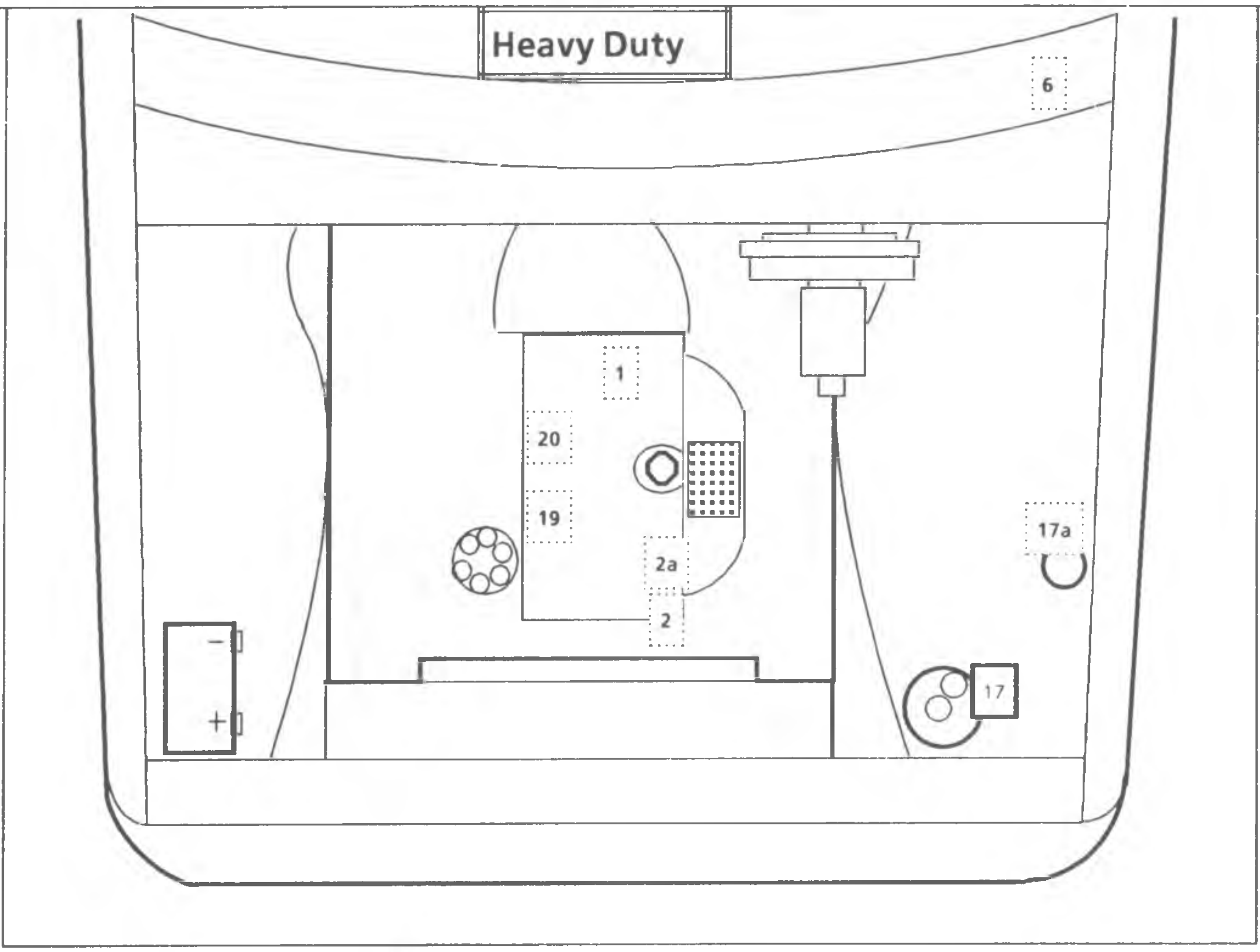
*55 2147-6E

Figure 4 Component Locations - 4.3L (G Series) - Fed

'C/K' SERIES RPO: L25 VIN CODE: T 4.8L L6 4BBL



⬚ EMISSIONS DEVICES

1	Crankcase vent valve (PCV)
2	Air injection pump
2a	Air injection divert valve
3	Deceleration valve
6	Fuse panel
17	Fuel vapor canister
17 a	Auxillary fuel vapor canister
19	Throttle return control
20	Throttle valve relay

◎ Exhaust Gas Recirculation valve

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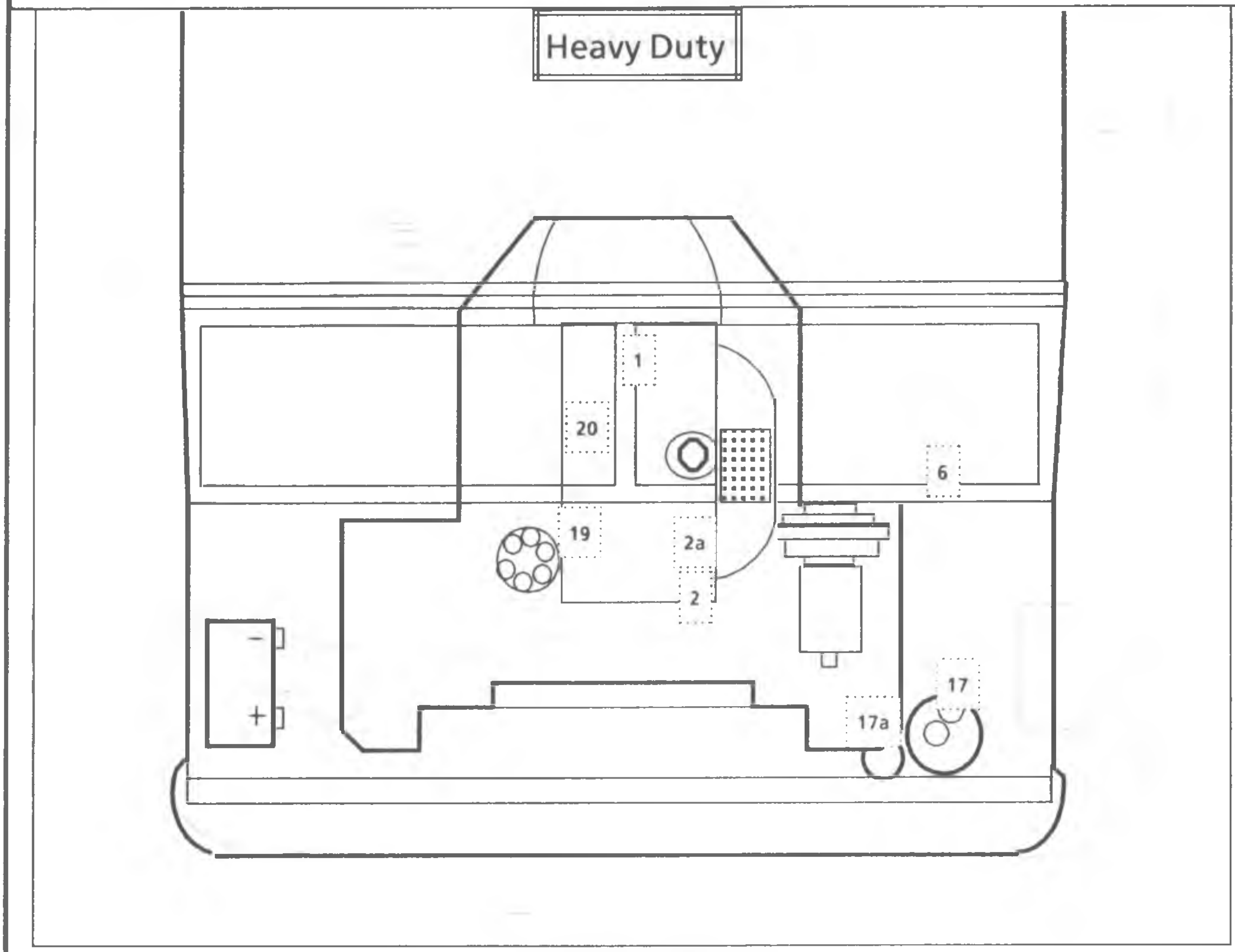
*5S2135-6E

Figure 5 Component Locations - 4.8L (CK Series)

'P' SERIES RPO: L25 VIN CODE: T 4.8L L6 4BBL



⬚ EMISSIONS DEVICES

1	Crankcase vent valve (PCV)
2	Air injection pump
2a	Air injection divert valve
6	Fuse panel
17	Fuel vapor canister
17 a	Auxillary fuel vapor canister
19	Throttle return control
20	Throttle valve relay
◎	Exhaust Gas Recirculation valve

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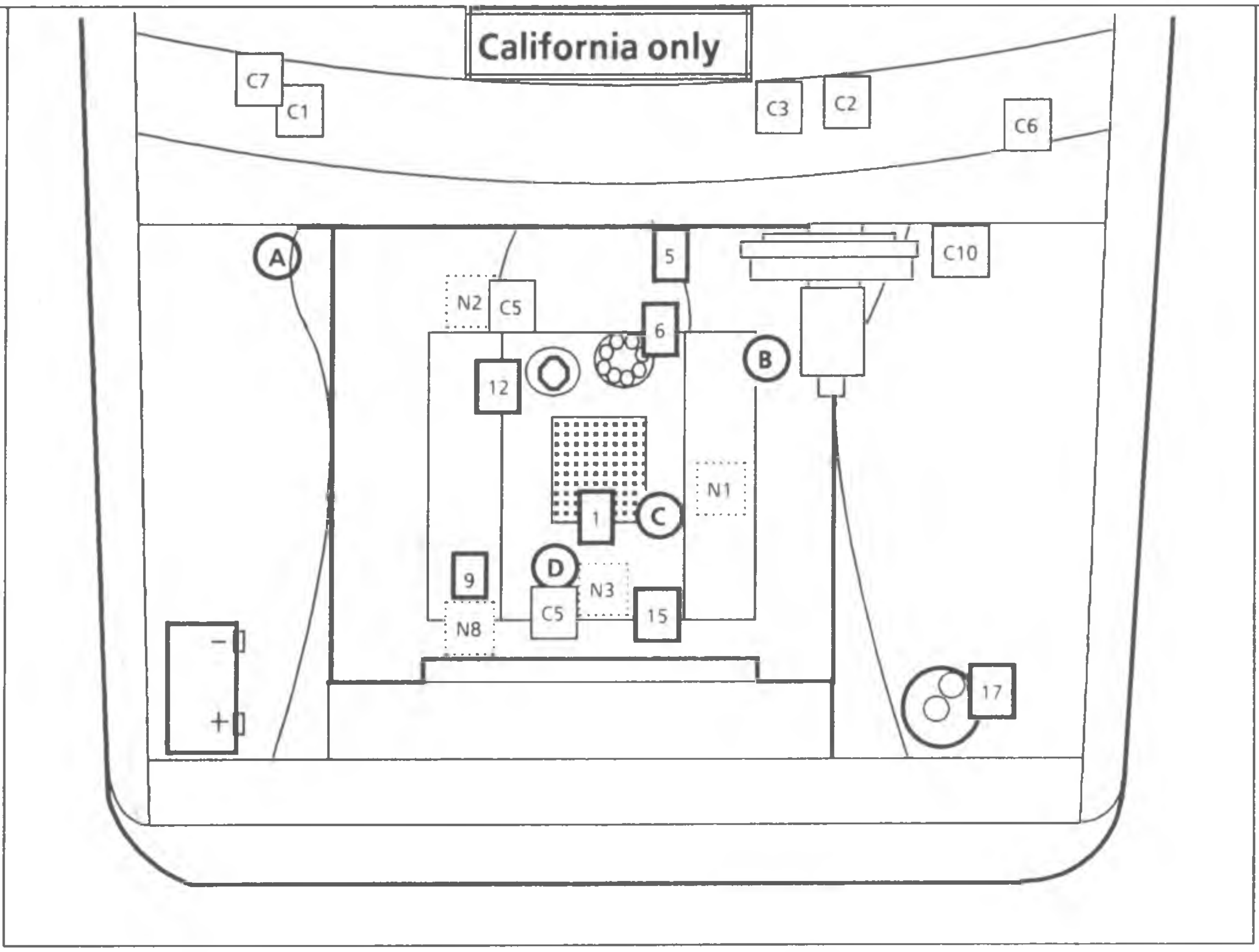
*5S 2151-6E

Figure 6 Component Locations - 4.8L (P Series)

'C/K' SERIES RPO: LF3/LS9 VIN CODE: F/L 5.0/5.7L V8 4BBL



□ COMPUTER HARNESS

C1	Electronic Control Module (ECM)
C2	ALCL diagnostic connector
C3	"SERVICE ENGINE SOON" light
C5	ECM harness ground
C6	Fuse panel
C7	Lamp driver
C10	A/F dwell connector

☐ CONTROLLED DEVICES

1	Mixture control solenoid
5	Trans. Conv. Clutch connector
6	Electronic Spark Timing
9	Air injection divert valve
12	Exhaust Gas Recirculation solenoid
15	Fuel vapor canister solenoid
17	Fuel vapor canister

◎ Exhaust Gas Recirculation valve

○ INFORMATION SENSORS

A	Manifold differential perssure
B	Exhaust oxygen
C	Throttle position
D	Coolant temperature

⬚ NOT ECM CONNECTED

N1	Crankcase vent valve (PCV)
N2	EFE valve
N3	Deceleration valve
N8	Air injection pump

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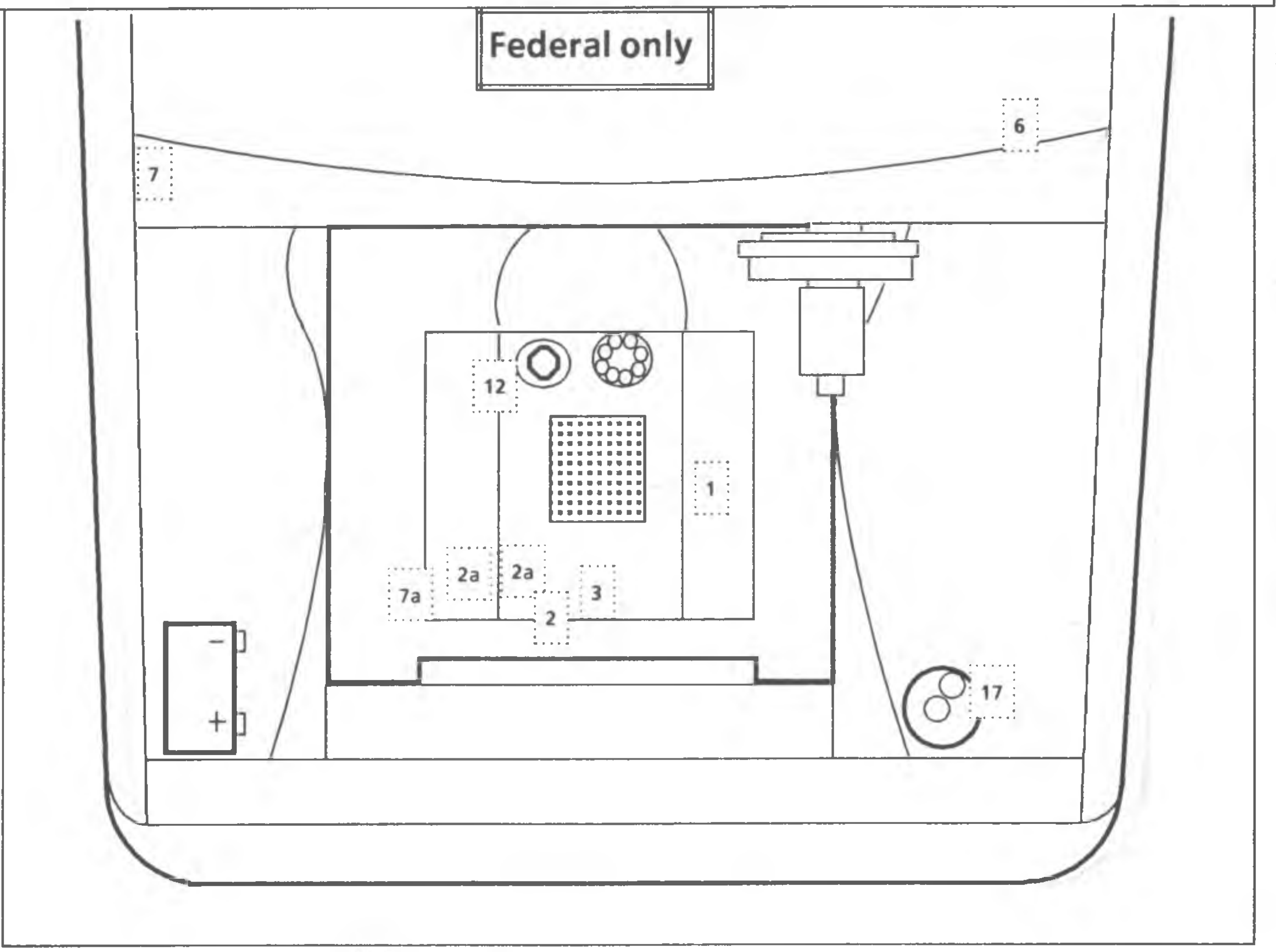
*5S 2136-6E

Figure 7 Component Locations - 5.0L/5.7L (CK Series) - Calif

'C/K' SERIES RPO: LE9/LS9 VIN CODE: H/L 5.0/5.7L V8 4BBL



⬚ EMISSIONS DEVICES

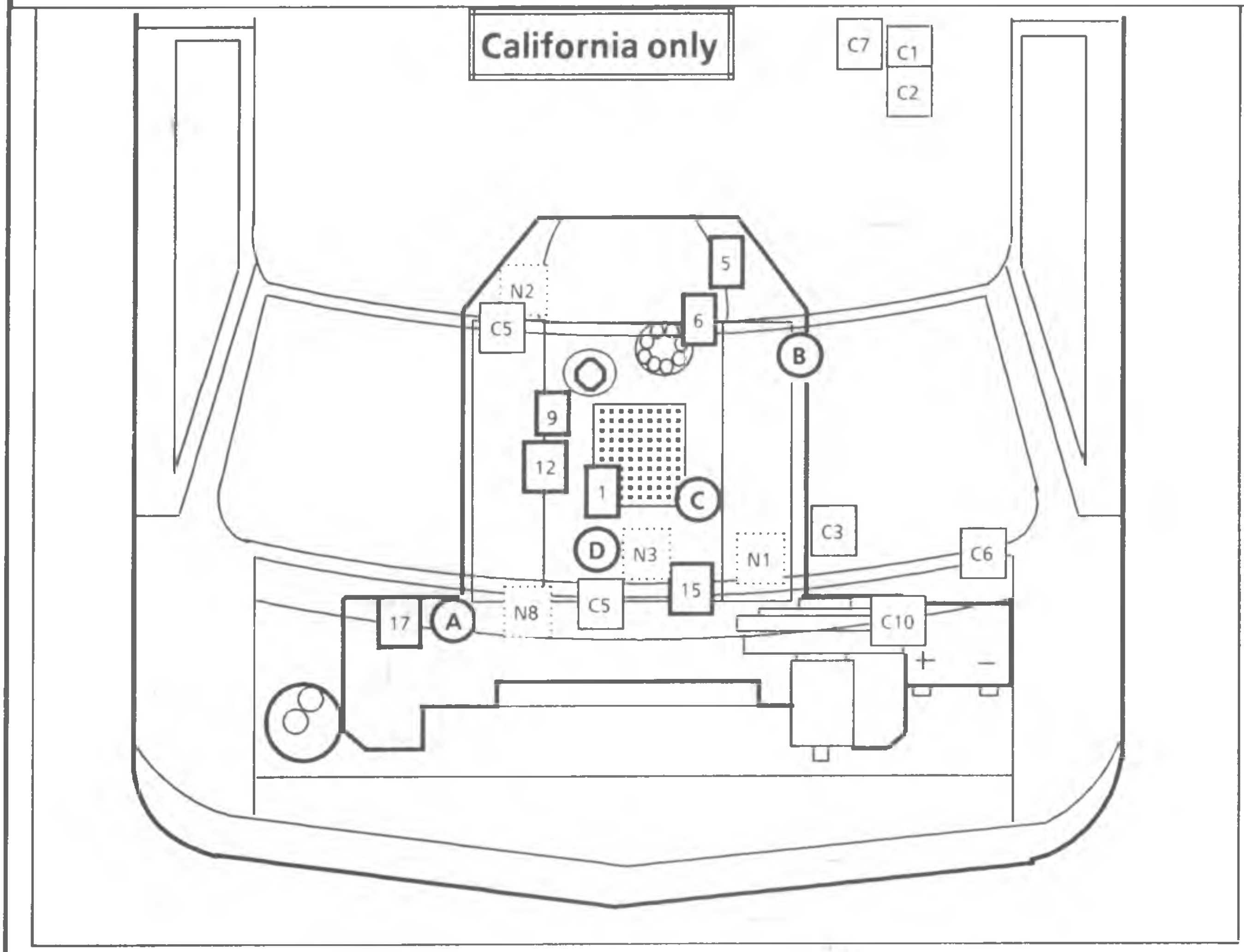
1	Crankcase vent valve (PCV)
2	Air injection pump
2a	Air injection divert valve
3	Deceleration valve
4	EFE valve
6	Fuse panel
7	Electronic Spark Control module
7a	ESC knock sensor
12	EGR control valve solenoid
17	Fuel vapor canister solenoid
◎	Exhaust Gas Recirculation valve

11-27-84

*5S2137-6E

Figure 8 Component Locations - 5.0L/5.7L (CK Series) - Fed

'G' SERIES RPO: LF3/LS9 VIN CODE: F/L 5.0/5.7L V8 4BBL



☐ **COMPUTER HARNESS**

C1 Electronic Control Module (ECM)
C2 ALCL diagnostic connector
C3 "SERVICE ENGINE SOON" light
C5 ECM harness ground
C6 Fuse panel
C7 Lamp driver
C10 A/F dwell connector

⬚ **EMISSION SYSTEMS (NOT ECM CONTROLLED)**

N1 Crankcase vent valve (PCV)
N2 EFE valve
N3 Deceleration valve
N8 Air injection pump

☐ **CONTROLLED DEVICES**

1 Mixture control solenoid
5 Trans. Conv. Clutch connector
6 Electronic Spark Timing
9 Air injection divert valve
12 Exhaust Gas Recirc. solenoid (PWM)
15 Fuel vapor canister solenoid
17 Fuel vapor canister

◎ Exhaust Gas Recirculation valve

○ **INFORMATION SENSORS**

A Manifold differential perrssure
B Exhaust oxygen
C Throttle position
D Coolant temperature

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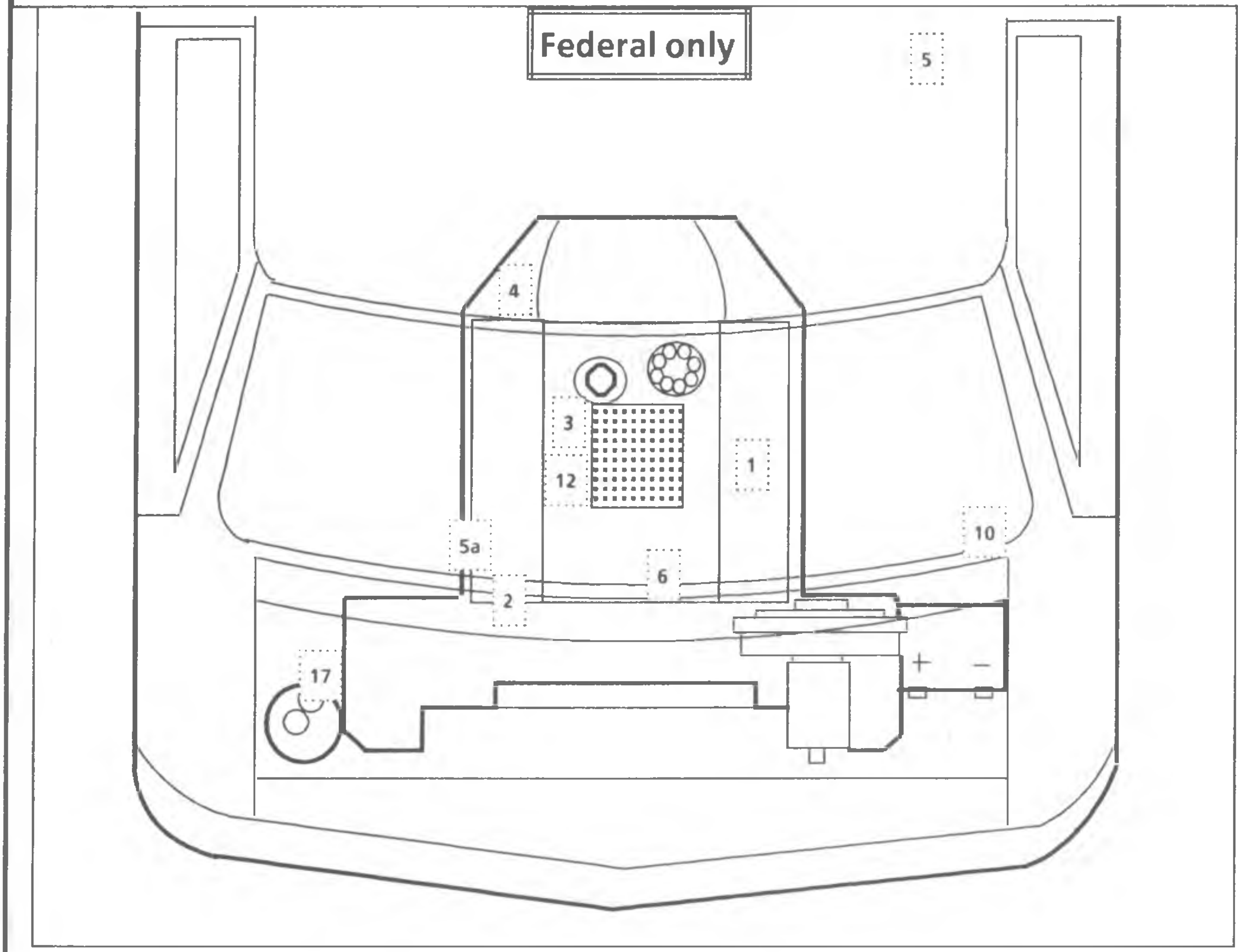
*5S 2145-6E

Figure 9 Component Locations - 5.0L/5.7L (G Series) - Calif.

'G' SERIES RPO: LE9/LS9 VIN CODE: H/L 5.0/5.7L V8 4BBL



⬚ **EMISSIONS DEVICES**

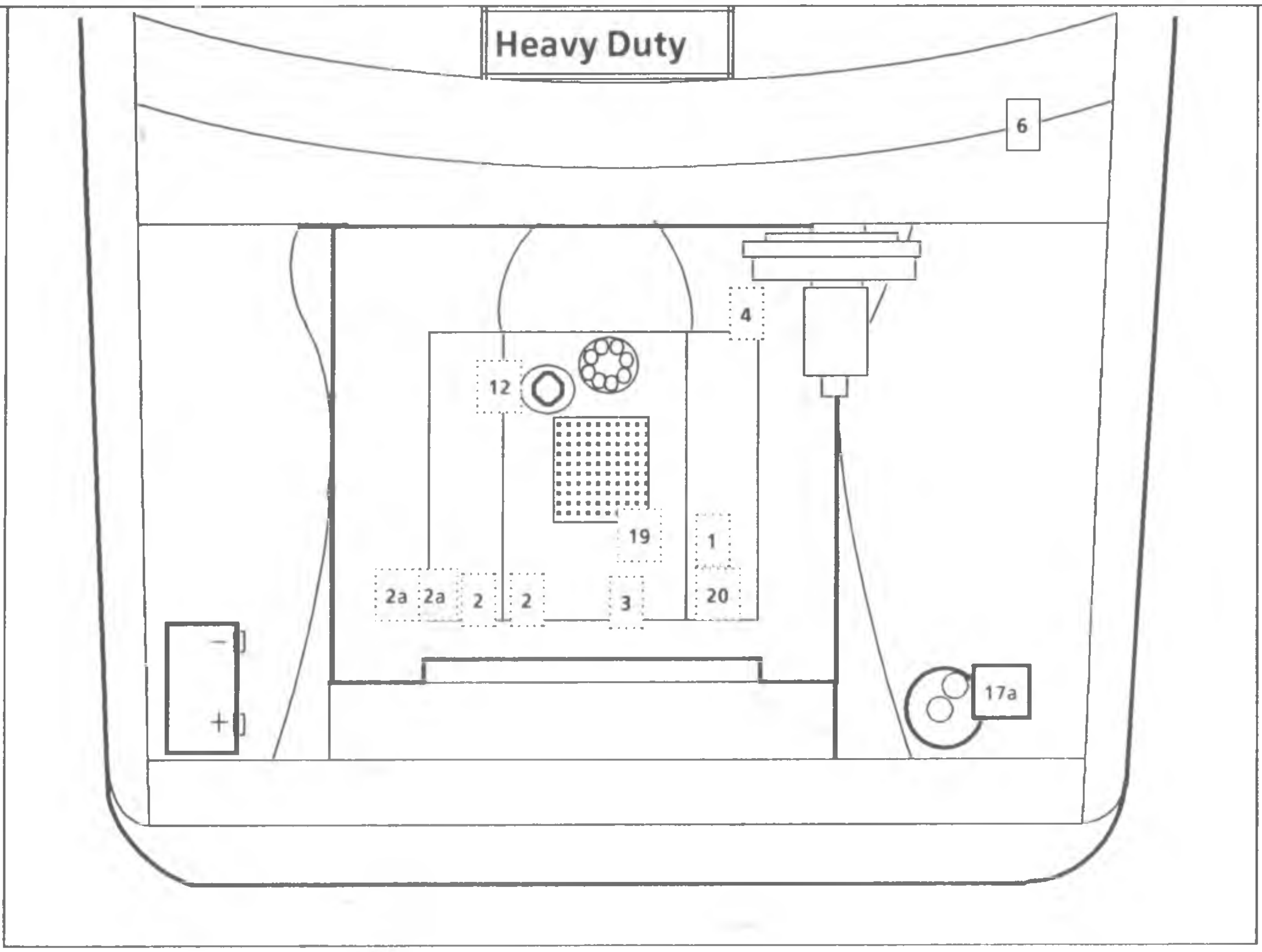
1 Crankcase vent valve (PCV)
2 Air injection pump
3 Air injection divert valve
4 EFE valve
5 Electronic Spark Control module
5a ESC knock sensor
6 Deceleration valve
10 Fuse panel
12 EGR solenoid
17 Fuel vapor canister

◯ Exhaust Gas Recirculation valve

11-27-84
*5S 2148-6E

Figure 10 Component Locations - 5.0L/5.7L (G Series) - Fed

'C/K' SERIES RPO:LT9 VIN CODE:M 5.7L V8 4BBL



⬚ **EMISSIONS DEVICES**

1 Crankcase vent valve (PCV)
2 Air injection pump
2a Air injection divert valve
3 Deceleration valve
4 EFE valve
6 Fuse panel
12 EGR control valve solenoid
17a Fuel vapor canister solenoid
19 Throttle return control
20 Throttle valve relay
⬡ Exhaust Gas Recirculation valve

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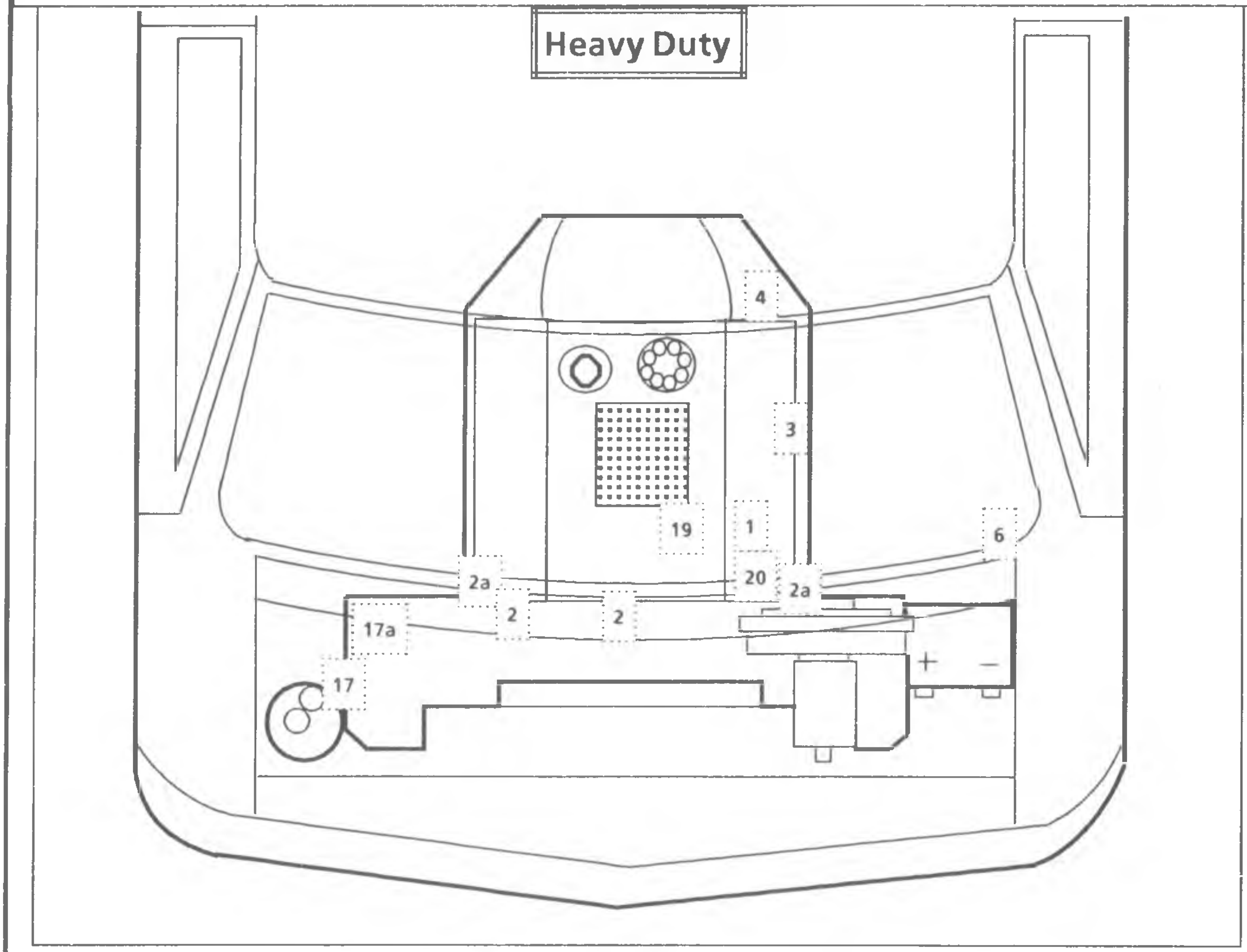
*5S2138-6E

Figure 11 Component Locations - 5.7L (CK Series) - H.D. Emissions

'G' SERIES RPO:LT9 VIN CODE:M 5.7L V8 4BBL



⬚ EMISSIONS DEVICES

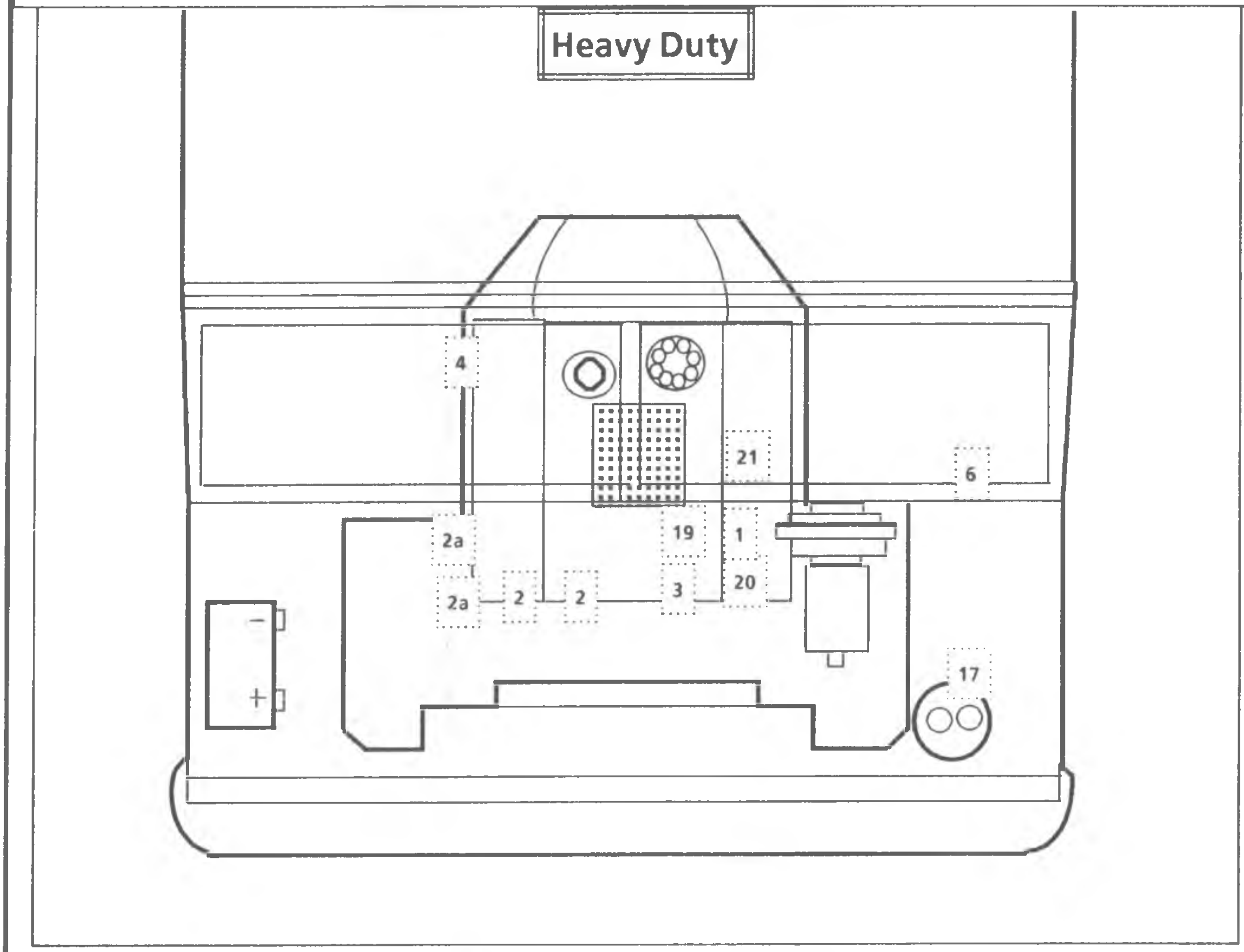
1	Crankcase vent valve (PCV)
2	Air injection pump
2a	Air injection divert valve
3	Deceleration valve
4	EFE valve
6	Fuse panel
17	Fuel vapor canister
17a	Fuel vapor canister solenoid
19	Throttle return control
20	Throttle valve relay
◎	Exhaust Gas Recirculation valve

11-27-84

*5S 2149-6E

Figure 12 Component Locationms - 5.7L (G Series) - H.D. Emissions

'P' SERIES RPO:LT9 VIN CODE:M 5.7L V8 4BBL



⬚ EMISSIONS DEVICES

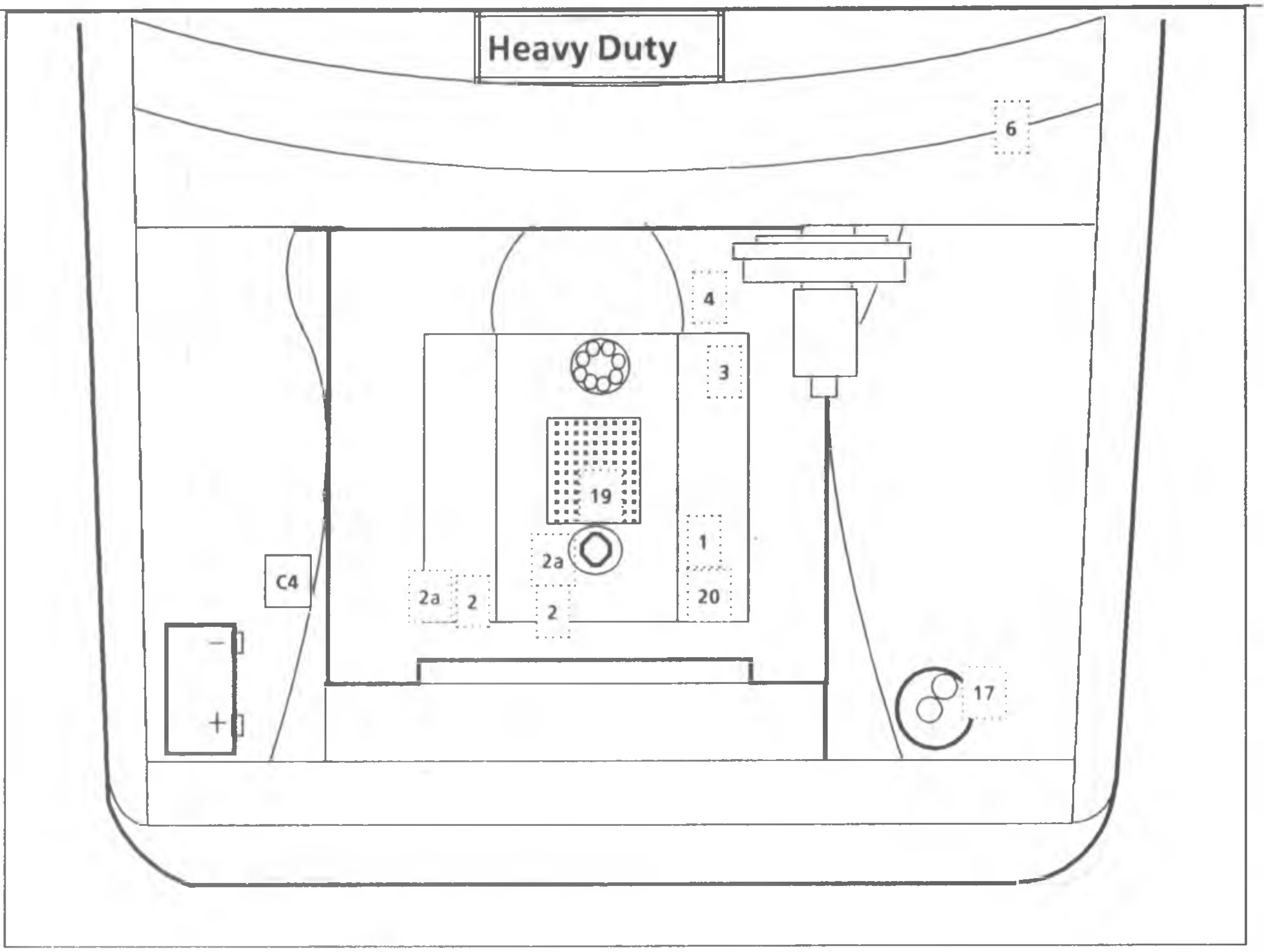
1	Crankcase vent valve (PCV)
2	Air injection pump
2a	Air injection divert valve
3	Deceleration valve
4	EFE valve
6	Fuse panel
17	Fuel vapor canister solenoid
19	Throttle return control
20	Throttle valve relay
21	Engine speed relay
◎	Exhaust Gas Recirculation valve

11-27-84

*5S 2150-6E

Figure 13 Component Locations - 5.7L (P Series)

'C/K' SERIES RPO: LE8 VIN CODE: W 7.4L V8 4BBL



⬚ EMISSIONS DEVICES

1	Crankcase vent valve (PCV)
2	Air injection pump
2a	Air injection divert valve
3	Deceleration valve
4	EFE valve
6	Fuse panel
17	Fuel vapor canister solenoid
19	Throttle return control
20	Throttle valve relay
◎	Exhaust Gas Recirculation valve

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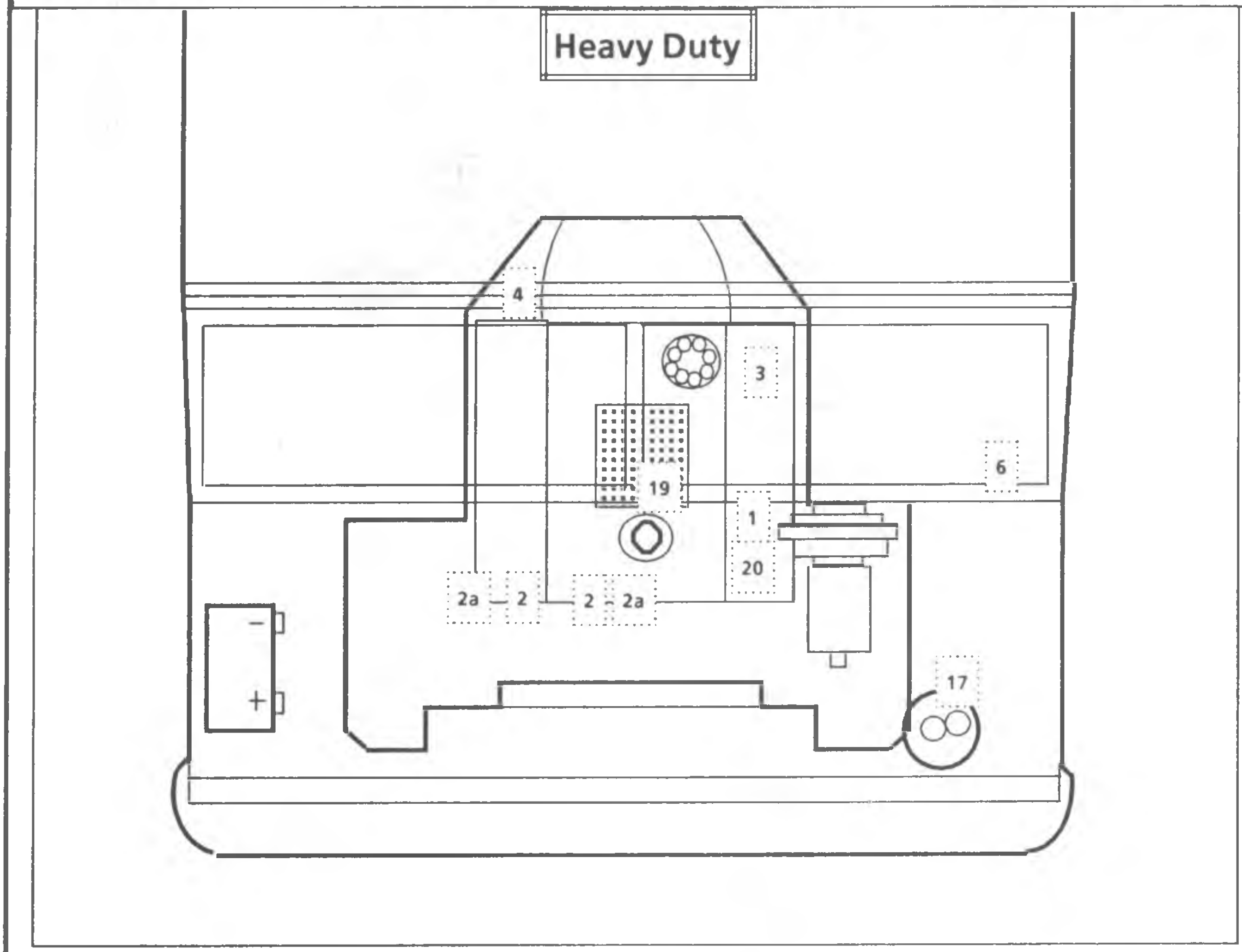
*5S2158-6E

Figure 14 Component Locations - 7.4L (CK Series)

'P' SERIES RPO:LE8 VIN CODE:W 7.4L V8 4BBL



EMISSIONS DEVICES

1	Crankcase vent valve (PCV)
2	Air injection pump
2a	Air injection divert valve
3	Deceleration valve
4	EFE valve
6	Fuse panel
17	Fuel vapor canister
19	Throttle return control
20	Throttle valve relay
◎	Exhaust Gas Recirculation valve

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*5S 2152-6E

Figure 15 Component Locations - 7.4L (P Series)

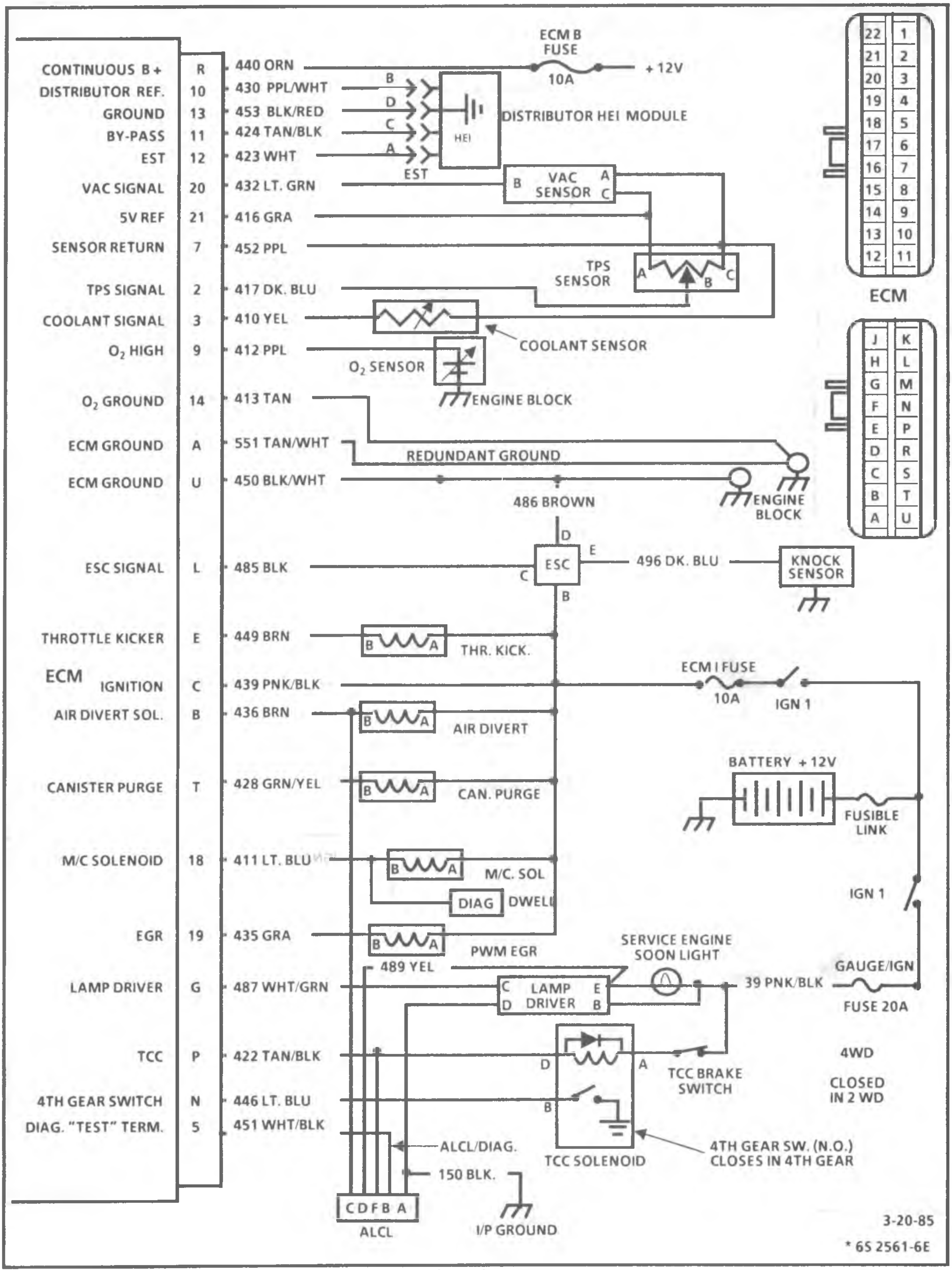


Figure 16 ECM Wiring Diagram - 4.3L - CALIF.

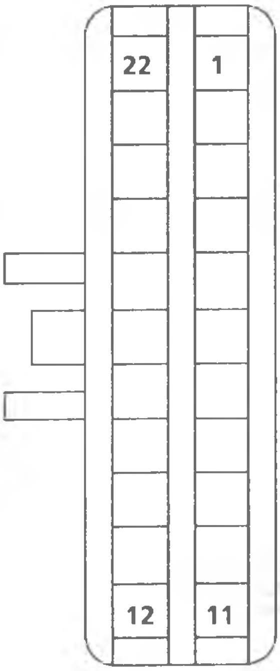
ECM TERMINAL VOLTAGE

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:

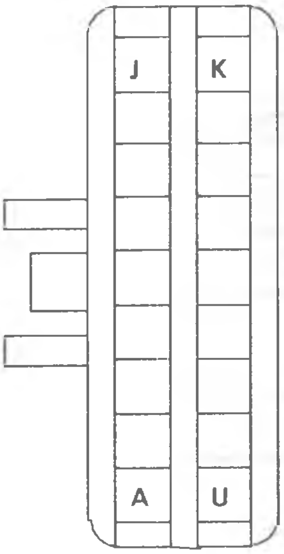
- Engine at operating temperature
- Engine idling in closed loop (for "Engine Run" column)
- Engine at 1000 RPM for "engine run" column
- Test terminal not grounded
- ALCL tool (scanner) not installed
- 2 WD

VOLTAGE KEY "ON"	ENG. RUN	WIRE COLOR	
			NOT USED
5	5	GRA	5V REFERENCE
.5-.65	2-3	LT. GRN	VAC. SENS. SIG.
12	14	GRA	EGR
12	5-10 (VAR.)	LT. BLU	M/C SOLENOID
			NOT USED
			NOT USED
			NOT USED
*.5	*.5	TAN	O2 SENS. - LO
*.5	*.5	BLK/RED	DIST. REF. - LO
*.5	1-2 (VAR.)	WHT	EST



	VOLTAGE KEY "ON"	ENG. RUN	WIRE COLOR
NOT USED			
TPS SENSOR SIGNAL	*1.0 +5.0	*2.0	DK. BLU
COOLANT TEMP. SENSOR SIG.	*3.0	*2.5	YEL
NOT USED			
DIAGNOSTIC "TEST" TERMINAL	5	5	WHT/BLK
NOT USED			
COOLANT RETURN	0	0	BLK
NOT USED			
O2 SENSOR - HI	.3-.45	.1-.9 (VAR)	PPL
DIST.REF. PULSE -HI	*.5	1-2 (VAR.)	PPL/WHT
IGN. MOD. BY-PASS	*.5	3.7	TAN/BLK

			NOT USED
			NOT USED
10	*.5	WHT/GRN	SERVICE ENGINE SOON LAMP
			NOT USED
12	14	BRN	THROTTLE KICKER
			NOT USED
12	14	PNK/BLK	IGN 1 POWER
12	.14	BRN	AIR DIVERT SOL.
0	0	TAN/WHT	GROUND (TO ENGINE)



NOT USED			
ESC SIGNAL	7-10	7-10	BLK
NOT USED			
4TH GEAR SWITCH	*.5	*.5	LT. BLU
TRANS. CONVERTER CLUTCH SOLENOID	12	14	BLU/BLK[1] TAN/BLK[2]
CONTINUOUS BATTERY	12	14	ORN
NOT USED			
PURGE	12	.12	GRN/YEL
GROUND TO ENGINE	0	0	BLK/WHT

[1] - FOUR WHEEL DRIVE - 4WD
[2] - TWO WHEEL DRIVE - 2WD

* = VALUE SHOWN, OR LESS THAN THAT VALUE.
(VAR.) = VARIABLE
\+ = WIDE OPEN THROTTLE

ENGINE 4.3L
VEHICLE C,K,G,TRK

*6S 2556-6E
3-20-85

Figure 17 ECM Connector Terminal End View - 4.3L - CALIF.

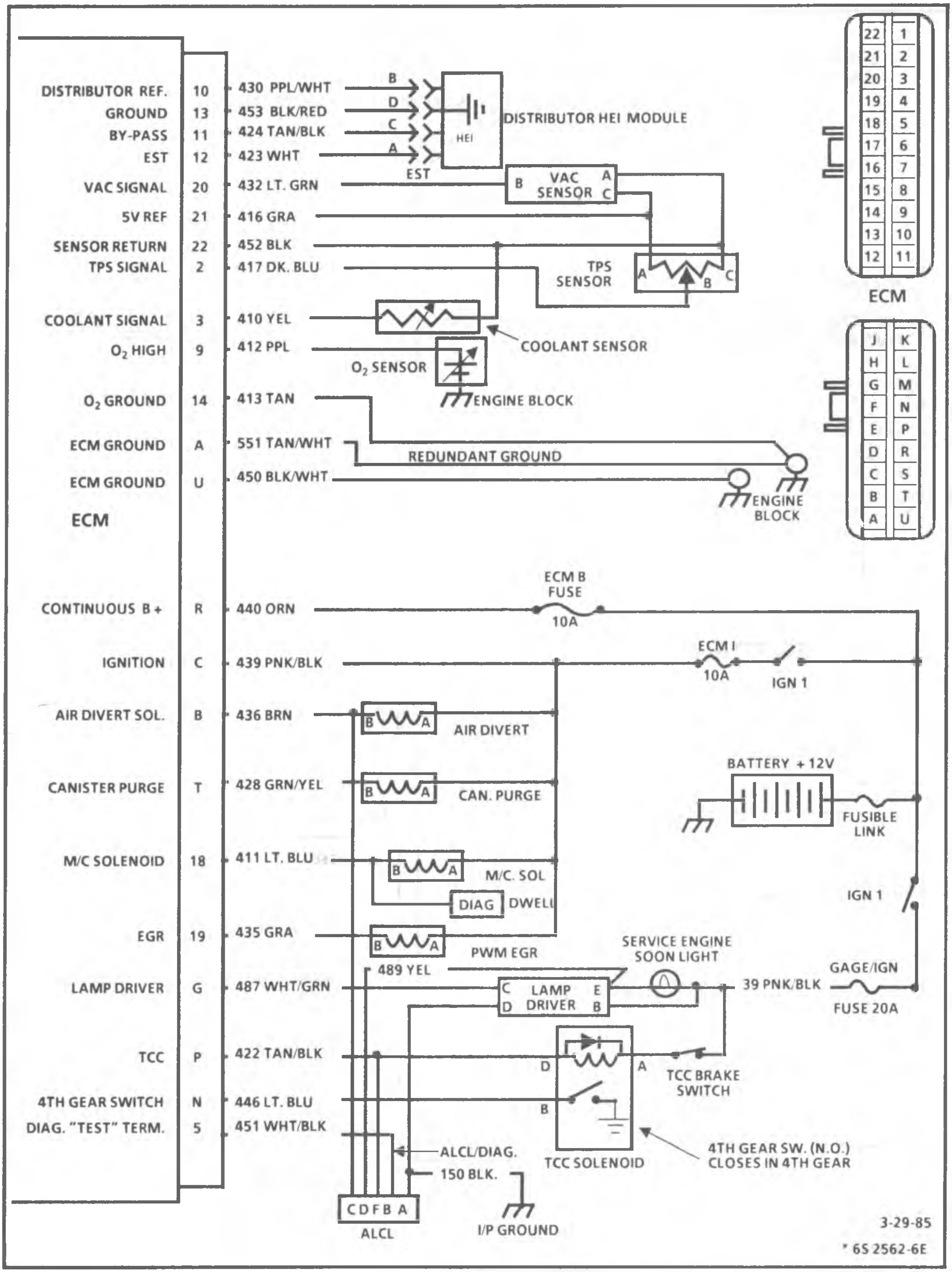


Figure 18 ECM Wiring Diagram - 5.0L/5.7L - CALIF.

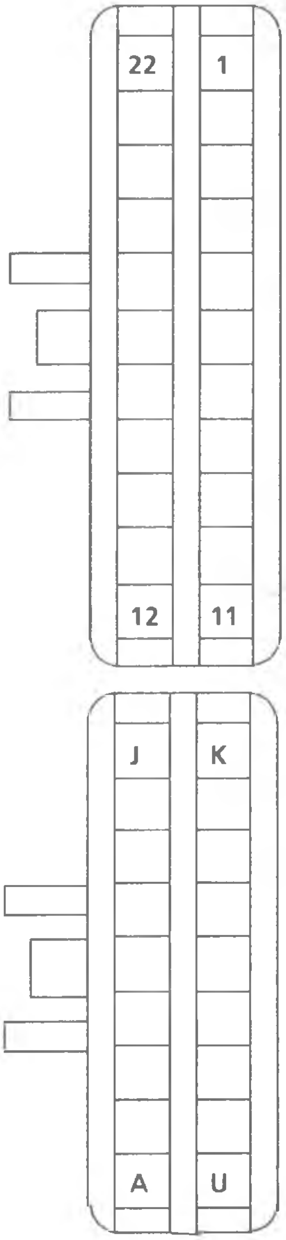
ECM TERMINAL VOLTAGE

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)
- Engine at 1000 RPM for "engine run" column
- Test terminal not grounded
- ALCL tool (scanner) not installed
- 2 WD

VOLTAGE KEY "ON"	ENG. RUN	WIRE COLOR	
0	0	BLK	SENSOR RETURN
5	5	GRA	5V REFERENCE
.5-.65	2-3	LT. GRN	VAC. SENS. SIG.
12	14	GRA	EGR
12	5-10 (VAR.)	LT. BLU	M/C SOLENOID
			NOT USED
			NOT USED
			NOT USED
*.5	*.5	TAN	O2 SENS. - LO
*.5	*.5	BLK/RED	DIST. REF. - LO
*.5	1-2 VAR.	WHT	EST



	VOLTAGE KEY "ON"	ENG. RUN	WIRE COLOR
NOT USED			
TPS SENSOR SIGNAL	*1.0 +5.0	*2.0	DK. BLU
COOLANT TEMP. SENSOR SIG.	*3.0	*2.5	YEL
NOT USED			
DIAGNOSTIC "TEST" TERMINAL	5	5	WHT/BLK
NOT USED			
NOT USED			
NOT USED			
O2 SENSOR - HI	.3-.45	.1-.9 VAR	PPL
DIST.REF. PULSE -HI	*.5	1-2 VAR	PPL/WHT
IGN. MOD. BY-PASS	*.5	3.7	TAN/BLK

			NOT USED
			NOT USED
10	*.5	WHT/GRN	SERVICE ENGINE SOON LIGHT
			NOT USED
			NOT USED
12	14	PNK/BLK	IGN 1 POWER
12	.14	BRN	AIR DIVERT SOL.
0	0	TAN/WHT	GROUND (TO ENGINE)

NOT USED			
NOT USED			
NOT USED			
4TH GEAR SWITCH	*.5	*.5	LT. BLU
TRANS. CONVERTER CLUTCH SOLENOID	12	14	BLU/BLK [1] TAN/BLK [2]
CONTINUOUS BATTERY	12	14	ORN
NOT USED			
PURGE	12	.12	GRN/YEL
GROUND TO ENGINE	0	0	BLK/WHT

[1] FOUR WHEEL DRIVE - 4WD
[2] TWO WHEEL DRIVE - 2WD

* = VALUE SHOWN, OR LESS THAN THAT VALUE.
(VAR.) = VARIABLE
\+ = WIDE OPEN THROTTLE

ENGINE 5.0/5.7L
VEHICLE C,K,G,TRK

*6S 2557-6E
3-20-85

Figure 19 ECM Connector Terminal End View - 5.0L/5.7L - CALIF.

SECTION A
DIAGNOSTIC CHARTS
4.3L, 5.0L (RPO LF3) 5.7L (RPO LS9) ENGINE
CALIFORNIA ONLY

GENERAL

The diagnostic information for Section A should only be used for California vehicles with Computer Command Control and an Electronic Control Module. Review the Introduction in Section 6E before using this Section.

Trouble Code Identification

The trouble code identification chart (Figure 20) is a brief explanation of why a trouble code was set by the ECM. Before referring to a trouble code chart, perform a "Diagnostic Circuit Check".

PERFORMANCE CHARTS

When the performance of the system has indicated a problem with a fixed dwell reading, a diagnostic "A" chart will check and lead to the correction.

When checking the "Diagnostic Circuit Check", Chart A-5 will determine why the "service engine soon" lamp is inoperative.

Chart A-6 will correct the reason for the "service engine soon" lamp being "ON" all the time or why the ECM will not flash trouble code 12.

STARTING POINT

The "Diagnostic Circuit Check" is the starting point for driveability or emission diagnosis on vehicles with Computer Command Control. It 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.

TROUBLE CODE IDENTIFICATION

4.3L, 5.0L OR 5.7L ENGINE - CALIFORNIA

The "SERVICE ENGINE SOON" light will only be "ON" if the malfunction exists under the conditions listed below. It takes up to five seconds minimum for the light to come on when a problem occurs. If the malfunction clears, the light will go out and a trouble code will be set in the ECM. Code 12 does not store in memory. If the light comes "on" intermittently, but no code is stored, go to Section B - Symptoms. Any codes stored will be erased if no problem reoccurs within 50 engine starts. A specific engine may not use all available codes.

The trouble codes indicate problems as follows:

TROUBLE CODE 12	No distributor reference signal to the ECM. This code is not stored in memory and will only flash while the fault is present. Normal code with ignition "on," engine not running.
TROUBLE CODE 13	Oxygen Sensor Circuit - The engine must run up to four minutes at part throttle, under road load, before this code will set.
TROUBLE CODE 14	Shorted coolant sensor circuit - The engine must run two minutes before this code will set.
TROUBLE CODE 15	Open coolant sensor circuit - The engine must run five minutes before this code will set.
TROUBLE CODE 21	Throttle Position Sensor (TPS) circuit voltage high (open circuit or misadjusted TPS). The engine must run 10 seconds, at specified curb idle speed, before this code will set.
TROUBLE CODE 23	M/C solenoid circuit open or grounded.
TROUBLE CODE 34	Differential Pressure (Vacuum) sensor circuit - The engine must run up to two minutes, at specified curb idle, before this code will set.
TROUBLE CODE 41	No distributor reference signal to the ECM at specified engine vacuum. This code will store in memory.
TROUBLE CODE 42	Electronic spark timing (EST) bypass circuit or EST circuit grounded or open.
TROUBLE CODE 43	Electronic Spark Control (ESC) retard signal for too long a time; causes retard in EST signal.
TROUBLE CODE 44	Lean exhaust indication - The engine must run two minutes, in closed loop and at part throttle, before this code will set.
TROUBLE CODE 45	Rich exhaust indication - The engine must run two minutes, in closed loop and at part throttle, before this code will set.
TROUBLE CODE 51	Faulty or improperly installed calibration unit (PROM). It takes up to 30 seconds before this code will set.
TROUBLE CODE 54	M/C solenoid voltage high at ECM as a result of a shorted M/C solenoid circuit and/or faulty ECM.

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6S 2552-6E

Figure 20 Trouble Code Identification

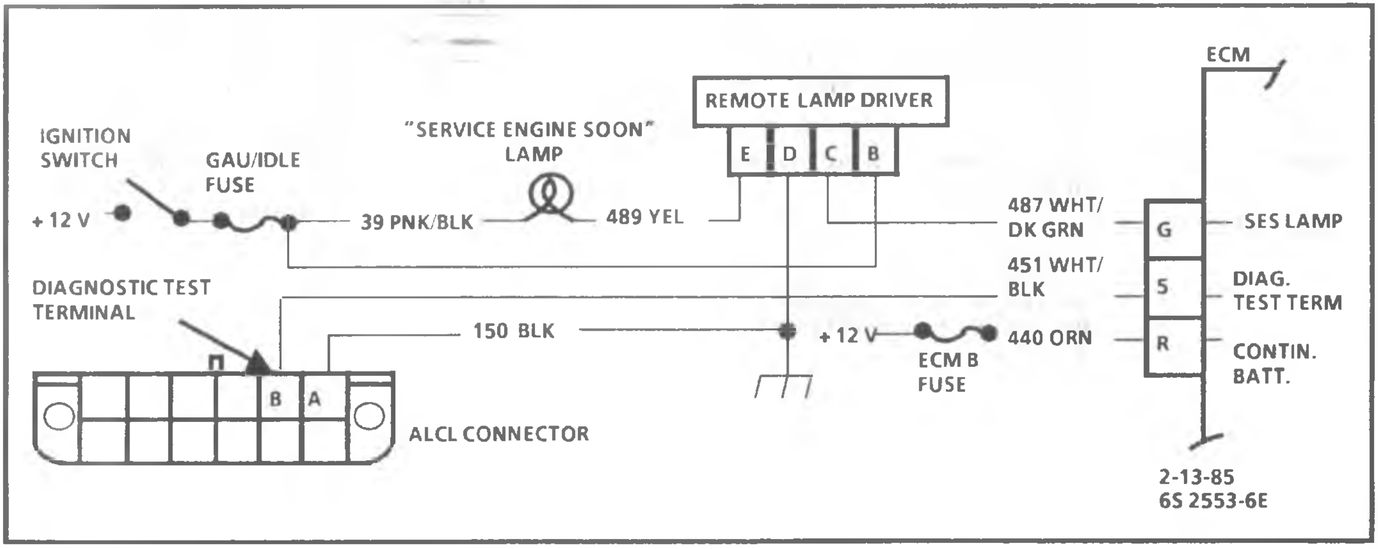
DIAGNOSTIC CIRCUIT CHECK

4.3L, 5.0L OR 5.7L ENGINE

CARBURETED - CALIF.

The purpose of the Diagnostic Circuit Check is to 1) make sure the "SERVICE ENGINE SOON" light works, 2) the ECM is operating and can recognize a fault, and 3) to determine if any codes are stored. If codes are stored, it also checks to see if they indicate an intermittent problem. This is the starting point for any diagnosis. If there are no codes indicated, go to the System Performance Check. If no additional checks are called out from the System Performance Check, go to the Driveability Symptoms, Section "B."

1. Check for proper operation of the "SERVICE ENGINE SOON" light with the key "ON," engine not running. The light should be on steady.
2. Grounding the test terminal will flash a Code 12 and any stored trouble codes. The light must go "ON" and "OFF" for a proper code. If the light goes from "Bright" to "Dim" this is not considered a code. See Chart A-6 in that case.
3. This step is to determine if any codes, other than Code 12 that was recorded before, are still present, or were intermittent and are no longer there. Memory is cleared and vehicle run for two minutes to see if trouble code(s) will reset.
4. If the light is "ON," fault is still present; therefore, go to the applicable trouble code chart.
5. If the light is "OFF," the fault is either intermittent, or it is a code that cannot be set in the stall in two minutes. For codes that cannot be set in the stall during the Diagnostic Circuit Check, the applicable trouble code chart will determine if those codes are intermittent.



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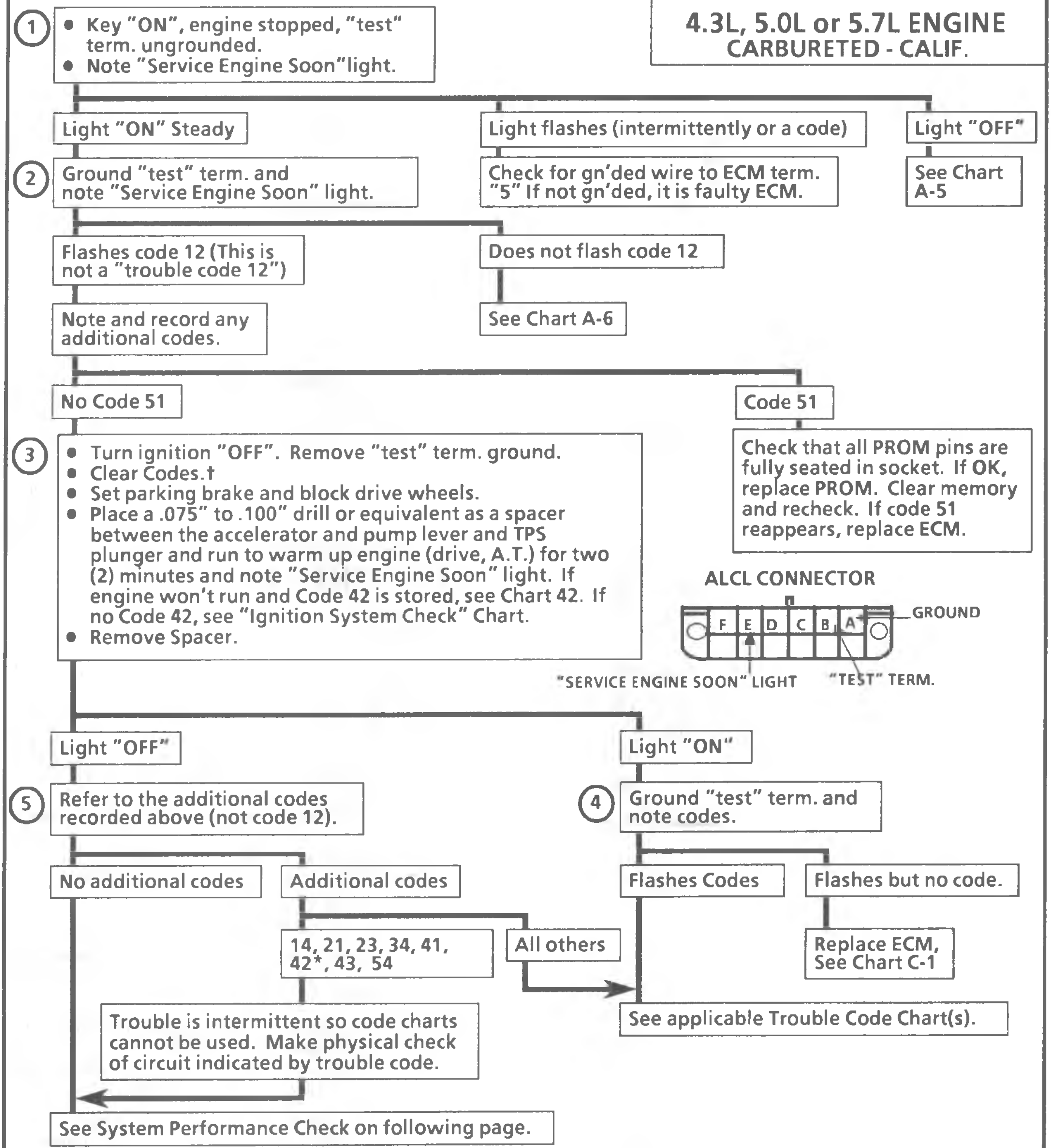
6S 2553-6E

DIAGNOSTIC CIRCUIT CHECK

4.3L, 5.0L or 5.7L ENGINE
CARBURETED - CALIF.



① • Key "ON", engine stopped, "test" term. ungrounded.
• Note "Service Engine Soon" light.

Light "ON" Steady

② Ground "test" term. and note "Service Engine Soon" light.

Flashes code 12 (This is not a "trouble code 12")

Note and record any additional codes.

No Code 51

③ • Turn ignition "OFF". Remove "test" term. ground.
• Clear Codes.†
• Set parking brake and block drive wheels.
• Place a .075" to .100" drill or equivalent as a spacer between the accelerator and pump lever and TPS plunger and run to warm up engine (drive, A.T.) for two (2) minutes and note "Service Engine Soon" light. If engine won't run and Code 42 is stored, see Chart 42. If no Code 42, see "Ignition System Check" Chart.
• Remove Spacer.

Light "OFF"

⑤ Refer to the additional codes recorded above (not code 12).

No additional codes

Additional codes

14, 21, 23, 34, 41, 42*, 43, 54

Trouble is intermittent so code charts cannot be used. Make physical check of circuit indicated by trouble code.

All others

See System Performance Check on following page.

Light "ON"

④ Ground "test" term. and note codes.

Flashes Codes

Flashes but no code.

Replace ECM, See Chart C-1

See applicable Trouble Code Chart(s).

Code 51

Check that all PROM pins are fully seated in socket. If OK, replace PROM. Clear memory and recheck. If code 51 reappears, replace ECM.

Does not flash code 12

See Chart A-6

Light flashes (intermittently or a code)

Check for gn'ded wire to ECM term. "5" If not gn'ded, it is faulty ECM.

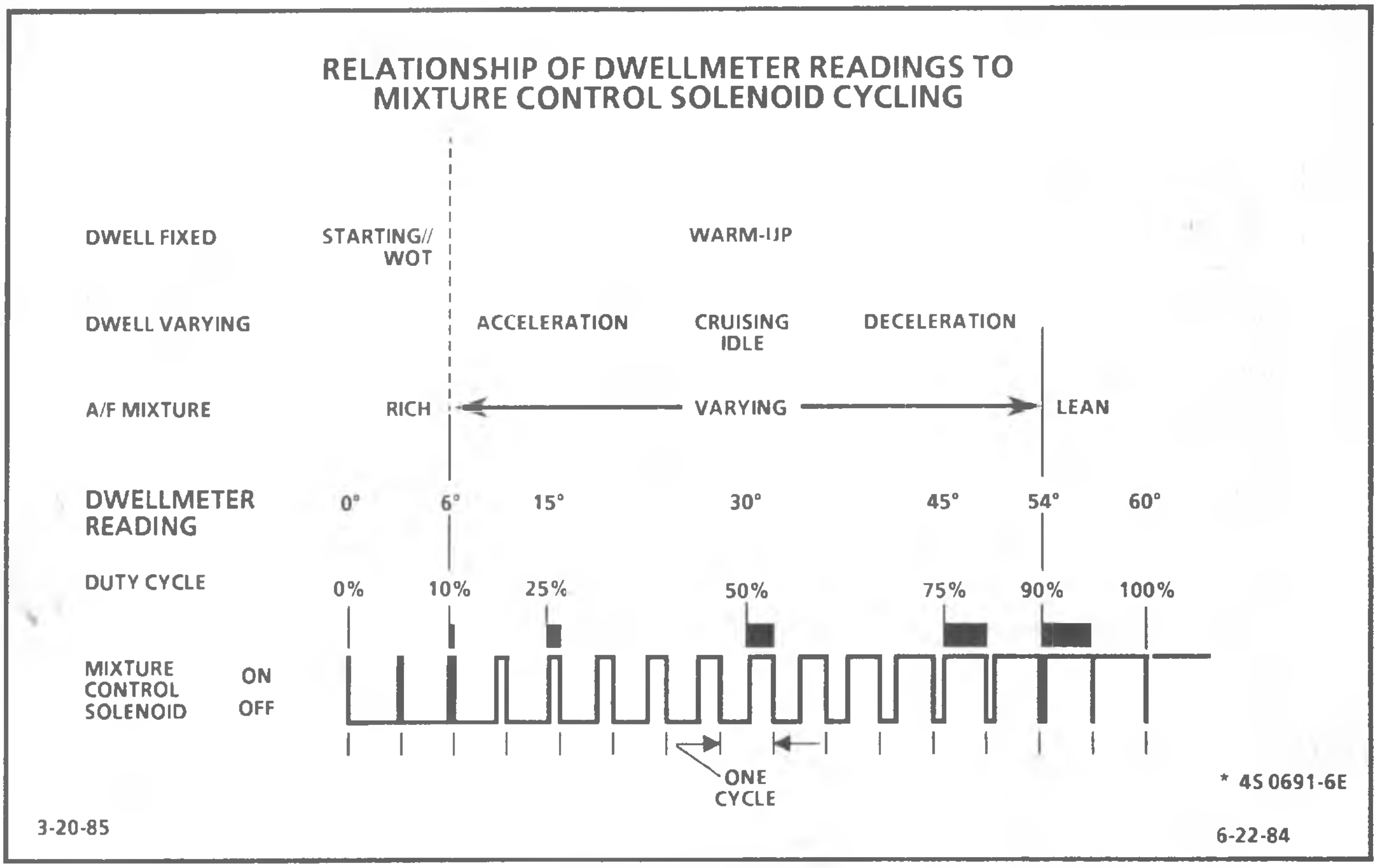
Light "OFF"

See Chart A-5

† To clear codes, remove power to 'R' term. of ECM for 10 sec. by removing ECM connector with ignition "OFF", or ECM B fuse, or disconnect ECM power feed at battery. Verify codes have been cleared. The System Performance Check should be performed after any repairs to the System have been made.

* It is possible to set a false Code 42 on starting, but the "Service Engine Soon" light will not be "ON". No corrective action is necessary.

3-20-85
* 5S 1790 6EA



SYSTEM PERFORMANCE CHECK

4.3L, 5.0L, OR 5.7L ENGINE

CARBURETED - CALIF.

1. Checks for ability of carburetor main metering system to change the Air/Fuel mixture. Disconnecting M/C solenoid makes carburetor operate full-rich and reconnecting it with the dwell lead grounded makes it operate full-lean. Normal response - RPM drops as M/C solenoid is reconnected. Usually 400-1000 RPM, but should be at least 300 RPM.

1A. If plugging the PCV, Purge, or Bowl Vent vacuum hose causes RPM to drop over 300 RPM, that hose leads to the souce of the problem. If RPM increases as M/C solenoid is connected, it indicates the system is running extremely rich. This can sometimes be caused by incorrect valve timing.

2. Checks for proper control of idle circuit.

2A. This is a full-rich command to the carburetor and can be caused by:
   1. Lean engine condition.
   2. Grounded oxygen sensor wire or bad sensor.
   3. Open in wire from ECM term. "14" to ground.
   4. Open wire to ECM term. "22".
   5. Open in coolant sensor circuit.

2B. There is an open loop condition. It can be caused by:
   1. An open oxygen sensor circuit or bad sensor.
   2. An open in coolant sensor circuit.
   3. An open in wire from ECM term. "14" to ground.

2C. This is a full lean command. It can be caused by:
   1. Rich engine condition caused by:
      a. M/C Solenoid wire connections reversed.
      b. Leaking Bowl Vent valve, excessive fuel in vapor canister, fuel in crankcase, faulty carburetor calibration or carburetor, or silicone contaminated oxygen sensor.

2D. Normal reading - operates in closed loop - dwell is between 10°-50°, but varying. Running for 1 minute at fast idle is to make sure the oxygen sensor is warm.

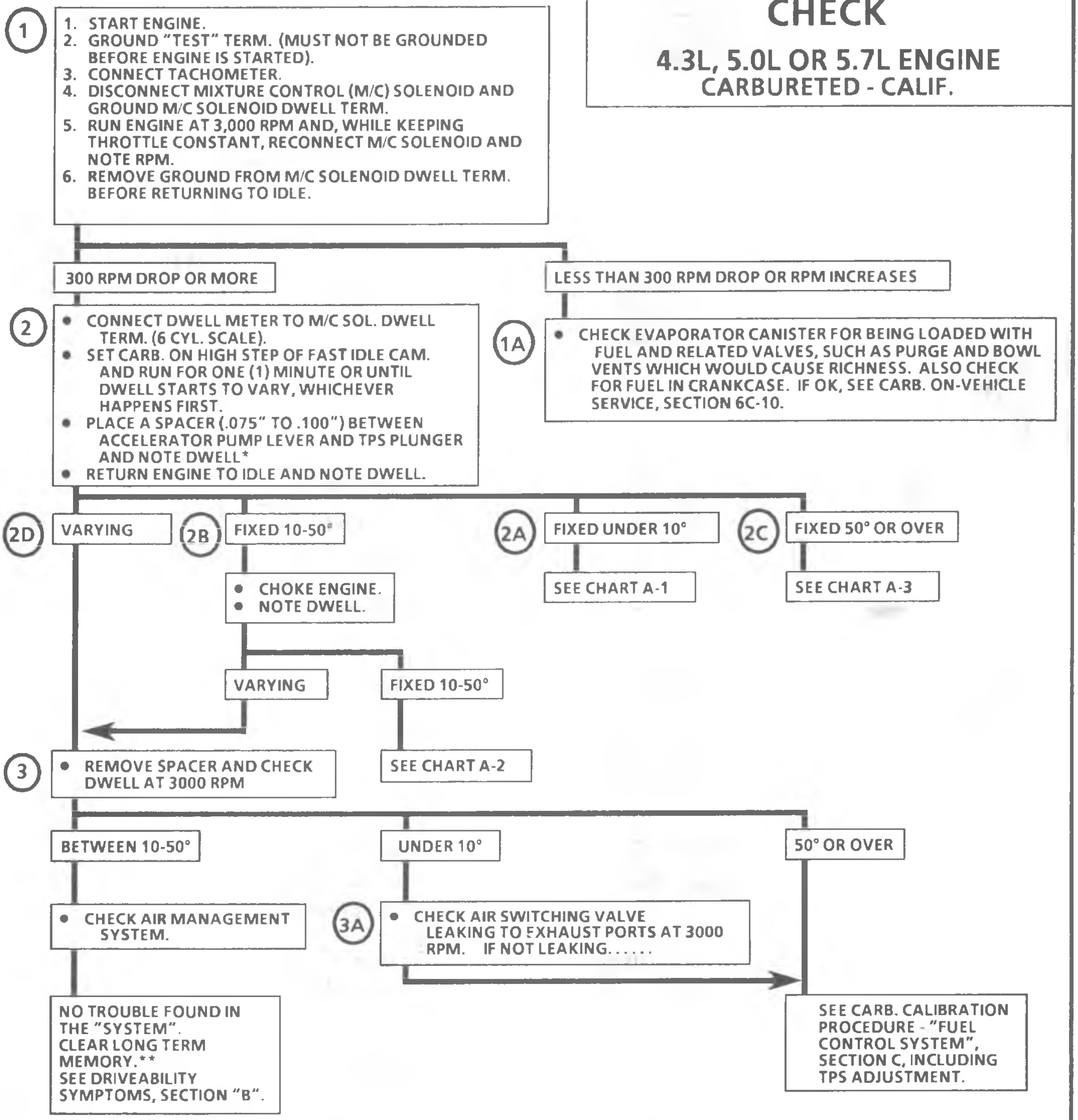
3. Checks for proper control of main metering system. RPM must be at least 3000 to get into the main metering system operation. Removing and plugging the hose may set a Code 34 so memory will have to be cleared.

3A. A missing "O" ring between the switching valve solenoid and the valve, or a faulty valve, may cause air to leak to the exhaust ports at higher RPM only.

SYSTEM PERFORMANCE CHECK

4.3L, 5.0L OR 5.7L ENGINE

CARBURETED - CALIF.



①
1. START ENGINE.
2. GROUND "TEST" TERM. (MUST NOT BE GROUNDED BEFORE ENGINE IS STARTED).
3. CONNECT TACHOMETER.
4. DISCONNECT MIXTURE CONTROL (M/C) SOLENOID AND GROUND M/C SOLENOID DWELL TERM.
5. RUN ENGINE AT 3,000 RPM AND, WHILE KEEPING THROTTLE CONSTANT, RECONNECT M/C SOLENOID AND NOTE RPM.
6. REMOVE GROUND FROM M/C SOLENOID DWELL TERM. BEFORE RETURNING TO IDLE.

300 RPM DROP OR MORE

②
- CONNECT DWELL METER TO M/C SOL. DWELL TERM. (6 CYL. SCALE).
- SET CARB. ON HIGH STEP OF FAST IDLE CAM. AND RUN FOR ONE (1) MINUTE OR UNTIL DWELL STARTS TO VARY, WHICHEVER HAPPENS FIRST.
- PLACE A SPACER (.075" TO .100") BETWEEN ACCELERATOR PUMP LEVER AND TPS PLUNGER AND NOTE DWELL*
- RETURN ENGINE TO IDLE AND NOTE DWELL.

LESS THAN 300 RPM DROP OR RPM INCREASES

(1A)
- CHECK EVAPORATOR CANISTER FOR BEING LOADED WITH FUEL AND RELATED VALVES, SUCH AS PURGE AND BOWL VENTS WHICH WOULD CAUSE RICHNESS. ALSO CHECK FOR FUEL IN CRANKCASE. IF OK, SEE CARB. ON-VEHICLE SERVICE, SECTION 6C-10.

(2D) VARYING

(2B) FIXED 10-50°

- CHOKE ENGINE.
- NOTE DWELL.

VARYING

FIXED 10-50°

SEE CHART A-2

(2A) FIXED UNDER 10°

SEE CHART A-1

(2C) FIXED 50° OR OVER

SEE CHART A-3

③
- REMOVE SPACER AND CHECK DWELL AT 3000 RPM

BETWEEN 10-50°

- CHECK AIR MANAGEMENT SYSTEM.

NO TROUBLE FOUND IN THE "SYSTEM". CLEAR LONG TERM MEMORY.** SEE DRIVEABILITY SYMPTOMS, SECTION "B".

UNDER 10°

(3A)
- CHECK AIR SWITCHING VALVE LEAKING TO EXHAUST PORTS AT 3000 RPM. IF NOT LEAKING......

50° OR OVER

SEE CARB. CALIBRATION PROCEDURE - "FUEL CONTROL SYSTEM", SECTION C, INCLUDING TPS ADJUSTMENT.

* AN OXYGEN SENSOR MAY COOL OFF AT IDLE AND THE DWELL CHANGE FROM VARYING TO FIXED. IF THIS HAPPENS, RUNNING THE ENGINE AT FAST IDLE WILL WARM IT UP AGAIN.

** BY DISCONNECTING POWER FROM ECM TERMINAL "R" OR ECM B FUSE FOR 10 SECONDS WITH IGNITION SWITCH OFF.

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6S 2554-6E

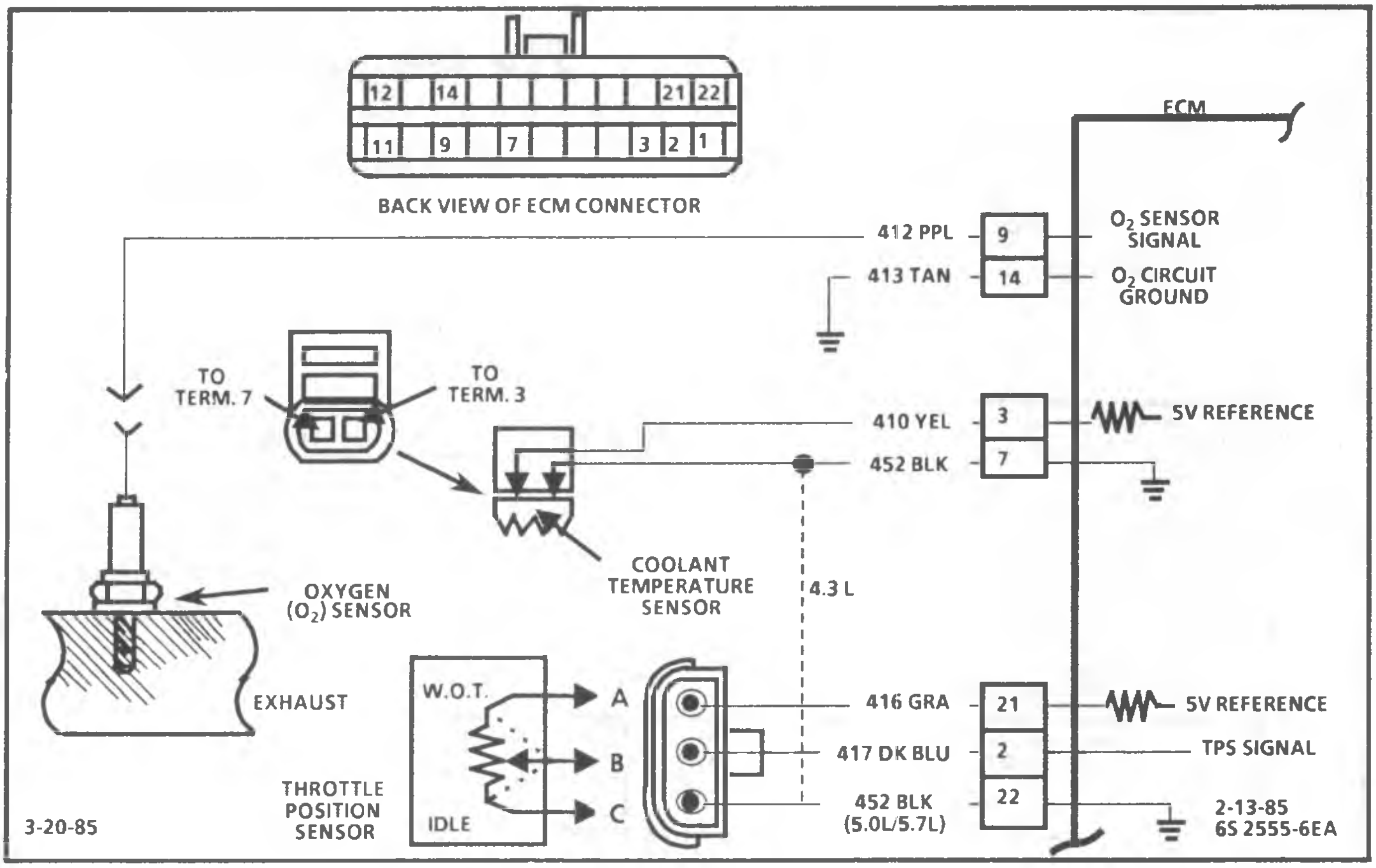


CHART A-1

DWELL FIXED UNDER 10°

4.3L, 5.0L OR 5.7L ENGINE

CARBURETED - CALIF.

1. Determines if the problem is Computer Command Control related or engine related. Dwell should start increasing as soon as engine is choked, and go higher as it is choked more, until it goes over 50°. With severe choking, the dwell could move up scale momentarily even if it is not engine related, but it will move right back to a low dwell. If dwell responds, the problem is a lean engine.

1A. Checks for cause of lean condition that resulted in full rich command.

2. Checks for ECM response to input to O_2 sensor circuit. The voltmeter is used to put a voltage on the oxygen sensor circuit to simulate a rich condition. Dwell should increase (a lean command) if ECM and harness are good.

3. Checks for normal coolant sensor circuit condition. Voltage on a normalized hot engine should be under 2.5V.

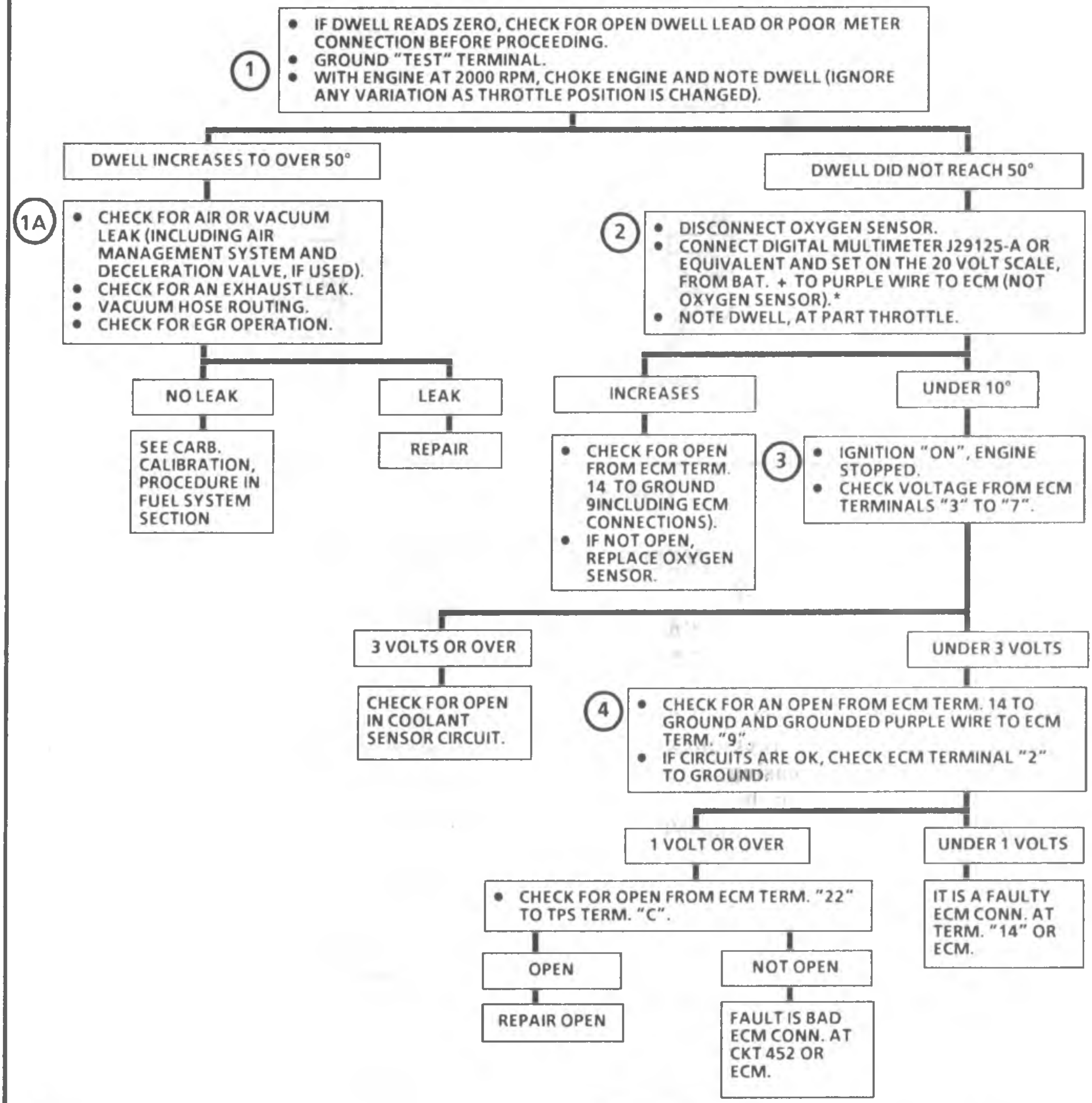
4. This step checks for an open in the ground circuit to ECM Term. "14" and grounded 0_2 sensor circuit.

Terminal "2" voltage should be under 1.0 volt at idle. A high voltage could be caused by an open in circuit 452. Normally, this would cause Codes 21 and 34 but, won't set them on some engines.

CHART A-1

DWELL FIXED UNDER 10°
(LEAN EXHAUST INDICATION)

4.3L, 5.0L OR 5.7L ENGINE
CARBURETED - CALIF.



* DO NOT USE AN ORDINARY VOLTMETER OR JUMPER IN PLACE OF DIGITAL VOLTMETER, BECAUSE THEY HAVE TOO LITTLE RESISTANCE. A VOLTAGE SOURCE OF 1.0V TO 1.7V (SUCH AS A FLASHLIGHT BATTERY) CAN BE CONNECTED WITH THE POSITIVE TERMINAL TO THE PURPLE WIRE AND THE NEGATIVE TERMINAL TO GROUND AS A JUMPER. IF THE POLARITY IS REVERSED, IT WON'T WORK.

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* 4S 0284-6EA

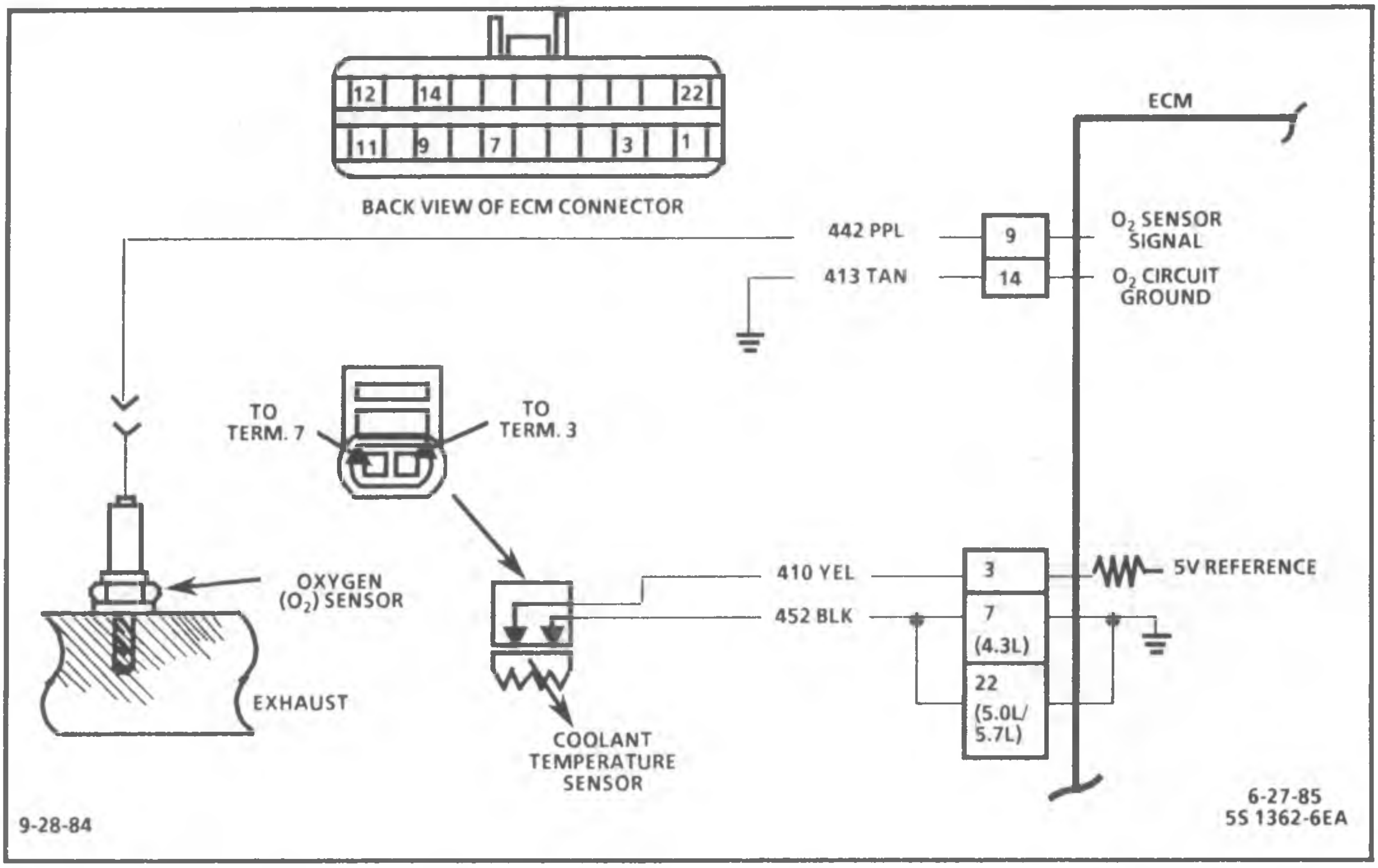


CHART A-2

DWELL FIXED BETWEEN 10° AND 50°

4.3L, 5.0L OR 5.7L ENGINE

CARBURETED -CALIF.

1. Running engine at part throttle for one minute warms up the oxygen sensor.

   Grounding 0_2 sensor input checks ECM response to a "lean" signal.

   Normal response-dwell decreases to full rich command.

1A. On some ECM's, an open in circuit to Term. "14" can cause open loop.

1B. Checks output of 0_2 sensor with full rich command from ECM caused by grounded 0_2 sensor input.
Normal response, voltage at 0_2 sensor over .8 volt.

2. This step grounds 0_2 sensor circuit at ECM to check for opens in wiring, to ECM Terminals "9" and "14".

   Normal response to "lean" signal, dwell decreases; that is a rich command.

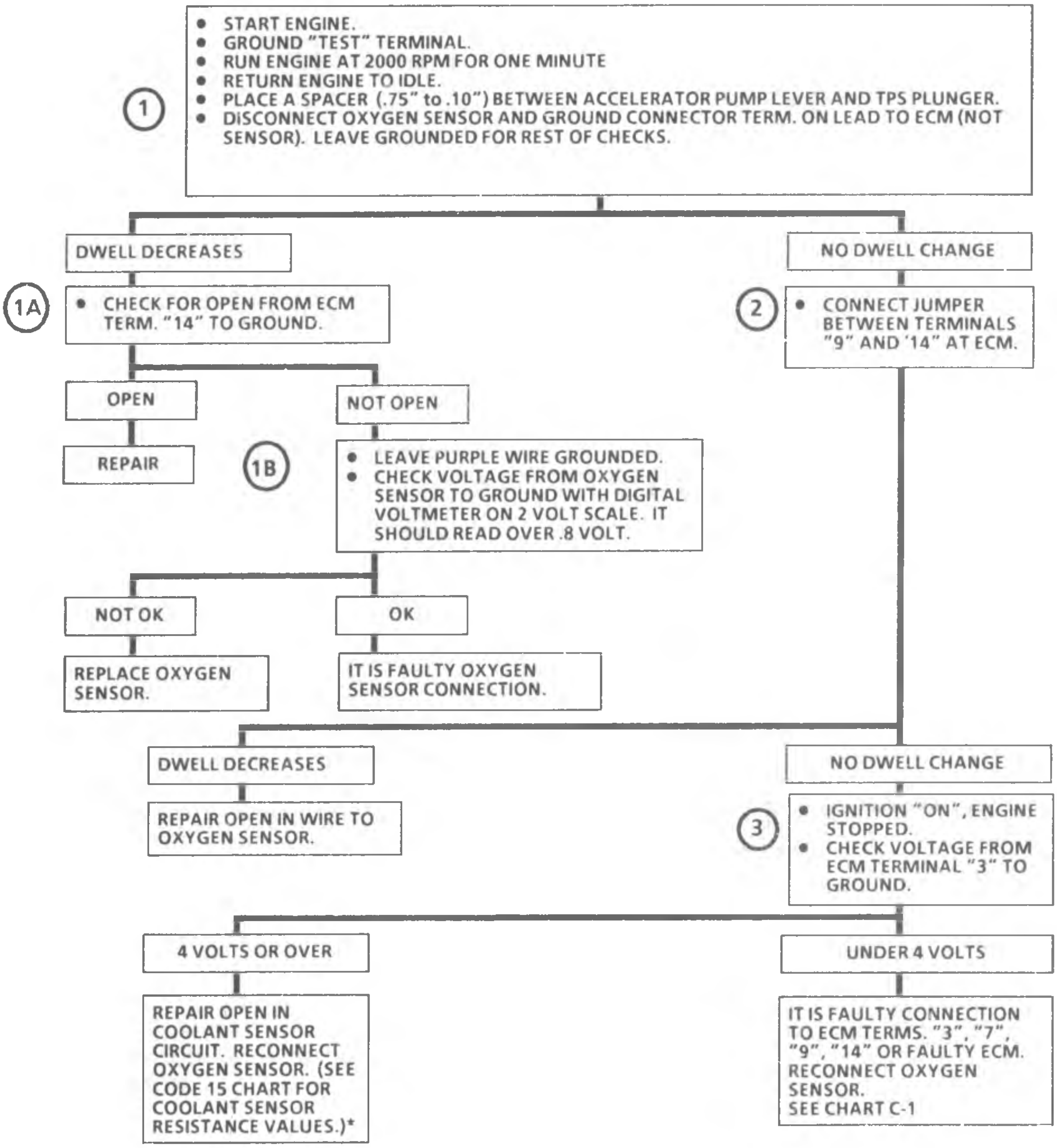
3. This step checks for voltage to the coolant sensor. Normal reading on a warm engine is less than 2.5 volts.

   An open circuit would cause a reading of approximately 5 volts.

CHART A-2

DWELL FIXED BETWEEN 10° - 50°
(OPEN COOLANT OR OXYGEN SENSOR CIRCUIT)

4.3L, 5.0L OR 5.7L ENGINE
CARBURETED - CALIF.



①
- START ENGINE.
- GROUND "TEST" TERMINAL.
- RUN ENGINE AT 2000 RPM FOR ONE MINUTE
- RETURN ENGINE TO IDLE.
- PLACE A SPACER (.75" to .10") BETWEEN ACCELERATOR PUMP LEVER AND TPS PLUNGER.
- DISCONNECT OXYGEN SENSOR AND GROUND CONNECTOR TERM. ON LEAD TO ECM (NOT SENSOR). LEAVE GROUNDED FOR REST OF CHECKS.

DWELL DECREASES

(1A)
- CHECK FOR OPEN FROM ECM TERM. "14" TO GROUND.

OPEN

REPAIR

NOT OPEN

(1B)
- LEAVE PURPLE WIRE GROUNDED.
- CHECK VOLTAGE FROM OXYGEN SENSOR TO GROUND WITH DIGITAL VOLTMETER ON 2 VOLT SCALE. IT SHOULD READ OVER .8 VOLT.

NOT OK

REPLACE OXYGEN SENSOR.

OK

IT IS FAULTY OXYGEN SENSOR CONNECTION.

NO DWELL CHANGE

②
- CONNECT JUMPER BETWEEN TERMINALS "9" AND '14" AT ECM.

DWELL DECREASES

REPAIR OPEN IN WIRE TO OXYGEN SENSOR.

NO DWELL CHANGE

③
- IGNITION "ON", ENGINE STOPPED.
- CHECK VOLTAGE FROM ECM TERMINAL "3" TO GROUND.

4 VOLTS OR OVER

REPAIR OPEN IN COOLANT SENSOR CIRCUIT. RECONNECT OXYGEN SENSOR. (SEE CODE 15 CHART FOR COOLANT SENSOR RESISTANCE VALUES.)*

UNDER 4 VOLTS

IT IS FAULTY CONNECTION TO ECM TERMS. "3", "7", "9", "14" OR FAULTY ECM. RECONNECT OXYGEN SENSOR.
SEE CHART C-1

* CHECKING COOLANT SENSOR RESISTANCE MAY REQUIRE USE OF CONNECTOR AND WIRE ASSEMBLY NO. 12026621 FOR ACCESSIBILITY.

2-14-85
5S 1791-6E

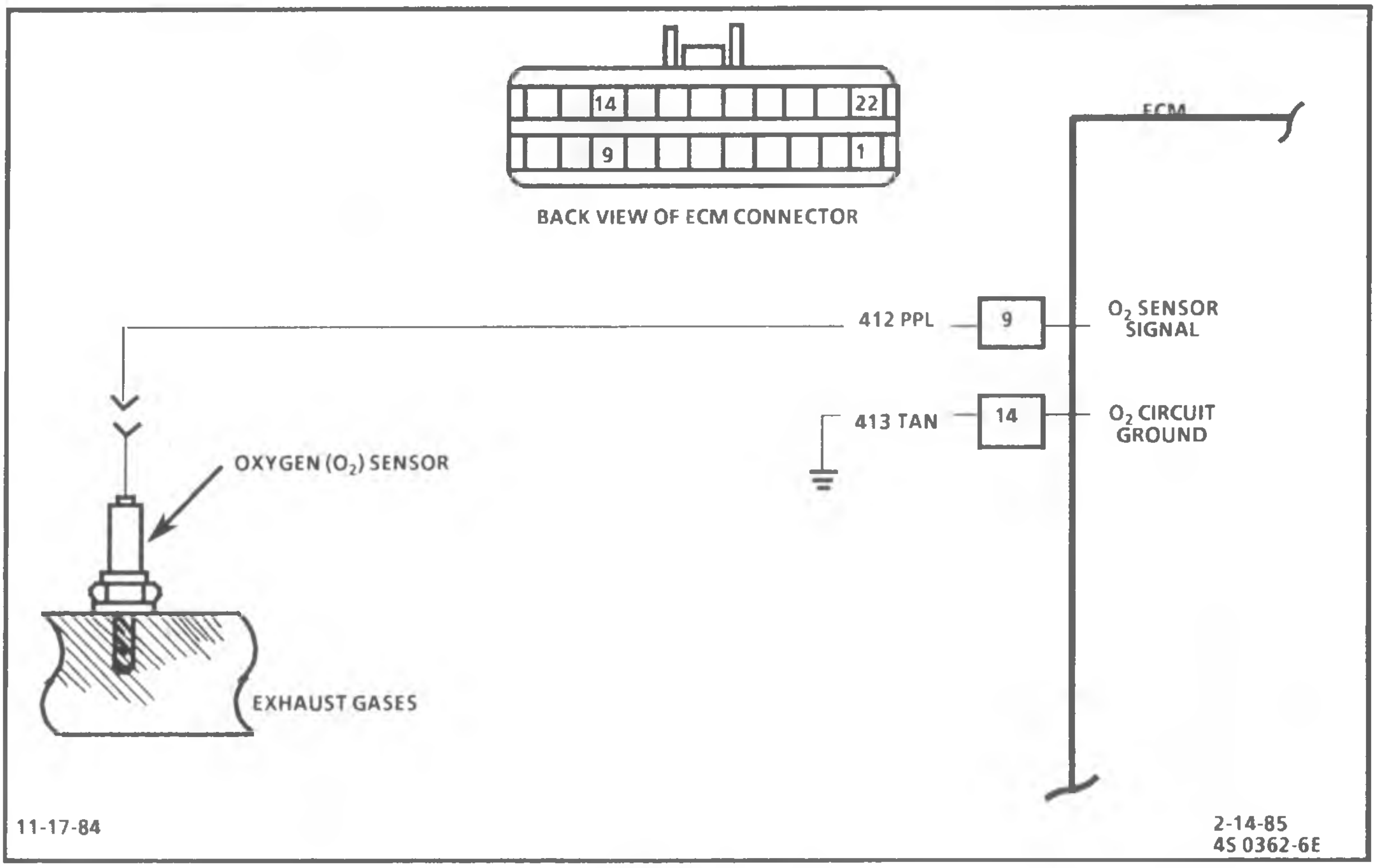


CHART A-3

DWELL FIXED OVER 50°

4.3L, 5.0L OR 5.7L ENGINE

CARBURETED - CALIF.

1. Determines whether problem is related to engine or electronics.

   Normal response - dwell decreases (rich command) - says electronics (0_2 sensor, harness and ECM) are OK; problem is a rich engine condition.

   This may require a large air leak if engine is very rich. When it is lean enough, the engine will start to run rough.

2. If plugging the PCV or bowl vent vacuum hose causes the dwell to decrease, that hose leads to the source of the problem.

3. Checks ECM response to a "lean" 0_2 signal. Normal response - low dwell (rich command) No dwell change says it is bad ECM. It couldn't be an open wire because that would cause open loop operation and may set Code 13.

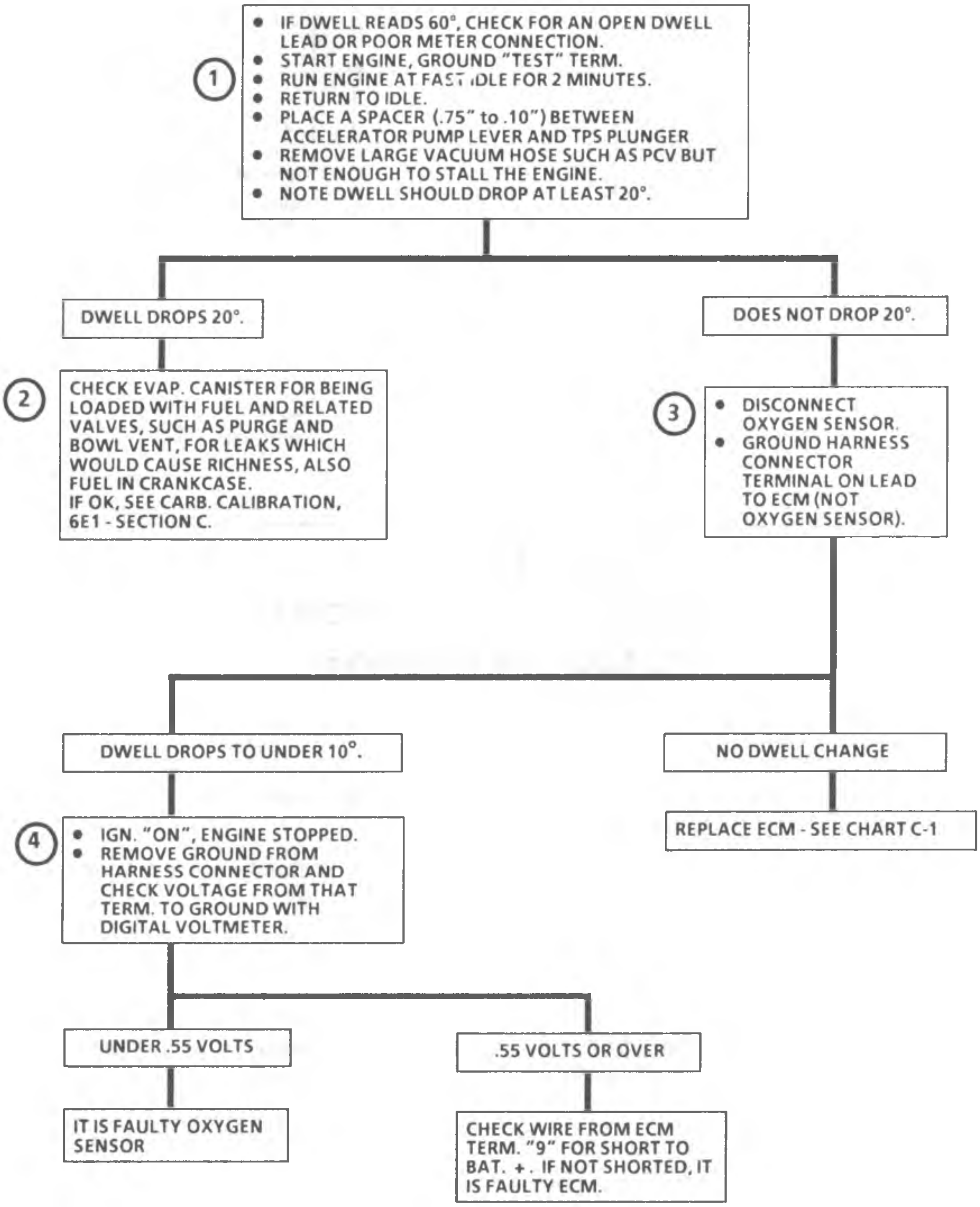
4. Checks for excessive voltage in 0_2 line.

   If under .55V, wire and ECM are OK; fault is in 0_2 sensor which could be the result of silicone contamination. If over .55V, wire is shorted to B + or a faulty ECM.

CHART A-3

DWELL FIXED OVER 50°
RICH EXHAUST INDICATION

4.3L, 5.0L, OR 5.7L ENGINE
CARBURETED - CALIF.



①
- IF DWELL READS 60°, CHECK FOR AN OPEN DWELL LEAD OR POOR METER CONNECTION.
- START ENGINE, GROUND "TEST" TERM.
- RUN ENGINE AT FAST IDLE FOR 2 MINUTES.
- RETURN TO IDLE.
- PLACE A SPACER (.75" to .10") BETWEEN ACCELERATOR PUMP LEVER AND TPS PLUNGER
- REMOVE LARGE VACUUM HOSE SUCH AS PCV BUT NOT ENOUGH TO STALL THE ENGINE.
- NOTE DWELL SHOULD DROP AT LEAST 20°.

DWELL DROPS 20°.

② CHECK EVAP. CANISTER FOR BEING LOADED WITH FUEL AND RELATED VALVES, SUCH AS PURGE AND BOWL VENT, FOR LEAKS WHICH WOULD CAUSE RICHNESS, ALSO FUEL IN CRANKCASE. IF OK, SEE CARB. CALIBRATION, 6E1 - SECTION C.

DOES NOT DROP 20°.

③
- DISCONNECT OXYGEN SENSOR.
- GROUND HARNESS CONNECTOR TERMINAL ON LEAD TO ECM (NOT OXYGEN SENSOR).

DWELL DROPS TO UNDER 10°.

④
- IGN. "ON", ENGINE STOPPED.
- REMOVE GROUND FROM HARNESS CONNECTOR AND CHECK VOLTAGE FROM THAT TERM. TO GROUND WITH DIGITAL VOLTMETER.

UNDER .55 VOLTS

IT IS FAULTY OXYGEN SENSOR

.55 VOLTS OR OVER

CHECK WIRE FROM ECM TERM. "9" FOR SHORT TO BAT. +. IF NOT SHORTED, IT IS FAULTY ECM.

NO DWELL CHANGE

REPLACE ECM - SEE CHART C-1

2-14-85
5S 1792-6E

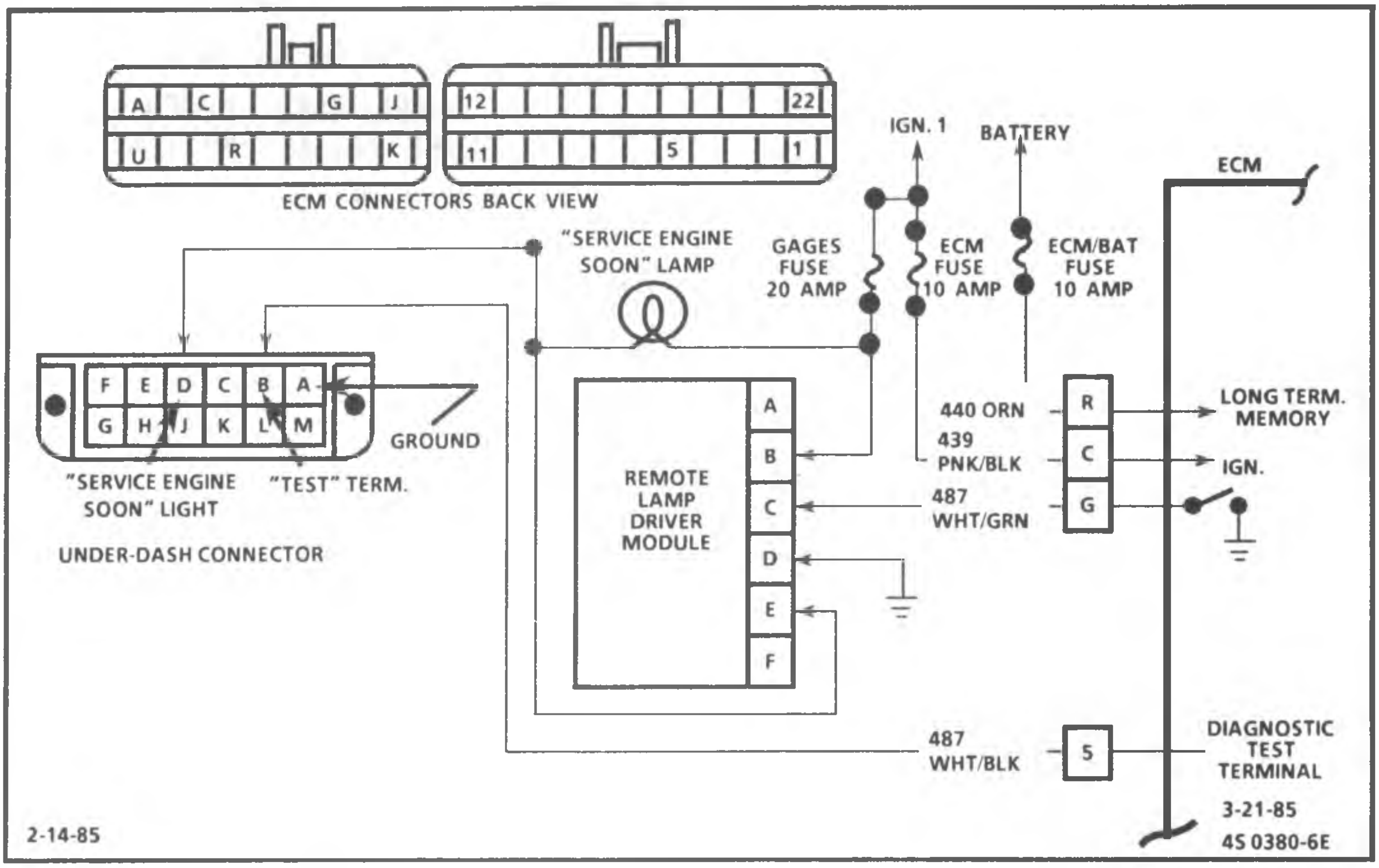


CHART A-5

"SERVICE ENGINE SOON" LIGHT INOPERATIVE

4.3L, 5.0L, OR 5.7L ENGINE

CARBURETED - CALIF.

1. This checks for open gage fuse or open in "SERVICE ENGINE SOON" light circuit, including IP connector, printed circuit, and "SERVICE ENGINE SOON" lamp.

   Normal response is lamp "ON".

2. This checks for a shorted ECM.

   Grounded ECM terminal "G" will turn the "SERVICE ENGINE SOON" light "OFF". If disconnecting ECM turns light "ON", ECM is shorted.
   Normal response is lamp "ON".

3. This checks for grounded wire from terminal "C" of lamp driver to terminal "G" of ECM, an open circuit to terminal "B" of lamp driver, a bad ground or faulty lamp driver.

   A normal reading is about 9 to 11 volts because of the drop through the upper resistor in the lamp driver. Over 11 volts indicates there is no drop in the lamp driver.

   This indicates a bad ground or faulty lamp driver.

4. This step checks for an open in the wire to terminal "B".

   Normal voltage is approximately battery voltage.

4A. This checks for an open wire to terminal "E" from the "SERVICE ENGINE SOON" lamp. With terminal "E" grounded, the lamp should normally light. Lamp "OFF" indicates an open, and lamp "ON" indicates faulty lamp driver connection or lamp driver.

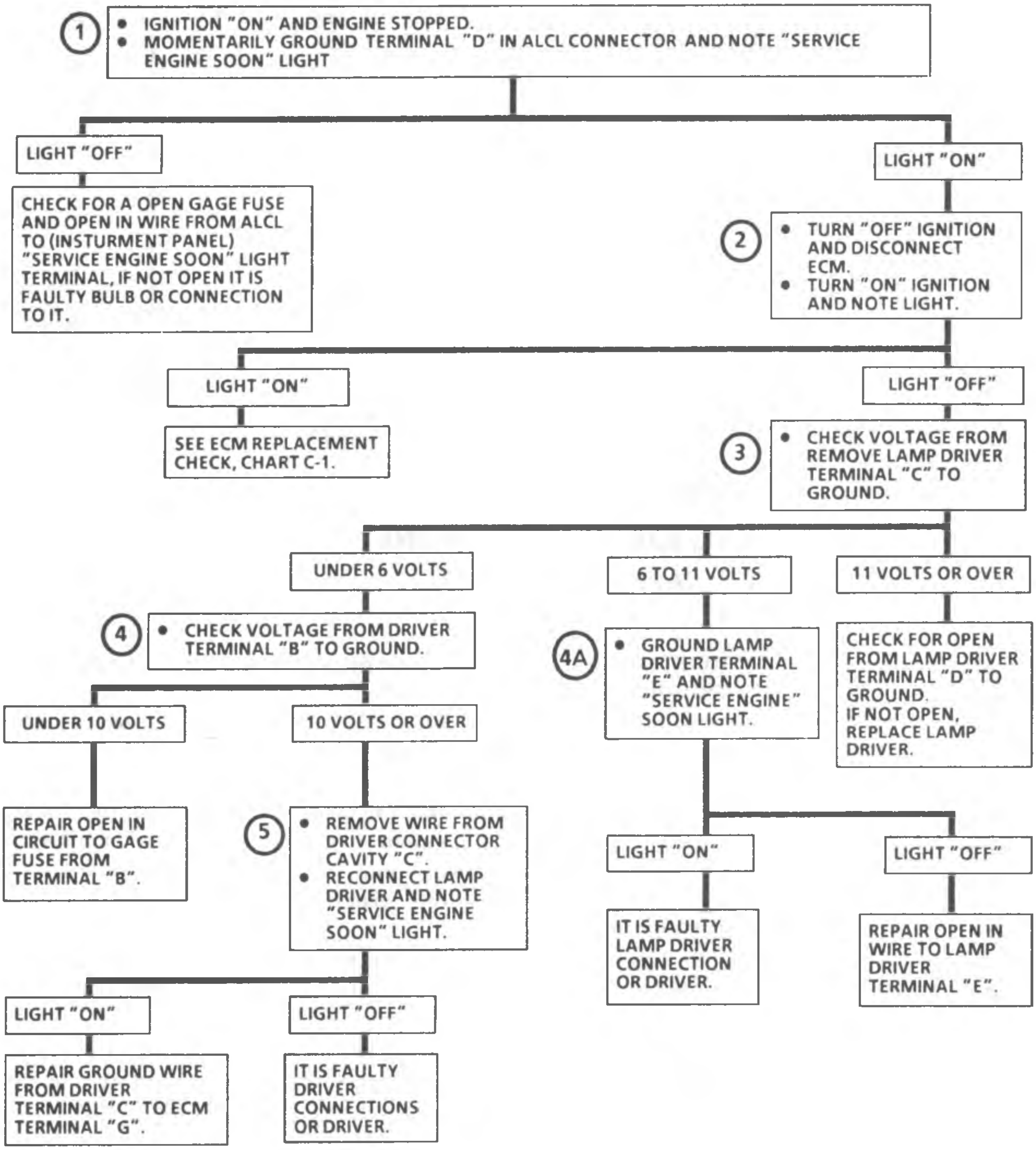
5. This checks for a grounded wire from driver terminal "C" to ECM terminal "G". Normal response is light "ON".

CHART A-5

"SERVICE ENGINE SOON" LIGHT INOPERATIVE

4.3L, 5.0L, OR 5.7L ENGINE

CARBURETED - CALIF.



3-21-85
6S 2559-6E

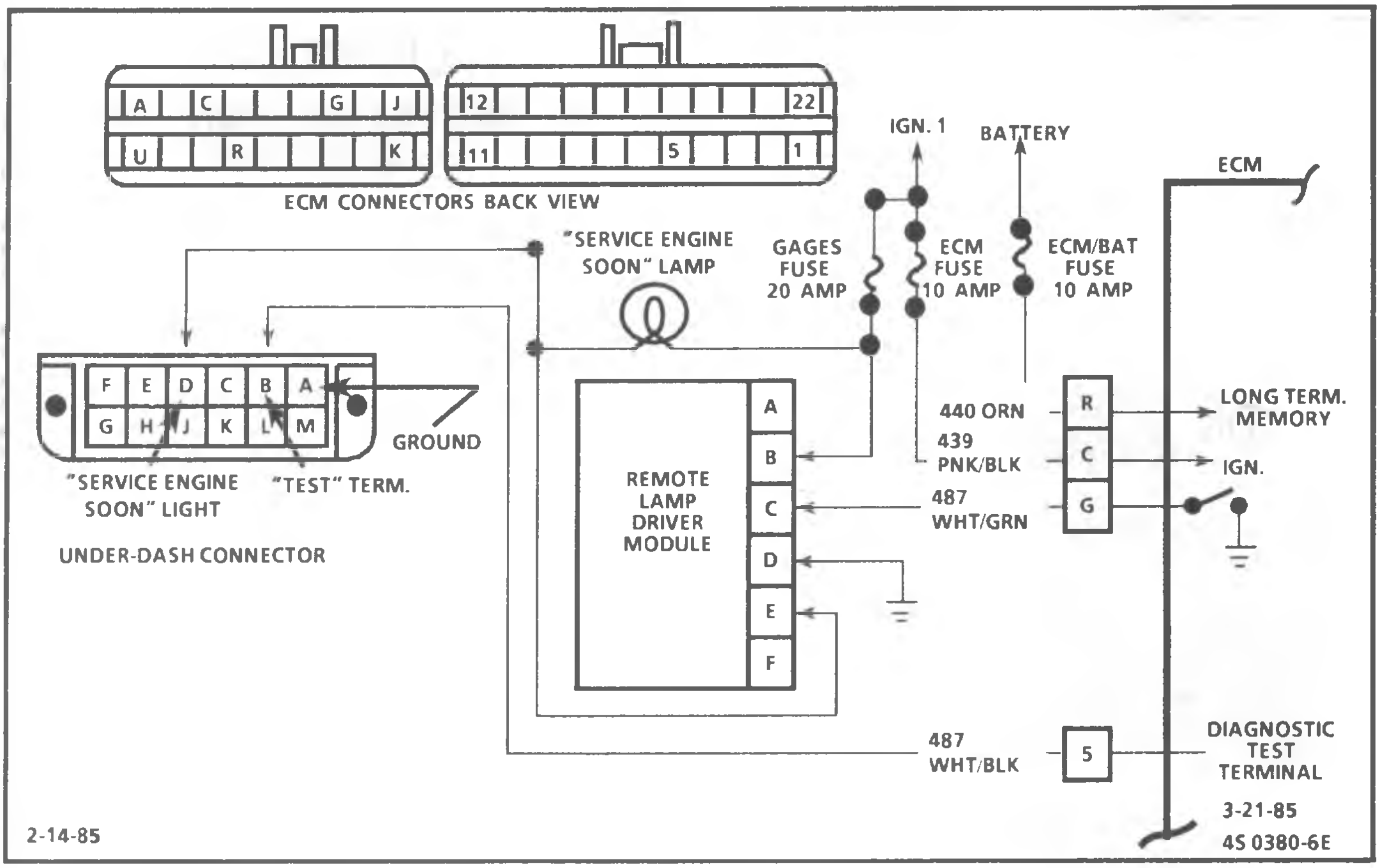


CHART A-6

WON'T FLASH CODE 12

4.3L, 5.0L, OR 5.7L ENGINE

CARBURETED - CALIF.

1. This step checks for short to battery voltage in wire to Terminal "C" or faulty lamp driver.

   Normal voltage reading is 9-11 volts.

2. This step checks to see if problem is related to the ECM or the lamp driver.

   Normally, grounding Terminal "C" should turn lamp "OFF". If it does, the problem is related to the ECM and its wiring. If not, it is related to the lamp driver and its wiring.

3. Grounding Terminal 'G' at ECM and finding light "ON" indicates an open in the wire to Terminal 'C' of lamp driver.

   Normally, grounding Terminal 'G' should turn lamp "OFF".

4. This step checks for open in wire from ECM to test terminal in ALCL connector. The lamp should flash Code 12 when Terminal "5" is grounded.

5. Checks for proper voltage supply to ECM. Both should read over 9 volts. Terminal 'C' is ignition and Terminal 'R' is constant battery for long term memory.

6. Checks for a bad ground to ECM - Terminals 'A' and 'U' are connected together in the ECM.

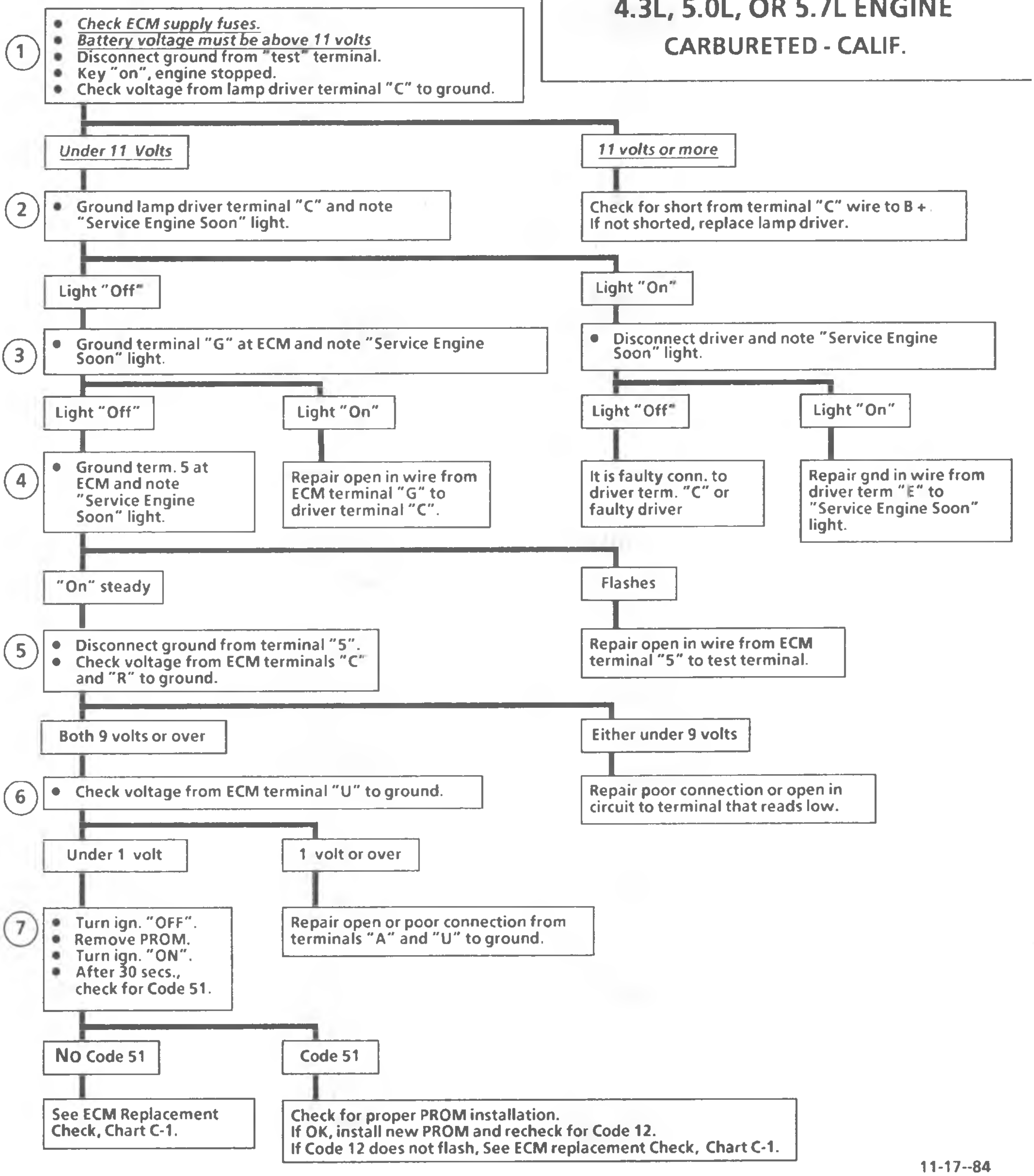
7. This step distinguishes between a faulty ECM and PROM. Normal response is for Code 51 to flash even though the PROM is not installed in the ECM. If it doesn't, it means that the ECM is faulty.

CHART A-6

"SERVICE ENGINE SOON" LIGHT ON AT ALL TIMES OR WON'T FLASH CODE 12

4.3L, 5.0L, OR 5.7L ENGINE

CARBURETED - CALIF.



①
- *Check ECM supply fuses.*
- *Battery voltage must be above 11 volts*
- Disconnect ground from "test" terminal.
- Key "on", engine stopped.
- Check voltage from lamp driver terminal "C" to ground.

Under 11 Volts

②
- Ground lamp driver terminal "C" and note "Service Engine Soon" light.

11 volts or more

Check for short from terminal "C" wire to B +. If not shorted, replace lamp driver.

Light "Off"

③
- Ground terminal "G" at ECM and note "Service Engine Soon" light.

Light "On"

- Disconnect driver and note "Service Engine Soon" light.

Light "Off"

④
- Ground term. 5 at ECM and note "Service Engine Soon" light.

Light "On"

Repair open in wire from ECM terminal "G" to driver terminal "C".

Light "Off"

It is faulty conn. to driver term. "C" or faulty driver

Light "On"

Repair gnd in wire from driver term "E" to "Service Engine Soon" light.

"On" steady

⑤
- Disconnect ground from terminal "5".
- Check voltage from ECM terminals "C" and "R" to ground.

Flashes

Repair open in wire from ECM terminal "5" to test terminal.

Both 9 volts or over

⑥
- Check voltage from ECM terminal "U" to ground.

Either under 9 volts

Repair poor connection or open in circuit to terminal that reads low.

Under 1 volt

⑦
- Turn ign. "OFF".
- Remove PROM.
- Turn ign. "ON".
- After 30 secs., check for Code 51.

1 volt or over

Repair open or poor connection from terminals "A" and "U" to ground.

No Code 51

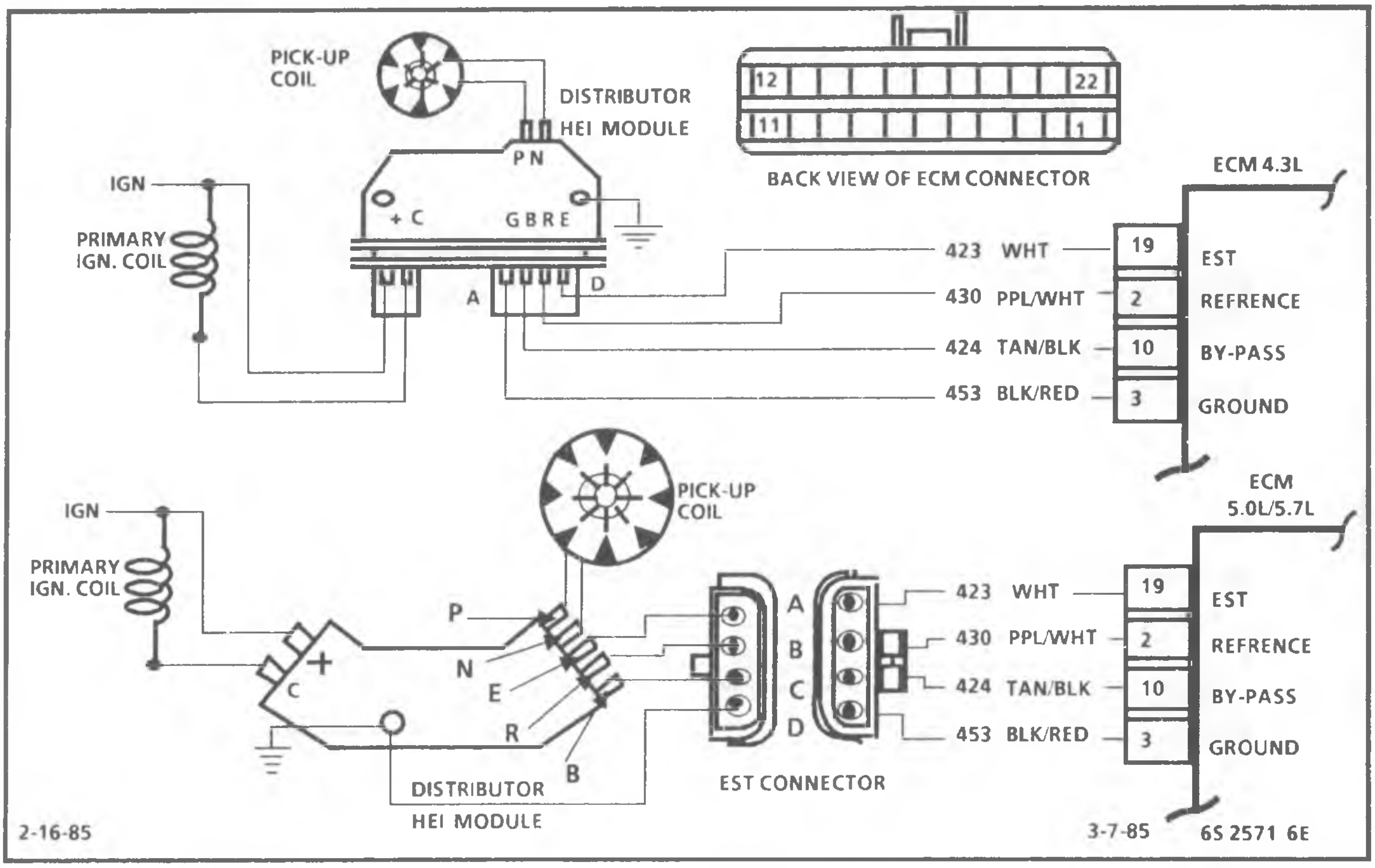
See ECM Replacement Check, Chart C-1.

Code 51

Check for proper PROM installation.
If OK, install new PROM and recheck for Code 12.
If Code 12 does not flash, See ECM replacement Check, Chart C-1.

REPEAT DIAGNOSTIC CIRCUIT CHECK AFTER ANY REPAIR

11-17--84
*4S 0291-6EA



CODE 12

NO DISTRIBUTOR REFERENCE SIGNAL

4.3L, 5.0L OR 5.7L ENGINE

CARBURETED - CALIF.

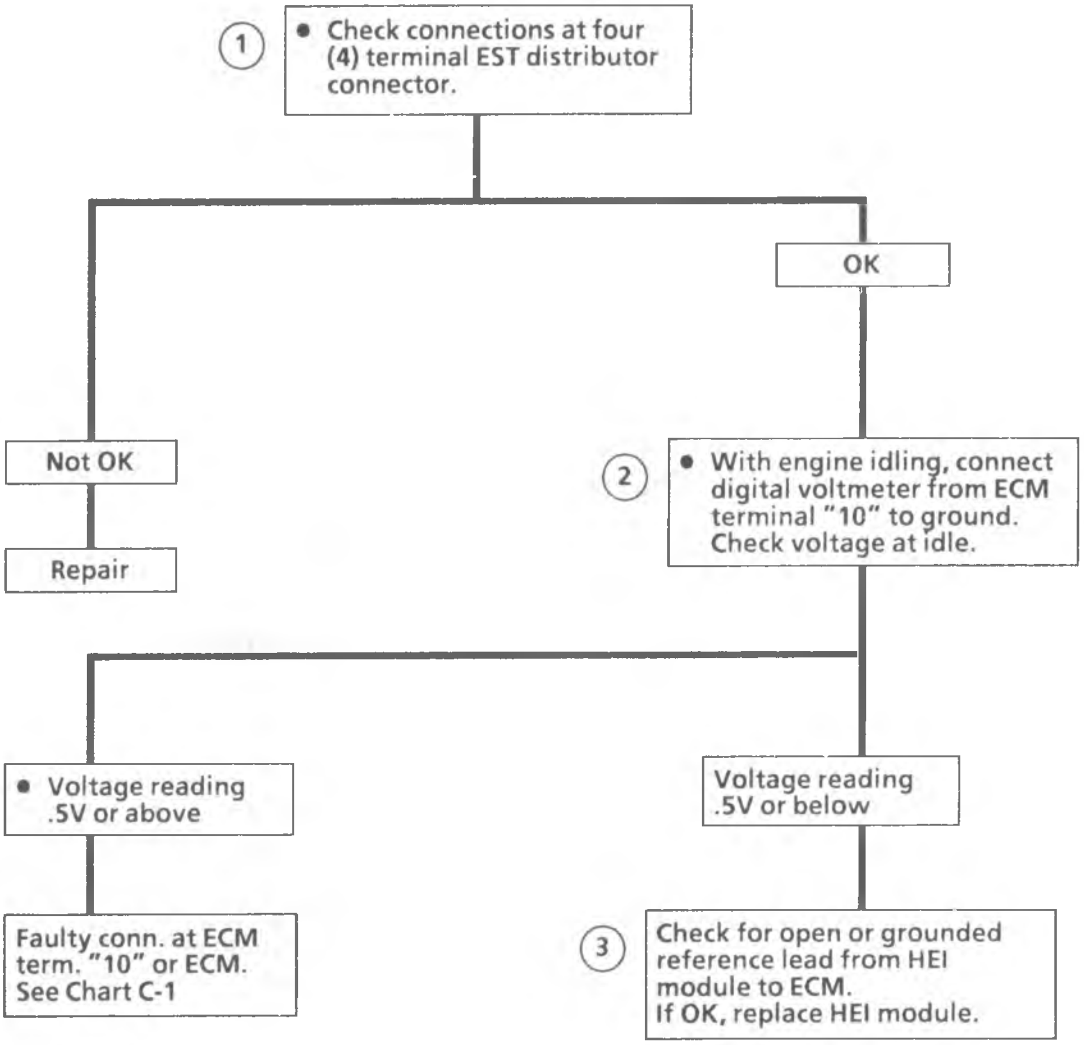
Code 12 means the ECM is "ON" and sees no reference pulse from the distributor. This is a normal code with the ignition "ON" and engine not running. Code 12 is not stored and will only flash when the fault is present. With the engine running, Code 12 could mean an open or ground in the distributor reference circuit. Code 41 will appear with Code 12 if the engine is running with no distributor reference signal. If the problem clears, Code 41 will store.

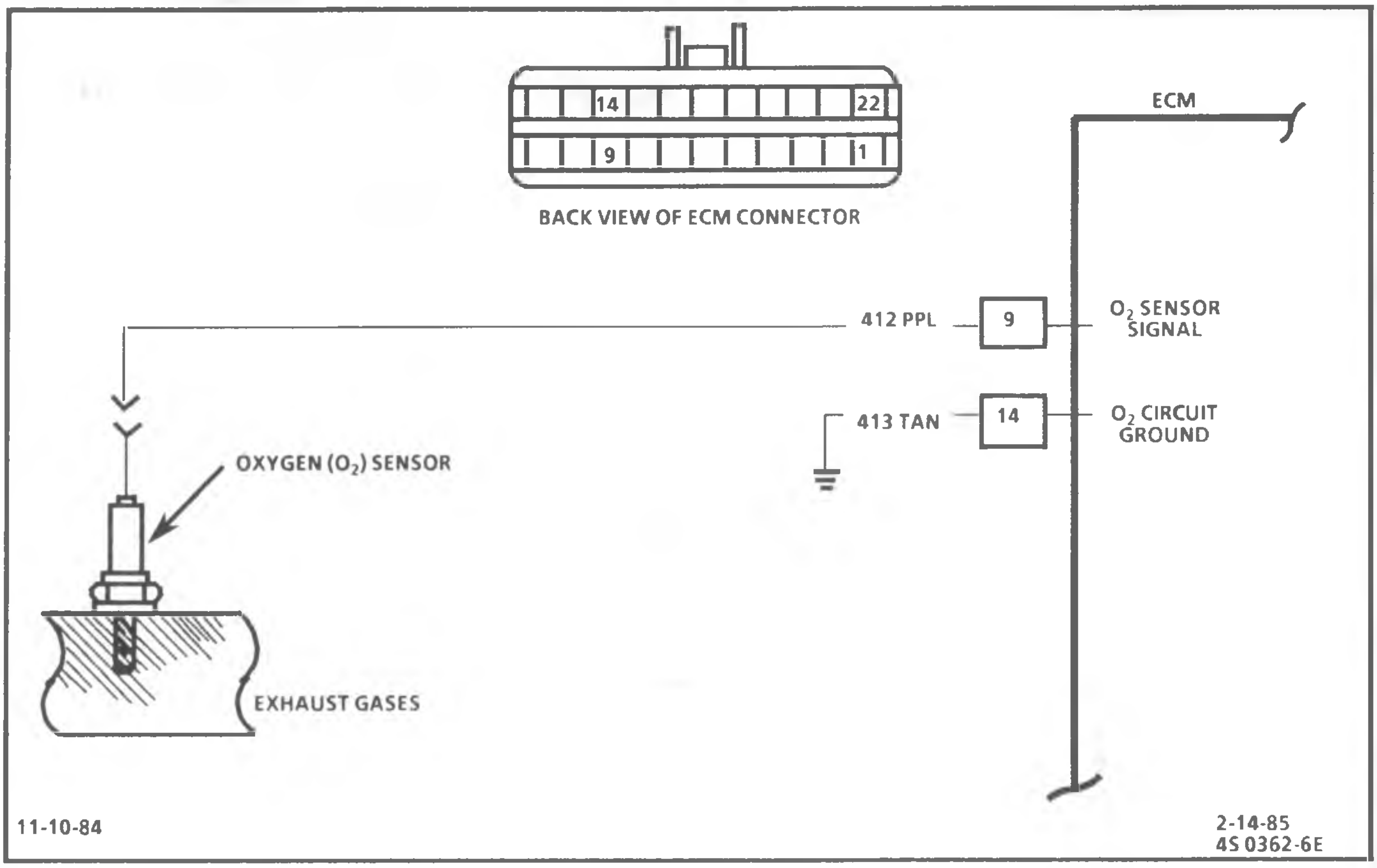
1. This step checks for a poor connection at the EST connector as being the source of no distributor reference pulse. Check for corrosion, connector terminals not fully seated, or terminal not properly attached to the wire. The terminal must be removed from the connector and carefully inspected.

2. This step determines if a reference pulse is being sent to the ECM. Voltage should normally be above .5V indicating that the signal is being generated by the module and fault is a bad connection at the ECM, or faulty ECM. To check the connection at the ECM, the terminal must be removed from the connector.

3. With an open circuit, there is still a small amount of voltage at the ECM. It will not increase when the throttle is opened. If the circuit from Terminal "10" to the module is not opened or grounded, the source of no signal is the module itself.

CODE 12
NO DISTRIBUTOR REFERENCE SIGNAL TO THE ECM
4.3L, 5.0L OR 5.7L ENGINE
CARBURETED - CALIF.





11-10-84

2-14-85
4S 0362-6E

CODE 13

OXYGEN SENSOR CIRCUIT

4.3L, 5.0L OR 5.7L ENGINE

CARBURETED - CALIF.

Code 13 means an open in the oxygen sensor circuit with the following conditions:

- Oxygen sensor voltage is within a specified range.
- Above a specified TPS value.
- More than a specified time after the engine has warmed up.

The ECM supplies a voltage of about .45V between Terminals "9 and 14". (Voltage may read as low as .32V when measured with a 10 megohm DVM.) The O_2 sensor varies the voltage within a range from about 1 volt if the exhaust is rich down through about .1V if exhaust is lean.

1. This step is to determine if the problem is still present.

   A Normal dwell will vary indicating the fault is not present, while a fixed dwell indicates the fault is still present.

2. By grounding the O_2 sensor circuit to the ECM, a "low voltage (lean) signal" is sent to the ECM. If the ECM is not faulty and the circuit is complete a "low voltage signal" should result in a full rich command (low dwell) from the ECM.

3. This step determines if the O_2 sensor is functioning. With the rich command, the O_2 sensor should read a high voltage, over .8V if it is functional, since the exhaust is rich. If the O_2 sensor functions, fault is in the connections to the sensor.

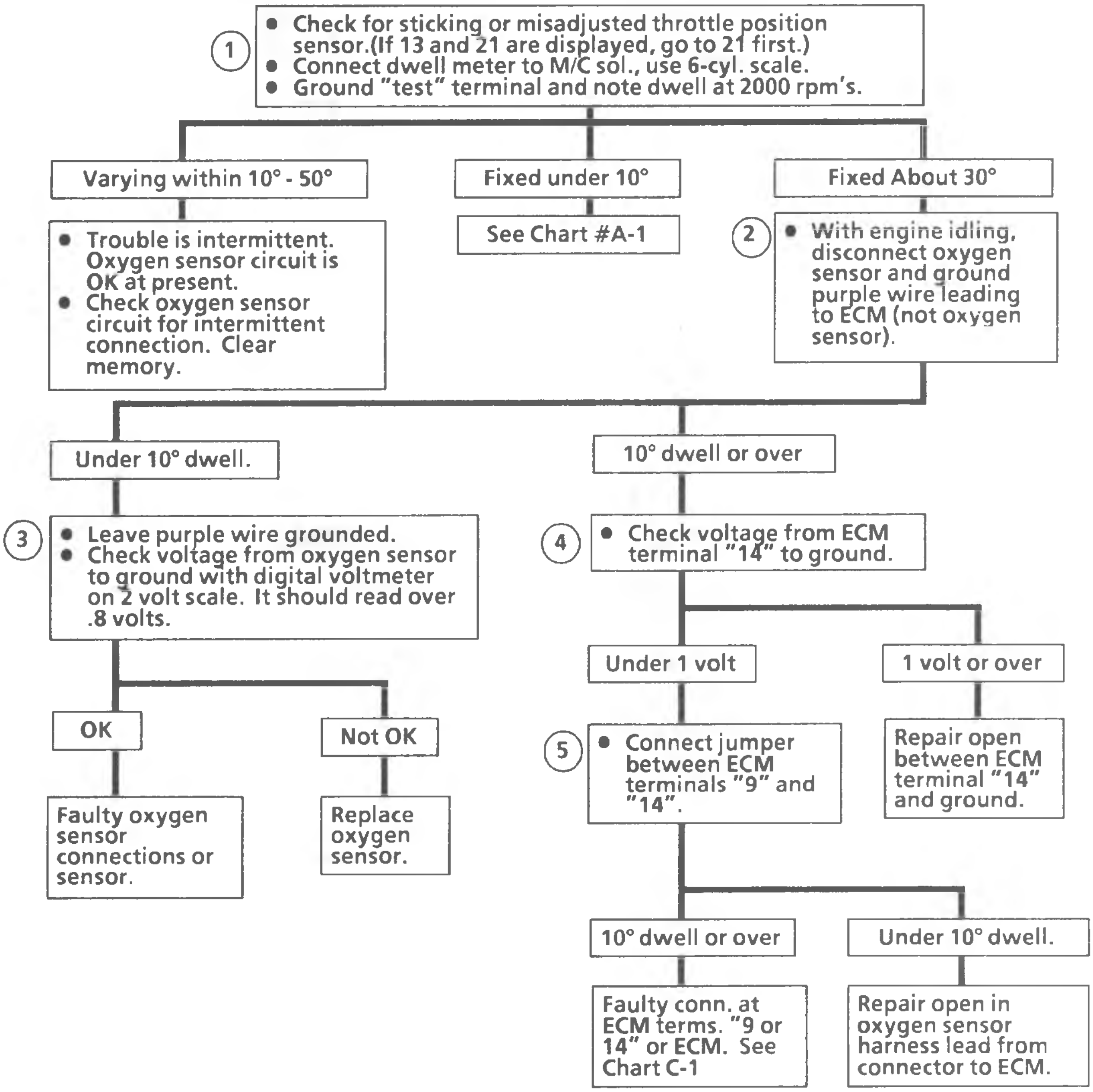
4. This step checks for an open in the ECM O_2 sensor ground circuit. Normal voltage is below 1 volt if the circuit is complete. The worse the connection is, the higher the voltage will read.

5. This step grounds the O_2 signal wire at the ECM. If the ECM is functional, dwell should go to below 10°, since this is a "low voltage signal" indicating lean exhaust. No change indicates a problem at the ECM connections, or the ECM.

CODE 13

OPEN OXYGEN SENSOR CIRCUIT

4.3L, 5.0L, OR 5.7L ENGINE
CARBURETED - CALIF.



(1)
- Check for sticking or misadjusted throttle position sensor.(If 13 and 21 are displayed, go to 21 first.)
- Connect dwell meter to M/C sol., use 6-cyl. scale.
- Ground "test" terminal and note dwell at 2000 rpm's.

Varying within 10° - 50°
- Trouble is intermittent. Oxygen sensor circuit is OK at present.
- Check oxygen sensor circuit for intermittent connection. Clear memory.

Fixed under 10°

See Chart #A-1

Fixed About 30°

(2)
- With engine idling, disconnect oxygen sensor and ground purple wire leading to ECM (not oxygen sensor).

Under 10° dwell.

(3)
- Leave purple wire grounded.
- Check voltage from oxygen sensor to ground with digital voltmeter on 2 volt scale. It should read over .8 volts.

OK

Faulty oxygen sensor connections or sensor.

Not OK

Replace oxygen sensor.

10° dwell or over

(4)
- Check voltage from ECM terminal "14" to ground.

Under 1 volt

(5)
- Connect jumper between ECM terminals "9" and "14".

10° dwell or over

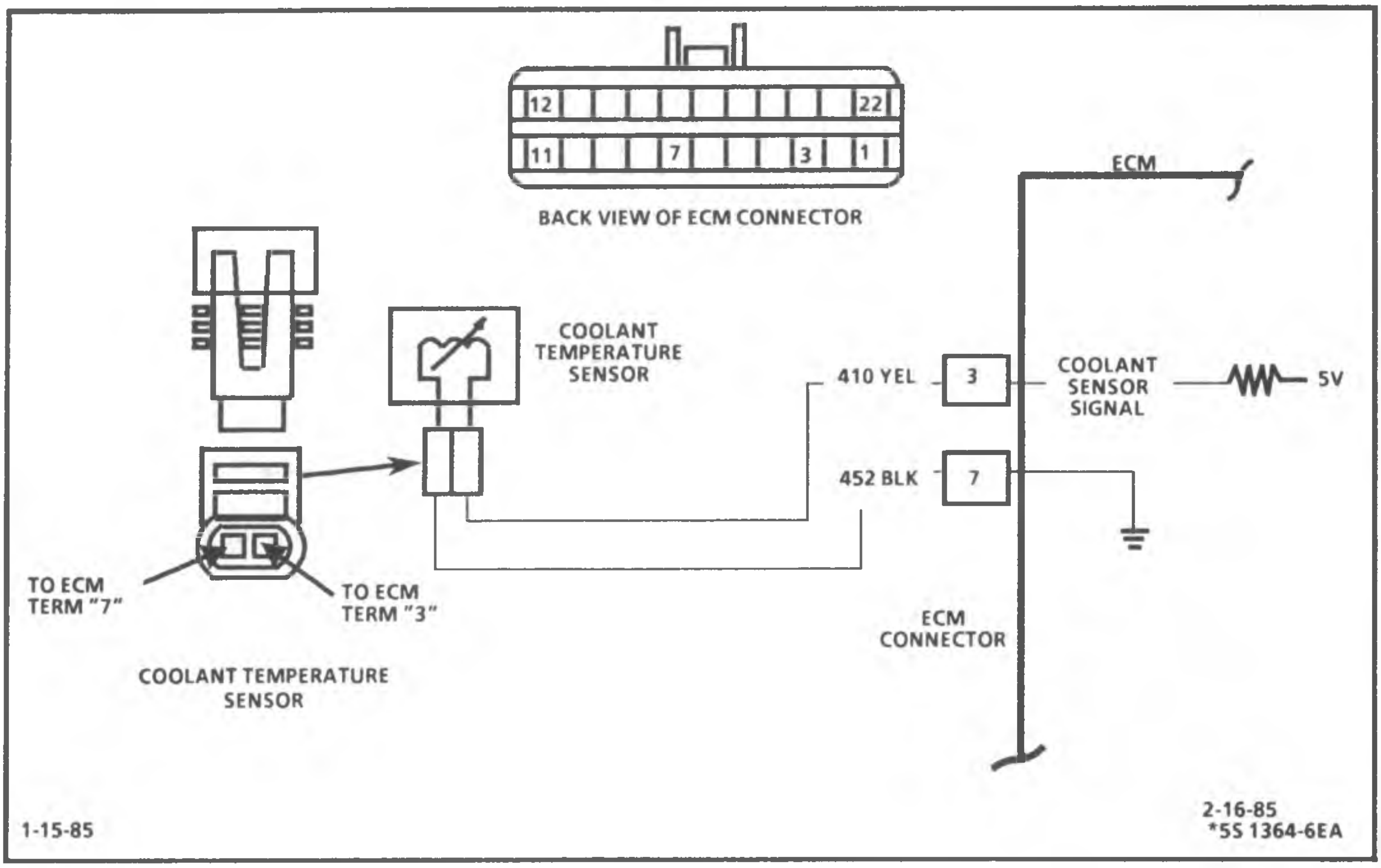
Faulty conn. at ECM terms. "9 or 14" or ECM. See Chart C-1

Under 10° dwell.

Repair open in oxygen sensor harness lead from connector to ECM.

1 volt or over

Repair open between ECM terminal "14" and ground.



CODE 14

COOLANT SENSOR CIRCUIT SHORTED

4.3L, 5.0L, OR 5.7L ENGINE

CARBURETED - CALIF.

Code 14 means the ECM has seen low resistance of the coolant sensor circuit as follows:

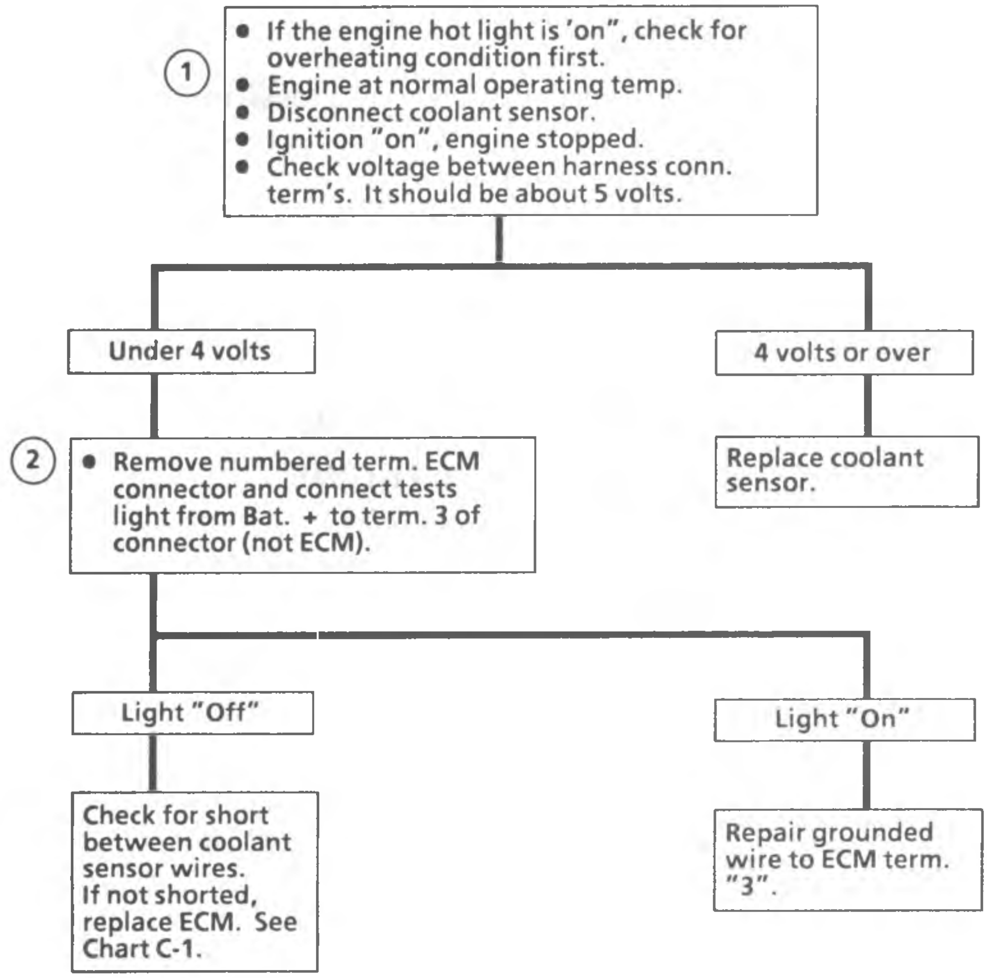
- Low resistance (high engine temperature)
- Or low voltage (at ECM Terminal "3")
- For a time longer than specified

1. This step determines whether the fault is at the coolant sensor or elsewhere in the circuit. Normal voltage shoud be about 5 volts in the circuit.
2. This step checks for a grounded circuit between the ECM and the coolant sensor. Test light to B+ should be "OFF" in an ungrounded circuit. The coolant sensor is not connected during the test.

CODE 14

COOLANT SENSOR CIRCUIT SHORTED

4.3L, 5.0L, OR 5.7L ENGINE
CARBURETED - CALIF.



①
- If the engine hot light is 'on", check for overheating condition first.
- Engine at normal operating temp.
- Disconnect coolant sensor.
- Ignition "on", engine stopped.
- Check voltage between harness conn. term's. It should be about 5 volts.

Under 4 volts

②
- Remove numbered term. ECM connector and connect tests light from Bat. + to term. 3 of connector (not ECM).

Light "Off"

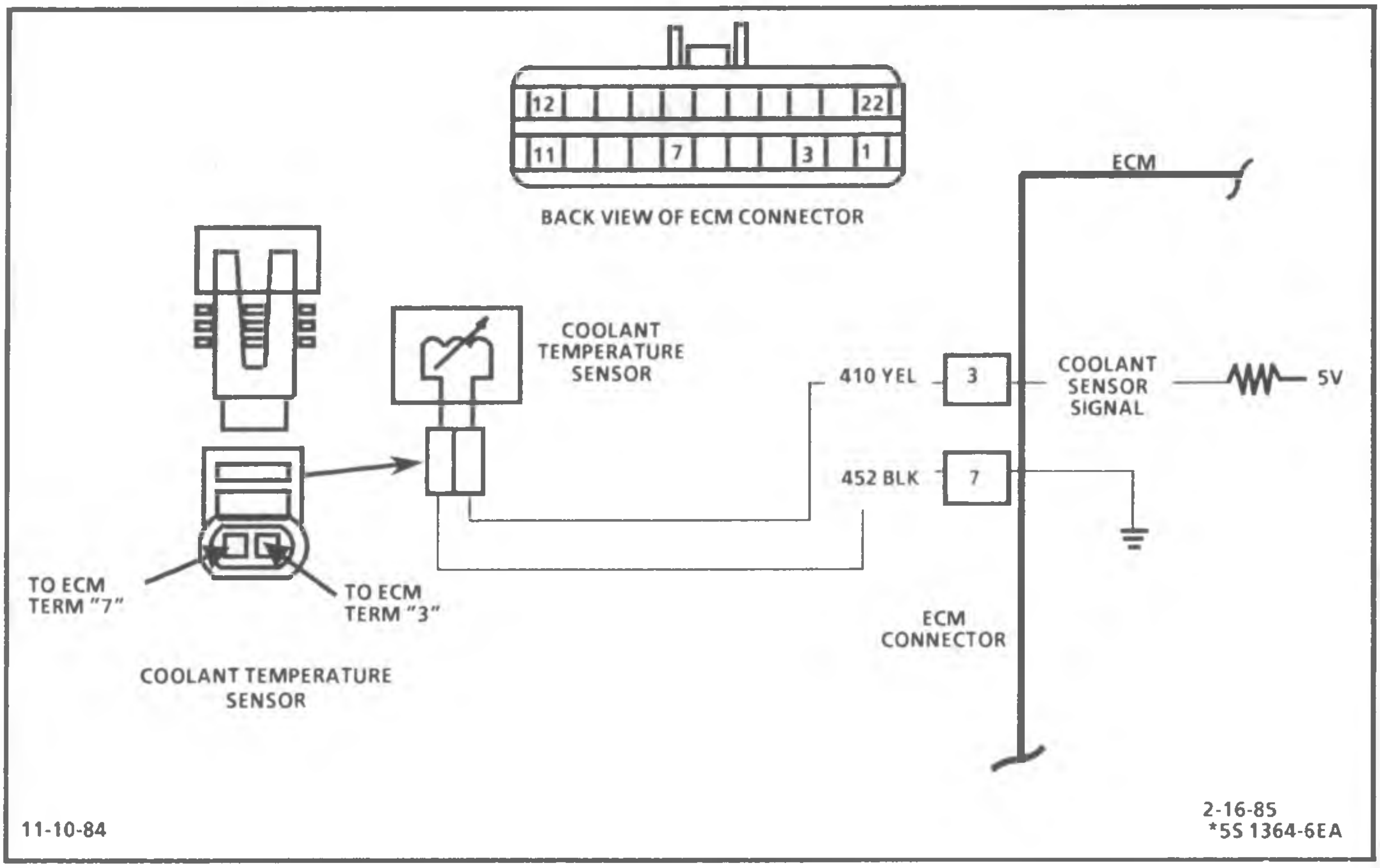
Check for short between coolant sensor wires. If not shorted, replace ECM. See Chart C-1.

Light "On"

Repair grounded wire to ECM term. "3".

4 volts or over

Replace coolant sensor.



CODE 15

COOLANT SENSOR OPEN

4.3L, 5.0L, OR 5.7L ENGINE

CARBURETED - CALIF.

Code 15 means the ECM has seen the resistance of the Coolant Sensor Circuit too high as follows:

- High resistance (Cold Engine Temperature)
- Or high voltage (at ECM Terminal "3")
- For a time longer than specified

This could cause detonation on a warm engine due to too much spark advance or poor driveability due to wrong fuel control.

1. Checks to see if problem is still present. If it is, the "SERVICE ENGINE SOON" light will come "ON" and Code 15 will be set.

2. Checks to see if the fault is the coolant sensor or lack of voltage to the coolant sensor. Normally you should have 5 volts across the coolant sensor connector terminals.

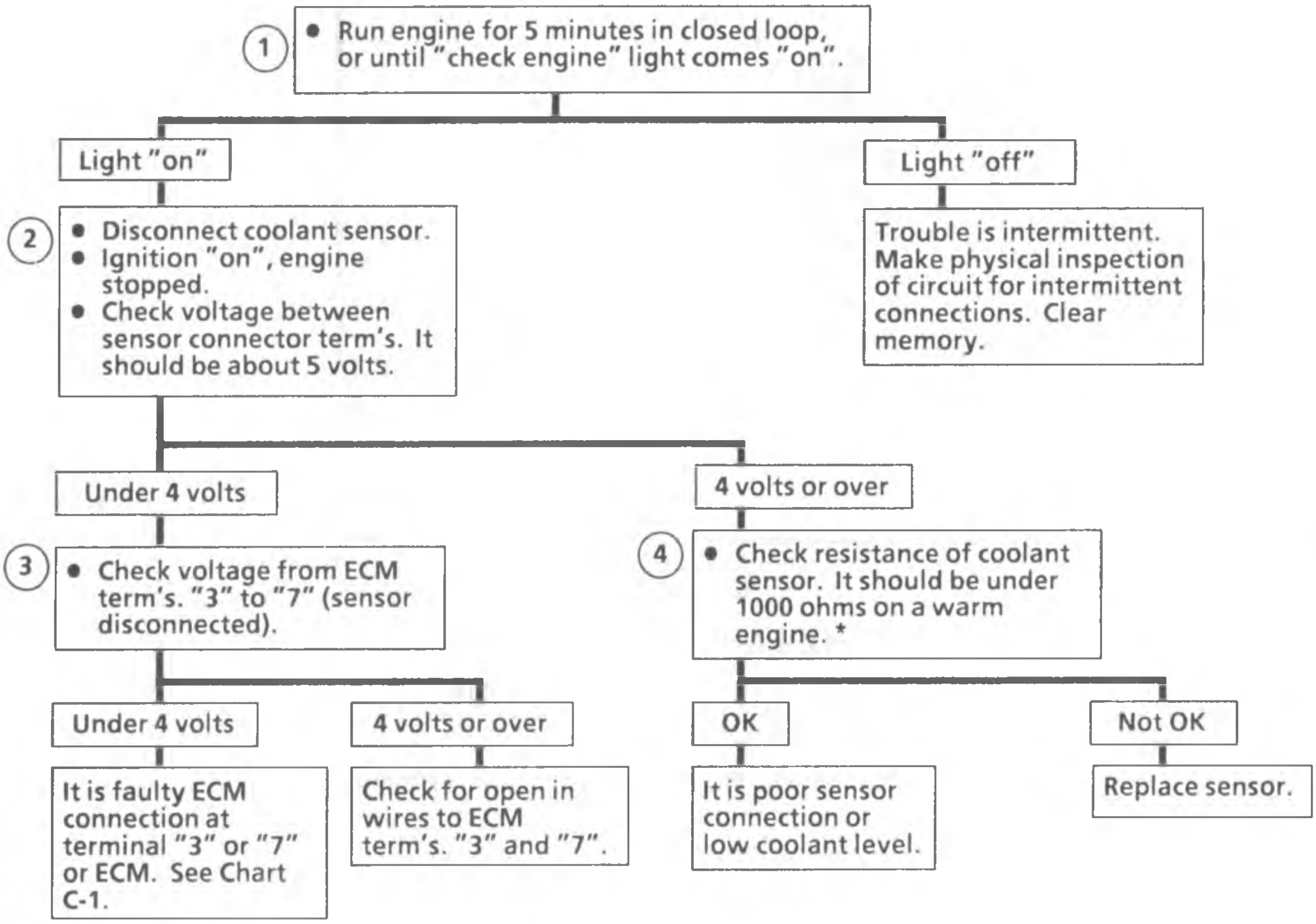
3. Determines whether the low voltage at the sensor connector is due to opens in the coolant sensor wires, or in another part of the 5V ref. circuit. Normal voltage should be about 5V from ECM Terminals "3" to "7".

4. Checks resistance of the coolant sensor. If the resistance is within the chart specifications, coolant sensor is not faulty; therefore, check for corrosion at the connector, or low coolant level.

CODE 15

COOLANT SENSOR CIRCUIT OPEN

4.3L, 5.0L, OR 5.7L ENGINE
CARBURETED - CALIF.



① • Run engine for 5 minutes in closed loop, or until "check engine" light comes "on".

Light "on"

② • Disconnect coolant sensor.
• Ignition "on", engine stopped.
• Check voltage between sensor connector term's. It should be about 5 volts.

Under 4 volts

③ • Check voltage from ECM term's. "3" to "7" (sensor disconnected).

Under 4 volts

It is faulty ECM connection at terminal "3" or "7" or ECM. See Chart C-1.

4 volts or over

Check for open in wires to ECM term's. "3" and "7".

4 volts or over

④ • Check resistance of coolant sensor. It should be under 1000 ohms on a warm engine. *

OK

It is poor sensor connection or low coolant level.

Not OK

Replace sensor.

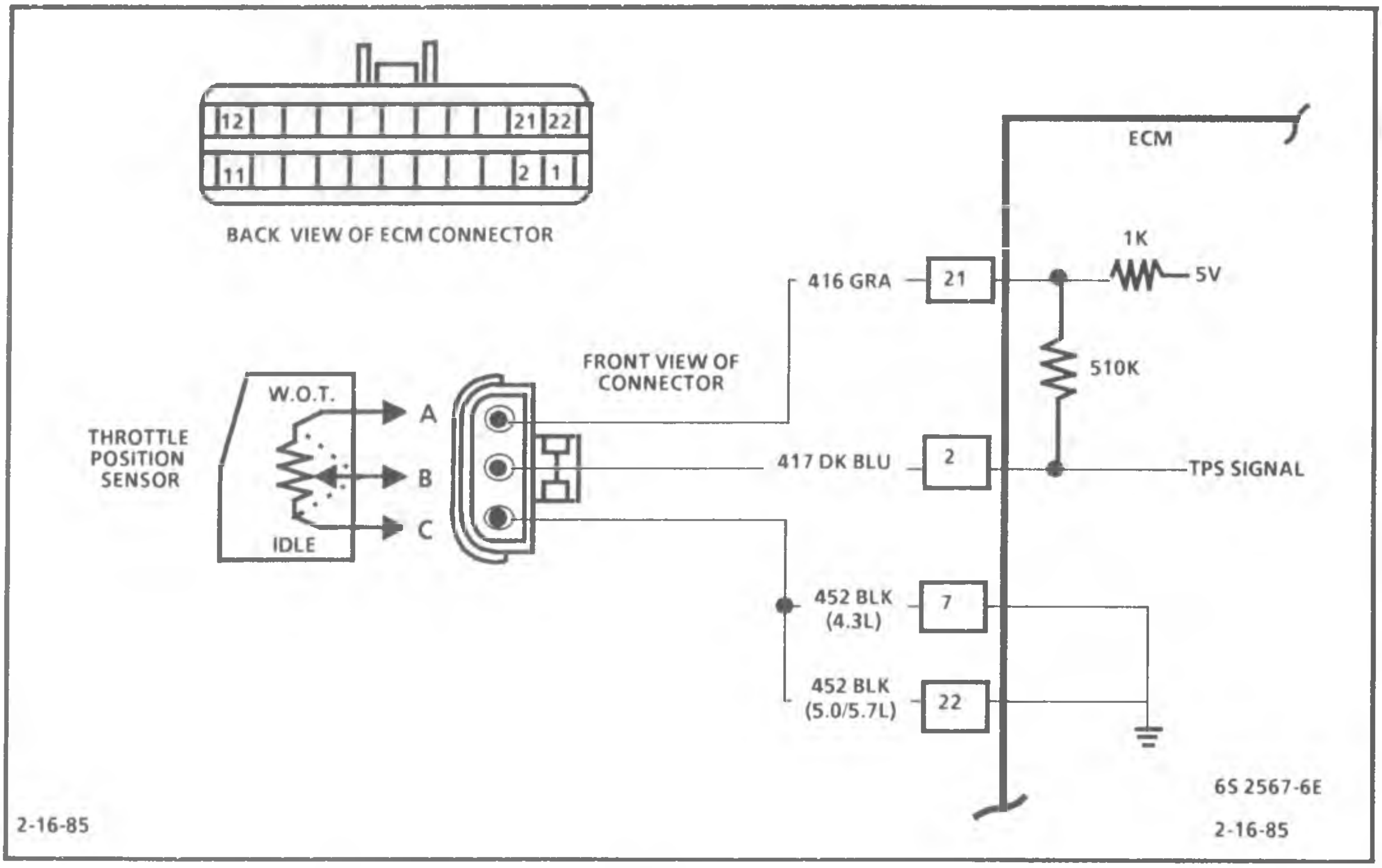
Light "off"

Trouble is intermittent. Make physical inspection of circuit for intermittent connections. Clear memory.

* COOLANT SENSOR

TEMPERATURE TO RESISTANCE VALUES (APPROXIMATE)

°F	°C	OHMS
210	100	185
160	70	450
100	38	1,600
70	-20	3,400
40	4	7,500
20	-7	13,500
0	-18	25,000
-40	-40	100,700



CODE 21

TPS OPEN OR MISADJUSTED

4.3L, 5.0L OR 5.7L ENGINE
CARBURETED - CALIF.

Code 21 means that the ECM has seen a high TPS voltage for:

- Over about 10 seconds
- Below a specified RPM (normally curb idle).
- Below a specified engine load.

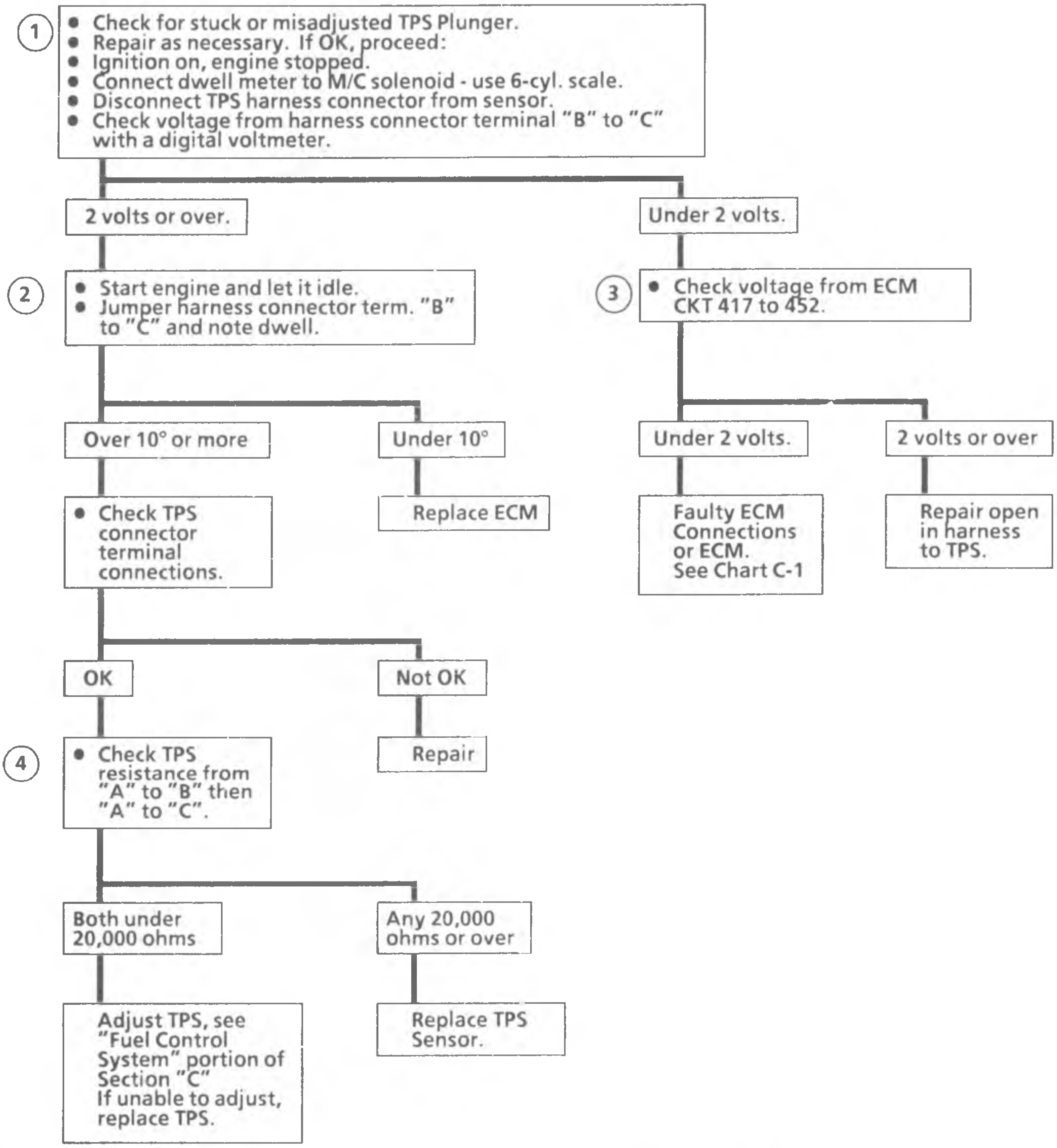
Due to the pull-up resistor between Terms. "21" and "2" within the ECM, an open in the TPS circuit will place about 5 volts (high TPS signal) at Term. "2" of the ECM.

1. Checks the circuits from the TPS connector back to the ECM. The circuit should read about 5V because of the pull-up resistor in the ECM. A 10 Meg. ohm resistence meter must be used. A lower resistence voltmeter would read virtually zero at terminal B.
2. Checks to see if the low voltage at the TPS connector is an open in the circuit or a faulty ECM. A normal reading at the ECM is about 5V.
3. This step simulates closed throttle, so dwell should increase if the ECM is good.
4. This step tests the resistance of the TPS switch itself. A normal reading is under 20,000 ohms.

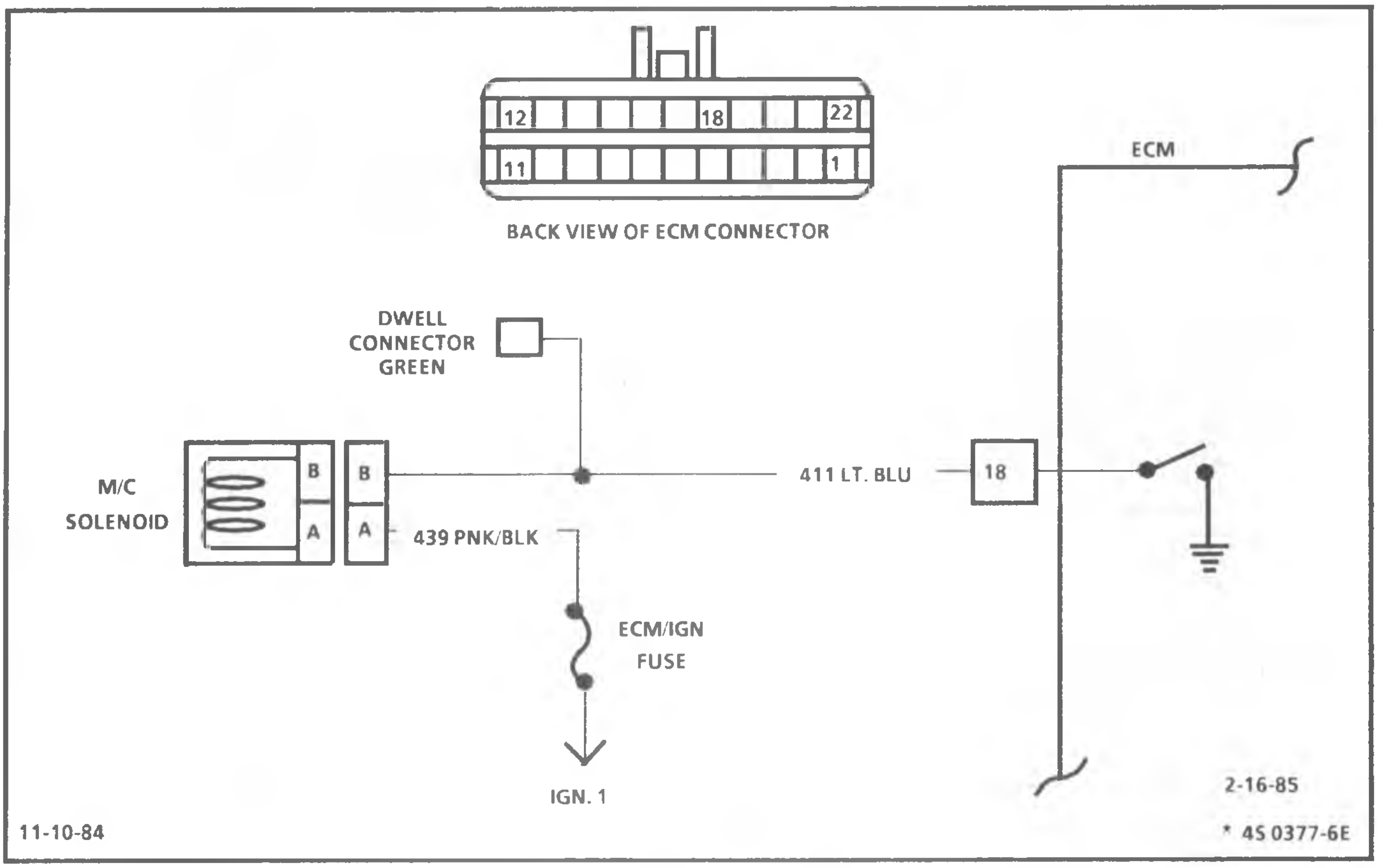
CODE 21

TPS OPEN OR MISADJUSTED

4.3L, 5.0L OR 5.7L ENGINE
CARBURETED - CALIF.



After any repair, clear long term memory by removing ECM fuse for 10 seconds.



CODE 23

M/C SOLENOID VOLTAGE LOW TO ECM

4.3L, 5.0L OR 5.7L ENGINE

CARBURETED - CALIF.

Code 23 says the ECM has seen the voltage at ECM Term. "18" stay low instead of rising and falling as the M/C solenoid is turned "ON" and "OFF". This could be caused by an open in the M/C solenoid circuit or a ground on the ECM side of the M/C solenoid.

An open would cause a full rich condition and cause poor economy, odor, smoky exhaust or poor driveability. A ground would cause a full lean condition and cause poor driveability.

1. Checks for a complete circuit from the battery to the M/C solenoid dwell lead. It should be battery voltage. Battery voltage means there might be an open circuit between the dwell connector and ground. No voltage could be either an open between the connector and battery or a ground on the ECM side of the M/C solenoid.

2. Checks for B+ on the pink ignition source wire. Test light should light between the ignition source and ground.

2A. Checks for an open in the solenoid to ECM circuit. A normal circuit would read about battery voltage at the ECM Terminal "18".

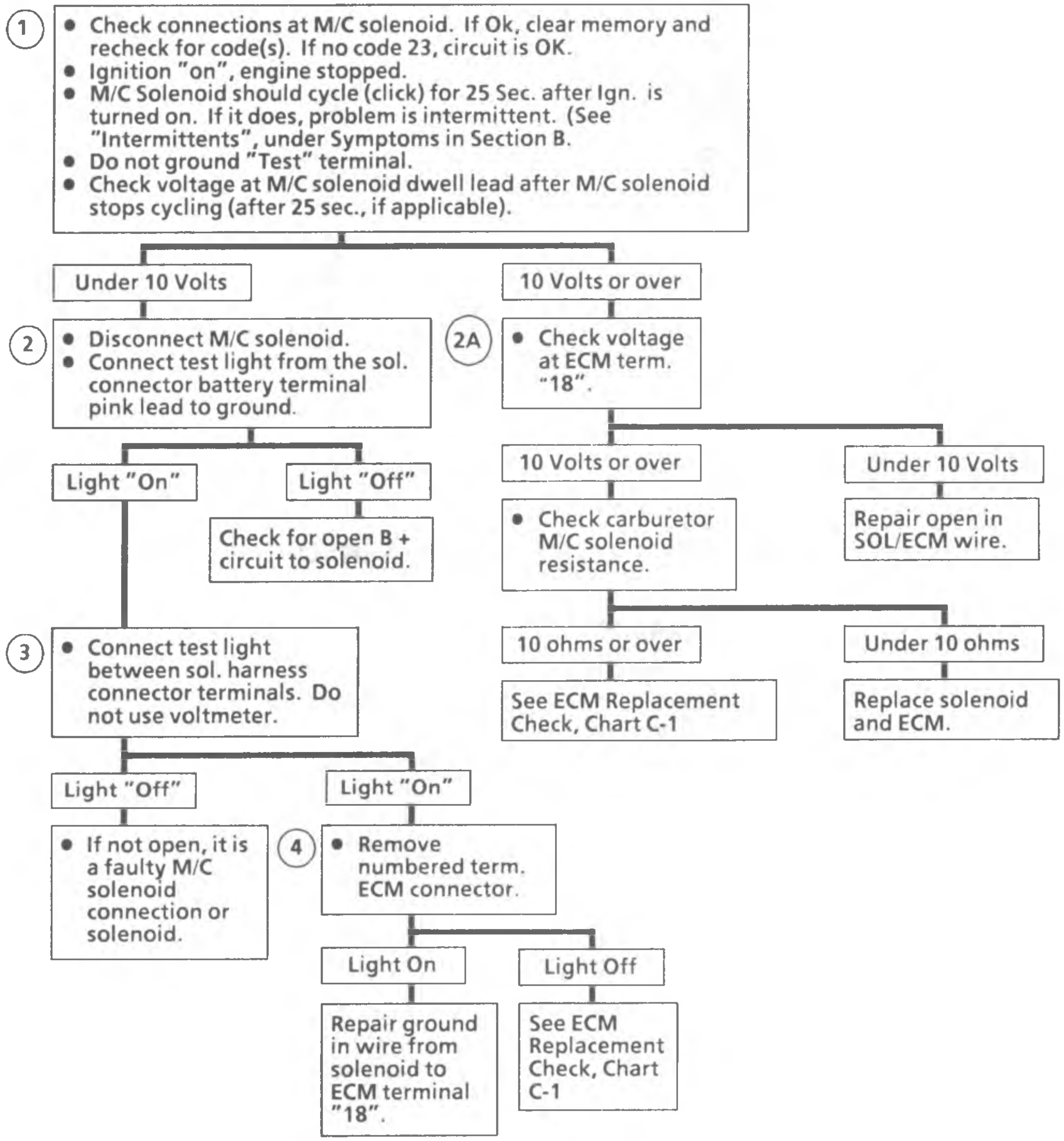
3. This step determines whether the fault is in the M/C solenoid, a ground in the circuit to the ECM, or the ECM. A light would indicate a ground in circuit to Terminal "18" or a faulty ECM. A voltmeter can't be used because it is normal to have enough current flow through the ECM even with the circuit open to make a voltmeter read, but not enough to light a test light.

4. This checks for ground in the wire to ECM Term. "18". If it is grounded, the light will stay "ON".

CODE 23

M/C SOLENOID VOLTAGE LOW TO ECM

4.3L, 5.0L OR 5.7L ENGINE
CARBURETED - CALIF.



①
- Check connections at M/C solenoid. If Ok, clear memory and recheck for code(s). If no code 23, circuit is OK.
- Ignition "on", engine stopped.
- M/C Solenoid should cycle (click) for 25 Sec. after Ign. is turned on. If it does, problem is intermittent. (See "Intermittents", under Symptoms in Section B.
- Do not ground "Test" terminal.
- Check voltage at M/C solenoid dwell lead after M/C solenoid stops cycling (after 25 sec., if applicable).

Under 10 Volts

②
- Disconnect M/C solenoid.
- Connect test light from the sol. connector battery terminal pink lead to ground.

Light "On"

③
- Connect test light between sol. harness connector terminals. Do not use voltmeter.

Light "Off"

- If not open, it is a faulty M/C solenoid connection or solenoid.

Light "On"

④
- Remove numbered term. ECM connector.

Light On

Repair ground in wire from solenoid to ECM terminal "18".

Light Off

See ECM Replacement Check, Chart C-1

Light "Off"

Check for open B + circuit to solenoid.

10 Volts or over

2A
- Check voltage at ECM term. "18".

10 Volts or over

- Check carburetor M/C solenoid resistance.

10 ohms or over

See ECM Replacement Check, Chart C-1

Under 10 ohms

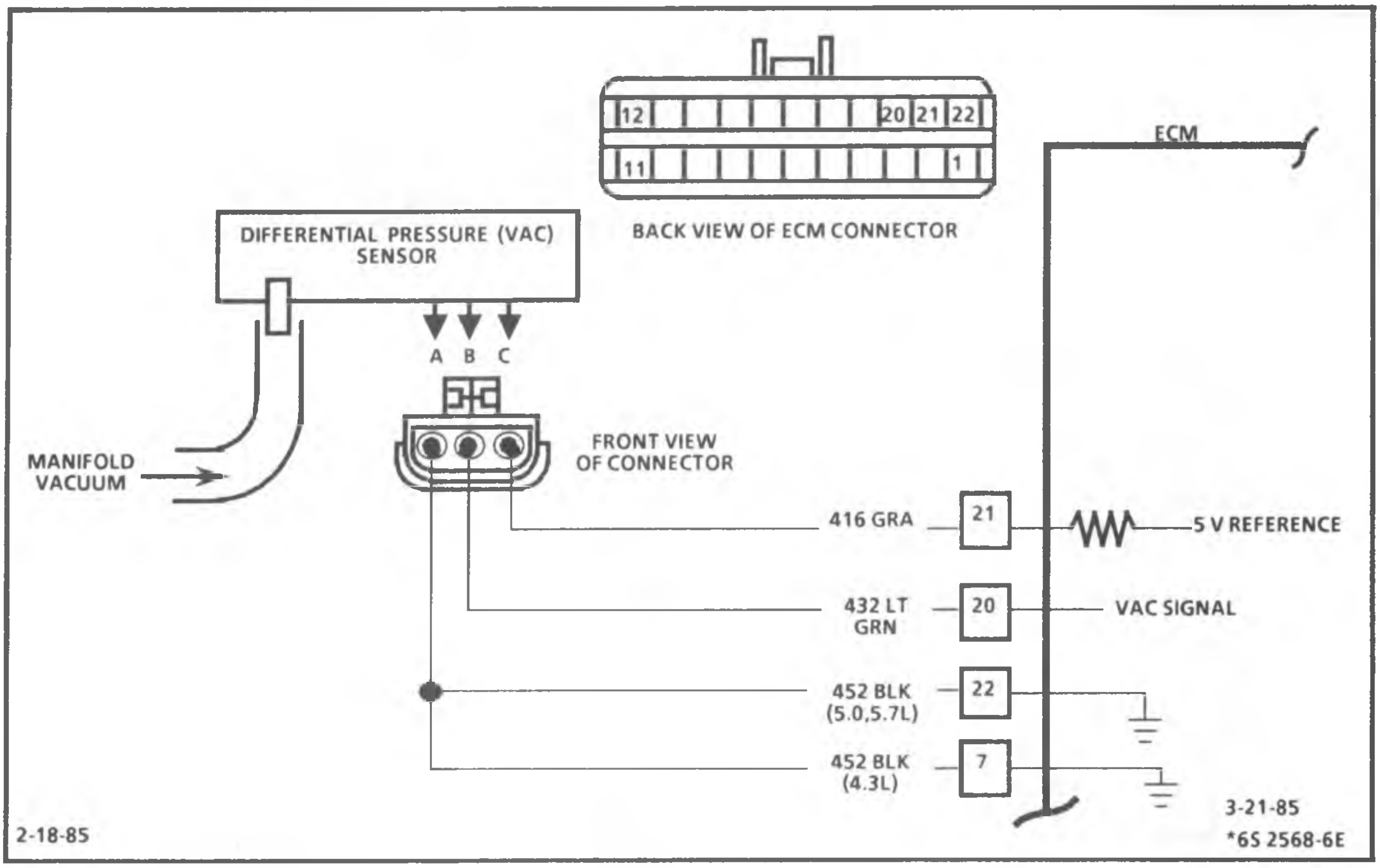
Replace solenoid and ECM.

Under 10 Volts

Repair open in SOL/ECM wire.

84-85
* 6S 2637-6E

4-2-85



CODE 34

DIFFERENTIAL PRESSURE (VAC) SENSOR

4.3L, 5.0L OR 5.7L ENGINE

CARBURETED - CALIF.

Code 34 says that the ECM has seen the following:

- Pressure outside a specified voltage range (seen by ECM as voltage at Term. 20).
- Engine RPM less than a given value (normally curb idle).
- Engine at operating temperature.
- All the above for a time greater than specified.

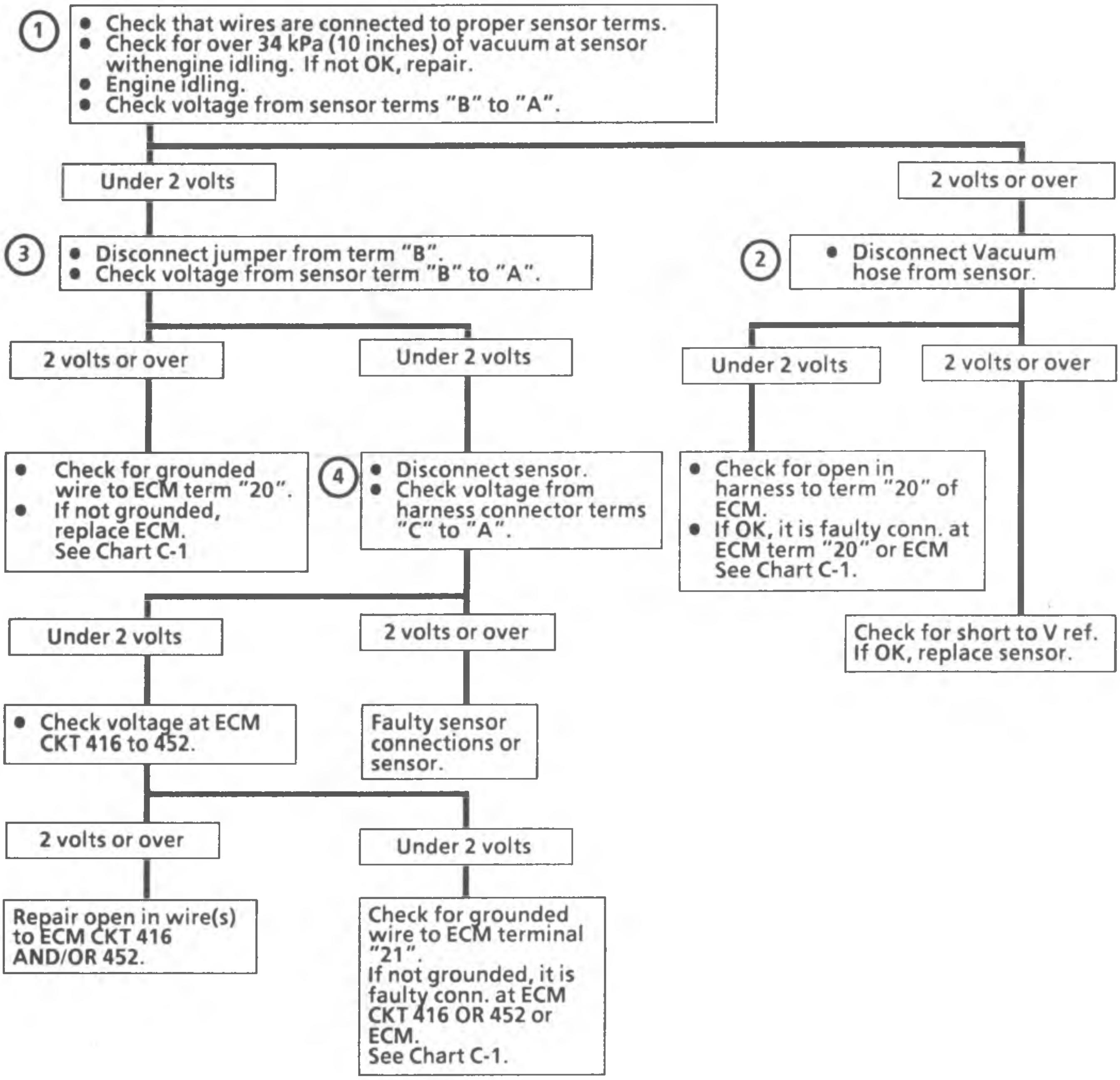
The VAC sensor is a differential pressure sensor that measures the difference in pressure between atmosphere and manifold. The VAC sensor supplies high voltage at high vacuum. High voltage increases spark advance while low voltage reduces advance.

1. Checks output of sensor at idle to determine if sensor is within specification. Normal sensor will read less than 1 volt with key "ON", engine "OFF" and over 3 volts with engine idling with a minimum of 15" vacuum.
2. A normal sensor should drop below 1 volt when vacuum is removed. This step tests for that drop at the sensor.
3. Check for a ground in wire from Term. 'B' of VAC sensor to ECM. This would be the case if the voltage went up over 2 volts when the line was opened.
4. Checks to see if the fault is in the sensor, or in the ECM wiring, or in the ECM. If the voltage goes over 2 volts with the sensor disconnected, the sensor or sensor connections are faulty.

CODE 34

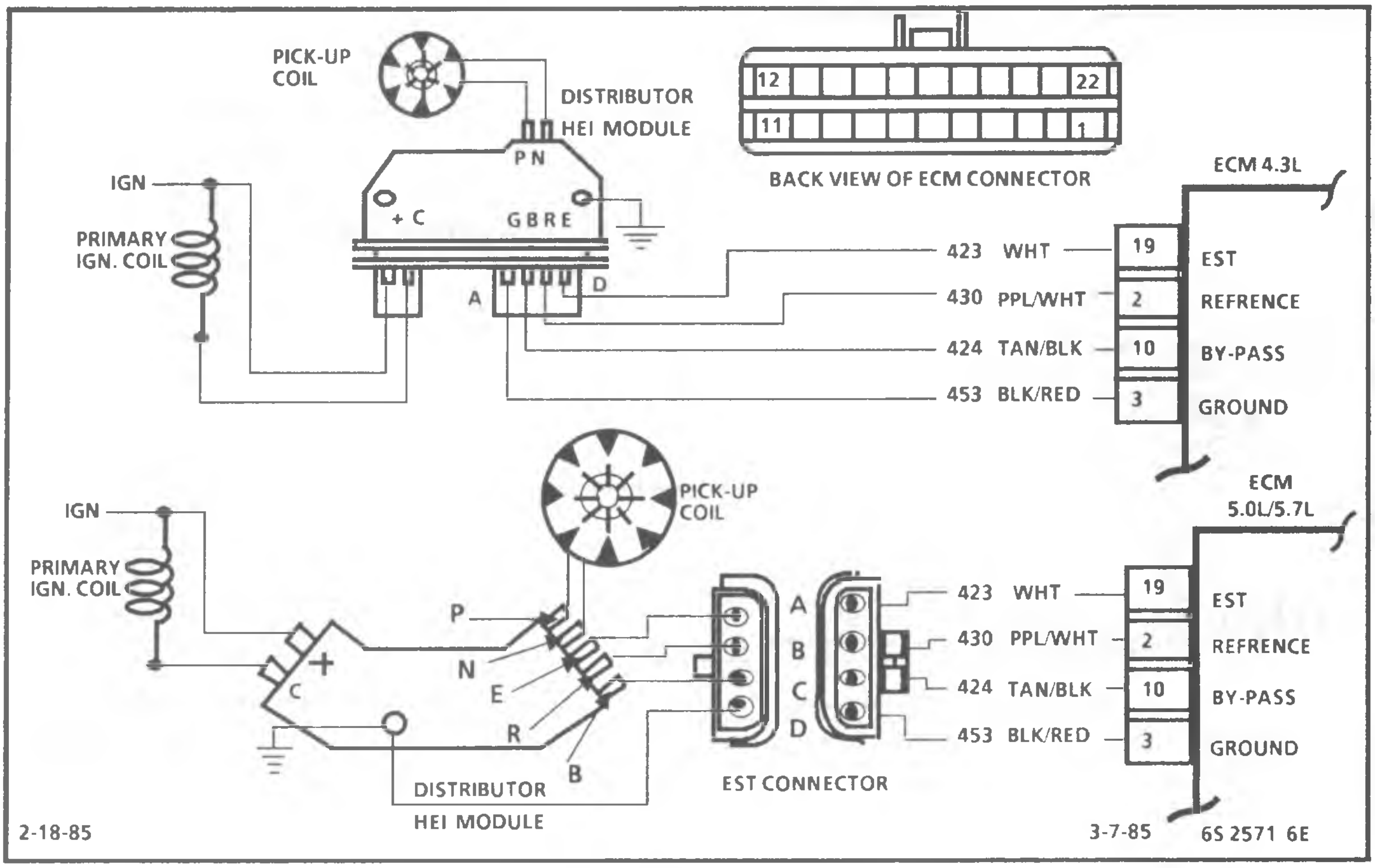
DIFFERENTIAL PRESSURE (VAC) SENSOR
(SIGNAL VOLTAGE INCORRECT)

4.3L, 5.0L OR 5.7L ENGINE
CARBURETED - CALIF.



* This requires use of three jumpers between the sensor and the connector. They can be made using terminals 12014836 and 12014837.

2-18-85



CODE 41

NO DISTRIBUTOR REFERENCE SIGNAL

4.3L, 5.0L OR 5.7L ENGINE

CARBURETED - CALIF.

Code 41 says that there are no distributor references pulses to the ECM at a specified engine vacuum. This code could set with the key "ON", engine "Not Running" if the VAC sensor was defective by indicating "Engine Running" voltage with just the key "ON". With a constant open or ground in the reference signal circuit, Code 12 would be set along with a 41. Use Chart 12 if 12 and 41 are set. Code 41 alone indicates the problem is intermittent. When the distributor reference line signal is lost, the engine runs full rich and with retarded (base) spark timing. The result is poor performance, poor fuel economy, and possibly rotten egg odor from exhaust.

1. Checks to see if VAC sensor voltage changes with loss of vacuum supply. A good sensor will change voltage at Terms. 'A' to 'B' by 1 volt or more.

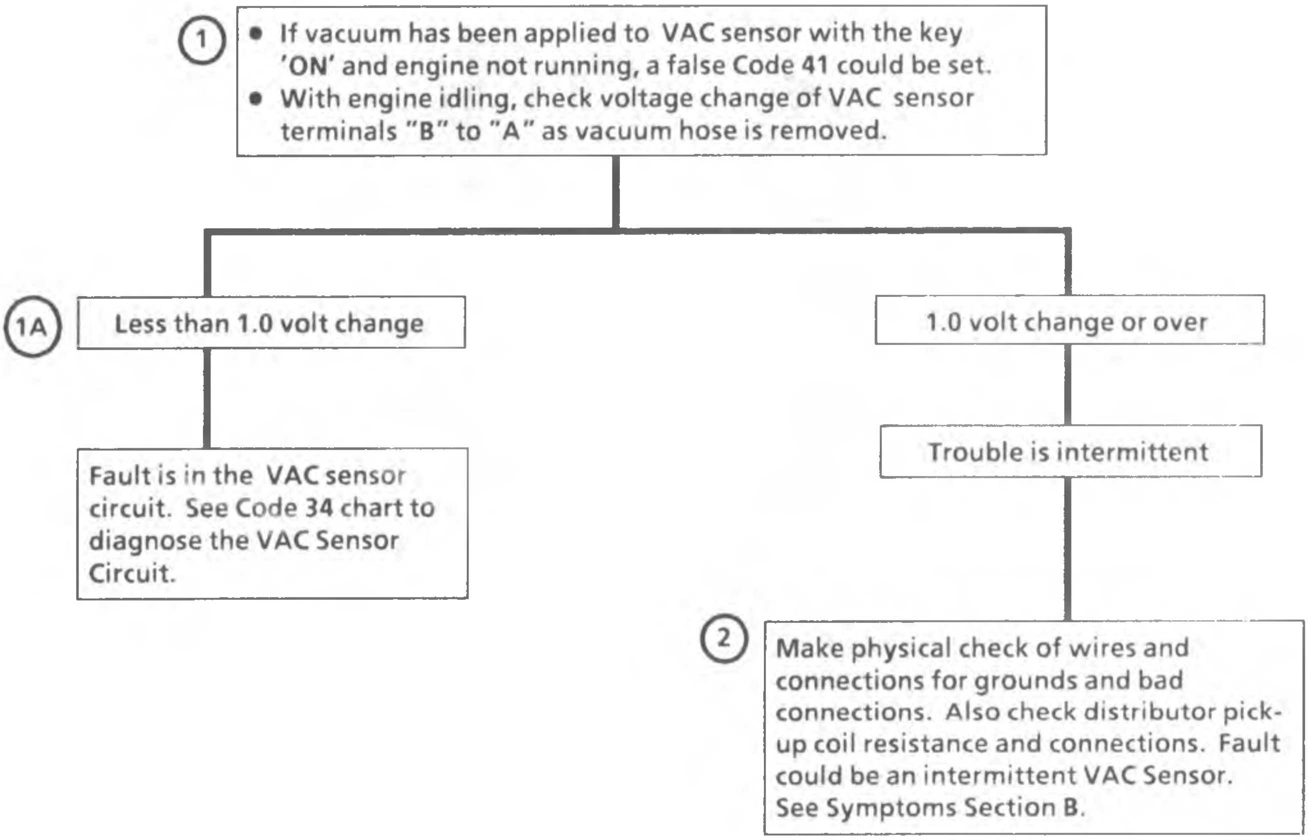
1A. Since the voltage change was less than 1 volt, the problem is in the Vacuum system. The ECM has "seen" engine running vacuum equivalent with no distributor reference signal, with the key "ON", engine not running.

2. Checks for cause of an intermittent open or ground in the distributor circuit. Fault could also be an intermittent stuck Vacuum sensor that has the same voltage output as an engine "running" with only the key "ON", thus, no reference signal. Terminals must be removed from connectors to properly check them. The distributor pick-up coil should also be checked.

CODE 41

NO DISTRIBUTOR REFERENCE SIGNAL

4.3L, 5.0L OR 5.7L ENGINE
CARBURETED - CALIF.



①
- If vacuum has been applied to VAC sensor with the key 'ON' and engine not running, a false Code 41 could be set.
- With engine idling, check voltage change of VAC sensor terminals "B" to "A" as vacuum hose is removed.

(1A) Less than 1.0 volt change

Fault is in the VAC sensor circuit. See Code 34 chart to diagnose the VAC Sensor Circuit.

1.0 volt change or over

Trouble is intermittent

② Make physical check of wires and connections for grounds and bad connections. Also check distributor pick-up coil resistance and connections. Fault could be an intermittent VAC Sensor. See Symptoms Section B.

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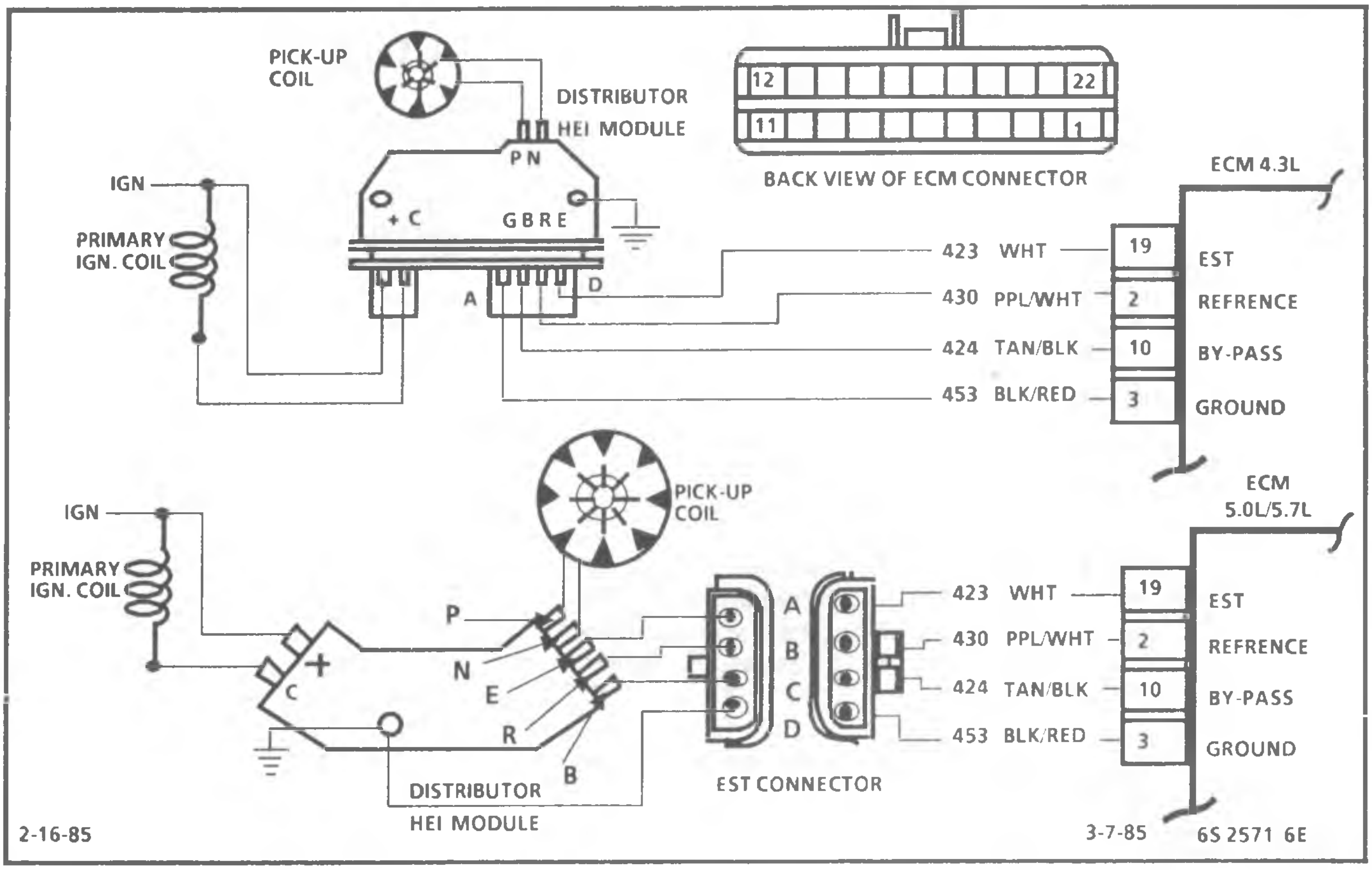
6S 2570-6E



CODE 42

ELECTRONIC SPARK TIMING (EST)

4.3L, 5.0L OR 5.7L ENGINE

CARBURETED - CALIF.

Code 42 says that the ECM has seen:

- Open or grounded By-pass Circuit (Term. "11")
- Open or grounded EST Circuit (Term. "12")

A grounded EST may sometimes not set a code unless cranked 10 seconds or longer with circuit grounded.

1. This checks operation of EST. Grounding the "test' terminal causes timing to go to a fixed value which is normally different from that obtained with EST operating. Therefore, the timing should change. Usually the change can be heard in engine RPM. If so, the timing change does not have to be checked. If timing varies with increase in engine RPM, problem is indicated.

2. This step eliminates the ECM and ECM connections from the module input. By jumpering Terminals "A" and "B", the distributor ref. signal is fed directly into the EST line of the module.

   By putting voltage through the test light on Terminal "C" of the harness, the module is switched to the EST mode and the vehicle should run. If the engine stops, there is no EST signal reaching the module due to open or poor connections, or the module is faulty.

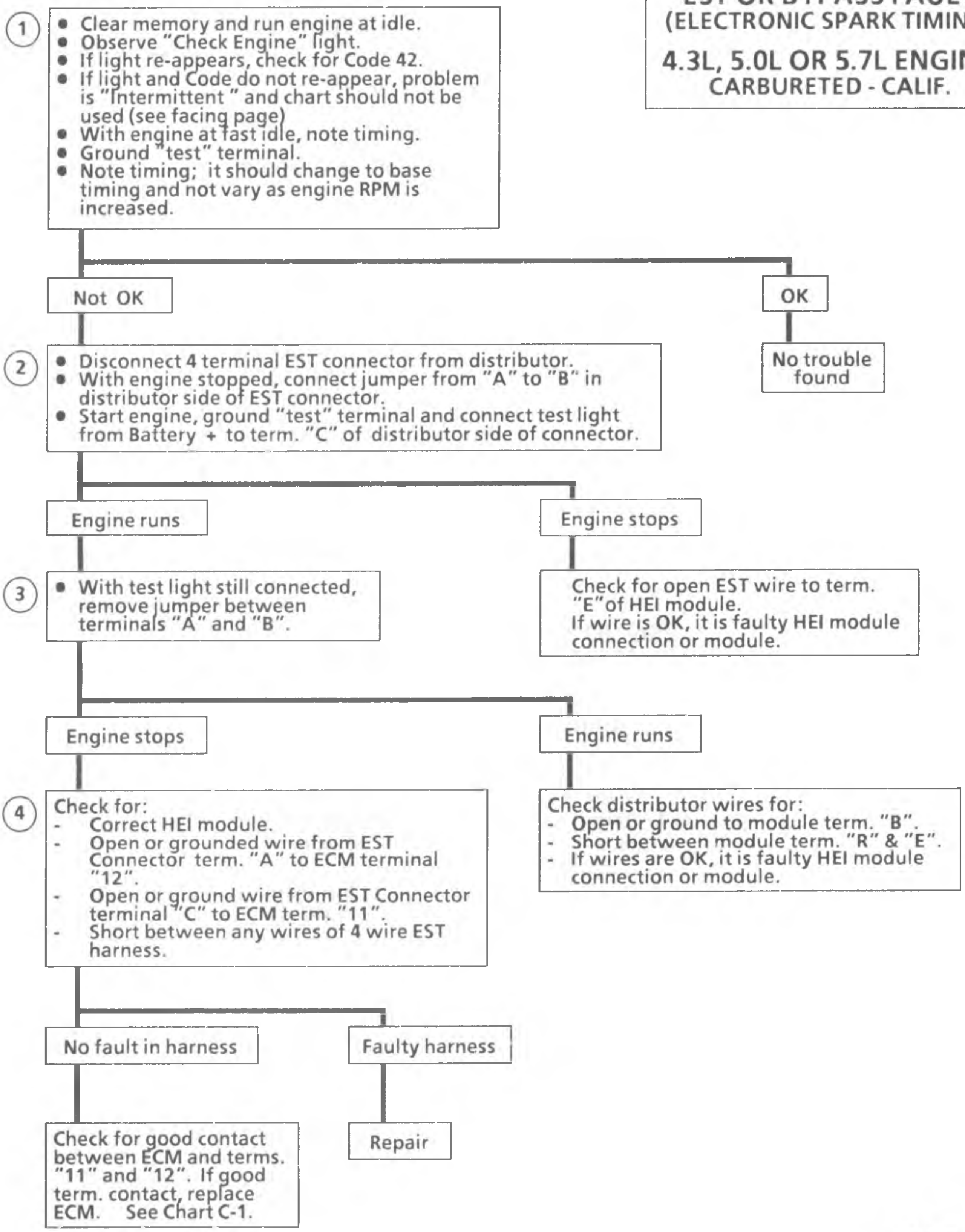
3. By removing the jumper, you are opening the EST signal and the engine should stop.

4. Since the engine ran when the module was jumpered, it says the problem is not in the distributor (if the correct HEI module is installed). The wrong HEI module can set a Code 42.

CODE 42

EST OR BYPASS FAULT
(ELECTRONIC SPARK TIMING)

4.3L, 5.0L OR 5.7L ENGINE
CARBURETED - CALIF.



①
- Clear memory and run engine at idle.
- Observe "Check Engine" light.
- If light re-appears, check for Code 42.
- If light and Code do not re-appear, problem is "Intermittent" and chart should not be used (see facing page)
- With engine at fast idle, note timing.
- Ground "test" terminal.
- Note timing; it should change to base timing and not vary as engine RPM is increased.

Not OK

OK

No trouble found

②
- Disconnect 4 terminal EST connector from distributor.
- With engine stopped, connect jumper from "A" to "B" in distributor side of EST connector.
- Start engine, ground "test" terminal and connect test light from Battery + to term. "C" of distributor side of connector.

Engine runs

Engine stops

Check for open EST wire to term. "E" of HEI module.
If wire is OK, it is faulty HEI module connection or module.

③
- With test light still connected, remove jumper between terminals "A" and "B".

Engine stops

Engine runs

④
Check for:
- Correct HEI module.
- Open or grounded wire from EST Connector term. "A" to ECM terminal "12".
- Open or ground wire from EST Connector terminal "C" to ECM term. "11".
- Short between any wires of 4 wire EST harness.

Check distributor wires for:
- Open or ground to module term. "B".
- Short between module term. "R" & "E".
- If wires are OK, it is faulty HEI module connection or module.

No fault in harness

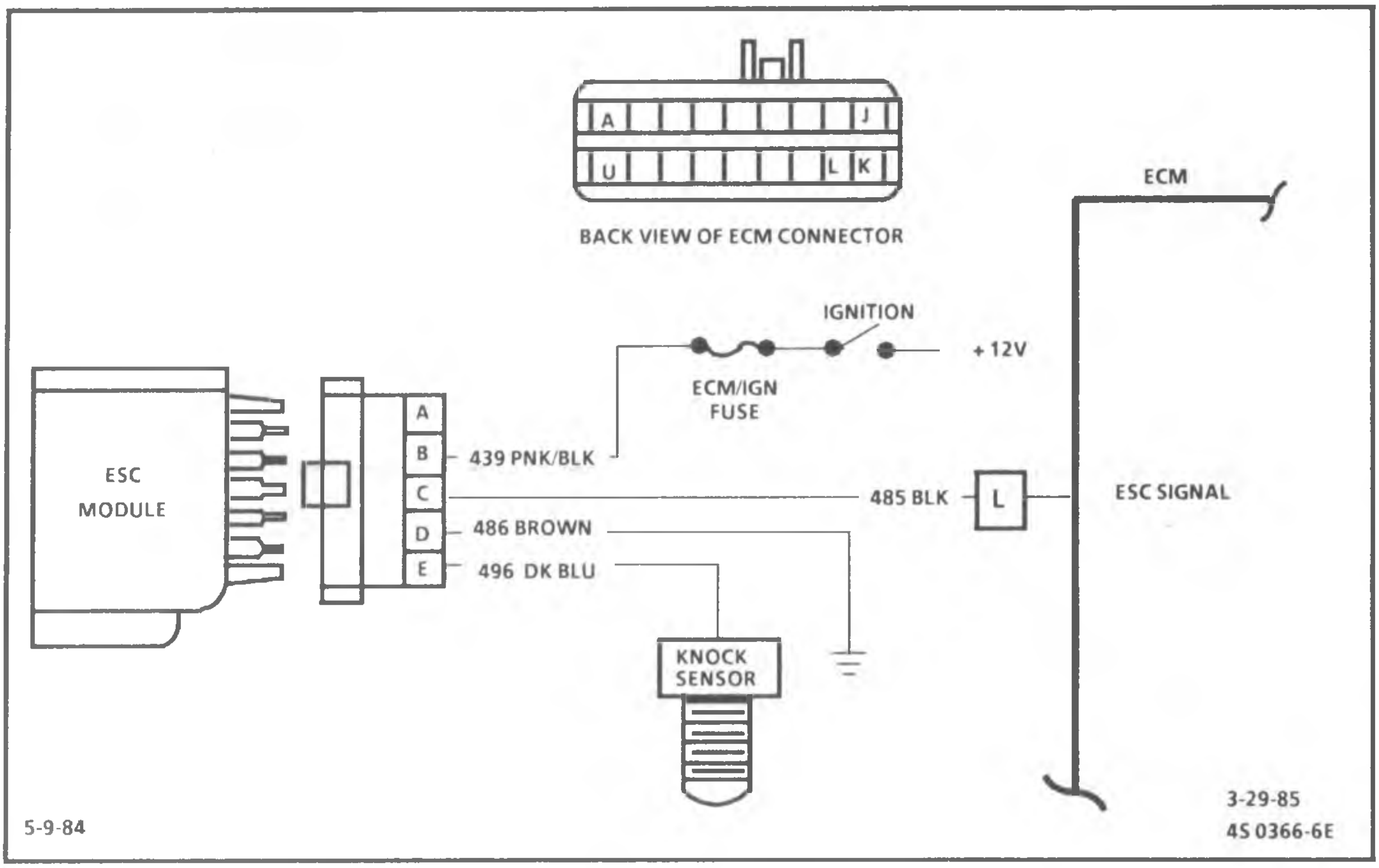
Faulty harness

Check for good contact between ECM and terms. "11" and "12". If good term. contact, replace ECM. See Chart C-1.

Repair

4-2-85

6S 2639-6E



CODE 43

ESC VOLTAGE LOW TO ECM
(ELECTRONIC SPARK CONTROL)

4.3 L ENGINE
CARBURETED - CALIF.

Code 43 says that the Electronic Spark Control (ESC) retard signal has been seen by the ECM for too long a period of time. When voltage at Terminal 'L' at the ECM is low, spark is retarded. Normal voltage in non-retard mode is about 7.5V or more.

1. Normal voltage would be over 7.5 volts. If 7.5 volts is present at Term. "L", the reason for a Code 43 is a poor connection to ECM or faulty ECM.

2. Over 6 volts indicates an overly sensitive knock sensor or controller, or noise in the engine that fools the knock sensor.

3. Checks for grounded ECM.

4. Checks for an open in wire from ESC to ECM. If over 6 volts was obtained at Term. "C" of the ESC, the fault is an open to Term. "L" of ECM.

5. Checks for proper 12V ignition source to ESC Term. 'B'. Term. 'B' should be battery voltage.

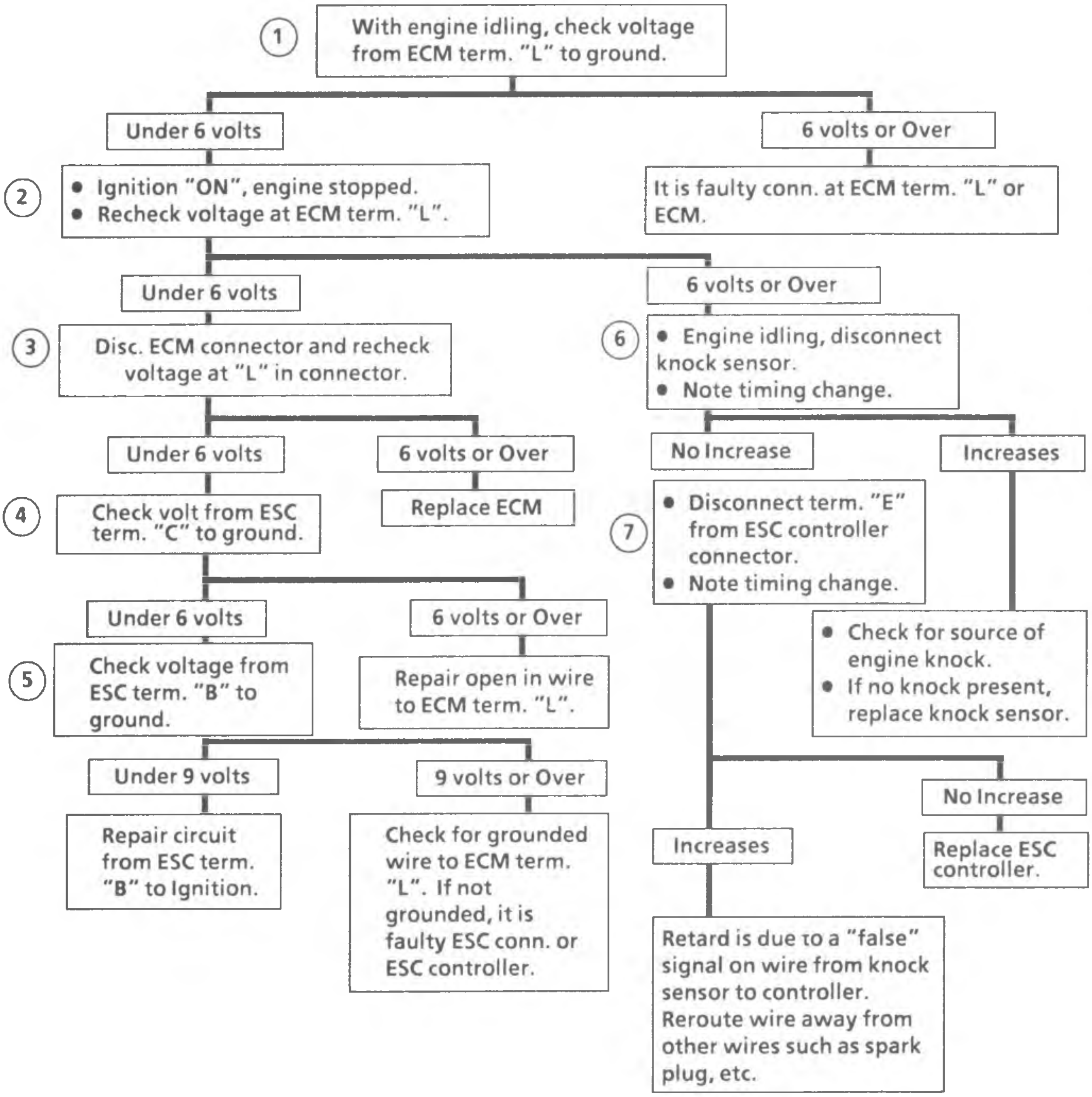
6. Checks to see if spark retard is due to engine knock or a faulty knock sensor. If by disconnecting the knock sensor spark advances, fault is in engine "noise" or sensor. Normally no increase would be noted.

7. Checks to see if spark retard is due to "noise" on ESC to knock sensor line or a faulty ESC controller. By removing terminal "E" from the connector, the determination can be made. If spark advances, check for improper routing of knock sensor signal wire.

CODE 43

ESC VOLTAGE LOW TO ECM
(ELECTRONIC SPARK CONTROL)

4.3L ENGINE
CARBURETED - CALIF.



① With engine idling, check voltage from ECM term. "L" to ground.

Under 6 volts

②
- Ignition "ON", engine stopped.
- Recheck voltage at ECM term. "L".

6 volts or Over

It is faulty conn. at ECM term. "L" or ECM.

Under 6 volts

③ Disc. ECM connector and recheck voltage at "L" in connector.

6 volts or Over

⑥
- Engine idling, disconnect knock sensor.
- Note timing change.

Under 6 volts

④ Check volt from ESC term. "C" to ground.

6 volts or Over

Replace ECM

No Increase

⑦
- Disconnect term. "E" from ESC controller connector.
- Note timing change.

Increases

- Check for source of engine knock.
- If no knock present, replace knock sensor.

Under 6 volts

⑤ Check voltage from ESC term. "B" to ground.

6 volts or Over

Repair open in wire to ECM term. "L".

Under 9 volts

Repair circuit from ESC term. "B" to Ignition.

9 volts or Over

Check for grounded wire to ECM term. "L". If not grounded, it is faulty ESC conn. or ESC controller.

Increases

Retard is due to a "false" signal on wire from knock sensor to controller. Reroute wire away from other wires such as spark plug, etc.

No Increase

Replace ESC controller.

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* 6S 2640-6E

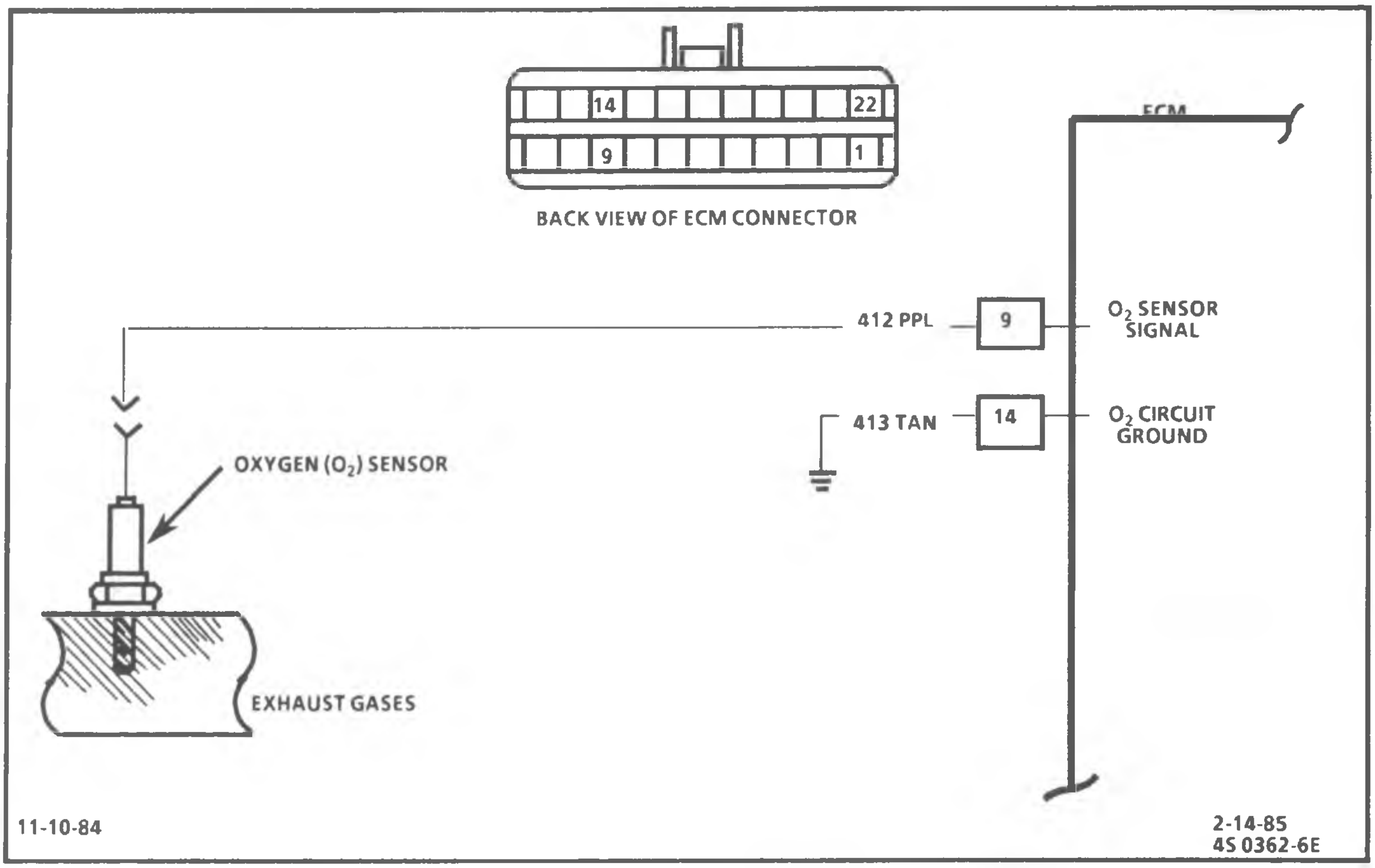


CHART 44

LEAN EXHAUST INDICATION

4.3L, 5.0L OR 5.7L ENGINE

CARBURETED - CALIF.

Code 44 says that the ECM has seen 0_2 sensor voltage under the following conditions:

- Voltage lower than specified
- Closed loop
- Above a specified TPS value
- For a time longer than specified

1. Checks to see if the condition is still present. A fixed dwell of under 10° indicates the problem is still present. A fixed dwell under 10° at idle, with dwell varying at 3000 RPM, usually indicates an intake leak. Check these areas prior to replacing the 0_2 sensor.

2. Checks to see if the ECM is able to respond to a rich condition caused by choking the engine. If it does, the problem is a lean engine condition, NOT electrical.

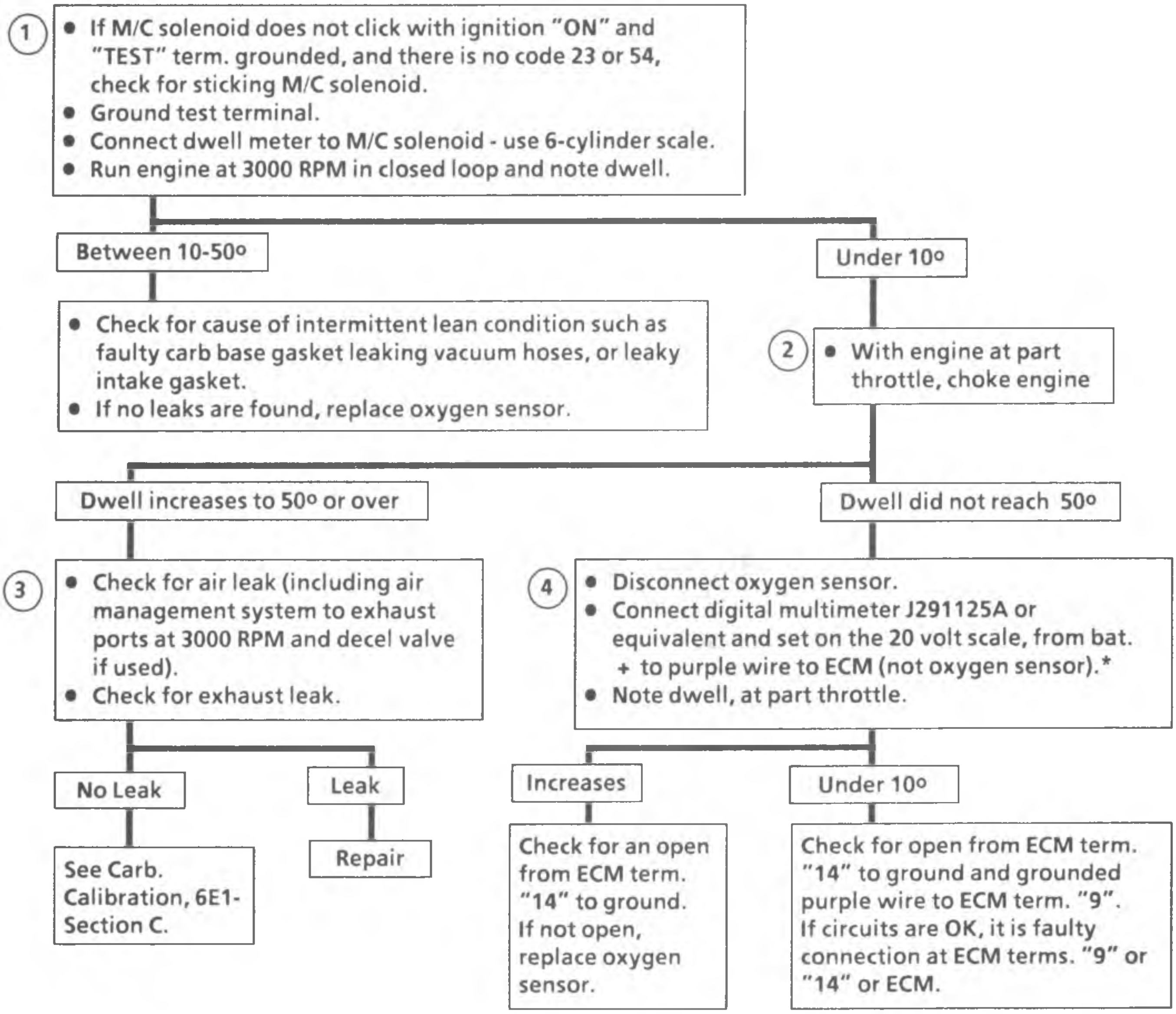
3. If dwell increases to over 50° with heavy choking the fault is an air leak, since the ECM was able to respond. If air is going to exhaust ports, disconnect the solenoid(s) for the air control valve. If air still goes to the ports, it is a faulty valve.

4. This step puts a rich 0_2 signal (about 1 volt) into Terminal "9" of the ECM. Dwell should increase (lean command).

CODE 44

LEAN EXHAUST INDICATION

4.3L, 5.0L OR 5.7L ENGINE
CARBURETED - CALIF.



①
- If M/C solenoid does not click with ignition "ON" and "TEST" term. grounded, and there is no code 23 or 54, check for sticking M/C solenoid.
- Ground test terminal.
- Connect dwell meter to M/C solenoid - use 6-cylinder scale.
- Run engine at 3000 RPM in closed loop and note dwell.

Between 10-50°

- Check for cause of intermittent lean condition such as faulty carb base gasket leaking vacuum hoses, or leaky intake gasket.
- If no leaks are found, replace oxygen sensor.

Under 10°

②
- With engine at part throttle, choke engine

Dwell increases to 50° or over

③
- Check for air leak (including air management system to exhaust ports at 3000 RPM and decel valve if used).
- Check for exhaust leak.

No Leak

See Carb. Calibration, 6E1-Section C.

Leak

Repair

Dwell did not reach 50°

④
- Disconnect oxygen sensor.
- Connect digital multimeter J291125A or equivalent and set on the 20 volt scale, from bat. + to purple wire to ECM (not oxygen sensor).*
- Note dwell, at part throttle.

Increases

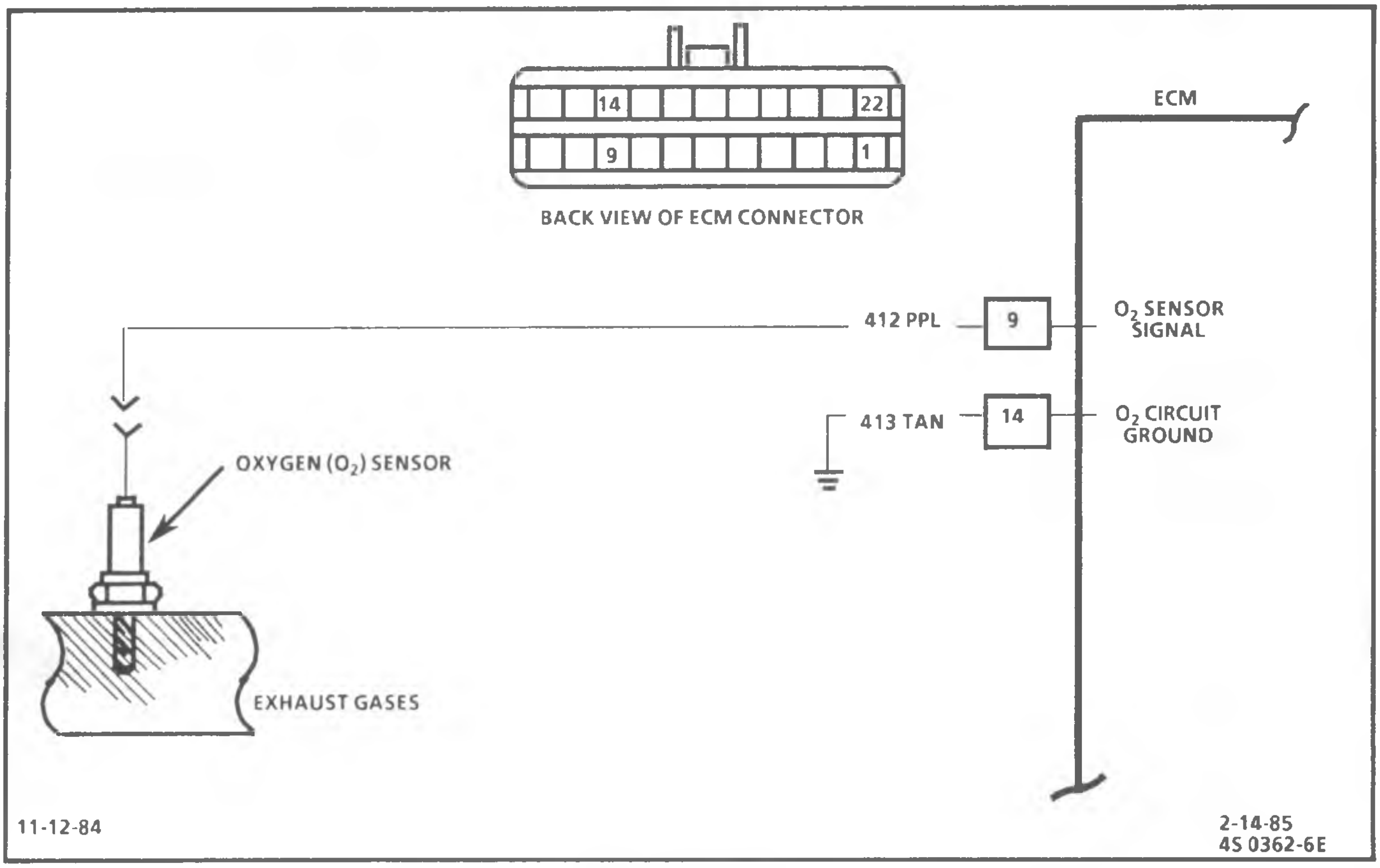
Check for an open from ECM term. "14" to ground. If not open, replace oxygen sensor.

Under 10°

Check for open from ECM term. "14" to ground and grounded purple wire to ECM term. "9". If circuits are OK, it is faulty connection at ECM terms. "9" or "14" or ECM.

*Do not use an ordinary voltmeter or jumper in place of the digital voltmeter because they have too little resistance. A voltage of 1.0V to 1.7V (such as a flashlight battery) can be connected with the Positive terminal to the purple wire and the negative terminal to ground as a jumper. If the polarity is reversed, it won't work.

If chart does not resolve problem, see Driveability Symptoms, Section "B".



CODE 45
RICH EXHAUST INDICATION
4.3L, 5.0L OR 5.7L ENGINE
CARBURETED - CALIF.

Code 45 says that the ECM has seen:

- High oxygen sensor voltage
- More than specified time (about 2 minutes)
- Above a specified TPS value
- Closed loop

A high voltage can be caused by a rich exhaust or 0_2 sensor contaminated with silicone.

1. Checks to see if fault is still present. A dwell of under 50° indicates engine should be checked for cause of intermittent rich condition: i.e.,

    - Purge or bowl vent valves leaking.
    - Fuel in crankcase.
    - Fuel in evaporative canister.
    - Sticking mixture control solenoid or metering rods.

2. This step causes a lean condition by putting an air leak into the engine to see if ECM can respond. A drop in the dwell indicates ECM and 0_2 sensor are not faulty. Look for source of constant rich condition. See step one examples.

3. This step tests to see if ECM is able to respond to a lean exhaust 0_2 signal (low voltage). If no dwell change with a grounded lead to 0_2 sensor Term. "9", fault is in ECM. It couldn't be an open 0_2 wire because that would set Code 13.

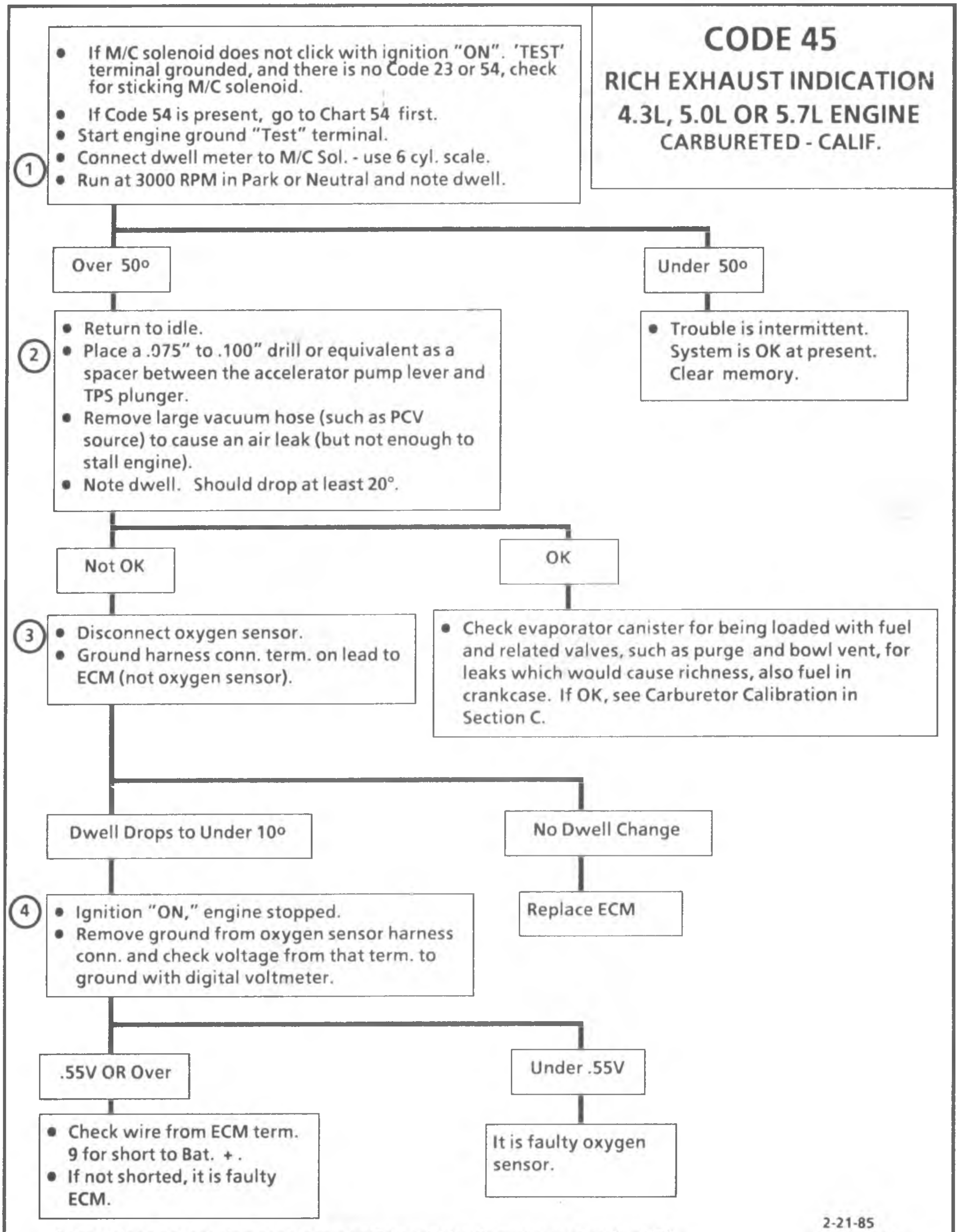
4. This step checks the voltage from the ECM at the 0_2 sensor harness. Normal voltage at this point is the ECM bias voltage for no 0_2 signal which is approximately .45V. If voltage is high, the wire to the ECM could be shorted to B+, or it is a faulty ECM.

CODE 45

RICH EXHAUST INDICATION

4.3L, 5.0L OR 5.7L ENGINE

CARBURETED - CALIF.



①
- If M/C solenoid does not click with ignition "ON". 'TEST' terminal grounded, and there is no Code 23 or 54, check for sticking M/C solenoid.
- If Code 54 is present, go to Chart 54 first.
- Start engine ground "Test" terminal.
- Connect dwell meter to M/C Sol. - use 6 cyl. scale.
- Run at 3000 RPM in Park or Neutral and note dwell.

Over 50°

②
- Return to idle.
- Place a .075" to .100" drill or equivalent as a spacer between the accelerator pump lever and TPS plunger.
- Remove large vacuum hose (such as PCV source) to cause an air leak (but not enough to stall engine).
- Note dwell. Should drop at least 20°.

Not OK

③
- Disconnect oxygen sensor.
- Ground harness conn. term. on lead to ECM (not oxygen sensor).

Dwell Drops to Under 10°

④
- Ignition "ON," engine stopped.
- Remove ground from oxygen sensor harness conn. and check voltage from that term. to ground with digital voltmeter.

.55V OR Over

- Check wire from ECM term. 9 for short to Bat. +.
- If not shorted, it is faulty ECM.

Under .55V

It is faulty oxygen sensor.

No Dwell Change

Replace ECM

OK

- Check evaporator canister for being loaded with fuel and related valves, such as purge and bowl vent, for leaks which would cause richness, also fuel in crankcase. If OK, see Carburetor Calibration in Section C.

Under 50°

- Trouble is intermittent. System is OK at present. Clear memory.

If chart does not resolve problem, see Driveability Symptoms, Section "B".

2-21-85
5S 1793-6E

CODE 51

PROM
4.3L, 5.0L,OR 5.7L ENGINE
CARBURETED - CALIF.

Code 51 sets if any one of the following occur:

- Faulty PROM unit
- PROM unit improperly installed (may not set a code if installed backwards)
- Some PROM pins not making contact (i.e., bent)

Always check to see that the PROM pins are not bent and are inserted properly into the ECM.

Make certain the PROM is installed in the proper direction as shown in the chart.

THE IGNITION SHOULD ALWAYS BE OFF WHEN INSTALLING OR REMOVING THE ECM CONNECTORS

↔ Remove or Disconnect (Figures 1 and 2)

1. Connectors from ECM
2. ECM mounting hardware

! Important

ELECTRONIC CONTROL MODULE (ECM) MOUNTING HARDWARE NOT ILLUSTRATED. HARDWARE CONFIGURATION WILL VARY WITH CAR DIVISION.

3. ECM from passenger compartment
4. ECM access cover
5. PROM

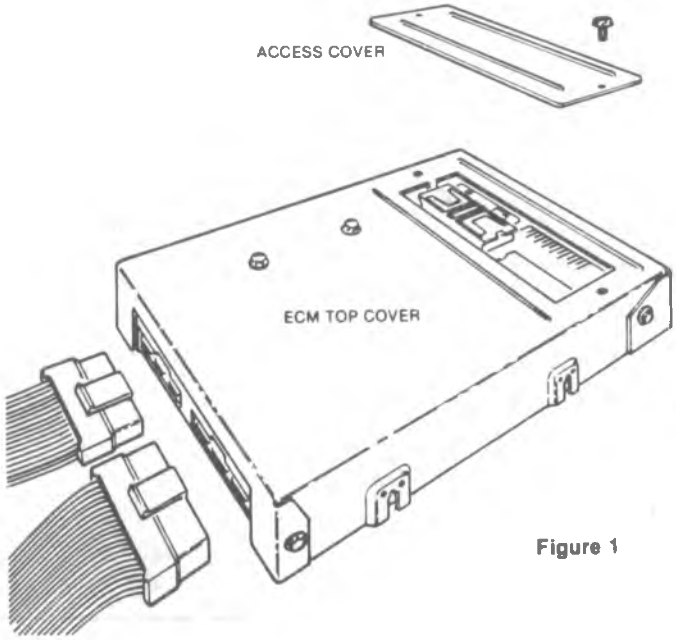


Figure 1

! Important

Using the rocker-type PROM removal tool, engage one end of the PROM carrier with the hook end of the tool. 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 (Figure 2). Other methods could cause damage to the PROM or PROM socket.

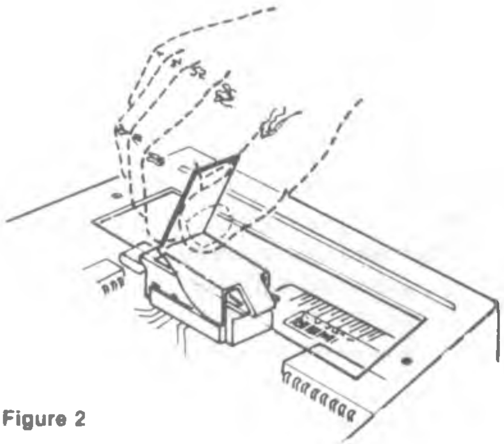


Figure 2

! Important

REPLACEMENT ELECTRONIC CONTROL MODULE (ECM) IS SUPPLIED WITHOUT AN ENGINE CALIBRATION UNIT (PROM) SO CARE SHOULD BE TAKEN WHEN REMOVING THE PROM AS IT WILL BE REUSED IN THE NEW ECM IF THE ORIGINAL ECM IS FOUND TO BE DEFECTIVE.

04 26 85

4S 1027-6EB

CODE 51

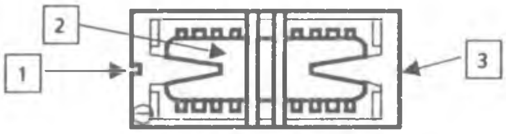
PROM PROBLEM

4.3L, 5.0L, OR 5.7L ENGINE
CARBURETED - CALIF.

CHECK THAT ALL PINS ARE FULLY INSERTED IN THE SOCKET. IF OK, REPLACE PROM AND RECHECK. IF CONDITION IS NOT CORRECTED, REPLACE ECM. SEE CHART C-1.

Inspect (Figure 3)

For correct indexing of reference end of the PROM carrier and carefully set aside. Do not remove PROM from carrier to conform PROM correctness.



NOTCH IN PROM REFERENCED TO SMALLER NOTCH IN CARRIER AND THE PIN #1 END

1	REFERENCE END
2	PROM
3	PROM CARRIER

Important
(Before installing new PROM)

ANYTIME THE PROM IS INSTALLED BACKWARDS AND THE IGNITION SWITCH IS TURNED ON, THE PROM IS DESTROYED.

Install or Connect (Figures 1 and 3)

1. PROM in PROM socket.

Important

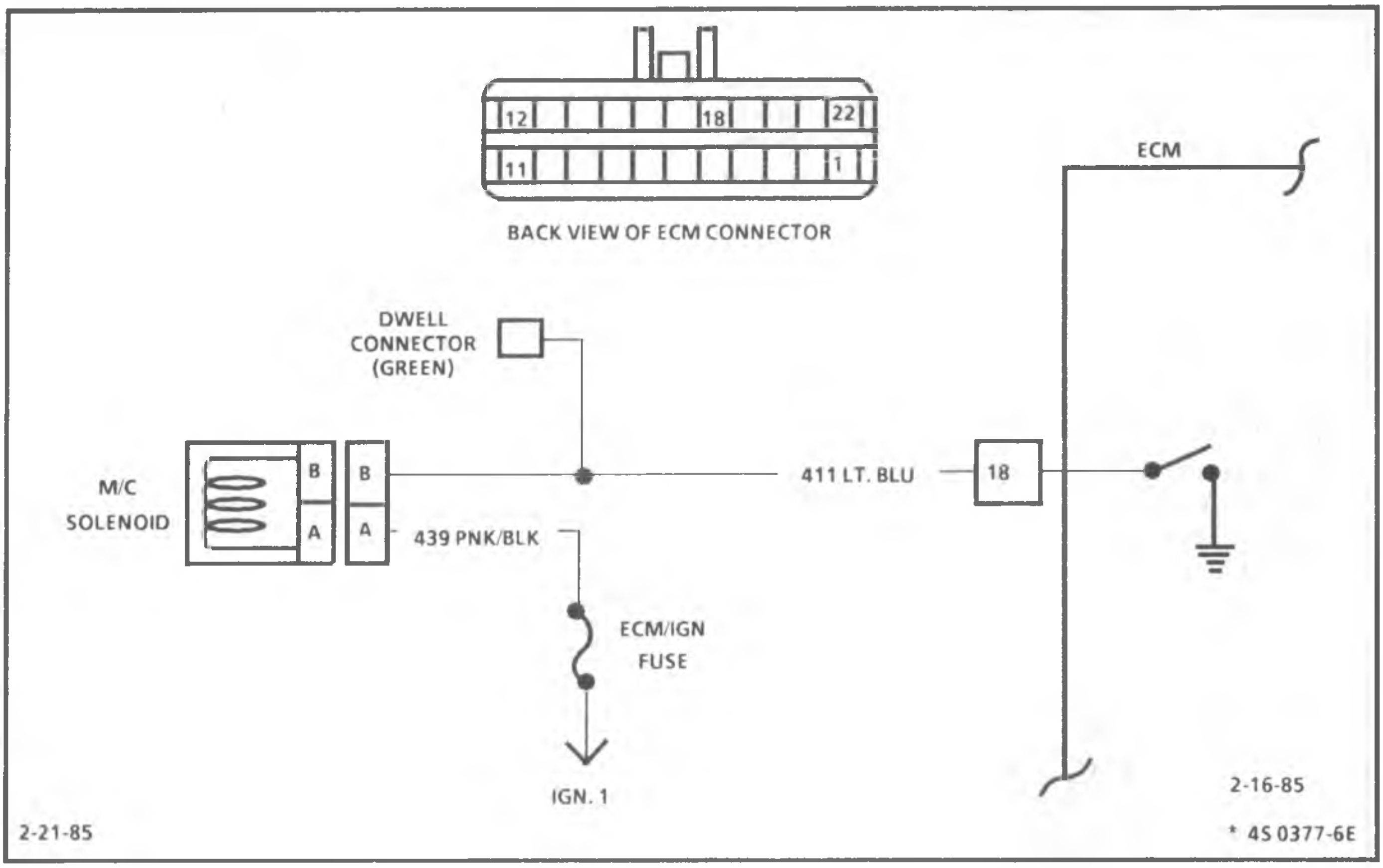
DO NOT PRESS ON PROM - ONLY CARRIER.

Small notch of carrier should be aligned with small notch in socket. Press on PROM carrier until it is firmly seated in the socket. Do not press on PROM; only the carrier.

2. Access cover on ECM.
3. ECM in passenger compartment.
4. Connectors to ECM.

Functional Check

1. Turn ignition on.
2. Enter diagnostics.
   a. Code 12 should flash four times. (No other codes present.) This indicates the PROM in installed properly.
   b. If trouble code 51 occurs or if the check engine light is on constantly with no codes, the PROM is not fully seated, installed backwards, has bent pins, or is faulty.
      - If not fully seated, press firmly on PROM carrier.
      - If it is necessary to remove the PROM, follow instructions in steps "A" & "B".
      - If installed backwards, REPLACE THE PROM.
      - If pins bend, remove PROM, straighten pins, and reinstall. IF bent pins break or crack during straightening, discard PROM and replace it.



CODE 54

M/C SOLENOID VOLTAGE HIGH TO ECM

4.3L, 5.0L OR 5.7L ENGINE

CARBURETED - CALIF.

Code 54 will be set if there is constant high voltage at ECM Term. "18".

A shorted solenoid or a wiring short to 12V on circuit to ECM would cause the solenoid to remain in the full rich position, resulting in potential ECM damage, excessive fuel consumption, and excessive exhaust odor.

1. Checks the M/C solenoid resistance to determine if the fault is in the solenoid or ECM harness/ECM. A normal solenoid has about 20 to 32 ohms of resistance.

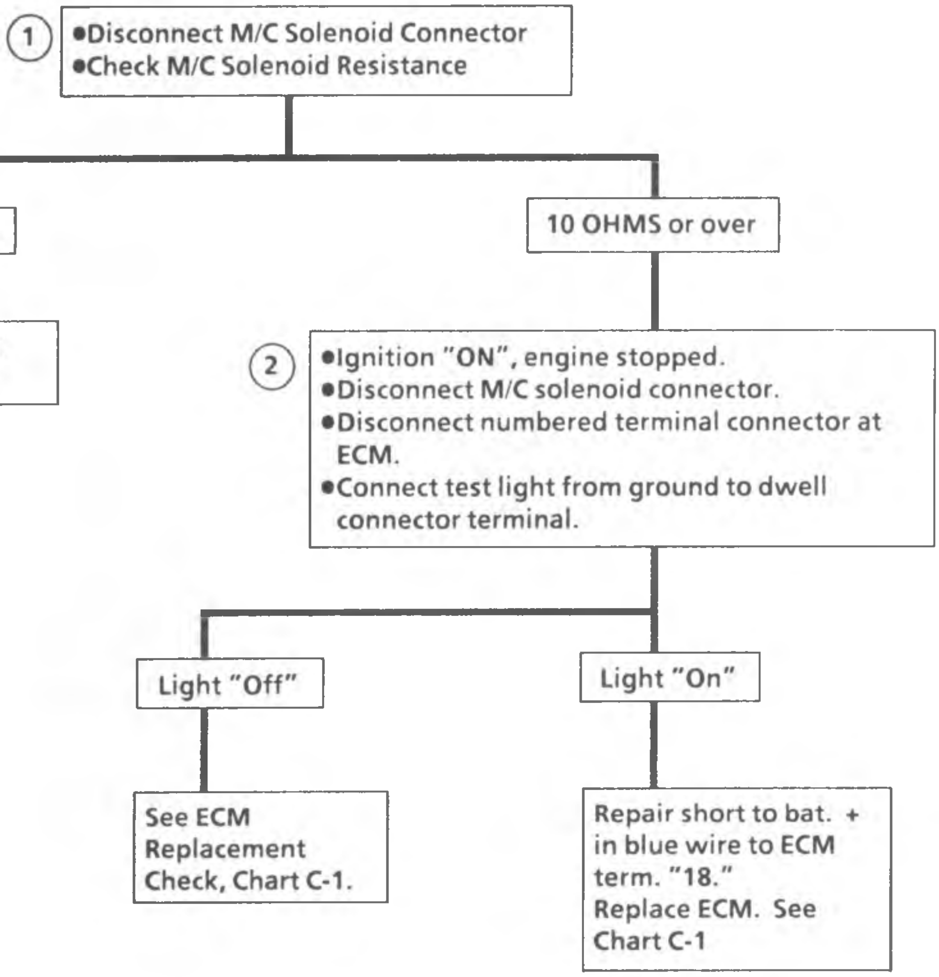
2. Checks to see if reason for high voltage to Term. '18" is a faulty ECM or a short to 12V on that wire. If the test light illuminates with both ends of harness disconnected, there is a short to 12V in the wire.

CODE 54

M/C SOLENOID VOLTAGE HIGH TO ECM

4.3L, 5.0L OR 5.7L ENGINE

CARBURETED - CALIF.



①
- Disconnect M/C Solenoid Connector
- Check M/C Solenoid Resistance

Under 10 OHMS

Replace solenoid and ECM.

10 OHMS or over

②
- Ignition "ON", engine stopped.
- Disconnect M/C solenoid connector.
- Disconnect numbered terminal connector at ECM.
- Connect test light from ground to dwell connector terminal.

Light "Off"

See ECM Replacement Check, Chart C-1.

Light "On"

Repair short to bat. + in blue wire to ECM term. "18."
Replace ECM. See Chart C-1

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6S 2641-6E

SECTION B - SYMPTOMS

BEFORE STARTING

California Only

Before using this section you should have performed the DIAGNOSTIC CIRCUIT CHECK and found out that:

1. The ECM and "SERVICE ENGINE SOON" light are operating.
2. There are no trouble codes stored, or only intermittent codes.
3. The fuel control system is operating OK (by performing SYSTEM PERFORMANCE CHECK).

Federal and California

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 "No Start - Engine Cranks OK" below.

DISTRIBUTOR INFORMATION

Refer to Section 6D, Engine Electrical, for Ingnition System including distributor information.

CARBURETOR ADJUSTMENT

Carburetor adjustment and specification can be found in Section 6C10 for the E4ME carburetor, Section 6C7 for the 1ME carburetor or Section 6C10 for the M4ME/M4MC carburetor.

VISUAL CHECK

Several of the symptom procedures below call for a careful visual check. This check should include:

- Vacuum hoses for splits, kinks, and proper connections, as shown on Emission Control Information label.
- Air leaks at carburetor 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

CALIFORNIA ONLY - 4.3L, 5.0L OR 5.7L ENGINE

Problem may or may not turn "on" the "SERVICE ENGINE SOON " light, or set a code.

DO NOT use the Code Charts in Section A for intermittent problems. The fault must be present to locate the problem. If a fault is intermittent, use of 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 in Section 6E.
- If a visual (physical) check does not find the cause of the problem, the car can be driven with a voltmeter connected to a suspected circuit. An abnormal voltage reading when the problem occurs indicates the problem may be in that circuit.
- Check for intermittent connection in circuit from:
  - Open Ignition coil ground and arcing at spark plug wires or plugs.
  - "SERVICE ENGINE SOON" light wire to ECM for short to ground.
  - Diagnostic "Test" Terminal wire to ECM, for short to ground.
  - ECM terminals A and U to engine ground.
- Loss of trouble code memory. To check, ground the dwell lead for 10 seconds with "Test" terminal left ungrounded. Code 23 should be stored after engine is stopped, and ignition turned to "run" position. If not, the ECM is faulty.
- Check for an electrical system interference caused by a defective relay, ECM driven solenoid, or switch. They can cause a sharp electrical surge. Normally, the problem will occur when the faulty component is operated.
- Check for improper installation of electrical options, such as lights, 2-way radios, etc.
- EST wires should be kept away from spark plug wires, distributor wires, distributor housing, coil, and generator. Wire from ECM terminal 13 to distributor, should be a good ground.
- Check for open diode or resistor across A/C compressor clutch, and for other open diodes (see wiring diagrams).

WON'T START - ENGINE CRANKS OK

Definition: Engine cranks OK, but does not start. May fire a few times.

- Perform "Diagnostic Circuit Check". (Cal.)
- Make sure proper starting procedure is being used. See Owner's Manual.
- Visual 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 at both distributor cap and spark plugs.
- Remove air cleaner:
  - Check carburetor choke valve, vacuum break(s), linkage and unloader operation. See Section 6C. Set to specifications. Choke valve should move smoothly and be closed when cold, and open when hot.
- Check for presence of fuel by noting carburetor accelerator pump operation. Look for gas squirt in carburetor bore while quickly opening throttle lever.
  - If no pump squirt,
    - Check for fuel in tank.
    - Check carburetor fuel inlet filter. Replace if dirty or plugged.
    - Check fuel pump capacity.
    - If fuel pump checks OK, check float needle for sticking in seat, or binding float.
  - If there is a pump squirt,
    - Crank engine and check for flooding.
    - If not flooding, see "Ignition System Check", Chart C-4A in Section C,
- Remove spark plugs. Check for wet plugs, cracks, wear, improper gap, burned electrodes, or heavy deposits. Repair or replace as necessary.
- Visually check distributor cap inside and out for moisture, dust, cracks, burns, and arcing to coil mounting screws.
- Try to turn distributor shaft by hand. Drive pin may be broken.
- After starting engine, perform the "System Performance Check." (Cal.)
- Very cold temperatures:
  - Check that the proper viscosity oil is being used, and crank case oil is not contaminated with gasoline.

HARD START - COLD

Definition: Engine cranks OK, but does not start for a long time. Does eventually run. If the engine starts but immediately dies (as soon as key is released from start position), See "No Start, Engine Cranks OK" symptom.

- Perform "Diagnostic Circuit Check" (Cal.)
- Perform the "System Performance Check" (Cal.)
- Make sure driver is using correct starting procedure. See Owner's Manual.
- Visual Check:
  - Vacuum hoses for splits, kinks and proper connections, as shown on Vehicle Emission Control Information label.
  - Air leaks at carburetor mounting and intake manifold.
  - Ignition wires for cracking, hardness, and proper connections, at both the distributor cap and spark plugs.
  - Wiring for proper connections, pinches and cuts.
- Check the choke valve, throttle and fast idle cam for sticking. Replace any malfunctioning parts. If caused by foreign material and gum, clean with suitable non-oil base solvent. See Section 6C.
- Check choke and vacuum break operation and adjustment. Choke should be closed cold. See Section 6C.
- Check EGR system for sticky operation that could cause valve to stick open.
- Check float level using external float gage. Adjust float to specification if required. See Section 6C.
- Check carburetor fuel inlet filter. Replace if dirty or plugged.
- Check ignition system - see Chart C-4,Check distributor for:
  - Worn shaft
  - Bare and shorted wires
  - Pick-up coil resistance and connections
  - Loose ignition coil ground
  - Moisture in distributor cap.
- Remove spark plugs; check for wet plugs, wear, improper gap, burned electrodes or heavy deposits. Repair or replace as necessary.
- Check ignition timing per Vehicle Emission Control Information label.
- Verify proper engine oil viscosity per recommendations in Maintenance Schedule.
- Check fuel pump volume, pressure and vacuum.

HARD START - HOT

Definition: Engine cranks OK, but does not start for a long time. Does eventually run. If the engine starts but immediately dies (as soon as key is released from start position), see Ignition System Check", Chart C-4,

- Perform "Diagnostic Circuit Check."
- Perform the "System Performance Check."
- Visual (physical) 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, at the distributor cap and spark plugs.
  - Wiring for proper connections, pinches and cuts.
- Make sure driver is using correct starting procedure. See Owner's Manual.
- Check choke valve, throttle linkage and fast idle cam for sticking.
- Check choke and vacuum break operation and adjustment. Choke should be open hot. See Section 6C.
- Check for carburetor flooding.
- Check fuel inlet filter. If plugged replace.
- Check float level using external float gage. Adjust float to proper specification if required. See Section 6C.
- Check fuel pump volume, pressure and vacuum.
- Check fuel line routing.
- Check EFE valve. EFE valve should be open.
- Check EGR for sticky operation that could cause valve to stick open.
- Check for obvious overheating problems.
  - Low coolant.
  - Loose water pump belt.
  - Restricted air flow to radiator, or restricted water flow thru radiator.
- Check ignition system, Section 6D. Check distributor for:
  - Worn shaft.
  - Bare and shorted wires.
  - Intermittent pickup coil or connections, module, ignition coil ground and condenser. Repair or replace as necessary.
- Remove spark plugs. Check for cracks, wear, improper gap, burned electrodes, heavy deposits. Repair or replace as necessary.
- Check ignition timing. See Vehicle Emission Control Information label.

STALL AFTER START - COLD

Definition: Engine at room or outside temperature, within three minutes after start. (1) Stalls after brief idle; (2) dies as soon as any load is placed on engine (such as A/C turned "ON" or transmission engaged); or (3) Dies on initial driveaway.

If symptom is present cold and hot, go to symptom "Stall After Start - Hot".

- Perform "Diagnostic Circuit Check." (Cal.)
- Perform "System Performance Check." (Cal.)
- Visual (physical) Check:
  - Vacuum hoses for splits, kinks and proper connections, as shown on Vehicle Emission Control Information label.
- Make sure hot air tube is connected to air cleaner
- Check proper operation of THERMAC.
- Check carburetor choke valve, throttle linkage and fast idle cam for sticking.
- With engine running, visually check vacuum break linkage for movement while removing and re-installing vacuum hoses to vacuum breaks. If the linkage does not move and vacuum is at hose, check for binding linkage. If linkage OK, replace vacuum break unit.
- With engine "OFF", check all choke adjustments, including vacuum breaks and TVS if used. See Section 6C.
- Check fast idle speed setting, if applicable, and curb idle speed.
- Check carburetor accelerator pump operation.
- Check EFE valve for proper operation. EFE valve should be closed cold. See Chart C-9C.
- Check EGR valve for proper operation. See Chart C-7.
- Check engine timing. See Vehicle Emission Control Information label.
- Poor or contaminated gasoline. Suggest owner try different brand.

STALL AFTER START - HOT

Definition: The engine starts OK, but (1) dies after brief idle; (2) dies as soon as any load is placed on engine (such as A/C turned "ON" or transmission engaged); (3) dies on initial driveaway.

- Perform "Diagnostic Circuit Check."(Cal.)
- Perform "System Performance Check." (Cal.)
- Visual (physical) Check:
  - Vacuum hoses for splits, kinks and proper connections, as shown on Vehicle Emission Control Information label.
- Make sure hot air tube is connected to air cleaner.
- Check proper operation of THERMAC.
- Check carburetor choke and vacuum breaks for proper operation. See Section 6C for check procedure.
- Check float level using external float gage. See Section 6C.
- Check carburetor accelerator pump operation.
- Check EGR valve for proper operation - Chart C-7A in Section C.
- Check for overcharged A/C System.
- Check for obvious overheating problems:
  - Low coolant
  - Loose water pump belt
  - Restricted air flow to radiator or restricted water flow thru radiator.

HESITATION/ SAG, STUMBLE

Definition: Momentary lack of response as the accelerator is pushed down. Can occur at all vehicle speeds. Usually most severe when first trying to make vehicle move, as from a stop sign. May cause the engine to stall if severe enough.

- Perform "Diagnostic Circuit Check."(Cal.)
- Perform "System Performance Check." (Cal.)
- Visual (physical) 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, at both distributor and spark plugs.
  - Wiring for proper connections, pinches and cuts.
- Make sure hot air tube is connected to air cleaner.
- Check proper operation of THERMAC See Section C..
- Note: Cold engine only - check the following for sticking or faulty operation:
  - Carburetor choke, including vacuum break, throttle linkage and fast idle cam.
  - Check choke TVS if used.
  - Check all choke adjustments, including vacuum breaks.
- Check float level using external float gage. See Section 6C.
- Check carburetor accelerator pump operation.
- Check vacuum hose to vacuum sensor for leaks, restrictions, and proper connections (should be manifold vacuum).
- Check EGR valve operation, Chart C-7A Section C.
- Check TPS adjustment in Section C. Use ALCL tool if available.
- Check canister purge system for proper operation, Chart C-3 in Section C.
- Check for open ignition coil ground and for intermittent ECM ground.
- Check engine timing. See Vehicle Emission Control Information label.
- Poor or contaminated gasoline. Try a different brand of gasoline.

SURGES AND/OR CHUGGLE

Definition: Engine power variation under steady throttle or cruise. Feels like the car speeds up and lows down with no change in the accelerator pedal.

- Perform "Diagnostic Circuit Check." (Cal.)
- Perform "System Performance Check." (Cal.)
- Visual (physical) 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, at both distributor cap and spark plugs.
  - Wiring for proper connections, pinches and cuts.
  - 4-Terminal EST connector and wires near spark plug wires.
- Have driver read explanation of transmission converter clutch and A/C compressor operation in Owner's Manual.
- Make sure hot air tube is connected to air cleaner.
- Check proper operation of THERMAC in Section C.
- Check for intermittent open, or short to ground in TCC circuit, term. "N" at ECM, to terminal "B" at transmission.
- Check for proper operation of EGR. See Chart C-7A.
- Check carburetor fuel inlet filter, replace if dirty or plugged.
- Check carburetor float level using external float gage. See Section 6C.
- Test fuel pump capacity. See Section 6C.
- Remove spark plugs, check for cracks, wear, improper gap, burned electrodes or heavy deposits.
- Check condition of distributor cap, rotor and spark plug wires.
- Check for arcing to coil attaching screws in distributor cap.
- Check for intermittent ground connection on integral ignition coil.
- Poor or contaminated gasoline. Try a different brand of gasoline.

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 "Diagnostic Circuit Check." (Cal.)
- Perform "System Performance Check." (Cal.)
- Visual Check:
  - Vacuum hoses for splits, kinks and proper connections, as shown on Vehicle Emission Control Information label.
  - Ignition wires for cracking, harness, and proper connections, at both the distributor cap and spark plugs.
  - Wiring for proper connections, pinches and cuts.
- Compare customer's vehicle to similar unit. Make sure the customer's vehicle has an actual problem. Was the customer's old vehicle much more powerful?
- Make sure hot air tube is connected to air cleaner.
- Remove air cleaner and check air filter for dirt.
- Check for proper operation of THERMAC.
- Check for full throttle valve opening in carburetor by depressing accelerator pedal to floor.
- Check carburetor float level using external float gage.
- Check for proper operation of carburetor air valve (if equipped). See Section 6C.
- Check ignition timing. See Vehicle Emission Control Information label.
- Check transmission for proper downshift and TCC operation.
- Check EGR operation. See Chart C-7A.
- Check EST operation. If ALCL tool is available, check for excessive retard. Excessive retard may be caused by carbon build-up in cylinders which can be removed with "Top Engine Cleaner."
- Check VAC sensor output as applicable. see Chart C-1E.
- Check EFE Valve
- Remove spark plugs. Check for cracks, wear, improper gap, burned electrodes, heavy deposits. Repair or replace as necessary.
- Check for an exhaust system restriction:
  1. With engine at normal operating temperature, connect a vacuum gage to any convenient 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 steady 2500 RPM is more than 3" lower than 1000 RPM, exhaust system should be inspected for retstrictions, See CHART B-1.
- Check engine valve timing and compression.
- Check engine for proper or worn camshaft, see Section 6A.
- Poor or contaminated fuel. Try a different brand of gasoline.

BACKFIRE

Definition: Fuel ignites in intake manifold, or exhaust system, making a loud popping noise.

- Perform "Diagnostic Circuit Check." (Cal.)
- Perform "System Performance Check." (CAl.)
- Visual Check:

- Vacuum hoses for splits, kinks and proper connections, as shown on Vehicle Emission Control Information label.
- Ignition wires for cracking or hardness proper connection, at both the distributor cap and spark plugs.
- Chaffed wiring harness by pulleys or metal edges.

- Make sure hot air tube is connected to air cleaner.
- Check proper operation of THERMAC in Section C.
- Note: Cold engine only - check the following for sticking or faulty operation:

- Carburetor choke, including vacuum break and throttle linkage. Check choke TVS if used.

- Check EFE Valve.
- Check carburetor accelerator pump operation.
- Check vacuum sensor hose for restriction, or for fuel or water in hose.
- Check for proper operation of EGR valve.

Perform a compression check - look for sticking or leaking valves.

- Check for restricted exhaust system, see CHART B-1 at end of Section B.
- Check output voltage of ignition coil. See Chart C-4A in Section C.
- Check operation of decel (gulp) valve if so equipped.
- Check for crossfire between spark plugs, distributor cap, spark plug wires and proper routing of plug wires. Wires for cylinders which fire in sequence on the same side of the engine should not be routed next to each other; i.e., 8 and 4, and 5 and 7. See Section 6D.
- Check for intermittent condition in ignition system.

- Pick-up coil
- EST wire (to ECM Terminal 12)
- Ignition coil ground on integral coil
- Ignition coil primary connections

- Check for proper valve timing.

MISSES (CUTS OUT)

Definition: Pulsation or jerking that follows engine speed, usually more pronounced as engine load increases. The exhaust may have a steady spitting sound at idle or low speed. Not normally felt above 1500 RPM or 30 MPH (48 Km/h).

- Perform "Diagnostic Circuit Check." (Cal.)
- Perform "System Performance Check." (Cal.)
- Visual (Physical) 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 at both distributor cap and spark plugs.
    - Wiring for proper connections, pinches and cuts. (Verify good connections grounding of ECM terminals "A" and "U").
- Check spark plug wire routing for correct firing order.
- Check for misfiring at spark plugs:
    1. Disconnect and plug air cleaner and EGR vacuum hoses.
    2. Check spark at all plug wires with J26792 (ST-125).
        - If there is no spark on any cylinder, see "Ignition System Check", Chart C-4,
        - Spark at all cylinders
- Visually check distributor cap inside and out for moisture,dust, cracks, burns and check for to coil arcing mounting screws. With engine running, spray cap and plug wires with fine water mist to check for shorts.
- Check for poor ground on integral ignition coil.
- Check EGR valve for sticking partially open.
- Remove spark plugs and check for cracks, wear, improper cap, burned electrodes and heavy deposits.
- Check pickup coil in distributor with ohmmeter, and check for proper connections at module. Pickup coil should be 500-1500 OHMS and not grounded. See Sec. 6D.
    - If pickup coil checks OK,
        - Check for ignition dwell increase from low to high RPM by connecting dwell meter -to distributor "TACH" terminal. If dwell doesn't increase, replace ECM.
- Remove rocker covers, check for bent pushrods, worn rocker arms, broken valve springs, worn camshaft lobes. Repair as necessary. See Section 6A.

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 "Diagnostic Circuit Check." (Cal.)
- Perform "System Performance Check." (Cal.)
- Visual (physical) Check:
    - Vacuum hoses for splits, kinks and proper connections as shown on Vehicle Emission Control Information label.
    - Ignition wires for cracking, hardness, or proper connections, at both distributor cap and spark plugs.
- Check throttle linkage for sticking or binding.
- Check carburetor for flooding.
- Check float level using external float gage. See Section 6C.
- Check engine idle speed, See Vehicle Emission Control Information label.
- Check EGR System. See Chart C-7A, There should be no EGR at idle. Pulse Width Modulated Systems do not work in Park or Neutral.
- If rough idle occurs hot, perform these additional checks:
    - Check PCV valve for proper operation by placing finger over inlet hole in valve end several times. Valve should snap back. If not, replace valve.
    - Check canister purge and bowl vent control system. See Chart C-3 in Section C..
    - Remove carbon with top engine cleaner. Follow instructions on can.
    - Check for proper spark plug gap.
    - Run a cylinder compression check. See Section 6.
- Check ignition timing. See Vehicle Emission Control Information label.
- Check for exhaust system restriction. See Chart B-1.

WON'T IDLE

Definition: Engine starts OK, but dies at idle. Will run if accelerator pedal is held at part throttle.

- Perform "Diagnostic Circuit Check."
- Perform "System Performance Check." if possible.
- Visual (physical) Check:
  - Vacuum hoses for splits, kinks and proper connections as shown on Vehicle Emission Control Information label.
  - Air leaks at carburetor mounting and intake manifold.
- Check carburetor float level using external float gage. See Section 6C.
- Check for carburetor flooding. See Section 6C.
- Check EGR system, See Chart C-7A in Section C.. Check for a loose valve or sticking EGR plunger. If sticking operation is found, clean or replace valve. There should be no EGR at idle. It may be necessary to remove the valve to check for leaking.
- Check engine idle speed, See Vehicle Emission Control Information label.
- Check carburetor idle adjustment. If unable to adjust, check carburetor idle system. See Section 6C.
- Check spark plug condition and gap.
- Check for exhaust system restriction. See Chart B1.

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 driver read "Important Facts on Fuel Economy" in Owner's Manual.
- Perform "Diagnostic Circuit Check." (Cal.)
- Perform the "System Performance Check." (Cal.)
- Check air cleaner damper door operation. (Thermal)
- Check air cleaner element (filter) for dirt or being plugged.
- Check for proper calibration of speedometer.
- Visual Check:
  - Vacuum hoses for splits, kinks and proper connections as shown on Vehicle Emission Control Information label.
  - Ignition wires for cracking, hardness and proper connections.
- Check ignition timing. See Vehicle Emission Control Information label.
- Check EST operation, Chart C-4C. (Cal.)
- Check ESC operation, Chart C-5. If ALCL tool is available, check for excessive retard. (Cal.)
- 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-8B, Use ALCL tool if available. (Cal.)
- Check for dragging brakes.
- Suggest owner fill fuel tank and recheck fuel economy.
- Check for exhaust system restriction. See Chart B-1.

DIESELING, RUN-ON

Definition: Definition: Engine continues to run after key is turned "OFF", but runs very roughly. If engine runs smoothly, check ignition switch and adjustment.

- Visually Check:
  - Vacuum hoses for splits, kinks and proper connections as shown on Vehicle Emission Control Information Label.
  - Carburetor choke, throttle linkage and fast idle cam for sticking.
- Check carburetor choke, vacuum break linkage, throttle linkage and fast idle cam for proper adjustment. See Section 6C.
- Check cruise control for proper adjustment. See Section 9.
- Check engine idle speed,
- Check ignition timing. See Vehicle Emission Control Information label.
- Remove carbon with top engine cleaner. Follow instructions on can.
- Check for engine overheating. Use ALCL tool if available. Normal coolant temperature is 85 °C- 100°C (185°F-215°F).
  - Low coolant:
  - Loose fan belt
  - Restricted air flow
  - Inoperative fan clutch.

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 EGR System for proper operation. See Chart C-7A,
- Check Vacuum sensor hose for fuel in hose or restrictions, and Vacuum sensor for low output and proper connections or vacuum sensor for high output. (Cal.)
- Check ignition timing. See Vehicle Emission Control Information label.
- Check for obvious overheating problems. Use ALCL tool if available. 85°C-100°C (185°F-215°F) is normal.
  - Low coolant:
  - Loose water pump belt.
  - Restricted air flow to radiator, or restricted water flow thru radiator.
- Check for air leaks at carburetor mounting and intake manifold.
- Check for poor fuel quality, proper octane rating.
- Check TPS enrichment operation. See Chart C-2F. (Cal.)
- Remove carbon with top engine cleaner. Follow instructions on can.
- If excessive carbon in cylinders, check for leaking valve seals.
- Check for incorrect PROM. (Cal.)
- Check for improper operation of transmission (i. e., linkage adjustment) and TCC. Use ALCL tool if available. (Cal.)
- Check for incorrect basic engine parts, such as cam, heads, pistons, etc.

EXCESSIVE EXHAUST EMISSIONS (ODORS)

Definition: Car fails an emission test. May also have excessive "rotten egg" smell (hydrogen sulfide).

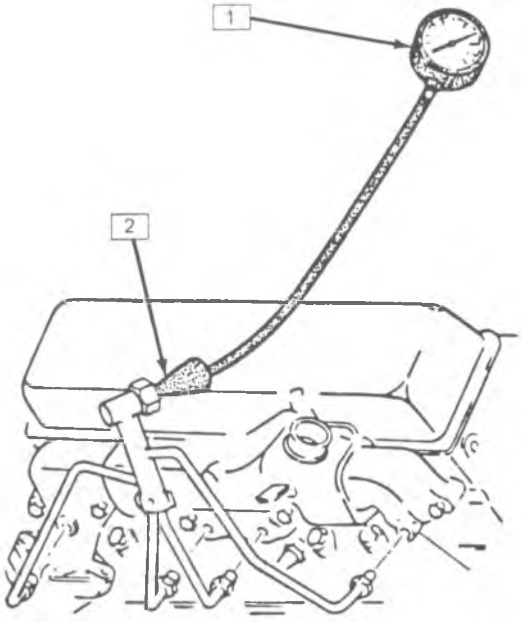
- Perform "Diagnostic Circuit Check." (Cal.)
- Perform "System Performance Check." (Cal.)
- If test shows excessive CO and HC, (also has excessive odors):
  - Check items which cause car to run rich.
    - Make sure engine is at normal operating temperature.
    - Visually check hoses for splits, kinks and proper connections, as shown on Vehicle Emission Control Information label.
    - Remove air cleaner and check air filter for dirt or being plugged. Replace as necessary.
    - Check for misadjusted idle mixture if plugs are removed.
    - Check choke valve and linkage for sticking of faulty operation.
    - Check choke, vacuum breaks and fast idle adjustments.
    - Check for stuck PCV valve or obstructed hose.
    - Check for lead contamination of catalytic converter. Check for absence of filler neck restrictor.
    - Check operation of air management system. See Chart C-6C or Chart C-6D in Section C.
    - Check carburetor for flooding.
    - Check float level using external float gage. See Section 6C.
    - Check canister for loading and check purge system for proper operation. See Chart C-3 in Section C..
    - Check for incorrect idle speed.
    - Check for incorrect timing. See Vehicle Emission Control Information label.
    - Check condition of spark plugs, plug wires and distributor cap.
- If test shows excessive NOx:
  - Check items which cause vehicle to run lean, or to run too hot.
    - Check EGR valve for not opening. See Chart C-7A in Section C..
    - Check for vacuum leaks.
    - Check for inoperative THERMAC.
    - Check coolant system and coolant fan for proper operation.
    - Remove carbon with top engine cleaner. Follow instructions on can.
    - Check ignition timing for excessive base advance. See Vehicle Emission Control Information label.

CHART B-1

RESTRICTED EXHAUST SYSTEM CHECK

Proper diagnosis for a restricted exhaust system is essential before any components are replaced. The following diagnostic procedure is recommended:

1. Remove the rubber hose at the exhaust manifold A.I.R. pipe check valve. Remove check valve.
2. Connect a fuel pump pressure gage 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.
4. With the engine at normal operating temperature and running at 2500 rpm, observe the exhaust system backpressure reading on the gage.
5. If the backpressure exceeds 2 3/4 psi, 19 kPa a restricted exhaust system is indicated.
6. Inspect the entire exhaust system for a collapsed pipe, heat distress, or possible internal muffler failure.
7. If there are no obvious reasons for the excessive backpressure, a restricted catalytic converter should be suspected, and replaced using current recommended procedures.



1 FUEL PUMP PRESSURE GAUGE

2 HOSE AND NIPPLE FROM PROPANE ENRICHMENT DEVICE (J-26911)

3-22-85

SECTION C

COMPONENT SYSTEMS

Section C provides on-vehicle service for the following systems:

- Computer Command Control (Calif. Only)
- Fuel Control (Calif. Only)
- Throttle Return Control
- Evaporative Emission Control
- Electronic Spark Timing (Calif. Only)
- Electronic Spark Control (Calif. Only)
- Air Management System (under 8500 GVW)
- Air Management System (over 8500 GVW)
- Exhaust Gas Recirculation
- Transmission Converter Clutch (Calif. Only)
- Early Fuel Evaporation
- Positive Crankcase Ventilation
- Thermostatic Air Cleaner
- Throttle Return Control - V8 engine (over 8500 GVW)

The following are diagnostic charts used in Section C:

•Chart C-1	ECM Replacement Check
•Chart C-1A	Differential Pressure Sensor Check
•Chart C-2F	TPS Enrichment Check
•Chart C-2T	Idle Speed Solenoid - 4.3L with A/C (Calif.)
•Chart C-2W	Idle Speed Solenoid - 4.3L without A/C (Calif.)
•Chart C-3	Solenoid Valve Check
•Chart C-4A	Ignition System Check - with EST
•Chart C-4D	EST Performance Check
•Chart C-4E	Ignition System Check - without EST
•Chart C-5	Electronic Spark Control Check
•Chart C-6C	Air Management Check
•Chart C-6HD	Air Management Check
•Chart C-7D	EGR Bleed Solenoid Check
•Chart C-7E	PWM Exhaust Gas Recirculation Check - with ECM
•Chart C-7C	Exhaust Gas Recirculation Check - without ECM
•Chart C-8B	Transmission Converter Clutch Electrical Check
•Chart C-9C	Early Fuel Evaporation System Check

COMPUTER COMMAND CONTROL

4.3L, 5.0L (RPO LF3) OR 5.7L (LS9) ENGINE

CALIFORNIA ONLY

GENERAL DESCRIPTION

The Computer Command Control system in California is an electronically controlled exhaust emission system which consists of an electronic control module and various information sensors to control the following systems:

- Fuel Control
- Evaporative Emission Control
- Electronic Spark Timing
- Electronic Spark Control (4.3L only)
- Air Injection Reaction
- Exhaust Gas Recirculation
- Transmission Converter Clutch

Electronic Control Module (ECM)

The Electronic Control Module (ECM) (Figures 21 and 27) is the control center of the Computer Command Control system. It constantly looks at the information from various sensors, and controls the various 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. Refer to Section 6E and Section "A" for more information.

An ECM used for service (called a Controller) comes without program information (a PROM) for specific engine and vehicle.

PROM (FIGURE 23)

The program information is programed in the ECM using an intergrated circuit called a PROM (Programmable Read-Only Memory). In the parts book, it is listed as a calibrator.

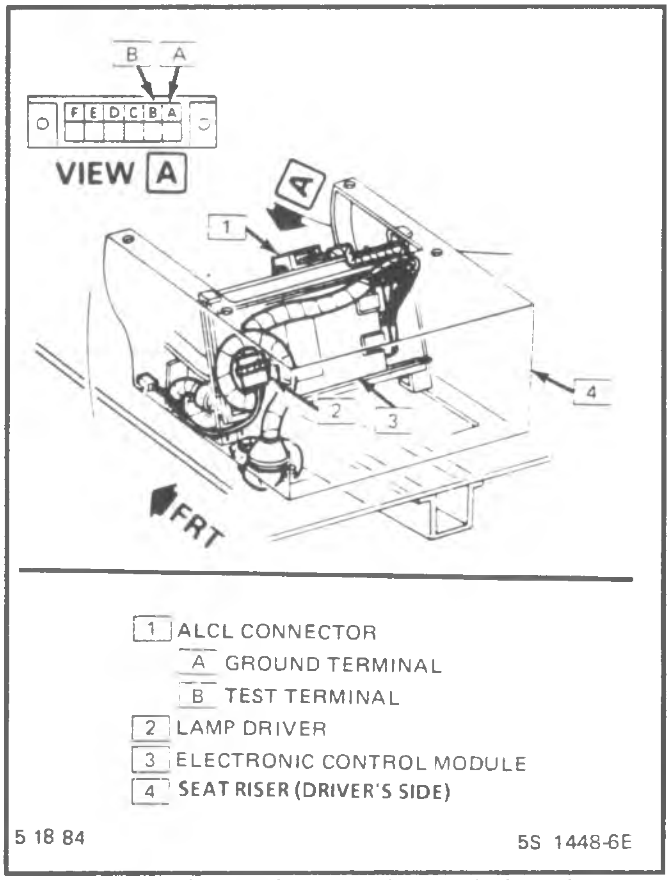


Figure 21 Electronic Control Module (ECM) - G

The PROM allows one model controller to be used for many different vehicles. It is located inside the ECM and has information on the vehicle's weight, engine, transmission, axle ratio, and several others. While one ECM part number can be used by many engines, a PROM is very specific and must be used for the right vehicle. For this reason, it is very important to check the latest parts book and Service Bulletin information for the correct part number when replacing a PROM.

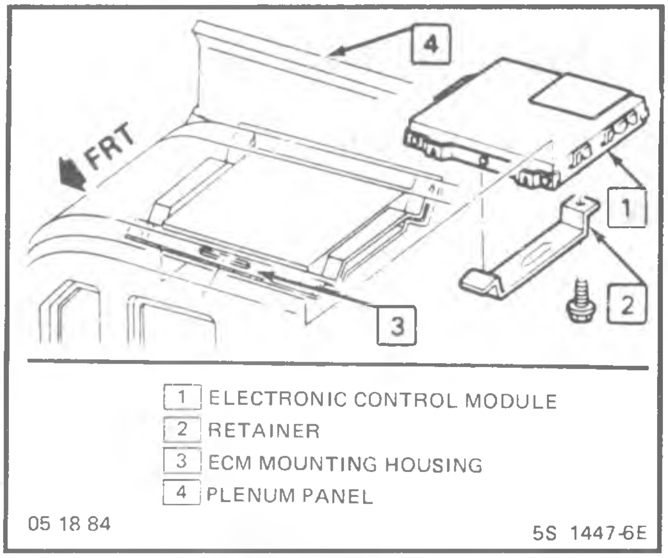


Figure 22 Electronic Control Module (ECM) - CK

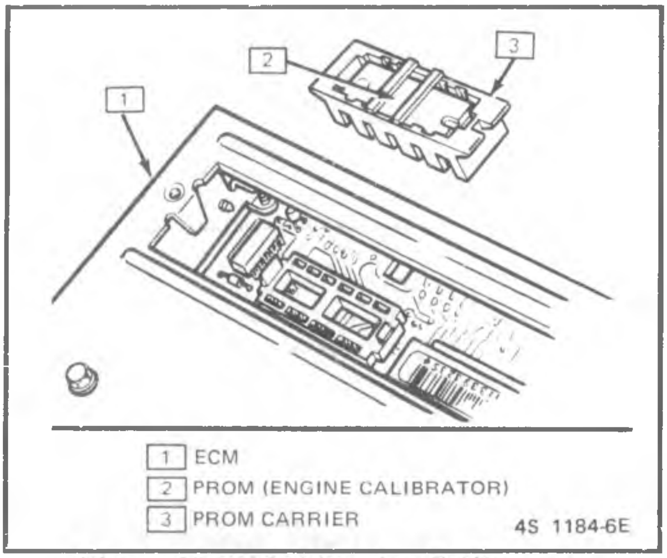


Figure 23 PROM (Engine Calibrator)

Remote Lamp Driver (FIGURE 24)

The Remote Lamp Driver controls the "SERVICE ENGINE SOON" Light. It is a small circuit board located in a plastic holder taped to the harness near the ECM. It turns the "SERVICE ENGINE SOON" Light "ON" any time the ignition is "ON" and the ECM is not pulling Terminal "C" of the Lamp Driver to ground. This normally occurs with the ignition "ON", engine not running. The main advantage of the Remote Lamp Driver is if the ECM looses power, the "SERVICE ENGINE SOON" Light will come "ON" to indicate a fault.

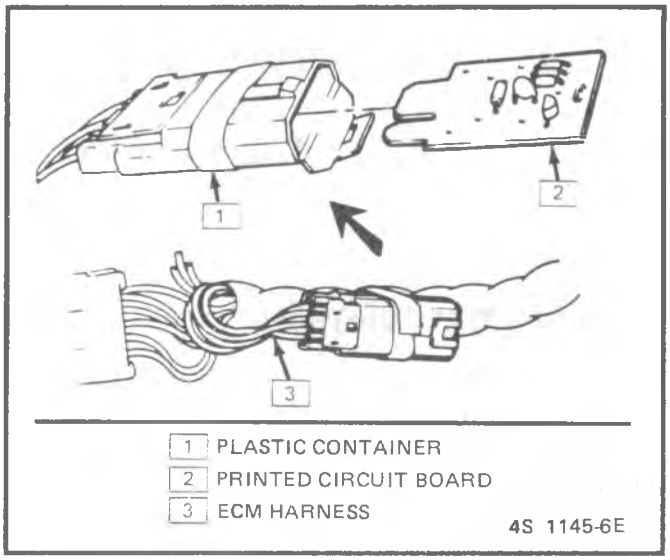


Figure 24 Remote Lamp Driver

INFORMATION SENSORS

Engine Coolant Temperature Sensor
(FIGURE 25)

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.

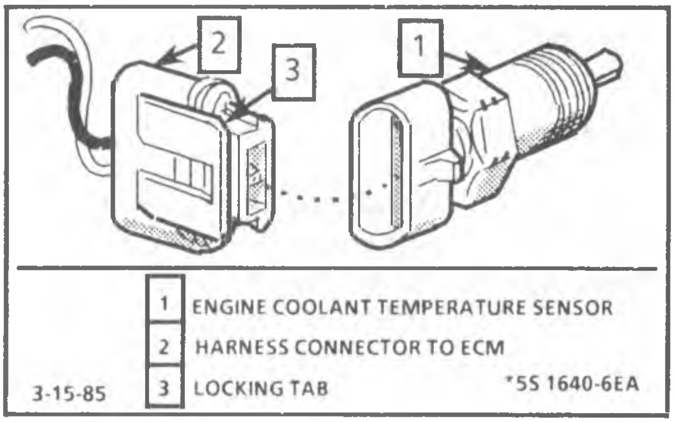


Figure 25 Engine Coolant Temperature Sensor

Differential Pressure (Vacuum) Sensor
(FIGURE 26)

The Differential Pressure (Vacuum on VAC) sensor located under the hood. It measures engine vacuum directly. It has a high voltage output (near 5 volts) at high vacuum. and a low output at low vacuum. It is called a Differential Pressure sensor since it measures the difference between outside air pressure and manifold vacuum, rather than an absolute pressure.

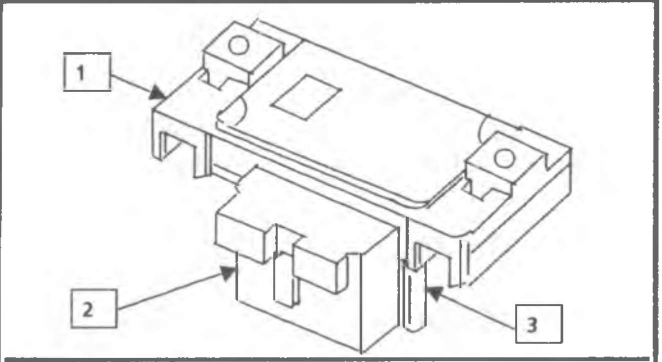


Figure 26 VAC Sensor

Exhaust Oxygen (O_2) Sensor
(FIGURE 27)

The exhaust oxygen (O_2) 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 volt (high O_2 - lean mixture) to .9 volts (low O_2 - rich mixture).

By monitoring the voltage output of the O_2 sensor, the ECM will know what fuel mixture command to give to the carburetor injector (lean mixture-low O_2 voltage-rich command, rich mixture-high O_2 voltage-lean command).

The O_2 sensor, if open, should set a Code 13. A shorted sensor circuit should set a Code 44. A high voltage in the circuit should set a Code 45.

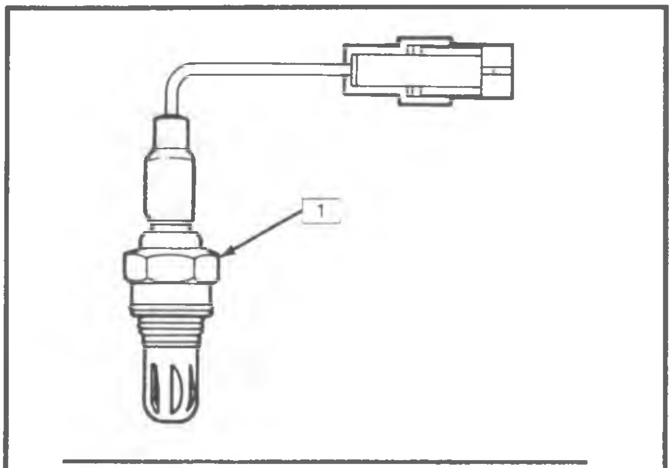


Figure 27 Exhaust Oxygen (O_2) Sensor

Throttle Position Sensor (TPS)
(FIGURE 28)

The Throttle Position Sensor (TPS) is a variable resistor that is mounted in the carburetor float bowl. The TPS plunger is under the pump lever. As the TPS varies position, so does the signal to the ECM. The ECM measures the voltage output of the TPS. As closed throttle, the voltage is about 1 volt or less and as the throttle opening is increased, the voltage is increased to about 5 volts at wide-open throttle.

The ECM used the TPS information to regulate the M/C solenoid, idle speed, EST and TCC.

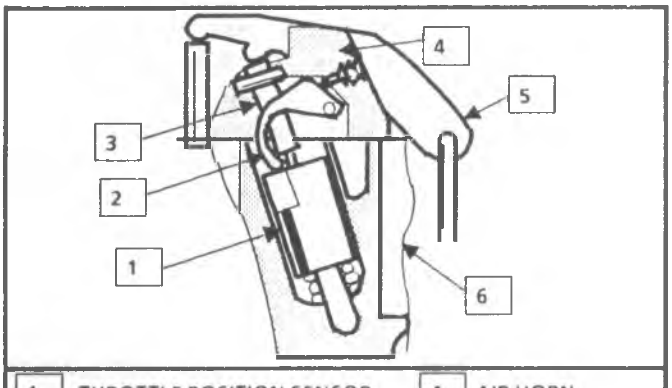


Figure 28 Throttle Position Sensor

INPUT SIGNALS

Distributor

The distributor not only controls engine timing, but acts as a sensor to tell the ECM the crankshaft position and engine RPM. See "Electronic Spark Timing." for service information.

DIAGNOSIS

ELECTRONIC CONTROL MODULE

Since the ECM can have a failure which may effect only one circuit, following the Diagnostic Procedures starting with the Diagnostic Circuit Check in Section A which will indicate if the ECM requires replacement. Refer to Chart C-1 before replacing the ECM.

PROM

A PROM failure will generally set a Code 51. Code 51, also indicates that the PROM may have been installed improperly. Check the PROM installation for bent pins or pins not fully seated. Replace the PROM if installation is correct and there is still a Code 51. Refer to Section A for diagnosis.

REMOTE LAMP DRIVER

Refer to Chart A-5 or Chart A-6 in Section A for diagnosis of the remote lamp driver.

COOLANT TEMPERATURE SENSOR

A failure in the coolant sensor circuit should set either a Code 14 or Code 15. Remember, these codes indicate a failure in the coolant temperature circuit, so proper use of the chart will lead to either repairing a wiring problem or replacing the sensor, to properly repair a problem. Refer to Section A for diagnosis.

DIFFERENTIAL PRESSURE SENSOR

A Code 34 will set if the ECM has seen an incorrect signal voltage in the differential pressure sensor circuit. Refer to Section A for diagnosis.

Chart C-1E will diagnosis the differential pressure sensor circuit.

OXYGEN SENSOR

Code 13 will set if there is an open in the oxygen sensor circuit. A shorted sensor circuit will set a Code 44. A high voltage in the circuit will set a Code 45. Refer to Section A for diagnosis.

THROTTLE POSITION SENSOR

An open TPS circuit or a misadjusted throttle position sensor will set a Code 21. Refer to Section A for diagnosis. Chart C-2F will diagnosis the throttle position sensor circuit.

DISTRIBUTOR REFERENCE SIGNAL

Code 42 chart will diagnosis the electronic spark timing circuit. Refer to Section A.

Refer to Chart C-4A for diagnosis of the Ignition System.

ON-VEHICLE SERVICE

ELECTRONIC CONTROL MODULE (ECM)

Replacement of the electronic control module (ECM) consists of a service controller without a PROM.

Refer to General Description in Section C for location of the ECM and additional information.

Service of the ECM should normally consist of either replacement of the ECM or a PROM change (Figure 29).

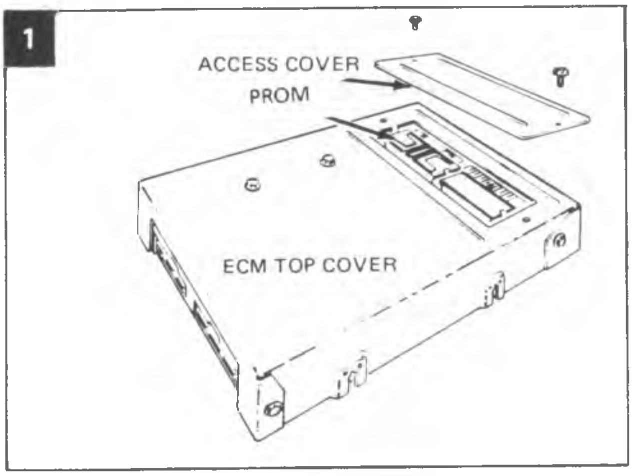
If the diagnostic procedures requires the ECM to be replaced, the engine calibrator (PROM) and ECM should be checked first to see if they are the correct parts. If they are, remove the PROM from the faulty ECM and install it in the service controller.

Important

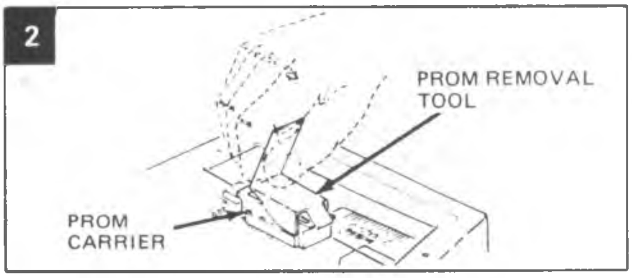
When replacing the production ECM with a new ECM, it is important to transfer the Production Broadcast Code and Production ECM number to the new ECM Label. Please do not record on ECM Cover. This will enable positive identification of ECM Components throughout the service life of the vehicle.

NOTICE: To prevent internal ECM damage, the ignition must be "OFF" when disconnecting or reconnecting power to ECM (for example, battery positive cable, ECM pigtail, ECM fuse, jumper cables, etc.).

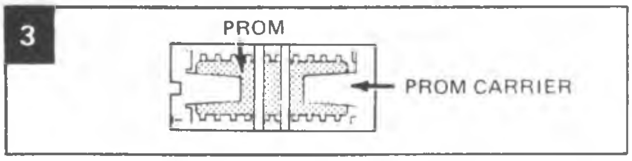
1. Remove ECM access cover.



2. Remove PROM using the rocker-type PROM removal tool shown. Engage one end of the PROM carrier with the hook end of the tool. 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.

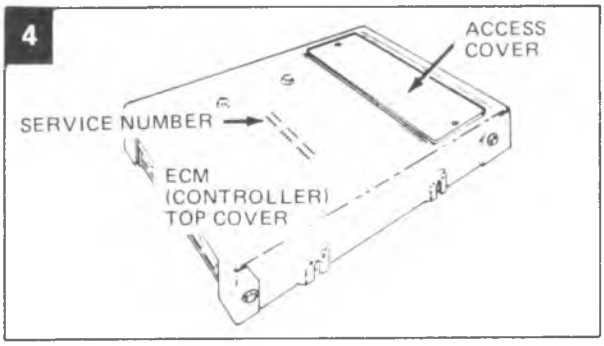


3. Inspect reference end of the PROM carrier and carefully set aside. Do not remove PROM from the carrier to confirm PROM correctness. Notch in PROM referenced to smaller notch in carrier and the ①



04 26 85

4. If a service controller is being installed, check the service number on the controller to make sure it is the same as the removed ECM. Remove access cover.



5. Install PROM. If a service PROM is being installed, make sure it has the same part number as the removed PROM.

Important (Before installing PROM)

ANY TIME THE PROM IS INSTALLED BACKWARDS AND THE IGNITION SWITCH TURNED ON, THE PROM IS DESTROYED.

Important

DO NOT press on PROM ONLY CARRIER.

Small notch of carrier must 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.

6. Install ECM access cover.
7. Install ECM in passenger compartment and perform a "DIAGNOSTIC CIRCUIT CHECK" to confirm proper installation.

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Figure 29 Replacement of PROM

PROM REPLACEMENT

Before replacing a PROM, check it for proper installation and correct alignment of the locator marks. The PROM's pins should be fully inserted in their sockets when the PROM is plugged into the ECM. The CODE 51 chart has PROM replacement instructions, and replacement package also has instructions included.

Refer to Figure 29 for replacement of the PROM.

REMOTE LAMP DRIVER (FIGURE 23)

Replace remote lamp driver only if diagnosis has determined that it has failed. The driver is inside a container, taped to the harness near the ECM. Open container and replace remote lamp driver as required.

WIRING HARNESS

The wiring harness routings and component locations for the Computer Command Control used in California are shown in Figure 35 through 37.

INFORMATION SENSORS

ENGINE COOLANT TEMPERATURE SENSOR

Refer to Figures 35 through 37 for location of the coolant temperature sensor.

NOTICE: Care must be taken when handling coolant sensor. Damage to coolant sensor will affect proper operation of the Fuel Control system. See Wire Harness views in Introduction for location of coolant sensor.

Remove or Disconnect

1. Negative battery cable.
2. Drain cooling system below level of sensor.
3. Electrical connector.
4. Carefully back out sensor.

Install or Connect

1. Sensor in engine.
2. Electrical connector.
3. Refill coolant system if necessary.
4. Negative battery cable.

DIFFERENTIAL PRESSURE SENSOR (FIGURE 30)

The differential pressure sensor is retained in a bracket on the air cleaner.

Remove or Disconnect

1. Electrical connector.
2. Vacuum hose.
3. Sensor.

Install or Connect

1. Sensor.
2. Vacuum hose.
3. Electrical connector.

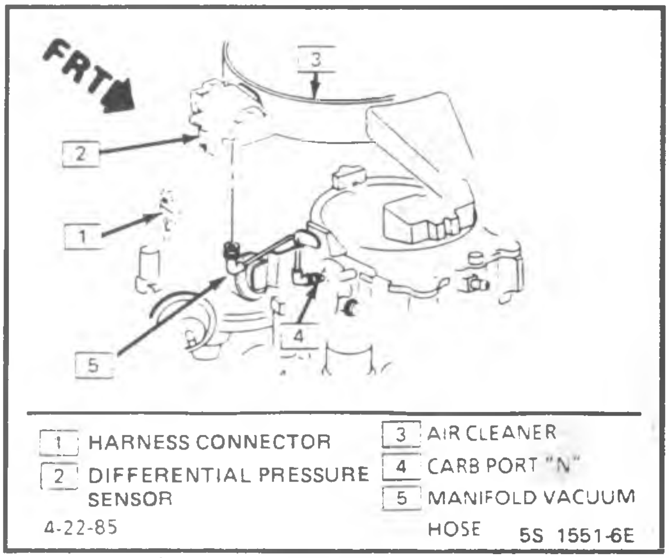


Figure 30 Diff. Press. Sensor

OXYGEN SENSOR (FIGURES 31 THRU 34)

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.
Take care when handling the oxygen sensor. The in-line electrical connector and louvered end must be kept free of grease, dirt or other contaminants. Also, avoid using cleaning solvents of any type. Do not drop or roughly handle the oxygen sensor.

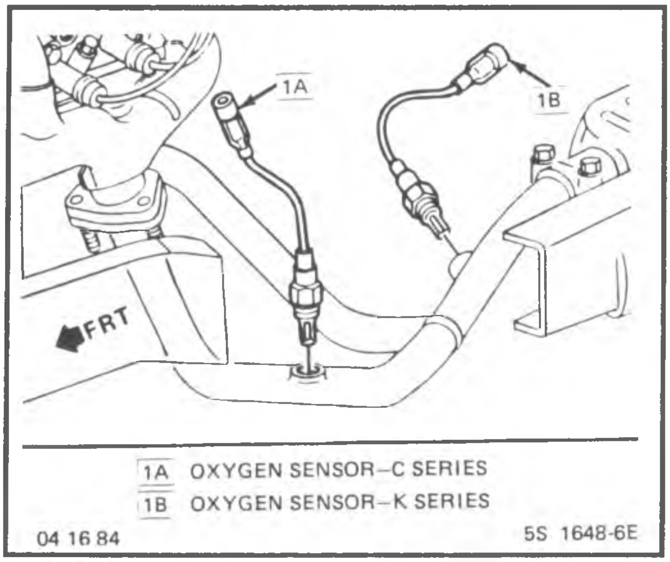


Figure 31 O_2 Sensor - V6 (CK)

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. Raise vehicle if necessary for access.
3. Electrical connector.
4. Carefully back out Oxygen Sensor.

Install or Connect

Important

A special anti-seize compound is used on the oxygen sensor threads. The compound consists of a liquid graphite and glass beads. The graphite will tend to burn away, but the glass beads will remain, making the sensor easier to remove.

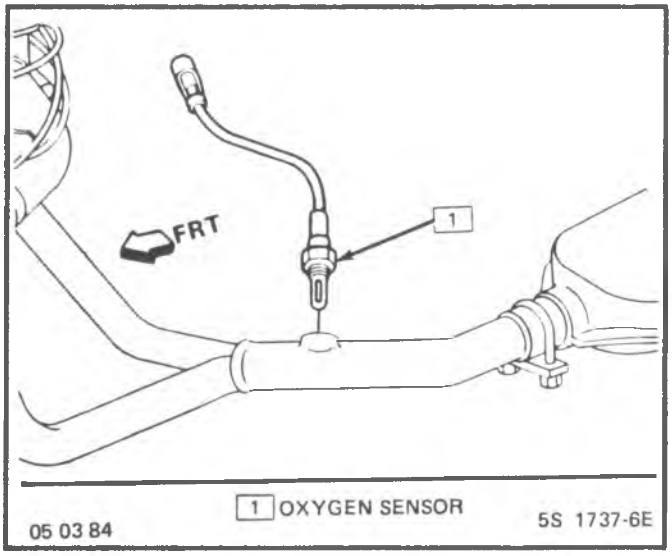


Figure 32 O_2 Sensor - V6 - (G)

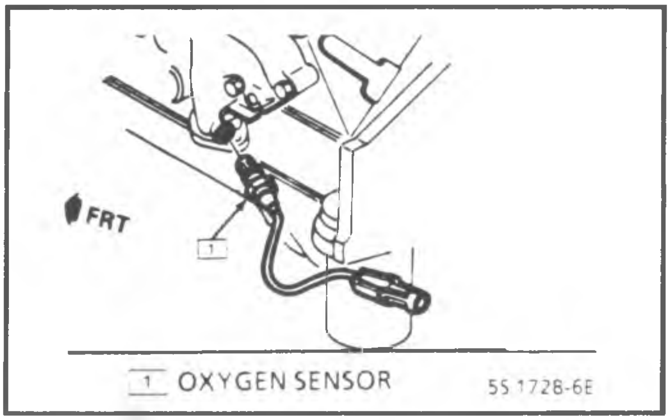


Figure 33 O_2 Sensor - V8 - (CK)

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 40 N·m (30 ft. lbs.).
3. Electrical connector.
4. Lower vehicle if necessary.
5. Negative battery cable.

PARTS INFORMATION

PART NAME	GROUP
Controller, ECM	3.670
Calibrator, PROM	3.670
Sealer, Exhaust Oxygen Sender (Anti-Seize Compound)	3.671
Sensor, Coolant Temp	3.760
Sensor, Exhaust Oxygen	3.670
Sensor, Manif. Diff. Press	3.670

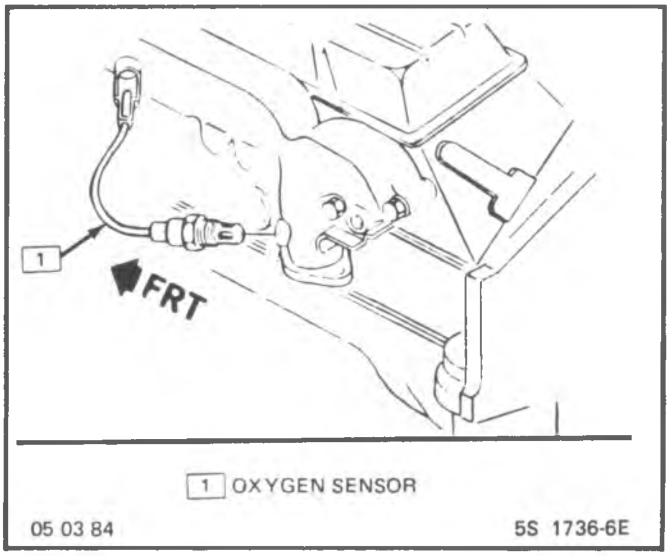
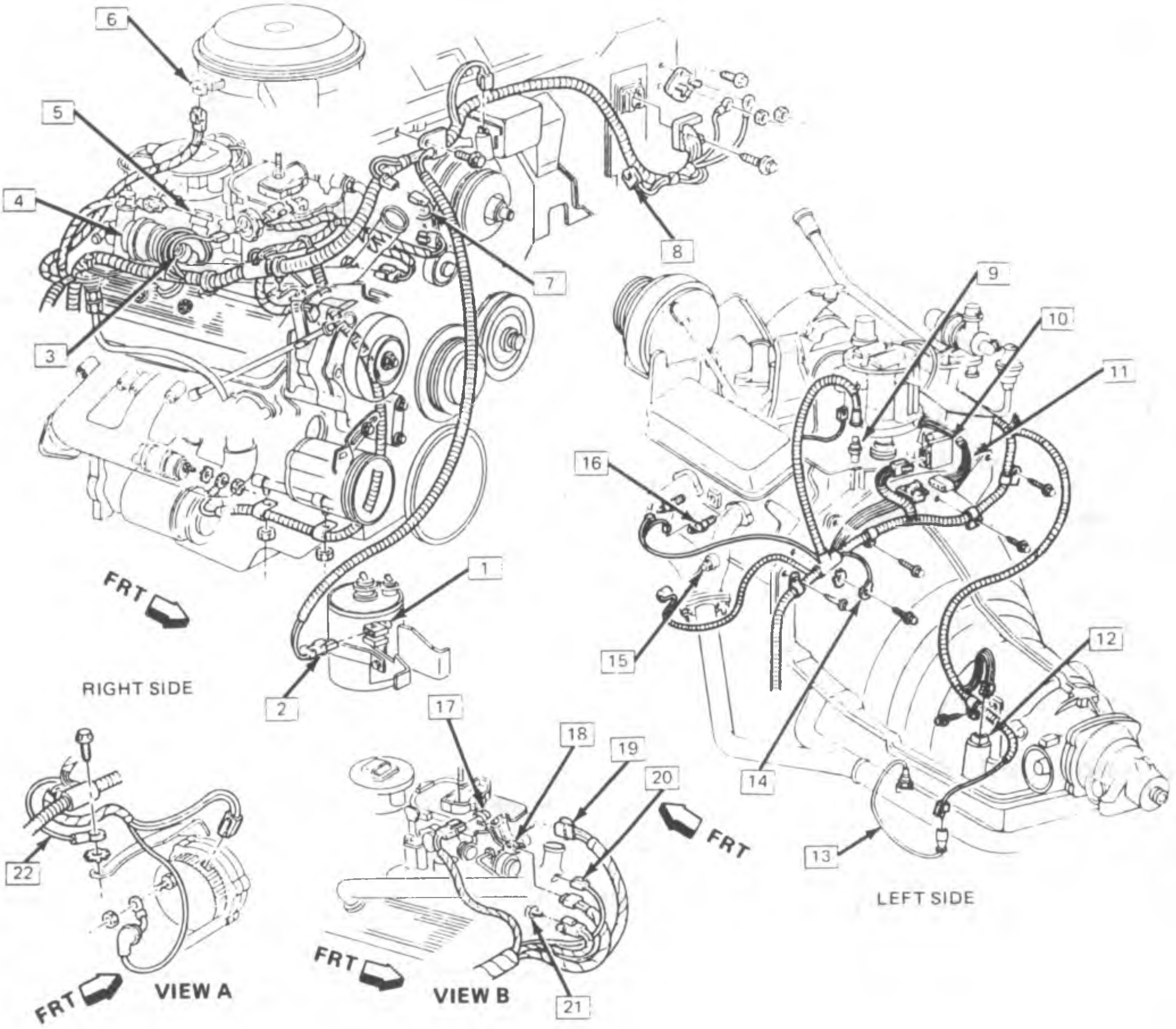


Figure 34 O_2 Sensor - V8 - (G)



1	CANISTER PURGE SOLENOID
2	FUEL VAPOR CANISTER
3	AIR DIVERT SOLENOID
4	AIR DIVERT VALVE
5	EGR SOLENOID
6	VACUUM SENSOR
7	A/C HARNESS CONNECTOR
8	DWELL METER CONNECTOR
9	OIL PRESSURE SWITCH
10	ESC MODULE
11	EST CONNECTOR
12	TCC SOLENOID
13	OXYGEN SENSOR
14	GROUND CONNECTOR
15	ESC KNOCK SENSOR
16	ENGINE COOLANT SWITCH
17	M/C SOLENOID
18	ACCELERATOR PUMP SOLENOID
19	THROTTLE POSITION SENSOR
20	ACCELERATOR PUMP TEMPERATURE SWITCH
21	COOLANT SENSOR
22	GROUND CONNECTOR

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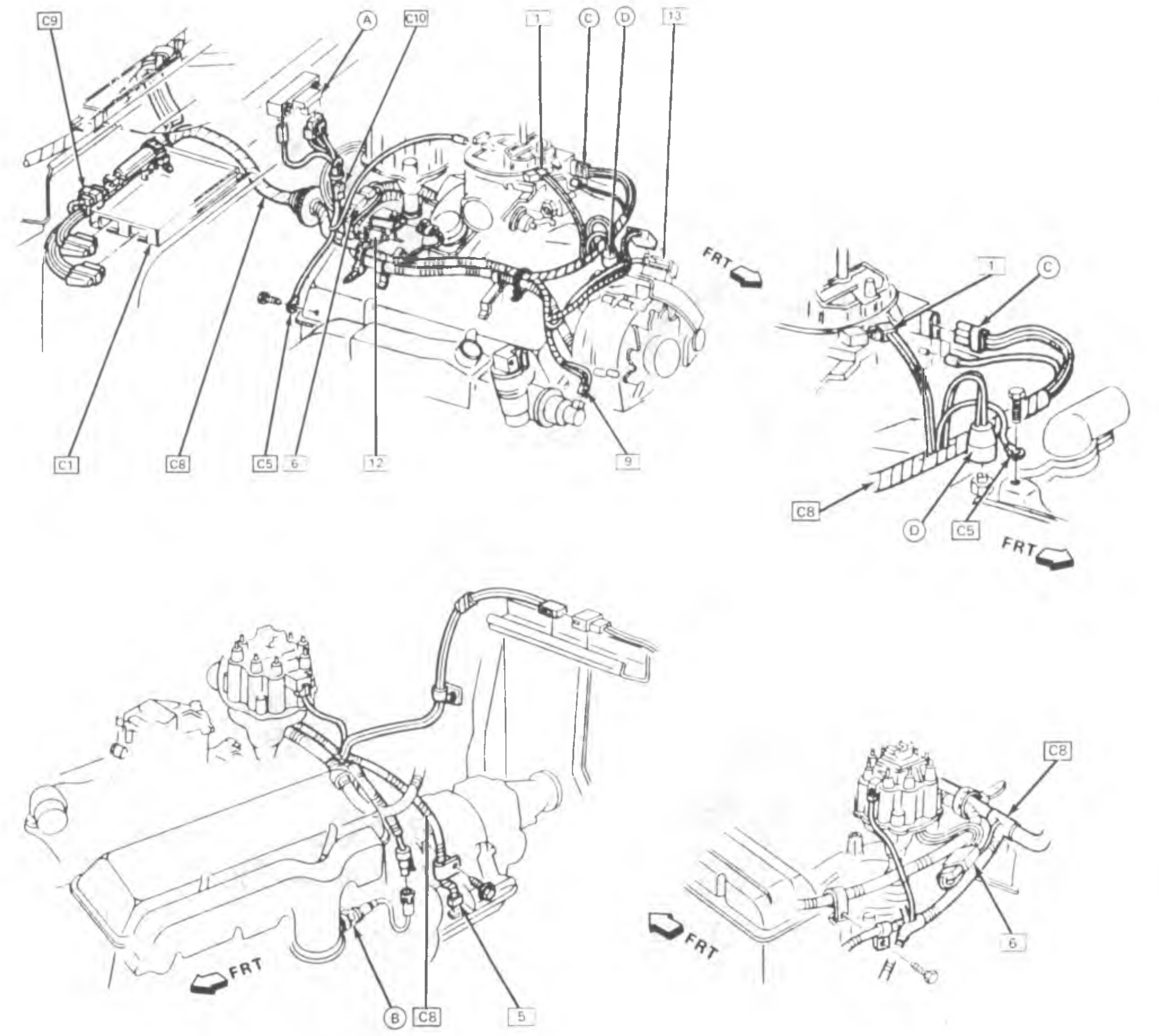
Figure 35 Wiring Harness - V6



COMPUTER SYSTEM

C1	Electronic Control Module (ECM)
C2	ALCL Connector
C5	System Ground
C8	Computer Control Harness
C9	Remote Lamp Driver
C10	Dwell Connector

AIR/FUEL SYSTEM

1	Mixture Control Solenoid

TRANSMISSION CONVERTER CLUTCH CONTROL SYSTEM

5	Trans. Conv. Clutch Connector

IGNITION SYSTEM

6	Electronic Spark Timing Connector

AIR INJECTION SYSTEM

9	Air Divert Solenoid Valve

EXHAUST GAS RECIRCULATION CONTROL SYSTEM

12	Exhaust Gas Recirculation Solenoid Valve

FUEL VAPOR CONTROL SYSTEM

13	Canister Purge Solenoid Valve

SENSORS/SWITCHES

A	Vacuum Sensor
B	Exhaust Oxygen Sensor
C	Throttle Position Sensor
D	Coolant Sensor

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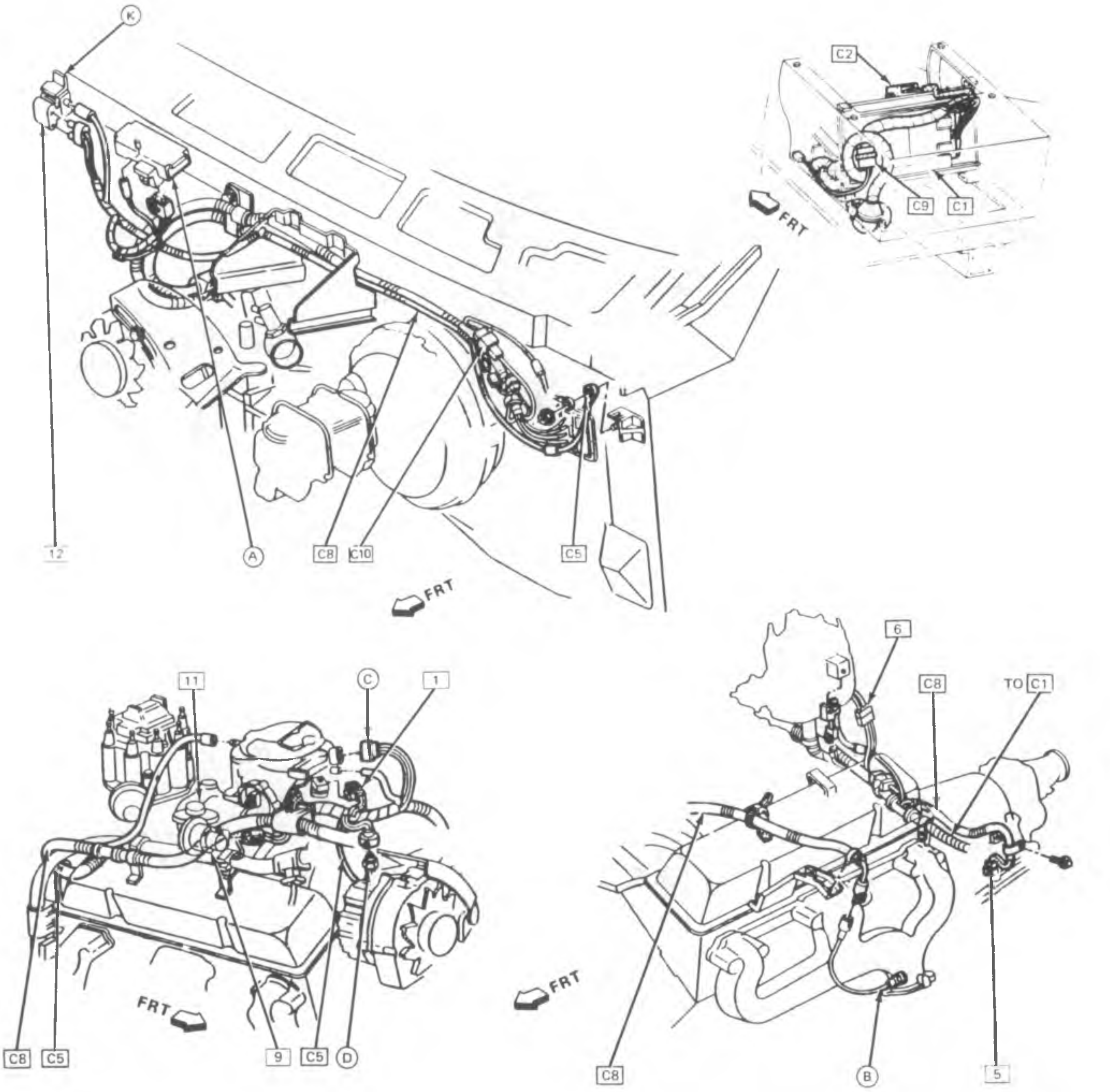
5S 1730-6E

Figure 36 Wiring Harness - V8 (CK Series)



COMPUTER SYSTEM

C1 Electronic Control Module (ECM)
C5 System Ground
C8 Computer Control Harness

AIR/FUEL SYSTEM

1 Mixture Control Solenoid

TRANSMISSION CONVERTER CLUTCH CONTROL SYSTEM

5 Trans. Conv. Clutch Connector

AIR INJECTION SYSTEM

9 Air Divert Solenoid Valve

EXHAUST GAS RECIRCULATION CONTROL SYSTEM

11 Exhaust Gas Recirculation Valve
12 Exhaust Gas Recirculation Solenoid Valve

IGNITION SYSTEM

6 Electronic Spark Timing Connector

SENSORS/SWITCHES

Ⓐ Manifold Pressure Sensor
Ⓑ Exhaust Oxygen Sensor
Ⓒ Throttle Position Sensor
Ⓓ Coolant Sensor

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5S 1729-6E

5 02 84

Figure 37 Wiring Harness - V8 (G Series)

BLANK

CHART C-1

ECM REPLACEMENT CHECK

4.3L, 5.0L OR 5.7L ENGINE

CARBURETED - CALIF.

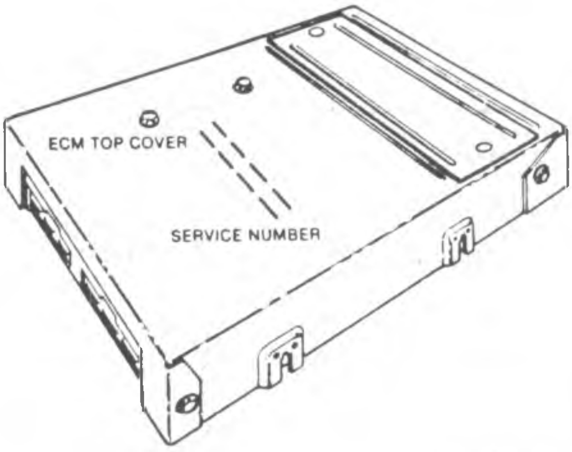
Prior to replacing an ECM, the circuit involved must be tested for:

- Poor connector terminal to ECM contact;
- Direct battery voltage on an ECM ground circuit from a short to B+; or
- Shorted solenoid or relay. If a short is found, the circuit must be repaired prior to replacing the ECM to prevent repeat ECM failures

1. Check for good terminal contact due to weak or dirty terminals. Remove terminal to inspect. Replace if broken or dirty. If coolant is present, replace coolant sensor and connector. Also, replace ECM connector terminal and blow coolant out of harness. Clean connector with alcohol or spray contact cleaner and replace ECM.
2. Check for a short to ignition or shorted solenoid or relay. All terminals must be tested since several are connected internally in the ECM. A short in one circuit may cause another circuit in the ECM to be inoperative that does not have an external fault, but was the cause of "driver's complaint." Any circuit testing below 20 ohms is shorted to ignition, or shorted across the relay or solenoid.
3. Check for shorted TCC solenoid. Some transmissions have a normally open 4th gear switch in series with the solenoid. The ohmmeter will read infinite resistance (open circuit) in these cases. If the reading is less than 20 ohms, a short to ignition or faulty solenoid exists. A normal solenoid will read between 20 - 50 ohms.
4. Check for shorted TCC circuit in units with a 4th gear switch. The vehicle must be in 4th gear to close the switch to obtain a resistance reading. A normal solenoid will read between 20-50 ohms.

↔ **Remove or Disconnect** (Figures 1 and 2)

1. New electronic control module out of its packaging and check the service number to make sure it is the same as the faulty ECM.
2. Access cover so that PROM from faulty ECM may be installed in replacement ECM.



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Important

REPLACEMENT ELECTRONIC CONTROL MODULE (ECM) IS SUPPLIED WITHOUT AN ENGINE CALIBRATION UNIT (PROM) SO CARE SHOULD BE TAKEN WHEN REMOVING THE PROM FROM THE DEFECTIVE ECM AS IT WILL BE REUSED IN THE NEW ECM. REFER TO PROM REPLACEMENT PROCEDURE AS DETAILED IN SECTION "A", CODE 51.

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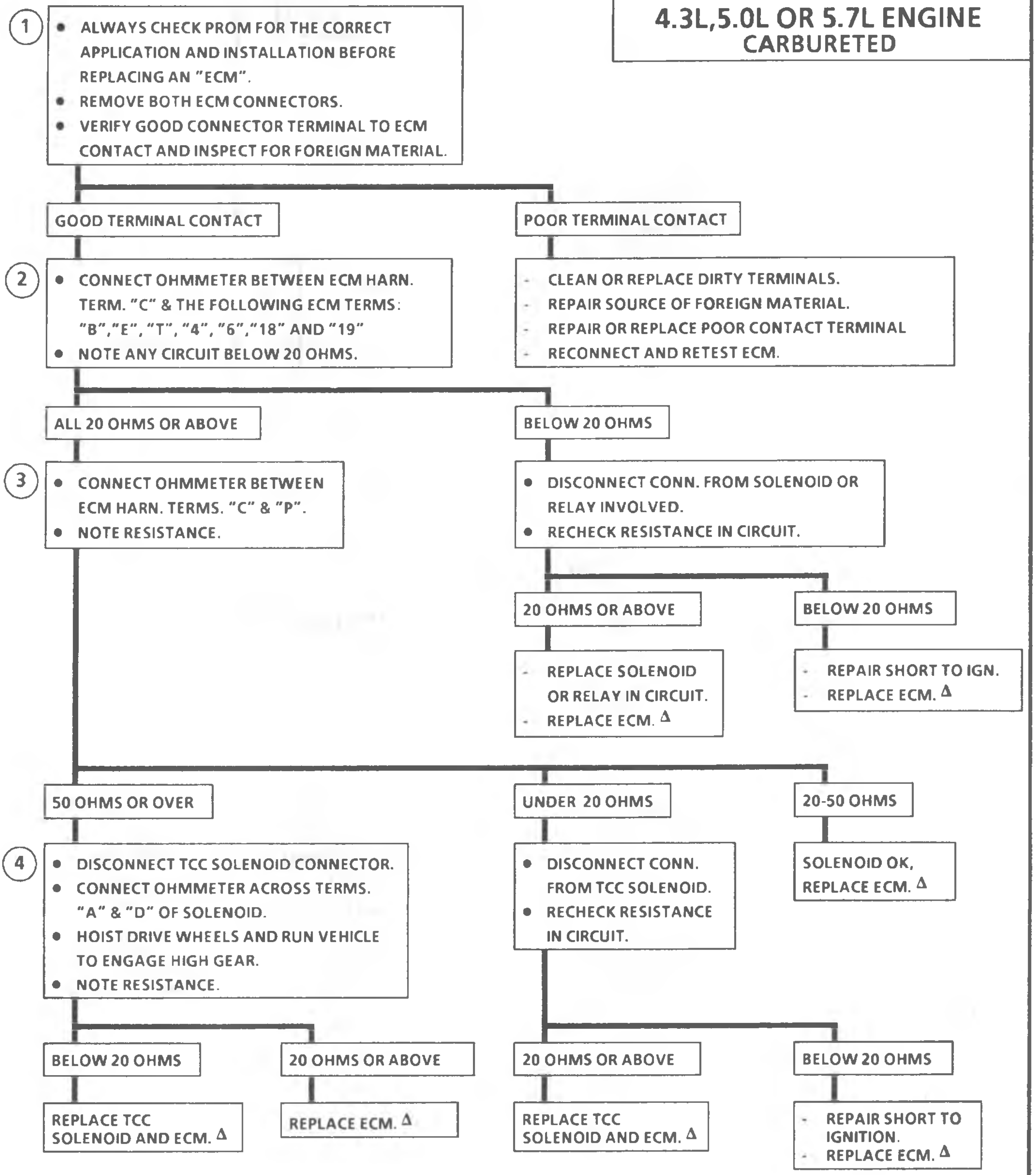
CHART C-1

ECM REPLACEMENT CHECK

4.3L,5.0L OR 5.7L ENGINE CARBURETED



①
- ALWAYS CHECK PROM FOR THE CORRECT APPLICATION AND INSTALLATION BEFORE REPLACING AN "ECM".
- REMOVE BOTH ECM CONNECTORS.
- VERIFY GOOD CONNECTOR TERMINAL TO ECM CONTACT AND INSPECT FOR FOREIGN MATERIAL.

GOOD TERMINAL CONTACT

②
- CONNECT OHMMETER BETWEEN ECM HARN. TERM. "C" & THE FOLLOWING ECM TERMS: "B","E","T","4","6","18" AND "19"
- NOTE ANY CIRCUIT BELOW 20 OHMS.

POOR TERMINAL CONTACT

- CLEAN OR REPLACE DIRTY TERMINALS.
- REPAIR SOURCE OF FOREIGN MATERIAL.
- REPAIR OR REPLACE POOR CONTACT TERMINAL
- RECONNECT AND RETEST ECM.

ALL 20 OHMS OR ABOVE

③
- CONNECT OHMMETER BETWEEN ECM HARN. TERMS. "C" & "P".
- NOTE RESISTANCE.

BELOW 20 OHMS

- DISCONNECT CONN. FROM SOLENOID OR RELAY INVOLVED.
- RECHECK RESISTANCE IN CIRCUIT.

20 OHMS OR ABOVE

- REPLACE SOLENOID OR RELAY IN CIRCUIT.
- REPLACE ECM. Δ

BELOW 20 OHMS

- REPAIR SHORT TO IGN.
- REPLACE ECM. Δ

50 OHMS OR OVER

④
- DISCONNECT TCC SOLENOID CONNECTOR.
- CONNECT OHMMETER ACROSS TERMS. "A" & "D" OF SOLENOID.
- HOIST DRIVE WHEELS AND RUN VEHICLE TO ENGAGE HIGH GEAR.
- NOTE RESISTANCE.

BELOW 20 OHMS

REPLACE TCC SOLENOID AND ECM. Δ

20 OHMS OR ABOVE

REPLACE ECM. Δ

UNDER 20 OHMS

- DISCONNECT CONN. FROM TCC SOLENOID.
- RECHECK RESISTANCE IN CIRCUIT.

20 OHMS OR ABOVE

REPLACE TCC SOLENOID AND ECM. Δ

BELOW 20 OHMS

- REPAIR SHORT TO IGNITION.
- REPLACE ECM. Δ

20-50 OHMS

SOLENOID OK, REPLACE ECM. Δ

1. IF REPLACING AN ORIGINAL EQUIPMENT ECM, TRANSFER THE ORIGINAL BROADCAST CODE TO THE LABEL ON THE REPLACEMENT ECM.
2. IF AFTER REPLACING THE "ECM', THE PROBLEM STILL EXISTS, THE "PROM" MAY BE FAULTY.

