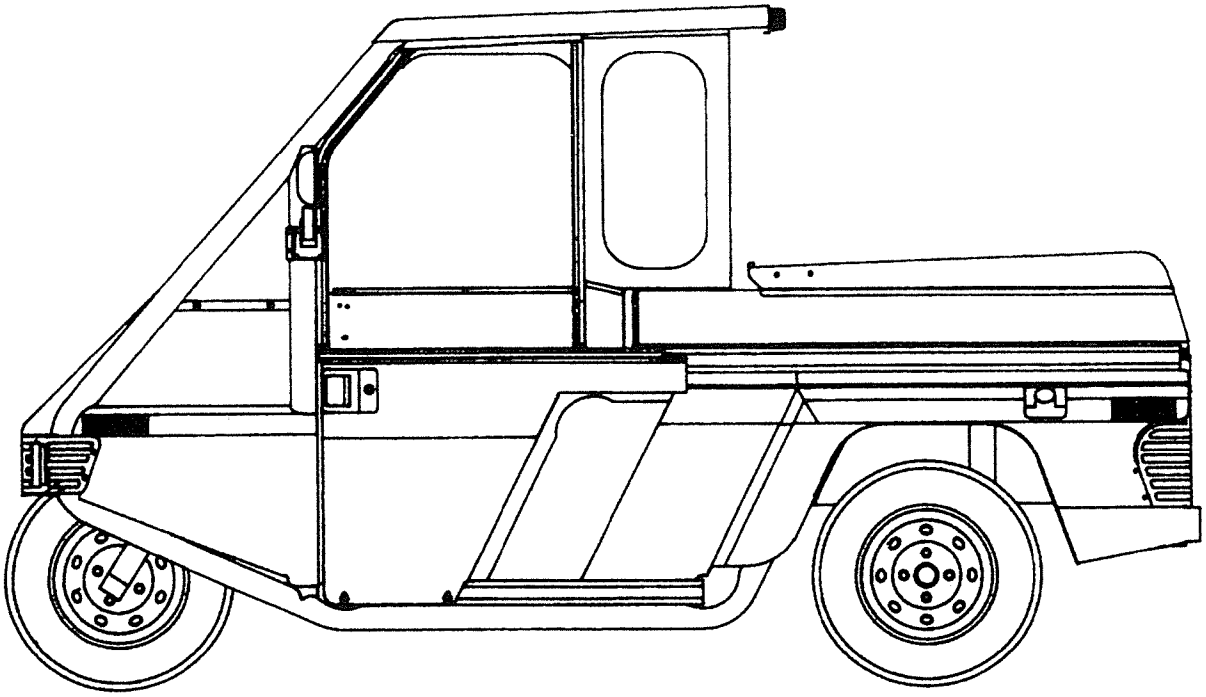
WESTWARD INDUSTRIES LTD



"THE INTERCEPTOR"

2501 Hwy 1A West
Portage la Prairie, MB
CANADA R1N 3L5

SHOP MANUAL
PART NO. 938000

INTRODUCTION

Important Safety Notice

Good service methods and correct repair procedures are important for the safe, reliable operation of the GO-4 Interceptor vehicle as well as the personal safety of the person doing the work. This SERVICE MANUAL provides general directions for doing service and repair work with tested, effective techniques. By following them it will assure reliability.

There are many variations in procedures, techniques and tools, and parts for servicing vehicles, as well as in the skills of the person doing the work. The Service Manual cannot possibly use all these variations and provide advice or cautions for each procedure or operation. Thus anyone who departs from the instructions provided in this manual must first establish that he compromises neither his personal safety nor the vehicle integrity by his choice of methods, tools or parts.

Notes, Cautions, and Warnings

As you read these procedures, you will come across NOTES, CAUTIONS, and WARNINGS. NOTES give you added information that will help to complete a particular procedure. CAUTIONS are given to prevent you from making an error that could damage a vehicle. WARNINGS remind you to be very careful in those areas where carelessness can cause personal injury.

The following general WARNINGS should be followed when you work on a vehicle.

- Always wear safety glasses for eye protection.
- Do not smoke when working on a vehicle.
- Remove rings, watches, loose hanging jewelry and loose clothing before beginning to work on a vehicle.
- Use safety stands whenever a procedure requires you to be under the vehicle.
- Be sure the ignition switch is in the OFF, unless otherwise required by the procedure.
- Set the park brake when working on the vehicle. Set the automatic transmission in PARK unless instructed otherwise for a specific operation. Place wood blocks (4" x 4" or larger) against the front and rear surfaces of the tires to provide further restraint from inadvertent vehicle movement.
- Operate the engine in a well-ventilated area to avoid the danger of carbon monoxide.
- Keep yourself and your clothing away from moving parts (e.g. drive belts) when the engine is running.
- Avoid contact with hot metal parts such as radiator, exhaust, manifold, tail pipe, catalytic converter and muffler.
- If it is necessary to work under the engine compartment, keep hands and other objects clear of the radiator fan blades! The GO-4 is equipped with a cooling fan that may turn on, even though the ignition switch is in the OFF position. Disconnect the radiator electric motor when working around the engine when engine is not running.

What Subjects Are Covered In This Manual?

The GO-4 Service Manual covers normal service repairs and maintenance for vehicles sold in the United States.

How Is This Manual Organized?

This manual is organized by Section Sub-section and Page

Section - This covers a specific portion of the vehicle. The first set of numbers on each page indicate the Group.

Note: A Section usually contains more than one group.

The Sections found in this service manual are:

1 - Vehicle Identification/General Information

2 - Maintenance and Lubrication

3 - Wheels and Tires

4 - Brake System

5 - Steering

6 - Suspension

7 - Axles and Driveshafts

8 - Automatic Transaxle

9 - Emission Control Systems

10 - Noise, Vibration and Harshness

11 - Engine

12 - Ignition System

13 - Fuel System

14 - Exhaust System

15 - Cooling System

16 - Starting System

17 - Battery and Charging System

18 - Lighting Systems

19 - Instruments, Clusters, Controls and Warning Systems

20 - Wiring Harness, Connectors and Circuit Protection System

21 - Auxiliary Equipment

22 - Heating and Air Conditioning

23 - Seat and Seat Belts

24 - Window Glass, Fixed Glass and Mirrors

25 - Headliner and Flooring

26 - Cargo Box

27 - Body Shell/Frame

28 - Exterior Finishes

Sub-section - each Sub-section covers a component or system. The headings on top of each page indicate the Section it is in.

Page - this set of numbers is indicated in each Section.

How Do You Find the Material in the Service Manual?

1. Locate the Section in the Table of Contents. If you are not sure which Section contains the information you need, refer to the index located in the back of this manual.
2. Locate the Section number by using the index located at the beginning of each Section.

How Do You Use Each Section?

Each Section has a standard organization that consists of the following information:

Description and Operation - describes how the component or system works.

Diagnosis and Testing - shows how to pinpoint problems.

Removal and Installation - how to remove and reinstall components or systems.

Disassembly and Assembly - how to take apart the part or system and put it back together.

Adjustments - how to perform in-vehicle adjustments.

Specifications - provides a summary of all specifications used in the Section.

Service Tools/Equipment - lists all the Service Tools used in the Section. Additional headings such as Service Procedures and Cleaning and Inspection may be used.

What to Do If You Discover an Error?

Please let us know if you discover a questionable procedure OR if you have any suggestions for improving this manual. Your feedback is very important to improving our technical publications. You will get a response to your questions and suggestions. If necessary, a revision will be issued.

NOTE: The description and specifications contained in this manual were in effect at the time this manual was approved for printing. Westward Industries reserves the right to discontinue models at any time, or changing specifications or design without notice and without incurring any obligation.

TABLE OF CONTENTS

SECTION 1 - Vehicle Identification/General Information

DESCRIPTION

Vehicle Certification Label

The plate is located on the front left-hand side of the dash.

The upper half of the label contains the name of the manufacturer, month and year of manufacture, Gross Vehicle Weight Rating (GVWR), and Gross Axle Weight Rating (GAWR). The Vehicle Certification Label also contains a 17 character Vehicle Identification Number (VIN).

Vehicle Identification Number

The official Vehicle Identification Number (VIN) for title and registration is stamped on a decal.

Use this number for warranty identification of the vehicle: it indicates manufacturer, body type, engine, model and product serial number.

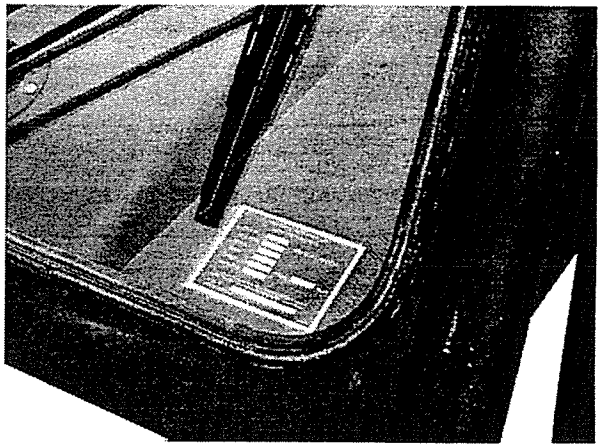
The last three (3) digits of the Vehicle Identification Number indicates the serial number of the unit.

Engine Model and Serial Number

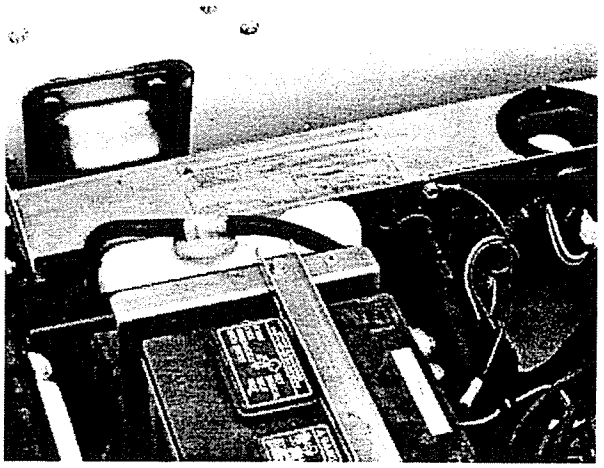
It is located just below the oil filler cap of the engine.

Vehicle Emission Control Information

It is located on the engine electrical rail above the coolant recovery bottle.



Vehicle Certification Label/Vehicle Identification Number



Engine Model and Serial Number/Vehicle Emission Control Information Decal

GENERAL INFORMATION

Preparing of Tools and Measuring Equipment

Make sure that all necessary tools and measuring equipment are available before starting work.

Special Tools - use when they are required.

Removal of Parts - while correcting a problem, try to determine the cause. Begin work only after first learning which parts and subassemblies must be removed and disassembled for replacement or repair.

Disassembly - if the disassembly procedure is complex, requiring many parts to be disassembled, all parts should be disassembled in a way that will not affect their performance or external appearance and can be identified so that reassembly can be performed efficiently.

1. *Inspection of parts*. Each part, when removed, should be carefully inspected for malfunctioning, deformation, damage or other problems.

2. *Arrangement of parts* - all disassembled parts should be carefully arranged for reassembly. Keep new and reused parts separate so that they will be easy to identify and replace.

3. *Cleaning parts for reuse* - parts that are to be reused should be carefully and thoroughly cleaned by the appropriate method.

Reassembly

Standard values, such as torques and certain adjustments, must be strictly observed in the reassembly of parts.

If removed, these parts should be replaced with new ones.

1. Oil Seals
2. Gaskets
3. O-rings
4. Lockwashers
5. Cotterpins (lock pins)
6. Nylon nuts

Depending on where they are:

1. Sealant should be applied to gaskets.
2. Oil should be applied to moving components of parts.
3. Specified oil or grease should be applied at the prescribed locations (e.g. oil seals, etc.) before the assembly.

Adjustments

- Use gauges and testers to make adjustments to standard values.

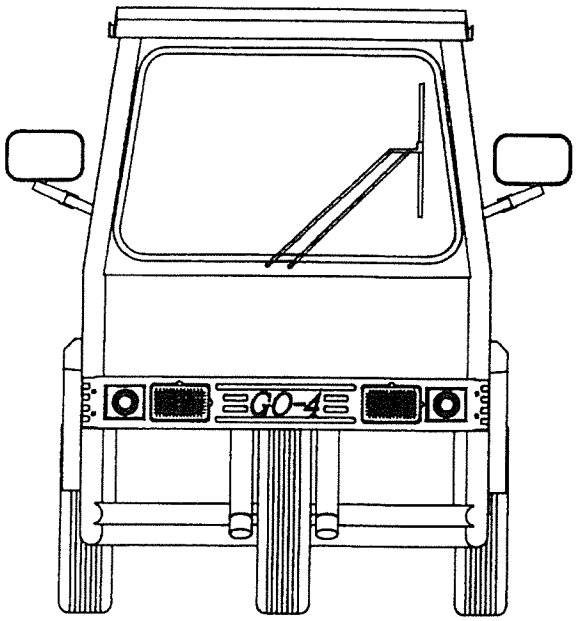
Electrical System

- Be sure to disconnect the battery cable from the negative (-) terminal to battery.
- Never pull on the wiring when disconnecting connectors.
- Locking connectors must be heard to click for the connector to be secure.
- Handle sensors and relays carefully. Be careful not to drop them or hit them against parts.

Rubber Parts and Tubing - always prevent gasoline or oil from touching rubber parts or tubing.

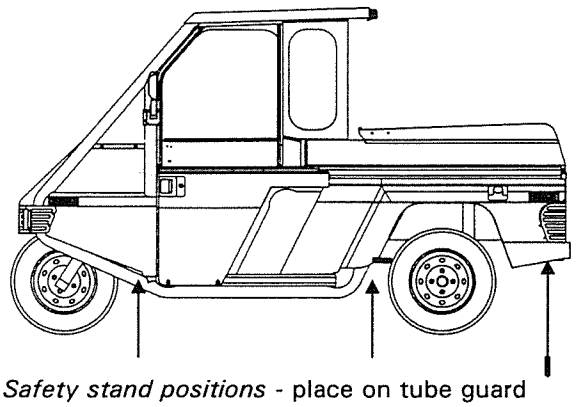
Jack and Safety Stand Rigid Rack) Positions

Front - *Jack Position:* place under the center of the front frame.



Safety Stand Positions - place on the side of tube guard frame.

Rear *- Jack Position*: Place at the back of the tube guard frame under trailing arm.

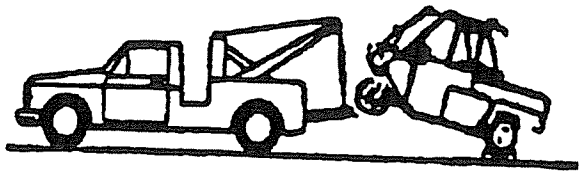


Safety stand positions - place on tube guard frame at front of frame and near bumper.

Towing

Proper towing equipment is necessary to prevent damage to the vehicle during any towing operation. Laws and regulations applicable to vehicles in tow must be observed.

CAUTION: Tow this vehicle from the front with the rear wheel on dollies.



Towing vehicle when stuck

CAUTION:

a) The power assistance segment of the brakes will be inoperable when the engine is off.

b) When using either tow hooks or chains, always pull cable or chain straight away from the hook and do not apply any sideways force to it. To further help prevent damage, do not take up slack too quickly in the cable or chain.

c) Rear towing should be used only in emergency situations (e.g. to pull the vehicle from a ditch, a snowbank or mud).

WARNING: PLEASE MAKE SURE THE TRANSMISSION IS IN "N" (Neutral) AND EMERGENCY BRAKE IS OFF. FAILURE TO DO SO CAN CAUSE SEVERE DAMAGE TO THE TRANSMISSION.

Units

ft-lb (N-m, m-Kg) ..... Torque
rpm ..... Revolutions per minute
A ..... Amperes
V ..... Volt(s)
W ..... ohm(s)(resistance)
psi (kPa, kg/cm2) ..... pressure (usually positive)
in Hg (mm Hg) ..... pressure (usually negative)
W ..... Watt

Abbreviations used in manual

ABDC ..... After bottom dead center
ACC ..... Accessories
ACV ..... Air control valve
ATDC ..... After top dead center
ASSY ..... Assembly
BBDC ..... Before bottom dead center
BTDC ..... Before top dead center
EX ..... Exhaust
IC ..... Integrated circuit
IG ..... Ignition
IN ..... Intake
INT ..... Intermittent
LH ..... Left hand
M ..... Motor

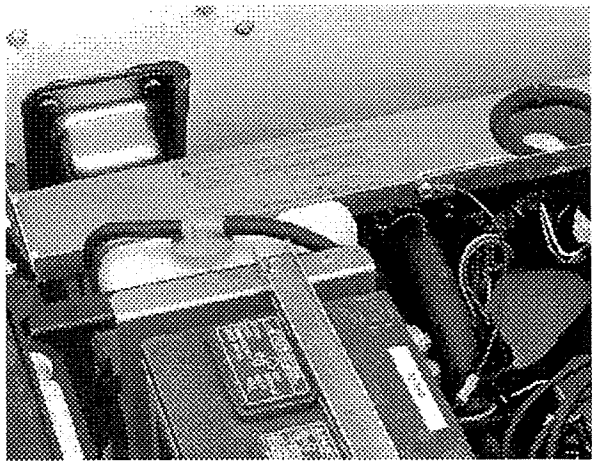
OFF ..... Switch off
ON ..... Switch on
PCV Valve.... Positive crankcase ventilation valve
PTC..... Positive temperature coefficient
RH .....Right hand
ST.....Start
SW.....Switch
TDC .....Top dead center

SECTION 2 - Maintenance and Lubrication

DESCRIPTION AND OPERATION

Vehicle Emission Control Information Decal

The Vehicle Emission Control Information Decal is located on the engine electrical panel right above the coolant recovery bottle.



VEHICLE EMISSION CONTROL INFORMATION - WESTWARD INDUSTRIES LTD.
ENGINE FAMILY: TWW1.3P8GAEA EVAPORATIVE FAMILY: TWW1065BYM07
TWC
O2S
SFI
EGR

TUNE-UP SPECIFICATIONS AND ADJUSTMENTS (REFER TO YOUR OWNER'S MANUAL)

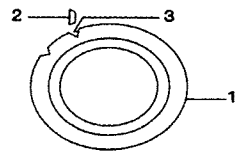
DISPLACEMENT: 1323 cc VALVE LASH & HIGH ALTITUDE ADJUSTMENT: Self adjusting

Set parking brake. Block wheels. Make adjustments at normal operating temperature with accessories off.

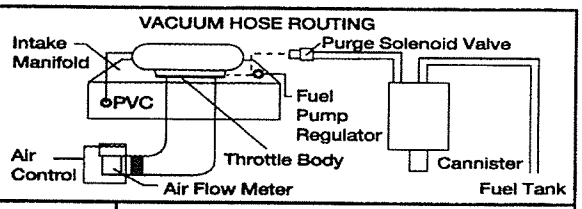
1. Before adjusting, connect test connector for idle speed setting.
2. Set idle speed and timing.

IDLE SPEED	850 RPM	Transmission in Park "P".
IGNITION TIMING	Adjust alignment mark at crank shaft pulley to timing indicator at idle.	

3. Disconnect test connector.



1. Crank shaft pulley
2. Timing indicator
3. Alignment mark



SPARK PLUG & GAP: AGS32C 1.0 - 1.1mm | FUEL: Unleaded min. octane 87 | ENGINE OIL: SAE 5W/30 TYPE: SG

THIS VEHICLE CONFORMS TO U.S. EPA AND CALIFORNIA REGULATIONS APPLICABLE TO 1996 MODEL YEAR NEW MOTORCYCLES AND IS CERTIFIED TO 1.4 g/km HC ENGINE FAMILY EXHAUST EMISSION STANDARD IN CALIFORNIA.

THIS MOTORCYCLE MEETS 1986 AND LATER EPA NOISE EMISSION REQUIREMENTS OF THE FEDERAL TEST PROCEDURE. MODIFICATIONS WHICH CAUSE THIS MOTORCYCLE TO EXCEED FEDERAL NOISE STANDARD ARE PROHIBITED BY FEDERAL LAW. SEE OWNERS MANUAL
LIMIT/CLOSING: 76 dBA/4300 RPM.

69-4001

Scheduled Maintenance - Emissions

The Emissions Systems Required Maintenance Schedule lists the items required to maintain the vehicle emissions systems at levels determined by the Federal Government (Environmental Protection Agency). Follow the procedures to perform the required emission system maintenance items listed on the maintenance schedules.

Maintenance service must conform to the specifications contained in this section, or to those listed on the Vehicle Emission Control Information Decal, or the emission systems may become inoperative.

Gasoline Octane Rating

The GO-4 Interceptor is designed to use regular unleaded fuel with an octane rating of 87.

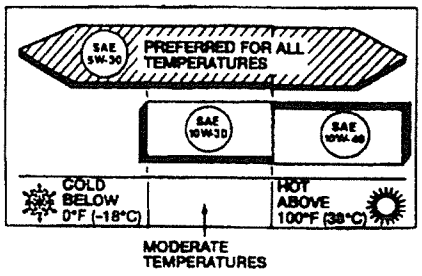
Using a fuel with a lower octane rating can cause persistent and heavy knocking, which can damage the engine.

If the vehicle is experiencing problems with starting, rough engine idle, or hesitation when the engine is cold, it may be caused by fuel with low volatility. Inform the operator to use a different grade and/or brand of fuel.

Engine Oil Viscosity

WARNING: CONTINUOUS CONTACT WITH USED ENGINE OIL HAS CAUSED SKIN CANCER IN LABORATORY MICE. PROTECT YOUR SKIN BY WASHING WITH SOAP AND WATER.

Choose the correct viscosity oil by considering the temperatures the vehicle will be driven. The use of SAE 5W-30 is preferred in all climate conditions. The use of 10W-30 is acceptable in moderate climates. Using SAE 10W-40 is acceptable in hot climates.



MAINTENANCE

Perform the necessary scheduled maintenance to assure the durability of the GO-4 and its emission control systems. Use genuine Westward Industries parts for maintenance, repair and replacement of the emissions control devices and systems.

Maintenance Information

The required Scheduled Maintenance Services listed in this section are considered important to assure the proper operation, performance and safety of the GO-4 Interceptor. It is recommended that the listed Owner Maintenance Checks be performed. These services are regular every day care that is important to the proper operation of your vehicle. The recommended fluids, lubricants and service parts conform to Westward Industries Ltd. specifications.

MAINTENANCE SCHEDULES

Maintenance schedules are based on how the vehicle is driven.

Regularly Scheduled Maintenance Intervals

The normal maintenance schedule should be followed if, generally, the vehicle is driven on a daily basis for more than 10 miles and **NONE OF THE CONDITIONS IN THE SEVERE MAINTENANCE SCHEDULE APPLY TO THE DRIVING HABITS.**

The Severe Maintenance Schedule should be followed if the vehicle owner's driving habits mainly include one or more of the following:

1. Short trips of less than 10 miles (16 km) when outside temperatures remain below 0° F.
2. Operating when outside temperatures remain below freezing.
3. Operating during hot weather in stop-and-go "rush hour" traffic.
4. Extensive idling, such as police or door-to-door service.
5. Operating in extremely humid climates.
6. Driving in severe dust conditions.
7. Driving in area where road salt or other corrosives are used.
8. Driving on rough and/or muddy roads.

Owner Maintenance Checks

The following list of vehicle checks and inspections should be performed at the intervals indicated.

Whenever You Stop for Fuel

1. Check the engine oil level.
2. Look for under-inflated tires.

At Least Monthly

1. Check tire pressure. Check tires when cold, not after a long drive.
2. Check the coolant in the radiator coolant recovery reservoir.
3. Check the operation of all exterior lamps including the brake lamps, turn signals, and hazard warning flashers.

At Least Twice a Year

1. Check the windshield wiper operation.
2. Check and replace worn windshield wiper blades.
3. Check for worn tires and loose wheel hub bolts.
4. Check pressure in the spare tire (option).
5. Check headlamp alignment.
6. Check the muffler, exhaust pipe, catalytic converter, and clamps for damage.
7. Check the lap and shoulder belt for wear and function.
8. Check the radiator, heater, and air conditioning hoses for leaks or damage.
9. Check the rear driveshaft joint boots for cuts or leakage.

At Least Once a Year

1. Lubricate all hinges, checks, latches, roller, and outside key locks.
2. Lubricate the door rubber weather-strips.
3. Check the air conditioning system (if equipped) before the warm weather season.
4. Clean door guide rails.
5. Check brake fluid level.
6. Clean battery connections and check fluid level. Top up if necessary.

7. Lubricate transaxle controls and linkage.
8. Inspect the refrigerant amount.
9. Inspect the A/C compressor operation.

Severe Maintenance Schedule

The Severe Maintenance Schedule should be followed if the owner/operator's driving habits include one or more of the following:

1. Short trips of less than 10 miles.
2. Operating when outside temperatures remain below freezing.
3. Operating during hot weather in stop-and-go "rush hour" traffic.
4. Extensive idling, such as police or door-to-door service.
5. Operating in extremely humid climates.
6. Driving in severe dust/dirt conditions.
7. Driving in areas where road salt or other corrosives are used.
8. Driving on rough and/or muddy roads.

For items marked with a number in brackets (1), see footnotes at the end of this section.

3,000 miles/5,000 km (200 hours)

- Change engine oil and replace oil filter (4).

6,000 miles/10,000 km (400 hours)

- Change engine oil and replace oil filter (4).
- Rotate tires and adjust air pressure.

9,000 miles/15,000 km (600 hours)

- Change engine oil and replace oil filter (4).

12,000 miles/20,000 km (800 hours)

- Change engine oil and replace oil filter (4).

15,000 miles/25,000 km (1,000 hours)

- Change engine oil and replace oil filter (4).
- Inspect air cleaner element (1) (4).
- Inspect front and rear disc brake pads and rotors.
- Inspect bolts and nuts on chassis and body.
- Rotate tires and adjust air pressure.

18,000 miles/30,000 km (1,200 hours)

- Change engine oil and replace oil filter (4).

21,000 miles/35,000 km (1,400 hours)

- Change engine oil and replace oil filter (4).
- Change automatic transmission fluid (2).

24,000 miles/40,000 km (1,600 hours)

- Change engine oil and replace oil filter (4).
- Rotate tires and adjust air pressure.

27,000 miles/45,000 km (1,800 hours)

- Change engine oil and replace oil filter (4).

30,000 miles/50,000 km (2,000 hours)

- Change engine oil and replace oil filter (4).
- Replace spark plugs (4).
- Replace air cleaner element (4).
- Inspect alternator and A/C compressor belts (4).
- Check idle speed (3)(4).
- Change engine coolant every 30,000 miles/50,000 km (2,000 hours) or 36 months (4).
- Inspect engine cooling system, hoses, clamps: and check coolant strength every 30,000 miles/50,000 km (2,000 hours) (4).
- Inspect fuel lines and hoses (1)(4).
- Inspect exhaust heat shield.
- Inspect rear wheel driveshaft joint boots.
- Inspect front and rear brakes.
- Inspect brake lines, hoses and connections.
- Inspect front fork assembly.
- Inspect steering operation and linkage.

33,000 miles/55,000 km (2,200 hours)

- Change engine oil and replace oil filter.
- Rotate tires and adjust air pressure.

36,000 miles/60,000 km (2,400 hours)

- Change engine oil and replace oil filter.

39,000 miles/65,000 km (2,600 hours)

- Change engine oil and replace oil filter.

42,000 miles/70,000 km (2,800 hours)

- Change engine oil and replace oil filter.

- Rotate tires and adjust air pressure.
- Change automatic transmission fluid (2).

45,000 miles/75,000 km (3,000 hours)

- Change engine oil and replace oil filter.
- Inspect air cleaner element (1) (4).
- Inspect front and rear disc brake pads and front and rear disc brake rotors.
- Inspect bolts and nuts on chassis and body.

48,000 miles/80,000 km (3,200 hours)

- Change engine oil and replace oil filter (4).

51,000 miles/85,000 km (3,400 hours)

- Change engine oil and replace oil filter (4).
- Rotate tires and adjust air pressure.

54,000 miles/90,000 km (3,600 hours)

- Change engine oil and replace oil filter (4).

57,000 miles/95,000 km (3,800 hours)

- Change engine oil and replace oil filter (4).

60,000 miles/100,000 km (4,000 hours)

- Change engine oil and replace oil filter (4).
- Replace spark plugs (4).
- Inspect alternator and A/C compressor drive belts (4).
- Replace air cleaner element (4).
- Inspect ignition timing (1)(4).
- Check idle speed (3)(4).
- Change engine coolant every 30,000 miles/50,000 km (2,000 hours) or 36 months (4).
- Inspect engine cooling system, hoses and clamps; and check coolant strength every 30,000 miles/50,000 km (2,000 hours) or 36 months (4).
- Replace fuel filter (3) (4).
- Inspect fuel lines and hoses (3)(4).
- Inspect fuel hoses and tube for emissions (1)(4).
- Inspect exhaust heat shield.
- Inspect rear wheel driveshaft joint boots.
- Inspect front and rear brakes.
- Inspect brake lines, hoses and connections.
- Inspect bolts and nuts on chassis and body.
- Inspect front fork assembly.
- Inspect steering operation and linkage.
- Repack front and rear wheel bearings.
- Rotate tires and adjust air pressure.
- Replace timing chain/belt. Failure to replace timing chain/belt may result in damage to the engine (3)(4).
- Inspect timing chain/belt(3)(4).

63,000 miles/105,000 km (4,200 hours)

- Change engine oil and replace oil filter (4).
- Change automatic transmission fluid (2).

66,000 miles/110,000 km (4,400 hours)

- Change engine oil and replace oil filter (4).

69,000 miles/115,000 km (4,600 hours)

- Change engine oil and replace oil filter (4).
- Rotate tires and adjust air pressure.

72,000 miles/120,000 km (4,800 hours)

- Change engine oil and replace oil filter (4).

75,000 miles/125,000 km (5,000 hours)

- Change engine oil and replace oil filter (4).
- Inspect air cleaner element (1)(4).
- Inspect front and rear disc brake pads and disc brake rotors.
- Inspect bolts and nuts on chassis and body.

78,000 miles/130,000 km (5,200 hours)

- Change engine oil and replace oil filter (4).
- Rotate tires and adjust air pressure.

81,000 miles/135,000 km (5,400 hours)

- Change engine oil and replace oil filter (4).

84,000 miles 140,000 km (5,600 hours)

- Change engine oil and replace oil filter (4).
- Change auto. transmission fluid (2).

87,000 miles/145,000 km (5,800 hours)

- Change engine oil and replace oil filter (4).
- Rotate tires and adjust air pressure.

90,000 miles/150,000 km (6,000 hours)

- Change engine oil and replace oil filter (4).
- Replace spark plugs (4).
- Inspect alternator and A/C compressor drive belts (4).
- Replace air cleaner element (4).
- Check idle speed (3) (4).

- Change engine coolant every 30,000 miles/50,000 km (2,000 hours) or 36 months (4).
- Inspect engine cooling system, hoses and clamps; and check coolant strength every 30,000 miles/50,000 km (2,000 hours) or 36 months (4).
- Inspect timing chain/belt (1)(4).
- Inspect fuel lines and hoses (1)(4).
- Inspect exhaust shield.
- Inspect rear wheel driveshaft joint boots.
- Inspect front and rear brakes.
- Inspect brake lines, hoses and connections.
- Inspect bolts and nuts on chassis and body.
- Inspect front fork assembly.
- Inspect steering operation and linkage.

93,000 miles/155,000 km (6,200 hours)

- Change engine oil and replace oil filter (4).

96,000 miles/160,000 km (6,400 hours)

- Change engine oil and replace oil filter (4).
- Rotate tires and adjust air pressure.

99,000 miles/165,000 km (6,600 hours)

- Change engine oil and replace oil filter (4).

102,000 miles/170,000 km (6,800 hours)

- Change engine oil and replace oil filter (4).

105,000 miles/175,000 km (7,000 hours)

- Change engine oil and replace oil filter (4).
- Inspect air cleaner element (1)(4).
- Replace timing chain/belt (4).
- Inspect fuel hoses (4).
- Inspect front and rear disc brake pads and front and rear disc brake rotors.
- Inspect bolts and nuts on chassis and body.
- Rotate tires and adjust air pressure.
- Change automatic transmission fluid (2).

108,000 miles/180,000 km (7,200 hours)

- Change engine oil and replace oil filter (4).

111,000 miles/185,000 km (7,400 hours)

- Change engine oil and replace oil filter (4).

114,000 miles/190,000 km (7,600 hours)

- Change engine oil and replace oil filter (4).
- Rotate tires and adjust air pressure.

117,000 miles/195,000 km (7,800 hours)

- Change engine oil and replace oil filter (4).

120,000 miles/200,000 km (8,000 hours)

- Change engine oil and replace oil filter (4).
- Replace spark plugs (4).
- Inspect alternator and A/C compressor drive belts (4).
- Replace air cleaner element (4).
- Check idle speed (4).
- Inspect ignition timing (1) (4).
- Change engine coolant every 30,000 miles/50,000 km (2,000 hours) or 36 months (4).
- Inspect engine cooling system. hoses and clamps; and check coolant strength every 30,000 miles/50,000 km (2,000 hours) or 36 months (4).
- Replace fuel filter(4)(5).
- Inspect fuel line and hoses (4).
- Inspect fuel hoses and tube for emissions (4).
- Inspect exhaust heat shield.
- Inspect rear wheel driveshaft joint boots.
- Inspect front and rear brakes.
- Inspect brake lines, hoses and connections.
- Inspect bolts and nuts on chassis and body.
- Inspect front fork assembly.
- Inspect steering operation and linkage.
- Repack front and rear wheel bearings.
- Replace timing chain/belt. Failure to replace timing/belt chain may result in damage to the engine (4)(5).

FOOTNOTES:

1. This item is not required to be performed, however Westward Industries recommends that you perform maintenance on this item in order to achieve best vehicle operation.

2. Change automatic transmission fluid if your driving habits frequently include one or more of the following conditions:
   - Operation during hot weather (above 90° F, 32°C), carrying heavy loads or driving in hilly terrain.
   - Police or door-to-door delivery service.

3. This item is required for all states.

4. These items are for emission control.

5. Required for all states except California.

Normal Maintenance Schedule

The Normal Maintenance Schedule should be followed if the vehicle is generally driven on a daily basis for more than 10 miles (16 km) and NONE OF THE CONDITIONS SHOWN IN THE SEVERE MAINTENANCE SCHEDULE APPLY TO DRIVING HABITS.

For items marked with a number in brackets (1), see footnotes at end of this section.

5,000 miles/8,000 km (325 hours)

- Change engine oil and replace oil filter. (4)
- Rotate tires and adjust air pressure.

10,000 miles/16,000 km (650 hours)

- Change engine oil and replace oil filter (4).

15,000 miles/24,000 km (1,000 hours)

- Change engine oil and replace oil filter (4).
- Rotate tires and adjust air pressure.

20,000 miles/32,000 km (1,325 hours)

- Change engine oil and replace oil filter (4).

25,000 miles/40,000 km (1,650 hours)

- Change engine oil and replace oil filter (4).
- Rotate tires and adjust air pressure.

30,000 miles/48,000 km (2,000 hours)

- Change engine oil and replace oil filter (4).
- Replace spark plugs (4).
- Inspect alternator and A/C compressor belts (4).
- Replace air cleaner element (4).
- Check idle speed (2)(4).
- Change engine coolant every 30,000 hours/50,000 km (2,000 hours) or 36 months.
- Inspect engine cooling system, hoses and clamps; and check coolant strength every 30,000 miles/50,000 km (2,000 hours) or 36 months (4).
- Inspect fuel lines and hoses.
- Inspect exhaust heat shield.
- Inspect rear driveshaft joint boots.
- Inspect front and rear brakes.
- Inspect brake lines, hoses and connections.
- Inspect front steering system.
- Inspect steering operation and linkage.
- Change automatic transmission fluid.

35,000 miles/42,000 km (2,325 hours)

- Change engine oil and replace oil filter (4).
- Rotate tires and adjust air pressure.

40,000 miles/48,000 km (2,650 hours)

- Change engine oil and replace oil filter (4).

45,000 miles/54,000 km (3,000 hours)

- Change engine oil and replace oil filter (4).
- Rotate tires and adjust air pressure.

50,000 miles/60,000 km)(3,325 hours)

- Change engine oil and replace oil filter (4).

55,000 miles/66,000 km (3,650 hours)

- Change engine oil and replace oil filter (4).
- Rotate tires and adjust air pressure.

60,000 miles/72,000 km (4,000 hours)

- Change engine oil and replace oil filter (4).
- Replace spark plugs (4).
- Inspect alternator and A/C compressor drive belts (4).
- Replace air cleaner element (4).
- Replace timing chain/belt (2)(4).
- Inspect ignition timing (1)(4).
- Check idle speed (2)(4).
- Change engine coolant every 30,000 miles/50,000 km (2,000 hours) or 36 months (4).
- Inspect engine cooling system, hoses and clamps; and check coolant strength every 30,000 miles/50,000 km (2,000 hours) or 36 months.
- Replace fuel filter (2)(4).
- Inspect fuel lines and hoses (2)(4).
- Inspect fuel hoses and tube for emissions (2)(4).
- Inspect exhaust heat shield.
- Inspect rear wheel driveshaft joint boots.
- Inspect front and rear brakes.
- Inspect brake lines, hoses and connections.
- Inspect front steering assembly.
- Inspect bolts and nuts on chassis and body.
- Inspect steering operation and linkage.
- Repack front wheel and rear wheel bearings.
- Change automatic transmission fluid.

65,000 miles/78,000 km (4,325 hours)

- Change engine oil and replace oil filter (4).
- Rotate tires and adjust air pressure.

70,000 miles/90,000 km (4,650 hours)

- Change engine oil and replace oil filter (4).

75,000 miles/90,000 km (5,000 hours)

- Rotate tires and adjust air pressure.
- Change engine oil and replace oil filter (4).

80,000 miles/96,000 km (5,325 hours)

- Change engine oil and replace oil filter (4).

85,000 miles/102,000 km (5,650 hours)

- Change engine oil and replace oil filter (4).
- Rotate tires and adjust air pressure.

90,000 miles/108,000 km (6,000 hours)

- Change engine oil and replace oil filter (4).
- Replace spark plugs (4).
- Inspect alternator and A/C compressor drive belts (4).
- Replace air cleaner element (4).
- Check idle speed (2)(4).
- Change engine coolant every 30,000 miles/50,000 km (2,000 hours) or 36 months (4).
- Inspect engine cooling system, hoses and clamps; and check coolant strength every 30,000 miles/50,000 km (2,000 hours) or 36 months.
- Inspect timing chain/belt. (1)(4).
- Inspect fuel line and hoses (1)(4)..
- Inspect exhaust heat shield.
- Inspect rear wheel driveshaft joint boots.
- Inspect front and rear brakes.
- Inspect brake lines, hoses and connections.
- Inspect steering assembly.
- Inspect bolts and nuts on chassis and body.
- Inspect steering operation and linkage.
- Change automatic transmission fluid.

95,000 miles/114,000 km (6,325 hours)

- Change engine oil and replace oil filter (4).
- Rotate tires and adjust air pressure.

100,000 miles (6,650 hours)

- Change engine oil and replace oil filter (4).

105,000 miles (7,000 hours)

- Change engine oil and replace oil filter (4).
- Replace timing chain/belt (4).
- Inspect fuel hoses (4).
- Rotate tires and adjust air pressure.

110,000 miles (7,325 hours)

- Change engine oil and replace oil filter (4).

115,000 miles (7,650 hours)

- Change engine oil and replace oil filter (4).
- Rotate tires and adjust air pressure.

120,000 miles (8,000 hours)

- Change engine oil and replace oil filter (4).
- Replace spark plugs (4).
- Inspect alternator and A/C compressor drive belts (4).
- Replace air cleaner element (4).
- Inspect ignition timing (1)(4).
- Check idle speed (2)(4).
- Change engine coolant every 30,000 miles (2,000 hours) or 36 months.
- Inspect engine cooling system, hoses and clamps; and check coolant strength every 30,000 miles (2,000 hours) or 36 months.
- Replace fuel filter (3)(4).
- Inspect fuel lines and hoses (2)(4).
- Inspect hoses and tube for emissions (1)(4).
- Inspect exhaust heat shield.
- Inspect rear wheel driveshaft joint boots.
- Inspect front and rear brakes.
- Inspect brake lines, hoses and connections.
- Inspect front fork assembly.
- Inspect bolts and nuts on chassis and body.
- Inspect steering operation and linkage.
- Repack front and rear wheel bearings.
- Replace timing chain/belt. (3)(4).
- Change automatic transmission fluid.

FOOTNOTES:

1. This item is not required to be performed, however Westward recommends that you perform maintenance on this item in order to achieve best vehicle operation.

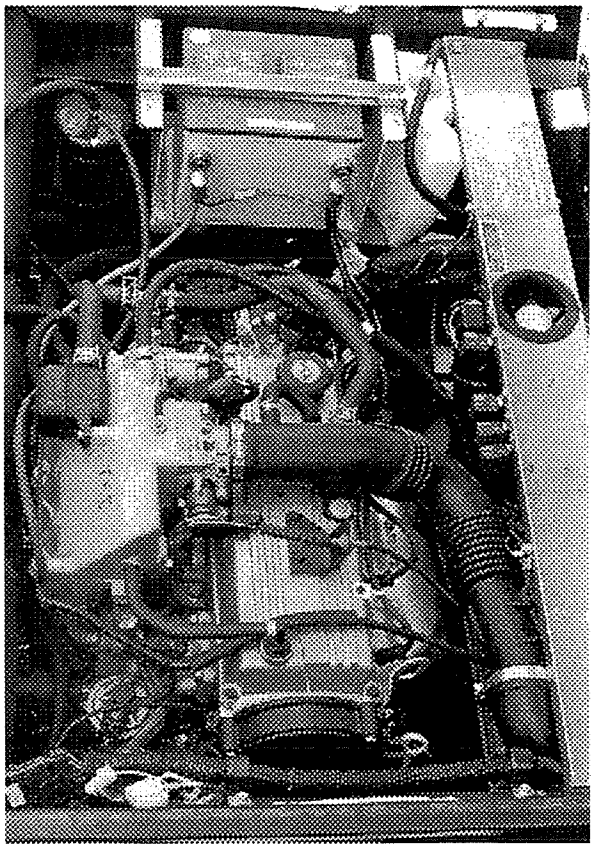
2. This item is required for all states.

3. Required for all states except California.

LUBRICATION

Service Points - Engine Compartment

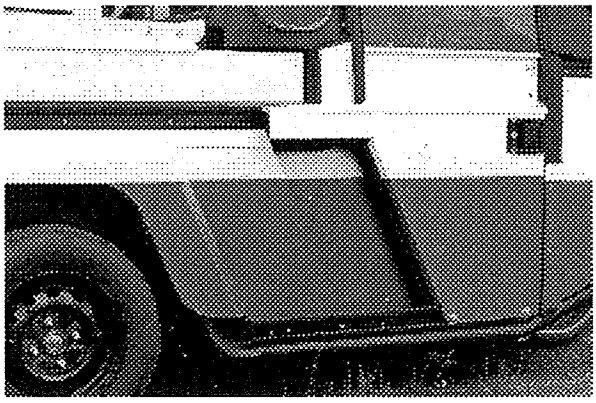
Item	Description
1	Oil Filler Cap
2	Transaxle Oil Level Dipstick
3	Fuel Filter
4	Main Fuse Junction Panel
5	Radiator Coolant Recovery Reservoir
6	Radiator Cap
7	Spark Plugs
8	Engine Oil Level Dipstick
9	Oil Filter
10	Positive Crankcase Ventilation Valve
11	Battery
12	Fuel Pump Shut-off Switch

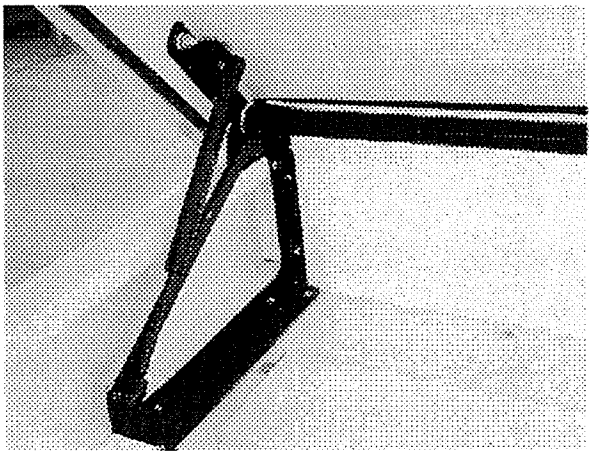


Service Points - Body

Lubricate periodically the following points with Multi-Purpose Grease.

- Door latches
- Door tracks/rollers
- Window tracks/rollers
- Cargo Box Hinges





Lubrication and Maintenance Specification Chart

Item/Description	Part Name/Number
Air Cleaner Element	Part No. 134037 (FA1064)
A/C Drive Belt	Part No. 613893
Alternator Drive Belt	Part No. 184044
Battery	Part No. 182863, 550 CCA, 12 volt
Brake Pedal Pivot Bolt Bushing	SAE 10W30 Engine Oil
Brake Master Cylinder	DOT 3 Brake Fluid
Brake Master Cylinder Push Rod and Bushing	SAE 10W30 Engine Oil
Disc Brake Caliper Pin and Caliper Insulator	Disc Brake Caliper Slide Grease
Door Latches	Multi-Purpose Grease
Door Lock/Cargo Box Lock Cylinders	Lock Lubricant
Door Rollers/Slides	Multi-Purpose Grease
Door Weather-stripping	Silicone Lubricant
Engine Oil Filter	Oil Filter - FL810 or similar
Engine Oil	SAE 5W30 - recommended SAE 5W20 - temperatures below 20 F(-10 C) SAE 10W30 - temperatures above 100 F (38 C)
Engine Coolant	50/50 mixture - compatible with aluminum
Fuel Canister	Part No. 133017
Fuel Filter	Part No. 423016 (FG871)
Positive Crankcase Ventilation Valve	Part No. 104041
Rear Wheel Bearings	Wheel Bearing Grease
Rear Wheel Driveshaft and Joint(inboard side)	Constant Velocity Joint Grease
Rear Wheel Driveshaft and Joint(outboard side)	Constant Velocity Joint Grease - high temperature
Spark Plug	Motorcraft AGS32C
Steering Gearbox	
Tire Mounting Bead	Liquid Soap
Transaxle	Mercon Automatic Transmission Fluid
Wiper Blade	Part No. 644001

Refill Capacities

Component	U.S.	Metric
Cooling System	6.3 qts	6.0 liters
Engine Oil, with filter	3.6 qts	3.4 liters
Engine Oil, without filter	3.3 qts	3.1 liters
Fuel Tank	7.0 gal	26.5 liters
Radiator Cap	11 to 15 psi	74 to 103 kPa
Transaxle	6.0 qts	5.7 liters

SECTION 3 - Wheels and Tires

DESCRIPTION AND OPERATION

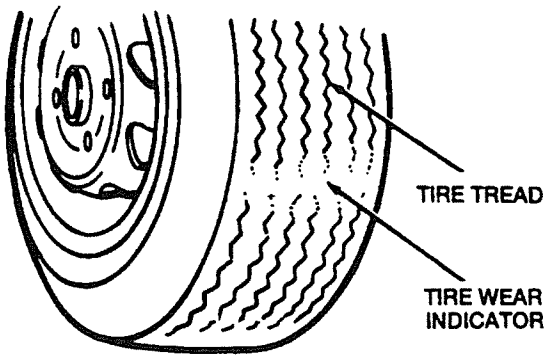
Wheel and Tire Assemblies

The GO-4 uses P155/80R13 all-season steel-belted radial tires mounted on 4-1/2 x 13 steel rims.

DIAGNOSIS AND TESTING

Tire Wear

Tire life can be maximized for performance and longevity by inspecting the tires for patterns of wear that may indicate improper inflation, need for rotation, need for alignment and tire balancing, or a need for rear suspension alignment. If the tires show uneven or abnormal wear patterns, refer to the Tire Wear Troubleshooting Chart in this section.
Check tires frequently for abrasions, blisters, cuts, stone bruises and objects imbedded in the tread. Inspect more frequently in times of rapid or extreme temperature changes and after driving on rough road surfaces that are littered with road debris.

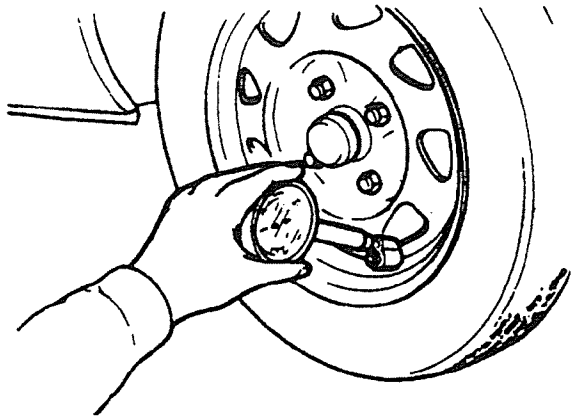


Wear indicators are embedded in the bottom of the tread grooves. They appear as 0.5 inch wide bands that show when the tread depth is reduced to 0.0625 inch. When the tread indicators appear in two or more locations on the tire, or when the cord or fabric or steel is exposed, replace the tire.

Tire Pressure

Tire inflation pressure for the front is 28 psi; and the rear is 30 psi.

Check tire pressure using an accurate pressure gauge. Never inflate or deflate the tires above or below recommended pressure. Tire inflation pressures are carefully calculated to the give the vehicle satisfactory ride and steering characteristics, without compromising tire tread life.



The recommended vehicle load capacities and tire inflation pressures for load operation are listed on the Tire Size and Inflation Pressure Chart.

Check and adjust tire inflation pressure only when the tires are cold (after the vehicle has been parked for at least three hours), or after the vehicle has been driven less than two (2) miles (2.5 km) at speeds less than 40 mph (48 km/h).

Do not reduce tire pressure when tires are hot, or after the vehicle has been driven over two (2) miles 2.2 km at speeds in excess of 40 mph (48 km/h). Under such conditions, pressures can increase as much as 6 psi over cold inflation pressure.

After checking or adjusting the tire inflation pressures, make certain to install the tire valve stem caps. The caps prevent air leaks and keep dust and dirt out of the valve stems. Check valve stems. Replace valve stems that are worn, cracked, loose or leaking.

CAUTION: Radial-ply tires have highly flexible sidewalls, which produce a noticeable sidewall bulge. This makes the tires appear underinflated. This is a normal condition for radial-ply tires. Do not attempt to eliminate this bulge by overinflating the tires.

Tire Size

Tire size used on the GO-4 vehicle is the P155/80R 13 all season radial. Do not install tires of a different size other than recommended on the Tire Size and Inflation Pressure Chart. Larger or smaller tires can damage the vehicle, affect durability and cause incorrect speedometer readings. Be certain the new tires match recommended sizes and offsets.

WARNING: DO NOT MIX DIFFERENT TYPES OF TIRES ON THE SAME VEHICLE SUCH AS RADIAL, BIAS, AND BIAS-BELTED TIRES EXCEPT IN EMERGENCIES, BECAUSE VEHICLE HANDLING MAY BE SERIOUSLY AFFECTED ANY MAY RESULT IN LOSS OF CONTROL.

Wheel Rim Condition

Check the condition of the wheel rims. Replace rims that are bent, cracked, heavily rusted, air leaks or with excessive lateral or radial runout. Wheels with greater than recommended runout may cause high-speed vehicle vibration. Replace rims with equal to the original equipment wheels in load capacity, diameter, width, offset and mounting configuration. Improper wheel may affect wheel and bearing life, ground and tire clearance and speedometer/odometer calibrations.

Tire Roughness and Vibration

Vibration, roughness, tramp, shimmy and thump may be caused by excessive tire or wheel runout, worn or cupped tires, wheel and tire imbalance This may also be caused by rough road surfaces. Drive the vehicle on different road surfaces to determine whether the road surfaces are actually the cause of the problem.

Do not immediately suspect the tires or wheels when attempting to diagnose a vibration problem.

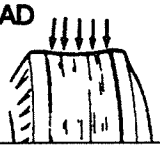
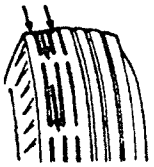
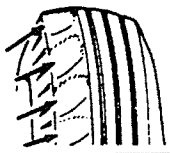
Other sources of vibration include:

- Loose or worn wheel bearings
- Loose or worn suspension or steering components.
- Worn upper shock mounts
- Worn or damaged CV joints
- Brake rotor runout
- Loose engine or transaxle supports
- Engine driven accessories

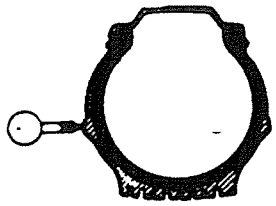
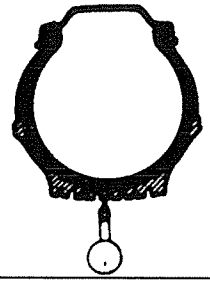
This Section of the manual covers those vibration problems actually associated with tires and wheels.

For diagnostic procedures and repairs of non-tire related vibrations, refer to Section 10 - Noise, Vibration and Harshness.

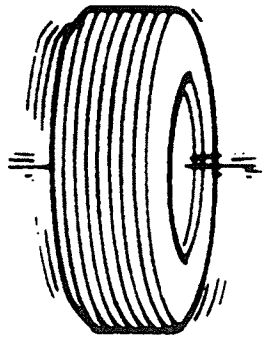
Tire Wear Troubleshooting Chart

CONDITION	POSSIBLE CAUSES	REMEDY
• RAPID WEAR AT THE SHOULDERS 	Tires underinflated. Worn suspension components such as brace, wheel plate, adjustment bolts. Excessive cornering speeds	Inflate tires to recommended pressure - rotate tires. Replace worn components. Slow cornering speeds - rotate tires.
• RAPID WEAR AT CENTER OF TREAD 	Tires overinflated	Inflate tires to recommended pressure - rotate tires.
• WEAR AT ONE SHOULDER 	Toe out of adjustment Camber measurement is out of specification Bent Brace Loose wheel plate adjustment bolts.	Adjust toe to specifications Check for worn or damaged suspension components. Replace Brace Add or remove washers to adjust wheel plate.
• FEATHER EDGE 	Toe out of adjustment Bent or Worn Brace Damaged front axle.	Adjust to specifications Replace brace Replace front axle.
• BALD SPOTS OR TIRE CUPPING 	Unbalanced wheel. Excessive radial runout. Shock absorber worn.	BALANCE the tire and wheel. CHECK the runout and replace tire if necessary REPLACE the shock absorber (rear wheels) and recharge the front absorber.
• TIRE SCALLOPED 	Toe out of adjustment. Camber is out of specification. Worn suspension components, weak springs, shock absorber assemblies.	ADJUST the toe to specifications. CHECK for worn or damaged suspension components. REPLACE the worn suspension components.

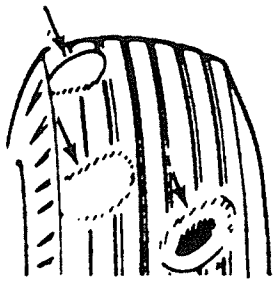
Wheel/Tire Vibration Troubleshooting Chart

CONDITION	POSSIBLE CAUSE/REMEDY
• TIRE AND WHEEL LATERAL RUNOUT 	Tire and wheel lateral runout. Not a cause of vibration below 55 mph, unless runout is extreme. Vehicle speed sensitive vibration.
• TIRE AND WHEEL RADIAL RUNOUT 	Tire and radial runout. Not a cause of vibration below 20 mph. Speed required to cause vibration increases as runout decreases. Vehicle speed sensitive vibration.

Wheel/Tire Vibration Troubleshooting Chart - (cont'd)

CONDITION	POSSIBLE CAUSE/REMEDY
• WHEEL HOP 	Wheel hop. Not a cause of vibration below 20 mph. Produces up-down movement in steering wheel and instrument panel along with mechanical vibration. Most noticeable between 20-40 mph. Caused by tires having radial runout of more than 0.045 inch. Do not attempt to correct by balancing; replace tire. Vehicle speed sensitive vibration.
• TIRE BALANCE 	Tire balance. Static imbalance not a cause of vibration below 30 mph. Dynamic imbalance not a cause under 40 mph. Vehicle speed sensitive vibration.

Wheel/Tire Vibration Troubleshooting Chart - (cont'd)

CONDITION	POSSIBLE CAUSE/REMEDY
• TIRE WEAR 	Tire wear. Abnormal wear can cause vibration in 30 to 45 mph range and may also generate whine at high speed changing to growl at low speed. Vehicle speed sensitive vibration.
Waddle	Waddle is side to side movement at the front and/or rear of the vehicle. It is caused by a steel belt not being straight within the tire. It is most noticeable at low speed, 5 to 30 mph. It may also appear as ride roughness at 50 to 70 mph. It is possible to road test vehicle and tell on which end of the vehicle the faulty tire is located. If the waddle is on the rear, the rear end of the vehicle will shake from side to side or "waddle". From the driver's seat it feels as though someone is pushing on the side of the vehicle. If the faulty tire is on the front, the driver feels as though he is at the pivot point in the vehicle.

Road Test

Always begin a tire diagnostic procedure with a road test. The road test and customer interview (if available) will provide much information needed to find the source of the vibration. During the road test, drive the vehicle on a smooth road. If the vibration is apparent, note and record the following:

The speed(s) at which the vibration occurs.
The type of vibration (mechanical and/or audible) occurring in each speed range.

How changes in vehicle speed, engine speed, and engine torque affect the vibration.

The type of vibration sensitivity (torque-sensitive, engine-speed sensitive, or vehicle speed sensitive.

Torque Sensitivity

When the vibration is torque-sensitive, the condition can be improved or worsened by accelerating, decelerating, coasting, maintaining a constant vehicle speed, and applying more or less engine torque.

Vehicle Speed Sensitivity

When the vibration is linked to vehicle speed, the vibration always occurs at the same vehicle miles per hour and is unaffected by engine torque, engine speed or transmission gear selected.

Engine Speed Sensitivity

When the vibration is linked to engine speed, the vibration occurs at varying vehicle speeds when a different transmission gear is selected. It can be isolated by increasing or decreasing engine rpm with the transmission in Neutral, or by stall testing with the transmission in gear. If the vibration is related to engine speed, the problem is most likely not a wheel or tire problem.

If the road test indicates that the vibration is related to the tires or wheels, refer to the Wheel/Tire Vibration Troubleshooting Charts in this section of the manual. If the vehicle leans to one side during the road test, refer to the Tire Lead Troubleshooting Chart in this section.

NOTE: A complete road test procedure is provided in Section 10 - Noise, Vibration and Harshness of the Service Manual.

If the road test discovers tire whine, but no shaking or vibration, the noise is caused by contact between the tires and road surface. Tire

whine can be distinguished from axle whine because axle noise diminishes or changes according to load or speed. Tire noise remains the same over a range of speeds. A thumping noise usually means that the tire has flat spots or soft spots that make noise as they slap the road surface.

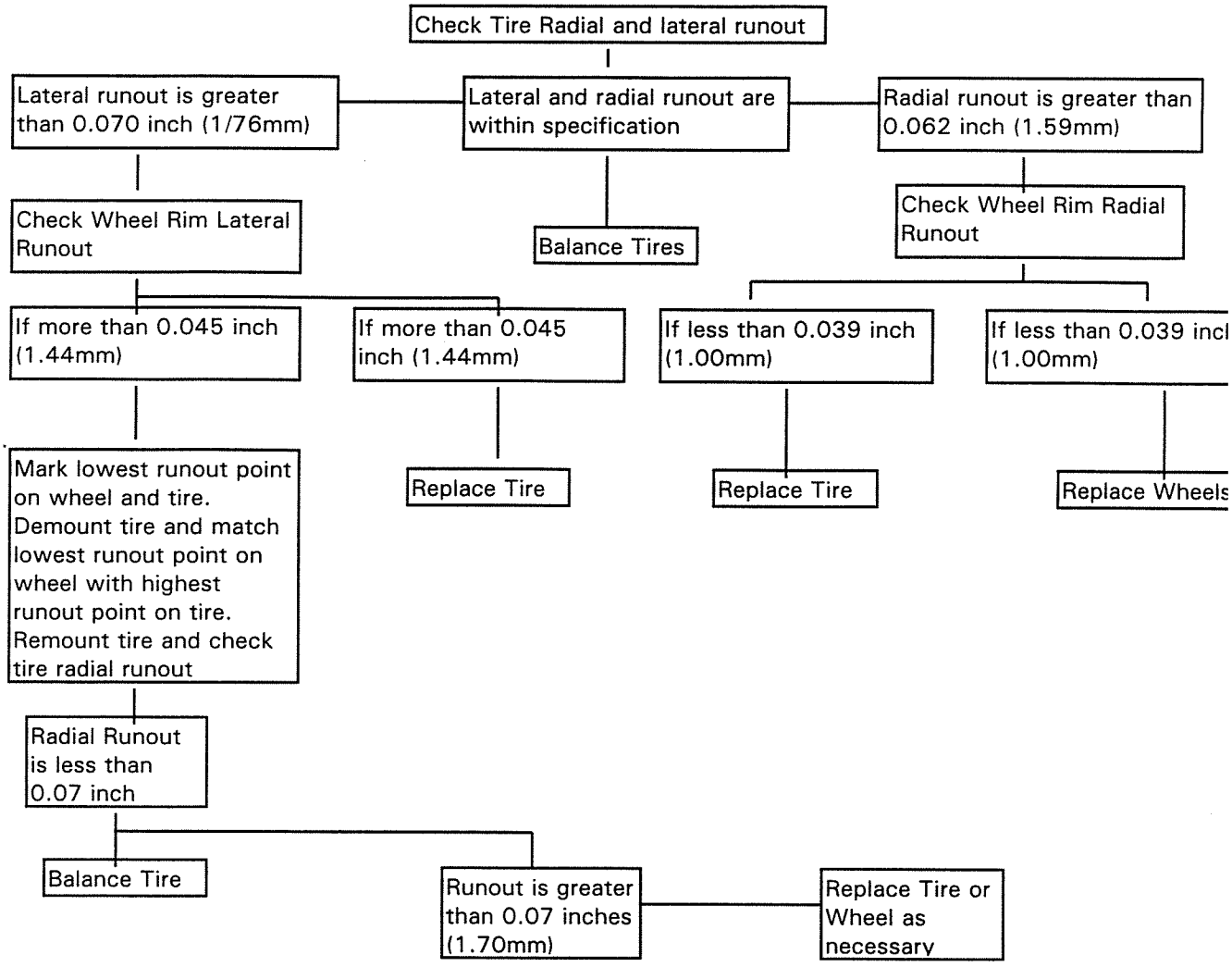
Wheel and Tire Runout Troubleshooting

Check wheel and tire runout while the tires are inflated to the normal load inflation pressure. To ensure accurate results, make the measurements with a Radial Runout Gauge, after the road test. If time is allowed to pass between the road test and the runout checks, the tires may develop slight flat spots which can affect the accuracy of the runout measurements.

Measure the tire radial runout at the center and outside ribs of the tread face. If necessary, apply tape on the tire tread to prevent the gauge roller from slipping into the tire tread block grooves. Measure the lateral runout just above the letters identifying the tire size.

Measure wheel radial runout at the tire rim along the inside edge of the flange. Use the following Wheel/Tire Runout Troubleshooting Chart to determine whether the wheel or runout is the source of the vibration problem.

TIRE LEAD DIAGNOSIS CHART



Tire Lead Troubleshooting

Lead is the deviation of the vehicle from a straight path on a level surface without pressure on the steering wheel. Lead is usually caused by:
Incorrect wheel alignment
Faulty tire construction
Tire misconstruction, such as off-center radial belts can reduce lead. Off-center belts cause a tire to roll to one side developing a side force which causes the tire to lead.

1. Inflate tires to recommended pressure and check alignment.

2. Road Test the vehicle on level uncrowned road in both directions.

3. Lead corrected if roughness results. Replace tires.

Mounting Replacement Tires

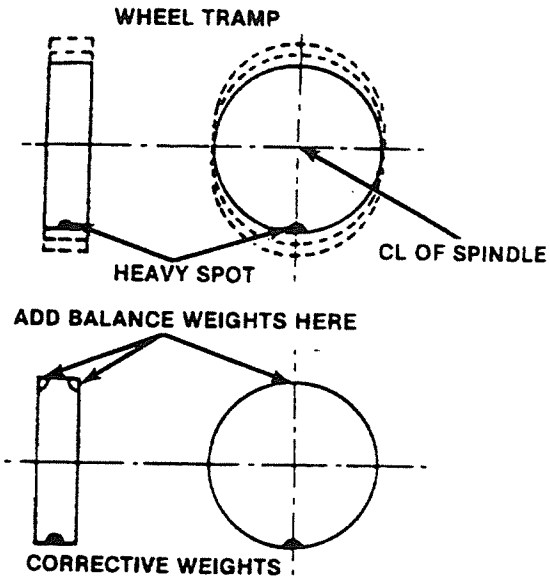
If the new tire has sticker or dye mark to indicate the high spot, always mount the tire so that the sticker or dye mark is at the valve stem. Always replace the valve stem if the tire is being replaced. The sticker or dye mark will wash off after a few weeks of normal operation.

When installing wheels, use a torque wrench for final tightening of the wheel bolts. Proper tightening of the wheel bolts will prevent warping of disc rotors and stretching of the wheel bolts. Torque the wheel bolts to 65-87 ft-lbs (88-118 N-m).

Tire and Wheel Balance

Before balancing wheels, clean deposits of dirt, mud and ice from the wheel and tire, as well as from the inside and outside of the rims. Remove existing balance weights. Remove all stones and other any objects wedged between tire beads to avoid operator injury and obtain a good balance. Inspect the tire for damage. Check and, if necessary, correct tire inflation pressure, then balance the tire and wheel according to the equipment manufacturer's instructions.
Never add more that 5.5 ounces of balancing weight to any one wheel. When using a double balancer on the vehicle spin balancer, always split the weight so that one is on the outside of the wheel and the other half is on the outside.

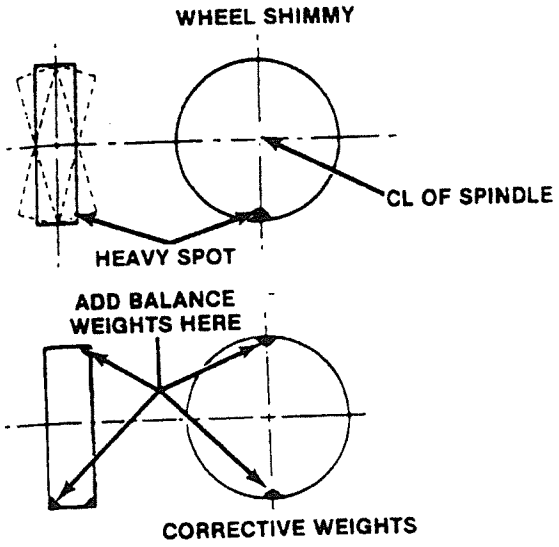
Static Wheel Balance



The two types of wheel balance are single-plane STATIC balance and two-plane DYNAMIC balance. STATIC balance is the equal distribution of weight around the wheel. A wheel which is not statically balanced will often experience a bounding motion called wheel tramp. Wheel tramp can eventually lead to uneven tire wear.

Dynamic Wheel Balance

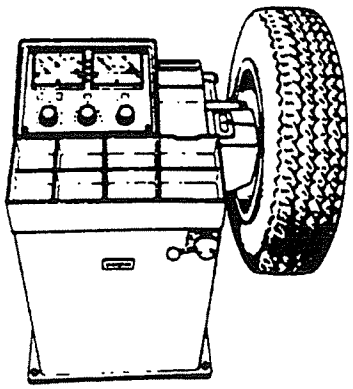
This is the equal distribution of weight on each side of the wheel centerline so that there is no tendency for side-to side movement when the wheel rotates. A wheel which is not dynamically balanced may cause wheel shimmy.



The two methods of wheel balancing are off-vehicle balancing and on-vehicle balancing.

Off-Vehicle balancing -

This involves removing the wheel from the vehicle and installing on a special machine which balances it. In most cases (except for bubble balancers), the wheel is spun on the machine and both static and dynamic balance are corrected. When performing off-vehicle balancing, always place the centering cone on the back side of the rim. This is important when balancing stamped wheels, because most steel wheels are stamped from the back side. Locating the cone on the front side of the wheel could cause an incorrect balance. Also, when using special adapters, it is important that the wheels be located by the center hole, not by the stud holes.



On-Vehicle Balancing -

This can be performed using a strobe-type on-vehicle balancer. When balancing the rear wheels, use the engine to spin the wheels. Place an old rim upside down under the wheel and one of the studs for proper positioning when the wheel is replaced. Make sure the halfshafts are not hitting any suspension parts while performing a rear wheel on-vehicle balance. Support the rear suspension so that the axle shaft angles at or near curb height angles. The wheel being balanced should be two inches or slightly more off the floor.

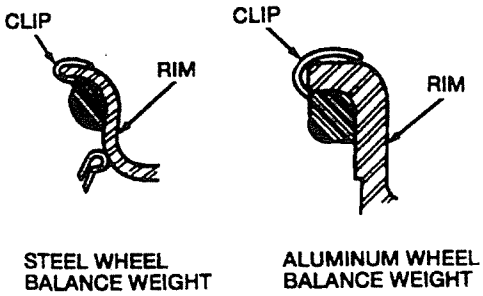
Before spinning the wheels, check for loose suspension joints, worn wheel bearings and brake grab.

Start the engine, select drive and accelerate slowly. Make certain that the speedometer does not exceed an equivalent road speed of 35 mph (56km/h). Remember that wheel speed (when engine driven) will be twice speedometer speed.

WARNING: WHEN BALANCING REAR WHEELS ON REAR WHEEL DRIVE AXLES WITH CONVENTIONAL TRANSAXLES, LIMIT THE WHEEL SPEED TO 35 MPH (56 km/h) AS INDICATED ON THE SPEEDOMETER. IF CARE IS NOT EXERCISED DURING THIS PROCEDURE, POSSIBLE TIRE DISINTEGRATION, TRANSAXLE AND/OR HALFSHAFT FAILURE CAN RESULT IN PERSONAL INJURY OR EXTENSIVE COMPONENT FAILURE.

Balance Weights

Balance weights should be specifically designed for steel wheels. Install balance weights securely around the wheel.



Tires

If tires are given a small amount of maintenance, they will give a better and longer service life. Check and correct tire inflation pressures regularly.

Check any tire for leaks if it requires the addition of air. Check for leaks at the valve stem, valve core, tread, sidewall and bead. Check tires visually for cracks, damage and foreign matter such as pieces of metal, stones, glass and nails. Check the wheel rims regularly for damage.

SPECIFICATIONS

TORQUE SPECIFICATIONS

Description	Lb-Ft	N-m
Wheel Bolts	65 - 87	87 - 118

Tire Pressure (PSI)

Tire Size	Front	Rear
P155/80R13	28	30

SECTION 5 - Steering System

DESCRIPTION AND OPERATION

The steering system is a rack and pinion design. The steering assembly consists of the following components:

- Steering Wheel
- Upper Steering Shaft
- Steering Bracket (weldment)
- Steering Column U-joint Coupling
- Steering Gearbox (Rack and Pinion)

DIAGNOSIS AND TESTING

Inspection - Steering System

Steering system complaints usually relate to excessive steering effort or handing problems. Excessive steering effort can be caused by:

- Underinflated tires.
- Worn or damaged suspension components.
- Excessive friction in the steering, which is caused by:

a) Improper or lack of lubrication

b) Damaged seals allowing contaminants such as moisture and dirt to enter.

c) Improper adjustment of the steering components.

Handling problems include the following:

- Pulls to one side or wanders.
- Loose feeling in the steering.

When these occur there could be problems in the:

- Steering column.
- Steering gearbox.
- Suspension components
- Wheels and tires

Perform the following inspection:

1. Verify the customer concern by road testing the vehicle to duplicate the problem.
2. Inspect visually the components of the steering system.
3. If the problem is not visually evident, go to the Troubleshooting Chart in this section.

Refer to Section 6 - Suspension for diagnosis of handling problems caused by suspension system components.

Troubleshooting Chart - Steering

Condition	Possible Source	Remedy/Action
Excessive steering effort	• Tire(s) are underinflated.	• Adjust tire pressure. Refer to Section 3 - Wheels and Tires.
	• Excessive/uneven tire wear	• Replace tire.
	• Insufficient lubrication of steering rack	• Lubricate steering rack.
	• Steering gear damage	• Perform the turning effort check in this section.
	• Steering column U-joint binding	• Adjust or replace U-joint.
	• No lubricant in bearings of the fork support assembly	• Lubricate the bearings in the fork support assembly.
Unstable Driving	• Incorrect tire pressure.	• Adjust tire pressure. Refer to Section 3 - Wheels and Tires.
	• Distorted or unbalanced wheel(s).	• Repair or replace wheels.
	• Incorrect wheel alignment.	• Adjust wheel alignment.
	• Worn front wheel bearings.	• Replace front wheel bearings.
	• Incorrect adjustment of front wheel bearing preload.	• Adjust front wheel bearing preload. Refer to Section 6 - Suspension.
	• Steering gearbox preload is incorrect.	• Perform steering gearbox test in this section.
	•	
	• Front shock malfunction.	• Inspect front shock. Refer to Section 6 - Suspension.
Steering Wheel Vibration	• Incorrect tire pressure	• Adjust tire pressure. Refer to Section 3 - Wheels and Tires.
	• Front tire wears unevenly, worn or mismatched.	• Replace tires. Check alignment.
	• Wheel alignment incorrect.	• Adjust wheel alignment. Refer to Section 6 - Suspension.
	• Unbalanced or distorted wheels.	• Repair or replace wheels.
	• Steering gearbox is loose or worn.	• Check steering gearbox mounting.
	• Front fork is loose or malfunctioning.	• Inspect front fork. Repair or replace if necessary.
	•	
	• Front shock is loose or malfunctioning.	• Inspect shock. Repair or replace if necessary.
	• Worn front wheel bearings.	• Replace front wheel bearings.
Steering Wheel Pulls to One Side	• Incorrect tire pressure.	• Adjust tire pressure. Refer to Section 3 - Wheels and Tires.
	• Wheel alignment incorrect.	• Adjust wheel alignment. Refer to Section 6 - Suspension.
	• Uneven tire wear.	• Replace tire. Check alignment.
	• Front wheel bearing preload incorrectly adjusted.	• Adjust front wheel bearing preload. Refer to Section 6 - Suspension.
	• Fatigued front shock(s).	• Repair or replace shocks.
	• Dragging brake(s).	• Adjust brakes. Refer to Section 9 -Brakes.
	• Damaged front fork assembly.	• Inspect front fork. Repair or replace if necessary.
	• Front axle is loose in the fork.	• Inspect front fork assembly. Replace or tighten if necessary.

Troubleshooting Chart - Steering (Cont'd)

• Condition	• Possible Source	• Remedy/Action
• Excessive Steering Wheel Play	• Front wheel bearing preload incorrectly adjusted. • Front wheel axle worn or damaged. • Worn front wheel bearing(s). • Steering u-joint coupling is worn or loose. • Steering gearbox loose or worn.	• Adjust front wheel bearing preload. Refer to Section 6 - Suspension. • Repair or replace if necessary. • Replace front wheel bearing(s). • Tighten or replace steering u-joint coupling. • Repair or replace steering gearbox.
• Steering System Noise	• Steering gearbox loose in its mountings. • Steering u-joint is contacting another component.	• Check steering gearbox mounting. Repair if necessary. • Inspect steering. Repair if necessary.
• Required steering effort is uneven	• Steering gearbox is restricted, loose installation bolt(s). • Steering u-joint is contacting another component. • Steering rack and pinion malfunction.	• Check steering gearbox mounting. Repair if necessary. • Inspect steering u-joint. Repair if necessary. • Replace rack and pinion gear in steering gearbox.

• Troubleshooting Chart - Steering Column/Front Fork Support

• Condition	• Possible Source	• Remedy/Action
• Rubbing Noise	• Steering u-joint is rubbing on other components.	• Check where rubbing Is occurring and repair if necessary.
• Clunk during acceleration or deceleration	• Loose steering gearbox and/or fork support mounting bolts and nuts.	• Tighten steering gearbox and/or fork support mounting bolts and nuts.
• Rattles, loose steering	• Loose steering u-joint. • Loose fork support. • Loose steering gearbox to mounting bracket.	• Tighten steering u-joint. • Tighten fork support. • Tighten steering gearbox mounting bolts.
• Squeak, moan when the steering wheel is turned.	• Play or looseness of fork support. • Play or looseness of steering gearbox. • Steering wheel rubbing on steering column covers.	• Tighten, adjust, or replace fork support. Refer to this section. • Tighten, adjust, or replace steering gearbox. Refer to this section. • Install steering column covers to proper location. Refer to this section.

Service Procedures

Turning Effort Check

1. Raise the front wheel clear off the hard, level surface. Position the jack stands so they do not interfere with steering travel.

2. Turn the steering wheel until the front wheel is in a straight position.

3. NOTE: For accurate readings, always pull the Spring Scale in the direction the point of the scale attachment is moving (tangential to the wheel rim) through the full circle.

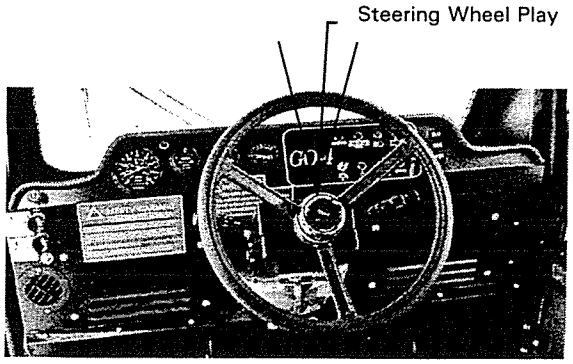
   Attach the Spring Scale to the steering rim and measure the steering effort through one full turn of the steering wheel. Steering wheel effort should be 1.0 - 4.5 lbs (5-20 N) through a full revolution in either direction from the straight ahead position.

   If the effort is greater than the specification, check tire inflation, binding or damage to the steering gearbox, and fork support.

Steering Wheel Play

With the ignition OFF, and the front wheel in the straight ahead position, turn the steering wheel left and right until wheel resistance is felt. Free play should not exceed 1.18 inches (30mm) at the wheel rim. Excessive free play indicates wear

in the steering u-joint coupling, worn rack and pinion or improper steering gearbox preload. To check the steering column u-joint coupling, grip or feel the lower joint at the instrument panel and repeat the free play check. Any free play between steering wheel and the gearbox, which is clamped to the instrument panel is in the steering column assembly.

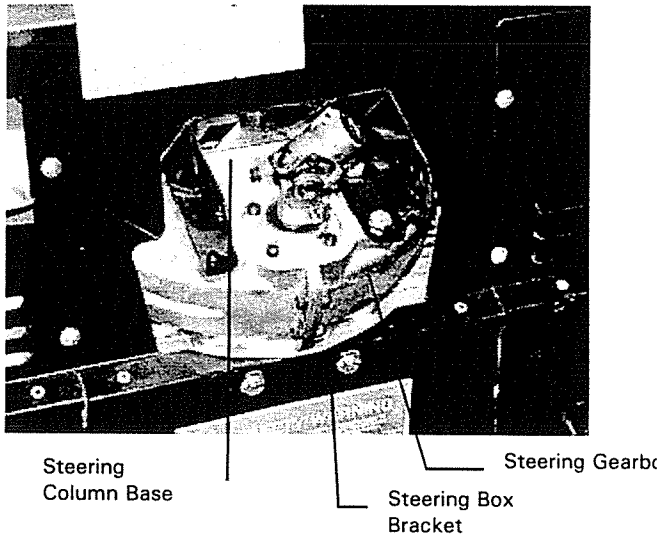


Check the front wheel axle supports and axle by raising the wheel off the floor. Check the wheel for wobble. First, check the wheel vertically to verify that outer and inner front wheel bearings are correctly adjusted, then check the wheel horizontally while an assistant grips the steering column u-joint coupling from inside the vehicle. If horizontal wobble is evident, check for loose attachment to the forks. If no free play is detected, any horizontal steering wheel wobble must be the result of excessive gear free play between steering gearbox and the steering wheel. In either case, the steering gearbox must be removed and adjusted, repaired, or replaced to correct the condition. See Section 5-6.

Steering Gearbox Mount

The steering gearbox is mounted on the instrument panel bulkhead with a steering column base (on top) and steering box bracket (on the bottom). Check for movement with the front wheel on the ground. If the housing moves more than 0.06 inch (1.5mm), the steering gearbox base and brackets may be loose. Tighten bolts 30 ft-lbs (40 N-m). Tighten the bolts securing the steering gearbox to the steering box bracket to 30 ft-lbs (40 N-m). Use Loctite when tightening. If the housing movement is still excessive after tightening the steering box bracket, check the mounting brackets for wear or damage.

1. Disconnect battery ground cables.
2. Remove multi-function switch. Refer to Section 19 for the removal procedure.
3. Remove steering "U" joint coupler.
4. Remove steering column base with four 3/8x3/4 bolts.
5. Remove two bolts bolting lower steering box bracket through console.
6. Remove cotterpins and castellated nut from top steering gearbox.
7. Remove eight panhead screws from dash front.
8. Pull dash face forward as far as possible to clear steering box when lifted off of main steering shaft.



Trunion Tube Bearing Preload

The trunion is mounted to the frame with six bolts. There should be no noticeable movement. Check bolts to ensure they are tight. Then check the trunion for movement between it and the mounting plate. This will determine if the bearings are loose. If they are, adjust (see procedure in Section 6 - Suspension). If they are loose or steering effort increases above 4.5 lbs, then remove the trunion and check the bearings. If necessary, replace the bearings.

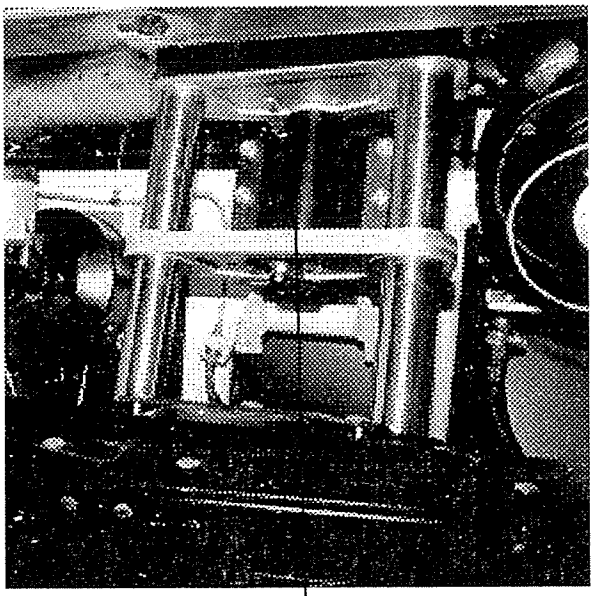
1. Remove the steering wheel, column and console.
2. Remove and discard cotterpin after removing the castellated nut.

2. Remove and discard cotterpin after removing the castellated nut.

3. Raise the front of the vehicle until the front tire clears the floor.

4. Tighten the castellated nut to 80 ft-lbs and check for drag on steering wheel. Install a new cotterpin.

5. Install steering column u-joint, lower and upper steering panel and steering wheel.



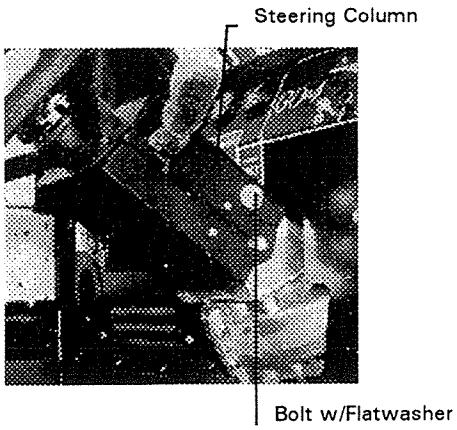
Tilt Steering Adjustment

Change steering angle as follows:

1. Loosen a bolt with brass flatwasher on each side of the steering column.

2. Adjust steering wheel to desired position.

3. Tighten the bolts.



DIAGNOSIS AND TESTING

Inspection and Verification - Steering Column

Refer to Inspection and Verification - Steering System and the Troubleshooting Charts in this section.

CLEANING AND INSPECTION

1. Clean all parts.

2. Inspect the bearings, steering shaft, trunion tube for unusual wear or damage. If any defects are found, replace the bearings, steering shaft, trunion tube. Check the trunion tube for cracks, dents, or abnormal wear. Replace if necessary.

REMOVAL AND INSTALLATION

Steering Gearbox

Removal

1. Apply park brake.

2. Put transmission in "PARK."

3. Block rear wheels.
4. Disconnect the battery ground cable.

5. Raise and block front of vehicle ensuring front wheel is clear of the floor.
6. Remove the steering wheel. Refer to procedure in this section.

7. Remove the multi-function switch. Refer to Section 19 for the removal procedures.

8. Remove upper steering shaft. Refer to procedure in this section.

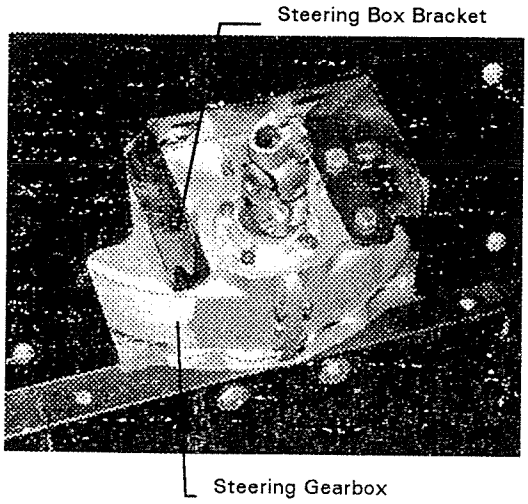
9. Remove 3/8 x 3/4 bolts and lockwashers securing steering column base to gearbox.

10. Remove steering column base.

11. Remove two bolts, two lockwashers and two nuts which hold steering gearbox to the instrument panel.

12. Remove cotterpin and castellated nut from the top of the steering gearbox.

13. Remove the steering gearbox.



Installation

To install, reverse the removal procedure.

Use a new cotterpin after the castellated nut has been installed.

- Tighten socket bolts to secure steering box to steering box bracket 30 ft-lbs (40 N-m).
- Tighten upper steering bolts on u-joint to 17 ft-lbs (23 N-m).
- Turn front wheel from side to side. It should have slight drag.
- Tighten castellated nut to 80 ft-lbs. Secure with cotterpin.

Disassembly/ Assembly

1. Remove four 1/4 x 3/4 sockethead bolts from the gearbox.
2. Remove the eccentric housing and steering hub from the steering gearbox.
3. Remove steering bracket.
4. Remove eight nuts and socket head bolts which secures gearbox case together.
5. Split the gearbox case into its two halves.
6. Separate the steering rack from the plate mount by removing five 5/16 x 3/4 flange bolts.
7. Remove bearings from both ends of the eccentric housing.
8. Remove bearings on each end of the steering hub.
9. Assemble steering gearbox in reverse order of removal.
10. Apply lithium grease to the steering rack teeth and pinion gear.

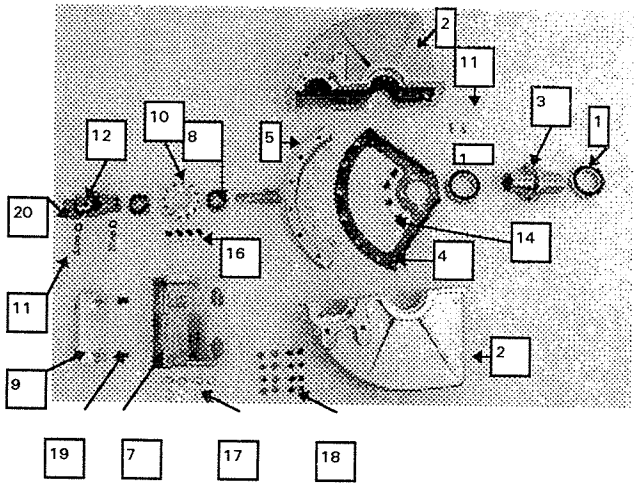
    NOTE: Position short end of the eccentric housing up.

    Tighten flange locking bolts holding steering rack to plate to 40 ft-lbs

    Tighten bolts the steering hub to steering plate mount 40 ft.-lbs. (8 N-m). Use non-serviceable Loctite.

    Tighten bolts holding eccentric housing to gearbox case 120 in-lbs.

    Tighten gearbox bolts to 17 ft-lbs (20 N-m).



Item	Part Number	Description
1	321843	Bearing - Gearbox
2	321106	Gearbox Case, Left & Right
3	323561	Steering Hub
4	321875	Steering Mount Plate
5	322018	Steering Rack
6	321105	Steering Pinion Gear
7	321179	Steering Column Base
8	321157	Bearing
9	343879	Steering Box Bracket
10	322620	Eccentric Housing
11	320988	Upper Steering Joint Bolt
12	320990	Steering U-joint
13	329003	Steering Wheel(not shown)
14	771953	Sockethead Bolt
15	770818	5/16 x 3/4 Flange Locking
	770325	1/4 Lockwasher
16	771495	1/4 x 3/4 Sockethead Bolt
17	771033	3/8 x 3/4 Bolt
18	771150	3/8 Lockwasher
19	773677	3/8 Socket Bolt
20	770950	Lockwasher

Inspection

1. Check all splines and gear teeth. Replace parts that are worn or damaged.

2. Check steering universal joint for a snug fit to the shaft spline.

3. Check the steering pinion gear and rack for looseness or rough operation. If the steering pinion gear, rack and bearings is defective, replace the bearing, steering pinion gear and rack as an assembly.

4. Examine all bolts holes on the aluminum case to ensure no cracking, wear on bolt holes or stripped threads.
5. Carefully examine the steering gearbox case for fractures at the mounting points, cracks, or abnormal wear. Check the gearbox half to ensure proper fit when assembling it.

6. Apply a lithium grease to the steering rack teeth and pinion gear.

Trunion Tube

The trunion tube is mounted to the vehicle frame with six (6) bolts. It supports the forks, shocks, and front wheel assembly.

Removal and Installation

1. Apply park brake.

2. Put transmission in "PARK."

3. Block rear wheels.

4. Disconnect the battery ground cable.

5. Remove dash top

6. Remove cotter key and castellated nut from top of steering shaft.

7. Mark the steering shaft to the steering box hub to ensure it gets reassembled in the same position

8. Remove steel brake line from front brake flex hose and disconnect fix hose from holder. (Plug lines)

9. Place jack as near as possible to the center of vehicle directly behind the front wheel..

10. Jack up until most of the weight is off of front wheel..

11. Remove 6 bolts holding trunion tube to frame.

12. Now make sure steering shaft is free in steering box. NOTE: You may have to pull up on box and tap on steering shaft. Be careful not to damage steering shaft. This will require assistance of another technician..

13. When free of steering box, jack up. For removal roll assembly out from under unit.

14. Loosen two outer and one center Allen head bolt in upper fork plate. Remove plate.

15. Lift trunion tube off of steering shaft.

To install, reverse the removal procedure.

Tighten the trunion tube mounting bolts to 80 ft-lbs (110 N-m).

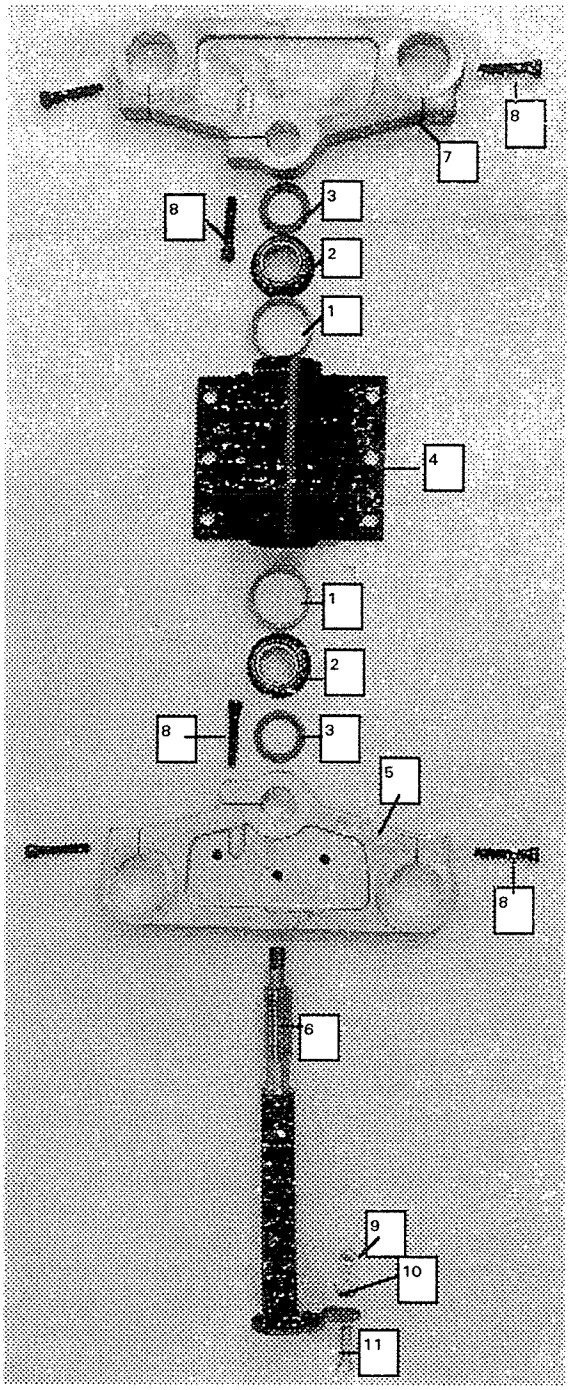
Disassembly/Assembly

1. Loosen the 3/8 socket head bolts on the upper and lower fork supports.

2. Remove the upper and lower fork supports from the trunion tube.

3. Remove the bushing washers from the upper and lower ends of the trunion tube.

Item	Part Number	Description
1	320056	Tapered Cut
2	320057	Tapered Seal Cone, Brg.
3	321139	Bushing Washer
4	349019	Trunion Tube
5	342246	Lower Fork Support
6	323816	Steering Shaft
7	342247	Upper Fork Support
8	771140	3/8 x 2 Socket Head
9	770223	3/8 Stover Locknut
10	770324	5/16 Flatwasher
11	772363	3/8 x 1/4 Bolt NC



4. Pull the tapered bearings and tapered cut from the trunion tube. If necessary use a bearing puller.

5. Remove bearing(s) from the steering shaft.

CAUTION: Do not damage bearings and steering shaft while removing from the trunion tube.

6. To install, reverse the removal procedure.

7. Do a bearing preload. Refer to the Trunion Bearing Preload procedure in this section.

Steering Support Weldment

The steering column connects the steering wheel to the steering gearbox.

The multi-function switch is mounted to the steering support weldment.

Removal

1. Center the front wheel to the straight ahead position.
2. Disconnect the battery ground cable.
3. Remove screws and 2 5/16 bolts with flatwashers which secure upper and lower steering cover..
4. Remove upper bolt from steering U-joint coupling then pull up on steering wheel and upper steering shaft wheel will come off as an assembly..
5. Remove multi-function switch. Refer to Section 19.
6. Remove steering support weldment from steering box.
7. **CAUTION: Do not attempt to remove the steering wheel by hitting the steering column shaft with a hammer. The steering column shaft will collapse causing the steering wheel to bind.**

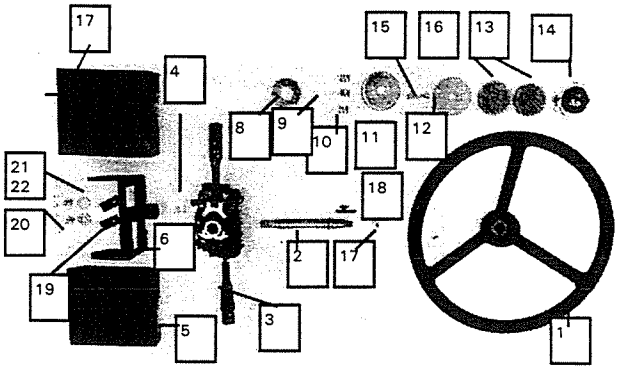
To install, reverse the removal procedure, aligning the index marks on the steering wheel and steering wheel column U-joint coupling.

Tighten the steering wheel nut to 29-36 ft-lbs (39-49 N-m).

Upper Steering Shaft

Removal

1. Remove the screws and two 5/16 bolts with flatwashers which secure the upper steering cover and lower steering panel.
2. Separate the upper steering cover and lower steering panel and remove from the steering column.
3. Remove the multi-function switch. Refer to Section 19 for removal procedures.
4. Remove the steering support weldment from the instrument panel.



5. Remove upper steering bolt and lockwasher at each end of the steering u-joint and disconnect the upper steering shaft.
6. Remove steering u-joint from steering gearbox.

Item	Part Number	Description
1	322702	Steering Wheel
2	322654	Upper Steering Shaft
3	660991	Combination Switch
4	322770	Plastic Bushing - steering
5	322761	Lower Steering Panel
6	322764	Steering Support Weldment
7	322995	Upper Steering Cover
8	323532	Washerplate Assembly
9	323602	Upper Steering Bushing
10	323513	Compression Spring
11	323497	Upper Steering Wheel Plate
12	322526	Horn Cup Plate
13	324000	Horn Cup Puck
14	329004	Horn Button Assembly
15	771698	1/2 x 20 Panhead Machine Screw
16	771417	1/4 Nut Insert
17	771645	1/2 Flange Locknut
18	771682	Woodruff Key
19	771736	5/16 Extended Panel Nuts
20	771685	# 8 Tapping Screws
21	771117	Brass Flatwasher
22	771951	5/16 Bolt

Installation

To install, reverse the removal procedure.

NOTE: Use Loctite (serviceable) when tightening bolts.

Tighten the upper steering u-joint bolts to 17 ft-lbs. (240 in-lbs or 23 N-m).

Tighten the steering support weldment bolts to 40 ft-lbs (55 N-m).

Tighten the 5/16 bolt for the tilt steering mechanism to 40 ft-lbs (55 N-m).

Steering Support (weldment)

The steering support is not serviceable. If damaged or worn, replace the part.

Steering Column Base

The steering column base and steering box bracket are not serviceable. If damaged or worn, replace the part.

Steering Box Bracket

The steering column base and steering box bracket are not serviceable. If damaged or worn, replace the part.

SPECIFICATIONS

Torque Specifications

- Tighten two socket bolts to secure steering box to steering box bracket 30 ft-lbs (40 N-m).
- Tighten two upper steering bolts on u-joint to 17 ft-lbs (23 N-m).
- Tighten castellated nut to 80 ft-lbs and check for drag on steering wheel
- Tighten flange locking bolts holding steering rack to plate to 40 ft-lbs (55 N-m).
- Tighten bolts the steering hub to steering plate mount 40 ft-lbs. Use non-serviceable Loctite.
- Tighten bolts holding eccentric housing to gearbox case 120 in-lbs.
- Tighten gearbox bolts to 17 ft-lbs (20 N-m).
- Tighten the steering wheel nut to 29-36 ft-lbs (39-49 N-m).
- Tighten the steering support weldment bolts to 40 ft-lbs (55 N-m).
- Tighten the 5/16 bolt for the tilt steering mechanism to 40 ft-lbs (55 N-m).

SERVICE TOOLS AND EQUIPMENT

- Steering Wheel Puller
- Bearing Puller

SECTION 6 - Suspension, Service

DESCRIPTION AND OPERATION

Component Replacement

Suspension, Front

The front suspension system on the GO-4 is a two-shock layout with an single-wheel and axle mounted to the bottom of the shocks.

The following front suspension components may be serviced or replaced either individually or as an assembly.

- The front shocks may be disassembled in order to replace any of the individual components. They need to be repaired or replaced in pairs.
- The front disc brake and rear wheel hub may be replaced individually.
- The front wheel bearings, inner and outer races and rollers, are replaced as a set.

Suspension, Rear

The following rear suspension components may be replaced either individually or as an assembly.

- The rear shock absorber and rear coil spring assembly may be disassembled in order to replace any of the individual components. They do not need to be replaced in pairs.
- The rear brake disc and rear wheel hub may be replaced individually.
- The rear wheel bearings, inner and outer races and rollers, are replaced as a set.
- The axle torsion bar and axle torsion bar arms are replaced individually.
- The torsion bar bracket and bushings may be replaced individually.
- The upper and lower controls arms may be replaced individually or as parts.

DIAGNOSIS AND TESTING

Inspection and Verification - Suspension System

Tire Wear

The tires should be equally and correctly inflated, and uniformly worn, left and right and center. Abnormal tread wear patterns provide clues to suspension and other conditions. For example, non-uniform tread wear across the face of the tire which is greater toward the inboard or outboard edge, indicates incorrect camber. While two camber settings are available, the range of adjustment is limited. If camber problems are severe enough to produce one-side tire wear, look for worn or damaged suspension parts or distortion of body mounting points.

Saw tooth tread wear, with tread ribs higher on the inboard or outboard edges, indicates excessive toe-in or toe-out, respectively. Cupping wear of flat spots indicated an imbalance or runout of wheels and / or tires. If evident, refer to this section for corrective procedures. Severely worn tires should be replaced.

Vibration and Roughness

Vibration, roughness, tramp, shimmy, and thump may be caused by excessive tire or wheel runout, worn or cupped tires, or wheel and tire imbalance. These conditions may also be caused by rough road surfaces. Drive the vehicle on different road surfaces to determine whether the surfaces are actually the cause of the condition.

Do not immediately suspect the tires or wheels when attempting to diagnose a vibration problem. Other sources of vibration include:

- Loose or worn wheel bearings.
- Loose or worn suspension or steering components.
- Worn or damaged rear wheel driveshaft joints.
- Disc brake rotor runout.
- Loose engine or transaxle supports.
- Engine-driven accessories.

Road Test

Always begin a suspension diagnostic procedure with a road test. The road test and customer interview (if available) will provide much information needed to find the source of vibration.

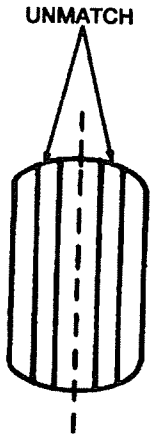
During the road test, drive the vehicle on a smooth road. If vibration is apparent, note and record the following:

- The speed(s) at which the vibration occurs.
- The type of vibration (mechanical and/or audible) occurring in each speed range.
- How changes in vehicle speed, engine speed, and engine torque affect the vibration.

The type of vibration sensitivity (torque sensitive, engine speed sensitive, or vehicle speed sensitive).

Read the following explanations to help isolate the source of vibration.

If the customer concern is about steering drift or pull, the cause may be tire conicity. Tire conicity is a directional force related to greatly exaggerated, unmatched tire tread contours.



1. Check the cold tire air pressure. Air pressure should be as follows:
   - Front tire - 28 psi
   - Rear tires - 30 psi.
2. WARNING: TO AVOID PERSONAL INJURY DUE TO LOSS OF VEHICLE CONTROL, THE INSPECTION SHOULD BE PERFORMED BY TWO PEOPLE TO MAINTAIN SAFE DRIVING CONDITIONS. ONE PERSON SHOULD DRIVE WHILE THE OTHER

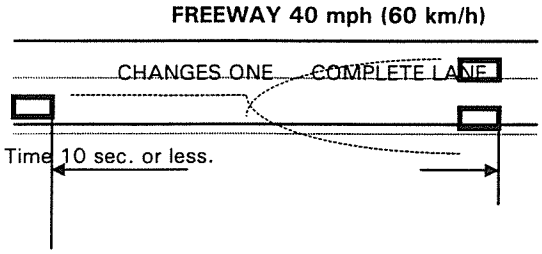
CHECKS THE TIME. ADEQUATE GRIP SHOULD ALWAYS BE MAINTAINED ON THE STEERING WHEEL.

NOTE: The following conditions must be met when evaluating the vehicle.

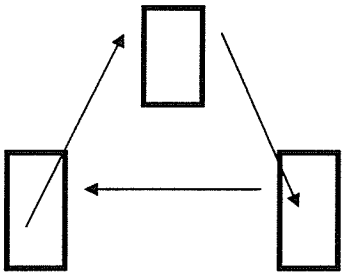
- Be sure that no crosswinds or gusting breezes are present.
- Drive the vehicle in both (opposing) directions at least twice.
- Average the results.
-

Drive the vehicle at 40 mph (60 km/h) on a level and straight road. Drive in the center lane of a three lane freeway.

3. If the vehicle changes one complete 12 foot wide lane within ten seconds, it has a drift.



4. Rotate the tires as shown in the following illustration. Perform Step A, and then if necessary, Step B.



Torque Sensitive

When the vibration is torque sensitive, the condition can be improved or worsened by accelerating, decelerating, coasting, maintaining a constant vehicle speed, or applying engine torque.

Vehicle Speed Sensitive

When the vibration is linked to engine speed, the vibration always occurs at the same vehicle speed and is not affected by engine torque, engine speed, or transaxle gear selected.

Engine Speed Sensitive

When the vibration is linked to engine speed, the vibration occurs at varying vehicle speeds when a different transaxle gear is selected. It can sometimes be isolated by increasing or decreasing engine rpm with the transaxle in NEUTRAL (N), or by stall testing with the transaxle in gear. If the vibration is linked to engine speed, the problem is probably not a wheel or tire condition.

If the road test indicates that the vibration is related to the tires and wheels, refer to the Troubleshooting Chart in this section. If the vehicle leads to one side during the road test, refer to the Troubleshooting Chart.

If the road test reveals tire whine, but no shaking or vibration, the noise is caused by contact between the tires and the road surface. Tire whine can be distinguished from axle whine because axle noise diminishes or changes according to load or speed. Tire noise remains the same over a range of speeds. A thumping noise usually means that the tire has flat soft spots that make noise as they slap the road surface.

Front End

Do not check and adjust the front wheel alignment without first making the following inspections for front end damage or wear:

1. Check for specified air pressures in all three tires.

2. Raise the vehicle off the floor. Refer to Section 2 for the procedure. Check the front forks for looseness, wear, and damage. Tighten any loose nuts and bolts to specification. Replace any worn parts.

3. Check the steering gearbox mountings and all steering linkage connections for looseness. Tighten all mountings to specification. If any of the linkage is worn or bent, replace the parts. Refer to Section 5 for the procedures.

Wheel Bearings, Front End

Check for bearing wear by raising the vehicle until the tire is clear of the floor. Support the front end so there is no load on the front shocks. Try to rock the wheel top-to-bottom; if any wobble is felt, look for movement around the axle mounting and shocks. If the axle mounting and shocks appear tight, check and adjust the front wheel bearings. Then repeat the wobble check.

Front wheel bearings that need replacing may be indicated by a noise that occurs only when turning. To diagnose the front wheel bearings:

1. Road test the vehicle on a smooth road. Make sharp turns to the right and left.
   - If the vehicle makes noises on right or left turns, the front wheel bearings may need to be replaced.
   - If the front wheel bearing noise is heard on either right or left turns, the wheel hub and front wheel bearing assembly should be disassembled and inspected.
2. Raise the front of the vehicle and check for loose front wheel bearings by rocking the tires at top and bottom.
3. Spin the tire quickly by hand and make sure the tire turns smoothly without noise from the bearings.
4. Remove the wheel and brake caliper. Hang the disc brake caliper from the body using a cord or piece of wire.
5. Position Dial Indicator with Bracket or equivalent against the wheel hub, then push and pull the wheel hub. Measure the end play of the wheel hub. Measure the end play of the wheel hub and bearing assembly. The maximum allowable end play is: 0 inch (0 mm). If the end play exceeds the specified limit, replace the wheel bearings.

Shock Absorber Checks

Visually inspect each component of the suspension and replace worn or damaged parts as necessary. Refer to this section for procedures for the front suspension and rear suspension.

Cycle the shock absorber piston up and down to check for proper fluid resistance.

Bounce test the vehicle at each wheel to check shock absorber function. Damping action should be positive and uniform all around. Inspect the shock absorber for evidence of oil leakage. A thin film is normal. Check the rear shock upper and lower bushings by shake-testing with the vehicle raised just enough to unload the shocks. Any looseness is indicative of worn or deteriorated bushings, which must be replaced.

Rear Suspension

At regular intervals, the following rear suspension checks should be made:

1. Check for evidence of fluid leaks on the rear shock absorbers. Make sure fluid is not from sources other than the rear shock absorber.
2. Check rear shock absorber operation.
3. Check condition of rear axle torsion beam bushings.

   Replace any damaged or worn components.

   The rear wheel bearings should be checked using the following procedure:
4. Raise the rear of the vehicle and check for loose wheel bearings by rocking the tires at top and bottom.

If any looseness or noise is found, replace the rear wheel bearings. Refer to this section for the removal and installation procedure.

Rear wheel bearings that need replacing may be indicated by a noise that occurs only when turning. To diagnose the rear wheel bearings:

1. Road test the vehicle on a smooth road. Make sharp turns to the right and left.
   - If the vehicle makes noises on right or left turns, the rear wheel bearings on the right or left side may need to be replaced.
   - If the rear wheel bearing noise is heard on either right or left turns, the wheel hub and rear wheel bearing assembly should be disassembled and inspected.

2. Raise the rear of the vehicle and check for loose rear wheel bearings by rocking the tires at top and bottom.

3. Spin the tire quickly by hand and make sure the tire turns smoothly without noise from the bearings.

4. Remove the wheel and brake caliper. Hang the disc brake caliper from the spring using a cord or piece of wire.

5. Position Dial Indicator with Bracket or equivalent against the wheel hub, then push and pull the wheel hub. Measure the end play of the wheel hub. Measure the end play of the wheel hub and bearing assembly. The maximum allowable end play is: 0 inch (0 mm). If the end play exceeds the specified limit, replace the wheel bearings.

TROUBLESHOOTING CHART - Suspension System

SUSPENSION SYSTEM

CONDITION	POSSIBLE SOURCE	REMEDY / ACTION
Drift Left or Right	• Excessive side-to-side difference in camber or caster. • Tire(s) have excessive wear. • Steering gear or linkage worn or defective	• Go to Pinpoint Test A1.
Tracks Improperly	• Excessive side-to-side caster. • Rear suspension damage.	• Go to Pinpoint Test C1.
Rough Ride	• Weak rear spring or front shock(s). • Malfunctioning spring/shock assembly.	• Go to Pinpoint Test D1.
Excessive Noise	• Wear of lower or upper control arm joint. • Damaged or worn axle torsion beam. • Looseness of suspension connection. • Malfunctioning spring/shock assembly.	• Go to Pinpoint Test E1.
Improper Tire Wear	• Incorrect tire pressure. • Excessive positive or negative camber. • Excessive toe adjustment. • Wheel/tire imbalance or runout. • Defective shock absorber(s). • Tires not rotated properly.	• Go to Pinpoint Test F1.
Vibration	• Excessive positive caster or side-to-side caster difference. • Wheel/tire imbalance or runout. • Driveline vibration, • Steering gearbox mounts loose.	• Go to Pinpoint Test G1.
Heavy Steering	• Castellated nut on steering gearbox is overtightened. • Broken bearing in steering gearbox. • Distorted steering shaft. • Vehicle attitude incorrect (high at front or low at rear). • Steering gearbox worn, damaged, or improperly adjusted.	• Adjust. Refer to Section 5. • Replace the bearing. • Replace. • Check for abnormal loading, spring damage, spring sag, front shock damage, front shock shag. • Check for steering system conditions. Refer to Section 5.

TROUBLESHOOTING CHART - Suspension System (Continued)

CONDITION	POSSIBLE SOURCE	REMEDY / ACTION
Brake Pull	• Excessive negative caster.	• Check the caster. If incorrect, check the suspension components for looseness or damage.
	• Unequal tire pressure.	• Inflate the tires uniformly to the recommended pressure. Refer to Section 3.
	• Brake drag or damage to the brake system.	• Check the brakes. Refer to Section 4.
Bump Steer	• Worn or bent steering gearbox mounting brackets.	• Replace the steering gearbox mounting brackets.
Steering Wheel Pulls to One Side.	• Damaged tires, wheels or rims.	• Check the tires, wheels or rims. Replace if necessary.
	• Braking System malfunction.	• Check the brakes, if necessary refer to Section 4.
Steering Wheel Pulls to One Side -	• Steering system malfunction.	• Check the steering System. If necessary, refer to Section 6.
	• Improper wheel alignment • Torsion Rod (Sway bar) out of adjustment • Damaged or worn front suspension component.	• Adjust the wheel alignment. • Refer to Trailing Arm Adjustment Section 6-25 • Replace the worn front suspension component.
Front / Rear Suspension Noises	• Loose/broken shock absorber mount bolts.	• Tighten/Replace the shock absorber mounts. Refer to this section for information on front and/or rear shock absorbers.
Body Rolls	• Damaged or worn axle torsion beam bushings. • Torsion Rod (Sway bar) out of adjustment • Malfunctioning spring/shock assembly.	• Replace the axle torsion beam bushings. • Refer to Trailing Arm Adjustment Section 6-25 • Replace the spring/shock assembly if necessary.
Body Leans	• Weak rear spring or front shock.	• Replace the rear spring or repair the front shock(s).
	• Torsion Rod (Sway bar) out of adjustment • Damaged or worn rear suspension lower control arm bushings.	• Refer to Trailing Arm Adjustment Section 6-25 • Replace the rear suspension lower control arm bushings.

Troubleshooting Chart - Suspension System (continued)

CONDITION	POSSIBLE SOURCE	REMEDY / ACTION
General Driving Instability	• Damaged tires or unbalanced wheels.	• Check the tires. Refer to Section 3. Replace the tires if necessary. Balance the wheels if necessary.
	• Torsion Rod (Sway bar) out of adjustment	• Refer to Trailing Arm Adjustment Section 6-25
	• Improper wheel alignment.	• Adjust the wheel alignment.
	• Steering system malfunction.	• Check the steering system. If necessary, refer to Section 5.
	• Damaged rear suspension lower control arm joint.	• Replace the rear suspension lower control arm joint.
	• Weak rear spring or front shock.	• Replace the rear spring or front shock(s).
	• Damaged or worn rear suspension lower or upper control arm bushings.	• Replace the worn rear suspension lower or upper control arm bushings.

Pinpoint Tests - Suspension System

PINPOINT TEST A: DRIFT LEFT OR RIGHT

TEST STEP	RESULT	ACTION TO TAKE
A1 CHECK ALIGNMENT		
• Check the vehicle alignment. Refer to the procedure in this section. • **Is the alignment within specification?**	Yes ⇒ No ⇒	Go to A2. Adjust alignment to specifications. Inspect suspension components for looseness or deformation and repair or replace as necessary.
A2 EXAMINE SUSPENSION COMPONENTS		
• Inspect the front and rear suspension components for looseness or deformation. • Torsion bar (Sway Bar) out of adjustment • **Are there loose or deformed front or rear suspension components?**	Yes ⇒ No ⇒	Repair or replace as necessary. Go to A3. Go to Section 6-21
A3 INSPECT TIRES		
• Inspect the tires for excessive or improper wear. Refer to Section 3 as necessary. • **Are the tires excessively or improperly worn?**	Yes ⇒ No ⇒	Replace the tire(s). Go to A4.
A4 CHECK FOR IMPROPER VEHICLE ATTITUDE		
• Raise the vehicle on a hoist. • Check for spring damage, spring sag, front shock damage, front shock sag, or non-standard rear springs. • **Is the vehicle high or low at the front or rear due to spring concerns?**	Yes ⇒ No ⇒	Replace the springs as necessary. Check for improper vehicle loading and Inform the customer about the proper loading of vehicle. Go to A5.

PINPOINT TEST A: DRIFT LEFT OR RIGHT (Continued)

TEST STEP	RESULT	ACTION TO TAKE
A5 CHECK THE STEERING SYSTEM		
• Check for looseness in the steering column, gearbox mounting, and linkages. • Raise the vehicle on a hoist. • Check the steering gearbox and linkage for worn or damaged components. • **Is there is looseness in the steering column, or are there indications of wear or damage in the steering gearbox or linkage?**	Yes ⇒ No ⇒	Service or replace components as necessary. Refer to Section 5 for further information. Vehicle OK.

PINPOINT TEST D: ROUGH RIDE

D1 CHECK FRONT SHOCKS		
• Raise the vehicle on a hoist. Refer to Section 2. • Inspect the front shocks for leaks or damage. • **Are the front shocks OK?**	Yes ⇒ No ⇒	Go to D2. Replace the front shocks. Refer to this section.
D2 CHECK REAR SHOCK ABSORBERS		
• With the vehicle on the hoist, inspect the rear shock absorbers for leaks or damage. • **Are the rear shock absorbers OK?**	Yes ⇒ No ⇒	Inspect the front shocks and rear coil springs for damage, weakness, or sagging. Repair/replace as necessary.

PINPOINT TEST E: EXCESSIVE NOISE

E1 INSPECT FRONT END		
• Inspect the front end. Refer to the procedure in this section. • **Is the front end OK?**	Yes ⇒ No ⇒	Perform Pinpoint Test D to inspect the shocks. Service as necessary.

PINPOINT TEST F: IMPROPER TIRE WEAR

F1 CHECK TIRE PRESSURE		
• Check the tire pressure. • **Is the cold tire pressure 28 psi - front; 30 psi - rear?**	Yes ⇒ No ⇒	Go to F2. Inflate tires to proper pressure. Go to F2.
F2 CHECK ALIGNMENT		
• Place the vehicle on an alignment rack. • Check the vehicle alignment. Refer to the procedure in this section. • **Is the alignment within specification?**	Yes ⇒ No ⇒	Go to F3. Adjust alignment to specification. Inspect suspension components for looseness or deformation and repair or replace as necessary.
F3 CHECK TOE ADJUSTMENT		
• Check the toe adjustment. Refer to the adjustment procedures in this section. • **Is the toe within specification?**	Yes ⇒ No ⇒	Go to F4. Align toe adjustment as necessary.
F4 CHECK WHEEL AND TIRE BALANCE		
• Check the tire and wheel balance. Refer to this section for the procedure. • **Are the tires and wheels balanced?**	Yes ⇒ No ⇒	Go to F5. Balance the tires and wheels as necessary.
F5 CHECK SHOCK ABSORBERS AND SPRINGS		
• Perform Pinpoint Test D to check the shock absorbers and springs. • **Are the shock absorbers and springs OK?**	Yes ⇒ No ⇒	Rotate the tires. Service as necessary.

PINPOINT TEST G: VIBRATION

G1	CHECK CASTER		
•	Check vehicle caster. Refer to the procedure in this section. • **Is the caster within specification?**	Yes ⇒ No ⇒	Go to G2. Check the suspension components for looseness or damage. Repair/replace components as necessary.
G2	CHECK TIRE AND WHEEL BALANCE		
•	Check the tire and wheel balance. Refer to this section for the procedure. • **Are the tires and wheels balanced?**	Yes ⇒ No ⇒	Go to G3. Balance the tires and wheels as necessary.
G3	CHECK WHEEL AND TIRE RUNOUT		
•	Check the wheel and tire runout. Refer to the procedure in this section. • **Is the wheel and tire runout within specification?**	Yes ⇒ No ⇒	Go to G4. Repair/replace components as necessary.
G4	CHECK DRIVELINE		
•	Check the driveline for imbalance or misalignment. • **Is the driveline imbalanced or misaligned?**	Yes ⇒ No ⇒	Repair as necessary. Inspect the steering system for a loose steering gearbox mounting bracket, or loose or damaged steering component in the steering gearbox. Replace/repair as necessary.

ADJUSTMENTS

Alignment, Front

The front wheel adjustments that can be made is the positioning of the front wheel to the front forks. Wheel adjustments should be checked only after the following conditions have been met:

- All excessive mud, dirt, and road deposit accumulation have been removed from the chassis and underbody.
- Inspection has ruled out the possibility of worn or damaged suspension components which need to be replaced.
- Heavy cargo item have been removed and vehicle attitude is correct.
- Spare tire (if so equipped), jack, and jack handle are in position.
- Tire condition and inflation (cold) have been verified to be uniform and correct.
- Wheel bearing preload has been checked, and adjusted if necessary.
- Fuel tank, engine oil, and coolant are filled to specification. If necessary, add about six pounds of weight to the cargo box for each gallon of gasoline missing from the fuel tank.

Equipment Installation

Equipment used for wheel alignment inspection must be accurate. All wheel alignment readings must be performed on an alignment rack level to within 1/16 inch (1.59 mm) side-to-side and front-to-rear. The instrumentation used must have a means of compensating for wheel runout.

The alignment rack must be level and the vehicle front wheel positioned on swivel plates. If using magnetic-type hub gauges, the wheel bolt must be removed and replaced with hub gauge adapters.

Install the wheel alignment equipment on the vehicle and follow the installation and inspection instructions provided by the manufacturer.

Wheel/Tire Runout

Excessive radial and lateral runout of a wheel and tire assembly can cause roughness, vibration, wheel tramp and steering wheel nibbles (tremor).

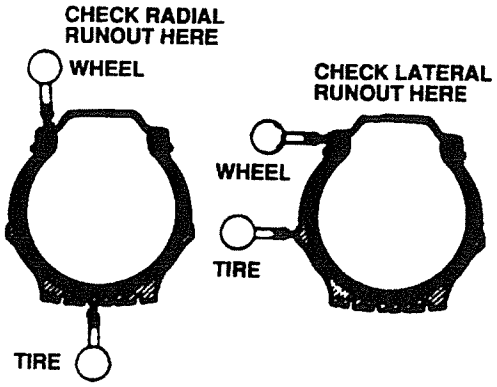
To avoid false readings caused by temporary flat spots in the tires, check runout only after the vehicle has been driven. Visually inspect the tire carcass for abnormal bulges or distortions.

Runout should be measured with a Radial Runout Gauge or equivalent. All measurements should be made on the vehicle with the tires inflated to recommended tire pressures.

Measure the wheel radial and lateral runout at the positions shown in the following illustration. The wheel runout must not exceed 0.039 inch (1.0 mm) in either position.

Using the Radial Runout Gauge or equivalent, measure the radial runout of the tires at the center and outside ribs of the tread face. Measure the lateral runout of the tire just above the buffing rib on the tire sidewall. Mark the high points of lateral and radial runout for future reference. On tires, radial runout should not exceed 0.06 inch (1.5 mm), and lateral runout should not be more than 0.10 inch (2.5 mm).

CHECKING WHEEL/TIRE RUNOUT



Tire Lead

"Lead" is the deviation of the vehicle from a straight path on a level road with no pressure on the steering wheel. Lead can be caused by:

- Incorrect wheel alignment.
- Uneven brake adjustment.
- Uneven or incorrect tire inflation pressure.
- Faulty tire construction.

The way in which a tire is constructed can produce a lead. Off-center belts on a radial tire cause the tire to develop a side force while rolling straight down the road. If one side of the tire is slightly larger in diameter that the other, the tire will have a tendency to roll to one side. This will develop a side force which can produce lead.

Tire Wear Troubleshooting Chart

CONDITION	POSSIBLE CAUSES	REMEDY
Rapid Wear at the Shoulders	• Tires underinflated. • Worn suspension components such as brace, wheel plate, adjustment bolts. • Excessive cornering speeds	• Inflate tires to recommended pressure - rotate tires. • Replace worn components. • Slow cornering speeds - rotate tires.
Rapid Wear at Center of Tread	• Tires overinflated	• Inflate tires to recommended pressure - rotate tires.
Wear at One Shoulder	• Bent Brace • Loose wheel plate adjustment bolts.	• Replace Brace • Add or remove washers to adjust wheel plate.
Feather Edge	• Bent or Worn Brace • Damaged Front Axle / Fork Assembly.	• Replace brace • Replace front axle / fork assembly.

Tire Wear Troubleshooting Chart - (cont'd)

CONDITION	POSSIBLE CAUSE	REMEDY/ACTION
Bald Spots or Tire Cupping	• Unbalanced wheel. • Excessive radial runout. • Shock absorber worn or the front shock absorber needs recharging.	• BALANCE the tire and wheel. • CHECK the runout and replace tire if necessary • REPLACE the shock absorber (rear wheels) and recharge the front absorber(s).
Tire Scalloped	• Toe out of adjustment. • Camber is out of specification. • Worn suspension components, weak springs, shock absorber assemblies.	• ADJUST the toe to specifications. • CHECK for worn or damaged suspension components. • REPLACE the worn suspension components.

Wheel Alignment

Toe-in and Camber Measurements

1. Place the vehicle on a level surface.

2. **CAUTION: Securely block the front wheel to prevent movement during the toe-in and camber adjustments.**

   When possible, use an alignment machine to adjust the toe-in and camber measurements.

3. Raise the rear of the vehicle until the rear wheels clear the ground.

4. Turn the wheels by hand, mark a line in the center of each tire tread using a toe-in gauge.

5. Lower the vehicle and measure the distance between the marked lines at the front and rear of the wheels.

6. The difference in distance between the front and rear should be no more than 1/8" toe-in.

6. Adjust the length of lower control arms.

7. When toe-in adjustment is done, raise the rear of the vehicle.

8. Remove the rear wheels.

9. Place a level on the wheel hub and adjust the upper control arms until the camber is near zero (0°) degrees.

10. Install the rear wheels. Recheck tow in.

11. Lower the vehicle.

12. Road test the vehicle to ensure the camber and toe-in measurements are adjusted properly.

Bearing, Front Wheel

Refer to this section for the front wheel bearing adjustment procedure.

Bearing, Rear Wheel

Refer to this section for the rear wheel bearing adjustment procedure.

Ride Height Correction

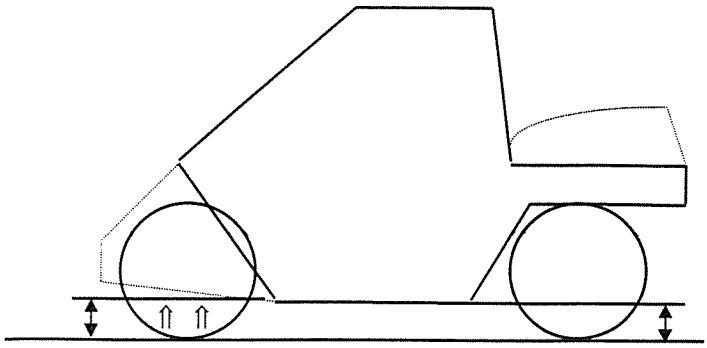
1. Check the tire pressure and adjust as necessary.

2. Inspect the wheel bearing play and correct as necessary.

3. NOTE: Ensure the vehicle is on level ground and has no luggage or passenger load before performing the following procedure.

4. Verify at the front and rear that the difference is in the ride height between the left and right sides is within 0.4 inch (10 mm). Measure from the bottom center of the tube frame.

   NOTE: Measure behind the front wheel and in front of both rear wheels to the level surface.



5. If the ride height is not within specification, check for spring damage, spring sag, front shock sag or leaking, or non-standard replacement rear springs.

Suspension, Rear

Rear wheel alignment is controlled by the upper and lower control arms. The suspension arms carry the drivelines and axle shafts, connected and aligned by a semi-rigid axle torsion beam. Torsional flexing of the axle torsion beam permits, and stabilizes, semi-independent rear wheel action.

Limited side-to-side adjustment of the axle torsion beam is provided to center the suspension for true tracking. The adjustment is part of the rear suspension installation and seldom requires service attention.

Deviations from the specification for rear wheel camber and toe can only result from distortion of the axle torsion beam structure by improper hoisting, road impact, or collision damage.

Alignment, Rear

Camber and toe-in adjustment are provided. The lower control arms are for toe-in. The upper control arms are for camber.

Toe-in out of specification indicates axle torsion beam distortion, resulting from curb impacts, collision damage, or improper hoisting.

Camber out of specification indicates axle torsion beam distortion, resulting from curb impacts, collision damage, or improper hoisting.

SPECIFICATIONS

TORQUE SPECIFICATIONS

Description	LB-Ft	N-m
Wheel Bolts	65 - 87	87 - 118

TIRE PRESSURE (PSI)

Tire Size	Front	Rear
P155/80R13	28	30

SERVICE TOOLS/EQUIPMENT

- Dial Indicator with Bracket
- Radial Runout Gauge

SECTION 6 - Suspension, Suspension and Wheel Hubs, Front and Rear

DESCRIPTION AND OPERATION

Components

Suspension, Front

The front suspension system on the GO-4 is a two-shock layout with a single-wheel and axle mounted to the bottom of the front shocks. The following front suspension components may be serviced or replaced either individually or as an assembly.

- The front shocks may be disassembled in order to replace any of the individual components. They need to be serviced, repaired or replaced in pairs.
- The front disc brake and rear wheel hub may be replaced individually.
- The front wheel bearings, inner and outer races and rollers, are replaced as a set.

Suspension, Rear

The following rear suspension components may be replaced either individually or as an assembly.

- The rear shock absorber and rear coil spring assembly may be disassembled in order to replace any of the individual components. They do not need to be replaced in pairs.
- The rear brake disc and rear wheel hub may be replaced individually.
- The rear wheel bearings, inner and outer races and rollers, are replaced as a set.
- The axle torsion bar and axle torsion bar arms are replaced as an assembly.
- The torsion bar bracket and bushings may be replaced individually.
- The upper control arms and lower control arms and center control arm mount and bushings may be replaced individually.

Shock Absorbers

The function of the two front shock absorbers in front wheel layout is to guide, dampen, and limit vehicle wheel motion. Acting as a structural member of the suspension system, the front shock absorbers dampen the up and down loads that are placed on a vehicle body when changing road conditions are met.

In addition to allowing for the up and down movement of the wheel, the front shock absorbers is part of the axis that is needed for wheel turning. The front shocks support the single front wheel and disc brake system.

Since the front shock absorber carries a side load at all times on a vehicle, its dampening forces are much higher while on a vehicle than the dampening forces when the front shock absorbers is out of the vehicle.

The rear shock absorber reacts to braking forces and provides necessary suspension damping.

The following definitions will indicate when a shock absorber should or should not be replaced because of oil weeping or leakage:

Weeping: is a condition in which a thin film of oil may be deposited on the shock absorber outer tube, and is normally noticed due to the collection of dust in this area. This condition is normal during the shock absorber seal break-in period of 3000-5000 miles (4800-8000 km) and may or may not occur in some shock absorbers. Although the film of oil may be noticed on most of the shock absorber body, the amount of weeped oil required to cause this film is less than one percent of the total shock absorber oil and, therefore, does not affect the performance of the shock absorber.

Leakage: is a condition in which the entire shock absorber body is covered with oil that has dripped down onto the suspension components and onto the pavement (e.g. during overnight parking). In this case, the shock absorber always shows a wet surface and does not dry as in weepage.

Replace a shock absorber only if it shows signs of leakage as described, but not if it falls under the description of weepage.

Wheel Bearing and Hub

The wheel hub is supported by the front axle and the hub assembly for the rear wheels on opposed outer and inner wheel bearings. A press fit secures the bearing inner races into the hub.

The rear wheel driveshaft and joint, which is splined to the wheel hub, is secured to the wheel hub with a staked axle wheel hub retainer and a large axle wheel hub retainer washer. When the axle wheel hub retainer Is loosened, it must be replaced with a new axle wheel hub retainer.

The rear wheel mounting area on each side of the vehicle is located at the junction of drive, braking and suspension components. The outboard length of the halfshaft is the rear wheel drive member. The wheel plate (hub assembly) is the support member for the wheels and disc brakes.

DIAGNOSIS AND TESTING

Suspension and Wheel Hubs, Front and Rear

Refer to Service part of this section for diagnosing the suspension and wheel hubs.

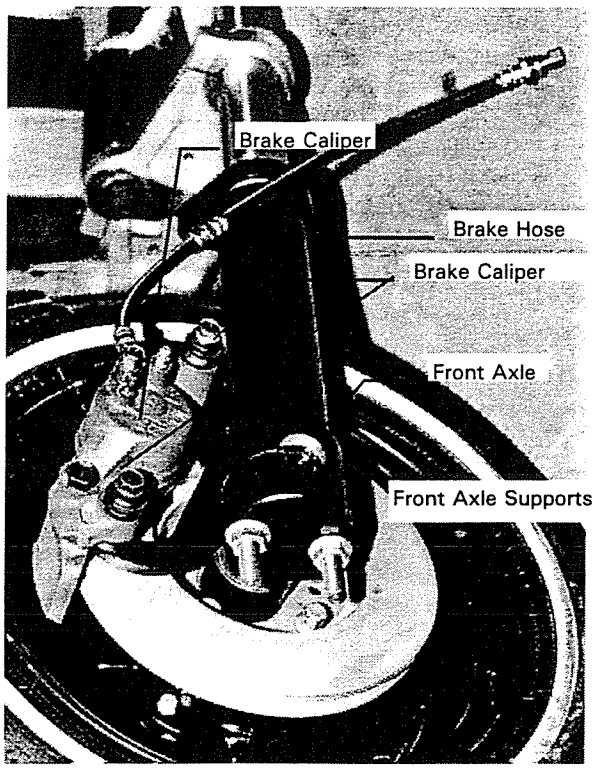
REMOVAL AND INSTALLATION

Shocks, Front

Removal

1. Raise the vehicle and support the front of the vehicle on the cross tube. Make sure that the wheel just clears the floor.
2. Remove four flange nuts holding the front axle shaft supports.
3. Remove the front axle shaft supports.
4. Remove two brake caliper bolts and slide the disc brake caliper off the brake disc.

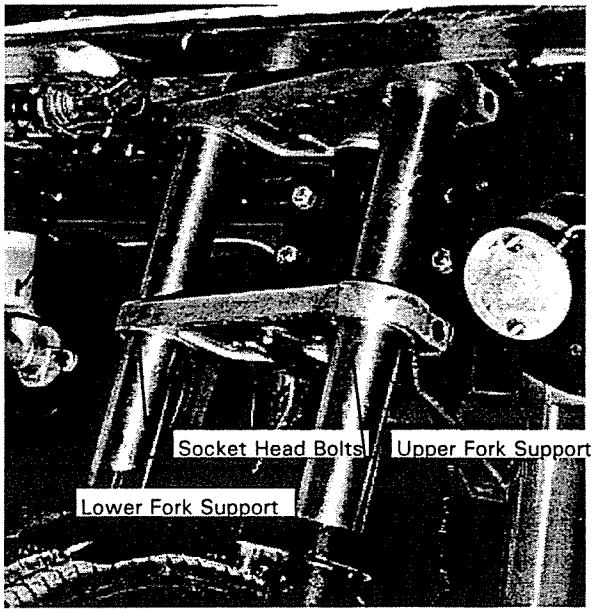
   Caution: Do not allow the brake disc to hang from the brake line. This can cause splitting and cracking of the brake line.
5. Tie up the brake caliper to the frame.
6. Remove axle and wheel assembly.



7. Remove the brake hose clip from the cutout on the front fender and disengage the front brake hose.

8. Remove four 3/8 x 1-3/4 carriage bolts, flatwashers and locknuts.

9. Remove the front fender and two fender supports from between the front shocks.



10. Loosen socket head bolts on the upper fork support and lower fork support until shocks can be turned by hand.

    NOTE: The top of the shock is threaded and fits into the upper fork support.

11. Gently tap down on the base of the shock.

12. Remove the front shock from the upper and lower fork supports.

Installation

1. Tap the threaded end of the shock up through the lower fork support and into the upper fork support.

   The top of the shock should bottom out in upper support..

   NOTE: Use a heavy rubber mallet on the shock to prevent damage.

2. Tighten the 3/8 x 2 socket head bolt to 18-20 lb-ft (25-28 N-m).

3. Install fender in reverse order of removal.

4. Push axle and wheel assembly up into the ends of the shock.

5. Install the front axle supports. Tighten the flange nuts to 50 lb-ft (164 N-m).
6. Install disc brake caliper by sliding it over the brake disc. Fasten with the two bolts.

7. Position the front brake hose in the cutout on the front fender and secure with the brake hose clip.

8. Lower vehicle.

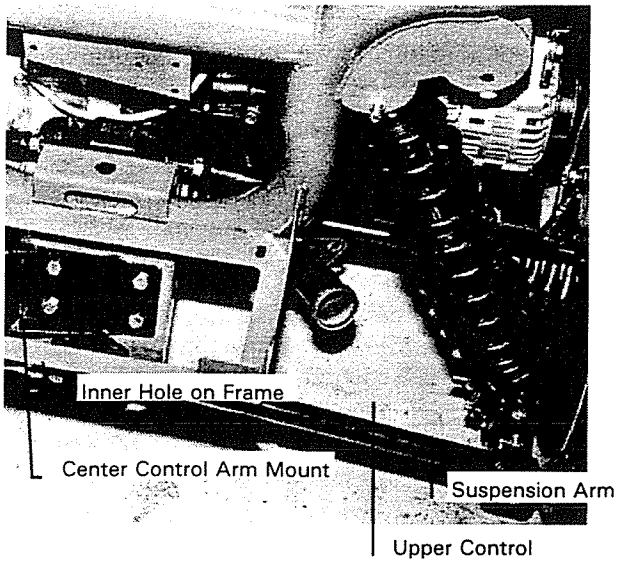
Rear Coil Springs and Shock Absorber

Removal

1. CAUTION: If removal and installation of the left and right rear spring and shock absorbers is necessary, do not attempt it simultaneously. Damage to the components may occur. Remove and install one and then the other.

2. Raise and support the vehicle.

3. Remove the rear spring and shock absorber bolt from the vehicle frame and the suspension arm.



4. Pull the rear spring and rear shock absorber assembly downward.

Installation

1. Before installing the rear shock absorber and rear spring, inspect them.

2. Insert the rear spring and rear shock absorber toward the upper vehicle frame, guiding the rear shock absorber rod into the inner mounting hole of the vehicle frame.

3. Line up the lower end of the shock absorber with the hole in the suspension arm.
4. Secure the rear coil spring and rear shock absorber by inserting one 3/8 x 2-1/2 bolts, nut, and jam nut at the top and bottom. Torque shock absorber bolts to 50-60 lb-ft (68-81 N-m).

Wheel Bearings - Front

Removal

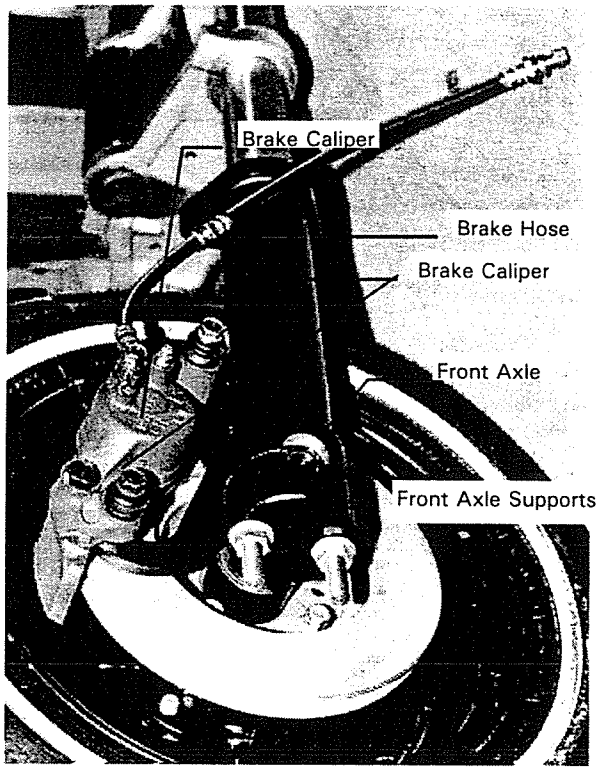
1. Raise the vehicle and support the front of the vehicle on the cross tube. Make sure that the wheel just clears the floor.

2. Remove two brake caliper bolts and slide the disc brake caliper off the brake disc.

Note: On large brake Disc: Rim, axle and caliper must be removed as an asssembly with wheel bolts loose.

CAUTION: Do not allow the brake disc to hang from the brake hose. This can cause splitting and cracking of the brake hose.

3. Tie up the brake caliper to the frame.



4. Remove two socket head bolts and caliper brake mount from the front shock assembly.

5. Remove four flange nuts holding the front axle shaft supports.

6. Remove the front axle shaft supports.

7. Remove axle and wheel assembly.

8. Remove wheel bolts and wheel assembly.

Installation

NOTE: Apply a thin film of SAE 30 weight oil to the front axle.
1. Pre-tighten the front axle assembly by rotating the outer axle sleeve, to the axle until all end play has been removed.

2. Tighten the outer axle sleeve until a light bind on the bearings can be felt. Loosen the outer axle sleeve by 1/2 to 1/8 turn. Once the wheel is installed in the machine it is suggested to check the ability of the wheel to rotate freely, by jacking up the unit so the front is off the ground.

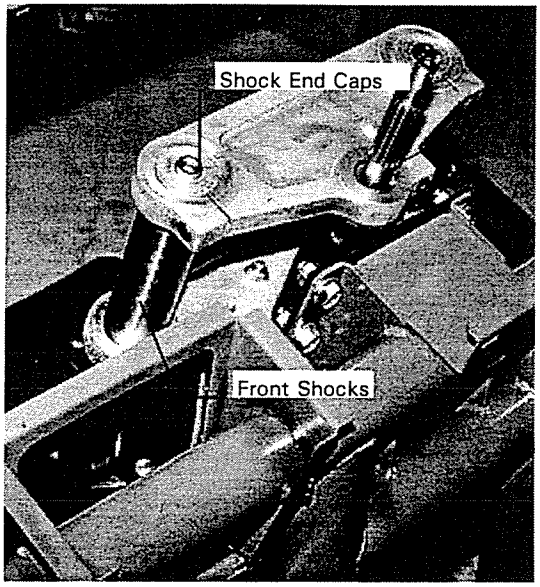
   IMPORTANT: Failure to adjust the bearing properly will result in premature wear from either being too loose or running hot from being too tight.

3. Install rotor and wheel.

4. Place axle in front shock group.

5. Install shock end caps.

6. Torque axle cap nuts to 50 ft-lbs.



7. Torque front first, then rear axle cap nuts (standard motorcycle procedure).

   Tighten the 3/8 bolts; 40 - 50 lb.-ft (54 - 68 N-m).

Wheel Bearings - Rear

Removal

1. Raise and support the vehicle.

2. Remove the wheel and tire assembly.

3. CAUTION: Use care not to damage the groove and thread in the rear wheel drive shaft and joint end.

   Use a small cape chisel to raise the staked edge of the rear axle wheel hub retainer.

4. NOTE: Have an assistant apply the brakes during procedure to prevent the wheel hub assembly from turning.

   Remove the rear axle wheel hub retainer and discard.

5. Remove the brake hose clip that secures the rear brake hose to the frame.

6. Remove the two rear disc brake caliper bolts.

7. Lift the rear disc brake caliper off the rear disc brake rotor.

8. CAUTION: Do not allow the rear disc brake caliper to hang freely by its rear brake hose.

9. Remove the two disc brake rotor screws and the rear disc brake rotor.

10. Remove the rear suspension upper control arm bolt at the point where connects to the rear wheel mount.

11. Release the upper control arm from the rear wheel mount. Use a prybar, if needed.

12. Remove the rear wheel hub assembly from the rear wheel driveshaft.

13. If necessary, use a chisel to separate the rear disc rotor from the rear wheel hub assembly.

Installation

1. NOTE: Apply a thin film of SAE 30 weight oil to the rear wheel driveshaft and joint splines.

2. Guide the rear wheel hub assembly onto the rear wheel driveshaft and joint and along the prelubricated splines.

3. Install the rear wheel.

4. Lower vehicle.

Wheel Bearings and Hubs

The wheel plate hub is a support member which contains the wheel hub bearings. The brake components associated with the hubs includes the disc brake caliper. The wheel plate and disc brake rotor are mounted on the wheel hub flange.

The wheel hub is supported in the wheel plate on tapered roller bearings. A press fit secures the bearings' inner races to the hub and the outer races to the wheel plate. Bearing preload is set using a selective spacer that is installed in the wheel plate between the inner and outer bearings and races on the hub between the inner races.

The halfshaft on the rear wheels, which is splined to the hub, is secured to the hub with a staked nut and a large flatwasher. When the nut is loosened, it must be replaced with a new nut.

Front

Removal/Installation

Refer to the Front Shock removal/installation procedure in this section.

Wheel Bearing Hub - Rear

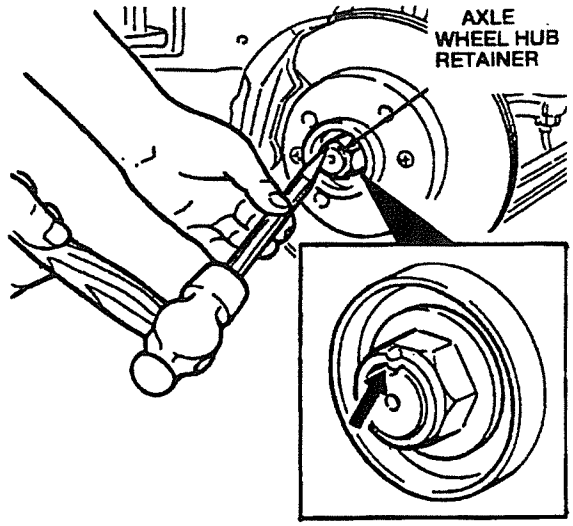
Removal

1. Raise the vehicle.

2. Unbolt and remove the rear wheel from the hub assembly.

3. Straighten the staked edge of the halfshaft attaching nut flange using a small cape chisel.

   Caution: Use care not to damage the groove and threads in the halfshaft end.



4. Remove the halfshaft attaching nut. Discard the nut, regardless of condition.

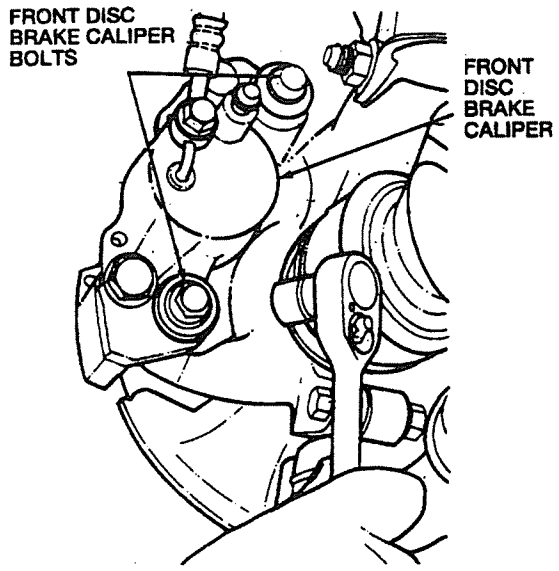
   Apply the brakes during this procedure to prevent the hub assembly from turning.

   NOTE: A used halfshaft attaching nut is not a secure method of attaching the hub assembly. Use a new nut each time the retaining nut is removed.

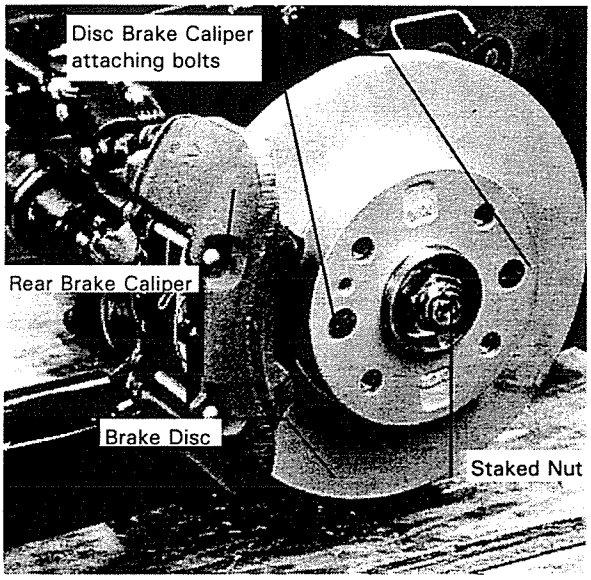
5. Remove the clip securing the caliper hose to the frame bracket.

6. Remove the cotter pin and parking brake linkage.

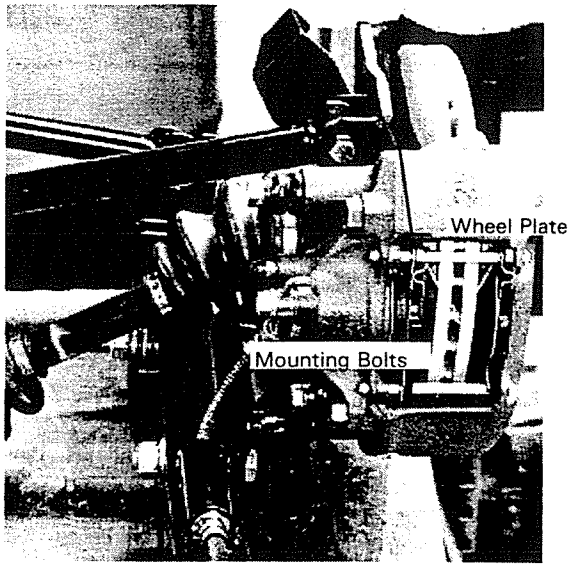
7. Remove the disc brake caliper attaching bolts.



8. Remove the disc brake caliper.



9. Lift the caliper off the rotor. Do not allow the caliper to hang freely by its flex hose. Use a rope or wire to suspend the brake assembly from the frame.



10. Remove two bolts which secure the wheel plate.

11. Slide the hub assembly off the end of the halfshaft.

    If binding occurs, tap the end of the shaft with a plastic-tipped hammer. If the wheel hub is rusted to the halfshaft, use either a two-jaw puller or a hub puller to achieve separation.

Installation - Rear Wheel

1. Slide wheel plate bolts into wheel plate and fasten to the rear suspension yoke.

2. Bolt mechanical brake caliper to wheel plate.

3. Position the hydraulic caliper to the wheel plate and install the attaching bolts. Tighten the caliper attaching bolts to 29-36 ft-lb. (39-49 N-m).

4. Position the caliper hose in the routing bracket and install the retaining clip.

5. Install a new halfshaft attaching nut. Tighten the attaching nut to 116-174 ft-lb. (157-235 N-m). After installation of the nut, the wheel hub assembly must rotate freely by hand.

6. Stake the halfshaft attaching nut into the shaft groove.

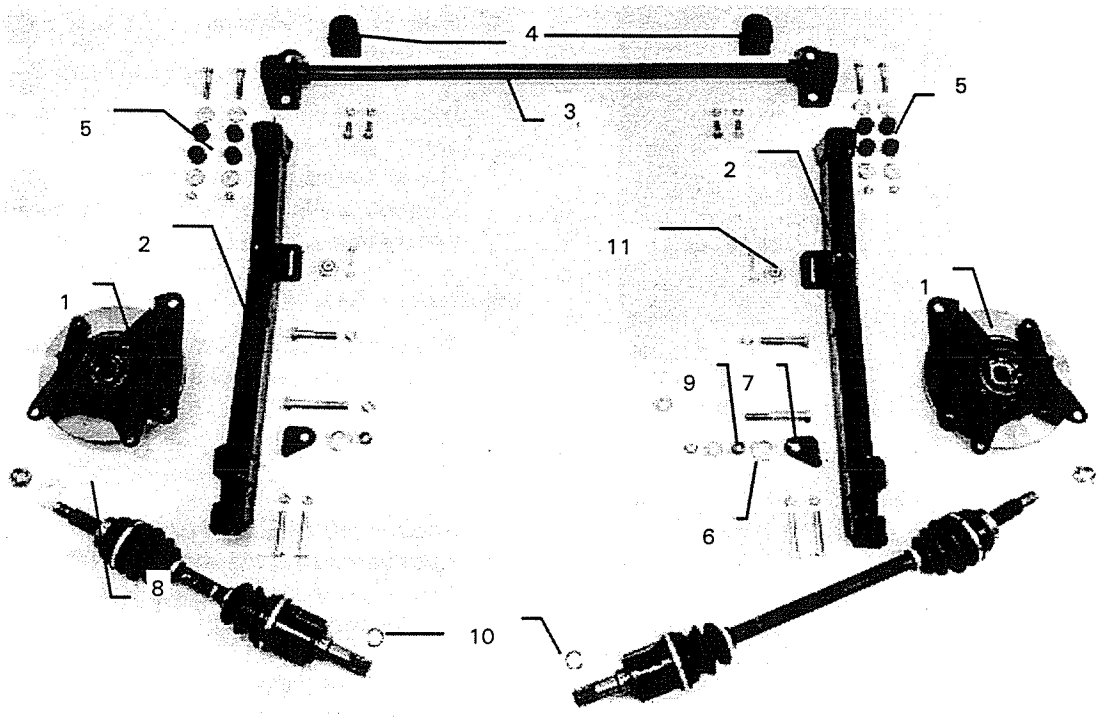
   Caution: Do not use a pointed tool. If the nut cracks even slightly during staking, replace it with another one.

Axle Torsion Bar and Suspension Arms

Removal

1. Raise and support the vehicle.
2. Remove the wheel and tire assemblies.
3. Remove the lower and upper control arms from the left and right wheel mounts.
4. Remove the right and left rear wheel mounts.
5. Disconnect the rear wheel brake hose.
6. Disconnect the parking brake cable and conduit clevises at the parking brake.
7. Remove the rear spring and shock absorber bolt from the vehicle frame and the suspension arm.
8. Remove the 3/8 bolts and nuts securing the suspension arm(s) to the outer brackets on the axle torsion bar.
9. Remove the axle torsion bar bolts from the torsion bar brackets and remove the axle torsion bar.

Axle Torsion Beam and Suspension Arms - Exploded View



Item	Part Number	Description
1	289005 289004	Hub - LH Rear Assembly Hub - RH Rear Assembly
2	283882 283883	LH Suspension Arm RH Suspension Arm
3	283599	Torsion Bar
4	282729	Rubber Torsion Bushing
5	282728	Rubber Bushing Kit

Item	Part Number	Description
6	583873	Pulley
7	442887 442888	LH Cable Bracket RH Cable Bracket
8	442868	Emergency Brake Pulley
9	442876	Bushing - Pulley
10	250747	Clip
11	280751	Locknut with Washer

Installation

1. If installing a new axle torsion bar, install new bushings. Replace bushings if worn or damaged.

2. Position the torsion bar to the torsion bar brackets.

3. Align the bolt holes and install the torsion beam bolts and locknuts. Loosely install the axle torsion bar nuts.

4. Position the left and right hand suspension arms to the outer brackets on the rear torsion bar. Loosely install the 3/8 bolts and nuts.

5. Install the left and right hand wheel mounts (hub assembly). Refer to the procedure in this section.

6. Install the parking brake cable and pulley on the axle torsion bar and connect to the front parking brake cable.

7. Connect the right and left rear wheel brake hose at the rear brake hose support bracket and clip in place.

8. Install the wheel and tire assemblies, tighten the wheel hub bolts to 65-87 lb-ft (88-118 N-m) and lower the vehicle to load the suspension to normal ride height.

9. Tighten the axle torsion bar nuts to 69-86 lb-ft (93-117 N-m).

10. Tighten the suspension arm nuts to 40-50 lb-ft (54-68 N-m).

11. Check the wheel alignment. Refer to the Wheel Alignment procedure.
12. Bleed the rear brakes. Operate the park brakes and adjust if necessary. Refer to Section 4 for the procedure.

Control Arms, Rear Upper and Lower

The procedure applies to the upper and/or lower control arms.

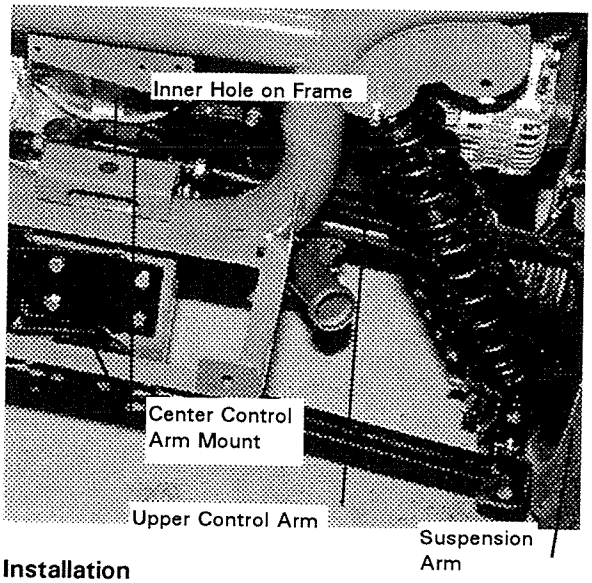
1. Raise and support the rear end of the vehicle.

2. Remove the wheels and tires from rear hubs.

3. Remove the 3/8 bolts securing the control arm to wheel mount and frame.

   NOTE: The upper control arms are connected together with a center control arm mount. The lower control arms are connected to the frame of the vehicle.

4. Remove the control arm from the wheel mount and the center arm mount or frame.



Installation

Install the control arm in reverse order of removal.

Torque the bolts 40-50 lb-ft (30-35 N-m).

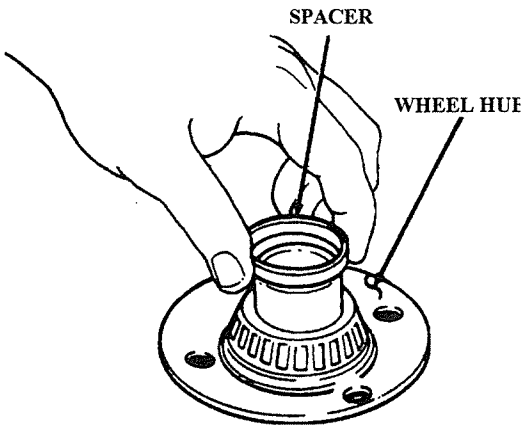
DISASSEMBLY AND ASSEMBLY

Wheel Hub and Wheel Bearings

1. Remove the wheel hub/rotor assembly from the wheel plate using a knuckle puller.

2. Remove the bearing preload spacer from the hub.

NOTE: The spacer is preselected to yield the correct bearing preload. Save removed spacer for use during assembly.

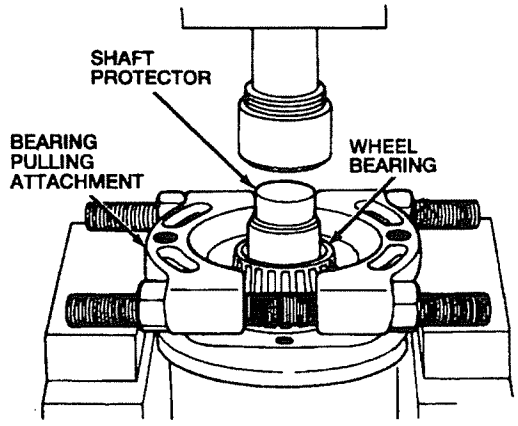


3. Clamp the hub/rotor assembly in a vise with protective jaw caps.

4. Scribe aligning marks on the hub and rotor for use during assembly.

5. Remove attaching bolts and the rotor.

6. Remove the outer bearing from the wheel hub using a bearing splitter, shaft protector and a press.



7 Discard the seal. Replace with a new one.

Preparation (Pre-assembly)

1. Wash the disassembled components before inspection.

   NOTE: Never "spin-dry" a bearing using forced air, since this may damage its friction surfaces. Remove any minor rust with fine sandpaper. Replace defective parts.

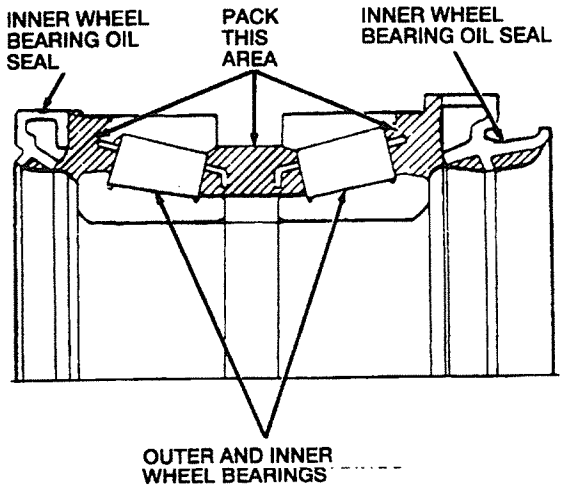
2. Use the following check points during inspection of the cleaned components:

Bearings - Damage or abnormal wear patterns. Refer to the inspection charts in this section.

Hub - cracks or damage to the casting. Wear pattern at the oil seal contact surface. Scoring or rusting of the bearing bore.

Assembly

1. Pack the bearing with lubricant. Pack the hub area as shown in the installed view below.



2. Place the inner bearing into the bore so that it rests in a level position.

3. Lubricate the lip of the new inner grease seal. Form the lubricant into a strip, concentrating along the edges of the seal lip.

   Form the lubricant into a strip, concentrated along the edges of the inner wheel bearings oil seal lip.

4. Use Seal Replacer and Driver Handle and install the new inner wheel bearing oil seal oil seal in the bore.

5. Place the original wheel outer bearing retainer washer, or retainer washer selected from the wheel bearing adjustment procedure, in the wheel bore.

6. Position the outer wheel bearing in the wheel bore.

7. NOTE: Form the lubricant into a strip, concentrated along the edges of the inner wheel bearing seal lip.

   Lubricate the lip of a new inner wheel bearing oil seal with a premium long life grease or similar.

8. Use a seal replacer and driver handle and install the new inner wheel bearing oil seal in the wheel bore.

9. Use spacer from the spacer selection tool and position the wheel hub / disc brake rotor assembly in the wheel bore and press into position.

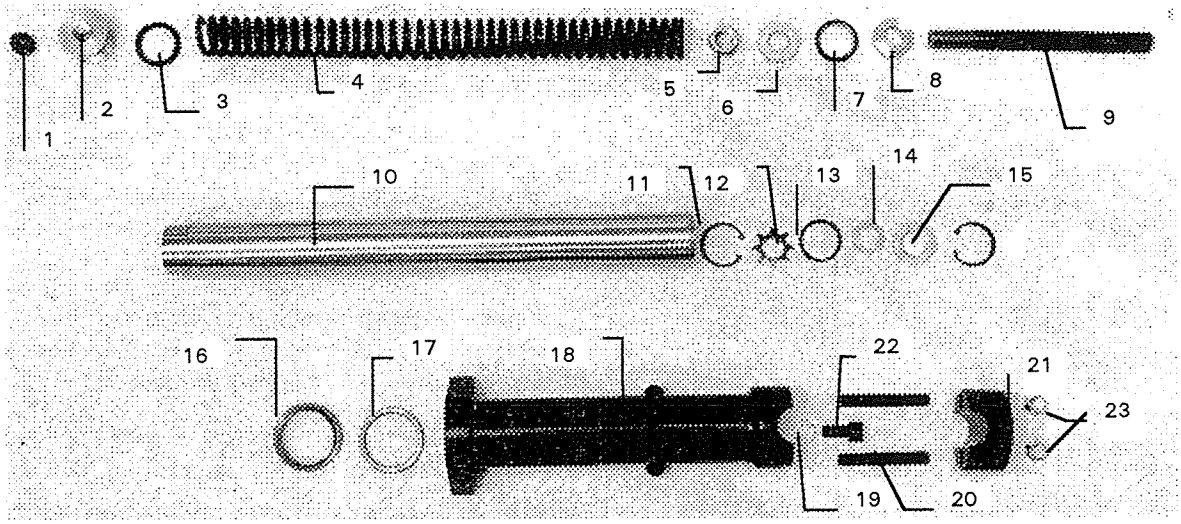
10. Position the rotor on the hub, observing the original aligning marks and install the attaching bolts. Tighten the attaching bolts to 33-40 ft-lb. (44-54 N-m).

    Install the wheel hub and wheel bearing assembly. Refer to the procedure in this section.

Front Shock(s)

1. Refer to removal procedure in removal and installation of the front shock.

2. Place the painted end of the front shock assembly into a soft-jawed vise.



Item	Part Number	Description
1	343668	Filler Plug
2	343598	Strut Cap
3	341488	O-Ring Strut Cap
4	344012	Compression Spring
5	344009	Hex Nut Damper Tube
6	344005	Front Shock Damper Washer
7	343594	Piston Uni-ring
8	344004	Damper Piston
9	344011	Damper Tube
10	344001	Front Shock Strut
11	344017	Snap Ring
12	343630	Star Washer

Item	Part Number	Description
13	344008	O-Ring
14	344007	Washer
15	343631	Damper Washer
16	343595	Rod Wiper
17	343593	Load U-Cup
18	342251	Front Shock Reservoir
19	344006	1/2 inch Copper Washer
20	341120	Axle Support, Fork Stud
21	344000	Front Axle Support
22	774024	Bolt, Socket Head
23	770823	½ Stover Locknut

8. Remove the filler plug.

9. Invert the fork and turn it several times to drain out the fork oil. Hold the fork inverted for a few minutes to drain oil.

10. Remove the strut cap from the front shock strut.

    NOTE: Hold down the strut cap as it is being removed. The compression spring will pop it open.

11. Remove the socket head bolt from the bottom of the front shock reservoir.

12. Remove the shock damper tube with compression spring from the top of the front shock.

13. Remove the rod wiper and loaded U-cup.

14. Pull and remove the front shock strut from the front shock reservoir.

Assembly

Assemble the front shocks in reverse order of removal.

ADJUSTMENTS

Bearing Preload

1. Lubricate the bearing races and bearing with a thin film of clean engine oil.

2. Install the bearings in the wheel plate.

3. Install spacer selection tool and clamp the bolt head in a vise.

4. Tighten the center bolt in increments of 36, 72, 108 and 145 ft-lb. (49, 98, 147 and 196 N-m).

5. After tightening the center bolt to a specified increment, seat the bearings by rotating the hub.

6. Remove the tool from the vise.

7. Mount the wheel plate in a vise.

8. Measure the amount of torque required to rotate the spacer selection tool, using an inch-pound torque wrench.

9. Take the torque wrench reading just as the tool starts to rotate.

   IMPORTANT: If the torque wrench indicates 2.2-10.4 lb.-in (0.25-1.8 N-m), the spacer is the correct thickness.

   If the torque wrench indicates less than 2.2 lb.-in (0.25 N-m), a thinner spacer must be installed.

   If the torque wrench indicates more than 10.4 lb.-in (1.8 N-m), a thicker spacer must be installed.

Bearing Spacer

Each bearing spacer has been assigned a numerical code that identifies its thickness. Refer to the chart for bearing spacer thickness. The code is stamped into the outer diameter of the spacer. The numbers range from 1 to 26, with spacer #1 being the thinnest.

If the number stamped on the spacer is not legible, measure the spacer with a micrometer and compare it to the chart to determine which number it is.

Changing the spacer thickness by one number (either higher or lower) will change bearing preload by 1.7-3.5 lb.-in (0.2-0.4 N-m). Refer to the Spacer Chart following the Bearing Inspection Charts.

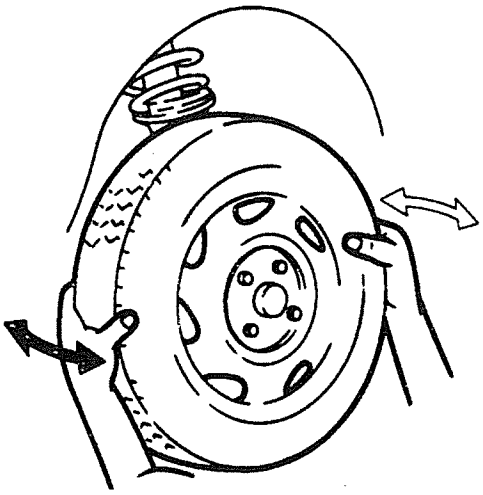
Balance Weights

Balance weights should be designed for steel wheels. Install balance weights securely around the rim of the wheel.

Bearing End Play

1. Raise and support the vehicle.

2. Rock the tire by hand and confirm there is no bearing play in the axial direction.



3. Wheel bearing end play should be 0 inch (0 mm) in the axial direction. If the wheel bearing end play exists, adjust the bearing preload. Refer to the procedure in this section. Replace any components necessary.

4. Spin the tire quickly by hand. Check that it spins smoothly and there is no abnormal bearing noise. If any problem is found, adjust or replace the bearing.

Wheel Bearings

1. Use a Bearing Cup Replacer or equivalent and Driver Handle and install the outer bearing races in the hub.

2. Lubricate the bearing races and inner and outer wheel bearings with a thin film of clean grease.

3. Install the inner and outer wheel bearings into the hub.

4. Install the Spacer Selection Tool and clamp the bolt head in a vise.

5. Tighten the nut, in increments, to 36,72, 108, and 145 lb-ft (49, 98, 147, and 196 N-m). After tightening the nut to each specified increment, seat the bearings by rotating the wheel hub.

6. Remove the hub and Spacer Selection Tool from the vise.

7. Mount the wheel hub in a vise, clamping the wheel hub in place.

8. NOTE: The torque wrench reading must be taken just as the tool starts to rotate.

   Measure the amount of torque required to rotate the Spacer Selection Tool, using an inch-pound torque wrench.

If the torque wrench indicates 2.2-10.4 lb.-in (0.25-1.8 N-m), the outer wheel bearing retainer washer is the correct thickness.

If the torque wrench indicates less than 2.2 lb.-in (0.25 N-m), a thinner wheel outer bearing retainer washer must be installed.

Of the torque wrench indicates more than 10.4 lb.-in (1.8 N-m), a thicker outer bearing retainer washer must be installed.

Each wheel outer bearing retainer washer is assigned a numerical code that identifies its thickness. This code is stamped into the outer diameter of the wheel outer bearing retaining washer. The numbers range from 1-21, with one being the thinnest wheel outer bearing retainer washer.

If the number stamped on the wheel outer bearing retainer washer is not legible, measure the wheel outer bearing retainer washer with a micrometer and compare it to the chart to determine which number it is.

Changing the outer bearing retainer washer thickness by one number, either higher or lower, will change bearing preload by 1.7-3.5 lb.-in (0.2-0.4 N-m).

Wheel Outer Bearing Retainer Washer Chart

Stamped Mark	Retainer Washer Thickness (in., mm)
1	0.2474 in. (6.285 mm)
2	0.2490 in. (6.325 mm)
3	0.2506 in. (6.365 mm)
4	0.2522 in. (6.405 mm)
5	0.2538 in. (6.445 mm)
6	0.2554 in. (6.485 mm)
7	0.2570 in. (6.525 mm)
8	0.2586 in. (6.565 mm)
9	0.2602 in. (6.605 mm)
10	0.2618 in. (6.645 mm)
11	0.2634 in. (6.685 mm)
12	0.2560 in. (6.725 mm)
13	0.2666 in. (6.765 mm)
14	0.2682 in. (6.805 mm)
15	0.2698 in. (6.845 mm)
16	0.2714 in. (6.885 mm)
17	0.2730 in. (6.925 mm)
18	0.2746 in. (6.965 mm)
19	0.2762 in. (7.005 mm)
20	0.2778 in. (7.045 mm)
21	0.2794 in. (7.085 mm)
22	0.2810 in. (7.125 mm)
23	0.2826 in. (7.165 mm)
24	0.2842 in. (7.205 mm)
25	0.2858 in. (7.245 mm)
26	0.2874 in. (7.285 mm)

WHEEL ALIGNMENT

Toe-In and Camber Measurements

1. Place the vehicle on a level surface prior to starting the wheel alignment.

2. Raise the rear of the vehicle until the rear wheels are off the ground.

3. Turn the wheels by hand, mark a line in the center of each tire tread using a toe-in gauge.

4. Lower the vehicle and measure the distance between the marked lines at the front and rear of the wheels. The difference between the front and rear should be no more than 1/8 inch toe-in.

   Adjustments can be done by increasing or decreasing the length of the lower control arms.

5. When finished adjusting toe-in, raise the rear of the vehicle and remove the rear wheels.

6. Place a level on the wheel hub and adjust the upper control arms until the camber is near zero (0°) degrees.

   NOTE: Use when possible an alignment machine to adjust the toe-in and camber measurements.

7. Before placing the vehicle into service: road test the vehicle to ensure all functions are operational and adjusted properly.

CLEANING AND INSPECTION

Axle Shaft

Use a dial gauge, check the axle shaft for runout and replace it if the runout exceeds 0.25mm.

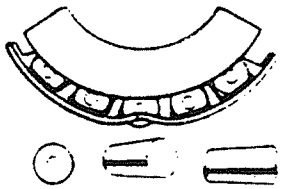
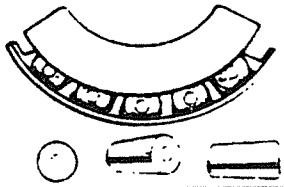
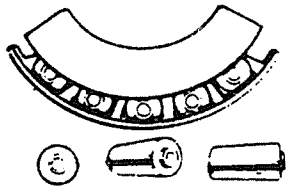
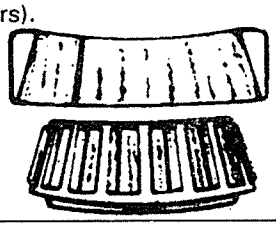
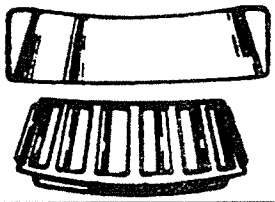
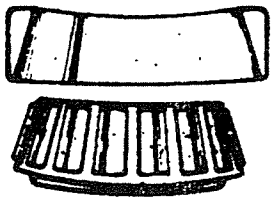
Compression Spring - Front Shock

Measure the compression spring on the front shock. If it is shorter than the service limit (18.5 inches or 44.4 cm), replace with a new one.

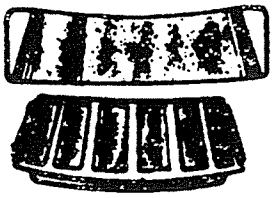
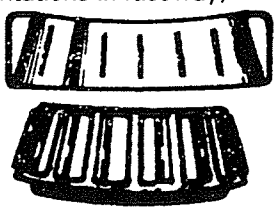
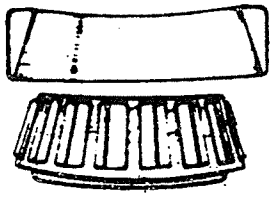
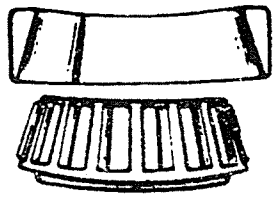
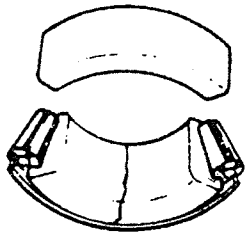
Front Shock Tube

Inspect the inner tube sliding surfaces and outer tube sliding surface for any scuffing.

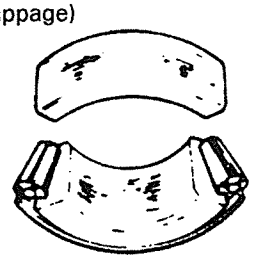
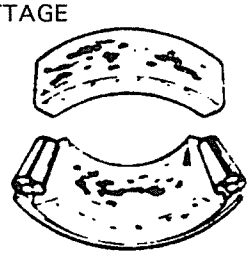
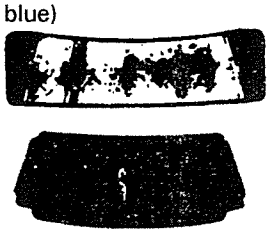
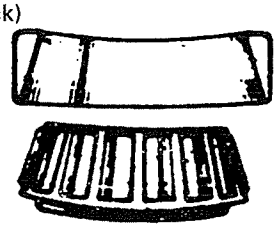
WHEEL BEARING AND HUB COMPONENT INSPECTION CHART - Bearings

CONDITION	CAUSE	CORRECTION
BENT CAGE 	Improper handling or tool usage	Replace bearings
GALLING (Metal smears on roller ends) 	Overheating Lubricant failure Incorrect lubricant	Replace bearings Use only specified lubricant.
ABRASIVE STEP WEAR 	Fine abrasives mixed with lubricant	Replace bearings
ETCHING (Outer and inner bearing surfaces appear gray or grayish black in color. Etching of outer and inner wheel bearing material may occur between the rollers). 	Incorrect lubricant Lubricant failure	Replace bearings Use only specified lubricant
MISALIGNMENT 	Outer and inner bearing cup misaligned in spindle bore due to burr, nick or dirt on cup seal.	Replace inner and outer wheel bearings. Inspect inner and outer bearing cup seals for damage or dirt.
INDENTATIONS 	Contaminated lubricant	Replace inner and outer wheel bearings.

WHEEL BEARINGS AND HUBS COMPONENT INSPECTION CHART - Bearings (Con't)

CONDITION	CAUSE	CORRECTION
FATIGUE SPALLING (Flaking of surface metal) 	Excessive wheel preload Insufficient lubricant Incorrect lubricant	Replace wheel bearings. Use only specified lubricant.
BRINELLING (Surface indentations in raceway) 	Impact loading or vibration while the bearing is not rotating. Insufficient lubricant.	Replace inner and outer wheel bearings if rough or noisy.
CAGE WEAR 	Fine abrasives mixed with lubricant. Insufficient lubricant.	Replace inner and outer wheel bearings. Use only specified lubricant.
ABRASIVE ROLLER WEAR 	Fine abrasives mixed with lubricant.	Replace inner and outer wheel bearings if rough or noisy.
CRACKED RACE 	Improper fit. Misaligned bearing cup. Metal chips.	Replace bearings. Use correct bearings. Inspect bearing cup seats for damage or dirt.

WHEEL BEARINGS AND HUBS COMPONENT INSPECTION CHART (Cont)

CONDITION	CAUSE	CORRECTION
SMEARS (Smears of metal due to slippage) 	Improper fit. Incorrect lubricant. Overheating. Excessive loading.	Replace bearings. Use correct bearings. Use only specified lubricant.
FRETTAGE 	Corrosion set up by small relative movement between bearing rollers, races and cups without adequate lubrication.	Replace inner and outer wheel bearings.
HEAT DISCOLORATION (Color can range from faint yellow to dark blue) 	Excessive loading. Incorrect lubricant. Insufficient lubricant. Improper fit. Excessive preload.	Replace bearings. Use only specified lubricant. Use correct bearings.
STAIN DISCOLORATION (Color can range from light brown to black) 	Incorrect lubricant. Moisture contamination.	Reuse bearings if stains can be removed by light polishing or if no evidence of overheating is observed. Use only specified lubricant.

SPECIFICATIONS

Torque Specifications

Description	lb.-ft	N-m
Wheel plate bolts	69-86	93-117
Disc brake caliper attaching bolts	29-36	39-49
Halfshaft attaching nut	116-174	157-235
Wheel attaching bolts	65-87	88-118
Rotor attaching bolts	33-40	44-54

Wheels and Tires

Wheels	Type
Size	13 x 4-1/2 J
Offset inches (mm)	1.8 (45)
Bolt diameter Inches (mm)	4.0 (100)
Material	Steel
Tires	
Size	P155/80R13
Air Pressure, front - psi (kPa)	30 (200)
Air Pressure, rear - psi (kPa)	28 (180)

Wheel Rim Runout and/or Balance Specifications

Description	inches	mm
Wheel radial runout	0.04	1.0
Wheel Lateral runout	0.04	1.0

Tire Runout Specifications

Description	Specification
Tire Lateral Runout	0.010 in., 2.5 mm
Tire Radial Runout	0.06 in., 1.5 mm

Torque Specifications

Description	Lb.-ft	N-m
Wheel hub bolts	65-87	88-118

SERVICE TOOLS/EQUIPMENT

- Deluxe Tire Changer
- Computerized Wheel Balancer
- Inflation Chamber
- Electronic Strobe Balancer
- Radial Run-out Gauge
- Tire Spreader
- Heat Gun

SECTION 7 - Axles and Driveshafts

SECTION TITLE PAGE
HALFSHAFTS 7-1

DESCRIPTION AND OPERATION

Halfshafts, Rear Wheel

The rear wheel driveshaft and joints are the mechanical links that transfer engine torque from the transaxle to the rear wheels. At the transaxle end, the rear wheel driveshaft joint is splined to the differential side gear. Disengagement of the tripod-type rear wheel driveshaft joint from the differential side gear is prevented by an expanding spring steel driveshaft bearing retainer circlip. During installation, the driveshaft bearing retainer circlip compresses around the rear wheel driveshaft joint as it enters the differential side gear. Once through the differential side gear, the driveshaft bearing retainer circlip expands into a counterbore machined into the back side of the differential side gear.

The wheel end of the right hand rear wheel driveshaft and joint or the left hand rear wheel driveshaft and joint is splined to the wheel hub which is supported on opposed tapered rear wheel bearings. Disengagement of the rear wheel driveshaft and joint from the wheel hub is prevented by the rear axle wheel hub retainer washer and the rear axle wheel hub retainer.

Backlash between the wheel hubs and rear wheel driveshaft and joints is eliminated by the splines. The rear wheel hub splines are machined straight while the rear wheel driveshaft and joint splines are machined with a slight helical cut. The difference in splines provides a tight, backlash-free coupling without the removal and installation problems associated with an interference fit.

Rear wheel driveshaft joints exist at both ends of the rear wheel driveshafts.

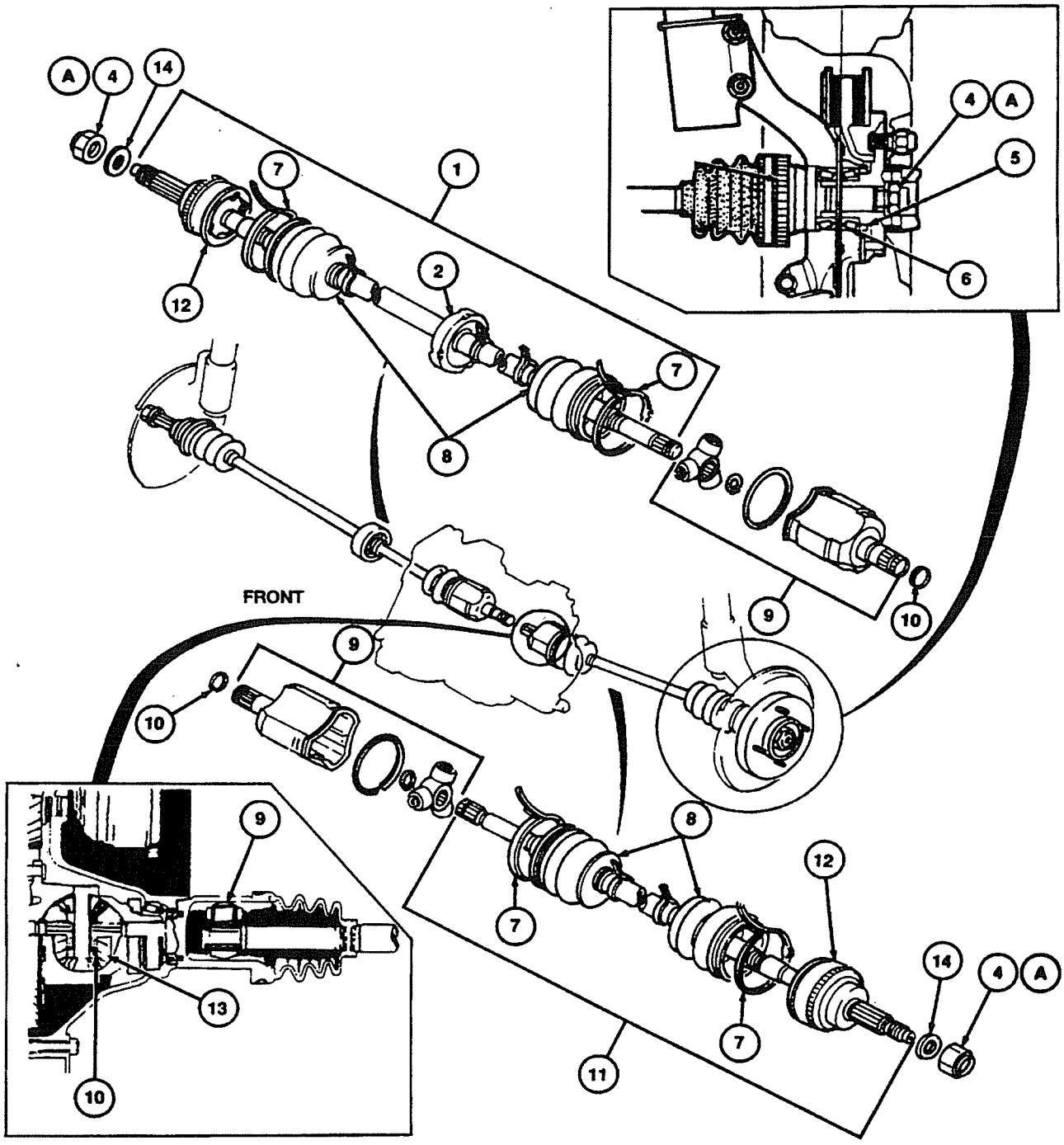
Two different types of rear wheel driveshaft joints are used. The inboard rear wheel driveshaft joints are repairable tripod-type rear wheel driveshaft joints. The outboard rear wheel driveshaft joints are non-repairable Birfield-type rear wheel driveshaft joints.

Tripod-type rear wheel driveshaft joints are used to prevent the transfer of engine vibration through the rear wheel driveshafts to the vehicle body. Additional reduction of vibration is provided by a dynamic damper installed approximately in the middle of the right hand rear wheel driveshaft and joint.

Rear wheel driveshaft joints are necessary because the rear wheel driveshaft is required to transmit torque while compensating for rear suspension movement. As the suspension moves, the rear wheel driveshaft joints allow the rear wheel driveshafts to change length and operate smoothly through varying angles.

For the necessary flexibility, Birfield-type rear wheel driveshaft joints use ball bearings positioned by a cage. The tripod-type rear wheel driveshaft joint uses three balls mounted on needle bearings and a spider. In both types of rear wheel driveshaft joints, the outer race is machined into the rear wheel driveshaft joint housing.

The inboard, tripod-type rear wheel driveshaft joints can be disassembled and serviced. Other than the rear wheel driveshaft joint boot, the outboard Birfield-type rear wheel driveshaft joint is serviced only as an assembly with the right hand rear wheel driveshaft and joint or the left hand rear wheel driveshaft and joint.



Item	Part Number	Description
1	250744	Rear Wheel Driveshaft and Joint, RH
3	280751	Rear Axle Wheel Hub Retainer
4	-	Wheel Hub
5	-	Rear Wheel Bearing
6	-	Rear Wheel Driveshaft Joint Boot Clamp
7	-	Rear Wheel Driveshaft Joint Boots
9	-	Rear Wheel Driveshaft Joint, Tripod-Type
10	250747	Driveshaft Bearing Retainer Circlip.
11	250745	Rear Wheel Driveshaft and Joint, LH
12	-	Rear Wheel Driveshaft Join (Part of 3B436/7), Birfield-Type
13	-	Differential Side Gear
14	771146	Rear Axle Wheel Hub Retainer Washer
A	-	Tighten to 157-235 N-m

Halfshaft Handling

CAUTION: Never hold a rear wheel driveshaft and joint by the inboard tripod-type rear wheel driveshaft joint only.

Care should be exercised during rear wheel driveshaft and joint removal and installation, and during the disassembly and assembly procedures.

- Do not remove the inboard tripod-type rear wheel driveshaft joint by pulling on the rear wheel driveshaft.
- The complete rear wheel driveshaft and joint should be handled by the rear wheel driveshaft to avoid pulling apart or damage to the inboard tripod-type rear wheel driveshaft joint.
- Do not over-angle rear wheel driveshaft joints beyond their capacity.
- Ensure that machined surfaces and splines are not damaged.
- Do not allow rear wheel driveshaft joint boots to come into contact with sharp edges or hot engine and exhaust components.
- Do not drop assembled rear wheel driveshaft and joints as the impact will cut the rear wheel driveshaft joint boots from the inside without external evidence of damage.
- The rear wheel driveshaft and joint is not to be used as a lever arm to position other rear end components. Always support the free end of the rear wheel driveshaft and joint.
- Ensure internal rear wheel driveshaft joint cleanliness and proper grease refill when the rear wheel driveshaft joint boot is replaced.
- An assembled inboard rear wheel driveshaft joint may be damaged if it is "over-plunged" outward from the outer race.
- Never use a metallic hammer to remove or install rear wheel driveshaft joints.

Wheel and Tire Balancing, Rear

WARNING: ON-VEHICLE REAR WHEEL AND TIRE BALANCING WITH REAR SUSPENSION IN THE FULLY EXTENDED (REBOUND) POSITION MAY OVERHEAT AND DAMAGE THE REAR WHEEL DRIVESHAFT JOINTS. PROPER BALANCING REQUIRES THAT THE REAR WHEEL(S) AND TIRE(S) BE LIFTED OFF THE GROUND BY PLACING A JACK UNDER THE REAR SUSPENSION LOWER ARM.

ANOTHER METHOD IS TO REMOVE THE REAR WHEEL(S) AND TIRE(S) FROM THE VEHICLE FOR BALANCING.

Hoisting

Never raise the vehicle using the rear wheel driveshaft and joints as lift points. Refer to Section 3 for hoisting procedures.

Towing

CAUTION: Never tow the vehicle using the rear wheel driveshaft and joints as anchor points for tow truck cables or chains. Vehicle damage may result.

Undercoating and Rustproofing

Extreme care must be taken during undercoating and rustproofing procedures to protect the rear wheel driveshaft joint boots from coating materials. Foreign materials on the rubber boot convolutions will cause advanced wear.

DIAGNOSIS AND TESTING

Inspection and Verification - Halfshafts, Rear Wheel

Inspect the rear wheel driveshaft joint boots for cuts, undercoating and loose rear wheel driveshaft joint boot clamps. With a damaged driveshaft boot, the driveshaft joint will wear prematurely. Look for any unusual shiny spots on any suspension components. A shiny spot indicates that a component is bent, worn, or broken and is causing mechanical interference. Refer to Section 6 - Suspension for diagnosis of suspension concerns; otherwise, continue with the following Troubleshooting Chart.