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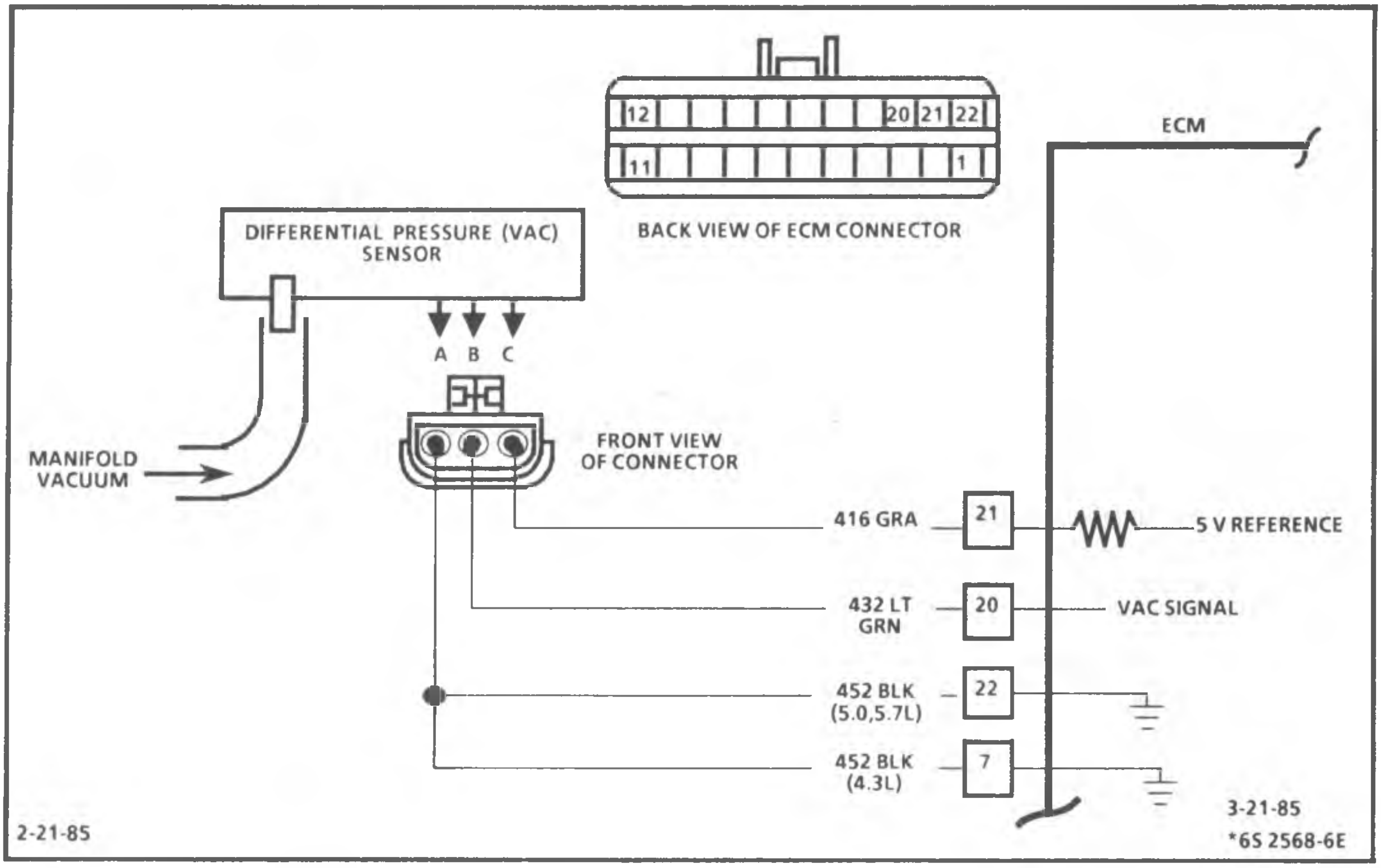


CHART C-1E

DIFFERENTIAL PRESSURE (VAC) SENSOR CHECK

4.3L, 5.0L OR 5.7L ENGINE

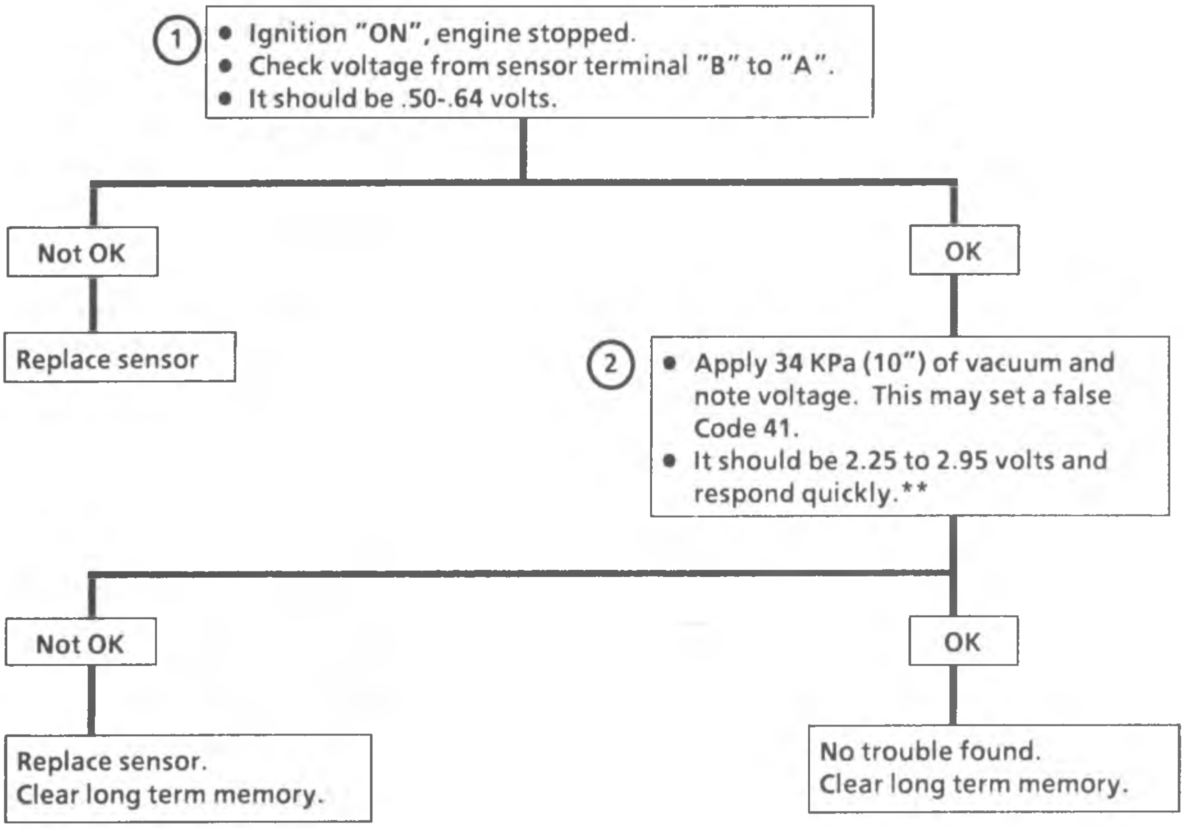
CARBURETED - CALIF.

1. This checks the output of the sensor. The VAC sensor is a differential pressure sensor that measures the difference in pressure between atmosphere and manifold. The voltage output normally with engine stopped and key "ON" is less than 1 volt, while at idle it should be above 3 volts. High voltage increases spark advance, while low voltage reduces spark advance.
2. This checks the rate of change of the output with vacuum. Again, the normal reading would be about in the middle of the range indicated. Also, the voltage should change as soon as the vacuum changes. If it doesn't, it could result in detonation or a sag on acceleration. It could also be caused by poor fuel or a restriction in the hose to the sensor.

CHART C-1E

DIFFERENTIAL PRESSURE (VAC) SENSOR CHECK

4.3L, 5.0L OR 5.7L ENGINE
CARBURETED - CALIF.



①
- Ignition "ON", engine stopped.
- Check voltage from sensor terminal "B" to "A".
- It should be .50-.64 volts.

Not OK: Replace sensor

OK:

②
- Apply 34 KPa (10") of vacuum and note voltage. This may set a false Code 41.
- It should be 2.25 to 2.95 volts and respond quickly.**

Not OK: Replace sensor. Clear long term memory.

OK: No trouble found. Clear long term memory.

* This requires use of three jumpers between the sensor & the connector. They can be made using terminals 12014836 and 12014837.

**If voltage does not immediately follow vacuum change, sensor is faulty.

After any repair clear long term memory by removing ECM fuse for 10 seconds.

11-17-84

* 4S 0293-6EA

FUEL CONTROL SYSTEM

4.3L, 5.0L OR 5.7L ENGINE
CALIFORNIA ONLY

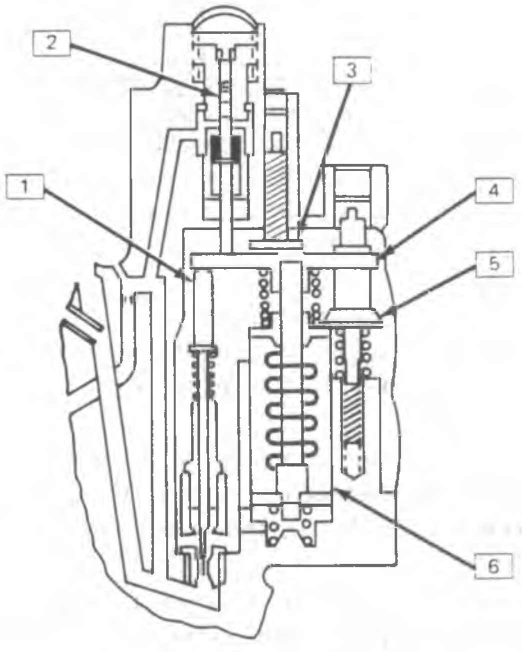
GENERAL DESCRIPTION

The basic function of the fuel control system is to control fuel delivery to the engine.

The Electronic Control Module (ECM) controls the fuel delivery from information received regarding:

- Coolant temperature
- Crankshaft RPM
- Amount of oxygen in the exhaust stream
- Throttle position
- Intake Manifold Pressure

The ECM controls fuel delivery to an E4ME carburetor through an electrically operated Mixture Control (M/C) solenoid (Figure 38) mounted in the float bowl. A plunger in the solenoid is pulsed by the ECM to allow more or less fuel to mix with the air entering the carburetor. When the solenoid is energized, there is less fuel flow providing a leaner fuel mixture. When the solenoid is de-energized, there is more fuel flow providing a richer fuel mixture. The solenoid is turned on and off at a rate of 10 times per second.



1 MAIN METERING ROD
2 IDLE AIR BLEED VALVE
3 RICH STOP
4 PADDLE
5 LEAN STOP
6 M/C SOLENOID

4S 0419-6E

Figure 38 M/C Solenoid - E4ME

The M/C solenoid "on" time verse "off" time is varied to change the mixture. This is called ECM command.

OXYGEN SENSOR

An exhaust oxygen (O_2) sensor, mounted in the exhaust system, monitors 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 0.100 volts (high O_2 - lean mixture) to 0.900 volts (low O_2 - rich mixture).

By monitoring the voltage output of the O_2 sensor, the ECM will know what fuel mixture command to give to the solenoid (lean mixture-low voltage-rich command, rich mixture-high voltage-lean command).

ECM COMMAND

The ECM command determines the fuel control delivery and can be monitored with a dwell meter set on the 6 cylinder scale. It is connected to the M/C Solenoid dwell connector (green) located in the harness near the solenoid (Figure 39).

CLOSED LOOP *(FIGURE 40)*

On a normal operating engine the dwell meter needle, at part throttle, will be between 10° and 50° dwell and varying. This is called "CLOSED LOOP" operation. This means that the oxygen sensor affects control of the fuel delivery.

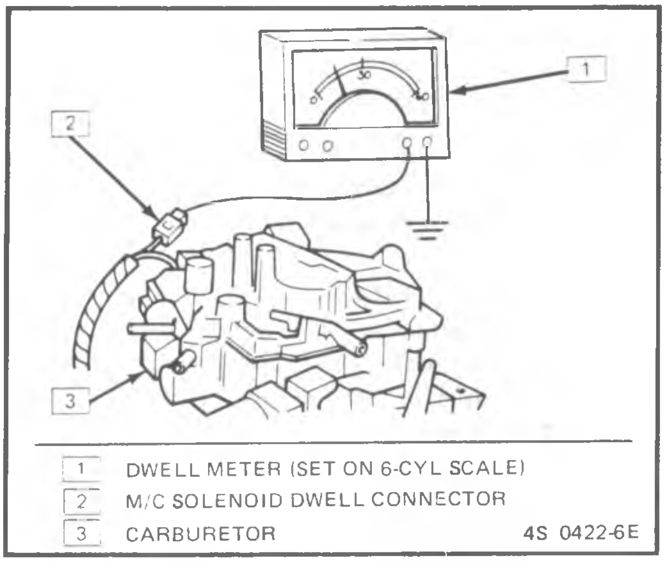


Figure 39 Dwell Meter

OPEN LOOP

The oxygen sensor does not affect fuel control in "OPEN LOOP" operation and the dwell reading will not vary. This condition is when the engine is cold, the oxygen sensor is below 316°C (600°F) at idle or at wide-open throttle (WOT).

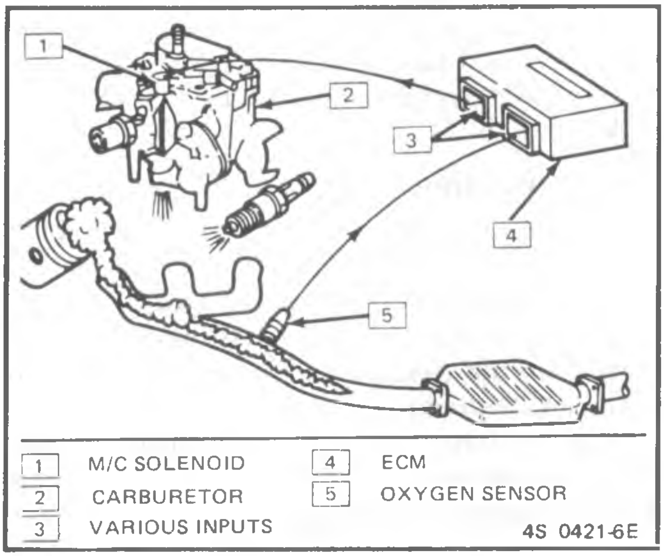


Figure 40 Closed Loop Cycle

The fuel control system includes the following:

- An Electronic Control Module (ECM) - the control center.
- Mixture Control (M/C) solenoid - pulses to meter more or less fuel.
- Oxygen (O_2) sensor - sends voltage signal to ECM depending on the amount of oxygen in exhaust stream.
- Throttle Position Sensor - sends voltage signal to ECM affecting fuel delivery.
- ECM Command - visual view of fuel delivery using dwell meter.
- Idle Speed Control - The throttle lever actuator plunger extends to maintain idle speed with A/C and increase idle speed during cold starts.

THROTTLE POSITION SENSOR

The throttle position sensor (TPS) changes position as the throttle valve angle changes. The TPS is a potentimeter, mounted in the caburetor, with one end connected to 5 volts from the ECM and the other end to ground. A third wire is connected to the ECM to measure voltage from the TPS. At a closed throttle position, the output of the TPS is approximately .31 volts. As the throttle valve opens, the output voltage increases so that at wide-open throttle the output is approximately 5 volts.

IDLE SPEED CONTROL
FIGURES 41 or 42

An idle speed control is used on a 4.3L engine to increase idle speed during cold start and to maintain idle speed with air conditioning "on" or power steering during a full turn. Idle speed control is called stepped speed control on the Vehicle Emission Control Information label.

When the engine coolant temperature is below 85°C (185°F) and the engine is started, a vacuum solenoid is energized, which opens manifold vacuum to a throttle kicker (stepped speed control actuator). The throttle kicker plunger extends onto the throttle lever and idle speed is increased. When coolant temperature is above 85°C (185°F), the ECM opens the circuit to the solenoid and actuator retracts.

If the engine coolant temperature is above 85°C (185°F) and engine is started, the solenoid will energize for 30 seconds and then the ECM opens the circuit.

When air conditioning is turned "on", the vacuum solenoid is energized through a relay and remains on during this mode to maintain idle speed.

During full steering turn on a power steering equipped vehicle, the solenoid is energized through a switch to maintain idle speed during a static full turn load.

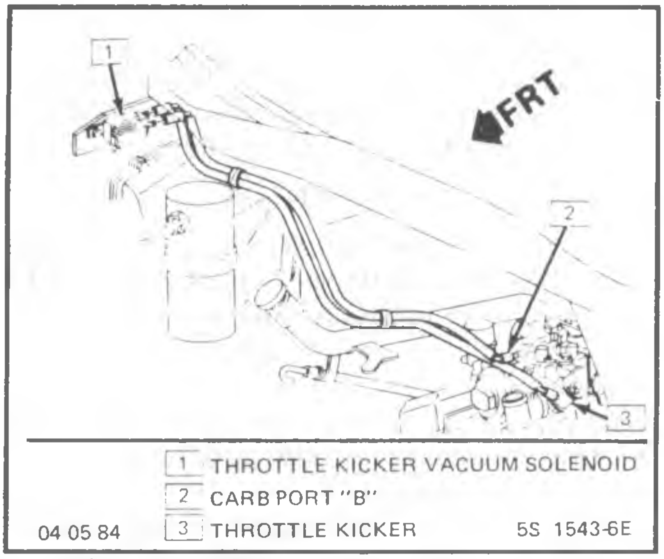


Figure 41 Idle Speed Control - G Series

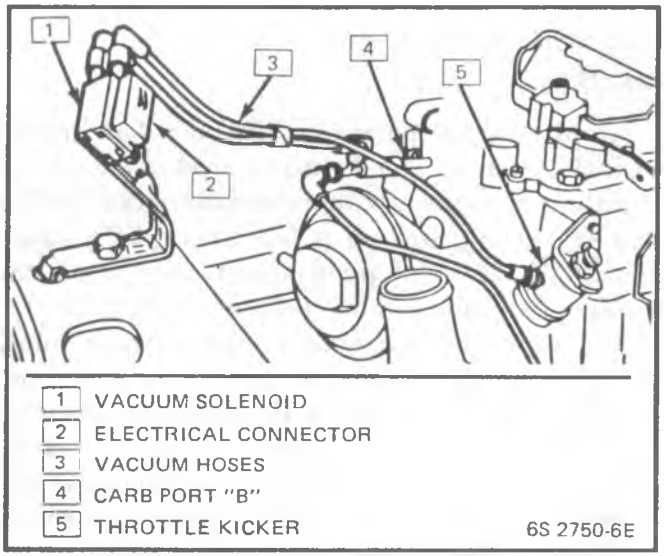


Figure 42 Idle Speed Control - CK Series

DIAGNOSIS

FUEL CONTROL SYSTEM

The fuel control system diagnosis is in SECTION A.

Also, refer to SECTION B for driveability symptoms related to the fuel control system.

If during diagnosis, code diagnosis indicates that carburetor calibration is required, refer to ON-VEHICLE SERVICE.

System Performance Check

The M/C solenoid, which is controlled by the ECM, changes the air/fuel mixture to the engine by allowing more or less fuel to flow through the carburetor.

The System Peraformance Check is used to check the operation of the mixture control solenoid, the main metering circuit in the carburetor, and the operation of the Computer Command Control by use of a dwell meter.

The dwell reading is used to determine carburetor calibration and is sensitive to changes in fuel mixture such as heat, air leaks, or lean and rich condition. A normal dwell will increase and decrease over a narrow dwell range. However, it may occasionally vary as much as a 10° to 15° dwell range momentarily because of a temporary mixture change. A dwell reading is the average of the most consistant variation within the 10° to 50° scale of the meter.

The carburetor has been calibrated at the factory and should not normally need adjustment in the field. If during diagnosis, the System Performance Check indicates that carburetor calibration is required, refer to ON-VEHICLE SERVICE.

Throttle Position Sensor

If the TPS is out of adjustment, idle quality may be affected and performance may be poor. If the TPS circuit is open, the ECM will think the vehicle is at wide-open throttle, and cause the ECM to go full rich, and set a Code 21. Refer to Section A for diagnosis.

Refer to Chart C-2F for throttle position sensor enrichment check.

IDLE SPEED CONTROL

Refer to Chart C-2T or C-2W for diagnosis of the Idle Speed Control.

ON-VEHICLE SERVICE

CARBURETOR CALIBRATION

1. Check float level, using gage J-34935-1, BT-8420-A, or equivalent (Figure 43). If setting is not within 14/32" specified float level, float adjustment is required. After removing air horn, refer to Figure 48 for adjustment.

1. WITH ENGINE IDLING AND CHOKE WIDE OPEN, INSERT GAGE IN VENT SLOT OR VENT HOLE ALLOW GAGE TO FLOAT FREELY

NOTICE: DO NOT PRESS DOWN ON GAGE FLOODING OR FLOAT DAMAGE COULD RESULT.

2. OBSERVE THE MARK ON GAGE THAT LINES UP WITH TOP OF CASTING. SETTING SHOULD BE WITHIN ±2/32" (1.588mm) OF SPECIFIED FLOAT LEVEL SETTING

INCORRECT FUEL PRESSURE WILL ADVERSELY AFFECT FUEL LEVEL.

3. IF NOT WITHIN SPECIFICATION, REMOVE AIR HORN AND ADJUST FLOAT.

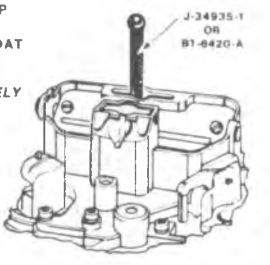


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Figure 43 External Float Gage Check

2. If system performance check indicates that the M/C solenoid dwell is incorrect, DO NOT attempt any carburetor calibration changes, until ALL possible causes listed on System Performance Chart have been thoroughly checked.
   a. If the M/C dwell at 3000 rpm is still incorrect, adjustment of the Mixture Control Solenoid is required.
   b. If the M/C dwell at idle was incorrect, refer to: Idle Mixture Adjustment, which follows in this Section. The air horn assembly must be removed to adjust the M/C Solenoid.

AIR HORN ASSEMBLY REMOVAL

The following operations are necessary to perform removal of the air horn.

1. Float adjustment.
2. M/C solenoid and plunger adjustments.
3. TPS replacement.

←→ Remove or Disconnect

1. Electrical connectors; M/C solenoid and TPS assembly.
2. Air horn:
   a. Upper choke lever from end of choke shaft by removing attaching screw. Rotate upper choke lever to remove lever from choke link.
   b. Choke link form lower lever inside the float bowl casting. Remove link by holding lower lever outward with small screwdriver and twisting link counterclockwise.
   c. The retainer from the pump link, and remove link from lever. DO NOT remove pump lever from air horn, (Figure 44).
   d. Front vacuum break hose from tube on float bowl.
   e. Secondary metering rod holder screw. Lift the holder with the metering rods straight up out of the air horn.
   f. Air horn-to-bowl screws; then remove the two countersunk attaching screws located next to the venturi.
   g. Air horn from bowl by lifting it straight up. (Gasket should remain on float bowl).
3. Solenoid adjusting screw and rich limit stop (Figure 45), using tool J-28696-10, BT-7928, or equivalent.
4. Solenoid-metering rod plunger by lifting straight up (Figure 46).
5. Air horn gasket by lifting it from the dowel locating pins on the float bowl. DISCARD GASKET.
6. Float bowl insert.

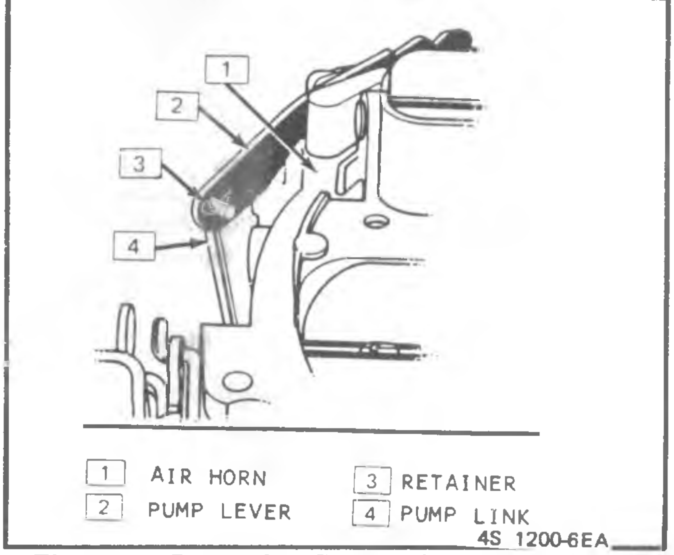


Figure 44 Removing Pump Link From Lever

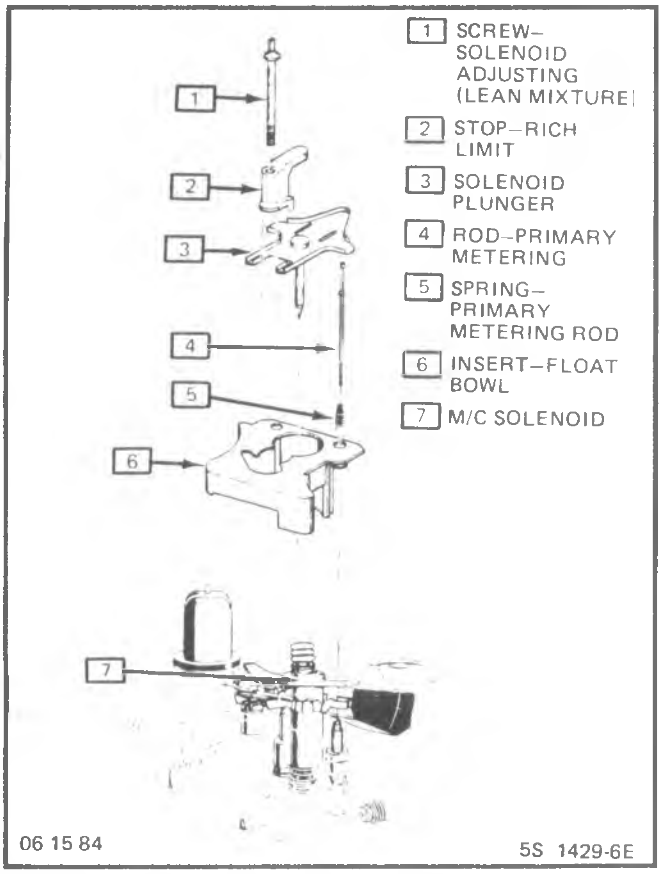


Figure 45 M/C Solenoid and Related Parts

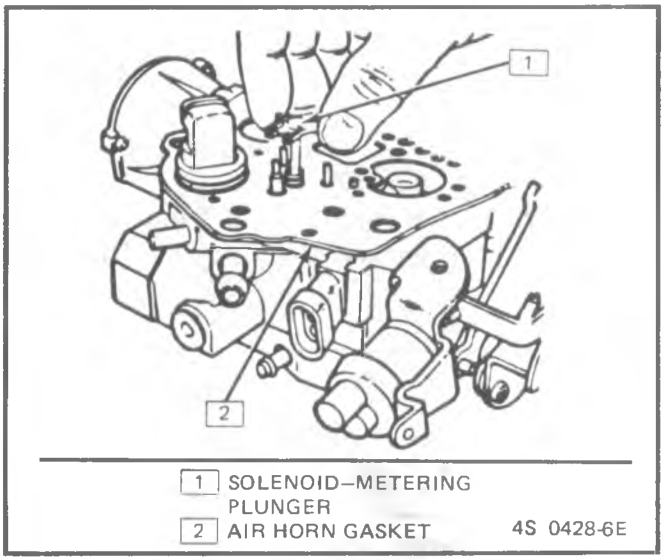


Figure 46 Solenoid-Metering Plunger

7. Metering rods and springs.
8. Throttle Postition Sensor (TPS) Removal (Figure 47), if required for replacement:

   Push up from bottom on electrical connector and remove TPS and connector assembly from bowl.

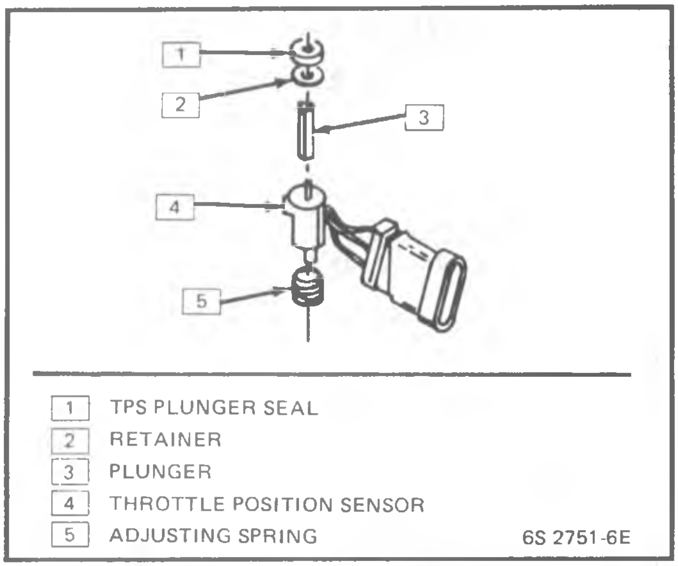


Figure 47 Throttle Position Sensor

Inspect

METERING COMPONENTS

1. If the carburetor interior has obvious signs of dirt or contamination, it should be completely disassembled and cleaned.
2. Examine all M/C solenoid parts.
   a. M/C solenoid; bore and plunger for signs of sticking or wear.
   b. Plunger return spring for damage or distortion and for correct assembly on solenoid body.
   c. Metering rod and spring assemblies.
      (1) Any damage to rods; bent or burred.
      (2) Metering rod springs for: distortion, collapse, and for correct installation on rods.
      (3) Correct part numbers.
   d. Metering jets.
      (1) For looseness in bowl.
      (2) Any damage, such as bent guide that could cause a bind.
      (3) Any damage or foreign material in metering jet orfice.
      (4) Correct part numbers.

Float Adjustment, If Necessary

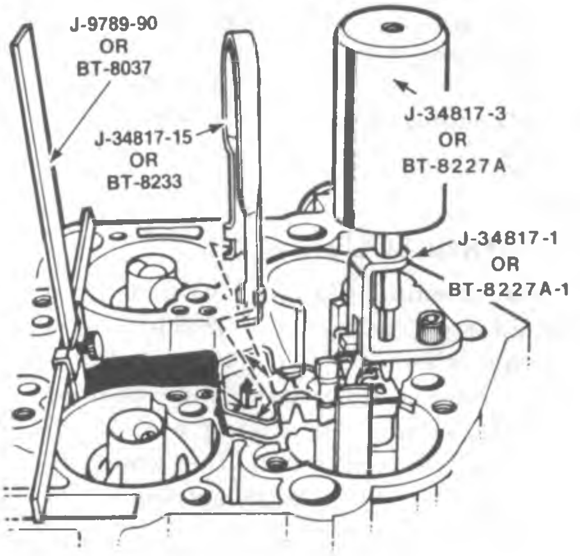
1. Refer to Figure 48 for procedure and tools required for making float adjustment.
2. Set float to specification 14/32" ± 2/32".

Remove or Disconnect

MIXTURE CONTROL SOLENOID REPLACEMENT

1. If diagnosis or inspection indicates that a new M/C solenoid assembly is required, install a Service Replacement Package. The solenoid and plunger MUST be installed as a matched set.

1. REMOVE AIR HORN & GASKET.
2. REMOVE SOLENOID PLUNGER, METERING RODS, FLOAT BOWL INSERT. IF NECESSARY TO REMOVE SOLENOID (LEAN MIXTURE) ADJUSTING SCREW, COUNT AND MAKE RECORD OF NUMBER OF TURNS IT TAKES TO LIGHTLY BOTTOM SCREW, USING J-28696-10 OR BT-7928. (RETURN TO EXACT POSITION WHEN REASSEMBLING.)
3. ATTACH J-34817-1 OR BT-8227A-1 TO FLOAT BOWL.
4. PLACE J-34817-3 OR BT-8227A IN BASE WITH CONTACT PIN RESTING ON OUTER EDGE OF FLOAT LEVER.
5. MEASURE DISTANCE FROM TOP OF CASTING TO TOP OF FLOAT, AT POINT 3/16" FROM LARGE END OF FLOAT. USE J-9789-90 OR BT-8037.
6. IF MORE THAN ±2/32" FROM SPECIFICATION, USE J-34817-15 OR BT-8233 TO BEND LEVER UP OR DOWN. REMOVE BENDING TOOL AND MEASURE, REPEATING UNTIL WITHIN SPECIFICATION.
7. CHECK FLOAT ALIGNMENT.
8. REASSEMBLE CARBURETOR.



FLOAT ADJUSTMENT (E2M, E4M)

6S 2725-6E

Figure 48 Float Adjustment

a. Using tool J28696-10, or BT-7928, or equivalent, remove Solenoid adjusting screw and Rich Limit Stop.
b. Remove solenoid assembly attaching screw and lift the M/C solenoid and connector assembly from the float bowl.

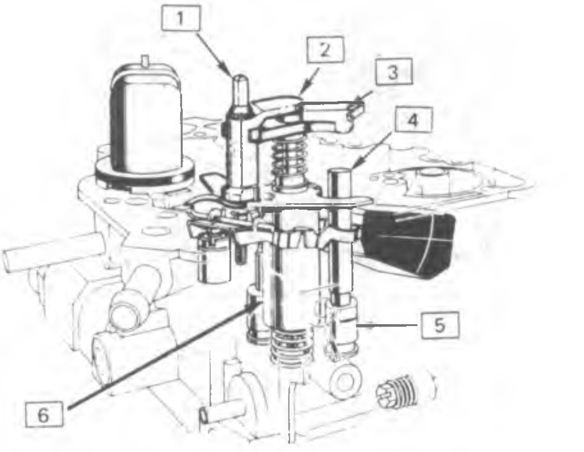
2. Proceed to M/C solenoid assembly.

→← Install or Connect

MIXTURE CONTROL SOLENOID ASSEMBLY
Figure 49

1. Be certain large M/C solenoid tension spring is properly positioned over boss on bottom of float bowl.
2. Be certain lean stop screw tension spring is properly positioned between raised bosses next to float hinge pin.
3. Mixture control solenoid gaging tool, J-33815-1, BT-8253-A, or equivalent, over throttle side metering jet rod guide.
4. M/C solenoid assembly in the float chamber, aligning pin on end of solenoid with hole in raised boss at bottom of bowl.

a. Press down on M/C solenoid body (compressing tension spring under the solenoid) and hold down.
b. Solenoid adjusting screw through rich limit stop and tension spring.



1	SOLENOID ADJUSTING (LEAN MIXTURE) SCREW
2	RICH LIMIT STOP
3	SOLENOID PLUNGER
4	GAGING TOOL J33815-1 OR BT823-A
5	THROTTLE SIDE PRIMARY METERING JET
6	SOLENOID ASSEMBLY

4-29-85

5S 1466-6E

Figure 49 Installing Mixture Control Solenoid Gaging Tool

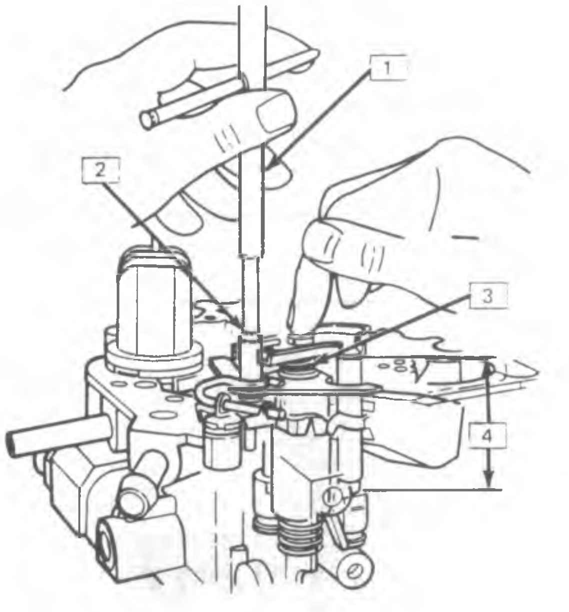
c. Carefully start engagement of solenoid screw threads. Use adjusting tool J28696-10 or BT-7928 or equivalent, to turn screw.

Align solenoid connector wires in slot in bowl and install connector attaching screw and tighten securely.

Adjust

MIXTURE CONTROL SOLENOID

1. Holding the solenoid plunger down against the solenoid stop, use Tool J-28696-10, BT-7928, or equivalent, to turn the adjusting screw (lean stop screw), until the solenoid plunger just contacts the gaging tool. The adjustment is correct when the solenoid plunger is contacting BOTH the solenoid stop and the gaging tool, (Figure 50).



1	TOOL J28696-10/BT7928
2	SOLENOID ADJUSTING SCREW
3	PLUNGER CONTACTING SOLENOID STOP AND GAGING TOOL
4	GAGING TOOL J33815-1/BT8253-A (1.304" HIGH)

4S 0576-6E

Figure 50 Adjusting Solenoid Screw

2a. Note exact position of solenoid adjusting screw tool tee handle and record the number of turns as solenoid adjusting screw is turned clockwise until M/C solenoid bottoms out against float bowl.

2b. Remove:
- Solenoid adjusting (lean mixture) screw
- Rich limit stop
- M/C Solenoid plunger
- Solenoid adjustment screw spring
- Gaging tool

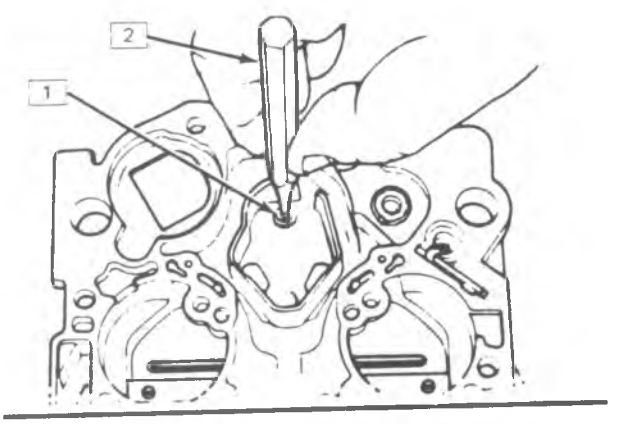
2c. Reinstall:
- Solenoid adjusting screw spring
- M/C Solenoid
- Plastic filler block
- Primary metering rods with springs
- M/C Solenoid plunger
- Rich limit stop
- Solenoid adjusting (lean mixture) screw

3. Turn solenoid adjusting (lean mixture) screw clockwise until M/C solenoid bottoms out against float bowl, then counter clockwise the exact number of turns recorded in step 2a.
4. Remove lean mixture screw plug from air horn. (Figure 51).

Install or Connect

AIR HORN ASSEMBLY TO BOWL

1. Install pump plunger spring and pump plunger.
2. Install TPS plunger by pushing up through seal in air horn.
3. Holding pump plunger down, position new air horn gasket over pump plunger stem and over two locating pins on float bowl.



1	SOLENOID ADJUSTING SCREW PLUG
2	PUNCH

6S 2752-6E

Figure 51 Removing Plug

4. Carefully lower air horn assembly onto float bowl while positioning the TPS Adjustment Lever of the TPS sensor, and guiding pump plunger stem through seal in air horn. To ease installation, insert a thin screw driver between air horn gasket and float bowl to raise the TPS adjustment Lever over the TPS sensor, (Figure 52).

   Be certain that the bleed tubes and accelerating well tubes are positioned properly through the holes in the air horn gasket. DO NOT force the air horn assembly onto the bowl, lower it lightly into place.

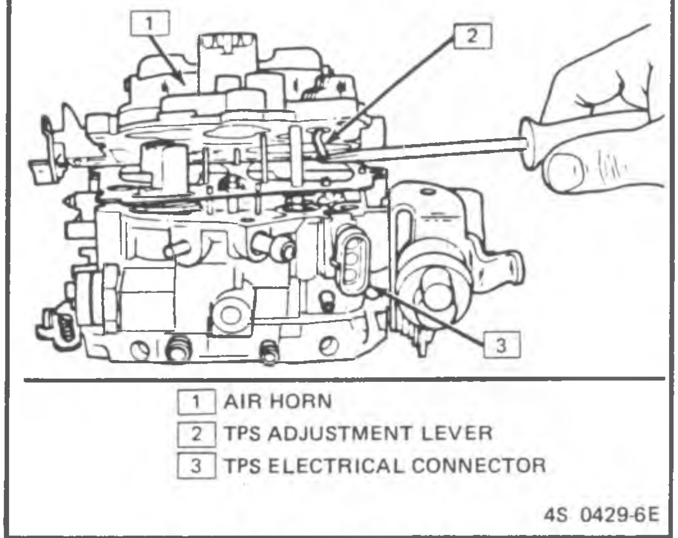


Figure 52 Installing Air Horn

5. All air horn screws and tighten evenly and securely, following tightening sequence shown in Figure 53.

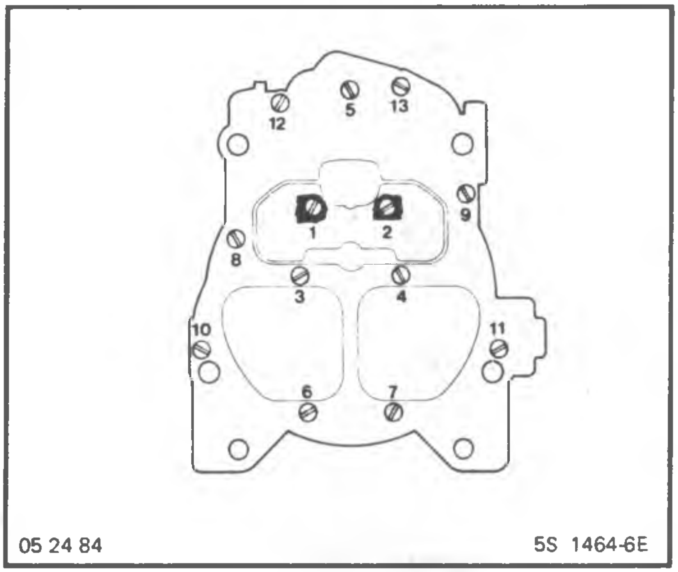


Figure 53 Air Horn Tightening Sequence

6. Pump link to pump lever and install retainer.
7. Secondary metering rods to metering rod holder (upper ends of rods point toward each other). Carefully lower rods into air horn openings and place the holder onto the air valve cam follower. Install retaining screw. Work Air Valves up and down, to make sure they move freely in both directions, with no binds.
8. Choke link into lower choke lever inside bowl cavity. Install choke link into upper choke lever and position lever on end of choke shaft, being sure flats on end of choke shaft align with flats in lever. Install attaching screw and tighten.
9. Front vacuum break hose to tube on front of float bowl.

IDLE AIR BLEED VALVE SETTING

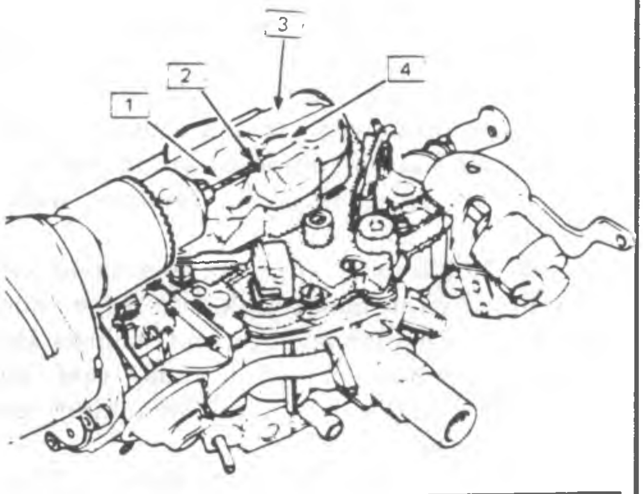
Following Mixture Control Solenoid replacement and/or adjustments, it is necessary to make the Idle Air Bleed Valve setting.

↔ Remove or Disconnect

1. Idle Air Bleed Valve Cover Removal.
   a. Cover internal bowl vents and air inlets to idle air bleed valve with masking tape or equivalent.
   b. Carefully drill out pop rivet heads in valve cover (Figure 54).
   c. Drive out remaining portion of the rivets with a drift punch and small hammer.
   d. Discard the bleed valve cover. Use a small magnet if necessary to remove rivet and chips remaining on air horn surface. Remove masking tape.
   e. Remove the idle air bleed valve assembly by carefully turning counter-clockwise until the valve assembly can be lifted from air horn.

Inspect

2. Idle Air Bleed Valve
   a. Inspect the bleed valve for any damage or contamination that could prevent free and unrestricted movement of valve plunger.
   b. If the two O-rings are damaged, hardened, or swollen they must be replaced.



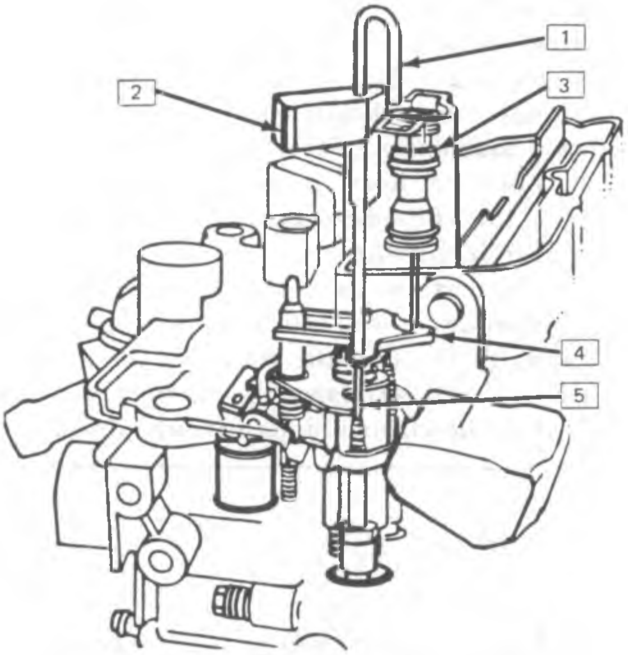
1 DRILL #35 (.110")
2 RIVET
3 MASKING TAPE
4 IDLE AIR BLEED VALVE COVER

6S 2605-6E

Figure 54 Idle Air Bleed Cover Removal

→← Install or Connect

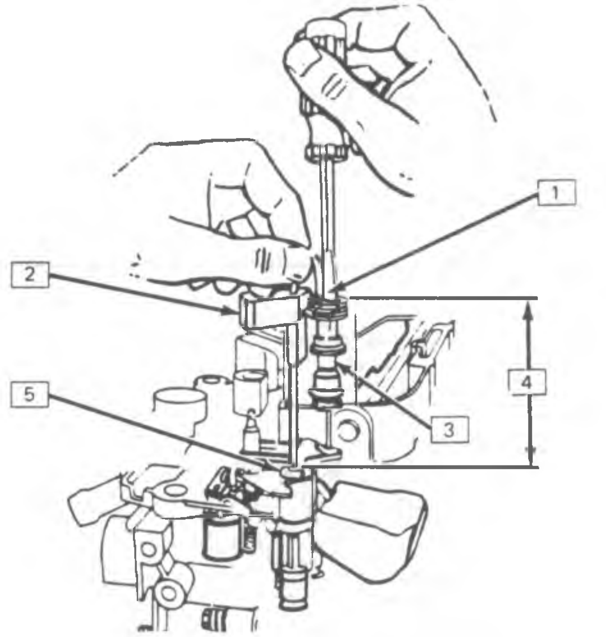
3. Idle Air Bleed Valve.
   a. Cavity in the air horn must be clean and free of any foreign material.
   b. Install new O-rings, if necessary. Lightly coat the two O-rings with automatic transmission fluid, to aid in installation. Install the valve assembly, making sure there is proper thread engagement.
4. Setting the Idle Air Bleed Valve.
   a. Install air bleed valve gaging Tool J-33815-2, BT-8253-B, or equivalent, in throttle side "D" shaped vent hole in the air horn casting. The upper end of the tool should be positioned over the open cavity next to the idle air bleed valve.
   b. While holding the gaging tool down lightly, so that the solenoid plunger is against the solenoid stop, adjust the idle air bleed valve so that the gaging tool will pivot over and just contact the top of the valve. No further adjustment is required, (Figure 56).
   c. Remove gaging tool.



1 GAGING TOOL – J-33815-2/BT8253-B
2 GUIDE
3 IDLE AIR BLEED VALVE
4 SOLENOID PLUNGER
5 METERING ROD

4S 0583-6E

Figure 55 Installing Idle Air Bleed Valve Gaging Tool



1 TOOL CONTACTING VALVE
2 GUIDE
3 IDLE AIR BLEED VALVE
4 GAGING TOOL – J-33815-2/BT8253B (1.756" HIGH)
5 PLUNGER AGAINST STOP

4S 0584-6E

Figure 56 Positioning Idle Air Bleed Valve

5 a. Disconnect and plug canister purge hose at canister.

b. Place a spacer (.75 to .10") between accelerator pump lever and TPS plunger.

c. Start engine and allow it to reach normal operating temperature, (closed loop).

d. If the idle dwell is not within 25° - 35°, the idle needle plugs will have to be removed and the idle needles adjusted.

↔ Remove or Disconnect

6. IDLE MIXTURE NEEDLE PLUG

a. Carburetor from the engine, following normal service procedures, to gain access to the plugs covering the idle mixture needles.

b. Invert carburetor and drain fuel into a suitable container.

c. Place carburetor on a suitable holding fixture, with manifold side up. Use care to avoid damaging linkage, tubes, and parts protruding from air horn.

d. With a hacksaw, make two parallel cuts in the throttle body, one on each side of the locator points beneath the idle mixture needle plug (manifold side), (Figure 57). The cuts should reach down to the steel plug, but should not extend more than 1/8" beyond the locator points. The distance between the saw cuts depends on the size of the punch to be used.

e. Place a flat punch near the ends of the saw marks in the throttle body. Hold the punch at a 45° angle and drive it into the throttle body until the casting breaks away, exposing the steel plug.

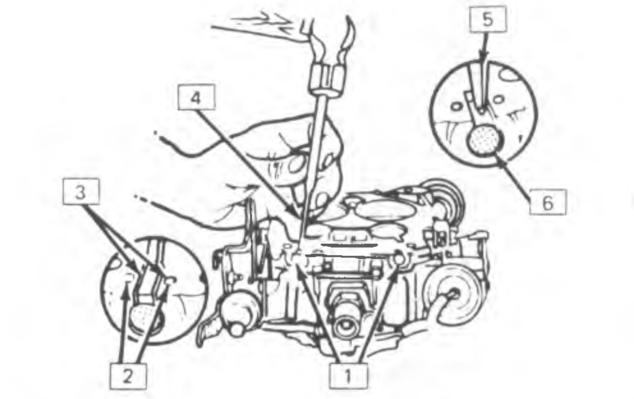


Figure 57 Removing Idle Needle Plugs

f. Use a center punch to break the plug for access to the idle mixture needle. Remove pieces of plug. Repeat this procedure with the other mixture needle.

Adjust

7. IDLE MIXTURE NEEDLES

a. Using tool J-29030, BT-7610-B, or equivalent, remove both idle mixture needles and springs for inspection:

  (1) Needles must not be bent, burred or otherwise damaged.

  (2) Inspect both idle needle openings in the throttle body for any damage or foreign material. Clean as necessary.

b. Install idle mixture needles and springs in the throttle body.

  (1) Using tool J-29030-B, BT-7610-B, or equivalent, turn both mixture needles clockwise until lightly seated.

  (2) Turn each mixture needle counter clockwise 3 turns.

c. Reinstall carburetor on engine using a new flange gasket, but do not install air cleaner at this time.

d. Disconnect vacuum hose to canister purge valve and plug it.

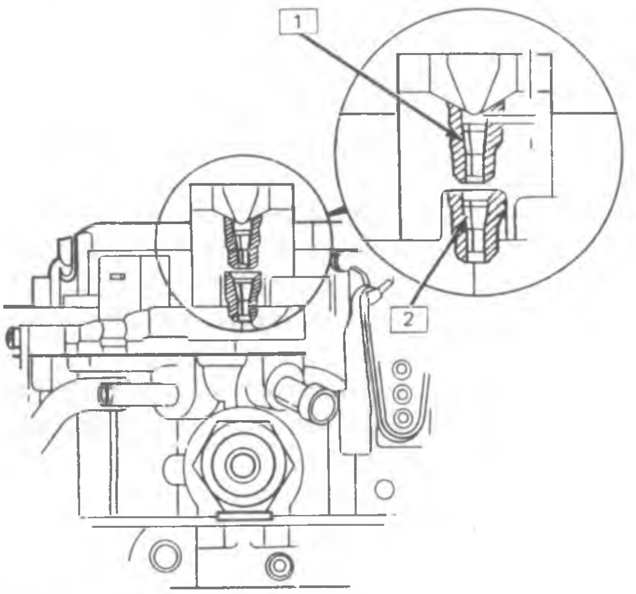
e. Place a spacer (.75 to.10") between accelerator pump lever and TPS plunger. Start engine and allow it to reach normal operating temperature.

8. While idling in Drive (Neutral for manual transmision) adjust both mixture needles equally, in 1/8 turn increments, until dwell reading varies within the 25-35° range, attempting to be as close to 30° as possible. If reading is too low, turn mixture needles counterclockwise. If reading is too high, turn mixture needles clockwise. Allow time for dwell reading to stabilize after each adjustment.

9. After adjustments are complete, seal the idle mixture needle opening in the throttle body, using silicone sealant, RTV rubber, or equivalent. The sealer is required to discourage unnecessary readjustment of the setting, and to prevent fuel vapor loss in that area.

Install

8. Plug on solenoid adjusting screw. (Figure 58)
   a. Install plug, hollow end down, into the access hole to solenoid screw, and use suitably sized punch to drive plug into the air horn until the top of plug is even with the lower edge off chamfer. Plug must be installed to retain the screw setting and to prevent fuel vapor loss.



1 SOLENOID STOP SCREW PLUG–NOT USED ON ALL MODELS (TOP OF PLUG SHOULD BE 1/16" BELOW SURFACE)

2 SOLENOID ADJUSTING SCREW PLUG (TOP OF PLUG SHOULD BE FLUSH WITH BOTTOM OF CHAMFER)

6S 2753-6E

Figure 58 Installing Solenoid Adjusting Screw Plug

Adjust

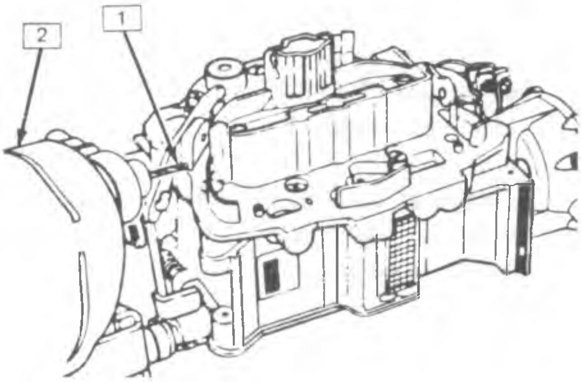
Curb idle speed and fast idle speed as described on the Vehicle Emission Control Information label.

THROTTLE POSITION SENSOR

Before the Throttle Postitin Sensor (TPS) voltage output setting can be accurately checked or adjusted, the idle rpm settings must be set to specifications as shown on the Vehicle Emission Control Information label.

1. TPS Adjustment is required only if voltage readings are not within a range of .31 ± .1 Volts on a 5.0L, 5.7L, or 4.3L (with A/T) engine or .25 ± .1 Volts on a 4.3L engine with M/T.
   a. Connect a 10 meg digital voltmeter such as J-29125-A from TPS connector center terminal "B" to bottom terminal "C", (Jumpers for access can be made using terminals 12014836 and 12014837) or use Scan tool.
   b. Read TPS voltage, under these conditions:
      (1) Ignition ON.
      (2) Engine stopped.
      (3) Disconnect electrical connector from Idle Solenoid, (plunger retracted).
      (4) Throttle lever against idle speed screw.
   c. If adjustment is required, remove TPS plug to allow adjustment.

2. **TPS Plug Removal and Adjustment**
   a. Using a 2mm (5/64") drill, drill a 1/16" to 1/8" deep hole in aluminum plug covering TPS adjustment screw, (Figure 59). Use care in drilling to prevent damage to adjustment screw head.



1 PLUG (THROTTLE POSITION SENSOR ADJUSTMENT SCREW)

2 DRILL

4S 0425-6E

Figure 59 TPS Plug

   b. Start a No. 8, 1/2" long self-tapping screw in drilled hole turning, screw in only enough to ensure good thread engagement in hole.

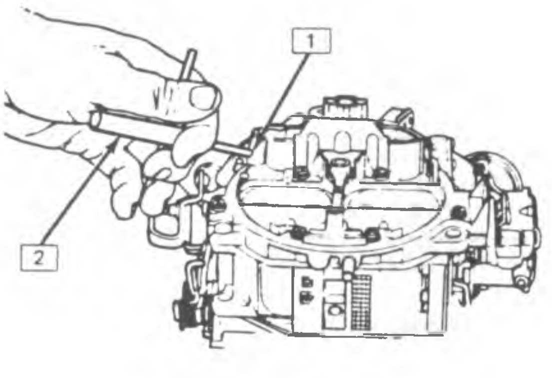
c. Placing a wide-blade screwdriver between screw head and air horn casting, pry against screw head to remove plug. DISCARD PLUG.

d. Using tool J-28696, BT-7967-A, or equivalent, adjust TPS screw to obtain correct voltage, (Figure 60).

e. After adjustment, install new plug (supplied in service kits) in air horn, driving plug in place until flush with raised pump lever boss on casting.

NOTICE: *Plug must be installed to retain the TPS adjustment screw setting. If plug is not available, remove screw and apply GM 1052624 Threadlock or equivalent to screw threads, then repeat adjustment.*

f. Clear trouble code memory after adjustment.



1 TPS ADJUSTMENT SCREW
2 TOOL–J28696/BT7967A

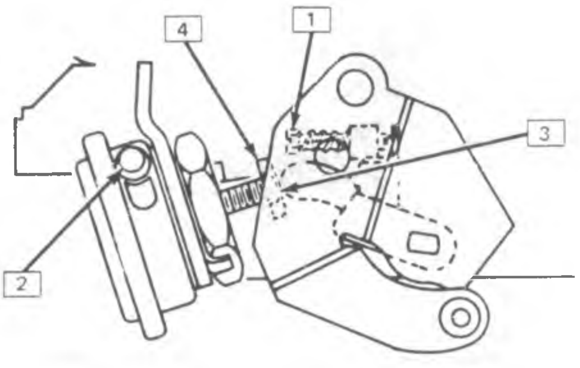
4S 0426-6E

Figure 60 TPS Adjustment Screw

IDLE SPEED CONTROL
Throttle Kicker

Adjust

Refer to Figure 61 and Vehicle Emission Control Information label for adjustment of the throttle kicker.



- ENGINE AT OPERATING TEMPERATURE
- CHOKE WIDE OPEN
- CAM FOLLOWER STEPS OF FAST IDLE CAM

1 ADJUST IDLE SPEED SCREW TO OBTAIN SPECIFIED CURB IDLE R.P.M. (SEE LABEL)
2 APPLY 68 kPa (20") WITH OUTSIDE VACUUM SOURCE TO FULLY EXTEND PLUNGER
3 MANUALLY OPEN THROTTLE SLIGHTLY AND THEN RELEASE AGAINST PLUNGER
4 WITH PLUNGER HELD INWARD, TURN PLUNGER IN OR OUT TO OBTAIN SPECIFIED R.P.M. (SEE LABEL)

4S 1061-6E

Figure 61 Throttle Kicker Adjustment

Remove or Disconnect
Figure 62

1. Vacuum hose.
2. Bracket and throttle kicker.
3. Tab locking washer.
4. Throttle Kicker.

Install or Connect

1. Throttle Kicker.
2. Tab locking washer - do not lock.
3. Bracket and throttle kicker.
4. Adjust throttle kicker.
5. Lock tab washer.
6. Vacuum hose.

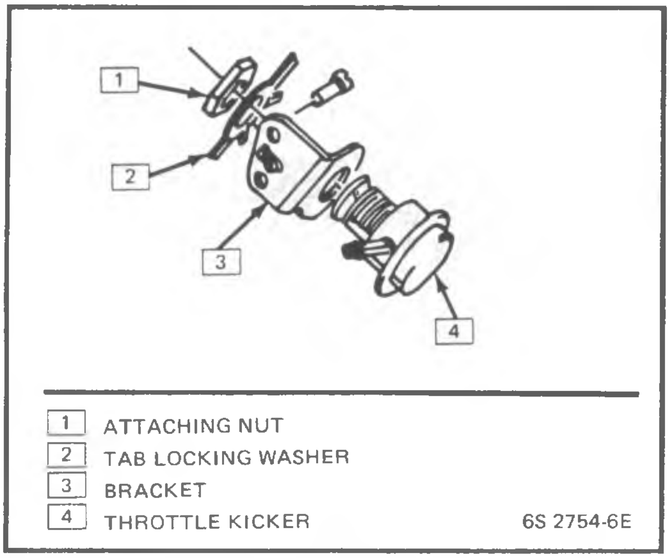


Figure 62 Throttle Kicker

Vacuum Solenoid
Figure 42 or 63

Remove or Disconnect

1. Electrical Connector.
2. Vacuum hoses.
3. Vacuum Solenoid.

Install or Connect

1. Vacuum Solenoid.
2. Vacuum hoses.
3. Electrical Connector.

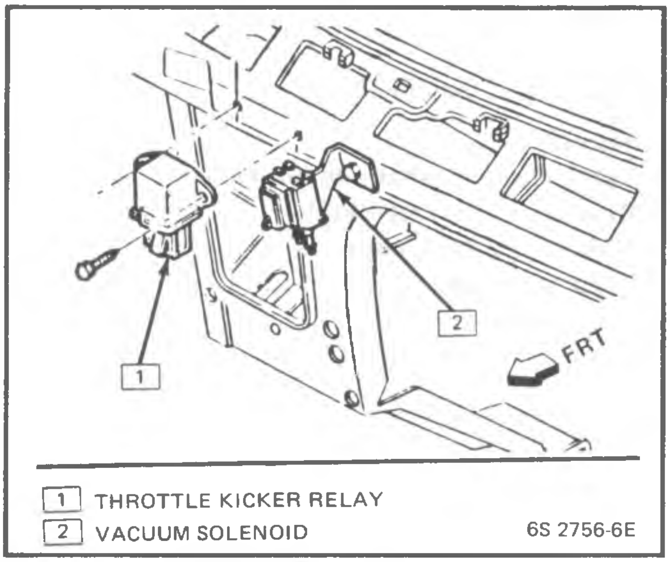


Figure 63 Vacuum Solenoid and Relay - G Series

Throttle Kicker Relay
Figure 63 or 64

Remove or Disconnect

1. Electrical Connector.
2. Throttle Kicker relay.

Install or Connect

1. Throttle Kicker relay.
2. Electrical connector.

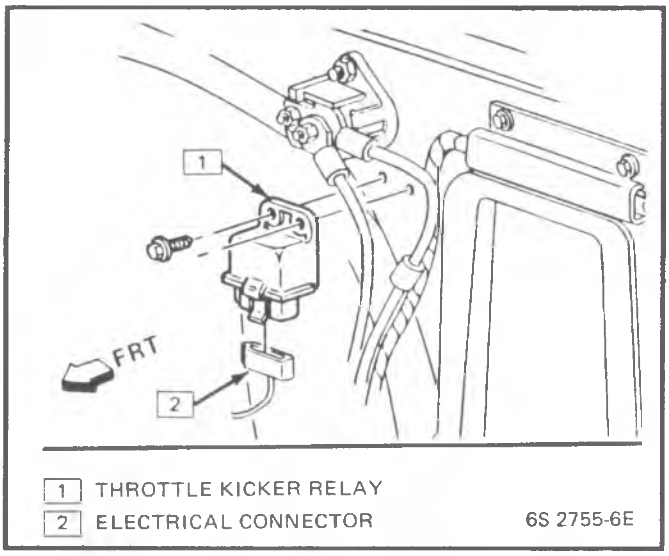


Figure 64 Throttle Kicker Relay - CK Series

Power Steering Switch

Remove or Disconnect

1. Electrical Connector.
2. Power steering switch.

Install or Connect

1. Power steering switch.
2. Electrical connector.

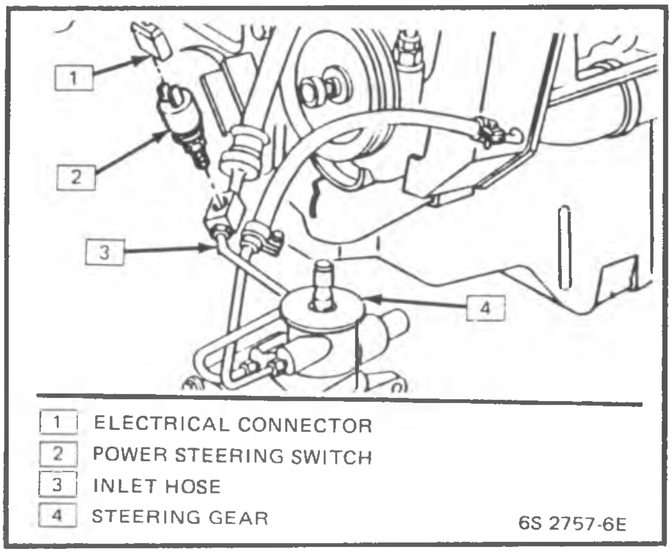


Figure 65 Power Steering Switch

PARTS INFORMATION

PART NAME	GROUP
Carburetor	3.725
Sensor Kit, Throttle Position	3.764
Solenoid Kit, Mixture Control	3.440

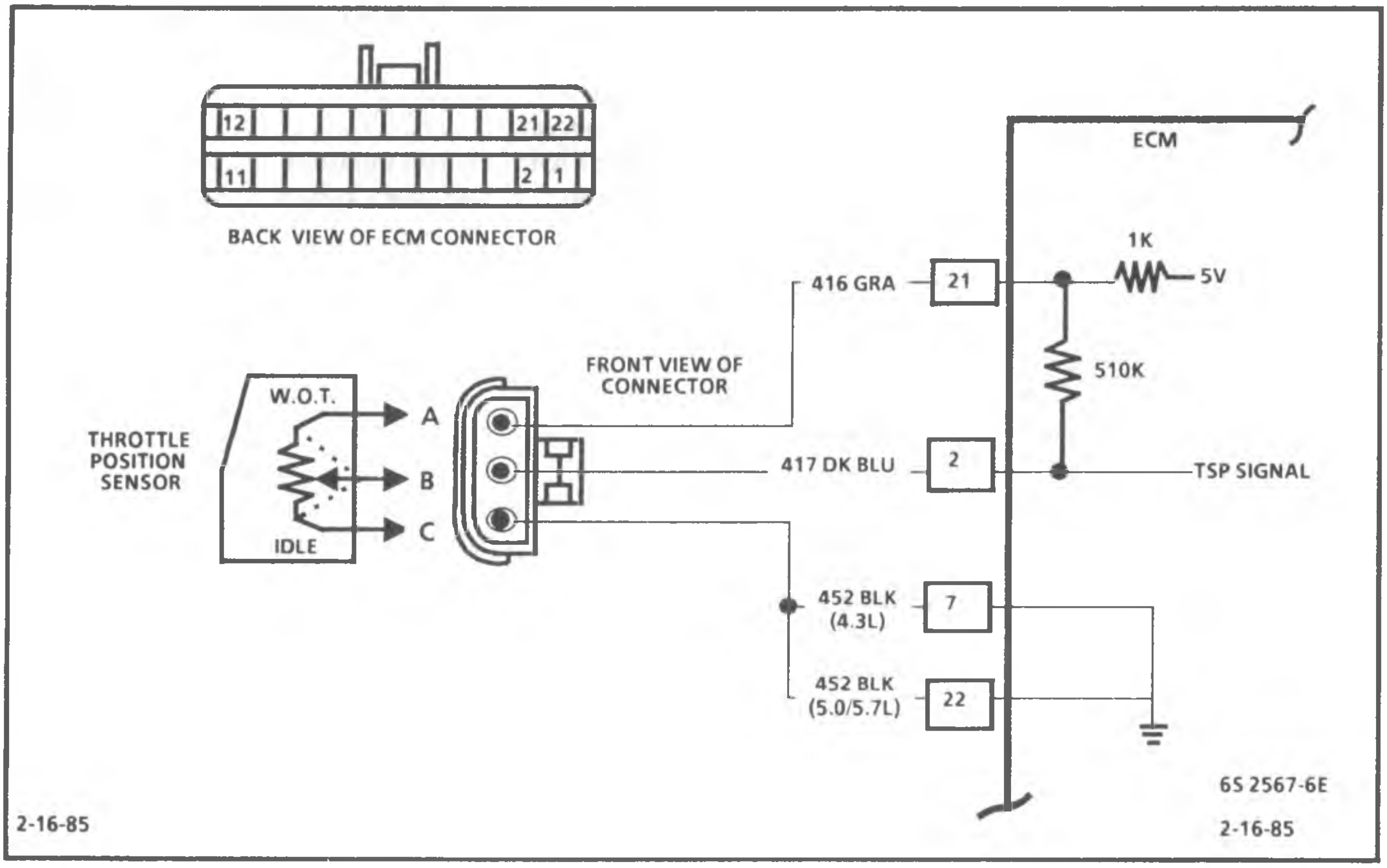


CHART C-2F

TPS ENRICHMENT CHECK

4.3L, 5.0L OR 5.7L ENGINE

CARBURETED - CALIF.

1. This step checks that the TPS will cause an ECM "Rich" command when fully depressed manually. On some vehicles, this will cause a low dwell (full rich). On others it will not.

   Code 21 should normally be set.

2. This step distinguishes between a faulty TPS or ECM harness/ECM.

   Code 21 should normally be set, if engine RPM is not set above specifications.

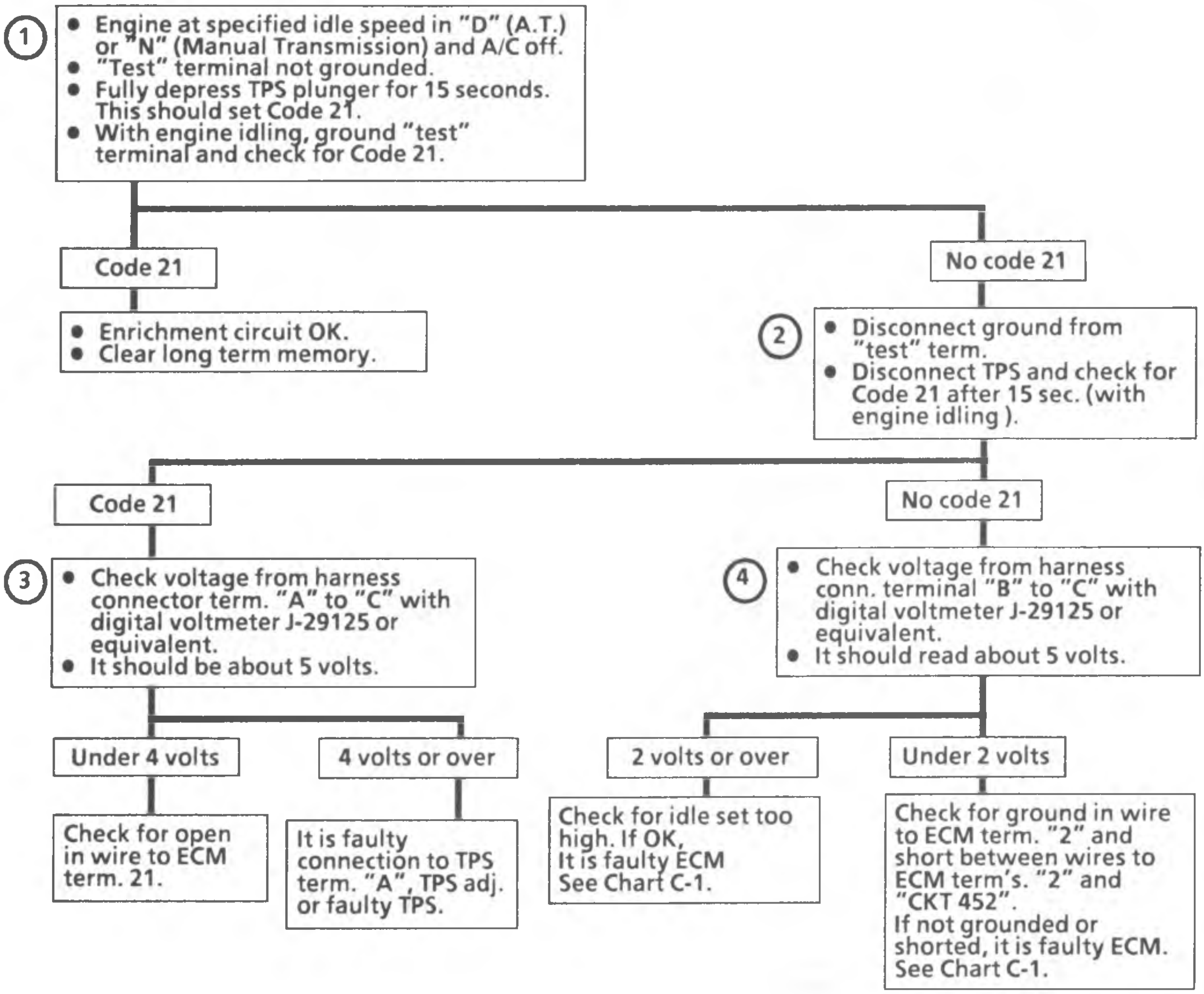
3. This step checks for 5V. ref. at TPS. It should be about 5 volts. If loss of V. Ref. were in the ECM, it should set Codes 21, 32 and 34 since this is the same 5V to VAC Sensor. Therefore, it must be an open in the wire.

4. This step checks for a grounded circuit. Normal circuit should read about 5 volts. Checking for grounded TPS output to Terminal "2" of ECM, or short in CKT 417 and 452 from TPS, indicates whether fault is in wiring or ECM. A voltmeter with a 10 megohms resistance must be used for an accurate reading.

CHART NO. C-2F

TPS ENRICHMENT CHECK

4.3L, 5.0L, OR 5.7L ENGINE
CARBURETED - CALIF.



①
- Engine at specified idle speed in "D" (A.T.) or "N" (Manual Transmission) and A/C off.
- "Test" terminal not grounded.
- Fully depress TPS plunger for 15 seconds. This should set Code 21.
- With engine idling, ground "test" terminal and check for Code 21.

Code 21
- Enrichment circuit OK.
- Clear long term memory.

No code 21

②
- Disconnect ground from "test" term.
- Disconnect TPS and check for Code 21 after 15 sec. (with engine idling).

Code 21

③
- Check voltage from harness connector term. "A" to "C" with digital voltmeter J-29125 or equivalent.
- It should be about 5 volts.

Under 4 volts

Check for open in wire to ECM term. 21.

4 volts or over

It is faulty connection to TPS term. "A", TPS adj. or faulty TPS.

No code 21

④
- Check voltage from harness conn. terminal "B" to "C" with digital voltmeter J-29125 or equivalent.
- It should read about 5 volts.

2 volts or over

Check for idle set too high. If OK, It is faulty ECM See Chart C-1.

Under 2 volts

Check for ground in wire to ECM term. "2" and short between wires to ECM term's. "2" and "CKT 452". If not grounded or shorted, it is faulty ECM. See Chart C-1.

After any repair clear long term memory by removing ECM fuse for 10 seconds

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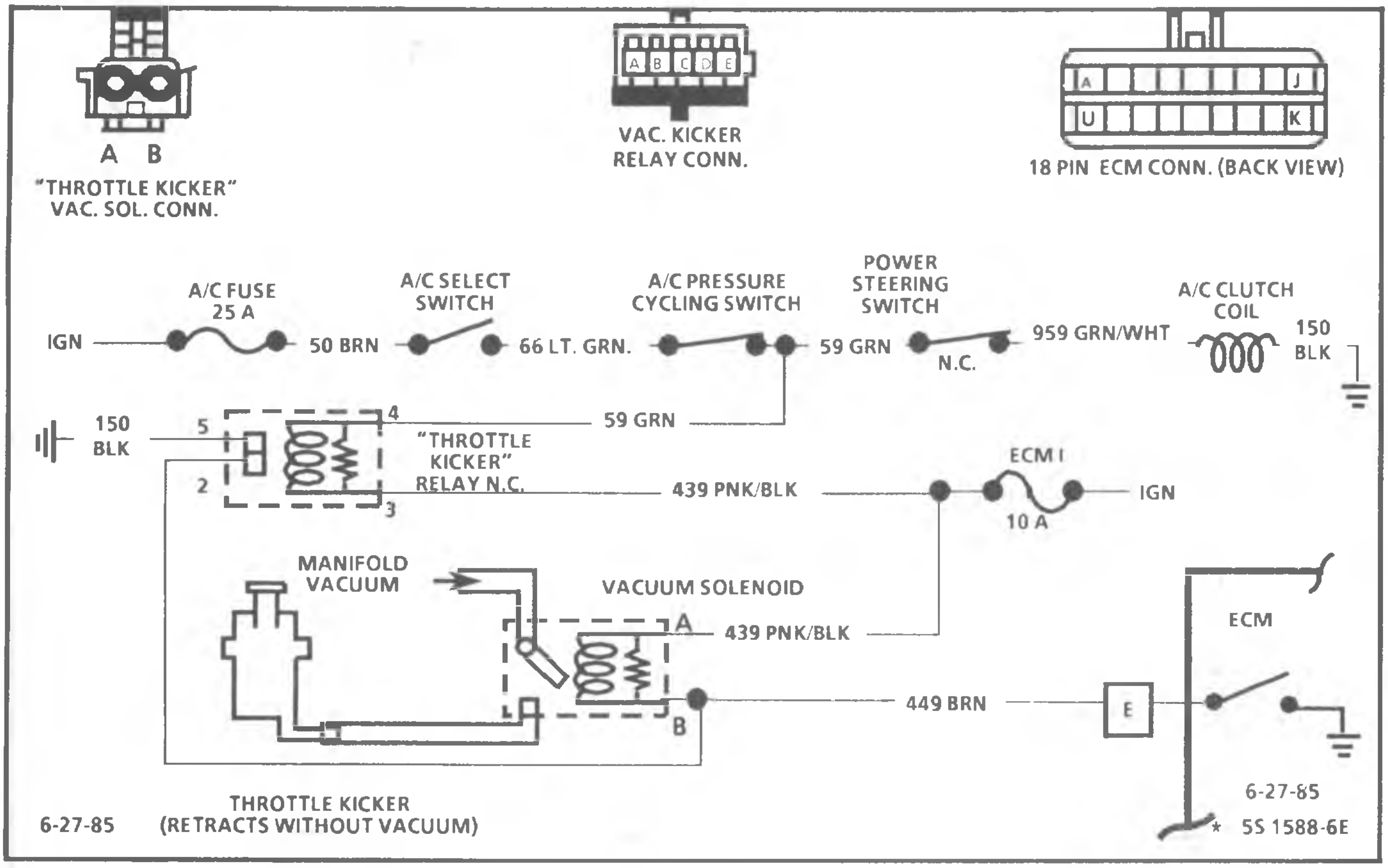


CHART C-2T-1

IDLE SPEED CONTROL CHECK

"THROTTLE KICKER"

4.3L WITH A / C - CALIFORNIA

CARBURETED - CALIF.

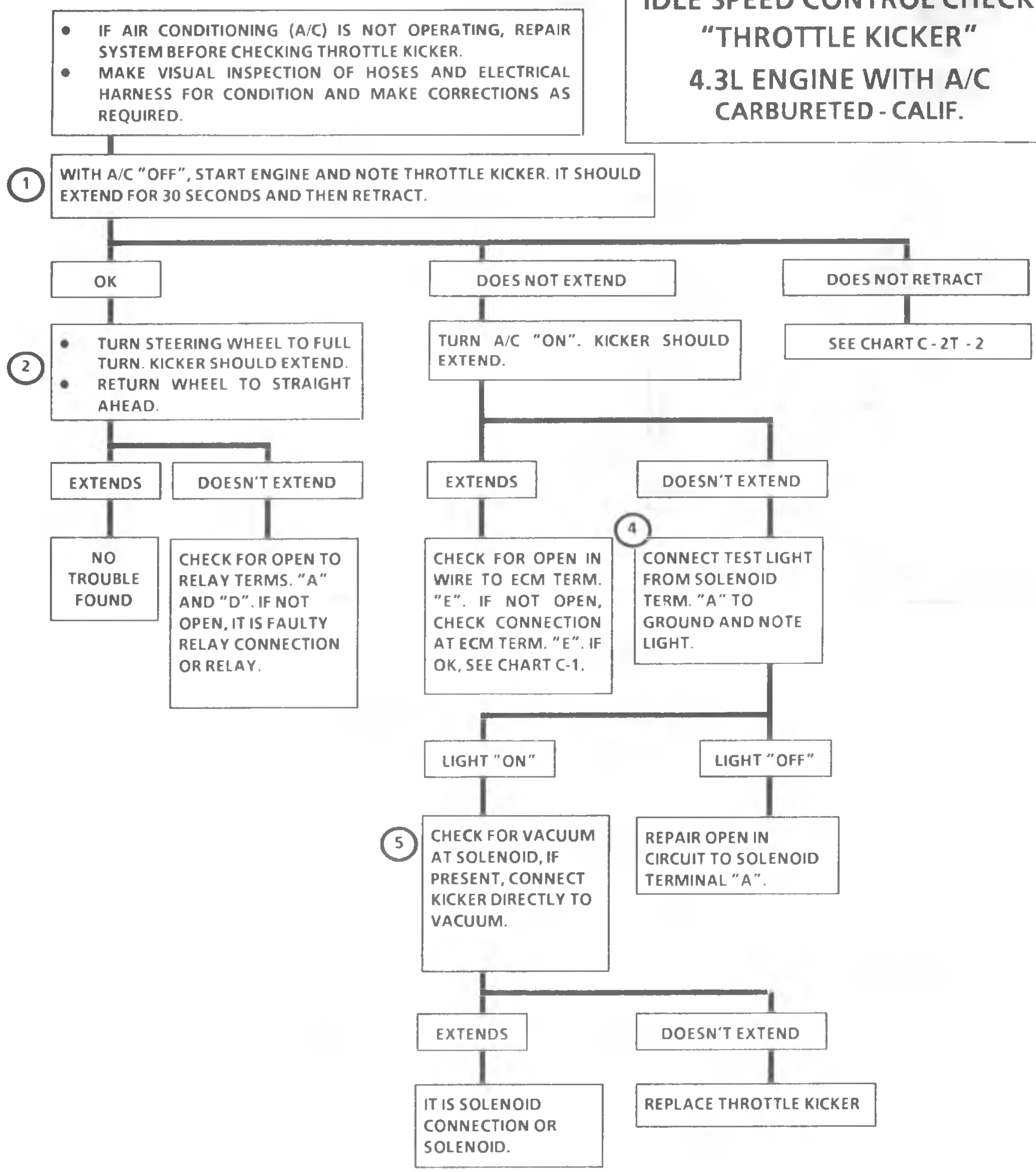
The throttle kicker is manifold vacuum operated and extends under the following conditions:

- Coolant temperature below 85°C (185°F).
- For 30 seconds after starting engine, if coolant temperature is above 85°C (185°F).
- If A/C equipped, A/C "on" and pressure cycling switch closed (clutch "ON").
- If power steering equipped, full steering turn will open switch and solenoid will energize (with A/C "off").

1. Checks ECM control of solenoid and for an open in relay coil circuit.
2. Checks to see that power steering switch opens, and the relay contact circuit is not open.
3. Checks for open relay coil circuit to ECM.
4. Checks for open ignition circuit to solenoid.
5. Checks vacuum source to solenoid, then checks for faulty throttle kicker.

CHART C - 2T - 1

IDLE SPEED CONTROL CHECK
"THROTTLE KICKER"
4.3L ENGINE WITH A/C
CARBURETED - CALIF.



- IF AIR CONDITIONING (A/C) IS NOT OPERATING, REPAIR SYSTEM BEFORE CHECKING THROTTLE KICKER.
- MAKE VISUAL INSPECTION OF HOSES AND ELECTRICAL HARNESS FOR CONDITION AND MAKE CORRECTIONS AS REQUIRED.

① WITH A/C "OFF", START ENGINE AND NOTE THROTTLE KICKER. IT SHOULD EXTEND FOR 30 SECONDS AND THEN RETRACT.

OK

②
- TURN STEERING WHEEL TO FULL TURN. KICKER SHOULD EXTEND.
- RETURN WHEEL TO STRAIGHT AHEAD.

EXTENDS

NO TROUBLE FOUND

DOESN'T EXTEND

CHECK FOR OPEN TO RELAY TERMS. "A" AND "D". IF NOT OPEN, IT IS FAULTY RELAY CONNECTION OR RELAY.

DOES NOT EXTEND

TURN A/C "ON". KICKER SHOULD EXTEND.

EXTENDS

CHECK FOR OPEN IN WIRE TO ECM TERM. "E". IF NOT OPEN, CHECK CONNECTION AT ECM TERM. "E". IF OK, SEE CHART C-1.

DOESN'T EXTEND

④ CONNECT TEST LIGHT FROM SOLENOID TERM. "A" TO GROUND AND NOTE LIGHT.

LIGHT "ON"

⑤ CHECK FOR VACUUM AT SOLENOID, IF PRESENT, CONNECT KICKER DIRECTLY TO VACUUM.

EXTENDS

IT IS SOLENOID CONNECTION OR SOLENOID.

DOESN'T EXTEND

REPLACE THROTTLE KICKER

LIGHT "OFF"

REPAIR OPEN IN CIRCUIT TO SOLENOID TERMINAL "A".

DOES NOT RETRACT

SEE CHART C - 2T - 2

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*5S 1587-6E

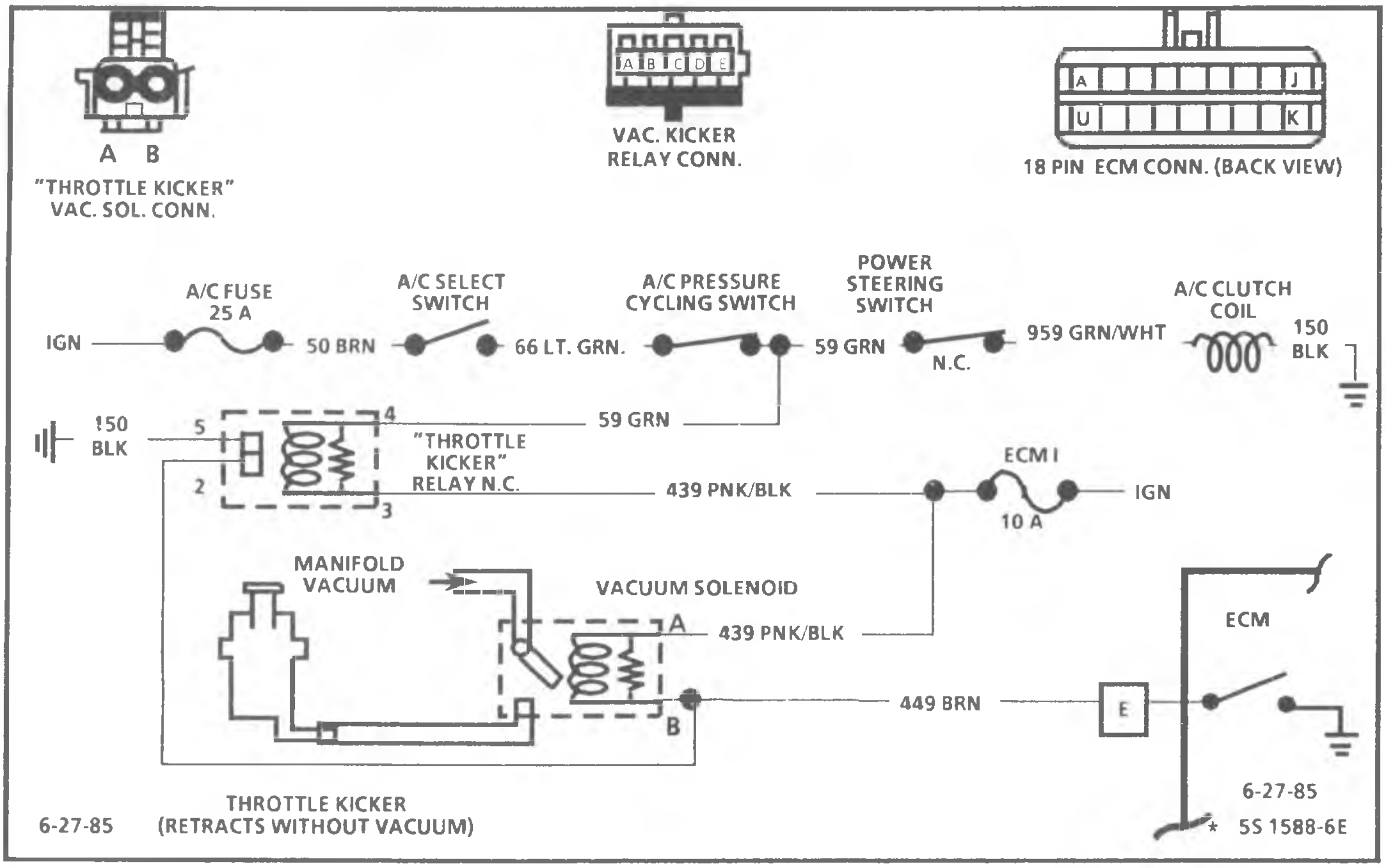


CHART C-2T-2

IDLE SPEED CONTROL CHECK

"THROTTLE KICKER"

4.3L WITH A / C

CARBURETED - CALIF.

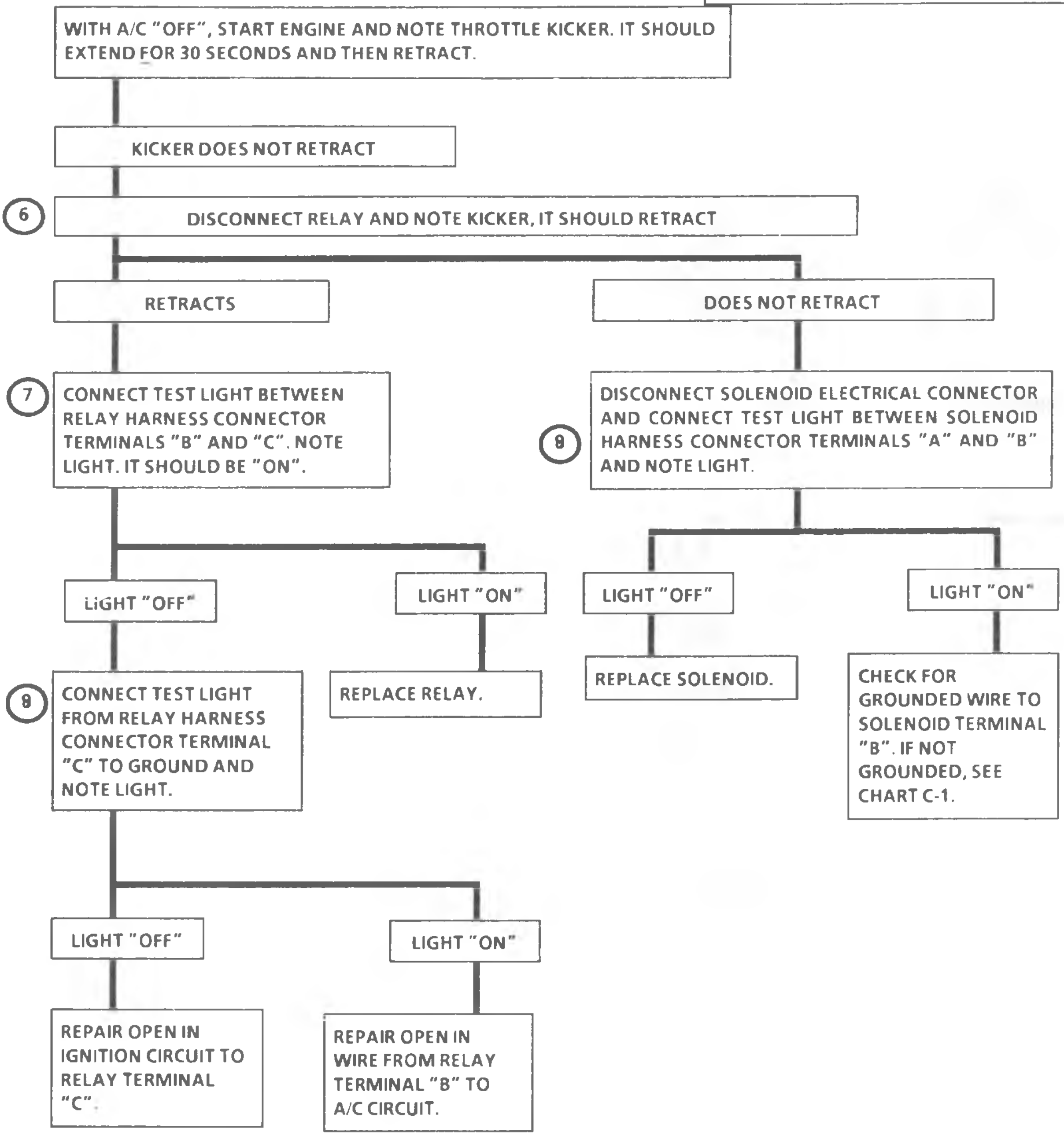
The diagnosis is continued from Chart C-2T-1

6. If throttle kicker retracts, relay or circuit is cause of the problem.
7. "Light off" indicates an open relay coil circuit.
8. Checks for ignition voltage to relay.
9. Checks for grounded wire from solenoid terminal "B" to relay terminal "D" or ECM terminal "E".

CHART C - 2T - 2

IDLE SPEED CONTROL CHECK
"THROTTLE KICKER"
4.3L ENGINE WITH A/C
CARBURETED - CALIF.

CONTINUED FROM CHART C-2T-1



WITH A/C "OFF", START ENGINE AND NOTE THROTTLE KICKER. IT SHOULD EXTEND FOR 30 SECONDS AND THEN RETRACT.

KICKER DOES NOT RETRACT

⑥ DISCONNECT RELAY AND NOTE KICKER, IT SHOULD RETRACT

RETRACTS

⑦ CONNECT TEST LIGHT BETWEEN RELAY HARNESS CONNECTOR TERMINALS "B" AND "C". NOTE LIGHT. IT SHOULD BE "ON".

LIGHT "OFF"

⑧ CONNECT TEST LIGHT FROM RELAY HARNESS CONNECTOR TERMINAL "C" TO GROUND AND NOTE LIGHT.

LIGHT "OFF"

REPAIR OPEN IN IGNITION CIRCUIT TO RELAY TERMINAL "C".

LIGHT "ON"

REPAIR OPEN IN WIRE FROM RELAY TERMINAL "B" TO A/C CIRCUIT.

LIGHT "ON"

REPLACE RELAY.

DOES NOT RETRACT

⑨ DISCONNECT SOLENOID ELECTRICAL CONNECTOR AND CONNECT TEST LIGHT BETWEEN SOLENOID HARNESS CONNECTOR TERMINALS "A" AND "B" AND NOTE LIGHT.

LIGHT "OFF"

REPLACE SOLENOID.

LIGHT "ON"

CHECK FOR GROUNDED WIRE TO SOLENOID TERMINAL "B". IF NOT GROUNDED, SEE CHART C-1.

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*5S 1585-6E

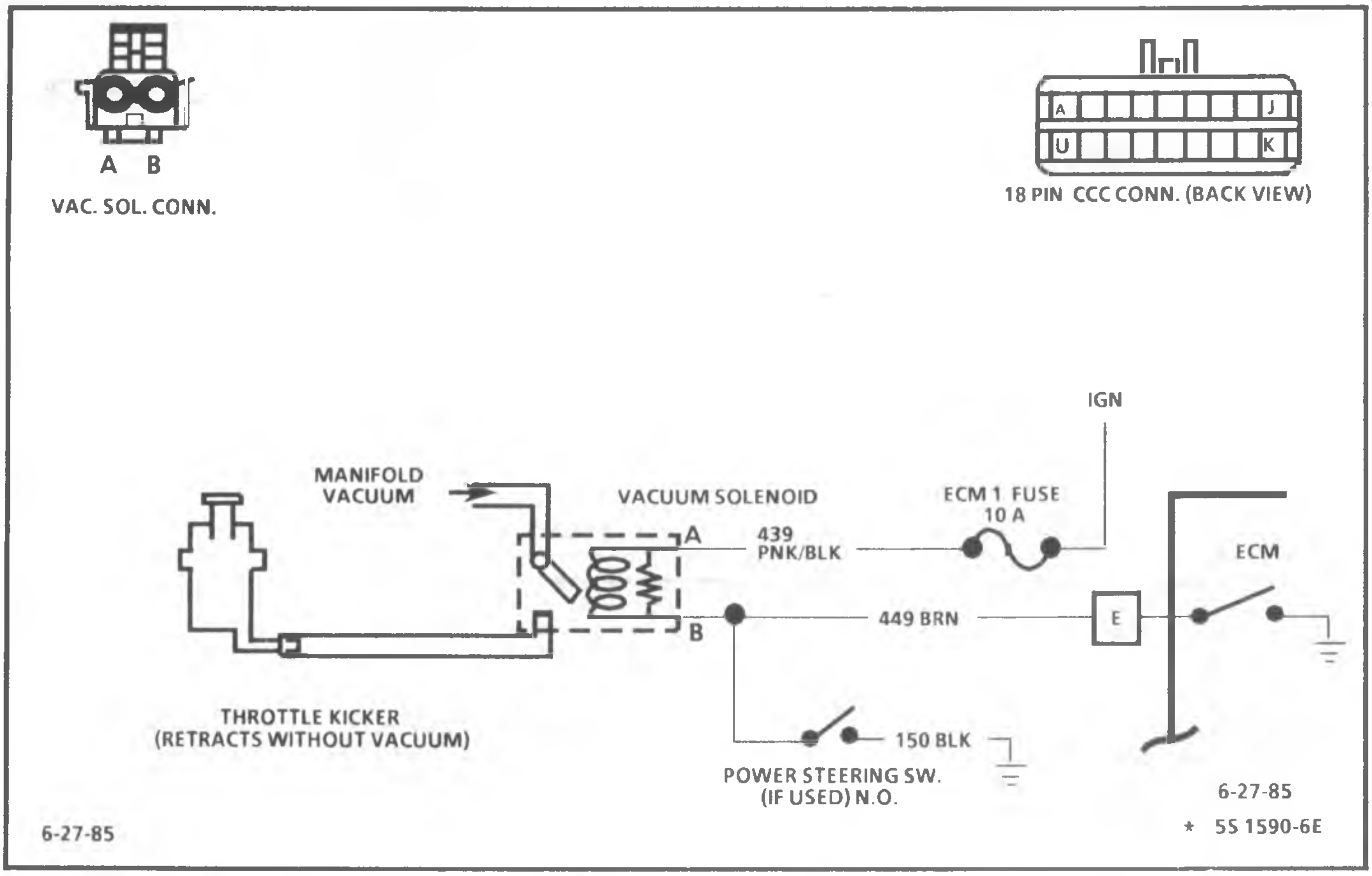


CHART C-2W

IDLE SPEED CONTROL CHECK "THROTTLE KICKER"

4.3L WITHOUT A / C

CARBURETED - CALIF.

The throttle lever actuator is manifold vacuum operated and extends under the following conditions:

- Coolant temperature below 85°C (185°F).
- For 30 seconds after starting engine, if coolant temperature is above 85°C (185°F).
- If power steering equipped, full steering turn will close switch and energize the solenoid.

1. This checks the ECM operation of the throttle kicker and determines if there is an open or grounded circuit.

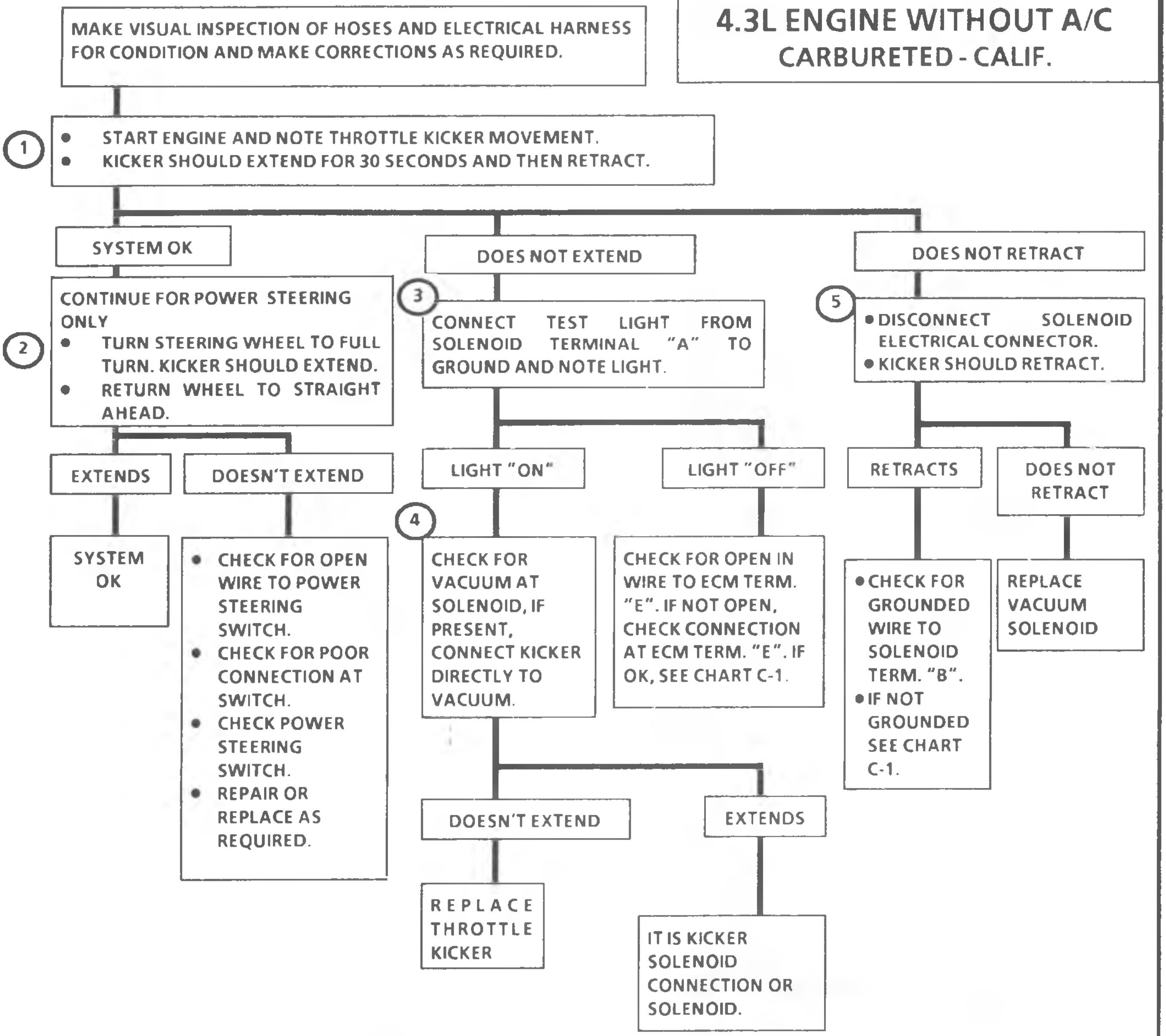
2. This checks the power steering switch circuit to determine if the switch is working properly or if this is an open circuit. Since the engine is loaded down by an extreme turn, the solenoid is energized to increase idle to compensate the load.

3. Checks for an open ignition circuit to the solenoid.

4. Checks for manifold vacuum to the throttle kicker or faulty kicker as reason for an inoperative kicker.

5. Checks solenoid and ground circuit to the solenoid.

CHART C - 2W
IDLE SPEED CONTROL CHECK "THROTTLE KICKER" 4.3L ENGINE WITHOUT A/C CARBURETED - CALIF.



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*5S 1586-6E

EVAPORATIVE EMISSION CONTROL SYSTEM (EECS)

ALL ENGINES

GENERAL DESCRIPTION

PURPOSE

The Evaporative Emission Control System (EECS) (Figure 66 and 67) limits fuel vapor into the atmosphere. The system traps fuel vapor from the fuel tank and carburetor float bowl into a fuel vapor canister. The fuel tank has a non-vented fuel cap and a single vent pipe to the canister. The canister absorbs and stores the fuel vapor in a carbon element until it can be removed and burned during the normal combustion process. When the engine is running, a thermostatic vacuum switch or a solenoid valve determines when the fuel vapor is purged into the intake air flow.

EVAPORATIVE EMISSION SYSTEM WITHOUT AN ECM

(Figures 66 or 67)

This system uses the following control valves:

- Purge control valve mounted on the canister.
- Vapor vent valve mounted on the canister.
- A thermal bowl vent valve (some applications).
- A thermostatic vacuum switch (TVS) installed in the intake manifold to sense engine coolant temperature.

When the engine is shut off, manifold vacuum is lost at the vapor vent valve. The spring loaded valve in the vapor vent valve now connects the carburetor bowl vent to the canister. Carburetor float chamber vapors now pass into the canister for storage. When the engine is restarted, manifold vacuum draws the vapor vent controlling valve against spring pressure, closing off the bowl vent. Ported vacuum from the carburetor is connected to the TVS. When the TVS opens, ported vacuum opens the purge control valve. When the valve opens, manifold vacuum draws vapors from the canister into the intake manifold.

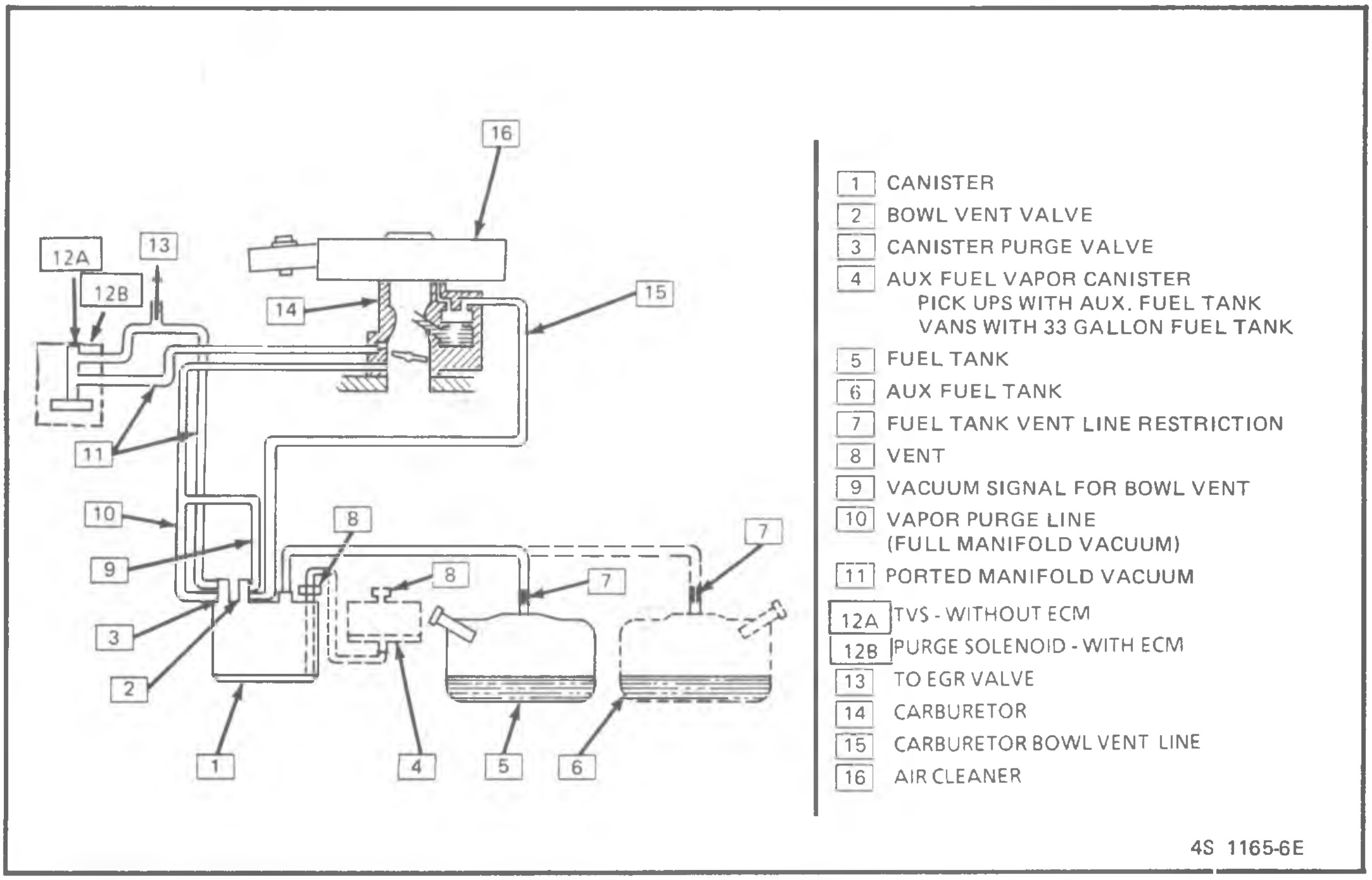

Figure 66 Evaporative Emission System - V6 and L6

The thermal bowl vent valve (TBVV) is located in the section of hose that connects the carburetor bowl vent fitting to the canister control valve.

The TBVV will close and prevent vapor movement at 32°C (90°F) and below. The TBVV will open at 49°C (120°F) to permit vapor flow to the canister control valve.

EVAPORATIVE EMISSION SYSTEM WITH AN ECM (Figure 66 or 67)

The controlling valves in this system are:

- Purge control valve mounted on the canister.
- Vapor vent valve mounted on the canister.
- Canister purge solenoid valve controlled by the ECM.

When the engine is shut off, full manifold vacuum is lost at the vapor vent valve. The spring loaded valve in the vapor vent valve now connects the carburetor bowl vent to the canister. Carbureter float chamber vapors now pass into the canister for storage. When the engine is restarted, full manifold vacuum draws the valve against spring pressure, closing off the bowl vent.

Ported manifold vacuum from the carburetor is connected to the canister purge solenoid valve. When the purge solenoid valve is de-energized by the ECM, vacuum will be applied to the canister purge valve, causing the valve to open and vapors from the canister to purge through the carburetor purge port.

The ECM will de-energize the purge solenoid valve and allow canister purge to occur when the following conditions have been met:

Engine has been running for a period of time after starting.

- System is in closed loop.
- Engine RPM above idle speed.
- System not in ALCL mode.
- Engine at normal operating-temperature.

FUEL VAPOR CANISTER, PRIMARY (Figure 68)

The basic large size, two chamber closed bottom canister is used on all systems and operates as follows:

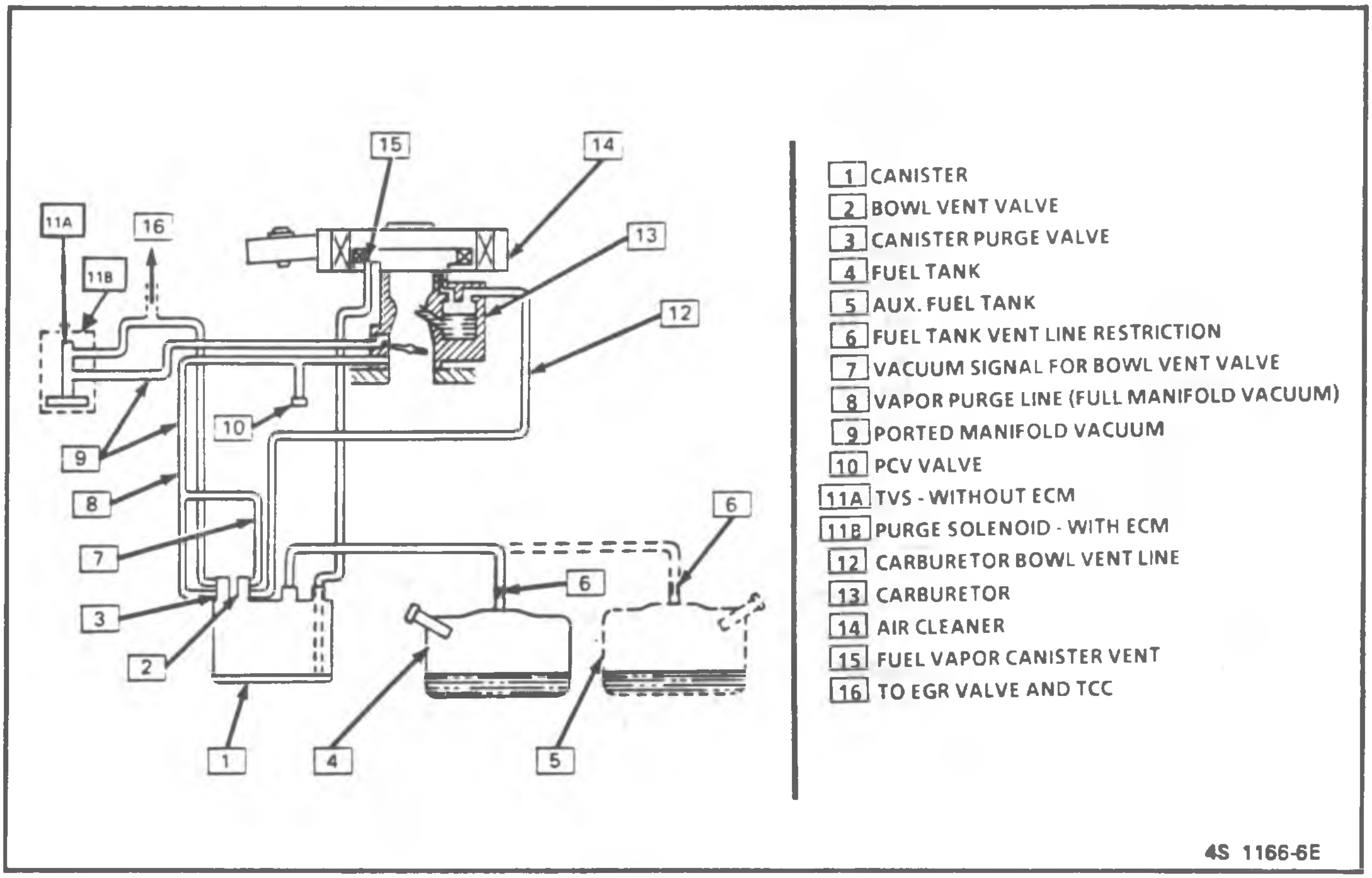

Figure 67 Evaporative Emission System

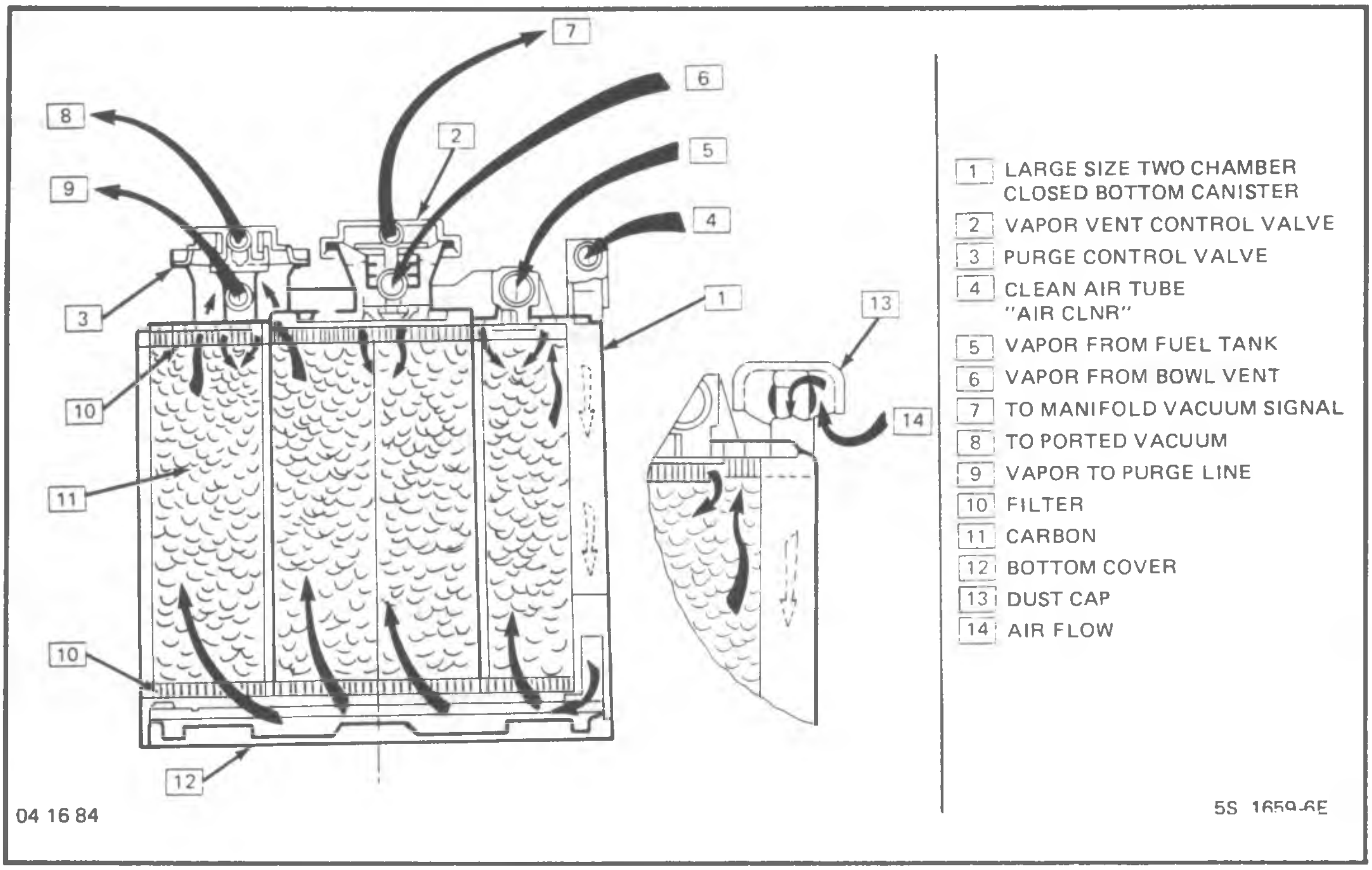

Figure 68 Fuel Vapor Canister

Gasoline vapors from the fuel tank flow into the tube labeled "Fuel Tank", and vapors from the carburetor float bowl flow into the tube labeled "CARB BOWL",and are absorbed by the carbon. The canister is purged when the engine is running above idle speed. The closed bottom design keeps water from entering the bottom of the canister, freezing, and restricting purge air flow. During purge, air is drawn from the clean side of the air cleaner, to the tube on the canister labeled "AIR CLNR", through the carbon and into the intake manifold to be burned. Some closed bottom canisters draw purge air directly from the atmosphere.

CANISTER PURGE CONTROL VALVE (Figure 68)

The Canister Purge Control Valve is a spring-biased diaphragm valve, normally closed, which allows or prevents purging of the canister. When the engine is off or idling, the spring holds the valve closed, preventing canister purge. When the engine is off- idle, however, timed manifold vacuum pulls the diaphragm upward, opening the valve and allowing the canister to be purged.

VAPOR VENT CONTROL VALVE (FIGURE 68)

The vapor vent control valve prevents venting of the carburetor float bowl during engine operation. A spring-biased diaphragm valve, normally open, allows (or prevents) fuel vapors from the float bowl to enter the canister. When the engine is off, spring tension holds the valve open, allowing normal venting.

When the engine is turned on, however, manifold vacuum pulls the diaphragm up to close the valve.

FUEL VAPOR CANISTER, AUXILIARY (Figure 69)

An Auxiliary Fuel Vapor Canister is added to a primary closed bottom canister to increase capacity when a dual (aux.) fuel tank is used. On the bottom is a hose which connects to the primary canister's purge air inlet. On top is a purge air inlet. Vapor overflowing from the primary canister is stored in the auxiliary canister. During purge, vapor flows through the auxiliary canister, the primary canister and into the intake manifold for burning during combustion.

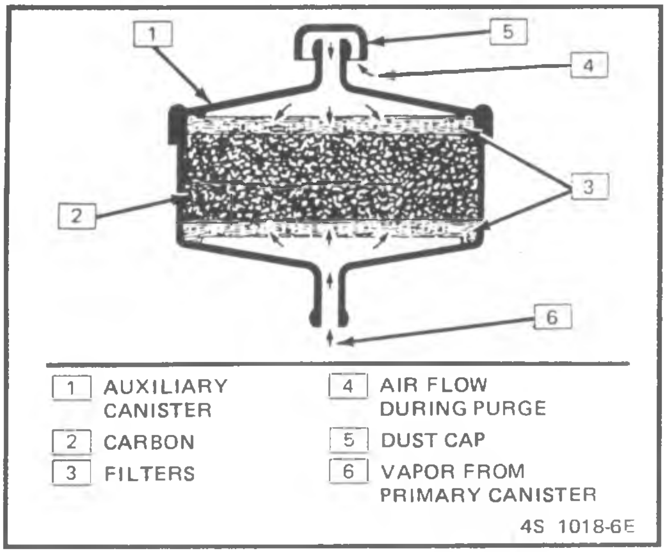

Figure 69 Auxiliary Vapor Canister

DIAGNOSIS

SYSTEM DIAGNOSIS

- Poor idle, stalling and poor driveability can be caused by:
  - Inoperative vapor vent valve
  - Inoperative purge control valve
  - Damaged canister
  - Hoses split, cracked and, or, not connected to the proper tubes.
- Evidence of fuel loss or fuel vapor odor can be caused by:
  - Liquid fuel leaking from fuel lines, fuel pump or carburetor
  - Cracked or damaged canister
  - Inoperative bowl vapor vent valve
  - Inoperative purge control valve
  - Disconnected, misrouted, kinked, deteriorated or damaged vapor hoses, or control hoses
  - Bowl vent hose misrouted
  - Air cleaner or air cleaner gasket inproperly seated

FUEL VAPOR CANISTER

Visually check canister and replace if cracked, damaged or saturated with fuel. Apply a short length of hose to the carburetor bowl vapor tube of the canister (lower tube), and blow into it,to determine that air will pass the vapor vent valve into the canister. If not possible to blow into the canister, it must be replaced.

VAPOR VENT CONTROL VALVE

Functional Test

Apply a short length of hose to the carburetor bowl vapor tube of the canister (lower tube), and blow into it to determine that air will pass the vapor vent valve into the canister. If not possible to blow into the canister, it must be replaced.

With a hand vacuum pump, apply vacuum 51kPa (15" Hg) to the vacuum signal tube on the diaphragm assembly cover. The diaphragm should hold vacuum for at least 20 seconds. If it does not, diaphragm is leaking, and the canister must be replaced.

With vacuum still applied to the vacuum signal tube, again attempt to blow intothe carburetor bowl vapor tube of the canister. Now air should not pass the vapor vent valve into the canister, indicating that the valve is sealing properly.If air does enter the canister past the vapor vent valve, the valve is not functioning properly, and the canister must be replaced.

PURGE CONTROL VALVE

Functional Test

Apply a short length of hose to the PCV tube of purge valve assembly (lower tube), and attempt to blow through it. Little or no air should pass into the canister. (A small amount of air will pass if the canister has a constant purge hole.)

With a hand vacuum pump, apply vacuum 51kPa (15" Hg) through the control vacuum signal tube to the purge valve diaphragm. If the diaphragm does not hold vacuumfor at least 20 seconds, the diaphragm is leaking, and the canister must be replaced.

If the diaphragm holds vacuum, again try to blow through the hose connected to the PCV tube while vacuum is still being applied. An increased flow of air should be observed. If not, the canister must be replaced.

THERMOSTATIC VACUUM SWITCH (TVS) REPLACEMENT

Thermal vacuum switches opens, closes, or switches vacuum source when the calibration temperature is reached. The following general checking procedures can be used for all thermal vacuum switches. Refer to number stamped on base of valve or switch for calibration temperature.

1. Allow TVS to cool below calibration temperature.

2. Inspect switch to make sure it is in good condition.
3. Connect hand vacuum pump(s) to output port(s) of the TVS. (See vacuum hose schematic on Vehicle Control Emission Information label.)
4. Apply 51 kPa (15" Hg) vacuum.
5. Heat TVS to a temperature above the calibration temperature. Never apply a torch or open flame directly to the TVS.
6. Compare vacuum gage reading to the correct reading indicated on switch or valve base.

   NOTICE: *Leakage of up to 7 kPa (2" HG) vacuum in 2 minutes is allowable and does not mean a defective part.*

7. If operation is satisfactory, reinstall valve or switch. If valve or switch is defective, replace with a new part.

SOLENOID VALVE

If the solenoid valve is open, or is not receiving power, the canister can purge to the intake manifold at all times. This can allow extra fuel at idle or during warm-up, which can cause rough or unstable idle, or too rich operation during warm-up.

SOLENOID VALVE CHECK

The solenoid valve check is covered in Chart C-3 at the end of this system section.

ON-VEHICLE SERVICE

SYSTEM HOSES

Refer to Vehicle Emission Control Information label for routing of system hoses.

When replacing hoses, use hose identified with the word "Fluoroelastromer".

VAPOR PIPE

The vapor pipe is secured to the underbody with clamp and screw assemblies. Flexible hoses are connected at the fuel tank and the fuel vapor canister. The pipe should be inspected occasionally for leaks, kinks or dents and repaired as required.

Repair

Repair vapor pipe in sections using brazed seamless steel tubing meeting GM Specification 123M or its equivalent or hose identified with the word "Fluoroelastomer". Hose not so marked could cause early failure or failure to meet emission standard.

- Do not use copper or aluminum tubing to replace steel tubing. Those materials do not have satisfactory durability to withstand normal vehicle vibrations.
- Do not use rubber hose within 4" (100 mm) of any part of the exhaust system or within 10" (254 mm) of the catalytic converter. Hose inside diameter must match steel tubing outside diameter.

1. In repairable areas, cut a piece of fuel hose 4" (100 mm) longer than portion of the line removed. If more than a 6 inch (152 mm) length of pipe is removed, use a combination of steel tubing and hose so that hose lengths will not be more than 10 inches (254 mm). Follow the same routing as the original pipe.
2. Cut ends of pipe remaining on vehicle 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.
3. Use screw type hose clamp, Part Number 2494772, or equivalent. Slide clamps onto pipe and push hose 2" (51 mm) onto each portion of fuel pipe. Tighten clamps on each side of repair.
4. Pipes must be properly secured to the frame to prevent chafing.

FUEL CAP

If a fuel tank filler cap requires replacement, use only a cap with the same features. Failure to use the correct cap can result in a malfunction of the system.

CANISTER

Replacement

1. Disconnect hoses from canister. Mark hoses for installation on new canister. Also refer to the Vehicle Emission Control Information label.
2. Remove screw from bracket and remove canister.
3. Install canister and bracket screw.
4. Connect hoses to canister.

AUXILIARY VAPOR CANISTER

Replacement

1. Disconnect hose from canister.
2. Remove screw from bracket and remove canister.
3. Install canister and connect hose.

SOLENOID VALVE ECM CONTROLLED

1. Disconnect electrical connector.
2. Disconnect vacuum hoses.
3. Remove solenoid valve.
4. Install replacement valve.
5. Connect vacuum hoses and electrical connector.

THERMOSTATIC VACUUM SWITCH NOT ECM CONTROLLED

1. Drain coolant below level of switch.
2. Disconnect vacuum hoses.
3. Remove switch.
4. Apply a soft setting sealant to the threads of thermostatic vacuum switch. Sealant should not be on the end of the switch.
5. Install switch, tighten to 14 N-m (120 in. lbs.) and then turn clockwise as required to align with hoses.
6. Connect hoses.
7. Add coolant as required.

PARTS INFORMATION

PART NAME	GROUP
Canister, Fuel Vapor	3.130
Solenoid, Fuel Vapor Canister	3.140

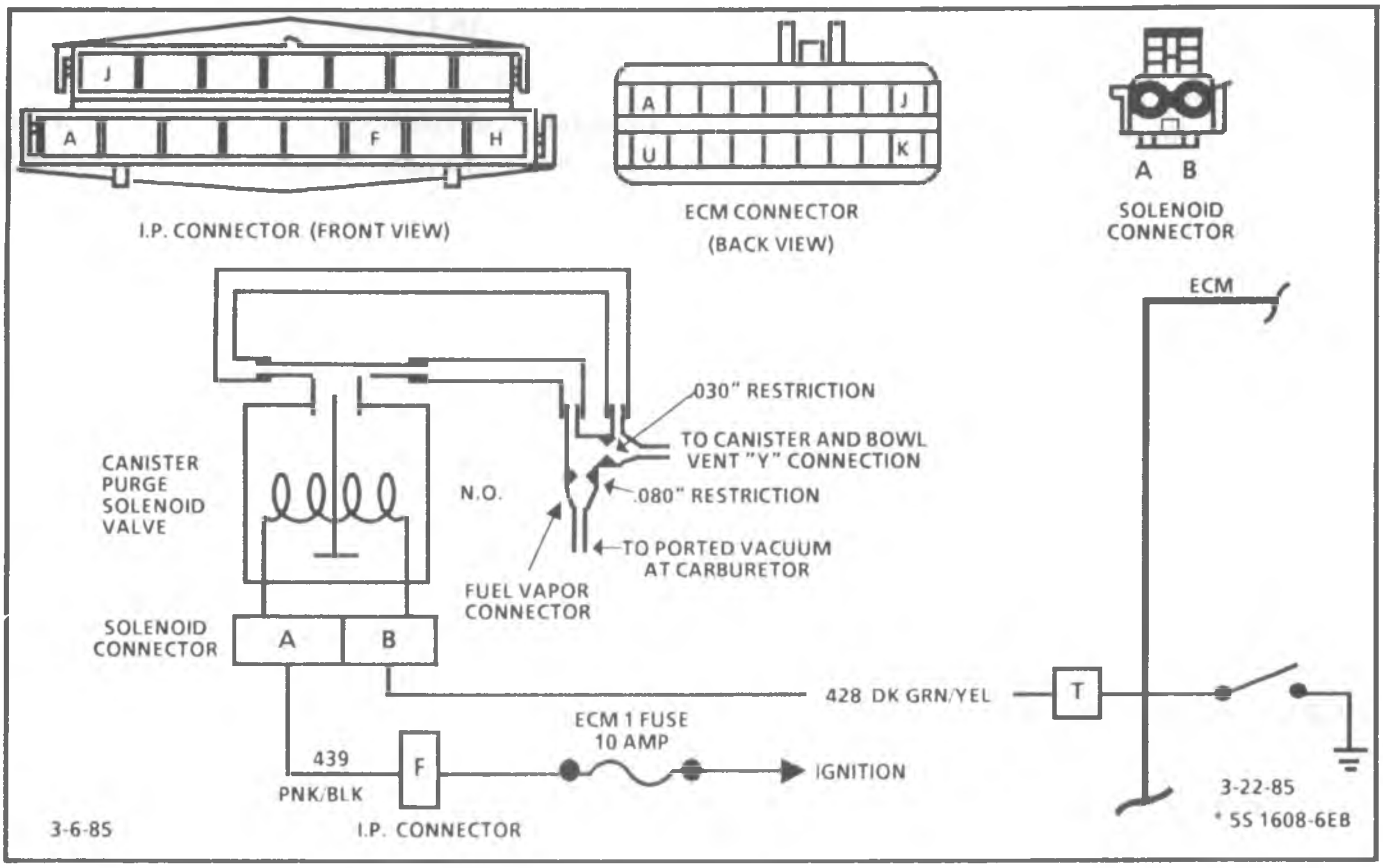

CHART C-3

SOLENOID VALVE CHECK
4.3L, 5.0L, or 5.7L ENGINE
CARBURETED - CALIFORNIA

Canister purge is controlled by a solenoid valve that allows manifold vacuum to purge the canister when de-energized. The ECM supplies a ground to energize the solenoid (purge off). The solenoid is energized (no purge) by grounding the test terminal with the ingition "ON" and engine stopped, or with the engine running if the following are met:

- Engine run time less than specified.
- Coolant temperature below a given value.
- TPS below a given value.

If the above are not met, the solenoid valve is not energized.

1. Checks to see if solenoid is energized and will not allow vacuum to pass.
2. Checks to see if signal to energize solenoid (Light "ON") is present at the solenoid. Light "ON" is normal and would indicate no fault in ECM or circuit to solenoid.
3. Checks to see if solenoid passes vacuum when "test" terminal is ungrounded (solenoid de-energized). It should open and keep the pump from building up a vacuum.

CHART C-3
SOLENOID VALVE CHECK
4.3L, 5.0L, or 5.7L ENGINE
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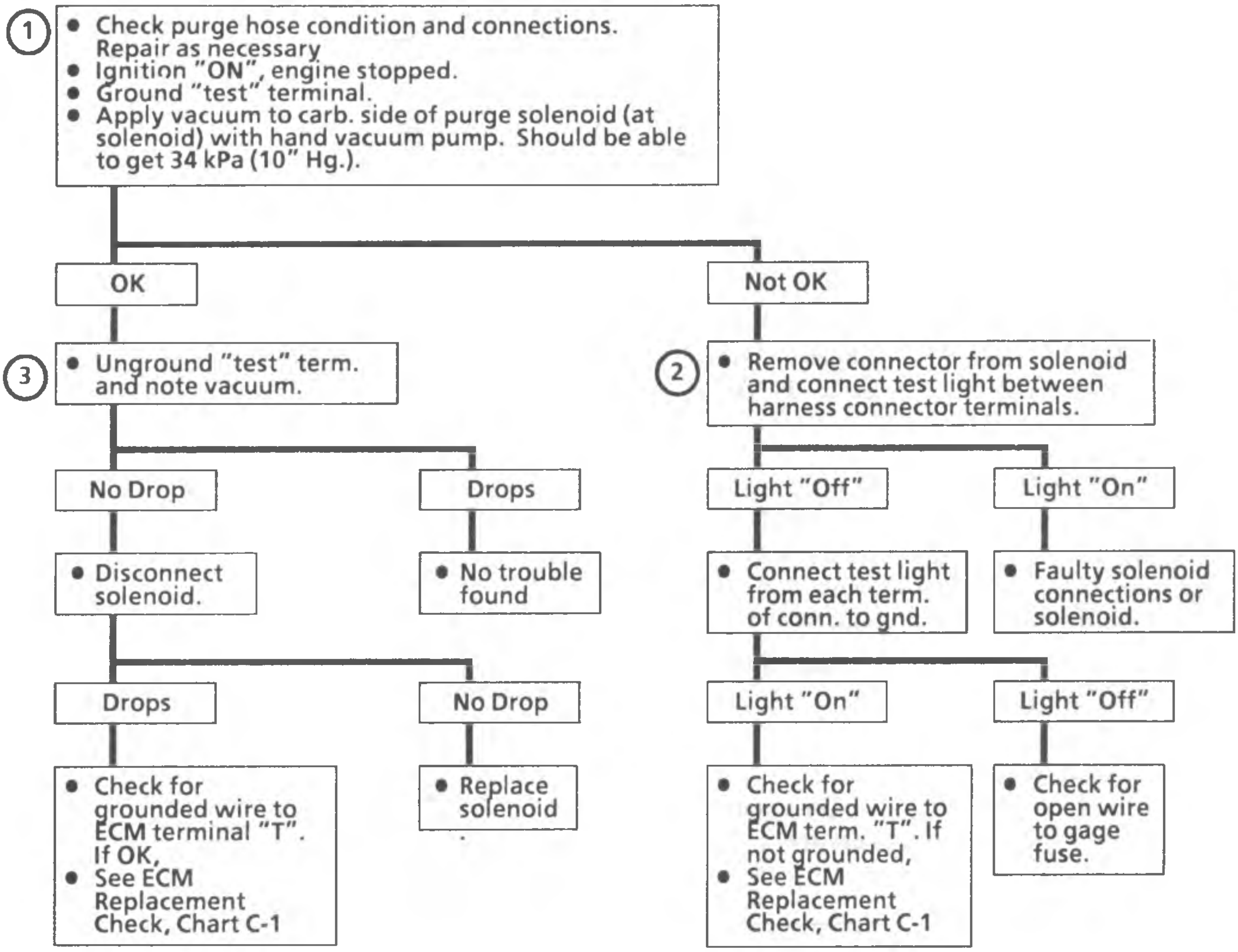

①
- Check purge hose condition and connections. Repair as necessary
- Ignition "ON", engine stopped.
- Ground "test" terminal.
- Apply vacuum to carb. side of purge solenoid (at solenoid) with hand vacuum pump. Should be able to get 34 kPa (10" Hg.).

OK

③
- Unground "test" term. and note vacuum.

No Drop

- Disconnect solenoid.

Drops

- Check for grounded wire to ECM terminal "T". If OK,
- See ECM Replacement Check, Chart C-1

No Drop

- Replace solenoid

Drops

- No trouble found

Not OK

②
- Remove connector from solenoid and connect test light between harness connector terminals.

Light "Off"

- Connect test light from each term. of conn. to gnd.

Light "On"

- Check for grounded wire to ECM term. "T". If not grounded,
- See ECM Replacement Check, Chart C-1

Light "Off"

- Check for open wire to gage fuse.

Light "On"

- Faulty solenoid connections or solenoid.

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ELECTRONIC SPARK TIMING (EST) SYSTEM

4.3L, 5.0L, or 5.7L ENGINE

CALIFORNIA ONLY

GENERAL DESCRIPTION

PURPOSE

The High Energy Ignition (HEI) system controls fuel combustion by providing a spark to ignite the compressed air/fuel mixture at the correct time. To provide improved engine performance, fuel economy, and control of exhaust emissions, the ECM controls distributor spark advance (timing) with the Electronic Spark Timing (EST) system.

Only the Electronic Spark Timing (EST) system will be described here. Additional information on the HEI system is found in Section 6D.

GENERAL DESCRIPTION

The high energy ignition (HEI) system (described in Section 6D) with EST has a distributor HEI module (Figures 70 & 71) with four terminals for the EST system.

To properly control ignition/combustion timing the ECM needs to know:

- crankshaft position
- engine speed (rpm)
- engine load (manifold pressure or vacuum)
- atmospheric (barometric) pressure
- engine coolant temperature

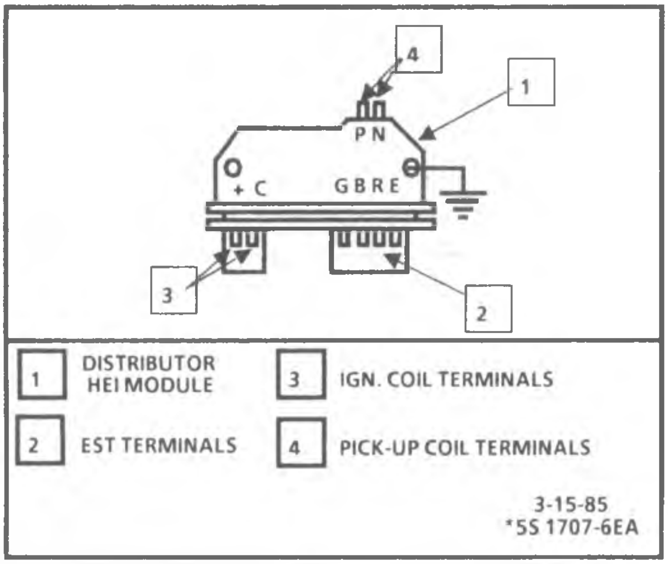


Figure 70 Distributor HEI Module (4.3L)

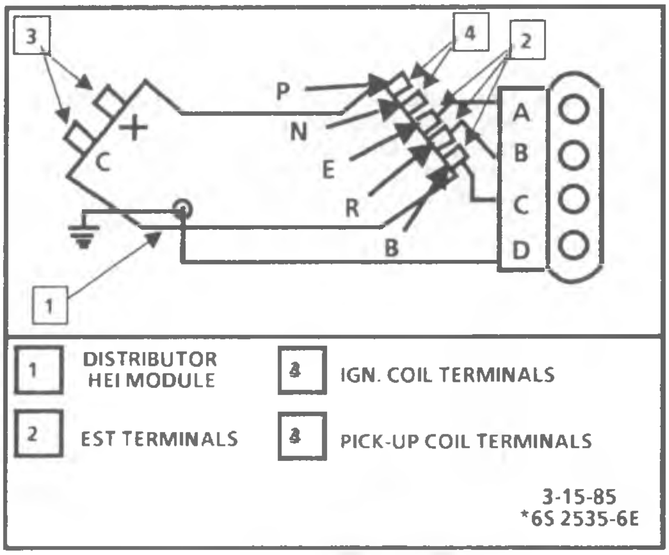


Figure 71 Distributor HEI Module (5.0/5.7L)

The EST system consists of a distributor HEI module, an ECM, and connecting wires. The connector four terminals for EST are lettered as shown in Figures 70 & 71.

These circuits perform the following functions:

- TERMINAL A - EST
  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.
- TERMINAL B - DISTRIBUTOR REFERENCE HI
  This provides the ECM with RPM and crankshaft position information.
- TERMINAL C - BY-PASS
  At about 400 RPM, the ECM applies 5 volts to this circuit to switch spark timing control from the HEI module to the ECM. An open or grounded bypass circuit will set a Code 42 and the engine will run at base timing, plus a small amount of advance built into the HEI module.
- TERMINAL D - REFERENCE GROUND LO
  This wire is grounded in the distributor and makes sure the ground circuit has no voltage drop which could affect performance. If it is open, it may cause poor performance.

DIAGNOSIS

HEI SYSTEM

The description and operation of the HEI system can be found in Section 6D.

Refer to Chart C-4A for Ignition System Check with EST.

Refer to Chart C-4E for Ignition System Check without EST.

EST SYSTEM

Code 12 is used during the Diagnostic Circuit Check in Section A 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.

EST PERFORMANCE CHECK

Refer to EST Performance Check, Chart C-4E

Results of Incorrect EST Operation

Detonation could be caused by high vac. sensor output, or high resistance in the coolant sensor circuit.

Poor performance could be caused by low VAC sensor output or low resistance in the coolant sensor circuit.

CODE 42

A fault in the EST system will usually set a Code 42 as diagnosed in Section A. Always perform a Diagnostic Circuit Check before diagnosing Code 42.

When the system is running on the distributor 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 module so the EST voltage should be varying.

If the by-pass line is open, the 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 module will switch to EST but because the line is grounded there will be no EST signal and the engine will not run. A Code 42 may or may not be set.

An open in the EST circuit will set a Code 42 and cause the engine to run on the distributor HEI module timing. This will cause poor performance and poor fuel economy. A ground may set a Code 42, but the engine will not run.

The ECM uses information from the VAC sensor and coolant sensors in addition to RPM to calculate spark advance as follows.

Cold Engine = more spark advance
High Vacuum Sensor Output Voltage = more spark advance
Low Vacuum Sensor Output Voltage = less spark advance
Hot Engine = less spark advance

ON-VEHICLE SERVICE

Refer to Section 6D for On-Vehicle service of the HEI distributor, pick-up coil, distributor cap, ignition coil, rotor, or distributor HEI module, EST System.

Refer to Section 6D for replacement of the distributor HEI module.

Refer to Section 6E for repair of the EST wires or connectors.

Refer to Section C for replacement of the ECM.

SETTING TIMING

Set timing according to instructions on Vehicle Emission Control Information label.

PARTS INFORMATION

PART NAME	GROUP
Distributor	2.361
Module, Distr	2.383
Coil, Distr	2.170

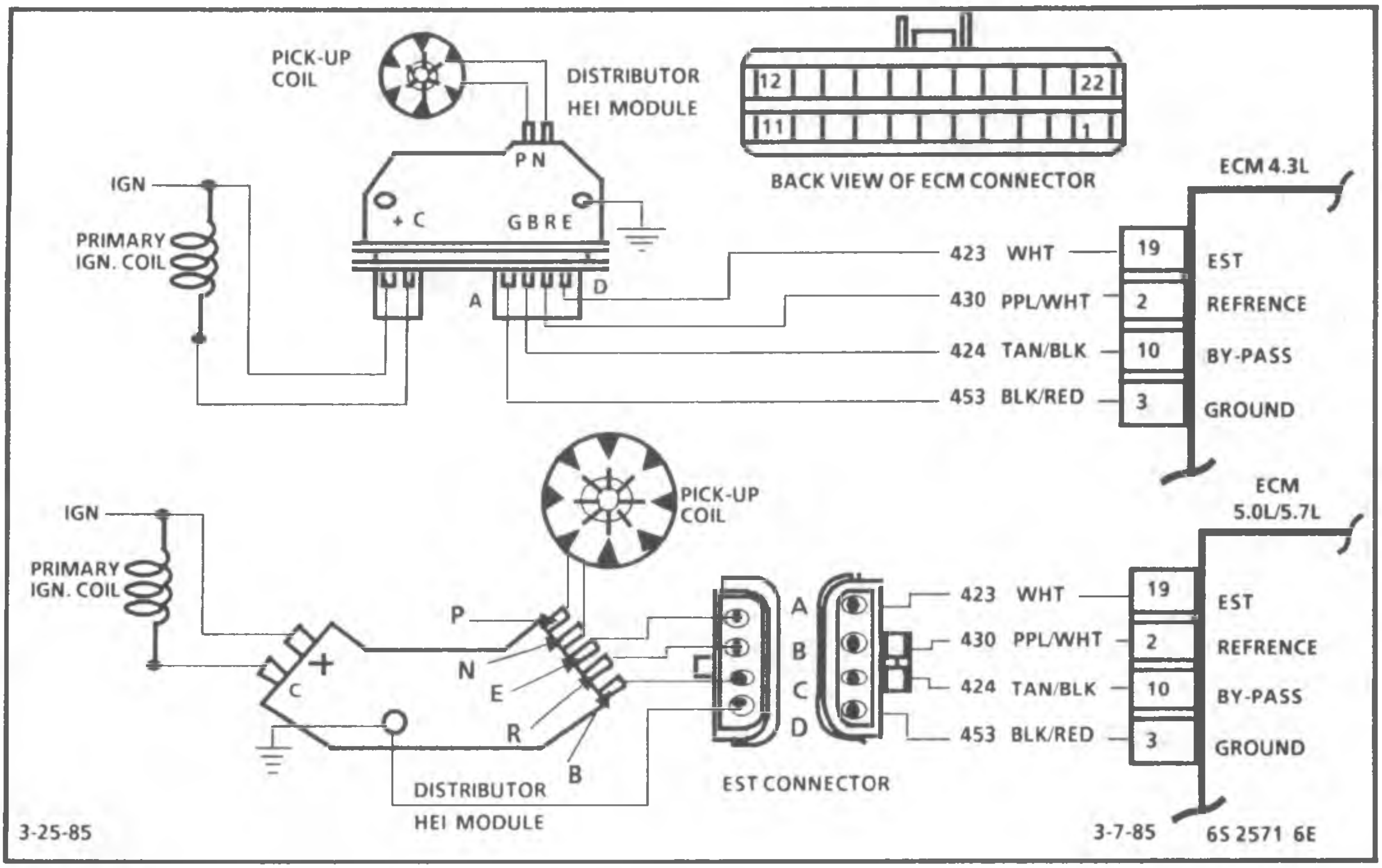


CHART C-4A
IGNITION SYSTEM CHECK
4.3L, 5.0L OR 5.7L ENGINE WITH EST
CARBURETED - CALIF.

1. Checks for proper output from the ignition system. The J26792 (ST-125) spark tester requires a minimum of 25,000 volts to fire. This check can be used in case of an ignition miss because the system may provide enough voltage to run the engine but not enough to fire a spark plug under heavy load.

1A. If the engine will start with the connector disconnected, it indicates the problem is related to the EST circuit. The problem would usually be a grounded EST line or no ground to the ECM.

2. Normal reading during cranking is about 8-10 volts.

3. Checks for a shorted module or grounded circuit from the ignition coil to the module. The distributor module should be turned off so normal voltage should be about 12 volts. If the module is turned "ON", the voltage would be low but above 1 volt. This could cause the ignition coil to fail from excessive heat. With an open ignition coil primary winding, a small amount of voltage will leak through the module from the "Bat." to the tach. terminal.

4. Checks the voltage output with the pick-up coil triggering the module. A spark indicates that the ignition system has sufficient output, however intermittent no-starts or poor performance could be the result of incorrect polarity between the ignition coil and the pick-up coil.

   The color of the pick-up coil connector has to be yellow if one of the ignition coil leads is yellow. If the ignition coil has a white lead, any pick-up coil connector color except yellow is OK.

5. Checks for an open module or circuit to it. 12 volts applied to the module "P" terminal should turn the module "ON" and the voltage should drop to about 7-9 volts.

6. This should turn off the module and cause a spark. If no spark occurs, the fault is most likely in the ignition coil because most module problems would have been found before this point in the procedure. A module tester could determine which is at fault.

CHART C-4A
IGNITION SYSTEM CHECK
4.3L, 5.0L, or 5.7L ENGINE
WITH EST
CARBURETED - CALIFORNIA

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. (Intermittent no start may be caused by wrong pick-up or ign. coil)
- 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). <u>A few sparks and then nothing, is considered no spark.</u>

No Spark →

(1A)
- Disconnect 4 term. EST connector and check for spark.

Spark → Check fuel,spark plugs, etc. See section "B" symptoms.

(1A) **No spark** →

②
- Check voltage at distributor "Bat." terminal while cranking.

(1A) **Spark** → Replace pick-up coil

② **7 Volts or more** →

③
- With ignition on, check voltage at "Tach." terminal

② **Under 7 volts** → Repair primary circuit to ignition switch

③ **Over10 volts** →

④
- Check for spark at coil output terminal with spark tester while cranking.

③ **Under 1 volt** → Repair faulty coil connection or replace faulty ignition coil

③ **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

④ **No spark** →

⑤
- Remove pick-up coil leads from module.
- Ignition "on", Engine stopped.
- Observe voltage at "Tach." terminal as test light is momentarily connected from Bat. + to module term. "P". (Fig. 1) <u>Don't touch for more than 5 seconds.</u>

④ **Spark** → Check color match of pick-up coil connector and ign. coil lead. (See Below) Inspect cap for water, cracks, etc. If ok replace rotor.

⑤ **Voltage drops** →

⑥
- Check for spark from coil wire with spark tester as test light is removed from module term.

⑤ **No drop in voltage** → Check module ground and for open in wires from coil to module. If OK, replace module.

⑥ **No Spark** →
- If no module tester is available; Replace ign. coil and repeat Step 5.
  - **No Spark** → Ign. coil removed is OK, reinstall original coil and replace dist. module.
  - **Spark** → System OK
- If module tester is available: test module
  - **OK** → Check coil wire from cap to coil. If OK, replace coil.
  - **Not OK** → Replace module

⑥ **Spark** → Check pick-up coil or conns. (Coil resistance should be 500-1500 ohms and not grounded).

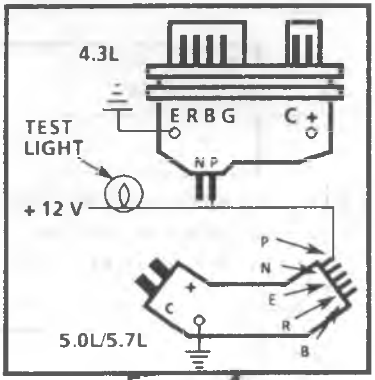
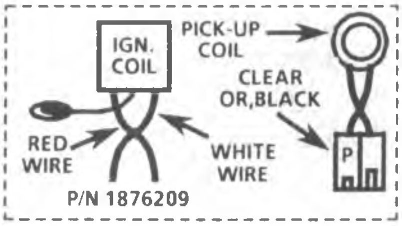


Figure 1



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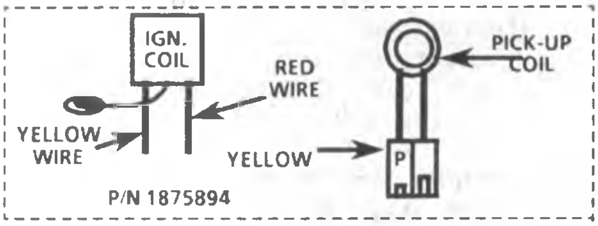

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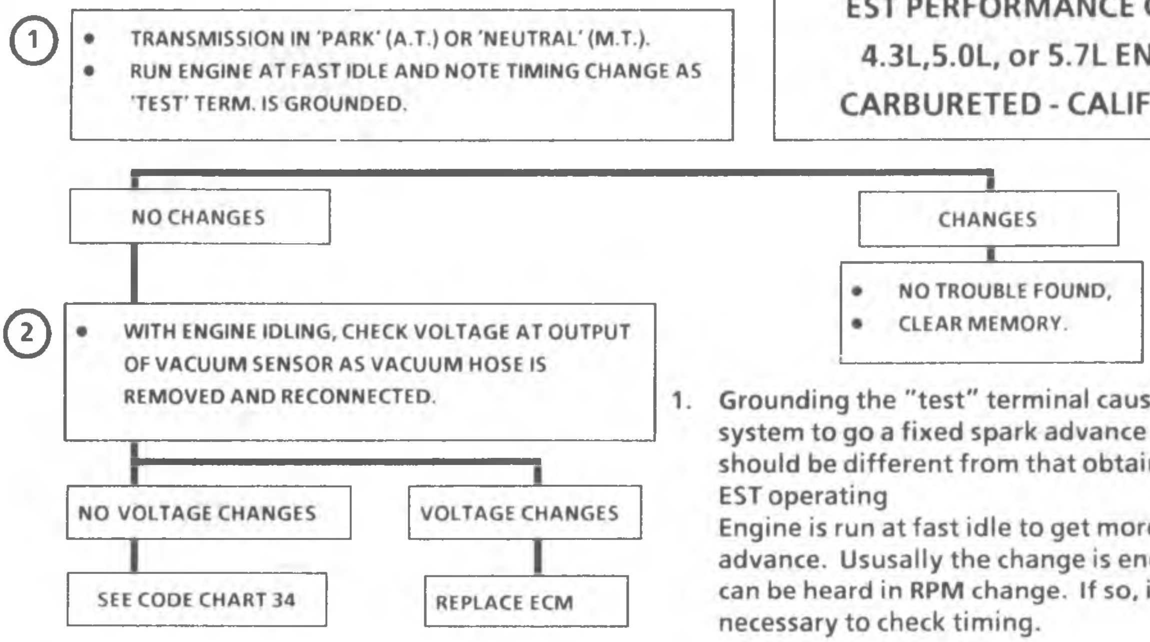
CHART C–4D
EST PERFORMANCE CHECK
4.3L,5.0L, or 5.7L ENGINE
CARBURETED - CALIFORNIA



1. Grounding the "test" terminal causes the system to go a fixed spark advance which should be different from that obtained with EST operating
   Engine is run at fast idle to get more spark advance. Ususally the change is enough so it can be heard in RPM change. If so, it is not necessary to check timing.
2. Checks to see if fault is in VAC system.

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CHART C-4E
IGNITION SYSTEM CHECK WITHOUT EST

1. Checks for proper output from the ignition system. The J26792 (ST-125) spark tester requires a minimum of 25,000 volts to fire. This check can be used in case of an ignition miss because the system may provide enough voltage to run the engine but not enough to fire a spark plug under heavy load.
2. Normal reading during cranking is about 8-10 volts.
3. Checks for a shorted module or grounded circuit from the ignition coil to the module. The distributor module should be turned off so normal voltage should be about 12 volts. If the module is turned "ON", the voltage would be low but above 1 volt. This could cause the ignition coil to fail from excessive heat. With an open ignition coil primary winding, a small amount of voltage will leak through the module from the "Bat." to the tach. terminal.
4. Checks the voltage output with the pick-up coil triggering the module. A spark indicates that the ignition system has sufficient output,however intermittent no-starts or poor performance could be the result of incorrect polarity between the ignition coil and the pick-up coil.
   The color of the pick-up coil connector has to be yellow if one of the ignition coil leads is yellow. If the ignition coil has a white lead, andy pick-up coil connector color except yellow is OK.
5. Checks for an open module or circuit to it. 12 volts applied to the module "P" terminal should turn the module "ON" and the voltage should drop to about 7-9 volts.
6. This should turn off the module and cause a spark. If no spark occurs, the fault is most likely in the ignition coil because most module problems would have been found before this point in the procedure. A module tester could determine which is at fault.

CHART C-4E

IGNITION SYSTEM CHECK WITHOUT EST

CARBURETED

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. (Intermittent no start may be caused by wrong pick-up or ign. coil)
- Check spark at plug with spark tester J-26792 or equivalent (ST-125) while cranking (if no spark on one wire, check a second wire). A few sparks and then nothing, is considered no spark.

Spark

Check fuel,spark plugs, etc. See section "B" symptoms.

No spark

②
- Check voltage at distributor "Bat." terminal while cranking.

Under 7 Volts

Repair primary circuit to ignition switch

7 Volts or more

③
- With ignition on, check voltage at "Tach." terminal

Under 1 volt

Repair faulty coil connection or replace faulty ignition coil

1 to 10 volts

Replace module and check for spark from coil as in Step 6.

Spark

System OK

No Spark

Replace ign. coil, it too is faulty

Over10 volts

④
- Check for spark at coil output terminal with spark tester while cranking.

Spark

Check color match of pick-up coil connector and ign. coil lead. (See Below) Inspect cap for water, cracks, etc. If ok replace rotor.

No spark

⑤
- Remove pick-up coil leads from module.
- Ignition "on", Engine stopped.
- Observe voltage at "Tach." terminal as test light is momentarily connected from Bat. + to module term. "G". (Fig. 1) Don't touch for more than 5 seconds.

No drop in voltage

Check module ground and for open in wires from coil to module. If OK, replace module.

Voltage drops

⑥
- Check for spark from coil wire with spark tester as test light is removed from module term.

Spark

Check pick-up coil or conns. (Coil resistance should be 500-1500 ohms and not grounded).

No Spark

- If no module tester is available; Replace ign. coil and repeat Step 5.

No Spark

Ign. coil removed is OK, reinstall original coil and replace dist. module.

Spark

System OK

- If module tester is available: test module

OK

Check coil wire from cap to coil. If OK, replace coil.

Not OK

Replace module

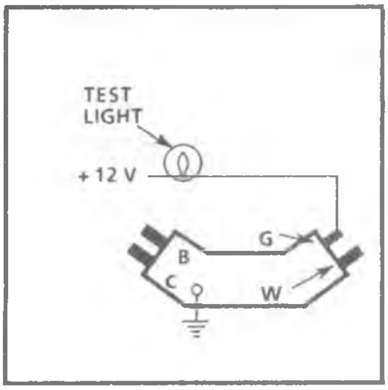
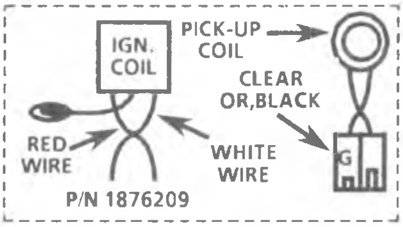
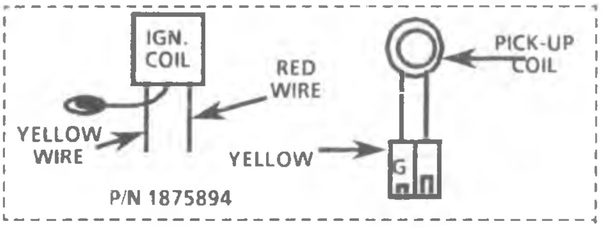


Figure 1





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ELECTRONIC SPARK CONTROL (ESC) SYSTEM

4.3L ENGINE
CALIFORNIA ONLY

GENERAL DESCRIPTION

PURPOSE

Varying octane levels in today's gasoline can cause detonation in an engine. Detonation is called spark knock.

To control spark knock on a 4.3L engine, an Electronic Spark Control (ESC) system has been added. This system is designed to retard spark timing up to 20° to reduce spark knock in the engine. This allows the engine to use maximum spark advance to improve driveability and fuel economy.

OPERATION

The ESC system has two major components:

- ESC Module
- ESC Knock Sensor Fig. 72)

The ESC knock sensor (Figure 72) detects abnormal vibration (spark knocking) in the engine. The sensor is mounted in the engine block near the cylinders (Fig. 73). The ESC module receives the knock sensor information and sends a signal to the ECM. The ECM then adjusts the electronic spark timing (EST) to reduce spark knocking.

The ESC module (Fig. 74) sends a voltage signal (8 to 10 volts) to the ECM when no spark knocking is detected by the ESC knock sensor, and the ECM provides normal spark advance.

When the knock sensor detects spark knock, the module turns off the circuit to the ECM. The ECM then retards EST to reduce spark knock.

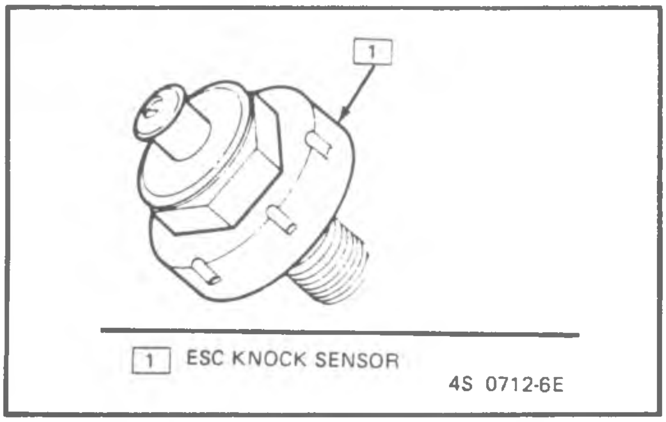


Figure 72 ESC Knock Sensor

DIAGNOSIS

ESC SYSTEM

Loss of the ESC knock sensor signal or loss of ground at ESC module would causethe signal to the ECM to remain high. This condition would cause the ECM to control EST as if no spark knocking were happening. No retard would occur, and spark knocking could become severe under heavy engine load conditions.

Spark retard without the knock sensor connected could indicate a noise signal on the wire to the ECM or a malfunctioning ESC module.

Loss of the ESC signal to the ECM would cause the ECM to constantly retard EST. This could result in sluggish performance and cause a CODE 43 to be set.

When no CODE 43 is present but the ESC system is a possible cause of excesisive spark knock, refer to CHART C-5 for ESC system check.

CODE 43

CODE 43 indicates that the ECM is receiving less than 6 volts for a 4 second period with the engine running. If code is present after performing the Diagnostic Circuit Check, refer to CODE 43 chart in Section A for diagnosis.

ON-VEHICLE SERVICE

ESC KNOCK SENSOR

FIGURE 73

The ESC Knock Sensor is located to the lower left of the engine block, below the spark plugs.

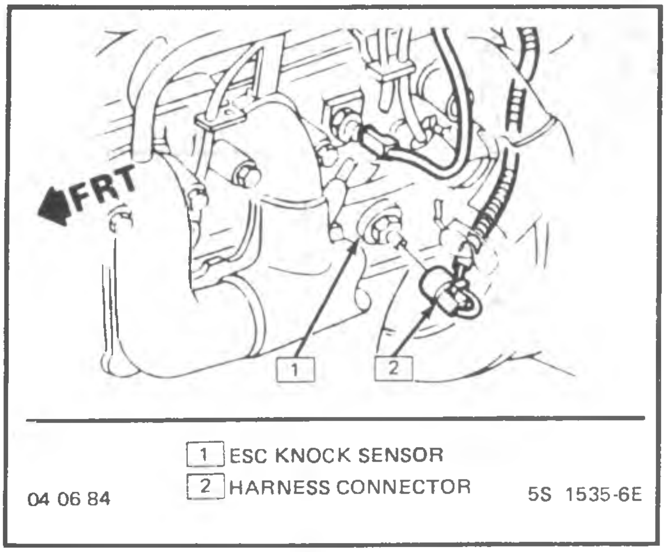


Figure 73 ESC Knock Sensor - 4.3L

Remove or Disconnect

1. Negative battery cable
2. ESC wiring harness connector from ESC sensor
3. Knock sensor from engine block

Install or Connect

1. Knock sensor into engine block. Apply thread sealer, such as soft sealing tape, to ESC sensor threads.
2. ESC wiring harness connector to the ESC sensor
3. Negative battery cable

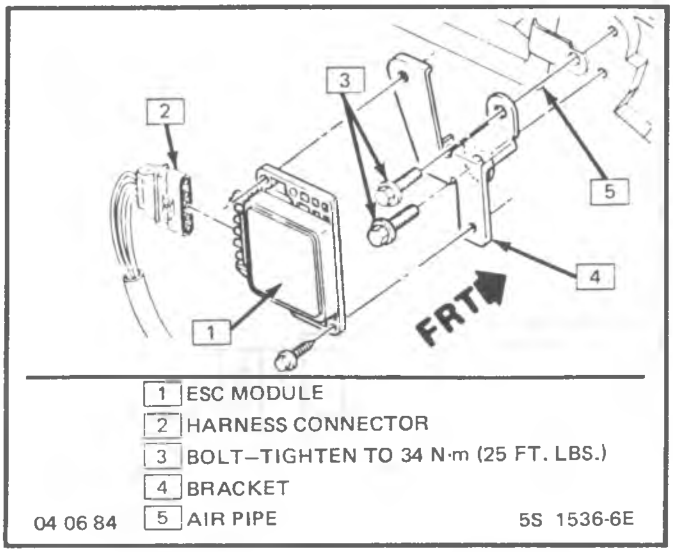


Figure 74 ESC Module - 4.3L

ESC MODULE AND BRACKET

FIGURE 74

The ESC module is located at the top rear of the engine.

Remove or Disconnect

1. ESC module connector
2. Attaching screws
3. ESC module

Install or Connect

1. ESC module
2. Attaching screws
3. ESC module connector

PARTS INFORMATION

PART NAME	GROUP
Sensor, ESC Knock	3.682
Module, Elek Spark Cont	2.383
Bracket, Elek Spark Cont Md	2.383
Shield, Elek Spark Cont Knock	2.383

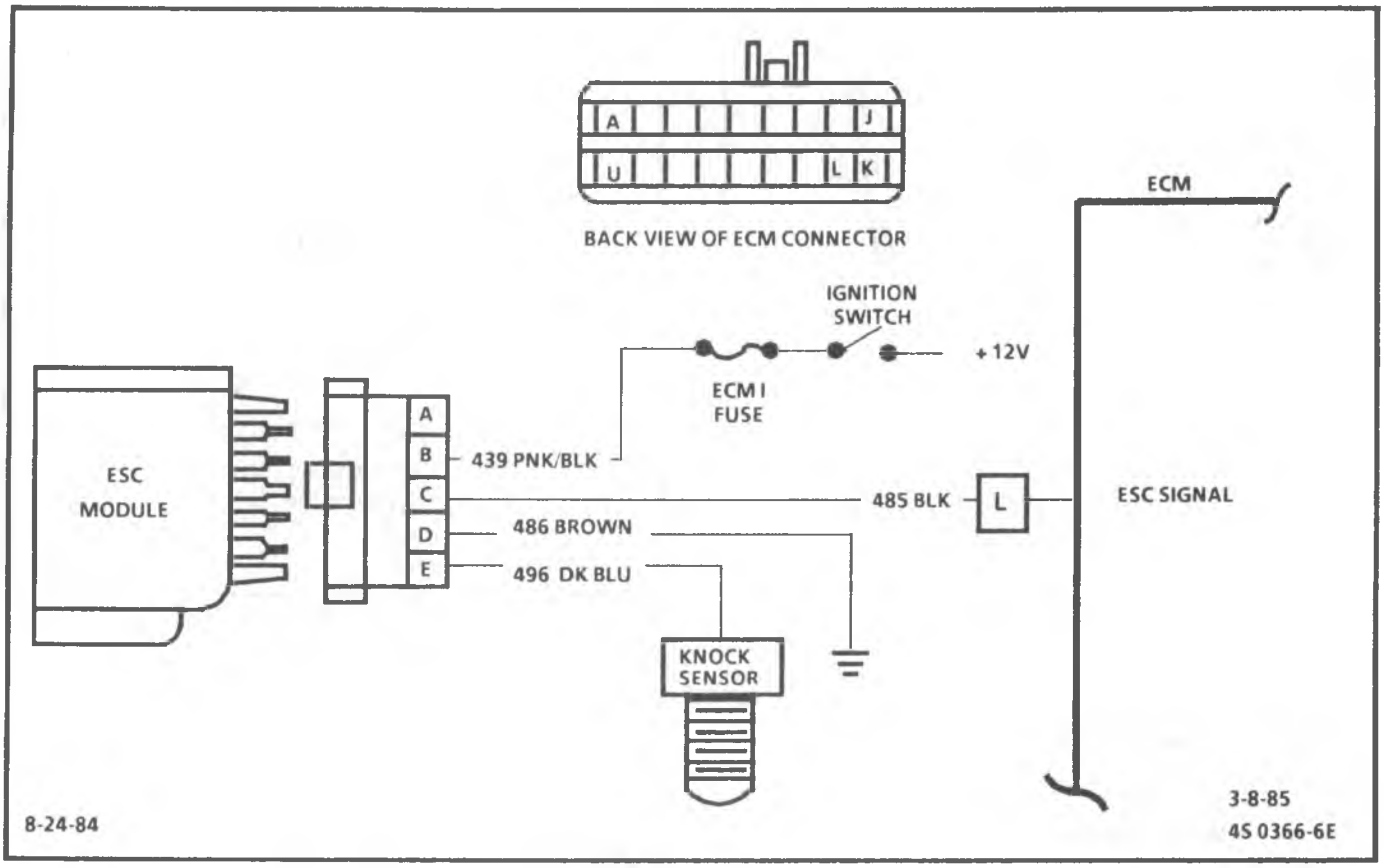


CHART C-5

ELECTRONIC SPARK CONTROL

4.3L ENGINE

CARBURETED - CALIFORNIA

If the timing is retarded at idle, it may be due to ESC operating. ESC should not operate unless a knock is present.

1. This is the ESC functional check. Simulating an engine knock by tapping the engine block should normally cause an RPM drop (decrease timing). If it doesn't drop, either the timing is not retarding or is retarded all the time.

2. This should cause full retard by dropping the voltage at ECM term. "L." Retarded timing should cause an RPM drop.

3. Normally, voltage should be .08V AC or higher for a good knock sensor circuit.

4. Check engine light should be "on" and a Code 43 set because ESC system would be retarded too long. If no light comes on, the ECM is not retarding the spark because of a voltage on the circuit to terminal "L" or the ECM is faulty.

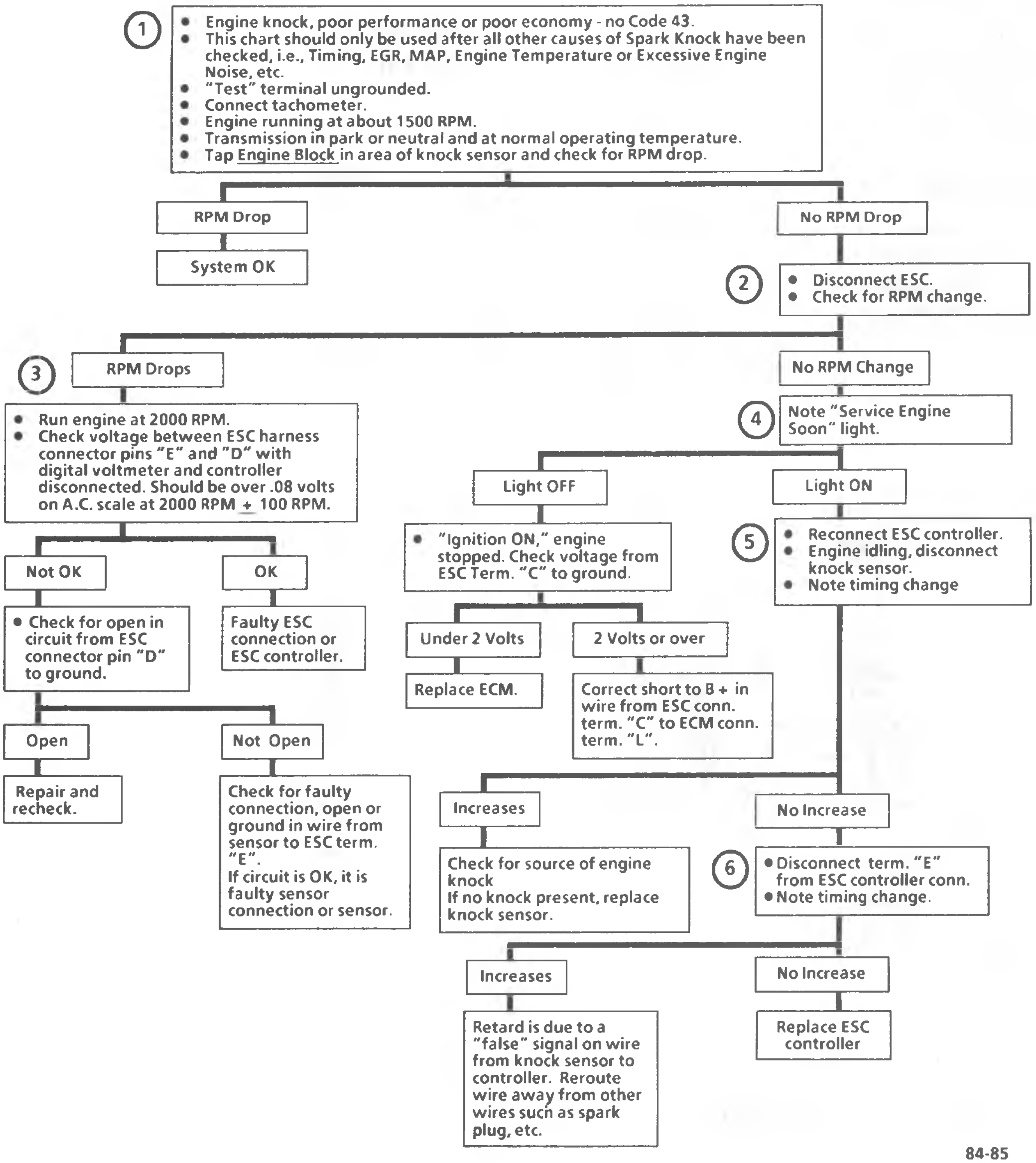
5. Checks to see if knock sensor is reason for retard signal. If engine knock is not present, and timing increases when knock sensor is disconnected, fault is an over sensitive knock sensor. Timing should not normally increase.

6. Checks to see if retard signal is due to "noise" on signal wire or faulty controller. If timing increases when wire is disconnected from controller, fault is due to knock sensor signal wire running too close to an ignition or charging system wire. Reroute wire to correct.

CHART C-5

ELECTRONIC SPARK CONTROL (ESC) CHECK

4.3L ENGINE
CARBURETED - CALIFORNIA



①
- Engine knock, poor performance or poor economy - no Code 43.
- This chart should only be used after all other causes of Spark Knock have been checked, i.e., Timing, EGR, MAP, Engine Temperature or Excessive Engine Noise, etc.
- "Test" terminal ungrounded.
- Connect tachometer.
- Engine running at about 1500 RPM.
- Transmission in park or neutral and at normal operating temperature.
- Tap Engine Block in area of knock sensor and check for RPM drop.

RPM Drop

System OK

No RPM Drop

②
- Disconnect ESC.
- Check for RPM change.

RPM Drops ③

- Run engine at 2000 RPM.
- Check voltage between ESC harness connector pins "E" and "D" with digital voltmeter and controller disconnected. Should be over .08 volts on A.C. scale at 2000 RPM ± 100 RPM.

Not OK

- Check for open in circuit from ESC connector pin "D" to ground.

Open

Repair and recheck.

Not Open

Check for faulty connection, open or ground in wire from sensor to ESC term. "E".
If circuit is OK, it is faulty sensor connection or sensor.

OK

Faulty ESC connection or ESC controller.

No RPM Change

④ Note "Service Engine Soon" light.

Light OFF

- "Ignition ON," engine stopped. Check voltage from ESC Term. "C" to ground.

Under 2 Volts

Replace ECM.

2 Volts or over

Correct short to B + in wire from ESC conn. term. "C" to ECM conn. term. "L".

Light ON

⑤
- Reconnect ESC controller.
- Engine idling, disconnect knock sensor.
- Note timing change

Increases

Check for source of engine knock
If no knock present, replace knock sensor.

No Increase

⑥
- Disconnect term. "E" from ESC controller conn.
- Note timing change.

Increases

Retard is due to a "false" signal on wire from knock sensor to controller. Reroute wire away from other wires such as spark plug, etc.

No Increase

Replace ESC controller

84-85
* 4S 0330-6EA

3-25-85

AIR MANAGEMENT SYSTEM

ALL VEHICLES UNDER 8500 GVW

GENERAL DESCRIPTION

PURPOSE

The air management system is used to reduce carbon monoxide and hydrocarbon emissions. One part of the system is called air injection reaction (AIR) and the other is a deceleration control.

AIR SYSTEM

This system, under certain conditions, adds air (oxygen) to the exhaust manifold to continue combustion after the exhaust gases leave the combustion chamber. This added air also brings the catalytic converter up to operating temperature more quickly when the engine is cold.

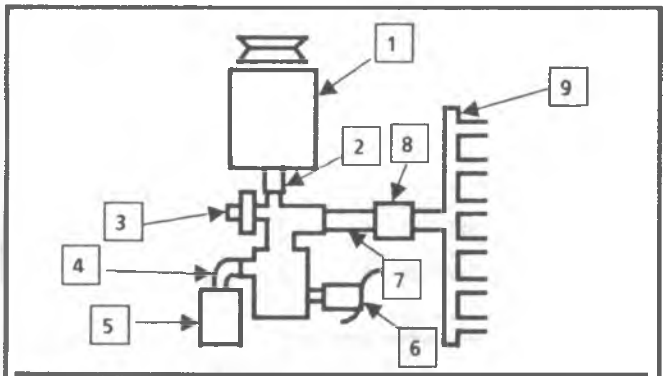
The system consists of an air pump, a diverter valve or an electric air control valve, check valve(s), and necessary plumbing.

The 4.3L, 5.0L (RPOLF3) or 5.75L (LS9) engine in California have an electric air control valve controlled by an ECM and all other engines use a diverter valve without an ECM.

Operation Without ECM

FIGURES 75 AND 76

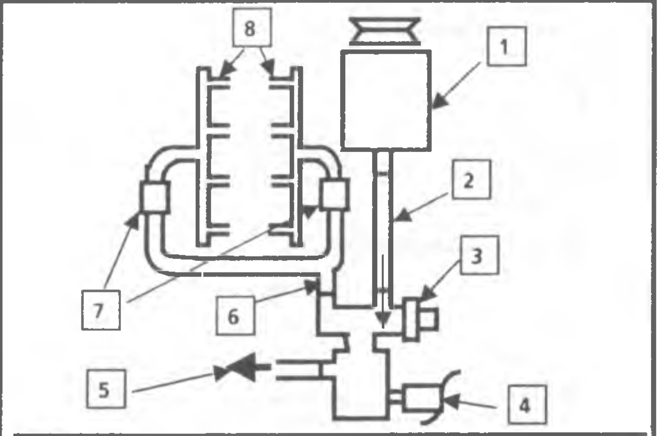
A belt driven air pump supplies compressed air through a centrifugal filter fan to a diverter valve (Figure 77). This valve, during normal operation, allows air to go to the exhaust manifold or ports. At high engine speeds, air is directed to the air cleaner/silencer through a pressure relief valve. During engine decel, when there is a rise in the manifold vacuum signal, air is directed to the air cleaner/silencer.



1	AIR PUMP
2	AIR TO DIVERTER VALVE
3	DIVERTER VALVE
4	AIR TO SILENCER
5	SILENCER
6	MANIFOLD VACUUM SIGNAL
7	AIR TO EXHAUST PORTS
8	CHECK VALVE
9	AIR INJECTION PIPES (AIR TO EXHAUST PORTS)

3-18-85 *6S 2540-6E

Figure 75 AIR System (L6)



1	AIR PUMP
2	AIR TO DIVERTER VALVE
3	DIVERTER VALVE
4	MANIFOLD VACUUM SIGNAL
5	AIR TO AIR CLEANER
6	AIR TO EXHAUST PORTS
7	CHECK VALVES
8	AIR INJECTION PIPES (AIR TO EXHAUST PORTS)

3-19-85 *6S 2595-6E

Figure 76 AIR System - Without ECM (V6/V8)

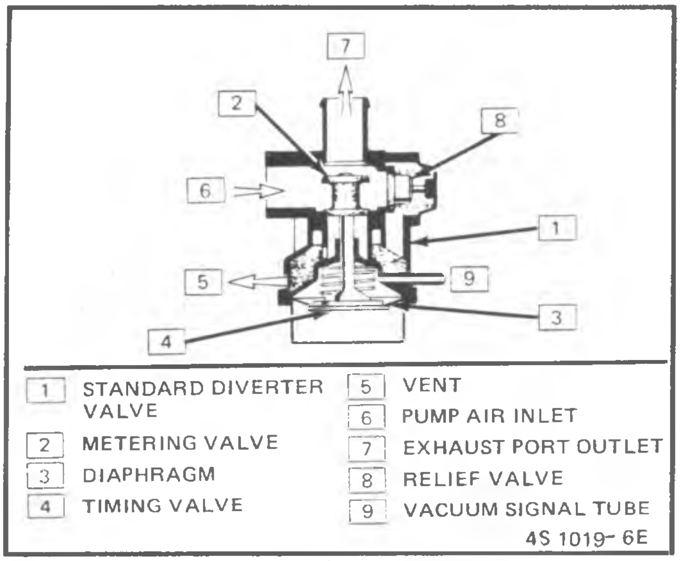


Figure 77 Diverter Valve

One check valve is used on an L6 engine and the V6 or V8 engine has two check valves on either side of the engine. The check valves prevent back flow of exhaust into the air pump if there is an exhaust backfire or pump drive belt failure.

Operation With ECM

FIGURE 78

A belt driven air pump supplies air through a centrifugal filter fan to the electric air control EAC) valve (Figure 79). This valve directs the air to either the engine exhaust manifold ports or to the air cleaner. When the engine is cold or in wide open throttle condition, the ECM energizes the solenoid on the valve and air is directed to the exhaust manifold ports. When the coolant temperature increases, the solenoid is de-energized and air goes into the air cleaner which also acts as a silencer. At higher engine speeds, air is directed to the air cleaner through the pressure relief valve even though the solenoid may be energized. During engine decel, when there is a rise in the manifold vacumn signal, air is directed to the air cleaner.

A Check valve on either side of the engine prevents back flow of exhaust into the air pump if there is an exhaust backfire or pump drive belt failure.

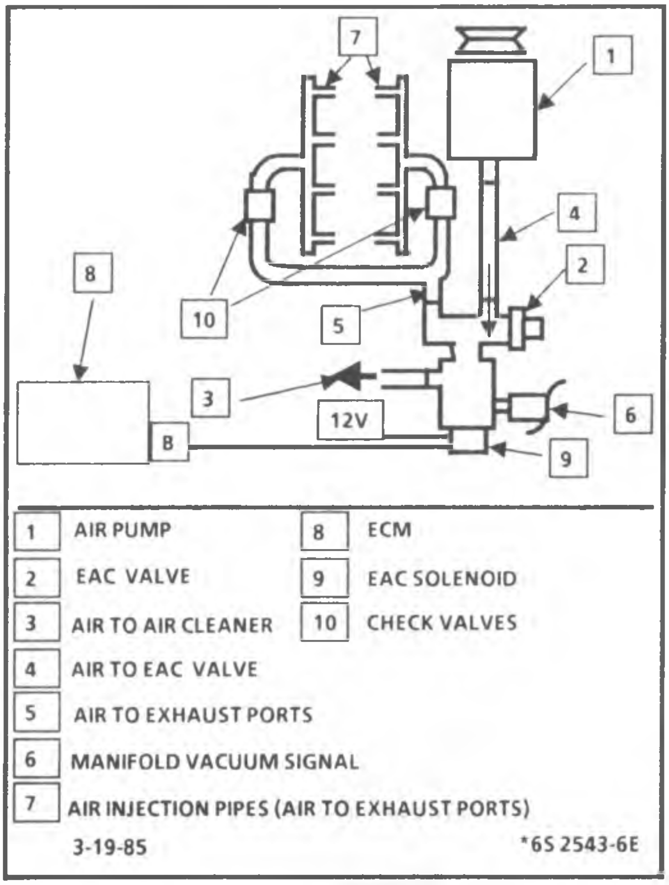


Figure 78 AIR System - With ECM (V6/V8)

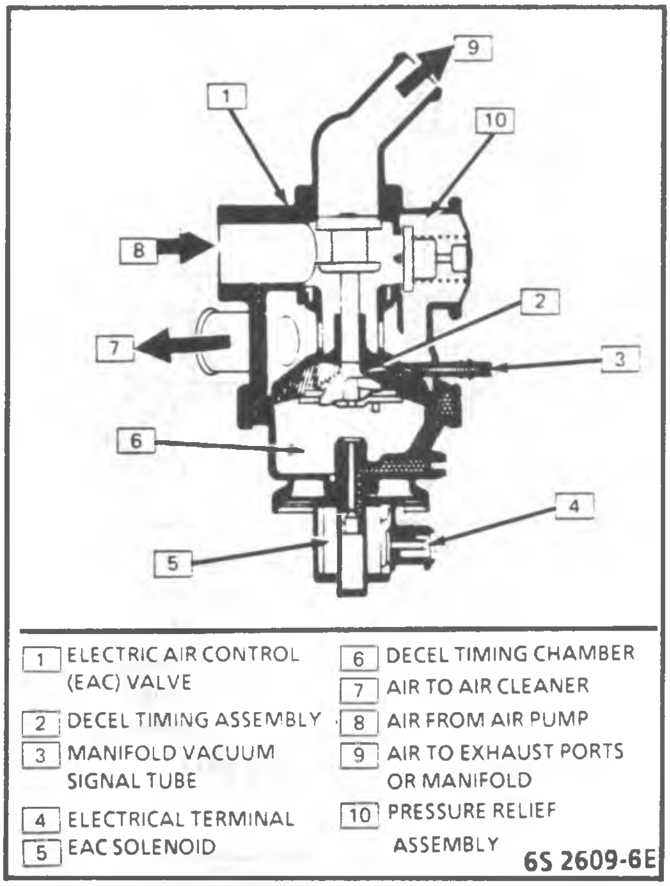


Figure 79 EAC Valve

If the engine is operating under a rich condition or the "SERVICE ENGINE SOON" lamp lights, the solenoid is de-energized and air goes to the air cleaner.

DECELERATION CONTROL

FIGURE 80

To help prevent backfiring during high vacuum conditions a deceleration (gulp) valve is used to allow air to flow into the intake manifold. This air enters the air/fuel mixture to lean the rich condition created by high vacuum when the throttle valve closes on deceleration.

The vacuum draws the deceleration valve diaphragm down and opens the valve allowing air from the air cleaner to flow into the intake manifold.

DIAGNOSIS

AIR SYSTEM

Refer to CHART C-6C for the diagnosis of the AIR System with an electric air control valve and an ECM.

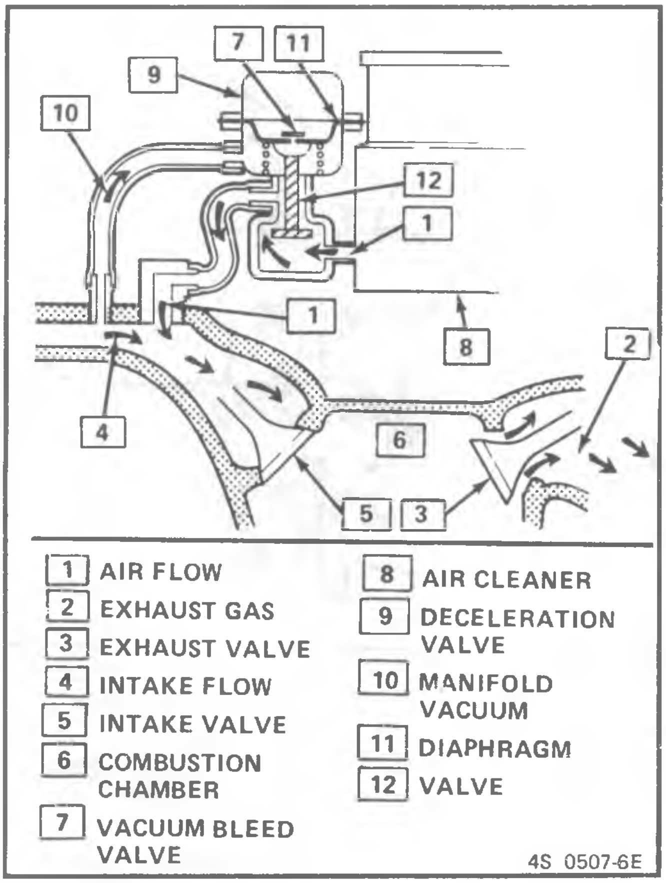


Figure 80 Deceleration Control

NOTICE: *If the engine or underhood compartment is to be cleaned with steam or high-pressure detergent, the centrifugal filter fan should be masked off to prevent liquids from entering the pump.*

The AIR System is not completely noiseless. Under normal conditions, noise rises in pitch as engine speed increases. To determine if excessive noise is the fault of the AIR System pump, operate the engine with the pump drive belt removed.

If noise is caused by the AIR System pump, check for :

- A seized air pump.
- Proper mounting and Bolt torque of pump.
- Proper routine and connections of hoses.

NOTICE; Do not oil air air pump

- *Replace pump if there is excessive noise.*

Air Pump

The air pump is a positive displacement vane type which is permanently lubricated and requires no periodic maintenance.

Accelerate engine to approximately 1500 RPM and observe air flow from hose. If air flow increases as engine is accelerated, pump is operating satisfactorily. If air flow does not increase or is not present, proceed as follows:

Inspect

1. For proper drive belt tension.
2. For a leaky pressure relief valve. Air may be heard leaking with the pump running.

Check Valve

Inspect

1. A check valve should be inspected whenever the hose is disconnected from a check valve or whenever check valve failure is suspected (A pump that had become inoperative and had shown indications of having exhaust gases in the pump would indicate check valve failure).
2. Blow through the check valve (toward the cylinder head) then attempt to suck back through the check valve. Flow should only be in one direction (toward the exhaust manifold). Replace valve which does not operate properly.

Hoses and Pipes

Inspect

1. Hose or pipe for deterioration or holes.
2. All hoses or pipe connections, and clamp tightness.
3. Hose or pipe routing. Interference may cause wear.
4. If a leak is suspected on the pressure side of the system or if a hose or pipe has been disconnected on the pressure side, the connections should be checked for leaks with a soapy water solution. With the pump running, bubbles will form if a leak exists.

DECELERATION VALVE
Functional Check

1. Remove air cleaner, plug air cleaner vacuum source and connect tachometer.
2. With the engine running at specified idle speed, remove the small deceleration valve signal hose from the manifold vacuum source.
3. Reconnect the signal hose and listen for air flow through the ventilation pipe and into the deceleration valve. There should also be a noticeable speed drop when the signal hose is reconnected.
4. If the air flow does not continue for at least one second or the engine speed does not drop noticeably, check the deceleration valve hoses for resitrictions or leaks.
5. If no restrictions or leaks are found, replace the deceleration valve.

ON-VEHICLE SERVICE

DRIVE BELT

Remove or Disconnect

Inspect drive belt for wear, cracks or deterioration and replace if required. When installing new belt, it must be seated and fully secured in grooves of A/C compressor, air pump, generator, and crankshaft pulleys.

PUMP CENTRIFUGAL FILTER FAN

The centrifugal filter fan should not be cleaned, either with compressed air or solvents.

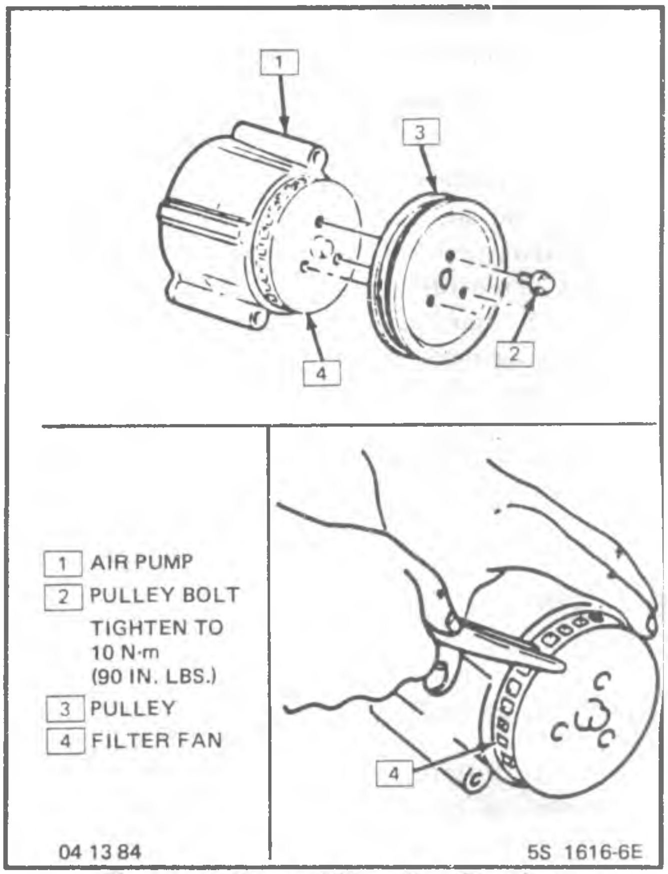


Figure 81 Pump Filter Fan Service

CAUTION: Centrifugal fan should not be removed from pump unless it is damaged, as removal will destroy the fan.

Before starting replacement note the following:

- Do not allow any filter fragments to enter the air pump intake hole.
- Do not remove filter fan by inserting a screwdriver between pump and filter fan. Air damage to sealing lip pump will result.
- Do not remove metal drive hub from filter fan.
- It is seldom possible to remove the filter fan without destroying it.

Remove or Disconnect

FIGURE 81

1. Air pump
2. Pump pulley
3. Insert needle nose pliers and pull filter fan from pump hub.

Install or Connect

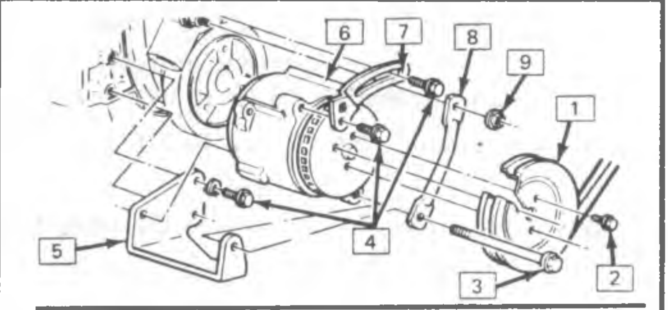
1. New filter fan on pump hub.
2. Spacer and pump pulley against centrifugal filter fan.
3. Pump pulley bolts and tighten equal to 10 N·m (90 in.lbs.). This will compress the centrifugal filter fan onto the pump hole. Do not drive filter fan on with a hammer. A slight amount of interference with the housing bore is normal. After a new filter fan has been installed, it may squeal upon initial operation or until O.D. sealing lip has worn in. This may require a short period of pump operation at various engine speeds.
4. Air pump.

AIR PUMP

FIGURE 82

Remove or Disconnect

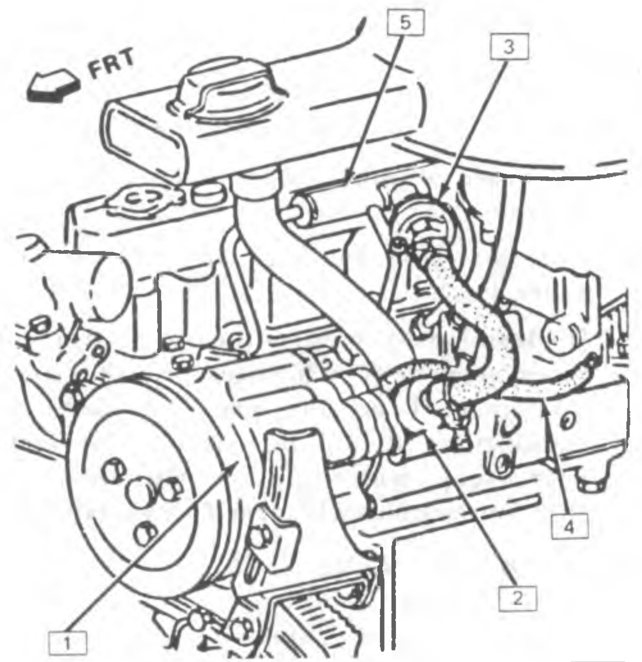
1. Hold pump pulley from turning by compressing drive belt, then loosen pump pulley bolts.
2. Loosen bolt, holding pump to mounting brackets, release tension on drive belts.
3. Move belts out of the way, then remove pump hoses, vacuum and electrical connections, and control valve.
4. Pulley, then pump.
5. If required, insert needle nose pliers and pull filter fan from hub (see Figure 81).



1 PULLEY
2 BOLT–TIGHTEN TO 10 N·m (90 IN. LBS.)
3 BOLT–TIGHTEN TO 45 N·m (32 FT. LBS.)
4 BOLT–TIGHTEN TO 84 N·m (25 FT. LBS.)
5 SUPPORT
6 AIR PUMP
7 BRACKET
8 BRACE
9 NUT–TIGHTEN TO 34 N·m (25 FT. LBS.)

04 06 84 5S 1528-6E

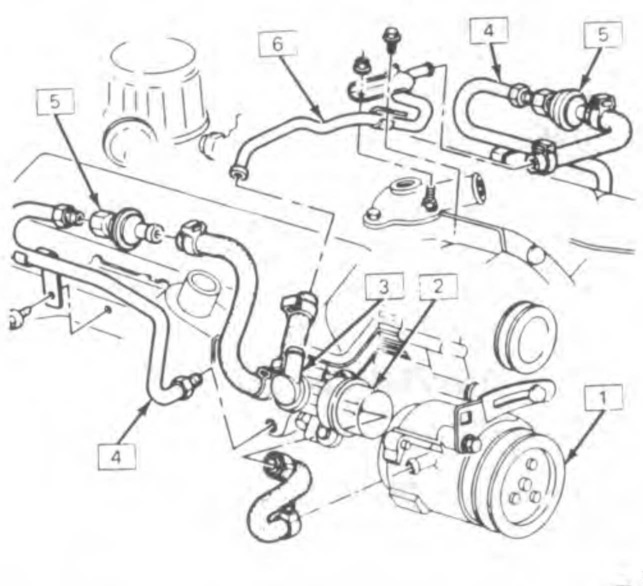
Figure 82 Air Pump - Typical



1 AIR PUMP
2 DIVERT VALVE
3 CHECK VALVE
4 VACUUM HOSE
5 INJECTION PIPE

05 04 84 4S 1086-6EA

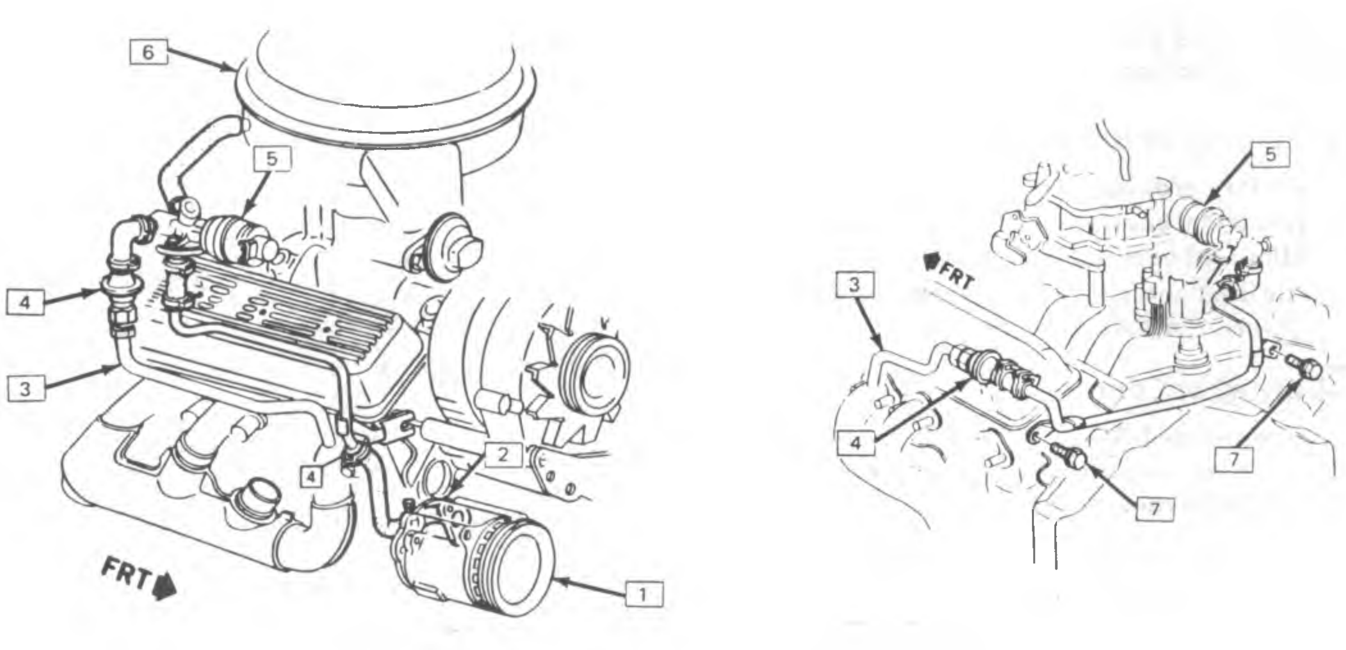
Figure 83 AIR System - L6



1 AIR PUMP
2 DIVERTER VALVE OR EAC VALVE
3 TO AIR CLEANER
4 INJECTION PIPE - TIGHTEN TO 30 N·m
5 CHECK VALVE - TIGHTEN TO 23 N·m (17 FT. LBS.)
6 PIPE ASSEMBLY

5S 1741-6E

Figure 84 A I R System - V8 (Lt. Duty Emissions - CK)



1 AIR PUMP
2 ADAPTER AND SEAL - TIGHTEN SCREWS TO 25 N·m (18 FT. LBS)
3 AIR INJECTION PIPE - TIGHTEN NUTS TO 28 N·m (20 FT. LBS.)
4 CHECK VALVE - TIGHTEN TO 85 N·m (26 FT. LBS.)
5 DIVERTER VALVE OR EAC VALVE
6 AIR CLEANER
7 BOLT - TIGHTEN TO 34 N·m (25 FT. LBS.)

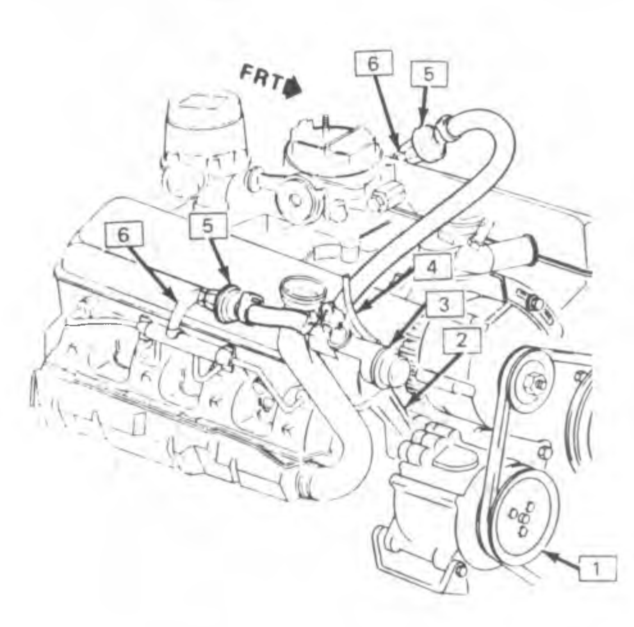
04 06 84

5S 1532-6E

Figure 85 A I R System - V6

Install or Connect

1. Air pump assembly, and tighten mounting bolts.
2. Hose.
3. New filter fan on pump hub.
4. Spacer and pump pulley against centrifugal filter fan.
5. Pump pulley bolts and tighten equally to 13 N·m (10 lb.-ft.). This will compress the centrifugal filter fan onto the pump hole. Do not drive filter fan on with a hammer. A slight amount of interference with the housing bore is normal. After a new filter fan has been installed, it may squeal upon initial operation or until O.D. sealing lip has worn in. This may require a short period of pump operation at various engine speeds.
6. Pump drive belt and adjust.
7. Check air management system with an ECM for proper operation (see Chart C- 6C).



1 AIR PUMP
2 ADAPTER
3 DIVERTER VALVE
4 VACUUM HOSE
5 CHECK VALVE
6 INJECTION PIPE

05 03 84

5S 1738-6E

Figure 86 AIR System - 7.4L

DIVERTER OR EAC VALVE

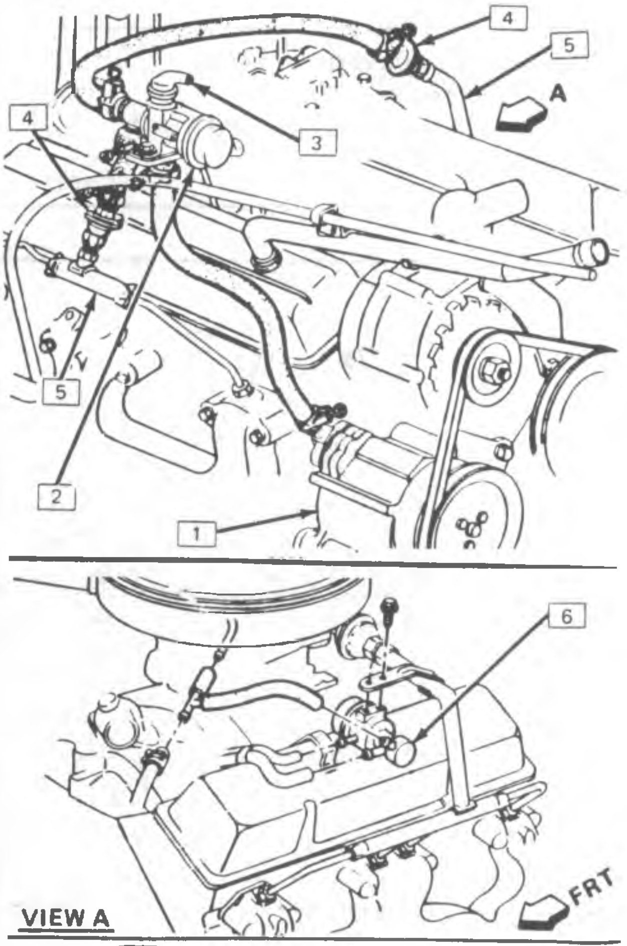
FIGURES 83 THRU 88

Remove or Disconnect

1. Battery ground cable.
2. Electrical connector on EAC valve.
3. Manifold vacuum signal hose.
4. Air inlet and outlet hoses from valve.
5. Diverter or EAC valve.

Install or Connect

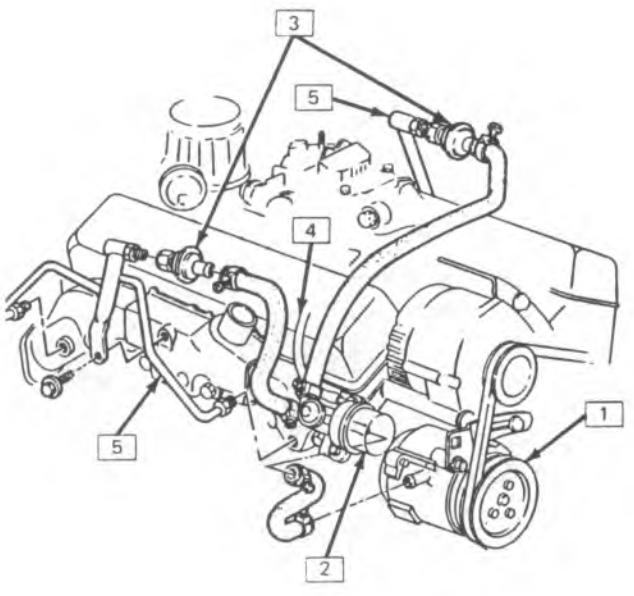
1. Diverter or EAC valve.
2. Air inlet and outlet hoses to valve.
3. Manifold vacuum signal hose.
4. Electrical connector on EAC valve.
5. Battery ground cable.



1 A I R PUMP
2 DIVERTER VALVE OR AIR CONTROL VALVE
3 TUBE TO A CLEANER
4 CHECK VALVE
5 INJECTION PIPE
6 DECELERATION VALVE

5 04 84 4S 1088-6EA

Figure 87 AIR System - V8
(Lt. Duty Emissions - G)



1 A I R PUMP
2 DIVERTER VALVE
3 CHECK VALVE
4 VACUUM HOSE
5 INJECTION PIPE

05 04 84 4S 1087-6EA

Figure 88 AIR System - V8
(Heavy Duty Emissions)

6. Check system operation (California 4.3L, 5.0L, or 5.7L only, Chart C-6C).

CHECK VALVE

FIGURES 83 THRU 88

Remove or Disconnect

1. Any parts required for access.
2. Release clamp and disconnect air hoses from check valve.
3. Unscrew check valve from air injection pipe.

Install or Connect

1. Screw check valve onto air injection pipe.
2. Position air hose on check valve and secure with clamp.
3. Any parts removed for access.

AIR INJECTION PIPE ASSEMBLY

FIGURES 83 THRU 88

Remove or Disconnect

1. Hose.
2. Check Valve.
3. Nuts attaching pipes-to-manifold.
4. Pipe Assembly.

Install or Connect

1. Nuts attaching pipes-to-manifold.
2. Check Valve.
3. Hose.

DECELERATION VALVE

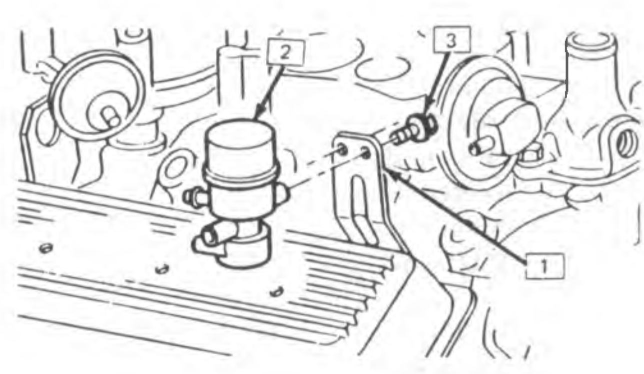
FIGURE 89 or 90

Remove or Disconnect

1. Vacuum hoses from valve.
2. Screws securing valve to engine bracket.
3. Deceleration valve.

Install or Connect

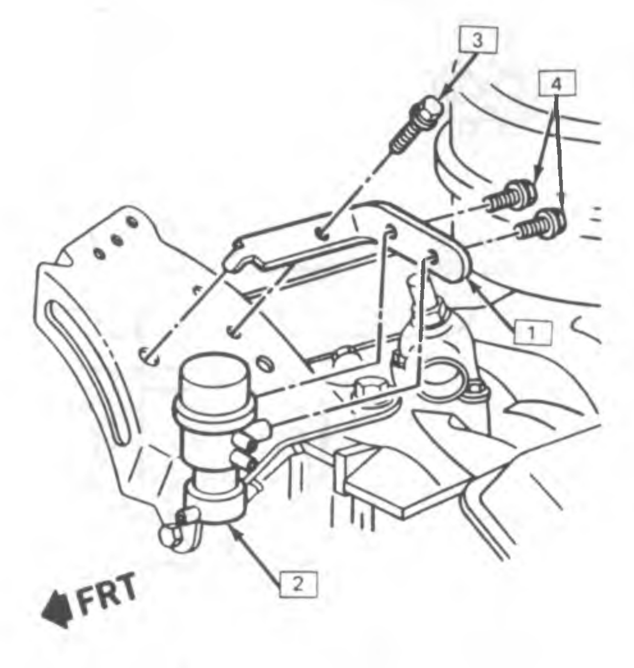
1. Deceleration valve.
2. Screws securing valve to engine bracket.
3. Vacuum hoses to valve.



1 BRACKET
2 DECELERATION VALVE
3 BOLT–TIGHTEN TO 3.5 N·m (30 IN. LBS.)

04 17 84 5S 1657-6E

Figure 89 Deceleration Valve - V6



1 BRACKET
2 DECELERATION VALVE
3 BOLT–TIGHTEN TO 17 N-m (12 FT. LBS.)
4 BOLT–TIGHTEN TO 14 N-m (12 LBS.)

05 04 84 5S 1740-6E

Figure 90 Deceleration Valve - V8

PARTS INFORMATION

PART NAME	GROUP
Adapter, AIR Inj Cont Vlv	3.671
Bracket, AIR Inj Pump Supt	3.655
Bracket, AIR Inj Pump	3.655
Fan, AIR Pump	3.665
Gasket, AIR Inj Dvtr Vlv El	3.671
Harness, AIR Inj Cont Vlv Vac	3.675
Hose, AIR Inj Cont Vlv	3.675
Hose, AIR Inj Cont Vlv Dvtr	3.675
Pulley, AIR Inj Pump	3.650
Pump, AIR Inj	3.660
Valve, AIR Inj Cont	3.670
Valve, AIR Inj Eng Chk	3.670
Valve, AIR Inj Control (Divert)	3.620
Valve, AIR Inj Switching	3.670

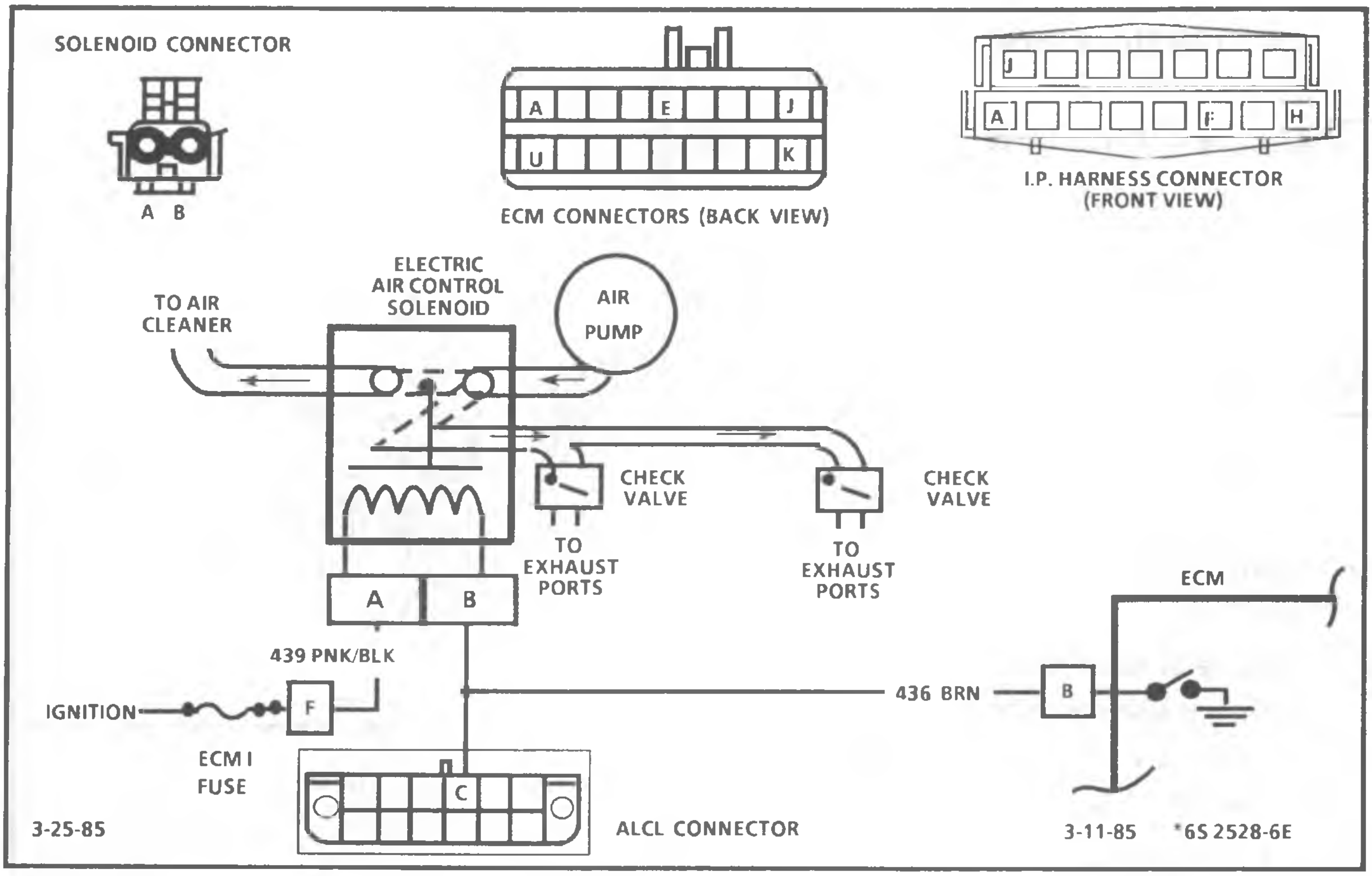


CHART C-6C

AIR MANAGEMENT CHECK (EAC)

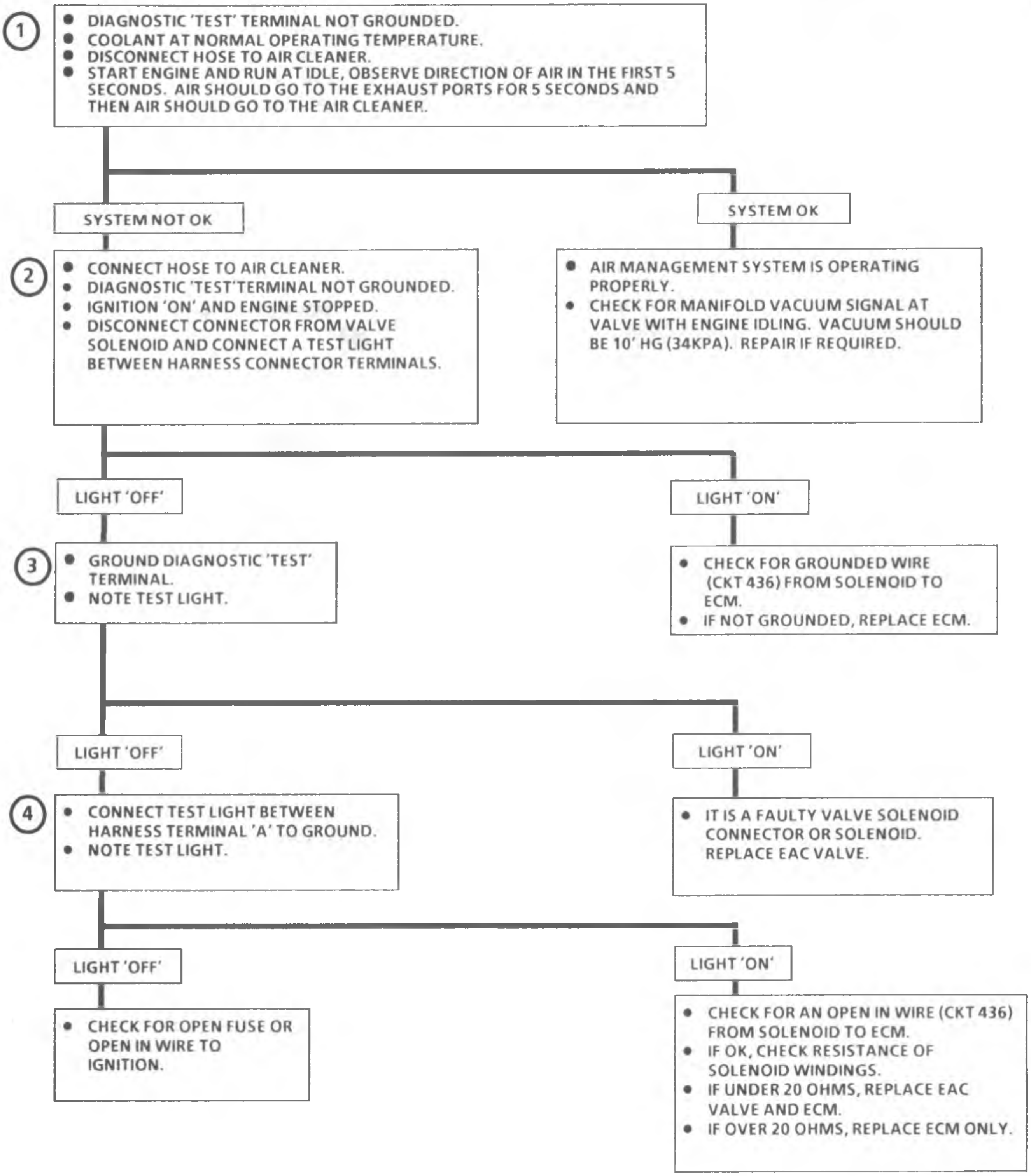
4.3L, 5.0L, or 5.7L ENGINE

CARBURETED - CALIFORNIA

The air management system has a single bed catalytic converter. An electric air control valve solenoid that directs air into the exhaust ports or the air cleaner. During cold start, the ECM completes ground circuit, the EAC solenoid is energized, and air is directed to the exhaust ports. As "coolant" temperature increases, or system goes to "closed loop", the ECM opens the ground circuit, the EAC solenoid is de-energized, and air goes to the air cleaner.

1. This is a system performance test. When vehicle goes to "closed loop", air will switch from the ports and divert to the air cleaner.
2. Tests for a grounded electric divert circuit. Normal system light will be "OFF".
3. Checks for an open control circuit. Grounding test terminal will energize the solenoid if ECM and circuits are normal. In this step, if test light is "ON", circuits are normal and fault is in valve connections or valve.
4. Checks for voltage from battery through a fuse to the solenoid.

CHART C-6C
AIR MANAGEMENT CHECK
(ELECTRIC AIR CONTROL(EAC) VALVE)
4.3L, 5.0L, OR 5.7L ENGINE
CARBURETED - CALIFORNIA



①
- DIAGNOSTIC 'TEST' TERMINAL NOT GROUNDED.
- COOLANT AT NORMAL OPERATING TEMPERATURE.
- DISCONNECT HOSE TO AIR CLEANER.
- START ENGINE AND RUN AT IDLE, OBSERVE DIRECTION OF AIR IN THE FIRST 5 SECONDS. AIR SHOULD GO TO THE EXHAUST PORTS FOR 5 SECONDS AND THEN AIR SHOULD GO TO THE AIR CLEANER.

SYSTEM NOT OK

②
- CONNECT HOSE TO AIR CLEANER.
- DIAGNOSTIC 'TEST' TERMINAL NOT GROUNDED.
- IGNITION 'ON' AND ENGINE STOPPED.
- DISCONNECT CONNECTOR FROM VALVE SOLENOID AND CONNECT A TEST LIGHT BETWEEN HARNESS CONNECTOR TERMINALS.

SYSTEM OK

- AIR MANAGEMENT SYSTEM IS OPERATING PROPERLY.
- CHECK FOR MANIFOLD VACUUM SIGNAL AT VALVE WITH ENGINE IDLING. VACUUM SHOULD BE 10' HG (34KPA). REPAIR IF REQUIRED.

LIGHT 'OFF'

③
- GROUND DIAGNOSTIC 'TEST' TERMINAL.
- NOTE TEST LIGHT.

LIGHT 'ON'

- CHECK FOR GROUNDED WIRE (CKT 436) FROM SOLENOID TO ECM.
- IF NOT GROUNDED, REPLACE ECM.

LIGHT 'OFF'

④
- CONNECT TEST LIGHT BETWEEN HARNESS TERMINAL 'A' TO GROUND.
- NOTE TEST LIGHT.

LIGHT 'ON'

- IT IS A FAULTY VALVE SOLENOID CONNECTOR OR SOLENOID. REPLACE EAC VALVE.

LIGHT 'OFF'

- CHECK FOR OPEN FUSE OR OPEN IN WIRE TO IGNITION.

LIGHT 'ON'

- CHECK FOR AN OPEN IN WIRE (CKT 436) FROM SOLENOID TO ECM.
- IF OK, CHECK RESISTANCE OF SOLENOID WINDINGS.
- IF UNDER 20 OHMS, REPLACE EAC VALVE AND ECM.
- IF OVER 20 OHMS, REPLACE ECM ONLY.

6-27-85

*6S 2530-6EB

AIR INJECTION REACTION (A I R) SYSTEM

(VEHICLE OVER 8500 GVW)

GENERAL DESCRIPTION

The heavy duty emission engines with vehicle weight over 8500 GVW have an AIR System with increased air flow. The system is used to reduce carbon monoxide (CO), and hydrocarbon (HC) emissions. The air injection reaction (AIR) system provides additional oxygen to continue the combustion process after the exhaust gases leave the combustion chamber. The system diverts air from the exhaust manifold at increased engine speed or when an electrical malfunction is detected in the system.

The system used on a 4.8L engine consists of an air pump, an air filter, an air control valve, a check valve, a silencer, an air temperature switch, a control module and necessary plumbing.

The system used on a 5.7L or 7.4L engine consists of two AIR pumps, an air filter, two air control valves, two check valves, a control module and necessary plumbing. The 7.4L engine also uses a control relay to operate the "SERVICE ENGINE SOON" light.

AIR OPERATION

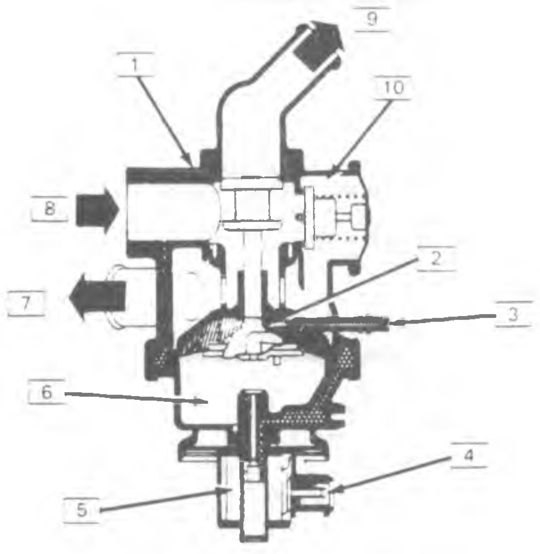
- The air pump(s) is belt driven on the front of the engine and supplies the air to the system.
- Intake air passes through an external air filter to the air pump(s).
- Air flow from the pump(s) passes through a control valve(s) to a check valve(s) and an AIR pipe(s) and into the exhaust manifold.
- The check valve prevents back flow of exhaust into the pump in the event of an exhaust backfire or pump drive belt failure.

AIR CONTROL VALVE (HFEAC)

FIGURE 91

This valve is a high flow electric air control (HFEAC) valve that has an electric solenoid to combine electronic control with normal diverter valve function.

With ignition "ON", the solenoid is energized through the control module and the air control valve operates like a standardized diverter valve. With the solenoid energized, air is directed to the exhaust manifold. During an engine decel, when there is a rise in the manifold vacuum signal, air is directed to the air cleaner or silencer even though the solenoid is energized. The solenoid is de-energized when there is high engine RPM over a prolonged period or a malfunction of the electrical circuit.



1	HIGH FLOW ELECTRIC AIR CONTROL VALVE	6	DECEL TIMING CHAMBER
2	DECEL TIMING ASSEMBLY	7	DIVERT AIR TO AIR CLEANER OR SILENCER
3	VERY HIGH VACUUM SIGNAL PORT	8	AIR FROM PUMP
4	ELECTRICAL TERMINAL	9	AIR TO EXHAUST PORTS
5	SOLENOID	10	PRESSURE RELIEF ASSEMBLY

09 25 84

5S 1934-6E

Figure 91 Air Control Valve (HFEAC)

SERVICE ENGINE SOON LIGHT

If there is a malfunction in the control module, wiring harness or solenoid(s), an amber "service engine soon" light will illuminate on the instrument panel. The "SERVICE ENGINE SOON" light is "ON" with the ignition key "ON" and the engine not running as a bulb check (except 7.4L). When the engine is started, the light will remain on for three to six seconds and then turn off. On a 7.4L system, with ignition "ON" and the engine not running, the "SERVICE ENGINE SOON" light will come "ON" and stay "ON" for 1-2 seconds and then go "OFF" as a bulb check.

DECELERATION CONTROL

FIGURE 92

To help prevent backfiring during high vacuum conditions a deceleration (gulp) valve is used with these AIR systems. Thge high vacuum draws the deceleration valve diaphragm down and opens the valve allowing air from the air cleaner to flow into the intake manifold. This air enters the air/fuel mixture to lean the rich condition created by high vacuum when the throttle valve closes on deceleration.

The vacuum draws the deceleration valve diaphragm down and opens the valve allowing air from the air cleaner to flow into the intake manifold.

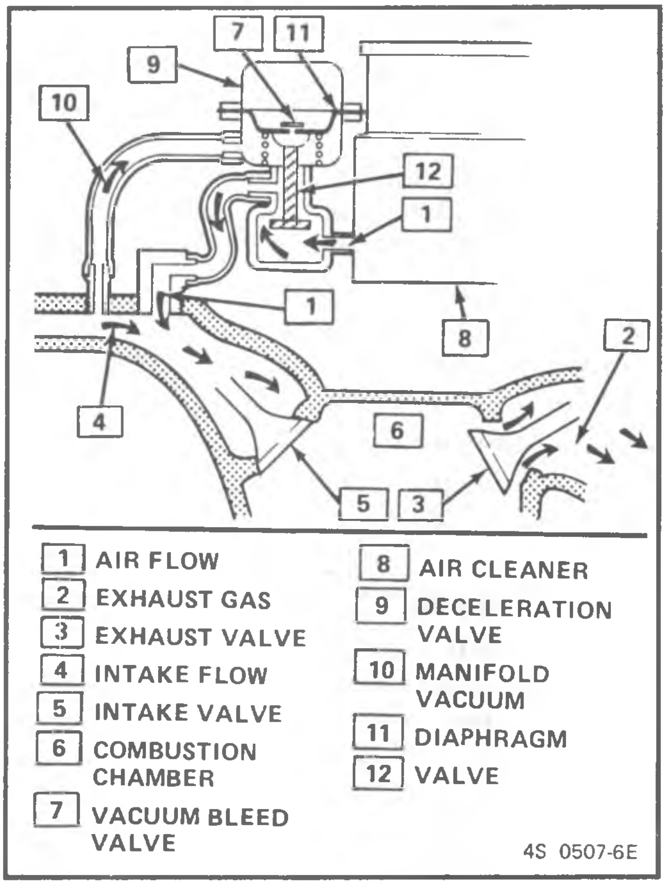


Figure 92 Deceleration Control

DIAGNOSIS

AIR SYSTEM

NOTICE: If the engine or under hood compartment is to be cleaned with steam or high-pressure detergent, the intake air filter should be masked off to prevent liquids from entering the pump.

The AIR System is not completely noiseless. Under normal conditions, noise rises in pitch as engine speed increases. To determine if excessive noise is the fault of the Air Injection Reactor System, operate the engine with the pump drive belt removed. If excessive noise does not exist with the belt removed proceed as follows:

- A seized air pump.
- Proper mounting and bolt torque of pump.
- Proper routing and connections of hoses.
  CAUTION: Do not oil air. pump.
- Replace pump if there is excessive noise.

"SERVICE ENGINE SOON" LIGHT

If the "service engine soon" light is on with the engine running, refer to the proper C-6HD CHART for diagnosis.

AIR PUMP

The air pump is permanently lubricated and requires no periodic maintenence.

Accelerate engine and observe air flow from hoses(s). If air flow increases as engine is accelerated, pump is operating satisfactory. If air flow does not increase or is not present, proceed as follows:

Inspect

1. For proper drive belt tension.
2. For a leaky pressure relief valve. Air may be heard leaking with the pump running.

AIR CONTROL VALVE

Air pump should be working properly. Disconnect solenoid connector at valve. With ignition "on" check for 12 volts at the connector. If there is no voltage, refer to the proper C-6HD CHART for diagnosis. Start engine. Air should go to the air cleaner or silencer. Connect the solenoid connector and air should go to the exhaust ports. Check for manifold vacuum signal at valve with engine idling. Vacuum should be 10" Hg (34kpa). During decel and high vacuum signal, air should go to the air cleaner and silencer. Replace valve if any of the conditions are not correct.

CHECK VALVE

Inspect

1. A check valve should be inspected whenever the hose is disconnected from a check valve or whenever check valve failure is suspected (A pump that had become inoperative and had shown indications of having exhaust gases in the pump would indicate check valve failure).
2. Blow through the check valve (toward the cylinder head) then attempt to suck back through the check valve. Flow should only be in one direction (toward the exhaust manifold). Replace valve which does not operate properly.

HOSE AND PIPES

Inspect

1. Hose or pipe for deterioration or holes.
2. All hoses or pipe connections, and clamp tightness.
3. Hose or pipe routing. Interference may cause wear.
4. If a leak is suspected on the pressure side of the system or if a hose or pipe has been disconnected on the pressure side, the connections should be checked for leaks with a soapy water solution. With the pump running, bubbles will form if a leak exists.

CONTROL MODULE

Refer to the proper C-6HD CHART for diagnosis of the control module.

DECELERATION VALVE

1. Remove air cleaner, plug air cleaner vacuum source and connect tachometer.
2. With the engine running at specified idle speed, remove the small deceleration valve signal hose from the manifold vacuum source.
3. Reconnect the signal hose and listen for air flow through the ventilation pipe and into the deceleration valve. There should also be a noticeable speed drop when the signal hose is reconnected.
4. If the air flow does not continue for at least one second or the engine speed does not drop noticeably, check the deceleration valve hoses for resitrictions or leaks.
5. If no restrictions or leaks are found, replace the deceleration valve.

ON-VEHICLE SERVICE

AIR WIRING DIAGRAM

Refer to the proper C-6HD CHART for the wiring diagram for L6 and V8 engines.

DRIVE BELT

Remove or Disconnect

1. Inspect drive belt for wear, cracks or deterioration and replace if required. When installing new belt, it must be seated and fully secured in grooves of A/C compressor, AIR pump, generator, and crankshaft pulleys.

AIR INJECTION PUMP

FIGURES 93 THRU 97

Remove or Disconnect

1. Hold pump pulley from turning by compressing drive belt, then loosen pump pulley bolts.
2. Loosen bolt, holding pump to mounting brackets, release tension on drive belts. Remove belt from pulley.
3. Disconnect hoses at rear of pump.
4. Disconnect vacuum and electrical connections if control valve is attached to the pump.
5. Remove pump pulley.
6. Remove pump.
7. Remove control valve if attached.

Install or Connect

1. Install pump with control valve if attached.
2. Connect vacuum and electrical connections if control valve is attached to pump.
3. Connect hoses at rear of pump.
4. Install pump pulley bolts and tighten equally to 15 N.m (10 lb.-ft.). Tighten again within 10 minutes to 15 N.m (10 lb.-ft.). using a click wrench, port-a-torque or other equivalent tool.

6. Install pump drive belt and adjust tension.

AIR CONTROL VALVE

FIGURES 93 THRU 97

Remove or Disconnect

1. Electrical connector from solenoid.
2. Air outlet hoses from valve.
3. Manifold vacuum hose.
4. Air control valve, gaskets and adapter.

Install or Connect

1. Gaskets, adapter and air control valve.
2. Manifold vacuum hose.
3. Air outlet hoses to valve with clamps.
4. Electrical connector to solenoid.

CHECK VALVE

FIGURES 93 THRU 97

Remove or Disconnect

1. Any parts required for access to valve.
2. Release clamp and disconnect air hoses from check valve.
3. Valve from bracket.
4. Unscrew check valve from air injection pipe.

Install or Connect

1. Screw check valve onto air injection pipe.
2. Valve to bracket
3. Position air hose on check valve and secure with clamp.
4. Any parts removed for access.

AIR INJECTION PIPE ASSEMBLY

FIGURE 93 THRU 97

Remove or Disconnect

1. Hose from check valve.
2. Check Valve
3. Nuts attaching pipes-to-manifold
4. Pipe Assembly

Install or Connect

1. Nuts attaching pipes-to-manifold
2. Check Valve
3. Hose to check valve with clamp.

FILTER

FIGURE 93 THRU 97

Remove or Disconnect

1. Filter from bracket.
2. Hose from air intake and pump.

Install or Connect

1. Hose from air intake and pump.
2. Filter to bracket.

SILENCER - 4.8L

FIGURE 93

Remove or Disconnect

1. Hose from silencer.
2. silencer from bracket.

Install or Connect

1. silencer to bracket
2. Hose to silencer.

DECELERATION VALVE

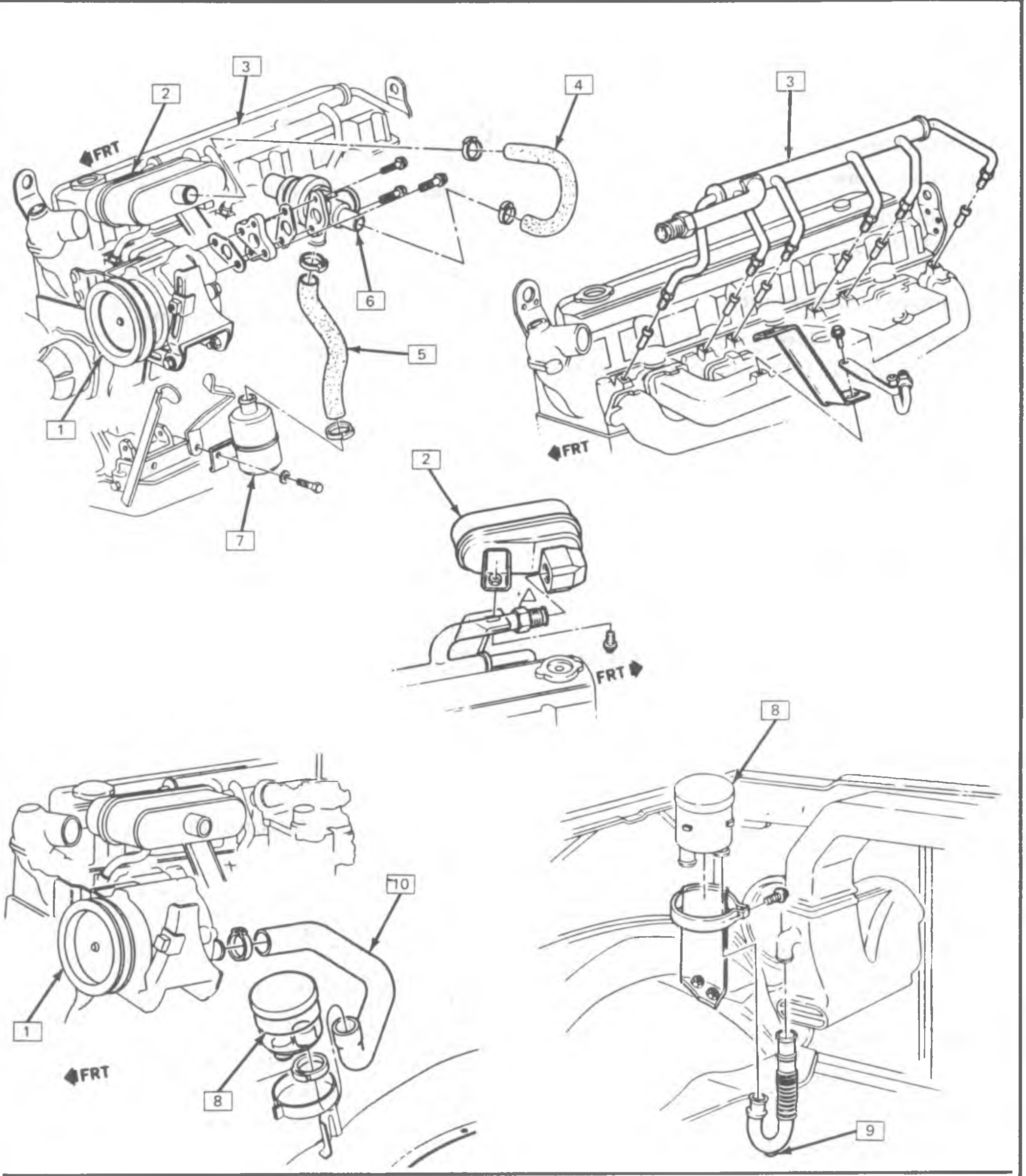
FIGURES 98 OR 101

Remove or Disconnect

1. Vacuum hoses from valve.
2. Screws securing valve to bracket.
3. Deceleration valve.

Install or Connect

1. Deceleration valve.
2. Screws securing valve to bracket.
3. Vacuum hoses to valve.



1 A.I.R. PUMP–TIGHTEN MOUNTING SCREWS TO 25 N·m (18 FT. LBS.)

2 CHECK VALVE–TIGHTEN NUT TO 35 N·m (26 FT. LBS.)

3 AIR INJECTION PIPE–TIGHTEN NUTS TO 28 N·m (20 FT. LBS.)

4 HOSE–AIR CONTROL VALVE TO CHECK VALVE

5 HOSE–SILENCER TO AIR CONTROL VALVE

6 HIGH FLOW ELECTRIC AIR CONTROL VALVE–TIGHTEN ATTACHING BOLTS TO 10 N·m (94 IN. LBS.)

7 SILENCER

8 FILTER

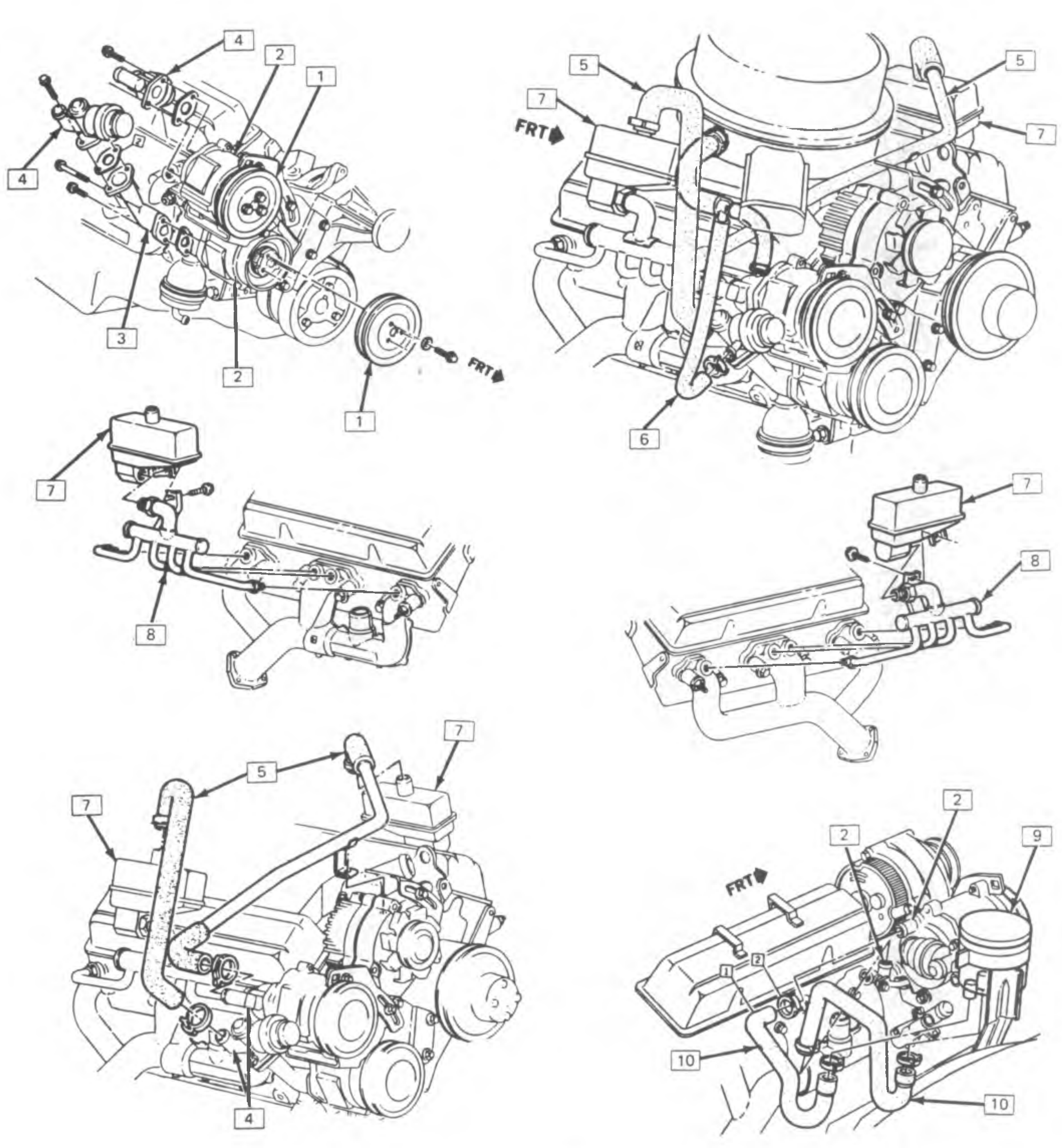
9 DUCT (DRAIN HOLE MUST POINT DOWNWARD)

10 HOSE–FILTER TO PUMP

10 15 84

5S 1958-6E

Figure 93 AIR System - 4.8L Engine



1 PULLEY–TIGHTEN SCREWS TO 15 N·m (10 FT. LBS.). TIGHTEN AGAIN WITHIN 10 MINUTES TO 15 N·m (10 FT. LBS.)

2 A.I.R. PUMP–TIGHTEN MOUNTING SCREWS TO 50 N·m (36 FT. LBS.)

3 ADAPTER–TIGHTEN SCREWS TO 25 N·m (18 FT. LBS.)

4 AIR CONTROL VALVE–TIGHTEN SCREWS TO 25 N·m (18 FT. LBS.)

5 HOSE–AIR CONTROL VALVE TO CHECK VALVE

6 HOSE–AIR CONTROL VALVE TO AIR CLEANER

7 CHECK VALVE–TIGHTEN NUT TO 35 N·m (25 FT. LBS.)

8 AIR INJECTION PIPE–TIGHTEN NUTS TO 25 N·m (18 FT. LBS.)

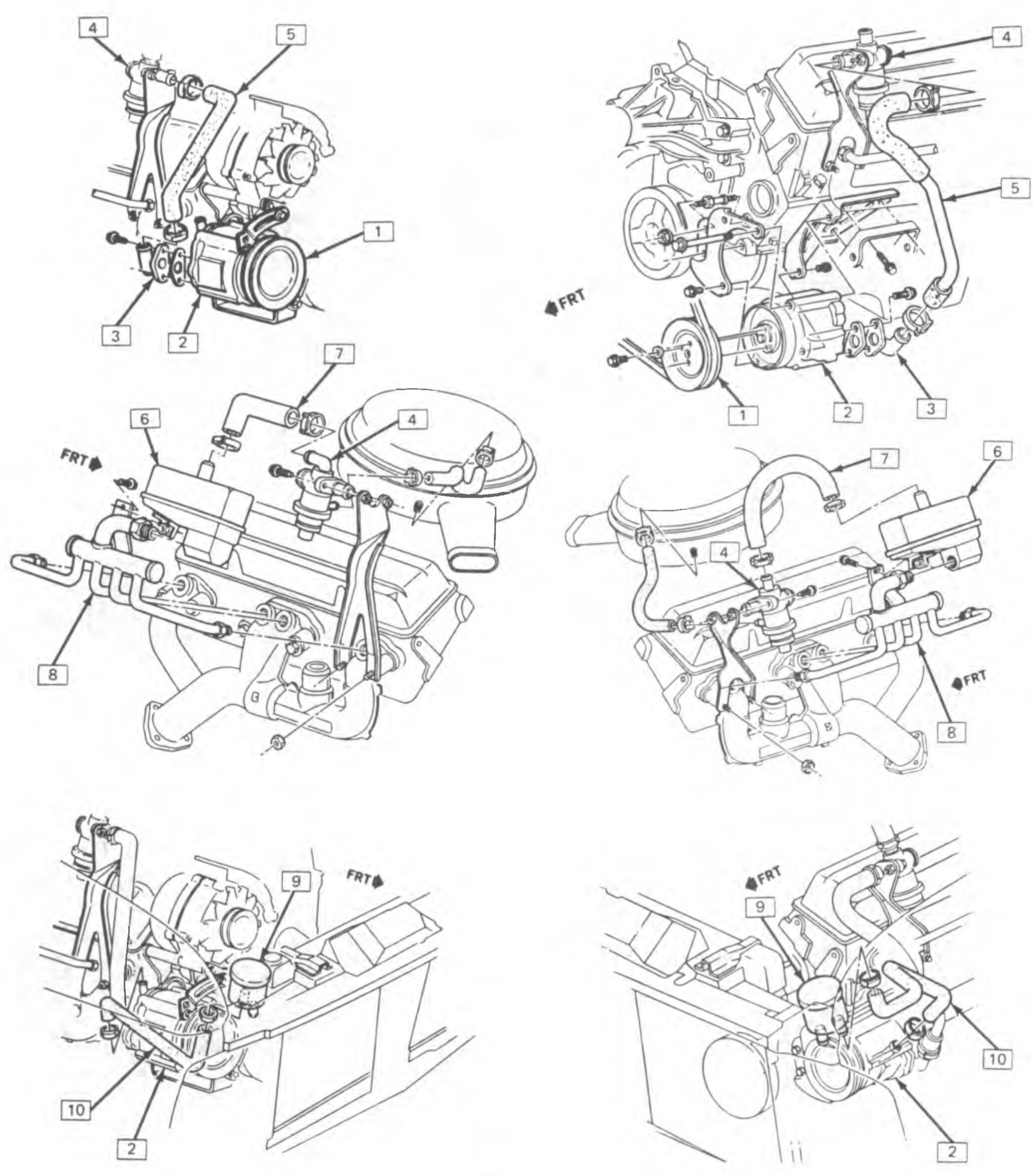
9 FILTER–DRAIN HOLE ON INLET HOSE MUST POINT DOWNWARD

10 HOSE–FILTER TO PUMP

10 15 84

5S 1959-6E

Figure 94 AIR System - 5.7L (CK)



1 PULLEY–TIGHTEN SCREWS TO 15 N·m (10 FT. LBS.). TIGHTEN AGAIN WITHIN 10 MINUTES TO 15 N·m (10 FT. LBS.).

2 A.I.R. PUMP-TIGHTEN MOUNTING SCREWS TO 25N·m (18FT.LBS).

3 ADAPTER–TIGHTEN SCREWS TO 25 N·m (18 FT. LBS.)

4 AIR CONTROL VALVE–TIGHTEN SCREWS TO 25 N·m (18 FT. LBS.)

5 HOSE–PUMP TO AIR CONTROL VALVE

6 CHECK VALVE–TIGHTEN NUT TO 35 N·m (26 FT. LBS.)

7 HOSE–AIR CONTROL VALVE TO CHECK VALVE

8 AIR INJECTION PIPE–TIGHTEN NUTS TO 28 N·m (20 FT. LBS.)

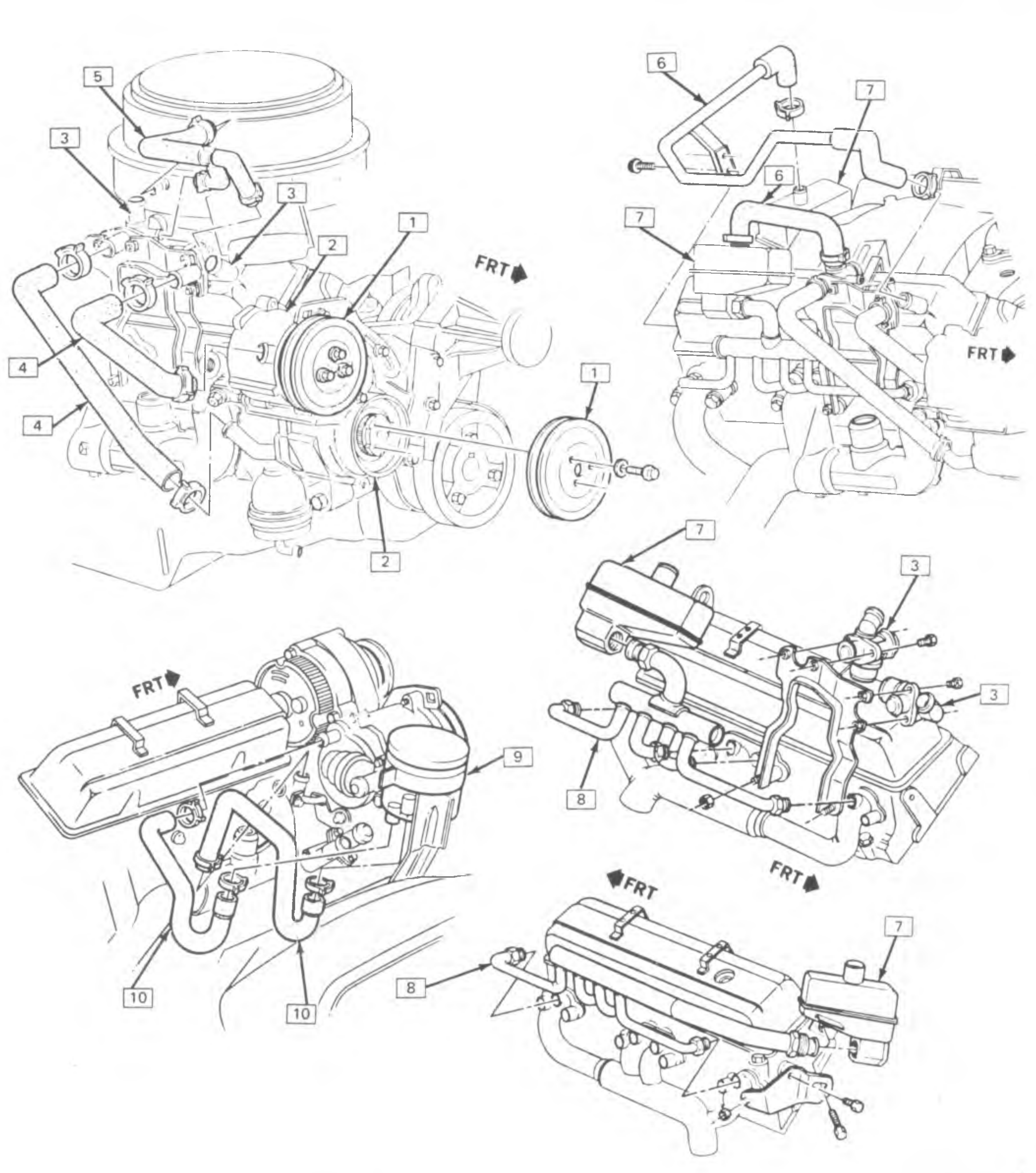
9 FILTER–DRAIN HOLE IN INLET HOSE MUST POINT DOWNWARD

10 HOSE–FILTER TO PUMP

10 15 84

5S 1960-6E

Figure 95 AIR System - 5.7L (G)



1 PULLEY—TIGHTEN SCREWS TO 15 N·m (10 FT. LBS.) TIGHTEN AGAIN WITHIN 10 MINUTES TO 15 N·m (10 FT. LBS.)

2 A.I.R. PUMP—TIGHTEN MOUNTING SCREWS TO 50 N·m (36 FT. LBS.)

3 AIR CONTROL VALVE—TIGHTEN SCREWS TO 25 N·m (18 FT. LBS.)

4 HOSE—PUMP TO AIR CONTROL VALVE

5 HOSE—AIR CONTROL VALVES TO AIR CLEANER

6 HOSE—AIR CONTROL VALVE TO CHECK VALVE

7 CHECK VALVE—TIGHTEN NUT TO 35 N·m (26 FT. LBS.).

8 AIR INJECTION PIPE—TIGHTEN NUTS TO 28 N·m (20 FT. LBS.)

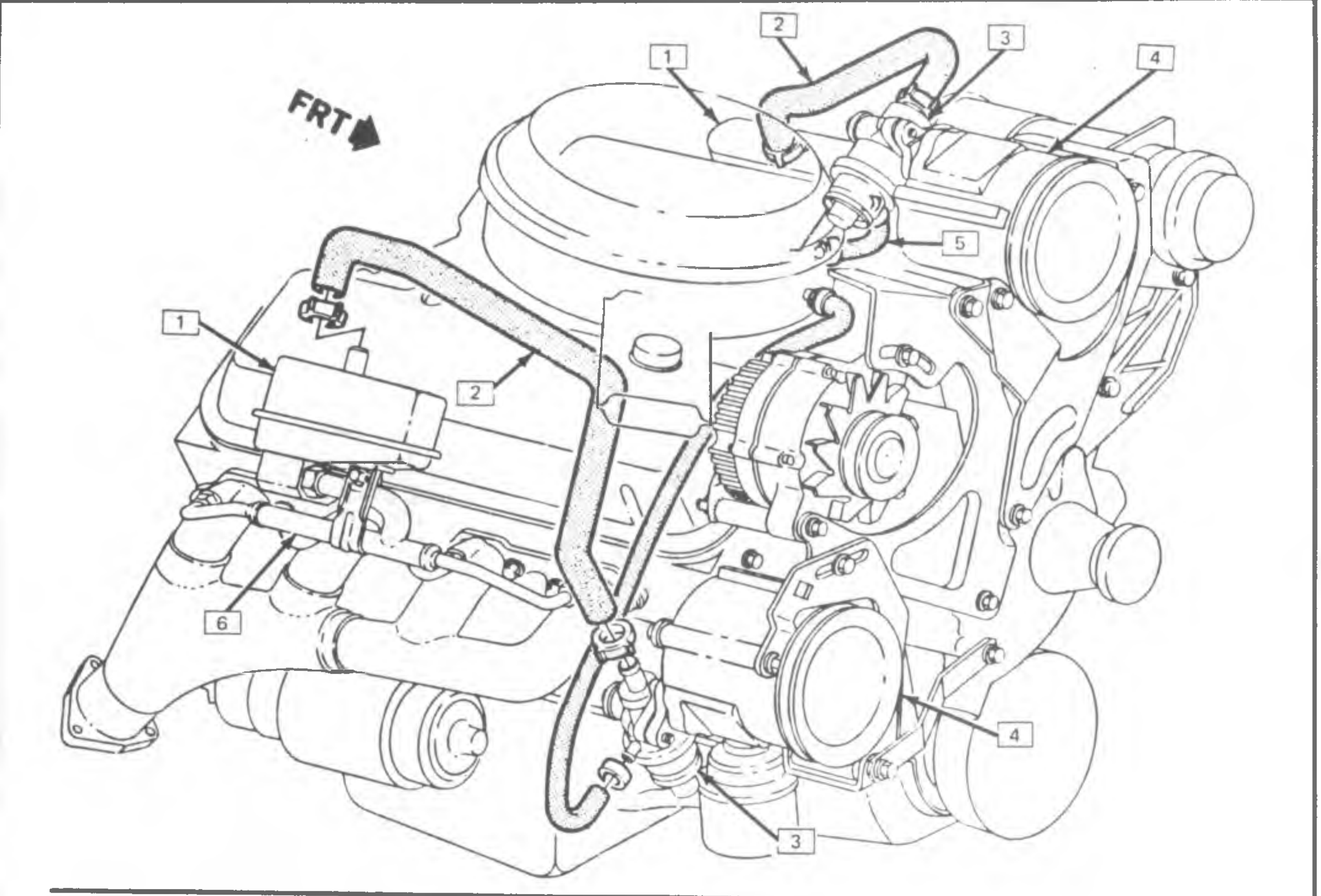
9 FILTER—DRAIN HOLE ON INLET HOSE MUST POINT DOWNWARD

10 HOSE—FILTER TO PUMP

10 15 84

5S 1971-6E

Figure 96 AIR System - 5.7L (P)



1	CHECK VALVE—TIGHTEN TO 35 N·m (26 FT. LBS.)
2	HOSE—VALVE TO CHECK VALVE
3	AIR CONTROL VALVE—TIGHTEN MOUNTING SCREWS TO 25 N·m (18 FT. LBS.)
4	A.I.R. PUMP—TIGHTEN MOUNTING SCREWS TO 25 N·m (18 FT. LBS.)
5	HOSE—VALVE TO AIR CLEANER
6	AIR INJECTION PIPE (TIGHTEN NUTS TO 28 N·m/ 20 FT. LBS.) RIGHT SHOWN—LEFT SIMILAR

10 15 84

5S 1961-6E

Figure 97 AIR System - 7.4L Engine

CONTROL MODULE

FIGURES *102 OR 106*

←→ Remove or Disconnect

1. Electrical connector.
2. Control module.

→← Install or Connect

1. Control module.
2. Electrical connector.

CONTROL RELAY (7.4L ONLY)

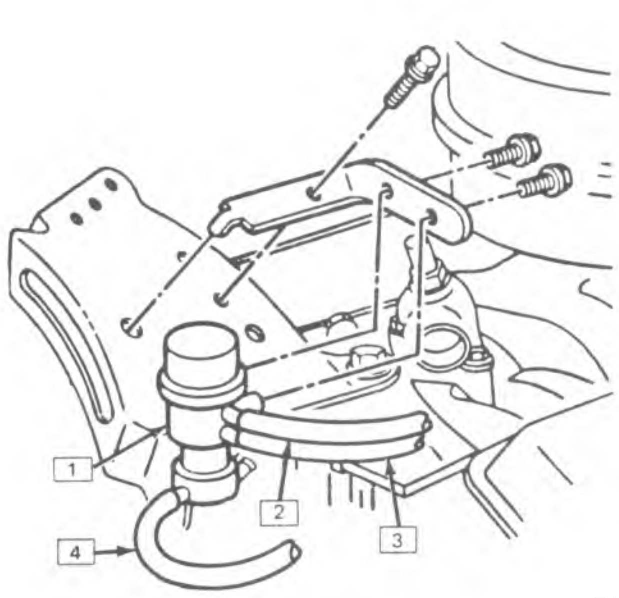
FIGURES *103, 105, or 106*

←→ Remove or Disconnect

1. Electrical connector.
2. Control module.

→← Install or Connect

1. Control module.
2. Electrical connector.



1 DECELERATION VALVE

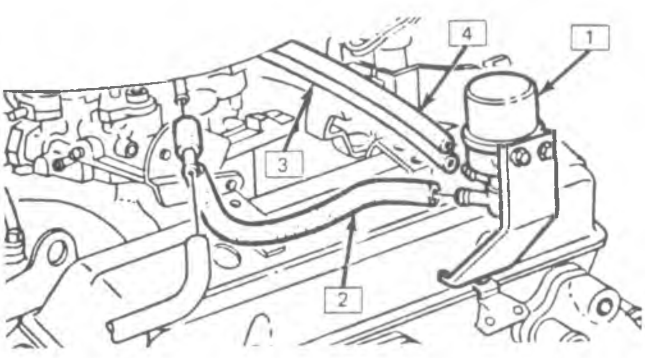
2 HOSE–MANIFOLD VACUUM

3 HOSE–VALVE-TO INTAKE MANIFOLD

4 HOSE–AIR CLEANER-TO-VALVE

10 15 84 5S 1963-6E

Figure 98 Deceleration Valve



1 DECELERATION VALVE

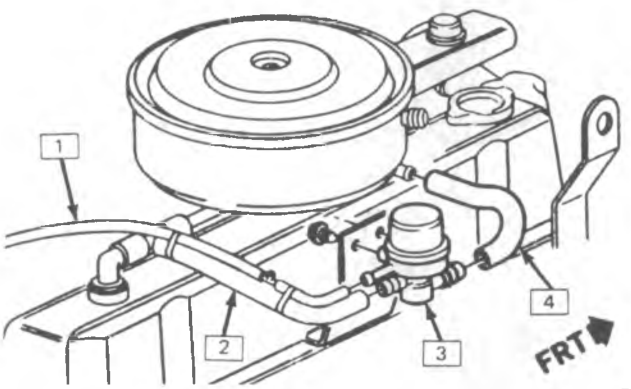
2 HOSE–AIR CLEANER--TO-VALVE

3 HOSE–VALVE TO INTAKE MANIFOLD

4 HOSE–MANIFOLD VACUUM

10 15 84 5S 1964-6E

Figure 99 Deceleration Valve - 4.3L



1 HOSE–MANIFOLD VACUUM

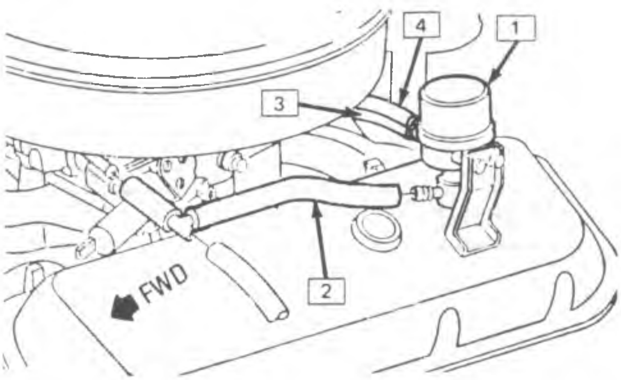
2 HOSE–VALVE-TO-INTAKE MANIFOLD

3 DECELERATION VALVE

4 HOSE–AIR CLEANER-TO VALVE

10 15 84 5S 1965-6E

Figure 100 Deceleration Valve - 4.8L



1 DECELERATION VALVE

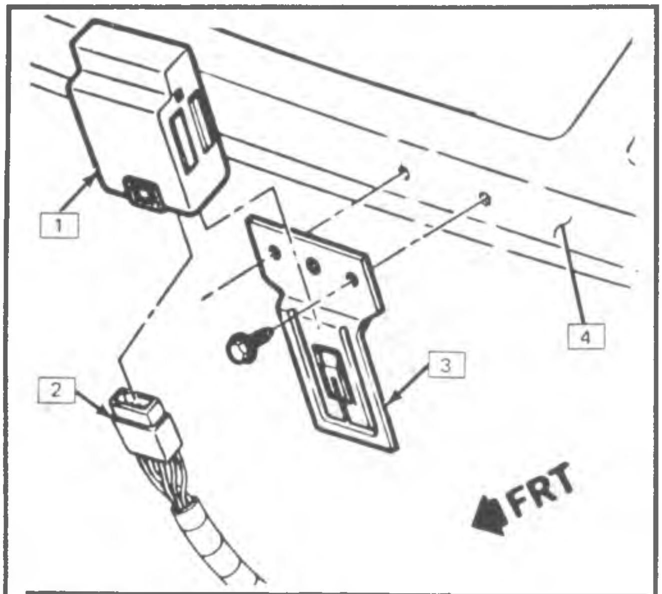
2 HOSE–AIR CLEANER-TO-VALVE

3 HOSE–MANIFOLD VACUUM

4 HOSE–VALVE-TO-INTAKE MANIFOLD

10 15 84 5S 1962-6E

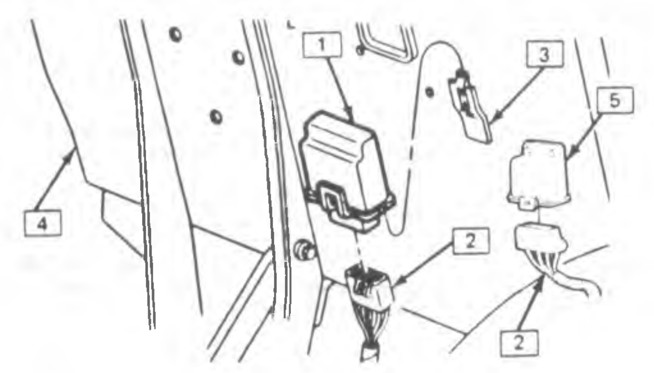
Figure 101 Deceleration Valve - 7.4L



1 CONTROL MODULE
2 ELECTRICAL CONNECTOR
3 BRACKET
4 PLENUM PANEL

10 15 84 5S 1967-6E

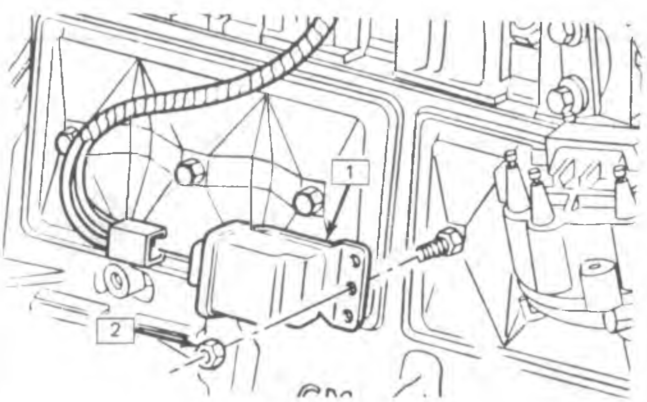
Figure 102 Control Module - 5.7L (G)



1 CONTROL MODULE
2 ELECTRICAL CONNECTOR
3 BRACKET
4 DASH AND TOE PANEL
5 CONTROL RELAY (7.4L ENGINE)

10-7-85 5S 1969-6E

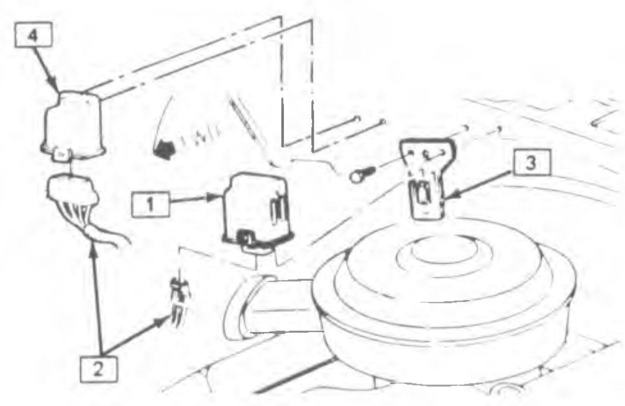
Figure 103 Control Module - 5.7L/7.4L (P42)



1 CONTROL MODULE
2 NUT (TIGHTEN TO 20 N·m/15 FT. LBS.)

10 15 84 5S 1968-6E

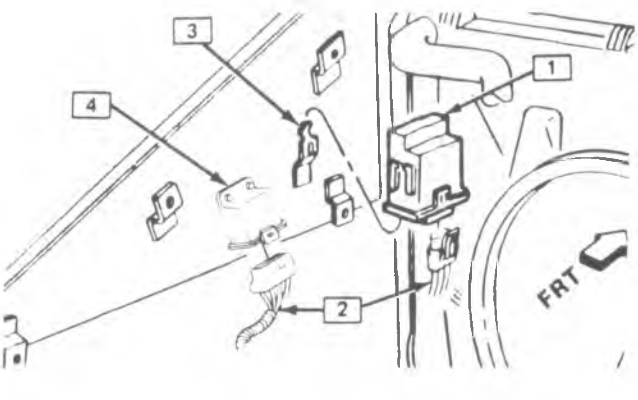
Figure 104 Control Module - 4.8L



1 CONTROL MODULE
2 ENGINE WIRING HARNESS
3 BRACKET
4 CONTROL RELAY (7.4L ENGINE)

10-7-85 5S 1966-6E

Figure 105 Control Module - 5.7L/7.4L (CK)



1 CONTROL MODULE
2 ELECTRICAL CONNECTOR
3 BRACKET
4 CONTROL RELAY

10-7-85 5S 1970-6E

Figure 106 Control Module - 7.4L (P32)

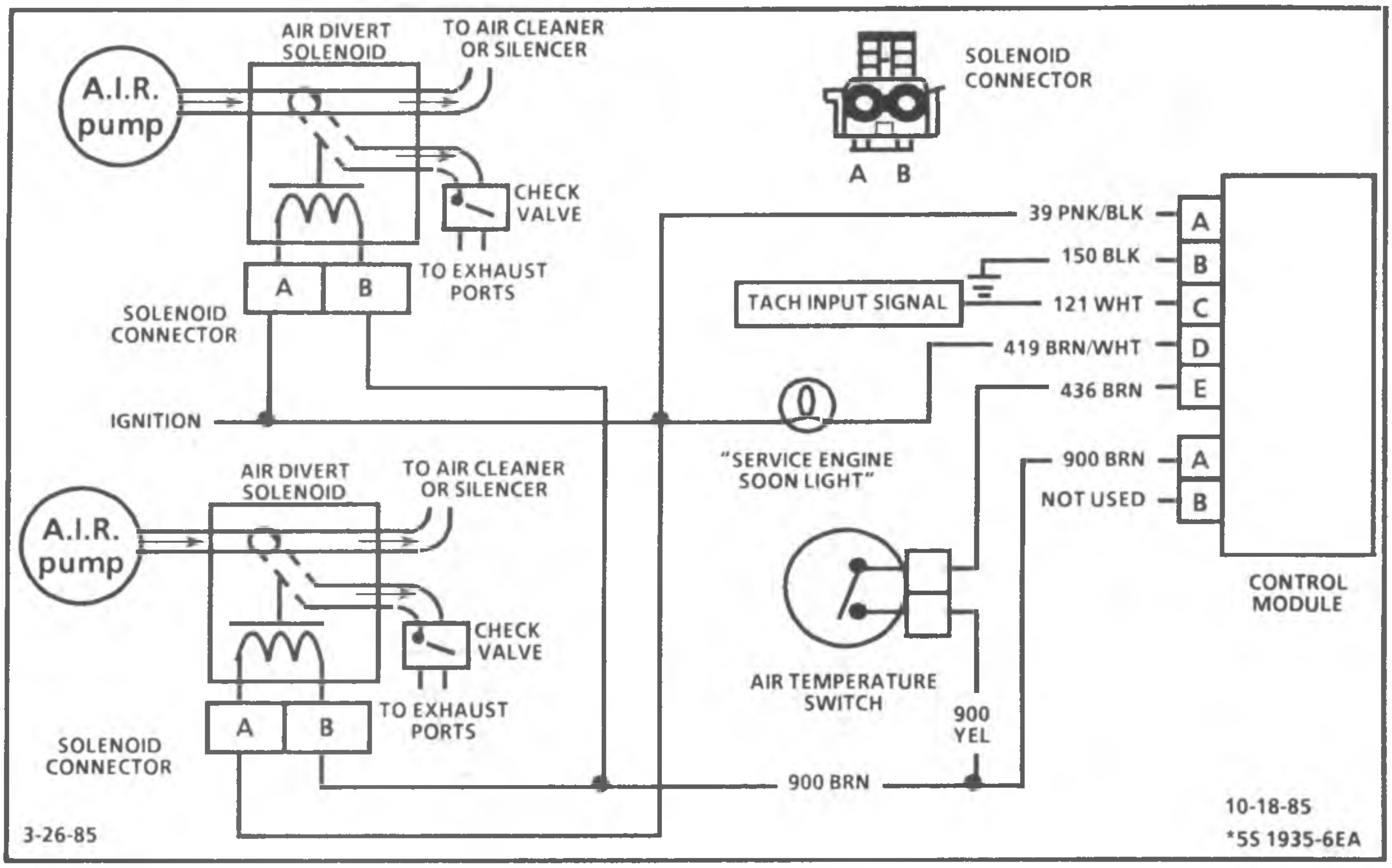


CHART C-6HD-1

AIR MANAGEMENT SYSTEM

5.7L ENGINE

(VEHICLE OVER 8500 GVW)

"SERVICE ENGINE SOON" LIGHT IS "ON"

The illumination of the "Service Engine Soon" light indicates that there is a malfunction in the solenoid, control module, or wiring.

Check solenoid and module connectors for proper connection.

1. Disconnect Air Temperature Switch and install a jumper wire across the terminals.
2. With ignition on, disconnect each solenoid connector and with a test light, check for a light from the pink/black wire to ground.
   - If light does not illuminate, check for an open in circuit 39 to the solenoid.
   - If light illuminates, check for a light across terminals. Circuit is O.K. if there is a light. Check solenoid coil resistance and if less than 20 ohms, replace solenoid and valve. If there is no light, check for an open in circuit 900 to the Air Temperature Switch, an open in circuit 436 or faulty Control Module.
3. Connect solenoid connectors and disconnect both connectors at Control Module. Check for a light between terminals "A" and "B" of the 5 pin connector.
   - If the test light does not illuminate, check for an open circuit to the module.
   - If the test light illuminates, check for a light between 5 pin connector harness terminals "A" and "D".
     - If the test light illuminates, check for a short to ground in circuit 419.
     - If the test light does not illuminate, check for an open in circuit 900 between the solenoid terminal "B" and the module 2 pin connector terminal "A". If circuit 900 is not open, replace the Control Module.

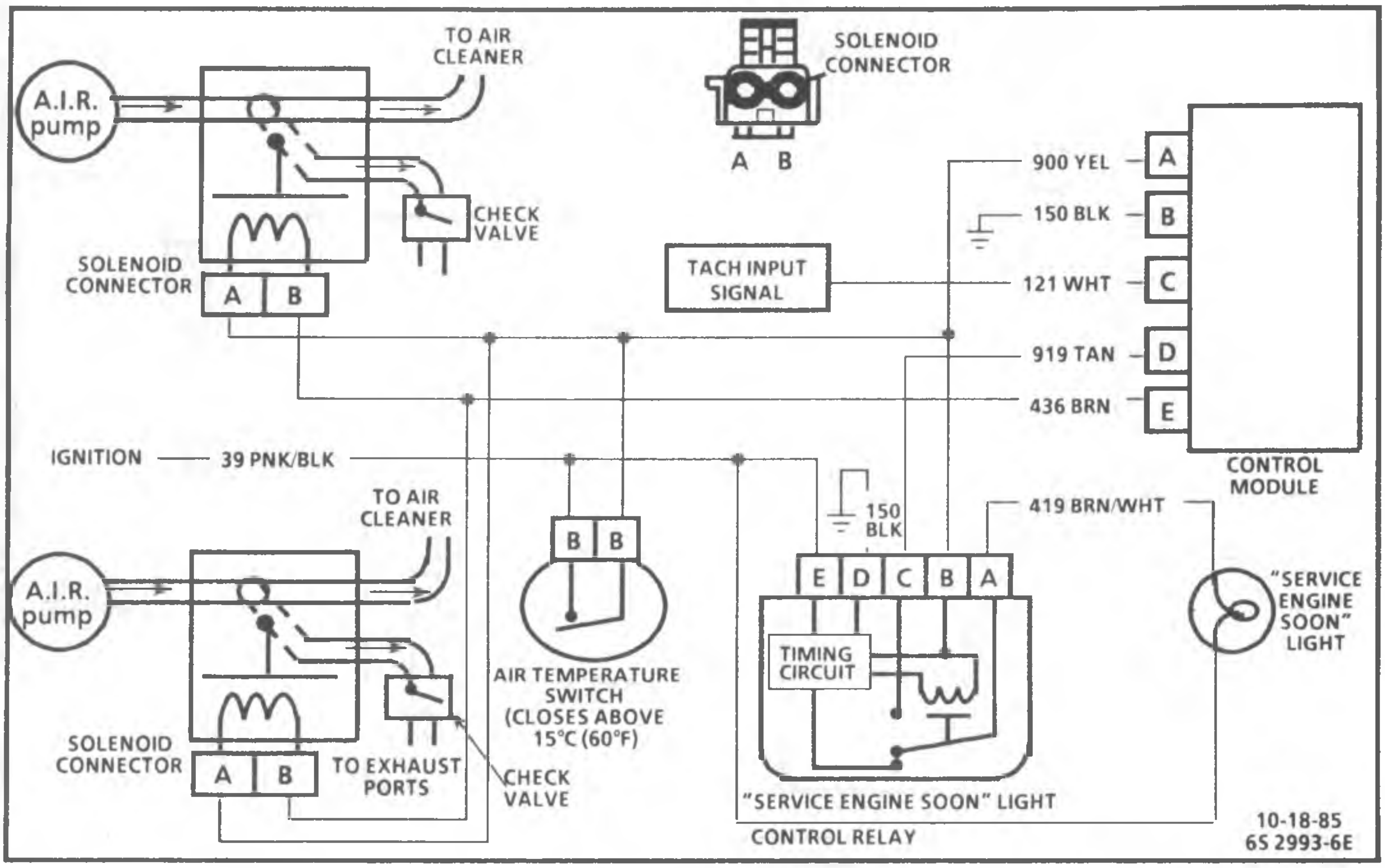


CHART C-6HD-2

AIR MANAGEMENT SYSTEM

7.4L ENGINE

(Vehicle Over 8500 GVW)

"SERVICE ENGINE SOON" LIGHT IS "ON"

The illumination of the "Service Engine Soon" light indicates that there is a malfunction in the solenoid, control module, control relay or wiring.

Before diagnosis, check the solenoid and module connectors for proper connection.

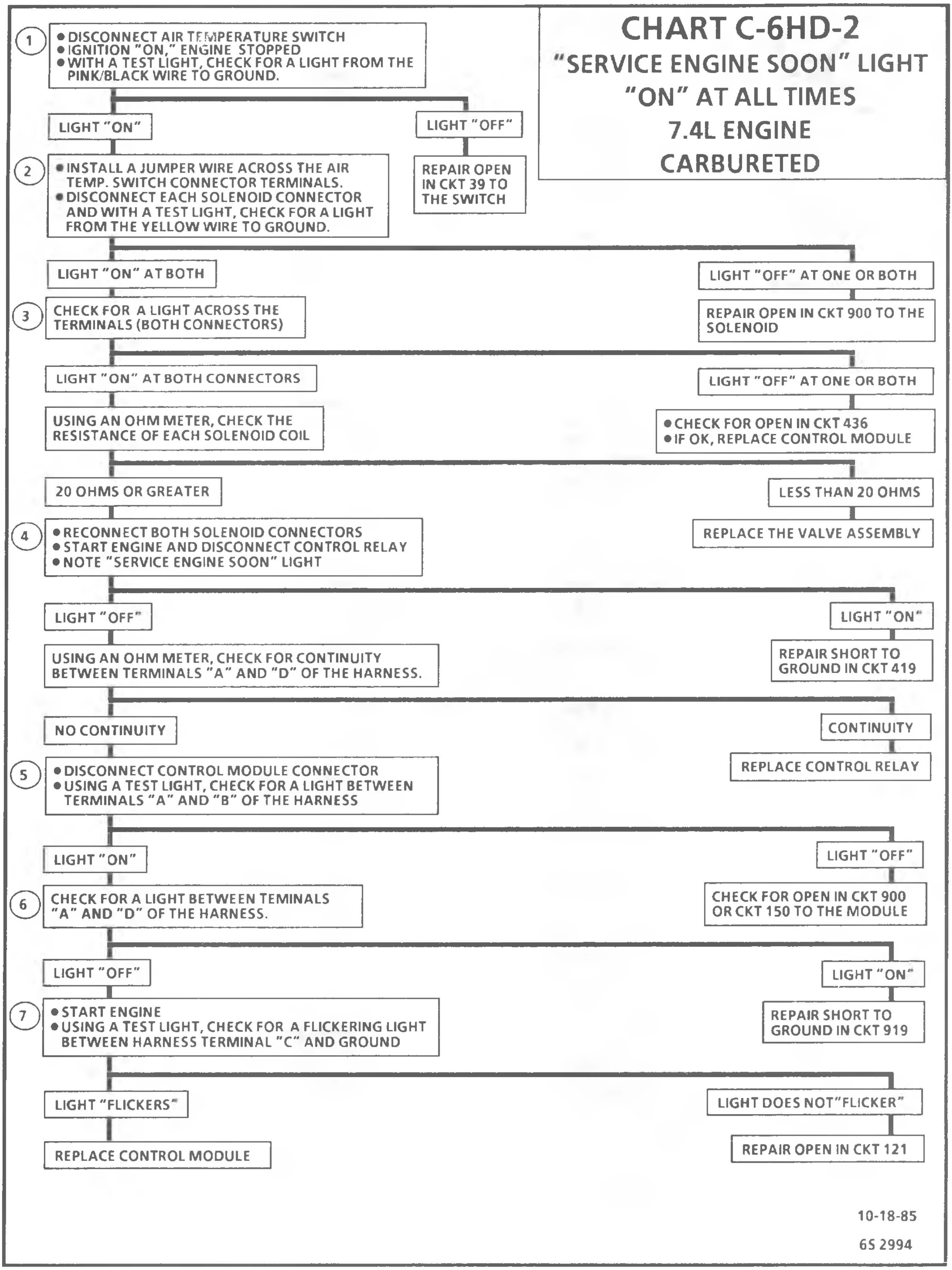
1. This step is to determine if there is power to the Air Temperature Switch.
2. This step will insure that there is power to the circuit by eliminating the Air Temperature Switch.

   This step will also check the wiring between the Air Temperature Switch and the Solenoids.
3. This step will check the wiring between the solenoids and ground including the circuit inside the Control Module.
4. This step will determine if the problem is a short to ground in the "Service Engine Soon" light circuit or a malfunction in the Air Management System.
5. This step checks for Bat. (+) at "A" and a ground at "B", to power up the Control Module.
6. This step will determine if a ground signal is sent to the relay because CKT 919 is grounded outside the module.
7. This step checks for a Tach signal to the Control Module

CHART C-6HD-2

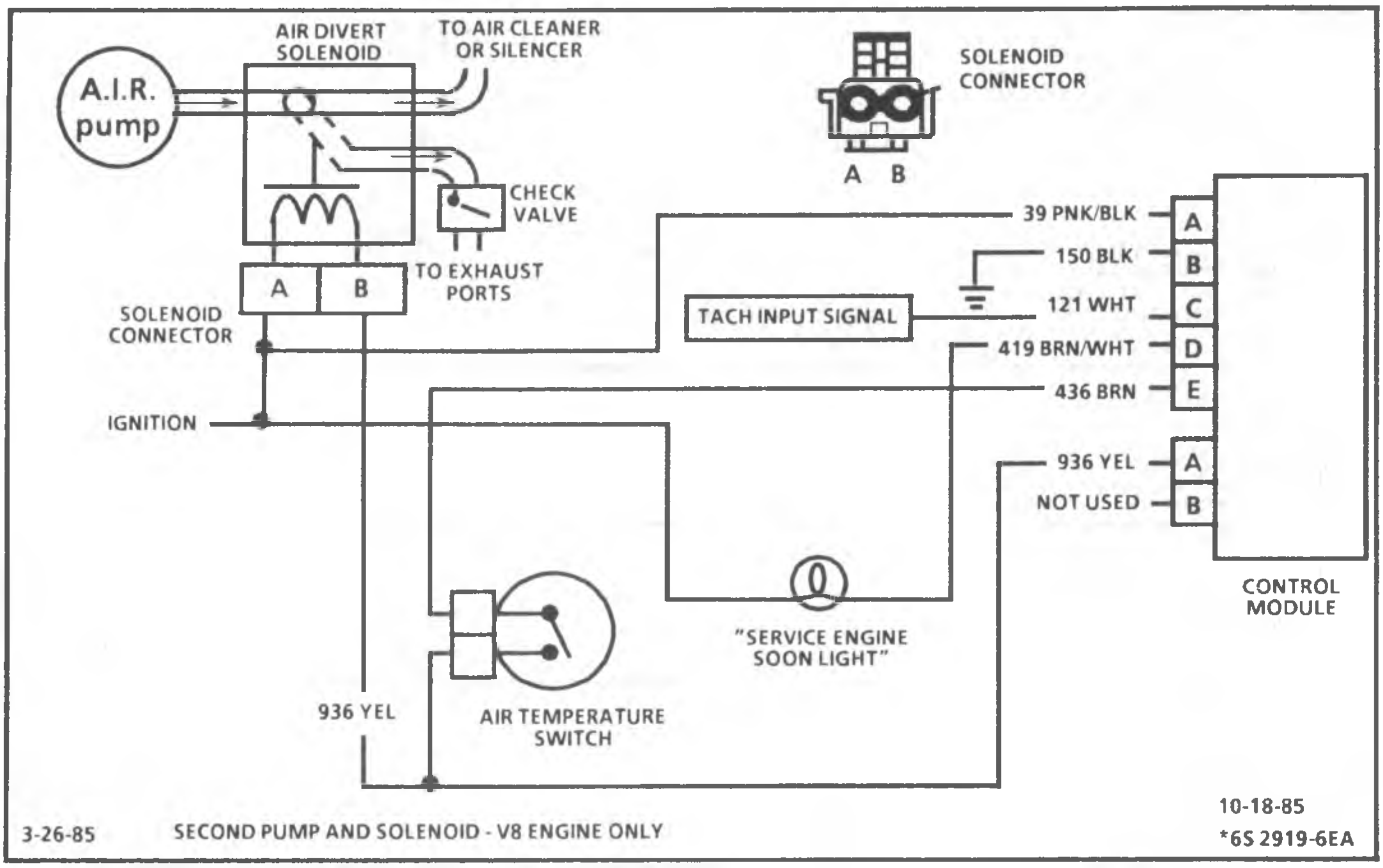
"SERVICE ENGINE SOON" LIGHT "ON" AT ALL TIMES

7.4L ENGINE CARBURETED



10-18-85

6S 2994



SECOND PUMP AND SOLENOID - V8 ENGINE ONLY

CHART C-6HD-3

AIR MANAGEMENT SYSTEM

4.8L ENGINE

(VEHICLE OVER 8500 GVW)

"SERVICE ENGINE SOON" LIGHT IS "ON"

The illumination of the "Service Engine Soon" light indicates that there is a malfunction in the solenoid, control module, or wiring.

Check solenoid and module connectors for proper connection.

1. Disconnect Air Temperature Switch and install a jumper wire across the terminals.
2. With ignition on, disconnect solenoid connector and with a test light, check for a light from the pink/black wire to ground.
   - If light does not illumlinate, check for an open in circuit 39 to the solenoid.
   - If light illuminates, check for a light across terminals. Circuit is O.K. if there is a light. Check solenoid coil resistance and if less than 20 ohms, replace solenoid and valve. If there is <u>no</u> light, check for an open in circuit 936 to the Air Temperature Switch, an open in circuit 436 or faulty Control Module.
3. Connect solenoid connector and disconnect both connectors at Control Module. Check for a light between terminals "A" and "B" of the 5 pin connector.
   - If the test light does not illuminate, check for an open circuit to the module.
   - If the test light illuminates, check for a light between 5 pin connector harness terminals "A" and "D".
     - If the test light illuminates, check for a short to ground in circuit 419.
     - If the test light does not illuminate, check for an open in circuit 936 between the solenoid terminal "B" and the module 2 pin connector terminal "A". If circuit 936 is not open, replace the Control Module.

BLANK

EXHAUST GAS RECIRCULATION (EGR) SYSTEM

ALL ENGINES EXCEPT 4.8L & 7.4L FED

GENERAL DESCRIPTION

PURPOSE

The EGR system is used to lower NOx (oxides of nitrogen) emission levels caused by high combustion temperatures. It does this by decreasing combustion temperature.

The EGR system has a negative backpressure EGR valve (Figure 107), hose from a ported manifold vacuum source and a method to control the vacuum source. On an engine without an ECM, a coolant temperature TVS is used to control vacuum and on an engine with an ECM, a solenoid is used to control vacuum.

OPERATION

On an engine without an ECM, the thermostatic vacuum switch (TVS) blocks vacuum to the EGR valve during cold engine operation (Figure 108).

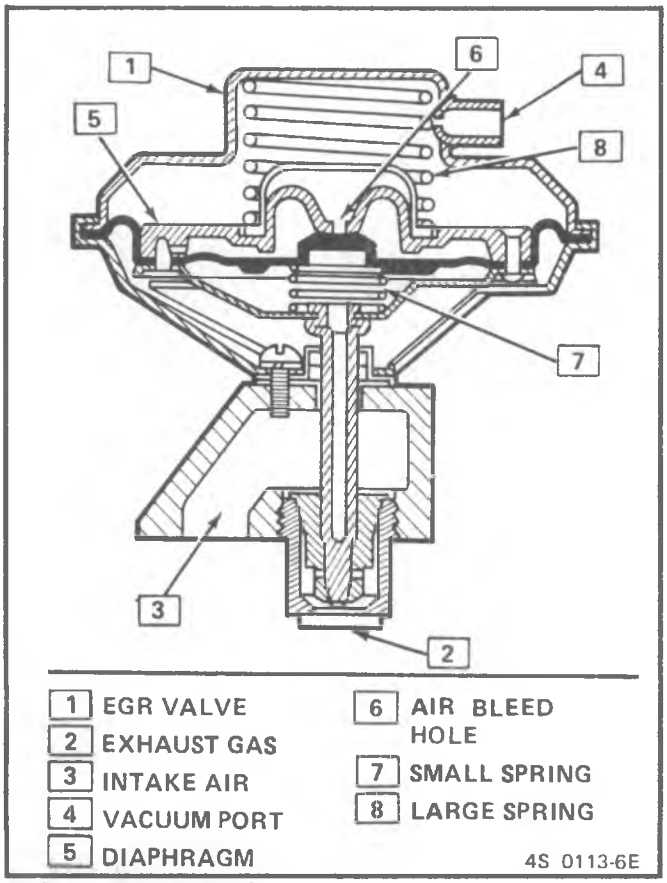


Figure 107 Negative Backpressure EGR Valve

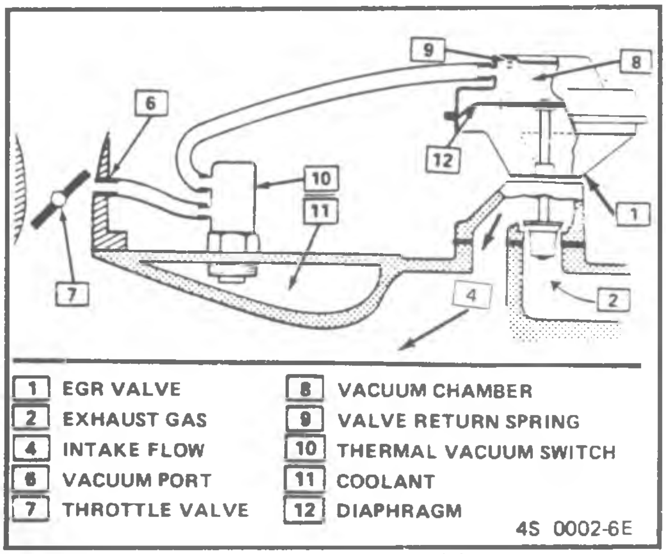


Figure 108 EGR System with TVS

On an engine with an ECM, a vacuum solenoid energized by a signal from the ECM block vacuum to the EGR valve during cold engine operation, cranking and at wide-open throttle (Figure 109).

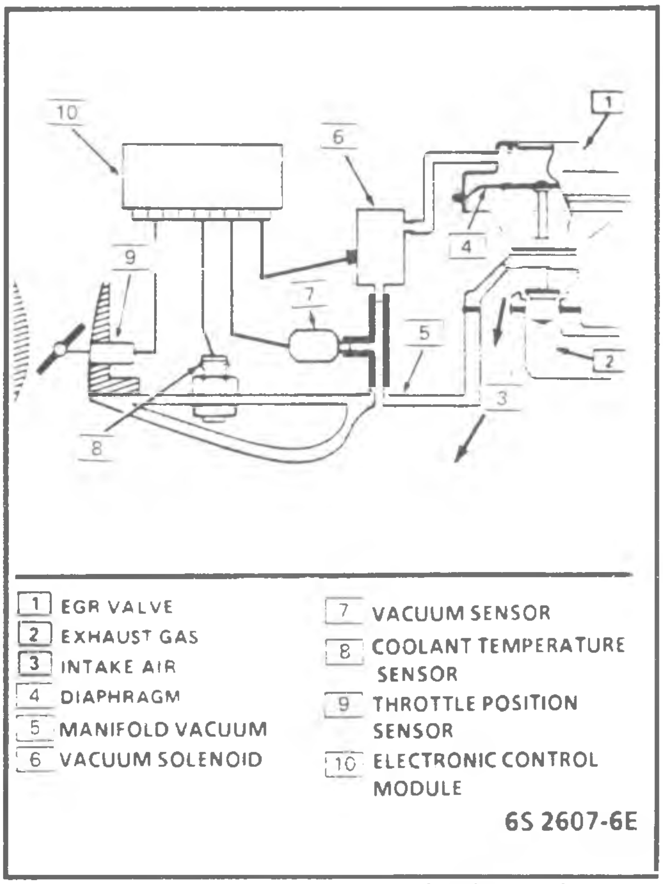


Figure 109 EGR System - with Solenoid

When the engine is warm, the TVS opens or the solenoid de-energizes which opens the vacuum source to the EGR valve. At idle or wide-open throttle, there is little or no vacuum from the vacuum source, the EGR pintle is closed and there is no exhaust gas recirculation. When the engine is above idle speed, the pintle valve rises and a small amount of exhaust gas goes into the combustion chamber. The negative backpressure valve varies the amount of exhaust gas flow into the manifold depending on manifold vacuum and variations in exhaust backpressure.

The diaphragm on the valve has an internal air bleed hole which is held closed by a small spring when there is no exhaust backpressure.

Engine vacuum opens the EGR valve against the pressure of a large spring. When manifold vacuum combines with negative exhaust backpressure, the vacuum bleed hole opens and the EGR valve closes.

This cycle occurs approximately forty times per second during normal engine operation.

If there is enough vacuum signal from the vacuum source to operate the EGR valve, the pintle valve cycles at a greater valve opening when exhaust manifold pressure is high, and intake manifold vacuum is fairly low, and will cycle at a lower valve opening when exhaust manifold pressure is low, and intake manifold vacuum is high.

On engines with an ECM, the EGR System is called "Pulse Width Modulation" (PWM), which means the ECM turns the solenoid "ON" and "OFF" many times a second and varies the amount of "ON" time (Pulse Width) to vary the amount of exhaust gas recirculation.

EGR Bleed Solenoid

On 5.0L and 5.7L Federal engines with light duty emissions and automatic transmission, an EGR bleed solenoid is connected in the transmission converter clutch circuit. When the transmission converter clutch applies, the solenoid is energized and the vacuum to the EGR valve is reduced to about half normal value.

DIAGNOSIS

EGR SYSTEM

Too much EGR flow tends to weaken combustion, causing the engine to run roughly or stop. With too much EGR flow at idle, cruise, or cold operation, any of the following conditions may happen:

- Engine stops after cold start.
- Engine stops at idle after deceleration.
- Vehicle 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.

System Check

Diagnosis of the EGR system is covered in charts at the end of this system.

- CHART C-7A for Pulse Width Modulated EGR System Check - ECM Controlled.
- CHART C-7C for EGR System Check - Non-ECM Controlled.

EGR VALVE

Refer to EGR System Checks at the end of this section for diagnosis of the EGR valve.

The valve will open if vacuum is applied with the engine not running.

VACUUM SOLENOID

Refer to EGR System Check in CHART C-7E for diagnosis of the vacuum solenoid.

EGR BLEED SOLENOID

Refer to EGR Bleed Solenoid in Chart C-7D to check diagnosis of the solenoid.

THERMOSTATIC VACUUM SWITCH

A thermal vacuum switch opens, closes, or switches vacuum source when the calibration temperature is reached. The following general checking procedures can be used for all thermal vacuum switches. Refer to number stamped on base of valve or switch for calibration temperature.

1. Allow TVS to cool below calibration temperature.
2. Inspect switch to make sure it is in good condition.
3. Connect vacuum gage(s) to output port (s) of the TVS. (See vacuum hose schematic on Vehicle Control Emission Information label).
4. Compare vacuum gage reading(s) with the procedures and in the TVS descriptions given under each valve name.
5. Heat TVS to a temperature above the calibration temperature. Never apply a torch or open flame directly to the TVS.
6. Compare vacuum gage reading to the correct reading indicated on switch or valve base.

   NOTICE; Leakage of up to 7 kPa (2" HG) vacuum in 2 minutes is allowable and does not mean a defective part.
7. If operation is satisfactory, re-install valve or switch. If valve or switch is defective, replace with a new part.

ON-VEHICLE SERVICE

CLEANING MANIFOLD PASSAGE

Inspect

If EGR passages in the inlet manifold indicate excessive build-up of deposits, the passages should be cleaned. Care should be taken to ensure that all loose particles are completely removed to prevent them from clogging the EGR valve or from being ingested into the engine.

Do not wash EGR valve in solvents or degreaser - permanent damage to valve diaphragm may result. Also, sand blasting of the valve is not recommended since this can affect the operation of the valve.

System Hoses

Refer to Vehicle Emission Control Information label for routing of system hoses.

When replacing hoses, use hose identified with the word "Fluoroelastromer".

EGR VALVE

Identification

Refer to Figure 110 to identify a negative backpressure EGR valve.

Remove or Disconnect

1. Air Cleaner.
2. EGR valve vacuum hose at valve. (Figure 111 or 112).
3. Bolts.
4. EGR valve from manifold.

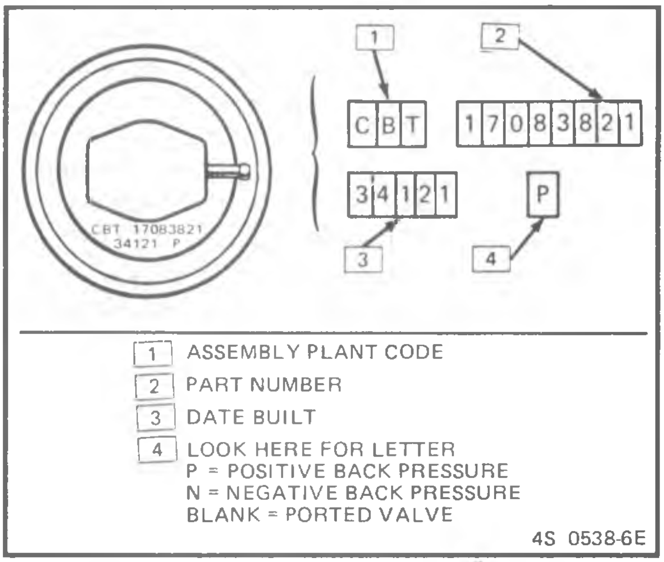


Figure 110 EGR Valve Identification

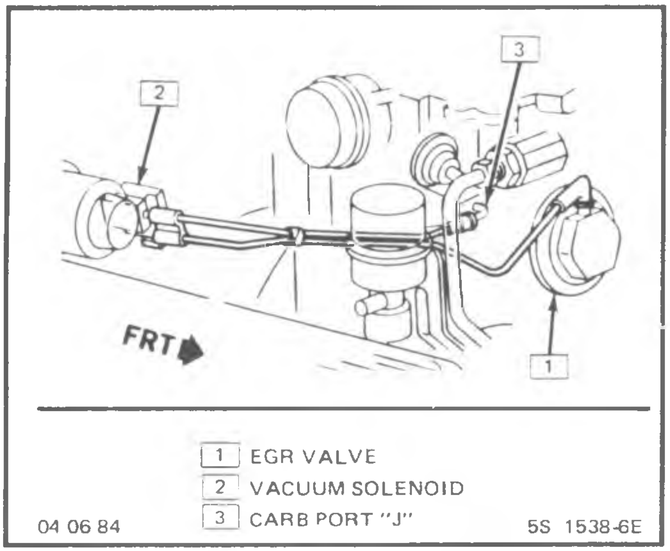


Figure 111 EGR Valve & Solenoid - 4.3L Cal.

Install or Connect

1. EGR valve to manifold (use new gasket).
2. Bolts.
3. Vacuum hose to EGR valve.
4. Air cleaner.

EGR VACUUM SOLENOID

FIGURE 111 OR 112

Remove or Disconnect

1. Negative battery cable.
2. Air cleaner.
3. Electrical connector at solenoid.
4. Vacuum hoses.
5. Nut and solenoid.

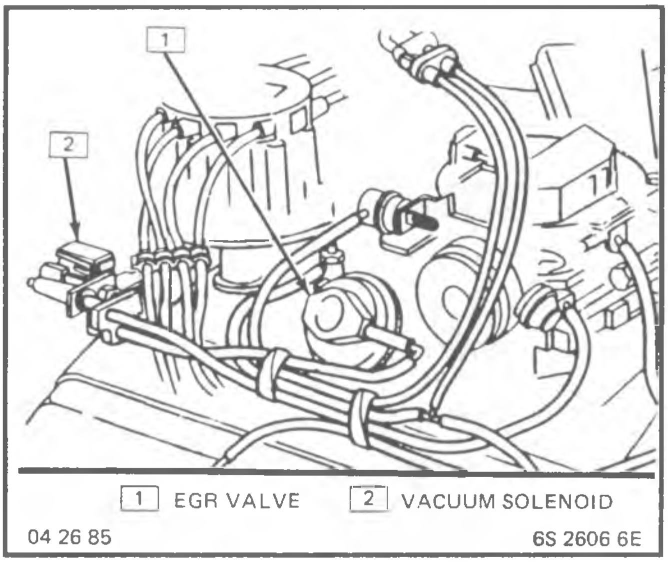


Figure 112 EGR Valve & Solenoid - 5.0L/5.7L Cal.

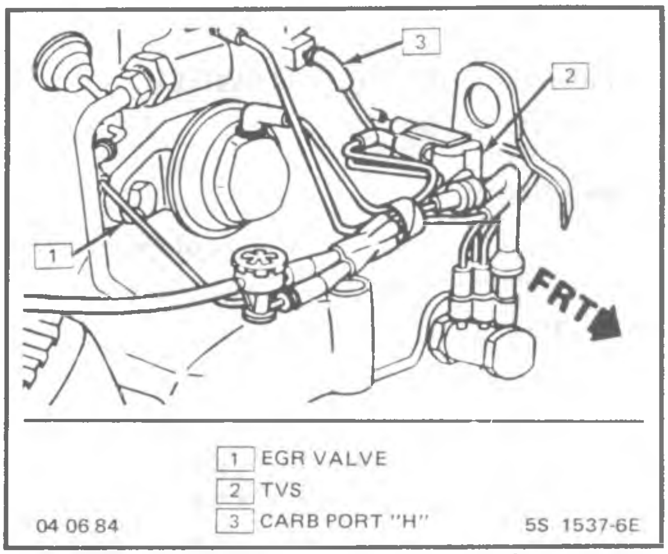


Figure 113 EGR Bleed Solenoid

Install or Connect

1. Solenoid and bracket. Tighten nut to 24 N-m (17 ft. lbs.).
2. Vacuum hoses.
3. Electrical connector.
4. Air cleaner.
5. Negative battery cable.

EGR BLEED SOLENOID

FIGURE 113

Remove or Disconnect

1. Negative battery cable.
2. Air cleaner.
3. Electrical connector at solenoid.
4. Vacuum hoses.
5. Nut and solenoid.

Install or Connect

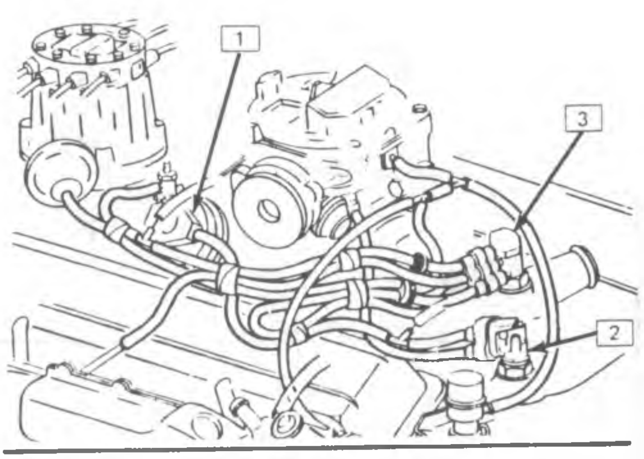
1. Solenoid and bracket. Tighten nut to 24 N-m (17 ft. lbs.).
2. Vacuum hoses.
3. Electrical connector.
4. Air cleaner.
5. Negative battery cable.

THERMOSTATIC VACUUM SWITCH

FIGURES 114 TO 116

Replacement

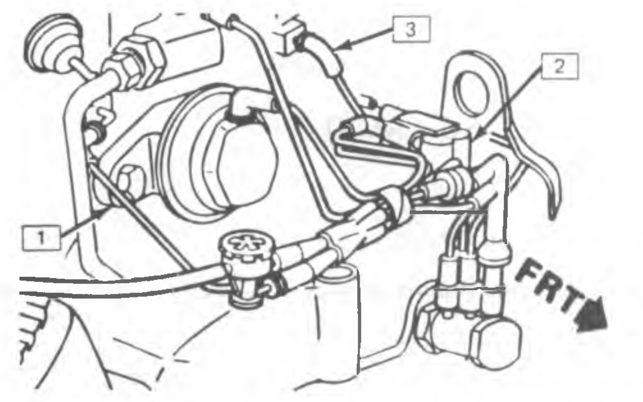
1. Drain coolant below level of thermostatic vacuum switch (TVS).
2. Disconnect vacuum hoses.
3. Remove TVS.
4. Install replacement TVS with soft setting sealant applied to male threads. Sealant should not be on end of TVS.
5. Tighten TVS to 14 N-m (120 in. lbs.) then turn clockwise as required to align with hoses.
6. Connect vacuum hoses.
7. Add coolant as required.



1 EGR VALVE
2 TVS (EGR)
3 TVS (DIST) EFE

4S 1049-6E

Figure 115 TVS Location,5.0L-LE9, Federal, 5.7L-LS9, Federal, 5.7L-LT9,California

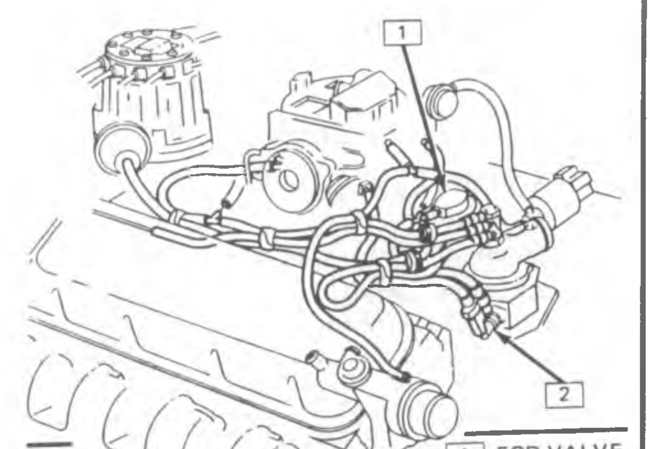


1 EGR VALVE
2 TVS
3 CARB PORT "H"

04 06 84

5S 1537-6E

Figure 114 TVS Location, 4.3L, Federal



1 EGR VALVE
2 TVS (EGR)

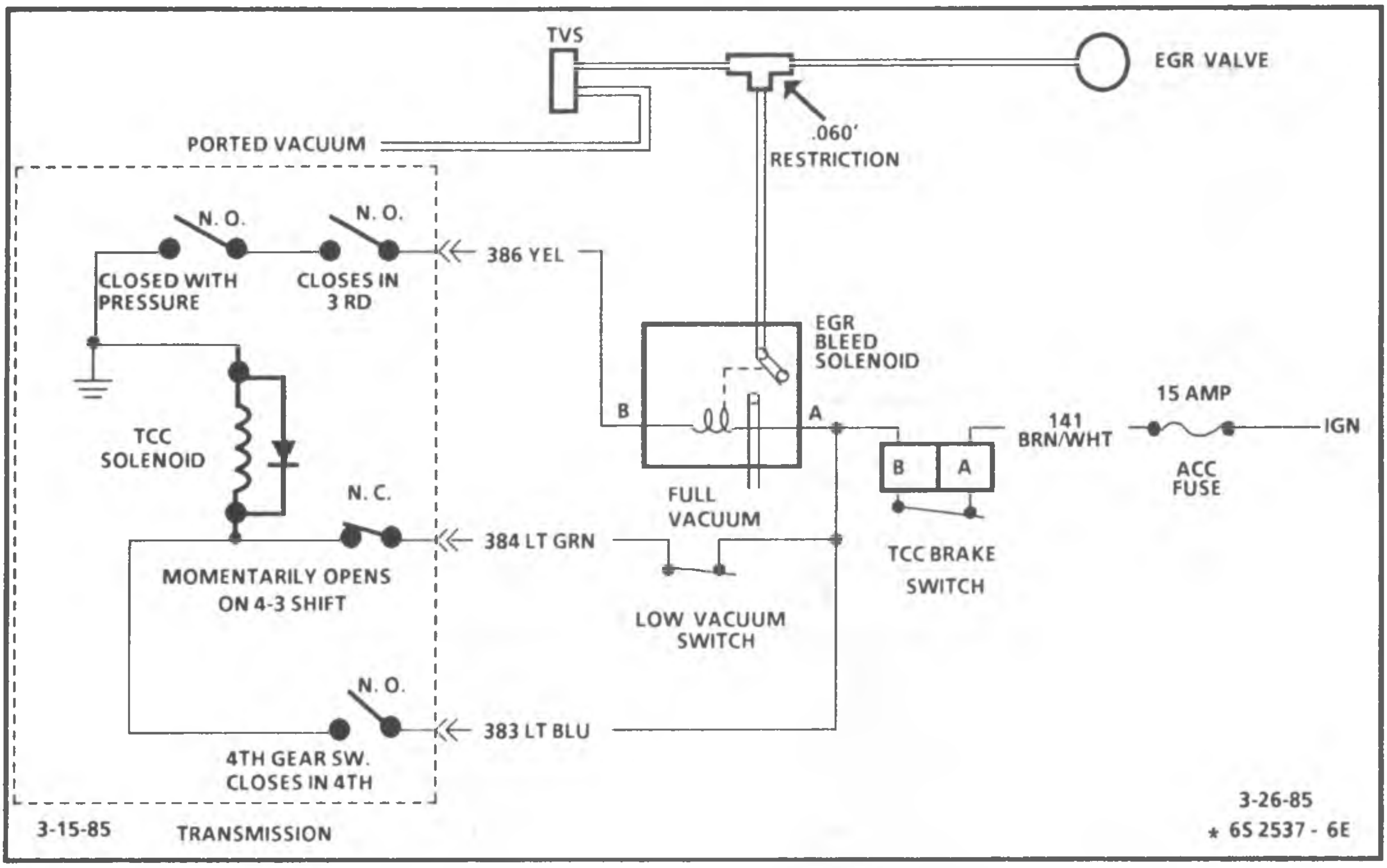
4S 1050-6E

Figure 116 TVS Location, 7.4L-LE8, California

PARTS INFORMATION

PARTS NAME	GROUP
Valve	3.670
Solenoid, EGR cont VLV RLY (14)	3.670
Gasket, EGR Valve (15)	3.680

CHART C-7D
EGR BLEED SOLENOID CHECK
5.0L or 5.7L ENGINE - FEDERAL WITH LIGHT DUTY EMISSIONS AND AUTOMATIC TRANSMISSION



1. Disconnect EGR bleed solenoid connector.
2. Connect a test light from solenoid terminal "A" to ground.
3. With the ignition "ON" and engine stopped, the test light should illuminate. If not, there is an open in the circuit to the ignition switch.
4. Connect solenoid connector.
5. Disconnect vacuum hose from solenoid to the EGR valve and connect a vacuum gage to solenoid.
6. Start engine. There should be no vacuum reading. Replace solenoid if there is a reading.
7. Connect a test light from solenoid terminal "B" to ground. Solenoid should energize and there should be a full vacuum reading. Replace solenoid as required.
8. Connect a test light from terminal "D" at the TCC solenoid to ground. Solenoid should energize and there should be a full vacuum reading. If not, there is an open in circuit 386.

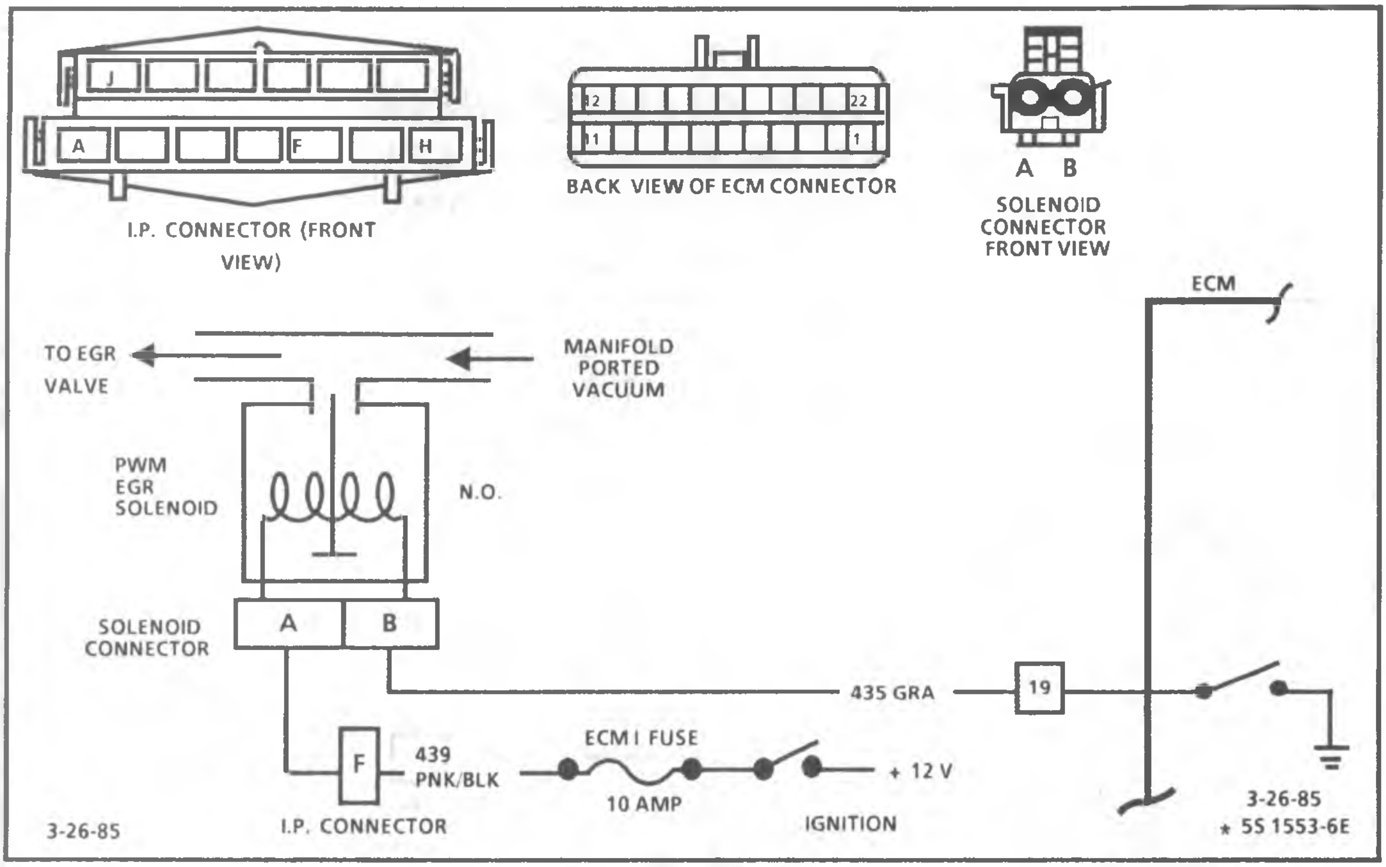


CHART C-7E

PULSE WIDTH MODULATED (PWM) EGR SYSTEM CHECK

4.3L, 5.0L, or 5.7L ENGINE

CARBURETED - CALIFORNIA

PWM EGR is an ECM control that pulses the vacuum signal to the EGR. This is accomplished through a normally open EGR solenoid which when energized by the ECM shuts off the vacuum to the EGR valve diaphragm. This system can pulse the solenoid many times per second (PWM). The EGR solenoid is always energized (EGR off) when any one of the following conditions are met:

- Throttle Position greater than specified.
- Coolant temperature less than specified.

1. Checks to see if the EGR passages are restricted or if the valve is stuck open.
2. A cold engine is simulated by disconnecting the coolant temperature sensor which will also energize the EGR solenoid.
3. With the 4 wire EST connector disconnected, the ECM thinks the engine is not running. Grounding the test terminal, under this condition, causes the ECM to pulse the EGR solenoid "ON" and "OFF" for testing which will result in a controlled vacuum supply to the EGR valve diaphragm at 2000 RPM.
4. By disconnecting EGR solenoid electrical connector, control by the ECM is overridden and the normally opened EGR solenoid will pass available vacuum. At 2000 RPM EGR valve should move if EGR control system is functioning properly.
5. If vacuum is below 23.6 kPa (7" Hg) at 2000 RPM with EGR solenoid electrical connector disconnected, a leak or restriction between test point (EGR diaphragm) and source is evident.
6. Checks EGR solenoid electrical control circuit. The test light should "flicker faintly" if the ECM, harness and connections are OK. "Flicker faintly" refers to a slightly pulsing glow as opposed to a "bright steady" glow from a continuous ground path.

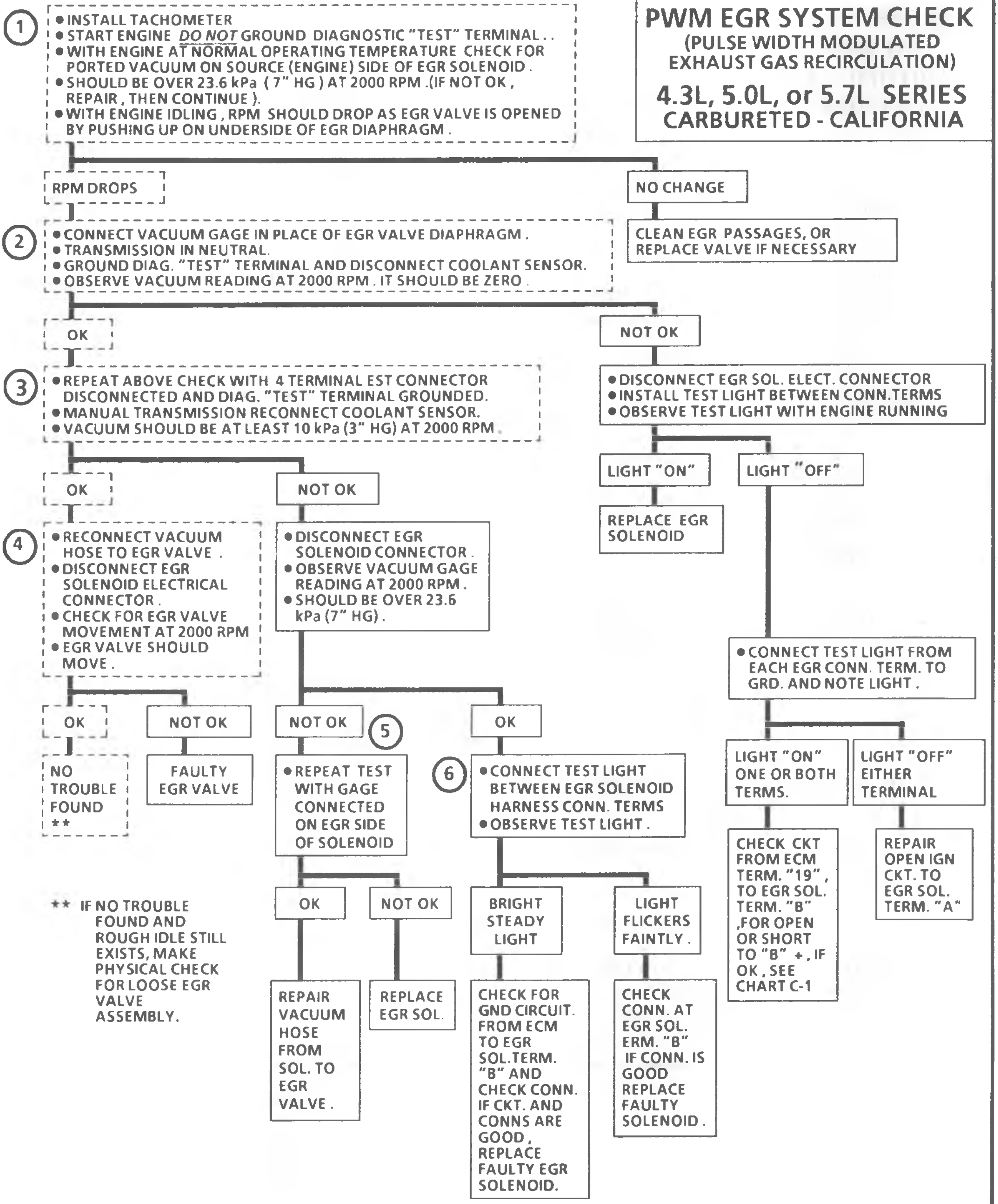
Steps 1, 2, and 3 represent an EGR system operation check.

CHART C-7E

PWM EGR SYSTEM CHECK

(PULSE WIDTH MODULATED
EXHAUST GAS RECIRCULATION)

4.3L, 5.0L, or 5.7L SERIES
CARBURETED - CALIFORNIA



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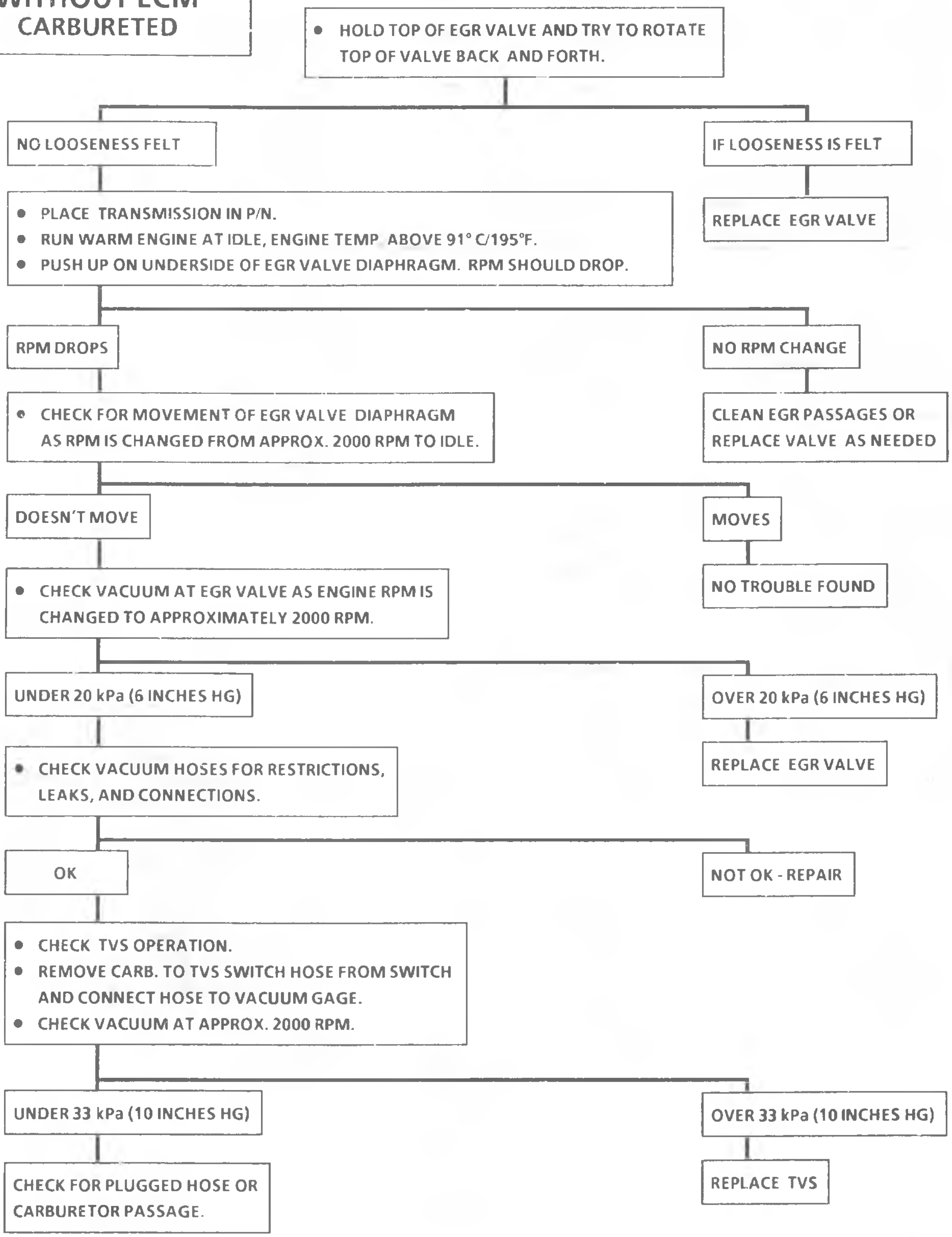
* 6S 2538-6E

CHART C-7C

EGR SYSTEM CHECK
ALL ENGINES
WITHOUT ECM
CARBURETED



- HOLD TOP OF EGR VALVE AND TRY TO ROTATE TOP OF VALVE BACK AND FORTH.

NO LOOSENESS FELT

IF LOOSENESS IS FELT

REPLACE EGR VALVE

- PLACE TRANSMISSION IN P/N.
- RUN WARM ENGINE AT IDLE, ENGINE TEMP. ABOVE 91° C/195°F.
- PUSH UP ON UNDERSIDE OF EGR VALVE DIAPHRAGM. RPM SHOULD DROP.

RPM DROPS

NO RPM CHANGE

CLEAN EGR PASSAGES OR REPLACE VALVE AS NEEDED

- CHECK FOR MOVEMENT OF EGR VALVE DIAPHRAGM AS RPM IS CHANGED FROM APPROX. 2000 RPM TO IDLE.

DOESN'T MOVE

MOVES

NO TROUBLE FOUND

- CHECK VACUUM AT EGR VALVE AS ENGINE RPM IS CHANGED TO APPROXIMATELY 2000 RPM.

UNDER 20 kPa (6 INCHES HG)

OVER 20 kPa (6 INCHES HG)

REPLACE EGR VALVE

- CHECK VACUUM HOSES FOR RESTRICTIONS, LEAKS, AND CONNECTIONS.

OK

NOT OK - REPAIR

- CHECK TVS OPERATION.
- REMOVE CARB. TO TVS SWITCH HOSE FROM SWITCH AND CONNECT HOSE TO VACUUM GAGE.
- CHECK VACUUM AT APPROX. 2000 RPM.

UNDER 33 kPa (10 INCHES HG)

OVER 33 kPa (10 INCHES HG)

CHECK FOR PLUGGED HOSE OR CARBURETOR PASSAGE.

REPLACE TVS

10-22-85

* 4S 0611 - 6E

TRANSMISSION CONVERTER CLUTCH (TCC) SYSTEM

4.3L, 5.0L, or 5.7L ENGINE

CALIFORNIA ONLY

GENERAL DESCRIPTION

PURPOSE

The Transmission Converter Clutch (TCC) System uses a solenoid operated valve in the automatic transmission to couple the engine flywheel to the output shaft of the transmission thru the torque converter. This reduces the slippage losses in the converter, which increases fuel economy.

OPERATION

For the converter clutch to apply, two conditions must be met:

- Internal transmission fluid pressure must be correct. For information on internal transmission operation, see Section 7A. This section will cover only the electrical operation of the TCC system.

- The ECM completes a ground circuit to energize a TCC apply solenoid in the transmission which moves a check ball in a fluid line (Figure 117). This allows 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:

- 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 vehicle is accelerating or decelerating at a certain rate.

- Gear Select Switch. The transmission uses a 4th gear switch to send a signal to the ECM telling it what gear the transmission is in. The ECM uses this information to vary the conditions under which the clutch applies or releases. However, the transmission does not have to be in high gear in order for the ECM to turn the clutch on. Transmissions using gear select switches can be identified by three wires coming out of TCC connector. On 4 wheel drive, the 4th gear switch is externally mounted on transmission.

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.

Also, the transmissions use a 4-3 pulse switch to open the TCC solenoid circuit momentarily during a downshift.

The diagnostic charts will cover the switches used with each engine/transmission combination.

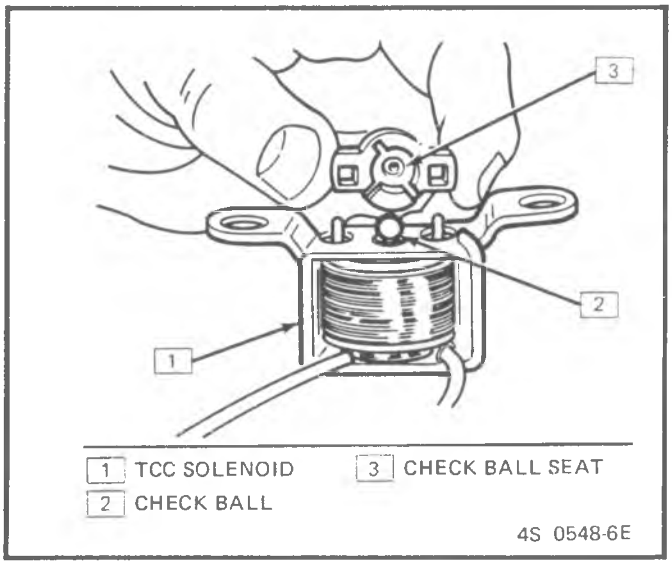


Figure 117 TCC Solenoid

DIAGNOSIS

TCC System

If the converter clutch is applied at all times, the engine will stall immediately, just as in a manual transmission with the clutch applied.

If the converter clutch does not apply, fuel ecomony may be lower than expected. If the Vehicle Speed Sensor fails, the TCC will not apply. If the 4th gear switch does not operate, the TCC will not apply at the right time.

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 vehicle should be road tested and compared to a similar vehicle to see if a real problem exists. The Owner's Manual section on TCC operation should be reviewed with the driver. Another TCC complaint may be a downshift felt when going up a grade, especially with cruise control. This may not be a downshift, but a clutch disengagement due to the change in TPS to maintain cruising speed.

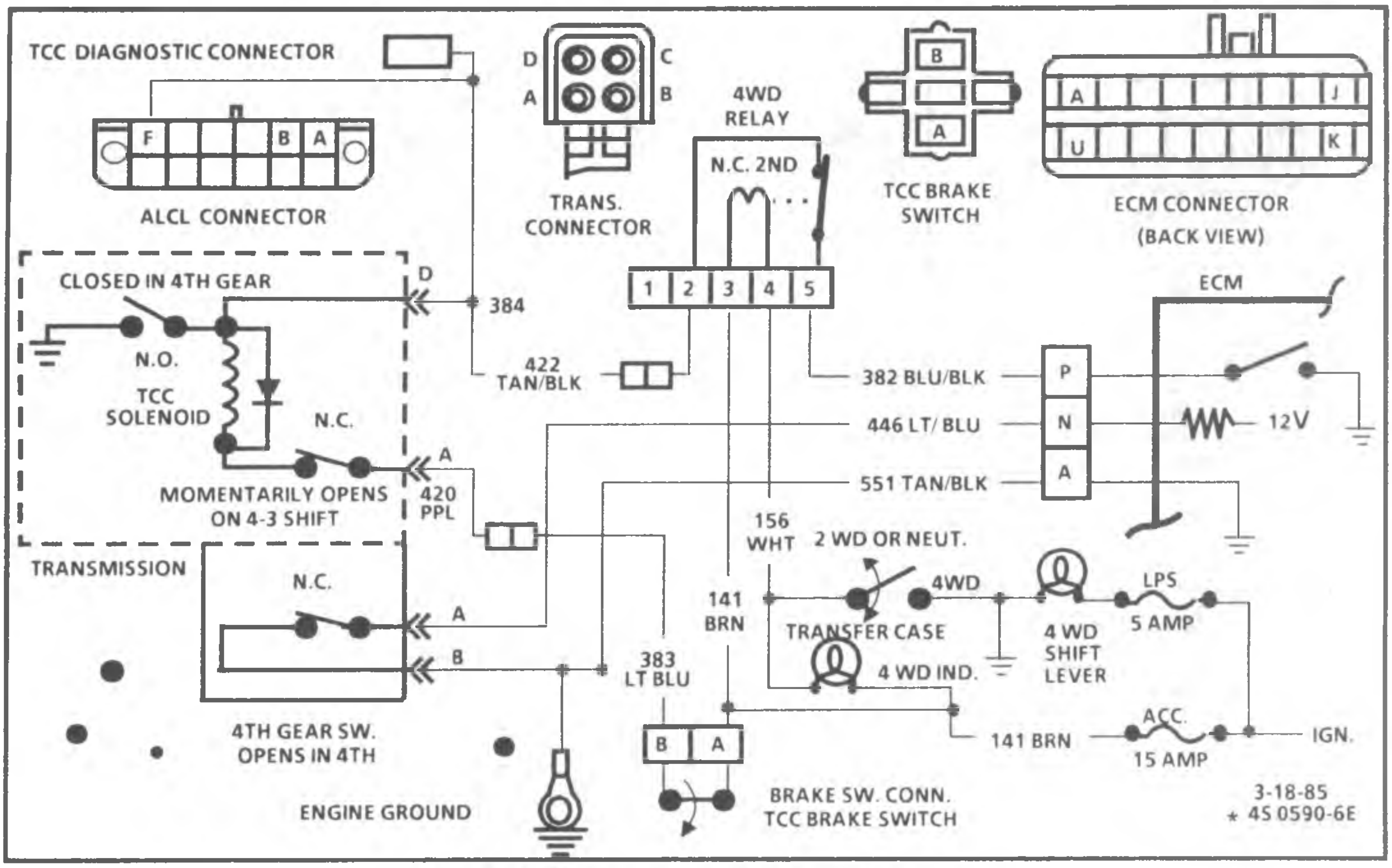
The electrical diagnosis of the TCC system is covered in CHART C-8B.

ON-VEHICLE SERVICE

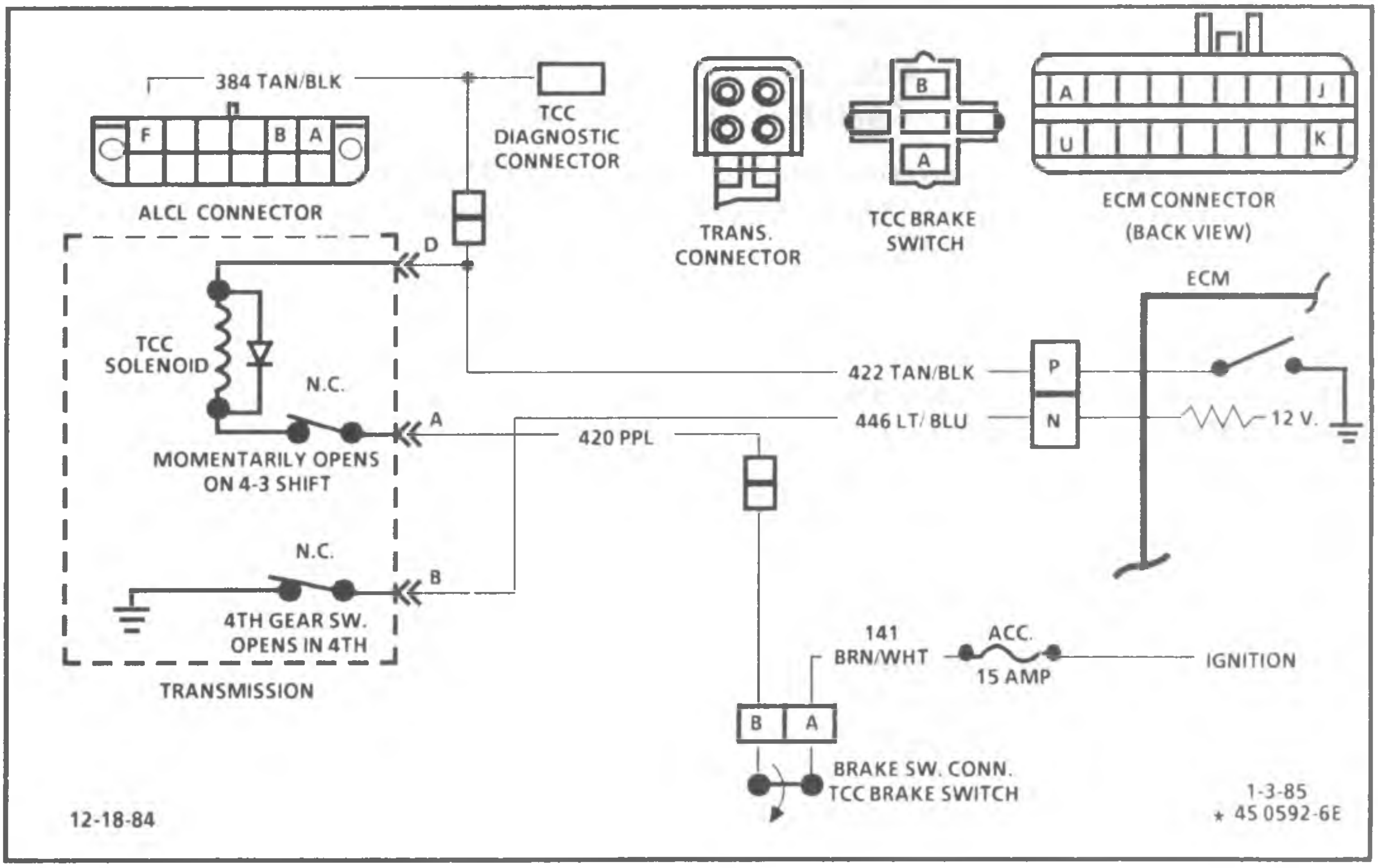
- See Section 7A for TCC Solenoid replacement.
- See Section 8C for brake switch replacement.

PARTS INFORMATION

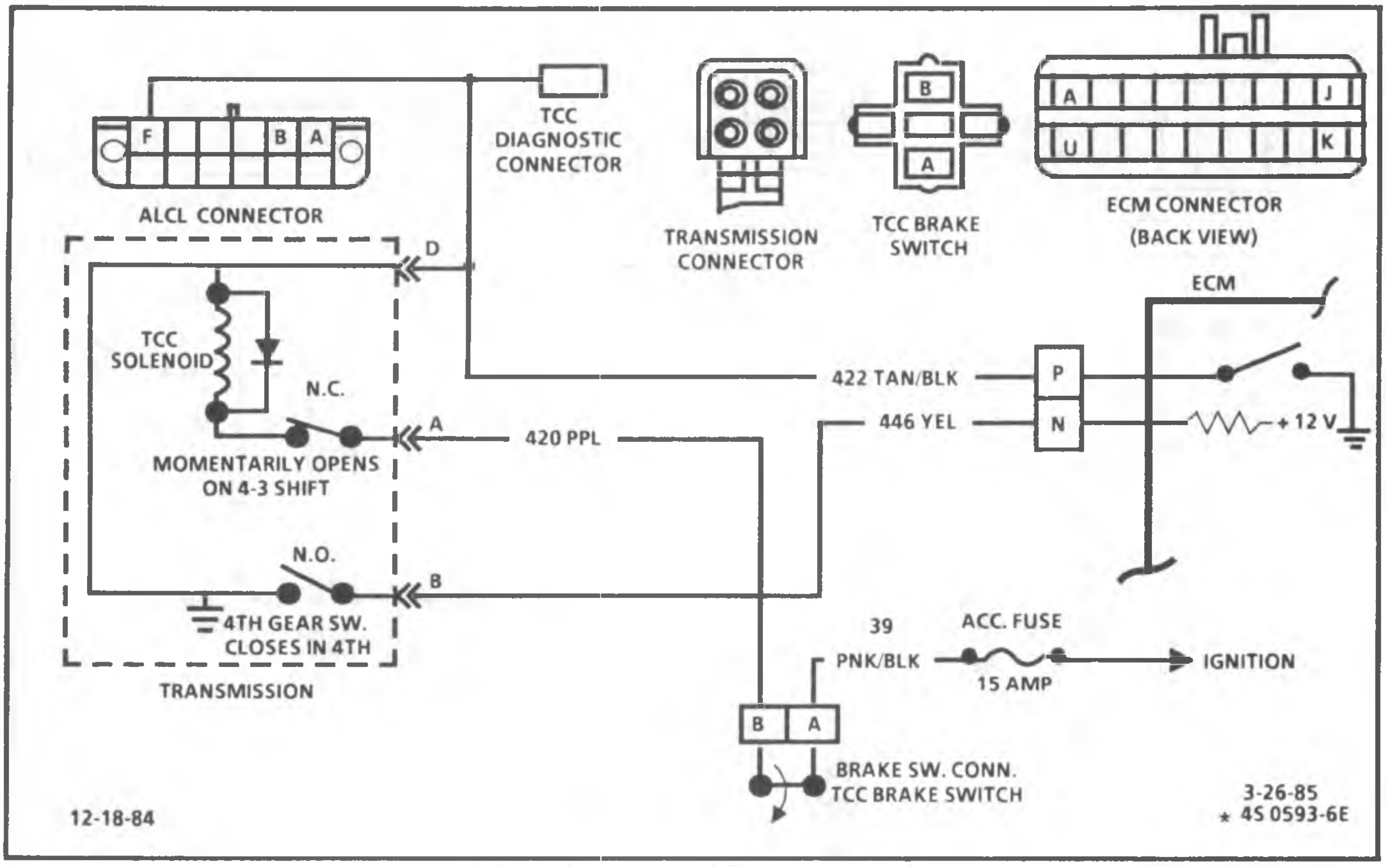
PART NAME	GROUP
Sensor, VSS (1)	9.761
Valve, Clutch and Cruise Vac. Sw	3.885
Solenoid, TCC	4.122



Wiring Diagram - TCC 4WD V6 or V8 - (K)



Wiring Diagram - TCC 2WD V8 - (C)



Wiring Diagram - TCC - V6 or V8 - G

CHART C-8B
TRANSMISSION CONVERTER CLUTCH(TCC) ELECTRICAL DIAGNOSIS
4.3L, 5.0L, or 5.7L ENGINE
CARBURETED - CALIFORNIA

The transmission converter clutch is activated by a TCC solenoid located inside the transmission. The solenoid is supplied voltage by the ignition and the ECM completes the ground to energize the solenoid.

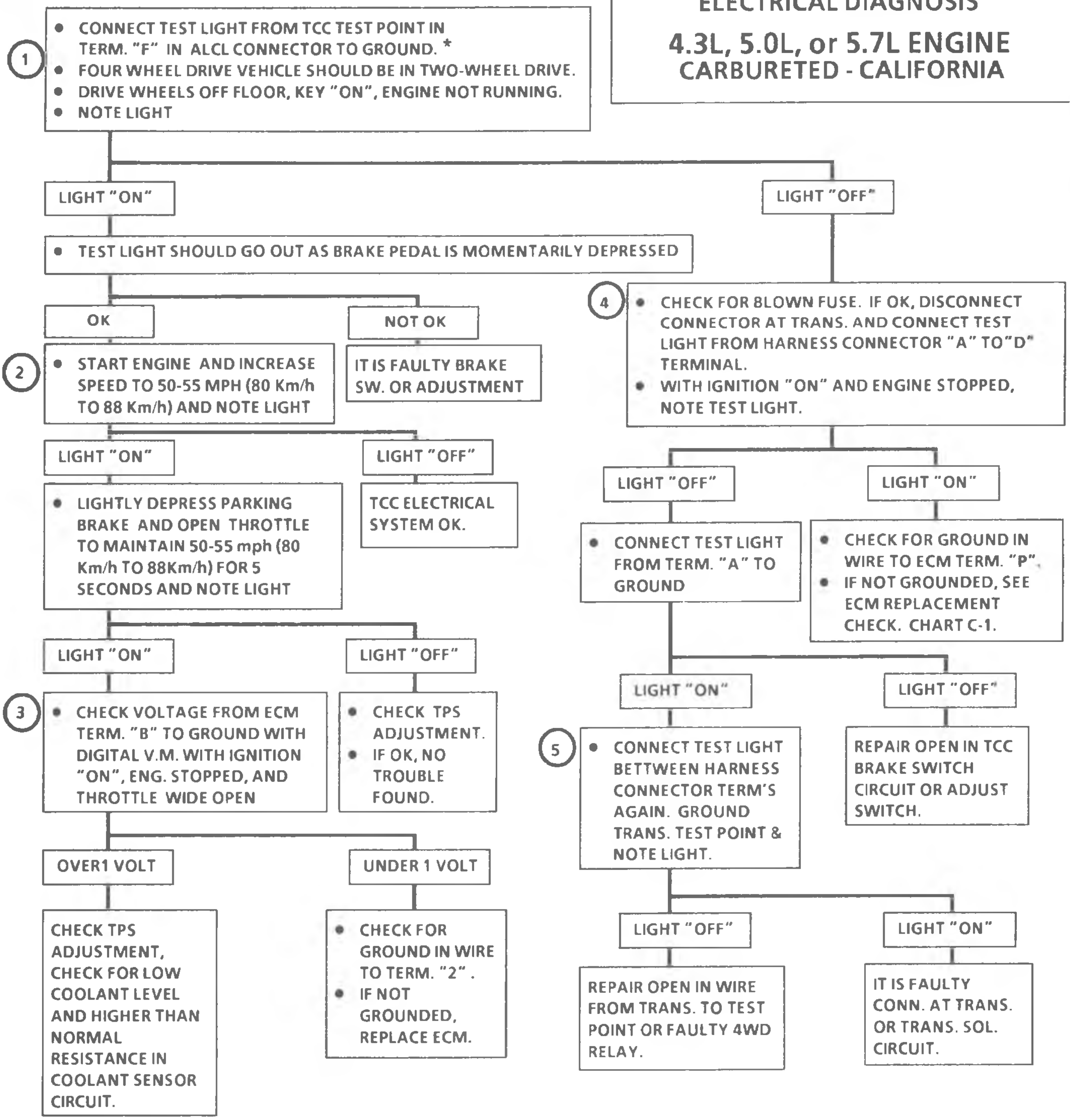
1. Checks for complete circuit from ignition through TCC solenoid to ALCL TCC test terminal. Normally the light should be "ON" if circuit is not grounded or open.
2. Checks to see if ECM completes ground to energize TCC solenoid. Light should go "OUT".
3. This increases throttle opening to increase TPS output. If TPS output is too low, the clutch won't apply. On some applications, running free doesn't require enough throttle opening to allow the transmission to shift.
4. Checks for ground in circuit to ECM terminal "P". Normally light should be "OFF".
5. Checks for open in wire to transmission from TCC test point or open in TCC solenoid connections or solenoid. If wiring is complete, test light should be "ON".

CHART C-8B

TRANSMISSION CONVERTER CLUTCH ELECTRICAL DIAGNOSIS

4.3L, 5.0L, or 5.7L ENGINE CARBURETED - CALIFORNIA

MECHANICAL CHECKS, SUCH AS LINKAGE, OIL LEVEL, ETC., SHOULD BE PERFORMED PRIOR TO USING THIS CHART.



* A LOW RESISTANCE LIGHT BULB COULD RESULT IN IMMEDIATE TCC APPLY DUE TO GROUNDING OF TEST TERMINAL "F". TO AVOID THIS POSSIBILITY, A HIGH RESISTANCE BULB SHOULD BE USED.

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* 4S 0680-6E

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EARLY FUEL EVAPORATION SYSTEM (EFE)

ALL ENGINES EXCEPT 4.8L

GENERAL DESCRIPTION

PURPOSE

The EFE system used on all engines except 4.8L, provides a source of rapid heat to the engine induction system during cold driveaway. Rapid heating is desirable because it provides quick fuel evaportion and more uniform fuel distribution to aid cold driveability. It also reduces the length of time caburetor choking is required, so it reduces exhaust emissions.

OPERATION

The EFE system is a Vacuum Servo type that uses a valve and vacuum actuator which increases the exhaust gas flow under the intake manifold during cold engine operation. The valve is located in the exhaust and the vacuum actuator is vacuum operated (Figure 118) by a Thermal Vacuum Switch (TVS) (Figure 119). When vacuum is applied to the actuator, the valve closes, causing the intake manifold to heat up.