Troubleshooting Chart - Halfshafts, Rear Wheel

CONDITION	POSSIBLE SOURCE	REMEDY
Improper Operation of Rear Wheel Driveshaft and Joint	• Worn or seized rear wheel driveshaft joint.	• Inspect rear wheel driveshaft joint. Replace rear wheel driveshaft if necessary.
Abnormal Noise from Rear Wheel Driveshaft and Joint.	• Insufficient grease in rear wheel driveshaft joint or spline. • Excessive backlash on spline. • Worn rear wheel driveshaft joint. • Loose dynamic damper.	• Add grease or Replace the rear wheel driveshaft and joint. • Inspect the rear wheel driveshaft and joint. Replace if necessary. • Inspect the rear wheel driveshaft joint. Replace rear wheel drive-shaft joint if necessary. • Inspect dynamic damper.
Steering Wheel Pulls Toward either the Right or Left Side while Driving on a Straight and Level Road.	• Incorrect rear wheel bearing preload adjustment. • Fatigued rear coil spring. • Rear suspension lower mounting bolt bushing worn or damaged. • Bent rear suspension lower arm or loose mounting. • Incorrect toe adjustment. • Improper tire pressure. • Unevenly worn tires (difference in wear between left and right rear tires). • Brakes dragging.	• Adjust preload or replace rear wheel bearing. • Refer to Section 6. • Refer to Section 6. • Refer to Section 6 - Suspension. • Adjust toe. Refer to Section 6. • Adjust tire pressure. • Refer to Section 6 - Suspension • Refer to Section 4- Brake System.

CONDITION	POSSIBLE SOURCE	REMEDY
Unstable Handling	• Incorrect rear wheel bearing preload adjustment. • Bent suspension linkage. • Fatigued rear coil spring. • Worn rear spring and shock absorber assemblies. • Rear suspension lower arm mounting bolt bushing worn or damaged. • Incorrect toe adjustment. • Improper tire pressure. • Wheels bent or out of balance.	• Adjust rear wheel bearing preload or Replace bearing. • Refer to Section 6. • Refer to Section 6. • Refer to Section 6. • Refer to Section 6. • Adjust toe. Refer to Section 6. • Adjust tire pressure. Section 3. • Refer to Section 3.
Excessive Steering Wheel Play	• Rear suspension lower arm mounting bolt bushing worn or damaged.	• Refer to Section 6 - Suspension.
Tires Are Excessively Worn or Worn Unevenly.	• Incorrect rear wheel bearing preload adjustment (excessively loose). • Incorrect toe adjustment. • Improper tire pressure. • Wheels out of balance.	• Adjust rear wheel bearing. preload or Replace rear wheel bearing. • Adjust toe. Refer to Section 6. • Adjust tire pressure. Refer to Section 3- Wheels and Tires. • Refer to Section 6.
Abnormal Noise from Wheel Hub	• Faulty rear wheel bearing.	• Replace rear wheel bearing.

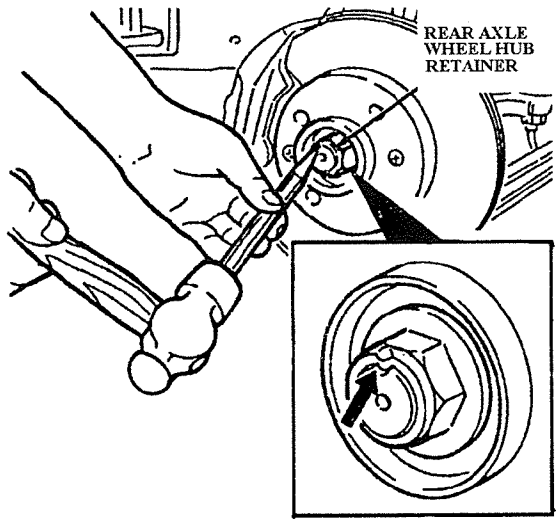
REMOVAL AND INSTALLATION

Halfshaft Assembly

Removal

NOTE: The following procedure applies to either the left-hand or right hand rear wheel driveshaft and joints.

1. Raise and support the vehicle.
2. Drain the transmission fluid from the transaxle. Refer to Section 8 for automatic transaxles.
3. Remove the wheel hub bolts and the rear wheel and tire assembly.
4. Use a small cape chisel carefully to raise the staked portion of the rear axle wheel hub retainer.



5. While another technician applies the brakes, loosen, but do not remove, the rear axle wheel hub retainer.
6. Remove the rear suspension lower arm ball joint bolt and nut.

7. **CAUTION: Take care not to damage the ball joint dust boot.**

   Carefully pry down on the rear suspension lower arm to separate the rear suspension lower arm ball joint from the wheel knuckle.

8. **CAUTION: Separate the rear wheel driveshaft and joint from the transaxle gradually. If it is suddenly yanked out of the transaxle, the differential oil seal may be damaged.**

   Use a pry bar to separate the rear wheel driveshaft and joint from the transaxle.

9. Remove the rear axle wheel hub retainer and rear axle wheel hub retainer washer. Discard the rear axle wheel hub retainer.

10. **CAUTION: Take care not to damage the inner wheel bearing oil seal while removing the rear wheel driveshaft and joint from the rear wheel hub.**

    NOTE: If necessary, use a brass drift and hammer to tap the rear wheel driveshaft and joint from the rear wheel hub.

    Separate the rear wheel driveshaft and joint from the rear wheel hub.

11. Pry the driveshaft bearing retainer circlip off of the rear wheel driveshaft joint. Discard the driveshaft bearing retainer circlip.

12. Install Differential Plugs.

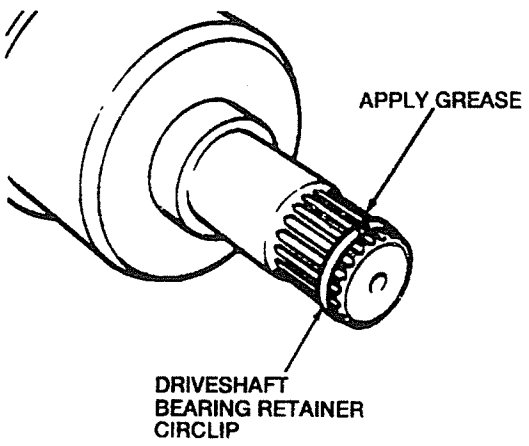
Installation

1. Before installing the rear wheel driveshaft and joint, inspect the differential oil seals and inner wheel bearing oil seals and replace, if necessary. Refer to Sections 6, 8, for the procedures.

2. NOTE: The original driveshaft bearing retainer circlip must not be reused.

   Install a new driveshaft bearing retainer circlip on the front wheel driveshaft joint.

3. Lubricate the end of the rear wheel driveshaft joint with grease.



4. Remove the Differential Plugs.

5. **CAUTION: Insert the front wheel driveshaft joint carefully so as not to damage the differential oil seal.**

   Install the end of the front wheel driveshaft joint into the differential side gear (4236).

6. Lubricate the end of the front wheel driveshaft and joint with grease.

7. **CAUTION: Insert the front wheel driveshaft and joint carefully so as not to damage the inner wheel bearing oil seal.**

   Insert the end of the front wheel driveshaft and joint into the front wheel hub.

8. Install the front axle wheel hub retainer washer and a new front axle wheel hub retainer onto the front wheel driveshaft and joint and finger-tighten.

9. **CAUTION: Avoid damaging the ball joint dust boot.**

   Install the rear suspension lower arm by placing the rear suspension lower arm ball joint into the rear wheel knuckle.

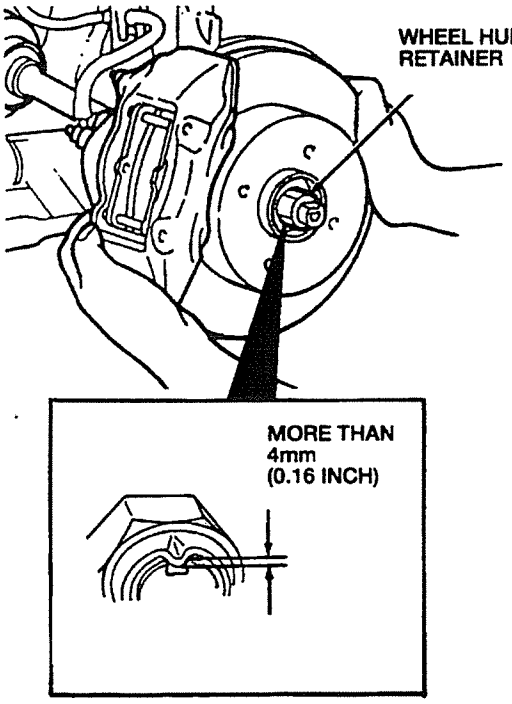
10. Install the rear suspension lower arm ball joint bolt and nut on the rear suspension lower arm. Tighten the rear suspension lower arm ball joint nut to 32-40 lb-ft (43-54 N-m).

11. While another technician applies the brakes, tighten the rear axle wheel hub retainer to 116-174 lb-ft (157-235 N-m).

12. **CAUTION: If the rear axle wheel hub retainer splits or cracks after staking, it must be replaced with a new rear axle wheel hub retainer.**

    NOTE: Make sure the rear axle wheel hub retainer flange is bent at least 0.16 inch (4mm) into the slot in the rear wheel driveshaft and joint to ensure locking effectiveness. After staking the rear axle wheel hub retainer, pull strongly on the wheel hub to verify that the rear wheel driveshaft and joint is installed properly. Turn the rear wheel hub by hand to check for smooth operation. Make repairs as necessary.

    Use a cape chisel with the cuffing edge rounded to stake the rear axle wheel hub retainer.



13. Install the rear wheel and tire assemblies and the wheel hub bolts. Tighten the wheel hub bolts to 65-87 lb-ft (88-118 N-m).

14. Fill the transaxle to the proper level with the specified grade of transmission fluid. Refer to Section 8.

15. Lower the vehicle.

DISASSEMBLY AND ASSEMBLY

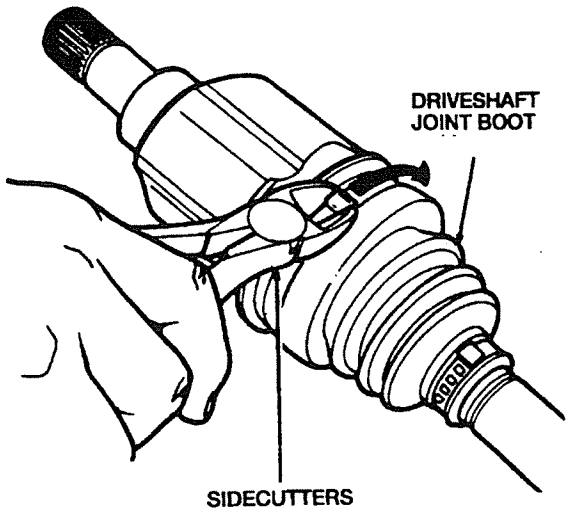
Halfshaft Assembly - Inboard

Disassembly

1. Clamp the front wheel driveshaft and joint in a vise equipped with protective jaw caps to prevent damage to any machined parts.

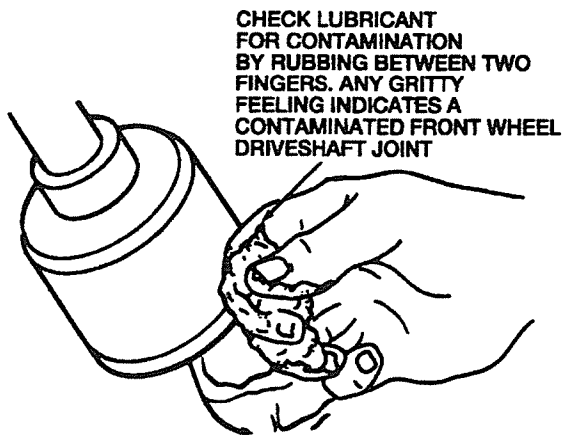
2. NOTE: Peel the rear wheel driveshaft joint boot clamp away from the rear wheel driveshaft joint boot as shown.

   Remove the large rear wheel driveshaft joint boot clamp and discard. Side cutters can be used to cut the rear wheel driveshaft joint boot clamp. After removing the rear wheel driveshaft joint boot clamp, roll the rear wheel driveshaft joint boot back over the rear wheel driveshaft and joint.

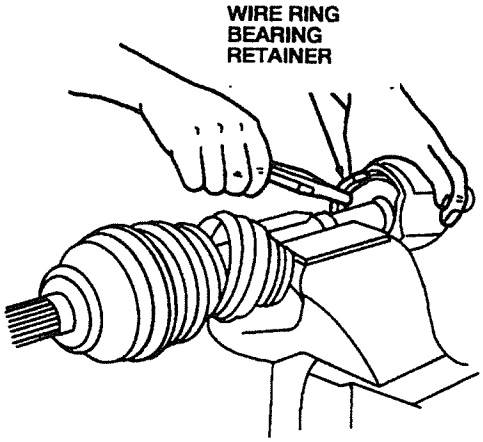


3. If this procedure is being performed to replace only a damaged rear wheel driveshaft joint boot, the grease should be checked for contamination. The grease can be checked for contamination by rubbing it between two fingers. Any gritty feeling indicates a contaminated rear wheel driveshaft joint.

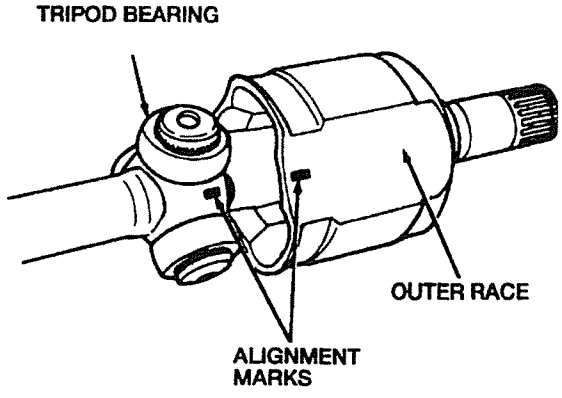
   A contaminated rear wheel driveshaft joint must be completely disassembled, cleaned, and inspected. If the grease is not contaminated and the rear wheel driveshaft joint has been operating satisfactorily, replace only the rear wheel driveshaft joint boot and add the required lubricant.



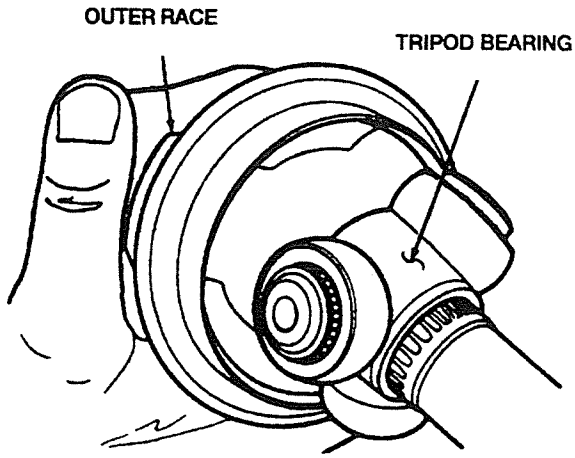
4. Remove the wire ring bearing retainer.



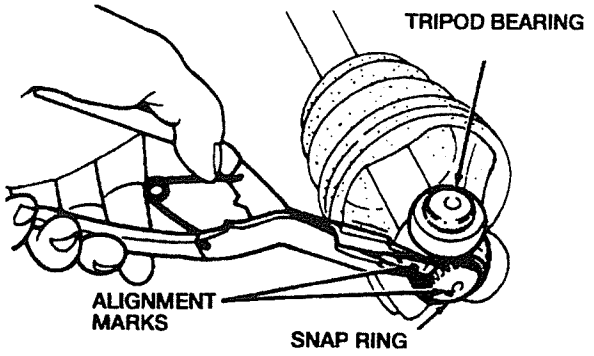
5. Paint alignment marks on the outer race and tripod bearing for assembly reference.



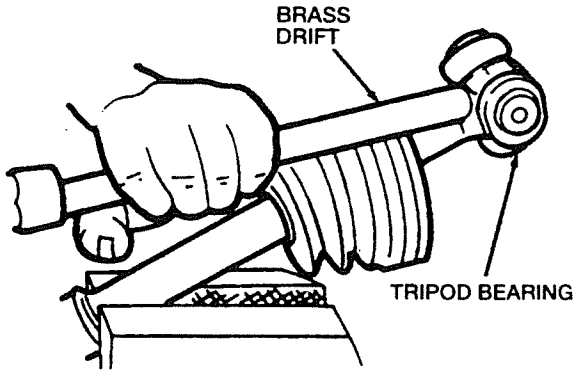
6. Remove the outer race.



7. Remove the snap ring.



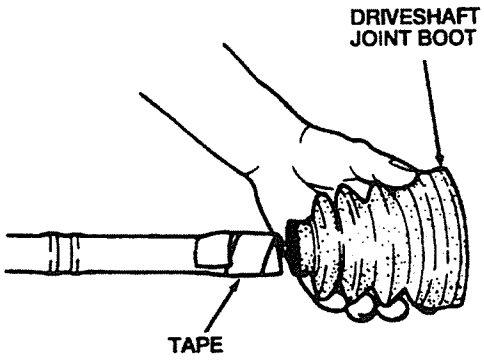
8. Use a brass drift and hammer to gently tap the tripod bearing from the rear wheel driveshaft.

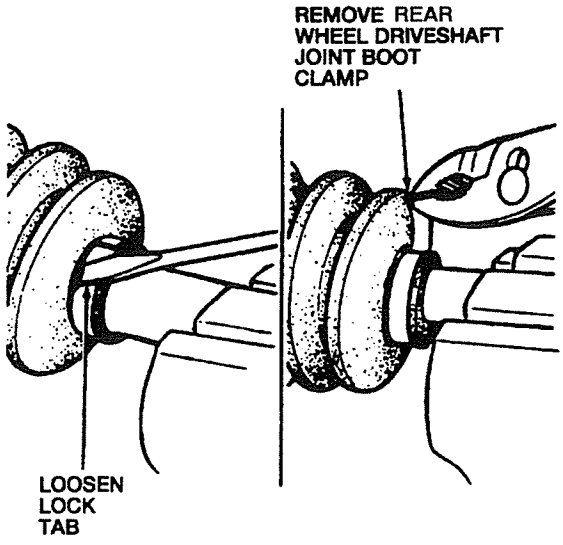


9. If the rear wheel driveshaft joint boot is to be reused, wrap the rear wheel driveshaft splines with tape before removing the boot from the rear wheel driveshaft.

10. If necessary, remove the small rear wheel driveshaft joint boot clamp and the rear

wheel driveshaft joint boot from the rear wheel driveshaft.

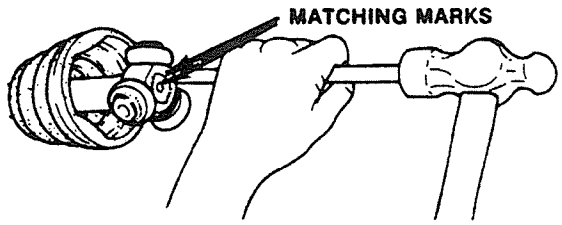




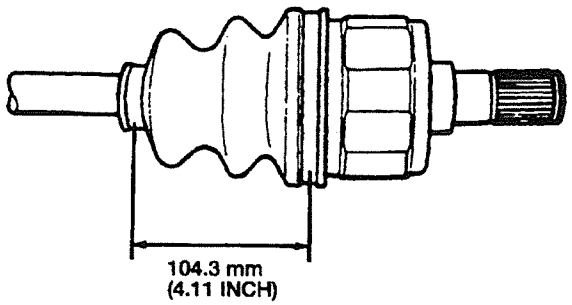
Assembly

CAUTION: The rear wheel driveshaft joint components must be lubricated with a Constant Velocity Joint Grease - High Temperature prior to assembly.

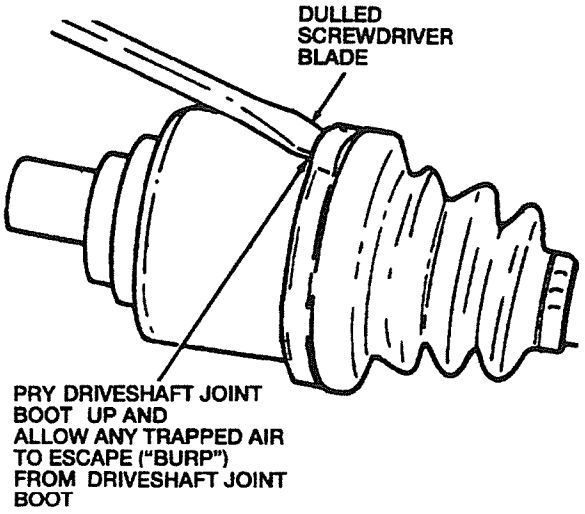
1. If necessary, cover the rear wheel driveshaft splines with tape and install the rear wheel driveshaft joint boot.
2. Align the marks on the tripod bearing and the rear wheel driveshaft.
3. Use a soft faced hammer to gently tap the tripod bearing on the rear wheel driveshaft.



4. Use snap ring pliers to install the snap ring.
5. Fill the outer race with 3-5 ounces (100 g) of Constant Velocity Joint Grease - High Temperature.
6. Align the marks and install the outer race over the tripod bearing and install the wire ring bearing retainer.
7. Position the rear wheel driveshaft joint boot so that the rear wheel driveshaft joint boot is fully seated in the grooves in the rear wheel driveshaft and outer race.
8. Extend or compress the rear wheel driveshaft joint as necessary until the distance between the rear wheel driveshaft joint boot clamp grooves measures 4.11 inches (104.3mm).

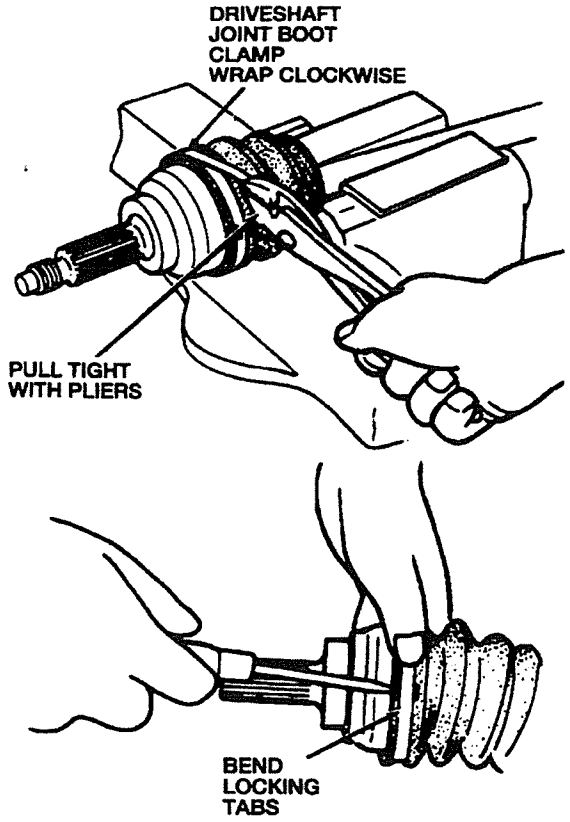


9. Insert a dulled screwdriver blade between the rear wheel driveshaft joint boot and the outer race to allow trapped air to escape from the rear wheel driveshaft joint boot.



10. NOTE: Always use new rear wheel driveshaft joint boot clamps.

    Install new rear wheel driveshaft joint boot clamps. Wrap the rear wheel driveshaft joint boot clamps around the rear wheel driveshaft joint boots in a clockwise direction, pull tight with pliers, and bend the locking tabs to secure in position.



11. Work the rear wheel driveshaft joint through its full range of travel at various angles. The rear wheel driveshaft joint should flex, extend, and compress smoothly.

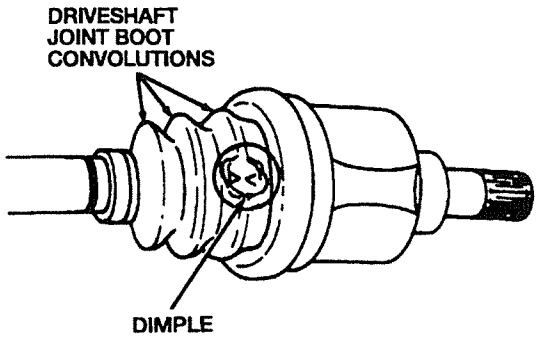
CLEANING AND INSPECTION

CV Joint Boot Indentation

Inspection

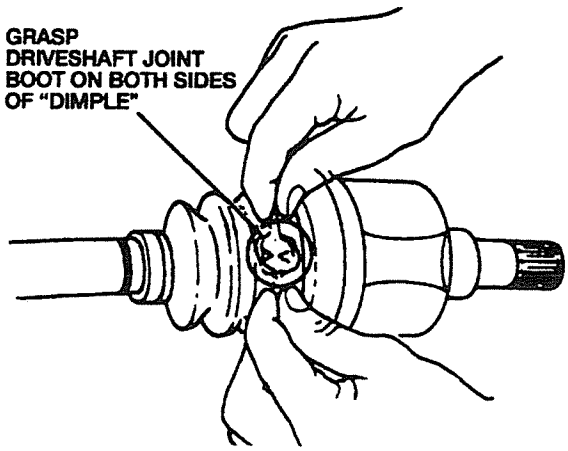
Indentations or "dimples" in the inboard and/or outboard rear wheel driveshaft joint boots may occur due to improper handling during storage or service of the rear wheel driveshaft and joints. If, during inspection, a rear wheel driveshaft joint boot is observed to be "dimpled," proceed as follows:

1. Inspect the rear wheel driveshaft joint boot(s) for any sign of grease leakage in the dimple which would indicate a cut. Replace the rear wheel driveshaft joint boot if a cut exists or if there is evidence of other damage.

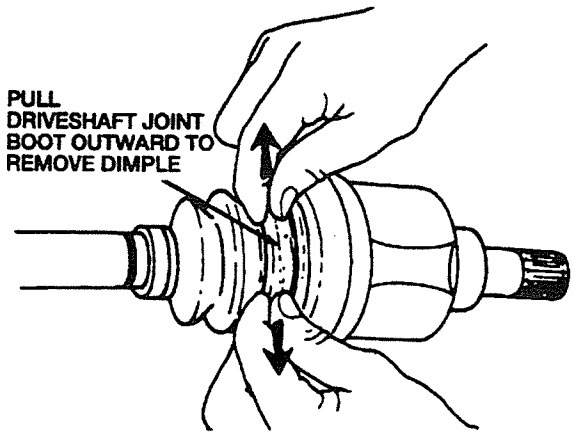


2. If the rear wheel driveshaft joint boot is in good condition, the dimple can be removed as follows:

    a. Grasp the dimpled convolution on either side of the dimple using the forefinger and thumb of each hand.



b. While grasping the rear wheel driveshaft joint boot, pull the convolution by moving hands in opposite directions. The dimple should "pop out." If the dimple does not invert or if it dimples again, one front wheel driveshaft joint boot clamp should be removed and the internal and external air pressure equalized. Refer to the appropriate rear wheel driveshaft joint boot installation steps within assembly of the halfshaft assembly inboard, in this section, for the necessary procedure.

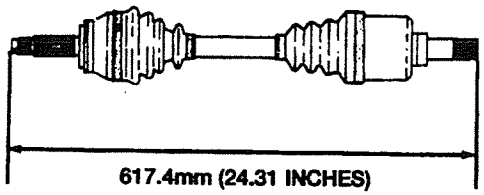


Extreme care should be taken not to allow the rear wheel driveshaft joint boots to come in forceful contact with foreign objects that may cause the external rear wheel driveshaft joint boot convolutions to become indented.

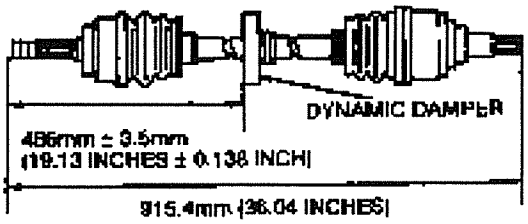
SPECIFICATIONS

Half shaft Assembled Lengths

LEFT DRIVESHAFT AND JOINTS



RIGHT DRIVESHAFT AND JOINTS



HALFSHAFT SPECIFICATIONS

Item	Specification
	ATX
Front Wheel Driveshaft Diameter (0.83 in)	21.0mm (0.83 in)
Distance Between Front Wheel Driveshaft Joint Boot Clamps 104.3mm (4.11 inches)	104.3mm (4.11 inches)

LUBRICANT SPECIFICATIONS

Specification	Quantity
High-Temp Constant Velocity Joint Grease E43Z-19590-A (ESP-M1C207-A)	100g (3.5 oz.)

TORQUE SPECIFICATIONS

Description	N-m	Lb-Ft
Rear Suspension Lower Arm Ball Joint Nut	43-54	32-40
Rear Axle Wheel Hub Retainer	157-235	116-174
Wheel Hub Bolts	88-118	65-87

SERVICE TOOLS/EQUIPMENT

- Differential Plugs

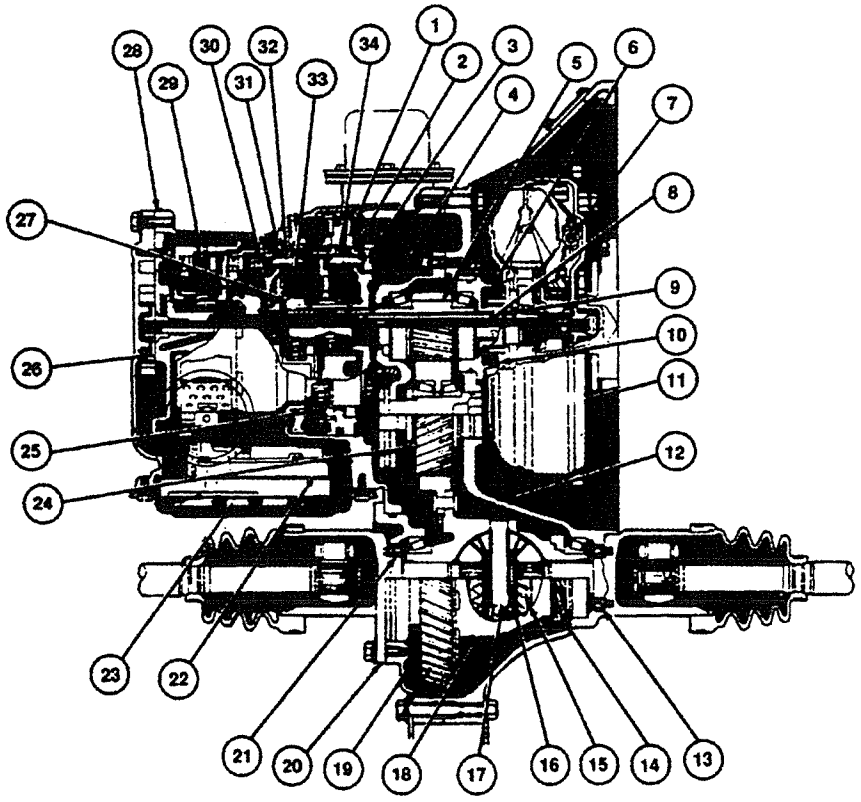
SECTION 8 - Automatic Transaxle

DESCRIPTION AND OPERATION

Automatic Transaxle

The automatic transaxle combines an automatic transmission and differential into a single component. The automatic transaxle is a hydraulically controlled unit and uses a torque converter equipped with a centrifugal type torque converter clutch.

Automatic Transaxle - Cutaway View



Item	Part Number	Description
1	-	One-Way Clutch
2	-	One-Way Clutch Race
3	-	Drum Hub Assembly
4	-	Bearing Housing
5	-	Output Gear
6	-	Turbine Shaft

Continued

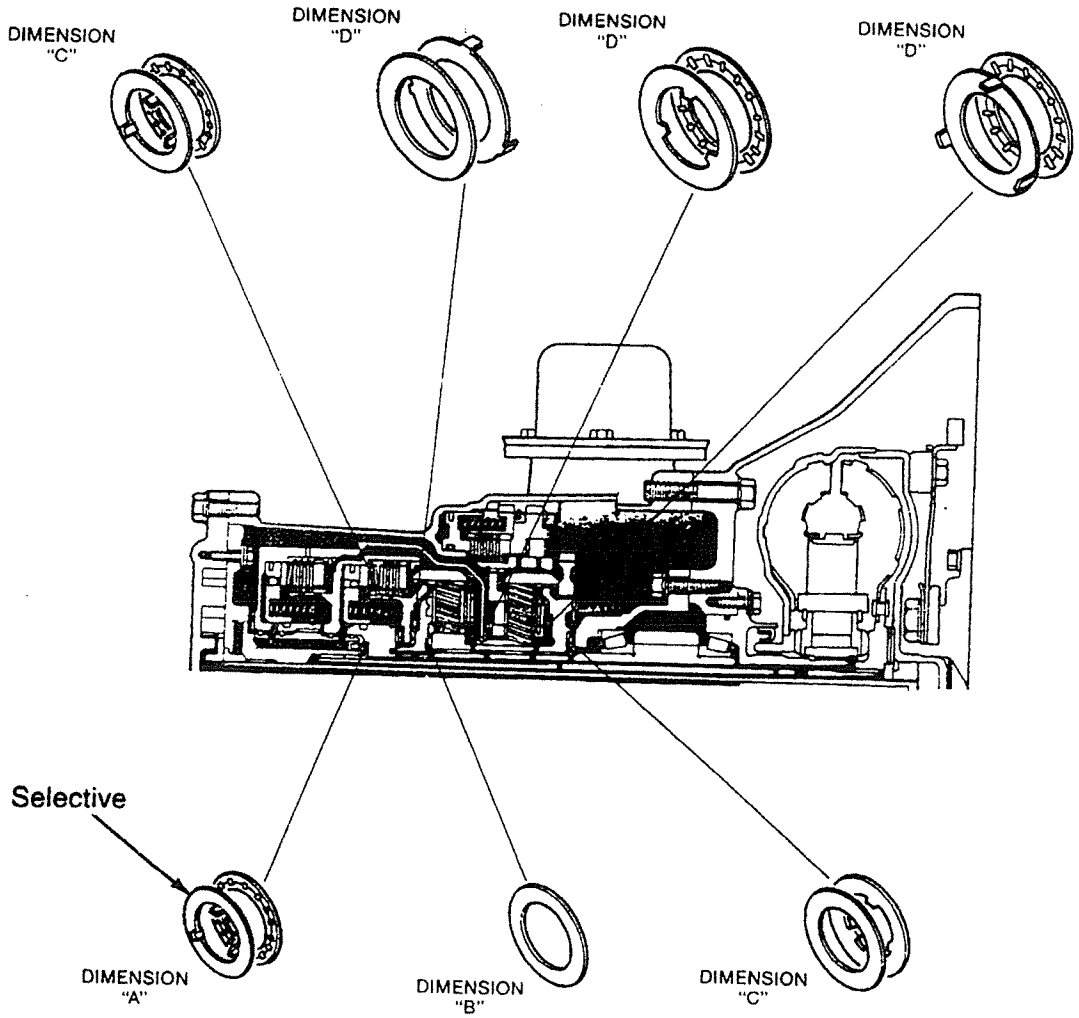
Item	Part Number	Description
7	-	Torque Converter Clutch (TCC)
8	-	Oil Pump Shaft
9	-	Torque Converter Stator Support
10	-	Converter Impeller Hub Seal

Continued

Item	Part Number	Description
11	-	Torque Converter
12	-	Converter Housing
13	-	Differential Oil Seal
14	-	Speedometer Drive Gear
15	-	Differential Side Gear
16	-	Differential Pinion Gear
17	-	Differential Pinion Shaft
18	-	Differential Gear Case
19	-	Differential Ring Gear
20	-	Side Bearing Housing
21	-	Differential Oil Seal
22	-	Main Control Valve Body

Item	Part Number	Description
23	-	Transmission Oil Pan
24	-	Idler Gear
25	-	Low/Reverse Clutch
26	-	Oil Pump
27	-	Sun Gear
28	-	Transaxle Case
29	-	Direct Clutch
30	-	Forward Clutch
31	-	Sun Shell
32	-	Rear Clutch Hub
33	-	Front Planet
34	-	Rear Planet Carrier

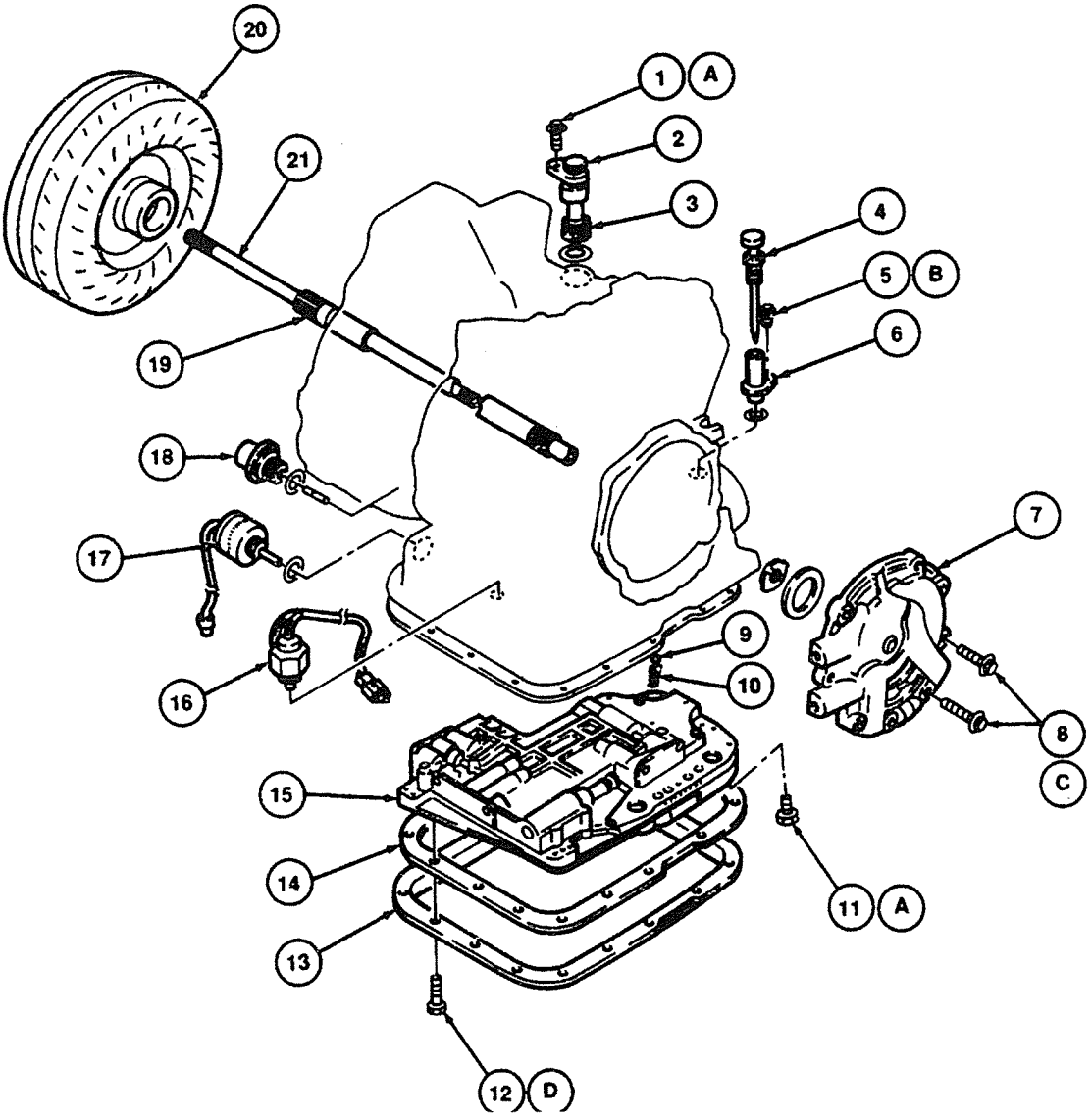
Thrust Bearing/Washer Locations



THRUST BEARING/WASHER LOCATION

Component	Dimension			
	A	B	C	D
Thrust Bearing	1.65 in (41.9mm)	1.85 in (46.9mm)	2.08 in (52.9mm)	2.75 in (69.9mm)
Thrust Washer	1.61 in (41.0mm)	-	2.03 in (51.5mm)	2.74 in (70.0mm)

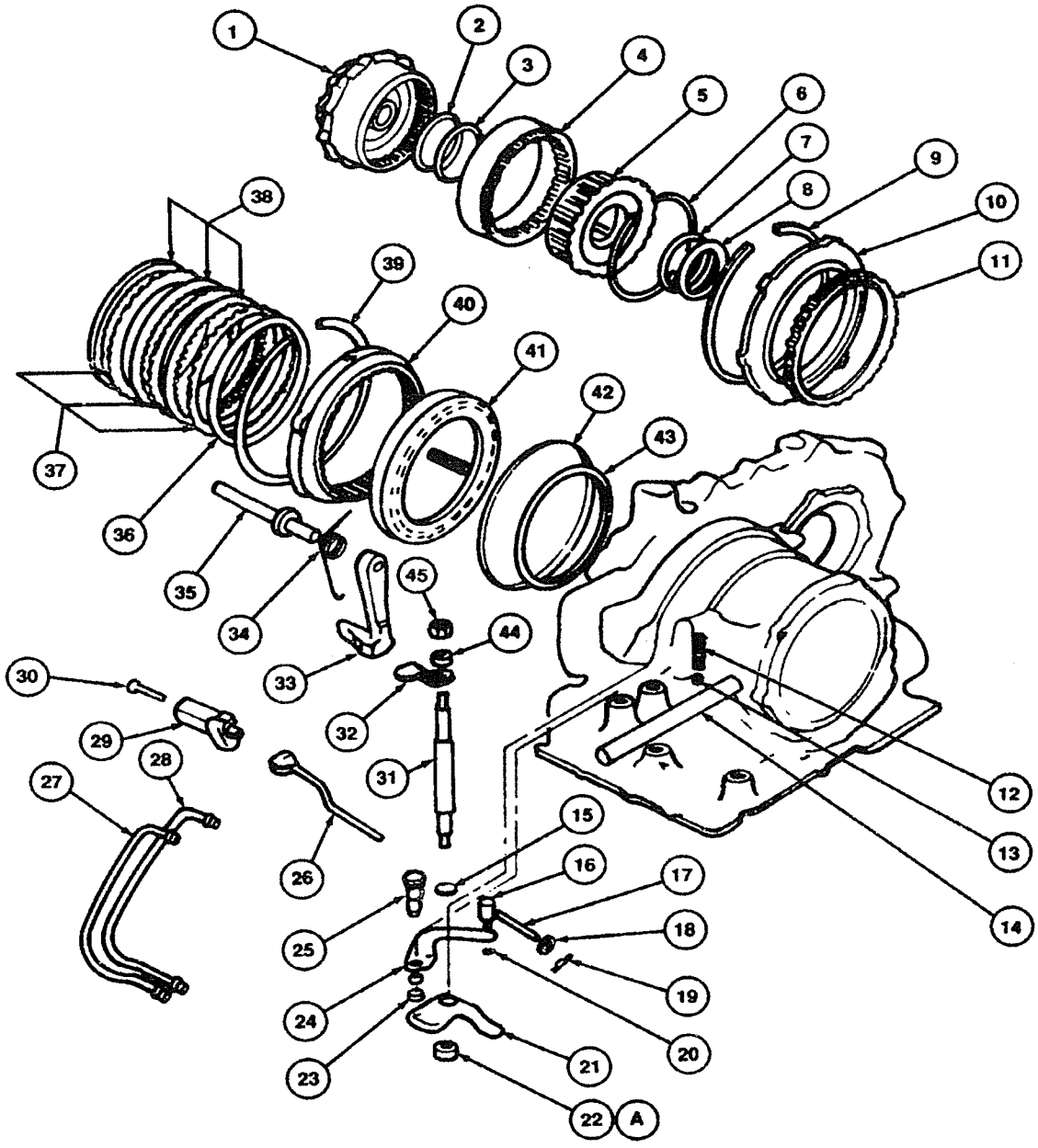
Torque Converter, Oil Pump, Main Control Valve Body and Externally Mounted Controls



Item	Part Number	Description / (Qty Req'd)
1	-	Speedometer Cable Sleeve Bolt
2	-	Speedometer Cable Sleeve
3	179001	Speedometer Gear
4	-	Fluid Level Indicator
5	-	Oil Filler Tube Bolt
6	-	Oil Filler Tube
7	-	Oil Pump
8	-	Oil Pump-to-Transaxle Bolts (8)
9	-	Check Ball
10	-	Case Detent Spring
11	-	Main Control Valve Body Bolts (9 Req'd)
12	-	Transmission Oil Pan Bolts (16)
13	-	Transmission Oil Pan

Item	Part Number	Description / (Qty Req'd)
14	194000	Oil Pan to Case Gasket
15	-	Main Control Valve Body
16	-	Park/Neutral Position Switch (PNP) Switch
17	-	Main Control Valve Body
18	-	Vacuum Throttle Valve Diaphragm
19	-	Turbine Shaft
20	194001	Torque Converter
21	-	Oil Pump Shaft
A	-	Tighten to 71-97 lb-in (8-11 N-m)
B	-	Tighten to 61-87 lb-in (7-10 N-m)
C	-	Tighten to 11-16 lb-ft (15-22 N-m)
D	-	Tighten to 43-69 lb-in (5-8 N-m)

Internal Linkages, Rear Planetary Gearset and Low/Reverse Clutch

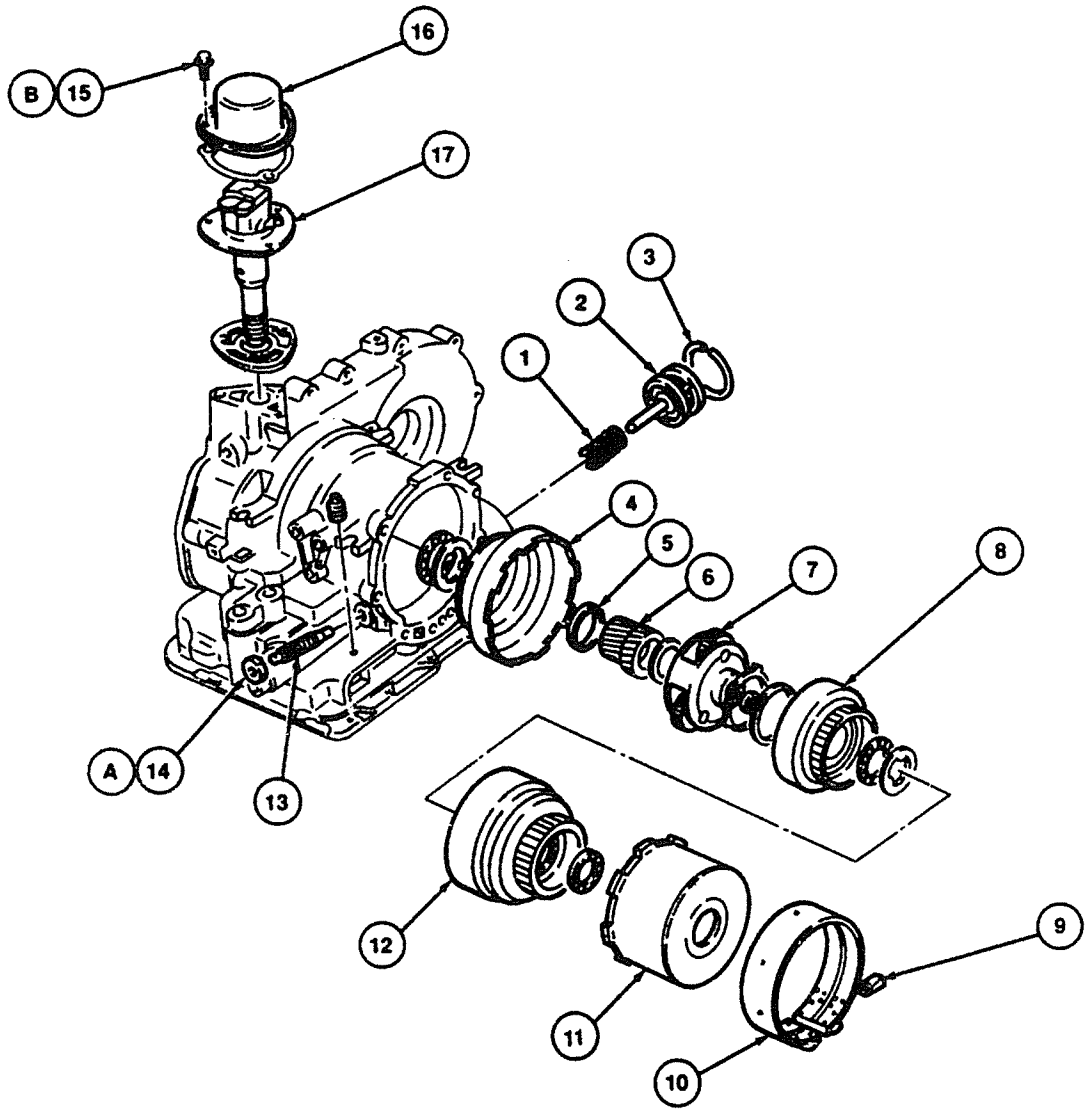


Item	Part Number	Description
1	-	Drum Hub Assembly
2	-	Needle Bearing
3	-	Thrust Washer
4	-	Low One-Way Clutch Inner Race
5	-	Rear Carrier
6	-	Retaining Ring
7	-	Thrust Bearing
8	-	Sun Shell Thrust Washer
9	-	Low/Reverse Snap Ring
10	-	One-Way Clutch
11	-	Retaining Plate, One-Way Clutch
12	-	Case Detent Spring
13	-	Detent Check Ball
14	-	Manual Control Lever Shaft
15	-	Manual Control Lever Shaft Seal
16	-	Ferrule
17	-	Spring
18	-	Washer
19	-	Retaining Pin
20	-	Circlip
21	-	Park Lever Plate
22	-	Manual Control Lever Nut
23	-	Park Actuator Support
24	-	Park Actuator Lever
25	-	Pivot Pin
26	-	Parking Lever Actuating Rod
27	-	Governor Inlet Tube
28	-	Governor Outlet

Item	Part Number	Description
29	-	Support
30	-	Support Retaining Bolt
31	-	Manual Control Lever
32	-	Manual Control Lever Arm
33	-	Parking Pawl
34	-	Parking Pawl Return Spring
35	-	Parking Pawl Shaft
36	-	Low/Reverse Clutch Dished Plate
37	-	Low/Reverse Clutch External Spline Clutch Plate
38	-	Low/Reverse Clutch Internal Spline Clutch Plate
39	-[1]	Low/Reverse Clutch Pressure Plate Retainer Snap Ring
40	-	Low and Reverse Clutch Hub
41	-	Low/Reverse Clutch Piston
42	-	Reverse Clutch Piston Large Seal
43	-	Reverse Clutch Piston Small Seal
44	-	Manual Shaft O-Ring
45	-	Manual Control Lever Nut
A	-	Tighten to 30-39 N-m (22-29 Lb-Ft)

1 NOT used when the transaxle is assembled in production, however it is required in assembly when servicing the transaxle.

Hydraulic Apply Devices, Governor Assembly, and Front Planetary Gearset

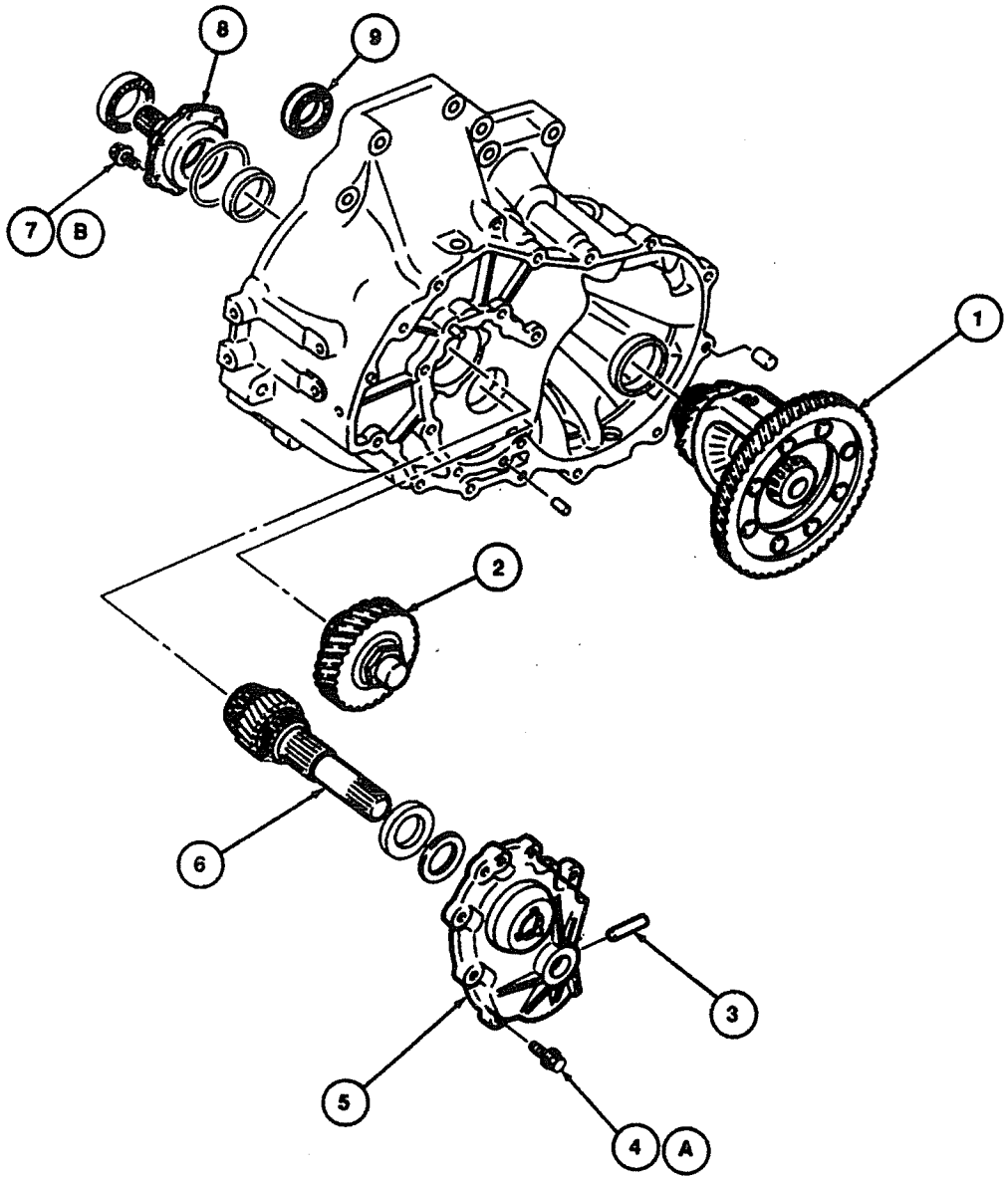


Item	Part Number	Description
1	-	Servo Piston Spring
2		Servo Piston
3	-	Intermediate Band Servo Retainer
4	-	Sun Shell
5	-	Sun Gear Spacer
6	-	Sun Gear
7	-	Front Planet Carrier
8	-	Front Ring Gear
9	-	Band Strut
10	-	Intermediate Band

(Continued)

Item	Part Number	Description
11	-	Direct Clutch Assembly
12	-	Forward Clutch Drum
13	-	Band Adjusting Stop
14	-	Band Adjusting Stop Nut
15	-	Governor Cover Bolt (3 Req'd)
16	-	Governor Cover
17	-	Governor Valve
A	-	Tighten to 41-59 Lb-Ft (55-80 N-m)
B	-	Tighten to 71-97 Lb-in (8-11N-m)

Differential, Idler Gear Assembly and Output Shaft



Item	Part Number	Description
1	-	Differential
2	-	Idler Gear and Idler Gear Shaft
3	-	Idler Gear Shaft Roll Pin
4	-	Bearing Housing Bolt (8 Req'd)
5	-	Bearing Housing
6	-	Output Shaft

(Continued)

Item	Part Number	Description
7	-	Torque Converter Stator Support Bolt (6 Req'd)
8	-	Torque Converter Stator Support
9	-	Differential Oil Seal
A	-	Tighten to 19-26 N-m (14-19 Lb-Ft)
B	-	Tighten to 11-14 N-m (95-122 Lb-in)

Transaxle Identification

The U.S. Motor Vehicle Theft Law Enforcement Act of 1984 requires identification of certain high theft vehicle, to reduce the National Auto Theft Rate. This federal law requires the Vehicle Identification Number (VIN) to be placed on specific parts. These parts are the are the engine and transaxles. In addition, the service replacement parts must be identified as service parts.

The production vehicle parts are identified by an adhesive backed white label approximately 2 3/16 inches long by 5/8 inch wide. Printed on this label is the VIN number and a logo. The service parts are identified by a similar label approximately 2 3/4 inches long and 5/8 inch wide. Printed on this label is the letter R and the logo. Other information on this label is printed in gray lettering.

In the event of collision damage not requiring part replacement or drivetrain service, the persons making the repair should take care not to damage or remove the labels, unless such action is reasonably necessary in performing the repair.

The areas selected for the location of the production and service labels are unlikely to be affected during normal servicing and non-collision repairs.

Gear Shift Lever and Shift Patterns

The gearshift lever allows the driver to select any of six gear positions. These are:

Park

The PARK (P) position allows no powerflow through the transaxle and engages a parking pawl into a parking gear which locks the output shaft into a fixed position, allowing no rotation of the wheels.

Reverse

The REVERSE (R) position allows the vehicle to be operated in a rearward direction at a reduced gear ratio. The internal operation is as follows:

- The direct clutch locks the turbine shaft to the sun gear driving it clockwise.
- The low/reverse clutch holds the rear carrier causing the rear planet pinion gears to rotate counterclockwise.
- This rotates the rear internal ring gear counterclockwise driving the output gear counterclockwise.
- These actions provide a gear ratio of 2.4:1 at the output gear.

Neutral

The NEUTRAL (N) position allows no powerflow through , the transaxle and allows the wheels to rotate freely.

Drive

In the DRIVE (D) position the automatic transaxle upshifts and downshifts as determined by road speed and engine load signals sent to the main control valve body. Internal transaxle operation is as follows:

- D position first gear:
  -The forward clutch locks the front internal ring gear which drives the front planet carrier clockwise.
  -This drives the sun gear counterclockwise.
  -The low one-way clutch holds the rear planet carrier stationary causing the rear planet pinion gears to rotate clockwise.
  -This drives the rear ring gear and output gear clockwise.
  -These actions provide a gear ratio of 2.841:1 at the output gear.

NOTE: In D position first gear, the one-way clutch holds the rear planet carrier stationary only on acceleration and allows the carrier to freewheel during deceleration. This prevents engine braking from occurring in D position first gear.

- D position second gear:
  -The forward clutch locks the turbine shaft to the front ring gear, driving it clockwise.
  -The intermediate band holds the sun gear stationary. This forces the front planet carrier to rotate around the fixed sun gear clockwise, driving the output gear clockwise.
  -These actions provide a gear ratio of 1. 541:1 at the output shaft.

- D position third gear:
  -The forward clutch locks the turbine shaft to the front ring gear, driving it clockwise.
  -The direct clutch locks the sun gear to the forward clutch housing, driving the sun gear clockwise at turbine shaft speed.
  -With two planetary members being driven in the same direction at the same speed the entire gearset rotates clockwise at turbine shaft speed.
  -This provides a gear ratio of 1:1 at the output gear.

Second

In the SECOND (2) position the transaxle will start out from a stop in second gear. No upshifts or downshifts will occur without manually moving the gearshift lever. This allows the transaxle to provide better traction, with minimum wheel spin, when the vehicle is operated on slippery surfaces such 6s mud or snow. Operation of the internal transaxle components in 2 position second gear is the same as in D position second gear.

Manual Low

In the MANUAL LOW (1) position first gear, no upshifts can occur. Internal operation is as follows:

- The forward clutch locks the front internal ring gear, which drives the front planet carrier clockwise.
- This drives the sun gear counterclockwise.
- The low/reverse clutch holds the rear planet carrier causing the rear planet pinion gears to rotate clockwise.
- These drive the rear internal ring gear and output gear clockwise.
- These actions provide a gear ratio of 2.841:1 at the output gear.

NOTE: Because the low/reverse clutch holds the rear planet carrier stationary during both acceleration and deceleration, engine braking will occur in 1 (one) position first gear.

Torque Converter

The torque converter automatically couples the transaxle to the engine at engine speeds above idle. At high loads and low road speeds the torque converter also multiplies engine torque. The components of the torque converter are:

Converter Cover

The converter cover bolts to the engine's flywheel and encloses the other torque converter components.

Turbine

The turbine splines to the turbine shaft. Fluid motion from the impeller causes the turbine to rotate Allowing the transfer of power from the engine to the transaxle. At engine idle fluid motion is not great enough to overcome vehicle weight, so the engine can idle without having to place the transaxle in NEUTRAL (N).

Impeller

The impeller connects to the converter cover and throws transmission fluid against the turbine, causing turbine rotation.

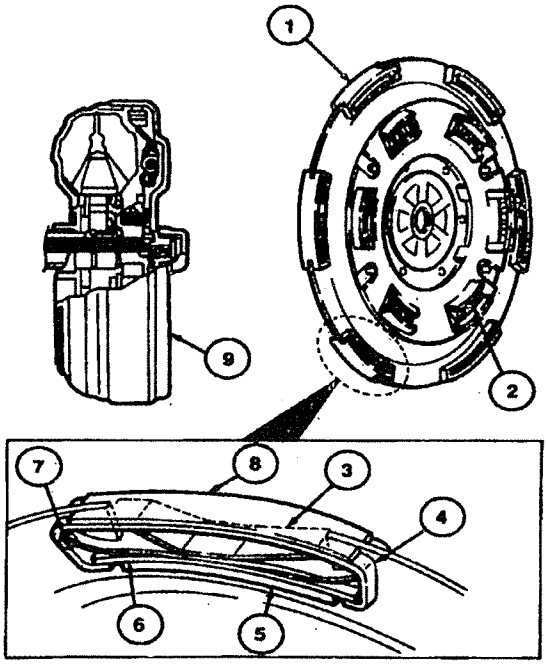
Reactor

The reactor redirects fluid returning from the turbine to the impeller. This not only improves fluid flow, but also multiplies the torque the turbine is driven with.

Torque Converter Clutch

The GO-4 utilizes a Torque Converter Clutch (TCC) to attain maximum fuel economy. The TCC eliminates the loss of power inherent with conventional torque converters. This power loss is due to the inability of the transmission fluid to transfer all of the engine's torque from the impeller to the turbine. The TCC mechanically couples the turbine shaft to the converter cover (and impeller) eliminating this power loss.

The TCC consists of a drive plate assembly which is located between the turbine shaft and the converter cover and splines to the turbine shaft of the transaxle. Mechanical power transfer occurs due to the centrifugal force of the rotating torque converter. This force causes the centrifugally actuated clutch linings, on the drive plate, to contact the machined inner surface of the converter cover. The drive plate also contains torsional dampening springs to help smooth out any engine pulsation.



Item	Part Number	Description
1	-	Drive Plate *
2	-	Torsional Dampening* Springs *
3	-	Main Spring*
4	-	Shoe Bracket*
5	-	Weight*
6	-	Retractor Spring*
7	-	Pin*
8	-	Clutch Linings*
9	194001	Torque Converter

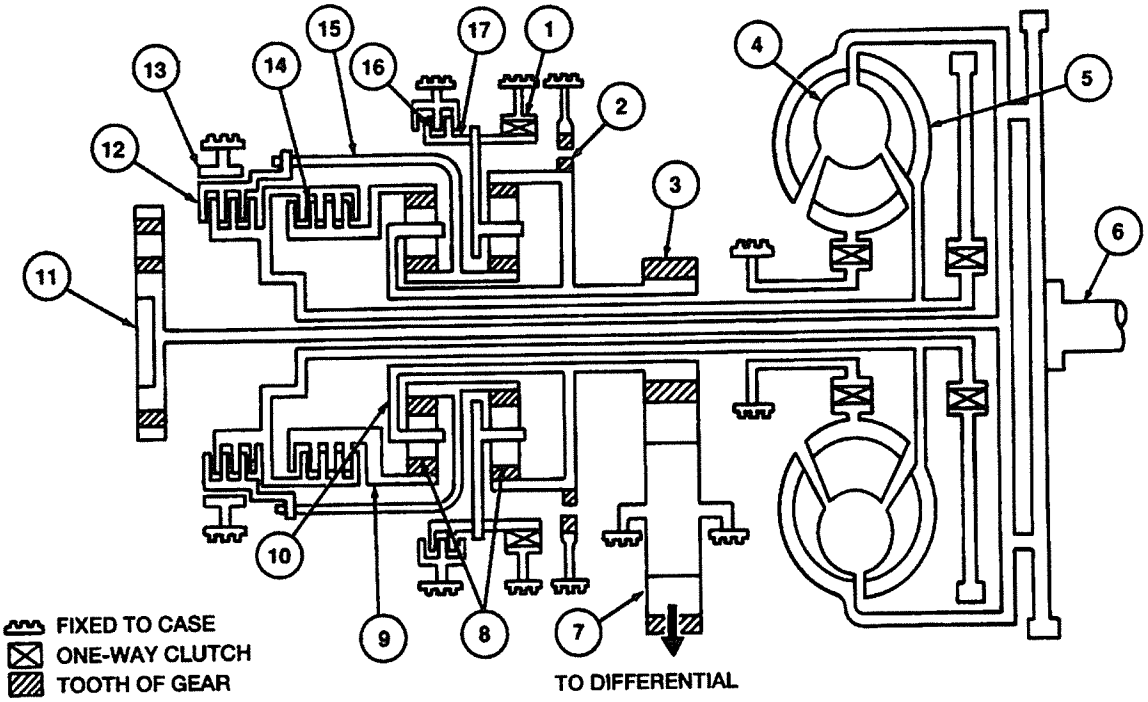
* all of the above items are part of the Torque Converter, item 9.

Geartrain

The control of the planetary geartrain provides the transaxle with three forward gears and reverse. The geartrain is a Simpson Compound planetary gearset which consists of two planet carriers (front and rear), two ring gears (front and rear) and a common sun gear.

The gearset is controlled using three multi-disc clutches (direct, forward, and low/reverse), a band (intermediate band), and a one-way roller clutch (low one-way clutch).

Automatic Transaxle - Mechanical Schematic



Item	Part Number	Description
1	-	One-Way Clutch
2	-	Park Gear
3	-	Output Gear
4	-	Impeller (Part of 7902)
5	-	Turbine (Part of 7902)
6	-	Crankshaft
7	-	Idler Gear
8	-	Planetary Carriers

(Continued)

Item	Part Number	Description
9	-	Front Ring Gear
10	-	Front Planet Carrier
11	-	Oil Pump
12	-	Direct Clutch
13	-	Intermediate Band
14	-	Forward Clutch
15	-	Sun Shell
16	-	Low/Reverse Clutch
17	-	Rear Planet Carrier

Direct Clutch

The direct clutch is a multi-disc clutch that couples the turbine shaft to the front sun gear during operation of third gear and reverse.

Forward Clutch

The forward clutch is a multi-disc clutch that couples the turbine shaft to the front ring gear in first, second, and third gear.

Sun Gear and Sun Shell

The sun gear and sun shell connect the front planetary gearset to the rear planetary gearset. It is either driven by the direct clutch or held by the intermediate band.

Low One-Way Clutch

The low one-way clutch holds the rear planet carrier to the transaxle case in DRIVE (D) position first gear during acceleration. During deceleration it overruns allowing the vehicle to coast without engine braking.

Intermediate Band

The intermediate band wraps around the direct clutch drum and holds it and the sun gear stationary to the transaxle case in second gear.

Planet Carrier

The two planet carriers are located on either side of the common sun gear which connects them. They carry the pinion gears which are surrounded by ring gears. The front planet splines to the output shaft and is the output from the front planetary gearset. The rear planet carrier can be held by either the one-way clutch or the low/reverse clutch.

Low/Reverse Clutch

The low/reverse clutch holds the rear planet carrier stationary to the transaxle case. It is the holding device for reverse and provides for engine braking in MANUAL LOW (1) position first gear.

Park Gear and Parking Pawl

The park gear attaches to the output gear and locks the output gear to the transaxle case. This is accomplished by a parking lever actuating rod which presses the parking pawl into the teeth of the park gear when the gearshift lever is placed in the PARK (P) position.

Output Gear

The output gear attaches to the output shaft and transfers power from the planetary gearset to the idler gear.

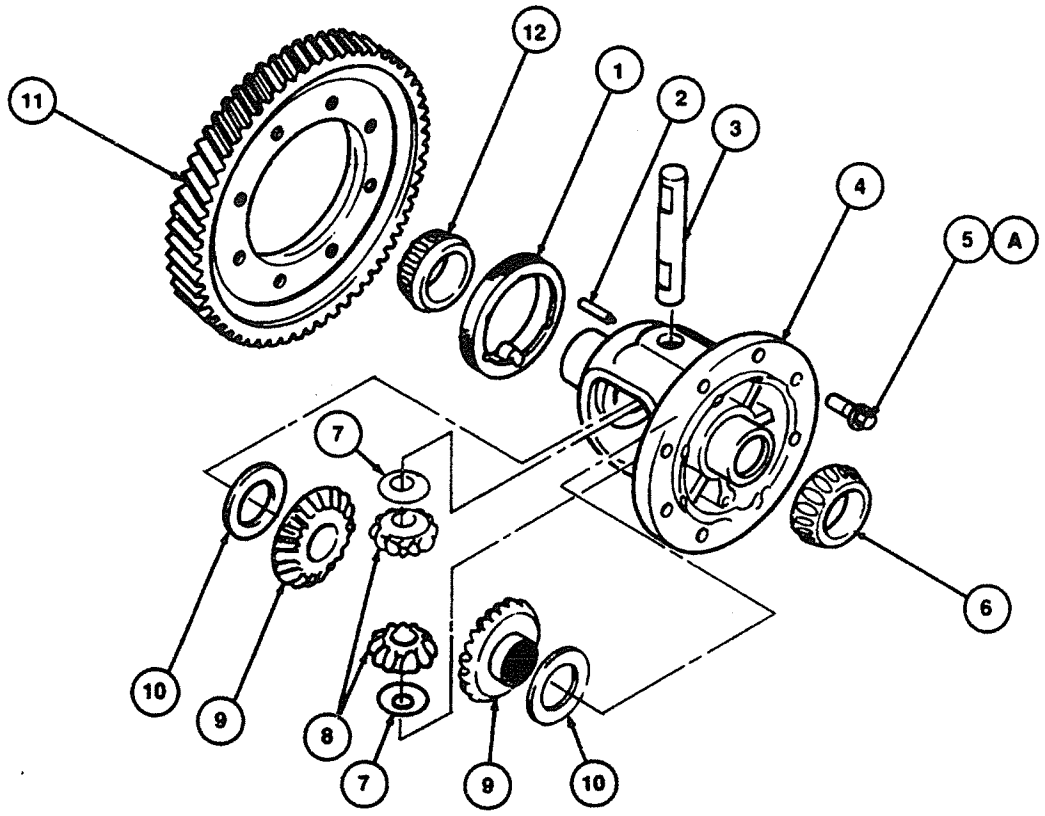
Idler Gear

The idler gear rides between the output gear and the differential ring gear. It is required because two external gears in mesh rotate in opposite directions. If the output gear connected directly to the differential ring gear, the ring gear would rotate backwards. The idler gear acts as the "middleman" and maintains the correct rotation.

Differential Assembly

The differential transfers power from the planetary gearset to the front wheel driveshaft and joints and wheels. It allows for differences in wheel rotation speeds during cornering through the use of differential pinion gears and differential side gears. The differential also provides the final gear reduction from the transaxle. The ratio it provides is 3.45:1.

Differential - Exploded View



Item	Part Number	Description
1	-	Speedometer Drive Gear
2	-	Differential Pinion Shaft Lock Pin
3	-	Differential Pinion Shaft
4	-	Gearcase (Part of 4028)
5	-	Ring Gear Bolt (8 Req'd)
6	-	Differential Bearing (Ring Gear End)
7	-	Differential Pinion Thrust Washers

(Continued)

Item	Part Number	Description
8	-	Differential Pinion Gears
9	-	Differential Side Gears
10	-	Differential Side Gear Thrust Washers
11	-	Ring Gear (Part of 4026)
12	-	Differential Bearing (Speedometer Drive Gear End)
A	-	Tighten to 69-83 N-m (51-62 Lb-Ft)

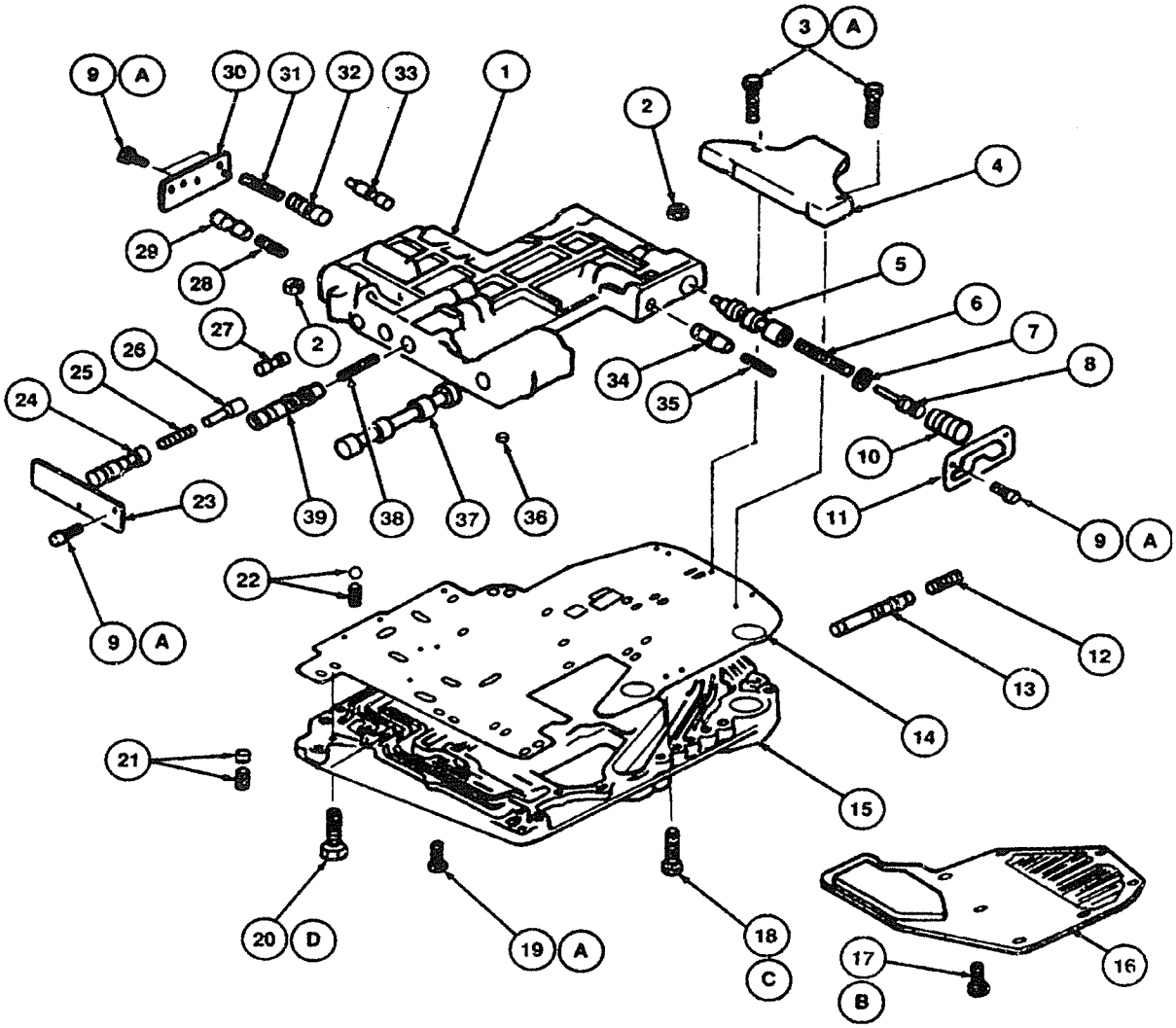
Hydraulic System

The hydraulic system controls the application of the multi-disc clutches and intermediate band, and also provides lubrication and cooling for the transaxle and torque converter.

Main Control Valve Body

Fluid is directed to the various components at the correct pressures through the main control valve body. The main control valve body receives information on vehicle operating requirements from the governor, vacuum throttle valve diaphragm (modulator), and kickdown solenoid. It interprets this information and selects the optimum operating configuration for the transaxle.

Main Control Valve Body - Exploded View



Item	Part Number	Description
1	-	Upper Valve Body
2	-	Upper-to-Lower Valve Body Nuts (2 Req'd)
3	-	Valve Body Sub-Body Bolts (2 Req'd)
4	-	Sub-Body
5	-	Pressure Regulator Valve
6		Spring
7	-	Spring Set
8	-	Pressure Regulator
9	-	Side Plate Bolt
10	-	Pressure Regulator Sleeve
11	-	Side Plate
12	-	Spring
13	-	3-2 Timing Valve
14	-	Separator Plate

Item	Part Number	Description
15	-	Lower Valve Body
16	-	Filter Screen
17	-	Oil Filter Bolt
18	-	Main Control Valve Body Bolt (9 Req'd)
19	-	Upper-to Lower Valve Body A-bolts
20	-	Upper-to-Lower Valve Body B-bolts
21	-	Orifice Check Valve and Spring
22	-	Check Ball and Spring
23	-	Side Plate
24	-	2-3 Shift Valve
25	-	Spring
26	-	2-3 Shift Plug
27	-	Modifier Valve
28	-	Spring

Item	Part Number	Description
29	-	Downshift Valve
30	-	Side Plate
31		Spring
32	-	Throttle Backup Valve
33	-	Vacuum Throttle Valve
34	-	Second Lock Valve
35	-	Spring
36	-	Orifice Check Valve
37	-	Manual Valve
38	-	Spring
39	-	1-2 Shift Valve
A	-	Tighten to 22-30 lb-in (5-3.4 N-m)
B	-	Tighten to 26-35 lb-in (3-4 N-m)
C	-	Tighten to 71-97 lb-in (8-11 N-m)
D	-	Tighten to 43-61 lb-in (5-7 N-m)

Oil Pump

The transaxle uses a positive displacement gear and crescent type oil pump. It is located at the rear of the transaxle, and is driven by a oil pump shaft connected to the torque converter cover. Fluid output from the oil pump is controlled through the use of a pressure regulator valve.

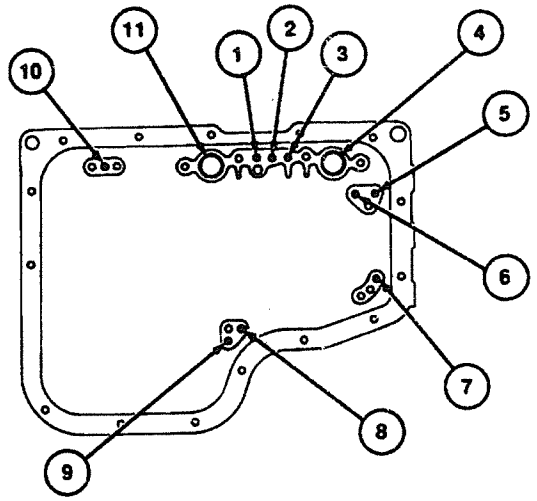
Governor

The governor is a centrifugal type, and is driven by the governor drive gear located on the drum hub assembly. The governor sends road speed information to the main control valve body for use in determining shift strategy.

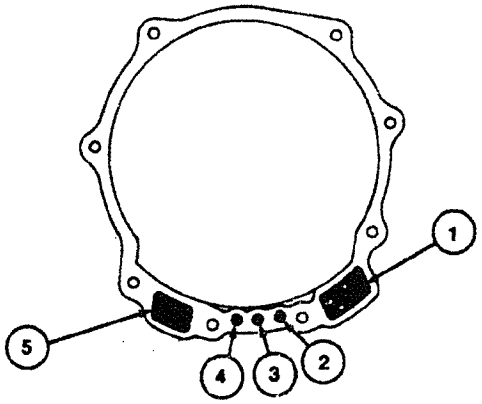
Intermediate Servo

The servo piston is a hydraulic piston connected to a rod. When the servo piston is actuated it forces the rod against the end of the intermediate band causing the intermediate band to hold the direct clutch and front sun gear stationary to the transaxle case.

Fluid Passageway Locations



Item	Part Number	Description
1	-	To the Torque Converter
2	-	To the Forward Clutch
3	-	To the Direct Clutch
4	-	Oil Pump Inlet
5	-	Servo Piston (Apply Side)
6	-	Servo Piston (Release Side)
7	-	To the Low/Reverse Clutch
8	-	Governor Outlet
9	-	Governor Inlet
10	-	Line Pressure Check Port
11	-	Oil Pump Outlet



Item	Part Number	Description
1	-	Oil Pump Inlet
2	-	To the Direct Clutch
3	-	To the Forward Clutch
4	-	To the Torque Converter
5	-	Oil Pump Outlet

Vacuum Throttle Valve Diaphragm

The vacuum throttle valve diaphragm regulates the position if the vacuum throttle valve. As engine vacuum changes the diaphragm within the vacuum throttle valve diaphragm moves the vacuum throttle valve diaphragm. As the vacuum throttle valve diaphragm moves the vacuum throttle valve within the main control valve body moves modifying the throttle valve pressure.

Shift Strategies

Automatic upshifts and downshifts will occur According to road speed and engine load. The governor valve, which is driven by the drive hub, senses road speed. The throttle. valve, which is controlled by a vacuum throttle valve diaphragm, senses engine load.

When engine load is high and road speed low the transaxle will automatically delay upshifts. When road speed is higher and engine load lower, the transaxle will upshift early.

If a forced downshift is desired for passing, an electric kickdown solenoid which is connected from the accelerator pedal and shaft to the main control valve body will cause the transaxle to downshift to a lower gear.

DIAGNOSIS AND TESTING

The automatic transaxle diagnosis is in order of difficulty and probability. The diagnostic steps are used to determine the causes of the transaxle malfunctions and to provide corrective actions.

Engine or driveline problems can affect transaxle performance; therefore, these systems should be serviced first to avoid incorrect or unnecessary repairs. Always make certain proper safety precautions are used when performing any test or repair.

The diagnosis and testing should be performed in the following sequence:

1. **Inspection and Verification:** provide easy inspection to detect obvious problems with the transaxle.
2. **Transaxle Fluid Level Check:** is important in detecting problems with the transaxle. Refer to the transmission fluid level check in this section.
3. **Troubleshooting Charts:** provide a breakdown to relate customer concerns to possible faults. The Troubleshooting Charts refer the technician to the following: Pinpoint Tests, Stall Test, Road Test, or removal and installation. However, for an unlisted symptom, follow the diagnosis and testing sequence to completion.
4. **Pinpoint Tests:** provide further evaluation of the downshift circuit, and the vacuum throttle valve diaphragm.
5. **Component Tests:** provide the technician with the necessary tests to diagnose the transaxle. The Troubleshooting Charts refer to the technician to the appropriate Component Test based on the vehicle's symptoms.

Inspection and Verification

Transaxle

1. Verify the customer concern by operating the vehicle and observing shift points.

2. Visually inspect the following components of the kickdown circuit:

VISUAL INSPECTION CHART

Mechanical	Electrical
• Binding or damaged accelerator pedal	• Blown fuse: -15A METER
• Automatic Transmission Fluid (ATF) leak	• Loose or corroded connections
• Contaminated or burned ATF	• Damaged wiring harness
	• Damaged kickdown switch
• ATF level	• Damaged kickdown solenoid

3. Check the accelerator pedal for freedom of travel.

Troubleshooting Charts - Automatic Transaxle

NOTE: Use a Digital Multimeter or equivalent to perform electrical Pinpoint Tests.

SHIFT RELATED CONDITIONS

CONDITION	POSSIBLE SOURCE	ACTION
• Upshift Does not Occur -No 1-2 Shift -No 2-3 Shift	• Vacuum throttle valve diaphragm. • Kickdown circuit. • Main control valve body. • Governor valve • Band apply servo. • Clutch(es). • Intermediate band. • Hydraulic circuit.	• GO to Pinpoint Test B1. • GO to Pinpoint Test Al. • GO to Stall Test in this section. • GO to Governor Check in this section. • GO to Stall Test in this section. • GO to Stall Test in this section. • GO to Stall Test in this section. • GO to In-Shop Test in this section.
• Upshift(s) Harsh	• Vacuum throttle valve diaphragm. • Accumulators • Pressure regulator valve. • Intermediate band. • Clutch(es).	• GO to Pinpoint Test B1. • GO to Stall Test in this section. • GO to Stall Test in this section. • GO to Stall Test in this section. • GO to Stall Test in this section.
• Shift Points Incorrect -Too High -Too Low	• Vacuum throttle valve diaphragm. • Kickdown circuit. • Hydraulic circuit. • Main control valve body. • Governor. • Clutch(es). • Accumulators. • Intermediate band.	• GO to Pinpoint Test B1. • GO to Pinpoint Test Al. • GO to In-Shop Test in this section. • GO to Stall Test in this section. • GO to Governor Check in this section. • GO to Stall Test in this section. • GO to Stall Test in this section. • GO to Stall Test in this section.
• Shifting is Erratic -No Set or Specific Shifts -Shift Points Are Seldom the Same	• Vacuum throttle valve diaphragm. • Kickdown circuit. • Main control valve body. • Governor valve. • Intermediate band. • Clutch(es).	• GO to Pinpoint Test B1. • GO to Pinpoint Test Al. • GO to Stall Test in this section. • GO to Governor Check in this section. • GO to Stall Test in this section. • GO to Stall Test in this section.
• Engine Races Between Shifts	• Main control valve body. • Intermediate band. • Clutch(es).	• GO to Stall Test in this section. • GO to Stall Test in this section. • GO to Stall Test in this section.
• Kickdown Does Not Occur	• Kickdown circuit. • Clutch(es). • Intermediate band.	• GO to Pinpoint Test A1. • GO to Stall Test in this section. • GO to Stall Test in this section.

DRIVE RELATED CONDITIONS

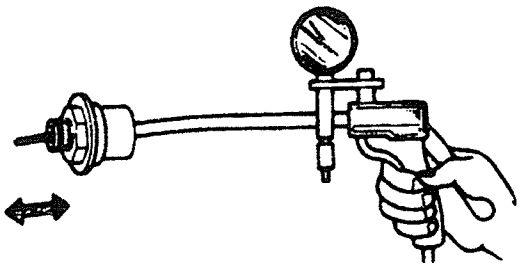
CONDITION	POSSIBLE SOURCE	ACTION
• Transaxle Does Not Engage Properly	• Main control valve body. • Accumulators. • Intermediate band. • Clutch(es).	• GO to Stall Test in this section • GO to Stall Test in this section. • GO to Stall Test in this section. • GO to Stall Test in this section.
• Vehicle does not move in any gear	• Main control valve body • Oil pump • Torque converter. • Clutch(es) • Hydraulic circuit.	• GO to Stall Test in this section • GO to Stall Test in this section. • GO to Stall Test in this section. • GO to Stall Test in this section. • GO to In-Shop Test in this section
• Engine Braking Inadequate	• Main control valve body. • Intermediate band. • Hydraulic circuit.	• GO to Stall Test in this section. • GO to Stall Test in this section. • GO to In-Shop Test in this section.
• Excessive Creep	• Torque converter.	• GO to Stall Test in this section.
• No Creep	• Main control valve body. • Front and rear clutch(es). • Oil pump.	• GO to Stall Test in this section. • GO to Stall Test in this section. • GO to Stall Test in this

OTHER CONDITIONS

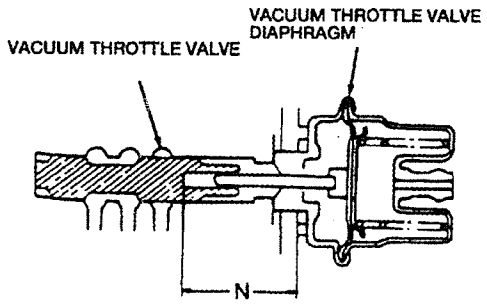
CONDITION	POSSIBLE SOURCE	ACTION
• Noise Only During Acceleration and/or Deceleration	• Torque converter. • Gear(s). • One-way clutch • Oil pump.	• GO to Stall Test in this section • GO to In-Shop Test in this section. • REPLACE the one-way clutch. • GO to Stall Test in this section.
Noise in PARK (P) and NEUTRAL (N)	• Torque converter. • Oil pump.	• GO to Stall Test in this section. • GO to Stall Test in this section.
• Noise in All Gears Only During Acceleration	• Final drive gearset.	• REPLACE the final drive gearset.
• Noise in All Gears Changes Acceleration to Deceleration	• Bearing(s). • Differential. • Gear(s).	• INSPECT/REPLACE the bearing(s). • INSPECT/REPLACE the differential. • INSPECT/REPLACE the gears.
• Vehicle Moves in PARK (P)	• Parking pawl. • Gearshift lever out of adjustment.	• INSPECT the parking pawl. • CHECK gearshift lever adjustment.
• No Start	• Park/Neutral Position Switch.	• REFER to Section 7.
• Overheating NOTE: Excessive overheating may cause damage to internal components. Whenever burned fluid is encountered, the main control valve body must be disassembled and cleaned to remove contamination. Always retest automatic transaxle for other symptoms after overheating problem is resolved and burned fluid is purged and replaced.	• Cooler and lines. • Intermediate band. • Clutch(es). • Improper Automatic Transmission Fluid (ATF) level	• INSPECT/REPLACE the cooler and/or lines. • GO to Stall Test in this section. • GO to Stall Test in this section. • CHECK ATF level.

Pinpoint Tests - Automatic Transaxle

PINPOINT TEST A: VACUUM THROTTLE VALVE DIAPHRAGM

TEST STEP		RESULT	ACTION TO TAKE
A1	CHECK SYSTEM INTEGRITY		
•	Inspect all hoses, connections, and the vacuum throttle valve diaphragm for evidence of cracks, separations, overheating, or any other damage. • Check for evidence of Automatic Transmission Fluid (ATF) or water at the diaphragm port. • **Do all of the components appear to be OK?**	Yes ⇒ No ⇒	GO to **A2**. SERVICE as required.
A2	CHECK VACUUM AT VACUUM THROTTLE VALVE DIAPHRAGM		
•	Key OFF. • Disconnect the hose from the vacuum throttle valve diaphragm. • Connect the Vacuum Tester, or equivalent, to the hose. • Key ON, engine running. • Engine at idle. • Read the vacuum on the gauge • **Is the manifold vacuum (15-22 in-Hg [381-559 mm-Hg]) present and held by the hose?**	Yes ⇒ No ⇒	GO to **A3**. REPLACE the vacuum hose.
A3	CHECK THROTTLE VALVE DIAPHRAGM FUNCTION		
•	Key OFF. • Remove the vacuum throttle valve diaphragm. • Connect a Vacuum Tester, or equivalent, to the vacuum throttle valve diaphragm as shown below.  • Apply 16-20 in-Hg (406.4-508 mm-Hg) vacuum. • Check that vacuum is held. • Check that the throttle control valve rod moves freely. • Check that the spring returns the throttle control valve rod to a fully closed position when vacuum is released. • **Does the vacuum throttle valve diaphragm operate properly?**	Yes ⇒ No ⇒	GO to **A4**. REPLACE the vacuum throttle valve diaphragm.

PINPOINT TEST A: VACUUM THROTTLE VALVE DIAPHRAGM (Continued)

<table>
<tr><th colspan="2">TEST STEP</th><th>RESULT</th><th>ACTION TO TAKE</th></tr>
<tr><td>A4</td><td>CHECK VACUUM DIAPHRAGM ROD</td><td></td><td></td></tr>
<tr><td colspan="2">• Remove the vacuum throttle valve diaphragm.
• Measure the dimension inside the automatic transaxle (see diagram below) using the Vacuum Diaphragm Rod Gauge.
 

• Measure the dimension of the throttle control valve rod.
• Compare the measurements using the chart below.</td><td>Yes ⇒

No ⇒</td><td>Vacuum throttle valve diaphragm OK. CHECK for proper operation of vacuum throttle valve inside main control valve body.
REPLACE the throttle control valve rod.</td></tr>
<tr><td colspan="2"><table>
<tr><th>N Dimension</th><th>Applicable Throttle Control Rod Length</th></tr>
<tr><td>Below 1.000 inches (25.4mm)</td><td>1.161 inches (29.6mm)</td></tr>
<tr><td>1.000-1.020 inches (25.4-25.9 mm)</td><td>1.181 inches (30.0mm)</td></tr>
<tr><td>1.020-1.039 inches (25.9-26.4mm)</td><td>1.200 inches (30.5mm)</td></tr>
<tr><td>1.039-1.059 inches (26.4-26.9mm)</td><td>1.220 inches (31.0mm)</td></tr>
<tr><td>1.059 inches (26.9mm) or over</td><td>1.240 inches (31.5mm)</td></tr>
</table></td><td></td><td></td></tr>
<tr><td colspan="2">• Are the measurements within specifications?</td><td></td><td></td></tr>
</table>

Component Tests

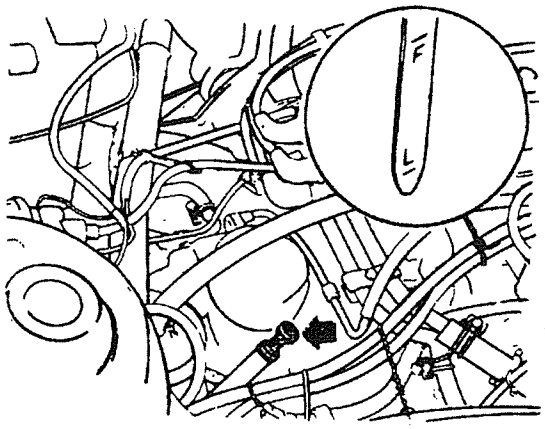
Transmission Fluid Level Check

1. Apply the parking brake and ensure that the vehicle is in a level position.

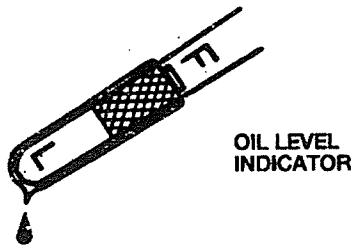
2. Run the engine at normal idle speed. If the Automatic Transmission Fluid (ATF) is cold, run the engine at fast idle speed (about 1200 rpm) for several minutes. When the ATF is warm, slow the engine down to normal idle speed.

3. Apply the brakes firmly and shift the gearshift lever through all the gear positions. Place the gearshift lever in the PARK (P) position. Do not shut off the engine during the ATF level checks.

4. Clean all dirt from the transmission oil level indicator cap before removing the transmission oil level indicator from the transmission oil filler tube.



5. Pull the transmission oil level indicator out of the transmission oil filler tube, Wipe it clean, and push it completely back into the transmission oil filler tube. Ensure that the transmission oil level indicator is properly seated in the transmission oil filler tube.



6. Pull the transmission oil level indicator out of the transmission oil filler tube and check the ATF level. The ATF level should be between the L and F marks.

7. If necessary, add enough ATF to the transaxle through the transmission oil filler tube to bring the level between the L and F marks on the transmission oil level indicator. Do not overfill the transaxle.

8. Install the transmission oil level indicator in the transmission oil filler tube.

Transmission Fluid Condition Check

1. Make the normal transmission fluid level check. Refer to the procedure in this section.

2. Observe the color and odor of the Automatic Transmission Fluid (ATF). It should be red; not brown or black. Odor can sometimes indicate an overheating condition, clutch disc, or band failure.

3. Use an absorbent white facial tissue to wipe the transmission oil level indicator. Examine the stain for evidence of solids (specks of any kind) and for antifreeze signs (gum or varnish on the transmission oil level indicator).

If specks are present in the ATF or there is evidence of engine coolant, the transmission oil pan must be removed for further inspection. If ATF contamination or transaxle failure is confirmed by further evidence of coolant or excessive solids in the transmission oil pan, the transaxle must be disassembled, completely cleaned and serviced. This includes cleaning the torque converter and ATF cooling system. Do not perform any further checks before cleaning and servicing the transaxle.

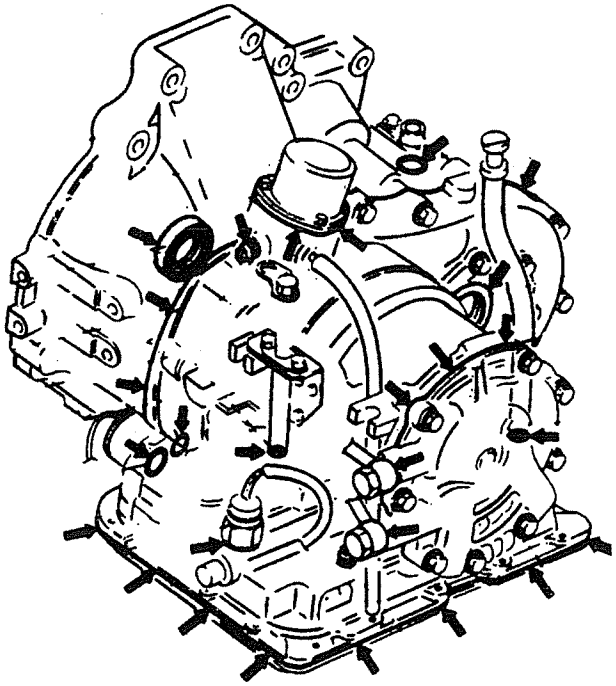
During disassembly and assembly, all overhaul checks and adjustments of clearances and end play must be made.

Transmission Fluid Leakage Checks

1. Clean the transaxle case and operate the vehicle to warm the Automatic Transmission Fluid (ATF) to normal operating temperature.

2. Inspect the areas of the transaxle indicated in the illustration for signs of leakage.

Transaxle Fluid Leakage Check Points (illus.)



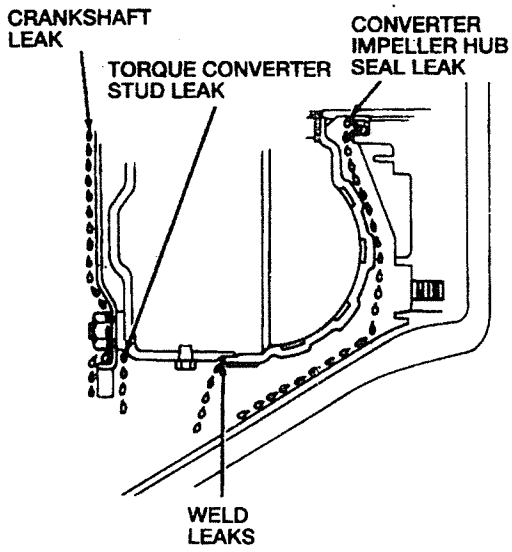
3. If no visual sign of leakage is found, it may be necessary to use oil soluble aniline or fluorescent dyes to find the leak. Use the Oil Leak Detector or equivalent to check for ATF leaks. Test the transaxle for leaks following the procedures supplied with the leak tester.

4. If any sign of leakage is found, repair as necessary.

Fluid Leakage in Torque Converter Area

In diagnosing and correcting Automatic Transmission Fluid (ATF) leaks in the converter area, use the following procedures to locate the exact cause of the leakage. Leakage at the front of the transaxle, as evidenced by ATF around the torque converter housing, may have several sources. By careful observation it is possible in many instances to pinpoint the source of the leak before removing the transaxle from the vehicle. The paths which the ATF can take to reach the
bottom of the torque converter housing are as follows:

Possible Converter Area Leak Points



1. ATF leaking by the torque converter impeller hub seal lip will tend to move along the torque converter impeller hub and onto the back of the impeller housing. Except in the case of a total seal failure, ATF leakage by the lip of the seal will be deposited on the inside of the torque converter housing only, near the outside diameter of the housing.

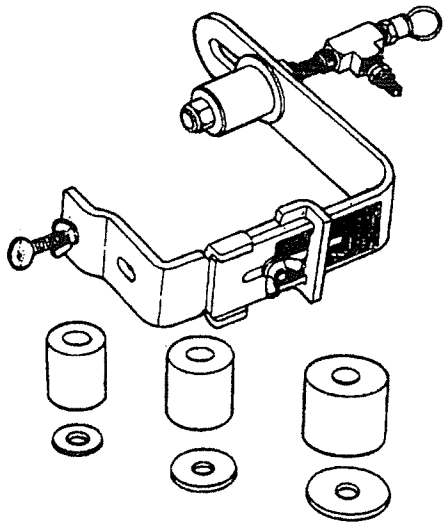
2. ATF leakage by the outside diameter of the torque converter hub seal and the case will follow the same path which the leaks by the inside diameter of the seal follow.

3. ATF leakage from the torque converter to the flywheel stud weld will appear at the outer diameter of the torque converter on the back face of the flywheel, and in the torque converter housing only near the flywheel. If a torque converter-to-flywheel stud leak is suspected, remove the torque converter and perform the torque converter checks in this section.

Torque Converter Leakage Check

If welds on the torque converter indicate leakage, remove the torque converter and make the following check:

Assemble a Torque Converter Leak Test Kit or equivalent to the torque converter. Test the torque converter for leaks, following the directions supplied with the kit.



TORQUE CONVERTER LEAK TEST KIT

Engine Idle Speed Check

1. Warm the engine up until normal operating temperature is reached.

2. Place the gearshift lever in the PARK (P) range.

3. Run the engine between 2,500 and 3,000 rpm for three minutes and then return the engine to idle.

4. Connect a Digital Multimeter, or equivalent to the vehicle to monitor engine speed.

5. Ground the engine self-test (STI[TEN]) terminal in the data link connector.

6. The idle speed should be within 750 ±50 rpms. Refer to Section 11 for the idle speed adjustment procedures if the idle speed is not within specification.

Stall Test

1. Check the engine coolant level, the oil level and the Automatic Transmission Fluid (ATF) level.

2. Connect a Digital Multimeter, or equivalent, to the vehicle to monitor engine speed.

3. Apply the parking brake and block the wheels to prevent the vehicle from rolling.

4. Warm the engine until the ATF temperature reaches normal operating temperature 122°-176-F (50°-80°C).

   CAUTION: This procedure must be completed within five seconds, followed by cooling the ATF in NEUTRAL (N) while idling the engine for at least two minutes.

5. Depress the brake pedal.

6. Place the gearshift lever in REVERSE (R).

7. Steadily increase engine speed to its maximum, quickly read the speed, and release the accelerator.

8. Repeat the test, followed by cooling the ATF in NEUTRAL (N) while idling the engine for at least two minutes for each of the gearshift lever ranges: DRIVE (D), 2, and 1.

9. Use the following stall test evaluation chart to verify the test results.

STALL TEST EVALUATION CHART

Test Result	Possible Location of Problem	Action to Take
Higher than specification[1] at every position	Insufficient line pressure a. Worn oil pump b. Oil leakage from the oil pump, main control valve body or transaxle case c. Pressure regulator valve sticking	INSPECT/SERVICE as required.
Higher than specification' in D, 2, and 1 range	Rear clutch slipping	INSPECT/SERVICE as required.
Higher than specification' only in D range	One-way clutch slipping	INSPECT/SERVICE as required.
Higher than specification' only in 2 range	Intermediate band slipping	ADJUST intermediate band. RETEST
Higher than specification' only in R range	Low/reverse clutch slipping Front clutch slipping	PERFORM road test to determine whether the condition is the low and reverse brake or front clutch a. Engine brake applied in 1st: front clutch b. Engine brake not applied in 1st: low and reverse brake SERVICE as required.
Within specification'	Shift control elements in transaxle all normal	GO to In-Shop Test in this section.
Lower than specification'	One-way clutch in torque converter slipping	REPLACE the torque converter.

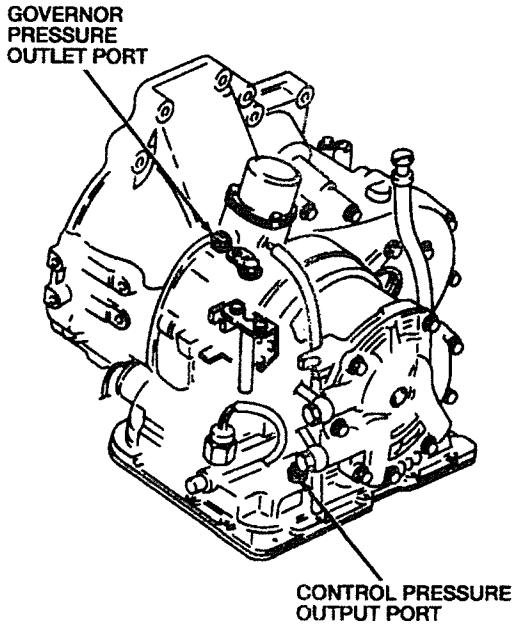
Governor Check

SPECIAL SERVICE TOOL(S) REQUIRED

- Engine Oil Pressure Gauge

1. Warm the engine until the Automatic Transmission Fluid (ATF) reaches normal operating temperature 122°-176°F (50° - 80°C).

2. Connect an Engine Oil Pressure Gauge to the governor pressure outlet.



[1]Specified stall speed: 2300-2500 rpm

3. Drive the vehicle at the speeds indicated on the governor pressure specifications chart.

4. Record the governor pressure at these speeds.

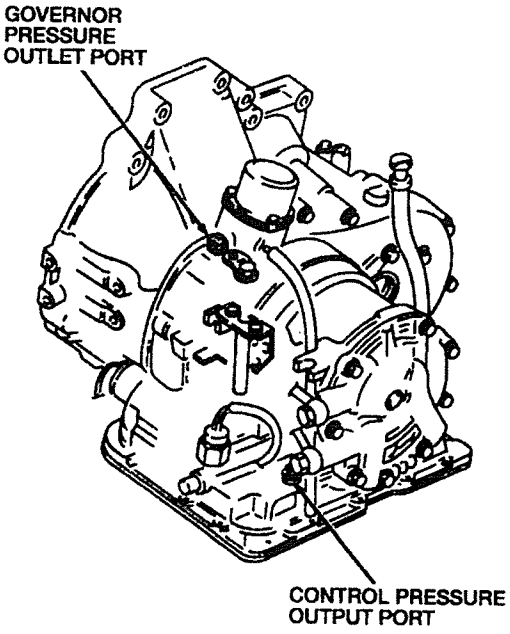
GOVERNOR PRESSURE SPECIFICATIONS CHART

Speed	Governor Pressure
20 mph (32 km/h)	13 - 21 psi (88 - 147 kPa)
35 mph (56 km/h)	27 - 36 psi (186 - 245 kPa)
55 mph (88.5km/h)	58 - 70 psi (402 - 481 kPa)

GOVERNOR PRESSURE EVALUATION CHART

Governor Pressure	Possible Location of Problem	Action to Take
Within specifications	--	GO to next step
Out of specifications	Fluid leakage from governor or line pressure hydraulic circuit. Governor malfunction.	SERVICE as required.

5. Connect an Engine Oil Pressure Gauge to the control pressure output point and the governor pressure outlet.



6. Disconnect and plug the vacuum throttle valve diaphragm hose(s).

7. Connect a Vacuum Tester or equivalent to the vacuum throttle valve diaphragm.

8. Drive the vehicle.

9. Gradually increase the engine rpm and apply vacuum slowly to the vacuum throttle valve diaphragm.

10. Record the governor pressure when the control pressure drops abruptly.

CONTROL PRESSURE CUTBACK SPECIFICATIONS CHART

Vacuum Pump Pressure	Governor Pressure
0 in-Hg (0 mm - Hg)	14-23 psi (98-157 kPa)
7.87 in-Hg (200 mm - Hg)	6-14 psi (39-98 kPa)

CONTROL PRESSURE CUTBACK EVALUATION CHART

Control Pressure	Possible Location of Problem	Action to Take
Within specifications	--	PERFORM Road Test in this section.
Out of specifications	Throttle control valve rod not installed properly. Valve malfunction (inside main control valve body). Diaphragm spring weak.	SERVICE as required. REPLACE the valve. SERVICE as required.

Transmission Oil Cooler Flow Test

NOTE: The transmission linkage/cable adjustment, Automatic Transmission Fluid (ATF) level, and line pressure must be within specification before performing this test.

1. Remove the transmission oil level indicator from the transmission oil filler tube.
2. Place a funnel in the transmission oil filler tube.
3. Raise and support the vehicle.
4. Remove the oil cooler hose (rear fitting) from the fitting on the transaxle case.
5. Connect one end of a hose to the oil cooler hose and route the other end of the hose up to a point where it can be inserted into the funnel at the filler tube.
6. Lower the vehicle. Insert the end of the hose into the funnel.
7. Start the engine and run at idle with transaxle in NEUTRAL(N).
8. When the fluid flowing from hose is solid, the amount of fluid should be about 0.5 qt (0.47L) delivered in 30 seconds. If the flow is within specification, test is completed.
9. If the flow is not within specification, stop the engine. Disconnect the hose from the cooler return line and connect it to the converter-out line fitting (front fitting) on the transaxle case.
10. Repeat steps 7 and 8. If the flow is not within specification, flush the system. If specified flow is not yet obtained, replace the cooler lines.

Shift Point Checks

Road Test

1. Warm the engine until the Automatic Transmission Fluid (ATF) reaches normal operating temperature 122 -176°F (500-800°C).
2. Place the gearshift lever in DRIVE (D).
3. Drive the vehicle.
4. Accelerate the vehicle at minimum throttle.
5. Compare the shift points with those listed in the shift point chart.
6. Retest the vehicle with the throttle fully open, then at half throttle, and compare the shift points with the chart below.

SHIFT POINT CHART

Throttle Condition (Manifold Vacuum)	Range	Shift	Vehicle Speed mph (km/h)
Fully opened (0 - 1.97 in-Hg [0 - 5 mm-Hg])	D	1st - 2nd 2nd - 3rd 3rd - 2nd 2nd - 1st	28 - 33 (44 - 63) 55 - 63 (88 - 101)* 48 - 53 (78 - 86)* 22 - 24 (35-39)
Half throttle (2.76 in-Hg [70.1 mm-Hg])	D	1st - 2nd 2nd - 3rd	9 - 17 (15 - 28) 16 - 34 (26 - 55)
Fully closed	D 1	2nd - 1st 2nd - 1st	6 - 9 (9 - 14) 20 - 24 (32 - 39)

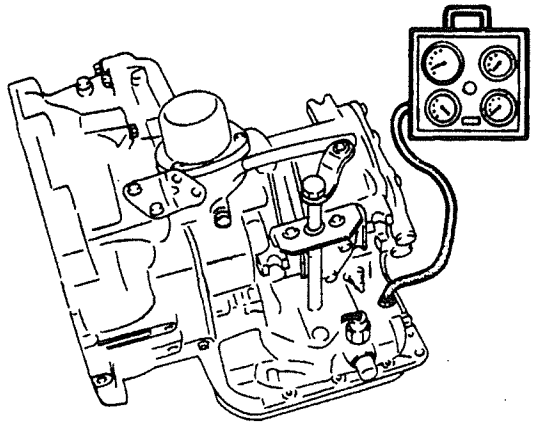
* The governed top speed is 40 mph (70 km/h).

7. If the shift points are not as specified, perform the In-Shop Test. Otherwise, continue to next step.
8. Place the gearshift lever in D.
9. Drive the vehicle until 2nd gear is obtained.
10. Shift the gearshift lever into 1 (one) range.
11. Engine braking should be felt immediately. If it is, refer to Troubleshooting Charts. Otherwise, service as necessary.

In-Shop Test

1. Connect a Digital Multimeter, or equivalent to the vehicle to monitor engine speed.

2. Connect a Transmission Tester Kit with the Pressure Test Fittings or equivalent to the transaxle as shown.



3. Apply the parking brake and block the wheels to prevent the vehicle from rolling.

4. Key ON, engine running.

5. Warm the engine until the Automatic Transmission Fluid (ATF) reaches normal operating temperature of 122°-176°F (50-80°C).

6. Apply the brake pedal.

7. Place the gearshift lever in DRIVE (D).

8. **CAUTION: The following steps must be completed within five seconds, followed by cooling the ATF in NEUTRAL (N) idling for at least two minutes.**

   Steadily increase the engine speed to its maximum, quickly read the control pressure when the engine speed remains constant, and then release the accelerator pedal.

9. Repeat these steps for the 1, 2, and R range.

CONTROL PRESSURE SPECIFICATIONS CHART

	Control Pressure		
	D and 1	2	R
When idling	46-54 psi (314-373 kPa)	150-166 psi (1030-1148 kPa)	76-95 psi (520-657 kPa)
At stall speed	141-157 psi (971-1089 kPa)	150-166 psi (1030-1148 kPa)	251-262 psi (1727-1813 kPa)

CONTROL PRESSURE TEST EVALUATION CHART

Control Pressure	Possible Location of Problem	Action to Take
High pressure when idling	Vacuum tube broken or disconnected. Vacuum throttle valve diaphragm broken.	GO to Pinpoint Test A1.
Within specifications		PERFORM Governor Check component test
Low pressure in D, 2, or R	Worn oil pump. Oil leakage from oil pump, main control valve body, or transaxle case. Pressure regulator valve sticking.	SERVICE as required.
Low pressure in D and 2 only	Oil leakage from hydraulic circuit of D and 2 (rear clutch, governor).	SERVICE as required.
Low pressure in R only	Oil leakage from hydraulic circuit of R (low/reverse clutch).	SERVICE as required.

IN-VEHICLE SERVICE

Transmission Fluid Drain

NOTE: The transaxle cannot be drained completely through the drainplug opening. For complete draining, also remove the transmission oil pan.

Refer to Section 2 for information concerning the maintenance schedule(s). If a major repair, such as a clutch, band, or bearing replacement is required, the transaxle will have to be removed for service. At this time the torque converter and the oil cooler hoses must be thoroughly flushed to remove any foreign particles.

The following procedures are for partial drain and refill for an in-vehicle service operation.

1. Raise and support the vehicle.
2. Place a suitable container under the transaxle.
3. **CAUTION: Avoid spilling the transmission fluid. The fluid may be hot.**

   Remove the transmission fluid drainplug and drain the transmission fluid into the container.
4. Remove the 16 transmission oil pan bolts and carefully remove the transmission oil pan.
5. Thoroughly clean the transmission oil pan and oil filter. Replace the oil filter if necessary.
6. Install the oil filter. Tighten the oil filter bolts to 26-35 lb-in (3-4 N-m).
7. NOTE: Do not over tighten the bolts. DO NOT use any type of gasket sealer, RTV, etc., on the transmission oil pan or gasket. If necessary, soak the gasket in clean ATF.

   Place a new gasket on the transmission oil pan and install the transmission oil pan on the transaxle. Install the transmission oil pan bolts and tighten to 43-69 lb-in (5-8 N-m).
8. Install a new washer on the transmission fluid drainplug. Install the transmission fluid drainplug and tighten the transmission fluid drainplug to 29-40 lb-ft (39-54 N-m).
9. Lower the vehicle.

Transmission Fluid Fill

If the automatic transaxle has begun completely drained, remove the fluid level indicator and add 3 qts (2.8L) of the specified transmission fluid through the oil filler tube.

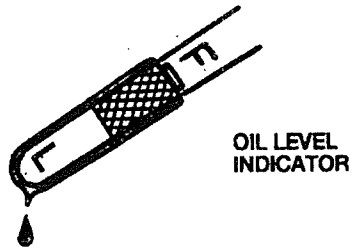
If the automatic transaxle has been disassembled, and the torque converter has been drained, remove the fluid level indicator and add 6.0 quarts (5.7L) of the specified transmission fluid through the oil filler tube.

Check the transmission fluid.

Transmission Fluid Check

NOTE: Make sure that the transmission fluid level is always just below the F mark. Do not overfill.

Start and run the engine until it is at normal operating temperature. Press the brake pedal firmly and move the gearshift lever through all gear positions. Place the gearshift lever in the PARK (P) position and measure the fluid level using the oil level indicator markings. If the level is low, add enough fluid so that the oil level indicator reading is between the F and L marks.



Main Control Valve Body

Removal

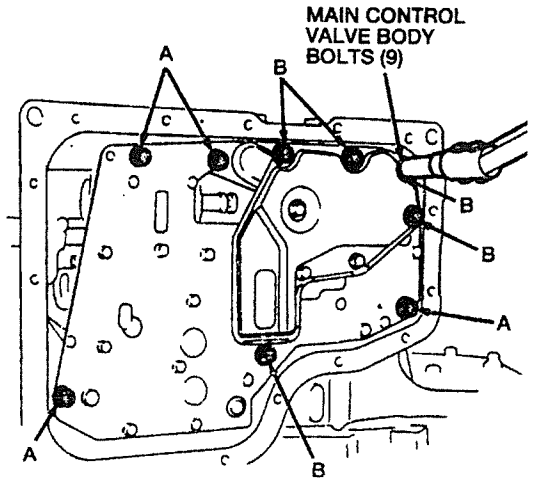
1. Raise and support the vehicle.
2. Remove the access shields to gain access to the transaxle.
3. **WARNING: AVOID PILLING THE TRANSMISSION FLUID. THE FLUID MAY BE HOT.**

Drain the transmission fluid. Refer to the procedure in this section.

4. Remove the 16 transmission oil pan bolts and remove the transmission oil pan from the transaxle.
5. NOTE: Be careful not to lose the throttle control valve rod or the check ball and detent spring used for the torque converter relief valve.

   NOTE: Note the position of each main control valve body bolt for installation reference.

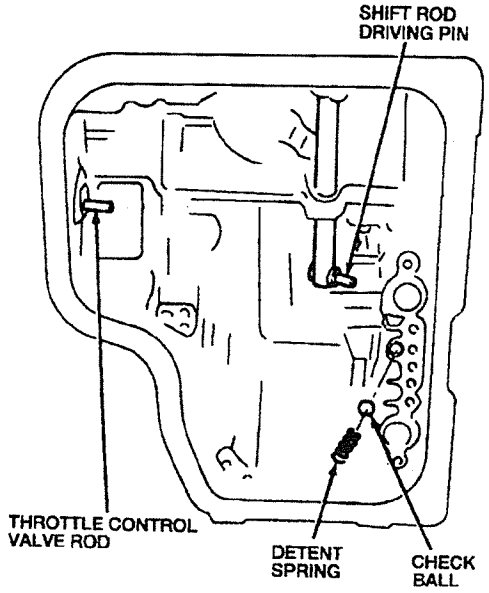
   Remove the nine main control valve body bolts from the main control valve body and carefully remove the main control valve body.



Installation

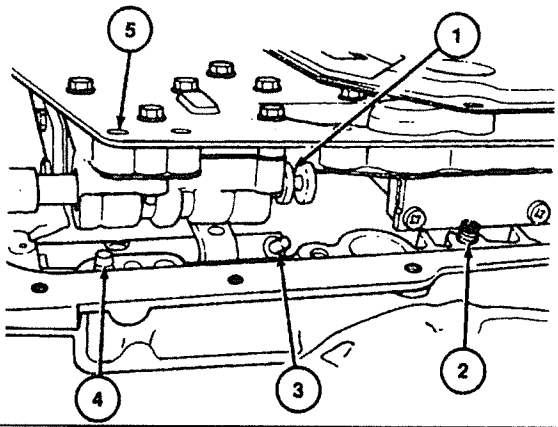
1. NOTE: The check ball is inserted first, then the detent spring is installed. Use petroleum jelly, if necessary, to retain the detent spring and check ball.

   Install the throttle control valve rod into its hole in the transaxle case. Install the check ball and detent spring into the slotted hole in the transaxle case.

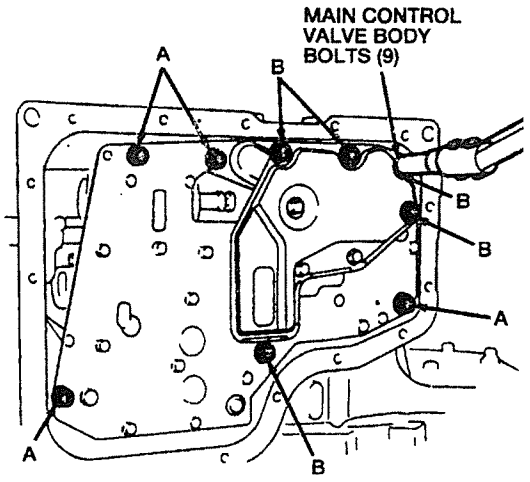


2. **CAUTION: Do not overtighten the main control valve body bolts. Overtightening may result in component failure.**

   Install the main control valve body, mating the manual valve groove with the shift rod driving pin. Match the dowels in the transaxle case with the mating holes in the main control valve body. Tighten the main control valve body bolts to 71-97 lb-in (8-11 N-m).



Item	Part Number	Description
1	-	Manual Valve
2	-	Check Ball and Detent Spring Installed
3	-	Shift Rod Driving Pin
4	-	Main Control Valve Body Locating Dowel
5	-	Locating Dowel Hole



A = 30mm (1.18 INCH) BOLT
B = 40mm (1.57 INCH) BOLT

3. NOTE: Do not use any type of gasket sealer, RTV, etc., on the transaxle pan or gasket. If necessary, soak the gasket in clean automatic transmission fluid.

   Install the transmission oil pan using a new oil pan to case gasket. Install the 16 transmission oil pan bolts and tighten to 43-69 lb-in (5-8 N-m).

4. Install the access shield(s) to the vehicle.

5. With the vehicle on level ground, check the transmission fluid and add fluid as necessary. Refer to the procedure in this section.

6. Ensure that there are no fluid leaks.

Differential Oil Seals

SERVICE TOOL(S) REQUIRED

- Differential Seal Replacer

Removal

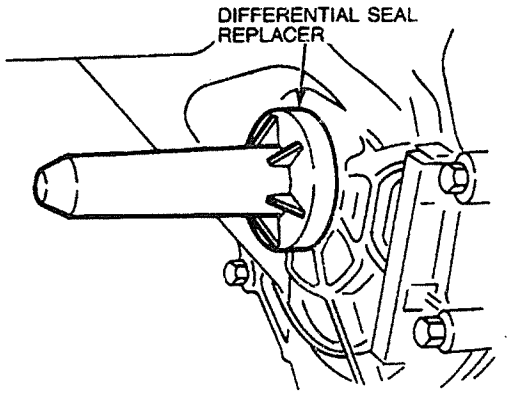
1. Raise and support the vehicle.

2. Remove the rear wheel driveshaft and joint. Refer to Section 7 for the removal procedure.

3. Use a flat-blade screwdriver to remove the differential oil seal.

Installation

1. Use Differential Seal Replacer to install the differential oil seal.



2. Install the rear wheel driveshaft and joint. Refer to Section 7 for the installation procedure.

3. Lower the vehicle.

4. Check the transmission fluid level and fill as needed. Refer to the procedure in this section.

5. Ensure that there are no fluid leaks.

Intermediate Servo

Removal

1. Raise and support the vehicle.

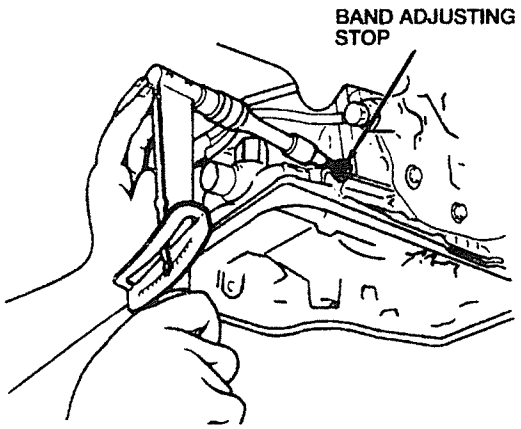
2. Remove the LH rear wheel and tire assembly.

3. Drain the transmission fluid. Refer to the procedure in this section.

4. Remove the main control valve body. Refer to the procedure in this section.

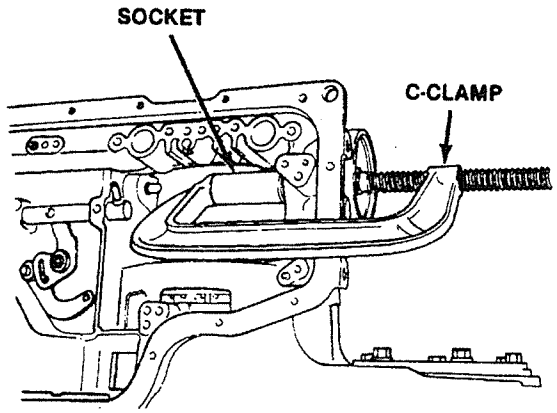
5. Remove the rear wheel driveshaft and joint. Refer to Section 7 for the removal procedure.

6. Loosen the band adjusting stop and band adjusting stop nut.



7. Remove the band strut.

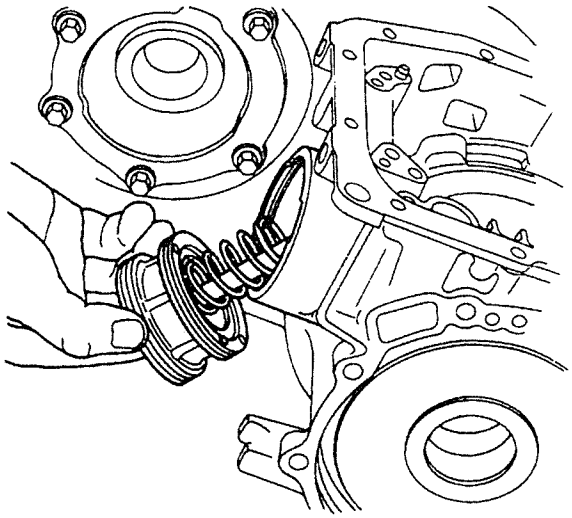
8. Use a C-clamp and a socket to compress the servo piston into the transaxle case.



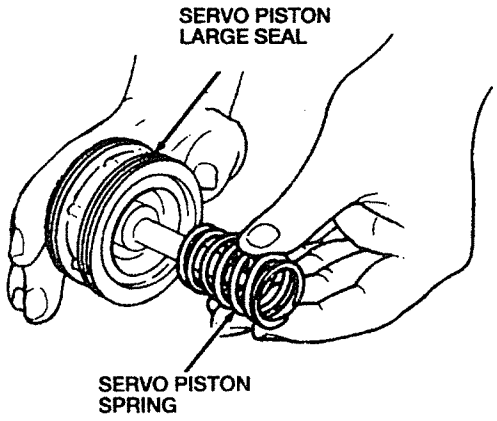
9. **WARNING: TO AVOID PERSONAL INJURY, WEAR EYE PROTECTION DURING THE FOLLOWING PROCEDURE.**

   Use a screwdriver to remove the servo piston retaining snap ring.

10. Remove the servo retainer, servo piston, and servo piston spring by slowly loosening the C-clamp.



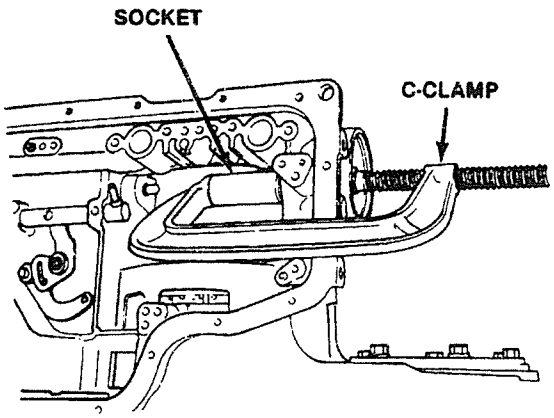
11. Remove the servo piston spring and the servo piston large seal.



Installation

1. Lubricate the servo piston with the specified transmission fluid. Assemble the servo retainer, servo piston, servo piston large seal and servo piston spring and insert them into the transaxle case.

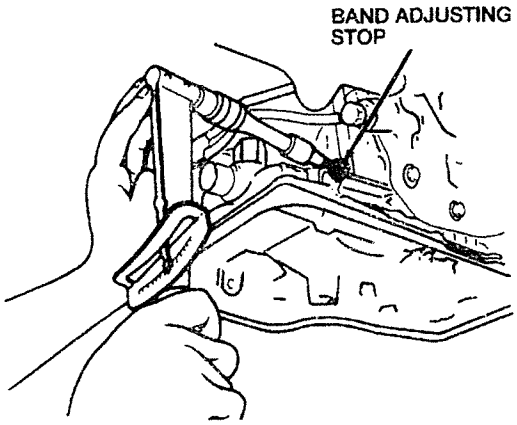
2. Use a C-clamp and socket to compress the assembly.



3. Install the servo piston retaining snap ring to the snap ring groove. Remove the C-clamp.

4. Install the band strut to the intermediate band.

5. Install the band adjusting stop to the intermediate band and tighten to 9-10 lb-ft (12-15 N-m). Loosen the band adjusting stop three turns.



6. Install and tighten the band adjusting stop nut to 41-59 lb-ft (55-80 N-m). Do not allow the band adjusting stop to turn while tightening the band adjusting stop nut.

7. Install the rear wheel driveshaft and joint. Refer to Section 7 for the installation procedure.

8. Install the main control valve body. Refer to the procedure in this section.

9. Install the LH rear wheel and tire assembly and the wheel hub bolts. Tighten the wheel hub bolts to 65-87 lb-ft (88-118 N-m).

10. Lower the vehicle.
11. Check the transmission fluid level and fill as needed. Refer to the procedure in this section.

12. Ensure that there are no fluid leaks.

Vacuum Throttle Valve Diaphragm

SERVICE TOOL(S) REQUIRED

- Vacuum Diaphragm Rod Gauge

Removal

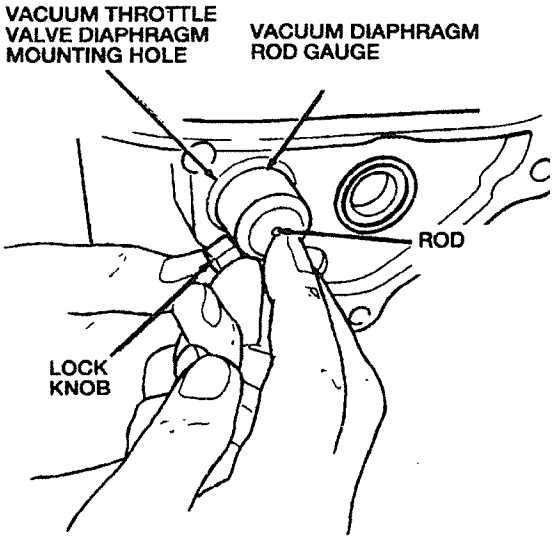
1. Drain the transmission fluid. Refer to the procedure in this section.

2. Disconnect the vacuum hose from the vacuum throttle valve diaphragm.

3. Unscrew the vacuum throttle valve diaphragm by hand or use pliers on the flange and remove the throttle valve diaphragm gasket and the throttle control valve rod from the transaxle case.

4. NOTE: The throttle control valve rod is a selective component. If the vacuum throttle valve diaphragm is being replaced, use the procedure that follows to select the correct throttle control valve rod from the chart.

   Clean the vacuum throttle valve diaphragm mounting hole and Vacuum Diaphragm Rod Gauge to ensure there is no transmission fluid on these surfaces.

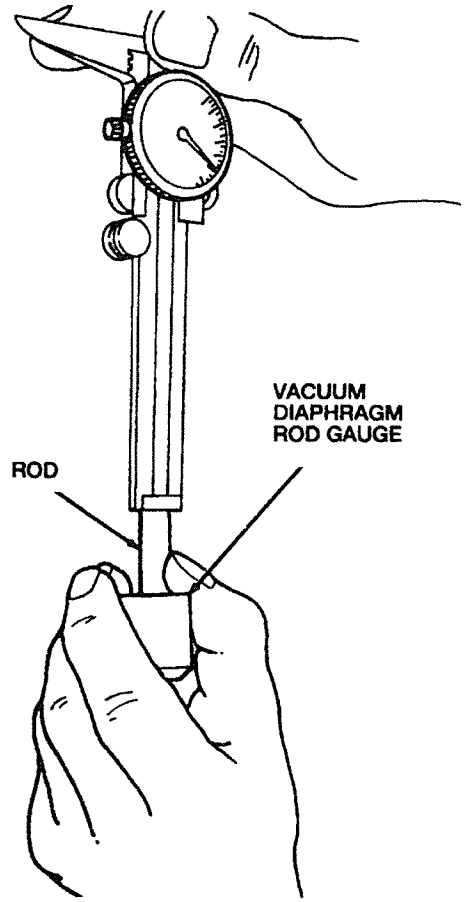


5. With the beveled side out, insert Vacuum Diaphragm Rod Gauge into the vacuum throttle valve diaphragm mounting hole until the tool bottoms out.

6. Place the Rod through the opening of the Vacuum Diaphragm Rod Gauge until the Rod bottoms out against the vacuum throttle valve.

7. Tighten the lock knob on the Vacuum Diaphragm Rod Gauge and remove Vacuum Diaphragm Rod Gauge from the transaxle case.

8. Use a depth gauge to measure the distance from the flat surface of the Vacuum Diaphragm Rod to the end of the Rod.



9. Use this measurement to select the correct size throttle control valve rod from the following chart.

THROTTLE CONTROL VALVE ROD SELECTION

Depth Measurement - inch (mm)	Throttle Control Valve Rod Length - inch (mm)
Under 1.000 (25.4)	1.161 (29.5)
1.000 -1.020 (25.4 - 25.9)	1.181 (30.0)
1.020 -1.039 (25.9 - 26.4)	1.200 (30.5)
1.039 -1.059 (26.4 - 26.9)	1.220 (31.0)
Over 1.059 (26.9)	1.240 (31.5)

Installation

1. Install the throttle control valve rod into the transaxle case.

2. Lubricate a new throttle valve diaphragm gasket with the specified transmission fluid and install it on the vacuum throttle valve diaphragm.

3. Coat the threads of the vacuum throttle valve diaphragm with Gasket Eliminator and install the vacuum throttle valve diaphragm into the transaxle case. Use pliers to tighten the crimped portion of the vacuum throttle valve diaphragm.

4. Connect the vacuum hose to the vacuum throttle valve diaphragm.

5. Fill and check the transmission fluid level. Refer to the procedures in this section.

Backup Lamp Switch

Removal and Installation

Refer to Section 19 for removal and installation procedures for the backup lamp switch.

Switch, Kickdown

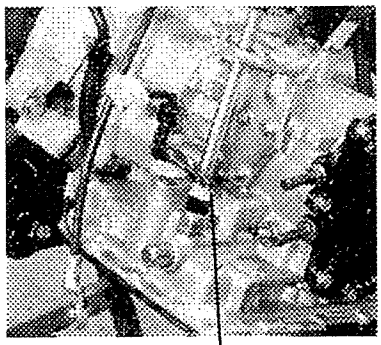
Removal

1. Disconnect the kickdown switch electrical connector.

2. Remove the kickdown switch locknut.

3. Unscrew the kickdown switch from the accelerator shaft retainer.

4. Remove the kickdown switch.



Installation

To install, reverse the removal procedure.

Adjust the kickdown switch. Refer to the procedure in this section.

REMOVAL

Transaxle

SPECIAL SERVICE TOOL(S) REQUIRED

- Differential Plugs

1 Disconnect the battery ground cable.

2. Remove the manual control lever nut and the manual control lever arm.

3. Remove the shift cable and bracket from the transaxle.

4. Disconnect the speedometer cable from the transaxle.

5. Disconnect the transaxle electrical connectors located next to the governor.

6. Disconnect the transaxle vacuum hose and vent hose located below the distributor cap.

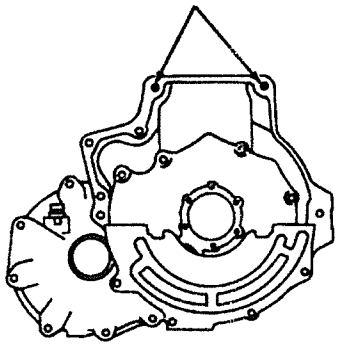
7. Disconnect the ground strap bolt and ground strap from the transaxle.

8. Remove the starter motor. Refer to Section 16 for the removal procedure.

9. Remove coolant pipe retaining bracket located below the distributor cap.

10. Remove two engine-to-transaxle bolts.

ENGINE-TO-TRANSAXLE BOLTS LOCATION



11. Use Three Bar Engine Support or equivalent to support the engine.

12. Raise and support the vehicle.

13. Drain the transmission fluid. Refer to the procedure in this section.

14. Remove the rear wheel and tire assemblies.

15. Remove the access shields on the engine sides of the vehicle.

16. **CAUTION: Be careful not to damage the ball joint dust boot.**

    Remove the clamp bolts and nuts. Pull the rear suspension lower arms downward, separating the rear suspension lower arms from the rear wheel knuckles.

17. Remove the tie rod end cotter pin and tie rod end nut and disconnect the tie rod end from the front wheel knuckle. Discard the tie rod end cotter pin.

18. NOTE: Use Differential Plugs to prevent the differential side gears from becoming misaligned.

    Remove the rear wheel driveshaft and joints. Refer to Section 7 for the removal procedure.

19. Remove the front and rear transaxle support insulator nuts.

20. Remove the four rear engine support rebound insulator bolts and the rear engine support.
21. Remove the front transaxle support insulator through bolt nut and bolt. Remove the front transaxle support insulator.

22. Remove the four front transaxle support bracket bolts and the front transaxle support bracket.

23. Remove the two rear transaxle support bracket bolts and the rear transaxle support bracket and insulator.

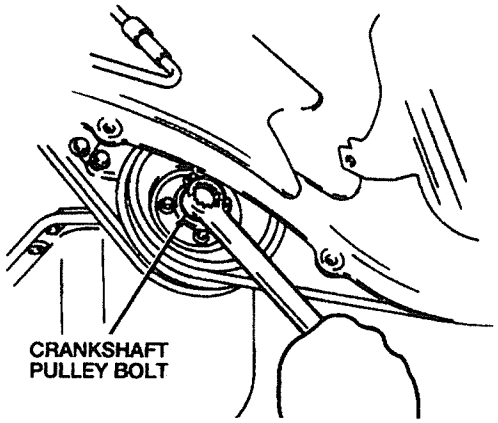
24. Remove the intake manifold support.

25. Remove the three transaxle-to-engine bolts and remove the case rear bracket.

26. Remove the three transaxle-to-engine bolts from the transaxle case to cylinder block front bracket. Remove the transaxle case to cylinder block front bracket.

27. Remove the transmission housing cover bolts and the transmission housing cover.

28. Using a wrench, rotate the crankshaft pulley bolt clockwise to gain access to all torque converter-to-flywheel nuts. Remove torque converter-to-flywheel nuts.



29. Mark alignment marks between the oil cooler tubes and the oil cooler hoses. Disconnect the oil cooler hoses from the oil cooler tubes.

30. Position Hi-Lift Jack under the transaxle.

31. Secure the transaxle to Hi-Lift Jack.

32. Remove the remaining engine-to-transaxle bolts.

33. Remove the transaxle from the vehicle.

DISASSEMBLY

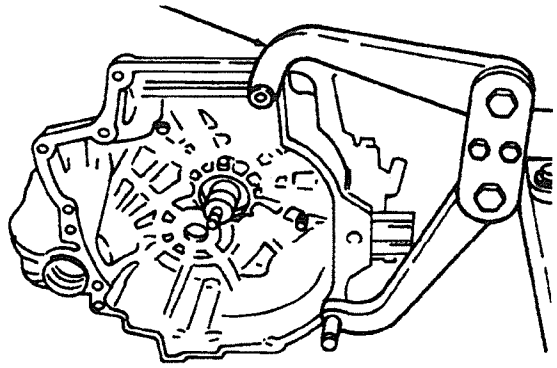
Transaxle

SPECIAL SERVICE TOOL(S) REQUIRED

- Bench Mounted Holding Fixture
- Clutch Compressor
- Stator Driven Sprocket Bearing Remover
- Puller
- Impact Slide Hammer
- Driver Handle

1. Mount the transaxle to Bench Mounted Holding Fixture.

BENCH MOUNTED
HOLDING FIXTURE

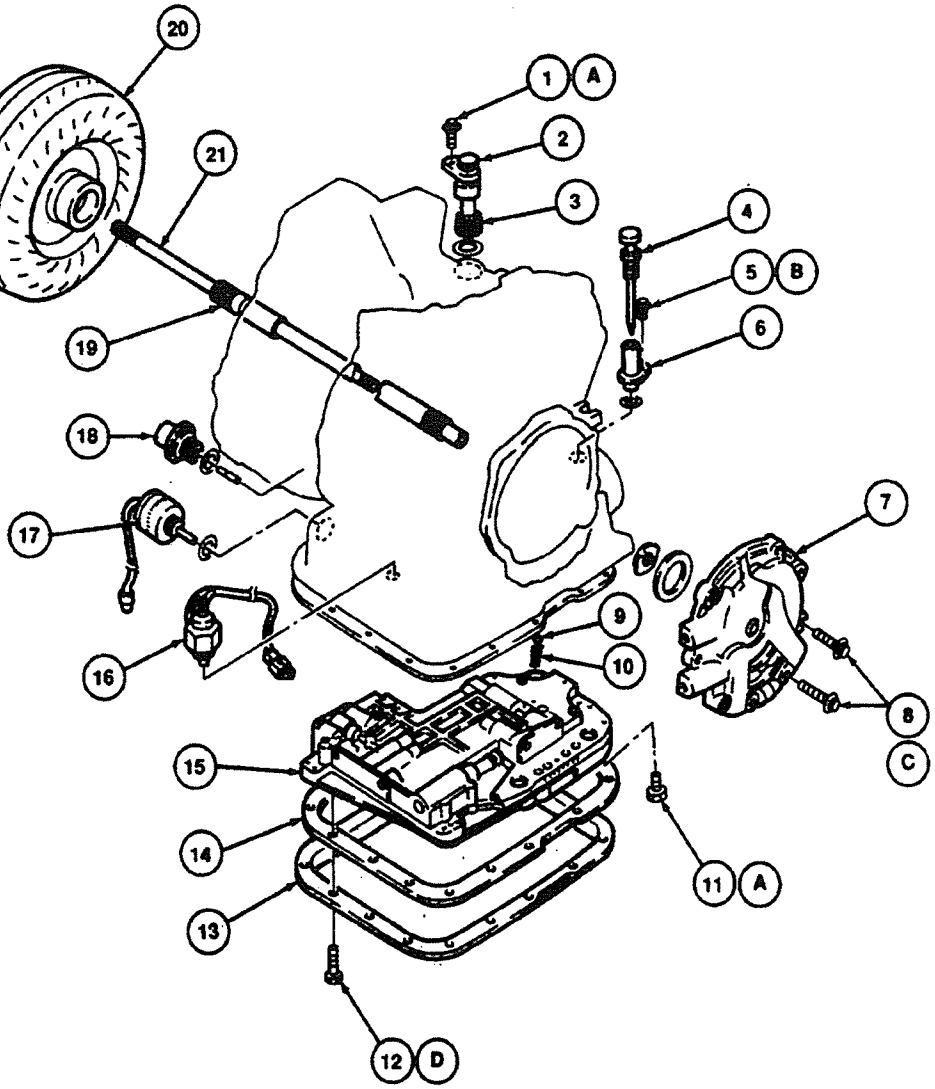


CAUTION: To prevent dirt from entering the transaxle, it should be disassembled and kept in a clean area. Remove the torque converter, taking care not to spill the transmission fluid. Before disassembly, clean the outer surface of the transaxle by using steam, cleaning fluid, etc.

CAUTION: During disassembly, avoid using rags that can leave fabric particles on components as this can block passages and cause valves to stick. Clean the disassembled parts, and clean the oil passages with compressed air and check to be sure they are not clogged.

NOTE: The casings allow separate repairs to be carried out on either the automatic transaxle or the final drive section. When a problem exists that only requires work on one section, separate the transaxle. Cover the section not requiring attention to prevent foreign material from entering the assembly.

Torque Converter, Oil Pump, Main Control Valve and Externally Mounted Controls - illus.

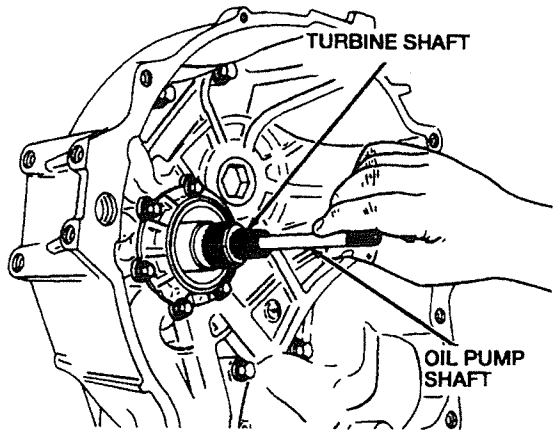


Item	Part Number	Description
1	-	Speedometer Cable Sleeve Bolt
2	-	Speedometer Cable Sleeve
3	179001	Speedometer Gear
4	-	Fluid Level Indicator
5	-	Oil Filler Tube Bolt
6	-	Oil Filler Tube
7	-	Oil Pump
8	-	Oil Pump-to-Transaxle Bolts (8 Req'd)
9	-	Check Ball
10	-	Case Detent Spring
11	-	Main Control Valve Body Bolts (9 Req'd)
12	-	Transmission Oil Pan Bolts (16 Req'd)
13	-	Transmission Oil Pan

(Continued)

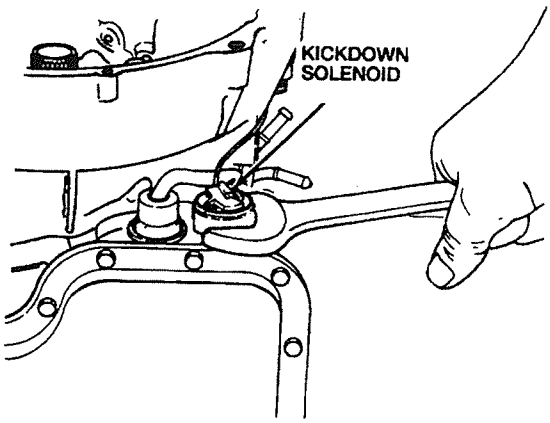
Item	Part Number	Description
14	194000	Oil Pan to Case Gasket
15	-	Main Control Valve Body
16	-	Park/Neutral Position Switch (PNP Switch)
17	-	Kickdown Solenoid
18	-	Vacuum Throttle Valve Diaphragm
19	-	Turbine Shaft
20	194001	Torque Converter
21	-	Oil Pump Shaft
A	-	Tighten to 71-97 lb-in (8-11 N-m)
B	-	Tighten to 61-87 lb-in (7-10 N-m)
C	-	Tighten to 11-16 lb-ft (15-22 N-m)
D	-	Tighten to 43-69 lb-in (6-8 N-m)

2. Pull the oil pump shaft out of the turbine shaft.

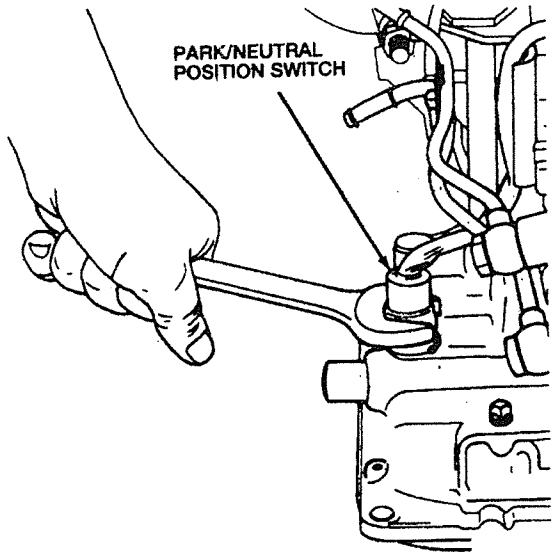


3. Pull the turbine shaft out of the torque converter stator support.

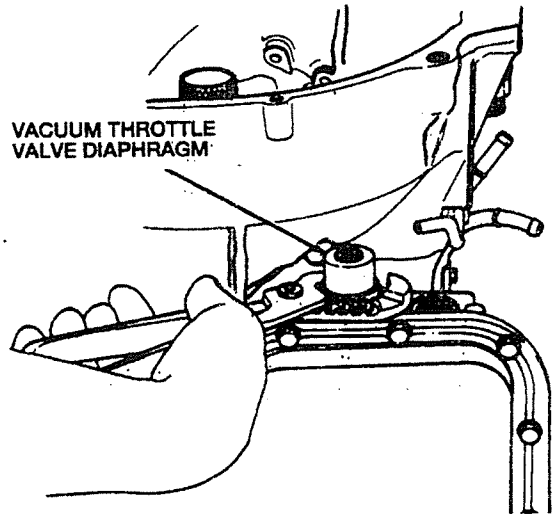
4. Separate the kickdown solenoid wire from the wiring harness and remove the kickdown solenoid.



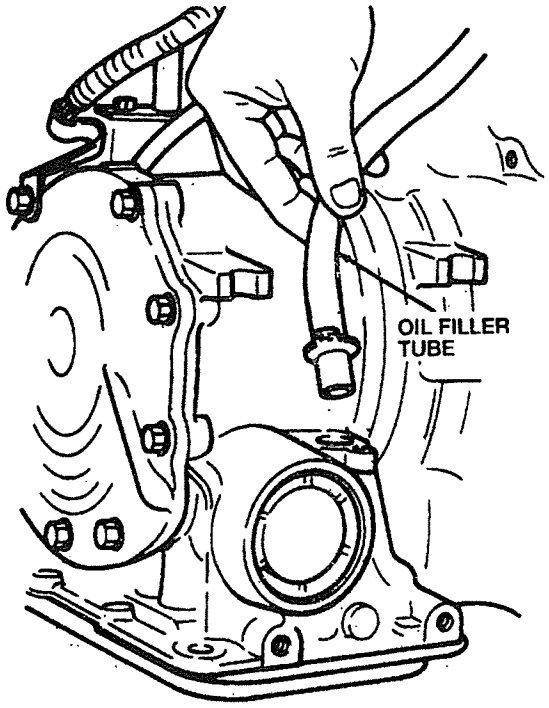
5. Remove the Park/Neutral Position Switch (PNP switch).



6. Remove the vacuum throttle valve diaphragm from the transaxle case. If it is difficult to remove, use pliers to grasp the flange. Remove the throttle control valve rod.



7. Remove the oil filler tube bolt securing the oil filler tube to the transaxle. Remove the oil filler tube and fluid level indicator.

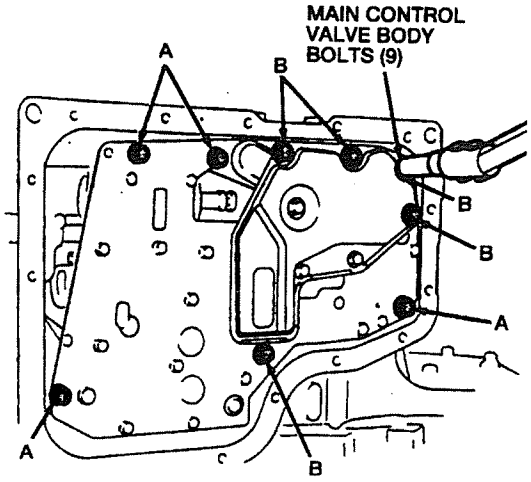


8. Remove the speedometer cable Sleeve bolt securing the speedometer cable sleeve and speedometer gear assembly to the transaxle and remove the speedometer cable sleeve and speedometer gear assembly.

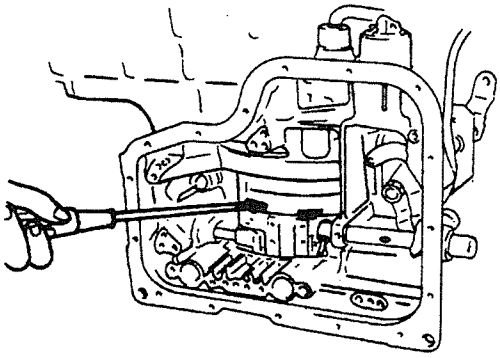
9. Remove the 16 transmission oil pan bolts and remove the transmission oil pan from the transaxle. Discard the oil pan to case gasket.

10. NOTE: Be careful not to lose the check ball and detent spring, located in the slotted hole.

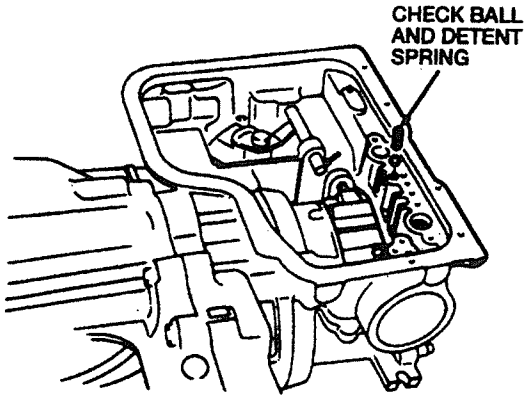
    Remove the nine main control valve body bolts securing the main control valve body and filter. Remove the main control valve body from the transaxle. Note the position of each main control valve body bolt for installation reference.



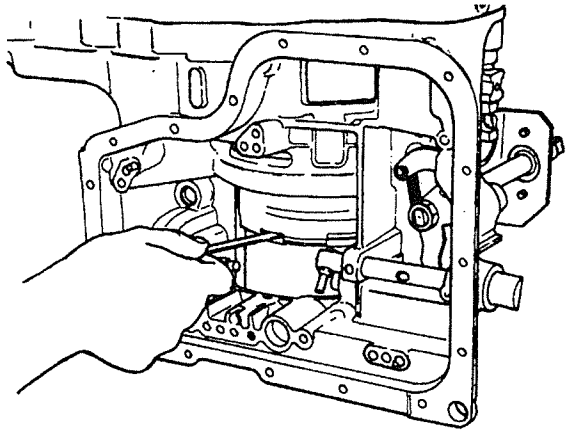
A = 30mm (1.18 INCH) BOLT
B = 40mm (1.57 INCH) BOLT



12. Measure the direct clutch drum end play by checking the clearance of the small slot between the direct clutch drum tabs and the sun shell slots. Record this measurement for reference upon reassembly. The standard end play is 0.020-0.031 inch (0.5-0.8mm).

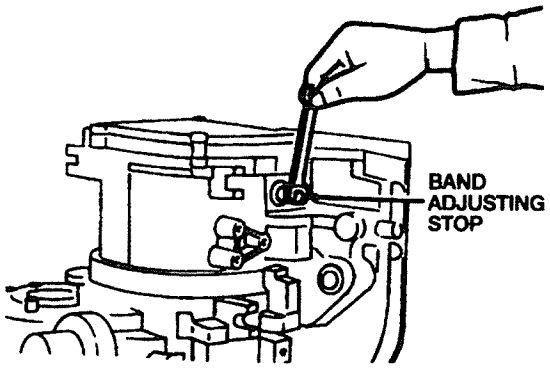


11. Position the transaxle with the oil pump end facing down. With a flat-blade screwdriver inserted in the wide slot between the front clutch drum and the sun shell, pry down on the front clutch drum. Do this several times as you rotate the assembly two complete revolutions.



13. Remove the oil cooler hose fittings from the oil pump body.

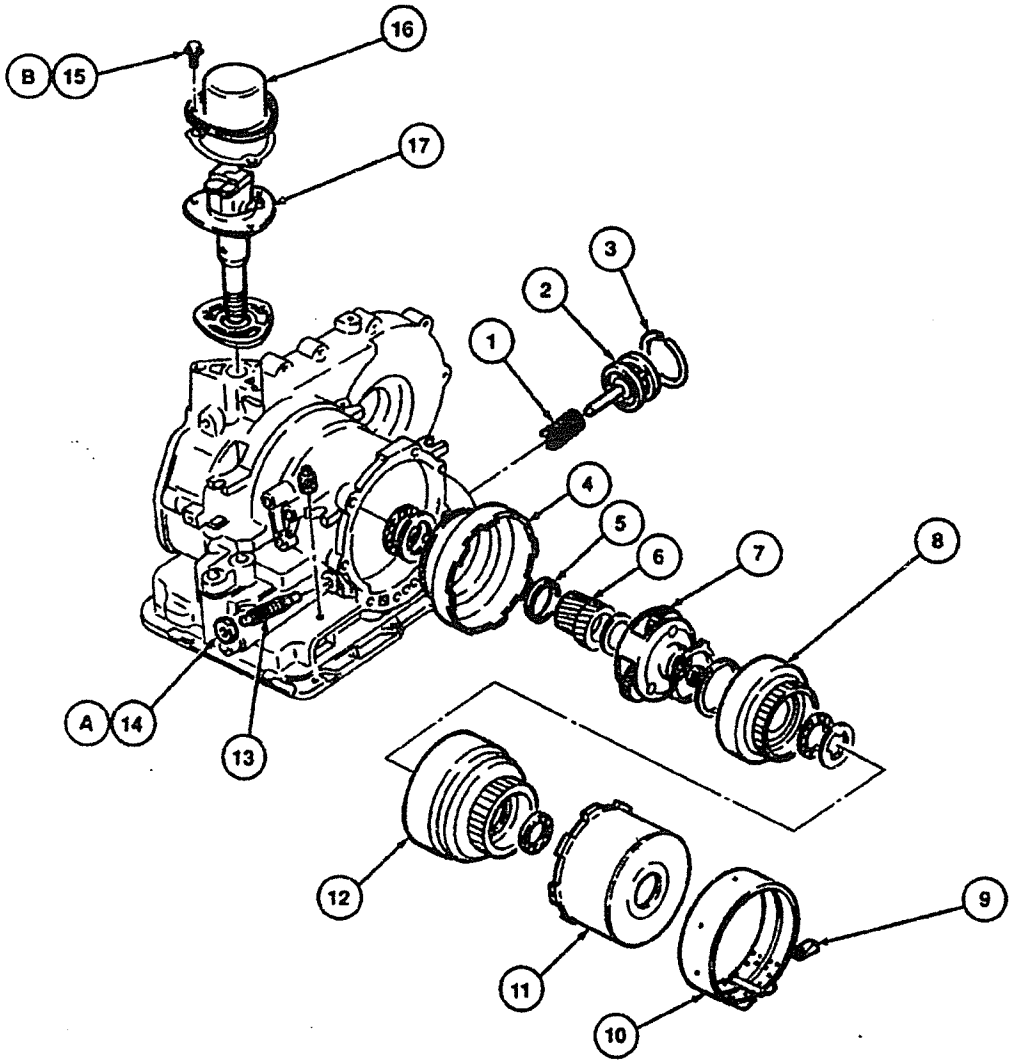
14. Secure the direct clutch in place by tightening the band adjusting stop.



15. Remove the eight oil pump-to-transaxle bolts and note the position of each bolt for installation reference. Remove the oil pump assembly from the transaxle.

16. Place the oil pump assembly on a workbench with the outer surface face down.

Hydraulic Apply Devices, Governor Assembly, and Front Planetary Gearset



Item	Part Number	Description
1	-	Servo Piston Spring
2	-	Servo Piston
3	-	intermediate Band Servo Retainer
4	-	Sun Shell
5	-	Sun Gear Spacer
6	-	Sun Gear
7	-	Front Planet Carrier
8	-	Front Ring Gear

(Continued)

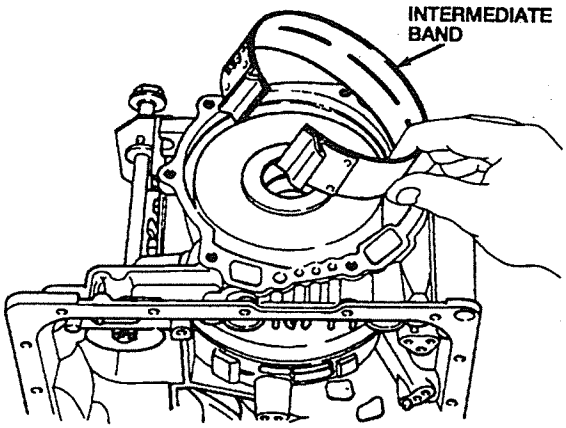
Item	Part Number	Description
9	-	Band Strut
10	-	Intermediate Band
11	-	Direct Clutch Assembly
12	-	Forward Clutch Drum
13	-	Band Adjusting Stop
14	-	Band Adjusting Stop Nut
15	-	Governor Cover Bolt (3 Req'd)
16	-	Governor Cover

(Continued)

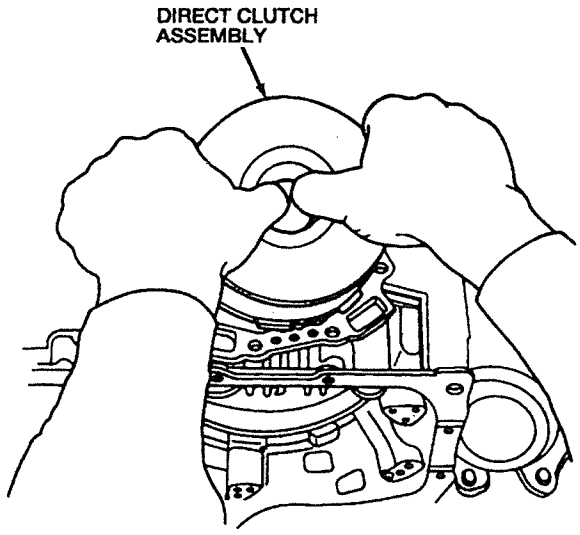
Item	Part Number	Description
17	-	Governor Valve
A	-	Tighten to 41-59 lb-ft (55-80 N-m)
B	-	Tighten to 71-97 lb-in (8-11 N-m)

17. Remove the band adjusting stop and band adjusting stop nut from the transaxle case. As the band adjusting stop is removed, retrieve the intermediate band strut from inside the transaxle case.

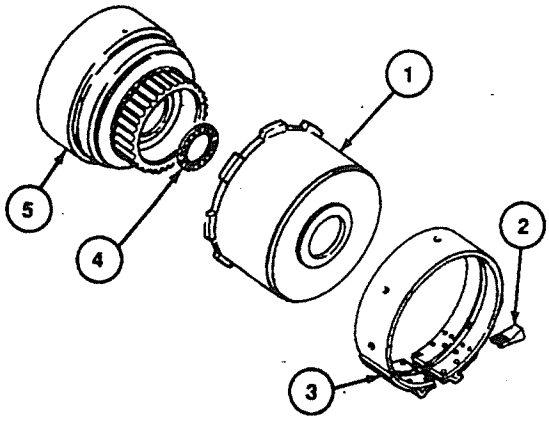
18. Remove the intermediate band from the transaxle case through the oil pump opening.



19. Remove the direct clutch assembly.

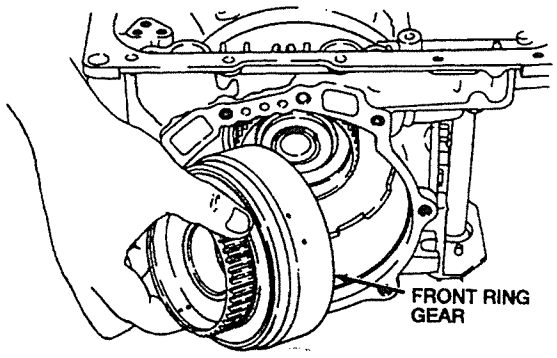


20. Remove the forward clutch drum needle bearing located on the forward clutch drum.



Item	Part Number	Description
1	-	Direct Clutch Drum
2	-	Intermediate Band Strut
3	-	Intermediate Band
4	-	Forward Clutch Drum Needle Bearing
5	-	Forward Clutch Drum

21. Remove the front ring gear.

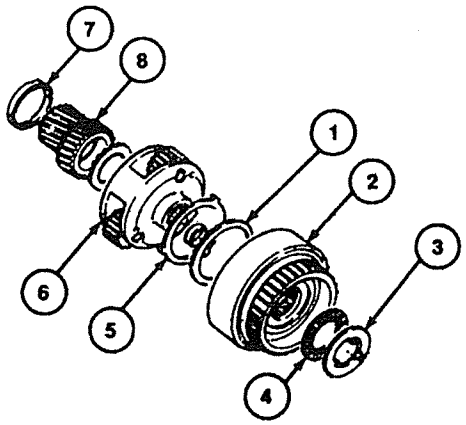


22. Remove the oil pump thrust washer if the thrust washer did not stay with the oil pump.

23. Remove the thrust bearing located on the front ring gear.

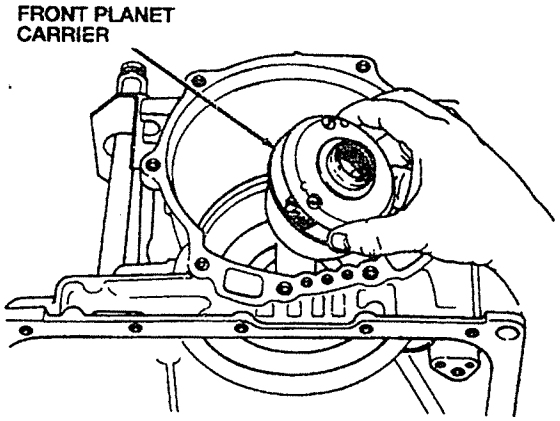
24. Remove the forward clutch hub assembly.

25. Remove the thrust bearing and sun gear spacer from the front planet carrier.

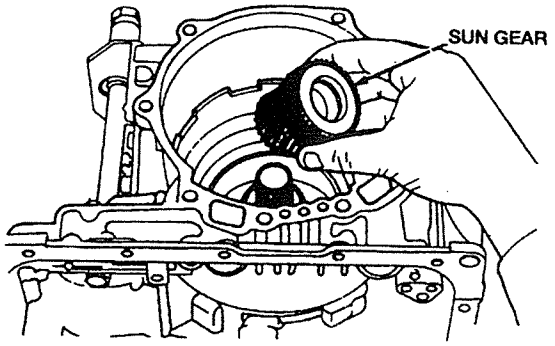


Item	Part Number	Description
1	-	Thrust Bearing
2	-	Front Ring Gear
3	-	Thrust Washer
4	-	Front Ring Gear Needle Bearing
5	-	Front Planet Carrier Thrust Washer
6	-	Front Planet Carrier
7	-	Sun Gear Spacer
8	-	Sun Gear

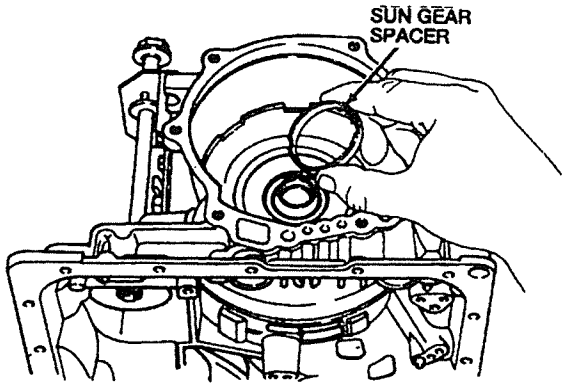
26. Remove the front planet carrier.



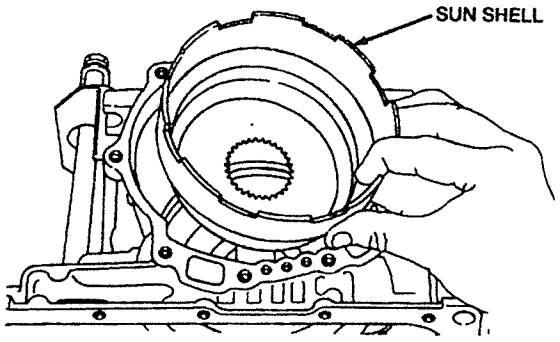
27. Remove the sun gear.



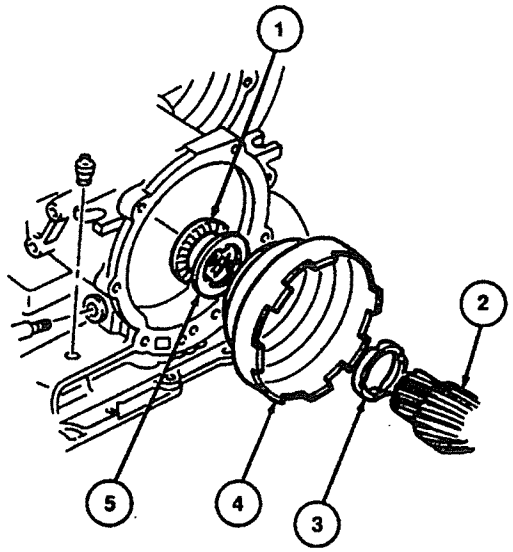
28. Remove the sun gear spacer.



29. Remove the sun shell.

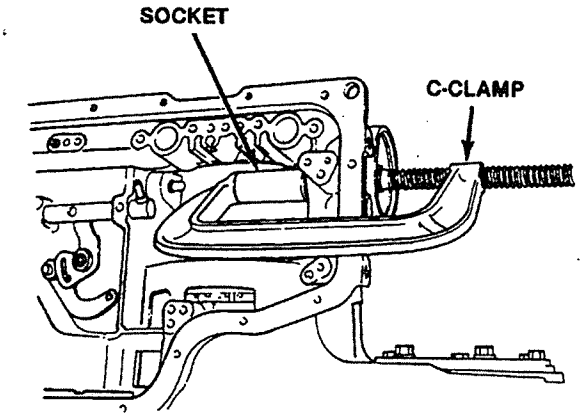


30. Remove the sun shell thrust washer and thrust bearing.



Item	Part Number	Description
1	-	Thrust Bearing
2	-	Sun Gear
3	-	Sun Gear Spacer
4	-	Sun Shell
5	-	Sun Shell Thrust Washer

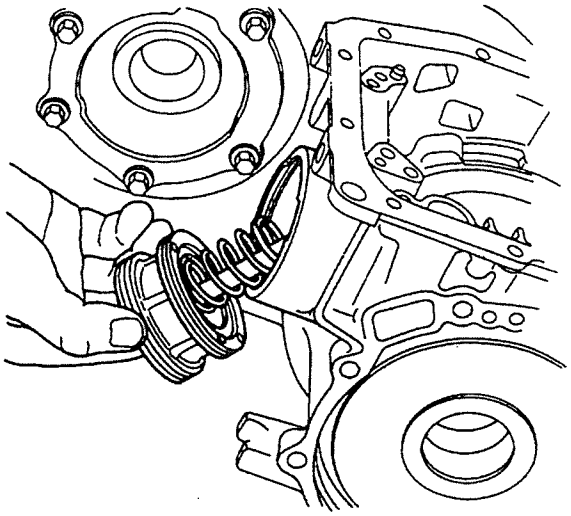
31. Use a C-clamp and a socket to compress the servo piston into the transaxle case as shown.



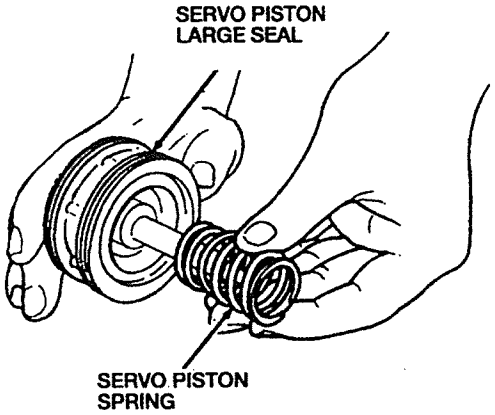
32. **WARNING: TO AVOID PERSONAL INJURY, WEAR EYE PROTECTION DURING THE FOLLOWING PROCEDURE.**

    Use a flat-blade screwdriver to remove the servo piston retaining snap ring.

33. Remove the servo retainer, servo piston and servo piston spring by slowly loosening the C-clamp.



34. Disassemble the band apply servo by removing the servo piston spring. Remove the servo piston large seal. Discard the servo piston large seal.

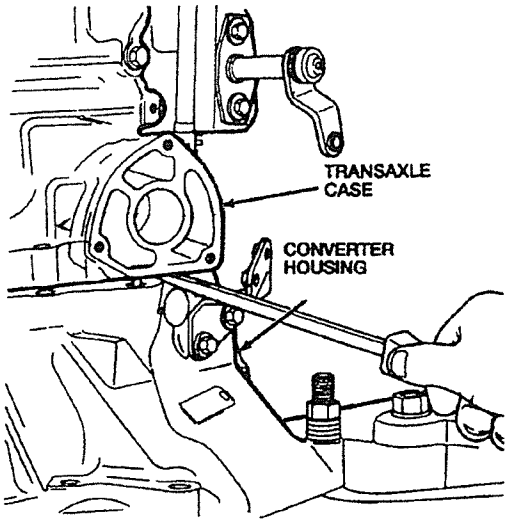


35. Remove the governor cover bolts, governor cover and governor gasket. Discard the governor gasket.

36. Remove the governor from the transaxle case.

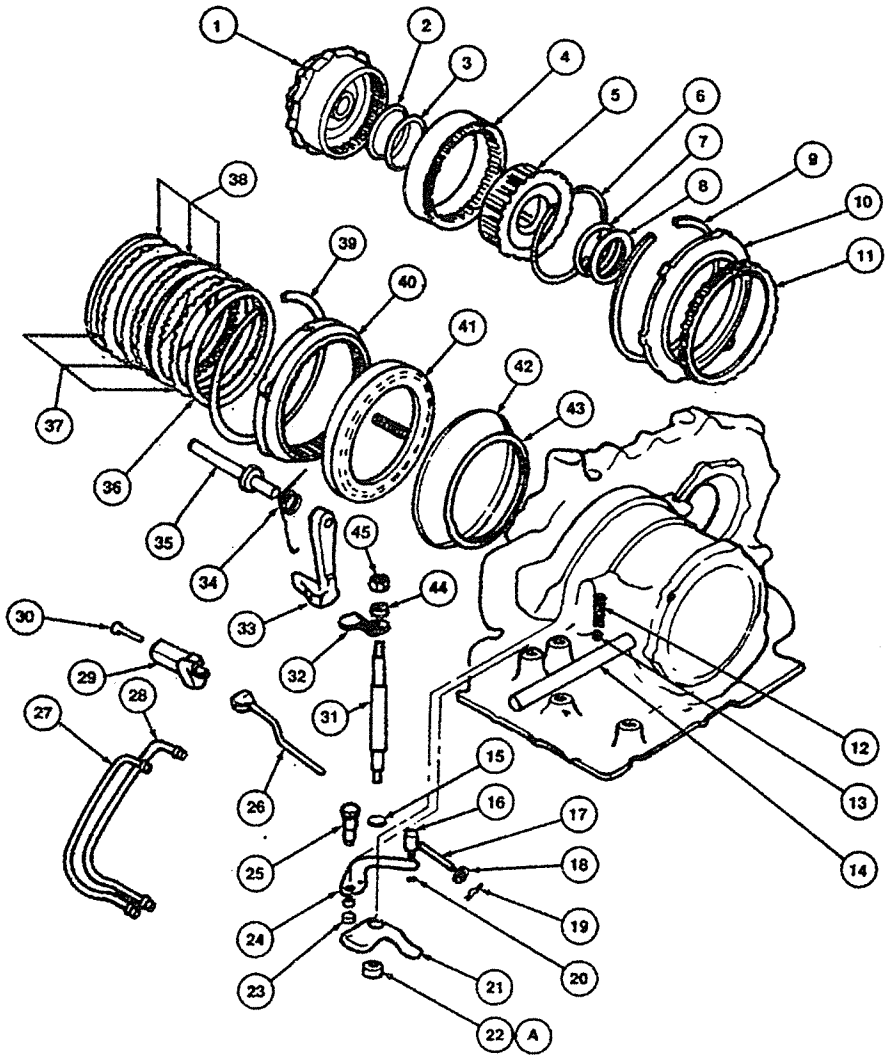
37. Remove the 12 transaxle case-to-converter housing bolts.

38. Separate the transaxle case from the converter housing using a flat-blade screwdriver to pry the cases apart at the point shown. Remove the transaxle case.



39. Position the converter housing to remove the differential.

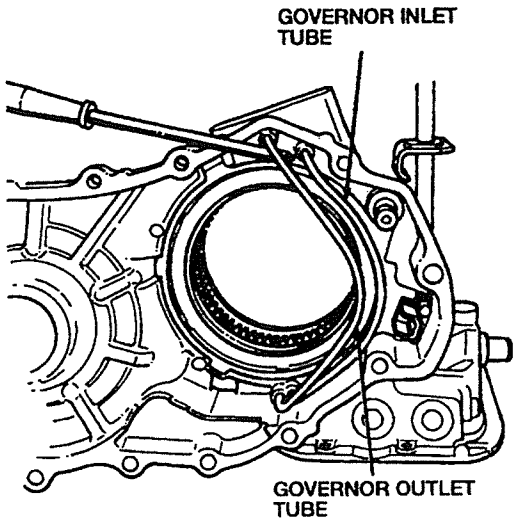
Internal Linkages, Rear Planetary Gearset and Low/Reverse Clutch



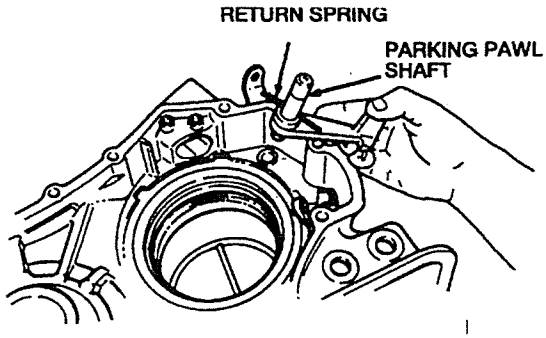
Item	Part Number	Description
1	-	[)rum Hub Assembly
2	-	Needle Bearing
3	-	Thrust Washer
4	-	Low One-Way Clutch Inner Race
5	-	Rear Carrier
6	-	Retaining Ring
7	-	Thrust Bearing
8	-	Sun Shell Thrust Washer
9	-	Low/Reverse Snap Ring
10	-	One-Way Clutch
11	-	Retaining Plate, One-Way Clutch
12	-	Case Detent Spring
13	-	Detent Check Ball
14	-	Manual Control Lever Shaft
15	-	Manual Control Lever Shaft Seal
16	-	Ferrule
17	-	Spring
18	-	Washer
19	-	Retaining Pin
20	-	Circlip
21	-	Park Lever Plate
22	-	Manual Control Lever Nut
23	-	Park Actuator Support
24	-	Park Actuator Lever
25	-	Pivot Pin

Item	Part Number	Description
26	-	Parking Lever Actuating Rod
27	-	Governor Inlet Tube
28	-	Governor Outlet Tube
29	-	Support
30	-	Support Retaining Bolt
31	-	Manual Control Lever
32	-	Manual Control Lever Arm
33	-	Parking Pawl
34	-	Parking Pawl Return Spring
35	-	Parking Pawl Shaft
36	-	Low/Reverse Clutch Dished Plate
37	-	Low/Reverse Clutch
	-	External Spline Clutch Plate
38	-	Low/Reverse Clutch Internal Spline Clutch Plate
39	-[2]	Low/Reverse Clutch Pressure Plate Retainer Snap Ring
40	-	Low and Reverse Clutch Hub
41	-	Low/Reverse Clutch Piston
42	-	Reverse Clutch Piston Large Seal
43	-	Reverse Clutch Piston Small Seal
44	-	Manual Shaft O-Ring
45	-	Manual Control Lever Nut
A	-	Tighten to 22-29 lb-ft (30-39 N-m)

40. Place a screwdriver underneath the governor outlet tube and governor inlet tube and gently pry outward. Remove the governor outlet tube and governor inlet tube.

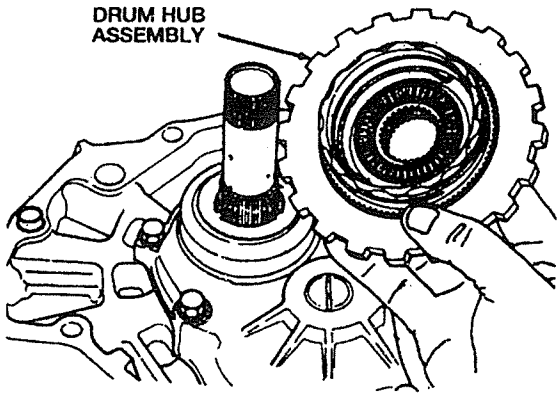


41. Note the position of the parking pawl return spring for installation reference. Remove the parking pawl assembly by pulling the parking pawl shaft straight out.



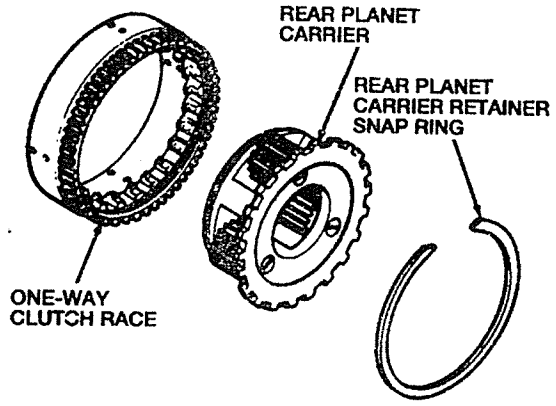
2 NOT used when the transaxle is assembled in production, however, it is required in assembly when servicing the transaxle

42. Remove the drum hub assembly from the transaxle case.



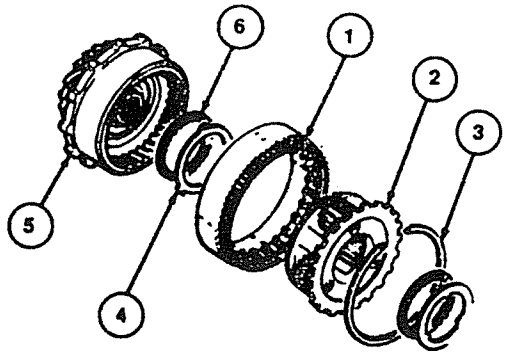
43. Remove the one-way clutch race and rear planet carrier from the converter housing.

44. Use a flat-blade screwdriver to remove the low/reverse snap ring from the one-way clutch race.



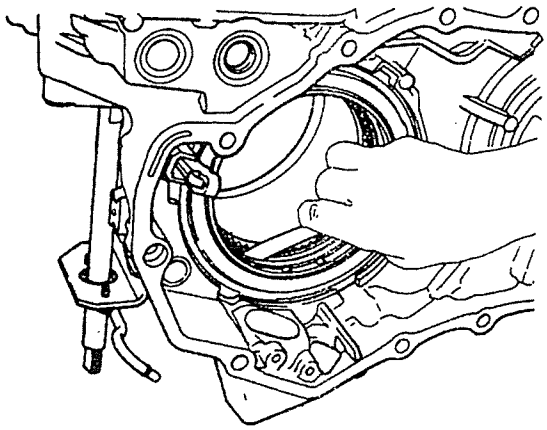
45. Separate the rear planetary carrier from the one-way clutch race.

46. Remove the rear planet carrier to ring gear needle bearing and rear planet carrier to ring gear thrust washer from the rear planet carrier.



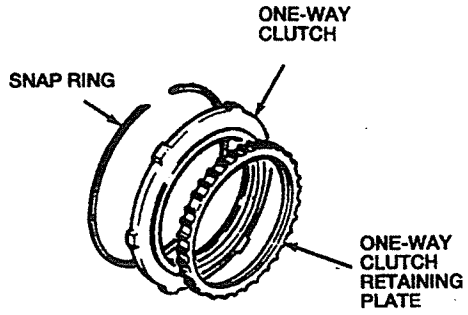
Item	Part Number	Description
1	-	One-Way Clutch Race
2	-	Rear Planet Carrier
3	-	Snap Ring
4	-	Rear Carrier to Ring Gear Thrust Washer
5	-	Drum Hub Assembly
6	-	Rear Carrier to Ring Gear Needle Bearing

47. Before removing the one-way clutch, use a feeler gauge to measure the clearance of the one-way clutch retaining plate and the one-way clutch. The clearance should be 0.032-0.041 inch (0.8-1.05mm). If the clearance is out of specification, adjust it by selecting the proper one-way clutch retaining plate at the time of installation.



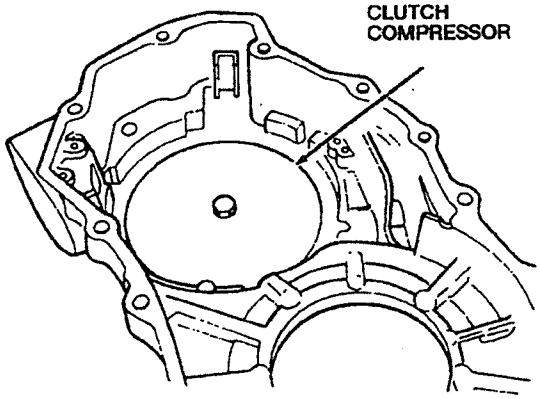
48. **WARNING: TO AVOID PERSONAL INJURY, WEAR EYE PROTECTION DURING THE FOLLOWING PROCEDURE.**

    Use a flat-blade screwdriver to remove the snap ring securing the one-way clutch and the one-way clutch retaining plate to the transaxle case. Remove the one-way clutch and the one-way clutch retaining plate.



49. Remove the low/reverse clutch pack and the low/reverse clutch dished plate.

50. Use Clutch Compressor to place the recessed side of the large plate over the low and reverse clutch hub. Place the small plate on the opposite side of the case. Insert the bolt through the clutch compressor plates and tighten the nut until the tension is relieved from the low/reverse snap ring.



51. **WARNING: TO AVOID PERSONAL INJURY, WEAR EYE PROTECTION DURING THE FOLLOWING PROCEDURE.**

    Use a flat-blade screwdriver to pry the low/reverse snap ring from the snap ring groove.

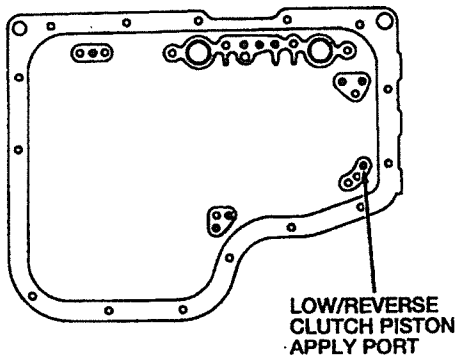
52. Remove Clutch Compressor.

53. Remove the low/reverse clutch hub.

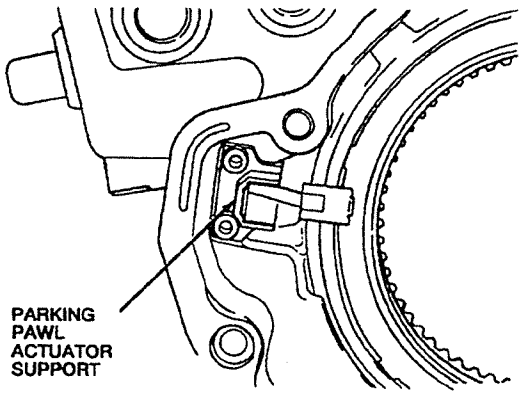
54. Remove the return springs from the low/reverse clutch piston.

55. **WARNING: WHEN PERFORMING THE FOLLOWING PROCEDURE, USE CARE TO PROTECT YOURSELF FROM THE FORCE OF THE PISTON. KEEP YOUR FINGERS FROM BETWEEN THE WOOD BLOCK AND THE PISTON. EYE PROTECTION SHOULD ALSO BE USED WHEN PERFORMING THIS OPERATION.**

    To remove the low/reverse clutch piston, hold a wood block over the low/reverse clutch piston and apply a short burst of air pressure (not to exceed 60 psi [400 kPa]) into the low/reverse clutch piston apply port in the transaxle case as shown.

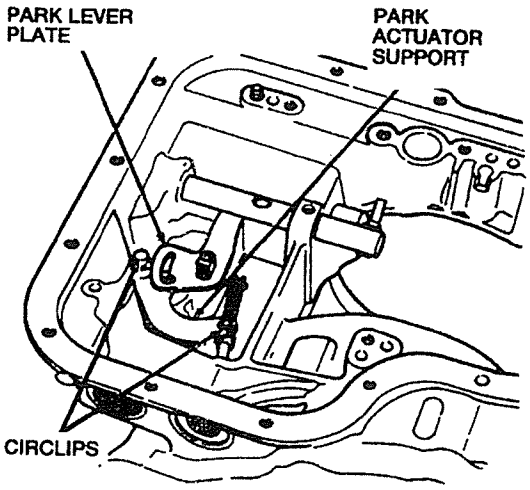


56. Remove the parking pawl actuator support bolts. Remove the parking pawl actuator support.



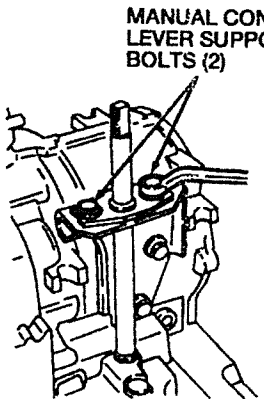
57. Remove the manual control lever nut at the end of the manual control lever assembly, holding the manual control lever with an open-end wrench.

58. Remove the two circlips from the park actuator support.

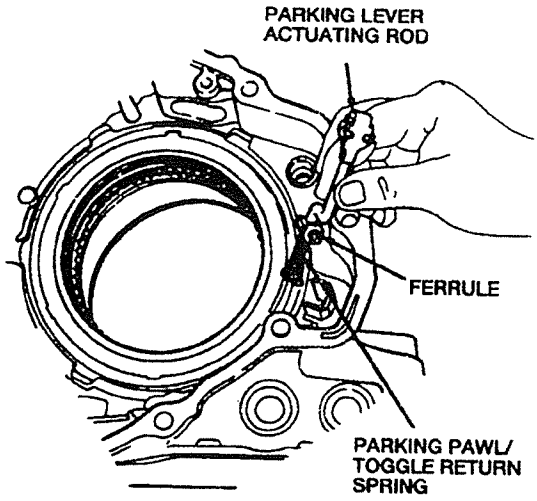


59. Remove the park lever plate and park actuator support from the manual control lever.

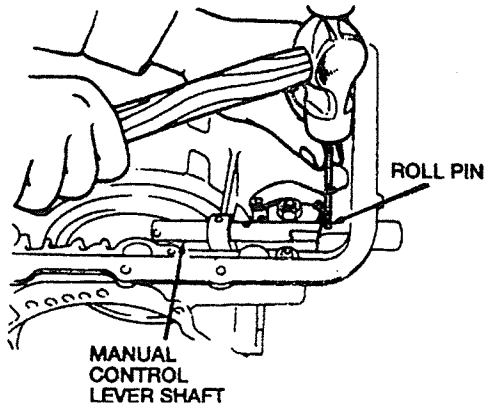
60. Remove the two manual control lever support bolts from the manual control lever support and slide the manual control lever out of the transaxle case.