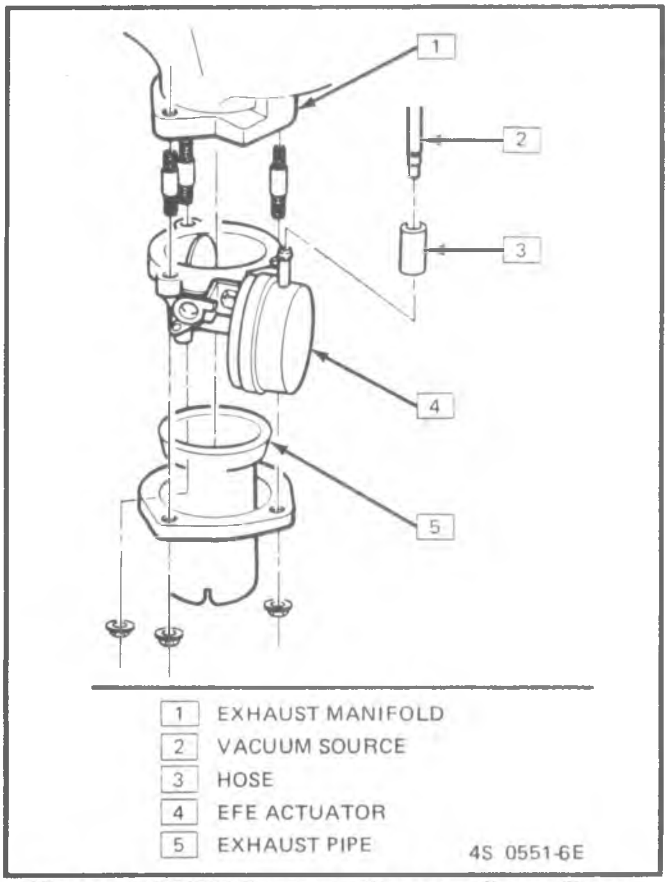


Figure 118 EFE System - Vacuum Servo Type

When coolant temperature increases, the TVS stops vacuum to the actuator.

Results of Incorrect EFE Operation

- No EFE when cold:
- Engine may stumble and stall during warm-up.
- Engine takes longer time to warm up.
- Choke may heat up and be off before engine is warm.

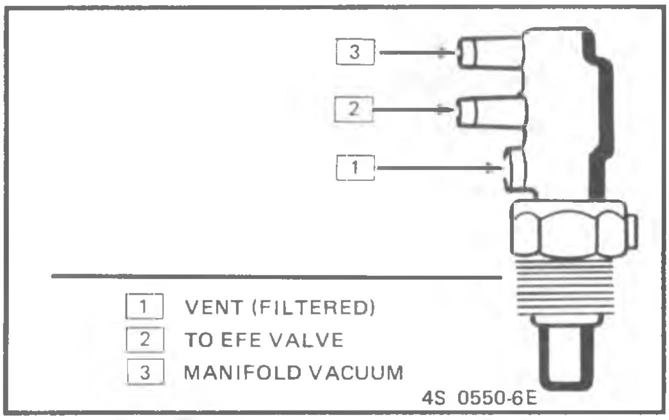


Figure 119 Thermal Vacuum Switch

EFE stays on:

- Poor performance.
- Lack of power when warm due to superheated gases.
- Engine may overheat.

DIAGNOSIS

GENERAL

The operation of the EFE system is to be checked at regular maintenance intervals. Refer to Section 0B for maintenance interval information.

VACUUM SERVO EFE DIAGNOSIS

- TVS controlled - See CHART C-9C.

ON-VEHICLE SERVICE

VALVE AND ACTUATOR

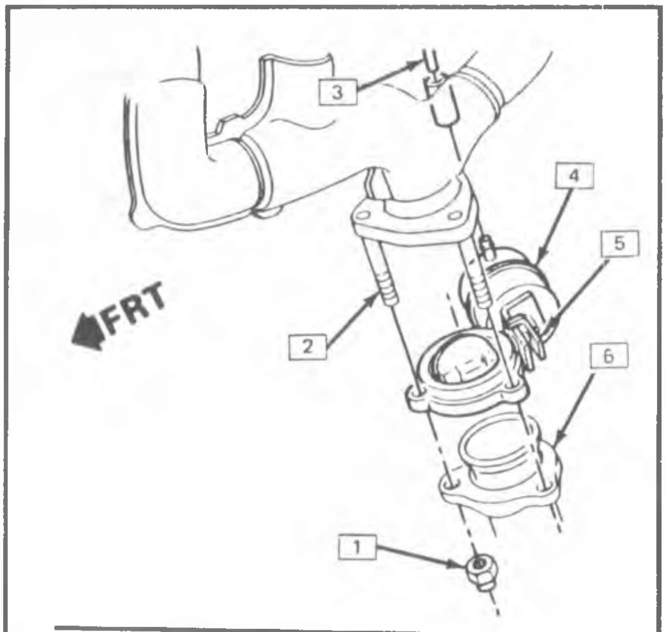
FIGURES 120, 121, AND 122

Remove or Disconnect

1. Vacuum hose at EFE valve.
2. Exhaust pipe to manifold nuts, and tension springs.
3. Lower right hand exhaust (crossover) pipe and seal - complete removal of pipe is not always necessary.
4. EFE valve and actuator

Install or Connect

1. EFE valve (replace seals and gaskets if used).
2. Exhaust (crossover) pipe and seal.
3. Exhaust pipe to manifold nuts and tension springs. Tighten nuts to 20 N.m (15 ft.lbs.).
4. Vacuum hose at EFE valve.



1 NUT-TIGHTEN TO 20 N·m (15 FT LBS.)
2 STUD-EXHAUST MANIFOLD
3 MANIFOLD VACUUM PIPE
4 VALVE AND ACTUATOR
5 VALVE ACTUATOR ARM
6 LEFT HAND EXHAUST MANIFOLD

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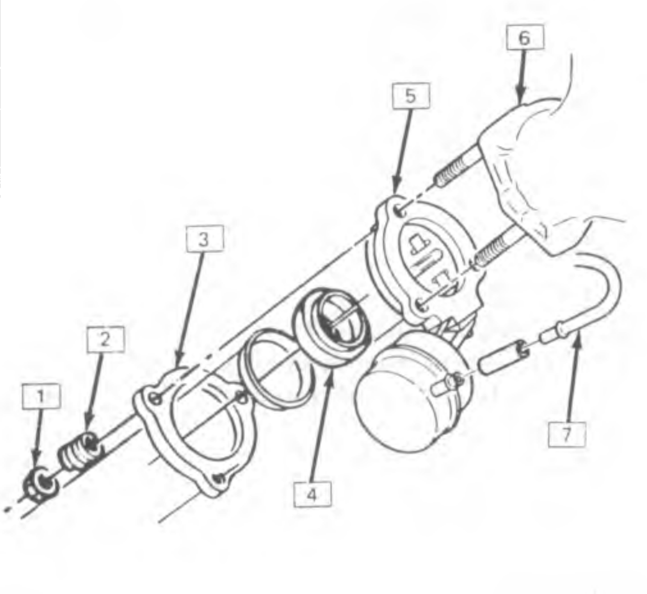
5S 1534-6E

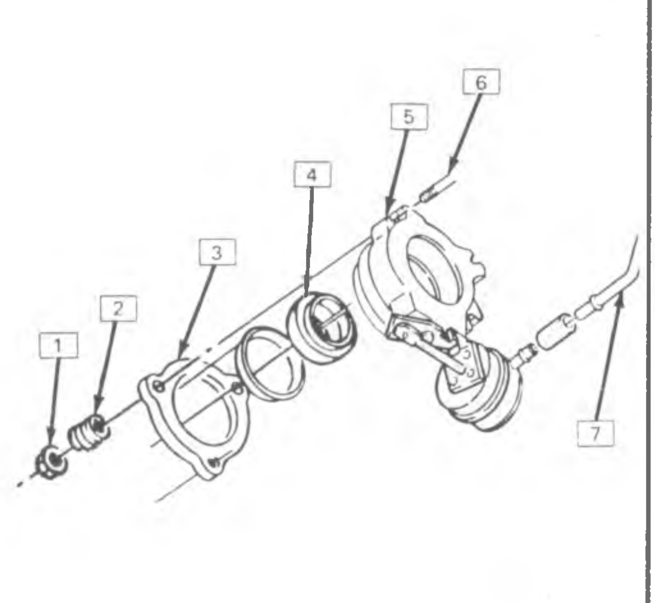
Figure 120 Valve and Actuator - 4.3L



1 NUT–TIGHTEN TO 20 N·m (15 FT. LBS.)
2 TENSION SPRING
3 RIGHT HAND EXHAUST PIPE
4 SEAL
5 VALVE AND ACTUATOR
6 EXHAUST MANIFOLD
7 MANIFOLD VACUUM PIPE

4S 1028-6E

Figure 121 Valve and Actuator - 7.4L



1 NUT–TIGHTEN TO N·m (15 FT. LBS.)
2 TENSION SPRING
3 RIGHT HAND EXHAUST PIPE
4 SEAL
5 VALVE AND ACTUATOR
6 STUD–EXHAUST MANIFOLD
7 MANIFOLD VACUUM PIPE

4S 1029-6E

Figure 122 Valve and Actuator - V8 (Except 7.4L)

COOLANT THERMAL VACUUM SWITCH (TVS)

FIGURE 123

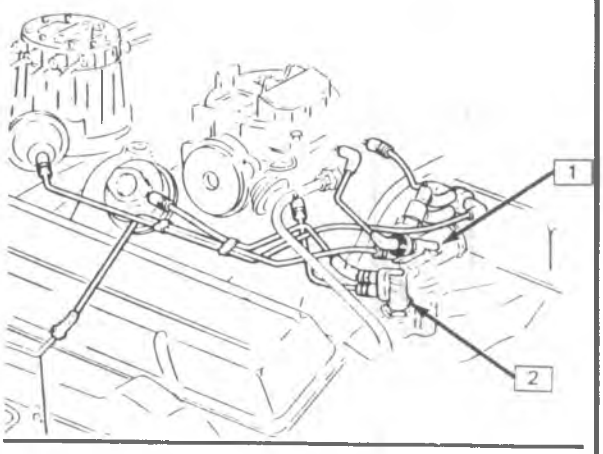
The TVS is located on the engine coolant outlet housing.

↔ Remove or Disconnect

1. Drain coolant below level of engine coolant outlet housing.
2. Hoses at TVS ports.
3. TVS. Refer to number stamped on base of TVS for calibration temperature.

→← Install or Connect

1. Apply a soft setting sealant uniformly on replacement TVS male threads. No sealant should be applied to sensor end of TVS.
2. TVS. Tighten to 14 N.m (120 lbs. in.) and then hand torque clockwise as required to align TVS to accommodate hoses.
3. Hoses to TVS ports.
4. Coolant as required.



1 EFE–TVS SWITCH

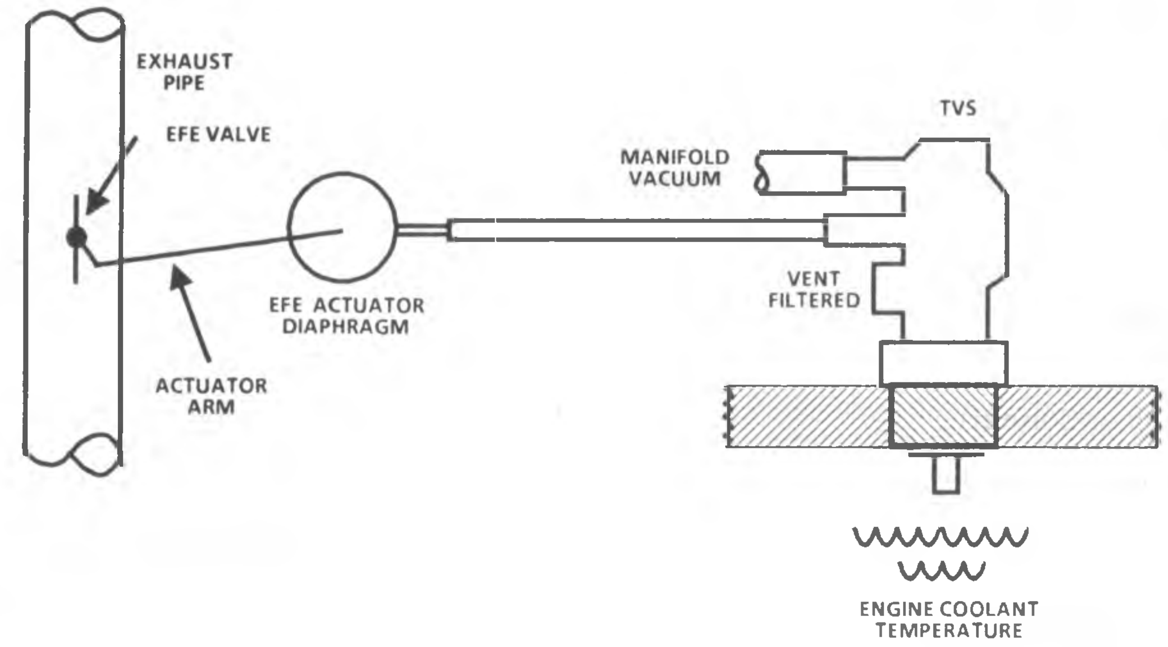
2 EGR–TVS SWITCH

4S 0549-6E

Figure 123 EFE Coolant TVS

PARTS INFORMATION

PART NAME	GROUP
Valve, w/Actuator, EFE	3.140
Switch, EFE Vlv Thermo Vac	3.140



* 4S 0614-6E

3-19-85

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CHART C-9C

EFE SYSTEM CHECK - WITH TVS

ALL ENGINES EXCEPT 4.8L

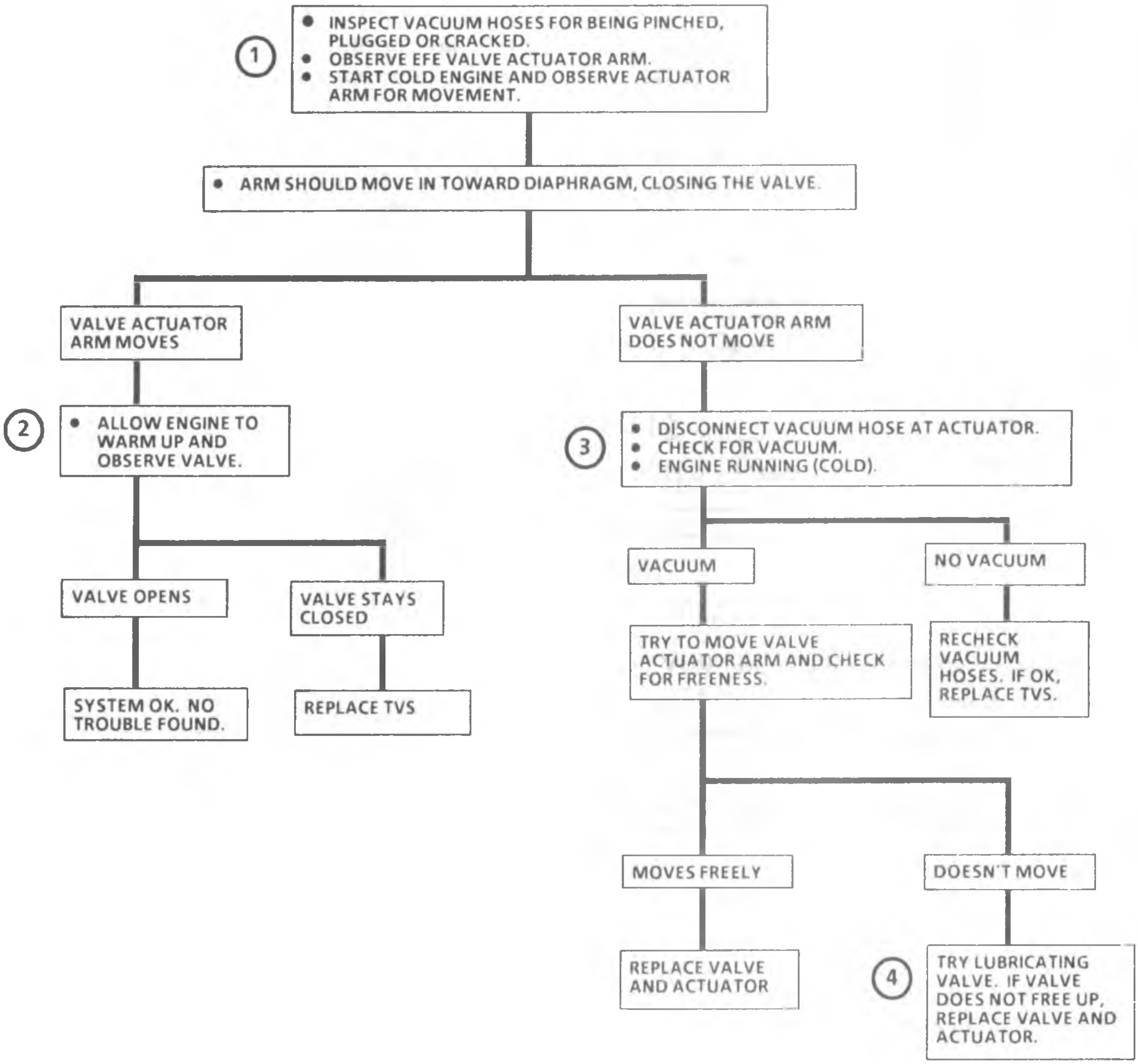
CARBURETED

1. Engine coolant temperature should be below 40°C (105°F).
2. EFE valve should open above 40°C (105°F).
3. There should be at least 34 kPa (10" Hg.) vacuum available to EFE actuator diaphragm.
4. Valve may be seized up. It may be freed up by using heat valve lubricant (part # 1052627 or equivalent). If valve does not free up, it must be replaced.

CHART C-9C

EFE SYSTEM CHECK - WITH TVS

ALL ENGINES EXCEPT 4.8L
CARBURETED



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3-19-85

POSITIVE CRANKCASE VENTILATION (PCV)

ALL ENGINES

GENERAL DESCRIPTION

PURPOSE

A Positive Crankcase Ventilation (PCV) system is used to provide more complete scavenging of crankcase vapors.

OPERATION

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 125).The primary control is through the PCV valve (Figure 124) which meters the flow at a rate depending on manifold vacuum.

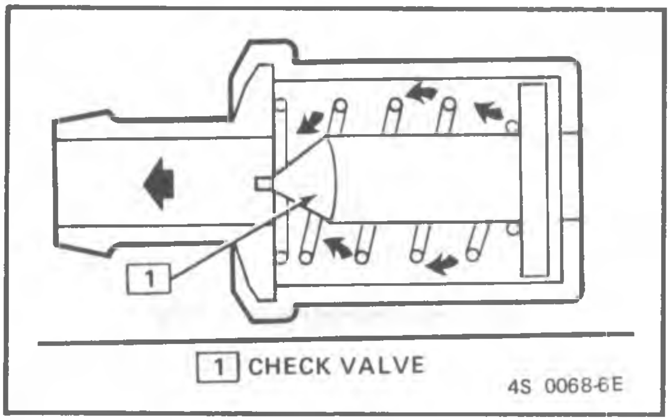


Figure 124 PCV Valve Cross Section

To maintain idle quality, the PCV valve restricts the flow when intake manifold vacuum is high. If abnormal operating conditions arise, the system is designed to allow excesisive 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 PCV Operation

- A plugged valve or hose may cause:
  - Rough idle.
  - Stalling or slow idle speed.
  - Oil leaks.
  - Oil in air cleaner.
  - Sludge in engine.
- A leaking valve or hose would cause:
  - Rough idle.
  - Stalling.
  - High idle speed.

DIAGNOSIS

If an engine is idling rough, check for a clogged PCV valve or plugged hose. Replace as required. Use the following procedure:

1. Remove PCV valve from rocker arm cover.
2. Run the engine at idle.

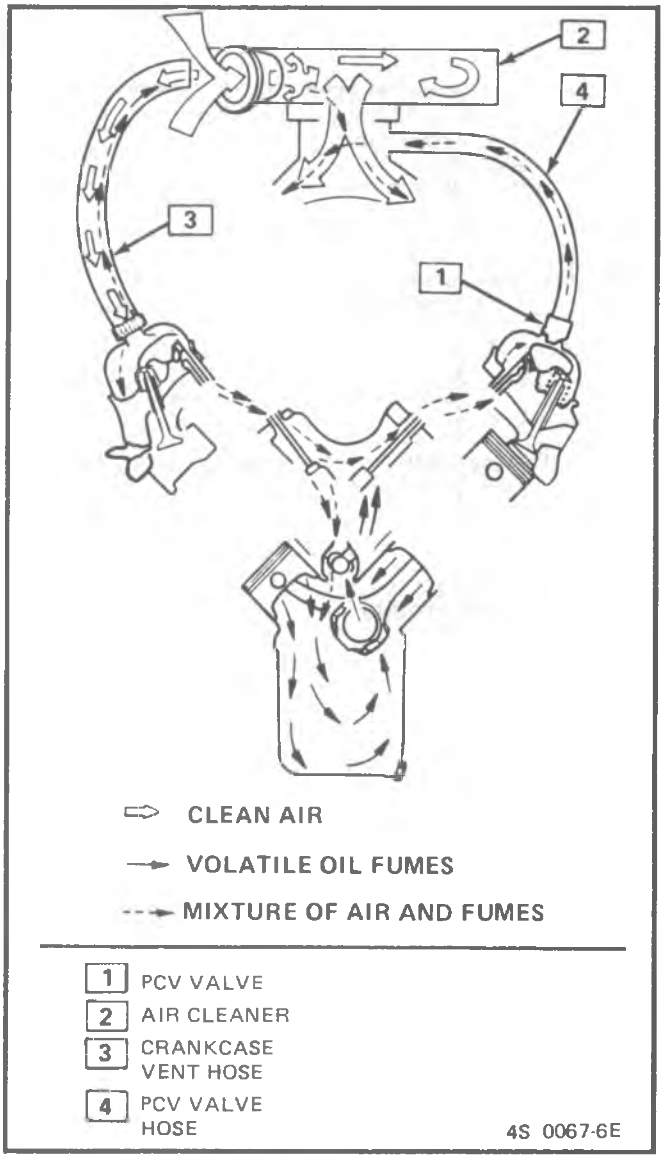


Figure 125 PCV Flow

3. Place your thumb over end of valve to check for vacuum. If there is no vacuum at valve, check for plugged hoses or manifold port, or PCV valve. Replace plugged or deteriorated hoses.
4. Turn off the engine and remove PCV valve. Shake valve and listen for the rattle of check needle inside the valve. If valve does not rattle, replace valve.

With this system, any blow-by in excess of the system capacity (from a badly-worn engine, sustained heavy load, etc.) is exhausted into the air cleaner and is drawn into the engine.

Proper operation of the PCV System (Figure 116) 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-VEHICLE SERVICE

See Figure 126 for 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 cleaner breather at intervals shown in Section 0.B.

Periodically, inspect the hoses and clamps and replace any showing signs of deterioration.

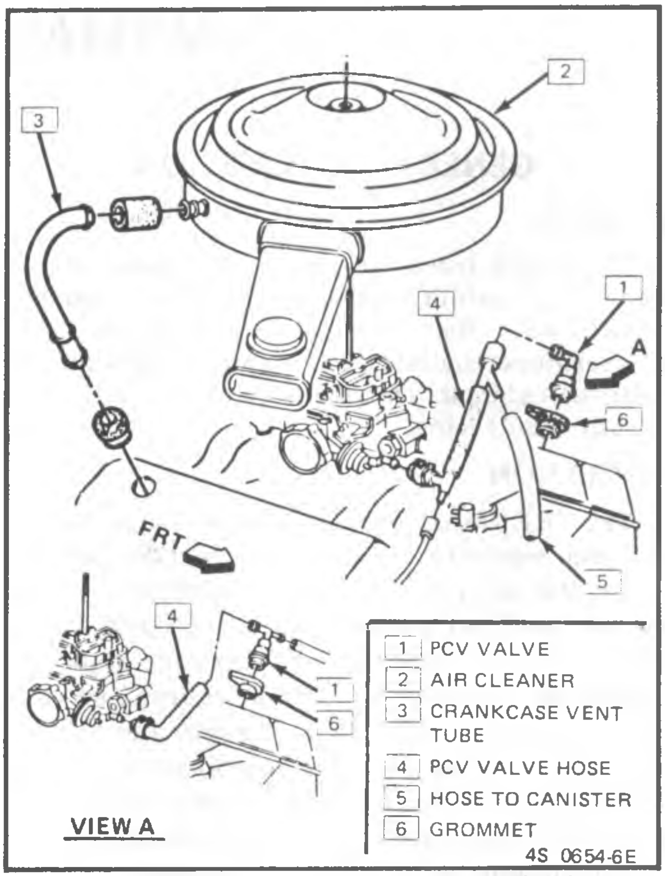


Figure 126 Positive Crankcase Ventilation System

PARTS INFORMATION

PART NAME	GROUP
Air Cleaner	3.402
Tube, C/Case Vent	1.762
Hose, C/Case Vent Vlv	1.762

THERMOSTATIC AIR CLEANER (THERMAC)

ALL ENGINES

GENERAL DESCRIPTION

PURPOSE

A heated intake air system is used to give good driveability under varying climatic conditions. By having a uniform inlet temperature, the fuel system can be calibrated to reduce exhaust emissions and to eliminate throttle blade icing.

OPERATION

The THERMAC air cleaner operates by heated air and manifold vacuum (Figure 127). Air can enter the air cleaner from outside the engine compartment or from a heat stove built around the exhaust manifold. A vacuum diaphram motor, built into the air cleaner snorkel, moves a damper door, to admit hot air from the exhaust manifold, outside air, or a combination of both. Inside the air cleaner is a temperature sensor that reacts to air intake temperature and controls the amount of vacuum going to the motor.

A HOT AIR DELIVERY MODE. When the temperature is below 86°F (30°C), the sensor allows vacuum to the motor and the damper door will be up, shuting off outside air and allowing only heated air from the exhaust manifold to enter the air cleaner.

B REGULATING MODE. Between 86°F (30°C) and 131°F (55°C) the damper door allows both heated and outside air to enter the air cleaner.

C OUTSIDE AIR DELIVERY MODE. When the temperature is above 131°F (55°C), the damper door drops down and only outside air enters the air cleaner.

THERMAC Delay Valve

Some applications use a delay valve on the hose connecting the vacuum motor to the temperature sensor (Figure 128). When vacuum in this hose drops for any reason, the check valve will bleed off the vacuum to the vacuum motor slowly.

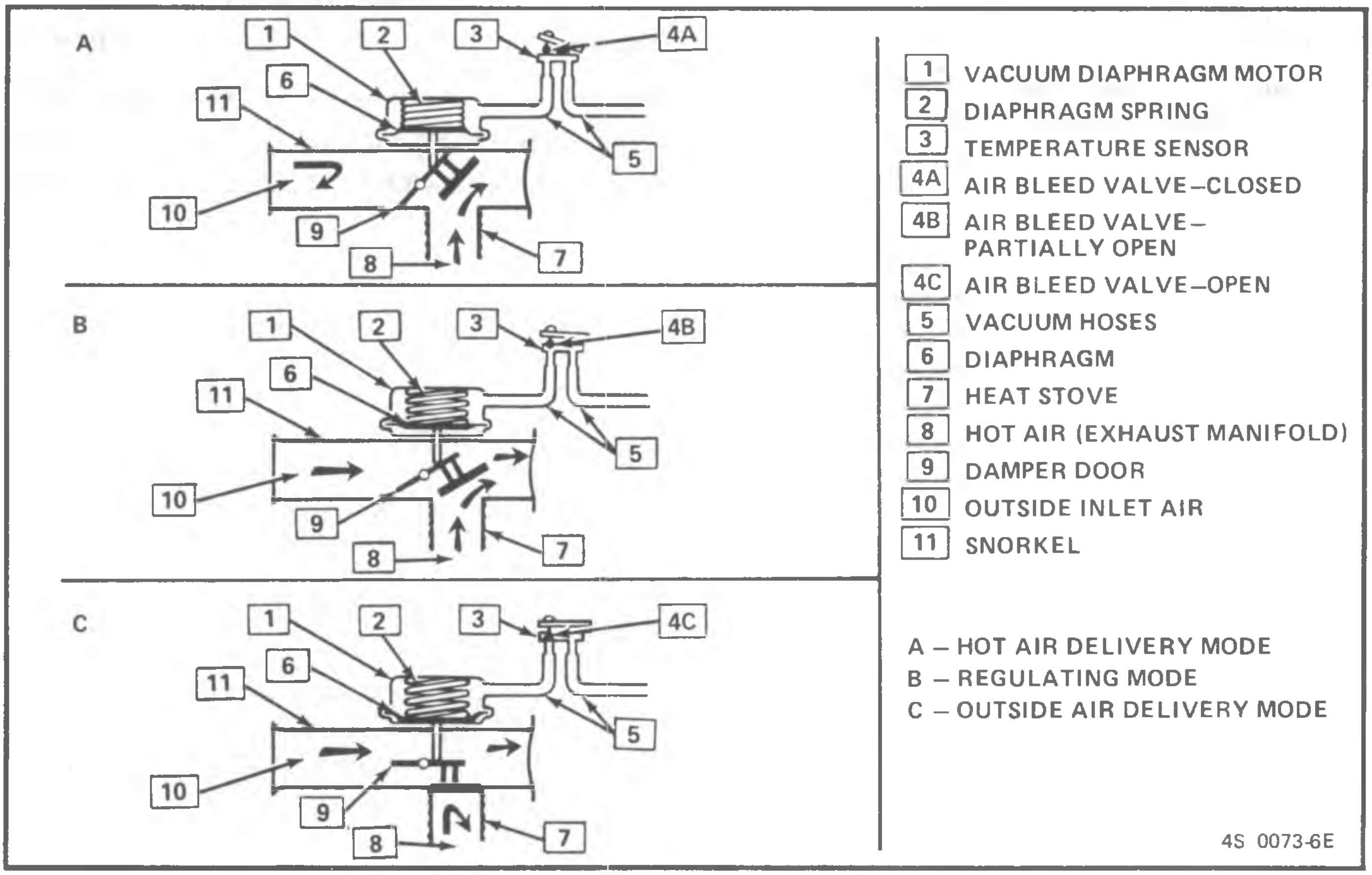


Figure 127 THERMAC Operation

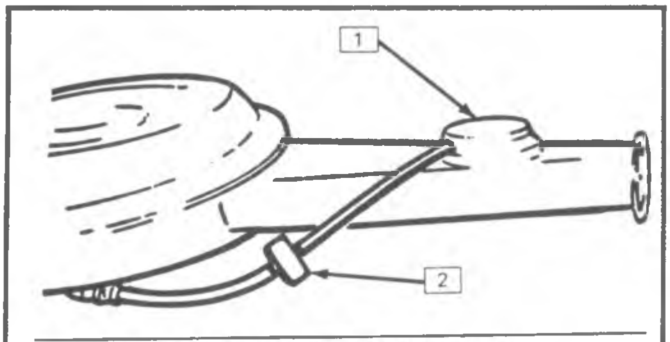


Figure 128 THERMAC Delay Valve

Results of Incorrect THERMAC operation

- Hesitation during warm-up can be caused by:
  - Heat stove tube disconnected.
  - Vacuum diaphram motor inoperative (open to Snorkel).
  - No manifold vacuum.
  - Damper door does not move.
  - Missing air cleaner to carburetor seal.
  - Missing air cleaner cover seal or loose cover.
  - Loose air cleaner.
- Lack of power, sluggish, or spongy, on a hot engine can be caused by:
  - Damper door does not open to outside air.
  - Temperature sensor doesn't bleed off vacuum.

DIAGNOSIS

THERMAC AIR CLEANER CHECK

1. Inspect system to be sure all hoses and heat stove tube are connected. Check for kinked, plugged or deteriorated hoses.
2. Check for presence and condition of air cleaner-to-carburetor gasket seal.
3. With air cleaner assembly installed, damper door should be open to outside air.
4. Start engine. Watch damper door in air cleaner snorkel. When engine is first started, damper door should move and close off outside air. As air cleaner warms up, damper door should open slowly to outside air.
5. If the air cleaner fails to operate as described above, perform vacuum motor check. If it operates, the door may not be moving at the right temperature. If the driveability problem is during warm-up, make the temperature sensor check below.

VACUUM MOTOR CHECK

1. With engine off, disconnect vacuum hose at vacuum diaphragm motor.
2. Apply at least 23 kPa (7 in. Hg.) of vacuum to the vacuum diaphragm motor. Damper door should completely block off outside air when vacuum is applied. If not, check to see if linkage is hooked up correctly.
3. With vacuum still applied, trap vacuum in vacuum diaphragm motor by bending hose. Damper door should remain closed. If not, replace vacuum diaphragm motor assembly. (Failure of the vacuum diaphragm motor assembly is more likely to be caused from binding linkage or a corroded snorkel than from a failed diaphragm. This should be checked first, before replacing the diaphragm.)
4. If vacuum motor checks OK, check vacuum hoses and connections. If OK, replace the temperature sensor.

TEMPERATURE SENSOR CHECK

1. Start test with air cleaner temperature below 30°C (86°F). If engine has been run recently, remove air cleaner cover and place thermometer as close as possible to the sensor. Let air cleaner cool until thermometer reads below 30°C (86°F) about 5 to 10 minutes. Reinstall air cleaner on engine and continue to Step 2.
2. Start and idle engine. Damper door should move to close off outside air immediately if engine is cool enough. When damper door starts to open the snorkel passage (in a few minutes), remove air cleaner cover and read thermometer. It must read about, 55°C (131°F).
3. If the damper door is not open to outside air at temperature indicated, temperature sensor is malfunctioning and must be replaced.

ON-VEHICLE SERVICE

AIR CLEANER ELEMENT

Remove or Disconnect

1. Air cleaner cover.
2. Old element.

Install or Connect

1. New element.
2. Air cleaner cover. Do not over-torque nuts (install finger- tight).

VACUUM DIAPHRAGM MOTOR (Figure 129)

Remove or Disconnect

1. Air cleaner.
2. Vacuum hose from motor.
3. Drill out the two spot welds with a 1. 6mm (1/16") drill, then enlarge as required to remove the retaining strap. Do not damage the snorkel tube.
4. Motor retaining strap.
5. Lift up motor, cocking it to one side to unhook the motor linkage at the control damper assembly.

Install or Connect

1. Drill a 2.8mm (7/64") hole in snorkel tube at center of vacuum motor retaining strap.
2. Vacuum motor linkage into control damper assembly.
3. Use the motor retaining strap and sheet metal screw provided in the motor service package to secure motor to the snorkel tube.

   Make sure the screw does not interfere with the operation of the damper assembly. Shorten screw if required.
4. Vacuum hose to motor and install air cleaner.

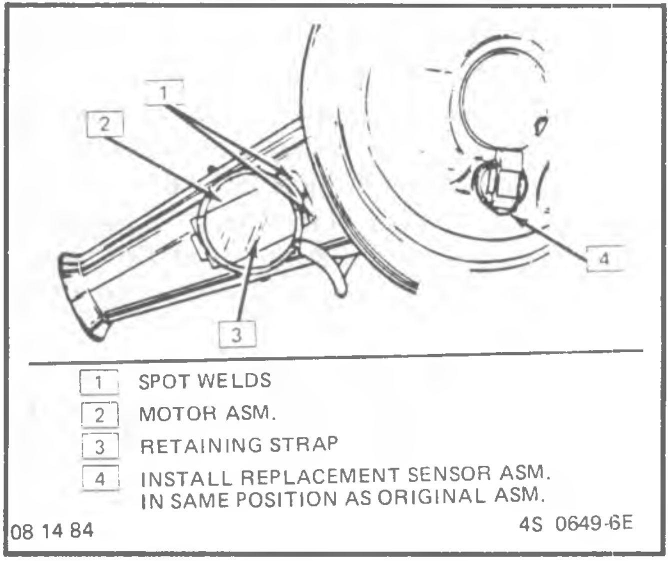


Figure 129 Replacing Vacuum Diaphragm Motor

SENSOR (FIGURE 130)

Remove or Disconnect

1. Air cleaner.
2. Hoses at sensor.
3. Pry up tabs on sensor retaining clip. Remove clip and sensor from air cleaner. Note position of sensor for installation.

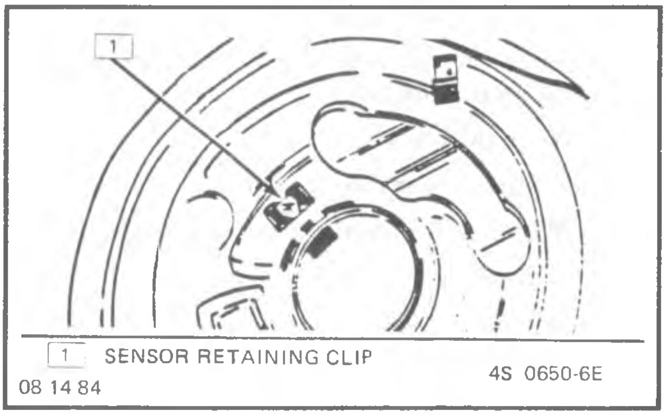


Figure 130 Replacing THERMAC Sensor Retaining Clip

PARTS INFORMATION

PART NAME	GROUP
Air Cleaner	3.402
Element(Paper)	3.410
Nut, A/Cl	3.403
Seal,Air Cleaner	3.403
Sensor, A/Cl	3.415
Motor,A/Cl Vac Diaph	3.415
Tube,Eng Air Heat Stove	3.417
Stove,Eng Air Heat	3.417

THROTTLE RETURN CONTROL (TRC) SYSTEM

California V-8 Engines With Heavy Duty Emissions

GENERAL DESCRIPTION

PURPOSE

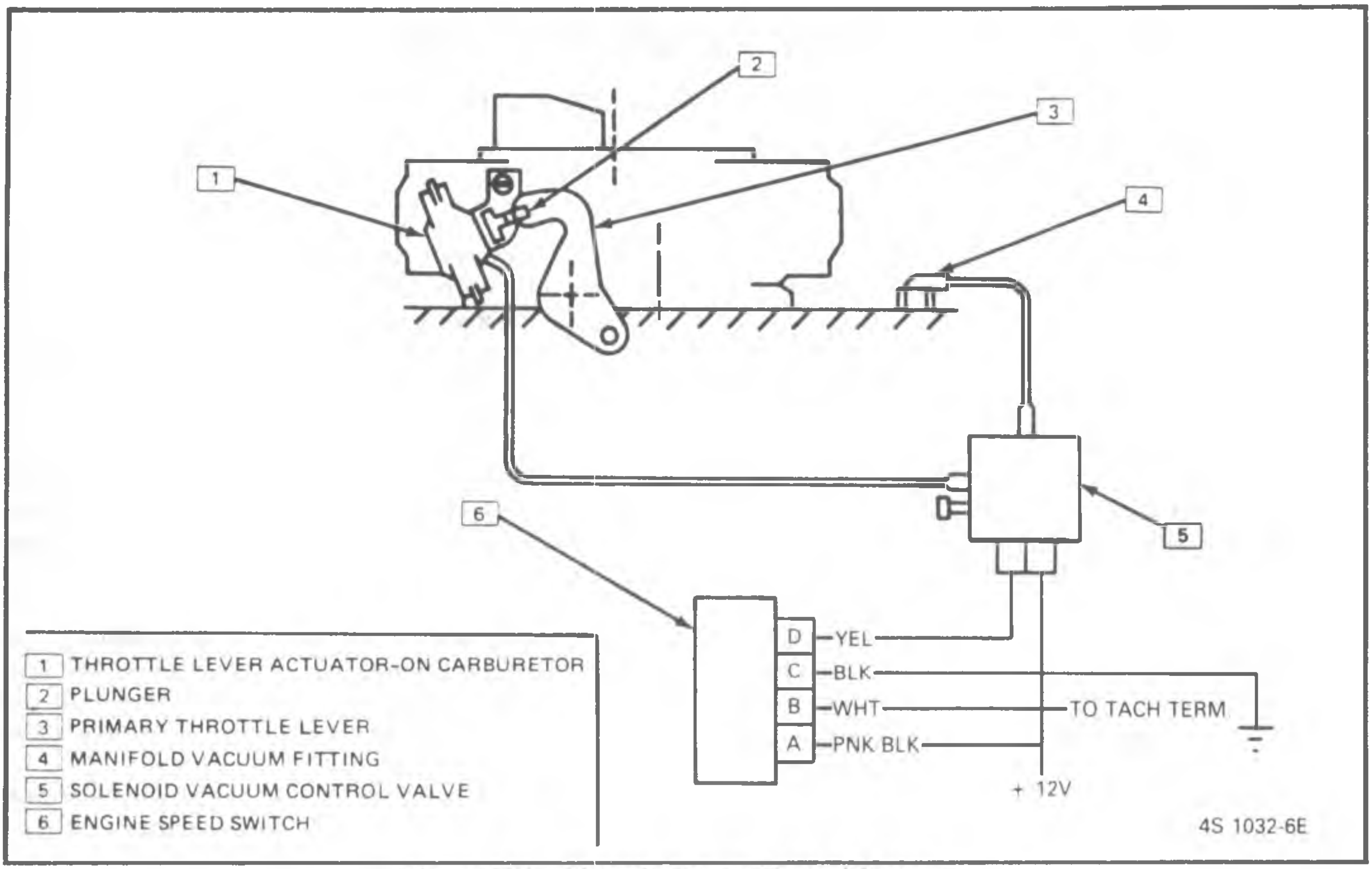
The TRC system (Fig. 131), used on V8 heavy duty emission vehicles in California, consists of three major components:

- Throttle Lever Actuator - Mounted as part of the carburetor assembly, this device opens the primary throttle plates a preset amount in excess of curb idle, when engine vacuum is applied to it. This actuating vacuum is controlled by a separate solenoid vacuum control valve.
- Solenoid Vacuum Control Valve - Mounted separately from the carburetor, this off-on valve is held open, above a present nominal engine speed, by a signal from an engine speed sensor. The valve, when open, allows a vacuum signal to be applied to the throttle lever actuator as long as the present engine speed is exceeded.
- Engine Speed Switch - Mounted separately from the solenoid vacuum control valve, this switching device monitors engine speed at the distributor and supplies a continuous electrical signal to the solenoid vacuum control valve as long as the preset engine speed is exceeded.

DIAGNOSIS

Check hoses for cracking, abrasion, or deterioration and replace as necessary. Check for shorted or broken wires and ensure that electrical connectors are fully engaged at the distributor, speed switch, and control valve. Check system function for proper operation and adjust as necessary.

1. Connect precision tachometer (capable of resolving 10 RPM) to the distributor "TACH" terminal.
2. Start engine and advance throttle to indicated 1890 RPM. Throttle lever actuator should be extended at this speed.
3. Reduce throttle opening to indicated 1700 RPM. Throttle lever actuator should be retracted at this speed.
4. If the throttle lever actuator operates outside of the 1700 to 1890 RPM limits, the speed switch is out of calibration and should be replaced.
5. If the actuator does not operate at any speed, proceed with the following steps.
   a. With a voltmeter, check for voltage at the control valve and speed switch. This is accomplished by connecting the negative probe of the voltmeter to the engine "ground" and inserting the positive probe in the connector cavity of the voltage source wire. A voltage of 12-14 volts should be measured at this terminal on both the valve and speed switch. When making this measurement, it is not necessary to unplug the connector from its component. The voltmeter probe can be inserted in the connector body on the wire side of the connector to contact the metal terminal.
   b. If voltage is present at one device and not the other, repair the engine wiring harness as required.
   c. If voltage is not present at either device, check the engine harness connections at the distributor and/or bulkhead connector. Repair as required.
   d. If the proper voltage exists at each device, to check for proper solenoid valve operation, "ground" the valve-to-switch connecting wire terminal at the solenoid connector, using a jumper wire. The throttle lever actuator should extend (engine running).
   e. If it does not extend, remove the hose from the solenoid side port that connects to the actuator hose. Visually, check the orifice in this port for plugging. Clear the orifice as required. If not plugged, replace the solenoid vacuum control valve.
   f. If the actuator extends in Step D, ground the valve-to-switch wire terminal at the speed switch. If it does not extend, repair the wire connecting the speed switch and valve. If it does extend, check the speed switch ground wire for "ground" - it should read 0 volts when checked with a voltmeter, with the engine running, check the speed switch-to-distributor wire for



1 THROTTLE LEVER ACTUATOR-ON CARBURETOR
2 PLUNGER
3 PRIMARY THROTTLE LEVER
4 MANIFOLD VACUUM FITTING
5 SOLENOID VACUUM CONTROL VALVE
6 ENGINE SPEED SWITCH

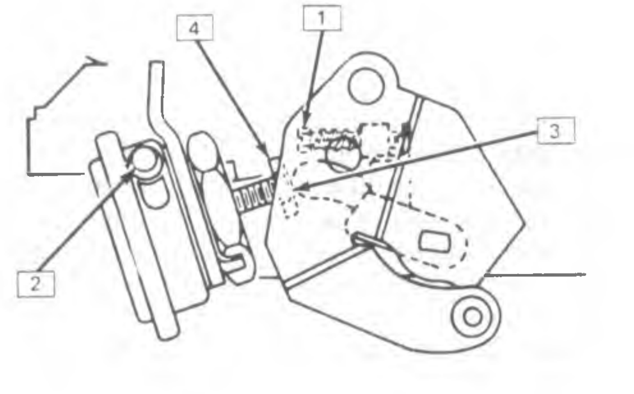
4S 1032-6E

Figure 131 - Throttle Return Control System

proper connection. With both the ground and distributor wires properly connected, and if the actuator does not extend when operating above 1890 RPM, replace the speed switch.

Throttle Lever Actuator-Checking Procedure

1. Disconnect valve to actuator hose at valve and connect to an external vacuum source equipped with a vacuum gage.
2. Apply 68 kPa (20" Hg) vacuum to the actuator and seal off the vacuum source. If the vacuum gage reading drops, then the actuator is leaking and must be replaced.
3. To check the actuator for proper operation:
   a. Check the throttle lever, shaft, and linkage to be sure that they operate freely without binding or sticking.
   b. Start engine and run until warmed up and idle is stable. Note idle rpm.
   c. Apply 68 kPa (20" Hg) vacuum to the actuator. Manually, open the throttle slightly and allow to close against the extended actuator plunger. Note the engine rpm.
   d. Release and reapply 68 kPa (20" Hg) vacuum to the actuator and note the rpm to which the engine speed increased (do not assist the actuator).



- ENGINE AT OPERATING TEMPERATURE
- CHOKE WIDE OPEN
- CAM FOLLOWER STEPS OF FAST IDLE CAM

1 ADJUST IDLE SPEED SCREW TO OBTAIN SPECIFIED CURB IDLE R.P.M. (SEE LABEL)
2 APPLY 68 kPa (20") WITH OUTSIDE VACUUM SOURCE TO FULLY EXTEND PLUNGER
3 MANUALLY OPEN THROTTLE SLIGHTLY AND THEN RELEASE AGAINST PLUNGER
4 WITH PLUNGER HELD INWARD, TURN PLUNGER IN OR OUT TO OBTAIN SPECIFIED R.P.M. (SEE LABEL)

4S 1061-6E

Figure 132 - Throttle Lever Actuator Adjustment

e. If the rpm obtained in Step D is not within 150 rpm of that obtained in Step C, then the actuator plunger may be binding due to dirt, corrosion, varnish, etc., or the actuator diaphragm may be too weak. If binding is not indicated, or cannot be corrected, then the actuator must be replaced.

f. Release the vacuum from the actuator and the engine speed should return to within 50 rpm of the idle speed noted in Step 2. If it does not, the plunger may be binding due to dirt, corrosion, varnish, etc. If the problem cannot be corrected, the actuator must be replaced.

g. If the engine rpm noted in Step 3 is not within the specified TRC speed range, the TRC actuator must be adjusted. Refer to Figure 131 and Vehicle Emission control Information label for adjustment of the throttle lever actuator.

ON-VEHICLE SERVICE

THROTTLE KICKER

Adjust

Refer to Figure 131 and Vehicle Emission Control Information label for adjustment of the throttle kicker.

Remove or Disconnect

Figure 133

1. Vacuum hose.
2. Bracket and throttle kicker.
3. Tab locking washer.
4. Throttle Kicker.

Install or Connect

1. Throttle Kicker.
2. Tab locking washer - do not lock.
3. Bracket and throttle kicker.
4. Adjust throttle kicker.
5. Lock tab washer.
6. Vacuum hose.

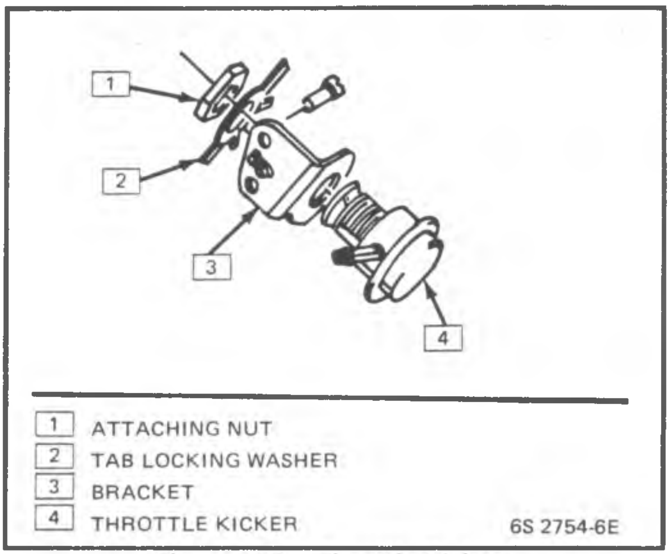


Figure 133 - Throttle Kicker

ENGINE SPEED SWITCH
Figure 134

Remove or Disconnect

1. Electrical connector.
2. Engine speed switch.

Install or Connect

1. Engine speed switch.
2. Electrical connector.

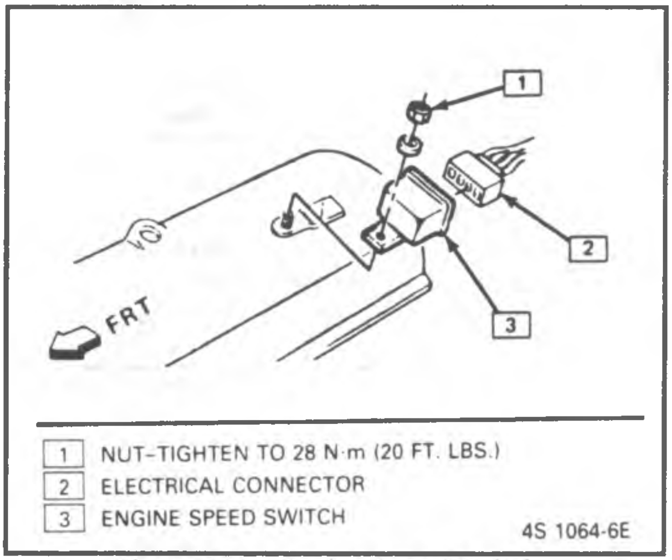


Figure 134 - Engine Speed Switch

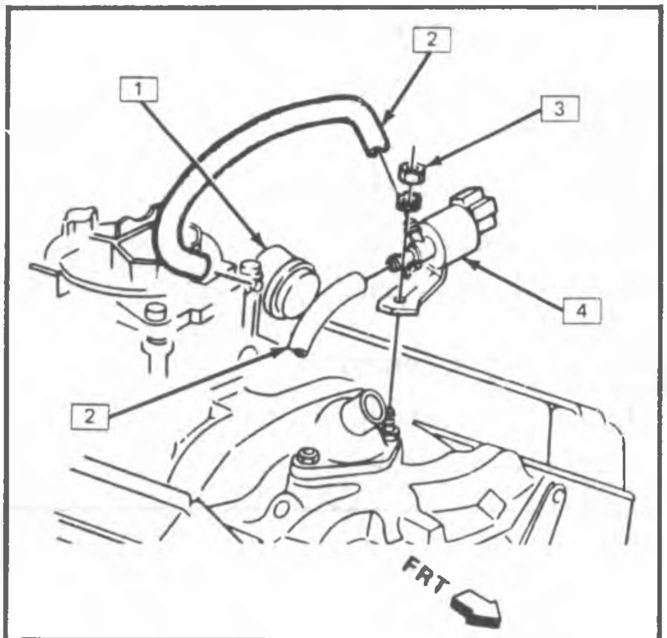
SOLENOID VACUUM CONTROL VALVE
Figure 135

Remove or Disconnect

1. Electrical connector.
2. Vacuum hoses.
3. Solenoid vacuum control valve.

Install or Connect

1. Solenoid vacuum control valve.
2. Vacuum hoses.
3. Electrical connector.



1 THROTTLE LEVER ACTUATOR
2 VACUUM HOSE
3 NUT TIGHTEN TO 28 N·m (20 FT. LBS.)
4 SOLENOID VACUUM CONTROL VALVE

4S 1063-6E

Figure 135 - Solenoid Vacuum Control Valve

PARTS INFORMATION

PART NAME	GROUP
Throttle Kicker	Carb. Chart
Engine Speed Switch	3.440
Solenoid Vacuum Control Valve	3.440

SECTION 6E9

DRIVABILITY AND EMISSIONS—DIESEL

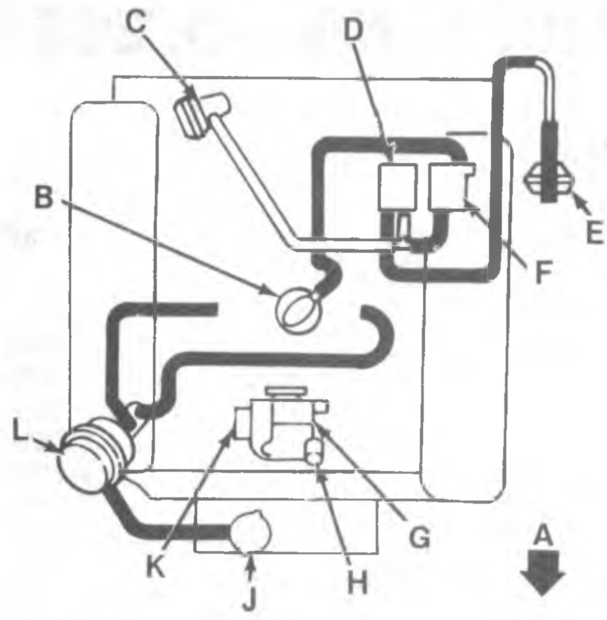
CONTENTS

SUBJECT **PAGE**

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, also refer to the appropriate Canadian Service Manual Supplement.

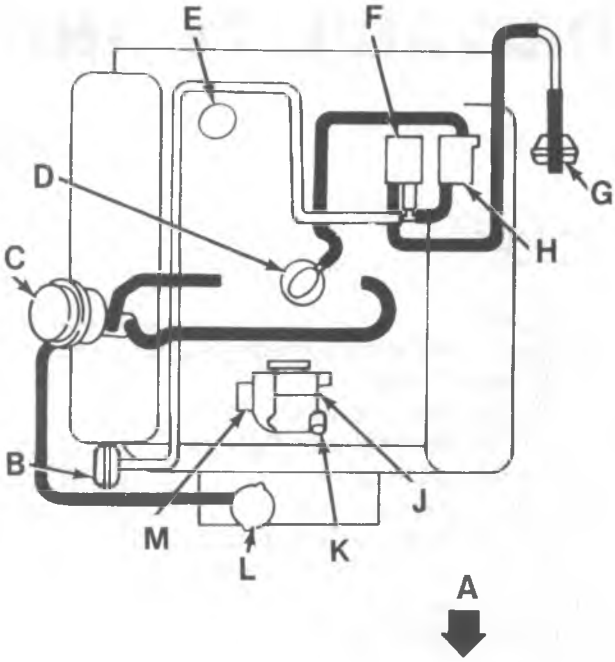
DESCRIPTION



A. Front of Vehicle
B. EGR Valve
C. Vacuum Pump
D. EPR Solenoid
E. EPR Valve
F. EGR Solenoid
G. Injection Pump
H. Fast Idle Solenoid
J. Oil Fill Pipe
K. Throttle Position Switch
L. Crankcase Depression Regulator Valve

F-00017

Figure 1—C-K Emission System With Light Duty Emissions

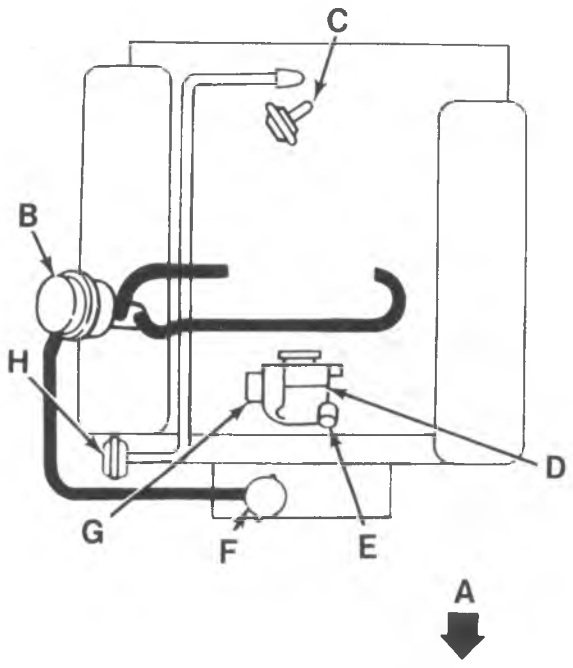


A. Front of Vehicle
B. Vacuum Pump
C. Crankcase Depression Regulator Valve
D. EGR Valve
E. Engine Speed Sensor
F. EPR Solenoid
G. EPR Valve
H. EGR Solenoid
J. Injection Pump
K. Fast Idle Solenoid
L. Oil Fill Pipe
M. Throttle Position Switch

F-00024

Figure 2—G-Van Emission System With Light-Duty Emissions

The 6.2L diesel engine has controls to reduce exhaust emissions while maintaining good drivability and fuel economy. The light duty emission engine (RPO LH6) has Crankcase Ventilation and Exhaust Gas Recirculation (figures 1 and 2). The heavy duty emission engine (RPO LL4) has Crankcase Ventilation and a Vacuum Regulator Valve (figure 3).



A. Front of Vehicle
B. Crankcase Depression Regulator Valve
C. Vacuum Pump (G-P Series)
D. Injection Pump
E. Fast Idle Solenoid
F. Oil Fill Pipe
G. Vacuum Regulator Valve
H. Vacuum Pump (C-K Series)

F-00023

Figure 3—Heavy Duty Emission System

CRANKCASE VENTILATION SYSTEM

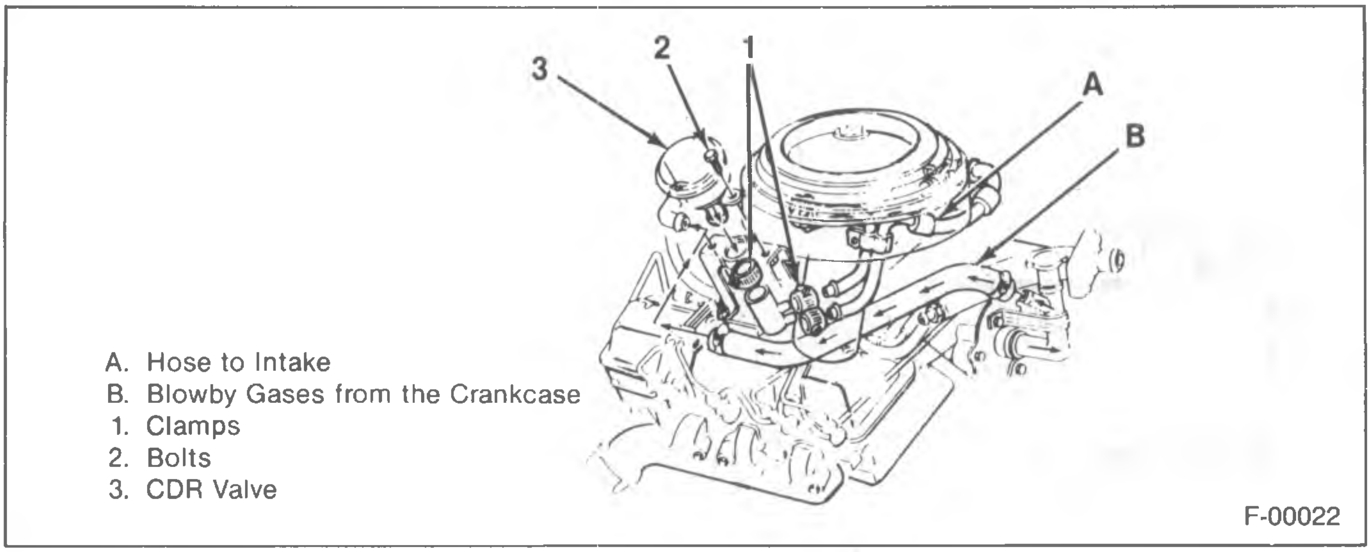


Figure 4—Crankcase Ventilation System

The crankcase ventilation system is used on all 6.2L diesel engines to reduce crankcase pressure at idle (figure 4). This reduced pressure reduces engine oil leaks. The system consists of connecting hoses and a Crankcase Depression Regulator (CDR) valve located at the front right cylinder head.

The CDR valve is used to regulate the flow of crankcase gases back into the engine. The valve limits vacuum in the crankcase as the gases are drawn from the oil fill pipe and into the intake manifold.

Intake manifold vacuum acts against a spring loaded diaphragm to control the flow of crankcase gases (figure 5). Higher intake vacuum pulls the diaphragm closer to the top of the outlet tube. This reduces the amount of gases being drawn from the crankcase and also decreases the vacuum in the crankcase. As the intake vacuum decreases, the spring pushes the diaphragm away from the top of the outlet tube. This allows more crankcase gases to flow to the intake manifold.

Refer to MAINTENANCE AND LUBRICATION (SEC. 0B) for diesel crankcase ventilation system maintenance requirements.

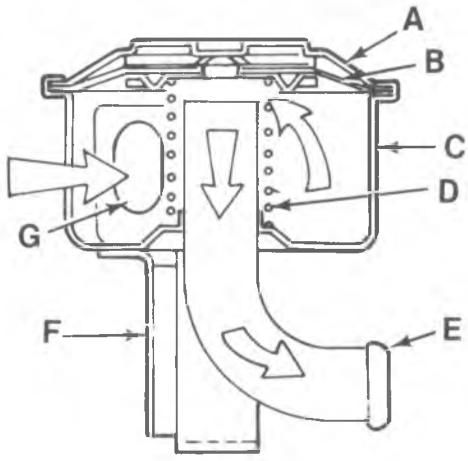
CDR VALVE CHECK

The purpose of the CDR valve is to maintain 0.75-1.0 kPa (3-4 inches of water) vacuum in the crankcase. Too little vacuum may force oil leaks while too much vacuum will pull oil into the air crossover.

The CDR valve is checked with a water manometer. The U-tube manometer indicates pressure or vacuum by the difference in the height of the two columns of the fluid (figure 6).

Inspect

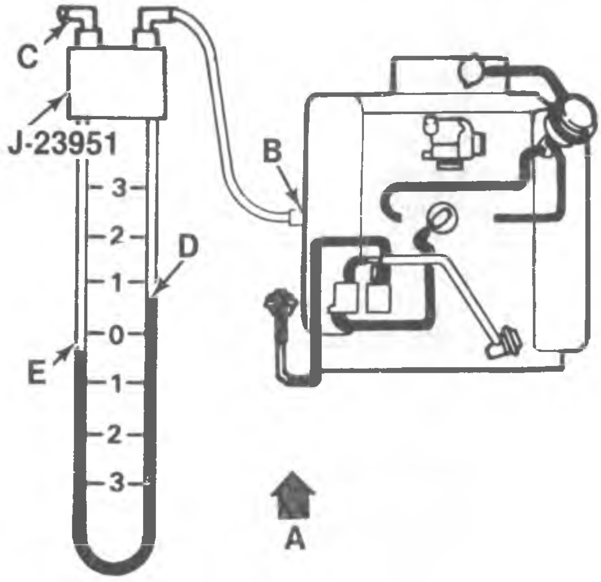
1. Connect one end of the manometer to the oil dipstick hole
    - The other end of the manometer is vented to atmosphere.
2. Run the engine at idle.
3. The reading should be about 0.25 kPa (1-inch of water) pressure at idle to 0.5-1.25 kPa (2-5 inches of water) vacuum at full load.
    - Add the amount that the manometer column travels up to the amount the other column travels down to get the total pressure or vacuum.



A. Cover
B. Diaphragm
C. Body
D. Spring
E. Outlet Tube (Gases To Intake Manifold)
F. Mounting Bracket
G. Inlet Port (Gases From Crankcase)

F-00021

Figure 5—CDR Valve Operation



A. Front
B. Engine Oil Dipstick Tube
C. Vent To Atmosphere
C. ½-Inch Above Zero
D. ½-Inch Below Zero

F-00028

Figure 6—CDR Valve Test

As an example; 12.7 mm (one-half inch) above zero plus 12.7 mm (one-half inch) below zero gives a 25.4 (one-inch) vacuum reading (figure 6).

CDR VALVE REPLACEMENT

↔ Remove or Disconnect (Figure 4)

1. Clamps (1) from the hoses.
2. Hoses.
3. Bolts (2).
4. CDR valve (3).

→← Install or Connect (Figure 4)

1. CDR valve to the bracket.
2. Bolts.
3. Hoses.
4. Clamps.

EXHAUST GAS RECIRCULATION SYSTEM

The Exhaust Gas Recirculation (EGR) system is used on 6.2 L diesel engines with Federal light duty emissions. The EGR system (figure 7) consists of:

- EGR valve.
- Exhaust Pressure Regulator (EPR).
- EGR solenoid.
- EPR solenoid.
- Throttle Position Switch (TPS).
- Vacuum Pump.

Nitrogen oxides (NOx) are formed at high combustion temperatures. The purpose of the EGR system is to reduce these emissions.

Exhaust gases are introduced into the intake manifold through the EGR valve (figure 8). These exhaust gases act as an inert (non-combustible) ingredient in the combustion chamber. This reduces NOx through lower combustion temperatures.

The EPR valve is located between the exhaust manifold and the exhaust pipe (figure 9). It increases exhaust backpressure during idle to increase exhaust flow through the EGR system. The EPR valve is normally open.

The TPS is mounted on the throttle shaft of the injection pump. As the throttle is opened, one switch contact opens a circuit and another switch closes a circuit at calibrated throttle angles.

At idle, the EPR solenoid is energized through the TPS, allowing vacuum to close the EPR valve. This increases exhaust backpressure. At a calibrated throttle angle, the EPR soleniod is de-energized and the EPR valve is opened.

At idle, the EGR solenoid is de-energized, allowing vacuum to open the EGR valve. At a calibrated throttle angle, the EGR solenoid is energized. This cuts off vacuum to the EGR valve and the valve closes.

The EPR solenoid is normally de-energized and the EGR solenoid is normally energized. The EPR solenoid is de-energized before, or at the same time that the EGR solenoid is energized.

There are three different cams used to change the time when the EPR valve opens and the EGR valve closes.

- Blue Cam — 0 degree difference.
- Black Cam — 5 degree difference.
- Red Cam — 10 degree difference.

Refer to figure 10 for a summary of EGR and EPR operation.

EGR SYSTEM CHECK

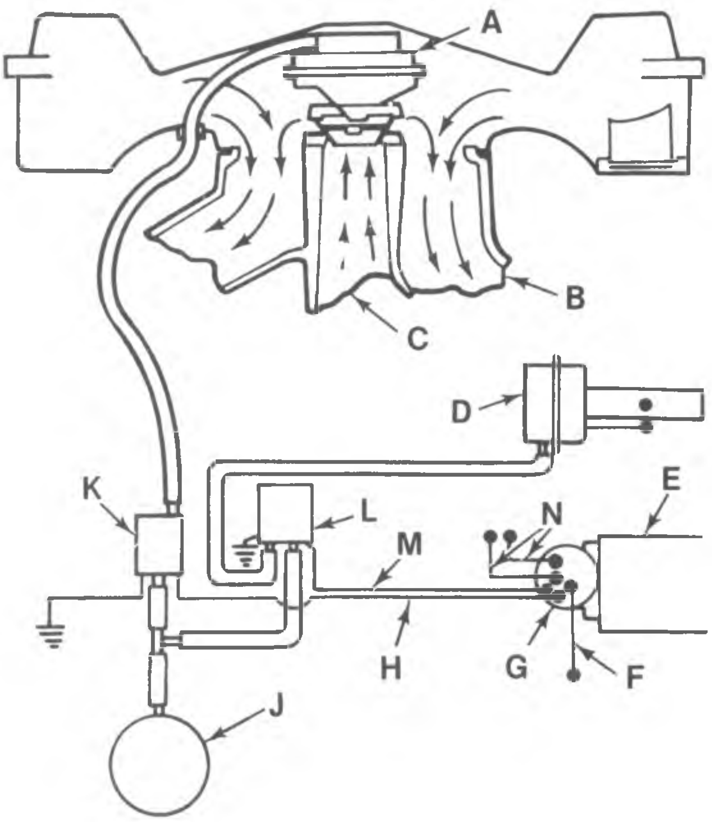
Heavy black exhaust smoke during acceleration usually indicates a problem in the system.

1. Start the engine and bring it to operating temperature.
2. Remove the air cleaner cover to observe EGR valve operation.
3. With the engine at idle, the EGR valve should be open (valve head in the up position and noticeable exhaust noise). If not, check and correct any electrical and hose connection which may be loose and/or disconnected.
4. Remove the vacuum hose from the EGR valve. The valve head should drop with a noticeable reduction in noise. Connect the hose.
5. The hose to the EGR valve should have 6.75 kPa (20-inches of water) vacuum at idle. If vacuum is not present, check the output of the vacuum pump at the pump. The pump should produce a minimum of 6.75 kPa (20-inches of water) vacuum.
6. If vacuum is present at the EGR valve, but the valve does not operate as the hose is put on and taken off, the EGR valve is stuck and should be checked and replaced if necessary.
7. Manually operate the throttle lever at the injection pump through about 15 to 20 degrees of travel. The EGR valve should close when the TPS reaches the calibrated point.
8. Check the pink wire to the TPS for 12 volts (key on). If 12 volts is not present, check for loose connections, open wires, or a blown fuse.
9. With the key on, the blue wire from the TPS should also have 12 volts. The blue wire feeds the EPR solenoid. If the pink wire has 12 volts at idle, but the blue wire does not, the TPS is inoperative and should be changed.
10. With the engine off and the key on, operate the throttle through 20 degrees of travel. At about 15 degrees, the TPS will stop sending 12 volts to the blue wire (EPR). At about 20 degrees, the TPS will supply 12 volts to the yellow wire (EGR). If not, the TPS is inoperative.
11. Make sure the electrical connections are made at the EGR/EPR solenoid assembly and that the hoses are routed correctly.
12. If there is vacuum at the solenoid assembly and the solenoids are receiving the proper electrical signal but operation of the TPS does not operate the EGR and/or EPR valve(s), the solenoid assembly is inoperative and should be replaced.

EGR VALVE REPLACEMENT

↔ **Remove or Disconnect (Figure 8)**

1. Air cleaner cover.
2. Vacuum hose from the EGR valve.



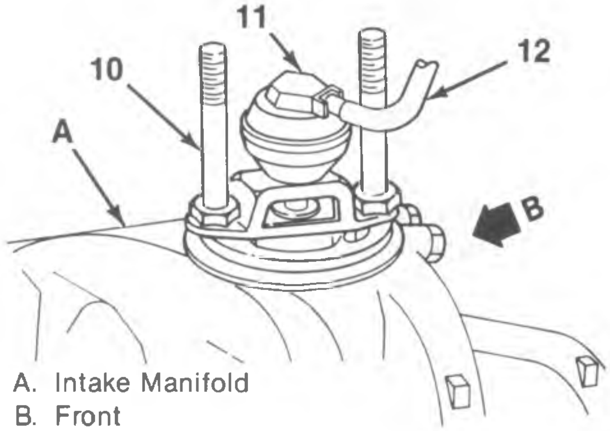
A. EGR Valve
B. Intake Runner
C. Exhaust Gases
D. EPR Valve
E. Injection Pump
F. 12 Volts (Pink Wire)
G. Throttle Position Switch
H. EGR Wire (Yellow)
J. Vacuum Pump
K. EGR Solenoid
L. EPR Solenoid
M. EPR Wire (Blue)
N. To 700 R4 Transmission Converter Clutch

Figure 7—EGR System

3. Studs.
4. EGR valve.

Install or Connect (Figure 8)

1. EGR valve.
2. Studs.
   - Seal the studs with Loctite 272 or equivalent.



A. Intake Manifold
B. Front
10. Stud
11. EGR Valve
12. Vacuum Hose (To Air Cleaner)

Figure 8—EGR Valve

3. Vacuum hose.
4. Air cleaner cover.

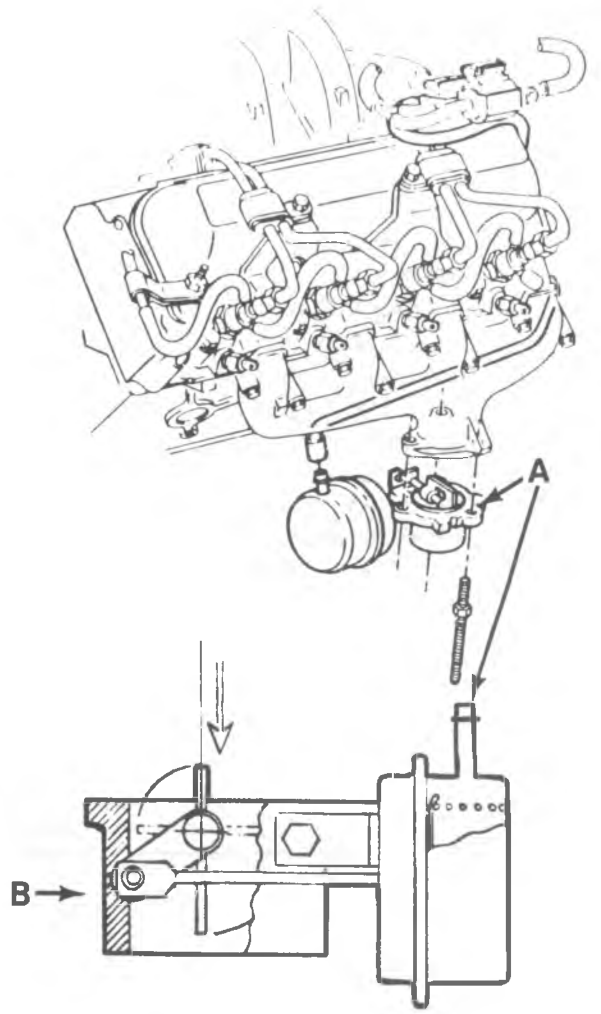
EPR VACUUM ACTUATOR REPLACEMENT

Remove or Disconnect (Figure 9)

1. The vacuum hose from the actuator.
2. Clip from the valve lever.
3. Bolt holding the actuator to the valve.
4. Actuator from the EPR valve.

Install or Connect (Figure 9)

1. Actuator to the EPR valve.
2. Bolt.
3. Clip.
4. The vacuum hose.



A. EPR Valve
B. Normally Spring Loaded Open

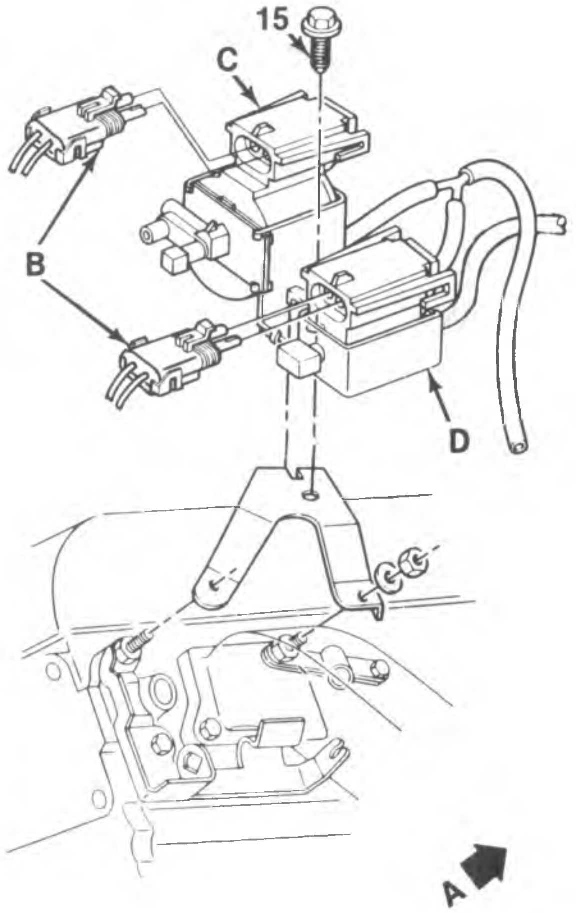
F-00026

Figure 9—EPR Valve

Throttle Position	EGR Valve	EGR Solenoid	EPR Valve	EPR Solenoid
Idle to 15° Throttle	Open	Not Energized (Vacuum to Valve)	Closed	Energized (Vacuum To Valve)
15° to 20° Throttle	Open	Not Energized (Vacuum to Valve)	Open	Not Energized (No Vacuum to Valve)
20° to Full Throttle	Closed	Energized (No Vacuum to Valve)	Open	Not Energized (No Vacuum to Valve)

F-00001

Figure 10—EGR System Operation



A. Front
B. Connector
C. EGR Solenoid
D. EPR Solenoid
15. Bolt

F-00031

Figure 11—EGR/EPR Solenoid Assembly

EPR/EGR SOLENOID REPLACEMENT

Remove or Disconnect (Figure 11)

1. The vacuum hoses.
   - Observe the hose routings for proper installation.
2. Electrical connectors.
3. Bolt (15).
4. Solenoid assembly.

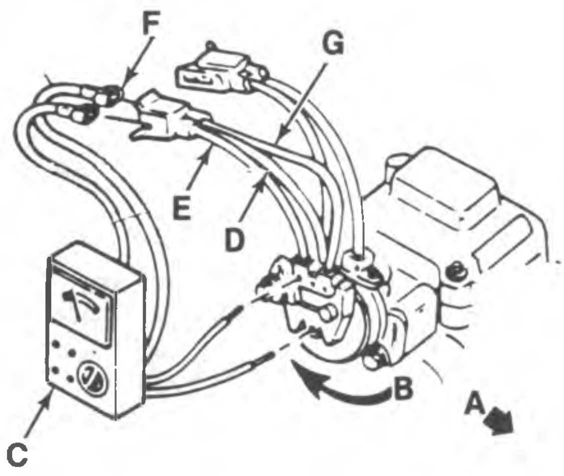
Install or Connect (Figure 11)

1. Solenoid assembly.
2. Bolt (15).
3. Electrical connectors.
4. The vacuum hoses.

THROTTLE POSITION SWITCH ADJUSTMENT

Tool Required:
J-33043, Gage Block.

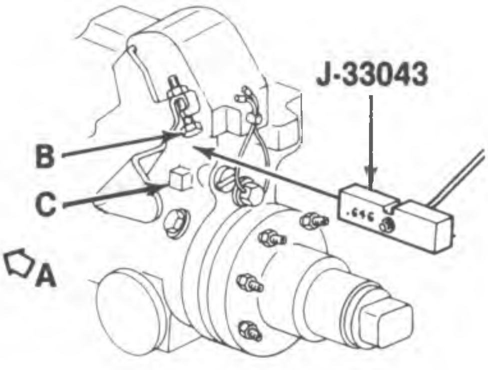
1. Disconnect the throttle position switch (TPS) connector.
2. Loosen the mounting screws that hold the TPS.
3. Connect an ohmmeter or test light to the IGN (pink) and EGR (yellow) terminals of the TPS (figure 12).
4. Insert the proper "switch closed" gage block between the gage boss on the injection pump and the wide open stop screw on the throttle shaft (figure 13).
   - Refer to the Emission Control Information label for correct gage block size.
5. Rotate the throttle lever and hold the wide open stop screw against the gage block.
6. Rotate the TPS until there is continuity between the terminals.
7. Hold the TPS and tighten the mounting screws to 6 N·m (53 in. lbs.).
8. Return the throttle lever to the idle position and remove the gage block.
9. Insert the proper "switch open" gage block and rotate the throttle lever against the block. There should be no continuity. If there is continuity, repeat steps 1 through 9.
   - Refer to the Emission Control Information label for correct gage block size.
10. Remove the gage block and ohmmeter.
11. Connect the TPS connector.



A. Front
B. Clockwise Rotation
C. Power Test Light Or Ohmmeter
D. IGN (Pink Wire)
E. EGR (Yellow Wire)
F. Optional Test Location
G. EPR (Blue or Violet Wire)

F-00008

Figure 12—Testing The TPS For Continuity

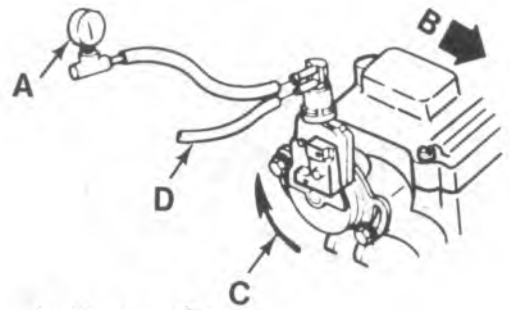


A. Front
B. Wide Open Stop Screw
C. Gage Boss

F-00007

Figure 13—TPS Adjustment Block

VACUUM REGULATOR VALVE



A. Vacuum Gage
B. Front
C. Clockwise Rotation
D. To Vacuum Source

B-06943

Figure 14—Vacuum Regulator Valve Adjustment

A vacuum regulator valve is used on engines with heavy duty emissions and automatic transmission. The valve regulates the vacuum signal to the vacuum modulator of a 400 automatic transmission. The valve is mounted to the injection pump and vacuum is supplied by the vacuum pump.

VRV ADJUSTMENT

Tool Required:
J-33043, Gage Block.

1. Loosen the vacuum regulator valve so it is free to rotate on the pump.
2. Attach a vacuum source of 67 ± 5 kPa (20-inches Hg. ± 1.5-inch Hg.) to the bottom vacuum port.
3. Attach a vacuum gage to the top vacuum port (figure 14).
4. Insert the proper gage block between the gage boss on the injection pump and the wide open stop screw on the throttle lever (switch on position) (figure 13).
    - Refer to the Emission Control Information label for correct gage block size.
5. Rotate the throttle shaft and hold it against the gage block.

NOTICE: Valve must be set while rotating the valve body clockwise only.

6. Slowly rotate the vacuum regulator valve body clockwise (facing the valve) until the vacuum gage reads 27 ± 2 kPa (8 ± 0.6 inches Hg.) Hold the valve body at this position and tighten the mounting screws to 6 N·m (54 in. lbs.).
7. Check by allowing the throttle shaft to return to the idle stop position. Then rotate the throttle shaft back against the gage block and read the vacuum gage. The gage should read 27 ± 2 kPa (8 ± 0.6 inches Hg). If vacuum is outside of limits, reset the valve.

SECTION 6F

EXHAUST

CONTENTS

SUBJECT **PAGE**

DESCRIPTION

Exhaust system designs will vary according to model designation and intended use of the vehicle.

The exhaust pipe(s), muffler(s) and tailpipe(s) are standard equipment. The exhaust system uses a ball joint coupling to secure the exhaust pipe to the engine manifold. The ball joint will allow angular movement for alignment purposes. The other connections use a slip joint coupling design with a clamp and U-bolt.

The exhaust system is suspended by hangers attached to the frame members. This will permit some movement of the exhaust system, but should not permit the transfer of noise and vibration into the vehicle.

Heat shields are used to protect both the vehicle and the environment from the high temperatures developed from the exhaust system, especially the catalytic converter.

The catalytic converter is an emission control device added to the gasoline engine exhaust system to reduce hydrocarbon and carbon monoxide pollutants from the exhaust gas stream. The converter contains beads which are coated with a catalytic material containing platinum and palladium. The catalytic converter for the computer command control emission system will also contain rhodium to reduce the level of nitrogen oxides. The catalyst in the converter is not serviceable.

THE CATALYTIC CONVERTER REQUIRES THE USE OF UNLEADED FUEL ONLY.

The diesel engine does not use a catalytic converter, and uses only diesel fuel.

DIAGNOSIS OF EXHAUST SYSTEM

Exhaust system performance complaints, such as excessive back pressure, are noticeable by their effect on engine performance. However, other malfunctioning vehicle components have similar effects on engine performance and are characterized by the same symptoms or complaints. Therefore, it is necessary to refer to the engine diagnosis procedure when attempting to diagnose this type of problem.

NOTICE: Replacement of exhaust system parts MUST be OEM standard.

PROBLEM	POSSIBLE CAUSE	CORRECTION
Vibrating or Rattling From Exhaust System	Loose and/or misaligned components.	Align, then tighten connections. Check for damaged hanger or mounting brackets and clamps.
Restricted Exhaust System	1. "Kinked" exhaust tubing. 2. Restriction within the muffler. 3. End of tail pipe obstruction. 4. Plugged catalytic converter (may result from serious engine malfunction).	1. If possible, repair the damaged condition, otherwise replace the component. 2. if restriction is suspected, remove the muffler and visually check it. Replace muffler if condition is doubtful. 3. Remove the obstruction, or if end is crimped, straighten outlet. 4. Replace the catalytic converter.
Exhaust Leakage and/or Noise	1. Leakage at exhaust component joints and couplings. 2. Improperly installed or misaligned. 3. Exhaust manifold cracked or broken. 4. Leak between exhaust manifold and cylinder head. 5. Damaged or worn seals or packing. 6. Burned or rusted out exhaust pipe heat tube extension. 7. Burned or rusted out exhaust pipe. 8. Burned or blown out muffler. 9. Broken or loose clamps and/or brackets.	1. Tighten clamps or couplings to specified torque. 2. Align, then tighten connections. 3. Replace the manifold. 4. Tighten the manifold to cylinder head nuts and bolts to specifications. 5. Replace the seals or packing as necessary. 6. Replace the heat tube extensions as required. 7. Replace the exhaust pipe. 8. Replace the muffler assembly. 9. Repair or replace as necessary.

ON-VEHICLE SERVICE

INSPECTION

Inspect exhaust pipes, catalytic converters (if equipped), mufflers and tailpipes for cracked joints, broken welds and corrosion damage that would result in a leaking exhaust system. Inspect the clamps, brackets and insulators for cracks and stripped or corroded bolt threads.

The exhaust system, including heat shields, must be free of leaks, binding, grounding and excessive vibration. These conditions are usually caused by damaged or loose flange bolts, heat shields, brackets or pipes. If any of these conditions exist, check the exhaust system components and alignment. Align and replace as necessary.

INSTALLING EXHAUST PARTS

When installing a new exhaust pipe or muffler and tailpipe, on any model, check for proper alignment. Rattles and noise vibrations in the exhaust system are usually caused by misalignment of parts. When aligning the system, leave all bolts or nuts loose until all parts are properly aligned, then tighten, working from the front to the rear.

Exhaust system hangers, hanger brackets, and clamps which are damaged should be replaced to maintain exhaust system alignment.

Important

- When jacking or lifting the vehicle from the frame side rails, be certain lift pads do not contact the catalytic converter as damage to the converter will result.
- Sealer 9985020 or equivalent is to be applied to all slip joint connections.
- When replacing a muffler, the tailpipe should also be replaced.
- When installing the exhaust pipe to the engine manifold, always use new packings and nuts. Clean the engine manifold stud threads with a wire brush before installing the new nuts.

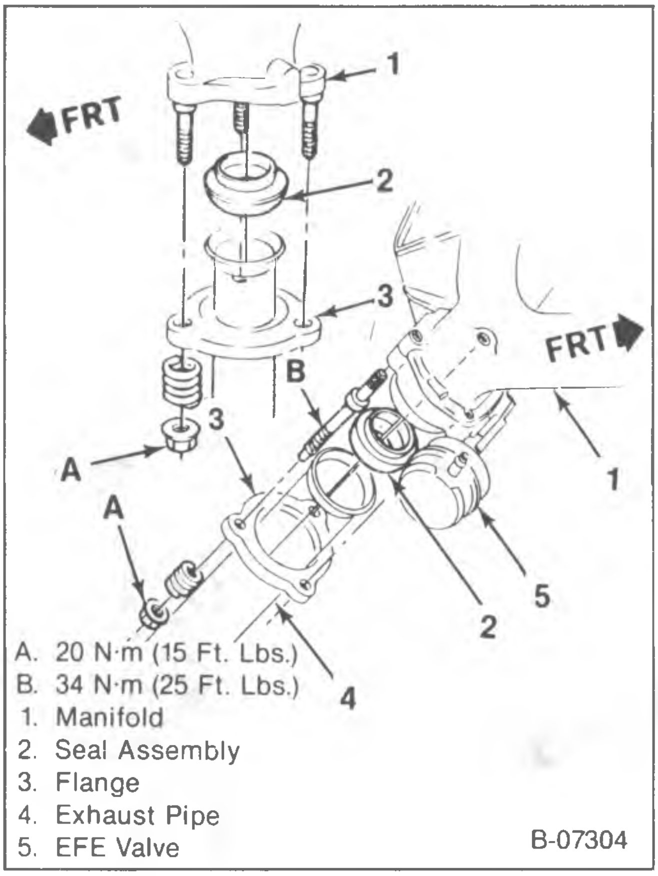
Refer to figures 1 through 18 for component replacement of the engine exhaust system.

CATALYTIC CONVERTER REPLACEMENT

Remove or Disconnect (Figure 8)

- Raise the vehicle on a hoist.

1. Heat shield.
2. Clamps at the front and rear of the converter.



A. 20 N·m (15 Ft. Lbs.)
B. 34 N·m (25 Ft. Lbs.)
1. Manifold
2. Seal Assembly
3. Flange
4. Exhaust Pipe
5. EFE Valve

B-07304

Figure 1—Exhaust Pipe to Manifold (Typical) CK-Model

3. Converter pipe-to-front-exhaust pipe and converter pipe-to-rear-exhaust pipe.

Install or Connect (Figure 8)

- Apply sealer 9985020 or equivalent at the slip joint connection.

1. New catalytic converter into the exhaust pipe.
2. New U-bolts and clamps at the front and rear of the converter.

- Check for clearance and alignment.

Tighten

- Clamps and support to 40 N·m (30 ft. lbs.).

3. Heat shield.
4. Lower the vehicle.

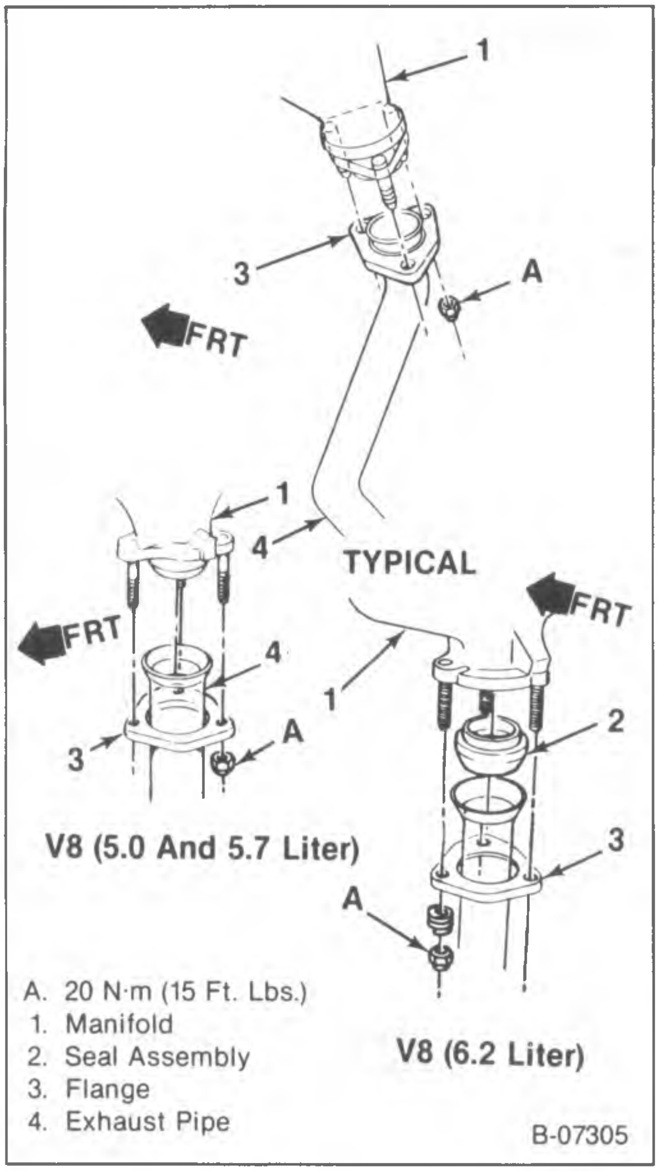


Figure 2—Exhaust Pipe to Manifold G-Model

BOTTOM COVER REPLACEMENT

If, for any reason, the bottom cover of a bead type converter is torn or punctured, it can be replaced with a repair kit.

Remove or Disconnect (Figures 19 and 20)

1. Bottom cover.
   - Cut close to the bottom outside edge (Figures 19 and 20). Do not remove the fill plug. The depth of the cut must be very shallow to prevent damage to the inner shell of the converter.
2. Insulator.

Inspect

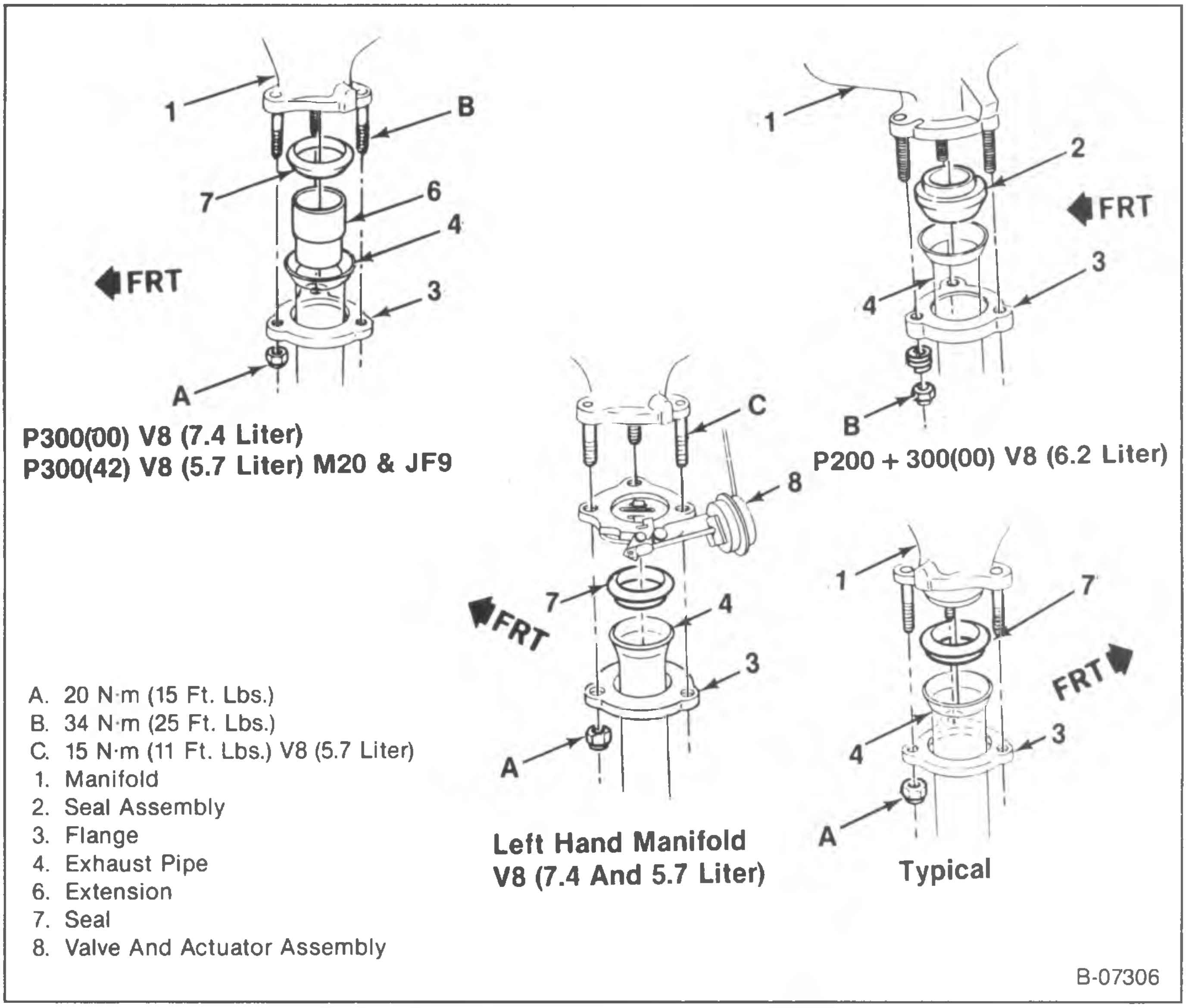
- Inner shell of the converter for damage. If damaged the converter assembly must be replaced.

Install or Connect (Figures 21 through 24)

- Place new insulation in the replacement cover. Apply sealing compound 9985020 or equivalent, all around the cover after the insulation is in position (figure 21). Apply extra sealer at the front and rear opening for the pipes. On the dual bed converter, also apply extra sealer around the air inlet tube.

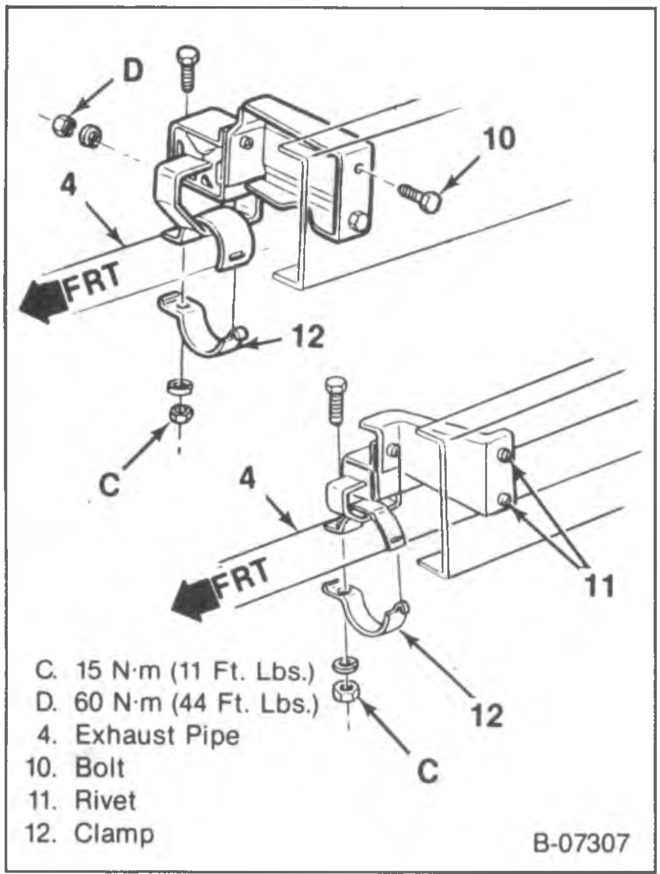
1. Cover on the converter (figure 22).
2. Cover retaining channels on both sides of the converter (figure 23).

- On the single bed converter, attach two clamps over the retaining channels at each end of the converter (figure 24).
- On the dual bed converter, attach two clamps over the retaining channels at each end of the converter plus one clamp without a retaining channel between the air inlet tube and exhaust inlet pipe. Position the air inlet tube clamps.



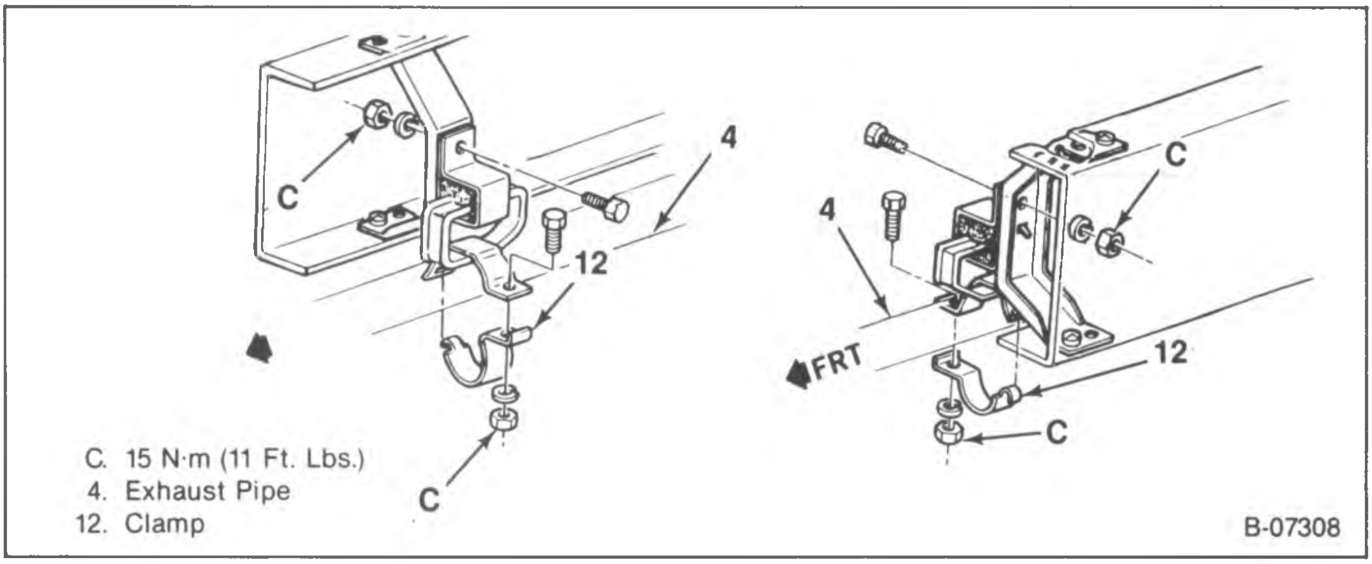
A. 20 N·m (15 Ft. Lbs.)
B. 34 N·m (25 Ft. Lbs.)
C. 15 N·m (11 Ft. Lbs.) V8 (5.7 Liter)
1. Manifold
2. Seal Assembly
3. Flange
4. Exhaust Pipe
6. Extension
7. Seal
8. Valve And Actuator Assembly

Figure 3—Exhaust Pipe to Manifold P-Model



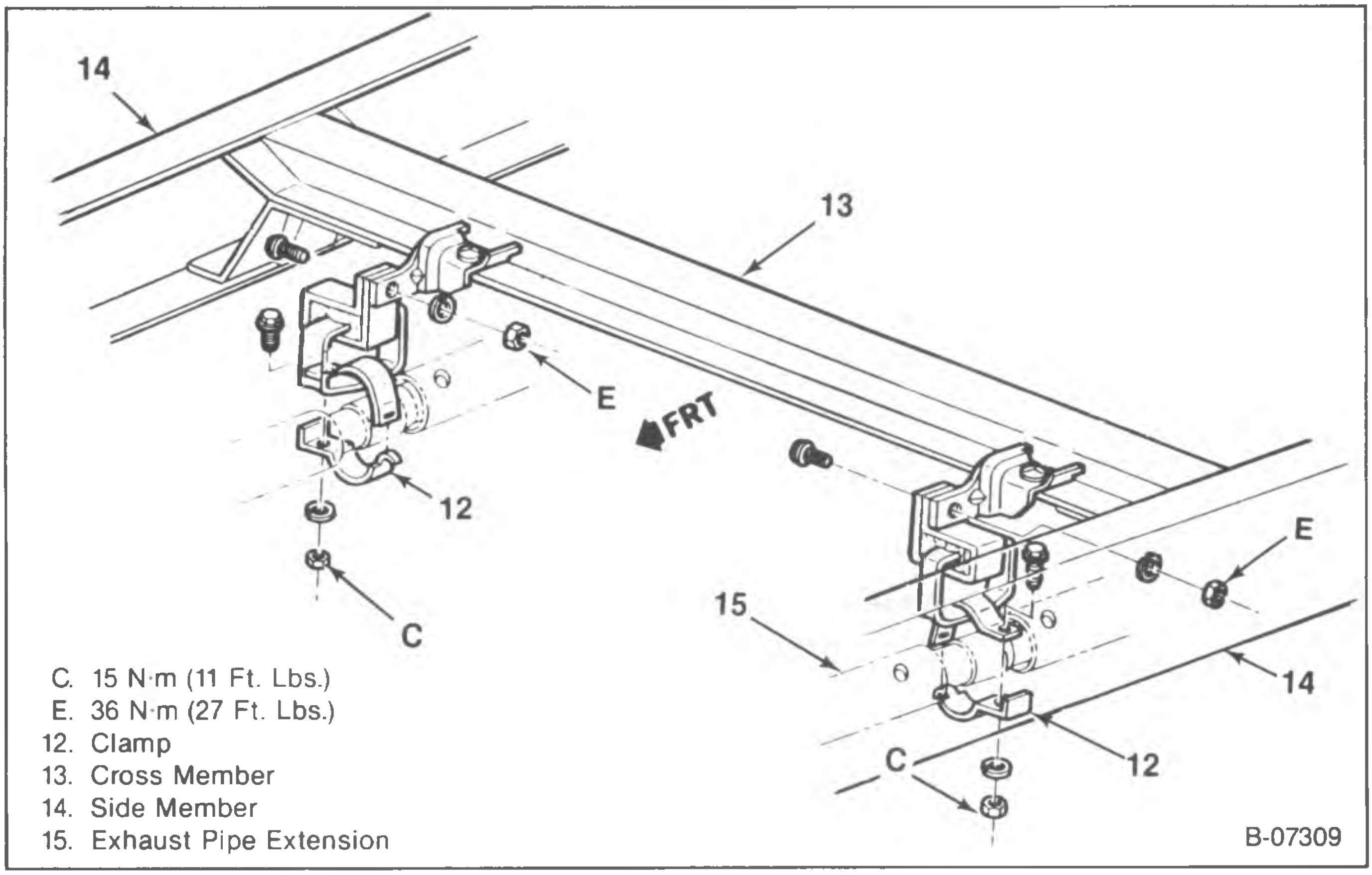
C. 15 N·m (11 Ft. Lbs.)
D. 60 N·m (44 Ft. Lbs.)
4. Exhaust Pipe
10. Bolt
11. Rivet
12. Clamp

Figure 4—Exhaust Pipe Hangers (Typical) CK-Model



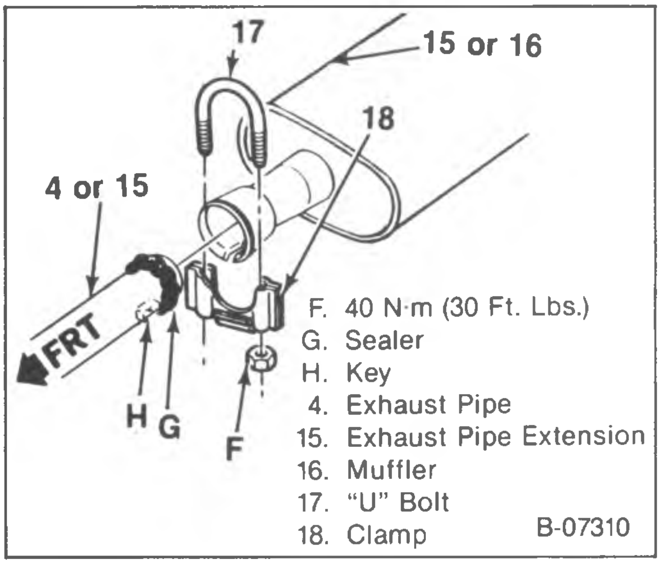
C. 15 N·m (11 Ft. Lbs.)
4. Exhaust Pipe
12. Clamp

Figure 5—Exhaust Pipe Hangers (Typical) P-Model



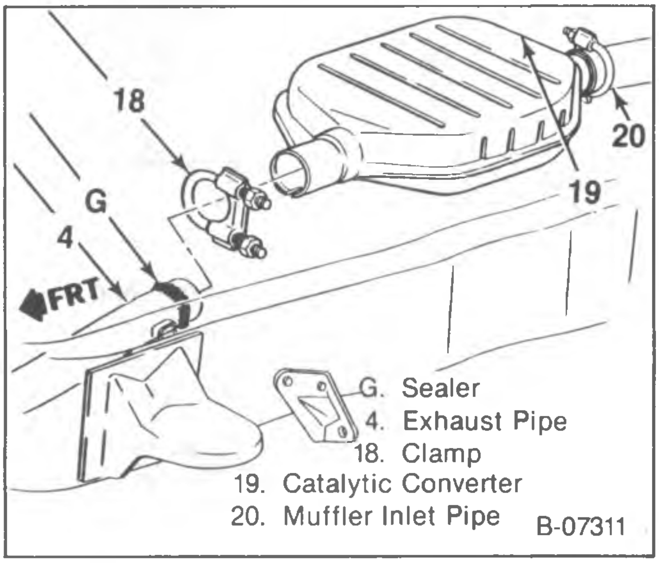
C. 15 N·m (11 Ft. Lbs.)
E. 36 N·m (27 Ft. Lbs.)
12. Clamp
13. Cross Member
14. Side Member
15. Exhaust Pipe Extension

Figure 6—Exhaust Pipe Extension Hanger P-Model



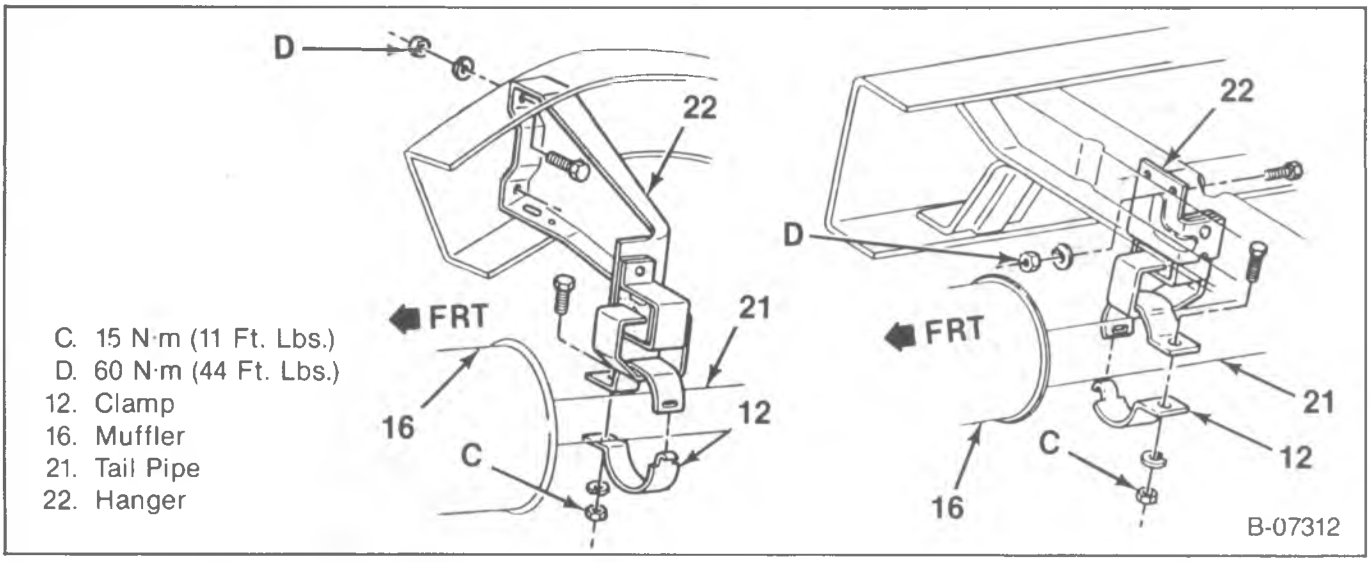
F. 40 N·m (30 Ft. Lbs.)
G. Sealer
H. Key
4. Exhaust Pipe
15. Exhaust Pipe Extension
16. Muffler
17. "U" Bolt
18. Clamp

Figure 7—Exhaust Pipe Clamping (Typical)



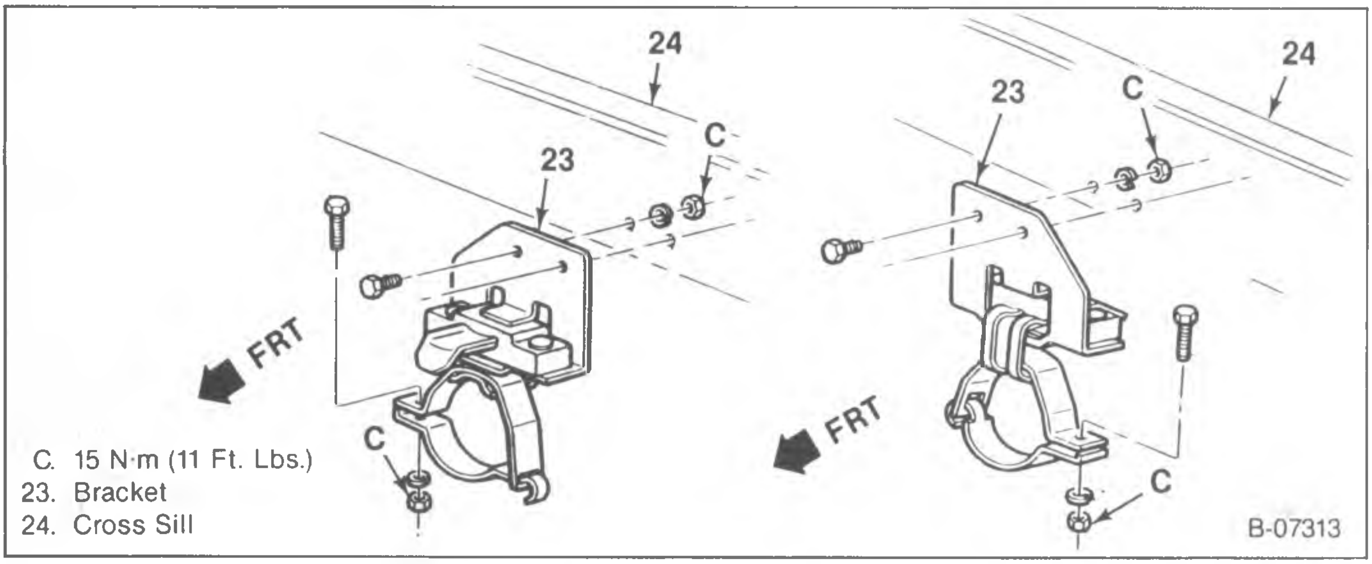
G. Sealer
4. Exhaust Pipe
18. Clamp
19. Catalytic Converter
20. Muffler Inlet Pipe

Figure 8—Catalytic Converter Clamping (Typical)



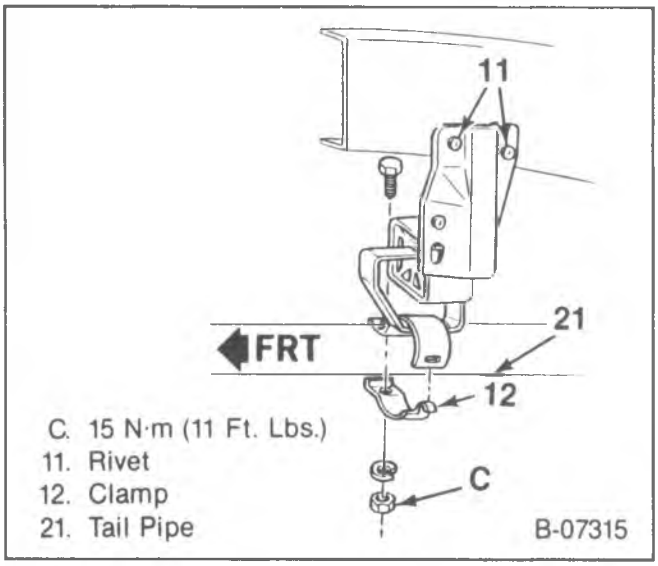
C. 15 N·m (11 Ft. Lbs.)
D. 60 N·m (44 Ft. Lbs.)
12. Clamp
16. Muffler
21. Tail Pipe
22. Hanger

Figure 9—Muffler Hangers (Typical) CK-Model



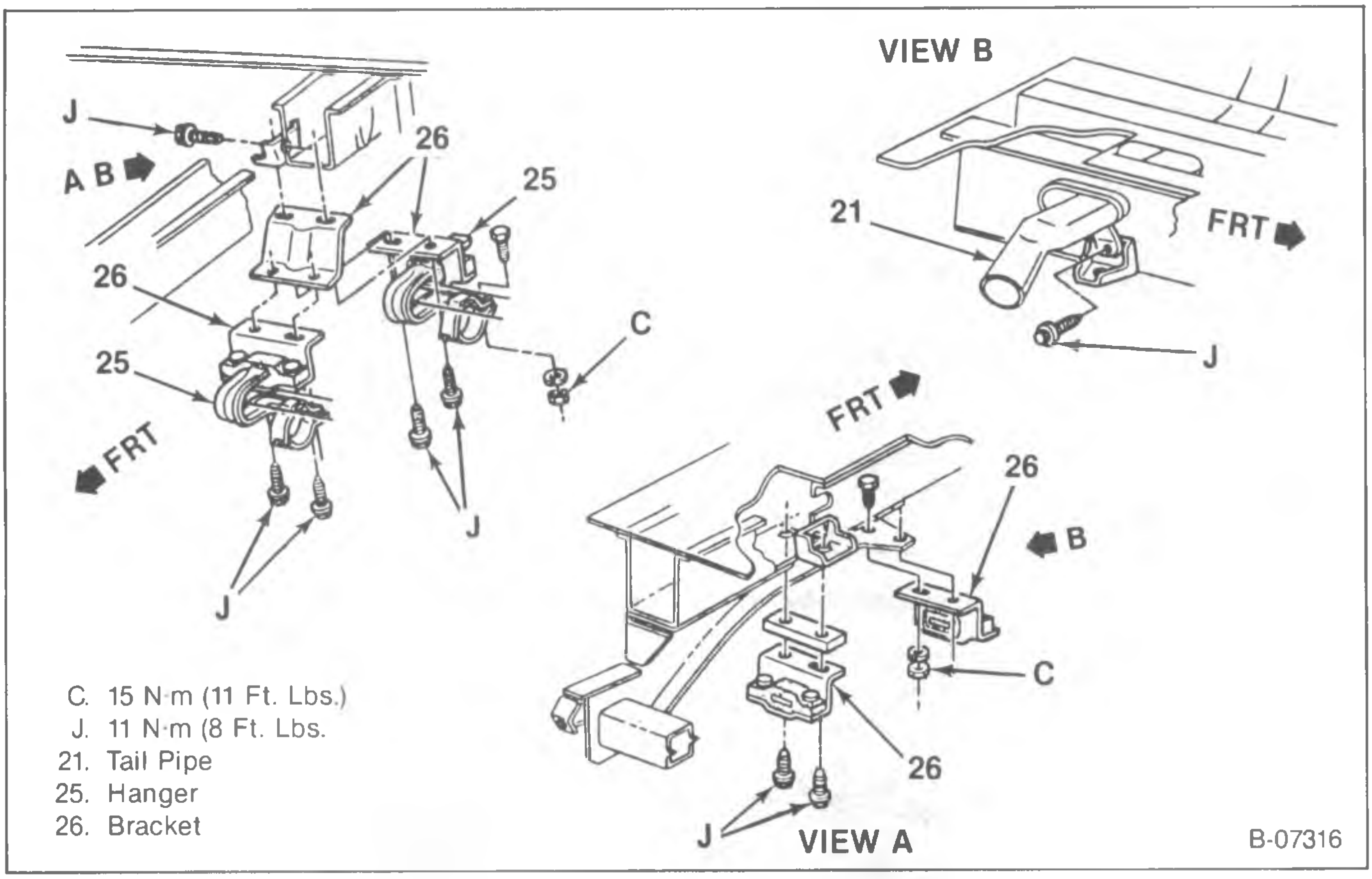
C. 15 N·m (11 Ft. Lbs.)
23. Bracket
24. Cross Sill

Figure 10—Front and Rear Muffler Hangers (Typical) G-Model



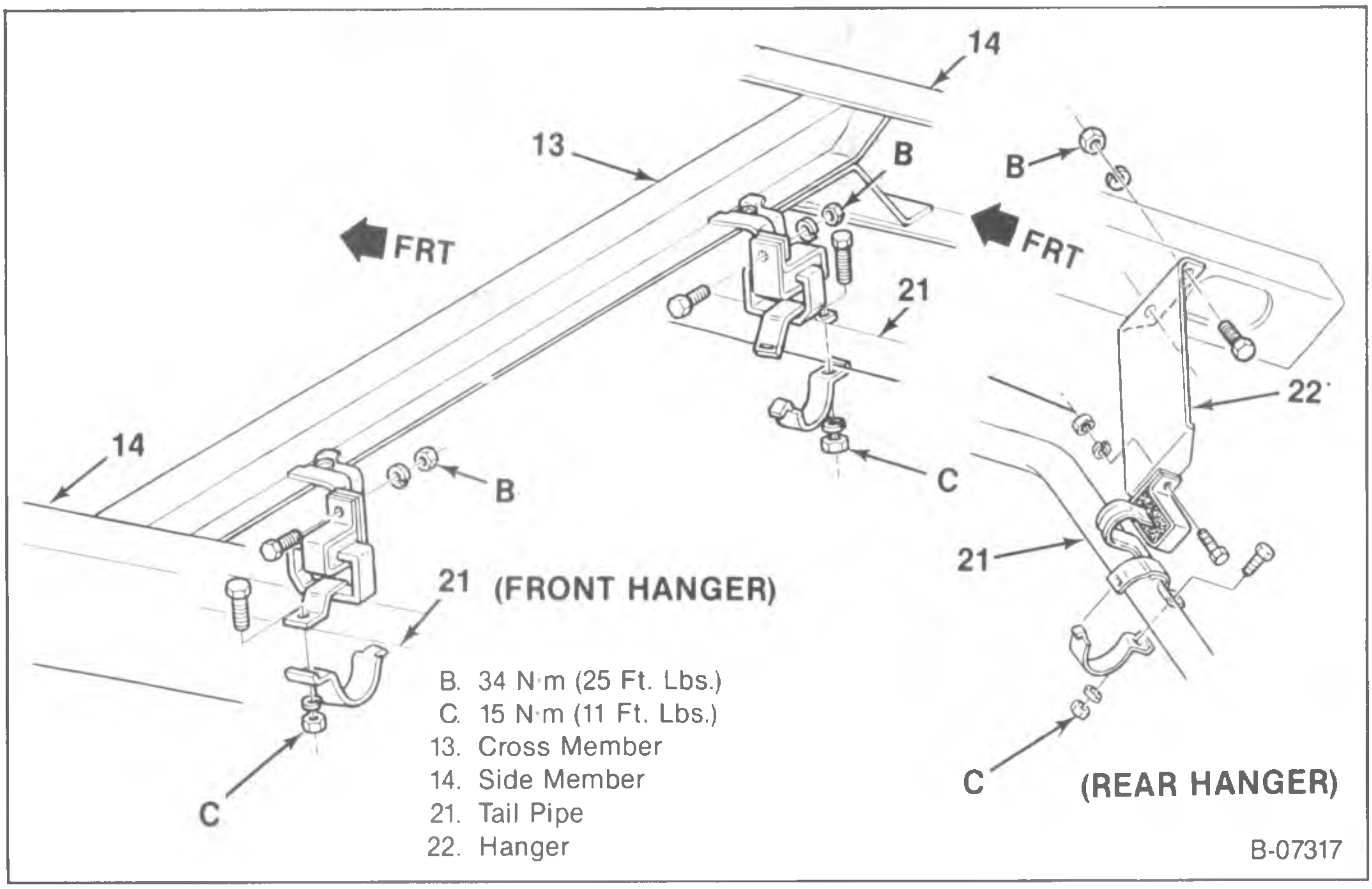
C. 15 N·m (11 Ft. Lbs.)
11. Rivet
12. Clamp
21. Tail Pipe

Figure 11—Tail Pipe Hanger (Typical) CK-Model



C. 15 N·m (11 Ft. Lbs.)
J. 11 N·m (8 Ft. Lbs.
21. Tail Pipe
25. Hanger
26. Bracket

Figure 12—Tail Pipe Hanger (Typical) G-Model



B. 34 N·m (25 Ft. Lbs.)
C. 15 N·m (11 Ft. Lbs.)
13. Cross Member
14. Side Member
21. Tail Pipe
22. Hanger

Figure 13—Tail Pipe Hanger (Typical) P-Model

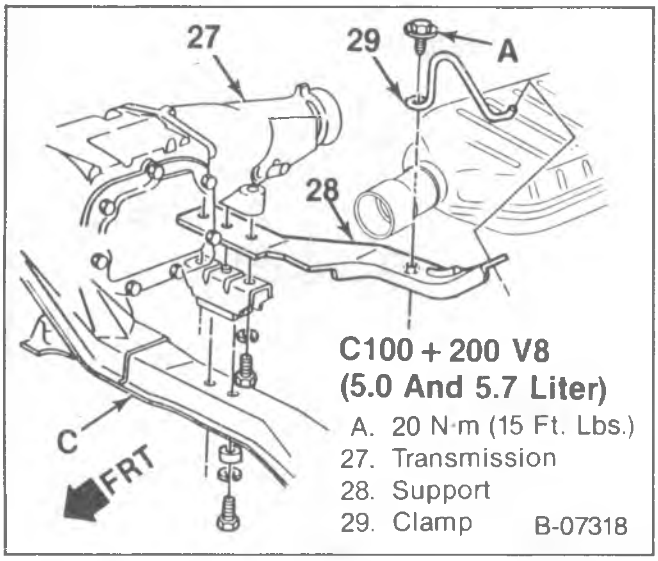


Figure 14—Catalytic Converter Support C-Model

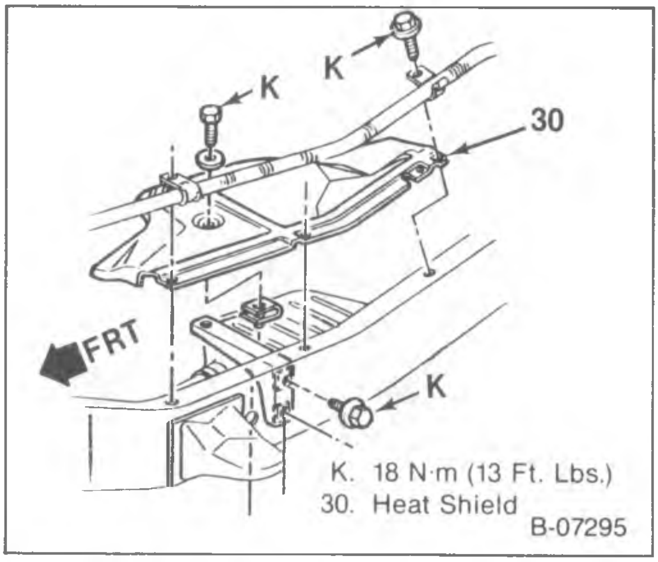


Figure 15—Converter Heat Shield (Typical) C-Model

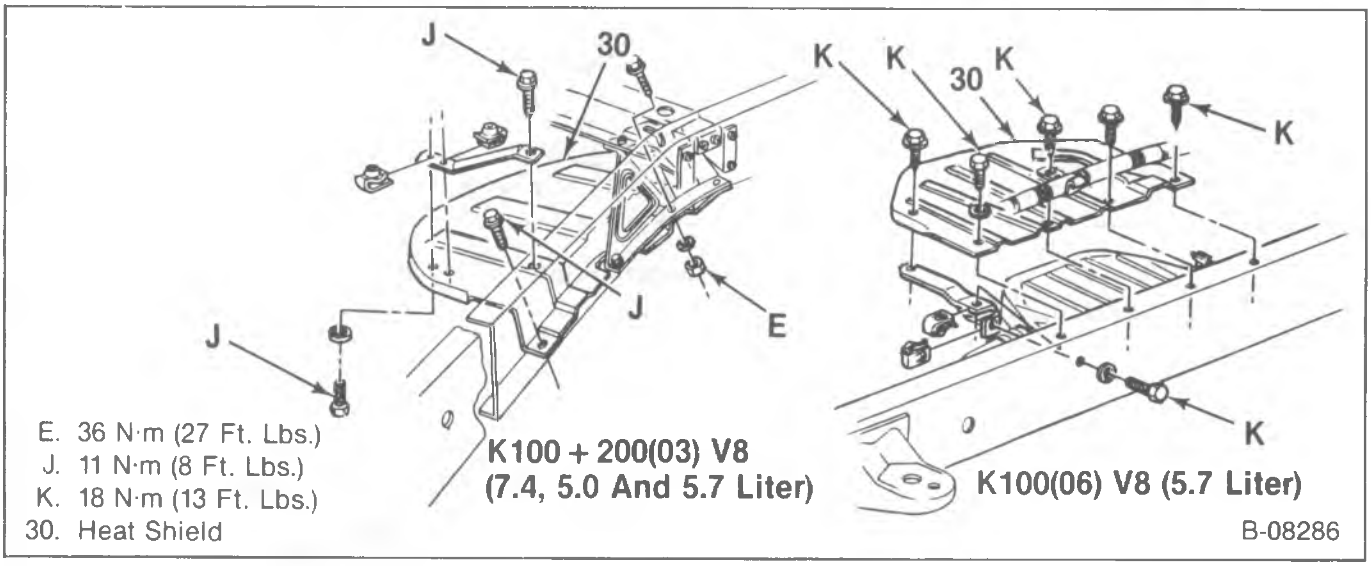


Figure 16—Converter Heat Shield K-Model

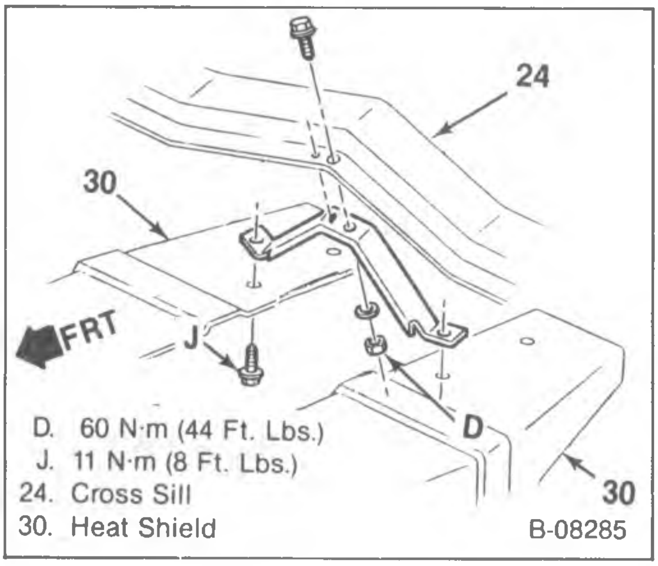


Figure 17—Heat Shield Attachment (CK 200)

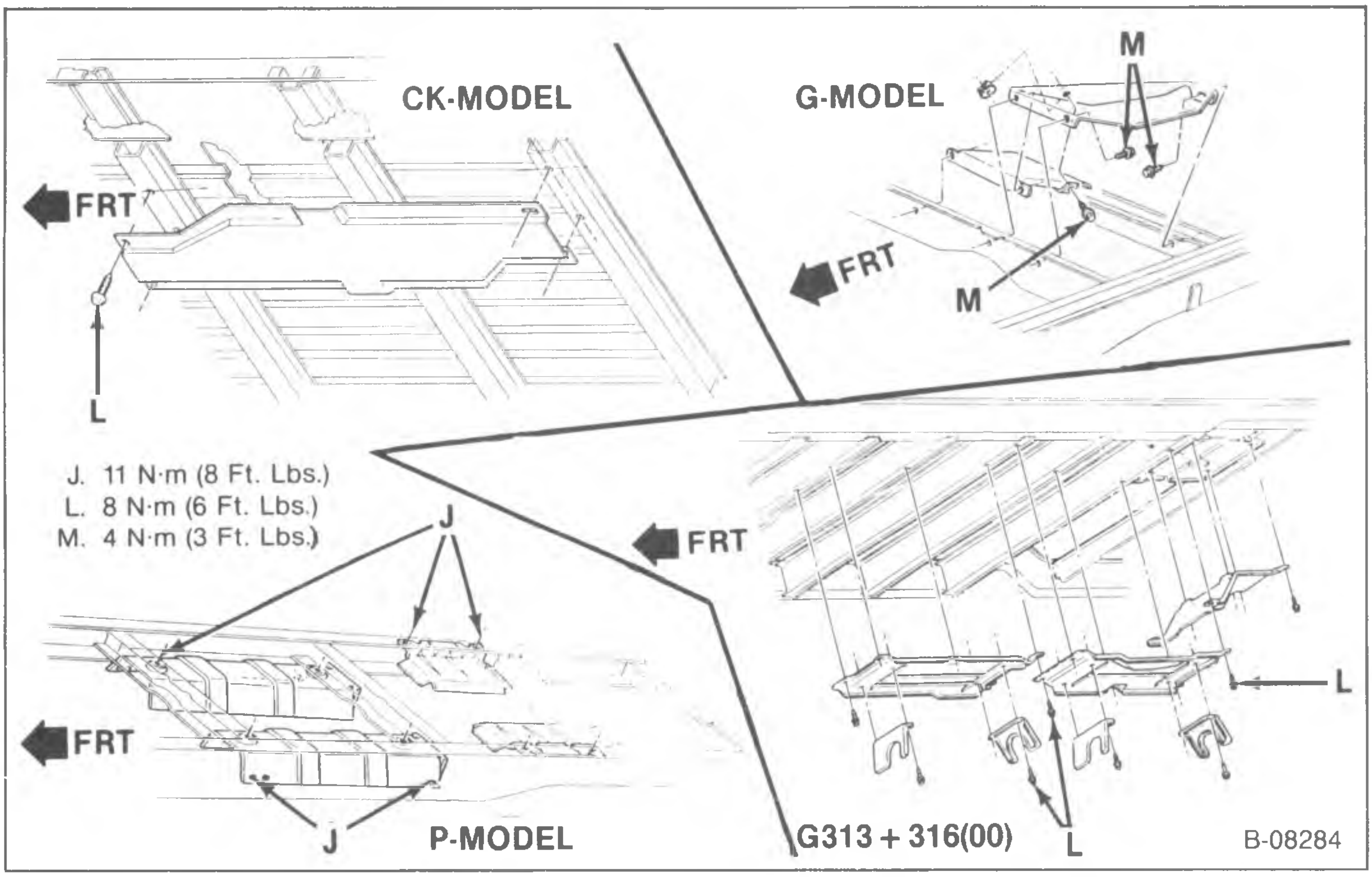


Figure 18—Exhaust Heat Shields (Typical)

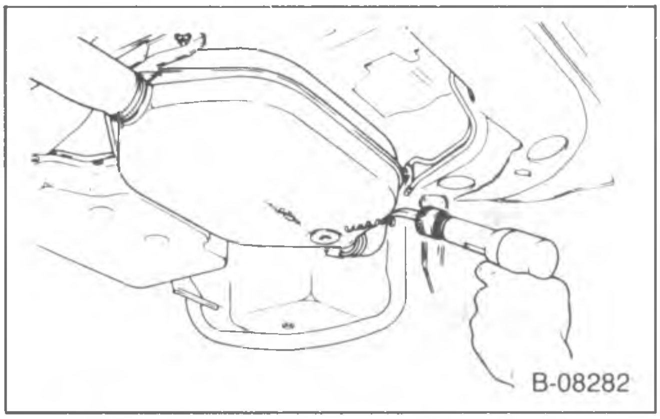


Figure 19—Removing Bottom Cover—Power

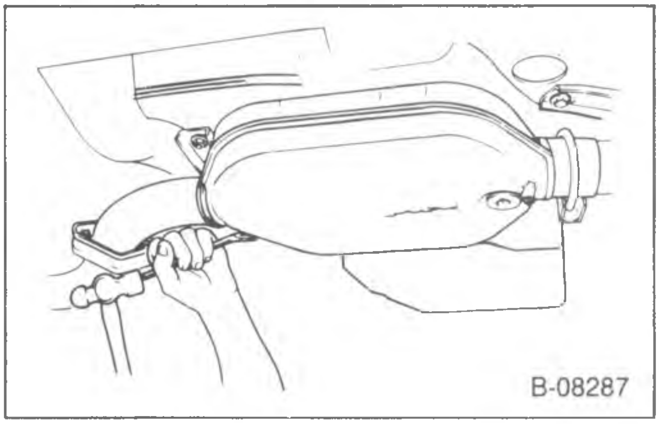


Figure 20—Removing Bottom Cover—Hand

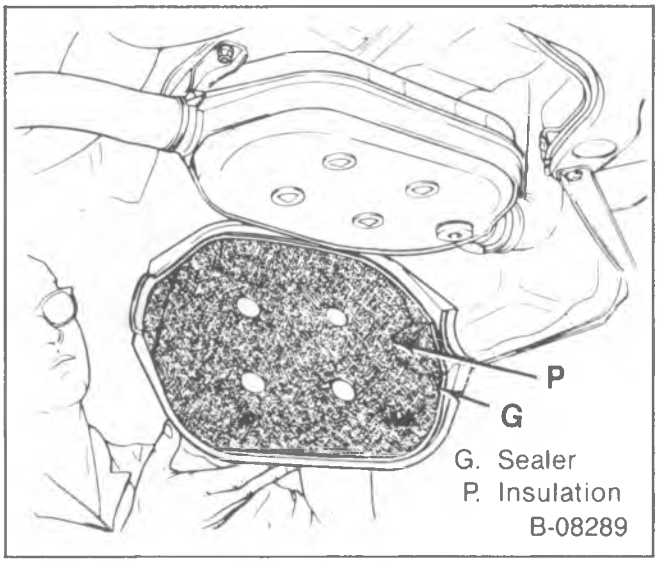


Figure 21—Insulation and Sealer on New Cover

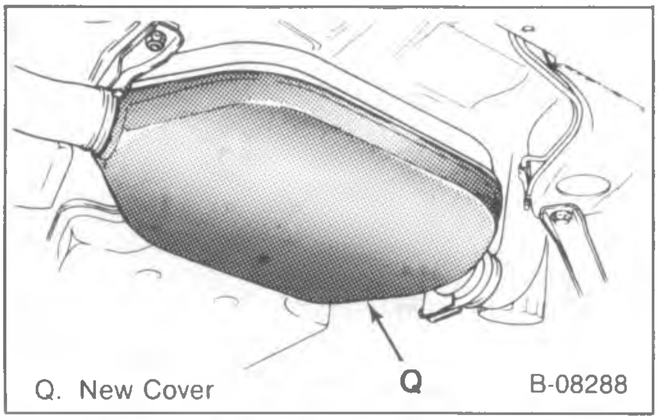


Figure 22—Replacement Cover

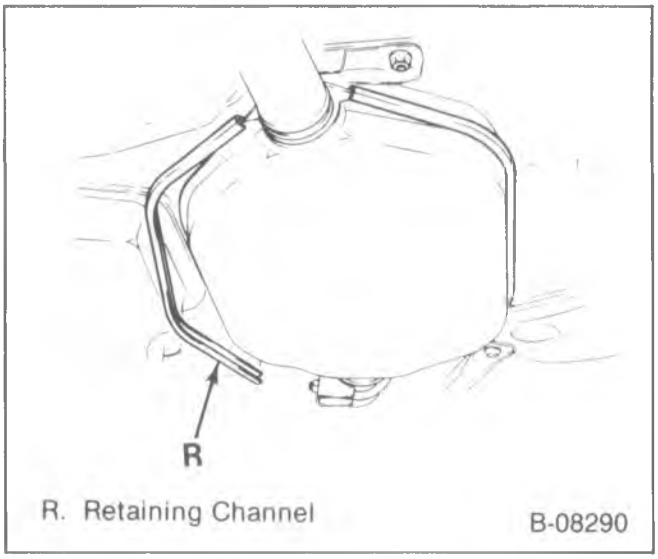


Figure 23—Retaining Channels

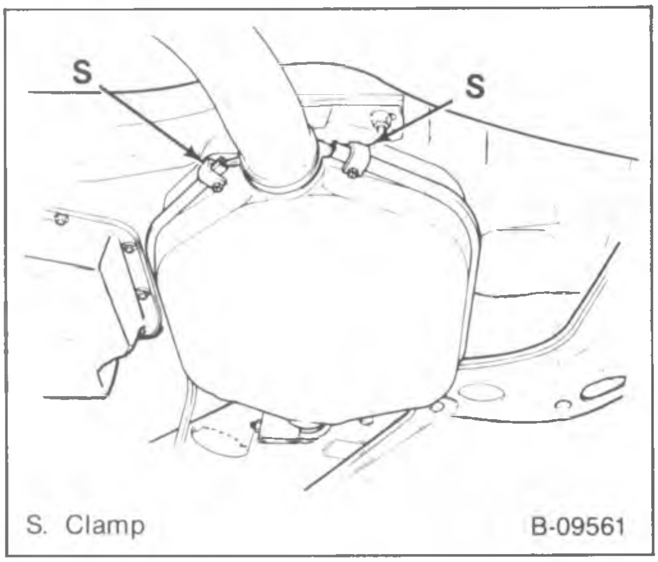


Figure 24—Retaining Channel Clips

SPECIFICATIONS

TORQUE SPECIFICATIONS

	N·m	Ft. Lbs.
Exhaust Pipe to Manifold	20	15
Exhaust Pipe Hanger Clamp	15	11
Exhaust Pipe Hanger Bracket to Frame (CK-Model)	60	44
Exhaust Pipe Extension Hanger to Bracket (P-Model)	36	27
Exhaust Pipe Clamp	40	30
Catalytic Converter Clamp	40	30
Muffler Hanger Clamp	15	11
Muffler Hanger to Frame	60	44
Tail Pipe Hanger Clamp	15	11
Tail Pipe Hanger to Bracket/Side Member (P-Model)	34	25
Catalytic Converter Support (C-Model)	20	15
Catalytic Converter Heat Shield	18	13
Heat Shield Attachment	11	8
Heat Shield Attachment (CK200(00))	60	44
Exhaust Heat Shields (CK-Model)	8	6
Exhaust Heat Shields (G-Model)	4	3
Exhaust Heat Shields (P-Model)	11	8

SECTION 6H

VACUUM PUMPS

CONTENTS

SUBJECT **PAGE**

GENERAL DESCRIPTION

The vacuum pump is mounted on diesel engines and supplies power for operating emission controls, transmission modulators, cruise control, and air conditioning controls. It may be belt driven or gear driven. Refer to figure 1 for model breakdown. The pump is a diaphram pump which does not require periodic maintenance.

BELT DRIVEN VACUUM PUMP

The belt driven model is bracket mounted at the right front of the engine. It has a pulley attached which is driven by the generator belt. With the exception of the pulley, the vacuum pump is replaced as an assembly.

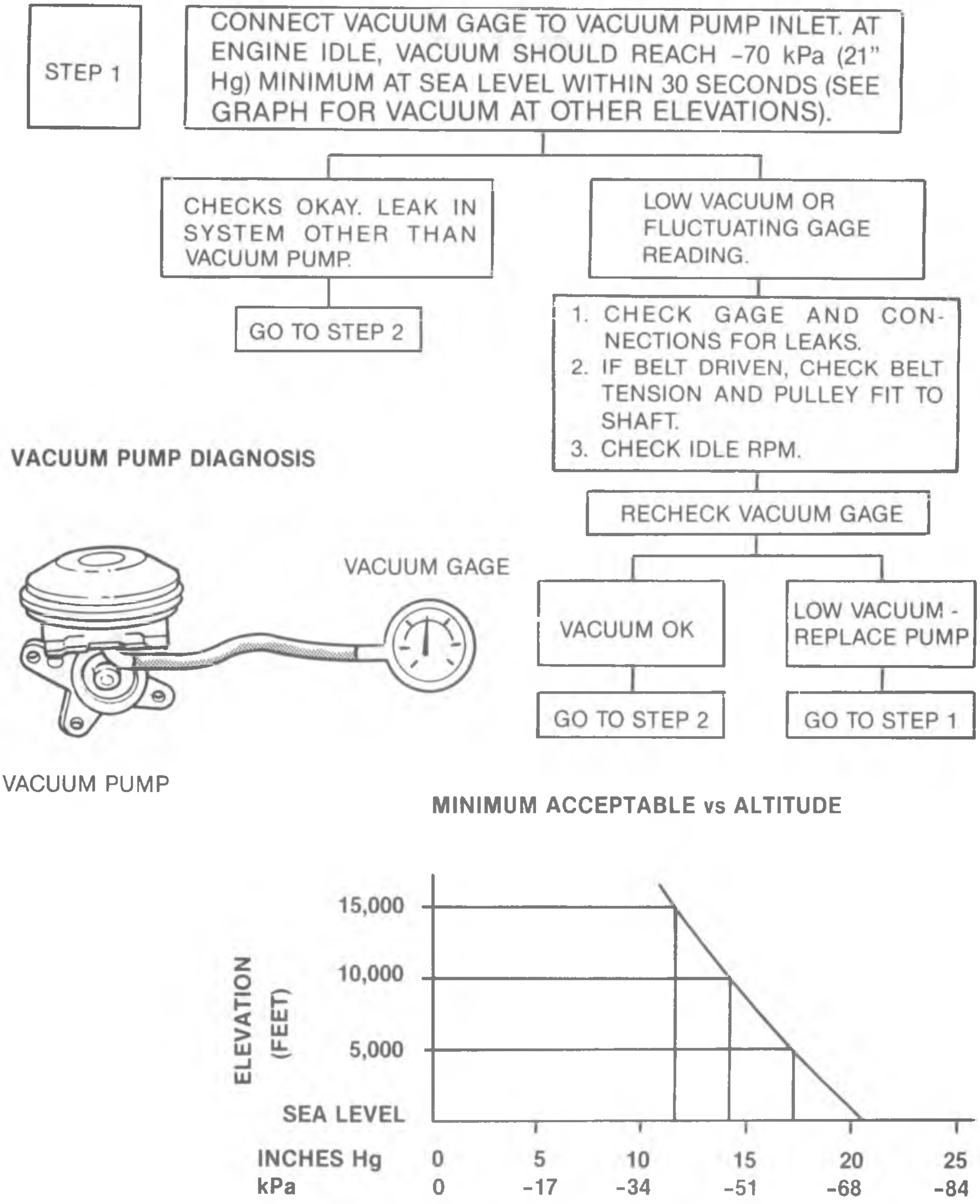
GEAR DRIVEN VACUUM PUMP

The gear driven model is mounted at the top rear of the engine. It is driven by a cam inside the drive assembly to which it mounts. The drive housing assembly has a drive gear on the lower end which meshes with the camshaft gear in the engine. This drive gear causes the cam in the drive housing to rotate. The drive gear also powers the engine oil lubricating pump.

DIAGNOSIS OF VACUUM PUMP

Refer to figures 1 and 2 for diagnosis of the vacuum pump.

AUTOMATIC TRANSMISSION (VACUUM MODULATED) WILL NOT SHIFT OUT OF FIRST (LOW) GEAR. BLOCK WHEELS, APPLY PARKING BRAKE AND PLACE TRANSMISSION SELECTOR LEVER IN "PARK" OR "NEUTRAL" BEFORE STARTING ENGINE.



STEP 1

CONNECT VACUUM GAGE TO VACUUM PUMP INLET. AT ENGINE IDLE, VACUUM SHOULD REACH -70 kPa (21" Hg) MINIMUM AT SEA LEVEL WITHIN 30 SECONDS (SEE GRAPH FOR VACUUM AT OTHER ELEVATIONS).

CHECKS OKAY. LEAK IN SYSTEM OTHER THAN VACUUM PUMP.

GO TO STEP 2

LOW VACUUM OR FLUCTUATING GAGE READING.

1. CHECK GAGE AND CONNECTIONS FOR LEAKS.
2. IF BELT DRIVEN, CHECK BELT TENSION AND PULLEY FIT TO SHAFT.
3. CHECK IDLE RPM.

RECHECK VACUUM GAGE

VACUUM OK

GO TO STEP 2

LOW VACUUM - REPLACE PUMP

GO TO STEP 1

VACUUM PUMP DIAGNOSIS

MINIMUM ACCEPTABLE vs ALTITUDE

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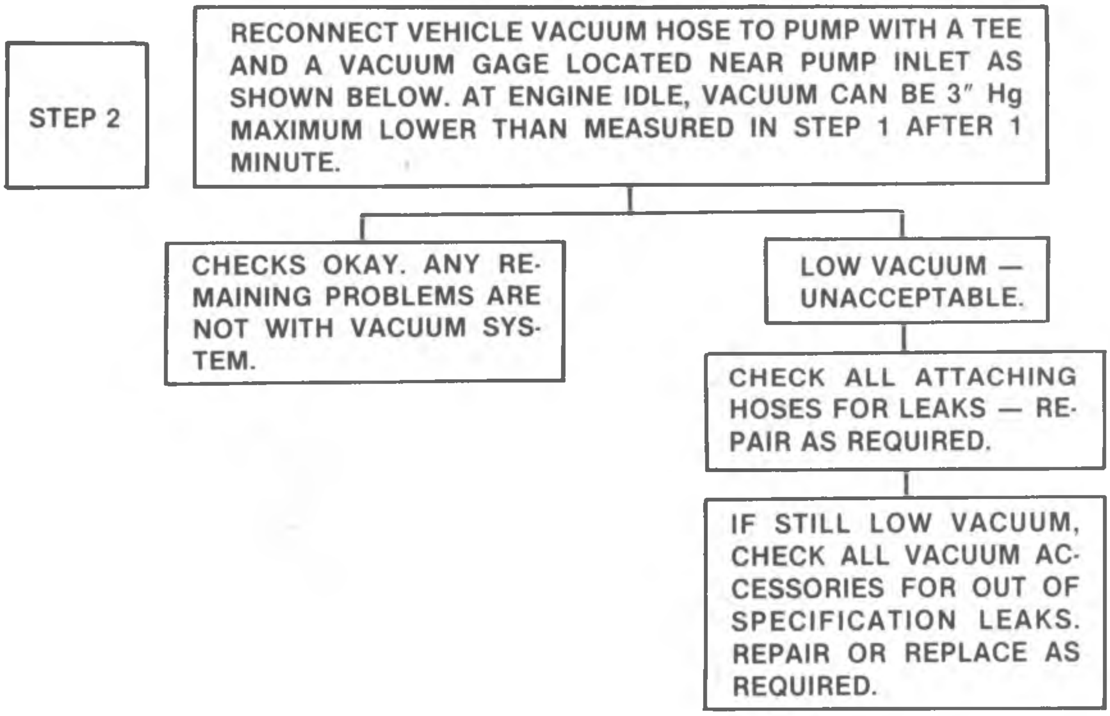
Figure 1—On-Vehicle Diagnosis of Vacuum Pump



STEP 2

RECONNECT VEHICLE VACUUM HOSE TO PUMP WITH A TEE AND A VACUUM GAGE LOCATED NEAR PUMP INLET AS SHOWN BELOW. AT ENGINE IDLE, VACUUM CAN BE 3″ Hg MAXIMUM LOWER THAN MEASURED IN STEP 1 AFTER 1 MINUTE.

CHECKS OKAY. ANY REMAINING PROBLEMS ARE NOT WITH VACUUM SYSTEM.

LOW VACUUM — UNACCEPTABLE.

CHECK ALL ATTACHING HOSES FOR LEAKS — REPAIR AS REQUIRED.

IF STILL LOW VACUUM, CHECK ALL VACUUM ACCESSORIES FOR OUT OF SPECIFICATION LEAKS. REPAIR OR REPLACE AS REQUIRED.

VEHICLE VACUUM SYSTEM DIAGNOSIS

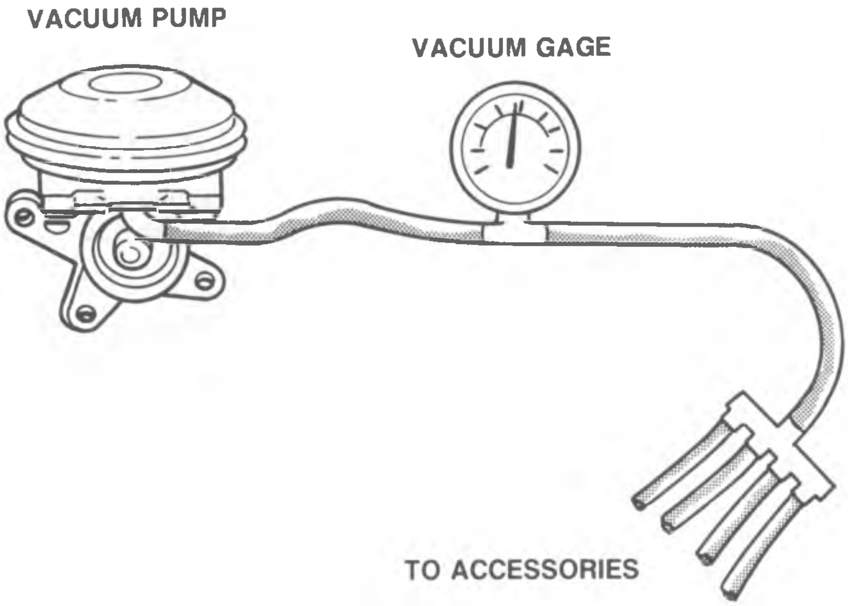


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Figure 2—On-Vehicle Diagnosis of Vacuum Pump

ON-VEHICLE SERVICE

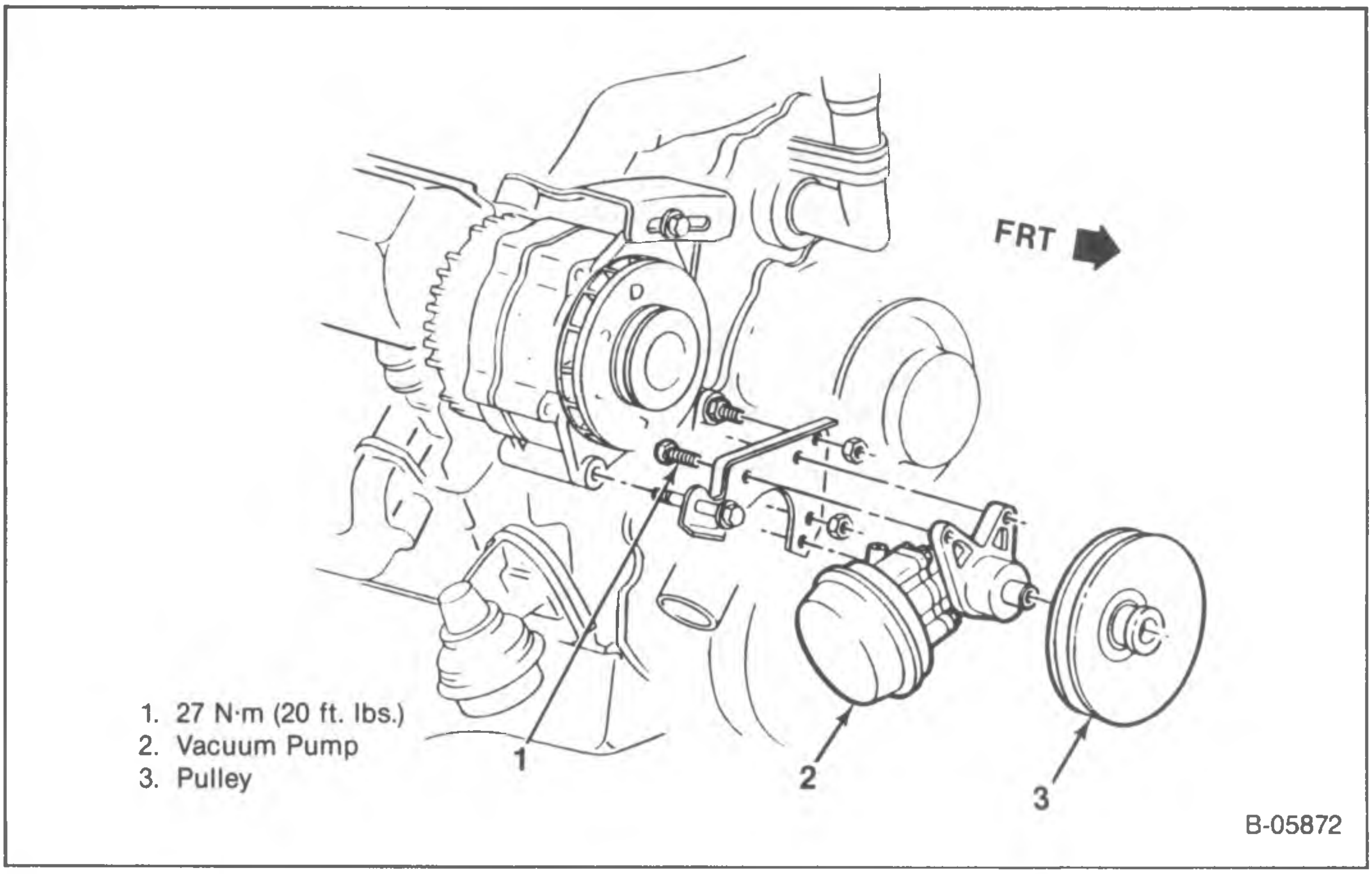


Figure 3—Belt Driven Vacuum Pump Assembly

BELT DRIVEN PUMP REPLACEMENT

↔ Remove or Disconnect (Figure 3)

1. Negative battery cable.
2. Generator belt.
3. Upper vacuum pump attaching bolts.
   - Raise the vehicle.
4. Engine coolant.
5. Lower radiator hose.
6. Vacuum hose.
7. Lower vacuum pump attaching bolt.
8. Vacuum pump including the pulley.

Disassemble (Figure 4)

Tool Required:
J-29785-A Pump Pulley Remover

- Pulley from the pump with J-29785-A.

NOTICE: Do not pry from the back of the pulley. Damage could occur to the pulley or pump.

Assemble (Figure 5)

Tool Required:
J-25033-B Pump Pulley Installer

- Pulley to the pump with J-25033-B until the pulley is flush with the end of the shaft.

NOTICE: Do not tap pulley back onto pump shaft. The pump could be damaged.

→← Install or Connect (Figure 3)

1. Vacuum pump assembly to the engine.
2. Vacuum pump lower attaching bolt.

   Tighten

   - Bolts to 27 N·m (20 ft. lbs.)
3. Vacuum hose.
4. Bottom radiator hose.
   - Lower the vehicle.
5. Upper vacuum pump attaching bolts.
6. Generator belt and tighten it.
   - Refer to ENGINE COOLING (SEC. 6B) for belt specifications.

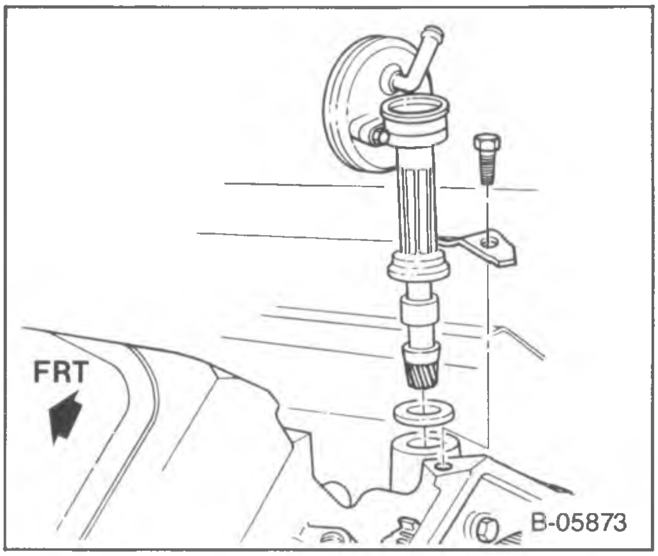


Figure 4—Removing The Pulley

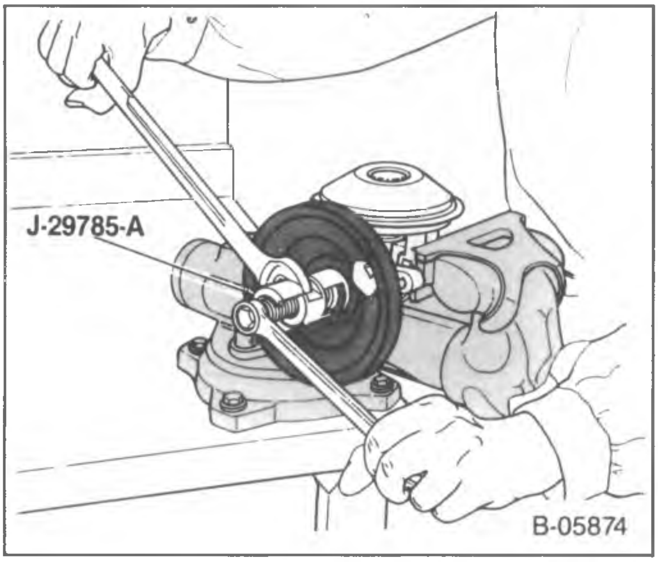


Figure 5—Installing The Pulley

Figure 6—Gear Driven Vacuum Pump Assembly

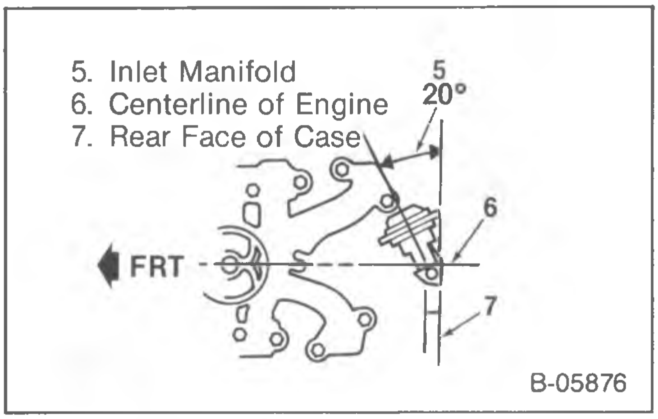


Figure 7—Vacuum Pump Positioned

7. Battery cable.
8. Engine coolant.

GEAR DRIVEN PUMP REPLACEMENT

Remove or Disconnect (Figure 6)

Tool Required:

J-29664 Manifold Cover Set

1. Air cleaner.

Important

Cover the air intake with J-29664 to prevent foreign material from falling into the manifold.

2. Vacuum hose from the pump inlet.
3. Bolt and bracket holding the drive assembly to the engine block.
4. Pump and drive assembly.

NOTICE: Do not run the engine without the vacuum pump installed. Since the oil pump is powered by the vacuum pump drive gear, no oil would circulate through the engine. The engine could be damaged.

Inspect

- Gasket on the pump assembly. Replace if necessary.

Install or Connect (Figure 6)

1. New pump assembly making sure that the gear on the drive assembly meshes with the gear on the engine camshaft.

Adjust (Figure 7)

- Rotate the pump so the inlet tube faces the front of the engine.
- Pump should be on a 20-degree angle (figure 7).

2. Bolt and bracket.

Tighten

- Bolt to 27 N·m (20 ft. lbs.)

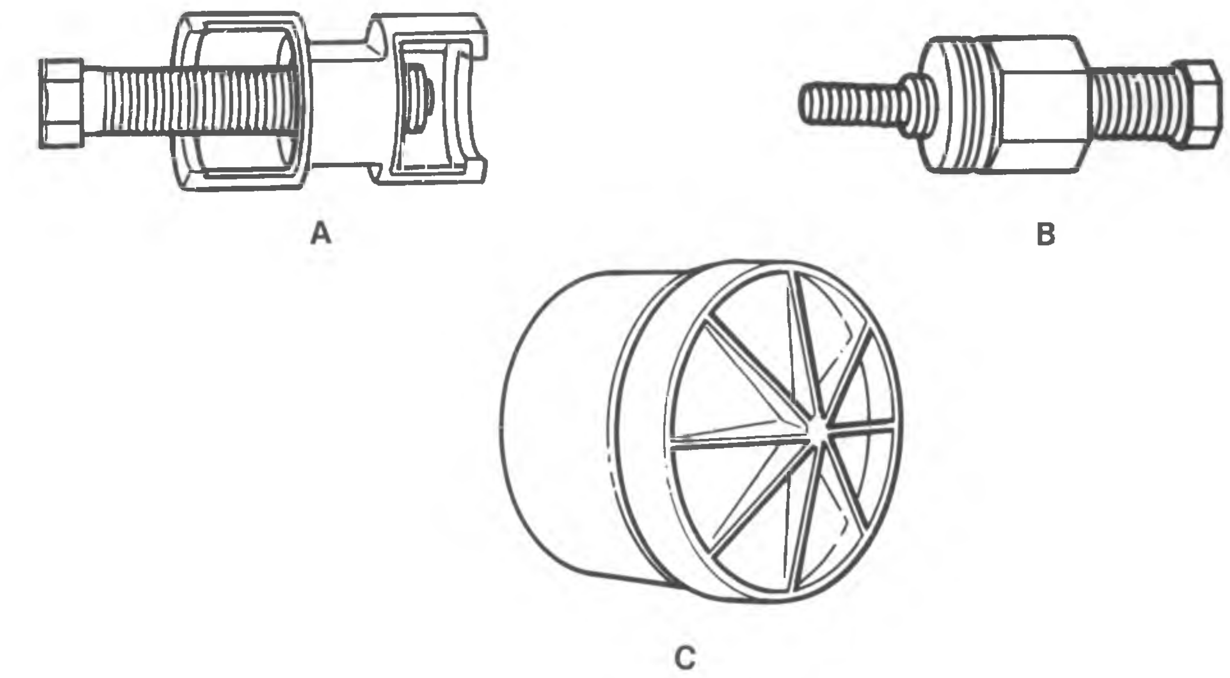
3. Vacuum hose to the inlet port.
4. Air cleaner.
   - Remove J-29664 from the air cleaner inlet.
   - Install the air cleaner.

SPECIFICATIONS

VACUUM PUMP APPLICATIONS

Model Designation	6.2 L V8 (379 Cu. In.) Diesel Engine	Vacuum Pump Type	Pump P/N
CK Series			
Federal	LH6, LL4	Gear Driven	7839416
California	LL4	Gear Driven	7839416
G Series			
Federal	LH6, LL4	Belt Driven	7841746
California	LL4	Belt Driven	7841746
P Series			
Federal	LL4	Belt Driven	7841746
California	LL4	Belt Driven	7841746

SPECIAL TOOLS



A. J-29785-A Pump Pulley Remover
B. J-25033-B Pump Pulley Installer
C. J-29664 Manifold Cover

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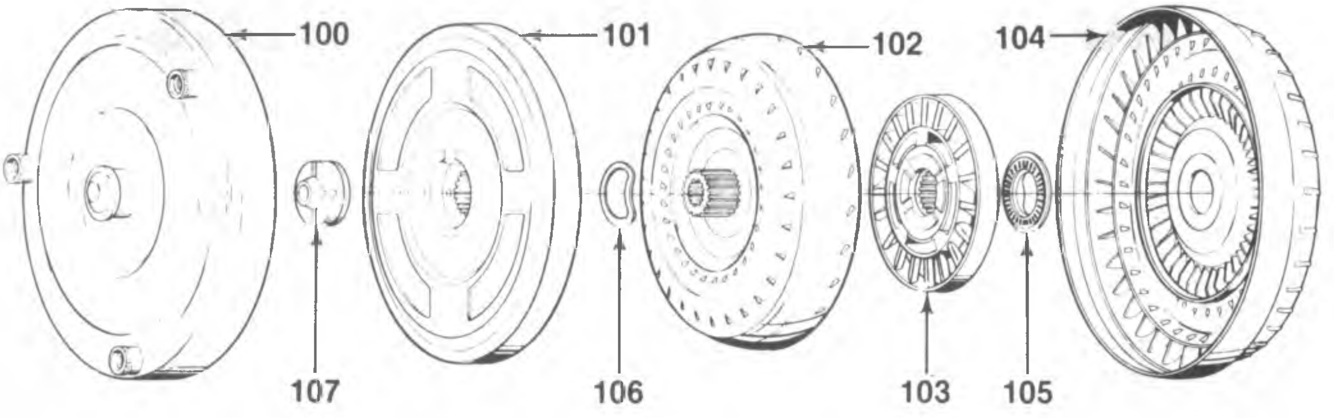
SECTION 7A

AUTOMATIC TRANSMISSIONS

CONTENTS

SUBJECT **PAGE**

DESCRIPTION



100. Cover
101. Pressure Plate
102. Turbine
103. Stator
104. Pump
105. Thrust Bearing
106. Spring
107. Thrust Spacer

Figure 1—Torque Converter Components

TORQUE CONVERTER

The torque converter is of welded construction and is serviced as an assembly. The unit is made up of two vaned sections, or halves, that face each other in an oil filled housing. The pump half of the converter is connected to the engine and the turbine half is connected to the transmission.

When the engine makes the converter pump revolve, it sends oil against the turbine, making it revolve also. The oil then returns in a circular flow back to the converter pump, continuing this flow as long as the engine is running.

The converter also has a smaller vaned section, called a stator, that funnels oil back to the converter pump through smaller openings, at increased speed. The speeded up oil directs additional force to the engine-driven converter pump, thereby multiplying engine torque (figure 1).

TORQUE CONVERTER CLUTCH (TCC)

The converter clutch assembly consists of a 3-element torque converter with the addition of a converter clutch. The converter clutch is splined to the turbine assembly, and when operated applies against the converter cover providing a mechanical direct drive coupling of the engine to the transmission planetary gears. When the converter clutch is released, the assembly operates as a conventional torque converter (figure 1).

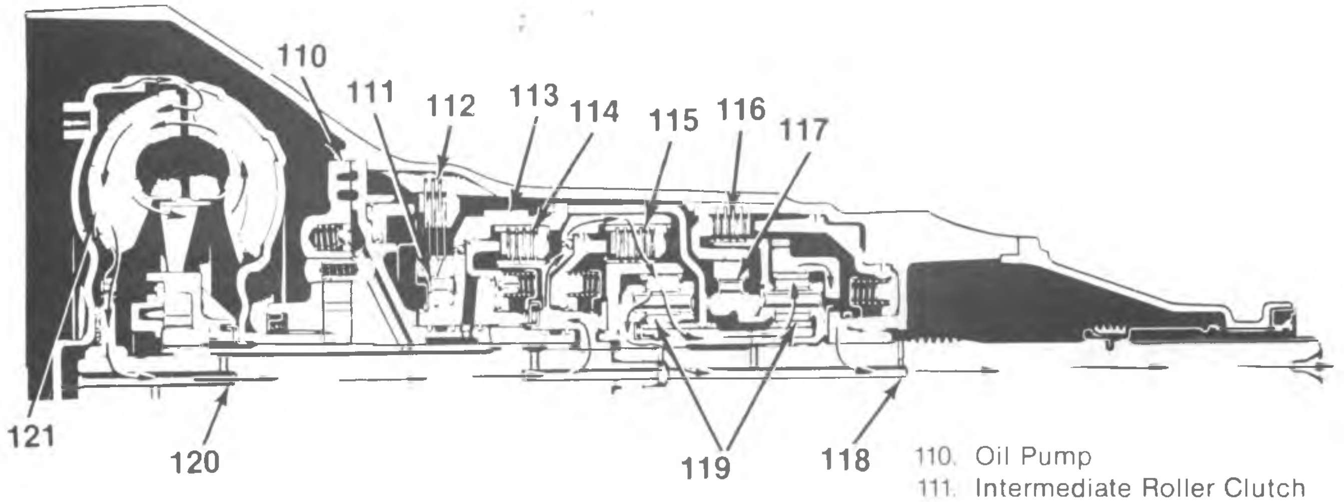
A converter clutch apply (control) valve is used to control the direction of oil flow throughout the torque converter and therefore the apply or release of the converter clutch.

All apply valves are moved to the apply position by oil pressure through an orifice to an area between the valve and a bleed (TCC) solenoid. The restriction is smaller than the bleed in the solenoid so no pressure is available to move the valve when the solenoid is not energized electrically.

There are two types of pressure plates in the present converter assemblies. Both types have spring type torsional dampening. The unit used on diesel engines has additional valves in the plate. These valves are used to equalize oil pressure on both sides of the pressure plate during a disengagement. Since the diesel engine is compressing a full charge of air on every stroke, during deceleration as well as any other time, engine braking is greater and torsional shock is greater. The rapid slowing of the diesel engine causes a reverse rotation of the plate on the hub and opens two valves which allows oil to move to the front side of the plate effecting a quicker release. This results in less RPM drop and less feel during clutch release. Other converter clutches do not use the poppet valves in the pressure plate.

The THM 350-C apply valve is a one piece valve located in an auxiliary valve body on the front of the separator plate. The valve is held in the release position by spring pressure. 2-3 clutch oil, acting on the ring land difference, moves the valve to the apply position.

The THM 700-R4 uses a one piece valve spring loaded to the release position. Oil to move it to the apply position is controlled by a TCC shift valve that



RANGE	GEAR	INT CLUTCH	INT. BAND	INT. ROLLER CLUTCH	DIRECT CLUTCH	FORWARD CLUTCH	LO-REV. CLUTCH	LO-REV. ROLLER CLUTCH
DRIVE	FIRST					ON		ON
	SECOND	ON		ON		ON		
	THIRD	ON			ON	ON		
MAN	FIRST					ON	ON	ON
	SECOND	ON	ON	ON		ON		
REV					ON		ON	

110.	Oil Pump
111.	Intermediate Roller Clutch
112.	Intermediate Clutch
113.	Intermediate Band
114.	Direct Clutch
115.	Forward Clutch
116.	Lo And Reverse Clutch
117.	Lo And Reverse Roller Clutch
118.	Output Shaft
119.	Planetary Gears
120.	Input Shaft
121.	Torque Converter

B-09167

Figure 2—THM 350-C Clutches And Operation

operates like any shift valve. Governor pressure must rise to move the shift valve before oil called signal can move the apply valve. The 1-2 shift must also be made to supply 2nd clutch oil to the TCC shift valve. The screen in the signal oil passages helps to keep the apply valve and the solenoid bleed clean.

TRANSMISSION AND CONTROLS

THM 350-C (RPO MV4)

The THM 350-C is a fully automatic transmission for rear wheel drive vehicles which provides three forward gear ranges and a reverse (figure 2).

The major components of this transmission are:

- Clutch Type Torque Converter.
- Gear Type Oil Pump.
- Intermediate Overrun Band.
- Four Multiple Disc Clutches.
- Two Planetary Gear Sets.
- Two Roller Clutches.
- Valve Body Assembly.

External control connections to the transmission are:

- Manual Linkage — To select the desired operating range.
- Engine Vacuum — To operate the vacuum modulator.
- Detent Cable — To operate the detent valve.

THM 400 (RPO M 40)

The THM 400 is a fully automatic transmission for rear wheel drive vehicles which provides three forward gear ranges and a reverse (figure 3).

The major components of this transmission are:

- Torque Converter.
- Gear Type Oil Pump.
- Two Bands.
- Three Multiple Disc Clutches.
- Two Planetary Gear Sets.
- Two Roller Clutches.
- Valve Body Assembly.

External control connections to the transmission are:

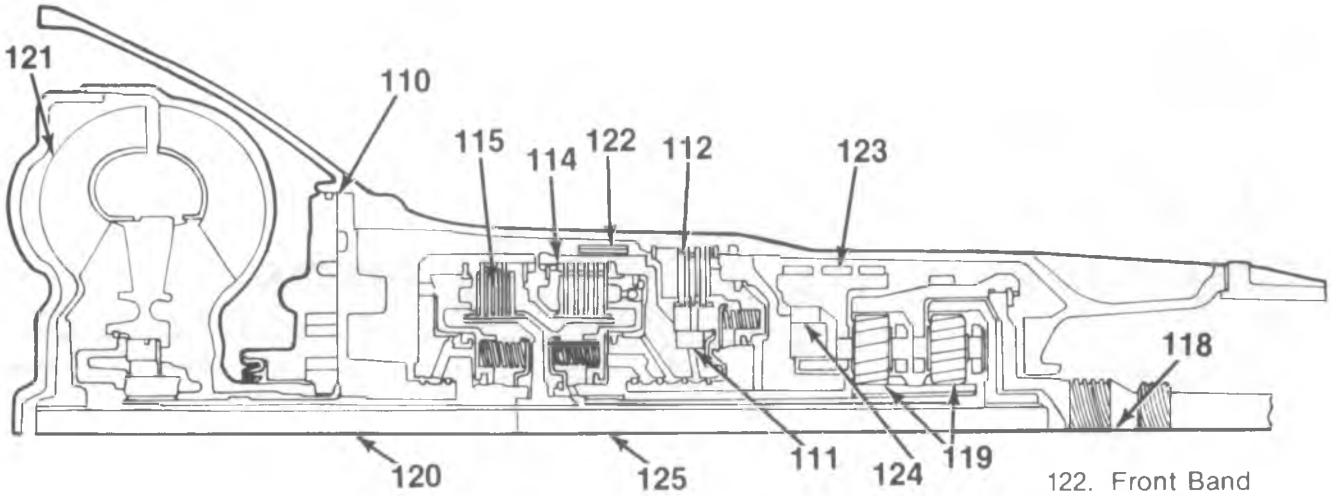
- Manual Linkage — To select the desired operating range.
- Engine Vacuum — To operate the vacuum modulator.
- 12 Volt Electrical Signals — To operate an electrical detent solenoid.

THM 700-R4 (RPO MD8)

The THM 700-R4 is a fully automatic transmission for rear wheel drive vehicles which provides four forward gear ranges and a reverse (figure 4).

The major components of this transmission are:

- Clutch Type Torque Converter.
- Vane Type Oil Pump.
- 2-4 Band Assembly.
- Five Multiple Disc Clutches.
- Two Planetary Gear Sets.



110. Oil Pump
111. Intermediate Roller Clutch
112. Intermediate Clutch
114. Direct Clutch
115. Forward Clutch
118. Output Shaft
119. Planetary Gears
120. Input Shaft
121. Torque Converter
122. Front Band
123. Rear Band
124. Lo Roller Clutch
125. Main Shaft

RANGE	GEAR	FORWARD CLUTCH	DIRECT CLUTCH	FRONT BAND	INT. CLUTCH	INT. ROLLER CLUTCH	LO ROLLER CLUTCH	REAR BAND
PARK - NEUTRAL								
DRIVE	FIRST	ON					EFFECTIVE	
	SECOND	ON			ON	EFFECTIVE		
	THIRD	ON	ON		ON			
INT.	FIRST	ON					EFFECTIVE	
	SECOND	ON		ON	ON	EFFECTIVE		
LO	FIRST	ON					EFFECTIVE	ON
	SECOND	ON		ON	ON	EFFECTIVE		
REV.			ON					ON

B-09168

Figure 3—THM 400 Clutches And Operation

- One Sprag Clutch.
- One Roller Clutch.
- Valve Body Assembly.

External control connections to the transmission are:

- Manual Linkage — To selected the desired operating rang.
- Throttle Valve (TV) Cable — To control shift points by throttle opening.

The transmission identification number is located on the right side of the transmission on the pan rail (figure 5).

DETENT (DOWNSHIFT) CABLE SYSTEM

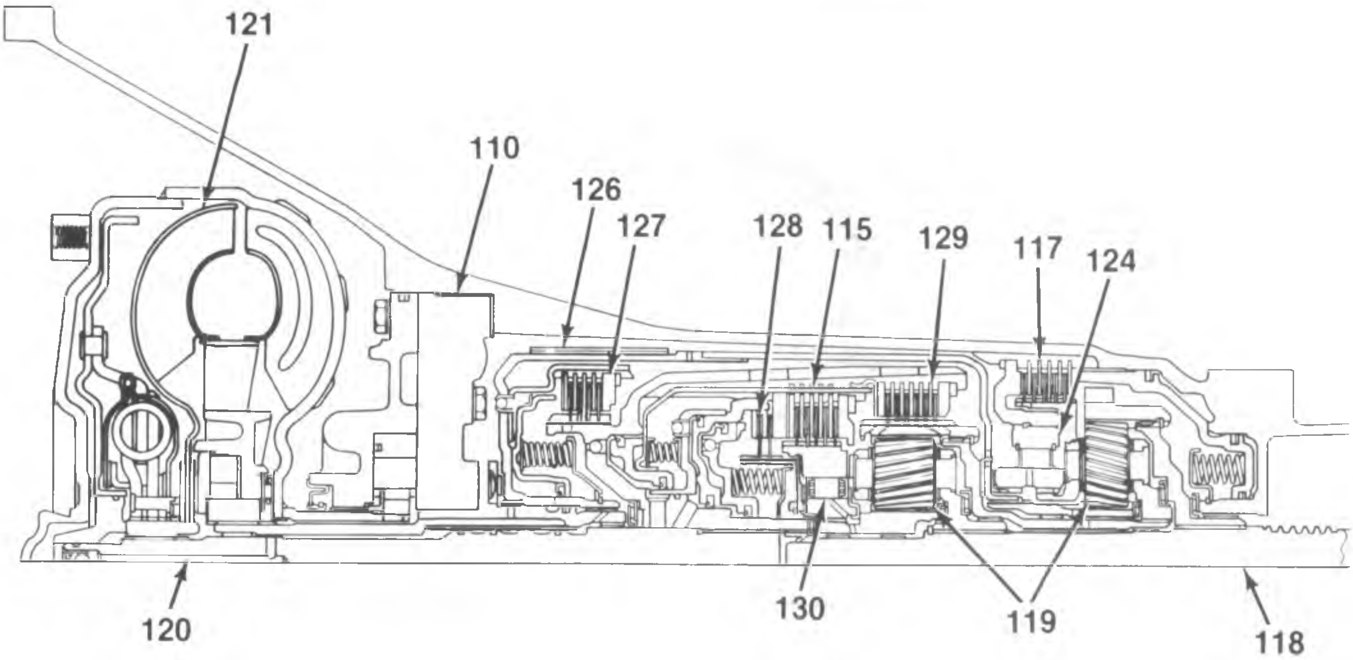
The detent valve in the THM 350-C is activated by the downshift cable which is connected to the carburetor linkage. When the throttle is half open, the detent valve is actuated, causing a part throttle downshift at speeds below 80 km/h (50 mph). When the throttle is fully opened, the detent valve is actuated causing the transmission to downshift.

DETENT (DOWNSHIFT) SWITCH

While operating the THM 400 at speeds below approximately 70 mph, a forced or detent downshift is possible by depressing the accelerator fully. This engages an electrically operated switch at the accelerator pedal that activates the detent solenoid. The detent solenoid opens an orifice that allows line oil at the detent valve to be exhausted, thus permitting the detent regulator valve to downshift the transmission.

VACUUM MODULATOR

A vacuum modulator is used to automatically sense any change in torque input to the transmission. The vacuum modulator transmits this signal to the pressure regulator, which controls line pressure, so that all torque requirements of the transmision are met and smooth shifts are obtained at all throttle openings.



110. Oil Pump
115. Forward Clutch
117. Lo And Reverse Clutch
118. Output Shaft
119. Planetary Gears
120. Input Shaft
121. Torque Converter
124. Lo Roller Clutch
126. 2-4 Band
127. Reverse Input Clutch
128. Overrun Clutch
129. 3-4 Clutch
130. Forward Sprag Clutch

GEAR RANGE	2-4 BAND	REVERSE INPUT CLUTCH	OVERRUN CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CL. ASSEMBLY	3-4 CLUTCH	LO ROLLER CLUTCH	LO-REV. CLUTCH
1ST DR4				ON	ON		ON	
2ND DR4	ON			ON	ON			
3RD DR4				ON	ON	ON		
4TH DR4	ON			ON		ON		
3RD DR3			ON	ON	ON	ON		
2ND DR2	ON		ON	ON	ON			
1ST LO			ON	ON	ON		ON	ON
REV.		ON						ON

B-09169

Figure 4—THM 700-R4 Clutches And Operation

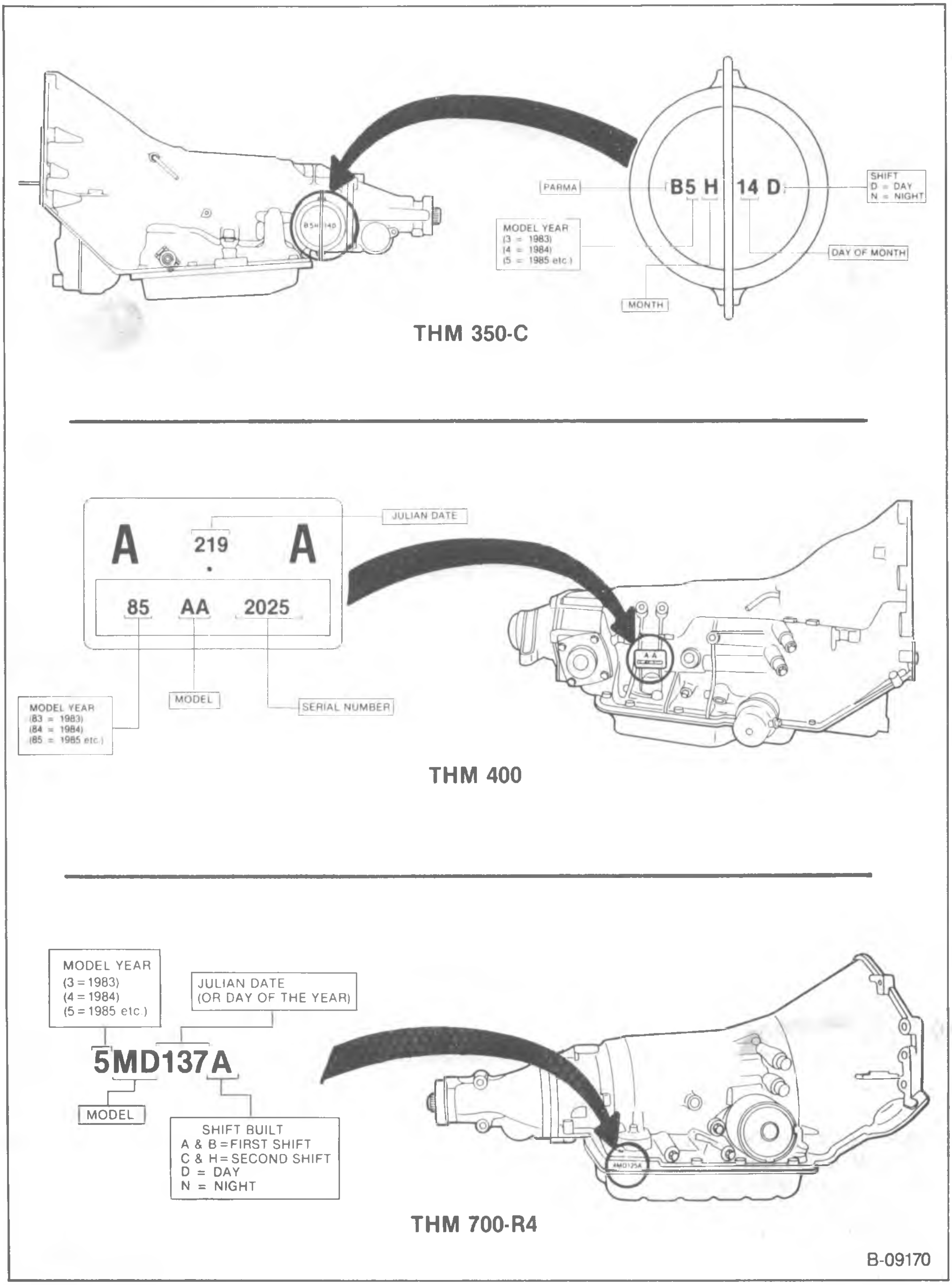
THROTTLE VALVE (TV) CABLE SYSTEM

The TV Cable used with the THM 700-R4 transmission should not be thought of as an automatic downshift cable. The TV cable used on the THM 700-R4 controls line pressure, shift points, shift feel, part throttle downshifts and detent downshifts. The function of the cable is similar to the combined functions of the vacuum modulator and the detent cable used on the THM 350-C.

The TV cable operates the throttle lever and bracket assembly (figures 6 and 7).

The Throttle Lever and Bracket Assembly serves two (2) basic functions:

1. The primary function of this assembly is to transfer the carburetor throttle plate movement to the TV plunger in the control valve assembly as related by the TV cable and linkage (figure 6).

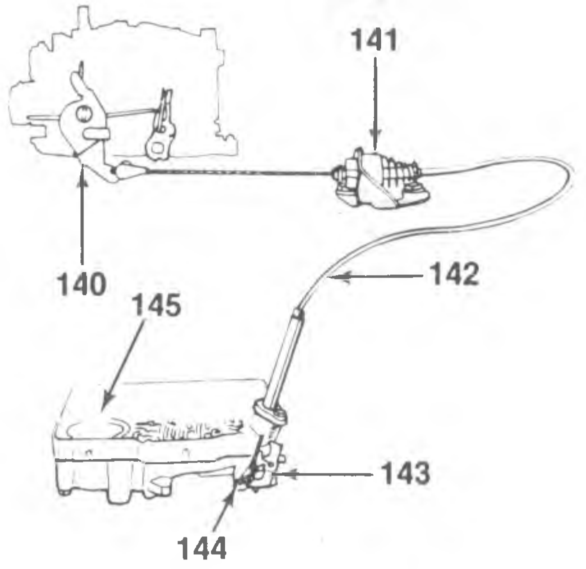


THM 350-C

THM 400

THM 700-R4

Figure 5—Transmission Identification



140. Carburetor Lever
141. Cable Adjuster
142. TV Cable
143. Throttle Lever And Bracket
144. TV Link
145. Valve Body

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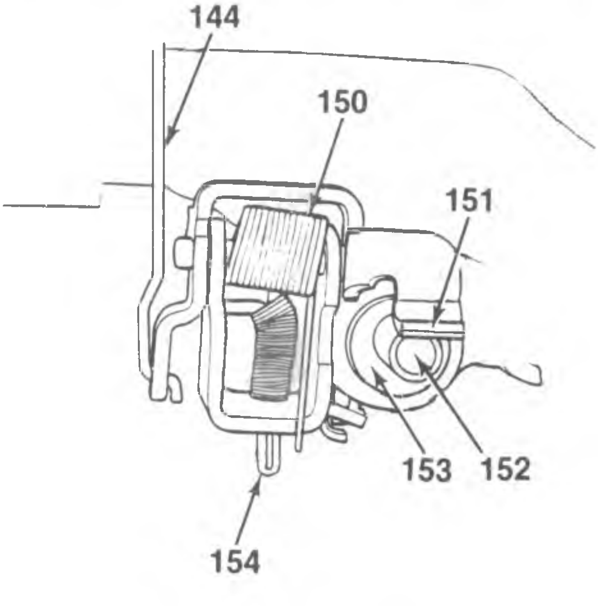
Figure 6—Throttle Valve (TV) Cable And Linkage



144. TV Link
150. Throttle Lever Spring
152. TV Plunger
153. TV Bushing
154. TV Exhaust Valve Lifter Rod

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Figure 7—Throttle Lever And Bracket Assembly

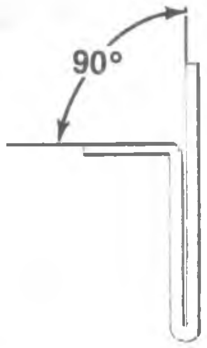

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Figure 8—Throttle Valve Lifter Rod

This causes TV pressure and line pressure to increase according to engine throttle opening and also controls part throttle and detent downshifts. The proper adjustment of the TV cable is based on the TV plunger being fully depressed to flush with the TV bushing at engine wide open throttle.

2. The second function of the assembly involves the TV exhaust valve lifter rod, spring and the TV exhaust ball. The function of this system is to prevent the transmission from operating at low (idle position) pressures, if the TV cable should become broken or disconnected. If the cable is not connected or broken, the TV lifter rod will not move from its normal spring loaded up position which holds the TV exhaust check ball off its seat. The TV lifter rod will drop down to allow the TV exhaust ball to seat only if the cable is broken, disconnected or extremely out of adjustment. With the transmission pan removed, it should be possible to pull down on the TV exhaust valve lifter rod and the springs should return the rod to its normal up position. If the throttle lever and bracket assembly or lifter rod binds or sticks so that the TV lifter rod cannot lift the exhaust ball off its seat, high line pressures and delayed shifts will result. The normal shape of the TV lifter rod is shown in figure 8. The right angle leg must not be bent to any other angle or it will not function properly.

INSPECTION OF COMPONENTS

Before diagnosing transmission complaints, first check any related components for problems to be sure the transmission itself is not at fault.

- Engine for proper tune.
- Transmission fluid condition and level.
- Manual linkage for dirt, corrosion and damage. Be sure the linkage is adjusted properly.
- Transmission mount for looseness and damage.
- Engine and transmission vacuum lines.
- TV and detent cable for damage and adjustment. Detent switch and solenoid for damage and adjustment.
- Transmission wiring for loose connections, corrosion and damage.
- EGR system for proper operation.
- Transmission for fluid leaks.

TRANSMISSION FLUID

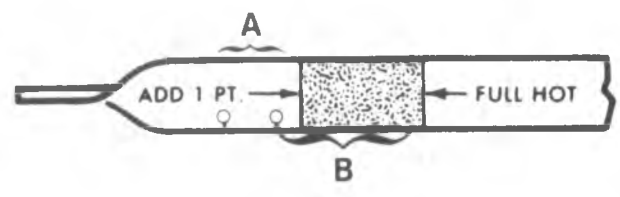
Before diagnosis of any transmission complaint is attempted, there must be understanding of fluid checking procedure and what appearance the fluid should have. Many times a transmission malfunction can be traced to low fluid level or improper reading of the dipstick. Due to the transmission fluid that 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 fluid is free of air bubbles or not. Fluid with air bubbles gives an indication of an air leak in the suction lines, which can cause inconsistent operation and slipping. Water in the fluid gives a milky, pink color to the fluid and can cause spewing. Water in the fluid can also cause swelling of nylon parts.

The automatic transmission is designed to operate at the "FULL HOT" mark on the dipstick at normal operating temperatures of 88°-93°C (190°-200°F) and should be checked under these conditions. The normal operating temperature is obtained only after at least 24 km (15 miles) of highway type driving.

Automatic transmissions are frequently overfilled because the fluid level is checked when the fluid is cold and the dipstick indicates fluid should be added. However, the low reading is normal since the level will rise as the fluid temperature increases. A level change of over 19.05 mm (3/4-in.) will occur as fluid temperature rises from 16°-82°C (60°-180°F) (figure 9).

If the vehicle has recently been operated for an extended period at high speed or in city traffic in hot weather or the vehicle is being used to pull a trailer, an accurate fluid level cannot be determined until the fluid has cooled down, usually about 30 minutes after the vehicle has been parked.



A. Cool
B. Warm

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Figure 9—Transmission Dipstick

1. Apply the parking brake and block the vehicle wheels.
2. With the selector lever in the PARK position, start engine. DO NOT RACE ENGINE. Move the selector lever through each range.
3. Immediately check the fluid with the selector lever in PARK, engine running at SLOW IDLE and the vehicle on a LEVEL surface.
4. Remove the dipstick and touch the transmission end of the dipstick cautiously to find out if the fluid is cool, warm or hot.
5. Wipe it clean and re-insert it until the cap seats. Remove the dipstick and note the reading.
6. If the fluid feels cool, about room temperature, 18°-29°C (65°-85°F), the level should be between the two dimples below the "ADD" mark.
7. If it feels warm, the level should be close to the "ADD" mark (either above or below).
8. If it feels hot (cannot be held comfortably), the level should be between the "ADD" and "FULL" marks.
9. If additional fluid is needed, add enough fluid to bring the level to the proper mark.

Overfilling can cause foaming and loss of fluid through the vent. Slippage and transmission failure can result.

Fluid level too low can cause slipping, particularly, when the transmission is cold or the vehicle is on a hill.

SHIFT LINKAGE

Shift linkage should be adjusted so that the engine will start in the Park and Neutral positions only.

With the selector lever in the Park position, the parking pawl should freely engage within the rear/reaction internal gear lugs or output ring gear lugs. The pointer on the indicator quandrant should line up properly with the range indicators in all ranges.

If the linkage is not adjusted properly, an internal leak could occur at the manual valve which could cause a clutch and/or band failure.

CAUTION: With the selector lever in the "Park" position, the parking pawl should freely engage within the rear/reaction internal gear lugs or output ring gear lugs and prevent the vehicle from rolling, which could cause personal injury.

Check the linkage for:

1. Proper adjustment.
2. Loose swivels and fittings.
3. Dirt and corrosion.
4. Bent or damaged rods.

TRANSMISSION MOUNT

1. Raise the vehicle. Push up and pull down on the transmission tailshaft while watching the transmission mount.
2. If there is movement between a metal plate of the mount and its attaching point, thighten the screws or nuts attaching the mount to the transmission or crossmember.
3. If the rubber separates from a metal plate of the mount or the tailshaft moves up but not down (mount bottomed out) replace the mount.

VACUUM MODULATOR

A vacuum modulator can cause one or more of the following complaints.

1. Harsh upshifts and downshifts.
2. Delayed upshifts.
3. Soft upshifts and downshifts.
4. Slips in low, drive and reverse.
5. Transmission overheating.
6. Engine burning transmission oil.

   If any one of the above complaints are encountered, the modulator must be checked.

CAUSES OF IMPROPER VACUUM AT MODULATOR

1. Engine.
   a. Tune up.
   b. Loose vacuum fittings or improperly routed hoses/lines.
   c. Vacuum operated accessory leak (hoses, vacuum valve, etc.).
   d. Engine exhaust system restricted.
   e. Diesel—Vacuum Regulator Valve adjustment (refer to DIESEL FUEL INJECTION, SEC. 6C6).
2. Vacuum line to the modulator.
   a. Leak.
   b. Loose fitting.
   c. Restricted orifice or incorrect orifice size.
   d. Carbon build up at modulator vacuum fitting.
   e. Pinched line.
   f. Grease in pipe (delayed or no upshift-cold).

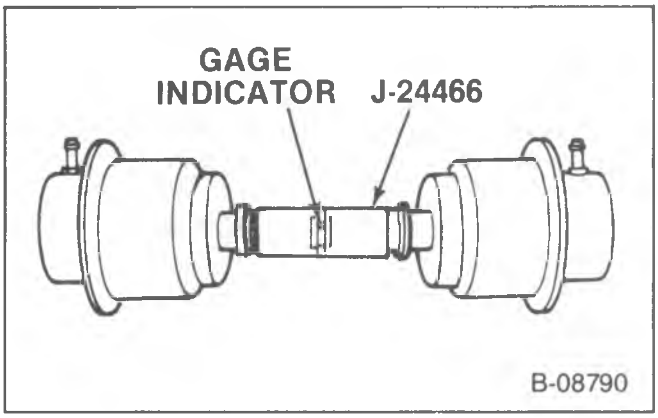


Figure 10—Checking The Modulator

VACUUM DIAPHRAGM CHECK

1. Raise the vehicle and disconnect the vacuum line at the modulator.
2. Turn the modulator so the vacuum line stem points downward.
3. If transmission oil comes out, the modulator must be replaced.
4. If gasoline and/or water vapor are found in a vehicle which may be exposed to -12°C (10°F) temperatures or below, the modulator must be changed.
5. If oil is not found in the vacuum side of the modulator, but the transmission oil level is continually low, and no external leaks are found, there is a possibility that a pin hole leak exists in the diaphragm and the modulator should be replaced.

ATMOSPHERIC LEAK CHECK

1. Apply a thick coating of soap bubble solution to the vacuum connector pipe seam and the crimped upper to lower housing seam.
2. Using a short piece of rubber hose, apply air pressure to the vacuum pipe by blowing into the tube.
3. If bubbles appear, replace the modulator.

   Do not use any method other than human lung power for applying air pressure, as pressures over 41.37 kPa (6 psi) may damage the modulator.

LOAD CHECK

1. Install a modulator that is known to be good on either end of tool J-24466.
2. Install the moduator in question on the opposite end of the gage (figure 10).

3. Holding the modulators in a horizontal position, bring them slowly together under pressure. If the modulator in question is bad, the gage line will remain blue. If the modulator is good, the gage line will be white. When making the comparison, make sure that both modulators are of the same type. The part numbers are stamped on the dome of the modulator.

SLEEVE ALIGNMENT CHECK

1. Roll the main body of the modulator on a flat surface.
2. If the sleeve is not concentric to the can, replace the modulator.
3. If the plunger is not free, replace the modulator.

The following items should also be checked as a possible cause of the problem.

1. Check freeness of modulator valve in transmission case.
2. Check the vacuum line from the manifold or vacuum pump to modulator for holes, cracks or dents. Check the rubber hose connection at the modulator and at the intake manifold or vacuum pump for leaks.

TV CABLE

If the TV cable is broken, sticky, misadjusted or the incorrect part for the model, the vehicle may exhibit various malfunctions.

Sticking or binding TV linkage can result in delayed or full throttle shifts. The TV cable must be free to travel to the full throttle position and return to the closed throttle position without binding or sticking.

Some binding or sticking of the TV cable and associated parts may only occur with the engine running and will not be noted or obtained with the engine off.

Inspection of the TV linkage for sticking or binding should be made with engine running at idle speed, with the transmission selector in Neutral and the parking brakes set. Pull the TV cable full travel through the cable terminal and then release the cable; it should return to the closed throttle position against the cable terminal (figure 11). If the TV cable sticks, and remains ahead of the cable terminal (figure 12), it may be caused by one or more of the following:

1. Sharp bends or a damaged TV cable housing. Correct by rerouting the cable or replace it if required.
2. Sharp end or burr on the TV link, dragging in the TV cable housing. Correct by making end smooth, using a file or stone. DO NOT SHORTEN LINK.
3. Bent TV link. Correct by straightening or replace as required.

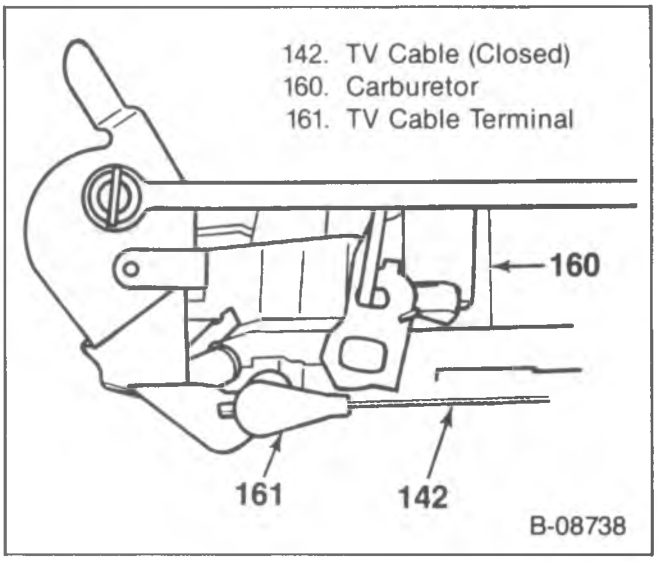


Figure 11—TV Cable At Carburetor Lever

4. Misalignment of the throttle lever and bracket assembly on the coiled pin in the control valve assembly (figure 13).
5. Damaged or binding throttle lever and bracket assembly. Correct by straightening or replace as required.
6. Throttle lever spring unhooked or damaged. Correct by assembling the spring properly or replace the throttle lever and bracket assembly as required.

If the TV cable is adjusted too long, it may result in one of the two following conditions:

1. Early and slipping shifts and/or no detent downshifts.
2. Delayed or full throttle shifts by causing the transmission to operate in the high pressure mode. The transmission senses a malfunction of the TV cable and associated parts; and to prevent burning the clutches and band due to low line

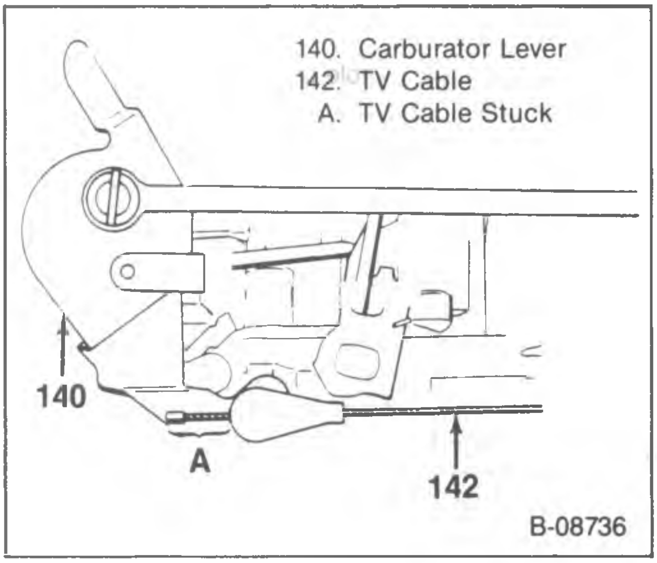


Figure 12—Sticking TV Cable

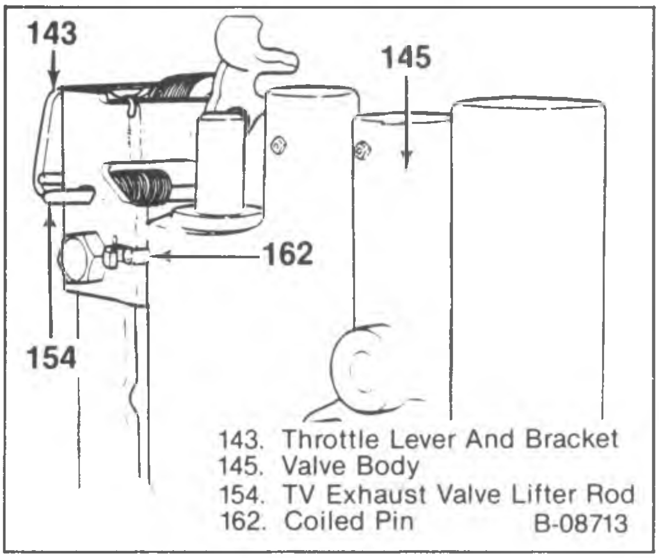


Figure 13—Alignment Of Throttle Lever And Bracket Assembly

pressures, it will go into the high pressure mode. Line pressures checked under the minimum TV conditions in Neutral and Drive will be in the range of the "full" TV pressures if the transmission is in high pressure mode. The complaint could be described as no upshifts, delayed or sharp upshifts.

If the TV cable is adjusted too short or not adjusted at all, it will result in raising the line pressure and shift points. It may also limit the carburetor or injection pump opening to prevent full throttle operation.

CHECK TV CABLE OPERATION

1. Check the transmission oil level and correct as required.
2. Be sure the engine is operating properly and the brakes are not dragging.
3. Check for correct cable, according to the parts catalog.
4. Check that the cable is connected at both ends.
5. Adjust the cable.
6. Check to insure the cable is not sticking or binding.
7. Road test the vehicle.
8. If delayed or only full throttle shifts still occur, remove the oil pan and inspect the throttle lever and bracket assembly (figure 12). Check that the TV exhaust valve lifter rod is not distorted and not binding in the control valve assembly or spacer plate. The TV exhaust check ball must move up and down as the lifter rod does. Also, be sure lifter spring holds the lifter rod up against the bottom of the control valve assembly. Make sure TV plunger is not stuck. Inspect transmission for correct throttle lever to cable link (figure 14).

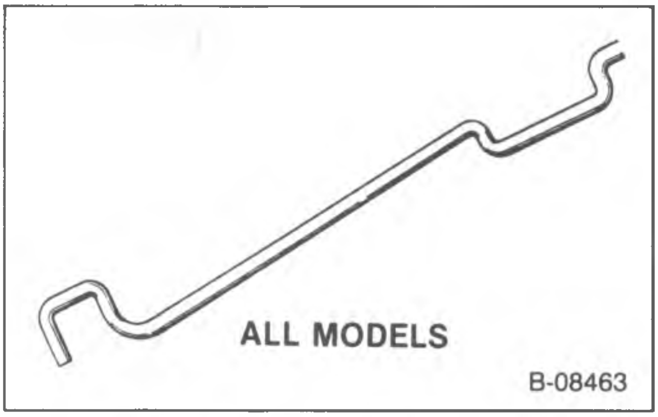


Figure 14—Throttle Lever To Cable Link

DETENT (DOWNSHIFT) CABLE

If the detent cable is broken, sticky, misadjusted or incorrect part for the model, the vehicle may exhibit various malfunctions. Check for:

1. Sharp bends or a damaged cable housing. Correct by rerouting the cable or replace it if required.
2. Damaged or binding throttle lever and bracket assembly. Correct by straightening or replace as required.
3. Throttle lever spring unhooked or damaged. Correct by assembling the spring properly or replace the throttle lever and bracket assembly as required.

CHECK DETENT CABLE OPERATION

1. Check the transmission oil level and correct as required.
2. Be sure the engine is operating properly and the brakes are not dragging.
3. Check for correct cable, according to the parts catalog.
4. Check that the cable is connected at both ends.
5. Adjust the cable.
6. Check to insure the cable is not sticking or binding.
7. Road test the vehicle.

The 3-1 detent downshift may be obtained when the vehicle speed is approximately 9-19 km/h (6-12 mph) below the maximum throttle 1-2 upshift point. The 3-2 detent downshift may be obtained when the vehicle speed is approximately 6-13 km/h (4-8 mph) below the maximum throttle 2-3 upshift point.

DETENT (DOWNSHIFT) SWITCH

Check the detent downshift switch and wires for:

1. Sharp bends or a damaged wire casing. Replace and reroute the wires if needed.
2. Damaged or binding accelerator pedal and bracket assembly. Correct by straightening or replace as required.
3. Loose or corroded wires. Clean or replace as needed.
4. Loose or broken switch. Tighten or replace as needed.

CHECKING DETENT SWITCH OPERATION

1. Check the transmission oil level and correct as required.
2. Be sure the engine is operating properly and the brakes are not dragging.
3. Check the wire connections at both ends.
4. Adjust the switch.
5. Road test the vehicle.

   A detent 3-2 downshift is possible at 117.5-109.5 km/h (73-68 mph) by depressing the accelerator fully, and a 2-1 downshift can also be accomplished at 51.5-45 km/h (32-28 mph).

CHECKING DETENT SOLENOID CIRCUIT

1. With the transmission shift lever in Park, turn the ignition switch to "ON" position, but do not start the car. Leave the ignition switch "ON" throughout the checking procedure.
2. Working under the hood, slowly advance the throttle linkage to the wide open position. One click should be heard from the transmission.
3. Allow the throttle to return to the closed position. One click should be heard from the transmission.
4. If the system performed as described above, the downshift circuit is operating properly.
5. Use a test light to check the brown wire at the connector on the side of the transmission case. The test light should light with the throttle wide open and go out when the throttle is released.
   a. If the system operates as described above, but did not perform properly during steps 1-3, replace the solenoid after first checking to see that the internal wiring is operational.
   b. If the light fails to light with the throttle in the wide open position, the circuit is open. Proceed to step 6.
   c. If the light lights with the throttle closed, the circuit is shorted. Proceed to step 9.
6. Remove the air cleaner. Remove the orange wire connector located at the transmission downshift switch. Use the test light to check from the bare terminal at the switch with the throttle wide open.

   If the test light lights, replace the brown wire. Recheck the system.
7. Check the black striped orange feed wire at the transmission downshift switch with the test light.

   If the thest light lights, replace the transmission downshift switch. Recheck the system.
8. Check the transmisison control fuse in the fuse panel.
   a. If necessary to replace the fuse, recheck the system.
   b. If the fuse is all right, it will be necessary to locate the open in the wiring. Test the circuit continuity from the black-striped orange wire at the downshift switch to the battery.
9. Remove the air cleaner. Remove the black-striped orange wire connector at the transmission downshift switch. Use the test light to check from the bare terminal at the switch with the throttle closed.

   If the test light fails to light, the orange wire is shorted. Correct the shorting condition.
10. With the throttle in the closed position, check the black striped orange feed wire at the transmission downshift switch.
    a. If the test light fails to light, replace the transmission downshift switch. Recheck the system.
    b. If the test light lights, it will be necessary to locate the short in the wiring. Test the circuit from the black striped orange wire at the downshift switch to the battery.

EGR SYSTEM

With Exhaust Gas Recirculation (EGR), the throttle is open enough in "Drive" range (1000 rpm) to cause the EGR valve to open. When the EGR valve opens, exhaust gas enters the intake manifold which lowers intake manifold vacuum. When intake manifold vacuum is lowered, the transmission line oil pressure raises and may go above the upper specification limit. for this reason, if high line pressures are found, proceed as follows:

1. Disconnect the EGR vacuum line at the EGR valve and plug the vacuum line.
2. Recheck line pressures as indicated on the proper oil pressure chart.
3. If high line pressures are still found, it may be that the engine is not producing enough vacuum to lower the transmisison line pressure within specifications. The newer engines with emission controls characteristically have lower engine vacuum than older past model engines. To obtain line pressures suitable for evaluation, it is recommended that vacuum be applied to the modulator, using an external vacuum source such as J-23738 hand operated vacuum device or its equivalent. The unit allows definite amounts of

vacuum to be applied to the modulator so that consistent line pressures may be obtained for evaluation as follows:

4. Disconnect the vacuum hose to the modulator at the modulator and plug the vacuum hose.
5. Attach the hand operated vacuum device and apply 20″ of vacuum.
6. Recheck line pressures according to the proper oil pressure chart.
7. If line pressures are still high, proceed to the specific diagnosis chart that applies to the malfunction encountered.
8. If line pressures are normal with external vacuum applied, check engine vacuum and vacuum systems for leaks.

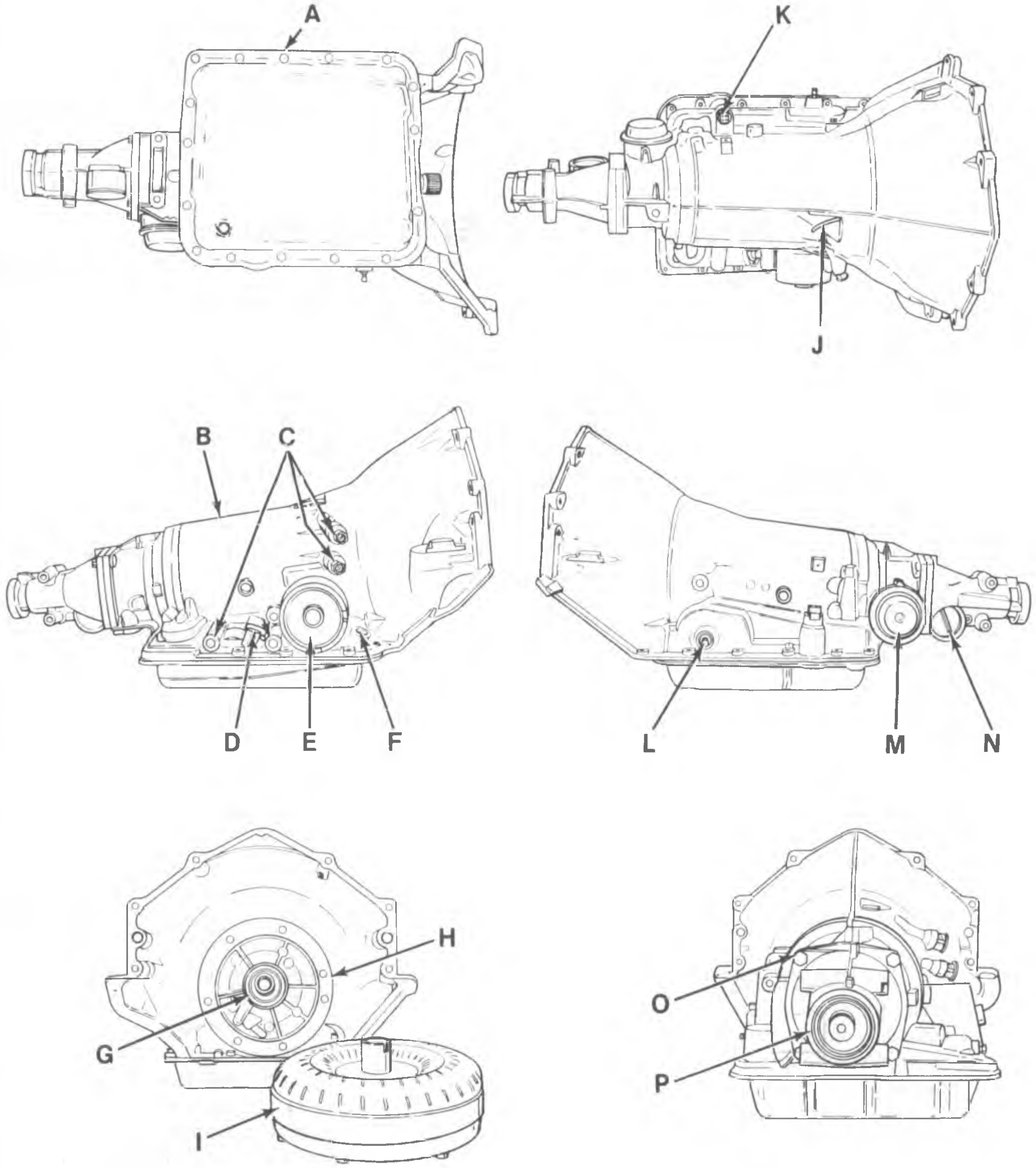
FLUID LEAK PRECAUTIONS

The precautions that must be observed to prevent fluid leaks are as follows:

1. Use new gaskets and "O" ring seals whenever there is a disassembly.
2. Use a very small amount of petrolatum to hold gaskets and thrust washers in place during assembly, or to seal gaskets. Never use gasket paste or shellac.
3. Make sure that composition cork and paper gaskets are not wrinkled or creased when installed. Make sure that gaskets have not stretched or shrunk during storage.
4. Make sure the square type "O" ring seals are installed squarely and are not twisted during assembly.
5. Make sure that mating surfaces of castings are flat and smooth, free of deep scratches, chips, and burrs.
6. Torque fasteners to proper torque. When checking for oil leaks, first determine whether leak originates from transmission or engine. The original factory fill fluid in the transmission is formulated with a red aniline dye to assist in locating leaks. Red dye appearing in the leaking oil will give positive identification as to the location of the leak (figure 15).

CAUSES

1. Transmission oil pan leaks.
    A. Attaching screws not correctly torqued.
    B. Improperly installed or damaged pan gasket.
    C. Oil pan gasket mounting face not flat.
2. Case extension leak.
    A. Attaching screws not correctly torqued.
    B. Rear seal assembly damaged or improperly installed. (Propeller shaft yoke damaged).
    C. Gasket — (Extension to case) damaged or improperly installed.
    D. Porous casting.
    E. Output shaft "O" ring damaged.
3. Case leak.
    A. Filler pipe "O" ring seal damaged or missing; misposition of the filler pipe bracket to the engine "loading" one side of the "O" ring.
    B. Modulator assembly "O" ring seal damaged or improperly installed.
    C. Connector "O" ring seal damaged or improperly installed.
    D. Governor cover, gasket and screws damaged, loose; case face leak.
    E. Damaged or porous. Leak at the speedometer driven gear housing or seal. Leak at the speedometer hole plug.
    F. Manual shaft seal damaged, improperly installed.
    G. Line pressure tap plug stripped, lacking compound.
    H. Vent Pipe (refer to item 5).
    I. Porous case, or cracked at the pressure plug boss.
4. Front end leak.
    A. Front seal damaged, (check the converter neck for nicks, etc., also for the pump bushing moved forward) garter spring missing.
    B. Pump attaching screws, and seals damaged, missing, screws loose.
    C. Converter leak in the weld.
    D. Pump "O" ring seal damaged. (Also check the pump oil ring groove and the case bore).
    E. Porous casting (pump or case).
    F. Pump drain back hole not open.
5. Oil comes out the vent pipe.
    A. Transmission over-filled.
    B. Water in the oil.
    C. Filter "O" ring seal damaged or improperly assembled causing the oil to foam.
    D. Foreign material between the pump and case or between the pump cover and body
    E. Case porous, the pump face improperly machined.
    F. Pump — insufficient metal, porous.
    G. Pump to case gasket mispositioned.
    H. Pump breather hole blocked or missing.
    I. Hole in intake pipe.
6. Oil cooler lines.
    A. Connections at the radiator loose or stripped.
    B. Connections at the case loose or stripped.
7. Modulator assembly. Diaphragm leaking.



A. Oil Pan	F. Oil Fill Tube Seal	L. Manual Shaft Seal
B. Case	G. Oil Pump Seal Assembly	M. Governor Cover
C. Cooler Connectors & Plugs	H. Oil Pump To Case Seal	N. Speedo Seal
D. TV Cable Seal	I. Converter	O. Extension To Case Seal
E. Servo Cover	J. Vent	P. Extension Oil Seal Assembly
	K. Electrical Connector Seal	

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Figure 15—Possible Leak Points

DIAGNOSIS OF FLUID LEAKS

CONDITION	INSPECT COMPONENT	FOR CAUSE
Fluid Leak **To Correctly Identify Fluid Leaks, Perform The Following Procedure:** • **Clean all residual oil from the transmission with electramotive cleanser or equivalent.** • **Dust the transmission with leak tracing powder or spray foot powder.** • **Bring the engine to normal operating temperature.** • **Turn the engine off and let the vehicle set for thirty minutes.** • **Check for leaks.**	1. Oil pan.	1. a. Low bolt torque. b. Cut or damaged oil pan gasket.
	2. TV cable connector.	2. a. Connector cocked and interfering with mount. b. Connector cracked. c. Seal missing, cut or damaged.
	3. Fill tube.	3. a. Fill tube cracked or damaged. b. Seal missing, cut, or damaged.
	4. Electrical connector.	4. a. Electrical connector cracked. b. Seal missing, cut or damaged.
	5. Manual shaft.	5. a. Manual shaft nicked or damaged. b. Manual shaft seal assembly missing, cut or damaged.
	6. Governor cover.	6. Gaps in sealant. (Remove & reseal).
	7. Speedo fitting.	7. a. Low bolt torque. b. Seal missing, cut or damaged.
	8. Servo cover.	8. a. Porosity. b. Sharp edges on case cut seal.
	9. Cooler fittings.	9. a. Low torque. b. Cracked fitting.
	10. Converter assembly.	10. Hub or seam weld leak.
	11. Vent.	11. a. Oil overfill. b. Engine coolant in transmission oil.
	12. Oil pump assembly.	12. a. Low bolt torque. b. Cut or damaged oil pump to case seal. c. Damaged seal. (Restricted drain-back passage). d. Porosity.
	13. Rear extension.	13. a. Damaged extension to case seal. b. Porosity. c. Damaged oil seal assembly.

DIAGNOSIS OF TORQUE CONVERTER

CONDITION	INSPECT COMPONENT	FOR CAUSE
Converter Shudder	1. Torque converter assembly.	1. Internal damage.
	2. Valve body.	2. Converter clutch shift valve stuck.
	3. Oil pump assembly.	3. a. Converter clutch apply valve stuck. b. Restricted oil passage.
	4. Oil filter.	4. a. Crack in filter body. b. Flash restricting filter neck. c. Seal cut or damaged.
	5. Miscellaneous.	5. a. Low oil pressure. b. Engine not tuned properly.
	6. Input housing and shaft assembly.	6. a. Turbine shaft seal cut or damaged. b. Turbine shaft retainer and ball assembly damaged.

DIAGNOSIS OF TORQUE CONVERTER (CONT.)

CONDITION	INSPECT COMPONENT	FOR CAUSE
No Converter Clutch Release	1. Solenoid 2. Converter. 3. Oil pump assembly.	1. External ground. 2. Internal damage. 3. Converter clutch apply valve stuck.
No Converter Clutch Apply	1. Electrical.	1. a. 12 volts not supplied to transmission. b. Outside electrical connector damaged. c. Inside electrical connector, wiring harness or solenoid damaged. d. Electrical short (pinched solenoid wire). e. Solenoid not grounded. f. Incorrect or damaged pressure switches.
	2. Converter.	2. Internal damage.
	3. Oil pump assembly.	3. a. Converter clutch apply valve stuck or assembled backwards. b. Converter clutch apply valve retaining ring mispositioned. c. Pump to case gasket mispositioned. d Orifice cup plug plugged. e. Solenoid seal cut or damaged. f. Orifice cup plug omitted from cooler in passage. g. High or uneven bolt torque (pump body to cover).
	4. Valve body assembly.	4. Valves stuck. a. Converter clutch shift valve. b. Throttle valve.
	5. Input housing and shaft.	5. a. Turbine shaft seal cut or damaged. b. Turbine shaft retainer and ball assembly plugged.

STATOR ASSEMBLY FREEWHEELS

If the stator roller clutch becomes ineffective, the stator assembly freewheels at all times in both directions. With this condition, the vehicle tends to have poor acceleration from a standstill. At speeds above 48 to 56 km/h (30-35 mph), the vehicle may act normal. If poor acceleration problems are noted, it should first be determined that the exhaust system is not blocked, the engine is running properly and the transmission is in first (1st) gear when starting out.

If the engine will free acclerate to high rpm in Neutral (N), it can be assumed that the engine and exhaust system are normal.

STATOR ASSEMBLY REMAINS LOCKED UP

If the stator assembly remains locked up at all times, the engine rpm and vehicle speed will tend to be limited or restricted at high speeds. The vehicle performance when accelerating from a standstill will be normal. Engine overheating may be noted. Visual examination of the converter may reveal a blue color from the overheating that will result.

TORQUE CONVERTER CLUTCH (T.C.C.) ELECTRICAL DIAGNOSIS

MECHANICAL CHECKS, SUCH AS LINKAGE, OIL LEVEL, ETC., SHOULD BE PERFORMED PRIOR TO USING THIS CHART.

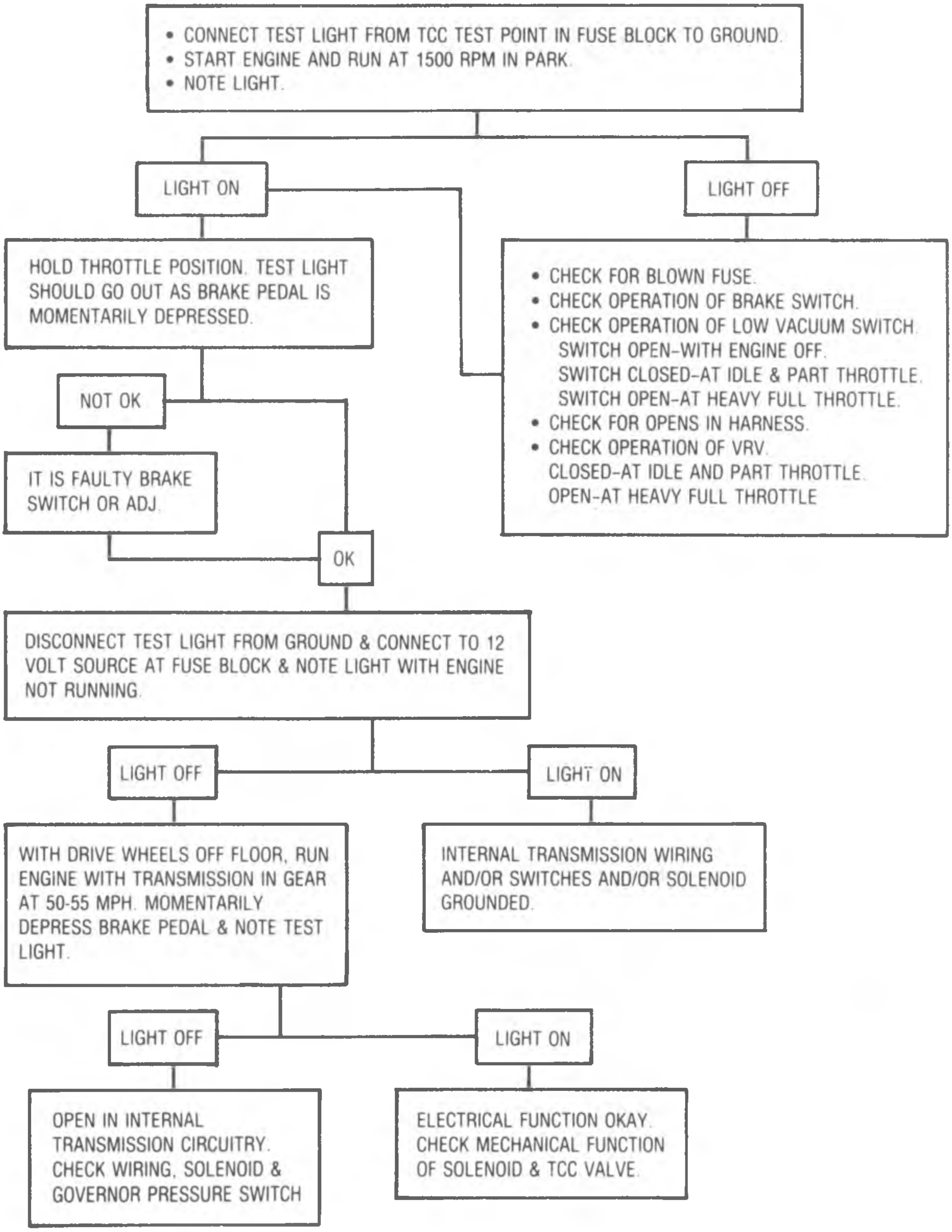

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Figure 16—TCC Diagnosis

THM 350-C PRELIMINARY CHECKING

CHECK TRANSMISSION OIL LEVEL

CHECK OUTSIDE MANUAL LINKAGE AND CORRECT

CHECK ENGINE TUNE

INSTALL OIL PRESSURE GAGE (FIGURE 18)

CONNECT VACUUM GAGE TO MODULATOR LINE & TACHOMETER TO ENGINE

CHECK OIL PRESSURES IN FOLLOWING MANNER

RANGE	MODELS	– PSI				
		Modulator* Line Connected		Modulator** Line Disconnected		
		kPa	PSI	kPa	PSI	
DRIVE – BRAKES APPLIED	XA	467-607	68-88	1020-1179	148-171	— ***
	XX	379-441	55-64	1020-1193	148-173	
L2 or L1 – BRAKES APPLIED	XA	614-756	89-111	1020-1186	148-172	
	XX	552-641	80-93	1020-1193	148-173	
REVERSE – BRAKES APPLIED	XA	703-924	102-134	1558-1786	226-259	
	XX	572-667	83-97	1634-1862	237-270	
NEUTRAL – BRAKES APPLIED	XA	467-593	68-86	1020-1172	148-170	
	XX	379-427	55-62	1020-1193	148-173	
DRIVE IDLE – SET ENGINE IDLE TO SPECIFICATIONS BRAKES APPLIED	XA	467-607	68-88			
	XX	379-441	55-64			
DRIVE – 30 MPH CLOSED THROTTLE OR ON HOIST*	XA	467-607	68-88			
	XX	379-441	55-64			

*MODULATOR LINE CONNECTED: Run engine to 1,000 RPM, close throttle and check PSI

**MODULATOR LINE DISCONNECTED: Check PSI at 1,000 RPM, throttle open

*****TOTAL RUNNING TIME FOR THIS COMBINATION NOT TO EXCEED 2 MINUTES.**

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Figure 17—Preliminary Check Procedure

The key to correcting any complaint is to make use of all the available symptoms and logically letting them direct you to the cause. Symptoms or conditions that will help are determined by subjective road test, oil pressure checks or noise evaluation.

When dealing with automatic transmission complaints, it is best to gather as many symptoms as possible before making the decision to remove the transmission from the vehicle. Remember, THE VEHICLE IS THE BEST TEST STAND AND DIAGNOSITC TOOL AVAILABLE TO YOU, if the transmission is operable. Once the transmission is on the bench, it cannot tell you "what hurts" and quite frequently the correction of the cause of the complaint does not require removal of the transmission from the vehicle.

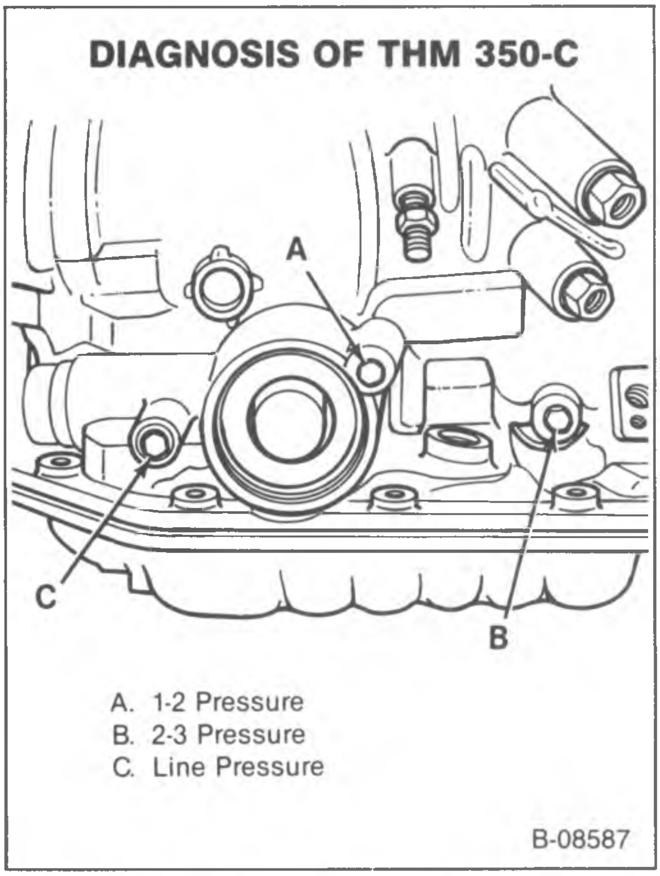


Figure 18—THM 350-C Pressure Tap Locations

DIAGNOSIS OF THM 350-C

PROBLEM	POSSIBLE CAUSE	CORRECTION
No Drive Range — (Install Pressure Gage).	1. Low oil level.	1. Correct level–check for external leaks or vacuum modulator (leaking diaphragm will evacuate oil from unit).
	2. Manual linkage adjustment.	2. See manual linkage adjustment.
	3. Low oil pressure.	3. a. Filter assembly–blocked. b Pump assembly–pressure regulator, pump drive gear–tangs damaged by converter. c. Case-porosity in intake bore.
	4. Control valve assembly.	4. Manual valve disconnected from inner lever.
	5. Forward clutch.	5. a. Forward clutch does not apply–piston cracked; seals missing, damaged; clutch plates burned. b. Pump feed circuit to forward clutch oil seal rings missing or broken on pump cover; leak in feed circuits; pump to case gasket mispositioned or damaged. Clutch drum ball check stuck or missing.
	6. Roller clutch assembly.	6. Broken spring or damaged cage.

DIANOSIS OF THM 350-C (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Oil Pressure High-Low	1. High oil pressure.	1. a. Vacuum line or fittings leaking. b. Vacuum modulator. c. Modulator valve. d. Pressure regulator. e. Oil pump.
	2. Low oil pressure.	2. a. Vacuum line or fittings obstructed. b. Vacuum modulator. c. Modulator valve. d. Pressure regulator. e. Governor. f. Oil pump.
1-2 Shift-Full Throttle Only	1. Detent valve misadjusted.	1. Sticking or linkage.
	2. Vacuum leak.	2. Vacuum line or fittings leaking.
	3. Control valve assembly.	3. a. Valve body gaskets-leaking, damaged, incorrectly installed. b. Detent valve train stuck. c. 1-2 valve stuck.
	4. Case assembly.	4. Porosity.
First Speed Only-No 1-2 Shift	1. Governor assembly.	1. a. Governor valve sticking. b. Driven gear loose, damaged or worn (check for pin in case and length of pin showing); also, check output shaft drive gear for nicks or rough finish, if driven gear shows damage.
	2. Control valve assembly.	2. a. 1-2 shift valve train stuck closed. b. Governor feed channels blocked. c. Valve body gaskets-leaking, damaged, incorrectly installed.
	3. Case	3. a. Porosity between channels. b. Governor feed channel blocked, governor bore scored or worn, allowing cross pressure leak.
	4. Intermediate clutch.	4. a. Clutch piston seals-missing, improperly assembled, cut. b. Intermediate roller clutch. c. Broken spring or damaged cage.
First And Second Speeds Only, No 2-3 Shift	1. Control valve assembly.	1. a. 2-3 shift train stuck. b. Valve body gaskets-leaking, damaged, incorrectly installed.
	2. Direct clutch.	2. a. Pump hub-direct clutch oil seal rings-broken, missing. b. Clutch piston seals-missing, improperly assembled, cut, piston ball check stuck or missing.

DIAGNOSIS OF THM 350-C (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Drive In "Neutral"	1. Manual linkage.	1. Misadjusted.
	2. Forward clutch.	2. Clutch does not release-(this condition will also cause "No Reverse").
No Motion In "Reverse", Or Slips In "Reverse"-(Install Pressure Gage)	1. Low oil level.	1. Add oil.
	2. Manual linkage.	2. Misadjusted.
	3. Oil pressure.	3. a. Modulator valve stuck. b. Modulator and reverse boost valve stuck. c. Pump hub-direct clutch oil seal rings broken. d. Direct clutch piston seal cut or missing. e. Low and reverse clutch piston seal cut or missing. f. No. 1 check ball missing.
	4. Control valve assembly.	4. a. Valve body gaskets-leaking, damaged, incorrectly installed (other malfunctions may also be indicated). b. 2-3 valve train stuck in upshifted position. This will also cause 1-3 upshift in drive range. c. 1-2 valve train stuck in upshifted position.
	5. Intermediate servo.	5. Piston or pin stuck so intermediate overrun band is applied.
	6. Low and reverse clutch.	6. Piston out or seal damaged or missing.
	7. Direct clutch.	7. a. Outer seal damaged or missing. b. Clutch plates burned-may be caused by stuck ball check in piston.
	8. Forward clutch.	8. Clutch does not release (will also cause "Drive" in "Neutral").
Slips In All Ranges, Slips On Take-Off-(Install Pressure Gage)	1. Oil level low.	1. Add oil.
	2. Oil pressure.	2. a. Vacuum modulator inoperative. b. Vacuum modulator valve sticking. c. Filter assembly-plugged or leaks.
	3. Case.	3. a. Pressure regulator valve stuck. b. Pump to case gasket damaged or incorrectly installed.
	4. Forward clutch slipping.	4. Cross leaks, porosity.
Slips 1-2 Shift-(Install Pressure Gage)	1. Oil level low.	1. Add oil.
	2. Oil pressure.	2. a. Vacuum modulator assembly inoperative. b. Modulator valve sticking. c. Pump pressure regulator valve.
	3. 2-3 accumulator.	3. Oil ring damaged or missing.

DIAGNOSIS OF THM 350-C (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Slips 1-2 Shift-(Install Pressure Gage) (Continued)	4. 1-2 accumulator. 5. Pump to case gasket. 6. Case. 7. Intermediate clutch.	4. Oil ring missing or damaged, case bore damaged. 5. Mispositioned. 6. Porosity between channels. 7. Piston seals missing or damaged; clutch plates burned.
Rough 1-2 Shift-(Install Pressure Gage)	1. Oil pressure. For loose fittings, restrictions in line. 2. Case. 3. 1-2 accumulator assembly.	1. a. Vacuum modulator-check. b. Modulator valve stuck. c. Valve body-regulator or boost valve stuck. d. Pump to case gasket-off location or damaged. 2. Porosity between channels. 3. a. Oil rings damaged. b. Piston stuck. c. Broken or missing spring. d. Bore damaged. e. Check accumulator feed hole in valve body plate.
Slips 2-3 Shift-(Install Pressure Gage)	1. Oil level low. 2. Oil pressure low. 3. Case. 4. Direct clutch.	1. Add oil. 2. a. Modulator assembly. b. Modulator valve. c. Pump pressure regulator valve or boost valve; pump to case gasket off location. 3. Porosity. 4. Piston seals leaking, or ball check leak.
Rough 2-3 Shift-(Install Pressure Gage)	1. Oil pressure high. 2. 2-3 accumulator assembly.	1. a. Vacuum leak. b. Modulator valve sticking. c. Valve body-pressure regulator or boost valve inoperative. 2. a. 2-3 accumulator spring missing, broken. b. Accumulator piston stuck.
No Engine Braking-L2-2nd Gear	1. Intermediate servo and 2-3 accumulator. 2. Intermediate overrun band. 3. Oil pressure low.	1. a. Servo or accumulator oil rings or bores leaking. b. Servo piston stuck. 2. Intermediate overrun band broken, burned (check for cause). 3. Pressure regulator and/or boost valve stuck.
No Engine Braking-L1-1st Gear	1. Manual low control valve assembly. 2. Oil pressure low. 3. Low and reverse clutch.	1. Stuck. 2. Pressure regulator and/or boost valve stuck. 3. Piston inner seal damaged or missing.

DIAGNOSIS OF THM 350-C (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
No Part Throttle Downshift-(Install Pressure Gage)	1. Oil pressure. 2. Detent valve and linkage. 3. 2-3 shift valve.	1. Vacuum modulator assembly, modulator valve, pressure regulator valve train (other malfunctions may also be noticed). 2. Sticks or disconnected or broken. 3. Stuck.
No Detent Downshifts	1. Control valve assembly. 2. Detent valve and linkage.	1. 2-3 valve stuck. 2. Sticks or disconnected or broken.
Low Or High Shift Points-(Install Pressure Gage)	1. Oil pressure. 2. Governor. 3. Detent valve and linkage. 4. Control valve assembly. 5. Case.	1. a. Engine vacuum–check at transmission end of the modulator pipe. b. Vacuum modulator assembly vacuum line connections at engine and transmission, modulator valve, pressure regulator valve train. 2. a. Valve sticking. b. Feed holes restricted or leaking, pipes damaged or mispositioned. 3. Stuck open. (Will cause late shifts). 4. a. 2-3 valve train sticking. b. 1-2 shift valve train sticking. 5. Porosity.
Won't Hold In "Park"	1. Manual linkage. 2. Internal linkage.	1. Misadjusted. 2. a. Parking brake lever and actuator assembly. Check for chamfer on actuator rod sleeve. b. Parking pawl broken or inoperative.
Locks Up In Manual Low (Usually Hot Only)	1. Converter pressure leaking into direct clutch through stator shaft. 2. Direct clutch. 3. Lo and reverse clutch.	1. Check stator shaft position. 2. a. Direct clutch bore undersize or piston oversize. b. Direct clutch feed hole shy small chamber. 3. Lo and reverse clutch piston center seal missing or cut.
Second Gear Start Or Slips Second Gear Only	Intermediate clutch.	Wrong number of clutch plates or wrong piston.
Locks Up In Reverse (Usually Hot Only)	1. Forward clutch. 2. Direct clutch.	1. Bore undersize or piston oversize. 2. Direct clutch feeding forward clutch through stator shaft. (Check stator shaft position.)

DIAGNOSIS OF THM 350-C (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Locks In Reverse From Park To Reverse Only	Parking pawl.	Parking pawl staying in due to a burr on leading edge.
Cold Morning Reverse No Drive Till Engine Warms Up	Pressure regulator bore or sleeve tight.	Remove and repair.
Shifts Cold But Not Warm	Governor assembly.	Nylon gear roll pin shy.
No Drive-But Has Manual Low	Low and reverse roller clutch.	Low and reverse roller clutch installed backwards.
No 1-2 Shift-Makes 1-3 Shift And 3-1 Shift, But Has All Shifts Manually	Intermediate roller clutch.	Intermediate roller clutch not locking.
Governor Nylon Gear Stripped 360°	1. Case pin missing. 2. Output shaft.	1. Governor case pin. 2. Output shaft rough or worn.
Governor Gear Stripped One Side	Governor seizing in bore.	Repair or replace as necessary.
Slow Reverse (Cold Only)	Low oil level.	Adjust oil level.
Harsh 1-2 Shift	1-2 accumulator.	a. Piston or spring. b. Accumulator feed hole in valve body plate.
Slow Reverse (Hot Only)	1. Valve body. 2. Shift selector lever.	1. Leaking valve body support plate. 2. a. Bent or S-hook hole off location. b. S-hook bent. c. Detent roller spring hole off location. d. Manual valve S-hook hole off location.

THM 350-C AUTOMATIC TRANSMISSION DIAGNOSIS CHART

PROBLEM

CAR ROAD TEST →

LEGEND
X—PROBLEM AREA V.S. CAUSE
*—@ "O" VACUUM ONLY
O—BALLS #2/3/4 ONLY
L—LOCKED
S—STUCK

POSSIBLE CAUSE	ALL RANGES—SLIPS	DRIVE—SLIPS—NO 1ST GEAR	LINE PRESSURE—ALL LOW	LINE PRESSURE—ALL HIGH	1-2 INTERM. CL. PRES. HIGH	1-2 INTERM. CL. PRES. LOW	2-3 DIRECT CL. PRES. HIGH	2-3 DIRECT CL. PRES. LOW	NO 1-2 UPSHIFT	1-2 U.S. EARLY/LATE	1-2 UPSHIFT @ W.O.T. ONLY	SLIPS—1-2 UPSHIFT	ROUGH—1-2 UPSHIFT	NO 2-3 UPSHIFT	2-3 U.S.—EARLY/LATE	SLIPS—2-3 UPSHIFT	ROUGH—2-3 UPSHIFT	NO WOT. 1-2 UPSHIFT	NO—PART TH. DOWN SHIFT	NO—FULL TH. DOWN SHIFT	2-3 UPSHIFT—W.O.T. ONLY	HARSH—DOWN SHIFT	L1 RANGE—NO ENG. BRAKING	L2 RANGE—NO ENG. BRAKING	NEUTRAL—DRIVES IN NEUTRAL	REVERSE—NO REVERSE	SLIPS IN REVERSE	PARK—NO PARK—RATCHETS	NOISY—ALL RANGES	1-2, 2-3 SHIFT NOISY	REV. & D. L1 & L2 NOISY	LOW COOLER—FLOW	SPEWS OIL OUT BREATHER
LOW OIL LEVEL/WATER IN OIL	X	X	X			X		X				X				X											X		X	X		X	X
VACUUM LEAK				X	X		X		X	X	X		X		X		X				X												
MODULATOR & / OR VALVE	X	X	*	X	X							X	X		X	X	X										X						
STRAINER & / OR GASKET	X	X	X			X		X																			X		X			X	X
GOVERNOR—VALVE/SCREEN			X	X					X	X					X																		
VALVE BODY—GASKET/PLATE	X	X	X			X		X	X	X		X		X	X	X											X		X				
PRES. REG. & / OR BOOST VALVE	X	X	X	X	X	X	X	X	X			X	X			X	X						X	X		X	X						
BALL (#1) SHY	X	X	*			X				X		X			X	X						O				X	X						
1-2 SHIFT VALVE						X			X	X	X	X											X				X						
2-3 SHIFT VALVE								X						X	X	X	X		X														
MANUAL LOW CONT'L VALVE																							X										
DETENT VALVE & LINKAGE				X							X				X				X	X	X												
DETENT REG. VALVE																		X															
2-3 ACCUMULATOR						X						X					X																
MANUAL VALVE/LINKAGE	X	X	X																				X	X		X	X						
POROSITY/CROSS LEAK	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X					X	X		X	X						
PUMP—GEARS	X	X	X			X		X				X				X													X				
PRIMING VALVE SHY	X	X	X																														S
COOLER VALVE LEAK																																X	X
CLUTCH SEAL RINGS	X	X	X			X		X	X			X		X		X							X	X		X	X						
POROUS/CROSS LEAK	X	X	X			X		X	X			X	X	X		X		X								X	X					X	X
GASKET SCREEN—PRESSURE	X	X	X																							X	X		X			X	
BAND—INTERM. O.R.																								X									
CASE—POROUS/X LEAK	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X						X			X	X					X	
1-2 ACCUMULATOR	X	X	X			X			X			X	X																				
INTERMED. SERVO		X	X			X						X												X									
FORWARD CLUTCH ASS'Y		X																					X	X	X	L							
DIRECT CLUTCH ASS'Y								X						X		X										X	X			X			
INTERMED. CL. ASS'Y						X			X			X																		X			
L & REV. CL. ASS'Y																							X			X	X						
INT. ROLLER CL. ASS'Y									X			X												X									
L. & R. ROLLER CL. ASS'Y		X																															
PARK PAWL/LINKAGE																												X					
CONVERTER ASS'Y																													X		X		
GEAR SET & BEARINGS																													X	X			

Figure 19—THM 350-C Diagnosis Chart

B-08600

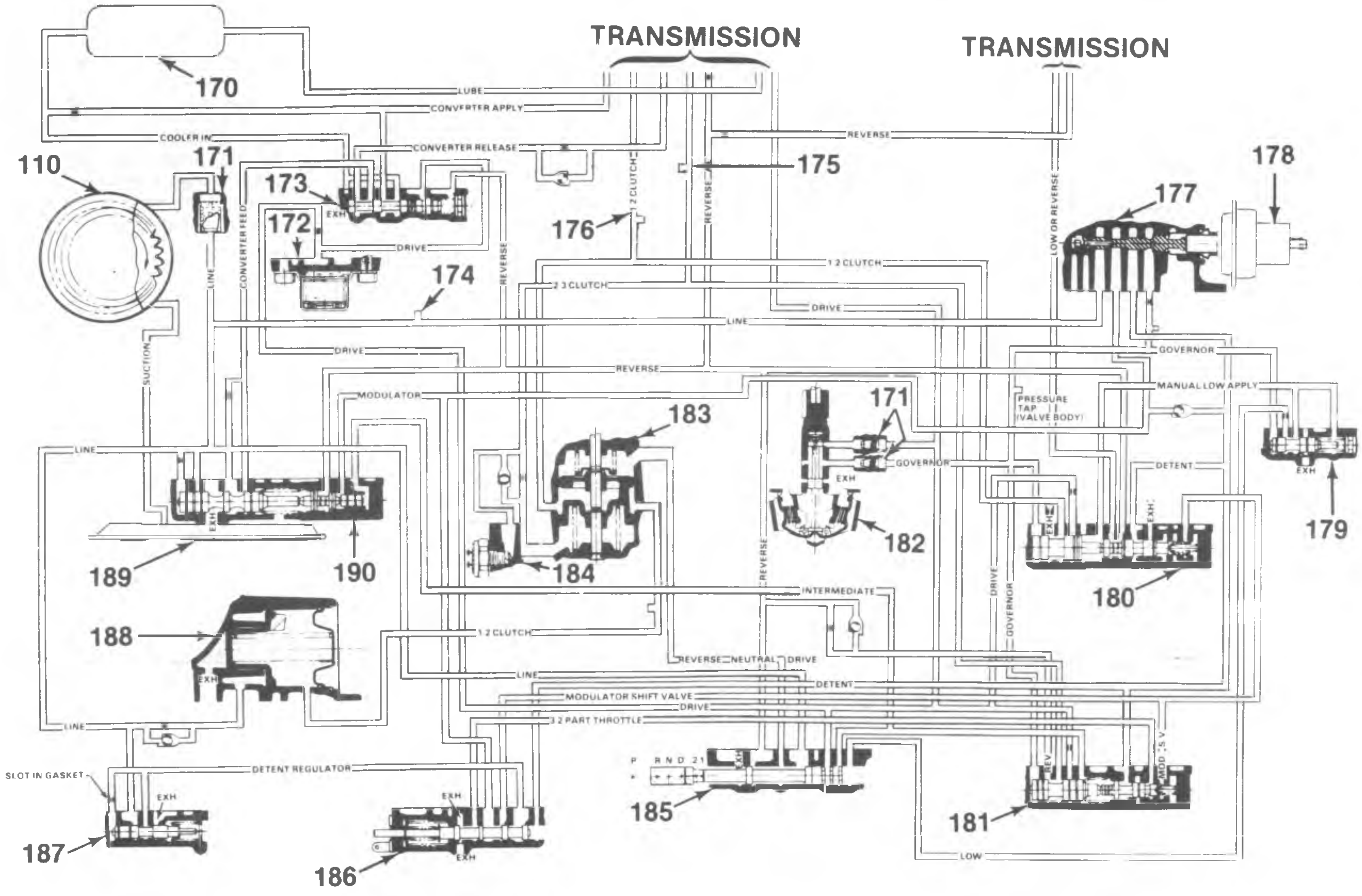


Figure 20—THM 350-C Oil Circuit

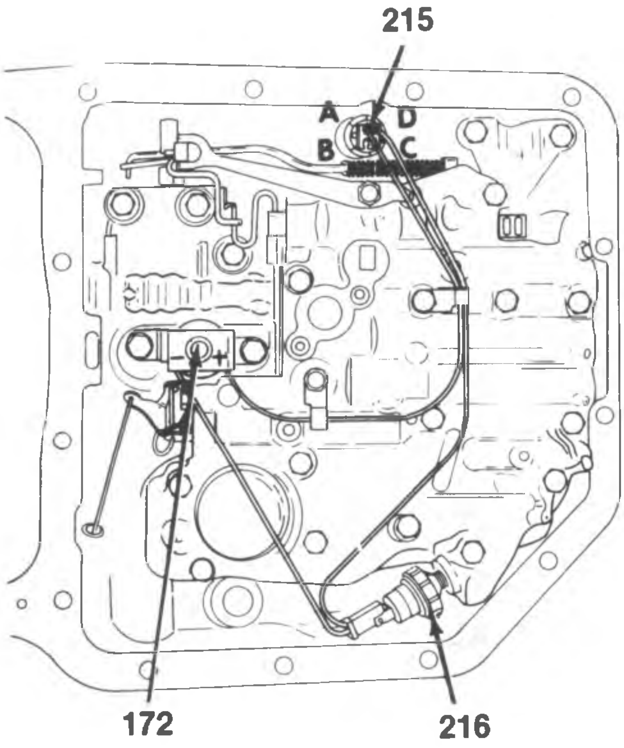
110. Oil Pump
170. Oil Cooler
171. Screen
172. TCC Solenoid
173. TCC Apply Valve
174. Line Pressure Tap

175. 2-3 Clutch Pressure Tap
176. 1-2 Clutch Pressure Tap
177. Modulator Valve
178. Vacuum Modulator
179. Manual Low Control Valve

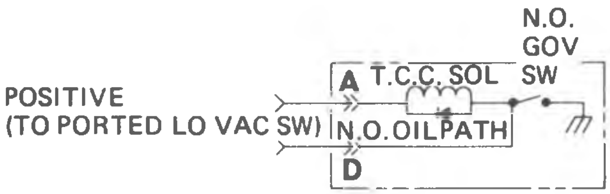
180. 1-2 Shift Valve
181. 2-3 Shift Valve
182. Governor
183. 2-3 Accumulator
184. 3rd Gear Pressure Switch

185. Manual Valve
186. Detent Valve
187. Detent Pressure Regulator
188. 1-2 Accumulator
189. Filter
190. Pressure Regulator

B-08602



172. TCC Solenoid
215. Connector
216. Governor Pressure Switch



5.0 L C- TRUCK
5.0 L G- VAN–SHORT
5.0 L G-VAN–LONG

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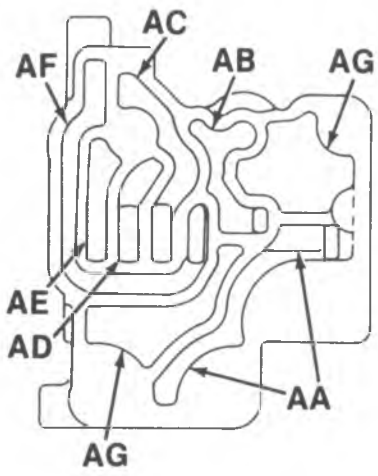
Figure 21—THM 350-C Wiring Diagram



AA. Reverse
AB. 2-3 Clutch
AC. Converter Apply
AD. Converter Feed
AE. Converter Release
AF. Cooler In
AG. Void

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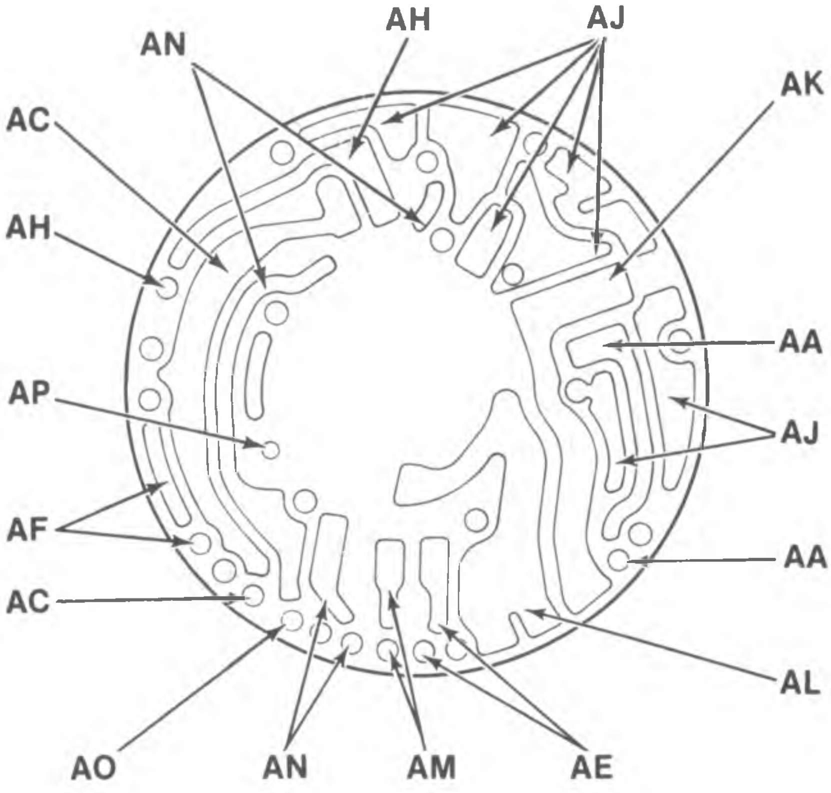
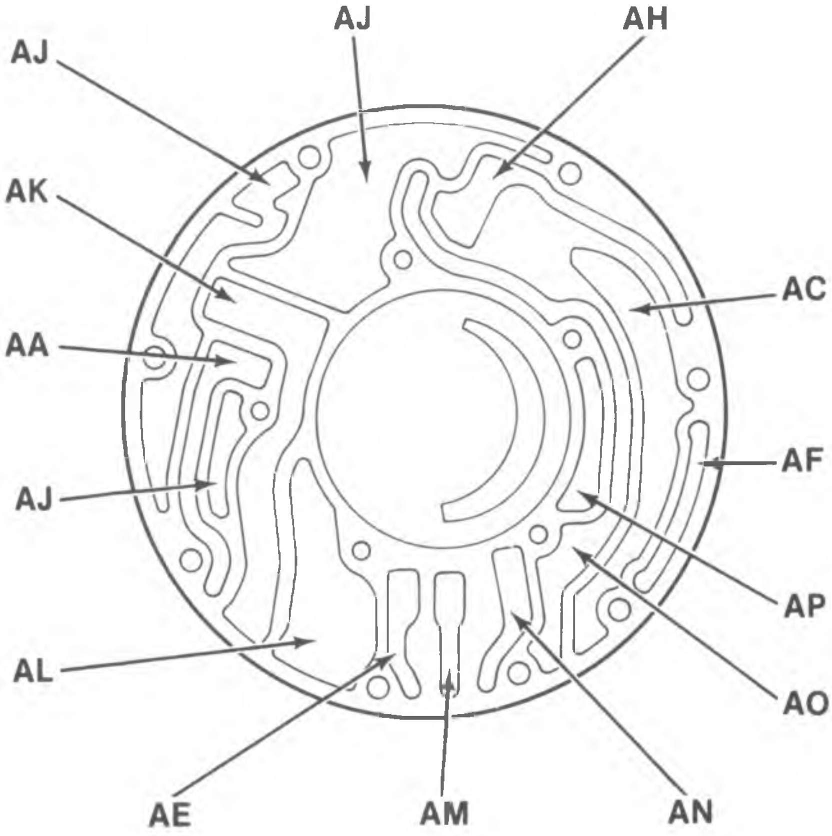
Figure 22—THM 350-C Auxiliary Valve Body Oil Passages



IDENTIFICATION OF OIL CHANNELS IN PUMP COVER



IDENTIFICATION OF OIL CHANNELS IN PUMP BODY FRONT FACE

AA. Reverse (Direct Clutch Outer)
AC. Converter Clutch Apply
AE. Converter Release
AF. Cooler In
AH. Cooler Out
AJ. Exhaust
AK. Pump Pressure
AL. Suction
AM. Forward Clutch (Drive)
AN. Direct Clutch
AO. Intermediate Clutch
AP. Lip Seal Drain

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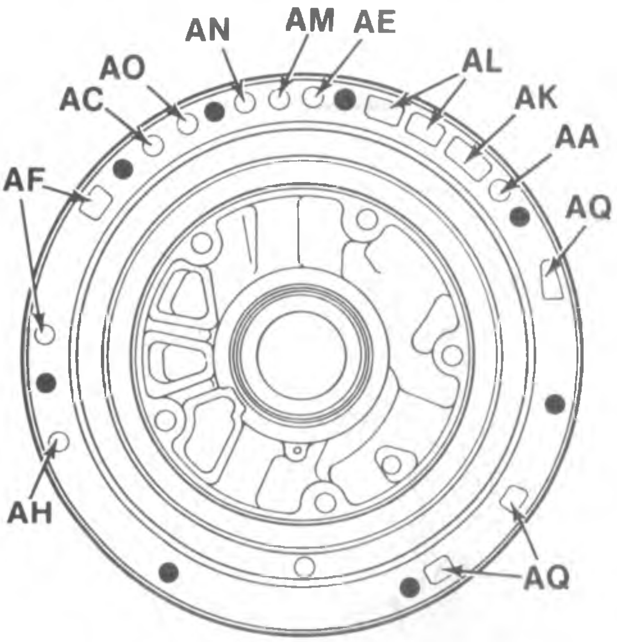
Figure 23—THM 350-C Oil Pump Passages



● Bolt Holes
AA. Reverse (Direct Clutch — Outer)
AC. Converter Apply
AE. Converter Release
AF. Cooler In
AH. Cooler Out
AK. Pump Pressure
AL. Suction
AM. Forward Clutch
AN. Direct Clutch
AO. Intermediate Clutch Apply
AQ. Breather

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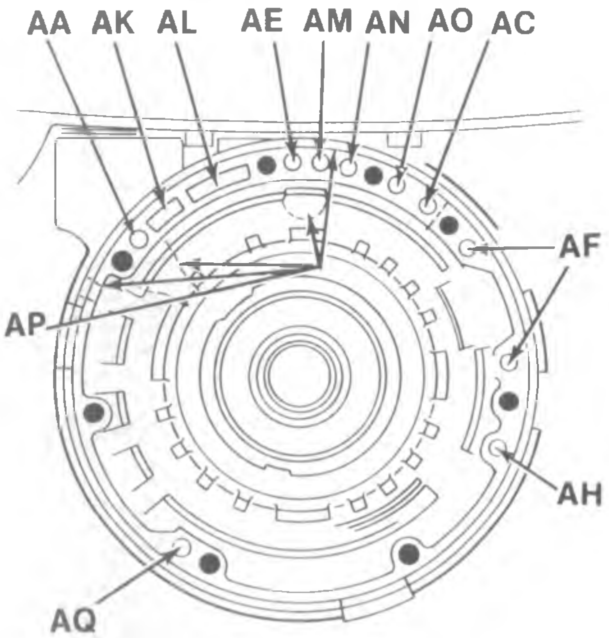
Figure 24—THM 350-C Pump Rear Face Oil Passages



● Bolt Holes
AA. Reverse (Direct Clutch — Outer)
AC. Converter Apply
AE. Converter Release
AF. Cooler In (To Radiator)
AH. Cooler Out (From Radiator)
AK. Pump Pressure
AL. Suction
AM. Forward Clutch
AN. Direct Clutch
AO. Intermediate Clutch Apply
AP. Drain (4) Cast Open Ports
AQ. Breather

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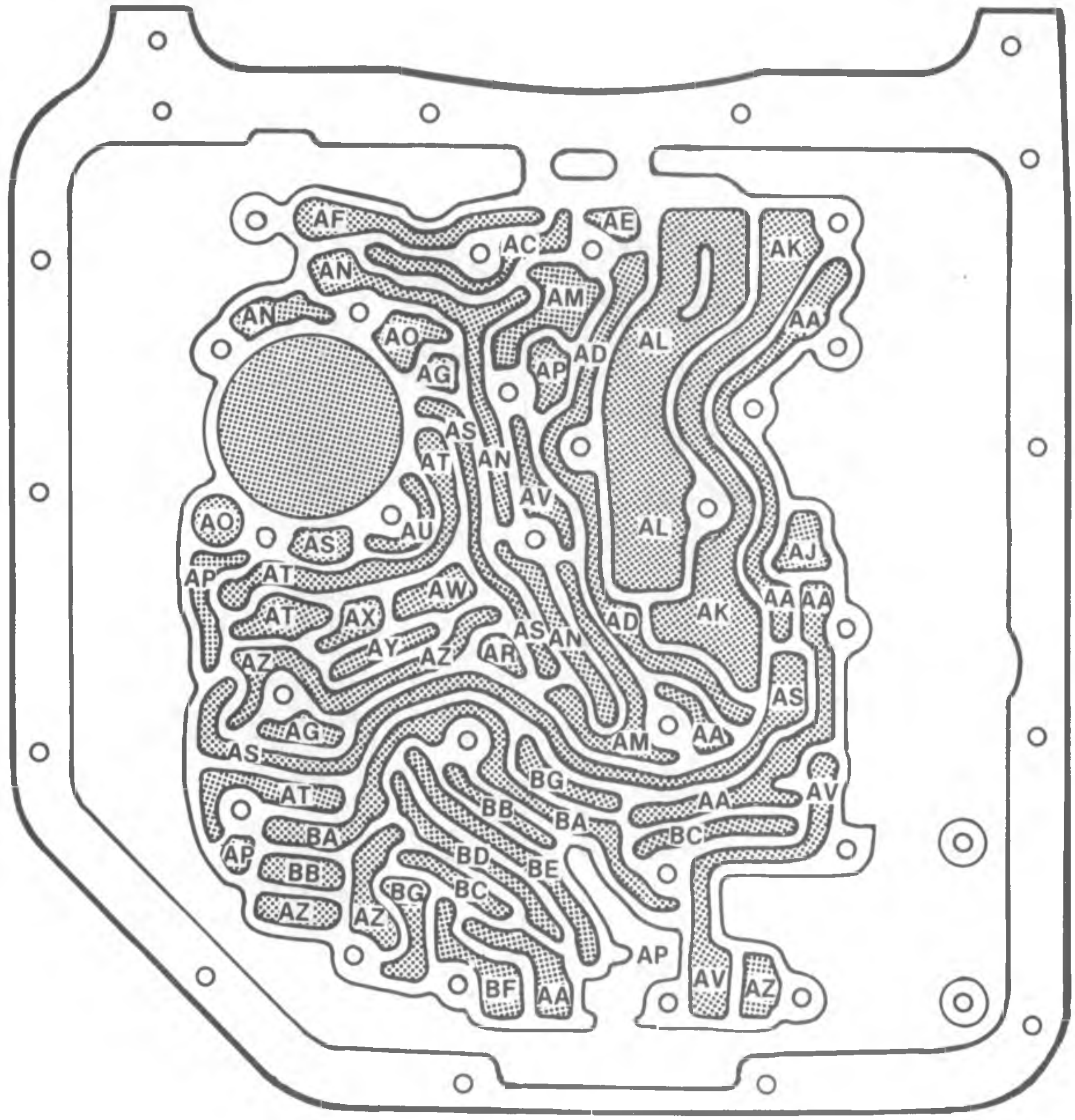
Figure 25—THM 350-C Case To Pump Oil Passages



AA. Reverse
AC. Converter Apply
AD. Converter Feed
AE. Converter Release
AF. Cooler In
AG. Void
AJ. Exhaust
AK. Pump Pressure
AL. Suction
AM. Drive Forward Clutch
AN. Direct Clutch (2-3)
AO. Intermediate Clutch (1-2)
AP. Drain
AR. Exhaust, 1-2 Clutch
AS. Intermediate Service Release (RND)
AT. Line
AU. 2-3 Clutch
AV. Drive
AW. Modulator Or Detent Regulator
AX. Exhaust, Intermediate Clutch
AY. Detent Regulator.
AZ. Governor
BA. Modulator
BB. Detent 2
BC. Lo
BD. Detent Modulator (3-2)
BE. Modulator Thru Detent Valve
BF. Lo/Reverse Clutch
BG. Manual Lo Control

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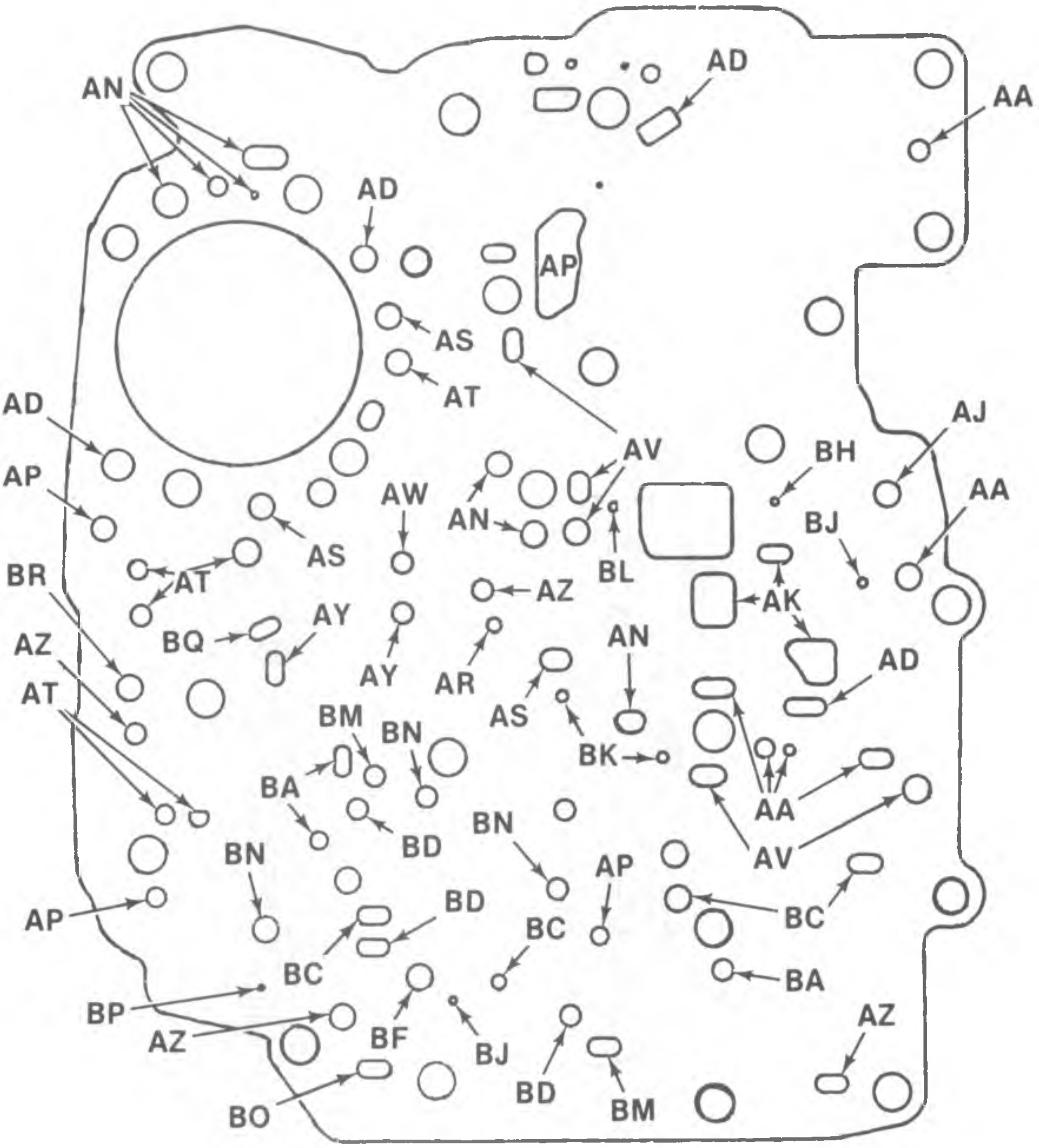
Figure 26—THM 350-C Case Face Oil Passages



●	Bolt Hole
AA.	Reverse
AD.	Converter Feed
AJ.	Exhaust
AK.	Pump Pressure
AL.	Suction
AN.	Direct Clutch 2-3
AO.	Intermediate Clutch 1-2
AP.	Drain
AR.	Exhaust 1-2 Clutch
AS.	Intermediate Servo Release (RND)
AT.	Line
AV.	Drive
AW.	Modulator Or Detent Regulator
AY.	Detent Regulator
AZ.	Governor
BA.	Modulator
BC.	Lo
BD.	Detent Modulator (3-2)
BF.	Lo Reverse Clutch
BH.	Pump Pressure Orifice
BJ.	Reverse Orifice
BK.	Drive Orifice
BL.	Converter Feed Orifice
BM.	Modulator Thru Detent Valve
BN.	Detent
BO.	Manual Lo Control
BP.	Governor Orifice
BR.	Intermediate Servo (RND)

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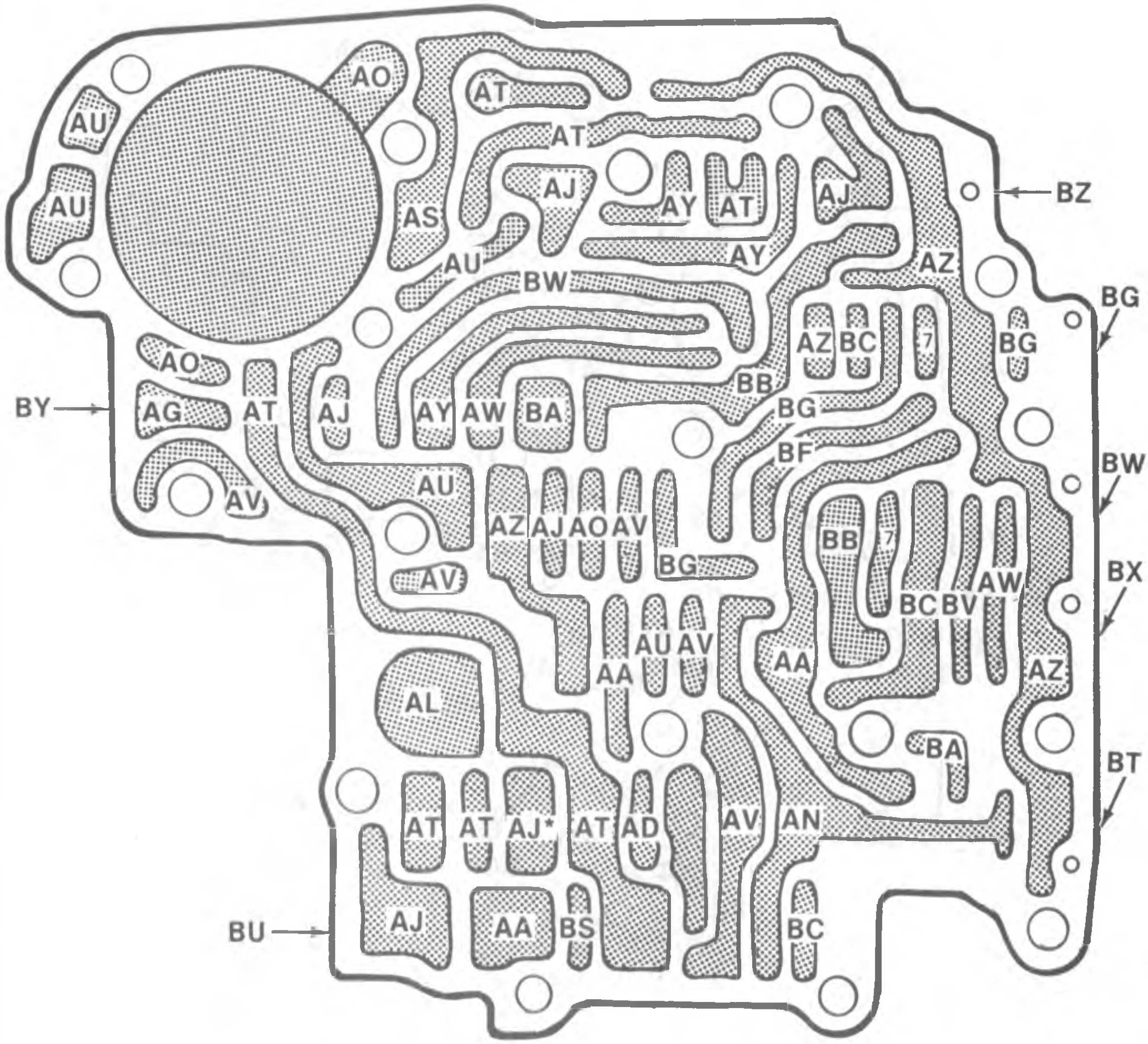
Figure 27—THM 350-C Valve Body Spacer Plate



AA.	Reverse
AD.	Converter Feed
AG.	Void
AJ.	Exhaust (*-To Sump)
AL.	Suction
AN.	Intermediate (L2)
AO.	1-2 Clutch
AS.	Intermediate Servo Release
AT.	Line
AU.	2-3 Clutch
AV.	Drive
AW.	Modulator Or Detent Regulator
AY.	Detent Regulator
AZ.	Governor
BA.	Modulator
BB.	Detent 2
BC.	Lo
BF.	Lo Or Reverse
BG.	Manual Lo Control
BS.	Speed Release
BT.	Pressure Regulator
BU.	Manual
BV.	Detent 1
BW.	1-2 Shift
BX.	2-3 shift
BY.	Detent
BZ.	Detent Pressure Regulator

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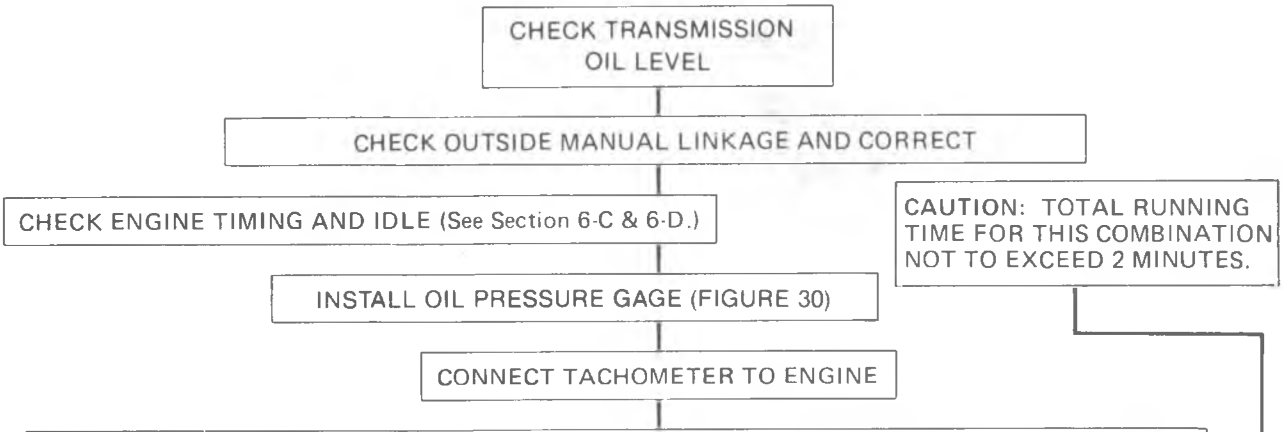
Figure 28—THM 350-C Valve Body Oil Passages

THM 400 PRELIMINARY CHECKING



CHECK OIL PRESSURES IN FOLLOWING MANNER

	RANGE	NORMAL kPa	NORMAL P.S.I.	OIL PRESSURE PATTERN LOW–NORMAL–HIGH
1	NEUTRAL–BRAKES APPLIED ENGINE AT 1000 RPM	379 TO 483	55 TO 70	
2	DRIVE IDLE–SET ENGINE IDLE TO SPECIFICATIONS	414 TO 586	60 TO 85	
3	DRIVE–BRAKES APPLIED ENGINE AT 1000 RPM	414 TO 621	60 TO 90*	
4	INTERMEDIATE OR LO–BRAKES APPLIED ENGINE AT 1000 RPM	931 TO 1103	135 to 160*	
5	REVERSE–BRAKES APPLIED ENGINE AT 1000 RPM	655 TO 1034	95 TO 150*	
6	DRIVE–BRAKES APPLIED ENGINE AT 1000 RPM DOWNSHIFT SWITCH ACTIVATED	621 TO 758	90 TO 110	
7	GOVERNOR CHECK– FOR UPSHIFT PROBLEM	DROP OF 69 PSI OR MORE	DROP OF 10 PSI OR MORE	
8	DRIVE–30 MPH–CLOSED THROTTLE ON ROAD, OR ON HOIST**	379 TO 483	55 TO 70	

* IF HIGH LINE PRESSURES ARE EXPERIENCED, REFER TO "CAUSES OF HIGH LINE PRESSURE" IN THIS SECTION.

** VEHICLE ON HOIST, DRIVING WHEELS OFF GROUND, SELECTOR IN DRIVE, BRAKES RELEASED, RAISE ENGINE TO 3000 R.P.M., CLOSE THROTTLE AND READ PRESSURE BETWEEN 2000 AND 1200 R.P.M.

B-08660

Figure 29—Preliminary Checking Procedure

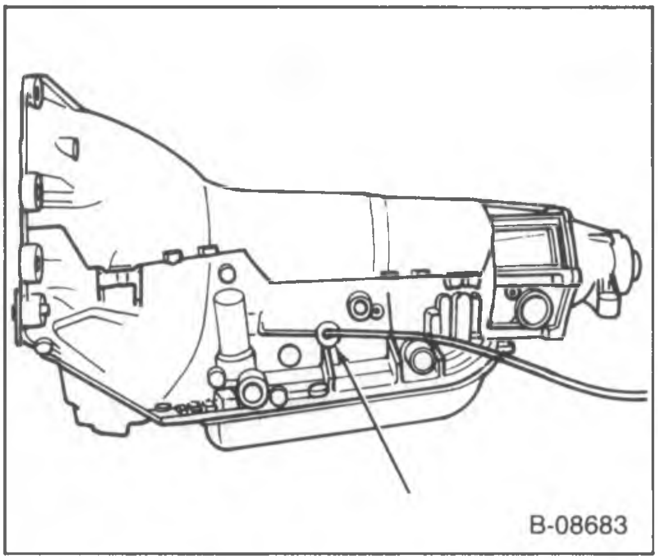


Figure 30—THM 400 Pressure Tap Location

UPSHIFT	MINIMUM
1-2	15 MPH
2-3	30 MPH
UPSHIFT	**MAXIMUM**
1-2	44-48 MPH
2-3	77-83 MPH
DETENT DOWNSHIFT	**MINIMUM**
3-2	68-73 MPH
2-1	28-32 MPH

B-08325

Figure 31—THM 400 Shift Points

ROAD TEST

1. Connect a portable tachometer to the engine. Engine rpm will identify the shift points.
2. Place the selector in "Drive" position and accelerate the vehicle from a rest at a minimum throttle opening. The specifications for the shifts points are:

   Downshifts should occur (3-2 and 2-1) as the vehicle speed decreases to 0 mph. Stop the vehicle.
3. Place the selector in "Intermediate" position and accelerate the vehicle from a rest. A 1-2 shift should occur at all throttle openings. No 2-3 shift can be obtained in this range. Stop the vehicle.
4. Place the selector in "Low". No upshift should occur in this range regardless of the throttle opening.
5. Position the selector in "Drive" and accelerate the vehicle to 35 mph and move the selector to "Intermediate". A 3-2 downshift should occur, increasing the engine rpm and an engine braking effect should be noticed on deceleration.
6. With the selector in "Intermediate" at approximately 25 mph, but not over 40 mph, at closed throttle, move the selector to "Low." A 2-1 downshift should occur, increasing the engine rpm and an engine braking effect should be noticed on deceleration. Stop the vehicle.
7. Place the selector in "Reverse" and check for reverse operation.

DIAGNOSIS OF THM 400

	1	2	3	4	5	6	7	8	
Malfunction	Neutral Brakes Applied 1000 rpm	Drive Idle	Drive Left — Brakes Applied 1000 rpm	Drive-R Brakes Applied 1000 rpm	Reverse Brakes Applied 1000 rpm	Drive Left — Brakes Applied 1000 rpm Downshift Switch Activated	Pressure Drop Occurs while Engine rpm Increases from 1000 to 3000 rpm Wheels Free to Move*	Drive 30 mph Closed Throttle	Possible Cause of Malfunction
	Oil Pressure	Oil Pressure	Oil Pressure	Oil Pressure	Oil Pressure	Oil Pressure		Oil Pressure	
No 1-2 Upshift and/or Delayed Upshift	Normal	Normal	Normal	Normal	Normal	Normal	10 psi Drop or More	Normal	Malfunction in Control Valve Assembly
	Normal	Normal	Normal	Normal	Normal	Normal	Less than 10 psi Drop	Normal	Malfunction in Governor or Governor Feed System
	Normal	High	High	Normal	Normal	Normal		High	Malfunction in Detent System
	High	High	High	Normal	High	—	—	—	Malfunction in Modulator or Vacuum Feed System to Modulator
Slipping-Reverse	Normal	Normal	Normal	Normal	Low	Normal		Normal	Oil Leak in Feed System to the Direct Clutch
Slipping-1st Gear	Normal	Low to Normal	Low to Normal	Low to Normal	Normal	Low to Normal	—	Low to Normal	Oil Leak in Feed System to the Forward Clutch
Downshift with Zero Throttle and No Engine Braking in Drive	Normal	High	Normal	Normal	Normal	—	—	High	Stator and Detent Wires Switched
No Detent Downshifts	Normal	Normal	Normal	Normal	Normal	Low		Normal	Malfunction in Detent System

*Drive range, vacuum line disconnected from modulator.

A dash (–) in the above chart means that the oil pressure reading has no meaning under the test condition.

Pressures obtained by the Preliminary Checking procedure

B-08741

Figure 32—THM 400 Oil Pressure Check Chart

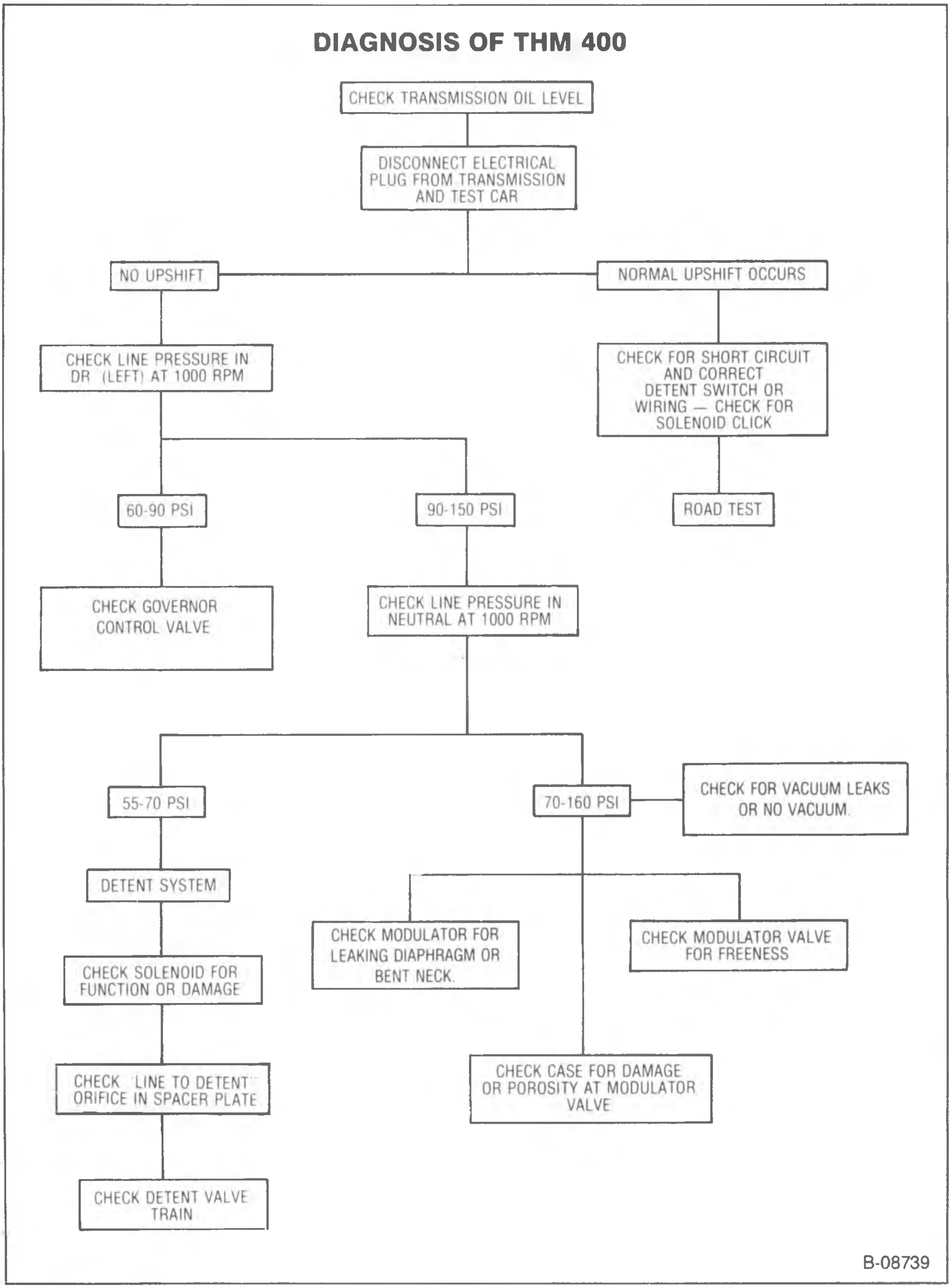
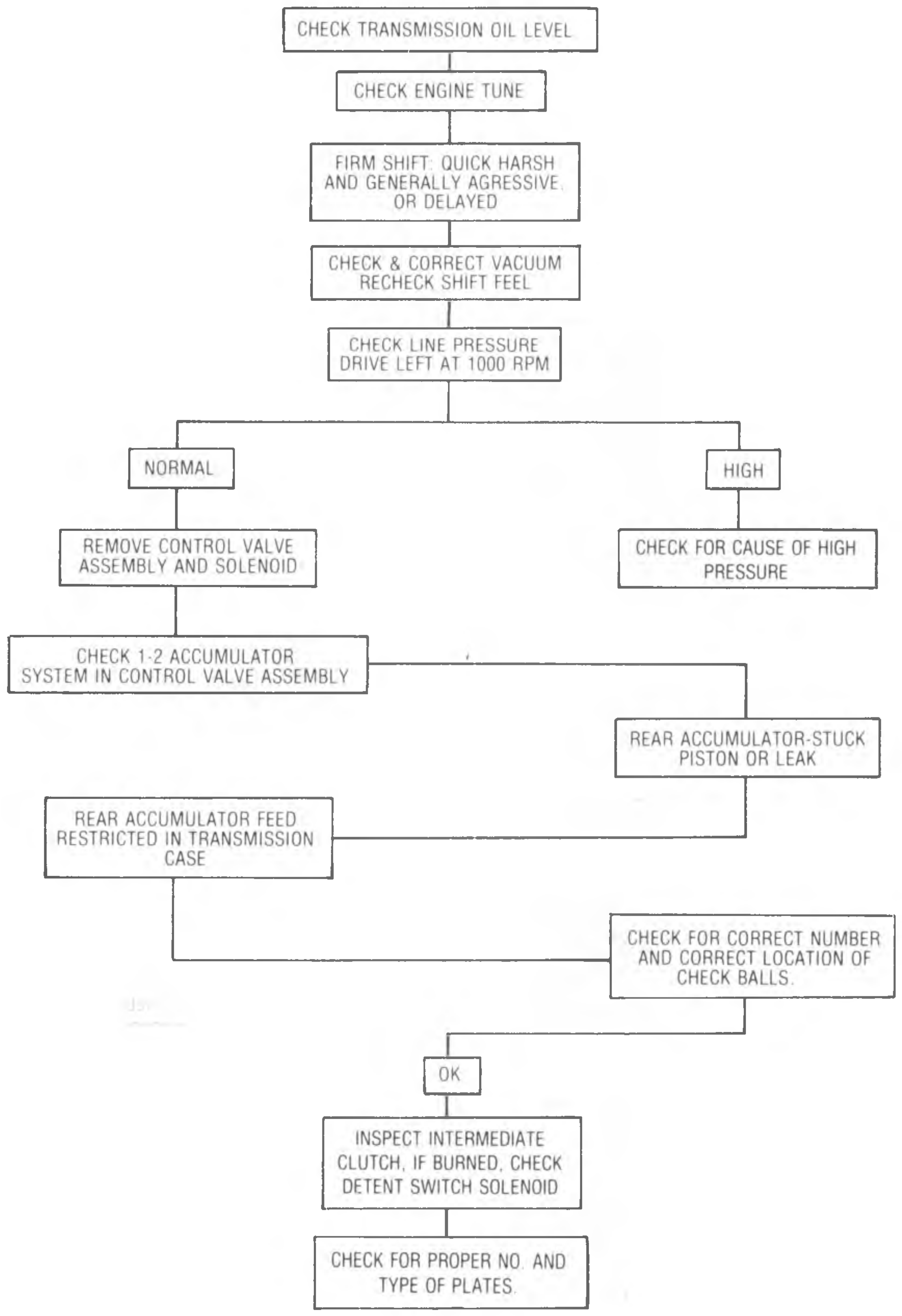


Figure 33—No 1-2 Upshift And/Or Delayed Upshift

DIAGNOSIS OF THM 400 (CONT.)



B-08737

Figure 34—102 Shift Feel Complaint — Firm Shift

DIAGNOSIS OF THM 400 (CONT.)

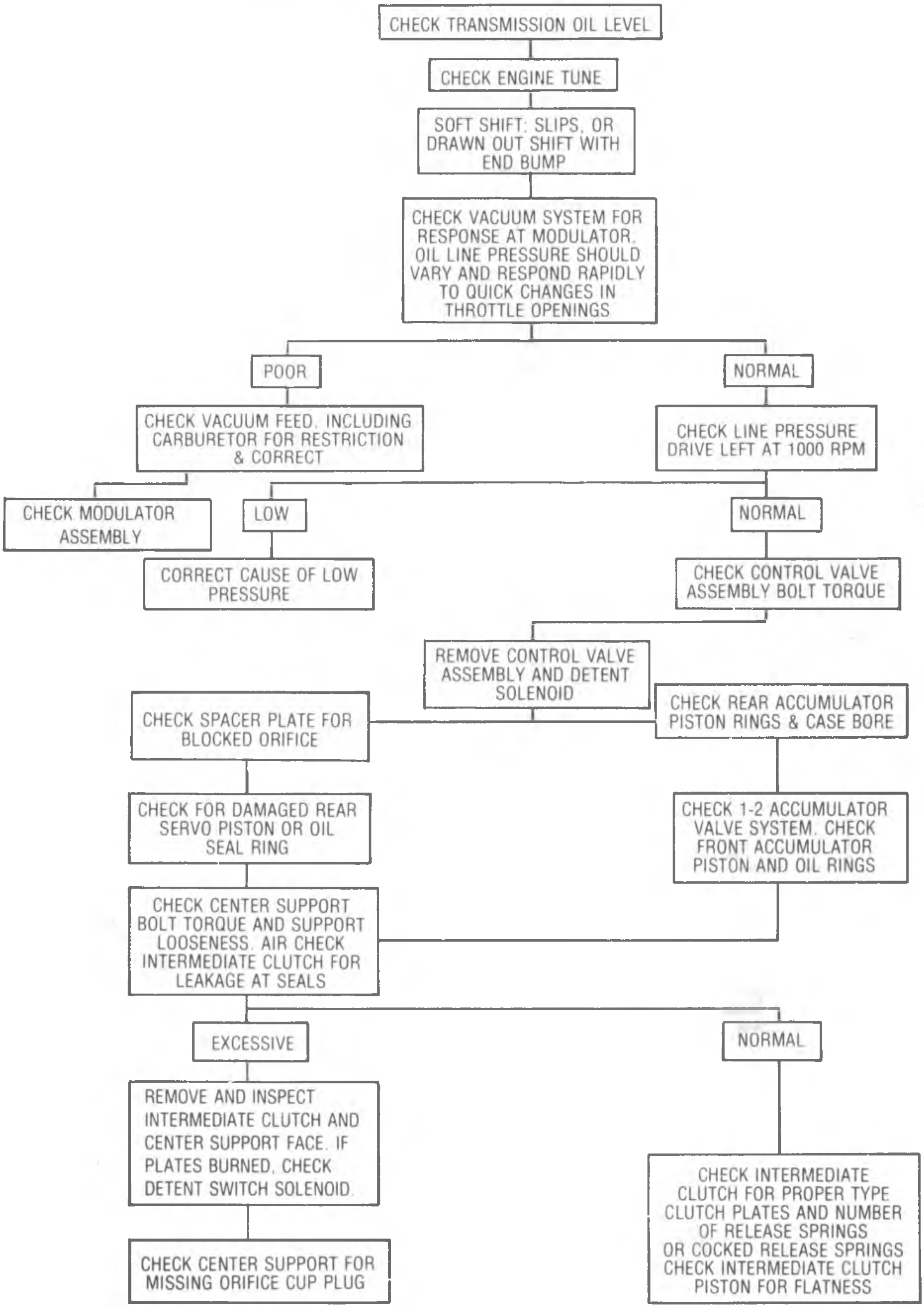


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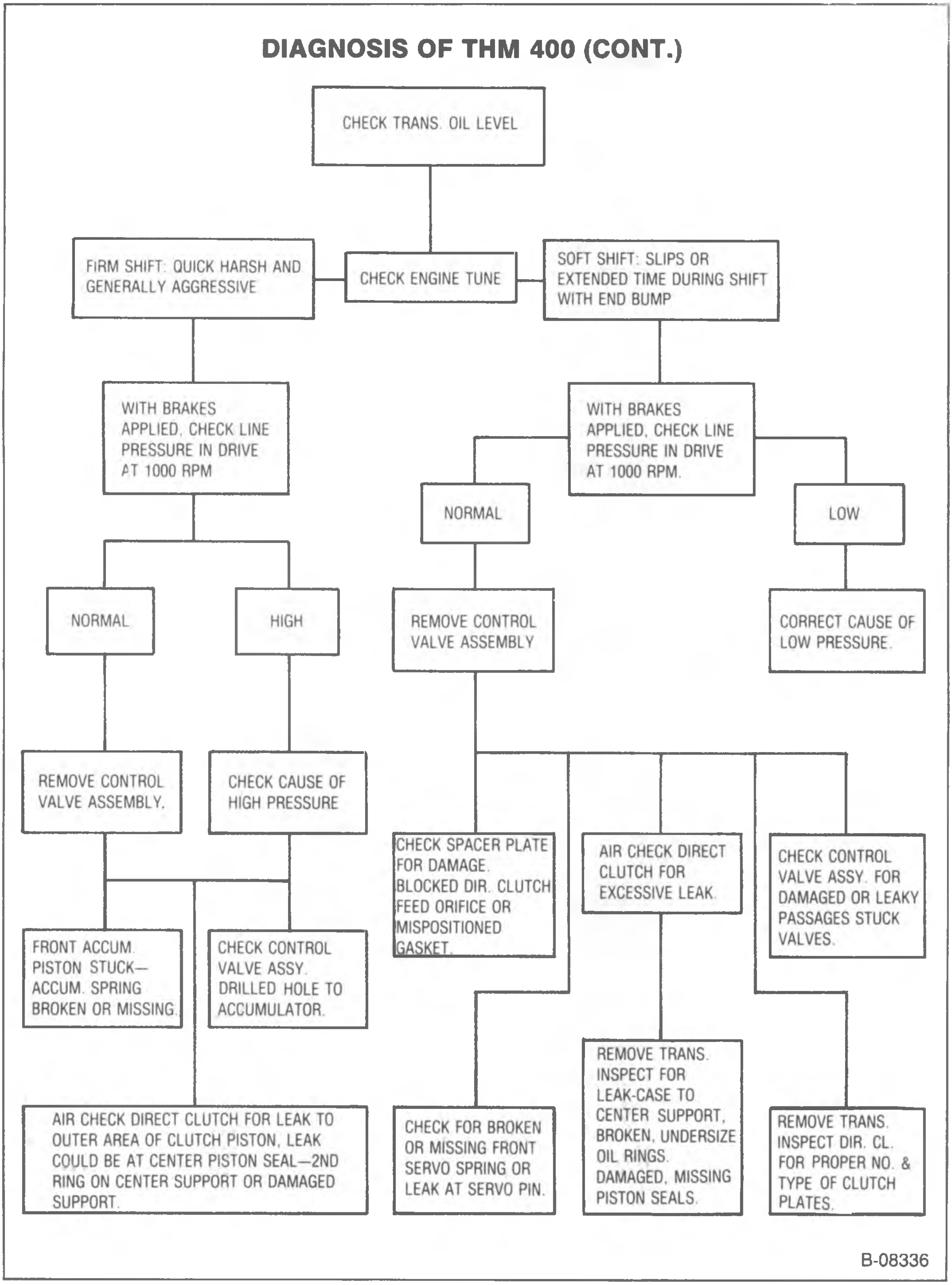
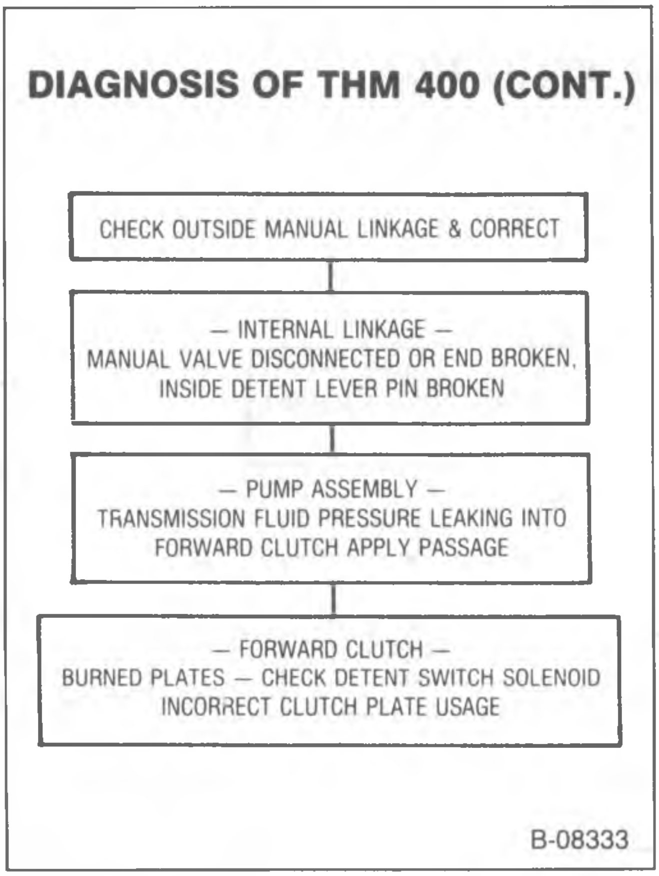
Figure 35—1-2 Shift Feel Complaint — Soft Shift



DIAGNOSIS OF THM 400 (CONT.)

Figure 36—2-3 Shift Complaint



DIAGNOSIS OF THM 400 (CONT.)

CHECK OUTSIDE MANUAL LINKAGE & CORRECT

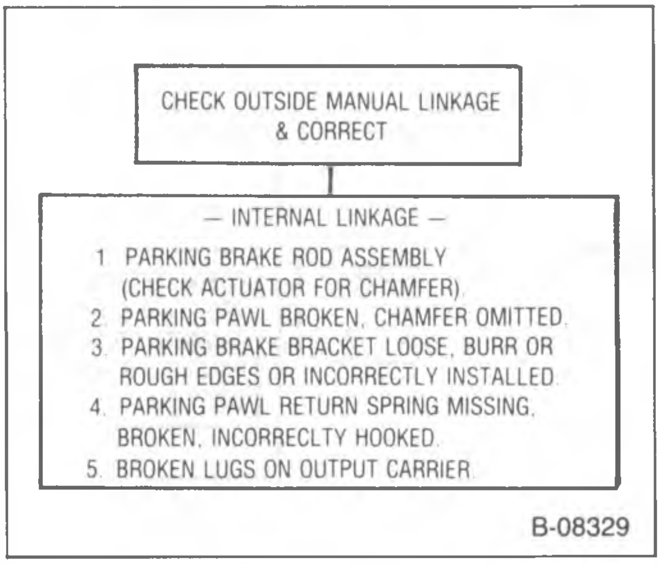
— INTERNAL LINKAGE —
MANUAL VALVE DISCONNECTED OR END BROKEN, INSIDE DETENT LEVER PIN BROKEN

— PUMP ASSEMBLY —
TRANSMISSION FLUID PRESSURE LEAKING INTO FORWARD CLUTCH APPLY PASSAGE

— FORWARD CLUTCH —
BURNED PLATES — CHECK DETENT SWITCH SOLENOID INCORRECT CLUTCH PLATE USAGE

B-08333

Figure 37—Drive In Neutral



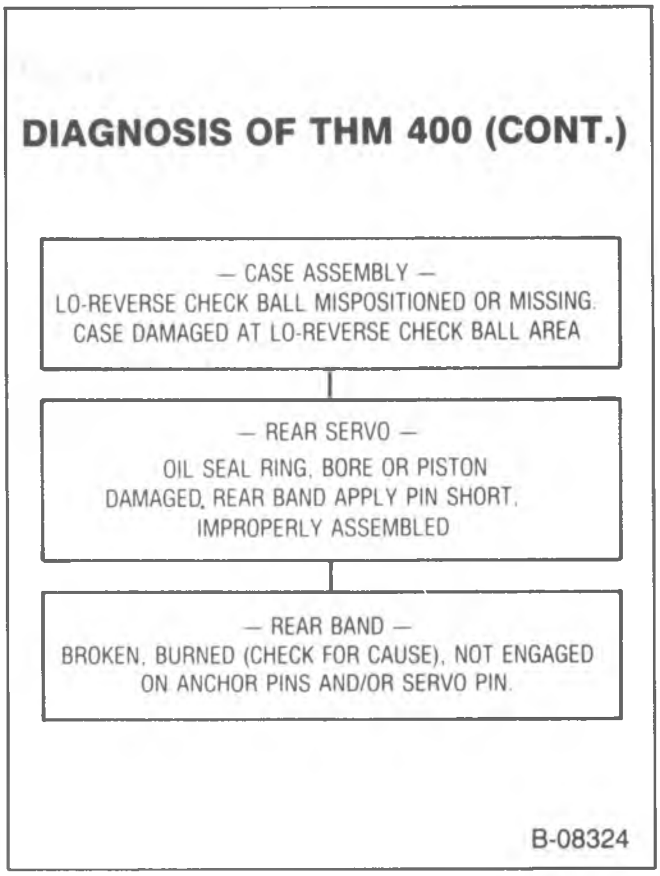
CHECK OUTSIDE MANUAL LINKAGE & CORRECT

— INTERNAL LINKAGE —

1. PARKING BRAKE ROD ASSEMBLY (CHECK ACTUATOR FOR CHAMFER).
2. PARKING PAWL BROKEN, CHAMFER OMITTED.
3. PARKING BRAKE BRACKET LOOSE, BURR OR ROUGH EDGES OR INCORRECTLY INSTALLED.
4. PARKING PAWL RETURN SPRING MISSING, BROKEN, INCORRECLTY HOOKED.
5. BROKEN LUGS ON OUTPUT CARRIER.

B-08329

Figure 38—Will Not Holt In Park Or Will Not Release From Park



DIAGNOSIS OF THM 400 (CONT.)

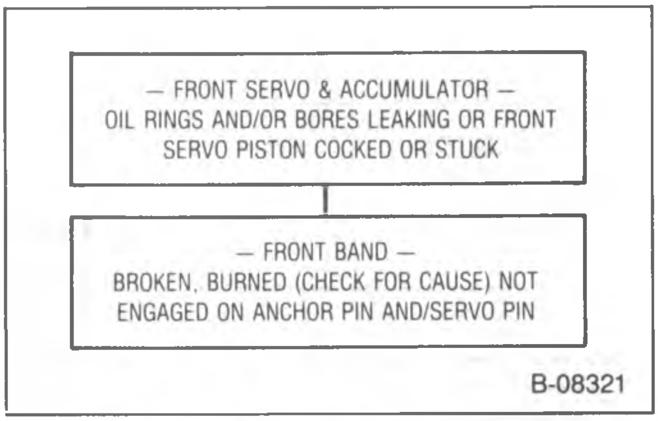
— CASE ASSEMBLY —
LO-REVERSE CHECK BALL MISPOSITIONED OR MISSING. CASE DAMAGED AT LO-REVERSE CHECK BALL AREA

— REAR SERVO —
OIL SEAL RING, BORE OR PISTON DAMAGED, REAR BAND APPLY PIN SHORT, IMPROPERLY ASSEMBLED

— REAR BAND —
BROKEN, BURNED (CHECK FOR CAUSE), NOT ENGAGED ON ANCHOR PINS AND/OR SERVO PIN.

B-08324

Figure 39—No Engine Braking-Lo Range-1st Gear



— FRONT SERVO & ACCUMULATOR —
OIL RINGS AND/OR BORES LEAKING OR FRONT SERVO PISTON COCKED OR STUCK

— FRONT BAND —
BROKEN, BURNED (CHECK FOR CAUSE) NOT ENGAGED ON ANCHOR PIN AND/SERVO PIN

B-08321

Figure 40—No Engine Braking-Intermediate Range-2nd Gear

DIAGNOSIS OF THM 400 (CONT.)

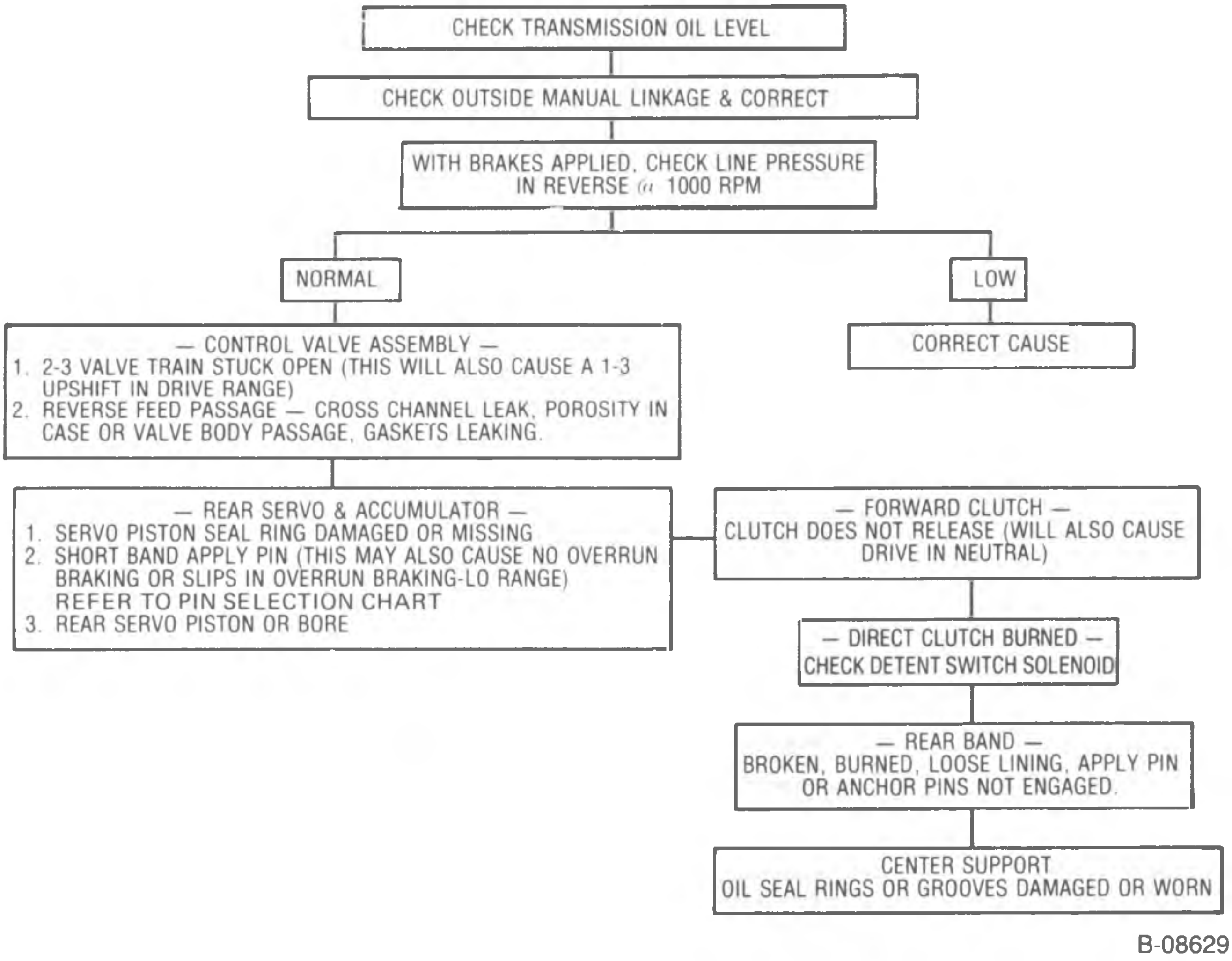


Figure 41—No Reverse Or Slips In Reverse

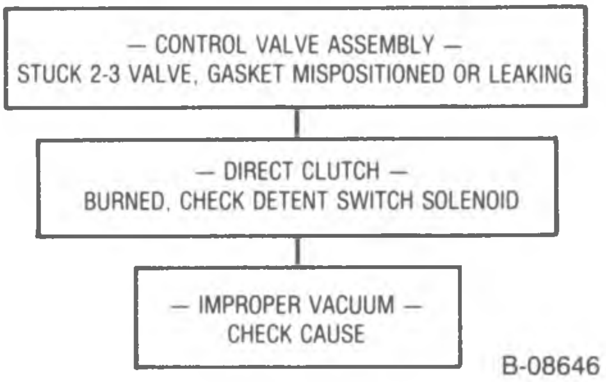


Figure 42—1st And 2nd Speeds Only, No 2-3 Upshift

DIAGNOSIS OF THM 400 (CONT.)

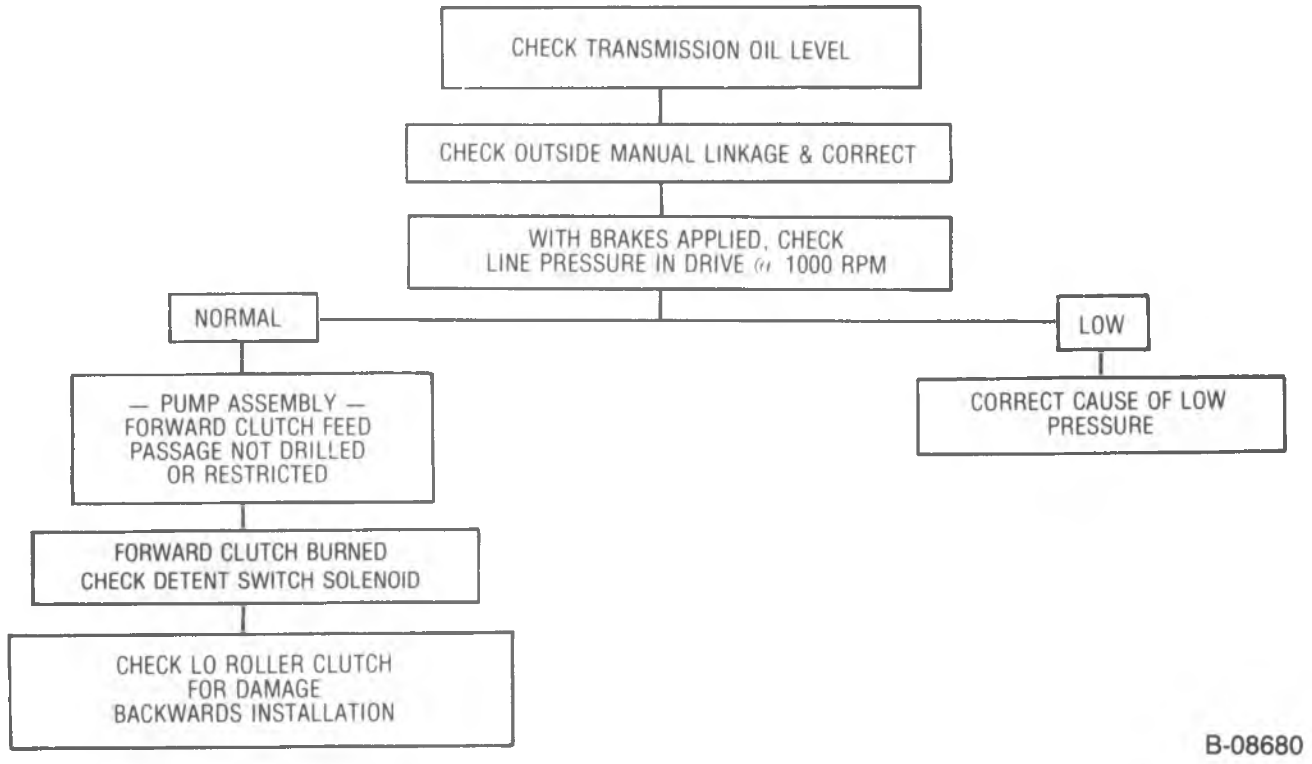


Figure 43—No Drive In Drive Range

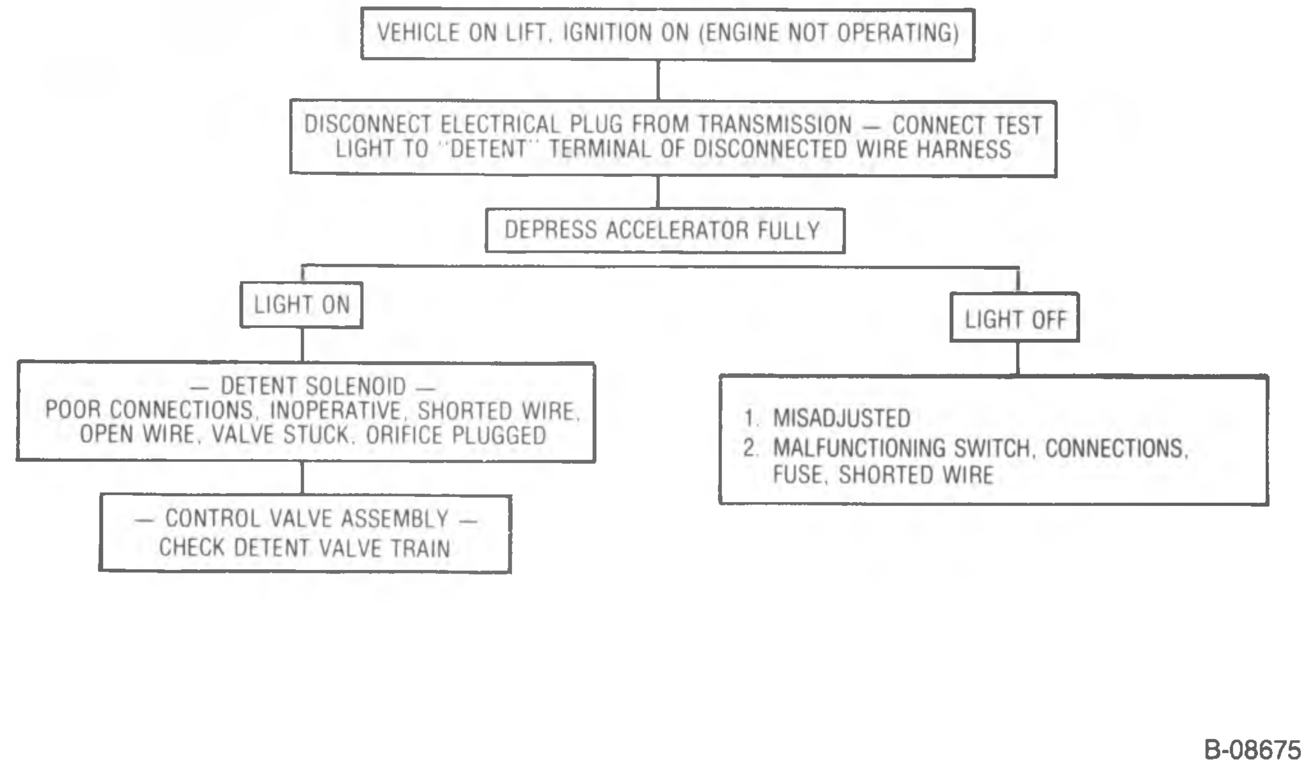
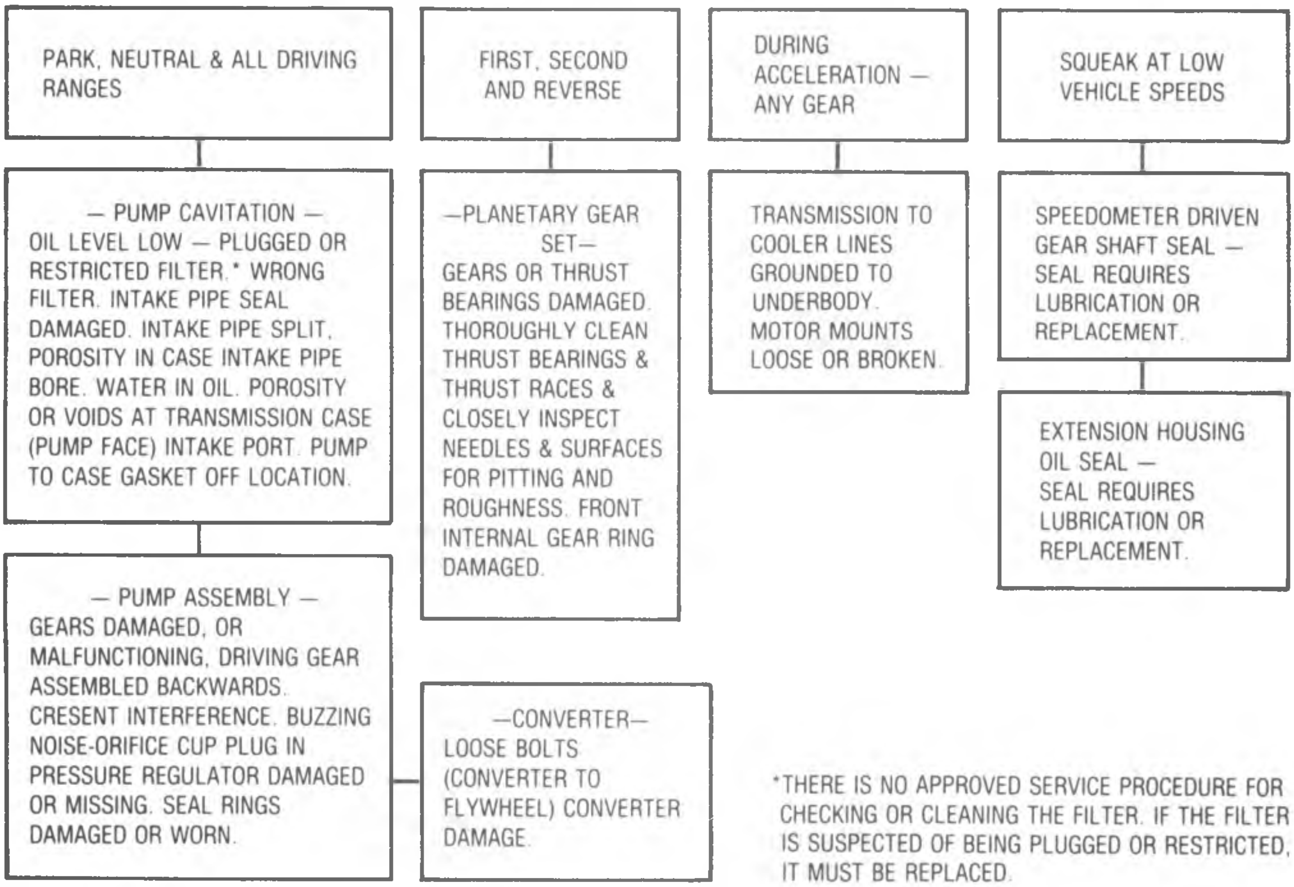


Figure 44—No Detent Downshift

DIAGNOSIS OF THM 400 (CONT.)

NOTE: BEFORE CHECKING TRANSMISSION FOR WHAT IS BELIEVED TO BE "TRANSMISSION NOISE," MAKE CERTAIN THE NOISE IS NOT FROM THE WATER PUMP, GENERATOR, AIR CONDITIONER, POWER STEERING, ETC. THESE COMPONENTS CAN BE ISOLATED BY REMOVING THE PROPER BELT AND RUNNING THE ENGINE NO MORE THAN TWO MINUTES AT ONE TIME.



PARK, NEUTRAL & ALL DRIVING RANGES

— PUMP CAVITATION — OIL LEVEL LOW — PLUGGED OR RESTRICTED FILTER.* WRONG FILTER. INTAKE PIPE SEAL DAMAGED. INTAKE PIPE SPLIT. POROSITY IN CASE INTAKE PIPE BORE. WATER IN OIL. POROSITY OR VOIDS AT TRANSMISSION CASE (PUMP FACE) INTAKE PORT. PUMP TO CASE GASKET OFF LOCATION.

— PUMP ASSEMBLY — GEARS DAMAGED, OR MALFUNCTIONING, DRIVING GEAR ASSEMBLED BACKWARDS. CRESENT INTERFERENCE. BUZZING NOISE-ORIFICE CUP PLUG IN PRESSURE REGULATOR DAMAGED OR MISSING. SEAL RINGS DAMAGED OR WORN.

—CONVERTER— LOOSE BOLTS (CONVERTER TO FLYWHEEL) CONVERTER DAMAGE.

FIRST, SECOND AND REVERSE

—PLANETARY GEAR SET— GEARS OR THRUST BEARINGS DAMAGED. THOROUGHLY CLEAN THRUST BEARINGS & THRUST RACES & CLOSELY INSPECT NEEDLES & SURFACES FOR PITTING AND ROUGHNESS. FRONT INTERNAL GEAR RING DAMAGED.

DURING ACCELERATION — ANY GEAR

TRANSMISSION TO COOLER LINES GROUNDED TO UNDERBODY. MOTOR MOUNTS LOOSE OR BROKEN.

SQUEAK AT LOW VEHICLE SPEEDS

SPEEDOMETER DRIVEN GEAR SHAFT SEAL — SEAL REQUIRES LUBRICATION OR REPLACEMENT.

EXTENSION HOUSING OIL SEAL — SEAL REQUIRES LUBRICATION OR REPLACEMENT.

*THERE IS NO APPROVED SERVICE PROCEDURE FOR CHECKING OR CLEANING THE FILTER. IF THE FILTER IS SUSPECTED OF BEING PLUGGED OR RESTRICTED, IT MUST BE REPLACED.

B-08669

Figure 45—Transmission Noisy

CAUSES OF LOW LINE PRESSURE

1. Low transmission oil level.
2. Modulator Assembly.
3. Filter.
    - Blocked or restricted. (There is no approved service procedure for checking or cleaning the filter. If the filter is suspected or being plugged or restricted, it must be replaced).
    - O ring on intake pipe and / or grommet omitted or damaged.
    - Split or leaking intake pipe.
    - Wrong filter assembly.
4. Pump.
    - Pressure regulator or boost valve stuck.
    - Gear clearance, damaged, worn. (Pump will become damaged if drive gear is installed backwards, or if converter pilot does not enter crankshaft freely).
    - Pressure regulator spring, too week.
    - Not enough spacers in pressure regulator.
    - Pump to case gasket mispositioned.
    - Malfunctioning pump body and/or cover.
    - Mismatched pump cover/pump body.
5. Internal circuit leaks.
    - Forward clutch leak (pressure normal in neutral and reverse-pressure low in drive).
        - — Check pump rings.
        - — Check forward clutch seals.
    - Direct clutch leak (pressure normal in neutral, low, intermediate, and drive-pressure low in reverse).
        - — Check center support oil seal rings.
        - — Check direct clutch outer seal for damage.
        - — Check rear servo and front accumulator pistons and rings for damage or missing.
6. Case assembly.
    - Porosity in intake bore area.
    - Check case for intermediate clutch plug leak or missing plug.
    - Lo-reverse check ball mispositioned or missing (this will cause no reverse and no overrun braking in Lo range).

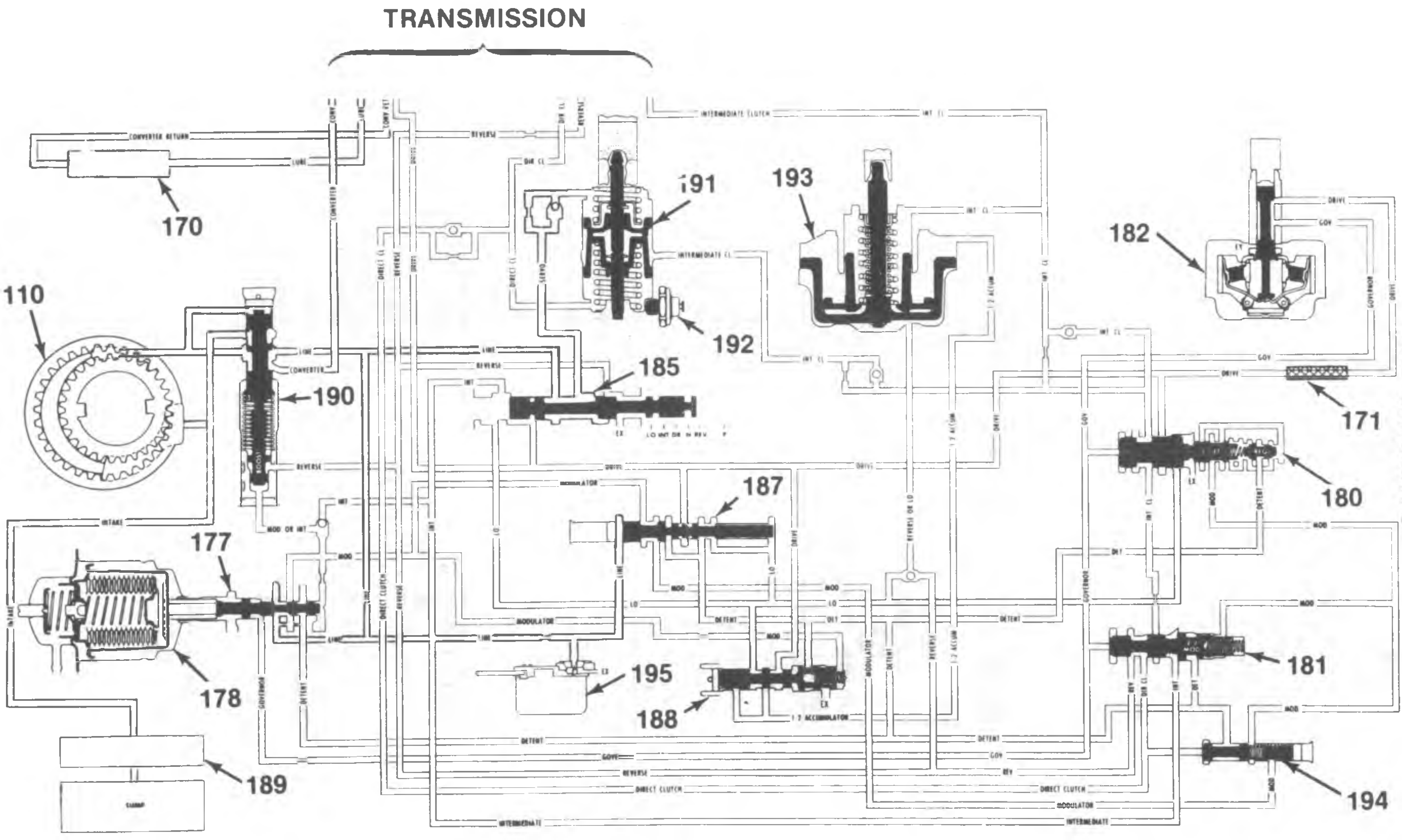
CAUSES OF HIGH LINE PRESSURE

1. Vacuum leak.
    - Full leak (vacuum line disconnected).
    - Partial leak in the line from the engine modulator.
    - Improper engine vacuum.
    - Vacuum operated accessory leak. (Hoses, vacuum advance, etc.).
2. Damaged modulator.
    - Stuck valve.
    - Water in the modulator.
    - Not operating properly.
3. Detent system.
    - Detent switch actuated (plunger stuck) or shorted.
    - Detent wiring shorted.
    - Detent solenoid stuck open.
    - Detent feed orifice in the spacer plate blocked.
    - Detent solenoid loose.
    - Detent valve bore plug damaged.
    - Detent regulator valve pin short.
4. Pump.
    - Pressure regulator and/or boost valve stuck.
    - Incorrect pressure regulator spring.
    - Too many pressure regulator valve spacers.
    - Pump casting bad.
    - Pressure boost valve installed backwards or malfunctioning.

CONTROL VALVE ASSEMBLY—GOVERNOR LINE PRESSURE CHECK

1. Install an oil pressure test gage.
2. Install a tachometer.
3. Disconnect the vacuum line to the modulator.
4. With the vehicle on a hoist driving wheels off the ground, foot off the brake, in drive, check the line pressure at 1000 rpm.
5. Slowly increase the engine rpm to 3000 rpm and determine if a line pressure drop occurs (69 kPa [10 psi] or more).
6. If pressure drop of 69 kPa (10 psi) or more occurs, disassemble, clean and inspect the control valve assembly.
7. If the pressure drop is less than 69 kPa (10 psi):
    - Inspect the governor.
        - — Stuck valve.
        - — Weight freeness.
        - — Restricted orifice in the governor valve.
        - — Check the governor valve entry and exhaust (0.50 mm [0.20-in.] min.).
    - Governor feed system.
        - — Check the screen in the control valve assembly or case.
        - — Check for restrictions in the governor pipe.
        - — Check for fit of the governor pipes in the case holes.

OIL CIRCUITS



110. Oil Pump
170. Oil Cooler
171. Screen
177. Modulator Valve
178. Vacuum Modulator
180. 1-2 Shift Valve
181. 2-3 Shift Valve
182. Governor
185. Manual Valve
187. Detent Pressure Regulator
188. 1-2 Accumulator
189. Filer
190. Pressure Regulator
191. Front Servo
192. Pressure Switch
193. Rear Servo
194. 3-2 Shift Valve
195. Detent Solenoid

B-08656

Figure 46—THM 400 Oil Circuit

1986 THM 400 CLUTCH PLATE APPLICATION CHART
FORWARD CLUTCH

MODELS	NO. OF FLAT STEEL PLATES		NO. OF WAVED STEEL PLATES	NO. OF DISHED PLATES	NO. OF COMPOSITION PLATES
THICKNESS	2.32 MM (.0915″)	1.97 MM (.0775″)	1.54 MM (.0605″)	1.37 MM (.054″)	
EV, FI, FS, HR, MA	5				5
FG, RC, RR, RT, RV, ZD, ZV	5			1	5
ALL OTHERS		4	1		5

1986 THM 400 CLUTCH PLATE APPLICATION CHART
DIRECT CLUTCH

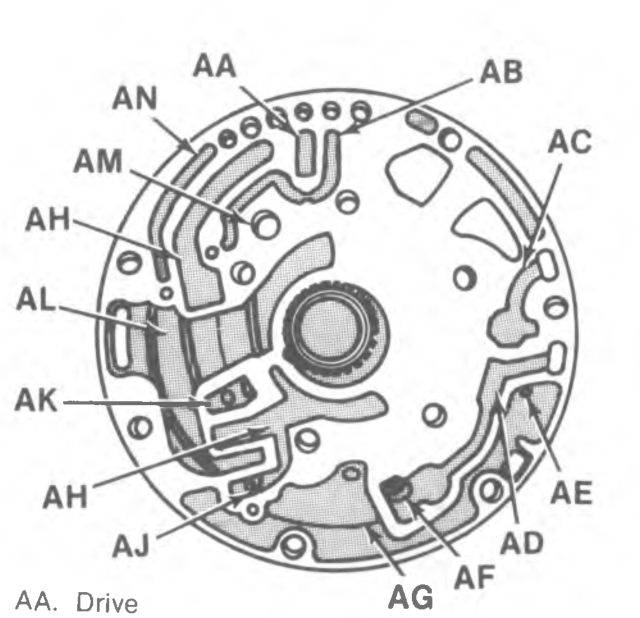
MODELS	NO. OF FLAT STEEL PLATES		NO. OF WAVED STEEL PLATES	NO. OF DISHED PLATES	NO. OF COMPOSITION PLATES
THICKNESS	2.32 MM (.0915″)	1.97 MM (.0775″)	1.54 MM (.0605″)	1.37 MM (.054″)	
FA, FB, FC, FD, FF, FJ, FK, FM FN, FP, FR, FT, FV, FW, FX, FZ	5				5
FG, ZD, ZV	2	3		1	5
EV, FT, FS, HR, MA, RV	6				6
FL, FQ, HZ, RC, RR	4		1		5
LR, LS	3		1		4
RT	5		1		6

1986 THM 400 CLUTCH PLATE APPLICATION CHART
INTERMEDIATE CLUTCH

MODELS	NO. OF FLAT STEEL PLATES	NO. OF WAVED STEEL PLATES	NO. OF COMPOSITION PLATES
THICKNESS	2.51 MM (.099″)	1.74 MM (.0685″)	
EV, FG, FI, FS, HR, MA RV, ZD, ZV	3		3
ALL OTHERS	2	1	3

B-08647

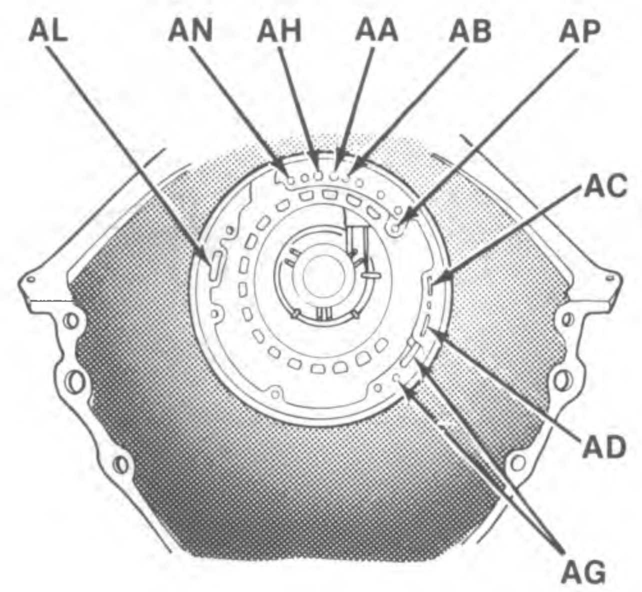
Figure 47—THM 400 Clutch Usage Chart



AA. Drive
AB. Modulator Or Intermediate
AC. To Cooler
AD. From Cooler
AE. Breather
AF. Lubrication
AG. Vent
AH. Line
AJ. Pressure Regulator Feed
AK. Converter
AL. Intake
AM. Exhaust
AN. Reverse

B-08635

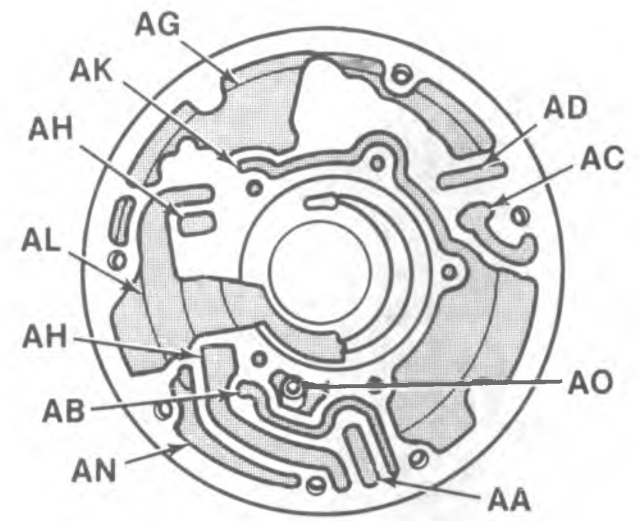
Figure 48—THM 400 Pump Cover Oil Passages



AA. Drive
AB. Modulator Or Intermediate
AC. To Cooler
AD. From Cooler
AG. Vent
AH. Line
AL. Intake (Pump)
AN. Reverse
AP. Intermediate Clutch Cup Plug

B-08630

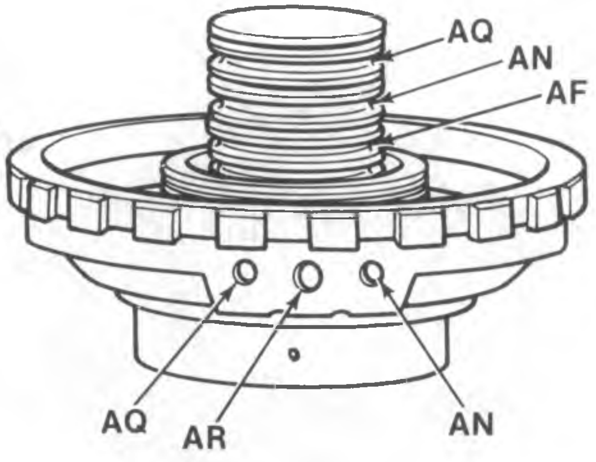
Figure 50—THM 400 Case Oil Passages



AA. Drive
AB. Modulator Or Intermediate
AC. To Cooler
AD. From Cooler
AG. Vent
AH. Line
AK. Converter
AL. Intake
AN. Reverse
AO. Seal Drain Back Hole

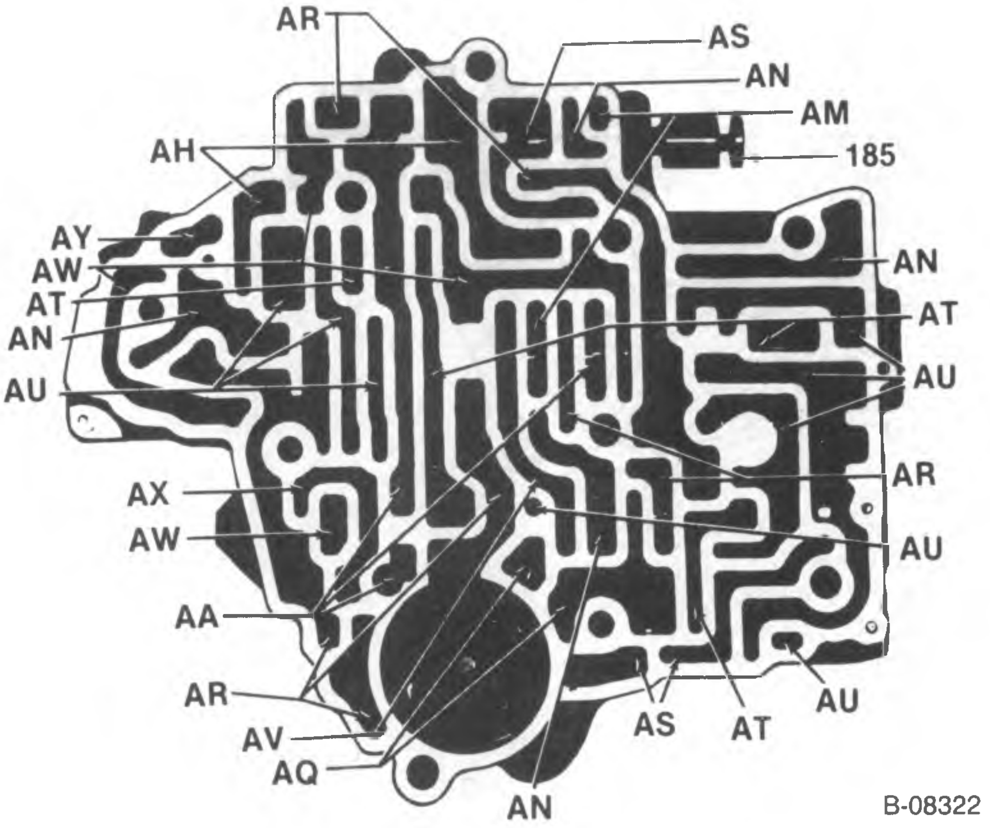
B-08641

Figure 49—THM 400 Pump Body Oil Passages



AF. Lubrication
AN. Reverse
AQ. Direct Clutch
AR. Intermediate

Figure 51—THM 400 Center Support Oil Passages



AA. Drive
AH. Line
AM. Exhaust
AN. Reverse
AQ. Direct Clutch
AR. Intermediate
AS. Servo
AT. Detent
AU. Modulator
AV. Governor
AW. Lo
AX. 1-2 Accumulator
AY. Void
185. Manual Valve

Figure 52—THM 400 Valve Body Oil Passages

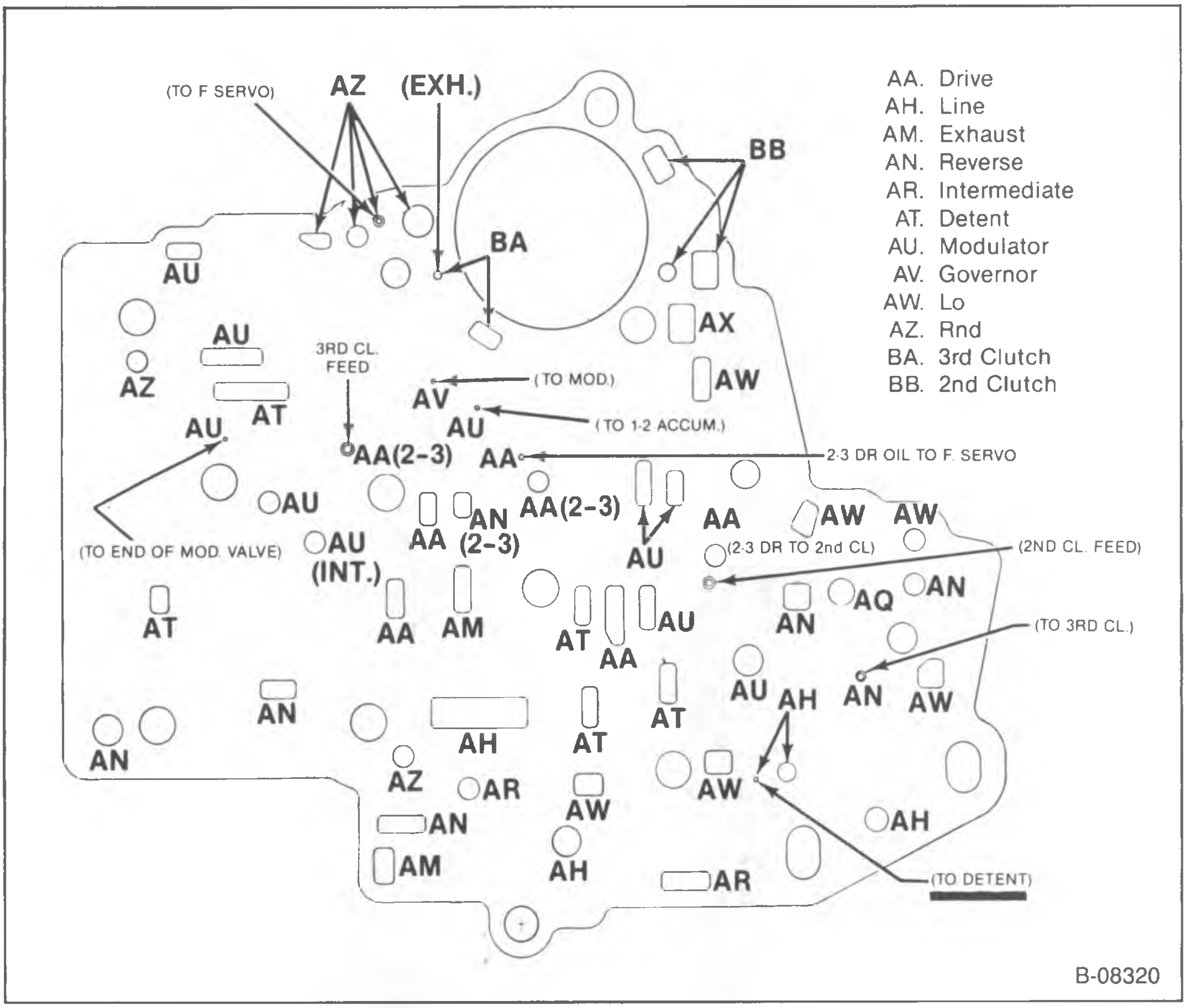
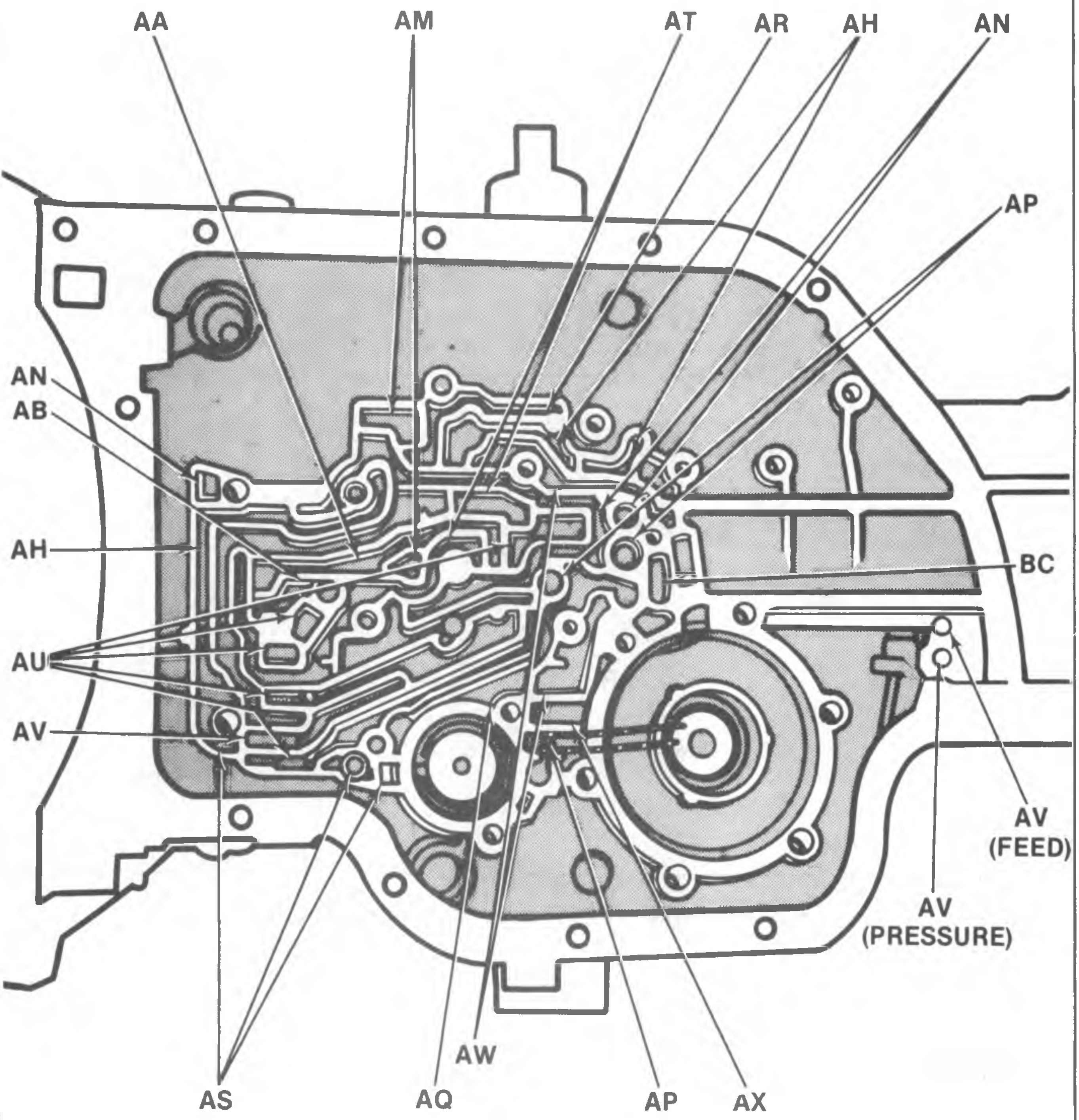


Figure 53—THM 400 Valve Body Spacer Plate (Typical)



AA.	Drive	AS.	Servo
AB.	Modulator or Intermediate	AT.	Detent
AH.	Line	AU.	Modulator
AM.	Exhaust	AV.	Governor
AN.	Reverse	AW.	Lo
AP.	Intermediate Clutch	AX.	1-2 Accumulator
AQ.	Direct Clutch	BC.	Reverse or Lo
AR.	Intermediate		

B-08323

Figure 54—THM 400 Case Oil Passages — Bottom View

THM 700-R4 PRELIMINARY CHECKING

- CHECK TRANSMISSION OIL LEVEL
- CHECK AND ADJUST T V CABLE
- CHECK OUTSIDE MANUAL LINKAGE AND CORRECT
- CHECK ENGINE TUNE
- INSTALL OIL PRESSURE GAGE (FIGURE 57)
- CONNECT TACHOMETER TO ENGINE
- CHECK OIL PRESSURE AS FOLLOWS:

***NOTICE** Total running time for this combination not to exceed 2 minutes.

CAUTION Brakes must be applied at all times.