61. Remove the parking lever actuating rod and ferrule as an assembly from the transaxle case.

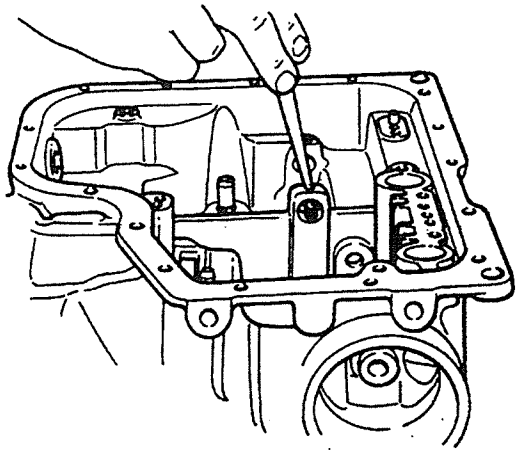


62. Position the transaxle with the oil pan opening facing up. Remove the roll pin securing the manual control lever shaft to the transaxle case by lightly tapping the roll pin with a 3/32 inch pin punch and a hammer.

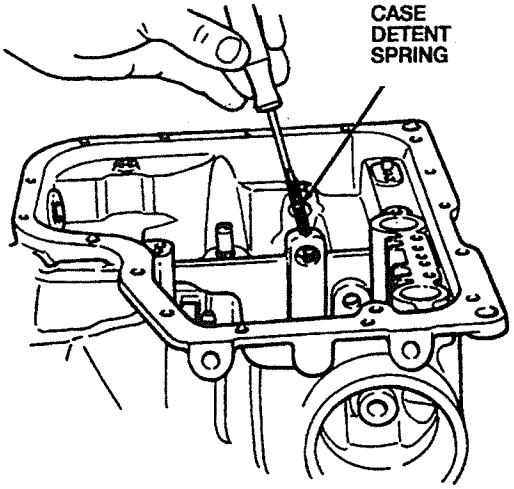


63. Carefully slide the manual control lever shaft out of the transaxle case, making sure not to lose the detent ball and case detent spring.

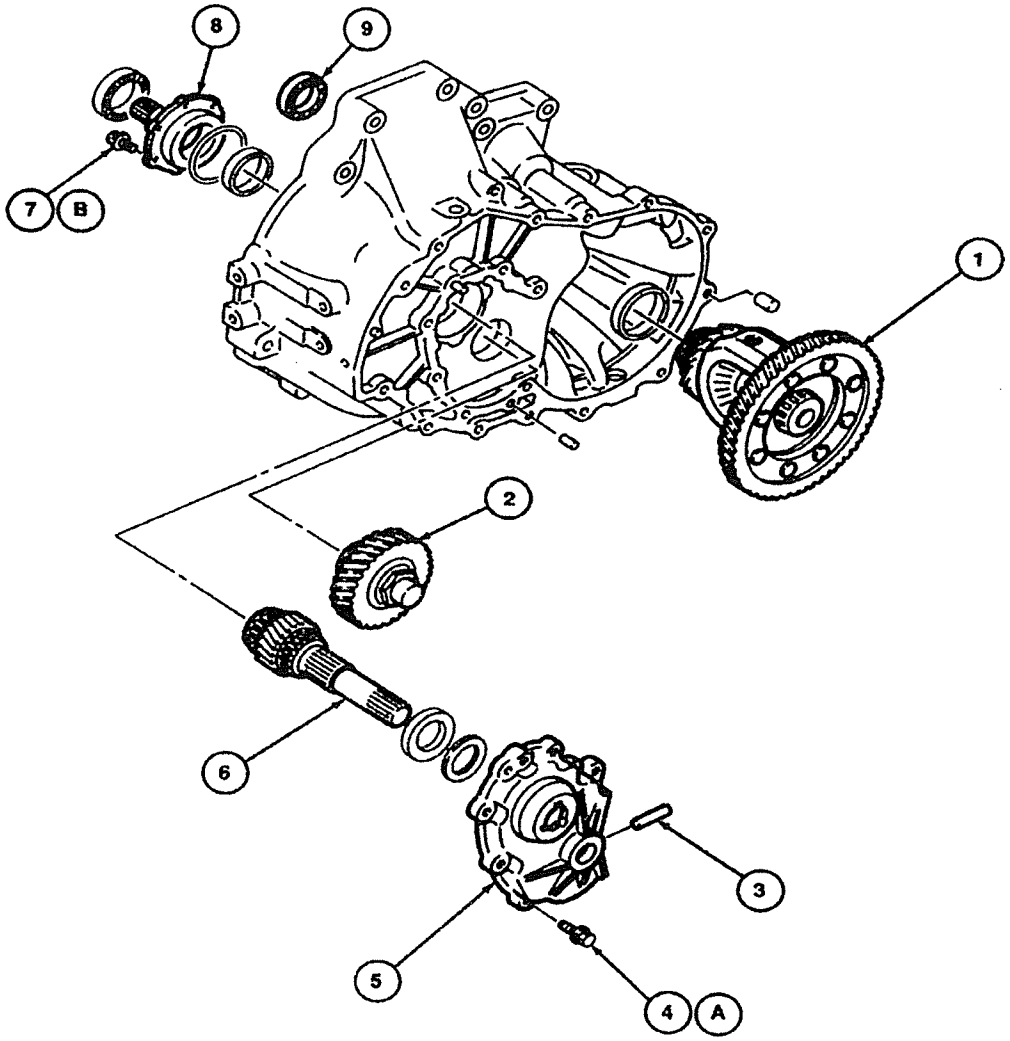
64. Remove the detent ball.



65. Use a small flat-blade screwdriver to remove the case detent spring.



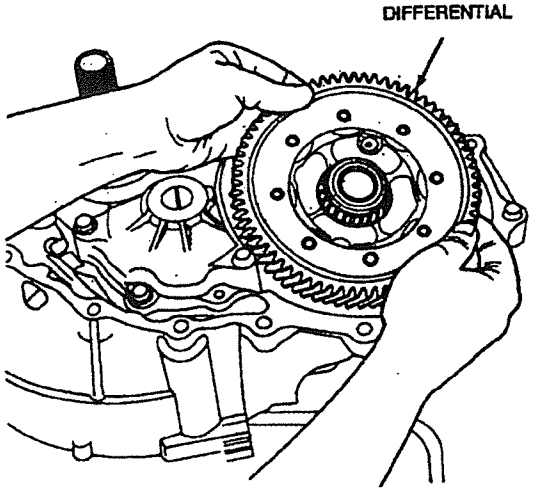
Differential, Idler Gear Assembly and Output Shaft



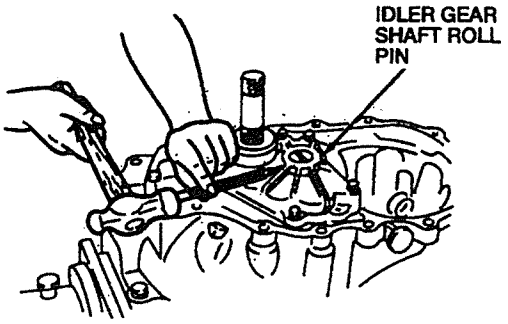
Item	Part Number	Description
1	-	Differential
2	-	Idler Gear and Idler Gear Shaft
3	-	Idler Gear Shaft Roll Pin
4	-	Bearing Housing Bolt (8 Req'd)
5	-	Bearing Housing
6	-	Output Shaft
7	-	Torque Converter Stator Support Bolt (6 Req'd)

Item	Part Number	Description
8	-	Torque Converter Stator Support
9	-	Differential Oil Seal
A	-	Tighten to 14-19 lb-ft (19-26 N-m)
B	-	Tighten to 95-122 lb-in (11-14 N-m)

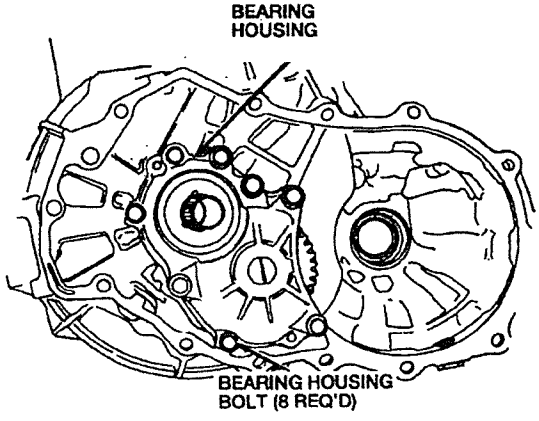
66. Lift the differential out of the converter housing.



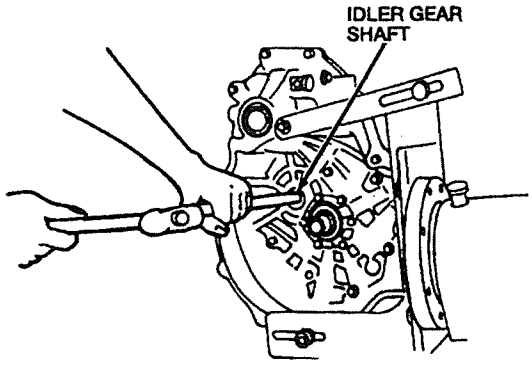
67. Remove the idler gear shaft roll pin. Discard the idler gear shaft roll pin.



68. Remove the eight bearing housing bolts attaching the bearing housing to the converter housing.

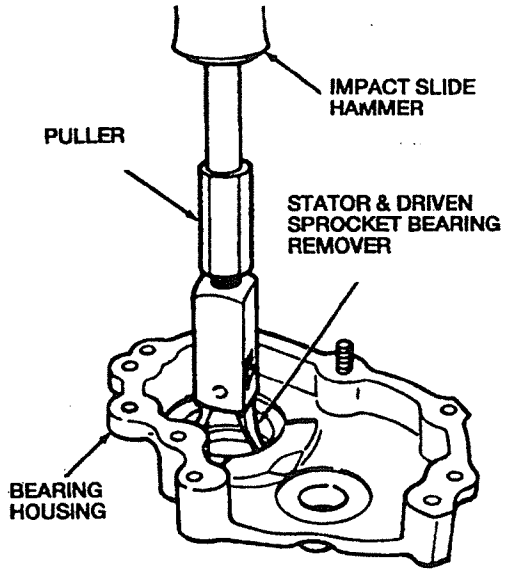


69. Remove the idler gear and output gear assemblies by lightly tapping the idler gear shaft with a brass drift and hammer.



70. Use a brass drift and hammer and tap lightly on the idler gear shaft to remove the idler gear and output gear assembly from the bearing housing.
71. NOTE: Separate or mark each output shaft bearing selective shim upon removal for installation reference.

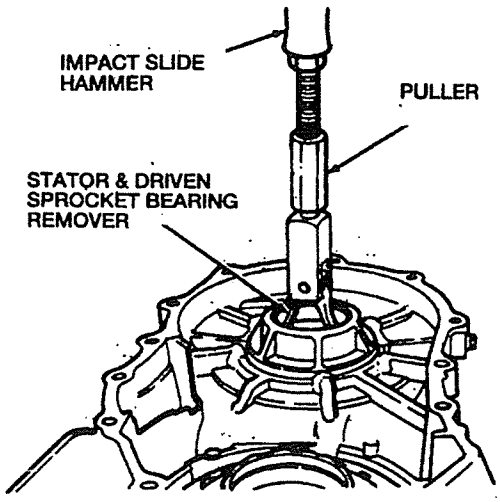
    Use Stator & Driven Sprocket Bearing Remover, Puller, and Impact Slide Hammer to remove the bearing race from the bearing housing. Remove the output shaft bearing selective shim from the bearing housing.



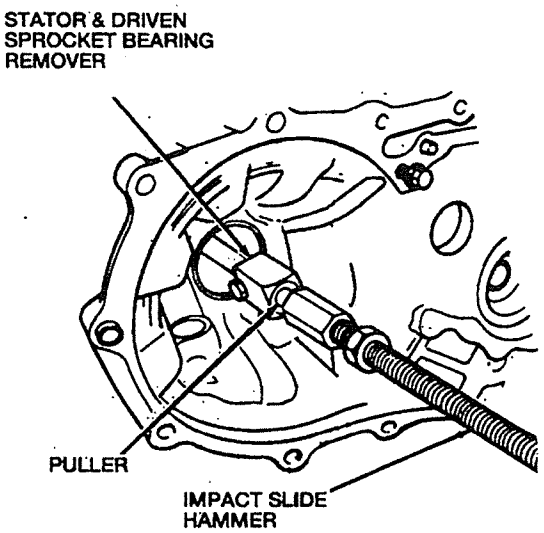
72. Use Puller, Stator & Driven Sprocket Bearing Remover, and Impact Slide to remove the differential side bearing races

from the transaxle case and from the converter housing.

Transaxle Case

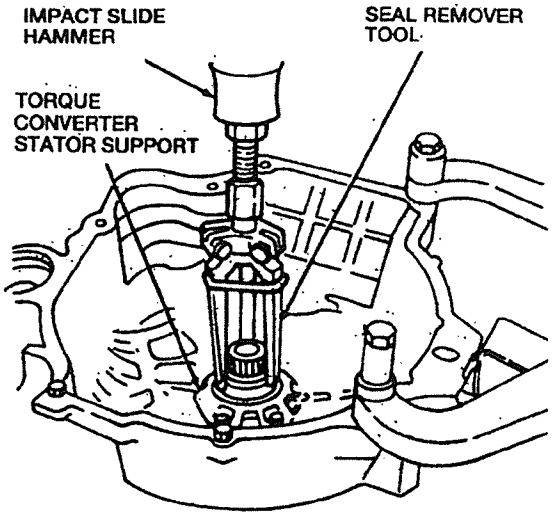


Converter Housing

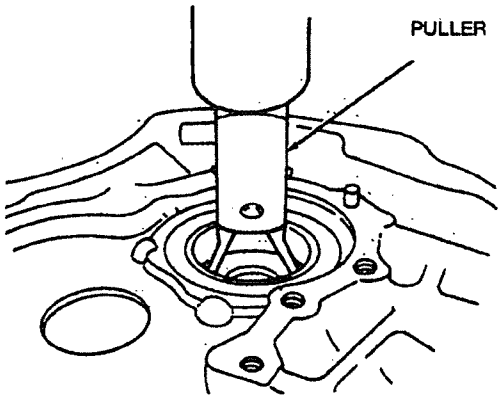


73. Use a flat-blade screwdriver to remove the differential oil seals.

74. Use Seal Remover or equivalent, and Impact Slide Hammer to remove the converter impeller hub seal from the torque converter stator support.



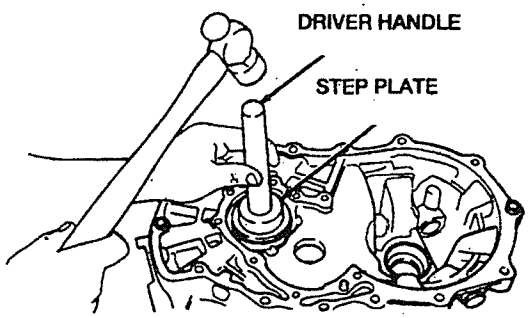
75. Use Puller and impact Slide Hammer to remove the output shaft bearing race from the torque converter stator support (still mounted in the converter housing).



76. Remove the six torque converter stator support bolts.

77. **CAUTION: Have an assistant hold the torque converter stator support to prevent it from failing on the floor and being damaged.**

    Use the appropriate step plate from Step Plate Adapter Set or equivalent and Driver Handle to remove the torque converter stator support.



78. Refer to cleaning and inspection for transaxle inspection.

DISASSEMBLY AND ASSEMBLY OF SUBASSEMBLIES

Differential

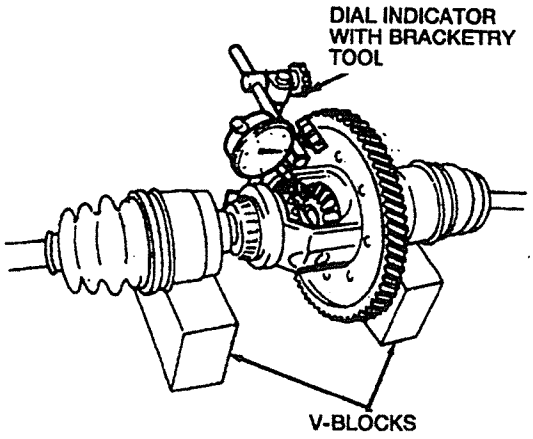
SPECIAL SERVICE TOOL(S) REQUIRED

- Differential Side Bearing Puller
- Driver Handle
- Bearing Cone Replacer

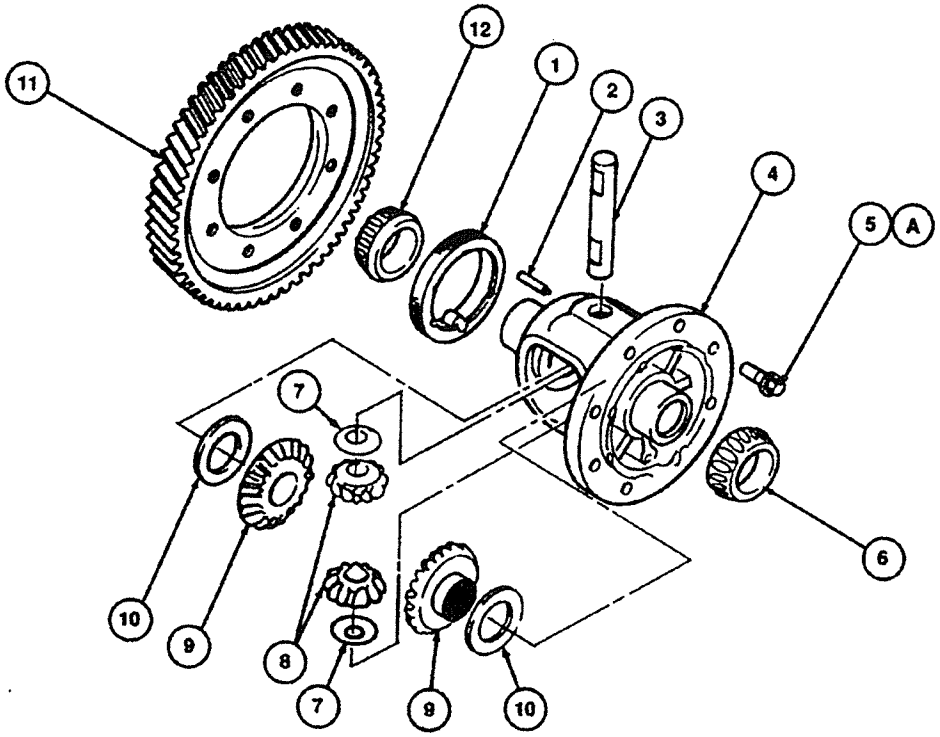
Disassembly

Before disassembling the differential, measure and record the backlash of the differential pinion gears as follows:

1. Install the left and right front wheel driveshaft and joints on the differential.
2. Support the front wheel driveshaft and joints on V-blocks.
3. Measure and record the backlash of both differential pinion gears using Dial Indicator with Bracketry or equivalent. Standard backlash is 0.000-0.004 inch (0-0.1 mm).



Differential - Exploded View



Item	Part Number	Description
1	-	Speedometer Drive Gear
2	-	Differential Pinion Shaft Lock Pin
3	-	Differential Pinion Shaft
4	-	Gearcase
5	-	Ring Gear Bolt (8 Req'd)
6	-	Differential Bearing (Ring Gear End)
7	-	Differential Pinion Thrust Washers
8	-	Differential Pinion Gears
9	-	Differential Side Gears
10	-	Differential Side Gear Thrust Washers
11	-	Ring Gear
12	-	Differential Bearing (Speedometer Drive Gear End)
A	-	Tighten to 51-62 lb-ft (69-83 N-m)

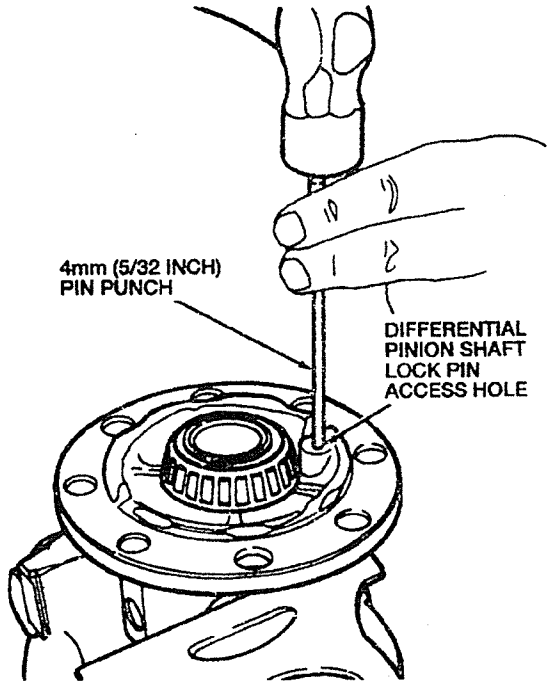
(Continued)

4. Remove the eight differential ring gear bolts that secure the ring gear to the gearcase. Tap the ring gear around its circumference with a plastic or fiber mallet to loosen it and remove the ring gear from the gearcase.

5. **CAUTION: Do not exert excess pressure on the gearcase.**

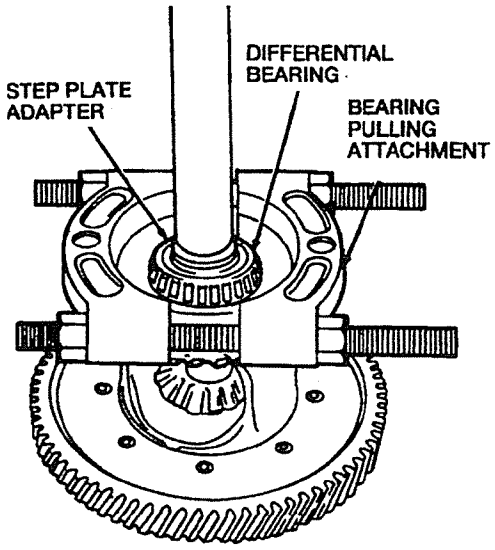
   Mount the gearcase in a vise equipped with soft jaws.

6. Use a 5/32 inch (4mm) pin punch at least 3.5 inches (90mm), long, and a hammer to remove the differential pinion shaft lock pin. Drive the differential pinion shaft lock pin free of the gearcase.



7. NOTE: Whenever a differential bearing is removed from the gearcase, it must be replaced with a new bearing and race.

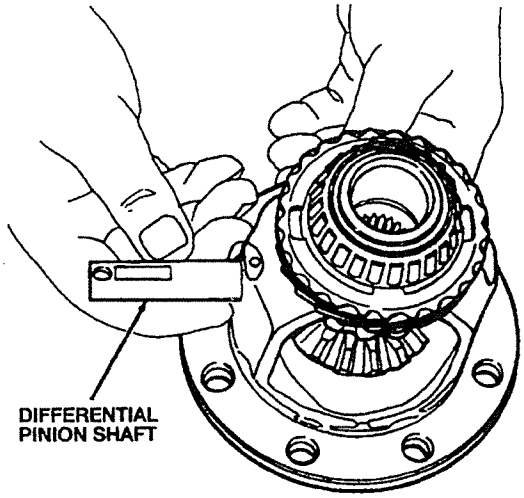
   Use Bearing Pulling Attachment and Step Plate Adapter or equivalent to press the differential bearing (speedometer drive gear end) from the gear case.



8. Remove the speedometer drive gear from the gearcase.

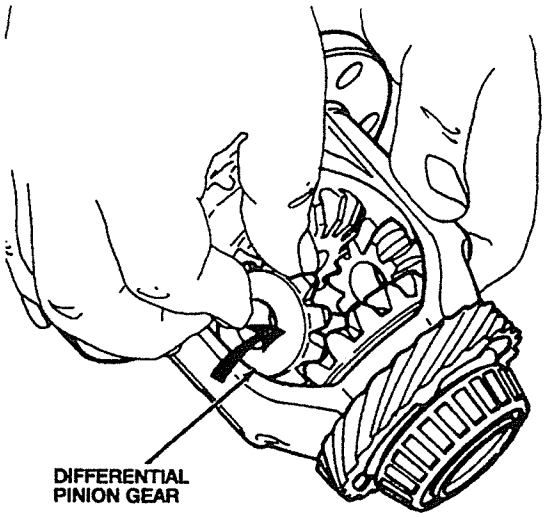
9. Use Differential Side Bearing Puller and Step Plate Adapter or equivalent to remove the differential bearing (ring gear end) from the gearcase.

10. Slide the differential pinion shaft out of the gearcase.

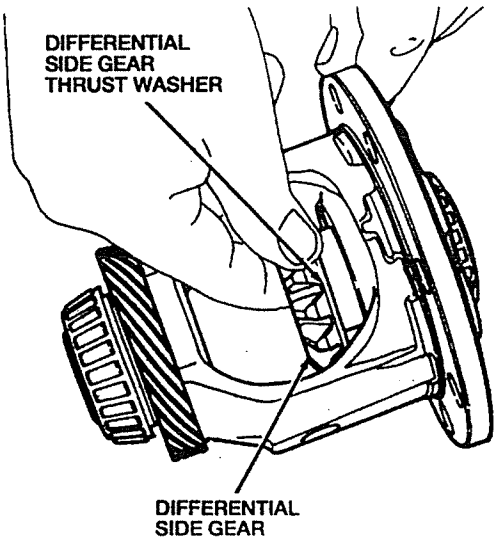


11. NOTE: The differential pinion thrust washer and differential side gear thrust washer should be kept with their respective gears for possible reinstallation.

Rotate the differential pinion gears and differential pinion thrust washers out of the gearcase.



12. Remove the differential side gears and differential side gear thrust washer from the gearcase.



13. Refer to cleaning and inspection for differential inspection.

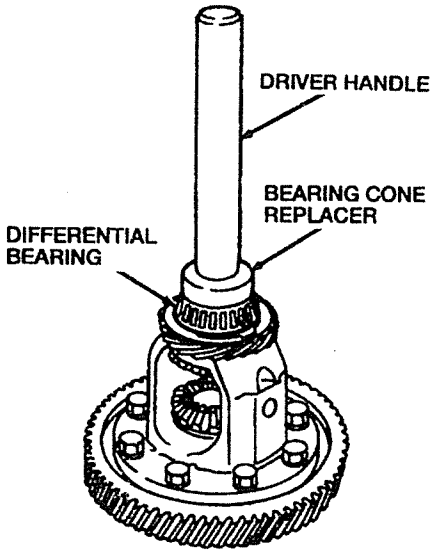
Assembly

Before differential assembly, clean all parts and dry with compressed air. Apply the specified transmission fluid to all surfaces after assembly.

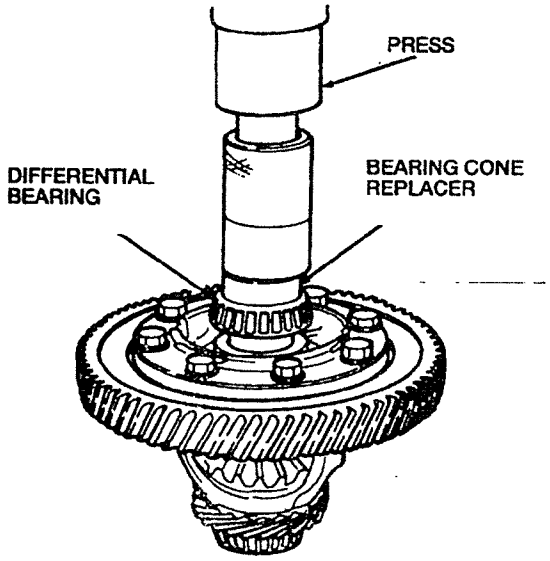
1. Install the speedometer drive gear to the gearcase, aligning the locating tang on the

speedometer drive gear with the groove in the gearcase.

2. Use Driver Handle, Bearing Cone Replacer or a press to install the differential bearing (speedometer drive gear end) to the gearcase.



3. Use Driver Handle, Bearing Cone Replacer or a press to install the rear differential bearing to the gearcase.



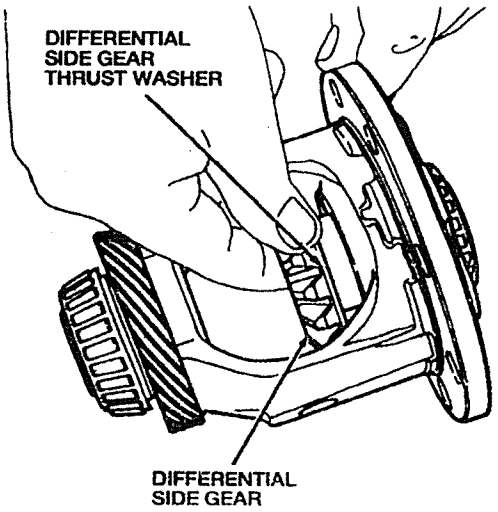
4. Locate and record the identification number on each differential side gear thrust washer. The following chart gives the thickness of the differential side gear thrust washers.

This information may be used when setting the backlash of the differential side gears and the differential pinion gear.

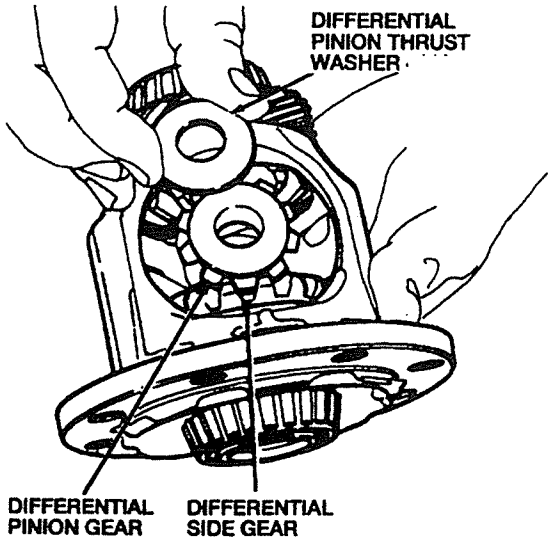
DIFFERENTIAL SIDE GEAR THRUST WASHERS

Identification Mark	Thickness
0	0.079 inch (2.0mm)
1	0.083 inch (2.1mm)
2	0.087 inch (2.2mm)

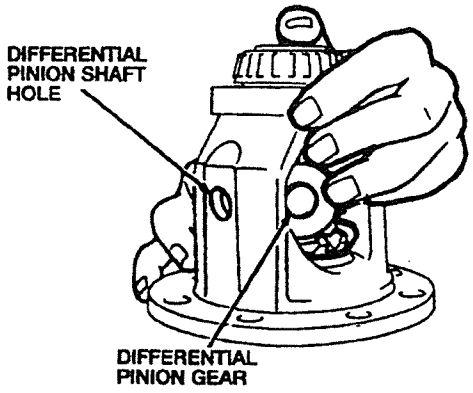
5. Coat the differential side gear thrust washers with the specified transmission fluid and install the differential side gear thrust washers to the differential side gears. Install the side gear assemblies to the gearcase



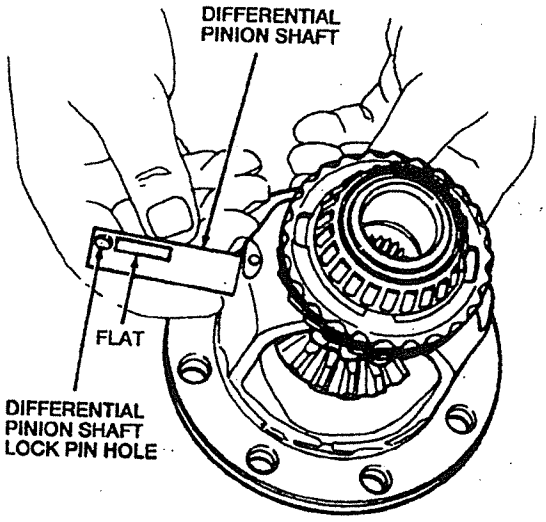
6. Coat the differential pinion thrust washers with the specified transmission fluid. Install the differential side gears to the gearcase so that they are parallel to each other. Install the thrust washers onto the differential side gears.



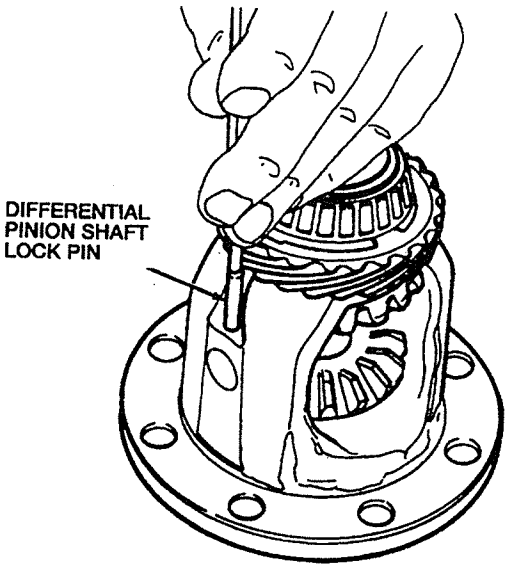
7. After installing the differential pinion thrust washers on the differential pinion gears, turn the differential pinion gears back on the differential side gears and install them into the gearcase. The differential pinion gears and differential pinion shaft hole must be aligned on both sides of the gearcase. If the differential side gears and gearcase shaft hole do not line up, remove the differential pinion gears and install them into the gearcase again.



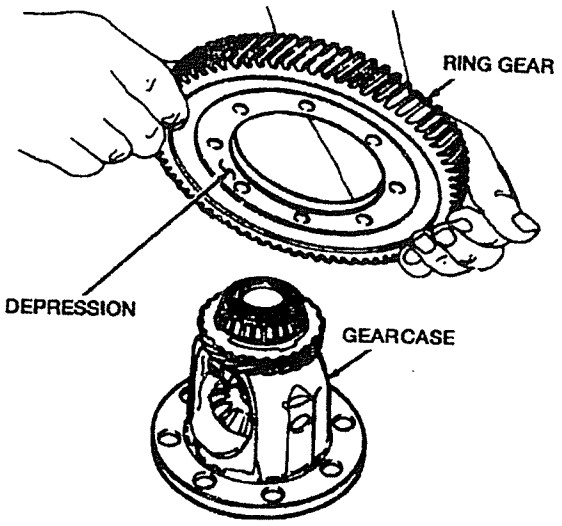
8. Install the differential pinion shaft into the gearcase with the flat on the shaft up and the differential pinion shaft lock pin hole entering the case last.



9. Use a suitable drift and hammer to install the differential pinion shaft lock pin through the gearcase and into the differential pinion shaft. Sink the differential pinion shaft lock pin until it is approximately 1/16 inch (1.5mm) below the surface of the gearcase.



10. Install the ring gear to the gear case, with the depression on the gear toward the gearcase.



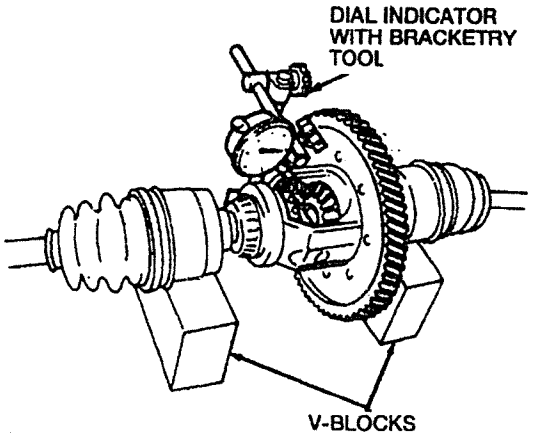
11. Align the threaded holes in the gear with the holes in the gearcase. Install the ring gear bolts and hand-tighten all of them.

12. Tighten the ring gear bolts to 51-62 lb-ft (69-83 N-m). Tighten in two stages, marking the first bolt to be tightened and working in a crisscross pattern until all the bolts have been properly tightened.

13. Check and adjust (if necessary) the side gear and pinion gear backlash as follows:

    a. Install the left and right front wheel driveshaft and joints into the differential.

    b. Support the front wheel driveshaft and joints on V-blocks.



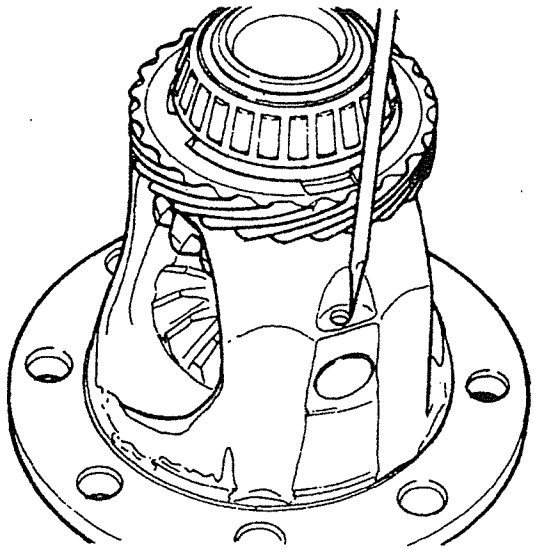
    c. Use Dial Indicator with Bracket or equivalent to measure the backlash of both differential pinion gears. The standard backlash is 0.000-0.004 inch (0-0.1 mm).

    d. If the backlash is more than allowed, adjust it by selecting a differential side gear thrust washer from the following table. Differential side gear thrust washers should be the same thickness at each side gear.

DIFFERENTIAL SIDE GEAR THRUST WASHER SIZE

Identification Mark	Thickness
0	0.079 inch (2.0mm)
1	0.083 inch (2.1mm)
2	0.087 inch (2.2mm)

14. After installing the differential pinion shaft lock pin, stake the gear case to prevent the differential pinion shaft lock pin from coming out.

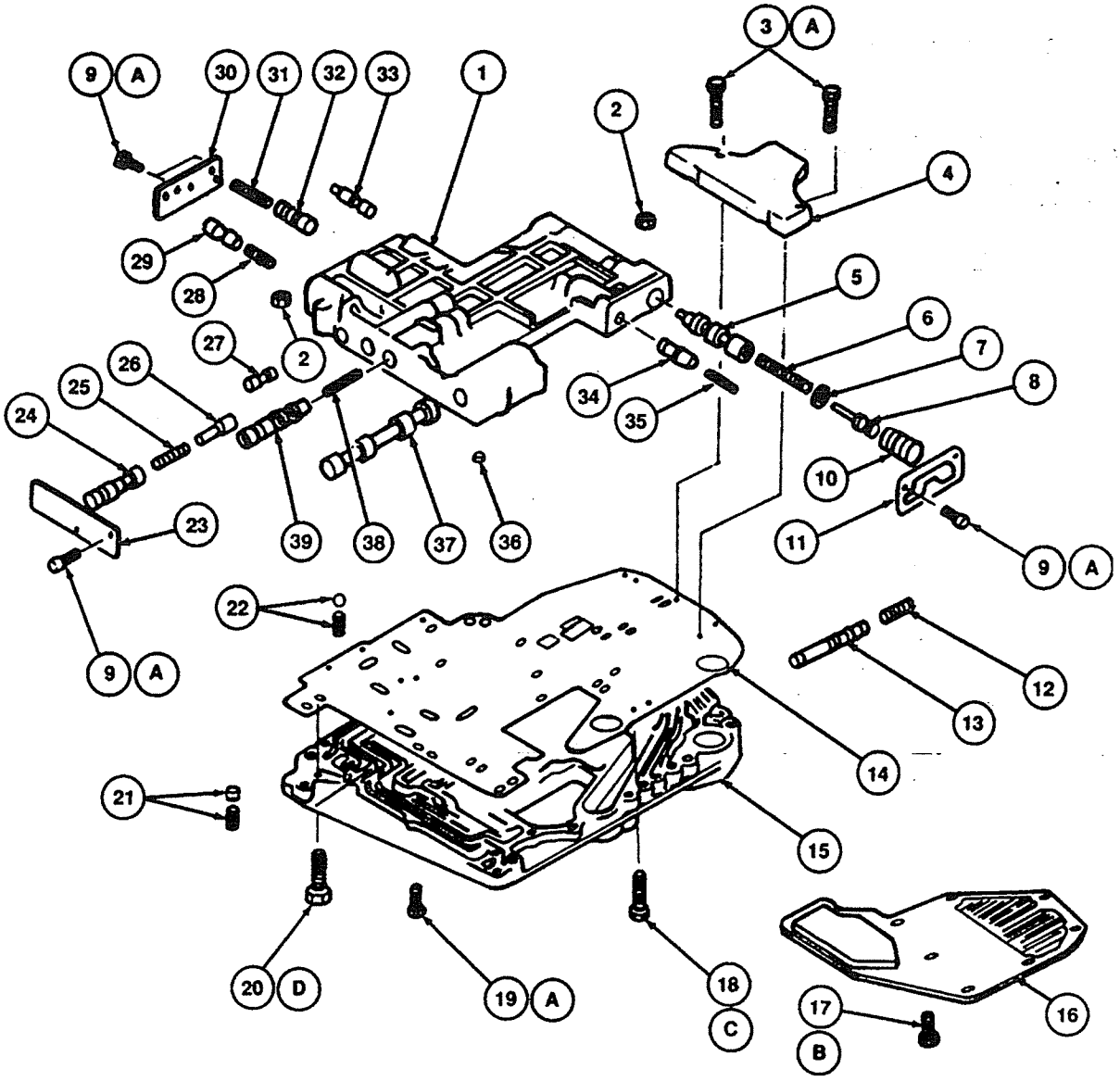


Main Control Valve Body

Disassembly

CAUTION: The main control valve body is the highest-precision part used in the automatic transaxle. It should be handled very carefully. Since many parts look alike, they should be kept in a well-arranged order. If the clutches have been overheated, or the intermediate band has been burned, be sure to disassemble, clean, and inspect the main control valve body.

Main Control Valve Body - Exploded View

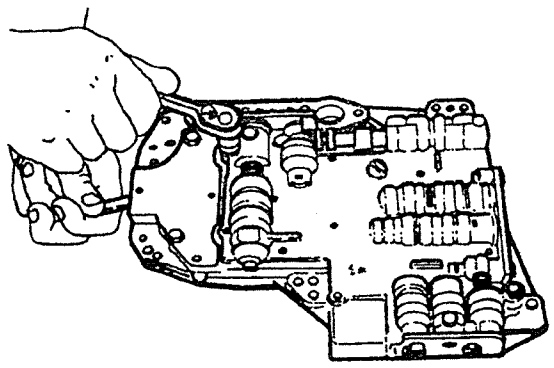


Item	Part Number	Description
1	-	Upper Valve Body
2	-	Upper-to-Lower Valve Body Nuts (2 Req'd)
3	-	Valve Body Sub-Body Bolt
4	-	Sub-Body
5	-	Pressure Regulator Valve
6	-	Spring
7	-	Spring Seat
8	-	Pressure Regulator Plug
9	-	Side Plate Bolt
10	-	Pressure Regulator Sleeve
11	-	Side Plate
12	-	Spring
13	-	3-2 Timing Valve
14	-	Separator Plate
16	-	Lower Valve Body
16	-	Filter Screen
17	-	Oil Filter Bolt
18	-	Main Control Valve Body Bolt (9 Req'd)
19	-	Upper-to-Lower Valve Body A-Bolts (17 Req'd)
20	-	Upper-to-Lower Valve Body B-Bolts (2 Req'd)
21	-	Orifice Check Valve and Spring
22	-	Check Ball and Spring

(Continued)

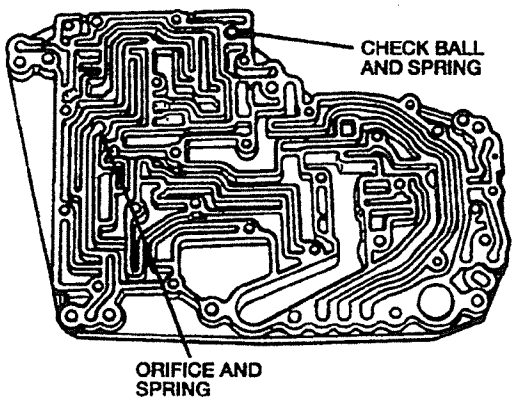
Item	Part Number	Description
23	-	Side Plate
24	-	2-3 Shift Valve
25	-	Spring
26	-	2-3 Shift Plug
27	-	Modifier Valve
28	-	Spring
29	-	Downshift Valve
30	-	Side Plate
31	-	Spring
32	-	Throttle Backup Valve
33	-	Vacuum Throttle Valve
34	-	Second Lock Valve
35	-	Spring
36	-	Orifice Check Valve
37	-	Manual Valve
38	-	Spring
39	-	1-2 Shift Valve
A	-	Tighten to 22-30 lb-in (2.5-3.4 N-m)
B	-	Tighten to 26-35 lb-in (3-4 N-m)
C	-	Tighten to 71-97 lb-in (8-11 N-m)
D	-	Tighten to 43-61 lb-in (5-7 N-m)

1. Remove the manual valve from the upper valve body.
2. Remove the bolts attaching the oil filter to the valve body and remove the oil filter.
3. With the lower half facing you, remove the nuts and bolts attaching the upper and lower valve bodies, noting the position of each bolt for installation reference.

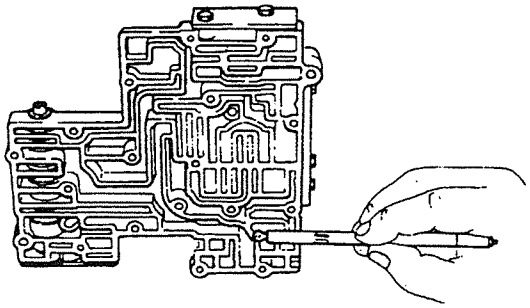


4. Carefully lift the lower body from the upper valve body, keeping the separator plate attached to the lower body to prevent losing the check ball, orifice check valves, and springs.

5. Turn the assembly over and carefully remove the separator plate, the check ball and spring, and the orifice check valves and spring from the lower valve body.

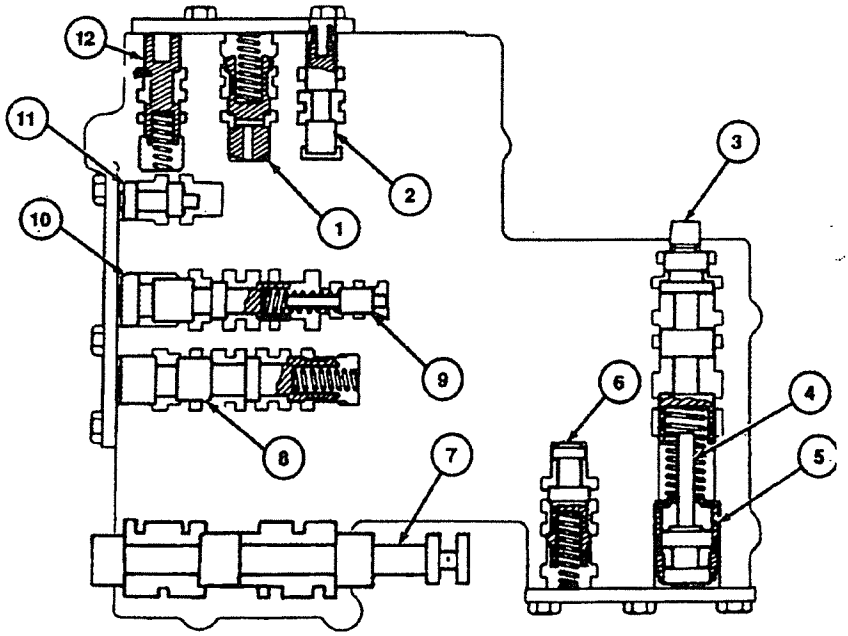


6. Remove the orifice check valve from the upper valve body with a magnet as shown.



7. The following illustration shows the position and components for each of the valve assemblies in the upper valve body.

Upper Valve Body - Valve Location



Item	Part Number	Description
1	-	Throttle Backup Valve
2	-	Vacuum Throttle Valve
3	-	Pressure Regulator Valve
4	-	Pressure Regulator Plug
5	-	Pressure Regulator Sleeve
6	-	Second Lock Valve
7	-	Manual Valve
8	-	1-2 Shift Valve
9	-	2-3 Shift Plug
10	-	2-3 Shift Valve
11	-	Modifier Valve
12	-	Downshift Valve

(Continued)

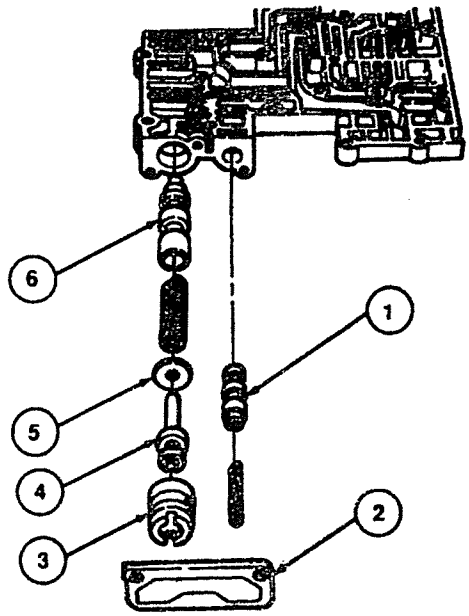
8. Carefully remove the side plates of the upper valve body to gain access to the valves. Keep the parts for each valve separated to prevent interchanging of springs that look alike (consult the chart).

VALVE RETURN SPRING SPECIFICATION CHART

Name	Outer Dia. inch (mm)	Free Length inch (mm)	No. of Coils	Wire Dia. inch (mm)
Throttle Backup	0.287 (7.3)	1.42 (36.0)	16.0	0.031 (0.8)
Downshift	0.219 (5.55)	0. 862 (21.9)	14.0	0.022 (0.55)
2-3 Shift	0.272 (6.9)	1.61 (41.0)	20.0	0.028 (0.7)
1-2 Shift	0.258 (6.55)	1.26 (32.0)	18.0	0.022 (0.55)
Second Lock	0.219 (5.55)	1.32 (33.5)	18.0	0.022 (0.55)
Pressure Regulator	0.461 (11.7)	1.69 (43.0)	15.0	0.047 (1.2)
Throttle Relief	0.276 (7.0)	0.44 (11.2)	6.0	0.036 (0.9)
Orifice Check	0.197 (5.0)	0.61 (15.5)	12.0	0.009 (0.23)

9. Refer to cleaning and inspection for main control valve body inspection.

Second Lock Valve and Pressure Regulator Valve



Assembly

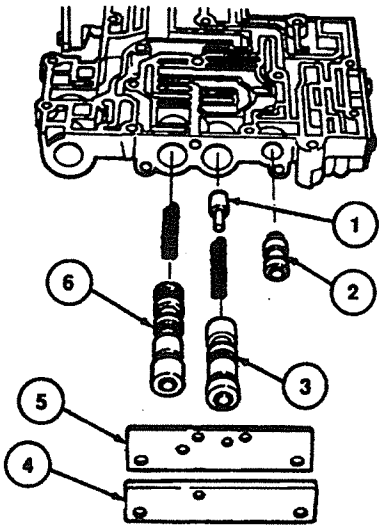
1. Ensure that the main control valve body and components are entirely clean and free of all dust and shop towel lint.

2. Lubricate all the components in the specified transmission fluid.

3. Install the valves and springs into their correct bores.

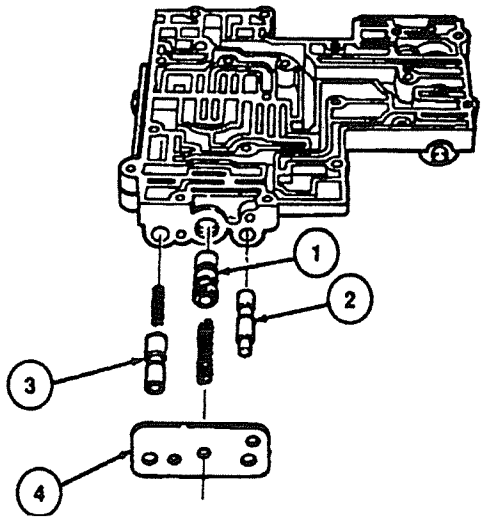
Item	Part Number	Description
1	-	Second Lock Valve
2	-	Side Plate
3	-	Pressure Regulator Sleeve
4	-	Pressure Regulator Plug
5	-	Spring Seat
6	-	Pressure Regulator Valve

1-2 Shift Valve, 2-3 Shift Valve, and Modifier Valve



Item	Part Number	Description
1	-	Shift Plug
2	-	Modifier Valve
3	-	2-3 Shift Valve
4	-	Side Plate
5	-	Separator Plate
6	-	1-2 Shift Valve

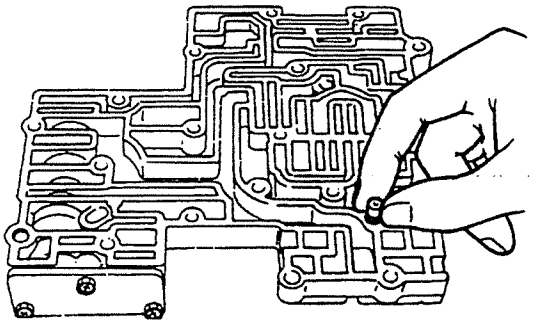
Downshift Valve, Throttle Backup Valve, and Vacuum Throttle Valve



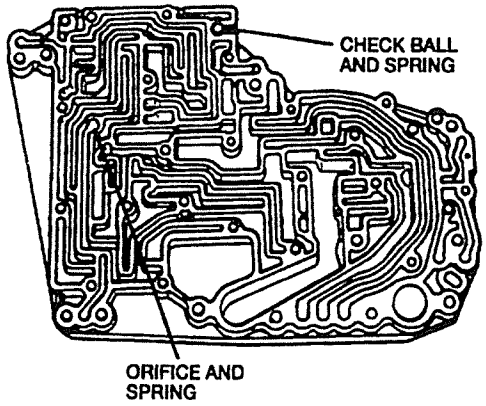
Item	Part Number	Description
1	-	Throttle Backup Valve
2	-	Vacuum Throttle Valve
3	-	Downshift Valve
4	-	Side Plate

4. Install the side plates to their correct positions. Install and tighten the side plate bolts to 22-30 lb-in (2.5-3.4 N-m).

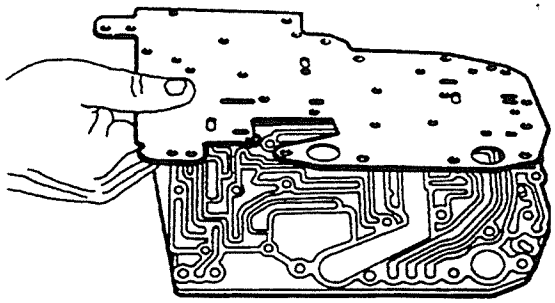
5. Install the orifice check valve in the upper valve body half at the position shown.



6. Install the one check ball and spring and the orifice check valve and spring to their correct position in the lower valve body as shown.



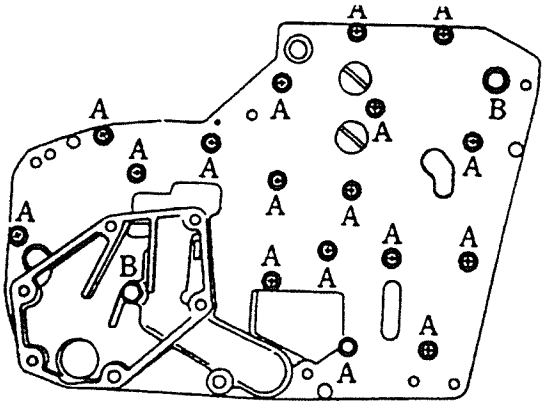
7. Place the separator plate over the lower valve body half. Hold the separator plate and lower valve body together and turn the assembly over and place it on the upper valve body.



8. Align the upper and lower valve bodies and install the valve body nuts and bolts.

   Tighten the upper-to-lower valve body A-bolts to 22-30 lb-in (2.5-3.4 N-m).

   While holding the nuts in place with a wrench, tighten the upper-to-lower valve body B-bolts to 43-61 lb-in (5-7 N-m).



9. Install the oil filter and tighten the oil filter bolts to 26-35 lb-in (3-4 N-m).

10. Install the subbody and tighten the valve body subbody bolts to 22-30 lb-in (2.5-3.4 N-m).

11. Set the assembled main control valve body aside in a clean area. Cover the main control valve body to prevent dirt or dust from accumulating.

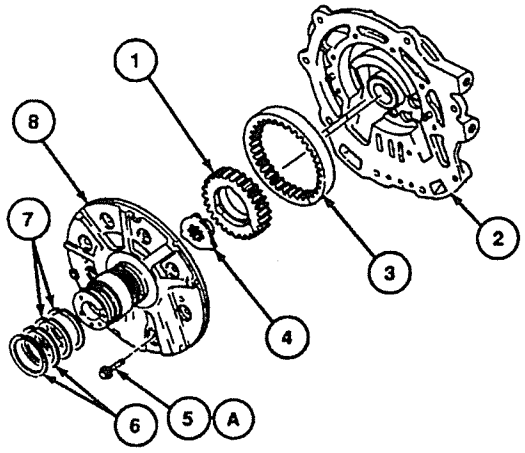
Oil Pump

SPECIAL SERVICE TOOL(S) REQUIRED

- Gauge Bar

Disassembly

Oil Pump - Exploded View



Item	Part Number	Description
1	-	Inner Gear
2	-	Pump Housing
3	-	Outer Gear
4	-	Pump Flange
5	-	Pump Cover Bolt (7 Req'd)
6	-	Oil Distributor Sleeve Seal
7	-	Front Clutch Cylinder Seal
8	-	Pump Cover
A	-	Tighten to 95-122 lb-in (11-14 N-m)

1. Position the oil pump with the pump cover facing up.

2. Remove the seven pump cover bolts.

3. Remove the pump cover. Do not allow the gears to fall out of the housing.

4. NOTE: Do not mark the gears by pin-punching or otherwise stressing the gears.

   Before removing the inner and outer gears, mark them with an indelible marker or equivalent.

5. Remove the pump flange and inner and outer gears.

6. Before assembly, inspect the oil pump as follows:

   a. Place Gauge Bar over the machined surface of the pump housing. Measure the clearance between the inner gear and the straightedge with a feeler gauge. Repeat this procedure and measure the clearance between the outer gear and the gauge bar. Standard clearance for both measurements is 0.001-0.002 inch (0.02-0.04mm). The maximum allowable clearance is 0.003 inch (0.08mm). If any measurement is beyond the wear limit, replace parts as necessary to obtain the desired clearance.

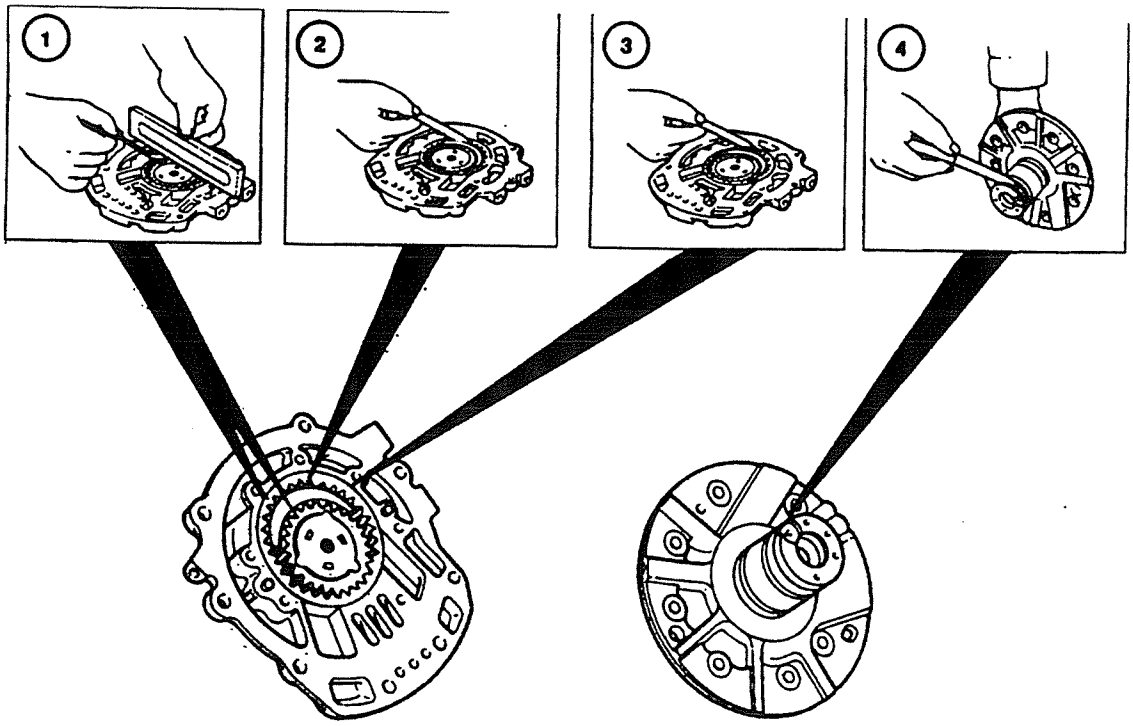
   b. Measure the clearance between the edge of the outer gear teeth and the crescent dam. Take this measurement at the high point of the crescent, with the outer gear pressed against the pump housing. Standard clearance is 0.006-0.008 inch (0.14-0.21 mm). Maximum allowable clearance is 0.010 inch (0.25mm).

   c. Measure the clearance between the outer gear and the pump housing. Standard clearance is 0.002-0.008 inch (0.05-0.20mm). Maximum allowable clearance is 0.010 inch (0.25mm).

   d. Measure the clearance between the seal ring and the seal ring grooves on the pump cover. Repeat this measurement procedure until all four seal ring groove clearance measurements have been taken. Standard clearance is 0.002-0.006

inch (0.04-0.16mm). Maximum allowable clearance is 0.016 inch (0.40mm).

NOTE: If, after installing new seal rings, the clearance is still beyond the maximum allowed, it will be necessary to replace the pump housing.



OIL PUMP CLEARANCES

Measured Location	Standard Value	Limit
1 INNER GEAR - PUMP COVER: OUTER GEAR - PUMP COVER	0.001-0.002 inch (0.02-0.04mm)	0.003 inch (0.08mm)
2 HEAD OF OUTER GEAR TEETH - CRESCENT DAM	0.006-0.008 inch (0.14-0.21 mm)	0.010 inch (0.25mm)
3 OUTER GEAR - HOUSING	0.002-0.008 inch (0.05-0.20mm)	0.010 inch (0.25mm)
4 SEAL RING - SEAL RING GROOVE	0.002-0.006 inch (0.04-0.16mm)	0.016 inch (0.40mm)

7. Check for a worn pump housing bushing as follows:

   a. Measure the outer diameter of the pump flange sleeve. The sleeve outer diameter limit is 1.492 inches (37.900mm). Replace the pump flange if the sleeve is worn beyond this limit.

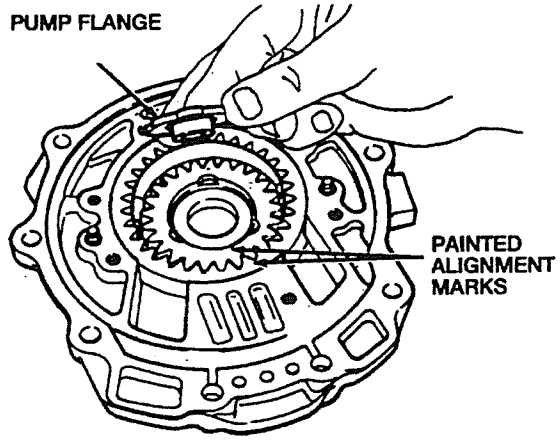
   b. Measure the pump cover bushing inside diameter. The bushing diameter limit is 1.499 inches (38.075mm). Replace the oil pump if the bushing is worn beyond this limit.

8. Refer to cleaning and inspection for oil pump inspection.

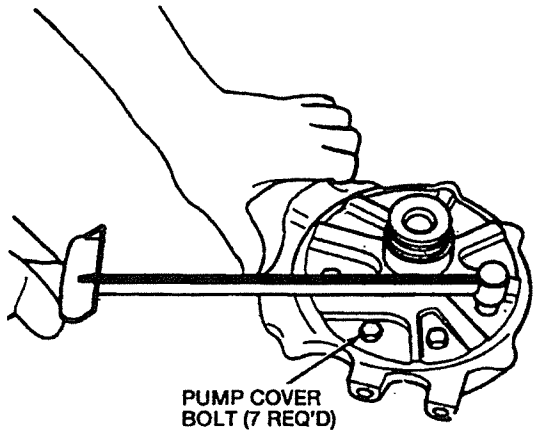
Assembly

1. Remove any oil pump gasket material remaining on the surfaces of the pump housing and transaxle case.

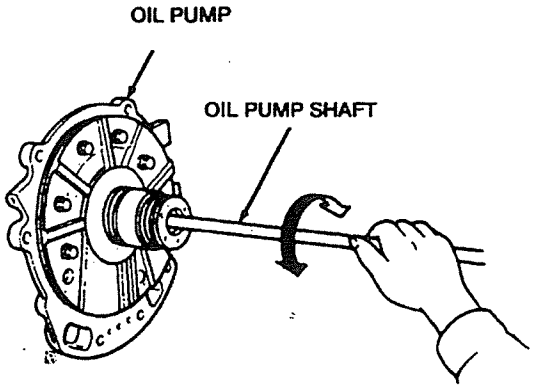
2. Assemble the pump gears and flange so that the alignment marks on the inner and outer gears are aligned and facing out. Coat the gears, pump housing, flange, and cover with the specified transmission fluid.



3. Install the pump cover to the pump housing. Install the seven pump cover bolts. Tighten the pump cover bolts to 95-122 lb-in (11-14 N-m).



4. After assembly, install the oil pump shaft to the oil pump and ensure the gears turn easily.



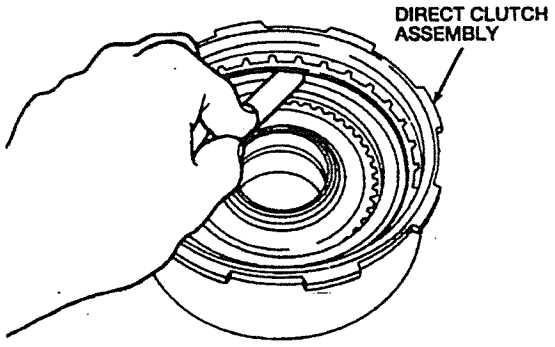
Direct Clutch

SPECIAL SERVICE TOOL(S) REQUIRED

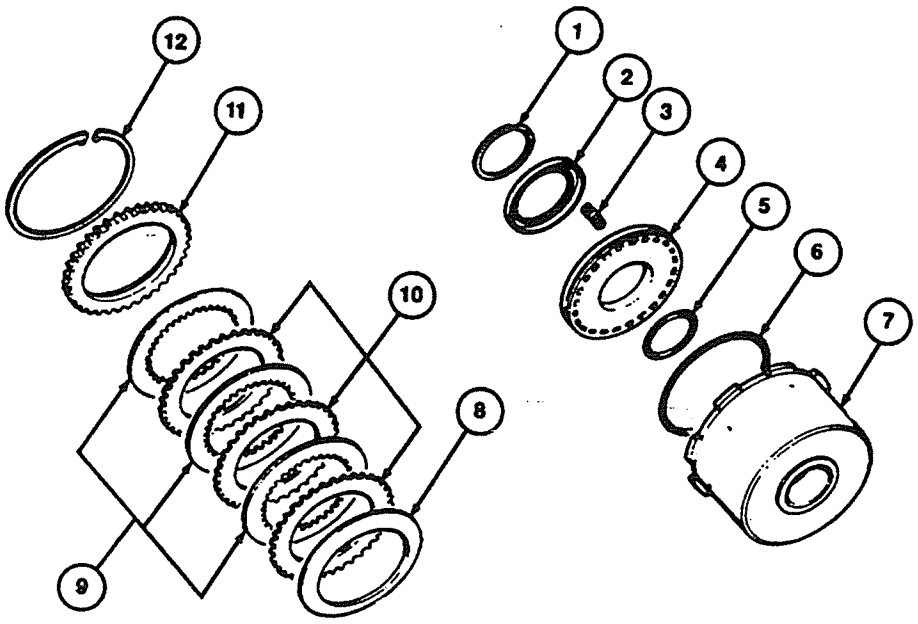
- Clutch Spring Compressor

Disassembly

Measure the clearance between the snap ring and the pressure plate of the direct clutch using a feeler gauge. The clearance should be 0.063-0.071 inch (1.6-1.8mm). If the clearance is not within specification, adjust by selecting the appropriate pressure plate during the assembly procedure.



Direct Clutch Assembly - Exploded View



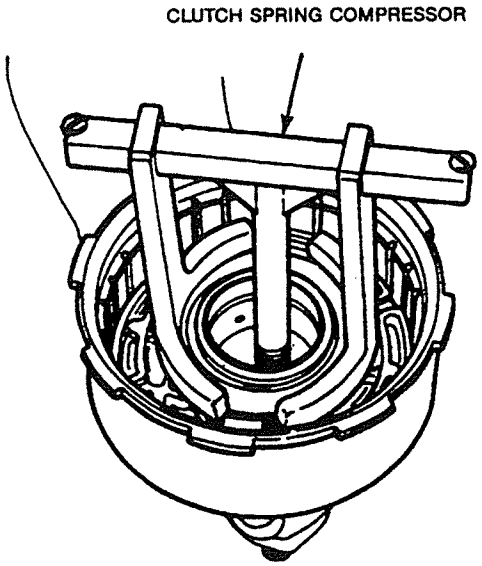
Item	Part Number	Description
1	-	Direct Clutch Hub Snap Ring
2	-	Direct Clutch Piston Spring Retainer
3	-	Direct Clutch Piston Return Spring
4	-	Direct Clutch Piston
5	-	Direct Clutch Inner Piston Seal[
6	-	Direct Clutch Outer Piston Seal

(Continued)

Item	Part Number	Description
7	-	Direct Clutch Drum
8	-	Direct Clutch Dished Plate
9	-	Direct Clutch Internal Spline Clutch Plates
10	-	Direct Clutch External Spline Clutch Plates
11	-	Direct Clutch Pressure Plate
12	-	Direct Clutch Snap Ring

1. Use snap ring pliers or a flat blade screwdriver to remove the direct clutch snap ring.
2. Remove the direct clutch pressure plate, clutch plates, and dished plate from the direct clutch drum.

3. Place the T-handle of Clutch Spring Compressor through the direct clutch drum. Install and tighten the nut of Clutch Spring Compressor until the tension is relieved from the direct clutch hub snap ring.



4. Use snap ring pliers or a flat blade screwdriver to remove the direct clutch hub snap ring.

5. Remove Clutch Spring Compressor.

6. Remove the direct clutch piston spring retainer and the return springs.

7. **WARNING: WHEN PERFORMING THE FOLLOWING PROCEDURE, USE CARE TO PROTECT YOURSELF FROM THE FORCE OF THE PISTON. KEEP FINGERS FROM BETWEEN THE WOOD BLOCK AND PISTON. EYE PROTECTION SHOULD ALSO BE USED TO PERFORM THIS OPERATION.**

   Place a wood block over the direct clutch drum. Remove the piston by applying compressed air (not to exceed 60 psi [400 kPa]) into the fluid hole of the direct clutch drum, and remove the piston.

8. Remove the inner and outer piston seal rings and discard.

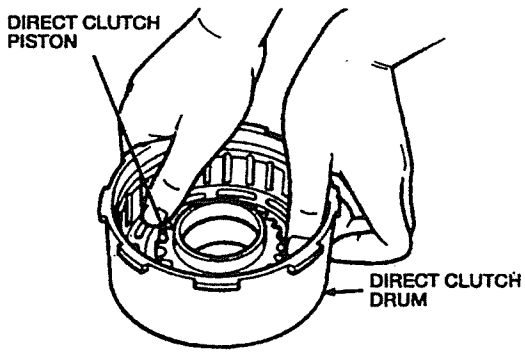
9. Refer to cleaning and inspection for clutch inspection.

Assembly

1. Clean and blow dry all parts.

2. Coat the new inner and outer piston seal rings with the petroleum jelly and install the seals to the direct clutch piston.

3. Install the direct clutch piston into the direct clutch drum by pushing evenly around the circumference, being careful not to damage the seal rings.

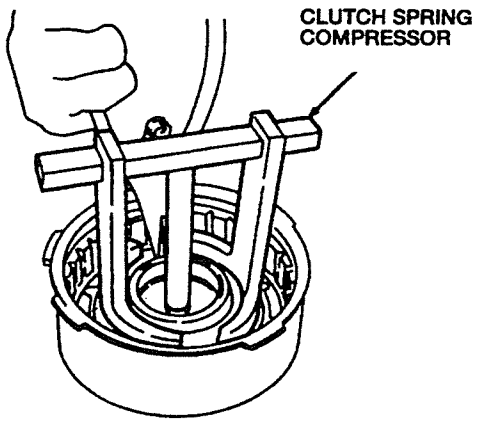


4. Install the piston return springs to the mounting pegs on the direct clutch piston.

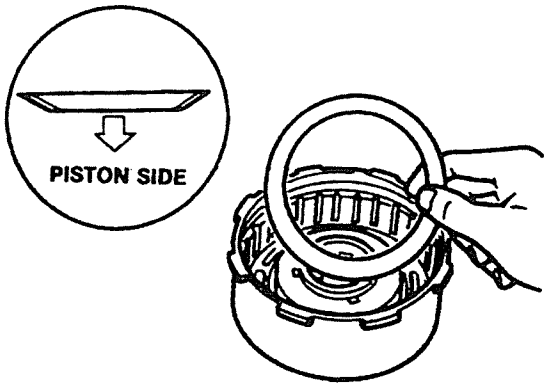
5. Place the spring retainer over the return springs.

6. Use Clutch Spring Compressor to compress the direct clutch to gain access to the snap ring groove.

7. Install the direct clutch hub snap ring and make sure it is fully seated in the groove. Remove Clutch Spring Compressor.



8. Install the direct clutch dished plate with the beveled side facing the direct clutch piston.



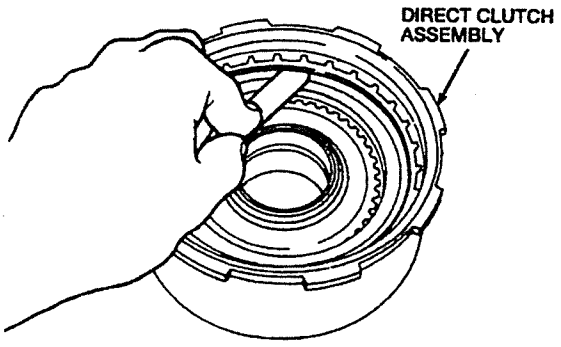
9. NOTE: When installing new clutch plates, allow the plates to soak in the specified transaxle fluid for a minimum of two hours.

   Install the direct clutch plates, starting with an external spline clutch plate, then an internal spline clutch plate, and alternating until all direct clutch plates are installed.

10. Install the direct clutch pressure plate and the direct clutch snap ring. Ensure that the direct clutch snap ring is fully seated in the snap ring groove.

11. Check and adjust the direct clutch clearance as follows:

    a. Measure the clearance between the snap ring and the pressure plate of the direct clutch by using a feeler gauge. If the clearance is not within 0.063-0.071 inch (1.6-1.8mm) adjust it by selecting a proper pressure plate using the following chart.

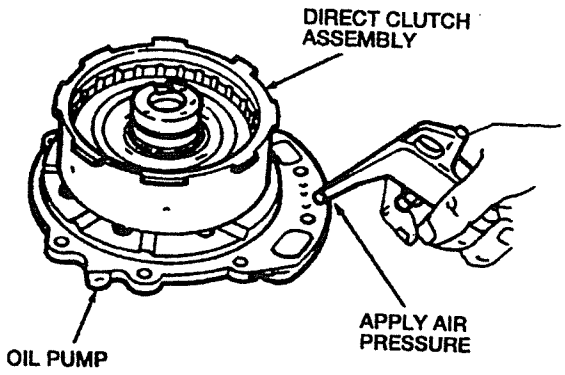


DIRECT CLUTCH PRESSURE PLATE SIZE

Part Number	Thickness of Pressure Plate
-	0.205 inch (5.2mm)
-	0.213 inch (5.4mm)
-	0.221 inch (5.6mm)
-	0.228 inch (5.8mm)
-	0.236 inch (6.0mm
-	0.244 inch (6.2mm)

   b. **WARNING: TO AVOID PERSONAL INJURY, WEAR EYE PROTECTION DURING THE FOLLOWING PROCEDURE.**

      Assemble the direct clutch assembly on the oil pump as shown. Check the operation of the direct clutch piston by applying a short burst of air pressure (not to exceed 57 psi [390 kPa]) to the orifice in the oil pump as shown. As air pressure is applied, the clutch pack should compress.



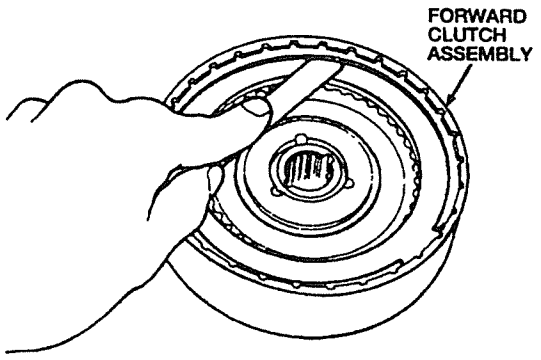
Forward Clutch

SPECIAL SERVICE TOOL(S) REQUIRED

- Clutch Spring Compressor

Disassembly

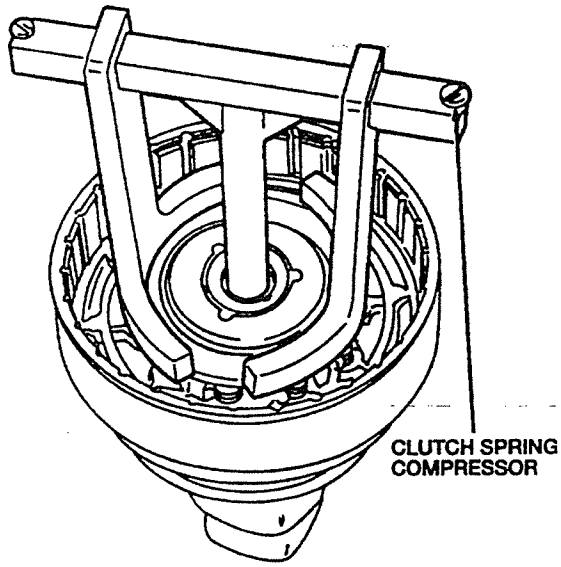
Use a feeler gauge to measure the clearance between the snap ring and the pressure plate of the forward clutch. The clearance should be 0.031-0.039 inch (0.8-1.0mm). If the clearance is not within specification, adjust it using the appropriate pressure plate during installation.



1. Use snap ring pliers or a flat blade screwdriver to remove the forward clutch snap ring.

2. Remove the pressure plate, the clutch plates, and the dished plate from the forward clutch drum.

3. Place the T-handle of Clutch Spring Compressor through the forward clutch drum. Install and tighten the nut of Clutch Spring Compressor until the tension is relieved from the forward clutch hub snap ring.



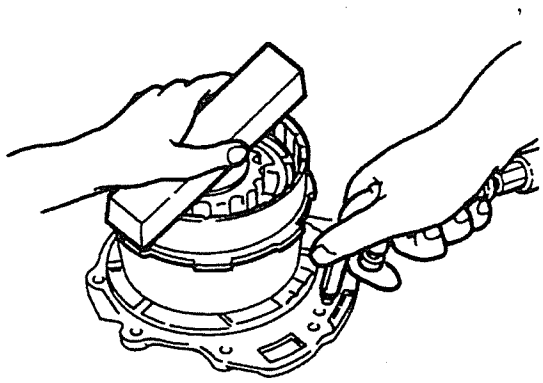
4. Remove the forward clutch hub snap ring using snap ring pliers or a flat blade screwdriver.

5. Remove Clutch Spring Compressor.

6. Remove the forward clutch piston spring retainer and the forward clutch return springs.

7. **WARNING: WHEN PERFORMING THE FOLLOWING PROCEDURE, USE CARE TO PROTECT YOURSELF FROM THE FORCE OF THE PISTON. KEEP FINGERS FROM BETWEEN THE WOOD BLOCK AND PISTON. EYE PROTECTION SHOULD ALSO BE USED WHEN PERFORMING THIS PROCEDURE.**

   Place a wood block over the forward clutch drum. Remove the forward clutch piston by applying a short burst of compressed air (not to exceed 60 psi [400 kPa]) into the fluid hole of the pump housing with the direct clutch and forward clutch assemblies positioned on the oil pump extension.



8. Remove the inner and outer piston seal rings and discard.

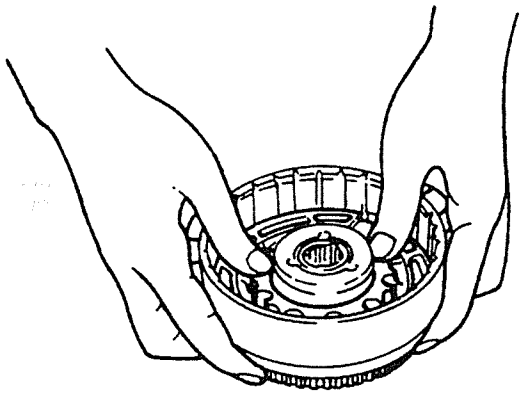
9. Refer to cleaning and inspection for clutch inspection.

Assembly

1. Clean and blow dry all parts.

2. Coat the new inner and outer piston seal rings with the petroleum jelly and install the seals to the forward clutch piston.

3. Install the forward clutch piston into the forward clutch drum by pushing evenly around the circumference. Be careful not to damage the seal rings.

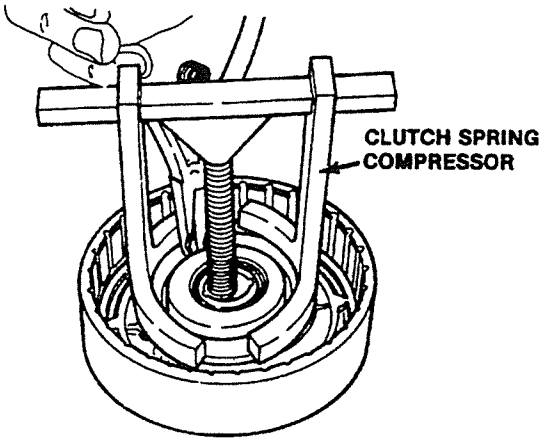


4. Install the forward clutch piston return springs on the mounting pegs on the forward clutch piston.

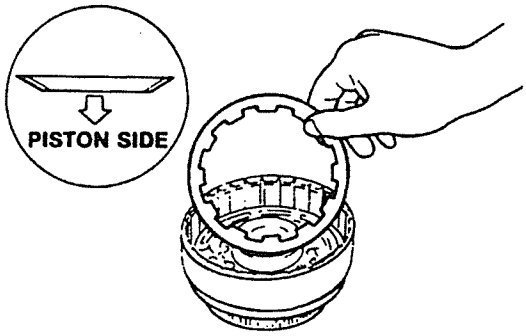
5. Place the forward clutch piston spring retainer over the forward clutch return springs.

6. Use Clutch Spring Compressor to compress the forward clutch to gain access to the forward clutch hub snap ring groove.

7. Install the forward clutch hub snap ring. Ensure it is fully seated in the groove, then remove Clutch Spring Compressor.



8. Install the forward clutch dished plate with the beveled side facing the forward clutch piston.



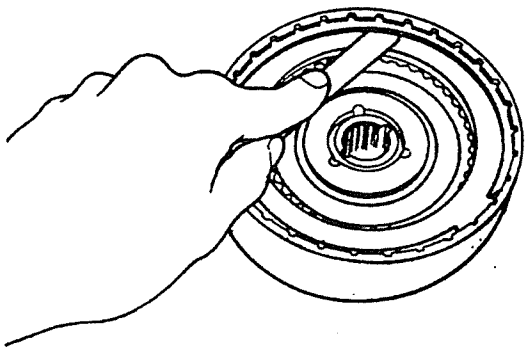
9. NOTE: When installing new clutch plates, allow the plates to soak in the specified transaxle fluid for a minimum of two hours.

   Install the clutch plates, starting with an external splined clutch plate, then an internal splined clutch plate, and alternating until all the clutch plates are installed. Install the forward clutch pressure plate and the forward clutch snap ring.

10. Check and adjust the forward clutch clearance as follows:

    a. Install the forward clutch retaining plate, one-way clutch, and the forward clutch snap ring. Ensure that the forward clutch snap ring is fully seated in the snap ring groove.

    b. Use a feeler gauge to measure the clearance between the snap ring and the pressure plate of the forward clutch. If the clearance is not within 0.031-0.039 inch (0.8-1.0mm) adjust it by selecting the proper forward clutch pressure plate from the following chart.



FORWARD CLUTCH PRESSURE PLATE SIZE

Part Number	Thickness of Pressure Plate
-	0.197 inch (5.0mm)
-	0.205 inch (5.2mm)
-	0.213 inch (5.4mm)
-	0.221 inch (5.6mm)
-	0.228 inch (5.8mm)
-	0.236 inch (6.0mm)
-	0.244 inch (6.2mm)
-	0.189 inch (4.8mm)

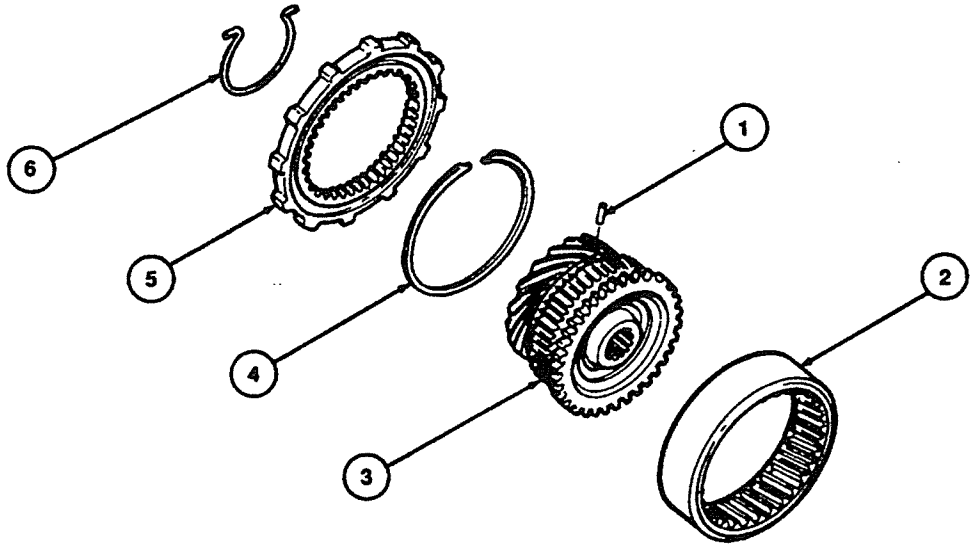
11. **WARNING: TO AVOID PERSONAL INJURY, WEAR EYE PROTECTION DURING THE FOLLOWING PROCEDURE.**

    Assemble the direct clutch drum and the forward clutch drum on the oil pump as shown. Check the operation of the forward clutch piston by applying a short burst of air pressure (not to exceed 400 kPa [60 psi]) to the opening in the oil pump. As air pressure is applied, the clutch pack should compress.

Drum Hub

Disassembly

Drum Hub - Exploded View

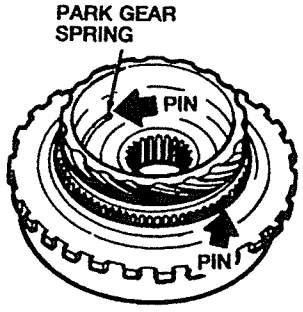


Item	Part Number	Description
1	-	Pin (2 Req'd)
2	-	Ring Gear
3	-	Drive Hub

(Continued)

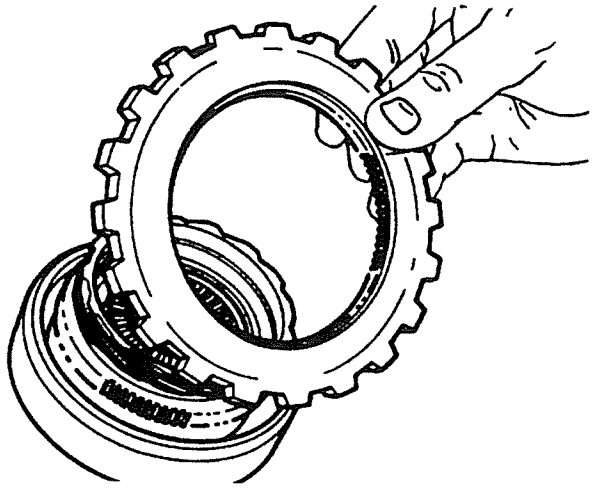
Item	Part Number	Description
4	-	Output Gear Retainer Snap-Ring
5	-	Park Gear
6	-	Park Gear Spring

1. Use a flat blade screwdriver to remove the park gear spring from the park gear.



2. Remove the two pins from the ring gear by driving them inward.

3. Separate the park gear from the ring gear.



4. Remove the snap ring from the ring gear.

5. Separate the drive hub from the ring gear.

6. Refer to cleaning and inspection for drum hub inspection.

Assembly

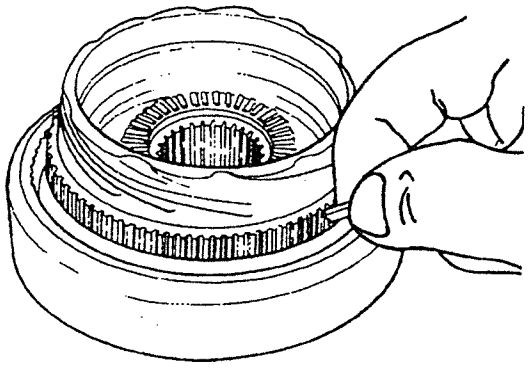
1. Clean and blow dry all parts.

2. Install the drive hub on the ring gear.

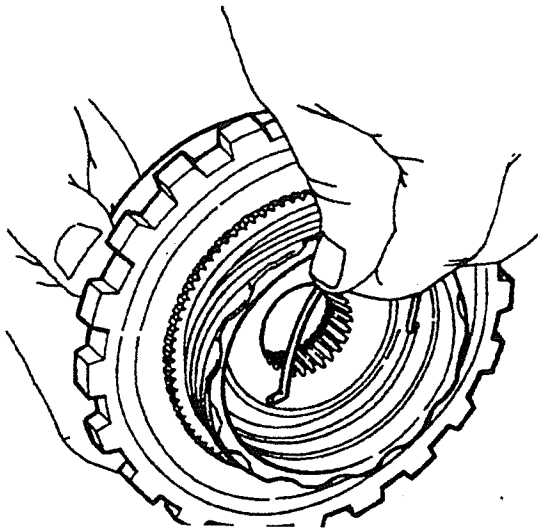
3. Install the snap ring to the ring gear and make sure the snap ring is fully seated in the snap ring groove.

4. Install the park gear onto the ring gear.

5. Insert the two pins that secure the park gear to the ring gear.

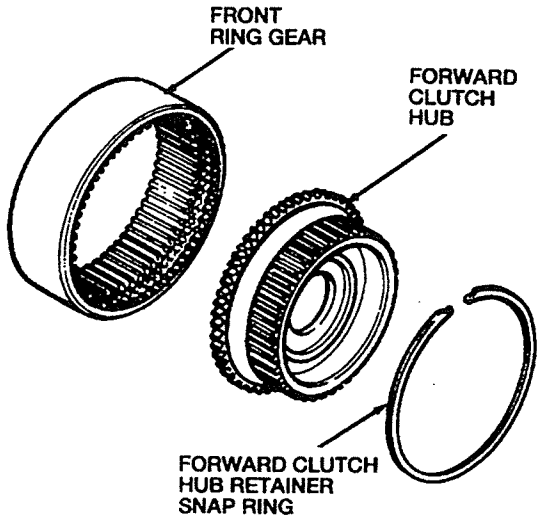


6. Install the park gear spring into the ring gear making sure that the ends of the clip are inserted into the holes of the pins.



Forward Clutch Hub

Disassembly



1. Use a flat blade screwdriver to remove the forward clutch hub retainer snap ring from the front ring gear.

2. Separate the forward clutch hub from the front ring gear.

3. Refer to cleaning and inspection for forward clutch hub inspection.

Assembly

1. Clean and blow dry all parts.
2. Install the front ring gear to the forward clutch hub.
3. Install the snap ring and ensure that the snap ring is fully seated in the snap ring groove.

Intermediate Servo

Disassembly

1. Remove the servo piston spring from around the servo rod.
2. Remove the servo piston from the servo retainer by pulling straight out on the stem.
3. Replace the seals and sealing rings.
4. Refer to cleaning and inspection for band apply servo inspection.

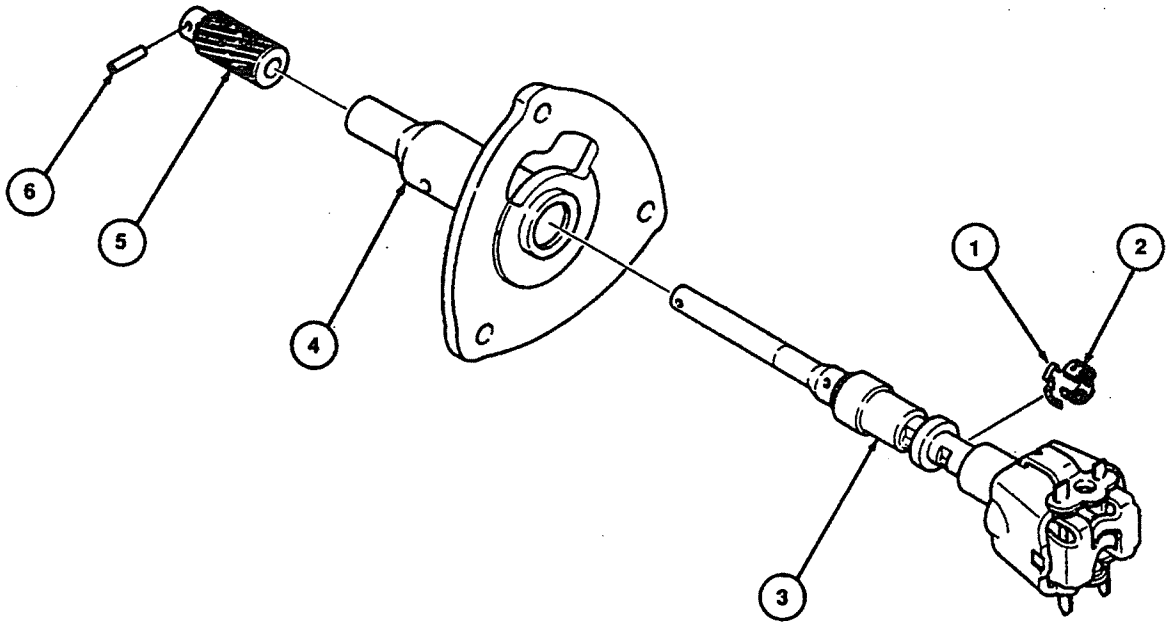
Assembly

1. Install the servo piston into the servo retainer by pressing straight in on the servo rod.
2. Place the servo piston spring around the servo rod.

Governor

Disassembly

Governor - Exploded View



Item	Part Number	Description
1	-	Governor Oil Screen Clamp
2	-	Governor Oil Screen
3	-	Governor valve

(Continued)

Item	Part Number	Description
4	-	Governor Sleeve
5	-	Governor Driven Gear
6	-	Roll Pin

1. Secure the governor assembly in a vise.
2. Drive out the roll pin from the governor driven gear. Discard the roll pin.
3. Remove the governor driven gear.
4. Remove the governor sleeve.
5. Remove the governor oil screen clamp.
6. Remove the governor oil screen.
7. Refer to cleaning and inspection for governor inspection.

Assembly

1. Secure the governor assembly in a vise.
2. Set the governor oil screen on the governor valve and install a new governor oil screen clamp.
3. Insert the governor valve through the governor sleeve.
4. Install the governor driven gear.
5. Install a new roll pin

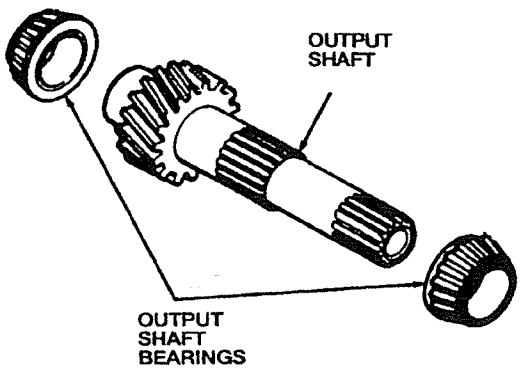
Output Shaft and Gear

SPECIAL SERVICE TOOL(S) REQUIRED

- Bearing Cone Replacer
- Axle Bearing/Seal Plate

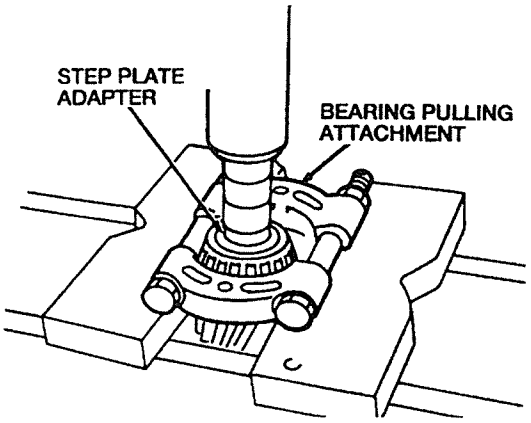
Disassembly

Output Shaft - Exploded View



1. NOTE: Label the output shaft bearings for proper installation.

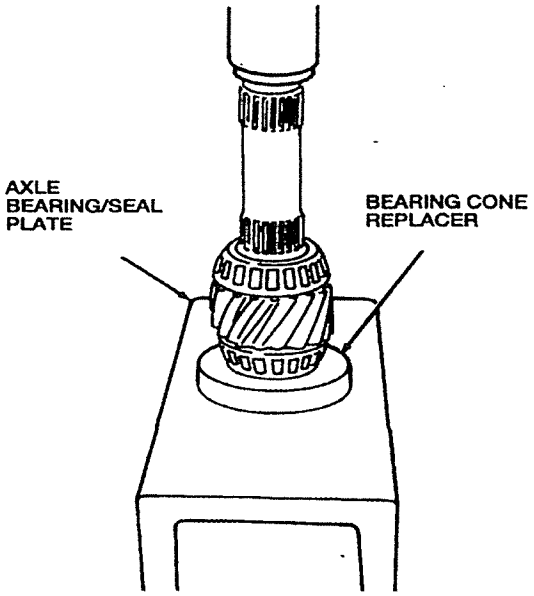
Use an arbor press, Bearing Pulling Attachment or equivalent and Step Plate Adapter or equivalent to remove both output shaft bearings.



2. Refer to cleaning and inspection for output shaft and gear inspection.

Assembly

1. Prior to installation of the output shaft bearings, thoroughly clean the output shaft bearings and inspect their condition. Lightly oil the output shaft bearings with the specified transmission fluid.
2. Use Bearing Cone, Axle Bearing/Seal Plate, and an arbor press to install the output shaft bearings on the output shaft. Ensure the output shaft bearings are pressed on the proper end as labeled during disassembly.



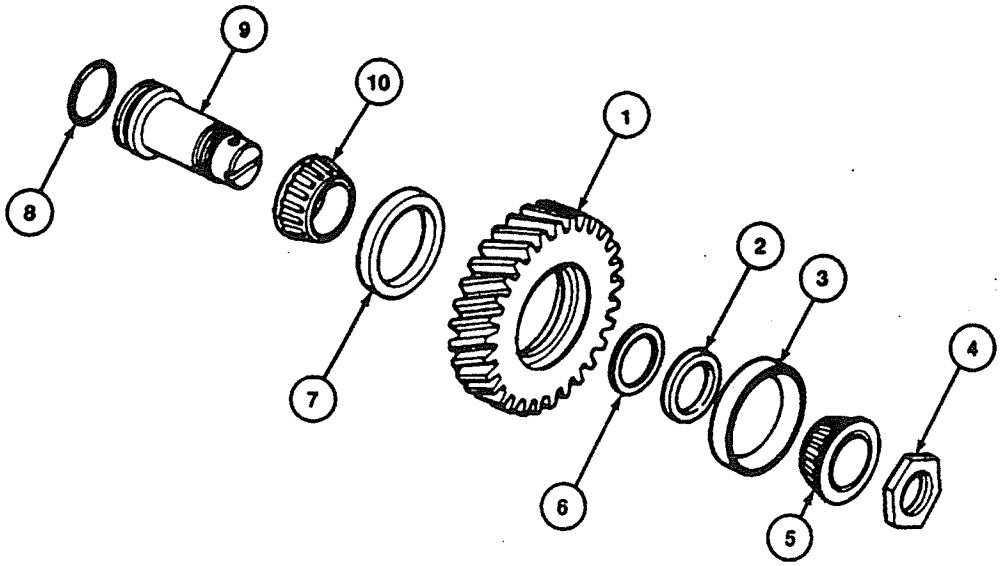
Idler Gear

SPECIAL SERVICE TOOL(S) REQUIRED

- Torque Adapter
- Impact Slide Hammer
- Driver Handle

Disassembly

Idler Gear and Idler Gear Shaft - Exploded View

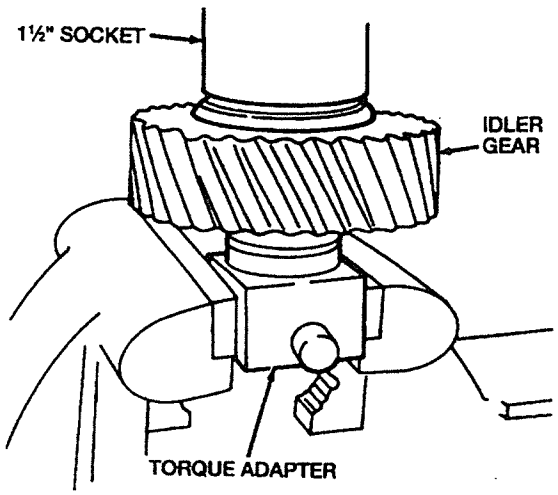


Item	Part Number	Description
1	-	Idler Gear
2	-	Idler Gear Spacer
3	-	Bearing Race
4	-	Idler Gear Shaft Nut
5	-	Idler Gear Bearing

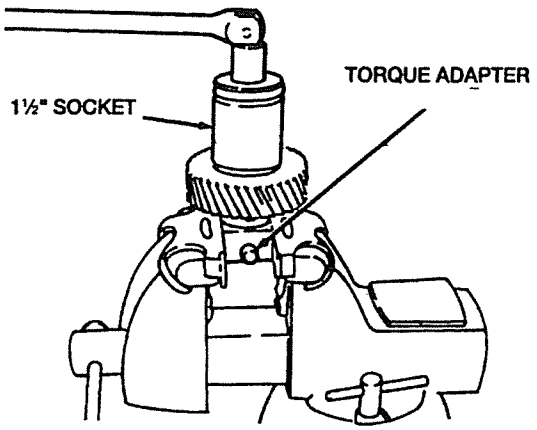
(Continued)

Item	Part Number	Description
6	-	Adjustment Shim
7	-	Bearing Race
8	-	Idler Gear Shaft Seal
9	-	Idler Gear Shaft
10	-	Idler Gear Bearing

1. Insert the hex of Torque Adapter into the end of the idler gear shaft and place the assembly into a vise as shown.



2. Use a 1-1/2 inch socket to remove the idler gear shaft nut.

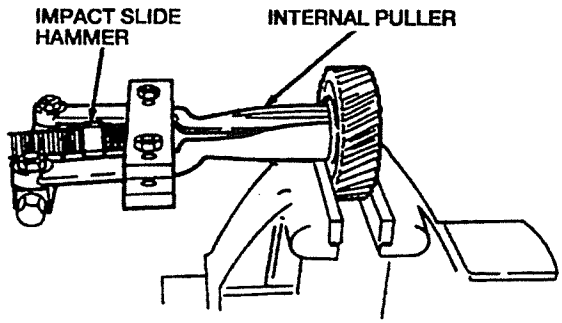


3. NOTE: Before removing the idler gear from the idler gear shaft, note the direction of the notches in the gear teeth face for assembly.

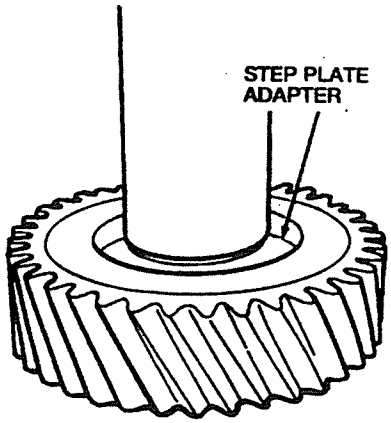
   Remove the idler gear bearings and the idler gear from the idler gear shaft.

4. Inspect the idler gear and idler gear bearings for pitting or scoring. Replace the idler gear bearing and bearing race as a set if worn or damaged.

5. Hold the idler gear in a vise equipped with soft jaws. Use Impact Slide Hammer and Internal Puller or equivalent to pull one bearing race from the idler gear.



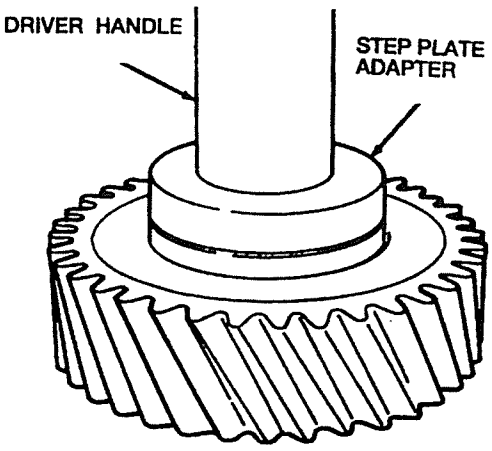
6. Press the remaining bearing race from the idler gear using Step Plate Adapter or equivalent as shown.



7. Inspect the bearing races for scoring. If worn or damaged, replace the bearing races and idler gear bearings as matched sets.

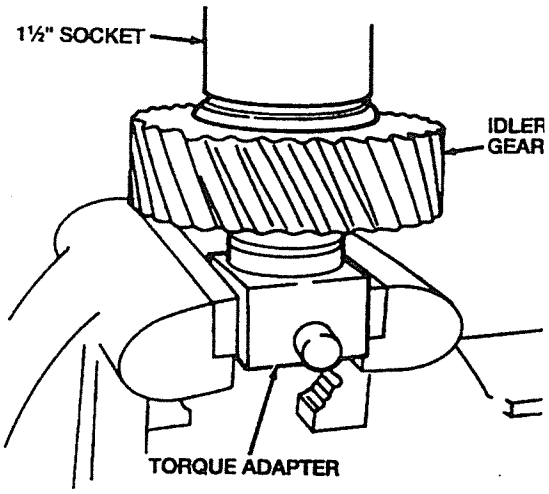
Assembly

1. Use a hydraulic press, Driver Handle, and the appropriate step plate adapter from Step Plate Adapter Set or equivalent to press the bearing races into the idler gear.



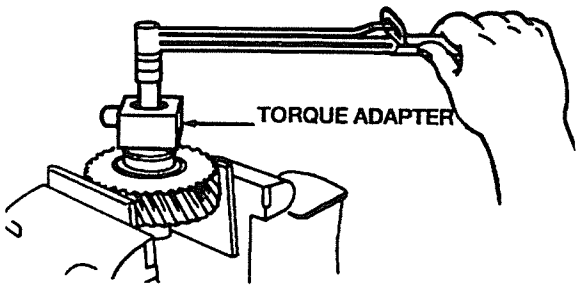
2. NOTE: Install the idler gear with the notches in the teeth facing the direction noted during disassembly.

   Assemble idler gear bearings, adjustment shims, idler gear, and idler gear shaft nut on the idler gear shaft. Use Torque Adapter to hold the idler gear shaft. Tighten the idler gear shaft nut to 94 lb-ft (128 N-m).



3. Reposition the assembly in a vise equipped with protective jaw caps.

4. Use Torque Adapter and a torque wrench to measure the bearing preload by rotating the torque adapter tool.



5. The correct amount of bearing preload will indicate a drag of 0.26-7.8 lb-in (0.03-0.9 N-m) torque while rotating the tool.

6. Higher torque readings indicate excessive bearing preload and the need for more adjustment shims. Too little drag indicates insufficient preload and need for fewer shims. Consult the chart for available shims and part numbers.

   Maximum allowable number of shims is seven.

   Preload can be reduced by increasing the total thickness of the adjustment shim, or increased by reducing the total thickness of the adjustment shims.

IDLER GEAR SHIM SIZE

Part Number	Thickness of Shim
-	0.004 inch (0.10mm)
-	0.005 inch (0.12mm)
-	0.006 inch (0.14mm)
-	0.007 inch (0.16mm)
-	0.008 inch (0.20mm)
-	0.020 inch (0.50mm)

7. When the correct preload is reached, position the idler shaft end in Torque Adapter and support both in a vise. Tighten the idler gear shaft nut to 94-130 lb-ft (128-177 N-m).

ASSEMBLY

Transaxle

SPECIAL SERVICE TOOL(S) REQUIRED

Description	Tool Number
Differential Seal Replacer	-
Driver Handle	-
Bearing Cup Replacer	-
Valve Body Guide Pins	-
Converter Seal Replacer	-
Clutch Compressor	-
Shim Selection Set	-
Torque Adapter	-
Support Housing Bearing Cup Replacer	-
Differential Rotator	-
Gauge Bar	-

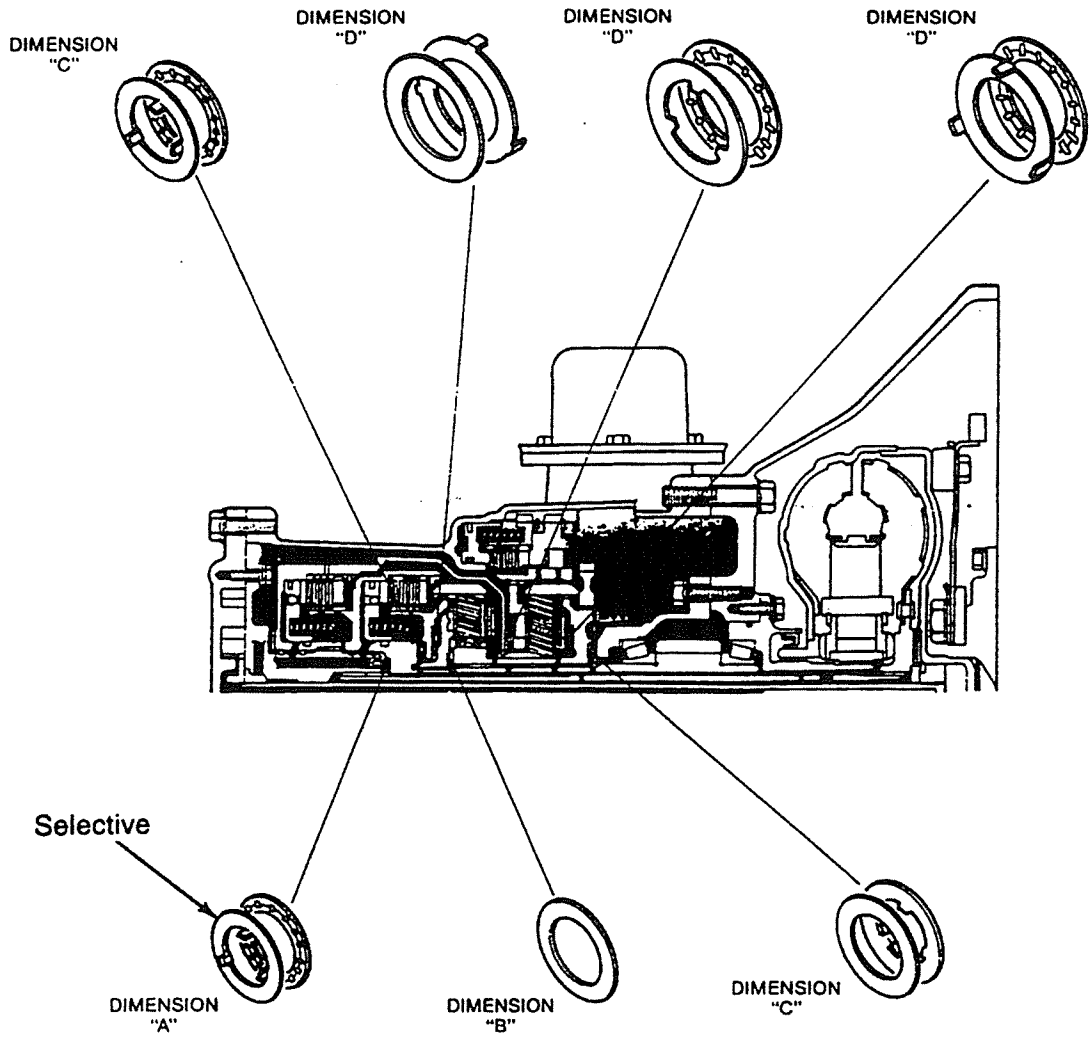
CAUTION: For dependable operation and long life, assembly operations must be performed in an area free of dirt and other contamination.

Inspect all parts for dents or nicks that could prevent proper fit or operation. Replace all seals, seal rings, roll pins, and gaskets with new parts.

Apply the specified transmission fluid to all seal rings, rotating parts, and sliding units before assembly.

Use petroleum jelly sparingly (not grease) to hold thrust washers or gaskets in place during assembly.

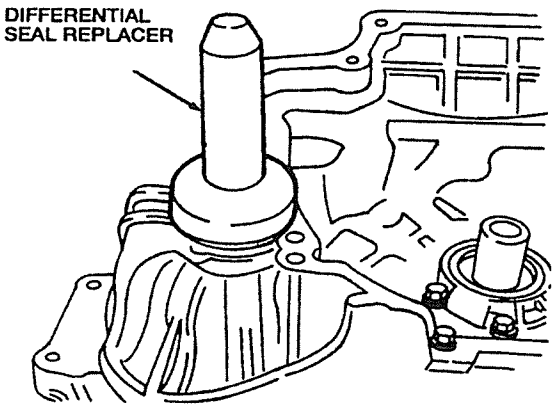
Thrust Bearing/Washer Locations



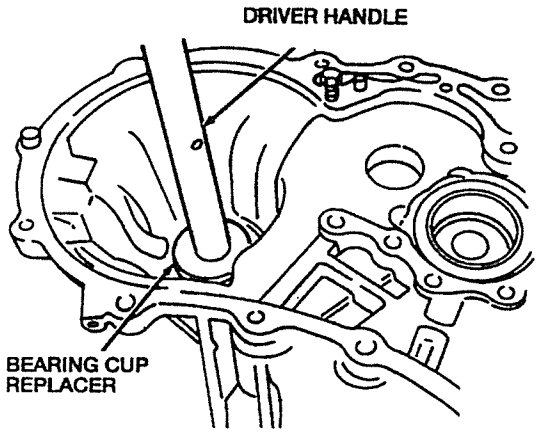
THRUST BEARING/WASHER LOCATION

Component	Dimension			
	A	B	C	D
Thrust Bearing	1.65 in (41.9mm)	1.85 in (46.9mm)	2.08 in (52.9mm)	2.75 in (69.9mm)
Thrust Washer	1.61 in (41.0mm)	-	2.03 in (51.5mm)	2.74 in (70.0mm)

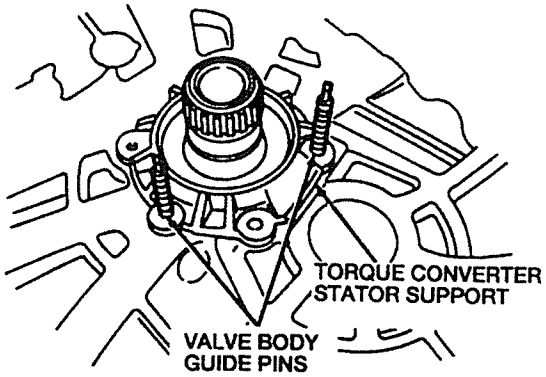
1. Use Differential Seal Replacer to install the differential oil seals.



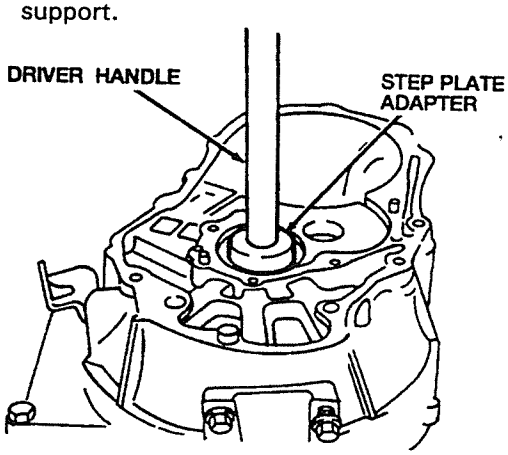
2. Use Driver Handle and Bearing Cup Replacer to install the differential bearing race in the converter housing.



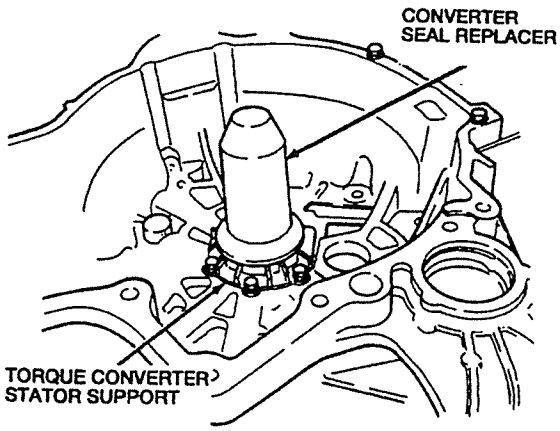
3. Use Valve Body Guide Pins to position the torque converter stator support in the converter housing and drive into place with a brass hammer. Install the six torque converter stator support bolts and tighten to 95-122 lb-in (11-14 N-m).



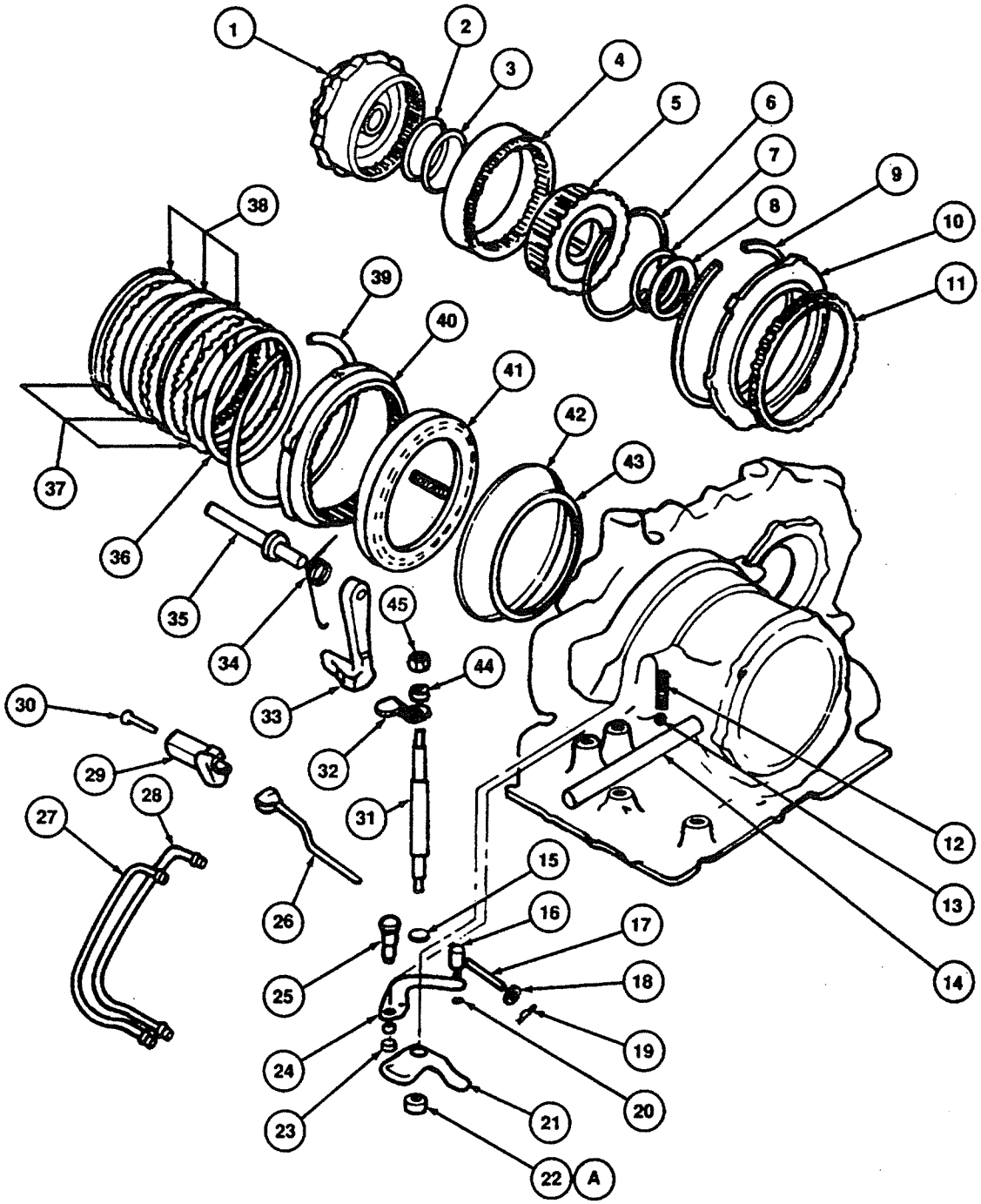
4. Use Driver Handle and the appropriate step plate from Step Plate Adapter Set or equivalent to press the outer race for the output shaft into the torque converter stator support.



5. Use Converter Seal Replacer to install the converter impeller hub seal into the torque converter stator support.



Internal Linkages, Rear Planetary Gearset and Low/Reverse Clutch



Item	Part Number	Description
1	-	Drum Hub Assembly
2	-	Needle Bearing
3	-	Thrust Washer

(Continued)

Item	Part Number	Description
4	-	Low One-Way Clutch Inner Race
5	-	Rear Carrier
6	-	Retaining Ring

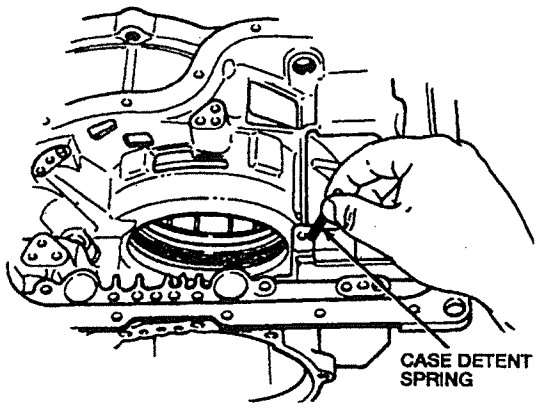
(Continued on next page)

Item	Part Number	Description
7	-	Thrust Bearing
8	-	Sun Shell Thrust Washer
9	-	Low/Reverse Snap Ring
10	-	One-Way Clutch
11	-	Retaining Plate, One-Way Clutch
12	-	Case Detent Spring
13	-	Detent Check Ball
14	-	Manual Control Lever Shaft
15	-	Manual Control Lever Shaft Seal
16	-	Ferrule
17	-	Spring
18	-	Washer
19	-	Retaining Pin
20	-	Circlip
21	-	Park Lever Plate
22	-	Manual Control Lever Nut
23	-	Park Actuator Support
24	-	Park Actuator Lever
26	-	Pivot Pin
26	-	Parking Lever Actuating Rod
27	-	Governor Inlet Tube
28	-	Governor Outlet Tube
29	-	Support
30	-	Support Retaining Bolt

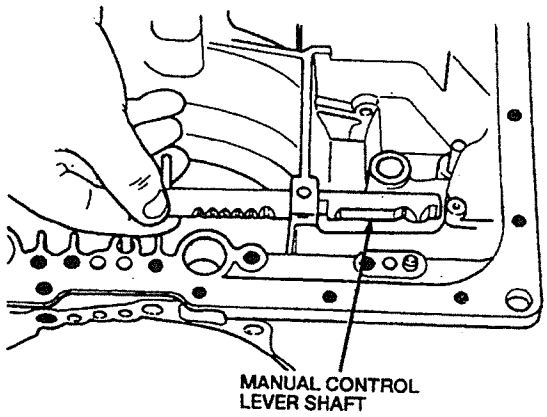
(Continued)

Item	Part Number	Description
31	-	Manual Control Lever
32	-	Manual Control Lever Arm
33	-	Parking Pawl
34	-	Parking Pawl Return Spring
35	-	Parking Pawl Shaft
36	-	Low/Reverse Clutch Dished Plate
37	-	Low/Reverse Clutch External Spline Clutch Plate
38	-	Low/Reverse Clutch Internal Spline Clutch Plate
39	-3	Low/Reverse Clutch Pressure Plate Retainer Snap Ring
40	-	Low and Reverse Clutch Hub
41	-	Low/Reverse Clutch Piston
42	-	Reverse Clutch Piston Large Seal
43	-	Reverse Clutch Piston Small Seal
44	-	Manual Shaft O-Ring
45	-	Manual Control Lever Nut
A	-	Tighten to 22-29 lb-ft (30-39 N-m)

6. Install the case detent spring and detent ball.

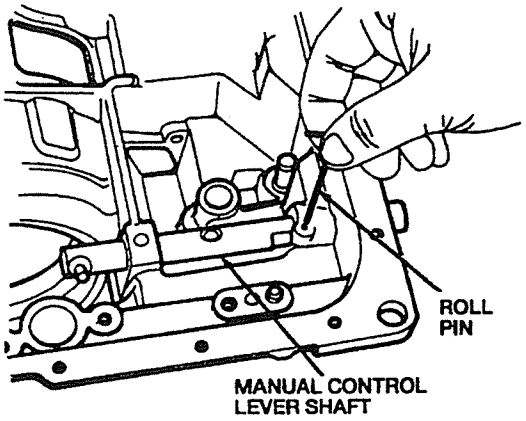


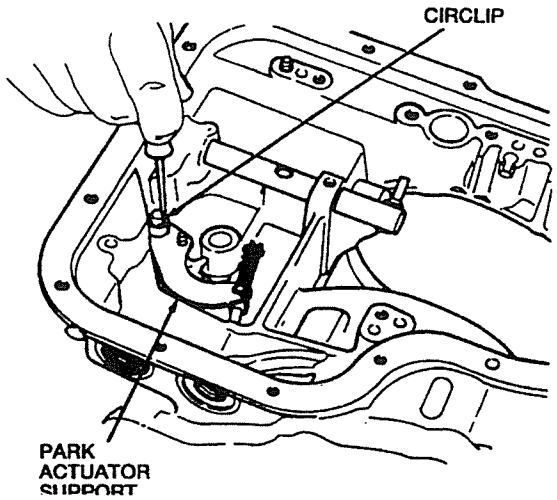
7. Install the manual control lever shaft.



3 NOT used when the transaxle is assembled in production, however, it is required in assembly when servicing the transaxle.

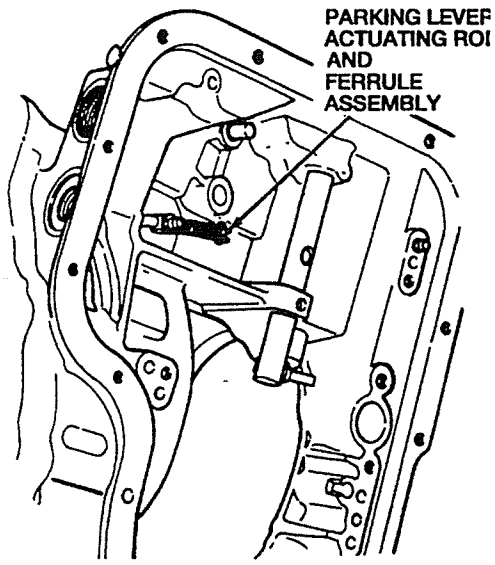
8. Install the roll pin to retain the manual control lever shaft.

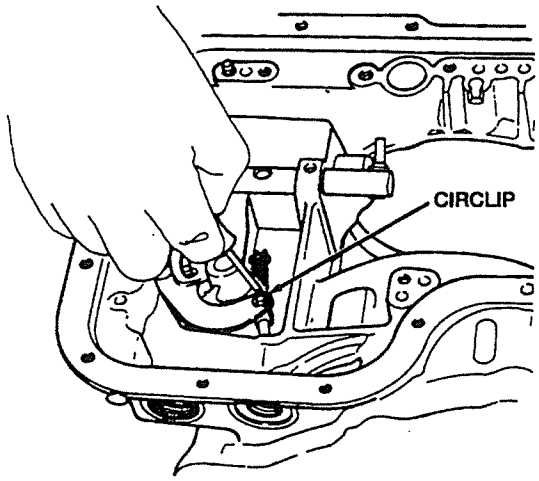




9. Install the parking pawl actuator support. Install the parking pawl actuator support bolts and tighten to 106-142 lb-in (12-16 N-m).

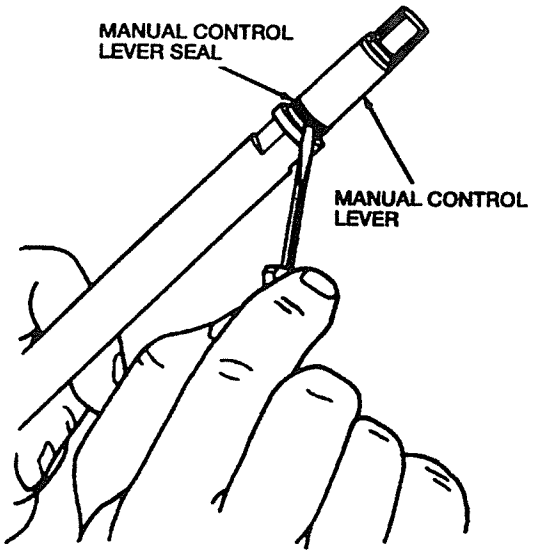
10. Install the parking lever actuating rod and ferrule assembly.





11. Install the park actuator support to the ferrule on the parking lever actuating rod and install the circlips.

12. Install a new manual control lever seal to the manual control lever.

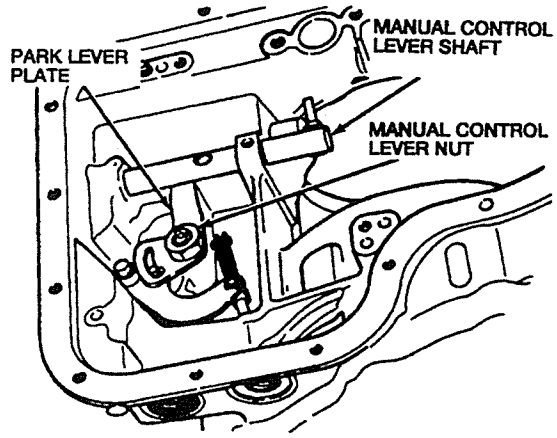


13. Install the manual control lever to the transaxle case.

14. Install the manual control lever support to the transaxle case. Tighten the two manual control lever support bolts to 43-69 lb-in (5-8 N-m).

15. Install the park lever plate to the manual control lever and align with the manual control lever shaft.

16. Install the manual control lever nut onto the manual control lever. Tighten the manual control lever nut to 22-29 lb-ft (30-39 N-m).

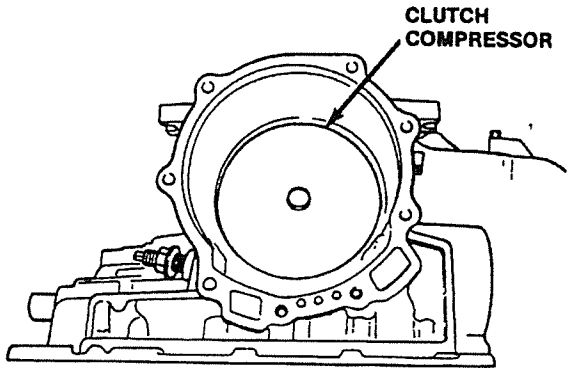


17. **CAUTION: Install the piston being careful not to fold or damage the lip seals.**

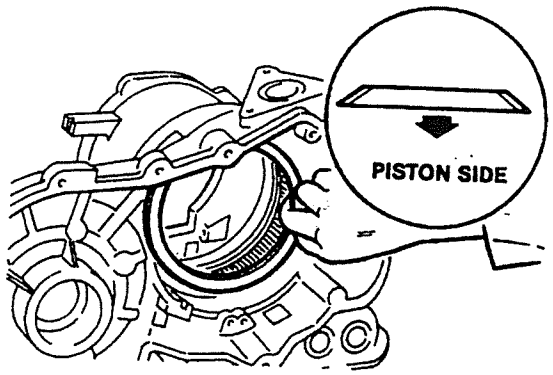
NOTE: Refer to cleaning and inspection for low/reverse clutch inspection.

Install new seals into the low/reverse piston. Lubricate the low/reverse piston and seals with petroleum jelly and install the low/reverse piston to its bore in the transaxle case.

18. Place the return springs and low and reverse clutch hub on top of the low/reverse piston. Install Clutch Compressor and compress the assembly far enough to permit insertion of the low/reverse snap ring. Install the low/reverse snap ring. Remove Clutch Compressor.

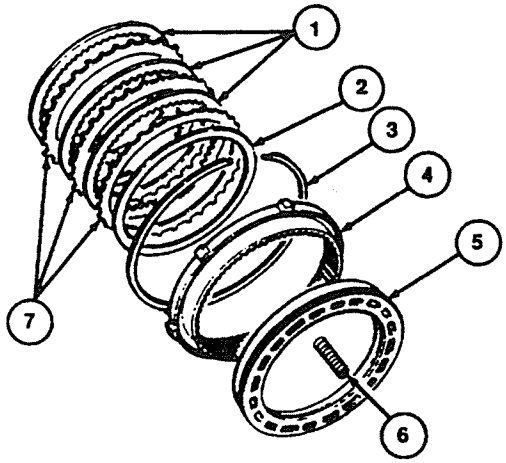


19. Install the low/reverse dished plate to the low/reverse clutch piston in the direction shown.



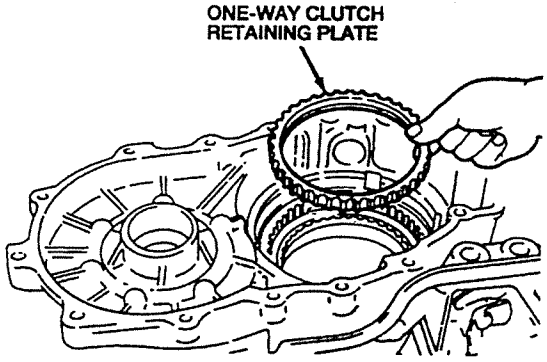
20. Install the low/reverse clutch pack starting with an external spline clutch plate against the dished plate. Alternate installation of external spline clutch plates and internal spline clutch plates until all of the plates have been installed.

Low/Reverse Clutch - Exploded View



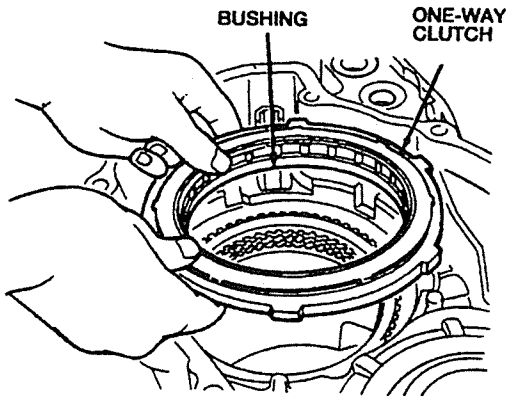
Item	Part Number	Description
1	-	Low/Reverse Clutch Internal Spline Clutch Plate
2	-	Low/Reverse Dished Plate
3	-	Low/Reverse Clutch Snap Ring
4	-	Low/Reverse Clutch Hub
5	-	Low/Reverse Clutch Piston
6	-	Low/Reverse Clutch Return Spring
7	-	Low/Reverse Clutch External Spline Clutch Plate

21. Install the one-way clutch retaining plate with the beveled edge up, over the clutch pack.

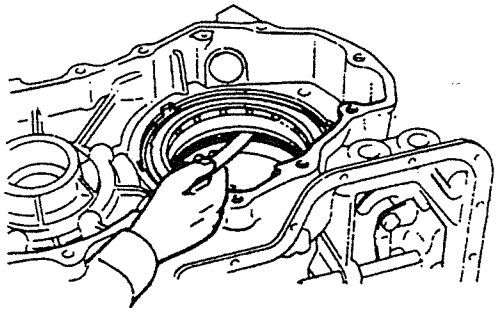


22. NOTE: The low/reverse snap ring is not used when the transaxle is assembled in production, however it is required in assembly when servicing the transaxle.

    Install the one-way clutch with the bushing against the one-way clutch retaining plate. Compress the clutch assembly enough to install the low/reverse snap ring. Install the low/reverse snap ring.



23. Use a feeler gauge to measure the clearance between the one-way clutch and the one-way clutch retaining plate.

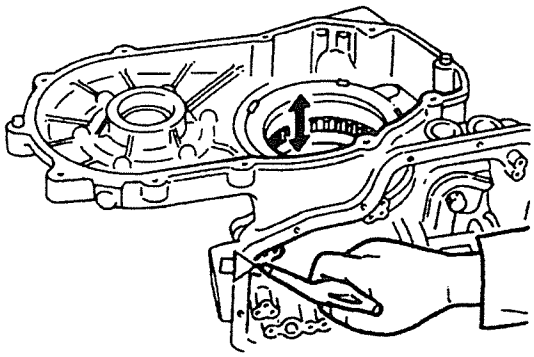


24. If the clearance is not within specifications of 0.032-0.041 inch (0.8-1.05mm), use a one-way clutch retaining plate (consult the following chart) to obtain the proper clearance.

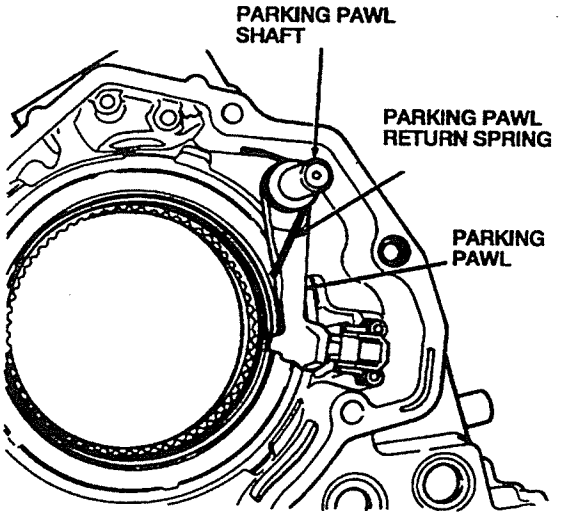
ONE-WAY CLUTCH RETAINING PLATE SIZE

Part Number	Thickness
-	0.102 inch (2.6mm)
-	0.071 inch (1.8mm)
-	0.079 inch (2.0mm)
-	0.087 inch (2.2mm)
-	0.094 inch (2.4mm)

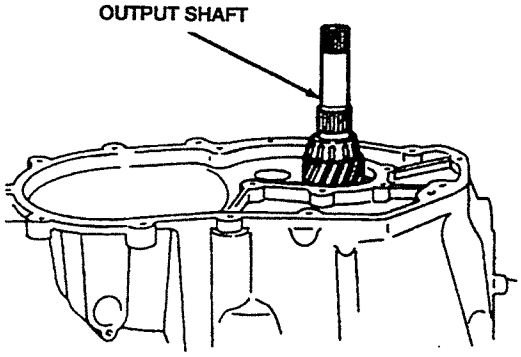
25. Apply a short burst of air pressure (not to exceed 60 psi [400 kPa]) to the transaxle case at the port shown to test the action of the assembled clutch. The plates should be compressed by the low/reverse clutch piston as air is applied.



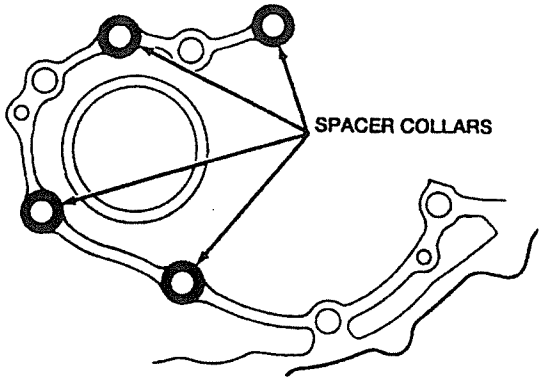
26. Install the parking pawl, parking pawl return spring, and parking pawl shaft to the transaxle case.



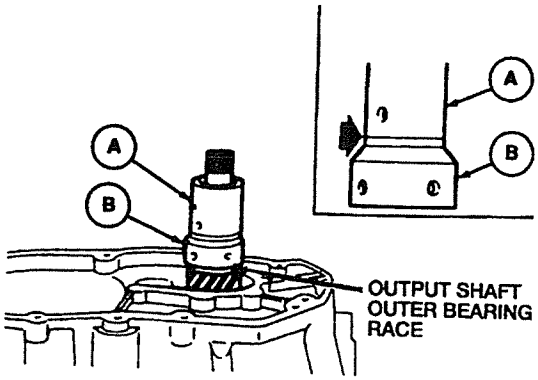
27. Position the output shaft into the converter housing.



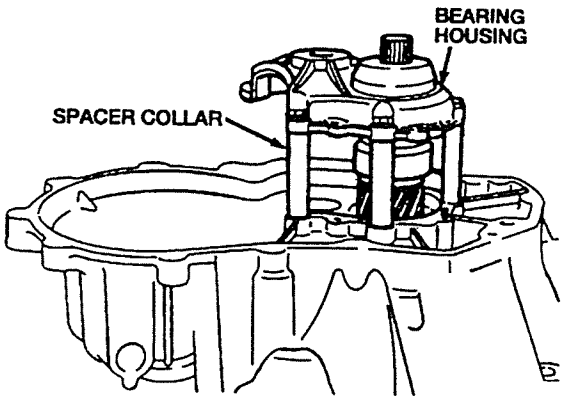
28. Locate the four spacer collars on the converter housing as shown.



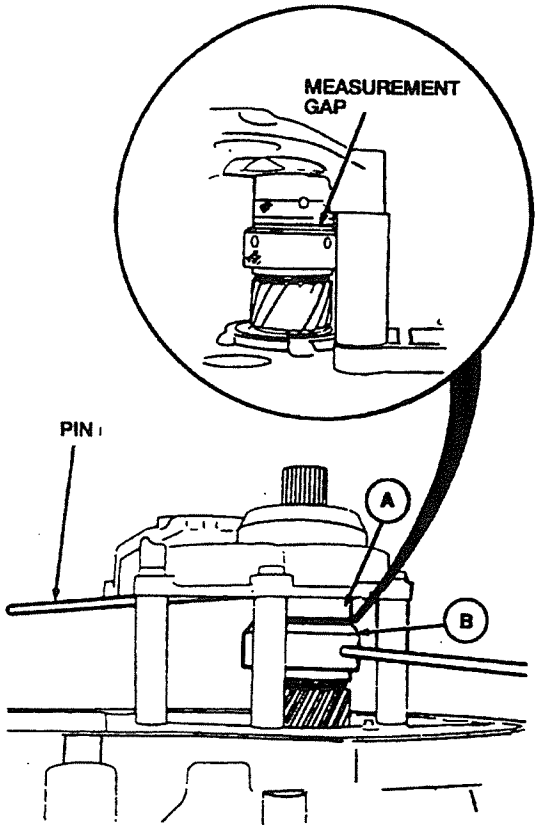
29. Insert the output shaft outer bearing race into the recessed end of the shim selection gauge and place the shim selection over the output shaft. Thread the two halves of the shim selection gauge together so that no clearance exists between the two halves (as shown below).



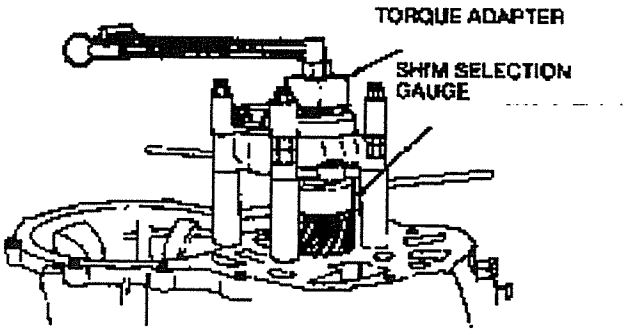
30. Use spacer collars and bolts shim selection gauge to assemble the converter housing to the bearing housing. Tighten to 14-19 lb-ft (19-26 N-m).



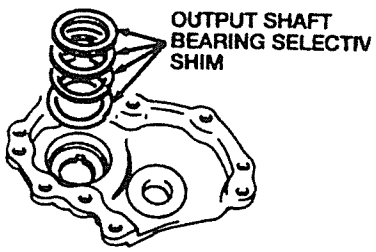
31. Use pins to unthread the shim selection gauge until all of the free play is removed and the output shaft bearings are seated.

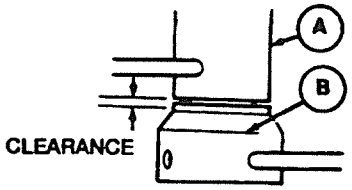


32. Measure the drag on the output shaft bearing using a torque wrench and Torque Adapter placed on the spline of the output shaft. Use the nylon screw in the adapter to hold the adapter to the output shaft splines.



33. Adjust the preload to listed specifications. Measure the gap of the shim selection gauge using a feeler gauge to determine the thickness of the output shaft bearing selective shim needed.





TEST PRELOAD: 4.42 - 7.97 lb-in (0.5 - 0.9 N-m)

ASSEMBLED PRELOAD: 0.26 - 7.96 lb-in (0.03 - 0.9 N-m)

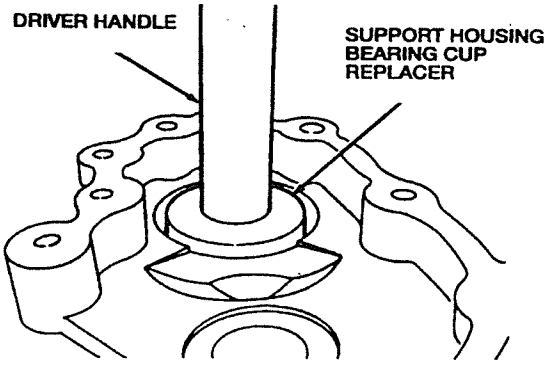
OUTPUT SHAFT BEARING SELECTIVE SHIM CHART

Part Number	Thickness of Shim
-	0.0039 inch (0.10mm)
-	0.0047 inch (0.12mm)
-	0.0055 inch (0.14mm)
-	0.0063 inch (0.16mm)
-	0.0071 inch (0.18mm)
-	0.0197 inch (0.50mm)

Measure the clearance around the entire circumference, and select output shaft bearing selective shims equivalent to the maximum clearance.

The maximum allowable number of output shaft bearing selective shims is seven.

34. Dismantle the shim selection gauge, spacer collars, and bolts and install the selected output shaft bearing selective shim(s) and output shaft bearing race into the bearing housing using Driver Handle and the Support Housing Bearing Cup Replacer.

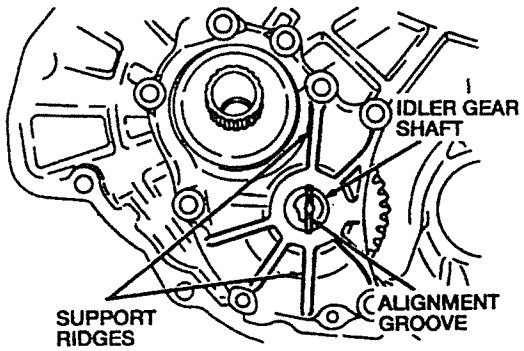


35. Assemble the output gear and the bearing housing to the converter housing. Tighten the bearing housing bolts to 14-19 lb-ft (19-26 N-m). Remeasure the bearing preload and confirm the specifications for assembled preload as shown previously. Repeat the gauging process if the specifications are not within limits.

36. After the proper preload specifications have been obtained, remove the bearing housing.

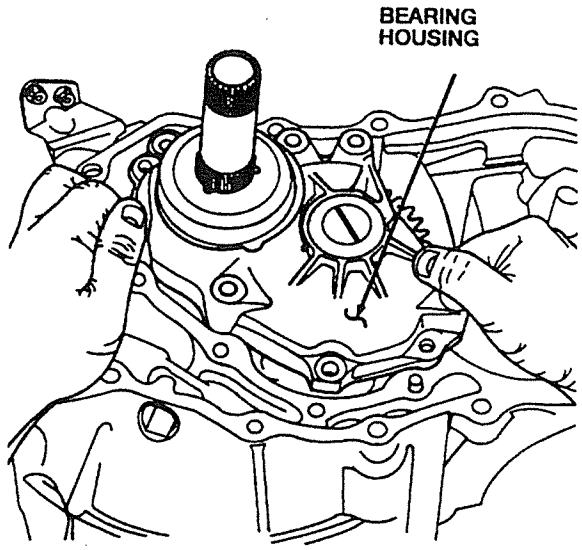
37. Replace the idler gear shaft seal on the idler gear shaft.

38. Install the idler gear and output gear assembly into the bearing housing. Ensure the alignment groove in the idler gear shaft lines up with the support ridges in the bearing housing.



39. Install a new idler gear shaft roll pin.

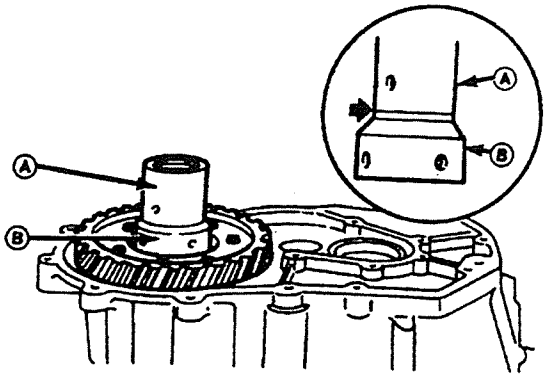
40. Install the bearing housing onto the transaxle case.



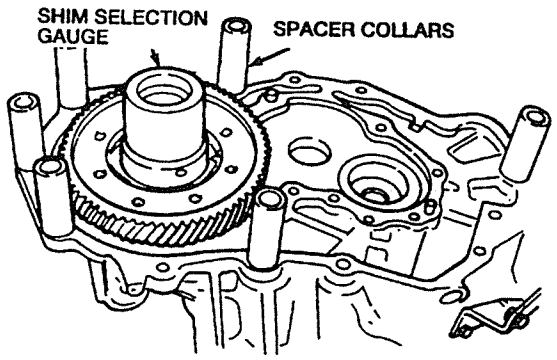
41. Install the eight bearing housing bolts. Tighten the bearing housing bolts to 14-19 lb-ft (19-26 N-m).

42. Install the differential into the converter housing.

43. Position the differential bearing race in the recessed end of shim selection gauge and position the gauge tool on the differential bearing. Thread shim selection together so that no clearance remains at the spot shown by the arrow.



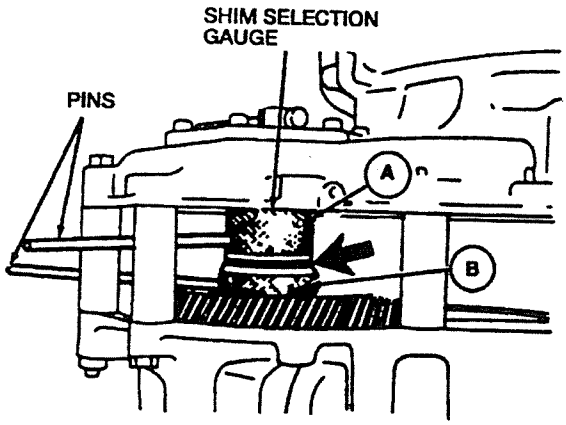
44. Position the spacer collars and assemble the transaxle case to the converter housing using the bolts and washers supplied in Shim Selection Set.



45. Tighten bolts to 22-34 lb-ft (29-46 N-m).

46. Use pins to unthread the shim selection gauge and establish preload on the differential. Measure the preload using a torque wrench and Differential Rotator placed through the axle shaft hole and engaged with the differential pinion shaft. Extend shim selection gauge until the drag reads 4.3 lb-in (0.5 N-m).

47. Measure the clearance at the separation of shim selection gauge. Add 0.0059 inch (0.15mm) to the measured clearance and select shims from the following chart according to the adjusted value. The maximum allowable number of shims is three.



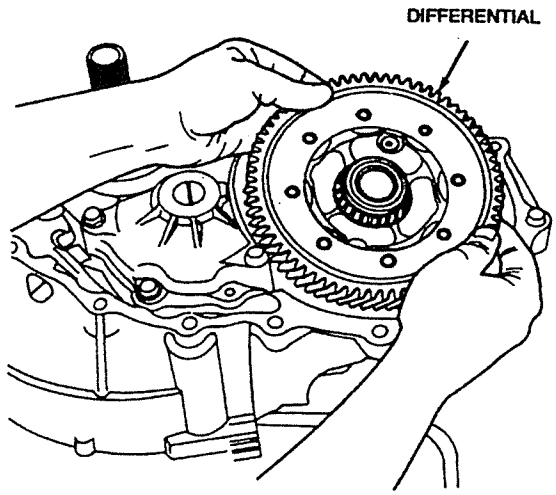
DIFFERENTIAL SHIM SIZE

Part Number	Thickness (inch)	Thickness (mm)
-	0.0039	0.10
-	0.0047	0.12
-	0.0055	0.14
-	0.0059	0.15
-	0.0063	0.16
-	0.0079	0.20
-	0.0098	0.25
-	0.0118	0.30
-	0.0138	0.35
-	0.0157	0.40
-	0.0177	0.45
-	0.0197	0.50
-	0.0217	0.55
-	0.0236	0.60
-	0.0256	0.65
-	0.0276	0.70
-	0.0295	0.75
	0.0315	0.80
-	0.0335	0.85
-	0.0354	0.90

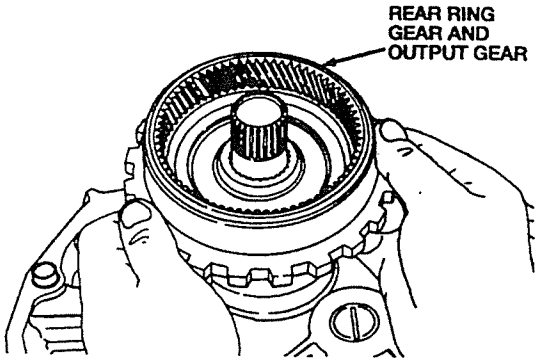
48. Disassemble shim selection gauge. Install the selected shims and the bearing race in the transaxle case and assemble the transaxle case and converter housing.

49. Test the bearing drag with the housing assembled to confirm the proper torque (preload) reading of 18-25 lb-in (2.1 - 2.8 N-m). If incorrect, repeat the gauging process until the correct readings are obtained.

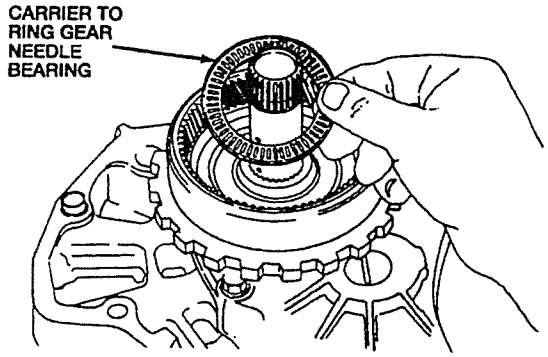
50. Install the differential, meshing the ring gear with the idler gear.



51. Install the rear ring gear and output gear onto the output shaft spline.

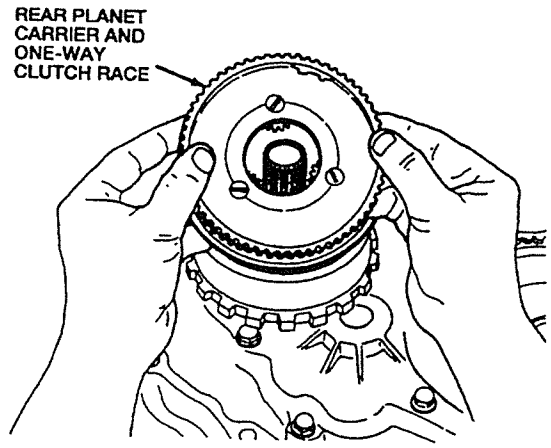


52. Install the carrier to ring gear needle bearing (dimension D) in the recess of the output gear.

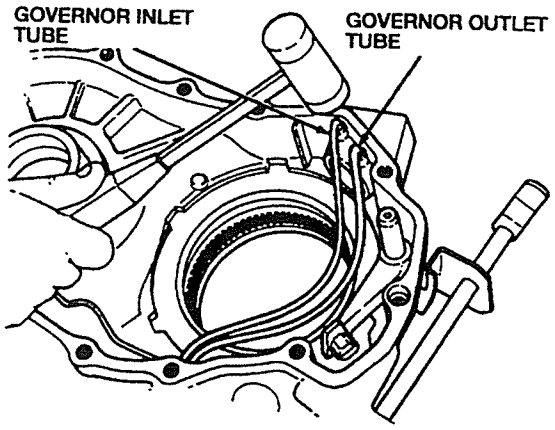


53. Install the rear planet carrier onto the one-way clutch race and secure it in place with the snap ring.

54. Install the rear planet carrier into the rear ring gear.



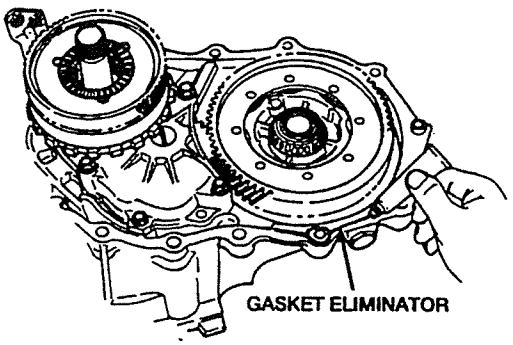
55. Use a plastic or rubber mallet to install the governor outlet tube and governor inlet tube into the transaxle case.



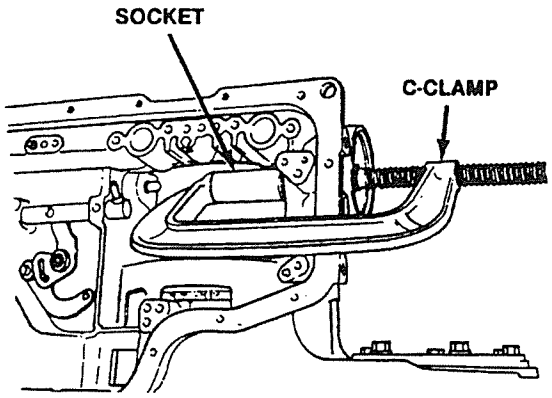
56. Install the governor with a new governor gasket so that the sleeve projection is aligned with the alignment mark on the transaxle case.

57. Install the governor cover and tighten the governor cover bolts to 71-97 lb-in (8-11 N-m).

58. Apply a 1/16 inch (1.5mm) wide, continuous bead of Gasket Eliminator or equivalent onto the converter housing mating surface as shown.



59. Install the servo into the transaxle case. Use a C-clamp and deep socket to compress the servo piston spring. Install the servo snap ring to its groove. Remove the C-clamp and socket.

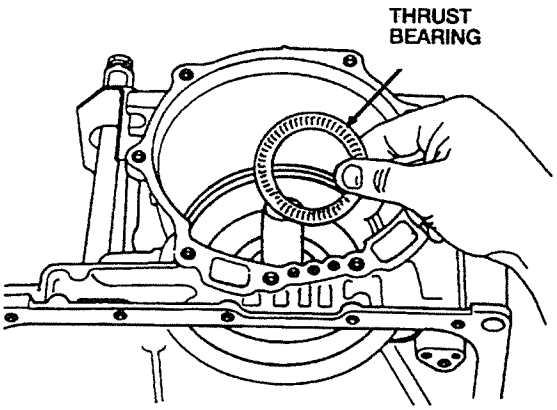


60. Assemble the transaxle case to the converter housing by rotating the one-way clutch race as the transaxle case is lowered onto the converter housing to engage the spline teeth of the one-way clutch race with the friction and steel discs.

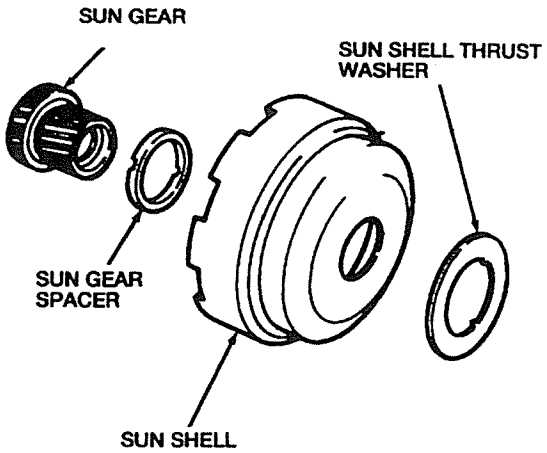
61. Install the 12 transaxle case to converter housing bolts into the transaxle case. Tighten the transaxle case to converter housing bolts to 22-34 lb-ft (29-46 N-m).

62. After the transaxle case and converter housing are bolted together, ensure that all rotating parts rotate without resistance.

63. Install the thrust bearing (dimension D) to the rear planet carrier as shown.

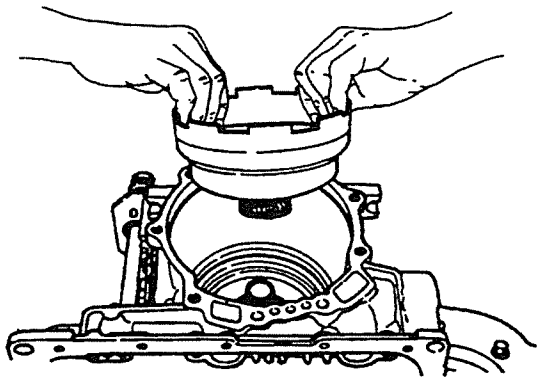


64. Install the sun gear spacer over the small end of the sun gear and insert the sun gear into the sun shell.

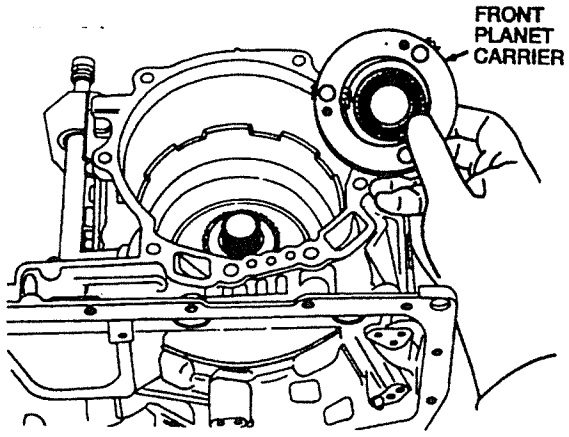


65. Place the sun shell thrust washer over the end of sun gear protruding from the sun shell. Hold the sun shell thrust washer in place with petroleum jelly.

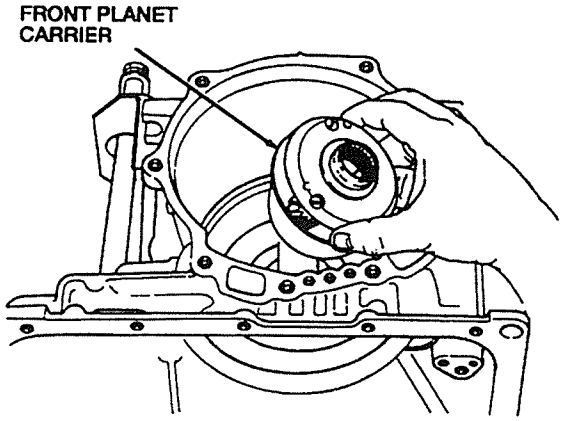
66. Install the sun shell/front sun gear assembly into the rear planet carrier.



67. Place the thrust bearing (dimension D) into the front planet carrier using petroleum jelly. Position the rollers pointing outward.

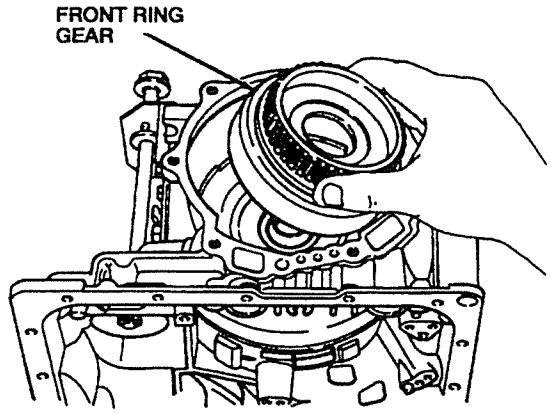


68. Install the front planet carrier into the sun shell.

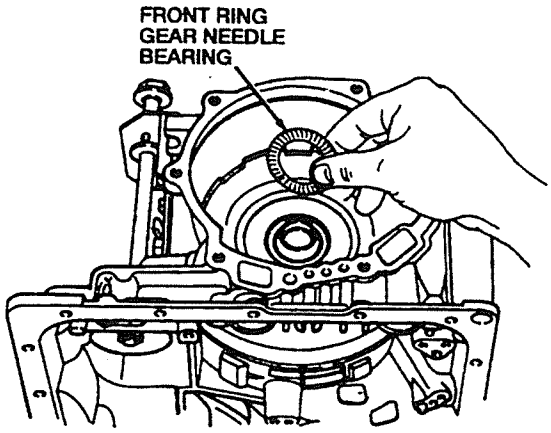


69. Install the thrust washer (dimension D) and matching thrust bearing to the end of the front planet carrier. Install the seal sleeve to the center of the front planet carrier.

70. Install the front ring gear over the front planet carrier.



71. Install the front ring gear needle bearing with the rollers up, in the front ring gear.

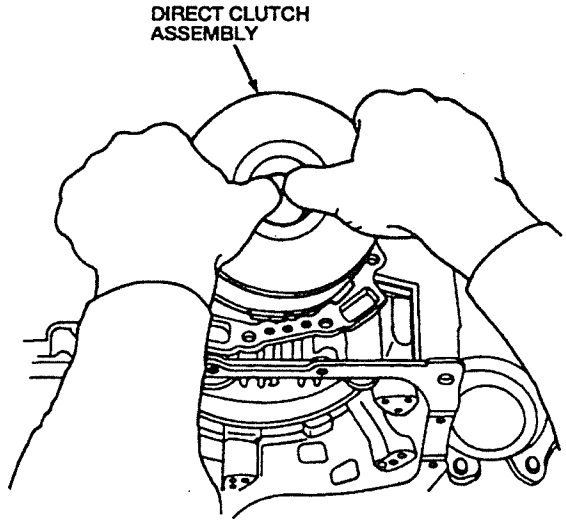


72. Coat the matching thrust washer with petroleum jelly. Match the tangs on the thrust washer with the mating holes in the rear clutch assembly and install the thrust washer.

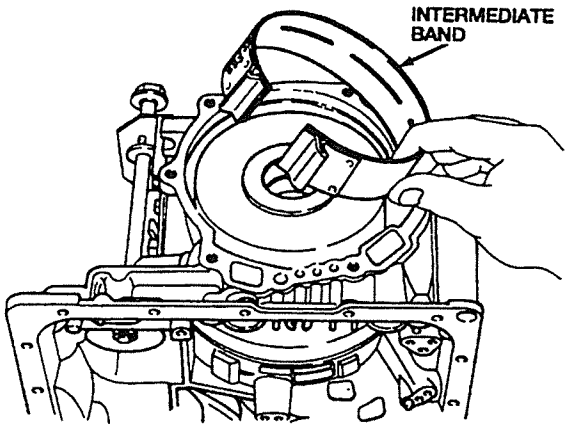
73. Install the forward clutch assembly to the front ring gear. Gentle rotation of the forward clutch with side to side movement will align the clutch discs.

74. Install the needle bearing in the forward clutch drum with the rollers up. The companion thrust washer will be fitted to the end of the oil pump extension later.

75. Place the direct clutch assembly over the splines of the forward clutch drum. Gentle rotation of the direct clutch assembly with side to side movement will make alignment of the clutch discs easier.



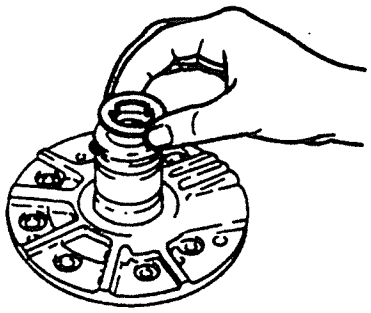
76. Install the intermediate band, intermediate band strut, and band adjusting stop. Apply Gasket Eliminator or equivalent to the threads of the band adjusting stop. Tighten the band adjusting stop to hold the components in place, but do not perform an adjustment until the oil pump has been installed.



77. Each time the transaxle is disassembled, measure the total end play as follows:

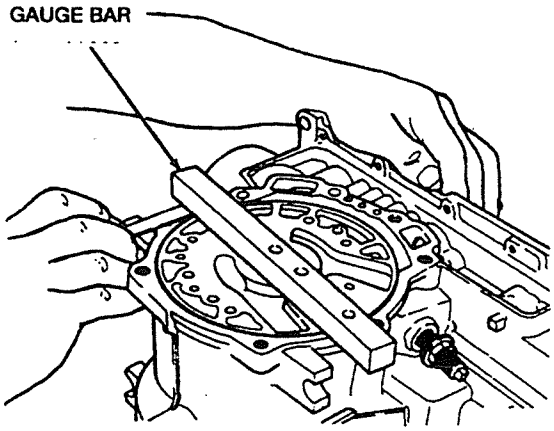
    a. Remove the bolts that attach the pump cover to the pump housing. Remove the pump cover. Place the pump housing (with gears installed) aside for assembly later.

    b. Coat the pump cover thrust washer (dimension A) with petroleum jelly. Engage the tangs of the washer with their mating holes in the end of the pump cover.



    c. Install the pump cover into the direct clutch housing (without the plastic adjusting washer).

    d. Position Gauge or a 9 inches (225mm) machinist straightedge over the pump cover in the transaxle case, being careful not to place the straightedge on the bolt holes in the transaxle case.



    e. Use a feeler gauge to measure the clearance at either of two locations:

        (1) Between the straightedge and the pump cover if the pump cover is lower than the transaxle case.

        (2) Between the gauge bar ends and the transaxle case if the pump cover is higher than the transaxle case. Allow the gauge bar to rest on the cover without pressure while taking this measurement to prevent incorrect readings.

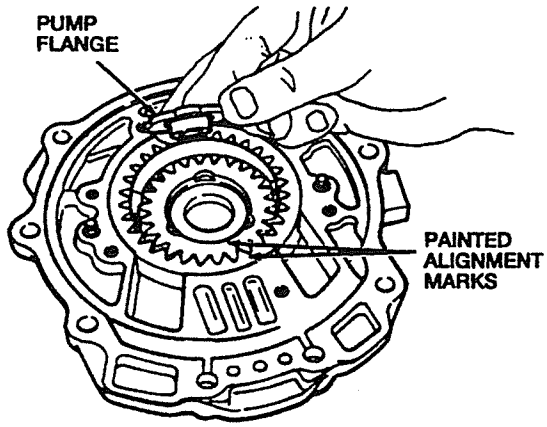
    f. The measurements obtained should not be greater than 0.004 inch (0.10mm) with the pump cover below the transaxle case surface, or 0.006 inch (0.15mm) with the pump cover above the transaxle case surface.

    g. If these limits are exceeded, it is necessary to replace the oil pump cover thrust washer with one of suitable thickness from the chart.

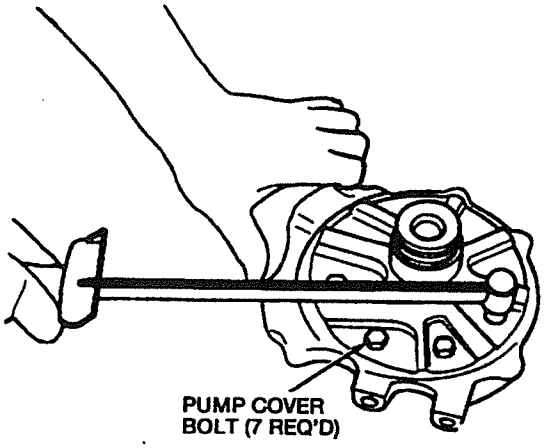
OIL PUMP COVER THRUST WASHER SIZE

Part Number	Bearing Race Thickness
-	0.047 inch (1.2mm)
-	0.055 inch (1.4mm)
-	0.063 inch (1.6mm)
-	0.071 inch (1.8mm)
-	0.079 inch (2.0mm)
-	0.087 inch (2.2mm)

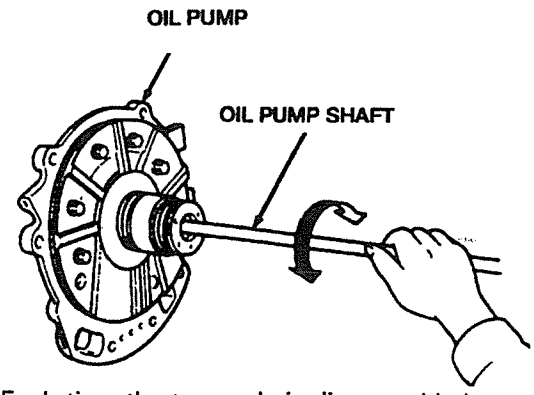
h. Reassemble the oil pump, taking care to assemble the pump flange correctly.



i. Install the pump cover bolts. Tighten the pump cover bolts to 95-122 lb-in (11-14 N-m).



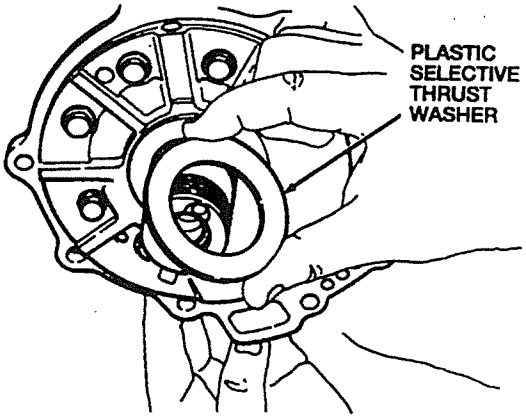
j. Lubricate the oil pump assembly with the specified transmission fluid. Test for free operation by using the oil pump shaft to turn the pump by hand. The pump internal gears should move freely without binding.



78. Each time the transaxle is disassembled measure and adjust the direct clutch end play as follows:

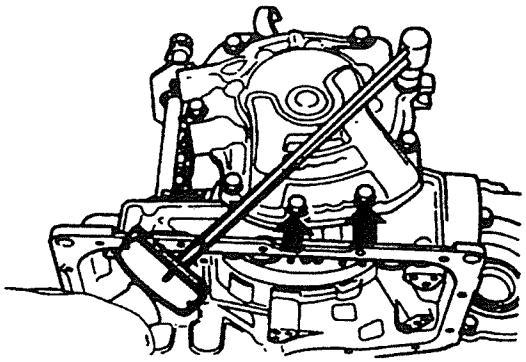
a. Use petroleum jelly to install the oil pump gasket to the oil pump.

b. Install the plastic selective thrust washer to the pump cover. Use petroleum jelly to keep it in place.



c. Install the thrust washer onto the end of the pump cover. Use petroleum jelly to keep it in place.

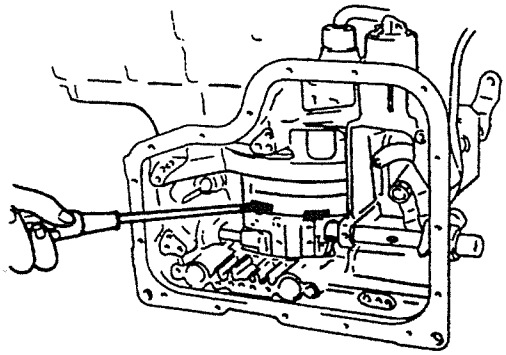
d. Install the oil pump to the transaxle. Tighten the oil pump to transaxle bolts to 11-16 lb-ft (15-22 N-m). Apply sealant to the seat face of the two bolts indicated by the arrows in the illustration.



e. Reposition the transaxle with the oil pump facing down.

f. NOTE: Sun shell slots alternate between deep and shallow. Pry at the deep slots, and measure, at the shallow slots.

While turning the sun shell through two complete revolutions, use a screwdriver to push the direct clutch drum toward the oil pump. Insert the screwdriver between the tabs of the direct clutch drum and the sun shell. Measure the clearance between the tabs of the direct clutch drum and the sun shell as shown.



g. If the end play is not within specifications 0.020-0.031 inch (0.5-0.8mm) replace the plastic selective thrust washer on the pump cover with the appropriate washer from the chart.

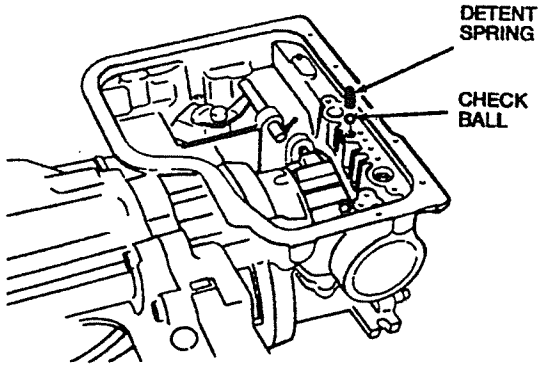
PLASTIC SELECTIVE THRUST WASHER CHART

Part Number	Thickness Of Shim
-	0.075 inch (1.9mm)
-	0.083 inch (2.1mm)
-	0.091 inch (2.3mm)
-	0.098 inch (2.5mm)
-	0.106 inch (2.7mm)
-	0.059 inch (1.5mm)
-	0.067 inch (1.7mm)
-	0.051 inch (1.3mm)

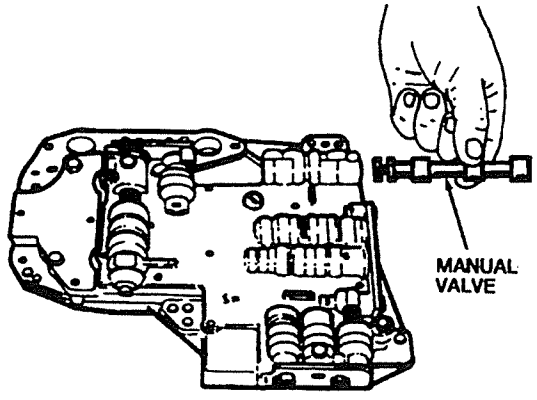
h. Reassemble the oil pump as previously outlined.

I Install the oil pump to the transaxle case. Apply Gasket Eliminator or equivalent to the threads of the oil pump to transaxle bolts. Install the oil pump to transaxle bolts and tighten to 11-16 lb-ft (15-22 N-m).

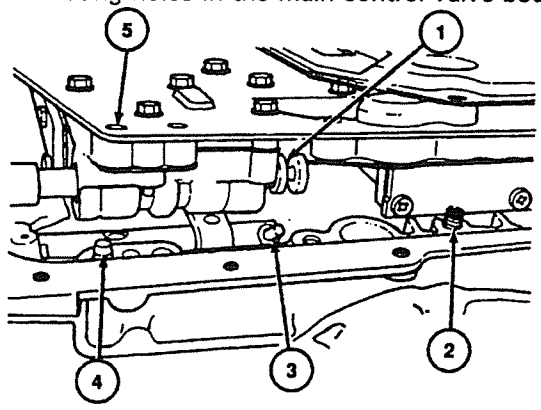
79. Install the check ball and detent spring into the transaxle case.



80. If necessary, install the manual valve into the main control valve body.



81. Align the manual valve land with the pin on the manual control lever shaft. Mate the dowels in the transaxle case with their mating holes in the main control valve body.

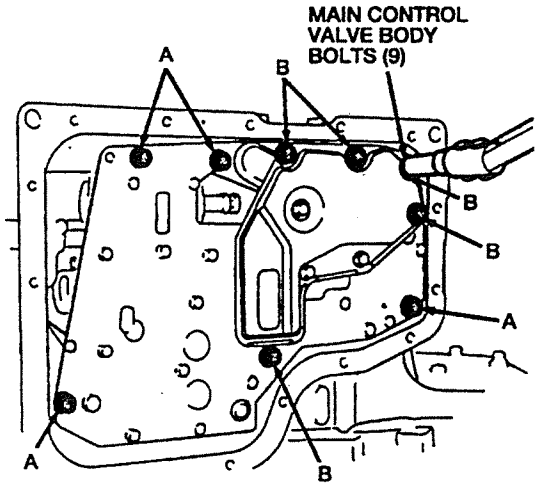


Item	Part Number	Description
1	-	Manual Valve
2	-	Check Ball and Detent Spring Installed
3	-	Shift Rod Driving Pin
4	-	Main Control Valve Body Locating Dowel
5	-	Locating Dowel Hole

82. **CAUTION: Do not overtighten the main control valve body mounting bolts.**

NOTE: Refer to the note made during disassembly for bolt locations.

Install the main control valve body bolts. Tighten the main control valve body bolts to 71-97 lb-in (8-11N-m).



A = 30mm (1.18 INCH) BOLT
B = 40mm (1.57 INCH) BOLT

83. Install the throttle control valve rod into the transaxle case.

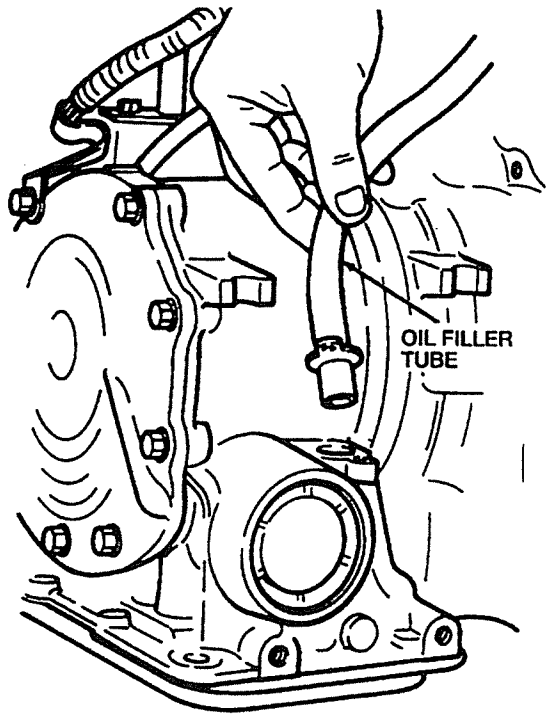
84. Lubricate a new throttle valve diaphragm gasket with the specified transmission fluid and install it on the vacuum throttle valve diaphragm. Install the vacuum throttle valve diaphragm into the transaxle case and tighten using pliers on the crimped portion of the vacuum throttle valve diaphragm.

85. Lube a new throttle valve diaphragm gasket with the specified transmission fluid and install the throttle valve diaphragm gasket to the kickdown solenoid.

86. Coat the threads of the kickdown solenoid with Sealer or equivalent and screw the kickdown solenoid into the transaxle case.

87. Install a new O-ring to the speedometer cable sleeve and install it to the transaxle case. Install the speedometer cable sleeve bolt. Tighten the speedometer cable sleeve bolt to 71-97 lb-in (8-11N-m).

88. Install a new O-ring onto the oil filler tube. Lubricate the end of the oil filler tube and O-ring with the specified transmission fluid and install the oil filler tube into the transaxle case. Tighten the oil filler tube bolt to 61-87 lb-in (7-10 N-m).

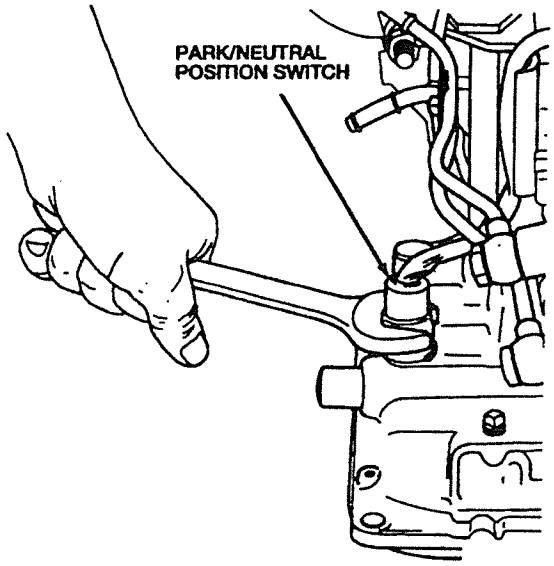


89. Install a new oil pan to case gasket)to the transmission oil pan. Do not use any type of sealer or adhesive on the oil pan to case gasket. If necessary, soak the oil pan to case gasket in the specified transmission fluid.

90. Position the transmission oil pan and oil pan to case gasket onto the transaxle case. Install the 16 transmission oil pan bolts. Tighten the transmission oil pan bolts to 43-69 lb-in (5-8 N-m).

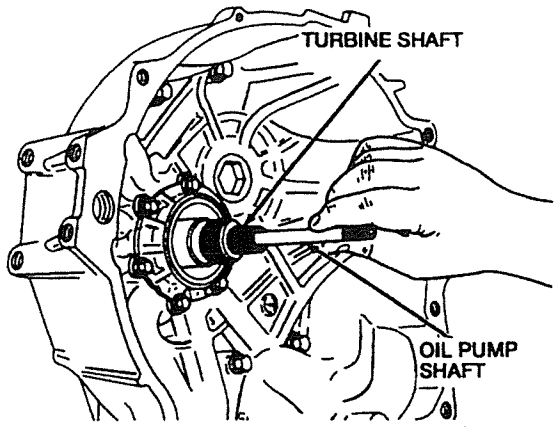
91. Apply Gasket Eliminator or equivalent to the threads of the Park/Neutral Position Switch (PNP switch).

92. Install the PNP switch onto the transaxle case. Tighten the PNP switch to 14-19 lb-ft (19-26 N-m).



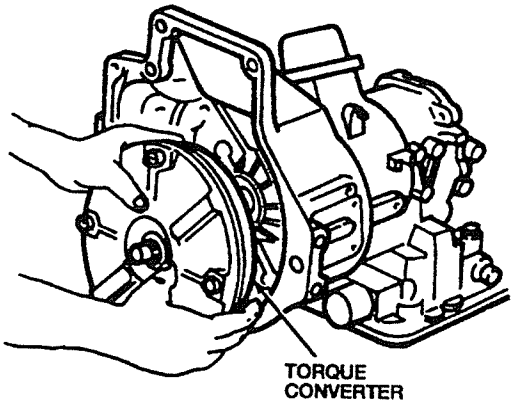
93. NOTE: Install a new clip on the turbine shaft.

    Install the turbine shaft and oil pump shaft.



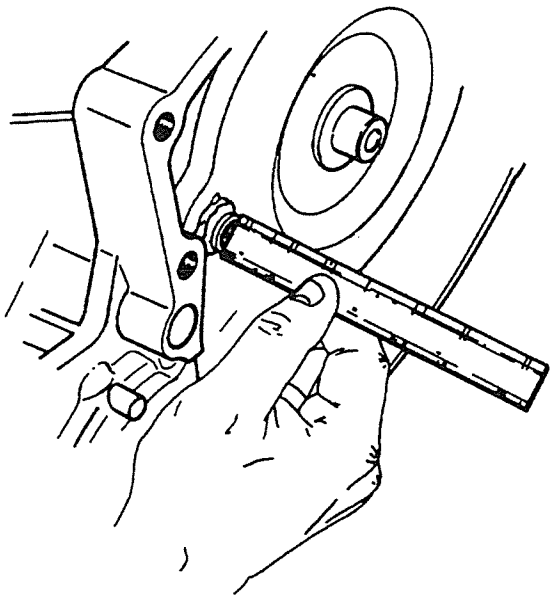
94. Lubricate the inside of the torque converter with no more than 0.5 quart (0.5L) of the specified transmission fluid.

95. Install the torque converter to the transaxle.



96. **CAUTION: Do not force the torque converter into place. If necessary, realign the splines.**

    The torque converter is correctly positioned when the torque converter is recessed 0.80 inch (20.5mm) from the converter housing as shown.



INSTALLATION

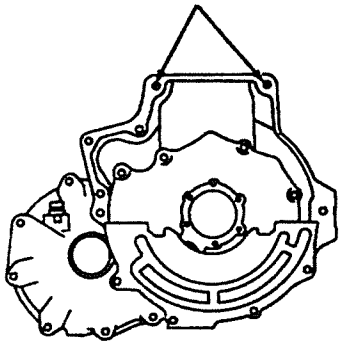
Transaxle

SPECIAL SERVICE TOOL(S) REQUIRED

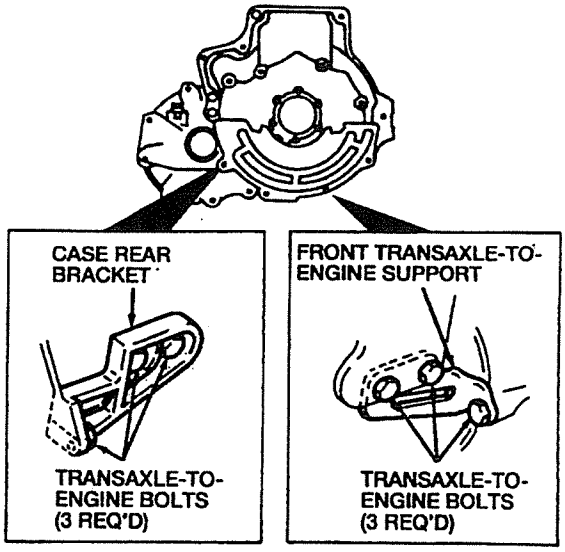
- Differential Plugs

1. Secure the transaxle to a Hi-Lift Jack.
2. Position the transaxle in the vehicle.
3. Install the two engine-to-transaxle bolts. Tighten the engine-to-transaxle bolts to 47-66 lb-ft (64-89 N-m).