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.

AUTOMATIC TRANSMISSION OIL PRESSURES

RANGE	MODEL	NORMAL OIL PRESSURE AT MINIMUM T.V.		NORMAL OIL PRESSURE AT FULL T.V.	
		kPa	PSI	kPa	PSI
PARK, NEUTRAL, OVERDRIVE & MANUAL 3RD @ 1000 RPM	YC	384-443	56-64	1019-1387	148-201
	YT, YX	451-514	65-75	945-1253	137-182
	YA, YD, YK, YL, YN, YP, YR, YS, YW, YZ	384-443	56-64	878-1182	127-171
	MH, TN, TR	451-514	65-75	885-1175	128-170
	FA, MA, MC, MD, MF, MK, MM, MP, MR, MT, MW, MX, PL, PR, TA, TB, TC, TD, TF, TJ, TK, TS, TW, YF	451-514	65-75	885-1175	128-170
REVERSE @ 1000 RPM *@ 2000 RPM	YC	631-728	92-106	*1674-2278	243-330
	YT, YX	740-845	107-123	*1552-2058	225-298
	YA, YD, YK, YL, YN, YP, YR, YS, YW, YZ	631-728	92-106	*1443-1942	209-282
	MH, TN, TR	740-845	107-123	*1453-1929	211-280
	FA, MA, MC, MD, MF, MK, MM, MP, MR, MT, MW, MX, PL, PR, TA, TB, TC, TD, TF, TJ, TK, TS, TW, YF	740-845	107-123	*1454-1930	211-280
MANUAL 2ND & MANUAL LO @ 1000 RPM	YC	704-813	102-118	704-813	102-118
	YT, YX	709-808	103-117	709-808	103-117
	YA, YD, YK, YL, YN, YP, YR, YS, YW, YZ	704-813	102-118	704-813	102-118
	MH, TN, TR	644-734	93-106	644-734	93-106
	FA, MA, MC, MD, MF, MK, MM, MP, MR, MT, MW, MX, PL, PR, TA, TB, TC, TD, TF, TJ, TK, TS, TW, YF	709-808	103-117	709-808	103-117

Line pressure is basically controlled by pump output and the pressure regulator valve. In addition, line pressure is boosted in Reverse, Second and Lo by the reverse boost valve.

Also, in the Neutral, Drive, Intermediate and Reverse positions of the selector lever, the line pressure should increase with throttle opening because of the T V system. The pressure is controlled by the T V cable, the throttle lever and bracket assembly and the T V link, as well as the control valve assembly.

The main line pressure tap plug is located on the left side of the transmission above the outside manual lever.

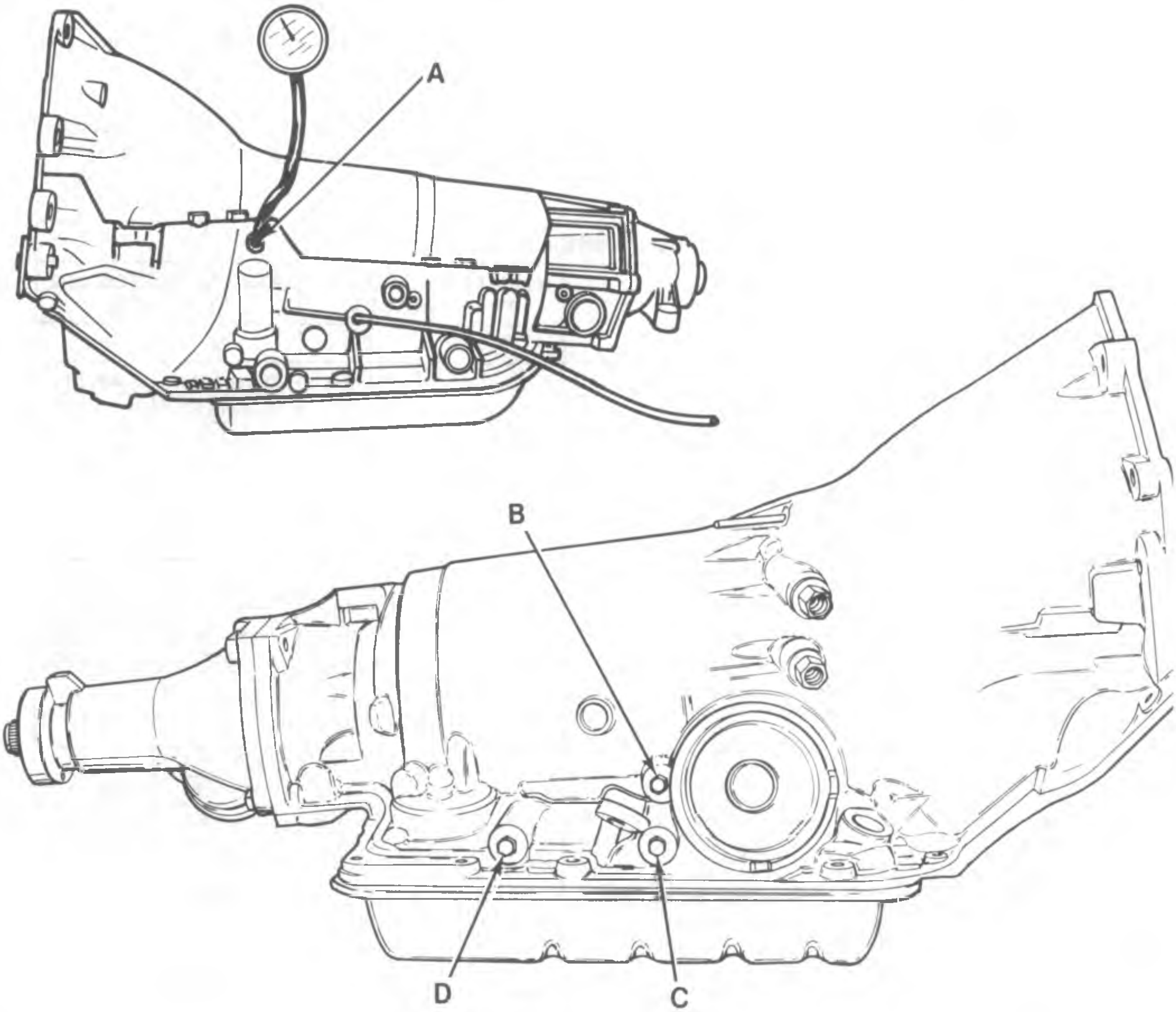
B-08640

Figure 55—Oil Pressure Check Procedure

DIAGNOSIS OF THM 700-R4

IMPORTANT

As a diagnosis aid, you can check the oil pressure differential between line pressure and the 2nd, 3rd, and 4th clutch pressure while driving the vehicle. If the pressure differential between line pressure and any of the clutch circuits is more than 10 P.S.I. (provided your gages are accurate), there is a possible leak in that clutch oil circuit.



A. Line Pressure
B. Third Pressure
C. Fourth Pressure
D. Second Pressure

B-08331

Figure 56—THM 700-R4 Pressure Tap Locations

DIAGNOSIS OF THM 700-R4

PROBLEM	INSPECT COMPONENT	FOR CAUSE
Oil Pressure High Or Low (Check With Gage - Check Oil Level & Engine Tune)	1. Oil pump assembly.	1. a. Pressure regulator valve stuck. b. Pressure regulator valve spring damaged. c. Rotor guide missing or misassembled. d. Rotor cracked or broken. e. TV valve, reverse boost valve or bushing stuck, damaged or incorrectly assembled. f. Orifice hole in pressure regulator valve plugged. g. Sticking slide or excessive rotor clearance. h. Pressure relief ball not seated or damaged. j. Porosity in pump cover or body. k. Wrong pump cover. l. Pump faces not flat.
	2. Oil filter.	2. a. Intake pipe restricted by casting flash. b. Cracks in filter body or intake pipe. c. Seal missing, cut or damaged.
	3. TV exhaust ball.	3. Stuck or damaged.
	4. Throttle lever and bracket assembly.	4. Misassembled, binding or damaged.
	5. Throttle link.	5. Misassembled, binding or damaged.
	6. Valve body.	6. a. Manual valve scored or damaged. b. Spacer plate or gaskets incorrect, misassembled or damaged. c. Face not flat. d. Throttle valve sticking. e. Throttle valve sleeve rotated in bore or retaining pin not seated. f. TV limit valve sticking. g. Modulated downshift valve stuck. h. Line bias valve stuck. j. 2-3 shift valve stuck. k. Check balls missing or misassembled.
	7. Case.	7. Case to valve body face not flat.
High Or Low Shift Points	1. TV cable.	1. Binding or not correctly adjusted.
	2. TV exhaust ball.	2. Stuck or damaged.
	3. Throttle lever and bracket assembly.	3. Misassembled, binding or damaged.
	4. Oil pump assembly.	4. a. Stuck pressure regulator valve or TV boost valve. b. Sticking pump slide.
	5. Valve body assembly.	5. a. Sticking throttle valve or plunger. b. Modulated TV up or down valves sticking. c. TV limit valve sticking. d. Spacer plate or gaskets misassembled, damaged or incorrect.

DIAGNOSIS OF THM 700-R4 (CONT.)

PROBLEM	INSPECT COMPONENT	FOR CAUSE
1st Gear Range Only — No Upshift	1. Governor assembly.	1. a. Governor valve sticking. b. Governor driven gear loose or damaged. c. Governor driven gear retaining pin missing. d. Nicks or burrs on output shaft. e. Nicks or burrs on governor sleeve or case bore. f. Governor support pin in case too long or short. g. Governor weights or springs missing binding or damaged.
	2. Valve body.	2. a. 1-2 shift valve sticking. b. Spacer plate or gaskets mispositioned or damaged.
	3. Case.	3. a. Case to valve body face not flat or damaged. b. Governor screen restricted or damaged.
	4. 2-4 servo assembly.	4. a. Restricted or blocked apply passages in case. b. Nicks or burrs on servo pin or pin bore in case. c. Missing or damaged piston or pin seals. d. 4th servo piston in backwards.
	5. 2-4 band assembly.	5. a. 2-4 band worn or damaged. b. Band anchor pin not engaged.
Slips In 1st Gear	1. Forward clutch assembly.	1. a. Clutch plates worn. b. Porosity or damage in forward clutch piston. c. Forward clutch piston inner and outer seals missing, cut or damaged. d. Input housing to forward clutch housing seal missing, cut or damaged. e. Damaged forward clutch housing. f. Forward clutch housing retainer and ball assembly not sealing or damaged.
	2. Input housing and shaft assembly.	2. Turbine shaft seals missing, cut or damaged.
	3. Valve body.	3. a. Accumulator valve stuck. b. Face not flat, damaged lands or interconnected passages. c. Spacer plate or gaskets incorrect, mispositioned or damaged.
	4. TV cable.	4. Binding or broken.

DIAGNOSIS OF THM 700-R4 (CONT.)

PROBLEM	INSPECT COMPONENT	FOR CAUSE
Slips In 1st Gear (Continued)	5. 1-2 accumulator piston assembly.	5. a. Porosity in piston or 1-2 accumulator cover and pin assembly. b. Damaged ring grooves on piston. c. Piston seal missing, cut or damaged. d. 1-2 accumulator cover gasket missing or damaged. e. Leak between piston and pin. f. Broken 1-2 accumulator spring.
	6. Oil pressure.	6. Refer to Causes of High or Low Oil Pressure.
	7. 2-4 servo assembly.	7. 4th servo piston in backwards.
1-2 Shift Speed — High Or Low	1. TV cable.	1. a. Binding or broken. b. Not correctly adjusted.
	2. Governor assembly.	2. Refer to 1st Gear Range Only — No Upshift.
	3. Throttle lever and bracket assembly.	3. a. Misassembled, binding or damaged. b. TV link missing, binding or damaged.
	4. Valve body.	4. a. TV exhaust check ball stuck. b. TV plunger sticking. c. Face not flat.
	5. Oil pump assembly or case.	5. Face not flat.
Slipping Or rough 1-2 Shift	1. Throttle lever and bracket assembly.	1. a. Incorrectly installed or damaged. b. TV cable broken or binding.
	2. Valve body assembly.	2. a. Throttle valve sticking. b. TV bushing turned in its bore. c. 1-2 shift valve train stuck. d. Gaskets or spacer plate incorrect, mispositioned or damaged. e. Line bias valve stuck. f. Accumulator valve stuck. g. TV limit valve stuck. h. Face not flat.
	3. 2-4 servo assembly.	3. a. Apply pin too long or too short. b. Servo seals missing, cut or damaged. c. Restricted or missing oil passages. d. Servo bore in case damaged.
	4. 2nd Accumulator.	4. a. Porosity in 1-2 accumulator housing or piston. b. Piston seal or groove damaged. c. Nicks or burrs in 1-2 accumulator housing. d. Missing or restricted oil passage.
	5. 2-4 band.	5. Worn or mispositioned.
	6. Oil pump assembly or case.	6. Faces not flat.

DIAGNOSIS OF THM 700-R4 (CONT.)

CONDITION	INSPECT COMPONENT	FOR CAUSE
No 2-3 Shift Or 2-3 Shift Slipping, Rough Or Hunting	1. Converter.	1. Internal damage.
	2. Governor assembly.	2. a. Valve stuck. b. Drive gear retaining pin missing or loose. c. Governor weights binding. d. Governor drive gear damaged. e. Governor support pin in case too long or too short.
	3. Oil pump.	3. Stator shaft sleeve scored or off location.
	4. Valve body.	4. a. 2-3 valve train stuck. b. Accumulator valve stuck. c. Spacer plate or gaskets incorrect, mispositioned or damaged. d. Throttle valve stuck. e. TV limit valve stuck.
	5. Input housing assembly.	5. a. Clutch plates worn (3-4 or forward). b. Excessive clutch plate travel. c. Cut or damaged piston seals (3-4 or forward). d. Porosity in 3-4 clutch housing or piston. e. 3-4 piston check ball stuck, damaged or not sealing. f. Restricted apply passages. g. Forward clutch piston retainer and ball assembly not seating. h. Sealing balls loose or missing.
	6. Case.	6. 3rd accumulator retainer and ball assembly not seating.
	7. 2-4 servo assembly.	7. a. 2nd apply piston seals missing, cut or damaged. b. Servo pin seals missing, cut or damaged.
No. 3-4 Shift/Slipping Or Rough 3-4 Shift	1. Governor.	1. a. Governor weights binding. b. Governor valve stuck. c. Governor drive gear retaining pin missing or loose. d. Governor drive gear damaged. e. Governor support pin in case too long or too short.
	2. Oil pump assembly.	2. a. Faces not flat. b. Pump cover retainer and ball assembly missing or damaged.

DIAGNOSIS OF THM 700-R4 (CONT.)

PROBLEM	INSPECT COMPONENT	FOR CAUSE
No 3-4 Shift/Slipping Or Rough 3-4 Shift (Continued)	3. Valve body assembly.	3. a. Valves stuck. –2-3 shift valve train. –Accumulator valve. –Throttle valve. –TV limit valve. –1-2 shift valve train. –3-2 control valve. b. Manual valve link bent or damaged. c. Spacer plates or gaskets incorrect, mispositioned or damaged.
	4. 2-4 servo assembly.	4. a. Incorrect band apply pin. b. Missing or damaged servo seals. c. Porosity in pistons, cover or case. d. Damaged piston seal grooves. e. Plugged or missing orifice cup plug.
	5. Case.	5. a. 3rd accumulator retainer and ball assembly leaking. b. Porosity in 3-4 accumulator piston or bore. c. 3-4 accumulator piston seal or seal grooves damaged. d. Plugged or missing orifice cup plug. e. Restricted oil passage.
	6. Input housing assembly.	6. Refer to Slipping 2-3 Shift.
	7. 2-4 band assembly.	7. Worn or misassembled.
No Reverse Or Slips In Reverse	1. Input housing assembly.	1. a. 3-4 apply ring stuck in applied position. b. Forward clutch not releasing. c. Turbine shaft seals missing, cut or damaged.
	2. Manual linkage.	2. Not adjusted.
	3. Oil pump assembly.	3. a. Retainer and ball assembly missing or damaged. b. Stator shaft seal rings or ring grooves damaged. c. Stator shaft sleeve scored or damaged. d. Reverse boost valve stuck, damaged or misassembled. e. Cup plug missing. f. Restricted oil passage. g. Faces not flat. h. Converter clutch apply valve stuck.
	4. Valve body assembly.	4. a. 2-3 shift valve stuck. b. Manual linkage not adjusted. c. Spacer plate and gaskets incorrect, mispositioned or damaged.

DIAGNOSIS OF THM 700-R4 (CONT.)

PROBLEM	INSPECT COMPONENT	FOR CAUSE
No Reverse Or Slips In Reverse (Continued)	5. Reverse input clutch.	5. a. Clutch plates worn. b. Reverse input housing and drum assembly cracked at weld. c. Clutch plate retaining ring out of groove. d. Return spring assembly retaining ring out of groove. e. Piston deformed or dished. f. Seals cut or damaged. g. Reatiner and ball assembly not sealing. h. Restricted apply passage.
	6. Lo and reverse clutch.	6. a. Clutch plates worn. b. Clutch plate retaining ring mispositioned. c. Porosity in piston. d. Seals damaged. e. Return spring assembly retaining ring mispositioned. f. Restricted apply passage.
	7. Case.	7. a. Cover plate gasket missing or damaged. b. Cover plate not torqued correctly. c. Porosity.
No Part Throttle Or Delayed Downshifts	1. External linkage.	1. Not adjusted.
	2. 2-4 servo assembly.	2. a. Apply pin seal cut or damaged. b. Servo cover retaining ring missing or misassembled. c. 4th apply piston damaged or misassembled. d. Servo inner housing damaged or misassembled.
	3. Governor assembly.	3. a. Governor weights binding. b. Governor valve stuck.
	4. Valve body assembly.	4. a. Valves stuck. –Throttle valve. –3-2 control valve. –TV modulated downshift. b. TV sleeve turned in bore. c. 4-3 sequence valve body channel blocked. d. #5 check ball missing from valve body.
No Overrun Braking — Manual 3-2-1	1. External linkage.	1. Not adjusted properly.
	2. Valve body assembly.	2. a. Valves stuck. –4-3 sequence valve. –Throttle valve. b. Check ball #3 mispositioned. c. Spacer plate and gaskets incorrect, damaged or mispositioned.

DIAGNOSIS OF THM 700-R4 (CONT.)

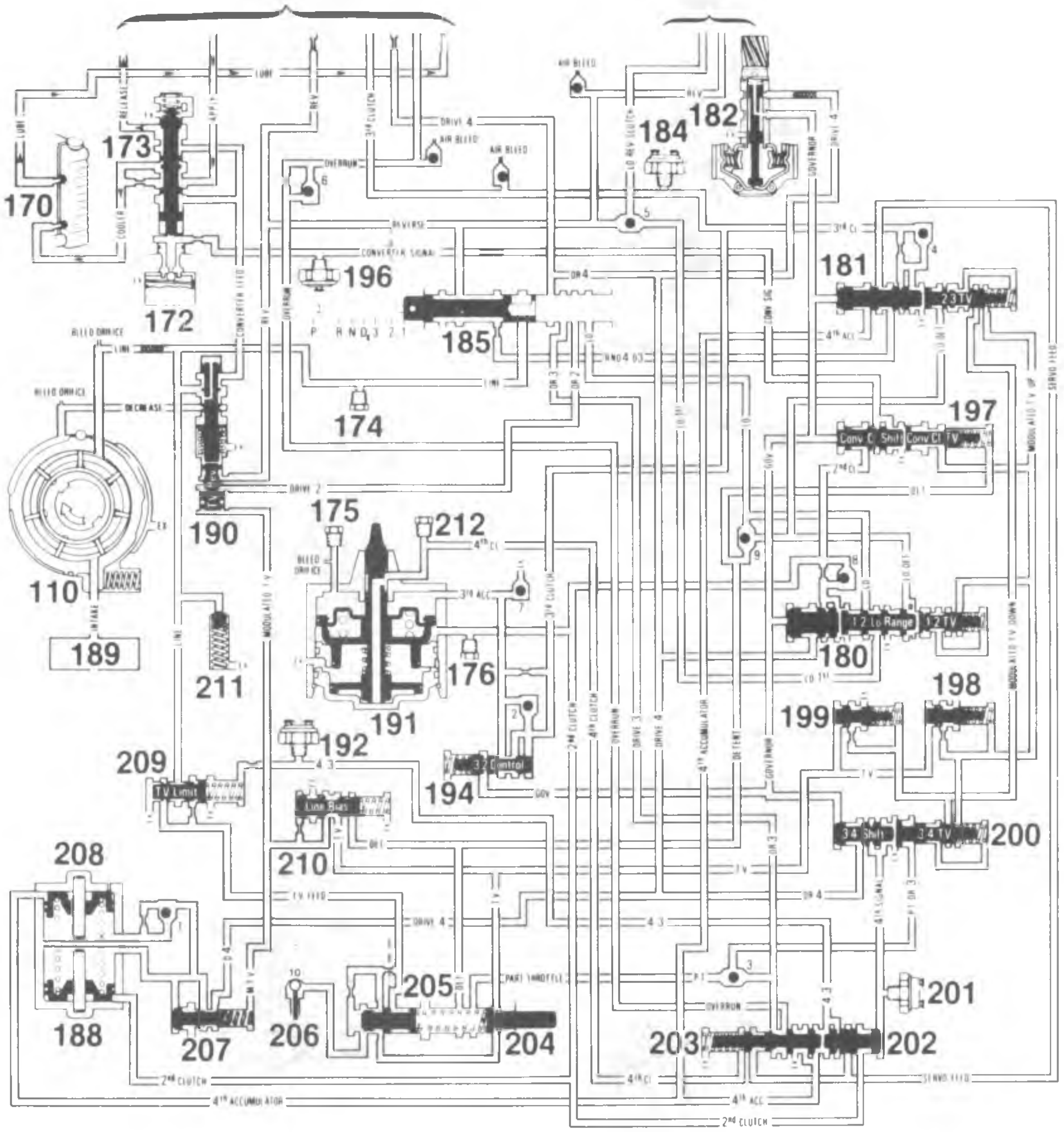
PROBLEM	INSPECT COMPONENT	FOR CAUSE
No Overrun Braking — Manual 3-2-1 (Continued)	3. Input clutch assembly.	3. a. Turbine shaft oil passages plugged or not drilled. b. Turbine shaft seal rings damaged. c. Turbine shaft sealing balls loose or missing. d. Porosity in forward or overrun clutch position. e. Overrun piston seals cut or damaged. f. Overrun piston check ball not sealing.
No Converter Clutch Apply	1. Electrical.	1. a. 12 volts not supplied to transmission. b. Outside electrical connector damaged. c. Inside electrical connector, wiring harness or solenoid damaged. d. Electrical short (pinched solenoid wire). e. Solenoid not grounded. f. Incorrect or damaged pressure switches.
	2. Converter.	2. Internal damage.
	3. Oil pump assembly.	3. a. Converter clutch apply valve stuck or assembled backwards. b. Converter clutch apply valve retaining ring mispositioned. c. Pump to case gasket mispositioned. d. Orifice cup plug plugged. e. Solenoid "O" ring seal cut or damaged. f. Orifice cup plug omitted from cooler in passage. g. High or uneven bolt torque (pump body to cover).
	4. Valve body assembly.	4. Valves stuck. –Converter clutch shift valve. –Throttle valve.
	5. Input housing and shaft.	5. a. Turbine shaft "O" ring seal cut or damaged. b. Turbine shaft retainer and ball assembly plugged.
Converter Shudder	1. Torque converter assembly.	1. Internal damage.
	2. Valve body.	2. Converter clutch shift valve stuck.
	3. Oil pump assembly.	3. a. Converter clutch apply valve stuck. b. Restricted oil passage.
	4. Oil filter.	4. a. Crack in filter body. b. Flash restricting filter neck. c. Seal cut or damaged.

DIAGNOSIS OF THM 700-R4 (CONT.)

CONDITION	INSPECT COMPONENT	FOR CAUSE
Converter Shudder (Continued)	5. Miscellaneous. 6. Input housing and shaft assembly.	5. a. Low oil pressure. b. Engine not tuned properly. 6. a. Turbine shaft seal cut or damaged. b. Turbine shaft retainer and ball assembly damaged.
No Converter Clutch Release	1. Solenoid. 2. Converter. 3. Oil pump assembly.	1. External ground. 2. Internal damage. 3. Converter clutch apply valve stuck.
Drives In Neutral	1. Forward clutch. 2. Manual linkage. 3. Case.	1. Not releasing. 2. a. Incorrectly adjusted. b. Disconnected. 3. a. Face not flat. b. Internal leakage.
2nd Gear Start (Drive Range)	1. Governor assembly. 2. Forward sprag clutch.	1. a. Valve stuck. b. Governor support pin too long or missing. 2. Sprag assembly installed backwards.
No Park	1. Parking linkage.	1. a. Acutator rod assembly bent or damaged. b. Actuator rod spring binding or improperly crimped. c. Actuator rod not attached to inside detent lever. d. Parking bracket damaged or not torqued properly. e. Inside detent lever not torqued properly. f. Detent roller mispositioned or not torqued properly. g. Parking pawl binding or damaged.
Racheting Noise	Parking pawl.	Parking pawl return spring weak, damaged or misassembled.
Oil Out The Vent	1. Oil pump. 2. Valve body.	1. Chamfer in pump body rotor pocket too large. 2. TV lmiit valve stuck.
Vibration In Reverse And Whining Noise In Park	Oil pump.	Broken vane rings.

OIL AND WIRING CIRCUITS

TRANSMISSION TRANSMISSION



110. Oil Pump
170. Oil Cooler
172. TCC Solenoid
173. TCC Apply Valve
174. Line Pressure Tap
175. 3rd Accumulator Pressure Tap
176. 2nd Clutch Pressure Tap
180. 1-2 Shift Valve Train
181. 2-3 Shift Valve Train
182. Governor
184. 3rd Clutch Pressure Switch
185. Manual Valve
188. 1-2 Accumulator
189. Filter
190. Pressure Regulator
191. 2-4 Servo
192. 4-3 Downshift Switch
194. 3-2 Control Valve Train
196. TCC Signal Switch
197. TCC Shift Valve Train
198. MTV Up Valve Train
199. MTV Down Valve Train
200. 3-4 Shift Valve Train
201. 4th Clutch Pressure Switch
202. 3-4 Relay Valve
203. 4-3 Sequence Valve
204. TV Plunger
205. Throttle Valve (TV)
206. TV Exhaust Lifter
207. Accumulator Valve Train
208. 3-4 Accumulator
209. TV Limit Valve Train
210. Line Bias Valve Train
211. Pressure Relief Valve
212. 4th Clutch Pressure Tap
● Check Balls

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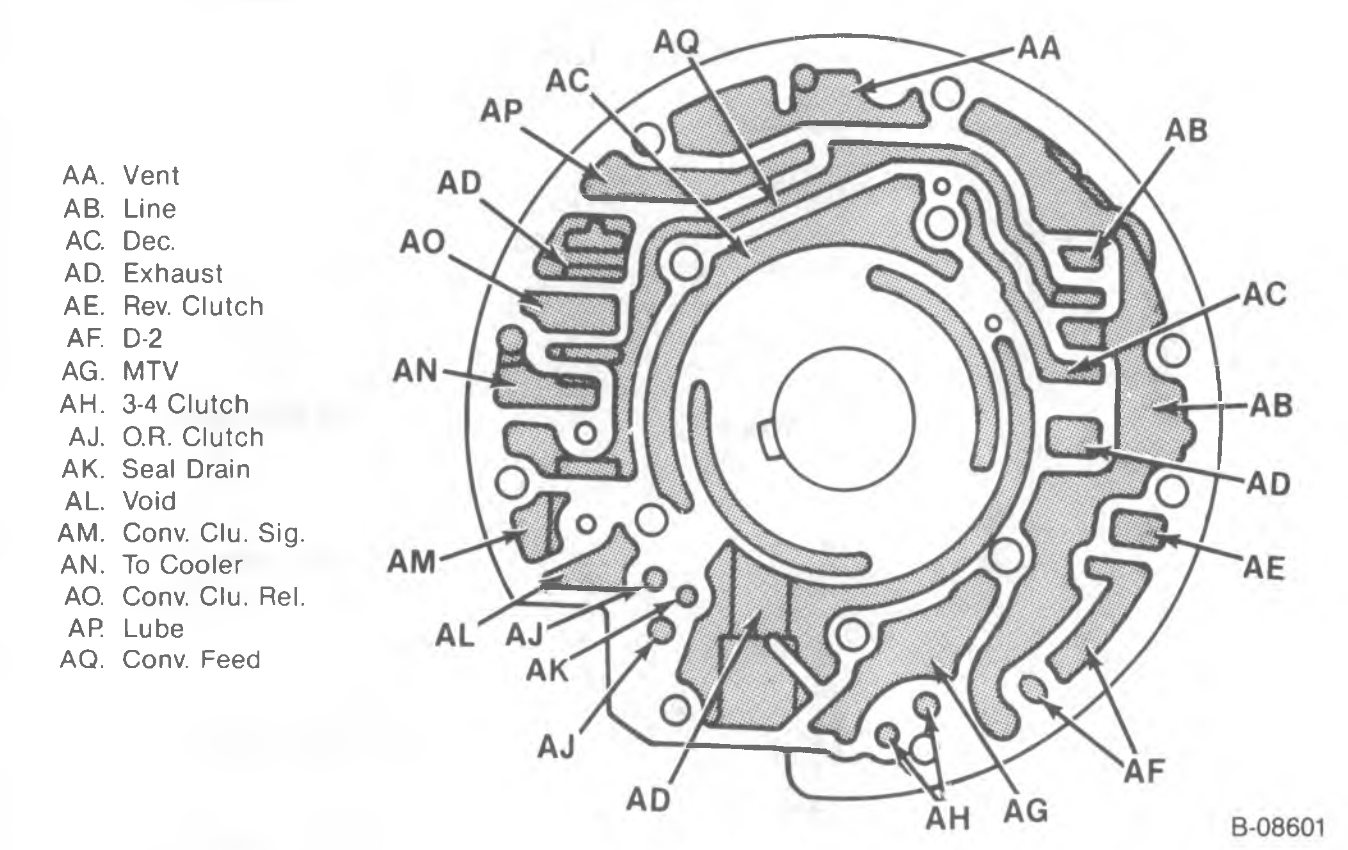
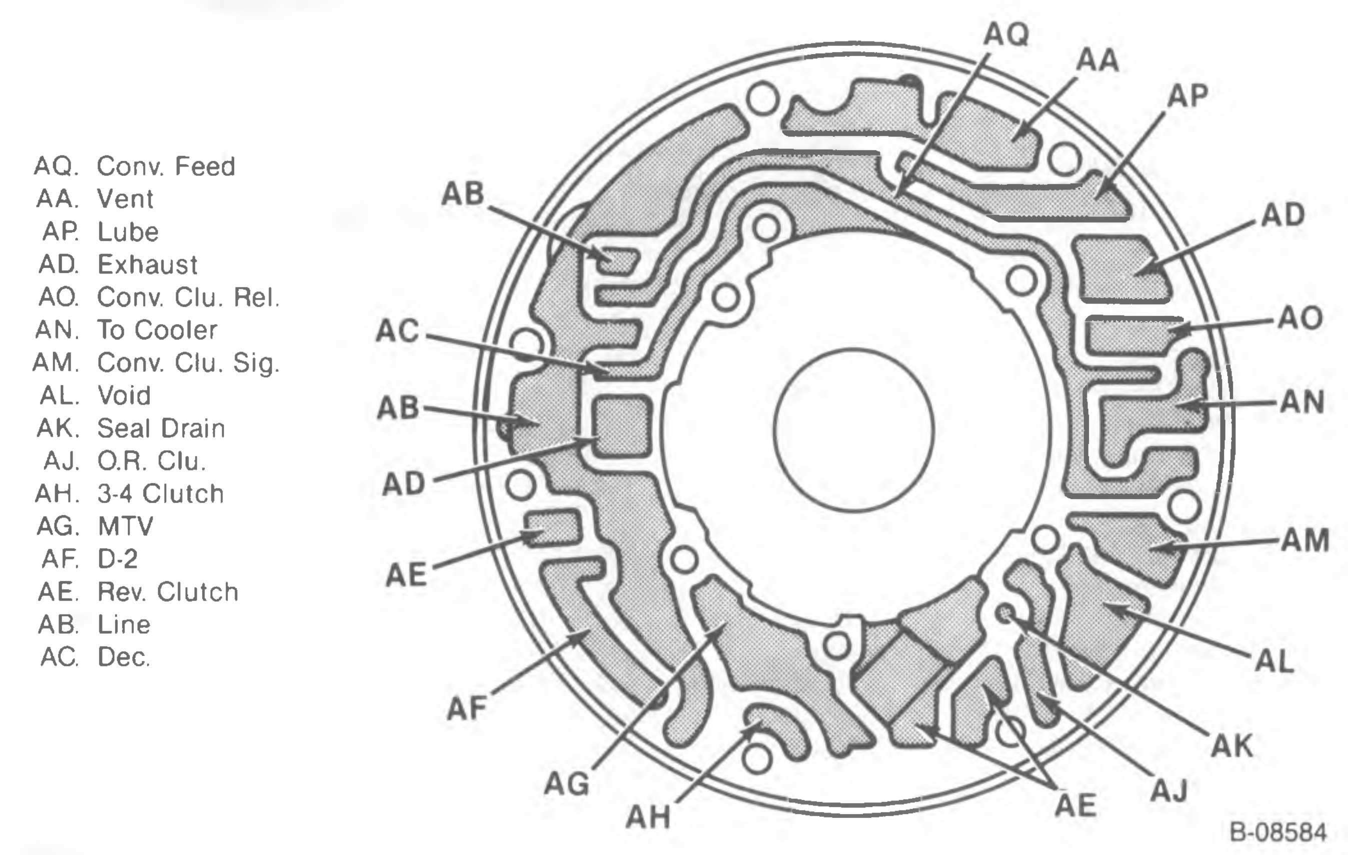
Figure 57—THM 700-R4 Oil Circuits



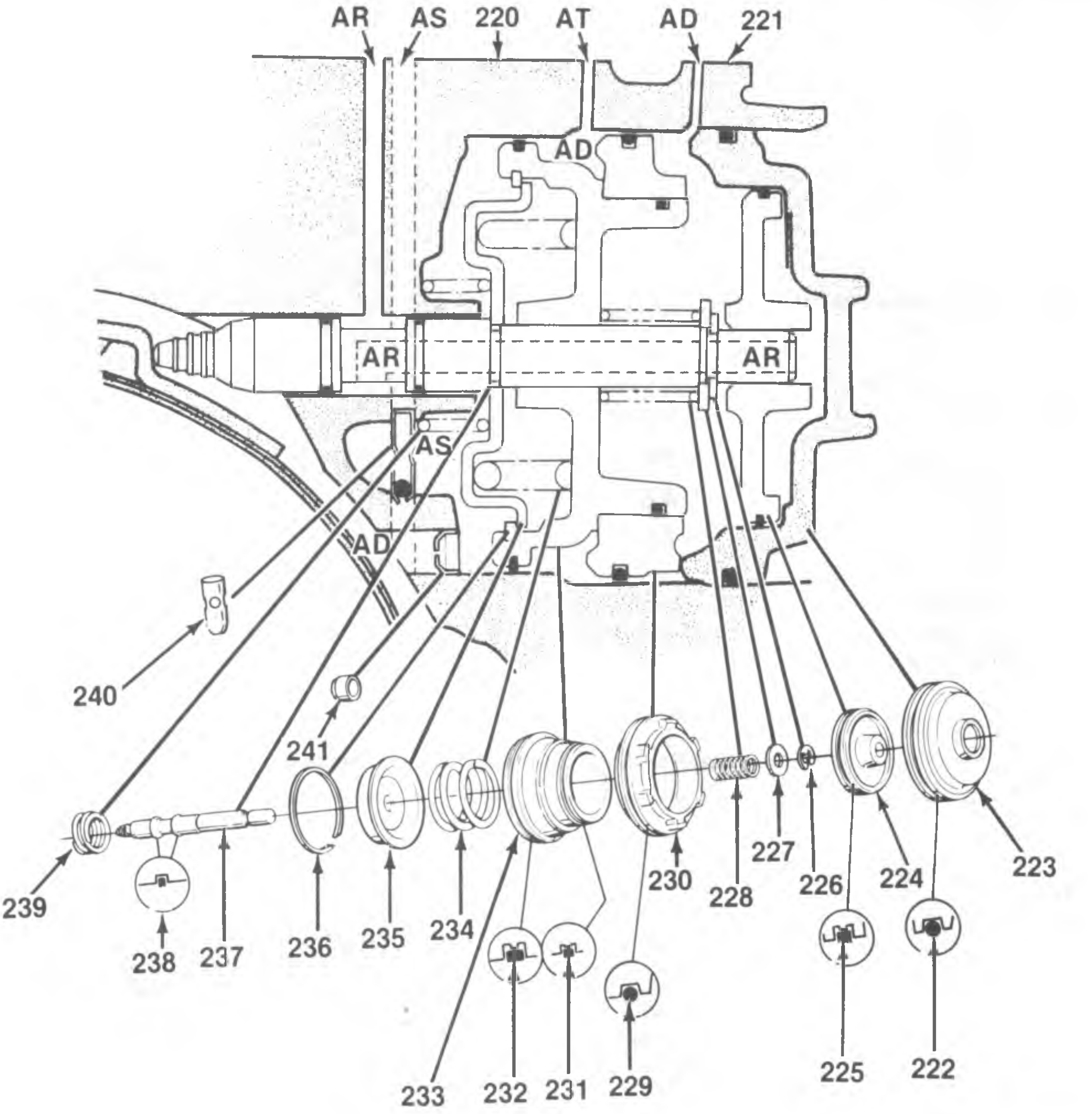
AA. Vent
AB. Line
AC. Dec.
AD. Exhaust
AE. Rev. Clutch
AF. D-2
AG. MTV
AH. 3-4 Clutch
AJ. O.R. Clutch
AK. Seal Drain
AL. Void
AM. Conv. Clu. Sig.
AN. To Cooler
AO. Conv. Clu. Rel.
AP. Lube
AQ. Conv. Feed

Figure 58—THM 700-R4 Pump Cover Oil Passages



AQ. Conv. Feed
AA. Vent
AP. Lube
AD. Exhaust
AO. Conv. Clu. Rel.
AN. To Cooler
AM. Conv. Clu. Sig.
AL. Void
AK. Seal Drain
AJ. O.R. Clu.
AH. 3-4 Clutch
AG. MTV
AF. D-2
AE. Rev. Clutch
AB. Line
AC. Dec.

Figure 59—THM 700-R4 Pump Body Oil Passages



AD. Exhaust
AR. 4th Oil
AS. 3rd Accumulator Oil
AT. 2nd Oil
220. Valve Body Face
221. Oil Pan Flange
222. Seal, "O" Ring (2-4 Servo Cover)
223. Cover, 2-4 Servo
224. Piston, 4th Supply
225. Ring, Oil Seal Outer (4th Apply Piston)
226. Ring, Retainer (Apply Pin)
227. Washer, Servo Apply Pin
228. Spring, Servo Apply Pin
229. Seal, "O" Ring
230. Housing, Servo Piston Inner
231. Ring, Oil Seal Inner (2nd Apply Piston)
232. Ring, Oil Seal Outer (2nd Apply Piston)
233. Piston, 2nd Apply
234. Spring, Servo Cushion
235. Retainer, Servo Cushion Spring
236. Ring, Retainer (2nd Apply Piston)
237. Pin, 2nd Apply Piston
238. Seal, 2nd Apply Piston Pin
239. Spring, Servo Return
240. Retainer & Ball Assembly, 3rd Accum.
241. Plug, Case Servo

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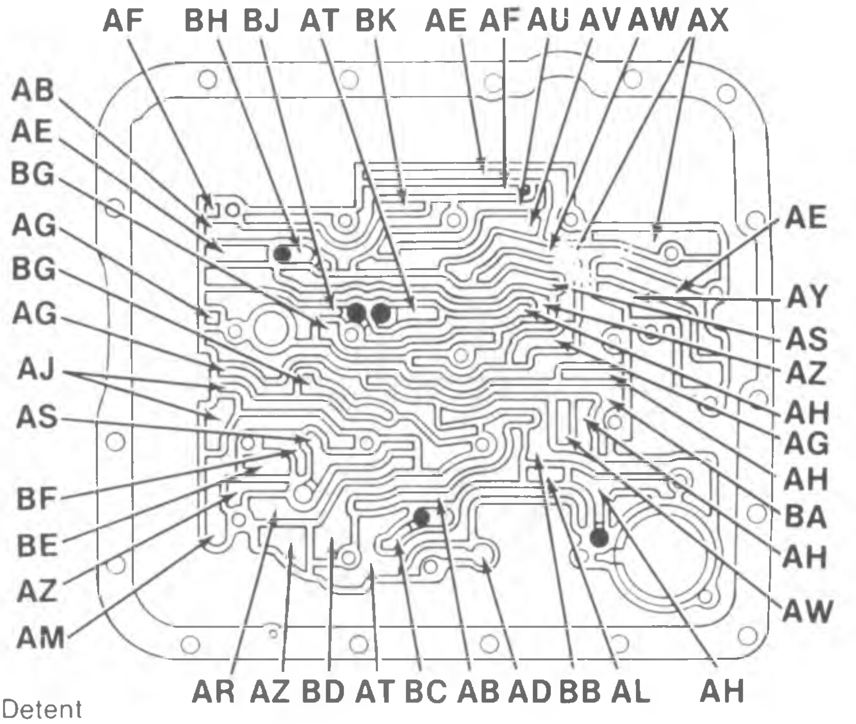
Figure 60—THM 700-R4 Servo Assembly



AE. Reverse
AF. D-2
AU. Lo
AV. Lo-1
AW. D-4
AX. Governor
AY. Lo Reverse
AS. 3 Accumulator
AZ. TV
AH. 3-4 Clutch
AG. MTV
AH. Accumulator (4th) •#1
BA. 4th Signal
AL. Void
BB. 3-4 Accumulator
AD. TV-Ex
AB. Line
BC. Part Throttle-Drive 3 •#3
AT. 2nd (1-2) •#8
BD. TVF
AR. 4th
AM. Conv. Clu. Sig.
BE. MTV Down
BF. MTV Up
AJ. O.R. Clutch

BG. Detent
BH. Det./Lo •#9
BJ. 3-4 Clutch (3-2 Ex.) •#10

BK. RND 4-3
• Check Balls

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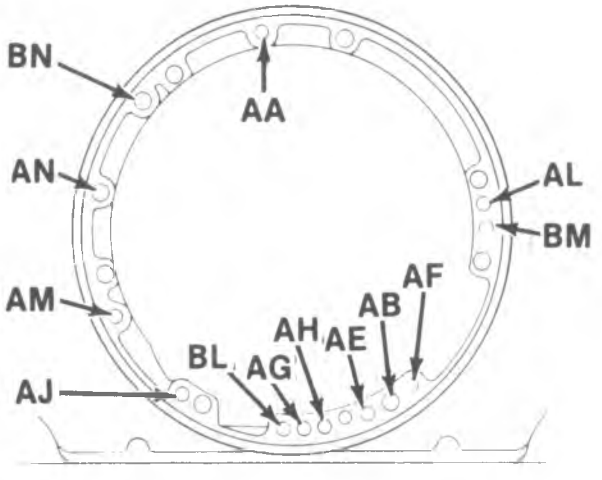
Figure 61—THM 700-R4 Chase Oil Passages And Check Ball Locations



BL. Fwd. Clutch
AG. MTV
AH. 3-4 Clutch
AE. Reverse
AB. Line
AF. D-2
BM. Pressure Tap

AL. Void
AA. Vent
BN. From Cooler
AN. To Cooler
AM. Conv. Clu. Sig.
AJ. O.R. Clutch

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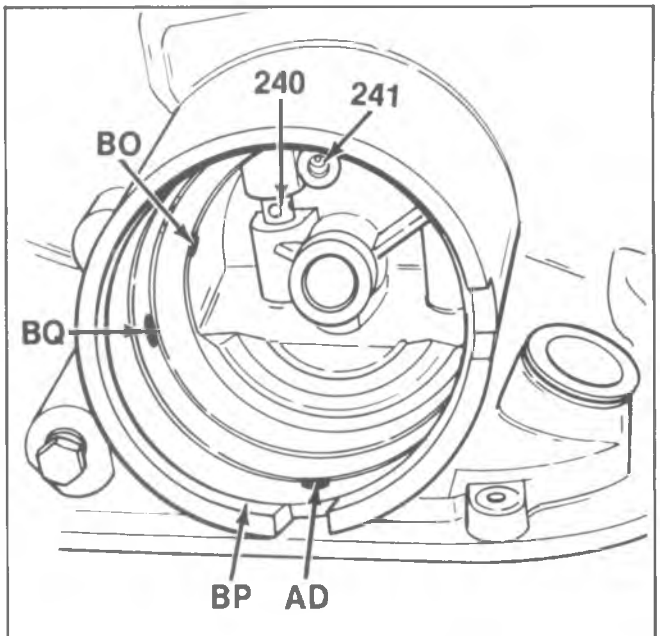
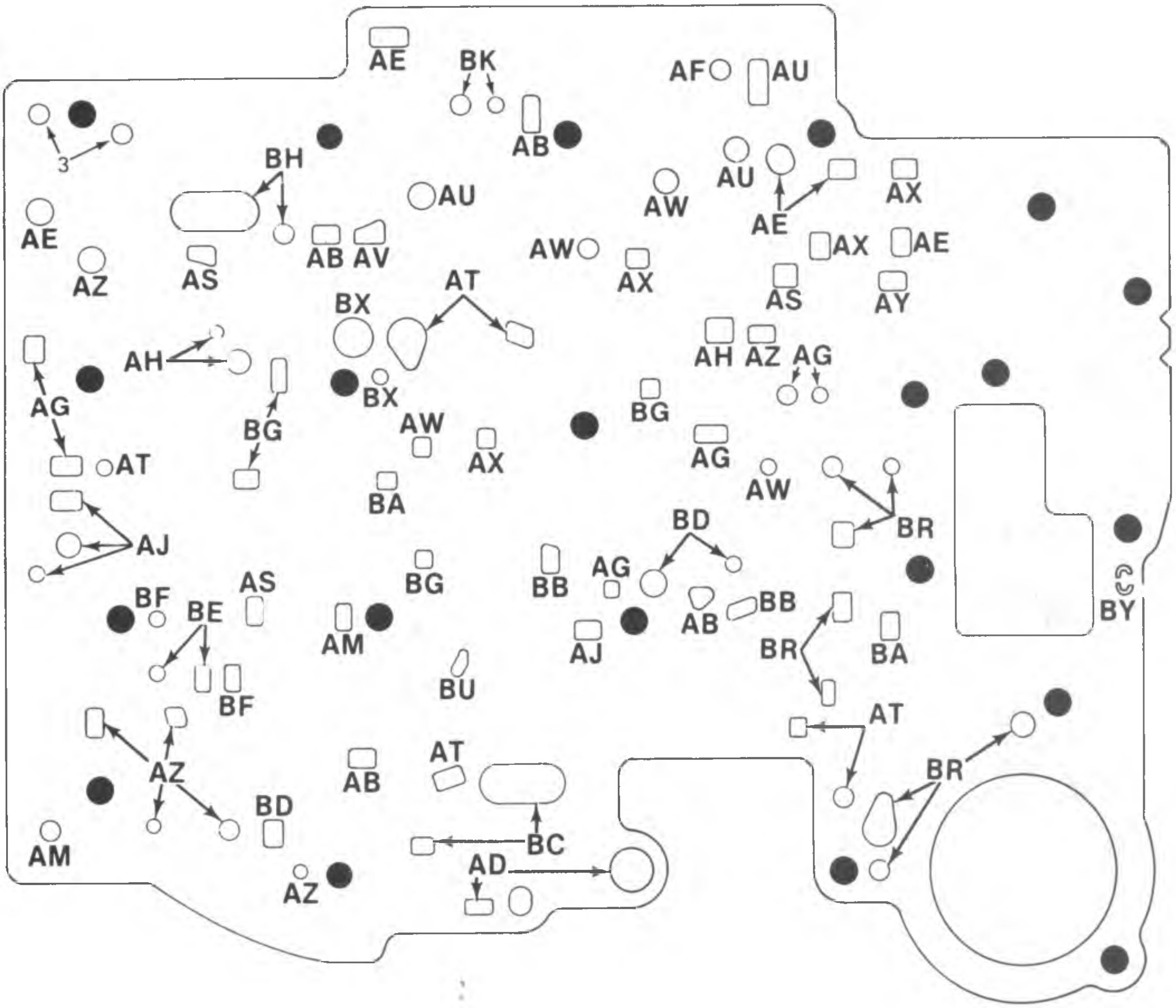
Figure 62—THM 700-R4 Pump To Case Oil Passages



AD. Servo Exhaust Hole
BO. 3rd Accumulator Pressure Tap Passage
BP. 2-4 Servo Bore
BQ. 2nd & 4th Band Apply Passage
240. Retainer & Ball Assembly, 3rd Accum.
241. Plug, Case Servo

B-08464

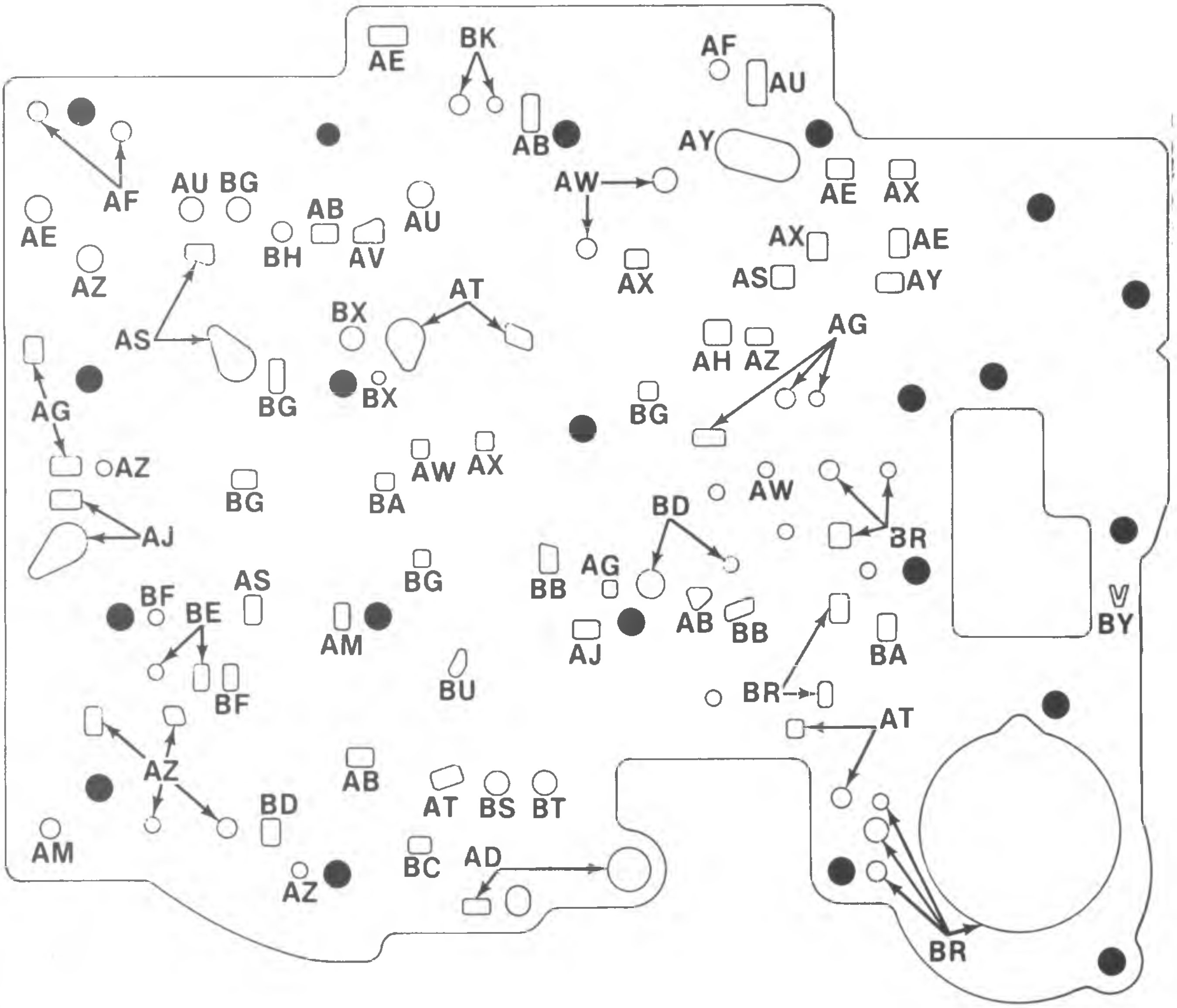
Figure 63—THM 700-R4 Servo Oil Passages



AB.	Line
AW.	D4
AE.	Reverse
AF.	D2
AU.	Lo
AV.	Lo-1
AX.	Governor
AY.	Lo/Reverse
AS.	3rd Accumulator
AZ.	TV
AG.	MTV
●	Bolt Holes
BR.	Accumulator
BA.	4th Signal
AT.	2nd Clutch
BB.	3-4 Accumulator
BD.	TVF
AJ.	Overrun Clutch
AD.	TV Ex.
BC.	DC3/Part Throttle
BS.	Part throttle
BT.	D3
BU.	4th Clutch
AM.	Conv. Clu. Sig.
BF.	MTV Up
BE.	MTV Down
BG.	Detent
AH.	3-4 Clutch
BH.	Detent/Lo
BK.	Rnd. 4-3
BX.	3rd Clutch
By.	Identification

B-08831

Figure 64—THM 700-R4 Spacer Plate To Case Gasket



AB. Line
AW. D4
AF. D2
AU. Lo
AE. Reverse
AX. Governor
AV. Lo-1
AY. Lo/Reverse
AS. 3rd Accumulator
AZ. TV
AG. MTV

● Bolt Holes
BR. Accumulator
BA. 4th Signal
AT. 2nd Clutch
BB. 3-4 Accumulator
BD. TVF
AJ. Overrun Clutch
AD. TV Ex.
BC. D3/Part Throttle
BS. Part Throttle
BT. D3

BU. 4th Clutch
AM. Conv. Clu. Sig.
BF. MTV Up
BE. MTV Down
BG. Detent
AH. 3-4 Clutch
BH. Detent/Lo
BK. RND. 4-3
BX. 3rd Clutch
BY. Identification

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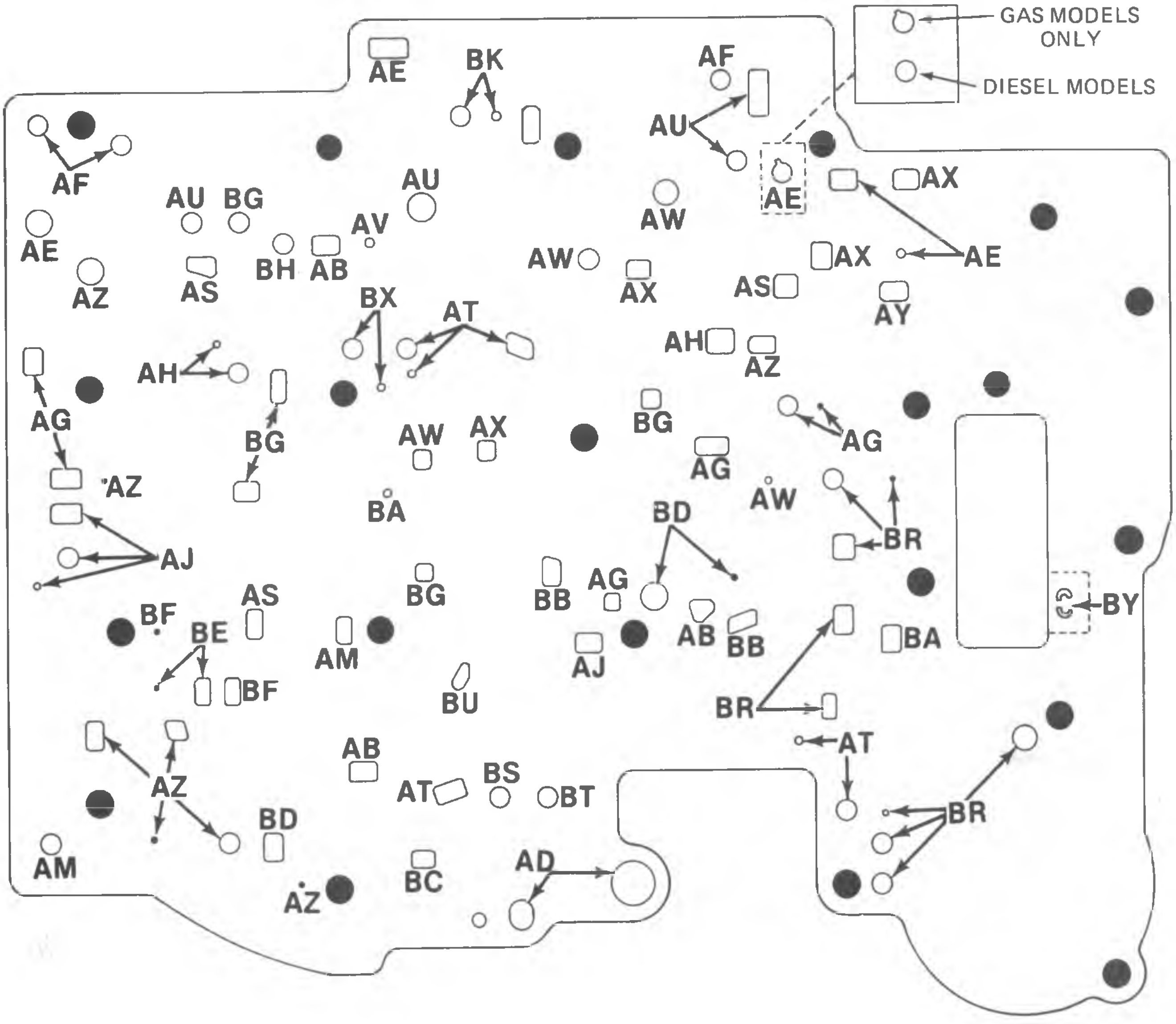
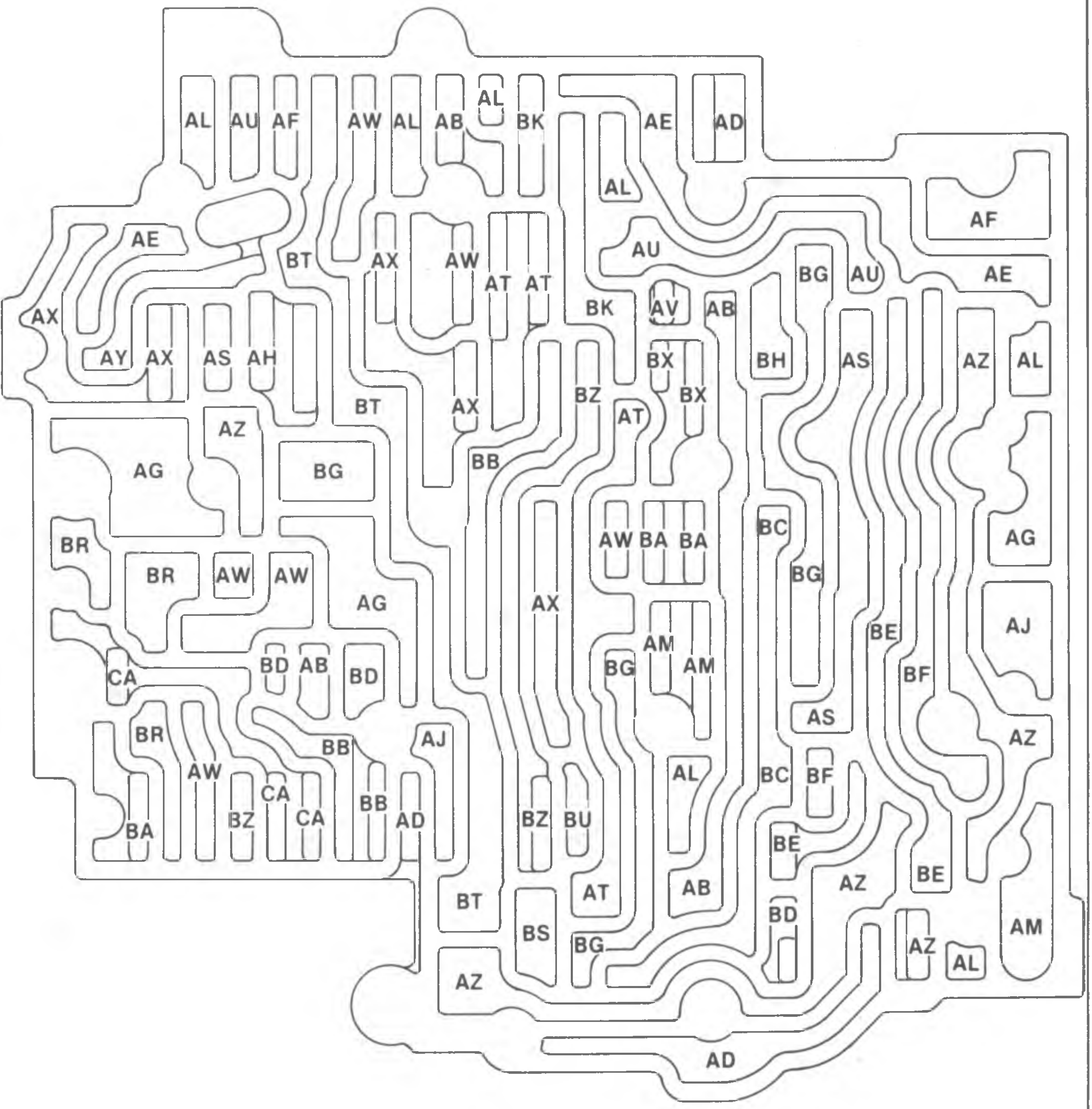
Figure 65—THM 700-R4 Spacer Plate To Valve Body Gasket



AB.	Line
AW.	D4
AF.	D2
AU.	Lo
AE.	Reverse
AX.	Governor
AV.	Lo-1
AY.	Lo/Reverse
AS.	3rd Accumulator
AZ.	TV
AG.	MTV
●	Bolt Holes
BR.	Accumulator
BA.	4th Signal
AT.	2nd Clutch
BB.	3-4 Accumulator
BD.	TVF
AJ.	Overrun clutch
AD.	TV Ex.
BC.	D3/Part Throttle
BS.	Part Throttle
BT.	D3
BU.	4th Clutch
AM.	Conv. Clu. Sign.
BF.	MTV Up
BE.	MTV Down
BG.	Detent
AH.	3-4 Clutch
BH.	Detent/Lo
BK.	RND. 4-3
BX.	3rd Clutch
BY.	Identification

F-00910

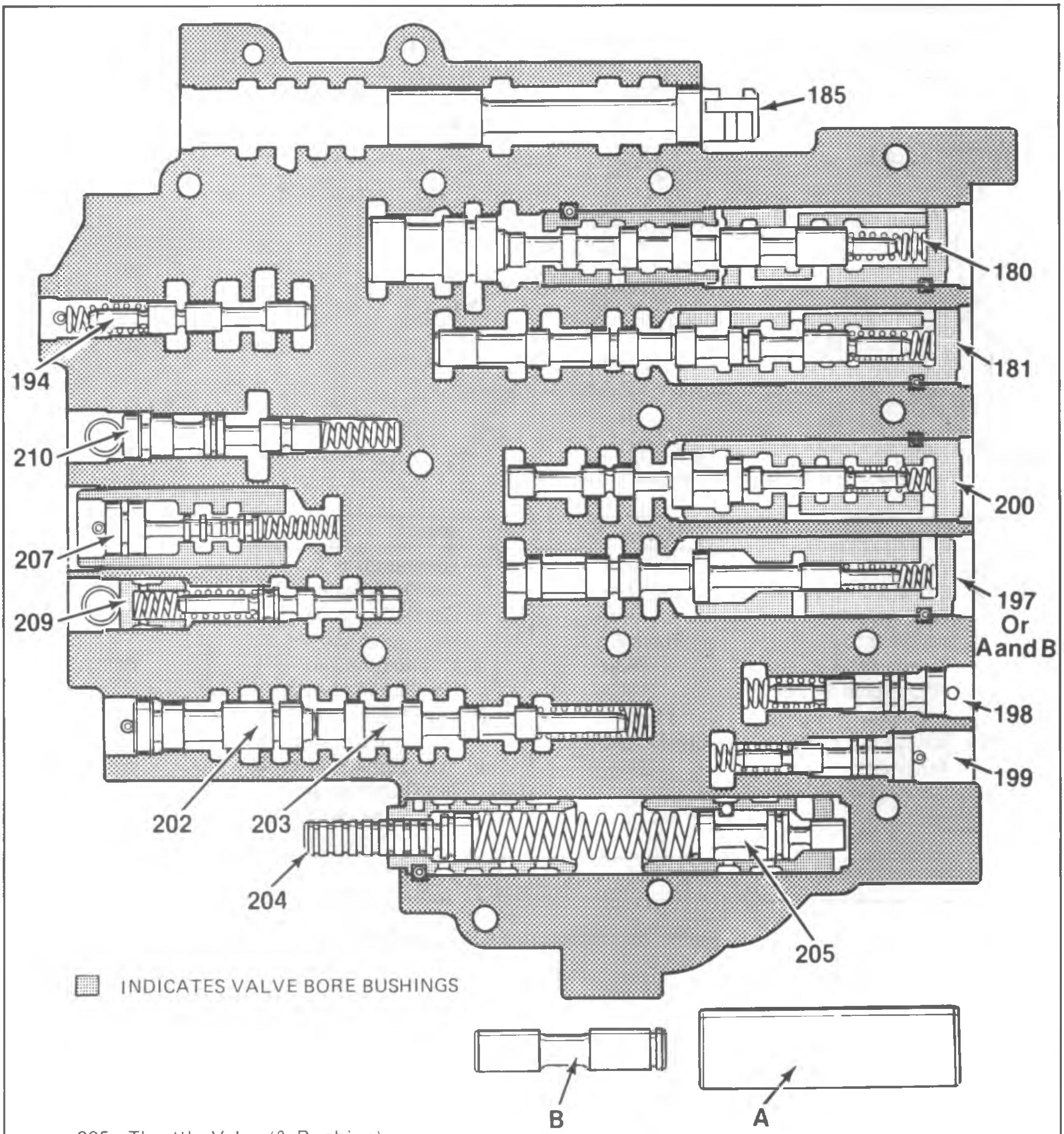
Figure 66—THM 700-R4 Typical Spacer Plate



AB.	Line	AZ.	TV	BC.	D3/Part Throttle	BH.	Detent/Lo
AW.	D4	AG.	MTV	BS.	Part Throttle	BK.	Rnd. 4-3
AF.	D2	BR.	Accumulator	BT.	D3	BX.	3rd clutch
AU.	Lo	BA.	4th Signal	BU.	4th Clutch	BY.	Identification
AE.	Reverse	AT.	2nd Clutch	AM.	Conv. Clu. Sig.	AL.	Void
AX.	Governor	BB.	3-4 Accumulator	BF.	MTV Up	AD.	Exhaust
AV.	Lo-1	BD.	TVF	BE.	MTV Down	BZ.	SF
AY.	Lo/Reverse	AJ.	Overrun Clutch	BG.	Detent	CA.	4-3
AS.	3rd Accumulator	AD.	TV Ex.	AH.	3-4 Clutch		

B-08520

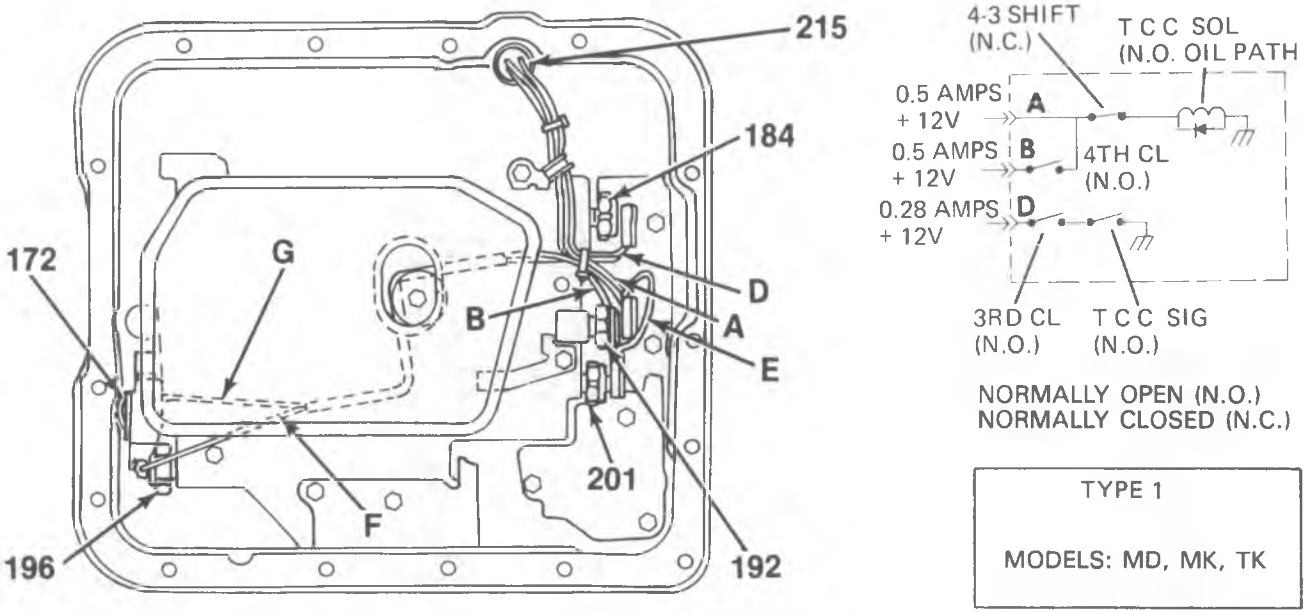
Figure 67—THM 700-R4 Valve Body Oil Passages



205. Throttle Valve (& Bushing)
204. TV Plunger (& Bushing)
203. 4-3 Sequence Valve
202. 3-4 Relay Valve
209. TV Limit Valve Train
207. Accumulator Valve Train
210. Line Bias Valve Train
194. 3-2 Control Valve Train
185. Manual Valve
180. 1-2 Shift Valve Train
181. 2-3 Shift Valve Train
200. 3-4 Shift Valve Train
197. TCC Shift Valve Train
198. M TV Up Valve Train
199. M TV Down Valve Train
A. Converter Clutch TV Bushing Bore Plug (ECM Controlled Vehicles)
B. Converter Clutch Shift Valve Bore Plug (ECM Controlled Vehicles)

B-08521

Figure 68—THM 700-R4 Valve Trains



TYPE 1

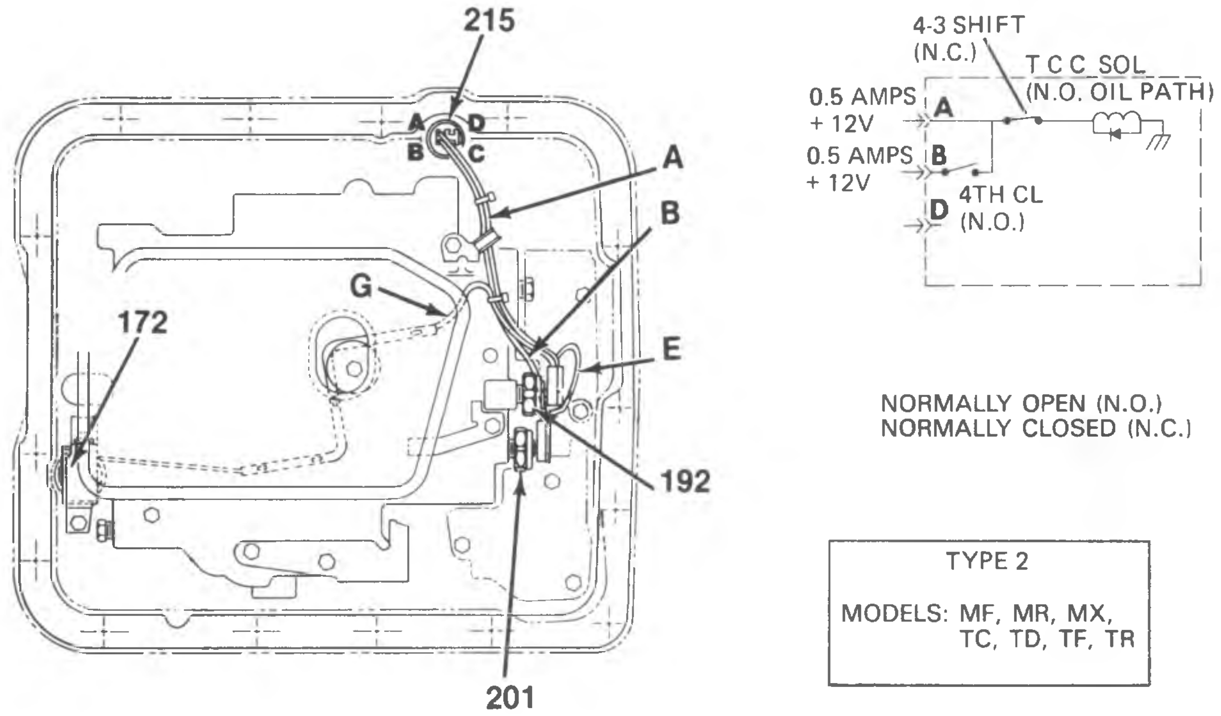
MODELS: MD, MK, TK

Component		Color ID
172.	TCC Solenoid	White
184.	3rd Clutch Switch	Black/Green Dot
	Terminals	Lt. Green
192.	4-3 Shift Switch	Black Body
	Terminals	Yellow
196.	TCC Signal Switch	Black
	Terminal	Lt. Green
201.	4th Clutch Switch	Black/Green Dot
	Terminals	Blue
215.	Connector	

Wire		Color ID
A.	Connector A To 4-3 Shift Switch	Red
B.	Connector B To 4th Clutch Switch	White
D.	Connector D To 3rd Clutch Switch	White
E.	4-3 Shift Switch To 4th Clutch Switch	White
F.	TCC Signal Switch To 3rd Clutch Switch	White
G.	TCC Solenoid To 4-3 Shift Switch	Red

B-08516

Figure 69—THM 700-R4 Wiring Type 1

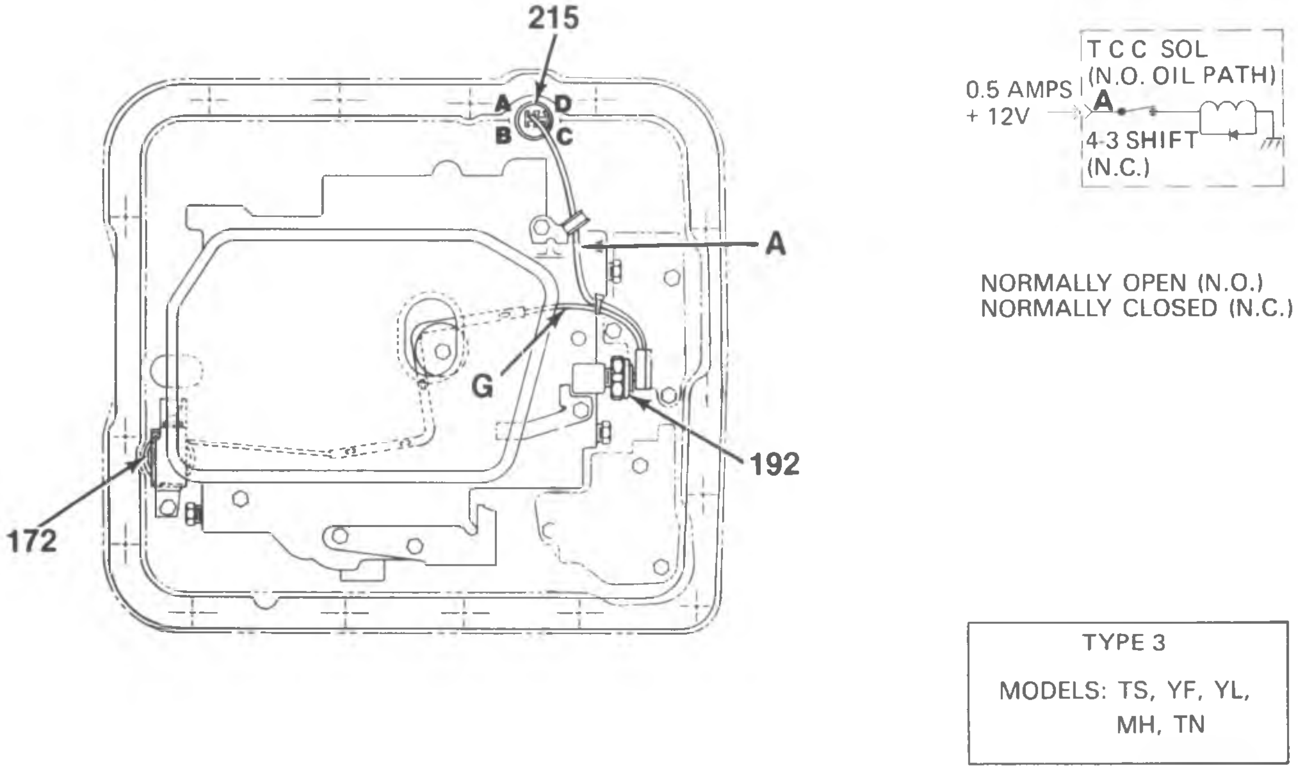


	Component	Color ID
172.	TCC Solenoid	Yellow
192.	4-3 Shift Switch	Black
	Terminal	Yellow
201.	4th Clutch Switch	Black/Green Dot
	Terminals	Blue
215.	Connector	

	Wire	Color ID
A.	Connector A To 4-3 Shift Switch	Red
B.	Connector B To 4th Clutch Switch	White
E.	4-3 Shift Switch To 4th Clutch Switch	White
G.	TCC Solenoid To 4-3 Shift Switch	Red

B-08517

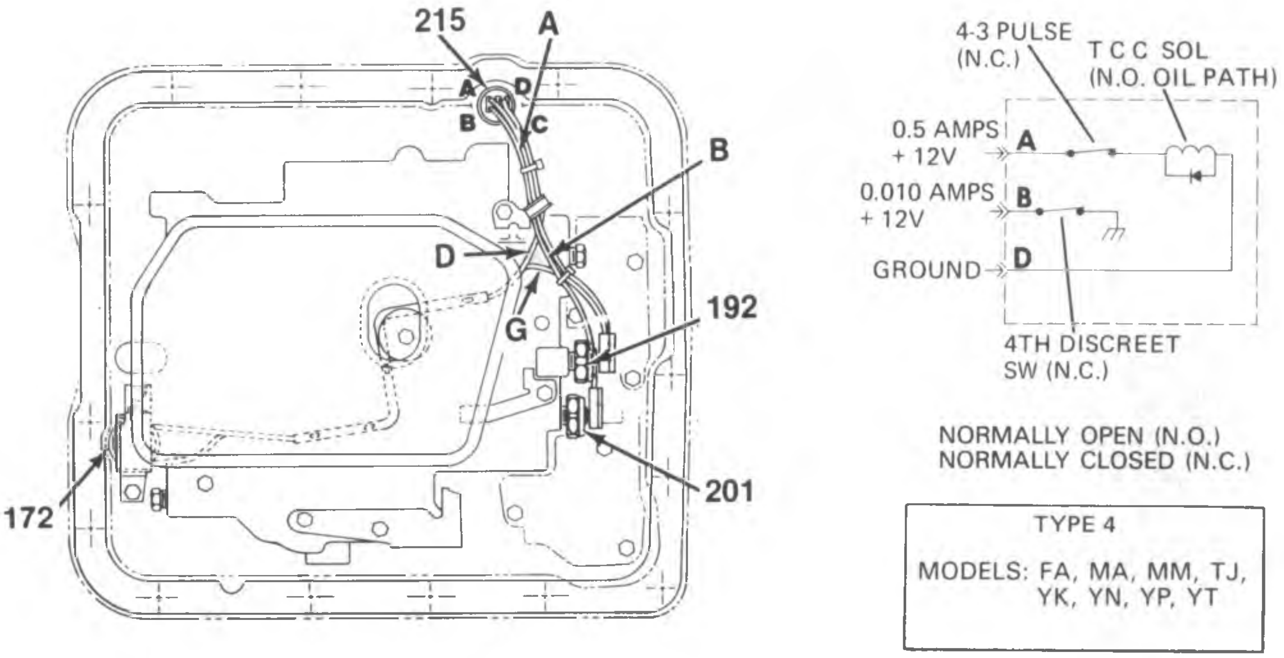
Figure 70—THM 700-R4 Wiring Type 2



Component	Color ID	Wire	Color ID
172. TCC Solenoid	Black	A. Connector A To 4-3 Shift Switch	Red
192. 4-3 Shift Switch Terminals	Black Body Yellow	G. TCC Solenoid (+) To 4-3 Shift Switch	Red
215. Connector			

B-08513

Figure 71—THM 700-R4 Wiring Type 3



NORMALLY OPEN (N.O.)
NORMALLY CLOSED (N.C.)

TYPE 4

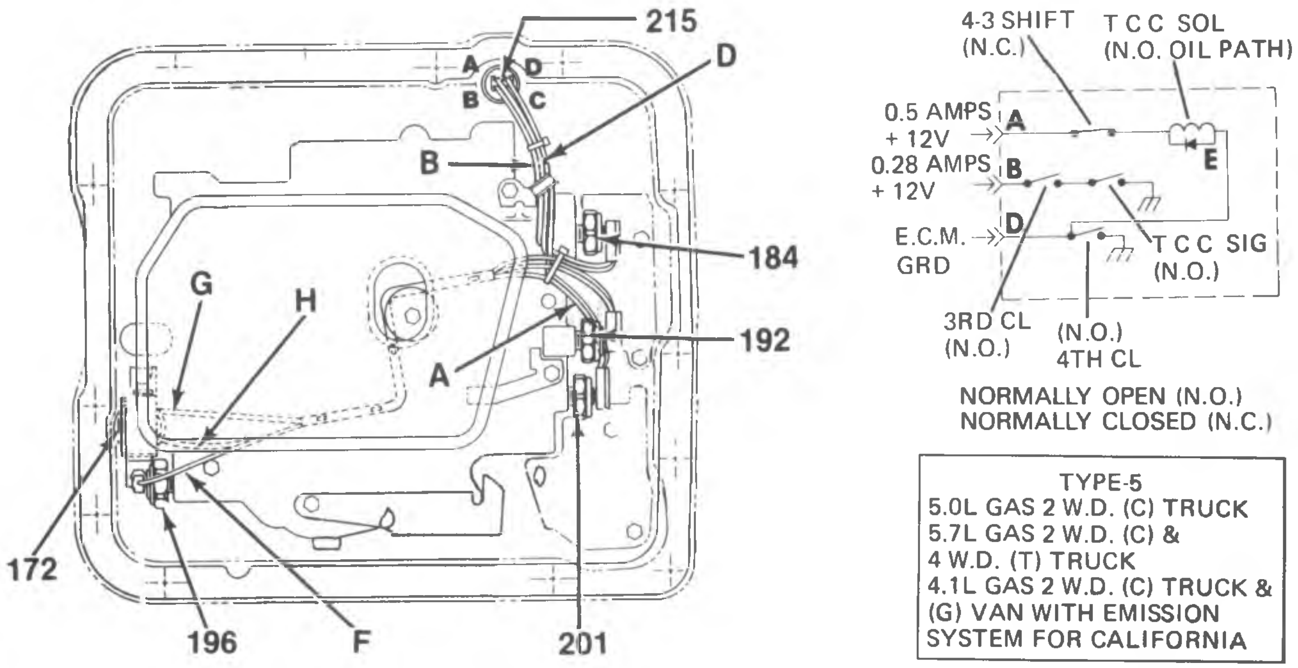
MODELS: FA, MA, MM, TJ, YK, YN, YP, YT

	Component	Color ID
172.	TCC Solenoid	Red
192.	4-3 Shift Switch	Black Body
	Terminal	Yellow
201.	4th Clutch Switch*	Metallic/White
	Terminal	Blue
215.	Connector	
	* Optional	Metallic/Black

	Wire	Color ID
A.	Connector A To 4-3 Shift Switch	Red
B.	Connector B To 4th Clutch Switch	White
D.	Connector D To TCC Solenoid (-)**	Black
G.	TCC Solenoid (+) To 4-3 Shift Switch	Red
**	CCC Ground	

B-08512

Figure 72—THM 700-R4 Wiring Type 4



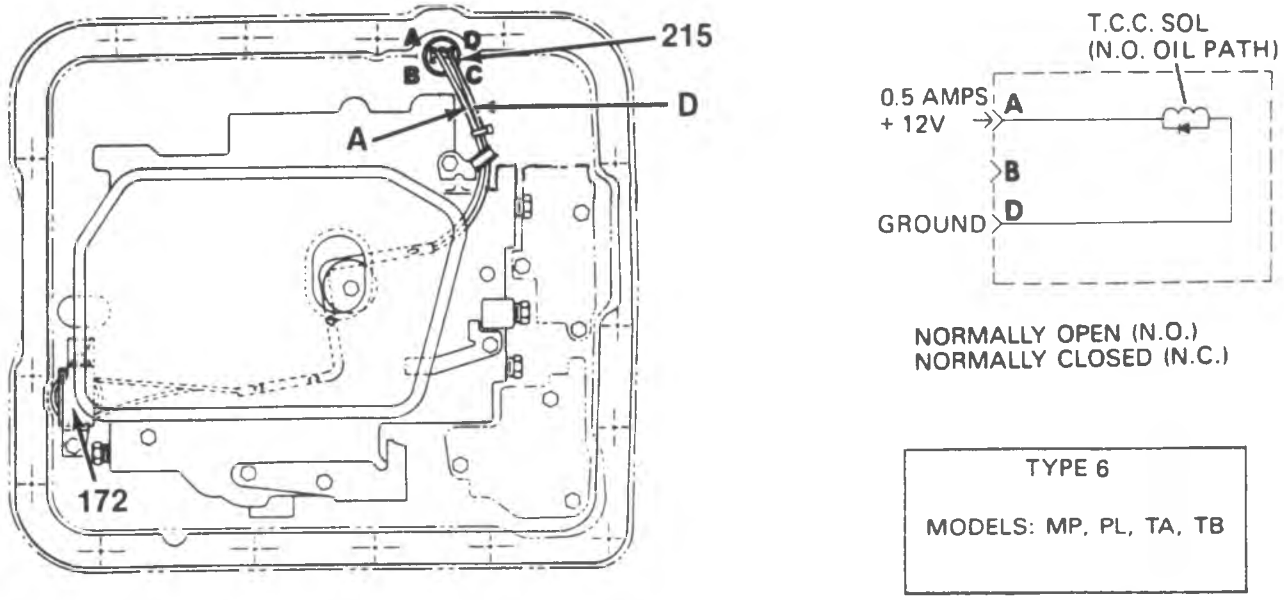
TYPE-5
5.0L GAS 2 W.D. (C) TRUCK
5.7L GAS 2 W.D. (C) &
4 W.D. (T) TRUCK
4.1L GAS 2 W.D. (C) TRUCK &
(G) VAN WITH EMISSION
SYSTEM FOR CALIFORNIA

Component	Color ID
172. TCC Solenoid	Blue
184. 3rd Clutch Switch	Black/Green Dot
Terminals	Lt. Green
192. 4-3 Shift Switch	Black Body
Terminals	Yellow
196. TCC Signal Switch	Black
Terminal	Lt. Green
201. 4th Clutch Switch	Black
Terminals	Blue
215. Connector	

Wire	Color ID
A. Connector A To 4-3 Shift Switch	Red
B. Connector B To 3rd Clutch Switch	White
D. Connector D To 4th Clutch Switch	Black
F. TCC Signal Switch To 3rd Clutch Switch	White
G. TCC Solenoid (+) To 4-3 Shift Switch	Red
H. TCC Solenoid (-) To 3rd Clutch Switch	Black

B-08508

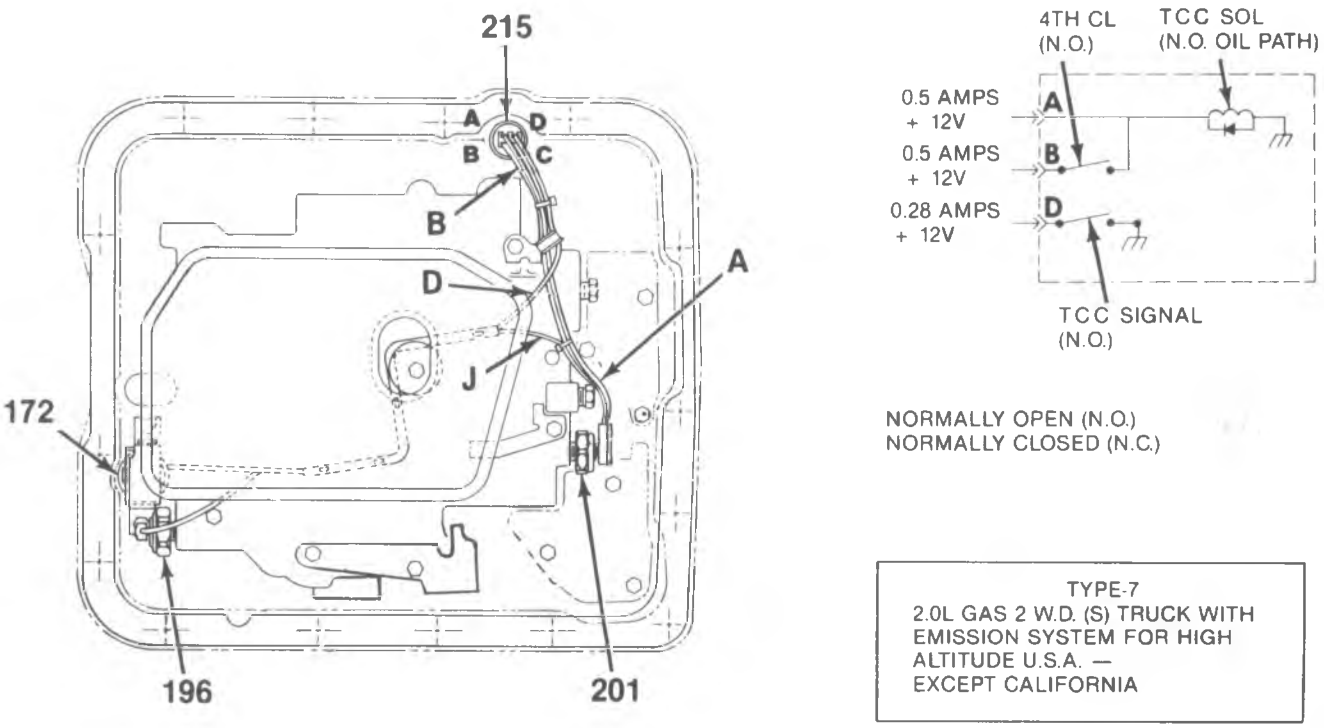
Figure 73—THM 700-R4 Wiring Type 5



Component	Color ID	Wire	Color ID
172. TCC Solenoid	Dk. Green	A. Connector A To TCC Solenoid (+)	Red
215. Connector		D. Connector D To TCC Solenoid (-)	Black

B-08510

Figure 74—THM 700-R4 Wiring Type 6



NORMALLY OPEN (N.O.)
NORMALLY CLOSED (N.C.)

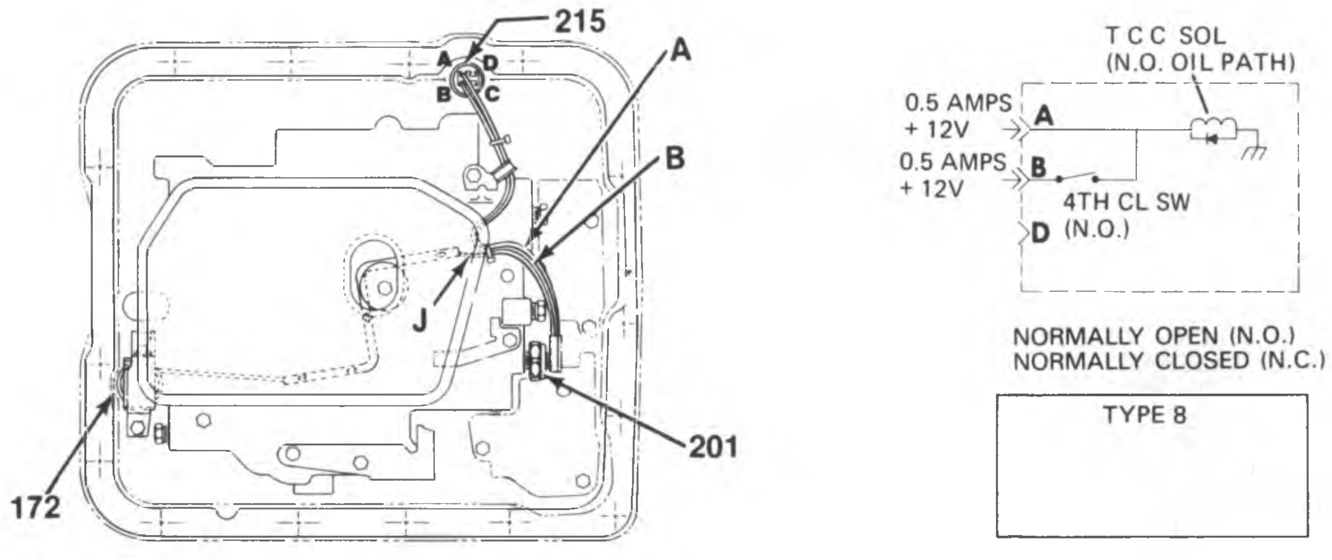
TYPE-7
2.0L GAS 2 W.D. (S) TRUCK WITH
EMISSION SYSTEM FOR HIGH
ALTITUDE U.S.A. —
EXCEPT CALIFORNIA

	Component	Color ID
172.	TCC Solenoid	Gray
196.	TCC Signal Switch	Black
	Terminal	Lt. Green
201.	4th Clutch Switch	Black/Green Dot
	Terminals	Blue
215.	Connector	

	Wire	Color ID
A.	Connector A To 4th Clutch Switch	Red
B.	Connector B To 4th Clutch Switch	Red
D.	Connector D To TCC Signal Switch	White
J.	TCC Solenoid To 4th Clutch Switch	Red

B-08509

Figure 75—THM 700-R4 Wiring Type 7

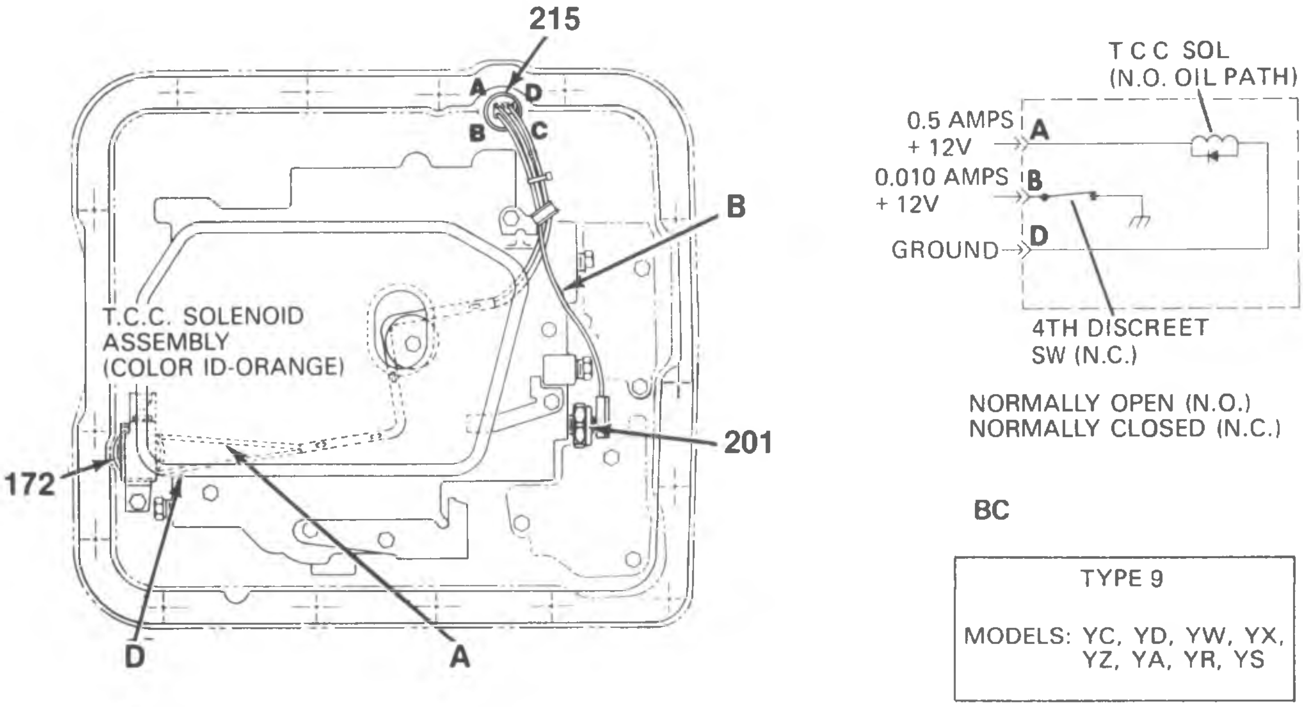


Component	Color ID
172. TCC Solenoid	Lt. Green
201. 4th Clutch Switch	Black
Terminals	Blue
215. Connector	

Wire	Color ID
A. Connector A To 4th Clutch Switch	Red
B. Connector B To 4th Clutch Switch	Red
J. TCC Solenoid To 4th Clutch Switch	Red

B-08505

Figure 76—THM 700-R4 Wiring Type 8

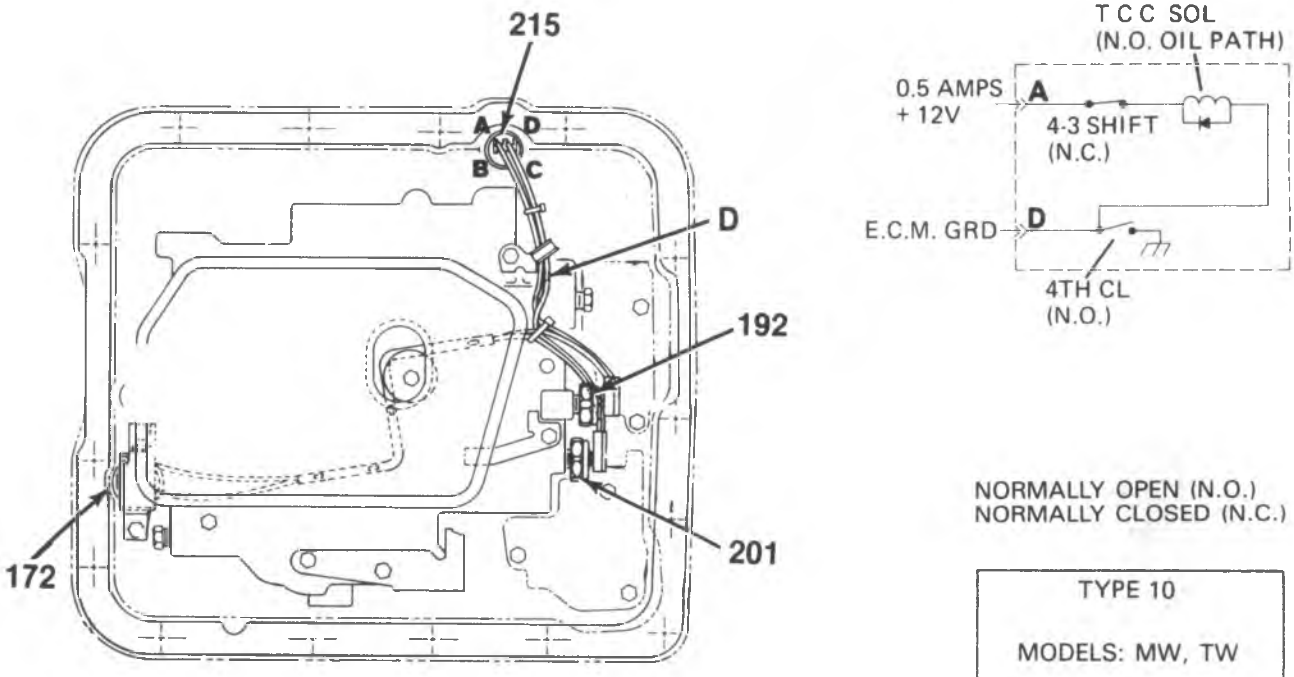


	Component	Color ID		Wire	Color ID
172.	TCC Solenoid Terminal (+)	Orange Red	A.	Connector A To TCC Solenoid (+)	Red
201.	4th Clutch Switch* Terminal	Metallic/White Blue	B.	Connector B To 4th Clutch Switch	White
			D.	Connector D To	Black
*Optional		Metallic/Black		TCC Solenoid (-)**	

**CCC Ground

B-08493

Figure 77—THM 700-R4 Wiring Type 9



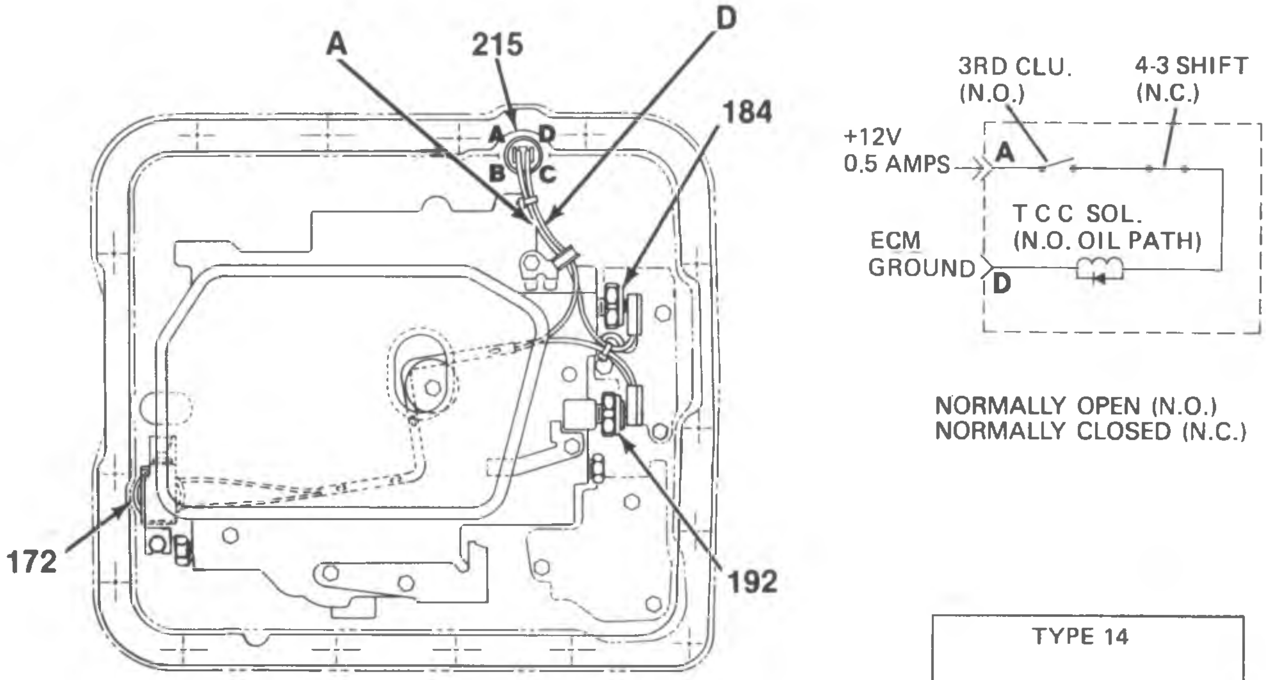
TYPE 10

MODELS: MW, TW

Component	Color ID	Wire	Color ID
172. TCC Solenoid	Brown	A. Connector A to 4-3 Switch	Red
192. 4-3 Shift Switch Terminals	Black Yellow	D. Connector D To 4th Clutch Switch	Black
201. 4th Clutch Switch Terminal	Black Blue	G. TCC Solenoid (+) To 4-3 Shift	
215. Connector			

B-08526

Figure 78—THM 700-R4 Wiring Type 10



TYPE 14

MODELS: MC, MT, PR

Component	Color ID
172. TCC Solenoid	Pink
184. 3rd Clutch Switch	Black/Green Dot
Terminals	Lt. Green
192. 4-3 Shift Switch	Black Body
Terminals	Yellow
215. Connector	

Wire	Color ID
A. Connector A To 3rd Clutch Switch	Red
D. Connector D To TCC Solenoid (-)	Black
G. TCC Solenoid (+) To 4-3 Shift Switch	

B-08527

Figure 79—THM 700-R4 Wiring Type 14

ON-VEHICLE SERVICE

GENERAL SERVICE PROCEDURES

ENGINE COOLANT IN TRANSMISSION

If the transmission oil cooler, located in the radiator assembly, has developed a leak allowing engine coolant to enter the transmission, use the following procedure:

1. Remove the transmission from the vehicle.
2. Disassemble the transmission and replace all rubber type seals. (The coolant will attack the seal material causing leakage.)
3. Replace the composition-faced clutch plate assemblies. (The facing material may become separated from the steel center portion).
4. Replace the nylon washers, speedometer gears and governor gear. (The nylon can swell and become damaged.)
5. Flush the converter, including TCC types.
6. Thoroughly clean and rebuild the transmission, using new gaskets and oil filter.
7. Flush the cooler lines after the transmission cooler has been properly repaired or replaced.

CASE POROSITY REPAIR

External leaks caused by case porosity can be repaired with the transmission in the vehicle by using the following recommended procedures:

1. Road test and bring the transmission to operating temperature, about 93°C (200°F).
2. Raise the vehicle on a hoist or jack stand, with engine running and locate the source of the oil leak. Check for leaks in all operating positions. A mirror may be helpful in finding leaks.
3. Shut the engine off and thoroughly clean the area to be repaired with a cleaning solvent and air dry.
4. Using the instructions of the manufacturer, mix a sufficient amount of epoxy, GM Part No. 1052533, or equivalent to make repair. Observe the cautions of the manufacturer in handling.
5. While the transmission case is still HOT, apply the epoxy to the area to be repaired. A clean, dry soldering acid brush can be used to clean the area and also to apply the epoxy cement. Make certain the area to be repaired is fully covered.
6. Allow the cement to cure for three hours before starting the engine.
7. Road test and check for leaks.

SERVICE METHODS

When servicing the transmission, it is recommended that upon disassembly of a unit, all parts should be cleaned and inspected as outlined under PARTS CLEANING AND INSPECTION. The unit should be assembled before disassembly of other units to avoid confusion and interchanging of parts.

1. Before disassembly of the unit, thoroughly clean the exterior.
2. Disassembly and reassembly of the unit and the subassemblies must be made on a clean 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.
3. Before installing cap screws into aluminum parts, ALWAYS DIP THE SCREWS INTO TRANSMISSION OIL to prevent cap screws from galling the aluminum threads and also to prevent the screws from seizing.
4. Always use a torque wrench when installing cap screws into aluminum parts to prevent the possibility of stripping the threads.
5. If tapped threads in aluminum parts are stripped or damaged, the part can be made serviceable by the use of Heli-Coils or equivalent.
6. 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.
7. The aluminum castings and the valve parts are very susceptible to nicks, burrs, etc., and care should be exercised when handling them.
8. The internal snap rings should be expanded and the external snap rings compressed if they are to be reused. This will insure proper seating when installed.
9. Replace all "O" ring seals, gaskets and oil seals that are removed. Oil seal rings should not be removed unless damaged.
10. During assembly of each unit, all internal parts must be lubricated with oil.

PARTS CLEANING AND INSPECTION

Cleanliness is an important factor in the overhaul of the transmission. Before attempting any disassembly operation, the exterior of the transmission should be thoroughly cleaned to prevent the possibility of dirt entering the transmission internal mechanism. During inspection and reassembly, all parts should be thoroughly cleaned with cleaning fluid and then air dried. Wiping cloths or rags should not be used to dry parts. Do not use solvents on neoprene seals, composition-faced clutch plates or thrust washers. All oil passages should be blown out ahd checked to make sure that they are not obstructed. Small passages should be checked with tag wire. All parts should be inspected to determine which parts are to be replaced.

The various inspections of parts are as follows:

1. Inspect linkage and pivot points for excessive wear.
2. Bearing and thrust surfaces of all parts should be checked for excessive wear and scoring.
3. Check for broken seal rings, damaged ring lands and damaged threads.
4. Inspect all seals.
5. Mating surfaces of castings and end plates should be checked for burrs and irregularities may be removed by lapping the surface with crocus cloth. The crocus cloth should be laid on a flat surface, such as a piece of plate glass.
6. Castings should be checked for cracks and sand holes.

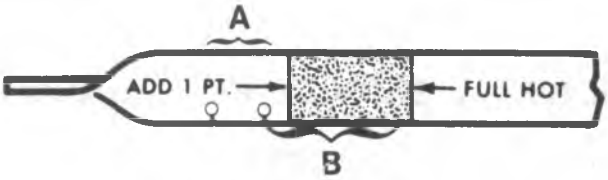
OIL COOLER LINES

If replacement of transmission steel tubing cooler lines is required, use only double wrapped and brazed steel tubing meeting GM specification 123M or equivalent. Under no condition use copper or aluminum tubing to replace steel tubing. Those materials do not have satisfactory fatigue durability to withstand normal vehicle vibrations. Steel tubing should be flared using the double flare method.

COOLER LINE FLUSHING

In a major transmission failure, where particles of metal have been carried with the oil throughout the units of the transmission, it will be necessary to flush out the oil cooler and connecting lines. To flush the oil cooler and lines, use the following procedure:

1. Disconnect both cooler lines from the transmission.
2. Place a hose over the end of the cooler inlet line (from the bottom of the cooler) and insert the hose into an empty container.
3. Flush clean oleum solvent or equivalent through the return line (from the top of the cooler) using an oil suction gun until clean solvent comes out of the hose. This will "back flush" the cooler.
4. Remove the hose from the inlet cooler line and place it on the return line.
5. Flush clean oleum solvent or equivalent through the inlet line until clean solvent comes out the return line. Remove remaining solvent from cooler with compressed air applied to the return line and flush with transmission fluid.
6. Reconnect oil cooler lines and torque nuts to 17 N·m (12 ft. lbs.).



A. Cool
B. Warm

B-08696

Figure 80—Transmission Dipstick

CHECKING AND ADDING FLUID

The automatic transmission is designed to operate at the "FULL HOT" mark on the dipstick at normal operating temperatures of 88°C–93°C (190°F–200°F), and should be checked under these conditions.

The normal operating temperature is obtained only after at least 24 km (15 miles) of highway type driving.

If the vehicle has recently been operated for an extended period at high speed or in city traffic in hot weather or the vehicle is being used to pull a trailer, an accurate fluid level cannot be determined until the fluid has cooled down, usually about 30 minutes after the vehicle has been parked.

Inspect (Figure 80)

- Check the transmission fluid level with the engine running, the shift lever in park, and the vehicle level.

1. Apply the parking brake and block the vehicle wheels.
2. With the selector level in the PARK position, start the engine. DO NOT RACE THE ENGINE. Move the selector lever through each range.
3. Remove the dipstick and touch the transmission end of the dipstick cautiously to find out if the fluid is cool, warm or hot. Wipe it clean and re-insert it until the cap seats.
4. Remove the dipstick and note the reading.
    - If the fluid feels cool, about room temperature, 18° to 29°C (65° to 85°F), the level should be between the two dimples below the "ADD" mark.
    - If it feels warm, the level should be close to the "ADD" mark (either above or below).
    - If it feels hot (cannot be held comfortably), the level should be between the "ADD" and "FULL" marks.
5. If additional fluid is required, add enough fluid to bring it to the correct mark on the dipstick.

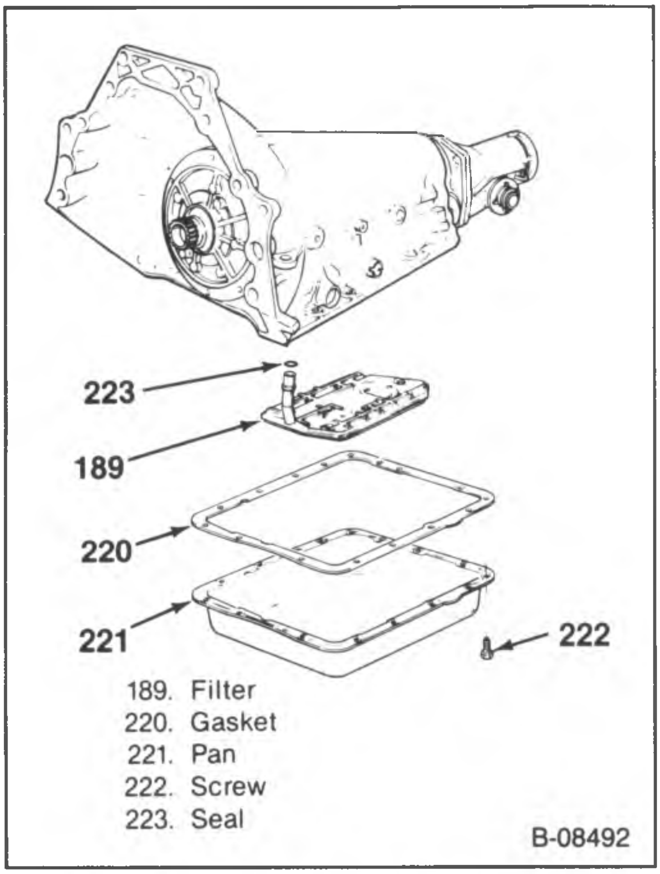


Figure 81—Transmission Filter And Pan

Important

DO NOT OVERFILL.

To bring fluid level from ADD mark to FULL mark requires 0.5 liter (one pint) of fluid.

Overfilling can cause foaming and loss of fluid through the vent. Slippage and transmission failure can result.

Fluid level too low can cause slipping, particularly, when the transmission is cold or the vehicle is on a hill.

FLUID AND FILTER

Remove or Disconnect (Figure 81)

- Raise the vehicle.
1. Screws (222) from the front and sides of the pan (221).
- Loosen the screws at the rear of the pan about four turns.
2. Pan (220) part way.
- Pry the front loose and drain the fluid into a pan.
3. Screws (222) from the rear of the pan (221).
4. Pan (221) and the gasket (220).
5. Filter (181) and the seal (223), or screen and the gasket, if used.
- Screws or clips as needed.

Clean (Figure 81)

- Drain remaining fluid from the pan.
- Gasket material from the pan and the transmission case.
- Pan, and the filter screen if used, with solvent. Dry with clean compressed air.

Install or Connect (Figure 81)

1. New filter (181) and new seal (223) or screen and new gasket, if used.
- Screws or clips as needed.
2. New gasket (220) and the pan (221).
3. Screws (222). Refer to "Specifications" for the proper torque.
- Lower the vehicle.
4. New fluid. Refer to "Specifications" for the proper amount.
- Check the fluid level and add as needed to bring the fluid to the proper level.

SHIFT LINKAGE

Remove or Disconnect (Figure 82)

- Apply the parking brake.
1. Retaining pin (226).
2. Rod (240) from the column lever.
    - Note the position of any washers, spacers and insulators removed.
3. Rod (240) from the equalizer lever (238).
    — C, K and P Models.
        - Screw (242) and the washer.
        - Swivel (232).
    — G Models.
        - Nut (236), washers and the insulator.
        - Swivel (232).
        - Spacer and the retainer.
4. Retaining pin (227) and the equalizer lever (238).
    - Insulator, washer and the spring.

Clean

— Metal parts using solvent. Wipe dry using a clean, dry rag.

— Rubber or nylon parts using soapy water. Wipe dry using a clean, dry rag.

Install or Connect (Figure 82)

1. Equalizer lever (238) and a new retaining pin (227).
    - Spring, washer and the insulator.
2. Rod (240) to the equalizer lever (238).
    — C, K and P Models.
        - Swivel (232).
        - Washer and the screw (242).

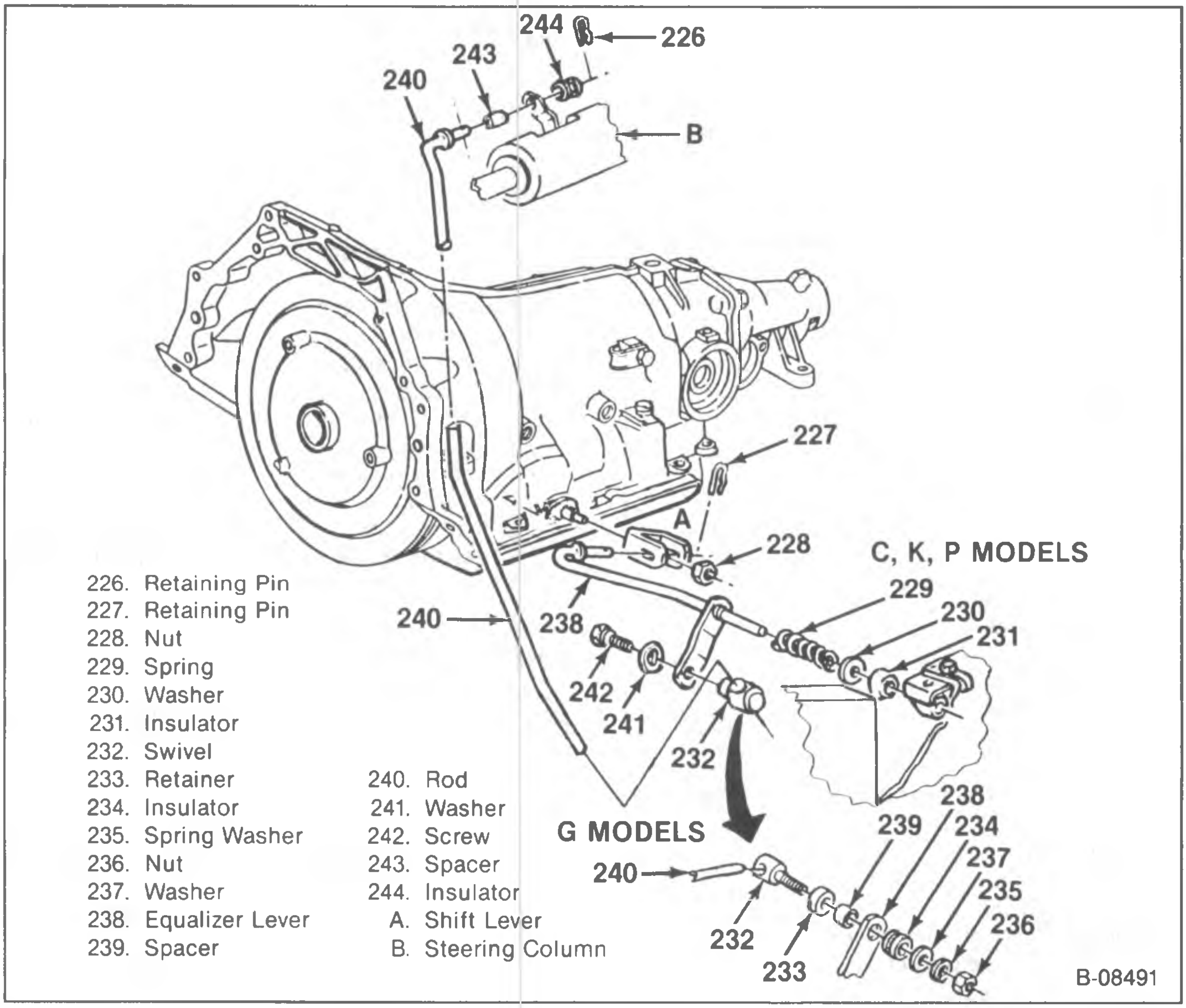


Figure 82—Shift Linkage

— G Models.

  - Retainer and the spacer.
  - Swivel (232).
  - Insulator, washers and the nut (236).

3. Rod (240) to the column lever.
   - Insulators, spacers and washers in the positions they were removed from.
4. New retaining pin (226).

Adjust

- Apply the parking brake.

1. Loosen the screw (242) or the nut (236), as used.
2. Put the column selector lever in the "N" (Neutral) position.
   - Put the lever into the neutral gate, do not use the indicator to find the neutral position.
3. Put the transmission in neutral.
   - Move the shift lever (A) to the forward position, the back to the second detent. (Figure 83).
4. Hold the rod (240) tightly in the swivel (232).

Tighten

- Nut (236) or the screw (242) to 23 N·m (17 ft. lb.).

5. Put the column selector lever in the "P" (Park) position.
6. Check the adjustment.
   - The column selector lever must go into all positions.
   - The engine must start in the "P" (Park) or "N" (Neutral) positions only. Adjust if needed, refer to "Neutral Start Switch" in this section.

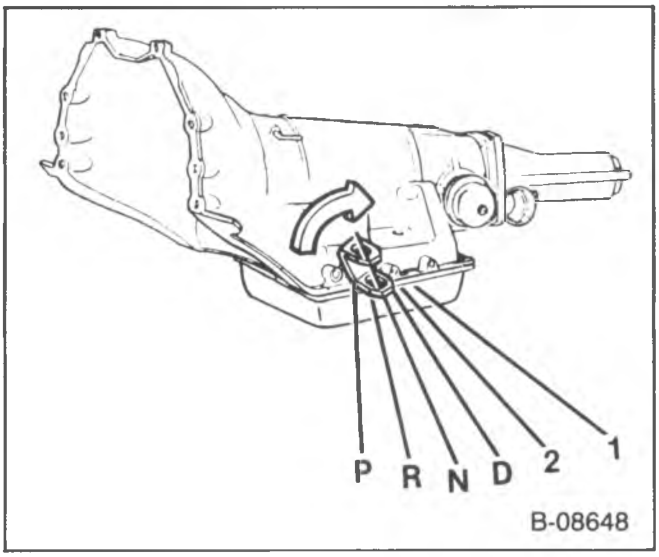


Figure 83—Shift Positions

CAUTION: With the selector lever in the "Park" position, the parking pawl should freely engage within the rear (reaction) internal gear lugs or output ring gear lugs and prevent the vehicle from rolling, which could cause personal injury.

- Align the indicator, if needed.
- Release the parking brake.

TV-DETENT CABLE (THM 350-C AND THM 700-R4)

Remove or Disconnect (Figure 84)

1. Air cleaner, if needed.
2. Cable (142) from the throttle lever.
   - Push the re-adjust tab (250) in and pull the slider (251) through the fitting (141).
   - Cable terminal from the throttle lever.
   - Push the lock tabs in and pull the fitting (141) from the bracket.
3. Routing clips or straps as used.
   - Raise the vehicle.
   - Lower the transmission if needed for clearance. Refer to "Transmission Replacement" in this section.
   - Note the routing of the cable (142).
4. Cable (142) from the transmission.
   - Screw and the washer.
   - Raise the cable and disconnect the link.
5. Seal (254).

Install or Connect (Figure 84)

1. New seal (254).
2. Cable (142) to the transmission.
   - Link.
   - Washer and the screw.

   Tighten

   - Screw to 10 N·m (8 ft. lb.).
3. Routing clips or straps as used.
   - The cable must be routed in the position it was removed from.
   - Raise the transmission if needed, refer to "Transmission Replacement" in this section.
   - Lower the vehicle.
4. Cable (142) to the throttle lever.
   - Both lock tabs must be through the bracket.
   - Cable terminal to the throttle lever.

   Important

   - The cable must not be kinked or damaged.

Adjust (Figure 84)

- Remove the air cleaner if needed.

1. Push the re-adjust tab (250) in and pull the slider (251) back against the fitting.

   Important

   - Do not press the lock tabs in.
2. Move the throttle lever to the full throttle position, and release it.

   Important

   - Do not use the accelerator pedal to open the throttle.
3. Install the air cleaner if needed.

DETENT SWITCH (THM 400)

Remove or Disconnect (Figure 85)

1. Wire connector.
2. Screw.
3. Switch (260).

Install or Connect (Figure 85)

1. Switch (260).
2. Screw.
3. Wire connector.

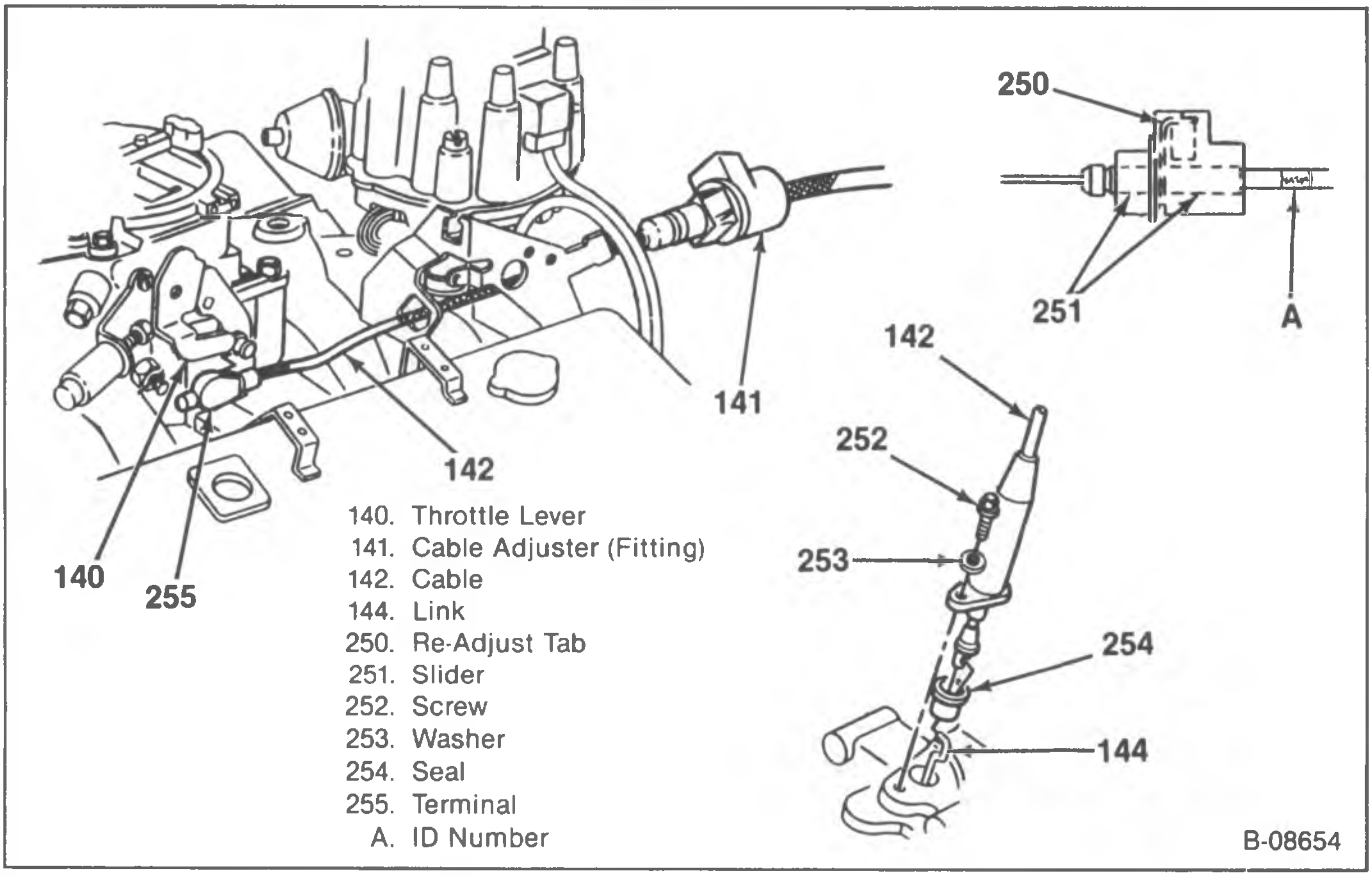


Figure 84—TV-Detent Cable (THM 350-C And THM 700-R4)

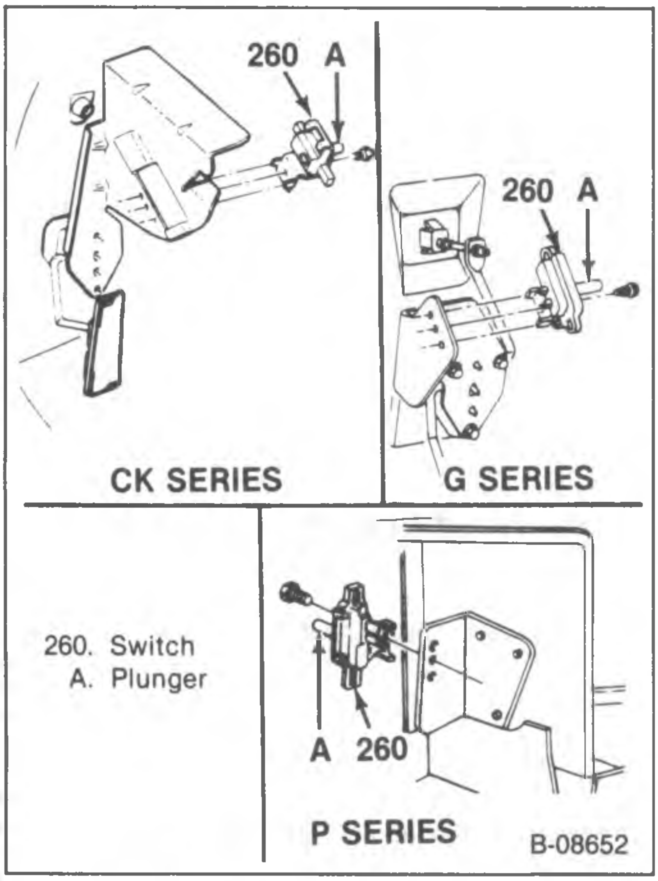


Figure 85—Detent Switch (THM 400)

Adjust (Figure 85)

1. Press the plunger (A) as far forward as possible.
2. Press the accelerator pedal to the floor.

VACUUM MODULATOR (THM 350-C AND THM 400)

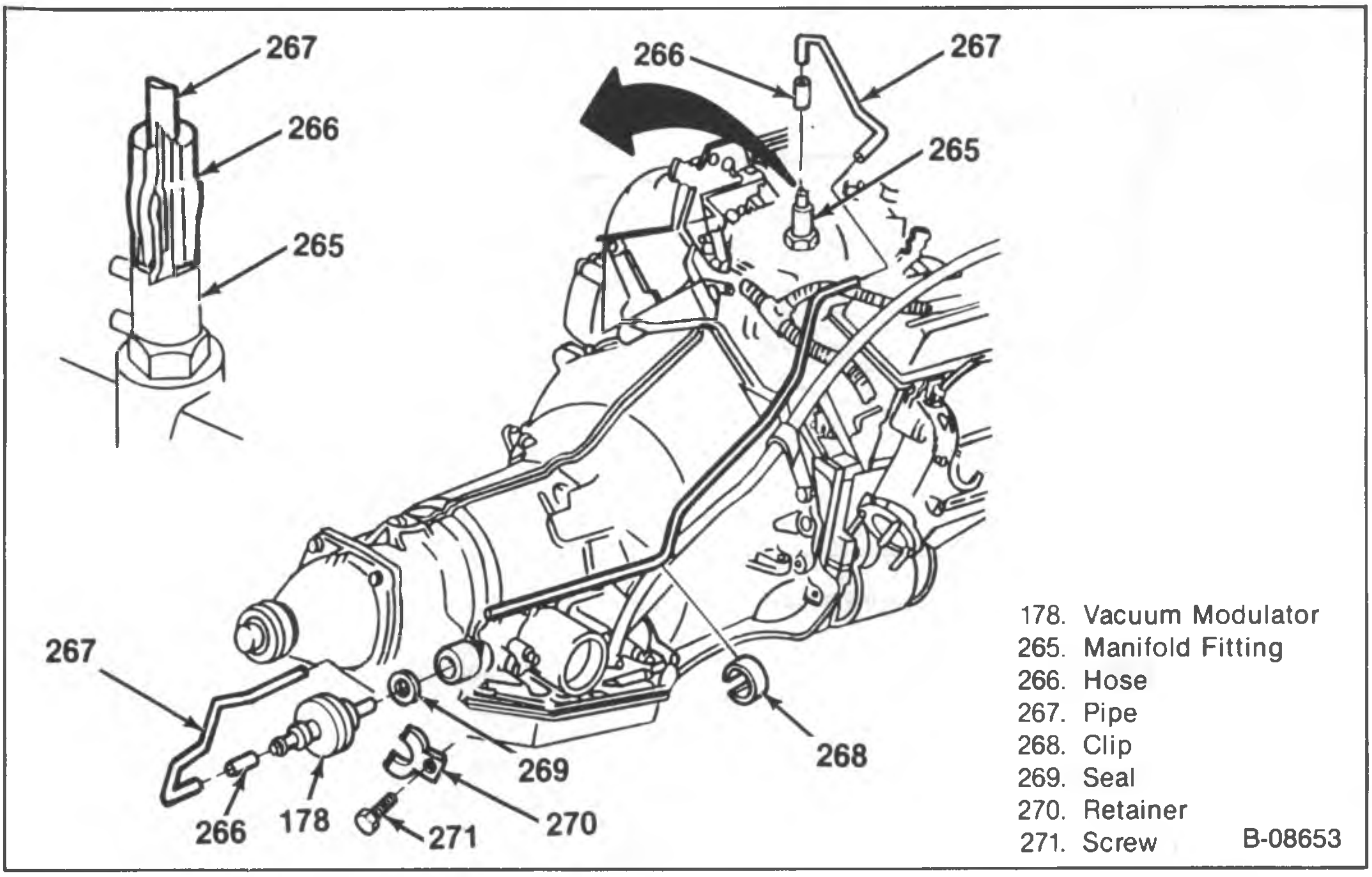
Remove or Disconnect (Figure 86)

- Raise the vehicle.

1. Pipe (267) from the modulator port.
   - Hose.
2. Vacuum modulator (178).
   - Screw and the retainer.
   - Seal.
3. Pipe (267) if needed.
   - Hose.
   - Note the position of the pipe and any clips.

Clean (Figure 86)

— All parts using soapy water. Air dry.



178. Vacuum Modulator
265. Manifold Fitting
266. Hose
267. Pipe
268. Clip
269. Seal
270. Retainer
271. Screw

Figure 86—Vacuum Modulator (THM 350-C And THM 400)

Inspect

— Modulator and pipe for kinks, cracks and damage.

— Hoses for cracks, wear and dry rot.

Install or Connect (Figure 86)

1. Pipe (267) if removed.
   - Seat the pipe against the manifold fitting.
   - The pipe must be routed in the position it was removed from.
2. Vacuum modulator (178).
   - New seal.
   - Retainer and the screw.
3. Pipe (267) onto the modulator port.

Important

- The pipe must not be twisted or bent.

4. Transmission fluid if needed. Refer to "Checking and Adding Fluid" in this section.

SPEEDOMETER DRIVEN GEAR—VEHICLE SPEED SENSOR

Remove or Disconnect (Figure 87)

- Apply the parking brake.

1. Speedometer cable (277).
2. Screw and the retainer.
3. Sleeve and the seal.
4. Driven gear or speed sensor (280), as used.

Inspect (Figure 87)

— Gear teeth for nicks and burrs.

— All parts for wear and damage.

Install or Connect (Figure 87)

1. Driven gear or speed sensor (280) as used.
2. New seal and the sleeve.
3. Retainer and the screw.
4. Speedometer cable (277).
   - Release the parking brake.
5. Transmission fluid if needed. Refer to "Checking and Adding Fluid" in this section.

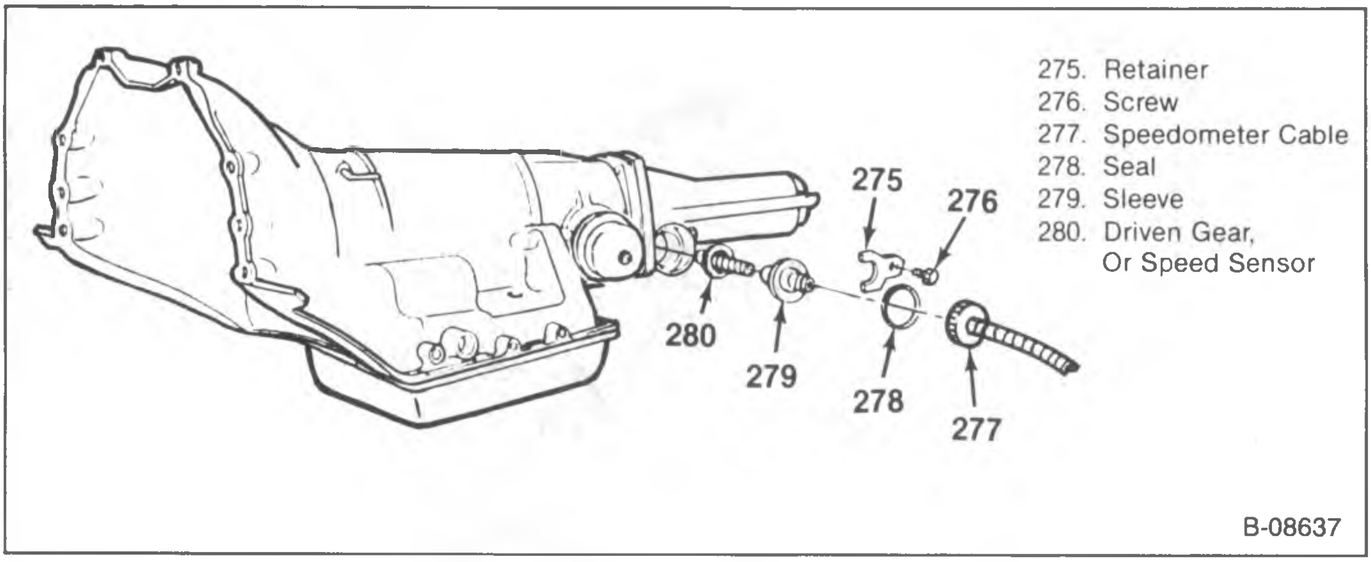


Figure 87—Speedometer Driven Gear

GOVERNOR

Remove or Disconnect (Figure 88)

- Raise the vehicle.
- Lower the transmission if needed for clearance, refer to "Transmission Replacement" in this section.

1. Governor cover (287) and the seal or gasket as used.
   - — THM 350-C and THM 700-R4
     - Tap around the cover flange with a punch.
   - — THM 400
     - Remove the screws.

Important

- Do not damage the governor cover. If the cover is damaged it must be replaced.

2. Governor (182).

Clean (Figure 88)

— Governor using solvent. Air dry and blow out all passages using dry compressed air.

Inspect (Figure 88)

- All parts for nicks, burrs, scoring and galling.
- Governor sleeve for binding.
- Governor valve for binding.
- Driven gear for loose fit.
- Weight springs for kinks or damage.
- Weights for binding.

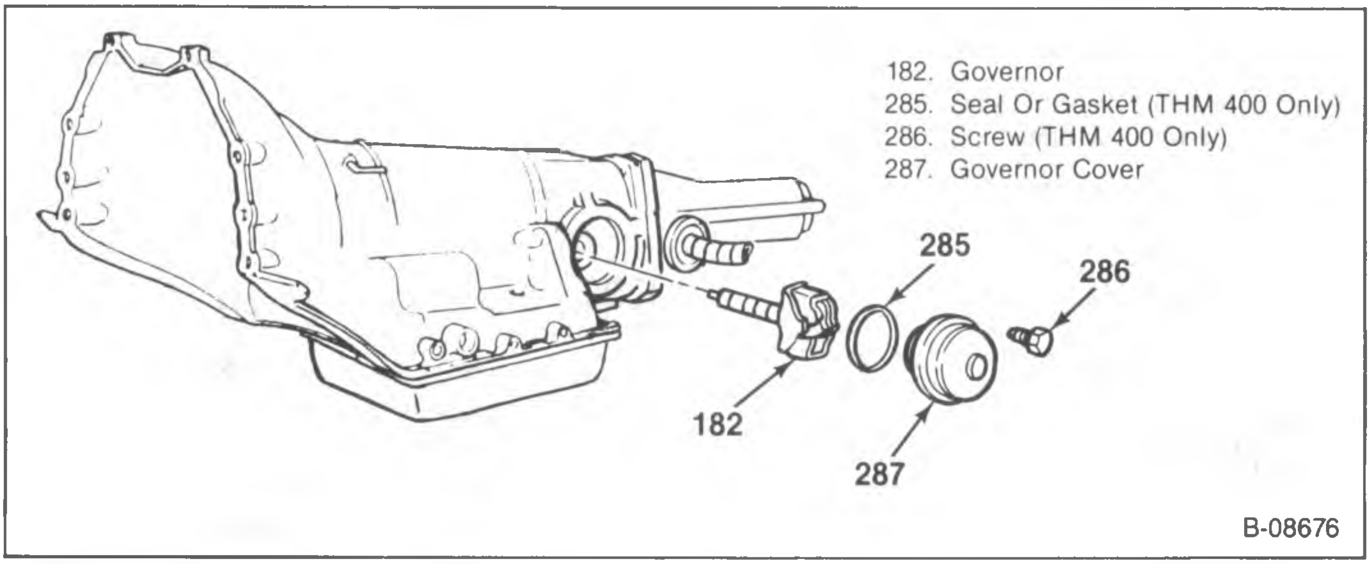


Figure 88—Governor

- Valve entry opening. With the weights held all the way outward, the opening should be 5.1 mm (0.020 in.) (Figure 89).
- Valve exhaust opening. With the weights held all the way inward, the opening should be 5.1 mm (0.020 in.) (Figure 90).
- If the weights, sleeve, or valve do not operate freely, disassemble and clean the governor.
- If the driven gear must be replaced, the governor must be disassembled.

Important

- All the governor parts are a select fit. Except for the driven gear, the governor must be replaced as an assembly if repair is needed.

Diassemble (Figures 91 and 92)

1. Remove the governor weight pins (310).
   - Cut off one end of each pin to remove them.
2. Remove the thrust cap (317), the weights (315 and 316) and the springs (314).
3. Remove the valve (311) from the sleeve.
4. Remove the driven gear, if needed.
   - Drive out the retaining pin using a punch or 1/8 in. drill.
   - Press the gear out of the sleeve using a punch, with the gear supported in a press with two 2.778 mm (7/64 in.) plates in the exhaust slots.
5. Clean the governor parts and inspect for damage.

Assemble (Figures 92, 93 and 94)

1. New driven gear into the sleeve, if needed.
   - Press the gear in until it is almost seated using a socket with the governor supported in a press with two 2.778 mm (7/64 in.) plates in the exhaust slots.
   - Remove any shavings from the gear hub and press the gear in until it is seated.
   - Drill a new pin hole 90° from the old one using a 1/8 in. drill in a press.
   - New retaining pin through the new pin hole so the ends are just below the top of the hole.
   - Stake both ends of the pin hole in two places, and wash the governor.
2. Valve (311) into the sleeve.
3. Springs (314), the weights (315 and 316) and the thrust cap (317) onto the governor, aligning the pin holes.
4. New weight pins (310) and crimp both ends of each pin.

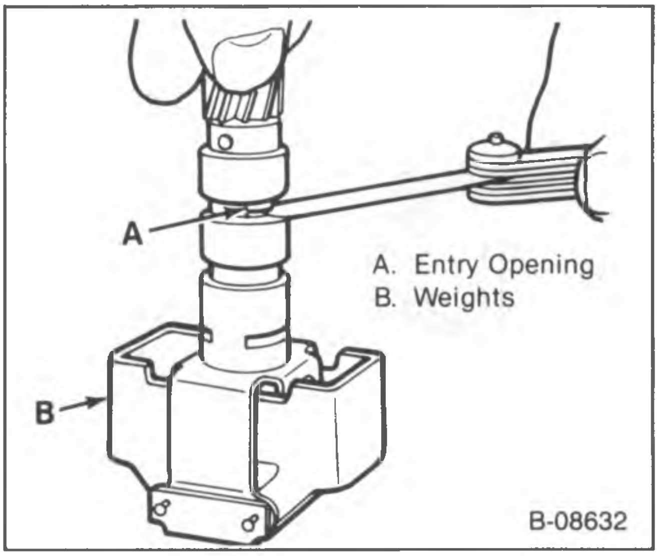


Figure 89—Measuring The Governor Value Entry Opening

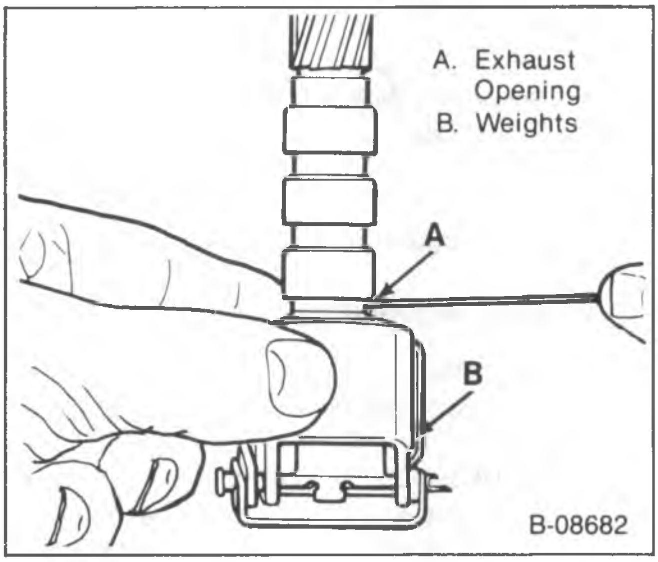


Figure 90—Measuring The Governor Value Exhaust Opening

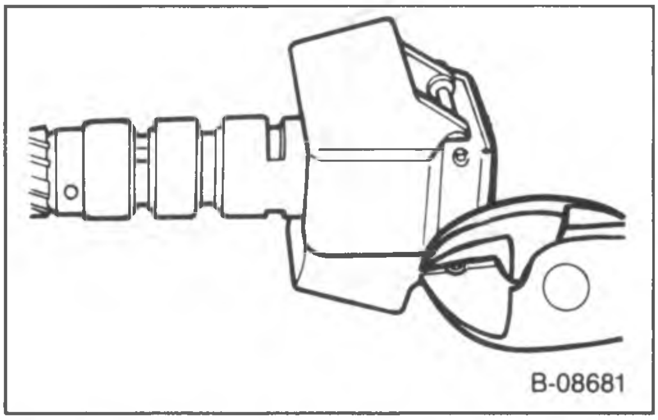
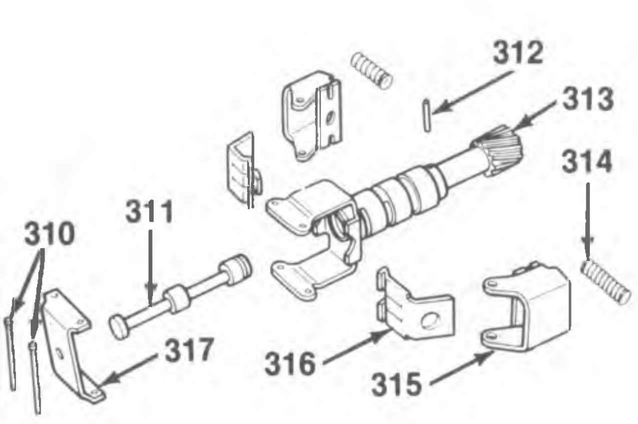


Figure 91—Removing The Governor Weight Pins



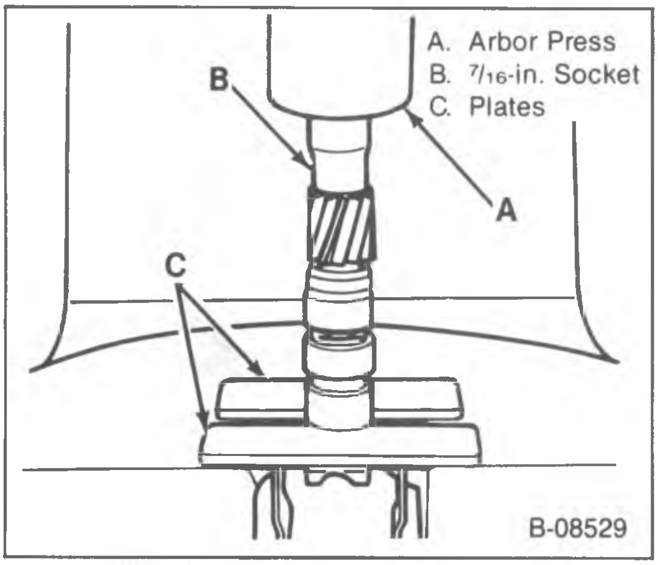
310. Weight Pins
311. Valve
312. Retaining Pin
313. Driven Gear
314. Spring
315. Primary Weight
316. Secondary Weight
317. Thrust Cap

B-08523

Figure 92—Governor

Install or Connect (Figure 88)

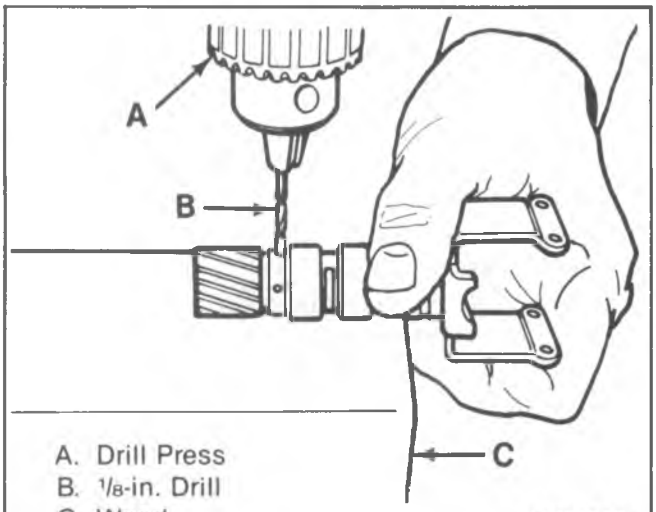
1. Governor (182).
2. Governor cover (287) and a new seal or gasket as used.
    — THM 350-C and THM 700-R4.
        - Put a thin coat of Loctite Cup Plug Sealant II, or equivalent, on the cover.



A. Arbor Press
B. 7/16-in. Socket
C. Plates

B-08529

Figure 93—Installing The Governor Driven Gear



A. Drill Press
B. 1/8-in. Drill
C. Wood

B-08515

Figure 94—Drilling The Driven Gear

        - Tap the cover into place using a brass drift.
    — THM 400.
        - Screws.
    - Raise the transmission if needed. Refer to "Transmission Replacement" in this section.
    - Lower the vehicle.
3. Transmission fluid if needed. Refer to "Checking and Adding Fluid" in this section.

1-2 ACCUMULATOR (THM 350-C)

Remove or Disconnect (Figures 95 and 96)

Tool Required:

J-23069 Accumulator Cover Remover and Installer

- Raise the vehicle.
- Lower the transmission, if needed for clearance. Refer to "Transmission Replacement" in this section.

1. Retaining ring and the cover (290) using J-23069.
    - Seal from the cover.
2. Spring (292).
3. Piston (295).

Important

- Do not remove the teflon seal rings from the piston.

Clean (Figure 96)

— All parts using solvent. Air dry.

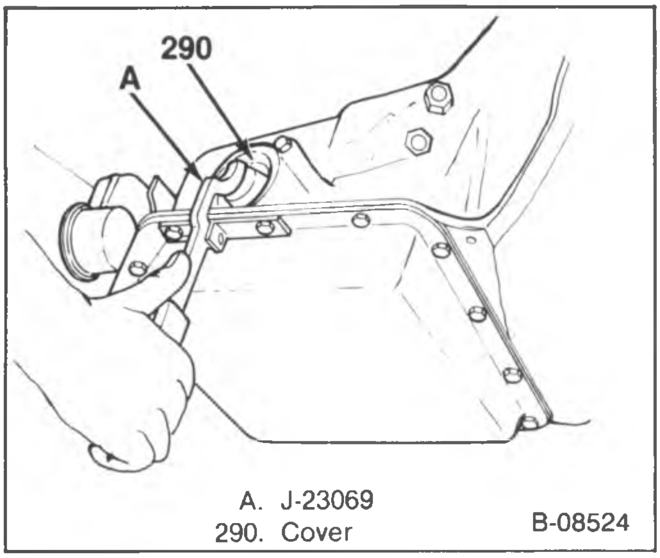


Figure 95—Removing The Accumulator Cover (THM 350-C)

Inspect (Figure 96)

- — All parts for wear and damage.
- — Cover seal groove for nicks and burrs.
- — Piston seal rings for scoring. If the seal rings are worn or scored, the piston and rings must be replaced as a unit.

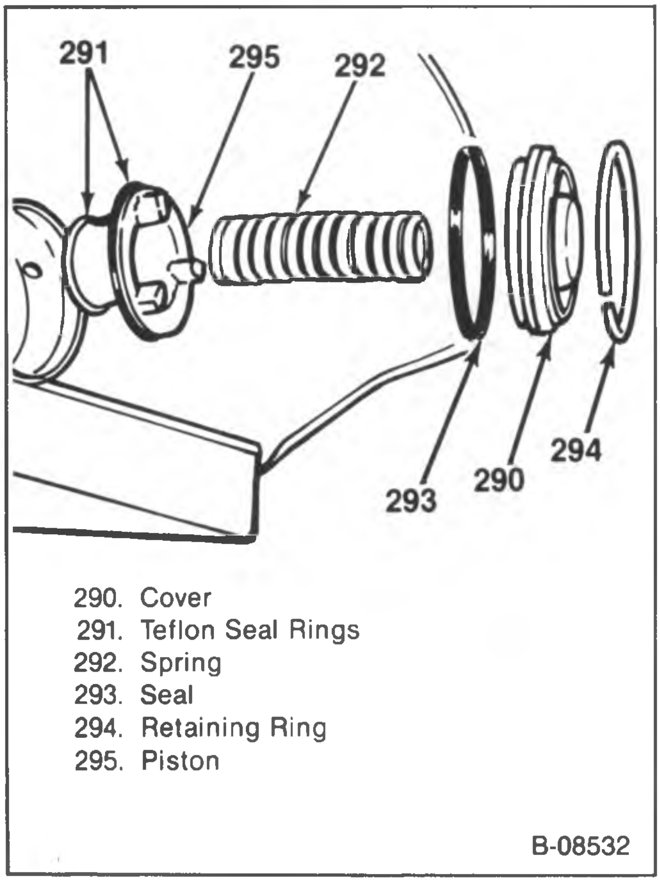


Figure 96—1-2 Accumulator (THM 350-C)

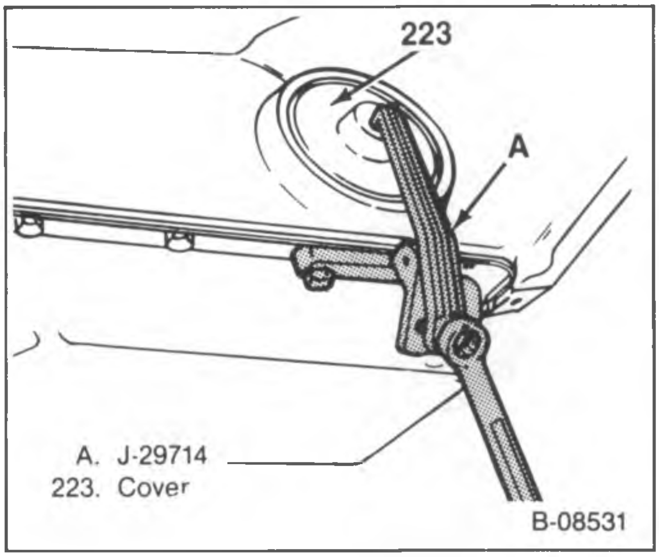


Figure 97—Removing The Servo Cover (THM 700-R4)

Install or Connect (Figures 95 and 96)

Tool Required:
J-23069 Accumulator Cover Remover and Installer.

1. Piston (295).
2. Spring (292).
3. Cover (290) and the retaining ring using J-23069.
    - New seal on the cover.
    - Raise the transmission if needed. Refer to "Transmission Replacement" in this section.
    - Lower the vehicle.
4. Transmission fluid if needed. Refer to "Checking and Adding Fluid" in this section.

2-4 SERVO (THM 700-R4)

Remove or Disconnect (Figures 97 and 98)

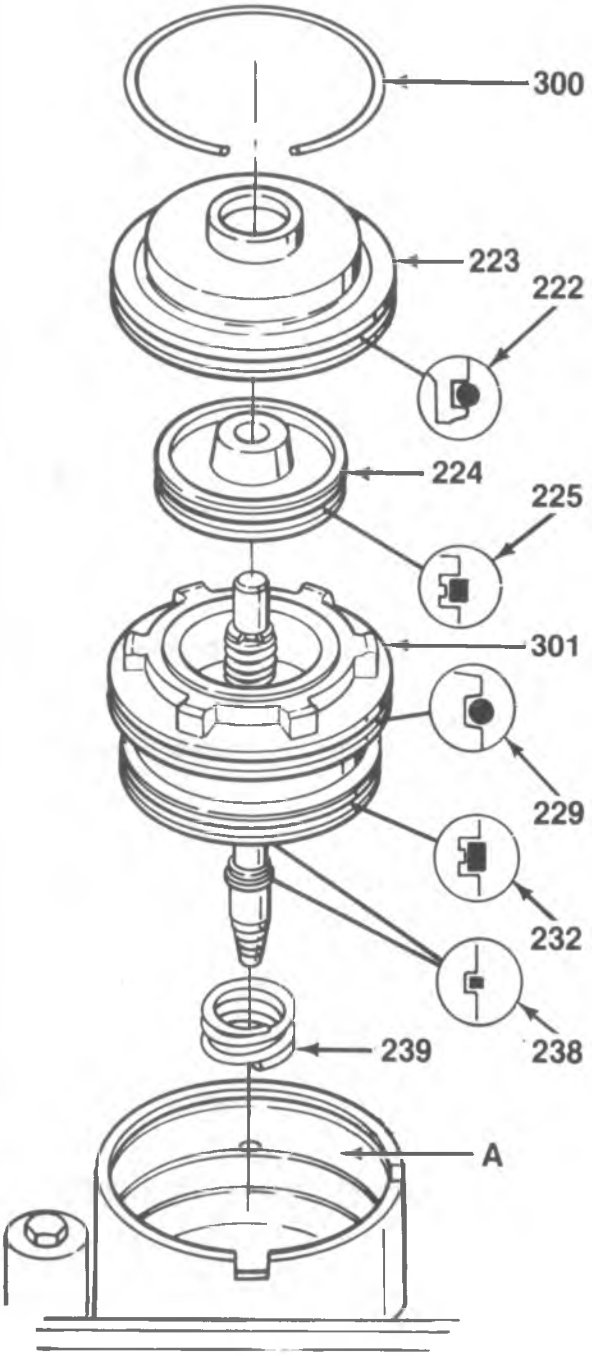
Tool Required:
J-29714 Servo Cover Compressor.

- Raise the vehicle.
- Lower the transmission if needed for clearance. Refer to "Transmission Replacement" in this section.

1. Retaining ring and the cover (223) using J-29714.
2. Seal from the cover.
3. 4th apply piston (224).
4. 2nd apply piston assembly (301).
5. Spring (239).

Disassemble (Figures 99 and 100)

Tool Required:
J-22269-01 Piston Compressor.



A. Case Servo Bore
222. Seal, "O" Ring (2-4 Servo Cover)
223. Cover, 2-4 Servo
224. Piston, 4th Apply
225. Ring, Oil Seal Outer (4th Apply Piston)
229. Seal, "O" Ring
232. Ring, Oil Seal Outer (2nd Apply Piston)
238. Seal, 2nd Apply Piston Ring
239. Spring, Servo Return
300. Ring, Servo Cover Retaining
301. 2nd Apply Piston Assembly

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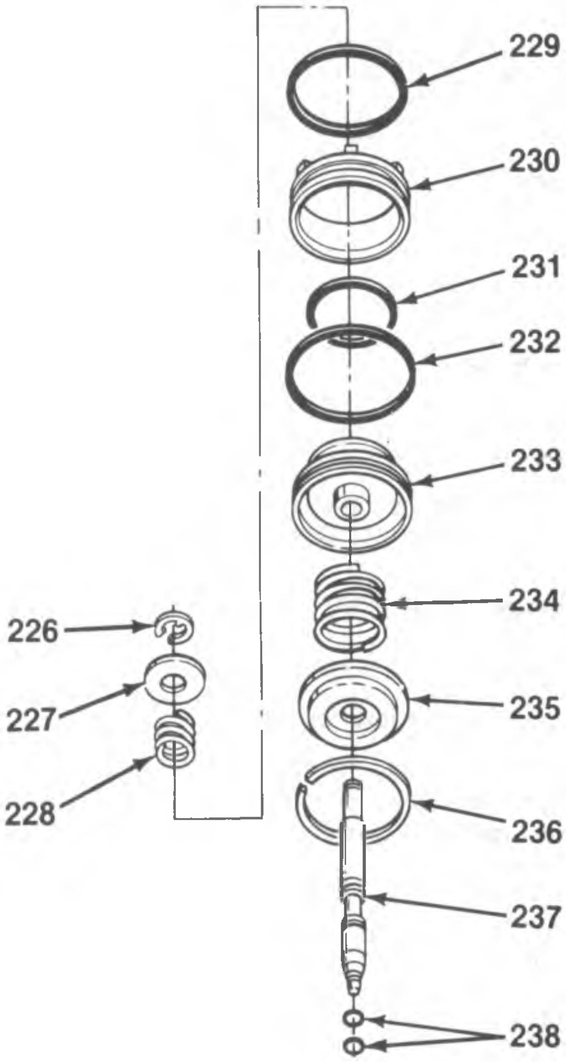
Figure 98—2-4 Servo (THM 700-R4)



226. Ring, Retainer (Apply Pin)
227. Washer, Servo Apply Pin
228. Spring, Servo Apply Pin
229. Seal, "O" Ring
230. Housing, Servo Piston Inner
231. Ring, Oil Seal Inner (2nd Apply Piston)
232. Ring, Oil Seal Outer (2nd Apply Piston)
233. Piston, 2nd Apply
234. Spring, Servo Cushion
235. Retainer, Servo Cushion Spring
236. Ring, Retainer (2nd Apply Piston)
237. Pin, 2nd Apply Piston
238. Seal, 2nd Apply Piston Pin

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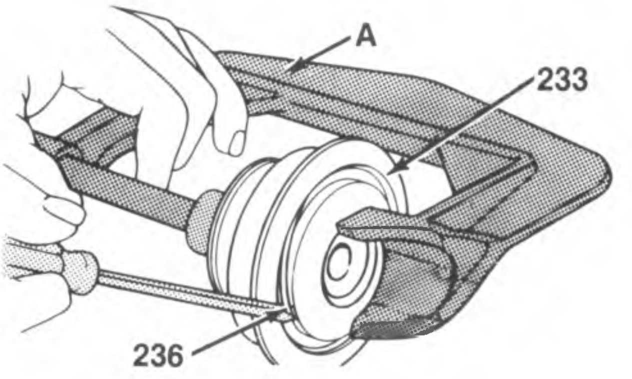
Figure 99—2nd Apply Piston Assembly (THM 700-R4)



A. J-22269-01
233. Piston, 2nd Apply
236. Ring, Retainer (2nd Apply Piston)

B-08729

Figure 100—Removing The Retainer Ring (THM 700-R4)

1. Housing (230) from the piston (233).
    - Seal from the housing.
2. Retainer ring from the pin (237).
    - Washer and the spring.
3. Pin (237).
    - Seals from the pin.
4. Retainer ring from the piston (233) using J-22269-01.
    - Retainer and the spring.
    - Seals from the piston.

Clean (Figures 98 and 99)

— All parts using solvent. Air dry.

Inspect (Figures 98 and 99)

— Pistons for porosity and damage.
— Seal grooves for damage.
— Cover for porosity and damage.
— Seals for nicks and cuts and binding in the seal grooves.
- If damage is found, check for the cause of the damage.

— Springs for kinks and bending.
— Pin for wear and burrs.

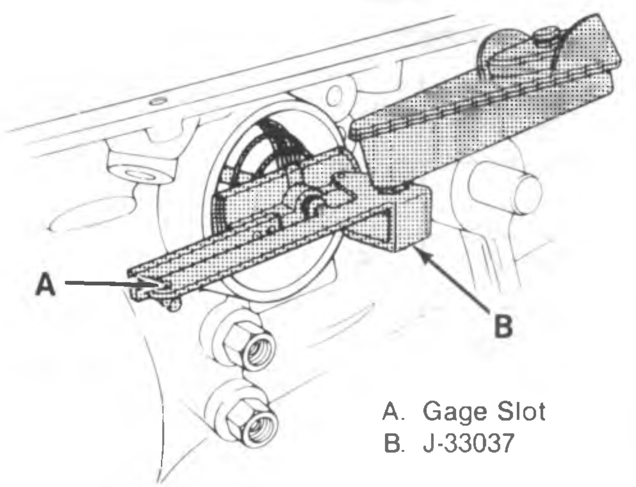
Important

- Check the case servo bore for damage and sharp edges.

Measure (Figures 101 and 102)

Tools Required:
J-33037 Band Apply Pin Tool
Vernier calipers or micrometer

1. Servo pin length (Figure 101).



A. Gage Slot
B. J-33037

Pin Is Preset At Factory And Must Not Be Re-adjusted

2-4 SERVO PIN SELECTION

PIN LENGTH		PIN I.D.
mm	INCH	
66.37-66.67	2.61-2.62	2 Rings
67.74-68.04	2.67-2.68	3 Rings
69.11-69.41	2.72-2.73	Wide Band

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Figure 101—Measuring The Servo Pin Length (THM 700-R4)

- Install pin and J-33037 as shown.
- Apply 11.0 N·m (110 in. lbs.) torque and check the gage slot (A).
    — If the white line is seen in the slot, the pin is correct.
    — If the white line is not seen in the slot, replace the pin using the chart.
- Remove the pin and J-33037.

2. Piston and housing dimension (Figure 102).
    - Measure the piston dimension (C).
    - Measure the housing dimension (D).
    - Check the chart for the proper dimensions.

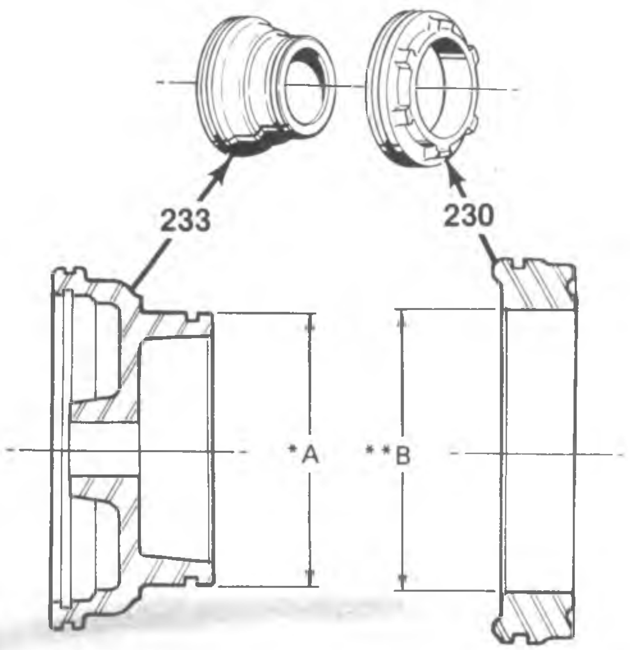
Assemble (Figures 99 and 100)

Tool Required:
J-22269-01 Piston Compressor

1. Retainer and the spring in the piston (233).
    - New seals on the piston.
    - Retainer ring using J-22269-01.
2. Pin (237).
    - New seals on the pin.
3. Retainer ring on the pin.
    - Spring and the washer.
4. Housing (230) on the piston (233).
    - New seal on the housing.

2ND APPLY PISTON & HOUSING APPLICATION

MODEL	PISTON DIMENSION *A	HOUSING DIMENSION **B
YT, Y6, YK	63.10 mm (2.48")	64.00 mm (2.52")
YC, YX	44.64 mm (1.78")	45.54 mm (1.79")
ALL OTHERS	57.85 mm (2.28")	58.74 mm (2.31")



230. Housing, Servo Piston (Inner)
233. Piston, 2nd Apply

B-08730

Figure 102—2nd Apply Piston And Housing Dimensions (THM 700-R4)

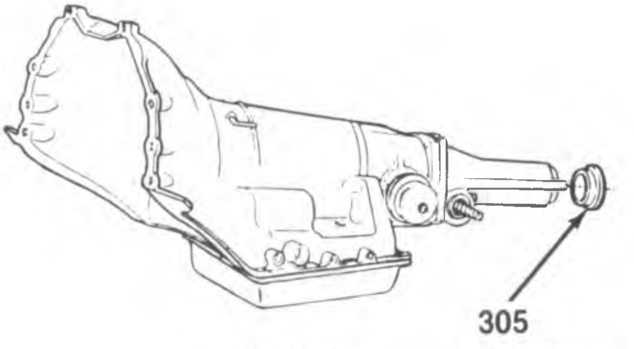
Important

- Be sure the proper seals are in the proper positions (Figure 98).

Install or Connect (Figures 97 and 98).

Tool Required:
J-29714 Servo Cover Compressor

1. Spring (239).
2. 2nd apply piston assembly (301).
3. 4th apply piston (224).
4. New seal on the cover.
5. Cover (223) and the retaining ring using J-29714.
    - Raise the transmission if needed. Refer to "Transmission Replacement" in this section.
    - Lower the vehicle.



305. Seal

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Figure 103—Rear Extension Oil Seal

6. Transmission fluid if needed. Refer to "Checking and Adding Fluid" in this section.

REAR EXTENSION OIL SEAL

Remove or Disconnect (Figure 103)

- Raise the vehicle.

1. Transmission fluid.
2. Propeller shaft. Refer to PROPELLER SHAFT (SEC. 4A).
3. Seal.

Install or Connect (Figure 103)

Tool Required:
J-21426 Extension Housing Oil Seal Installer (THM 350-C and THM 700-R4)
J-24057 Extension Housing and Pump Oil Seal Installer (THM 400)

1. New seal using J-21426 or J-24057 as needed.
    - Coat the outer edge of the seal case with a non hardening sealer.
2. Propeller shaft. Refer to PROPELLER SHAFT (SEC. 4A).
    - Lower the vehicle.
3. New transmission fluid. Refer to "Specifications" for the proper amount.

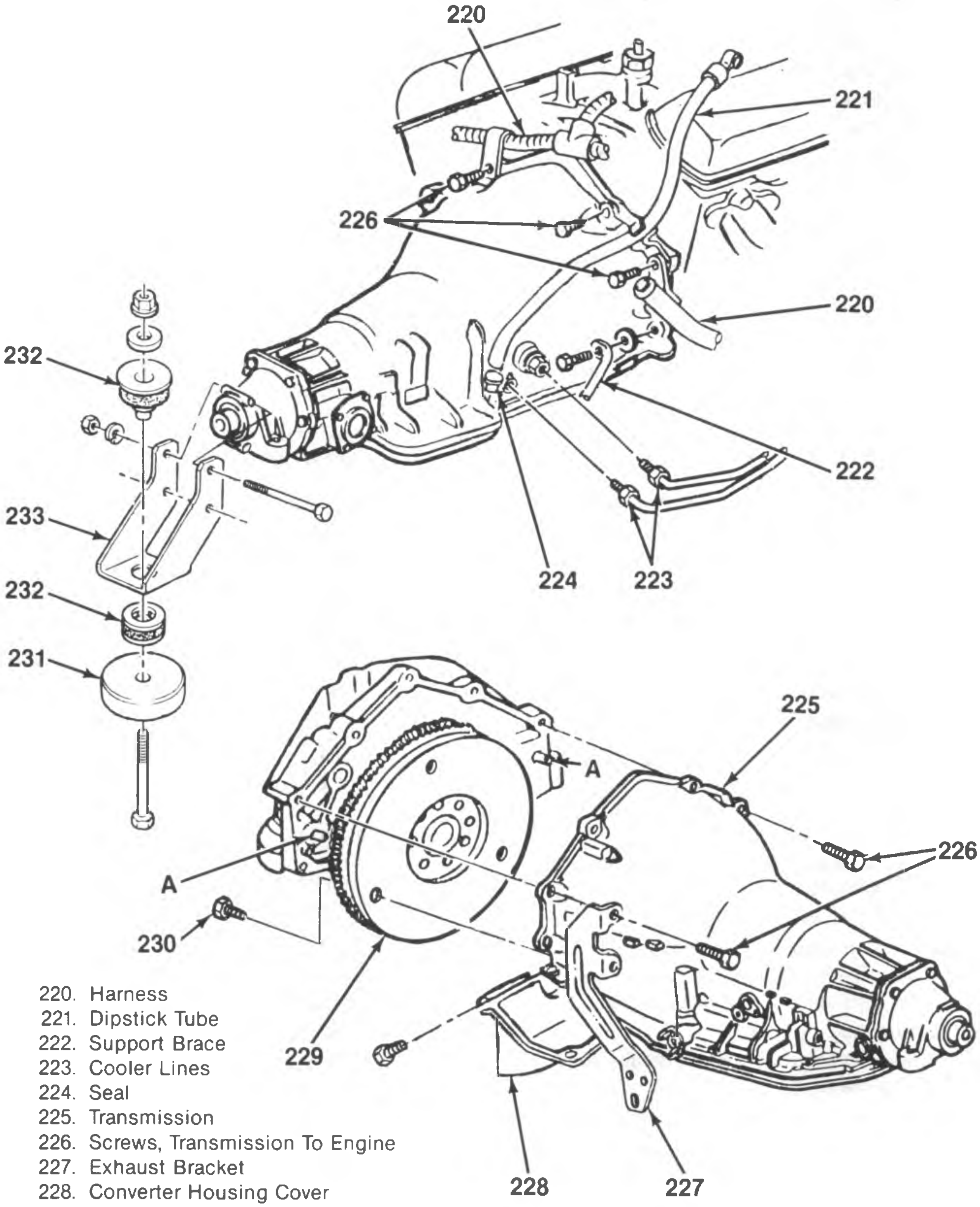
TRANSMISSION REPLACEMENT

If the transmission is being lowered for clearance, do steps 1–8 only.

Remove or Disconnect (Figure 104)

Tool Required:
J-21366 Converter Holding Strap

1. Negative battery cable.



220. Harness
221. Dipstick Tube
222. Support Brace
223. Cooler Lines
224. Seal
225. Transmission
226. Screws, Transmission To Engine
227. Exhaust Bracket
228. Converter Housing Cover
229. Flywheel
230. Screw, Flywheel To Torque Converter
231. Dampener
232. Insulator
233. Support

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Figure 104—Transmission And Components (Typical)

2. Air cleaner, and the TV or detent cable as used from the throttle linkage, if the transmission is being removed.
   - Raise the vehicle.
3. Transmission fluid.
4. Shift linkage.
5. Propeller shaft, refer to PROPELLER SHAFT (SEC. 4A).
   - Front propeller shaft, if used, from the transfer case.
6. The support bracket at the catalytic converter.
   - Any other components as needed for clearance.
   - Support the transmission, and the transfer case, if used, with a transmission jack.
7. Transmission crossmember.

Important

- Do not stretch or damage any cables, wires or other components when lowering the transmission.

8. Transmission far enough for clearance to reach other components.
9. Dipstick tube (221) and the seal.
   - Cover the opening in the transmission.
10. Speedometer cable.
11. Vacuum modulator line, if used.
12. Electrical connectors from the transmission.
13. Cooler lines (223).
    - Cap all openings in the transmission and the lines.
14. Transfer case shifter and move it aside, refer to TRANSFER CASE (SEC. 7D).
15. Dampener and the support, if used.
16. Transmission support braces (222).
    - Note the location of the braces, they must be installed in the same positions.
17. Converter housing cover (228).
    - Mark the flywheel and the torque converter alignment.
18. Screws (230).

Important

- Support the engine with a jack or hoist before disconnecting the transmission.

19. Screws (226).
    - Note the location of any brackets or clips and move them aside.
    - Slide the transmission straight back off the locating pins (A) and install J-21366.

Transmission (225) from the vehicle.

Clean (Figure 104)

- — Transmission case using a solvent dampened cloth, do not allow solvent to enter the transmission. Air dry.
- — All hardware and flywheel cover using solvent. Air dry.

Inspect (Figure 104)

- — All parts for wear and damage.
- — All seals and fittings for signs of leakage.
- — Torque converter for stripped or broken weld nuts or screw holes.
- — Transmission case for porosity.

Install or Connect (Figure 104)

Tool Required:
J-21366 Converter Holding Strap

- If the transmission was lowered for clearance only, do steps 13–20.

1. Transmission (225).
   - Be sure the torque converter is seated properly and that J-21366 is in place.
   - Support the transmission, and the transfer case if used, with a transmission jack.
   - Raise the transmission into place and remove J-21366.
   - Slide the transmission straight onto the locating pins (A) while lining up the marks on the flywheel and the torque converter.

Important

- The torque converter must be flush onto the flywheel and rotate freely by hand.

2. Screws (226).
   - All brackets, clips and harnesses must be in the positions they were removed from.
   - Do not install the dipstick tube or the transmission support brace screws.
3. Screws (230).

Tighten

- Screws finger tight to insure proper converter seating.
- Screws to 65 N·m (50 ft. lbs.).
- Remove the engine hoist or jack.

4. Converter housing cover (228).
   - Hook the cover under the lip of the engine oil pan.
5. The support and dampener, if used.
6. Transmission support braces (222).
   - The braces must be installed in the positions they were removed from.

7. Transfer case shifter, refer to TRANSFER CASE (SEC. 7D).
8. Cooler lines (223).
   - Uncover the openings.
   - Do not twist or bend the lines.
9. Vacuum modulator line, if used.
10. Speedometer cable.
11. Electrical connectors to the transmission.
12. Dipstick tube (221) with a new seal.
    - Uncover the opening and install the seal first.
    - Screw (226).
13. Transmission into place.

Important

- Do not pinch or damage any cables, wires or other components when raising the transmission.

14. Transmission crossmember and the transmission mount.
    - Any components that were removed for clearance.
    - Remove the transmission jack.
15. The support bracket at the catalytic converter.
16. Propeller shaft, refer to PROPELLER SHAFT (SEC. 4A).
    - Front propeller shaft to the transfer case, if used.
17. Shift linkage.
    - Lower the vehicle.
18. New transmission fluid.
19. Air cleaner, and the TV or detent cable, if removed.
20. Negative battery cable.

SPECIFICATIONS

FASTENER TORQUE

	N·m	Ft. Lbs.
Shift Linkage	25	19
TV-Detent Cable	10	7
Cooler Lines to Transmission	22	16
Cooler Lines to Radiator	27	20
Dipstick Tube to Alternator Bracket (G models)		
—Except with LBI Engine	43	32
—With LBI Engine	3.5	2.5
Transmission Support Braces		
—C and K Models	95	70
—G Models (to Engine)	57	42
(to Transmission)	37	27
Dampener Support	41	30
Dampener to Support	87	65
Converter Housing Cover		
—C and G Models Except with LBI Engine	10	7
With LBI Engine	35	25
—K Models		
Except 30/3500 with L25 Engine	35	25
30/3500 with L25 Engine	10	7
—P Models	10	7
Transmission to Engine	47	34.5
Converter to Flywheel	65	50
Crossmember to Frame		
—C, G and P Models	85	63
—K Models	70	52

Note:
LBI Engine - 4.3L (262 CID V6) Carbureted
L25 Engine - 4.8L (292 CID L6)

SPECIFICATIONS (CONT.)

LUBRICATION

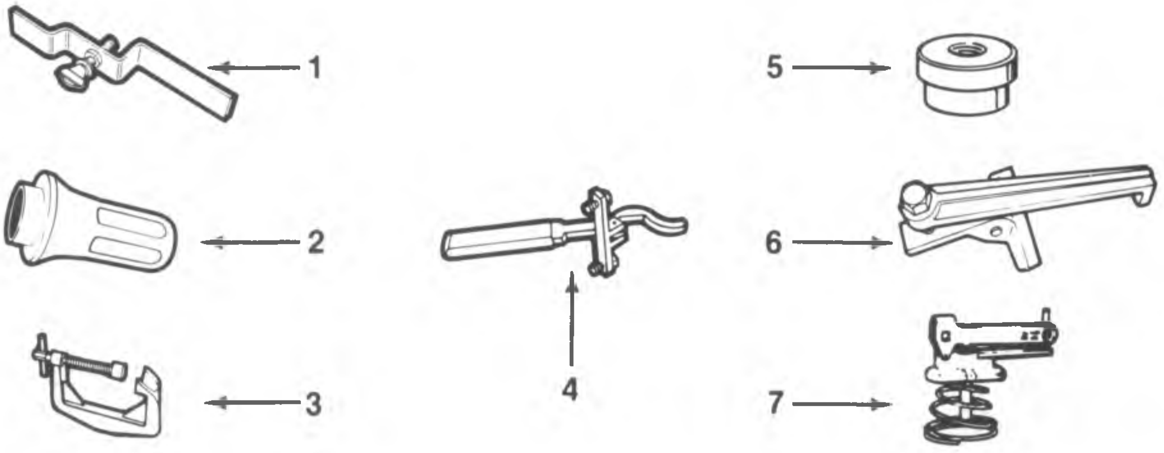
Capacity		
—Pan Removal		
THM 350-C	3.3 l.	6.3 pts.
THM 400	4 l.	9 pts.
THM 700-R4	4.7 l.	10 pts.
—Overhaul		
THM 350-C	9.5 l.	20 pts.
THM 400	10 l.	22 pts.
THM 700-R4	10.9 l.	23 pts.

Type Recommended DEXRON® II or equivalent

Note:

DO NOT OVERFILL. Refer to "Checking And Adding Fluid" in this section.

SPECIAL TOOLS



1. J-21366 Converter Holding Strap
2. J-21426 Extension Housing Oil Seal Installer (THM 350-C And THM 700-R4)
3. J-22269-01 Piston Compressor (THM 700-R4)
4. J-23069 Accumulator Cover Remover And Installer (THM 350-C)
5. J-24057 Extension Housing Oil Seal Installer (THM 400)
6. J-29714 Servo Cover Compressor (THM 700-R4)
7. J-33037 Band Apply Pin Tool (THM 700-R4)

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SECTION 7B

MANUAL TRANSMISSION

CONTENTS

DESCRIPTION

Manual transmissions are identified by: (A) the number of forward gears, and (B) the measured distance between centerlines of the mainshaft and the countergear.

3-SPEED 76MM

The three speed 76mm transmissions (RPO's M62 and M64) are in constant mesh and fully synchronized in all forward speeds with two sliding synchronizer sleeves.

Gearshift levers are either a floor-type or a steering column-type shift lever.

4-SPEED 89MM

The four speed 89mm transmission (RPO MY6) is an overdrive unit and is fully synchronized in all forward speeds.

The countershaft is not a press fit and is sealed in the front of the case with an expansion plug.

Gear shifting is done with a floor mounted shift control.

4-SPEED 117MM

The four speed 117mm transmission (RPO M20) uses a constant mesh first gear and synchronized second, third and fourth gears.

Gear shifting is done with a transmission cover mounted shift lever. The cover has a ball pin type interlock which stops the transmission from being shifted into two gears at one time.

INSPECTION

- Before repairing the transmission, check the clutch and shifting linkages to be sure the problem is in the transmission.
- If a hydraulic clutch is used, there are no adjustments for linkage or clutch pedal.

CONTROL LINKAGES

1. Check the clutch and shift linkage for dirt, wear, or damage.
2. Check clutch free pedal travel adjustment and adjust as necessary. Refer to CLUTCH (SEC. 7C).
3. Check the shift linkage for worn swivels, mounting brackets or damaged cordon shaft.
4. Check the shift linkage adjustment and adjust as necessary.

STEERING COLUMN SHIFT CONTROL

1. Remove the shift control rods from the column levers.
2. Check shift effort at the shift control lever knob.
3. If the effort is more than 9 N (2 lb.), adjust the steering column lower bearing. Refer to STEERING (SEC. 4B).
4. Lubricate all rod and swivel connections and recheck shift effort.
5. If shift linkage is free from binding, check for 0.13m mm (0.005 in.) end play between the column levers and control lever.
6. Connect the control rods and check the steering column control levers for alignment. In neutral, the column control lever tangs should line up with the slot in the relay lever.

CLUTCH SPIN DOWN TIME

1. Run the engine at a normal idle with the transmission in neutral and the clutch engaged.
2. Disengage the clutch, wait nine seconds and shift the transmission into reverse.
3. If a grinding noise is heard, check the clutch for the problem. Refer to CLUTCH (SEC. 7C).

TRANSMISSION SHIFT EFFORT

1. Remove the shift rods at the transmission.
2. Line up the problem gear by shifting into the gear and back to neutral.
3. Check the effort needed to shift into the problem gear using a torque wrench.
4. If the shift effort is more than 5 N·m (50 in. lbs.) and the shift lever shaft is clean and not damaged, add an anti-chatter lubricant, (positraction additive) to the transmission.
5. If the shift effort is still high, repair the transmission as needed.

DIAGNOSIS OF MANUAL TRANSMISSION

The following diagnosis information is to be used only as a guide to locating a transmission problem.

PROBLEM	POSSIBLE CAUSE	CORRECTION
Leaks Lubricant	1. Lubricant level too high. 2. Main drive bearing retainer or gasket loose or damaged. 3. Side cover or gasket loose or damaged. 4. Rear extension seal damaged. 5. Countershaft loose in case.	1. Drain to correct level. 2. Tighten or replace. 3. Tighten or replace. 4. Replace. 5. Replace case.
Hard Shifting, Column Shift — Refer to "Transmission Shift Effort" 7B-2	1. Levers binding — dirty or damaged. 2. Lever end play more than 0.13mm (0.005 in.).	1. Clean and lubricate or replace. 2. Adjust. Refer to STEERING COLUMN (SEC. 3B4).
Noisy Shifting	1. Shift linkage out of adjustment or damaged. 2. Clutch linkage out of adjustment or damaged. 3. Synchronizers or gears worn or damaged.	1. Adjust or replace. 2. Adjust or replace. Refer to CLUTCH (SEC. 7C). 3. Repair the transmission.
Noisy Neutral	1. Shift linkage out of adjustment or damaged. 2. Pilot bearing worn or damaged. 3. Main drive gear or countergear bearings worn or damaged.	1. Adjust or replace. 2. Replace. Refer to CLUTCH (SEC. 7C). 3. Repair the transmission.
Noisy Operation	1. Lubricant level low. 2. Shift linkage damaged. 3. Synchronizers worn or damaged. 4. Bearings worn or damaged. 5. Gears worn or damaged.	1. Fill to correct level. 2. Replace. 3. Repair the transmission. 4. Repair the transmission. 5. Repair the transmission.
Slips Out Of Gear	1. Shift lever seal stiff. 2. Shift linkage out of adjustment or binding. 3. Pilot bearing loose or damaged. 4. Dirt betwen the clutch housing and transmission. 5. Transmission loose. 6. Main drive gear retainer loose or damaged. 7. Transmission not aligned.	1. Replace. 2. Adjust or replace. 3. Replace. Refer to CLUTCH (SEC. 7C). 4. Clean the mating surfaces. 5. Tighten. 6. Tighten or replace. 7. Align.

SECTION 7B1

3 SPEED 76MM TRANSMISSION

CONTENTS

SUBJECT **PAGE**

ON VEHICLE SERVICE

DRAIN AND FILL

Remove or Disconnect (Figure 1)

1. The filler plug (102).
2. The drain plug (103).
3. Transmission oil.
    - Catch the oil in a pan.

Install or Connect (Figure 1)

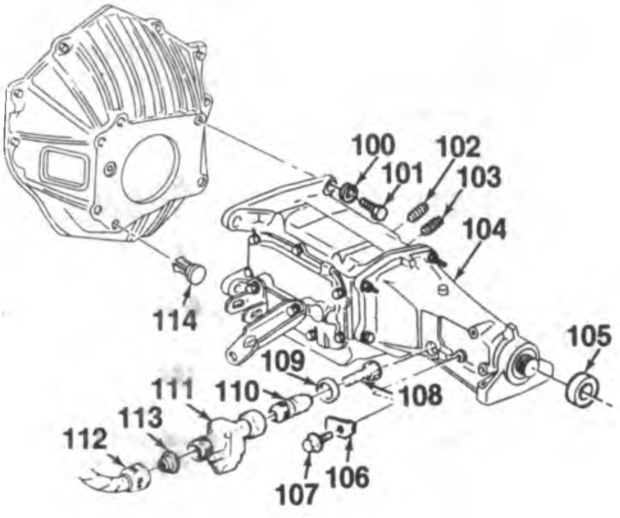
1. The drain plug (103).
2. New transmission oil.
    - Fill to the level of the fill plug hole. Refer to MAINTENANCE AND LUBRICATION (SEC. 0B0.
3. The filler plug (102).

REAR EXTENSION SEAL

Remove or Disconnect (Figure 1)

- Raise the vehicle.

1. Transmission oil.
2. Propeller shaft. Refer to PROPELLER SHAFT (SEC. 4A).



100. Spring Washer
101. Screw
102. Filler Plug
103. Drain Plug
104. Transmission
105. Seal
106. Retainer
107. Screw
108. Gear
109. Seal
110. Sleeve
111. Adapter
112. Cable
113. Seal
114. Plug

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Figure 1—Transmission and Components

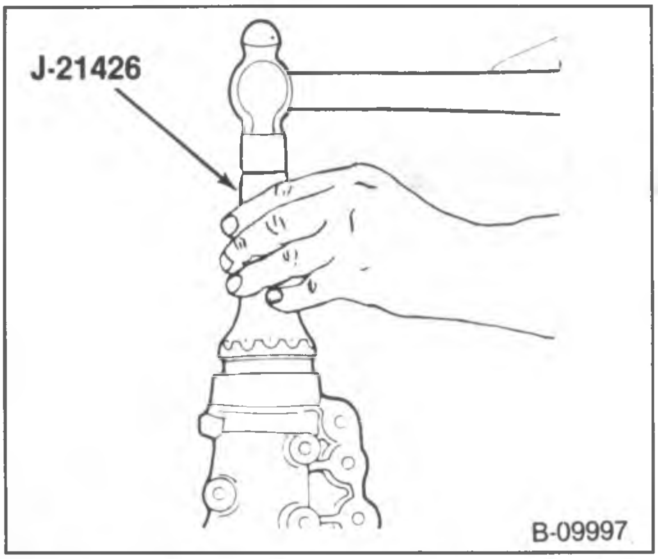


Figure 2—Rear Extension Seal Installation

3. Seal (105).

Install or Connect (Figure 1)

Tool Required:
J-21426, Rear Extension Seal Installer.

1. Locking compound on the outside of a new seal (105).
2. New seal (105), use J-21426 (figure 2).
   - Fill between the seal lips with chassis grease.
3. Propeller shaft. Refer to PROPELLER SHAFT (SEC. 4A).
4. New transmission oil. Refer to MAINTENANCE AND LUBRICATION (SEC. 0B).
   - Lower the vehicle.

SPEEDOMETER DRIVEN GEAR

Remove or Disconnect (Figure 1)

- Raise the vehicle.

1. Speedometer cable (112) and the seal (113).
2. Adapter (111) if used.
3. Retainer (106) and the screw (107) if used.
4. Sleeve (110).
5. Seal (109).
6. Gear (108).

Install or Connect (Figure 1)

- Put a thin coat of transmission oil on the gear and the seal.

1. Gear (108).
2. New seal (109) onto the sleeve (110).
3. Sleeve (110).
4. Retainer (106) and the screw (107) if used.
5. Adapter (111) if used.
6. New seal (113) and the speedometer cable (112).
   - Lower the vehicle.

SHIFT LINKAGE

STEERING COLUMN LINKAGE

Remove or Disconnect (Figures 3 and 4)

- Raise the vehicle.

1. Retainer (123).
2. Shift rod (120 or 124) from the column.
3. Spring (122) and the spacer (121).
4. Screw (129) and the washer (130).
5. Shift rod (120 or 124) and the swivel (131) from the transmission.
6. Swivel (131).
7. Retainer (127).
8. Nuts (136), the spring washers (137) and the screws (138).
9. Bracket (135).
10. Insulator (134), the washer (133) and the spring (132).
11. Cross lever (125).

Install or Connect (Figure 3)

- Put a thin coat of grease on the insulator.

1. Cross lever (125).
2. The spring (132), the washer (133) and the insulator (134).
3. Bracket (135).
4. Screws (138), new spring washers (137) and the nuts (136).
5. New retainer (127).
6. Swivel (131) onto the shift rod (120 or 124).
7. Shift rod (120 or 124) and the swivel (131) to the transmission.

Important

- The washer must stand off the lever as shown.

8. Washer (130) and the screw (129) loosely.
9. Spacer (121) and the spring (122).
10. Shift rod (120 or 124) to the column.
11. New retainer (123).
    - Lower the vehicle.

FLOOR SHIFT LINKAGE

Remove or Disconnect (Figure 5)

1. Retainer (148).
2. Washer (149).
3. Shift rod (150 or 156) from the shift control (146).

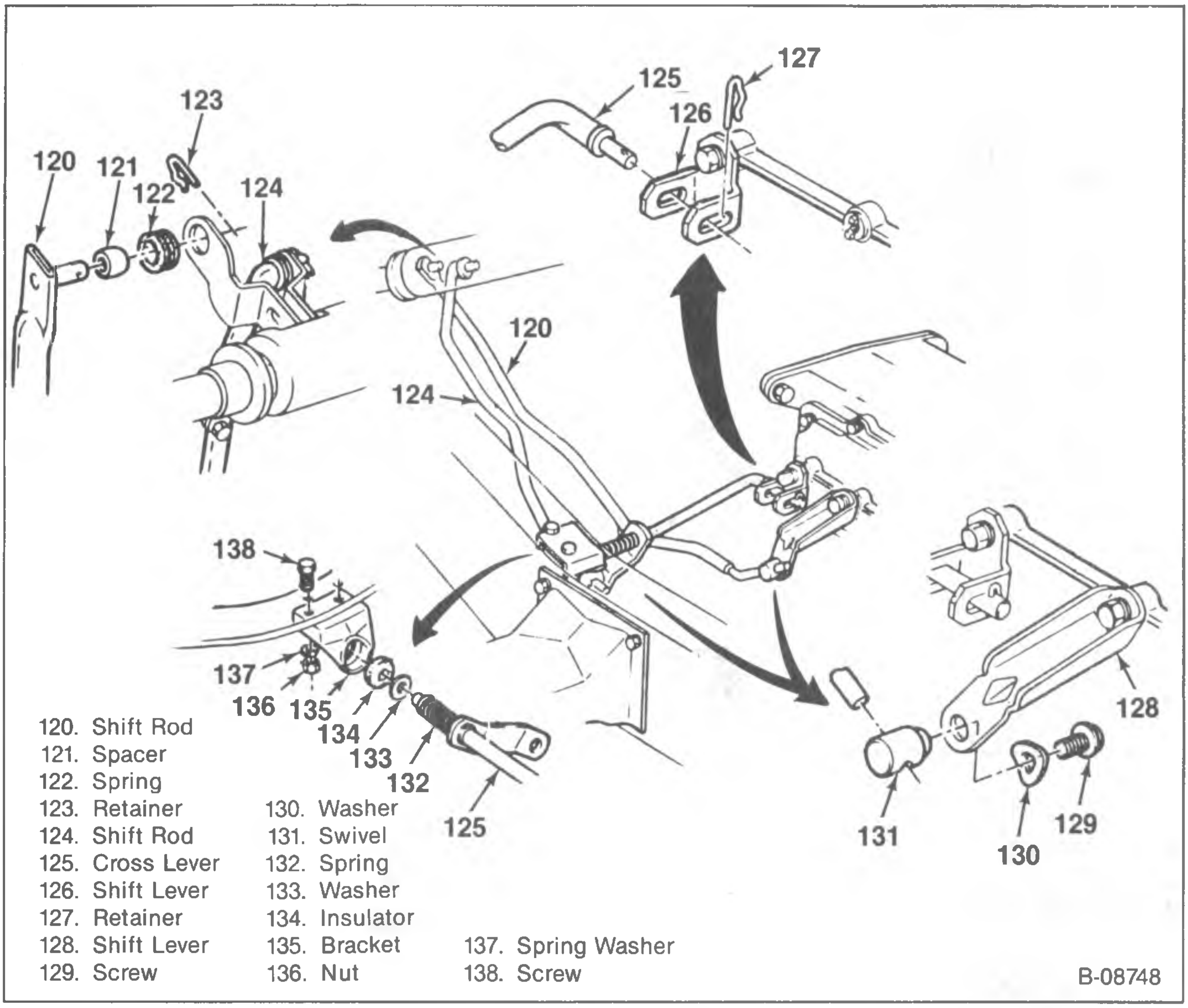


Figure 3—Column Shift Linkage

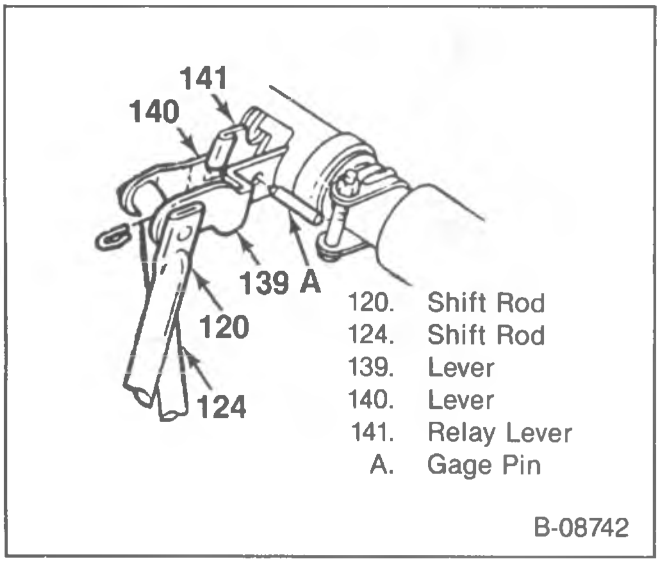


Figure 4—Column Linkage Adjustment

4. Retainer (154).
5. Washer (155).
6. Shift rod (150 or 156) from the transmission.
7. Nuts (151 and 153) and the swivel (152).

Install or Connect (Figure 5)

1. Nuts (151 and 153) and the swivel (152).
    - Do not tighten.
2. Shift rod (150 or 156) to the transmission.
3. Washer (155).
4. New retainer (154).
5. Shift rod (150 or 156) to the shift control (146).
6. Washer (149).
7. New retainer (148).
    - Adjust the shift rods.

126. Shift Lever
128. Shift Lever
145. Control Lever
146. Shift Control
147. Control Lever
148. Retainer
149. Washer
150. Shift Rod
151. Nut
152. Swivel
153. Nut
154. Retainer
155. Washer
156. Shift Rod
A. Gage Pin

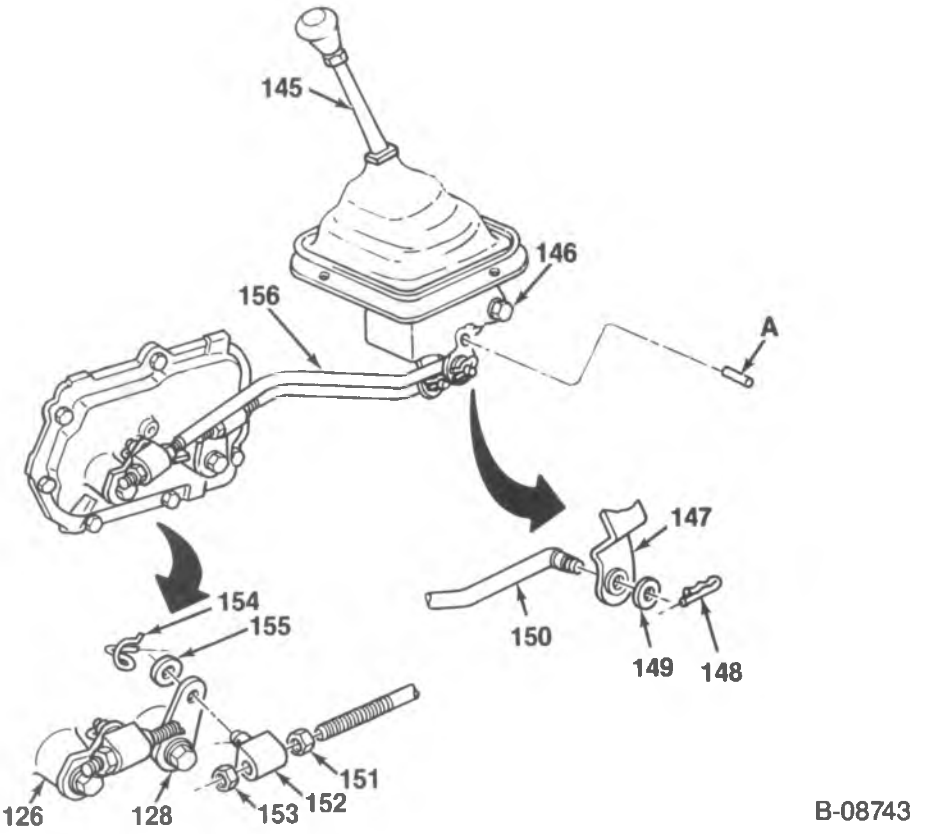


Figure 5—Floor Shift Linkage

FLOOR SHIFT CONTROL

Remove or Disconnect (Figure 6)

1. Knob (160) and the nut (161).
2. Screws (170) and the boot (162).
3. Shift lever (145).
   - Slide a piece of shim stock between the lever and the control to release the lever.
4. Shift rods at the control (figure 5).
5. Screws (168) and the fitting (169).
6. Shift control (146).
7. Screws (167) and the spring washers (166).
8. Nuts (165) and the spring washers (164).
9. Bracket (163).

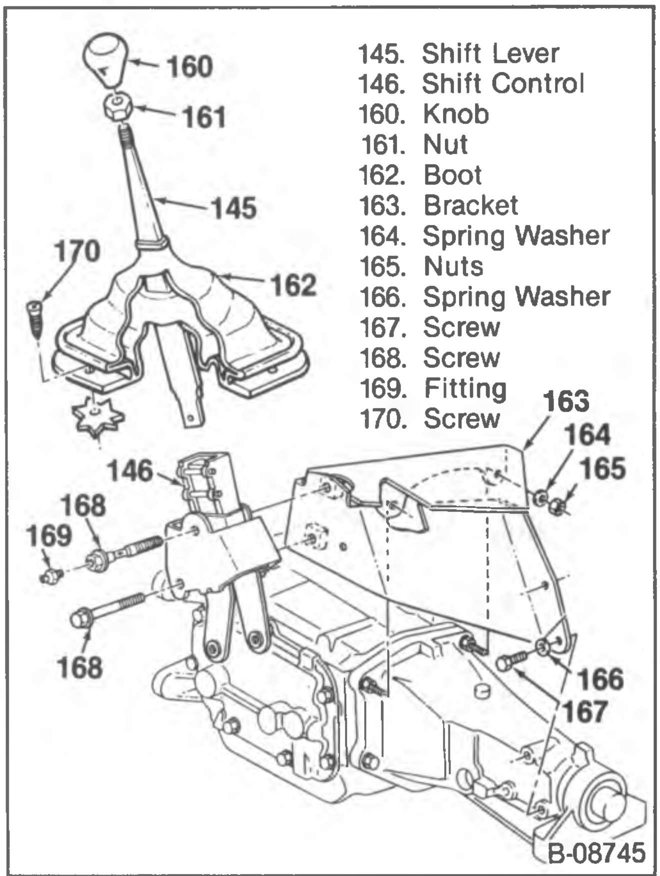
Install or Connect (Figure 6)

1. Bracket (163).
2. New spring washers (164) and the nuts (165).
3. New spring washers (166) and the screws (167).
4. Shift control (146).

Important

- The screw with the lubrication fitting must go into the top hole.

5. Fitting (170) and the screws (168).
6. Shift rods at the control (figure 5).



145. Shift Lever
146. Shift Control
160. Knob
161. Nut
162. Boot
163. Bracket
164. Spring Washer
165. Nuts
166. Spring Washer
167. Screw
168. Screw
169. Fitting
170. Screw

Figure 6—Floor Shift Control

7. Shift lever (145).
    - Wipe the lever with a damp rag and slide it into place.
8. Boot (162) and the screws (171).
9. Nut (161) and the knob (160).
10. Lubricate the shift control and the shift linkage. Refer to MAINTENANCE AND LUBRICATION (SEC. 0B).
    - Adjust the shift rods.

SHIFT LINKAGE ADJUSTMENT

COLUMN SHIFT LINKAGE

Adjust (Figure 3)

- The first and reverse shift rod (120) must be adjusted before the second and third shift rod (124).

1. Loosen the screw (129) if needed.
2. Put the transmission lever in place.
    — For shift rod (120), move the shift lever (128) into reverse, the front detent.
    — For shift rod (124), move the shift lever (126) into neutral, to the front detent then back one.
3. Put the column lever in place.
    — For shift rod (120), move the column lever into "Reverse" and lock the steering column.
    — For shift rod (124), move the column lever into "Neutral" and put a 0.249-0.250 in. gage pin through the levers (139 and 140) and the relay lever (141) (figure 4).
4. Hold the shift rod (120 or 124) down tightly in the swivel (131) and tighten the screw (129).
    - Unlock the steering column, or take the gage pin out.
5. Lubricate all rod and swivel connections. Refer to MAINTENANCE AND LUBRICATION (SEC. 0B).

FLOOR SHIFT LINKAGE

Adjust (Figure 5)

1. Loosen the nuts (151 and 153) if needed.
2. Move the shift control level (145) into "Neutral".
3. Move the shift levers (126 and 128) into neutral, to the front detent then back one.
4. Put a 0.249-0.250 in. gage pin through the control levers (147).
5. Hold the shift rods (150 and 156) forward tightly in the swivels (152) and tighten the nuts (151 and 153).
6. Remove the gage pin and lubricate the shift control. Refer to MAINTENANCE AND LUBRICATION (SEC. 0B).

SIDE COVER

Remove or Disconnect (Figure 7)

- Raise the vehicle.

1. Transmission oil.
2. Harness connectors (178).
3. Shift rods (figure 3 or 5).
    - Move the shift levers into neutral, to the front detent then back one.
4. Screws (183), spring washers (182) and the brackets (181).
5. Side cover (180) and the gasket (179).
    - Scrape all gasket material from the cover and the case.

Install or Connect (Figure 7)

1. New gasket (179) and the side cover (180).
    - The shift levers must be in neutral.
2. Brackets (181), new spring washers (182) and the screws (183).
3. Harness connectors (178).
4. Shift rods (figures 3 or 5).
5. New transmission oil. Refer to MAINTENANCE AND LUBRICATION (SEC. 0B).
    - Lower the vehicle and adjust the shift rods.

TRANSMISSION REPLACEMENT

Remove or Disconnect (Figure 1)

- Raise the vehicle.

1. Transmission oil.
2. Shift rods.
    - Floor shift control is used.
3. Parking brake lever and controls if used, refer to BRAKES (SEC. 5).
4. Propeller shaft. Refer to PROPELLER SHAFT (SEC. 4A).
5. Speedometer cable (112) and the seal (113).
6. Wiring harness.
7. Exhaust pipes. Refer to EXHAUST (SEC. 6F).
    - Support the transmission with a jack.
8. Any parts if needed for clearance.
9. Crossmember.

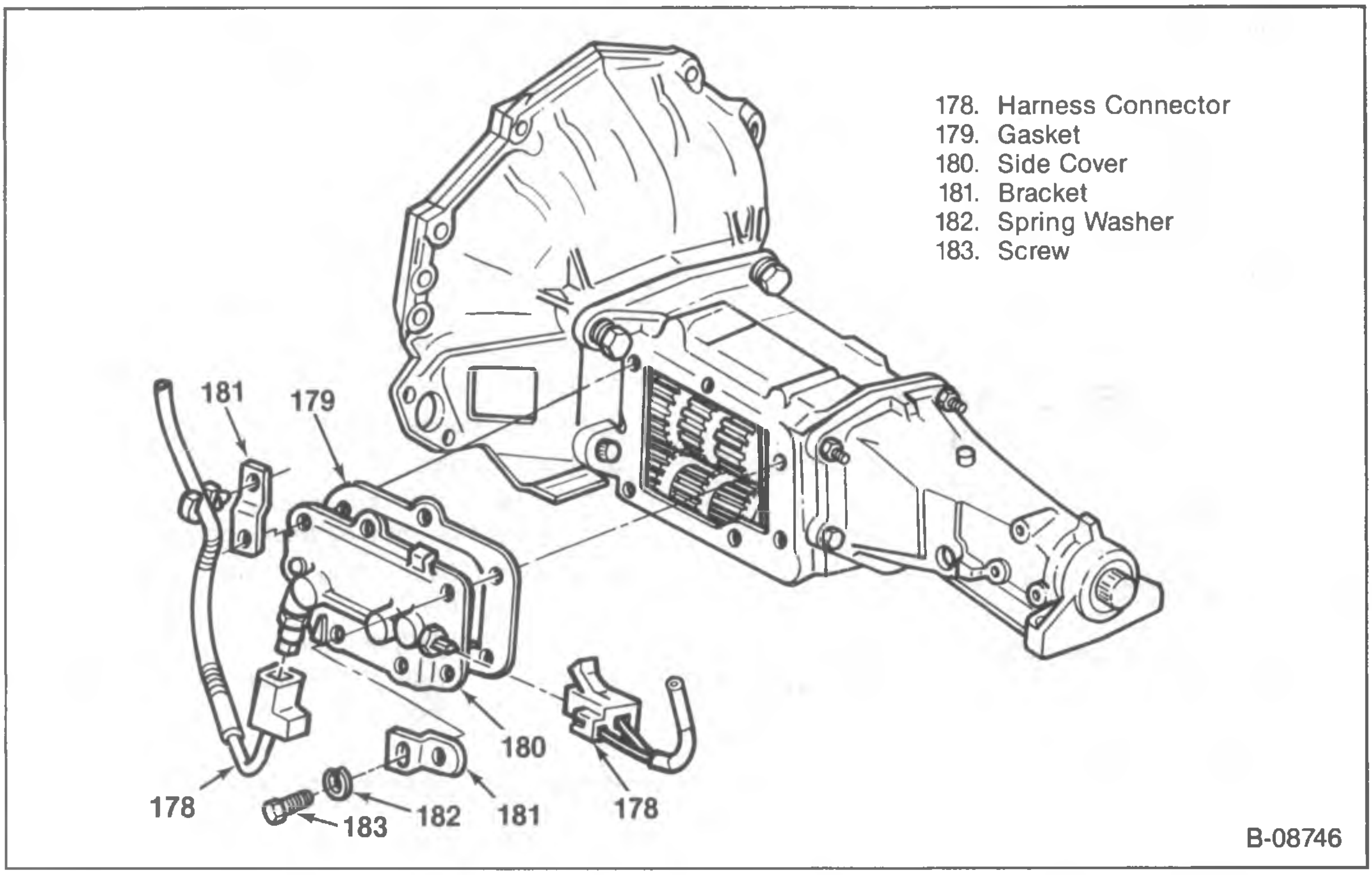


Figure 7—Side Cover

Important

- Do not let the transmission hang from the clutch.
- Pull the transmission straight back on the clutch hub splines.

10. Screws (101) and the spring washers (100).
    - Support the clutch release bearing.
11. Transmission (104).
12. Plugs (114), if they are loose or damaged.
    - Note the location of the plugs before removing.

Install or Connect (Figure 1)

1. New plugs (114) if needed.
    - Put a thin coat of high temperature grease on the main drive gear splines.

Important

- Do not force the transmission into the clutch.
- Do not let the transmission hang from the clutch.

2. Transmission (104).
    - Shift the transmission into high gear before installing.
    - Leave the jack under the transmission to support it.
3. New spring washers (100) and the screws (101).
4. Crossmember.
    - Remove the jack.
5. Any parts that were removed for clearance.
6. Exhaust pipes. Refer to EXHAUST (SEC. 6F).
7. Wiring harness.
8. New seal (113) and the speedometer cable (112).
9. Propeller shaft. Refer to PROPELLER SHAFT (SEC. 4A).
10. Parking brake lever and controls if used. Refer to BRAKES (Sec. 5).
11. Shift rods.
    - Floor shift control, if used..
    - Adjust the shift rods.
12. New transmission oil. Refer to MAINTENANCE AND LUBRICATION (SEC. 0B).
    - Lower the vehicle.

SPECIFICATIONS

FASTENER TORQUE

Plug, Drain and Fill	23 N·m	17 ft. lbs.
Cross Lever Bracket Screw	25 N·m	18 ft. lbs.
Shift Rod Swivel Screw (Column Shift)	25 N·m	18 ft. lbs.
Shift Rod Swivel Screw (Floor Shift)	14 N·m	10 ft. lbs.
Control Bracket Screw	33 N·m	24 ft. lbs.
Control Mounting Screw	32 N·m	23 ft. lbs.
Control Lubrication Screw	45 N·m	33 ft. lbs.
Side Cover Screw	20 N·m	15 ft. lbs.
Transmission to Clutch Housing Screw	100 N·m	74 ft. lbs.
Transmission to Mount Screw	47 N·m	35 ft. lbs.
Crossmember to Mount Screw	54 N·m	40 ft. lbs.
Crossmember to Frame Screw	75 N·m	55 ft. lbs.

LUBRICATION

Capacity	1.5 L	1.6 qts.
Type Recommended	API GL5 SAE 80W90	

SPECIAL TOOLS

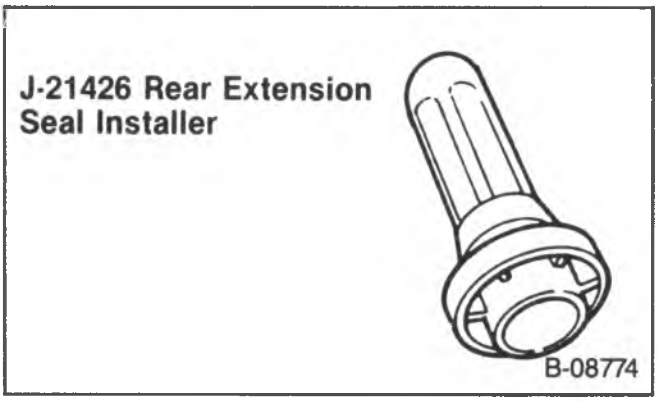


Figure 8—Special Tools

SECTION 7B2

4-SPEED 89MM TRANSMISSION

CONTENTS

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ON VEHICLE SERVICE

DRAIN AND FILL

↔ **Remove or Disconnect (Figure 1)**

1. The filler plug (104).
2. The drain plug (113).
3. Transmission oil.
    - Catch the oil in a pan.

→← **Install or Connect (Figure 1)**

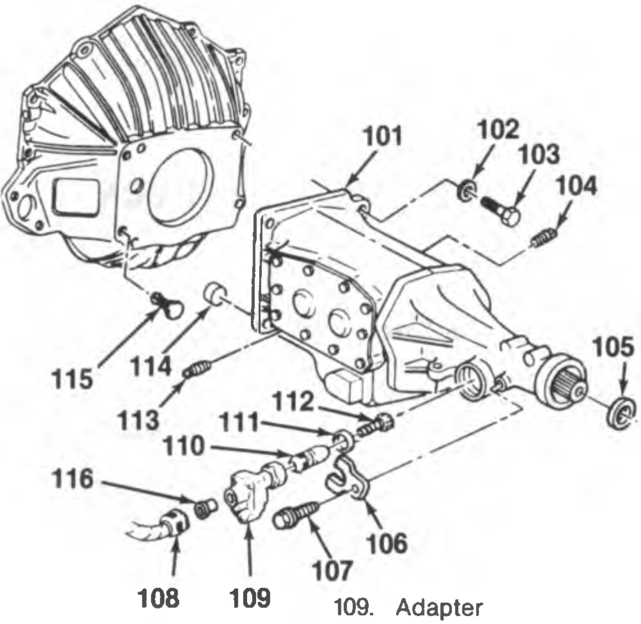
1. The drain plug (113).
2. New transmission oil.
    - Fill to the level of the filler plug hole. Refer to "Lubrication" in this section.
3. The filler plug (104).

REAR EXTENSION SEAL

↔ **Remove or Disconnect (Figure 1)**

- Raise the vehicle.

1. Transmission oil.
2. Propeller shaft. Refer to PROPELLER SHAFT (SEC. 4A).
3. Seal (105).



101.	Transmission
102.	Spring Washer
103.	Screw
104.	Filler Plug
105.	Rear Extension Seal
106.	Retainer
107.	Screw
108.	Speedometer Cable
109.	Adapter
110.	Sleeve
111.	Seal
112.	Gear
113.	Drain Plug
114.	Expansion Plug
115.	Plug
116.	Seal

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Figure 1—Transmission and Components

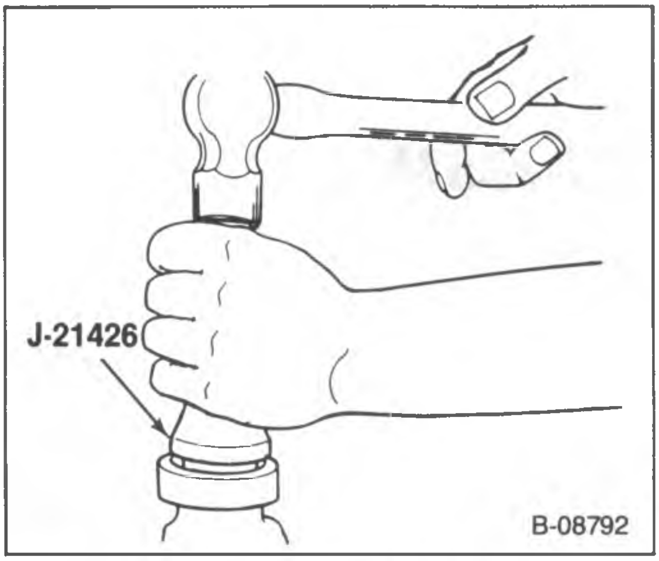


Figure 2—Rear Extension Seal Installation

Install or Connect (Figure 1)

Tool Required:
J-21426, Rear Extension Seal Installer.

1. Locking compound on the outside of a new seal (105).
2. New seal (105), use J-21426 (figure 2).
    - Fill between the seal lips with chassis grease.
3. Propeller shaft. Refer to PROPELLER SHAFT (SEC. 4A).
4. New transmission oil. Refer to "Drain and Fill" in this section.
    - Lower the vehicle.

SPEEDOMETER DRIVEN GEAR

Remove or Disconnect (Figure 1)

- Raise the vehicle.

1. Speedometer cable (108) and the seal (116).
2. Adapter (109) if used.
3. Retainer (106) and the screw (107) if used.
4. Sleeve (110).
5. Seal (111).
6. Gear (112).

Install or Connect (Figure 1)

- Put a thin coat of transmission oil on the gear and the seal.

1. Gear (112).
2. New seal (111) onto the sleeve (110).
3. Sleeve (110).
4. Retainer (106) and the screw (107) if used.
5. Adapter (109) if used.
6. New seal (116) and the speedometer cable (108).
    - Lower the vehicle.

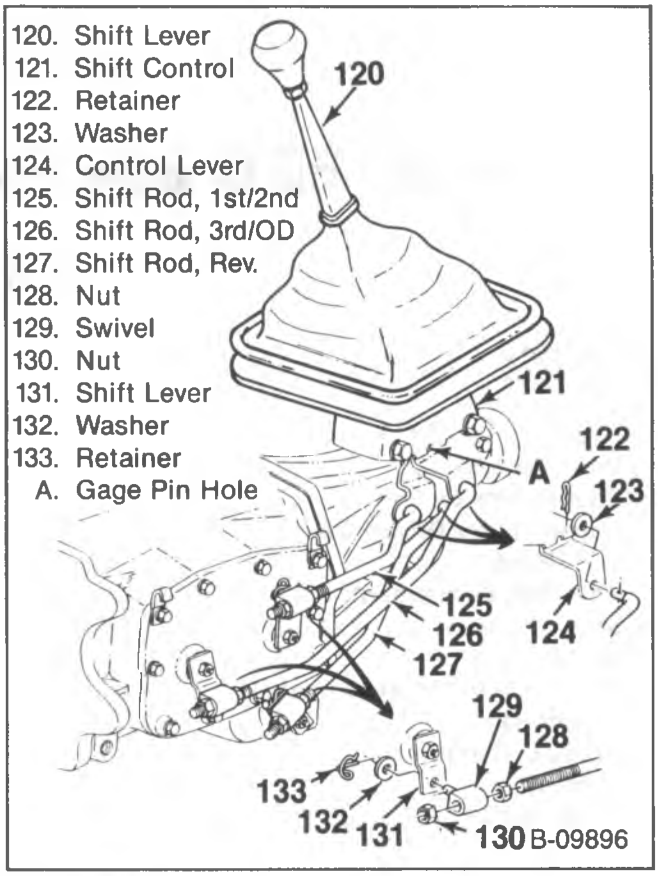


Figure 3—Shift Rods

SHIFT RODS

Remove or Disconnect (Figure 3)

1. Retainer (122).
2. Washer (123).
3. Shift rod (125, 126 or 127) from the shift control lever (124).
4. Retainer (133).
5. Washer (132).
6. Shift rod (125, 126 or 127) from the shift lever (131).
7. Nuts (128 and 130) and the swivel (129).

Install or Connect (Figure 3)

1. Nuts (128 and 130) and the swivel (129).
    - Do not tighten.
2. Shift rod (125, 126 or 127) to the shift lever (131).
3. Washer (132).
4. New retainer (133).
5. Shift rod (125, 126 or 127) to the shift control lever (124).
6. Washer (123).

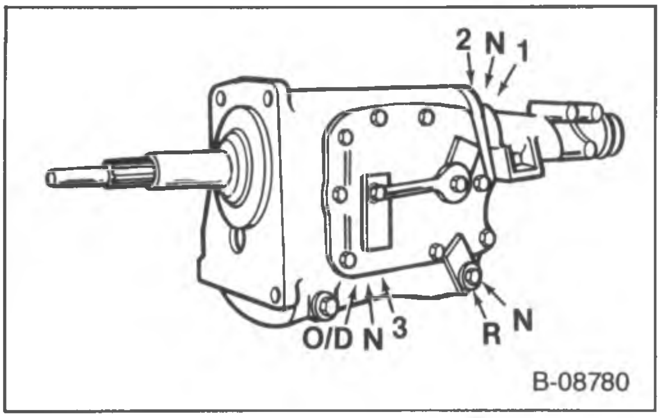


Figure 4—Transmission Shift Pattern

7. New retainer (122).
    - Adjust the shift rods.

SHIFT CONTROL

Remove or Disconnect (Figures 4, 5 and 6)

1. Knob (140) and the nut (141).
2. Screws (151) and the boot (142).
3. Plate (152) if used.
4. Shift lever (120).
    - Slide a piece of shim stock between the lever and the control to release the lever.
5. Shift rods at the control (figure 3).
6. Gear sensing switch (145).
7. Screws (143) and the fitting (144).
8. Washers (153) if used.
9. Shift control (121).
10. Screws (146) and the spring washers (147).
11. Nuts (149) and the spring washers (148) if used.
12. Bracket (150).

Install or Connect (Figures 4, 5, and 6)

1. Bracket (150).
2. New spring washers (148) and the nuts (149) if used.
3. New spring washers (147) and the screws (146).
4. Shift control (121).

Important

- The screw with the lubrication fitting must go into the top hole.
- The lubrication fitting must point in the direction shown (A).

5. Washers (153) if used.
6. Fitting (144) and the screws (143).
7. Gear sensing switch (145).
8. Shift rods at the control (figure 3).
9. Shift lever (145).
    - Wipe the lever with a damp rag and slide it into place.
10. Boot (142) and the screws (151).
    - The plate (152) if used.
11. Nut (141) and the knob (140).
12. Lubricate the shift control and the shift rods, refer to MAINTENANCE AND LUBRICATION (SEC. 0B).
    - Adjust the shift rods.

SHIFT ROD ADJUSTMENT

Adjust (Figure 3)

1. Loosen the nuts (128 and 130) if needed.
2. Move the shift control lever (120) into "Neutral."
3. Move the shift levers (125, 126 and 127) into neutral, (figure 4).
4. Put a 0.249-0.250 in. gage pin through the control levers (124).
5. Hold the shift rods (125, 126 and 127) forward tightly in the swivels (129) and tighten the nuts (128 and 130).
6. Remove the gage pin and lubricate the shift control. Refer to MAINTENANCE AND LUBRICATION (SEC. 0B).

SIDE COVER

Remove or Disconnect (Figure 7)

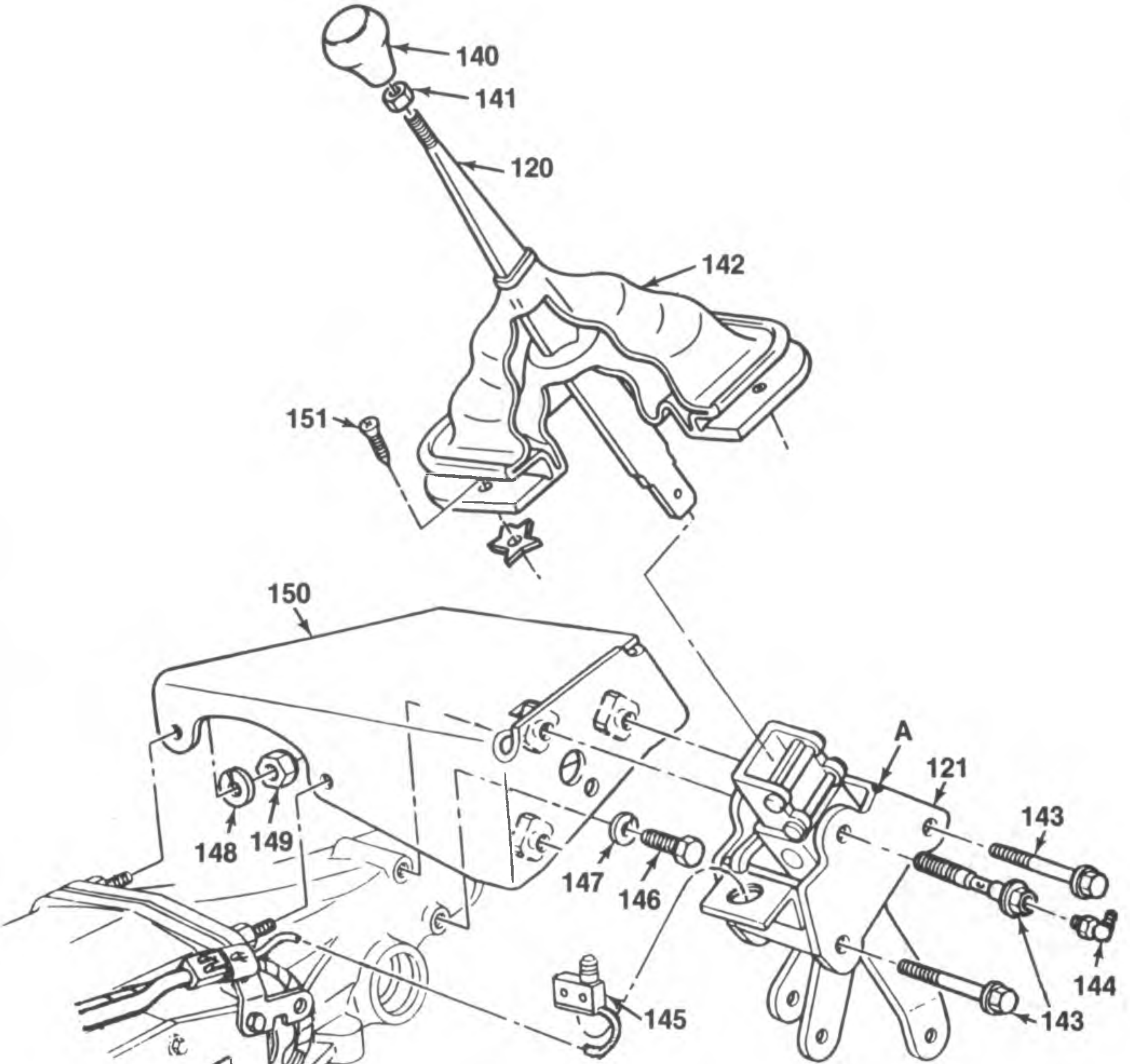
- Raise the vehicle.

1. Transmission oil.
2. Harness (160).
3. Shift rods (figure 3).
    - Move the shift levers into neutral.
4. Nut (166) and the washer (165).
5. Reverse shift lever (164).
6. Seal (163).
7. Screws (173), the spring washers (174) and the brackets (175).
8. Side cover (169).
9. Reverse detent ball (162) and the spring (161).

Important

- Note the positions of the shift forks before removing.

10. Shift forks (167).
11. Gasket (168).
    - Scrape all gasket material from the cover and the case.



120. Shift Lever
121. Shift Control
140. Knob
141. Nut
142. Boot
143. Screw
144. Fitting
145. Gear Sensing Switch
146. Screw
147. Spring Washer
148. Spring Washer
149. Nut
150. Bracket
151. Screw
A. Fitting Direction

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Figure 5—G Truck Shift Control

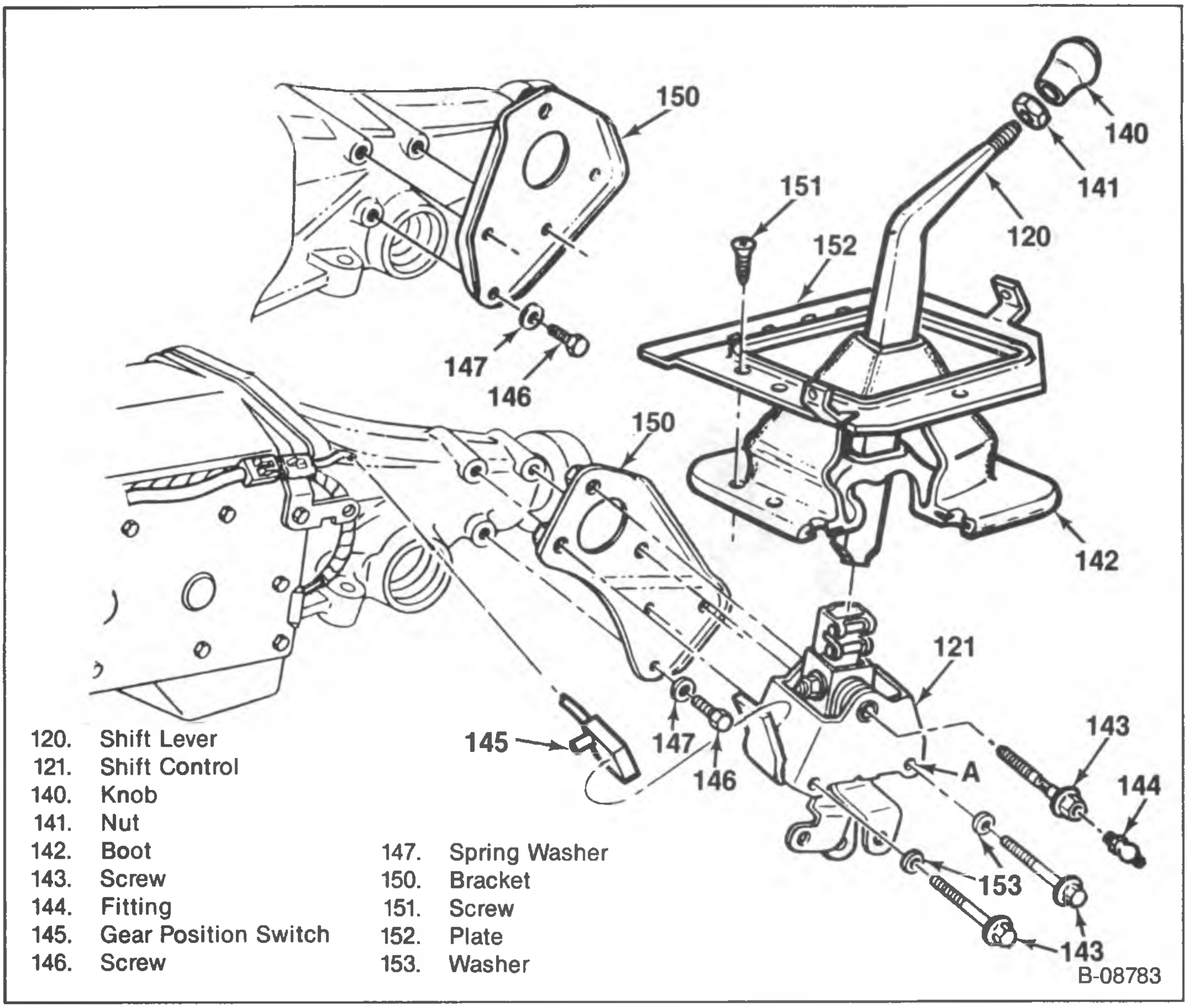


Figure 6—C-K Truck Shift Control

Install or Connect (Figure 7)

1. New gasket (168).
2. Shift forks (167).
   - Install the shift forks in the position they were removed.
3. Reverse detent spring (161) and the ball (162).
4. Slide cover (169).
   - Lift the reverse interlock lever to seat the cover.

Important

- The screw with the large shoulder is a locating screw and must be installed in the rear-center hole (A).

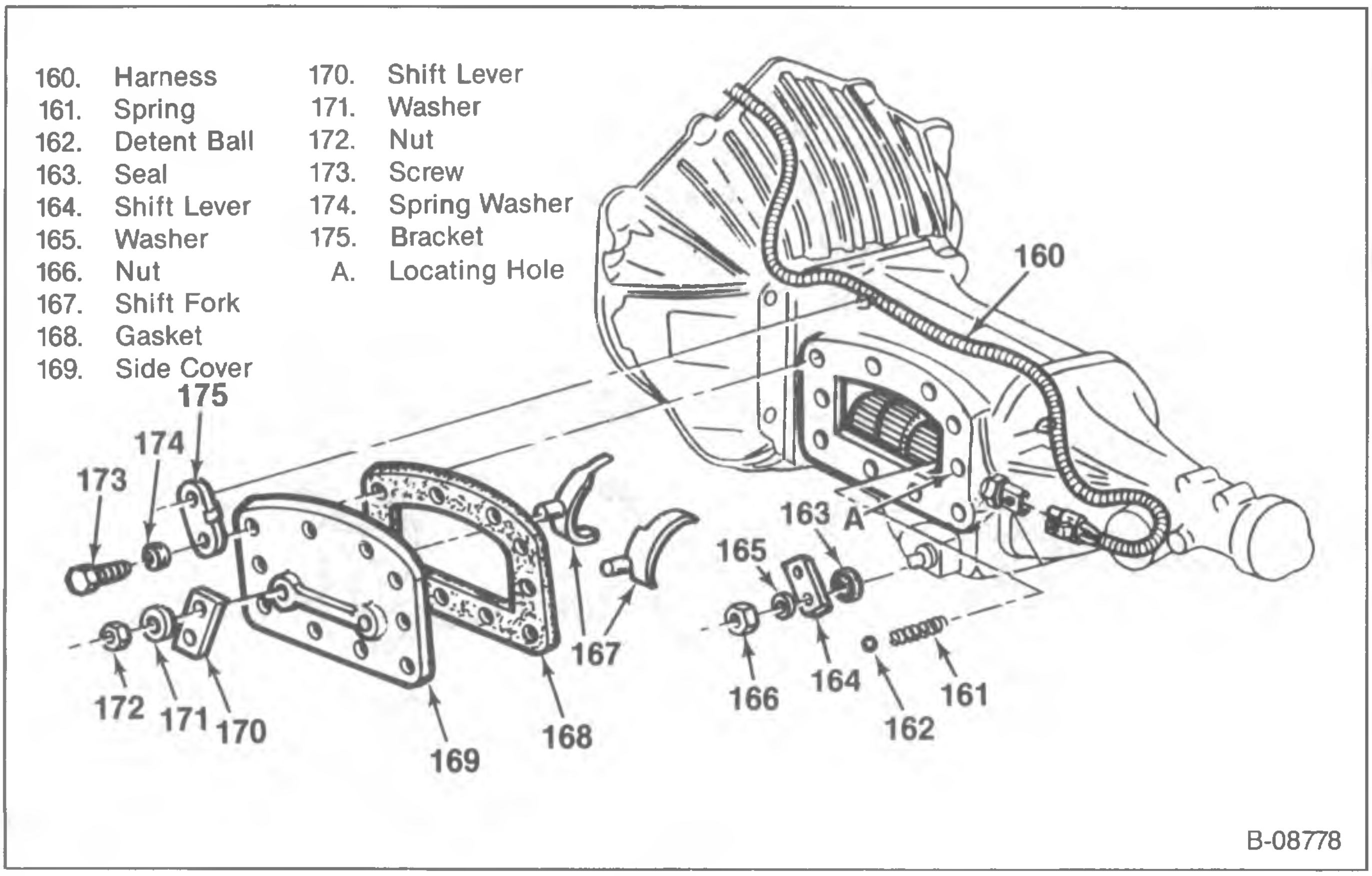
5. Brackets (175), new spring washers (174) and the screws (173).
6. New seal (163).
7. Reverse shift lever (164).
8. Washer (165) and the nut (166).
9. Shift rods (figure 3).
10. Harness (160).
11. New transmision oil. Refer to "Drain and Fill" in this section.
    - Lower the vehicle and adjust the shift rods.

TRANSMISSION REPLACEMENT

Remove or Disconnect (Figure 1)

- Raise the vehicle.

1. Transmission oil.
2. Shift rods.
3. Shift control.
4. Parking brake lever and controls if used. Refer to BRAKES (SEC. 5).



160.	Harness
161.	Spring
162.	Detent Ball
163.	Seal
164.	Shift Lever
165.	Washer
166.	Nut
167.	Shift Fork
168.	Gasket
169.	Side Cover
170.	Shift Lever
171.	Washer
172.	Nut
173.	Screw
174.	Spring Washer
175.	Bracket
A.	Locating Hole

Figure 7—Side Cover

5. Propeller shaft. Refer to PROPELLER SHAFT (SEC. 4A).
6. Speedometer cable (108) and the seal (116).
7. Wiring harness.
8. Exhaust pipes. Refer to EXHAUST (SEC. 6F).
    - Support the transmission with a jack.
9. Any parts if needed for clearance.
10. Crossmember.

Important

- Do not let the transmission hang from the clutch.
- Pull the transmission straight back on the clutch hub splines.

11. Screws (103) and the spring washers (102).
    - Support the clutch release bearing.
12. Transmission (101).
13. Plugs (115), if they are loose or damaged.
    - Note the location of the plugs before removing.

Install or Connect (Figure 1)

1. New plugs (115) if needed.
    - Put a thin coat of high temperature grease on the main drive gear splines.

Important

- Do not force the transmission into the clutch.
- Do not let the transmission hang from the clutch.

2. Transmission (101).
    - Shift the transmission into high gear before installing.
    - Leave the jack under the transmission to support it.
3. New spring washers (102) and the screws (103).
4. Crossmember.
    - Remove the jack.
5. Any parts that were removed for clearance.
6. Exhaust pipes. Refer to EXHAUST (SEC. 6F).
7. Wiring harness.
8. New seal (116) and the speedometer cable (108).
9. Propeller shaft. Refer to PROPELLER SHAFT (SEC. 4A).
10. Parking brake lever and controls if used, refer to BRAKES (SEC. 5).
11. Shift control.
12. Shift rods.
    - Adjust the shift rods.
13. New transmission oil. Refer to "Drain and Fill" in this section.
    - Lower the vehicle.

SPECIFICATIONS

FASTENER TORQUE

Plug, Drain and Fill	23 N·m	17 ft. lbs.
Cross Lever Bracket Screw	25 N·m	18 ft. lbs.
Shift Rod Swivel Screw	25 N·m	18 ft. lbs.
Control Bracket Screw	32 N·m	23 ft. lbs.
Control Mounting Screw	45 N·m	33 ft. lbs.
Side Cover Screw	20 N·m	15 ft. lbs.
Transmission to Clutch Housing Screw	100 N·m	74 ft. lbs.
Transmission to Mount Screw	54 N·m	40 ft. lbs.
Crossmember to Mount Screw	54 N·m	40 ft. lbs.
Crossmember to Frame Screw	75 N·m	55 ft. lbs.

LUBRICATION

Capacity	4.0 L	4.2 qts.
Type Recommended	Dexron II Automatic Transmission Fluid	

SPECIAL TOOLS

Figure 8—Special Tools

SECTION 7B3

4-SPEED 117MM TRANSMISSION

CONTENTS

ON VEHICLE SERVICE

DRAIN AND FILL

Remove or Disconnect (Figure 1)

1. The fill plug (112).
2. The drain plug (103).
3. Transmission oil.
   - Catch the oil in a pan.

Install or Connect (Figure 1)

1. The drain plug (103).
2. New transmission oil.
   - Fill to the level of the fill plug hole, refer to MAINTENANCE AND LUBRICATION (SEC. 0B).
3. The fill plug (112).

REAR RETAINER OIL SEAL

Remove or Disconnect (Figure 2)

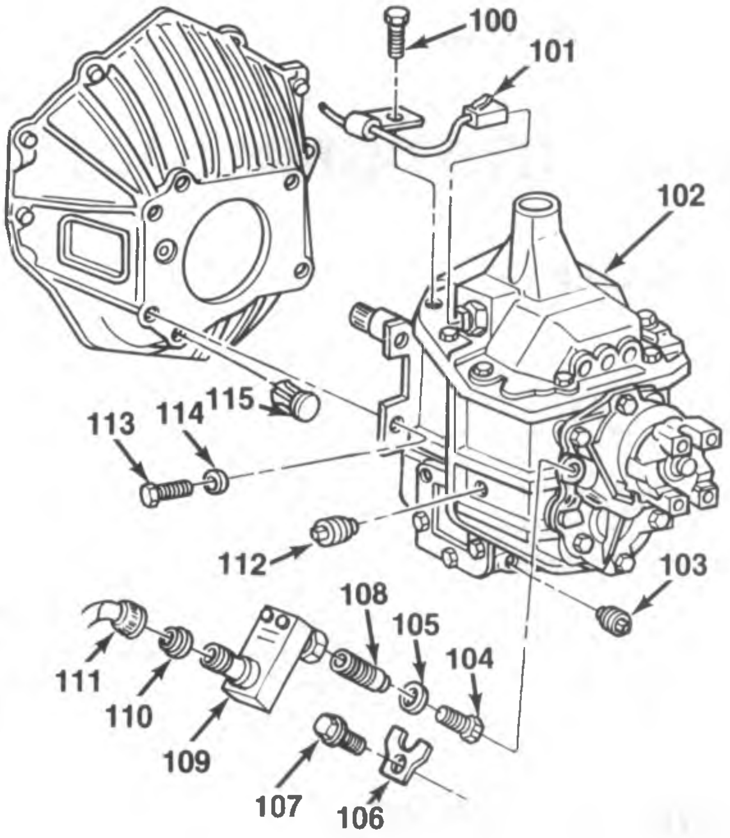
- Raise the vehicle.

1. Transmission oil.
2. Propeller shaft, refer to PROPELLER SHAFT (SEC. 4A).
3. Parking brake if used, refer to BRAKES (SEC. 5).
4. Speedometer cable (111) and the seal (110).
5. Nut (124) and the flange (123).
6. Transmission mount.
   - Support the transmission with a jack.
7. Screws (125) and the retainer (121).
8. Gasket (120).
   - Scrape all gasket material from the retainer and the case.
9. Seal (122).

Install or Connect (Figure 2)

Tool Required:
J-22834, Rear Retainer Seal Installer

1. Locking compound on the outside of the a new seal (122).
2. New seal (122), use J-22834-2 (figure 3).
   - Use J-22834-1 if a parking brake is used.
   - Fill between the seal lips with chassis grease.
3. New gasket (120).
4. Retainer (121) and the screws (125).
5. Transmission mount.
   - Remove the jack.
6. Flange (123) and the nut (124).
7. New seal (110) and the speedometer cable (111).
8. Parking brake if used, refer to BRAKES (SEC. 5).
9. Propeller shaft, refer to PROPELLER SHAFT (SEC. 4A).
10. New transmisssion oil, refer to MAINTENANCE AND LUBRICATION (SEC. 0B).
    - Lower the vehicle.



100. Screw
101. Clip
102. Transmission
103. Drain Plug
104. Speedometer Driven Gear
105. Seal
106. Retainer
107. Screw
108. Sleeve
109. Adapter
110. Seal
111. Speedometer Cable
112. Fill Plug
113. Screw
114. Spring Washer
115. Plug

B-08800

Figure 1—Transmission and Components

SPEEDOMETER DRIVEN GEAR

↔ Remove or Disconnect (Figure 1)

- Raise the vehicle.

1. Speedometer cable (111) and the seal (110).
2. Adapter (109) if used.
3. Retainer (106) and the screw (107) if used.
4. Sleeve (108).
5. Seal (105).
6. Gear (104).

→← Install or Connect (Figure 1)

- Put a thin coat of transmission oil on the gear and the seal.

1. Gear (104).

102. Transmission
110. Seal
111. Speedometer Cable
120. Gasket
121. Rear Bearing Retainer
122. Seal
123. U-joint Flange
124. Nut
125. Screw

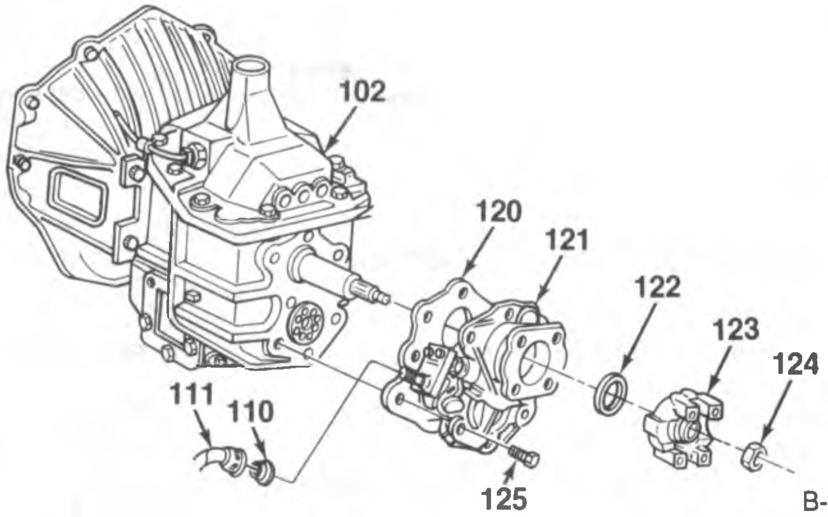


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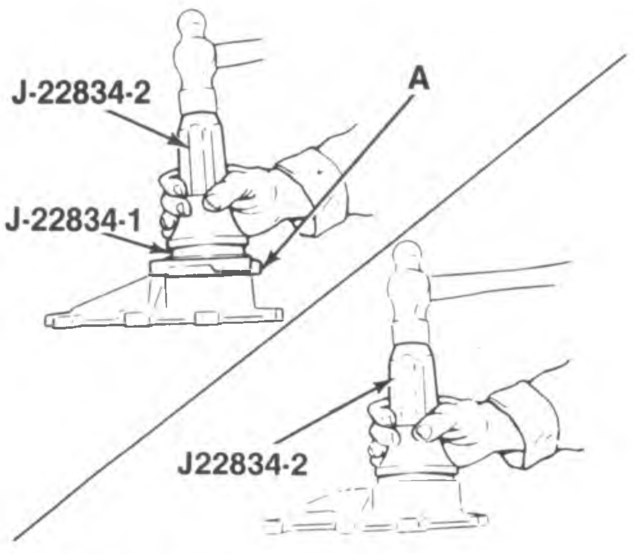
Figure 2—Rear Retainer and Seal



A. Parking Brake Mounting Flange

B-08801

Figure 3—Retainer Seal Installation

2. New seal (105) onto the sleeve (108).
3. Sleeve (108).
4. Retainer (106) and the screw (107) if used.
5. Adapter (109) if used.
6. New seal (110) and the speedometer cable (111).
    - Lower the vehicle.

SHIFT CONTROL LEVER

Remove or Disconnect (Figure 4)

1. Transfer case shift lever boot if used, refer to TRANSFER CASE (SEC. 7D).
2. Screws (137) and the retainer (136) if used.
3. Screws (135) if used.
4. Boot (133).
5. Lever (132).
    - Push the cap (134) down and turn counter-clockwise (A).

Install or Connect (Figure 4)

1. Lever (132).
    - Push the cap (134) down and turn clockwise (B).
2. Boot (133).
3. Screws (135) if used.
4. Retainer (136) and the screws (137) if used.
5. Transfer case shift lever boot if used, refer to TRANSFER CASE (SEC. 7D).

TRANSMISSION REPLACEMENT

Remove or Disconnect (Figure 1)

Tool Required:
J-1126, Transmission Guide Pin

- Raise the vehicle.

1. Transmission oil.
2. Propeller shaft, refer to PROPELLER SHAFT (SEC. 4A).
3. Transfer case if used, refer to TRANSFER CASE (SEC. 7D).
4. Parking brake and controls if used, refer to BRAKES (SEC. 5).
5. Shift control lever.
6. Screw (100) and the connector (101).
7. Speedometer cable (111) and the seal (110).
8. Exhaust pipes, refer to EXHAUST (SEC. 6F).
    - Support the transmission with a jack.
9. Any parts if needed for clearance.
10. Crossmember.

Important

- Do not let the transmission hang from the clutch.
- Use guide pins to pull tne transmission straight back on the clutch hub splines.

11. Screws (113) and the spring washers (114).
    - Remove the top two first and install guide pins J-1126.
    - Support the clutch release bearing.
12. Transmission (102).
13. Plugs (115), if they are loose or damaged.
    - Note the location of the plugs before removing.

Install or Connect (Figure 1)

- Put a thin coat of high temperature grease on the main drive gear splines.

1. New plugs (115) if needed.

Important

- Do not force the transmission into the clutch.
- Do not let the transmission hange from the clutch.

2. Transmission (102).
    - Shift the transmission into high gear before installing.

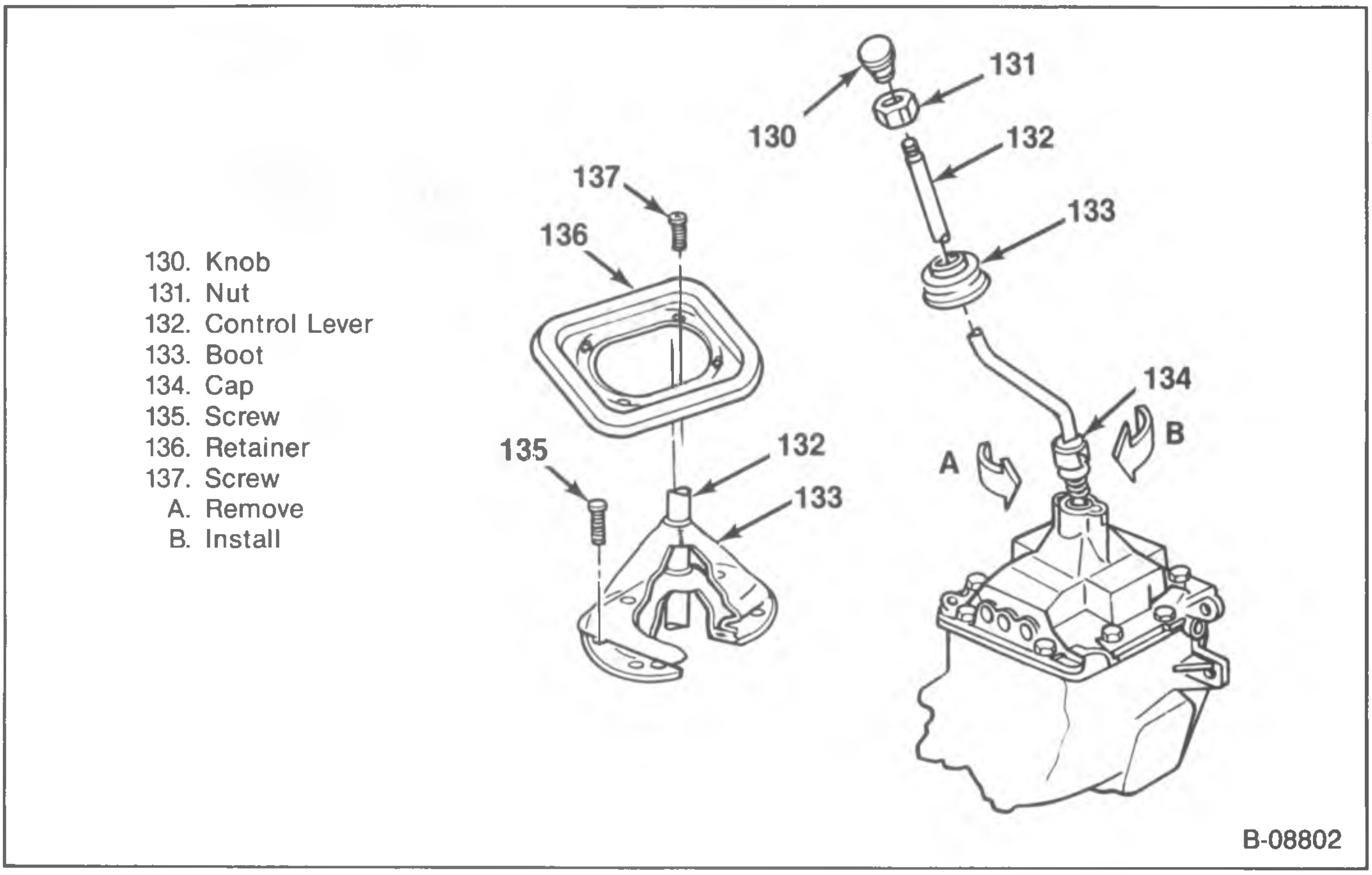


Figure 4—Shift Control Lever

- Leave the jack under the transmission to support it.

3. New spring washers (114) and the screws (113).
   - Install the two bottom screws before removing the guide pins.
4. Crossmember.
   - Remove the jack.
5. Any parts that were removed for clearance.
6. Exhaust pipes, refer to EXHAUST (SEC. 6F).
7. New seal (110) and the speedometer cable (111).
8. Connector (101) and the screw (100).
9. Shift control lever.
10. Parking brake and controls if used, refer to BRAKES (SEC. 5).
11. Transfer case if used, refer to TRANSFER CASE (SEC. 7D).
12. Propeller shaft, refer to PROPELLER SHAFT (SEC. 4A).
13. New transmission oil, refer to MAINTENANCE AND LUBRICATION (SEC. 0B).
    - Lower the vehicle.

SPECIFICATIONS

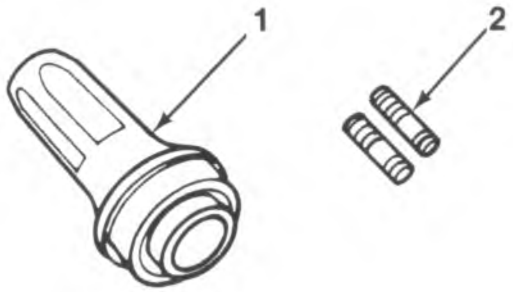
FASTENER TORQUE

Plug, Drain and Fill	23 N·m	17 ft. lbs.
U-joint Flange Nut	135 N·m	100 ft. lbs.
Rear Retainer Screw (Top)	27 N·m	20 ft. lbs.
Rear Retainer Screw (Bottom)	40 N·m	30 ft. lbs.
Transmission to Clutch Housing Screw	100 N·m	74 ft. lbs.
Transmission to Mount Screw	47 N·m	35 ft. lbs.
Crossmember to Mount Screw	54 N·m	40 ft. lbs.
Crossmember to Frame Screw	75 N·m	55 ft. lbs.

LUBRICATION

Capacity	4.0 L	4.2 qts.
Type Recommended	API GL5 SAE 80W90	

SPECIAL TOOLS



1. **J-22834** Rear Retainer Seal Installer
2. **J-1126** Transmission Guide Pins

Figure 5—Special Tools

SECTION 7C

CLUTCH

CONTENTS

SUBJECT **PAGE**

DESCRIPTION

CLUTCH

The principal components on a clutch are the driven plate, pressure plate, diaphragm-type spring and a release bearing.

The driven plate is splined on the transmission clutch shaft so that it can move back and forth when the clutch is disengaged, and can turn the shaft when the clutch is engaged. The driven plate has friction pads riveted to both sides of it, and a flexible center with springs to absorb vibration.

The pressure plate has a machined surface that fits against the driven plate and a diaphragm-type spring mounted in a cover on the pressure plate. The spring holds the pressure plate and driven plate together against the engine flywheel when the clutch is engaged.

The release bearing is a ball-thrust bearing on a sleeve that pushes in on the center of the diaphragm spring, releasing pressure on the pressure plate and driven plate to disengage the clutch.

CLUTCH CONTROLS

HYDRAULIC CONTROLS - C-K MODELS

The hydraulic clutch has a master cylinder with a separate reservoir. The clutch pedal moves the master cylinder push rod and a secondary cylinder at the clutch housing moves the clutch fork and the release bearing.

MECHANICAL CONTROLS - G AND P MODELS

G models have a pull rod from the clutch pedal that moves a cross lever. The cross lever moves the clutch fork and the release bearing with an adjustable rod.

P models have an upper pull rod from the clutch pedal to a bell crank lever and a lower pull rod from the bell crank lever to a cross lever. The cross lever moves the clutch fork and the release bearing with an adjustable rod.

INSPECTION

Before repairing the clutch, check the transmission and shift linkage, and the engine mounts to be sure the problem is in the clutch.

LINKAGE

1. Check the clutch rods for bending and damage.
2. Check for worn swivels and loose or damaged mounting brackets.
3. Check the clutch lever for bending, wear and damage.
    - Be sure there is some clearance between the clutch lever and the mounting brackets and ball studs.
4. Lubricate the clutch linkage.

CLUTCH PEDAL

1. Check the bushings for dirt, wear and damage.
2. Check the clutch release.
    - Hold the clutch pedal 12.7 mm (1/2 in.) above the floor mat with the engine running and the parking brake on.
    - Move the shift lever from first gear to reverse gear and back several times.
    - If the shift is smooth, the clutch is disengaging fully.
    - Adjust the clutch linkage and repeat, if needed.

RELEASE BEARING

1. Check the clutch fork for dirt, wear and damage.
2. Check the clutch fork for proper installation and lubrication.
3. Check the release bearing and clearance between the spring fingers and the transmission.

HYDRAULIC CLUTCH

1. Check the hoses for cracks and wear.
2. Check the cylinders for loose mounting screws and signs of leakage.
3. Check the clutch pedal travel, it should be 210.8 mm (8.3 in).
4. Check the secondary push rod travel at the clutch fork, it should be at least 25.4 mm (1.0 in).
5. Bleed the controls and repeat as needed.

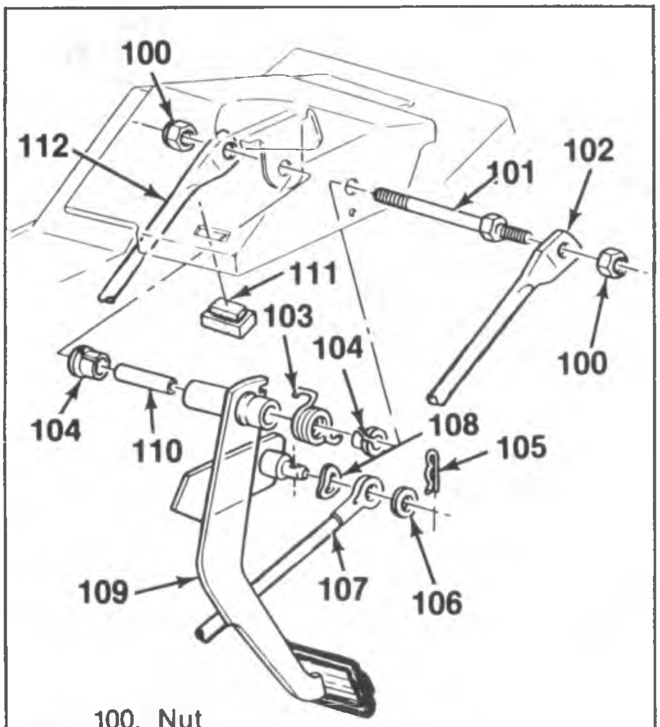
DIAGNOSIS OF CLUTCH

PROBLEM	POSSIBLE CAUSE	CORRECTION
Will Not Disengage (Pedal to the floor and hard to shift into reverse).	1. Linkage loose or out of adjustment. 2. Air in the hydraulic system. 3. Master or secondary hydraulic cylinder seals worn. 4. Not enough pedal travel. 5. Release bearing worn or damaged. 6. Driven plate worn or damaged. 7. Clutch fork off the ball stud. 8. Driven plate binding. 9. Driven plate warped-run-out more than 5.08 mm (0.20 in.).	1. Tighten or adjust. 2. Bleed and check for damage. 3. Repair. 4. Adjust the linkage or trim the pedal bumper. 5. Replace. 6. Replace. 7. Install correctly and lubricate. 8. Repair or replace the plate or clutch gear. 9. Replace.
Slipping.	1. Linkage out of adjustment. 2. Driven plate friction pads worn or oil soaked. 3. Pressure plate or flywheel warped. 4. Diaphragm spring weak. 5. Driven plate overheated or not seated.	1. Adjust. 2. Replace. Check for leaks as needed. 3. Replace as needed. 4. Replace. 5. Allow to cool and make 30-40 normal starts - DO NOT OVERHEAT.
Grabbing (Chattering).	1. Engine mounts loose or damaged. 2. Driven plate friction pads oil soaked. 3. Pressure plate or flywheel warped. 4. Driven plate friction pad material burned or smeared onto the pressure plate or flywheel. 5. Clutch gear worn.	1. Tighten or replace. 2. Replace and check for leaks. 3. Replace as necessary. 4. Clean off or replace as needed. 5. Repair the transmission.
Rattling (Transmission Click).	1. Diaphragm spring weak. 2. Clutch fork loose or off the ball stud. 3. Driven plate springs weak or oil in the damper.	1. Replace the pressure plate. 2. Replace the retaining spring or install the fork correctly. 3. Replace and check for leaks as needed.
Release Bearing Noisy With The Clutch Engaged	1. Linkage out of adjustment. 2. Release bearing binding. 3. Clutch fork off the ball stud or loose spring tension. 4. Linkage return springs weak.	1. Adjust. 2. Clean, or replace if damaged, and lubricate. 3. Install, and lubricate. 4. Replace.
Noisy	1. Release bearing worn or damaged. 2. Clutch fork off the ball stud. 3. Pilot bearing loose.	1. Replace. 2. Install correctly and lubricate. 3. Replace. Refer to ENGINE (Sec. 6A).

DIAGNOSIS OF CLUTCH (Cont.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Pedal Stays On The Floor When Disengaged.	1. Linkage or release bearing binding. 2. Diaphragm spring weak. 3. Return springs being over traveled.	1. Free up, or replace, and lubricate. 2. Replace the pressure plate. 3. Adjust the linkage or replace the pedal bumper if worn.
Pedal Is Hard To Push.	1. Linkage binding. 2. Hydraulic line blocked or crimped. 3. Master or secondary cylinders binding. 4. Driven plate worn.	1. Free up, or replace and lubricate. 2. Clean out or replace. 3. Repair or replace as needed. 4. Replace.

ON-VEHICLE SERVICE



100. Nut
101. Stud
102. Outboard Brace
103. Spring
104. Bushing
105. Retainer
106. Washer
107. Pushrod
108. Wave Washer
109. Pedal
110. Spacer
111. Bumber
112. Inboard Brace

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Figure 1—Hydraulic Clutch Pedal

HYDRAULIC CLUTCH PEDAL

Remove or Disconnect (Figure 1)

1. Negative battery cable.
2. The lower steering column covers.
3. The lower left side air conditioning duct if used.
4. Neutral start switch.
5. Retainer (105) and the washer (106).
6. Push rod (107) and the wave washer (108).
7. Nuts (100).
8. Braces (102 and 112).
9. Stud (101), the pedal (109) and the spring (103).
    - Slide a long screw or rod into the bracket while removing the stud.
10. Bushings (104) and the spacer (110).
11. Bumper (111) if it is worn or damaged.

Install or Connect (Figure 1)

1. New bumper (111) if needed.
2. New spacer (110) and new bushings (104).
    - Coat with grease before installing.

Important

- The rod must be installed as shown.

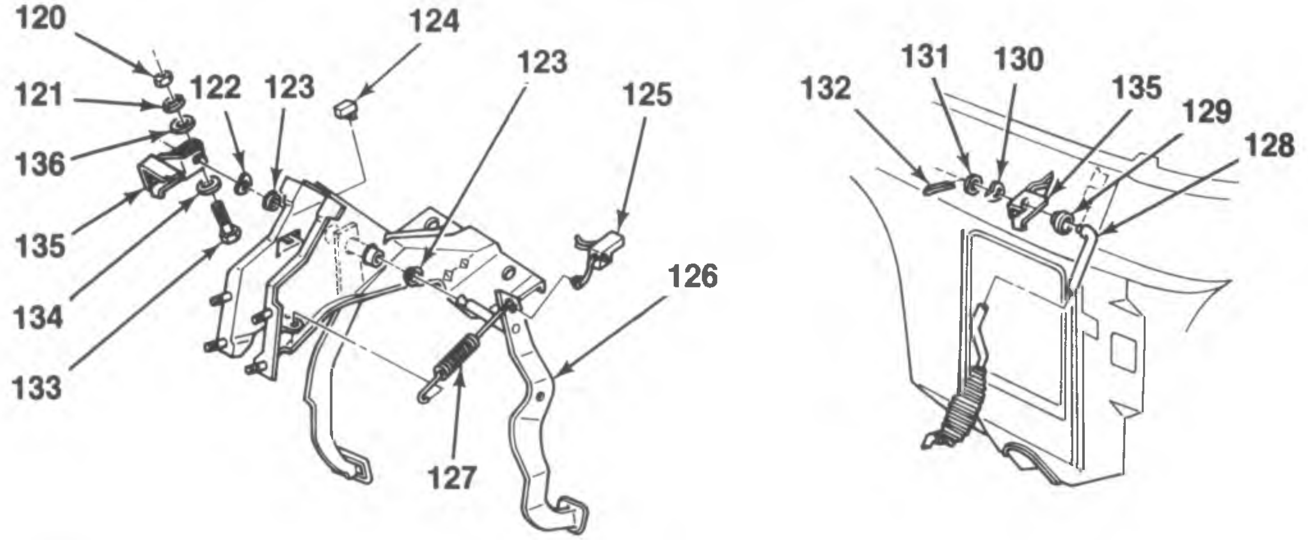
3. Spring (103), the pedal (109) and the stud (101).
    - Remove the long screw or rod while installing the stud.
4. Braces (102 and 112).
5. Nuts (100).
6. New wave washer (108) and the push rod (107).
    - The washer must stand off the pedal as shown.
7. Washer (106) and the retainer (105).
8. Neutral start switch.
9. The lower left side air conditioning duct, if used.
10. The lower steering column covers.
11. Negative battery cable.

- Bleed the clutch system. Refer to "Hydraulic Clutch Bleeding" in this section.
- Lubricate the clutch pedal. Refer to MAINTENANCE AND LUBRICATION (Sec. 0B).

MECHANICAL CLUTCH PEDAL

Remove or Disconnect (Figure 2)

1. Negative battery cable.
2. Cotter pin (132) and the washer (131).
3. Wave washer (130).
4. Pedal rod (128) and the bushing (129).
5. Neutral start switch (125).
    - Note the direction the switch is mounted in.
6. Nut (120) and the spring washer (121).
7. Screw (133) and the washer (136).
    - Note the direction the screw is mounted in.
    - Remove the washer (134) if used.
8. Arm (135) and the wave washer (122).
9. Spring (127).
    - Push the pedal down, move it to the side and let it up to release the spring.
10. Pedal (126).
    - Slide a long screw or rod through the bracket while removing the pedal to keep the brake pedal in place.
11. Bushings (123).



120. Nut	129. Bushing
121. Spring Washer	130. Wave Washer
122. Wave Washer	131. Washer
123. Bushing	132. Cotter Pin
124. Bumper	133. Screw
125. Neutral Start Switch	134. Washer
126. Pedal	135. Arm
127. Spring	136. Washer
128. Pedal Rod	

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Figure 2—Mechanical Clutch Pedal

12. Bumper (124) if it is worn or damaged.

Clean (Figure 2)

- — Metal parts with solvent. Wipe dry.
- — Plastic and rubber parts with a dry rag.

Inspect (Figure 2)

- — Pedal (126) for wear and bending.
- — Bushings (123 and 129) for cracks and wear.

Install or Connect (Figure 2)

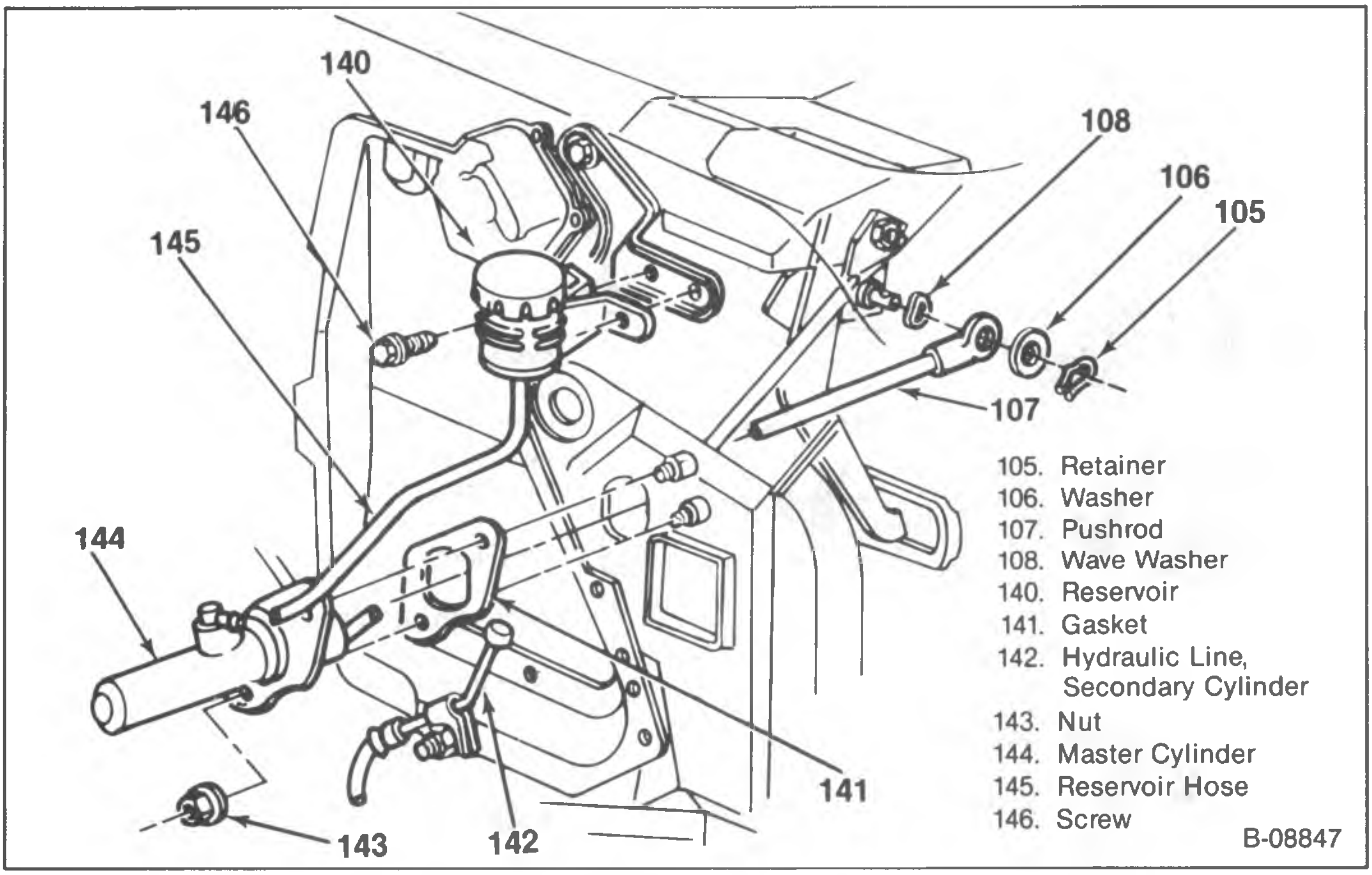
1. New bumper (124) if needed.
2. Bushings (123).
   - Coat the bushings with petroleum jelly.
3. Pedal (126).
   - Slide the screw or rod out while installing the pedal.
4. Spring (127).
   - Hold the pedal up, next to the pedal stop to hook the spring.
   - Push the pedal down, slide it to the side and let it up against the pedal stop.
5. New wave washer (122) and the arm (135).
6. Washer (136) and the screw (133).
   - Install the washer (134) if used.
   - Install the screw in the direction it was removed from.
7. New spring washer (121) and the nut (120).
8. Neutral start switch (125).
   - Install the switch in the position it was removed from.
9. Bushing (129) and the pedal rod (128).
10. New wave washer (130).
11. Washer (131) and a new cotter pin (132).
12. Negative battery cable.

- Adjust the clutch linkage. Refer to "Free Travel Adjustment" in this section.
- Lubricate the clutch pedal. Refer to MAINTENANCE AND LUBRICATION (Sec. 0B).

MASTER CYLINDER AND RESERVOIR

Remove or Disconnect (Figure 3)

1. Negative battery cable.
2. The lower steering column covers.
3. The lower left side air conditioning duct, if used.
4. Retainer (105) and the washer (106).
5. Push rod (107) and the wave washer (108).
6. Reservoir hose (145).



105. Retainer
106. Washer
107. Pushrod
108. Wave Washer
140. Reservoir
141. Gasket
142. Hydraulic Line, Secondary Cylinder
143. Nut
144. Master Cylinder
145. Reservoir Hose
146. Screw

Figure 3—Master Cylinder and Reservoir

7. Secondary cylinder hydraulic line (142) from the master cylinder (144).
8. Nuts (143) and the master cylinder (144).
9. Gasket (141).
    - Scrape all gasket material from the master cylinder and the cowl.
10. Screws (146) and the reservoir (140).

Disassemble (Figure 4)

1. Remove the adapter (221) and the seal (220).
2. Pull the dust cover (228) back and remove the snap ring (227).
3. Shake the push rod (107) and the plunger (224) out.
4. Remove the seal (226). Remove the spring (230), the support (222), the seal (225) and the shim (223).

Clean (Figure 4)

— All parts with clean brake fluid.

Inspect (Figure 4)

— The cylinder bore and the plunger for scratches, ridges, and pitting.

— The dust cover for wear and cracking.

Assemble (Figure 4)

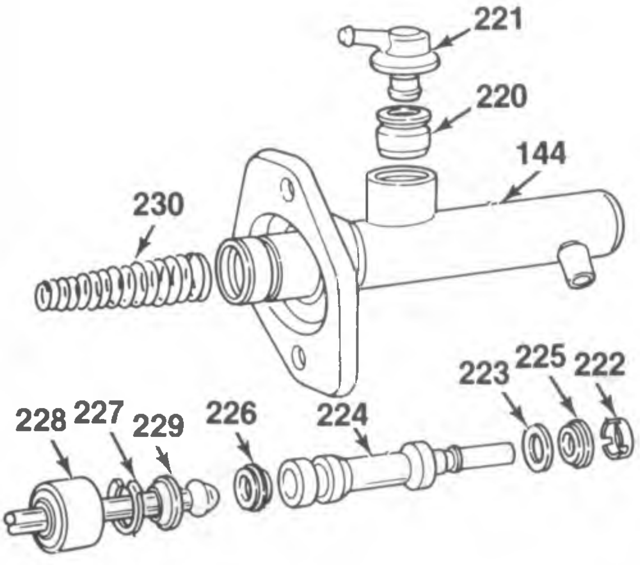
- Lubricate all seals with clean brake fluid.

1. Install the shim (223) and a new seal (225) with the flat against the shim (223). Install the support (222) and the spring (230).
2. Install a new seal (226).
3. Coat the cylinder bore with clean brake fluid and slide the plunger (224) and the push rod (107) in.
4. Push the push rod (107) in and install the snap ring (227). Coat the inside of the dust cover (228) with grease and slide it into place.
5. Install a new seal (220) and the adapter (221).

Install or Connect (Figure 3)

1. Reservoir (140) and the screws (146).
2. New gasket (141).
3. Master cylinder (144) and the nuts (143).
4. Secondary cylinder hydraulic line (142) to the master cylinder (144).
5. Reservoir hose (145).
6. New wave washer (108) and the push rod (107).
7. Washer (106) and the retainer (105).
8. The lower left side air conditioning duct, if used.
9. The lower steering column covers.
10. Negative battery cable.

- Fill the reservoir. Refer to "Specifications" in this section.



144.	Master Cylinder
220.	Seal
221.	Adapter
222.	Support
223.	Shim
224.	Plunger
225.	Seal
226.	Seal
227.	Snap Ring
228.	Dust Cover
229.	Push Rod
230.	Spring

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Figure 4—Master Cylinder Components

- Bleed the clutch system. Refer to "Hydraulic Clutch Bleeding" in this section.

SECONDARY CYLINDER AND HYDRAULIC LINE

Remove or Disconnect (Figure 5)

1. Negative battery cable.
    - Raise the vehicle.
2. Hydraulic line (142) from the secondary cylinder (153).
3. Nuts (151) and the secondary cylinder (153).
4. Hydraulic line (142).
    - Hydraulic line (142) from the master cylinder (144).
    - Nut (150) and the hydraulic line (142).

- Install the nut (150) to hold the speedometer cable (B) in place.

Important

- Cover all hydraulic line openings to keep dirt and moisture out of the components.

Disassemble (Figure 6)

1. Remove the push rod (241) and the dust cover (240).
2. Remove the snap ring (238) and shake the plunger (239) out.
3. Remove the spring (242) and the seal (237).

Clean (Figure 6)

— All parts with clean brake fluid.

Inspect (Figure 6)

— The cylinder bore and the plunger for scratches ridges and pitting.

— The dust cover for wear and cracking.

Assemble (Figure 6)

1. Coat a new seal (237) with clean brake fluid and slide it into place and install the spring (242).
2. Coat the cylinder bore with clean brake fluid and slide the plunger (239) in.
3. Push the plunger (239) in and install the snap ring (238).
4. Coat the inside of the dust cover (240) with grease and slide it into place. Install the push rod (241).

Install or Connect (Figure 5)

- Uncover the hydraulic line openings.

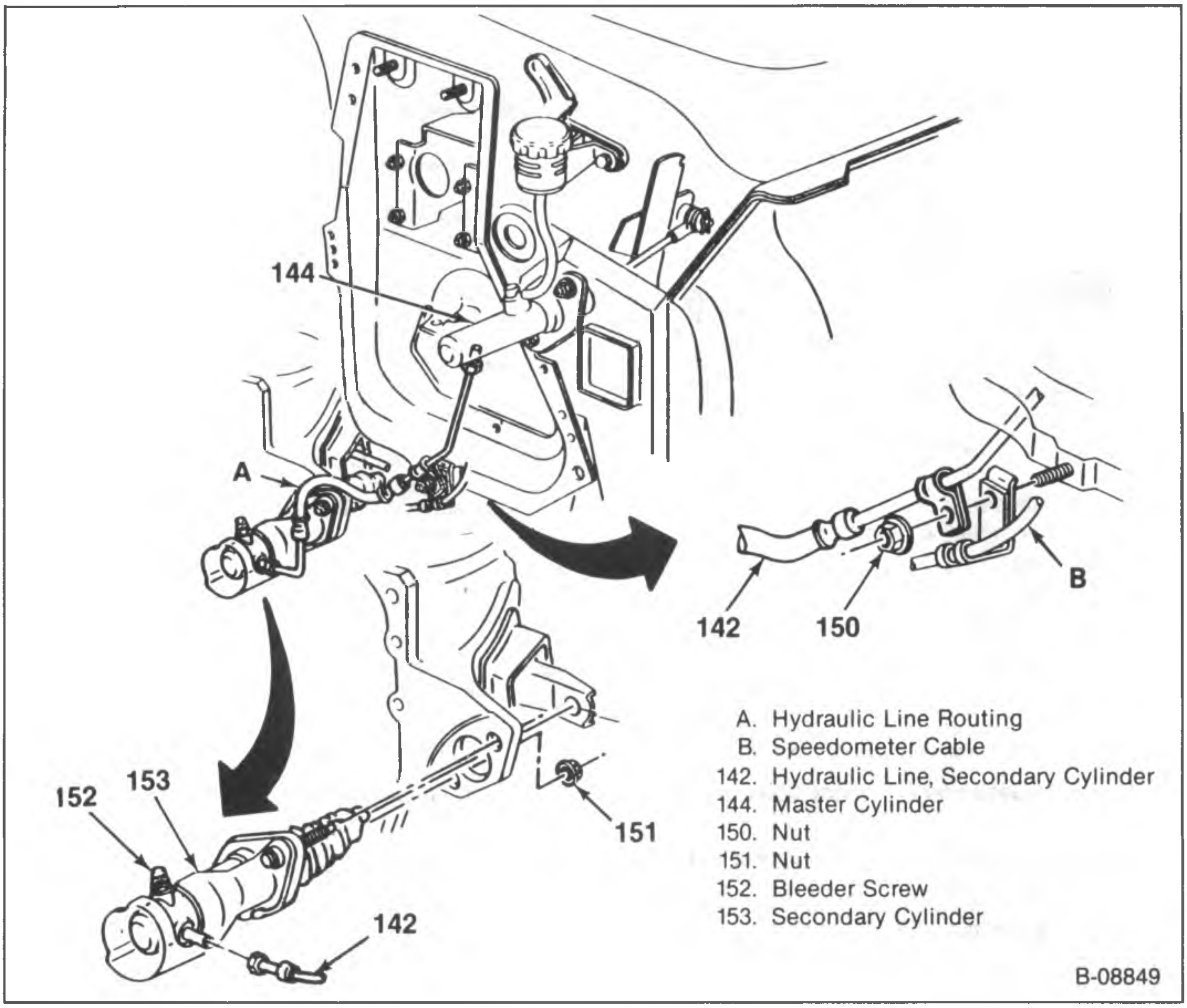
1. Hydraulic line (142).
    - Remove the nut (150).
    - Hydraulic line (142) onto the master cylinder (144).
    - Hydraulic line (142) and the nut (150).

Important

- The hydraulic line must be upright, as shown.

2. Secondary cylinder (153) and the nuts (151).
3. Hydraulic line (142) onto the secondary cylinder (153).
    - Lower the vehicle.
4. Negative battery cable.

- Bleed the clutch system. Refer to "Hydraulic Clutch Bleeding" in this section.



A. Hydraulic Line Routing
B. Speedometer Cable
142. Hydraulic Line, Secondary Cylinder
144. Master Cylinder
150. Nut
151. Nut
152. Bleeder Screw
153. Secondary Cylinder

Figure 5—Secondary Cylinder and Hydraulic Line

CLUTCH LINKAGE

Remove or Disconnect (Figures 7 and 8)

1. Negative battery cable.
2. Cotter pins (132), the washers (131) and the wave washers (130).
3. Pedal rod (128) and the bushing (129).
    - Note the direction the rod was removed from.
4. Screws (172) and the boot (171).
5. The lower pedal rod (163), (P models only).
    - Cotter pins (160), the washers (161) and the wave washers (162).
6. The pull back spring (166).
    - Retaining spring (164) if used.
7. Cotter pin (167), the washer (168) and the wave washer (169).
    - The nut (165), if used.
8. Adjusting rod (170).
    - Note the direction the rod was removed from.

Clean (Figures 7 and 8)

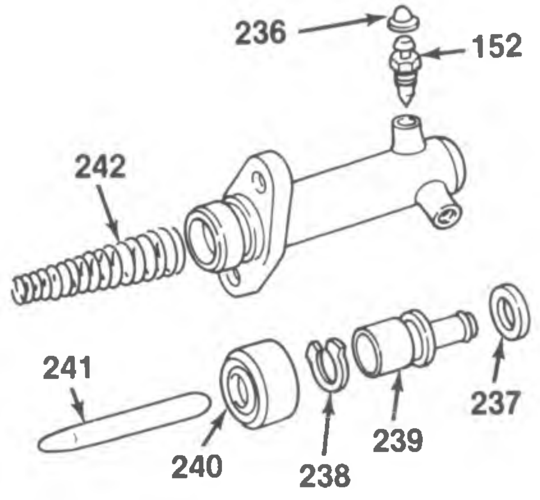
— All metal parts with solvent. Wipe dry.
— All nylon and rubber parts with a clean, dry rag.

Inspect (Figures 7 and 8)

— All metal parts for wear, damage and bending.
— All nylon and rubber parts for wear and cracks.

Install or Connect (Figures 7 and 8)

1. Adjusting rod (170).
    - Install the rod in the direction it was removed from.



152.	Bleeder Screw
153.	Secondary Cylinder
236.	Cap
237.	Seal
238.	Snap Ring
239.	Plunger
240.	Dust Cover
241.	Pushrod
242.	Spring

B-08850

Figure 6—Secondary Cylinder Components

2. New wave washer (169), the washer (168) and a new cotter pin (167).
   - The jam nut (165), if used.
3. The pull back spring (166).
   - The retaining spring (164), if used.
4. The lower pedal rod (163), (P models only).
   - New wave washers (162), the washers (161) and new cotter pins (160).
5. The boot (171) and the screws (172).
   - The dimple must face the rear of the vehicle, (P models only).
6. The bushing (129) and the pedal rod (128).
   - Install the rod in the direction it was removed from.
7. New wave washers (130), the washers (131) and new cotter pins (132).
8. Negative battery cable.

- Adjust the clutch, if needed. Refer to "Free Travel Adjustment" in this section.
- Lubricate the clutch linkage. Refer to MAINTENANCE AND LUBRICATION (Sec. 0B).

CROSS LEVER

Remove or Disconnect (Figure 9)

1. Negative battery cable.
2. Springs and the adjusting rod (170), (Figures 7 and 8).
3. Pedal rod or the lower pedal rod (A), (Figures 7 and 8).
4. Screws (185) and the spring washers (189).
   - Nuts (190), (P models only).
5. Bracket (186) and the cross lever (191).
6. Ball stud (181), the nut (188) and the star washer (187) from the bracket (186).
7. Engine side ball stud (181) if it is worn or damaged.

Clean (Figure 9)

— All metal parts with solvent. Wipe dry.

— All nylon and plastic parts with a clean, dry rag.

Inspect (Figure 9)

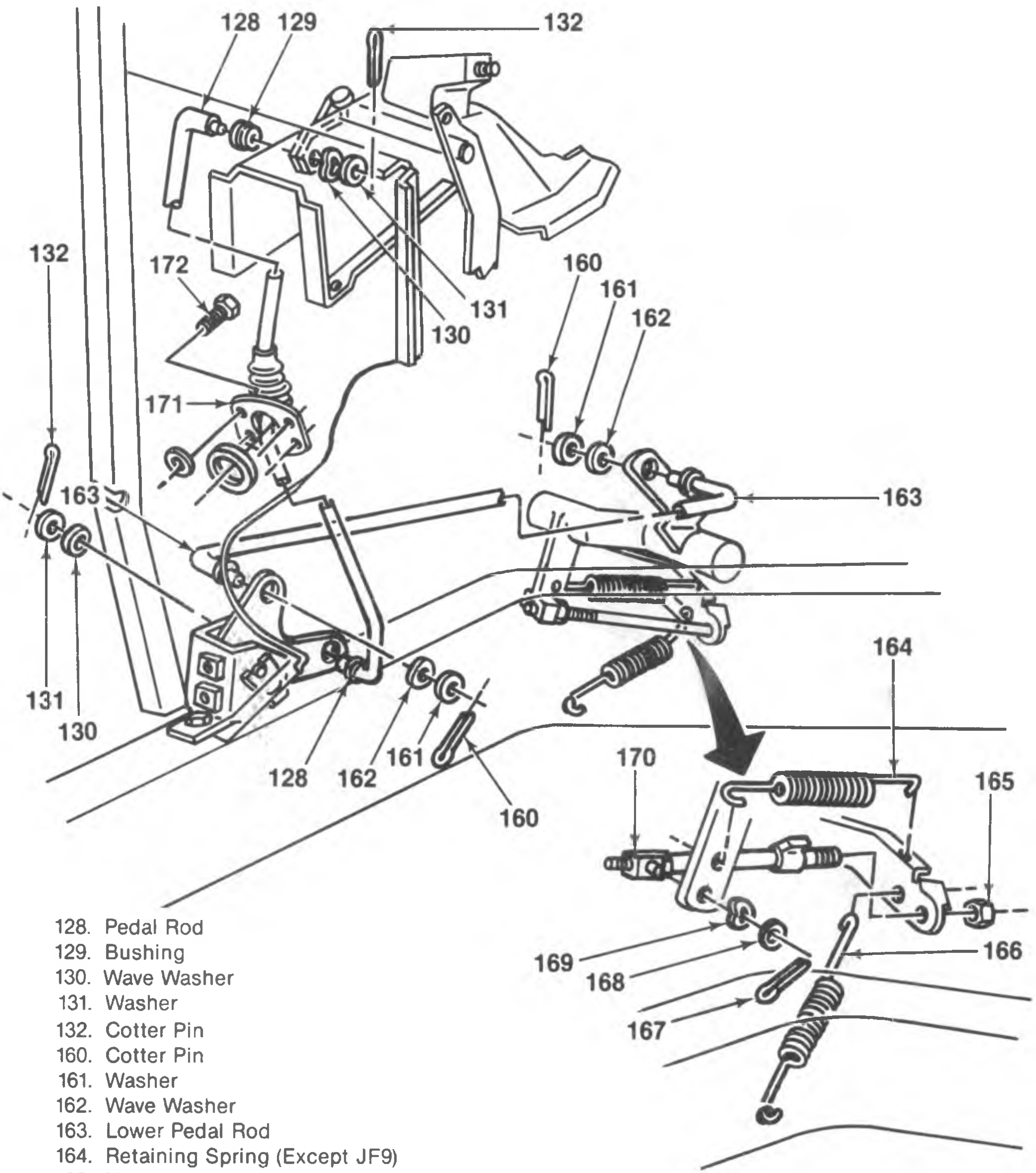
— All metal parts for wear, damage and bending.

— All nylon and plastic parts for wear and cracks.

Install or Connect (Figure 9)

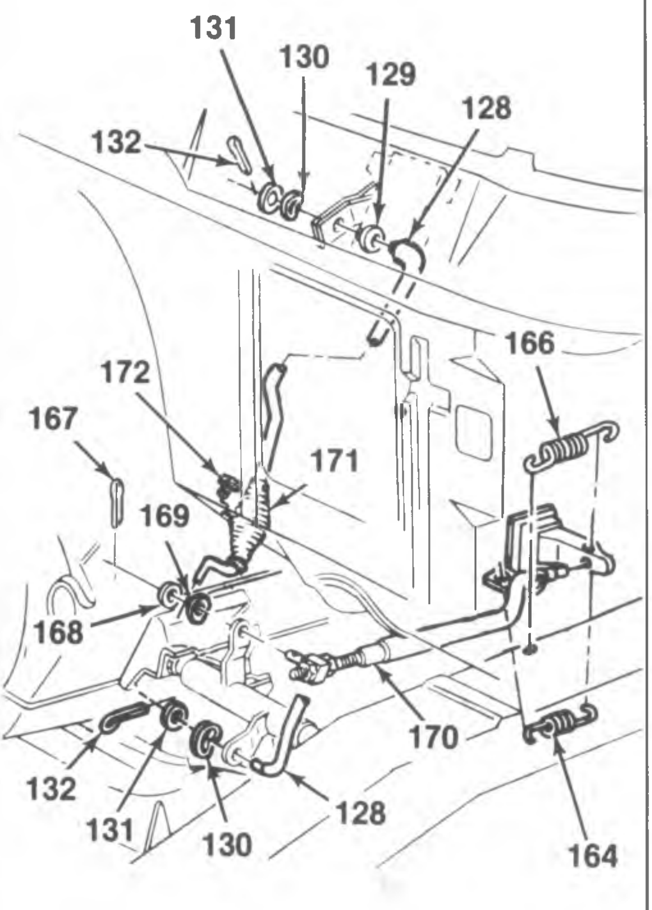
1. Engine side ball stud (181) if needed.
2. New star washer (187), the nut (188) and the ball stud (181) onto the bracket (186).
3. Cross lever (191) and the bracket (186).
4. New spring washers (189) and the screws (185).
   - Nuts (190), (P models only).
5. Pedal rod or the lower pedal rod (A), (Figures 7 and 8).
6. Adjusting rod (170) and the springs, (Figures 7 and 8).

- Adjust the clutch linkage. Refer to "Free Travel Adjustment" in this section.
- Lubricate the clutch linkage. Refer to MAINTENANCE AND LUBRICATION (Sec. 0B).



128. Pedal Rod
129. Bushing
130. Wave Washer
131. Washer
132. Cotter Pin
160. Cotter Pin
161. Washer
162. Wave Washer
163. Lower Pedal Rod
164. Retaining Spring (Except JF9)
165. Nut
166. Pull Back Spring
167. Cotter Pin
168. Washer
169. Wave Washer
170. Adjusting Rod
171. Boot
172. Screw

Figure 7—Clutch Linkage - P Models



128.	Pedal Rod
129.	Bushing
130.	Wave Washer
131.	Washer
132.	Cotter Pin
164.	Retaining Spring
166.	Pull Back Spring
167.	Cotter Pin
168.	Washer
169.	Wave Washer
170.	Adjusting Rod
171.	Boot (Two Piece)
172.	Screw

B-08839

Figure 8—Clutch Linkage - G Models

HYDRAULIC CLUTCH BLEEDING

C-K MODELS

Bleed (Figures 3 and 5)

1. Fill the reservoir (140) with new DOT 3 brake fluid to the level of the diaphragm.

NOTICE: Never, under any circumstances, use fluid which has been bled from a system to fill the reservoir, as it may be aerated, have too much moisture content and possibly be contaminated.

2. Remove the secondary cylinder (153) and hold it with the bleeder screw (152) the highest.
3. Hold the clutch pedal down, open the bleeder screw (152) to let air and fluid escape, and close the bleeder screw (152). Let the clutch pedal up.
4. Repeat step 3 unti all air is out of the system.

Important

- Check and refill the reservoir as needed while bleeding so that air is not drawn into the system.

5. Install the secondary cylinder (153) and refill the reservoir (140) if needed.

CLUTCH PEDAL FREE TRAVEL ADJUSTMENT

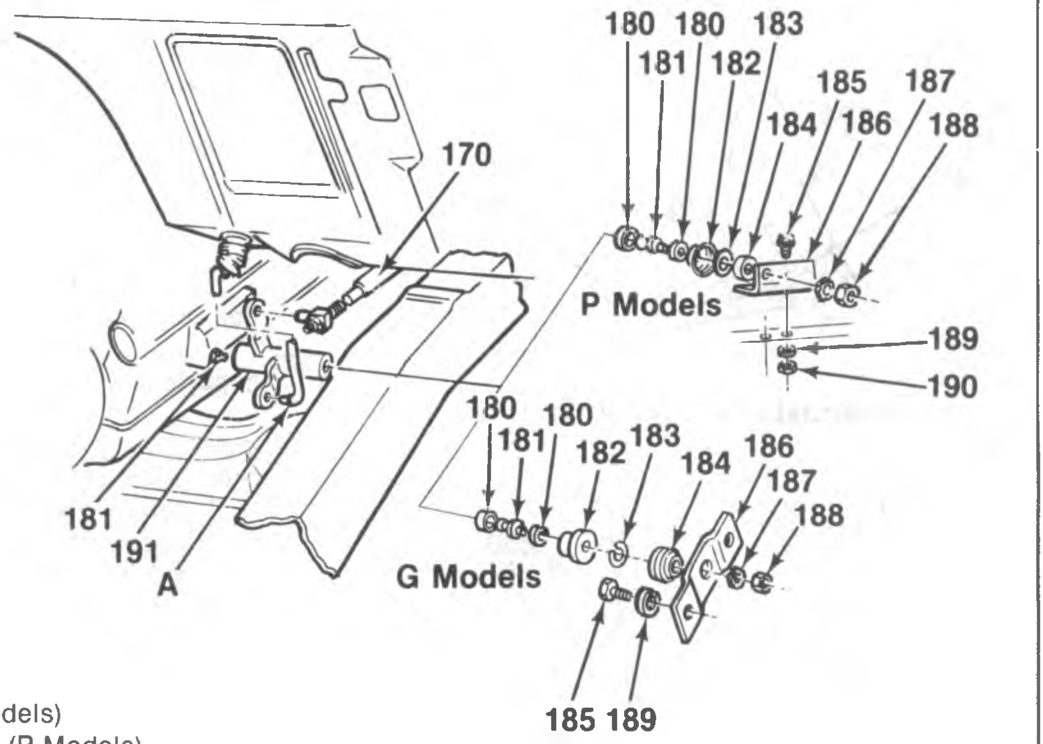
P MODELS

Adjust (Figures 7 and 10)

1. Remove the pull back spring (166).
2. Loosen the nut (201) at the swivel (202).
   - Take the swivel (202) out of the cross lever (191), (models without JF9).
3. Move the clutch fork (200) back until the clutch spring pressure is felt, and adjust the rod length.

   Models without JF9.
   - Hold the clutch pedal against the bumper.
   - Turn the nut (201) until the swivel (202) fits into the gage hole (A), then remove all lash.
   - Install the swivel (202) with a new wave washer (169) and cotter pin (167).

   Models with JF9.
   - Hold the clutch pedal against the bumper.
   - Loosen the jam nut (165) and turn the nut (203) until it is 0.29 in (7.37 mm) from the rod shoulder (B).
   - Tighten the jam nut (165) and turn the nut (201) to remove all lash.



170. Adjusting Rod
180. Seat
181. Ball Stud
182. Seal
183. Spring
184. Retainer
185. Screw
186. Bracket
187. Star Washer
188. Nut
189. Spring Washer
190. Nut
191. Cross Lever
A. Pedal Rod (G Models)
Lower Pedal Rod (P Models)

Figure 9—Cross Lever

4. Install the pull back spring (166).
5. Check the clutch pedal free travel and re-adjust if needed. Refer to "Clutch Pedal Free Travel" in this section.
6. Lubricate the clutch linkage. Refer to MAINTENANCE AND LUBRICATION (Sec. 0B).

G MODELS

Adjust (Figures 8 and 10)

1. Remove the pull back spring (166).
2. Loosen the nut (203).
3. Move the clutch fork (200) back until the clutch spring pressure is felt.
4. Hold the clutch pedal against the bumper and turn the nut (201) until it is 0.28 in. (7.11 mm) from the cross lever (191).
5. Tighten the nut (203) against the cross lever (191).
6. Install the pull back spring (166).
7. Check the clutch pedal free travel and re-adjust if needed. Refer to "Clutch Pedal Free Travel" in this section.
8. Lubricate the clutch linkage. Refer to MAINTENANCE AND LUBRICATION (Sec. 0B).

CLUTCH ASSEMBLY AND PILOT BEARING

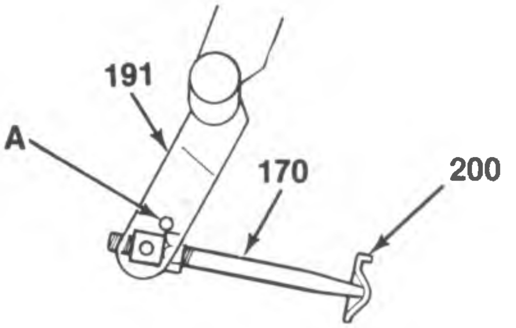
CAUTION: When servicing clutch parts, do not create dust by grinding or sanding clutch disc or by cleaning parts with a dry brush or with compressed air. (A water dampened cloth—NOT SOAKED—should be used). The clutch disc contains asbestos fibers which can become airborne if dust is created during servicing. Breathing dust containing asbestos fibers may cause serious bodily harm.

Remove or Disconnect (Figure 11)

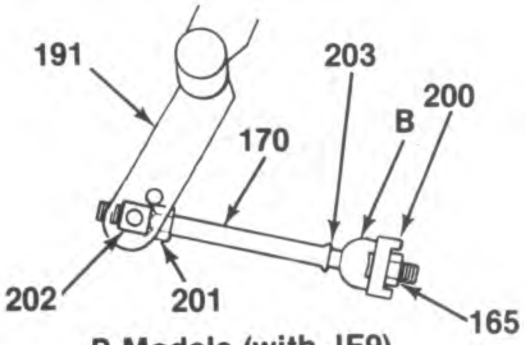
Tool Required:

- J-5824-01 Clutch Alignment Tool
- J-1448 Pilot Bearing Puller (Gas Engine Only)
- J-23907 Pilot Bearing Puller (6.2 L Diesel Only)

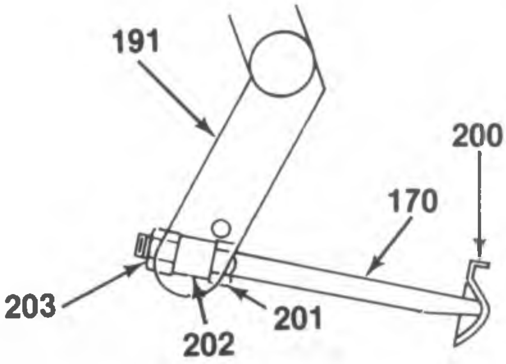
1. Transmission. Refer to TRANSMISSION (Sec. 7B).
2. Adjusting rod (170) or the secondary cylinder (153), (Figure 5, 7 or 8).



P Models (without JF9)



P Models (with JF9)



G Models

165. Jam Nut
170. Adjusting Rod
191. Cross Lever
200. Clutch Fork
201. Nut
202. Swivel
203. Nut
A. Gage Hole
B. Rod Shoulder

Figure 10—Clutch Linkage Adjustment

  - Pull back spring (166) if used.
  - Retaining spring (164) if used.
3. Screws (216) and the cover (215).
4. Screws (208) and the flywheel housing (207).
5. Boot (210), the clutch fork (200) and the release bearing (212).
   - Pry the clutch fork (200) off the ball stud (209).
   - Pry the retainer (211) out of the clutch fork (200) if it is worn or damaged.
6. Ball stud (209).

Important

- Install J-5824-01 clutch alignment tool or a used clutch drive gear to support the clutch.
- Mark the flywheel, clutch cover and a pressure plate lug for alignment when installing.

7. Screws (206) and the spring washers (205).

Important

- Loosen each screw one turn at a time to avoid warping the clutch cover.

8. Cover assembly (213) and the driven plate (214).
   - Remove the clutch alignment tool.
9. Pilot bearing (217) if it is worn or damaged. Use J-1448 or J-23907 as needed (figure 12).

Disassemble (Figure 11)

1. Remove the screws (218) and straps (219).
   - Note the location of the retracting springs.
2. Remove the pressure plate (220).

Clean (Figure 11)

1. All parts with a clean, water dampened cloth to remove any asbestos fibers.
2. Clutch fork (200), the flywheel housing (207) and the ball stud (209) with solvent. Wipe dry.

NOTICE: The release bearing is permanently packed with lubricant and should not be soaked in cleaning solvent as this will dissolve the lubricant.

Inspect (Figure 11)

- All parts for wear and damage.
- Contact surfaces for scoring, and flatness with a straight edge. Driven plate run-out must not be more than 0.20 in (5.08 mm).
- Friction pads for scoring, gouges, and loose rivets. Check to see if they are oil soaked.
- All splines for nicks, burrs and sliding fit.
- All springs for bending and breaks.

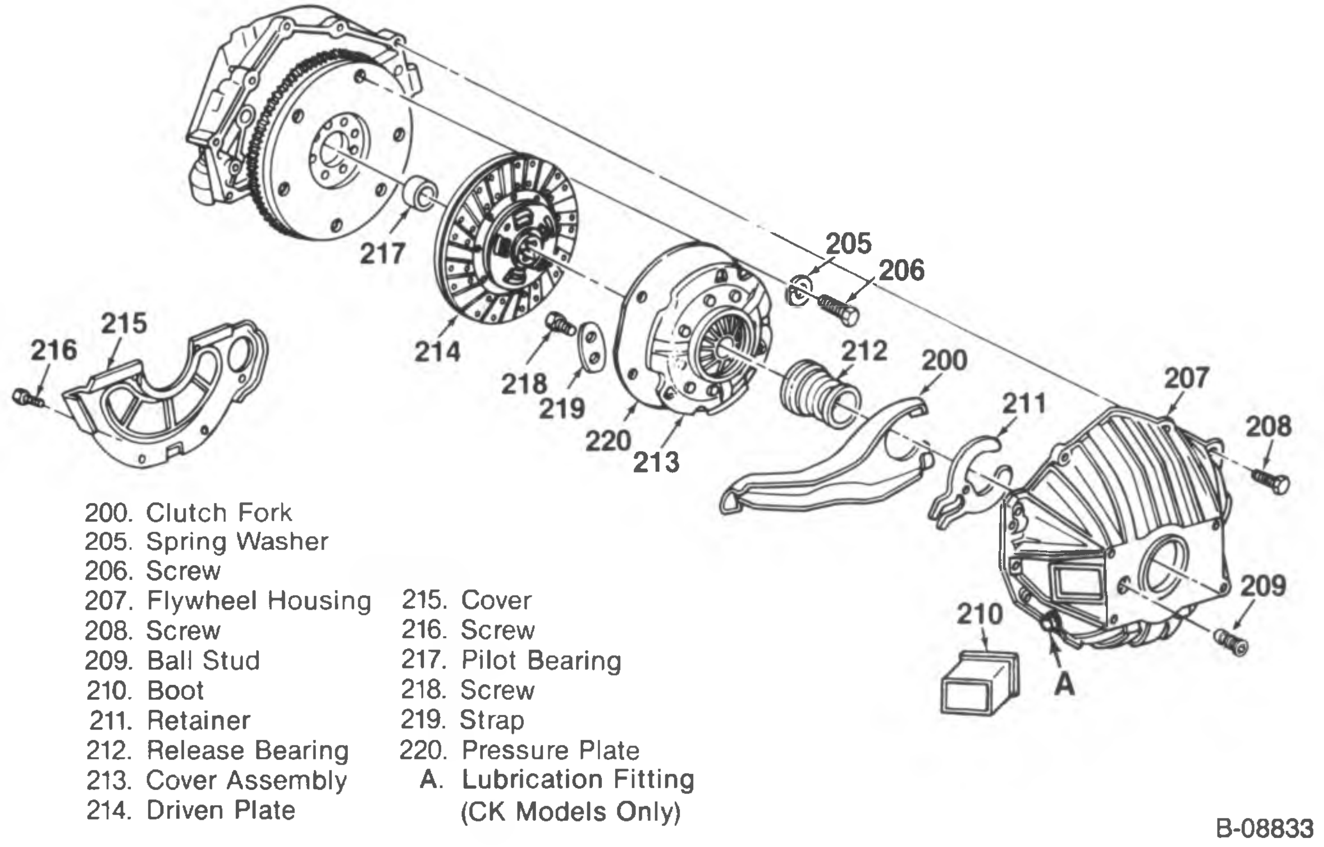


Figure 11—Clutch Assembly and Pilot Bearing

— Boot for tears and brittleness.

Measure (Figure 11)

— Transmission pilot hole in the clutch housing for run out using a dial indicator. Run out should not be more than 0.015 in. (0.380 mm).

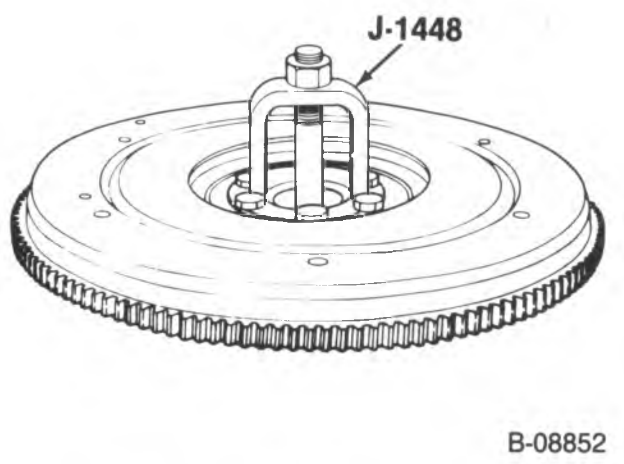


Figure 12—Pilot Bearing Removal

Assemble (Figure 11)

1., Install the pressure plate (220).

Important

- Line up the marks made during removal.

2. Straps (219) and the screws (218).
   - Install the retracting springs in the positions they were removed from.

Install or Connect (Figure 11)

Tool Required:

J-5824-01 Clutch Alignment Tool
J-1522 Pilot Bearing Driver (Gas Engine Only)
J-34140 Pilot Bearing Driver (6.2 L Diesel Only)

1. New pilot bearing (217) if needed. Use J-1522 or J-34140 as needed to drive the bearing in until the tool bottoms out.

— **Gas Engine**
Lubricate the bearing with a few drops of machine oil.

— **6.2 L Diesel Engine**
The bearing is sealed and does not need any lubrication.

2. Driven plate (214) and the cover assembly (213).

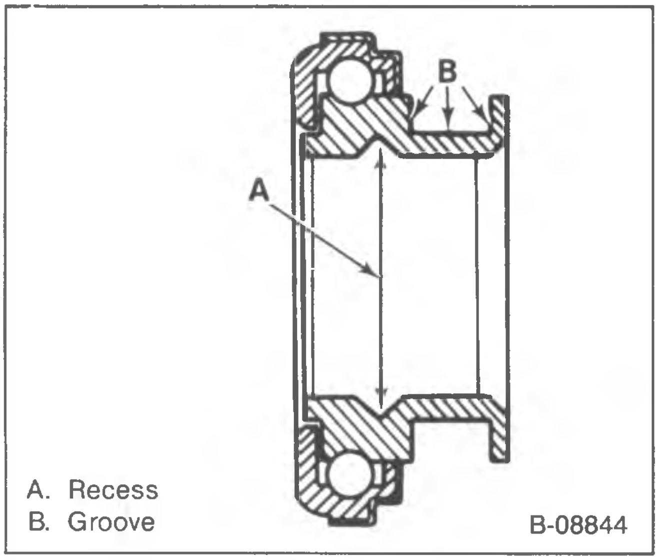


Figure 13—Release Bearing

Important

- Install J-5824-01 clutch alignment tool or a used clutch drive gear to support the clutch.
- Align the marks made during removal.

3. New spring washers (205) and the screws (206).
    - Remove the clutch alignment tool.

Important

- Tighten each screw one turn at a time to avoid warping the clutch cover.

NOTICE: Be careful not to use too much lubricant. Excessive lubricant may get on clutch fingers and cause slippage or damage may result to the clutch.

4. Ball stud (209).
    - Pack the seat with high temperature grease.
5. Coat the rounded end of the ball stud (209) with high temperature grease.
    - Pack the ball stud seat from the lubrication fitting (A) on the flywheel housing (207) (C-K models only).
6. New retainer (211) if needed.
    - The retainer must be installed so the fingers and tabs fit into the release bearing groove and the retainer wraps around the flat side of the ball stud head.
7. Release bearing (212), the clutch fork (200) and the boot (210).
    - Pack the inside recess (A) and the outside groove (B) of the release bearing (212) with high temperature grease as shown. (Figure 10).
8. Flywheel housing (207) and the screws (216).
9. Cover (215) and the screws (216).
10. Adjusting rod (170) or the secondary cylinder (153) as needed. (Figure 5, 7 or 8).
    - Retaining spring (164) if used.
    - Pull back spring (166) if used.
11. Transmission. Refer to TRANSMISSION (Sec. 7B).
12. Adjust the clutch linkage or bleed the hydraulic system as needed.

SPECIFICATIONS

FASTENER TORQUE

Flywheel Housing to Engine	54 N·m	40 ft. lb.
Clutch Pedal Stud	39 N·m	29 ft. lb.
Master Cylinder	18 N·m	13 ft. lb.
Secondary Cylinder	18 N·m	13 ft. lb.
Cross Lever Ball Stud -		
Bracket Side	27N·m	20 ft. lb.
Engine Side (G Models)	54 N·m	40 ft. lb.
(P Models)	46 N·m	34 ft. lb.
Adjusting Rod Swivel (G Models)	43 N·m	32 ft. lb.
(P Models)	27 N·m	20 ft. lb.

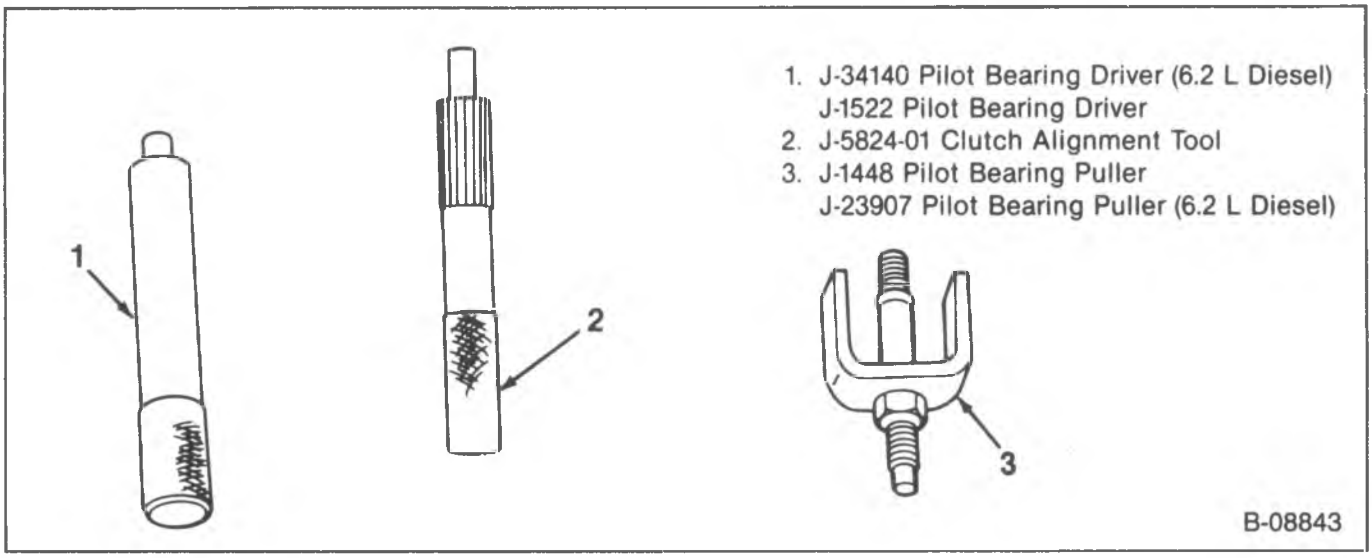
CLUTCH PEDAL FREE TRAVEL

G Models	34 mm	1.375 in.
P Models (Without JF9)	34 mm	1.375 in.
P Models (With JF9)	38 mm	1.500 in.

LUBRICATION

Hydraulic Clutch -	
Capacity	Fill to level of diaphragm.
Type recommended	Brake fluid meeting DOT 3.

SPECIAL TOOLS



1. J-34140 Pilot Bearing Driver (6.2 L Diesel)
   J-1522 Pilot Bearing Driver
2. J-5824-01 Clutch Alignment Tool
3. J-1448 Pilot Bearing Puller
   J-23907 Pilot Bearing Puller (6.2 L Diesel)

Figure 14—Special Tools

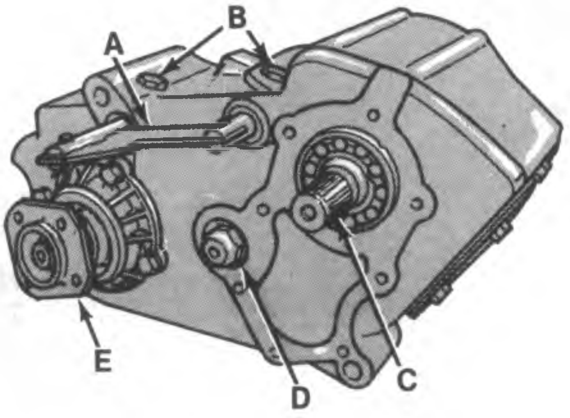
SECTION 7D1

205 TRANSFER CASE

CONTENTS

SUBJECT **PAGE**

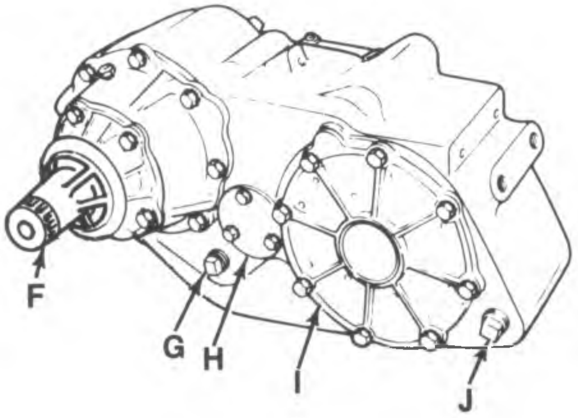
GENERAL DESCRIPTION



A. Shift Rail Link
B. Poppet Nuts
C. Front Input Shaft Assembly
D. Idler and Rear Output Shaft Nut
E. Front Output Shaft Assembly

F-00044

Figure 1—Front View



F. Rear Output Assembly
G. Fill Plug
H. Idler Shaft Cover
I. Front Output Shaft Rear Bearing Retainer
J. Drain Plug

F-00045

Figure 2—Rear View

The 205 transfer case mounts behind the transmission and allows drive torque to be transmitted in a proportional split to both the front axle and the rear axle, resulting in four-wheel drive (figures 1 and 2).

The shift control lever for the transfer case is floor-mounted in the passenger compartment.

The model 205 is a two-speed unit which offers two-wheel or four-wheel drive Direct drive (1:1 ratio) is available in two modes, 2H for two-wheel drive or 4H for four-wheel drive. Gear reduction (1.96:1 ratio) is used in the 4L position. This unit uses constant mesh helical gears to connect the input shaft, idler gear and two output gears, thus allowing gear selection to match driving conditions.

When driving in a four-wheel mode (4L or 4HI), turn the hubs on the front wheels to the "Locked" position.

MAINTENANCE AND ADJUSTMENT

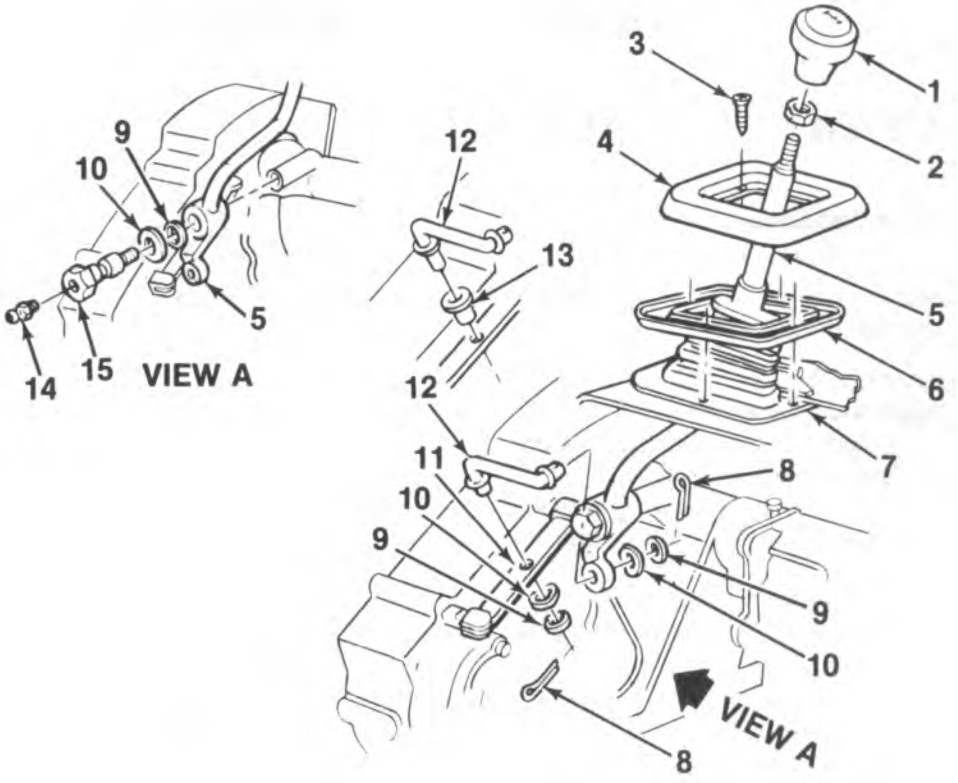
LUBRICATION INFORMATION

Refer to Section 0B for information on intervals and types of lubricant.

LINKAGE ADJUSTMENT AND INSPECTION

Periodically inspect the linkage system for freedom of operation, proper engagement, loose attaching bolts, foreign material, etc. Adjust, clean and tighten as necessary (figure 3).

1. Knob
2. Nut
3. Screw
4. Plate
5. Lever
6. Retainer
7. Boot
8. Pin
9. Washer
10. Washer
11. Link
12. Rod
13. Grommet
14. Fitting
15. Bolt



F-00035

Figure 3—Shift Control Component View

DIAGNOSIS OF TRANSFER CASE

Before servicing a malfunction, check the front hubs, axles, propeller shafts, wheels and tires, transmission or clutch.

PROBLEM	POSSIBLE CAUSE	CORRECTION
Excessive Noise	1. Lubricant level low. 2. Worn or damaged bearings. 3. Misalignment of drive shafts or universal joints. 4. Yoke bolts loose. 5. Loose adapter bolts.	1. Fill as required. 2. Replace. 3. Align. 4. Refer to Specifications. 5. Refer to Specifications.
Shift Lever Difficult To Move	Binding inside transfer case.	Repair as required.
Shifter Lever Disengages From Position	1. Gears worn or damaged. 2. Shift rod bent. 3. Missing detent ball or spring.	1. Replace. 2. Replace. 3. Replace.
Lubricant Leaking	1. Excessive lubricant in case. 2. Leaking seals or gaskets. 3. Loose bolts. 4. Scored yoke in seal contact area.	1. Adjust level. 2. Replace. 3. Tighten 4. Refinish or replace.

ON-VEHICLE SERVICE

TRANSFER CASE REMOVAL

Remove or Disconnect

- Raise and support the vehicle on a suitable hoist.
- Drain the transfer case.

1. Speedometer cable.
2. Skid plates and crossmembers (figure 4).
3. Strut rod (automatic transmissions) (figure 5).
4. Rear propshaft from the case.
   - Mark propshaft for assembly reference.
   - Tie it up and move it away from the work area.
5. Shift lever rod from the shift rail link.
6. Bolts attaching the transfer case to the transmission adapter (figure 6).
   - Support the transfer case with a suitable stand.
7. Transfer case.
   - Move the transfer case to the rear until the input shaft clears the adapter.

Install or Connect

- Support the transfer case in a suitable stand and position the case to the transmission adapter.

1. Bolts attaching the case to the adapter (figure 6).

   Tighten

   - Bolts to 61 N·m (45 ft. lbs.).
   - Remove the stand.
2. Connecting rod to the shift rail link or connect the shift lever to transfer case as required (figure 3).

   Tighten

   - Nuts to 17 N·m (12 ft. lbs.).
3. Front propshaft to the transfer case front output flange or yoke.

   Tighten

   - Bolts to 102 N·m (75 ft. lbs.).
4. Rear propshaft to the transfer case rear output yoke.

   Tighten

   - Bolts to 20 N·m (15 ft. lbs.).
5. Crossmember support and skid plate, if removed (figure 4).

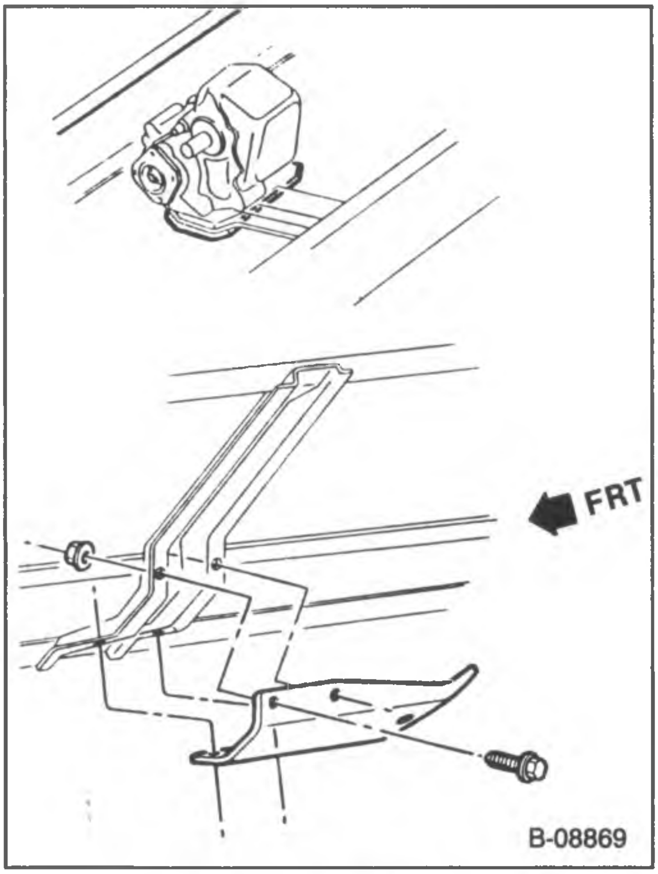


Figure 4—Skid Plate

Tighten

- Bolts to 63 N·m (46 ft. lbs.).

6. Strut rod (automatic transmission) (figure 5).

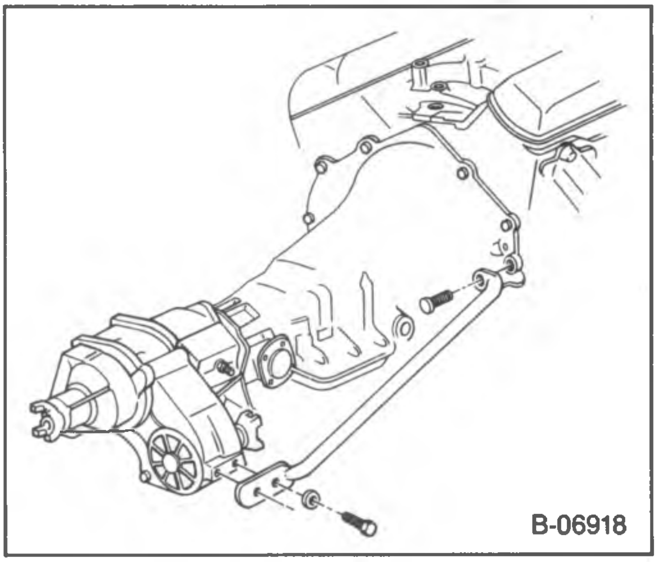


Figure 5—Strut Rod Support (Automatic Transmissions)

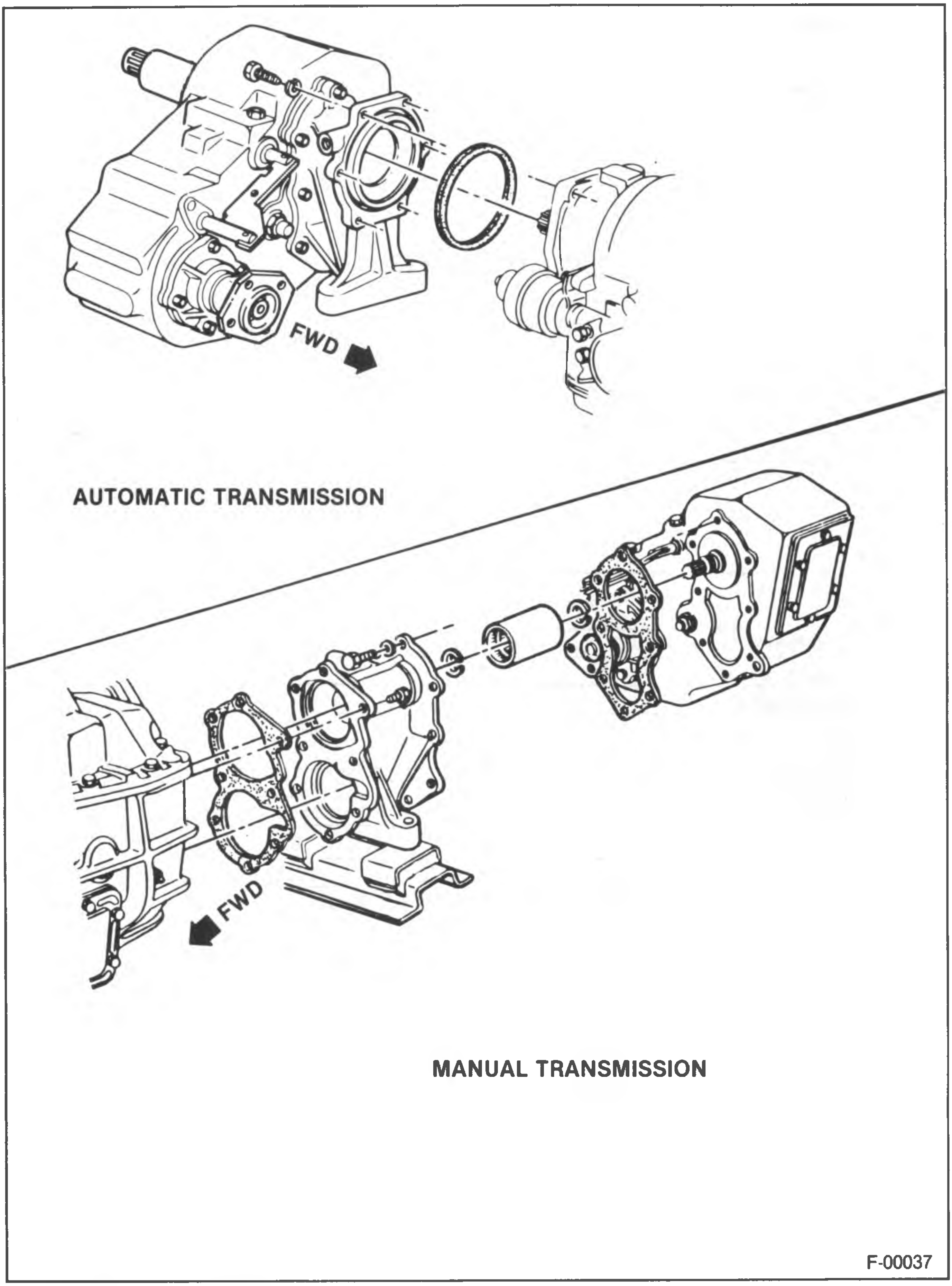


Figure 6—Transmission Adapters

Tighten

- Transmission end bolts to 47 N·m (35 ft. lbs.).
- Transfer case end bolts to 175 N·m (129 ft. lbs.).

7. Speedometer cable.
8. Fill the transfer case to the proper level with lubricant. Refer to Section 0B.
9. Filler plug.

Tighten

- Plug to 44 N·m (32 ft. lbs.).

10. Lower and remove the vehicle from hoist.

SPECIFICATIONS

	N·m	Ft. Lbs.	In. Lbs.
Nut, Shift Lever-To-Shifter Assembly	23	17	
Nut, Knob Assembly-To-Shift Lever	33	24	
Bolt, Shifter Assembly-To-Transfer Case	135	100	
Nut, Shift Arms-To-Case	17	13	
Screw, Shift Lever Boot Retainer	2.7		31
Bolt, Adapter-To-Transmission	33	24	
Bolt, Adapter-To-Transfer Case	33	24	
Drain Plug	44	32	
Filler Plug	44	32	
Bolts P.T.O. Cover	22	16	
Nut, Skid Plate-To-Crossmember	63	46	
Bolt, Support Strut Rod			
—Transmission End	47	35	
—Transfer Case End	175	129	
Propeller Shaft			
—Transfer Case (Front)	75	55	
—Transfer Case (Rear)	15	11	

MODEL NO.	205 (PART TIME)
AVAILABILITY	All K30 Series
RATIOS: Hi Range Lo Range	1.00 To 1 1.96 To 1
LEVER POSITIONS	4-Lo (All Wheel Underdrive) N (Neutral) 2-Hi (Rear Wheel Drive) 4-Hi (All Wheel Direct Drive)
LEVER LOCATION	Rear Of Transmission Shift Lever
POWER TAKE-OFF DATA: Opening and Location	SAE 6-Bolt; Left Side
LUBRICANTS: Oil Capacity	5.2 Pints*
Type, Grade	Dexron® II

*To Be Filled Within One Inch Of Fill Plug.

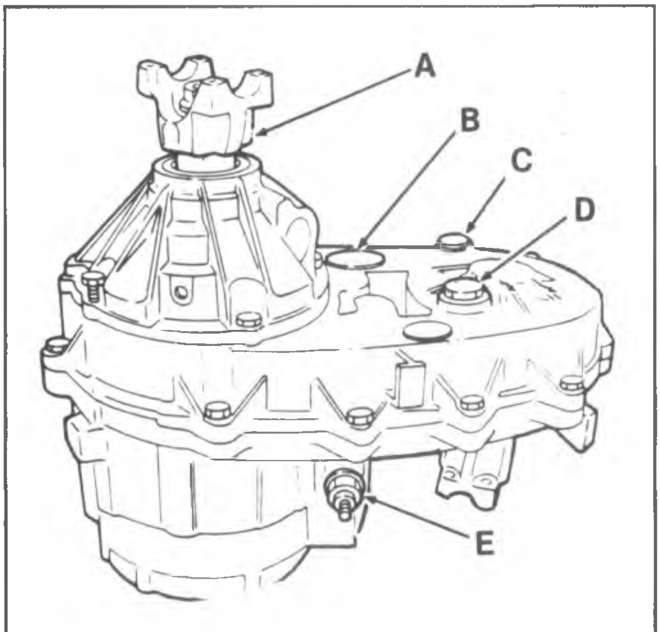
SECTION 7D2

208 TRANSFER CASE

CONTENTS

SUBJECT **PAGE**

GENERAL DESCRIPTION



A. Rear Yoke
B. Identification Tag
C. Drain Plug
D. Fill Plug
E. Indicator Switch

B-08894

Figure 1—Indicator Switch, Identification Tag, and Drain and Fill Plug Location

The Model 208 transfer case (figure 1) is an aluminum case, chain driven, four position unit providing four-wheel drive high and low ranges, a two-wheel high range and a neutral position. The model 208 is a part-time four-wheel drive unit. Torque input in four-wheel high and low ranges is the same.

A two-piece aluminum case contains front and rear output shafts, two drive sprockets, a shift mechanism and a planetary gear assembly. The drive sprockets are connected and operated by the drive chain. The planetary assembly, which consists of a four pinion carrier and an annulus gear, provides the four-wheel drive low range when engaged. Reduction ratio is 2.61:1 in this range.

SHIFT CONSOLE AND LEVER CONTROLS

A floor mounted shift lever is used to select the operating range (figure 2). The shift lever is located on the floorpan transmission tunnel adjacent to the transmission gearshift lever. The shift pattern is not in a straight line for 208 models (figure 3).

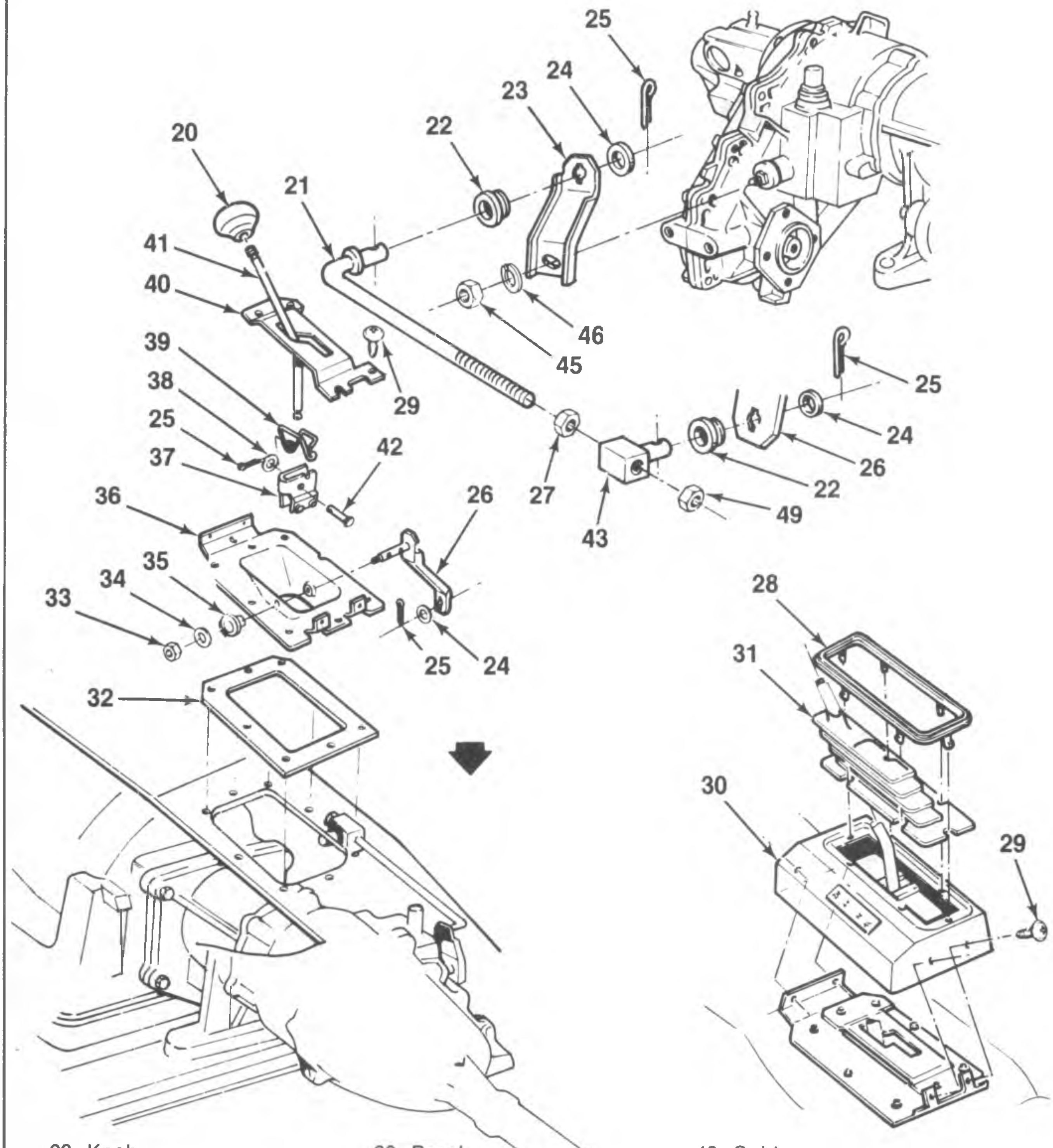
FOUR-WHEEL DRIVE INDICATOR LAMP

An indicator lamp mounted in the instrument panel alerts the driver whenever the vehicle is being operated in four-wheel range. An indicator switch in the transfer case controls the lamp (figure 2).

The switch is a ball and plunger unit activated by the range selector when four-wheel range is selected.

IDENTIFICATION

For servicing, an identification tag attached to the rear half of the transfer case provides the transfer case model number, low range reduction ratio and assembly number. If the tag is removed or becomes dislodged during service operations, reattach using an adhesive sealant such as Loctite 312 or equivalent (figure 1).



20. Knob
21. Rod
22. Grommet
23. Lever
24. Washer
25. Pin
26. Lever
27. Nut
28. Plate
29. Screw
30. Bezel
31. Boot
32. Seal
33. Nut
34. Washer
35. Bushing
36. Housing
37. Fork
38. Washer
39. Spring
40. Guide
41. Lever
42. Pin
43. Swivel
44. Bolt
45. Nut
46. Washer
47. Bolt
48. Nut
49. Nut

B-08867

Figure 2—Console and Shift Controls Component View

LUBRICATION

Change the lubricant at the intervals specified in Section 0B. when adding lubricant or refilling the transfer case after servicing, use DEXRON® II. Refer to the maintenance and adjustments section for lubricant change procedures and fill level.

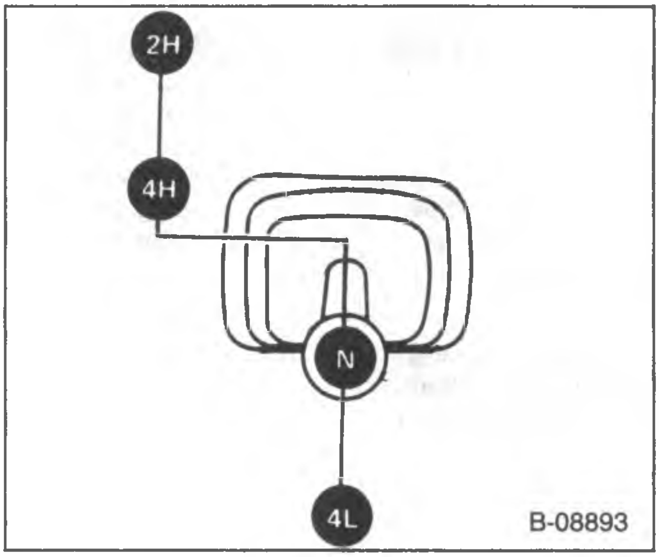


Figure 3—Shift Pattern

DIAGNOSIS OF TRANSFER CASE

Before repairing a suspected transfer case problem check the driveline components. The problem may be related to the front hubs, axles, propeller shafts, wheels and tires, transmission or clutch.

PROBLEM	POSSIBLE CAUSE	CORRECTION
Transfer Case Difficult To Shift Or Will Not Shift Into Desired Range	1. Vehicle speed too great to permit shifting. 2. If vehicle was operated for extended period in 4H mode on dry paved surface, driveline torque load may cause difficult shifting. 3. Transfer case external shift linkage binding. 4. Insufficient or incorrect lubricant. 5. Internal components binding, worn or damaged.	1. Stop vehicle and shift into desired range. Or reduce speed to 2-3 mph (3-4 km/h) before attempting to shift. 2. Stop vehicle, shift transmission to neutral, shift transfer case to 2H mode and operate vehicle in 2H on dry paved surfaces. 3. Lubricate or repair or replace linkage, or tighten loose components as necessary. 4. Drain and refill to edge of fill hole with DEXRON® II only. 5. Disassemble unit and replace worn or damaged components as necessary.
Transfer Case Noisy In All Drive Modes	1. Insufficient or incorrect lubricant.	1. Drain and refill to edge of fill hole with DEXRON® II only. Check for leaks and repair if necessary. Note: If unit is still noisy after drain and refill, disassembly and inspection may be required to locate source of noise.
Noisy In — Or Jumps Out Of Four Wheel Drive Low Range	1. Transfer case not completely engaged in 4L position. 2. Shift linkage loose or binding.	1. Stop vehicle, shift transfer case in Neutral, then shift back into 4L position. 2. Tighten, lubricate or repair linkage as necessary.

DIAGNOSIS OF TRANSFER CASE (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Noisy In — Or Jumps Out Of Four Wheel Drive Low Range (Continued)	3. Range fork cracked, inserts worn, or fork is binding on shift rail. 4. Annulus gear or lockplate worn or damaged.	3. Disassemble unit and repair as necessary. 4. Disassemble unit and repair as necessary.
Lubricant Leaking From Output Shaft Seals Or From Vent	1. Transfer case overfilled. 2. Vent closed or restricted. 3. Output shaft seals damaged or installed incorrectly.	1. Drain to correct level. 2. Clear or replace vent if necessary. 3. Replace seals. Be sure seal lip faces interior of case when installed. Also be sure yoke seal surfaces are not scored or nicked. Remove scores, nicks with fine sandpaper or replace yoke(s) if necessary.
Abnormal Tire Wear	1. Extended operation on dry hard surface (paved) roads in 4H range.	1. Operate in 2H on hard surface (paved) roads.

MAINTENANCE AND ADJUSTMENT

CASE-OIL CHANGE

Remove or Disconnect

- Raise the vehicle.
- Position a drain pan under the transfer case.
- Drain and fill plugs.
- Drain the lubricant.

Install or Connect

1. Drain plug.

   Tighten

   - Plug to 24 N·m (18 ft. lbs.)
   - Remove the drain pan.
   - Fill the transfer case to the edge of fill plug opening with DEXRON® II.
2. Fill plug.

   Tighten

   - Plug to 24 N·m (18 ft. lb.).
   - Lower the vehicle.

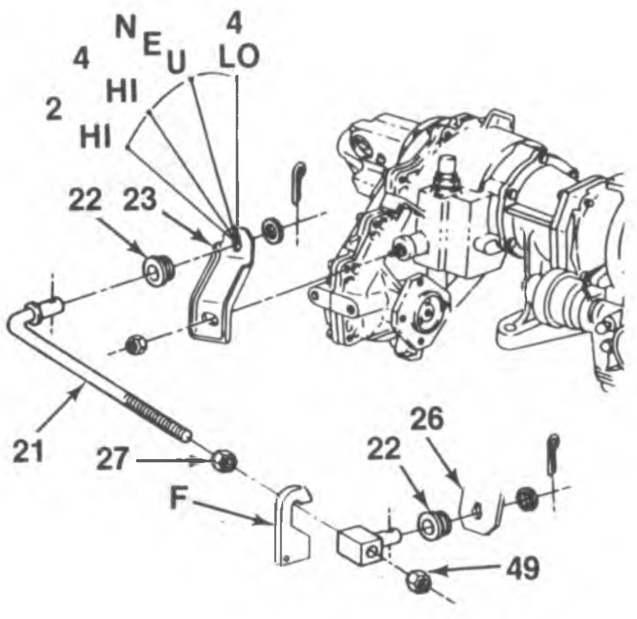
INSPECTION

Periodically inspect the linkage system for freedom of operation, proper engagement, loose attaching bolts and foreign material.