ENGINE-TO-TRANSAXLE BOLTS LOCATION



4. Remove the Hi-Lift Jack.
5. Install the starter motor. Refer to Section 16 for the installation procedure.
6. Install the four torque converter-to-flywheel nuts Tighten the torque converter-to-flywheel nuts to 26-36 lb-ft (34-49 N-m).
7. Install the transmission housing cover (7986) and tighten the transmission housing cover bolts to 71-97 lb-in (8-11N-m).
8. Install the front transaxle-to-engine support and the three transaxle-to-engine bolts. Tighten the transaxle-to-engine bolts to 27-38 lb-ft (37-52 N-m).



9. Install the intake manifold support. Tighten the intake manifold support bolts to 27-38 lb-ft (37-52 N-m).
10. Install the case rear bracket and the three transaxle-to-engine bolts. Tighten the transaxle-to-engine bolts to 27-38 lb-ft (37-52 N-m).
11. Install the front transaxle support insulator bracket and four front transaxle support insulator bracket bolts. Tighten the four front transaxle support insulator bracket bolts to 28-37 lb-ft (38-51N-m).
12. NOTE: Do not tighten the front transaxle support insulator through bolt and nut until the rear engine support is installed.

    Install the front transaxle support insulator and the front transaxle support insulator through bolt and nut.
13. Position the rear engine support and install the rear engine support rebound insulator

bolts. Tighten the rear engine support rebound insulator bolts to 47-66 lb-ft (64-89 N-m).

14. Tighten the front transaxle support bracket through bolt and nut to 69-83 lb-ft (93-113 N-m).

15. Install the two front transaxle support insulator nuts. Tighten the front transaxle support insulator nuts to 32-38 lb-ft (43-52 N-m).

16. Install the two rear transaxle support insulator nuts. Tighten the rear transaxle support insulator nuts to 21-34 lb-ft (28-46 N-m).

17. Remove Differential Plugs and install the rear wheel driveshaft and joints. Refer to Section 7 for the installation procedure.

18. Align the marks on the oil cooler tubes and oil cooler hoses, then slide the hoses over the lines. Install the hose clamps.

19. Attach the tie rod end to the rear wheel knuckle. Tighten the tie rod end nut to 26-30 lb-ft (35-40 N-m). Install a new tie rod end cotter pin.

20. Attach the rear suspension lower arm ball joint to the rear wheel knuckle. Tighten the clamp bolt to 40-50 lb-ft (54-68 N-m).

21. Install the access panels. Tighten the access panel bolts to 65-95 lb-in (8-10 N-m).

22. Install the rear wheel and tire assemblies. Tighten the wheel hub bolts to 65-87 lb-ft (88-118 N-m).

23. Lower the vehicle.

24. Remove Three Bar Engine Support or equivalent.

25. Attach the shift cable and bracket to the transaxle.

26. **CAUTION: Do not use any type of power wrench to tighten the nut. Damage to the transaxle may result.**

    Install the manual control lever arm on the manual control lever and tighten the manual control lever nut to 33-47 lb-ft (44-64 N-m).

27. Install coolant pipe retaining bracket located below the distributor.

28. Connect the transaxle vacuum hose.

29. Connect the transaxle electrical connectors.

30. Connect the ground strap to the transaxle. Tighten the ground strap bolt to 65-95 lb-in (8-10 N-m).

31. Connect the speedometer cable to the transaxle.

32. Connect the battery ground cable.

33. Add the specified transmission fluid to the transaxle. Refer to the procedure in this section.

34. **CAUTION: Ensure the gearshift lever position aligns with the manual control lever position exactly before starting vehicle.**

    Start the engine. Check for leaks and proper fluid level.

CLEANING AND INSPECTION

Transaxle

CAUTION: The composition clutch plates, valve body gaskets, bands, and synthetic seals should not be cleaned in a vapor degreaser, or with any type of detergent solution. To clean these parts wipe them off with a lint-free cloth. New clutch plates or bands should be soaked in the specified Automatic Transmission Fluid (ATF) for two hours before being assembled.

Clean the components with a suitable solvent and use compressed air to dry all parts and clean fluid passages.

Main Control Valve Body

Check for the following and replace any worn or damaged parts:

1. Check the main control valve body bores and valves for varnish or minor scoring. If the varnish buildup or scoring is excessive, replace the main control valve body. Use a carburetor cleaner or solvent to remove varnish or other residue.

VALVE SPRING DIMENSIONS

Name	Outer Dia. inch (mm)	Free Length inch (mm)	No. of Coils	Wire Dia. inch (mm)
Throttle Backup	0.287 (7.3)	1.42 (36.0)	16.0	0.031 (0.8)
Downshift	0.217 (5.5)	0.862 (21.9)	14.0	0.022 (0.55)
2-3 Shift	0.272 (6.9)	1.61 (41.0)	20.0	0.028 (0.7)
1-2 Shift	0.258 (6.55)	1.26 (32.0)	18.0	0.022 (0.55)
Second Lock	0.219 (6.55)	1.32 (33.5)	18.0	0.55 (0.022)
Pressure Regulator	0.461 (11.7)	1.69 (43.0)	15.0	0.047 (1.2)
Throttle Relief	0.276 (7.0)	0.44 (11.2)	6.0	0.035 (0.9)
Orifice Check	0.197 (5.0)	0.61 (15.5)	12.0	0.009 (0.23)

2. Check for broken or distorted valve springs. Check free length.

3. Clean all parts in solvent and dry with compressed air.

4. Insert each valve separately into its bore. Do not lubricate the valve or valve body at this time. Check the free movement of each valve in its bore by tipping the main control valve body. Each valve should slide freely when the main control valve body is shaken lightly.

5. **CAUTION: Do not round the corners of the valves while removing burrs.**

   Check for burrs on the valves. Remove burrs, by rotating or sliding the valve on #600 wet or dry finishing paper, wet with the specified transmission fluid on a flat plate.

6. Clean the oil screen.

Clutches

Direct Clutch

Check for the following and replace any faulty parts:

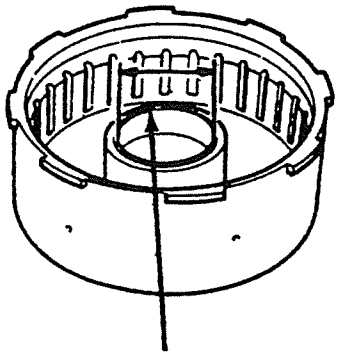
1. Worn, scored, or heat damaged clutch plates. If one clutch plate is to be replaced, replace all the clutch plates.

2. Broken or worn snap rings.

3. Deformed clutch piston spring retainer.

4. Weakened or damaged direct clutch piston spring. Free length of the direct clutch piston spring should measure 1.031inches (26.2mm). If one or more springs is not in specification, replace all of the springs.

5. Damaged, worn, or scored direct clutch drum bushing. Measure the front clutch drum bushing identification. It should not exceed 1.735 inches (44.075mm). Replace the direct clutch drum if the measurement is not in specification.



BUSHING MAXIMUM ALLOWABLE INSIDE DIAMETER 44.075 mm (1.735")

Forward Clutch

Check for the following and replace any worn or damaged parts:

1. Worn, scored, or heat damaged clutch plates. If worn, replace all clutch plates.

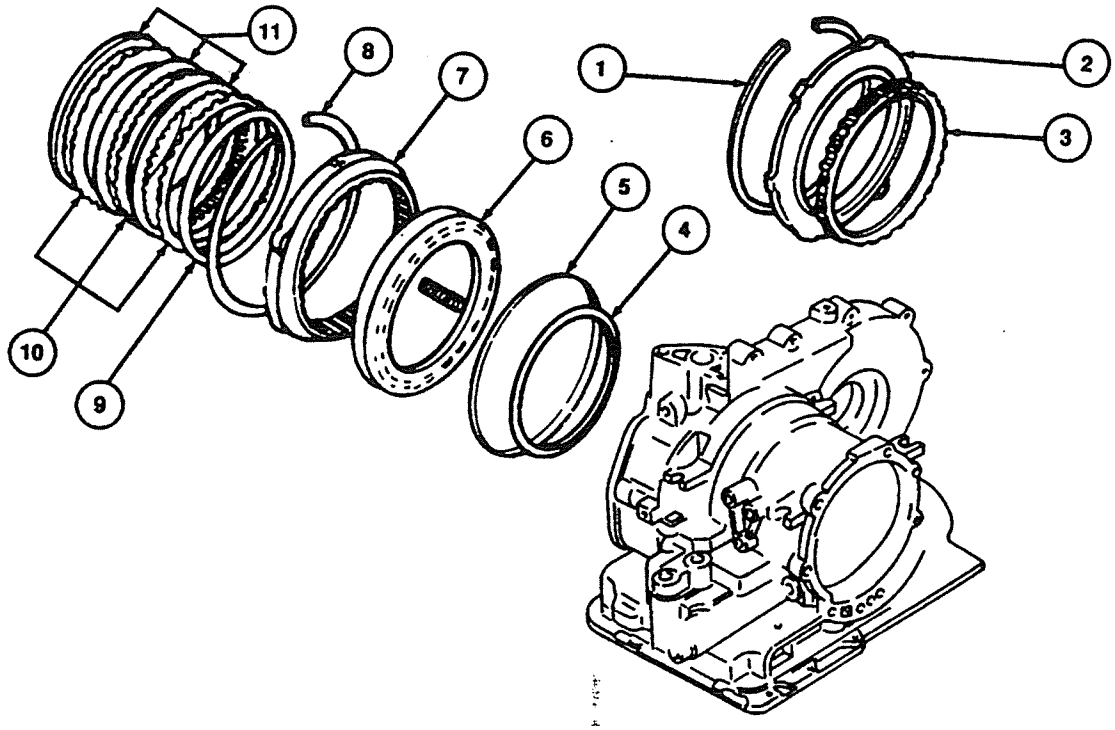
2. Broken or worn snap rings.

3. Deformed clutch piston spring retainer.

4. Weakened or damaged direct clutch piston springs. Free length of the forward clutch piston spring should measure 1.031 inches (26.2mm). If one or more forward clutch piston springs are out of specification, replace all of the springs.

Low/Reverse Clutch

Low/Reverse Clutch - Exploded View



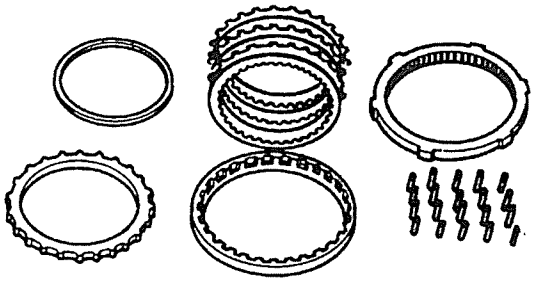
Item	Part Number	Description
1	-	Low/Reverse Snap Ring
2	-	One-Way Clutch
3	-	One-Way Clutch Retainer Plate
4	-	Reverse Clutch Piston Small Seal
5	-	Reverse Clutch Piston Large Seal
6	-	Low/Reverse Clutch Piston

(Continued)

Item	Part Number	Description
7		Low and Reverse Clutch Hub
8		Low/Reverse Pressure Plate Retainer Snap Ring
9		Low/Reverse Clutch Dished Plate
10		Low/Reverse Clutch External Spline Clutch Plate
11		Low/Reverse Clutch Internal Spline Clutch Plate

Check for the following and replace any worn or damaged parts:

1. Worn, scored, or heat damaged clutch plates. If one clutch plate is to be replaced, replace all of the clutch plates.
2. Broken or worn snap ring.
3. Deformed clutch piston spring retainer.
4. Weakened or damaged clutch piston return springs. Free length of the return springs should measure 1.091 inches (27.7mm). If one or more clutch piston return springs are out of specification, replace all of the clutch piston return springs.



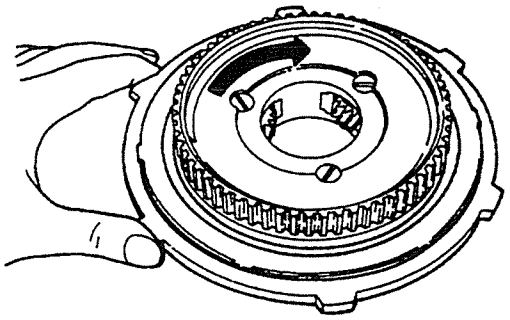
Low One-Way Clutch

Check for the following and replace any worn or damaged parts:

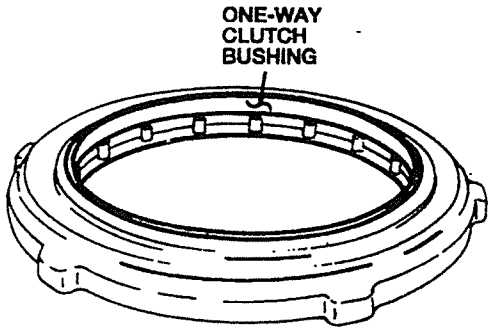
1. One-way clutch operation.

a. Install the one-way clutch to the one-way clutch race.

b. Make sure that when the one-way clutch is held and the one-way clutch race is turned, the clutch turns smoothly in one direction only.



2. Worn one-way clutch bushing. The bushing wear limit is 5.121 inches (130.063mm).



Drum Hub

Check for the following and replace any worn or damaged parts:

1. Broken or worn snap ring or park gear spring.

2. Broken or worn gears or direct clutch piston spring.

Forward Clutch Hub

Check for the following and replace any worn or damaged parts:

1. Broken or worn snap ring.

2. Damaged or worn ring gear or rear clutch hub.

Oil Pump

Check for the following and replace any faulty parts:

1. Damaged or worn inner or outer gear tooth surfaces.

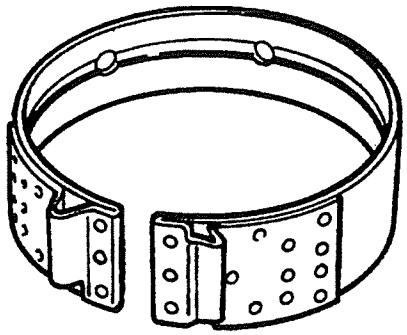
2. Seal rings.

3. Damaged or worn inner gear bushing of the pump housing sleeve.

Replace all seals, rings, and housing gasket.

Intermediate Band

Check and replace the intermediate band if damaged or worn.



Intermediate Servo Assembly

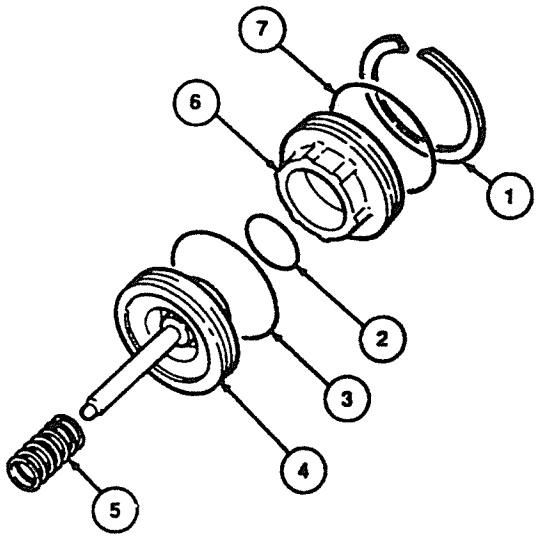
Check for the following and replace any damaged or worn parts:

1. Broken or damaged servo snap ring.

2. Damaged or worn servo band piston.

3. Weakened servo piston spring. The free length of the servo piston spring should measure 1.89 inches (48.0mm).

4. Discard old seal rings and coat new seal rings in the specified transmission fluid before installing.



Item	Part Number	Description
1	-	Servo Snap Ring
2	-	Servo Piston Small Seal
3	-	Servo Piston Large Seal
4	-	Servo Piston
5	-	Servo Piston Spring
6	-	Servo Retainer
7	-	Servo Retainer Seal

Governor

1. Check the governor driven gear for damage or wear.

2. Check for governor oil screen damage or obstruction.

3. Check the governor valve for damage.

Sun Gear and Sun Shell

1. Wash the sun gear and sun shell in mineral spirits and allow to dry.

2. Inspect bushings inside sun gear bore for wear, grooves, and fit.

3. Inspect the sun gear teeth for nicks, chips, or missing teeth.

4. Inspect the sun gear shell splines at the point they connect to the front sun gear. Look for partially worn down teeth on the splines.

5. Inspect the sun gear shell where it lugs into the front clutch drum for nicks or cracks.

Case

1. After component removal, clean the case with cleaning solvent, or use a high pressure steam cleaner to remove any internal or external grease, oil, or dirt.

2. Inspect all press fit bearing races for pitting, scoring or other types of damage. If any races must be replaced the mating bearing must be replaced as well.

3. Check the threads of any threaded bolt holes. All damaged threads must be repaired prior to reassembly of the transaxle.

4. Inspect all snap ring grooves looking for any damage to the slot into which the snap ring seats.

5. Check the case where the low one-way clutch notches into it. Look for broken notches or other types of damage.

6. Check case half mating surfaces for nicks or deformation. Look for cracks in the housings, and broken or cracked ears on the converter housing where it bolts to the engine.

Planet Assemblies

Check for the following and replace any faulty parts:

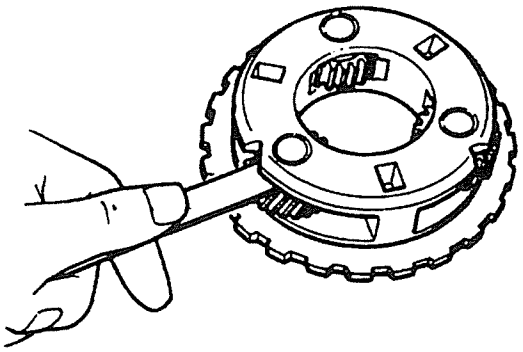
1. Broken or worn snap ring.

2. Binding, loose, or rough rotation of the pinion gears.

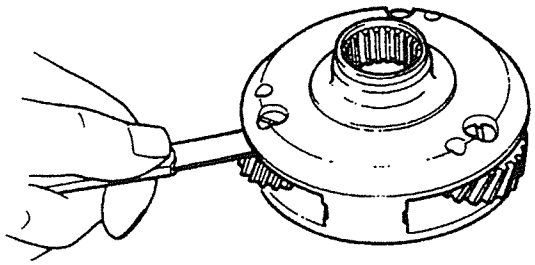
3. Damaged or worn rear planet carrier.

4. Measure the clearance between the pinion washer and the rear planet carrier by using a feeler gauge. If the clearance exceeds 0.032 inch (0.8mm), replace the rear planet carrier.

5. Binding, loose, or rough rotation of the pinion gears.



6. Measure the clearance between the pinion washer and the front planet carrier by using a feeler gauge. If the clearance exceeds 0.032 inch (0.8mm), replace the front planet carrier.



Thrust Bearings/Washers

Clean and dry thrust bearings and washers in mineral spirits. Check for damage to thrust faces, such as grooves, pitting, or scoring. If the thrust washer is selective, measure for correct size. Oil thrust bearings and rotate with slight pressure. If any roughness is detected, replace bearing.

Input Idler Gear and Final Drive Gears

1. Clean both gears with cleaning solvent and allow to dry.

2. Inspect gears for nicks, chips, or missing teeth. Any damage to one gear requires the replacement of both.

3. Inspect the idler gear bore for deformation, chipping, pitting, or overheating.

4. Check the ring gear for warpage or damaged bolt holes.

5. Look for damage to the surface of the gear teeth which may have been caused by lack of lubrication.

Differential

Case

1. Clean the gear case, differential pinion gears, differential pinion shaft, and differential side gears in cleaning solvent. Allow to dry.

2. Inspect the gear case for damage at the thrust areas where the gears ride. Look for grooves, pitting, or scoring.

3. Check the gear case for damage at the differential pinion shaft bore. Ensure that it has not become oblong. Check to see that the differential pinion shaft fits snugly in the bore without any lateral movement.

4. Check the differential pinion shaft for grooves and ensure that the roll pin bore has not become deformed.

Gears

1. Inspect the ring gear retaining bolt holes in the gear case. Ensure that no threads are damaged or stripped.

2. Check the gear teeth of the differential pinion gears and differential side gears. Look for chipped, nicked, or broken teeth. Ensure that there is no scoring on the teeth surfaces caused by lack of lubrication. Inspect the thrust washers on the rear of the gears for grooving, scoring, or pitting. Check the inner splines of the differential side gears where they spline to the front wheel driveshaft and joints for stripping or worn spline teeth.

3. Inspect the speedometer drive gear for chips, nicks, or concave wear at the gear's center.

Ball Bearings

1. Clean the bearing with cleaning solvent. Allow to dry.

2. Inspect the roller surface for pitting, brinelling, heat scoring, or uneven wear towards the outer ends.

3. Check the bearing cage for bends or distortion. Check the security of the roller in

3. Check the bearing cage for bends or distortion. Check the security of the roller in the cage and look for excessive play between the rollers and the cage.

4. Inspect the bearing races for pitting, scoring, or heat cracks and ensure they are secure in their bore.

5. Damaged bearings and races must be replaced as a matched set.

Speedometer Driven Gear

Inspect the speedometer driven gear for chips, nicks, or missing teeth. Ensure its housing has no burrs or cracks. If the speedometer driven gear is damaged, it is likely the speedometer drive gear on the differential case is also damaged and needs replacement.

Transmission Oil Filter

Inspect filter screens for tears or collapsed sections. If none are found, clean the filter screen in a cleaning solvent removing any trapped particles. Blow dry the filter screen with compressed air. If any damage is evident, replace the filter screen.

Torque Converter

The torque converter is welded together and cannot be disassembled.

1. Check the torque converter for damage or cracks and replace, if necessary.

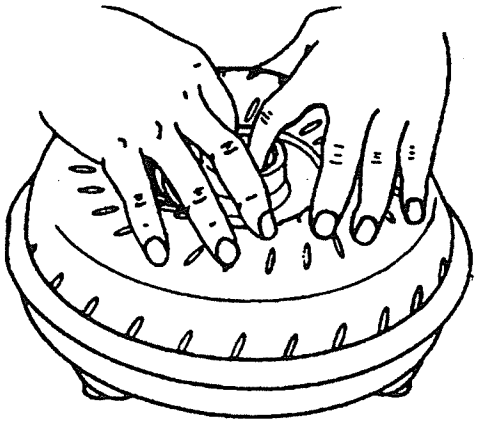
2. Inspect for damage, breakage, or rough areas on the inside bushing. Make sure the bushing size is within specification. If the bushing is not within specification, replace the torque converter.

3. Remove any rust from the pilot hub and boss of the torque converter.

4. Measure the inner diameter of the boss bushing. If it exceeds 2.0896 inches (53.075mm), replace the torque converter.

   When internal wear or damage has occurred in the transaxle, contaminants such as metal particles, clutch plate material, or band material may have been carried into the torque converter and oil cooler. These contaminants can be a major cause of recurring transaxle troubles and must be removed from the system before the transaxle is put back into service.

5. Inspect the one-way clutch end play by moving it with your fingers. If the end play is greater than 0.04 inch (1mm) or if a noise is heard or roughness is felt when the turbine shaft is turned, replace the torque converter.



6. Whenever the transaxle has been disassembled to replace worn or damaged parts or because the valve body sticks due to foreign material, the torque converter, oil and oil cooler hoses must be cleaned and flushed using the a Torque Converter/Oil Cooler Cleaner or equivalent. Under no circumstances should an attempt be made to clean torque converters by hand.

7. The lack of a drain plug in the torque converter increases the amount of residual flushing solvent retained in the converter after cleaning. This retained solvent is not acceptable, and diluting is required. The following procedure is to be used after removal of the torque converter from the cleaning equipment.

   a. **Thoroughly drain** the remaining solvent through the hub.

   b. Add 0.53 US quarts (0.5L) of clean transmission fluid into the converter. Agitate by hand.

   c. **Thoroughly drain** the solution through the converter hub.

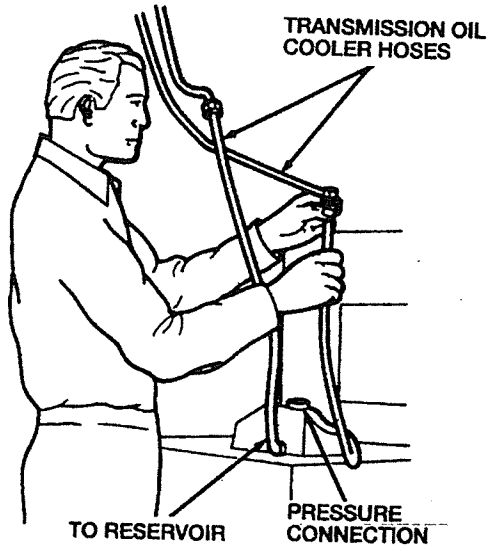
Transmission Oil Cooler (if equipped)

1. Conduct back-flushing with a Torque Converter/Oil Cooler Cleaner or equivalent. Test your equipment to make sure that a vigorous fluid flow is present before proceeding. Replace the system filter if flow is weak or contaminated.

2. To aid in attaching the cleaner to the transmission cooler hoses, connect two additional rubber hoses to the transmission cooler hoses as described following.

a. Connect the cleaner tank pressure line to the transmission cooler return hose (hose attached to LH fitting of the transmission oil cooler).

b. Connect a tank return hose to the transmission cooler pressure hose (hose attached to the RH fitting of the transmission oil cooler). Place the outlet end of this hose in the solvent tank reservoir.



3. Turn on solvent pump and allow the solvent to circulate a minimum of five minutes (cycling switch on and off will help dislodge contaminants in cooler system).

4. Switch off the solvent pump and disconnect the solvent pressure hose from the cooler return line.

5. Use compressed air to blow out the transmission oil cooler and hoses (blow air into the cooler return hose) until all solvent is removed.

6. Remove the rubber hose from the remaining transmission cooler hose.

ADJUSTMENTS

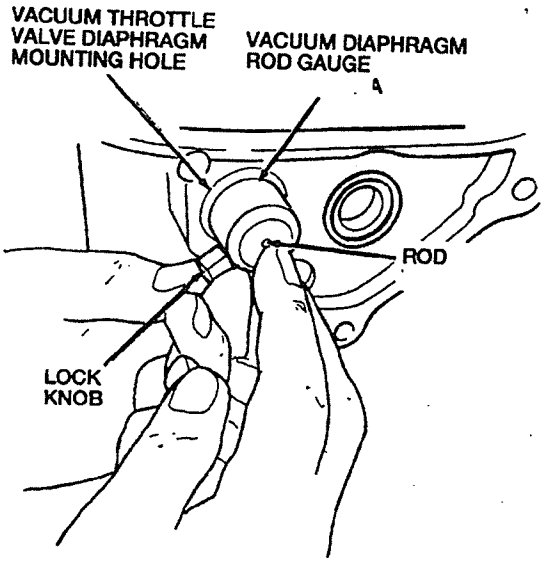
Throttle Control Valve Rod

SPECIAL SERVICE TOOL(S) REQUIRED

- Vacuum Diaphragm Rod Gauge

NOTE: The throttle control valve rod is a selective component. If the vacuum throttle valve diaphragm is being replaced, use the following procedure to select the correct throttle control valve rod.

1. Clean the vacuum throttle valve diaphragm mounting hole and Vacuum Diaphragm Rod Gauge and ensure that there is no transmission fluid on these surfaces.

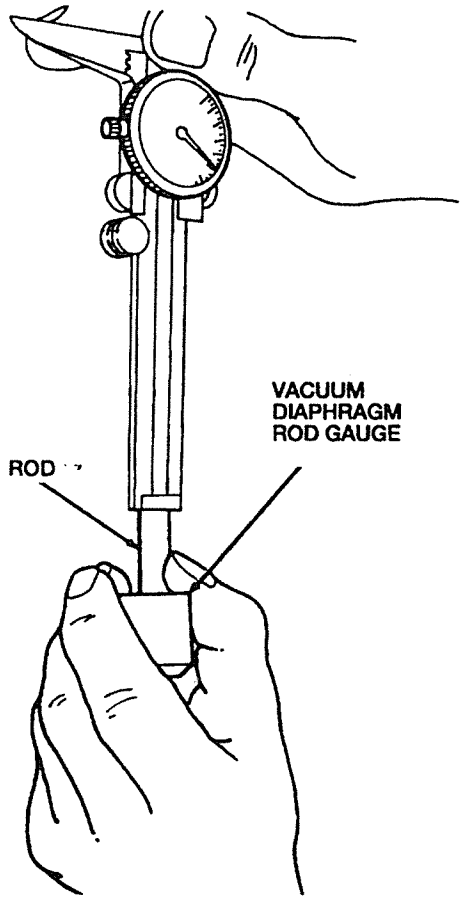


2. Insert Vacuum Diaphragm Rod Gauge into the vacuum throttle valve diaphragm mounting hole (with the beveled side facing out) until it bottoms out.

3. Place the through the opening of the vacuum diaphragm gauge until rod bottoms out against the valve.

4. Tighten the lock knob on the vacuum diaphragm rod gauge and remove it from the transaxle case.

5. Use a depth gauge to measure the distance from the flat surface of the vacuum diaphragm rod gauge to the end of the rod.



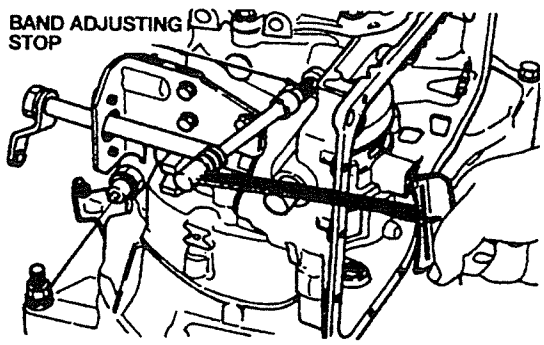
6. Using the gauge-to-rod measurement, select the correct throttle control valve rod from the following chart.

THROTTLE CONTROL VALVE ROD SIZE

Depth Measurement	Throttle Control Valve Rod Length	Part Number
Under 1.000 inch (25.4 mm)	1.160 inch (29.5 mm)	-
1.000 - 1.020 inch (25.4 - 25.9 mm)	1.180 inch (30.0 mm)	-
1.020 - 1.039 inch (25.9 - 26.4 mm)	1.200 inch (30.5 mm)	-
1.039 - 1.059 inch (26.4 - 26.9 mm)	1.220 inch (31.0 mm)	-
Over 1.059 inch (26.9 mm)	1.240 inch (31.5 mm)	-

Intermediate Band

1. Apply Gasket Eliminator or equivalent to the band adjusting stop. Install band adjusting stop into the transaxle case.
2. Tighten the band adjusting stop to 9-11 lb-ft (12-15 N-m). Back the band adjusting stop out exactly three turns.
3. Hold the band adjusting stop to prevent it from turning, install and tighten the band adjusting stop nut to 41-59 lb-ft (55-80 N-m).



Kickdown Switch

1. Disconnect the kickdown switch electrical connector.
2. Using a Digital Multimeter or equivalent, measure the resistance between the two kickdown switch terminals as follows:
   a. With the accelerator pedal in the fully released position the resistance should be greater than 10,000 ohms.
   b. Press the accelerator pedal to the wide open throttle position. The resistance should be less five (5) ohms.
3. If the kickdown switch does not meet the specifications loosen the kickdown switch locknut.
4. Adjust and recheck the kickdown switch until it is within specifications. If the kickdown switch can not be adjusted to be within the specifications, replace it.

SPECIFICATIONS

FLUID CAPACITY

Type	Liters	Quarts
"MERCON" Automatic Transmission Fluid	5.7	6.0

CLUTCH PACK PLATE USAGE AND CLEARANCE

Clutch Pack	Number of Drive (Steel) Plates	Number of Driven (Friction) Plates	Clutch Pack Clearance
Direct	3	3	0.063-0.071 inch (1.6-1.8mm)
Forward	3	3	0.031-0.039 inch (0.8-1.0mm)
Low/Reverse	3	3	0.032-0.041 inch (0.8-1.05mm)

CLUTCH AND BAND APPLICATION

Gear Shift Lever Position	Forward Clutch	Direct Clutch	Intermediate Band	Low/Reverse Clutch	Low One-Way Clutch
D (1st Gear)	Applied				Holding
D (2nd Gear)	Applied		Holding		
D (3rd Gear)	Applied	Applied			
2 (2nd Gear)	Applied		Holding		
1 (1st Gear)	Applied			Holding	
R (Reverse)		Applied		Holding	

CLEARANCE AND TOLERANCE SPECIFICATIONS

Item	Specifications
Front Clutch Drum End-Play	0.020-0.031 inch (0.5-0.8mm)
Pump Cover to Transaxle Case	Max. Below 0.004 inch (0.10mm) Max. Above 0.006 inch (0.15mm)
Pinions on Front or Rear Carrier	Max. 0.031 inch (0.8mm)
Standard Backlash Differential Pinion Gears	0-0.004 inch (0-.01 mm)

DIFFERENTIAL SHIM SIZE

Part Number	Thickness (inch)	Thickness (mm)
-	0.0039	0.10
-	0.0047	0.12
-	0.0055	0.14
-	0.0059	0.15
-	0.0063	0.16
-	0.0079	0.20
-	0.0098	0.25
-	0.0118	0.30
-	0.0138	0.35
-	0.0157	0.40
-	0.0177	0.46
-	0.0197	0.50
-	0.0217	0.55
-	0.0236	0.60
-	0.0256	0.65
-	0.0276	0.70
-	0.0295	0.75
-	0.0315	0.80
-	0.0335	0.85
-	0.0354	0.90

TORQUE SPECIFICATIONS

Description	Lb-Ft	Lb-In	N-m
Transaxle Fluid Drain Plug	29-40	-	39-54
Main Control Valve Body Bolts	-	71-97	8-11
Transmission Oil Pan Bolts	-	43-69	5-8
Band Adjusting Stop Nut	41-59	-	55-80
Wheel Hub Bolts	65-87	-	88-118
Ring Gear Bolts	51-62	-	69-83
Side Plate Bolts	-	22-30	2.5-3.4
Upper-to-Lower Valve Body A- Bolts	-	22-30	2.5-3.4
Upper-to-Lower Valve Body B-Bolts	-	43-61	5-7
Oil Filter Bolts	-	26-35	3-4
Valve Body Sub-Body Bolts	-	22-30	2.5-3.4
Pump Cover Bolts	-	95-122	11-14
Idler Gear Shaft Nut	94-130	-	128-177
Torque Converter Stator Support Bolts	-	95.122	11-14
Parking Pawl Actuator support Bolts	-	106-142	12-16

Torque Specifications (continued)

Description	Lb-Ft	Lb-In	N-m
Manual Control Lever Support Bolts	-	43-69	5-8
Manual Control Lever Nut	22-29	-	30-39
Bearing Housing Bolts	14-19	-	19-26
Governor Cover Bolts	-	71-97	8-11
Transaxle Case-to-Converter Housing Bolts	22-34	-	29-46
Oil Pump-to-Transaxle Bolts	11-16	-	15-22
Speedometer Cable Sleeve Bolt	-	71-97	8-11
Oil Filler Tube Bolt	-	61-87	7-10
Park/Neutral Position (PNP) Switch	14-19	-	19-26
Engine-to-Transaxle Bolts	47-66	-	64-89
Torque Converter-to-Flywheel Nuts	26-36	-	34-49
Transmission Housing Cover Bolts	-	71-97	8-11
Transaxle-to-Engine Bolts	27-38	-	37-52
Intake Manifold Support Bolts	27-38	-	37-52
Front Transaxle Support Insulator Bracket Bolts	28-37	-	38-51
Rear Engine Support Rebound Insulator Bolts	47-66	-	64-89
Front Transaxle Support Insulator Through Bolt & Nut	69-83	-	93-113
Front Transaxle Support Insulator Nuts	32-38	-	43-52
Rear Transaxle Support Insulator Nuts	21-34	-	28.46
Tie Rod End Nut	26-30	-	35-40
Clamp Bolt	40-50	-	54-68
Access Cover Shield Bolts	-	65-95	8-10
Manual Control Lever Nut	33-47	-	44-64
Ground strap Bolt	-	65-95	8-10

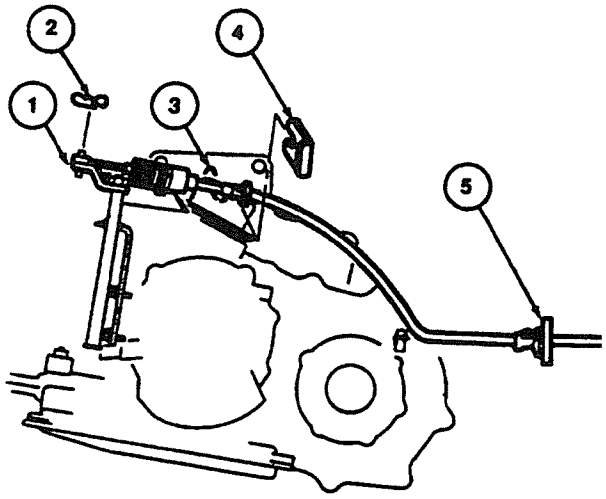
SERVICE TOOLS/EQUIPMENT

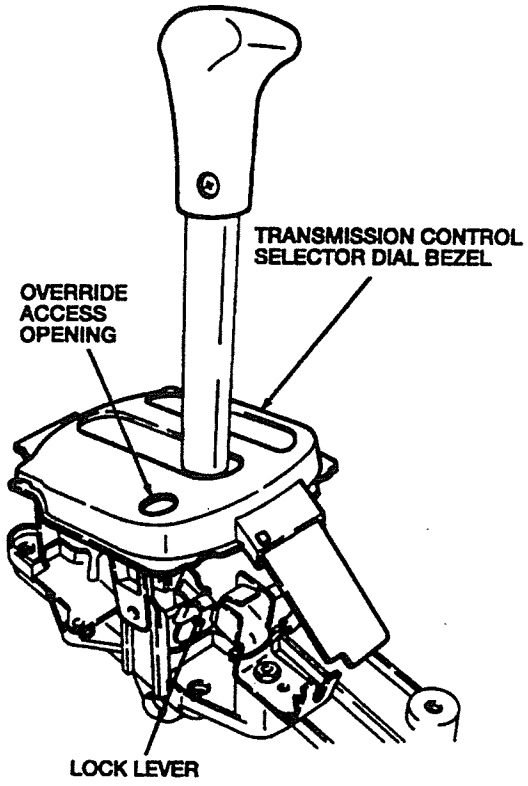
SPECIAL SERVICE TOOLS

Tool Description	Illustration
Impact Slide Hammer	
Bench Mounted Holding Fixture	
Puller	
Clutch Spring Compressor	
Engine Oil Pressure Gauge	
Axle Bearing/Seal Plate	
Bearing Cup Replacer	
Differential Side Bearing Puller	
Gauge Bar	
Valve Body Guide Pins	
Driver Handle	
Stator & Driven Sprocket Bearing Remover	
Differential Plugs	
Vacuum Diaphragm Rod Gauge	

Special Service Tools (continued)

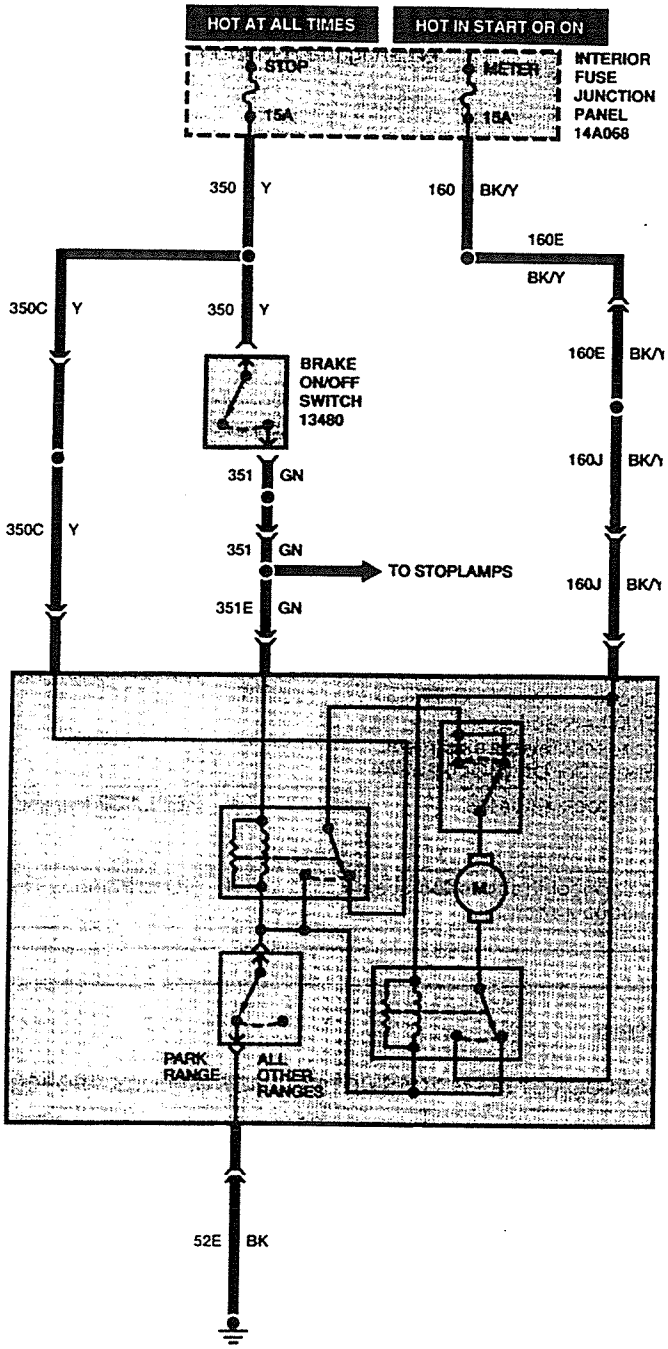
Tool Description	Illustration
Clutch Compressor	
Bearing Cone Replacer	
Bearing Cone Replacer	
Torque Adapter	
Converter Seal Replacer	
Differential Seal Replacer	
Shim Selection Set	
Differential Rotator	
Support Housing Bearing Cup Replacer	

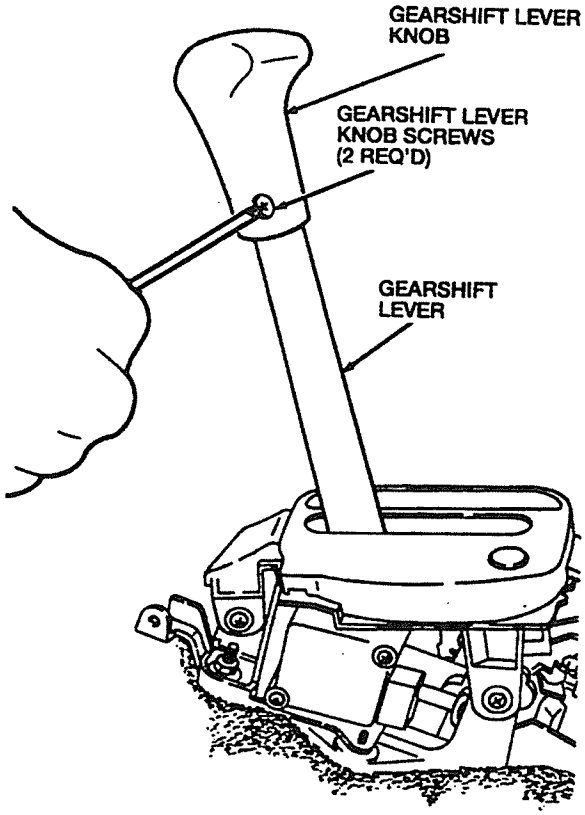


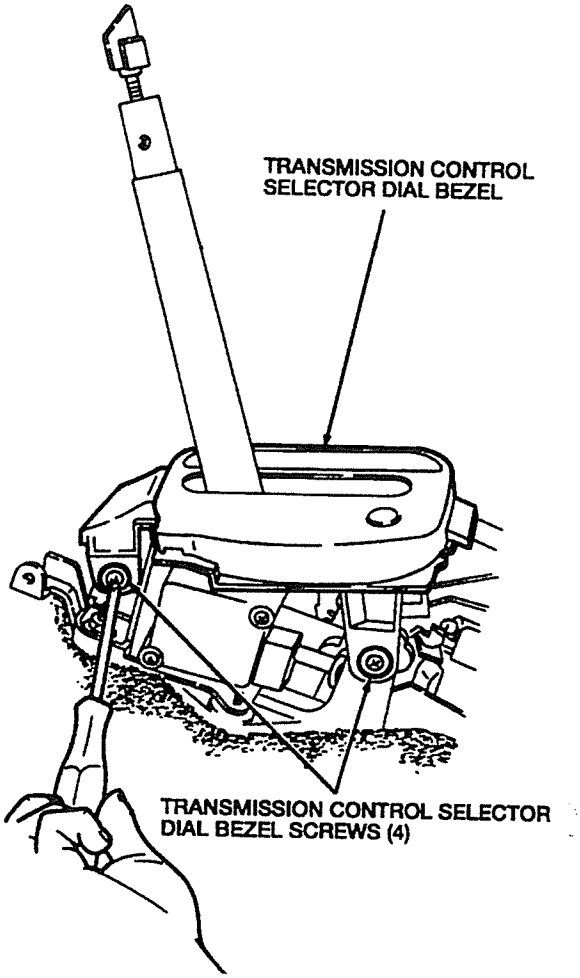


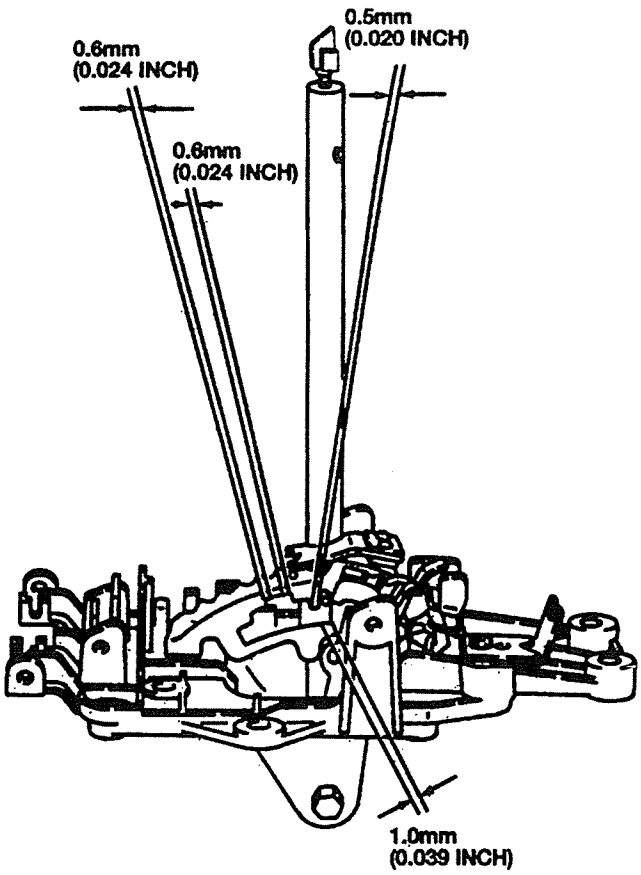
Description of Other Service Tools

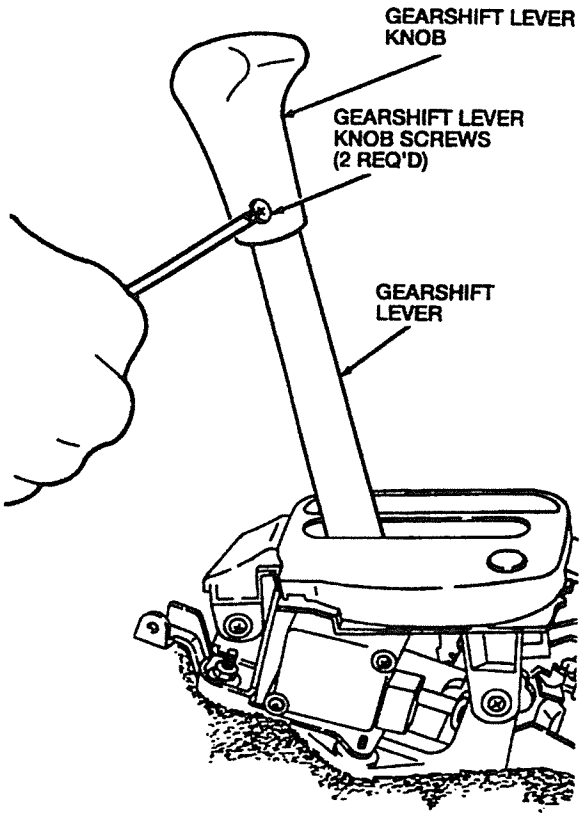
- Step Plate Adapter Set
- Internal Puller
- Bearing Pulling Attachment
- Three Bar Engine Support.
- Seal Remover
- Dial Indicator with Bracketry
- Hi-Lift Jack
- Transmission Jack
- Pressure Test Fittings
- Vacuum Tester
- Torque Converter Leak Test Kit
- Torque Converter/Oil Cooler Cleaner
- Digital Multimeter
- Oil Leak Detector

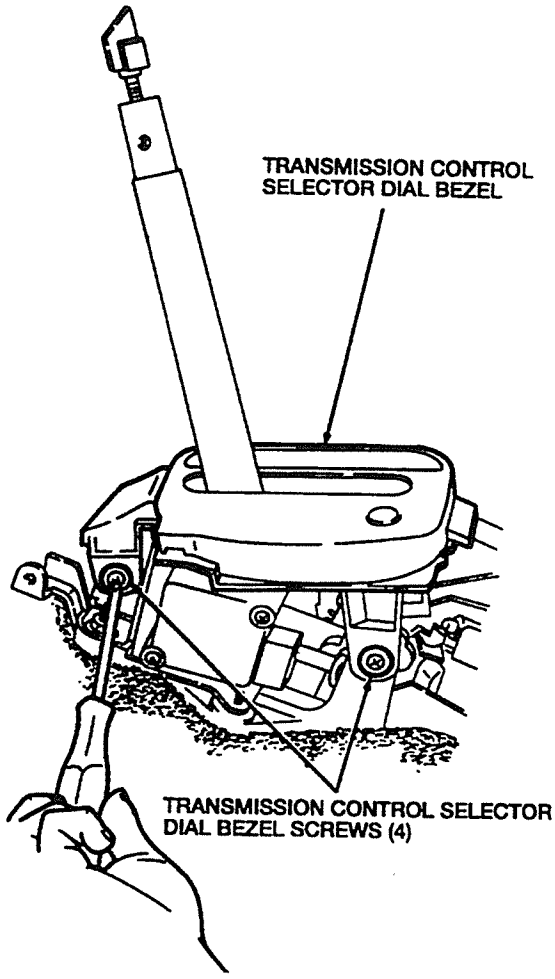

HOT AT ALL TIMES
HOT IN START OR ON
STOP
15A
METER
15A
INTERIOR FUSE JUNCTION PANEL 14A068
350 Y
160 BK/Y
160E BK/Y
350C Y
350 Y
BRAKE ON/OFF SWITCH 13480
160E BK/Y
160J BK/Y
351 GN
350C Y
351 GN
TO STOPLAMPS
160J BK/Y
351E GN
PARK RANGE
ALL OTHER RANGES
52E BK

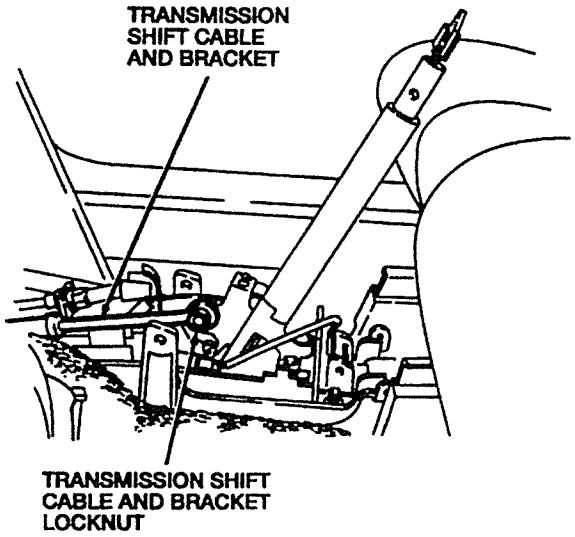

GEARSHIFT LEVER KNOB
GEARSHIFT LEVER KNOB SCREWS (2 REQ'D)
GEARSHIFT LEVER


TRANSMISSION CONTROL
SELECTOR DIAL BEZEL
TRANSMISSION CONTROL SELECTOR
DIAL BEZEL SCREWS (4)


0.6mm
(0.024 INCH)
0.5mm
(0.020 INCH)
0.6mm
(0.024 INCH)
1.0mm
(0.039 INCH)


GEARSHIFT LEVER KNOB
GEARSHIFT LEVER KNOB SCREWS (2 REQ'D)
GEARSHIFT LEVER


TRANSMISSION CONTROL SELECTOR DIAL BEZEL
TRANSMISSION CONTROL SELECTOR DIAL BEZEL SCREWS (4)


TRANSMISSION SHIFT CABLE AND BRACKET
TRANSMISSION SHIFT CABLE AND BRACKET LOCKNUT

SECTION 10 - Noise, Vibration and Harshness

General Information

The following information will provide a working knowledge of the process required to diagnose a noise, vibration or harshness (NVH) situation. Before attempting to diagnose an NVH condition, read the Diagnostic Theory and Glossary of Term in this section.

After becoming familiar with the methods and terms used in NVH diagnosis, proceed to the diagnostic procedures. The most important part of diagnosis is the road test. The wide range of NVH is defined and narrowed to a specific area of the vehicle.

With the type of condition known, the Diagnostic Procedures should be used to define the diagnosis of a specific component. After making any repair, always road test the vehicle to confirm that the condition had been corrected to the owner's satisfaction.

Use of Diagnostic Procedures

Study the Diagnostic Theory and Glossary portion of this section. The information here will help form an approach to NVH diagnosis and will also define the terms commonly used in NVH diagnosis.

Customer Interview/Road Test

Noise, vibration and harshness (NVH) usually occur in four areas: tires, engine accessories, suspension and driveline. It is important, therefore, that an NVH problem be isolated into its specific area as soon as possible. The easiest and quickest way to do this is to perform a road test. If necessary, refer to the road test procedure in this section.

Identify the Condition

NOISE: If the noise is produced as part of a vibration condition, correcting the vibration will eliminate the noise. If the noise is related to a specific component or system, refer to the appropriate Service Manual section for further diagnosis.

VIBRATION: Refer to the following:

a. Engine or accessory vibration, all speeds Refer to Engine Accessory Drive Belt and Tip-in Moan Checks.
b. High-speed shake, 40 mph and up.

1. Refer to Tire Roughness and Vibration Troubleshooting in Section 3.
2. Refer to hub and rotor, Runout checks contained in Brake Diagnosis in Section 4 - Brakes.
3. Tip-in Moan - Refer to Section 11 - Engine, Drive Belt and Tip-in Moan Checks.
4. Brake Shudder - Refer to Section 4 - Brakes.

HARSHNESS:

This term is commonly used to describe the ride quality of the vehicle. Hard ride or harshness is usually caused by the tires and suspension system, namely:

a. Over inflated, wrong size, or wrong type tire installed on the vehicle.
b. Suspension not sufficiently lubricated.
c. Suspension components installed with preload on pivot pin point, bearings and bushings.

Watch the belts ride in the pulleys at idle speed. If the belt appears to ride up and down the pulley, the sheave width is not constant and the pulley must be replaced.

A stethoscope or other probing device may save time in diagnosing an accessory vibration. Probing at the vibration speed, with the engine running in NEUTRAL will often immediately pinpoint the condition. If this proves unsatisfactory, remove the drive belts one at a time until the vibration is reduced or eliminated. The last belt removed thus pinpoints the accessory or drive system contributing to or causing the condition. In some cases belt removal will not eliminate an accessory from its mountings.

Once the vibration area has been located, the drive belt should be replaced first as construction variations in the belt may not be evident upon visual inspection and can set up a vibration.

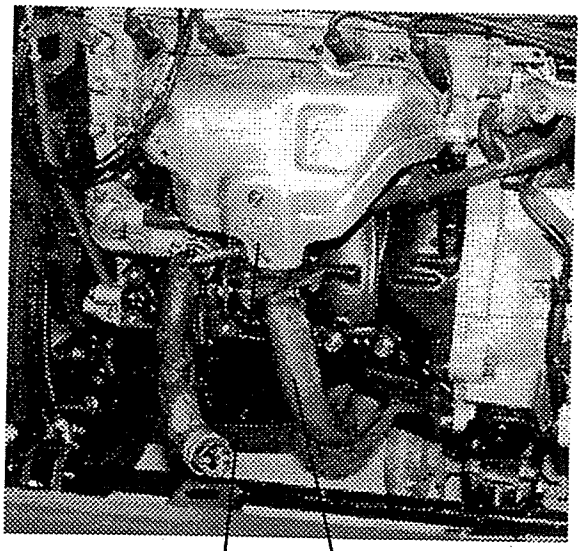
When the belt and related pulleys and accessory attachments are determined to be acceptable, replacement of the accessory may be necessary to solve the vibration problem.

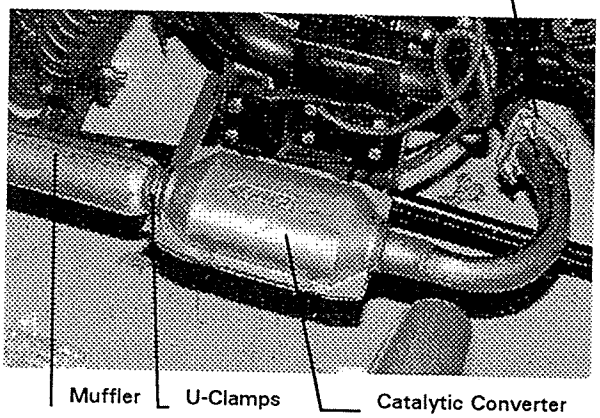
Neutralize Transaxle Mount and Exhaust System

To neutralize the engine/transaxle mount(s), loosen the attaching bolt(s) three turns, start the engine, shift into gear while idling, then shift back to NEUTRAL, shut off engine, and retighten the bolt.

An abnormal vibration can be caused by a component, such as engine/transaxle mount which is acting in a rigid manner because of a distorted or twisted mounting position. As a result, the mount does not absorb vibrations as it should. Grounded or abnormally strained exhaust system and hangers will also lead to this condition.

The exhaust system must be neutralized while it is hot because the thermal expansion of the pipe will otherwise place a strain on the hangers. While the exhaust system is at its normal operating temperature, loosen all attaching bolts and reposition as required so that they hang free and straight. Next, loosen the flanges at the manifold, start the engine, shift into gear while idling and shift back to NEUTRAL, then shut off the engine and retighten all flange and attaching bolts. Be certain that no grounding condition exists and that adequate clearance exists along the entire length of the exhaust system.





Neutral Coast Test

A neutral coast test is a good method to determine if the engine, driveline, wheels or tires are causing the vibration. To do this, accelerate to maximum legal speed on a seldom used road, place the gear selector lever in NEUTRAL and allow the engine to return to idle speed. If the vibration occurs, the problem can be confined to the transaxle, wheels, or tires, eliminating the engine and accessories that are suspicious. If the vibration does not exist during neutral coast, perform an engine run-up check.

GLOSSARY OF TERMS

Acceleration

Light:

Increase in speed at less than half throttle.

Heavy:

Half to full throttle increase in speed.

Ambient Temperature

The surrounding or prevailing temperature. Usually the temperature in the service area or outdoors, depending on where testing is taking place.

Boom

A cycling, rhythmic noise often accompanied by a sensation of pressure on the eardrums.

Bound Up

Refers to a stressed, rubber-mounted component that transmits any NVH that would normally be absorbed by the mount. (See Neutralize)

Brakes Applied

When the vehicle is stationary, service brakes applied with enough force to hold the vehicle still against movement with transaxle in gear.

Coast/Neutral Coast

Engine/transaxle taken out of gear by placing gearshift selector in NEUTRAL.

CPS

Cycles per second.

Cruise

Steady highway speed, neither accelerating or decelerating: even pressure on accelerator pedal on level ground.

Deceleration

Slowing of vehicle by releasing foot from accelerator at cruise and allowing engine to slow vehicle without application of brakes.

Drivetrain

Includes all power transmitting components from the engine to the wheels, including transaxle and transaxle halfshafts.

Engine Run-up Test

Operation of engine through normal rpm range with vehicle sitting still, transaxle in NEUTRAL. Used for engine and accessory vibration check.

Engine Misfire

One or more cylinders in the engine fail to fire at the proper time.

Engine Imbalance

A perceptible vibration in the vehicle caused by an engine component which is normally smoothly balanced.

Flat Spots (Tires)

Commonly caused by letting the vehicle stand while the tires cool off. Can be cured by operating the vehicle again until tires are warm. Also, regular tire wear patterns in the tire tread resulting from wheel-locked skids or defective tire.

Float

A cruise drive mode in which throttle setting matches engine speed to road speed, resulting in very gradual deceleration.

Gravelly Feel

A grinding or growl in a component similar to the feel experienced while driving on gravel.

Harshness

A harder than usual behavior of a component, like riding a vehicle with over-inflated tires.

Hz

Hertz (cycles per second).

Imbalance (or unbalance)

Out of balance: more weight on one side of a rotating component causing shake or vibration.

Inboard

Toward the centerline of the vehicle. (see Outboard).

Isolate

Separate from the influence of other components.

NVH

Noise, Vibration, Harshness.

Neutralize (Normalize)

To return to unstressed position. Used to describe various mounts and exhaust system hanger (see Bound Up).

Outboard

Toward the outside of the vehicle, rather than toward the centerline (see Inboard).

Pumping Feel

A very slow vibration that results in a movement of vehicle components similar to pumping the service brakes slightly.

Radial/Lateral

Radial is in the plane of rotation, lateral is at 90 degrees to the plane of rotation.

Road Test

Operation of vehicle under conditions designed to recreate the problem condition.

Runout

Out-of-round or wobble.

Shake

Low frequency vibration, usually results in visual movement of components.

Tire Force Vibration

Tire vibration caused by variations in tire construction, resulting in a vibration when the tire rotates against the pavement (this condition may even present on perfectly round tires).

Two-plane Balance

Radial and lateral balance.

Tire Deflection

Bending of the body of the tire during rotation.

TIR

Total indicator runout.

Tip-In Moan

A light moaning noise heard when the vehicle is lightly accelerated, usually between 25-50 mph (40-80 km/h).

Vibration

Regular movement of a component that results in a sound or feel of movement.

SERVICE TOOLS AND EQUIPMENT

- Belt Tension Gauge

SECTION 11 - Engine (Service)

SECTION 11 - Engine Service

The GO-4 Interceptor by Westward Industries Limited is powered by a inline 4-cylinder overhead valve engine port electronic fuel injection. It has 63 hp at 5,000 rpm; with 74 lb-ft torque at 3,000 rpm. The liquid-cooled engine has multiple

Bore and stroke:	2.78x3.29 inches (71x83.6mm)
Firing Order:	1-3-4-2 Compression Ratio: 9.7:1
Oil Capacity:	3.6 US qts (3.4 liters) w/filter

DESCRIPTION AND OPERATION

Introduction

This section covers various engine tests, adjustments, service procedures, and cleaning/inspection procedures. Engine assembly and service specifications appear at the end of this section.

Refer to Section 11-01 for engine removal, disassembly, assembly, installation, adjustment procedures, and specifications.

This engine incorporates a closed-type Positive Crankcase Ventilation (PCV) system and exhaust emission control system. All engine/emission control systems are covered in the Section 9-Powertrain Control/Emissions Diagnosis Manual.

To maintain the required exhaust emission levels, the fuel system, ignition system, and engine must be kept in good operating condition and meet recommended adjustment specifications.

When performing tests, adjustments, or service to the engine, ignition system, or fuel system, it is essential to follow the procedures and specifications in the appropriate service section in this manual, and in the Powertrain Control/Emissions Diagnosis Manual.'

*Can be purchased as a separate item.

WARNING: TO AVOID THE POSSIBILITY OF PERSONAL INJURY OR DAMAGE TO THE VEHICLE, DO NOT OPERATE THE ENGINE WITH THE HOOD OPEN UNTIL THE FAN HAS FIRST BEEN EXAMINED FOR POSSIBLE CRACKS AND SEPARATION.

Engine Identification

The U.S. Motor Vehicle Theft Law Enforcement Act of 1984 requires identification of certain high theft vehicles to reduce the National Auto Theft Rate. This federal law requires Westward Industries Limited to affix the Vehicle Identification Number (VIN) on the vehicle. The affected components are the engine and transaxle. In addition, the service replacement parts must also be identified as "service" parts.

In the event of collision damage not requiring part replacement or drivetrain service, the persons making the repairs should take care not to damage or remove the labels, unless such action is reasonably necessary in performing the repair.

The areas selected for the location of the "production" and "service" labels are unlikely to be affected during normal servicing and non-collision repairs.

Vehicle Certification Label

The Vehicle Certification Label is located on the front left-hand side of the dash. The upper half of the label contains the name of the manufacturer, month and year of manufacture, Gross Vehicle Weight Rating (GVWR), and Gross Axle Weight Rating (GAWR).

The Vehicle Certification Label also contains a 17 character Vehicle Identification Number (VIN). This number is used for warranty identification of the vehicle and indicates engine identification.

Exhaust Emission Control System

Operation, removal, installation, and required maintenance of the exhaust emission control devices used on these engines are covered in the Powertrain Control/Emissions Diagnosis Manual.

DIAGNOSIS AND TESTING

Inspection and Verification - Engine

1. Verify the customer concern by starting the engine and listening to it idle.
2. Check the oil level and condition.
3. Check the wiring harness for obvious signs of shorts, opens, bad connections, or damage.
4. If fault is not visually evident, determine the symptom and proceed to the following Troubleshooting Chart.

Troubleshooting Chart - Engine

ENGINE

CONDITION	POSSIBLE SOURCE	ACTION
• Difficult to Start During Hot or Cold Start	• Fuel system damaged or malfunctioning.	• REFER to Section 11.
	• Ignition system malfunctioning.	• REFER to Section 11.
	• Head gasket damaged.	• INSPECT head gasket.
	• Worn piston ring.	• INSPECT piston ring.
	• Worn piston.	• INSPECT piston.
	• Worn cylinder.	• INSPECT cylinder block.
• Poor Idling	• Fuel system damaged or malfunctioning.	• REFER to Section 11.
	• Head gasket damaged.	• INSPECT head gasket.
	• Hydraulic lash adjuster malfunctioning.	• INSPECT hydraulic lash adjuster.
	• Burnt valve.	• INSPECT valve.
	• Improper valve-to-valve seat contact.	• INSPECT valve and/or valve seat.
	• Restricted exhaust system.	• REFER to Section 9.
• Excessive or Insufficient combustion	• Carbon accumulation in Combustion chamber.	• INSPECT for carbon buildup.
	• Valve spring weak or broken.	• INSPECT valve spring.
	• Valve burnt or sticking.	• INSPECT valve.
	• Fuel system damaged or malfunctioning.	• REFER to Section 11.
	• Ignition system malfunctioning.	• REFER to Section 11.
• Excessive Oil Consumption	• Oil leakage.	• INSPECT for oil leakage.
	• Crankcase overfilled.	• CHECK oil level.
	• Incorrect oil viscosity.	• REPLACE the oil.
	• Incorrect oil pressure.	• CHECK oil pressure.
	• Diluted oil.	• CHECK oil for dilution. REPLACE if necessary.
	• Valve seal worn.	• INSPECT valve seal.
	• Valve stem or valve guide worn.	• INSPECT valve stem or valve guide.
	• Piston ring groove worn.	• INSPECT piston.
	• Piston ring sticking.	• INSPECT piston ring..
	• Piston or cylinder worn.	• INSPECT piston or cylinder block

(Continued)

CONDITION	POSSIBLE SOURCE	ACTION
• Engine Noise	• Timing chain/belt tensioner malfunction.	• INSPECT timing chain/belt tensioner.
	• Exhaust gas leakage.	• INSPECT for leakage.
	• Alternator bearing malfunction.	• REFER to Section 17.
	• Water pump bearing malfunction.	• REFER to Section 11.
	• Valve spring broken.	• INSPECT valve spring.
	• Excessive valve guide clearance.	• INSPECT valve guide.
	• Piston ring damaged.	• INSPECT piston ring.
	• Piston or piston pin worn.	• INSPECT piston or piston pin.
	• Connecting rod bent.	• INSPECT connecting rod.
	• Hydraulic lash adjuster malfunctioning.	• INSPECT hydraulic lash adjuster.
	• Cylinder worn.	• INSPECT cylinder block
	• Excessive main bearing oil clearance.	• INSPECT main bearing oil clearance.
	• Excessive connecting rod bearing oil clearance.	• INSPECT connecting rod oil clearance.
	• Connecting rod bearing heat damage.	• INSPECT connecting rod bearing.
	• Excessive crankshaft end play.	• INSPECT crankshaft end play.
	• Crankshaft main bearing seized or heat damage.	• INSPECT crankshaft main bearing.
	• Cooling system malfunctioning (i.e. water pump, vibration of radiator, etc.).	• REFER to Section 15.
	• Fuel system malfunctioning.	• REFER to Section 13.
	• Loose torque converter nuts.	• REFER to Section 8.
	• Loose flywheel to crankshaft bolts.	• REFER to Section 11.
• Insufficient Power	• Tire size incorrect.	• REFER to Section 3.
	• Brakes dragging.	• REFER to Section 9.
	• Fuel system damaged or malfunctioning.	• REFER to Section 13.
	• Ignition system damaged or malfunctioning.	• REFER to Section 17.
	• Valve seat compression leakage.	• INSPECT for valve seat or valve leakage.
	• Valve stem seized.	• INSPECT valve stem.
	• Valve spring weak or broken.	• INSPECT valve spring.
	• Piston ring damaged, worn, or sticking.	• INSPECT piston ring.
	• Piston cracked or worn.	• INSPECT piston.
	• Head gasket damaged.	• INSPECT head gasket.
	• Cylinder head cracked or distorted.	• INSPECT cylinder head.
	• Restricted exhaust system.	• REFER to Section 14.

SERVICE PROCEDURES

Positive Crankcase Ventilation (PCV) System, Closed-Type

A malfunction in the Positive Crankcase Ventilation (PCV) system can result in the engine having rough idle or loping. Do not attempt to correct this idle condition by performing an idle speed adjustment or by trying to bypass the airflow. Refer to Section 9 - Powertrain Control/Emissions Diagnosis, (Positive Crankcase Ventilation [PCV] System), for diagnosing a malfunction in the PCV system.

Engine Oil Leaks

When diagnosing engine oil leaks, it is important that the source and location of the leak be positively identified before service. The following procedure has been found to be very effective and requires minimum equipment. Prior to using this procedure, it is important to clean the cylinder block, cylinder heads, valve cover, oil pan, and flywheel housing areas with a suitable solvent to remove all traces of oil.

To perform oil leak diagnosis use Oil Leak Detector, perform the following procedure.

Fluorescent Oil Additive Method

1 Clean the engine with a suitable solvent to remove all traces of oil.

2. Drain the engine oil crankcase and refill it with recommended oil, premixed with Fluorescent Oil Additive. Use a minimum 1/2 oz (14.8ml) to a maximum 1 (one) oz. (29.6ml) of fluorescent additive. If oil is not premixed, fluorescent additive must be added to crankcase first.

3. Run the engine for 15 minutes. Stop the engine and inspect all seal and gasket areas for leaks using Oil Leak Detector. A clear bright yellow or orange area will identify the leak. For extremely small leaks, several hours of running the engine may be required for the leak to appear.

4. Service all leaks as required.

Pressure Method

Use a Pressurization Kit to test for engine oil leakage.

Testing Procedure

1. Plug all crankcase openings except the one used for connecting the leakage detector.

2. Connect the leakage detector to a crankcase opening (oil level indicator tube is convenient) and adjust the air pressure to 5 psi (34.4 kPa).

3. Using a solution of liquid soap and water, brush the solution along all of the gasket sealing surfaces and bearing seals. Look for bubbles or foam. If bubbles or foam are present, repair the leak as necessary.

Leakage Points

Examine the following areas for oil leakage:

Engine

- Camshaft oil seal
- Distributor O-ring
- Valve cover gasket
- Head gasket
- Oil level indicator tube
- Oil pressure sensor

Under Engine - with Vehicle on Hoist

- Oil pan gasket
- Crankshaft rear oil seal
- Crankshaft front seal
- Oil filter

With Transaxle and Flywheel Removed

- Crankshaft rear oil seal

Compression Test

Before performing the Engine Compression Test, check the battery. The battery must be fully charged, in good condition and properly connected. If the battery is not fully charged, recharge or replace it.

Compression Gauge Check

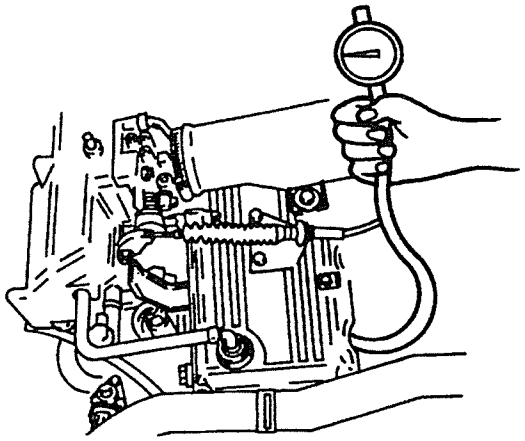
1. Run the engine until normal operating temperature is reached.

2. Turn the engine off.

3. Remove the spark plugs (if necessary, refer to Section 11 for the correct removal and installation procedure).

4. Disconnect the distributor connectors to eliminate fuel flow and spark.

5. Install Compression Tester tightly to the spark plug hole.



6. Depress and hold the accelerator to Wide Open Throttle and crank the engine.

7. Normally, the first compression stroke will run the gauge indicator needle a considerable distance up the scale. Succeeding strokes will raise it more until the highest level is shown (this will require at least four or five compression strokes). Record the highest reading.

Test Results

Repeat steps 5-7 above for each cylinder and compare the readings with the following specifications.

- Compression should be 204 psi (1412 kPa) with a minimum of 149 psi (1030 kPa).

Remember that the engine must be at normal operating temperature and the throttle valve must be fully open.

Compression Readings - Interpreting

Examine the readings for all of the cylinders. Pressure variation between the highest and lowest cylinders should be within 75 percent of one another. See Example Readings in this section. The following chart shows maximum compression readings and their corresponding 75 percent minimums.

Maximum PSI	Minimum PSI	Maximum PSI	Minimum PSI	Maximum PSI	Minimum PSI	Maximum PSI	Minimum PSI
134	101	164	123	194	145	224	168
136	102	166	124	196	147	226	169
138	104	168	126	198	148	228	171
140	105	170	127	200	150	230	172
142	107	172	129	202	151	232	174
144	108	174	131	204	153	234	175
146	110	176	132	206	154	236	177
148	111	178	133	208	156	238	178
150	113	180	135	210	157	240	180
152	114	182	136	212	158	242	181
154	115	184	138	214	160	244	183
156	117	186	140	216	162	246	184
158	118	188	141	218	163	248	186
160	120	190	142	220	165	250	187
162	121	192	144	222	166		

Variations between cylinders will have a greater effect on engine performance than overall readings that are even but slightly below specifications.

When taking compression readings, watch the action of the gauge needle. When it raises only a small amount on the first stroke, a little more on succeeding strokes, and ends up with a very LOW reading; burned, warped, or sticky valves are indicated.

A moderate reading with a low buildup on the first stroke and a gradual buildup on succeeding strokes, can mean worn, stuck, or scored rings.

If two adjacent cylinders are low, a blown head gasket or warped cylinder head to cylinder block surface could be responsible.

Add one teaspoon of heavy (30W minimum) engine oil to a cylinder with a low reading. Insert the compression gauge and recheck the cylinder. Crank the engine for a few extra compression strokes and watch the gauge. If the compression goes up 10 percent or more, worn piston rings are indicated. If the addition of the oil produces no significant change, valve trouble, a broken piston, or a blown head gasket is probably causing the low reading.

If the compression pressure exceeds specifications, there is a build-up of carbon on the head of the piston and on the combustion chamber walls.

Another sign of excessive carbon is "dieseling" (the engine continues to run after the ignition is turned off). Dieseling can be caused by glowing bits of carbon. Hard cranking can also indicate excessive compression from carbon buildup.

NOTE: If carbon build-up is present, and is causing pinging that cannot be stopped, the carbon should be removed by retarding the timing, by switching to a higher octane gasoline, or using a Carbon Blaster & Automotive Borescope or equivalent.

Example Readings

If the highest cylinder reads 134 psi (924 kPa) and the lowest cylinder reads 101 psi (696 kPa), then the 101 psi (696 kPa) reading is within 75 percent of the 134 psi (924 kPa) reading. See compression chart for maximum and minimum compression readings.

Cylinder Leakage Detector

When a cylinder produces a low reading, the use of Pressurization Kit or equivalent, will be helpful in pinpointing the exact cause.

The leakage detector is inserted in the spark plug hole, the piston is brought up to top dead center on the compression stroke, and compressed air is admitted through the leakage detector.

Once the combustion chamber is pressurized, a special gauge will read the percentage of leakage. Leakage exceeding 20 percent is considered excessive.
While the air pressure is retained in the cylinder, listen for the hiss of escaping air. A leak past the intake valve will be audible in the throttle body. A leak past the exhaust valve can be heard at the tail pipe. Leakage past the piston rings will be audible at the Positive Crankcase Ventilation (PCV) connection. If air is passing through a blown gasket to an adjacent cylinder, the noise will be evident at the spark plug hole of the cylinder into which the air is leaking, if all of the spark plugs are removed. Cracks in the cylinder block, cylinder head, or gasket leakage into the cooling system may be detected by a stream of bubbles in the radiator.

Oil Leak and Valve Stem Seal Test

The cylinder leakage detector can be used to test for engine oil leaks and to check the valve stem seals for leakage.

1. Plug all crankcase openings except the one used for connecting the leakage detector.

2. Connect the detector to a crankcase opening (oil level indicator tube is convenient) and adjust the air pressure to 5 psi (34 kPa).

3. Remove the spark plugs and rotate the crankshaft slowly with a wrench. Check for large amounts of air escaping into the cylinders as each intake valve and exhaust valve opens.

   The spark plugs on the leaking cylinders will probably show deposits of burned oil.

Intake Manifold Vacuum Test

1. Run the engine until normal operating temperature is reached.

2. Turn the engine off.

3. Connect Vacuum/Pressure Tester to the intake manifold where vacuum can be registered.

4. Turn the engine ON and operate it at the specified idle speed.

5. Read and record the value shown on the face of the gauge.

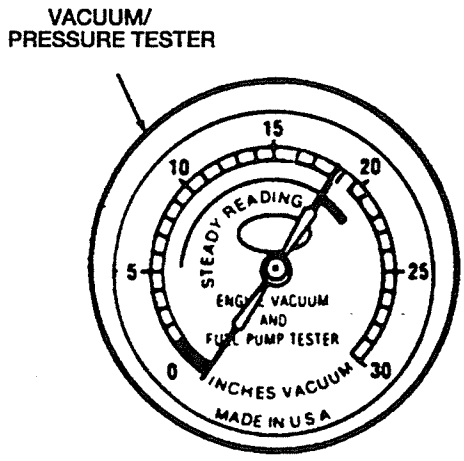
The vacuum gauge should read greater than 17.7 inches (60 kPa) depending upon the engine condition and the altitude at which the test is performed. Subtract 3.3 kPa (1 inch) from the specified reading for every 1,000 feet (305m) of elevation above sea level.

The reading should be quite steady. It may be necessary to adjust the gauge damper control (where used) if the needle is fluttering rapidly. Adjust the damper until the needle moves easily without excessive flutter.

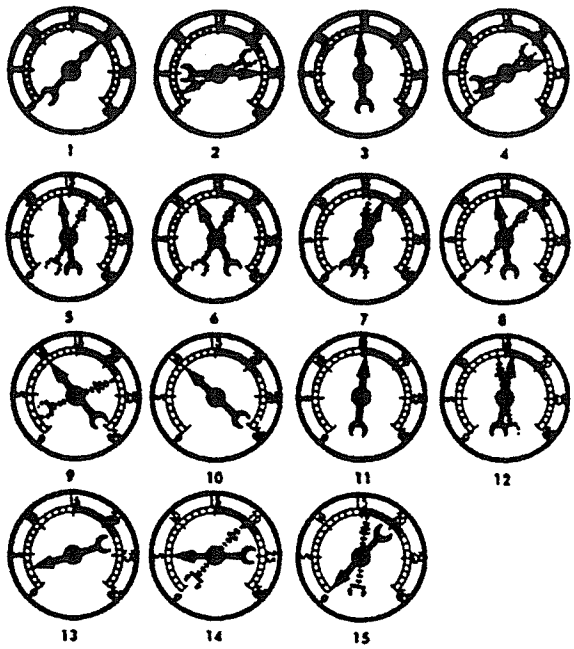
Vacuum Gauge Readings - Interpretation

A careful study of the vacuum gauge reading while the engine is idling will help pinpoint trouble areas. Always conduct other appropriate tests before arriving at a final diagnostic decision. Remember that vacuum gauge readings, although helpful, must be interpreted with care.

Most vacuum gauges have a NORMAL band indicated on the gauge face.



The following are potential gauge readings. Some should be considered as normal; others should be investigated further.



1. NORMAL READING: Needle greater than 17.7 inches (60 kPa) and holding steady.

2. NORMAL READING DURING RAPID ACCELERATION AND DECELERATION: When the engine is rapidly accelerated (dotted needle), the needle will drop to a low (not to 0) reading. When the throttle is suddenly released, the needle will snap back up to a higher than normal figure.

3. NORMAL FOR HIGH LIFT CAM WITH LARGE OVERLAP: Needle will register as low as 15 inches but will be relatively steady. Some oscillation is normal.

4. WORN RINGS OR DILUTED OIL: When the engine is quickly accelerated (dotted needle), the needle drops to 0 inches (0 kPa). Upon deceleration, the needle runs slightly above 22 inches (74 kPa).

5. STICKING VALVE(S): When the needle (dotted) remains steady at a normal vacuum but occasionally flicks (sharp, fast movement) down and back about 4 inches (13.5 kPa), one or more valves may be sticking.

6. BURNED OR WARPED VALVES: A regular, evenly spaced, downscale flicking of the needle indicates one or more burned or warped valves. Insufficient hydraulic lash

adjuster clearance will also cause this action.

7. POOR VALVE SEATING: A small but regular downscale flicking can mean one or more valves are not seating properly.

8. WORN VALVE GUIDES: When the needle oscillates over a 4 inches (13.5 kPa) range at idle speed, the valve guides could be worn. As engine speed is increased, the needle will become steady if the valve guides are responsible.

9. WEAK VALVE SPRINGS: When the needle oscillation becomes more violent as engine rpm is increased, weak valve springs are indicated. The reading at idle could be relatively steady.

10. LATE VALVE TIMING: A steady but low reading could be caused by late valve timing.

11. IGNITION TIMING RETARDING: Retarded ignition timing will produce a steady but low reading.

12. INSUFFICIENT SPARK PLUG GAP: When spark plugs are gapped too close, a regular, small pulsation of the needle can occur.

13. INTAKE LEAK: A low, steady reading can be caused by an intake manifold or throttle body mounting flange gasket leak.

14. BLOWN HEAD GASKET: A regular drop of approximately 10-15 inches (33.6-50.5 kPa) can be caused by a blown head gasket or warped cylinder head-to-cylinder block mounting surface.

15. RESTRICTED EXHAUST SYSTEM: When the engine is first started and is idled, the reading may be normal. But, as the engine rpm is increased, the back-pressure caused by a clogged muffler, kinked tail pipe, etc., will cause the needle to slowly drop to 0. The needle then may slowly rise. Excessive exhaust clogging will cause the needle to drop to a low point even if the engine is only idled.

When vacuum leaks are indicated, search out and correct the condition. Excess air leaking into the system will upset the fuel mixture and cause conditions such as rough idle, missing on acceleration, or burned valves. If the leak exists in an accessory unit, the unit will not function correctly. ALWAYS FIX VACUUM LEAKS.

Engine Oil Consumption, Excessive

NOTE: Use the following information to assist in explaining "normal" oil consumption to vehicle owners.

The amount of oil an engine uses will vary with the way the vehicle is driven in addition to normal engine-to-engine variation. This is especially true during the first 10,000 miles (16,000 kilometers), when a new engine is being "broken in" or until certain internal engine components become conditioned. Vehicles used in heavy duty operation (severe service) may use more oil. The following are examples of heavy duty operation:

- Taxicab applications
- Police service applications
- Severe loading applications
- Sustained high speed operation

Engines use oil to lubricate the following internal components:

- Cylinder block cylinder walls
- Pistons and piston rings
- Intake and exhaust valve stems
- Intake and exhaust valve guides
- All internal engine components

When the pistons move downward, a thin film of oil is left on the cylinder walls. This thin film of oil is burned away on the firing stroke during combustion. Efficient engines will use some oil or they would quickly wear out. As the vehicle is operated, some oil is drawn into the combustion chambers past the intake and exhaust valve stem seals and burned. For an efficient engine, the amount of oil lost or burned is minimal.

Several conditions can affect oil consumption rates. The following is a partial list of these items:

- Engine size
- Operator driving habits
- Ambient temperature
- Quality and viscosity of the oil

Operation under varying conditions can frequently be misleading. A vehicle that has been run for several thousand miles kilometers (miles) of short trip operations or below freezing ambient temperatures, may have consumed a "normal" amount of oil. However, when checking the engine oil level, it may measure up to the full mark on the oil level dipstick due to dilution (condensation and fuel) in the engine crankcase. The vehicle then might be driven at high speeds on the highway where the condensation and fuel boil off. The next time the oil is checked, it may appear that a quart of oil was used in 100 miles (160 kilometers). This *perceived* 100 miles/quart (160 kilometers per quart) consumption rate causes customer concern even though the actual oil consumption rate was about 1,500 miles/quart (2,400 kilometers per quart).

Make sure the selected engine oil meets the recommended API performance category "SG" and SAE viscosity grade as shown in the Operator's Manual. It is also important that the engine oil is changed at the intervals specified for the typical operating conditions of the vehicle. This information is available in the Operator's Manual, refer to the Maintenance Schedule and Record at the back of the manual or Section 2 of this Service Manual.

Oil Consumption Test

The following diagnostic procedure is intended to be used to determine the source of excessive internal oil consumption.

1. Determine what is considered excessive oil consumption, i.e., how many miles are driven per quart of oil? Also, determine the owner's driving habits, (i.e., sustained high speed operation, extended idling, etc.).

Oil usage is normally greater during the first 10,000 miles (16,000 kilometers) of service. As mileage increases, oil usage generally decreases. Vehicles in normal service should get at least 900 miles (1,450 kilometers) per quart after 10,000 miles (16,000 kilometers) of service. High speed driving, towing, high ambient temperature, etc. may result in greater oil usage.

2. Verify engine has no external oil leak. Refer to Engine Oil Leaks in this section.

3. Verify engine has correct oil level dipstick.

4. Verify that the engine is NOT being run in an overfilled condition. Check the oil level at least 5 minutes after a hot shutdown with the vehicle parked on a level surface. In no case should the level be above the "F" mark. If a significant overfill is indicated, perform steps 5a through 5d.

5. Perform an oil consumption test:
   a. Drain engine oil, replace the filter and refill with 1 (one) qt (0.9L) less than the recommended oil.
   b. Run the engine for 3 minutes (10 minutes if cold), then allow oil to drain to oil pan for at least 5 minutes. (Vehicle on level surface.)
   c. Remove oil level dipstick and wipe clean. (Do not wipe with anything contaminated with silicone compounds). Install oil level dipstick being sure to seat the oil level dipstick firmly in the oil level indicator tube. Remove the oil level dipstick and scribe a mark on the back (unmarked) surface at the indicated oil level. (This level should be about the same as the "U' mark on the face of the oil level dipstick.)
   d. Add 1 (one) qt (0.9L) of oil. Start the engine and allow to idle for at least two minutes. Shut off the engine and allow oil to drain to oil pan for at least 5 minutes. Mark the oil level dipstick using the procedure above. (This level may be slightly below the "F" mark.)
   e. Record the vehicle's mileage.
   f. Instruct the owner to drive the vehicle as usual and:
      (1) Check the oil level regularly at intervals of 100 to 150 miles (161 to 241 km).
      (2) Return to the service point when the oil level drops below the "U' mark on the oil level dipstick.
      (3) In an emergency, add only full gal bottles or, quarts of the same oil and note the mileage at which the oil is added.
   g. Check the oil level under the same conditions and at the same location as in steps 5c and 5d above.
      (1) Measure the distance from the oil level to the UPPER scribe mark on the oil level dipstick and record.
      (2) Measure the distance between the two scribe marks and record.

(3) Divide the first measurement by the second.
(4) Divide the distance driven during the oil test by the result. This quantity is the approximate oil consumption rate in Miles Per Quart (MPQ) or, Kilometers Per Liter (KPL).

h. If the oil consumption rate determined is unacceptable, proceed to step 6.

6. Check Positive Crankcase Ventilation (PCV) system. Make sure the system is not plugged.

7. Check for plugged oil drain-back holes in the cylinder heads and cylinder block.

8. If, after performing the above, the condition still exists, proceed to step 9.

9. Perform the Compression Test in this section, and/or perform a Cylinder Leakage Detector Test. This can be helpful in determining source of oil consumption (e.g., valves, piston rings, etc.).

10. NOTE: After checking for worn parts, if it is determined parts should be replaced, make sure correct replacement parts are used.

    Worn or damaged internal engine components can cause excessive oil consumption. Small deposits of oil on tips of spark plugs can be a clue to internal oil consumption. If internal oil consumption still persists, proceed as follows:

    a. Remove the engine from the vehicle and place it on an engine work stand. Remove the intake manifolds, cylinder heads, oil pan, and oil pump. Refer to Section 11-01 for the removal and installation procedures.
    b. Check the piston ring clearance, ring gap, and ring orientation. Service as required.
    c. Check for excessive main bearing clearance. Service as required.

11. Repeat the test to verify the concern has been repaired.

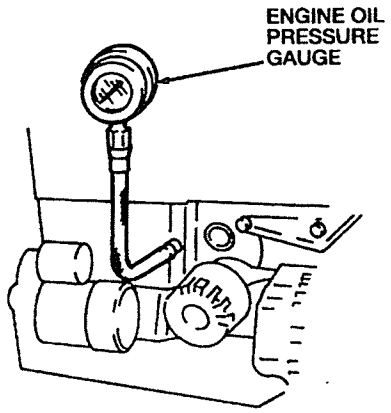
Oil Pressure Test

Service Tool(s) Required

- Engine Oil Pressure Gauge

1. Disconnect and remove the oil pressure sensor from the engine.

2. Connect an Engine Oil Pressure Gauge and Transmission Test Adapter to the oil pressure sender screw port.



3. Run the engine until normal operating temperature is reached.

4. Run the engine at 1,000 rpm and 3,000 rpm and record the gauge readings.

5. The oil pressure should be:
   - 28-43 psi (196-294 kPa) at 1,000 rpm.
   - 43-57 psi (294-392 kPa) at 3,000 rpm.

6. If the pressure is not within specification, check the following possible sources:

   a. Insufficient oil
   b. Oil leakage
   c. Worn or damaged oil pump
   d. Clogged oil strainer
   e. Excessive main bearing clearance
   f. Excessive connecting rod clearance

Valve Train Analysis - Static (Engine Off)

Valve Cover Removed

Remove the valve cover. Refer to Section 11-01 for the removal and installation procedure.

Rocker Arm

- Check rocker arm assemblies for loose mounting bolts, studs, and nuts.

- Check for plugged oil feed in the rocker arm and cylinder head.

Hydraulic Lash Adjusters (HLA), Overhead Camshaft

- Inspect the friction surfaces of the Hydraulic Lash Adjusters (HLA) for wear or damage.

Camshaft - Overhead Camshaft Engines

- Inspect camshaft, camshaft lobes, and journals for excessive wear or scoring. Repair or replace as necessary.

Valve Springs

- Check for broken or damaged components.

Valve Spring Retainer and Valve Spring Retainer Keys

- Check for proper seating of the valve spring retainer keys on the valve stems and in the valve spring retainers.

Valves and Cylinder Head

When inspecting the cylinder head, check the following:

a. Check the head gasket for proper installation.

b. Check for plugged oil drain back holes.

c. Check the exhaust valves and intake valves.

Valve Train Analysis - Dynamic Valves and Cylinder Head

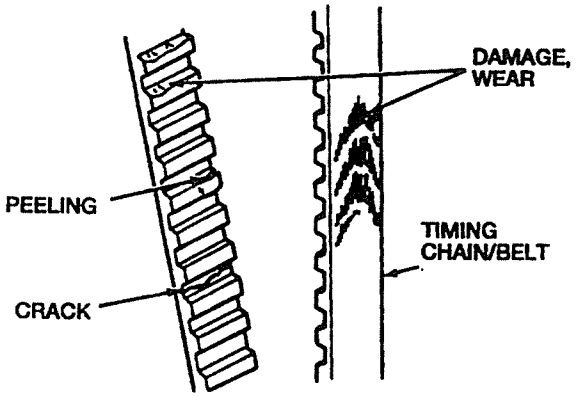
1. Remove the valve cover. Refer to the removal and installation procedure in Section 11-01.
2. Check for proper valve train lubrication
3. Check for plugged oil feed in the rocker arm or the cylinder head.
4. If a condition of insufficient oiling is suspected, accelerate the engine to 1,200 rpm, 1,000 rpm with the transaxle in Neutral (N) and the engine at normal operating temperature. Oil should spurt from the rocker arms so that the valve tips, and rocker arms are well oiled. If insufficient oiling is still suspected, check engine oil level, check oil passages for blockage, and check for proper engine oil pressure.