LINKAGE ADJUSTMENTS (FIGURES 1 AND 4)

Adjust (Figures 1 and 4)

1. Put the transfer case lever into the 4H detent (figure 4).
2. Push the lower shifter lever (26) forward into the 4H detent.
3. Install the rod swivel (21) into the shift lever hold.
4. Hang a 129 mm (0.200) gage (F) with a 6 mm (0.25 inch) radius over the rod behind the swivel.
5. Run the rear rod nut (27) against the gage with the shifter against the 4H detent.
6. Remove the gage and push the swivel rearward against the nut (27).
7. Run the front rod nut (49) against the swivel and tighten.



F. Gage 129 mm (0.200")
21. Rod
22. Grommet
23. Lever
26. Lever
27. Nut
49. Nut

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Figure 4—Linkage Adjustment

ON-VEHICLE SERVICE

TRANSFER CASE REMOVAL

Remove or Disconnect (Figures 2, 5, 6 and 7)

- Place the transfer case in 4H detent.
- Raise the vehicle.
- Drain the lubricant from the transfer case.

1. Cotter pin from the shift lever swivel (figure 2).
2. Speedometer cable.
3. Indicator switch wire.
4. Front and rear propeller shafts.
   - Mark the shafts and yokes for assembly alignment reference.
5. Parking brake cable guide from the pivot located on the right frame rail.
6. Engine strut rod on automatic transmission models (figure 5).
7. Transfer case-to-transmission adapter bolts (figure 6).
   - Support the transfer case with a suitable stand.
8. Skid plates (figure 7).
9. Case.
   - Move the transfer case rearward until it is free of the transmission output shaft.
10. Gasket material.

Install or Connect (Figures 5, 6 and 7)

- Place the transfer case in 4H detent.
- Place the transfer case in a support stand.

1. Gasket to the transmission (figure 6).
2. Output shaft.
   - Rotate the transfer case output shaft (turn yoke) until the ouput shaft gear engages the transfer case input shaft.
   - Move the transfer case forward until the case seats against the transmission.

NOTICE: Place the transfer case flush against the transmission. The case can be damaged if the attaching bolts are tightened when the case is cocked or in a bind.

3. Attaching bolts.

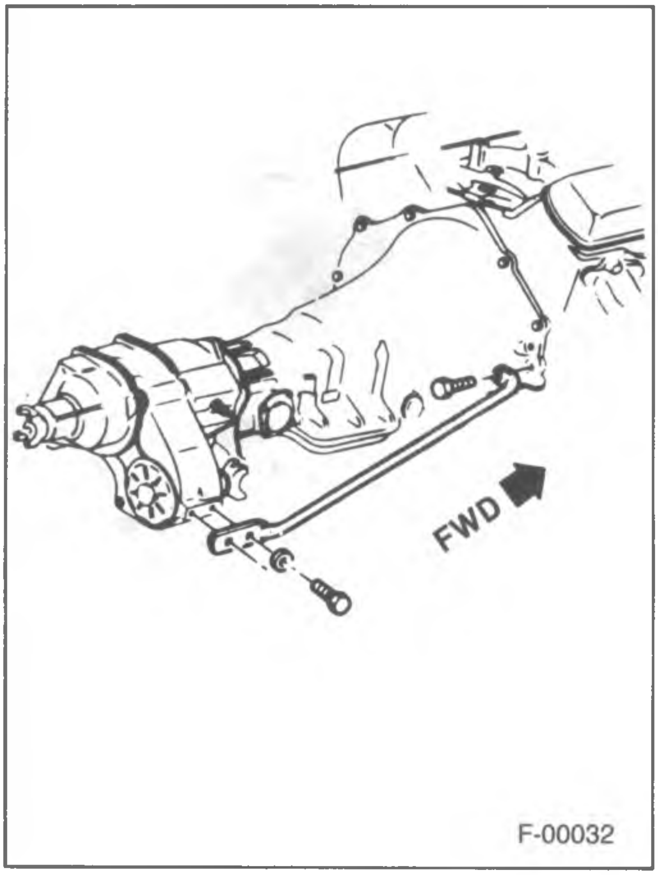


Figure 5—Strut Rod Support - Automatic Transmissions

Tighten

- Bolts to 41 N·m (30 ft. lbs.).

4. Speedometer cable.
5. Front and rear propeller shafts.

Tighten

- Front flange belts to 20 N·m (75 ft. lbs.).
- Rear strap nuts to 20 N·m (15 ft. lbs.).

Important

- Line up the reference marks made during removal.

6. Skid plate (figure 7).

Tighten

- Bolts to 63 N·m (46 ft. lbs.).
- Remove the support stand from under the transfer case.

7. Parking brake cable if disconnected.
8. Cotter pin to the shift lever swivel (figures 2 and 4).
9. Strut rod support to the transfer case on automatic transmissions (figure 5).

Tighten

Transmission bolts to 47 N·m (35 ft. lbs.).
Transfer case bolts to 175 N·m (129 ft. lbs.).

10. Fill the transfer case with DEXRON® II.
    - Lower the vehicle.

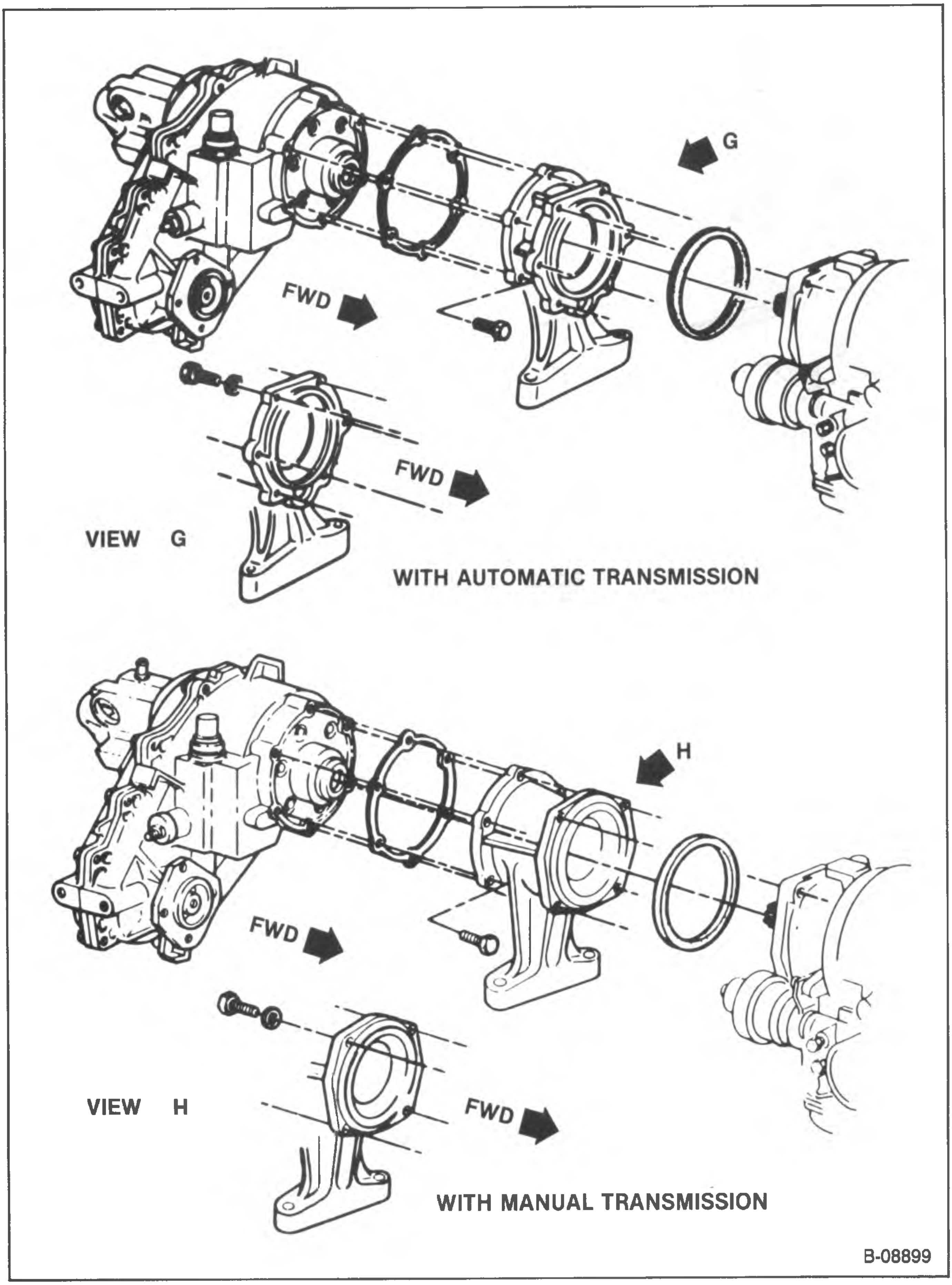


Figure 6—Transmission Adapters

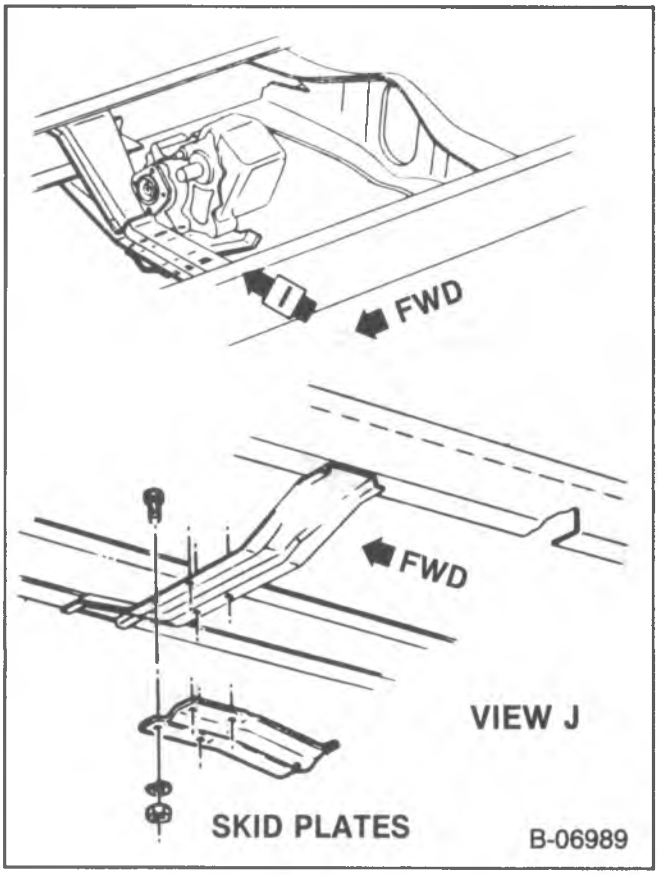


Figure 7—Skid Plate

SPECIFICATIONS

	N·m	Ft. Lbs.
Nut, Shift Lever-To-Shifter Assembly	23	17
Nut, Knob Assembly-To-Shift Lever	33	24
Bolt, Shifter Assembly-To-Transfer Case	130	96
Nut, Shift Arms-To-Case	17	13
Screw, Shift Lever Boot Retainer	2.7	24*
Bolt, Detent Retainer	31	23
Switch, Indicator	149	111
Bolt, Adapter-To-Transmission	33	24
Bolt, Adapter-To-Transmission Case	33	24
Filler Plug	47	35
Nut, Skid Plate-To-Crossmember	63	47
Bolt, Support Strut Rod		
— Transmission End	47	35
— Transfer Case End	175	129
Bolts, Yoke Steps		
Transfer Case, Front	75	55
Transfer Case, Rear	15	11

* Inch Pounds

Model No.	208 (Part Time)
Ratios: Hi Range Lo Range	 2.61 to 1
Lever Positions	4-Lo (All Wheel Underdrive) 2-Hi (Rear Wheel Drive) 4-Hi (All Wheel Drive)
Lever Location	Rear of Trans. Shift Lever
Lubricants: Oil Capacity	 10 Pints*
Type, Grade	DEXRON® II

*Fill To The Edge Of The Plug Hole.

SECTION 8

ELECTRICAL

CONTENTS

SUBJECT **PAGE**

SECTION 8A

CAB ELECTRICAL

CONTENTS

SUBJECT **PAGE**

CONTENTS (CONT.)

BASIC ELECTRICAL

CIRCUITS

An electrical circuit starts from a supply of electricity, conducts the electricity back to the supply of electricity. There should be a device to open and close the circuit, and a protective device to open the circuit in case too much current flows in the circuit.

Electrical circuits can be set up as series circuits or parallel circuits. The circuits in trucks are usually parallel circuits.

SERIES CIRCUITS (Figure 1)

In series circuits, each electrical device is connected in the circuit so that the current can only go along one path as it flows from the power supply, around the circuit and back to the power supply.

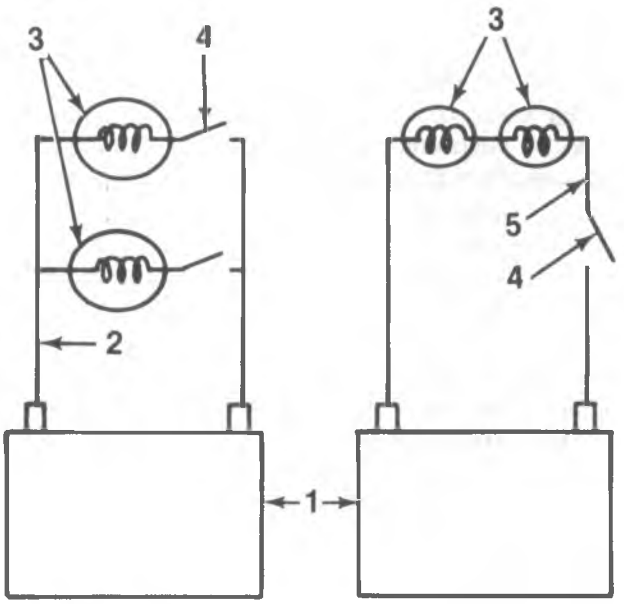
PARALLEL CIRCUITS (Figure 1)

In parallel circuits, the electrical devices are connected by parallel wires that are joined at the start of the circuit. The current divides: part of it flows into one device, part into another.

With circuits in parallel, each circuit can be switched on and off by itself since each circuit receives electricity directly from the power supply.

CIRCUIT COMPONENTS (Figure 2)

The usual circuit path starts at the power supply which is the battery/generator system. Next in the circuit is the circuit protection component which can be a fusible link, a fuse, or a circuit breaker. Then the circuit goes to the circuit controller which can be a switch or a relay. From the circuit controller the circuit goes into the circuit load. The circuit load can be one light or many lights in parallel, an electric motor or a solenoid. After the electricity has passed through the load it must return to the power supply via the ground



1. Battery
2. Parallel Circuit
3. Load
4. Switch
5. Series Circuit

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Figure 1—Basic Circuits

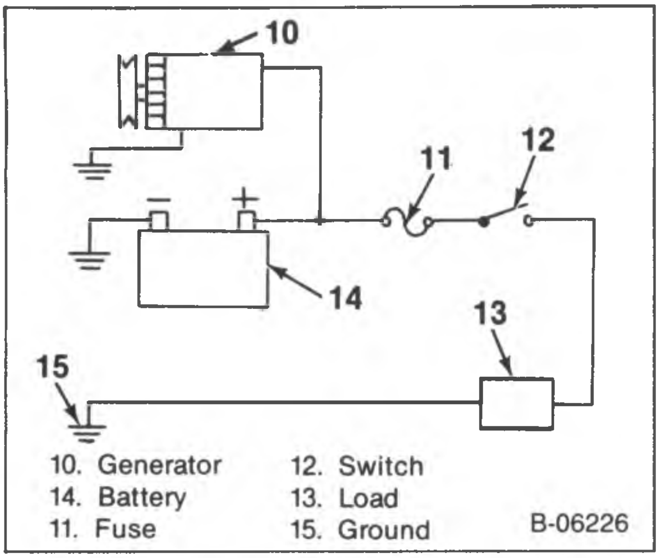


Figure 2—Circuit Components

path. The ground path can be a wire in the harness or it could be through the load housing into the body or frame, thus returning the electricity to the power supply. The body and frame are connected by flexible ground straps.

FUSIBLE LINK

A fusible link is a section of wire that is usually four gage sizes smaller than the circuit it protects. A special insulation is used that swells when heated by the wire. Fusible links are usually found in the engine compartment harnesses. The function of the fusible link is to melt open when an overload occurs, thus preventing any damage to the circuit.

FUSES

The most common protector in the vehicle circuit is a fuse. A fuse consists of a fine wire or strip of metal inside a glass tube or plastic housing. The strip melts and interrupts the flow of current in the circuit when there is an overload caused by an unwanted short or ground. The fuse is designed to melt before the wiring or electrical components in a circuit can be damaged. Naturally, the cause must be located and corrected before the fuse is replaced or the new fuse will also blow.

Since different circuits handle different amounts of current, fuses of various ratings are used. Fuses are rated in amperes. Be sure to replace a blown fuse with a fuse of the connecting rating.

CIRCUIT BREAKERS

Circuit breakers are another form of circuit protector. There are two types of circuit breakers; automatic reset and remote reset.

The automatic reset breaker opens when excess current heats a bimetallic strip, causing the strip to bend and open a set of contacts. Then the strip cools and closes the contacts. So the circuit breaker opens and closes until the excess current condition is corrected or the circuit is disconnected from the power supply.

The remote reset circuit breaker has a heating wire wound around the bimetallic strip. When an excess current happens, the strip heats, bends, and opens the contacts. Then a small current flows through the heat wire, keeping the strip hot and the contacts open. This type of breaker will stay open until either the power supply is disconnected from the circuit or the breaker is removed from the circuit. Then the breaker can cool and reset.

CIRCUIT CONTROLLERS

Circuit controllers consist of switches or relays. Switches are usually operated by a mechanical means such as a hand or lever. Switches are usually at the beginning of a circuit but can be used to control a ground path. For example, the switch controlling the headlights is at the power end of the circuit while the door switch controlling the domelight completes the ground path.

Relays are remotely controlled switches. They are used in high current circuits and in circuits controlled by sensors.

Relays are designed so that a small current circuit will be able to control a large current circuit.

WIRING HARNESS AND WIRES

Every wire is a specific size with colored or striped insulation that is indicated on the wiring diagrams. Insulation colors help to trace circuits and to make proper connections. Abbreviations and symbols used for indicating wire insulation colors and patterns are as follows:

BLK	Black	ORG	Orange
BRN	Brown	PPL	Purple
CH	Check	TR	Tracer
CR	Cross	YEL	Yellow
GRN	Green	//	Parallel
NAT	Natural	WHT	White
LT	Light	BLU	Blue
SGL	Single	STR	Stripe
ORN	Orange	PNK	Pink
GRA	Gray	DK	Dark

Some wires are grouped and taped together or encased in a split plastic casing. This grouping of wires is called a harness. For some purposes, it is more practical to use a single wire protected by a braided tubing called a loom.

Wiring harnesses are joined by using a multiple plug and receptacle connector block, or a terminal post chassis junction block. In the instrument panel area plastic insulated blade-type connectors and screw-type terminals are used.

Each harness or wire must be held securely in place by clips or other holding devices to prevent chafing of the insulation.

WIRE SIZE

Wire size in a circuit is determined by the amount of current, the length of the circuit and the voltage drop allowed. Wire size is specified using the metric gage. The metric gage describes the wire size directly in cross section area measured in square millimeters.

WIRE SIZE CONVERSION TABLE

METRIC SIZE $(mm)^2$	AWG SIZE
0.22	24
0.5	20
0.8	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
40.0	1
50.0	0
62.0	00

CIRCUIT MALFUNCTIONS

There are three electrical conditions that can cause a nonworking circuit; an "Open Circuit," a "Short Circuit," and a "Ground Circuit."

OPEN CIRCUIT (Figure 3)

An open circuit occurs whenever there is a break in the circuit. The break can be corrosion at the connector, a wire broken off in a device, or a wire that burned open from too much current.

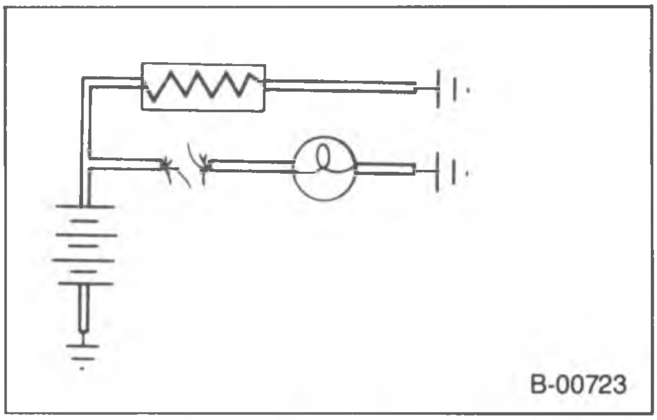


Figure 3—Open Circuit

SHORT CIRCUIT (Figure 4)

A short circuit happens when the current bypasses part of the normal circuit. This bypassing is usually caused by wires touching, salt water in or on a device such as a switch or a connector or solder melting and bridging conductors in a device.

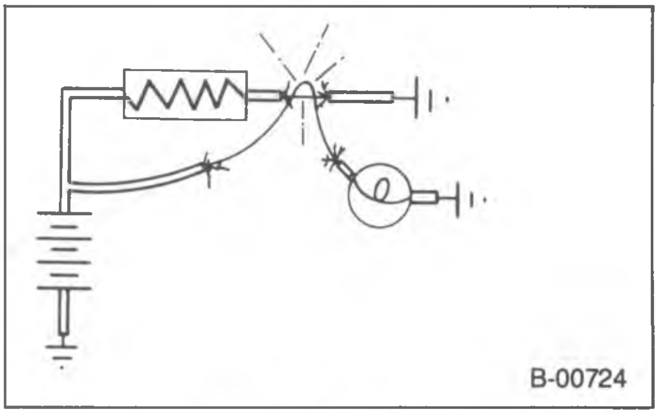


Figure 4—Short Circuit

GROUNDED CIRCUIT (Figure 5)

A ground circuit is like a short circuit but the current flows directly into a ground circuit that is not part of the original circuit. This may be caused by a wire rubbing against the frame or body. Sometimes a wire will break and fall against metal that is connected electrically to the ground side of the power supply. A ground circuit may also be caused by deposits of oil, dirt and moisture around connections or terminals, which provide a good path to ground.

CIRCUIT DIAGNOSIS

A clear understanding of the circuit and a wiring diagram are needed for effective diagnosis. Use a logical sequence of testing to find the trouble. Use the diagnostic tools. After the trouble is fixed, make sure the circuit works correctly.

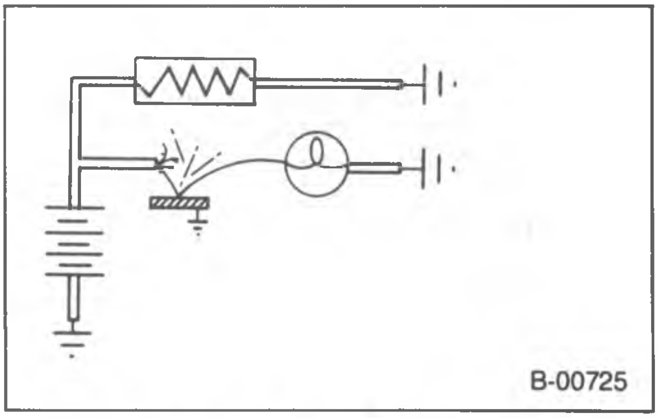


Figure 5—Grounded Circuit

DIAGNOSTIC TOOLS

UNPOWERED TEST LAMP

This tool consists of a 12 volt lamp with leads. The ends of the leads usually have alligator clamps, but various kinds of probes, terminal spades, and special connectors are used also.

The unpowered test lamp is used on an open circuit. One lead of the test lamp is grounded and the other lead is moved around the circuit to find the open. Depending on the physical layout of the circuit, sometimes it will be easier to start at the power supply and other times it is easier to start at the circuit load or ground circuit.

POWER TEST LAMP

This lamp is a pencil shaped unit with a self contained battery, a 1.5 volt lamp bulb, a sharp probe and a ground lead fitted with an alligator clip.

This test lamp is used mainly for testing components that are disconnected from the vehicle power supply. The power test lamp is also useful for testing suspected high resistance points in a circuit such as connectors and ground circuits that are corroded or loose.

JUMPER

The jumper is usually a long wire with alligator clamps. A version of the jumper has a fuse holder in it with a 10 Amp fuse. This will prevent damaging the circuit if the jumper is connected in the wrong way.

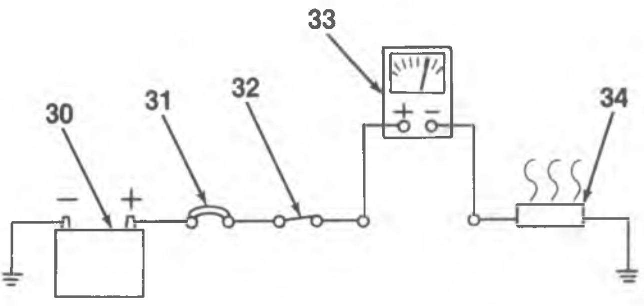
The jumper is used to locate opens in a circuit. One end of the jumper is attached to a power source and then the other end is attached to the load in the circuit, i.e.; lamp, motor. If the load works, try "jumping" to circuit points that are progressively closer to the power supply. When the circuit load stops working, the open has been located.

The jumper is also used to test components in the circuit such as connectors, switches, and suspected high resistance points.

NOTICE: The following instruments: Ammeter, Voltmeter, and Ohmmeter, each have a particular application for trouble shooting electrical circuits.

When using an ammeter or voltmeter, and the value being tested is unknown, always use the highest scale first and work downward to a midscale reading whenever possible. This will avoid damage to the instrument.

Never use an ohmmeter in a power circuit, or as a substitute for a voltmeter or ammeter, as damage to the instrument will result.



30. Power Source
31. Circuit Breaker
32. Switch (Closed)
33. Ammeter
34. Load

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Figure 6—Ammeter Circuit

AMMETER (Figure 6)

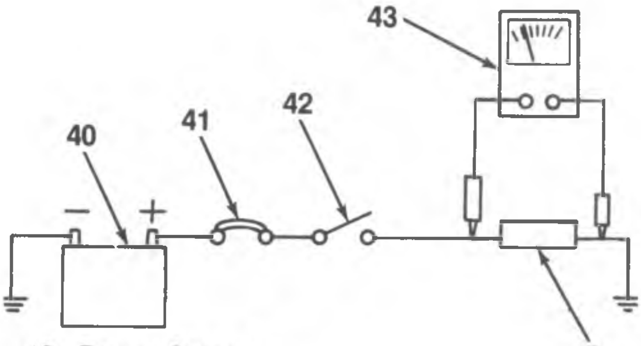
Disconnect the circuit from the power source before connecting the ammeter. The ammeter measures the amount of electrical current, amperes, moving through a conductor. The ammeter must be placed in series with the circuit being tested. Be sure that the ammeter's positive terminal is connected to the positive (battery) side of the circuit and the ammeter's negative terminal is connected to the negative (ground) side of the circuit.

OHMMETER (Figure 7)

The ohmmeter is an instrument designed to indicate resistance in ohms. It is used to test the condition of a unit disconnected from the circuit.

Ohmmeter Calibration

When the ohmmeter probes are connected together, a circuit is completed causing the meter needle to



40. Power Source
41. Circuit Breaker
42. Switch (Open)
43. Ohmmeter
44. Load

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Figure 7—Ohmmeter Circuit

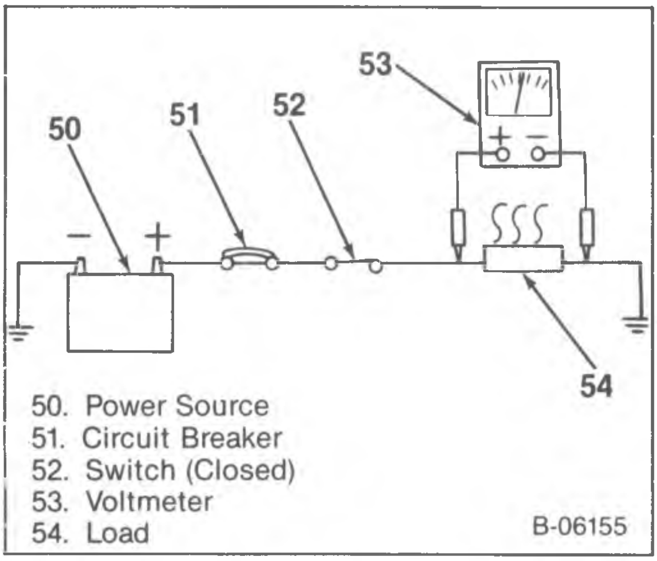


Figure 8—Voltmeter Circuit

deflect. The needle should read ZERO ohms, if it does not, rotate the CAL or ADJ knob to ZERO the needle.

When the probes are held apart, the needle moves to the maximum (infinite) resistance side of the scale.

The meter is now ready for use.

VOLTMETER (Figure 8)

The voltmeter (properly observed) will give the technician more information than the ammeter, ohmmeter and test lamp combined. Its application for troubleshooting here is to measure the electrical pressure (voltage) drop in a resistance circuit.

To use a voltmeter for troubleshooting an electrical problem, connect it in parallel with the existing circuit. If the voltmeter is connected in series with the circuit being tested, the nature of the circuit would be changed and the reading would have no particular value or use. Connect the meter terminals according to polarity as shown.

The dash mounted voltmeter (in the vehicle) should also be observed for monitoring proper operation of the generator battery cranking motor, and cranking circuit. In this application, battery voltage drop can be monitored while the engine is cranking; and after the engine is running, generator output voltage can be monitored. This can be a valuable first step prior to diagnosing other electrical problems.

CIRCUIT MAINTENANCE AND REPAIR

MAINTENANCE AND REPAIR

All electrical connections must be kept clean and tight. Loose or corroded connections may cause a discharged battery, difficult starting, dim lamps, and possible damage to the generator and regulator. Wires must be replaced if insulation becomes burned, cracked, or deteriorated.

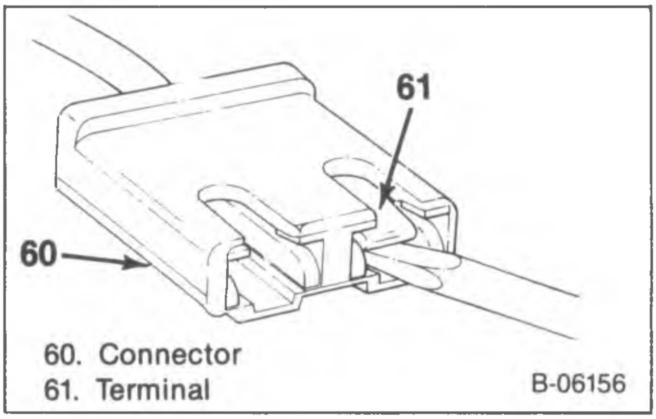


Figure 9—Removing Terminals From The Connector

To splice a wire or repair one that is frayed or broken, always use rosin flux solder to bond the splice and insulating tape to cover all splices or bare wires.

When replacing wire, it is important that the correct size wire be used as shown on applicable wiring diagrams or parts book. Each harness or wire must be held securely in place to prevent chafing or damage to the insulation due to vibration.

Never replace a wire with one of a smaller size or replace a fusible link with a wire of a larger size.

WIRING CONNECTOR TERMINAL REPLACEMENT (BLADE TYPE)

←→ Remove or Disconnect (Figure 9)

1. Terminal lock tang.
2. Terminal (61).

→← Install or Connect (Figure 10)

1. Pry up on the tang (70).
2. Terminal into the connector.

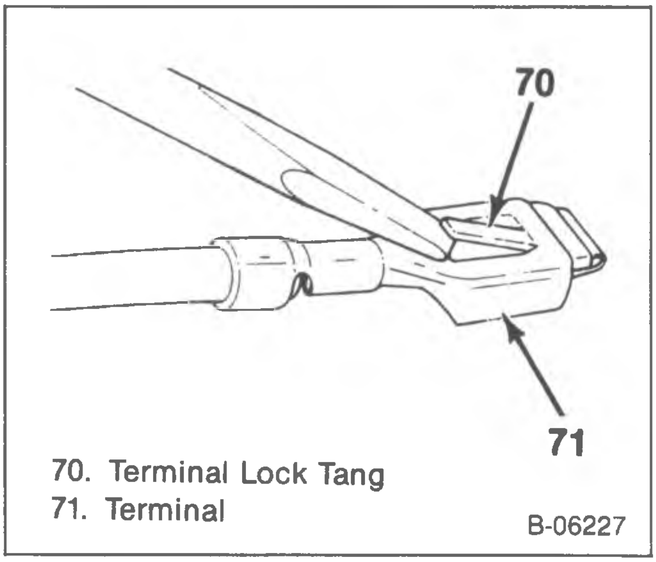


Figure 10—Resetting The Lock Tang

WIRING CONNECTOR TERMINAL REPLACEMENT (TWIN LOCK TYPE)

Remove or Disconnect (Figure 11)

Tool Required:

J-22727 Terminal Remover

1. Connector lock tangs.
2. Terminal locks using J-22727.
3. Terminal.

Install or Connect

1. Pry out the tangs.
2. Terminal into the connector.

WEATHER-PACK CONNECTORS (Figure 12)

Special connectors known as Weather-Pack connectors require a special tool J-28742 for servicing. This special tool is required to remove the pin and sleeve terminals. If removal is attempted with an ordinary pick, there is a good chance that the terminal will be bent or deformed. Unlike standard blade-type terminals, these terminals cannot be straightened once they are bent.

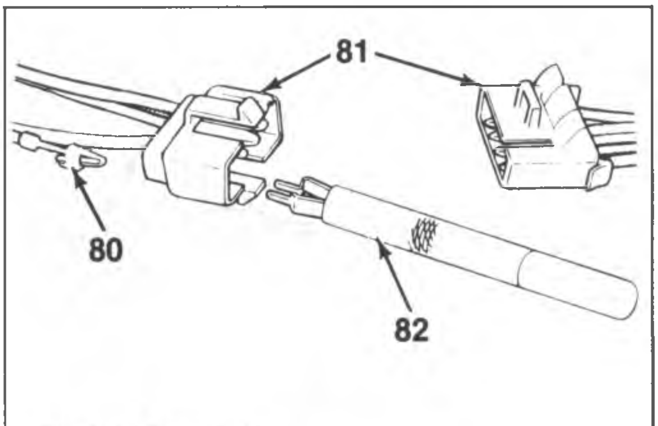
Make sure that the connectors are properly seated and all of the sealing rings are in place when connecting the leads. The hinge-type flap provides a back-up, or secondary locking feature for the terminals. They are used to improve the connector reliability by retaining the terminals if the small terminal lock tangs are not positioned properly.

Molded-on-connectors require complete replacement of the connection. This means splicing a new connector assembly into the harness. Environmental connections cannot be replaced with standard connections. Instructions are provided with the Weather-Pack connector and terminal packages.

With the low current and voltage levels found in some circuits, it is important that the best possible bond at all wire splices be made by soldering the splices.

Use care when probing the connections or replacing terminals in them, it is possible to short between opposite terminals. If this happens to the wrong terminal part, it is possible that damage may be done to certain components. Always use jumper wires between connectors for circuit checking. Never probe through the Weather-Pack seals.

When diagnosing for possible open circuits, it is often difficult to locate them by sight because oxidation or terminal misalignment are hidden by the connectors. Merely wiggling a connector on a sensor or in the wiring harness may correct the open circuit condition. This should always be considered when an open circuit is indicated while troubleshooting. Intermitten problems may also be caused by oxidized or loose connections.



80. Wire Terminal
81. Wiring Harness Connector
82. Terminal Remover Tool

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Figure 11—Twin Lock Connector Terminal

Remove or Disconnect (Figure 12)

Tool Required:

J-28742 Terminal Remover

1. Primary lock (121) by lifting.
2. Connector sections.
3. Secondary lock (125) by spreading the sides of the hasp, thus clearing the staples and rotating the hasp (127).
4. Terminal (131) by using J-28742 (128).
   - Snip off the old terminal assembly.
5. 5 mm of the wire insulation (130).

Clean

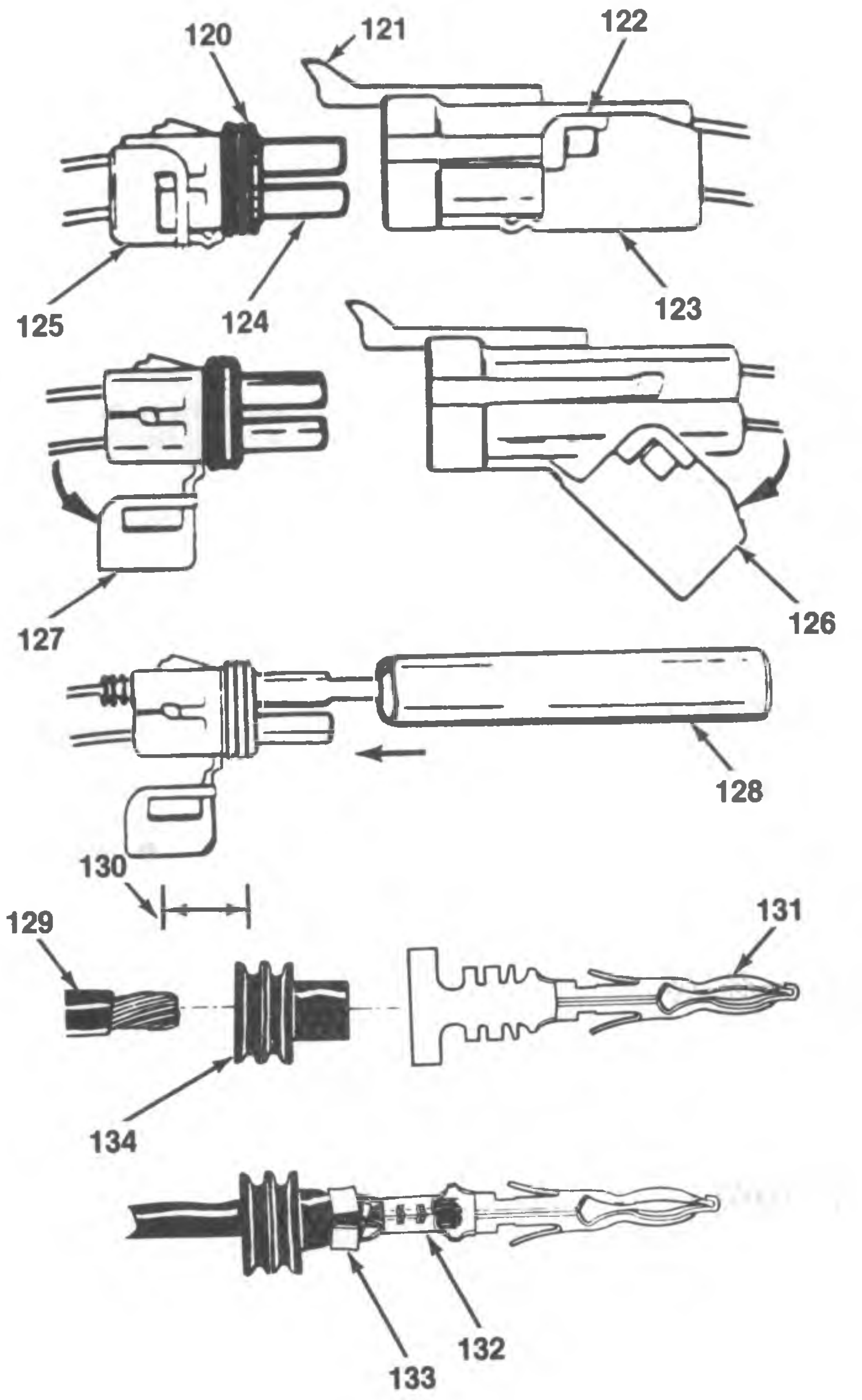
- Terminal Barrel (124).

Install or Connect (Figure 12)

1. Terminal insulator (134) on the wire. Slide the insulator back on the wire about 8 cm (3 inches).
2. Terminal (131) on the wire.
   - Roll crimp (132) and solder the terminal.
3. Terminal insulator (134) and roll crimp (133).
4. Terminal into the connector.
5. Secondary lock (125).
6. Connector sections until the primary lock (121) engages.

WIRING REPAIR

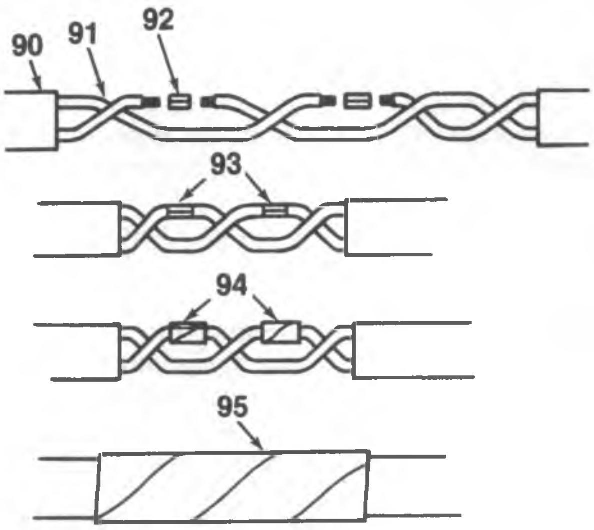
The wire repair is very important for the continued reliable operation of the vehicle. This repair must be done as described in the following procedures.



120. Connector Seal	128. J 28742 Terminal Remover
121. Primary Lock	129. Wire
122. Secondary Lock Staple	130. 5 mm (.2 inch)
123. Secondary Lock	131. Terminal
124. Terminal Barrel	132. Roll Crimp
125. Secondary Lock	133. Roll Crimp
126. Lock Opened	134. Terminal Insulator
127. Lock Opened	

B-06232

Figure 12—Weather-Pack Terminals



90. Jacket
91. Twisted Wires
92. Splice Clip
93. Crimp and Solder
94. Electrical Tape Wrap
95. Outer Electrical Tape Wrap.

B-06230

Figure 13—Twisted Lead Repair

WIRING REPAIR

The wire repair is very important for the continued reliable operation of the vehicle. This repair must be done as described in the following procedures.

Twisted Leads (Figure 13)

Remove or Disconnect

1. Jacket (90).
2. Twisted wires (91).
3. Insulation from the wire.

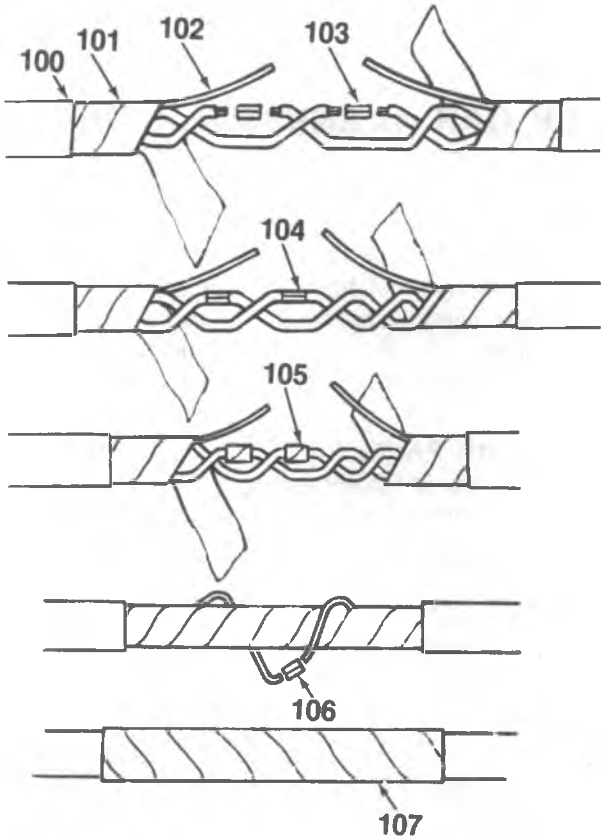
Install or Connect

1. Splice clip (93).
    - Crimp.
    - Solder.
2. Electrical tape wrap (94) on wires.
3. Outer electrical tape wrap (95).

Twisted Leads/Shielded Cable (Figure 14)

Remove or Disconnect

1. Jacket (100).
2. Unwrap aluminum/mylar tape (101).
3. Drain wire (102).
4. Leads.
5. Insulation on the leads.



100. Jacket
101. Aluminum/Mylar Tape
102. Drain Wire
103. Splice Clip
104. Crimp and Solder
105. Electrical Tape Wrap
106. Drain Wire Splice Clip, Crimped And Soldered.
107. Outer Electrical Tape Wrap.

B-06231

Figure 14—Twisted/Shielded Lead Repair

Install or Connect

1. Splice clips (103).
2. Crimp and solder the splice clips (104).
3. Electrical tape (105) on the splices.
4. Aluminum/mylar tape by wrapping and taping.
5. Drain wire with a splice clip (106). Crimp and solder the splice clip.
6. Outer jacket electrical tape wrap (107).

CAB ELECTRICAL SYSTEMS

CK CAB HARNESS ROUTINGS

There are several wiring harnesses routed throughout the cab which provide continuity between the electrical components. These harnesses consist of: the instrument panel harness, the power door locks and power window harness, the radio harness, the heater harnesses, the air conditioning harnesses and the interior lighting harnesses.

INSTRUMENT PANEL HARNESS (Figure 15)

This harness is located along the upper back edge of the instrument panel. It starts from the fuse panel which is located at the left side of the dash panel, and goes up to the left side of the instrument panel and across the instrument panel to the right side of the cab.

As the instrument panel harness is routed across the instrument panel, various circuits branch off to the switches, indicators, and the instrument panel. The harness is held in place with bendable clips.

Other harnesses are carried in the same supports as the instrument panel harness. These harnesses consist of the power door locks, power window, radio, heater and air conditioning.

POWER DOOR LOCKS AND POWER WINDOWS HARNESS (Figures 16 and 17)

This harness starts at the fuse block and routes to the left and right along the instrument panel. At the middle of the instrument panel, the harness branches off to the relay assembly. The relay assembly is located on the inside of the dash panel, just above the steering column. The harness then goes to a set of connectors on the inner wheel housing. From the connectors the harness passes through a grommet in the front door opening trim panel and then through a flexible coupling to the door. Inside the door the harness branches off to the control switches, the door lock motors, and the power window motors. The harness connectors are fastened to the control switches with retaining nuts.

REAR DOOR POWER LOCK HARNESS (Figure 18)

The rear door power lock harness starts at a connector in the fuse block. The harness is routed along the instrument panel harness, with a branch going to the power door lock switch assembly in the instrument panel. The harness then drops down the right front door hinge frame and routes back along the right door sill to the right front door latch frame. The harness then travels up the right front door latch frame to its mid-point where a connector is located. The harness then goes to the roof halo panel and back to the rear door frame.

At the rear door frame, the harness is connected to a contact assembly on the right rear door frame. This contact assembly is aligned with a contact assembly mounted on the right rear door. From the contact assembly on the door, the harness then goes to the lock motor.

CARGO LAMP HARNESS (Figure 19)

The harness starts from the instrument panel harness and routes under the left front door sill. The harness then goes up the left front door latch frame, through a connector, and into a control switch.

From the control switch, the harness goes down the frame, back along the rear door sill and then up the rear door latch frame. From the top of the frame the harness goes to the cargo lamp.

CK FUSE BLOCK

The fuse block holds the fuses and circuit breakers that protect the circuits. The fuse block is located on the left side of the dash panel and is fastened to the dash panel connector block with two screws. The fuse panel connects to the engine compartment harness. Power leads from the various circuits plug into the fuse block.

The fuses are encased in plastic and have twin blade connectors. The fuses are printed and color coded with the amperage rating. Refer to Figure 20.

G VAN CAB HARNESS ROUTINGS

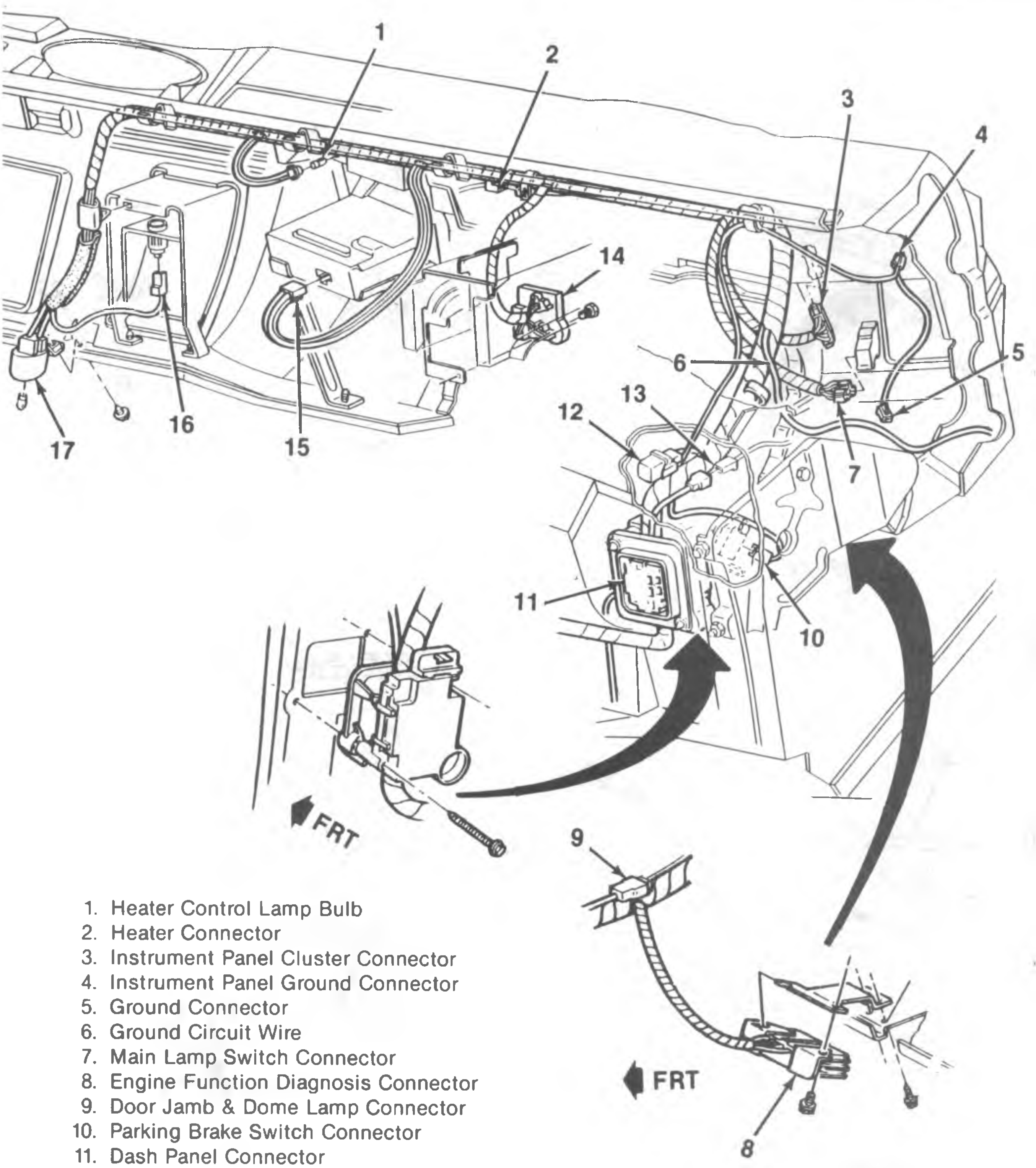
INSTRUMENT PANEL HARNESS (Figure 21)

The instrument panel harness in the G van includes the circuits for the instrument panel gages, indicators, main light switch, windshield wiper and washer, and the steering column controls. The harness is held in place with clips that plug into brackets which are mounted on the instrument panel.

FRONT DOOR POWER LOCK SYSTEM (Figure 22 and 23)

The harness starts from the fuse block, which is located under the far left side of the instrument panel. The left branch of the harness has a connector at the left door hinge frame. Then the harness passes into the frame and routes down to a flexible conduit to the door. Inside the door, the harness branches; one branch going down to the door lock motor, and the other branch going up to the door lock switch.

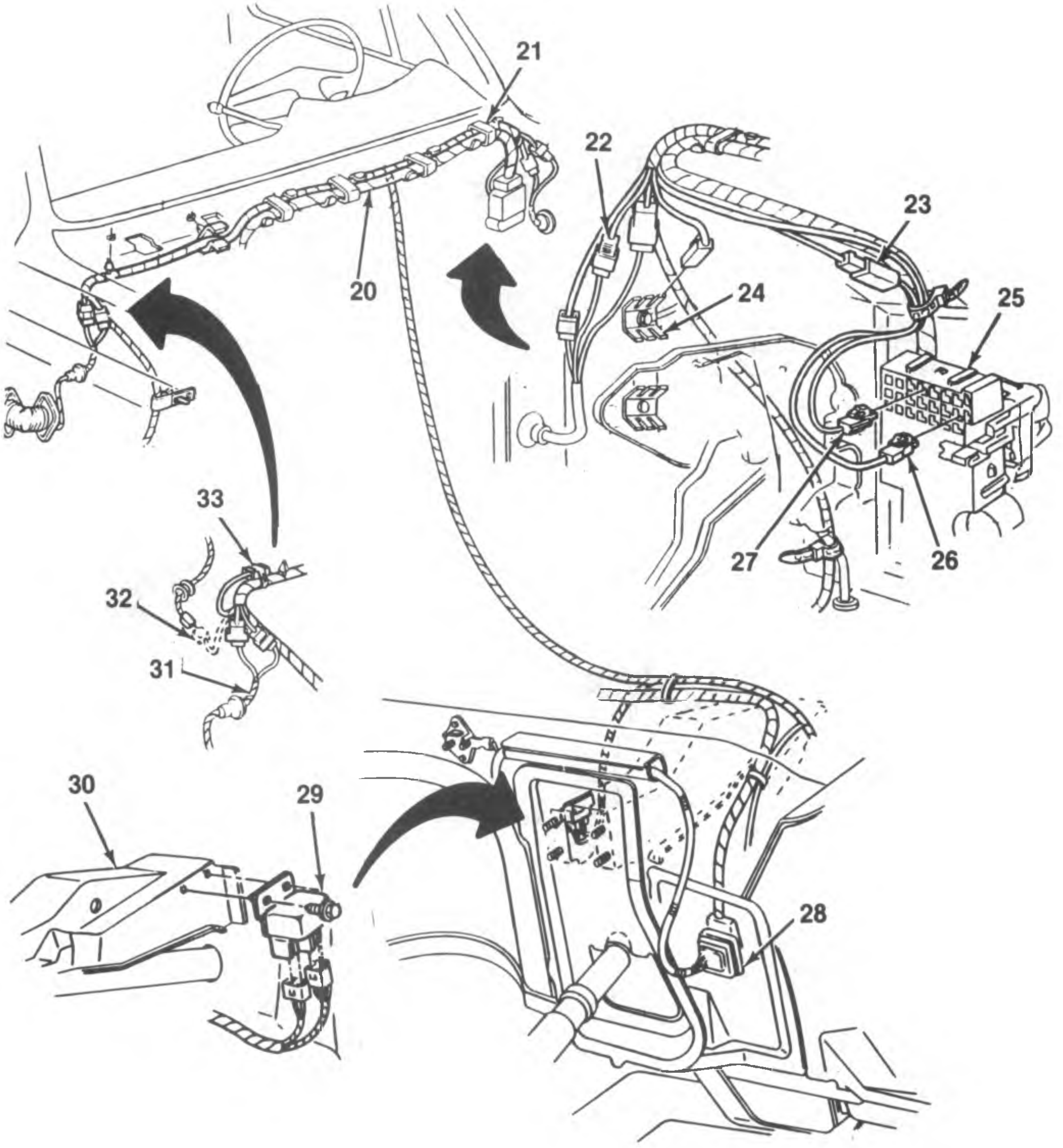
The right branch of the harness routes across the top of the instrument panel to the right door hinge frame. The harness passes through a connector and



1. Heater Control Lamp Bulb
2. Heater Connector
3. Instrument Panel Cluster Connector
4. Instrument Panel Ground Connector
5. Ground Connector
6. Ground Circuit Wire
7. Main Lamp Switch Connector
8. Engine Function Diagnosis Connector
9. Door Jamb & Dome Lamp Connector
10. Parking Brake Switch Connector
11. Dash Panel Connector
12. Horn Relay
13. Dome Lamp And Door Jamb Harness Connector
14. Convenience Center
15. Radio Connector
16. Cigarette Lighter Connector
17. Courtesy Lamp

F-00728

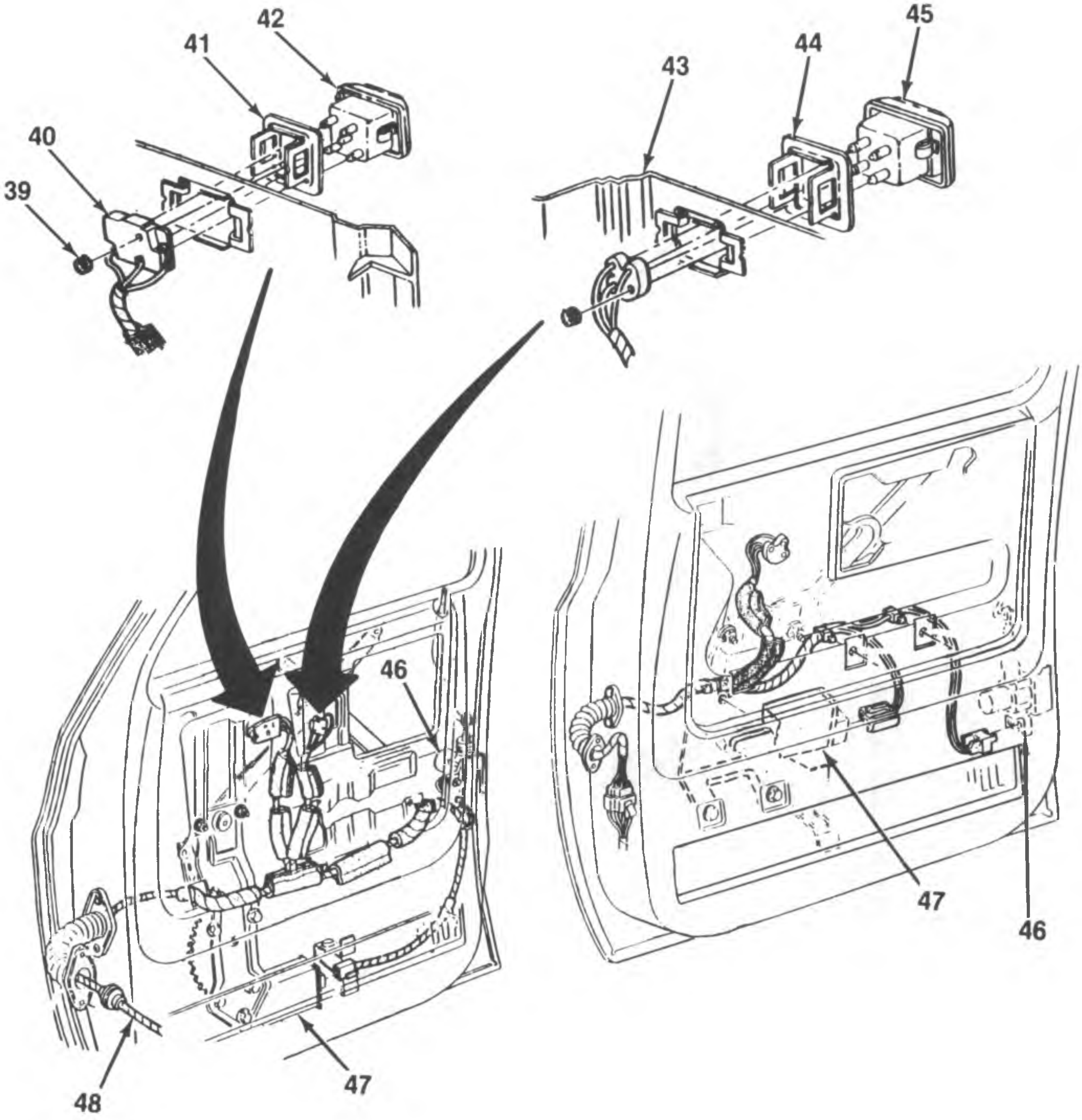
Figure 15—CK Instrument Panel Harness



20. Instrument Panel Harness
21. Power Lock And Window Harness
22. Door Harness Connector
23. Power Window Connector
24. Ground
25. Fuse Block
26. Power Lock Connector
27. Power Window Connector
28. Dash Panel Connector
29. Power Door Lock Relay
30. Brake Pedal Bracket
31. Side Front Door Harness
32. Rear Panel Door Harness Connector
33. Rear Panel Door Power Lock Connector

F-00729

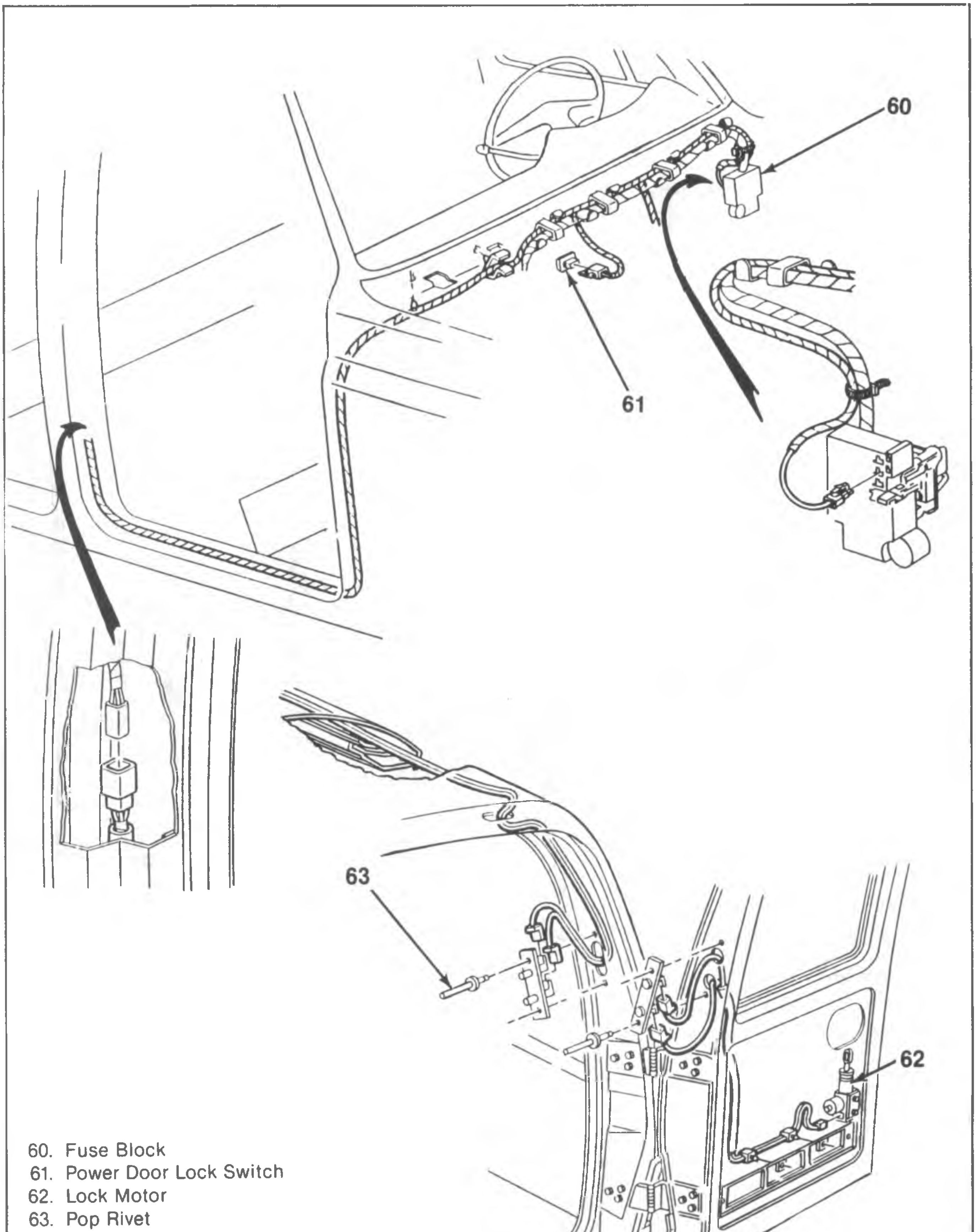
Figure 16—Power Door Locks And Power Window Harness



39. Nut
40. Power Window Switch Connector
41. Retainer Bezel
42. Power Window Switch
43. Power Door Lock Switch Connector
44. Retainer Bezel
45. Power Door Lock Switch
46. Power Door Lock Motor
47. Power Window Motor
48. Front Door Harness

F-00730

Figure 17—Power Door Locks And Power Window Harness-In Doors



60. Fuse Block
61. Power Door Lock Switch
62. Lock Motor
63. Pop Rivet

F-00731

Figure 18—Rear Door Power Lock Harness

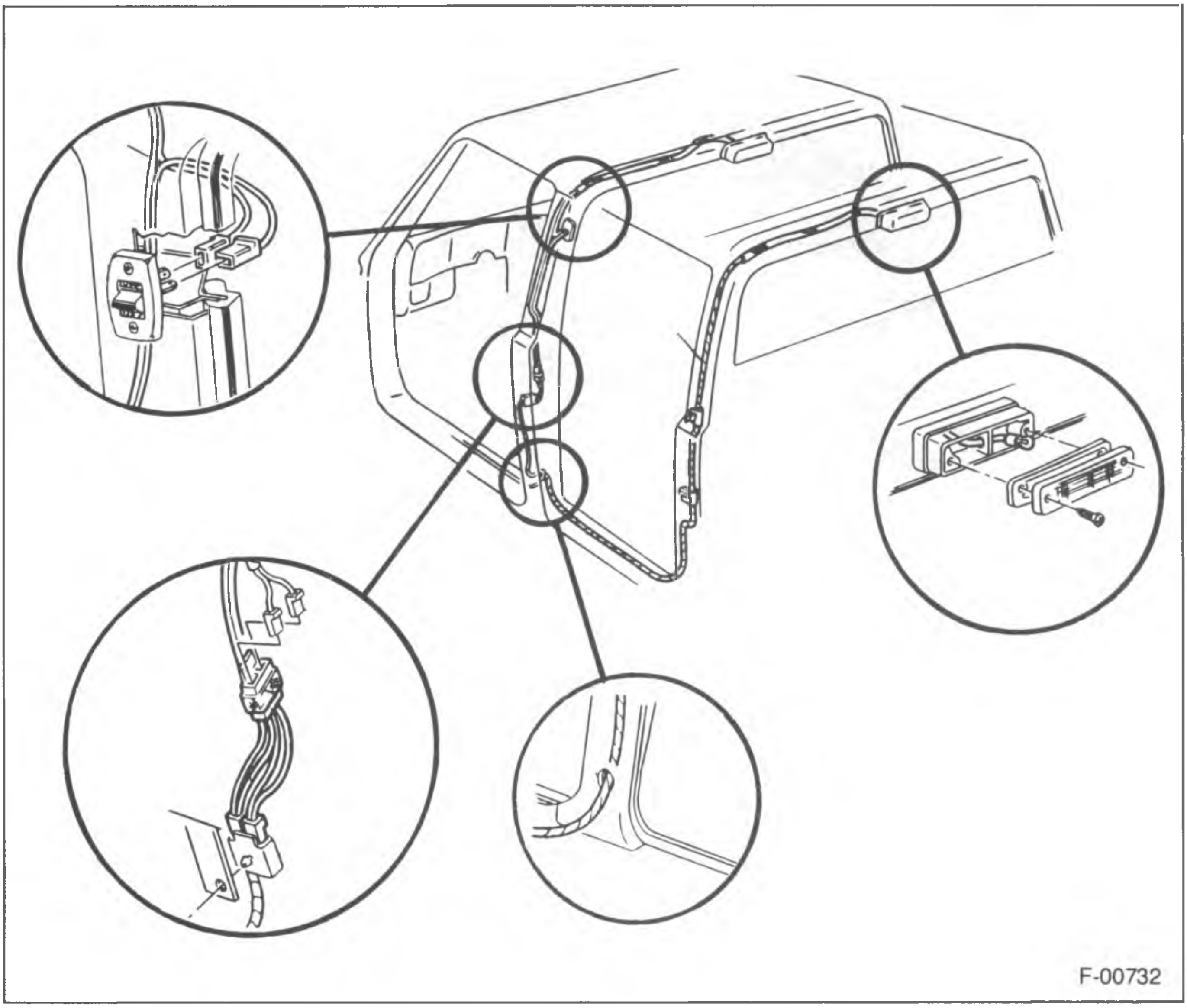


Figure 19—Cargo Lamp Harness

continues into the door frame. The harness routes down to a flexible conduit. The harness passes through the flexible conduit into the door. Inside the door, the harness branches; one branch going up to the door lock switch, and the other branch going to the door lock.

SIDE DOOR POWER LOCK CIRCUIT (Figure 24)

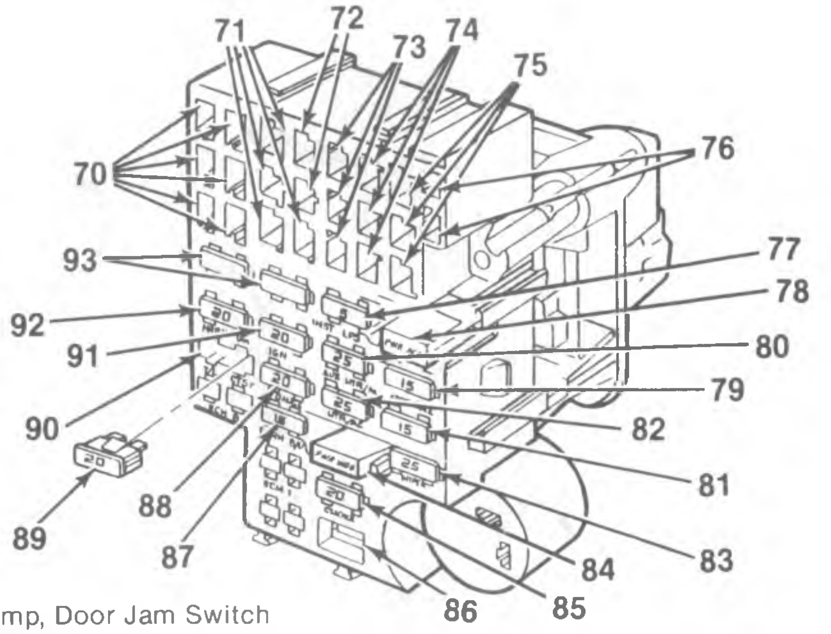
The side door power lock circuit branches off from the left roof halo harness just behind the front door latch frame. It goes across the roof frame and down the right front door latch frame, where it connects to the door frame contact assembly. The door frame contact assembly aligns with the door contact assembly so that electrical contact is made when the door is closed. In this way, electricity is conducted to the side door power lock motor.

REAR DOOR POWER LOCK CIRCUIT (Figure 25)

The rear power door lock harness is routed from the connector on the left front door hinge frame. The harness goes up the frame to the roof, rearward along the roof halo panel and then crosses over to the right rear corner, using the rear roof halo panel. The harness goes down the right rear corner to a connector just below the upper door hinge. The harness then passes through grommets and into the right rear door. Inside the door the harness connects to the power lock motor.

POWER WINDOW SYSTEM (Figures 22, 23, 24 and 25)

This harness starts at the fuse block and routes to the left and right along the instrument panel. The harness then routes into the left and right front doors. At the left door hinge pillar, the harness routes up to the left roof halo panel, back to the first roof frame, branches to the right side of the van and rearward to



70. Clock, Dome Lamp, Door Jam Switch
71. Cruise Control, Radio/Window Defogger, Diesel Indicator Circuit, Automatic Transmission Converter Switch, Tachometer, Overspeed Indicator Circuit
72. Power Window, Power Door Locks
73. Automatic Transmission Converter Clutch, 4 Wheel Drive Indicator Lamp, Auxiliary Battery
74. 4 Wheel Drive Indicator Lamp, Radio/Window Defogger
75. Power Door Lock, Power Windows, Radio/Window Defogger
76. Rear Air Conditioning Circuit, Auxiliary Heater
77. Instrument Panel Lamps
78. Power Accessories — Circuit Breaker, Power Windows
79. Stop/Hazard Lamps
80. Auxiliary Heater, Air Conditioning
81. Radio
82. Heater, Air Conditioning
83. Wiper
84. Power Window — Circuit Breaker
85. Choke Heater
86. Fuse/PLR
87. Turn, Back Up Lamps
88. Gages, Idle Solenoid
89. Fuse
90. Tail Lamps, Courtesy Lamps
91. Ignition Circuit
92. Horn, Dome Lamps
93. Spare Fuses

F-00733

Figure 20—CK Fuse Block

the rear door. The branch that went to the right side routed down the side door hinge pillar and into the side door.

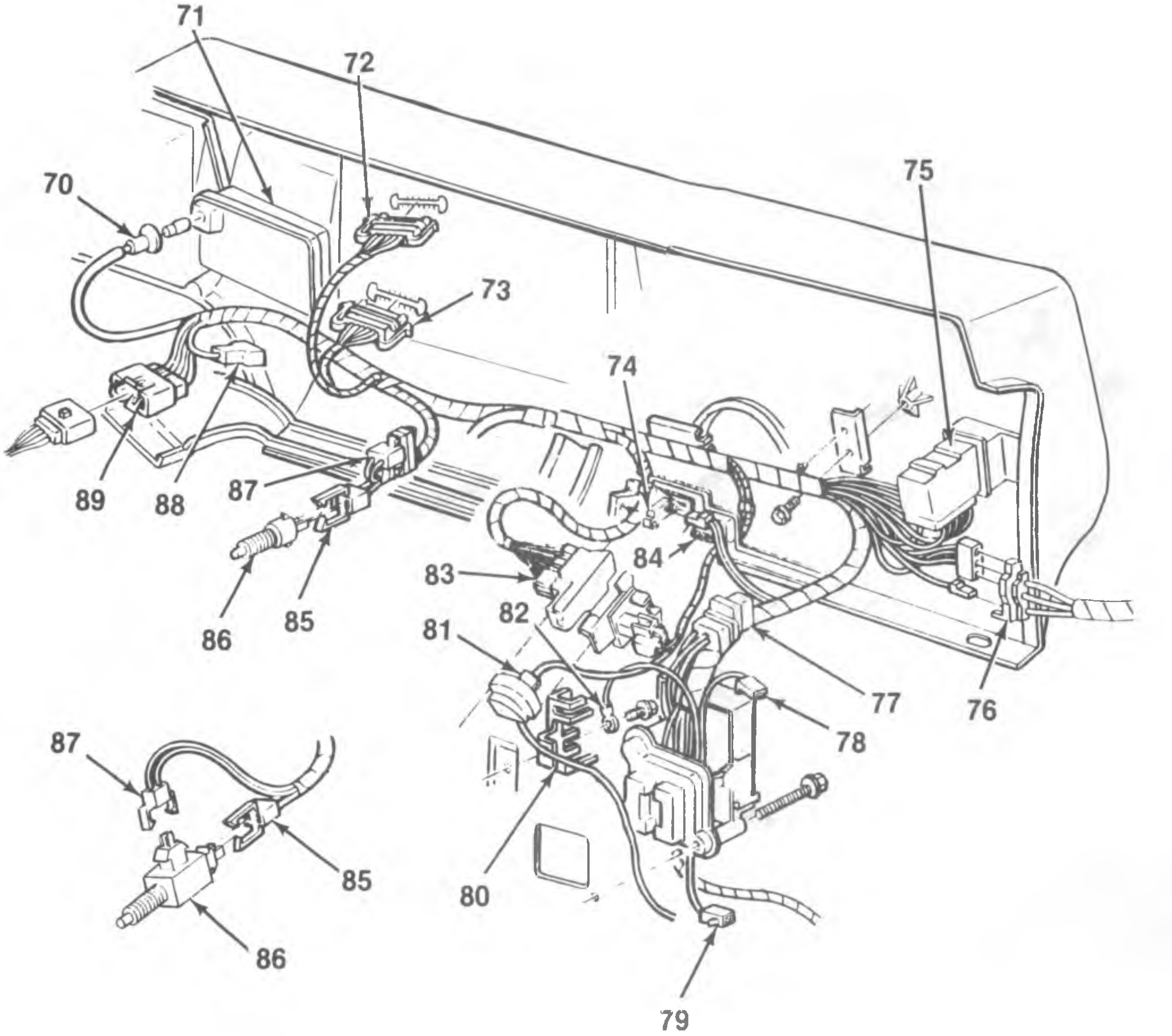
INTERIOR LIGHTING SYSTEM (Figures 26 and 27)

This circuit starts at the fuse block and routes to the body harness connector. The standard harness is then routed up the left front door hinge frame and back along the left roof halo panel. The harness branches at the first and third roof frames, with connectors located next to the left roof halo panel. The harnesses then go to the roof lamps and terminate in bulb clips. The standard harness also branches off to the door switches.

The optional harness is routed from the body harness connector to a control switch on the instrument panel. The harness then goes from the switch to the left front door hinge frame, up the frame, and back along the left roof halo panel.

When the harness reaches the first roof frame, it goes into a connector. There are two branches coming out of the connector. One branch goes to the center lamp assembly in the roof. This branch, after connecting to the center lamp assembly, continues on to the right side of the roof, where it goes into a connector. From this connector, one lead goes to the side door grounding switch. The other leads are routed down the right front door lock frame to the stepwell lamp assembly.

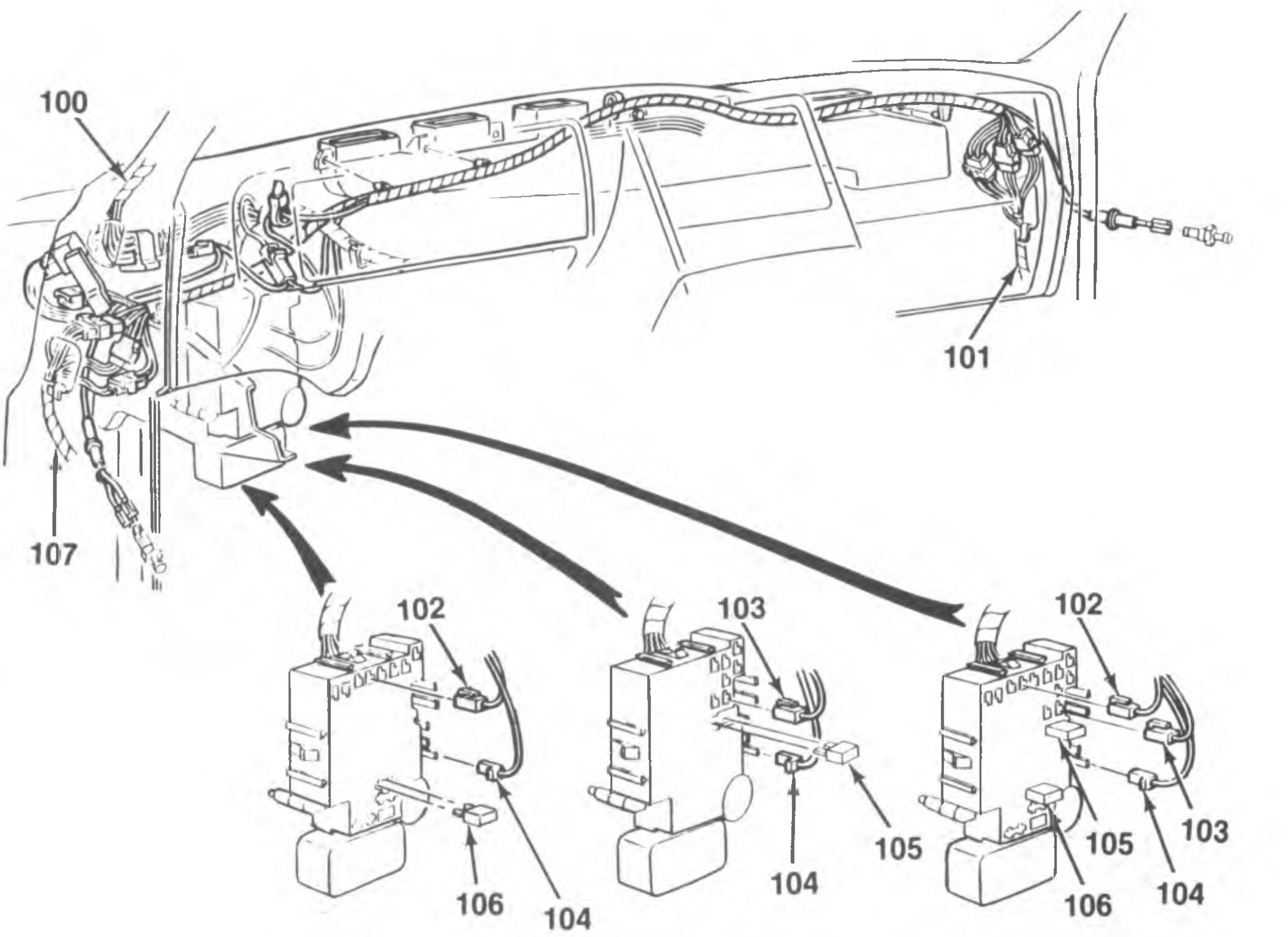
The other branch, coming out of the roof frame connector, goes back along the left roof halo panel, across the rear halo panel and terminates at the rear door ground switch. Also coming from this connector is a branch that goes down the left front door lock frame to the left stepwell lamp assembly.



70. Heater Lamp Connector
71. Heater Controls Assembly
72. Instrument Cluster Connector (Telltale)
73. Instrument Cluster Connector (Gages)
74. Neutral Switch (Manual Transmission)
75. Light Switch Connector
76. Body Wiring Harness Connector
77. Horn Relay
78. Park Brake Switch Connector
79. Test Connector
80. Ground Bus
81. Back Up Switch Connector
82. Instrument Panel Harness Ground Connector
83. Steering Column Connector
84. Windshield Wiper Connector
85. Stop Lamp Connector
86. Stop Lamp Switch
87. Torque Converter Clutch Connector
88. Blower Motor Connector
89. Windshield Wiper And Washer Harness Connector

F-00734

Figure 21—G Van Instrument Panel Harness



100. Power Lock Relay
101. Right Door Harness
102. Power Window Connector
103. Power Door Lock Connector
104. Ground Connector
105. Power Door Lock Circuit
106. Power Window Circuit Breaker
107. Left Door Harness

F-00735

Figure 22—G Van Power Door Lock And Power Window Harness

G VAN FUSE BLOCK

The fuse block holds the fuses and circuit breakers that protect the circuits. The fuse block is located on the left side of the dash panel and is fastened to the dash panel connector block with two screws. The fuse block connects to the engine compartment harness. Power leads from the various circuits plug into the fuse block.

The fuses are encased in plastic and have twin blade connectors. The fuses are printed and color coded with the amperage rating. Refer to Figure 28.

POWER DOOR LOCK SYSTEM

DESCRIPTION

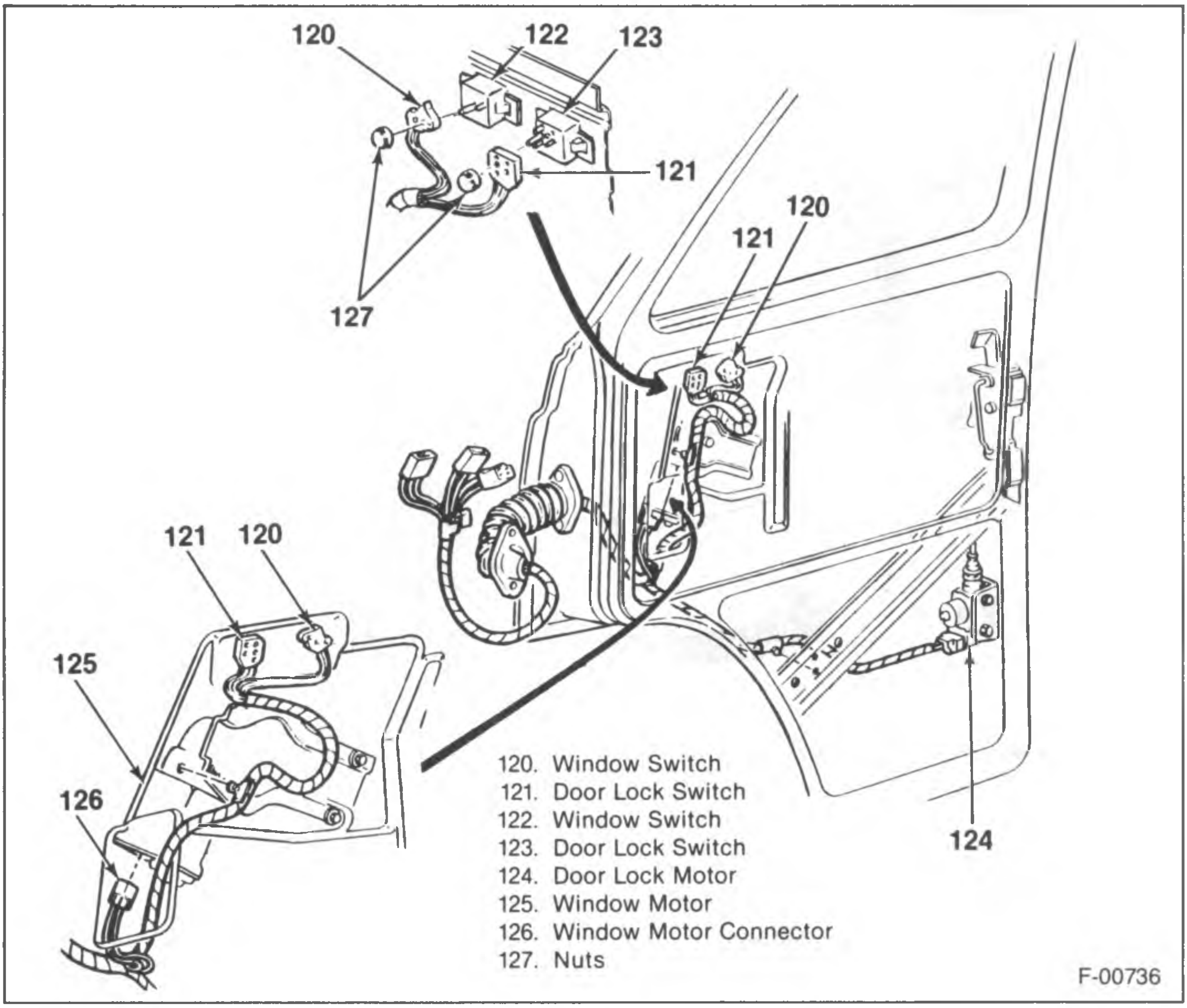
Individual motors operate each door lock. The direction the motor turns depends on the polarity of the supply voltage. The door lock switches control the supply voltage polarity. Each switch will lock all the doors.

Each motor has a self-resetting circuit breaker built in. Voltage is present at the door lock switches at all times. Voltage is also present on the open contacts of the door lock relay at all times.

When a door switch is moved to "Lock," current flows through the switch and lock relay coil to ground. The relay closes, causing current to flow through the lock relay contacts, door lock motor, the unlock relay contacts, and then to ground.

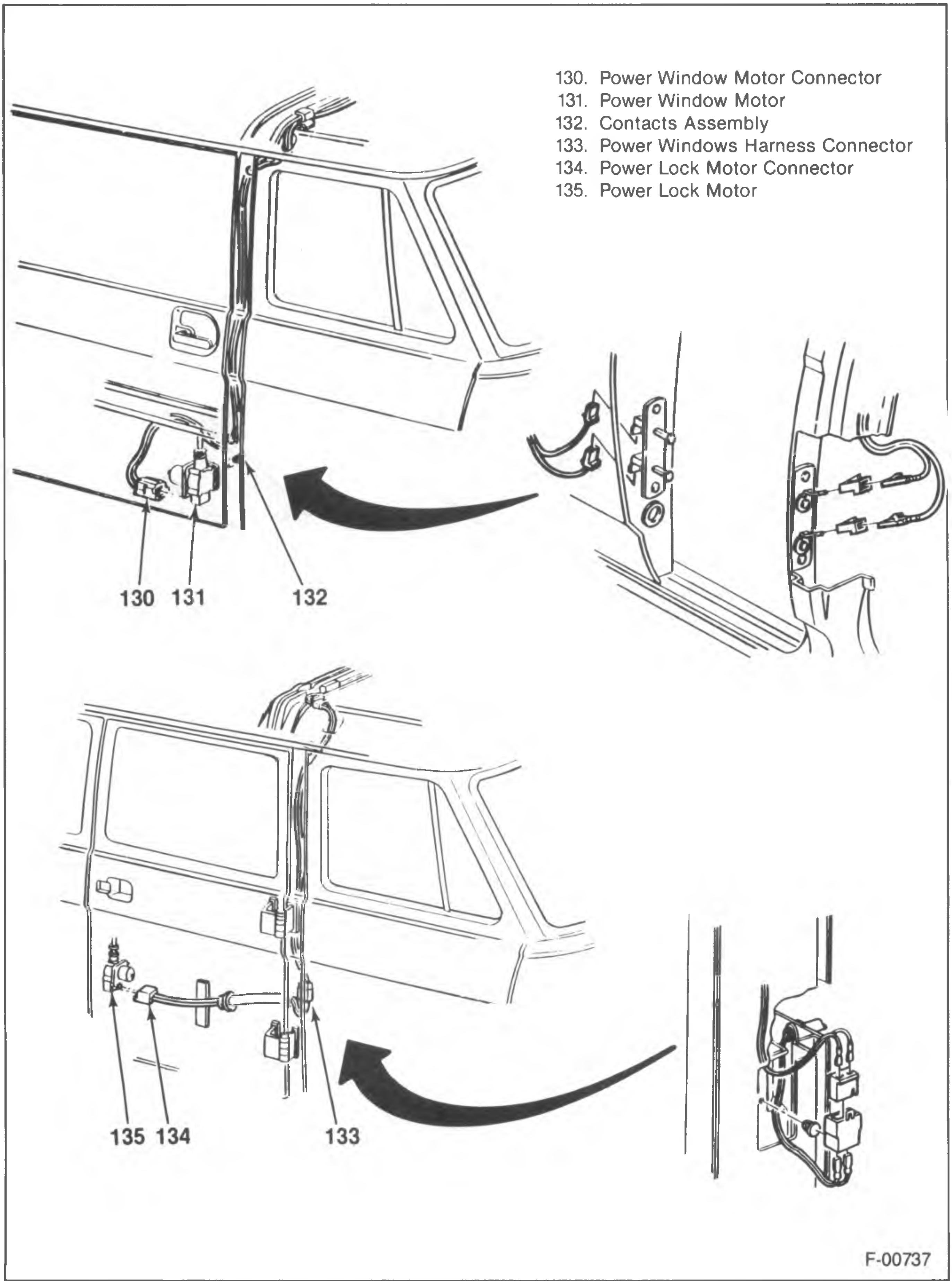
When a door lock switch is moved to "Unlock," current flows through the switch, the unlock relay contacts, the door lock motor, the lock relay contacts, and to ground. This causes the lock motor to unlock the door.

For CK models, the door lock relay is located on the dash panel, above the steering column. For G van models the door lock relay is located on front left door hinge pillar.



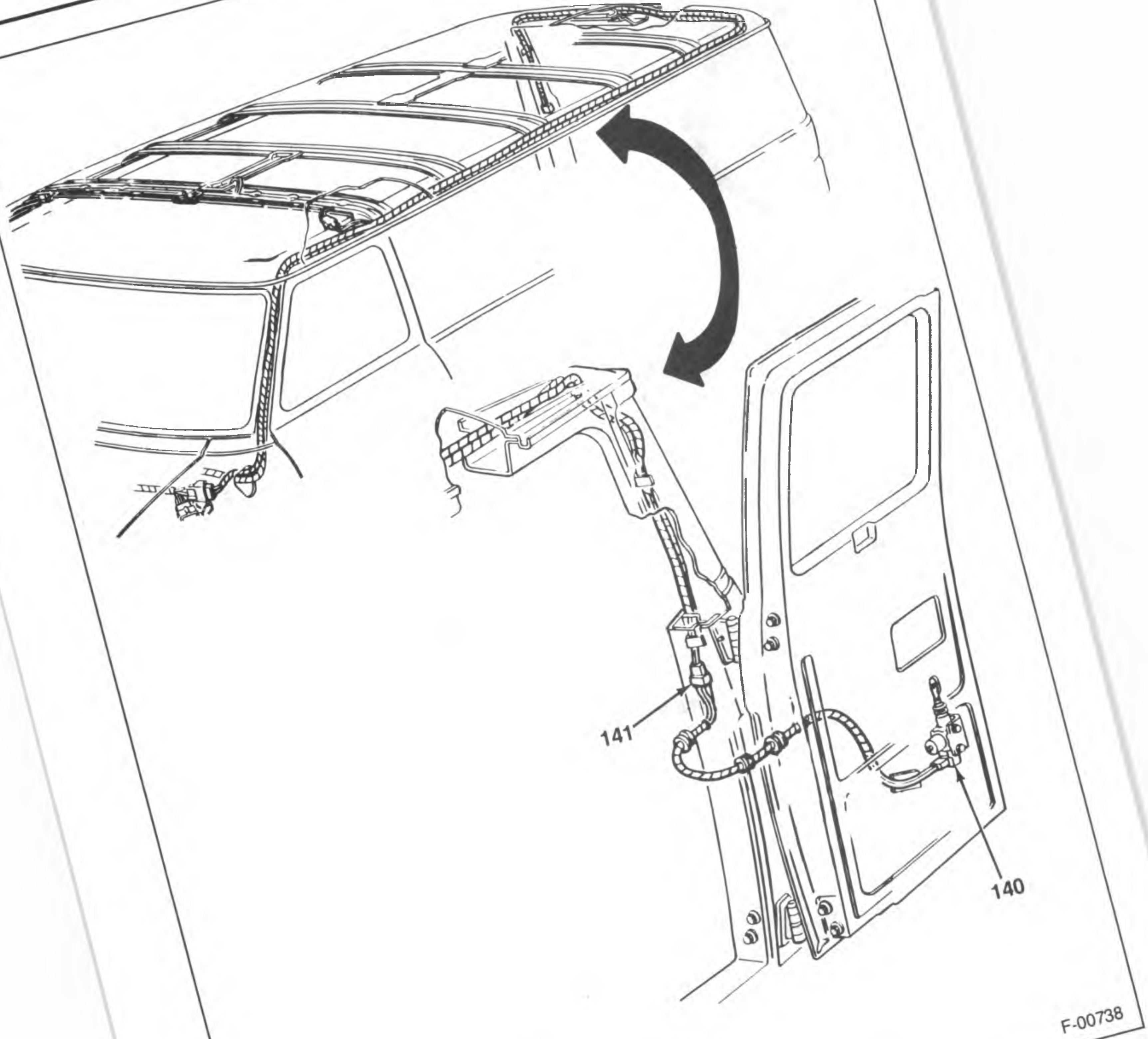
120. Window Switch
121. Door Lock Switch
122. Window Switch
123. Door Lock Switch
124. Door Lock Motor
125. Window Motor
126. Window Motor Connector
127. Nuts

Figure 23—G Van In-Door Harness



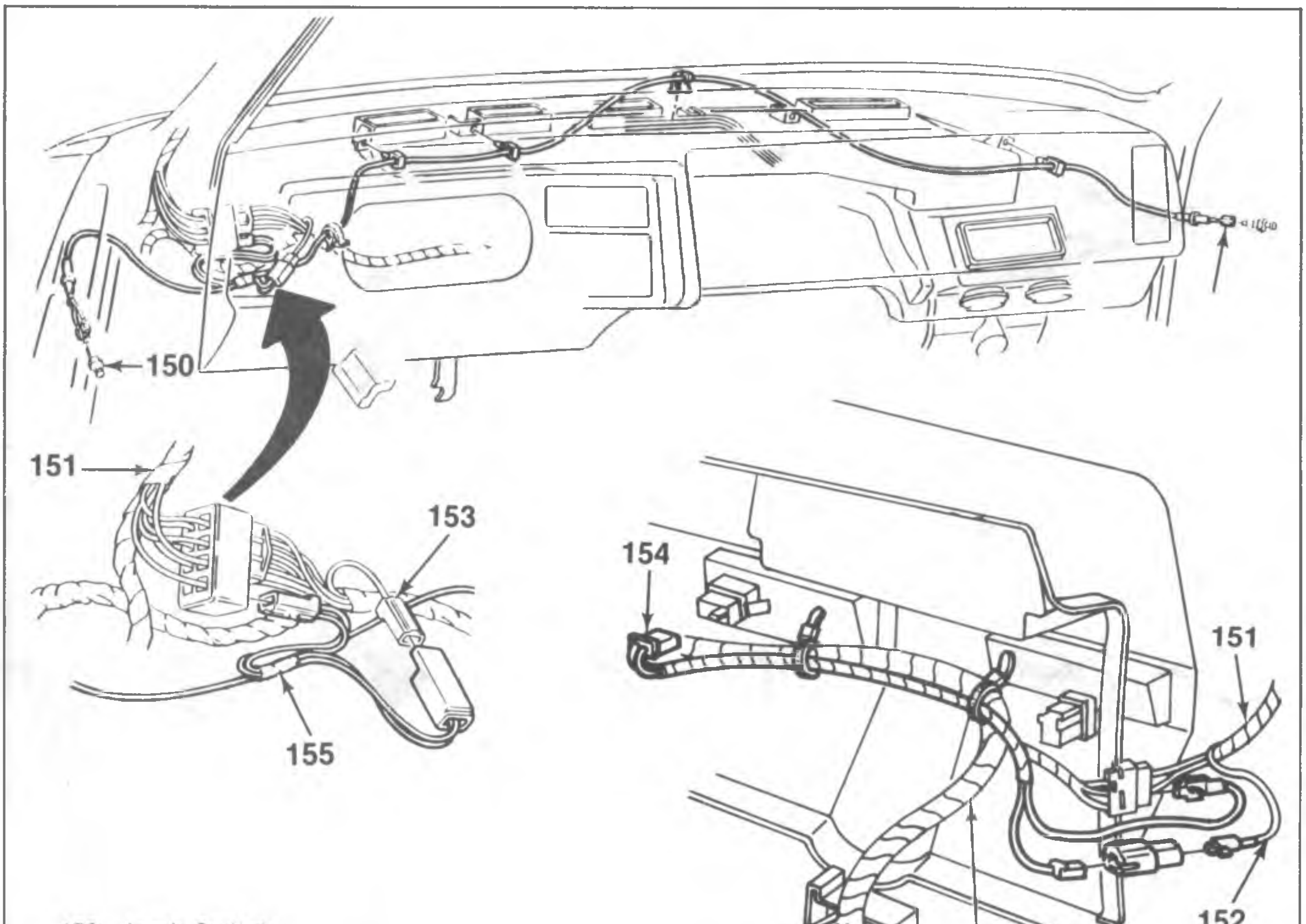
130. Power Window Motor Connector
131. Power Window Motor
132. Contacts Assembly
133. Power Windows Harness Connector
134. Power Lock Motor Connector
135. Power Lock Motor

Figure 24—G Van Side Door Harness



140. Power Lock Motor
141. Connector

Figure 25—G Van Rear Door Harness



150. Jamb Switch
151. Body Wiring Harness
152. ORG Wire
153. Instrument Panel Harness
154. Dome Lamp Switch Connector
155. Door Jamb Switch Harness

F-00739

Figure 26—Door Jamb Switch And Dome Lamp Switch Harness

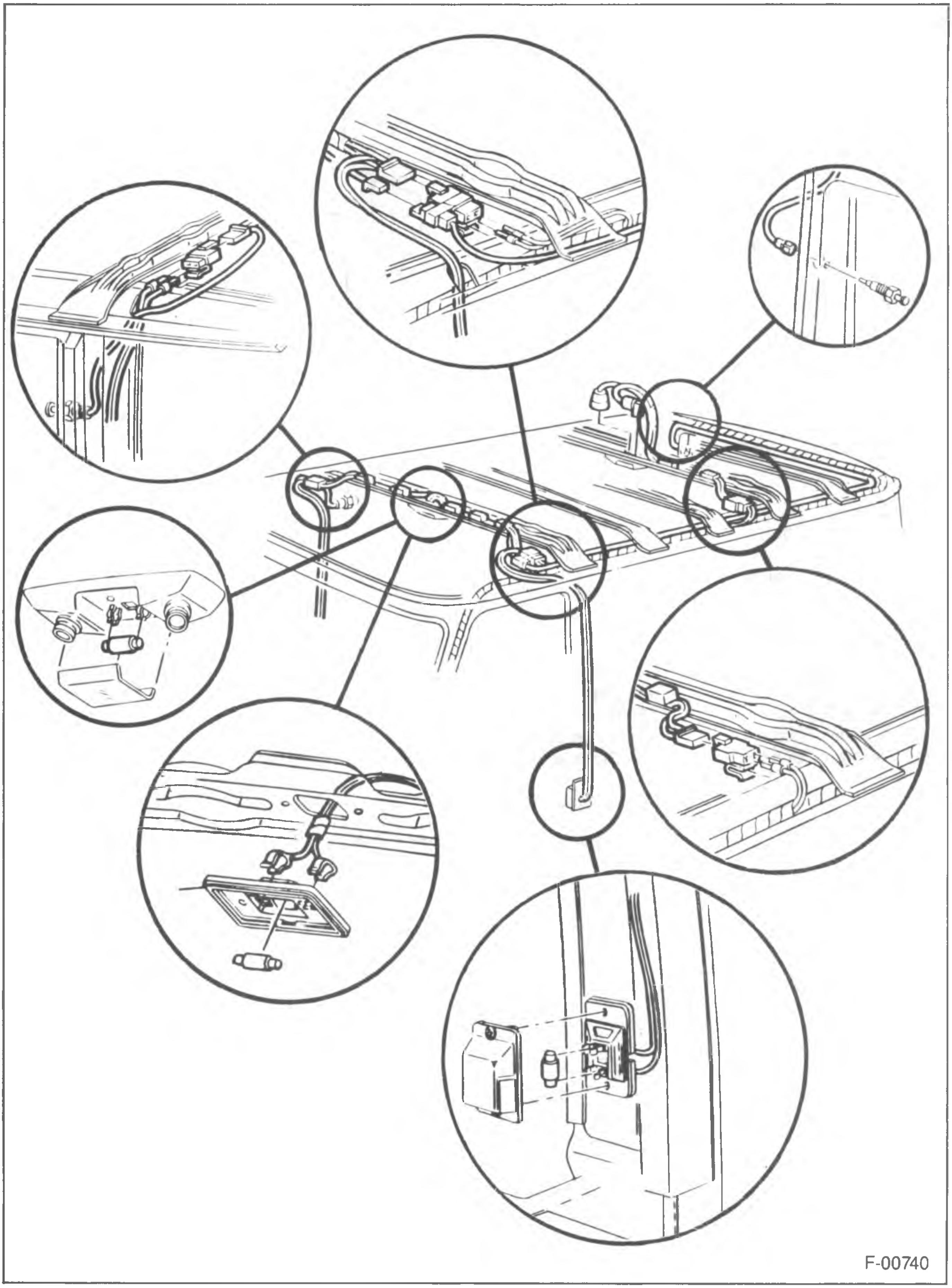
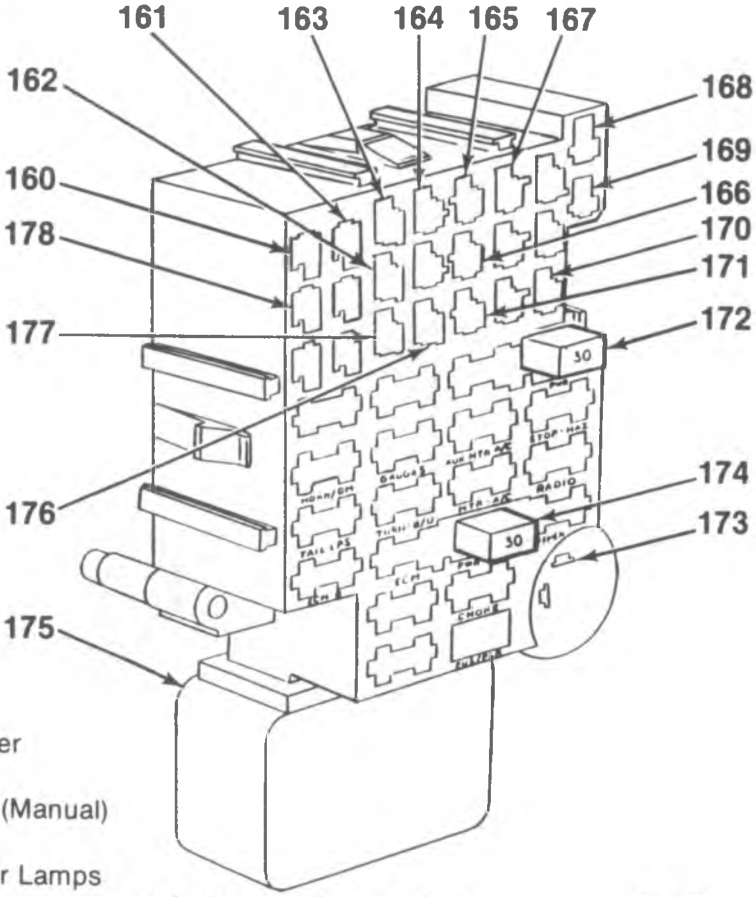


Figure 27—G Van Interior Lighting Harness



160. Cigarette Lighter
161. Clock
162. Cruise Control (Manual)
(Automatic)
163. Diesel Indicator Lamps
164. Power Window
165. Radio Feed
166. Front Auxiliary Battery
167. Radio Dial Lamp
168. Auxiliary Heater
169. Rear Air Conditioning
170. Power Windows And Power Door Locks
171. Overspeed Alarm System
172. Power Windows And Power Door Locks Circuit Breaker
173. Directional Signal Flasher
174. Power Windows And Power Door Locks Circuit Breaker
175. Audio Alarm Center
176. Check Engine 3C Jumper
177. TransmissionControllerSwitch
178. Theft Deterrent Harness

F-00741

Figure 28—G Van Fuse Block

DIAGNOSIS OF POWER DOOR LOCK SYSTEM

PROBLEM	POSSIBLE CAUSE	CORRECTION
One door lock will not work.	1. No power at lock motor.	1. Check for voltage at the lock motor. If no voltage at lock motor, check for voltage at the connector which is located at the front door hinge pillar. If there is no voltage at the connector, check for an open between the connector and the door lock relay.
	2. Open ground circuit between the motor and the relay.	2. Move a door switch to "Lock." Backprobe the TAN wire at the motor. If there is voltage, find the open between the motor and the relay.
None of the door locks function; all switches tried.	1. No power.	1. Check for power at the fuse block (ORN/BLK). Check for power at the door lock relay (ORN/BLK). If power is present at the fuse block but not present at the relay, find the open in the harness.
	2. Relay not working.	2. Hold a switch to "Lock." Backprobe the LT BLU wire at the relay. If there is no voltage, find the open in the harness. If there is voltage, check the relay case to ground path. If the ground is OK, check the relay coil for conduction. If the relay coil is OK, check for voltage on the TAN wire. If there is no voltage, replace the relay. If there is voltage, find the open in the harness.
One switch won't lock the doors.	1. No power to the switch.	1. Check for voltage on the ORN wire at the switch. If there is no voltage, find the open between the switch and the fuse block.
	2. Switch has internal open.	2. Move the switch to "Lock." Check for voltage on the LT BLU wire at the switch. If there is no voltage, replace the switch.

ON-VEHICLE SERVICE

POWER DOOR LOCK MOTOR REPLACEMENT

Remove or Disconnect

1. Battery ground cable from the battery.
2. Door paneling. Refer to SHEET METAL AND FIBERGLASS (SEC. 2C).
3. Motor. Refer to SHEET METAL AND FIBERGLASS (SEC. 2C).

Install or Connect

1. Motor. Refer to SHEET METAL AND FIBERGLASS (SEC. 2C).
2. Door Paneling. Refer to SHEET METAL (SEC. 2C).
3. Battery ground cable to the battery.

SWITCH REPLACEMENT

Remove or Disconnect

1. Battery ground cable from the battery.
2. Door panel. Refer to SHEET METAL AND FIBERGLASS (SEC. 2C).
3. Switch connector. The connector is secured with a retaining nut.
4. Switch. Press in both retaining tabs at the same time.

Install or Connect

1. Switch.
2. Switch connector.
3. Retaining nut.
4. Door panel. Refer to SHEET METAL AND FIBERGLASS (SEC. 2C).
5. Battery ground cable to the battery.

POWER WINDOW SYSTEM

DESCRIPTION

Each power window is moved by a single permanent magnet motor. The direction the motor turns depends on the polarity of the supply voltage. The control switches control the supply voltage polarity.

Switches for controlling all the power windows are located at the driver's door. Each passenger's window switch controls only the window at that passenger's position.

The motors have a self resetting circuit breaker built in. The circuit breaker allows the motor to be stalled without damage. There are no travel-limit switches.

When a window switch is moved to "UP," current flows through the circuit breaker, the window switch, the DK BLU wire, the motor, the circuit breaker, the BRN wire, the "DN" contacts in the switch, and into the BLK wire which goes to ground.

DIAGNOSIS OF POWER WINDOW SYSTEM

PROBLEM	POSSIBLE CAUSE	CORRECTION
Passenger Window Will Not Work, Using Either Passenger Switch Or Driver Switch	1. No power at the passenger switch.	1. Ignition switch at RUN or ACC. Check for voltage at the PNK wire on the passenger switch. If there is no voltage, find the open between the switch and the fuse block.
	2. Passenger switch is not working.	2. With the voltage on the PNK wire at the switch, move the switch to "UP." There should be voltage on the DK BLU wire at the switch. If there is no voltage on the DK BLU wire, replace the switch.

DIAGNOSIS OF POWER WINDOW SYSTEM (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Passenger Window Will Not Work, Using Either Passenger Switch Or Driver Switch (Continued)	3. Motor has an internal open.	3. With the window switch moved to the "UP" position, check for voltage on the DK BLU wire at the motor. If there is no voltage, find the open between the switch and the motor. If there is voltage on the DK BLU wire, backprobe a jumper ground at the BRN wire at the motor. If the motor does not run, replace the motor. If the motor does run, find the open in the ground circuit. Note: The ground circuit does run back through the passenger window "DN" contacts and the driver window switch "DN" contacts before reaching ground.
Passenger Window Will Not Work Using The Passenger Switch. The Window Will Work Using the Driver Switch	1. No power at the passenger switch.	1. Check for voltage on the PNK wire at the passenger switch. If voltage is not present, find the open in the circuit between the switch and the 1.P harness connector.
	2. Switch has internal open.	2. If voltage is present, replace the switch.
Passenger Window Won't Work Using The Driver Switch	1. No power.	1. Check driver window action. If the driver window works, power is at the switch.
	2. Open in driver switch.	2. With the driver switch moved to "UP," check for voltage on the DK BLU wire at the driver switch. If voltage is not present, replace the switch.
	3. Open in harness.	3. With voltage present on the DK BLU wire at the driver switch, find the open between the driver switch and the passenger switch.
Driver Window Won't Work. Passenger Window Works.	1. Switch won't work.	1. Switch moved to "UP." Check for voltage at the DK BLU wire at the switch. If voltage is not present, replace the switch.
	2. Motor has internal open.	2. Switch moved to "UP." Check for voltage on the DK BLU wire at the motor. If voltage is present, backprobe a jumper ground at the BRN wire at the motor. If the motor won't run, replace the motor.
	3. Motor ground circuit is open.	3. Backprobe a jumper ground at the BRN wire at the motor. Move the driver switch to "UP." If the motor runs, find the open in the ground circuit.

ON-VEHICLE SERVICE

POWER WINDOW MOTOR REPLACEMENT

Remove or Disconnect

1. Battery ground cable from the battery.
2. Door paneling. Refer to SHEET METAL AND FIBERGLASS (SEC. 2C).
3. Motor. Refer to SHEET METAL AND FIBERGLASS (SEC. 2C).

Install or Connect

1. Motor. Refer to SHEET METAL AND FIBERGLASS (SEC. 2C).
2. Door paneling. Refer to SHEET METAL (SEC. 2C).
3. Battery ground cable to the battery.

SWITCH REPLACEMENT

Remove or Disconnect

1. Battery ground cable from the battery.
2. Door panel. Refer to SHEET METAL AND FIBERGLASS (SEC. 2C).
3. Switch connector. The connector is secured with a retaining nut.
4. Switch. Press in both retaining tabs at the same time.

Install or Connect

1. Switch.
2. Switch connector.
3. Retaining nut.
4. Door panel. Refer to SHEET METAL AND FIBERGLASS (SEC. 2C).
5. Battery ground cable to the battery.

WINDSHIELD WIPER-CK AND G MODELS

DESCRIPTION

A permanent magnet type wiper is used on CK and G Series. The motor parts-field magnets, armature, drive gear etc. are enclosed in a two piece sheet metal housing. For purposes of explanation the housing halves are referred to as upper and lower housings. The two housings are attached to each other by ten extrusions which are staked over.

The wiper motor is protected by an automatic reset type circuit breaker located on the motor brush holder assembly. A fuse located in the fuse block protects the vehicle wiring.

The wiper motor can be operated only when the ignition switch is in the "run" or "accessory" position.

The wiper motor has three brushes; the "common," the low speed, and the high speed. When the ignition switch is "ON," power is applied to the common brush. The low speed and high speed brushes are connected to their respective ground via the control switch. When the control switch is positioned at "HI" or "LO" speed, a ground path is connected to the high or low speed brush in the motor. The motor runs at the switch selected speed.

In order to have the wiper blades stop in their normal park position and the wiper motor shut off properly, the motor must run in LO speed. When the control switch is moved to the OFF position, the low speed brush circuit goes through a park switch located in the gear housing and then to ground at the control switch. The park switch is normally closed and this allows the wiper to keep running. When the wiper blades reach their park position, the cam on the gear opens the normally closed park switch, which turns off the wiper. Refer to Figures 29 and 30.

ON-VEHICLE SERVICE

WIPER MOTOR REPLACEMENT

C-K Truck

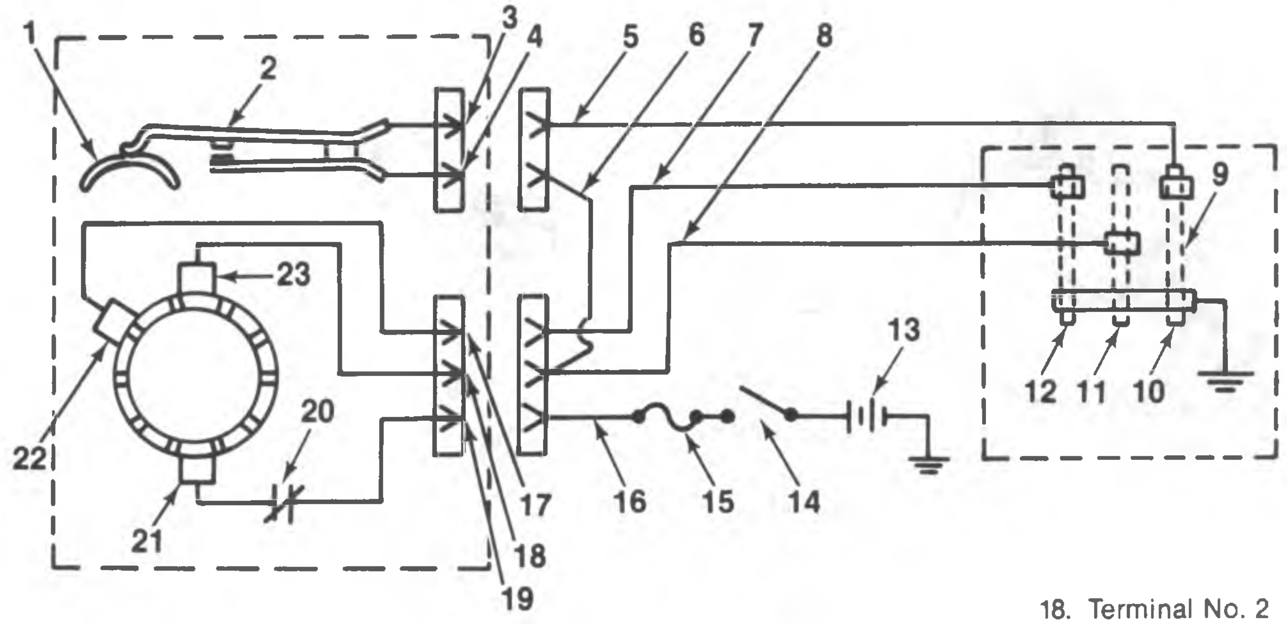
Remove or Disconnect (Figure 36)

- Wiper motor is in the Park position.

1. Ground cable from the battery.
2. Electrical harness (38) from the wiper motor.
3. Drive rod (34) from the wiper motor crank arm (36).
    - Reach down through the access hole (32) in the plenum and loosen the wiper drive rod attaching nuts (33) before removing the drive rod (34).
4. Wiper motor to dash panel attaching screws (40).
5. Wiper motor.

Install or Connect (Figure 36)

1. Wiper motor.
2. Wiper motor to dash panel attaching screws (40).
3. Drive rod (34) the wiper motor crank arm (36).
    - Lubricate wiper motor crank arm pivot ball (35) prior to installing the drive rod (34).
4. Electrical harness (38) to the wiper motor.



1. Gear Cam
2. Park Switch (Normally Closed)
3. Terminal No. 5
4. Terminal No. 4
5. BLK w/dbl LT BLU Tracer
6. BLK
7. LT BLU
8. BLK
9. Movable Contact
10. OFF Position
11. LOW Position
12. HIGH Position
13. Power
14. Ignition Switch
15. Fuse
16. BLK w/dbl YEL Tracer
17. Terminal No. 3
18. Terminal No. 2
19. Terminal No. 1
20. Circuit Breaker
21. Common Brush
22. High Speed Brush
23. Low Speed Brush

F-00668

Figure 29—CKG Windshield Wiper Diagram

5. Ground cable to the battery.

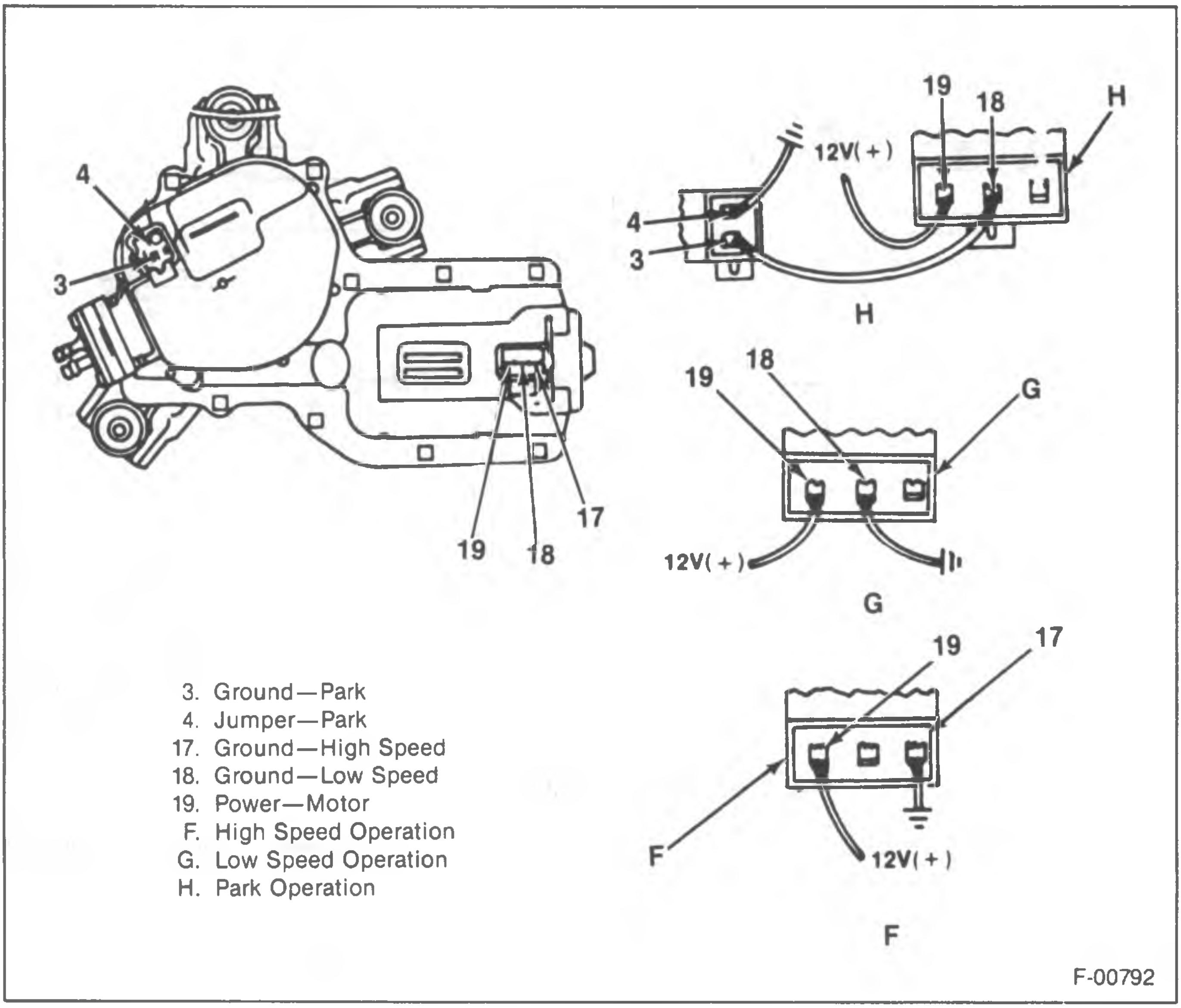
G Van

Remove or Disconnect (Figure 37)

- Wiper motor must be in Park position.
1. Ground cable from the battery.
2. Wiper arms.
3. Cowl panel cover.
4. Drive arm (34) to the wiper motor crank arm (36).
- Loosen nuts (33) holding the drive bar (34) to the wiper motor crank arm (36) removing the drive bar (34).
5. Electrical harness (38) from the wiper motor.
6. Left dash defroster outlet from the flex hose.
7. Screw securing the left hand heater duct to the engine cover shroud.
8. Heater duct down and out.
9. Three screws (30) securing the wiper motor to the cowl.
10. Wiper motor.

Install or Connect (Figure 37)

1. Wiper motor.
2. Three screws (30) securing the wiper motor to the cowl.
3. Heater duct in and up.
4. Screw securing the left hand heater duct to the engine cover shroud.
5. Left dash defroster outlet to the flex hose.
6. Electrical harness (38) to the wiper motor.
7. Drive bar (34) to the wiper motor crank arm (36).
- Lubricate the wiper motor crank arm pivot ball (35).
8. Cowl panel cover.
9. Wiper arms.
10. Ground cable to the battery.



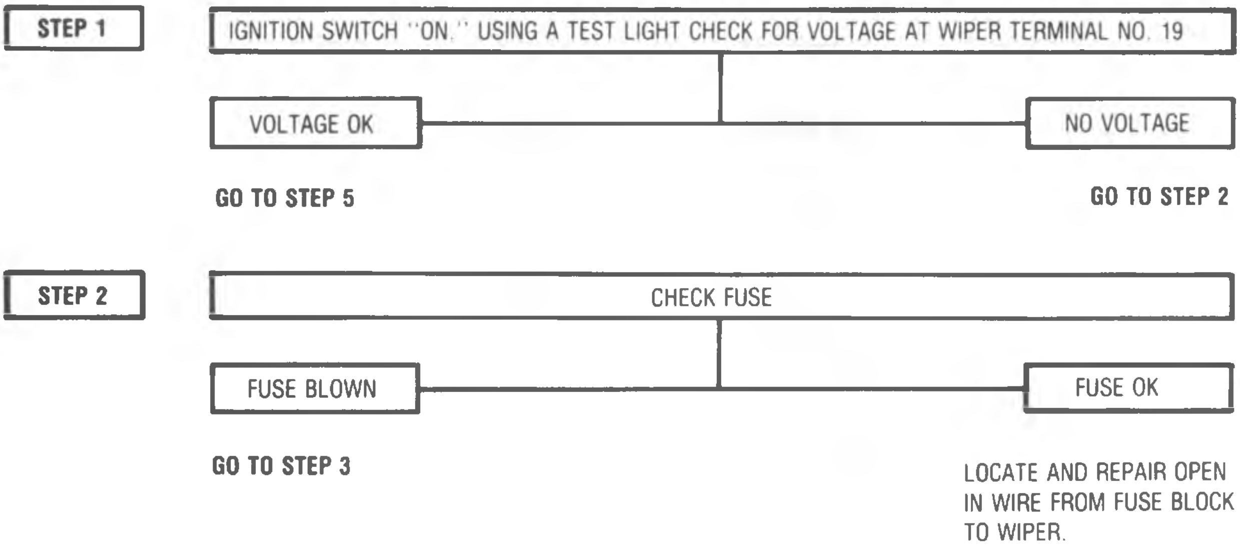
3. Ground—Park
4. Jumper—Park
17. Ground—High Speed
18. Ground—Low Speed
19. Power—Motor
F. High Speed Operation
G. Low Speed Operation
H. Park Operation

Figure 30—Diagnosis Connections

DIAGNOSIS CHART

SYMPTOM	PROCEDURE NO.
1) WIPER INOPERATIVE—BOTH LOW AND HIGH SPEED	1
2) LOW SPEED ONLY—INOPERATIVE IN HIGH SPEED	2
3) HIGH SPEED ONLY—INOPERATIVE IN LOW SPEED	3
4) ONE SPEED—SAME IN BOTH LOW AND HIGH SPEED	4
5) BLADES STOP AT RANDOM POSITIONS WHEN WIPER IS TURNED OFF. (DO NOT RETURN TO PARK POSITION.)	5
6) WIPER WILL NOT SHUT OFF	6
7) INTERMITTENT OPERATION	7
8) WIPER MOTOR RUNS BUT BLADES DON'T MOVE	8

PROCEDURE 1 (WIPER INOPERATIVE)



STEP 1

IGNITION SWITCH "ON." USING A TEST LIGHT CHECK FOR VOLTAGE AT WIPER TERMINAL NO. 19

VOLTAGE OK — **GO TO STEP 5**

NO VOLTAGE — **GO TO STEP 2**

STEP 2

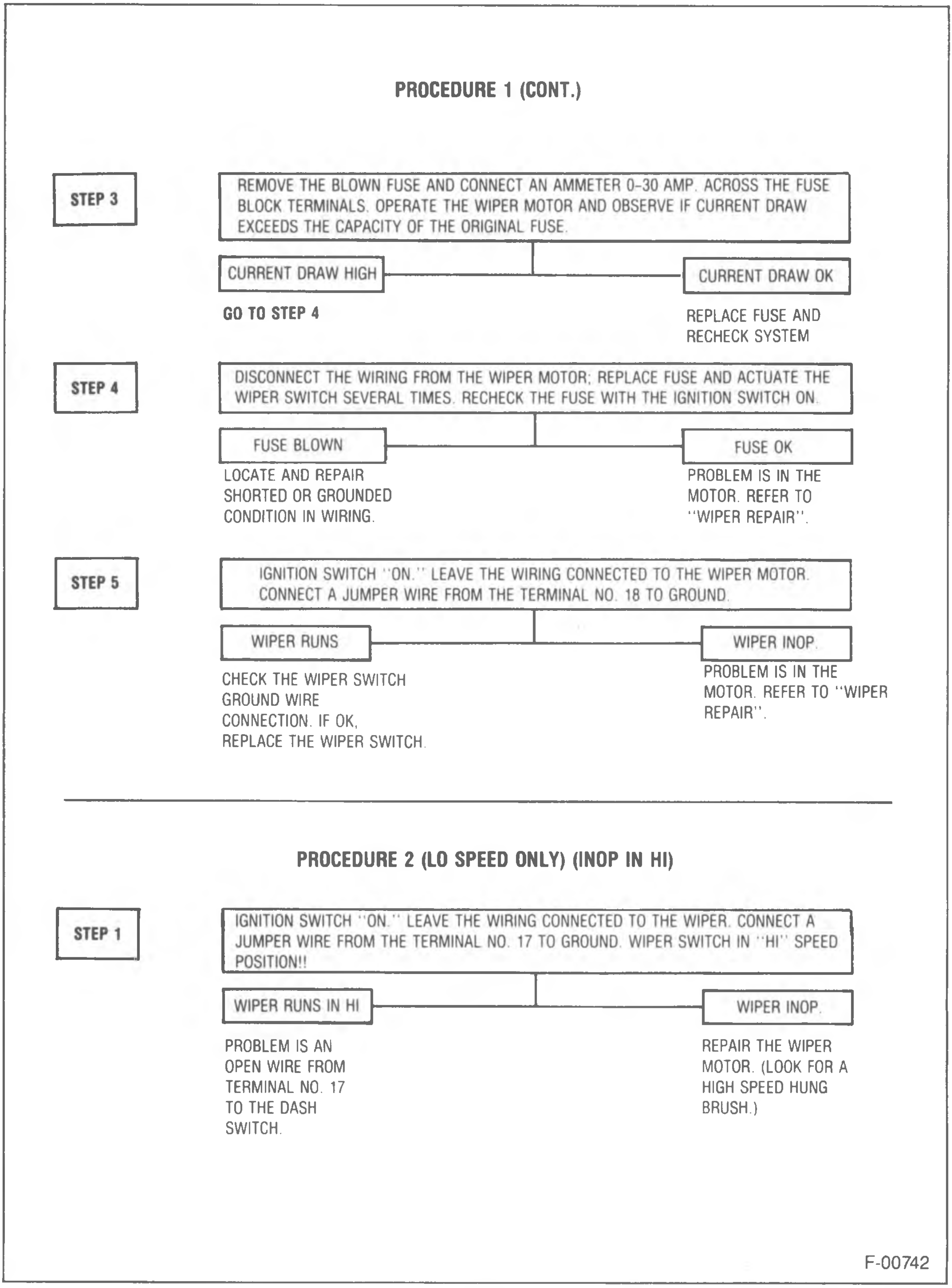
CHECK FUSE

FUSE BLOWN — **GO TO STEP 3**

FUSE OK — LOCATE AND REPAIR OPEN IN WIRE FROM FUSE BLOCK TO WIPER.

F-00715

Figure 31—Windshield Wiper Diagnosis



PROCEDURE 1 (CONT.)

STEP 3

REMOVE THE BLOWN FUSE AND CONNECT AN AMMETER 0-30 AMP. ACROSS THE FUSE BLOCK TERMINALS. OPERATE THE WIPER MOTOR AND OBSERVE IF CURRENT DRAW EXCEEDS THE CAPACITY OF THE ORIGINAL FUSE.

CURRENT DRAW HIGH

GO TO STEP 4

CURRENT DRAW OK

REPLACE FUSE AND RECHECK SYSTEM

STEP 4

DISCONNECT THE WIRING FROM THE WIPER MOTOR; REPLACE FUSE AND ACTUATE THE WIPER SWITCH SEVERAL TIMES. RECHECK THE FUSE WITH THE IGNITION SWITCH ON.

FUSE BLOWN

LOCATE AND REPAIR SHORTED OR GROUNDED CONDITION IN WIRING.

FUSE OK

PROBLEM IS IN THE MOTOR. REFER TO "WIPER REPAIR".

STEP 5

IGNITION SWITCH "ON." LEAVE THE WIRING CONNECTED TO THE WIPER MOTOR. CONNECT A JUMPER WIRE FROM THE TERMINAL NO. 18 TO GROUND.

WIPER RUNS

CHECK THE WIPER SWITCH GROUND WIRE CONNECTION. IF OK, REPLACE THE WIPER SWITCH.

WIPER INOP.

PROBLEM IS IN THE MOTOR. REFER TO "WIPER REPAIR".

PROCEDURE 2 (LO SPEED ONLY) (INOP IN HI)

STEP 1

IGNITION SWITCH "ON." LEAVE THE WIRING CONNECTED TO THE WIPER. CONNECT A JUMPER WIRE FROM THE TERMINAL NO. 17 TO GROUND. WIPER SWITCH IN "HI" SPEED POSITION!!

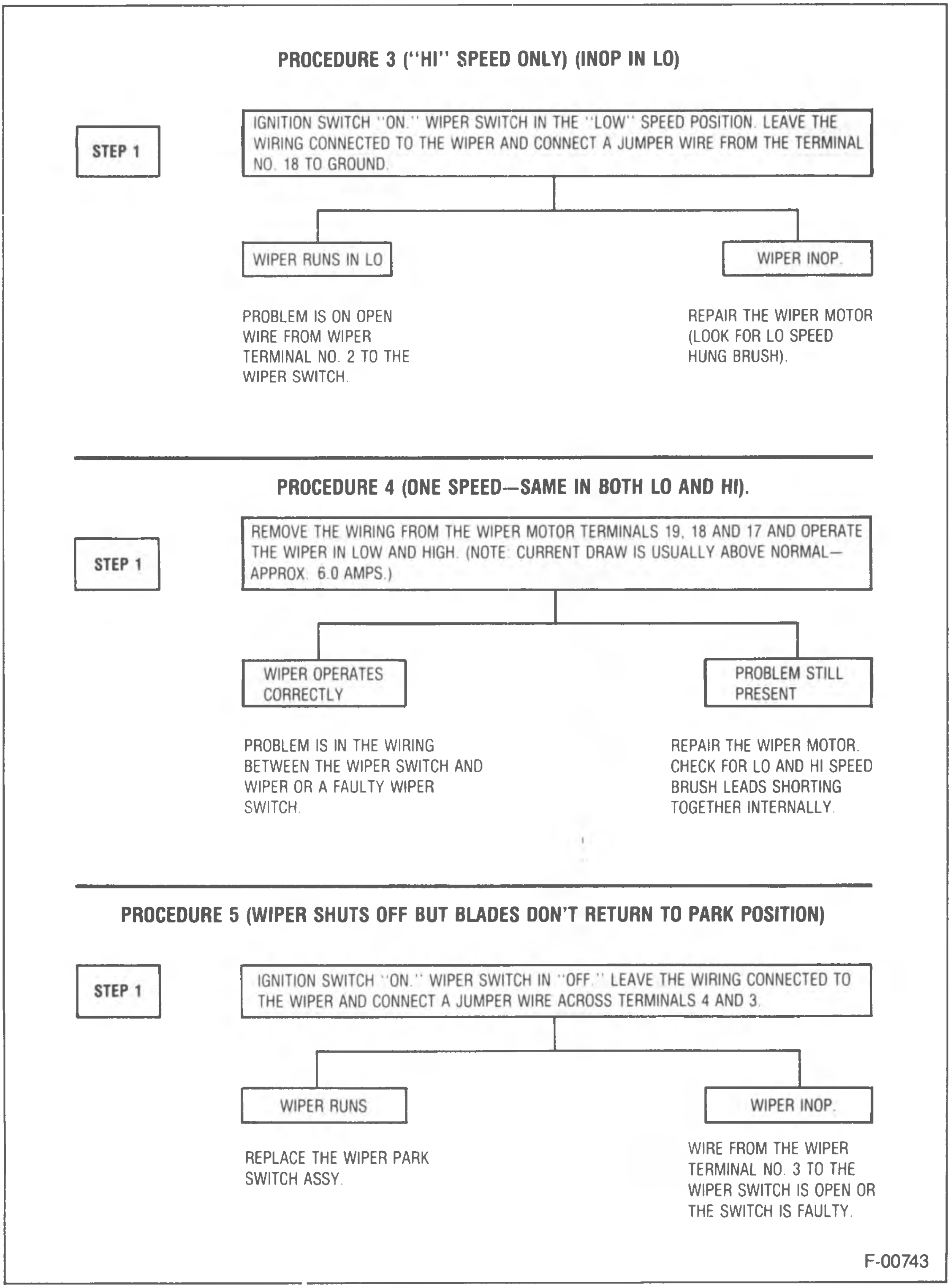
WIPER RUNS IN HI

PROBLEM IS AN OPEN WIRE FROM TERMINAL NO. 17 TO THE DASH SWITCH.

WIPER INOP.

REPAIR THE WIPER MOTOR. (LOOK FOR A HIGH SPEED HUNG BRUSH.)

Figure 32—Windshield Wiper Diagnosis



PROCEDURE 3 ("HI" SPEED ONLY) (INOP IN LO)

STEP 1

IGNITION SWITCH "ON." WIPER SWITCH IN THE "LOW" SPEED POSITION. LEAVE THE WIRING CONNECTED TO THE WIPER AND CONNECT A JUMPER WIRE FROM THE TERMINAL NO. 18 TO GROUND.

WIPER RUNS IN LO

PROBLEM IS ON OPEN WIRE FROM WIPER TERMINAL NO. 2 TO THE WIPER SWITCH.

WIPER INOP.

REPAIR THE WIPER MOTOR (LOOK FOR LO SPEED HUNG BRUSH).

PROCEDURE 4 (ONE SPEED—SAME IN BOTH LO AND HI).

STEP 1

REMOVE THE WIRING FROM THE WIPER MOTOR TERMINALS 19, 18 AND 17 AND OPERATE THE WIPER IN LOW AND HIGH. (NOTE: CURRENT DRAW IS USUALLY ABOVE NORMAL—APPROX. 6.0 AMPS.)

WIPER OPERATES CORRECTLY

PROBLEM IS IN THE WIRING BETWEEN THE WIPER SWITCH AND WIPER OR A FAULTY WIPER SWITCH.

PROBLEM STILL PRESENT

REPAIR THE WIPER MOTOR. CHECK FOR LO AND HI SPEED BRUSH LEADS SHORTING TOGETHER INTERNALLY.

PROCEDURE 5 (WIPER SHUTS OFF BUT BLADES DON'T RETURN TO PARK POSITION)

STEP 1

IGNITION SWITCH "ON." WIPER SWITCH IN "OFF." LEAVE THE WIRING CONNECTED TO THE WIPER AND CONNECT A JUMPER WIRE ACROSS TERMINALS 4 AND 3.

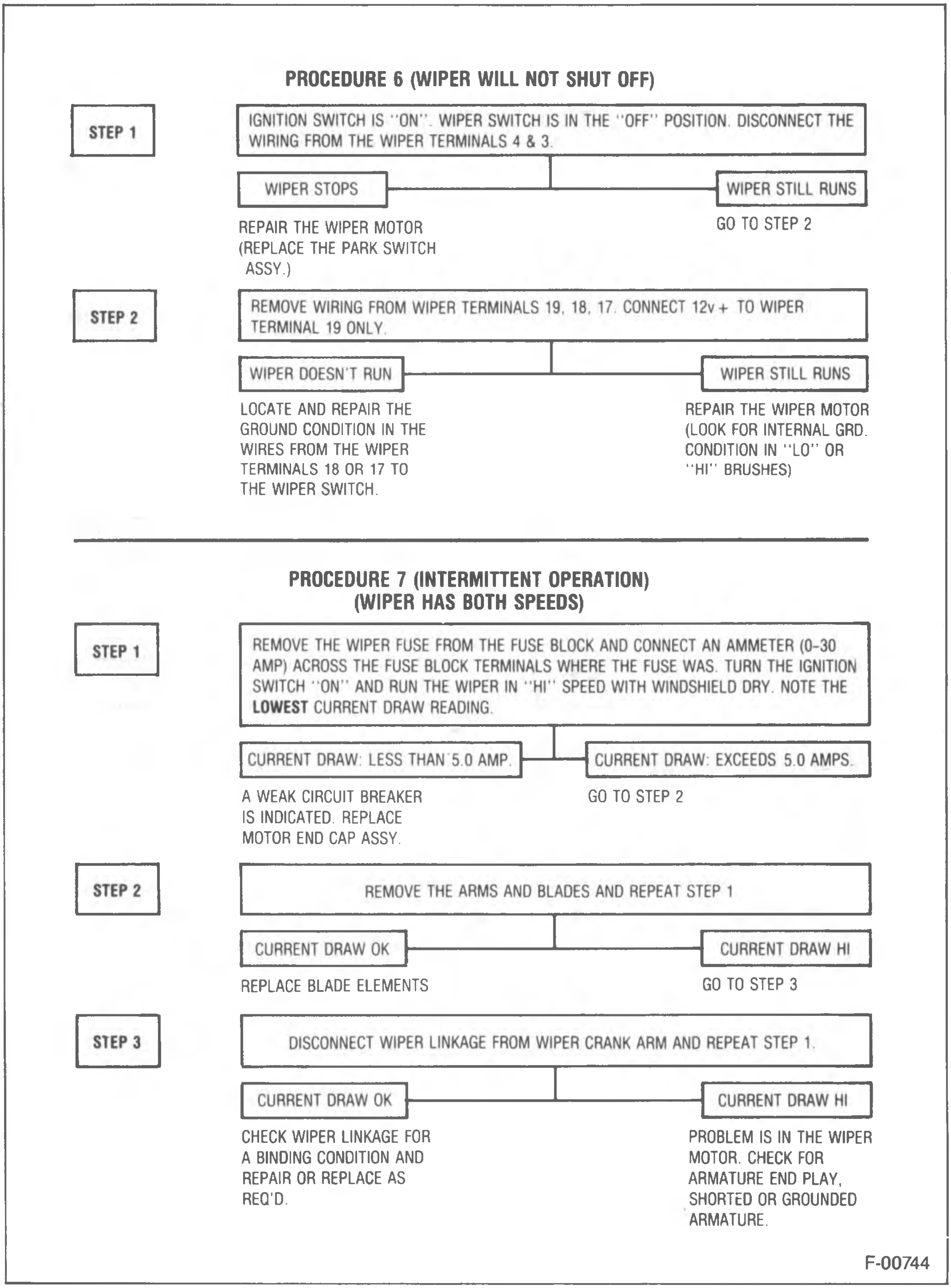
WIPER RUNS

REPLACE THE WIPER PARK SWITCH ASSY.

WIPER INOP.

WIRE FROM THE WIPER TERMINAL NO. 3 TO THE WIPER SWITCH IS OPEN OR THE SWITCH IS FAULTY.

Figure 33—Windshield Wiper Diagnosis



PROCEDURE 6 (WIPER WILL NOT SHUT OFF)

STEP 1

IGNITION SWITCH IS "ON". WIPER SWITCH IS IN THE "OFF" POSITION. DISCONNECT THE WIRING FROM THE WIPER TERMINALS 4 & 3.

WIPER STOPS

REPAIR THE WIPER MOTOR (REPLACE THE PARK SWITCH ASSY.)

WIPER STILL RUNS

GO TO STEP 2

STEP 2

REMOVE WIRING FROM WIPER TERMINALS 19, 18, 17. CONNECT 12v + TO WIPER TERMINAL 19 ONLY.

WIPER DOESN'T RUN

LOCATE AND REPAIR THE GROUND CONDITION IN THE WIRES FROM THE WIPER TERMINALS 18 OR 17 TO THE WIPER SWITCH.

WIPER STILL RUNS

REPAIR THE WIPER MOTOR (LOOK FOR INTERNAL GRD. CONDITION IN "LO" OR "HI" BRUSHES)

PROCEDURE 7 (INTERMITTENT OPERATION)
(WIPER HAS BOTH SPEEDS)

STEP 1

REMOVE THE WIPER FUSE FROM THE FUSE BLOCK AND CONNECT AN AMMETER (0-30 AMP) ACROSS THE FUSE BLOCK TERMINALS WHERE THE FUSE WAS. TURN THE IGNITION SWITCH "ON" AND RUN THE WIPER IN "HI" SPEED WITH WINDSHIELD DRY. NOTE THE **LOWEST** CURRENT DRAW READING.

CURRENT DRAW: LESS THAN 5.0 AMP.

A WEAK CIRCUIT BREAKER IS INDICATED. REPLACE MOTOR END CAP ASSY.

CURRENT DRAW: EXCEEDS 5.0 AMPS.

GO TO STEP 2

STEP 2

REMOVE THE ARMS AND BLADES AND REPEAT STEP 1

CURRENT DRAW OK

REPLACE BLADE ELEMENTS

CURRENT DRAW HI

GO TO STEP 3

STEP 3

DISCONNECT WIPER LINKAGE FROM WIPER CRANK ARM AND REPEAT STEP 1.

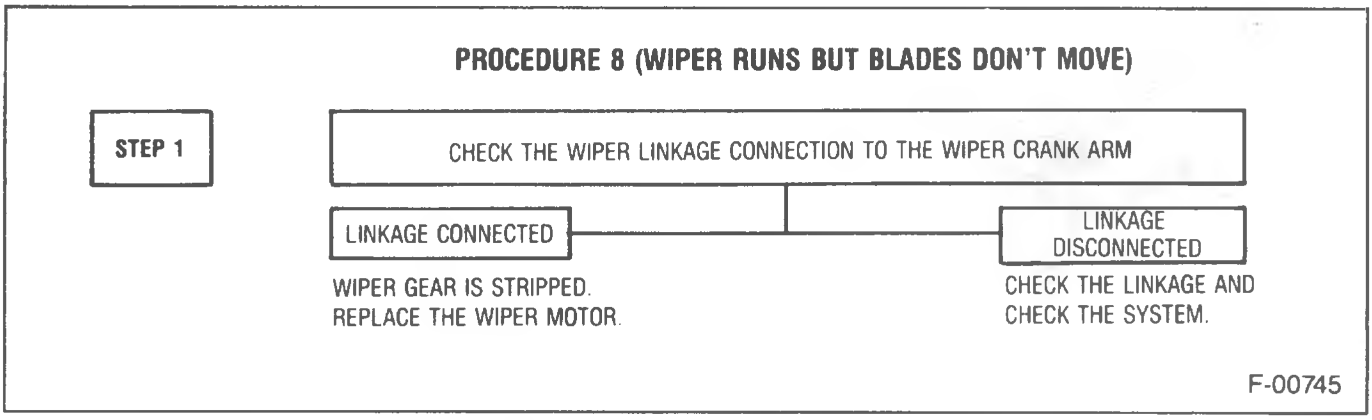
CURRENT DRAW OK

CHECK WIPER LINKAGE FOR A BINDING CONDITION AND REPAIR OR REPLACE AS REQ'D.

CURRENT DRAW HI

PROBLEM IS IN THE WIPER MOTOR. CHECK FOR ARMATURE END PLAY, SHORTED OR GROUNDED ARMATURE.

Figure 34—Windshield Wiper Diagnosis



PROCEDURE 8 (WIPER RUNS BUT BLADES DON'T MOVE)

STEP 1

CHECK THE WIPER LINKAGE CONNECTION TO THE WIPER CRANK ARM

LINKAGE CONNECTED

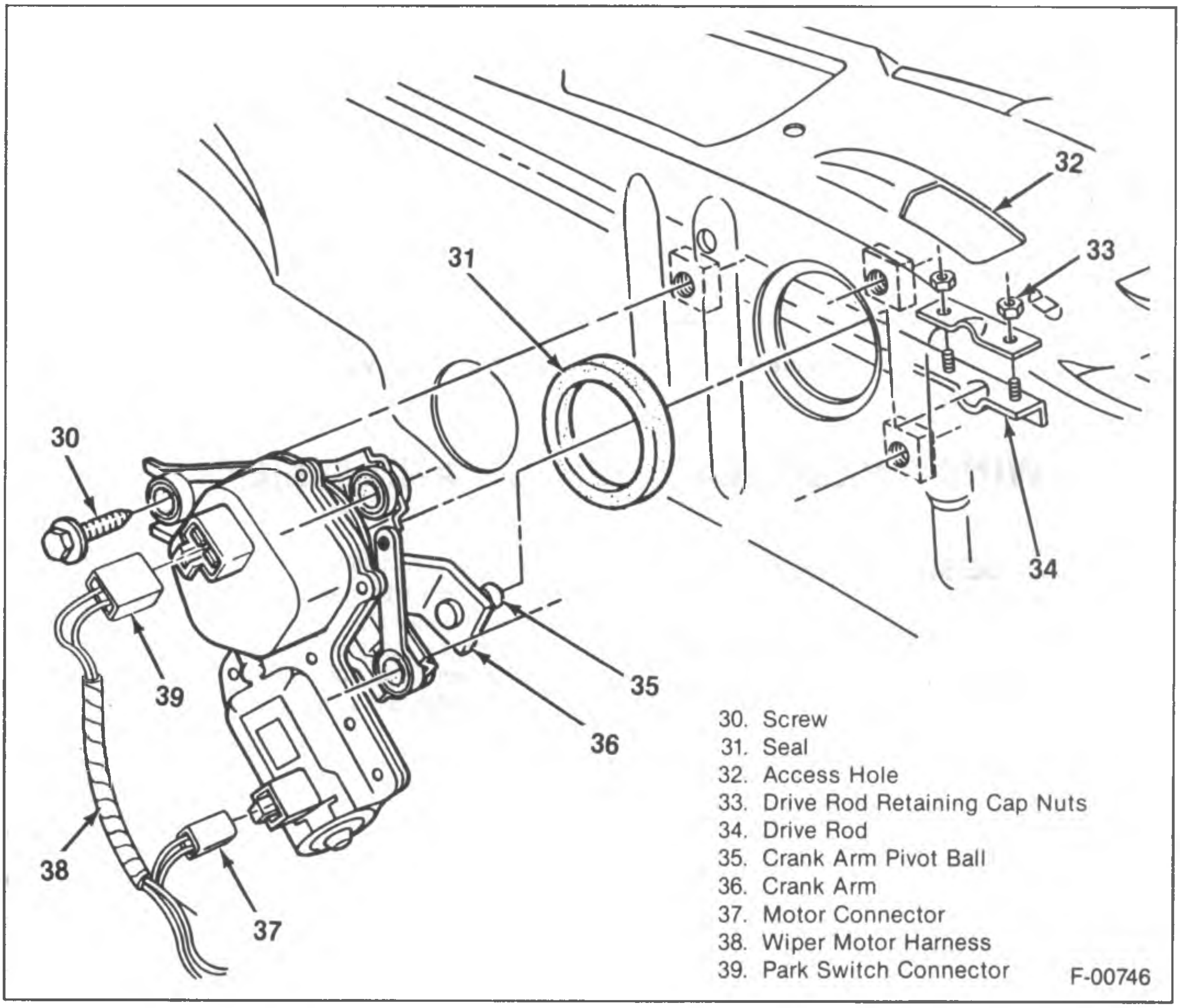
WIPER GEAR IS STRIPPED.
REPLACE THE WIPER MOTOR.

LINKAGE DISCONNECTED

CHECK THE LINKAGE AND
CHECK THE SYSTEM.

F-00745

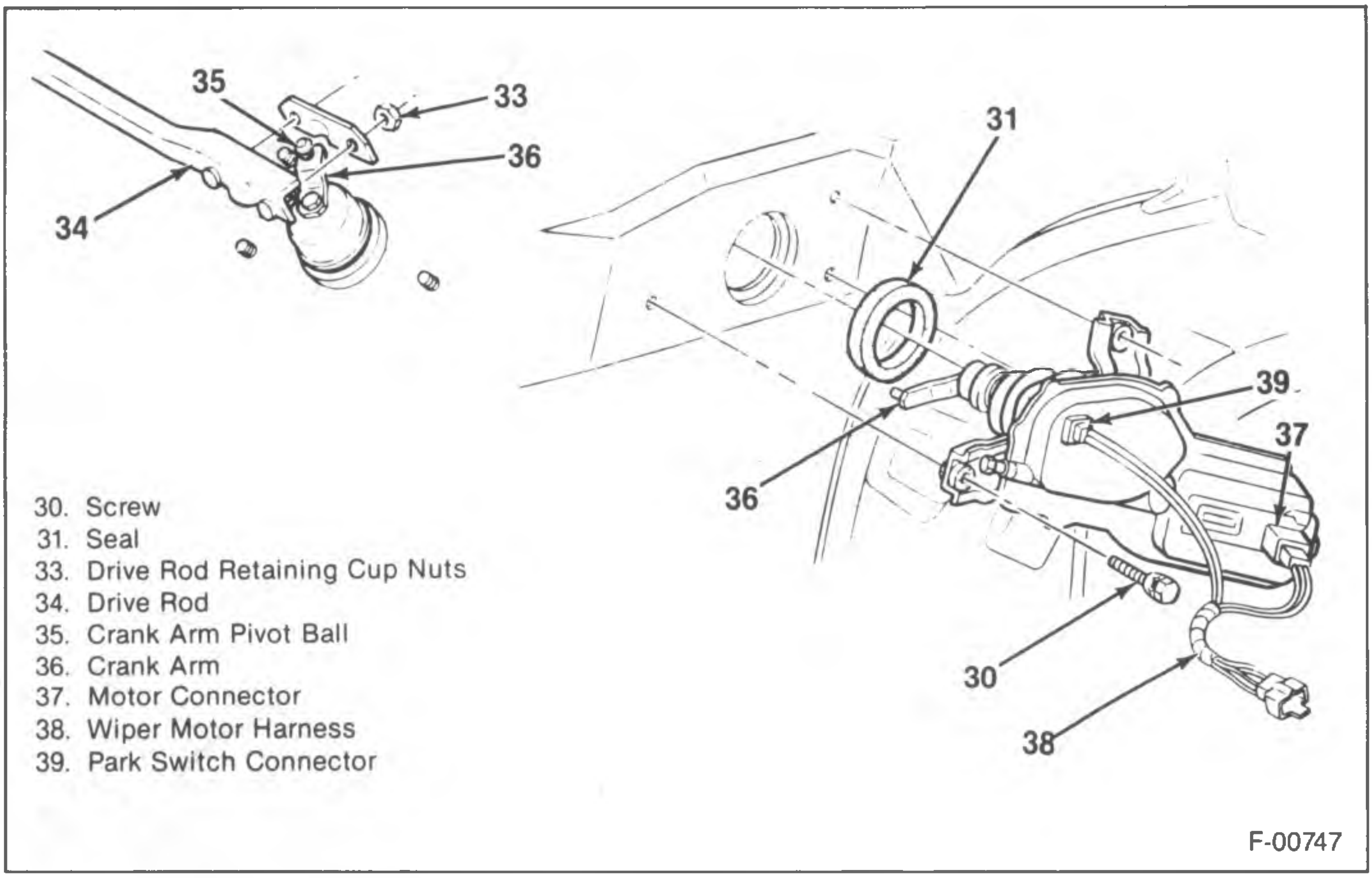
Figure 35—Windshield Wiper Diagnosis



30. Screw
31. Seal
32. Access Hole
33. Drive Rod Retaining Cap Nuts
34. Drive Rod
35. Crank Arm Pivot Ball
36. Crank Arm
37. Motor Connector
38. Wiper Motor Harness
39. Park Switch Connector

F-00746

Figure 36—Windshield Wiper Motor Mounting-CK



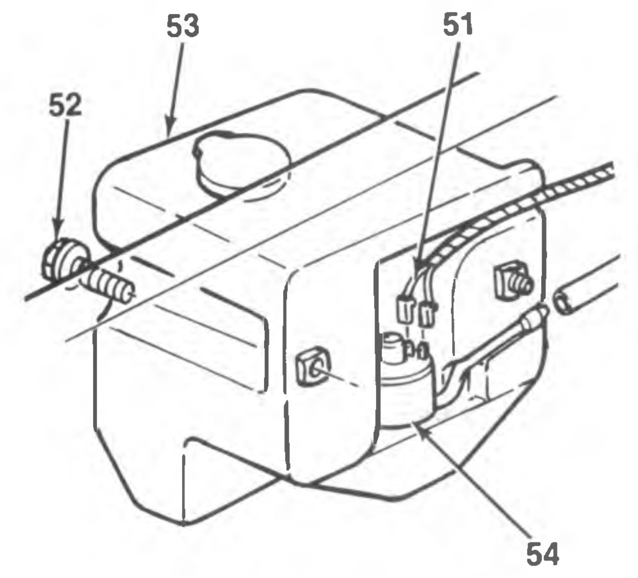
30. Screw
31. Seal
33. Drive Rod Retaining Cup Nuts
34. Drive Rod
35. Crank Arm Pivot Ball
36. Crank Arm
37. Motor Connector
38. Wiper Motor Harness
39. Park Switch Connector

Figure 37—Windshield Wiper Mounting-G Van

WINDSHIELD WASHER—CK AND G MODELS

DESCRIPTION

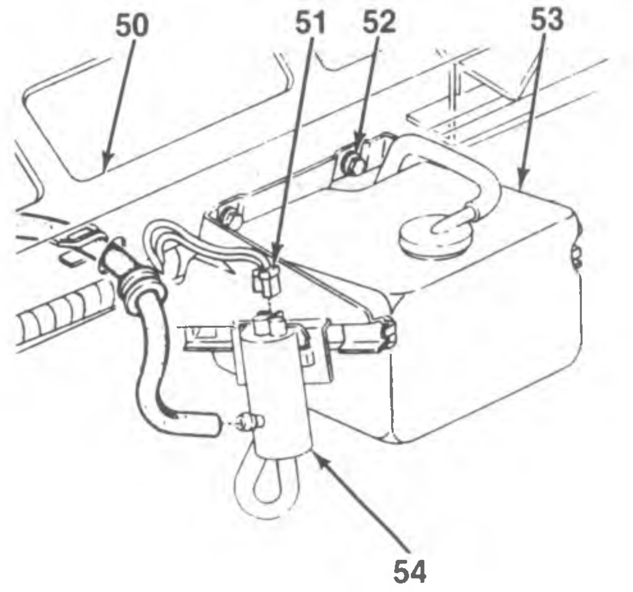
The washer motor is located in the bottom of the windshield washer fluid reservoir. The washer is controlled by a washer switch, which is located on the turn signal and multi-function lever. Two wires go to the washer. The white wire is power coming from the fuse box. The same fuse that protects the washer motor also protects the wiper motor. The pink wire is the ground circuit that goes through the washer switch to ground. Refer to Figures 38 and 39.



51. Windshield Washer Motor Connector
52. Reservoir Retaining Screw
53. Washer Fluid Reservoir
54. Windshield Washer Motor

F-00748

Figure 38—CK Windshield Washer



50. Dash Panel
51. Windshield Washer Motor Connector
52. Reservoir Retaining Screw
53. Washer Fluid Reservoir
54. Windshield Washer Motor

F-00749

Figure 39—G Van Windshield Washer

WINDSHIELD WASHER DIAGNOSIS

PROBLEM	POSSIBLE CAUSE	CORRECTION
Washer Fluid Does Not Spray On The Windshield	1. No fluid.	1. Check the fluid reservoir. Refill, if necessary.
	2. Clogged jets.	2. Using a fine pin, carefully clear the jets.
	3. Clogged filter in the reservoir.	3. Remove the filter and back flush it. Also clean the reservoir.
	4. Washer motor is not running.	4. Check for power on the WHT wire at the motor. If there is no power, and the wipers work, find the open in the power circuit. If there is power, check the PNK wire at the washer motor for ground. If the ground circuit is good, replace the washer motor.

ON-VEHICLE SERVICE

WASHER MOTOR REPLACEMENT

CK Truck

Remove or Disconnect

1. Battery ground cable from the battery.
2. Two reservoir retaining screws.
3. Reservoir.
4. Electrical connector at the motor.
5. Fluid tube at the motor.
6. Motor from the reservoir.

Install or Connect (Figure 38)

1. Motor to the reservoir.
2. Fluid tube at the motor.
3. Electrical connector at the motor.
4. Reservoir.
5. Two reservoir retaining screws.
6. Battery ground cable to the battery.

G Van

Remove or Disconnect (Figure 39)

1. Battery ground cable from the battery.
2. Electrical connector at the motor.
3. Fluid tubes from the motor.
4. Motor from the bracket.

Install or Connect (Figure 39)

1. Motor onto the bracket.
2. Fluid tubes to the motor.
3. Electrical connector to the motor.
4. Battery ground cable to the battery.

WIPER MOTOR UNIT REPAIR

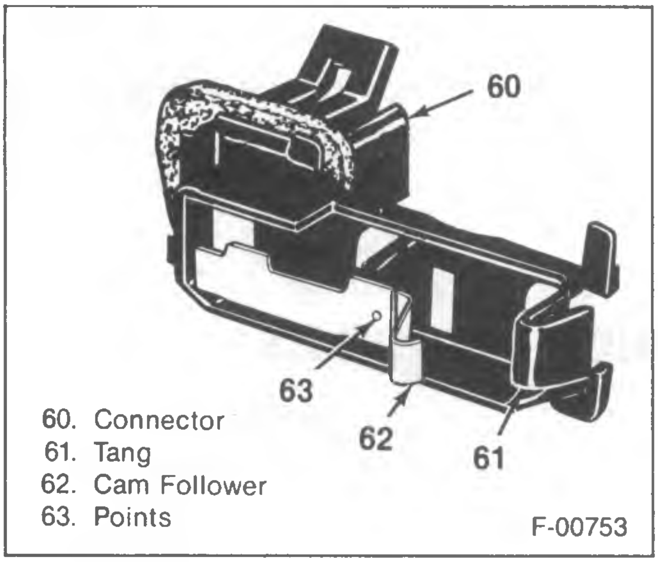


Figure 40—Park Switch

REPLACEMENT OF COMPONENTS

PARK SWITCH

Remove or Disconnect (Figure 40)

1. Cover
2. Park switch.
   - Depress tang (61).

Install or Connect (Figure 40)

1. Park switch.
2. Cover.

END CAP-BRUSH HOLDER, ARMATURE ASSEMBLY

Remove or Disconnect

1. Retainer tabs.
2. End cap assembly.
   - Rotate crank arm clockwise.
3. Armature.

Install or Connect (Figure 41 and 42)

1. Armature in the end cap assembly.
   - Release the brush spring tension (65).
   - Slide the brushes back in the brush holders.
   - Put the armature in the end cap assembly.
   - Reposition the brush spring legs behind their respective notches (66).
   - Tie the armature to the end cap assembly with small wire.
2. Armature in the wiper housing.
3. End cap into the slot area of the wiper housing.
   - Remove the wire.
4. End cap assembly into the housing until it bottoms.
5. Retainer tabs.

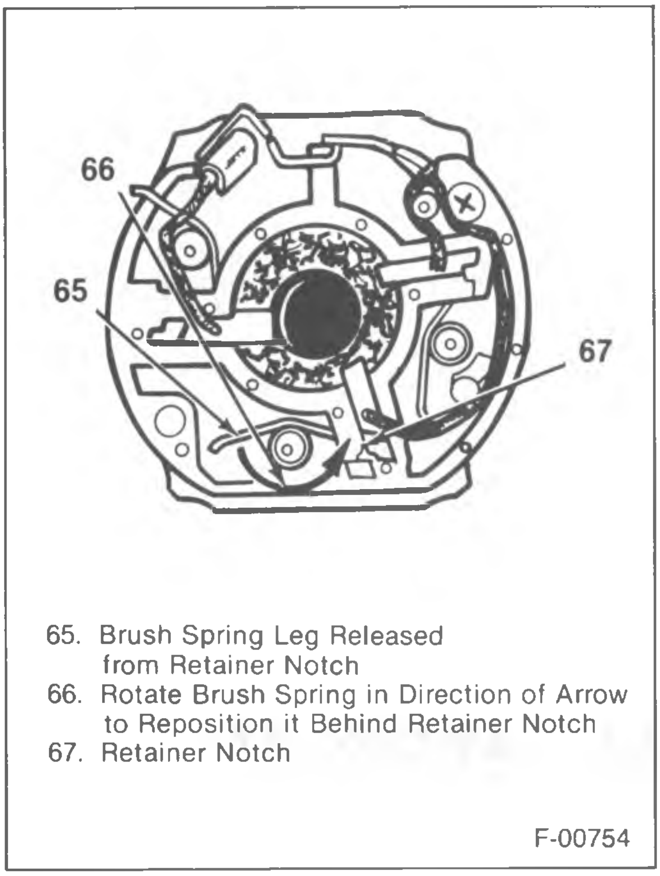


Figure 41—Brush Spring Release Position

CRANK ARM, SPACER, SEAL

↔ Remove or Disconnect (Figure 43)

1. Crank arm retaining nut (71).
    - Have the crank arm clamped in a vise.
2. Crank arm (70).
3. Shaft seal (72).
4. Spacer (73).

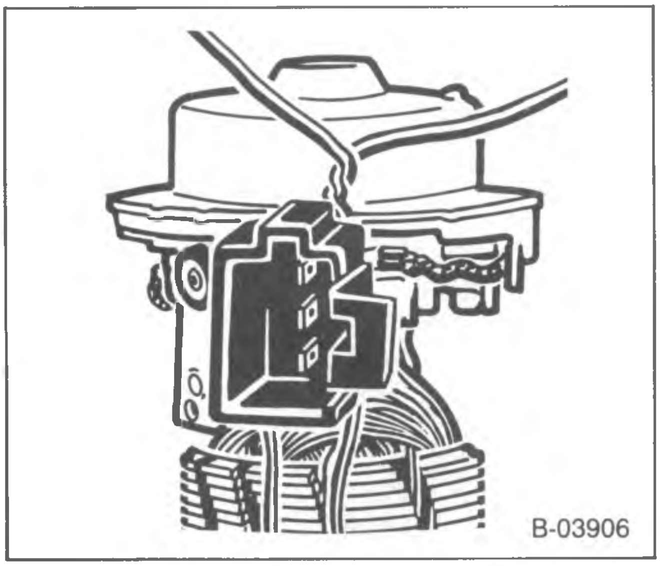


Figure 42—End Cap Assembly

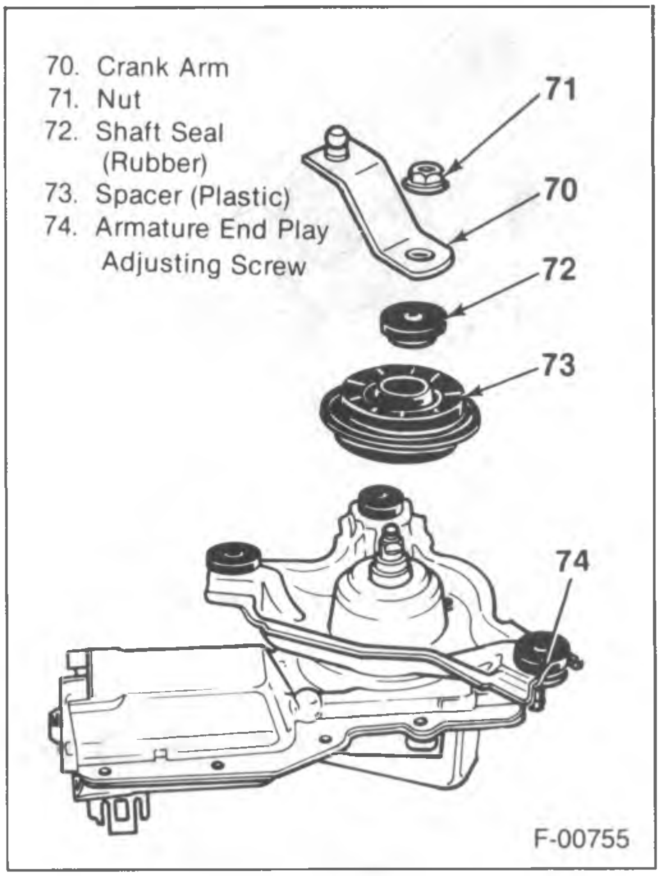


Figure 43—Crank Arm, Spacer, and Seal

→← Install or Connect (Figure 43, 44 and 45)

1. Spacer (73).
2. Shaftseal (72).
3. Crank arm (70).
    - Be sure the wiper motor is in "Park."
    - Install the crank arm according to figure 44 or 45, depending on the vehicle model.
4. Crank arm retaining nut (71).

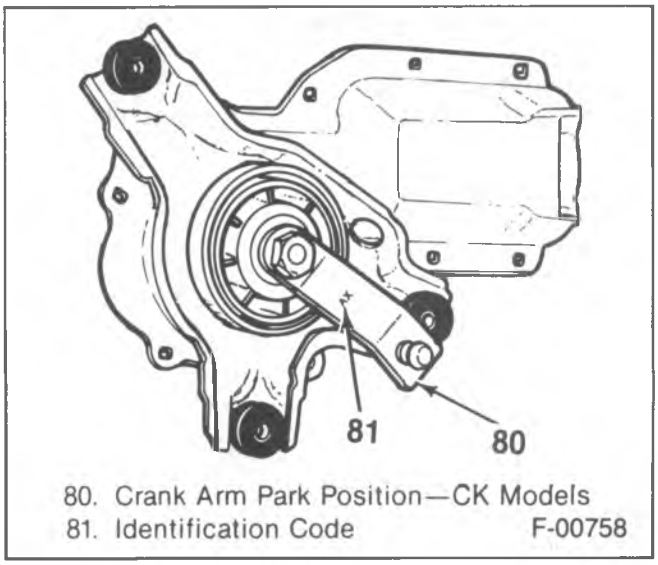
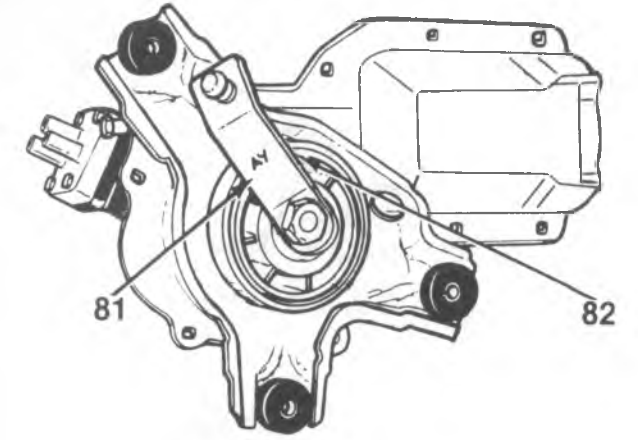


Figure 44—Crank Arm Position—CK Models



81. Identification Code
82. Crank Arm Park Position
G Van Models

F-00759

Figure 45—Crank Arm Position—G Van Model

WINDSHIELD WIPER DELAY CIRCUIT

DESCRIPTION

The wiper pulse control circuit is an option on CK and G models. This option allows the wiper to operate at a slower rate than the low speed setting on the standard control.

The optional module is inserted into the harness under the steering column. Refer to figure 46.

ON-VEHICLE SERVICE

REPLACEMENT OF THE MODULE

←→ Remove or Disconnect (Figure 46)

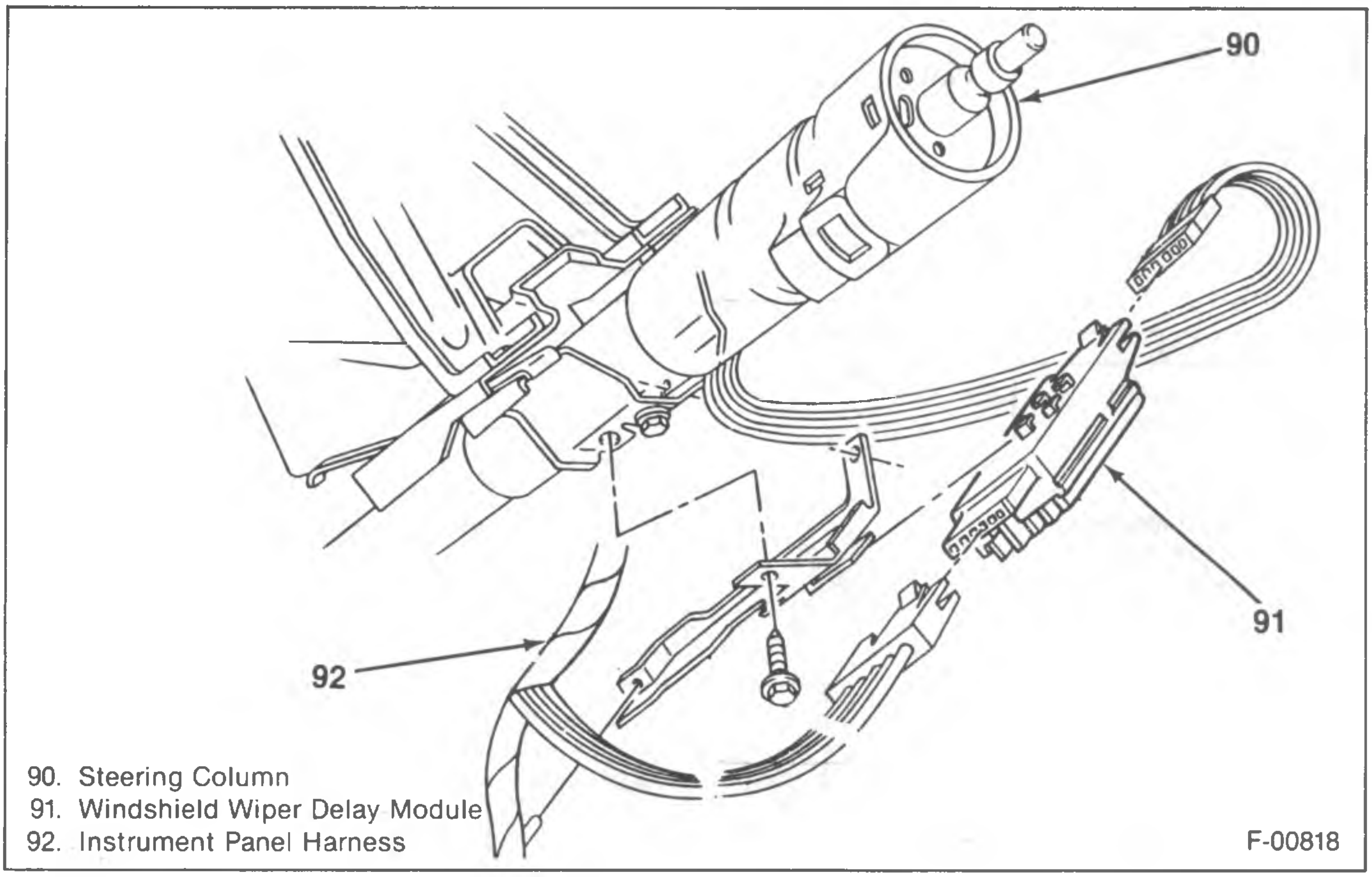
1. Harness connectors.
2. Module (91) by sliding it off the bracket.

→← Install or Connect

1. Module (91).
2. Harness connectors.

REPLACEMENT OF THE SWITCH.

Refer to STEERING COLUMN (SEC. 3B5).



90. Steering Column
91. Windshield Wiper Delay Module
92. Instrument Panel Harness

Figure 46—Windshield Wiper Pulse Module

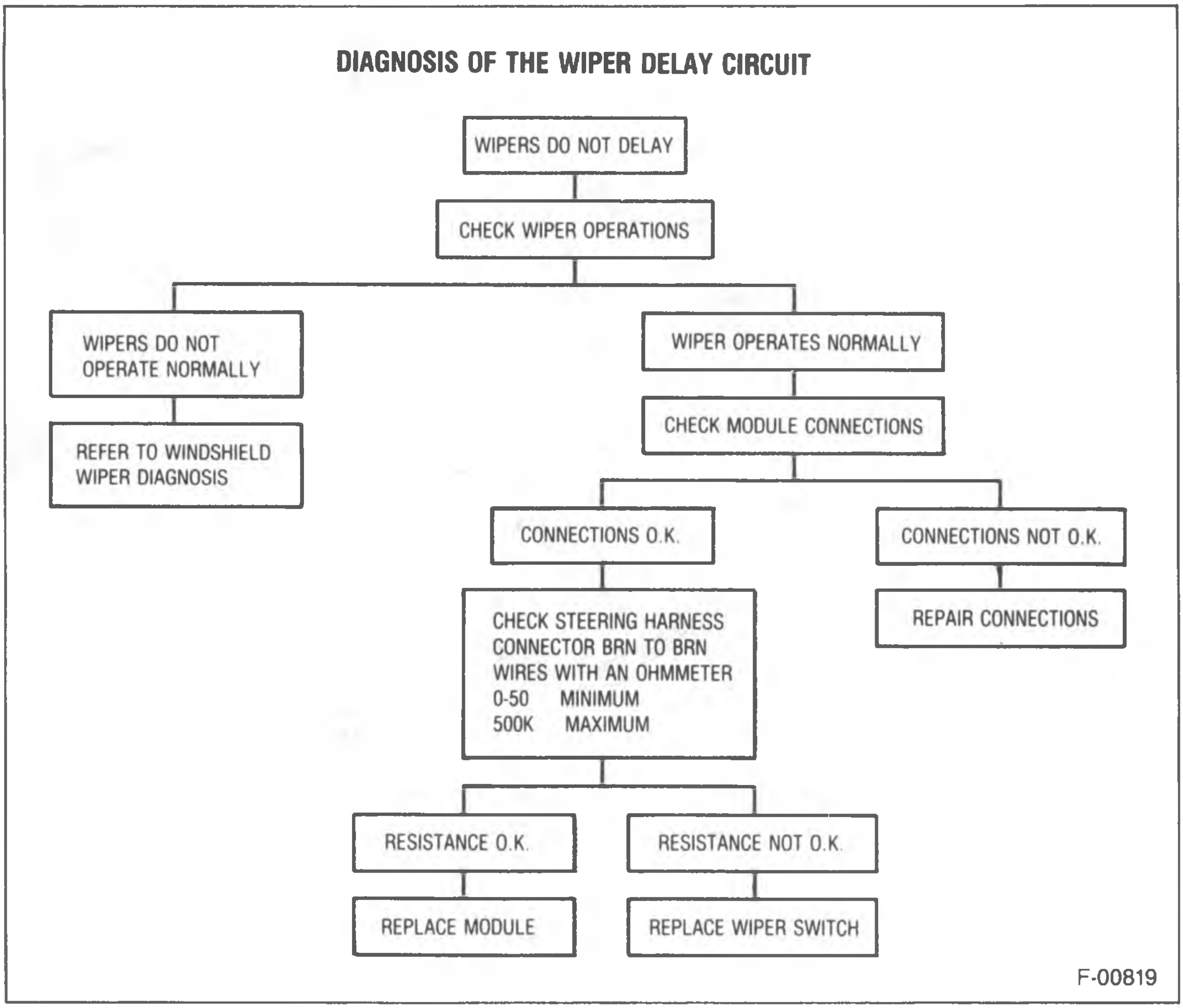
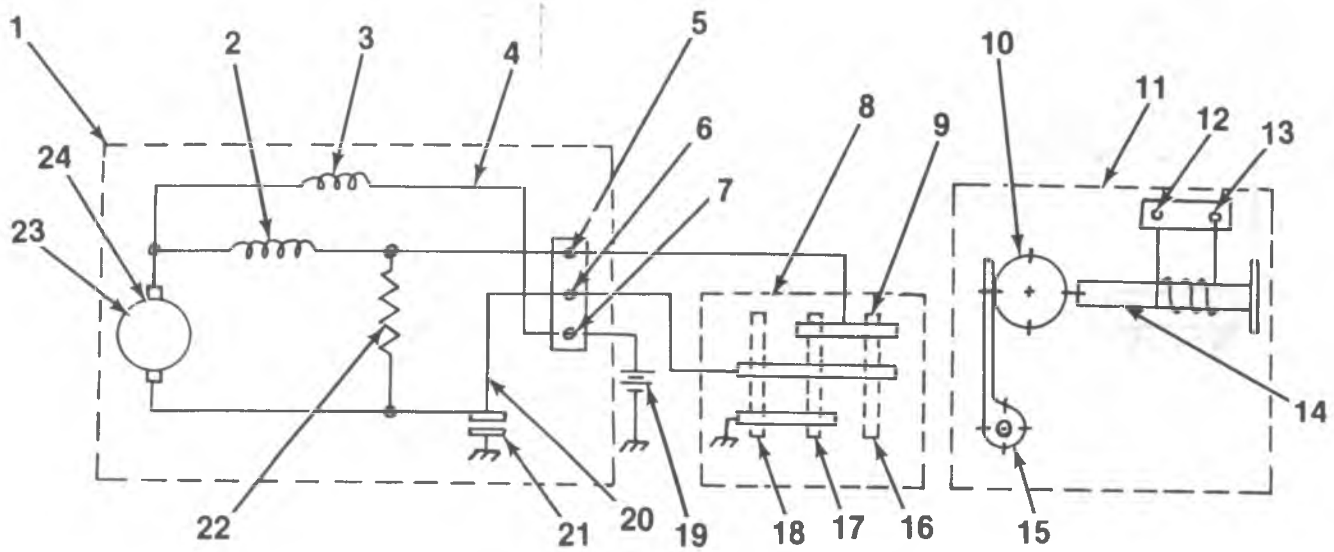


Figure 47—Diagnosis Of The Wiper Delay Module

WINDSHIELD WIPER AND WASHER P MODELS



1. Motor
2. Shunt Resistor
3. Series Resistor
4. GRA Wire
5. Terminal No. 3
6. Terminal No. 1
7. Terminal No. 2
8. Instrument Panel Switch
9. Moving Contact
10. Rachet
11. Washer
12. Terminal #1
13. Terminal #2
14. Solenoid
15. Pawl
16. OFF Position
17. LOW Position
18. HIGH Position
19. Power
20. RED Wire
21. PARK Switch
22. Resistor
23. Armature
24. Brush

F-00814

Figure 48—P-Model Wiper Diagram

DESCRIPTION

The system consists of a compound wound rectangular-shaped motor attached to a gear box containing a parking switch in addition to the gear train. The gear train consists of a motor armature helical gearshaft which drives an intermediate gear and pinion assembly. The pinion gear of the intermediate gear and pinion drives an output gear and shaft assembly.

Turning the wiper switch to the LO speed position completes the circuits from the wiper terminals 1 and 3 to ground (Figure 48). Current then flows from the battery via wiper terminal No. 2 through the series field and divides; (1) part passes through the armature to ground via wiper terminal No. 1 to the wiper switch and (2) the second part passes through the shunt field to ground through wiper terminal No. 3 to the wiper switch. The wiper switch must be securely grounded to body metal.

Moving the wiper switch to the HI speed position opens the shunt field circuit to ground at the switch. However, the shunt field is connected to a 20 ohm resistor which is connected across wiper terminals 1 and 3. The shunt field current then flows via terminal No. 3 through the resistor to terminal No. 1 to the switch, to ground.

The parking circuit covers that portion of wiper operation when the wiper switch is turned "off" and the wiper blades have not reached the park position.

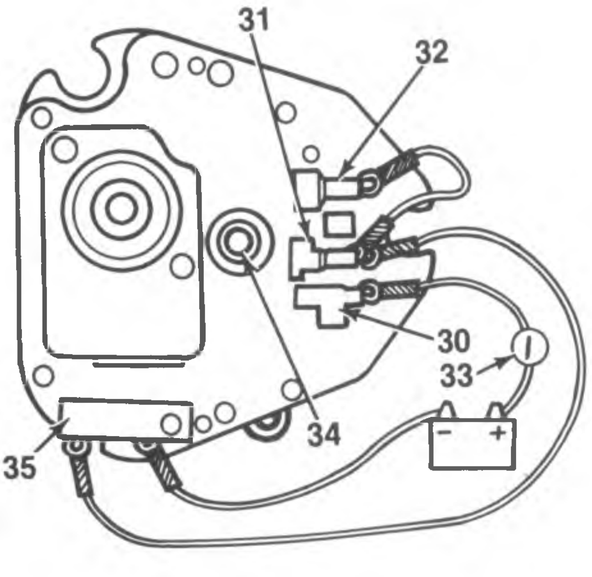
When the wiper blades are not in the normal park position, the parking switch contacts are still closed. The wiper will continue to operate until the wiper output gear is turned to a position where its cam opens the park switch. The wiper motor circuits are completed to ground through the parking switch.

The wiper motor must be securely grounded to body metal.

The shunt field circuit is completed from terminal No. 3 via the switch to terminal No. 1 through the parking switch to ground. The series field and armature circuit is also completed from terminal No. 1 through the parking switch to ground.

The shunt field is connected direct to ground, by-passing the resistor. This results in LO speed operation during the parking operation.

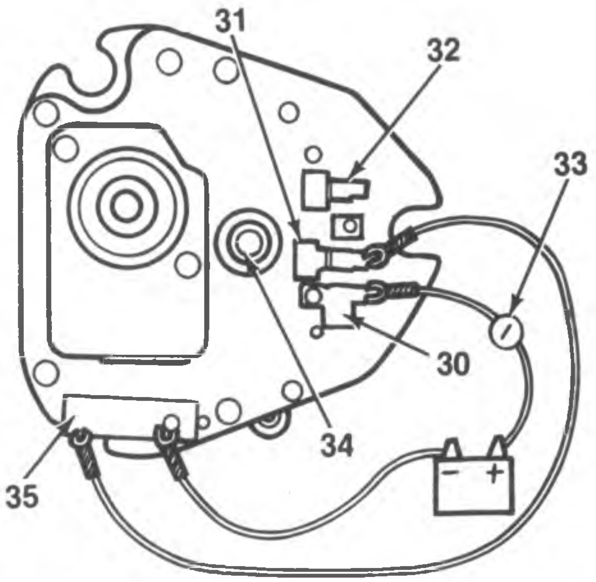
When the output gear cam opens the park switch contacts, the wiper is OFF.



30. Terminal No. 2
31. Terminal No. 1
32. Terminal No. 3
33. Ammeter; 0-30 Ampere Range
34. Gear Shaft In The Park Position
35. Wiper Ground Strap

F-00808

Figure 49—Wiper Motor Jumper Connections—Low Speed



30. Terminal No. 2
31. Terminal No. 1
32. Terminal No. 3
33. Ammeter; 0-30 Ampere Range
34. Gear Shaft In The Park Position
35. Wiper Ground Strap

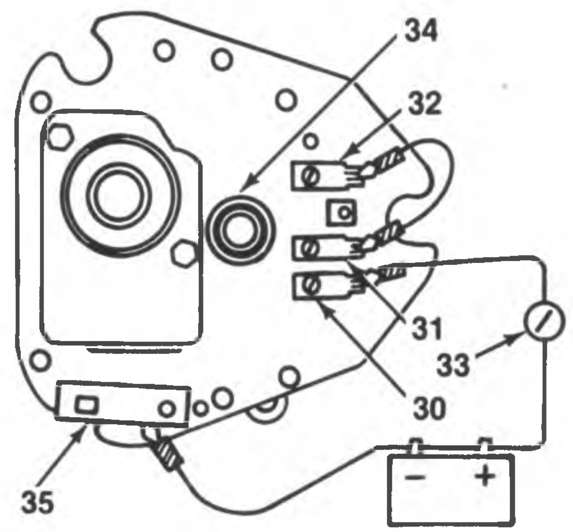
F-00809

Figure 50—Wiper Motor Jumper Connections—High Speed

DIAGNOSIS

WIPER SYSTEM CHECKS

1. Inspect for the following items:
   a. Wiring harness is securely connected to wiper and switch.
   b. Wiper motor is securely grounded to body.
   c. Wiper switch is securely mounted and grounded.
   d. Check fuse.
2. If items in Step 1 check out, try operating wiper in both "LO" and "HI" speeds, then turn wiper off (blades should return to park position). If wiper fails to operate correctly, proceed to Step 3.
3. Disconnect wiring harness from wiper and try operating wiper as shown in Figures 49, 50, and 51.
4. If wiper operates correctly independently of switch and vehicle wiring, refer to DIAGNOSIS CHART—WIPER ON VEHICLE.
5. If wiper still fails to operate correctly in Step 3, disconnect wiper linkage from motor crank arm and try operating wiper again. If wiper operates correctly independently of linkage, check linkage for cause of wiper malfunction.
6. If wiper fails to operate correctly independently of linkage, remove wiper motor from vehicle and refer to DIAGNOSIS CHART—WIPER OFF VEHICLE.



30. Terminal No. 2
31. Terminal No. 1
32. Terminal No. 3
33. Ammeter; 0-30 Ampere Range
34. Gear Shaft In The Park Position
35. Wiper Ground Strap

F-00810

Figure 51—Wiper Motor Jumper Connections—Off

DIAGNOSIS OF THE WIPER—ON VEHICLE

PROBLEM	POSSIBLE CAUSE	CORRECTION
Wiper Not Working Or Intermittent	1. Blown fuse 2. Open circuit in feed wire (No. 2 terminal on wiper motor) 3. Loose mounting of wiper switch. 4. Faulty wiper switch. 5. Open circuit in wire to wiper switch (No. 1 terminal on wiper motor)	1. Locate short circuit and repair. Replace fuse. 2. Locate broken wire and repair. 3. Tighten switch mounting. 4. Replace switch. 5. Locate broken wire and repair.
Wiper Will Not Shut Off. Wiper has Both "Lo" And "Hi" Speeds	1. Grounded wire (No. 1 terminal on wiper motor) to wiper switch.	1. Locate short circuit and repair.
Wiper Will Not Shut Off. Wiper Has "Lo" Speed Only.	1. Defective wiper switch. 2. Grounded wire (No. 3 terminal on wiper motor) to wiper switch.	1. Replace wiper switch. 2. Locate and repair short circuit.

DIAGNOSIS OF THE WIPER—ON VEHICLE (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Wiper Will Not Shut Off. Wiper has "Hi" Speed Only	1. Defective wiper switch. 2. Open circuit in wire (No. 3 terminal on wiper motor) to wiper switch.	1. Replace wiper switch. 2. Locate and repair broken wire.
Wiper Has "Hi" Speed Only	Open circuit in wire (No. 3 terminal on wiper motor) to wiper switch.	Locate broken wire and repair.
Wiper Has "Lo" Speed Only	1. Grounded wire (No. 3 terminal on wiper motor) to wiper switch. 2. Defective wiper switch.	1. Locate short circuit and repair. 2. Replace wiper switch.
Blades Do Not Return To Full Park Position	Loose wiper ground strap connection.	Tighten strap connection.

DIAGNOSIS OF THE WIPER—OFF VEHICLE

PROBLEM	POSSIBLE CAUSE	CORRECTION
Wiper Not Working or Intermittent	1. Broken or damaged gear train (only if not working). 2. Poor solder connections at terminal board. 3. Loose splice joints at brush plate. 4. Brushes binding in brush holder. 5. Open circuit in armature.	1. Replace gears as required. 2. Resolder wires at terminals. 3. Recrimp or solder splice joints. 4. Clean holder or replace brush, spring or brush plate assembly. 5. Replace armature.
Wiper Will Not Shut-Off. Wiper Has Normal "Hi" and "Lo" Speed	1. Faulty part switch. 2. Grounded red lead wire.	1. Replace terminal board assembly. 2. Repair short circuit in red wire.
Wiper Will Not Shut Off. Wiper Has "Lo" Speed Only	1. Grounded shunt field coil. 2. Grounded black wire.	1. Replace frame and field assembly. 2. Repair short circuit in black wire.
Wiper Will Not Shut Off. Wiper Has "Hi" Speed Only	1. Open circuit in shunt field coil. 2. Open circuit in black wire.	1. Replace frame and field assembly. 2. Repair broken wire or poor solder connection.
Wiper Shuts Off—But Not In Park Position	Park switch faulty or contacts dirty.	Replace terminal board assembly or clean contacts.
"Hi" Speed Too Fast	Resistor faulty.	Replace terminal board assembly.

DIAGNOSIS OF THE WASHER SYSTEM

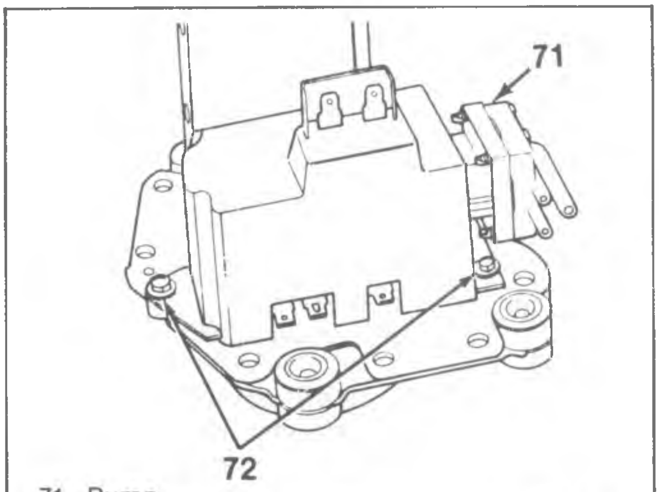
PROBLEM	POSSIBLE CAUSE	CORRECTION
Washers Inoperative	1 Inadequate quantity of washer solution.	1. Add washer solution.
	2. Hoses damaged or loose.	2. Cut short length off end of hose to insure air tight connection or replace hose.
	3. Plugged screen at end of jar cover hose.	3. Clean screen.
	4. Loose electrical connection to washer pump or wiper switch.	4. Check electrical connections and repair if necessary.
	5. Open circuit in feed wire to ratchet relay coil.	5. Locate open circuit and repair.
	6. Wiper switch faulty.	6. Replace wiper switch.
	7. Ratchet relay coil defective.	7. Replace ratchet relay.
	8. Washer nozzles plugged.	8. Clean washer nozzles.
	9. Ratchet wheel tooth missing.	9. Replace ratchet wheel.
	10. Ratchet pawl spring missing.	10. Replace ratchet pawl spring.
	11. Faulty pump valve assembly.	11. Replace pump valve assembly.
Washer Pumps Continuously When Wipers Are Operating	1. Grounded wire from ratchet relay to switch.	1. Locate grounded wire and repair.
	2. Wiper switch faulty.	2. Replace wiper switch.
	3. Ratchet wheel tooth missing.	3. Replace ratchet wheel.
	4. Ratchet wheel dog broken or not contacting ratchet wheel teeth.	4. Replace of repair ratchet wheel dog.
	5. Lock-out tang broken or bent on piston actuating plate.	5. Replace piston actuating plate.

ON-VEHICLE SERVICE

WIPER MOTOR

Wiper motor replacement procedures are not included here since installation is performed by the individual body manufacturers; however, disassembly of the unit will be covered in "Unit Repair."

UNIT REPAIR



71. Pump
72. Pump Mounting Screws

F-00832

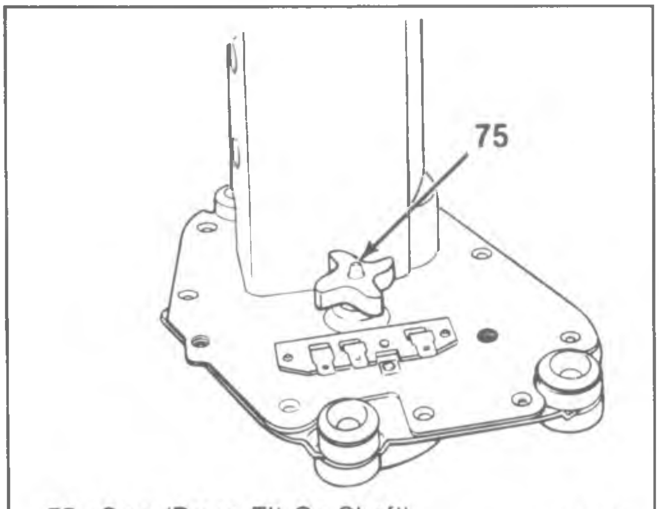
Figure 52—Washer Pump Mounting Screws

WIPER MOTOR DISASSEMBLY

GEAR BOX AND MOTOR

↔ Remove or Disconnect (Figure 52, 53, and 54)

1. Two washer pump mounting screws (72).
2. Pump (71) from the gear box cover.
3. Washer pump drive cam (75).
    - Wedge off the cam and the plate using two screwdrivers.
4. Crank arm retaining nut (58).
    - Clamp the crank arm (57) in a vise before removing the nut (58).
5. Crank arm (57).
6. Seal cap (56).
7. Retaining ring (55).
8. Spacer (54).
9. Gear box cover retaining rivets.
    - Drill out the rivets.
10. Gear box cover (53).
11. Output gear and shaft assembly (52).
12. Intermediate gear and pinion assembly off the shaft (51).
13. Terminal board and park switch assembly, if necessary.
    - Unsolder the motor leads from the terminals.
    - Label the motor leads.
    - Drill out the rivets securing the terminal board and the park switch ground strap to the mounting plate.
14. Motor through bolts (42).
15. Motor from the mounting plate.
    - Tap motor frame lightly.
16. Brush spring tension (61).
17. Armature (46) and end plate (43) from the motor frame (44).
18. End plate (43) from the armature (46).
    - There is a thrust plug (45) between the armature shaft and the end plate.
19. End play adjusting washers (47 and 41) from the armature.
    - Note the washers positions.



75. Cam (Press Fit On Shaft)

F-00833

Figure 53—Washer Pump Drive Cam

INSPECTION

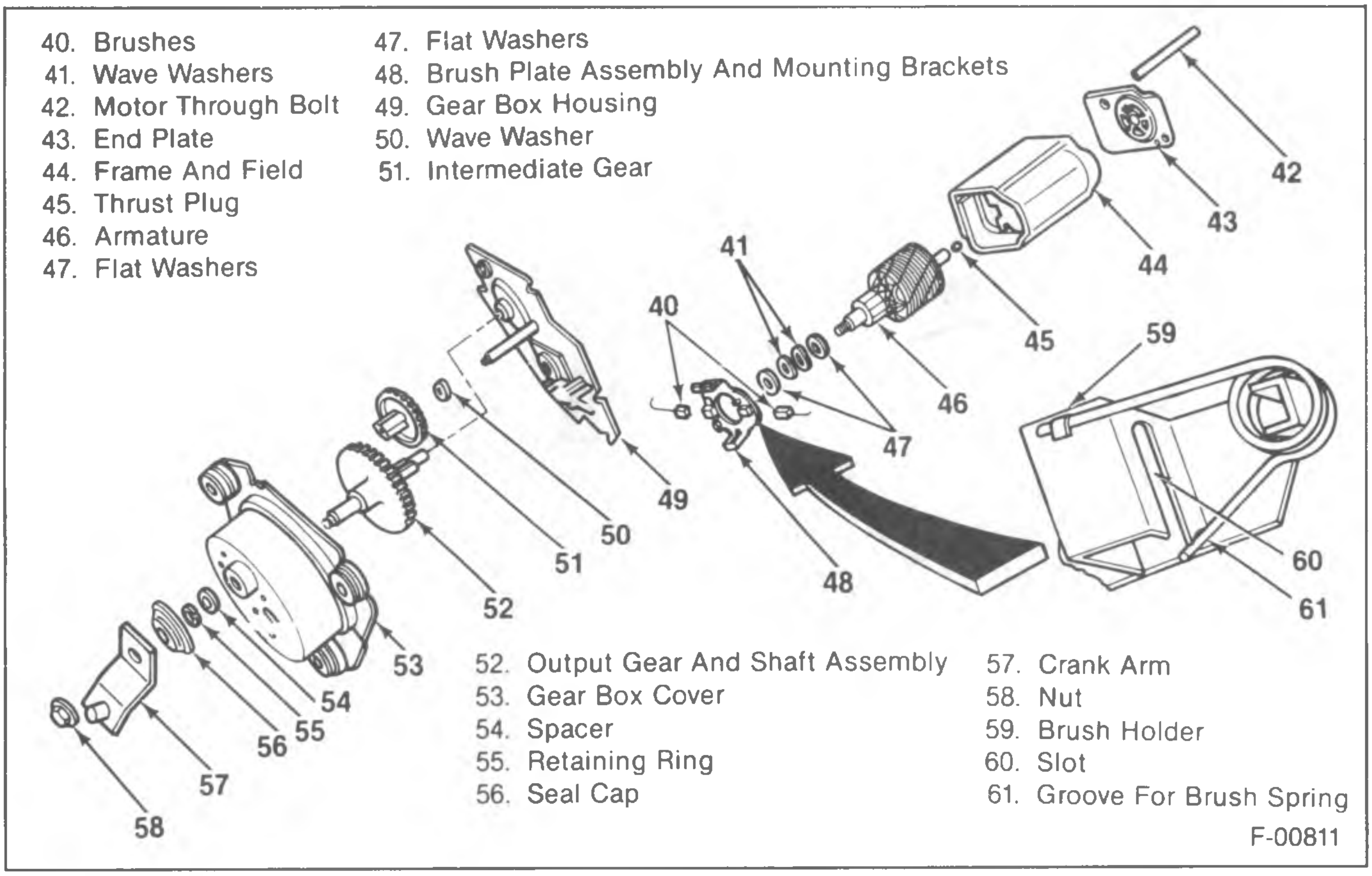
Inspect all the parts for wear or damage. All the parts can be replaced individually except the motor frame and field, which is serviced as an assembly. Service kits provide screws, nuts and washers to replace the gear cover and terminal board rivets.

WIPER MOTOR ASSEMBLY

GEAR BOX AND MOTOR

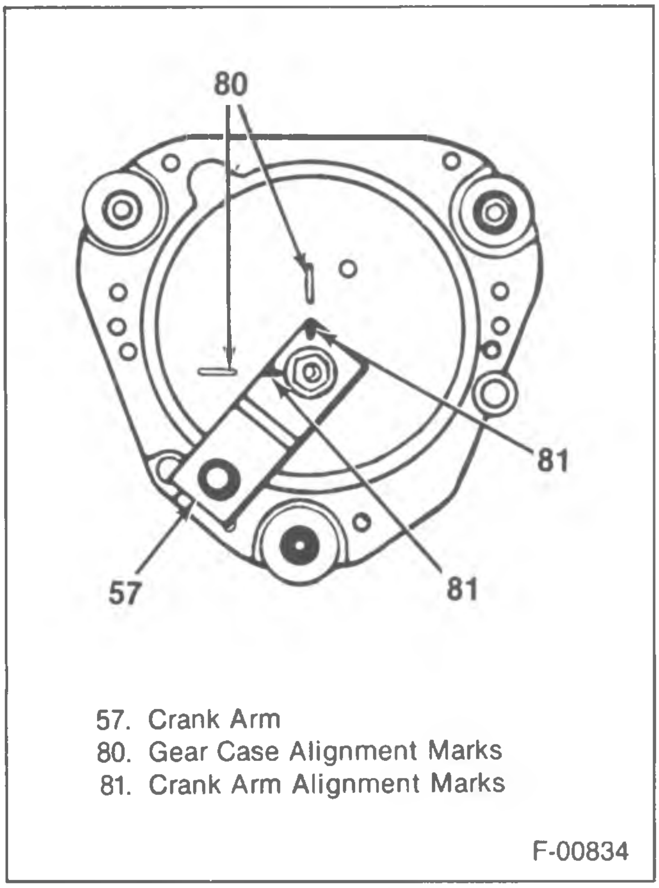
→← Install or Connect (Figure 52, 53, 54, and 55)

1. End play adjusting washers (41 and 47) on the armature (46).
2. End plate (43) on the armature (46).
    - Make sure the thrust plug (45) is between the armature shaft and the endplate.
    - Lubricate the bearing with light machine oil.
3. Armature and the end plate assembly on the motor frame (44).
4. Brush spring tension (60).



40. Brushes
41. Wave Washers
42. Motor Through Bolt
43. End Plate
44. Frame And Field
45. Thrust Plug
46. Armature
47. Flat Washers
47. Flat Washers
48. Brush Plate Assembly And Mounting Brackets
49. Gear Box Housing
50. Wave Washer
51. Intermediate Gear
52. Output Gear And Shaft Assembly
53. Gear Box Cover
54. Spacer
55. Retaining Ring
56. Seal Cap
57. Crank Arm
58. Nut
59. Brush Holder
60. Slot
61. Groove For Brush Spring

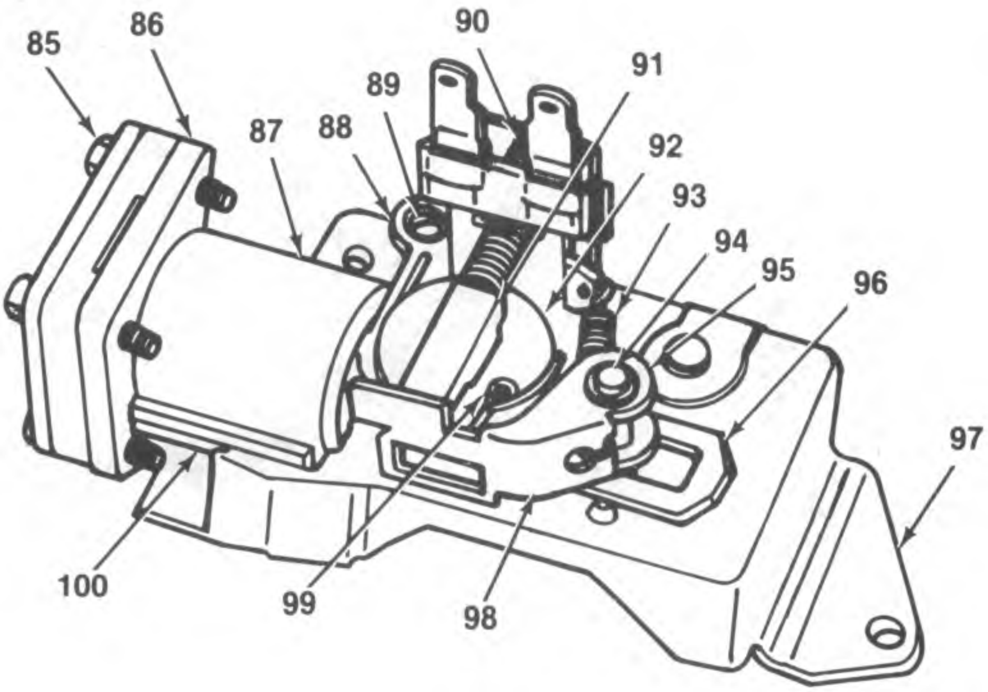
Figure 54—Wiper Motor And Gear Box Assembly



57. Crank Arm
80. Gear Case Alignment Marks
81. Crank Arm Alignment Marks

Figure 55—Crank Arm Park Alignment

5. Motor to the mounting plate (49).
6. Motor through bolts (42).
7. Terminal board and park switch assembly, if removed.
   - Secure the terminal board and park switch with the screws, washers and nuts supplied in the rebuild kits.
   - Solder the motor leads to the terminals.
8. Intermediate gear and pinion assembly on the shaft (51).
   - Lubricate the gear teeth with Delco Cam and Ball Bearing Grease (or equivalent).
9. Output gear and shaft assembly (52).
10. Gear box cover (53).
11. Gear box cover screw, washers, and nuts.
12. Spacer (54).
13. Retaining ring (55).
14. Seal cap (56).
15. Crank arm (57).
    - Place the wiper in the park position.
    - Install the crank arm on the output shaft.
    - Rotate the crank so that the alignment marks line up with those on the cover (80 and 81).
16. Crank arm retaining nut (58).
    - Clamp the crank arm in a vise before tightening the retaining nut.
17. Washer pump drive cam (75).
    - Press the cam on the shaft.



85. Valve Assembly Mounting Screw
86. Valve Assembly
87. Pump
88. Rachet Dog
89. Rachet Dog Retaining Screw
90. Solenoid Coil
91. Solenoid Plunger
92. Rachet Wheel
93. Rachet Pawl Spring
94. Cam Follower Upper Pin
95. "E" Ring
96. Cam Follower
97. Frame
98. Rachet Pawl
99. Rachet Wheel Spring
100. Retaining Groove

F-00835

Figure 56—Washer Pump Assembly

18. Pump on the gear box cover.
19. Two pump mounting screws (72).

WINDSHIELD WASHER DISASSEMBLY

Remove or Disconnect (Figure 56)

1. Washer pump cover
2. Ratchet dog retaining screw (89).
3. Solenoid assembly (90) and ratchet dog (88) off the pump frame (97).
   - Hold the spring loaded solenoid plunger (91) in position while lifting the solenoid assembly.
4. Ratchet pawl spring (93).
5. Ratchet pawl retaining ring (94).
6. Ratchet pawl (98) from the cam follower Upper Pin.
7. Ratchet wheel spring (99) out of the shaft groove.
8. Ratchet wheel (92) from the shaft.
9. Pump and actuator plate assembly.
   - Pull the pump housing away from the drive cam until the housing grooves (100) clear the frame.
   - Lift the cam follower (96) from the ratchet wheel and cam follower shafts.
10. Four valve assembly screws (85).
11. Valve assembly (86) from the pump housing.

WINDSHIELD WASHER ASSEMBLY

→← Install or Connect (Figure 56)

1. Valve assembly (86). To the pump housing (87).
   - Be sure that the seal between the pump housing and the valve plate is properly positioned in the pump housing and valve plate grooves.
   - Be sure that the triple seal is properly installed between the valve body and the pipe assembly.
2. Four valve assembly screws (85).
3. Pump (87) and cam follower (96) assembly to the frame (97).
4. Ratchet wheel (92) to the shaft.
5. Ratchet wheel spring (99) into the shaft groove.
6. Ratchet pawl (98) onto the cam follower upper pin (94).
7. Ratchet pawl retaining "E" ring (95).
8. Ratchet pawl spring (93).
9. Solenoid assembly (90) and ratchet dog (88) on the pump frame (97).
   - Hold the spring loaded solenoid plunger (91) in position while installing the solenoid assembly.
10. Ratchet dog retaining screw (89).
11. Washer pump cover.

HEATER SYSTEM CIRCUITS

DESCRIPTION

The heater blower motor is controlled by the blower switch. The blower switch is a four position switch; off, low, medium, and high. This switch controls the speed of the blower motor by connecting different resistances into the motor circuit, thereby dropping the voltage available to the motor.

The blower switch is located on the control assembly. The harness from the switch goes to the dash panel connector and into the engine compartment. The harness is then routed to the resistor block, which is located on the blower housing. From the resistor block, the harness then goes to the blower motor. The wire colors can be found in the wiring diagrams which are at the back of this manual.

DIAGNOSIS

For diagnosis of the heater blower circuit, refer to HEATER (SEC. 1A).

ON-VEHICLE SERVICE

For on-vehicle service of the heater blower circuit, refer to HEATER (SEC. 1A).

AIR CONDITIONING ELECTRICAL SYSTEM

DESCRIPTION

The compressor electro-magnetic clutch is turned on and off by the pressure sensing switch. When refrigerant pressure drops below a certain predetermined level, the switch opens the compressor clutch circuit, which causes the refrigeration system to stop working. The pressure sensing switch is located near the top of the accumulator.

DIAGNOSIS

For diagnosis of the A/C electrical system, refer to AIR CONDITIONING (SEC. 1B).

ON-VEHICLE SERVICE

For on-vehicle service of the air conditioning, refer to AIR CONDITIONING (SEC. 1B).

SPECIAL TOOLS

J-22727	Terminal Remover
J-28742	Terminal Remover

SECTION 8B

CHASSIS ELECTRICAL

CONTENTS

SUBJECT **PAGE**

FRONT LIGHTING SYSTEMS

The front lighting system includes the headlamps, the front parking lamps, and the front side marker lamps. The circuit starts at the fuse block and goes to the light switch in the instrument panel. From the light switch the circuit goes to the dash panel connector and then to the front lamps.

HEADLAMP SYSTEM

The headlamp system has two options. One option is two headlamps, each headlamp having a parking lamp located under it. The other option is four headlamps, with the parking lamps located in the grill. On the four headlamp option, when the low beam circuit is energized, only the upper headlamps will be on. When the high beam circuit is energized, only the lower headlamps will be on. Refer to figures 1, 2, 3, and 4.

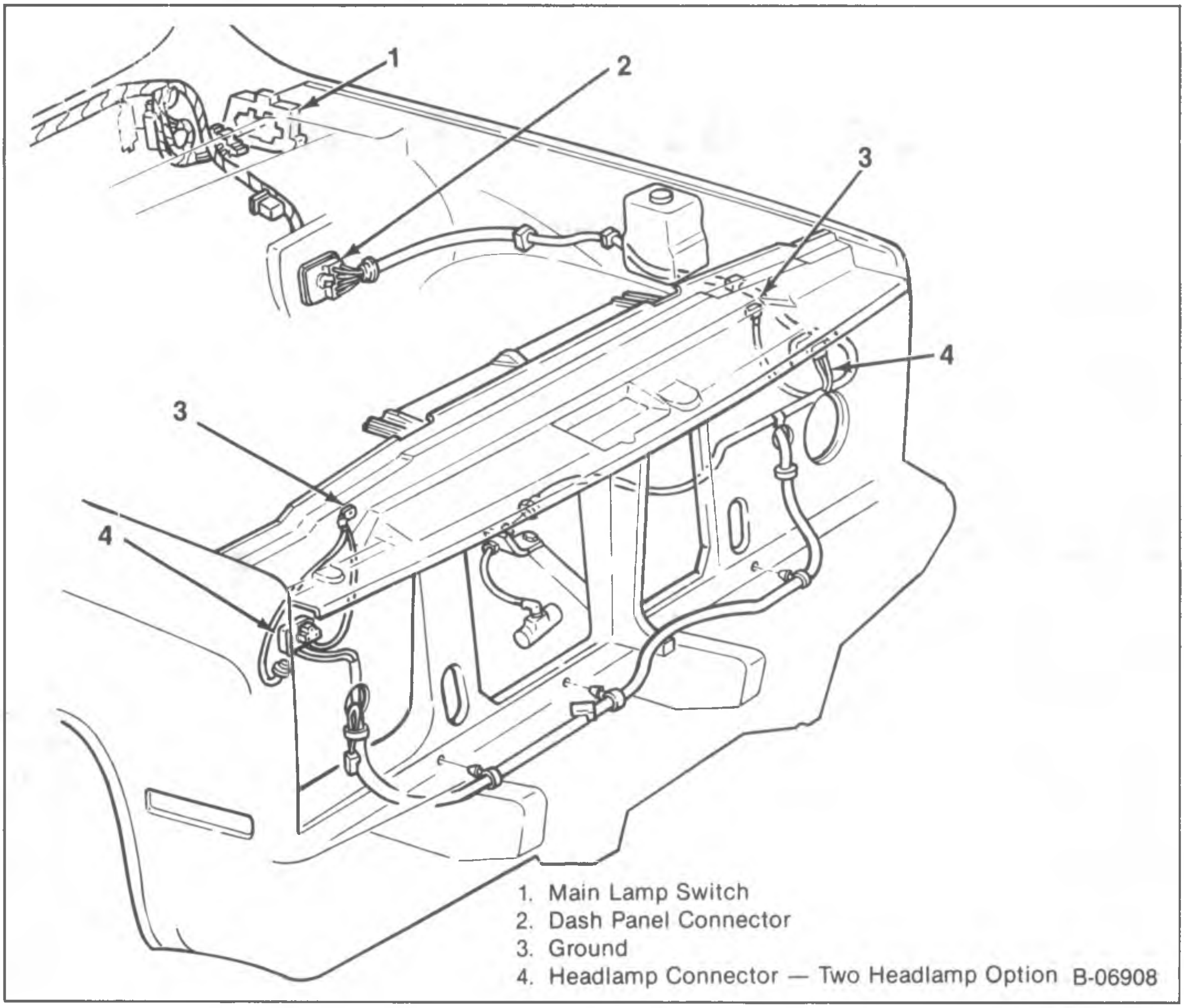
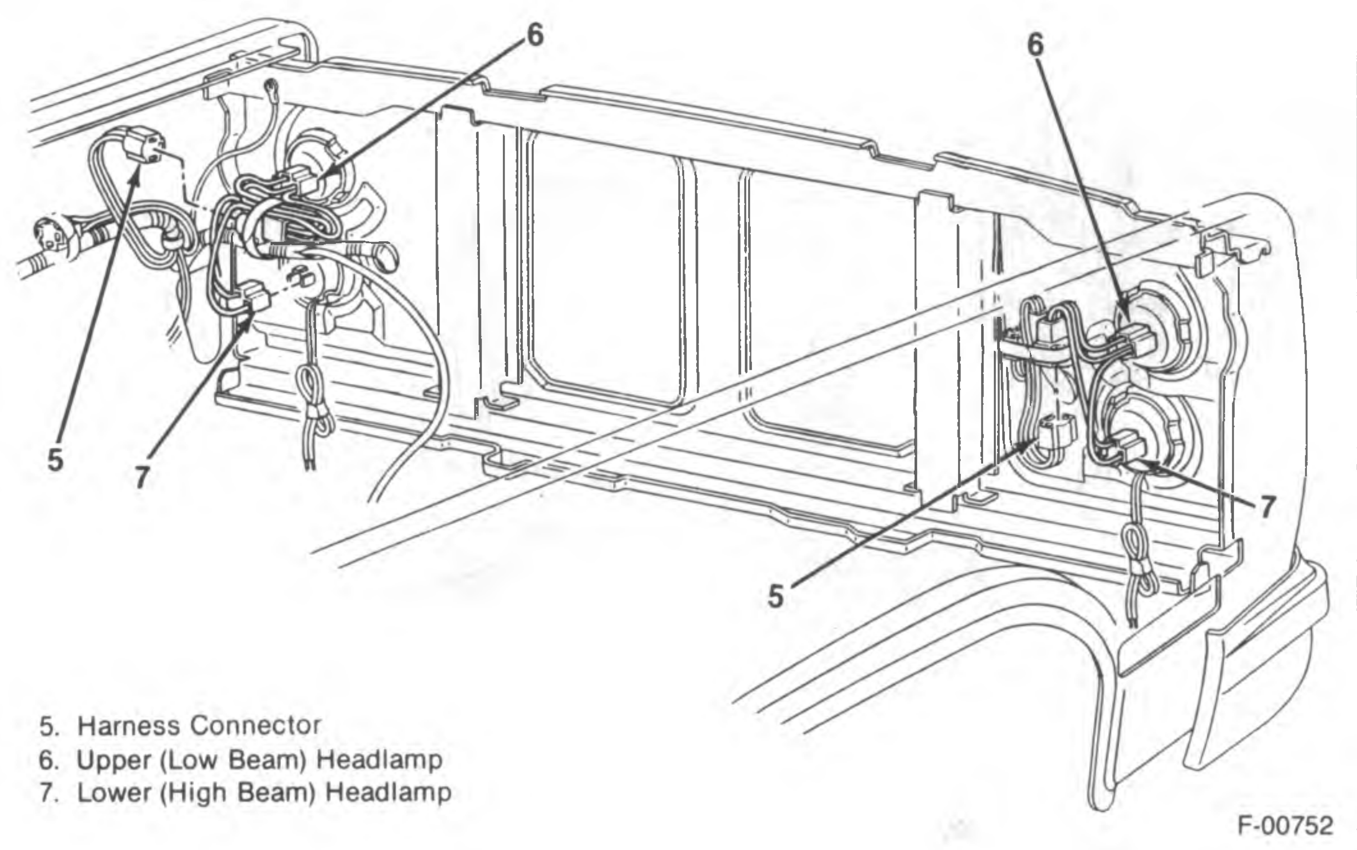
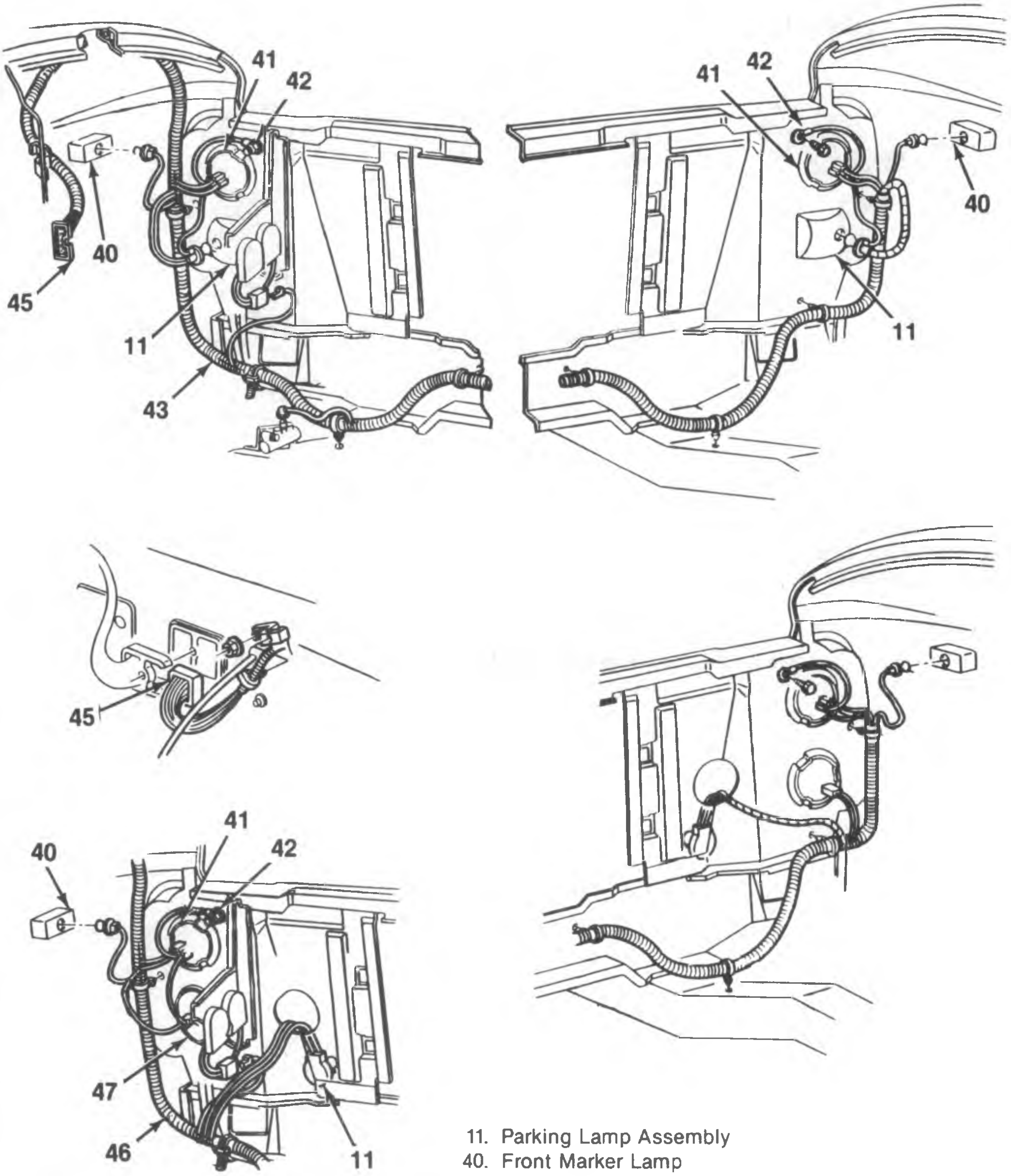


Figure 1—Headlamp Harness—Two Headlamp Option—CK



5. Harness Connector
6. Upper (Low Beam) Headlamp
7. Lower (High Beam) Headlamp

Figure 2—Headlamp Harness—Four Headlamp Option—CK



11. Parking Lamp Assembly
40. Front Marker Lamp
41. Headlamp
42. Ground
43. Two Headlamp Harness
45. Dash Panel Connector
46. Four Headlamp Harness
47. Lower Headlamp

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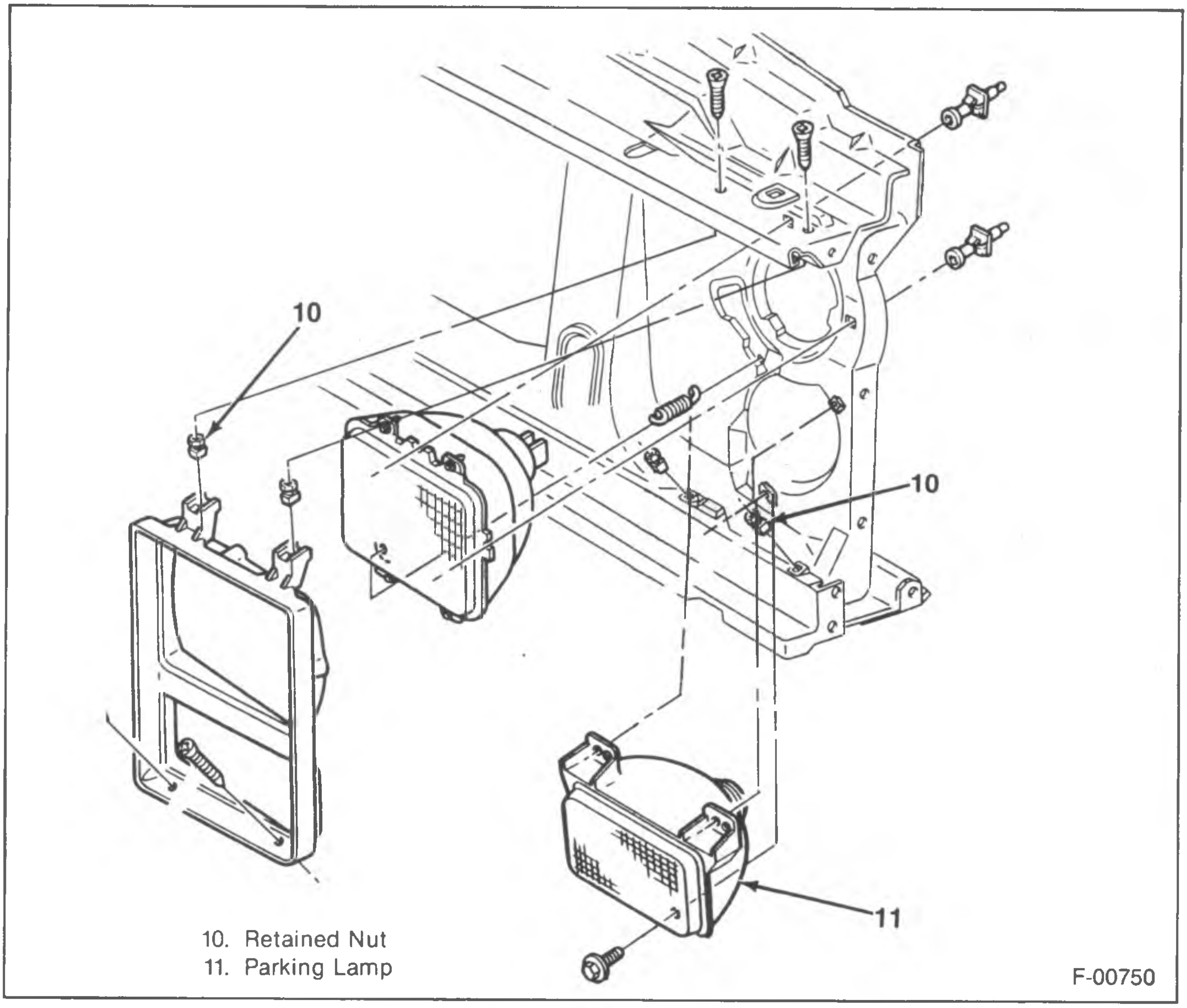
Figure 3—Front Lighting Harness—G Van



10. Retained Nut
11. Parking Lamp

Figure 4—Two Unit Headlamp Assembly—CKG

DIAGNOSIS OF HEADLAMP

PROBLEM	POSSIBLE CAUSE	CORRECTION
One Headlamp Inoperative Or Intermittent.	1. Loose connection.	1. Secure the connections to the headlamp including the ground (black wire).
	2. Defective sealed beam unit.	2. Replace the headlamp.
One Or More Headlamps Are Dim.	1. Open ground connection at the headlamp.	1. Repair the black wire connection between headlamp and the body ground.
	2. Black ground wire mislocated in the headlamp connector (three-wire, hi-lo, connector only).	2. Relocate the black wire in the connector.
One Or More Headlamps Short Life.	Charge circuit problem.	Refer to ENGINE ELECTRICAL (SEC. 6D), charging system diagnosis.
All Headlamps Inoperative Or Intermittent.	1. Loosen connection.	1. Check and secure the connections at the dimmer switch and the lamp switch.
	2. Defective dimmer switch.	2. Check the voltage at the dimmer switch with a test lamp. Refer to CAB ELECTRICAL (SEC. 8A) for the test points.
	3. Open wiring—lamp switch to the dimmer switch.	3. Check the yellow wire with a test lamp. If the bulb lights at the lamp switch yellow wire terminal but not at the dimmer switch, repair the open wire.
	4. Open wiring—lamp switch to the battery.	4. Check the red wire terminal at the lamp switch with a test lamp. If the bulb does not light, repair the open red wire circuit to the battery (possible open fusible link).
	5. Shorted ground circuit.	5. If, after a few minutes operation, the headlamps flicker "ON" and "OFF" and/or a thumping noise can be heard from the lamp switch (circuit breaker opening and closing), repair the short to ground in the circuit between the lamp switch and the headlamps. After repairing the short, check for headlamp flickering after one minute operation. If flickering occurs, the circuit breaker has been damaged and the lamp switch must be replaced.
	6. Defective switch.	6. Check the red and yellow wire terminals at the lamp switch with the test lamp. If the bulb lights at the red wire terminal but not at the yellow terminal, replace the lamp switch.

DIAGNOSIS OF HEADLAMP (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Upper Or Lower Beam Will Not Light Or Intermittent.	1. Open connection or defective dimmer switch.	1. Check the dimmer switch terminals with a test lamp. If the bulb lights at the light green or tan wire terminals, repair the open wiring between the dimmer switch and the headlamps. If the bulb will not light at either of these terminals, depending upon switch position, replace the dimmer switch.
	2. Short circuit to ground.	2. Follow the diagnosis above (all headlamps inoperative or intermittent).

ON-VEHICLE SERVICE

HEADLAMP UNIT REPLACEMENT

↔ **Remove or Disconnect (Figure 4 and 5)**

1. Battery ground cable from the battery.
2. Headlamp bezel retaining screws.
3. Bezel.
4. Retaining ring screws. Be careful not to move the adjustment screws.
5. Retaining ring spring, using a hooked tool.
6. Retaining ring from the mounting ring.
7. Headlamp unit.
8. Headlamp electrical connector.

→← **Install or Connect (Figure 4 and 5)**

1. Headlamp electrical connector.
    - On the dual headlamp option, the 2A1 headlamp is the upper unit and the 1A1 headlamp is the lower unit.
2. Headlamp.
3. Retaining ring.
4. Retaining ring screws. Make sure that the headlamp is properly seated.
5. Retaining ring spring.
6. Bezel.
7. Bezel retaining screws.
8. Battery ground cable to the battery.

HEADLAMP ADJUSTMENT (Figure 6)

Horizontal and vertical aiming of each headlamp is done by two (2) adjusting screws which move the mounting ring against the tension of the coil spring.

Some state and local authorities have specific requirements for aiming headlamps and these requirements should be followed.

Replacement of a headlamp will normally not require aiming adjustment. However, do check the aim.

Use the safety aimer J-6878-01 or equivalent. Instructions for using the safety aimer are supplied by the instrument manufacturer.

DIMMER SWITCH REPLACEMENT

Refer to STEERING COLUMNS (SEC. 3B5).

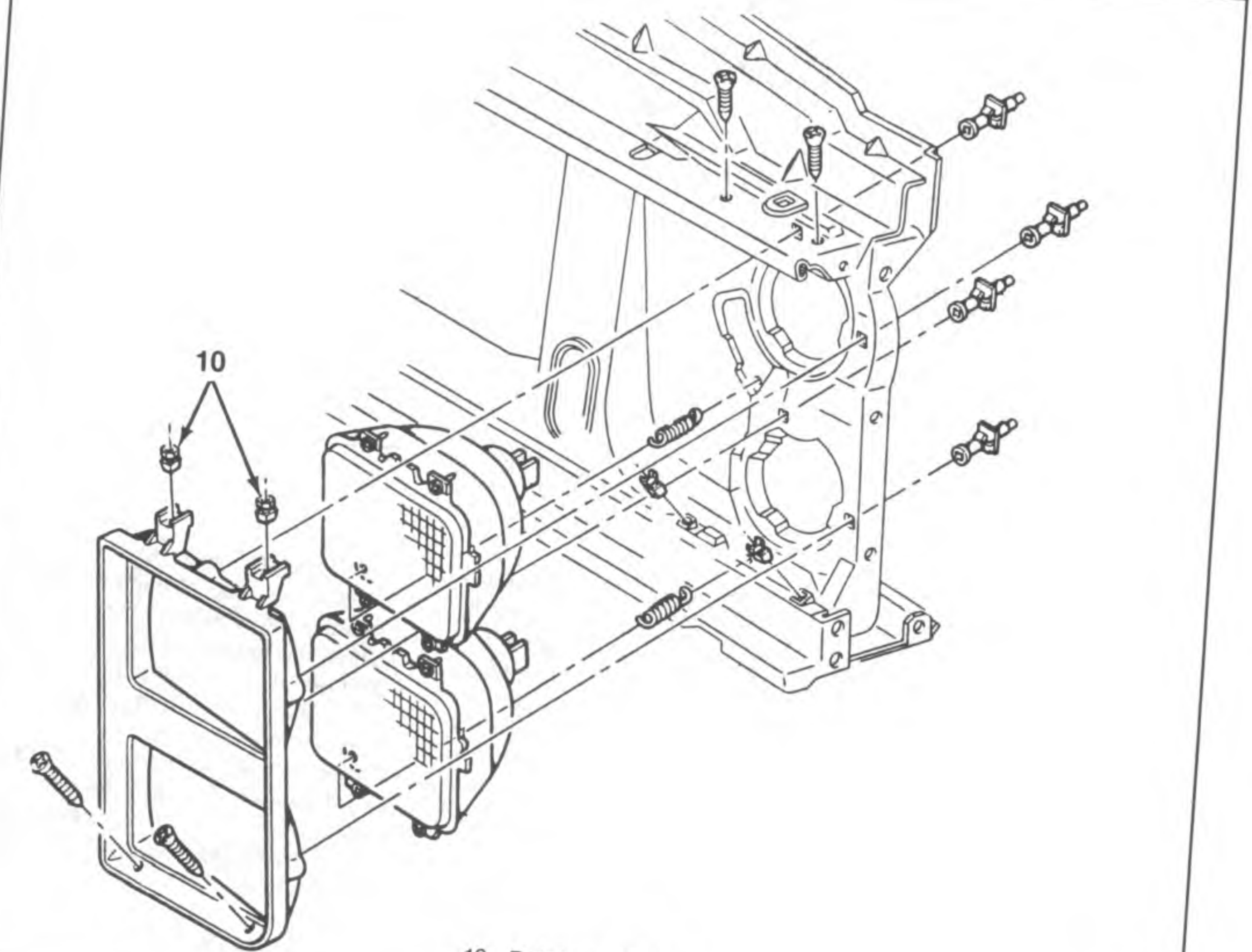
LAMP SWITCH REPLACEMENT

Refer to "Rear Lighting Systems."

FRONT PARKING LAMPS SYSTEM

DESCRIPTION

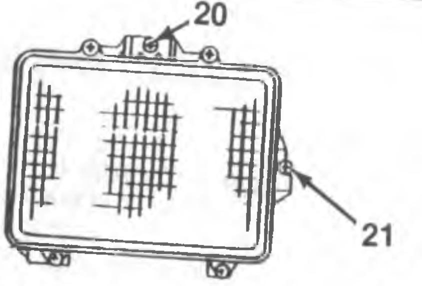
The front parking lamps circuit is in the headlamp harness. The circuit starts from the fuse block, goes to the lamp switch, and then forward to the front parking lamps. The circuit also includes the rear parking lamps, which are covered later in this section. The parking lamp system is turned on when the lamp switch is pulled out to the first detent.



10. Retained Nut

B-00751

Figure 5—Four Unit Headlamp Assembly—CKG



20. Vertical Adjusting Screw
21. Horizontal Adjusting Screw

F-00821

Figure 6—Headlamp Aiming Screw Locations

DIAGNOSIS OF THE FRONT PARKING LAMPS

PROBLEM	POSSIBLE CAUSE	CORRECTION
One Side Not Working.	1. Bulb burnt out. 2. Open connection at the bulb socket or the ground wire terminal.	1. Replace the bulb. 2. Jumper the bulb base socket connection to ground. If the bulb lights, repair the open ground circuit.
Both Sides Not Working.	1. Fuse blown.	1. Replace the fuse. If the new fuse blows, repair the short to ground in the brown wire circuit between the fuse panel through the lamp switch to the lamps.
	2. Loose connection.	2. Secure the connector at the lamp switch.
	3. Open wiring.	3. Using a test lamp, check the circuit on both sides of the fuse. If the test bulb does not lamp on either side, repair the open circuit between the fuse panel and the battery (possible open fusible link). If the test bulb lamps at the lamp switch brown wire terminal, repair the open wiring between the lamp switch and the lamps.
	4. Multiple bulb burnout.	4. If the test bulb lights at the lamp socket brown wire terminal, replace the bulb(s).
	5. Defective lamp switch.	5. If the test bulb lamps at the lamp switch orange wire but not at the brown wire, replace the defective lamp switch.

ON-VEHICLE SERVICE

REPLACEMENT OF THE LAMP SWITCH

Refer to INSTRUMENT PANEL (SEC. 8C).

REPLACEMENT OF THE FRONT PARKING LAMP

CK and G Models—Two Headlamp Option

Remove or Disconnect (Figures 3 and 4)

1. Battery ground cable from the battery.
2. Four bezel retaining screws.
3. Bezel.
4. Three park lamp retaining screws.
5. Parking lamp.
6. Electrical connector from the parking lamp.

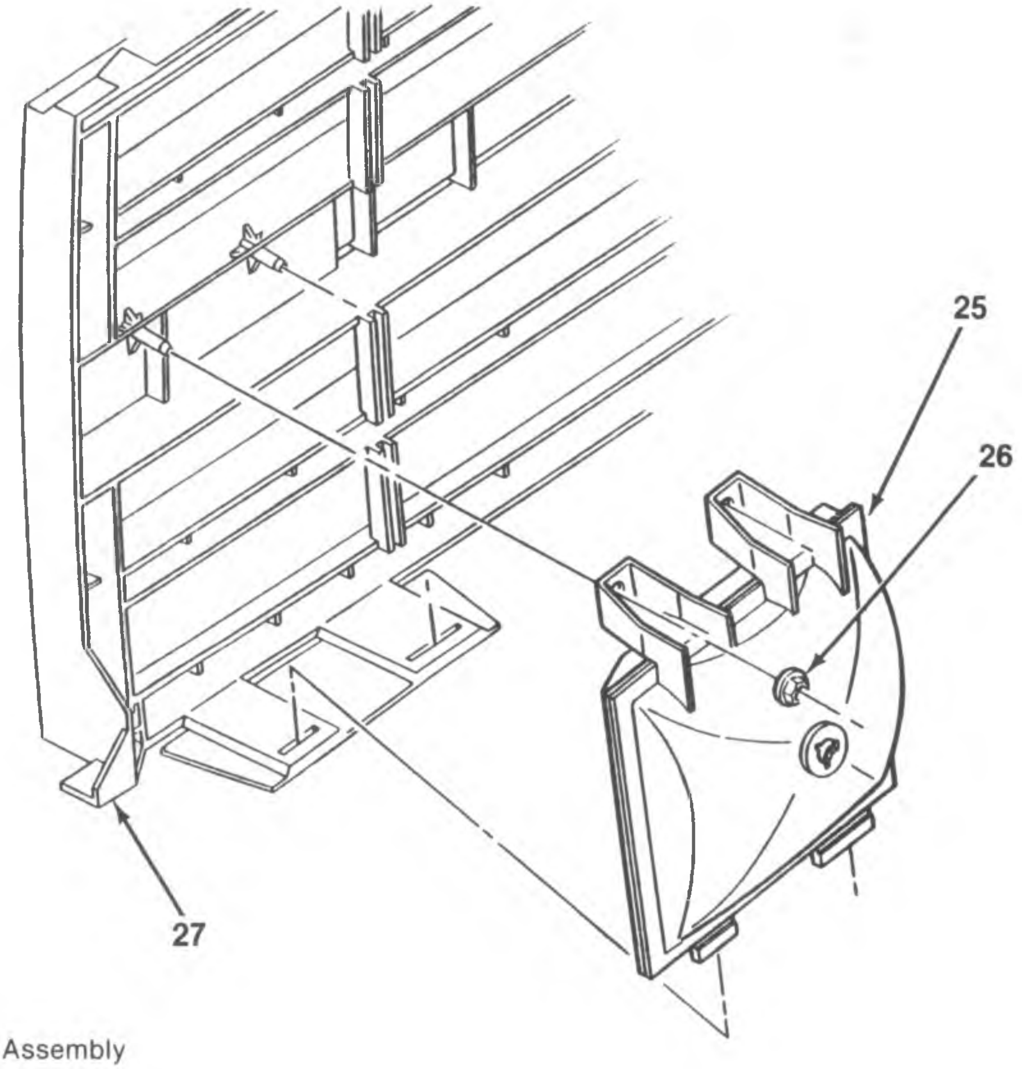
Install or Connect (Figures 3 and 4)

1. Electrical connector to the parking lamp.
2. Parking lamp.
3. Three parking lamp retaining screws.
4. Bezel.
5. Four bezel retaining screws.
6. Battery ground cable to the battery.

CK and G Models—Four Headlamp Option

Remove or Disconnect (Figure 7)

1. Radiator grille (27). Refer to SHEET METAL (SEC. 2C).
2. Electrical connector from the parking lamp.
3. Two nuts (26) at the top of the housing (25).
4. Housing by lifting it up from the radiator grille.



25. Park Lamp Assembly
26. Nut
27. Radiator Grille

Figure 7—Parking Lamp Assembly—CKG Models

Install or Connect (Figure 7)

1. Park lamp housing (25) on the radiator grille (27).
2. Two nuts (26) at the top of the housing (25).
3. Electrical connector into the parking lamp.
4. Radiator grille (27). Refer to SHEET METAL (SEC. 2C).

FRONT SIDE MARKER LAMP SYSTEM

DESCRIPTION

The front side marker lamp circuit is included in the headlamp harness. The circuit starts at the lamp switch. It goes to the dash panel connector and out to the front side marker lamps. The circuit also branches at the lamp switch and goes to the rear side marker lamps. This part of the circuit is covered later in this section.

DIAGNOSIS OF THE FRONT SIDE MARKER LAMPS

PROBLEM	POSSIBLE CAUSE	CORRECTION
One Lamp Won't Work	1. Turn signal bulb burnt out (front lamp).	1. Switch turn signals on. If the signal bulb does not light, replace the bulb. (Bulb filament provides ground path for marker lamp bulb through the dark blue or brown wires.)
	2. Side marker bulb burnt out.	2. Replace the bulb.
	3. Loose connection or open in wiring.	3. Using a test lamp, check the brown wire terminal at the bulb socket. If the test bulb lights, repair the open ground circuit. If the bulb does not light, repair the open in the brown wire circuit.
Front or Rear Lamps Won't Work	1. Loose connection or open ground circuit.	1. If the associated tail or park lamps do not operate, check all the connectors in the brown wire circuit. If the park and turn lamps are not working, repair the open ground connections.
	2. Multiple bulbs burnt out.	2. Replace the burnt out bulbs.
All Lamps Won't Work	1. Blown fuse.	1. If the park and tail lamps do not operate, replace the blown fuse. If the new fuse blows, check for a short to ground between the fuse panel and the lamps.
	2. Loose connection.	2. Secure the connector to the lamp switch.
	3. Open in wiring.	3. Check the tail lamp fuse with a test lamp. If the test bulb lights, repair the open wiring between the fuse and the light switch. If not, repair the open wiring between the fuse and the battery. (Possible open fusible link.)
	4. Defective lamp switch.	4. Check the lamp switch with a test light. If the test bulb lights at the orange wire but not at the brown wire, replace the lamp switch.

ON-VEHICLE SERVICE

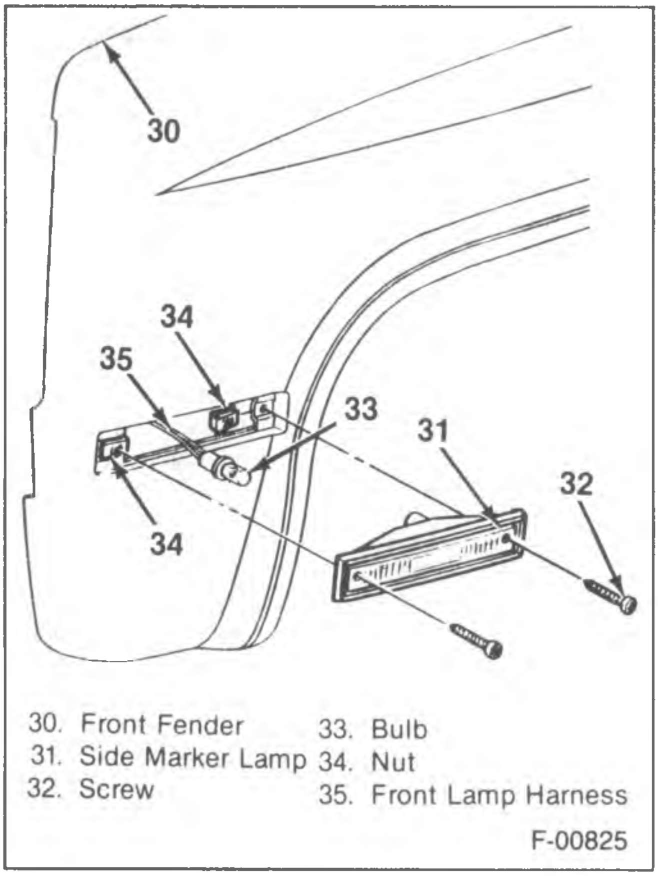
REPLACEMENT OF THE FRONT SIDE MARKER LAMP

Remove or Disconnect (Figures 8 and 9)

1. Two screws (32).
2. Side marker lamp (31).
3. Bulb (33) from the lamp (31).

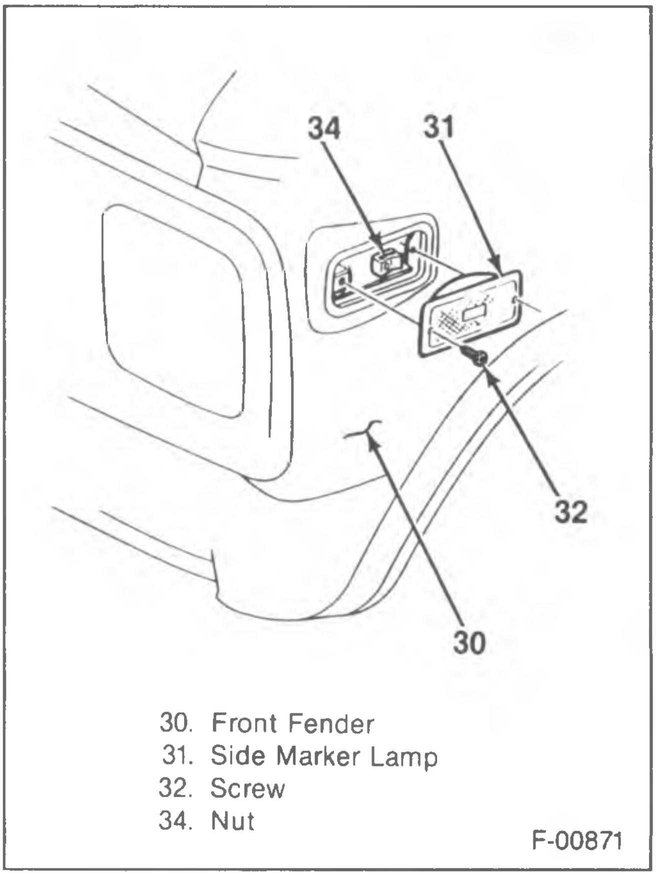
Install or Connect (Figures 8 and 9)

1. Bulb (33) into the lamp (31).
2. Side marker lamp (31) into the fender (30).
3. Two screws (32).



30. Front Fender
31. Side Marker Lamp
32. Screw
33. Bulb
34. Nut
35. Front Lamp Harness

Figure 8—Front Side Marker Lamp Assembly—CK Models



30. Front Fender
31. Side Marker Lamp
32. Screw
34. Nut

Figure 9—Front Side Marker Lamp Assembly—G Van

REAR LIGHTING SYSTEMS

The rear lighting systems contain the circuits for the running, park, turn, stop and license lamps. One bulb may function for more than one circuit. The harness for the rear lighting systems starts at the fuse block, goes to the various switches and then back along the left frame to the various lamps.

REAR RUNNING LAMPS AND MARKER LAMPS

This circuit starts at the lamp switch. The lamps will be on when the lamp switch is in the first and second detents. The front park lamps and front marker lamps will also be on when the lamp switch is in the first detent.

REAR PARK LAMPS

These lamps will be on when the lamp switch is in the first detent. The front park lamps will also be on. The side marker lamps will also be on.

REAR TURN, STOP, AND HAZARD SYSTEMS

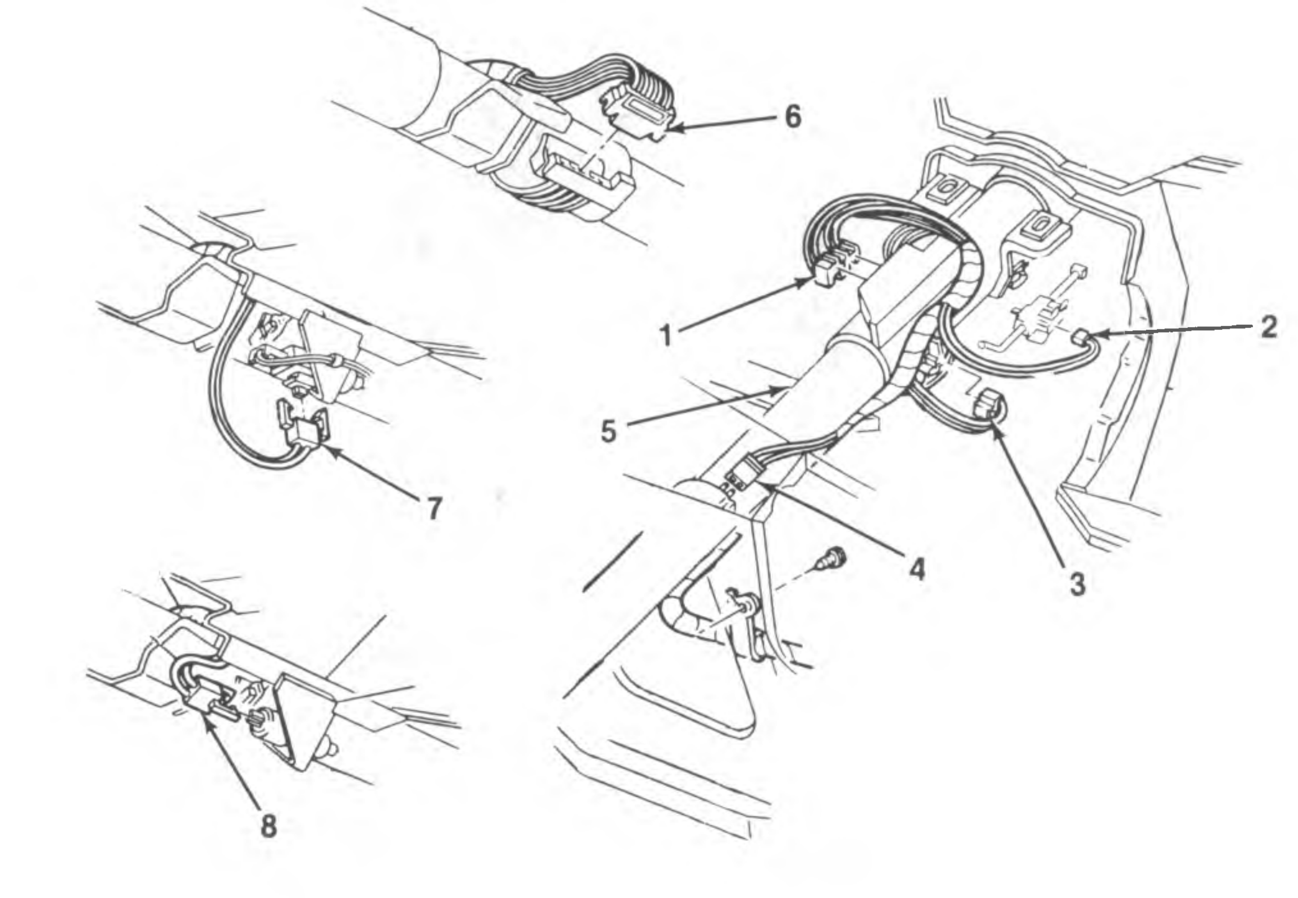
These three systems use the same bulb in the rear lamps. When the rear turn system is turned on, a thermal oscillator is turned on, which causes the system to flash. The front park lamps are also a part of the turn system.

The stop lamp system is turned on by a brake switch closing. The two rear bright lamps are then turned on.

The hazard system is turned on by the hazard switch. The hazard system thermal oscillator is then turned on which causes the front park lamps and the rear bright lamps to flash.

BACKUP LAMP SYSTEM

This circuit is turned on when the transmission is shifted into reverse. The backup switch is closed, thus turning on the backup lamps. The backup lamps are located in the rear lamp assemblies.



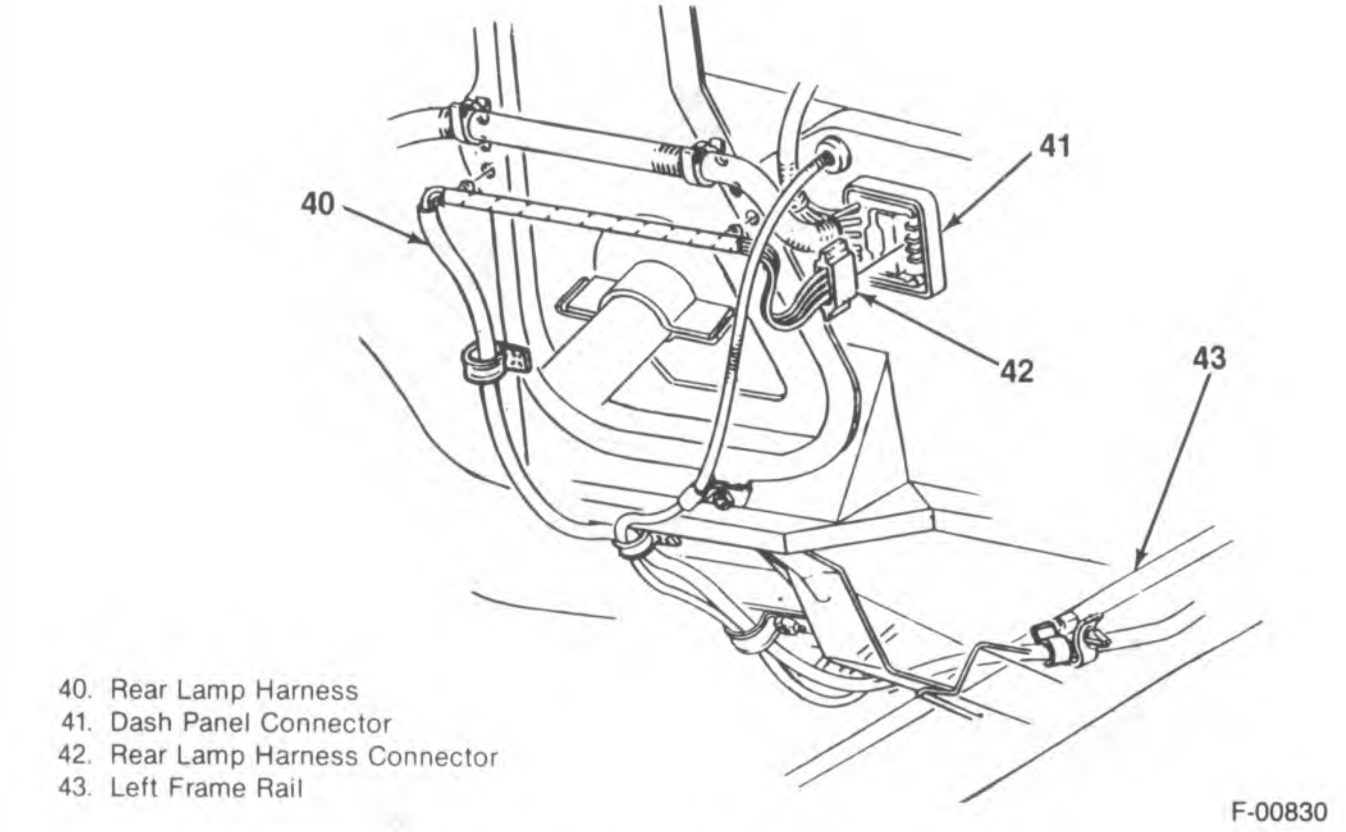
1. Ignition Switch Connector
2. Neutral Switch Connector
3. Dimmer Switch Connector
4. Back Up Switch Connector
5. Steering Column
6. Turn Signal Indicator Connector
7. Stop Lamp Switch Connector—With Cruise Control
8. Stop Lamp Switch Connector—Without Cruise Control

F-00837

Figure 10—Lamp Systems Connectors At The Steering Column—CK Models

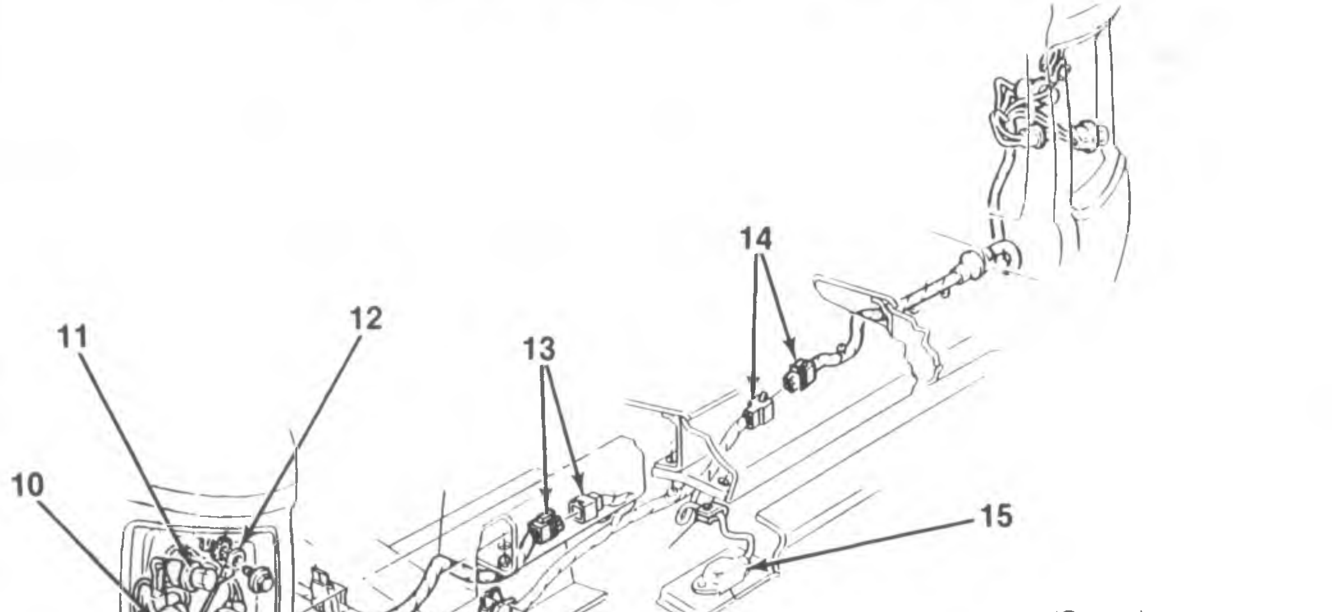
REAR LAMP HARNESS LAYOUTS

Refer to Figures 10, 11, 12, 13, 14, 15, 16, 17, 18 and 19.



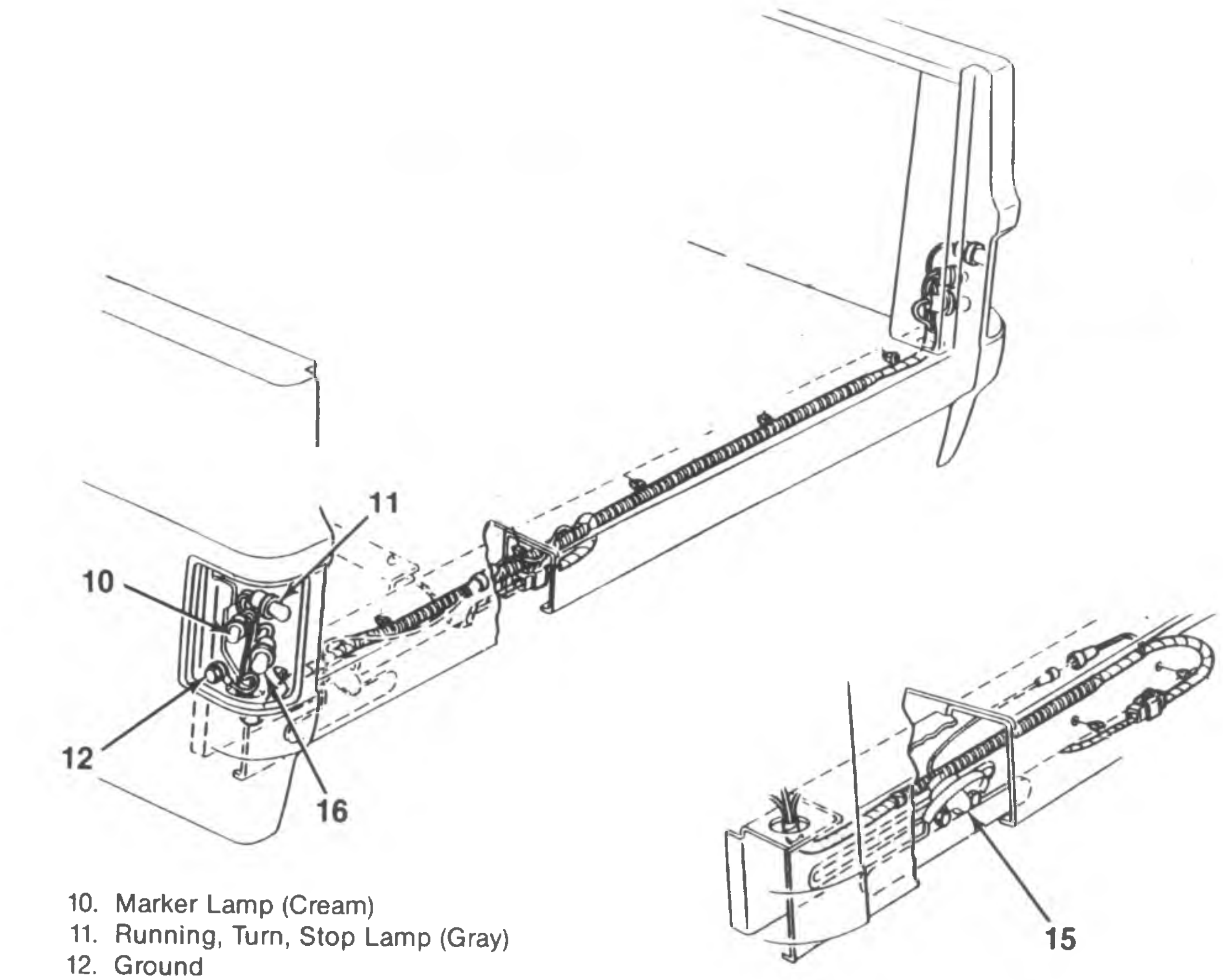
40. Rear Lamp Harness
41. Dash Panel Connector
42. Rear Lamp Harness Connector
43. Left Frame Rail

Figure 11—Rear Lamp Harness At the Dash Panel—CK Models



10. Marker Lamp (Cream)
11. Running, Turn, Stop Lamp (Gray)
12. Ground
13. Left Harness Connector
14. Right Harness Connector
15. License Lamp
16. Back Up Lamp

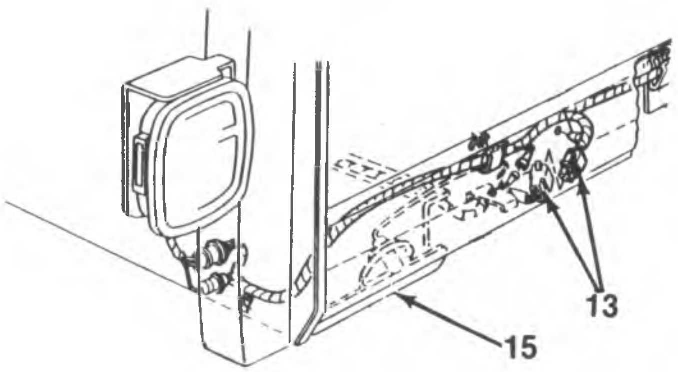
Figure 12—Rear Lamp Harness—Suburban



10. Marker Lamp (Cream)
11. Running, Turn, Stop Lamp (Gray)
12. Ground
15. License Lamp
16. Back Up Lamp

F-00841

Figure 13—Rear Lamp Harness—Pickup (Fleetside)



13. Left Harness Connector
15. License Lamp

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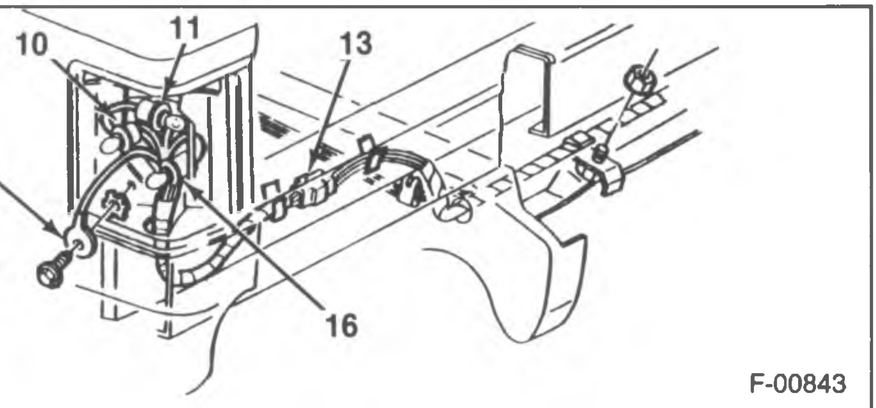
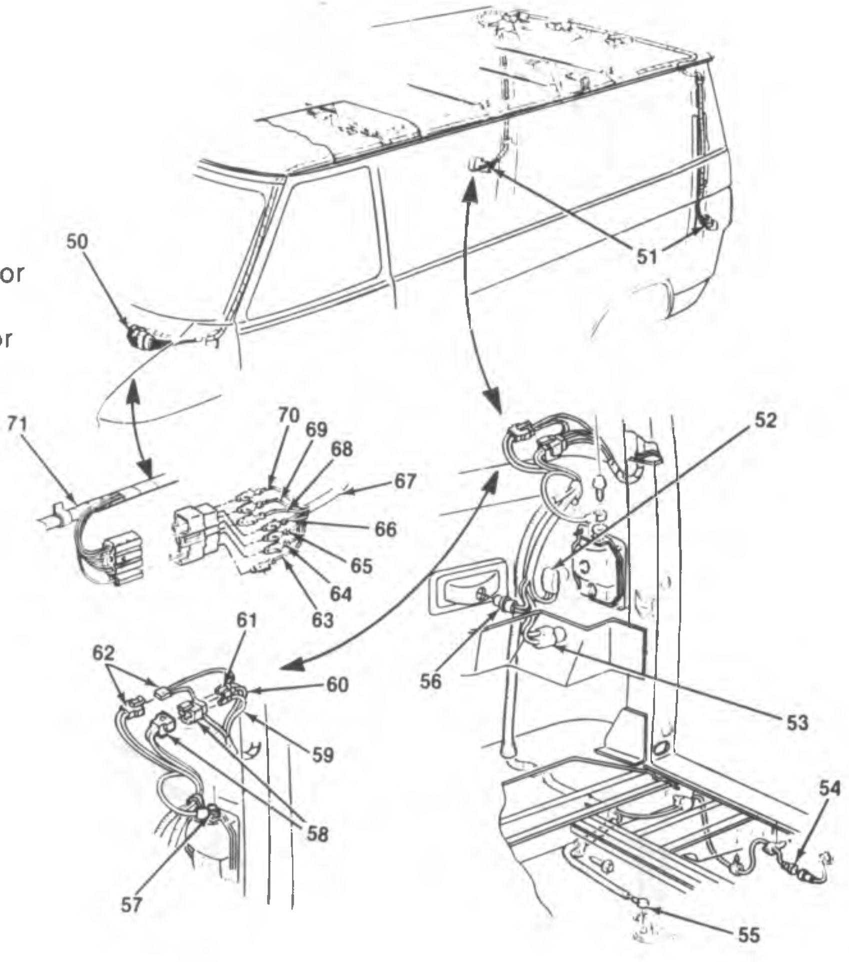
Figure 14—Rear Lamp Harness Pickup (Stepside)



10. Marker Lamp (Cream)
11. Running, Turn, Stop Lamp (Gray)
12. Ground
13. Left Harness Connector
16. Back Up Lamp

Figure 15—Rear Lamp Harness—Utility Vehicle



50. Rear Lighting Harness Connector
51. Rear Lamp Assemblies
52. Run, Stop, Turn Lamp Connector
53. Back Up Lamp Connector
54. License Lamp Connector
55. Fuel Tank Sender Connector
56. Side Marker Lamp Connector
57. Ground
58. Run, Stop, Turn, Back Up Lamps Connector
59. LT GRN Wire
60. GRN Wire
61. BRN Wire
62. License Lamp, Fuel Tank Sender Connector
63. WH Wire
64. ORG Wire
65. PNK Wire
66. BRN Wire
67. Rear Lamp Harness
68. YEL Wire
69. DK GRN Wire
70. LT GRN Wire
71. Instrument Panel Harness

Figure 16—Rear Lamp Harness—G Van

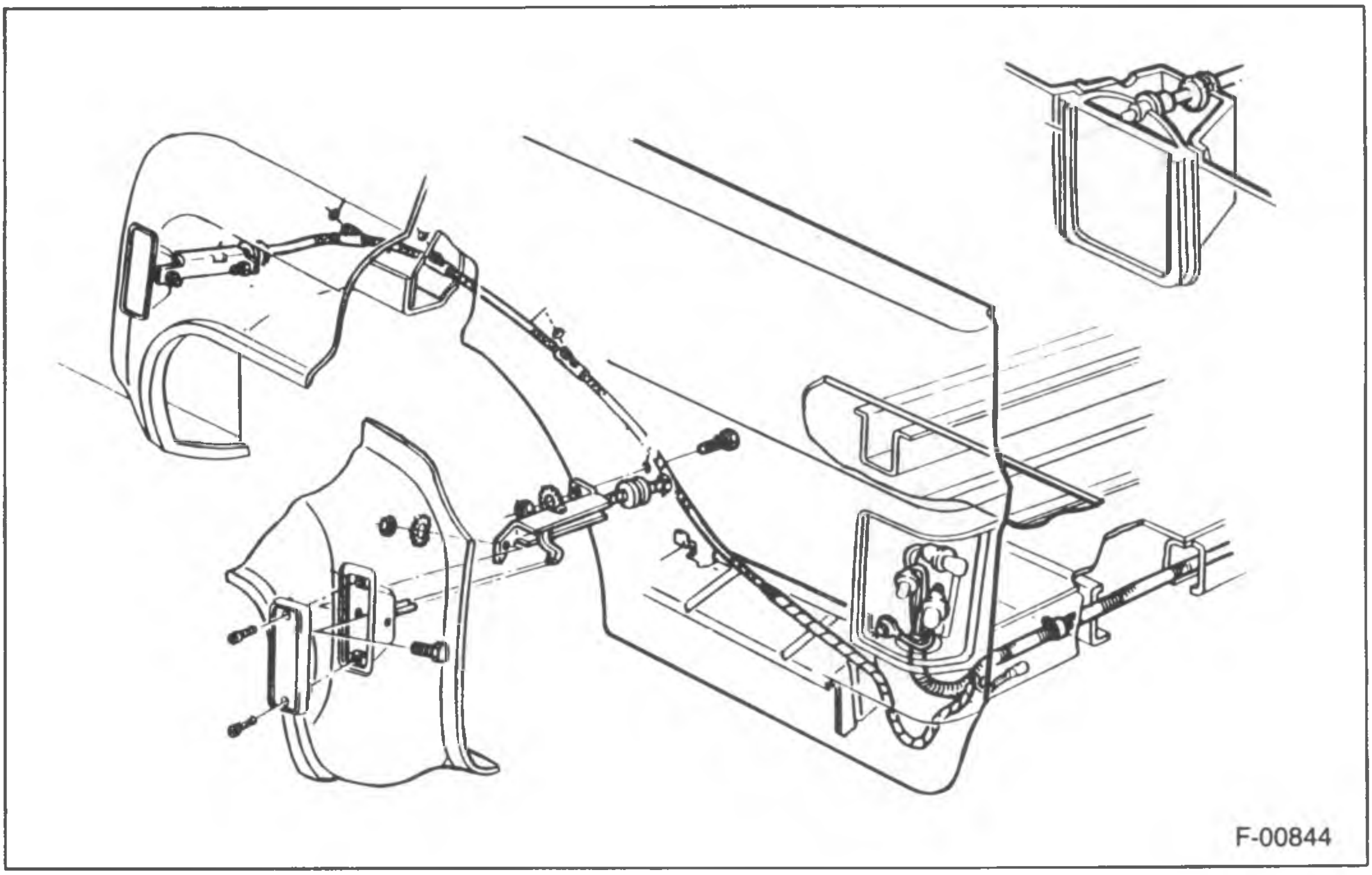


Figure 17—Side Fender Marker Lamp Harness— Pickup

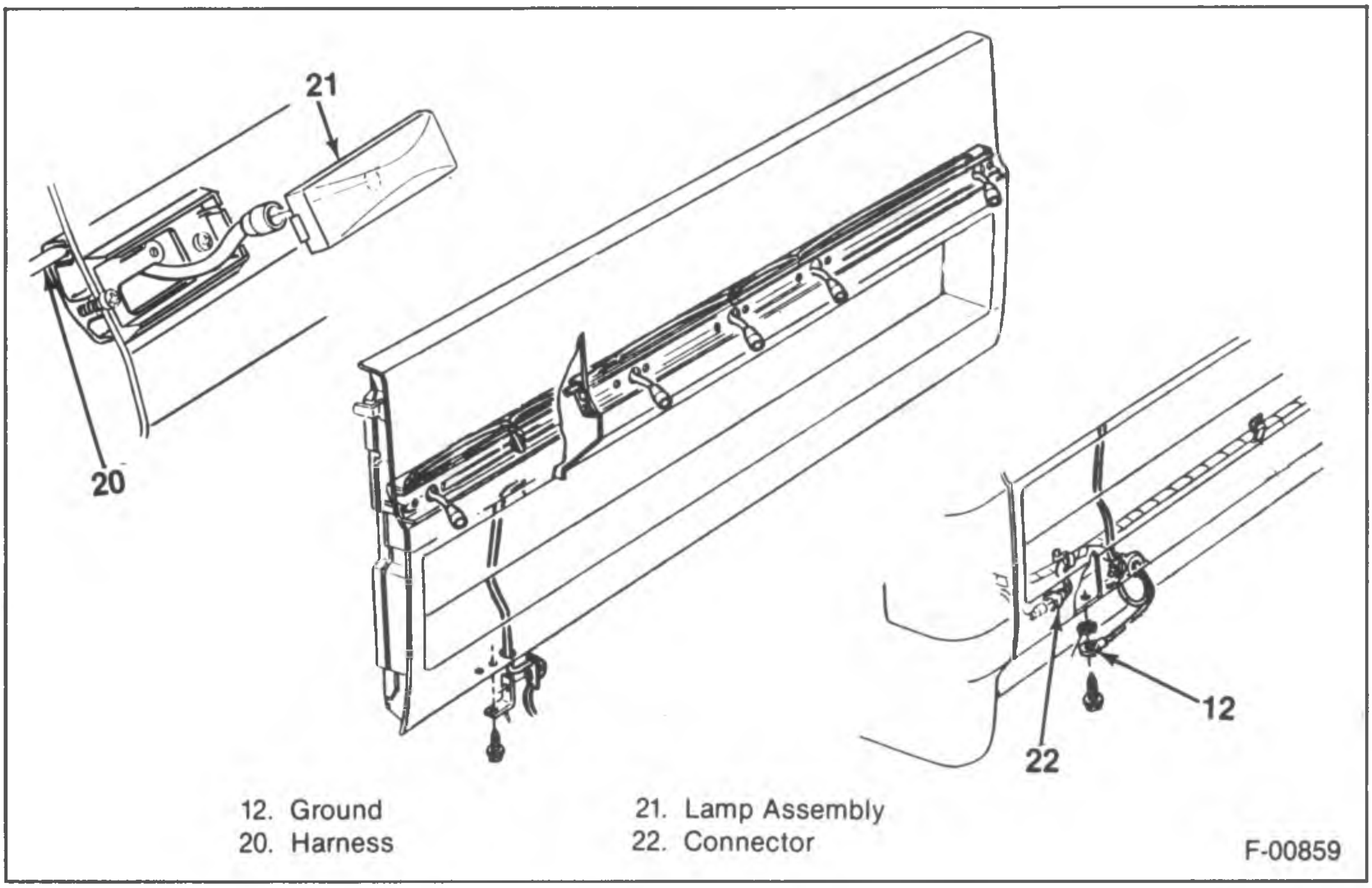


Figure 18—Tailgate Lamp Harness—Pickup

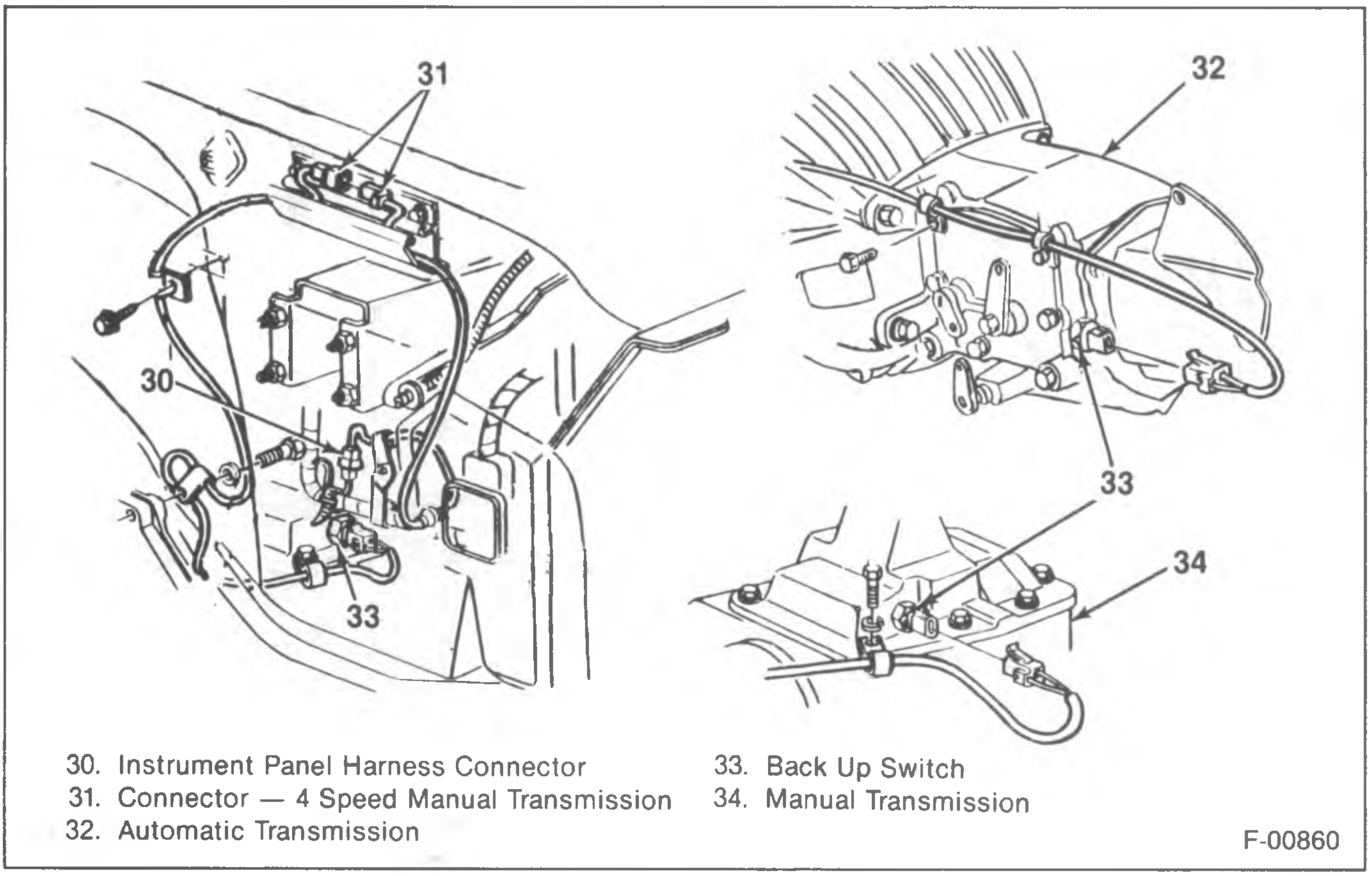


Figure 19—Back Up Lamp Switch Harnesses—CK

DIAGNOSIS OF THE REAR SIDE MARKER LAMPS

PROBLEM	POSSIBLE CAUSE	CORRECTION
One Lamp Won't Work	1. Turn signal bulb burnt out (front lamp).	1. Switch turn signals on. If the signal bulb does not light, replace the bulb. (Bulb filament provides ground path for marker lamp bulb through the dark blue or brown wires.)
	2. Side marker bulb burnt out.	2. Replace the bulb.
	3. Loose connection or open in wiring.	3. Using a test lamp, check the brown wire terminal at the bulb socket. If the test bulb lights, repair the open ground circuit. If the bulb does not light, repair the open in the brown wire circuit.
Front Or Rear Lamps Won't Work	1. Loose connection or open ground circuit.	1. If the associated tail or park lamps do not operate, check all the connectors in the brown wire circuit. If the park and turn lamps are not working, repair the open ground connections.
	2. Multiple bulbs burnt out.	2. Replace the burnt out bulbs.

DIAGNOSIS OF THE REAR SIDE MARKER LAMPS (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
All Lamps Won't Work	1. Blown fuse.	1. If the park and tail lamps do not operate, replace the blown fuse. If the new fuse blows, check for a short to ground between the fuse panel and the lamps.
	2. Loose connection.	2. Secure the connector to the lamp switch.
	3. Open in wiring.	3. Check the taillamp fuse with a test lamp. If the test bulb lights, repair the open wiring between the fuse and the lamp switch. If not, repair the open wiring between the fuse and the battery. (Possible open fusible link.)
	4. Defective lamp switch.	4. Check the lamp switch with a test lamp. If the test bulb lights at the orange wire but not at the brown wire, replace the light switch.

DIAGNOSIS OF THE RUNNING, PARK AND LICENSE LAMPS

PROBLEM	POSSIBLE CAUSE	CORRECTION
One Side Not Working	1. Bulb burnt out.	1. Replace the bulb.
	2. Open connection at the bulb socket or the ground wire terminal.	2. Jumper the bulb base socket connection to ground. If the bulb lights, repair the open ground circuit.
Both Sides Not Working	1. Tail lamp fuse blown.	1. Replace the fuse. If the new fuse blows, repair the short to ground in the brown wire circuit between the fuse panel through the lamp switch to the lamp.
	2. Loose connection.	2. Secure the connector at the lamp switch.
	3. Open wiring.	3. Using a test lamp, check a circuit on both sides of the fuse. If the test bulb does not light on either side, repair the open circuit between the fuse panel and the battery (possible open fusible link). If the test bulb lights at the lamp switch brown wire terminal, repair the open wiring between the lamp switch and the lamps.
	4. Multiple bulb burnout.	4. If the test bulb lights at the lamp socket brown wire terminal, replace the bulb(s).
	5. Defective lamp switch.	5. If the test bulb lights at the lamp switch orange wire but not at the brown wire, replace the defective lamp switch.

DIAGNOSIS OF THE TURN SIGNAL AND HAZARD SYSTEMS

PROBLEM	POSSIBLE CAUSE	CORRECTION
Turn Signals Not Working On One Side	1. Bulb(s) burnt out (flasher cannot be heard).	1. Turn the hazard warning system "ON." If one or more bulbs are inoperative, replace the bulbs as necessary.
	2. Open wiring or loose ground connector.	2. Turn the hazard warning system on. If one or more bulbs are inoperative, use the test lamp and check the circuit at the bulb socket. If the test bulb lights, repair the open ground connection. If not, repair the open wiring between the bulb socket and the turn signal switch.
	3. Improper bulb or defective turn signal switch.	3. Turn the hazard warning system on. If all the front lamps and rear lamps operate, check for an improper bulb (see bulb chart). If the bulbs are OK, replace the defective turn signal switch.
	4. Short to ground. (Flasher can be heard, no bulbs operate).	4. Locate and repair the short to ground by disconnecting the front and rear circuits separately.
Turn Signals Not Working	1. Blown turn signal fuse.	1. Turn the hazard warning system on. If all the lamps operate, replace the blown fuse. If the new fuse blows, repair the short to ground between the fuse and the lamps.
	2. Defective flasher (located in convenience center near steering column).	2. If the turn signal fuse is OK and the hazard warning system will operate the lamps, replace the defective turn signal flasher.
	3. Loose connection.	3. Secure the steering column connector.

DIAGNOSIS OF THE TURN SIGNAL AND HAZARD SYSTEMS (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Hazard Warning Not Working	1. Blown stop-hazard fuse.	1. Switch the turn signals "ON." If the lights operate, replace the stop-hazard fuse if blown. If the new fuse blows, repair the short to ground. (Could be in stop lamp circuit).
	2. Faulty hazard warning flasher. (Located in the convenience center).	2. If the stop-hazard fuse is OK, switch the turn signals on. If the lamps operate, replace the defective hazard flasher.
	3. Open in the wiring or a defective turn signal switch.	3. Using the test lamp, check the brown wire in the turn signal steering column connector. If the test bulb does not light, repair the open circuit between the flasher and the connector. If the test lamp indicates power on the brown wire and connection is good, use a test lamp to check the output terminals (lt. blue, blue, yellow and dark green wires).

DIAGNOSIS OF THE STOPLAMP SYSTEM

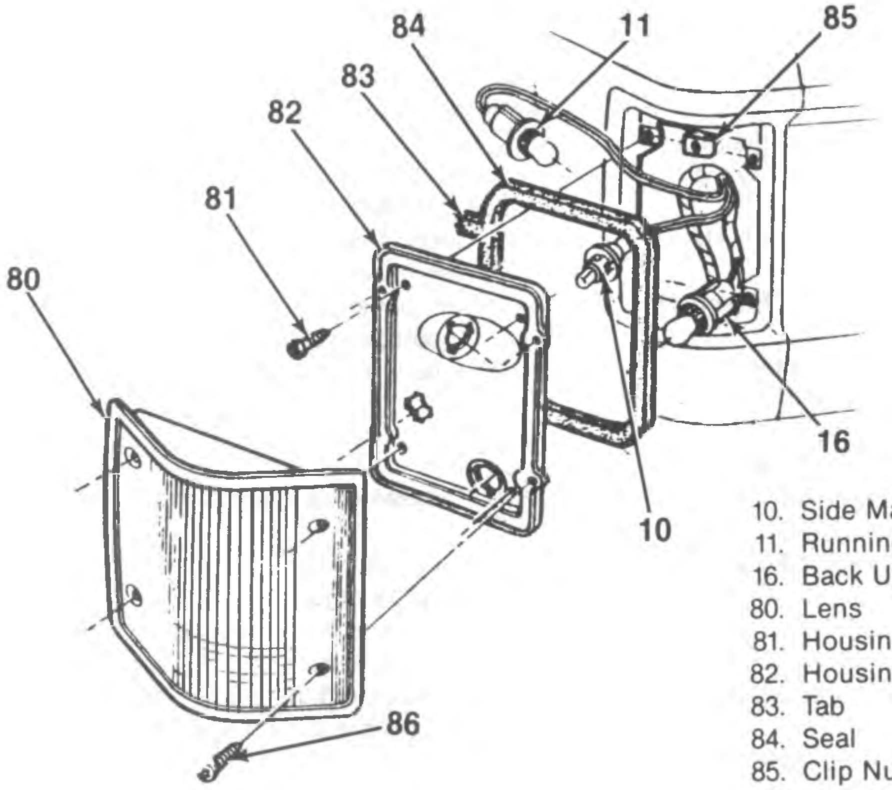
PROBLEM	POSSIBLE CAUSE	CORRECTION
One Bulb Not Working	Bulb burnt out.	Replace bulb.
One Side Not Working (Multi-Bulb Design)	1. Loose connection, open wiring or faulty bulbs.	1. Turn on the directional signal. If lamp does not operate, check the bulbs. If the bulbs are OK, check all connections. If the lamp still does not operate, use the test lamp and check for open wiring.
	2. Faulty directional signal switch or cancelling cam.	2. If the lamp will operate by turning the directional signal on, the switch is not centering properly during the cancelling operation. Replace faulty cancelling cam or directional signal switch.
All Stoplamps Inoperative	1. Stop-hazard fuse is blown.	1. Replace the fuse. If the new fuse blows, repair the short to ground in the circuit between the fuse and the lamps.
	1. Open in the wire from the fuse to the stop-switch.	2. Check for power at the brown wire at the stop-switch and at the fuse. If there is power at the fuse but not at the switch, check for an open in the brown wire.

DIAGNOSIS OF THE STOPLAMP SYSTEM (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
All Stoplamps Not Working (cont.)	3. Stop-switch misadjusted or faulty.	3. With the brake pedal pressed, check the white wire terminal in the steering column connector with a test lamp. If the bulb does not light, check the stop switch for proper adjustment. If the adjustment is OK, jumper the stop switch. If the stop lamps operate, replace the stop switch.
Will Not Turn Off	1. Stop switch misadjusted or faulty.	1. Readjust the switch. If the switch still malfunctions, replace the switch.

DIAGNOSIS OF THE BACKUP LAMP SYSTEM

PROBLEM	POSSIBLE CAUSE	CORRECTION
One Lamp Not Working Or Intermittent	1. Loose or burnt out bulb. 2. Loose connection. 3. Open ground connections.	1. Secure or replace the bulb. 2. Tighten the connectors. 3. Repair the bulb ground circuit.
Both Lamps Not Working Or Intermittent	1. Gear selector switch is misadjusted (open when shifter lever is in reverse position).	1. Readjust the gear selector switch.
	2. Loose connection or open circuit.	2. Check all connectors. If OK, check the continuity of the circuit from the fuse to the lamp on either side of the fuse. Correct the open circuit from the battery to the fuse.
	3. Blown fuse.	3. Replace the fuse. If the new fuse blows, repair the short to ground in the circuit from the fuse through the gear selector or the backup lamp switch to the backup lamps.
	4. Faulty gear selector or backup lamp switch.	4. With the ignition "ON," check the switch terminals in the backup position with the test lamp. If the test bulb lights at the dark blue wire terminal but not at the light green wire terminal, replace the switch.
	5. Faulty ignition switch.	5. If the test bulb lights at the ignition switch battery terminal, but not at the output terminal, replace the ignition switch.
Lamp Will Not Turn Off	1. Gear selector switch misadjusted (closed when the shift lever is not in the reverse position).	1. Readjust the gear selector switch.



10. Side Marker Lamp (Cream)
11. Running, Turn, Stop Lamp
16. Back Up Lamp
80. Lens
81. Housing Screw
82. Housing
83. Tab
84. Seal
85. Clip Nut
86. Lens Screw

Figure 20—Rear Lamp Assembly—CK Models

ON-VEHICLE SERVICE

REAR LAMP BULB REPLACEMENT—CK MODELS

↔ Remove or Disconnect (Figure 20)

1. Battery ground cable from the battery.
2. Lens retaining screws (86).
3. Lens (80).
4. Bulb (10, 11 or 16).

→← Install or Connect (Figure 20)

1. Bulb (10, 11 or 16).
2. Lens (80).
3. Lens retaining screws (86).
4. Battery ground cable to the battery.

REAR LAMP HOUSING AND SEAL REPLACEMENT—CK MODELS

↔ Remove or Disconnect (Figures 20)

1. Battery ground cable from the battery.
2. Lens retaining screws (86).
3. Lens (80).
4. Housing retaining screws (81).
5. Housing (82).
6. Lamps (10, 11 and 16).
7. Seal (84).

→← Install or Connect (Figure 20)

1. Seal (84).
   - Install the seal with the tabs (83) pointed forward.
   - Apply adhesive at the four corners of the seal in order to hold the seal in place.
2. Lamps (10, 11 and 16).
3. Housing (82).
4. Housing screws (81).
5. Lens (80).
6. Lens screws (86).
7. Battery ground cable to the battery.

LICENSE LAMP REPLACEMENT—CK MODELS

↔ Remove or Disconnect (Figure 21)

1. Battery ground cable from the battery.
2. Housing retaining screws (92) or bolts (97).
3. Lens.

4. Bulb.

Install or Connect (Figure 21)

1. Bulb.
2. Lens.
3. Housing retaining screws (92) or bolts (97).
4. Battery ground cable from the battery.

REAR LAMP BULB REPLACEMENT—G VAN

Remove or Disconnect (Figures 22 and 16)

1. Battery ground cable from the battery.
2. Lens housing retaining screws (101).
3. Lamp housing (100).
4. Bulb socket (52 and 53) by squeezing the retention lock and rotating the socket counterclockwise.
5. Bulb from the bulb socket (52 and 53).

Install or Connect

1. Bulb into the bulb socket.
2. Bulb socket (52 and 53) into the housing.
3. Lamp housing (100).
4. Lens housing retaining screws (101).
5. Battery ground cable to the battery.

REAR MARKER LAMP BULB REPLACEMENT—G VAN

Remove or Disconnect (Figure 23)

1. Battery ground cable from the battery.
2. Housing retaining screws (113).
3. Housing (112).
4. Bulb socket (56).
5. Bulb.

Install or Connect

1. Bulb.
2. Bulb socket (56) into the housing (112).
3. Housing (112).
4. Housing retaining screws (113).
5. Battery ground cable from the battery.

LIGHT SWITCH REPLACEMENT

C-K Models

Remove or Disconnect (Figures 24 and 25)

1. Battery ground cable from the battery.
2. Knob assembly (131).
    - Push in retainer pin on the switch body.
    - Pull out the knob assembly.
3. Trim panel screws (121).
4. Trim panel (120).
5. Bezel (132).
6. Light switch harness (130).
7. Light switch (133).

Install or Connect (Figures 24 and 25)

1. Light switch (133).
2. Light switch harness (130).
3. Bezel (132).
4. Trim panel (120).
5. Trim panel screws (121).
6. Knob assembly (131).
7. Battery ground cable to the battery.

G-Van

Remove or Disconnect (Figures 26 and 27)

1. Battery ground cable from the battery.
2. Knob assembly (141).
    - Press the knob assembly retaining pin on the switch.
    - Pull out the knob assembly.
3. Trim plate retaining screws (142).
4. Trim plate (140).
5. Bezel (143).
6. Light switch (144).
7. Light switch harness (145).

Install or Connect

1. Light switch harness (145) from the light switch (144).
2. Light switch (144).
3. Bezel (143).
4. Trim plate (140).
5. Trim plate retaining screws (142).
6. Knob assembly (141) into the switch (144).
7. Battery ground cable to the battery.

BACK UP SWITCH REPLACEMENT

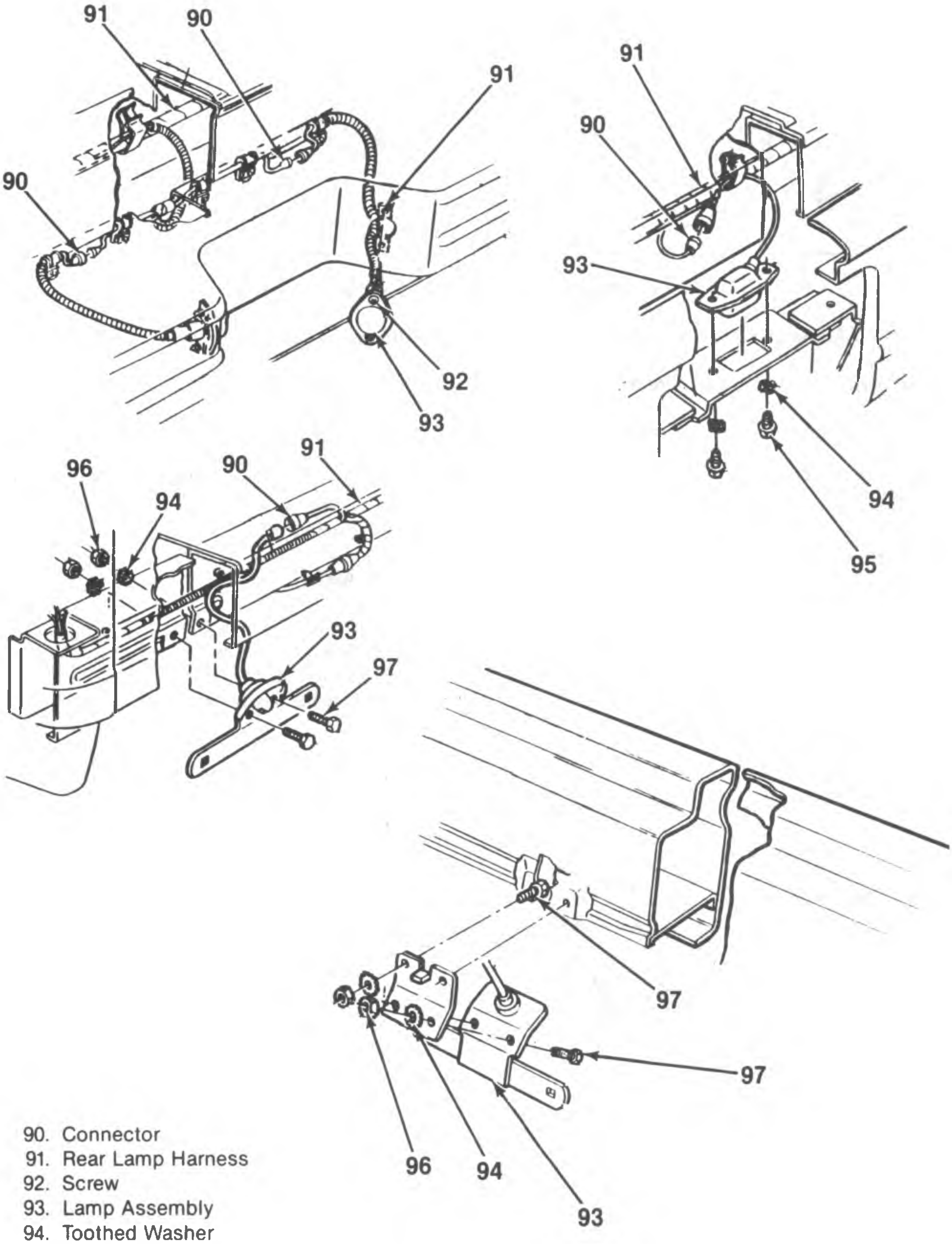
CKG Models—Manual Transmission

Remove or Disconnect (Figure 28)

1. Battery ground cable from the battery.
2. Backup switch harness (164).
3. Backup switch (163).
4. Seal (162).

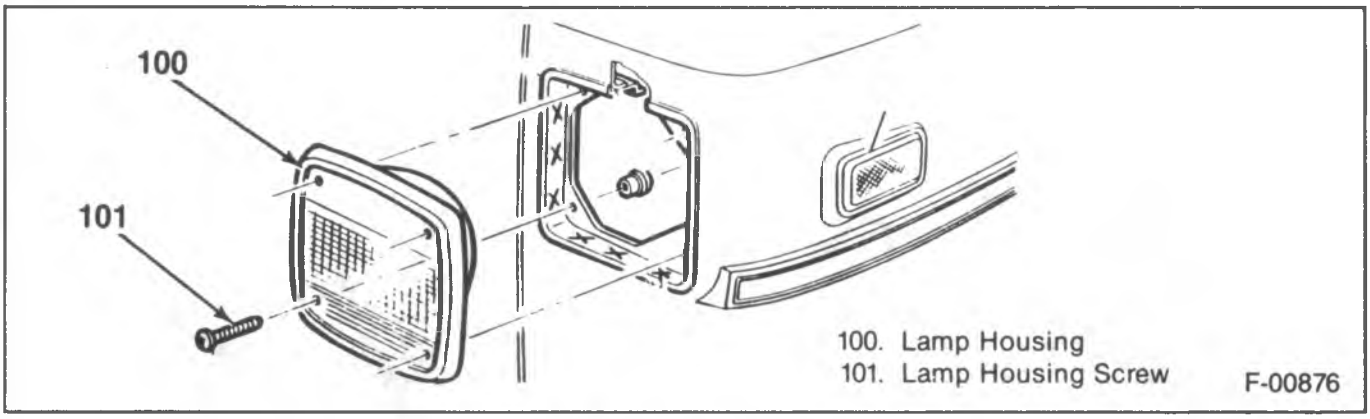
Install or Connect (Figure 28)

1. Seal (162).
2. Backup switch (163).
3. Backup switch harness (164).
4. Battery ground cable to the battery.



90. Connector
91. Rear Lamp Harness
92. Screw
93. Lamp Assembly
94. Toothed Washer
95. Bolt
96. Nut

Figure 21—License Lamp—CK Models



100. Lamp Housing
101. Lamp Housing Screw

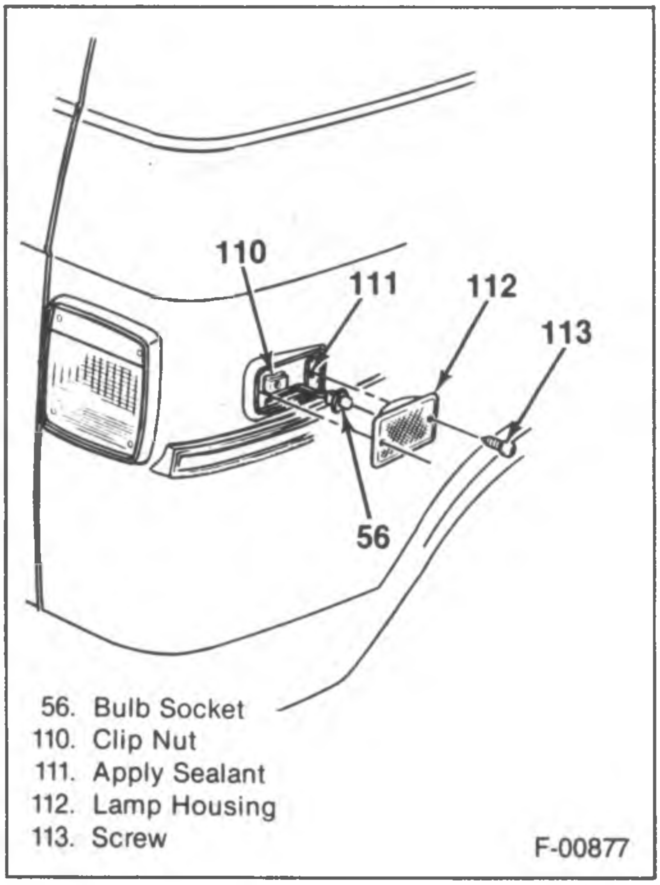
F-00876

Figure 22—Rear Lamp—G Van

CKG Models—Automatic Transmission

Remove or Disconnect (Figure 28)

1. Battery ground cable from the battery.
2. Switch assembly harness.
3. Switch assembly.
   - Place gear selector in neutral.
   - Squeeze the switch tangs (151) together.
   - Lift out the switch assembly (152).



56. Bulb Socket
110. Clip Nut
111. Apply Sealant
112. Lamp Housing
113. Screw

F-00877

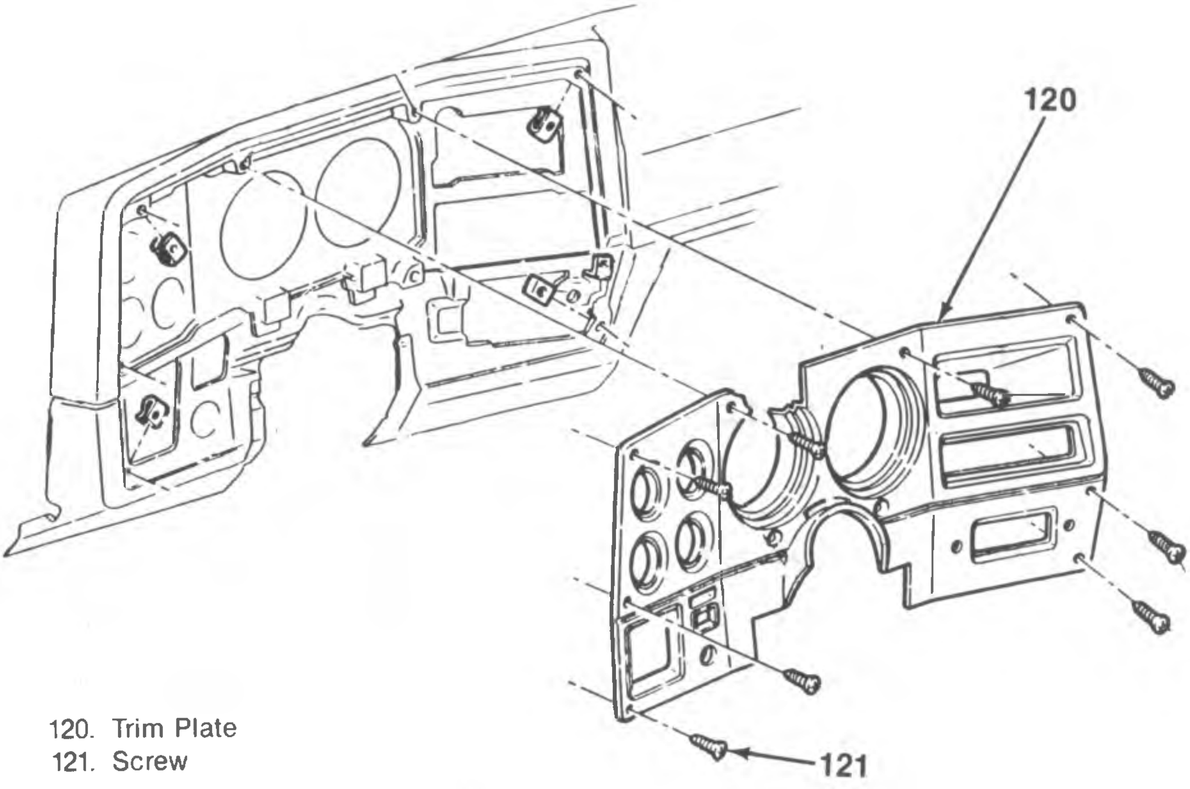
Figure 23—Rear Marker Lamp—G Van

Install or Connect

1. Switch assembly.
   - Place gear selector in neutral.
   - Align the actuator (157) with the cutout (159) in the steering column jacket (158).
   - Insert the tangs (151) into the rectangular holes (150).
   - Push down on the switch assembly (152).

   #### Adjust

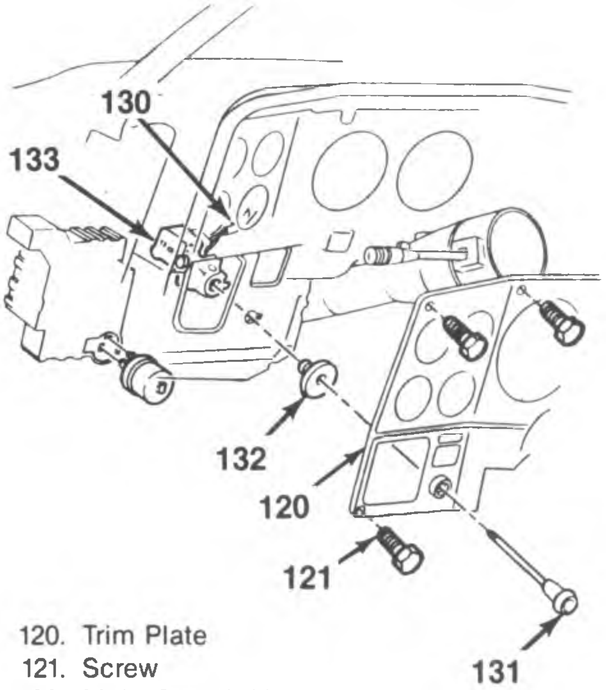
   - Switch by moving the gear selector to park. The actuator will rachet, providing proper switch adjustment.
2. Switch assembly harness.



120. Trim Plate
121. Screw

F-00878

Figure 24—Instrument Panel Trim Plate—CK Models



120. Trim Plate
121. Screw
130. Light Switch Harness
131. Light Switch
132. Bezel
133. Knob Assembly

B-06910

Figure 25—Light Switch Assembly—CK Models

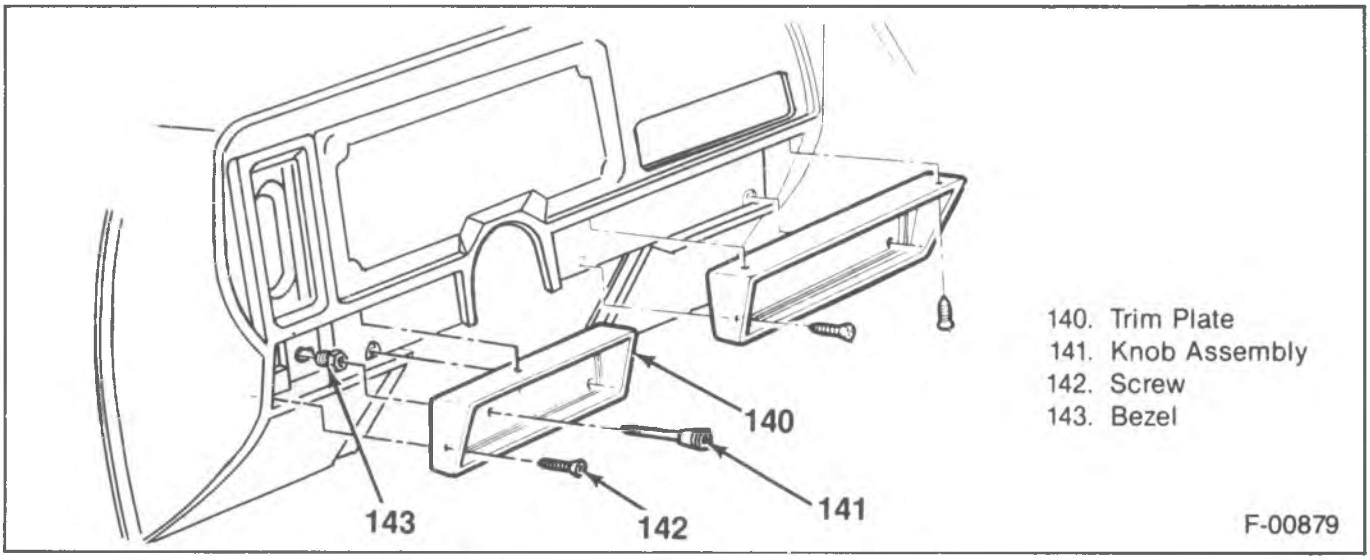


Figure 26—Instrument Panel Trim Plate—G Van

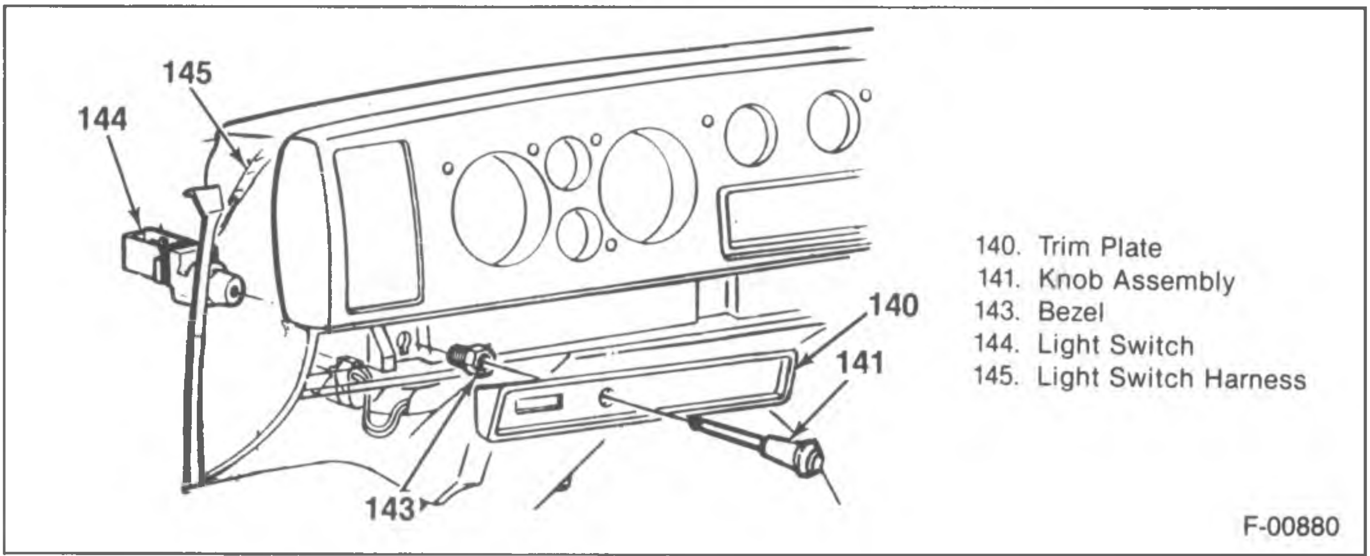
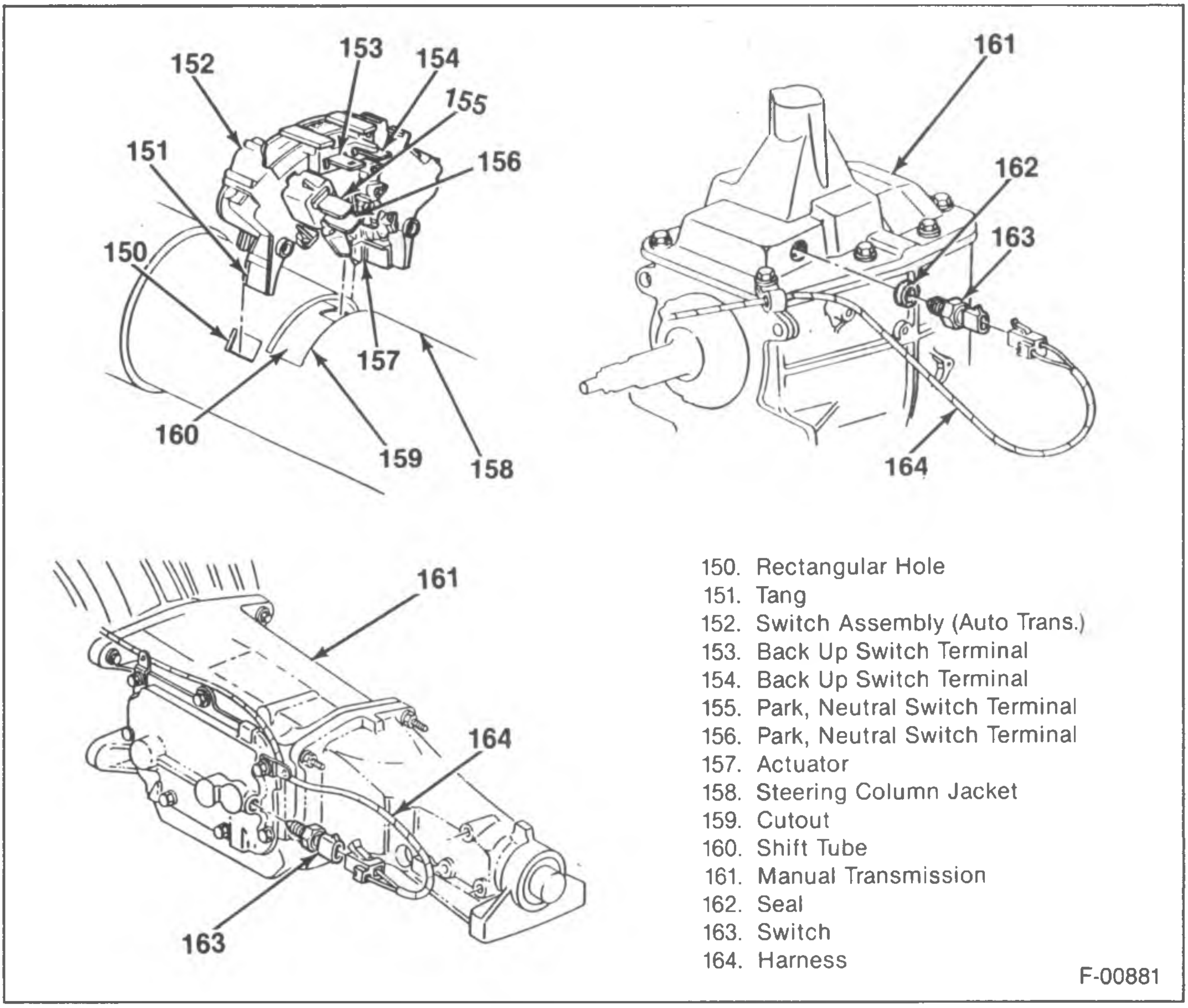


Figure 27—Light Switch Assembly—G Van



150. Rectangular Hole
151. Tang
152. Switch Assembly (Auto Trans.)
153. Back Up Switch Terminal
154. Back Up Switch Terminal
155. Park, Neutral Switch Terminal
156. Park, Neutral Switch Terminal
157. Actuator
158. Steering Column Jacket
159. Cutout
160. Shift Tube
161. Manual Transmission
162. Seal
163. Switch
164. Harness

Figure 28—Back Up Lamp Switch Assembly

FUSES—CIRCUIT BREAKERS SPECIFICATIONS

The wiring circuits are protected from short circuits by a combination of fuses, circuit breakers, and fusible thermal links in the wiring itself. This greatly reduces the hazard of electrically caused fires in the vehicles.

The headlamp circuits are protected by a circuit breaker in the light switch. An electrical overload on the breaker will cause the lamps to go on and off, or in some cases to remain off.

In addition to a fuse, the windshield wiper motor is also protected by a circuit breaker. If the motor overheats, due to overloading caused by heavy snow, etc., the wipers will remain stopped until the motor cools.

Fuses located in the Junction Block beneath the dash on the drivers side are:

C-K TRUCK

Heater, Front A/C, Generator Warning Lamp	20 Amp
Idle Stop Solenoid, Aux. Battery, Radio, Time Delay Relay, Emission Control Solenoid, Transmission Downshift (M40)	15 Amp
Cigarette Lighter, Clock, Dome Lamp, Cargo Lamp	20 Amp
Fuel Gage, Brake Warning Lamp, Temperature Warning Lamp, Oil Pressure Warning Lamp	4 Amp
Courtesy Lamp, Roof Marker Lamp, License Plate Lamp, Parking Lamp, Side Marker Lamp, Tail Lamp, Clearance Lamp	20 Amp
Directional Signal Indicator Lamp, Stop Lamp, Traffic Hazard	15 Amp
Instrument Cluster Lamp, Heater Dial Lamp, Radio Dial Lamp, Cruise Control Lamp, Windshield Wiper Switch Lamp	4 Amp
Windshield Wiper/Washer	25 Amp
Cruise Control, Rear Window Aux., Fuel Tank, Tachometer, Back-up Lamp, Directional Signal Indicator Lamp, Directional Signal Lamp, Headlamp Buzzer	15 Amp

P TRUCK

Heater*, Air Conditioning*	25 Amp
Instrument Cluster Lamp, Windshield Wiper Switch Lamp	3 Amp
Directional Signal Indicator Lamp, Stop Lamp, Traffic Hazard	15 Amp
Fuel Gage, Brake Warning Lamp	3 Amp
License Plate Lamp, Parking Lamp, Side Marker Lamp, Tail Lamp, Clearance Lamp, Identification Lamp	15 Amp
Windshield Washer/Wiper	25 Amp
Cigarette Lighter*, Clock*, Courtesy*, Dome Lamp*	15 Amp
Auxiliary Battery*, Back-up Lamp, Radio	15 Amp
Idle Stop Solenoid, Cruise Control*, Directional Signal Lamp, Time Delay Relay, Emission Control Solenoid, Transmission Downshift (M40)	10 Amp

In-line fuses are located in the auxiliary heater circuits (C-K-P models) and underhood lamp, front and rear A/C circuits (C-K models).

*When incorporated by body builder.

Do not use fuses of higher amperage than those recommended above.

The following wiring harnesses are protected by a "fusible link" which is a special wire incorporated in the circuit headlamp hi-beam indicator, horn, air conditioning high blower, ignition circuits (C-K-P models) starter solenoid (pull-in and hold) circuit (C-K models). Should an electrical overload occur, this wire will fail and prevent damage to the major harness.

G TRUCK

Heater, A/C	25 Amp
Idle Stop Solenoid, Cruise Control, Directional Signal Lamp, Directional Signal Indicator Lamp, Transmission Downshift (M-40)	10 Amp
Cigarette Lighter, Dome Lamp, Spot Lamp	15 Amp
Fuel Gage, Brake Warning Lamp, Temperature Warning Lamp, Generator Warning Lamp, Oil Pressure Warning Lamp	3 Amp
Stop Lamp, Traffic Hazard	15 Amp
Auxiliary Battery, Backing Lamp, Radio Dial Lamp, Radio	15 Amp
Instrument Cluster Lamp, Heater Dial Lamp, Transmission Control Lamp with Tilt Wheel, Cruise Control Lamp, W/S Wiper Switch Lamp, Headlamp Buzzer	3 Amp
License Lamp, Parking Lamp, Side Marker Lamp, Tail Lamp	15 Amp
Windshield Wiper	25 Amp

An in-line fuse is located in the ammeter and the auxiliary heater circuits.

Do not use fuses of higher amperage rating than those recommended above.

The following wiring harnesses are protected by a "fusible link" which is a special wire incorporated in the circuit, ignition, horn and headlamp hi-beam indicator circuits, air conditioning high blower. Should an electrical overload occur, this wire will fail and prevent damage to the major harness.

CIRCUIT BREAKERS

DEVICE OR CIRCUIT PROTECTED	MODELS	AMPS.	LOCATION
Headlamp and parking lamp circuit	C-K-P-G	15	Lamp switch
Tailgate window motor	C-K	30	Dash (forward side)
Rear A/C (C69 overhead)	G	35	Dash (forward side)

LAMP SPECIFICATIONS

LAMP BULB DATA
C-K-P TRUCK

USED IN	QUAN.	TRADE #	POWER
Dome Lamps:			
Cab	1	1004	15 CP
Utility & Surburban	1	211-2	12 CP
Oil Pressure indicator lamp[1]	1	168	3 CP
Generator indicator lamp[1]	1	168	3 CP
Instrument cluster lamps[2]	5	168	3 CP
Headlamp beam indicator lamp	1	168	3 CP
Lamp assembly—tail & stop lamp	2	1157	3-32 CP
License Lamp[4]	1	67	4 CP
Directional signal (front park lamps)[6]	2	1157	3-32 CP
Head Lamps	2	6014	50-60 W
Temperature indicator lamp	1	168	3 CP
Directional signal indicator lamp	2	168	3 CP
Clearance and marker lamps	4	168	3 CP
Roof marker lamps[5]	5	194	2 CP
Brake warning indicator lamp	1	168	3 CP
Transmission control (auto)	1	1445	0.7 CP
Backing lamp (exc. motor home)	2	1156	32 CP
Backing lamp (motor home)	2	1295	50 CP
Heater or A/C Illum. lamp	1	161	1 CP
Corner marker lamps (platform)	7	67	4 CP
Cargo lamp (C-K cab)	1	1142	21 CP
Radio dial lamp — AM	1	216	1 CP
—AM/FM	1	216	1 CP
Courtesy lamp	1	1003	15 CP
Windshield wiper switch lamp	1	161	1 CP
Clock lamp	1	168	3 CP
Rear identification[7] lamp	10	1895	2 CP
Underhood lamp	1	93	15 CP
Seat belt warning lamp	1	168	3 CP
Cargo/dome lamp	2	211-2	12 CP
Four wheel drive indicator lamp	1	161	1 CP
Choke heater indicator lamp	1	168	3 CP

LAMP BULB DATA
G TRUCK

USED IN	QUAN.	TRADE #	POWER
Dome lamps	2	211-2	12 CP
Oil pressure indicator lamp	1	161	1 CP
Generator indicator lamp	1	194	2 CP
Instrument cluster lamps[11]	1	161	1 CP
Headlamp beam indicator lamp	1	161	1 CP
Park, directional signal lamps	2	1157	3-32 CP
Tail, stop lamps	2	1157	3-32 CP
License lamp	1	67	4 CP
Head lamps[12]	2	6014	50-60 W
Temperature indicator lamp	1	194	2 CP
Directional signal indicator lamp	2	194	2 CP
Marker lamps	4	168	3 CP
Brake warning indicator lamp	1	194	2 CP
Back-up lamp	2	1156	32 CP
Radio dial lamp	1	1893	2 CP
Heater or A/C Illum. lamp	1	194	2 CP
Transmission control w/tilt wheel Illum. lamp	1	1445	0.7 CP
W/S wiper switch lamp	1	161	1 CP
Transmission control Illum. lamp	1	73	.3 CP
Choke heater indicator lamp	1	1893	2 CP
Seat belt warning lamp	1	194	2 CP
Instrument cluster lamps[9]	5	194	2 CP
Instrument cluster lamps[10]	1	168	3 CP

[1] On CA, KA 10-35 instrument clusters only.

[2] 3 lamps used on instrument cluster on P models or C-K w/o gages.

[3] Double filament sealed beam 60W high beam, 50W low beam.

[4] 2 lamps used with step bumper and P models.

[5] 4 required on P models.

[6] 1157 NA, 2.2-24 CP on C-K models.

[7] Wideside Pickup.

[8] 'P' truck only.

[9] 'G' model w/o gages; 1 lamp with gages.

[10] 'G' model w/o gages; 3 lamps with gages.

[11] 'G' model with gages only.

[12] Double filament sealed beam 60W high beam, 50W low beam.

SECTION 8C

INSTRUMENT PANEL AND GAGES

CONTENTS

SUBJECT **PAGE**

DESCRIPTION

SPEEDOMETER

The speedometer on the instrument panel is a mechanical type that is driven by a cased cable which is connected to the transmission. The speedometer is located in the center of the instrument panel. Refer to figure 1 for diagnosis.

FUEL GAGE

The fuel gage is an electrical, current sensing type of indicator. It has two coils in it. One coil sets up a constant magnetic field. The other coil has a varying magnetic field which is varied by the rheostat attached to a float in the fuel tank. A magnet, attached to a pointer, is located between the two coils. The magnet will establish a position which is controlled by the magnetic fields of the two coils. Refer to figure 2 for diagnosis.

OIL PRESSURE GAGE

The oil pressure gage displays the engine oil pressure. The gage is electrical. The sender is a variable resistance which controls the current passing through the gage. Refer to figure 3 for diagnosis.

TEMPERATURE GAGE

This gage displays the temperature of the engine coolant. It is an electrical gage. The gage's sender is a variable resistance that controls the current passing through the gage. Refer to figure 4 for diagnosis.

ENGINE CONTROL (IGNITION) SWITCH

On the CK and G models, the engine control (ignition) switch is located in the steering column on the right hand side just below the steering wheel. The electrical switching portion of the assembly is separate from the key and lock cylinder. However, both are synchronized and work in conjunction with each other through the action of the actuator rod assembly.

For a complete explanation of the key and lock cylinder, and the actuator rod assembly, see STEERING, (Sec. 3B4).

The engine control (ignition) and starting switch is key operated through the actuator rod assembly to close the ignition primary circuit and to energize the starting motor solenoid for cranking.

On the P models the engine control (ignition) switch is located on the instrument panel. The switch controls the engine run and start functions, and the accessories.

The connections to the engine control (ignition) switch are shown in the Wiring Diagrams at the end of this manual. The charts included on the diagrams show how the switches are internally connected in each switch position.

LAMP SWITCH

The lamp switch controls the headlamps, marker lamps, running lamps and parking lamps. The switch also controls the dome lamps and the light level of the instrument illumination lamps.

DIAGNOSIS—SPEEDOMETER SYSTEM

PROBLEM	POSSIBLE CAUSE	CORRECTION
Noisy	Kinked, pinched or burned casings.	Replace both the cable and casing. Recheck for noise.
"	Bent cable tips.	Replace both the cable and casing. Recheck for noise.
"	Improper or insufficient lubrication of cable.	Lubricate cable core with P/N 6478535 or equivalent. Pack ferrule with grease.
"	Faulty driven gear or rough drive gear.	Remove driven gear assembly from transmission. Check for free rotation of gear in sleeve. Check for burrs, flash or unusual worn spots. If gears appear faulty, replace and recheck for noise.
Whine	Oversize driven gear stem in transmission binds with adapter.	Replace driven gear and stem.
Buzzing sound with manual transmission.	Shift linkage vibration.	Adjust transmission shift linkage.
Tick or ringing sound with jumpy pointer between 0 and 30 MPH.	Faulty speedometer head.	Remove speedometer head for repair.
Sticky speedometer pointer.	Speedometer pointer is bent and rubs.	Remove speedometer cluster or lens and straighten pointer. Recheck speedometer operation.
Incorrect calibration.	Wrong transmission adapter, drive gear or sleeve.	Check speedometer gear reference for correct application and replace if necessary.
"	Oversize or undersize tires.	Check calibration using correct tire size.
"	Faulty speedometer head.	Remove speedometer for repair.

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Figure 1—Diagnosis Of The Speedometer System

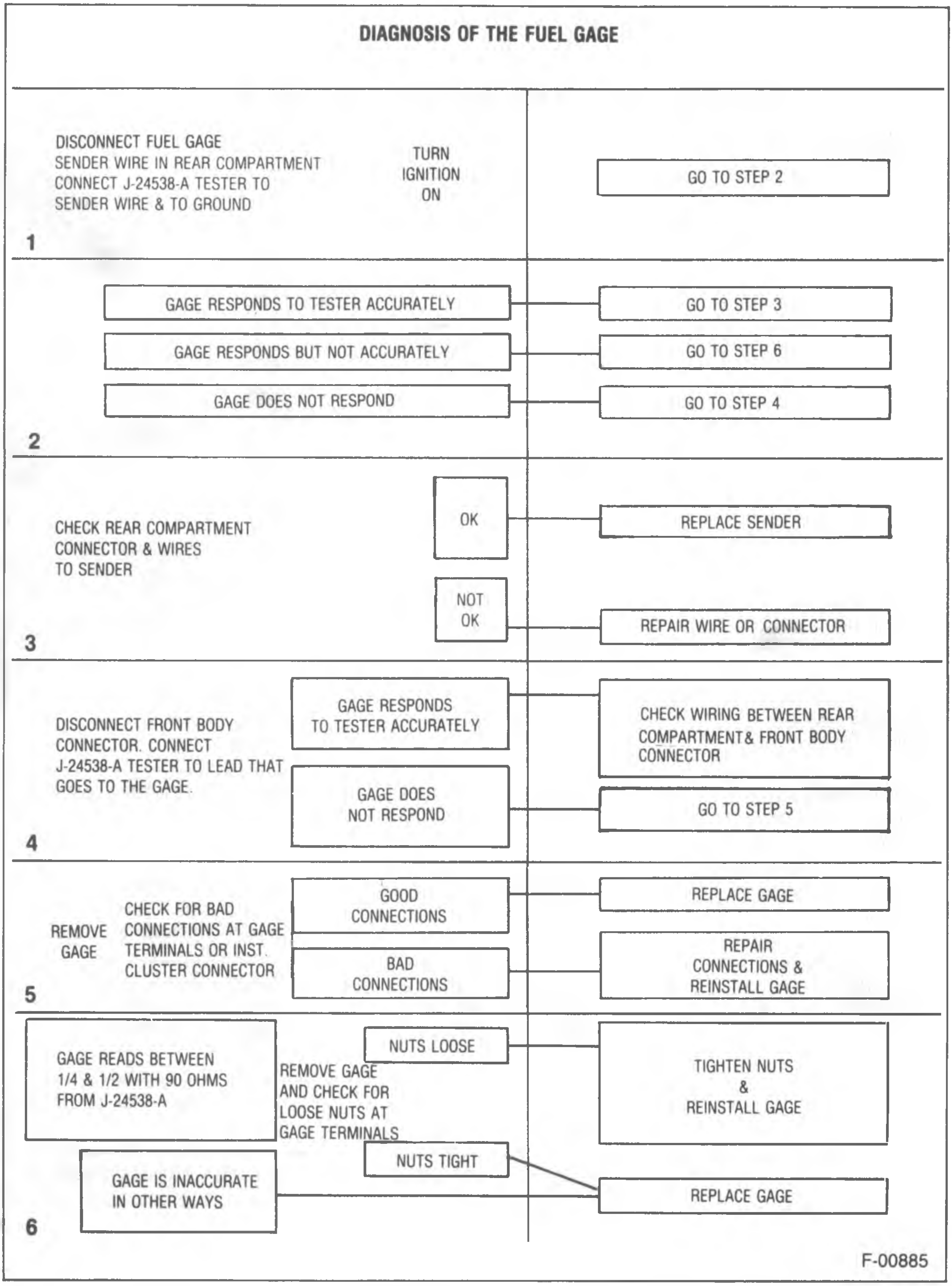


Figure 2—Diagnosis Of The Fuel Gage

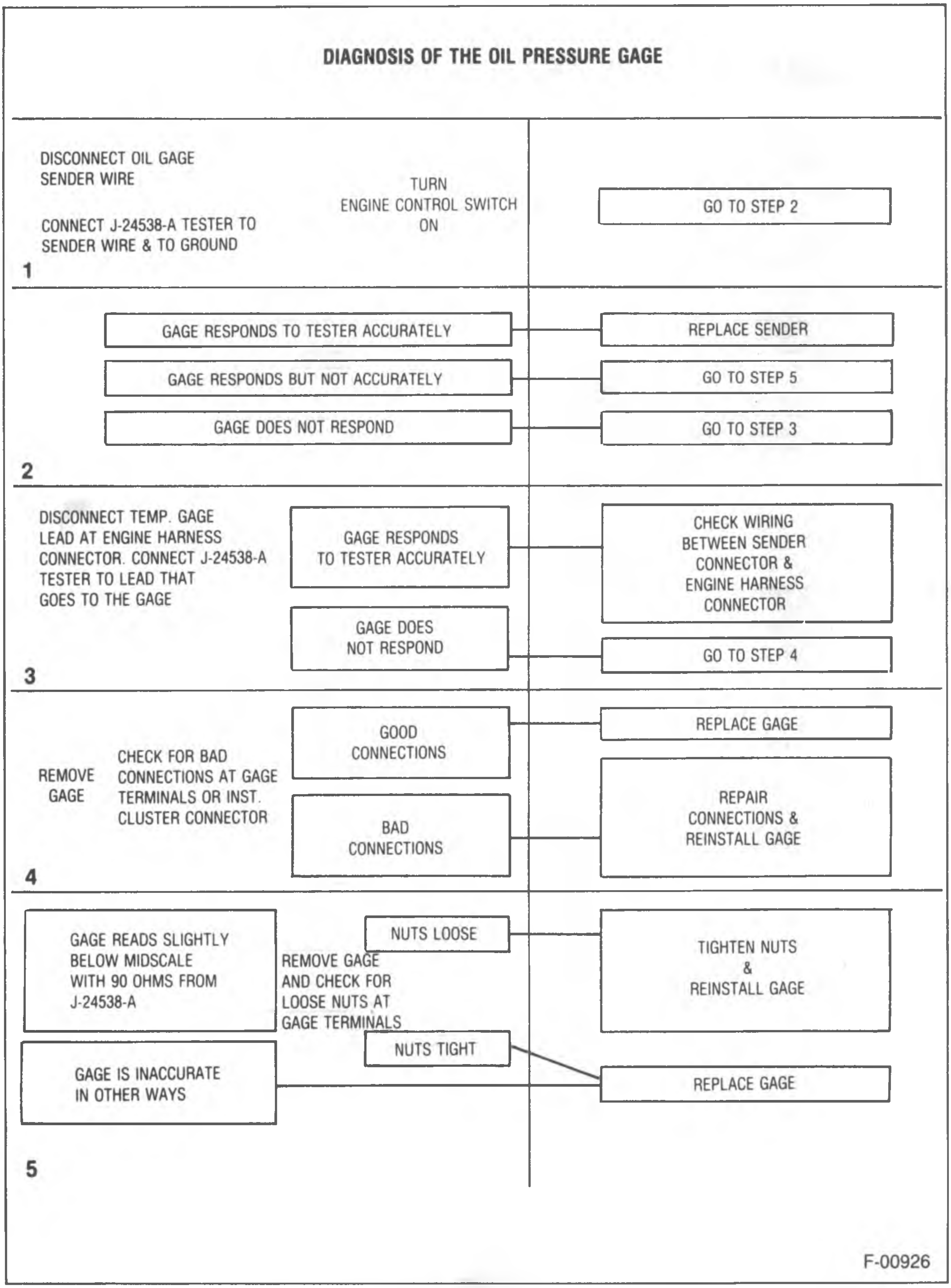


Figure 3—Diagnosis Of The Oil Pressure Gage

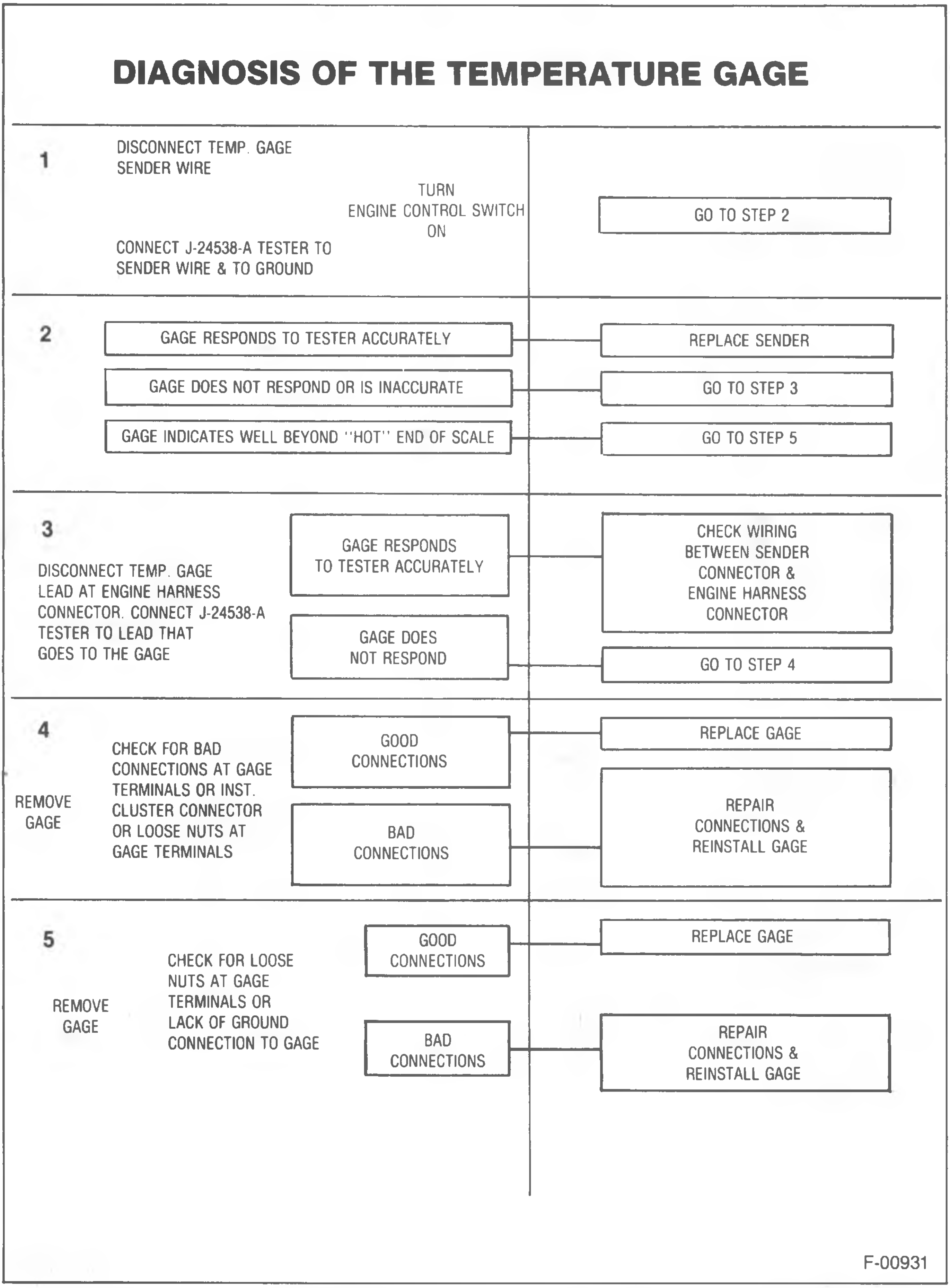


Figure 4—Diagnosis Of The Temperature Gage

ON VEHICLE SERVICE

SPEEDOMETER REPLACEMENT

Servicing of the speedometer assembly should only be performed by trained technicians having the proper test equipment.

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 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.

C-K MODELS

Remove or Disconnect (Figures 5 and 6)

1. Battery ground cable from the battery.
2. Headlamp switch knob assembly. Refer to CHASSIS ELECTRICAL (SEC. 8B).
3. Radio control knobs.
4. Clock adjuster stem.
5. Instrument cluster bezel (43).
6. Steering column cover.
7. Instrument cluster lens (42).
8. Transmission shift indicator (41).
9. Retainer (44).
10. Speedometer cable.
    - Depress spring clip (30).
    - Remove cable and case from the speedometer (36).

Install or Connect (Figures 5 and 6)

1. Speedometer (36).
2. Speedometer cable assembly.
    - Push the cable assembly into the speedometer head, rotating the cable assembly, until the spring clip engages.
3. Retainer (44).
4. Transmission shift indicator (41).
5. Instrument cluster lens (42).
6. Steering column cover.
7. Instrument cluster bezel (43).
8. Clock adjuster stem.
9. Radio control knobs.
10. Headlamp switch knob assembly.
11. Battery ground cable to the battery.

G MODELS

Remove or Disconnect (Figure 7)

1. Battery ground cable from the battery.
2. Instrument cluster. Refer to "Instrument Cluster Replacement" in this section.
3. Speedometer dial retaining screws.
4. Two hex head screws and rubber grommets securing the speedometer assembly to the cluster cover.
5. Speedometer cable assembly from the speedometer.
6. Speedometer (80).

Install or Connect

1. Speedometer (80).
2. Speedometer cable assembly.
3. Two hex head screws and rubber grommets that hold the speedometer assembly to the cluster cover.
4. Speedometer dial retaining screws.
5. Instrument cluster. Refer to "Instrument Cluster Replacement" in this section.
6. Battery ground cable to the battery.

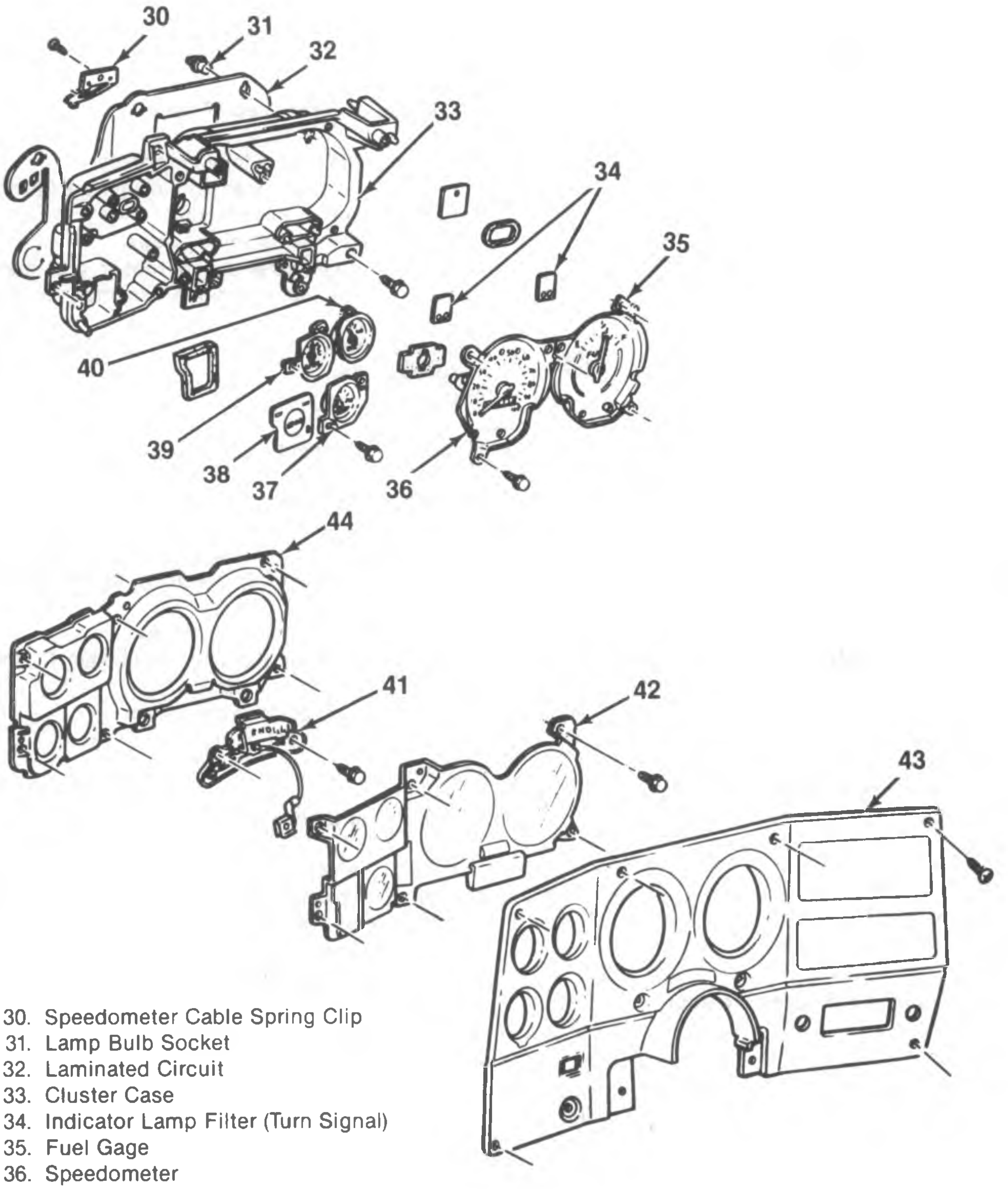
P MODELS

Remove or Disconnect

1. Battery ground cable from the battery.
2. Instrument cluster. Refer to "Instrument Cluster Replacement" in this section.
3. Lamp socket assemblies.
4. Laminated circuit retaining nuts.
5. Laminated circuit.
6. Cluster case retaining screws.
7. Cluster case from the bezel.
8. Speedometer retaining bolts.
9. Speedometer from the cluster case.

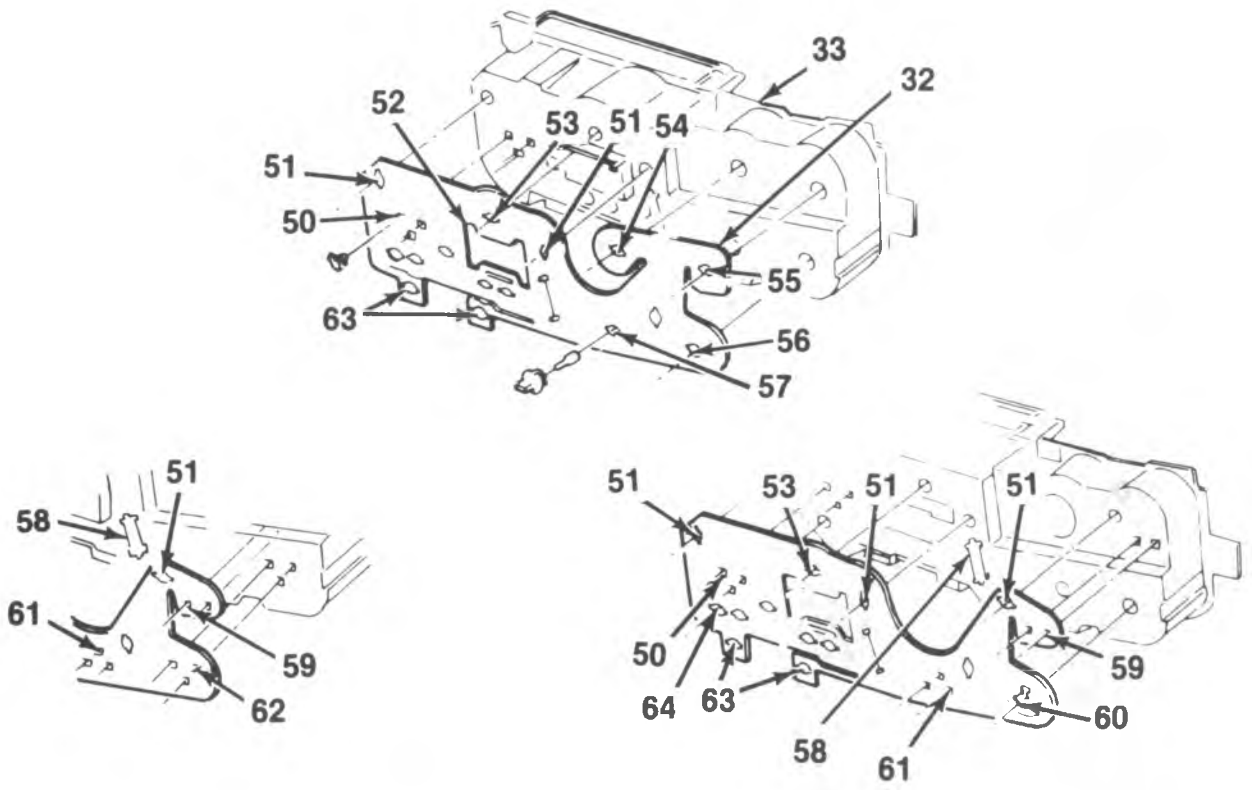
Install or Connect

1. Speedometer to the cluster case.
2. Speedometer retaining bolts.
3. Cluster case to the bezel.
4. Cluster case retaining screws.
5. Laminated circuit.
6. Laminated circuit retaining nuts.
7. Lamp socket assemblies.
8. Instrument cluster. Refer to "Instrument Cluster Replacement" in this section.
9. Battery ground cable from the battery.



30. Speedometer Cable Spring Clip
31. Lamp Bulb Socket
32. Laminated Circuit
33. Cluster Case
34. Indicator Lamp Filter (Turn Signal)
35. Fuel Gage
36. Speedometer
37. Temperature Gage
38. Brake Warning Lamp Filter
39. Ammeter
40. Oil Pressure Gage
41. Transmission Shift Indicator
42. Instrument Cluster Lens
43. Instrument Cluster Bezel
44. Retainer

Figure 5—Instrument Panel — CK Models



32. Laminated Circuit
33. Cluster Case
50. Fuel Gage Clip
51. Lamp Socket Hole
52. Speedometer Hole
53. High Beam Indicator Lamp
54. Oil Pressure Indicator Lamp
55. Engine Temperature Warning Lamp
56. Brake Warning Lamp
57. Charging System Lamp
58. Instrument Cluster Connector
59. Ammeter Clip
60. Brake Warning Lamp/Clock
61. Temperature Gage Clip
62. Fuel Gage Clip
63. Turn Signal Indicator Lamp
64. Brake Warning Lamp

F-00953

Figure 6—Laminated Circuit — CK Models

SPEEDOMETER CABLE CORE REPLACEMENT

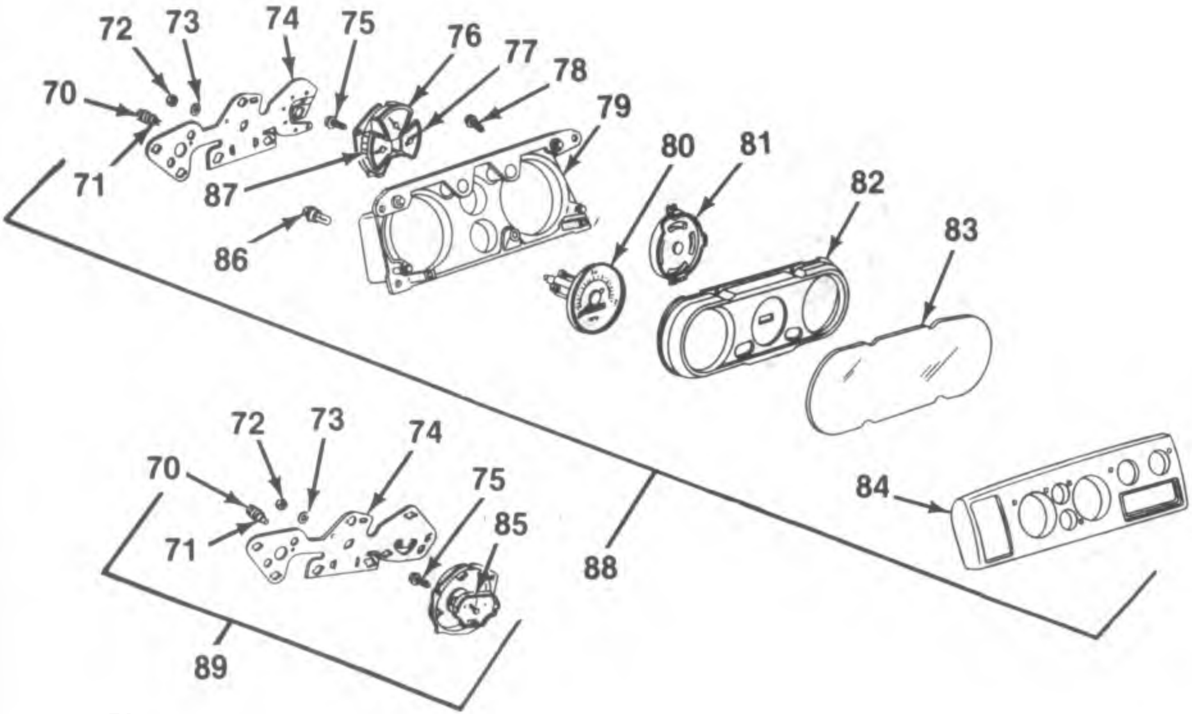
ALL VEHICLES

Remove or Disconnect (Figures 5, 8, 9, and 10)

1. Battery ground cable from the battery.
2. Speedometer cable assembly from the speedometer.
    - Compress the spring clip (30).
    - Pull the cable assembly from the speedometer.
3. Cable core.
    - Pull the core out of the speedometer end of the casing. If the cable core is broken, remove the lower piece of the core from the transmission end of the casing.

Install or Connect (Figures 5, 8, 9, and 10)

1. Lubricant in the casing and on the core.
2. Core into the speedometer end of the casing. Turn the core to engage the drive gear in the transmission.
3. Speedometer cable assembly into the speedometer head until the spring clip (30) engages.
4. Battery ground cable to the battery.



70. Bolt (#8-32 x $^{7}/_{16}$")
71. Speedometer Mounting Bushing
72. Nut
73. Flat Washer
74. Laminated Circuit
75. Screw (#8-18 x $^{7}/_{16}$")
76. Engine Coolant Temperature Gage
77. Voltmeter
78. Screw (#8-16 x $^{7}/_{16}$")
79. Retainer
80. Speedometer
81. Gage Mask
82. Lens Retainer
83. Lens
84. Bezel
85. Fuel Gage
86. Lamp
87. Engine Oil Pressure Gage
88. Instrument Cluster With Gages
89. Instrument Cluster Without Gages

F-00960

Figure 7—Instrument Panel — G Van

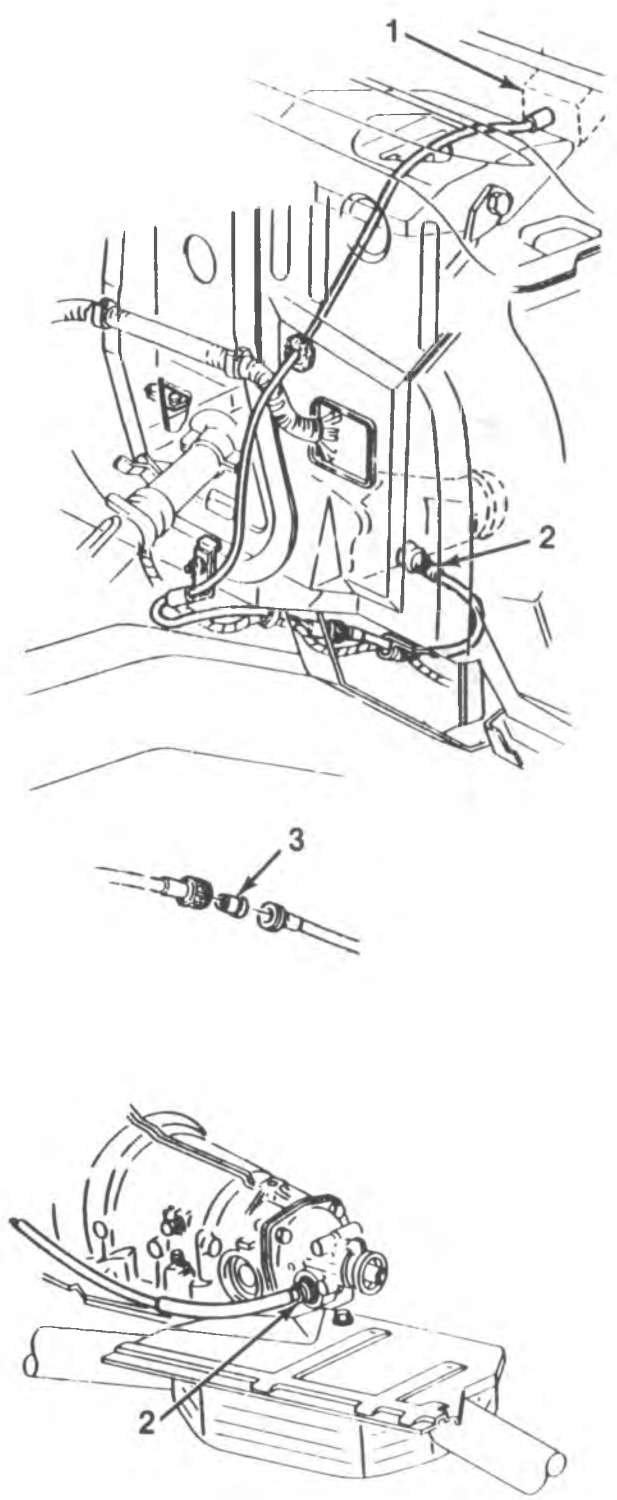
FUEL GAGE REPLACEMENT

Remove or Disconnect (Figures 5 and 6)

1. Battery ground cable from the battery.
2. Headlamp switch knob assembly. Refer to CHASSIS ELECTRICAL (SEC. 8B).
3. Radio control knobs.
4. Clock adjuster stem.
5. Instrument cluster bezel (43).
6. Steering column cover.
7. Instrument cluster lens (42).
8. Transmission shift indicator (41).
9. Case front cover (44).
10. Fuel gage attaching screws.
11. Fuel gage (35).

Install or Connect (Figures 5 and 6)

1. Fuel gage (35).
2. Fuel gage attaching screws.
3. Case front cover (44).
4. Transmission shift indicator (41).
5. Instrument cluster lens (42).
6. Steering column cover.
7. Instrument cluster bezel (43).
8. Clock adjuster stem.
9. Radio control knobs.
10. Headlamp switch knob assembly. Refer to CHASSIS ELECTRICAL (SEC. 8B).
11. Battery ground cable to the battery.



1. Speedometer
2. Speedometer Cable Connector
3. Seal

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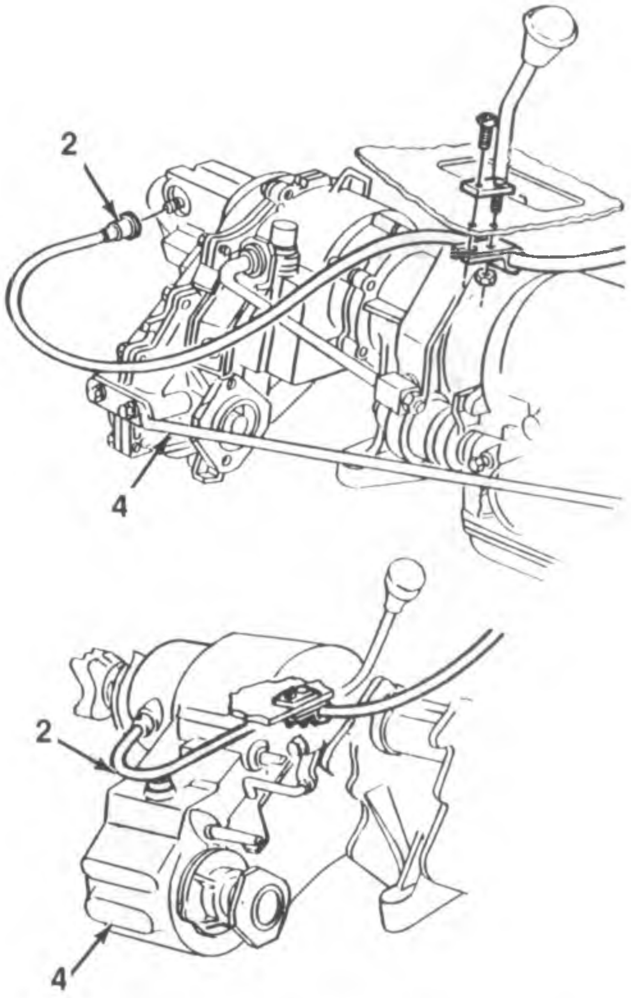
Figure 8—Speedometer Cable Assembly — Two Wheel Drive



2. Speedometer Cable Connector
4. Transfer Case

F-00883

Figure 9—Speedometer Cable Assembly — Four Wheel Drive

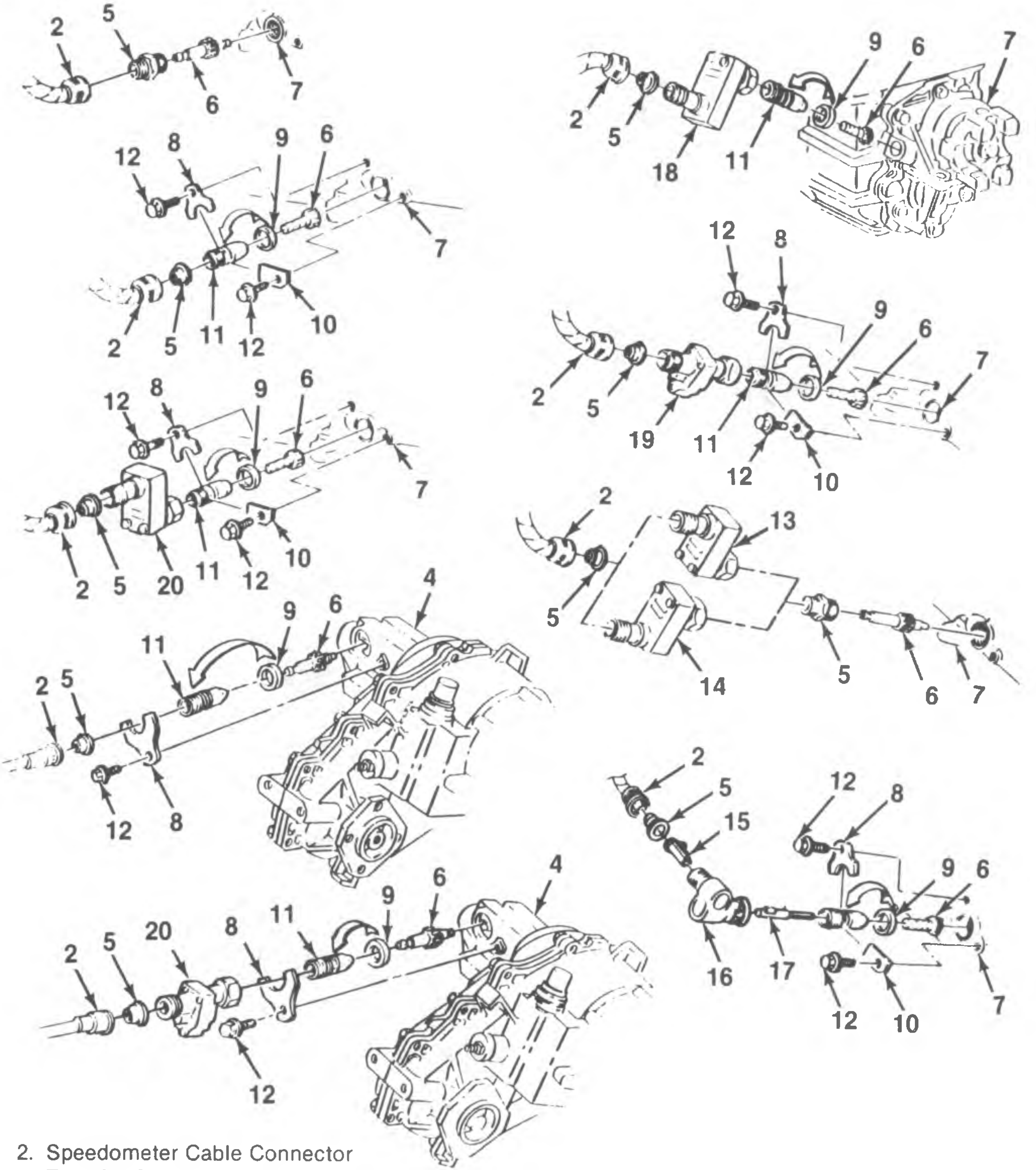
G MODELS

Remove or Disconnect (Figure 7)

1. Battery ground cable from the battery.
2. Instrument cluster assembly. Refer to "Instrument Cluster Replacement" in this section.
3. Lens (83).
4. Lens retainer (82).
5. Laminated circuit retaining nuts.
6. Laminated circuit (74) from the retainer (79).
7. Fuel gage retaining nuts (72).
8. Fuel gage.

Install or Connect (Figure 7)

1. Fuel gage to the laminated circuit.
2. Fuel gage retaining nuts (72).



2. Speedometer Cable Connector
4. Transfer Case
5. Sleeve
6. Gear
7. Transmission
8. Retainer
9. Seal
10. Retainer
11. Sleeve Assembly
12. Bolt
13. Adapter Assembly—Position for All Transmissions Except SM465
14. Adapter Assembly—Position For SM465 Transmission
15. Output Key
16. Adapter Assembly—Right Angle
17. Adapter Assembly
18. In-Line Adapter Assembly (With SM465 Transmission)
19. Parallel Adapter Assembly (Except SM465 Transmission)
20. In-Line Adapter

F-00884

Figure 10—Speedometer Adapter Assemblies

3. Laminated circuit (74) to the retainer (79).
4. Laminated circuit retaining nuts.
5. Lens retainer (82).
6. Lens (83).
7. Instrument cluster assembly. Refer to "Instrument Cluster Replacement" in this section.
8. Battery ground cable to the battery.

P MODELS

Remove or Disconnect

1. Battery ground cable from the battery.
2. Instrument cluster. Refer to "Instrument Cluster Replacement" in this section.
3. Lamp socket assemblies.
4. Laminated circuit retaining nuts.
5. Laminated circuit.
6. Cluster case retaining screws.
7. Cluster case from the bezel.
8. Fuel gage retaining bolts.
9. Fuel gage from the cluster case.

Install or Connect

1. Fuel gage to the cluster case.
2. Fuel gage retaining bolts.
3. Cluster case to the bezel.
4. Cluster case retaining screws.
5. Laminated circuit.
6. Laminated circuit retaining nuts.
7. Lamp socket assemblies.
8. Instrument cluster. Refer to "Instrument Cluster Replacement" in this section.
9. Battery ground cable from the battery.

FUEL SENDER UNIT REPLACEMENT

ALL MODELS

Refer to FUEL SYSTEMS (SEC. 6C).

TEMPERATURE GAGE REPLACEMENT

CK MODELS

Remove or Disconnect (Figure 5)

1. Battery ground cable from the battery.
2. Headlamp switch knob assembly. Refer to CHASSIS ELECTRICAL (SEC. 8B).
3. Radio control knobs.
4. Clock adjuster stem.
5. Instrument cluster bezel (43).
6. Steering column cover.
7. Instrument cluster lens (42).
8. Transmission shift indicator (41).
9. Retainer (44).
10. Temperature gage attaching screws.
11. Temperature gage (37).

Install or Connect (Figure 5)

1. Temperature gage (37).
2. Temperature gage attaching screws.
3. Retainer (44).
4. Transmission shift indicator (41).
5. Instrument cluster lens (42).
6. Steering column cover.
7. Instrument cluster bezel (43).
8. Clock adjuster stem.
9. Radio control knobs.
10. Headlamp switch knob assembly. Refer to CHASSIS ELECTRICAL (SEC. 8B).
11. Battery ground cable to the battery.

G MODELS

Remove or Disconnect (Figure 7)

1. Battery ground cable from the battery.
2. Instrument cluster assembly. Refer to "Instrument Cluster Replacement" in this section.
3. Lens (83).
4. Lens retainer (82).
5. Laminated circuit retaining nuts.
6. Laminated circuit (74) from the retainer (79).
7. Temperature gage retaining nuts (72).
8. Temperature gage (76).

Install or Connect (Figure 7)

1. Temperature gage (76) to the laminated circuit.
2. Temperature gage retaining nuts (72).
3. Laminated circuit (74) to the retainer (79).
4. Laminated circuit retaining nuts.
5. Lens retainer (82).
6. Lens (83).
7. Instrument cluster assembly. Refer to "Instrument Cluster Replacement" in this section.
8. Battery ground cable to the battery.

P MODELS

Remove or Disconnect

1. Battery ground cable from the battery.
2. Instrument cluster. Refer to "Instrument Cluster Replacement" in this section.
3. Lamp socket assemblies.
4. Laminated circuit retaining nuts.
5. Laminated circuit.
6. Cluster case retaining screws.
7. Cluster case from the bezel.
8. Temperature gage retaining bolts.
9. Temperature gage from the cluster case.

Install or Connect

1. Temperature gage to the cluster case.
2. Temperature gage retaining bolts.
3. Cluster case to the bezel.
4. Cluster case retaining screws.
5. Laminated circuit.
6. Laminated circuit retaining nuts.
7. Lamp socket assemblies.
8. Instrument cluster. Refer to "Instrument Cluster Replacement" in this section.
9. Battery ground cable from the battery.

TEMPERATURE GAGE SENDER REPLACEMENT

ALL MODELS

CAUTION: Do not remove cap with the engine hot. Allow the vehicle to cool off first.

Remove or Disconnect

1. Radiator cap.
    - Loosen the cap to the first stop. This will relieve the cooling system pressure.
    - Tighten the cap. This will minimize the loss of coolant when replacing the temperature sender.
2. Sender harness connector.
3. Sender.
    - Have the new sender ready to install or close the sender hole with a cork in order to minimize coolant loss.

Install or Connect

1. Sender.
2. Sender harness connector.
3. Coolant to return the coolant level to the proper level.

OIL PRESSURE GAGE REPLACEMENT

CK MODELS

Remove or Disconnect (Figure 5)

1. Battery ground cable from the battery.
2. Headlamp switch knob assembly. Refer to CHASSIS ELECTRICAL (SEC. 8B).
3. Radio control knobs.
4. Clock adjuster stem.
5. Instrument cluster bezel (43).
6. Steering column cover.
7. Instrument cluster lens (42).
8. Transmission shift indicator (41).
9. Retainer (44).
10. Oil pressure gage attaching screws.
11. Oil pressure gage (40).

Install or Connect

1. Oil pressure gage (40).
2. Oil pressure gage attaching screws.
3. Retainer.
4. Transmission shift indicator (41).
5. Instrument cluster lens (42).
6. Steering column cover.
7. Instrument cluster bezel (43).
8. Clock adjuster stem.
9. Radio control knobs.
10. Headlamp switch knob assembly. Refer to CHASSIS ELECTRICAL (SEC. 8B).
11. Battery ground cable to the battery.

G MODELS

Remove or Disconnect (Figure 7)

1. Battery ground cable from the battery.
2. Instrument cluster assembly. Refer to "Instrument Cluster Replacement" in this section.
3. Lens (83).
4. Lens retainer (82).
5. Laminated circuit retaining nuts.
6. Laminated circuit (74) from the retainer (79).
7. Oil pressure gage retaining nuts (72).
8. Oil pressure gage (87).

Install or Connect (Figure 7)

1. Fuel gage (87) to the laminated circuit.
2. Fuel gage retaining nuts (72).
3. Laminated circuit (74) to the retainer (79).
4. Laminated circuit retaining nuts.
5. Lens retainer (82).
6. Lens (83).
7. Instrument cluster assembly. Refer to "Instrument Cluster Replacement" in this section.
8. Battery ground cable to the battery.

P MODELS

Remove or Disconnect

1. Battery ground cable from the battery.
2. Instrument cluster. Refer to "Instrument Cluster Replacement" in this section.
3. Lamp socket assemblies.
4. Laminated circuit retaining nuts.
5. Laminated circuit.
6. Cluster case retaining screws.
7. Cluster case from the bezel.
8. Oil pressure gage retaining bolts.
9. Oil pressure gage from the cluster case.

Install or Connect

1. Oil pressure gage to the cluster case.
2. Oil pressure gage retaining bolts.
3. Cluster case to the bezel.
4. Cluster case retaining screws.
5. Laminated circuit.
6. Laminated circuit retaining nuts.
7. Lamp socket assemblies.
8. Instrument cluster. Refer to "Instrument Cluster Replacement" in this section.
9. Battery ground cable from the battery.

OIL PRESSURE GAGE SENDER REPLACEMENT

ALL MODELS

Remove or Disconnect

Tool Required: J-21757

1. Battery ground cable from the battery.
2. Wiring harness connector from the sender.
    - L-6 engines — the sender is located in the block above the starter.
    - V-8 engines — the sender is located at the left front side of the distributor.
    - V-8 (454) engines — the sender is located at the rear left side of the block.
3. Sender.
    - Use Tool J-21757.

Install or Connect

Tool Required: J-21757

1. Sender.
    - Use Tool J-21757.
2. Wiring harness connector to the sender.
3. Battery ground cable to the battery.

VOLTMETER REPLACEMENT

CK MODELS

Remove or Disconnect (Figure 5)

1. Battery ground cable from the battery.
2. Headlamp switch knob assembly. Refer to CHASSIS ELECTRICAL (SEC. 8B).
3. Radio control knobs.
4. Clock adjuster stem.
5. Instrument cluster bezel (43).
6. Steering column cover.
7. Instrument cluster lens (42).
8. Transmission shift indicator (41).
9. Retainer (44).
10. Voltmeter attaching screws.
11. Voltmeter.

Install or Connect (Figure 5)

1. Voltmeter.
2. Voltmeter attaching screws.
3. Retainer (44).
4. Transmission shift indicator (41).
5. Instrument cluster lens (42).
6. Steering column cover.
7. Instrument cluster bezel (43).
8. Clock adjuster stem.
9. Radio control knobs.
10. Headlamp switch knob assembly.
11. Battery ground cable to the battery.

G MODELS

Remove or Disconnect (Figure 7)

1. Battery ground cable from the battery.
2. Instrument cluster assembly. Refer to "Instrument Cluster Replacement" in this section.
3. Lens (83).
4. Lens retainer (82).
5. Laminated circuit retaining nuts.
6. Laminated circuit (74) from the retainer (79).
7. Voltmeter retaining nuts (72).
8. Voltmeter.

Install or Connect (Figure 7)

1. Voltmeter to the laminated circuit.
2. Voltmeter retaining nuts (72).
3. Laminated circuit (74) to the retainer (79).
4. Laminated circuit retaining nuts.
5. Lens retainer (82).
6. Lens (83).
7. Instrument cluster assembly. Refer to "Instrument Cluster Replacement" in this section.
8. Battery ground cable to the battery.

P MODELS

Remove or Disconnect

1. Battery ground cable from the battery.
2. Instrument cluster. Refer to "Instrument Cluster Replacement" in this section.
3. Lamp socket assemblies.
4. Laminated circuit retaining nuts.
5. Laminated circuit.
6. Cluster case retaining screws.
7. Cluster case from the bezel.
8. Voltmeter retaining bolts.
9. Voltmeter from the cluster case.

Install or Connect

1. Voltmeter to the cluster case.
2. Voltmeter retaining bolts.
3. Cluster case to the bezel.
4. Cluster case retaining screws.
5. Laminated circuit.
6. Laminated circuit retaining nuts.
7. Lamp socket assemblies.
8. Instrument cluster. Refer to "Instrument Cluster Replacement" in this section.
9. Battery ground cable from the battery.

INSTRUMENT CLUSTER REPLACEMENT

CK MODELS

Remove or Disconnect (Figure 5)

1. Battery ground cable from the battery.
2. Headlamp switch knob assembly.
3. Radio control knobs.
4. Four steering column cover retaining screws.
5. Steering column cover.
6. Eight instrument bezel retaining scerws.
7. Instrument bezel (43).
8. Speedometer drive cable.
   - Press the spring clip (30) at the speedometer (36).
   - Pull the cable from the speedometer head.
9. Four cluster retaining screws.
10. Cluster harness connector.
11. Cluster.

Install or Connect (Figure 5)

1. Cluster.
2. Cluster harness connector.
3. Four cluster retaining screws.
4. Speedometer drive cable.
5. Instrument bezel (43).
6. Eight instrument bezel retaining screws.
7. Steering column cover.
8. Four steering column cover retaining screws.
9. Radio control knobs.
10. Headlamp switch knob assembly.
11. Battery ground cable to the battery.

G MODELS

Remove or Disconnect (Figure 7)

1. Battery ground cable from the battery.
2. Speedometer drive cable.
   - Press in the tang on the speedometer head.
   - Pull out the drive cable.
3. Clock set stem knob.
4. Instrument cluster bezel retaining screws.
5. Instrument bezel (84).
6. Two lower cluster retaining screws.
7. Cluster.
   - Pull the top of the cluster away from the instrument panel.
   - Lift out the bottom of the cluster.
8. Instrument cluster harness connnector.

Install or Connect (Figure 7)

1. Cluster harness connector into the cluster.
2. Cluster.
3. Two lower cluster retaining screws.
4. Instrument bezel (84).
5. Instrument cluster bezel retaining screws.
6. Clock set stem knob.
7. Speedometer drive cable.
8. Battery ground cable to the battery.

P MODELS

Remove or Disconnect

1. Battery ground cable from the battery.
2. Speedometer drive cable.
   - Press in the tang on the speedometer head.
   - Pull out the drive cable.

3. Instrument cluster harness connector.
4. Instrument cluster bezel screws.
5. Instrument cluster from the dash panel.

→← Install or Connect

1. Instrument cluster to the dash panel.
2. Instrument cluster bezel screws.
3. Instrument cluster harness connector.
4. Speedometer drive cable.
5. Battery ground cable from the battery.

LAMINATED (PRINTED) CIRCUIT REPLACEMENT

ALL MODELS

←→ Remove or Disconnect (Figures 5, 6, and 7)

1. Instrument cluster assembly. Refer to "Instrument Cluster Replacement" in this section.
2. Instrument cluster lamp bulb assemblies (57).
3. Laminated circuit retaining screws.
4. G and P models.
    - Fuel gage terminal nuts.
    - Temperature gage terminal nuts.
    - Ammeter terminal nuts.
5. Laminated circuit from the cluster case (33).

→← Install or Connect (Figures 5, 6, and 7)

1. Laminated circuit (51) to the cluster case (33).
2. Laminated circuit retaining screws.
3. G and P models.
    - Fuel gage terminal nuts.
    - Ammeter terminal nuts.
4. Instrument cluster lamp bulb assemblies (57).
5. Instrument cluster assembly. Refer to "Instrument Cluster Replacement" in this section.

IGNITION SWITCH REPLACEMENT

Refer to STEERING COLUMN (SEC. 3B4).

LAMP SWITCH REPLACEMENT

Refer to CHASSIS ELECTRICAL (SEC. 8B).

SPECIAL TOOLS

Tool J-21757-03 Oil Pressure Sending Unit Socket

SECTION 9A

RADIO

CONTENTS

DESCRIPTION

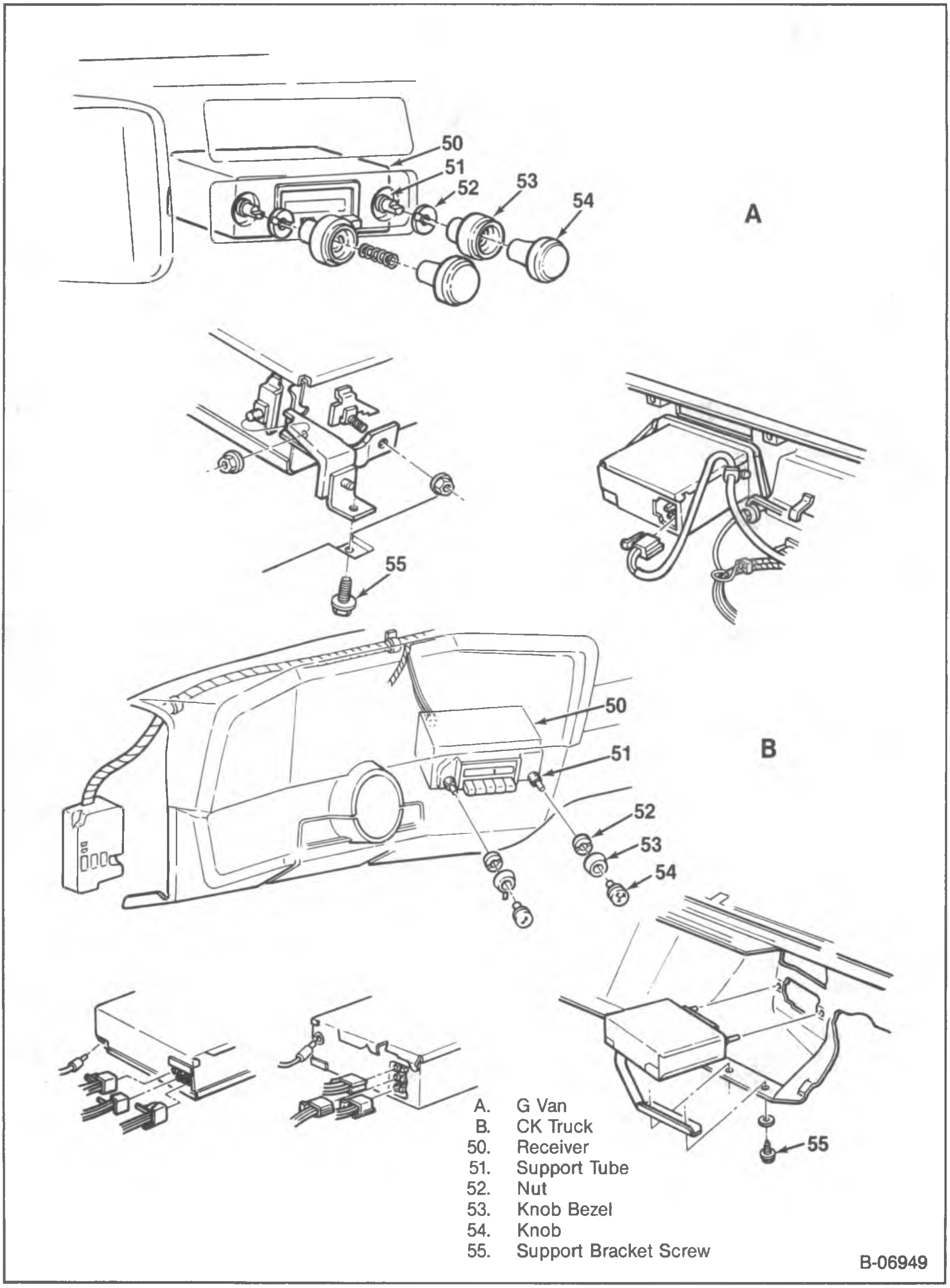
For operation of the factory installed standard and optional radios available, refer to the Owner's Manual or radio supplement supplied with the vehicle.

The receiver is mounted using the front support tubes surrounding the control shafts, and a rear support bracket. The front support tubes are secured with nuts. The rear support bracket is secured with a screw.

The power, antenna, and speaker harnesses connect to the rear of the receiver.

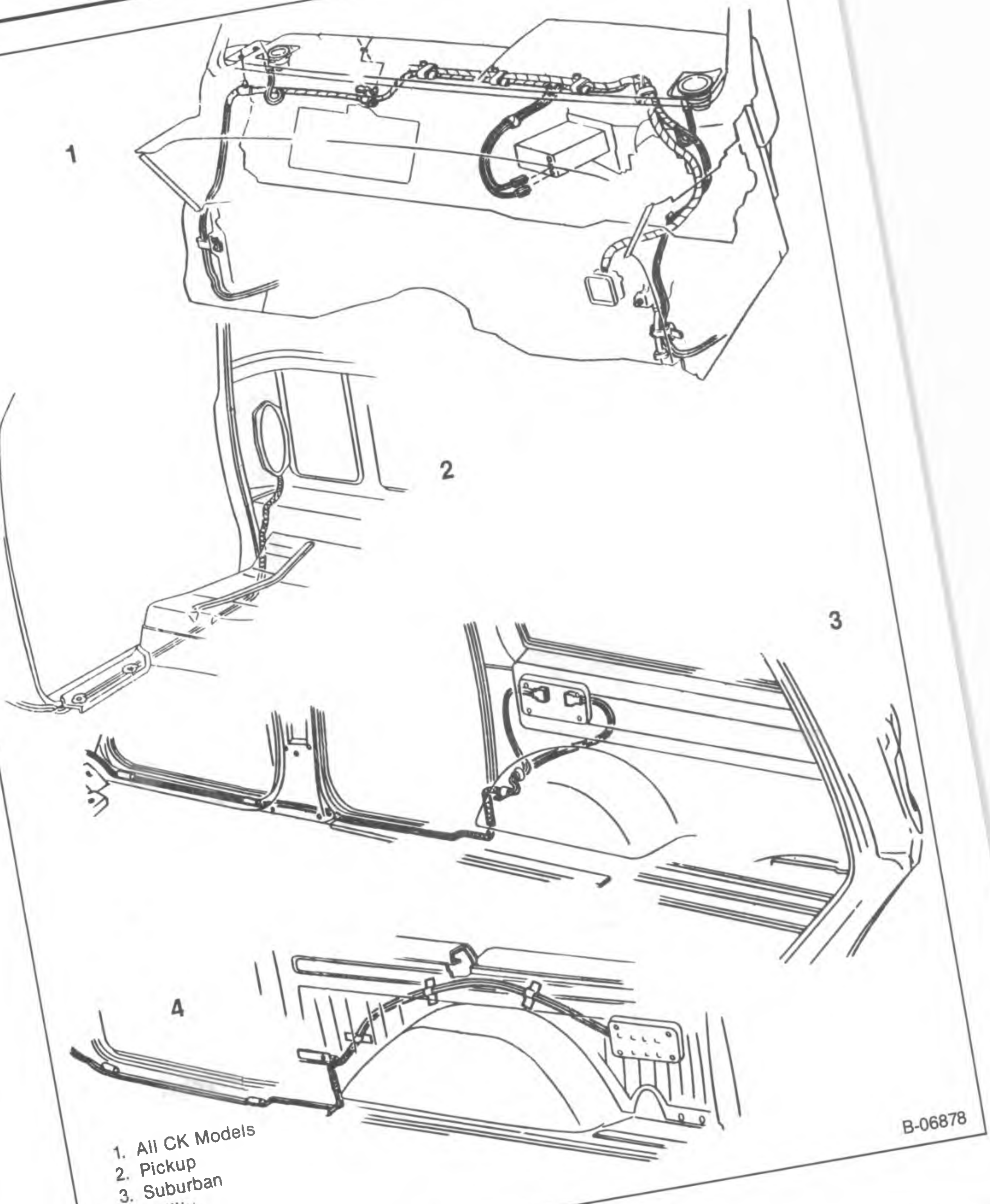
Depending on the system, the speakers can be mounted at the center or end of the dash, in the side panels or in the rear corners of the cab.

The antenna may be mounted in the windshield, or on the right front corner of the vehicle.



A. G Van
B. CK Truck
50. Receiver
51. Support Tube
52. Nut
53. Knob Bezel
54. Knob
55. Support Bracket Screw

Figure 1—Receiver Installation CK & G



1. All CK Models
2. Pickup
3. Suburban
4. Utility

Figure 2—CK Speaker Harness

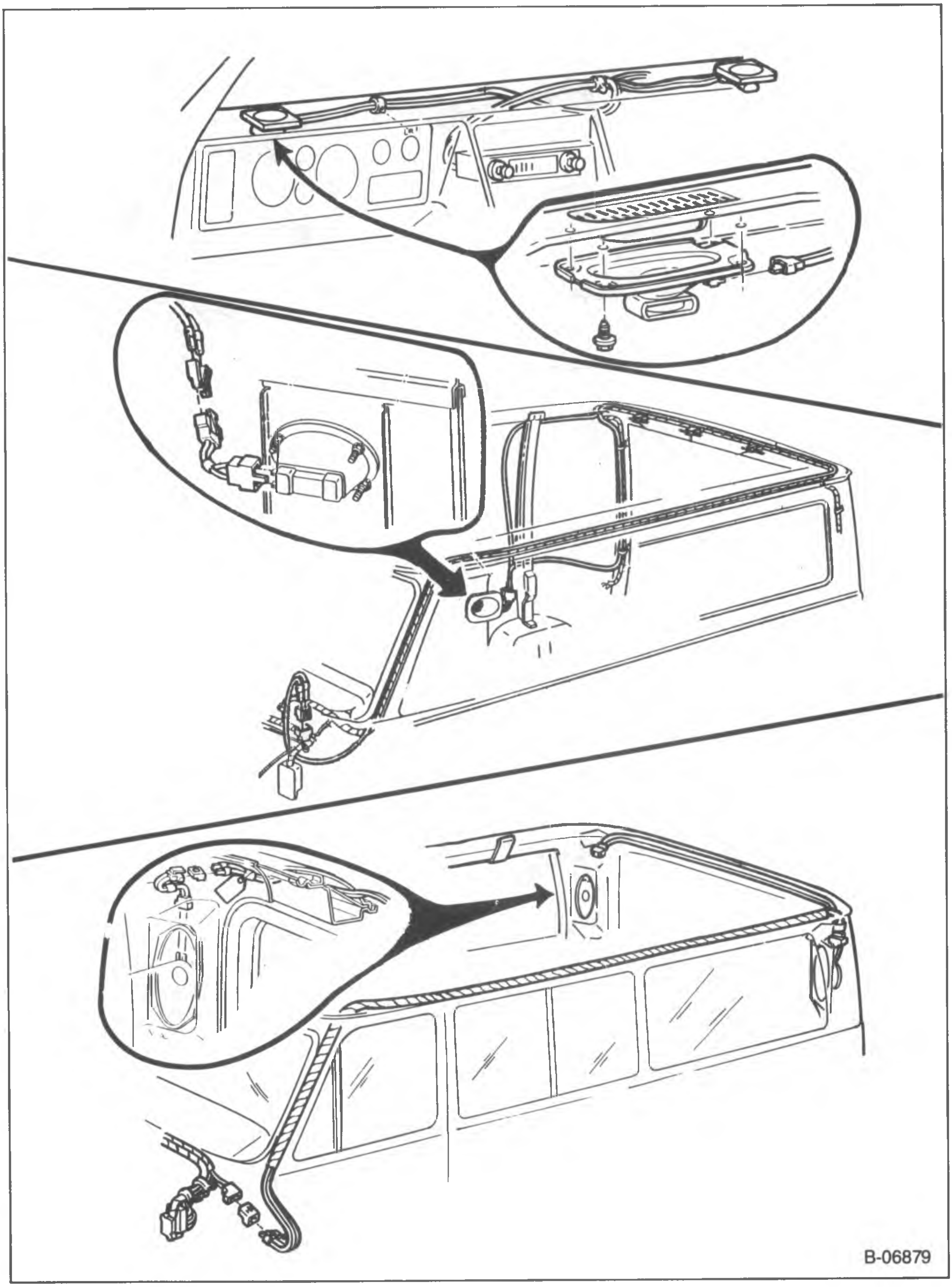


Figure 3—G Speaker Harness

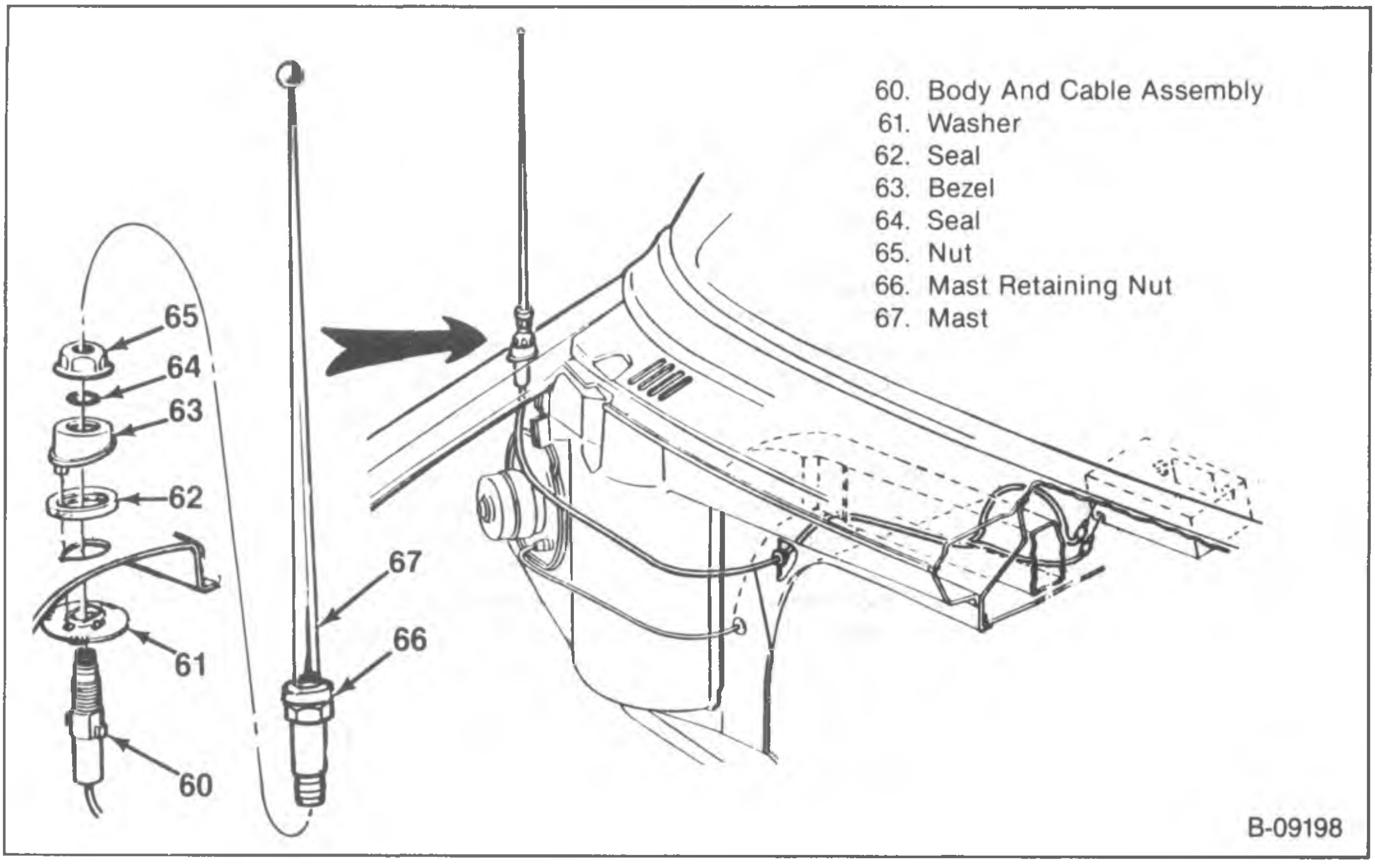


Figure 4—G Antenna System

DIAGNOSIS

Since radio problems are most often 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 showing up as "NO TROUBLE FOUND" units when received by the warranty repair stations. Many times, when this is the case, the trouble usually could have been corrected without removal of the radio, such as noise complaints.

The inconvenience of driving without a radio, while the set is being serviced at a warranty repair station, can frequently be avoided if the following quick checks are used to eliminate external radio system problems before removing the radio for repair:

- Test the radios outside, with the hood down.
- Most noise can be found on weak "AM" stations near the low frequency and end of the band
- Ignition noise on FM indicates a possible faulty HEI system.
- If a test antenna is used, ground the base to the car body and DO NOT HOLD THE MAST.
- 90% of the noises enter via the antenna.
- A small amount of ignition noise may be normal when the HEI is located near the cowl (windshield antennas only).
- Coated screws or bolts CAN act as a poor ground.
- Windshield antennas are more prone to noise and station directivity.
- Most hoses are conductive unless they have a white stripe.
- When shielding the dash, wire, hose, etc., use foil or screen and ground it.
- Weak or fading "AM" is often caused by improperly adjusted antenna trimmer (when present).

Always determine the exact nature of the radio problem as an aid to diagnosis. Knowing whether the condition is intermittent or constant, whether it occurs with engine off or running, and whether it occurs with car stationary or moving, will help to pinpoint the problem. Use Chart 1 to isolate radio problems, then proceed to the diagnostic charts.

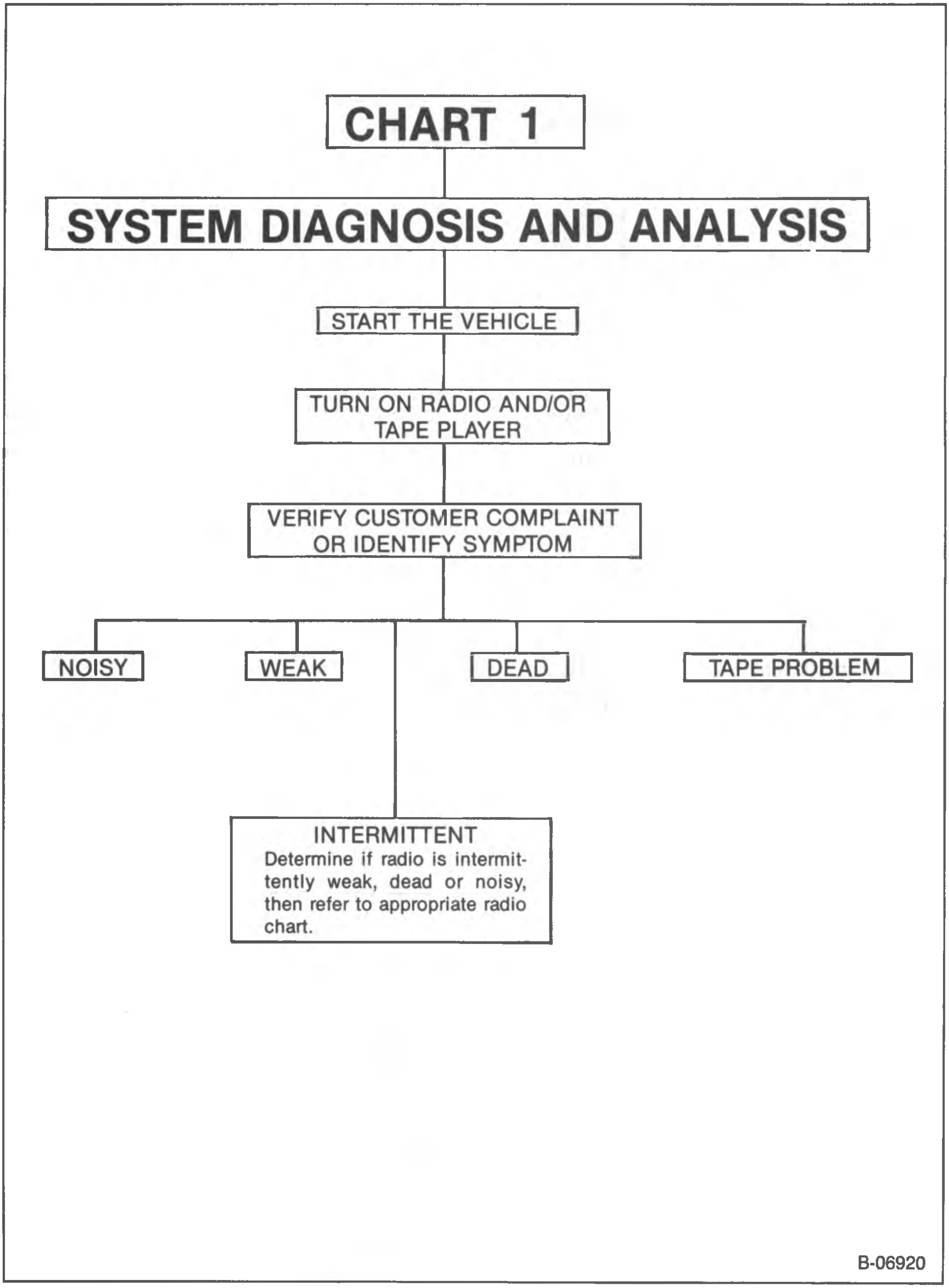


Figure 5—Chart 1

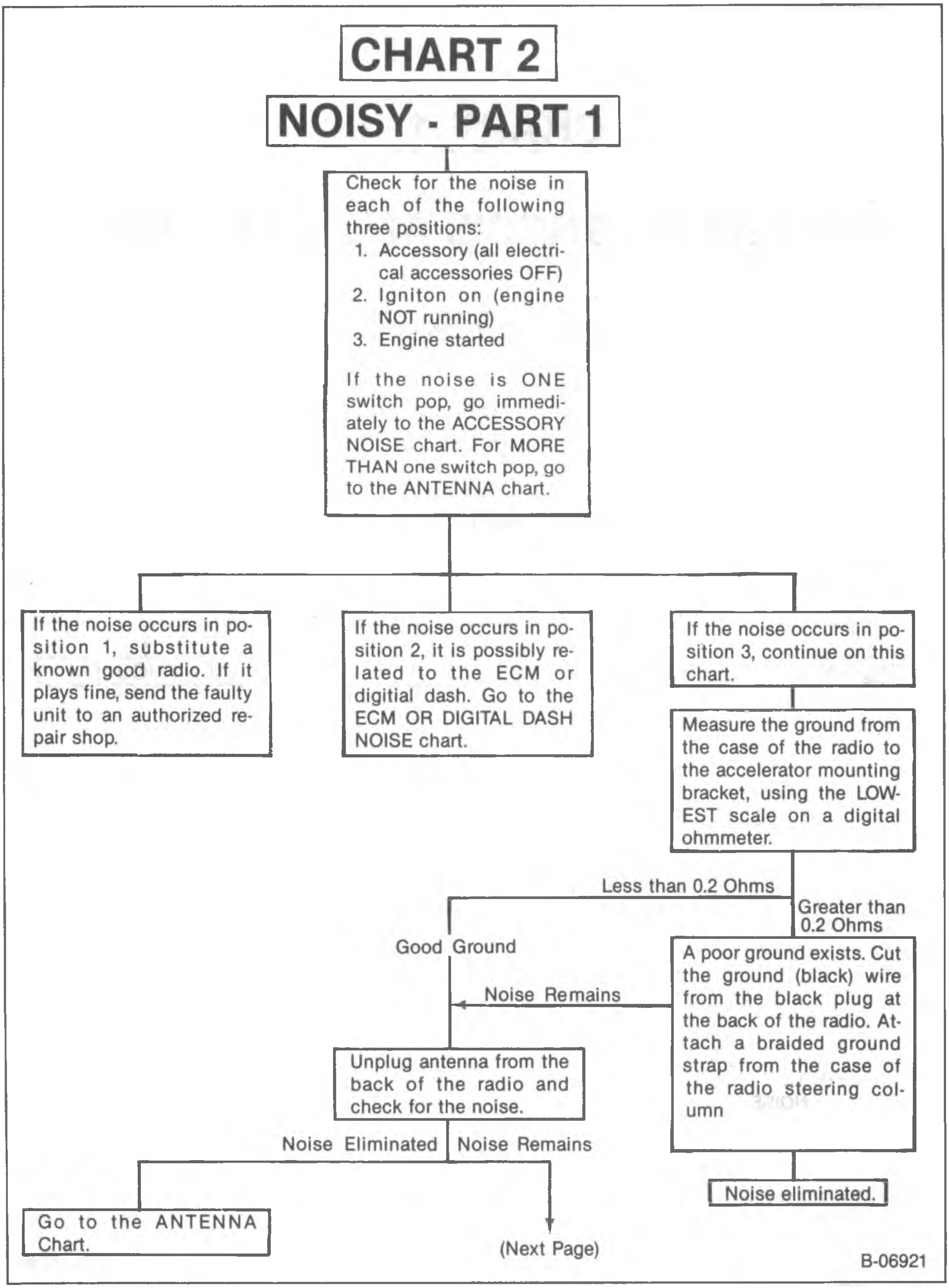


CHART 2

NOISY - PART 1

Check for the noise in each of the following three positions:

1. Accessory (all electrical accessories OFF)
2. Igniton on (engine NOT running)
3. Engine started

If the noise is ONE switch pop, go immediately to the ACCESSORY NOISE chart. For MORE THAN one switch pop, go to the ANTENNA chart.

If the noise occurs in position 1, substitute a known good radio. If it plays fine, send the faulty unit to an authorized repair shop.

If the noise occurs in position 2, it is possibly related to the ECM or digitial dash. Go to the ECM OR DIGITAL DASH NOISE chart.

If the noise occurs in position 3, continue on this chart.

Measure the ground from the case of the radio to the accelerator mounting bracket, using the LOWEST scale on a digital ohmmeter.

A poor ground exists. Cut the ground (black) wire from the black plug at the back of the radio. Attach a braided ground strap from the case of the radio steering column

Noise eliminated.

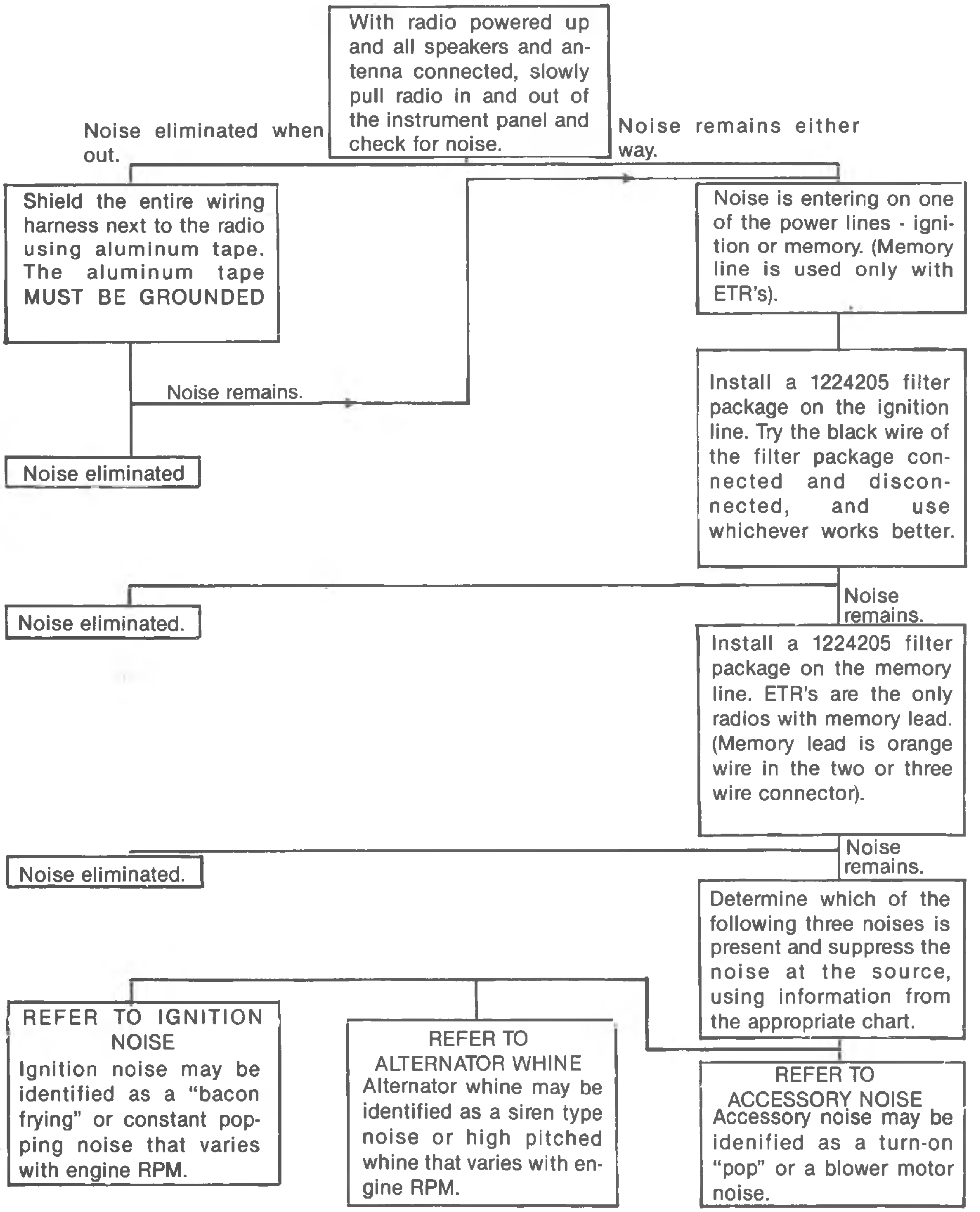
Unplug antenna from the back of the radio and check for the noise.

Go to the ANTENNA Chart.

Figure 6—Chart 2 (Noisy Part 1)

CHART 3

NOISY - PART 2



With radio powered up and all speakers and antenna connected, slowly pull radio in and out of the instrument panel and check for noise.

Shield the entire wiring harness next to the radio using aluminum tape. The aluminum tape MUST BE GROUNDED

Noise is entering on one of the power lines - ignition or memory. (Memory line is used only with ETR's).

Install a 1224205 filter package on the ignition line. Try the black wire of the filter package connected and disconnected, and use whichever works better.

Install a 1224205 filter package on the memory line. ETR's are the only radios with memory lead. (Memory lead is orange wire in the two or three wire connector).

Determine which of the following three noises is present and suppress the noise at the source, using information from the appropriate chart.

REFER TO IGNITION NOISE
Ignition noise may be identified as a "bacon frying" or constant popping noise that varies with engine RPM.

REFER TO ALTERNATOR WHINE
Alternator whine may be identified as a siren type noise or high pitched whine that varies with engine RPM.

REFER TO ACCESSORY NOISE
Accessory noise may be idenified as a turn-on "pop" or a blower motor noise.

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Figure 7—Chart 3 (Noisy Part 2)

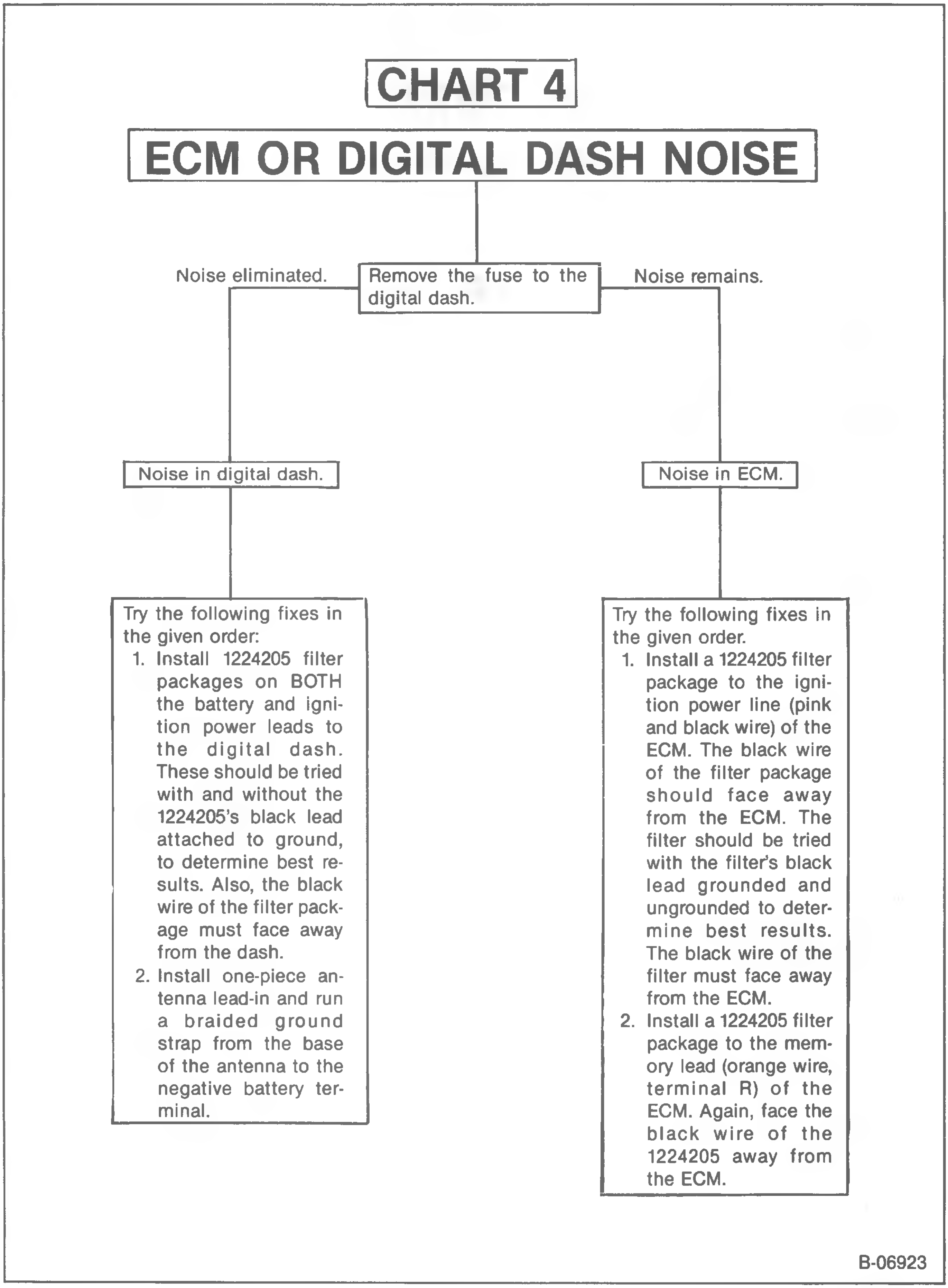

CHART 4

ECM OR DIGITAL DASH NOISE

Remove the fuse to the digital dash.

Noise in digital dash.

Try the following fixes in the given order:

1. Install 1224205 filter packages on BOTH the battery and ignition power leads to the digital dash. These should be tried with and without the 1224205's black lead attached to ground, to determine best results. Also, the black wire of the filter package must face away from the dash.
2. Install one-piece antenna lead-in and run a braided ground strap from the base of the antenna to the negative battery terminal.

Noise in ECM.

Try the following fixes in the given order.

1. Install a 1224205 filter package to the ignition power line (pink and black wire) of the ECM. The black wire of the filter package should face away from the ECM. The filter should be tried with the filter's black lead grounded and ungrounded to determine best results. The black wire of the filter must face away from the ECM.
2. Install a 1224205 filter package to the memory lead (orange wire, terminal R) of the ECM. Again, face the black wire of the 1224205 away from the ECM.

Figure 8—Chart 4 (ECM or Digital Dash Noise)

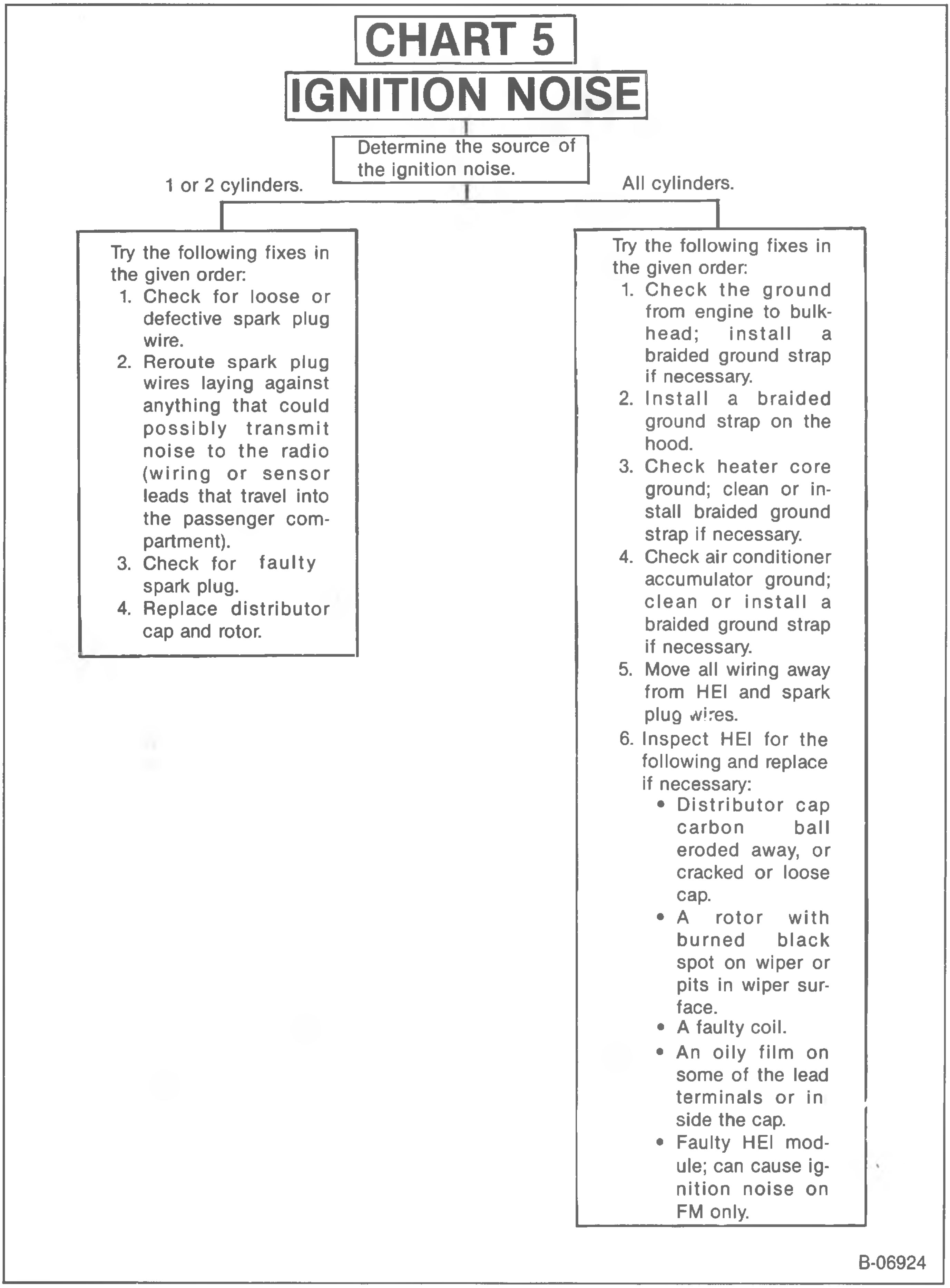

CHART 5

IGNITION NOISE

Determine the source of the ignition noise.

1 or 2 cylinders.

Try the following fixes in the given order:

1. Check for loose or defective spark plug wire.
2. Reroute spark plug wires laying against anything that could possibly transmit noise to the radio (wiring or sensor leads that travel into the passenger compartment).
3. Check for faulty spark plug.
4. Replace distributor cap and rotor.

All cylinders.

Try the following fixes in the given order:

1. Check the ground from engine to bulkhead; install a braided ground strap if necessary.
2. Install a braided ground strap on the hood.
3. Check heater core ground; clean or install braided ground strap if necessary.
4. Check air conditioner accumulator ground; clean or install a braided ground strap if necessary.
5. Move all wiring away from HEI and spark plug wires.
6. Inspect HEI for the following and replace if necessary:
   - Distributor cap carbon ball eroded away, or cracked or loose cap.
   - A rotor with burned black spot on wiper or pits in wiper surface.
   - A faulty coil.
   - An oily film on some of the lead terminals or inside the cap.
   - Faulty HEI module; can cause ignition noise on FM only.

Figure 9—Chart 5 (Ignition Noise)

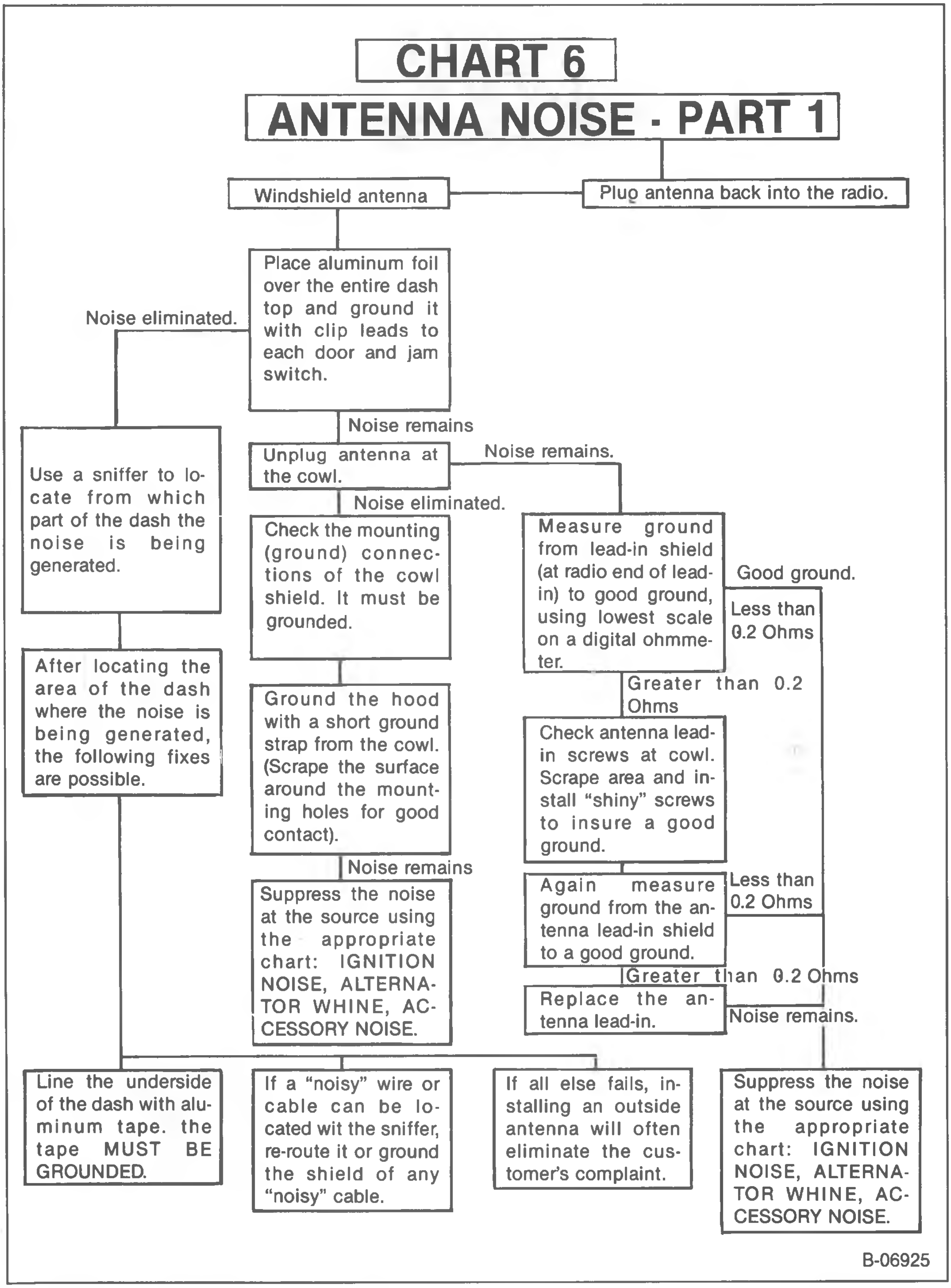

CHART 6

ANTENNA NOISE - PART 1

Plug antenna back into the radio.

Windshield antenna

Place aluminum foil over the entire dash top and ground it with clip leads to each door and jam switch.

Noise eliminated.

Use a sniffer to locate from which part of the dash the noise is being generated.

After locating the area of the dash where the noise is being generated, the following fixes are possible.

Line the underside of the dash with aluminum tape. the tape MUST BE GROUNDED.

If a "noisy" wire or cable can be located wit the sniffer, re-route it or ground the shield of any "noisy" cable.

If all else fails, installing an outside antenna will often eliminate the customer's complaint.

Noise remains

Unplug antenna at the cowl.

Noise eliminated.

Check the mounting (ground) connections of the cowl shield. It must be grounded.

Ground the hood with a short ground strap from the cowl. (Scrape the surface around the mounting holes for good contact).

Noise remains

Suppress the noise at the source using the appropriate chart: IGNITION NOISE, ALTERNATOR WHINE, ACCESSORY NOISE.

Noise remains.

Measure ground from lead-in shield (at radio end of lead-in) to good ground, using lowest scale on a digital ohmmeter.

Good ground.

Less than 0.2 Ohms

Greater than 0.2 Ohms

Check antenna lead-in screws at cowl. Scrape area and install "shiny" screws to insure a good ground.

Again measure ground from the antenna lead-in shield to a good ground.

Less than 0.2 Ohms

Greater than 0.2 Ohms

Replace the antenna lead-in.

Noise remains.

Suppress the noise at the source using the appropriate chart: IGNITION NOISE, ALTERNATOR WHINE, ACCESSORY NOISE.

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Figure 10—Chart 6 (Antenna Noise Part 1)

CHART 7

ANTENNA NOISE - PART 2

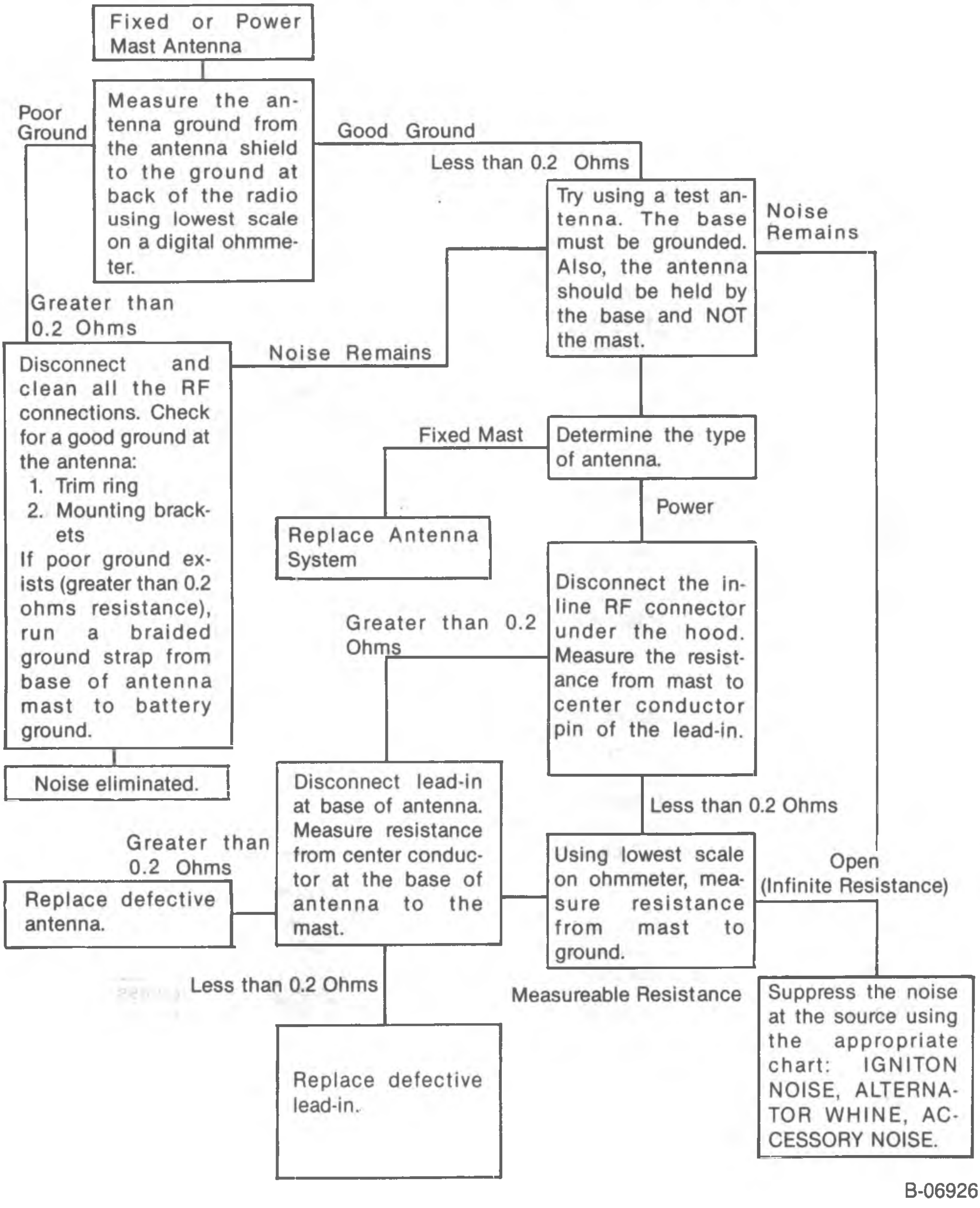
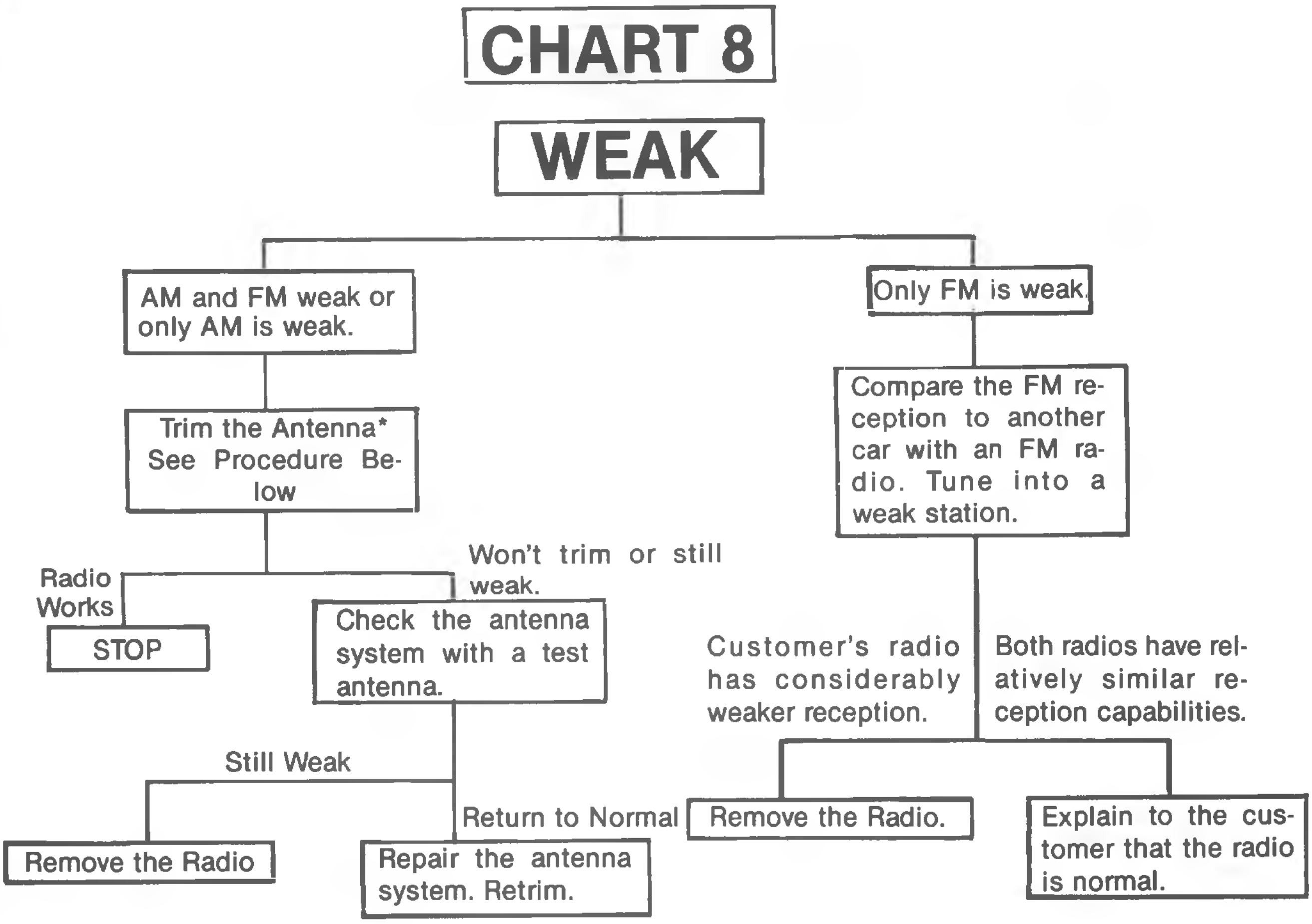


Figure 11—Chart 7 (Antenna Noise Part 2)



*ETR and 2000 series radios do not have an antenna trimmer. Try a substitute antenna.

ANTENNA TRIMMER ADJUSTMENT

The antenna trimmer adjustment matches the antenna coil in the radio to the antenna. Only AM radios, or the AM part of AM/FM radios, need this adjustment. (ETR models and all 2000 series radios use "self adjusting" circuits, and do not have an antenna trimmer).

1. Tune the radio to a weak AM station or noise near 1400 kHz. Turn the volume all the way up. You should barely hear the station.
2. Remove the right inner and outer knobs.
3. Use a small screwdriver to adjust the trimmer screw. Adjust the screw for the loudest volume.
4. Reinstall the control knobs.

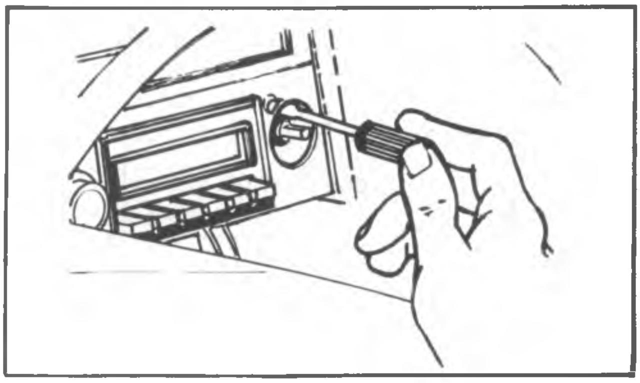


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Figure 12—Chart 8 (Weak)

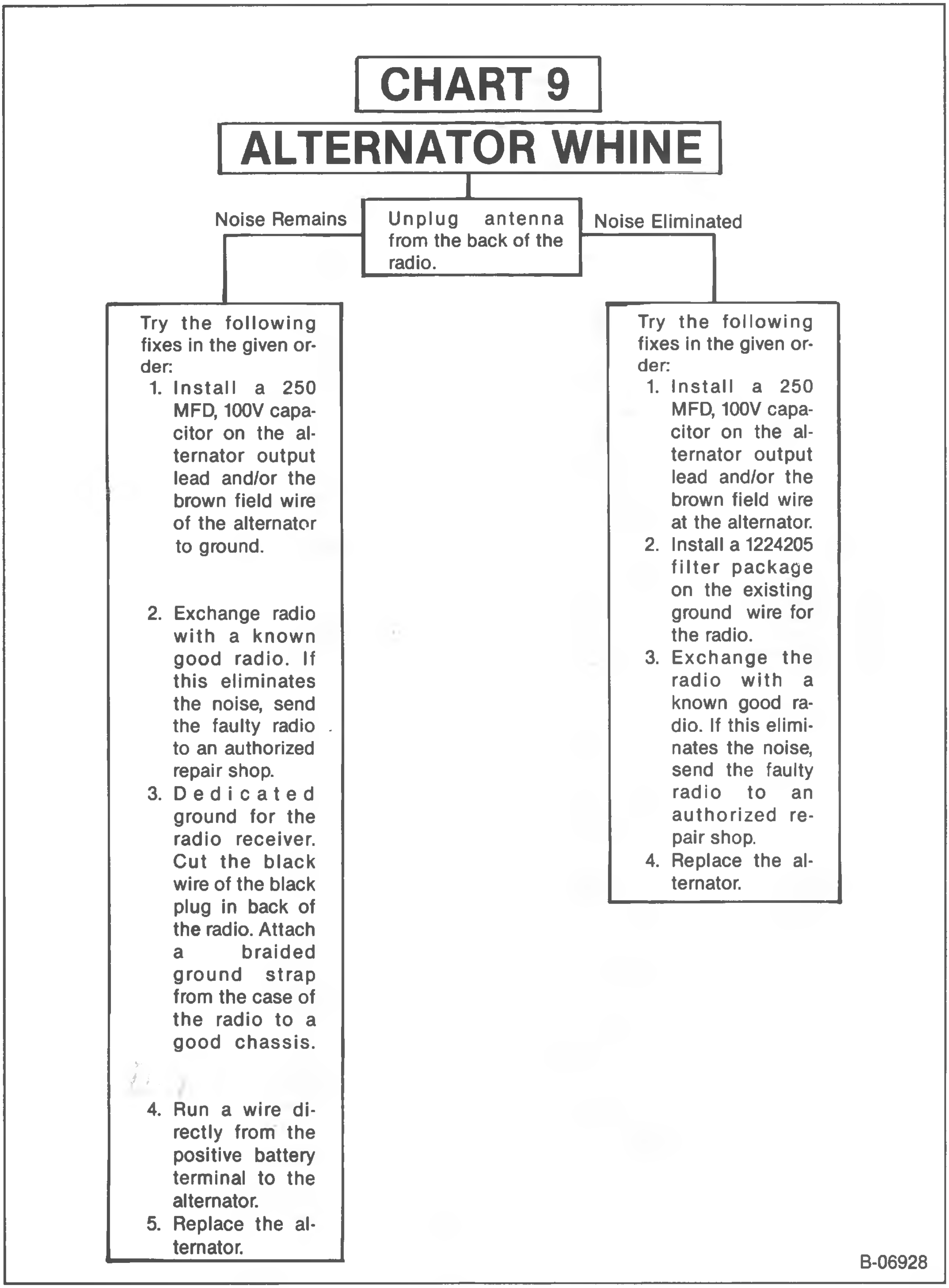

CHART 9

ALTERNATOR WHINE

Unplug antenna from the back of the radio.

Noise Remains

Try the following fixes in the given order:

1. Install a 250 MFD, 100V capacitor on the alternator output lead and/or the brown field wire of the alternator to ground.
2. Exchange radio with a known good radio. If this eliminates the noise, send the faulty radio to an authorized repair shop.
3. Dedicated ground for the radio receiver. Cut the black wire of the black plug in back of the radio. Attach a braided ground strap from the case of the radio to a good chassis.
4. Run a wire directly from the positive battery terminal to the alternator.
5. Replace the alternator.

Noise Eliminated

Try the following fixes in the given order:

1. Install a 250 MFD, 100V capacitor on the alternator output lead and/or the brown field wire at the alternator.
2. Install a 1224205 filter package on the existing ground wire for the radio.
3. Exchange the radio with a known good radio. If this eliminates the noise, send the faulty radio to an authorized repair shop.
4. Replace the alternator.

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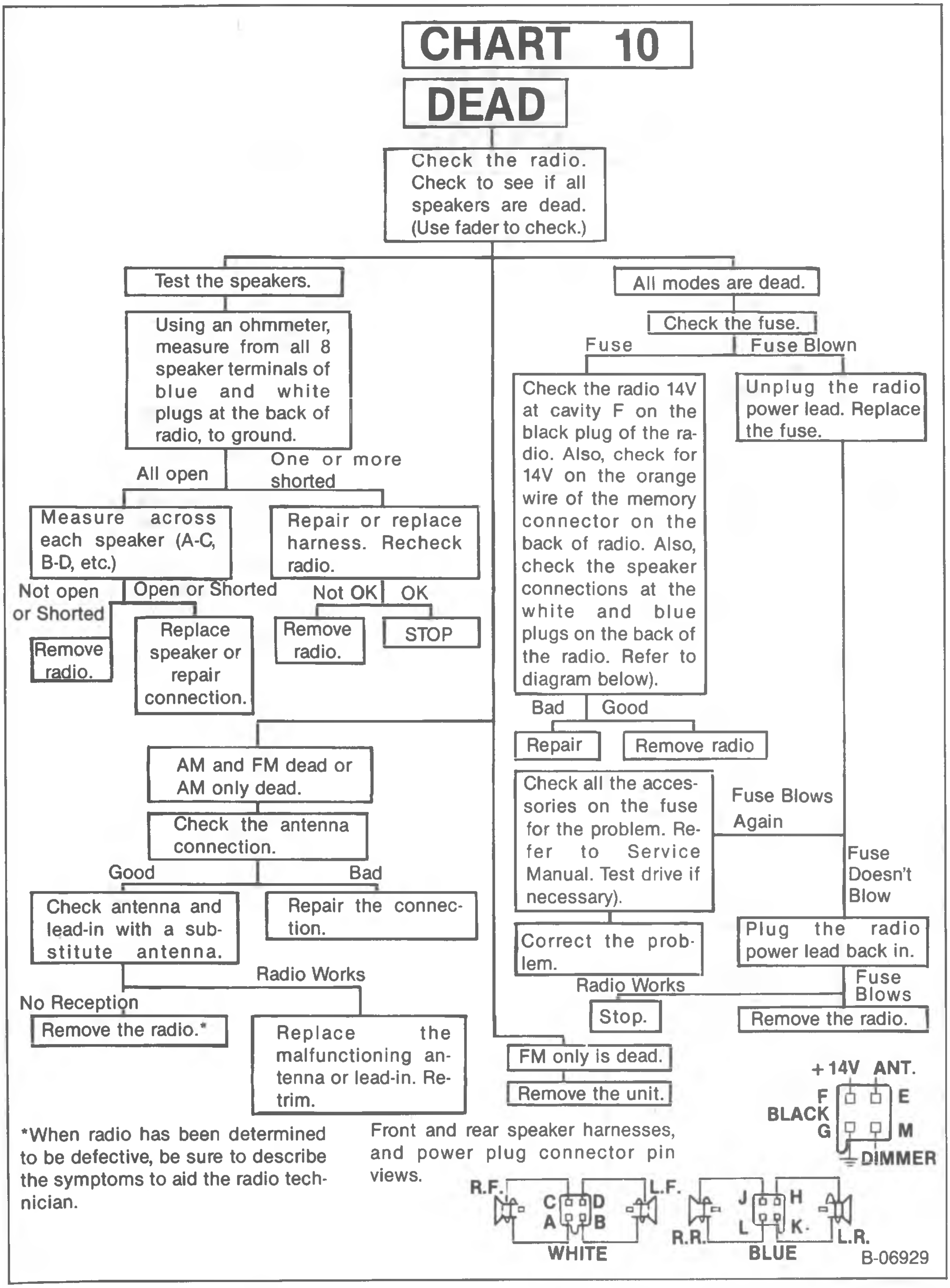
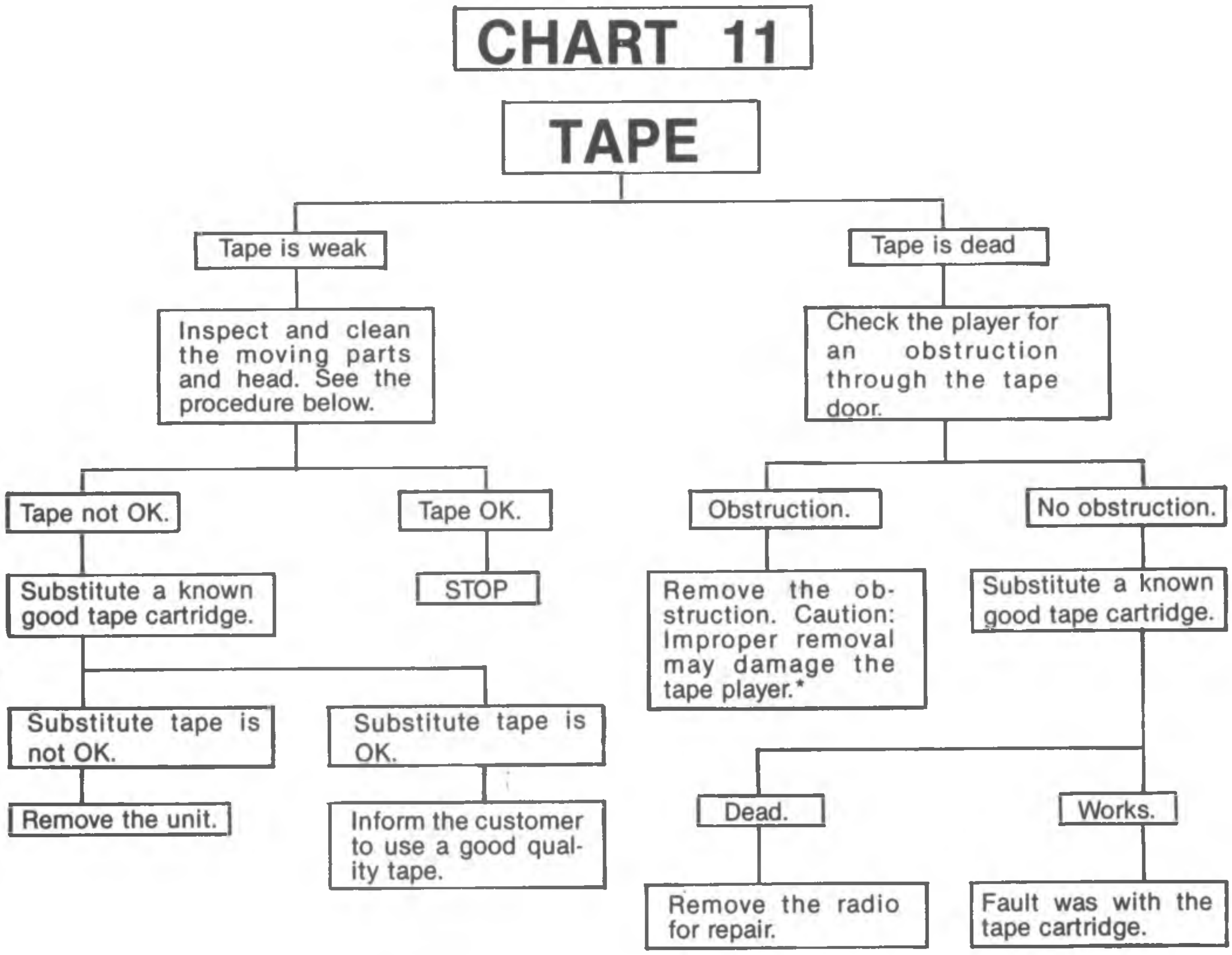
Figure 13—Chart 9 (Alternator Whine)



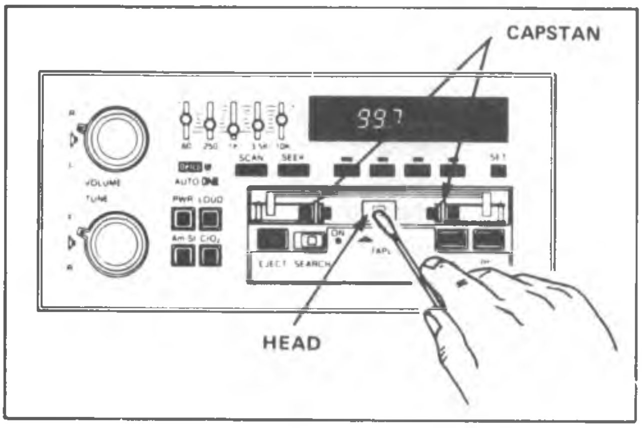
*When radio has been determined to be defective, be sure to describe the symptoms to aid the radio technician.

Front and rear speaker harnesses, and power plug connector pin views.

Figure 14—Chart 10 (Dead)



*NOTE: Jammed tape cannot be removed from the search and repeat tape deck. Send the radio to authorized repair shop.



CLEANING PARTS OF TAPE PLAYER TO REDUCE TAPE NOISE

There are two parts that you clean on a tape player; the head and the capstan. Since you can reach them through the tape door, you can leave the tape player in the car.

To clean the head and capstan, use a cotton swab dipped in ordinary rubbing alcohol. Wipe the head and capstan as shown.

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Figure 15—Chart 11 (Tape)

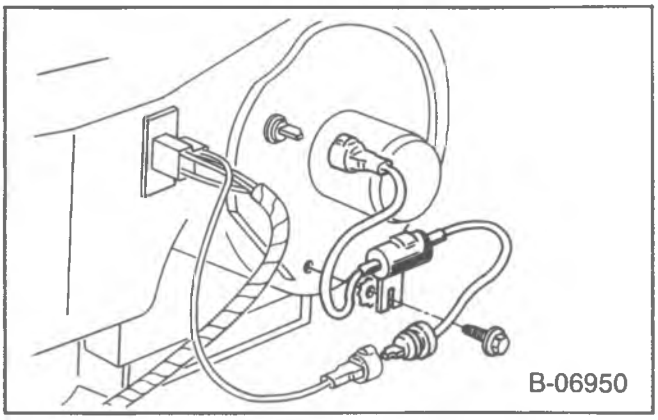


Figure 16—Blower Motor Noise Capacitor

ACCESSORY NOISE

BLOWER MOTOR NOISE

Install a blower motor feed through capacitor. Attach one end to the blower motor and the other end to the hot lead from the blower motor switch. Also, ground the capacitor ground tab.

BLOWER SWITCH POP (HIGH SETTING TO OFF)

Install a diode (diode number IN4001, or the equivalent diode to withstand a 50V inverse peak voltage) from the high speed switch wire (orange) to ground on the high speed blower relay under the hood.

BRAKE SWITCH POP

Install a 0.5 MFD capacitor between the two wires going to the brake switch at the brake pedal. Also, install a 0.5 MFD capacitor from the 14V lead to ground at the brake switch.

CLICKING OR POPPING NOISE (DIESEL ENGINE)

1) The problem will sound similar to ignition noise. However, it won't vary with engine speed. Also the noise will most likely be noticeable only in the idle condition.
2) The noise is being generated by the high vacuum switch in the EGR assembly.
3) Check the system for any vacuum leaks and repair.
4) If the noise still remains, change the EGR control assembly.

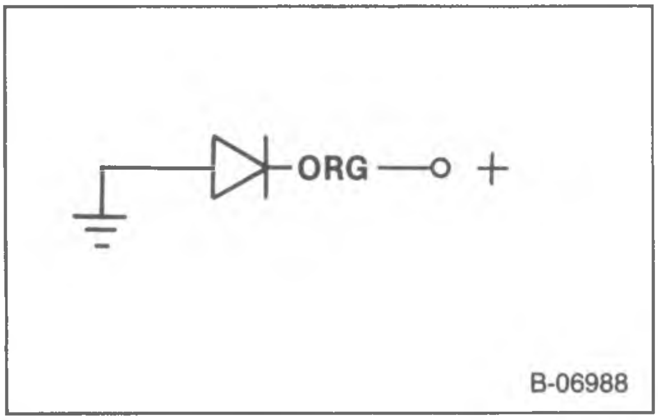
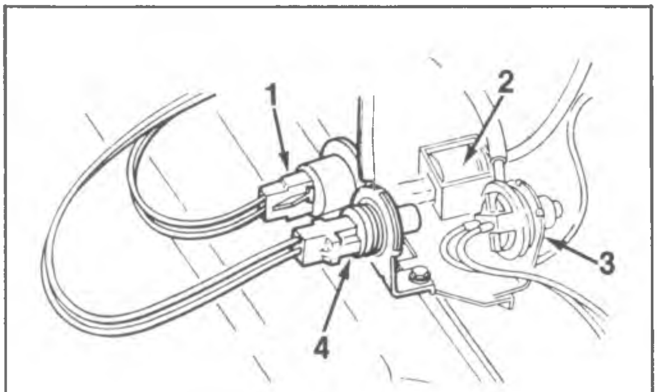


Figure 17—Diode IN4001



1. Low Vacuum Switch
2. Solenoid
3. EGR Assembly
4. High Vacuum Switch

Figure 18—Diesel EGR High Vacuum Switch

CRUISE CONTROL POP (TRANSDUCER TYPE)

For cruise control engage and disengage pops, install a 0.5 MFD capacitor from the hold line at the transducer to ground. If disengage pops are still present, splice a 0.5 MFD capacitor across the contacts of the disengage switch at the brake pedal.

HORN BLOW-THRU NOISE OR HASH (STATIC IN RADIO SPEAKERS WHEN USING HORN)

Splice blower motor capacitors into each lead. Install the capacitors as close to the horn as possible. Ground the case of the capacitor to chassis ground using the metal ground tab on the capacitor. The technician should solder all connections instead of using quick connects.

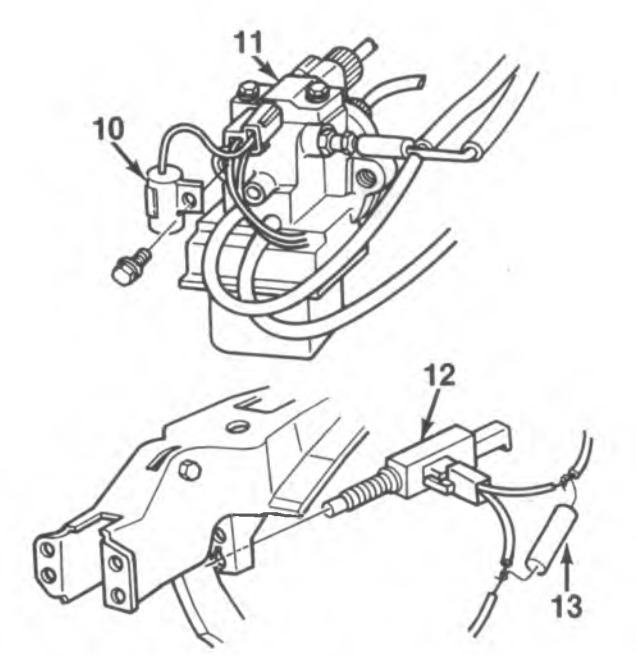
HORN SWITCH POPS

1) Install a 0.5 MFD capacitor between the switched 14 volt lead and horn lead at the horn delay.
2) If pop persists, install a 0.5 MFD capacitor from the switched 14 volt lead of the horn relay to ground and a 0.5 MFD capacitor from the horn lead to ground.

MIXTURE CONTROL SOLENOID POPPING

Complaint:

A popping noise which sounds like ignition noise occuring on the AM band. This noise will NOT vary with engine speed. Also this noise should be noticeable with the ignition "on", and engine "off", but not in "accessory" position.



10. .5 MFD Capacitor
11. Cruise Transducer
12. Brake Switch
13. .5 MFD Capacitor

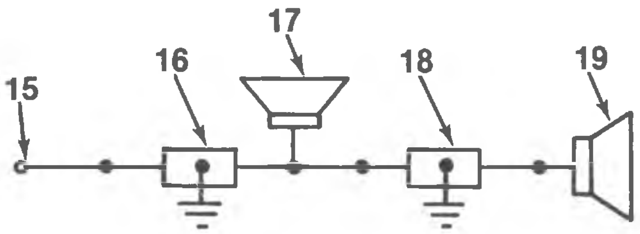
Figure 19—Cruise Transducer

Problem:

Noise is being radiated from the mixture control solenoid duty cycle lead to the ALDL connector.

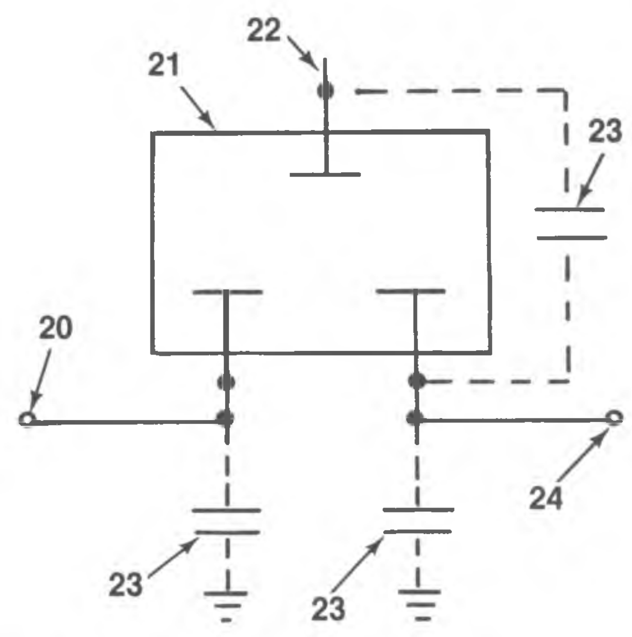
Fix:

1) Locate the breakout harness extending from the main harness, about six inches from the ECM harness connector.
2) Locate the light blue wire. It should connect to Pin D on the 15 pin breakout connector.
3) Cut the light blue wire on the vehicle side of the connector at the connector.



15. Lead from the Horn Switch
16. .5 MFD Feed through Capacitor
17. Horn No. 1
18. .5 MFD Feed through Capacitor
19. Horn No. 2

Figure 20—Horn Capacitors



20. To the horn switch (steering column)
21. Horn relay.
22. Power (fused 14 volts)
23. .5 MFD capacitor
24. To the horns.

Figure 21—Horn Switch Capacitors

REAR DEFOGGER NOISE OR HASH

A broken grid in the defogger in the rear glass may cause a "hash" in the radio. Repairing this break will eliminate the noise. A break in the rear defogger grid can be found by touching each "line" of the grid while the rear defogger is on. The cold grid is the one broken.

TACHOMETER NOISE

Locate the wire from the distributor cap to the tachometer and shield the wire by wrapping it with aluminum tape. The tape must also be connected to a good ground.

TORQUE CONVERTER LOCK-UP NOISE

Model:

Diesel Engines

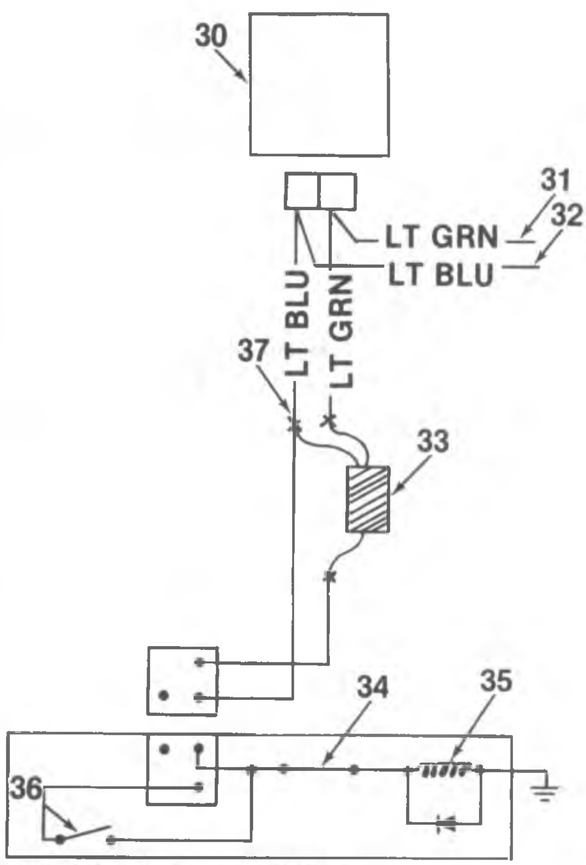
Complaint:

Hash or popping noise on "AM" band after torque converter "lock-up" (35-45 mph).

Fix:

1) Install a 1224205 filter package in series with green lead on the VRV switch (see the instructions in filter package). For this application, connect the ground lead in the filter package to the blue lead on the VRV switch, instead of to ground.

   Install a capacitor (0.5 MFD) from the blue lead on VRV switch to ground.



30. Low Vacuum Switch
31. To a Test Terminal
32. To the Brake Switch and Fuse Block
33. Filter Package. 1224205
34. 4-3 Shift (Momentary open)
35. TCC Solenoid
36. 4th Gear Switch (Closed when engaged)
37. Filter Ground Wire

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Figure 22—Torque Converter Lock Up Noise

Fix:

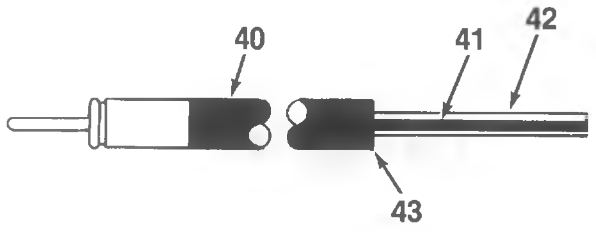
2) Install a 220 MFD capacitor rated at 50 VDC across the VRV switch between the green and blue wires.

WIPER SWISH WINDSHIELD ANTENNA

The swish sound encountered when the wipers pass over the windshield antenna is due to a static buildup between the windshield and the wiper. Try cleaning the windshield with Opticlean or add a tablespoon of dish soap to the washer bottle.

OTHER ELECTRIC MOTOR NOISES (POWER WINDOWS, BLOWER MOTORS)

Install a 0.5 MFD capacitor rated at 50 VDC across each motor.



40. Antenna Lead In
41. Center Wire
42. White Plastic Insulator
43. 50 mm (2 in.) of Coax Shield Removed

B-09197

Figure 23—RF Sniffer

OTHER SWITCH POPS (BLOWER SWITCHES, POWER LOCKS, POWER MIRROS, PARK - NEUTRAL SWITCH, POWER WINDOWS, WIPERS, REAR WINDOW DEFOGGER)

Install a 0.5 MFD capacitor rated at 50 VDC across the contacts of the switch, from the hot side of the switch to ground or both.

DIAGNOSTIC RF SNIFFER

The antenna sniffer can be used along with the car's radio to locate "Hot Spots" which are generating radio noise interference. These "Hot Spots" will be found in the harnesses, in the upper part of the dash or even between the hood and windshield.

The sniffer is made from an old piece of antenna lead-in from a mast or power antenna. The longer the lead-in the better, since it will make the sniffer more flexible as a diagnostic tool.

Make the sniffer as shown in figure 23. The 50 mm (2 inch) section with the black coating and braided shield stripped back becomes the antenna when the sniffer is plugged into the radio's antenna socket. It can then be used to probe and search out "Hot Spots".

Procedure:

1. While listening to the complaint noise, disconnect the antenna and plug the sniffer into the antenna socket.
2. Turn the radio volume up.
3. When searching for the noise source, keep fingers off of the probe, otherwise erroneous results will be received.

When checking for noise on a wire, the best results will be achieved when the sniffer is placed parallel to the wire.

The sniffer can also be used to determine from what area of the dash the noise is being generated onto a windshield antenna.

The sniffer can also be used to locate "Hot Spots" between the windshield and the hood that may be directing noise onto the windshield antenna.

It must be noted that the sniffer will also locate "normal" hot spots. However, the technician who becomes familiar with the sniffers capabilities will find it the most useful diagnostic tool in noise suppression work.

RADIO RECEIVER REPLACEMENT

C-K MODELS

Remove or Disconnect (Figure 24)

1. Battery ground cable
2. Control knobs (54)
3. Knob bezels (53)
4. Nuts (52) from the support tubes (51)
5. Support bracket retainer screws (55)
6. Harnesses
    - Lift up the rear edge of the receiver.
    - Push the receiver forward until the control shafts clear the instrument panel.
    - Lower the control shafts.
    - Remove the power feed, speaker and antenna connectors.
7. Receiver (50)

Install or Connect (Figure 24)

1. Receiver (50)
    - Position the receiver under the instrument panel.
    - Connect the power, speaker and antenna leads.
    - Lift the rear of the receiver into place.
    - Move the receiver rearward so that the control shafts slide through the control shaft holes in the instrument panel.
2. Support bracket screws (55)
3. Nuts (52) on the support tubes (51)
4. Knob bezels (53)
5. Control knobs (54)
6. Battery ground cable

G VAN

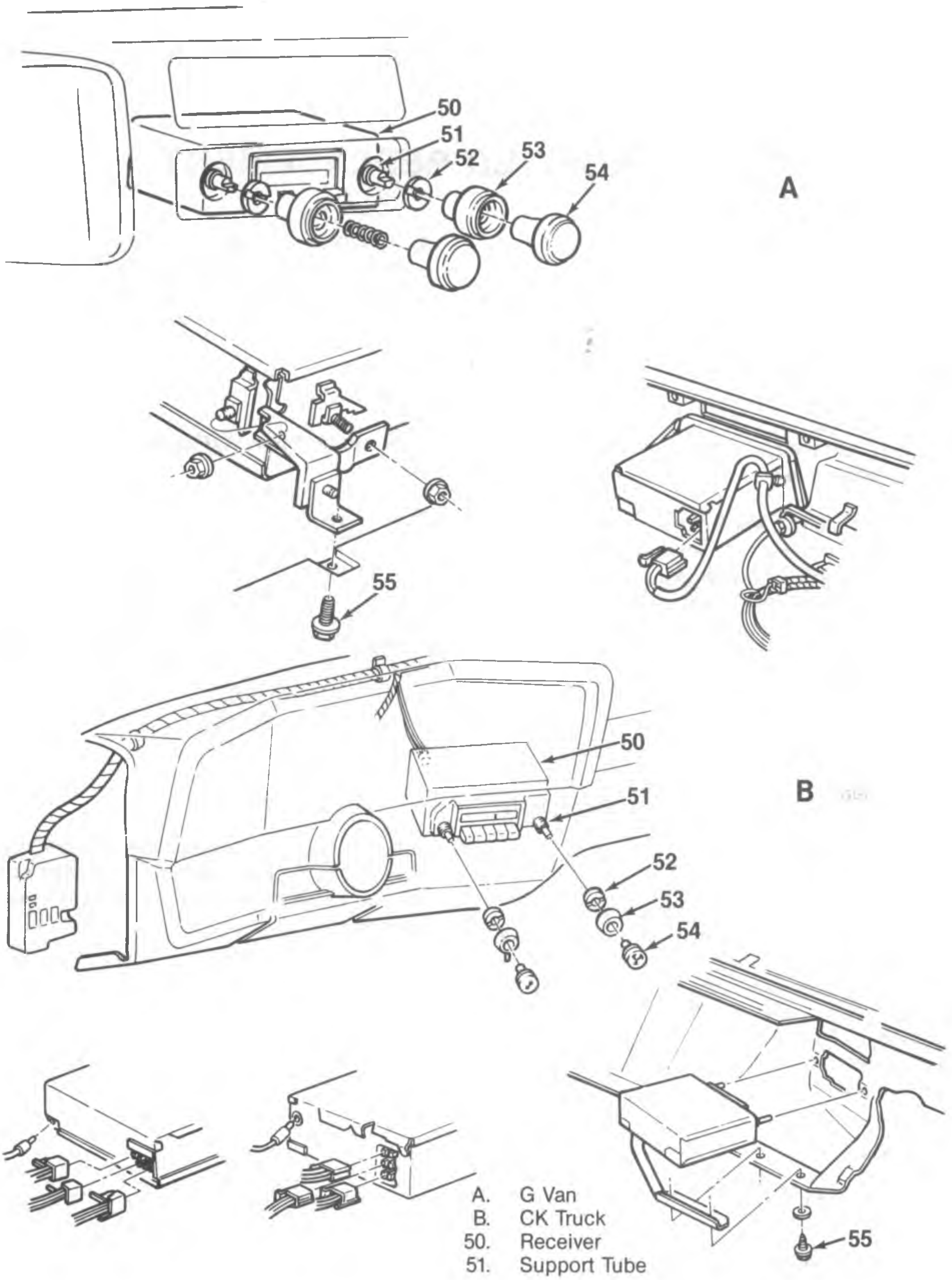
Remove or Disconnect (Figure 24)

1. Battery ground cable
2. Engine cover
3. Air cleaner cover
4. Air cleaner element
5. Control knobs (54)
6. Knob bezels (53)
7. Retaining nuts (52)
8. Rear mounting bracket screws (55)
9. Power, speaker and antenna leads
    - Push receiver forward.
    - Lower receiver.
    - Disconnect leads.
10. Receiver (50)

Install or Connect (Figure 24)

1. Power, speaker and antenna leads.
2. Receiver (50)
    - Raise receiver into place.
    - Move receiver rearward so that the control shafts are in the mounting holes.
3. Rear mounting bracket screws (55).
4. Retaining nuts (52) on the supporting tubes (51).
5. Knob bezel (53).
6. Control knobs (54).
7. Air cleaner element.
8. Air cleaner cover.
9. Engine cover.
10. Battery ground cable.

NOTICE: Always connect the speaker wiring harness to the receiver before applying power to the receiver in order to prevent receiver damage.



A. G Van
B. CK Truck
50. Receiver
51. Support Tube
52. Nut
53. Knob Bezel
54. Knob
55. Support Bracket Screw

Figure 24—Receiver Installation CK & G

ANTENNA REPLACEMENT

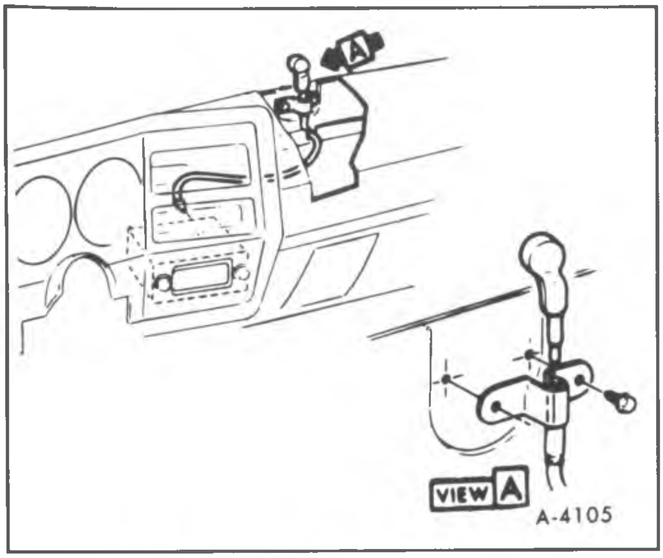


Figure 25—CK Antenna Cable

CK MODELS

←→ Remove or Disconnect (Figure 25)

1. Battery ground cable
2. Antenna cable connector
3. Window. Refer to Sec. 10 "Windshield Replacement".

→← Install or Connect (Figure 25)

1. Window. Refer to Sec. 10 "Windshield Replacement".
2. Antenna cable connector
3. Battery ground cable

G VAN

←→ Remove or Disconnect (Figure 26)

1. Battery ground cable
2. Mast retaining nut (56)
3. Mast (57)
4. Nut (55)
5. Seal (54) and bezel (53)
6. Seal (52)
7. Body and cable assembly (50)
8. Washer (51)

→← Install or Connect

1. Washer (51)
2. Body and cable assembly (50)
3. Seal (52)
4. Seal (54) and bezel (53)
5. Nut (55)
6. Nast (57)
7. Mast retaining nut (56)
8. Battery ground cable

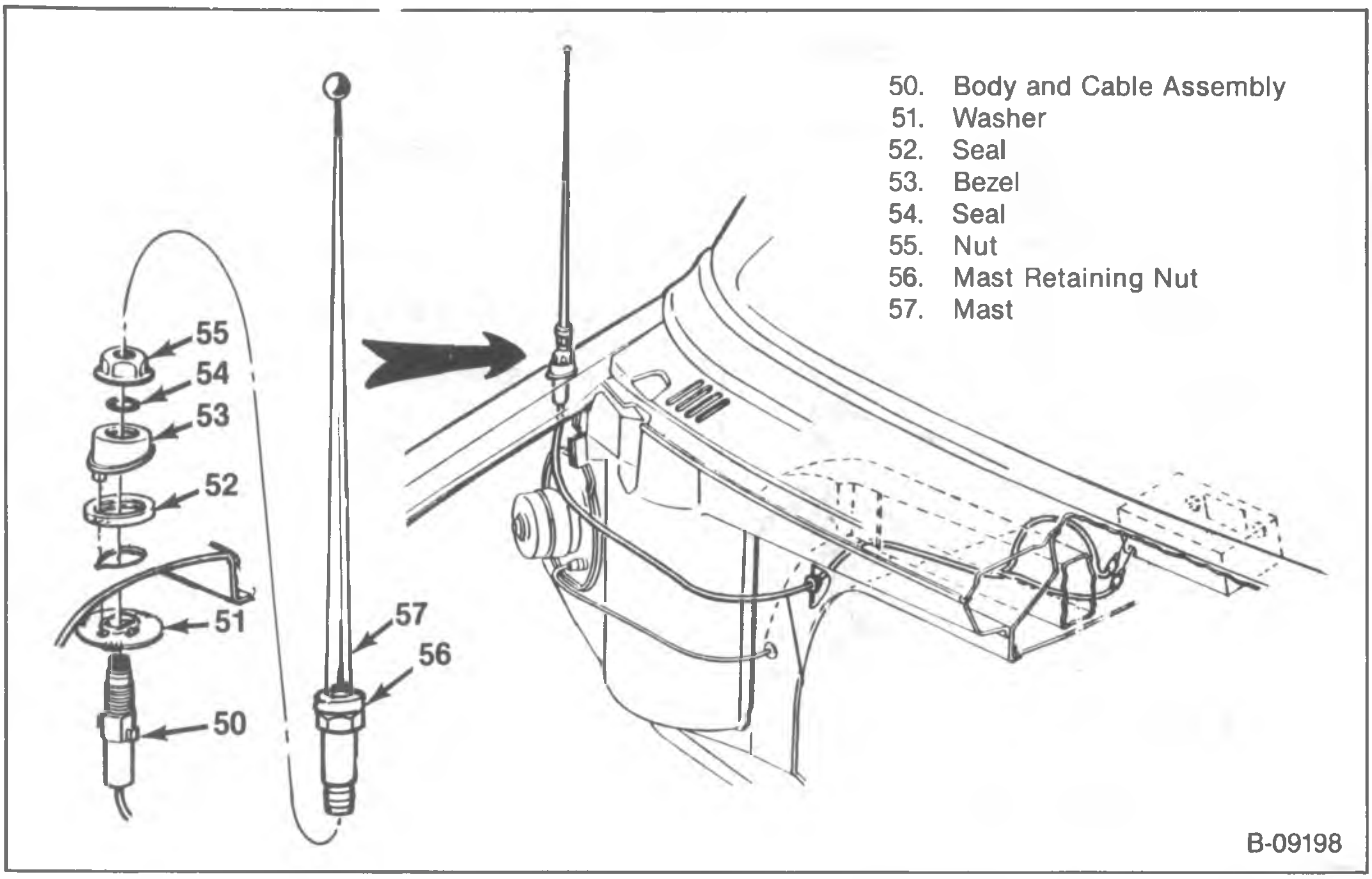


Figure 26—G Van Antenna System

SPEAKER REPLACEMENT

C-K MODELS

FRONT SPEAKER

←→ Remove or Disconnect (Figure 27)

1. Battery ground cable
2. Instrument cluster bezel upper four screws
3. Instrument panel pad screws
4. Pad (70)
5. Speaker to dash panel screws (72)
6. Speaker harness
   - Lift up speaker (71)
7. Speaker (71)

→← Install or connect (Figure 27)

1. Speaker harness to speaker (71)
2. Speaker (71)
3. Speaker to dash panel screws (72)
4. Pad (70)
5. Instrument panel pad screws
6. Instrument cluster bezel upper four screws
7. Battery ground cable

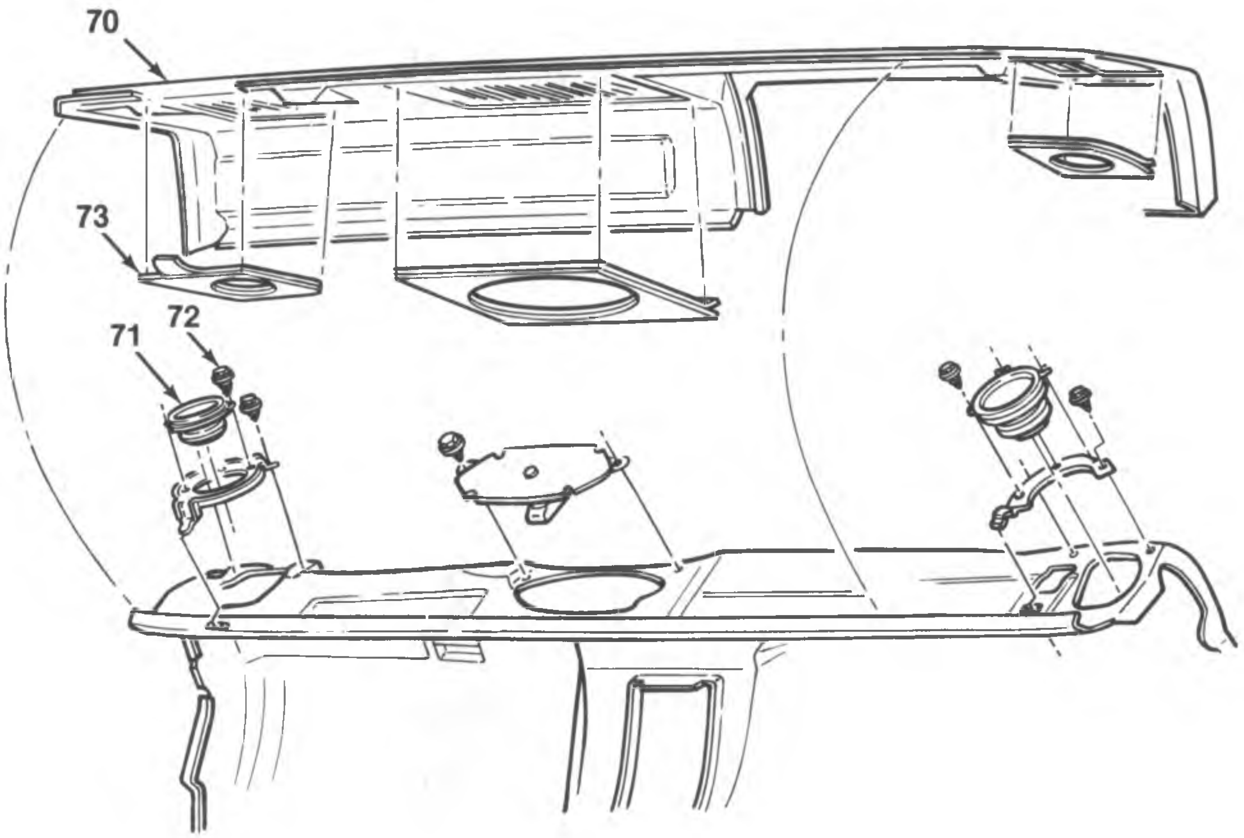
REAR SPEAKER

←→ Remove or Disconnect (Figure 28)

1. Battery ground cable
2. Grill retaining screws (90)
3. Grill (80)
4. Speaker retaining screws (82)
5. Speaker harness from the speaker (81)
6. Speaker (81)

→← Install or connect (Figure 28)

1. Speaker harness to the speaker
2. Speaker (81)
3. Speaker retaining screws (82)
4. Grill (80)
5. Grill retaining screws (82)
6. Battery ground cable



70. 1/P Pad
71. Speaker
72. Speaker retaining screw
73. Seal

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Figure 27—CK Front Speakers

G VAN

FRONT SPEAKER

↔ Remove or Disconnect (Figure 29)

1. Battery ground cable
2. Instrument panel bezel
3. Instrument cluster
4. Speaker screws (102)
5. Speaker connector (101)
6. Speaker (100)

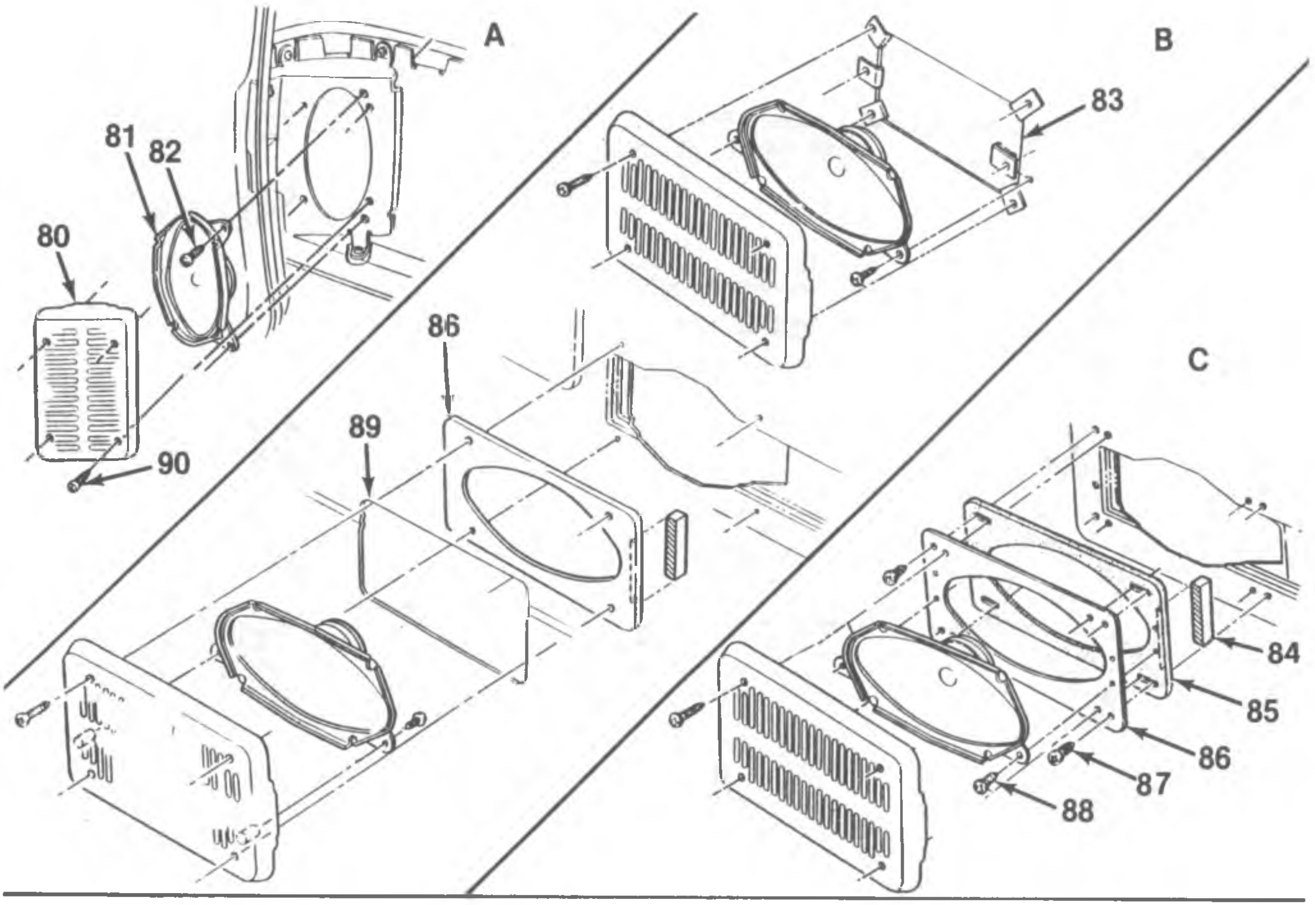
→← Install or Connect (Figure 29)

1. Speaker connector (101) to the speaker (100)
2. Speaker (100)
3. Speaker screws (102)
4. Instrument cluster
5. Instrument panel bezel
6. Battery ground cable

REAR CORNER SPEAKER

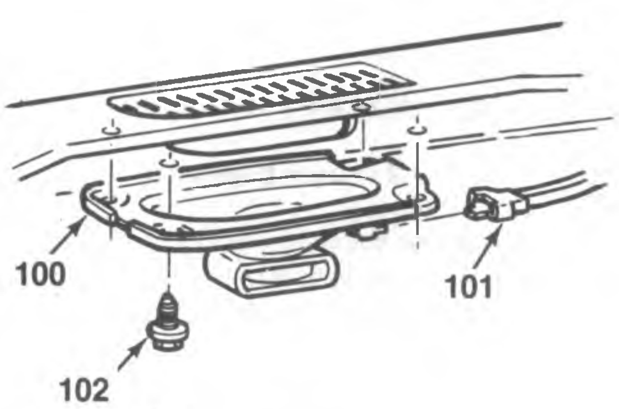
↔ Remove or Disconnect (Figure 30)

1. Battery ground cable.
2. Lower corner trim panel (114).
3. Lower edge screws of the upper corner trim panel (110).
4. Trim strip (115) screws.
5. Rear door upper molding (113) screws.
6. Upper corner trim panel (110) upper screws.
7. Upper corner trim panel assembly (110).
8. Horness connector from the speaker.
9. Insulation retaining screws.
10. Insulation (112).
11. Speaker retaining screws.



A. CK Pickup
B. Utility
C. Suburban
80. Grille
81. Speaker
82. Speaker Mounting Screw
83. Clip Nut
84. Insulator
85. Insulator
86. Bracket
87. Bracket Retaining Screw
88. Speaker Retaining Screw
89. Trim Panel
90. Grille Retaining Screw

Figure 28—CK Rear Speakers



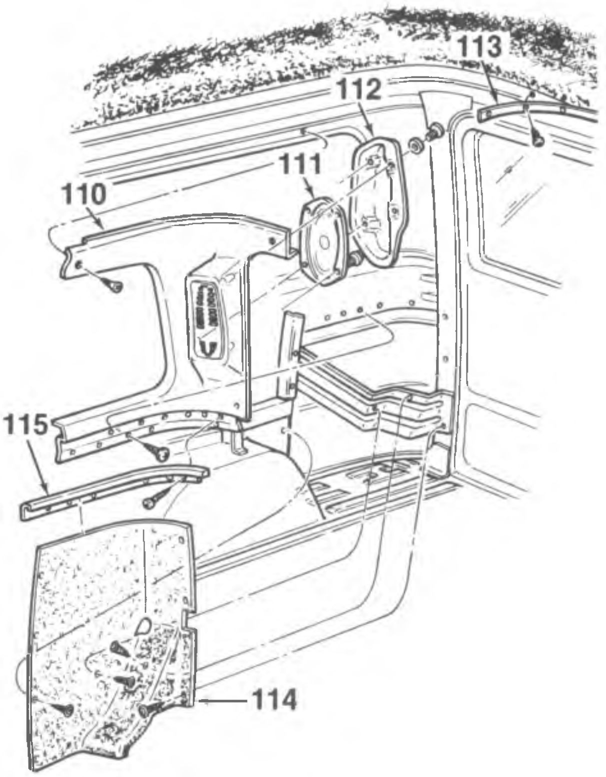
100. Speaker
101. Speaker Connector
102. Screw

Figure 29—G Van Front Speakers

12. Speaker (111) from the upper corner trim panel (110).

Install or Connect (Figure 30)

1. Speaker (111) to the upper corner trim panel (110).
2. Speaker retaining screws.
3. Insulation (112).
4. Inslulation retaining screws.
5. Harness connector to the speaker.
6. Upper corner trim panel assembly (110).
7. Upper corner trim panel screws.
8. Rear door upper molding (113) screws.
9. Trim strip (115).
10. Trim strip (115) screws.
11. Lower corner trim panel (114).
12. Battery ground cable.



110. Upper Corner Trim Panel
111. Speaker
112. Speaker Insulation
113. Rear Door Upper Molding
114. Lower Corner Trim Panel
115. Trim Strip

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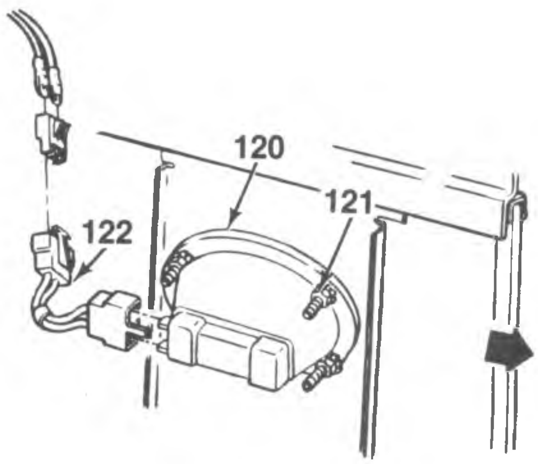
Figure 30—G Van Rear Corner Speakers



120. Speaker
121. Nut
122. Harness Connector

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Figure 31—G Van Rear Side Speakers

REAR SIDE SPEAKER

←→ Remove or Disconnect (Figure 31)

1. Battery ground cable.
2. Four forward lower screws retaining the rear trim panel.
   - Pull the trim panel out to reach the speaker.
3. Harness connector from the speaker.
4. Speaker retaining nuts.
5. Speaker.

→← Install or Connect (Figure 31)

1. Speaker.
2. Speaker retaining nuts.
3. Harness connector to the speaker.
4. Rear trim panel screws.
5. Battery ground cable.

SECTION 9B

CRUISE CONTROL

CONTENTS

GENERAL DESCRIPTION

Cruise control is a speed control system which maintains a desired vehicle 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 vehicle 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, 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 (and clutch pedal bracket on vehicles 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.

OPERATION

OFF/ON/RESUME/ACCEL SWITCH

(Figure 9B-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 reverts to the Accel mode. To accelerate the vehicle, move the slider switch to the R/A position and hold it there until the vehicle reaches the desired increased speed. When the slider switch is released, the speed the vehicle accelerated to becomes 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 vehicle must be above the low speed inhibit lockout (25 mph). The slide switch can also be used to "tap-up" vehicle speed. In order to do this the cruise must be engaged and operating. "Tapping-up" is done by quickly pressing the slide switch, not more than one second, toward the R/A position and quickly releasing it, or "tap" the lever. Do not hold the lever in the R/A position or the system will revert to the Accel mode. "Tap-up" is a function in which cruise speed can be increased by 1 mph increments (one tap = 1 mph increase) up to ten times, after 10 times the system must be reset to a new speed to continue this function.

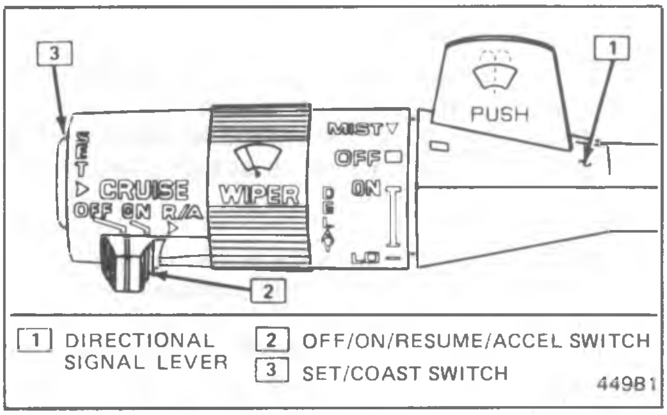


Figure 9B-1 Multi-Function Lever

SET/COAST BUTTON SWITCH

(Figure 9B-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 (vehicle 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 particular speed the vehicle was at when the button was released. Vehicle 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 (Trim) Position** - With the button switch fully depressed, the driver can raise or lower his control speed. To increase control speed, the driver would accelerate to a new speed, fully depress the switch (controller releases previously set speed) and release the button. Upon releasing the button a new speed is set. 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 (depressed position) disengaging the cruise system, and allowing the throttle to return to the idle position. When the vehicle has slowed to the desired lower 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 the Set/Coast Button (not more than .4 second) to the depressed position and quickly releasing it, or "tap" the button. Do not hold the button in the depressed position or the system will revert to the "coast" mode. "Tap-down" is a function in which cruise speed can be decreased by 1 mph increments (one tap = 1 mph decrease). The system can "tap-down" until it reaches the low speed lockout (25 mph), after this cruise will not operate.

  The accelerator may be depressed at any time to override the cruise system. Release of the accelerator will return the vehicle 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 Resume 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 9B-2)

The controller interprets the position of the servo, the position of the mode 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.

For mounting location, turn to the On-Vehicle Service portion of this section.

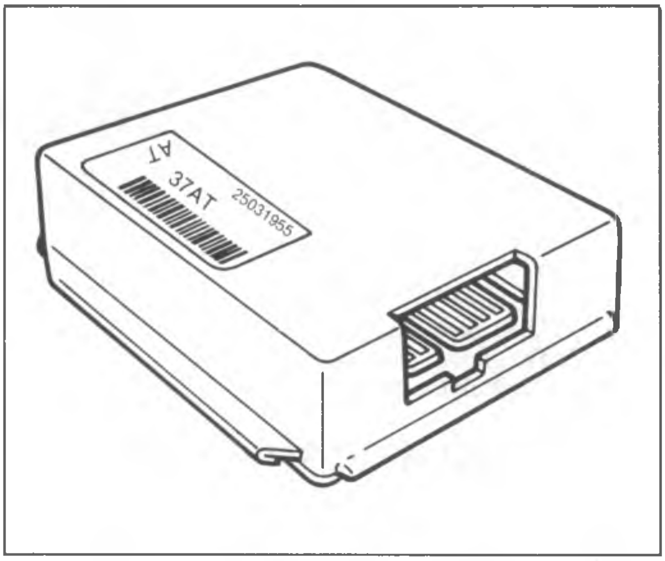


Figure 9B-2 Controller (Module)

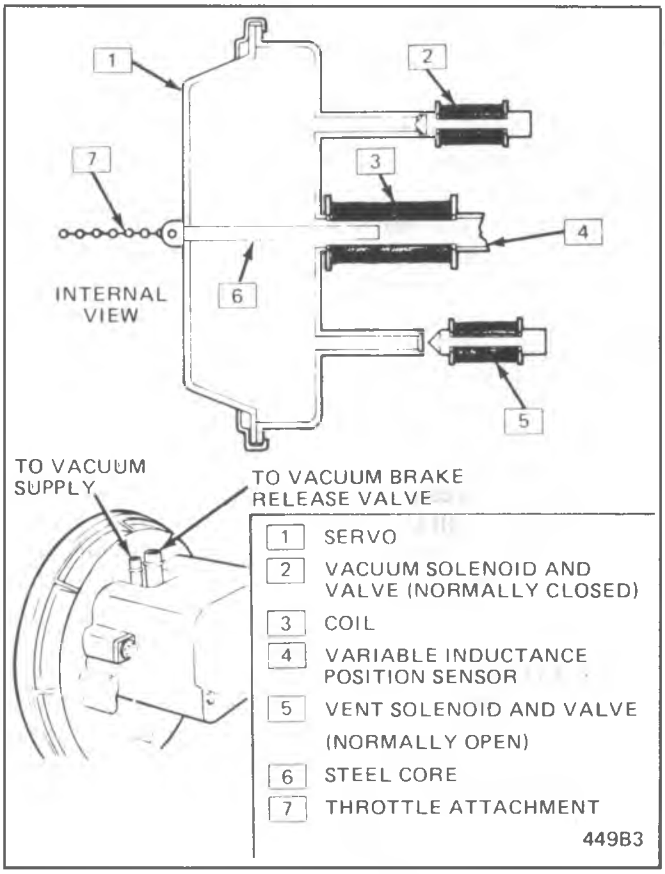


Figure 9B-3 Servo Unit

SERVO UNIT

(Figure 9B-3)

The servo consists of a vacuum operated diaphragm, a normally open solenoid valve to vent the diaphragm chamber to atmosphere, a normally closed solenoid valve to connect the diaphragm chamber to the vacuum source, and a variable inductance position sensor. The servo 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-flow requirements on the vacuum source. Vacuum is trapped in diaphragm chamber.

- **Vehicle Losing Speed** (due to steep grades or driver wishes to increase speed by operating mode control switches) - 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 operating mode control switches) - The controller de-energizes the vent solenoid to open the vent valve to the atmosphere which 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 vehicle exceeds approximately ±1/4 mph of set speed.

When the controller senses an over or underspeed condition it will pulse the opening of the vent or vacuum valve. The average duration of one pulse will be 10 milliseconds. The pulse will be repeated, as required, until the speed correction required brings the vehicle 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 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 pulses issued have corrected the speed error or if additional pulses are required. This comparison is also used to lengthen the average pulse when it is not enough to compensate for the speed error, such as a steep grade.

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 9B-4)

This is the device that will supply the vehicle speed input to the controller. 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 reflective 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 a buffer for amplification and signal conditioning. This amplified signal is then sent to the controller.

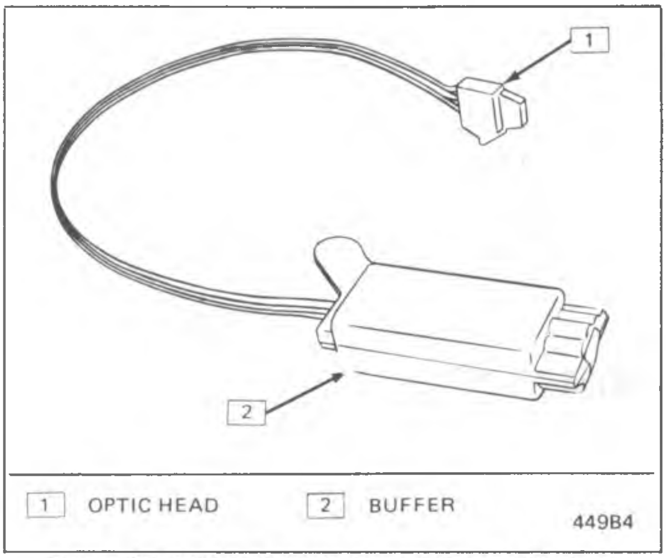


Figure 9B-4 VSS (Vehicle Speed Sensor) Typical

VACUUM SUPPLY

The vacuum supply to operate the Cruise Control system is routed to the servo. This can be done by routing manifold vacuum straight to the servo or from manifold through a vacuum storage tank.

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 vehicles equipped with manual transmission) 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 retain 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, etc. See On-Vehicle Service.

DIAGNOSIS

PRELIMINARY INSPECTION

An undesirable cruise control performance symptom can be mechanical, vacuum, electrical or a combination of the three. In all cases perform a visual inspection of all components in the cruise system. Things to check are:

- Disconnected or damaged wiring
- Pinched, cracked or disconnected vacuum hoses

- Cracked or broken vacuum fittings at the servo or accumulator
- Correct positioning of the check valve in the servo and accumulator line
- Damaged Components

NOTICE: To avoid breaking vacuum ports, care must be exercised in removing vacuum hoses from fittings. If necessary cut hose.

TEST PROCEDURES

CRUISE SYSTEM INOPERATIVE

1. Perform the voltage and resistance checks shown in Figure 9B-5. Servo resistance measurement (vent valve control or vacuum valve control) can be made at the servo as shown in Figure 9B-7.
2. Perform the following vacuum servo tests:
   - Perform preliminary inspection
   - Disconnect the bead chain, cable (or rod) and electrical connector at servo
   - Start the engine or apply vacuum to the servo vacuum port
   - Proceed to Figure 9B-8 Vacuum Servo Tests
3. Check electrical operation of the mode control switches by replacing the switch with a known "good switch". Perform the tests shown in 9B-9 Mode Control Switch Test.

A quick check box is available through Kent-Moore Tool Company under Tool Number J-34185 (or equivalent). This quick check box will plug in in place of the controller and determine which part of the system has a problem. Instructions on the operation of this tool will be provided with the tool.

CRUISE SYSTEM SURGES

- The servo and throttle linkages should operate freely and smoothly. This linkage should be adjusted as described in the On-Vehicle Service portion of this section.
- Check for dry speedometer cable, lubricate as required.
- Check for high voltage spikes on B+ line, repair as required.
- Check for excessive grease in speedometer head, replace speedometer.
- Check hose routing for pinches, leaks or restrictions, including three way check valve.
- Follow the servo test, Figures 9B-5, 9B-7 and 9B-8. Replace the servo if required.
- If no system problem is noted, replace the electronic controller (module).

CRUISE SET SPEED HIGH OR LOW

- Check vacuum hoses for proper routing, restrictions or leaks. Adjust or replace as required.
- Check servo linkage for excess slack and adjust as described in the On-Vehicle Service portion of this section.
- Incorrect module usage, check module for correct part number.
- If no system problem is noted, replace the electronic controller (module).

EXCESSIVE CRUISE SPEED LOSS ON HILLS

- Check hoses for vacuum leaks.
- Determine if check valve is functional.
- Check vacuum hose routing. Correct as necessary.

CRUISE "TAP-UP" & "TAP-DOWN" DOES NOT OPERATE

If all other functions of cruise control are working except "tap-up" and "tap-down" the controller (module) is at fault.

ON-VEHICLE SERVICE

Servo Mounting

See particular engine application.

Vacuum Hose Routing

See particular engine application.

Controller (Module) Location

See Figure 9B-10.

Release Switch and Valve Adjustments

See Figure 9B-11.

Engagement Switch

The cruise control engagement switch is part of the turn signal lever assembly and is not serviceable by itself. The turn signal lever must be replaced as an assembly as shown in Figure 9B-12.

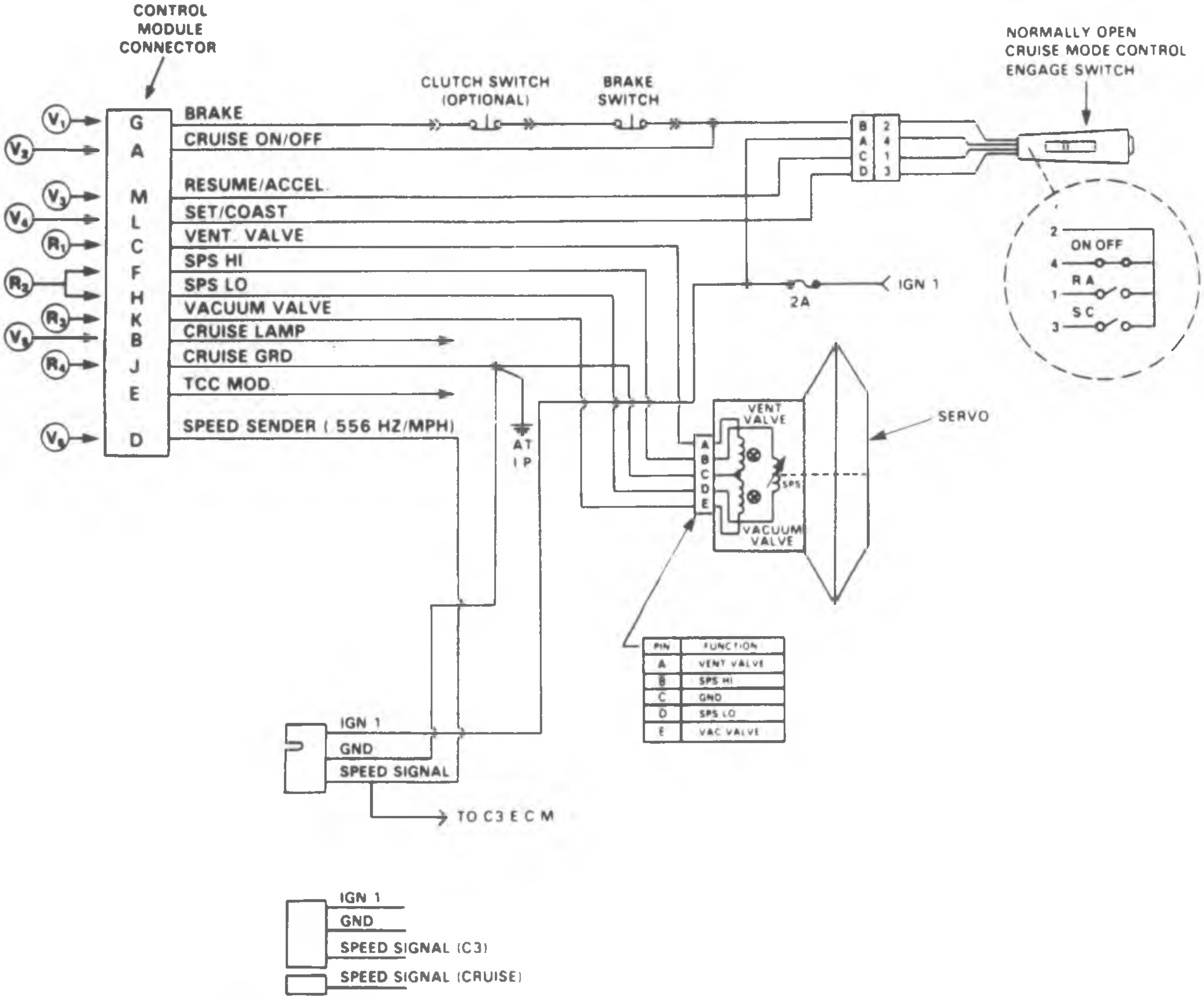
VOLTAGE CHECK — MODULE CONNECTED

TEST	TERMINAL	FUNCTION	SPECIFIED VOLTAGE TO GROUND	CONDITIONS
V_1	G	BRAKE INPUT	12V 0V	BRAKE/CLUTCH NOT APPLIED BRAKE/CLUTCH APPLIED
V_2	A	CRUISE ON-OFF INPUT	12V 0V	SLIDER SWITCH ON SLIDER SWITCH OFF, SET/COAST DEPRESSED OR NORMAL
V_3	M	RESUME/ACCEL INPUT	12V 0V 0V	SLIDER SWITCH IN R/A POSITION SLIDER SWITCH ON, SET/COAST DEPRESSED OR NORMAL SLIDER SWITCH OFF, SET/COAST DEPRESSED OR NORMAL
V_4	L	SET/COAST INPUT	12V 0V 0V	SLIDER SWITCH ON, SET/COAST DEPRESSED SLIDER SWITCH ON, SET/COAST NORMAL SLIDER SWITCH OFF, SET/COAST NORMAL
V_5	B	CRUISE LAMP	12V	CRUISE ENGAGED
V_6	D	SPEED SIGNAL	GREATER THAN 4V HIGH, NEAR 0V LOW	DRIVE WHEELS ROTATING ON APPLICATIONS LISTED

RESISTANCE CHECK — MODULE DISCONNECTED

TEST	TERMINAL	FUNCTION	SPECIFIED RESISTANCE	CONDITIONS
R_1	C TO GROUND	VENT VALVE CONTROL	30-55Ω OPEN CIRCUIT	MEASURED TO GROUND, SERVO CONNECTED MEASURED TO GROUND, SERVO DISCONNECTED
R_2	F TO H F TO GROUND H TO GROUND	SPS HIGH, SPS LOW	15-25Ω OPEN CIRCUIT	MEASURED F TO H, SERVO CONNECTED MEASURED F AND H TO GROUND, SERVO DISCONNECTED
R_3	K TO GROUND	VACUUM VALVE CONTROL	30-55Ω OPEN CIRCUIT	MEASURED TO GROUND, SERVO CONNECTED MEASURED TO GROUND, SERVO DISCONNECTED
R_4	J TO GROUND	GROUND	0Ω	MEASURED TO VEHICLE GROUND

Figure 9B-5 Custom Cruise III Voltage and Resistance Values



PIN	FUNCTION
A	VENT VALVE
B	SPS HI
C	GND
D	SPS LO
E	VAC VALVE

CUSTOM CRUSE III

Figure 9B-6 Custom Cruise III System Schematic (Typical)

- SERVO CONNECTOR DISCONNECTED
- MEASURE AT SERVO PINS

PIN	FUNCTION	RESISTANCE	CONDITIONS
D to B	SPS	15-25 Ω	MEASURED BETWEEN PINS D AND B (IF MEASURED RESISTANCE IS NOT STATED VALUE, REPLACE SERVO)
A to C	VENT VALVE	30-55 Ω	MEASURED BETWEEN PINS A AND C (IF MEASURED RESISTANCE IS NOT STATED VALUE, REPLACE SERVO)
E to C	VACUUM VALVE	30-55 Ω	MEASURED BETWEEN PINS E AND C (IF MEASURED RESISTANCE IS NOT STATED VALUE, REPLACE SERVO)

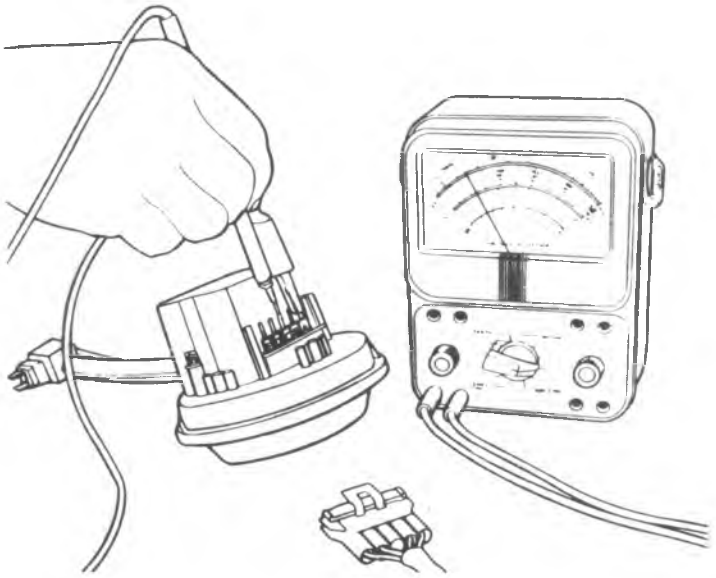


Figure 9B-7 Servo Resistance Measurement

Test	Action	Reaction
1	Apply 12 volts to A and E, then ground C (A-C closes the normally open vent valve — E-C opens the normally closed vacuum valve)	Servo should full stroke. If not, check vacuum hoses to the vacuum supply.
2	Remove voltage from E	The servo should hold a full stroke. If not, go to the next step. If servo holds, go to step 4.
3	Disconnect the vacuum brake release at the servo and plug the servo. Momentarily apply 12 volts to E to allow the servo to full stroke.	If the servo holds its position, adjust the brake vacuum release valve or replace the valve.
4	• Turn Ignition "ON" • Turn Ignition "OFF" and disconnect vacuum valve connector at the valve. Turn Ign. "ON"	• Vacuum release valve should engage. • With a properly adjusted brake switch, battery voltage should be present across the (2) connector terminals. No battery voltage indicates an open circuit.

Figure 9B-8 Vacuum Servo Tests

SET/COAST (S/C) SW	POSITION SLIDER	1-2 C-B	1-3 C-D	1-4 C-A	2-3 B-D	2-4 B-A	3-4 D-A
Normal	Off	O	O	O	O	O	O
Normal	On	O	O	O	O	C	O
Normal	R/A	C	O	C	O	C	O
Depressed	Off	O	O	O	C	O	O
Depressed	On	O	O	O	C	C	C
Depressed	R/A	C	C	C	C	C	C

C — Closed

O — Open

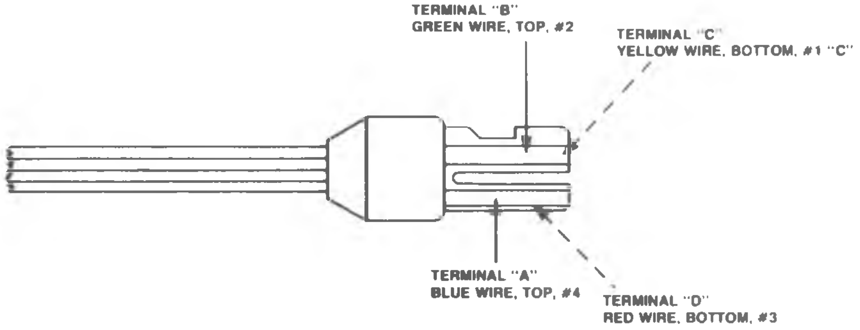
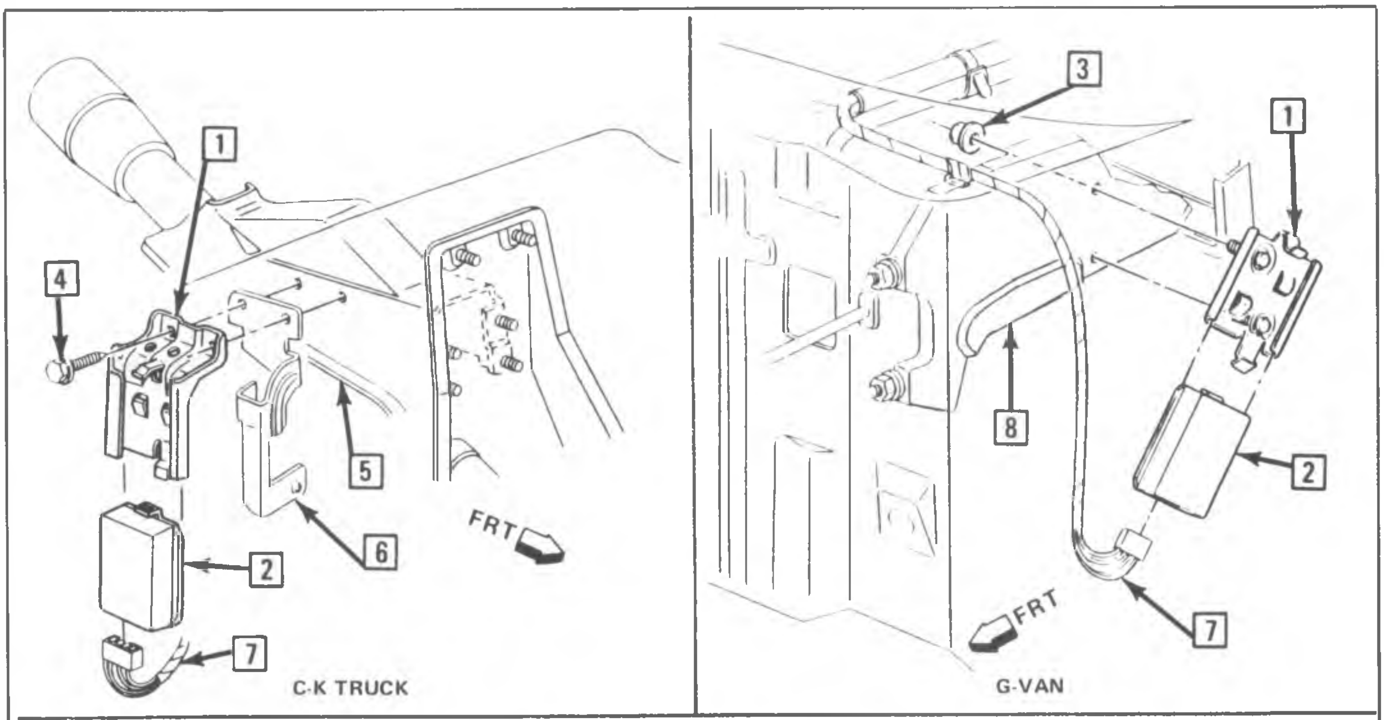
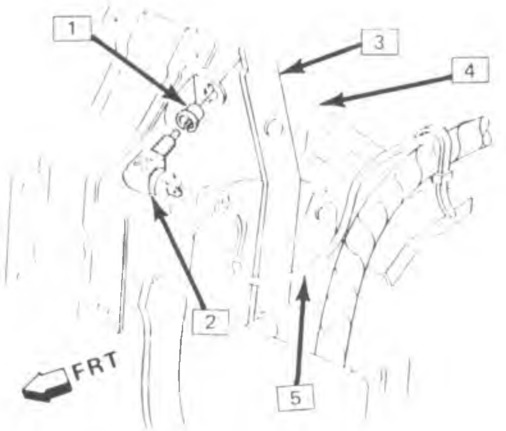


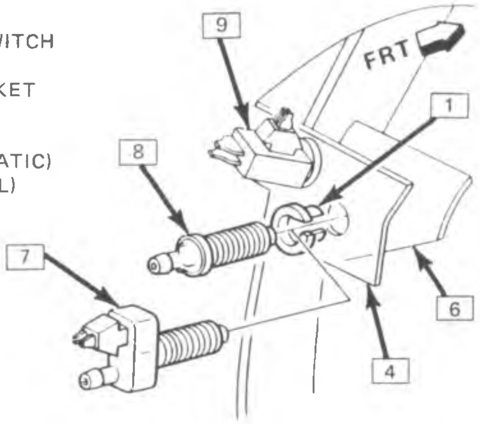
Figure 9B-9 Mode Control Switch Test



1. BRACKET ASM
2. MODULE
3. NUT (2.8-4.0 N·m)
4. BOLT/SCREW
5. BRAKE PEDAL BRACKET
6. CONVENIENCE PACK BRACKET
7. CRUISE CONTROL HARNESS
8. PARK BRAKE ASM

Figure 9B-10 Controller (Module) Mounting





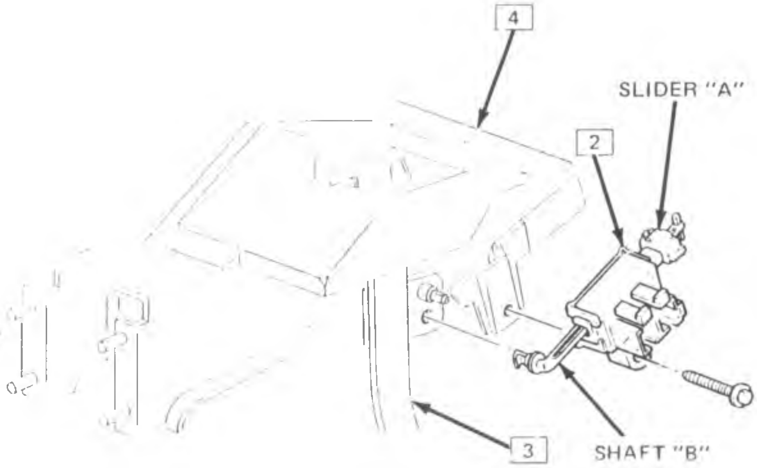
1. RETAINER
2. CLUTCH RELEASE SWITCH
3. CLUTCH PEDAL
4. BRAKE PEDAL BRACKET
5. I/P WIRING HARNESS
6. ACTUATOR
7. VALVE ASM (AUTOMATIC)
8. VALVE ASM (MANUAL)
9. STOP LAMP SWITCH

INSTALLATION OF SELF-ADJUSTING CRUISE CONTROL CLUTCH RELEASE SWITCH (G VAN)

1. Install retainer [1].
2. With clutch pedal depressed, insert switch [2] into tubular clip until switch body seats on clip. Note that audible "clicks" may be heard as threaded portion of switch is pushed through the clip toward the clutch pedal.
3. Pull clutch pedal fully rearward against pedal stop, until audible "click" sounds can no longer be heard. Switch will be moved in tubular clip providing adjustment.
4. Release clutch pedal and then repeat step #3 to assure that no audible "click" sounds remain.

INSTALLATION OF SELF-ADJUSTING VACUUM RELEASE VALVE

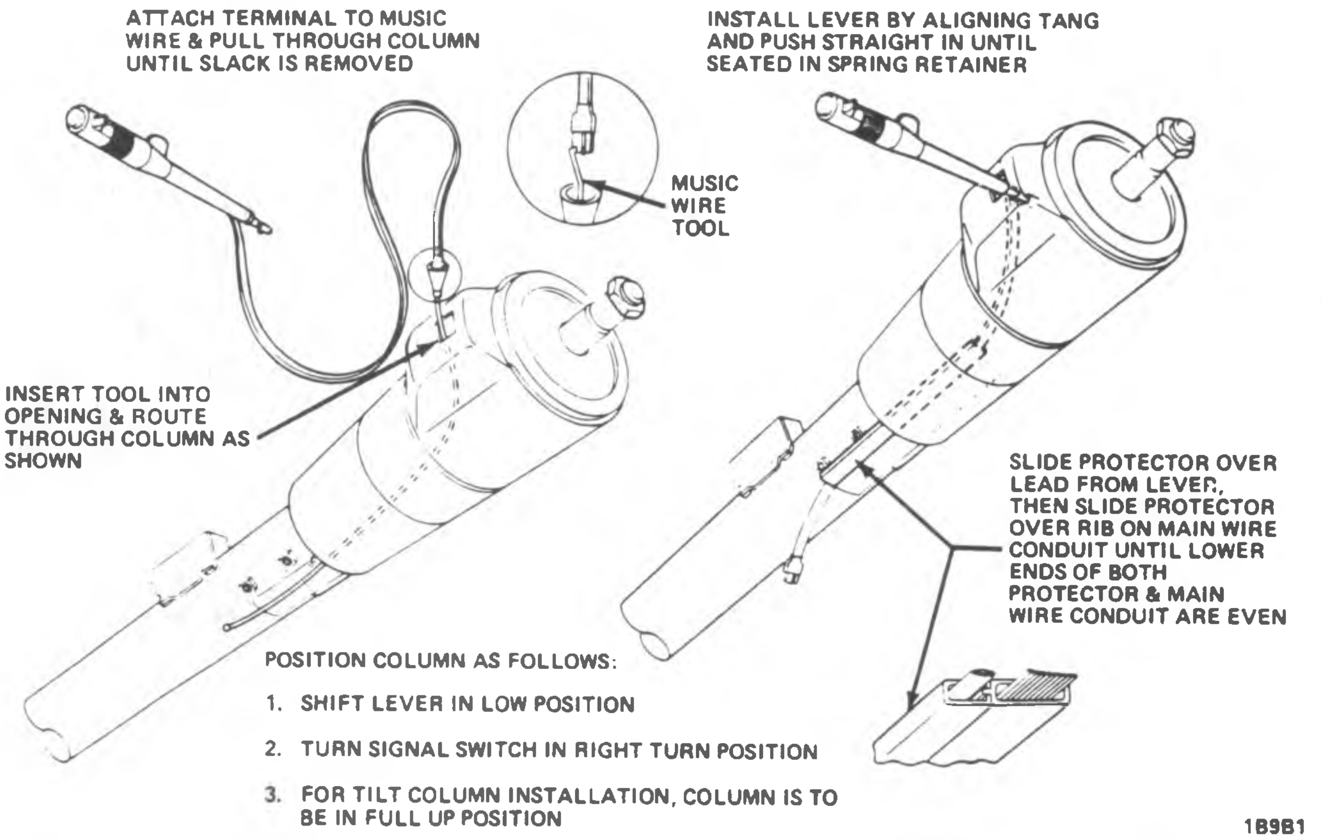
1. Install retainer [1].
2. With brake pedal depressed, insert valve [7] or [8] into tubular retainer until valve seats on retainer. Note that audible "clicks" can be heard as threaded portion of valve is pushed through the retainer toward the brake pedal.
3. Pull brake pedal fully rearward against pedal stop, until audible "click" sounds can no longer be heard. Valve will be moved in tubular retainer providing adjustment.
4. Release brake pedal, and then repeat step #3, to assure that no audible "click" sounds remain.



CRUISE CONTROL CLUTCH RELEASE SWITCH ADJUSTMENT PROCEDURE (C-K TRUCK)

1. Install switch asm with slider (A) in the "as received" position.
2. Care must be taken that the clutch pedal is not moved in such a manner that the slider is moved until all mats and/or carpets are installed in the vehicle.
3. When all mats and/or carpets are in place the clutch pedal should be depressed to the floor mat and/or carpet in order to adjust the switch by moving the slider (A) along the shaft (B) a "clicking" noise can be heard when this is happening.
4. If the slider is moved prematurely or accidentially resulting in an "adjustment" prior to what has been specified, the slider can be easily moved rearward along the shaft to a fully unadjusted "as received" position.
5. Failure to observe these requirements will result in a truck needing excessive clutch pedal to actuate the neutral start switch; or in some cases, a "no start" condition.

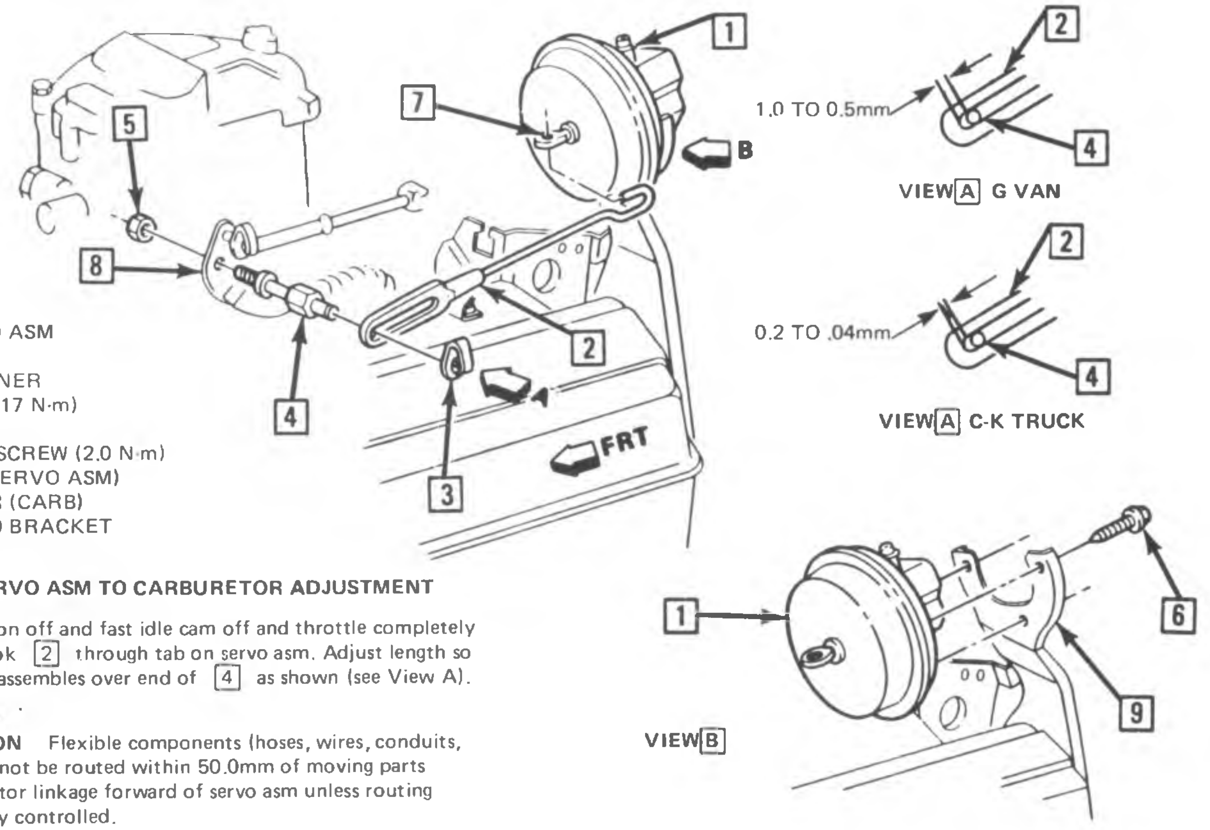
Figure 9B-11 Release Switches and Valves



POSITION COLUMN AS FOLLOWS:

1. SHIFT LEVER IN LOW POSITION
2. TURN SIGNAL SWITCH IN RIGHT TURN POSITION
3. FOR TILT COLUMN INSTALLATION, COLUMN IS TO BE IN FULL UP POSITION

Figure 9B-12 Cruise Control Lever Assembly (Turn Signal Lever)



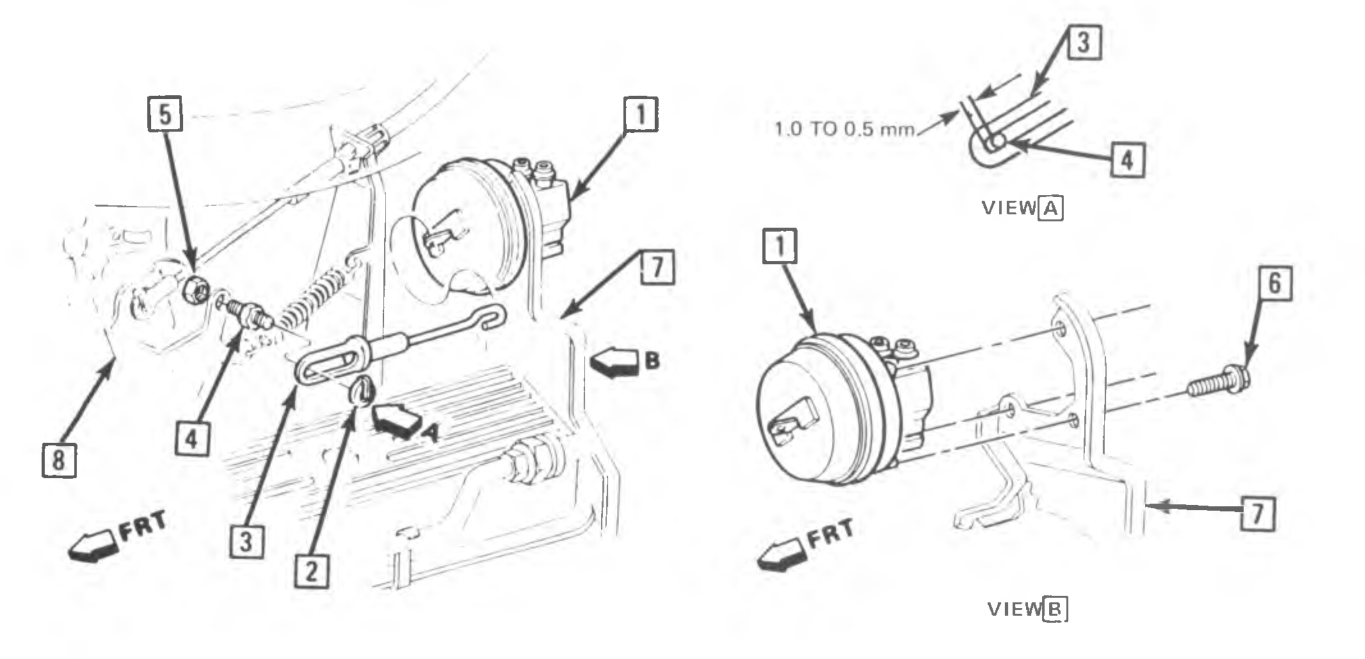
1. SERVO ASM
2. ROD
3. RETAINER
4. STUD (17 N·m)
5. NUT
6. BOLT/SCREW (2.0 N·m)
7. TAB (SERVO ASM)
8. LEVER (CARB)
9. SERVO BRACKET

SERVO ASM TO CARBURETOR ADJUSTMENT

With ignition off and fast idle cam off and throttle completely closed, hook 2 through tab on servo asm. Adjust length so that 2 assembles over end of 4 as shown (see View A). Install 3 .

CAUTION Flexible components (hoses, wires, conduits, etc.) must not be routed within 50.0mm of moving parts of accelerator linkage forward of servo asm unless routing is positively controlled.

Figure 9B-13 Servo Mounting (V8 Gas)

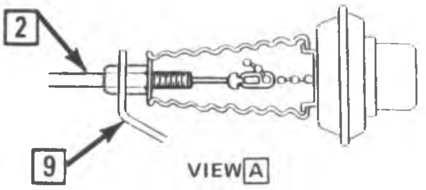


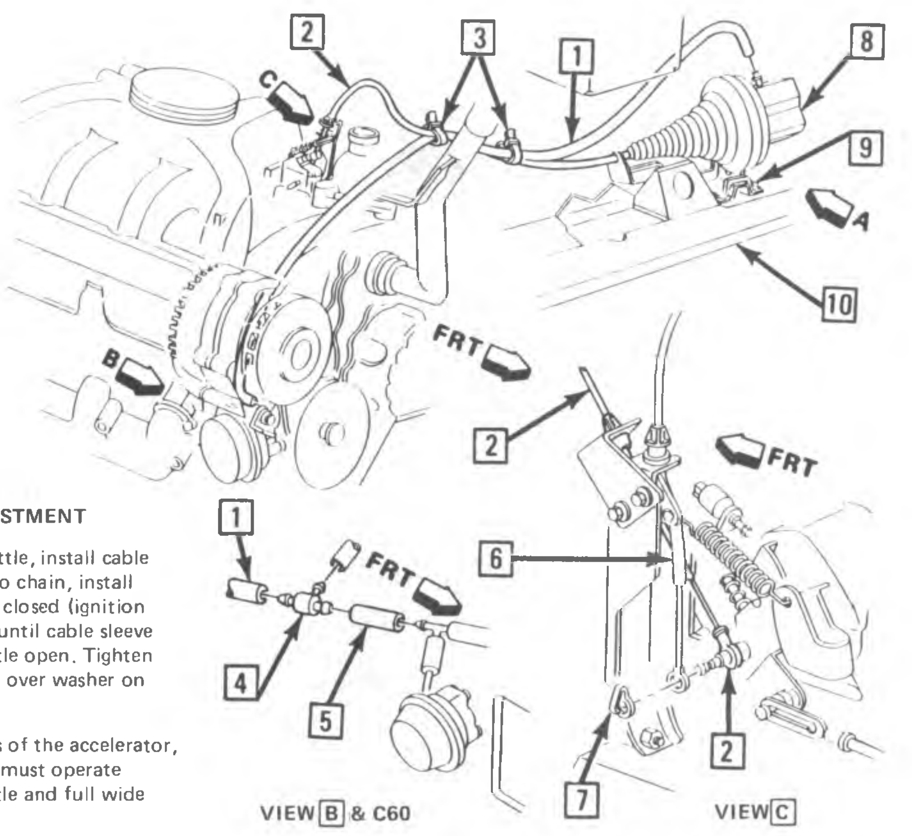
1. SERVO ASM
2. RETAINER
3. ROD ASM.
4. STUD
5. NUT (8-12 N·m)
6. BOLT/SCREW (2.0 N·m)
7. SERVO BRACKET
8. LEVER

SERVO ASM TO CARBURETOR ADJUSTMENT

With ignition off and fast idle cam off and throttle completely closed, hook [3] through tab on servo asm. Adjust length so that [3] assembles over end of [4] as shown (see View A). Install [2] .

Figure 9B-14 Servo Mounting (V6)





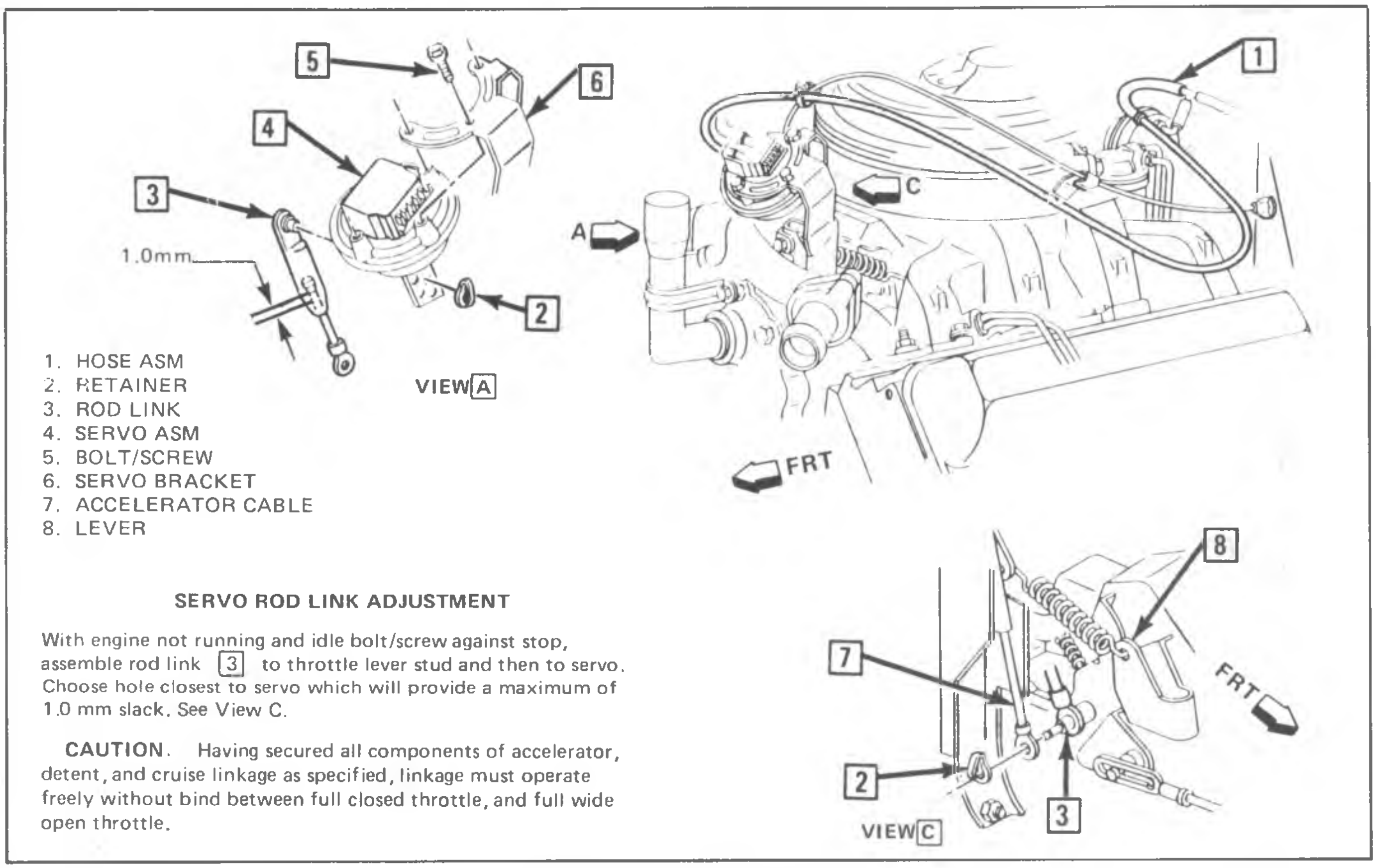
1. HOSE ASM
2. CRUISE CABLE ASM
3. STRAP
4. CONNECTOR
5. HOSE
6. ACCELERATOR CABLE
7. RETAINER
8. SERVO ASM
9. SERVO BRACKET
10. RADIATOR SUPPORT

CRUISE CONTROL CABLE ADJUSTMENT

With cable installed to cable bracket and throttle, install cable to servo bracket. Using third ball only on servo chain, install servo chain on cable with throttle completely closed (ignition off & fast idle cam off) adjust cable jam nuts until cable sleeve at throttle lever is tight but not holding throttle open. Tighten jam nuts to specified torque. Pull rubber boot over washer on cable.

CAUTION Having secured all components of the accelerator, detent and cruise linkage as specified, linkage must operate freely without bind between full closed throttle and full wide open throttle.

Figure 9B-15 Servo Mounting (G Van Diesel)



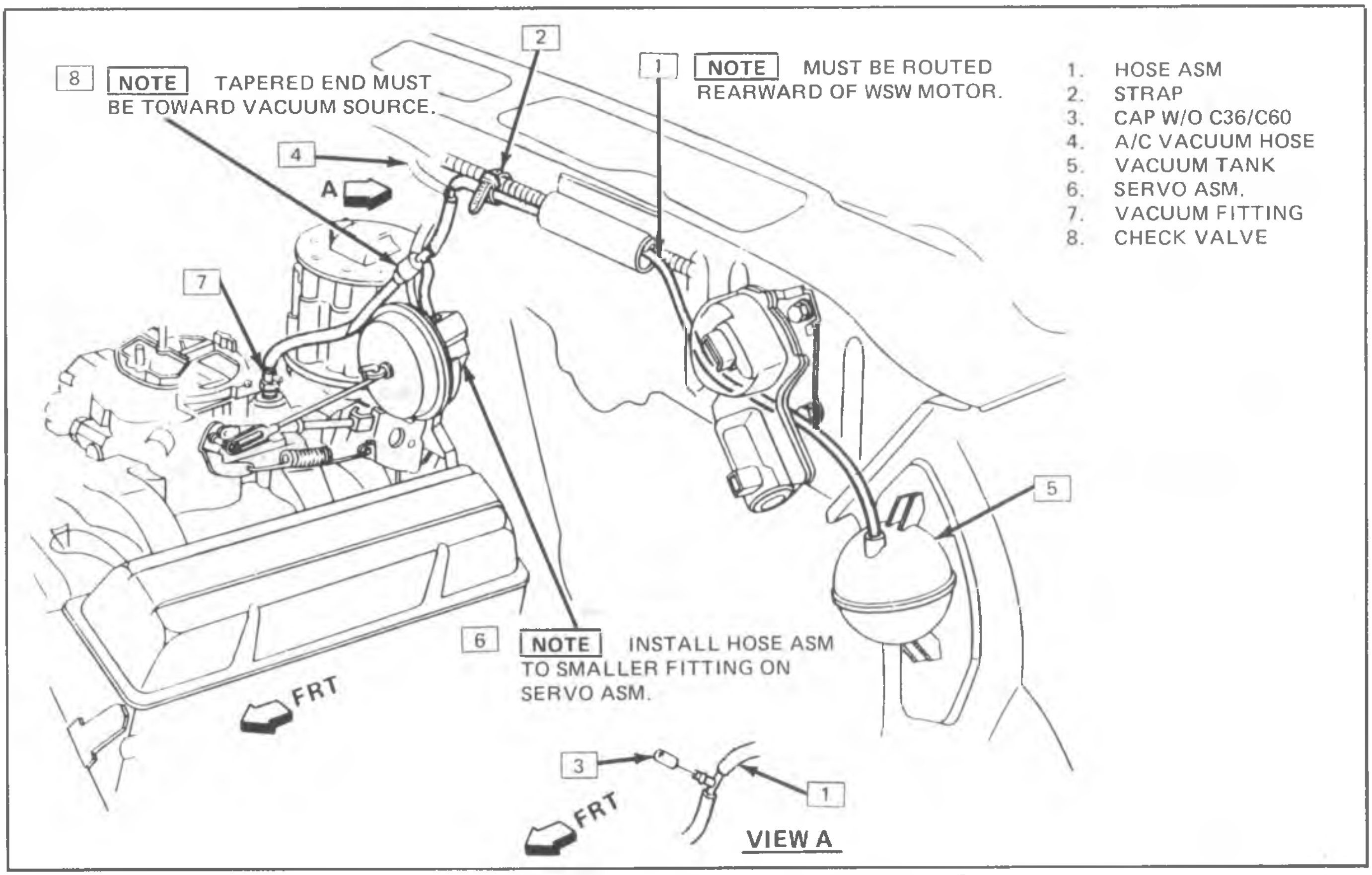
1. HOSE ASM
2. RETAINER
3. ROD LINK
4. SERVO ASM
5. BOLT/SCREW
6. SERVO BRACKET
7. ACCELERATOR CABLE
8. LEVER

SERVO ROD LINK ADJUSTMENT

With engine not running and idle bolt/screw against stop, assemble rod link 3 to throttle lever stud and then to servo. Choose hole closest to servo which will provide a maximum of 1.0 mm slack. See View C.

CAUTION. Having secured all components of accelerator, detent, and cruise linkage as specified, linkage must operate freely without bind between full closed throttle, and full wide open throttle.

Figure 9B-16 Servo Mounting (C-K Diesel)



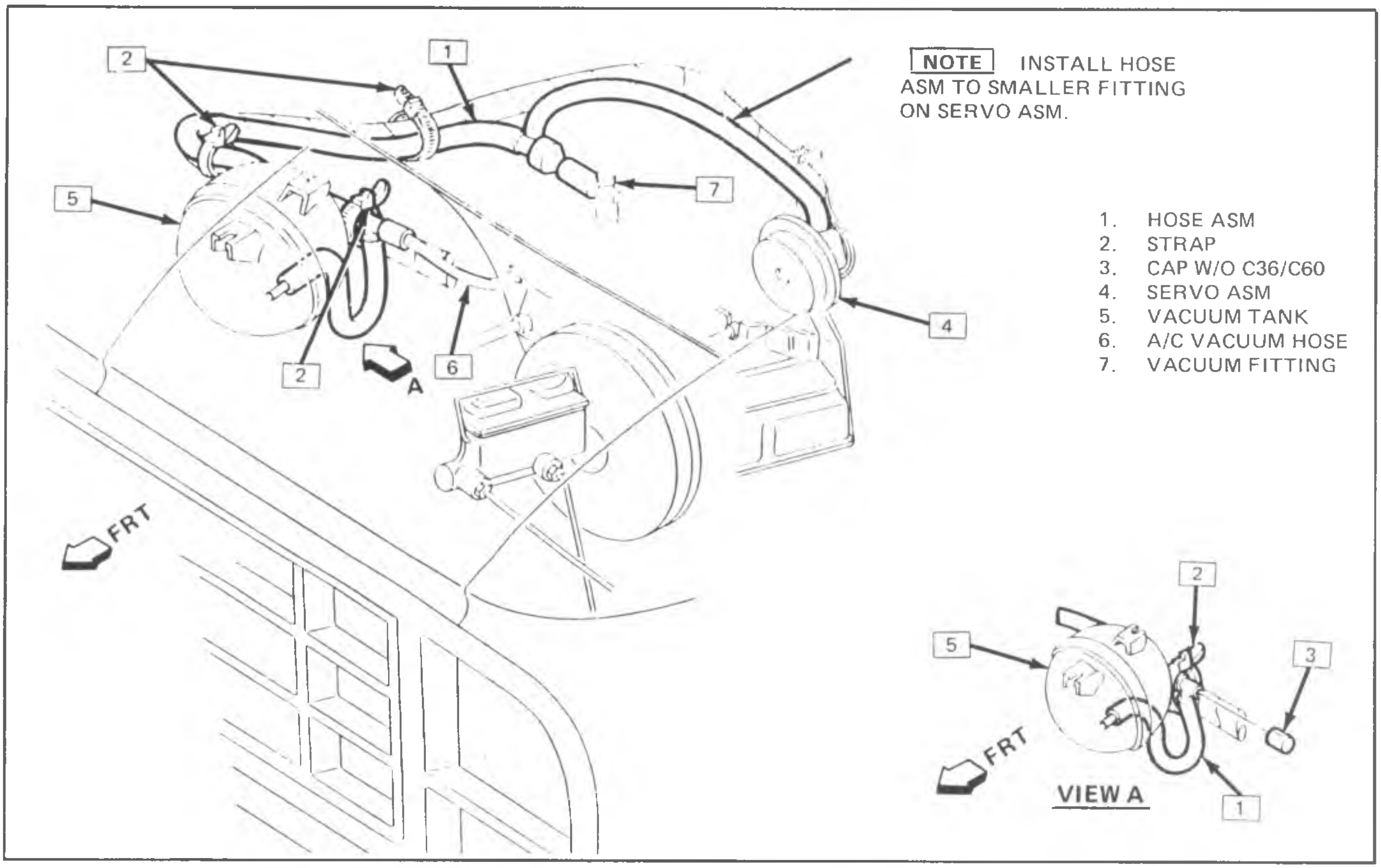
8 NOTE TAPERED END MUST BE TOWARD VACUUM SOURCE.

1 NOTE MUST BE ROUTED REARWARD OF WSW MOTOR.

6 NOTE INSTALL HOSE ASM TO SMALLER FITTING ON SERVO ASM.

1. HOSE ASM
2. STRAP
3. CAP W/O C36/C60
4. A/C VACUUM HOSE
5. VACUUM TANK
6. SERVO ASM.
7. VACUUM FITTING
8. CHECK VALVE

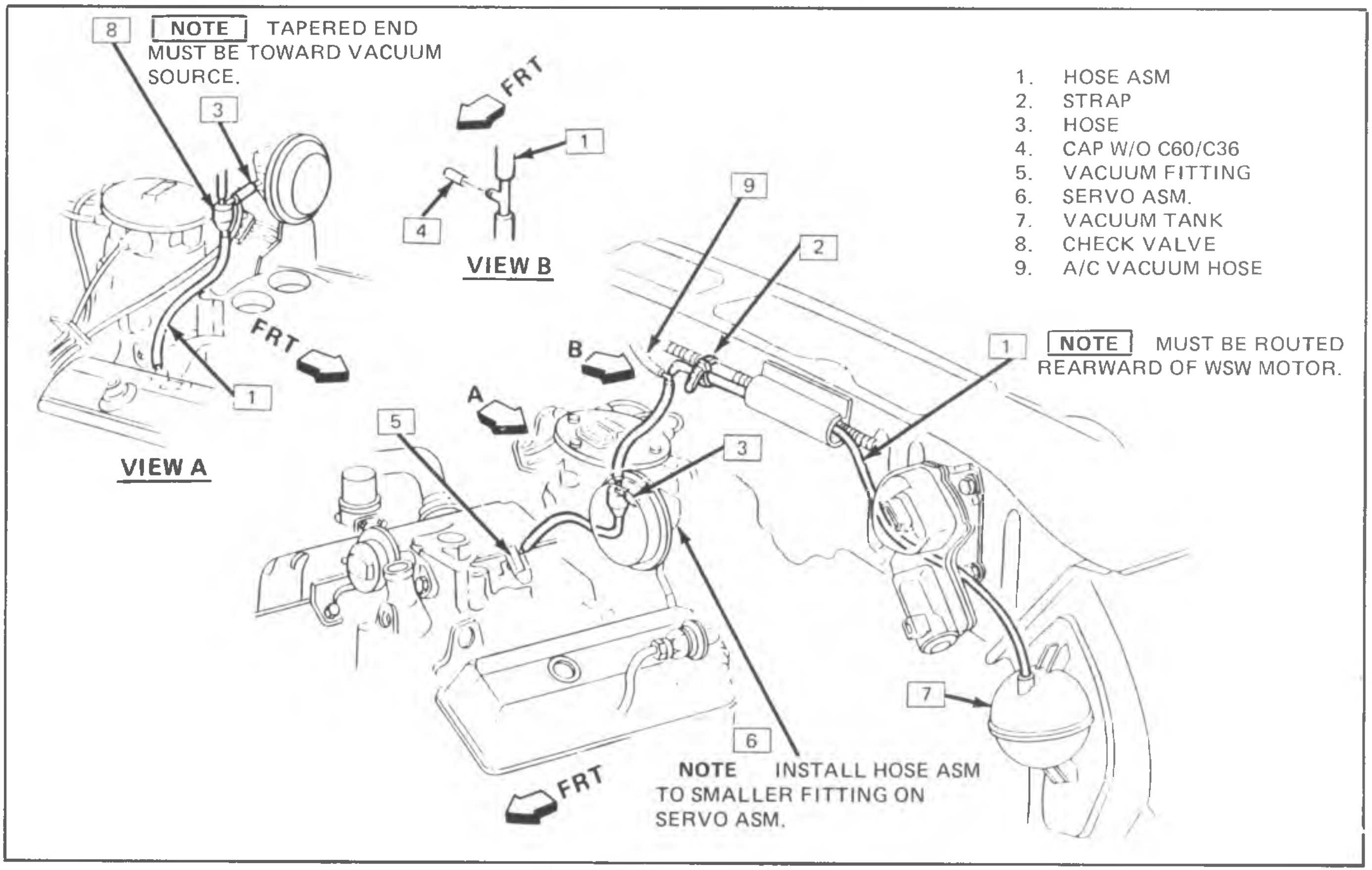
Figure 9B-17 Vacuum Hose Routing C-K Truck (V8 Gas)



NOTE INSTALL HOSE ASM TO SMALLER FITTING ON SERVO ASM.

1. HOSE ASM
2. STRAP
3. CAP W/O C36/C60
4. SERVO ASM
5. VACUUM TANK
6. A/C VACUUM HOSE
7. VACUUM FITTING

Figure 9B-18 Vacuum Hose Routing G Van (V8 Gas)



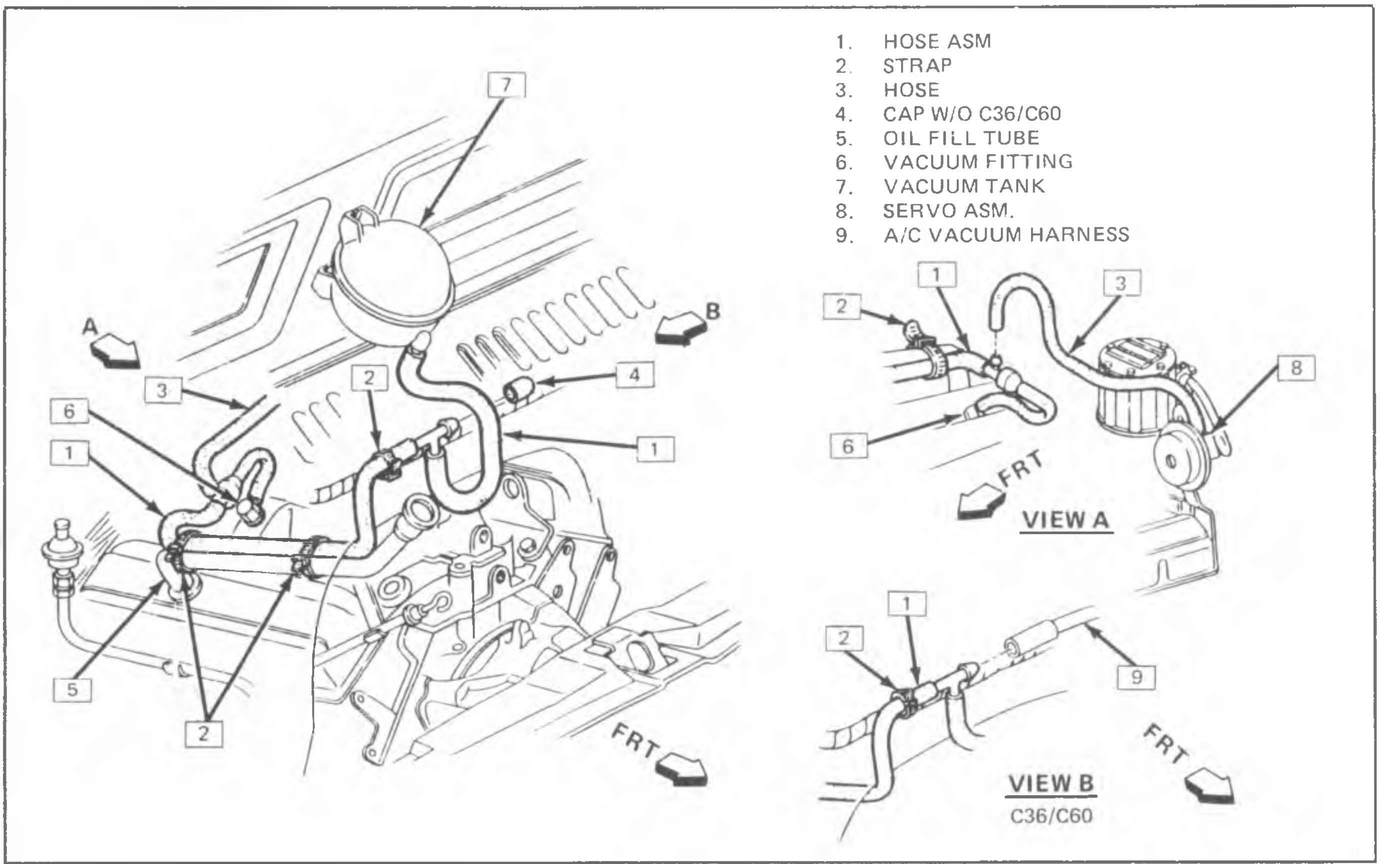
NOTE TAPERED END MUST BE TOWARD VACUUM SOURCE.

1. HOSE ASM
2. STRAP
3. HOSE
4. CAP W/O C60/C36
5. VACUUM FITTING
6. SERVO ASM.
7. VACUUM TANK
8. CHECK VALVE
9. A/C VACUUM HOSE

NOTE MUST BE ROUTED REARWARD OF WSW MOTOR.

NOTE INSTALL HOSE ASM TO SMALLER FITTING ON SERVO ASM.

Figure 9B-19 Vacuum Hose Routing C-K Truck (V6)



1. HOSE ASM
2. STRAP
3. HOSE
4. CAP W/O C36/C60
5. OIL FILL TUBE
6. VACUUM FITTING
7. VACUUM TANK
8. SERVO ASM.
9. A/C VACUUM HARNESS

Figure 9B-20 Vacuum Hose Routing G Van (V6)

SECTION 10

BODY

CONTENTS

SUBJECT **PAGE**

SECTION 10A1

DOORS

CONTENTS

SUBJECT **PAGE**

CONTENTS (CONTINUED)

CONTENTS (CONTINUED)

SUBJECT **PAGE**

G Model Intermediate Doors (Continued)

C/K MODEL SIDE FRONT DOOR

DOOR AND HINGE REPLACEMENT

Remove or Disconnect (Figure 1)

- Open the door.
1. Electrical wiring harness (if equipped).
    - Refer to "Door Trim Panel Replacement," for access to the wiring harness.
- Mark the position of the hinges on the door.
2. Door hinge to door bolts (4).
3. Door from the vehicle.
- Mark the position of the hinges on the body side pillar.
4. Hinge to door pillar bolts (6).
5. Door pillar to hinge bolt (7).
6. Hinges from the vehicle.

Install or Connect (Figure 1)

1. Hinges to the vehicle.
- Align the hinges to the marks on the body side pillars.
2. Hinge to door pillar bolts (6).
3. Door pillar to hinge bolt (7).
4. Door to the vehicle.
- Align the marks on the door to the hinges.
5. Door hinge to door bolts (4).
6. Electrical wiring harness (if equipped).
    - Refer to "Door Trim Panel Replacement," for access to the wiring harness.

DOOR ADJUSTMENT

Remove or Disconnect (Figures 2 and 3)

Tools Required:
J-22585-01 Door Hinge Bolt Wrench.
J-23457-A Wrench.

- Door striker bolt using J-23457-A.
- Use tool J-22585-01 when loosening the door hinge to body side pillar bolts. The rear fender bolts may need to be loosened for access to these bolts.

Adjust

- The door up or down, forward or rearward, and in or out, at the door hinges.
1. Adjust the door to obtain a gap of 6 mm ± (0.24-inch ± 0.09-inch) between the rocker panel and the door.
2. The gap between the door and the roof panel should be 5 mm ± 2 mm (0.19-inch ± 0.09-inch).

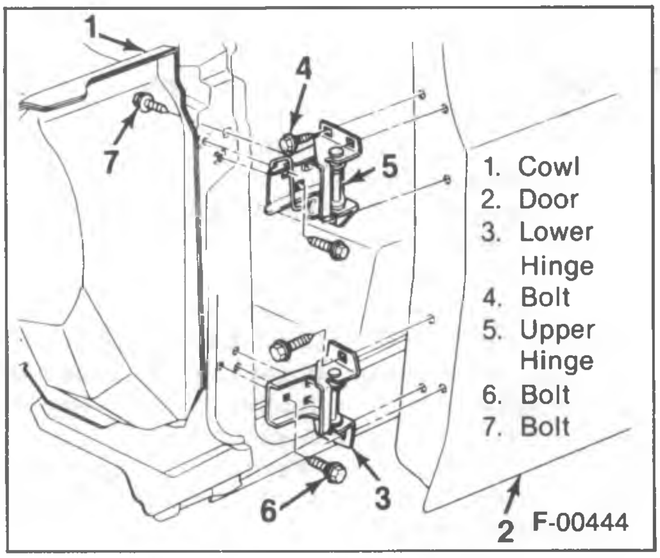


Figure 1—Door Hinge Components

3. Adjust the door to obtain a gap of 5 mm ± 2 mm (0.19-inch ± 0.09-inch) between the doors rear edge and the rear door pillar.
4. The gap between the door and the windshield pillar should be 2 mm ± 1.5 mm (0.08-inch ± 0.06-inch).
5. The door surface should be flush with the other panels within ± 1.5 mm (± 0.06-inch) except for the door to roof panel surface which should be flush within + 1.5 mm (+ 0.06-inch).
6. Tighten the hinge bolts.

Install or Connect (Figures 2 and 3)

1. Door striker bolt.

Adjust

- Bolt to properly engage the door lock.

2. Tighten the striker bolt.

Tighten

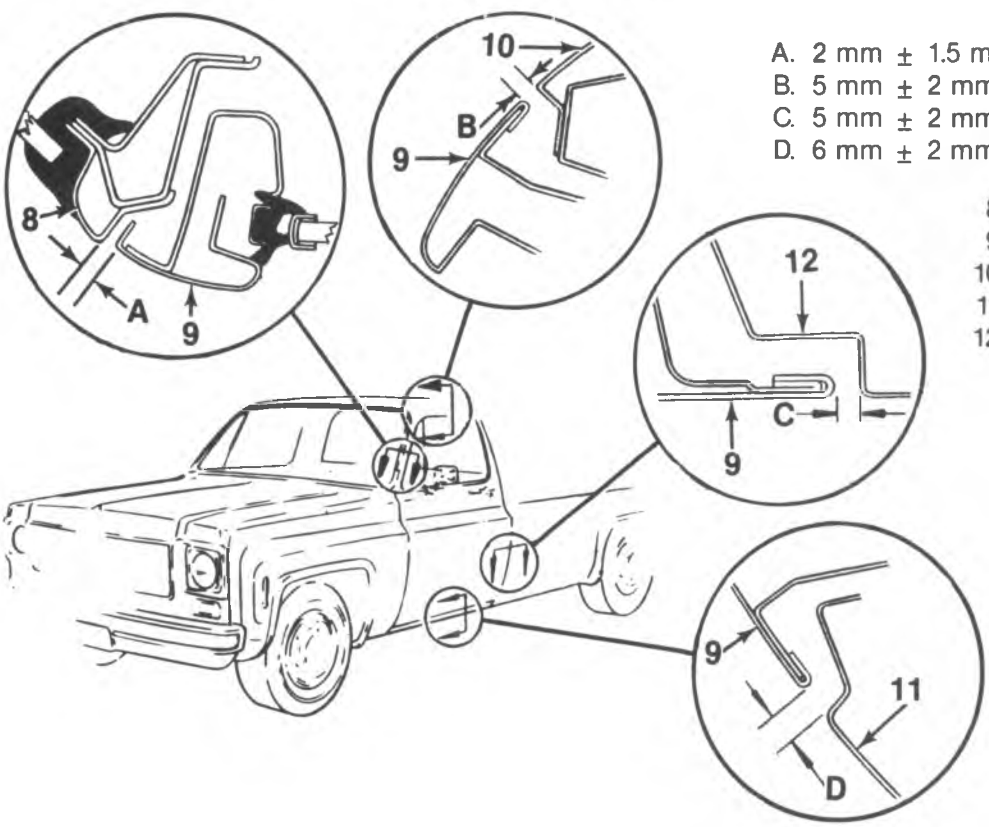
- Striker bolt to 63 N·m (46 ft. lbs.).

DOOR TRIM PANEL REPLACEMENT

Remove or Disconnect (Figures 4 and 5)

Tools Required:
J-9776-01 Door Handle Clip Remover.
J-24595-B Door Trim Pad Clip Remover.

1. Window regulator handle using J-9886-01.

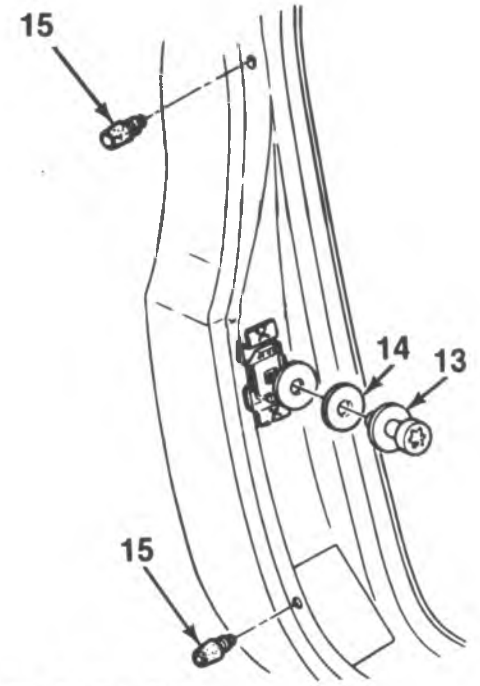


A. 2 mm ± 1.5 mm (0.08-inch ± 0.06-inch)
B. 5 mm ± 2 mm (0.19-inch ± 0.09-inch)
C. 5 mm ± 2 mm (0.19-inch ± 0.09-inch)
D. 6 mm ± 2 mm (0.24-inch ± 0.09-inch)

8. Windshield Pillar
9. Door Assembly
10. Roof Panel
11. Rocker Panel
12. Front Door Rear Pillar

F-00445

Figure 2—Door Adjustments

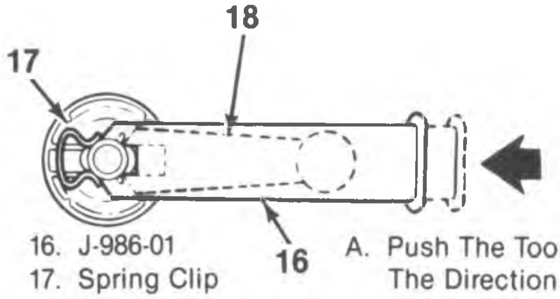


13. Striker Bolt
14. Washer
15. Bumper

F-00828

Figure 3—Door Striker

2. Lock knob.
3. Arm rest to arm rest bracket screws (77).
4. Arm rest from the door.
5. Strap assembly covers (if equipped).
6. Strap assembly screws (24) (if equipped).
7. Strap assembly (if equipped).
8. Door trim panel to door screws (22).
9. Door trim panel to door retainers using J-24595-B.
10. Door trim panel from the door.
    - Pry the top of the panel away from the door side window seal clips.



16. J-986-01
17. Spring Clip
18. Inside Handle

A. Push The Tool In The Direction Of The Arrow

F-01227

Figure 4—Handle Clip Removal

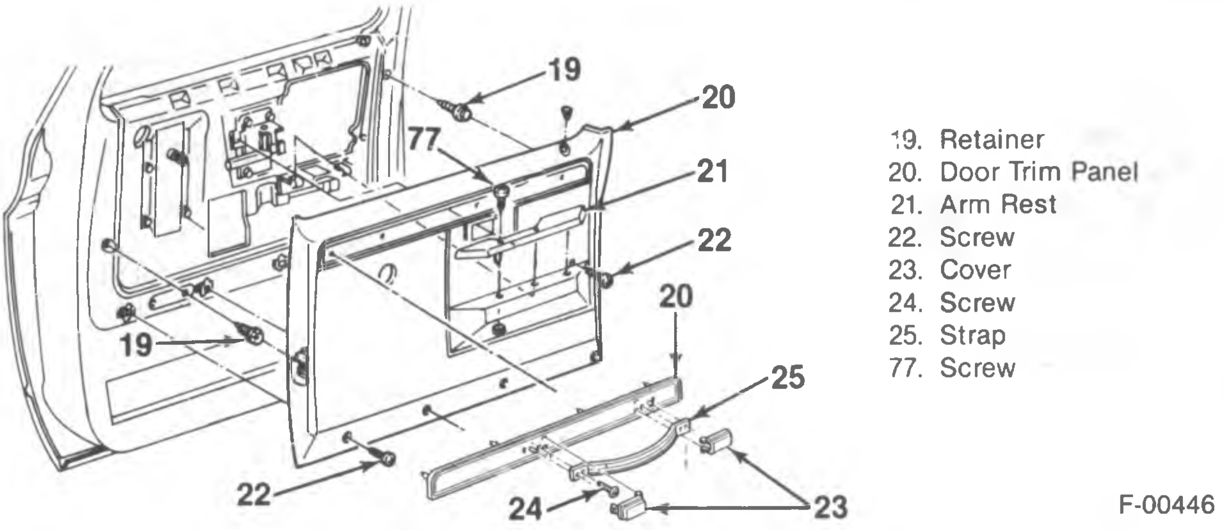


Figure 5—Trim Panel Components

Install or Connect (Figures 4 and 5)

- Check that all the trim retainers are securely fastened, and are not damaged. Replace any damaged fasteners.

1. Door trim panel onto the door side window seal clips.
2. Door trim retainers into the door panel.
3. Door trim panel to door screws (22).
4. Strap assembly onto the door (if equipped).
5. Strap assembly screws (if equipped).
6. Strap assembly covers (if equipped).
7. Arm rest to the door.
8. Arm rest to arm rest bracket screws (77).
9. Lock knob.
10. Window regulator handle.

DOOR VENT/WINDOW RUN CHANNEL ASSEMBLY REPLACEMENT

The door vent and the front window run channel are one assembly. This assembly is fit into the front of the door frame.

Remove or Disconnect (Figure 6)

- Place the window in the lowered position.

1. Door trim panel. Refer to "Door Trim Panel Replacement."
2. Run channel molding.
   - Pull the molding out of the vent assembly only.
3. Door panel to run channel bolt (31).
4. Door to ventilator screws (26) and spacers (27).
5. Door vent/window run channel assembly from the vehicle.
   - Pull the top of the vent backwards away from the door frame.
   - Lift and rotate the assembly out of the door.

Install or Connect (Figure 6)

1. Door vent/window run channel assembly to the vehicle.

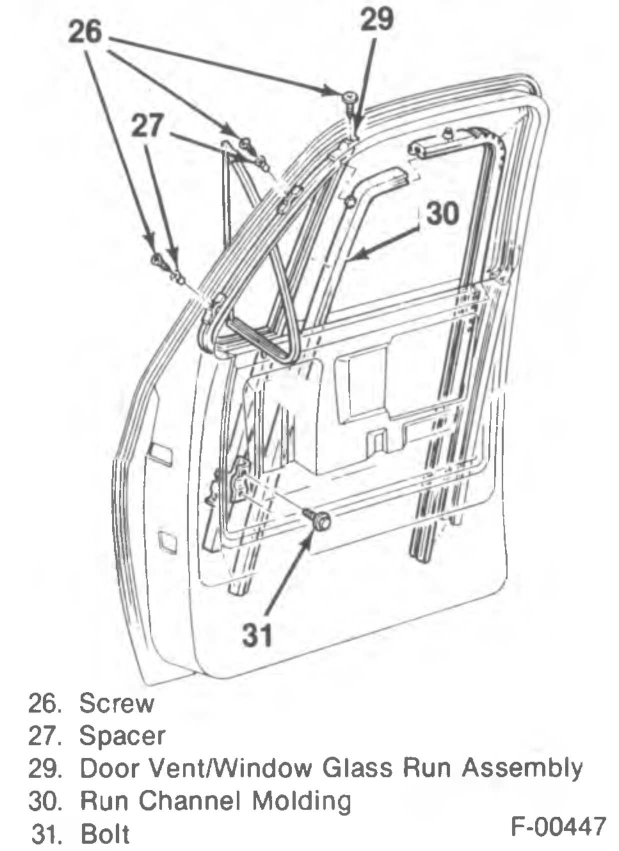


Figure 6—Door Vent/Window Run Channel Components

- Rotate the vent assembly into the door.
- Fit the assembly into the door frame.

2. Door to ventilator screws (26) and spacers (27).
    - Start with the screw at the top of the door, and work downward.
3. Door panel to run channel bolts (31).
4. Run channel molding.
    - Seat the clip into the vent, then push the remainder of the molding into the run channel.
5. Door trim panel. Refer to "Door Trim Panel Replacement."

VENT GLASS REPLACEMENT

CAUTION: Always wear heavy gloves when handling glass to minimize the risk of injury.

REMOVAL (Figure 6)

1. Open the vent window.
2. Squirt solvent on the tar-paper-like filler all around the glass channel, on both sides of the glass.
3. When the filler and sealer soften, pull the glass and the old filler from the channel.

INSTALLATION (Figure 6)

1. Thoroughly clean the inside of the glass channel with sandpaper to remove all rust and foreign matter.
2. Cut the new piece of glass channel filler 51 mm (2-inches) longer than required.
3. Position the filler (soap stoned side away from the glass) evenly around and over the edge of the glass that will be inserted in the channel. Press the filler firmly onto the edge of the glass to ensure a good bond. (Usually this is done with a mechanical window press.) Squeeze together the doubled ends of the filler which project beyond the edge of the glass.
4. Brush the inner channel with soap solution. DO NOT USE GREASE OR OIL.
5. Press the glass and the filler into the channel until firmly seated.
6. Trim off excess filler material around, and at the end of the channel.

VENT WINDOW ADJUSTMENT

🔧 **Adjust (Figure 7)**

1. Remove the door trim panel. Refer to "Door Trim Panel Replacement."
2. Bend the tabs on the adjustment nut away from the nut.

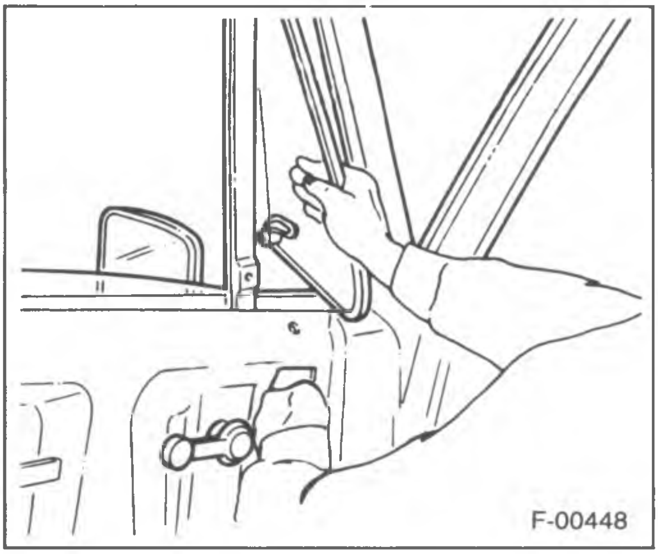


Figure 7—Vent Window Adjustment

3. Adjust the vent by placing a wrench on the adjusting nut, and then turning the vent window to the proper tension.
4. Bend the tabs over the adjustment nut.
5. Install the door trim panel. Refer to "Door Trim Panel Replacement."

DOOR WINDOW REPLACEMENT

↔ **Remove or Disconnect (Figure 8)**

CAUTION: Always wear heavy gloves when handling glass to minimize the risk of injury.

- Lower the glass to the bottom of the door.

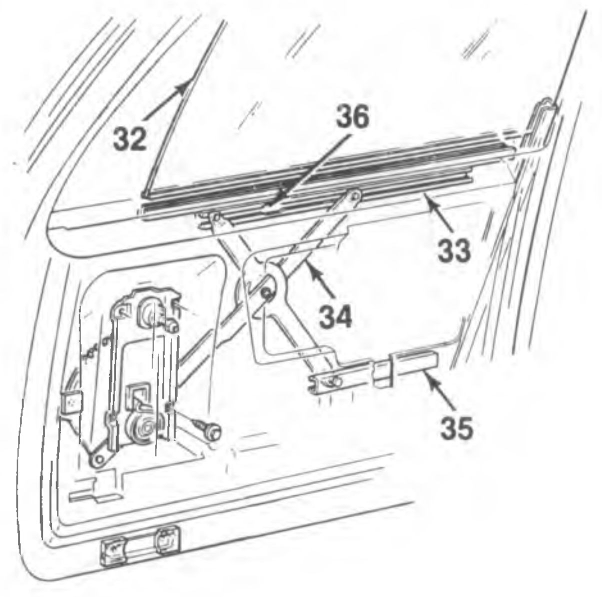
1. Door trim panel. Refer to "Door Trim Panel Replacement."
2. Door vent/window run channel assembly. Refer to "Door Vent/Window Run Channel Assembly Replacement."

- Mask or cover any sharp edges that could scratch the glass.

3. Door window glass.
    - Slide the glass forward until the front roller is in line with the notch in the sash channel. Disengage the roller from the channel.
    - Push the window forward, then tilt it up until the rear roller is disengaged.
    - Place the iwndow in a level position, and raise it straight up and out of the door.

→← **Install or Connect (Figure 8)**

1. Door window glass.
    - Lower the window into the door frame.
    - Push the window forward, then tilt it up, and slide the rear roller into the sash channel.



32. Glass
33. Window Sash
34. Regulator Assembly
35. Regulator Rail
36. Notch

F-00449

Figure 8—Window Assembly Components

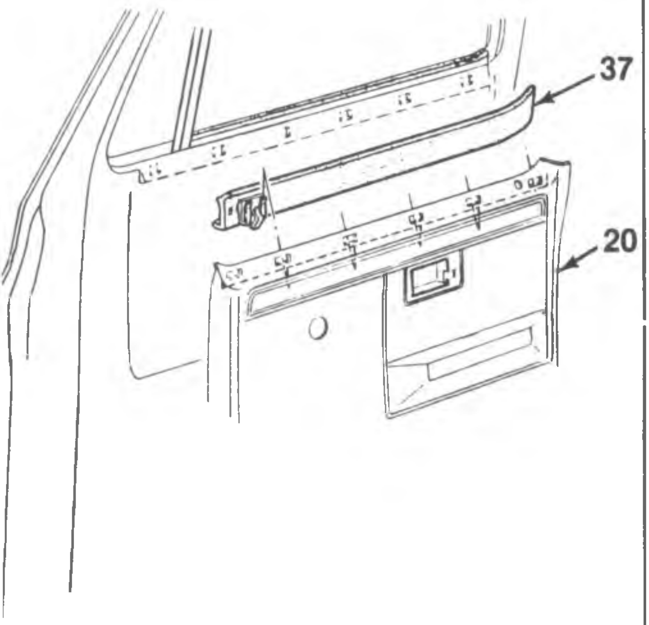
  - Slide the glass backward until the front roller is in line with the notch in the sash channel. Engage the roller to the sash channel.
  - Slide the glass rearward into the glass run channel.
- Remove any masking or covering.

2. Door vent/window run channel assembly. Refer to "Door Vent/Window Run Channel Assembly Replacement."
3. Door trim panel. Refer to "Door Trim Panel Replacement."

INNER WINDOW WEATHERSTRIP REPLACEMENT

Remove or Disconnect (Figure 9)

1. Door trim panel. Refer to "Door Trim Panel Replacement."
2. Weatherstrip (37) from the trim panel.
   - Pry the clips on the weatherstrip from the trim panel shoulder.



20. Trim Panel
37. Inner Weatherstrip

F-00450

Figure 9—Inner Window Weatherstrip

Install or Connect (Figure 9)

1. Weatherstrip (37) to the trim panel.
   - Push the weatherstrip clips onto the trim panel shoulder.
2. Door trim panel. Refer to "Door Trim Panel Replacement."

OUTER WINDOW WEATHERSTRIP REPLACEMENT

Remove or Disconnect (Figure 10)

- Lower the window.
- Weatherstrip (38) from the door.
  - Pry the weatherstrip clips from the door panel.

Install or Connect (Figure 10)

- Weatherstrip (38) to the door.
  - Push the weatherstrip clips onto the door panel.

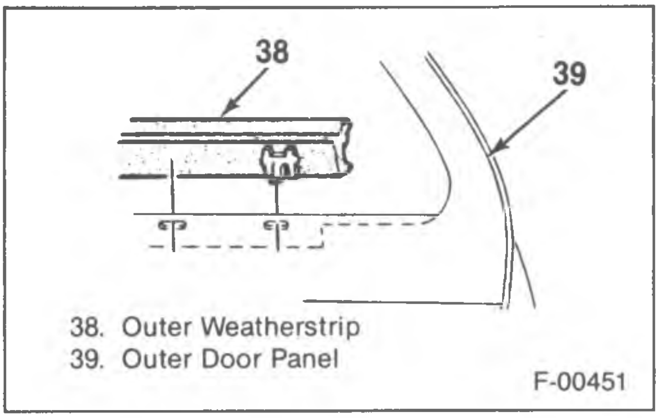


Figure 10—Outer Window Weatherstrip

REAR GLASS RUN CHANNEL REPLACEMENT

Remove or Disconnect (Figure 11)

1. Door trim panel. Refer to "Door Trim Panel Replacement."
- Lower the window completely.
2. Inner and outer window weatherstrips.
3. Door to run channel bolts (41).
4. Run channel from the vehicle.
    - Pull the run channel upwards while twisting to clear the lower bracket.

Install or Connect (Figure 11)

1. Run channel to the vehicle.
    - Work the run channel into the door frame. Be certain that the glass is in the channel.
2. Lower door to run channel bolt (41).
- Raise the window completely.
3. Upper door to run channel bolt (41).
4. Inner and outer window weatherstrips.
5. Door trim panel. Refer to "Door Trim Panel Replacement."

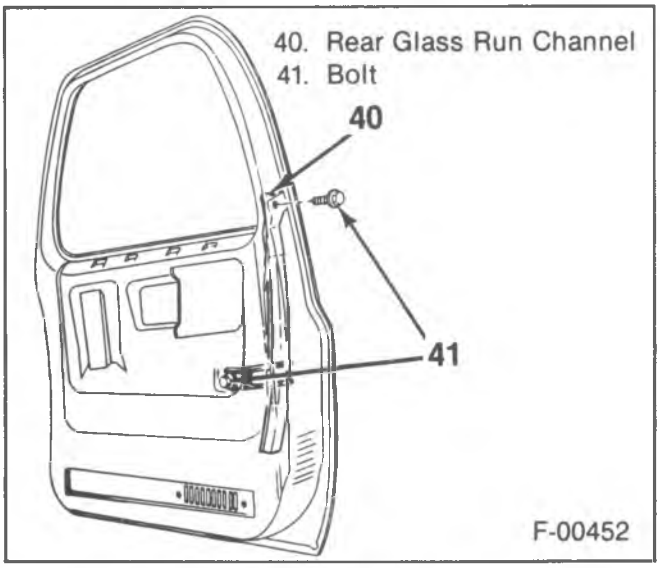


Figure 11—Rear Glass Run Channel Components

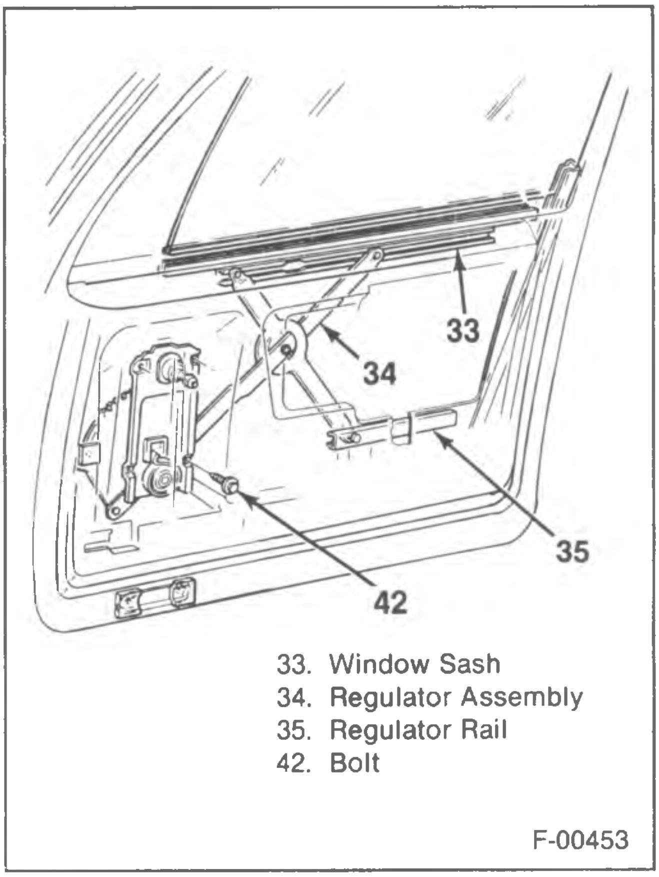


Figure 12—Manual Window Regulator

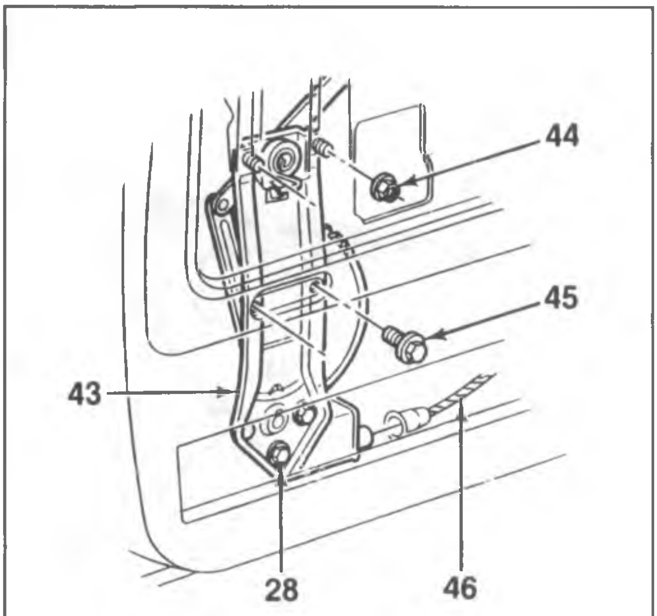
WINDOW REGULATOR REPLACEMENT

MANUAL REGULATOR

Remove or Disconnect (Figure 12)

- Raise the window and tape the glass in the full up position using cloth body tape.

1. Door trim panel. Refer to "Door Trim Panel Replacement."
2. Door panel to regulator bolts (42).
3. Window regulator.
    - Slide the regulator rearward to disengage the rear roller from the sash channel. Also disengage the lower roller from the regulator rail.
    - Disengage the forward roller from the sash channel at the notch inthe sash channel.
    - Collapse the regulator, and remove it through the access hole in the door.



28. Bolt
43. Regulator Assembly
44. Nut
45. Bolt
46. Wiring Harness

F-00454

Figure 13—Power Window Regulator

→← Install or Connect (Figure 12)

- Lubricate the regulator and the sash and regulator rails with lubriplate or equivalent.

1. Window regulator.
    - Collapse the regulator, and insert it through the access hole in the door.
    - Unfold the regulator, and engage the forward roller to the sash channel at the sash channel notch.
    - Slide the regulator rearward to engage the rear roller to the sash channel. Also engage the lower roller to the regulator rail.
    - Slide the regulator into its proper position, and insert the regulator drive through the door panel.
2. Door panel to regulator bolts (42).
3. Door trim panel. Refer to "Door Trim Panel Replacement."

- Remove the tape from the window.

POWER REGULATOR

For the diagnosis of power window circuits, refer to CAB ELECTRICAL (SEC. 8A).

←→ Remove or Disconnect (Figures 12 and 13)

- Raise the window and tape the glass in the full up position using cloth body tape.

1. Battery ground cable.
2. Door trim panel. Refer to "Door Trim Panel Replacement."
3. Remove control to door trim panel bolts.
    - Lay the control aside.
4. Regulator to door panel bolts (45) and nuts (44).
5. Wiring harness from the regulator.
6. Window regulator.
    - Slide the regulator rearward to disengage the rear roller from the sash channel. Also disengage the lower roller from the regulator rail.
    - Disengage the forward roller from the sash channel at the notch in the sash channel.
    - Collapse the regulator, and remove it through the access hole in the door.

CAUTION: The next step must be performed when the regulator is removed from the door. The regulator lift arms are under tension from the counterbalance spring and can cause serious injury if the motor is removed without locking the sector gear in position.

- Drill a hole through the regulator sector gear and back plate. Drill the hole at least 12.7 mm (1/2-inch) away from the edge of the sector gear or back plate. Install a pan head sheet metal tapping screw at least 19 mm (3/4-inch) long into the drilled hole to lock the sector gear in place.

7. Motor to regulator attaching bolts (28).
8. Motor from the regulator.

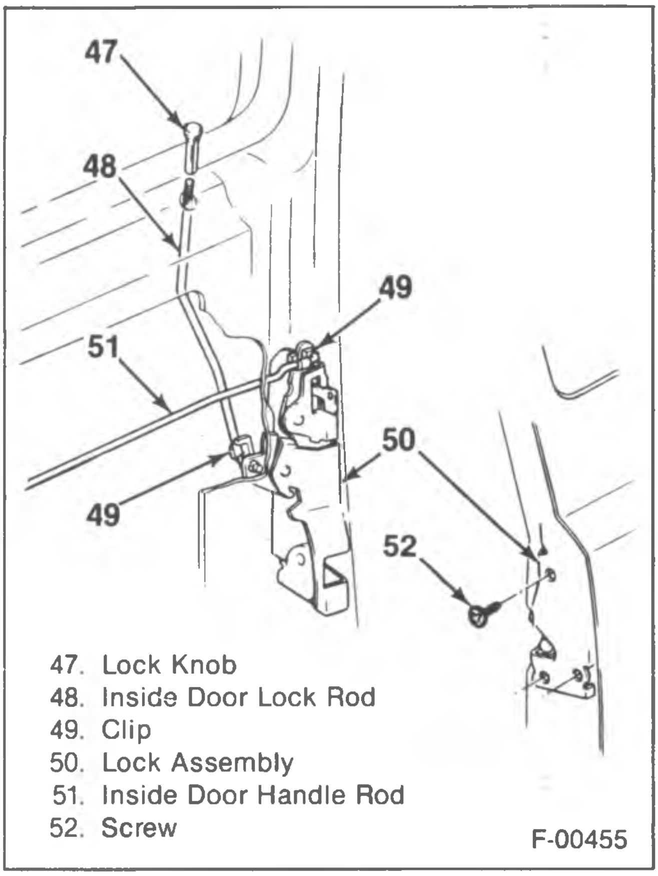
→← Install or Connect (Figures 12 and 13)

- Lubricate the motor drive gear and regulator sector teeth.

1. Regulator motor to regulator.
    - The motor pinion gear teeth must mesh properly with the sector gear teeth before installing the motor to regulator screws.
2. Regulator motor to regulator bolts (28).

- Remove the sheet metal screw from the back plate and sector gear.

3. Window regulator to the door.
    - Collapse the regulator, and insert it through the access hole in the door.
    - Unfold the regulator, and engage the forward roller to the sash channel at the sash channel notch.
    - Slide the regulator rearward to engage the rear roller to the sash channel. Also engage the roller to the regulator rail.
    - Slide the regulator into its proper position.
4. Wiring harness to the regulator.
5. Regulator to door panel bolts (45) and nuts (44).
6. Remote control to door trim panel bolts.



47. Lock Knob
48. Inside Door Lock Rod
49. Clip
50. Lock Assembly
51. Inside Door Handle Rod
52. Screw

Figure 14—Door Lock Components

7. Door trim panel. Refer to "Door Trim Panel Replacement."
8. Battery ground cable.

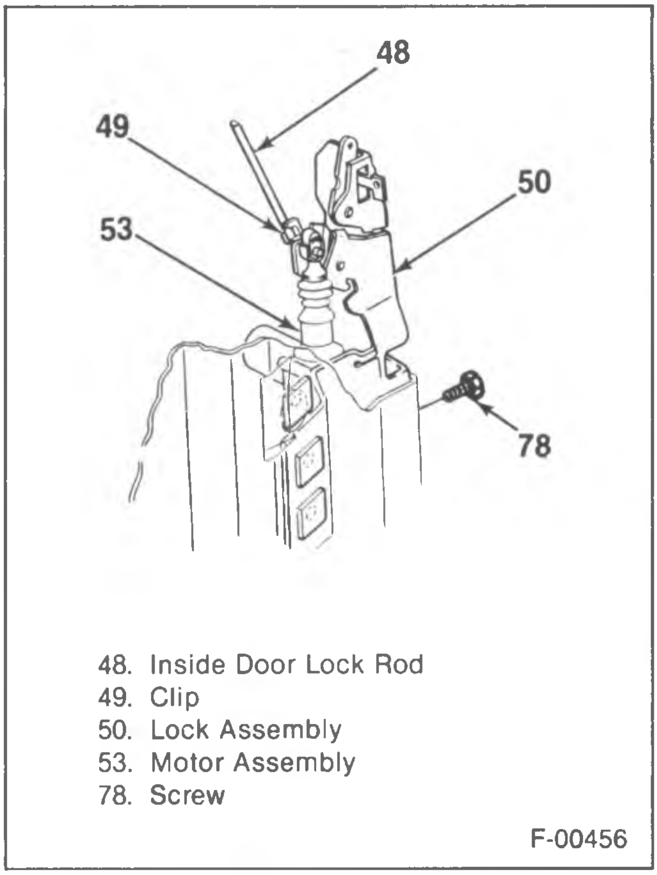
- Remove the tape from the window.

DOOR LOCK REPLACEMENT

Remove or Disconnect (Figure 14)

- Raise the window completely.

1. Door trim panel. Refer to "Door Trim Panel Replacement."
2. Inside door handle to lock rod clips (49).
    - Using a flat bladed screwdriver, push on the top of the clip where it is connected to the rod. Pivot the clip away from the rod.
3. Inside door handle to lock rod from the lock.
4. Outside door handle to lock rod clip.
    - Use the procedure given under step 2.
5. Outside door handle to lock rod from the lock.
6. Inside door lock knob.
7. Door to lock assembly screws (52).
8. Lock assembly from the door.
    - Tilt the lock assembly away from the outside lock cylinder. Pull the lock assembly downward to make clearance for the inside lock rod.



48. Inside Door Lock Rod
49. Clip
50. Lock Assembly
53. Motor Assembly
78. Screw

Figure 15—Power Door Lock Motor

Install or Connect (Figure 14)

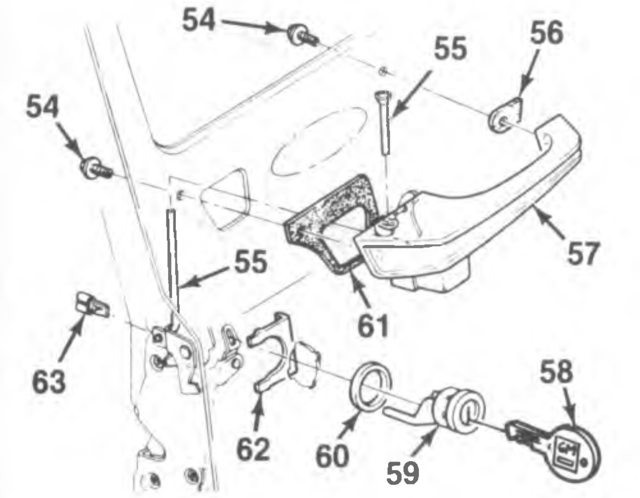
1. Lock assembly to the door.
    - Align the inside lock rod to the hole in the door panel. Tilt the lock assembly onto the outside lock cylinder.
2. Door to lock assembly screws (52).
3. Inside door lock knob.
4. Outside door handle to lock rod onto the lock assembly.
5. Clip onto the lock rod.
    - Pivot the clip up and onto the lock rod.
6. Inside door handle to lock rod onto the lock assembly.
7. Clip onto the lock rod.
    - Pivot the clip up and onto the lock rod.
8. Door trim panel. Refer to "Door Trim Panel Replacement."

POWER DOOR LOCK MOTOR REPLACEMENT

Refer to CAB ELECTRICAL (SEC. 8A) for electrical diagnosis of the door lock motor.

Remove or Disconnect (Figure 15)

1. Battery ground cable.



54. Bolt
55. Outside Handle Rod
56. Small Gasket
57. Handle Assembly
58. Key
59. Lock Cylinder
60. Gasket
61. Large Gasket
62. Retainer
63. Clip

F-00457

Figure 16—Outside Handle And Lock Cylinder Components

2. Door trim panel. Refer to "Door Trim Panel Replacement."
3. Electrical connector from the motor.
4. Door to motor screws (78).
5. Motor from the lock rod.
   - Slide the rubber mount at the top of the motor off of the door lock rod.
6. Motor from the door.

Install or Connect (Figure 15)

1. Motor into the door.
2. Motor to the lock rod.
   - Slide the rubber mount at the top of the motor onto the door lock rod.
3. Door to motor screws (78).
4. Electrical connector to the motor.
5. Door trim panel. Refer to "Door Trim Panel Replacement."
6. Battery ground cable.

DOOR OUTSIDE HANDLE REPLACEMENT

Remove or Disconnect (Figure 16)

- Raise the window completely.

1. Door trim panel. Refer to "Door Trim Panel Replacement."
2. Outside door handle to lock rod clip.
   - Using a flat bladed screwdriver, push on the top of the clip where it is connected to the rod. Pivot the clip away from the rod.
3. Outside door handle to lock rod from the lock.
4. Door to outside handle screws (54).
5. Handle with the control rod from the door.
6. Gaskets from the door.

Install or Connect (Figure 16)

1. Large gasket over the lock rod and onto the handle.
2. Handle with the lock rod onto the door.
3. Door to outside handle screw (54) to the push button side of the handle.
   - Do not tighten.
4. Small gasket between the door and the handle.
5. Door to outside handle screw (54) to the other side of the handle.
   - Tighten both screws.
6. Outside door handle to lock rod to the lock assembly.
7. Clip onto the lock rod.
   - Pivot the clip up and onto the lock rod.
8. Door trim panel. Refer to "Door Trim Panel Replacement."

DOOR LOCK CYLINDER REPLACEMENT

Remove or Disconnect (Figure 16)

- Raise the window completely.

1. Door trim panel. Refer to "Door Trim Panel Replacement."
2. Lock cylinder retaining clip (62) from the cylinder.
   - Slide the clip off the cylinder with a screwdriver.
3. Lock cylinder and gasket from the door.

Install or Connect (Figure 16)

1. Lock cylinder with gasket to the door.
   - The cylinder rod must engage the lock assembly lever.
2. Lock cylinder (62) retaining clip onto the cylinder.
3. Door trim panel. Refer to "Door Trim Panel Replacement."

DOOR INSIDE HANDLE REPLACEMENT

Remove or Disconnect (Figure 17)

1. Door trim panel. Refer to "Door Trim Panel Replacement."
2. Door handle seal.
3. Handle to door screws (65).
4. Control rod from the inside handle.
   - Slide the clip so that the large diameter slot is in line with the lock rod. Then, pull the rod from the handle.
5. Inside handle from the door.

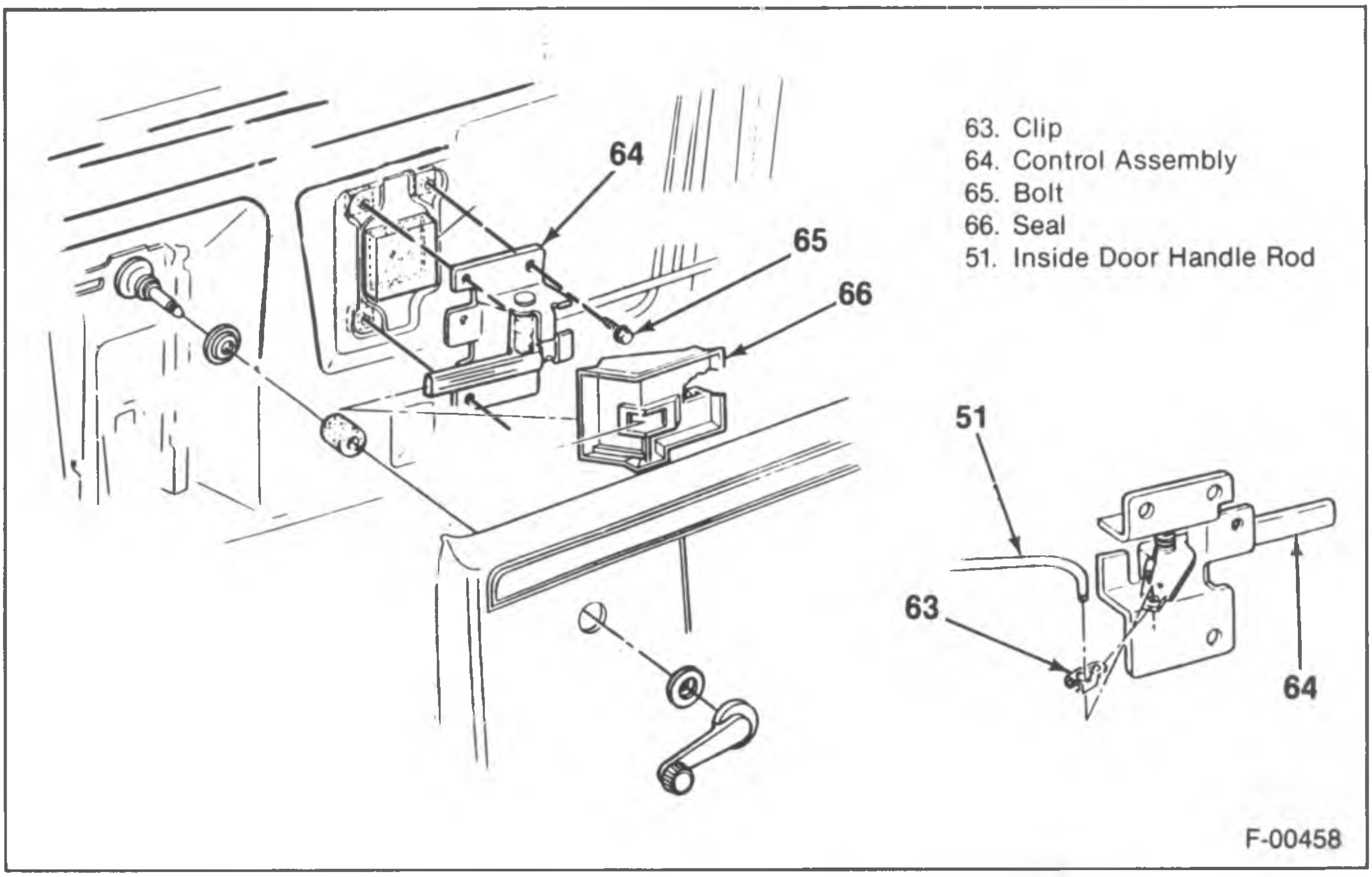


Figure 17—Door Inside Handle

Install or Connect (Figure 17)

1. Control rod to the inside handle.
    - Place the rod into the clip and the lever. Slide the clip so that the small diameter slot is in line with the lock rod.
2. Handle to door screws (65).
3. Door handle seal.
4. Door trim panel. Refer to "Door Trim Panel Replacement."

DOOR WEATHERSTRIP REPLACEMENT

Remove or Disconnect (Figure 18)

- Open the door.
1. Sill plate from the vehicle.
2. Weatherstrip from the pinchweld flange.
    - Pull the weatherstrip away from the flange.

Install or Connect (Figure 18)

1. Weatherstrip to the pinchweld flange.
    - Start at the bottom center of the door opening.
- Trim the weatherstrip, and butt the ends together.
2. Sill plate to the vehicle.

OUTSIDE REAR VIEW MIRROR REPLACEMENT

Remove or Disconnect (Figure 19)

1. Mirror to bracket screw.
2. Mirror from the door.
3. Bracket to door bolts.

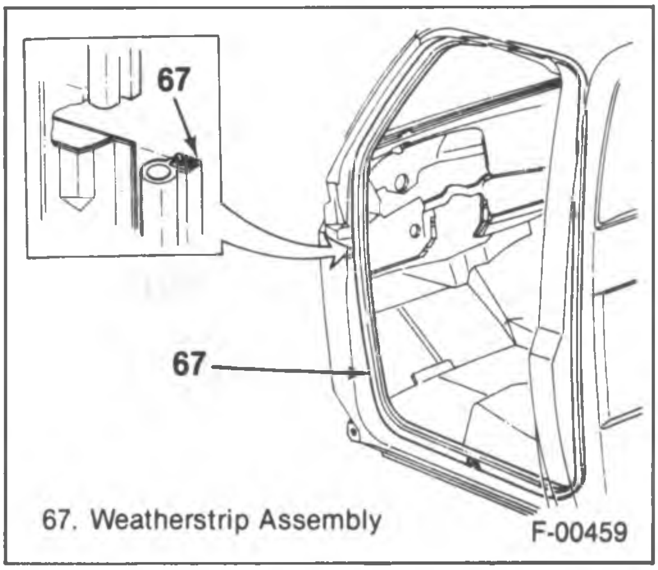


Figure 18—Front Door Weatherstrip

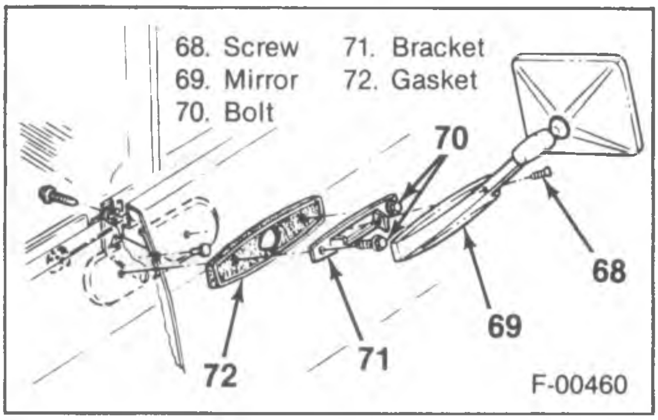


Figure 19—Outside Rear View Mirror Components

4. Bracket and gasket from the vehicle.

Install or Connect (Figure 19)

1. Bracket and gasket to the vehicle.
2. Bracket to door bolts.
3. Mirror to the bracket.
4. Mirror to bracket screw.

BELOW EYELINE OUTSIDE REAR VIEW MIRROR REPLACEMENT

Remove or Disconnect (Figure 20)

1. Mirror cover screw.
   - Lift the cover, and pivot the mirror towards the window.
2. Mirror to door bolts.
3. Mirror and seal from the door.

Install or Connect (Figure 20)

1. Mirror and seal to the door.
2. Mirror to door bolts.
   - Pivot the mirror away from the window, and lower the mirror cover.
3. Mirror cover screw.

WEST COAST OUTSIDE REAR VIEW MIRROR REPLACEMENT

Remove or Disconnect (Figure 20)

1. Mirror bracket to door bracket nuts, bolts, and bushings.
2. Mirror bracket from the vehicle.
3. Door bracket nuts and bolts.

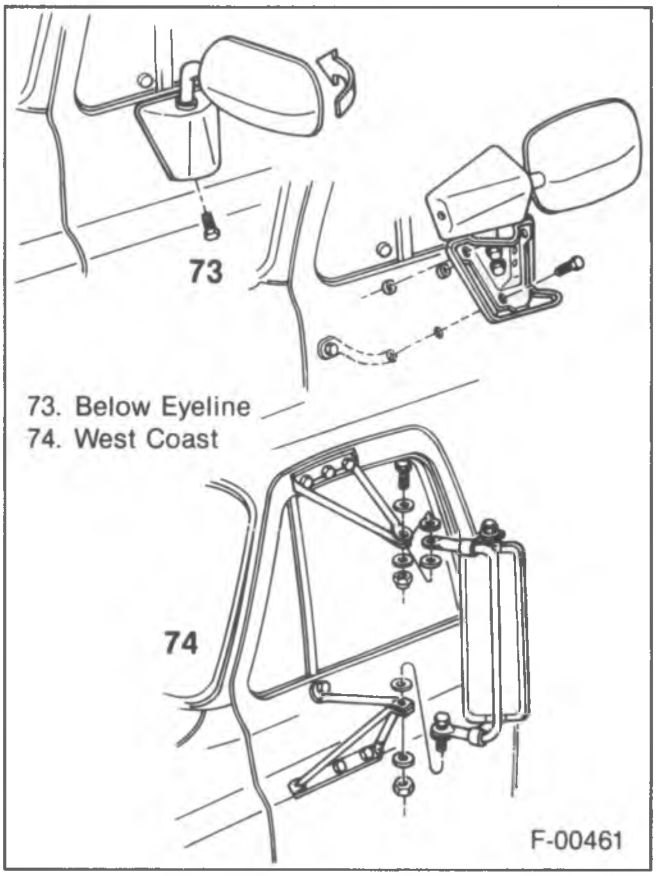


Figure 20—Below Eyeline And West Coast Style Mirrors

4. Brackets from the door.

Install or Connect (Figure 20)

1. Door brackets to the door.
2. Door bracket nuts and bolts.
3. Mirror bracket to the door brackets.
4. Mirror bracket to door bracket nuts, bolts, and bushings.

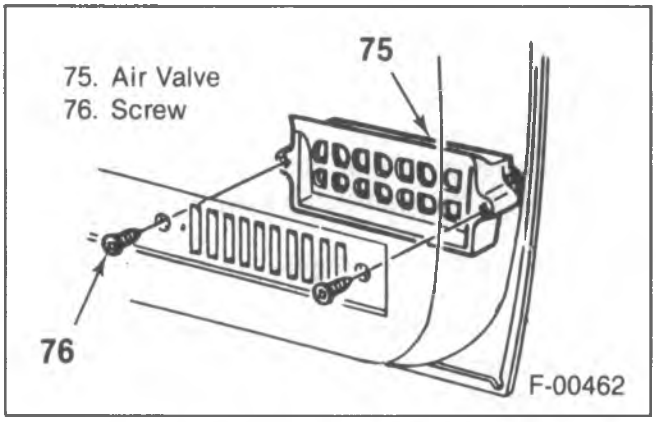


Figure 21—Door Air Valve

DOOR AIR VALVE REPLACEMENT

Remove or Disconnect (Figure 21)

1. Door trim panel. Refer to "Door Trim Panel Replacement."
2. Door to air valve screws.
3. Air valve from the door.

Install or Connect (Figure 21)

1. Air valve to the door.
2. Door to air valve screws.
3. Door trim panel. Refer to "Door Trim Panel Replacement."

C/K MODEL SIDE REAR DOORS

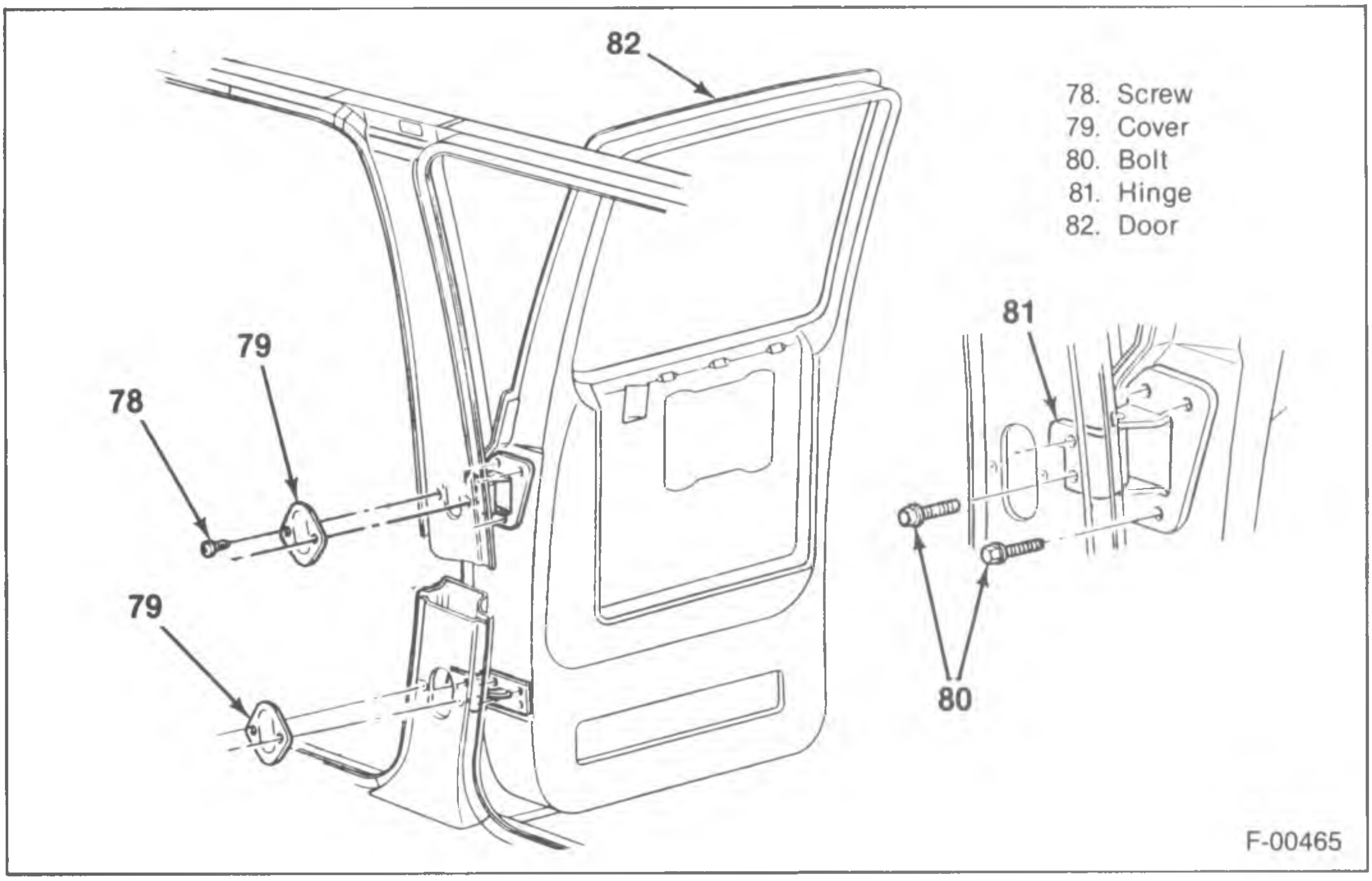


Figure 22—Door Hinge Components

DOOR AND HINGE REPLACEMENT

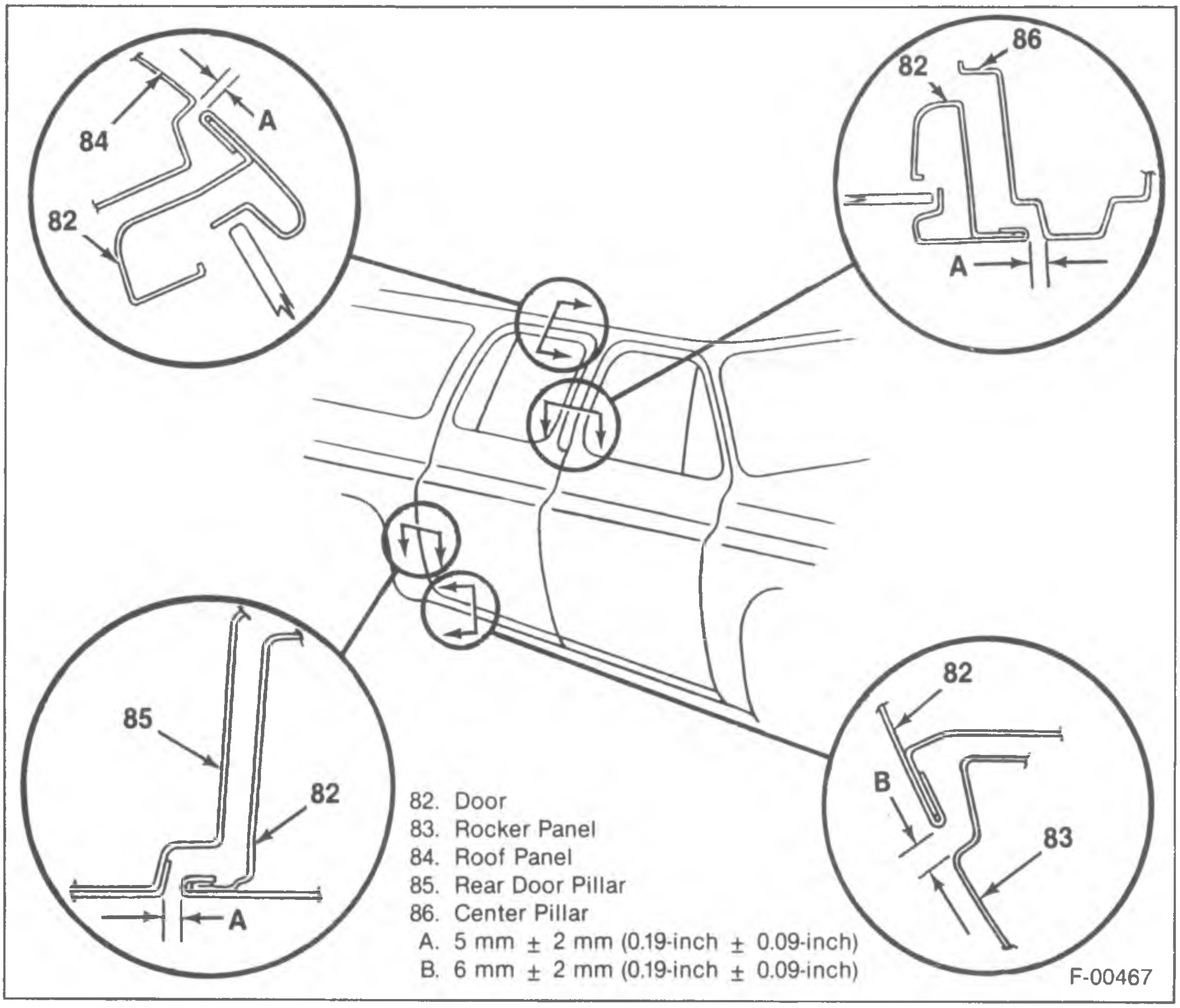
Remove or Disconnect (Figure 22)

- Open the door.

1. Electrical wiring harness (if equipped).
   - Refer to "Door Trim Panel Replacement" for access to the wiring harness.
2. Inner hinge pillar cover screws (78) and covers (79).
   - Mark the position of the hinges on the door and on the door pillar.
3. Hinge to door pillar bolts (80).
4. Door from the vehicle.
5. Hinge to door bolts (80).
6. Hinges from the door.

Install or Connect (Figure 22)

1. Hinges to the door.
   - Align the hinges with the previously made marks.
2. Hinge to door bolts (80).
3. Door to the vehicle.
   - Align the hinges with the previously made marks.



82. Door
83. Rocker Panel
84. Roof Panel
85. Rear Door Pillar
86. Center Pillar
A. 5 mm ± 2 mm (0.19-inch ± 0.09-inch)
B. 6 mm ± 2 mm (0.19-inch ± 0.09-inch)

Figure 23—Door Adjustments

4. Hinge to door pillar bolts (80).
5. Inner hinge pillar covers (79) and screws (78).
6. Electrical wiring harness (if equipped).
   - Refer to "Door Trim Panel Replacement" for access to the wiring harness.

DOOR ADJUSTMENT

Remove or Disconnect

Tool Required:

J-23457-A Wrench.

- Door striker bolt using J-23457-A.

Adjust (Figure 23)

- The door up or down, forward or rearward, and in or out, at the door hinges.

1. Adjust the door to obtain a gap of 6 mm ± 2 mm (0.24-inch ± 0.09-inch) between the rocker panel and the door.

2. The gap between the door and the roof panel should be 5 mm ± 2 mm (0.19-inch ± 0.09-inch).

3. Adjust the door to obtain a gap of 5 mm ± 2 mm (0.19-inch ± 0.09-inch) between the doors rear edge and the rear door pillar.

4. The gap between the door and the center pillar should be 5 mm ± 2 mm (0.19-inch ± 0.09-inch).

5. The door surface should be flush with the other panels within ± 1.5 mm (± 0.06-inch) except for the door to roof panel surface which should be flush within + 1.5 mm (+ 0.06-inch).

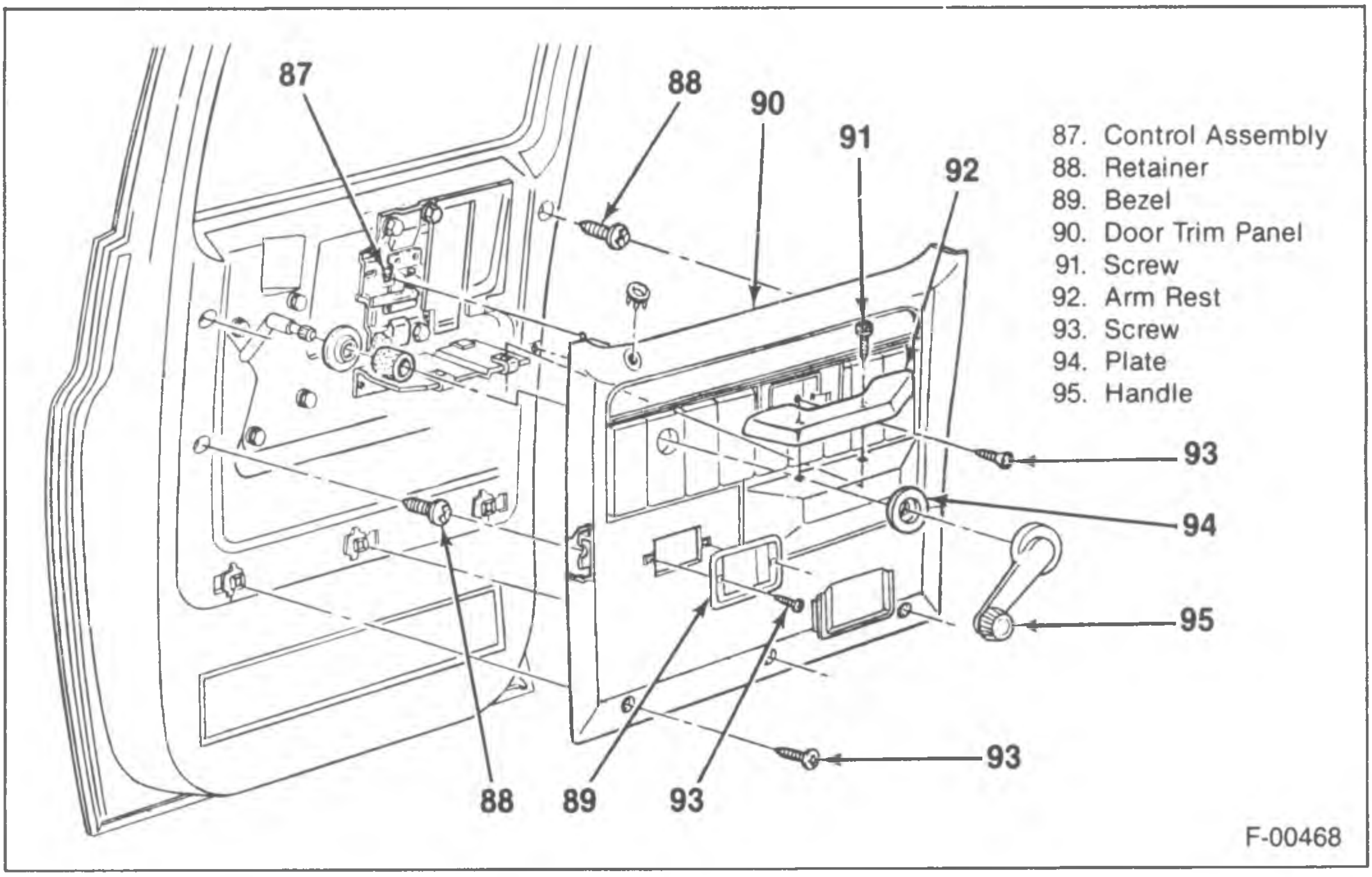


Figure 24—Door Trim Panel Components

Install or Connect

- Door striker bolt.

  Adjust

  - Bolt to properly engage the door lock.

  Tighten

  - Striker bolt to 63 N·m (46 ft. lbs.).

DOOR TRIM PANEL REPLACEMENT

Remove or Disconnect (Figure 24)

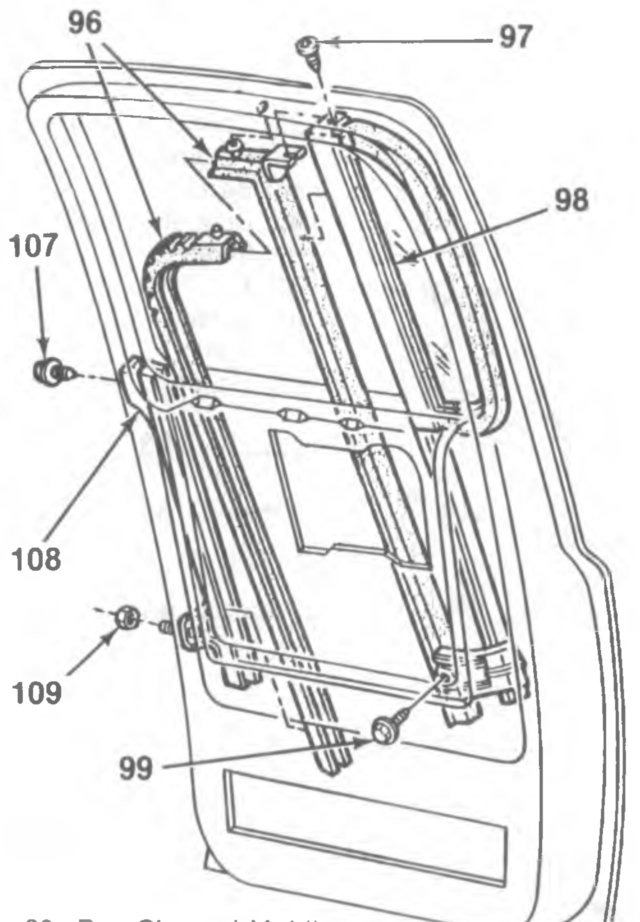
Tools Required:
J-9886-01 Door Handle Clip Remover.
J-24595-B Door Trim Pad Clip Remover.

1. Window regulator handle using J-9886-01.
2. Lock knob.
3. Arm rest to arm rest bracket screws (91).
4. Arm rest from the door.
5. Strap assembly covers (if equipped).
6. Strap assembly screws (if equipped).
7. Strap assembly (if equipped).
8. Door trim panel to door screws (93).
9. Door trim panel to door retainers using J-24595-B.
10. Door trim panel from the door.
    - Pry the top of the panel away from the door side window seal clips.

Install or Connect (Figure 24)

- Check that all the trim retainers are securely fastened, and are not damaged. Replace any damaged fasteners.

1. Door trim panel onto the door side window seal clips.
2. Door trim retainers into the door panel.
3. Door trim panel to door screws (93).
4. Strap assembly onto the door (if equipped).
5. Strap assembly screws (if equipped).
6. Strap assembly covers (if equipped).
7. Arm rest to the door.
8. Arm rest to arm rest bracket screws (91).
9. Lock knob.
10. Window regulator handle.



96. Run Channel Molding
97. Screw
98. Stationary Glass/Window Run Channel
99. Bolt
107. Bolt
108. Front Glass Run Channel
109. Nut

F-00469

Figure 25—Stationary Glass/Window Run Channel Components

STATIONARY GLASS/WINDOW RUN CHANNEL ASSEMBLY REPLACEMENT

The stationary glass and the rear window run channel are one assembly. This assembly fits into the rear of the door frame.

Remove or Disconnect (Figure 25)

- Place the window in the lowered position.

1. Door trim panel. Refer to "Door Trim Panel Replacement."
2. Run channel molding (96).
    - Pull the molding out of the run channel only.
3. Door panel to run channel bolt (99).
4. Door frame to run channel screw (97).
5. Stationary glass/window run channel assembly from the door.
    - Pull the top of the channel backwards away from the door frame.
    - Lift and rotate the assembly out of the door.

Install or Connect (Figure 25)

1. Stationary glass/window run channel assembly to the door.
    - Rotate the vent assembly into the door.
    - Fit the assembly into the door frame.
2. Run channel molding.
    - Push the molding into the run channel. The slot at the top of the molding must be on top of the run channel.
3. Door frame to run channel screw (97).
    - The screw must pass through the run channel molding slot.
4. Door panel to run channel bolt (99).
5. Door trim panel. Refer to "Door Trim Panel Replacement."

DOOR WINDOW REPLACEMENT

Remove or Disconnect (Figure 26)

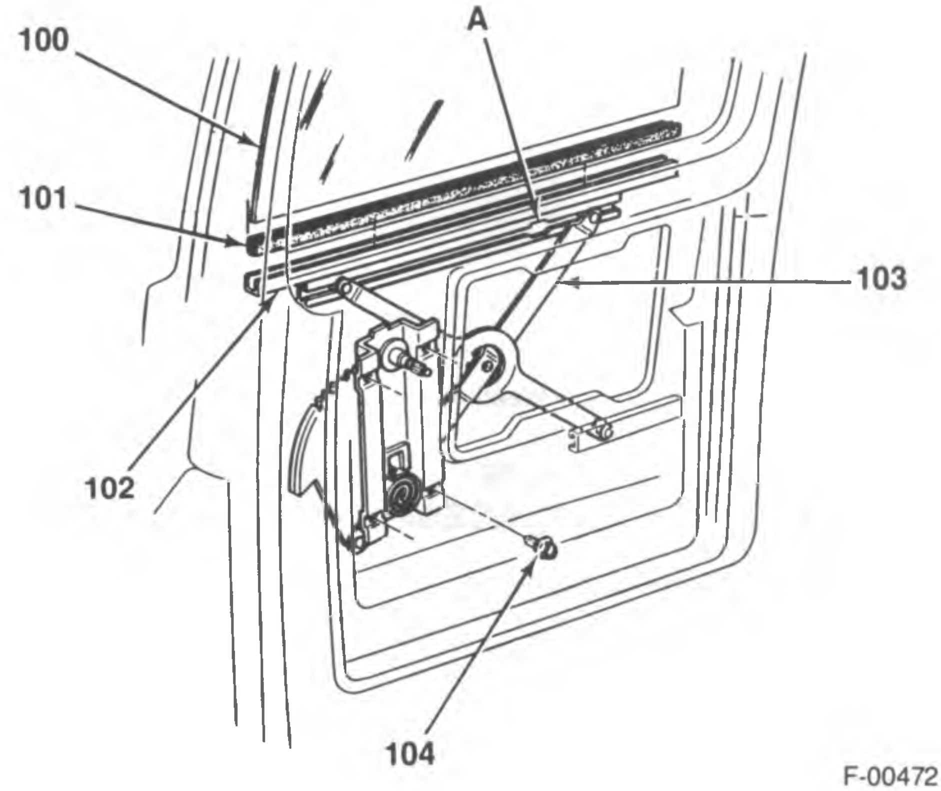
CAUTION: Always wear heavy gloves when handling glass to minimize the risk of injury.

- Lower the window to the bottom of the door.

1. Door trim panel. Refer to "Door Trim Panel Replacement."
2. Stationary glass/window run channel assembly. Refer to "Stationary Glass/Window Run Channel Assembly Replacement."
    - Mask or cover any sharp edges that could scratch the glass.
3. Door window glass (100).
    - Slide the glass rearward until the rear roller is in line with the notch in the sash channel. Disengage the roller from the channel.
    - Push the window rearward, then tilt it up until the front roller is disengaged.
    - Place the window in a level position, and raise it straight up and out of the door.

Install or Connect (Figure 26)

1. Door window glass (100).
    - Lower the window into the door frame.
    - Push the window rearward, then tilt it up, and slide the front roller into the sash channel.
    - Slide the glass forward until the rear roller is in line with the notch in the sash channel. Engage the roller to the sash channel.



- 100. Glass
- 101. Filler
- 102. Sash Channel
- 103. Regulator
- 104. Bolt
- A. Notch

Figure 26—Window Assembly Components

    - Slide the glass forward into the glass run channel.
  - Remove any masking or covering.
2. Stationary glass/window run channel assembly. Refer to "Stationary Glass/Window Run Channel Assembly Replacement."
3. Door trim panel. Refer to "Door Trim Panel Replacement."

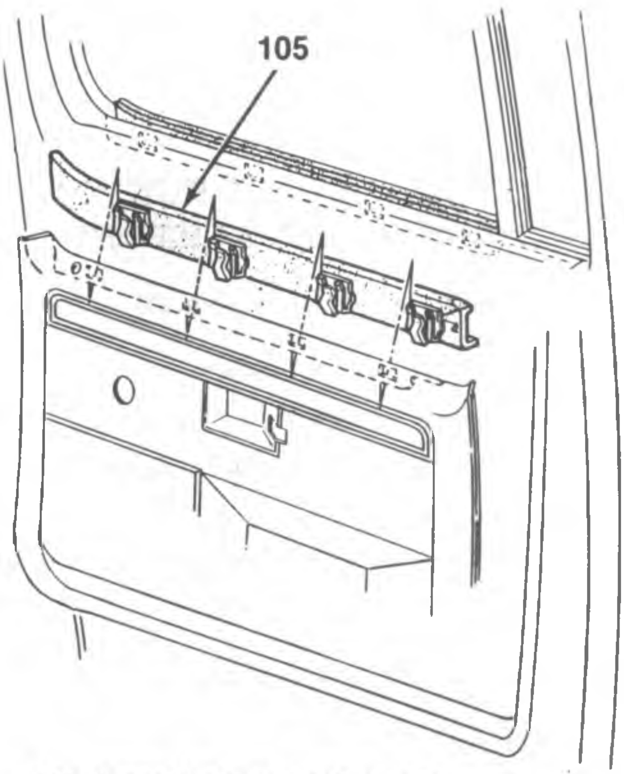
INNER WINDOW WEATHERSTRIP REPLACEMENT

Remove or Disconnect (Figure 27)

1. Door trim panel. Refer to "Door Trim Panel Replacement."
2. Weatherstrip from the trim panel.
    - Pry the clips on the weatherstrip from the trim panel shoulder.

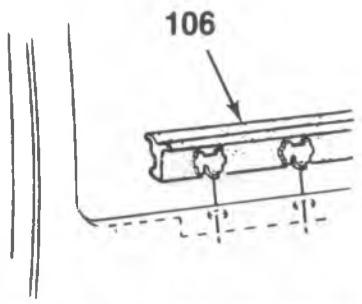
Install or Connect (Figure 27)

1. Weatherstrip to the trim panel.
    - Push the weatherstrip clips onto the trim panel shoulder.
2. Door trim panel. Refer to "Door Trim Panel Replacement."



105. Inner Window Weatherstrip

Figure 27—Inner Window Weatherstrip



106. Outer Window Weatherstrip F-00963

Figure 28—Outer Window Weatherstrip

OUTER WINDOW WEATHERSTRIP REPLACEMENT

Remove or Disconnect (Figure 28)

- Lower the window.

1. Weatherstrip from the door.
   - Pry the weatherstrip clips from the door panel.

Install or Connect (Figure 28)

1. Weatherstrip to the door.
   - Push the weatherstrip clips onto the door panel.

FRONT GLASS RUN CHANNEL REPLACEMENT

Remove or Disconnect (Figure 25)

- Lower the window completely.

1. Outer window weatherstrip.
2. Door to run channel bolt (107) and nut (109).
3. Run channel from the vehicle.
   - Pull the run channel upwards while twisting to clear the lower bracket.

Install or Connect (Figure 25)

1. Run channel to the vehicle.
   - Work the run channel into the door frame. Be certain that the glass is in the channel.
2. Door to run channel bolt (107) and nut (109).
3. Outer window weatherstrip.

WINDOW REGULATOR REPLACEMENT

MANUAL REGULATOR

Remove or Disconnect (Figure 26)

1. Door trim panel. Refer to "Door Trim Panel Replacement."
2. Door window. Refer to "Door Window Replacement."
3. Door panel to regulator bolts (104).
4. Window regulator.
   - Collapse the regulator, and remove it through the access hole in the door.

Install or Connect (Figure 26)

- Lubricate the regulator and the sash and regulator rails with lubriplate or equivalent.

1. Window regulator.
   - Collapse the regulator, and insert it through the access hole in the door.
2. Door panel to regulator bolts (104).
3. Door windows. Refer to "Door Window Replacement."
4. Door trim panel. Refer to "Door Trim Panel Replacement."

POWER REGULATOR

For the diagnosis of power window circuits, refer to CAB ELECTRICAL (SEC. 8A).

Remove or Disconnect (Figure 29)

1. Battery ground cable.
2. Door trim panel. Refer to "Door Trim Panel Replacement."
3. Door window. Refer to "Door Window Replacement."
4. Regulator to door panel bolts (110) and nuts (112).
5. Wiring harness from the regulator.
6. Window regulator.
   - Collapse the regulator, and remove it through the access hole in the door.

CAUTION: The next step must be performed when the regulator is removed from the door. The regulator lift arms are under tension from the counterbalance spring and can cause serious injury if the motor is removed without locking the sector gear in position.

- Drill a hole through the regulator sector gear and back plate. Drill the hole at least 12.7 mm ($^1/_2$-inch) away from the edge of the sector gear or

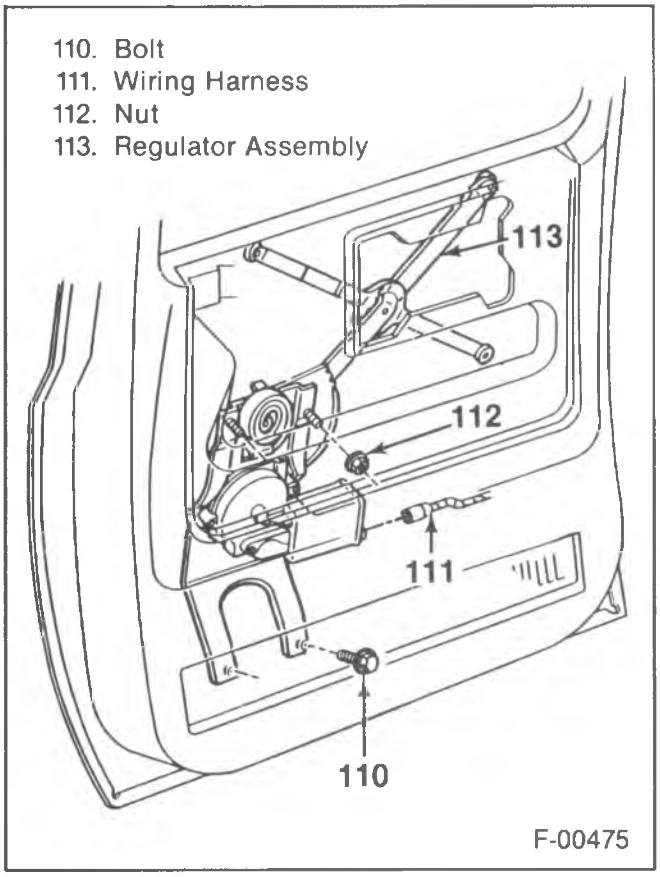


Figure 29—Power Regulator

back plate. Install a pan head sheet metal tapping screw at leat 19 mm (3/4-inch) long into the drilled hole to lock the sector gear in place.

7. Motor to regulator attaching screws.
8. Motor from the regulator.

Install or Connect (Figure 29)

- Lubricate the motor drive gear and regulator sector teeth.

1. Regulator motor to regulator.
   - The motor pinion gear teeth must mesh properly with the sector gear teeth before installing the motor to regulator screws.
1. Regulator motor to regulator screws.

- Remove the sheet metal screw from the back plate and sector gear.

3. Window regulator to the door.
   - Collapse the regulator, and insert it through the access hole in the door.
4. Wiring harness to the regulator.
5. Regulator to door panel bolts (110) and nuts (112).
6. Door window. Refer to "Door Window Replacement."
7. Door trim panel. Refer to "Door Trim Panel Replacement."
8. Battery ground cable.

DOOR LOCK REPLACEMENT

Remove or Disconnect (Figure 30)

- Raise the window completely.

1. Door trim panel. Refer to "Door Trim Panel Replacement."
2. Inside door handle to lock rod clip (115).
   - Using a flat bladed screwdriver, push on the top of the clip where it is connected to the rod. Pivot the clip away from the rod.
3. Inside door handle to lock rod from the lock.
4. Outside door handle to lock rod clip.
   - Use the procedure given under step 2.
5. Outside door handle to lock rod from the lock.
6. Remove control to lock assembly clip and rod.
7. Door to lock assembly screws (116).
8. Lock assembly from the door.
   - Tilt the lock assembly away from the outside lock cylinder. Pull the lock assembly downward to make clearance for the inside lock rod.

Install or Connect (Figure 30)

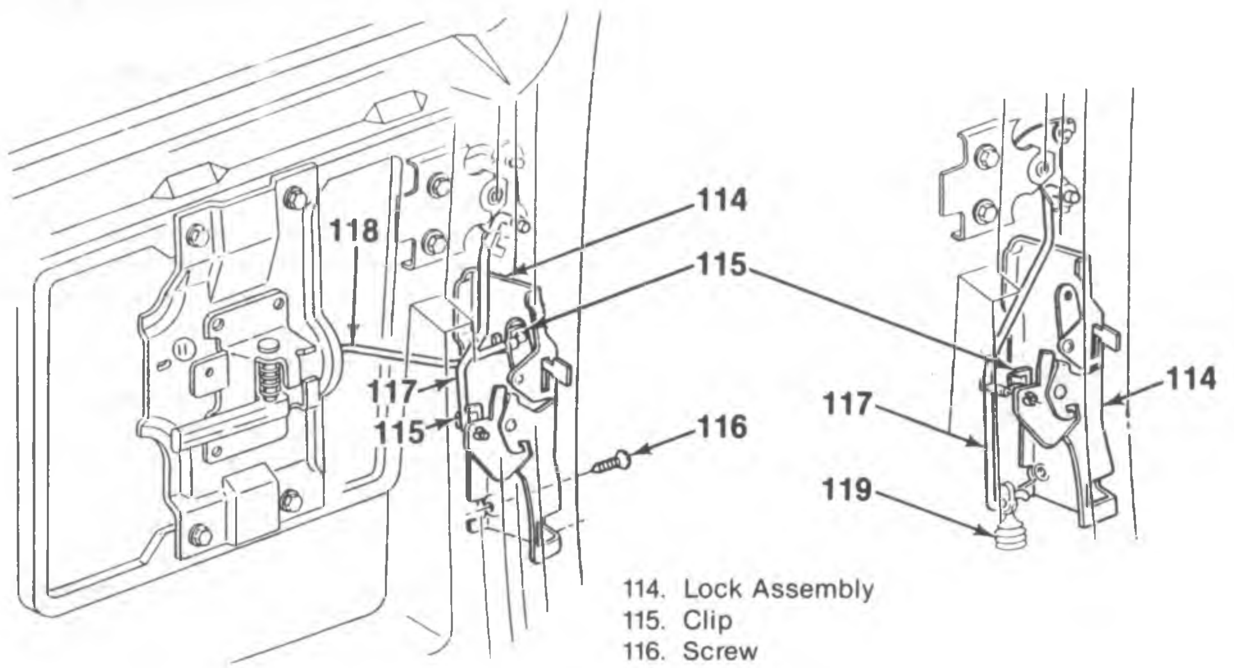
1. Lock assembly to the door.
   - Tilt the lock assembly onto the outside lock cylinder.
2. Door to lock assembly screws (116).
3. Remote control to lock assembly rod and clip.
4. Outside door handle to lock rod onto the lock assembly.
5. Clip onto the lock rod.
   - Pivot the clip up and onto the lock rod.
6. Inside door handle to lock rod onto the lock assembly.
7. Clip onto the lock rod.
   - Pivot the clip up and onto the lock rod.
8. Door trim panel. Refer to "Door Trim Panel Replacement."

POWER DOOR LOCK MOTOR REPLACEMENT

Refer to CAB ELECTRICAL (SEC. 8A) for electrical diagnosis of the door lock motor.

Remove or Disconnect (Figure 30)

1. Battery ground cable.
2. Door trim panel. Refer to "Door Trim Panel Replacement."
3. Electrical connector from the motor.
4. Door to motor screws.
5. Motor from the lock rod.
   - Slide the rubber mount at the top of the motor off of the door lock rod.



114. Lock Assembly
115. Clip
116. Screw
117. Remote Control To Lock Rod
118. Inside Door Handle To Lock Rod
119. Power Door Lock Motor

F-00476

Figure 30—Door Lock Components

6. Motor from the door.

Install or Connect (Figure 30)

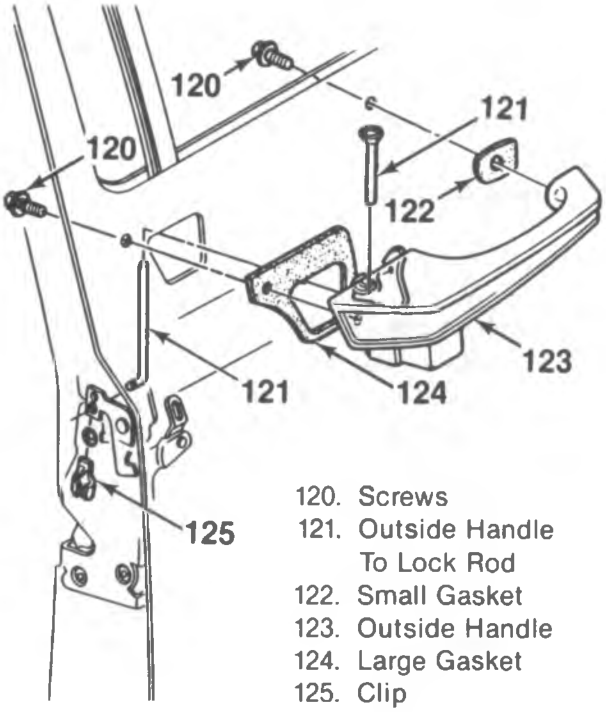
1. Motor into the door.
2. Motor to the lock rod.
    - Slide the rubber mount at the top of the motor onto the door lock rod.
3. Door to motor screws.
4. Electrical connector to the motor.
5. Door trim panel. Refer to "Door Trim Panel Replacement."
6. Battery ground cable.

DOOR OUTSIDE HANDLE REPLACEMENT

Remove or Disconnect (Figure 31)

- Raise the window completely.

1. Door trim panel. Refer to "Door Trim Panel Replacement."
2. Outside door handle to lock rod clip.
    - Using a flat bladed screwdriver, push on the top of the clip where it is connected to the rod. Pivot the clip away from the rod.
3. Outside door handle to lock rod from the lock.
4. Door to outside handle screws (120).



120. Screws
121. Outside Handle To Lock Rod
122. Small Gasket
123. Outside Handle
124. Large Gasket
125. Clip

F-00477

Figure 31—Door Outside Handle Components

5. Handle with the control rod from the door.
6. Gaskets from the door.

Install or Connect (Figure 31)

1. Large gasket over the lock rod and onto the handle.
2. Handle with the lock rod onto the door.
3. Door to outside handle screw (120) to the push button side of the handle.
   - Do not tighten.
4. Small gasket between the door and the handle.
5. Door to outside handle screw (120) to the other side of the handle.
   - Tighten both screws.
6. Outside door handle to lock rod to the lock assembly.
7. Clip onto the lock rod.
   - Pivot the clip up and onto the lock rod.
8. Door trim panel. Refer to "Door Trim Panel Replacement."

DOOR INSIDE HANDLE REPLACEMENT

Remove or Disconnect (Figure 32)

1. Door trim panel. Refer to "Door Trim Panel Replacement."
2. Door handle seal.
3. Handle assembly to door screws (131).
4. Control rod from the inside handle.
   - Slide the clip so that the large diameter slot is in line with the lock rod. Then, pull the rod from the handle.
5. Inside handle from the door.

Install or Connect (Figure 32)

1. Control rod to the inside handle.
   - Place the rod into the clip and the lever. Slide the clip so that the small diameter slot is in line with the lock rod.
2. Handle assembly to door screws (131).
3. Door handle seal.
4. Door trim panel. Refer to "Door Trim Panel Replacement."

REMOTE CONTROL REPLACEMENT

Remove or Disconnect (Figure 32)

1. Door trim panel. Refer to "Door Trim Panel Replacement."
2. Remote control to lock assembly rod.
   - Using a flat bladed screwdriver, push on the top of the clip where it is connected to the rod. Pivot the clip away from the rod.
   - Pull the rod from the remote control.
3. Door panel to remote control bolts (129).
4. Remote control levers and rods through the access hole.

Install or Connect (Figure 32)

1. Remote control levers and rods through the access hole.
2. Door panel to remote control bolts (129).
3. Remote control to lock assembly rod.
   - Pivot the clip up and onto the lock rod.
4. Door trim panel. Refer to "Door Trim Panel Replacement."

DOOR WEATHERSTRIP REPLACEMENT

Remove or Disconnect (Figure 33)

- Open the door.

1. Sill plate from the vehicle.
2. Weatherstrip from the pinchweld flange.
   - Pull the weatherstrip away from the flange.

Install or Connect (Figure 33)

1. Weatherstrip to the pinchweld flange.
   - Start at the bottom center of the door opening.

- Trim the weatherstrip, and butt the ends together.

2. Sill plate to the vehicle.

DOOR AIR VALVE REPLACEMENT

Remove or Disconnect (Figure 34)

1. Door trim panel. Refer to "Door Trim Panel Replacement."
2. Door to air valve screws.
3. Air valve from the door.

Install or Connect (Figure 34)

1. Air valve to the door.
2. Door to air valve screws.
3. Door trim panel. Refer to "Door Trim Panel Replacement."

126. Clip
127. Remote Control Assembly
128. Remote Control Rod
129. Bolt
130. Seal
131. Bolt
132. Door Inside Handle
133. Lock Knob

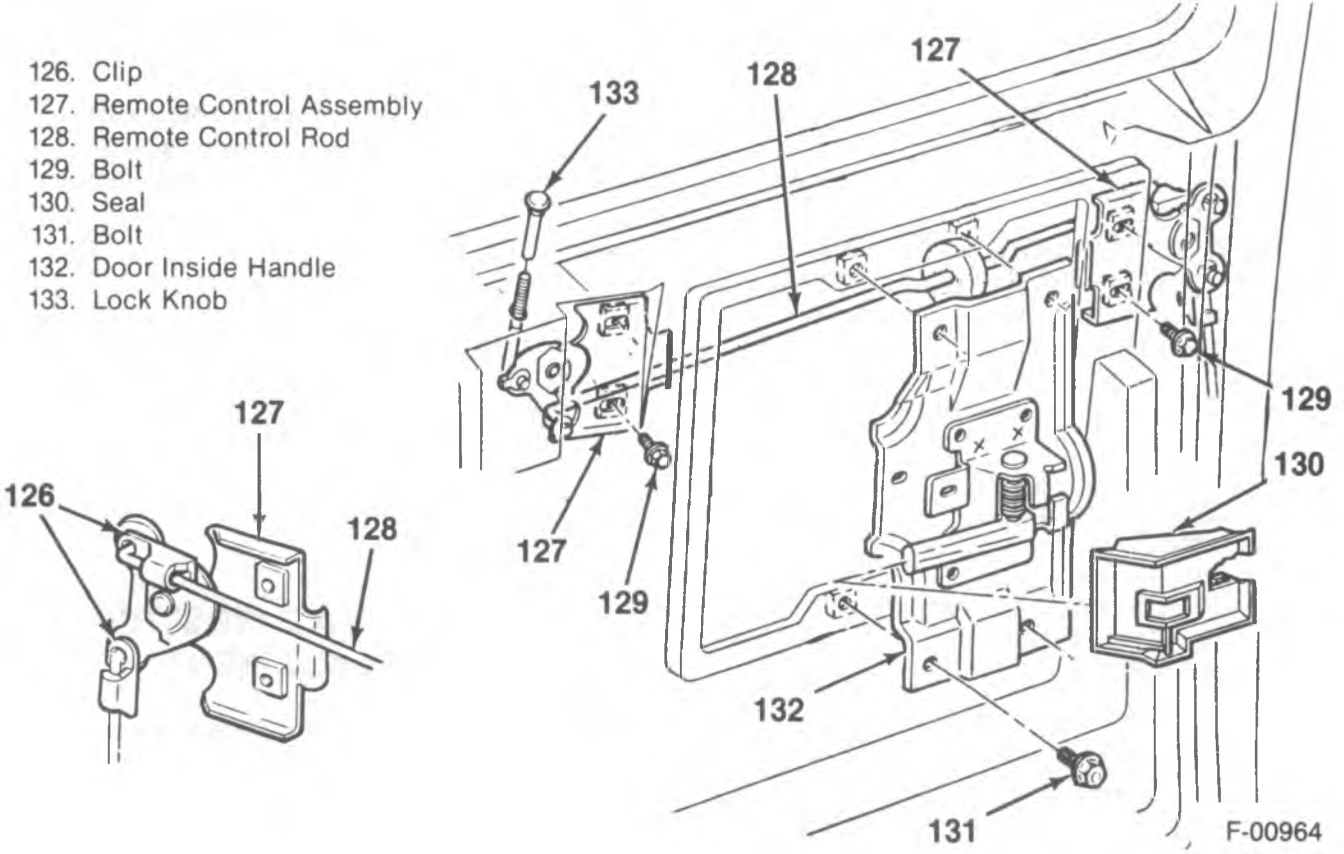


Figure 32—Door Inside Handle Components

134. Weatherstrip

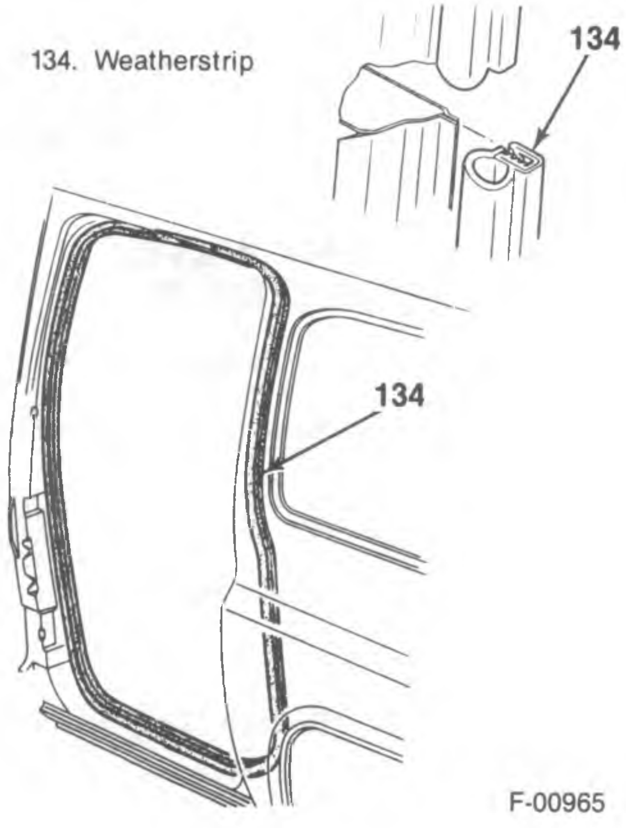


Figure 33—Door Weatherstrip

135. Air Valve
136. Screws

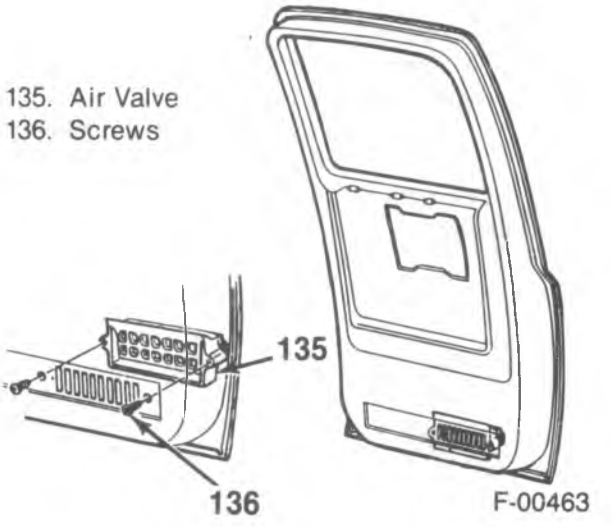


Figure 34—Door Air Valve

C/K MODEL REAR DOORS

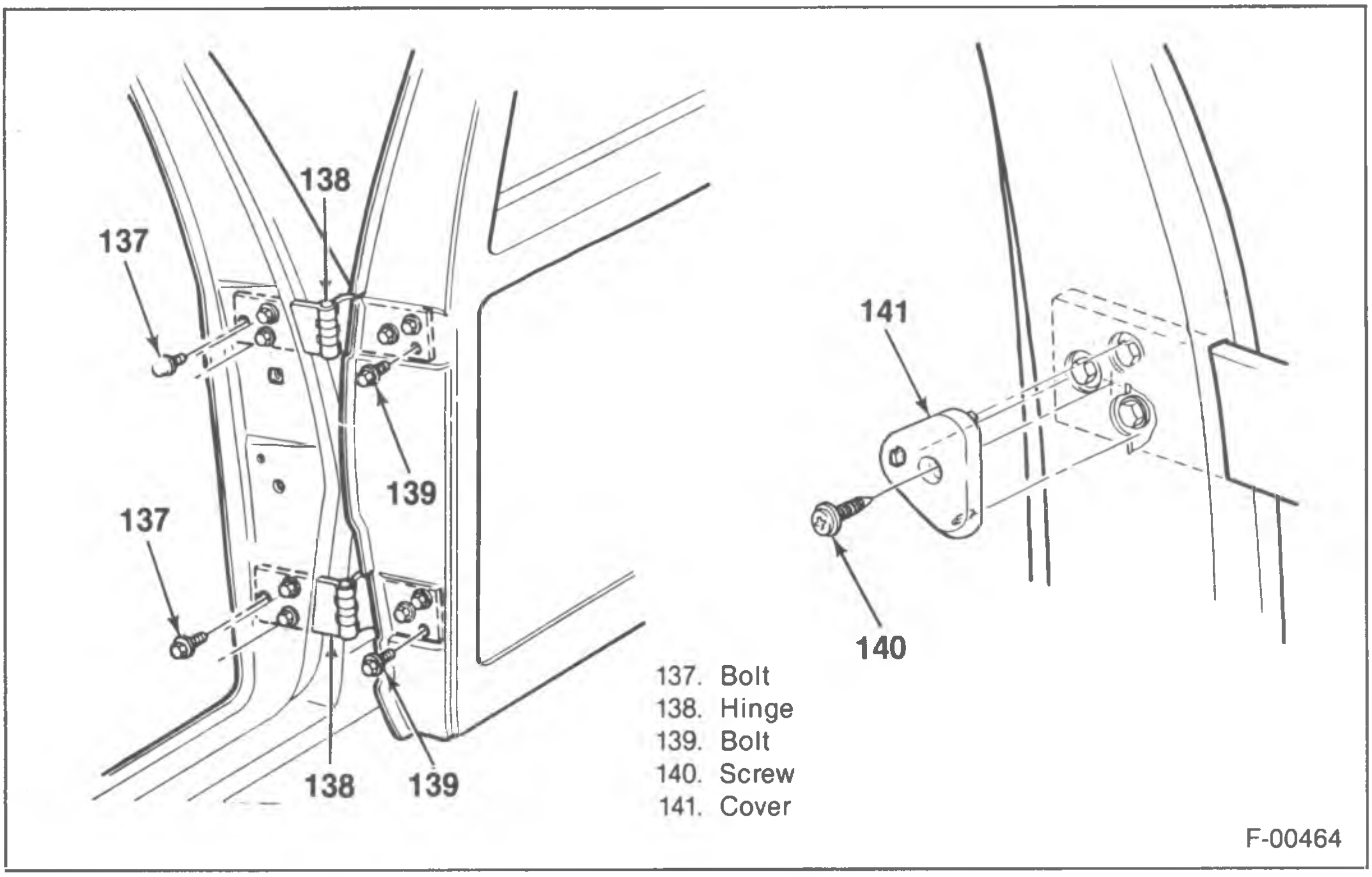


Figure 35—Hinge Components

DOOR AND HINGE REPLACEMENT

Remove or Disconnect (Figure 35)

- Mark the position of the door and the door opening on the hinges.

1. Strap pin.
2. Electrical wiring harness (if equipped).
    - Refer to "Door Trim Panel Replacement" for access to the wiring harness.
3. Rear door hinge access plug screw, and the access plug (if equipped).
4. Door to hinge bolts (139).
5. Door from the vehicle.
6. Door opening to hinge bolts (137).
7. Hinges from the door opening.

Install or Connect (Figure 35)

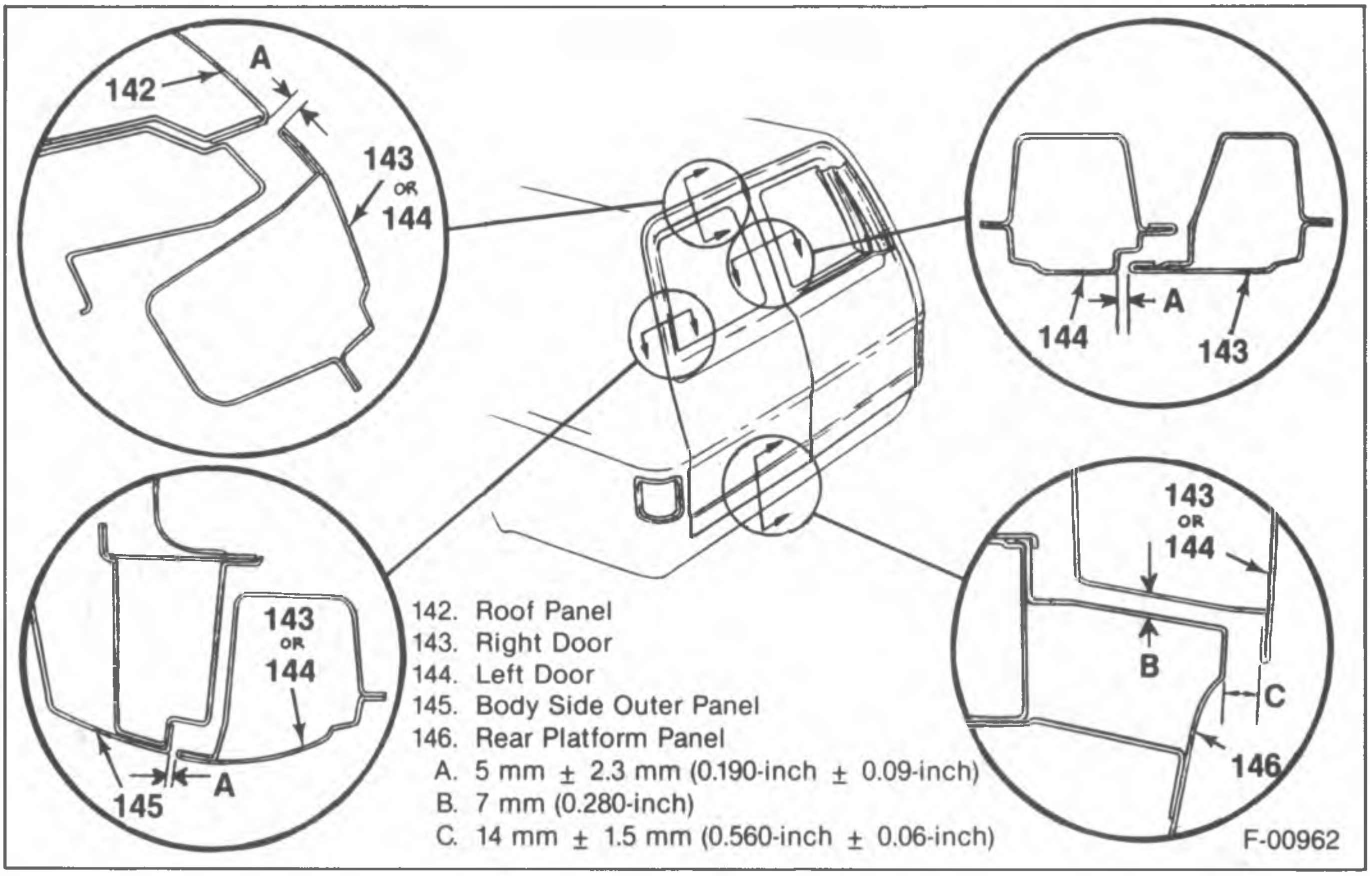
1. Hinges to the door opening.
    - Align the hinge with the previously made mark.
2. Door opening to the hinge bolts (137).
3. Door to the vehicle.
    - Align the hinge with the previously made mark.
4. Door to hinge bolts (139).
5. Rear door hinge access plug and screw (if equipped).
6. Electrical wiring harness (if equipped).
    - Refer to "Door Trim Panel" for access to the wiring harness.
7. Strap pin.

DOOR ADJUSTMENT

Each of the two doors must first be adjusted in the door opening before adjusting the door to door clearance.

Adjust (Figure 36)

1. The door height so that there is a gap of 5 mm ± 2.3 mm (0.190-inch ± 0.09-inch) between the roof panel and the rear door panel.
2. The gap between the bottom of the door panel (not the bottom of the outer panel) and the platform panel should be 7 mm (0.280-inch). This measurement should be taken on each door



142. Roof Panel
143. Right Door
144. Left Door
145. Body Side Outer Panel
146. Rear Platform Panel
A. 5 mm ± 2.3 mm (0.190-inch ± 0.09-inch)
B. 7 mm (0.280-inch)
C. 14 mm ± 1.5 mm (0.560-inch ± 0.06-inch)

Figure 36—Door Adjustments

individually from the side of the door. The door should be in its normal closed position. (The outer rear door panel is 14 mm ± 1.5 mm (0.560-inch ± 0.06-inch) away from the rear platform panel when normally closed).

3. The rear door outer panel to the body side outer panel gap to 5 mm ± 2.3 mm (0.190-inch ± 0.09-inch).
4. The door to door clearance between the left and right outer door panels should be 5 mm ± 2.3 mm (0.190-inch ± 0.09-inch).

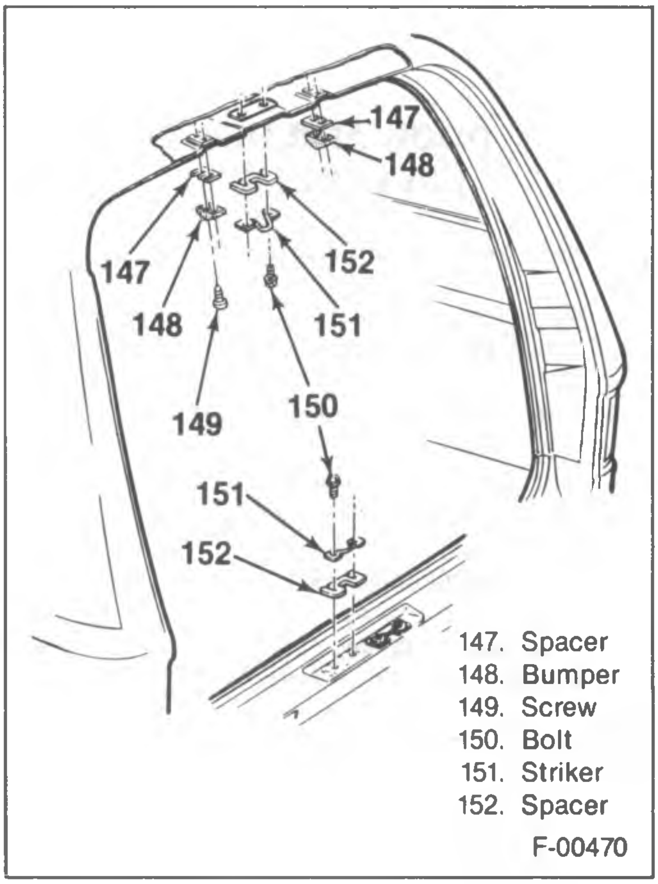
STRIKER REPLACEMENT

↔ Remove or Disconnect (Figure 37)

1. Striker to door frame bolts (150).
2. Striker from the door frame.
3. Spacer (if equipped).

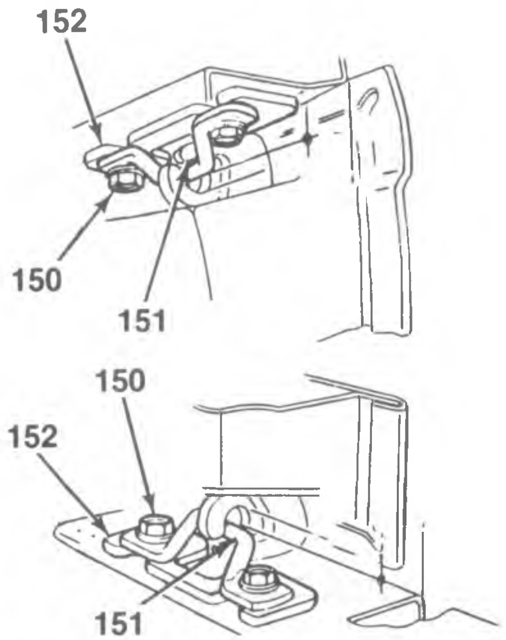
→← Install or Connect (Figure 37)

1. Spacer (as required).
2. Striker to the door frame.
3. Striker to door frame bolts (150).



147. Spacer
148. Bumper
149. Screw
150. Bolt
151. Striker
152. Spacer

Figure 37—Striker Components



150. Bolt
151. Striker
152. Spacer

Figure 38—Striker Adjustment

Adjust (Figure 38)

- The striker to door latch clearance so that there are 4.4 mm (0.172-inch) between the striker and the door latch when the door is in the secondary latched position. (The door is latched but not fully closed.) An $^{11}/_{64}$-inch diameter drill bit may be used to gage this clearance.

BUMPER WEDGE REPLACEMENT

Remove or Disconnect (Figure 37)

1. Bumper to upper door frame screws (149).
2. Bumper and spacer.

Install or Connect (Figure 37)

1. Spacer (as required).
2. Bumper.
3. Bumper to upper door frame screws (149).

Adjust

- The bumper to door clearance so that there is 1 mm (0.04-inch) between the bumper and the door when the door is in the secondary position. (The door is latched but not fully closed).

DOOR TRIM PANEL REPLACEMENT

Remove or Disconnect (Figure 39)

1. Lower garnish molding to door screws (158).
2. Lower garnish molding.
3. Check strap from the door.
4. Door trim panel to door screws (156).
5. Door trim panel.
6. Upper garnish molding to door screws (153).
7. Upper garnish molding.

Install or Connect (Figure 39)

1. Upper garnish molding.
2. Upper garnish molding to door screws (153).
3. Door trim panel.
4. Door trim panel to door screws (156).
5. Check strap to the door.
6. Lower garnish molding.
7. Lower garnish molding to door screws (158).

WINDOW REPLACEMENT

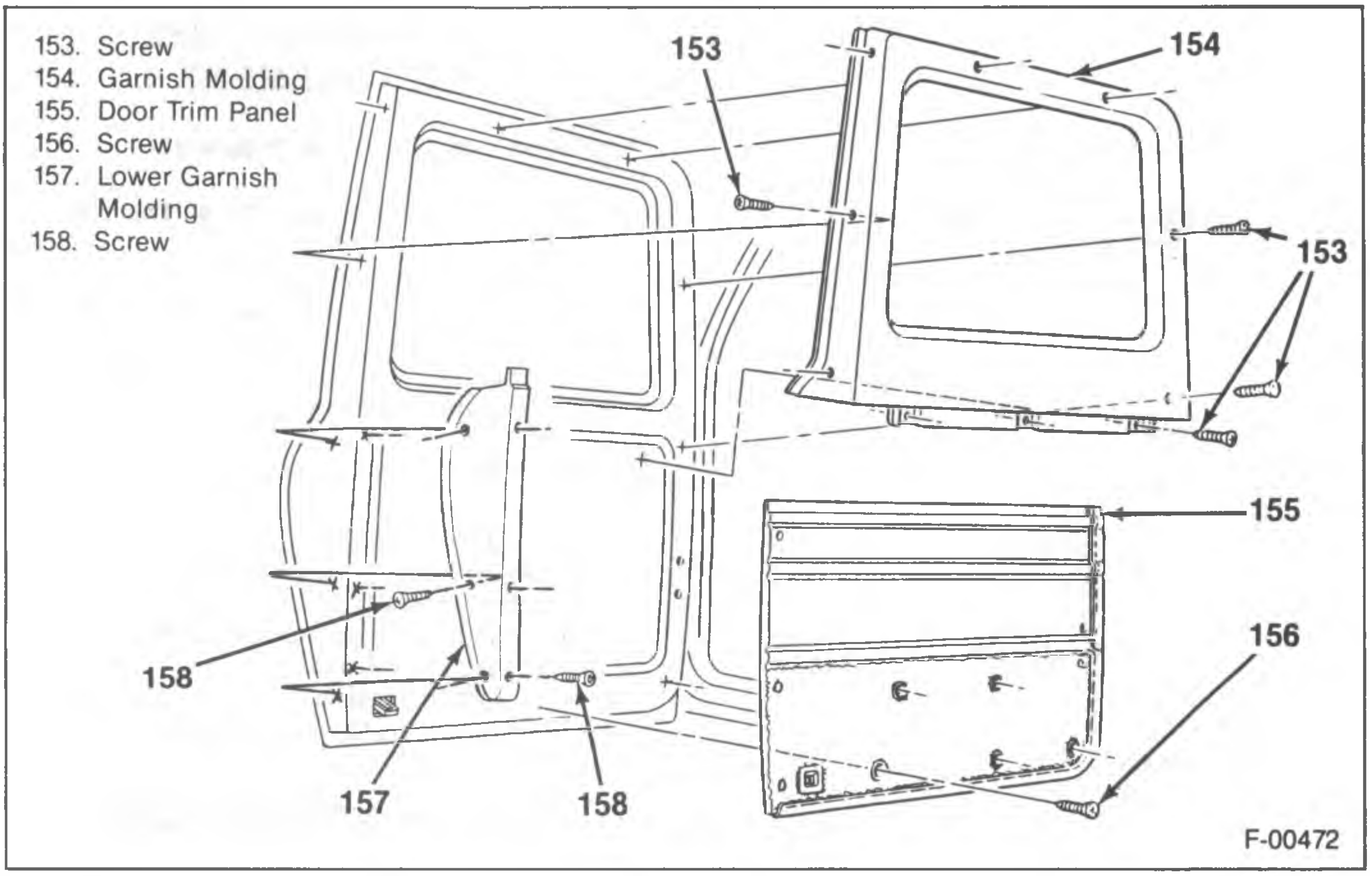
If a glass is cracked but still intact, it should be crisscrossed with masking tape to reduce the risk of injury and/or damage to the vehicle. If a crack extends to the edge of the glass, mark the door with a piece of chalk at the point where the crack meets the weatherstrip. Later, when examining the flange of the opening for a cause of the crack, start at the point marked.

It is important that the cause of the crack be determined and the condition corrected, before the new glass is installed. The cause of the crack may be an obstruction or high spot somewhere around the flange of the opening; cracking may not occur until pressure from the high spot or obstruction becomes particularly high due to winds, extremes of temperature, or rough terrain.

Remove or Disconnect (Figure 40)

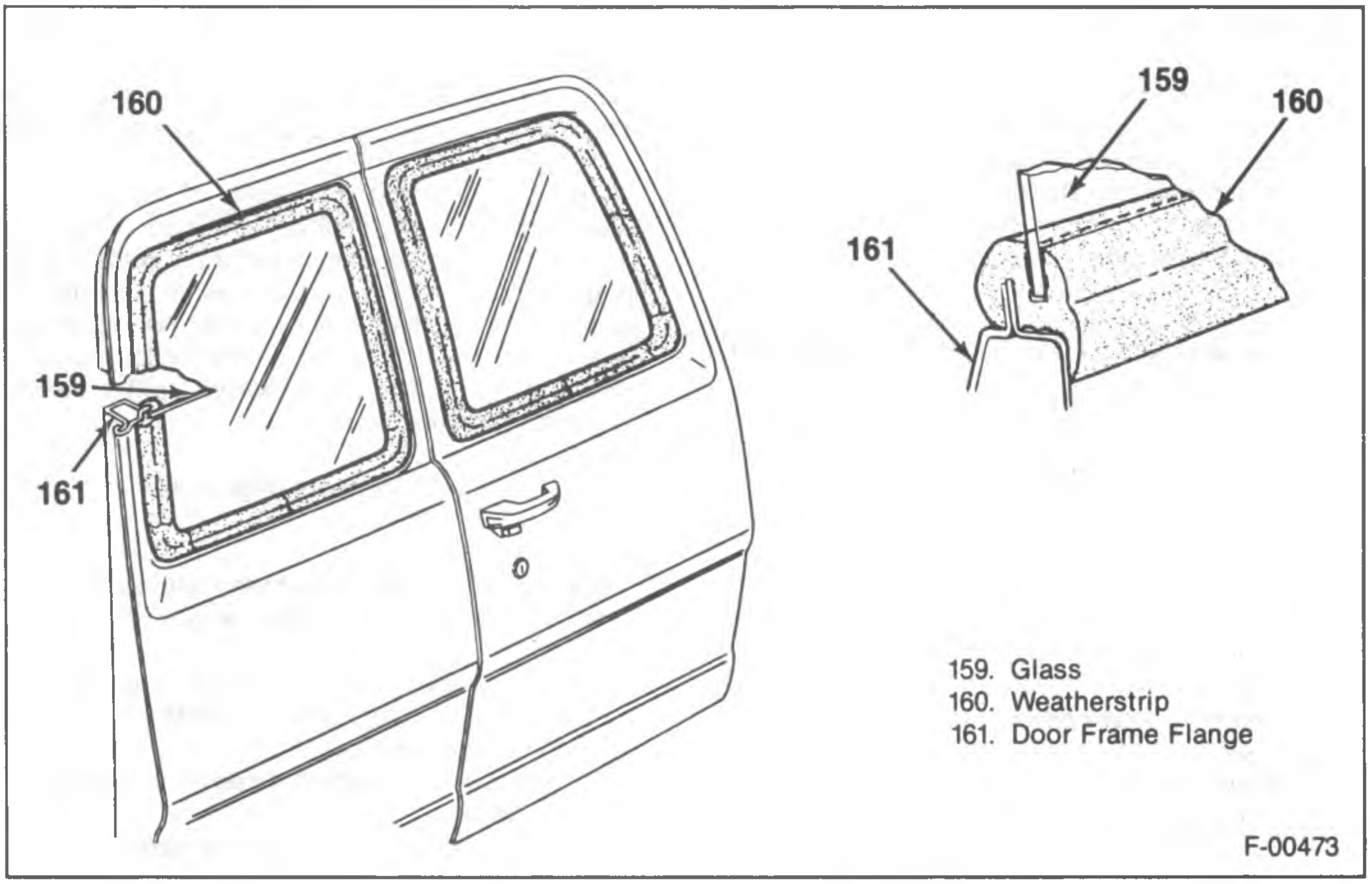
CAUTION: Always wear heavy gloves when handling glass to minimize the risk of injury.

1. Weatherstrip seal by running a putty knife between the flange and the weatherstrip (inside and outside the door).
   - Have an assistant outside the cab by the window.
2. Weatherstrip and glass from the flange.
   - Force the weatherstrip from the flange from the inside with a putty knife.
3. Window from the weatherstrip.



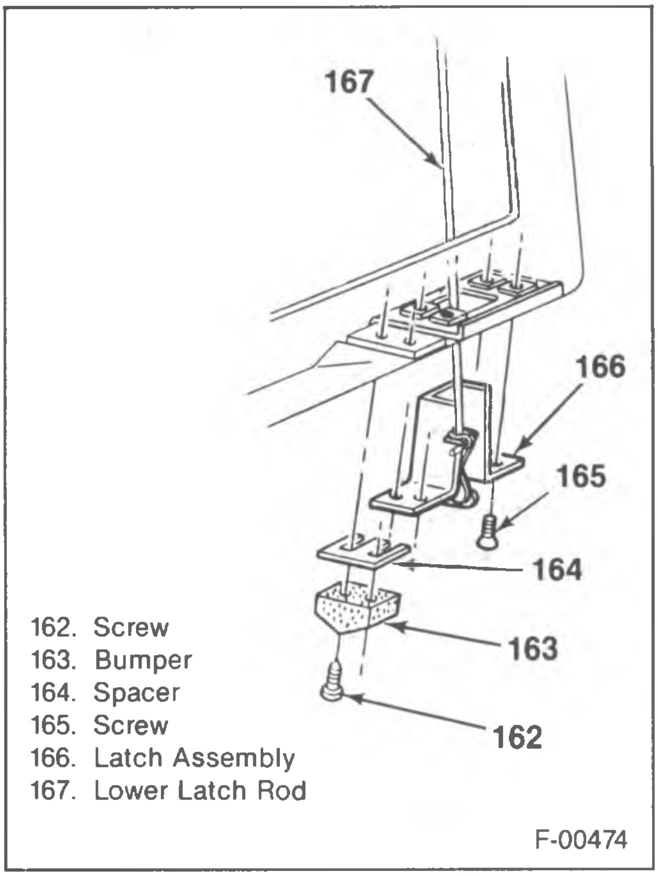
153. Screw
154. Garnish Molding
155. Door Trim Panel
156. Screw
157. Lower Garnish Molding
158. Screw

Figure 39—Door Trim Panel Components



159. Glass
160. Weatherstrip
161. Door Frame Flange

Figure 40—Window Components



162. Screw
163. Bumper
164. Spacer
165. Screw
166. Latch Assembly
167. Lower Latch Rod

F-00474

Figure 41—Right Door Lower Latch

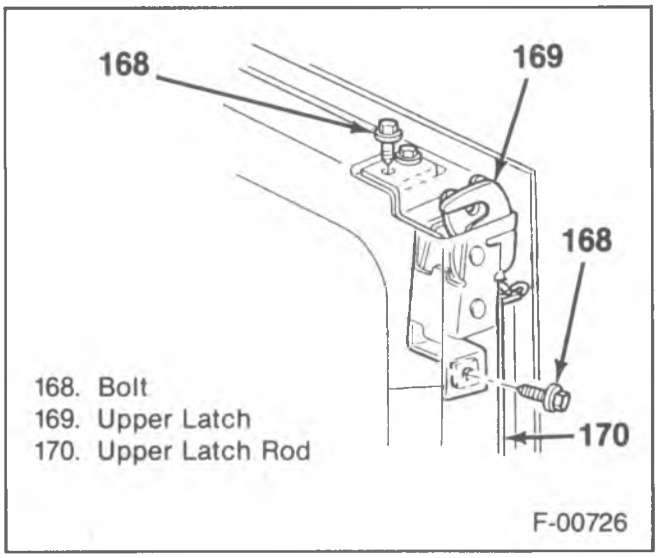
Install or Connect (Figure 40)

1. Weatherstrip to the glass.
2. A six mm (1/4-inch) cord in the weatherstrip groove. The ends should overlap about 5 cm (6-inches) at the window bottom.
3. Window and weatherstrip on the flange from outside the cab.
   - Brush soapy water on the flange.
   - Have an assistant pull the cord from inside the cab to seat the lip of the weatherstrip on the flange.

RIGHT DOOR LOWER LATCH REPLACEMENT

Remove or Disconnect (Figure 41)

1. Door trim panel. Refer to "Door Trim Panel Replacement."
2. Door lock access cover.
3. Lower latch to control assembly rod from the control assembly.
   - Using a flat bladed screwdriver, push on the top of the clip where it is connected to the rod. Pivot the clip away from the rod.
4. Lower latch to door screws (165).
5. Lower latch with the rod from the door.



168. Bolt
169. Upper Latch
170. Upper Latch Rod

F-00726

Figure 42—Right Door Upper Latch

Install or Connect

1. Lower latch with the rod to the door.
2. Lower latch to door screws (165).
3. Lower latch to control assembly rod into the control assembly.
   - Pivot the clip onto the rod.
4. Door lock access cover.
5. Door trim panel. Refer to "Door Trim Panel Replacement."

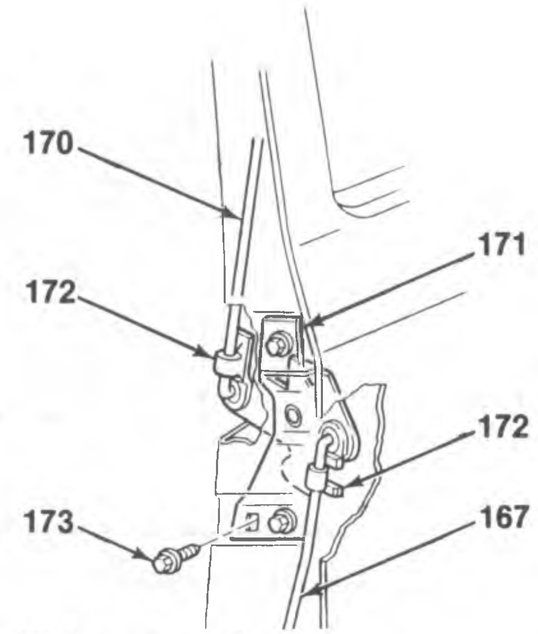
RIGHT DOOR UPPER LATCH REPLACEMENT

Remove or Disconnect (Figure 42)

1. Door trim panel. Refer to "Door Trim Panel Replacement."
2. Door lock access cover.
3. Upper latch to control assembly rod from the control assembly.
   - Using a flat bladed screwdriver, push on the top of the clip where it is connected to the rod. Pivot the clip away from the rod.
4. Upper latch to door bolts (168).
5. Upper latch with the rod from the door.

Install or Connect

1. Upper latch with the rod to the door.
2. Upper latch to door bolts (168).
3. Upper latch to control assembly rod into the control assembly.
   - Pivot the clip onto the rod.
4. Door lock access cover.
5. Door trim panel. Refer to "Door Trim Panel Replacement."



167. Lower Latch Rod
170. Upper Latch Rod
171. Control Assembly
172. Clip
173. Bolt

F-00826

Figure 43—Right Door Control Assembly

RIGHT DOOR CONTROL ASSEMBLY REPLACEMENT

Remove or Disconnect (Figure 43)

1. Door trim panel. Refer to "Door Trim Panel Replacement."
2. Door lock access cover.
3. Upper and lower door latch rods from the control assembly.
   - Using a flat bladed screwdriver, push on the top of the clip where it is connected to the rod. Pivot the clip away from the rod.
4. Electric door actuator (if equipped).
5. Door to control assembly bolts (173).
6. Control assembly through the access hole.

Install or Connect (Figure 43)

1. Control assembly through the access hole.
2. Door to control assembly bolts (173).
3. Electrical door actuator (if equipped).
4. Upper and lower door latch rods to the control assembly.
   - Pivot the clips onto the rods.
5. Door lock access cover.
6. Door trim panel. Refer to "Door Trim Panel Replacement."

DOOR OUTSIDE HANDLE REPLACEMENT

Remove or Disconnect (Figure 44)

1. Door trim panel. Refer to "Door Trim Panel Replacement."
2. Door lock access cover.
3. Outside door handle to lock rod clip.
   - Using a flat bladed screwdriver, push on the top of the clip where it is connected to the rod. Pivot the clip away from the rod.
4. Outside door handle to lock rod from the lock.
5. Door to outside handle screws (174).
6. Handle with the control rod from the door.
7. Gaskets from the door.

Install or Connect

1. Large gasket over the lock rod and onto the handle.
2. Handle with the lock rod onto the door.
3. Door to outside handle screw (174) to the push button side of the handle.
   - Do not tighten.
4. Small gasket between the door and the handle.
5. Door to outside handle screw (174) to the other side of the handle.
   - Tighten both screws.
6. Outside door handle to lock rod to the lock assembly.
7. Clip onto the lock rod.
   - Pivot the clip up and onto the lock rod.
8. Door lock access cover.
9. Door trim panel. Refer to "Door Trim Panel Replacement."

LEFT DOOR LOWER LATCH REPLACEMENT

Remove or Disconnect (Figure 45)

- Open the door.

1. Latch to door screws (182).
2. Latch from the door.

Install or Connect (Figure 45)

1. Latch to the door.
2. Latch to door screws (182).

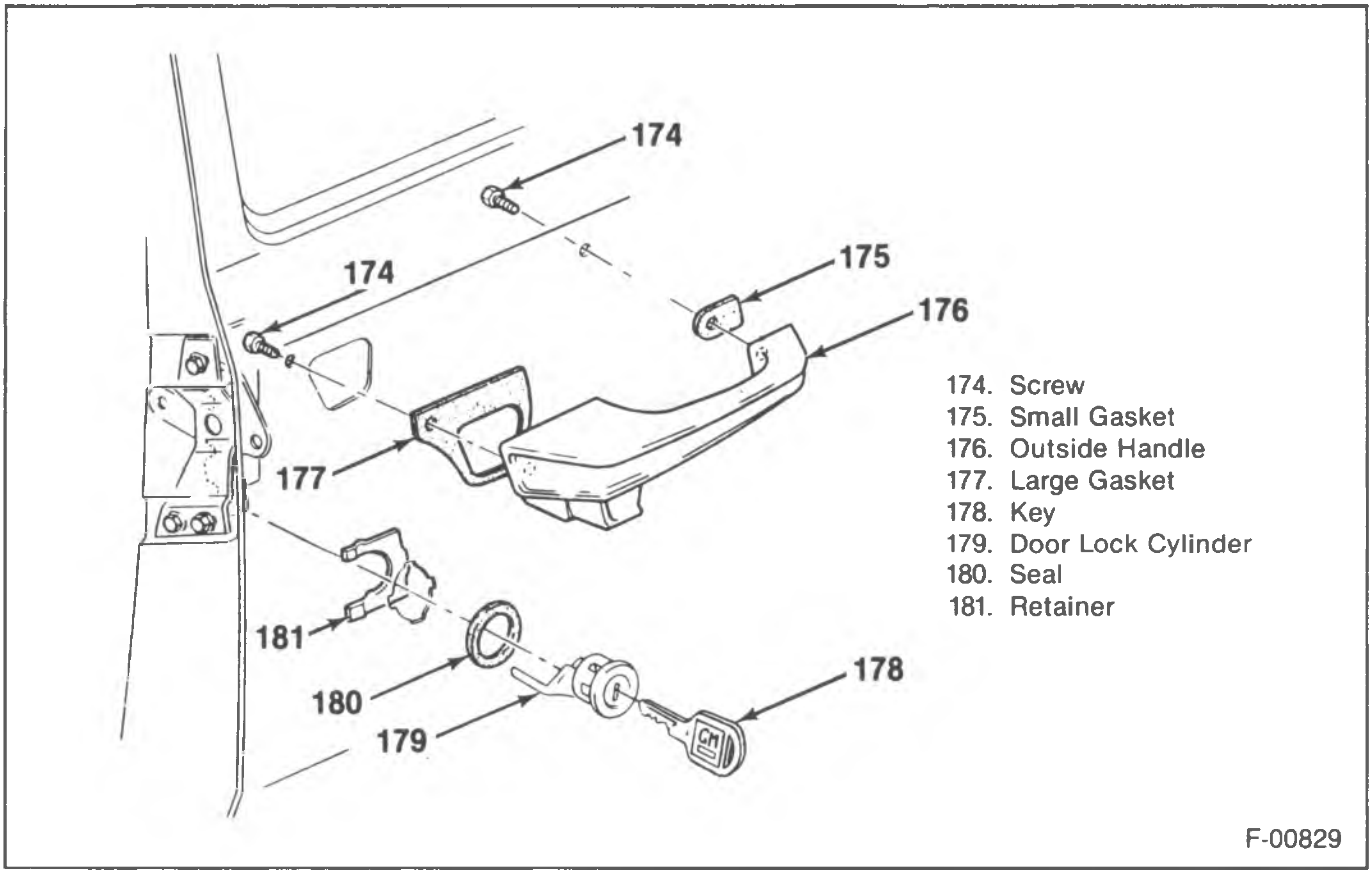


Figure 44—Door Outside Handle Components

CHECK STRAP REPLACEMENT

Remove or Disconnect (Figure 46)

1. Pin.
2. Strap to door bolts (184).
3. Strap.
4. Bracket to inner panel bolts (187).
5. Bracket.

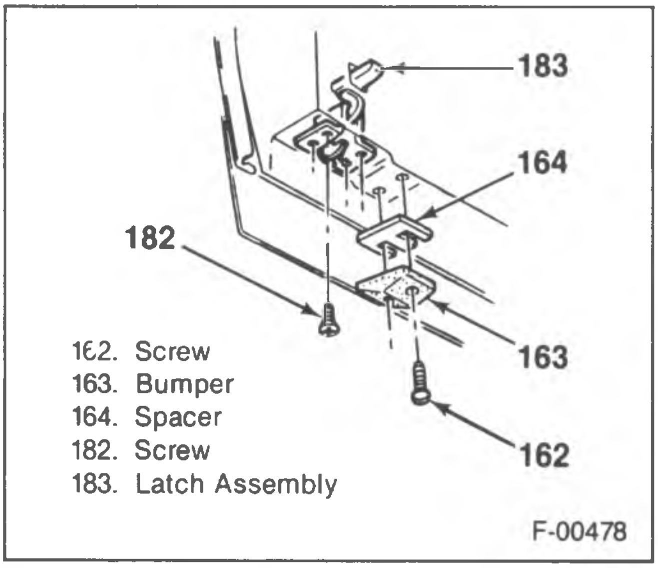


Figure 45—Left Door Lower Latch

Install or Connect (Figure 46)

1. Bracket.
2. Bracket to inner panel bolts (187).
3. Strap to the door.
4. Strap to door bolts (184).
5. Pin.

RIGHT DOOR WEATHERSTRIP REPLACEMENT

Remove or Disconnect (Figure 47)

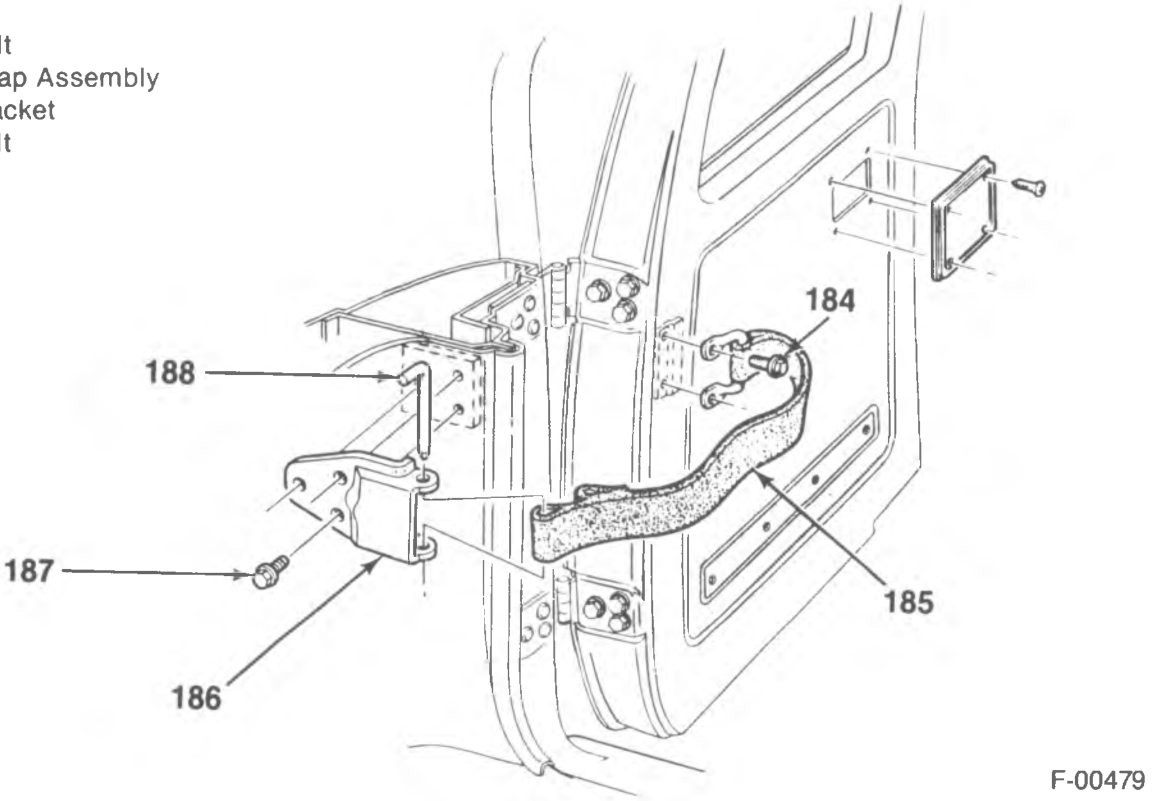
1. Weatherstrip from the door using 3M Release Agent (or equivalent).

Clean

- The door and weatherstrip of all the old cement.

Install or Connect (Figure 47)

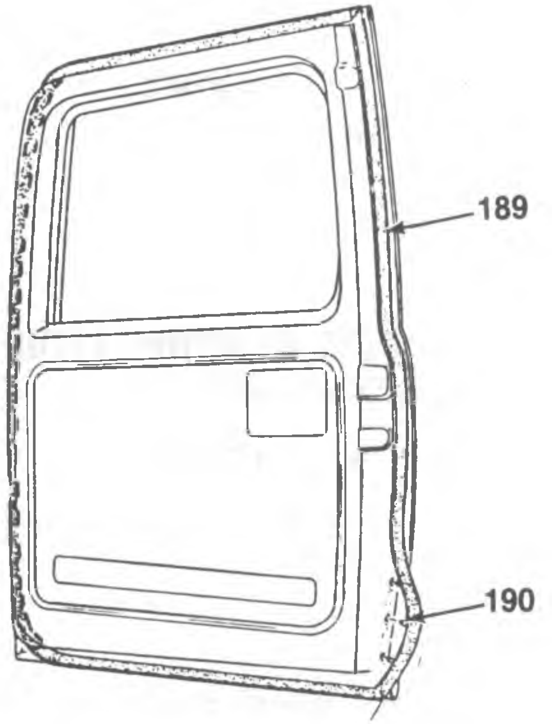
1. Weatherstrip to the door using 3M Weatherstrip Adhesive (or equivalent).



184. Bolt
185. Strap Assembly
186. Bracket
187. Bolt
188. Pin

F-00479

Figure 46—Check Strap Components



189. Weatherstrip
190. Plastic Nails

F-00480

Figure 47—Right Door Weatherstrip

LEFT DOOR WEATHERSTRIP REPLACEMENT

Remove or Disconnet (Figure 48)

Tool Required:

J-24595-B Door Trim Pad Clip Remover.

1. Weatherstrip to door fasteners using J-24595-B.
2. Weatherstrip from the door using 3M Release agent (or equivalent).

Clean

- The door and weatherstrip of all the old cement.

Install or Connect (Figure 48)

1. Weatherstrip to the door using 3M Weatherstrip Adhesive (or equivalent).
2. Weatherstrip to door fasteners.

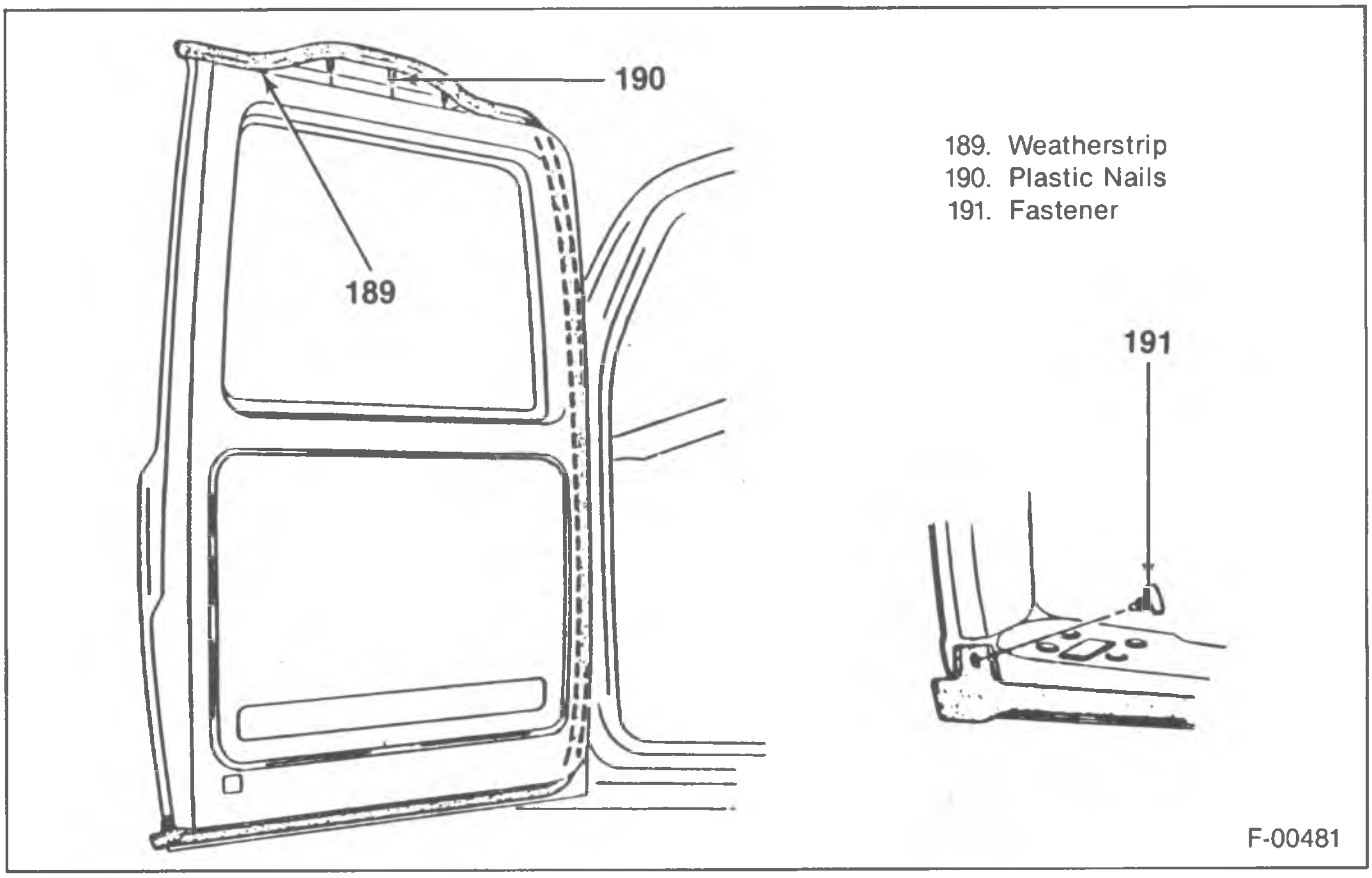


Figure 48—Left Door Weatherstrip

SECONDARY WEATHERSTRIP REPLACEMENT

↔ Remove or Disconnect (Figure 49)

1. Weatherstrip from the door using 3M Release Agent (or equivalent).

Clean

- The door and weatherstrip of all the old cement.

→← Install or Connect (Figure 49)

1. Weatherstrip to the door using 3M Weatherstrip Adhesive (or equivalent).

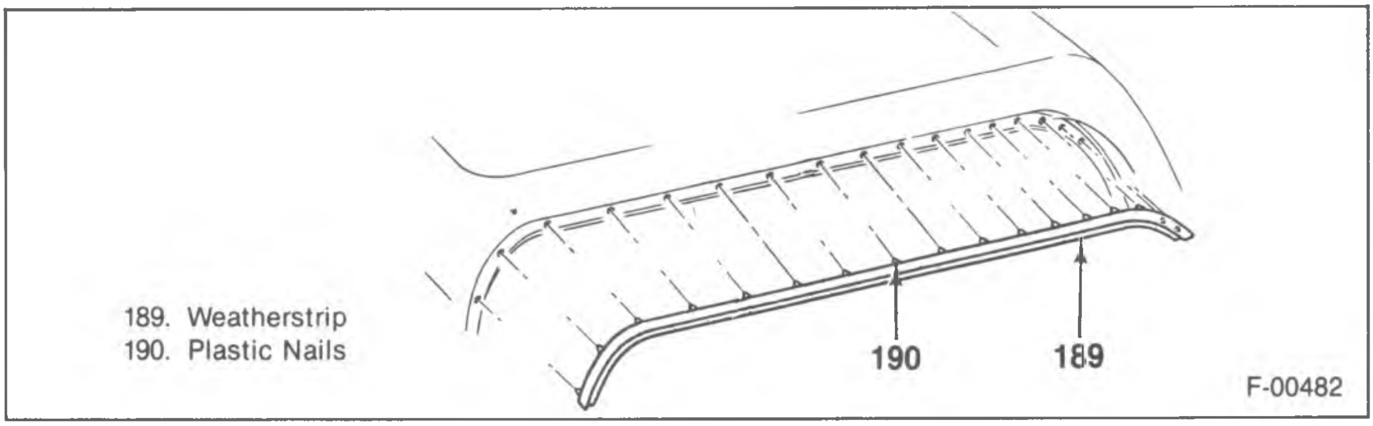


Figure 49—Door Secondary Weatherstrip

G MODEL SIDE FRONT DOORS

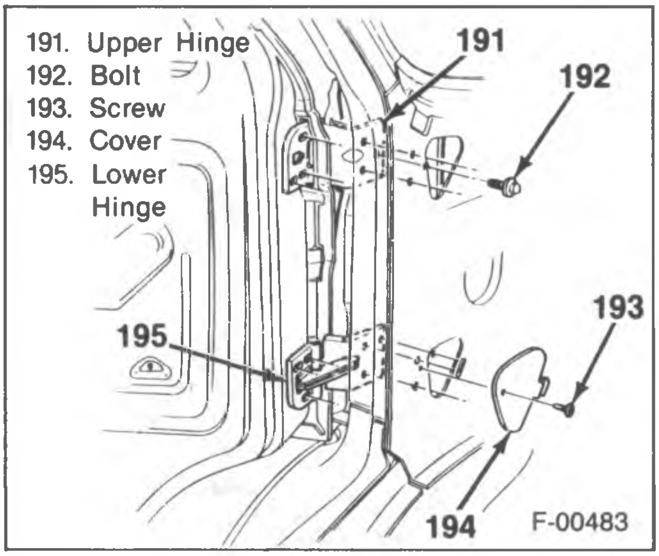


Figure 50—Door Hinge Components

DOOR AND HINGE REPLACEMENT

Remove or Disconnect (Figure 50)

1. Electrical wiring harness from the door (if equipped).
    - Refer to "Door Trim Pad Replacement" for access to the wiring harness.
2. Kick panel (if equipped).
3. Hinge bolt cover screw (193).
4. Hinge bolt cover.

- Mark the position of the hinges on the door and door pillar.
- Support the door.

5. Door frame to hinge bolts (192).
6. Door from the vehicle.
7. Hinge to door bolts.
8. Hinges from the door.

Install or Connect (Figure 50)

1. Hinges to the door.
2. Hinge to door bolts.
    - Align the hinges to the previously made mark.
3. Door to the vehicle.
    - Align the hinges with the previously made mark.

- Support the door.

4. Door frame to hinge bolts (192).
5. Hinge bolt cover.
    - Place the tab on the cover into the slot.
6. Hinge bolt cover screws (193).
7. Kick panel (if equipped).
8. Electrical wiring harness to the door (if equipped).
    - Refer to "Door Trim Panel Replacement" for access to the wiring harness.

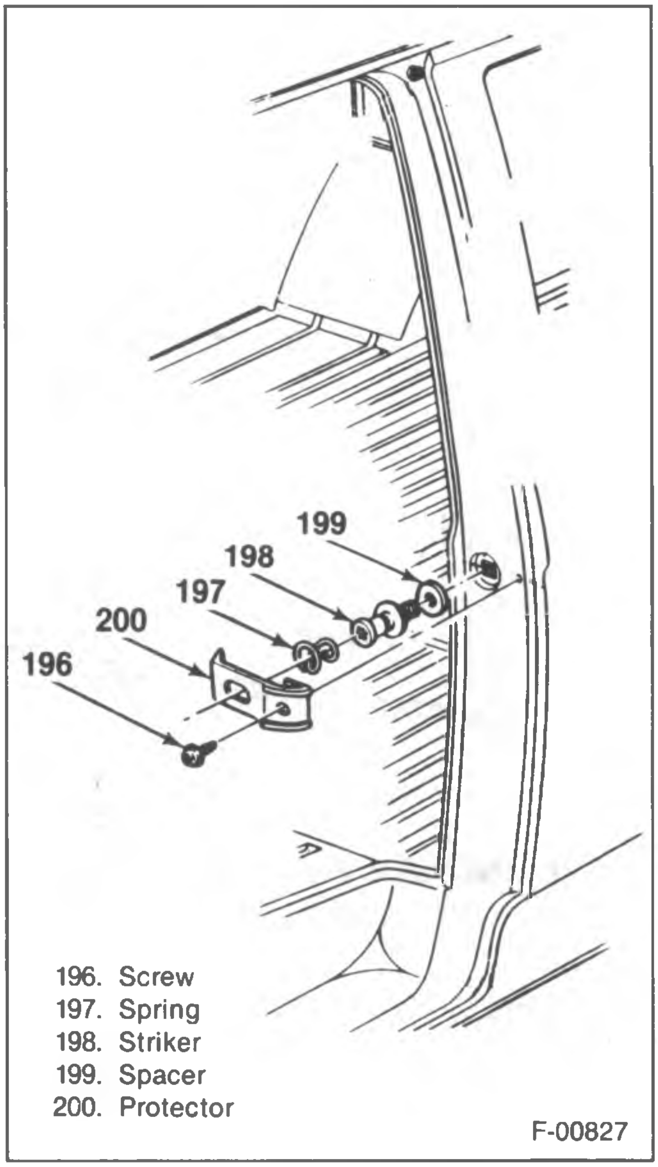


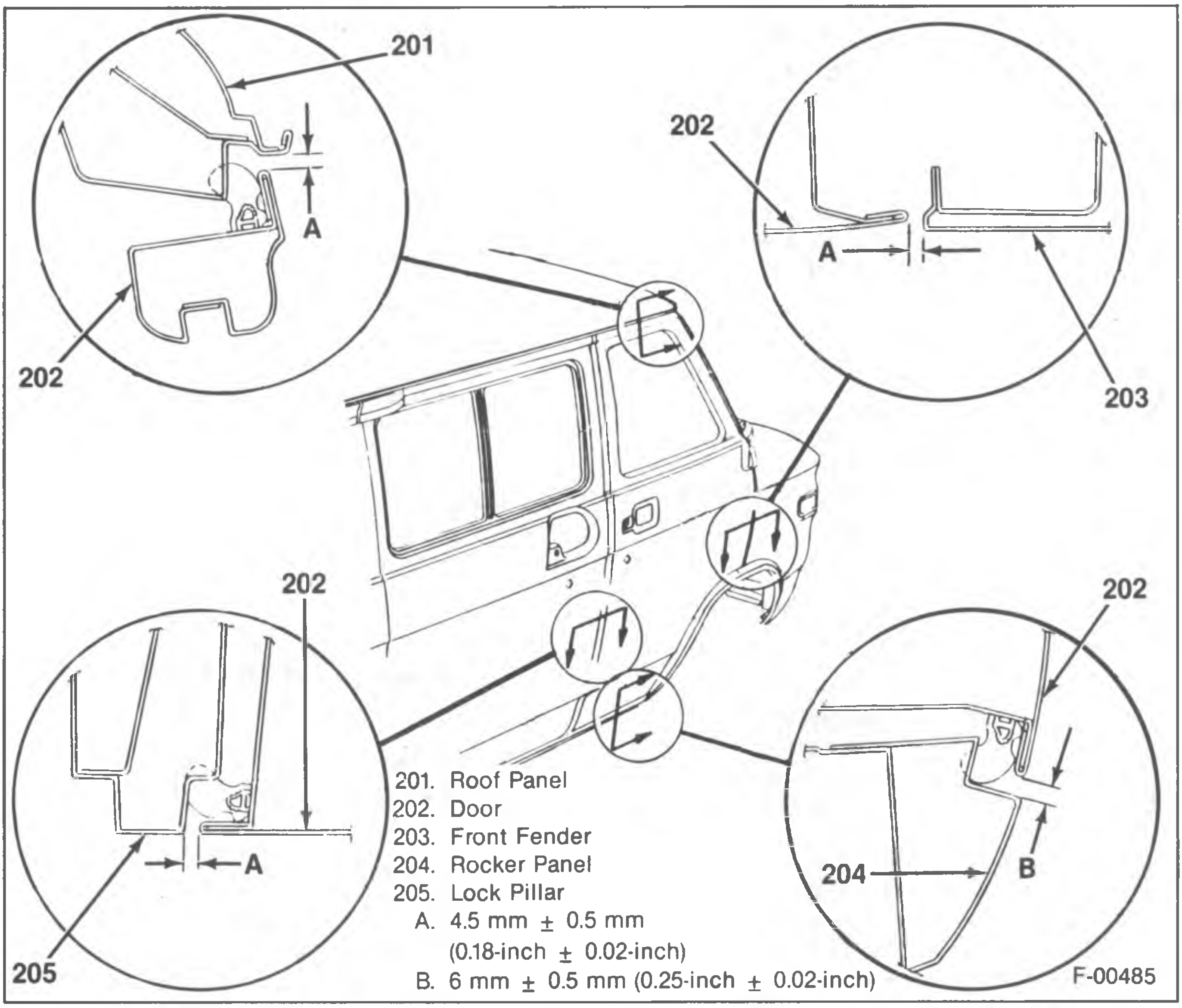
Figure 51—Striker Components

DOOR ADJUSTMENT

Remove or Disconnect (Figure 51)

Tool Required:
J-23457-A #50 Torx Wrench.

1. Lock striker protector screw (196).
2. Lock striker protecter.
3. Spring.
4. Door striker using J-23457-A.



201. Roof Panel
202. Door
203. Front Fender
204. Rocker Panel
205. Lock Pillar
A. 4.5 mm ± 0.5 mm (0.18-inch ± 0.02-inch)
B. 6 mm ± 0.5 mm (0.25-inch ± 0.02-inch)

Figure 52—Door Adjustments

5. Spacer.
6. Kick panel (if equipped).
7. Hinge bolt cover screw (193).
8. Hinge bolt cover.

- Loosen the door hinge bolts as needed to adjust the door.

Adjust (Figure 52)

- The door up or down, forward or rearward and in or out, at the door hinges.

1. Adjust the door to obtain a gap of 4.5 mm ± 0.5 mm (0.18-inch ± 0.02-inch) between the front door and the roof panel.
2. The gap between the rocker panel and the front door at its base should be 6 mm ± 0.5 mm (0.25-inch ± 0.02-inch).
3. Adjust the door to obtain a gap of 4.5 mm ± 0.5 mm (0.18-inch ± 0.02-inch) between the doors rear edge and the rear door pillar.
4. The gap between the doors front edge and the rear edge of the fender should be 4.5 mm ± 0.5 mm (0.18-inch ± 0.02-inch).

- Tighten the door hinge bolts that were loosened.

Install or Connect (Figure 51)

1. Hinge bolt cover.
    - Place the tab on the cover into the slot.
2. Hinge bolt cover screw (193).
3. Kick panel (if equipped).
4. Spacer to the door striker.
5. Door striker.
6. Spring.
7. Lock striker protecter.
8. Lock striker protecter screw (196).

DOOR TRIM PANEL REPLACEMENT

←→ Remove or Disconnect (Figures 53 and 54)

Tool Required:
J-9886-01 Door Handle Clip Remover.

1. Window regulator handle using J-9886-01.
2. Window regulator handle bezel.
3. Door lock control assembly handle using J-9886-01.
4. Control assembly handle bezel.
5. Assist handle (if equipped).
6. Arm rest (if equipped) (figure 55).
7. Door trim outer panel screws (if equipped).
8. Door trim outer panel (if equipped).
    - Pull the panel away from the retainers.
9. Door trim inner panel screws.
10. Door trim inner panel.

→← Install or Connect (Figures 53 and 54)

1. Door trim inner panel.
2. Door trim inner panel screws.
3. Door trim outer panel (if equipped).
    - Push the panel into the retainer.
4. Door trim outer panel screws (if equipped).
5. Arm rest (if equipped) (figure 55).
6. Assist handle (if equipped).
7. Control assembly handle bezel.
8. Window regulator handle bezel.
9. The clips to the window regulator handle and the door lock control assembly handle.
10. Window regulator handle.
    - Push the handle onto the shaft.
11. Door lock control assembly handle.
    - Push the handle onto the shaft.

DOOR VENT/WINDOW RUN CHANNEL ASSEMBLY REPLACEMENT

The door vent and the front window run channel are one assembly. This assembly is fit into the front of the door frame.

←→ Remove or Disconnect (Figure 56)

- Place the window in the lowered position.

1. Door trim panel. Refer to "Door Trim Panel Replacement."
2. Run channel molding.
    - Pull the molding out of the vent assembly only.
3. Door panel to run channel bolt (228).
4. Door to ventilator screws (223).
5. Door vent/window run channel assembly from the vehicle.
    - Pull the top of the vent backwards away from the door frame.
    - Lift and rotate the assembly out of the door.

→← Install or Connect (Figure 56)

1. Door vent/window run channel assembly to the vehicle.
    - Rotate the vent assembly into the door.
    - Fit the assembly into the door frame.
2. Door to ventilator screws (223).
    - Start with the screw at the top of the door, and work downward.
3. Door panel to run channel bolt (228).
4. Run channel molding.
    - Push the corner of the molding into the run channel.
5. Door trim panel. Refer to "Door Trim Panel Replacement."

VENT GLASS REPLACEMENT

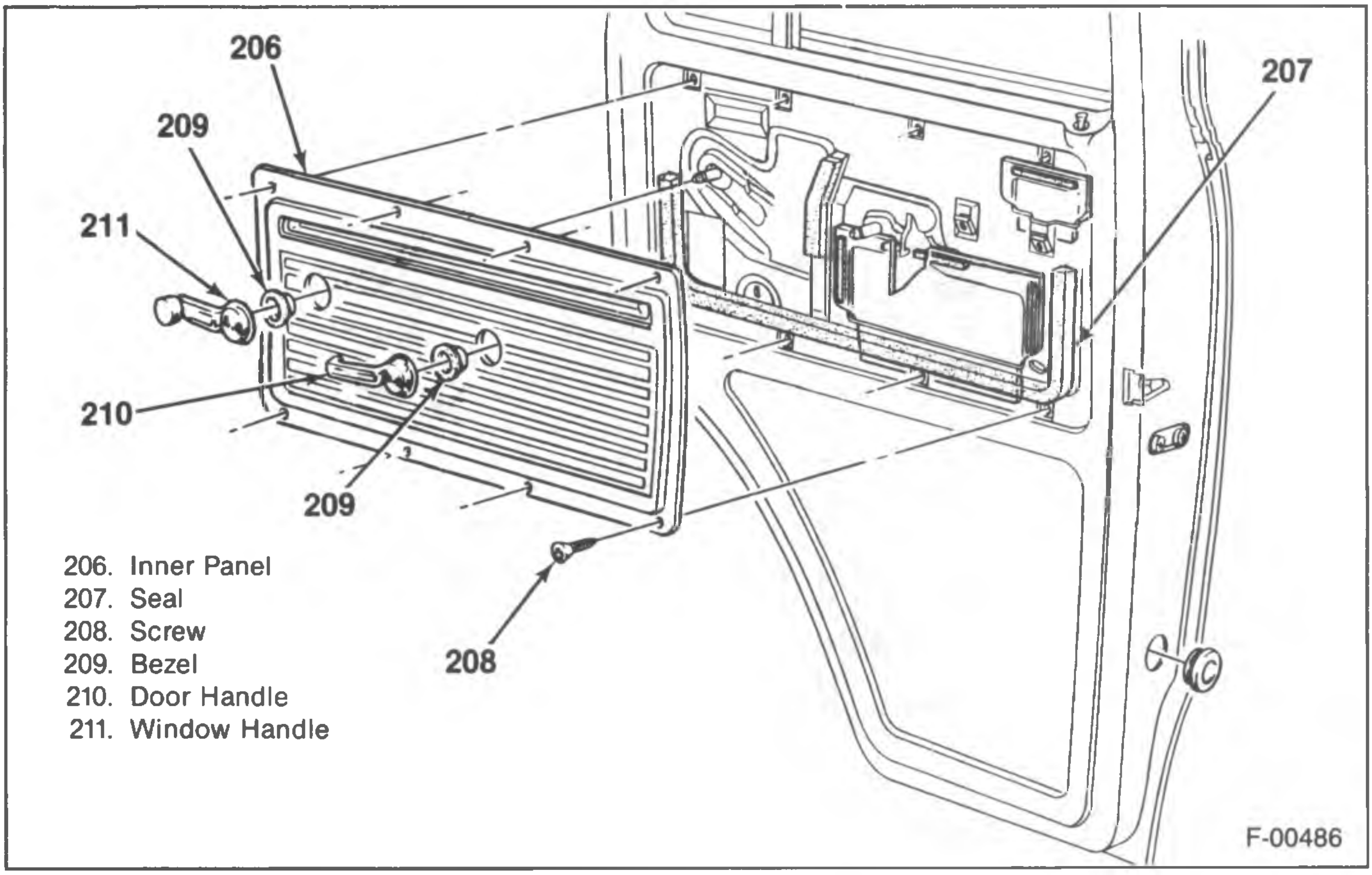
CAUTION: Always wear heavy gloves when handling glass to minimize the risk of injury.

REMOVAL (Figure 57)

1. Open the vent window.
2. Squirt solvent on the tar-paper-like filler all around the glass channel, on both sides of the glass.
3. When the filler and sealer soften, pull the glass and the old filler from the channel.

INSTALLATION

1. Thoroughly clean the inside of the glass channel with sandpaper to remove all rust and foreign matter.
2. Cut the new piece of glass channel filler 51 mm (2-inches) longer than required.
3. Position the filler (soap stoned side away from the glass) evenly around and over the edge of the glass that will be inserted in the channel. Press the filler firmly onto the edge of the glass to ensure a good bond. (Usually this is done with a mechanical window press.) Squeeze together the doubled ends of the filler which project beyond the edge of the glass.
4. Brush the inner channel with soap solution. DO NOT USE GREASE OR OIL.
5. Press the glass and the filler into the channel until firmly seated.
6. Trim off excess filler material around, and at the end of the channel.



206. Inner Panel
207. Seal
208. Screw
209. Bezel
210. Door Handle
211. Window Handle

Figure 53—Door Trim Inner Panel

VENT WINDOW ADJUSTMENT

Adjust (Figure 58)

- Remove the door trim panel. Refer to "Door Trim Panel Replacement."
- Bend the tabs on the adjustment nut away from the nut.
- Adjust the vent by placing a wrench on the adjusting nut, and then turning the vent window to the proper tension.
- Bend the tabs over the adjustment nut.
- Install the door trim panel. Refer to "Door Trim Panel Replacement."

DOOR WINDOW REPLACEMENT

Remove or Disconnect (Figure 59)

CAUTION: Always wear heavy gloves when handling glass to minimize the risk of injury.

- Lower the glass to the bottom of the door.

1. Door trim panel. Refer to "Door Trim Panel Replacement."
2. Door vent/window run channel assembly. Refer to "Door Vent/Window Run Channel Assembly Replacement."
   - Mask or cover any sharp edges that could scratch the glass.
3. Door window glass (230).
   - Slide the glass forward until the front roller is in line with the notch in the sash channel. Disengage the roller from the channel.
   - Push the window forward, then tilt it up until the rear roller is disengaged.
   - Place the window in a level position, and raise it straight up and out of the door.

Install or Connect (Figure 59)

1. Door window glass (230).
   - Lower the window into the door frame.
   - Push the window forward, then tilt it up, and slide the rear roller into the sash channel.
   - Slide the glass backward until the front roller is in line with the notch in the sash channel. Engage the roller to the sash channel.
   - Slide the glass rearward into the glass run channel.
- Remove any masking or covering.

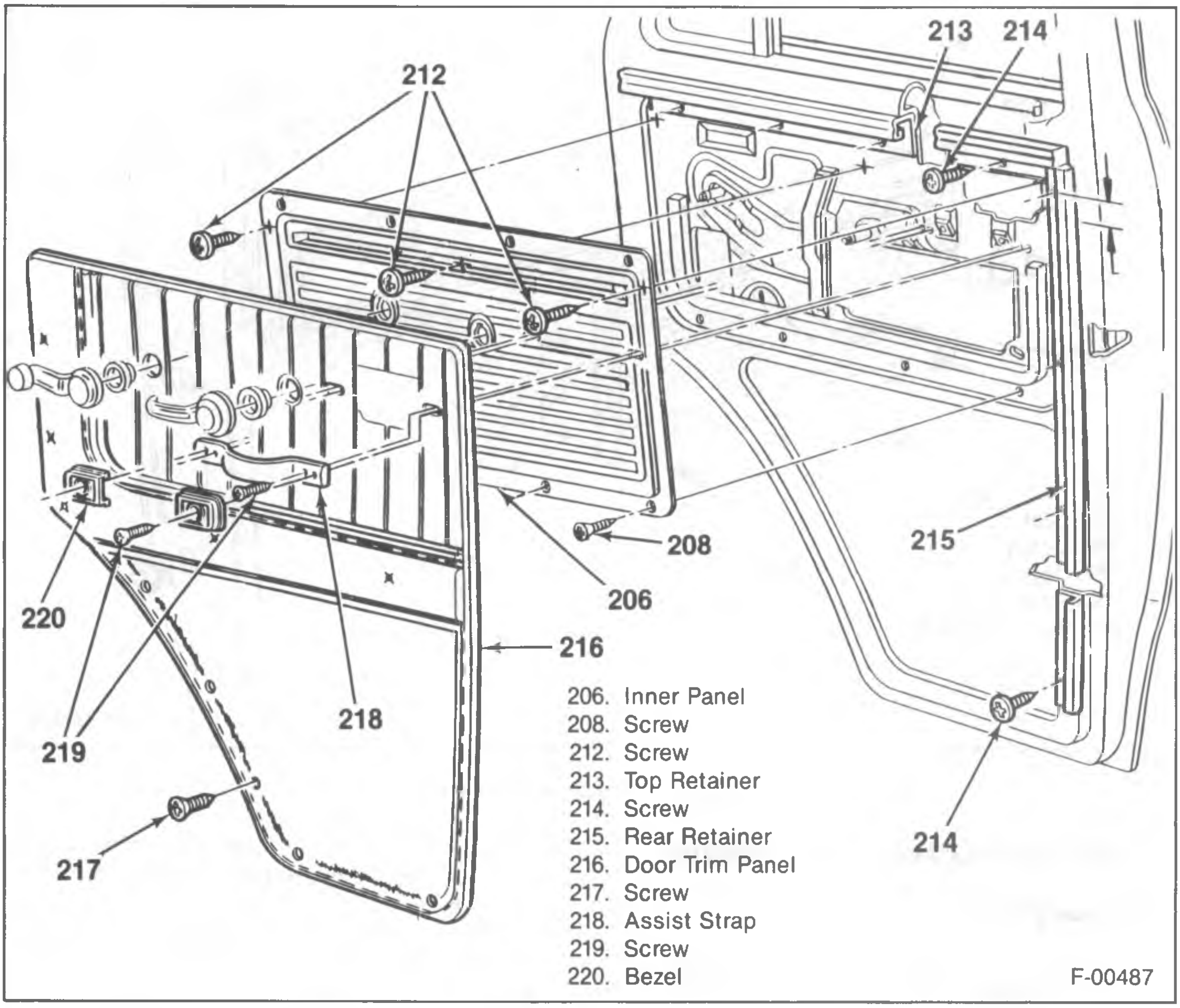


Figure 54—Door Trim Outer Panel

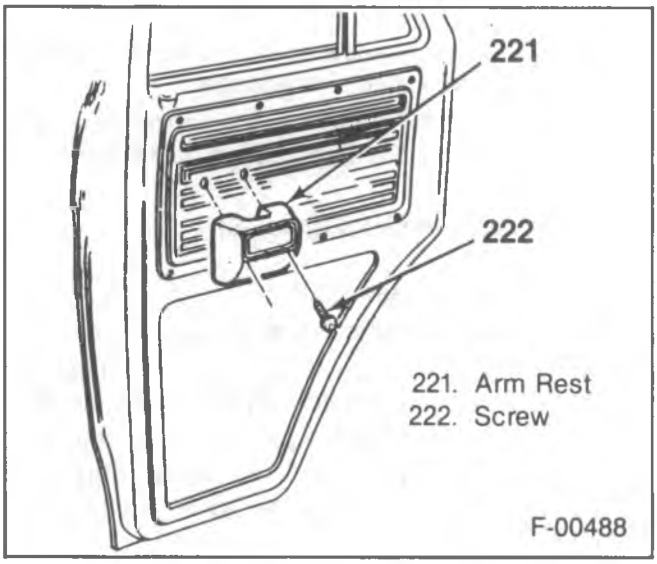
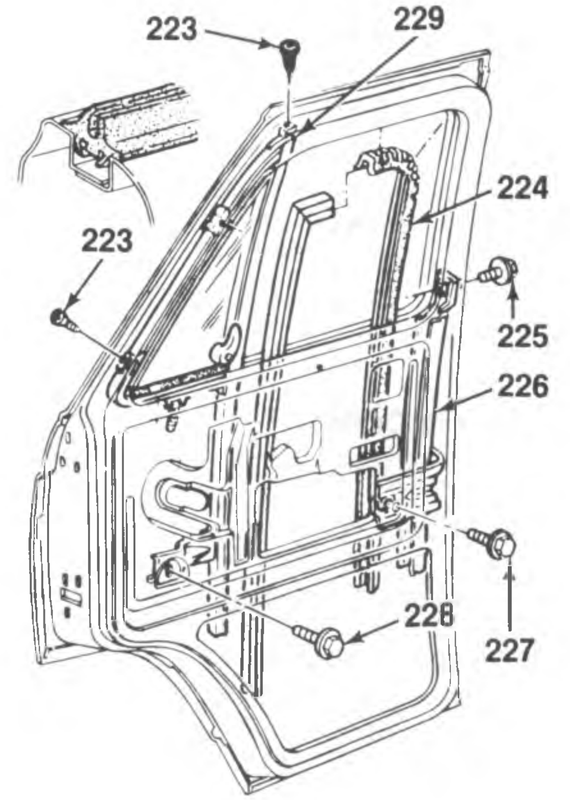


Figure 55—Arm Rest

2. Door vent/window run channel assembly. Refer to "Door Vent/Window Run Channel Assembly Replacement."
3. Door trim panel. Refer to "Door Trim Panel Replacement."

WINDOW STOP ASSEMBLY ADJUSTMENT

1. Remove the door trim panel. Refer to "Door Trim Panel Replacement."
2. Lower the window until it is flush with the window sill.
3. Loosen the glass stop bolt, and adjust the stop until the glass is completely flush with the window sill (figure 59).
4. Tighten the bolt.
5. Install the trim pad. Refer to "Door Trim Panel Replacement."



223. Screw
224. Run Channel Molding
225. Bolt
226. Rear Run Channel Assembly
227. Bolt
228. Bolt
229. Door Vent/Run Channel Assembly

F-00491

Figure 56—Door Run Channel Assemblies

INNER WINDOW WEATHERSTRIP REPLACEMENT

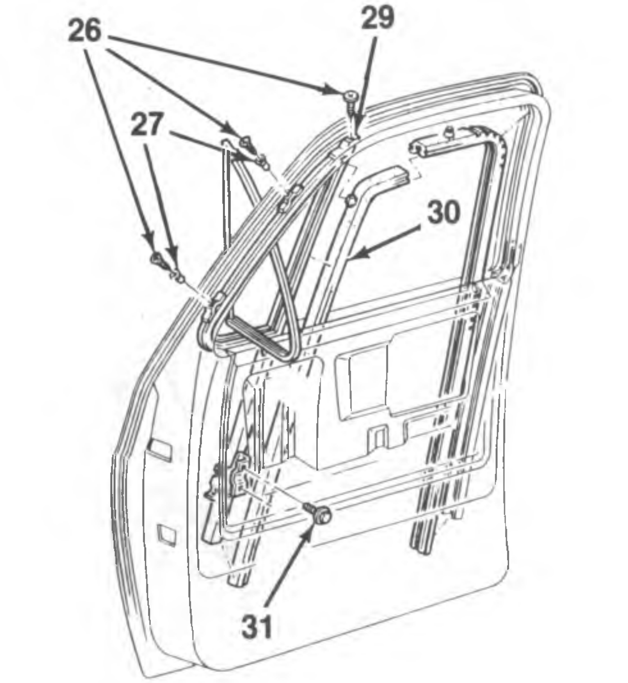
Remove or Disconnect (Figure 59)

- Lower the window.

1. Weatherstrip from the door.
   - Pry the weatherstrip clips from the door panel.

Install or Connect (Figure 59)

1. Weatherstrip to the door.
   - Push the weatherstrip clips onto the door panel.



26. Screw
27. Spacer
29. Door Vent/Window Glass Run Assembly
30. Run Channel Molding
31. Bolt

F-00447

Figure 57—Door Vent/Window Run Channel Components

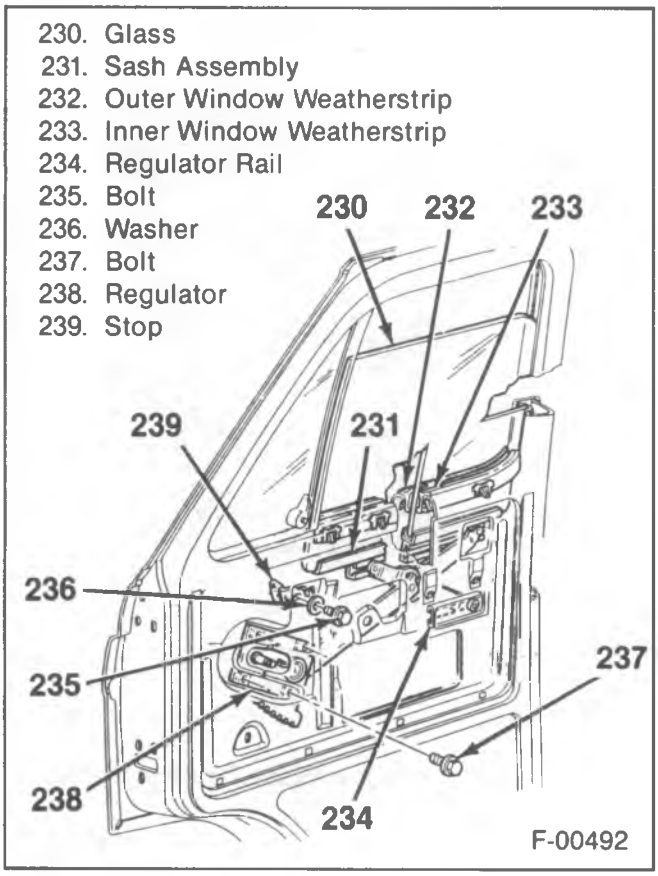
OUTER WINDOW WEATHERSTRIP REPLACEMENT

Remove or Disconnect (Figure 59)

- Lower the window.


F-00448

Figure 58—Vent Window Adjustment



230. Glass
231. Sash Assembly
232. Outer Window Weatherstrip
233. Inner Window Weatherstrip
234. Regulator Rail
235. Bolt
236. Washer
237. Bolt
238. Regulator
239. Stop

Figure 59—Door Window Components

1. Weatherstrip from the door.
    - Pry the weatherstrip clips from the door panel.

Install or Connect (Figure 59)

1. Weatherstrip to the door.
    - Push the weatherstrip clips onto the door panel.

REAR GLASS RUN CHANNEL REPLACEMENT

Remove or Disconnect (Figure 56)

1. Door trim panel. Refer to "Door Trim Panel Replacement."

- Lower the window completely.

2. Inner and outer window weatherstrips.
3. Door to run channel bolts (225 and 227).
4. Run channel from the vehicle.
    - Pull the run channel upwards while twisting to clear the lower bracket.

Install or Connect (Figure 56)

1. Run channel to the vehicle.
    - Work the run channel into the door frame. Be certain that the glass is in the channel.
2. Lower door to run channel bolt (227).

- Raise the window completely.

3. Upper door to run channel bolt (225).
4. Inner and outer window weatherstrips.
5. Door trim panel. Refer to "Door Trim Panel Replacement."

WINDOW REGULATOR REPLACEMENT

MANUAL REGULATOR

Remove or Disconnect (Figure 59)

- Raise the window and tape the glass in the full up position using cloth body tape.

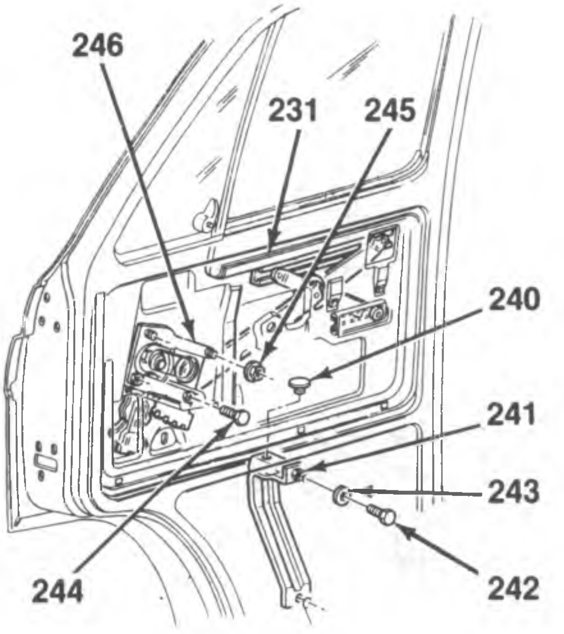
1. Door trim panel. Refer to "Door Trim Panel Replacement."
2. Door panel to regulator bolts (237).
3. Window regulator (238).
    - Slide the regulator rearward to disengage the rear roller from the sash channel. Also disengage the lower roller from the regulator rail.
    - Disengage the forward roller from the sash channel at the notch in the sash channel.
    - Collapse the regulator, and remove it through the access hole in the door.

Install or Connect

- Lubricate the regulator and the sash and regulator rails with lubriplate or equivalent.

1. Window regulator (238).
    - Collapse the regulator, and insert it through the access hole in the door.
    - Unfold the regulator, and engage the forward roller to the sash channel at the sash channel notch.
    - Slide the regulator rearward to engage the rear roller to the sash channel. Also engage the lower roller to the regulator rail.
    - Slide the regulator into its proper position, and insert the regulator drive through the door panel.
2. Door panel to regulator bolts (237).
3. Door trim panel. Refer to "Door Trim Panel Replacement."

- Remove the tape from the window.



231. Sash Channel
240. Bumper
241. Stop
242. Bolt
243. Washer
244. Bolt
245. Nut
246. Power Regulator

F-00493

Figure 60—Power Window Regulator

POWER REGULATOR

For the diagnosis of power window circuits, refer to CAB ELECTRICAL (SEC. 8A).

Remove or Disconnect (Figure 60)

- Raise the window and tape the glass in the full up position using cloth body tape.

1. Battery ground cable.
2. Door trim panel. Refer to "Door Trim Panel Replacement."
3. Remote control to door trim panel bolts.
   - Lay the control aside.
4. Regulator to door panel bolts (244) and nuts (245).
5. Wiring harness from the regulator.
6. Window regulator (246).
   - Slide the regulator rearward to disengage the rear roller from the sash channel. Also disengage the lower roller from the regulator rail.
   - Disengage the forward roller from the sash channel at the notch in the sash channel.
   - Collapse the regulator, and remove it through the access hole in the door.

CAUTION: The next step must be performed when the regulator is removed from the door. The regulator lift arms are under tension from the counterbalance spring and can cause serious injury if the motor is removed without locking the sector gear in position.

- Drill a hole through the regulator sector gear and back plate. Drill the hole at least 12.7 mm ($^{1}/_{2}$-inch) away from the edge of the sector gear or back plate. Install a pan head sheet metal tapping screw at least 19 mm ($^{3}/_{4}$-inch) long into the drilled hole to lock the sector gear in place.

7. Motor to regulator attaching screws.
8. Motor from the regulator.

Install or Connect (Figure 60)

- Lubricate the motor drive gear and regulator sector teeth.

1. Regulator motor to regulator.
   - The motor pinion gear teeth must mesh properly with the sector gear teeth before installing the motor to regular screws.
2. Regulator motor to regulator screws.

- Remove the sheet metal screw from the back plate and sector gear.

3. Window regulator to the door.
   - Collapse the regulator, and insert it through the access hole in the door.
   - Unfold the regulator, and engage the forward roller to the sash channel at the sash channel notch.
   - Slide the regulator rearward to engage the rear roller to the sash channel. Also engage the lower roller to the regulator rail.
   - Slide the regulator into its proper position.
4. Wiring harness to the regulator.
5. Regulator to door panel bolts (244) and nuts (245).
6. Remote control to door trim panel bolts.
7. Door trim panel. Refer to "Door Trim Panel Replacement."
8. Battery ground cable.

- Remove the tape from the window.

DOOR LOCK REPLACEMENT

Remove or Disconnect (Figures 61 and 62)

- Raise the window completely.

1. Door trim panel. Refer to "Door Trim Panel Replacement."
2. Door lock knob.
3. Remove control assembly. Refer to "Remote Control Replacement."
4. Rear glass run channel. Refer to "Rear Glass Run Channel Replacement."
5. Door to lock screws (267).
6. Lock from the door.
    - Lower the lock in the door far enough to provide clearance for the inside lock rod.

install or Connect (Figures 61 and 62)

1. Lock to the door.
    - Align the lock rod with the hole in the top of the door panel.
2. Door to lock screws (267).
3. Rear glass run channel. Refer to "Rear Glass Run Channel Replacement."
4. Remote control assembly. Refer to "Remote Control Assembly."
5. Door lock knob.
6. Door trim panel. Refer to "Door Trim Panel Replacement."

POWER DOOR LOCK MOTOR REPLACEMENT

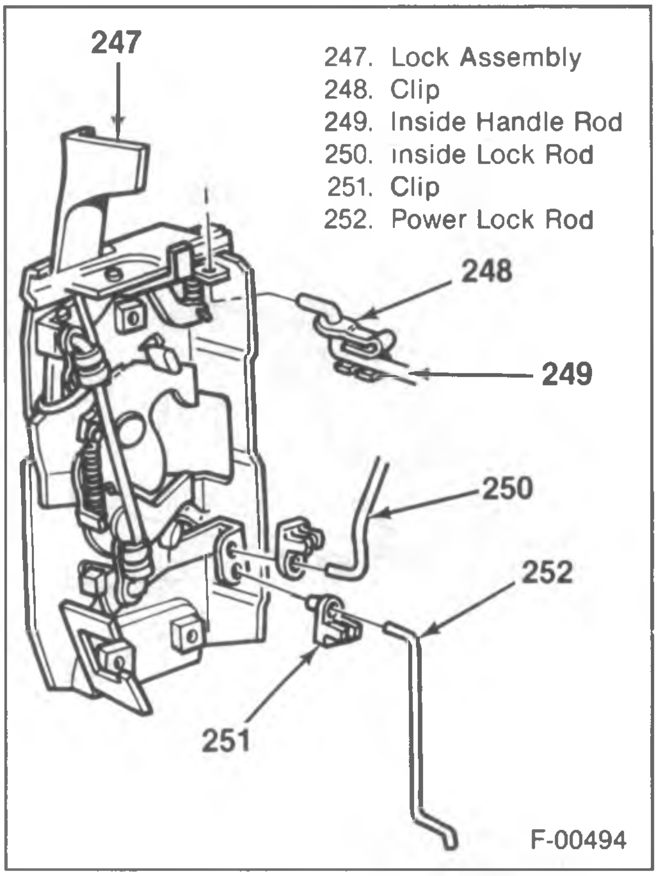
Refer to CAB ELECTRICAL (SEC. 8A) for electrical diagnosis of the door lock motor.

Remove or Disconnect (Figure 62)

1. Battery ground cable.
2. Door trim panel. Refer to "Door Trim Panel Replacement."
3. Electrical connector from the motor.
4. Door to motor screws (268).
5. Motor from the lock rod.
    - Slide the rubber mount at the top of the motor off of the door lock rod.
6. Motor from the door.

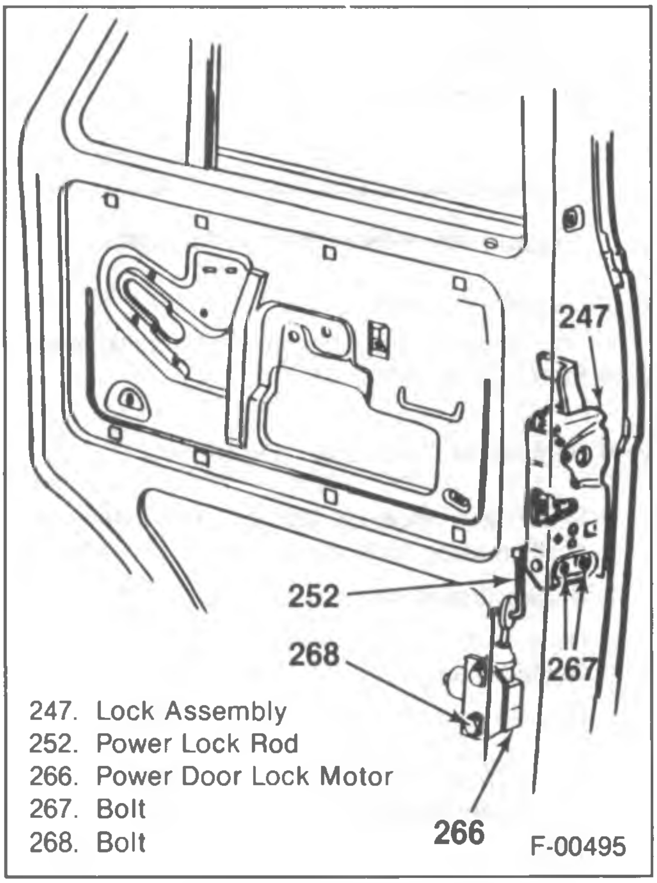
Install or Connect (Figure 62)

1. Motor into the door.
2. Motor to the lock rod.
    - Slide the rubber mount at the top of the motor onto the door lock rod.
3. Door to motor screws (268).
4. Electrical connector to the motor.



247. Lock Assembly
248. Clip
249. Inside Handle Rod
250. Inside Lock Rod
251. Clip
252. Power Lock Rod

Figure 61—Door Lock With Lock Rods



247. Lock Assembly
252. Power Lock Rod
266. Power Door Lock Motor
267. Bolt
268. Bolt

Figure 62—Door Lock Attachments

5. Door trim panel. Refer to "Door Trim Panel Replacement."
6. Battery ground cable.

DOOR OUTSIDE HANDLE REPLACEMENT

Remove or Disconnect (Figure 63)

- Raise the window completely.

1. Door trim panel. Refer to "Door Trim Panel Replacement."
2. Door to outside handle screws (253).
3. Handle from the door.
4. Gaskets from the door.

Install or Connect (Figure 63)

1. Large gasket onto the handle.
2. Door to outside handle screw (253) to the push button side of the handle.
    - Do not tighten.
3. Small gasket between the door and the handle.
4. Door to outside handle screw (253) to the other side of the handle.
    - Tighten both screws.
5. Door trim panel. Refer to "Door Trim Panel Replacement."

DOOR LOCK CYLINDER REPLACEMENT

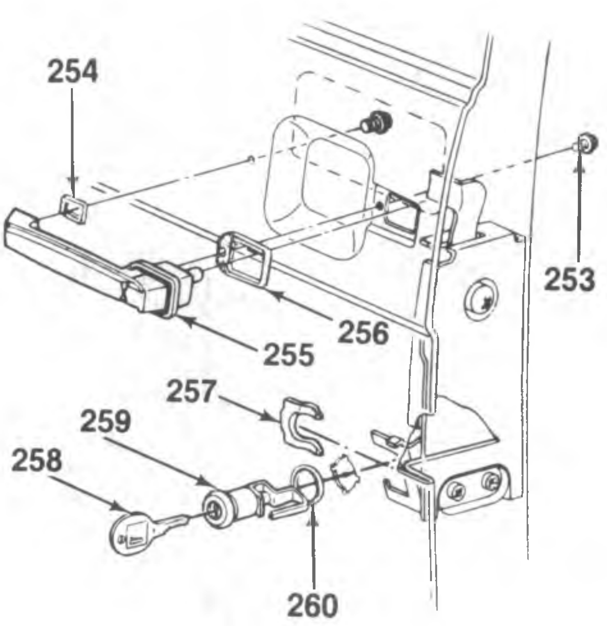
Remove or Disconnect (Figure 63)

- Raise the window completely.

1. Door trim panel. Refer to "Door Trim Panel Replacement."
2. Lock cylinder retaining clip from the cylinder.
    - Slide the clip off the cylinder with a screwdriver.
3. Lock cylinder and gasket from the door.

Install or Connect (Figure 63)

1. Lock cylinder with gasket to the door.
    - The cylinder rod must engage the lock assembly lever.
2. Lock cylinder retaining clip onto the cylinder.
3. Door trim panel. Refer to "Door Trim Panel Replacement."



253.	Bolt	257.	Retainer
254.	Small Gasket	258.	Key
255.	Door Handle	259.	Lock Cylinder
256.	Large Gasket	260.	Gasket

F-00496

Figure 63—Outside Handle And Lock Cylinder Components

DOOR LOCK CONTROL ASSEMBLY REPLACEMENT

Remove or Disconnect (Figure 64)

1. Door trim panel. Refer to "Door Trim Panel Replacement."
2. Door panel to control assembly screws (262).
3. Control assembly from the lock assembly rod.
    - Pivot the clip away from the rod at the control assembly.
    - Twist the control assembly off the rod.
4. Control from the vehicle.

Install or Connect (Figure 64)

1. Control to the vehicle.
2. Control assembly to the lock assembly rod.
    - Twist the control assembly (with clip) onto the rod.
    - Pivot the clip onto the rod.
3. Door panel to control assembly screws (262).
4. Door trim panel. Refer to "Door Trim Panel Replacement."

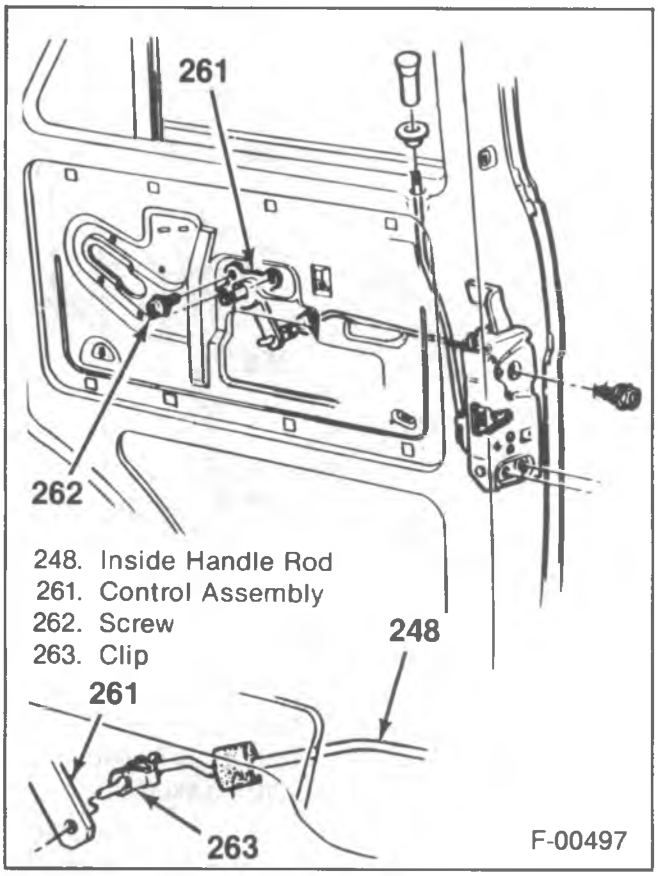


Figure 64—Door Lock Control

DOOR WEATHERSTRIP REPLACEMENT

Remove or Disconnect (Figure 65)

1. Weatherstrip from the door using 3M Release Agent (or equivalent).
2. Plastic nails from the door.

Clean

- The door of all the old cement.

Install or Connect (Figure 65)

1. Weatherstrip adhesive to the door. Use 3M Weatherstrip Adhesive (or equivalent).
2. Weatherstrip to the door.
    - Locate the weatherstrip part number, and place it at the top of the vent window.
    - Press the plastic nails into the door.

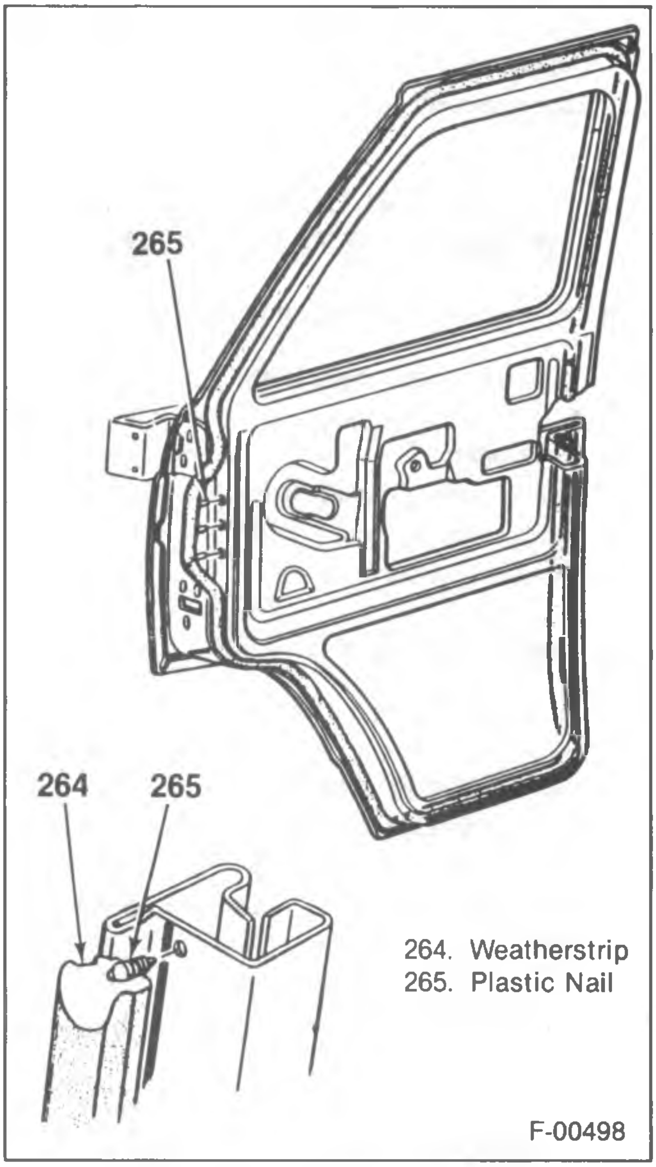


Figure 65—Door Weatherstrip

BELOW EYELINE OUTSIDE REAR VIEW MIRROR REPLACEMENT

Remove or Disconnect (Figure 20)

1. Mirror cover screw.
    - Lift the cover, and pivot the mirror towards the window.
2. Mirror to door bolts and nut.
3. Mirror and seal from the door.

Install or Connect (Figure 20)

1. Mirror and seal to the door.
2. Mirror to door bolts and nut.
    - Pivot the mirror away from the window, and lower the mirror cover.
3. Mirror cover screw.

G MODEL INTERMEDIATE DOORS

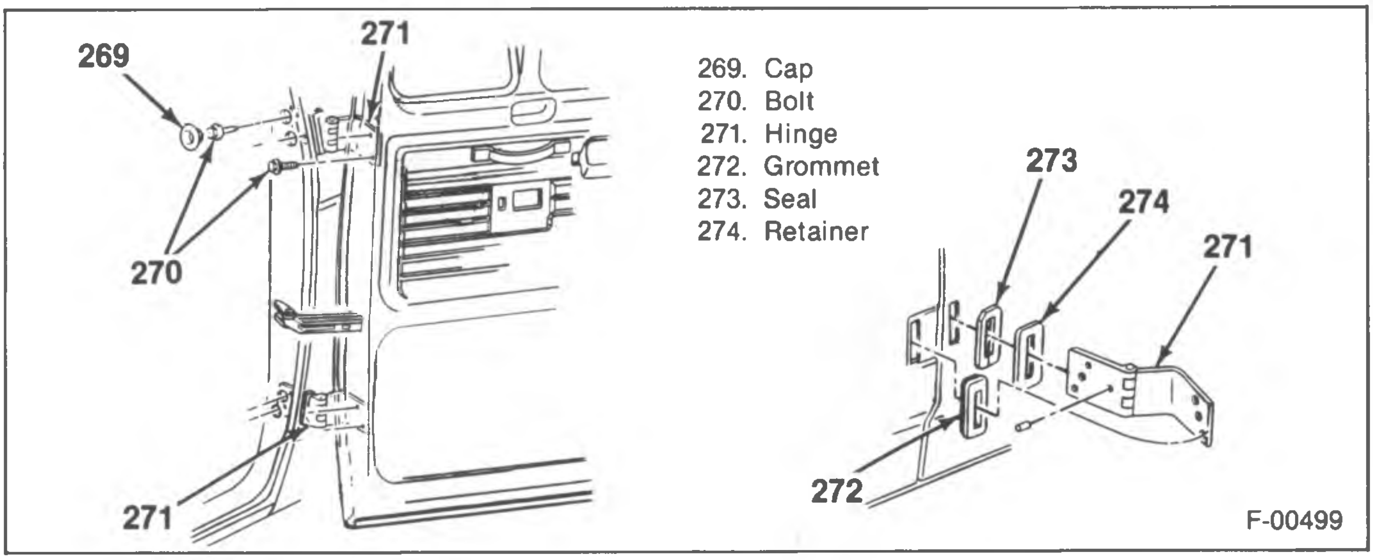


Figure 66—Door Hinge Components

DOOR AND HINGE REPLACEMENT

Remove or Disconnect (Figures 66 and 67)

- Open the door.

1. Electrical wiring harness (if equipped).
    - Refer to "Door Trim Panel Replacement" for access to the wiring harness.

- Mark the position of the door on the hinges using a wax pencil.

2. Hinge hole plugs on the body side pillar.
3. Strap pin (275) from the bracket.
    - Remove the snap ring from the pin, and pull the pin.

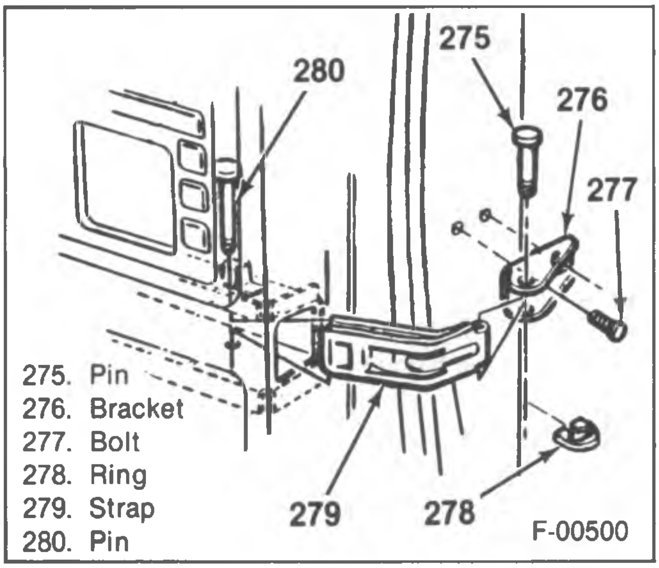


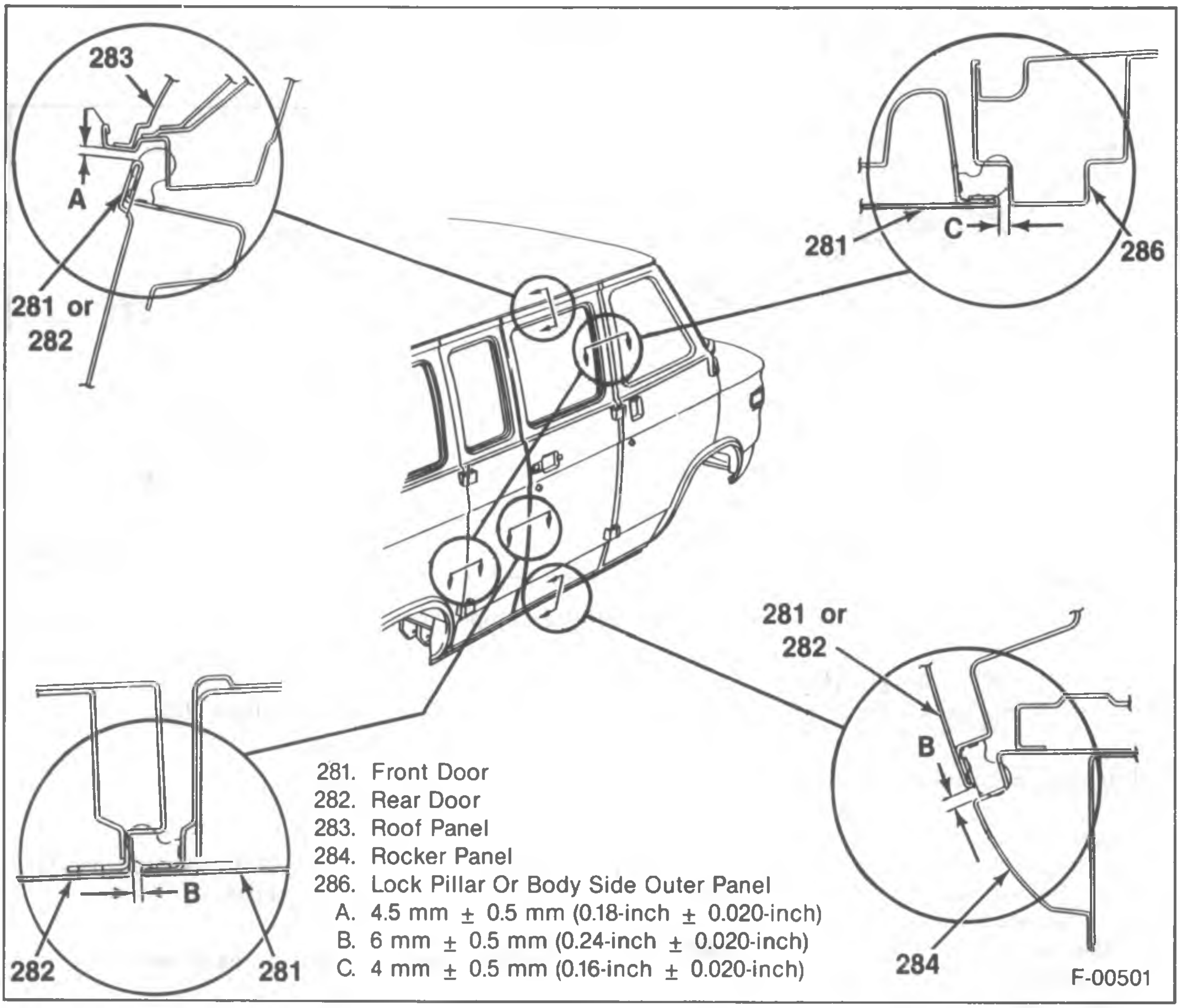
Figure 67—Check Strap Components

- Support the door.

4. Hinge to the body pillar bolts (270).
5. Door from the vehicle.
6. Hinge to door bolts (270).
7. Hinges from the door.
8. Retainers (274), seals (273), and grommets (272) from the door or the hinges.

Install or Connect (Figures 66 and 67)

1. Grommet to the door.
2. Hinge to the door.
3. Hinge to door bolts (270).
    - Align the hinge to the previously made mark.
4. The seals and retainers to the body half of the hinge.
5. Door to the vehicle.
    - Support the door.
6. Hinge to body pillar bolts (270).
    - Align the hinge to the previously made mark.
7. Strap pin (275) to the bracket.
8. Snap ring to the pin.
9. Hinge hole plugs on the body side pillar.
10. Electrical wiring harness (if equipped).
    - Refer to "Door Trim Panel Replacement" for access to the wiring harness.



281. Front Door
282. Rear Door
283. Roof Panel
284. Rocker Panel
286. Lock Pillar Or Body Side Outer Panel
A. 4.5 mm ± 0.5 mm (0.18-inch ± 0.020-inch)
B. 6 mm ± 0.5 mm (0.24-inch ± 0.020-inch)
C. 4 mm ± 0.5 mm (0.16-inch ± 0.020-inch)

Figure 68—Door Adjustments

DOOR ADJUSTMENT

Remove or Disconnect (Figure 68)

Tool Required:

J-23457-A Wrench.

1. Door lock striker from the rear intermediate door using J-23457-A.
2. Upper and lower rear intermediate door strikers.

- Loosen the hinge bolts as necessary to adjust the doors.

Adjust

- Each of the two doors must first be adjusted in the door opening before adjusting the door to door clearance.
- The door up or down, forward or rearward, and in or out, at the door hinges.

1. The door height so that there is a gap of 4.5 mm ± 0.5 mm (0.18-inch ± 0.020-inch) between the doors and the roof panel.
2. The gap between the door and the rocker panel to 6 mm ± 0.5 mm (0.24-inch ± 0.020-inch).
3. The gap between the doors and the body at the hinge pillars to 4 mm ± 0.5 mm (0.16-inch ± 0.020-inch).
4. The gap between the front and rear intermediate doors to 6 mm ± 0.5 mm (0.25-inch ± 0.020-inch).

- Tighten the hinge bolts that were loosened.

Install or Connect

1. Upper and lower rear intermediate door strikers to the body.
2. Door lock striker to the rear intermediate door using J-23457-A.

Adjust (Figure 69)

- The upper and lower rear intermediate door striker to door clearance so that there is 4.4 mm (0.172-inch) between the striker and the door latch when the door is in the secondary latched position. (The door is latched but not fully closed.) An $^{11}/_{64}$-inch diameter drill bit may be used to gage this clearance.
- The front intermediate striker on the rear door. Adjust it so that the front door lock properly engages the rear door, and so the front door is flush with the rear door.

BUMPER WEDGE REPLACEMENT

Remove or Disconnect (Figure 70)

1. Bumper to upper and lower door frame screws (308).
2. Bumper and spacer.

Install or Connect (Figure 70)

1. Spacer (as required).
2. Bumper.
3. Bumper to upper and lower door frame screws (308).

Adjust

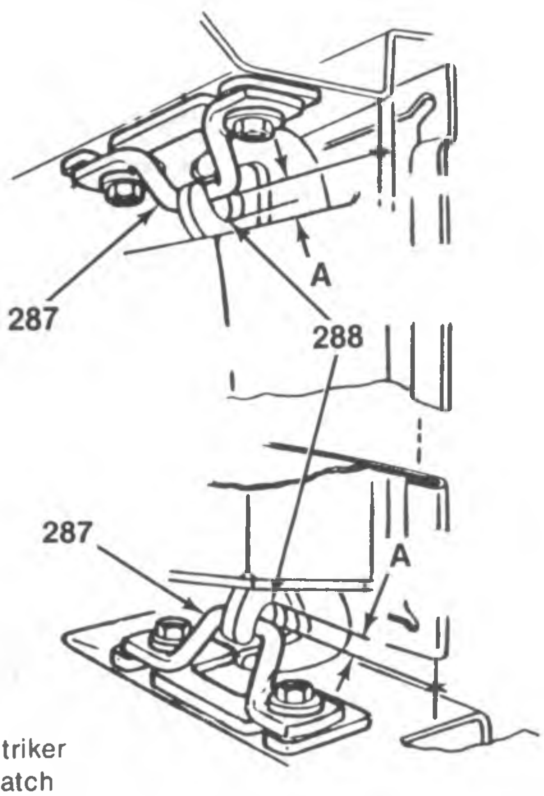
- The bumper to door clearance so that there is 1 mm (0.04-inch) between the bumper and the door when the door is in the secondary position. (The door is latched but not fully closed).

DOOR TRIM PANEL REPLACEMENT

INTERMEDIATE FRONT DOOR

Remove or Disconnect (Figure 71)

1. Door strap.
   - Pry the lock knob off of the lock rod, when the knob is in the unlocked position.
2. Door handle bezel screws.
3. Bezel and lock knob from the vehicle.
4. Door trim panel to door screws (295).
5. Door trim panel.
   - Pull the panel from the retainers.
6. Retainer to door screws (293).
7. Retainers from the door.
8. Door garnish molding screws (289).
9. Door garnish molding from the doors.



287. Striker
288. Latch
A. 4.4 mm (0.172-inch)

Figure 69—Striker Adjustments

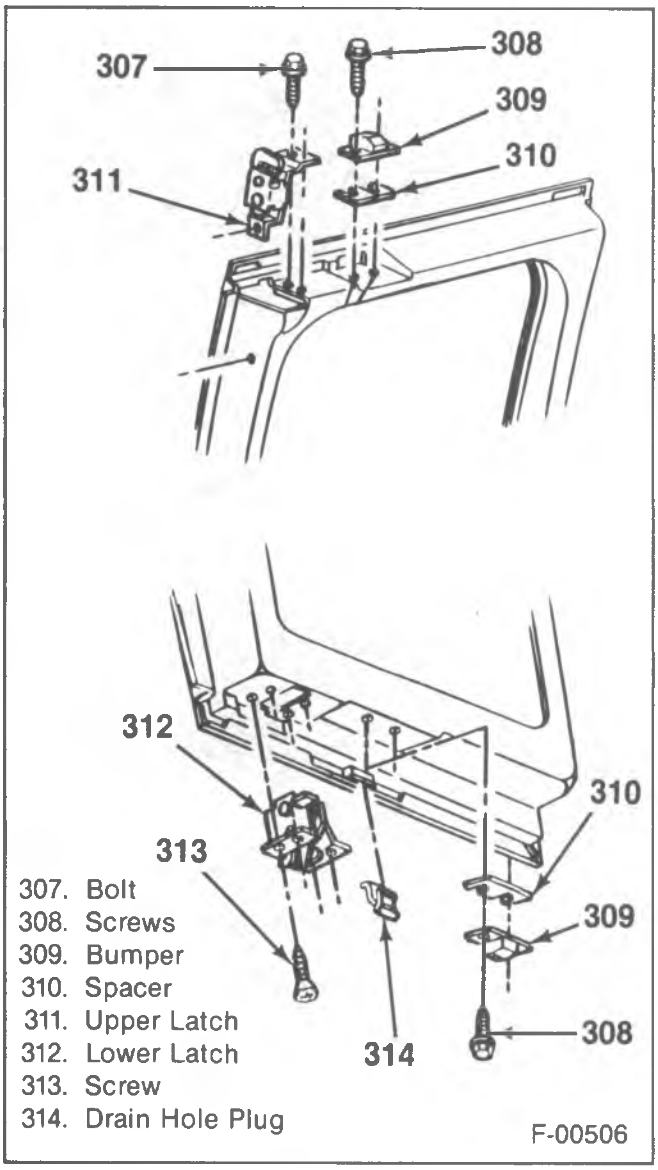
Install or Connect (Figure 71)

1. Door garnish molding to the door.
2. Door garnish molding screws (289).
3. Retainers to the door.
4. Retainer to door screws (293).
5. Door trim panel.
   - Push the edge of the panel into the retainers.
6. Door trim panel to door screws (295).
7. Door handle bezel and lock knob to the vehicle.
   - Place the lock knob onto the lock rod.
8. Door handle bezel screws.
9. Door strap.

INTERMEDIATE REAR DOORS

Remove or Disconnect (Figure 72)

1. Door trim panel to door screws (305).
2. Door trim panel.
   - Pull the panel from the retainers.
3. Side door garnish molding screws (304) and bolt (302).
4. Side door garnish molding from the door.
5. Retainer to door screws (301).
6. Retainer from the door.
7. Upper door garnish molding screws (298).
8. Upper door garnish molding from the door.



307. Bolt
308. Screws
309. Bumper
310. Spacer
311. Upper Latch
312. Lower Latch
313. Screw
314. Drain Hole Plug

Figure 70—Bumper Wedge Components

Install or Connect (Figure 72)

1. Upper door garnish molding to the door.
2. Upper door garnish molding screws (298).
3. Retainer to the door.
4. Retainer to door screws (301).
5. Side door garnish molding to the door.
6. Side door garnish molding screws (304) and bolt (302).
7. Door trim panel.
   - Push the edge of the panel into the retainer.
8. Door trim panel to door screws (305).

WINDOW REPLACEMENT

If a glass is cracked but still intact, it should be crisscrossed with masking tape to reduce the risk of injury and/or damage to the vehicle. If a crack extends to the edge of the glass, mark the door with a piece of chalk at the point where the crack meets the weatherstrip. Later, when examining the flange of the opening for a cause of the crack, start at the point marked.

It is important that the cause of the crack be determined and the condition corrected, before the new glass is installed. The cause of the crack may be an obstruction or high spot somewhere around the flange of the opening; cracking may not occur until pressure from the high spot or obstruction becomes particularly high due to winds, extremes of temperature, or rough terrain.

STATIONARY GLASS

Remove or Disconnect (Figure 73)

CAUTION: Always wear heavy gloves when handling glass to minimize the risk of injury.

1. Weatherstrip seal by running a putty knife between the flange and the weatherstrip (inside and outside the door).
   - Have an assistant outside the cab by the window.
2. Weatherstrip and glass from the flange.
   - Force the weatherstrip from the flange from the inside with a putty knife
3. Window from the weatherstrip.

Install or Connect (Figure 73)

1. Weatherstrip to the glass.
   - The seam of the weatherstrip must be located at the bottom centerline of the glass.
2. A six mm ($^1/_4$-inch) cord in the weatherstrip groove. The ends should overlap about 5 cm (6-inches) at the window bottom.
3. Window and weatherstrip on the flange from outside the cab.
   - Brush soapy water on the flange.
   - Have an assistant pull the cord from inside the cab to seat the lip of the weatherstrip on the flange.

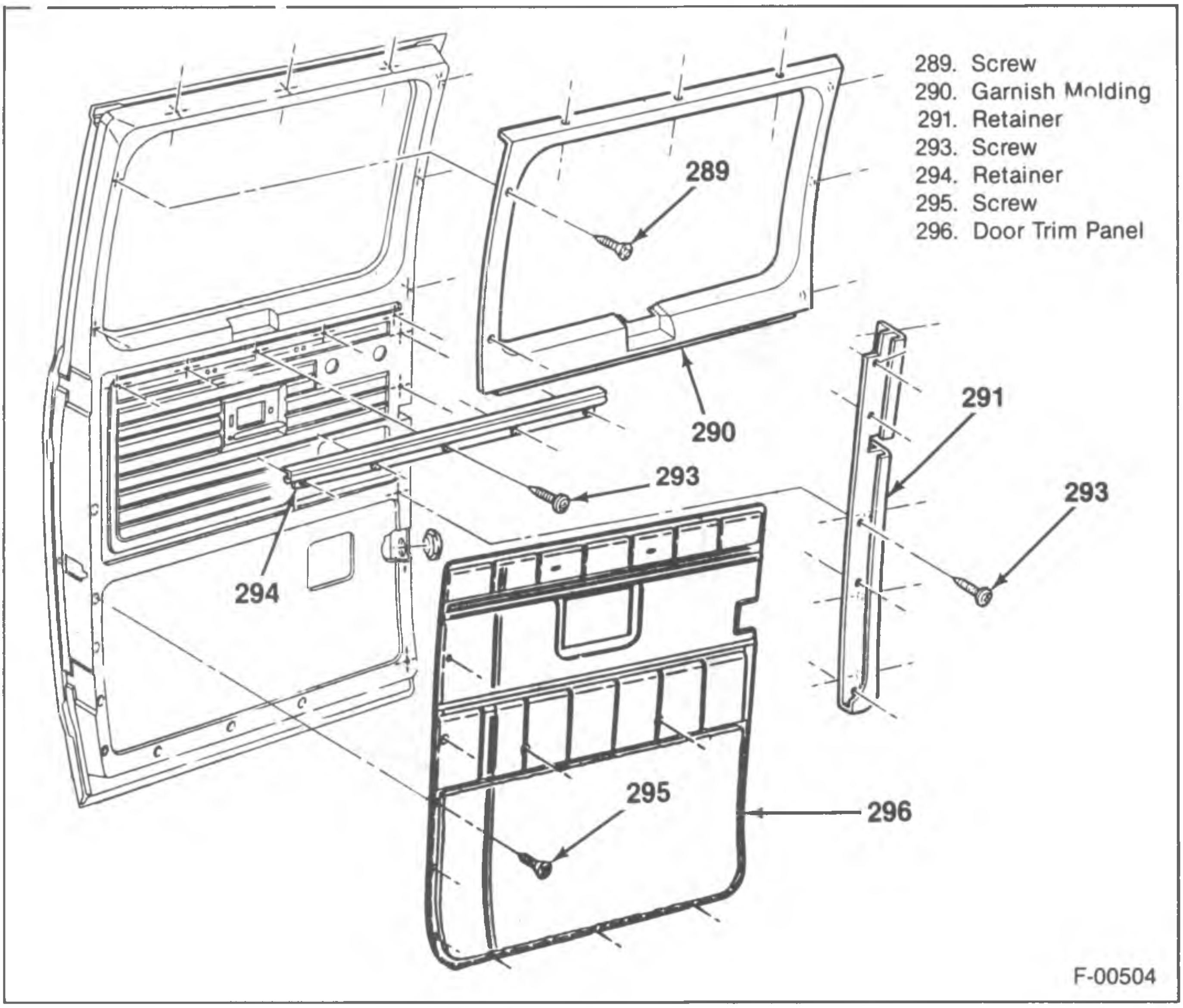


Figure 71—Intermediate Front Door Trim Panel

SWING OUT WINDOW

↔ Remove or Disconnect (Figures 74 and 75)

CAUTION: Always wear heavy gloves when handling glass to minimize the risk of injury.

1. Window latch to door screws (327).
2. Window latch from the window.
   - Twist the latch 1/4 of a turn to release the latch components from the window.
- Lift the window for access to the hinge screws.
3. Hinge to door screws (320).
4. Hinge from the door.
5. Hinge seal from the door.

→← Install or Connect (Figures 74 and 75)

1. Hinge and hinge seal to the door.
2. Hinge to door screws (320).
3. Window latch to the window.
   - Place the cover and spacer through the window.
   - Place the washer and spring onto the cover.
   - Twist the latch onto the cover with 1/4 of a turn.
4. Window latch to door screws (327).

INTERMEDIATE FRONT DOOR LOCK REPLACEMENT

↔ Remove or Disconnect (Figure 76)

1. Door trim panel. Refer to "Door Trim Panel Replacement."

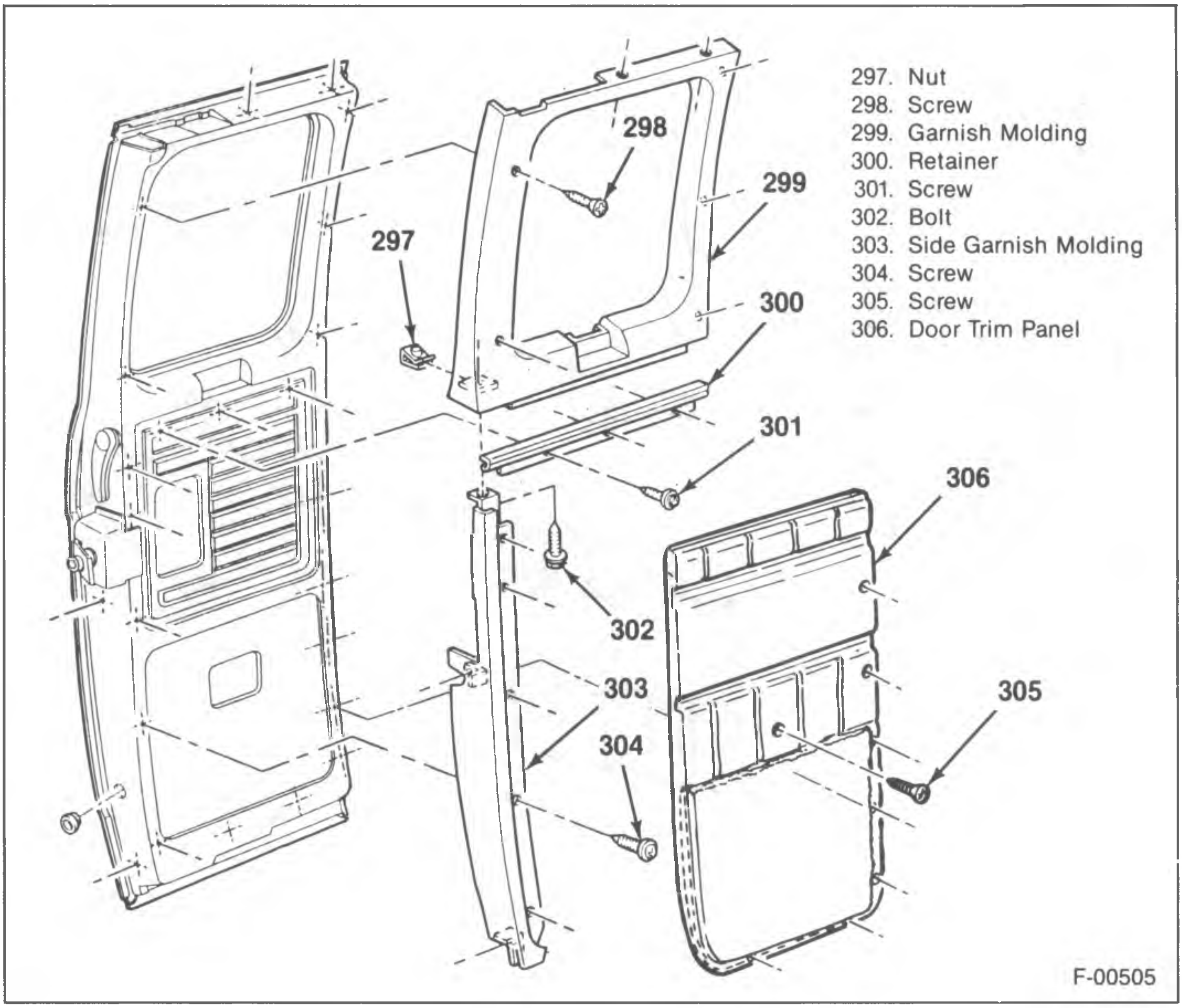


Figure 72—Intermediate Rear Door Trim Panel

2. Door lock control. Refer to "Door Lock Control Replacement."
3. Power door lock motor (if equipped). Refer to "Power Door Lock Motor Replacement."
4. Door to remote control screws (330).
5. Door to lock screws (331).
6. Lock and remote control with rods from the door.

→← Install or Connect (Figure 76)

1. Lock and remote control with rods to the door.
2. Door to lock screws (331).
3. Door to remote control screws (330).
4. Power door lock motor (if equipped). Refer to "Power Door Lock Motor Replacement."
5. Door lock control. Refer to "Door Lock Control Replacement."
6. Door trim panel. Refer to "Door Trim Panel Replacement."

INTERMEDIATE FRONT DOOR LOCK CONTROL REPLACEMENT

←→ Remove or Disconnect (Figure 77)

1. Door trim panel. Refer to "Door Trim Panel Replacement."
2. Lock control to door screw (337).
3. Lock control from the door.
   - Slide the control towards the front of the door.
4. Lock rod from the lock control.
   - Slide the clip so that the large diameter slot is in line with the lock rod. Then, pull the rod from the control.

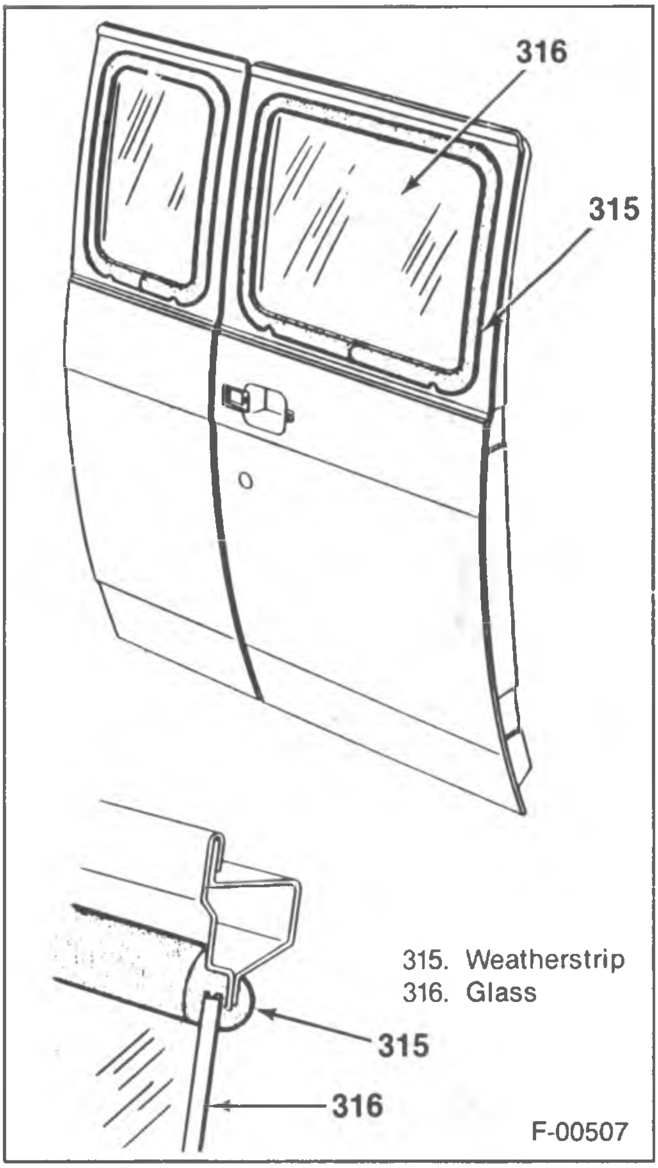


Figure 73—Window Components

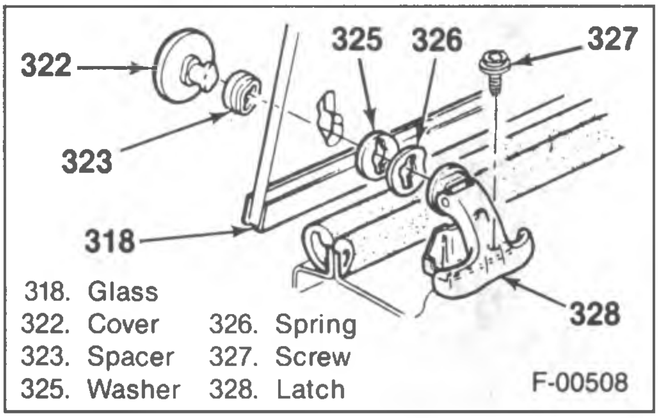


Figure 74—Swing Out Latch Components

Install or Connect (Figure 77)

1. Lock rod to the lock control.
   - Place the rod into the clip and the lever. Slide the clip so that the small diameter slot is in line with the lock rod.
2. Lock control to the door.
   - Slide the control towards the rear of the door.
3. Lock control to door screws (337).
4. Door trim panel. Refer to "Door Trim Panel Replacement."

DOOR LOCK CYLINDER REPLACEMENT

Remove or Disconnect (Figure 78)

1. Door trim panel. Refer to "Door Trim Panel Replacement."
2. Lock cylinder retaining clip from the cylinder.
   - Slide the clip off the cylinder with a screwdriver.
3. Lock cylinder and gasket from the door.

Install or Connect (Figure 78)

1. Lock cylinder with gasket to the door.
   - The cylinder rod must engage the lock assembly lever.
2. Lock cylinder retaining clip onto the cylinder.
3. Door trim panel. Refer to "Door Trim Panel Replacement."

DOOR OUTSIDE HANDLE REPLACEMENT

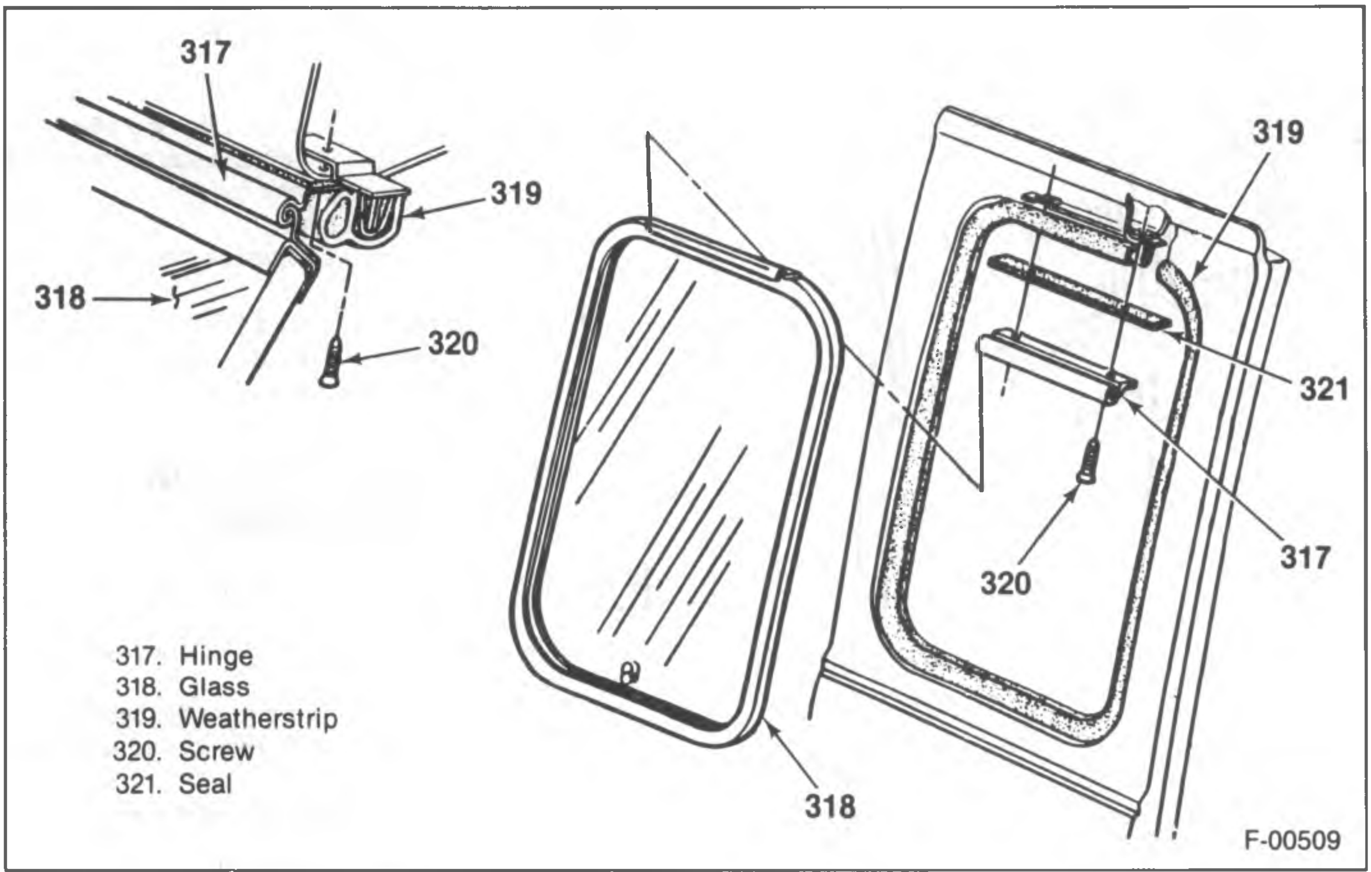
Remove or Disconnect (Figure 78)

- Raise the window completely.

1. Door trim panel. Refer to "Door Trim Panel Replacement."
2. Door to outside handle screws (341).
3. Handle from the door.
4. Gaskets from the door.

Install or Connect (Figure 78)

1. Large gasket onto the handle.
2. Door to outside handle screw (341) to the push button side of the handle.
   - Do not tighten.
3. Small gasket between the door and the handle.
4. Door to outside handle screw (341) to the other side of the handle.
   - Tighten both screws.



317. Hinge
318. Glass
319. Weatherstrip
320. Screw
321. Seal

Figure 75—Swing Out Window Attachment

329. Remote Control
330. Bolt
331. Bolt
332. Lock Assembly
333. Clip
334. Remote Control Rod
335. Inside Handle Rod
336. Inside Lock Rod

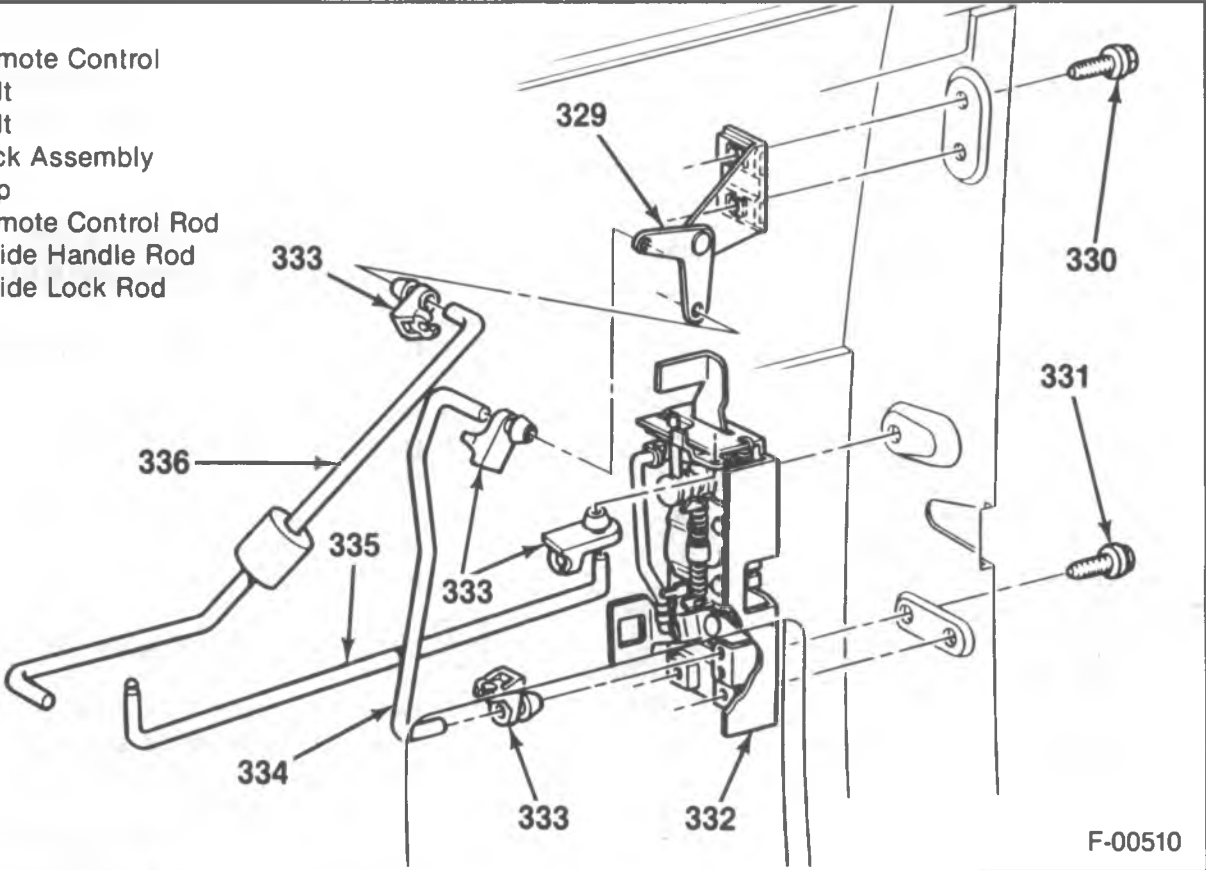


Figure 76—Intermediate Front Door Lock Components

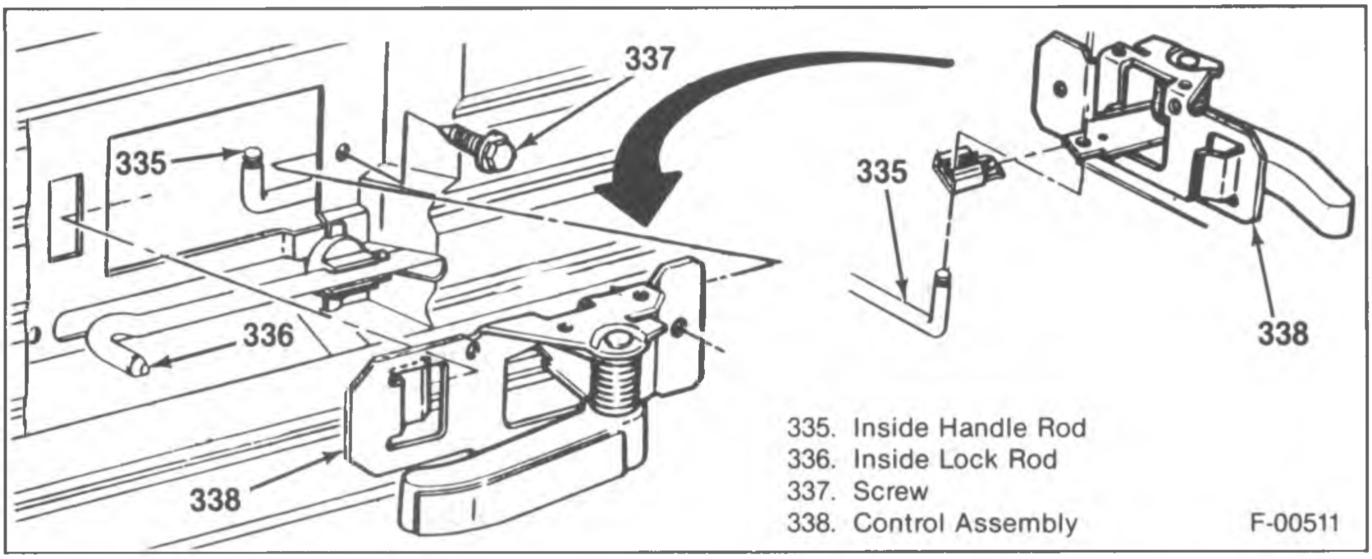


Figure 77—Intermediate Front Door Lock Control

5. Door trim panel. Refer to "Door Trim Panel."

INTERMEDIATE REAR DOOR LOWER LATCH REPLACEMENT

Remove or Disconnect (Figure 79)

1. Door trim panel. Refer to "Door Trim Panel Replacement."
2. Lower latch to control assembly rod from the control assembly.
   - Using a flat bladed screwdriver, push on the top of the clip where it is connected to the rod. Pivot the clip away from the rod.
3. Lower latch to door screws (349).
4. Lower latch with the rod from the door.

Install or Connect (Figure 79)

1. Lower latch with the rod to the door.
2. Lower latch to door screws (349).
3. Lower latch to control assembly rod into the control assembly.
   - Pivot the clip onto the rod.
4. Door trim panel. Refer to "Door Trim Panel Replacement."

INTERMEDIATE REAR DOOR UPPER LATCH REPLACEMENT

Remove or Disconnect (Figure 80)

1. Door trim panel. Refer to "Door Trim Panel Replacement."

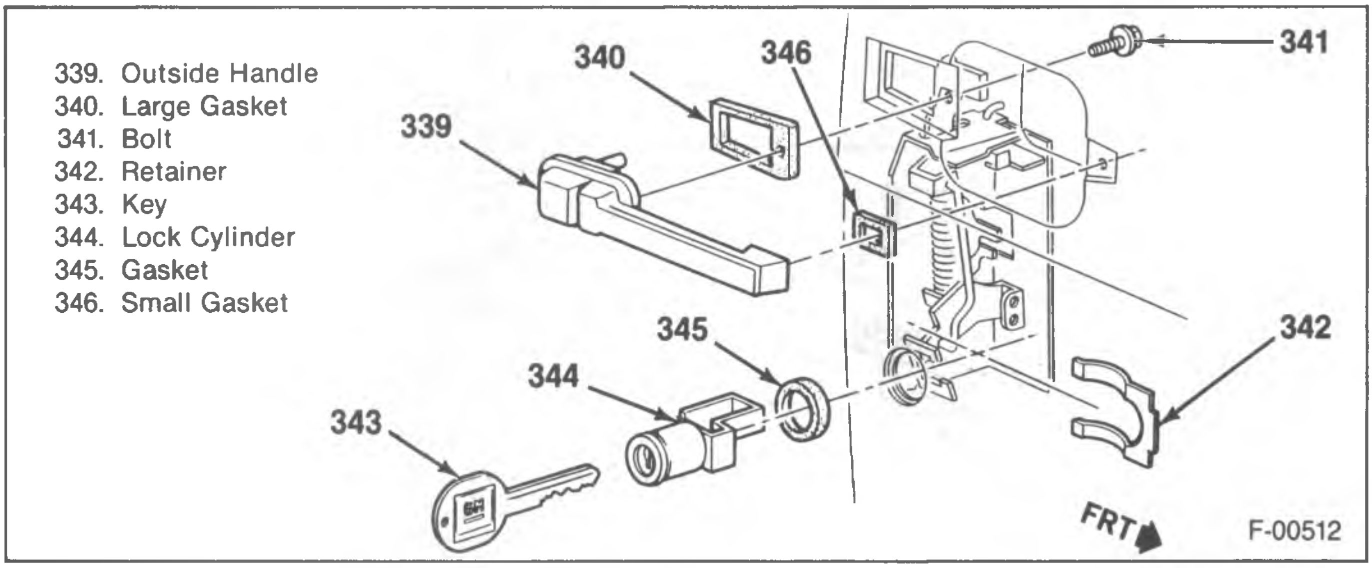


Figure 78—Outside Handle And Lock Cylinder Components

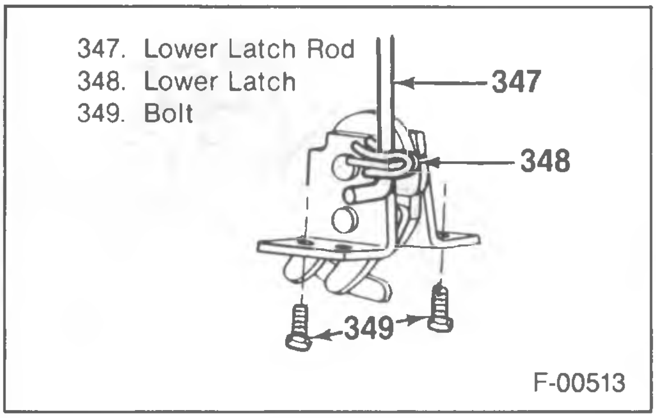


Figure 79—Intermediate Rear Door Lower Latch

2. Upper latch to control assembly rod from the control assembly.
   - Using a flat bladed screwdriver, push on the top of the clip where it is connected to the rod. Pivot the clip away from the rod.
3. Upper latch to door bolts (350).
4. Upper latch with the rod from the door.

Install or Connect (Figure 80)

1. Upper latch with the rod to the door.
2. Upper latch to door bolts (350).
3. Upper latch to control assembly rod into the control assembly.
   - Pivot the clip onto the rod.
4. Door trim panel. Refer to "Door Trim Panel Replacement."

INTERMEDIATE REAR DOOR CONTROL ASSEMBLY REPLACEMENT

Remove or Disconnect (Figure 81)

1. Door trim panel. Refer to "Door Trim Panel Replacement."
2. Upper and lower door latch rods from the control assembly.
   - Using a flat bladed screwdriver, push on the top of the clip where it is connected to the rod. Pivot the clip away from the rod.
3. Electric door actuator (if equipped).
4. Lock knob (356).
5. Rear door inside handle screw (364) and handle (365).
6. Rear door lock rod clip at the door panel.
   - Pivot the clip away from the rod.
7. Door to control assembly bolts (363).
8. Control assembly with lock rod through the access hole.

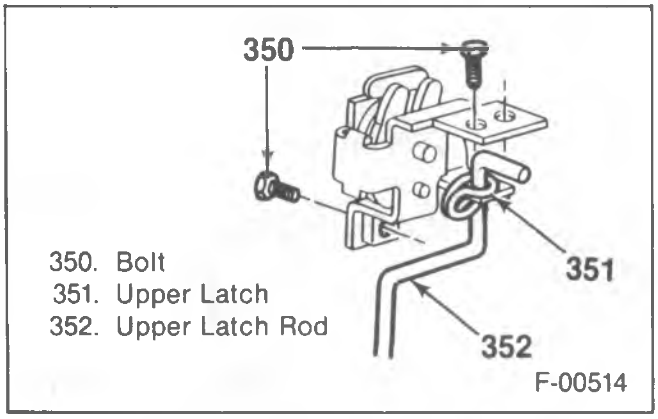


Figure 80—Intermediate Rear Door Upper Latch

Install or Connect (Figure 81)

1. Control assembly with lock rod through the access hole.
2. Door to control assembly bolts (363).
3. Rear door lock rod clip at the door panel.
   - Pivot the clip onto the rod.
4. Rear door inside handle (365) and screw (364).
5. Lock knob (356).
6. Electric door actuator (if equipped).
7. Upper and lower door latch rods to the control assembly.
   - Pivot the clip onto the rod.
8. Door trim panel. Refer to "Door Trim Panel Replacement."

POWER DOOR LOCK MOTOR REPLACEMENT

Refer to CAB ELECTRICAL (SEC. 8A) for electrical diagnosis of the door lock motor.

Remove or Disconnect (Figure 82)

1. Battery ground cable.
2. Door trim panel. Refer to "Door Trim Panel Replacement."
3. Electrical connector from the motor.
4. Door to motor screws (370).
5. Motor from the lock rod.
   - Slide the rubber mount at the top of the motor off of the door lock rod.
6. Motor from the door.

Install or Connect (Figure 82)

1. Motor into the door.
2. Motor to the lock rod.
   - Slide the rubber mount at the top of the motor onto the door lock rod.
3. Door to motor screws (370).
4. Electrical connector to the motor.

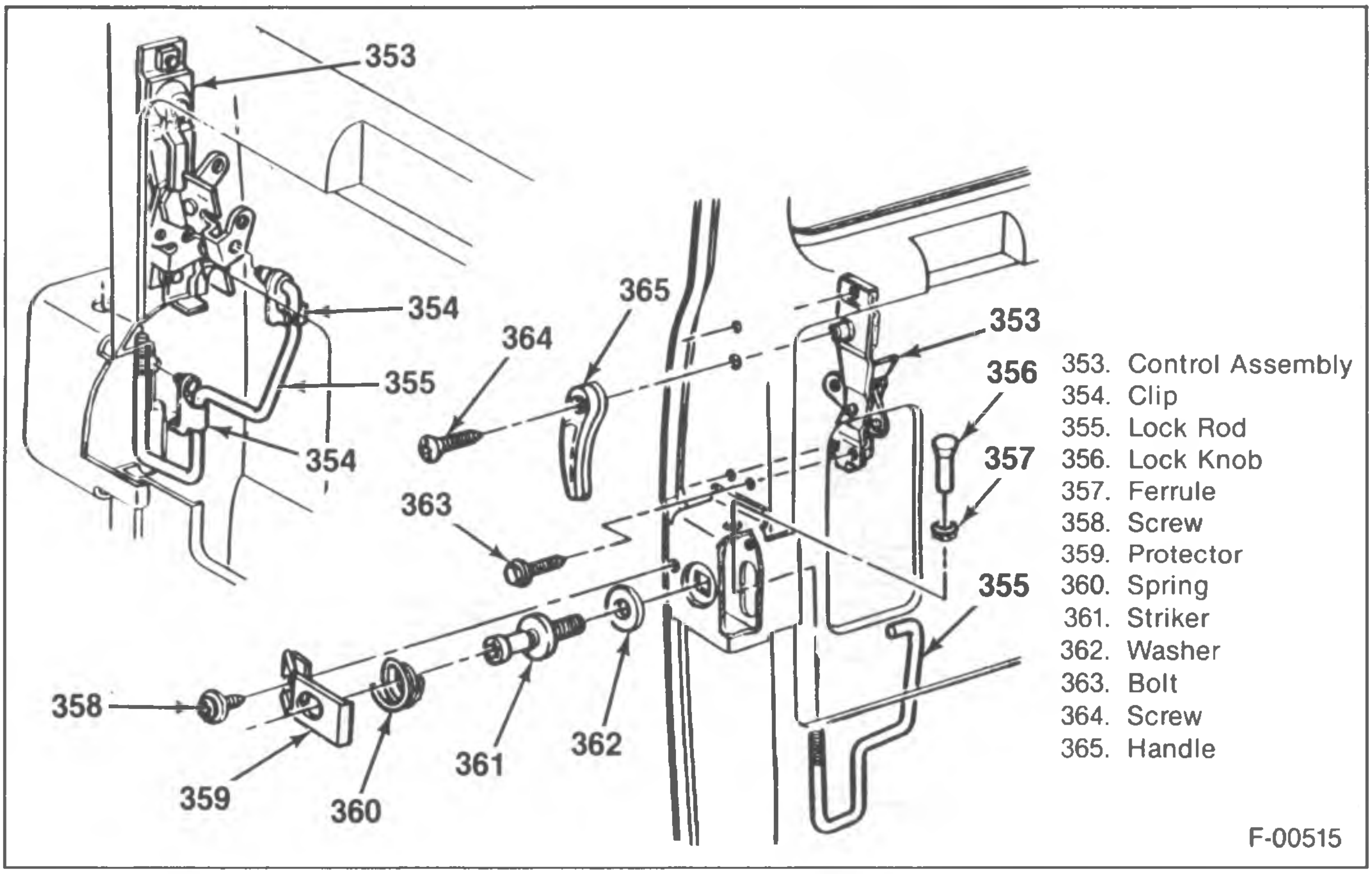


Figure 81—Intermediate Rear Door Control Assembly

5. Door trim panel. Refer to "Door Trim Panel Replacement."
6. Battery ground cable.

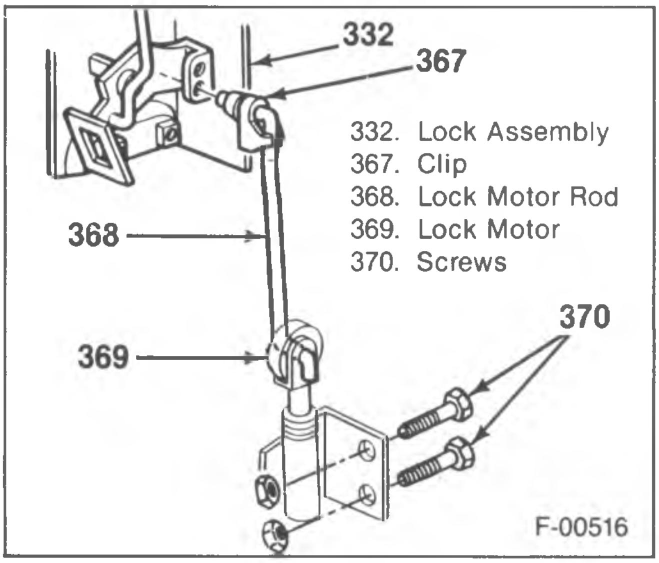


Figure 82—Power Door Lock Motor Attachments

INTERMEDIATE FRONT DOOR WEATHERSTRIP REPLACEMENT

Remove or Disconnect (Figure 83)

1. Weatherstrip from the door using 3M Release Agent (or equivalent).
2. Plastic nails from the door.

Clean

- The door of all the old cement.

Install or Connect (Figure 83)

1. Weatherstrip adhesive to the door. Use 3M Weatherstrip Adhesive (or equivalent).
2. New weatherstrip to the door.
   - Press the plastic nails into the door.

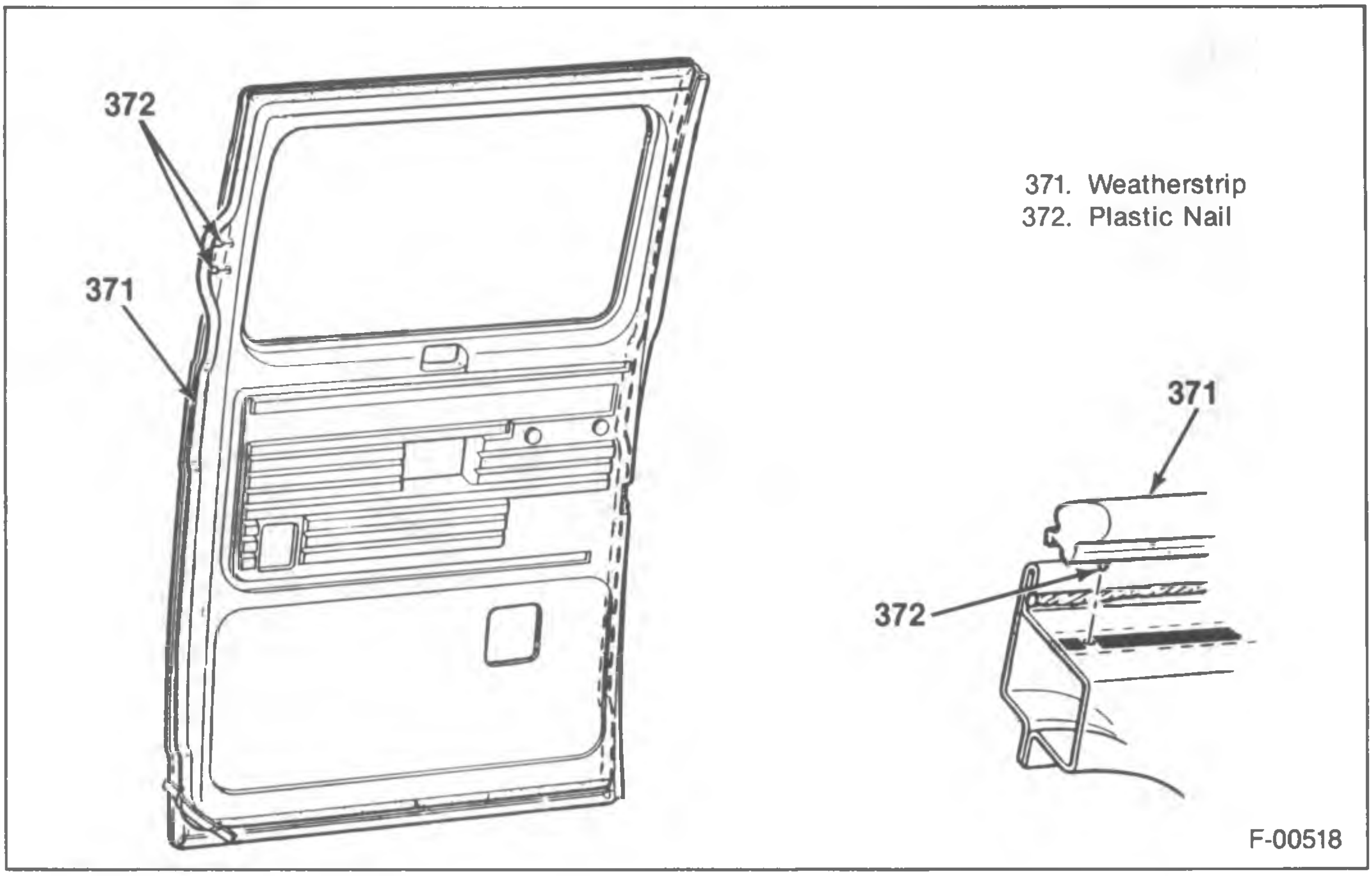


Figure 83—Intermediate Front Door Weatherstrip

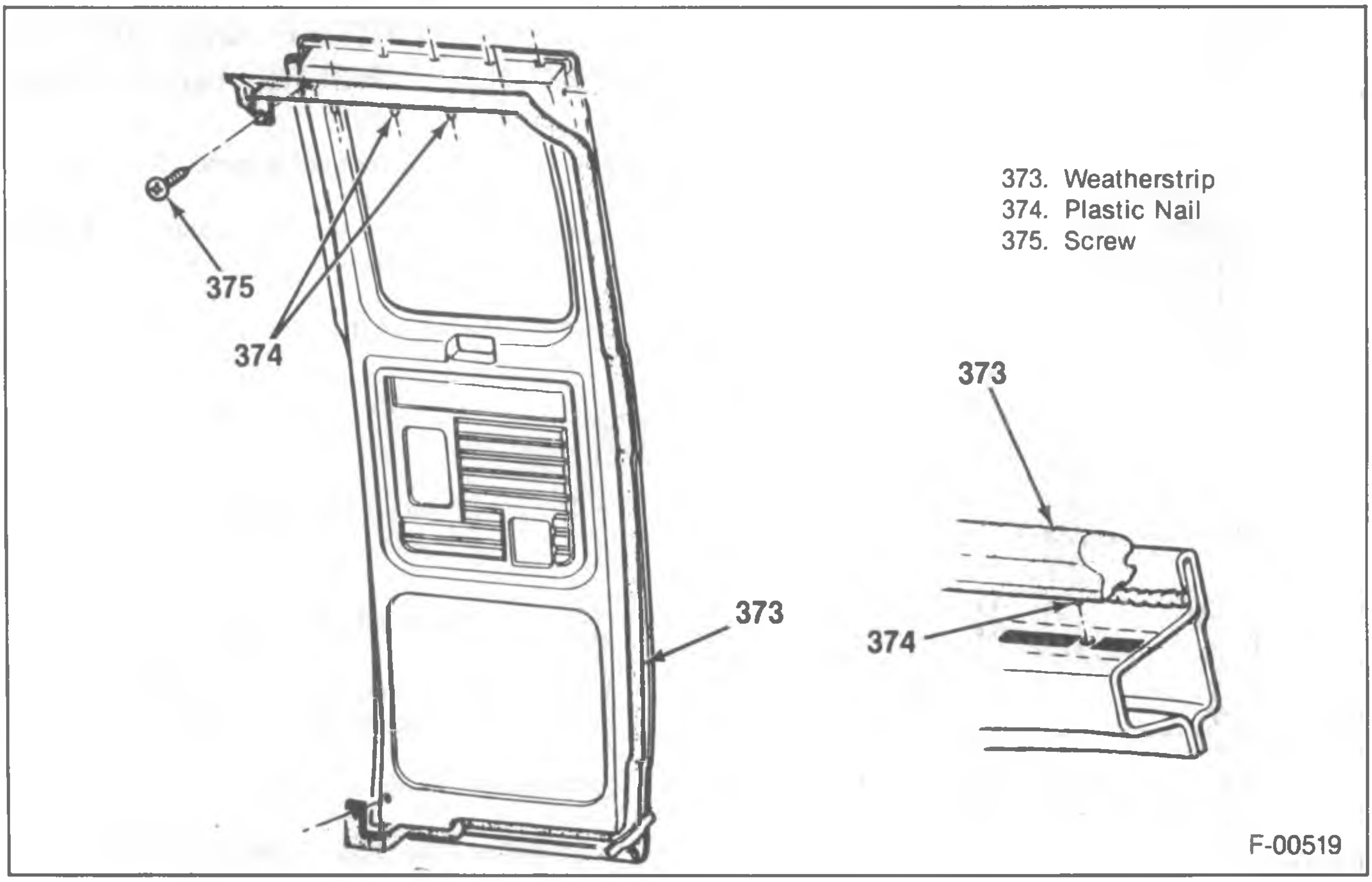


Figure 84—Intermediate Rear Door Weatherstrip

INTERMEDIATE REAR DOOR WEATHERSTRIP REPLACEMENT

Remove or Disconnect (Figure 84)

1. Weatherstrip to door panel screws (375).
2. Weatherstrip from the door using 3M Release Agent (or equivalent).
3. Plastic nails from the door.

Clean

- The door of all the old cement.

Install or Connect (Figure 84)

1. Weatherstrip adhesive to the door. Use 3M Weatherstrip adhesive (or equivalent).
2. New weatherstrip to the door.
    - Press the plastic nails into the door.
3. Weatherstrip to door panel screws (375).

G MODEL SLIDING SIDE DOOR

DOOR REPLACEMENT

Remove or Disconnect (Figures 85 through 89)

1. Upper rear track cover and hinge cover.

- Open the door completely.

2. Upper front roller assembly (381) from the door.
    - Mark the position of the roller assembly on the door.
3. Upper rear hinge retainer (393) from the hinge.
4. Upper rear hinge (394) from the upper rear track.
    - Lift the hinge off of the track.
5. Lower front roller (398) from the track.
    - Pivot the door away from the vehicle to disengage the rollers.
6. Door from the vehicle.

Install or connect (Figures 85 through 89)

1. Door to the vehicle.
2. Lower front roller (398) to the track.
    - Pivot the door away from the vehicle to engage the rollers to the track. Then pivot the door towards the vehicle.
3. Upper rear hinge (394) to the upper rear track.
    - Lift the hinge roller onto the track.
4. Upper rear hinge retainer (393) to the hinge.
5. Upper front roller assembly (381) to the door.
    - Align the roller assembly to the previously made mark.
6. Upper rear track cover and hinge cover.

HINGE ASSEMBLY REPLACEMENT

Remove or Disconnect (Figure 88)

- Close the door completely.

1. Hinge cover (figure 85).
2. Track cover (figure 86).
3. Hinge retainer plate (393).

- Mark the position of the hinge on the door.

4. Nut (390), washer (389), and retainer (380).
5. Hinge to door screw (391).
6. Hinge to door bolt (388).
7. Hinge from the vehicle.

Install or Connect (Figure 88)

1. Hinge to the vehicle.
    - Place the roller on the track.

- Align the hinge to the previously made mark.

2. Hinge to door bolt (388).
3. Hinge to door screw (391).
4. Retainer (380), washer (389) and nut (390).
5. Hinge retainer plate (393).
6. Track cover (figure 86).
7. Hinge cover (figure 85).

LOWER ROLLER ASSEMBLY REPLACEMENT

Remove or Disconnect (Figure 89)

- Mark the position of the assembly to the bracket on the roller assembly.

1. Roller assembly to door bracket bolts (401).
2. Catch clip (400) and rod from the catch.
3. Pivot the roller assembly out of the lower door track.

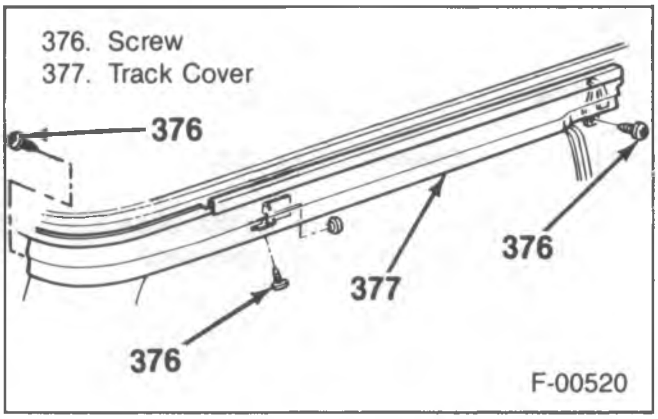


Figure 85—Upper Track Cover

Install or Connect (Figure 89)

1. Pivot the roller assembly into the lower door track.
2. Roller assembly to door bracket bolts (401).
   - Align the roller assembly to the previously made mark.
3. Catch clip (400) and rod to the catch.

UPPER FRONT ROLLER REPLACEMENT

Remove or Disconnect (Figure 87)

1. Roller molding (if equipped).
2. Plastic cap (if equipped).
3. Bracket to door bolts (386).
4. Roller from the track.

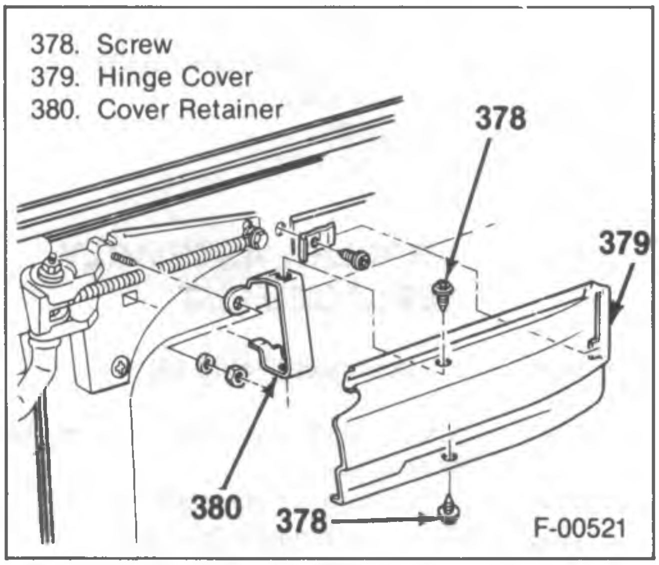


Figure 86—Upper Hinge Cover

Install or Connect (Figure 87)

1. Roller into the track.
2. Bracket to door bolts (386).
3. Plastic cap (if equipped).
4. Roller molding (if equipped).

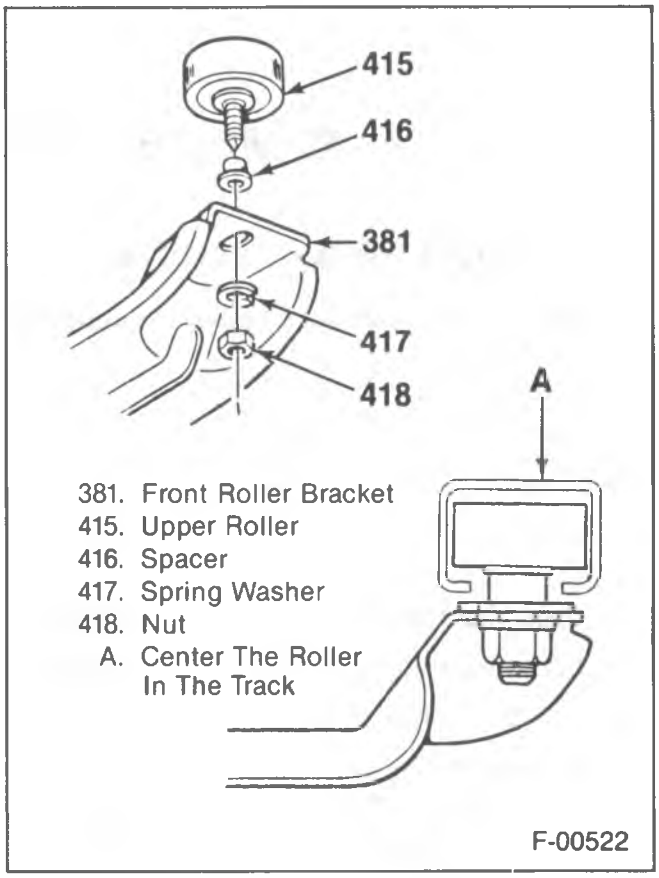
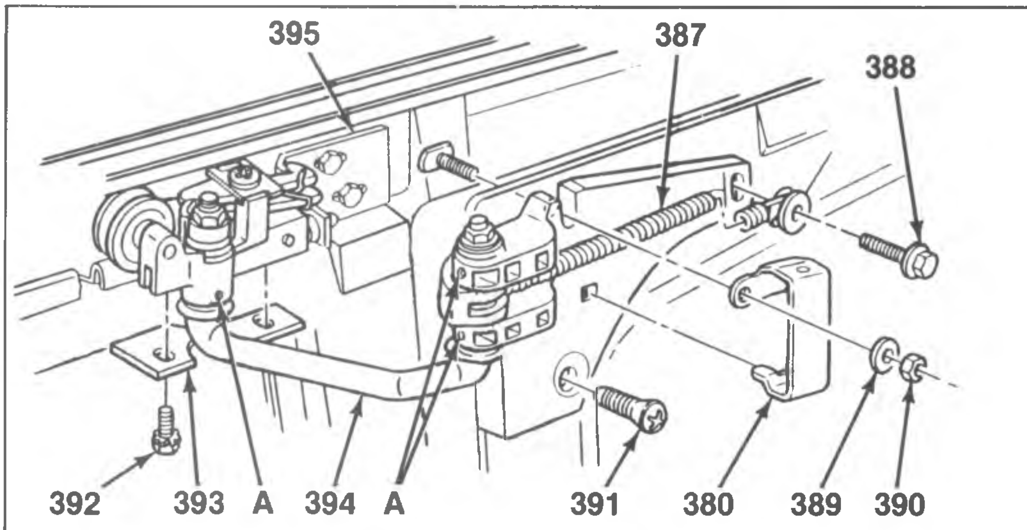


Figure 87—Upper Front Roller Components



380. Cover Retainer
387. Spring
388. Bolt
389. Washer
390. Nut
391. Screw
392. Bolt
393. Retainer
394. Hinge Assembly
395. Striker
A. Lubrication Points

F-00523

Figure 88—Upper Rear Hinge Components

DOOR ADJUSTMENT

UP AND DOWN ADJUSTMENT

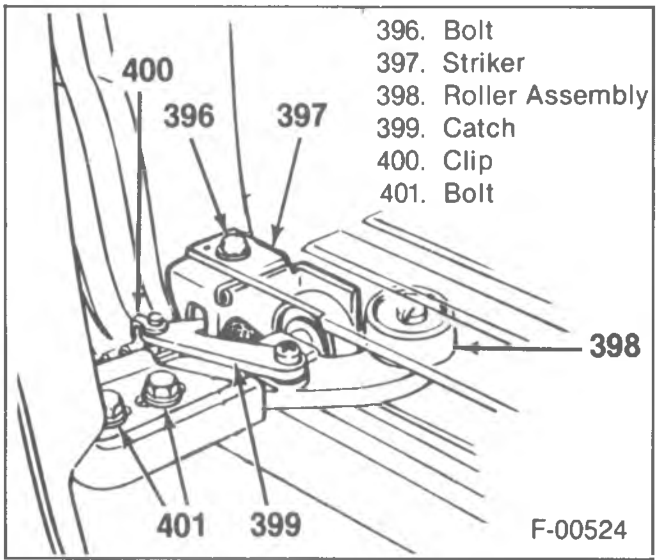
↔ Remove or Disconnect (Figure 90)

Tool Required:
J-23457 #50 Torx Wrench.

1. Upper rear hinge cover.
2. Front lock striker (404).
3. Rear lock striker (405) using J-23457.
4. Rear door wedge assembly (407).

Adjust (Figure 91)

1. The rear edge of the door to obtain a gap of 4.5 mm ± 0.5 mm (0.18-inch ± 0.02-inch) between the top of the door and the roof side rail. This adjustment should provide a gap of 6 mm ± 0.5 mm (0.25-inch ± 0.02-inch) between the bottom of the door and the rocker panel. To accomplish this adjustment, loosen the upper rear hinge to door bolts (figure 88), and align the rear edge ofthe door up or down. Next, tighten the upper rear hinge to door bolts (figure 88).
2. The front edge of the door by loosening the upper front roller bracket to door bolts (figure 87) and the lower hinge to door bolts (figure 89). Align the door to obtain the same gap as in step 1, then tighten the lower hinge to door bolts (figure 89).
3. The upper front roller bracket up or down so that the roller is centered in the track. The roller must not touch the top or bottom of the track. Tighten the upper front roller bracket to door bolts (figure 92).



396. Bolt
397. Striker
398. Roller Assembly
399. Catch
400. Clip
401. Bolt

F-00524

Figure 89—Lower Front Roller Assembly

→← Install or Connect (Figure 90)

1. Rear door wedge assembly (407).
2. Rear lock striker (405) using J-23457.
3. Front lock striker (404).
4. Upper rear hinge cover.

IN AND OUT ADJUSTMENT (Figures 90 through 92)

1. Remove the front lock striker (404).
2. Loosen the nut (418) retaining the upper front roller (415) to the upper roller bracket (381).
3. Loosen the lower front roller assembly to roller assembly bracket bolts (figure 89).
4. Loosen the rear door lock striker.
5. Adjust the door in or out until the surface of the door is flush with the surface of the body.
6. Tighten the rear door lock striker.
7. Tighten the lower front roller assembly to roller assembly bracket bolts (figure 89).
8. Tighten the nut (418) retaining the upper front roller (415) to the upper roller bracket (381).
9. Install the front lock striker.

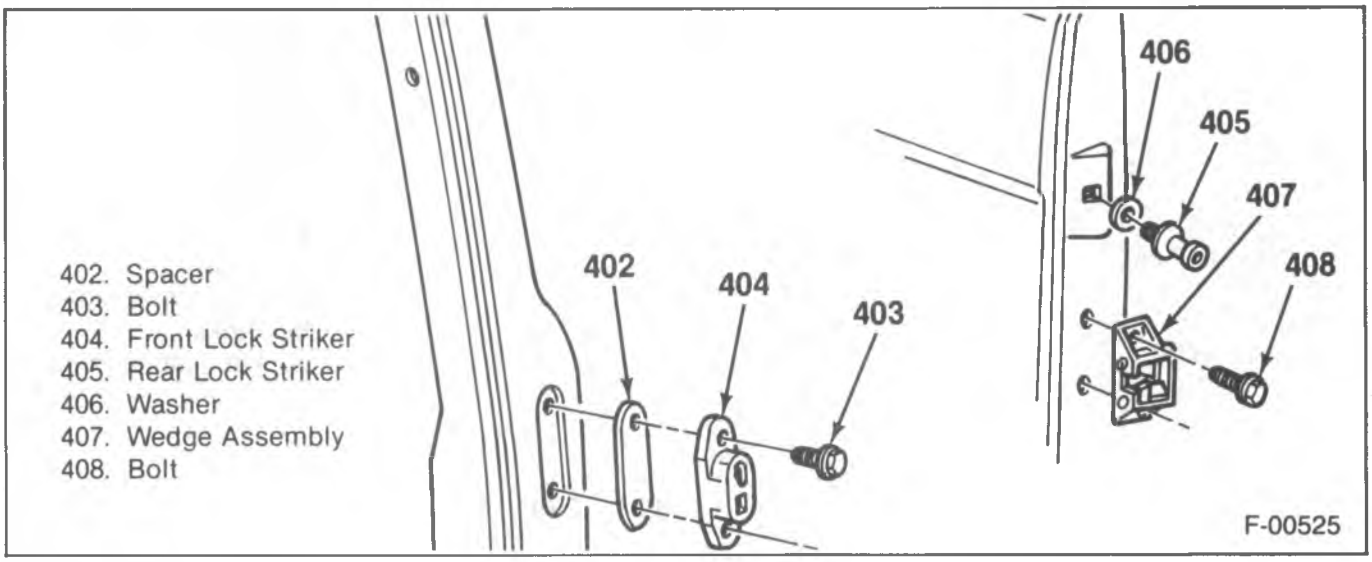


Figure 90—Front And Rear Lock Striker

FORWARD AND REARWARD ADJUSTMENT

1. Mark the position of the front and rear latch strikers on the body pillars.
2. Remove the front (404) and rear (405) lock strikers (figure 90).
3. Remove the upper front track over.
4. Loosen the upper rear hinge striker (figure 88).
5. Adjust the door forward or rearward to obtain a gap of 4.5 mm ± 0.5 mm (0.18-inch ± 0.02-inch) between the left and right door edge and the door pillars (figure 91).
6. Tighten the upper rear hinge striker (figure 88).
7. Install the upper front track cover.
8. Install the front (404) and rear (405) lock strikers at the position previously marked (figure 90).

FRONT STRIKER ADJUSTMENT (Figure 90)

1. Loosen the front latch striker bolts (403).
2. Slide the door towards the striker.
3. The guide on the door must fit snugly into the rubber lined opening in the striker assembly.
4. Check that the latch fully engages the striker. Add or delete shims behind the striker to accomplish this adjustment.
5. Tighten the striker bolts (403).

REAR STRIKER ADJUSTMENT (Figure 90)

Tool Required:

J-23457 Wrench.

1. Loosen the striker using J-23457.
2. Loosen the rear wedge assembly.
3. Center the striker vertically so that the striker properly engages the door lock. Mark the vertical position of the striker.
4. Adjust the striker in or out to align the surface of the door flush with the body surface. Mark the position of the striker.
5. Tighten the striker using J-23457.
6. Open the door, and apply grease to the striker.
7. Close the door to make an impression of the lock on the striker.
8. Open the door and measure the distance from the rear of the striker head to the impression. The distance should be between 5 mm and 8 mm (0.20-inch and 0.30-inch).
9. Adjust the striker by adding or deleting shims. Align the striker to the previously made marks.
10. Tighten the striker using J-23457.

UPPER REAR HINGE ADJUSTMENT (Figure 93)

1. The lower hinge lever (419) should have a gap of 2.5 mm to 4 mm (0.10-inch to 0.16-inch) between the outer edge of the lower lever and the striker latch edge. This adjustment is made by adding an equal amount of shims between the guide block (420) and the hinge assembly, and between the roller and the hinge assembly.
2. Adjust the striker up or down to obtain a gap of 1.5 mm (0.06-inch) between the lower edge of the striker plate (395) and the lower edge of the lower hinge lever (419).
3. Adjust the guide up or down to obtain a gap of 0.5 mm (0.02-inch) between the track and the guide.

DOOR HOLD OPEN CATCH ADJUSTMENT (Figure 89)

1. Mark the position of the lower roller assembly to the bracket.
2. Loosen the lower roller assembly bolts (401).
3. Pivot the lower roller assembly to properly engage the latch striker.
4. Tighten the lower roller assembly bolts (401).

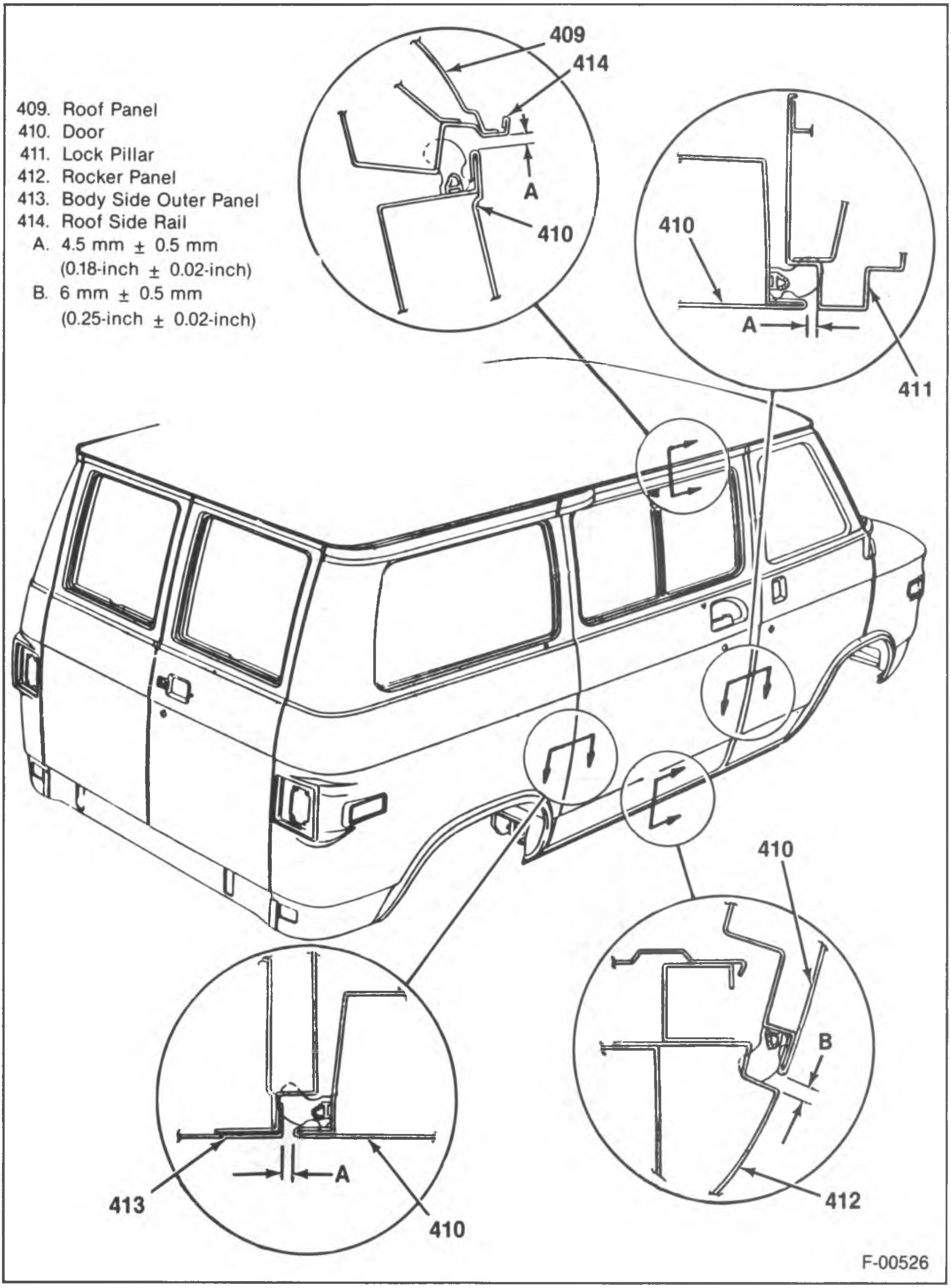


Figure 91—Door Adjustments

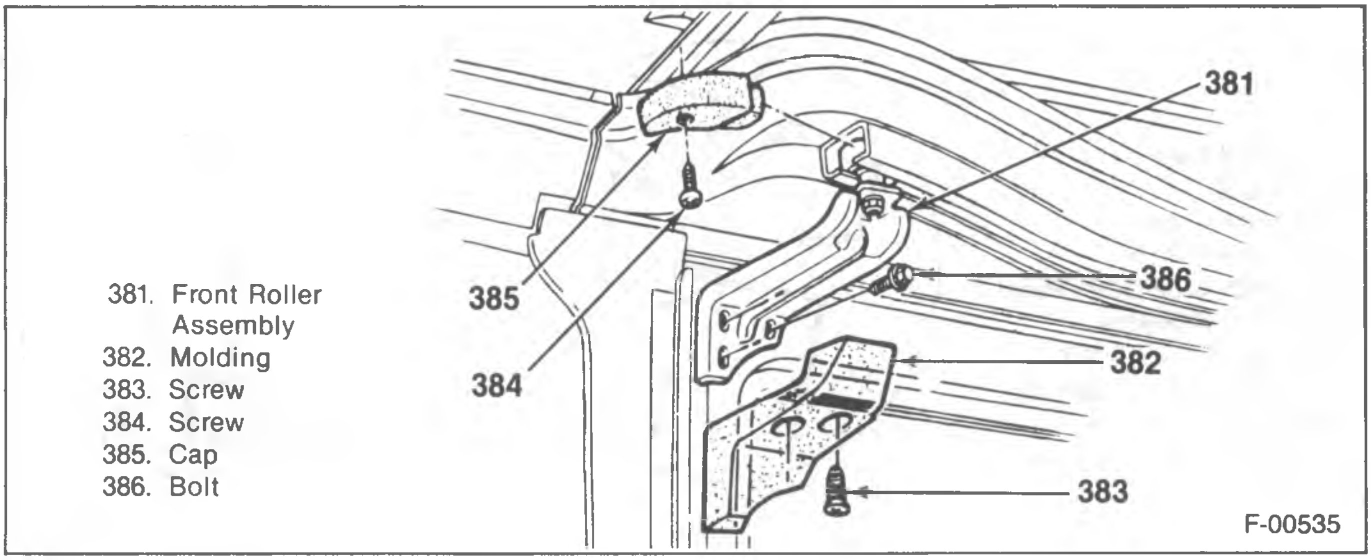


Figure 92—Upper Front Roller Adjustment

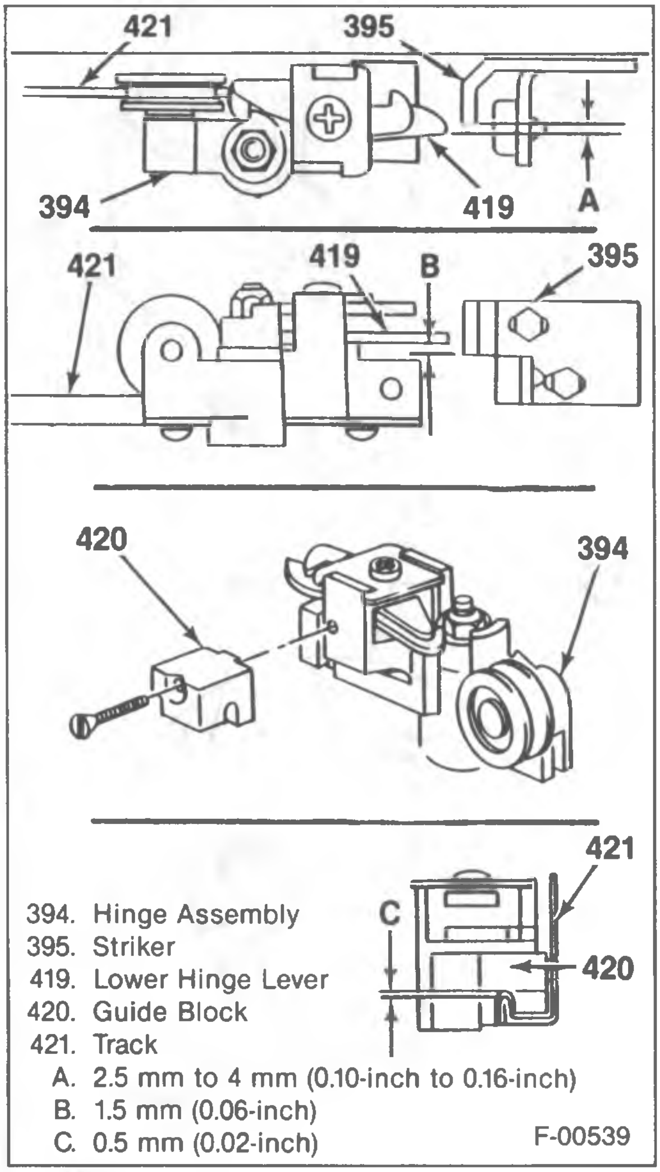


Figure 93—Upper Rear Hinge Adjustments

REAR WEDGE ASSEMBLY ADJUSTMENT (Figure 94)

1. Loosen the rear wedge assembly screws (408).
2. Completely close the door.
3. From inside the vehicle, center the wedge assembly (407) onto the door wedge.
4. Mark the position of the wedge assembly.
5. Open the door, and move the wedge assembly forward 4.7 mm (3/16-inch).
6. Tighten the rear wedge assembly screws (408).

DOOR TRIM PANEL REPLACEMENT

↔ Remove or Disconnect (Figure 95)

1. Inside door handle screw (429).
2. Inside door handle (422).
3. Inside door handle cover (430).
4. Lock knob (428).
   - Pull the knob from the door.

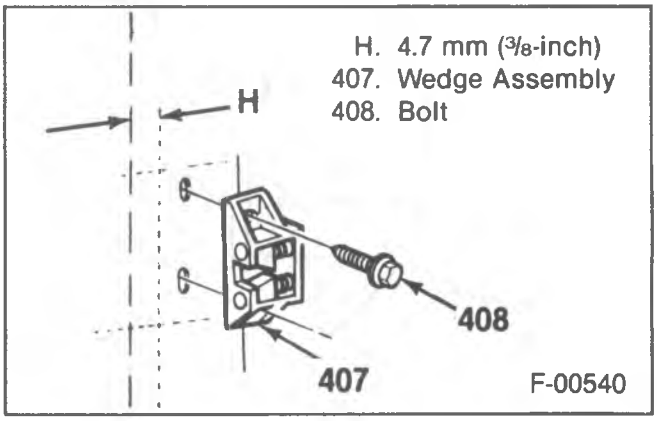


Figure 94—Rear Wedge Adjustment

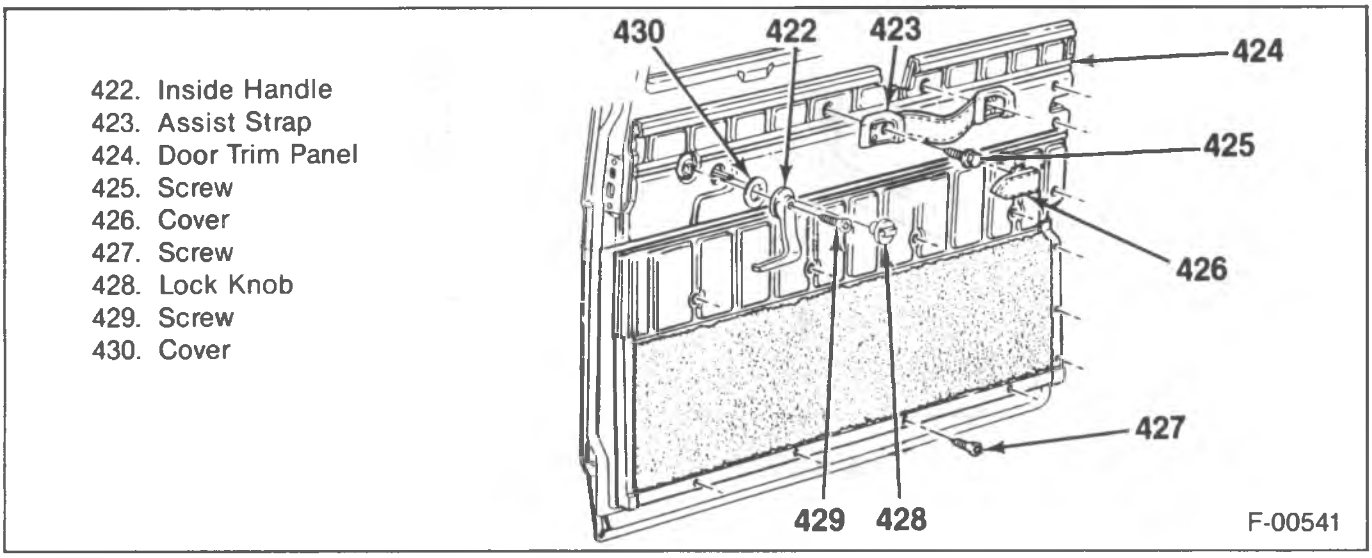


Figure 95—Door Trim Panel Components

5. Door assist strap screws (425), and assist strap (423).
6. Trim panel to door screws (427).
7. Trim panel from the door.

Install or Connect (Figure 95)

1. Trim panel to the door.
2. Trim panel to door screws (427).
3. Door assist strap (423) and assist strap screws (425).
4. Lock knob (428).
5. Inside door handle cover (430).
6. Inside door handle (422).
7. Inside door handle screw (429).

WINDOW REPLACEMENT

If a glass is cracked but still intact, it should be crisscrossed with masking tape to reduce the risk of injury and/or damage to the vehicle. If a crack extends to the edge of the glass, mark the door with a piece of chalk at the point where the crack meets the weatherstrip. Later, when examining the flange of the opening for a cause of the crack, start at the point marked.

It is important that the cause ofthe crack be determined and the condition corrected, before the new glass is installed. The cause of the crack may be an obstruction or high spot somewhere around the flange of the opening; cracking may not occur until pressure from the high spot or obstruction becomes particularly high due to winds, extremes of temperature, or rough terrain.

STATIONARY GLASS

Remove or Disconnect (Figure 96)

CAUTION: Always wear heavy gloves when handling glass to minimize the risk of injury.

1. Weatherstrip seal by running a putty knife between the flange and the weatherstrip (inside and outside the door).
   - Have an assistant outside the cab by the window.
2. Weatherstrip and glass from the flange.
   - Force the weatherstrip from the flange from the inside with a putty knife.
3. Window from the weatherstrip.

Install or Connect

1. Weatherstrip to the glass.
   - The seam of the weatherstrip must be located at the bottom of the glass.
2. Asix mm ($^1/_4$-inch) cord in the weatherstrip groove. The ends should overlap about 5 cm (6-inches) at the window bottom.
3. Window and weatherstrip on the flange from outside the cab.
   - Brush soapy water on the flange.
   - Have an assistant pull the cord from inside the cab to seat the lip of the weatherstrip on the flange.

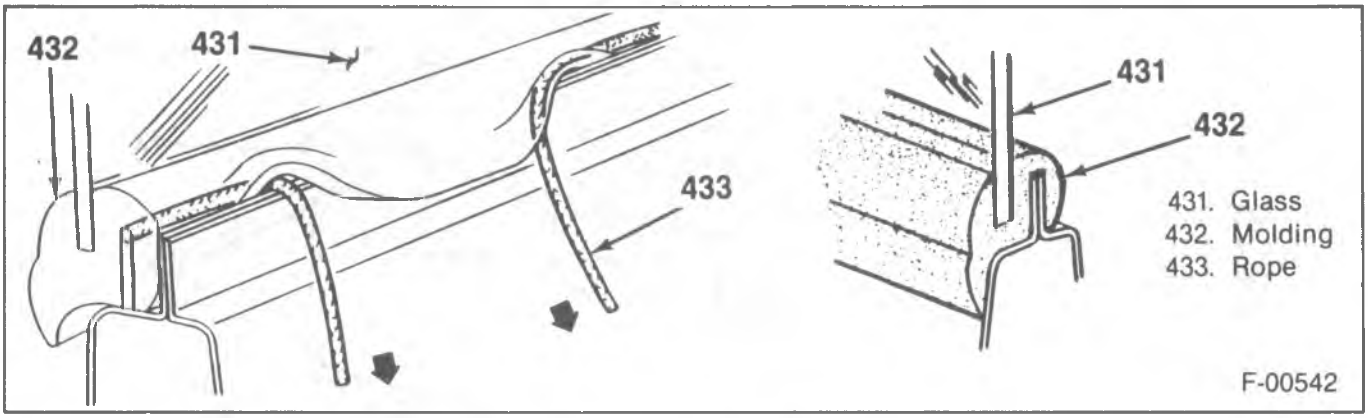


Figure 96—Window Components

SWING OUT WINDOW

Remove or Disconnect (Figure 97)

CAUTION: Always wear heavy gloves when handling glass to minimize the risk of injury.

1. Window latch to door screws (441).
2. Window latch from the window.
    - Twist the latch 1/4 of a turn to release the latch components from the window.
- Lift the window for access to the hinge screws.

3. Hinge to door screws (435).
4. Hinge from the door.
5. Hinge seal from the door.

Install or Connect (Figure 97)

1. Hinge and hinge seal to the door.
2. Hinge to the door screws (435).
3. Window latch to the window.
    - Place the cover and spacer through the window.
    - Place the washer and spring onto the cover.

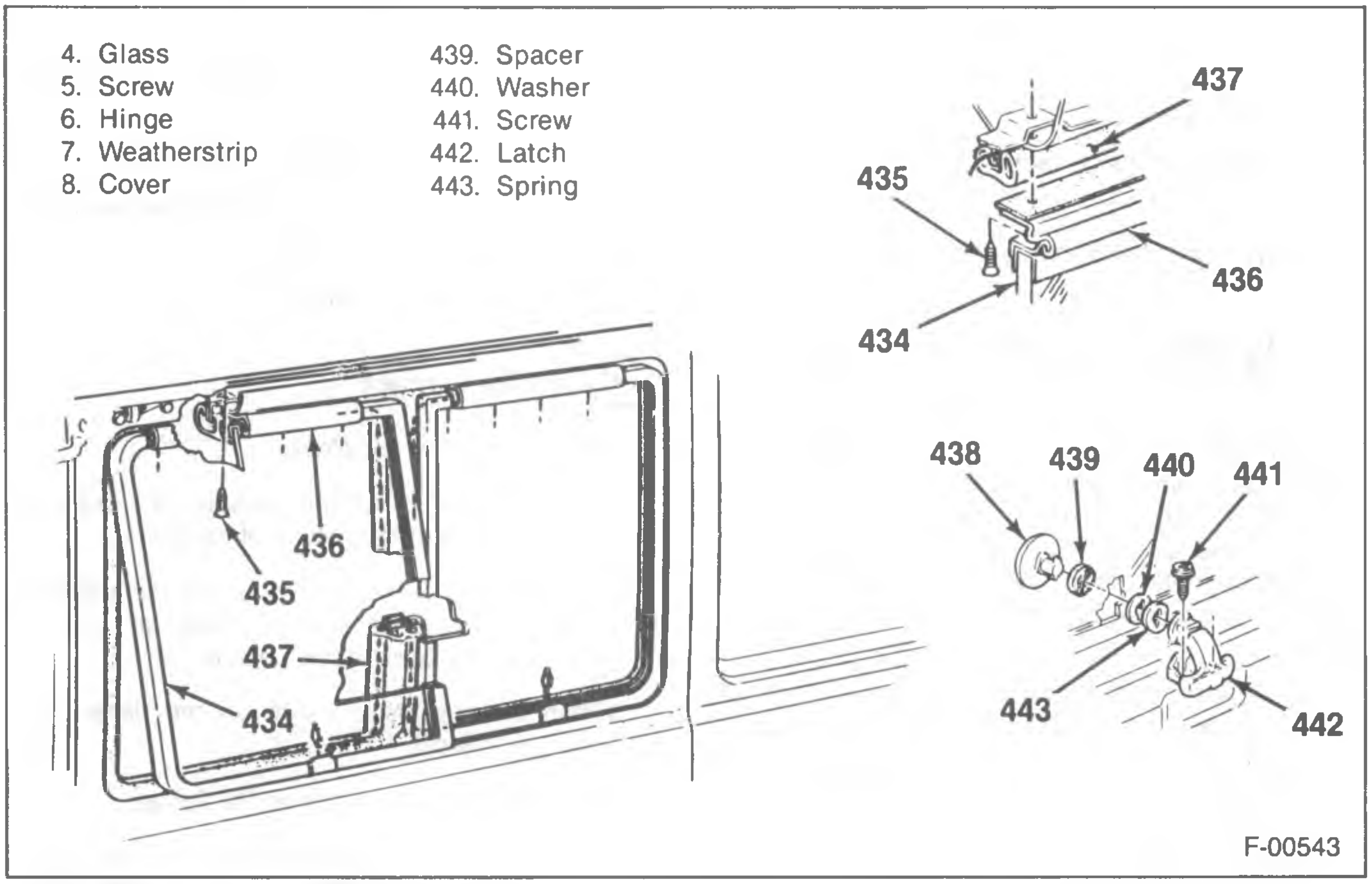


Figure 97—Swing Out Window Components

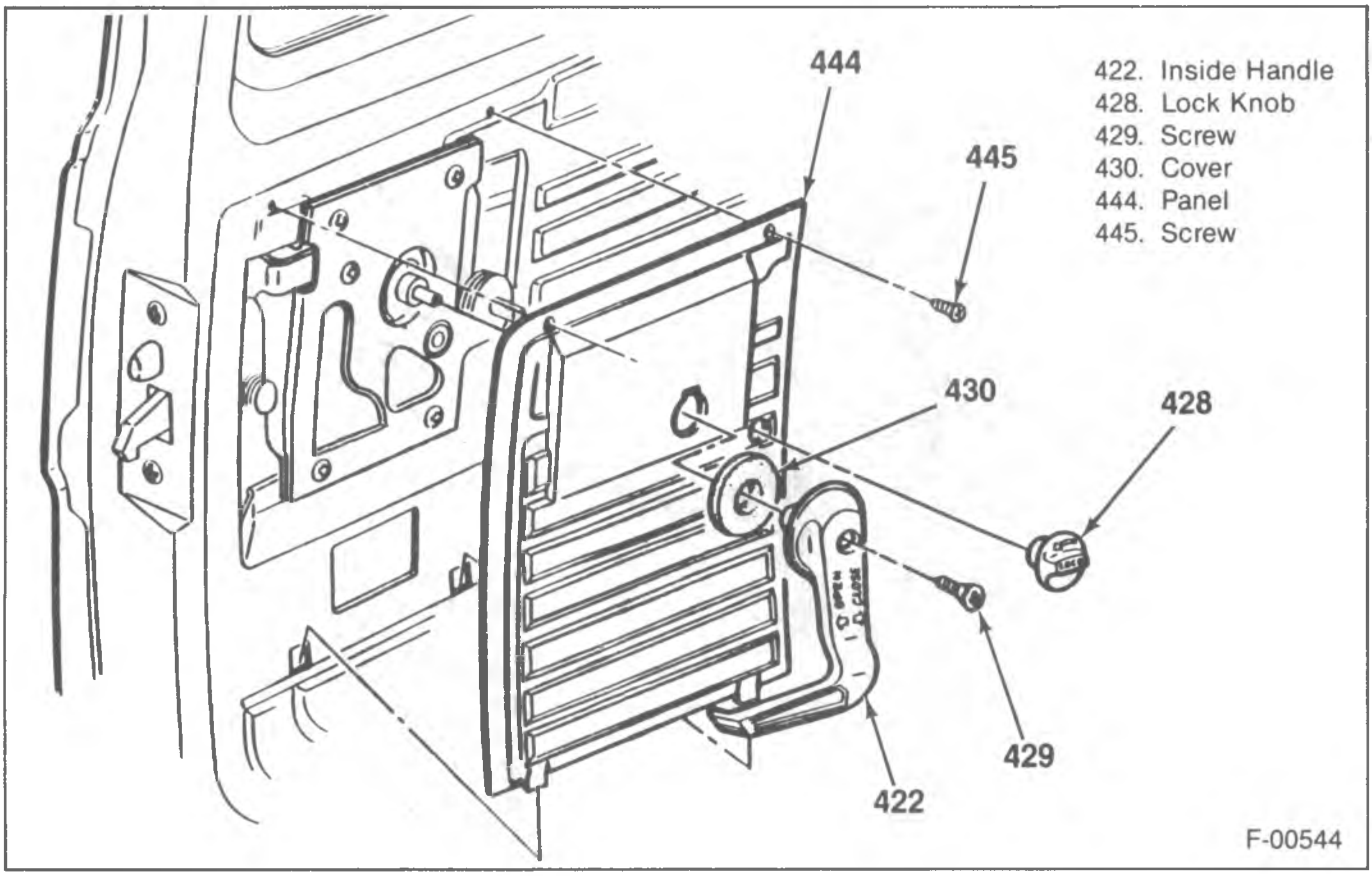


Figure 98—Door Lock Access Panel

- Twist the latch onto the cover with 1/4 of a turn.

4. Window latch to door screws (441).

FRONT LOCK REPLACEMENT

↔ Remove or Disconnect (Figures 98 and 99)

1. Door trim panel. Refer to "Door Trim Panel Replacement."
2. Lock access panel screws (445) and the panel (444).
   - Pull the panel upwards to disengage the clips.
3. Outside door handle (422).
4. Lock to door screws (449 and 451).
5. Rear door lock rods from the front lock.
   - Pivot the clips from the rods, and pull the rods from the lock.
6. Lower latch rod from the lock.
   - Pivot the clip from the rod and pull the rod from the lock.
7. Lock cylinder rod clips.
   - Slide the clip to release the rod.
8. Lock assembly from the door.

→← Install or Connect (Figures 98 and 99)

1. Lock assembly to the door.
2. Lock cylinder rod clip.
3. Lower latch rod to the lock.
   - Pivot the clip onto the rod.
4. Rear door lock rods to the front lock.
   - Pivot the clip onto the rod.
5. Lock to door screws (449 and 451).
6. Outside door handle (422).
7. Lock access panel (444) and panel screws (445).
8. Door trim panel. Refer to "Door Trim Panel Replacement."

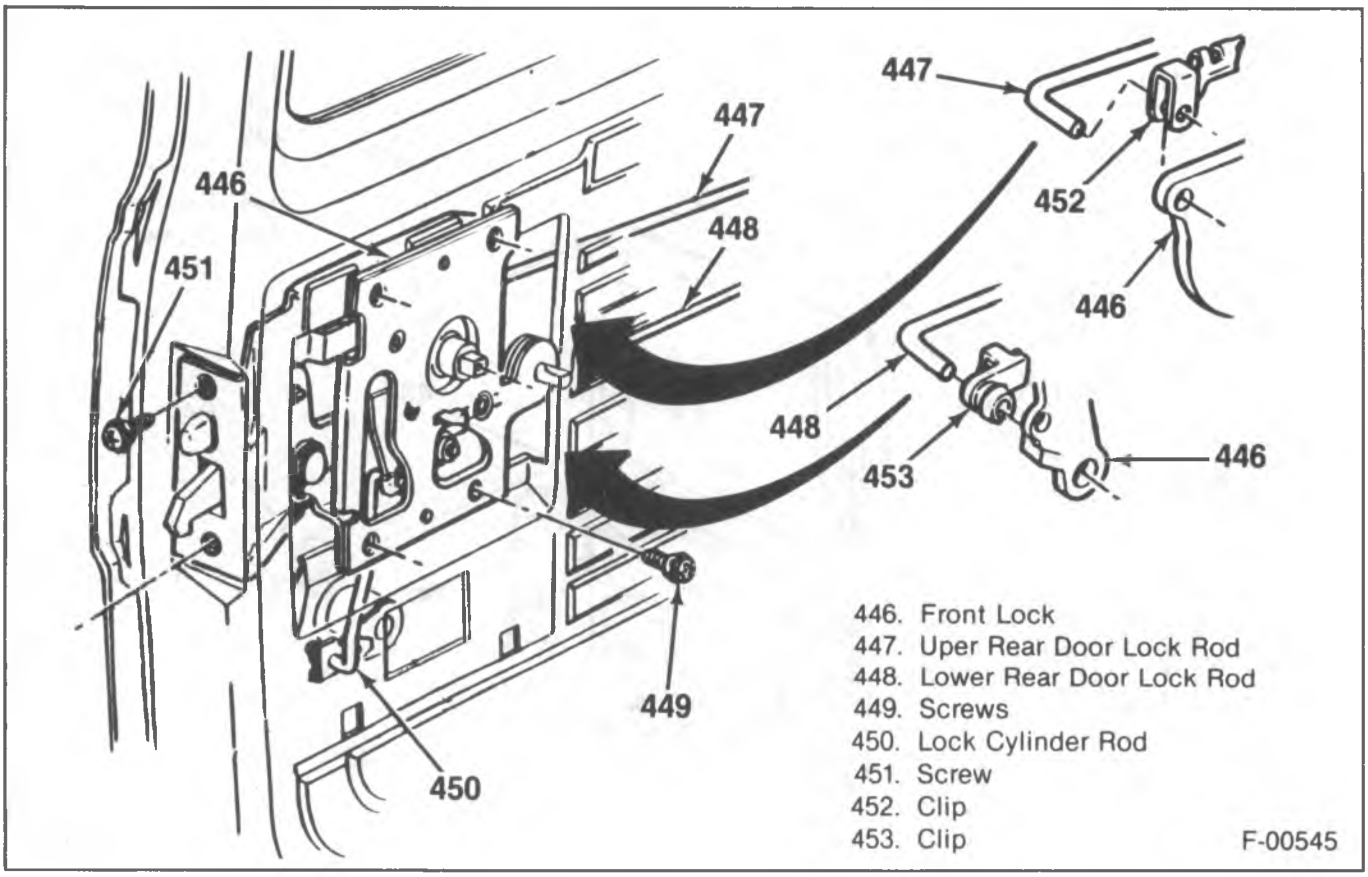
REAR LOCK REPLACEMENT

↔ Remove or Disconnect (Figure 100)

1. Lock rods from the lock.
   - Pivot the clip from the rod, and pull the rod from the lock.
2. Lock to door screws (457).
3. Lock from the door through the access hole.

→← Install or Connect (Figure 100)

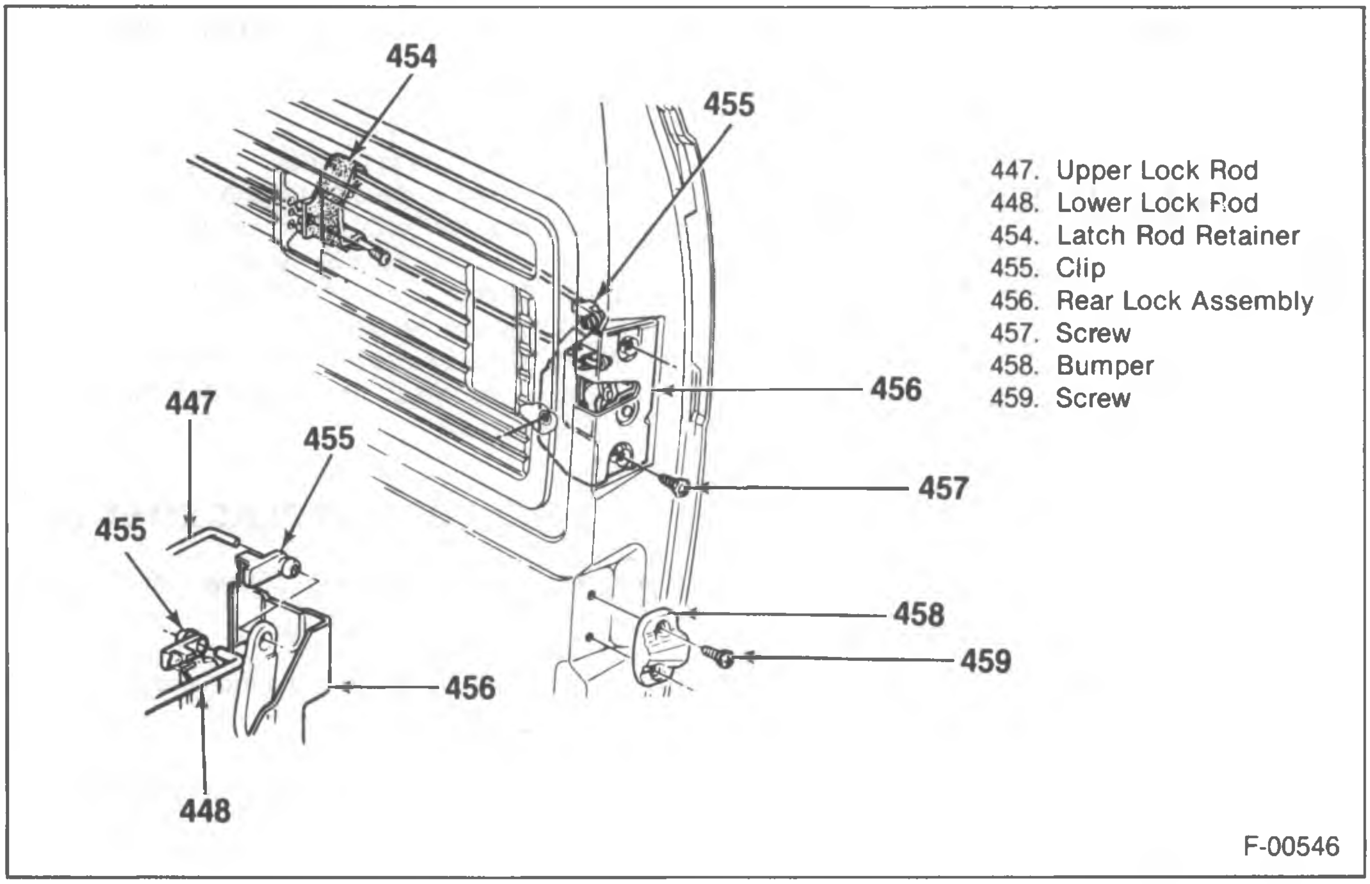
1. Lock to the door through the access hole.
2. Lock to door screws (457).



446. Front Lock
447. Uper Rear Door Lock Rod
448. Lower Rear Door Lock Rod
449. Screws
450. Lock Cylinder Rod
451. Screw
452. Clip
453. Clip

F-00545

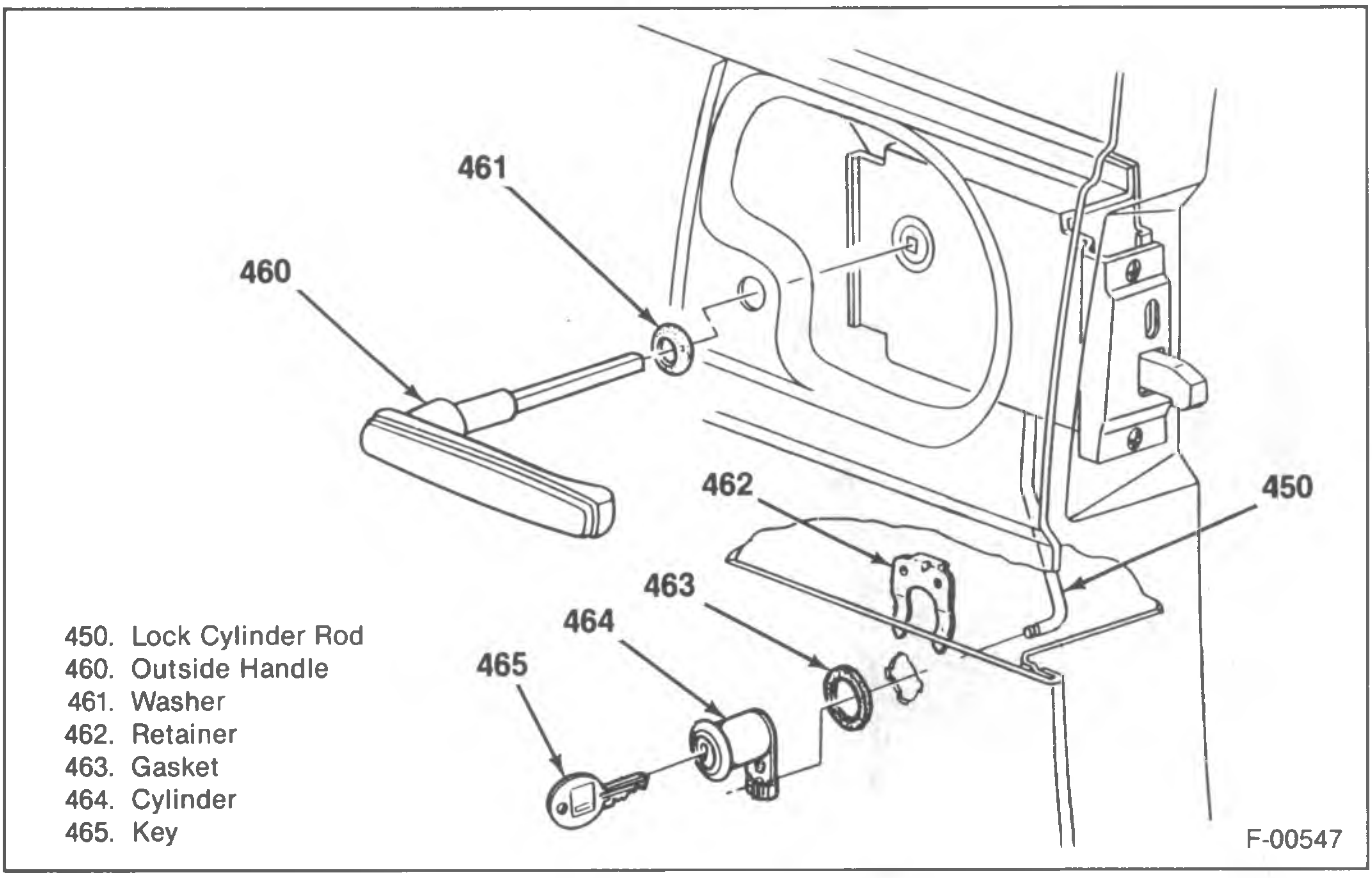
Figure 99—Door Lock Attachment



447. Upper Lock Rod
448. Lower Lock Rod
454. Latch Rod Retainer
455. Clip
456. Rear Lock Assembly
457. Screw
458. Bumper
459. Screw

F-00546

Figure 100—Rear Lock Attachment



450. Lock Cylinder Rod
460. Outside Handle
461. Washer
462. Retainer
463. Gasket
464. Cylinder
465. Key

F-00547

Figure 101—Outside Handle And Lock Cylinder Attachments

3. Lock rods to the lock.
    - Pivot the clip onto the rod.

LOCK CYLINDER REPLACEMENT

Remove or Disconnect (Figure 101)

1. Door trim panel. Refer to "Door Trim Panel Replacement."
2. Door lock cylinder rod (450).
3. Cylinder retainer (462).
    - Pry the retainer from the lock.
4. Cylinder (464) and seal (463) from the door.

Install or Connect (Figure 101)

1. Cylinder (464) and seal (463) to the door.
2. Cylinder retainer (462).
    - Push the retainer onto the cylinder.
3. Door lock cylinder rod (450).
4. Door trim panel. Refer to "Door Trim Panel Replacement."

SLIDING SIDE DOOR WEATHERSTRIP REPLACEMENT

Remove or Disconnect (Figure 102)

1. Weatherstrip from the door using 3M Release Agent (or equivalent).
2. Plastic nails from the door.

Clean

- The door of all the old cement.

Install or Connect (Figure 102)

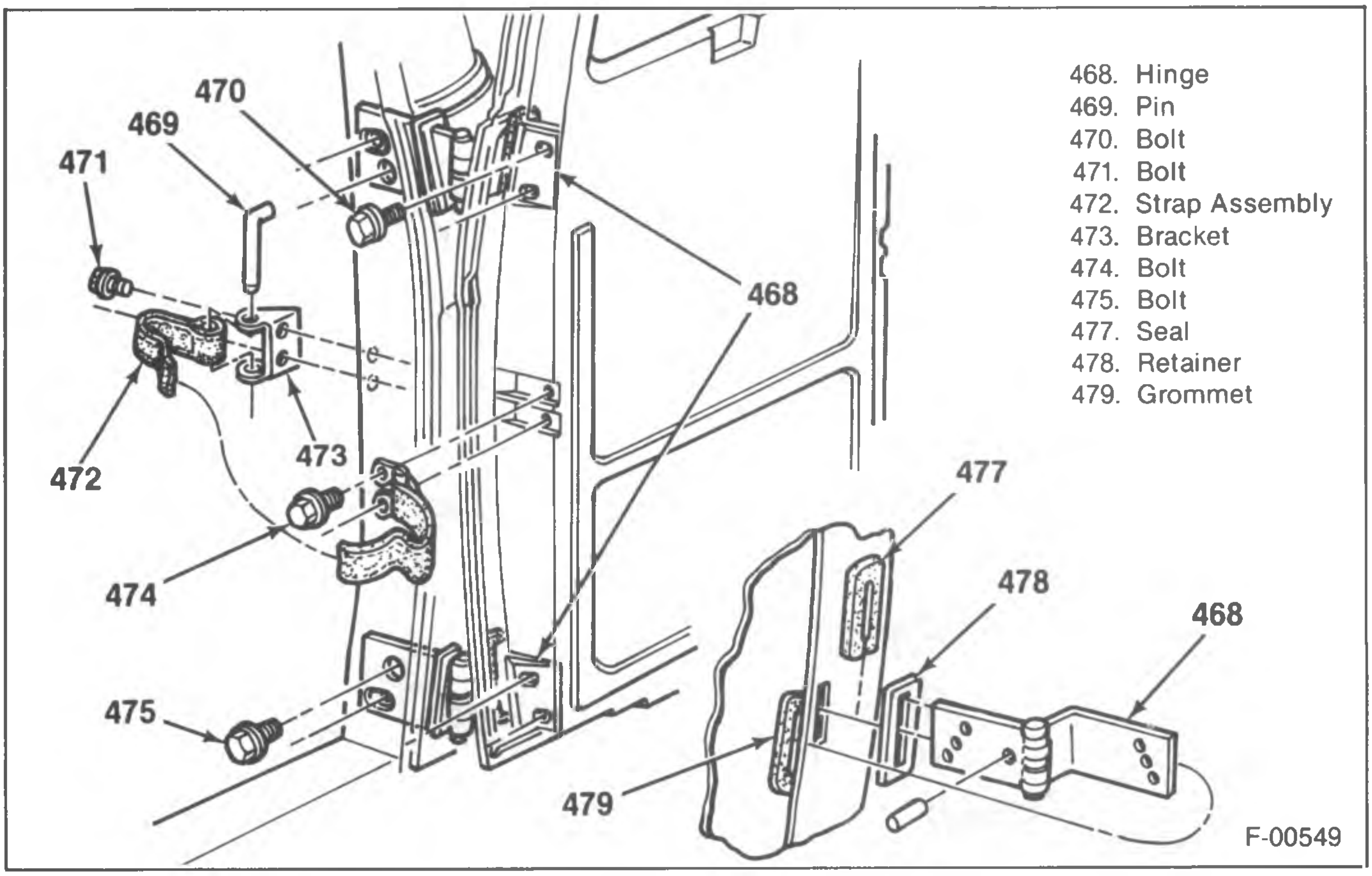
1. Weatherstrip adhesive to the door. Use 3M Weatherstrip Adhesive (or equivalent).
2. New weatherstrip to the door.
    - Press the plastic nails into the door.

466. Weatherstrip
467. Plastic Nails

F-00548

Figure 102—Sliding Side Door Weatherstrip

G MODEL REAR DOORS



468. Hinge
469. Pin
470. Bolt
471. Bolt
472. Strap Assembly
473. Bracket
474. Bolt
475. Bolt
477. Seal
478. Retainer
479. Grommet

Figure 103—Hinge Components

DOOR AND HINGE REPLACEMENT

Remove or Disconnect (Figure 103)

- Open the doors.

1. Electrical wiring harness (if equipped). Refer to "Door Trim Panel Replacement" for access to the wiring harness.
   - Mark the position of the door on the hinges using a wax pencil.
2. Strap pin (469).
   - Support the door.
3. Hinge to body pillar bolts (475).
4. Door from the vehicle.
5. Hinge to door bolts (470).
6. Hinges from the door.
7. Retainers (478), seals (477), and grommets (479) from the door or the hinges.

Install or Connect (Figure 103)

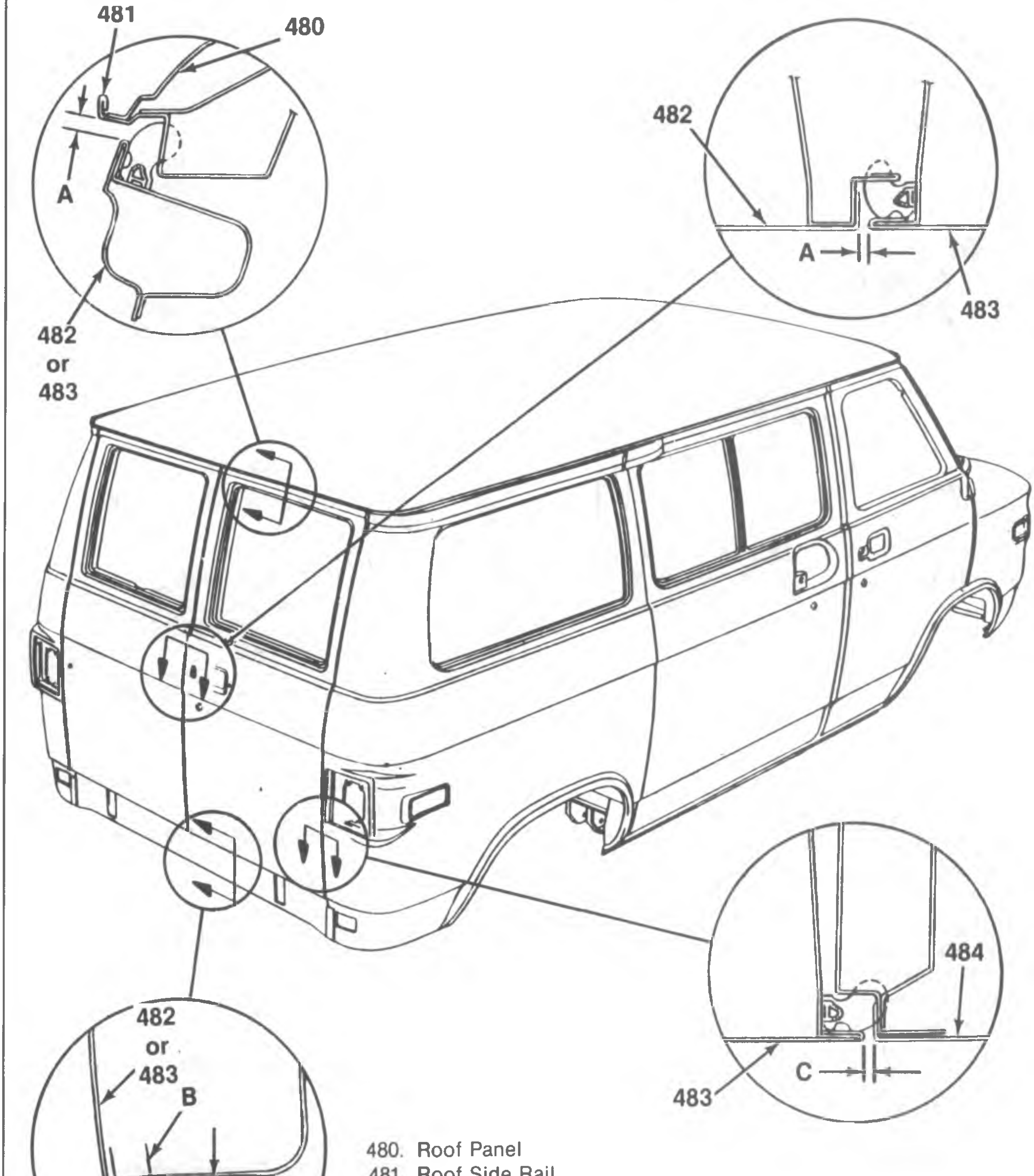
1. Grommet to the door.
2. Hinge to the door.
3. Hinge to door bolts (470).
   - Align the hinge to the previously made mark.
4. The seals and retainers to the body half of the hinge.
5. Door to the vehicle.
   - Support the door.
6. Hinge to body pillar bolts (475).
   - Align the hinge to the previously made mark.
7. Strap pin (469).
8. Electrical wiring harness.
   - Refer to "Door Trim Panel Replacement" for access to the wiring harness.

DOOR ADJUSTMENT

Each of the two doors must first be adjusted in the door opening before adjusting the door to door clearance.

Adjust (Figure 104)

1. The door height so that there is a gap of 6 mm ± 0.5 mm (0.25-inch ± 0.02-inch) between the roof panel and the rear door panel.



480. Roof Panel
481. Roof Side Rail
482. Left Door
483. Right Door
484. Body Side Panel
485. Floor Extension Panel
- A. 6 mm ± 0.5 mm (0.25-inch ± 0.02-inch)
- B. 15.25 mm ± 0.5 mm (0.60-inch ± 0.02-inch)
- C. 4 mm ± 0.5 mm (0.16-inch ± 0.02-inch)

F-00550

Figure 104—Door Adjustments

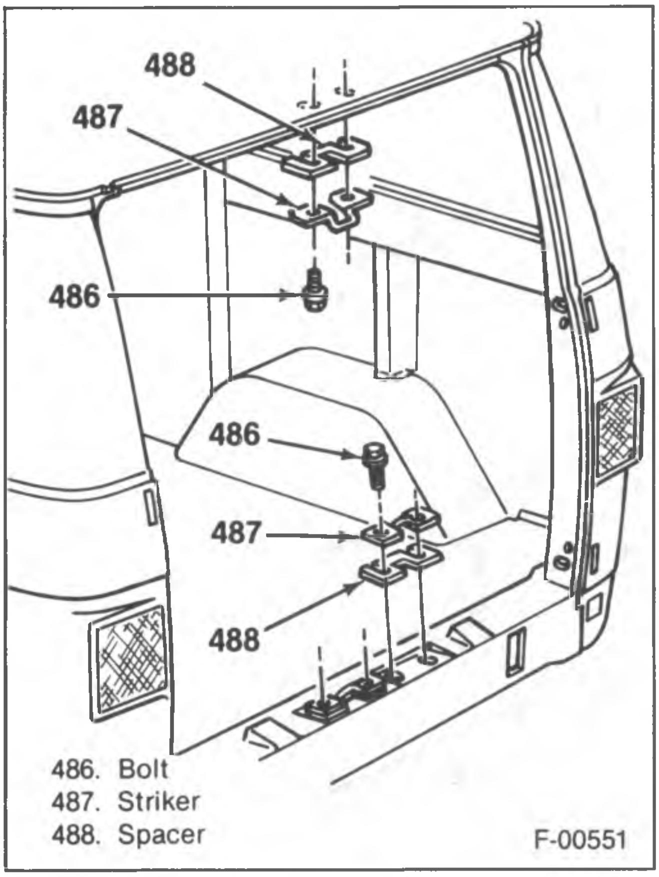


Figure 105—Striker Components

2. The gap between the bottom of the door panel (not the bottom of the outer panel) and the platform panel should be 6 mm ± 0.5 mm (0.25-inch ± 0.02-inch). This measurement should be taken on each door individually from the side of the door. Thedoor should be in its normal closed position. (The outer rear door panel is 15.25 mm ± 0.5 mm (0.60-inch ± 0.02-inch) away from the rear platform panel when normally closed).
3. The rear door outer panel to the body side outer panel gap to 4 mm ± 0.5 mm (0.16-inch ± 0.02-inch).
4. The door to door clearance between the left and right outer door panels should be 6 mm ± 0.5 mm (0.25-inch ± 0.02-inch).

STRIKER REPLACEMENT

Remove or Disconnect (Figure 105)

1. Striker to door frame bolts (486).
2. Striker from the door frame.
3. Spacer (if equipped).

Install or Connect (Figure 105)

1. Spacer (as required).

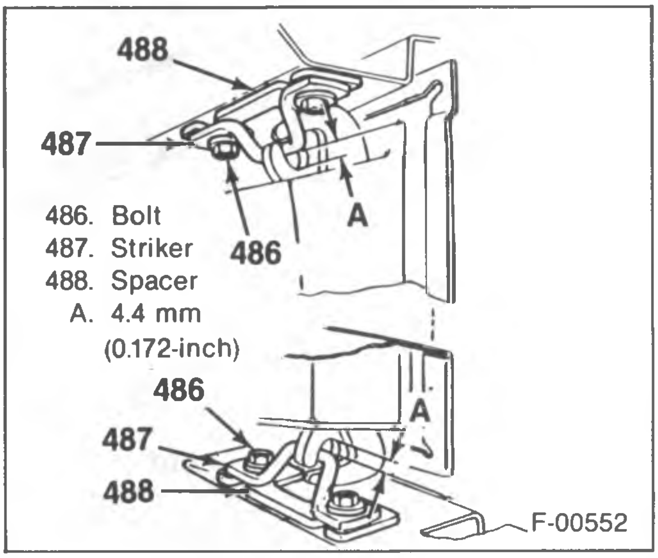


Figure 106—Striker Components

2. Striker to the door frame.
3. Striker to door frame bolts (486).

Adjust (Figure 106)

- The striker to door latch clearance so that there are 4.4 mm (0.172-inch) between the striker and the door latch when the door is in the secondary latched position. (The door is latched but not fully closed.) An $^{11}/_{64}$-inch diameter drill bit may be used to gage this clearance.

DOOR TRIM PANEL REPLACEMENT

Remove or Disconnect (Figure 107)

1. Door trim panel to door screws (489).
2. Door trim panel from the vehicle.
   - Slide the panel out of the retainers.

Install or Connect (Figure 107)

1. Door trim panel to the vehicle.
   - Slide the panel into the retainers.
2. Door trim panel to door screws (489).

BUMPER WEDGE REPLACEMENT

Remove or Disconnect (Figure 108)

1. Bumper to upper door frame screws (495).
2. Bumper and spacer.

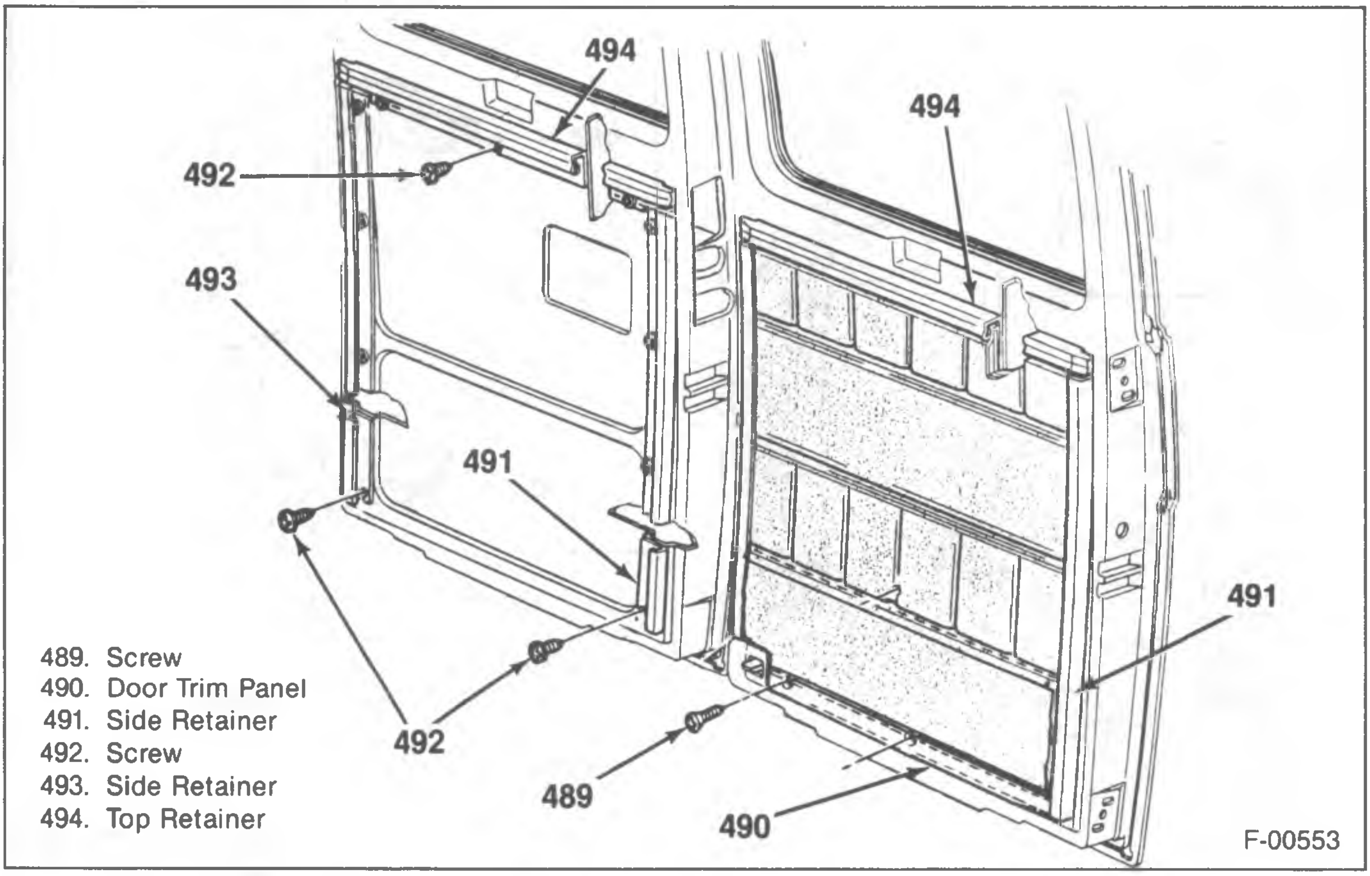


Figure 107—Door Trim Panel Components

Install or Connect (Figure 108)

1. Spacer (as required).
2. Bumper.
3. Bumper to upper door frame screws (495).

Adjust

- The bumper to door clearance so that there is 1 mm (0.04-inch) between the bumper and the door when the door is in the secondary position. (The door is latched but not fully closed).

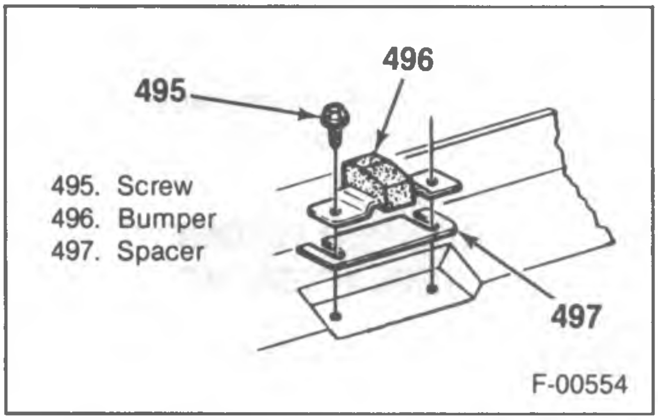


Figure 108—Bumper Wedge Components

WINDOW REPLACEMENT

If a glass is cracked but still intact, it should be crisscrossed with masking tape to reduce the risk of injury and/or damage to the vehicle. If a crack extends to the edge of the glass, mark the door with a piece of chalk at the point where the crack meets the weatherstrip. Later, when examining the flange of the opening for a cause of the crack, start at the point marked.

It is important that the cause of the crack be determined and the condition corrected, before the new glass is installed. The cause of the crack may be an obstruction or high spot somewhere around the flange of the opening; cracking may not occur until pressure from the high spot or obstruction becomes particularly high due to winds, extremes of temperature, or rough terrain.

Remove or Disconnect (Figure 109)

CAUTION: Always wear heavy gloves when handling glass to minimize the risk of injury.

1. Using a $^3/_{16}$-inch drill bit, drill the rivets from the weatherstrip (if equipped).

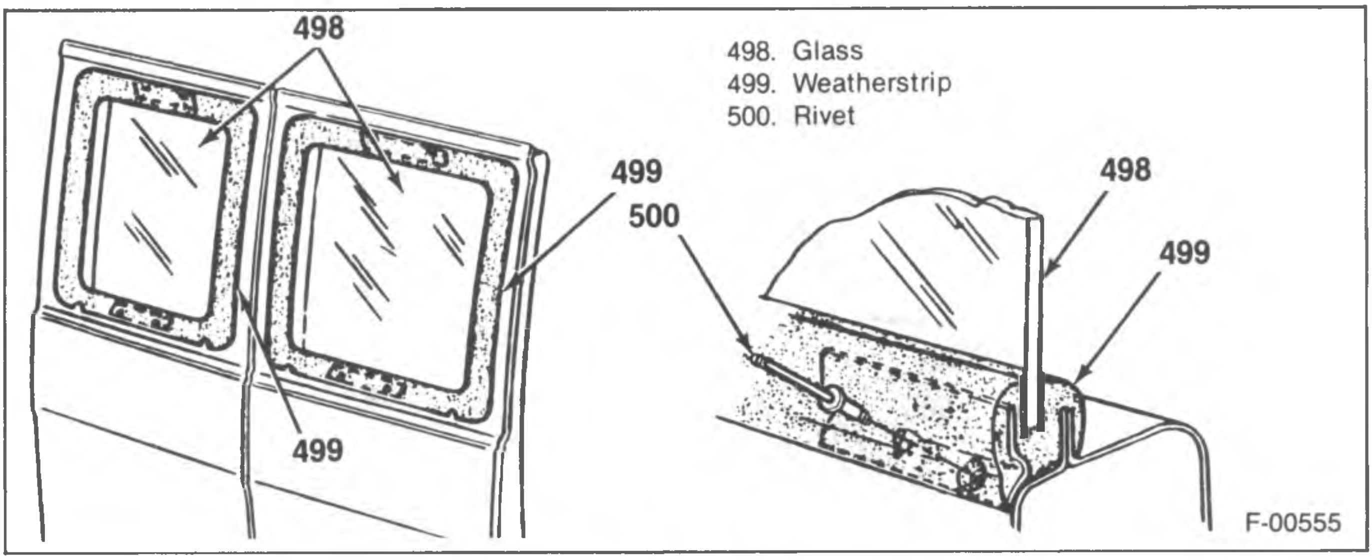


Figure 109—Window Components

2. Weatherstrip seal by running a putty knife between the flange and the weatherstrip (inside and outisde the door).
   - Have an assistant outside the cab by the window.
3. Weatherstrip and glass from the flange.
   - Force the weatherstrip from the flange from the inside with a putty knife.
4. Window from the weatherstrip.

Install or Connect (Figure 109)

1. Weatherstrip to the glass.
2. A six mm (1/4-inch) cord in the weatherstrip groove. The ends should overlap about 5 cm (6-inches) at the window bottom.
3. Window and weatherstrip on the flange from outside the cab.
   - Brush soapy water on the flange.
   - Have an assistant pull the cord from inside the cab to seat the lip of the weatherstrip on the flange.
4. Rivets (if equipped) to the weatherstrip with a rivet gun.
   - Use 3/16-inch blind rivets.

SWING OUT WINDOW

Remove or Disconnect (Figure 110)

CAUTION: Always wear heavy gloves when handling glass to minimize the risk of injury.

1. Window latch to door screws (509).
2. Window latch from the window.
   - Twist the latch 1/4 of a turn to release the latch components from the window.

- Lift the window for acess to the hinge screws.

3. Hinge to door screws (502).
4. Hinge from the door.
5. Hinge seal from the door.

Install or Connect (Figure 110)

1. Hinge and hinge seal to the door.
2. Hinge to door screws (502).
3. Window latch to the window.
   - Place the cover and spacer through the window.
   - Place the washer and spring onto the cover.
   - Twist the latch onto the cover with 1/4 of a turn.
4. Window latch to door screws (509).

LEFT DOOR LOWER LATCH REPLACEMENT

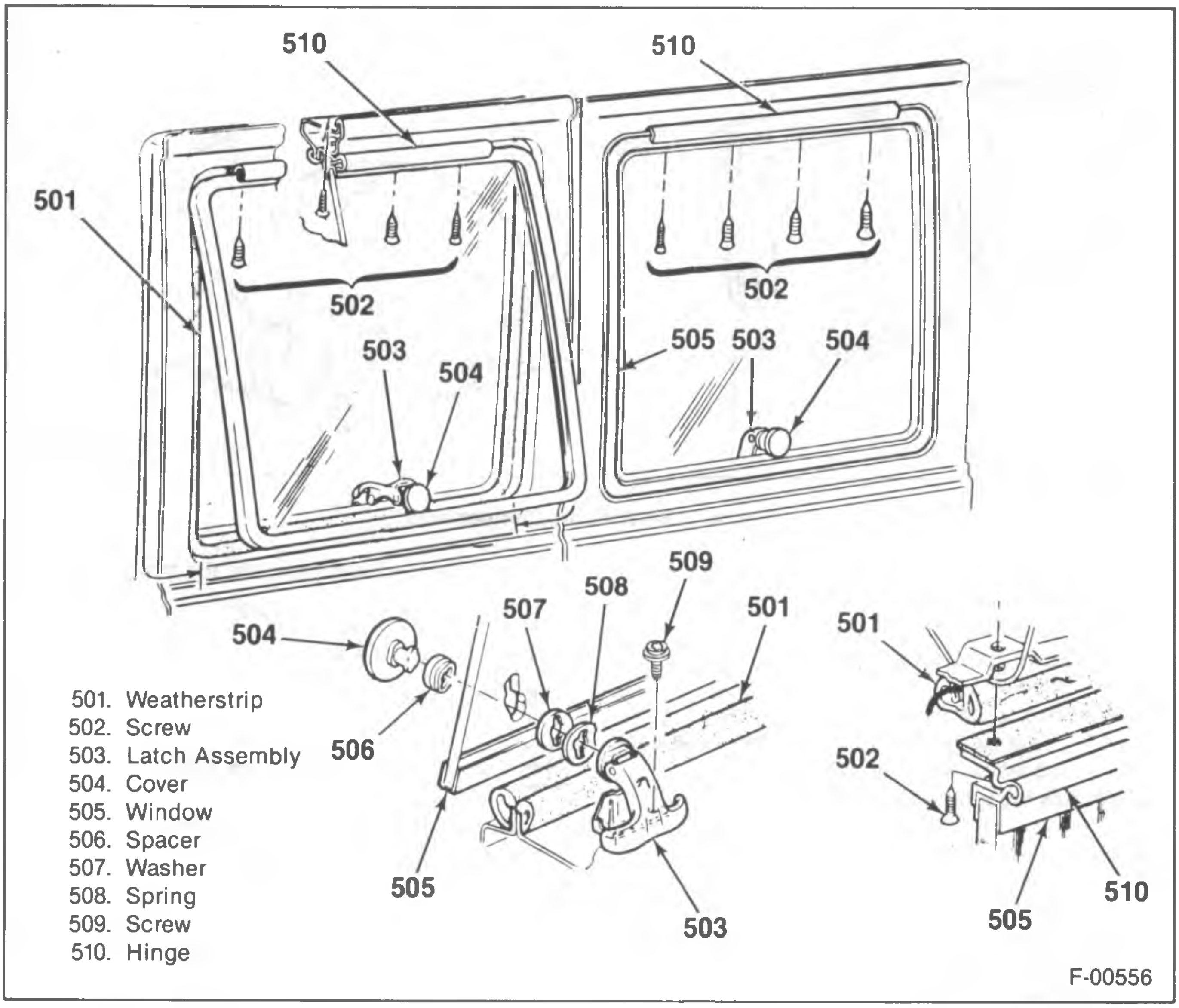
Remove or Disconnect (Figure 111)

- Open the door.

1. Latch to door screws (511).
2. Latch from the door.

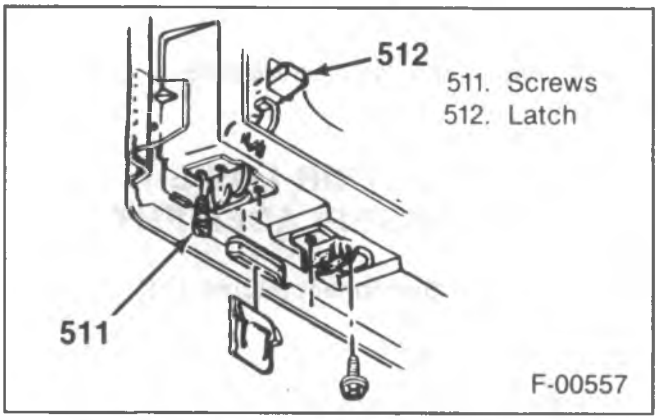
Install or Connect (Figure 111)

1. Latch to the door.
2. Latch to door screws (511).



501. Weatherstrip
502. Screw
503. Latch Assembly
504. Cover
505. Window
506. Spacer
507. Washer
508. Spring
509. Screw
510. Hinge

Figure 110—Swing Out Window Components



511. Screws
512. Latch

Figure 111—Left Door Latch Components

RIGHT DOOR LOWER LATCH REPLACEMENT

↔ Remove or Disconnect (Figure 112)

1. Door trim panel. Refer to "Door Trim Panel Replacement."
2. Lower latch to control assembly rod from the control assembly.
    - Using a flat bladed screwdriver, push on the top of the clip where it is connected to the rod. Pivot the clip away from the rod.
3. Lower latch to door screws (513).
4. Lower latch with the rod from the door.

→← Install or Connect (Figure 112)

1. Lower latch with the rod to the door.
2. Lower latch to door screws (513).

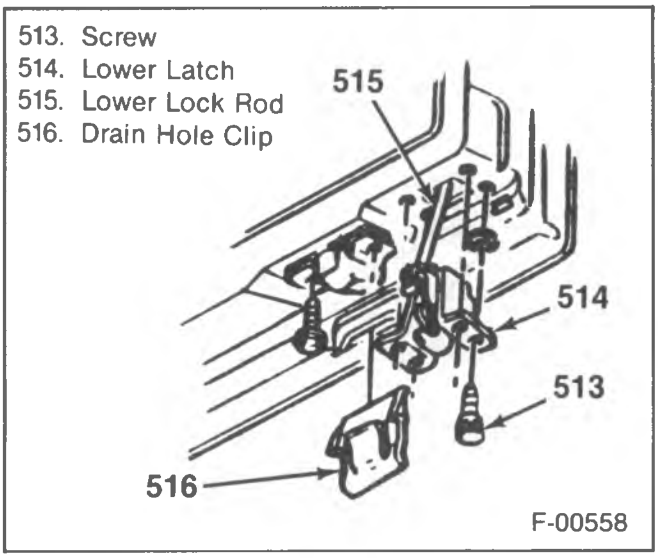


Figure 112—Right Door Lower Latch

3. Lower latch to control assembly rod into the control assembly.
   - Pivot the clip onto the rod.
4. Door trim panel. Refer to "Door Trim Panel Replacement."

RIGHT DOOR UPPER LATCH REPLACEMENT

←→ Remove or Disconnect (Figure 113)

1. Door trim panel. Refer to "Door Trim Panel Replacement."
2. Upper latch to control assembly rod from the control assembly.
   - Using a flat bladed screwdriver, push on the top of the clip where it is connected to the rod. Pivot the clip away from the rod.

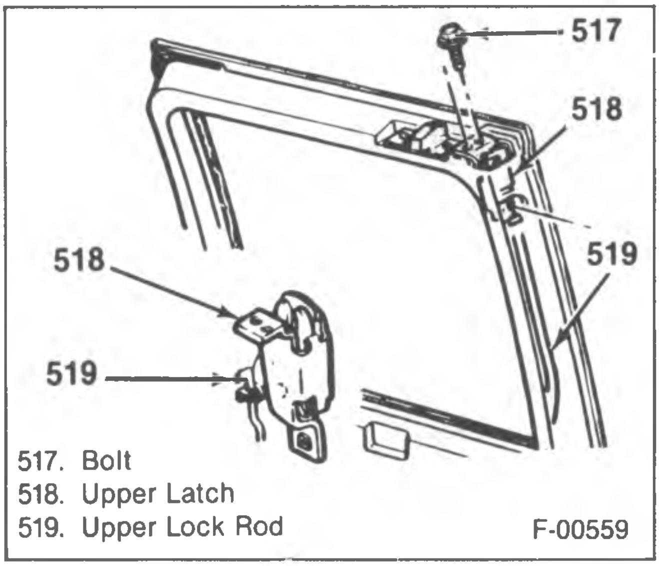


Figure 113—Right Door Upper Latch

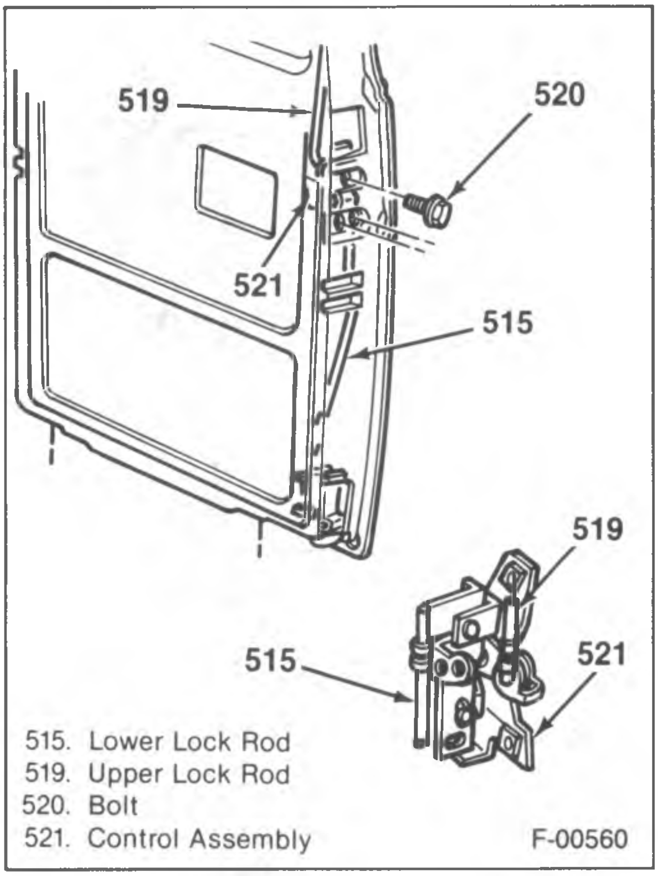


Figure 114—Right Door Control Assembly Attachment

3. Upper latch to door bolts (517).
4. Upper latch with the rod from the door.

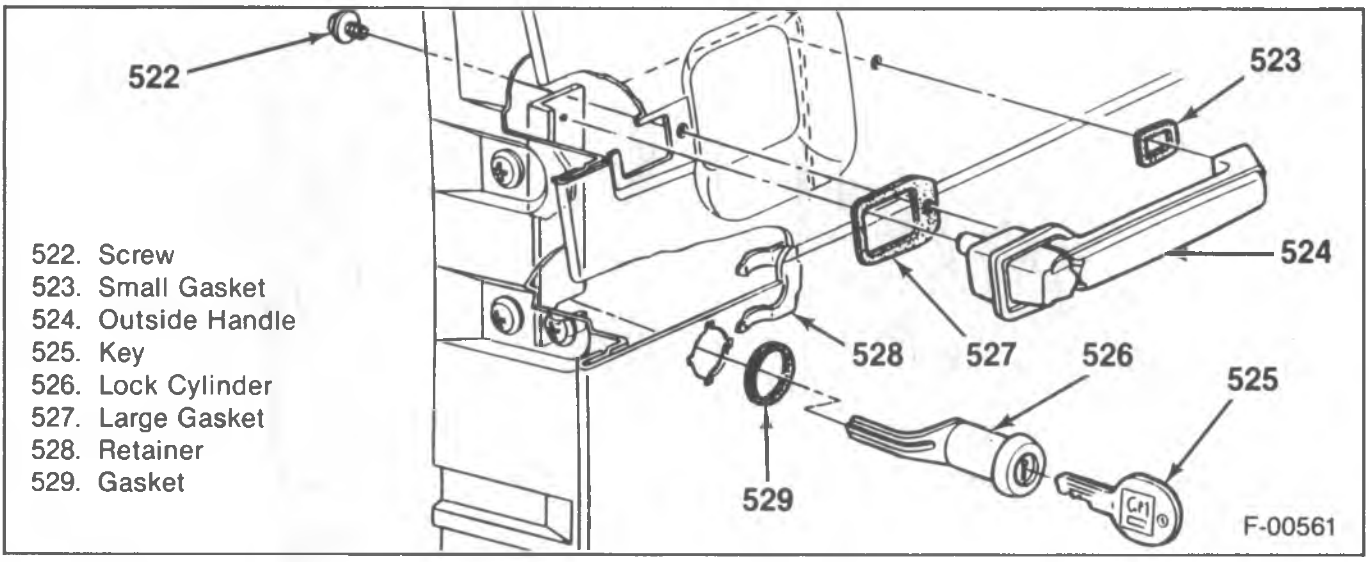
→← Install or Connect (Figure 113)

1. Upper latch with the rod to the door.
2. Upper latch to door bolts (517).
3. Upper latch to control assembly rod into the control assembly.
   - Pivot the clip onto the rod.
4. Door trim panel. Refer to "Door Trim Panel Replacement."

RIGHT DOOR CONTROL ASSEMBLY REPLACEMENT

←→ Remove or Disconnect (Figure 114)

1. Door trim panel. Refer to "Door Trim Panel Replacement."
2. Upper and lower door latch rods from the control assembly.
   - Using a flat bladed screwdriver, push on the top of the clip where it is connected to the rod. Pivot the clip away from the rod.
3. Electric door actuator (if equipped).
4. Door to control assembly bolts (520).



522. Screw
523. Small Gasket
524. Outside Handle
525. Key
526. Lock Cylinder
527. Large Gasket
528. Retainer
529. Gasket

Figure 115—Outside Handle And Lock Cylinder Components

5. Control assembly through the access hole.

Install or Connect (Figure 114)

1. Control assembly through the access hole.
2. Door to control assembly bolts (520).
3. Electrical door actuator (if equipped).
4. Upper and lower door latch rods to the control assembly.
   - Pivot the clips onto the rods.
5. Door trim panel. Refer to "Door Trim Panel Replacement."

DOOR OUTSIDE HANDLE REPLACEMENT

Remove or Disconnect (Figure 115)

1. Door trim panel. Refer to "Door Trim Panel Replacement."
2. Door to outside handle screws (502).
3. Handle from the door.
4. Gaskets from the door.

Install or Connect (Figure 115)

1. Large gasket onto the handle.
2. Door to outside handle screw (502) to the push button side of the handle.
   - Do not tighten.
3. Small gasket between the door and the handle.
4. Door to outside handle screw (522) to the other side of the handle.
   - Tighten both screws.
5. Door trim panel. Refer to "Door Trim Panel."

DOOR LOCK CYLINDER REPLACEMENT

Remove or Disconnect (Figure 115)

1. Door trim panel. Refer to "Door Trim Panel Replacement."
2. Lock cylinder retaining clip from the cylinder.
   - Slide the clip off the cylinder with a screwdriver.
3. Lock cylinder and gasket from the door.

Install or Connect (Figure 115)

1. Lock cylinder with gasket to the door.
   - The cylinder rod must engage the lock assembly lever.
2. Lock cylinder retaining clip onto the cylinder.
3. Door trim panel. Refer to "Door Trim Panel Replacement."

CHECK STRAP REPLACEMENT

Remove or Disconnect (Figure 103)

1. Pin (469).
2. Strap to door bolts (474).
3. Strap (472).
4. Bracket to inner panel bolts (471).
5. Bracket (473).

Install or Connect (Figure 103)

1. Bracket (473).
2. Bracket to inner panel bolts (471).

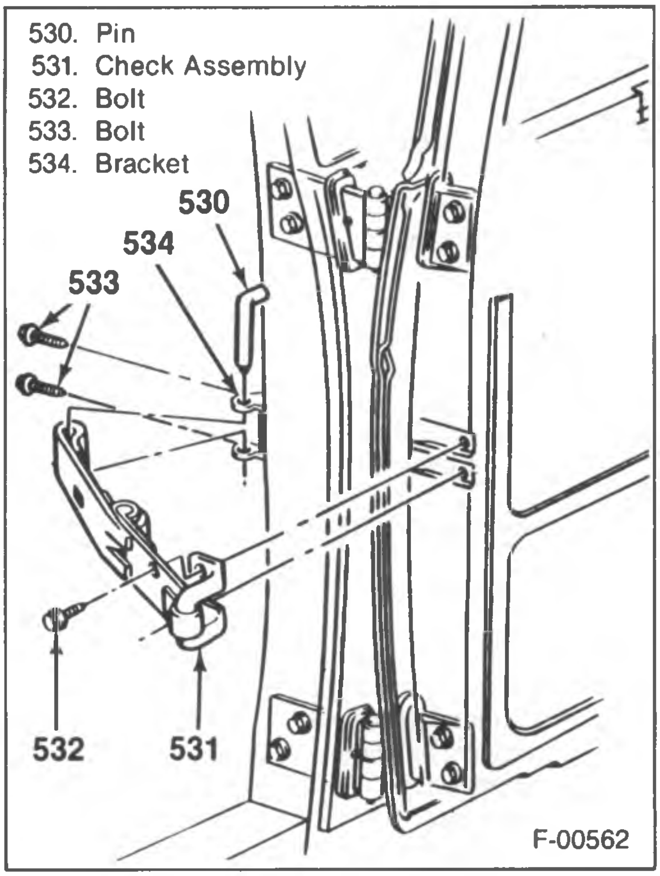


Figure 116—Check Assembly Components

3. Strap to the door.
4. Strap to door bolts (474).
5. Pin (469).

CHECK ASSEMBLY REPLACEMENT

Remove or Disconnect (Figure 116)

1. Pin (530).
2. Check assembly to door bolts (532).
3. Check assembly (531).
4. Bracket to inner panel bolts (533).
5. Bracket (534).

Install or Connect (Figure 116)

1. Bracket (534).
2. Bracket to inner panel bolts (533).
3. Check assembly (531).
4. Check assembly to door bolts (532).
5. Pin (530).

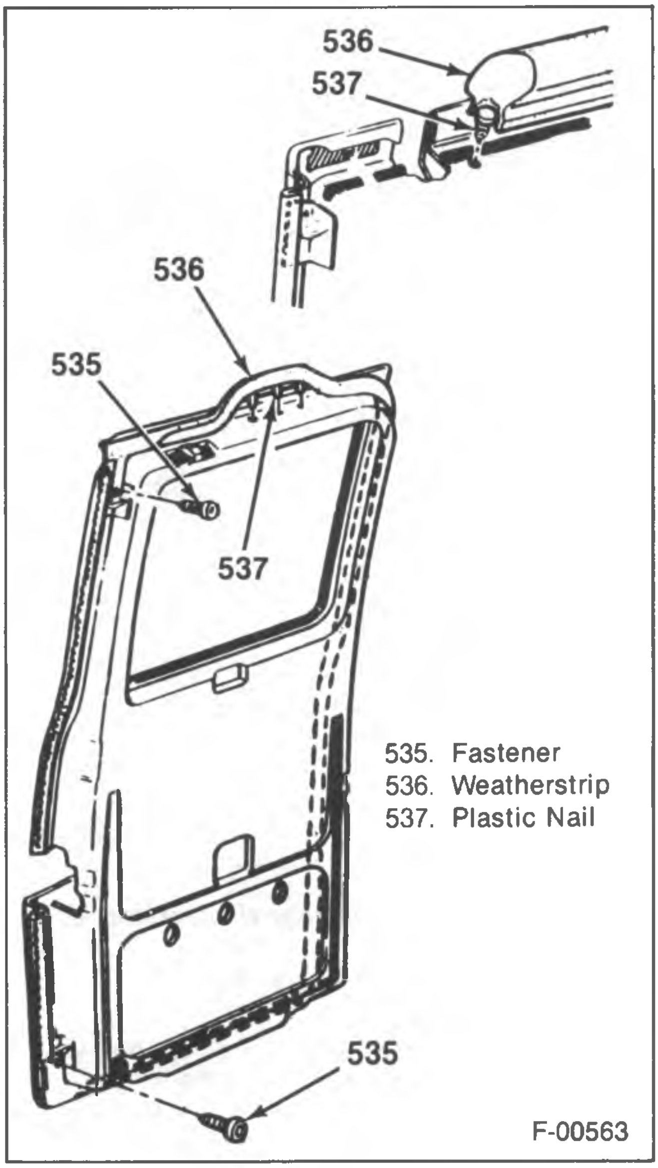


Figure 117—Left Door Weatherstrip

LEFT DOOR WEATHERSTRIP REPLACEMENT

Remove or Disconnect (Figure 117)

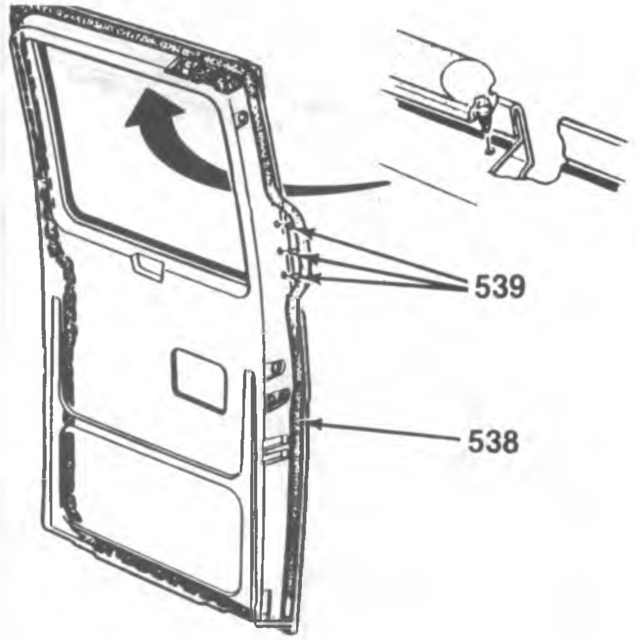
Tool Required:

J-24595-B Door Trim Pad Clip Remover.

1. Weatherstrip to door fasteners using J-24595-B.
2. Weatherstrip from the door using 3M Release Agent (or equivalent).
3. Plastic nails from the door frame.

Clean

- The door and weatherstrip of all the old cement.



538. Weatherstrip
539. Plastic Nail

F-00564

Figure 118—Right Door Weatherstrip

Install or Connect (Figure 117)

1. New weatherstrip to the door using 3M Weatherstrip Adhesive (or equivalent).
   - Push the plastic nails into the door frame.
2. Weatherstrip to door fasteners.

RIGHT DOOR WEATHERSTRIP REPLACEMENT

Remove or Disconnect (Figure 118)

1. Weatherstrip from the door using 3M Release Agent (or equivalent).
2. Plastic nails from the door frame.

Clean

- The door and weatherstrip of all the old cement.

Install or Connect (Figure 118)

1. New weatherstrip to the door using 3M Weatherstrip Adhesive (or equivalent).
   - Push the plastic nails into the door frame.

POWER DOOR LOCK MOTOR REPLACEMENT

Remove or Disconnect (Figure 119)

1. Battery ground cable.
2. Door trim panel. Refer to "Door Trim Panel Replacement."
3. Electrical connector from the motor.
4. Door to motor screws (540).
5. Motor from the lock rod.
   - Slide the rubber mount at the top of the motor off of the door lock rod.
6. Motor from the door.

Install or Connect (Figure 119)

1. Motor into the door.
2. Motor to the lock rod.
   - Slide the rubber mount at the top of the motor onto the door lock rod.
3. Door to motor screws (540).
4. Electrical connector to the motor.
5. Door trim panel. Refer to "Door Trim Panel Replacement."
6. Battery ground cable.

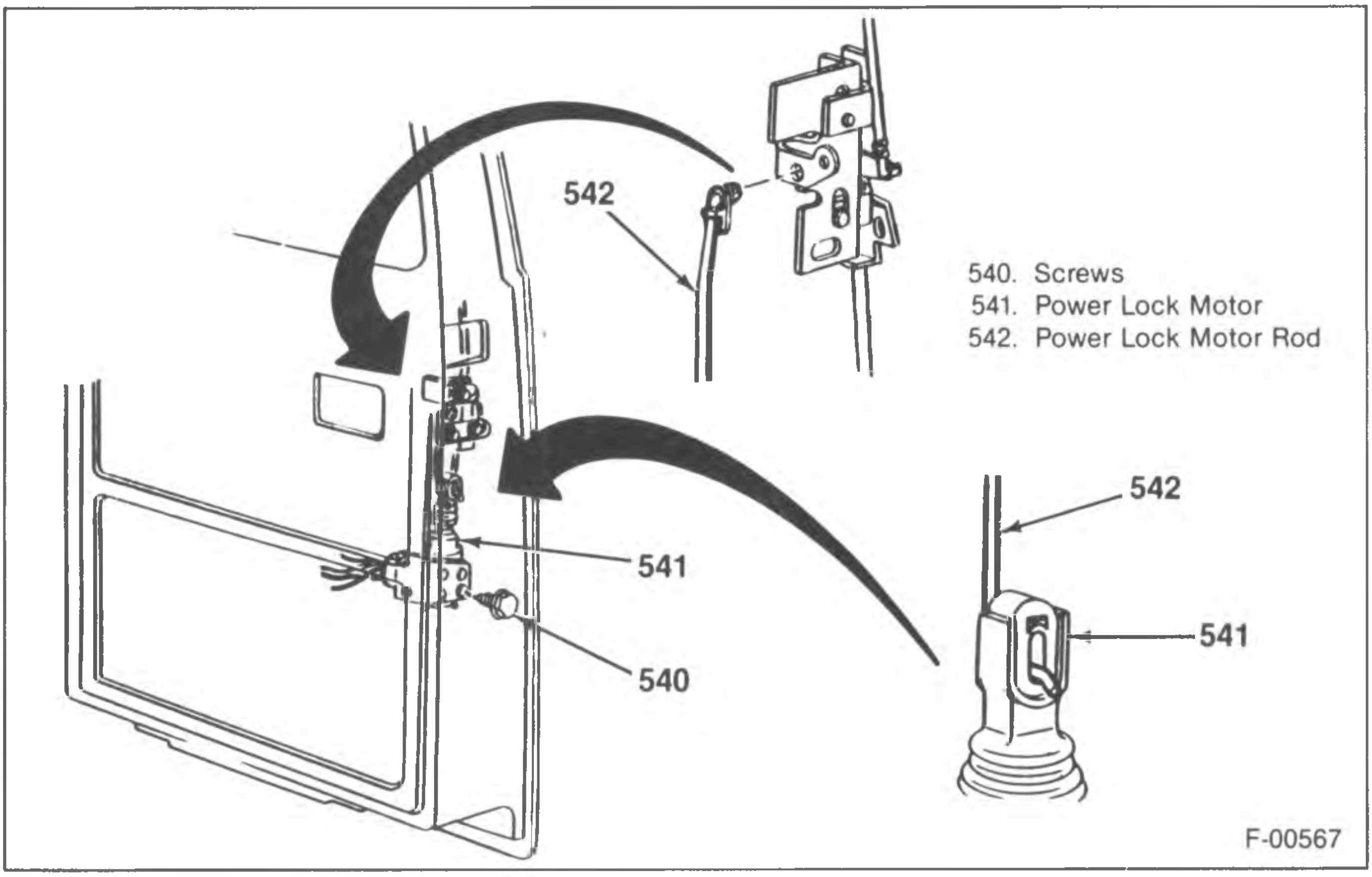


Figure 119—Power Door Lock Motor Attachment

SPECIAL TOOLS

J-22585-01	Door Hinge Bolt Wrench
J-23457-A	#50 Torx Wrench
J-9886-01	Door Handle Clip Remover
J-24595-B	Door Trim Pad Clip Remover

SECTION 10A2

SEATS

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 "NOTICE: See 'Notice' on page 10A2-1 of this section."

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

CONTENTS

CONTENTS (CONTINUED)

DIAGNOSIS OF MANUAL SEAT ADJUSTER

PROBLEM	POSSIBLE CAUSE	CORRECTION
Adjuster Will Not Lock	1. Locking wire too tight. 2. Adjuster lock bar spring disconnected or broken. 3. Adjuster lock bar sticking or binding.	1. Loosen the locking wire tension enough to provide full engagement of the lock bar in the locking slots of the adjuster lower channel. Refer to "Seat Adjuster Adjustment." 2. Connect the spring or install a new spring. 3. Lubricate the lock bar pivot. If the bar is binding, eliminate the cause of binding or replace the adjuster.
Adjuster Will Not Unlock	1. Locking wire too loose or disconnected. 2. Adjuster lock bar sticking or binding.	1. Tighten the locking wire enough to allow the lock bar to disengage from the locking slots in the adjuster lower channel when the lock control lever is activated. Refer to "Seat Adjuster Adjustment." 2. Lubricate the lock bar pivot. If the bar is binding, eliminate the cause of binding or replace the adjuster.
When The Left Adjuster Locks, The Right Adjuster Is Between Lock Positions	1. Right adjuster either rearward or forward of the left adjuster.	1. Loosen the adjuster to floor pan bolts or nuts — move one adjuster forward or rearward as far as possible and the other adjuster in the opposite direction. Refer to "Seat Adjuster Adjustments."

DIAGNOSIS OF MANUAL SEAT ADJUSTER (CONT.)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Seat Hard To Move Forward Or Rearward	1. Adjusters new, not broken in.	1. Operate the seat to the full forward and full rearward positions several times to work the new tightness out of the channels.
	2. Adjuster(s) improperly lubricated.	2. Lubricate the adjuster channels with Lubriplate or equivalent.
	3. Adjuster(s) binding due to bent or damaged channels.	3. Replace the adjuster.
	4. Adjusters not in parallel alignment with each other.	4. Loosen the floor pan attaching bolts or nuts, align the adjusters parallel on the floor pan and tighten nuts. Refer to "Seat Adjuster Adjustments."

SEAT ADJUSTER ADJUSTMENT

Adjust

- Remove the seat. Refer to "Front Seat and Seat Adjuster Replacement."
  - Leave the adjuster on the seat.
- Loosen the adjuster to seat bolts.

1. The adjuster rails forward or rearward so that both rails are the same distance from the front of the seat.
2. The adjuster rails so they are parallel to each other.

- Tighten the adjuster to seat bolts.

3. Wire assembly tension. Three holes on the secondary adjuster rail allow for tension adjustment of the wire assembly (figure 1).
   - Slide the spring off of the hook.
   - Open the hook, and remove it from the hole.

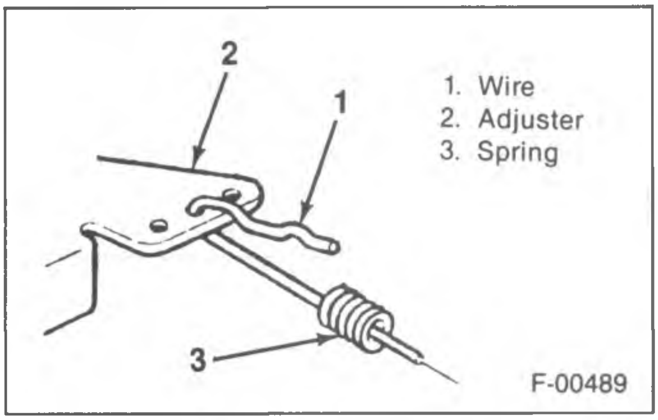


Figure 1—Adjustment Points

   - Move the hook to a forward hole to loosen the wire, move the hook to a rearward hole to tighten it.
   - Close the hook, and slide the spring over the hook.

- Install the seat. Refer to "Front Seat and Seat Adjuster Replacement."

C/K MODEL FRONT SEATS

FRONT SEAT AND SEAT ADJUSTER REPLACEMENT

This procedure applies to all C/K Model front seats, whether bench or bucket type with the exception of the utility vehicle passenger front bucket seat. Refer to "Utility Vehicle Passenger Front Bucket Seat Replacement" for information on this type of seat.

Remove or Disconnect (Figures 2 and 3)

1. Bolt cover (5) (if equipped).
2. Seat adjuster to floor panel bolts (7).
3. Seat (10) with adjuster (2) from the vehicle.
4. Adjuster to seat bolts (8).
5. Adjuster (2) from the seat (10).

Install or Connect (Figures 2 and 3)

1. Adjuster (2) to the seat (10).
2. Adjuster to seat bolts (8).
3. Seat (10) with adjuster (2) to the vehicle.
4. Seat adjuster to floor panel bolts (7).
5. Bolt cover (5) (if equipped).

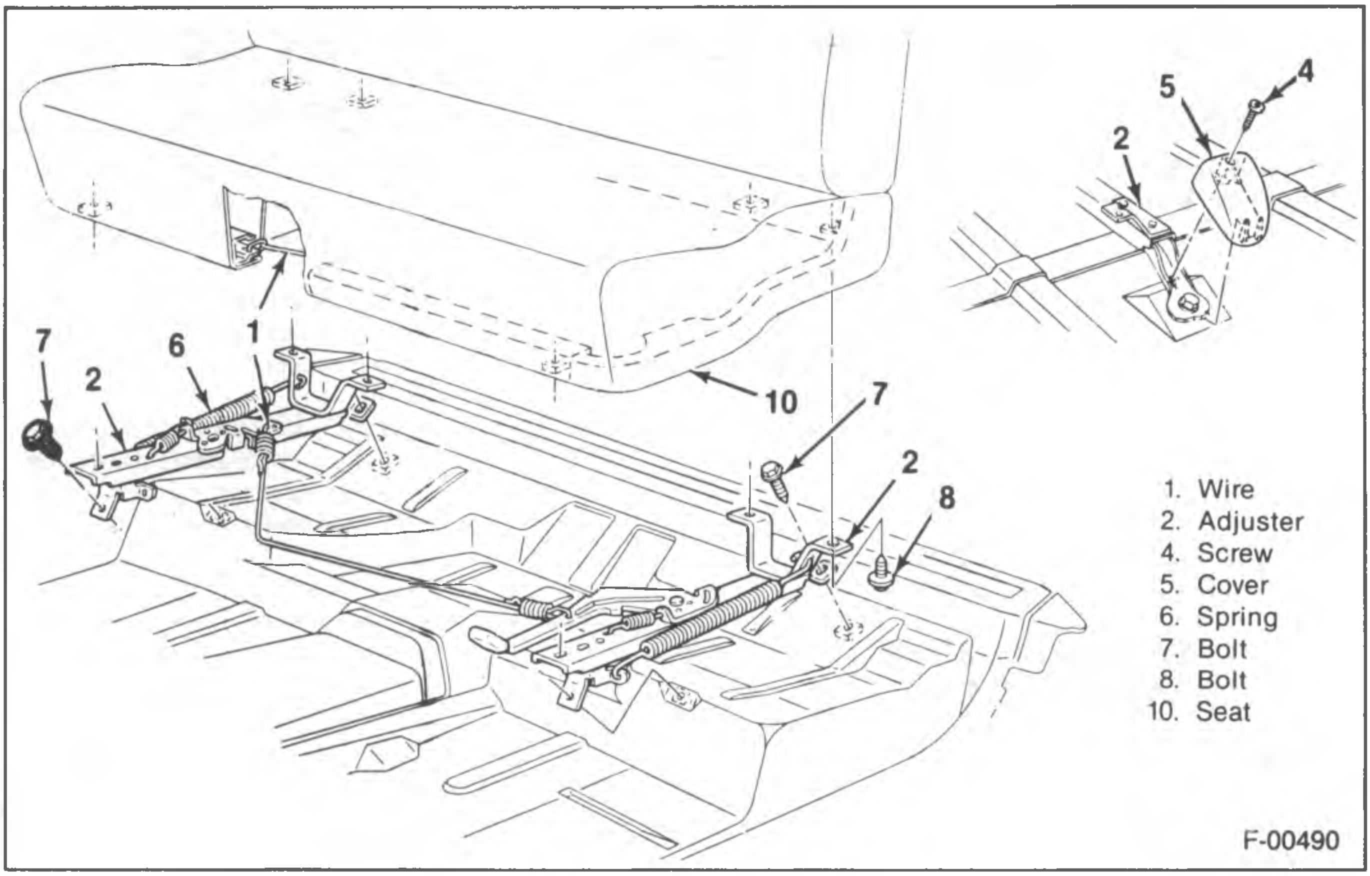


Figure 2—Bench Seat Components

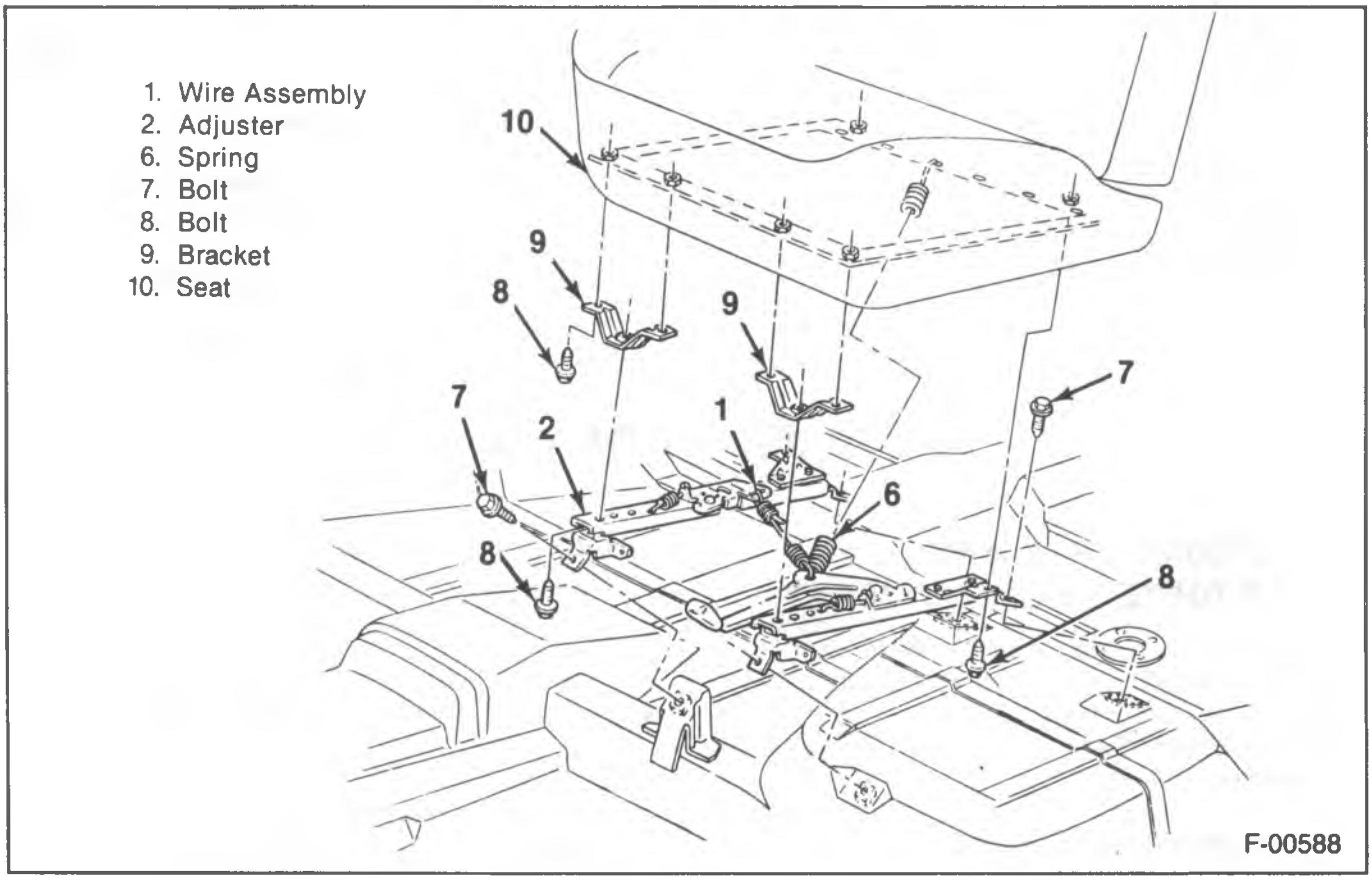
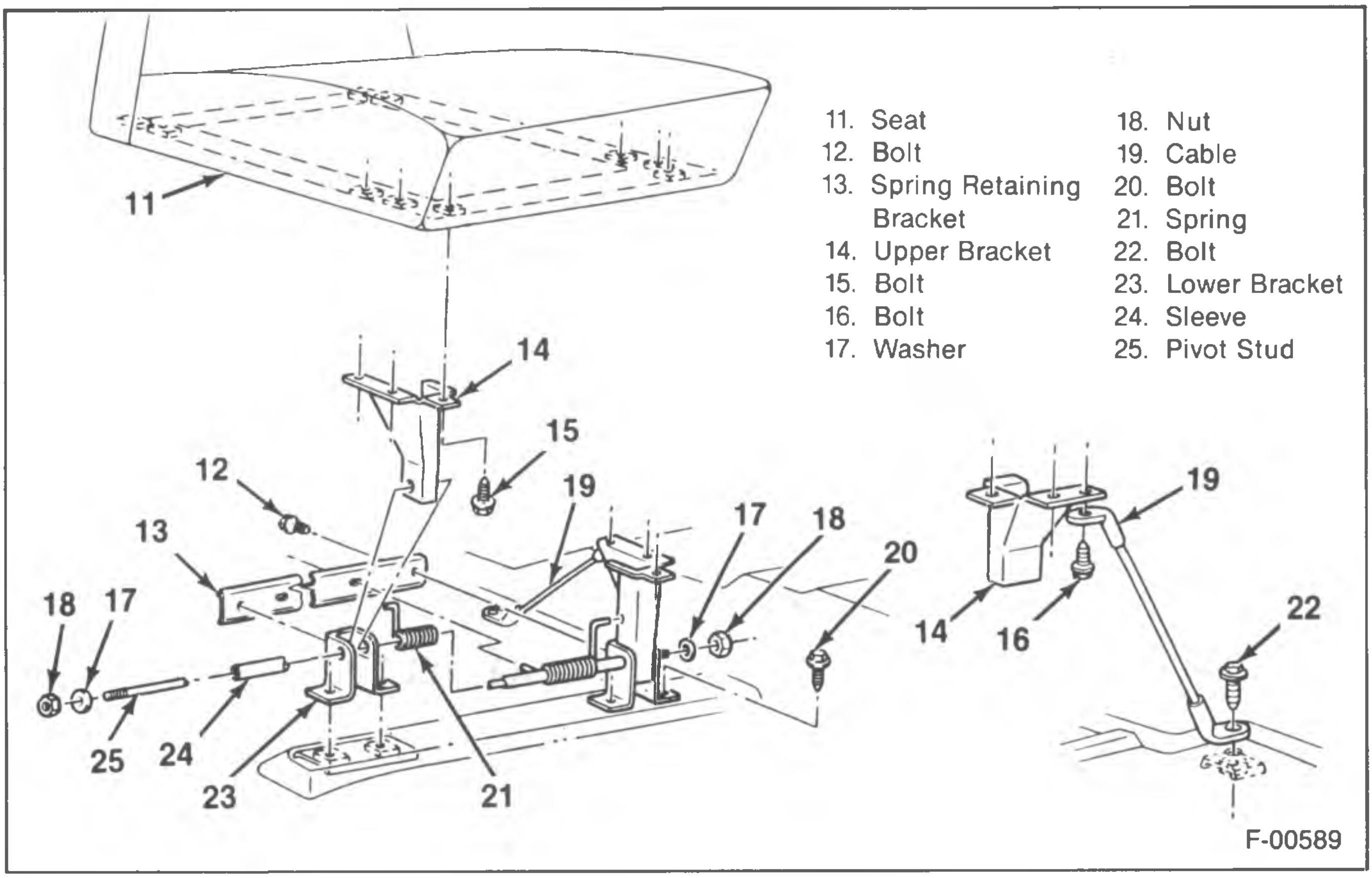


Figure 3—Bucket Seat Components



11. Seat
12. Bolt
13. Spring Retaining Bracket
14. Upper Bracket
15. Bolt
16. Bolt
17. Washer
18. Nut
19. Cable
20. Bolt
21. Spring
22. Bolt
23. Lower Bracket
24. Sleeve
25. Pivot Stud

Figure 4—Utility Vehicle Passenger Seat Components

UTILITY VEHICLE PASSENGER FRONT BUCKET SEAT REPLACEMENT

Remove or Disconnect (Figure 4)

- Place the seat in its forward position.

1. Restraint cable (19) to the floor panel bolt (22).
   - Allow the seat to tip forward.
2. Spring retaining bracket bolts (12) and the bracket (13).
3. Lower seat bracket (23) to the floor panel bolts (20).
4. Seat from the vehicle.
5. Upper seat bracket bolts (15).
6. Seat brackets (14) from the seat.
7. Latch assembly to seat bolts.
8. Latch assembly from the seat.

Install or Connect (Figure 4)

1. Latch assembly to the seat.
2. Latch assembly to seat bolts.
3. Seat brackets (14) to the seat.
4. Upper seat bracket bolts (15).
5. Seat to the vehicle.
6. Lower seat bracket (22) to the floor panel bolts (20).
7. Spring retaining bracket (13) onto the springs (21), and the spring retaining bracket bolts (12).
8. Restraint cable (19) to the floor panel bolts (22).

FRONT PIVOT BRACKET DISASSEMBLY

This procedure applies only to Utility Vehicle passenger front bucket seats.

Remove or Disconnect (Figure 4)

1. Seat. Refer to "Utility Vehicle Passenger Front Bucket Seat Replacement."
2. Nut (18).
3. Washer (17).
4. Pivot stud (25).
5. Sleeve (24).
6. Springs (21).
7. Upper bracket (14) from the lower bracket (23).

Install or Connect (Figure 4)

1. Upper bracket (14) to the lower bracket (23).
2. Springs (21) onto the sleeve (24).
3. Brackets (14 and 16) to the sleeve.
4. Pivot stud (25).
5. Washer (17).

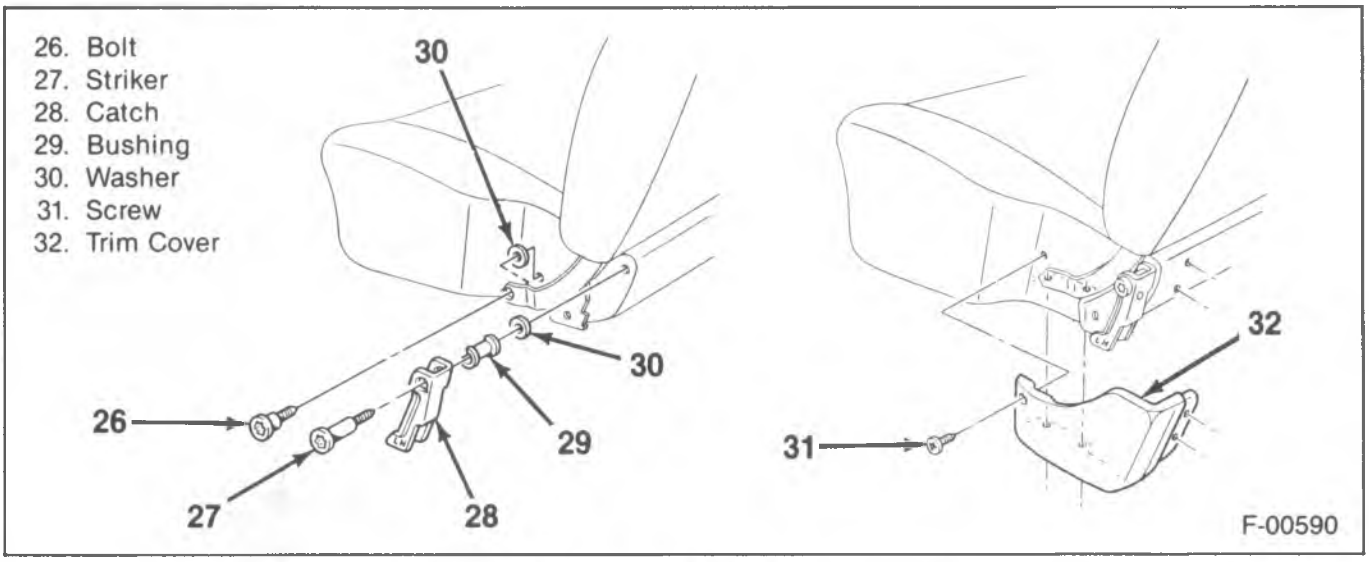


Figure 5—Seat Back Catch Components

6. Nut (18).
   - Tighten each nut until it bottoms out.
7. Seat. Refer to "Utility Vehicle Passenger Front Bucket Seat Replacement."

BENCH SEATBACK AND CATCH REPLACEMENT

Remove or Disconnect (Figure 5)

1. Seat back trim cover (32).
2. Striker (27).
3. Catch (28) with bushing (29).
4. Washer (30).
5. Seatback to seat base bolt (26).
6. Washer (30).
7. Seatback from the vehicle.

Install or Connect (Figure 5)

1. Seatback to the vehicle.
2. Washer (30) between the seat base and the seatback frame.
3. Seatback to seat base bolt (26).
4. Washer (30).
5. Catch (28) with bushing (29).
6. Striker (27).
7. Seat back trim cover (32).

SEAT BELT REPLACEMENT

This procedure covers belts for all seats except high back bucket seats.

Remove or Disconnect (Figures 6 and 7)

1. Upper seat belt anchor plate cover (42).
   - Pry the top of the cover away from the anchor plate.
2. Anchor plate bolt (36).
3. Anchor plate (35).
4. Plug (39) (except regular cab).
5. Retractor (33) to floor bolt (40).
6. Seat belt wire (left side only).
7. Retractor from the vehicle.
8. Plug (37).
9. Buckle (34) to floor bolt (38).
10. Buckle from the floor.

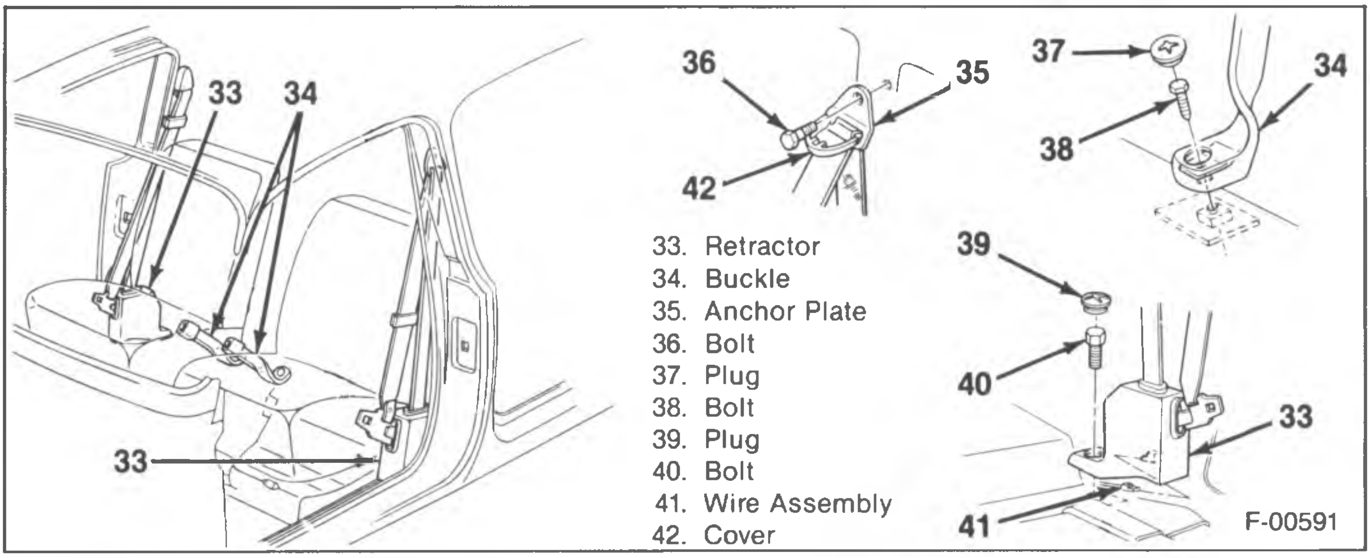
NOTICE: For steps 2, 6, and 9 see "Notice" on page 10A2-1 of this section.

Install or Connect

1. Buckle (38) to the floor.
2. Buckle to floor bolt (38).

Tighten

   - Bolt to 50 N·m (37 ft. lbs.).
3. Plug (37).
4. Retractor to the vehicle.
5. Seat belt wire (left side only).
6. Retractor to floor bolt (40).



33. Retractor
34. Buckle
35. Anchor Plate
36. Bolt
37. Plug
38. Bolt
39. Plug
40. Bolt
41. Wire Assembly
42. Cover

Figure 6—Bucket Seat Belt Components

Tighten

- Bolt to 50 N·m (37 ft. lbs.).

7. Plug (39) (except regular cab).

8. Anchor plate (35) to the door pillar.

9. Anchor plate bolt (36).

Tighten

- Bolt to 50 N·m (37 ft. lbs.).

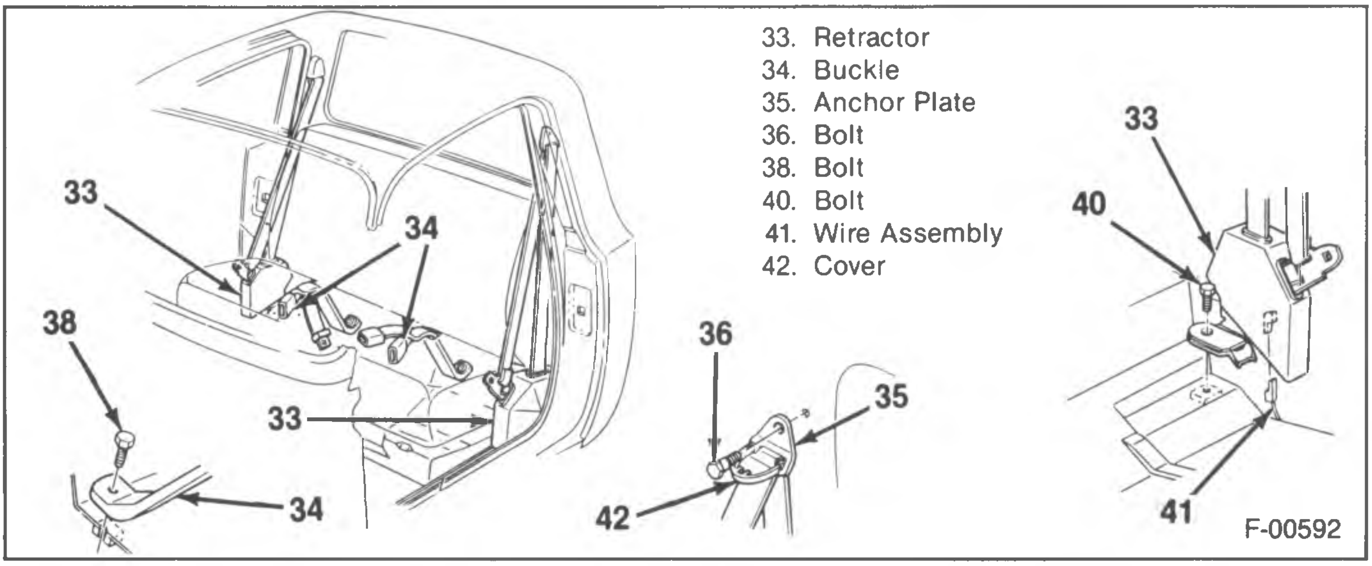
10. Upper seat belt anchor plate cover (42).

    - Pivot the cover upwards, and press it into place.

HIGH BACK BUCKET SEAT BELT REPLACEMENT

Remove or Disconnect (Figure 8)

1. Upper seat belt anchor plate cover (49).
    - Pry the top of the cover away from the anchor plate.
2. Anchor plate bolt (48).
3. Anchor plate (45).
4. Retractor lower flap (54).
5. Retractor (44) to pillar bolt (47).
6. Lower anchor bolt (53).
7. Lower anchor (46).
8. Retractor from the vehicle.
9. Plug (51).
10. Buckle (43) to floor bolt (50).
11. Seat belt wire (left side only).



33. Retractor
34. Buckle
35. Anchor Plate
36. Bolt
38. Bolt
40. Bolt
41. Wire Assembly
42. Cover

Figure 7—Bench Seat Belt Components

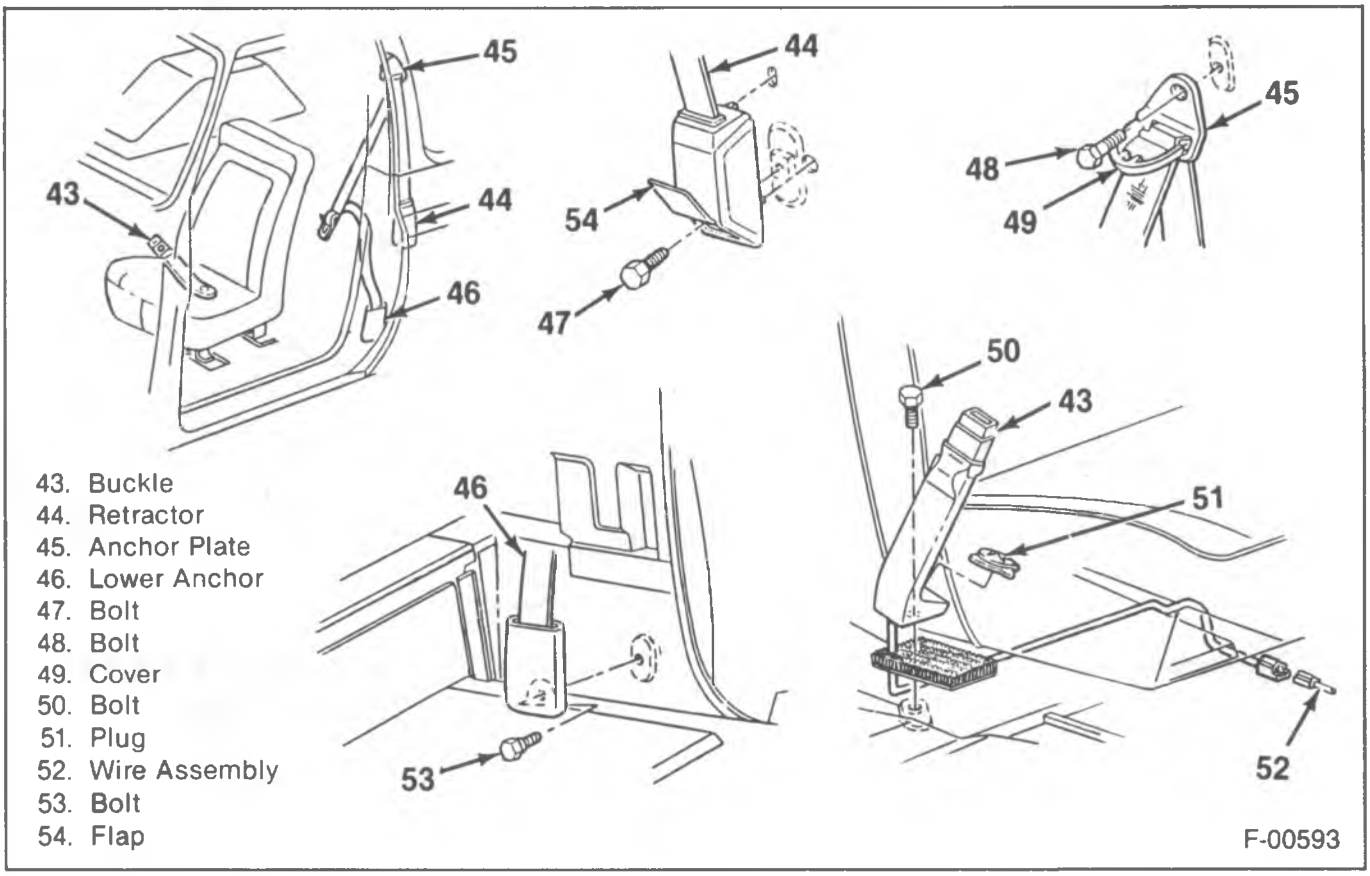


Figure 8—High Back Bucket Seat Back Components

12. Buckle from the floor.

NOTICE: For steps 3, 7, 8 and 11 see "Notice" on page 10A2-1 of this section.

Install or Connect

1. Buckle to the floor.
2. Seat belt wire (left side only).
3. Buckle (43) to floor bolt (50).

   Tighten

   - Bolt to 50 N·m (37 ft. lbs.).
4. Plug (51).
5. Retractor to the vehicle.
6. Lower anchor (46) to the pillar.
7. Lower anchor bolt (53).

   Tighten

   - Bolt to 50 N·m (37 ft. lbs.).
8. Retractor (44) to pillar bolt (47).

   Tighten

   - Bolt to 50 N·m (37 ft. lbs.).
9. Retractor lower flap.
10. Anchor plate (45).
11. Anchor plate bolt (48).

    Tighten

    - Bolt to 50 N·m (37 ft. lbs.).
12. Upper seat belt anchor plate cover (49).

C/K MODEL — SUBURBAN CENTER SEAT

55. Large Seatback
56. Small Seatback
57. Hinge
58. Bolt
59. Seal
60. Bolt

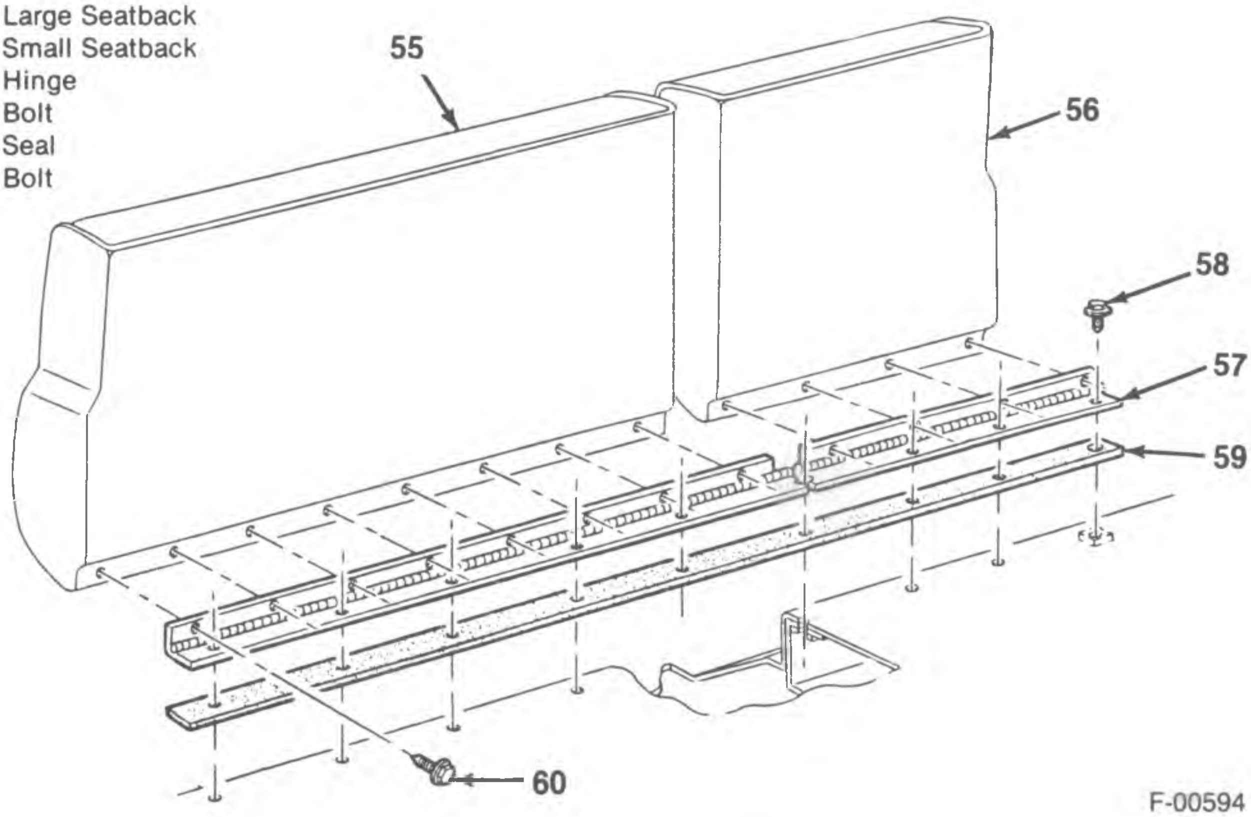


Figure 9—Center Seat Back Mounting

CENTER SEATBACK REPLACEMENT

↔ Remove or Disconnect (Figure 9)

- Fold the seatback forward.

1. Hinge (57) to floor panel bolts (58).
2. Seatback (55 or 56) from the vehicle.
3. Seal (59).
4. Hinge (57) to seatback bolts (60).
5. Hinge (57) from the seatback (55 or 56).

→← Install or Connect (Figure 9)

1. Hinge (57) to the seatback (55 or 56).
2. Hinge (57) to seatback bolts (60).
3. Seal (59).
4. Seatback (55 or 56) to the vehicle.
5. Hinge (57) to floor panel bolts (58).

CENTER SEAT BOTTOM REPLACEMENT

↔ Remove or Disconnect (Figure 10)

- Fold the seat bottom forward.

1. Bracket (105) to floor panel bolts (61).
2. Seat bottom (55 or 56) from the vehicle.
3. Center stop bracket bolts (103) and bracket (64).
4. Side stop bracket bolts (104) and brackets (63).

→← Install or Connect

1. Side stop bracket (63) and bolts (104).
2. Center stop bracket (64) and bolts (103).
3. Seat bottom (55 or 56) to the vehicle.
4. Bracket (105) to floor panel bolts (61).

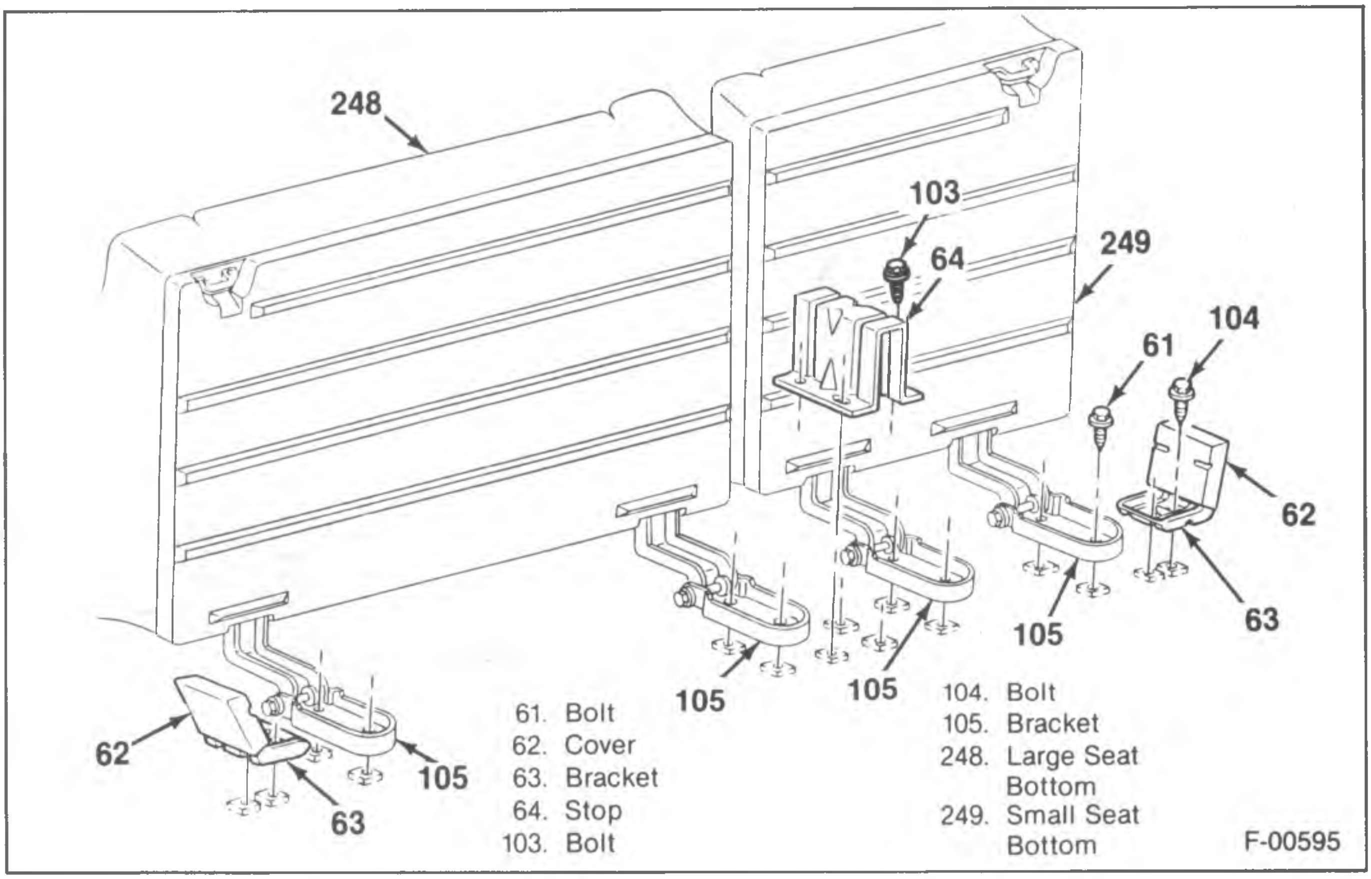


Figure 10—Center Seat Bottom Mounting

CENTER SEAT BOTTOM SUPPORT BRACKET REPLACEMENT

Remove or Disconnect (Figure 11)

- Fold the seat bottom forward.

1. Trim panel bolts (69) and the panel (68).
2. Bracket to seat bolts (67).
3. Bracket to floor panel bolts.
4. Bracket (105) from the vehicle.

Install or Connect (Figure 11)

1. Bracket (105) to the vehicle.
2. Bracket to floor panel bolts.
3. Bracket to seat bolts (67).
4. Trim panel (68) and bolts (69) to the seat.

CENTER SEATBACK BUMPER AND STRIKER REPLACEMENT

Remove or Disconnect (Figure 12)

- Fold the seatback forward.

1. Bumper covers (73).
2. Bumper (75) to seat bolts (74).
3. Bumpers (75).
4. Striker bolts (76).
5. Striker (77).
6. Spacer (78).
7. Plate (79).

Install or Connect (Figure 12)

1. Plate (79).
2. Spacer (78) as required.
3. Striker (77).
4. Striker bolts (76).
5. Bumpers (75).
6. Bumper (75) to seat bolts (74).
7. Bumper covers (73).

CENTER SEAT BOTTOM STRIKER REPLACEMENT

Remove or Disconnect (Figure 11)

- Fold the seat bottom forward.

1. Striker (65) to seat bolts (66).
2. Striker (65) from the seat.

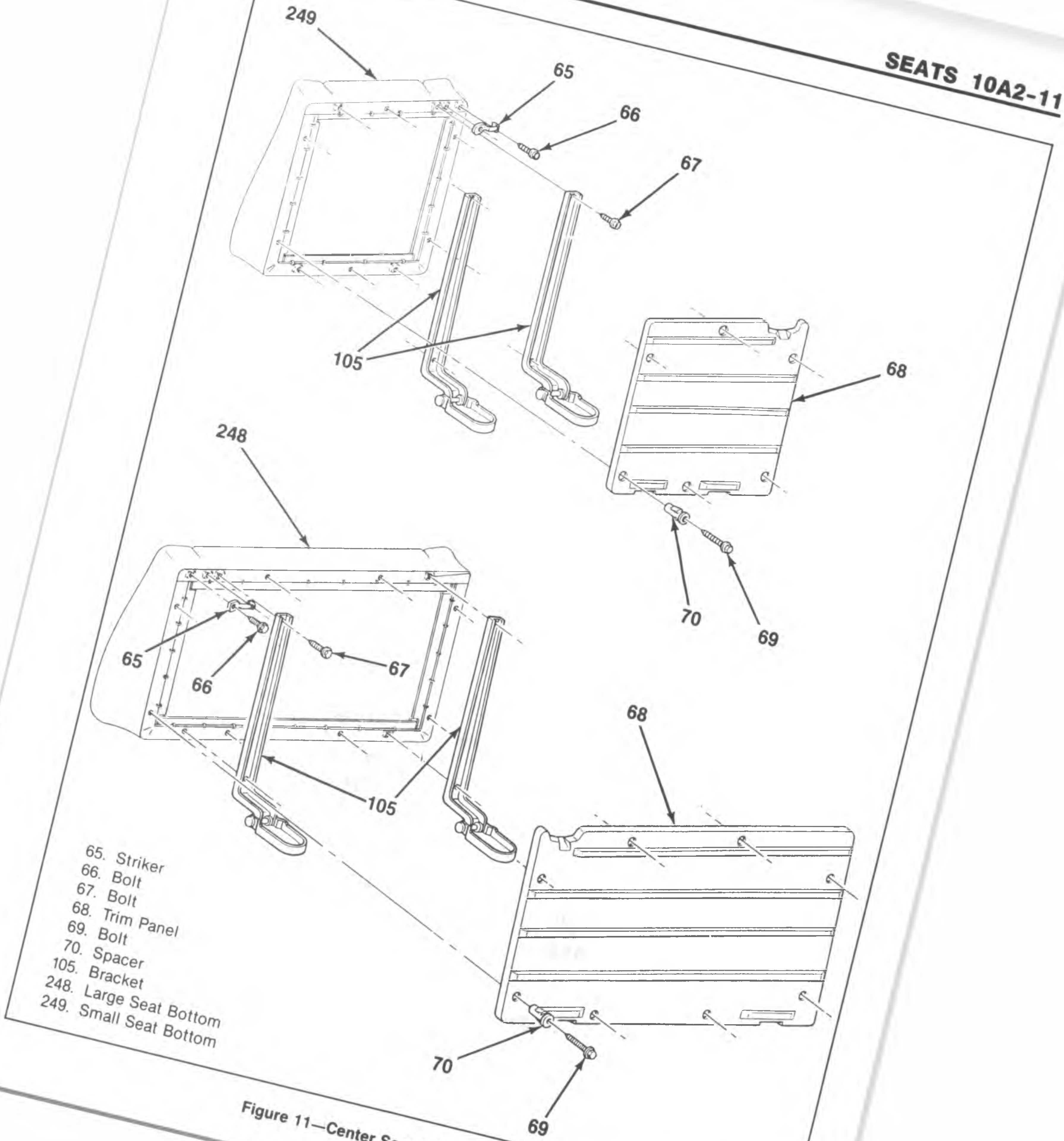


Figure 11—Center Seat Bottom Brackets

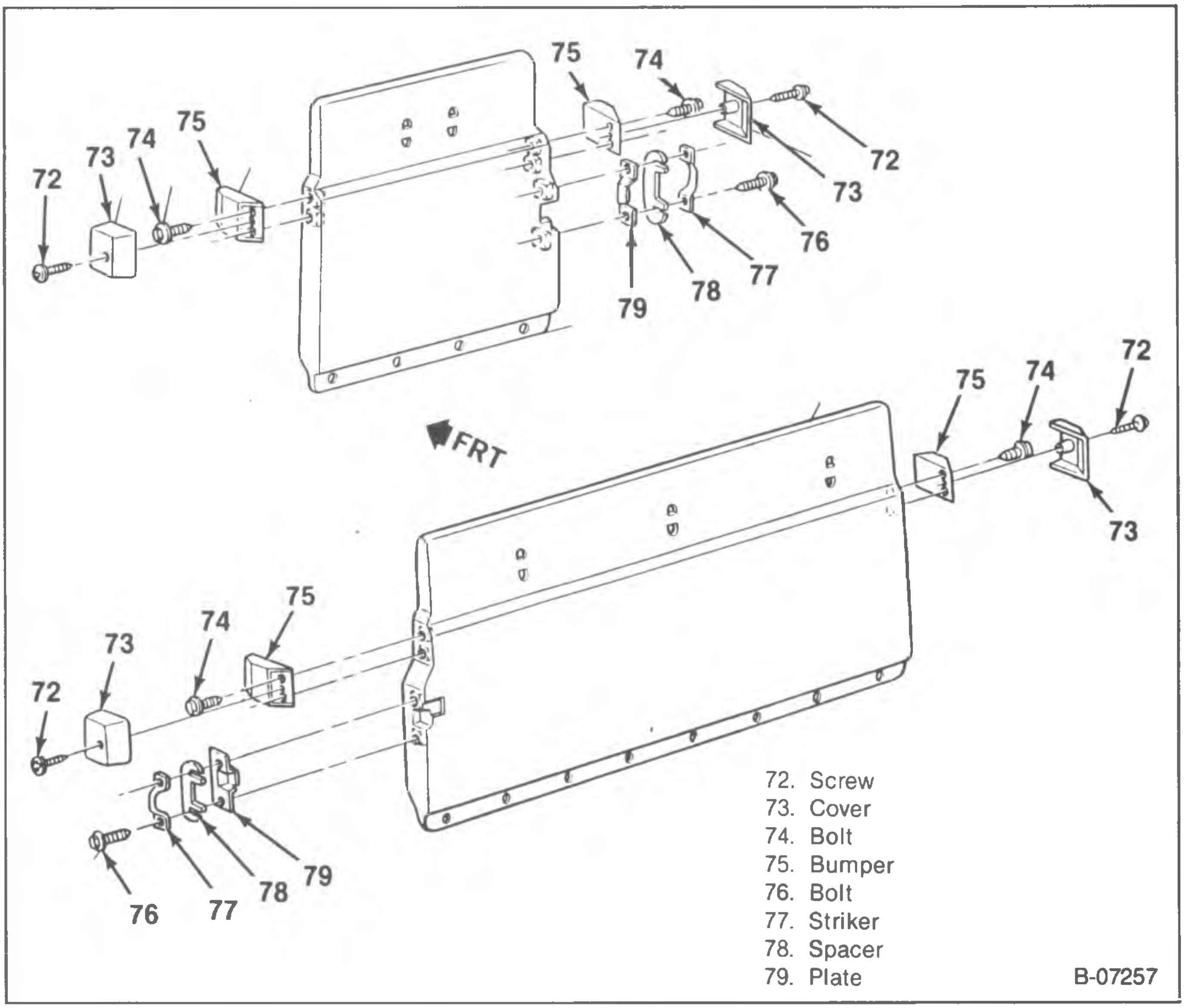


Figure 12—Center Seatback Bumper And Striker Components

→← Install or Connect (Figure 11)

1. Striker (65) to the seat.
2. Striker (65) to seat bolts (66).

CENTER SEATBACK LATCH REPLACEMENT

←→ Remove or Disconnect (Figure 13)

- Fold the seatback forward.

1. Latch bolts (83).
2. Latch from the vehicle.

→← Install or Connect (Figure 13)

1. Latch to the vehicle.
2. Latch bolts (83).

CENTER SEAT BOTTOM LATCH REPLACEMENT

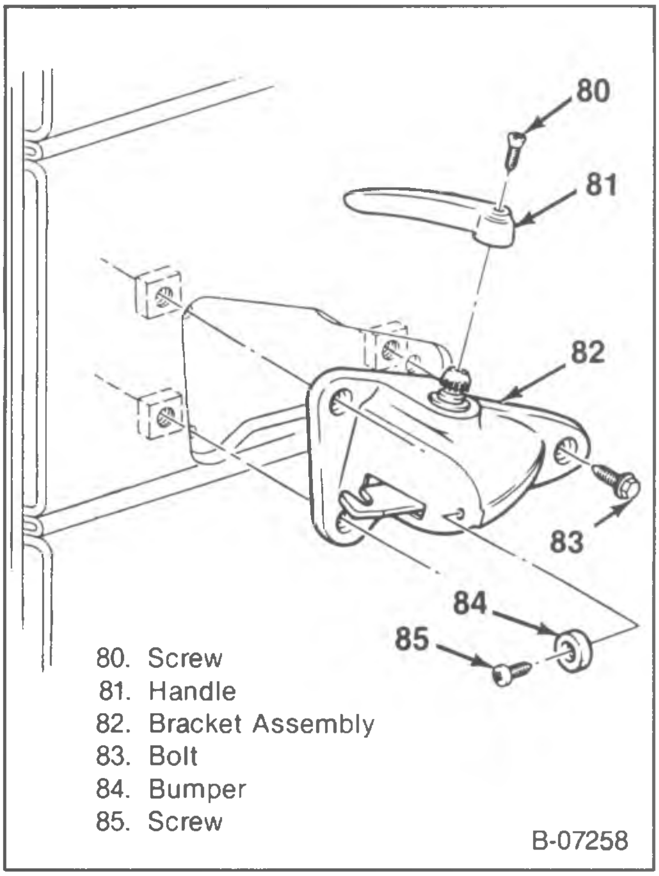
←→ Remove or Disconnect (Figure 14)

- Fold the seat bottom forward.

1. Latch to floor panel bolts (89).
2. Latch (88) from the vehicle.

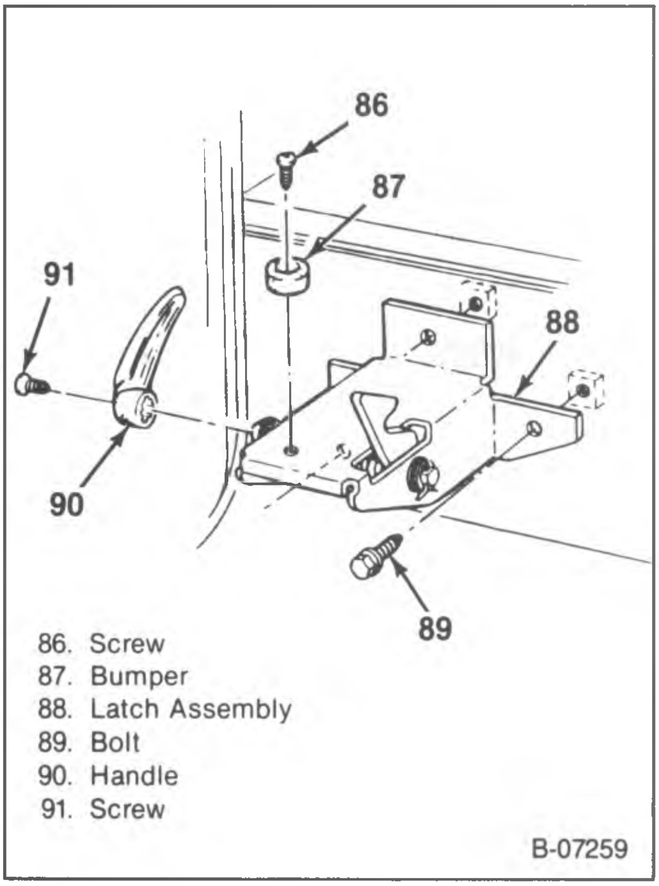
→← Install or Connect

1. Latch (88) to the vehicle.
2. Latch to floor panel bolts (89).



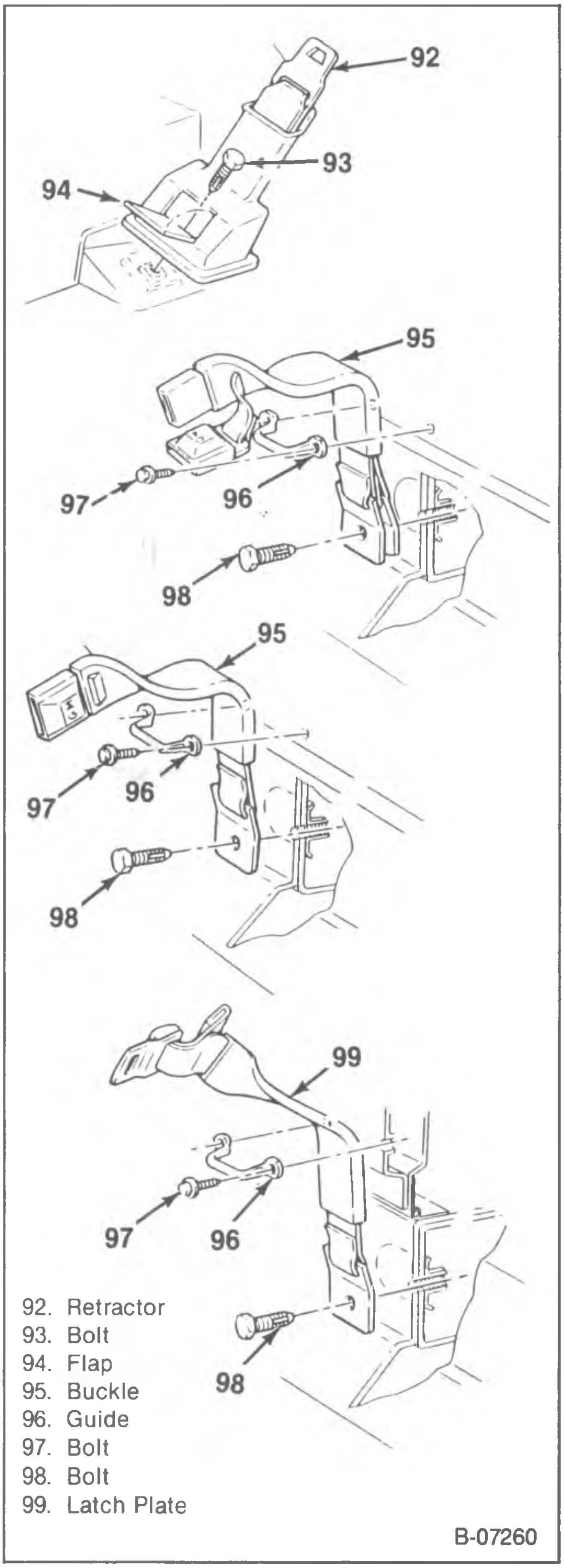
80. Screw
81. Handle
82. Bracket Assembly
83. Bolt
84. Bumper
85. Screw

Figure 13—Center Seatback Latch



86. Screw
87. Bumper
88. Latch Assembly
89. Bolt
90. Handle
91. Screw

Figure 14—Center Seat Bottom Latch



92. Retractor
93. Bolt
94. Flap
95. Buckle
96. Guide
97. Bolt
98. Bolt
99. Latch Plate

Figure 15—Center Seat Belt Components

CENTER SEAT BELT REPLACEMENT

Remove or Disconnect (Figure 15)

- Fold the seat bottoms forward.
- Note the position of the belts.

1. Retractor flaps (94).
2. Retractor bolts (93).
3. Retractor (92) from the vehicle.
4. Guide assembly bolts (97) and the guides (96).
5. Buckle (95) and latch plate (99) assembly bolts (98).
6. Buckle and latch plate assemblies from the vehicle.

Install or Connect (Figure 15)

NOTICE: For steps 2 and 5 see "Notice" on page 10A2-1 of this section.

1. Buckle and latch plate assemblies to the vehicle.
2. Buckle and latch plate assembly bolts (98).

Tighten

- Bolts to 50 N·m (37 ft. lbs.).

3. Guide assemblies (96) and guide bolts (97).
4. Retractor (92) to the vehicle.
5. Retractor bolts (93).

Tighten

- Retractor bolts to 50 N·m (37 ft. lbs.).

6. Retractor flaps (94).

C/K MODEL REAR SEATS

CREW CAB REAR SEAT REPLACEMENT

Remove or Disconnect (Figure 16)

1. Rear bracket (107) to floor bolts (106).
2. Front bracket (109) to floor bolts (110).
3. Seat from the vehicle.
4. Front and rear bracket to seat bolts (108).
5. Rear bracket (107).
6. Front bracket (109).

Install or Connect (Figure 16)

1. Front bracket (109) and bolts (108).
2. Rear bracket (107) and bolts (108).
3. Seat to the vehicle.
4. Front bracket (109) to floor bolts (110).
5. Rear bracket (107) to floor bolts (106).

CREW CAB REAR SEATBACK AND CATCH REPLACEMENT

Remove or Disconnect (Figure 5)

1. Seat back trim cover (32).
2. Striker (27).
3. Catch (28) with bushing (29).
4. Washer (30).
5. Seatback to seat base bolt (26).
6. Washer (30).
7. Seatback from the vehicle.

Install or Connect (Figure 5)

1. Seatback to the vehicle.
2. Washer (30) between the seat base and the seatback frame.
3. Seatback to seat base bolt (26).
4. Washer (30).
5. Catch (28) with bushing (29).
6. Striker (27).
7. Seat back trim cover (32).

CREW CAB REAR SEAT BELT REPLACEMENT

RETRACTOR REPLACEMENT

Remove or Disconnect (Figure 17)

1. Retractor to floor panel bolts (115).
2. Retractor (112).

Install or Connect (Figure 17)

1. Retractor (112) to the floor panel.

NOTICE: See "Notice" on page 10A2-1 of this section.

2. Retractor to floor panel bolts (115).

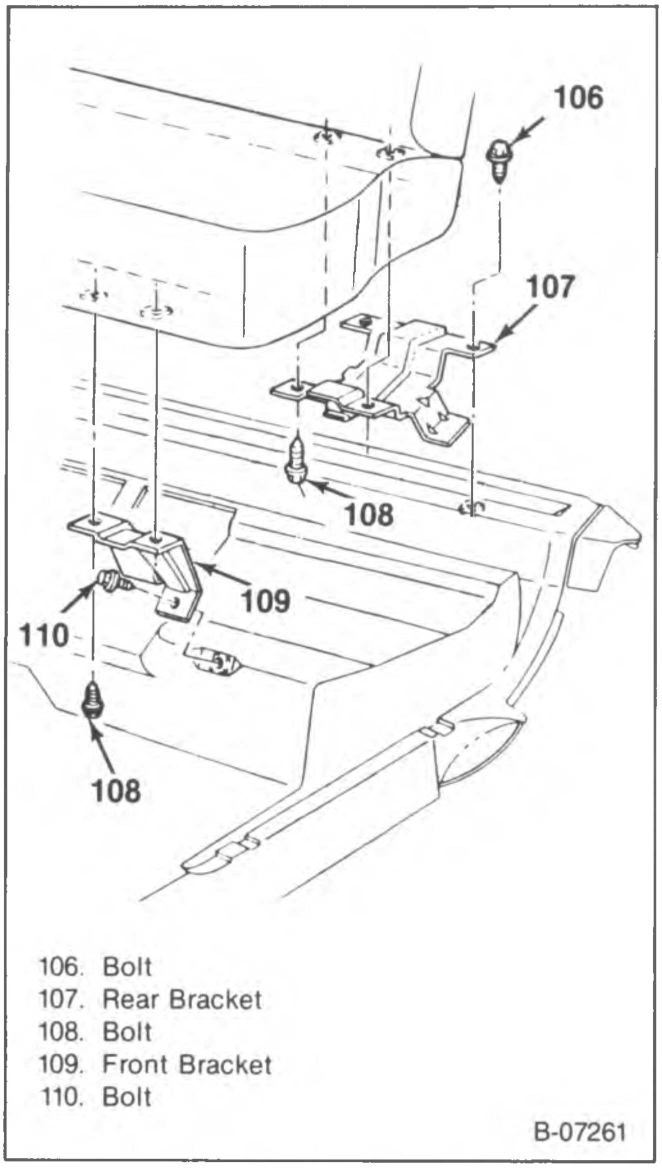


Figure 16—Crew Cab Rear Seat Components

Tighten

- Bolts to 50 N·m (37 ft. lbs.).

CENTER BUCKLE AND LATCH PLATE REPLACEMENT

Remove or Disconnect (Figure 17)

1. Seat. Refer to "Crew Cab Rear Seat Replacement."
- Note the position of the belts.
2. Belt to floor panel bolts (114).
3. Left belt (113) and right belt (113) from the vehicle.

Install or Connect (Figure 17)

1. Left belt (113) and right belt (113) to the vehicle.

NOTICE: See "Notice" on page 10A2-1 of this section.

2. Belt to floor panel bolts (114).

Tighten

- Bolts to 50 N·m (37 ft. lbs.).

3. Seat. Refer to "Crew Cab Rear Seat Replacement."

UTILITY VEHICLE REAR SEAT REPLACEMENT

Remove or Disconnect (Figure 18)

- Fold the seat forward.
1. Hinge to floor bolt (116) and spring washer (117).
2. Seat from the vehicle.

Install or Connect (Figure 18)

1. Seat to the vehicle.
2. Spring washer (117) and bolt (116).

UTILITY VEHICLE REAR SEAT COVER ROD REPLACEMENT

Remove or Disconnect (Figure 19)

1. Actuator rod clip (123).
2. Actuator rod (124).

Install or Connect (Figure 19)

1. Actuator rod (124).
2. Actuator rod clip (123).

UTILITY VEHICLE REAR SEAT STORAGE STRUT REPLACEMENT

Remove or Disconnect (Figure 20)

- Tilt the seat forward.
1. Strut (125) to floor bolts (126).
2. Strut (125) to seat bolts (127).
3. Strut from the vehicle.

Install or Connect (Figure 20)

1. Strut (125) to the vehicle.
2. Strut (125) to seat bolts (127).
3. Strut (125) to floor bolts (126).

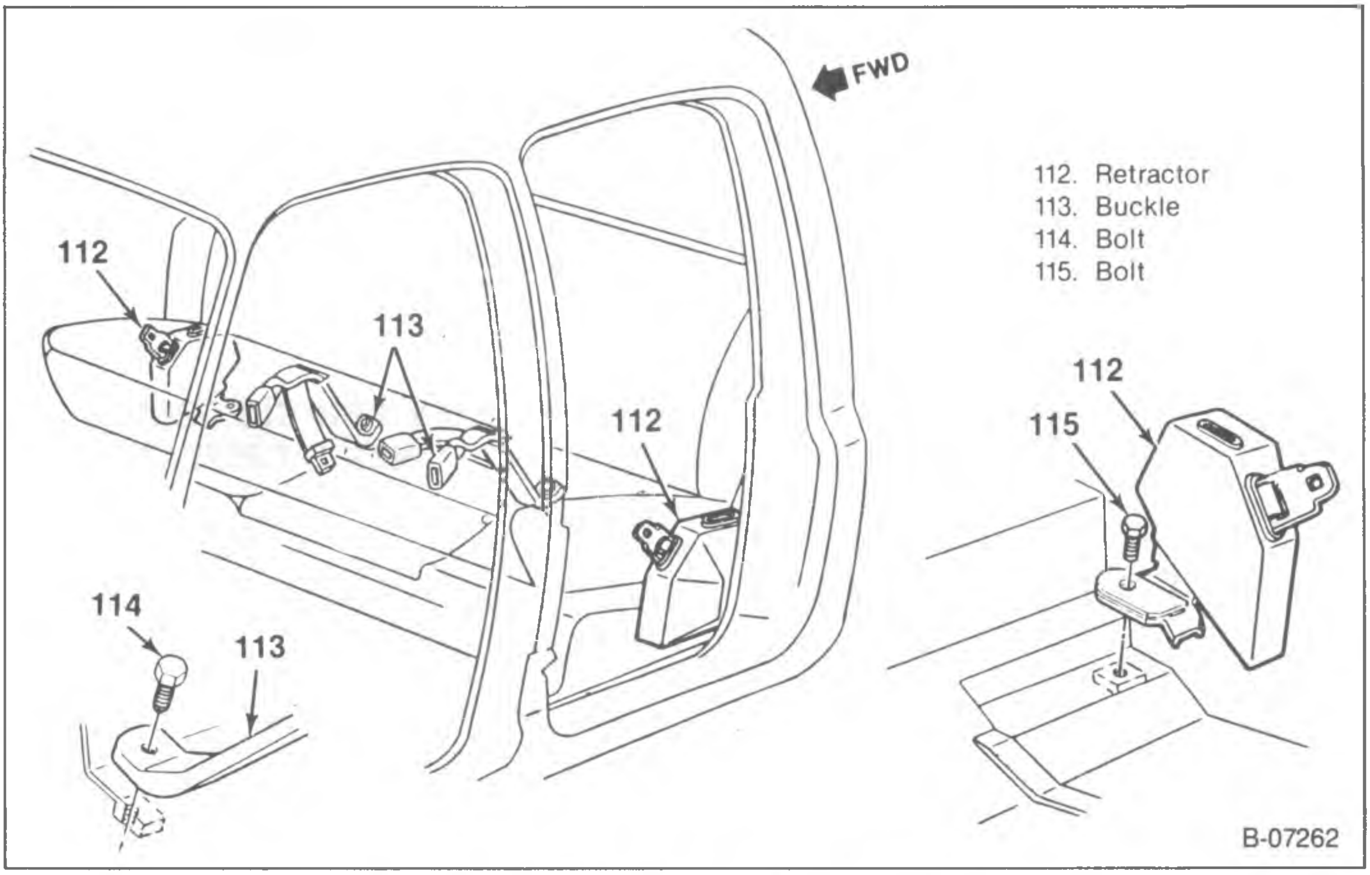


Figure 17—Crew Cab Rear Seat Belt Components

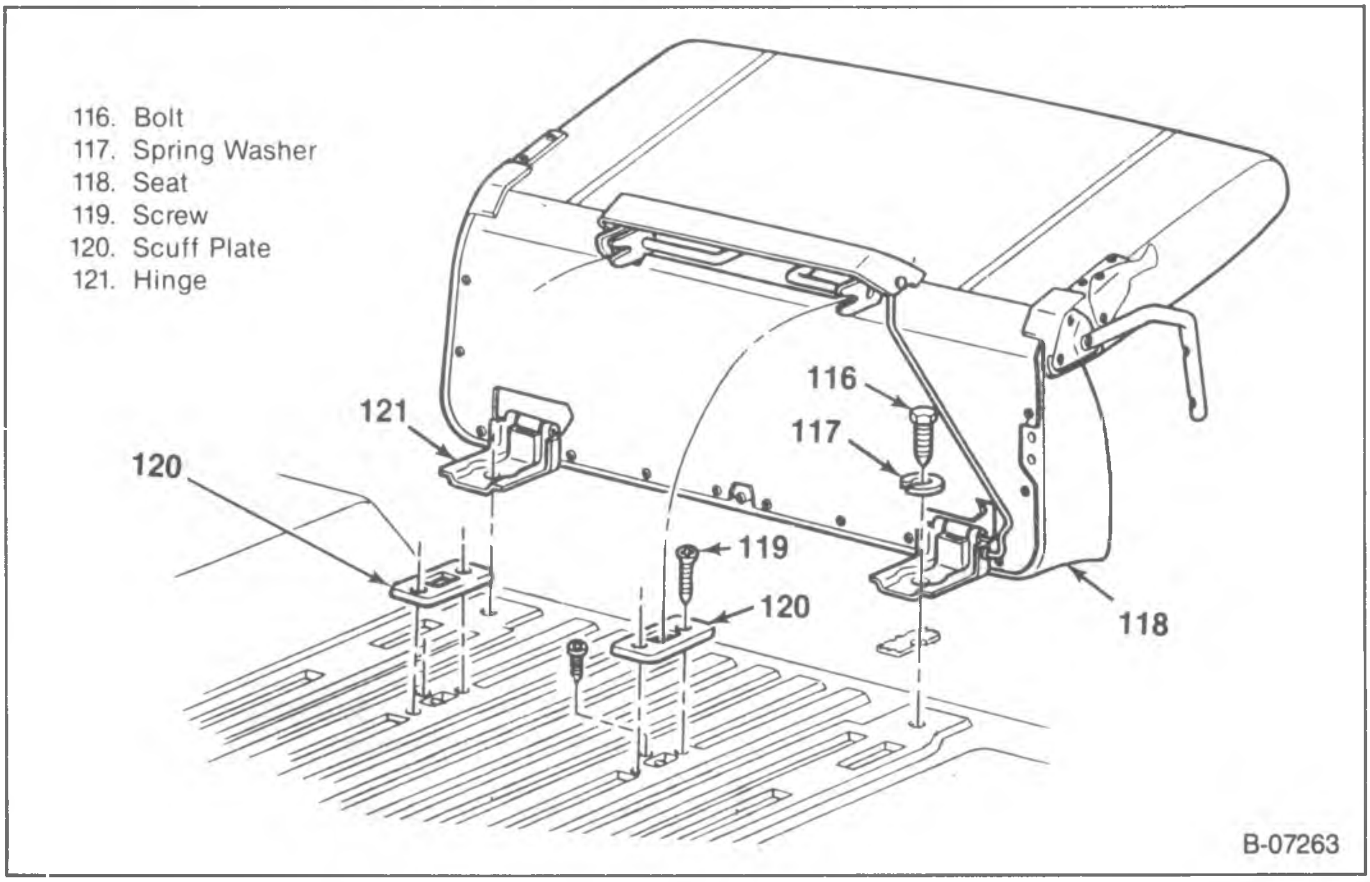


Figure 18—Utility Vehicle Rear Seat Components

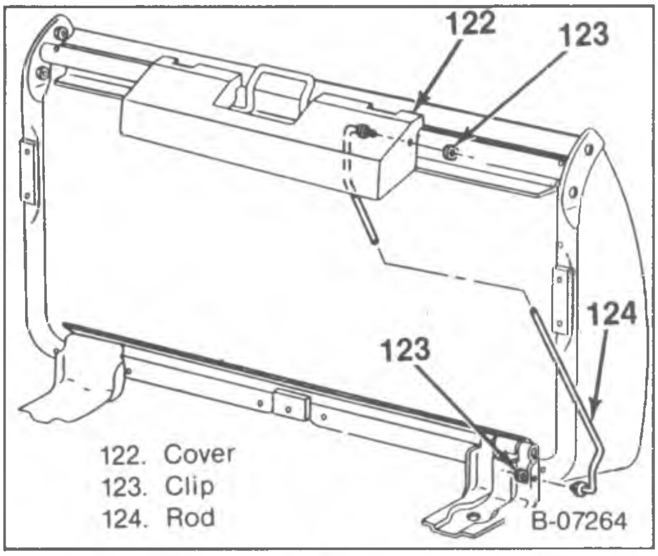


Figure 19—Utility Vehicle Cover Rod

UTILITY VEHICLE REAR SEAT BELT REPLACEMENT

Remove or Disconnect (Figure 21)

- Fold the seat forward.

1. Side latch plate (128) to floor panel bolts (129).
2. Side latch plate (128) from the vehicle.
3. Rear seat cover rod.
4. Latch and support assembly from the seat. Refer to "Utility Vehicle and Suburban Latch and Support Assembly Replacement."
5. Seat belt (130) to latch bolts (131).
6. Seat belts from the latch.

NOTICE: For steps 2 and 6 see "Notice" on page 10A2-1 of this section.

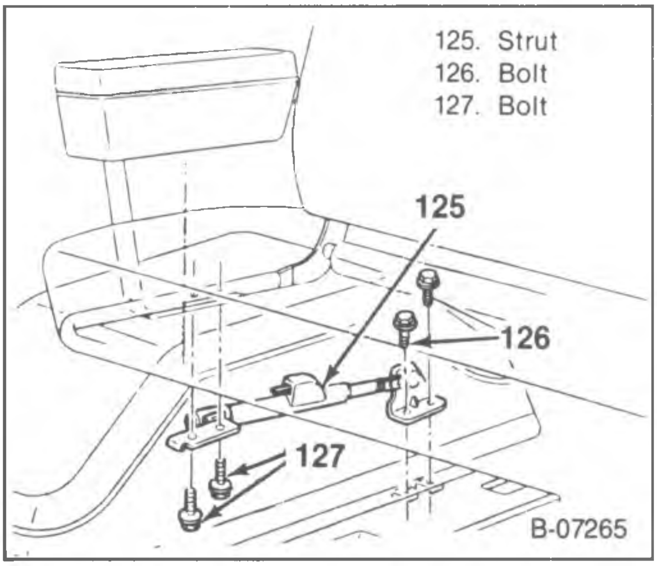


Figure 20—Utility Vehicle Storage Strut

Install or Connect (Figure 21)

1. Seat belts (130) to the latch.
2. Seat belts (130) to latch bolts (131).

Tighten

- Bolts to 50 N·m (37 ft. lbs.).

3. Latch and support assembly to the seat. Refer to "Utility Vehicle and Suburban Latch and Support Assembly Replacement."
4. Rear seat cover rod.
5. Side latch plate (128) to the vehicle.
6. Side latch plate (128) to floor panel bolts (129).

Tighten

- Bolts to 50 N·m (37 ft. lbs.).

UTILITY VEHICLE AND SUBURBAN SEATBACK AND HINGE REPLACEMENT

Remove or Disconnect (Figures 22 and 23)

1. Seatback to hinge bolts (139).
2. Seatback (154) from the vehicle.
3. Hinge (153) to seat bottom bolts (137).
4. Hinge from the vehicle.
5. Armrest to hinge bolt (136).
6. Armrest support (138) from the hinge.

Install or Connect

1. Armrest (133) to the hinge.
2. Armrest to hinge bolt (136).
3. Hinge to the vehicle.
4. Hinge (153) to seat bottom bolts (137).
5. Seatback (154) to the vehicle.
6. Seatback to hinge bolts (139).

UTILITY VEHICLE AND SUBURBAN LATCH AND SUPPORT ASSEMBLY REPLACEMENT

Remove or Disconnect (Figures 24 and 25)

- Fold the seat forward (Utility vehicle only).

1. The seat (Suburban only). Refer to "Suburban Seat Replacement."
2. Latch cover rod (Utility vehicle only).
3. Latch cover (Suburban only) (141).
4. Latch to seat bolts (145).
5. Latch (144) from the seat.

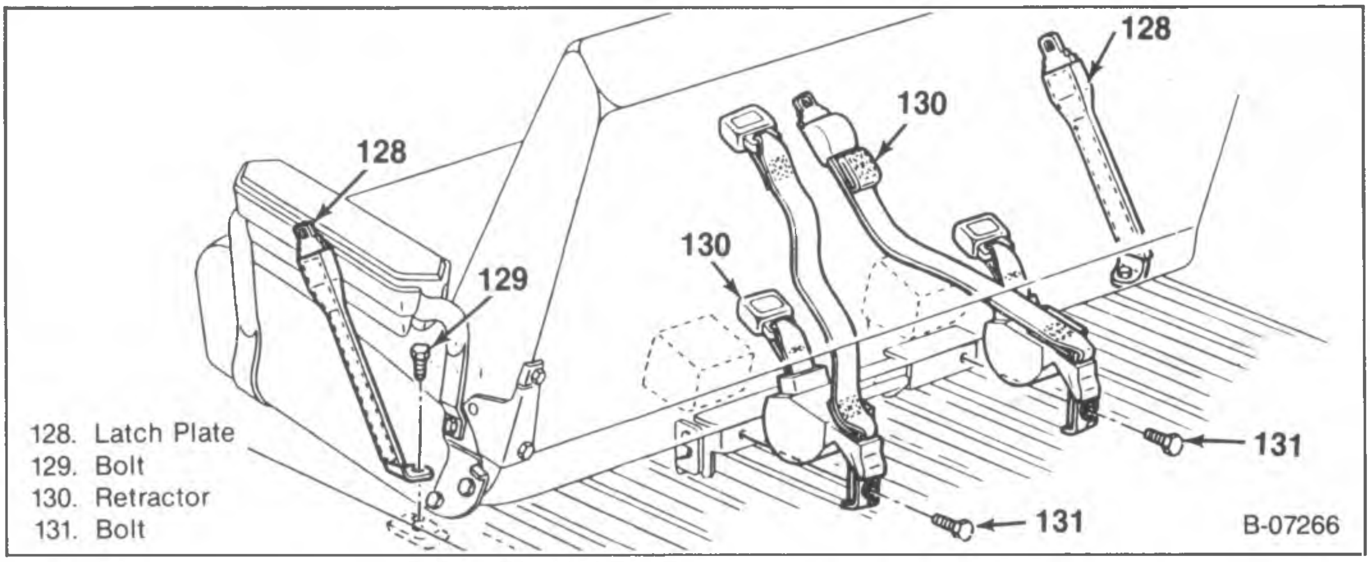


Figure 21—Utility Vehicle Rear Seat Belts

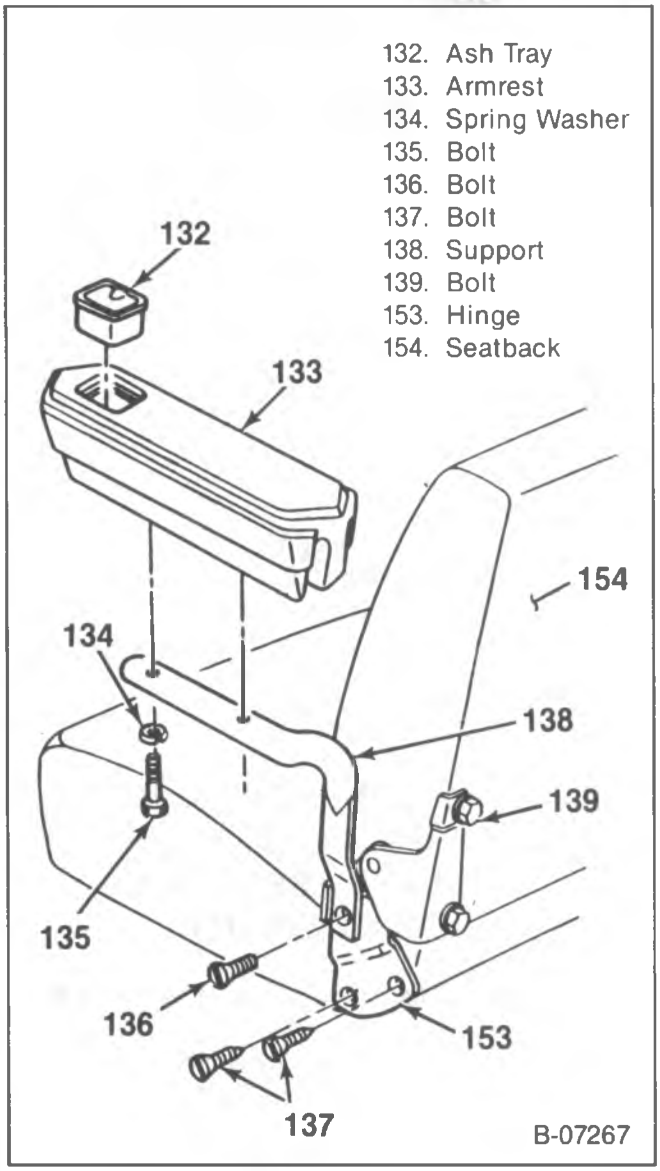


Figure 22—Left Seatback Hinge

6. Latch cover (143) (Utility vehicle only).

Install or Connect

1. Latch cover (141) to the seat (Utility vehicle only).
2. Latch (144) to the seat.
3. Latch to seat bolts (145).
4. Latch cover (Suburban only).
5. Latch cover rod (Utility vehicle only).
6. The seat (Suburban only). Referr to "Suburban Seat Replacement."

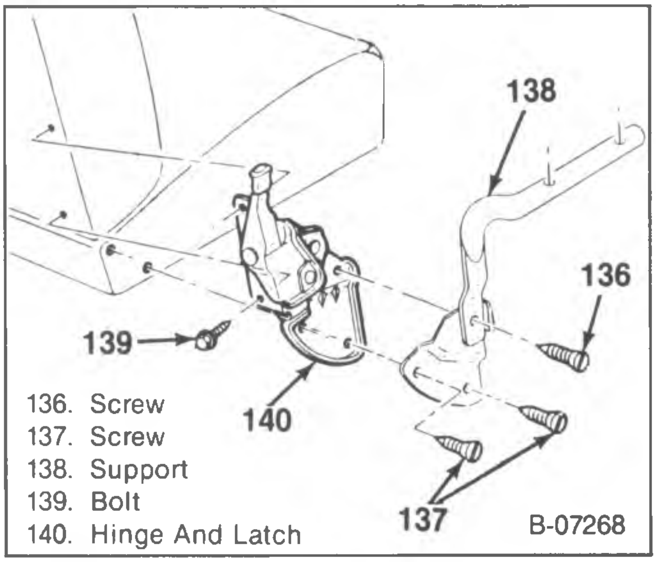


Figure 23—Right Seatback Hinge

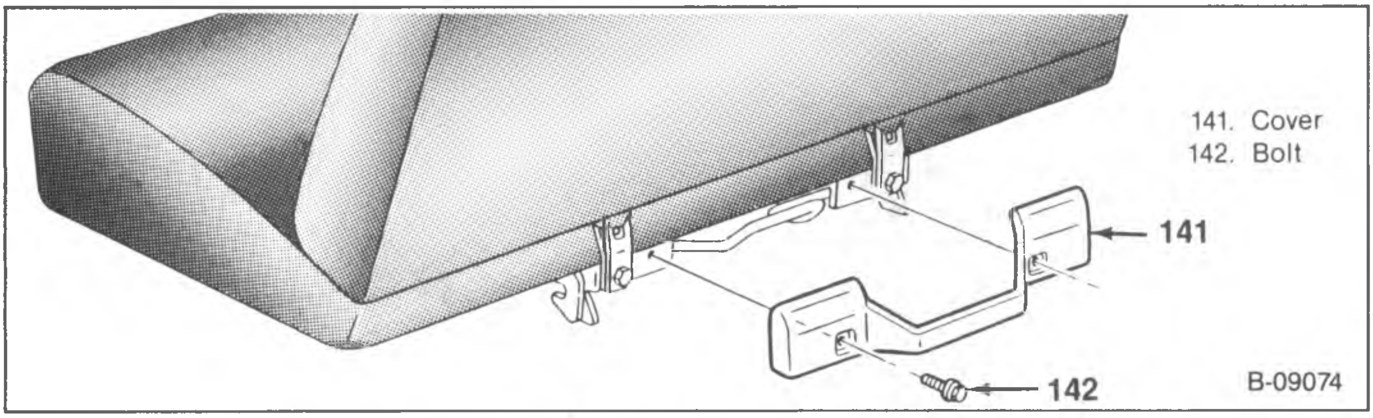


Figure 24—Suburban Rear Seat Latch Cover

SUBURBAN REAR SEAT REPLACEMENT

REMOVAL

1. Unlatch the seat, and pull towards the rear of the vehicle.
2. Remove the seat from the vehicle.

INSTALLATION

1. Place the seat in the vehicle.
2. Place the hooked retainers onto the anchor pins.
3. Latch the seat.
4. Push back and forth on the seat to be sure it is latched.

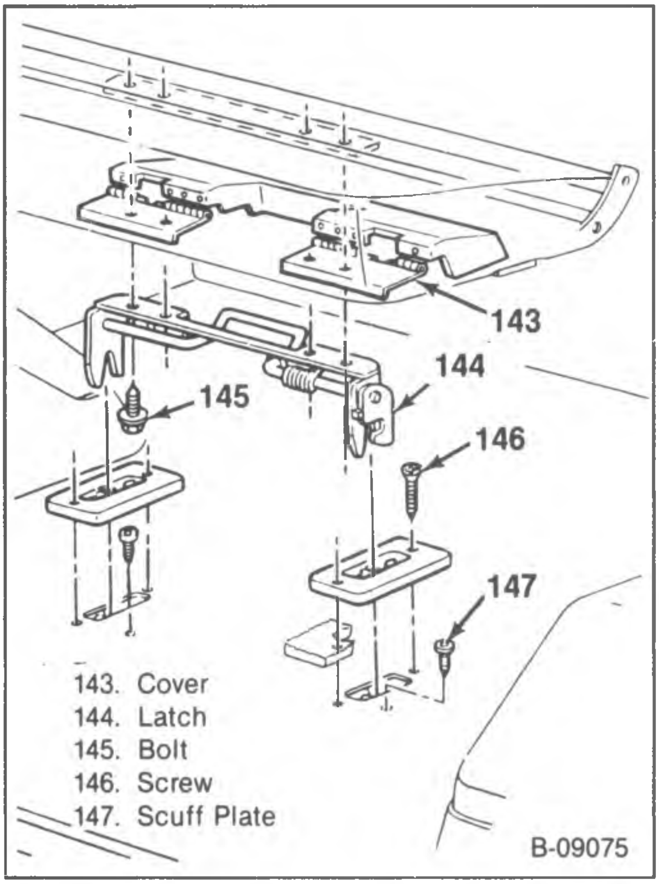


Figure 25—Rear Seat Latch Components

SUBURBAN REAR SEAT BELT REPLACEMENT

↔ Remove or Disconnect (Figure 26)

1. Rear seat latch cover (figure 24).
2. Seat belts (151 and 152) to latch bolts (150).
3. Seat belts from the seat.
4. Side buckle (148) to floor panel bolts (149).
5. Buckle (148) from the vehicle.

NOTICE: For steps 2 and 4 see "Notice" on page 10A2-1 of this section.

→← Install or Connect

1. Buckle (148) to the vehicle.
2. Buckle (148) to floor panel bolts (149).

Tighten

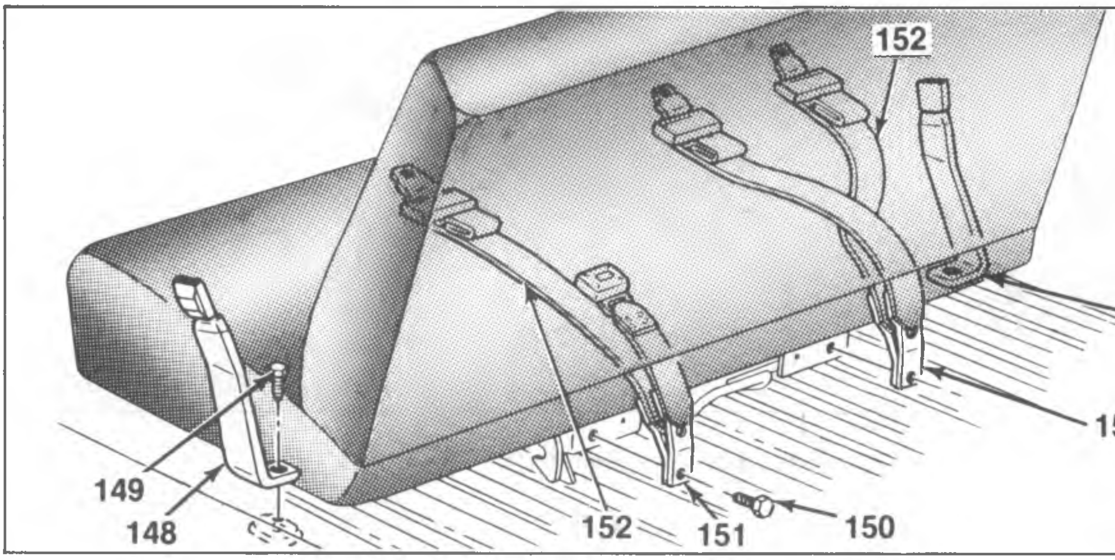
- Bolts to 50 N·m (37 ft. lbs.).

3. Seat belts (151 and 152) to the seat.
4. Seat belt to latch bolts (150).

Tighten

- Bolts to 50 N·m (37 ft. lbs.).

5. Rear seat latch cover (figure 24).



148. Buckle
149. Bolt
150. Bolt
151. Buckle Assembly
152. Latch Plate

Figure 26—Suburban Rear Seat Belts

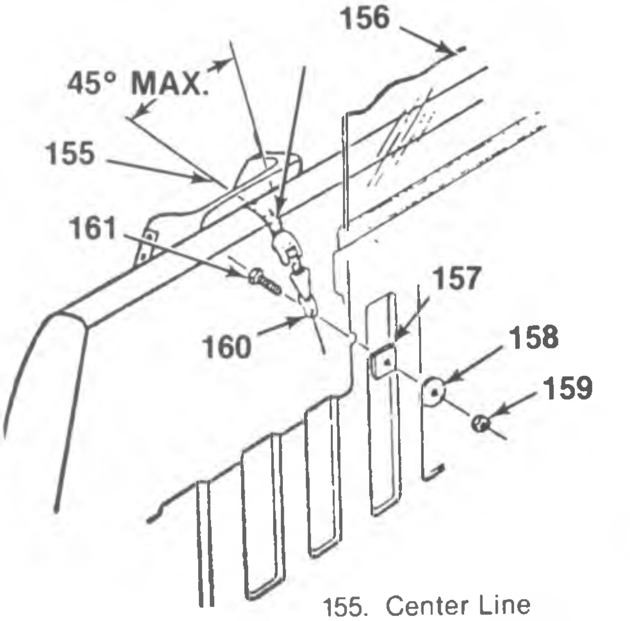
C/K MODEL TOP STRAP BELT ANCHOR INSTALLATION

All hardware discussed in this procedure should be supplied or available from the child seat manufacturer. Be sure the child seat position does not conflict with any additional requirements provided by its manufacturer, or with any recommendations in the Child Restraint section of the Owner's Manual.

The child seat may be used only in a forward facing seating location.

PICKUP AND CREW CAB MODELS

1. Place the Child Seat in the front seating position (rear seating position on crew cab models) (figure 27).
2. Secure the vehicle lap belt over the armrests of the Child Seat in the position which the Child Seat will be used.
3. Select a suitable anchor bracket mounting location on the cab back panel. The location must be:
   - — Located near the rear window reinforcement. The angle between the Child Seat top strap and horizontal should not exceed 45°.
   - — As close to the center line of the Child Seat as possible, but in no case more than 50 mm (2-inches) towards the passenger side of the cab, and 150 mm (6-inches) towards the drivers side of the cab.
   - — In a position clear of the fuel tank, fuel lines, brake lines, exhaust systems, etc.
4. Drill an 8 mm (5/16-inch) diameter hole through the cab panel at the selected location.



155. Center Line
156. Window
157. Sealer
158. Anchor Plate
159. Nut
160. Anchor Bracket
161. Bolt

B-09152

Figure 27—Pickup Top Strap Belt Components

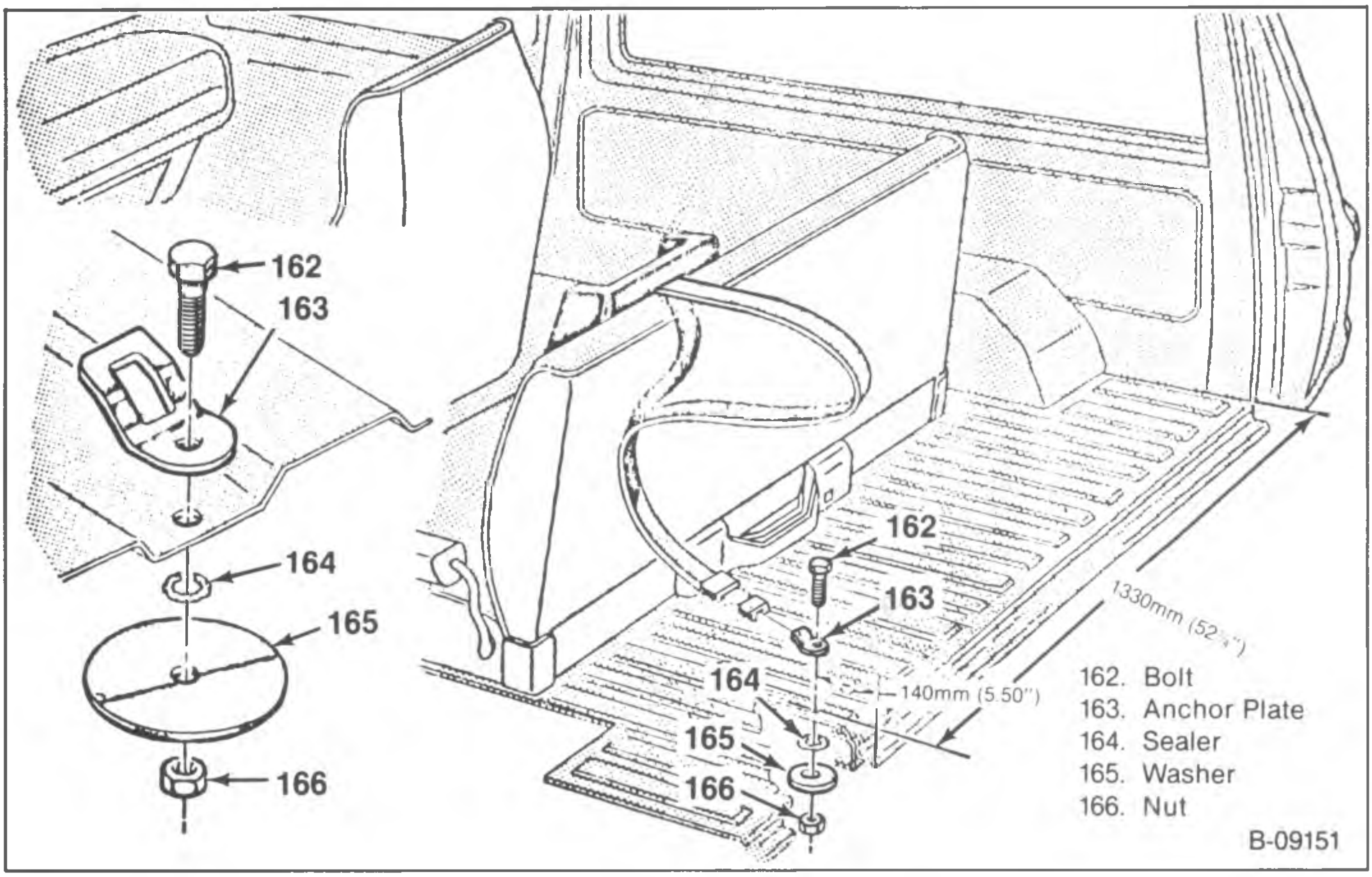


Figure 28—Utility Vehicle Second Seat Top Strap Belt Components

NOTICE: See "Notice" on page 10A2-1 of this section.

5. Install the bolt (161), anchor bracket (160), anchor plate (158), and lock nut (159) to the hole with an appropriate sealant.
6. Tighten the nut to 31 N·m (23 ft. lbs.).

   Use the Child Seat only in the seating position for which the anchor bracket has been installed, latching the Child Seat top strap hook to the anchor bracket as shown.

CAUTION: In the event that the Child Seat anchorage assembly is removed, the 8 mm ($^{5}/_{16}$-inch) diameter hole must be properly resealed to prevent toxic exhaust fumes from entering the cab.

UTILITY VEHICLE REAR SEAT

1. Determine the location for the anchor by measuring 140 mm (5½-inches) forward from the rear edge of the floor pan (figure 28). Make this measurement in the center of one of the depressed floor pan ribs. Next, measure 1330 mm (52.25-inches) inboard of the right quarter inner panel. Mark the position where these measurements meet.
2. Drill an 8 mm ($^{5}/_{16}$-inch) hole at the mark.
3. To insure proper sealing of the hole, remove any dirt or foreign matter from around the hole on the underside of the floor pan where the sealer is to be applied.

NOTICE: See "Notice" on page 10A2-1 of this section.

4. Place sealer on the hole from the underside of the vehicle and assembly the bolt (162), anchor plate (163), washer (165), and lock nut (166) to the floor pan.
5. Tighten the nut to 31 N·m (23 ft. lbs.). Use the Child Seat only in the seating position for which the anchor bracket has been installed.

NOTICE: In the event the Child Seat anchorage assembly is removed, the 8 mm ($^{5}/_{16}$—inch) diameter hole must be properly resealed.

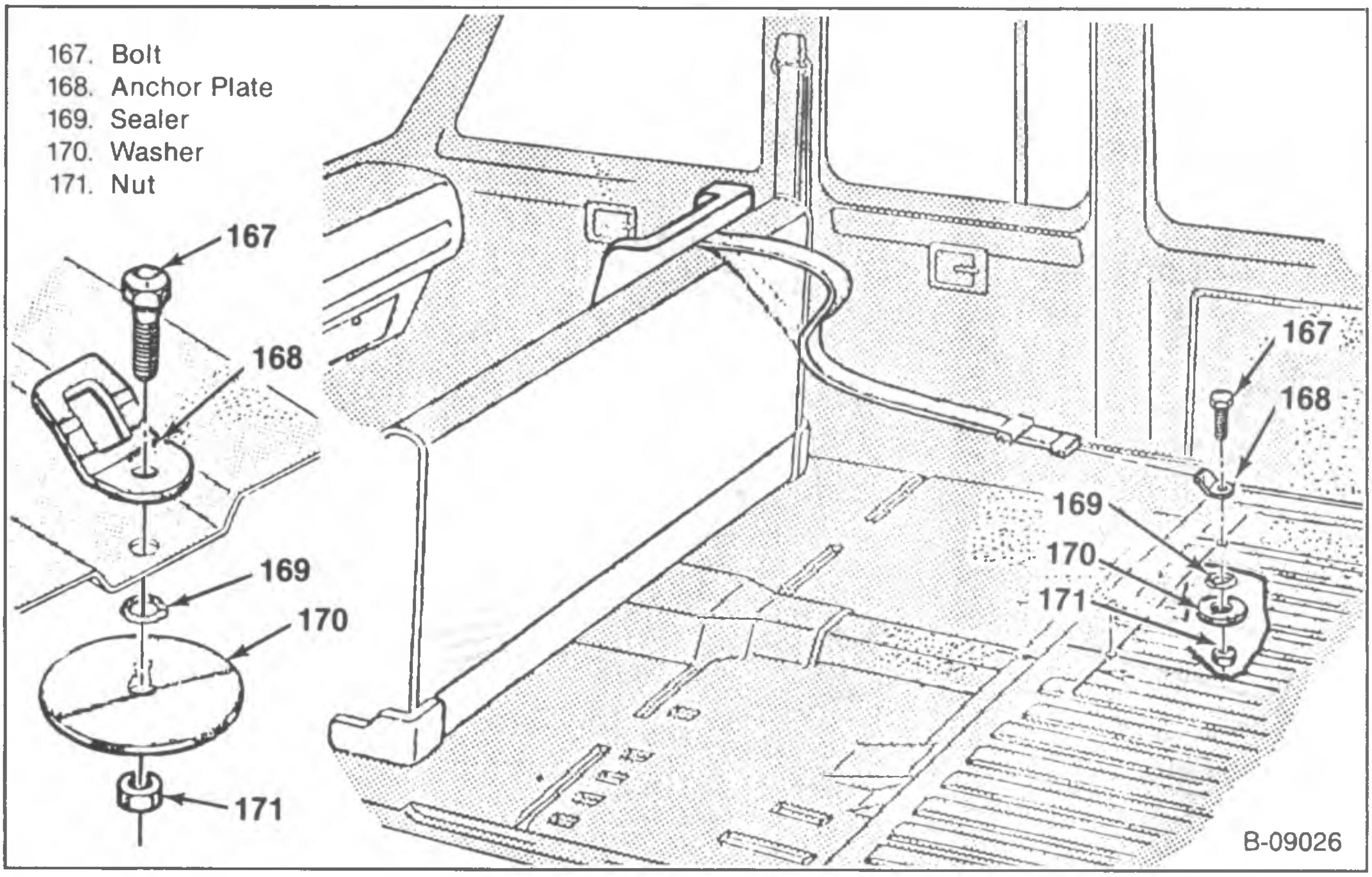


Figure 29—Suburban Front Seat Top Strap Belt Components

SUBURBAN FRONT SEAT

This procedure applies to vehicles not equipped with a second seat or vehicles with the second seat in the down position.

1. Determine the location for the anchor by measuring 51 mm (2-inches) rearward from the rear edge of the kick up molding. Make this measurement in the center of one of the depressed floor pan ribs (figure 29).
   - A. Measure 360 mm (14.6-inches) inboard of the right quarter inner panel for the right seating position.
   - B. Measure 895 mm (35.25-inches) inboard of the right quarter inner panel for the center seating position.

   Mark the position where the measurements meet.
2. Drill an 8 mm (5/16-inch) hole at the mark.
3. To insure proper sealing of the hole, remove any dirt or foreign matter from around the hole on the underside of the floor pan where the sealer is to be applied.

NOTICE: See "Notice" on page 10A2-1 of this section.

4. Place sealer on the hole from the underside of the vehicle and assemble the bolt (167), anchor plate (168), washer (170), and lock nut (171) to the floor pan.
5. Tighten the nut to 31 N·m (23 ft. lbs.). Use the Child Seat only in the seating position for which the anchor bracket has been installed.

NOTICE: In the event the child seat anchorage assembly is removed, the 8 mm (5/16-inch) diameter hole must be properly resealed.

SUBURBAN SECOND SEAT

1. Determine the location for the anchor by measuring 650 mm (25½-inches) rearward from the rear edge of the kick-up molding (figure 30). Next:
   - A. Measure 55 mm (2.12-inches) inboard of the right wheelhouse for the right seating position.
   - B. Measure 590 mm (23.25-inches) inboard of the right wheelhouse for the center seating position.
   - C. Measure 55 mm (2.12-inches) inboard of the left wheelhouse for the left seating position.

   Mark the position where the measurements for the desired seating position meet.

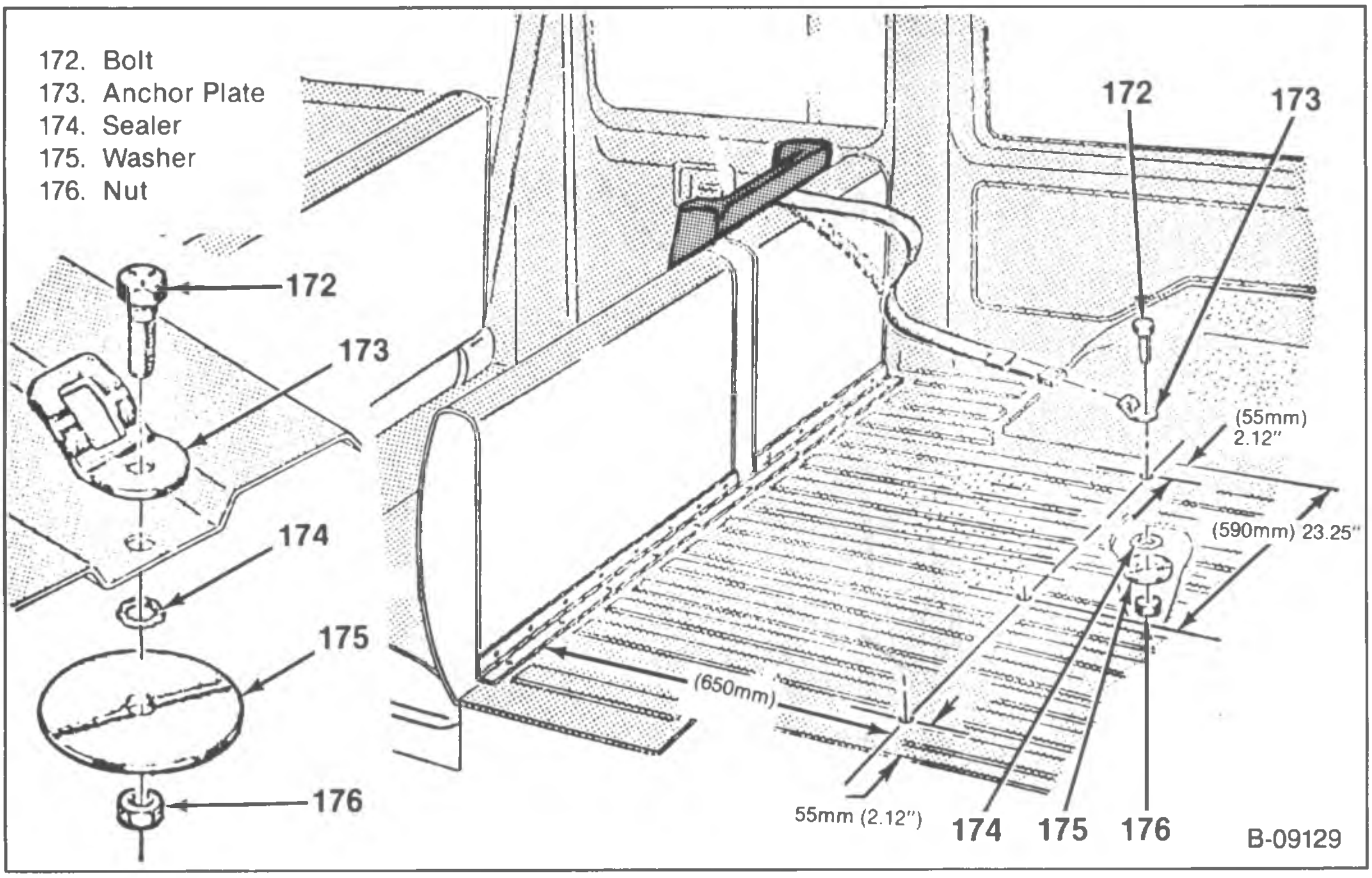


Figure 30—Suburban Second Seat Top Strap Belt Components

2. Drill an 8 mm (5/16-inch) hole at mark.

3. To insure proper sealing of the hole, remove any dirt or foreign matter from around the hole on the underside of the floor pan where the sealer is to be applied.

NOTICE: See "Notice" on page 10A2-1 of this section.

4. Place sealer on the hole from the underside of the vehicle and assemble the bolt (172), anchor plate (173), washer (175), and lock nut (176) to the floor pan.

5. Tighten the nut to 31 N·m (23 ft. lbs.). Use the Child Seat only in the second seat seating position for which the anchor bracket has been installed.

NOTICE: In the event the child seat anchorage assembly is removed, the 8 mm (5/16-inch) diameter hole must be properly resealed.

SUBURBAN THIRD SEAT

1. Determine the location for the anchor by measuring 127 mm (5-inches) forward from the rear edge of the floor pan. Make this measurement in the center of one of the depressed floor pan ribs (figure 31).

   Next:

   A. Measure 535 mm (21-inches) inboard of the right quarter inner panel for the right seating position.
   B. Measure 805 mm (31.75-inches) inboard of the right quarter inner panel for the center seating position.
   C. Measure 1,160 (45.75-inches) inboard of the right quarter inner panel for the left seating position.
2. Drill an 8 mm (5/16-inch) hole at the mark.
3. To insure proper sealing of the hole, remove anydirt or foreign matter from around the hole on the underside of the floor pan where the sealer is to be applied.

NOTICE: See "Notice" on page 10A2-1 of this section.

4. Place sealer on the hole from the underside of

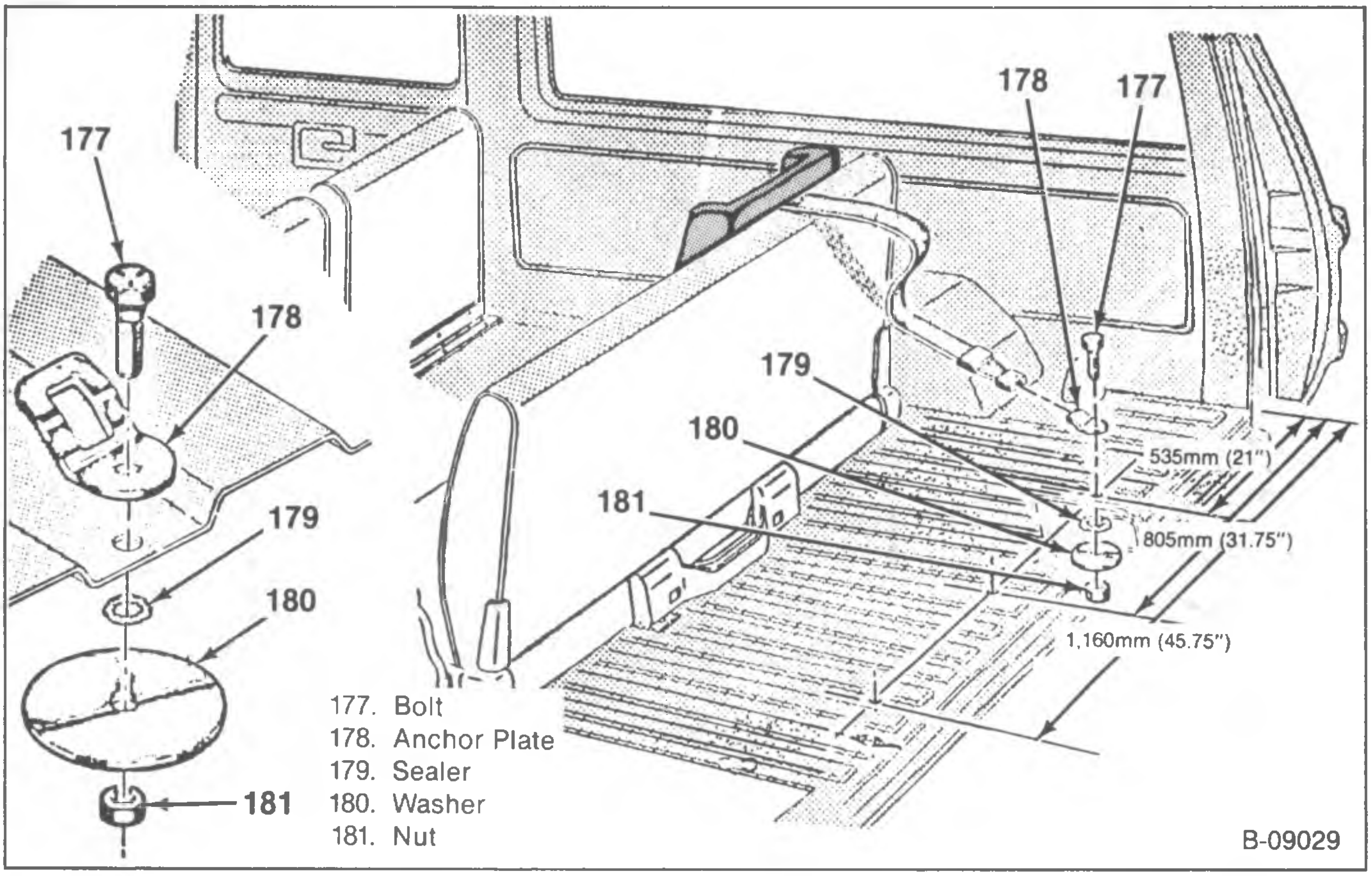


Figure 31—Suburban Third Seat Top Strap Belt Components

the vehicle and assemble the bolt (177), anchor plate (178), washer (180), and lock nut (181) to the floor pan.

5. Tighten the nut to 31 N·m (23 ft. lbs.). Use the Child Seat only in the third seat seating position for which the anchor bracket has been installed.

NOTICE: In the event the Child Seat anchorage assembly is removed, the 8 mm (5/16-inch) diameter hole must be properly resealed.

NOTICE: If the hole penetrates to the exterior of the vehicle, apply a sealant between the anchor bolt washer and the sheet metal to prevent carbon monoxide from entering the vehicle. Suitable sealers include silicone, butyl or acrylic type caulking.

In the event that the child seat anchorage assembly is removed, all bolt holes penetrating to the exterior of the vehicle must be resealed to prevent exhaust fumes from entering the vehicle.

G MODEL FRONT SEAT

FRONT SEAT REPLACEMENT

Remove or Disconnect (Figure 32

1. Seat belts. Refer to "Seat Belt Replacement."

- Raise and support the vehicle.

2. Seat riser (183) to floor panel nuts (185), washers (186), and reinforcements (187) from underneath the vehicle.

3. Seat from the vehicle.

Install or Connect (Figure 32)

1. Seat (182) to floor panel nuts (185), washers (186), and reinforcements (187) to the underside of the vehicle.

- Lower the vehicle.

3. Seat belts. Refer to "Seat Belt Replacement."

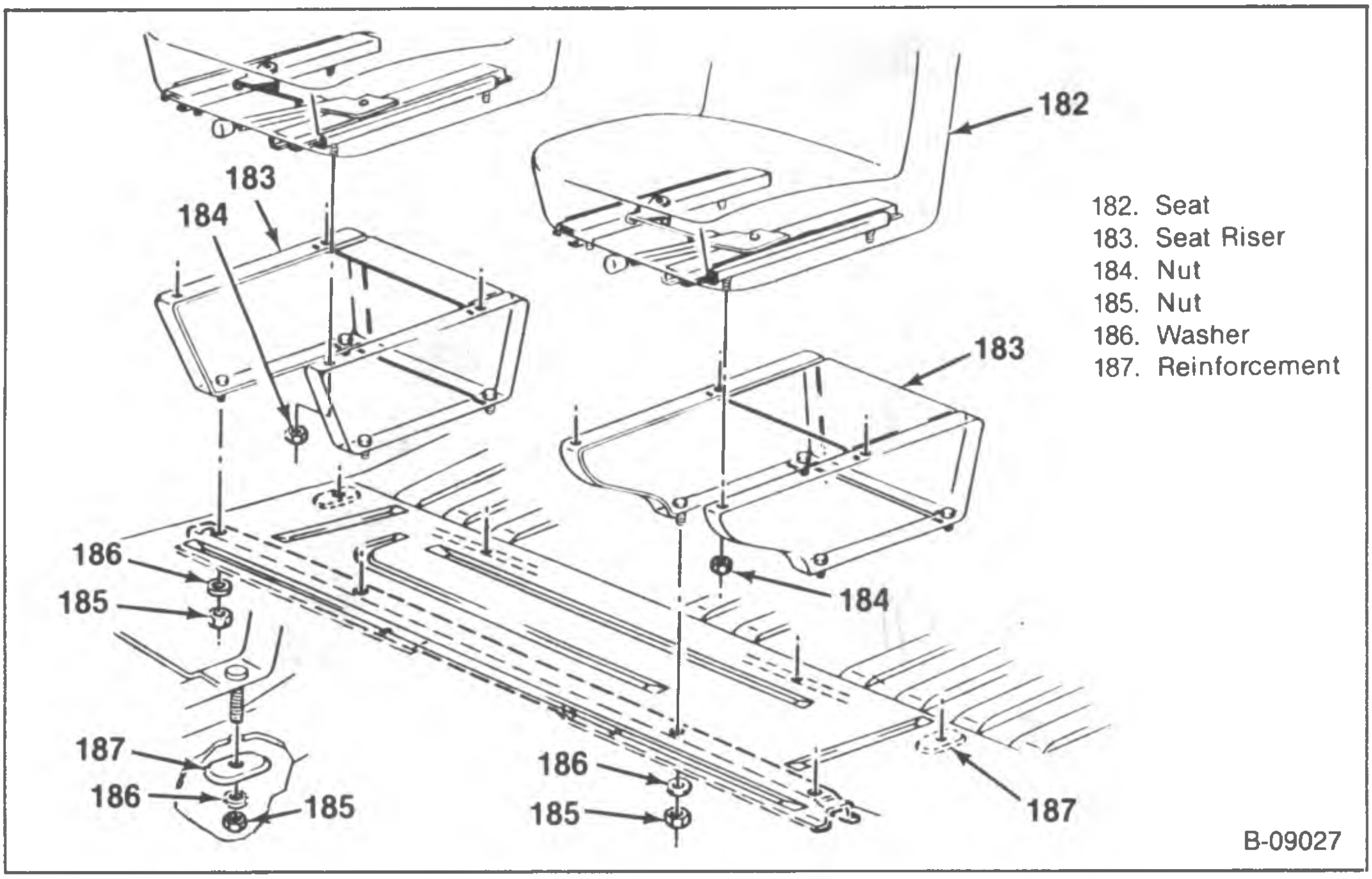


Figure 32—Front Bucket Seat Components

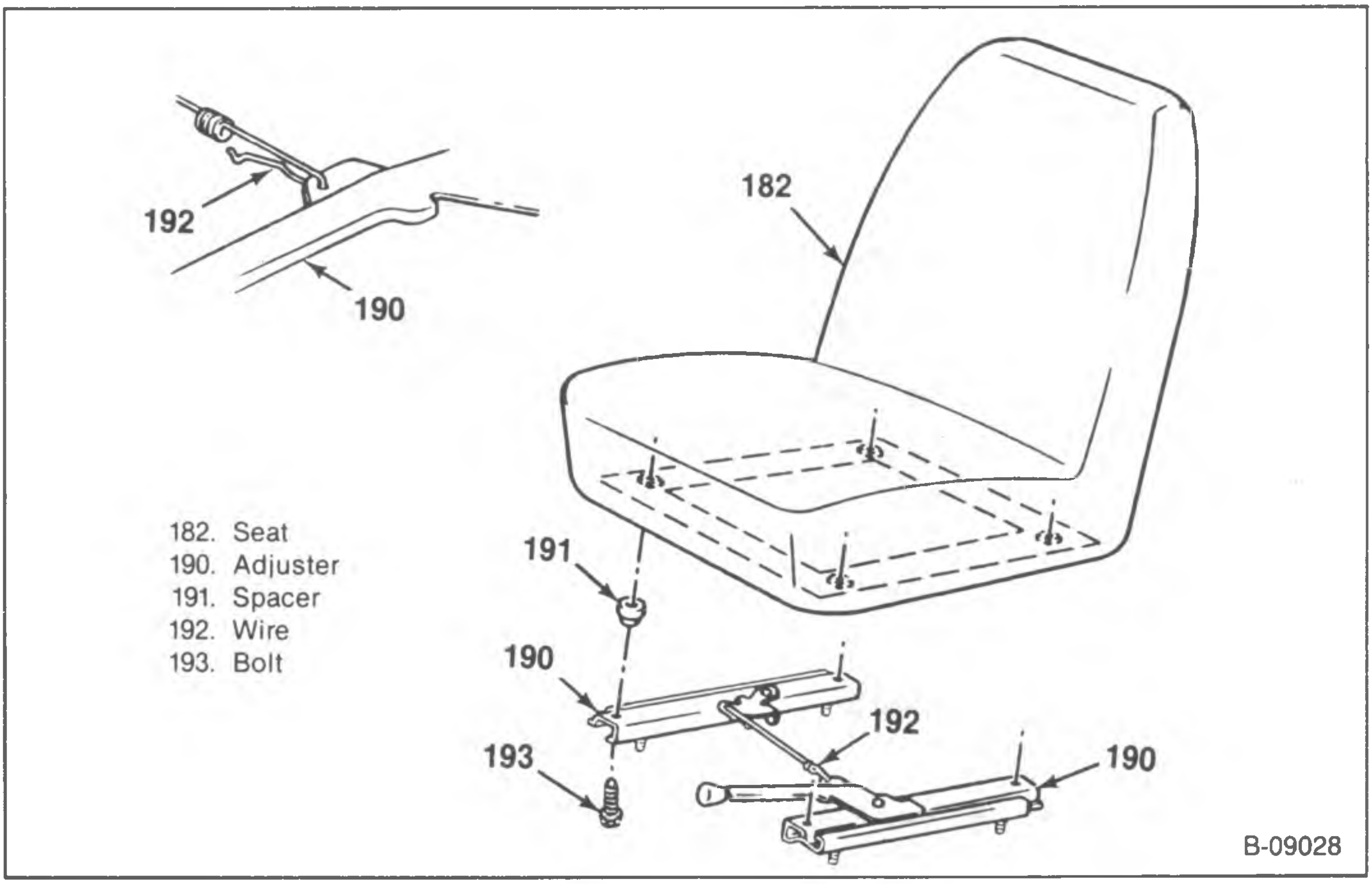


Figure 33—Bucket Seat Adjusters

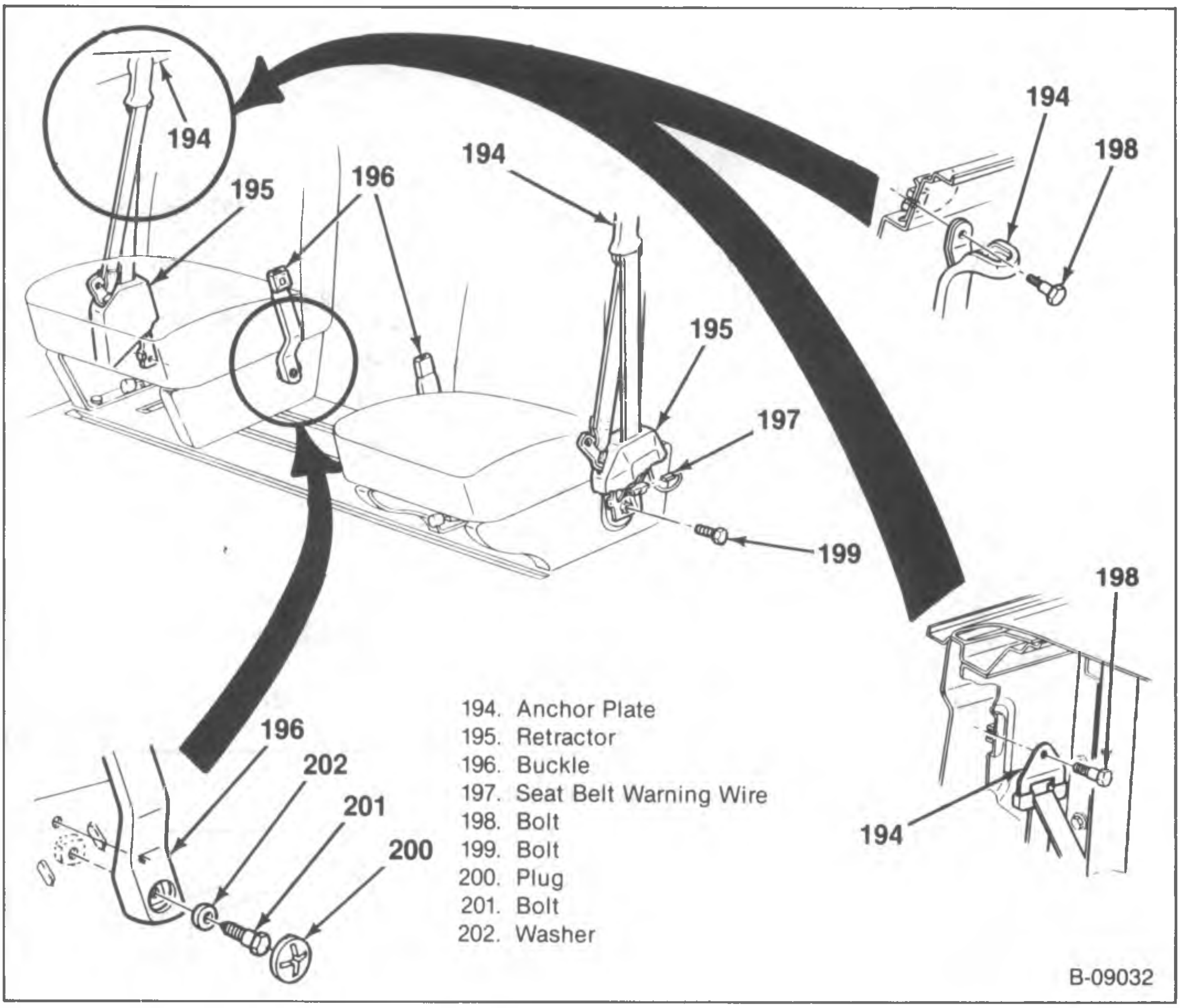


Figure 34—Bucket Seat Belt Components

FRONT SEAT DISASSEMBLY

Remove or Disconnect (Figures 32 and 33)

1. Seat. Refer to "Front Seat Replacement."
2. Seat riser to adjuster nuts (184).
3. Seat (182) and adjuster (190) from the riser (183).
4. Adjuster to seat bolts (193) and spacers (191).
5. Adjuster (190) from the seat (182).

Install or Connect (Figures 32 and 33)

1. Adjuster (190) to the seat (182).
2. Adjuster to seat spacers (191) and bolts (193).
3. Seat (182) and adjuster (190) to the riser (183).
4. Seat riser to adjuster nuts (184).
5. Seat. Refer to "Seat Replacement."

FRONT SEAT BELT REPLACEMENT

Remove or Disconnect (Figure 34)

1. Anchor plate (194) to the roof side rail bolt (198).
2. Anchor plate (194).
3. Seat belt warning wire (left side only).
4. Retractor (195) to seat riser bolt (199).
5. Retractor (195) and anchor plate (194) from the vehicle.
6. Plug (200).
7. Buckle (196) to seat riser bolt (201) and washer (202).
8. Buckle (196) from the vehicle.

NOTICE: For steps 2, 5, and 7 see "Notice" on page 10A2-1 of this section.

Install or Connect (Figure 34)

1. Buckle (196) to the vehicle.
2. Buckle (196) to seat riser washer (202) and bolt (201).

Tighten

- Bolt to 60 N·m (44 ft. lbs.).

3. Plug (200).
4. Retractor (195) and anchor plate (194) to the vehicle.
5. Retractor (195) to seat riser bolt (199).

Tighten

- Bolt to 60 N·m (44 ft. lbs.).

6. Seat belt warning wire (left side only).
7. Anchor plate (194) to the roof side rail.
8. Anchor plate bolt (198).

Tighten

- Bolt to 60 N·m (44 ft. lbs.).

G MODEL CENTER AND REAR SEATS

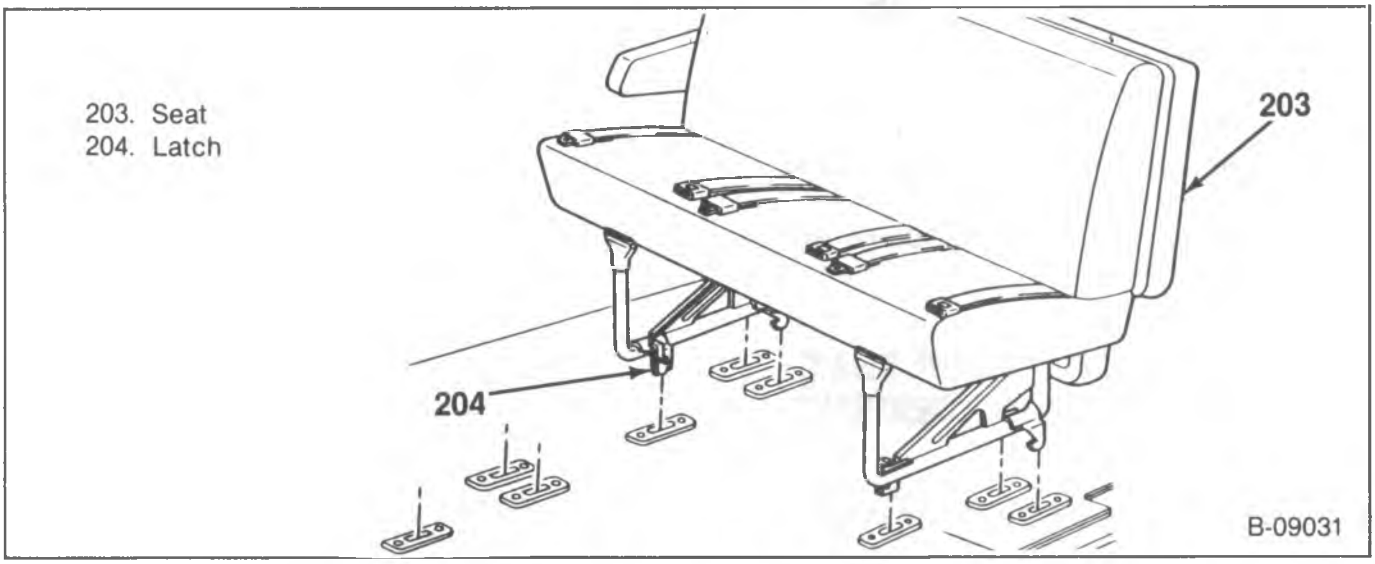


Figure 35—Rear Seat Mounting

CENTER AND REAR SEAT REPLACEMENT

REMOVAL (Figure 35)

1. Unlatch the seat, and pull towards the rear of the vehicle.

2. Remove the seat from the vehicle.

INSTALLATION (Figure 35)

1. Place the seat in the vehicle.

2. Place the hooked retainers onto the anchor pins.

3. Latch the seat.

4. Push back and forth on the seat to be sure it is latched.

CENTER AND REAR SEAT DISASSEMBLY

Remove or Disconnect (Figures 36 and 37)

1. Seat from the vehicle. Refer to "Center and Rear Seat Replacement."
2. Support (210) and leg assembly (209) to seat bolts (207 and 208).
3. Support assembly (210) to leg assembly (209), bolts (206) and spring washers (205).
4. Support assembly (210) from the legs (209).

Install or Connect (Figures 36 and 37)

1. Support assembly (210) to the legs (209).
2. Support assembly (210) to leg assembly (209), springs washers (205) and bolts (206).

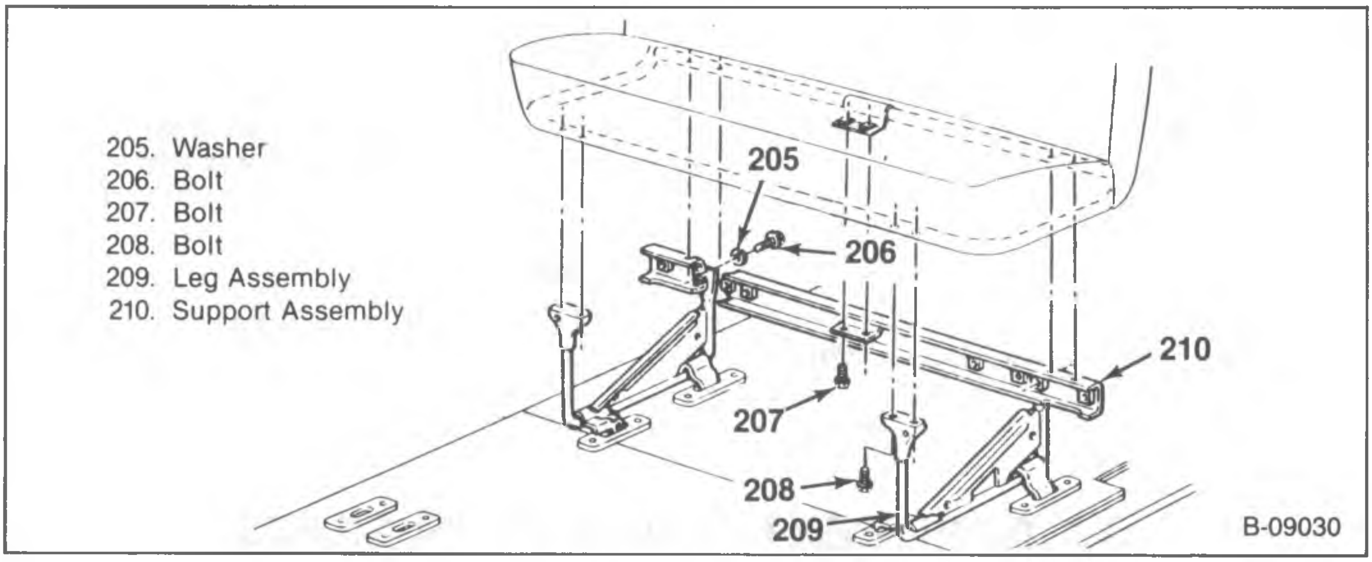


Figure 36—Center Seat Components

Tighten

- Bolts to 155 N·m (114 ft. lbs.).

3. Support (210) and leg assembly (209) to seat bolts (207 and 208).
4. Seat to the vehicle. Refer to "Center and Rear Seat Replacement."

CENTER AND REAR SEAT ARMREST REPLACEMENT

Remove or Disconnect (Figures 38 and 39)

1. Armrest bracket (217) to seat bolts (216).
2. Armrest to seatback bolts (213).
3. Armrest cover (218) (if equipped).
4. Armrest bracket (217) to armrest nuts (215) and washers (214).
5. Armrest bracket (217) from the armrest (212).

Install or Connect

1. Armrest bracket (217) to the armrest (212).
2. Armrest bracket (217) to armrest washers (214) and nuts (215).
3. Armrest cover (218) (if equipped).
4. Armrest to seatback bolts (213).
5. Armrest bracket (217) to seat bolts (216).

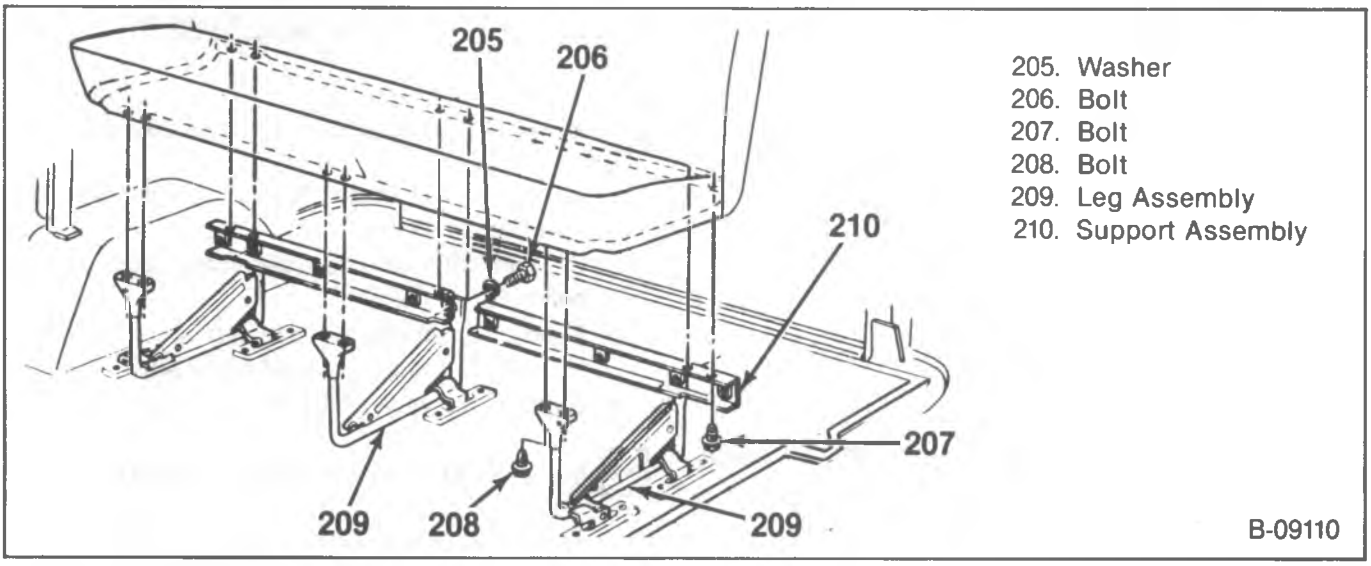
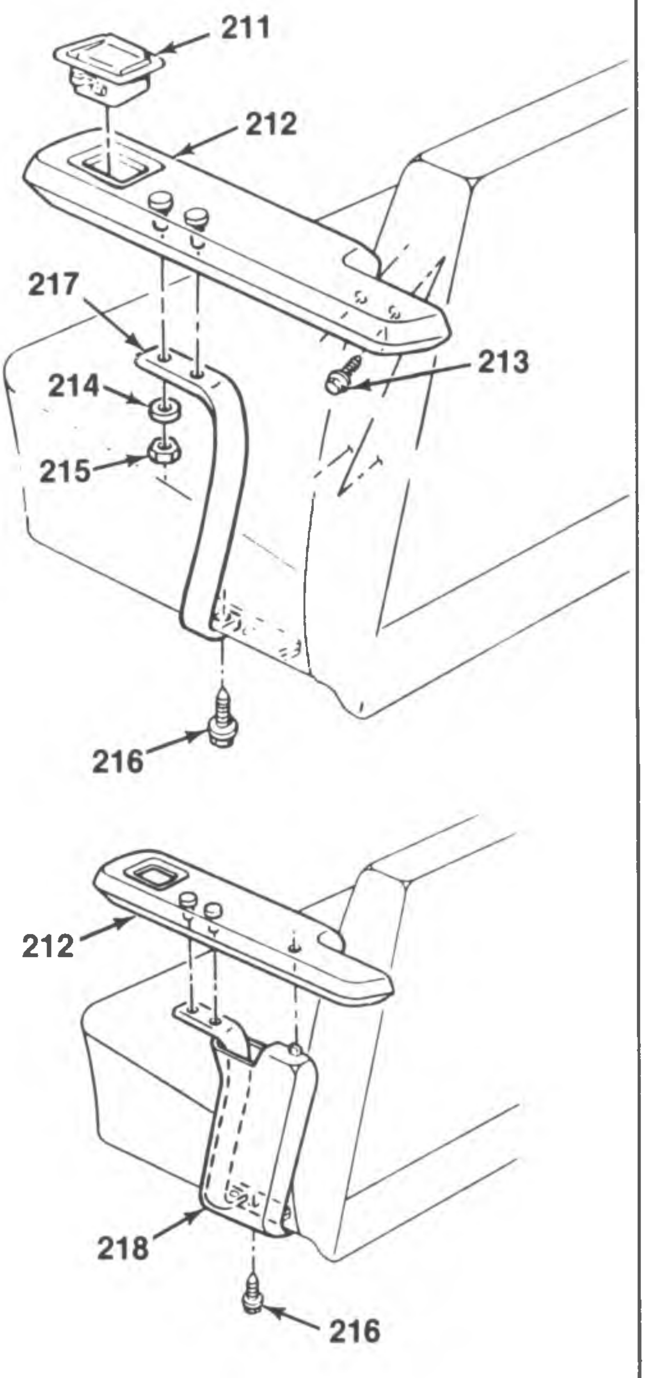


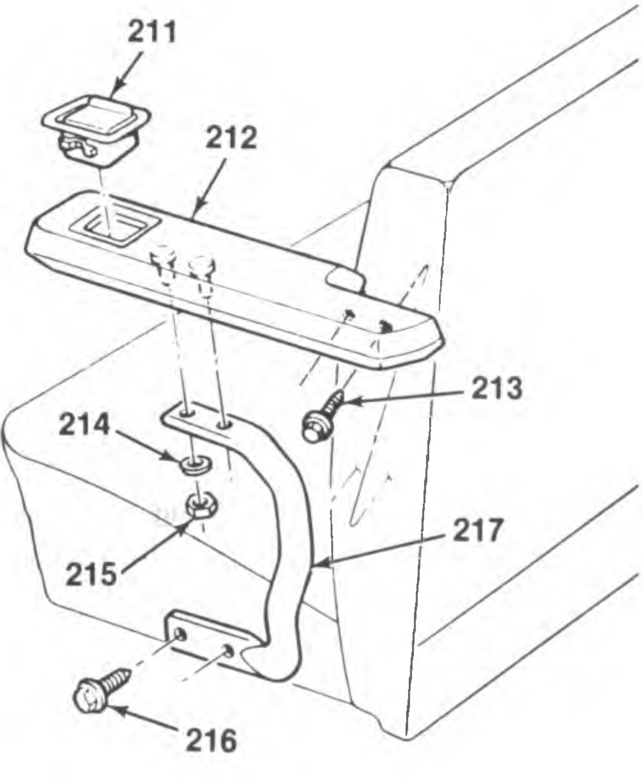
Figure 37—Rear Seat Components



211. Ash Tray
212. Arm Rest
213. Bolt
214. Washer
215. Nut
216. Bolt
217. Support Assembly
218. Cover

B-08586

Figure 38—Center Seat Armrest



211. Ash Tray
212. Arm Rest
213. Bolt
214. Washer
215. Nut
216. Bolt
217. Support Assembly

B-09108

Figure 39—Rear Seat Armrest

CENTER AND REAR SEAT BELT REPLACEMENT

↔ Remove or Disconnect (Figures 40, 41, and 42)

1. Retractor to support assembly bolts (221).
2. Retractor (220) from the seat.
3. Buckle (219) and latch plate (225) (if equipped) to support assembly bolts (222).
4. Buckle (219) and latch plate (225) (if equipped) from the seat.

NOTICE: For steps 2 and 4 see "Notice" on page 10A2-1 of this section.

1. Buckle (219) and latch plate (225) (if equipped) to the seat.

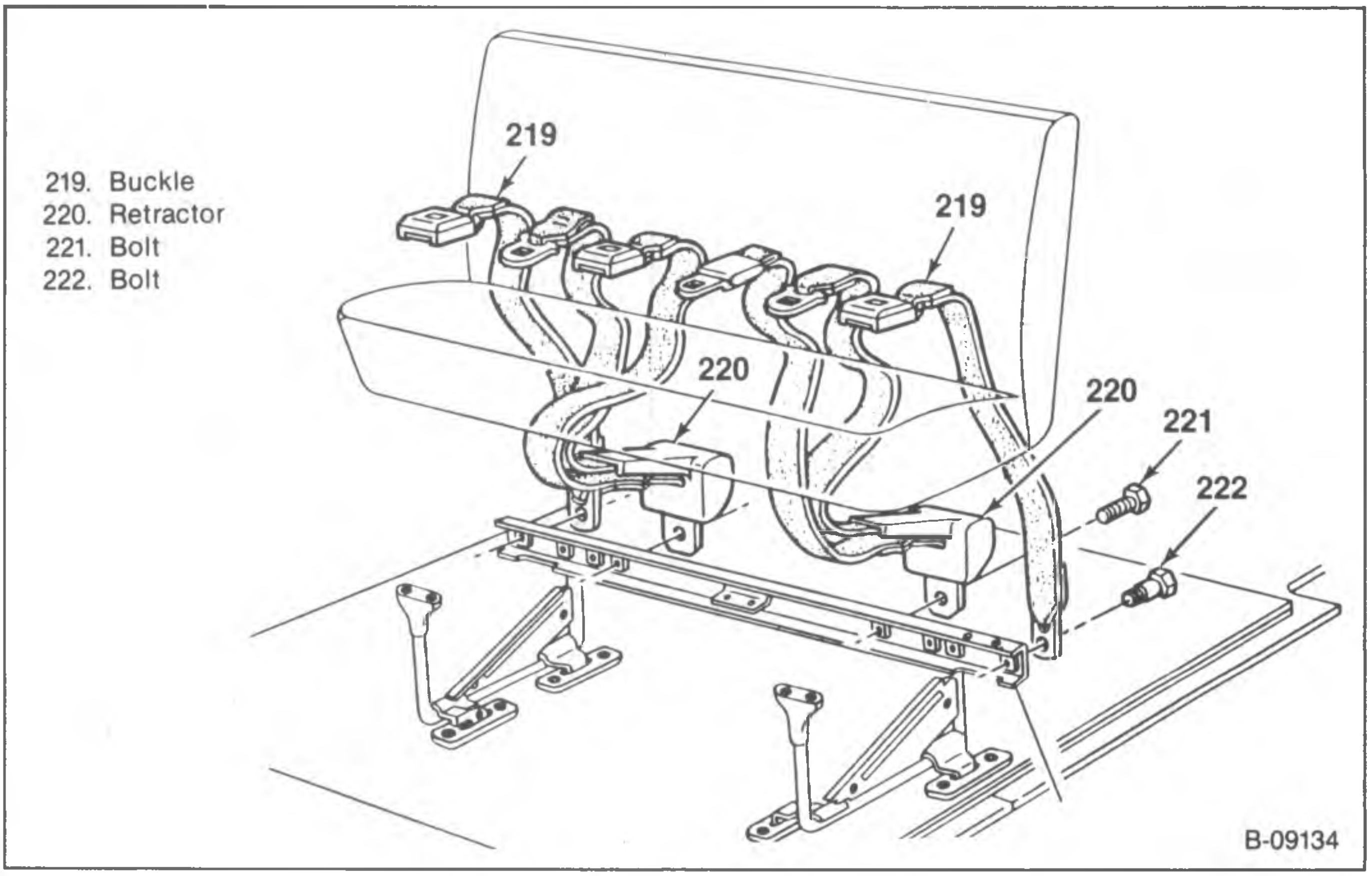


Figure 40—Center Seat Belt Components

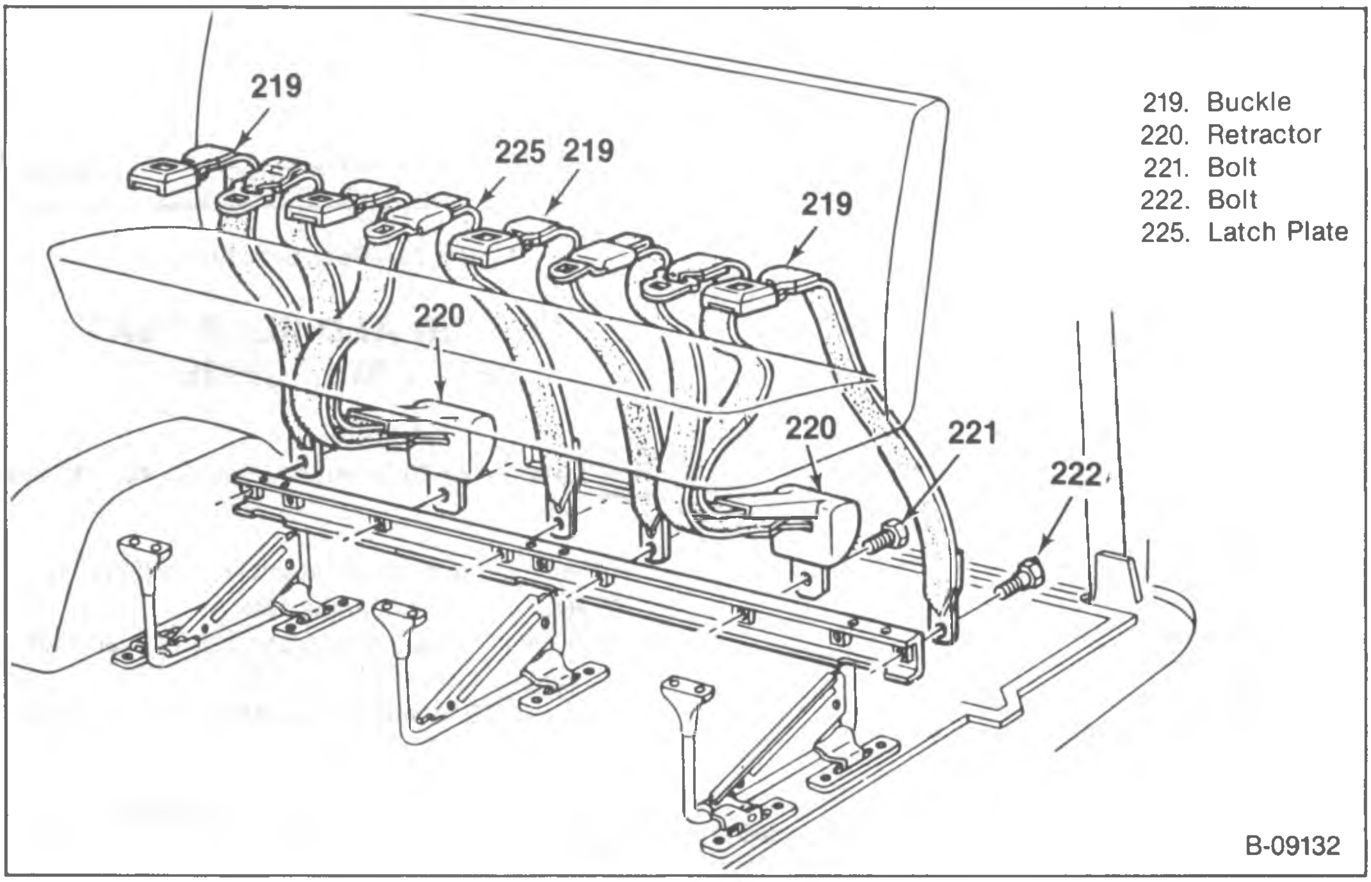


Figure 41—Rear Seat Belt Components

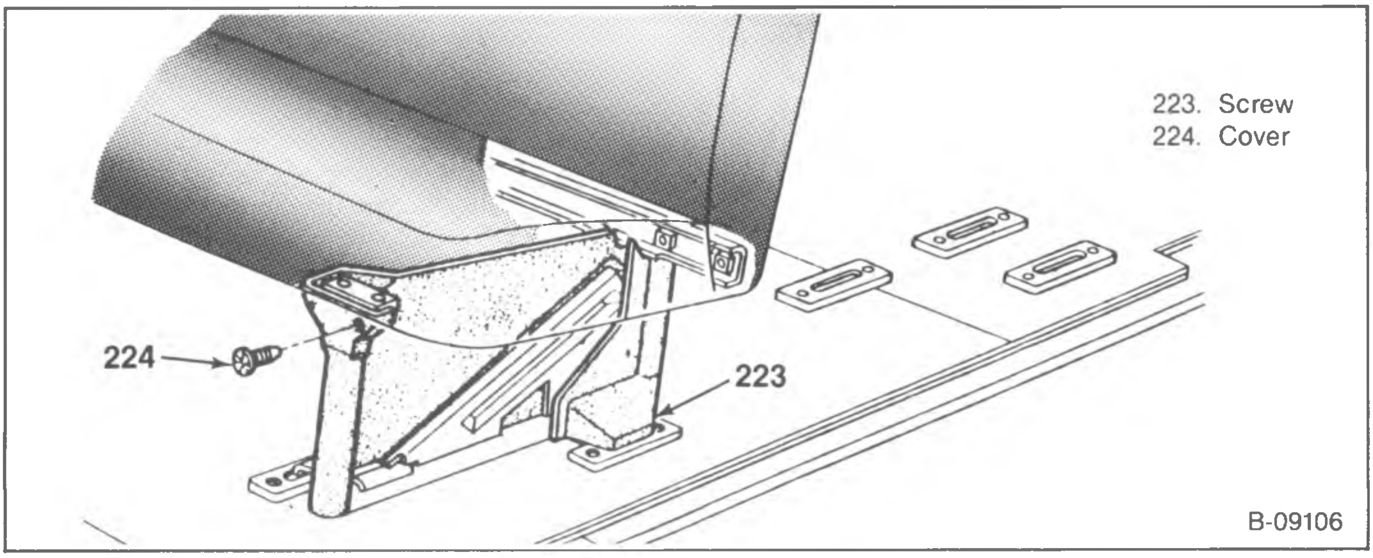


Figure 42—Seat Leg Cover

2. Buckle (219) and latch plate (225) (if equipped) bolts (222).
   - The shoulder of the bolt must bottom on the weld nut.

Tighten

- Bolts to 50 N·m (37 ft. lbs.).

3. Retractor (220) to the seat.
4. Retractor to support assembly bolts (221).

Tighten

- Bolts to 50 N·m (37 ft. lbs.).

G MODEL TOP STRAP BELT ANCHOR INSTALLATION

All hardware discussed in this procedure should be supplied or available from the child seat manufacturer. Be sure the child seat position does not conflict with any additional requirements provided by its manufacturer, or with any recommendations in the Child Restraint section of the Owner's manual.

The child seat may be used only in a forward facing seating location.

Installation of top strap belts is not recommended in the front passenger seat of "G" Vans. The second seat offset which allows passenger entry does not position a second seat lap belt within the recommended zone for attachment to the top strap hook. Also, a floor anchorage is impractical since the top strap length is insufficient to directly connect the restraint to the floor with high back bucket seats.

VEHICLES WITH A 125-INCH WHEELBASE

SECOND SEAT LEFT SEATING POSITION

This procedure is for vehicles not having a third seat.

1. Determine the location for the anchor by measuring 76 mm (3-inches) rearward from the front edge of the left wheelhouse. Measure 60 mm (2³/₈-inches) inboard from the left wheelhouse. Mark the position on top of the rib where these measurements meet (figure 43).

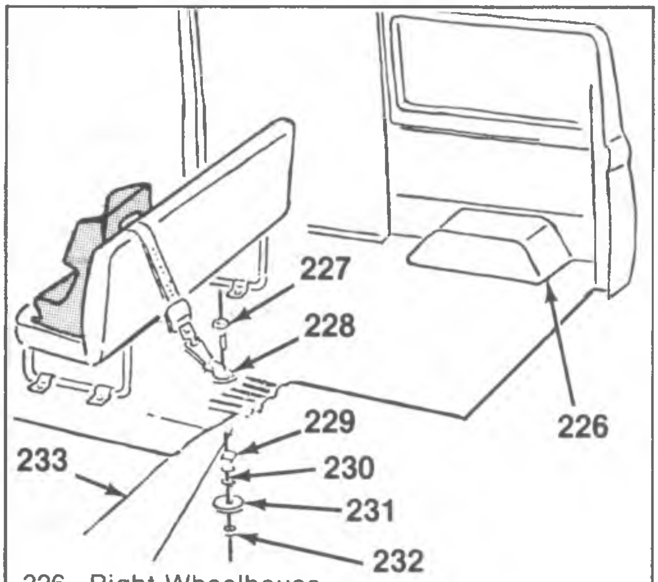
2. Drill an 8 mm (⁵/₁₆-inch) hole at the mark.

3. To insure proper sealing of the hole, remove any dirt or foreign matter from around the hole on the underside of the floor pan where sealer is to be applied.

NOTICE: See "Notice" on page 10A2-1 of this section.

4. Place sealer on the hole from the underside of the vehicle and assemble the bolt (227), anchor bracket (228), two 35 mm (1³/₈-inch) outside diameter spacer washers (230), anchor plate (231) and lock nut (232) to the floor pan.

5. Tighten the nut to 31 N·m (23 ft. lbs.). Use the Child Seat only in the seating position for which the anchor bracket has been installed.



226. Right Wheelhouse
227. Bolt
228. Anchor Bracket
229. Sealer
230. Spacer Washers
231. Anchor Plate
232. Lock Nut
233. Front Edge Of The Left Wheelhouse

B-09127

Figure 43—Second Seat Top Strap Components—Left Position

NOTICE: In the event the Child Seat anchorage assembly is removed, the 8 mm (5/16-inch) diameter hole must be properly resealed.

SECOND SEAT—CENTER OR RIGHT SEATING POSITIONS

This procedure is for vehicles not having a third seat.

1. Determine the location for the anchor by measuring 35 mm (1³/₈-inch) rearward from the front edge of the left wheelhouse (figure 44). Next:
   A. Measure 580 mm (22⁷/₈-inches) inboard from the right wheelhouse for the center seating position.
   B. Measure 395 mm (15¹/₂-inches) inboard of the right wheelhouse for the right seating position.

   Mark the position where the measurements for the desired seating positions meet.
2. Drill an 8 mm (⁵/₁₆-inch) hole at the mark.
3. To insure proper sealing of the hole, remove any dirt or foreign matter from around the hole on the underside of the floor pan where sealer is to be applied.

NOTICE: See "Notice" on page 10A2-1 of this section.

4. Place sealer on the hole from the underside of the vehicle and assemble the bolt (234), anchor bracket (237), two 35 mm (1³/₈-inch) outside diameter spacer washers (240), anchor plate (237) and lock nut (238) to the floor pan.
5. Tighten the nut to 31 N·m (23 ft. lbs.). Use the Child Seat only in the seating position for which the anchor bracket has been installed.

NOTICE: In the event the Child Seat anchorage assembly is removed, the 8 mm (⁵/₁₆-inch) diameter hole must be properly resealed.

THIRD SEAT

It is recommended that only the left seating position be used for the third seat.

1. Determine the location for the anchor by measuring 76 mm (3-inches) rearward from the left wheelhouse. Measure 10 mm (³/₈-inch) inboard from the left wheelhouse. Mark the position where those measurements meet (figure 45).
2. Drill an 8 mm (⁵/₁₆-inch) hole at the mark.
3. To insure proper sealing of the hole, remove any dirt or foreign matter from around the hole on the underside of the floor pan where sealer is to be applied.

NOTICE: See "Notice" on page 10A2-1 of this section.

4. Place sealer on the hole from the underside of the vehicle and assemble the bolt (241), anchor bracket (242), anchor plate (244) and lock nut (245) to the floor pan.
5. Tighten the nut to 31 N·m (23 ft. lbs.). Use the Child Seat only in the seating position for which the anchor bracket has been installed.

NOTICE: In the event the Child Seat anchorage assembly is removed, the 8 mm (⁵/₁₆-inch) diameter hole must be properly resealed.

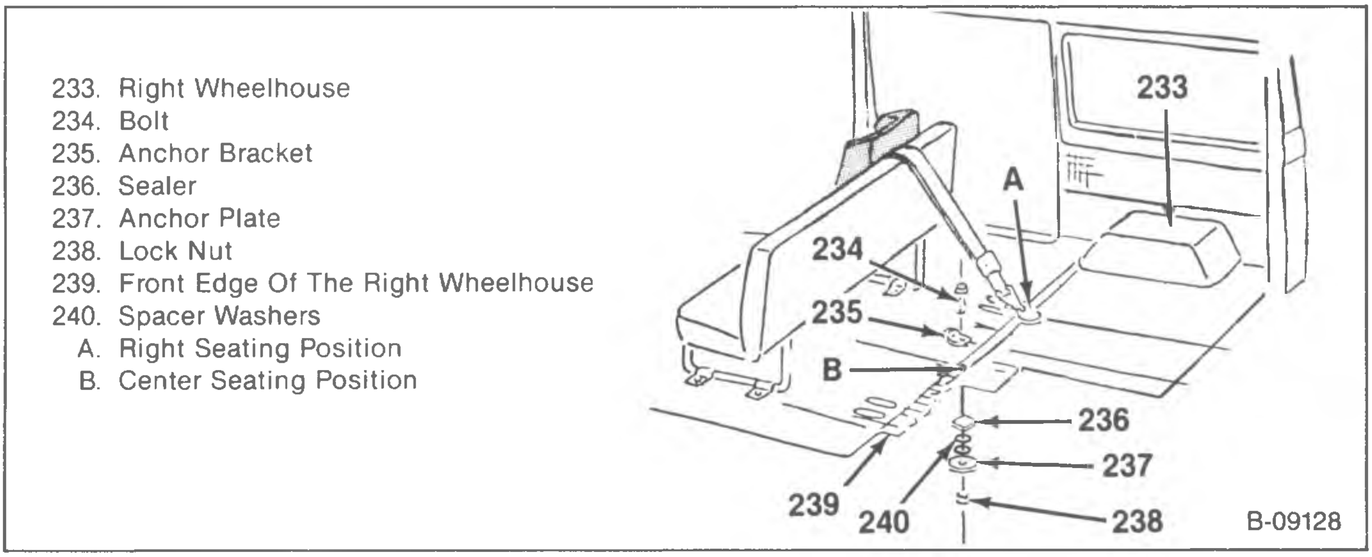


Figure 44—Second Seat Top Strap Components—Center And Right Position

VEHICLES WITH A 110-INCH WHEELBASE

SECOND SEAT

This procedure is for vehicles without a third seat (figures 46 and 47).

1. Determine the location of the anchor by:
   - A. Measuring 457 mm (18-inches) rearward from the front edge of the left wheelhouse. Measure 50 mm (2-inches) inboard of the left wheelhouse for the left seating position.
   - B. Measuring 546 mm (21½-inches) rearward from the front edge of the left wheelhouse. Make this measurement in the center of one of the depressed floor pan ribs. Next, measure 580 mm (22⅞-inches) inboard of the left wheelhouse for the center seating position.
   - C. Measure 546 mm (21½-inches) rearward from the front edge of the right wheelhouse. Next, measure 395 mm (15½-inches) inboard from the right wheelhouse for the right seating position.

   Mark the position where the measurements for the desired seatings positions meet.
2. Drill an 8 mm (5/16-inch) hole at the mark.
3. To insure proper sealing of the hole, remove any dirt or foreign matter from around the hole on the underside of the floor pan where sealer is to be applied.

NOTICE: See "Notice" on page 10A2-1 of this section.

4. Place sealer on the hole from the underside of

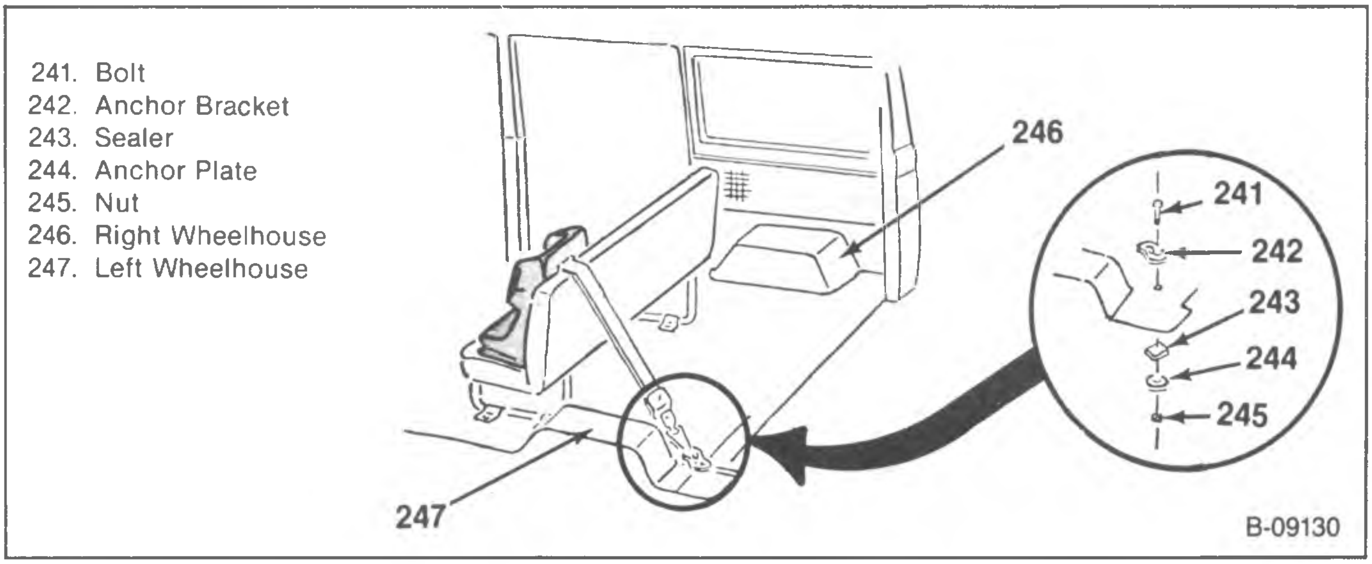
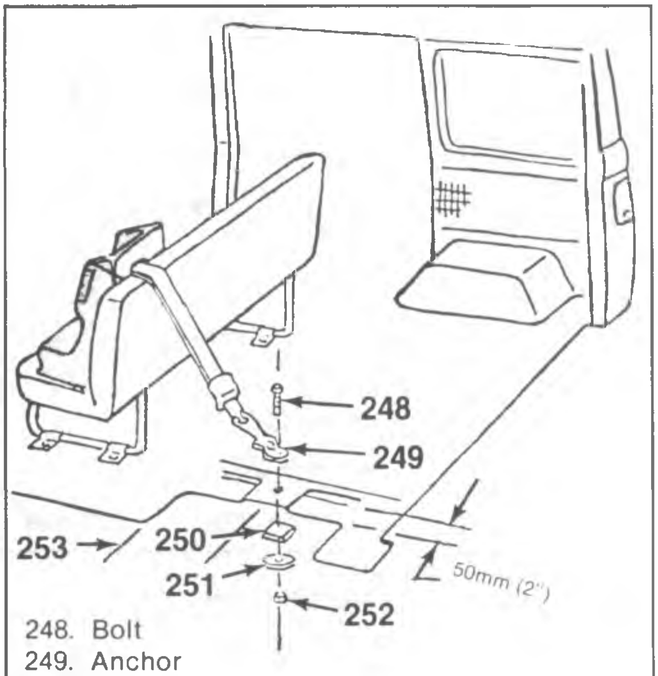


Figure 45—Third Seat Top Strap Components—Left Position



248. Bolt
249. Anchor
250. Sealer
251. Anchor Plate
252. Lock Nut
253. Front Edge Of The Left Wheelhouse

B-09131

Figure 46—Second Seat Top Strap Components—Left Position

the vehicle and assemble the bolt (248), anchor bracket (249), anchor plate (251) and lock nut (252) to the floor pan.

5. Tighten the nut to 31 N·m (23 ft. lbs.). Use the Child Seat only in the second seat seating position for which the anchor bracket has been installed.

NOTICE: In the event the Child Seat anchorage assembly is removed, the 8 mm (5/16-inch) diameter hole must be properly resealed.

SECOND SEAT — VEHICLES EQUIPPED WITH A THIRD SEAT

Use the Child Seat as directed in the usage instructions furnished with the Child Seat, in any second seating position. Latch the Child Seat top strap hook to the third seat lap belt tongue located most directly behind the Child Seat.

THIRD SEAT

The Child Seat is not recommended for use in the third seat of a 110-inch wheelbase model.

248. Bolt
249. Anchor Bracket
250. Sealer
251. Anchor Plate
252. Lock Nut
253. Front Edge Of The Left Wheelhouse
A. Right Seating Position
B. Center Seating Position

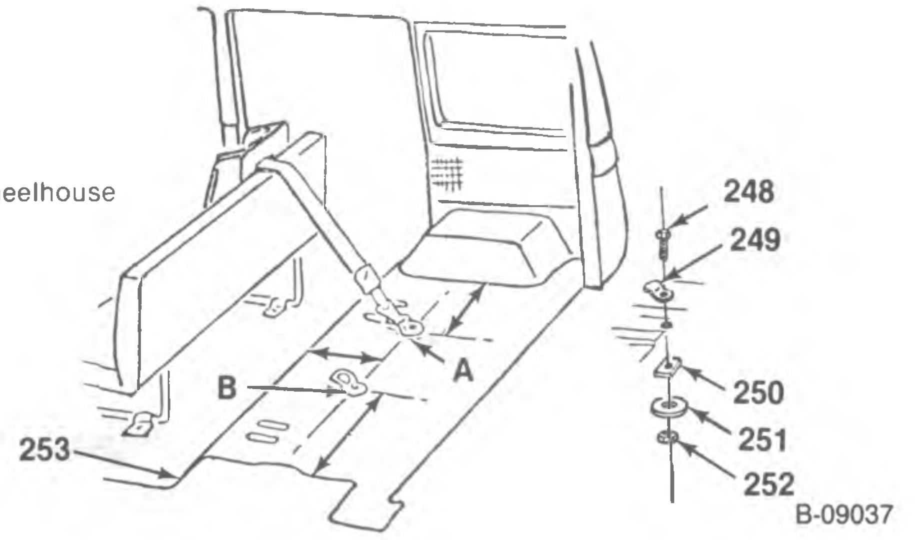


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Figure 47—Second Seat Top Strap Components—Center And Right Position

SPECIFICATIONS

ITEM	TORQUE N·m	TORQUE FT. LBS.
C/K Models		
All Seat Belt Fasteners — Except Top Strap	50	37
G Models		
Front Seat Belt Fasteners	60	44
Center And Rear Seat Belt Fasteners — Except Top Strap	50	37
Top Strap Fasteners		
All Models	31	23

SECTION 10A3

GLASS

CONTENTS

C/K MODELS

WINDSHIELD REPLACEMENT

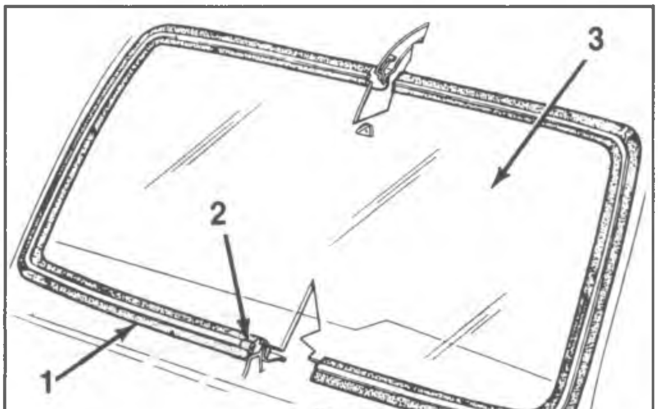
CAUTION: Always wear heavy gloves when handling glass to minimize the risk of injury.

When replacing a cracked windshield, it is important that the cause of the crack be determined and the condition corrected, before a new glass is installed. The cause of the crack may be an obstruction or high spot somewhere around the flange of the opening; cracking may not occur until pressure from the high spot or obstruction becomes particularly high due to winds, extremes of temperature, or rough terrain. Suggestions of what to look for are described later in this section under "Inspection".

REMOVAL (Figures 1 and 2)

If a windshield is broken, the glass may already have fallen or been removed from the weatherstrip. Often, however, it is necessary to remove a cracked or otherwise imperfect windshield that is still intact. In this case, it is a good practice to crisscross the glass with strips of masking tape before removing it; this will help hold the glass together and minimize the risk of injury.

If a crack extends to the edge of the glass, mark the point where the crack meets the weatherstrip. (Use a piece of chalk and mark the point on the cab, next to the weatherstrip.) Later, when examining the flange of the opening for a cause of the crack start at the point marked.



1. Weatherstrip
2. Cap
3. Glass
4. Windshield Reveal Molding

B-09049

Figure 1—Windshield Components

The higher the temperature of the work area, the more pliable the weatherstrip will be. The more pliable the weatherstrip, the more easily the windshield can be removed.

Before removing the glass, cover the instrument panel, and the surrounding sheet metal with protective covering. Remove the wiper arms. Disconnect the antenna lead if the vehicle has a windshield antenna.

1. Remove the reveal molding cap (2) and the reveal molding (lock strip) (4).
2. From inside the cab, remove the weatherstrip and glass from the pinchweld flange by applying a firm controlled pressure to the edge of the glass

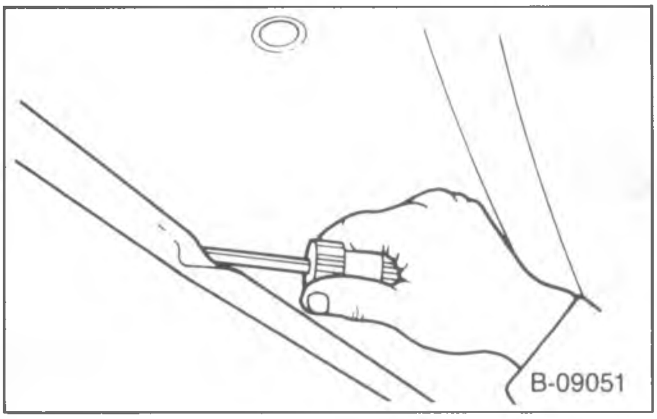


Figure 2—Forcing The Weatherstrip Over The Flange

while forcing the weatherstrip from the flange with a flat bladed tool.

3. With the aid of an assistant from outside the vehicle, remove the windshield from the opening.
4. Remove any excess urethane and remaining weatherstrip from the pinchweld flange.

INSPECTION

An inspection of the flange of the windshield opening, the weatherstrip, and the glass may reveal the cause of a broken windshield. This can help prevent future breakage. If there is no apparent cause of breakage, the weatherstrip should be removed from the flange of the opening and the flange inspected. Look for high weld or solder spots, hardened spot weld sealer, or any other obstruction or irregularity in the flange. Check the weatherstrip for irregularities or obstructions in it.

Check a windshield that is to be installed to make sure it does not have any chipped edges. Chipped edges can be ground off, restoring a smooth edge to the glass, and minimizing concentrations of pressure that cause breakage. Remove no more than necessary, in an effort to maintain the original shape of the glass and the proper clearance between it and the flange of the opening. See "Glass-To-Opening Clearance Check" later in this section.

GLASS-TO-OPENING CLEARANCE CHECK

Before installing a windshield, the clearance between the edge of the glass and the flange of the opening should be checked. On C/K Models the glass and flange overlap by 5 mm (0.2-inch). If the windshield is too big, rework the metal flange or grind off the edge of the glass. If the glass is to be ground off, place a strip of tape on the glass and use the edge of the tape as a guide.

If there is too much clearance between the glass and the flange of the opening, the flange can be built up. Braze a piece of 3 mm (1/8-inch) diameter wire to the edge of the flange. Usually, building up one side and half way around one corner will be enough. Taper off the ends of the wire to avoid an abrupt change in contour which could result, later, in a broken windshield.

INSTALLATION (Figures 3 and 4)

To replace a urethane adhered windshield, GM adhesive service kit No. 9636067 contains some the materials needed, and must be used to insure the original integrity of the windshield design. Materials in the kit include:

1. One tube of adhesive material.
2. One dispensing nozzle.
3. Steel music wire.
4. Rubber cleaner.
5. Rubber primer.
6. Pinchweld primer.
7. Blackout primer.
8. Filler strip (for use on windshield installations for vehicles equipped with embedded windshield antenna).
9. Primer applicators.

Other materials are required for windshield installation which are not included in the service kit. These include:

1. GM Rubber lubricant No. 1051717.
2. Alcohol for cleaning the edge of the glass.
3. Adhesive dispensing gun J-24811 or
4. A standard household cartridge type gun reworked as follows:
   a. Widen the end slot to fit the diameter ofthe dispensing nozzle of the adhesive tube.
   b. Reduce the diameter of the plunger disc so that the disc will enter the large end of the adhesive tube.
5. Commercial type razor knife (for cutting along the edge of the glass).
6. Weatherstrip Tool J-2189-02.

Windshield installation requires a number of timed steps because of the cure times involved with the primers, solvents, and adhesives used in this procedure. This timing is important and must be followed.

CAUTION: Always wear heavy gloves when handling glass to minimize the risk of injury.

1. Wipe the pinchweld clean with a dry cloth. Make sure the previous urethane has been removed.
2. Apply the pinchweld primer with a new applicator to the pinchweld as shown in view B. The primer must be thoroughly stirred and agitated prior to application. Allow the primer to cure for 30 minutes.
3. Apply rubber cleaner with a new applicator to both channels of the rubber weatherstrip as shown in view A. Wait 5 minutes before wiping the channels with a clean dry cloth.

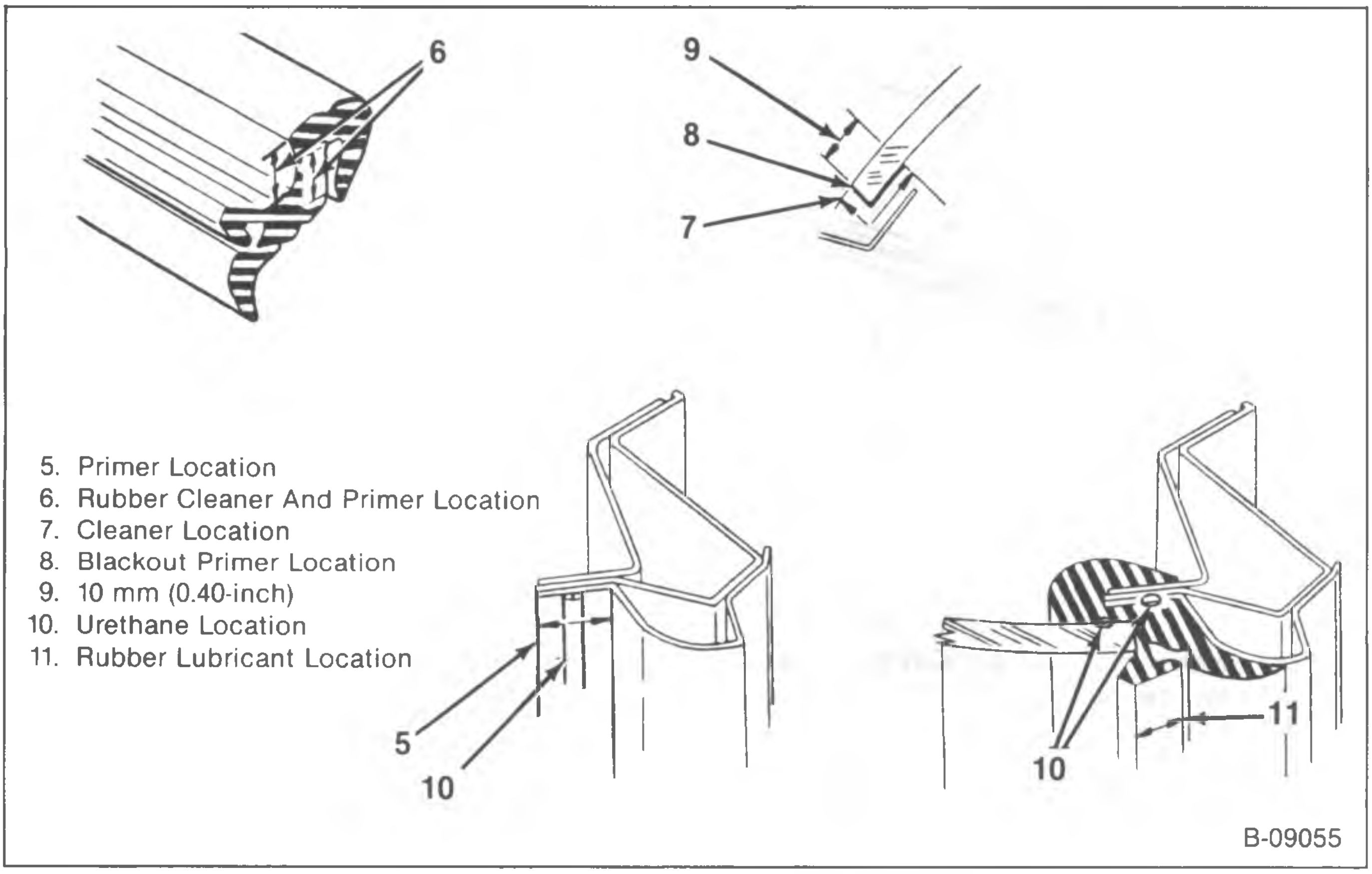


Figure 3—Primer And Adhesive Application Locations

4. Apply rubber primer to both channels of the rubber weatherstrip which were cleaned in the previous step. Allow 30 minutes for the primer to cure.
5. Thoroughly clean the surface of the glass to which the blackout primer will be applied (around the edge of the inside surface) by wiping the window with a clean alcohol dampened cloth. Allow the alcohol to air dry.

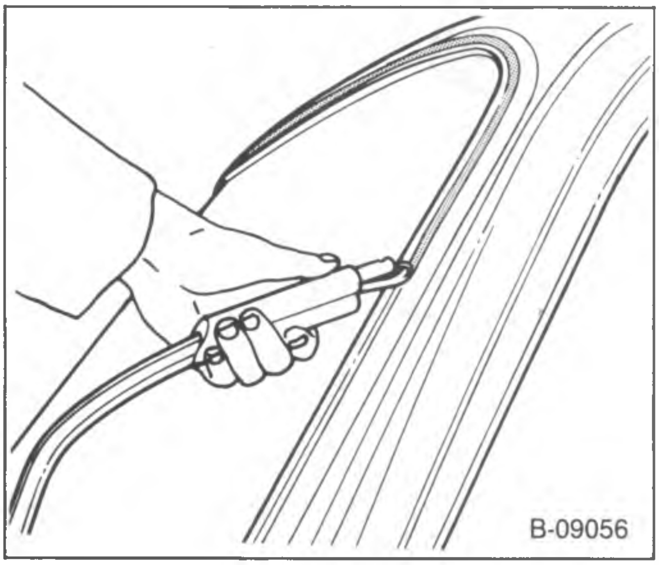
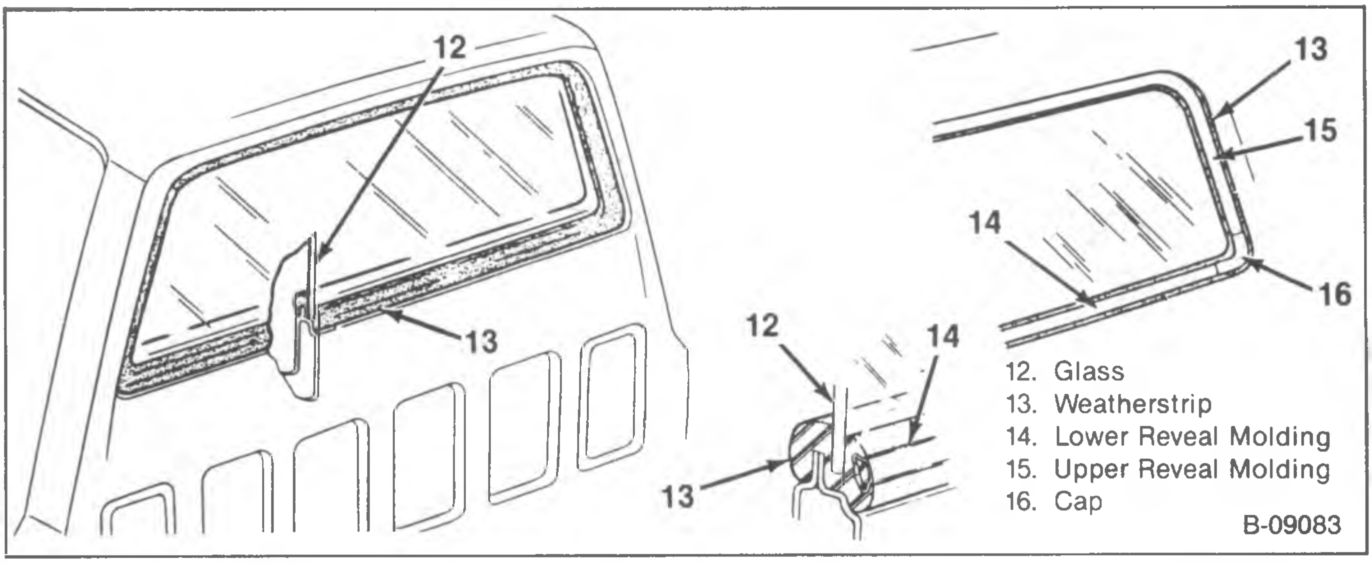


Figure 4—Installing The Reveal Molding

NOTICE: When cleaning windshield glass, avoid contacting the edge of the plastic laminate material (on the edge of the glass) with volatile cleaner. Contact may cause discoloration and deterioration of the plastic laminate by wicking action. Do not use a petroleum based solvent such as kerosene or gasoline. The presence of oil will prevent adhesion of new material.

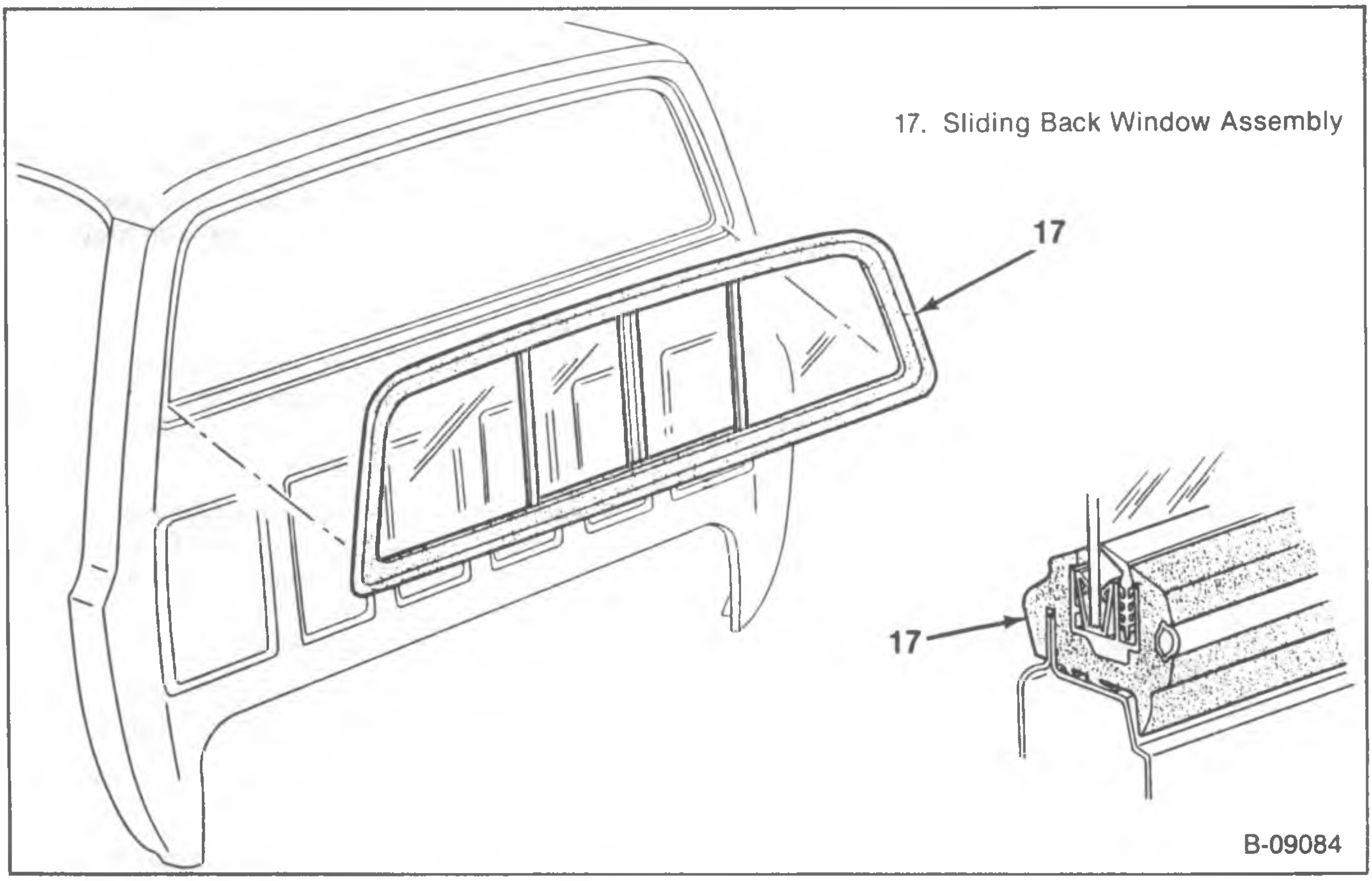
6. Apply the blackout primer to the inside face of the windshield starting 10 mm (0.40-inch) from the edge and working outward to the edge. Apply the primer to the edge of the glass also. Allow the primer to dry to the touch.
7. Apply a 6.0 mm (0.25-inch) diameter bead of urethane adhesive in the center of the pinchweld flange around the entire windshield opening. The windshield glass must be installed within 20 minutes of performing this step.
8. Apply a mist of plain water to the urethane bead on the pinchweld flange, wetting it fully.
9. Install the rubber weatherstrip to the pinchweld flange.
10. Apply a 4.5 mm (0.18-inch) diameter bead of urethane adhesive to the rubber weatherstrip glass channel as shown in view D.



12. Glass
13. Weatherstrip
14. Lower Reveal Molding
15. Upper Reveal Molding
16. Cap

Figure 5—Back Window Components

11. On windshields equipped with an embedded antenna, tape the pigtail to the inside of the windshield.
12. With the aid of a helper, lift the glass into the window opening.
13. Apply rubber lubricant to the lockstrip channel. The windshield must be seated before the lubricant is applied.
14. Install the lockstrip to the weatherstrip using J-2189-02.
15. Install the lockstrip cap at the lockstrip joint.
16. Install the antenna pigtail to the antenna lead of the radio (if equipped).
17. Install the windshield wiper arms.
18. Install the rear view mirror to the windshield.



17. Sliding Back Window Assembly

Figure 6—Sliding Back Window Components

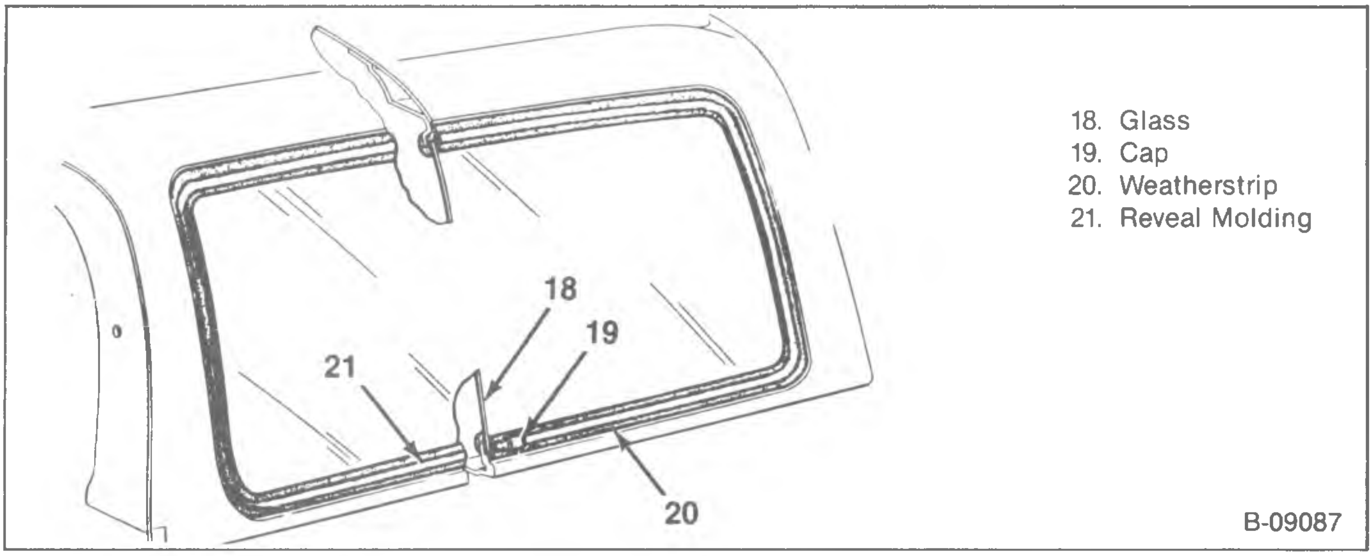


Figure 7—Body Side Window Components

STATIONARY GLASS REPLACEMENT

When replacing a cracked window, it is important that the cause of the crack be determined and the condition corrected, before a new glass is installed. The cause of the crack may be an obstruction or high spot somewhere around the flange of the opening; cracking may not occur until pressure from the high spot or obstruction becomes particularly high due to winds, extremes of temperature, or rough terrain. Suggestions of what to look for are described later in this section under "Inspection".

REMOVAL (Figures 5 through 9)

If a window is broken, the glass may already have fallen or been removed from the weatherstrip. Often, however, it is necessary to remove a cracked or otherwise imperfect window that is still intact. In this case, it is a good practice to crisscross the glass with strips of masking tape before removing it; this will help hold the glass together and minimize the risk of injury.

If a crack extends to the edge of the glass, mark the point where the crack meets the weatherstrip. (Use a piece of chalk and mark the point on the cab, next to the weatherstrip.) Later, when examining the flange of the opening for a cause of the crack start at the point marked.

The higher the temperature of the work area, the more pliable the weatherstrip will be. The more pliable the weatherstrip, the more easily the window can be removed.

CAUTION: Always wear heavy gloves when handling glass to minimize the risk of injury.

1. Push the clip that covers the ends of the reveal insert to one side, freeing the ends.
2. Pull the insert out of the weatherstrip.
3. Insert a putty knife between the glass and the weatherstrip. Pull it around the entire edge of the window to make sure the glass is not stuck to the weatherstrip.
4. Have an assistant stand outside the cab near the window.
5. From inside the cab, push the window from the weatherstrip.
6. Have an assistant remove the window.

INSPECTION

An inspection of the flange of the window opening, the weatherstrip, and the glass may reveal the cause of a broken window. This can help prevent future breakages. If there is no apparent cause of breakage, the weatherstrip should be removed from the flange of the opening and the flange inspected. Look for high weld or solder spots, hardened spot weld sealer, or any other obstruction or irregularities or obstructions in it.

Check a window that is to be installed to make sure it does not have any chipped edges. Chipped edges can be ground off, restoring a smooth edge to the glass, and minimizing concentrations of pressure that cause breakage. Remove no more than necessary, in an effort to maintain the original shape of the glass and the proper clearance between it and the flange of the opening.

INSTALLATION (Figures 5 through 9)

To ease installation, the weatherstrip can be heated with a non-flame source. At higher temperatures, the weatherstrip is more pliable. Do not heat above 52°C (125°F) and/or for longer than 1-1/2 hours.

Avoid hitting the glass on anything that may chip its edge. Pressure on the windshield will tend to concentrate at the chipped areas, causing cracks. If the glass is chipped, the edge should be ground smooth.

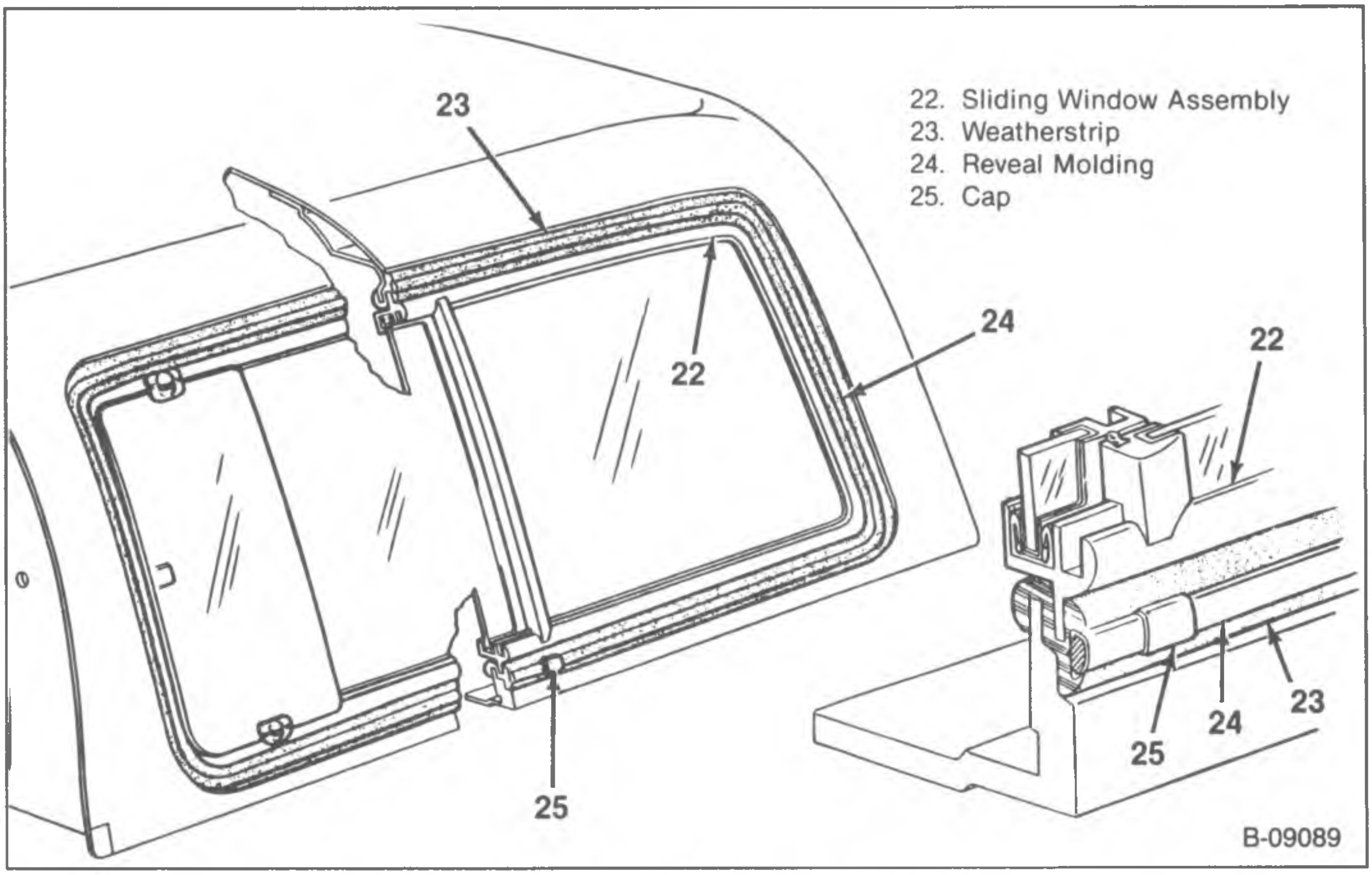


Figure 8—Sliding Body Side Window Components

CAUTION: Always wear heavy gloves when handling glass to minimize the risk of injury.

1. Place a 120 mm (six-inch) strip of sealing tape on the outside upper corners of opening. This will help hold the weatherstrip in place.
2. Push the weatherstrip onto the flange of opening. Start at the center of the bottom edge of the opening.
3. Brush the weatherstrip with soapy water.
4. Set the window in place on the weatherstrip.
5. Insert the hook end of tool J-2189-02 between the weatherstrip and the edge of the glass.
6. Pull the tool around the glass in such a way as to slip the edge of the glass into the groove of the weatherstrip.
7. Thread the end of insert through the handle of the loop of tool J-2189-02.

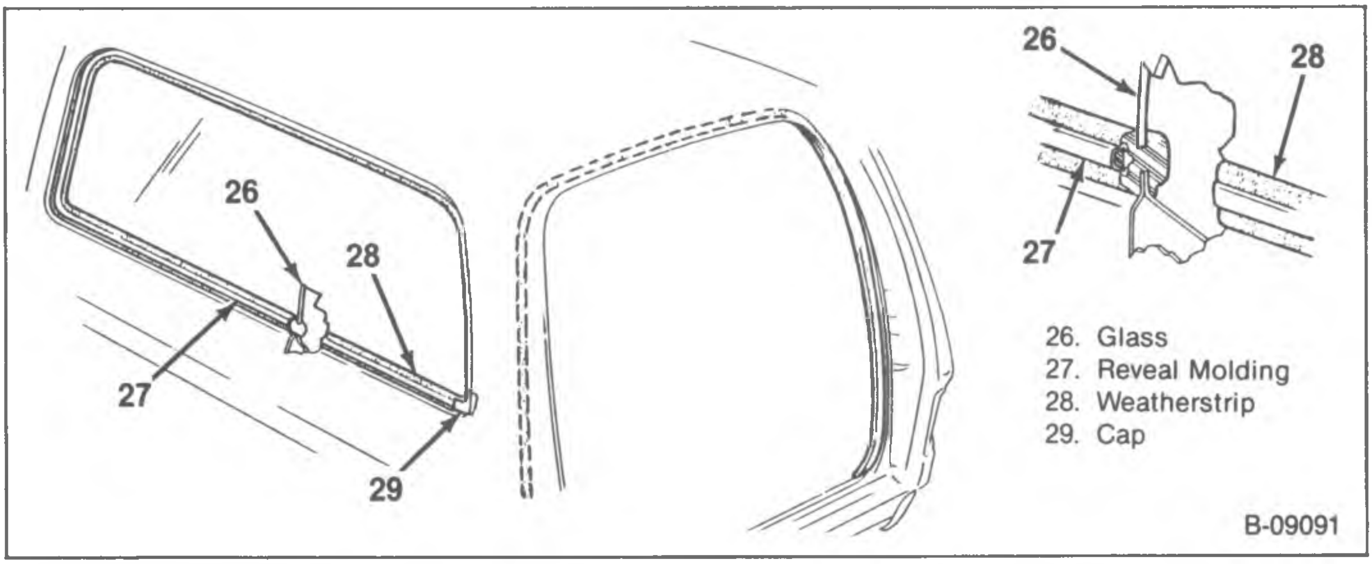


Figure 9—Suburban Rear Stationary Window Components

8. Push the loop of the tool and the end of the insert into the groove of the weatherstrip at the center of the bottom edge.
9. Move the tool around the window, while feeding the insert (figure 6). Use a hitching motion to avoid stretching the insert.
10. If the insert is longer than required, cut it, but allow the ends to overlap by 25 mm (one-inch).
11. Slip one end of the retaining clip over one end of the insert; butt the ends of the insert together and secure them with a clip.
12. Push the ends of the insert, with clip, into the groove of the weatherstrip.

G MODELS

WINDSHIELD REPLACEMENT

CAUTION: Always wear heavy gloves when handling glass to minimize the risk of injury.

When replacing a cracked windshield, it is important that the cause of the crack be determined and the condition corrected, before a new glass is installed. The cause of the crack may be an obstruction or high spot somewhere around the flange of the opening; cracking may not occur until pressure from the high spot or obstruction becomes particularly high due to winds, extremes of temperature, or rough terrain. Suggestions of what to look for are described later in this section under "Inspection".

REMOVAL (Figures 10 and 11)

If a windshield is broken, the glass may already have fallen or been removed from the weatherstrip. Often, however, it is necessary to remove a cracked or otherwise imperfect windshield that is still intact. In this case, it is a good practice to crisscross the glass with strips of masking tape before removing it; this will help hold the glass together and minimize the risk of injury.

If a crack extends to the edge of the glass, mark the point where the crack meets the weatherstrip. (Use a piece of chalk and mark the point on the cab, next to the weatherstrip.) Later, when examining the flange of the opening for a cause of the crack start at the point marked.

The higher the temperature of the work area, the more pliable the weatherstrip will be. The more pliable the weatherstrip, the more easily the windshield can be removed.

Before removing the glass, cover the instrument panel, and the surrounding sheet metal with protective covering. Remove the wiper arms.

There are two methods of windshield removal, depending on the method of windshield replacement chosen. When using the short method of installation, it is important to cut the glass from the urethane adhesive as close to the glass as possible. This is due to the fact that the urethane adhesive will be used to provide a base for the replacement windshield.

When using the extended method of windshield replacement, all the urethane adhesive must be removed from the pinchweld flange so, the process of cutting the window from the adhesive is less critical.

Tool Required:

J-24402-A Glass Sealant Remover Knife.

1. Place protective coverings around the area where the glass will be removed.
2. Remove the windshield wiper arms, and the interior garnish moldings.
3. Remove the exterior reveal moldings and the support molding from the urethane adhesive by prying one end of the molding from the adhesive. Pull the free end of the molding away from the windshield and/or pinchweld flange until the molding is completely free of the windshield.
4. Using J-24402-A cut the windshield from the urethane adhesive. If the short method of glass replacement is to be used, keep the knife as close to the glass as possible in order to leave a base for the replacement glass.
5. With the help of an assistant, remove the glass.
6. If the original glass is to be reinstalled, place it on a protected bench or holding fixture. Remove any remaining adhesive with a razor blade or sharp scraper. Any remaining traces of adhesive material can be removed with denatured alcohol or lacquer thinner.

NOTICE: When cleaning windshield glass, avoid contacting the edge of the plastic laminate material (on the edge of the glass) with volatile cleaner. Contact may cause discoloration and deterioration of the plastic laminate by wicking action. Do not use a petroleum based solved such as kerosene or gasoline. The presence of oil will prevent adhesion of new material.

INSPECTION

An inspection of the flange of the windshield opening, the weatherstrip, and the glass may reveal the cause of a broken windshield. This can help prevent future breakage. If there is no apparent cause

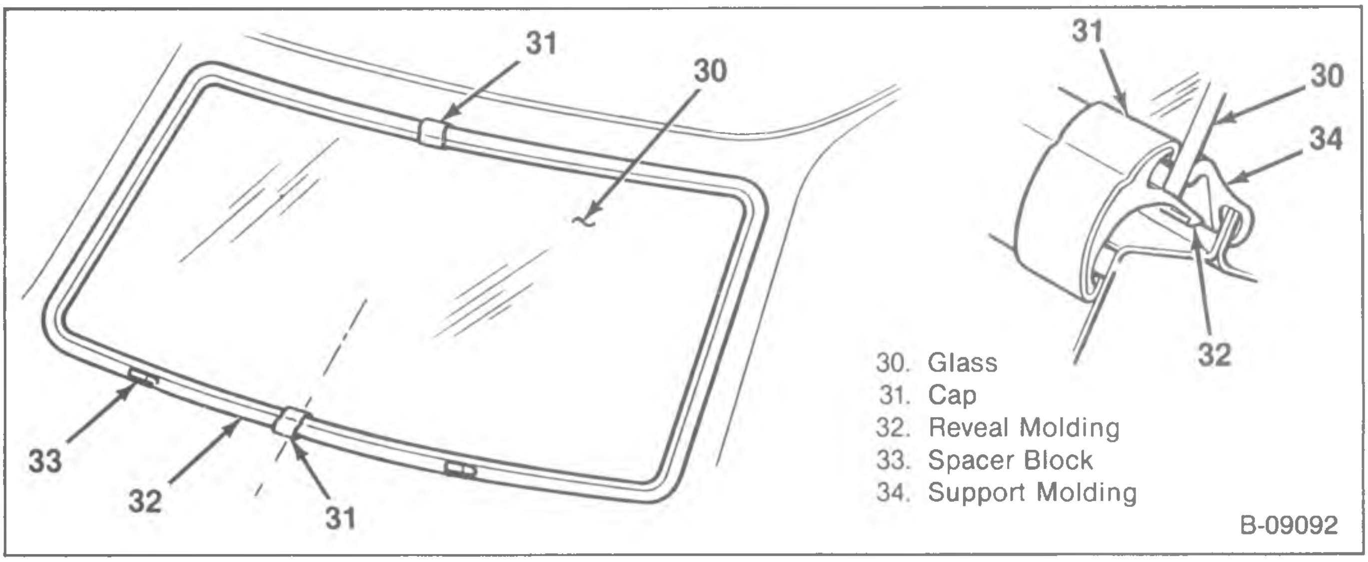


Figure 10—Windshield Components

of breakage, the weatherstrip should be removed from the flange of the opening and the flange inspected. Look for high weld or solder spots, hardened spot weld sealer, or any other obstruction or irregularity in the flange. Check the weatherstrip for irregularities or obstructions in it.

Check a windshield that is to be installed to make sure it does not have any chipped edges. Chipped edges can be ground off, restoring a smooth edge to the glass, and minimizing concentrations of pressure that cause breakage. Remove no more than necessary, in an effort to maintain the original shape of the glass and the proper clearance between it and the flange of the opening.

INSTALLATION METHODS

There are two methods used for windshield replacement. The short method described previously in the removal procedure is used when the urethane adhesive can be used as a base for the new glass. This method would be used in the case of a cracked glass, if, no other service needs to be done to the windshield frame such as sheet metal or repainting work.

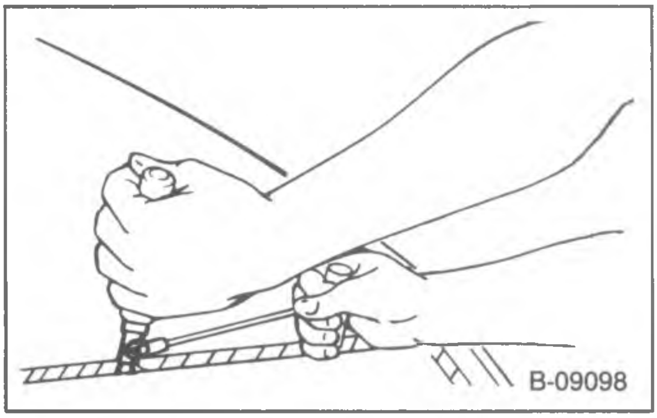


Figure 11—Cutting The Glass From The Adhesive

The second of the two methods is the extended method. This method should be used when work must be done to the windshield frame such as straightening or repairing sheet metal or repainting the windshield frame. In this method, all of the urethane adhesive must be removed from the pinchweld flange.

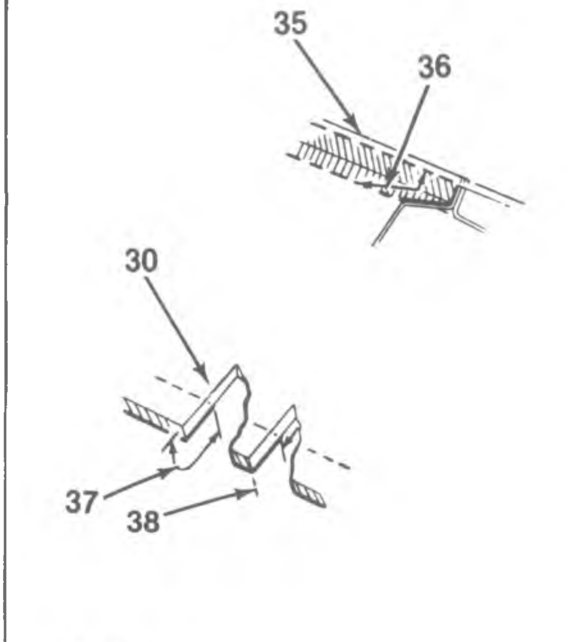
INSTALLATION (Figures 12 through 16)

To replace a urethane adhered windshield, GM adhesive service kit No. 9636067 contains some of the materials needed, and must be used to insure the original integrity of the windshield design. Materials in the kit include:

1. One tube of adhesive material.
2. One dispensing nozzle.
3. Steel music wire.
4. Rubber cleaner.
5. Rubber primer.
6. Pinchweld primer.
7. Blackout primer.
8. Filler strip (for use on windshield installations for vehicles equipped with embedded windshield antenna).
9. Primer applicators.

Other materials are required for windshield installation which are not included in the service kit. These include:

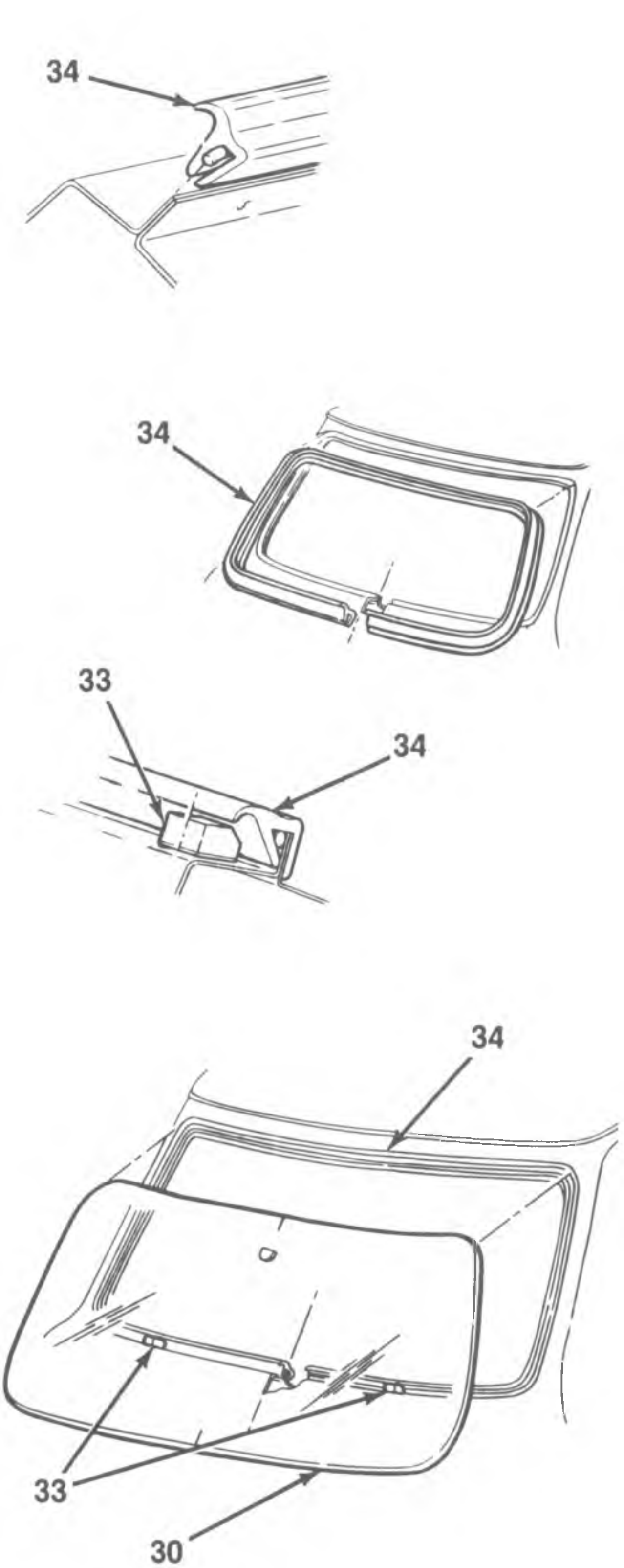
1. GM Rubber lubricant No. 1051717.
2. Alcohol for cleaning the edge of the glass.
3. Adhesive dispensing gun J-24811 or
4. A standard household cartridge type gun reworked as follows:
   a. Widen the end slot to fit the diameter of the dispensing nozzle of the adhesive tube.
   b. Reduce the diameter of the plunger disc so that the disc will enter the large end of the adhesive tube.
5. Commercial type razor knife.
6. Two rubber support spacers.



30. Glass
35. Pinchweld Flange
36. Pinchweld Primer Application Location
37. Clear Primer Application Location
38. 10 mm (0.40-inch)

B-09101

Figure 12—Primer Application Locations



30. Glass
33. Spacer Block
34. Support Molding

B-09102

Figure 13—Windshield Component Locations

Extended Method

1. Clean all the metal surrounding the windshield opening with a clean alochol dampened cloth. Allow the alcohol to air dry.
2. Apply the pinchweld primer found in the service kit to the pinchweld area (figure 12). Do not let any of the primer touch any exposed paint because damage to the finish will occur. Allow thirty minutes for the primer to dry.
3. Follow the steps listed under Short Method for the remainder of the procedure.

Short Method

1. Install the support molding onto the pinchweld flange from inside the vehicle. The joint of the molding should be located at the bottom center of the molding.
2. Thoroughly clean the edge of the glass to which the adhesive material will be applied with a clean alcohol dampened cloth. Allow the alcohol to dry.
3. Apply the clear glass primer in thekit to the inner edge of the windshield from the edge of the glass inward 10 mm (0.40-inch). Apply the primer around the entire perimeter of the glass. Allow the primer to cure for 30 minutes.
4. Apply the blackout primer to the glass in the same area as the clear primer. Allow the blackout primer to dry to the touch.

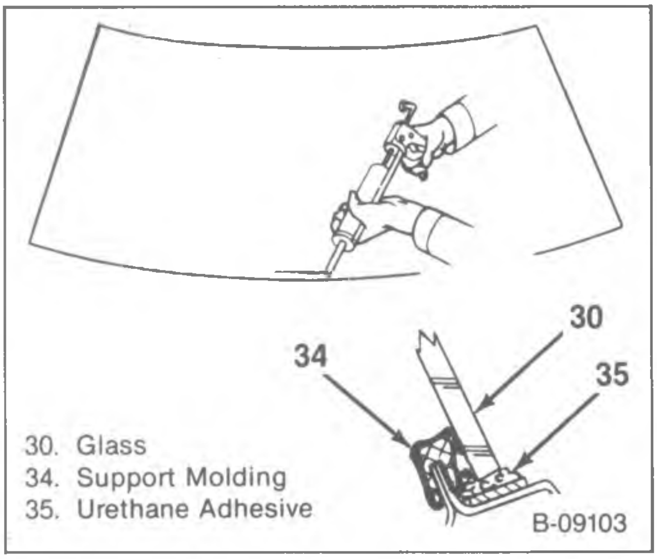


Figure 14—Urethane Application

5. Place two rubber blocks onto the base of the pinchweld flange. Place the blocks in line with the last screw on either side of the cowl grille cover.
6. With the aid of a helper, lift the glass into the opening. Center the glass in the opening, on top of the support molding.
7. Check the fit of the reveal molding. If necessary, remove the glass and cut away additional urethane to give the proper windshield height. Place the glass in the window opening.
8. Cut the tip of the adhesive cartridge approximately 5 mm ($^{3}/_{16}$-inch) from the end of the tip.
9. Apply the adhesive first in and around the spacer blocks. Apply a smooth continuous bead of adhesive into the gap between the glass edge and the sheet metal. Use a flat-bladed tool to paddle the material into position if necessary. Be sure that the adhesive contacts the entire edge of the glass, and extends to fill the gap between the glass and the primed sheet metal (extended method) or solidified urethane base (short method).
10. Spray a mist of water onto the urethane. Water will assist in the curing process. Dry the area where the reveal molding will contact the body or glass.
11. Install new reveal moldings. Remove the protective tape covering the butyl adhesive on the underside of the molding. Push the molding caps onto each end of one of the reveal moldings. Press the lip of the molding into the urethane adhesive while holding it against the edge of the windshield. Take care to seat the molding in the corners. The lip must fully contact the adhesive and the gap must be entirely covered by the crown of the molding. Slide the molding caps onto the adjacent moldings. Use tape to hold the molding in position until the adhesive cures.

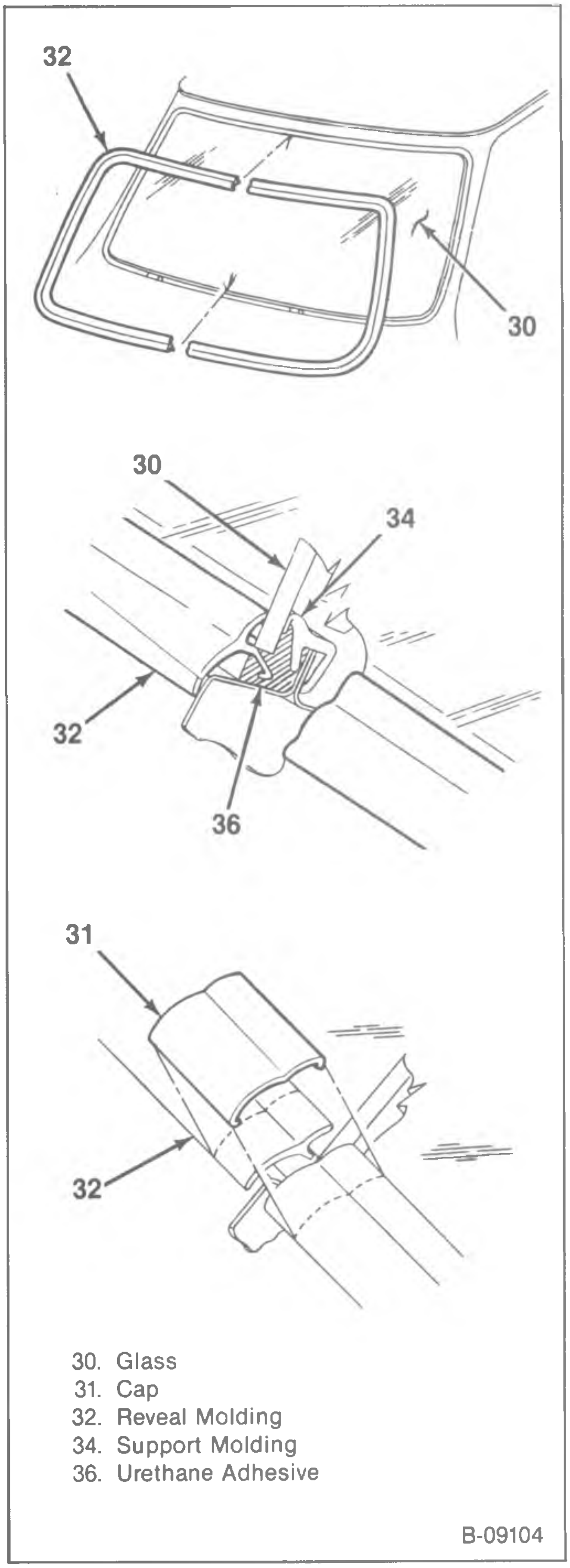


Figure 15—Reveal Molding

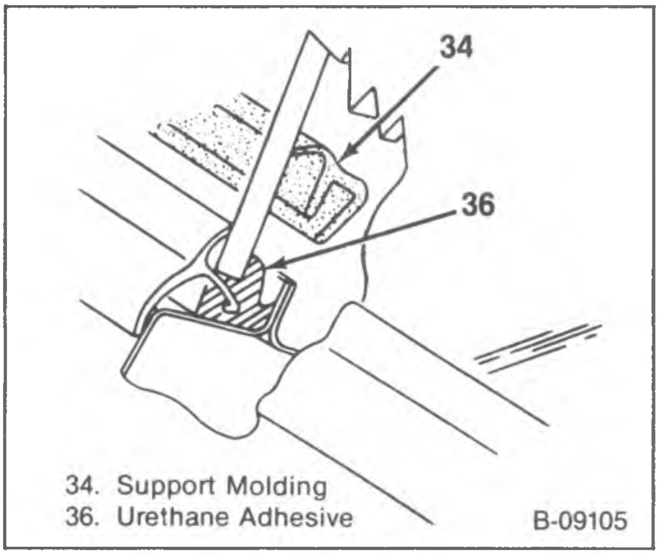


Figure 16—Windshield Support Molding — Short Method

12. Install the wiper arms and the interior garnish moldings.
13. The vehicle should not be driven and should remain at room temperature for six hours to allow the adhesive to cure.

STATIONARY GLASS REPLACEMENT

REMOVAL (Figures 17, 18 and 19)

If the glass is cracked but still intact, it should be crisscrossed with masking tape to reduce the risk of injury and/or damage to the vehicle. If a crack extends to the edge of the glass, mark the cab with a piece of chalk at the point where the crack meets the weatherstrip. This will aid the inspection later.

CAUTION: Always wear heavy gloves when handling glass to minimize the risk of injury.

1. Drill out the rivets (if equipped) with a 5 mm ($^3/_{16}$-inch) drill bit.
2. Run a putty knife around the edge of the window, between the weatherstrip and the cab panels (inside and outside the cab). This is to make sure the weatherstrip is not stuck to the cab.
3. Have an assistant stand outside the cab next to the window.
4. Use the putty knife, or other blunt tool, to force the edge of the weatherstrip off the flange of the opening inside the cab. While doing this, push out on the glass.
5. Continue around the window, forcing the weatherstrip off the flange, until the glass and weatherstrip are free of the opening.
6. Have an assistant remove the glass and weatherstrip from outside the vehicle.

INSPECTION

An inspection of the flange of the windshield opening, the weatherstrip, and the glass may reveal the cause of a broken windshield. This can help prevent future breakage. If there is no apparent cause of breakage, the weatherstrip should be removed from the flange of the opening and the flange inspected. Look for high weld or solder spots, hardened spot weld sealer, or any other obstruction or irregularity in the flange. Check the weatherstrip for irregularities or obstructions in it.

Check a windshield that is to be installed to make sure it does not have any chipped edges. Chipped edges can be ground off, restoring a smooth edge to the glass, and minimizing concentrations of pressure that cause breakage. Remove no more than

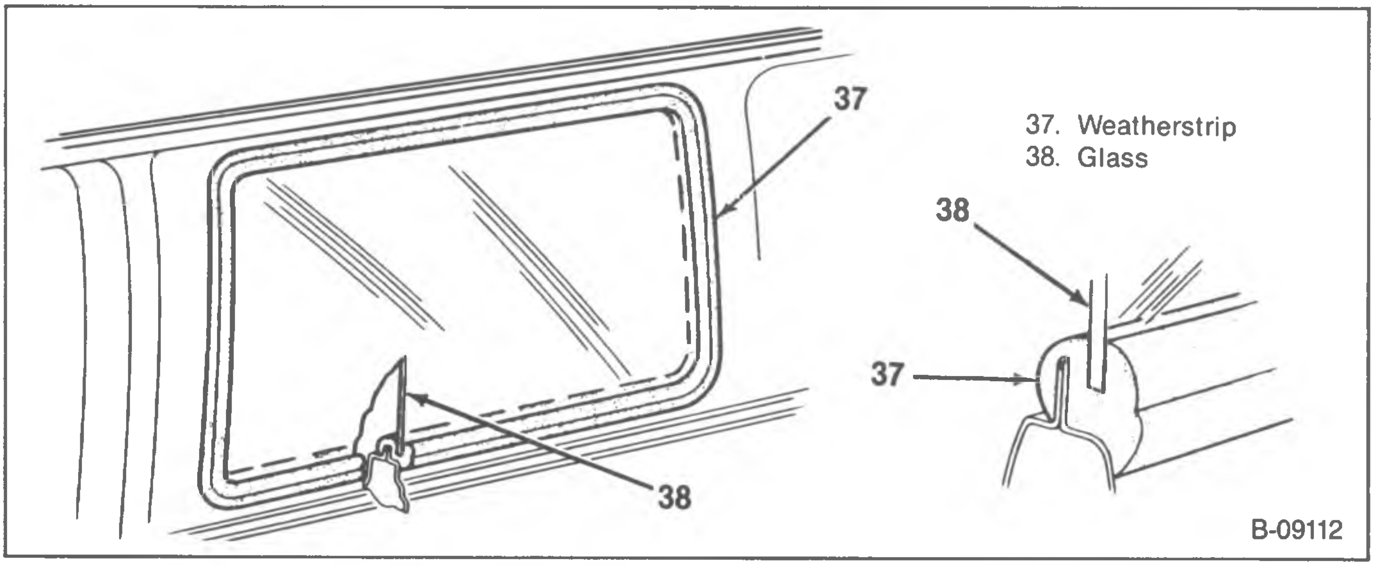


Figure 17—Body Side Front Window

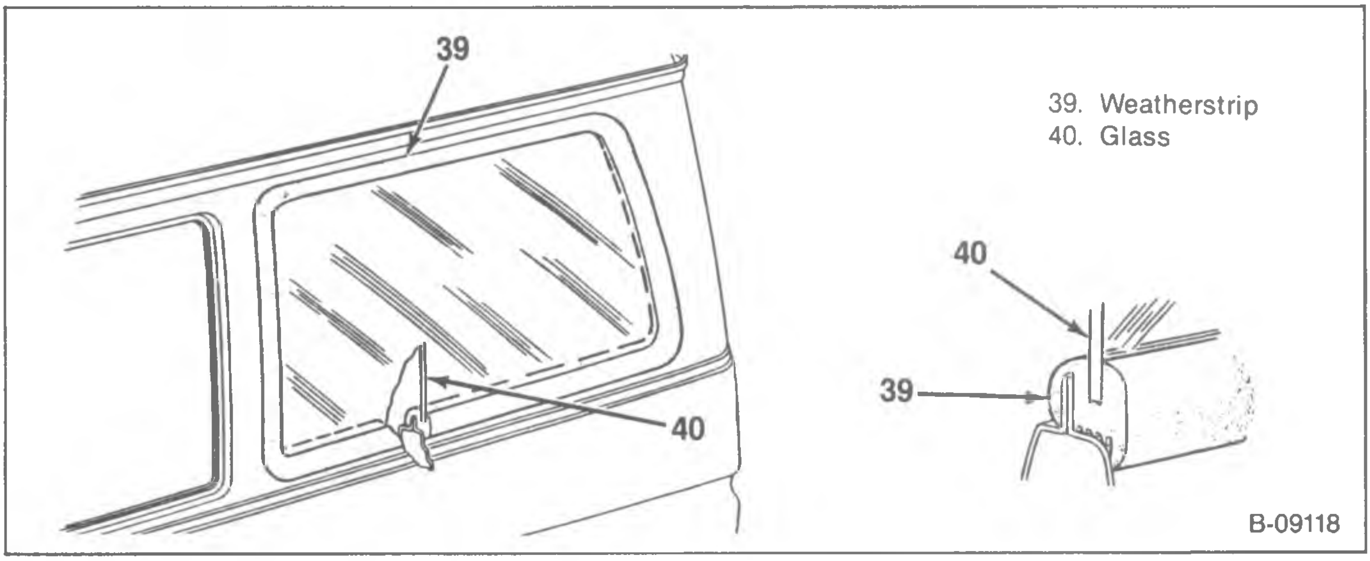


Figure 18—Body Side Rear Window

necessary, in an effort to maintain the original shape of the glass and the proper clearance between it and the flange of the opening.

INSTALLATION (Figures 17, 18, and 19)

Before a new glass is installed, the cause of the breakage should be determined. This may require an inspection of the weatherstrip and the flange of the window opening. See "Inspection", previously outlined in this section.

To ease installation, the weatherstrip can be heated with a non-flame source. At higher temperatures, the weatherstrip is more pliable. Do not heat above 52°C (125°F), or for more than 1-1/2 hours.

Avoid hitting the glass on anything that may chip its edges. Pressure on the glass will tend to concentrate at the chipped areas, causing cracks. If the glass is accidentally chipped, the edge should be ground smooth.

CUATION: Always wear heavy gloves when handling glass to minimize the risk of injury.

1. Place the weatherstrip around the edge of the glass to be installed.
2. Place a lengthof cord about 6 mm (1/4-inch) thick around the weatherstrip. It should be in the groove of the weatherstrip where the flange of the opening will fit. The ends of the cord should overlap about 152 mm (6-inches) and be located at the bottom of the window.
3. Brush a soapy solution of water around the outside edge of the cab opening.
4. Have an assistant hold the glass and weatherstrip (with the cord around it) up to the window opening from the outside of the cab; the ends of the cord should have been placed through the opening and hang loosely inside the cab.

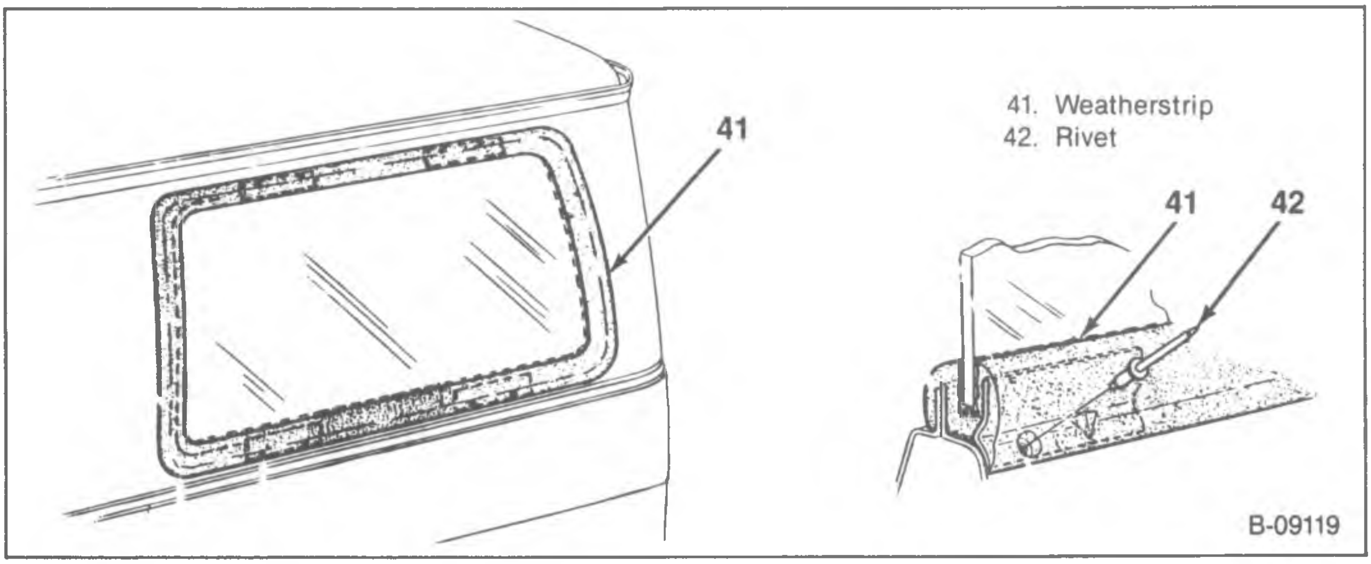


Figure 19—Body Side Rear Window — Riveted

5. While the assistant holds the glass firmly in place, pull one end of the cord, forcing the lip of the weatherstrip up and over the flange of the opening.
6. Continue pulling the cord until it is free from the weatherstrip and the lip of the entire weatherstrip is over the flange of the opening.
7. Install rivets (if equipped) to the weatherstrip and the side panel with a rivet installing gun.

ALL MODELS

GLASS POLISHING

MINOR SCRATCH AND ABRASION REMOVAL

Minor scratches and abrasions can be removed or reduced by following the procedure outlined below. Precautions must be taken, however, to prevent distortions of vision; double vision may result if an attempt is made to remove deep scratches. Deep scratches should not be removed from an area in the driver's line of vision; in such cases, the glass should be replaced.

The procedure that follows was developed using a cerium oxide compound. Follow manufacturer's directions if other materials are used.

Recommended Equipment

1. A low speed (600-1300 rpm) rotary polisher.
2. A wool, felt, rotary polishing pad 76 mm (three-inches) in diameter and 51 mm (two-inches) thick.
3. Powdered cerium oxide mixed with water. This is the abrasive compound.
4. A wide mouth container to hold the abrasive compound.

Polishing Procedure (Figure 20)

1. Mix at least 44 ml (1.5 oz.) of cerium oxide with enough water to obtain a creamy consistency. (If the mixture is too thick it will cake on the felt pad more quickly. If it is too runny, more polishing time will be needed.)
2. Draw a circle around the scratches on the opposite side of the glass with a marking crayon, or equivalent.
3. Draw a line directly behind the scratch(es) to serve as a guide for locating the scratch while polishing.
4. Cover the surrounding area with masking paper to catch the drippings or spattered polish.
5. Dip the felt pad attached to the polisher into the mixture. Do not submerge the pad or allow the pad to stay in the mixture as it may loosen the bond between the pad and the metal plate.

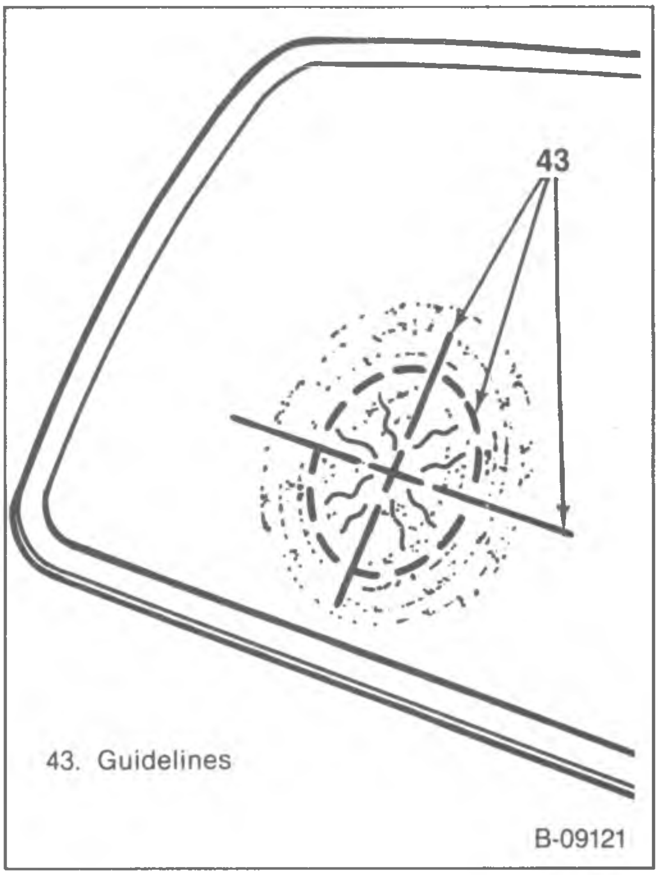


Figure 20—Glass Polishing Guidelines

NOTICE: Never hold the tool in one spot or operate the tool on the glass any longer than 30 to 45 seconds. If the glass becomes hot to touch, let it air cool before proceding further. Cooling with cold water may crack heated glass. Avoid excessive pressure. It may cause overheating of the glass.

6. Polish the scratched area, but note the following:
   a. Agitate the mixture as often as needed to maintain the creamy consistency of the compound.
   b. Use moderate but steady pressure.
   c. Hold the pad flat against the glass.
   d. Use a feathering-out motion.

   e. Dip the pad into the mixture every 15 seconds to ensure that the wheel and the glass are always wet during the polishing operation. (A dry pad causes excessive heat to develop.)
   f. Keep the pad free of dirt and other foreign substances.
7. After removing the scratch, wipe the area clean of any polish.
8. Clean the polishing pad.

SECTION 10A4

INTERIOR TRIM

CONTENTS

C/K MODEL INTERIOR TRIM

The following procedure covers the trim located at the front of the cab, and applies to all C/K models.

FRONT TRIM REPLACEMENT

Remove or Disconnect (Figures 1 through 4)

1. Sill plate screws (1).
2. Sill plate (2).
3. Kick panel screws (3).
4. Kick panel (4).
5. Instrument panel outer filler screws (5).
6. Instrument panel outer filler (6).
7. Upper garnish molding screws (7).
8. Upper garnish molding (8).
9. Windshield side garnish molding screws (9).
10. Windshield side garnish molding (10).

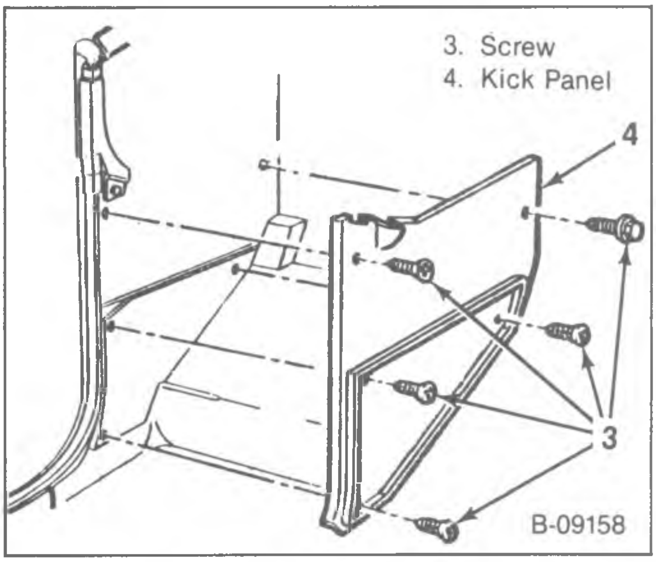


Figure 1—Kick Panel

Install or Connect (Figures 1 through 4)

1. Windshield side garnish molding (10).
2. Windshield side garnish molding screws (9).
3. Upper garnish molding (8).
4. Upper garnish molding screws (7).
5. Instrument panel outer filler (6).
6. Instrument panel outer filler screws (5).
7. Kick panel (4).
8. Kick panel screws (3).
9. Sill plate (2).
10. Sill plate screws (1).

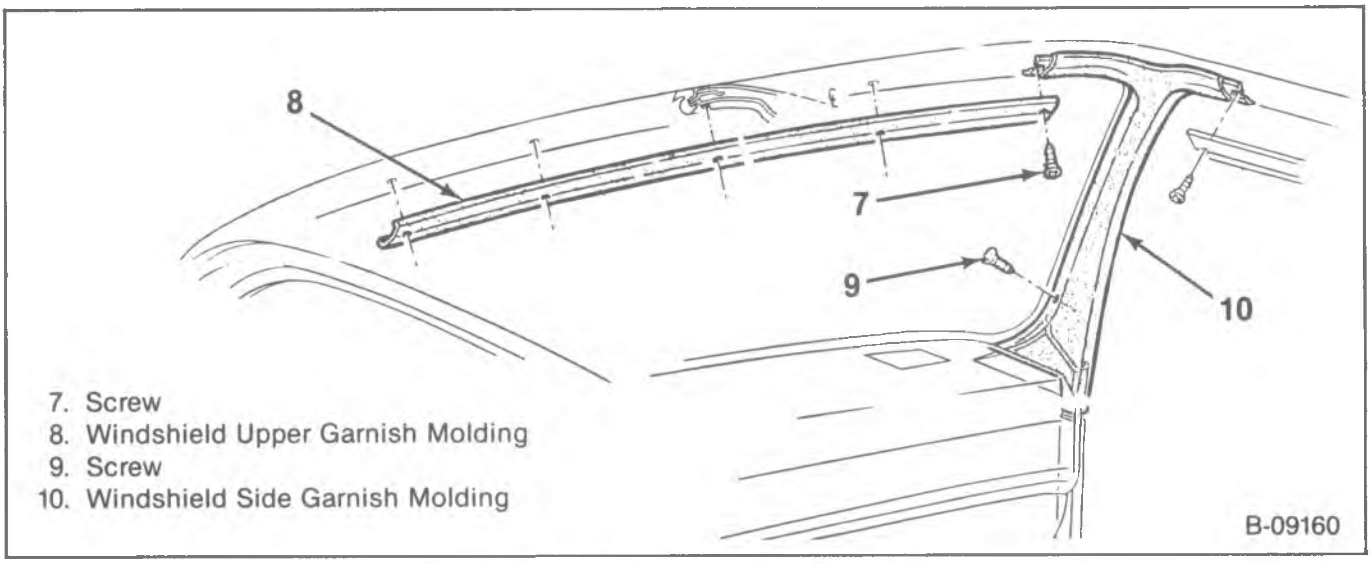


Figure 2—Windshield Garnish Moldings

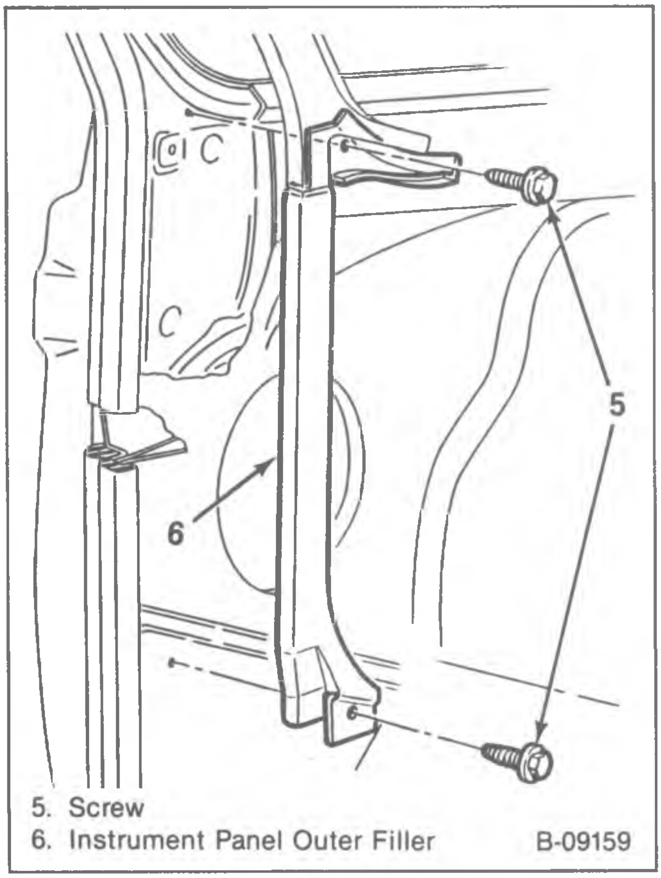


Figure 3—Instrument Panel Outer Filler

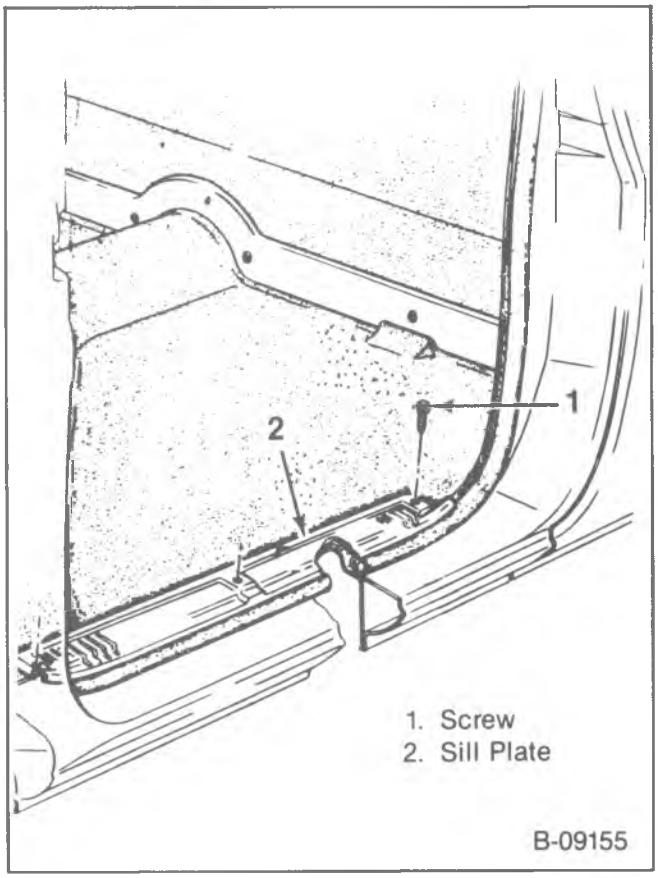


Figure 4—Sill Plate

PICK UP MODELS

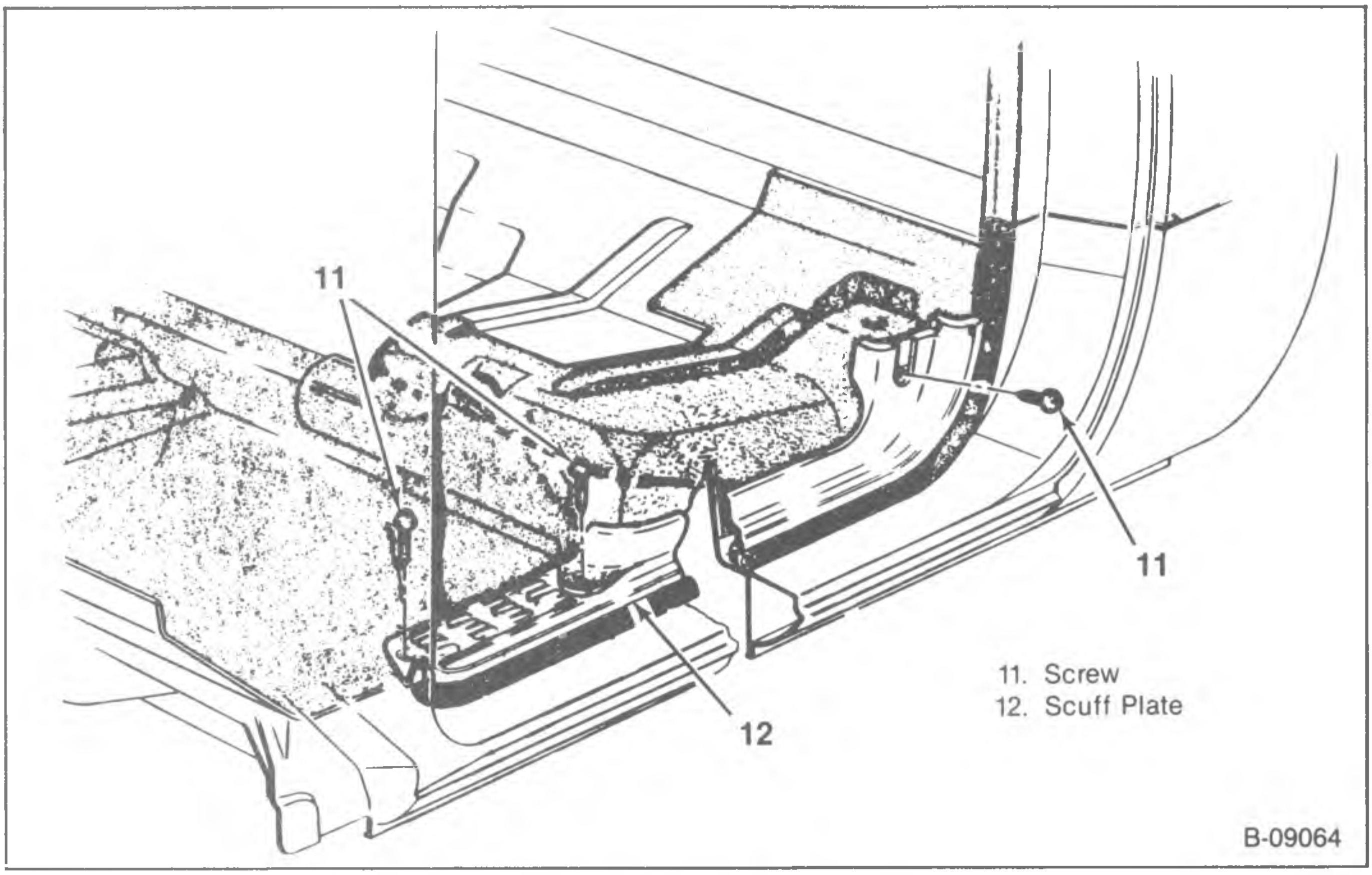


Figure 5—Front Door Sill Plate

CARPET REPLACEMENT

↔ Remove or Disconnect (Figures 5 through 8)

1. Seats and seat belts. Refer to SEATS (SEC. 10A2).
2. Kick panel.
3. Front door scuff plate (12).
4. Rear panel nails (13).
    - Pull the nails from the panel.
5. Rear panel (14).
6. Dash panel retainers (15).
7. Carpet (16) from the vehicle.

→← Install or Connect (Figures 5 through 8)

1. Carpet (16) to the vehicle.
2. Dash panel retainers (15).
3. Rear panel (14).
4. New rear panel nails (13).
    - Push the nails through the panel and into the body panels.
5. Front door scuff plate (12).
6. Kick panel.
7. Seats and seat belts. Refer to SEATS (10A2).

HEADLINER AND TRIM REPLACEMENT

↔ Remove or Disconnect (Figure 9)

1. Windshield upper garnish molding screws (23).
2. Windshield upper garnish molding (17).
3. Side window garnish molding screws (21).
4. Side window garnish molding (22).
5. Windshield garnish molding screws.
6. Windshield garnish molding (24).
7. Back window garnish molding screws.
8. Back window garnish molding (25).
9. Headliner (20).

→← Install or Connect (Figure 9)

1. Headliner (20).
2. Back window garnish molding (25).
3. Back window garnish molding screws.
4. Windshield garnish molding (24).

5. Windshield garnish molding screws.
6. Side window garnish molding (22).
7. Side window garnish molding screws (21).
8. Windshield upper garnish molding (17).
9. Windshield upper garnish molding screws (23).

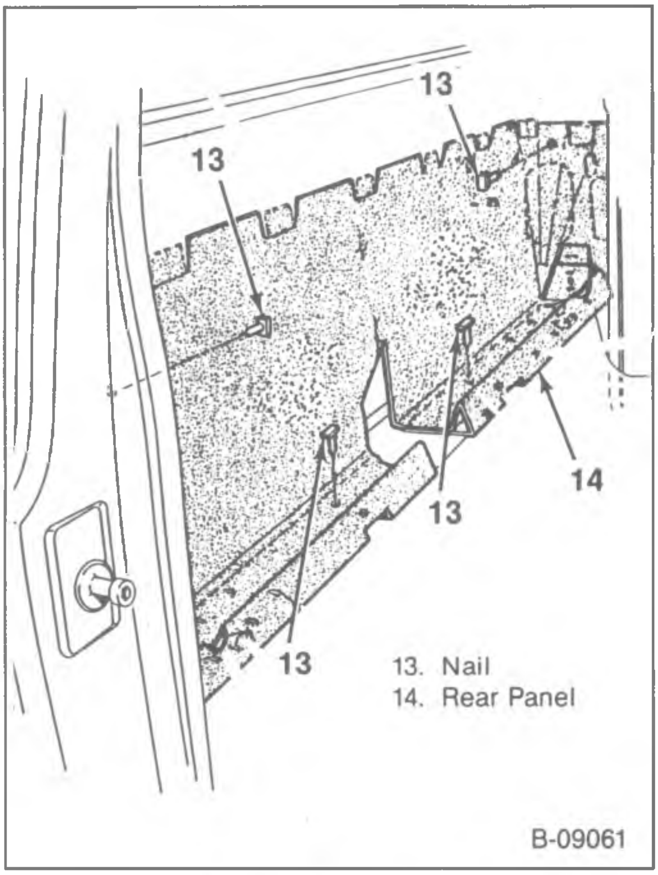


Figure 6—Rear Panel

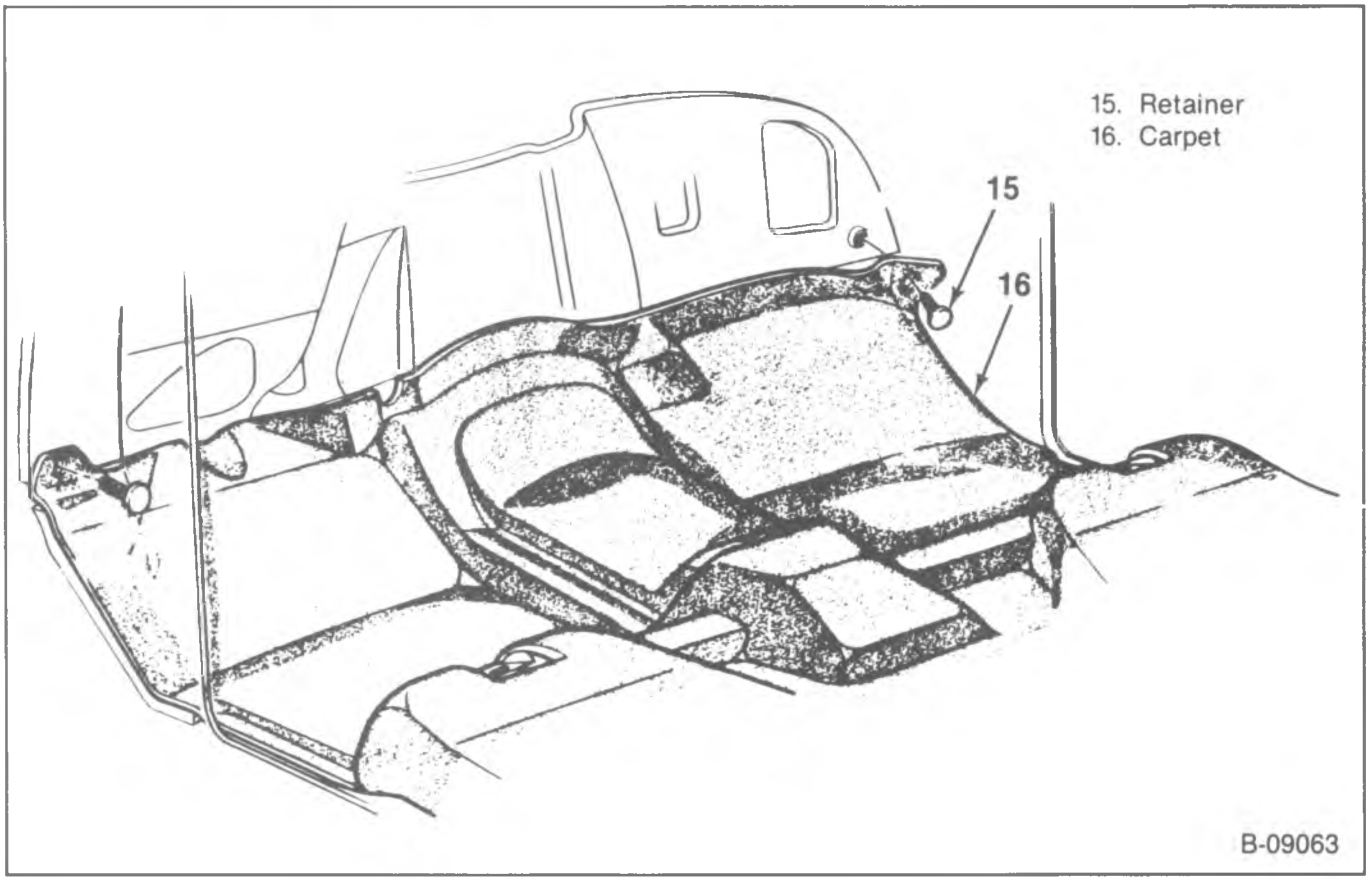


Figure 7—Carpet Retainers

16. Carpet

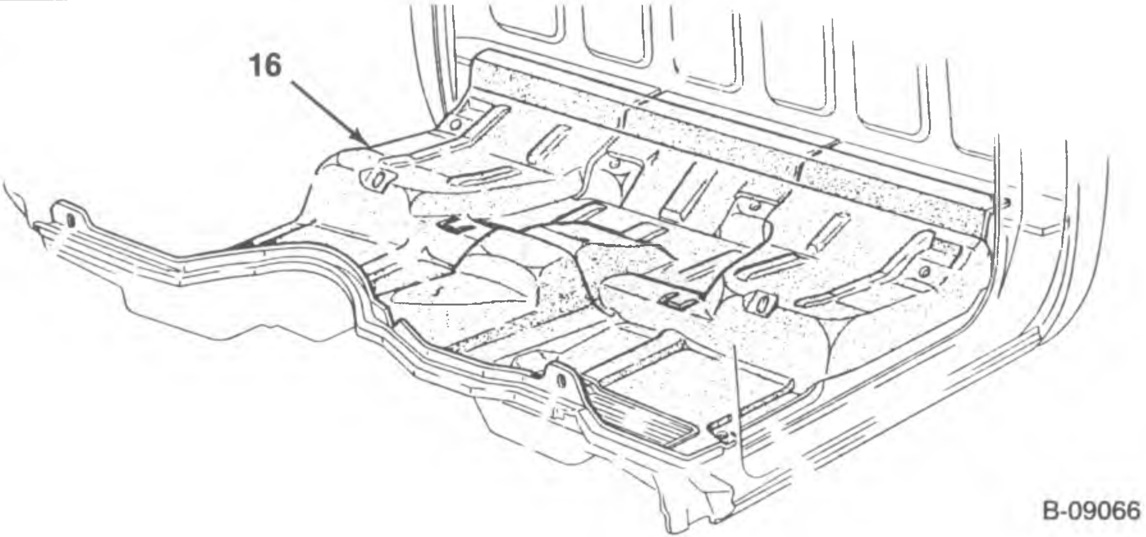


Figure 8—Carpet

17. Windshield Upper Garnish Molding
18. Screw
19. Back Window Upper Garnish Molding
20. Headliner
21. Screw
22. Side Window Garnish Molding
23. Screw
24. Windshield Garnish Molding
25. Back Window Garnish Molding

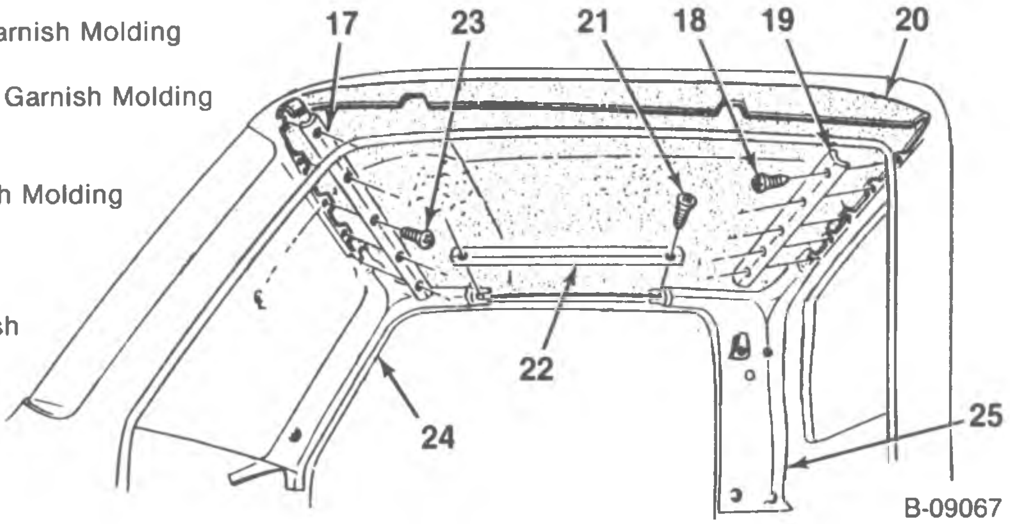


Figure 9—Headliner And Interior Trim

BONUS CAB MODELS

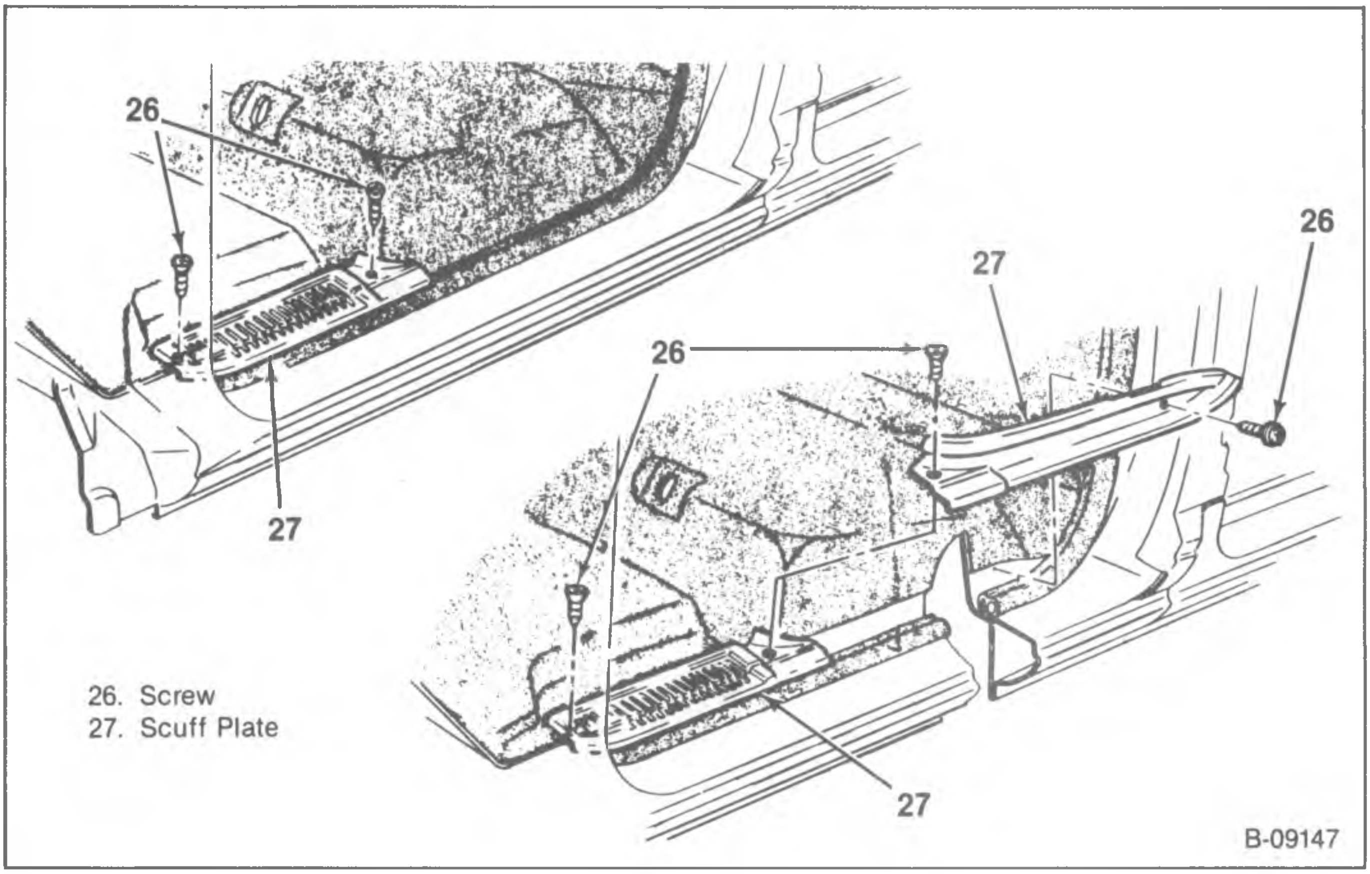


Figure 10—Front Door Sill Plate

CARPET REPLACEMENT

Remove or Disconnect (Figures 10 through 12)

1. Seats and seat belts. Refer to SEATS (Sec. 10A1).
2. Kick panel.
3. Front and rear door scuff plates (27).
4. Rear panel nails (figure 6).
    - Pull the nails from ther panel.
5. Rear panel (figure 6).
6. Dash panel retainers (figure 7).
7. Lock pillar garnish molding screws (41) and the molding (42).
8. Carpet to floor panel bolts (28) (if equipped).
9. Carpet (29) from the vehicle.

Install or Connect (Figures 10 through 12)

1. Carpet (29) to the vehicle.
2. Carpet to floor panel bolts (28) (if equipped).
3. Lock pillar garnish molding (42) and the screws (41).
4. Dash panel retainers (figure 7).
5. Rear panel (figure 6).
6. Rear panel nails (figure 6).
    - Push the nails through the panel and into the body panels.
7. Front and rear door scuff plates (27).
8. Kick panel.
9. Seats and seat belts. Refer to SEATS (SEC. 10A1).

HEADLINER AND TRIM REPLACEMENT

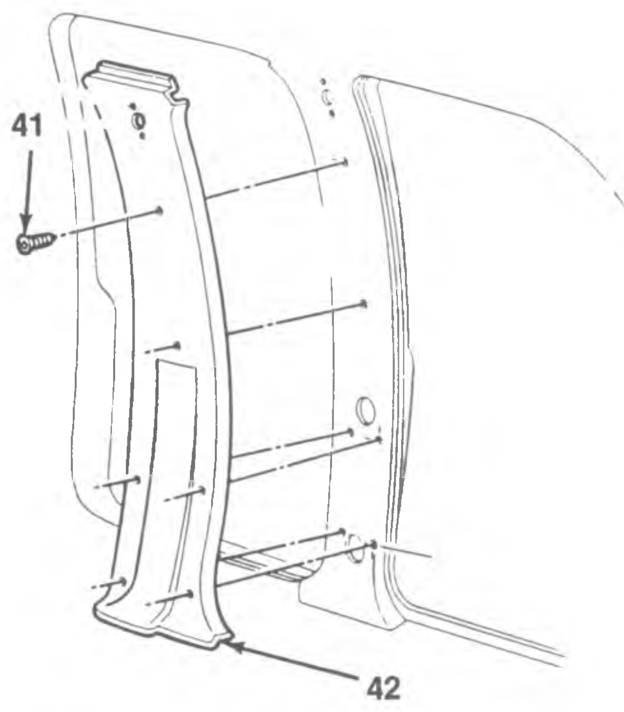
Remove or Disconnect (Figures 13 and 14)

1. Windshield upper garnish molding screws (39) and the molding (31).
2. Side window garnish molding screws (40) and the molding (38).
3. Windshield garnish molding screws and the molding (30).
4. Back window garnish molding screws and the molding (35).
5. Lock pillar garnish molding screws and the molding.

6. Sunshade screws (44) and sunshade (43).
7. Headliner (32) from the vehicle.

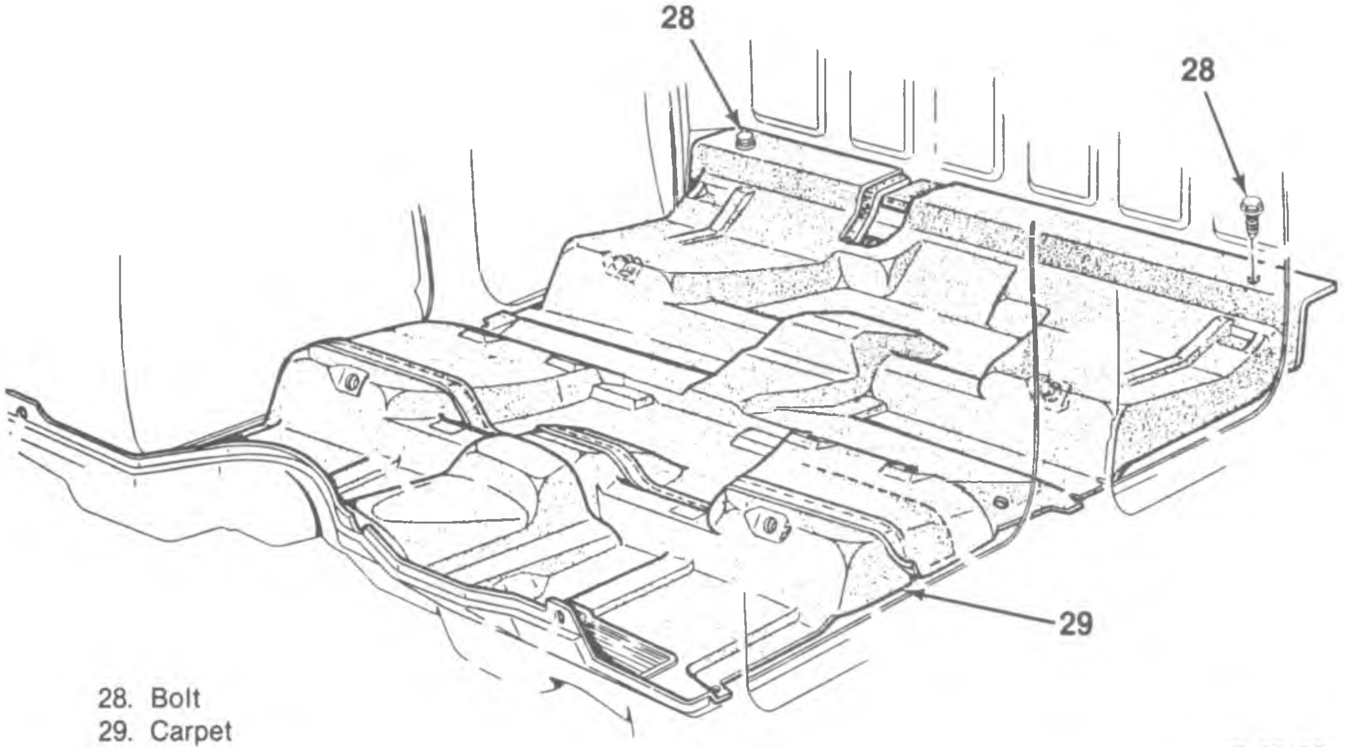
→← Install or Connect (Figures 13 and 14)

1. Headliner (32) to the vehicle.
2. Sunshade (43) and screws (44).
3. Lock pillar garnish molding and screws.
4. Back window garnish molding (35) and screws.
5. Windshield garnish molding (30) and screws.
6. Side window garnish molding (38) and screws (40).
7. Windshield upper garnish molding (31) and screws (39).



41. Screw
42. Lock Pillar Garnish Molding

Figure 11—Lock Pillar Garnish Molding



28. Bolt
29. Carpet

Figure 12—Carpet

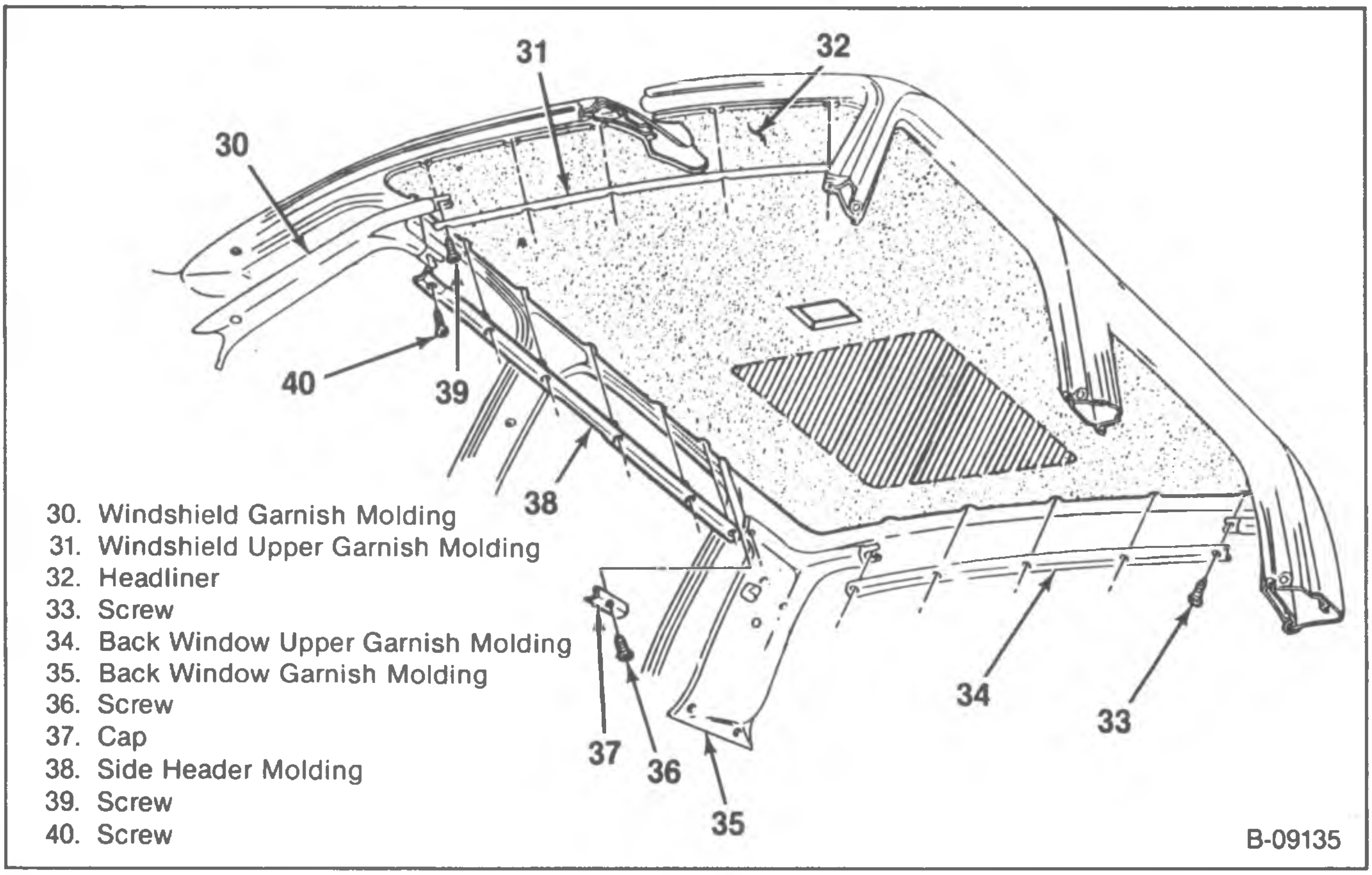


Figure 13—Headliner And Interior Trim

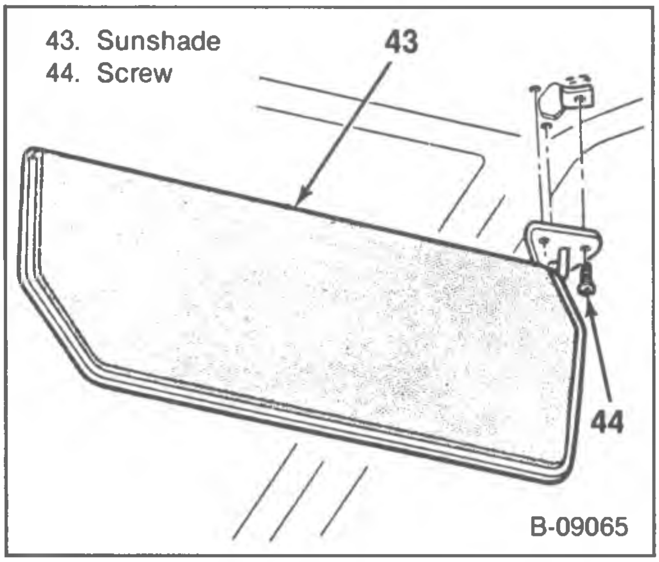
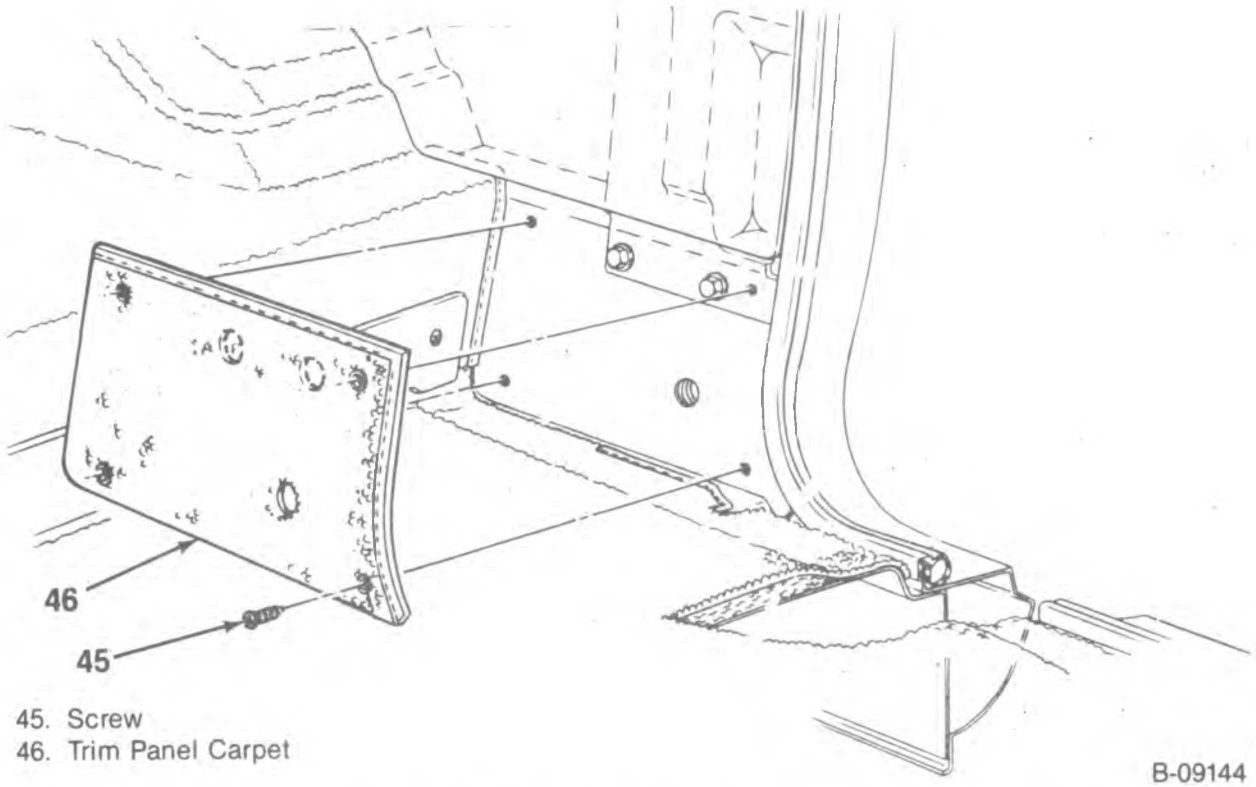


Figure 14—Sunshade

UTILITY VEHICLE MODELS



45. Screw
46. Trim Panel Carpet

Figure 15—Side Panel Trim Carpet

CARPET REPLACEMENT

Remove or Disconnect (Figures 15 through 19)

1. Seats and seat belts. Refer to SEATS (SEC. 10A2).
2. Kick panel.
3. Front door scuff plate.
4. Side trim carpet panel screws (45) and the panel (46).
5. Side trim panel screws (47) and the panel (48).
6. Floor panel trim plate screws (49) and the trim plate (50).
7. Rear scuff plate screws (51) and the plate (52).
8. Dash panel retainers (figure 7).
9. Carpet (53) from the vehicle.

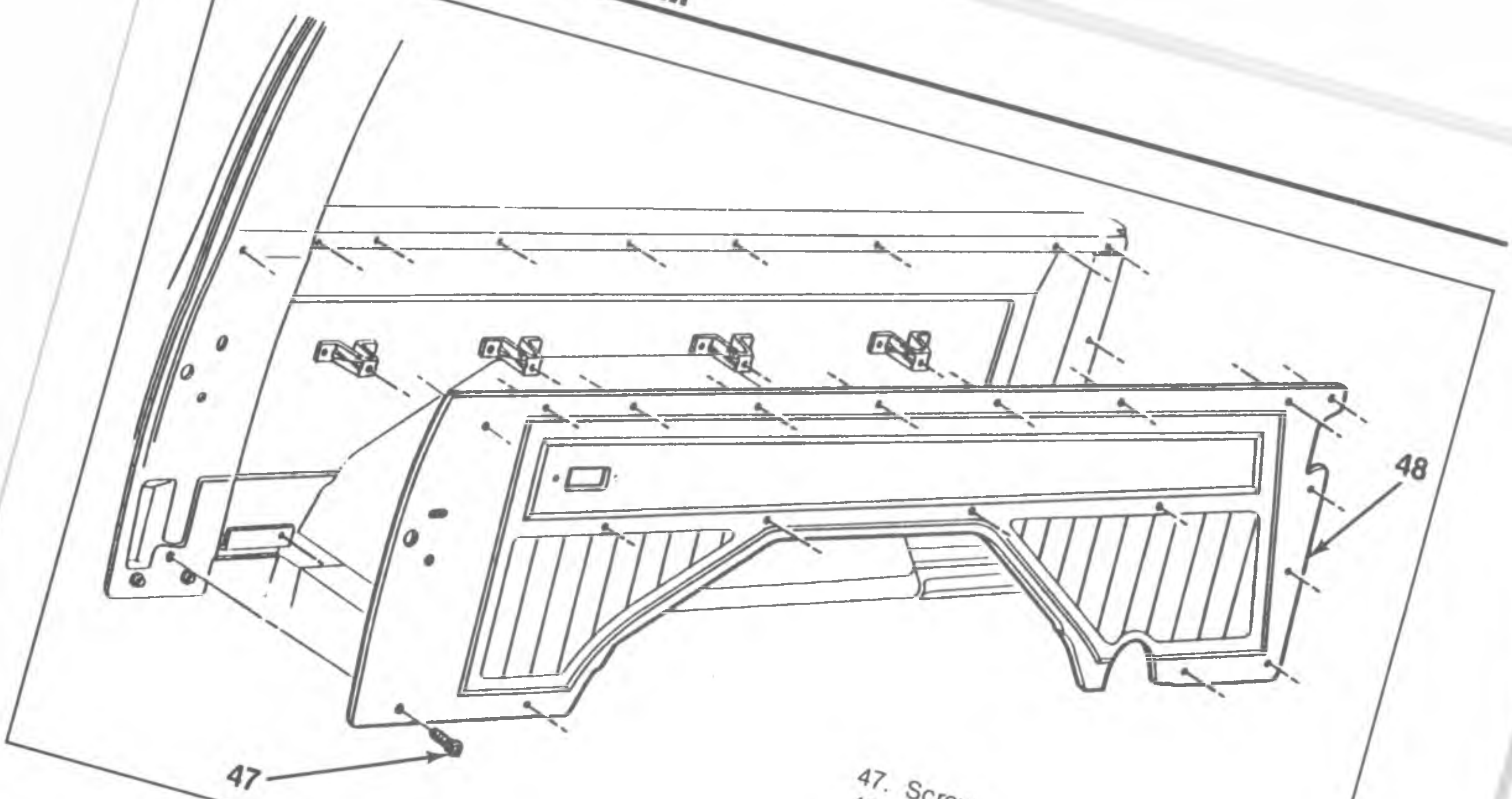
Install or Connect (Figures 15 through 19)

1. Carpet (53) to the vehicle.
2. Dash panel retainers (figure 7).
3. Rear scuff plate (52) and screws (51).
4. Floor panel trim plate (50) and screws (49).
5. Side trim panel (48) and screws (47).
6. Side trim carpet panel (46) and screws (45).
7. Front door scuff plate.
8. Kick panel.
9. Seats and seat belts. Refer to SEATS (Sec. 10A2).

HEADLINER AND TRIM REPLACEMENT

Remove or Disconnect (Figure 20)

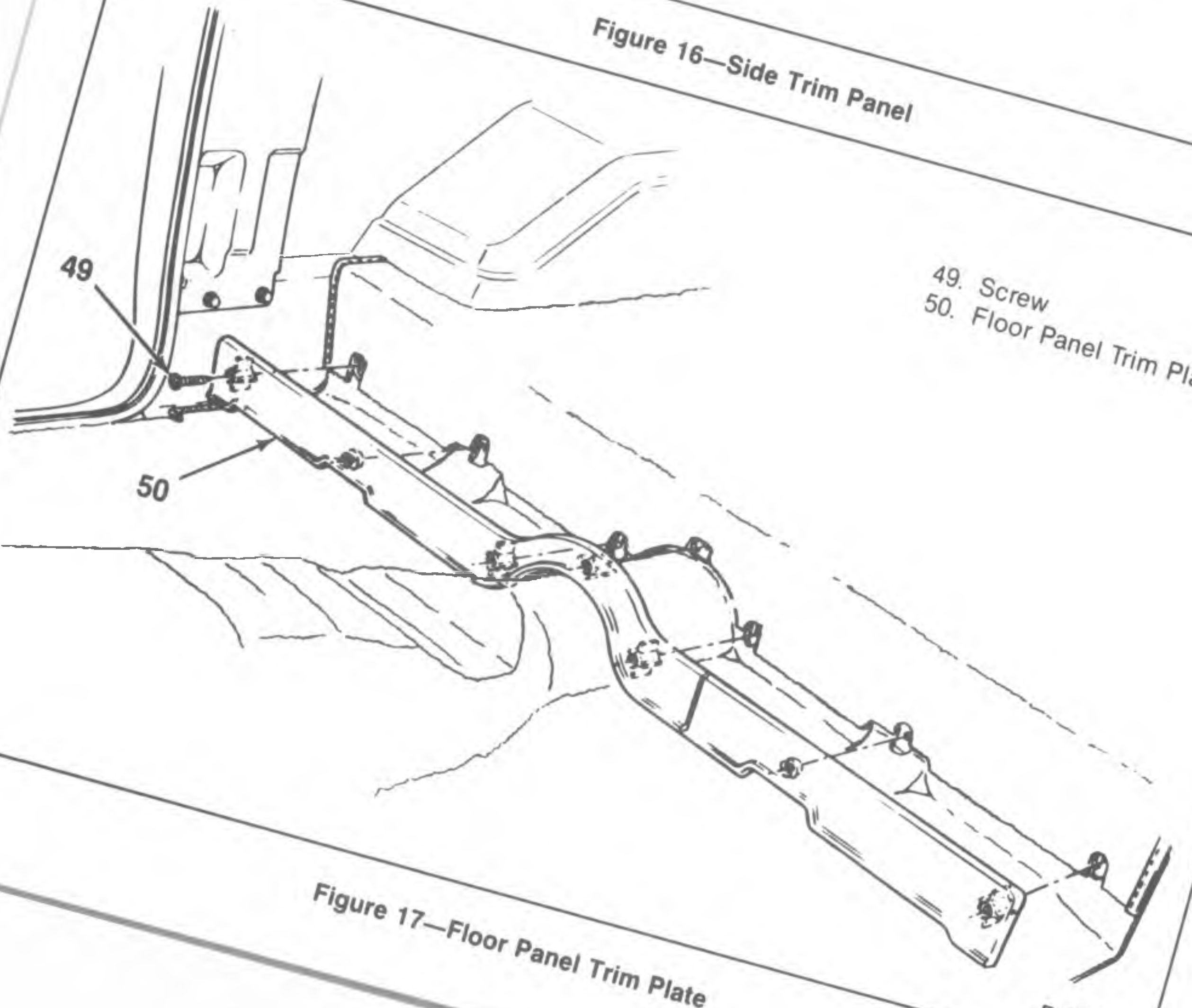
1. Windshield upper garnish molding screws (56) and the molding (55).
2. Side window garnish molding screws (58) and the molding (59).
3. Windshield garnish molding screws and the molding (57).
4. Roof rear header molding screws (60) and the molding (53).
5. Lock pillar garnish molding screws and the molding (61).
6. Sunshade screws and sunshade (figure 14).
7. Headliner (54) from the vehicle.



47. Screw
48. Side Trim Panel

Figure 16—Side Trim Panel

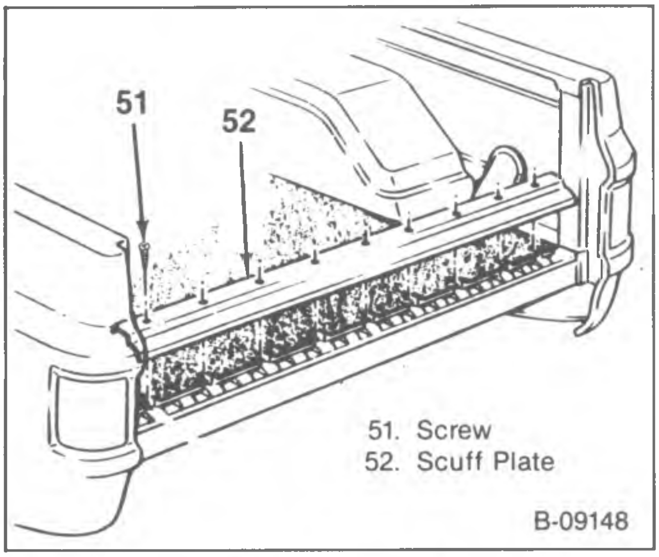
B-09111



49. Screw
50. Floor Panel Trim Plate

Figure 17—Floor Panel Trim Plate

B-09133



51. Screw
52. Scuff Plate

B-09148

Figure 18—Rear Scuff Plate

Install or Connect (Figure 20)

1. Headliner (54) to the vehicle.
2. Sunshade and screws (figure 14).
3. Lock pillar garnish molding(61) and screws.
4. Roof rear header molding (53) and screws (60).
5. Windshield garnish molding (57) and screws.
6. Side window garnish molding (59) and screws (58).
7. Windshield upper garnish molding (55) and screws (56).

FRONT FLOOR COMPARTMENT REPLACEMENT

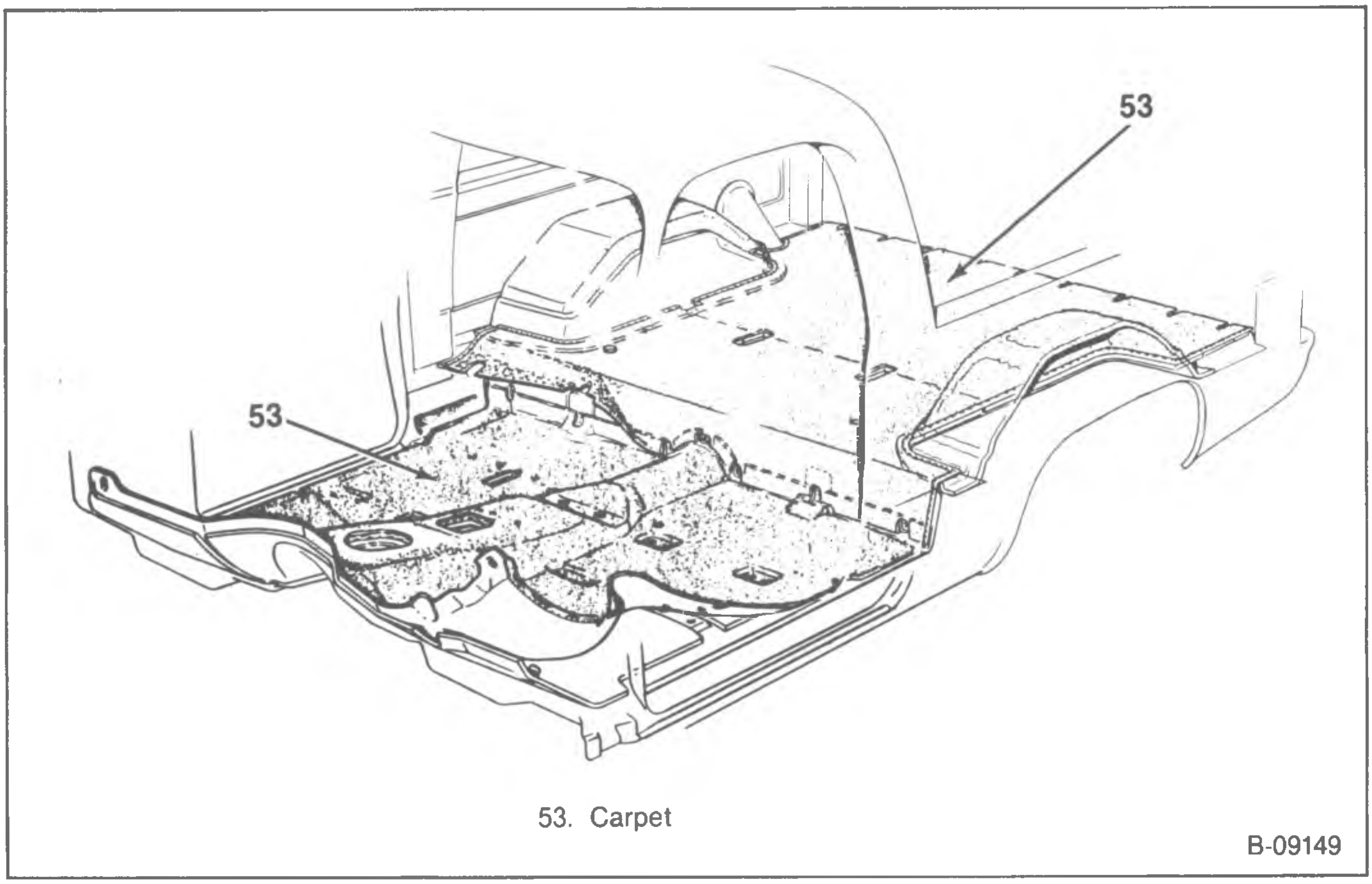
Remove or Disconnect (Figure 21)

- Open the compartment door.

1. Compartment to floor bolts (74).
2. Compartment from the vehicle.

Install or Connect (Figure 21)

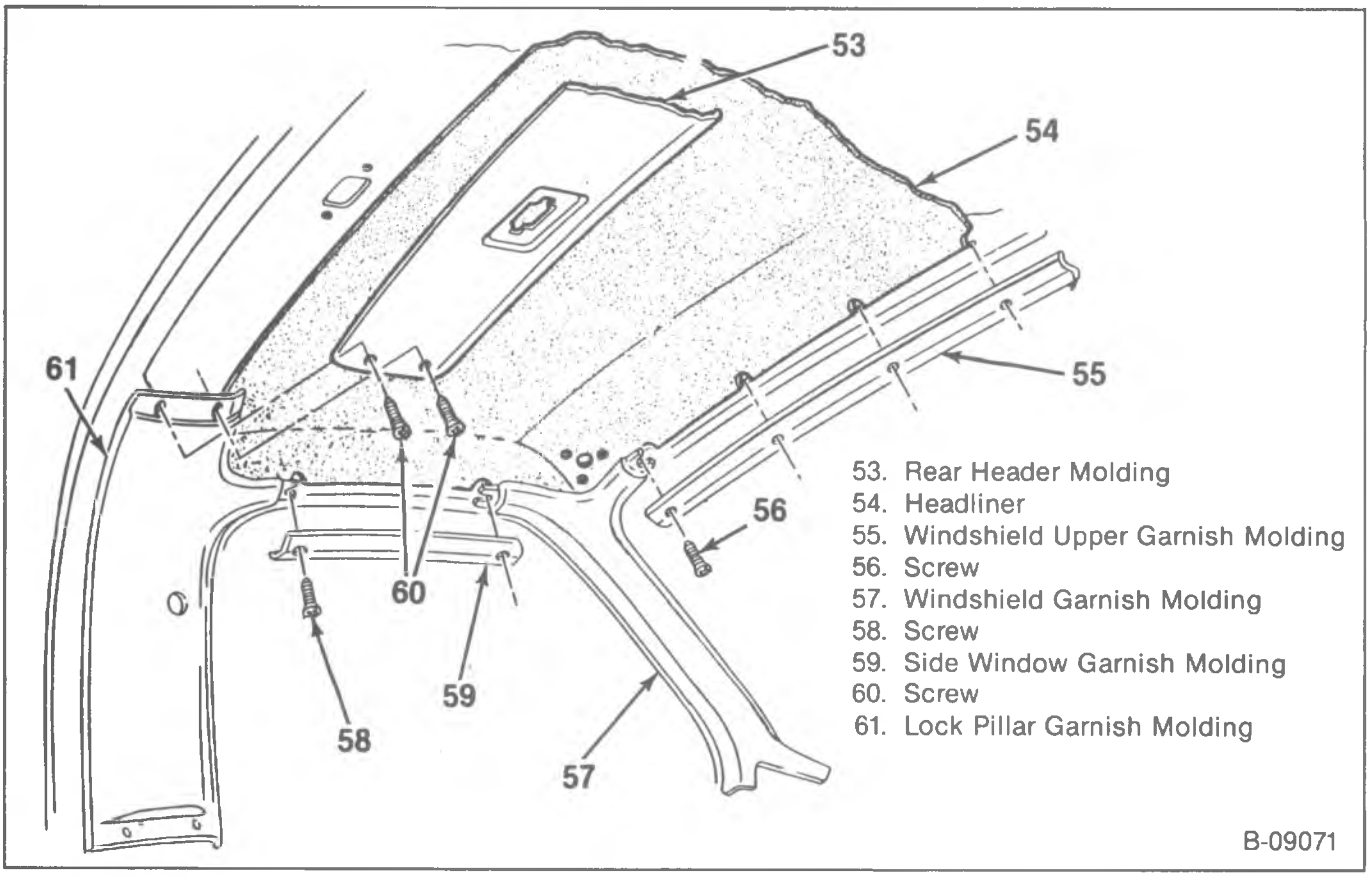
1. Compartment to the vehicle.
2. Compartment to the floor bolts (74).



53. Carpet

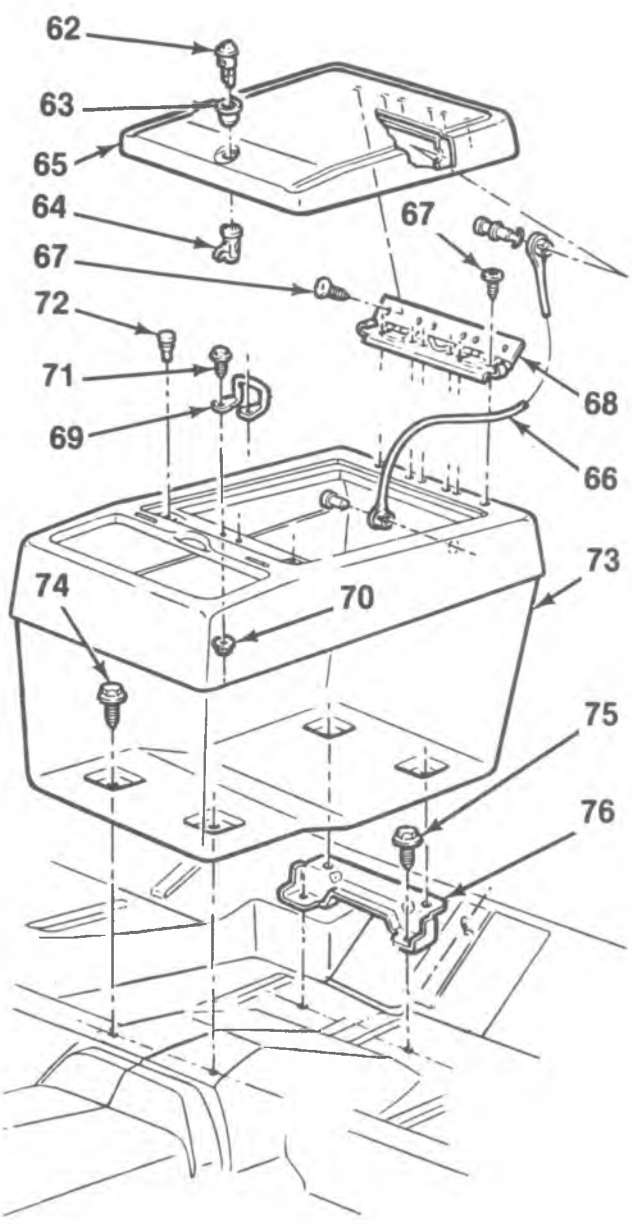
B-09149

Figure 19—Carpet Assemblies



53. Rear Header Molding
54. Headliner
55. Windshield Upper Garnish Molding
56. Screw
57. Windshield Garnish Molding
58. Screw
59. Side Window Garnish Molding
60. Screw
61. Lock Pillar Garnish Molding

Figure 20—Headliner And Interior Trim



62. Lock Cylinder
63. Bezel
64. Case Assembly
65. Door Assembly
66. Door Stop
67. Screw
68. Hinge
69. Striker
70. Nut
71. Bolt
72. Bumper
73. Compartment Assembly
74. Bolt
75. Bolt
76. Support

B-09072

Figure 21—Floor Compartment

SUBURBAN MODEL

CARPET REPLACEMENT

Remove or Disconnect (Figures 22 through 27)

1. Seats and seat belts. Refer to SEATS (SEC. 10A1).
2. Front and rear door scuff plates (figure 5).
3. Kick panel.
4. Rear corner garnish molding screws (77) and the molding (78).
5. Rear lock pillar garnish molding screws (79) and the molding (80).
6. Front lock pillar garnish molding screws (81) and the molding (82).
7. Body side trim panel screws (83) and the panel (84).
8. Front scuff plate screws (85) and the plate (86).
9. Rear scuff plate screws (87) and the plate (88).
10. Dash panel retainers (figure 7).
11. Carpet (89) from the vehicle.

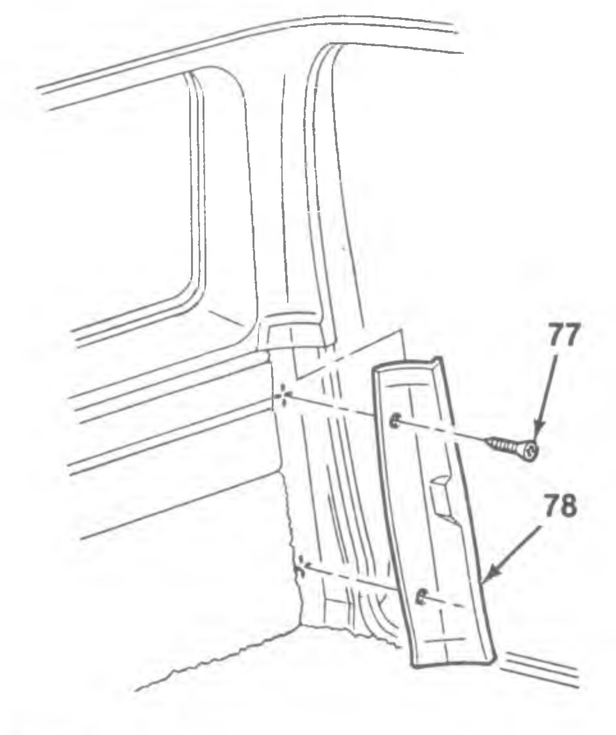
Install or Connect (Figures 22 through 27)

1. Carpet (89) to the vehicle.
2. Dash panel retainers (figure 7).
3. Rear scuff plate (88) and the screws (87).
4. Front scuff plate (86) and the screws (85).
5. Body side trim panel (84) and the screws.
6. Front lock pillar garnish molding (82) and the screws (81).
7. Rear lock pillar garnish molding (80) and the screws (79).
8. Rear corner garnish molding (78) and the screws (77).
9. Kick panel.
10. Front and rear door scuff plates (figure 5).
11. Seats and seat belts. Refer to SEATS (SEC. 10A1).

HEADLINER AND TRIM REPLACEMENT

Remove or Disconnect (Figures 28 and 29)

1. Windshield upper garnish molding screws (90) and the molding (91).
2. Side header garnish molding screws (92) and the molding (93).
3. Windshield garnish molding screws and the molding (94).



77. Screw
78. Corner Garnish Molding

Figure 22—Corner Garnish Molding

4. Rear roof header molding screws (95) and the molding (96).
5. Side header rear garnish molding screws (97) and the molding (98) (if equipped).
6. Upper side garnish molding screws (99) and the molding (100) (if equipped).
7. Roof inner trim panel screws (101) and the panel (102).
8. Headliner (103) from the vehicle.

Install or Connect (Figures 28 and 29)

1. Headliner (103) to the vehicle.
2. Roof inner trim panel (102) and screws (101).
3. Upper side garnish molding (100) and screws (99) (if equipped).
4. Side header rear garnish molding (98) and screws (97) (if equipped).
5. Rear roof header molding (96) and screws (95).
6. Windshield garnish molding (94) and screws.
7. Side header garnish molding (93) and screws (92).
8. Windshield upper garnish molding (91) and screws (90).

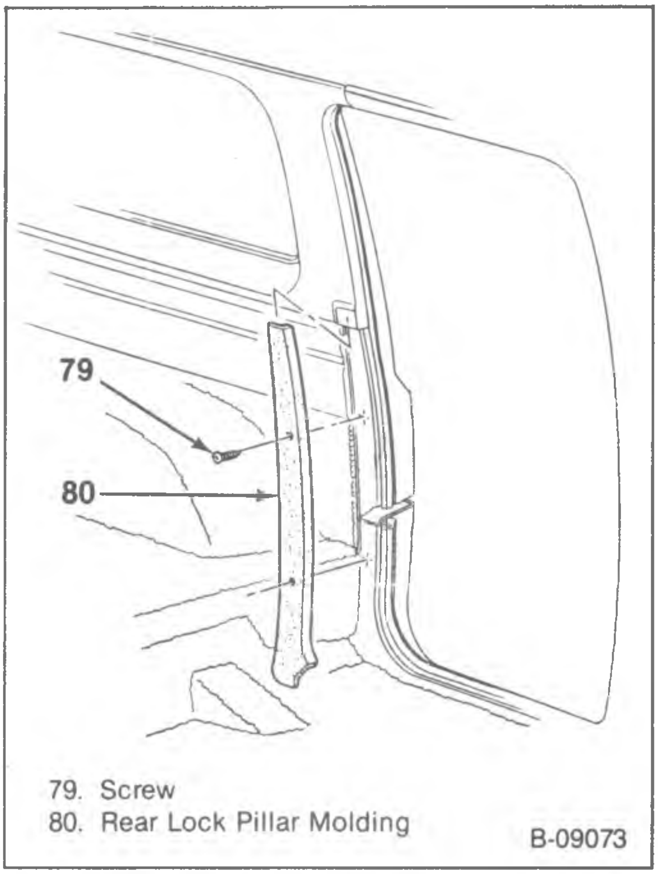


Figure 23—Rear Lock Pillar Molding

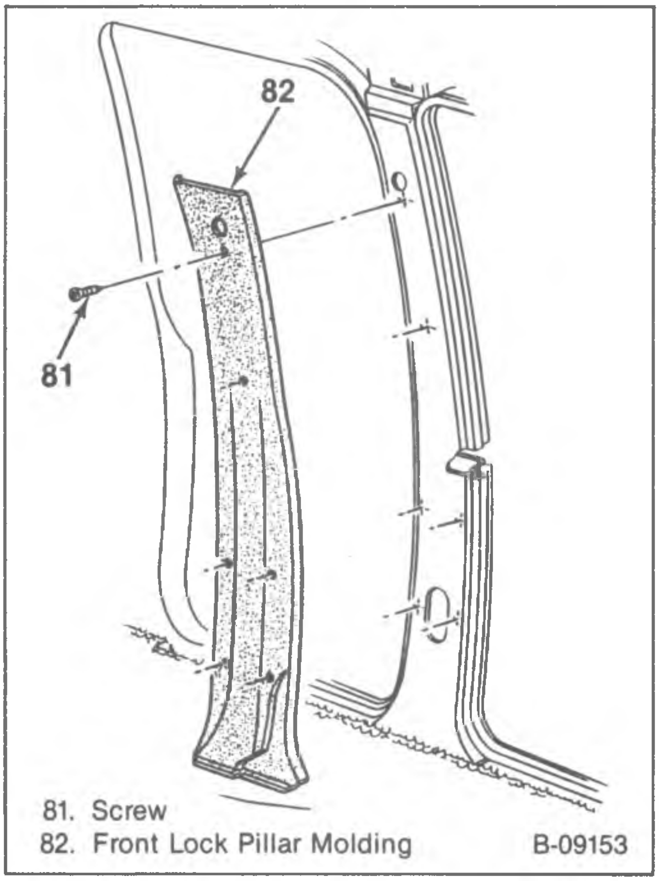


Figure 24—Front Lock Pillar Molding

ROOF REAR HEADER TRIM PANEL

Remove or Disconnect (Figures 30 and 31)

1. Lower trim panel screws (104) and the lower panel (105).
2. Upper trim panel screws (106) and the upper panel (107).

Install or Connect (Figures 30 and 31)

1. Upper trim panel (107) and the screws (106).
2. Lower trim panel (105) and the scerws (104).

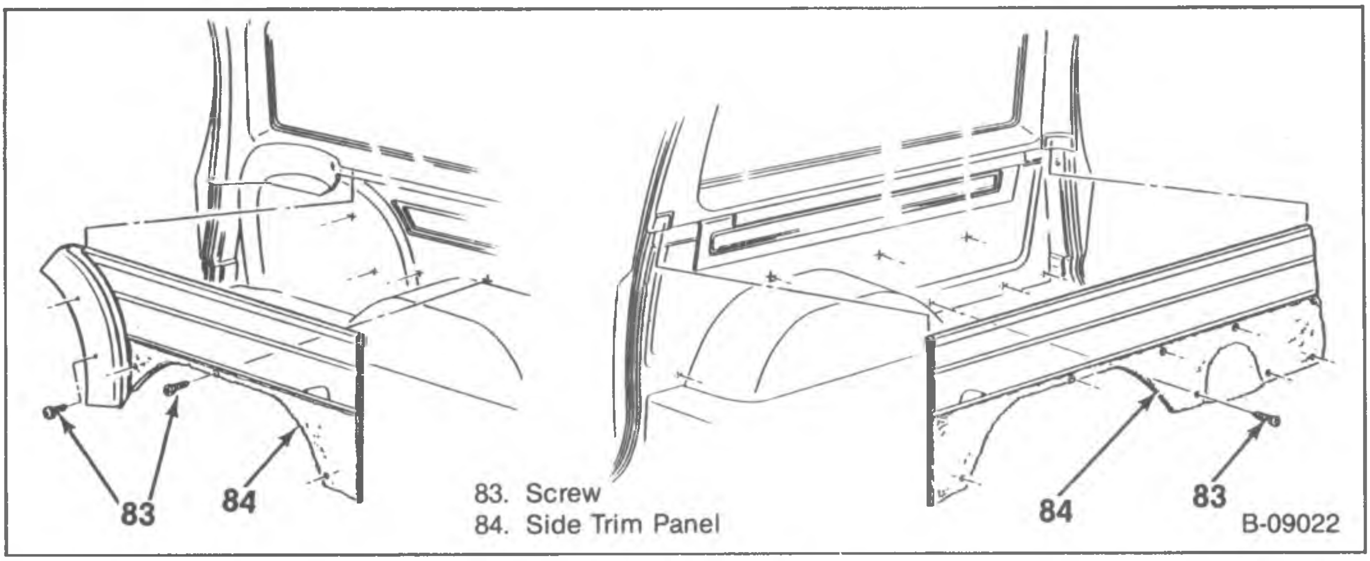


Figure 25—Side Trim Panel

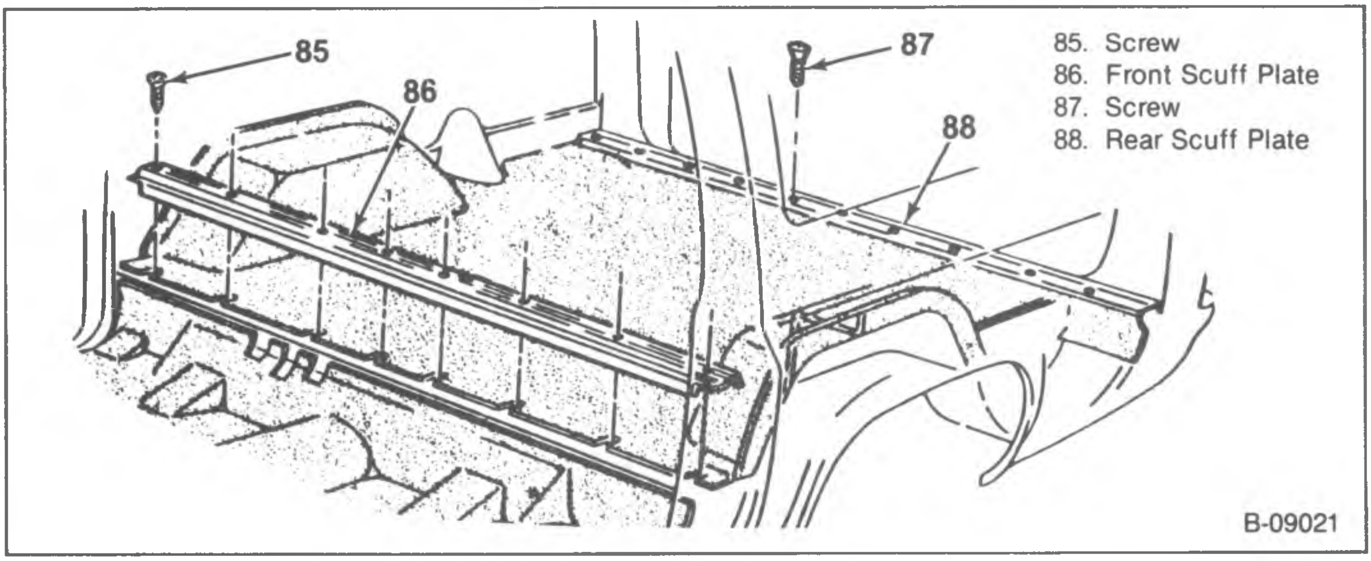
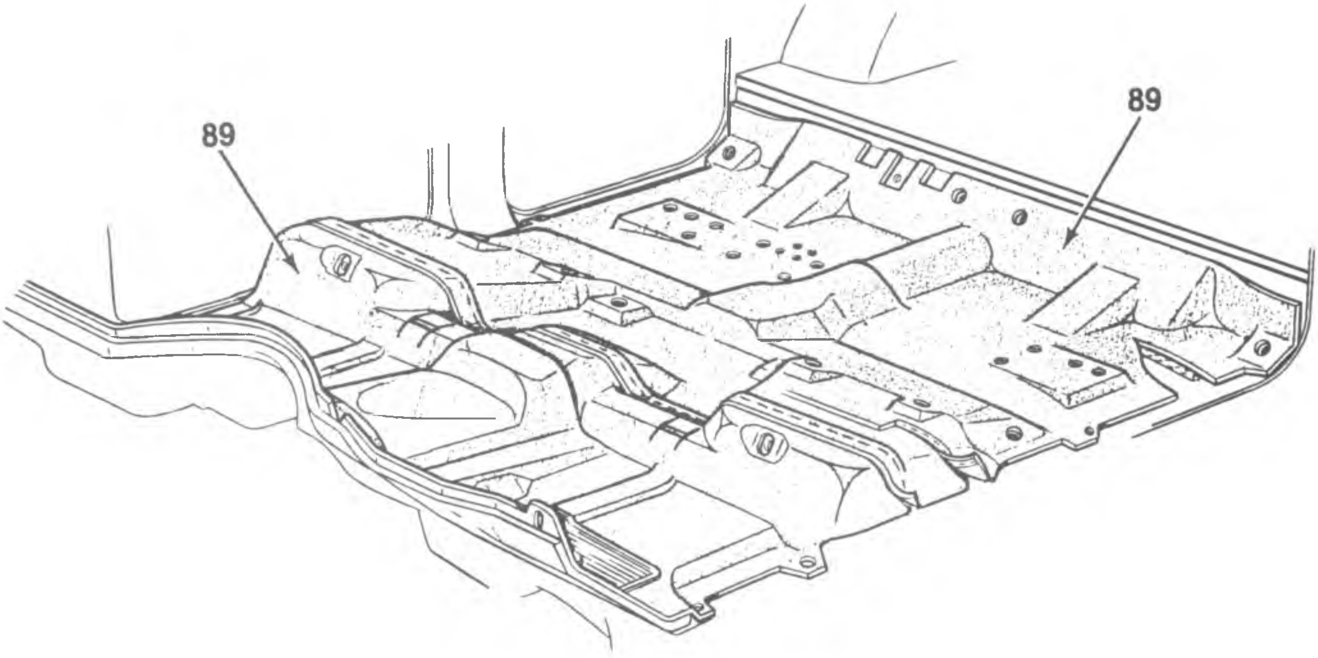


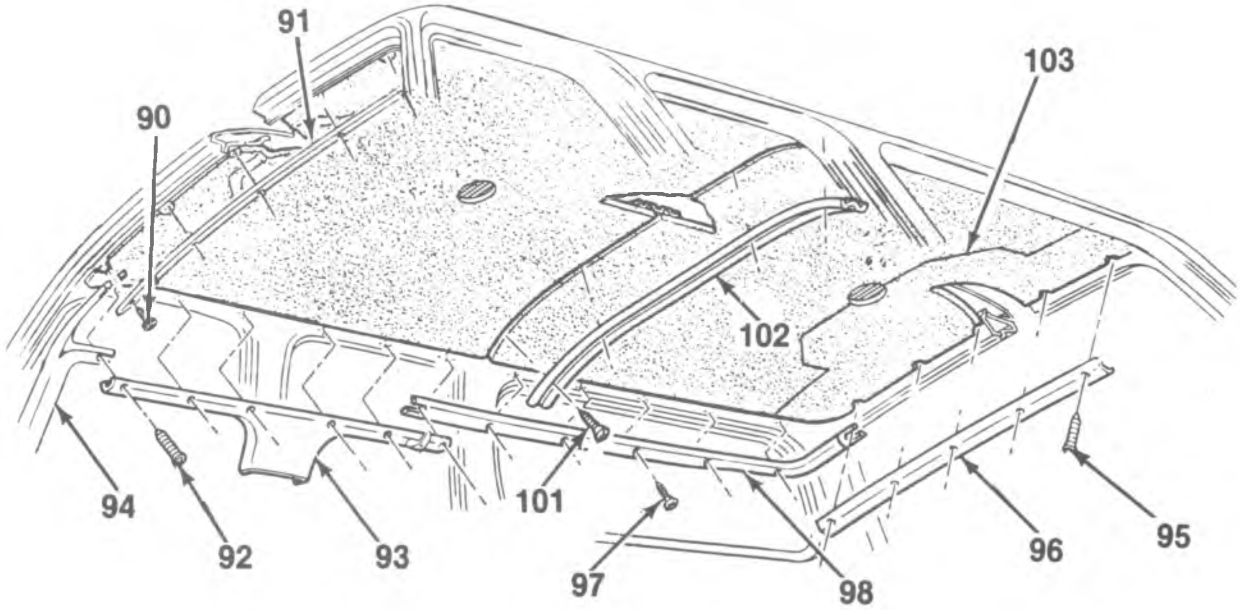
Figure 26—Scuff Plates



89. Carpet

B-09093

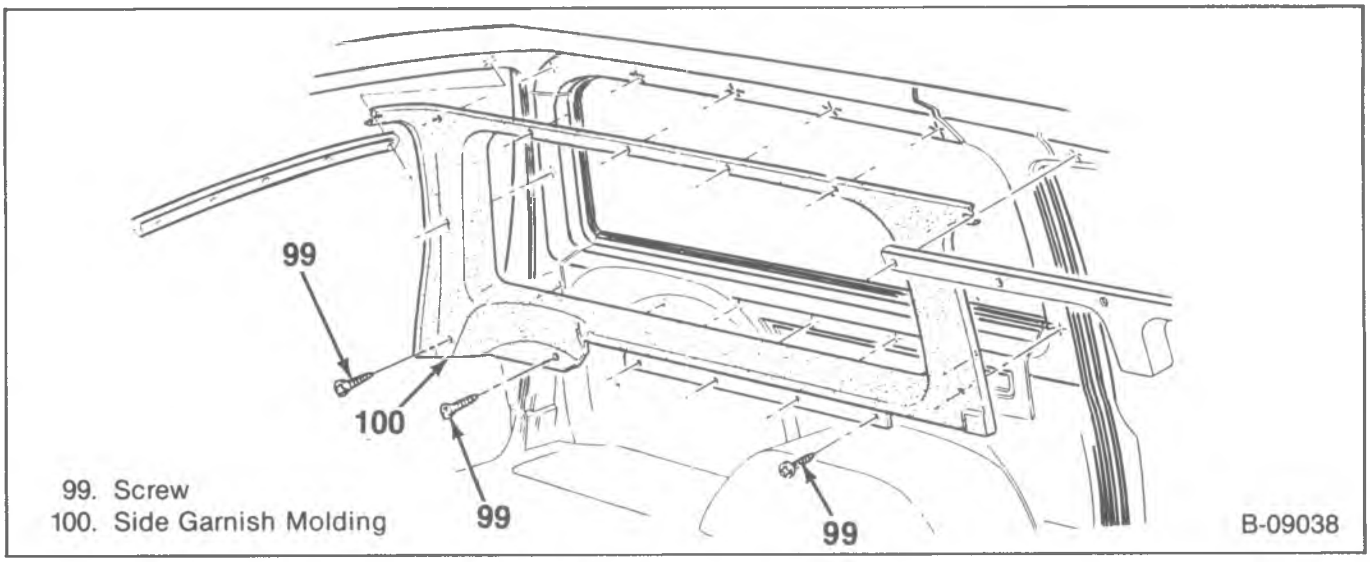
Figure 27—Carpet



90. Screw	96. Rear Roof Header Molding
91. Windshield Upper Garnish Molding	97. Screw
92. Screw	98. Side Header Rear Garnish Molding
93. Side Header Garnish Molding	101. Screw
94. Windshield Garnish Molding	102. Roof Inner Trim Panel
95. Screw	103. Headliner

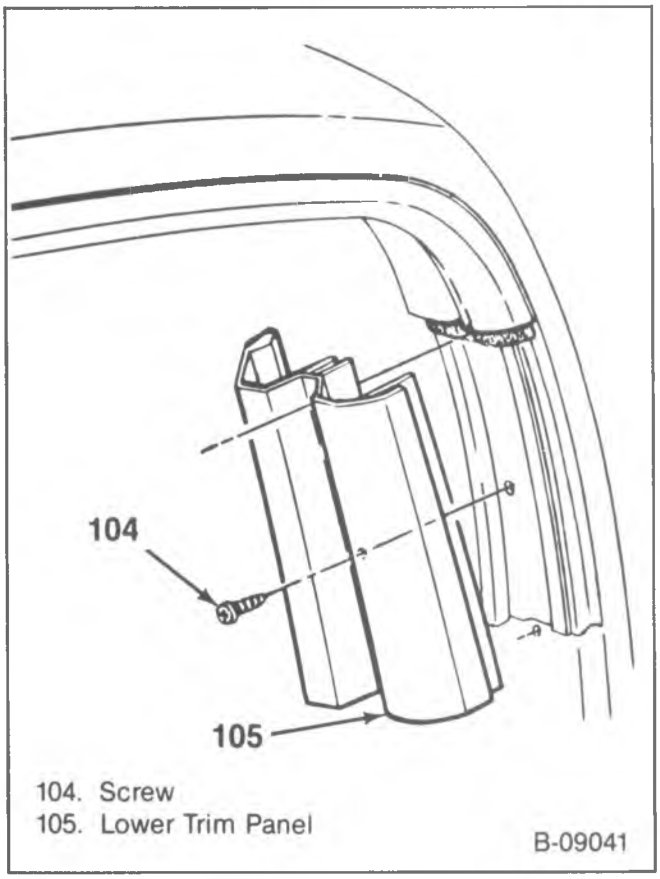
B-09039

Figure 28—Headliner And Interior Trim



99. Screw
100. Side Garnish Molding

Figure 29—Side Garnish Molding



104. Screw
105. Lower Trim Panel

Figure 30—Rear Header Lower Trim Panel

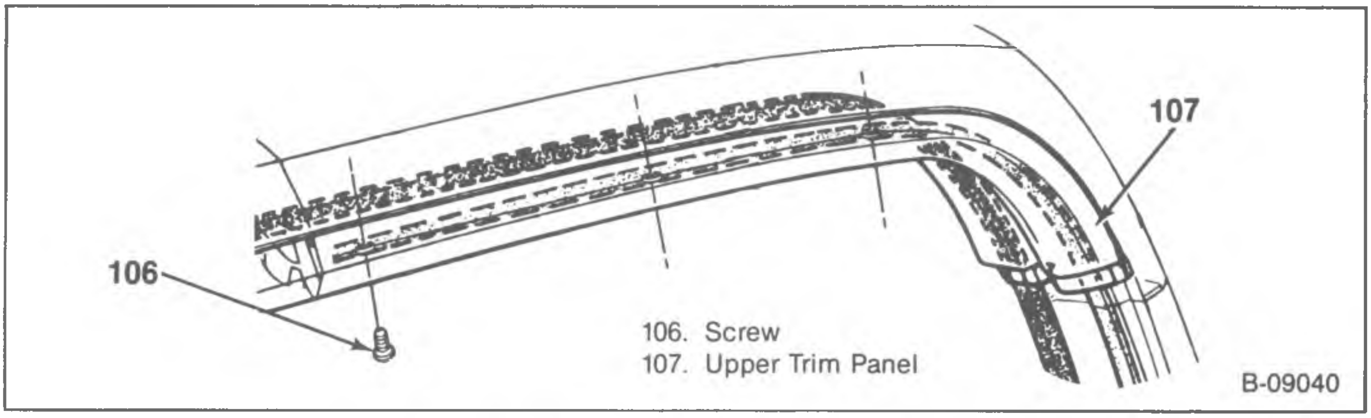


Figure 31—Rear Header Upper Trim Panel

G MODEL INTERIOR TRIM

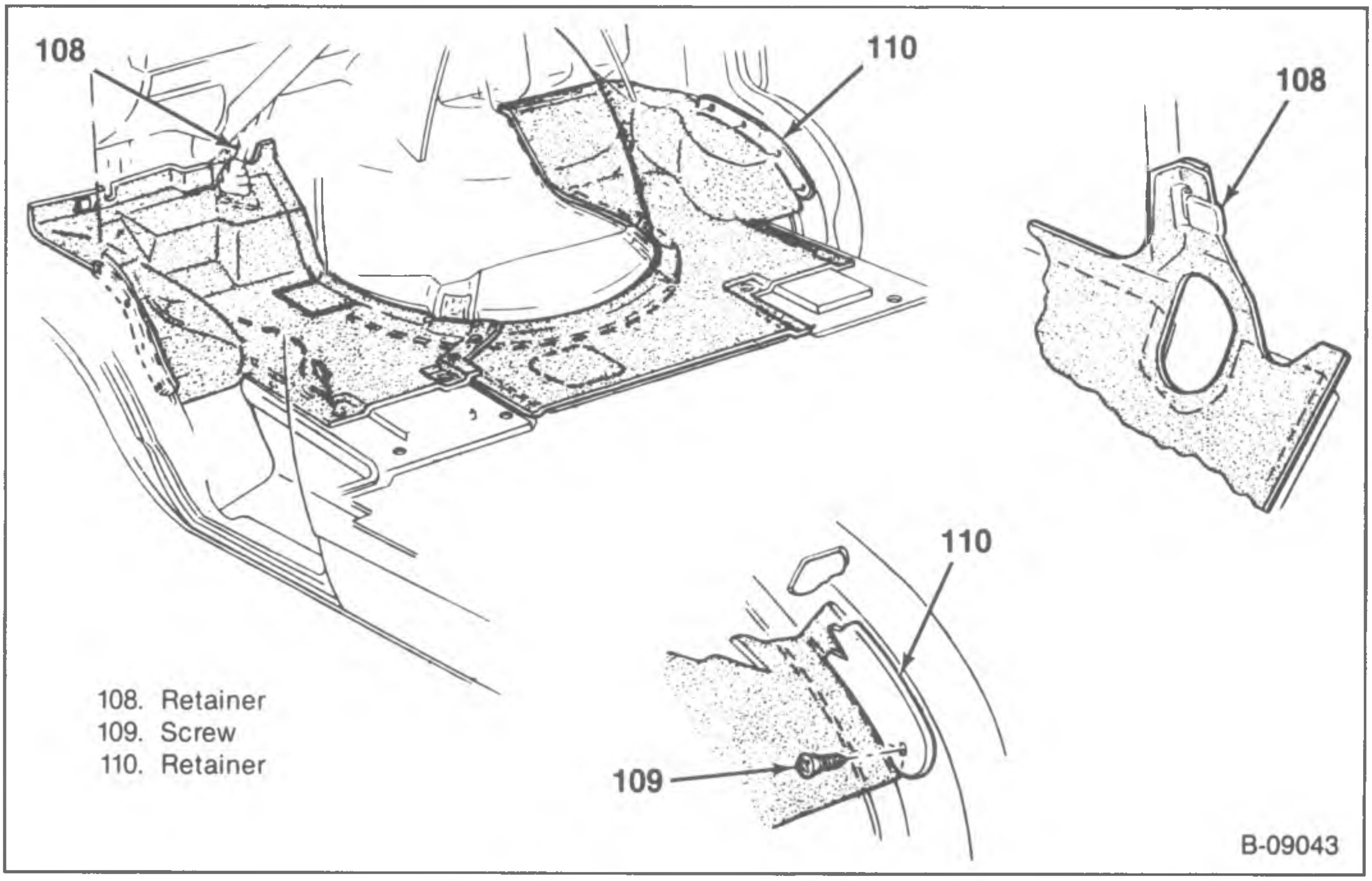
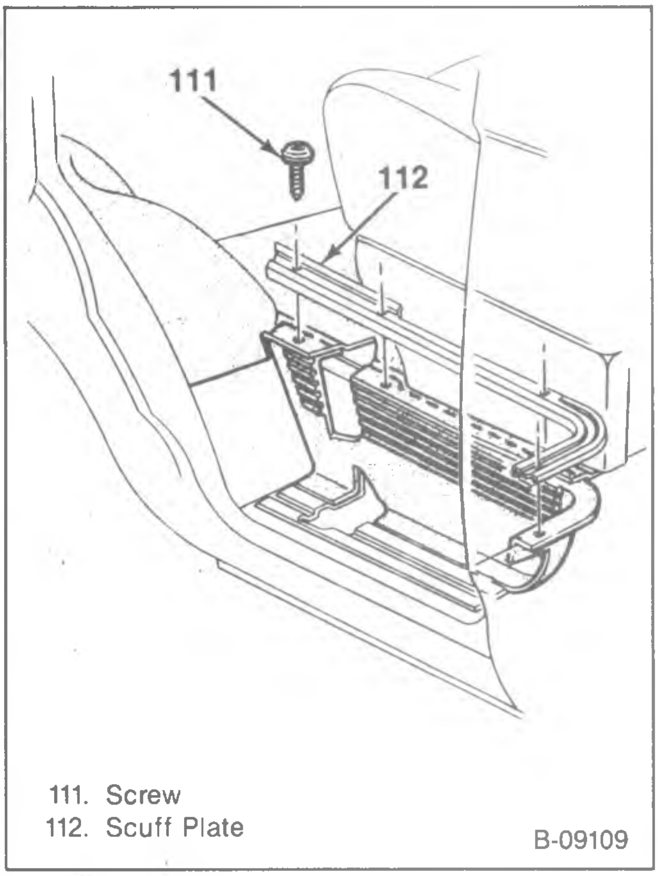


Figure 32—Carpet Retainers

CARPET REPLACEMENT

↔ **Remove or Disconnect (Figures 32 through 41)**

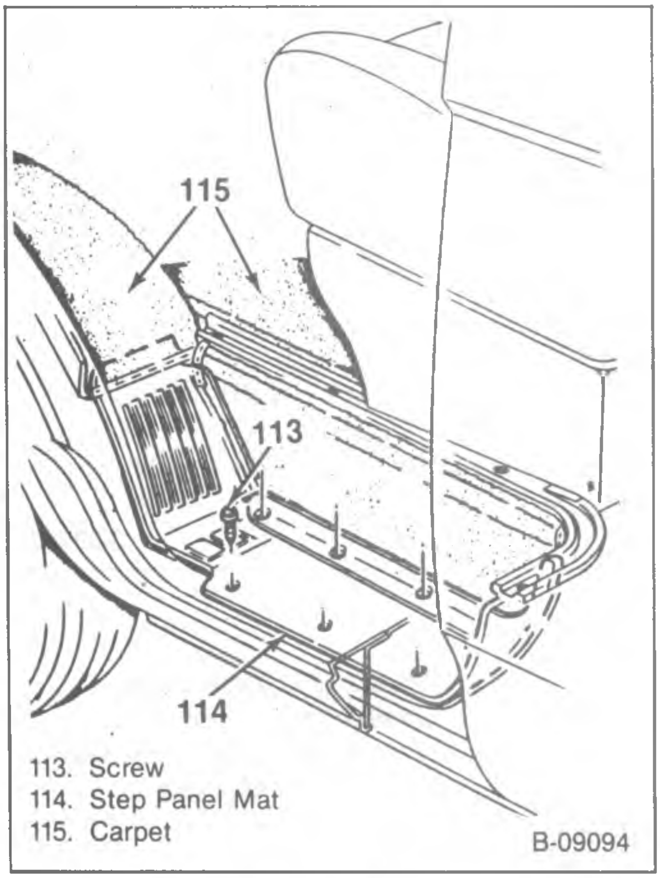
1. Seats. Refer to SEATS (SEC. 10A2).
2. Front carpet retainer (110).
3. Front door scuff plate (112).
4. Front step panel mat (if equipped) (114).
5. Carpet from the dash retainers (108).
   - Bend the retainers away from the dash.
6. Front carpet (115) from the vehicle.
7. Side door scuff plate (116).
8. Side door mat (if equipped) (118).
9. Carpet to side door screws (119).
10. Rear door scuff plate (121).



111. Screw
112. Scuff Plate

B-09109

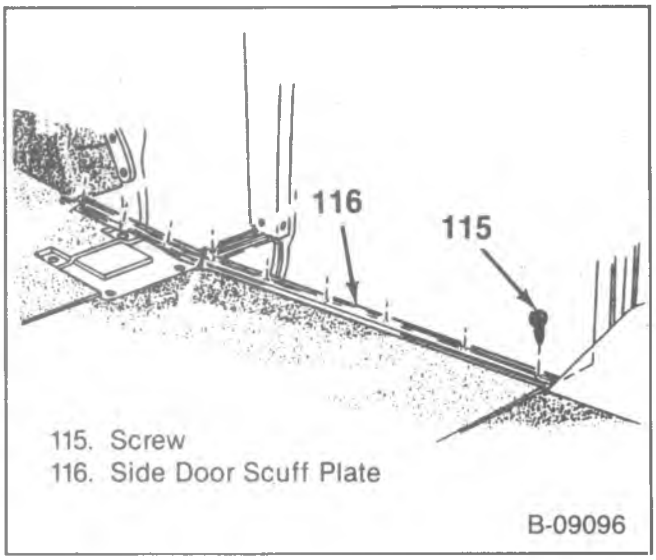
Figure 33—Scuff Plate



113. Screw
114. Step Panel Mat
115. Carpet

B-09094

Figure 34—Step Panel Mat



115. Screw
116. Side Door Scuff Plate

B-09096

Figure 35—Side Door Scuff Plates

11. Front trim panel (123).
12. Rear trim panel (125).
13. Rear corner panel (127).
14. Rear carpet from the vehicle.

Install or Connect (Figures 32 through 41)

1. Rear carpet to the vehicle.
2. Rear corner panel (127).
3. Rear trim panel (125).
4. Front trim panel (123).
5. Rear door scuff plate (121).
6. Carpet to side door screws (119).
7. Side door mat (if equipped) (118).
8. Side door scuff plate (116).
9. Front carpet (115) to the vehicle.
10. Carpet to the dash retainers (108).
    - Bend the retainers over the carpet.
11. Front step panel mat (if equipped) (114).
12. Front door scuff plate (112).
13. Front carpet retainer (110).
14. Seats. Refer to SEATS (SEC. 10A2).

HEADLINER REPLACEMENT

Remove or Disconnect (Figure 42)

1. Upper window trim that supports the headliner. Refer to "Interior Trim Replacement."
2. Headliner retainer bow (if equipped).
    - Pull the bow (128) from the retainer.
3. Retainer bolts (129) and the retainers (130).
4. Headliner (131) from the vehicle.
    - Shift the headliner from side to side to disengage the headliner from the clips.

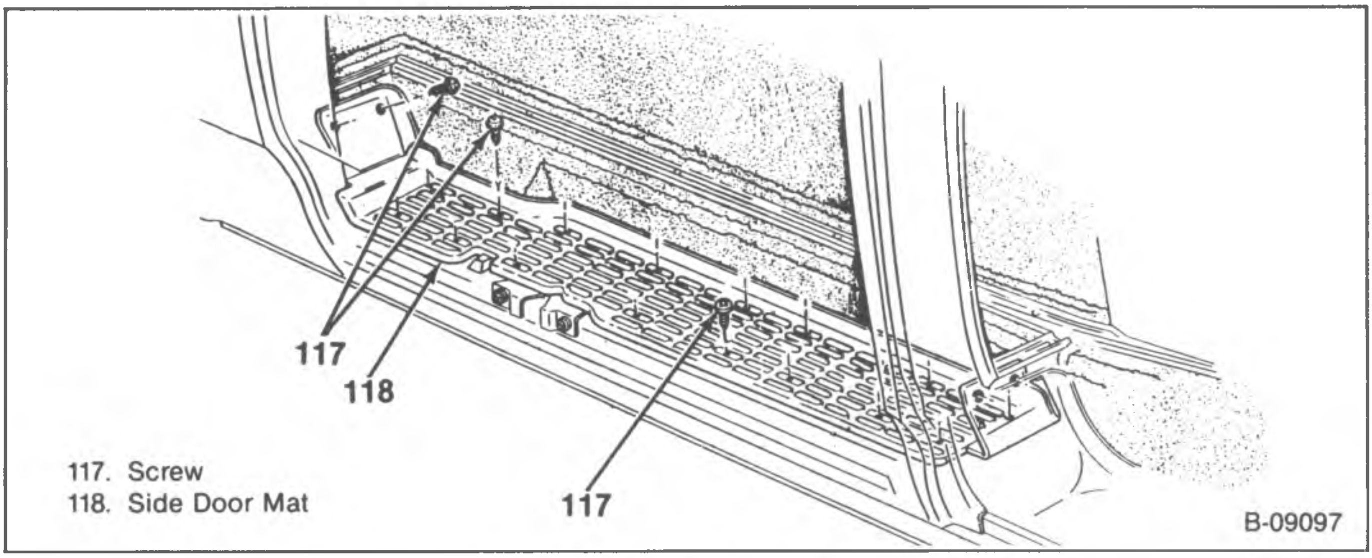


Figure 36—Side Door Mat

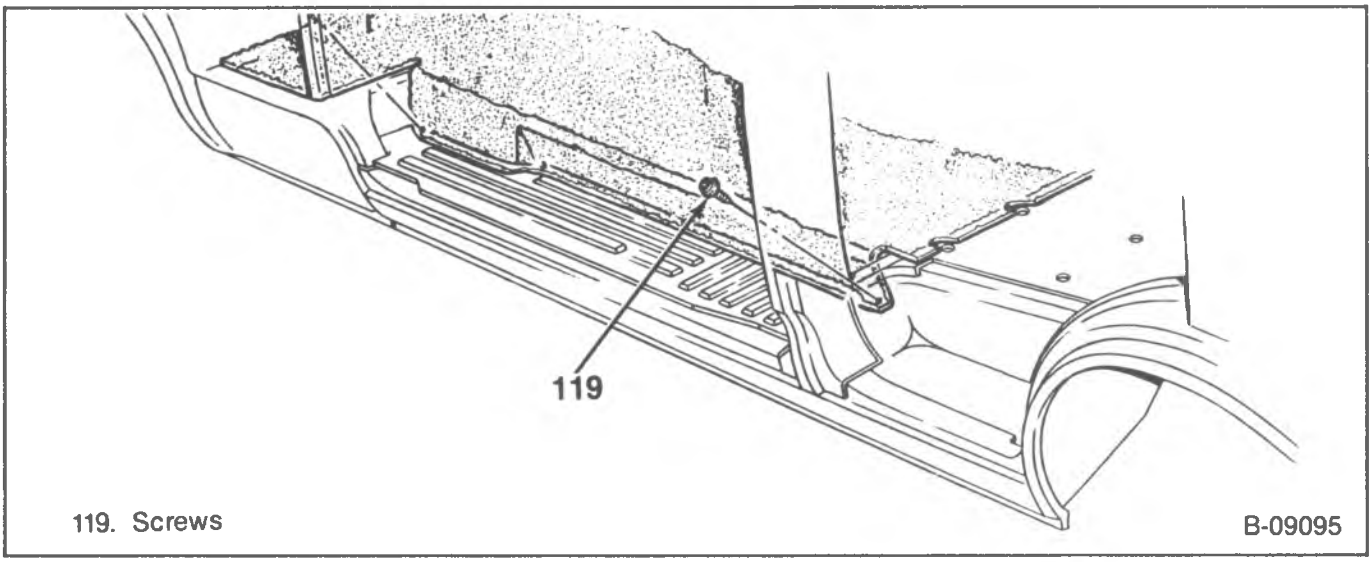


Figure 37—Floor Carpet Bolts

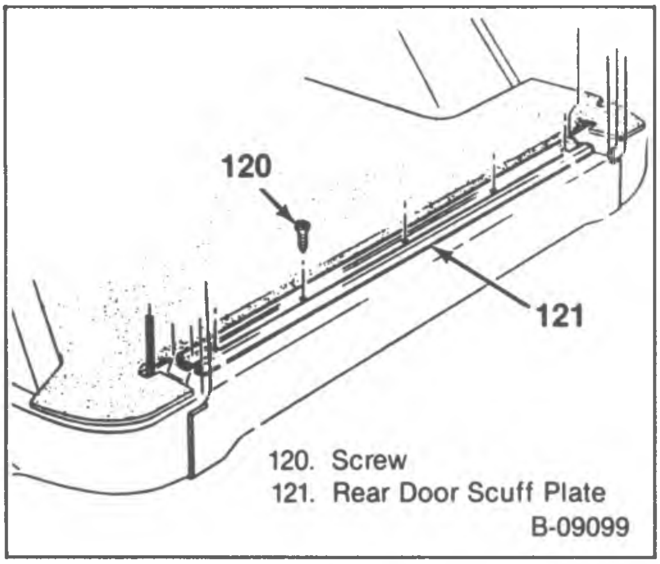
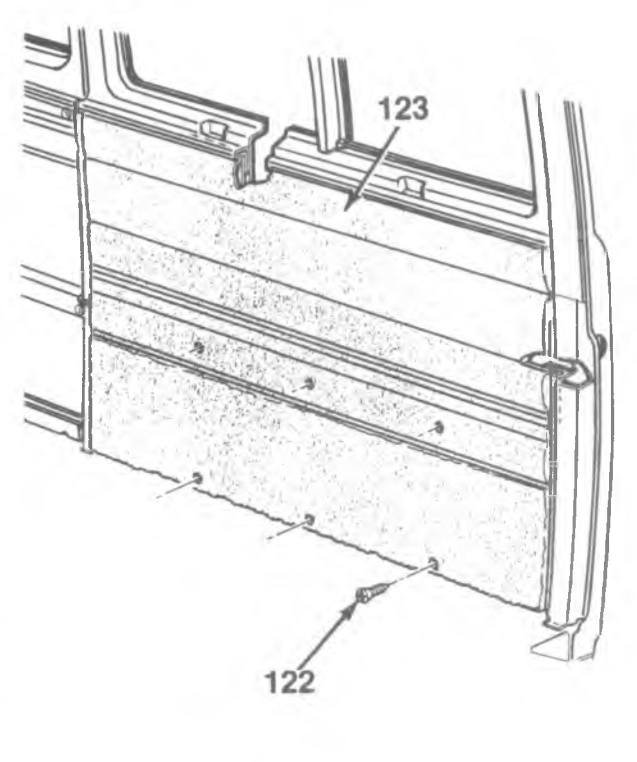


Figure 38—Rear Door Scuff Plates

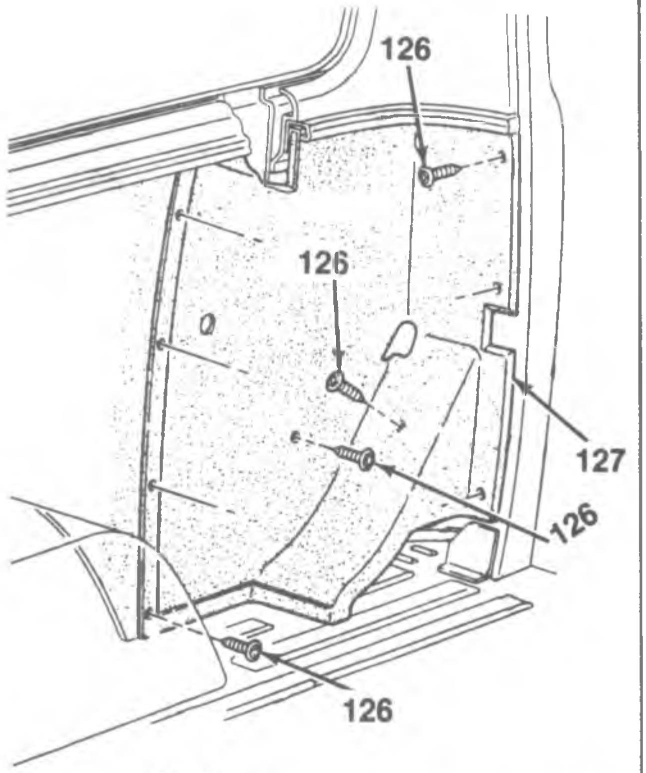
→← Install or Connect (Figure 42)

1. Headliner (131) to the vehicle.
   - Place the headliner into the roof clips.
2. Retainers (130) to the headliner, and the retainer bolts (129).
3. Headliner retainer bow (if equipped).
   - Push the bow (128) onto the retainer.
4. Upper window trim that supports the headliner. Refer to "Interior Trim Replacement."



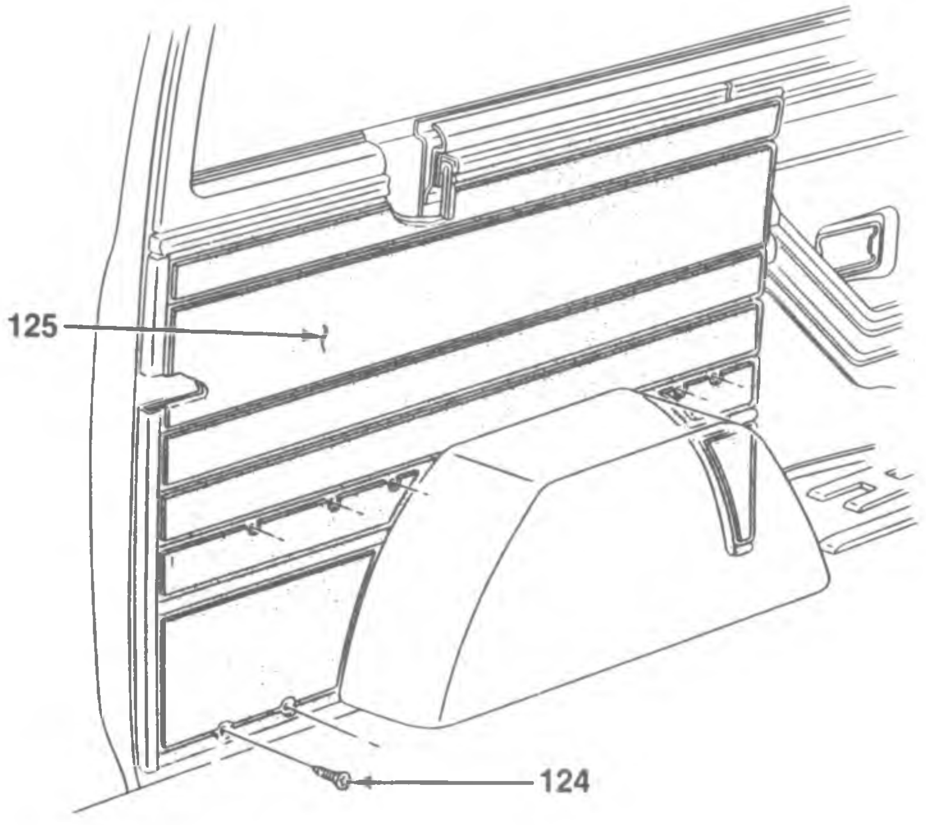
122. Screw
123. Front Trim Panel

Figure 39—Front Trim Panel



126. Screw
127. Rear Corner Panel

Figure 41—Rear Corner Panel



124. Screw
125. Rear Trim Panel

Figure 40—Rear Trim Panel

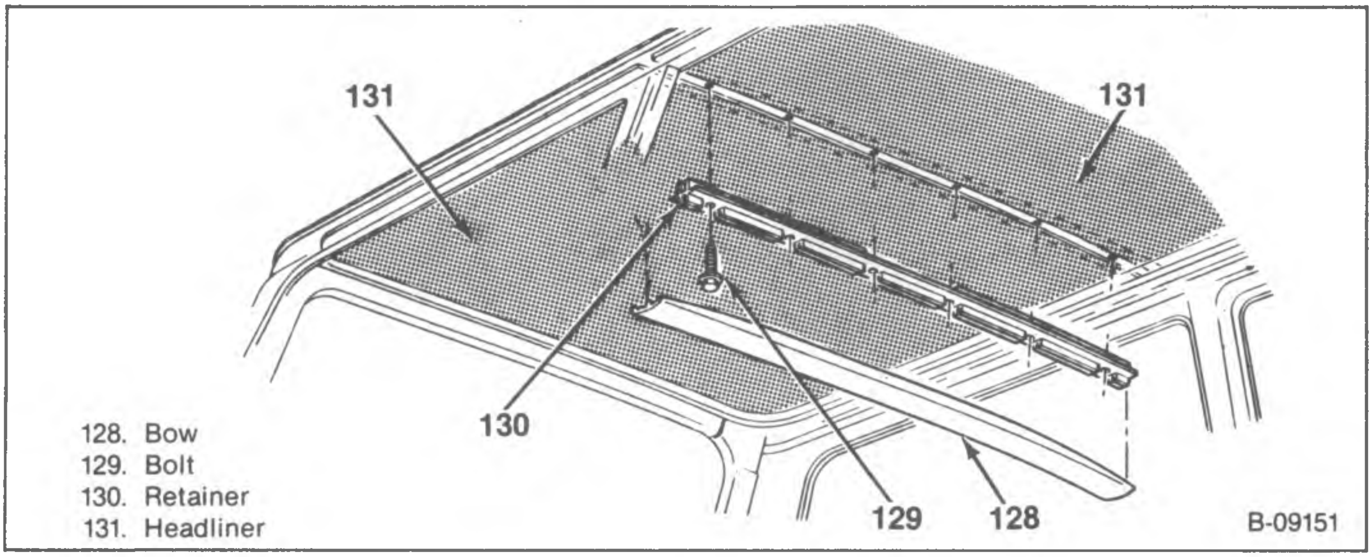


Figure 42—Headliner Retainer

INTERIOR TRIM REPLACEMENT

↔ Remove or Disconnect

1. Lock pillar garnish molding screws and the lock pillar garnish molding (figure 43).
2. Front door hinge pillar molding screws and the front door hinge pillar molding (figure 44).
3. Sunshade screws and the sunshade (figure 45).
4. Front header garnish molding screws and the front header garnish molding (figure 46).
5. Roof side rail garnish molding (figure 47). For vehicles with intermediate doors only.
6. Roof side header garnish molding (figure 48). For vehicles with the sliding side door only.
7. Lower lock pillar garnish molding screws and the molding (figure 49).
8. Body side front garnish molding screws and the molding (figure 49).
9. Roof rear header garnish molding screws and the molding (figure 50).
10. Body rear corner garnish molding screws and the molding (figure 51).
11. Body side rear garnish molding screws and the molding (figure 52).
12. Body side front trim panel screws and the trim panel (figure 39).
    - Pull the panel from the retainers.
13. Body side rear trim panel screws and the trim panel (figure 40).
    - Pull the panel from the retainers.
14. Body side trim rear corner panel screws and the panel (figure 41).
    - Pull the panel from the retainers.

→← Install or Connect

1. Body side trim rear panel and screws (figure 41).
2. Body side rear trim panel and screws (figure 40).
3. Body side front trim panel and screws (figure 39).
4. Body side rear garnish molding and screws (figure 52).
5. Body rear corner garnish molding and screws (figure 51).

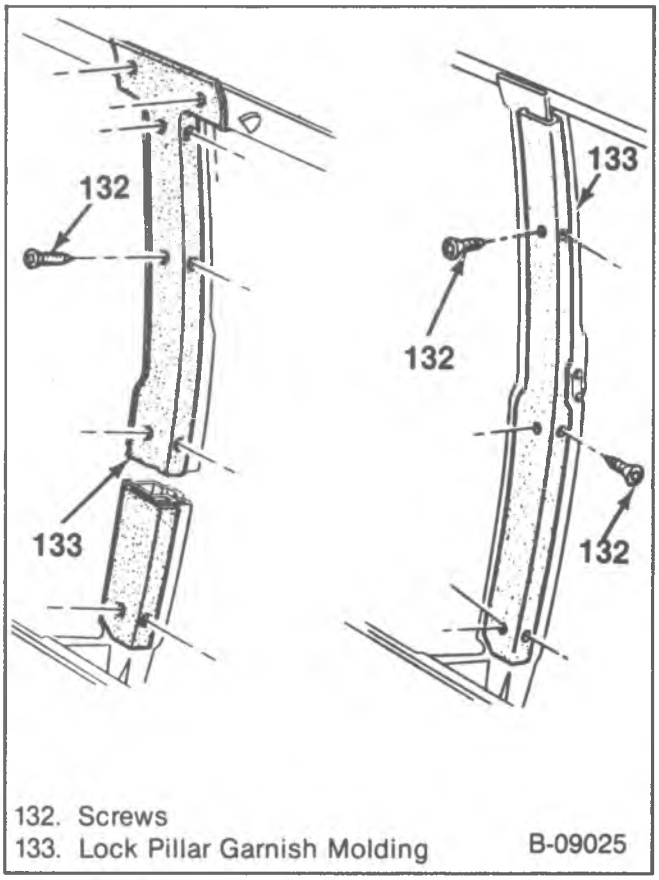


Figure 43—Lock Pillar Garnish Molding

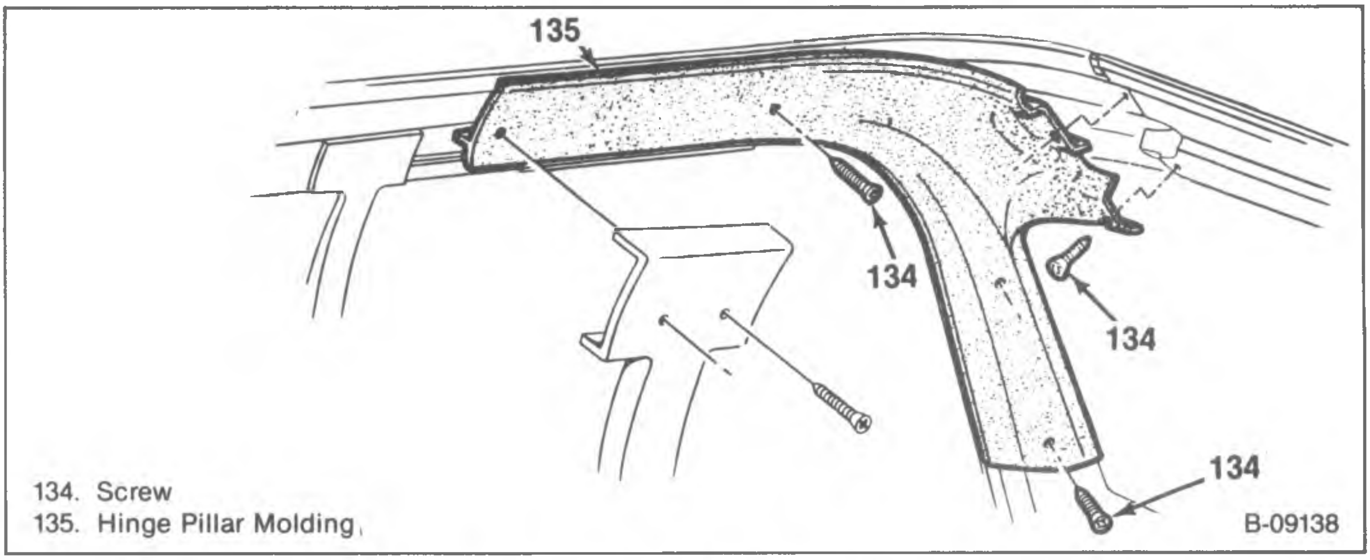


Figure 44—Hinge Pillar Molding

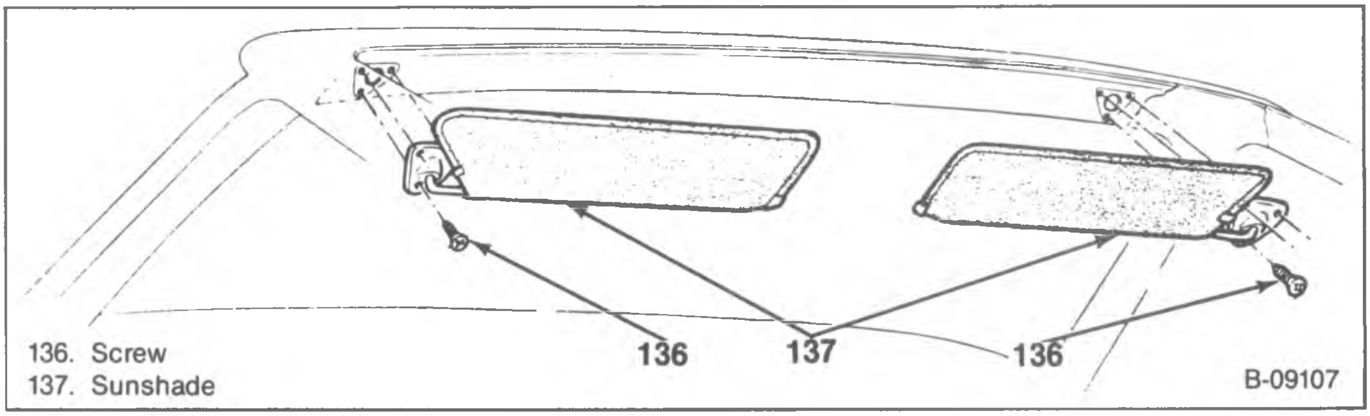


Figure 45—Sunshade

6. Roof rear head garnish molding and screws (figure 50).
7. Body side front garnish molding and screws (figure 49).

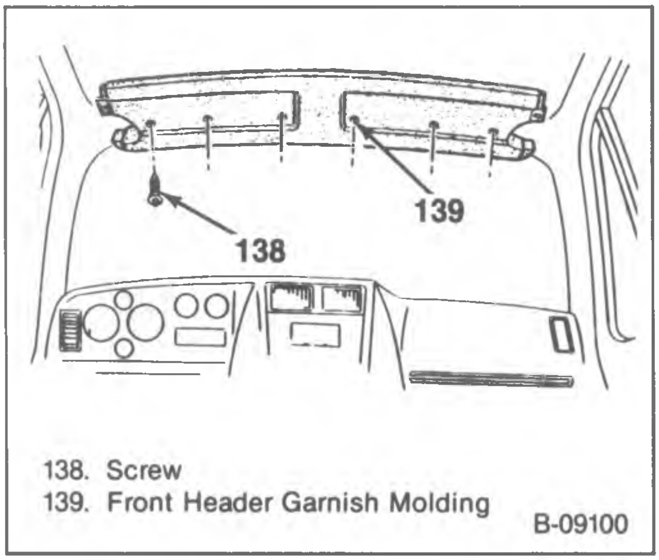


Figure 46—Front Header Garnish Molding

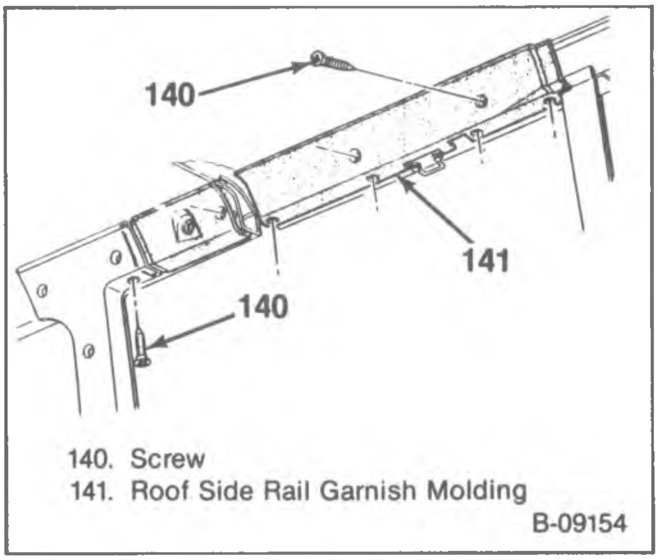


Figure 47—Roof Side Rail Garnish Molding

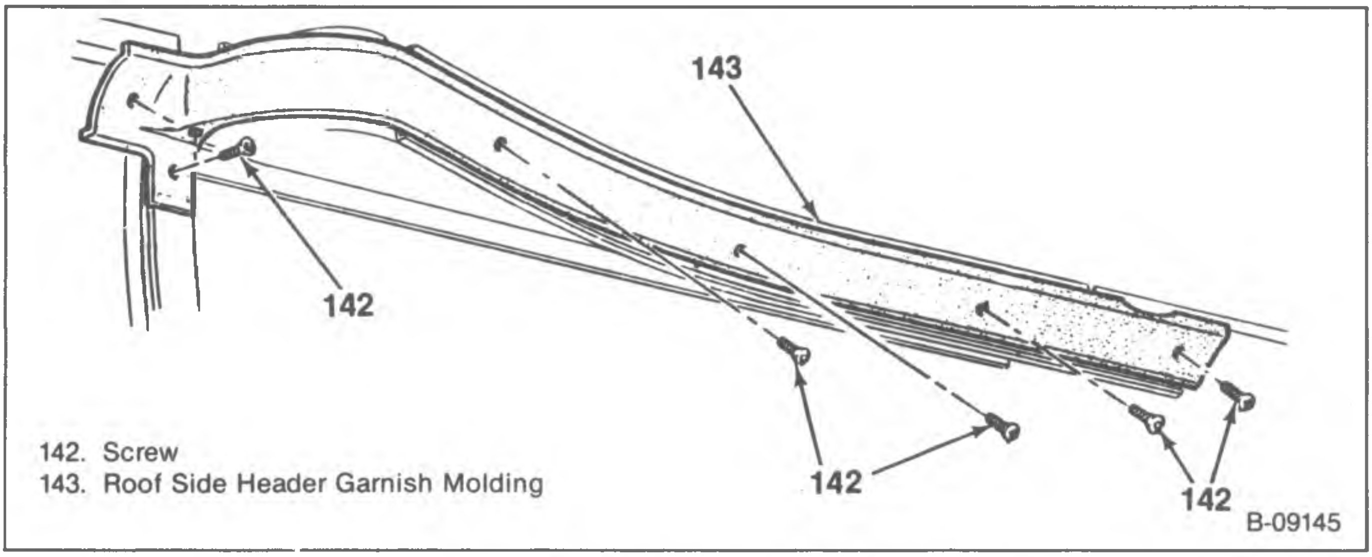


Figure 48—Roof Side Header Garnish Molding

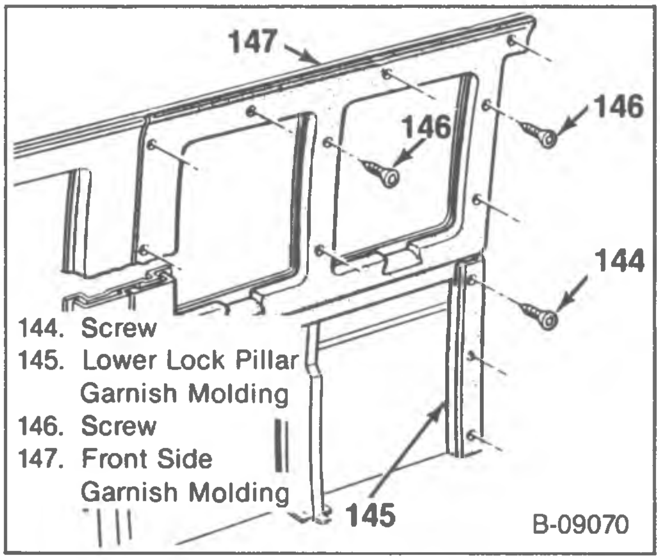


Figure 49—Front Garnish Moldings

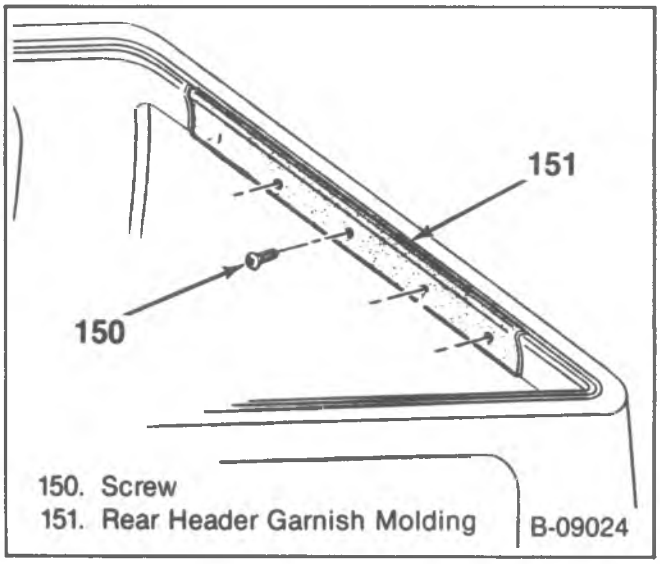


Figure 50—Rear Header Garnish Molding

8. Lower lock pillar garnish molding and screws (figure 49).
9. Roof side header garnish molding and screws (figure 48). For vehicles with the sliding side door only.
10. Roof side rail garnish molding and screws (figure 47). For vehicles with intermediate doors only.
11. Front header garnish molding and screws (figure 46).

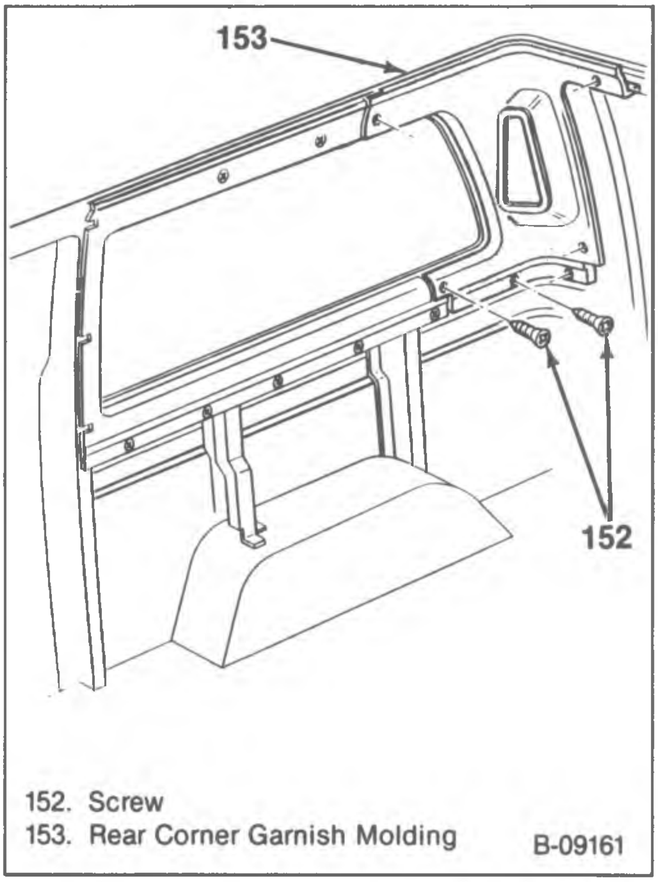


Figure 51—Rear Corner Garnish Molding

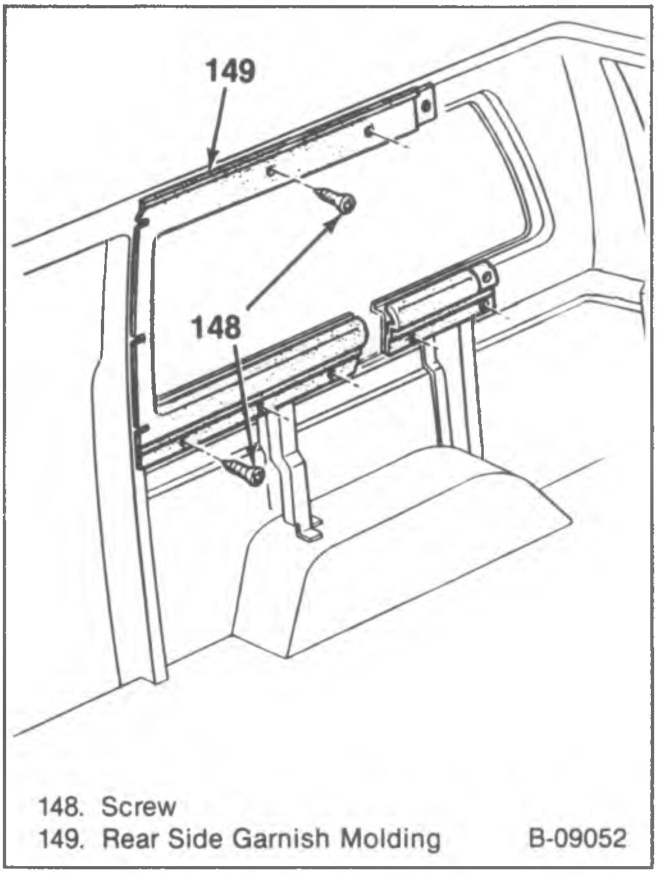


Figure 52—Rear Side Garnish Molding

12. Sunshade and screws (figure 45).
13. Front door hinge pillar molding and screws (figure 44).
14. Lock pillar garnish molding and screws (figure 43).

ENGINE COVER REPLACEMENT

Remove or Disconnect (Figures 53 and 54)

1. Instrument panel lower extension screws (150), washers (151), and shims (152).
2. Instrument panel lower extension (153).
3. Engine cover (158) to floor panel bolts (156).
4. Clamp (157) from the pin (155).
5. Engine cover (158) from the vehicle.

Install or Connect (Figures 53 and 54)

1. Engine cover (158) to the vehicle.
2. Clamp (157) to the pin (155).
3. Engine cover (158) to floor panel bolts (156).
4. Instrument panel lower extension (153).
5. Instrument panel lower extension screws (150), washers (151) and shims (152).

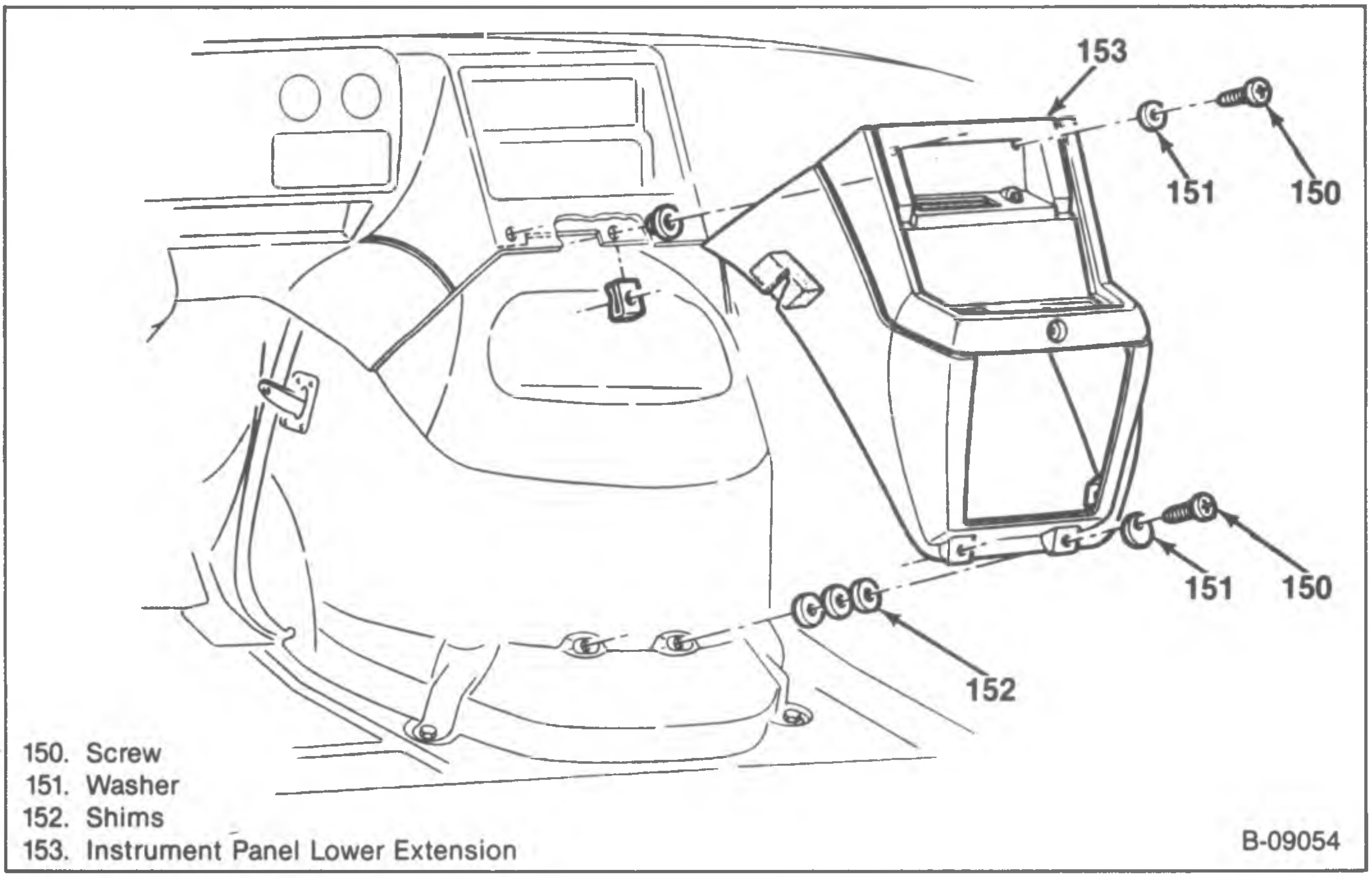


Figure 53—Instrument Panel Lower Extension

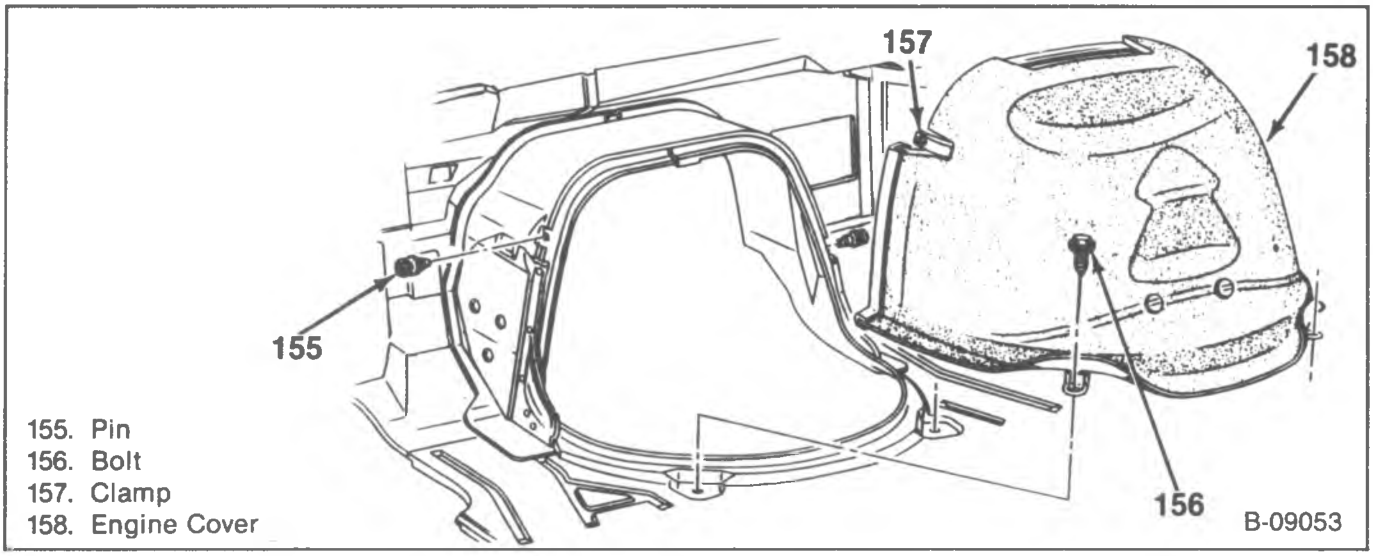


Figure 54—Engine Cover

SECTION 10A5

END GATE

CONTENTS

SUBJECT **PAGE**

FENDER SIDE MODELS

END GATE REPLACEMENT

↔ Remove or Disconnect (Figure 1)

- Open the end gate and support it with a table or other suitable support.

1. Fender to end gate bolt (6) and washer (7).
2. End gate (4), and bushing (5) from the vehicle.
3. Chain (3) to fender nut (1), washer (2), and eye bolt.

→← Install or Connect (Figure 1)

1. Chain (3) with eye bolt to the fender.
2. Washer (2) and nut (1) to the eye bolt.
3. End gate (4) and bushing (5) to the vehicle.
4. Fender to end gate washer (7), and bolt (6).

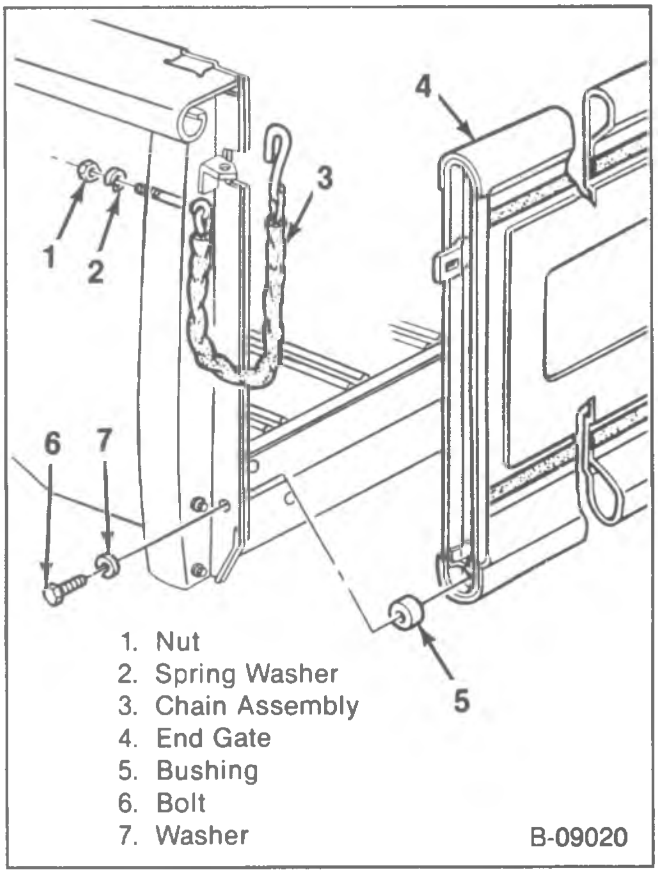


Figure 1—Fender Side End Gate Components

FLEET SIDE MODELS

END GATE REPLACEMENT

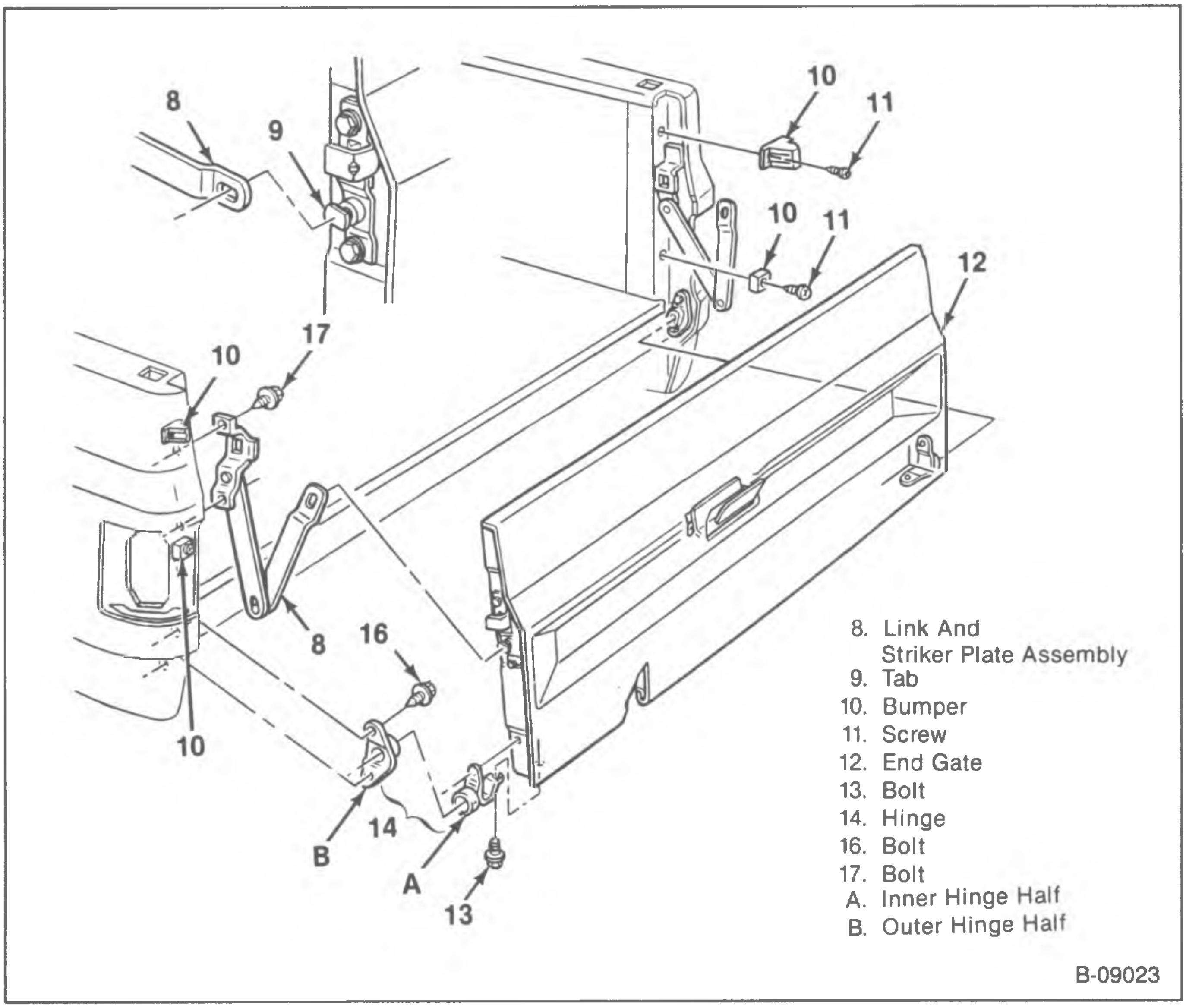
↔ Remove or Disconnect (Figure 2)

- Open the end gate and support it with a table or other suitable support.

1. Link and striker plate (8) to fender bolts (17).
2. Link and striker (8) from the end gate.
   - Rotate the link until it aligns with the tab (9) on the end gate, and pull it from the end gate.
3. Hinge (14) to end gate bolts (13).
4. End gate (12) from the vehicle.
5. Inner hinge half (A).
6. Hinge (14) to fender bolts (16).
7. Outer hinge half (B).
8. Bumper (10) to fender screws (11).
9. Bumpers (10) from the vehicle.

→← Install or Connect (Figure 2)

1. Bumpers (10) to the vehicle.
2. Bumper (10) to fastener screws (11).
3. Outer hinge half (B).
4. Hinge (14) to fender bolts (16).
5. Inner hinge half (A).
6. End gate (12) to the vehicle.
7. Hinge (14) to end gate bolts (13).
8. Link and striker (8) to the end gate.
   - Place the slot on the link in line with the tab (9) on the end gate, and place the link onto the end gate. Pivot the link into its proper position.
9. Link and striker to the fender.
10. Link and striker to fender bolts (17).



8. Link And Striker Plate Assembly
9. Tab
10. Bumper
11. Screw
12. End Gate
13. Bolt
14. Hinge
16. Bolt
17. Bolt
A. Inner Hinge Half
B. Outer Hinge Half

Figure 2—Fleet Side End Gate Components

HANDLE AND LATCH REPLACEMENT

Remove or Disconnect (Figure 3)

- Lower and support the end gate with a table or other suitable support.

1. Latch rods (19) from the clips (20).
2. End gate to handle bolts (22).
3. Handle (21) from the end gate.
4. Link from the end gate.
   - Refer to "End Gate Replacement."
5. Latch (18) to end gate bolts (23).
6. Latch (18) from the vehicle.

Install or Connect (Figure 3)

1. Latch (18) to the vehicle.
2. Latch (18) to end gate bolts (23).
3. Link to the end gate.
   - Refer to "End Gate Replacement."
4. Handle (21) to the end gate.
5. End gate to handle bolts (22).
6. Latch rods (19) to the clips (20).

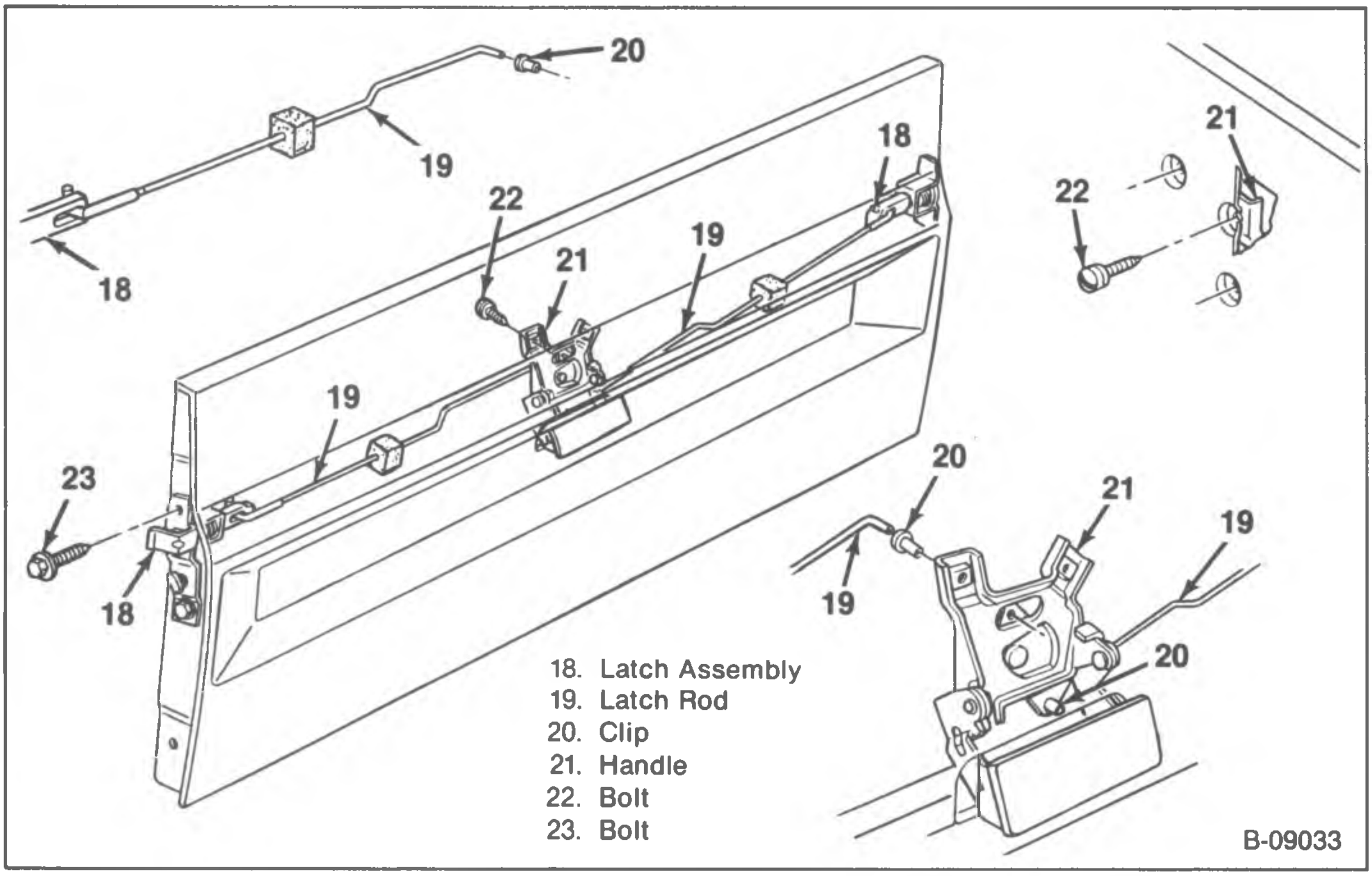


Figure 3—Handle And Latch Components

UTILITY VEHICLE MODELS

END GATE REPLACEMENT

↔ **Remove or Disconnect (Figures 4, 5, and 6)**

- The end gate must be in the closed position.

1. Torque rod to frame stud (30) and nut (32).
    - Allow the torque rod to swing down.

- Open the end gate, and support it with a table or other suitable support.

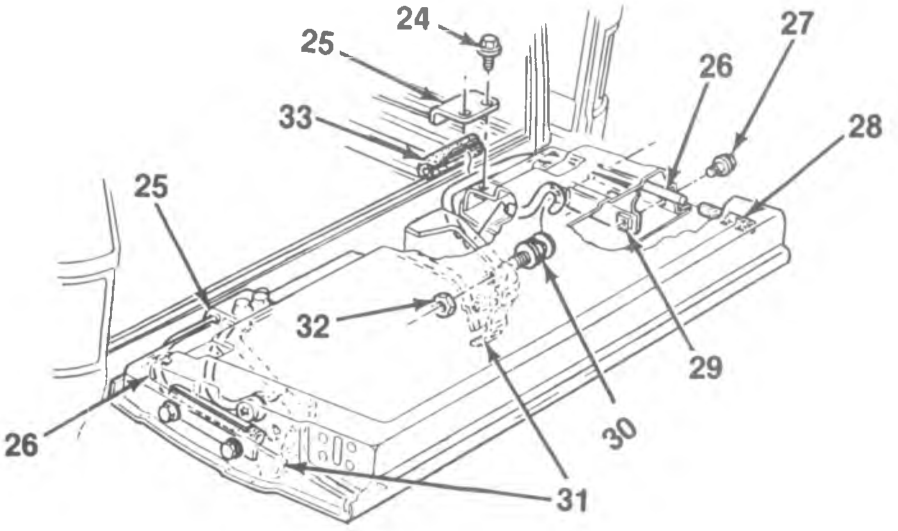
2. Electrical wiring harness (if equipped). Refer to "End Gate Cover Replacement" for access to the harness.
3. Cable (34) to end gate opening bolts (37), spacers (36), and washers (35).
4. Torque rod bracket bolts (24) and brackets (25).
5. Hinge (49) to floor panel bolts (48) from the under side of the vehicle.
6. End gate from the vehicle.
    - Lift the end gate from the body.
    - Guide the torque rods over the gravel deflectors to prevent damage.

→← **Install or Connect (Figures 4, 5, and 6)**

1. End gate to the vehicle.
    - Guide the torque rods over the gravel deflectors to prevent damage.
    - Insert the hinges into the floor panel slots.
2. Hinge (49) to floor pan bolts (48) to the under side of the vehicle.
3. Torque rod brackets (25) and bolts (24).
4. Cable (34) to the end gate opening with bolts (37), spacers (36), and washers (35).
5. Electrical wiring harness (if equipped). Refer to "End Gate Cover Replacement" for access to the harness.

- Close the end gate.

6. Torque rod to frame stud (30) and nut (32).
7. Torque rods onto the studs.



24. Bolt
25. Outer Bracket
26. Torque Rod
27. Bolt
28. Silencer
29. Inner Bracket
30. Stud
31. Frame
32. Nut
33. Silencer

Figure 4—Utility Vehicle—Torque Rod

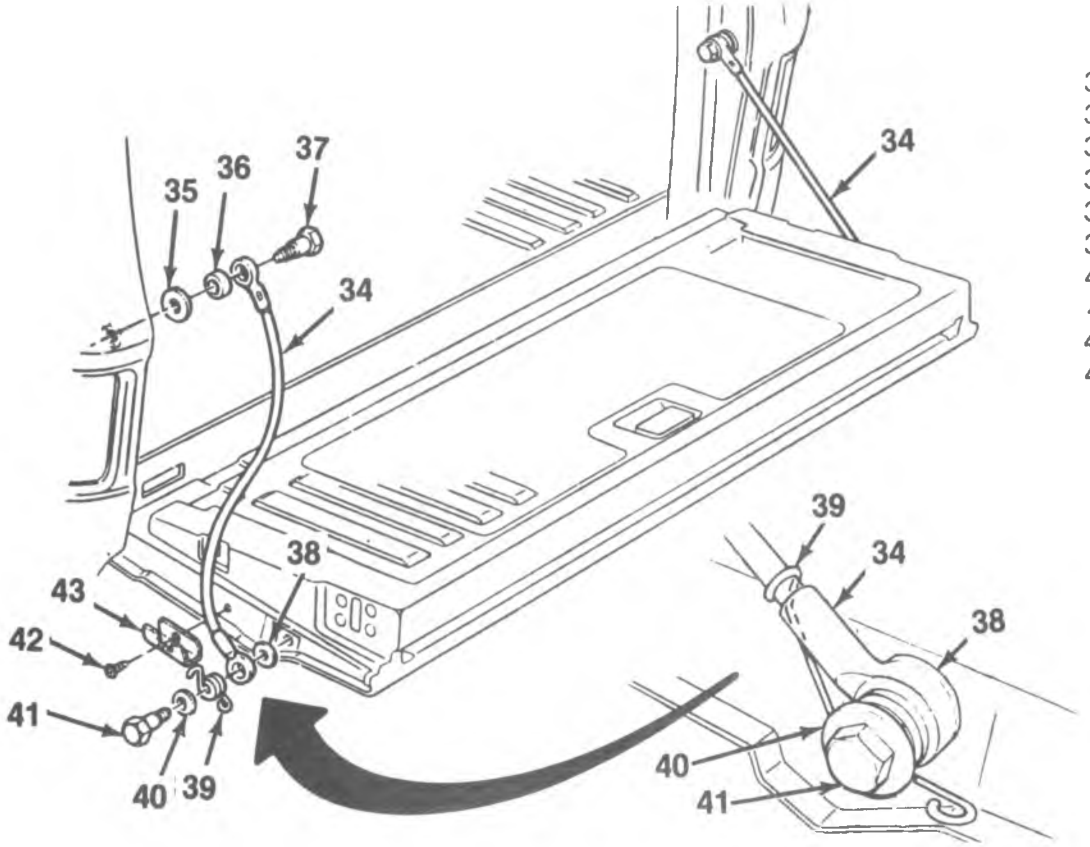
TORQUE ROD REPLACEMENT

Remove or Disconnect (Figure 4)

1. End gate. Refer to "End Gate Replacement."
2. End gate cover.
3. End gate to torque rod inner bracket bolts (27).
4. Torque rod (26) with silencers (28) from the end gate.
5. Inner bracket (29) from the end gate.

Install or Connect (Figure 4)

1. Torque rod (26) with silencers (28) to the end gate.
2. Inner bracket (29) to the torque rod.
3. End gate to torque rod inner bracket bolts (27).
4. End gate cover.



34. Cable
35. Washer
36. Spacer
37. Bolt
38. Washer
39. Spring
40. Washer
41. Bolt
42. Screw
43. Guide

Figure 5—Cable Assembly Components

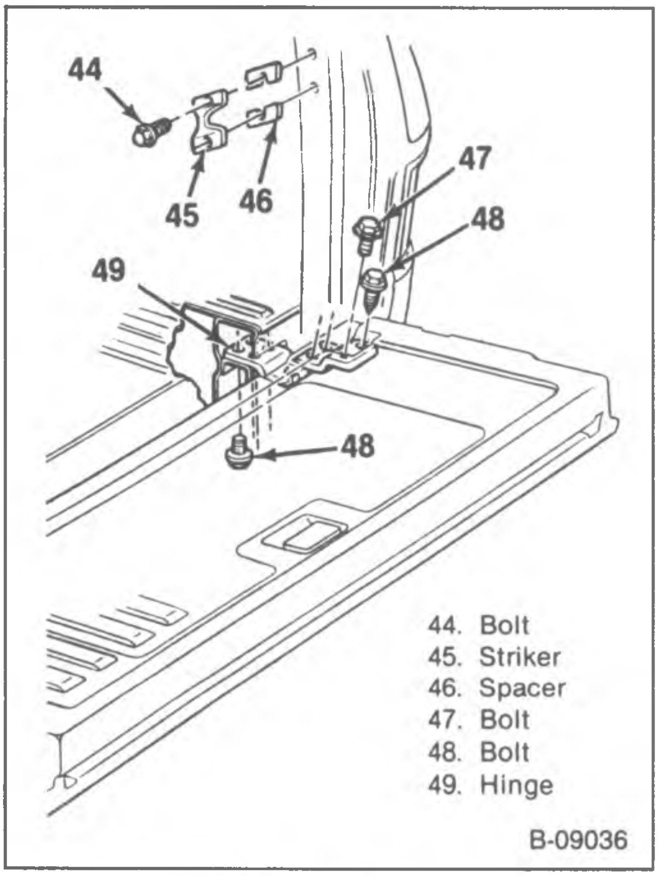


Figure 6—Hinge Assembly

5. End gate. Refer to "End Gate Replacement."

HINGE REPLACEMENT

Remove or Disconnect (Figure 6)

- Lower the end gate.

1. Hinge to body bolts (48) for the hinge to be removed only.
   - Loosen the hinge to body bolts (48) on the opposite hinge.
2. Hinge to end gate bolts (47) for the hinge to be removed.
   - Pull the end gate away from the body several inches and remove the hinge from the body.
   - Lift the end gate slightly to allow removal of the hinge from the end gate.

Install or Connect (Figure 6)

- Lift the end gate slightly and install the hinge to the end gate.
- Pull the end gate away from the body several inches, and insert the hinge into the body.

1. Hinge to end gate bolts (47).
2. Hinge to body bolts (48).
   - Tighten the hinge to body bolts on the opposite hinge.

END GATE COVER REPLACEMENT

Remove or Disconnect (Figure 7)

1. End gate cover screws (51).
2. End gate cover (50).

Install or Connect (Figure 7)

1. End gate cover (50).
2. End gate cover screws (51).

HANDLE AND CONTROL ASSEMBLY REPLACEMENT

Remove or Disconnect (Figure 8)

1. End gate cover.
2. Control rod (64) from the handle (61).
3. Handle to end gate screws (62).
4. Handle (61) from the end gate.
5. Right and left latch rods (65) from the control assembly.
6. Control assembly to end gate bolts (60).
7. Control assembly (55) from the end gate.
8. Window lockout rod spring (54).
9. Lockout rod (53) to end gate bolts (52).
10. Lockout rod (53) from the end gate.

Install or Connect (Figure 8)

1. Lockout rod (53) to the end gate.
   - The bottom of the rod must fit into the clip at the base of the end gate.
2. Lockout rod (53) to end gate bolts (52).
3. Window lockout rod spring (54).
4. Control assembly (55) to the end gate.
5. Control assembly to end gate bolts (60).
6. Right and left latch rods (65) from the control assembly.
7. Handle (61) to the end gate.
8. Handle to end gate screws (62).
9. Control rod (64) to the handle (61).
10. End gate cover.

LATCH REPLACEMENT

Remove or Disconnect (Figure 9)

1. End gate cover.
2. Right or left latch rod (65) from the control assembly.
3. Latch (66) to end gate screws (67).
4. Latch (66) from the end gate.

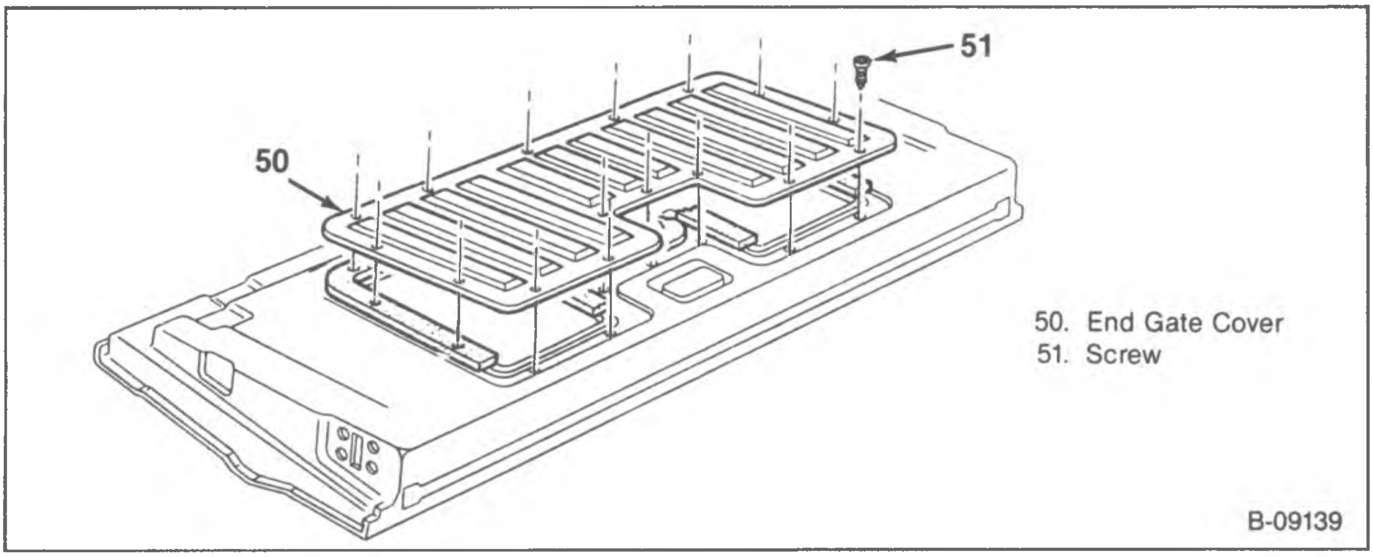


Figure 7—End Gate Cover

Install or Connect (Figure 9)

1. Latch (66) with rod to the end gate.
2. Latch (66) to end gate screws (67).
3. Right or left latch rod (65) to the control assembly.
4. End gate cover.

REGULATOR REPLACEMENT

MANUAL REGULATOR

Remove or Disconnect (Figure 10)

1. End gate cover.
2. Control assembly. Refer to "Handle And Control Assembly Replacement."

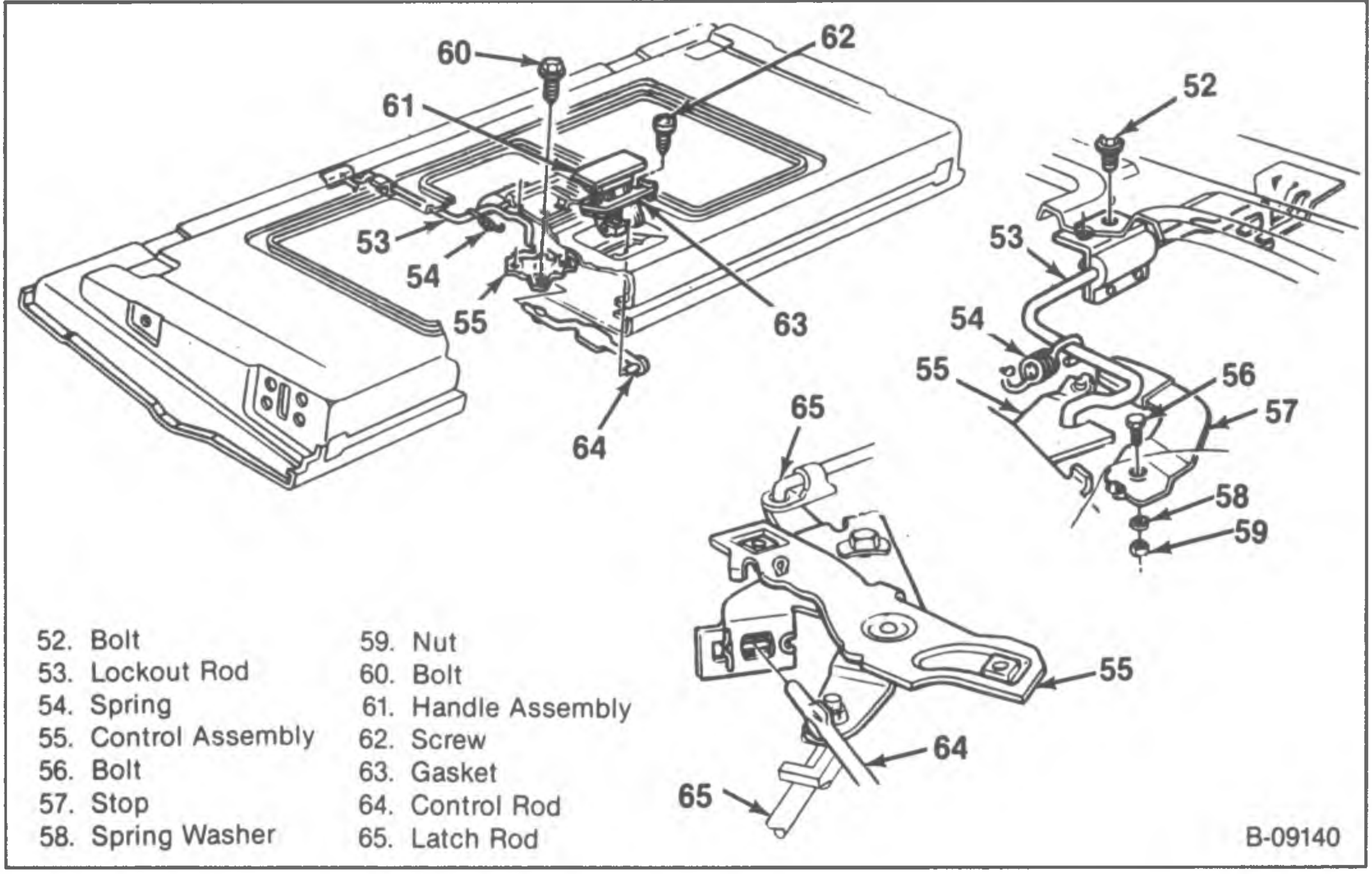


Figure 8—Handle And Control Assembly

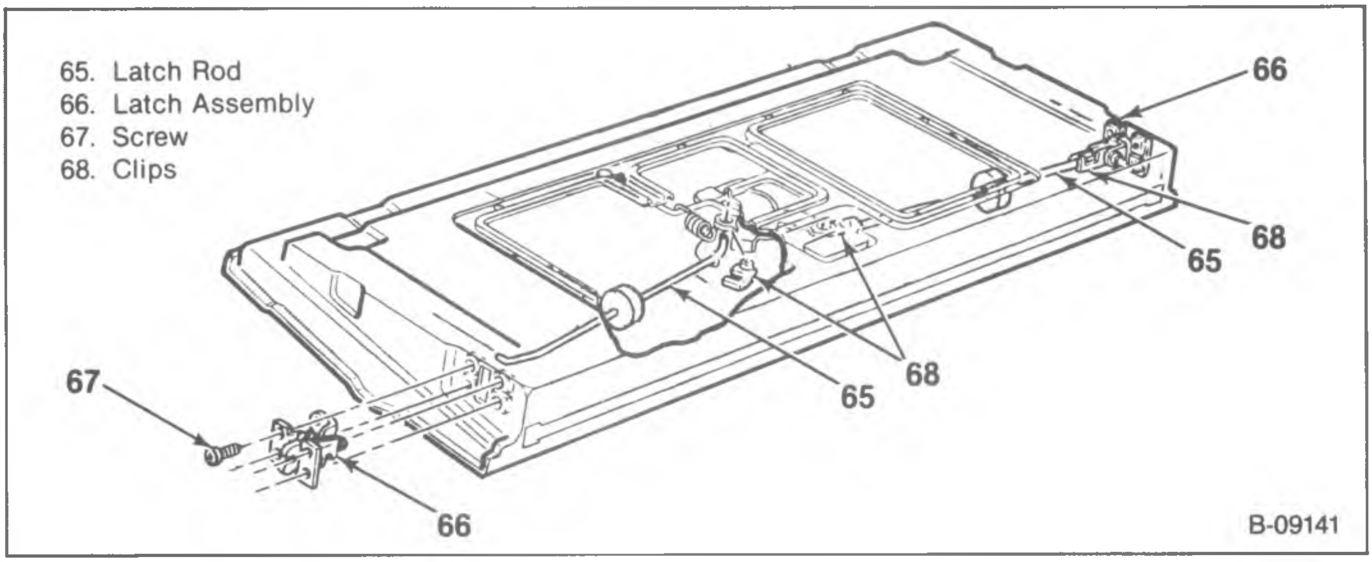


Figure 9—Latch Components

3. Sash assembly (73). Refer to "Sash Assembly Replacement."
4. Regulator (69) to end gate bolts (70).
5. Regulator (69) from the end gate.

→← Install or Connect (Figure 10)

1. Regulator (69) to the end gate.
2. Regulator (69) to end gate bolts (70).
3. Sash assembly (73). Refer to "Sash Assembly Replacement."
4. Control assembly. Refer to "Handle And Control Assembly Replacement."
5. End gate cover.

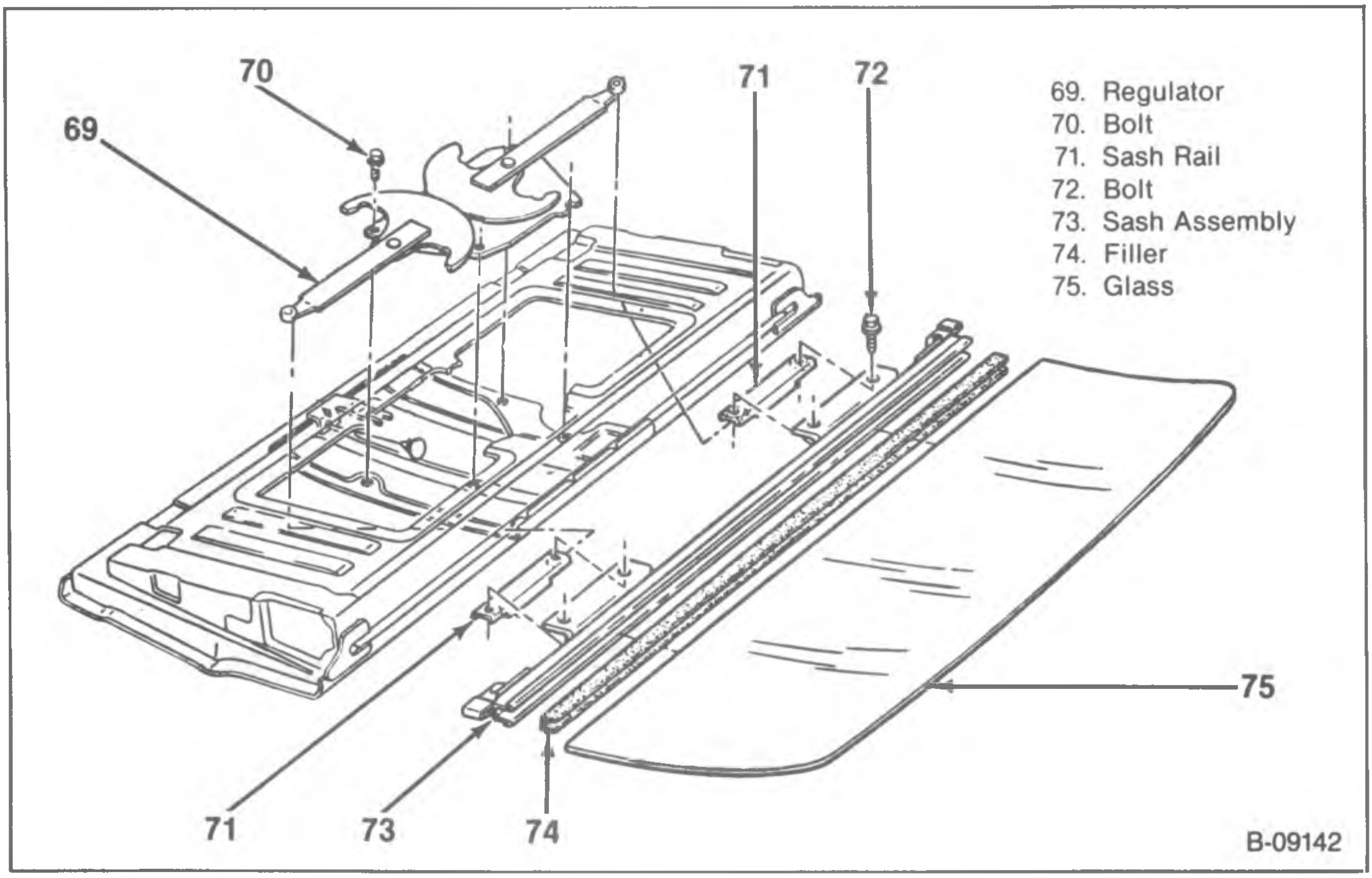


Figure 10—Regular And Sash Components

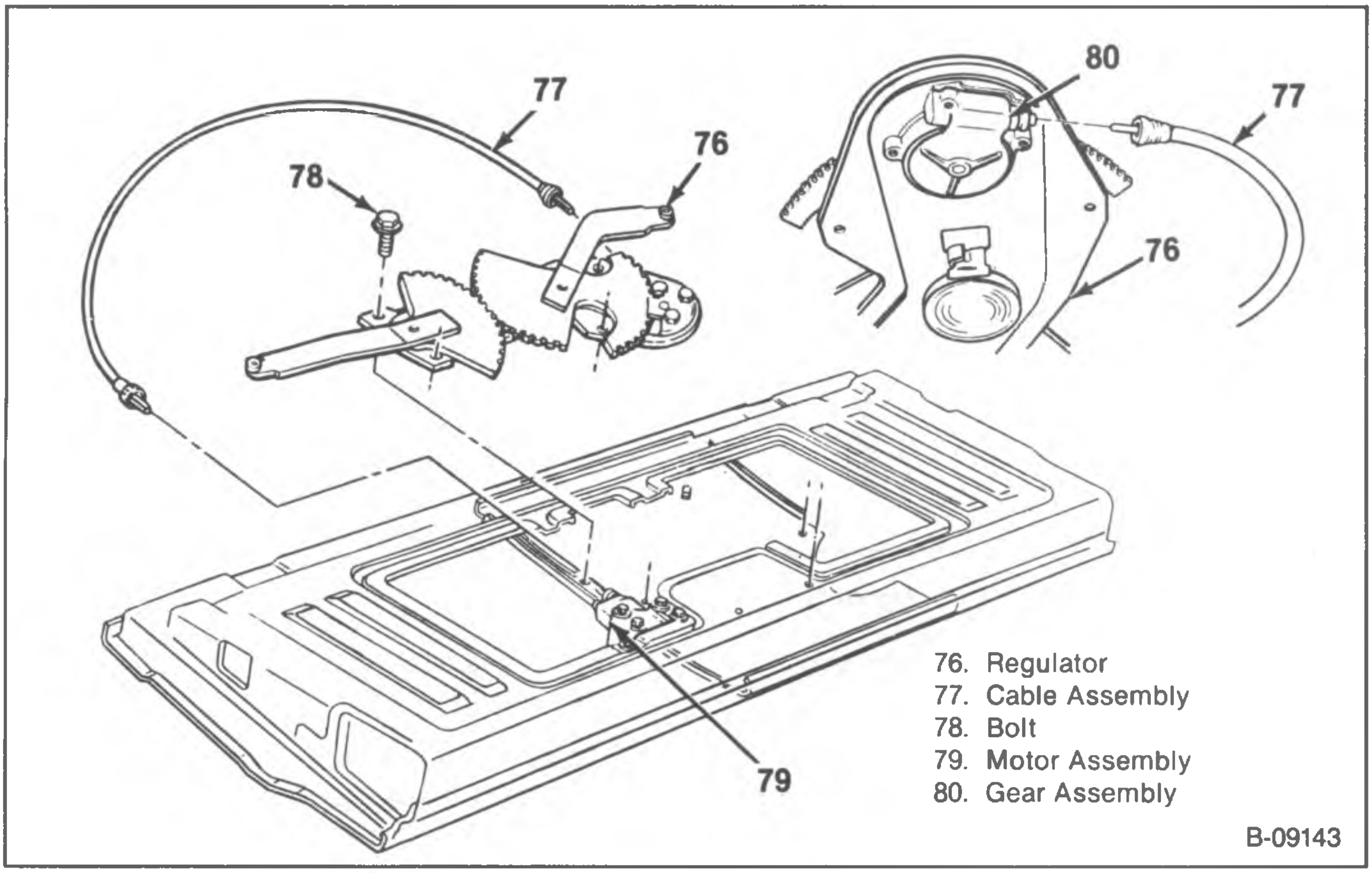


Figure 11—Power Regulator Components

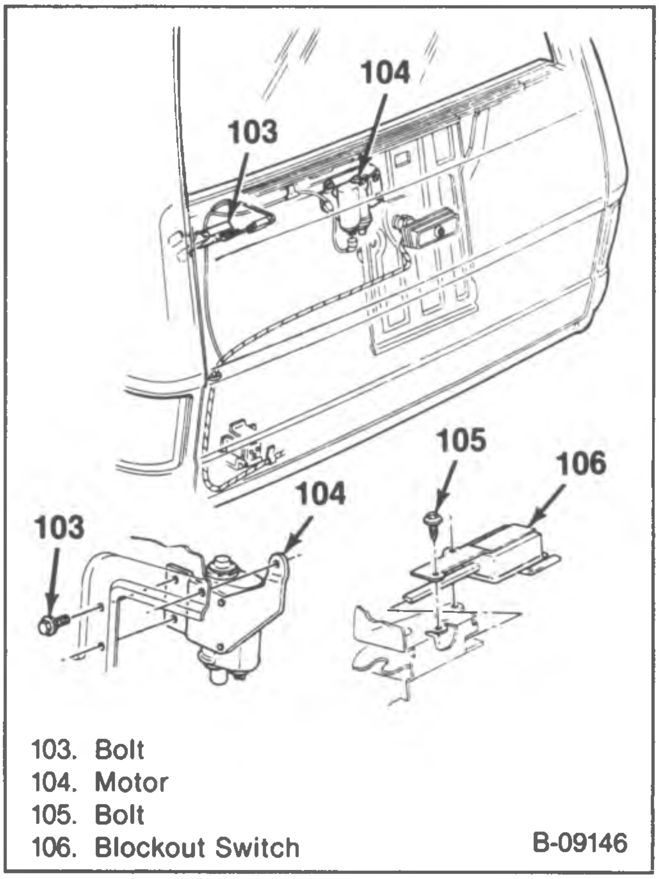


Figure 12—End Gate Electrical Components

POWER REGULATOR

↔ Remove or Disconnect (Figures 10 and 11)

1. End gate cover.
2. Control assembly. Refer to "Handle And Control Assembly Replacement."
3. Sash assembly (73). Refer to "Sash Assembly Replacement."

CAUTION: Step 4 must be performed if the gear box is removed or disengaged from the regulator lift arms. The left arms are under tension from the counterbalance spring, and can cause personal injury if the gear box is removed without locking the sector gears in place.

4. Drill a 3.1 mm (1/8-inch) diameter hole through the sector gear and back plate. Install a sheet metal tapping screw into the hole to lock the sector gears in position.
5. Drive cable (77) at regulator (76).
6. Regulator (76) to end gate bolts (78).
7. Regulator (76) from the end gate.
8. Gear assembly (80) to regulator bolts.
9. Gear assembly (80) from the regulator (76).

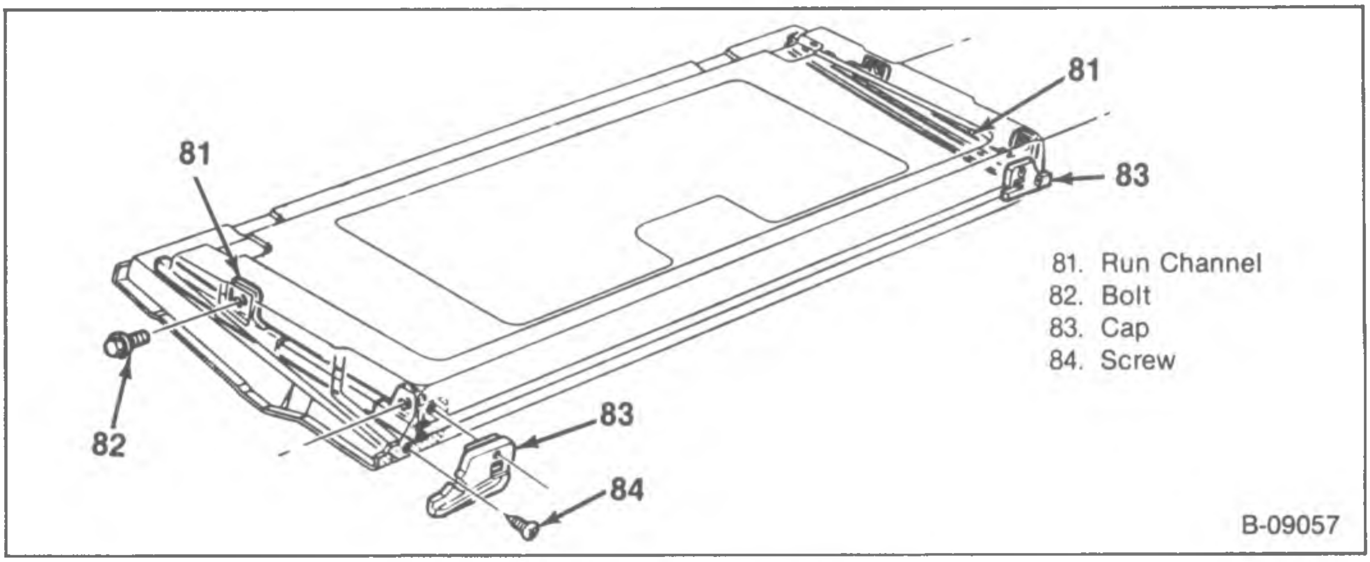


Figure 13—Run Channel Components

Install or Connect (Figures 10 and 11)

1. Gear box (80) to the regulator (76).
2. Gear box (80) to regulator bolts.
3. Regulator (76) to the end gate.
4. Regulator (76) to end gate bolts (78).
5. Drive cable (77) to the regulator (76).
   - Remove the sheet metal screw.
6. Sash assembly (73). Refer to "Sash Assembly Replacement."
7. Control assembly. Refer to "Handle and Control Assembly Replacement."
8. End gate cover.

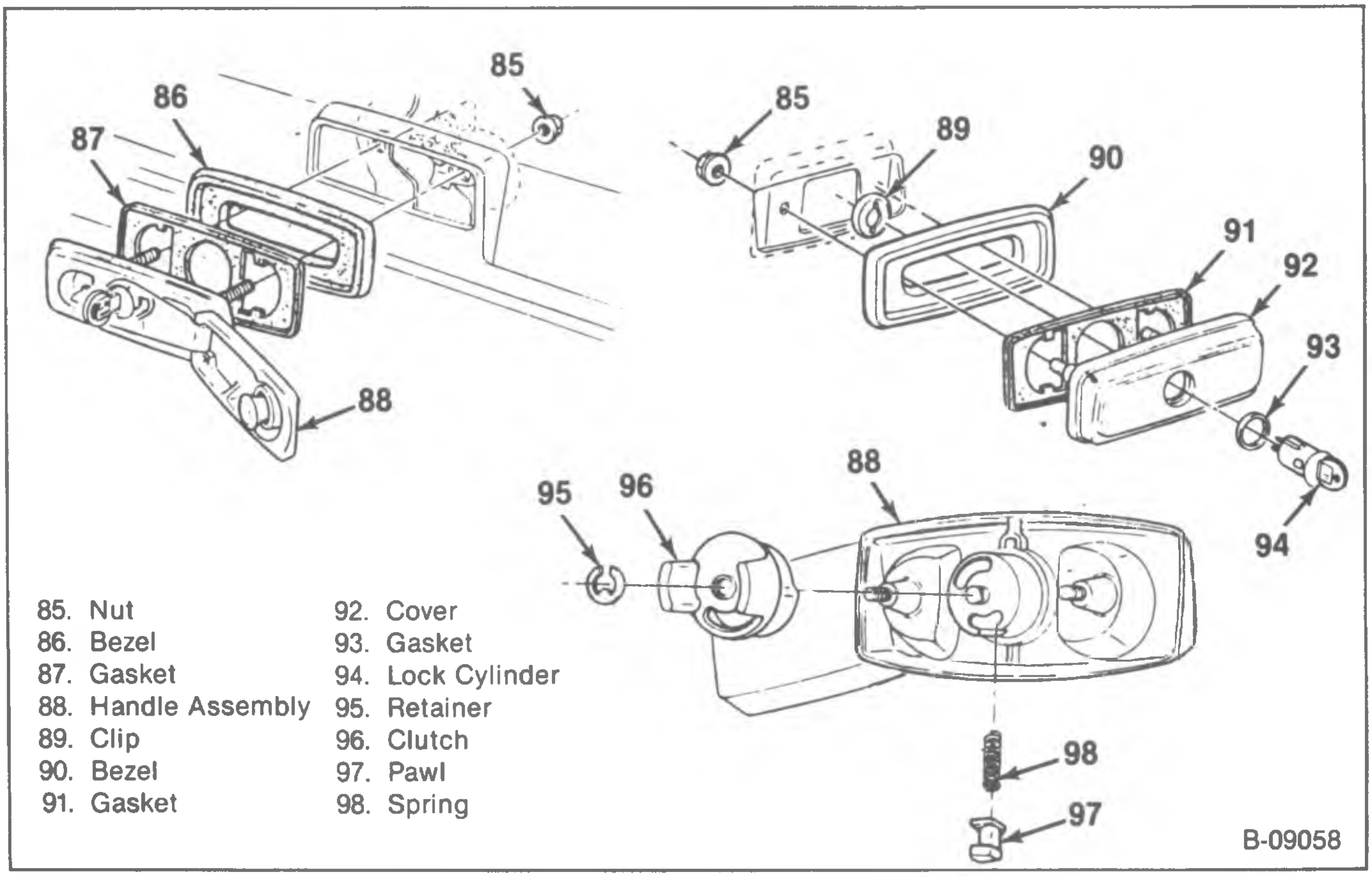


Figure 14—Window Control Components

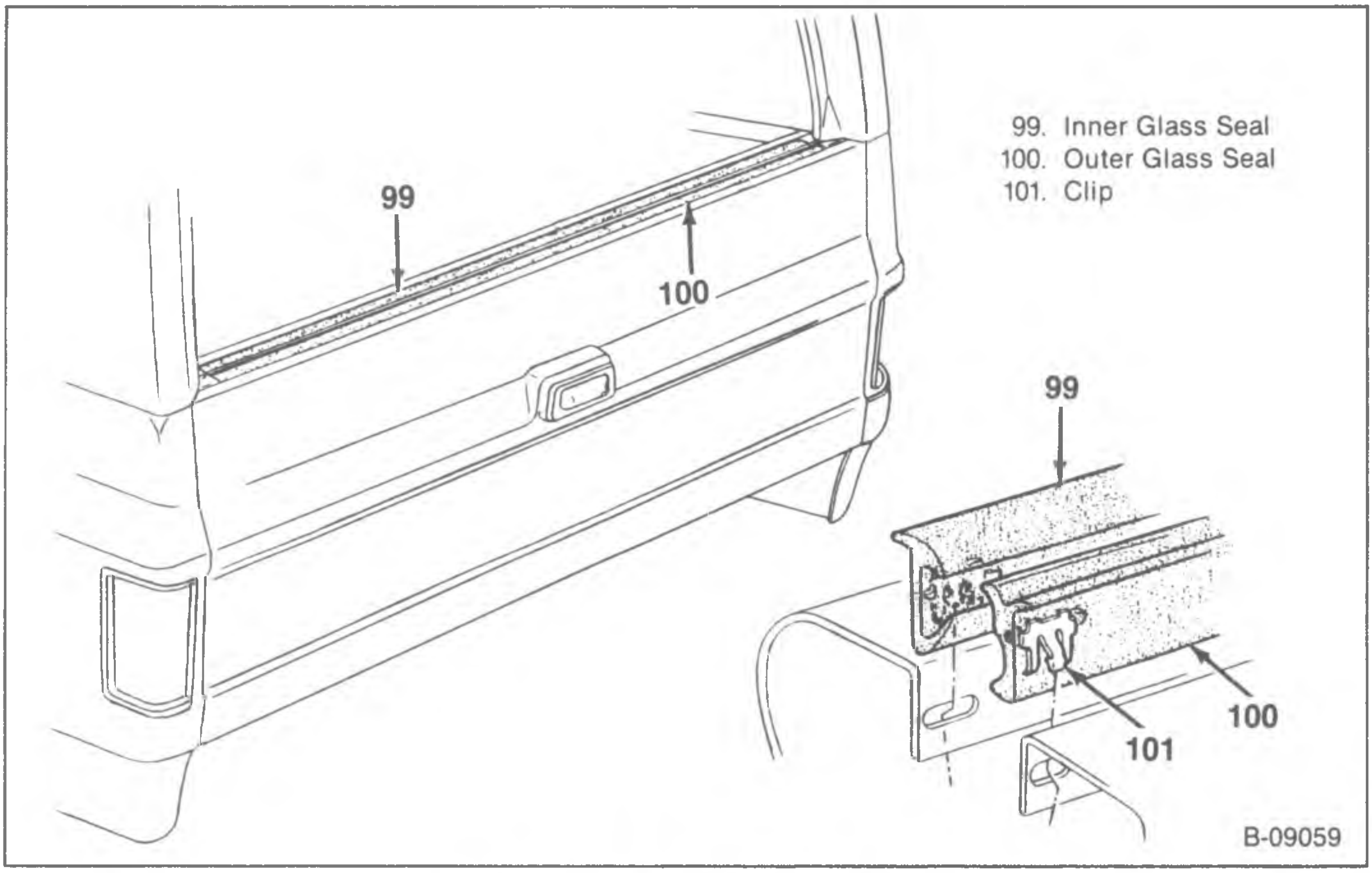


Figure 15—Window Glass Seals

WINDOW MOTOR AND BLOCKOUT SWITCH REPLACEMENT

Remove or Disconnect (Figure 12)

1. End gate panel.
2. Wiring harness from the motor and switch.
3. Cable from the motor.
4. End gate to motor bolts (103).
5. Motor (104) from the end gate.
6. Latch containing the blockout switch from the end gate. Refer to "Latch Replacement."
7. Blockout switch (106) to latch bolts (105).
8. Blockout switch (106) from the latch.

Install or Connect (Figure 12)

1. Blockout switch (106) to the latch.
2. Blockout switch (106) to latch bolts (105).
3. Latch to the end gate. Refer to "Latch Replacement."
4. Motor (104) to the end gate.
5. End gate to motor bolts (103).
6. Cable to the motor.
7. Wiring harness to the motor and the switch.
8. End gate panel.

SASH ASSEMBLY REPLACEMENT

Remove or Disconnect (Figure 10)

1. Window run channel caps (figure 13).
2. Inner and outer window glass seals. Refer to "Window Glass Seal Replacement."
3. End gate cover.
- Regulate the window so that the sash channel bolts (72) are accessable.
4. Sash (73) to sash channel bolts (72).
5. Sash (73) with glass (75) from the end gate.
6. Sash rails (71) from the regulator (69).

Install or Connect (Figure 10)

1. Sash rails (71) to the regulator (69).
2. Sash (73) with glass (75) to the end gate.
3. Sash (73) to sash channel bolts (72).
4. End gate cover.
5. Inner and outer window glass seals. Refer to "Window Glass Seal Replacement."
6. Window run channel caps (figure 13).

RUN CHANNEL REPLACEMENT

Remove or Disconnect (Figure 13)

1. Window run-channel caps (83).
- Completely lower the window.
2. Run-channel (81) from the end gate.
   - Pull the channel from the end gate. Twist the channel to clear the window opening.

Install or Connect (Figure 13)

1. Run-channel (81) to the end gate.
   - Twist the channel into the window opening.
2. Run-channel (81) to end gate bolts (82).
3. Window run-channel caps (83).

END GATE OUTSIDE CRANK REPLACEMENT

Remove or Disconnect (Figure 14)

1. Handle and control assembly. Refer to "Handle And Control Assembly Replacement."
2. Crank to end gate nuts (85).
3. Crank (88) and bezel (86) from the end gate.

Install or Connect (Figure 14)

1. Crank (88) and bezel (86) to the end gate.
2. Crank to end gate nuts (85).
3. Handle and control assembly. Refer to "Handle And Control Assembly Replacement."

WINDOW GLASS SEAL REPLACEMENT

Remove or Disconnect (Figure 15)

- Lower the window.
- Inner or outer seal by prying the clips from the end gate.

Install or Connect (Figure 15)

- Inner or outer seal by pressing the clips into the holes in the end gate.

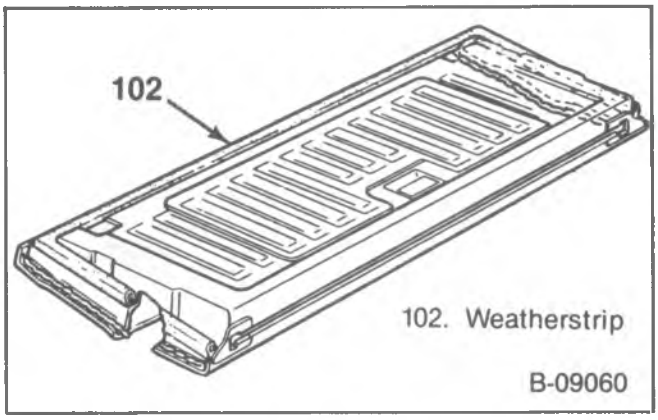


Figure 16—Weatherstrip Components

WEATHERSTRIP REPLACEMENT

Remove or Disconnect (Figure 16)

- Weatherstrip from the end gate using 3M Release Agent (or equivalent).

Install or Connect (Figure 16)

- Weatherstrip to the end gate using 3M Weatherstrip Adhesive (or equivalent).

UTILITY VEHICLE REMOVABLE TOP

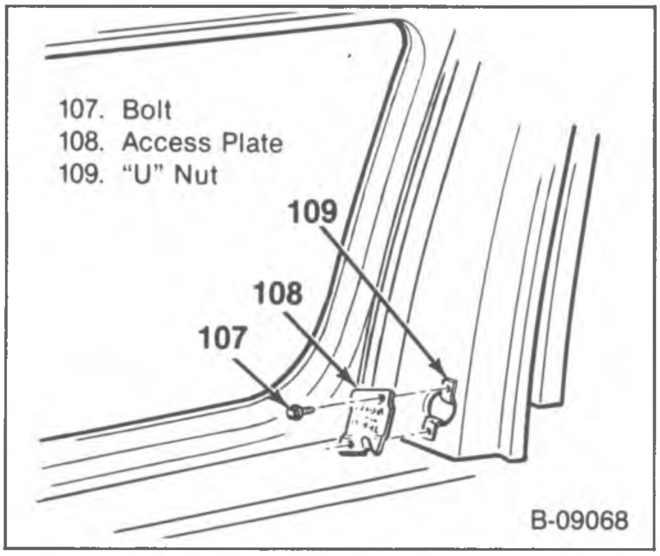


Figure 17—Removable Top—Access Plate Components

REMOVABLE TOP REPLACEMENT

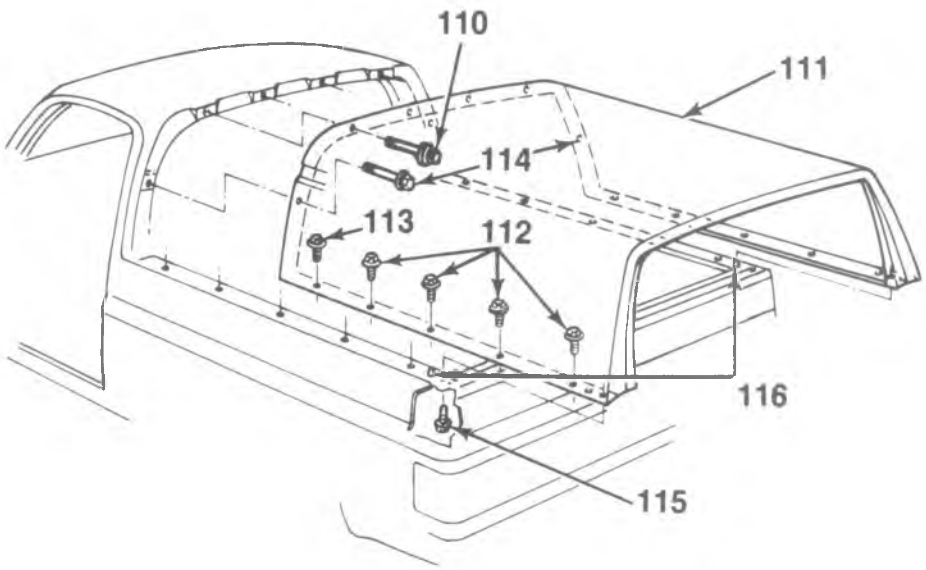
Remove or Disconnect (Figures 17 and 18)

1. Access plate (108) and dome lamp wiring harness.
- Lower the end gate.
2. Top (111) to roof mounting bolts (110) and (114).
3. Top (111) to side panel mounting bolts (113) and (112).
4. Upper tire brace bolt and the upper brace.
    - Reinstall the brace after the top is removed.
5. Side trim panel rear attaching screws.
    - Remove twelve screws on the left side.
    - Remove eleven screws on the right side.
- Pull the panel away only far enough to gain access to the hidden top bolt.
6. Hidden bolts (115).
7. The removable top (111).
    - With the assistance of helpers, carefully lift the top from the vehicle. Do not allow the sides to bend.

Install or Connect (Figures 17 and 18)

To prevent damage to the top and to ensure proper weatherstrip sealing, the following procedure must be followed.

- Remove the upper spare tire brace.
1. The top onto the vehicle.
    - Use the two rear guide pins as locators.
2. Top to roof mounting bolts (114).
3. Top to side panel mounting bolts (112).
    - Start with the bolts nearest the end gate, and work towards the cab.
    - Do not install the second bolt from the rear on the right side at this time.
    - Do not install the bolts (113) nearest the cab.
- Loosen the top (111) to roof mounting bolts (114).
4. Top to side panel mounting bolts (113).
5. Top to roof mounting bolts (110) and (114).
6. Hidden bolts (115).
7. Trim panel screws to the right and left trim panels.
8. The upper spare tire brace with the remaining bolt.
9. Dome lamp wiring harness, and access plate (108).



110. Bolt
111. Top
112. Bolt
113. Bolt
114. Bolt
115. Bolt
116. Guide Pins

B-09069

Figure 18—Removable Top Components

SUBURBAN MODELS

END GATE REPLACEMENT

Remove or Disconnect (Figures 19, 20, and 21)

- Lower the end gate.

1. Torque rod bracket (119).
2. Wiring harness (if equipped). Refer to "End Gate Trim And Cover Panel Replacement" for access to the wiring harness.
3. Hinge access cover (131) and seal (132).
4. End gate to hinge bolts (133).

- Lift the end gate to the almost closed position.

5. Support cable (136) to end gate bolt (142) and washer (143).
6. End gate with torque rod from the vehicle.

Install or Connect (Figures 19, 20 and 21)

1. End gate with torque rod (117) to the vehicle.
2. Support cable (136) to end gate washer (143) and bolt (142).
3. End gate to hinge bolts (133).
4. Hinge cover seal (132) and access cover (131).
5. Wiring harness (if equipped). Refer to "End Gate Trim And Cover Panel Replacement" for access to the wiring harness.
6. Torque rod bracket (119).

TORQUE ROD REPLACEMENT

Remove or Disconnect (Figure 19)

1. End gate. Refer to "End Gate Replacement."
2. Trim panel (if equipped) and the cover panel.
3. End gate to torque rod inner bracket bolts (126).
4. End gate to torque rod outer bracket bolts (122).
5. Inner (118) and outer (119) brackets from the end gate.
6. Torque rod (117) from the end gate.

Install or Connect (Figure 19)

1. Torque rod (117) to the end gate.
2. Outer brackets (117) to the end gate.
3. Outer bracket bolts (122).
4. Inner bracket (118) to the end gate.
5. Inner bracket bolts (126).
6. The cover panel and trim panel (if equipped).
7. End gate. Refer to "End Gate Replacement."

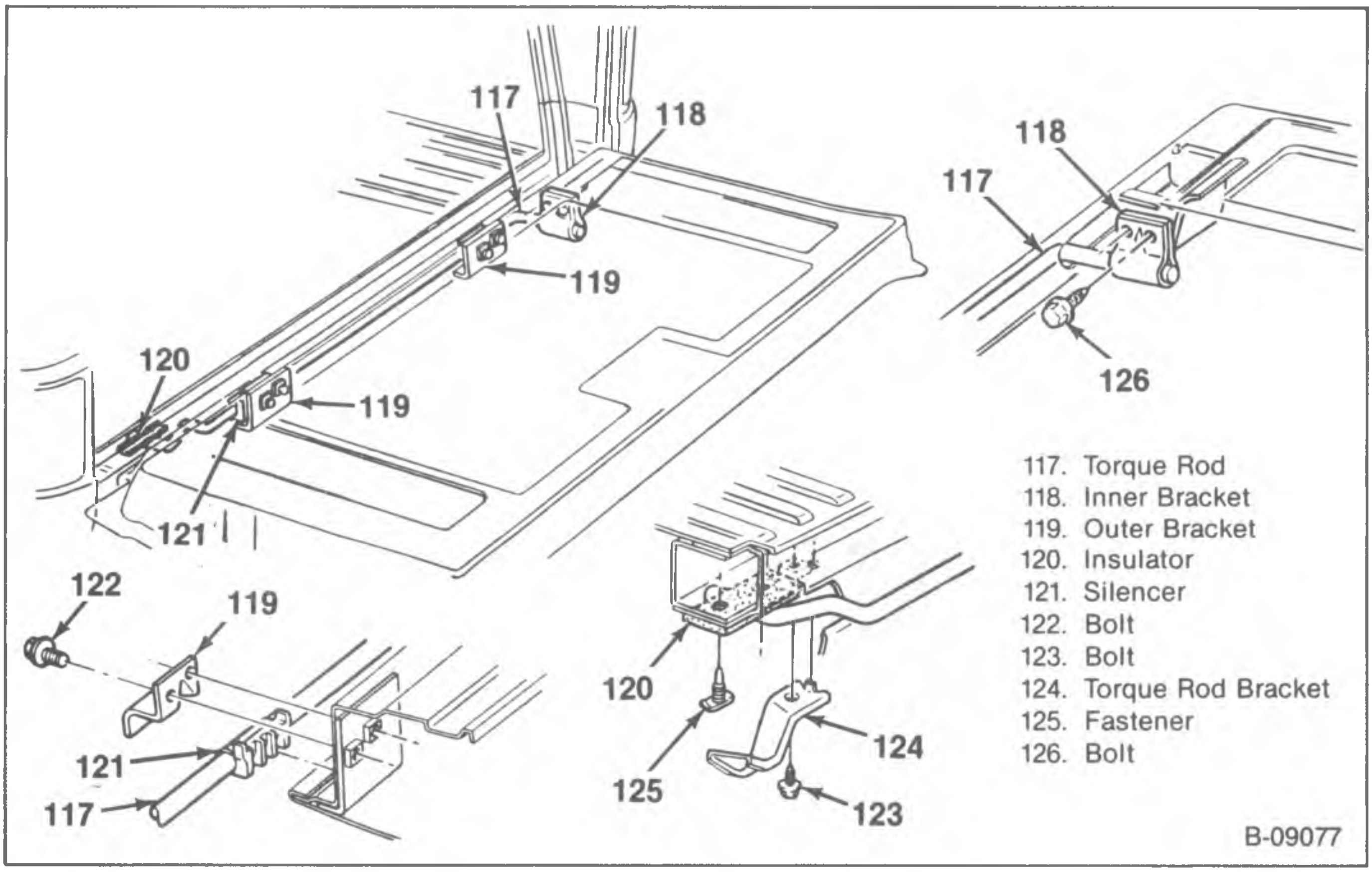


Figure 19—Suburban—Torque Rod Components

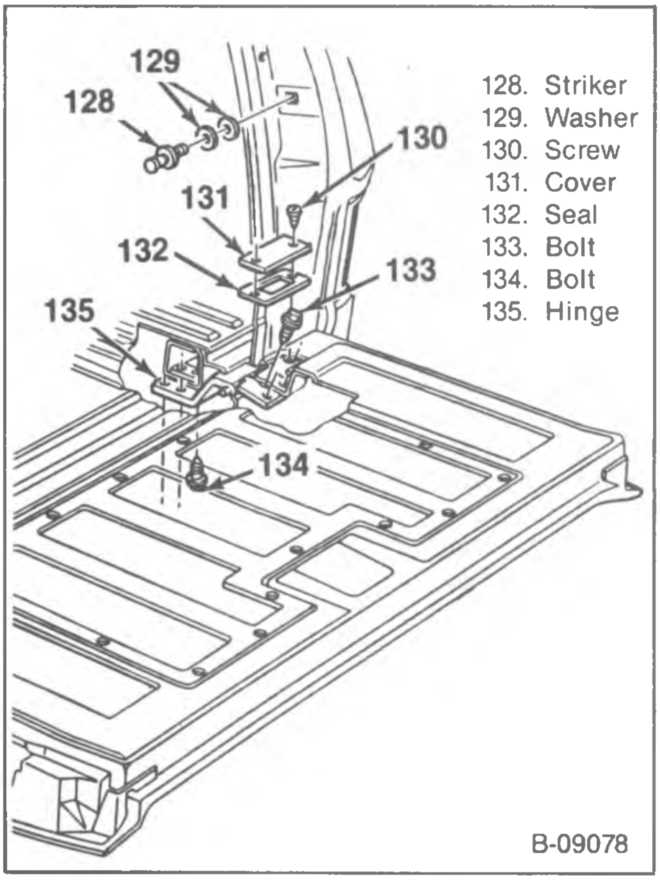


Figure 20—Hinge Components

HINGE REPLACEMENT

↔ Remove or Disconnect (Figure 20)

- Lower the end gate.

1. Hinge to body bolts (134) for the hinge to be removed.

- Loosen the hinge to body bolts (134) on the opposite hinge.

2. Hinge cover screws (130) and covers (131).
3. Hinge to end gate bolts (133) for the hinge to be removed.

- Pull the end gate away from the body several inches and remove the hinge from the body.
- Lift the end gate slightly to allow removal of the hinge from the end gate.

→← Install or Connect (Figure 20)

- Lift the end gate slightly and install the hinge to the end gate.
- Pull the end gate away from the body several inches, and insert the hinge into the body.

1. Hinge to end gate bolts (133).

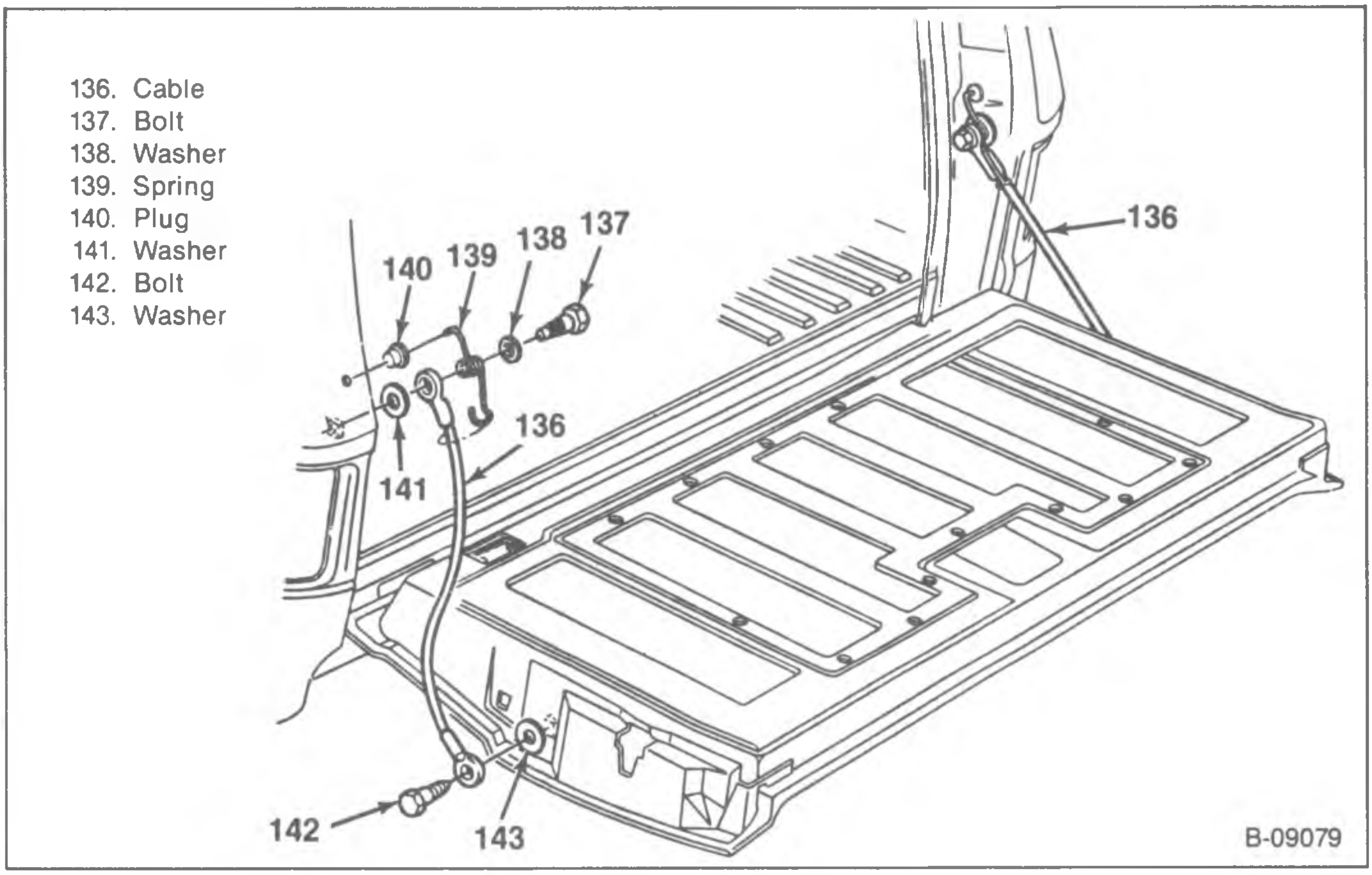


Figure 21—Cable Assembly Components

2. Hinge to body bolts (134).
   - Tighten the hinge to body bolts on the opposite hinge.
3. Hinge covers (131) and cover screws (130).

END GATE TRIM AND COVER PANEL REPLACEMENT

Remove or Disconnect (Figures 22 and 23)

1. Trim panel screws (145).
2. Trim panel (144).
   - Slide the panel away from the glass opening.
   - Note the position of the cover panel screws. Five of the holes in the cover panel are also holes for the trim panel.
3. Cover panel screws (146).
4. Cover panel (147).

Install or Connect (Figures 22 and 23)

1. Cover panel (147).
2. Cover panel screws (146).
3. Trim panel (144).
4. Trim panel screws (145).

HANDLE AND CONTROL ASSEMBLY REPLACEMENT

Remove or Disconnect (Figures 23 and 24)

1. Trim panel (if equipped) and the cover panel.
2. Control rod (154) from the handle (159).
3. Handle to end gate screws (161).
4. Handle (159) from the end gate.
5. Right and left latch rods (150) from the control assembly.
6. Control assembly to end gate bolts (148).
7. Control assembly (149) from the end gate.

Install or Connect (Figures 23 and 24)

1. Control assembly (149) to the end gate.
2. Control assembly to end gate bolts (148).
3. Right and left latch rods (150) from the control assembly.
4. Handle (159) to the end gate.
5. Handle to end gate screws (161).
6. Control rod (154) to the handle (159).
7. End gate cover and trim panel (if equipped).

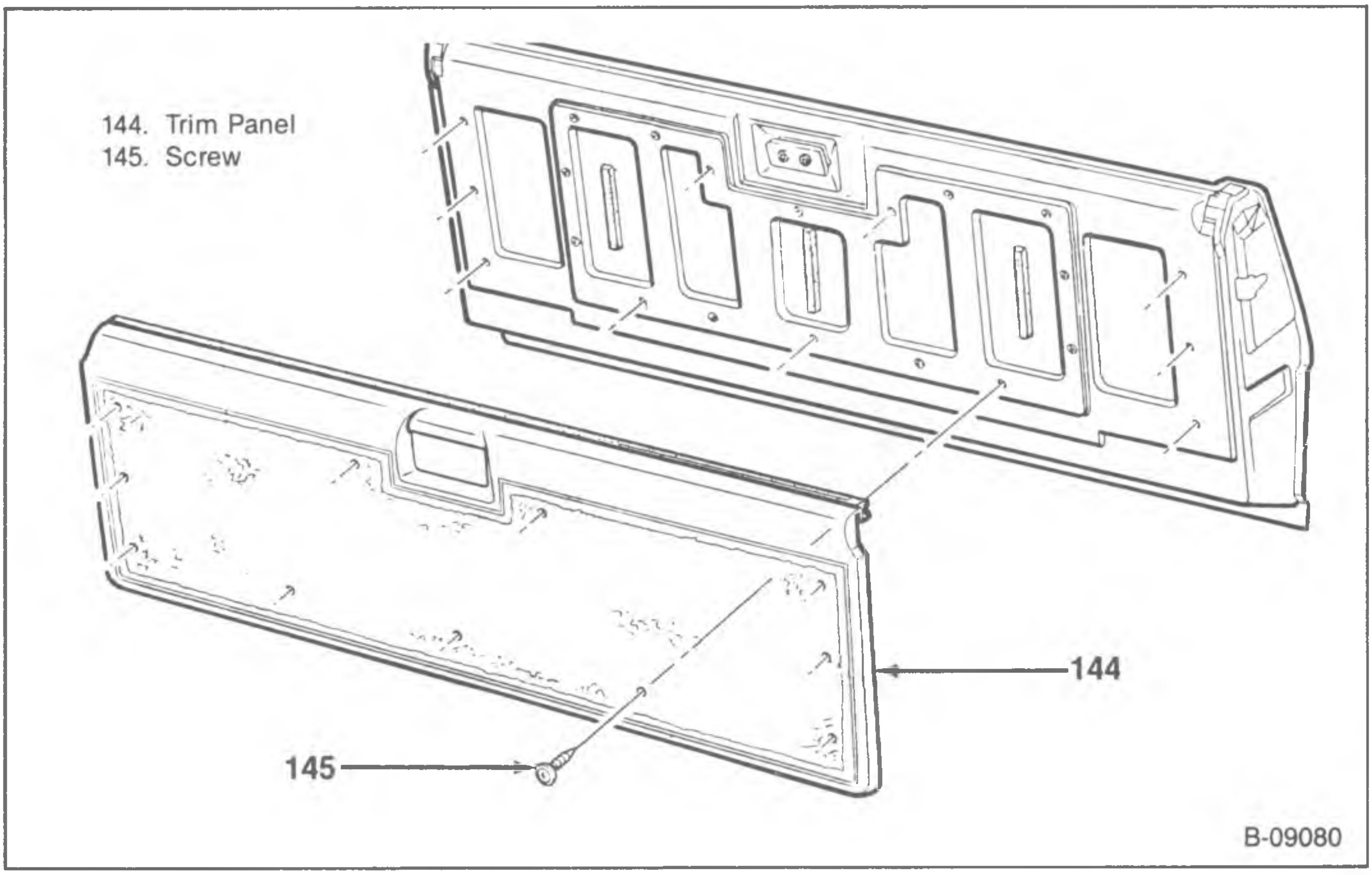


Figure 22—Trim Panel Components

LATCH REPLACEMENT

↔ Remove or Disconnect (Figure 24)

1. Trim panel (if equipped) and the cover panel.
2. Right or left latch rods (150) from the control assembly.
3. Latch (153) to end gate screws (152).
4. Latch (153) from the end gate.

→← Install or Connect (Figure 24)

1. Latch (153) with rod to the end gate.
2. Latch (153) to end gate screws (152).
3. Right or left latch rod (150) to the control assembly.
4. Cover panel and trim panel (if equipped).

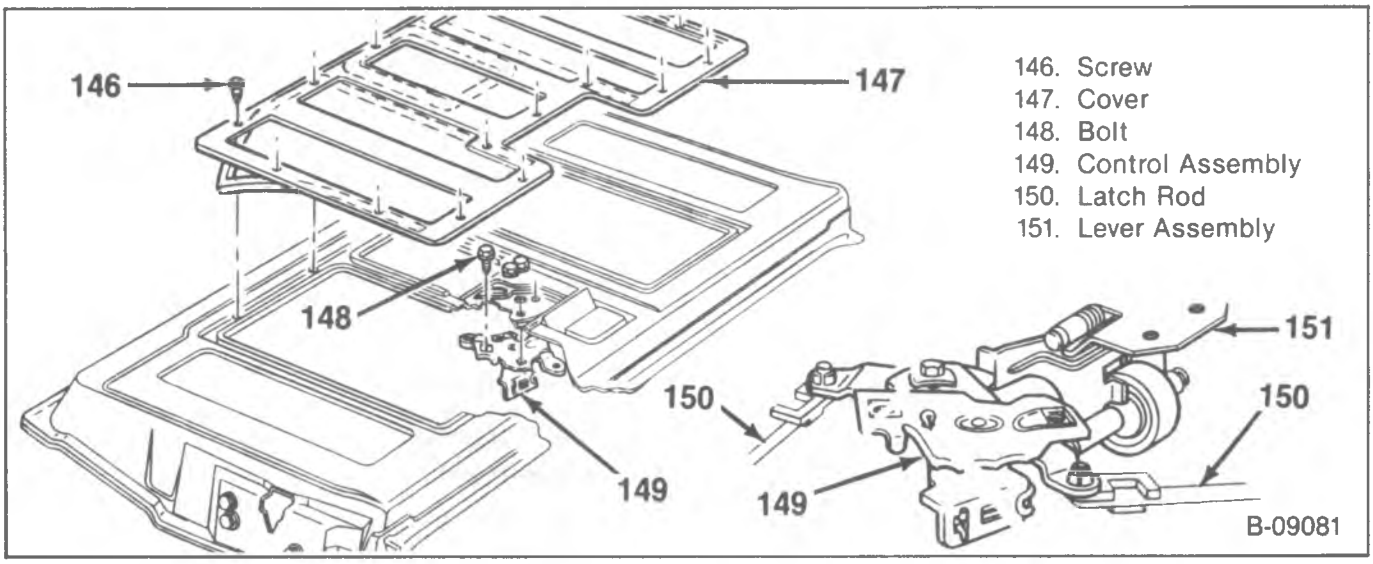


Figure 23—End Gate Cover And Control Assembly Components

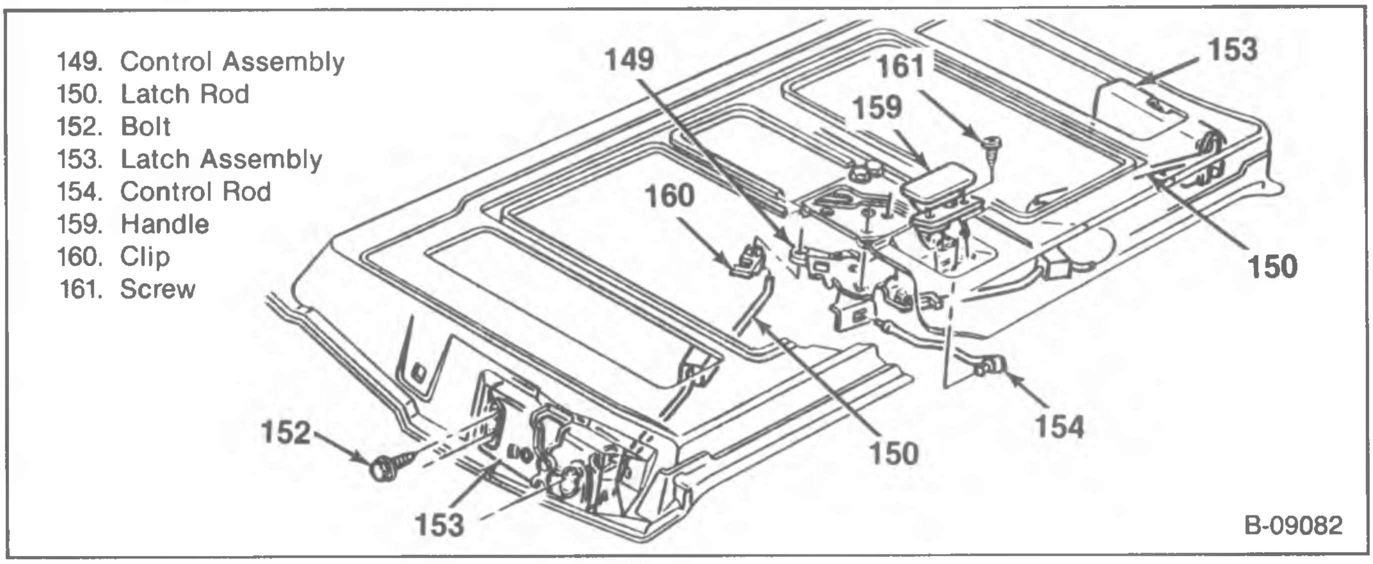


Figure 24—Handle And Latch Components

REGULATOR REPLACEMENT

MANUAL REGULATOR

Remove or Disconnect (Figure 10)

1. Trim panel (if equipped) and cover panel.
2. Control assembly. Refer to "Handle And Control Assembly Replacement."
3. Sash assembly (73). Refer to "Sash Assembly Replacement."
4. Regulator (69) to end gate bolts (70).
5. Regulator (69) from the end gate.

Install or Connect (Figure 10)

1. Regulator (69) to the end gate.
2. Regulator (69) to end gate bolts (70).
3. Sash assembly (73). Refer to "Sash Assembly Replacement."
4. Control assembly. Refer to "Handle And Control Assembly Replacement."
5. End gate cover and trim panel (if equipped).

POWER REGULATOR

Remove or Disconnect (Figures 10 and 11)

1. Trim panel (if equipped) and end gate cover.
2. Control assembly. Refer to "Handle And Control Assembly Replacement."
3. Sash assembly (73). Refer to "Sash Assembly Replacement."
4. Wiring harness from the motor.
5. Regulator (76) to end gate bolts (78).
6. Regulator (76) from the end gate.

CAUTION: Step 7 must be performed if the gear box is removed or disengaged from the regulator lift arms. The lift arms are under tension from the counterbalance spring, and can cause personal injury if the gear box is removed without locking the sector gears in place.

7. Drill a 3.1 mm (1/8-inch) diameter hole through the sector gear and back plate. Install a sheet metal tapping screw into the hole to lock the sector gears in position.
8. Motor to regulator bolts.
9. Motor from the regulator.

Install or Connect (Figures 10 and 11)

1. Motor to the regulator.
2. Motor to regulator bolts.
   - Remove the sheet metal screw.
3. Regulator (76) to the end gate.
4. Regulator (76) to end gate bolts (78).
5. Wiring harness to the motor.
6. Sash assembly (73). Refer to "Sash Assembly Replacement."
7. Control assembly. Refer to "Handle And Control Assembly Replacement."
8. Trim panel (if equipped) and end gate cover.

BLOCKOUT SWITCH REPLACEMENT

Remove or Disconnect

1. Trim panel (if equipped) and the end gate cover.
2. The right latch assembly. Refer to "Latch Replacement."
3. Wiring harness from the switch.
4. Switch from the latch.

Install or Connect

1. Switch to the latch.
2. Wiring harness to the switch.
3. The right latch assembly to the end gate. Refer to "Latch Replacement."
4. End gate cover and trim panel (if equipped).

SASH ASSEMBLY REPLACEMENT

Remove or Disconnect (Figure 10)

1. Inner and outer window glass seals. Refer to "Window Glass Seal Replacement."
2. Trim panel (if equipped) and cover panel.
- Regulate the window so that the sash channel bolts (72) are accessable.
3. Sash (73) to sash channel bolts (72).
4. Sash (73) with glass (75) from the end gate.
5. Sash rails (71) from the regulator (69).

Install or Connect (Figure 10)

1. Sash rails (71) to the regulator (69).
2. Sash (73) with glass (75) to the end gate.
3. Sash (73) to sash channel bolts (72).
4. End gate cover and trim panel.
5. Inner and outer window glass seals. Refer to "Window Glass Seal Replacement."

RUN CHANNEL REPLACEMENT

Remove or Disconnect (Figure 25)

- Completely lower the window.
1. Run-channel (156) to end gate bolts (155).
2. Run-channel (156) from the end gate.
    - Pull the channel from the end gate. Twist the channel to clear the window opening.

Install or Connect (Figure 25)

1. Run-channel (156) to the end gate.
    - Twist the channel into the window opening.
2. Run-channel (156) to end gate bolts (155).

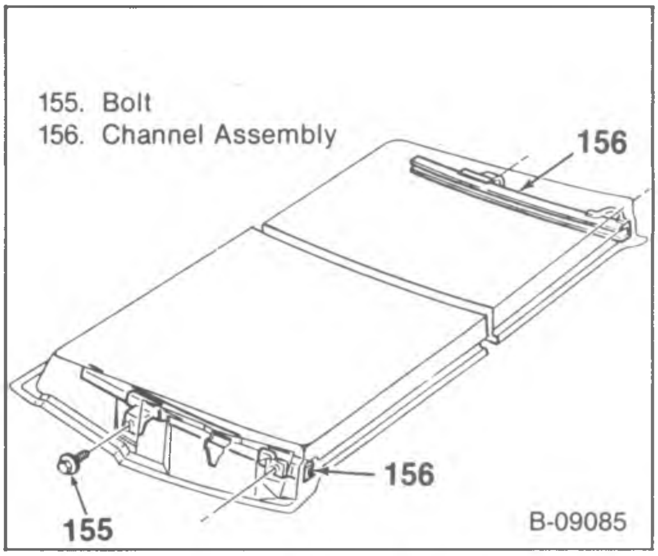


Figure 25—Run Channel Components

END GATE OUTSIDE CRANK REPLACEMENT

Remove or Disconnect (Figure 14)

1. Handle and control assembly. Refer to "Handle And Control Assembly Replacement."
2. Crank to end gate nuts (85).
3. Crank (88) and gasket (87) from the end gate.

Install or Connect (Figure 14)

1. Crank (88) and gasket (87) to the end gate.
2. Crank to end gate nuts (85).
3. Handle and control assembly. Refer to "Handle And Control Assembly Replacement."

WINDOW GLASS SEAL REPLACEMENT

Remove or Disconnect (Figure 15)

- Lower the window.
1. Trim panel (if equipped).
    - The inner seal is attached to the trim panel, when equipped, and replacement is not recommended.
2. Inner or outer seals by prying the clips from the end gate.

Install or Connect (Figure 15)

1. Inner or outer seal by pressing the clips into the holes in the end gate.
2. Trim panel (if equipped).

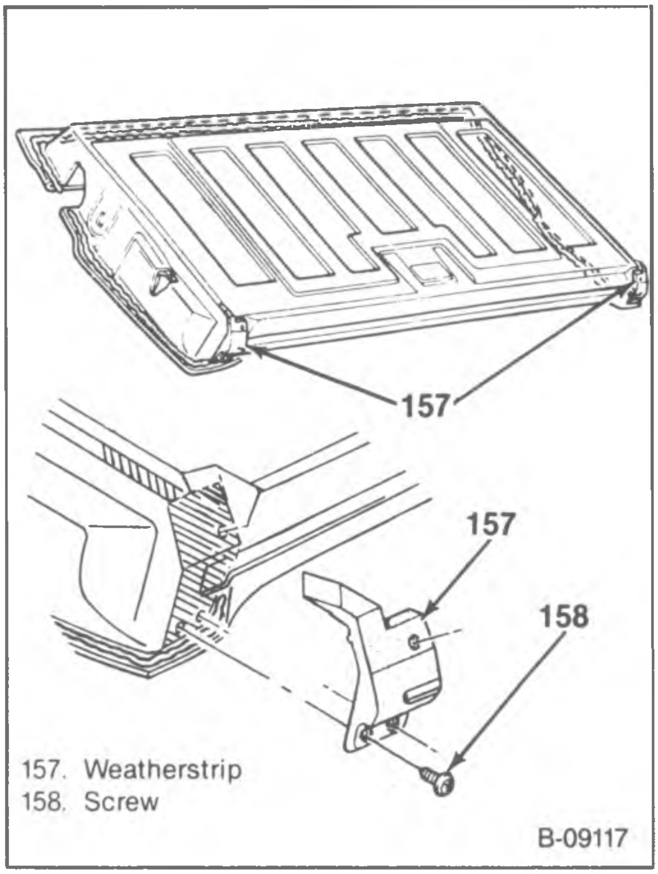


Figure 26—Weatherstrip Components

WEATHERSTRIP REPLACEMENT

↔ Remove or Disconnect (Figure 26)

1. Weatherstrip screws (158).
2. Weatherstrip from the end gate using 3M Release Agent (or equivalent).

→← Install or Connect (Figure 26)

1. Weatherstrip to the end gate using 3M Weatherstrip Adhesive (or equivalent).
2. Weatherstrip screws (158).

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