TROUBLESHOOTING CHART - HYDRAULIC LASH ADJUSTER (HLA)

CONDITION	POSSIBLE SOURCE	ACTION
Tappet Noise When Engine is First Started After Oil is Changed	Insufficient oil in system. Oil leakage from Hydraulic Lash Adjuster (HLA).	RUN engine at 2000-3000 rpm until warm. If noise stops, HLA is normal. If not, REPLACE HLA.
Tappet Noise When Engine is Started After Sitting Approximately One Day	Insufficient oil in system. Oil leakage from HLA.	RUN engine at 2000-3000 rpm until warm. If noise stops, HLA is normal. If not, REPLACE HLA.
Tappet Noise When Engine is Started After Cranking 3 Seconds or More	Insufficient oil in HLA. Oil leakage from HLA.	RUN engine at 2000-3000 rpm until warm. If noise stops, HLA is normal. If not, REPLACE HLA.
Tappet Noise When Engine is Started After New HLA is Installed	Insufficient oil in HLA. Oil leakage from HLA.	RUN engine at 2000-3000 rpm until warm. If noise stops, HLA is normal. CHECK for restricted oil passage. CHECK engine oil pressure. If all OK, REPLACE HLA.
Tappet Noise Continues More Than 10 Minutes	Insufficient oil pressure. Damaged HLA.	CHECK oil pressure. REPAIR as necessary. REPLACE HLA.
Tappet Noise During Idle After High Speed Running	Incorrect oil amount. Deteriorated oil.	ADD or DRAIN oil as necessary. REPLACE oil.

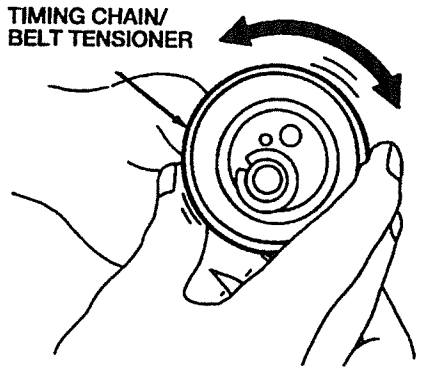
Timing Chain/Belt

Inspect and replace the timing chain/belt if it is contaminated with oil or grease. Also, inspect the timing chain/belt for damage, wear, peeling, cracks, or hardening. If necessary, replace the timing chain/belt. Refer to Section 11-01 for the removal and .installation procedure.



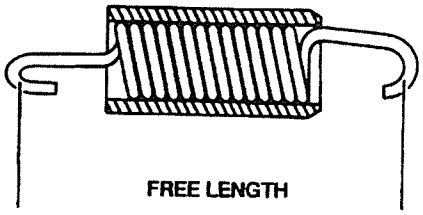
Tension and Idler

Check the timing chain/belt tensioner and timing chain/belt idler for smooth rotation and any binding or abnormal noise. Do not clean the timing chain/belt tensioner or timing chain/belt idler with cleaning fluids. Use a soft, clean rag to wipe the timing chain/belt tensioner and timing chain/belt idler. Avoid scratching these components.



Tensioner Spring

Inspect the timing chain/belt tensioner spring for abnormal shape and weak retraction. The free length of the timing chain/belt tensioner spring should be 2.520 inches (64.0mm). If necessary, replace the timing chain/belt tensioner spring.



Service Limit Specifications

Service limit specifications are intended to be a guide only, to be used when overhauling or reconditioning an engine or engine component. A determination can be made whether a component is suitable for continued service or should be replaced for extended service while the engine is disassembled.

Cylinder Block

Cleaning and Inspection

The cylinder block may be cleaned by immersing it in a cleaning vat, using a commercial cleaning solution. The cylinder block may also be cleaned with automotive parts cleaning solvents and brushes or by steam cleaning. Be sure to clean all oil passages and remove all gasket material, cements, and sealers from their surfaces.

It is also advisable at this time to clean the cylinder head bolt holes in the block by turning a grease-coated tap fully into the holes. Then clean the holes again and oil them.

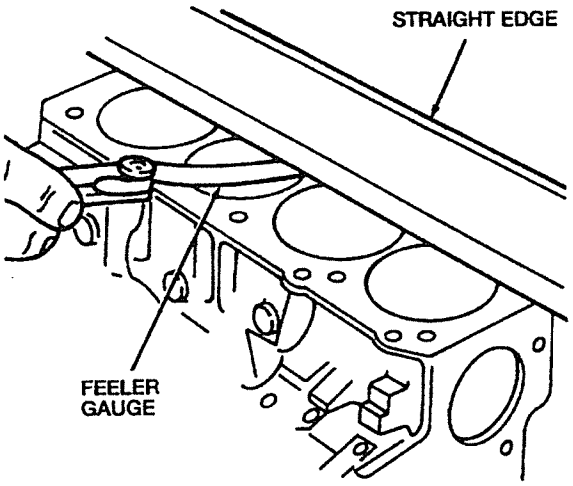
If the cylinder block is not inspected or assembled within 2-4 hours, coat the cylinder and bearing bores with engine oil to prevent rust.

Inspect the cylinder block for cracks in the cylinder bores and between cylinders. Also look for cracks at the water pump opening and in the main bearing web area. If cracks are suspected that cannot be seen with the eye, there are magnetic and dye check inspection processes available through automotive machine shops. Be sure the water jacket engine block plug opening is clean and not damaged.

If difficulty is encountered in rotating the crankshaft when fitting new crankshaft main bearings, or an unusual wear pattern is noticed on the crankshaft main bearings, the problem may be a distortion in the crankshaft main bearing bore alignment. The only correction is by line-boring or cylinder block replacement.

Cylinder Block Distortion

The cylinder block cylinder head surface must be flat within 0.006 inch (0. 15mm) over the entire surface. Use Straight Edge and a Feeler Gauge to determine the flatness.



If the flatness is out of specification, the head gasket surface can be machined a maximum of 0.008 inch (0.20mm). If the cylinder block distortion exceeds the maximum of 0.008 inch (0.20mm), the cylinder block must be replaced.

CAUTION: The boring size should be based on the size of an oversized piston.

Also, inspect the cylinder bores for wear. They must be round, straight (sides are parallel), and the diameter matched to the piston size.

Sand Holes or Porous Engine Castings Service

Porosity or sand hole(s) causing oil seepage or leakage can occur with modern casting-processes. A complete inspection of the engine and the transaxle should be made. If a leak is attributed to the porous condition of the cylinder block or sand hole(s), service can be made with an epoxy sealer.

CAUTION: Do not service cracks with this material. Service with this metallic plastic must be confined to those cast iron engine component surfaces where the inner wall surface is not exposed to the engine coolant pressure or oil pressure.

The areas of the cylinder block that can be serviced include the unmachined surfaces extending along the length of the block, upward from the oil pan rail to the cylinder water jacket, and the lower rear face of the cylinder block.

NOTE: Openings larger than 1/4 inch (6.35mm) should not be serviced using metallic plastic. Openings in excess of 1/4 inch (6.35mm) can be drilled, tapped, and plugged using common tools.

The following procedure should be used to service porous areas or sand holes in cast iron smaller than 1/4 inch (6.35mm).

1. Clean the surface to be serviced by grinding or rotary filing it down to a clean bright surface.
2. Chamfer or undercut the hole of porosity to a greater depth than the rest of the cleaned surface. Solid metal must surround the hole.
3. Clean the area to be serviced thoroughly. Epoxy sealer will not stick to a dirty or oily surface.
4. Mix the metallic plastic base and hardener as directed on the container. Stir it thoroughly until it has a uniform consistency.
5. Apply the service mixture with a suitable clean tool (putty knife, wood spoon, etc.) while forcing the epoxy into the hole or porosity.
6. Allow the service mixture to harden. This can be done by heat curing the surface with a 250-watt lamp placed 10 inches (254mm) from the serviced area or by letting the area air-dry for 10-12 hours at temperatures above 50° F (100 C).
7. Sand or grind the serviced area to blend with the general contour of the surrounding surface.
8. Paint the surface to match the rest of the cylinder block.

Cylinder Walls, Refinishing

Cleaning

NOTE: If poor or improper cleaning procedures of the cylinder bores and/or cylinder block are followed, rusting may occur.

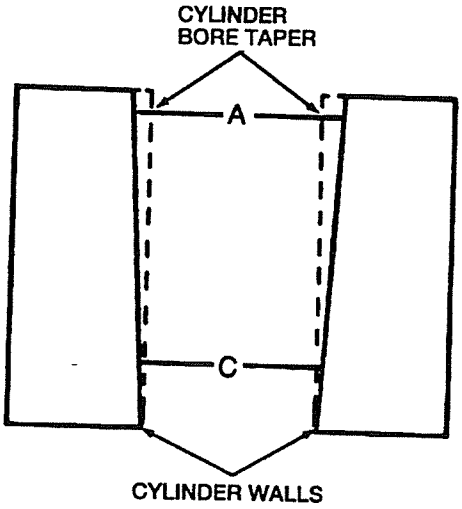
After any cylinder bore service operation, such as honing or deglazing, clean the bore(s) with soap or detergent and water. Then, thoroughly rinse the bore(s) with clean water to remove the soap or detergent. Wipe the bore(s) with a clean lint-free cloth. Finally, wipe the bore(s) with a clean cloth dipped in engine oil.

Inspection

After the cylinder block has been thoroughly cleaned, check it for cracks. Tiny cracks not visible to the naked eye may be detected by coating the suspected area with a mixture of 25 percent kerosene and 75 percent light engine oil. Wipe the part dry and immediately apply a coating of zinc oxide dissolved in wood alcohol. Do not use rubbing alcohol as a substitute. If cracks are present, the coating will become discolored at the damaged area. Replace the cylinder block if it is cracked.
Check all machined surfaces for burrs, nicks, scratches and scores. Remove minor imperfections with an oil stone.

Cylinder Bore Taper

Measure the cylinder bore diameter at points A and C as shown.

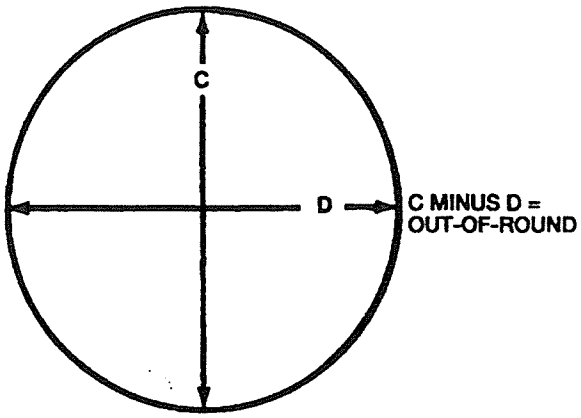


CAUTION: The boring size should be based on the size of an oversized piston.

If the difference between measurements A and C exceeds the maximum taper value of (0.0006 inch (0.015mm), rebore the cylinder to oversize.

Cylinder Out-of-Round

Measure the cylinder bore diameters in the C and D directions.



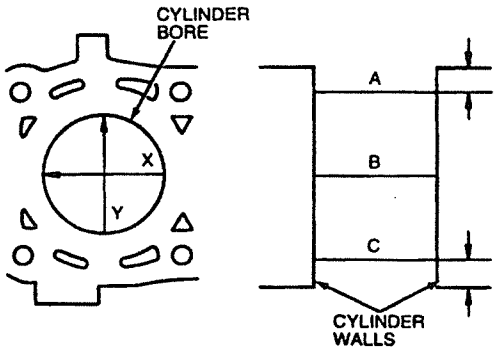
CYLINDER BORE DIAGRAM

CAUTION: The boring size should be based on the size of an oversized piston.

If the difference between measurements exceeds the maximum out-or-round value of 0.0006 inch (0.015mm), rebore the cylinder to oversize.

Cylinder Bore Diameter

Measure X and Y at the three levels shown.



The standard cylinder bore diameter is 2.7953-2.2760 inch (71.000-71.019mm). The maximum variation between readings A, B, and C can be no larger than 0.0007 inch (0.019mm). If the cylinder is not within specification either hone the cylinder or bore the cylinder to bring the cylinder within specification.

Cylinder Wall Honing

Service Tool Description

- Engine Cylinder Hone Set

If the bore out-of-round or taper dimensions exceed the specifications, then cylinder boring is required. This operation must be coordinated with piston selection. It is essential to select the pistons before boring the cylinder block. Then bore according to piston size.

WARNING: DO NOT ALLOW THE HONE TO COME OUT OF THE CYLINDER BORE WHILE IT IS TURNING. THE STONES COULD BE RELEASED AND CAUSE PERSONAL INJURY.

Follow the boring equipment manufacturer's instructions for proper use. Allow 0.0025 inch (0.0735mm) for final honing to size and to give a proper crosshatch pattern of approximately 30 degrees. A newly fit piston should have a piston-to-bore clearance of 0.0015-0.0020 inch (0.030-0.052mm) with a limit of 0.006 inch (0.15mm). Oversize pistons and piston rings are available in 0.010 inch (0.25mm) and 0.020 inch (0.50mm) sizes.

If the cylinders do not require boring, the cylinder walls should be prepared for a new set of piston rings by honing. An Engine Cylinder Hone Set turning approximately 450 rpm and cycling (up and down one time is a cycle) once per second produces a satisfactory pattern. Do not hone more than necessary to produce a pattern the full length of the bore. The cylinder hone set may be purchased with different grit stones.

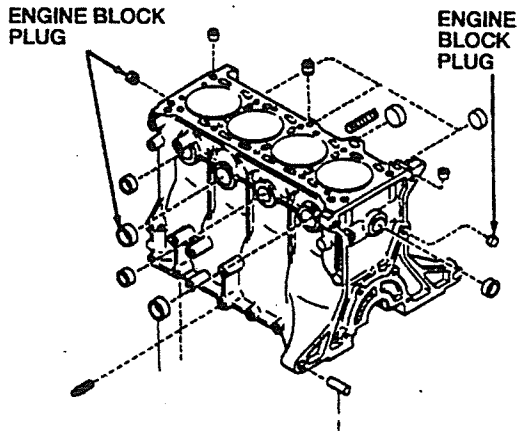
A cylinder wall taper condition can be corrected through the use of an adjustable (non-flexible) hone. Start by setting the non-flexible hone to a diameter slightly larger than the smallest cylinder diameter measurement. To finish the procedure you will need to incrementally increase the diameter of the non-flexible hone until a uniform diameter is obtained at the cylinder walls.

When the cylinder is sized and prepared for the piston, wash it thoroughly with detergent and hot water until a light-colored, lint-free cloth wiped through the bore comes out clean. Then apply engine oil to the cylinder walls.

Engine Block Plugs

Removal and Installation

To remove the oil passage and/or engine block plugs, drill holes in them and pry the engine block plugs out using a large punch or pointed pry bar.



Prior to installing the engine block plug, the plug bore should be inspected for any damage that would interfere with the proper sealing of the engine block plug. If the bore is damaged, it will be necessary to true-up the surface by boring to the next specified oversize engine block plug.

Oversize (OS) engine block plugs are identified by OS stamped in the flat located on the cup side of the engine block plug.

To install the water jacket engine block plugs, measure the engine block plug hole at the inner edge of the cylinder block and select a engine block plug that is the proper size. Apply a 1/8 inch (3.175mm) bead of Pipe Sealant with Teflon to the water jacket engine block plug hole at the inner edge of the cylinder block.

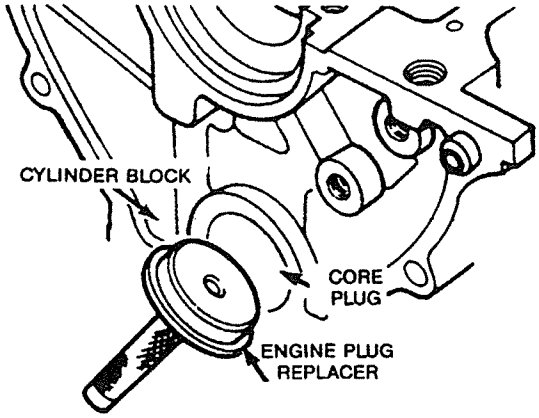
Cup-Type

Service Tool Description

- Engine Plug Replacer

Use Engine Plug Replacer Tool to install cup-type engine block plugs.

Cup-type engine block plugs are installed with the flanged edge outward. The maximum diameter of this engine block plug is located at the outer edge of the flange. The flange on cup-type plugs flares outward with the largest diameter at the outer (sealing) edge.

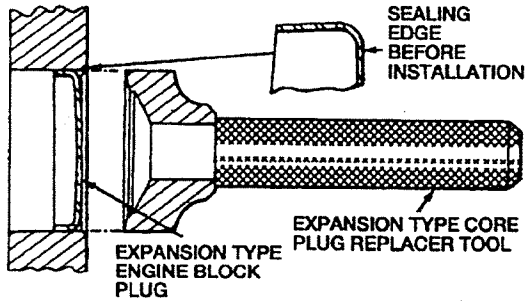


CAUTION: It is extremely important to install the engine block plug in the machined bore using the proper tool. Under no circumstances is the engine block plug to be driven into the bore using a tool that contacts the flange. This method will damage the sealing edge and will result in leakage and/or engine block plug blowout. The flanged (trailing) edge must be below the chamfered edge of the bore.

If the engine block plug replacing tool has a depth seating surface, do not seat the tool against a non-machined (casting) surface.

Expansion-Type

Expansion-type engine block plugs are installed with the flanged edge inward. The maximum diameter of this plug is located at the base of the flange with the flange flaring inward.



CAUTION: It is extremely important to push or drive the engine block plug into the machined bore by using a properly designed tool. Under no circumstances is the engine block plug to be installed using a tool that contacts the crowned portion of the engine block plug. This method will expand the engine block plug prior to installation and may damage the engine block plug and/or machined bore. When installed, the maximum diameter must be set-in the tapered edge of the bore to effectively seal the plugged bore.

If the engine block plug replacing tool has a depth seating surface, do not seat the tool against a non-machined (casting) surface.

Clean the bearings and caps thoroughly in solvent and dry them with compressed air.

Crankshaft Main and Connecting Rod Bearings

Cleaning

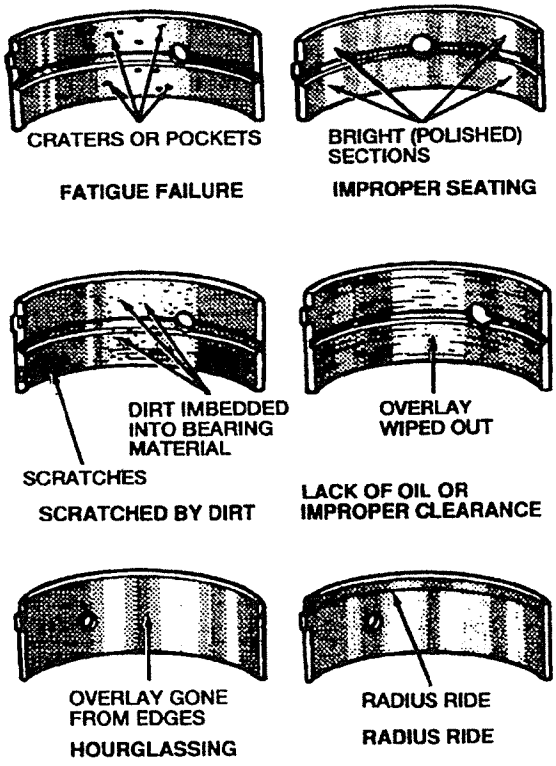
Crankshaft main bearings and connecting rod bearings that are to be reused should be identified so they can be installed in their original locations.

CAUTION: Do not scrape gum or varnish deposits from the bearing shells.

Clean the bearing inserts and caps thoroughly in solvent and dry them with compressed air.

Inspection

Inspect the crankshaft main bearings and connecting rod bearings for peeling, scoring, or other damage.



Bearings that have scored, chipped, or worn surfaces should be replaced. Typical examples of unsatisfactory bearings and their causes are shown. Check the clearance of bearings with Plastigage. Refer to the procedure in this section.

Clean the bearings and caps thoroughly in solvent and dry them with compressed air.

Crankshaft Main or Connecting Rod Bearings - Fitting

Plastigage Method

1. Clean the crankshaft journals. Inspect the journals and thrust faces for nicks, burrs, or roughness that would cause premature bearing wear.

2. Install the upper bearings to be checked.

3. NOTE: Do not rotate the crankshaft when measuring the oil clearances.

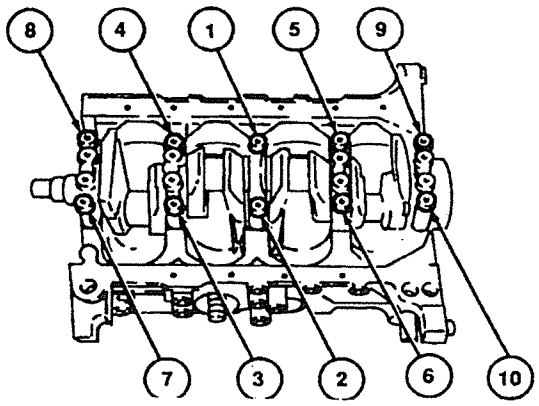
   Position the crankshaft into the cylinder block.

4. NOTE: An unsupported crankshaft and counterweight will compress the Plastigage and cause an erroneous reading.

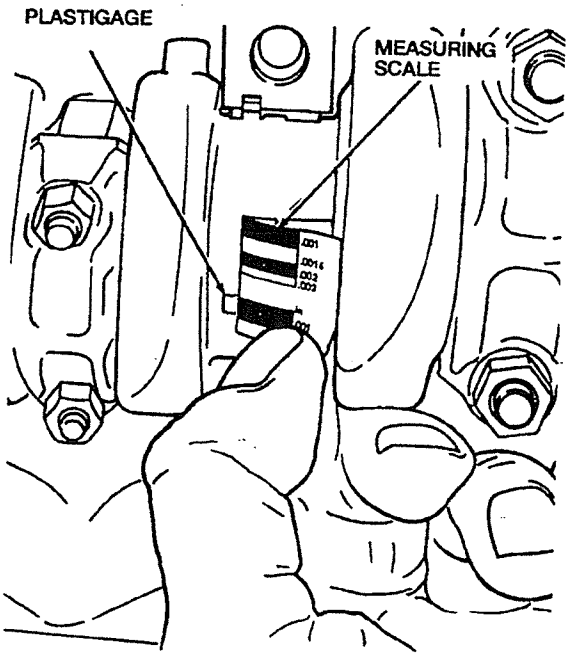
   If performed in-vehicle, leave at least two bearing caps installed at the proper torque or you may receive false readings.

5. Position Plastigage in the axial direction on a bearing that is properly installed in the appropriate main bearing cap.

6. Install the main bearing cap and tighten the main bearing cap bolts to 40-43 lb-ft (54-59 N-m) in the order shown.



7. Remove the main bearing cap and measure the crankshaft main bearing-to-journal clearance. The clearance should be 0.0007-0.0014 inch (0.018-0.036mm). The limit is 0.0039 inch (0.10mm). If the clearance is over the limit, grind the crankshaft and install oversize bearings.



8. If measuring the connecting rod bearing-to-journal clearance, install the lower connecting rod bearing in the connecting rod cap. Position Plastigage in the axial direction on the connecting rod bearing. Install the connecting rod cap and the connecting rod nuts. Tighten the connecting rod nuts to 11-13 lb-ft (15-17 N-m).

9. Remove the connecting rod caps and measure the connecting rod bearing-to-journal clearance. The clearance should be 0.0009-0.0017 inch (0.024-0.042 mm). The limit is 0.0039 inch (0.10 mm). If the clearance is over the limit, grind the crankshaft and install oversize bearings.

Crankshaft

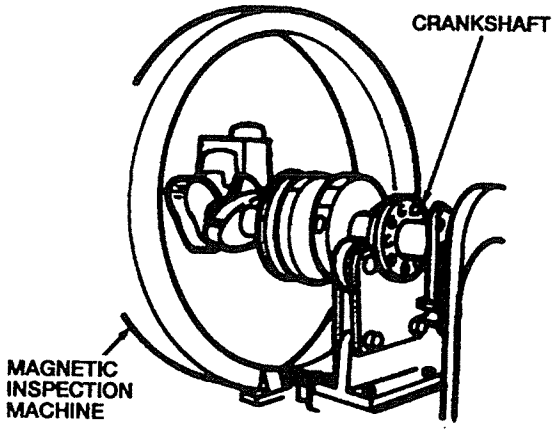
Cleaning

Clean the crankshaft with hot or cold commercial tank solutions, solvents and brushing, or by steam cleaning. Be sure to clean the drilled oil passages that connect the main and connecting journals.

Inspection

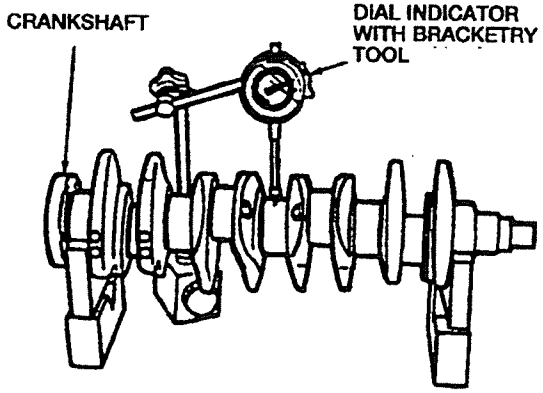
After cleaning, the crankshaft must be inspected to determine if it should be reused, reconditioned, or replaced.

If the crankshaft has been subjected to or will be subjected to high-stress operation, consider a magnetic inspection of the crankshaft for cracks that cannot be seen with the eye. This service is available through most automotive machine shops.



Crankshaft Runout

Support the crankshaft in V-blocks on the end main bearing journals. Set up Dial Indicator with Bracketry to read on the center main bearing journal.



Be sure that the journal surfaces are smooth. Rotate the crankshaft one revolution. Note the maximum variation of the indicator reading. This is the runout of the crankshaft in the center or amount of bow. Consider out-of-round journals when measuring runout. Mark the crankshaft at its high or low reading position. Then support the crankshaft on the center and on one end journal.

Repeat the above procedure, taking the reading on the unsupported end journal. Record this reading.

Repeat the last set-up on the opposite end journal.

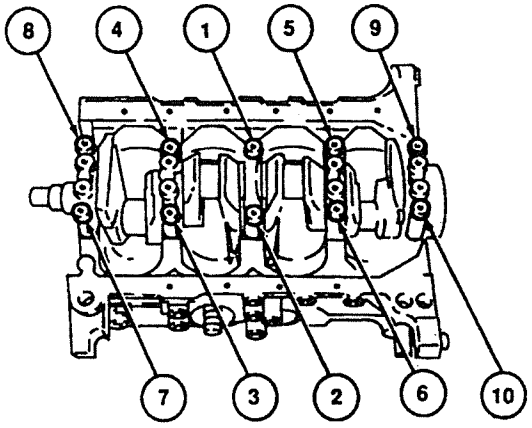
Study the above readings and marks, to know if, where, and how much the crankshaft is bent. Most automotive machine shops are equipped to straighten crankshafts.

Journal runout limit is 0.0016 inch (0.04mm) when inspected with a dial indicator with the crankshaft in 'V-blocks.

Crankshaft End Play

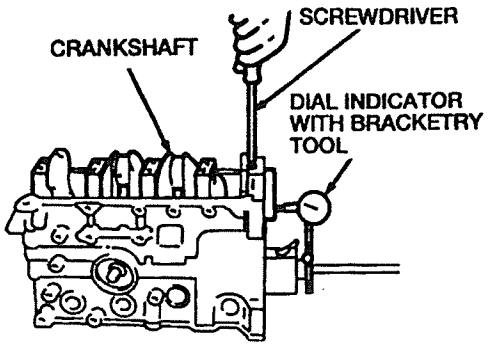
1. Apply a liberal amount of clean engine oil to the crankshaft main bearing, crankshaft thrust bearing, and main journals.

2. Be sure that the bearings are in their proper position. Install the crankshaft and crankshaft main bearing caps and tighten the main bearing cap bolts to 40-43 lb-ft (54-59 N-m) in the order shown.



3. Install the Dial Indicator with Bracketry so the contact point rests against the crankshaft with the indicator axis parallel to the crankshaft axis.

4. Pry the crankshaft towards the rear of the engine.

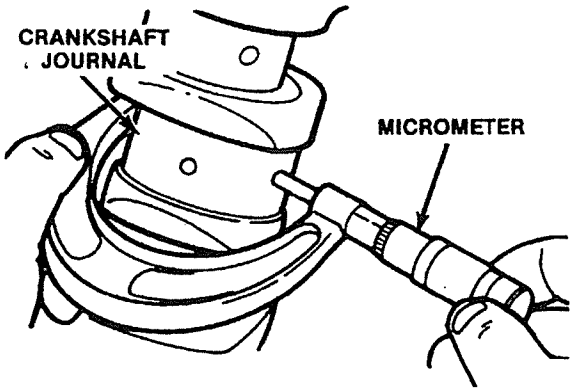


5. Zero the dial indicator.
6. Pry the crankshaft forward and note the reading on the dial.

7. The crankshaft end play should be 0.0031-0.0111 inch (0.080-0.282 mm). If end play exceeds 0.012 inch (0.30 mm), grind the crankshaft and install an oversize crankshaft thrust bearing or replace the crankshaft and crankshaft thrust bearing.

Crankshaft Main Journal and Connecting Rod Journals

Measure the main and connecting rod journals. Measure the journals in eight locations. Write down the figures on a sketch to give a profile of each journal.



A study of the readings will tell if the crankshaft is usable as is, if it must be reground, or if it must be replaced.

Main bearing journal diameter specification: 1.9661-1.9668 inches (49.938-49.956 mm).

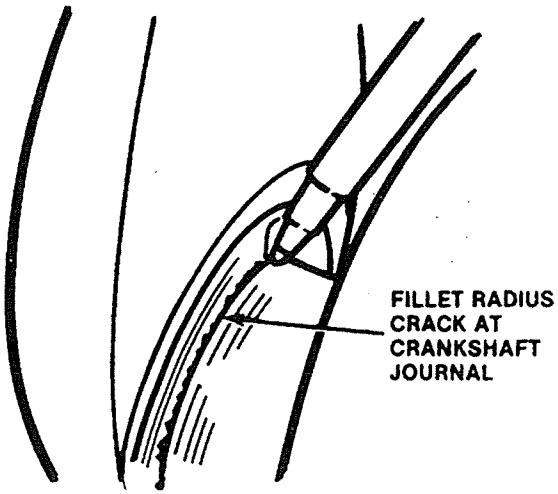
Connecting rod journal diameter specification: 1.5742-1.5731 inches (39.940-39.956 mm).

Main and connecting rod journal out-of-round limit: 0.002 inch (0.05 mm).

Journals, Refinishing

Crankshaft grinding is necessary to straighten and restore journals to a round condition. Crankshaft grinding should be done only by experienced professionals.

CAUTION: Failure to maintain the original fillet radius at the line where the journal meets the counterweight of the crankshaft can result in crankshaft damage.



The grinding limit is 0.030 inch (0.75 inch). Undersize bearings are available in 0.010 inch (0.25mm), 0.20 inch (0.50 mm) and 0.30 inch (0.75 mm) sizes. The fillet radius must be maintained at 0.12 inch (3 mm).

Make sure the crankshaft is polished and recleaned (especially the oil passages) after grinding it and before installing it in the engine.

Crankshaft Sprocket

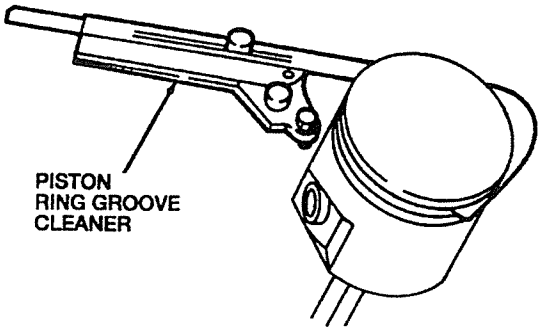
Inspect the crankshaft sprocket for warping, chipping, or abnormal wear. Inspect the crankshaft sprocket teeth for wear, deformation, chipping, or other damage. If necessary, replace the pulley as explained in Section 11-01.

Pistons, Piston Pins and Piston Rings

Cleaning

Clean the ring grooves with Piston Ring Groove Cleaner. Do not cut into the piston metal.

Carbon may be cleaned from the top of the piston with a wire brush or wheel. Do not use a wire wheel on the piston ring grooves or lands. Clean the oil drain holes in the oil ring grooves. Do not drill additional oil drain holes. Clean the remainder of the piston with solvent and a brush. Do not use a caustic (lye base) or acid cleaning solution.



Inspection

Inspect the piston for scores, cracks, excessively worn piston pin bores, pitted or eroded dome, worn piston ring grooves, and piston skirt diameter.

Carefully inspect the pistons for fractures at the ring lands, skirts, and pin bosses. Check for scuffed, rough, or scored skirts. If the lower inner portion of the ring grooves have high steps, replace the piston. This step will interfere with piston ring operation and cause excessive piston ring side clearance.

Spongy, eroded areas near the top of the piston are usually caused by detonation or premature ignition. A shiny thrust surface, offset from the centerline between the piston pin holes, can be caused by a bent connecting rod. Replace pistons showing signs of excessive wear, irregular or fractured ring lands, or damage from detonation and premature ignition.

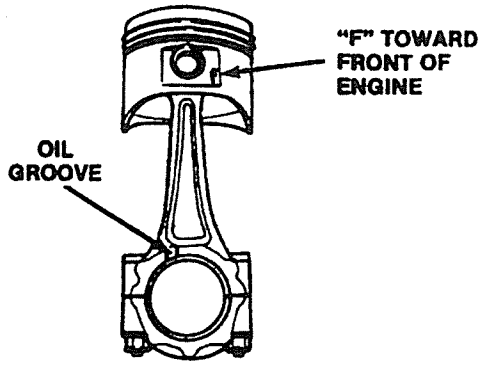
Inspect the outer circumferences of all pistons for seizure or scoring. Replace the piston if necessary.

Pistons - Fitting

Service Tool Description

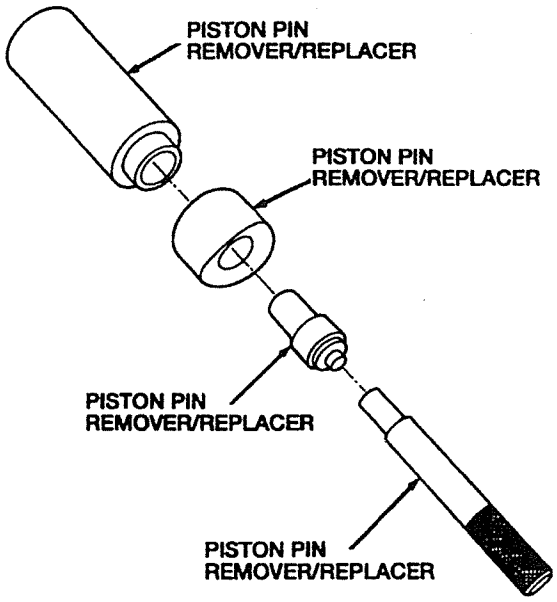
- Piston Pin Remover/Replacer

NOTE: The oil groove on the connecting rod and the F mark on the piston should be on the same side



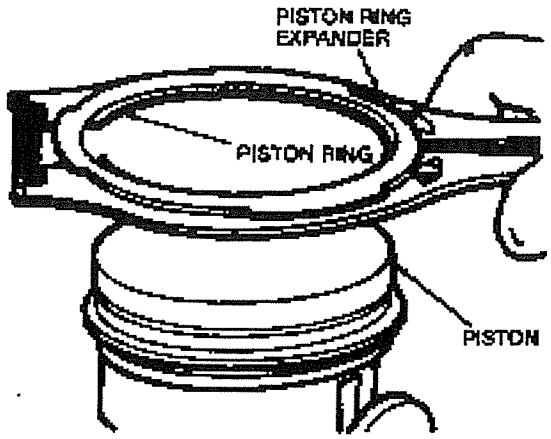
Keep the connecting rods and caps with matching numbers together. Use the proper tools to disassemble and assemble the piston, piston pin, and connecting rod. Extensive damage can result if the wrong tools are used. The piston pins are interference press fit in the connecting rod.

The proper tools for disassembling and assembling the connecting rod and piston are shown in the following illustration.

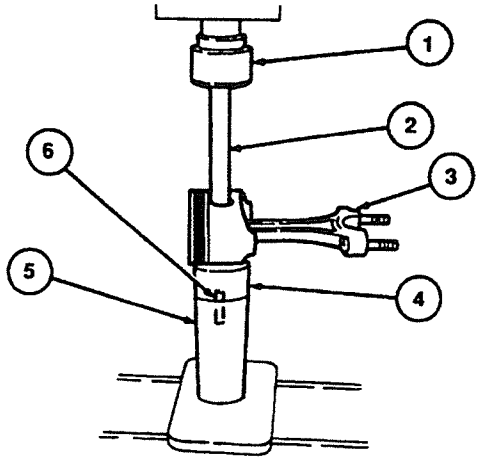


1. **CAUTION: Use care not to scratch the pistons.**

   Remove the piston rings with a piston ring expander.



2. Place the connecting rod and piston assembly onto Piston Pin Remover/Replacer between the press ram and the piston pin.



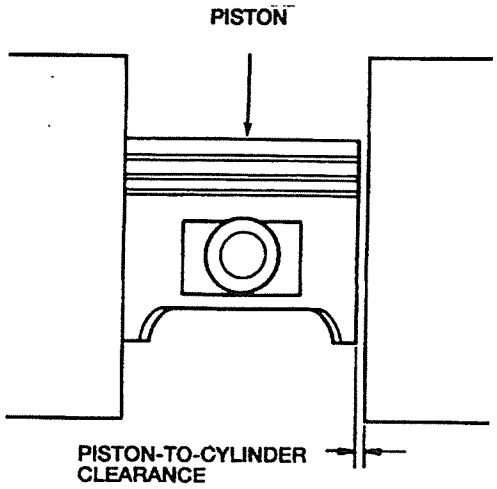
3. Press the piston pin out of the connecting rod and piston. The piston pin should enter the hollow portion of Piston Pin Remover/Replacer. While pressing the piston pin from the piston, check the press pressure. If the press pressure is lower than 1100 lb-ft (4905 N-m), replace the piston pin or connecting rod. Adjust the piston and connecting rod position on the press if necessary to align with the Piston Pin Remover/Replacer. Keep the piston pin with the piston it came from.

Item	Part Number	Description
1	-	Press
2	-	Piston Pin Remover/Replacer
3	-	Connecting Rod and Piston Assy
4	-	Piston Pin Remover Replacer
5	-	Piston Pin Remover/Replacer
6	-	Piston Pin Remover/Replacer

4. To install the piston pin, lubricate the piston pin and insert it between the piston and Piston Pin Remover/Replacer. Use an arbor press and press the piston pin into the piston. If the press pressure is lower than specifications, replace the piston pin or connecting rod.

Piston-to-Cylinder Clearance

The piston-to-cylinder wall clearance limit is 0.006 inch (0.15mm). Oversize pistons and piston rings are available in 0.10 inch (0.25mm) and 0.020 inch (0.50mm) sizes.

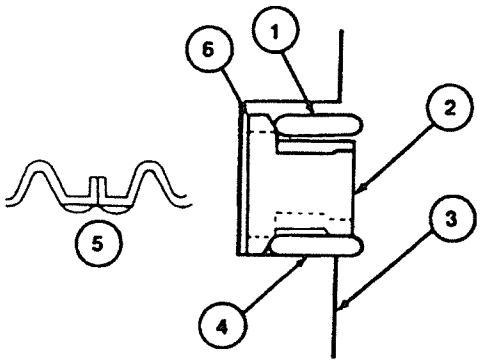


Piston Rings - Fitting

1. Install an oil ring spacer in the bottom ring groove of the piston. The ends of the oil ring spacer must butt one another and not overlap.

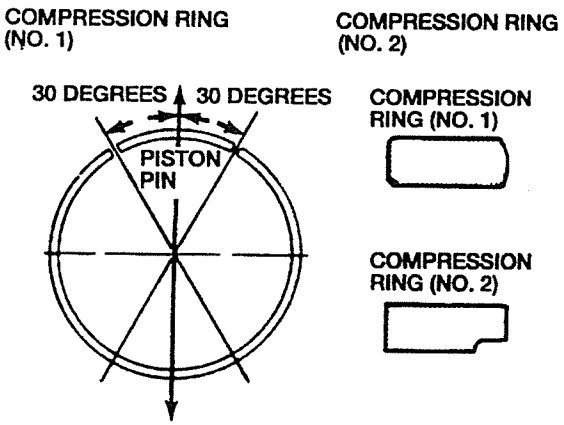
2. Start the end of an oil ring into the oil ring groove above the spacer. The end gap must be approximately one (1) inch (25.4mm) away from the spacer ends. Finish installing the oil ring by spiraling it on the remainder of the way. Repeat the oil ring installation with the other oil rail. Its gap must be approximately one (1) inch (25.4mm) on the other side of the spacer ends.

3. Stagger the ring end gaps so that no ring gap is aligned with either the spacer gap or the other ring gap.



Item	Part Number	Description
1		Upper Oil Ring
2		Oil Ring Spacer
3		Piston
4		Lower Oil Ring
5		Oil Ring Spacer Ends
6		Oil Ring Spacer Tang

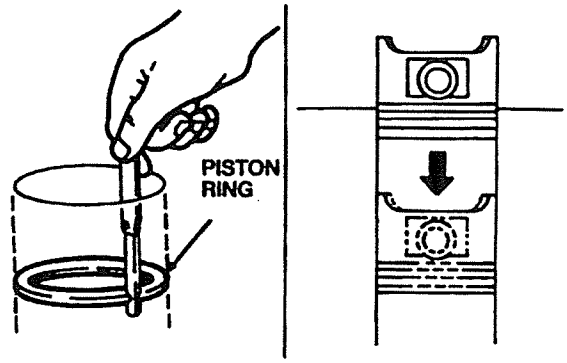
4. Select the No. 2 compression piston ring and install it in a piston ring expander with the proper side up. See instructions on the piston ring package. Spread the piston ring and install it in the piston ring groove.. Repeat step 3 with the top compression ring. Space the compression ring gaps approximately two (2) inches (50.8mm) on opposite sides of the oil ring gaps.



Piston Ring End Gap

Insert the piston ring into the cylinder head by hand and use the piston to push the piston ring to the bottom of the piston ring travel area.

Use a feeler gauge to measure the ring opening clearance (end gap).

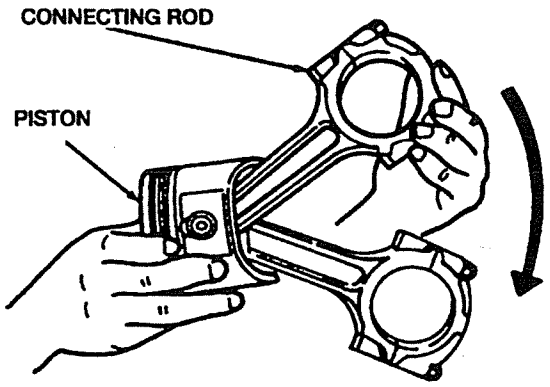


The minimum and maximum limits are as follows:
Top Ring: 0.006-0.012 inch (0.15-0.30 mm)
Second Ring: 0.006-0.12 inch (0.15-0.30 mm)
Oil Ring: 0.08-0.028 inch (0.20-0.70mm).

The oil ring clearance maximum limit is 0.039 inch (1.0 mm).

Piston and Piston Pin Fit

The piston pin-to-piston clearance should be 0.0003-0.0005 inch (0.0076-0.0127mm). The connecting rod should fall by its own weight when held horizontally by the piston.



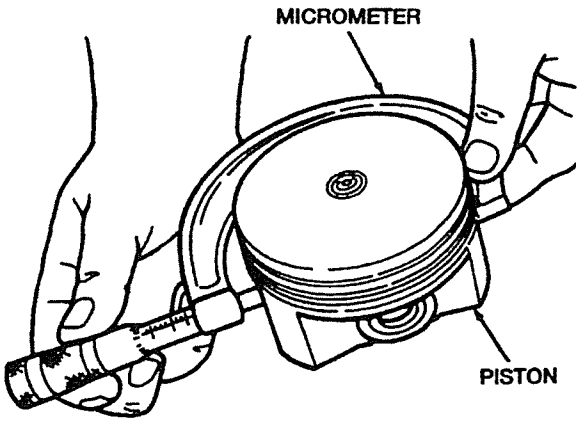
Piston Pin-to-Piston Clearance

Inspect the pin-to-piston clearance. The standard pin-to-piston clearance is 0.0003-0.0005 inch (0.0076-0.0127mm). If the clearance exceeds the specification, replace the piston and/or piston pin.

Piston Outer Diameter

Measure the outer diameter of each piston, and ensure the clearance between the piston and cylinder is correct.

NOTE: Measure the piston outer diameter at a right angle (90 degrees) to the piston pin and below the oil ring groove.



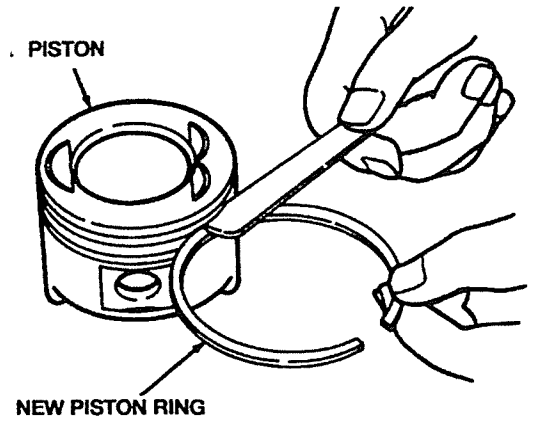
Standard size piston diameter is 2.793-2.794 inches (70.954-70.974 mm).

Piston Rings

Inspect the piston rings for damage, abnormal wear, or damage. Replace if necessary.

Piston Ring-to-Groove Clearance

Measure the ring-to-groove clearances. The top and second ring clearance is 0.001-0.003 inch (0.03-0.65 mm). The limit is 0.006 inch (0.15 mm).

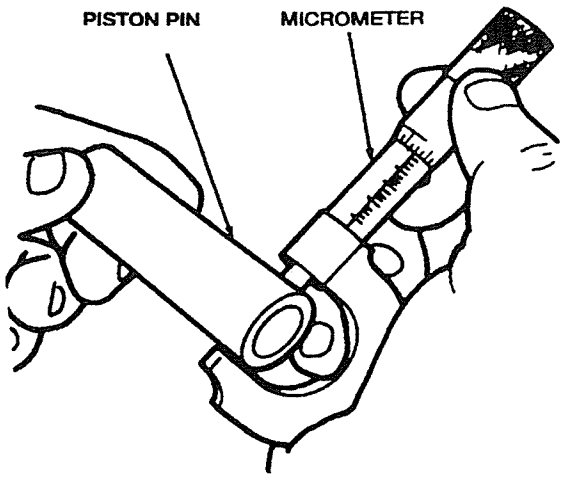


Piston Pin Hole Diameter

The pin hole diameter is 0.524 inch (13.309mm).

Piston Pin Diameter

The piston pin outside diameter is 0.7866 inch (19.980 mm).



Connecting Rods

Piston Pin Clearance

An interference fit of 0.0000-0.0102 inch (0.00-0.26mm) should exist between the piston pin outer diameter (OD) and the connecting rod inner diameter (ID).

Cleaning

Connecting rods may be cleaned in hot or cold commercial tank-type cleaners. They may also be cleaned with automotive parts cleaning solvents or steam cleaned.

Inspection

The connecting rod and related parts should be carefully inspected for conformance to specifications. Various forms of engine wear caused by these parts can be readily identified as follows:

- A shiny surface on the pin boss side of the piston usually indicates that a connecting rod is bent or a piston pin hole is not in proper relation to the piston skirt and ring grooves.
- Abnormal connecting rod bearing wear can be caused by either a bent connecting rod, an improperly machined journal, or a tapered connecting rod bore.
- Twisted connecting rods will not create an easily identifiable wear pattern. Badly twisted connecting rods will disturb the entire action of the piston, pin and piston ring, and connecting rod assembly and may be the cause of excessive oil consumption.

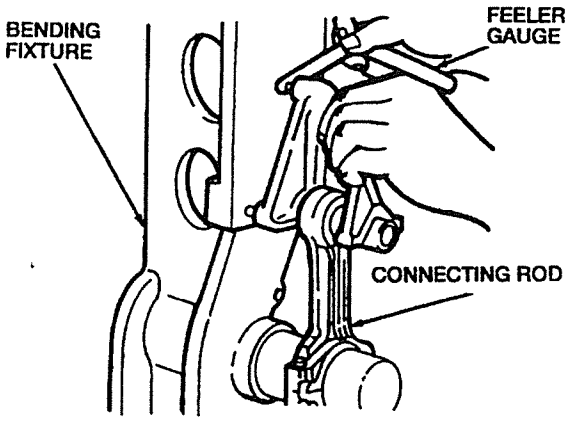
NOTE: It is not necessary to ream or hone the pin bore in the connecting rod bearing. Replace the damaged connecting rod nuts and bolts. Check the connecting rod for bends or twists on a suitable alignment fixture. Follow the manufacturer's instructions for the specific alignment fixture being used. If the bend and/or twist exceeds the specifications, the connecting rod must be replaced.

Inspect the connecting rods for signs of fractures and the bearing bores for out-of-round and taper. If the bore exceeds the recommended limits and/or if the connecting rod is fractured, it should be replaced. Measure the diameter of the connecting rod piston pin bore.

Assemble the piston, piston pin, and connecting rod following the procedures outlined.

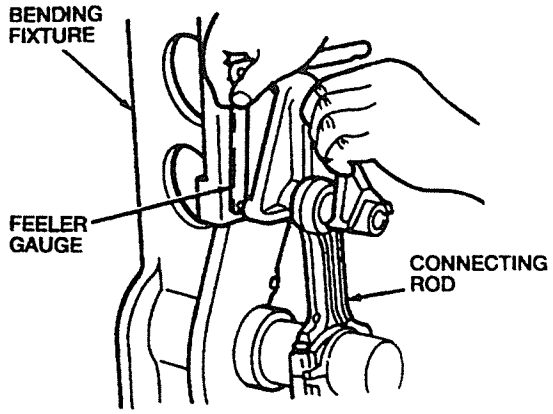
Connecting Rod Bending Clearance

The connecting rods should be inspected for proper piston pin bore diameter, crankshaft bearing bore diameter, length, bend, and twist.



Use a bending fixture and a feeler gauge to inspect the connecting rod bending clearance.

The bend limit is 0.0016 inch (0.04mm) per 3.94 inches (100mm).The twist limit is 0.0016 inch (0.04 mm) per 3.94 inches (100mm).



Camshaft and Cylinder Head Journals

Cleaning

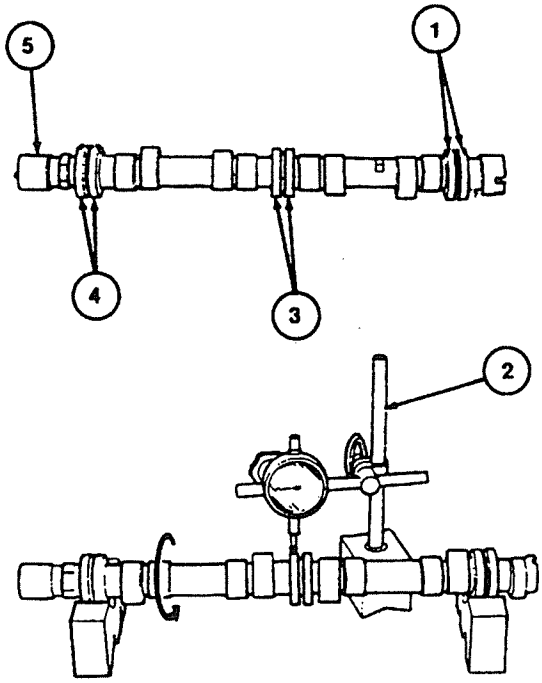
The camshaft may be cleaned by tank cleaning, solvents, or by steam cleaning.

Remove light scuffs, scores, or nicks from the camshaft machined surfaces with a smooth oil stone. Clean camshaft in solvent and wipe dry.

Inspection

Camshaft Runout

Check the camshaft runout with Dial Indicator and Bracket. The limit at the center journal is 0.0012 inch (0.03mm).



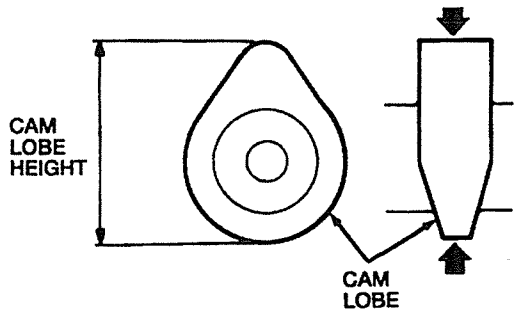
Item	Part Number	Description
1		Rear Journal
2		Dial Indicator with Bracketry
3		Center Journal
4		Front Journal
5		Front Oil Seal Contact Surface

Cam Lobes

Inspect the camshaft lobes for scoring and signs of abnormal wear. Lobe pitting, except in the general area of the lobe toe, is not detrimental to the operation of the camshaft. Do not replace the camshaft unless the lobe lift loss has exceeded specification or pitting has occurred in the lobe lift area.

Cam Lobe Heights

Inspect the camshaft lobe heights at the points shown.

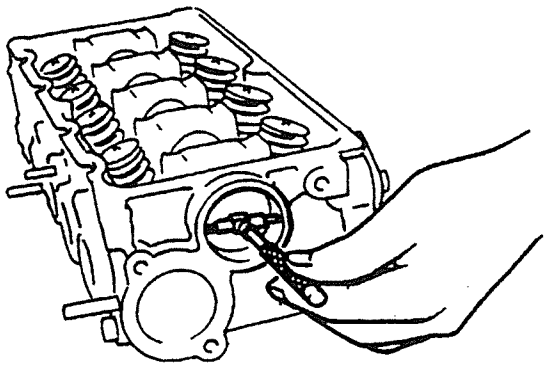


The standard intake lobe height is 1.4222 inches (36.124 mm). The minimum height is 1.4025 inches (35.624 mm).

The standard exhaust lobe height is 1.4332 inches (26.404 mm). The minimum height is 1.4135 inches (5.904 mm).

Camshaft Journal Oil Clearance

1. Measure the camshaft bores in the cylinder head.



The front and rear camshaft bore diameter should be 1.7124-1.7135 inch (43.495-43.525 mm).

The center camshaft bore diameter should be 1.7126-1.7135 inch (43.500-43.525 mm).

2. Measure the journal diameters. Refer to the procedure in this section.

3. Subtract the camshaft bearing journal outer diameter from the cylinder bore inner diameter to obtain the oil clearance.

The front and rear bearing bore oil clearance specification is 0.0014-0.0033 inch (0.035-0.085 mm).

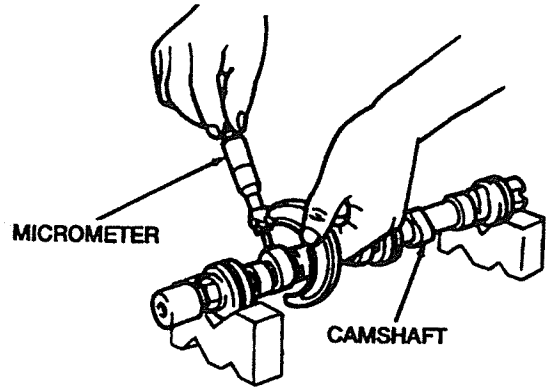
The center bearing oil clearance is 0.0026-0.0045 inch (0.065-0.115 mm).

The limit is 0.0059 inch (0.15 mm).

If the oil clearance exceeds the limit, replace the cylinder head and/or the camshaft.

Camshaft Journal Diameters

Measure the bearing journals. Standard diameter of the front and rear journals is 1.7103-1.7112 inches (43.440-43.465 mm). The center journal is 1.7079-1.7100 inches (43.410-43.435 mm).



The out-of-round limit on all journals is 0.002 inch (0.05 mm).

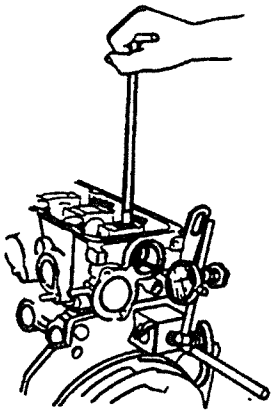
The front oil seal contact surface is 1.1796-1.1811 inches (29.961-30.000 mm).

Camshaft End Play

1. NOTE: Measure the camshaft end play with the camshaft thrust plate in position.

   Install Dial Indicator with Bracket, so the contact point rests against the end of the camshaft with the indicator axis parallel to the camshaft axis.

2. Pry the camshaft towards the rear of the cylinder head.



3. Zero the dial indicator.

4. Pry the camshaft forward and note the reading on the dial indicator.

5. Standard end play is 0.002-0.007 inch (0.05-0.18mm) with a limit of 0.008 inch (0.20mm). If the end play exceeds the limit, replace the camshaft thrust plate or the camshaft.

Camshaft Sprocket

Inspect the camshaft sprocket for warping or abnormal wear. Inspect the sprocket teeth for wear, deformation, chipping, or other damage. If necessary, replace the sprocket. Refer to Section 11-01 for the removal and installation procedure.

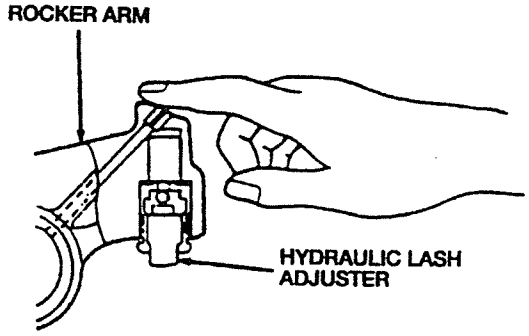
Hydraulic Lash Adjusters

Cleaning

Thoroughly clean all the parts in clean solvent and wipe them with a clean, lint-free cloth.

Inspection

Inspect Hydraulic Lash Adjuster operation by pushing down each rocker arm by hand. If a rocker arm moves down, replace the Hydraulic Lash Adjuster.



Oil Pump

Cleaning

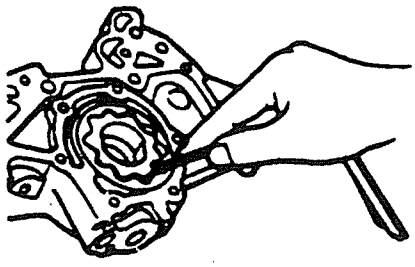
Wash all parts in a solvent and dry them thoroughly with compressed air. Use a brush to clean the inside of the oil pump housing and the relief valve chamber. Ensure all dirt and metal particles are removed.

Inspection

Rotor Clearance

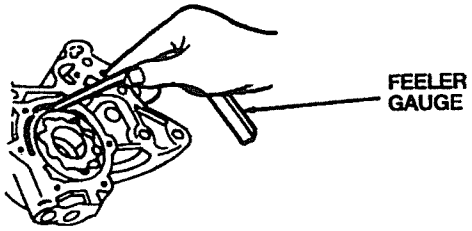
Tooth Tip Clearance

Use a feeler gauge to inspect the tooth tip clearance. Measure the inner gear tip to outer gear tip clearance. The clearance should be 0.0078 inch (0.198 mm) maximum.



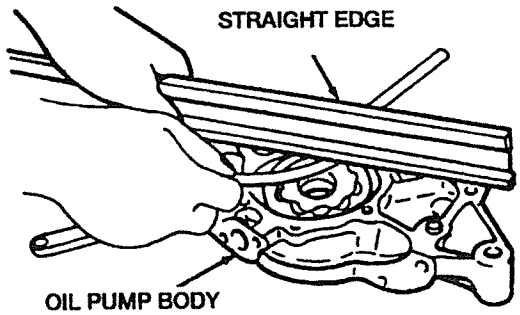
Outer Rotor-to-Pump Body Clearance

Inspect the oil pump body for scoring in the outer gear bore. Disregard light scoring. Measure the body (housing) to outer gear clearance with a feeler gauge. The outer race-to-housing clearance should be no more than .0087 inch (0.22mm).



Inner Rotor Side Clearance

Use a feeler gauge and Straight Edge to measure the inner rotor side clearance.

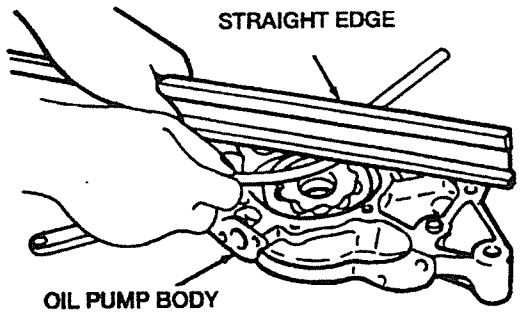


The limit is 0.0055 inch (0.14mm).

If the above clearance is out of limits, replace the gears or body. Clean the relief valve and check for scores, burrs, or sticking. Repair as necessary.

Outer Rotor Side Clearance

Use a feeler gauge and Straight Edge to measure the outer rotor side clearance.



The limit is 0.0055 inch (0.14 mm).

If the above clearance is out of limits, replace the gears or body. Clean the relief valve and check for scores, burrs, or sticking. Repair as necessary.

Oil Pan

Cleaning

Scrape any dirt or metal particles from the inside of the oil pan. Scrape all old oil pan gasket material from the gasket surface. Wash the oil pan in a solvent and dry it thoroughly. Ensure all foreign particles are removed.

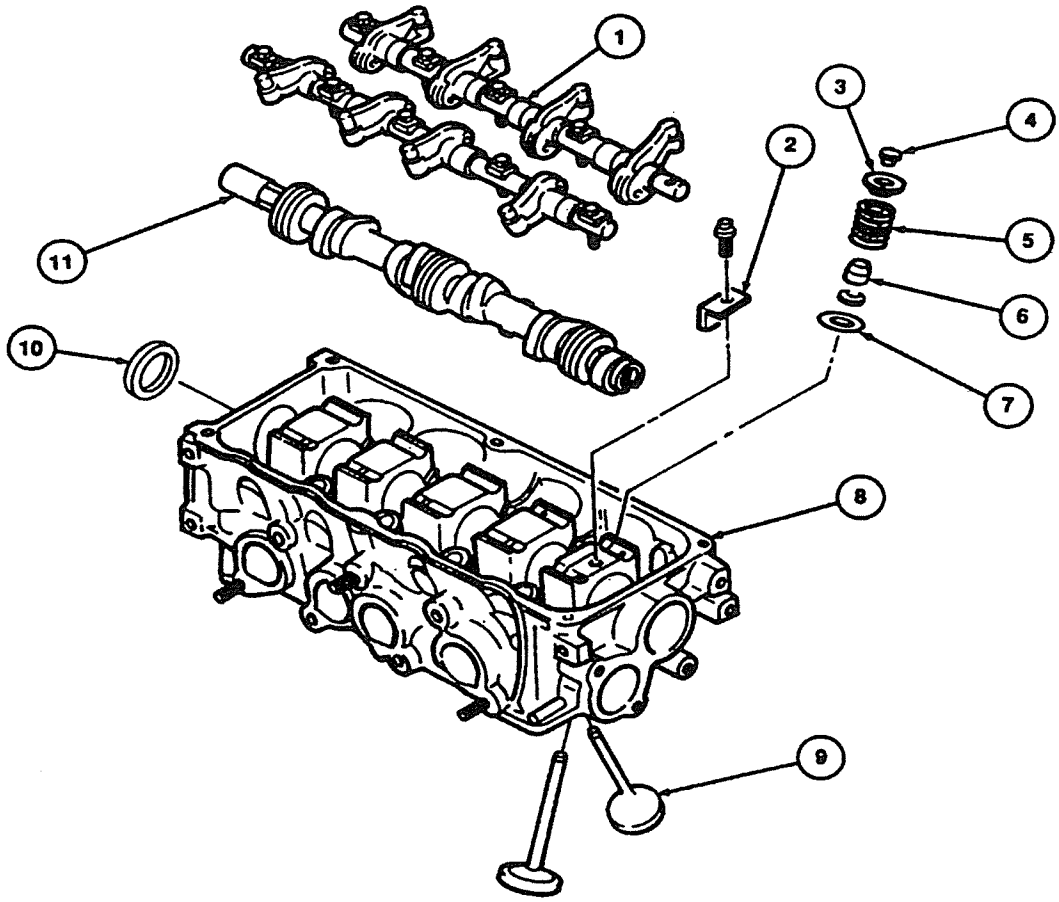
Inspection

Check the oil pan for cracks, holes, or damaged oil pan drain plug threads. Check the gasket surface for damage caused by over-tightened bolts. Replace with a new oil pan if repairs cannot be made.

Cylinder Head

The following illustration is an exploded view of the cylinder head and related components.

Cylinder Head - Exploded View



Item	Part Number	Description
1	-	Rocker Arm And Shaft Assembly
2	-	Camshaft Thrust Plate
3	-	Valve Spring Retainer
4	-	Valve Spring Retainer
5	-	Valve Spring Retainer Key
6	-	Valve Stem Seal
7	-	Valve Spring Retainer
8	104026	Cylinder Head
9	-	Exhaust Valve
	-	Intake Valve
10	-	Camshaft Oil Seal
11	-	Camshaft

Cleaning

The cylinder head may be cleaned with commercial hot or cold tank-type cleaners, with automotive parts cleaning solvents, or by steam cleaning. Clean the intake and exhaust ports with a small wire wheel and a drill motor. Be careful not to allow the drill chuck to contact the valve seats. Remove all gasket material from the valve cover gasket surface, head gasket surface, the exhaust and intake manifold surfaces, and the water outlet connection surface.

Use a valve guide cleaning tool and a small bristle brush to clean the valve guide bores.

Clean the cylinder head oil passages.
Clean the deposits from the valves with a wire wheel.

CAUTION: If the valve springs are painted, do not use a wire brush or paint remover to clean them. They could rust, become pitted, and break.

Remove deposits from the valve springs and valve spring retainers.

Inspection

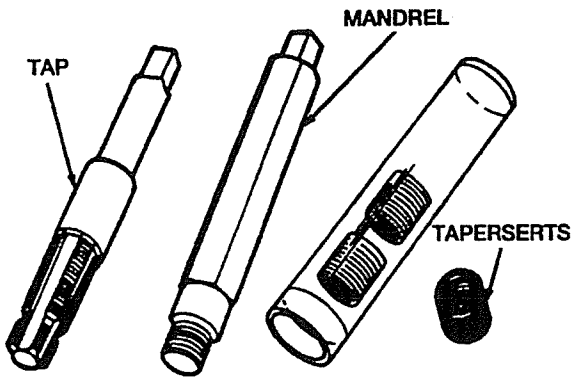
Inspect the cylinder head for cracks in valve seats and ports, at coolant passage holes, and between combustion chambers.

Spark Plug Thread Service

Damaged spark plug threads in the cylinder head can be serviced using Tapersert Installation Kit.

The procedure involves cutting new threads in the spark plug hole. After the rethreading operation, a tapered sleeve will be installed in the cylinder head. The sleeve is threaded on the inside and outside. The outside threads thread into the cylinder head while the inside thread is for the spark plug.

This service is permanent and will have no affect on cylinder head or spark plug life.



1. **CAUTION: Do not use power or air-driven tools to install the Taperserts.**

   CAUTION: The cylinder head must be removed from the engine before installing a Tapersert. The service procedure includes a thread cutting process which produces metal chips. Performing this procedure while the cylinder head Is on the engine will cause metal chips to fall Into the cylinder. Once in the cylinder, these chips can damage the cylinder wall when the engine is started.

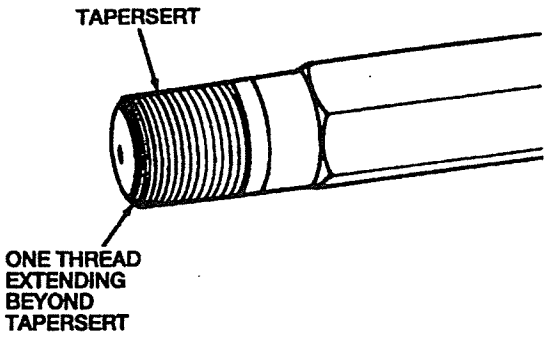
Thoroughly clean the spark plug counterbore, seat, and threads of all dirt or other foreign material.

2. Start the tap into the spark plug hole, being careful to keep it properly aligned. As the tap begins cutting the new threads, apply aluminum cutting oil to the tap.

   Continue cutting threads and applying oil until the stop ring bottoms against the spark plug seat.

3. Remove the tap. Remove all metal chips using compressed air.

4. Coat the threads of the mandrel with cutting oil. Thread the Tapersert onto the mandrel until one thread of mandrel extends beyond the Tapersert.



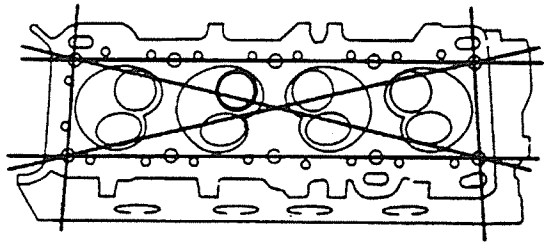
5. NOTE: A properly installed Tapersert will be flush to one millimeter below spark plug gasket seal.

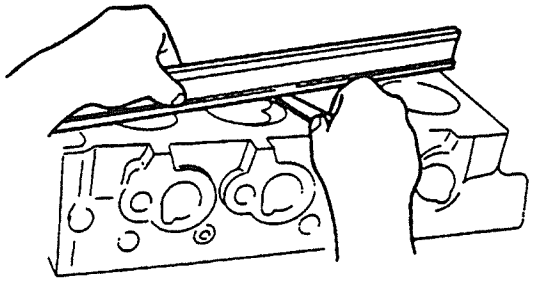
   Thread the Tapersert into the tapped spark plug hole using a torque wrench. Continue tightening the mandrel until the torque wrench indicates 45 ft-lb (61N-m).

6. To loosen the mandrel for removal, hold the mandrel stationary and turn the mandrel body approximately one-half turn. Remove the mandrel.

Cylinder Head Flatness

Check the cylinder head for flatness on the head gasket surface. The cylinder head must be within 0.006 inch (0.15 mm) over the entire cylinder head area.





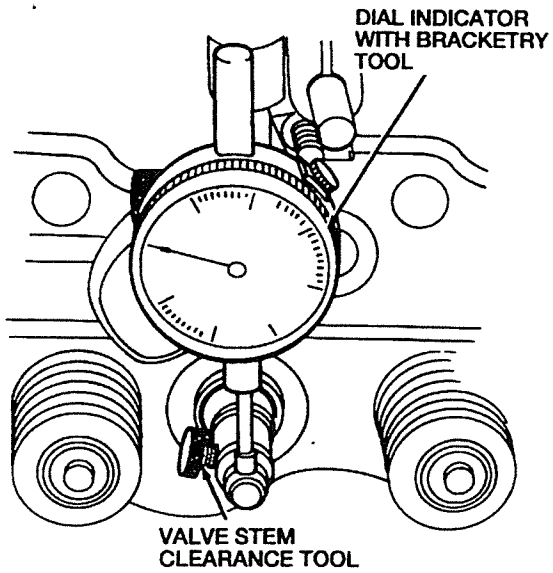
Valve Seat Runout

Before assembling the valves into the cylinder head, check the valve seat runout.

The seat face runout should not exceed 0.0016 inch (0.0406 mm).

Valve Stem-to-Valve Guide Clearance

Check the valve stem-to-valve guide clearance of each valve in its respective valve guide with Valve Stem Clearance Tool and Dial Indicator with Bracket. Use a flat-end indicator point.



Install the tool on the valve stem until the lip is fully seated, and tighten the knurled set screw firmly. Permit the valve to drop away from its seat until the tool contacts the upper surface of the valve guide.

Position the dial indicator on the cylinder head. Move the valve back and forth 90 degrees from the dial indicator shaft. Divide the measurement by two to determine the actual guide clearance.

The intake clearance is 0.0010-0.0024 inches (0.025-0.060 mm). The exhaust clearance is 0.0012-0.0026 inches (0.030-0.065 mm).

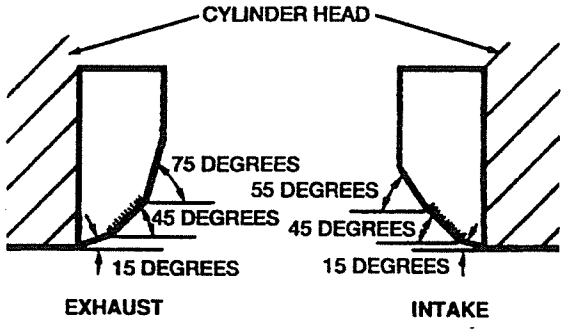
The maximum stem-to-valve guide clearance is 0.008 inch (0.20 mm).

If the clearance exceeds specification, replace the valve and/or valve guide.

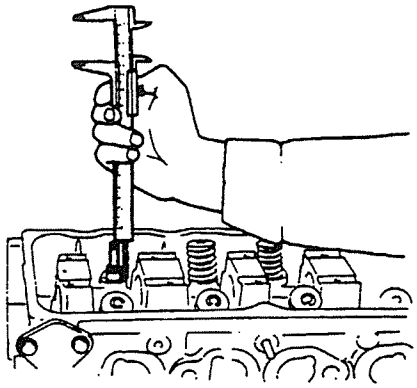
Valve Seats, Refacing

Cylinder head valve seats must be round, have the correct seat angle, face width, and be free of pits or burned areas.

The valve seat angle is 45 degrees. The valve seat face width is 0.043-0.067 inch (1.1-1.7 mm).



After grinding the seats, check the valve seat wear. This dimension will affect valve spring-load (pressure). With the valve on the seat, measure the distance from the lower spring seat surface on the cylinder to the end of the valve stem. Use the following specifications to determine if replacement is necessary:



1. If the dimension is 1.520-1.539 inches (38.6-39.1 mm), then use valve and seat as is.

2. N dimension is 1.539-1.579 inches (39.2-40.1 mm), then insert a spring seat shim of between 0.010 inch (0.25mm) and 0.060 inch (1.5 mm) between the valve spring and the cylinder head.

3. If dimension is more than 1.579 inches (40.1 mm), replace the cylinder head or valve seat. The valve seats must be replaced by a qualified machine shop facility.

If necessary, grind the valve seats to a 45 degree angle. Follow the instructions of the seat grinding equipment manufacturer. Be sure to use a tight fitting, straight pilot in the valve guide. Do not remove more metal than necessary to clean the seat.

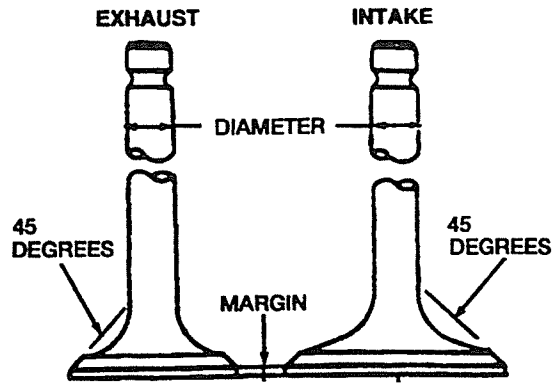
Valves

Valves, Inspection

Inspect each valve for damaged or bent stems, a rough or damaged face, and damaged or unevenly worn stem tips.

Valves, Refacing

If necessary, reface the valves to a 45 degree angle following the valve grinding equipment manufacturer's recommendations. Remove as much stock from the end of the valve stem as the total removed from the seat and valve face. Bevel the edge of the valve stem end after grinding the end of the stem.

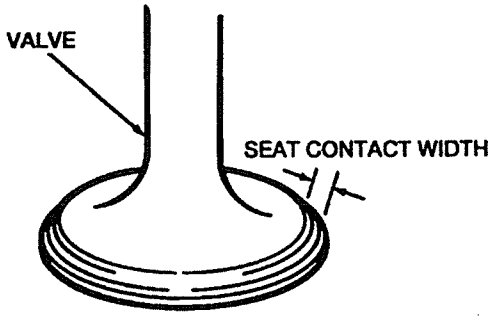


Valve Seat Contact Width

The center of the valve face should contact the seat in approximately the center of the valve seat.

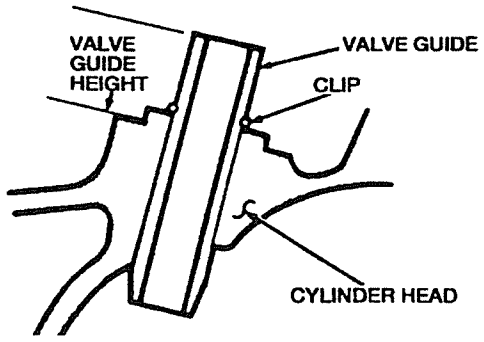
Lower the seat as required with a 15 degree or 30 degree stone seat cut. If contact is correct but the seat is too wide, trim the bottom of the seat with a 60 degree or 70 degree stone. After grinding, the seat will almost always be too wide, so some narrowing is usually necessary.

The final valve seat width should be 0.043-0.067 inch (1.1-1.7mm).



Valve Guide Height

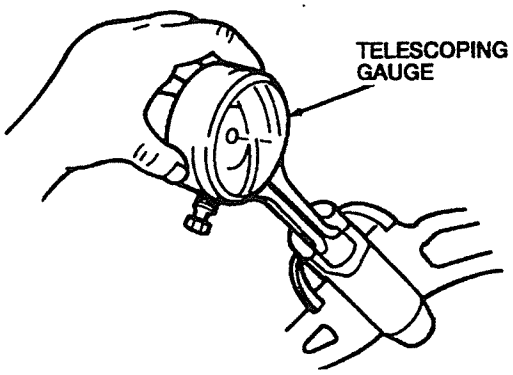
Measure the height of each valve guide.



The height of each valve guide should be within 0.520-0.543 inch (13.2-13.8 mm). The valve guide height limit is 0.518-0.5512 inches (13-14mm).

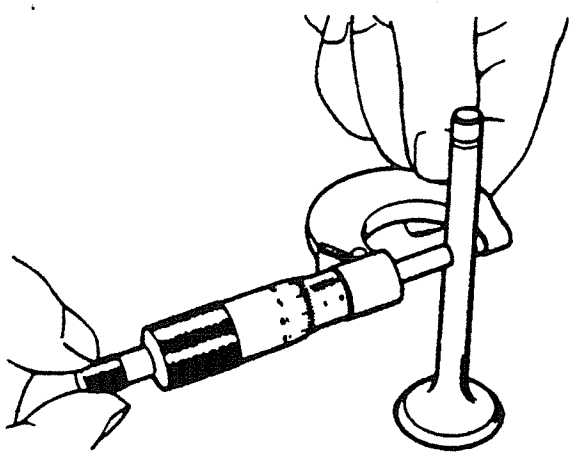
Valve Guide Inner Diameter

Inspect the valve guide bores for proper size. A telescoping gauge and a 1 inch (25.4 mm) micrometer should be used. The intake and exhaust guide bores should be 0.276-0.277 inch (7.01-7.03mm). Intake and exhaust valve stem-to-guide service limit clearance is 0.008 inch (0.20 mm).



Valve Stem Diameter

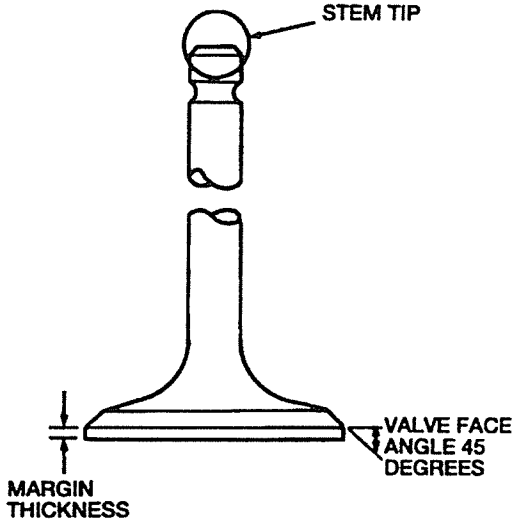
Measure the valve stem diameters. The intake valve stems are 0.27244-0.2750 inch (6.970-6.985mm) and the exhaust stems are 0.2742-0.2748 inch (6.965-6.980 mm).



If the clearance is greater than specified, replace the valve or valve guide, or both, depending on the dimension that is causing the excess clearance.

Valve Head Margin Thickness

Inspect the valve head margin thickness of each valve.

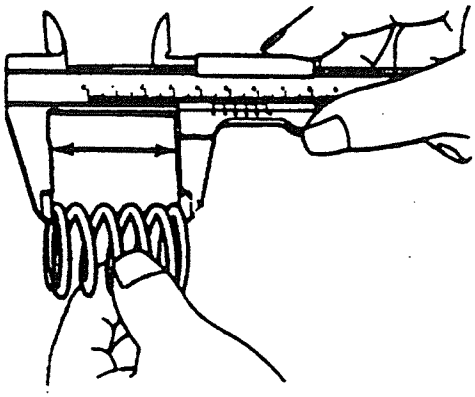


The exhaust valve head margin thickness is 0.039 inch (1.0mm).

The intake valve head margin thickness is 0.051 inch (1.30mm).

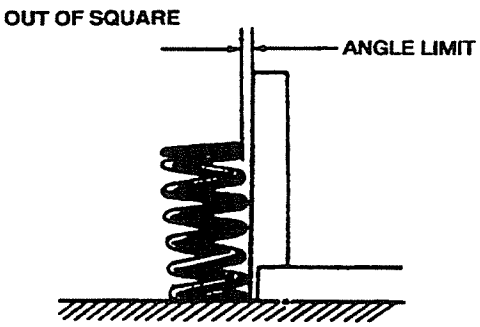
Valve Spring Length Inspection

Measure the free length of the spring. The limit is 1.717 inches (43.6mm).



Valve Spring Squareness

Check the valve springs for squareness. The maximum out-of-square is 0.059 inch (1.5mm).



Rocker Arm

Cleaning

Remove deposits from the rocker arms and rocker arm shafts by tank cleaning, solvents, or steam cleaning.

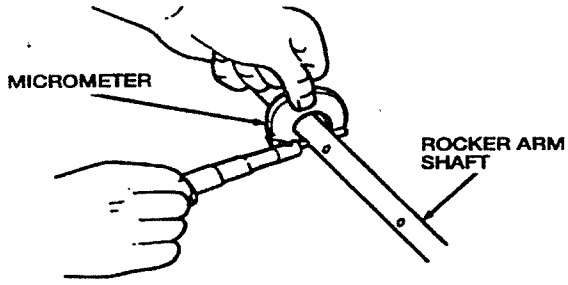
Inspection

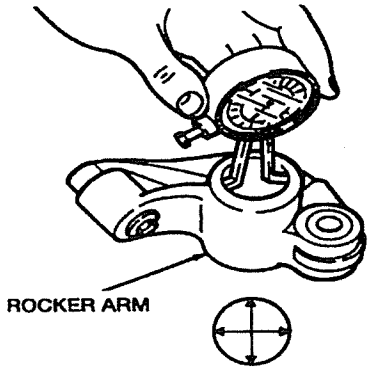
Inspect the rocker arm for nicks, cracks, scratches, scores, or scuffs. Replace any damaged parts.

Rocker Arm-to-Rocker Arm Shaft Clearance

Use a micrometer to measure the difference between the rocker arm shaft outside diameter and the rocker arm inside diameter. The difference is the oil clearance.

The limit is 0.004 inch (0.10mm).





Intake Manifold

Cleaning

Remove all gasket material from the machined surfaces of the intake manifold. Clean the intake manifold in a suitable solvent and dry it with compressed air.

Inspection

CAUTION: Remove all filings and foreign matter that may have entered the intake manifold as a result of service.

Inspect the intake manifolds for cracks, damaged gasket surfaces, or other damage that would make them unfit for further service. Replace all studs that are stripped or otherwise damaged. Clean the Exhaust Gas Recirculation (EGR) exhaust passages.

Check the intake manifold for flatness. Place a straightedge across the manifold. Use a feeler gauge between the straightedge and the intake manifold to measure the flatness.

Exhaust Manifold

Cleaning

Remove all gasket or foreign material from all outlet sealing surfaces of the exhaust manifold.

Inspection

Inspect the cylinder head joining flanges of the exhaust manifolds for evidence of exhaust gas leaks.

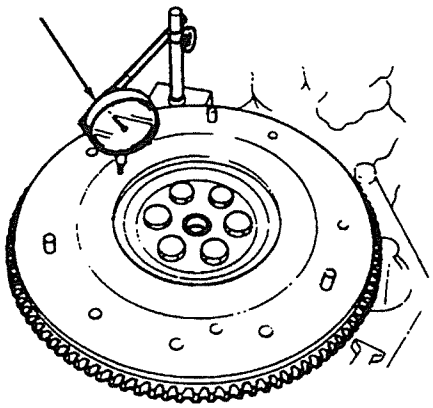
Inspect the exhaust manifolds for cracks, damaged sealing surfaces, or other damage that would make them unfit for further service. Warped or cracked exhaust manifolds must be replaced.

Flywheel Inspection

Inspect the flywheel for cracks or other damage that would make it unfit for further service. Inspect the flywheel ring gear for worn, chipped or cracked teeth. If the teeth are damaged, replace the ring gear and flywheel.

Flywheel Clutch Surface Machining

1. Install Dial indicator with Bracketry so that the indicator point contacts the flywheel face.



TOTAL INDICATOR
RUNOUT (MAXIMUM)
0.2mm (0.008 IN.)

2. Rotate the flywheel.

NOTE: Make sure to push, and hold the flywheel in toward the engine so that crankshaft end play will not be indicated as flywheel runout.

3. If the flywheel runout exceeds 0.008 inch (0.2mm), replace or machine the flywheel. The maximum machine limit of the flywheel is 0.020 inch (0.5mm).

4. Inspect the flywheel ring gear for worn, chipped, or cracked teeth. If teeth are damaged, replace the ring gear.

SPECIFICATIONS

FLYWHEEL AND CRANKSHAFT DIMENSIONS	
Crankshaft main bearing	
Journal diameter	(49.938 to 49.956 mm) 1.9661 to 1.9688 inch
Out-of-round limit	0.0020 inch (0.05mm) max
Runout service limit	0.0016 inch (0.04mm)
Connecting rod journal	
Diameter	1.5724 to 1.5731 inch (39.940 to 39.956 mm)
Out-of-round limit	0.0020 inch (0.05mm)
Crankshaft-to-journal clearance	0.0007 to 0.0014 inch (0.018 to 0.036mm)
Limit	0. 0039 inch (0.10mm)
Crankshaft free	
End play limit	0.0031 to 0.0111 inch (0.08 to 0.282 inch)
Service limit	0.012 inch (0.30mm)

TORQUE SPECIFICATIONS

Description	Lb-ft	N-m
Main Bearing Cap Bolts *3	40-43	54-59
Connecting Rod Nuts	11-13	15-17

* Bolts must be tightened in sequence - Refer to the procedure in this section.

SERVICE TOOLS/EQUIPMENT

SPECIAL SERVICE TOOLS

- Carbon Blaster and Automotive Borescope
- Dial Indicator with Bracket
- Engine Cylinder Hone Set
- Engine Oil Pressure Gauge
- Engine Plug Replacer
- Oil Leak Detector
- Piston Pin Remover/Replacer
- Piston Ring Groove Cleaner
- Plastigage
- Pressurization Kit
- Quick Disconnect Compresssion Tester
- Straight Edge
- Tapersert Installation Kit
- Transmission Test Adapter
- Vacuum/Pressure Tester
- Valve Stem Clearance

SECTION 11 -1 - Engine

DESCRIPTION AND OPERATION

Engine

The 1.3L engine is an in-line four cylinder gasoline engine. The engine employs a 9.7:1 compression ratio to help supply better fuel economy and performance. The cylinder head is a single overhead camshaft design that utilizes Hydraulic Lash Adjusters to reduce engine noise and eliminate periodic adjustment.

Engine intake air flows through the throttle body into the intake manifold. To enhance efficiency, tuned ports are used to channel the air into the aluminum cylinder head. Fuel is supplied to the cylinders through the use of Sequential Multiport Fuel Injection (SFI).

The cylinder block is cast-iron with five crankshaft main bearings supporting the crankshaft. The crankshaft front seal and crankshaft rear oil seals are a one-piece design. Piston pins are pressed into the small end of the connecting rod and float in the piston. The large end of the connecting rod

has replaceable insert bearings. Grooves at the connecting rod and cap parting face provide oil to lubricate the cylinder walls and cool the pistons.

Pressurized oil is supplied by an oil pump that is driven by the crankshaft. The oil pump draws oil from the oil pan. The oil is routed through the oil pump screen cover and tube, oil pump, oil filter, crankshaft main bearings and connecting rod bearings, to the camshaft bearings and rocker arms .

Engine Identification

The U.S. Motor Vehicle Theft Law Enforcement Act of 1984 requires identification of certain high theft vehicles to reduce the National Auto Theft Rate. This federal law requires Westward Industries Limited to affix the Vehicle Identification Number (VIN) on specific parts. These "body parts" are the bumpers, front fenders, hood, front and rear doors, quarter panels and liftgate. The other affected components are the engine and transaxle. In addition, the service replacement parts must also be identified as "service" parts.

Exhaust Emission Control System

Operation and required maintenance of the exhaust emission control devices used on this engine are covered in the Powertrain Control Emissions Diagnosis Manual '.

Induction System

The air/fuel mixture necessary for proper combustion in the cylinders is provided by the Sequential Multiport Fuel Injection (SFI) system. Refer to this section for description and operation of the SFI system.

Fuel is supplied from the fuel tank by a high-pressure fuel pump mounted in the fuel tank. The fuel is sent from the fuel pump, through an in-line fuel filter, to the fuel injection supply manifold. The fuel is sent from the fuel injection supply manifold to the individual fuel injectors and then through the fuel pressure regulator. Any amount of fuel in excess of demand, supplied to the fuel injection supply manifold is returned by the fuel pressure regulator to the fuel tank through the fuel tube hose.

Crankshaft

The crankshaft is positioned on the bottom of the cylinder block. The crankshaft is supported by five two-bolt main bearing caps, the crankshaft main bearings, and the crankshaft thrust bearings. The crankshaft thrust bearings are located with the No. 4 crankshaft main bearings. The crankshaft thrust bearings limit the crankshaft end play and absorb thrust loads applied to the crankshaft ends. A Camshaft sprocket, a timing chain/belt and a crankshaft sprocket connect the crankshaft to the camshaft.

Camshaft

The camshaft is installed in the cylinder head and is supported by five main journals. The distributor is directly driven from the end of the camshaft. The camshaft sprocket, which is located at the front of the camshaft, a timing chain/belt, and a crankshaft sprocket, connect the camshaft to the crankshaft.

Valve Train

Hydraulic Lash Adjusters (HLA) provide automatic lash adjustment. The HLA's ride between the rocker arms and the top of the valve stems. Any clearance between the rocker arms and the valve stems is taken up by the hydraulic expansion of each HLA. The HLA's are designed to maintain 0 inch (0mm) clearance between the rocker arms and the valve stems.

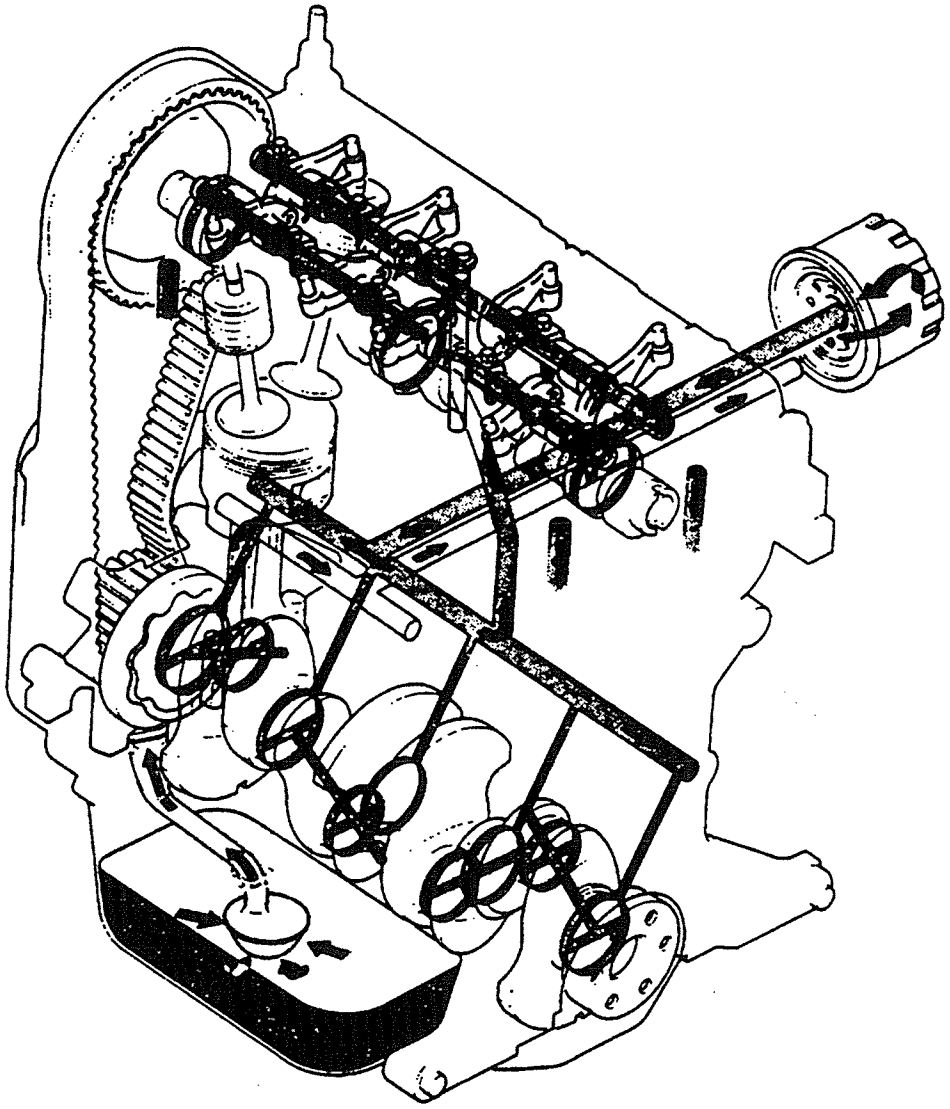
Positive Crankcase Ventilation System

The 1.3L engine is equipped with a closed-type positive crankcase ventilation system which recycles the crankcase vapors to the intake manifold. Refer to this section for additional engine emission information.

Engine Lubrication System

The engine oil lubrication system and the lubrication components are designed for lubrication efficiency and engine noise reduction. The oil pump is crankshaft-driven and draws the oil from the oil pan through the oil pump screen cover and tube. The oil pump then sends the oil to the oil filter, where it is directed to the crankshaft main bearings, connecting rod bearings, camshaft bearings and rocker arms. The oil then drains, back into the oil pan.

Engine Lubrication System



Oil Pump

The oil pump is bolted to the front of the cylinder block and is crankshaft driven. A full-flow oil filter is mounted to the cylinder block. Under normal operating conditions, all of the engine oil will pass through the oil filter. If this oil filter becomes clogged or blocked, the oil will be routed through a bypass valve, directly to the engine.

Oil Pan

The oil pan is bolted to the bottom of the cylinder block. Engine oil is pulled up from the oil pan through the oil pump screen cover and tube and delivered to the oil pump where it is then circulated through the other various engine components.

Engine Cooling System

Engine cooling is provided by a water pump mounted on the front end of the cylinder block. A water thermostat controls coolant temperature and is located in the water hose connection at the transaxle end of the cylinder head.

An engine cooling fan motor is mounted on the rear side of the radiator. The engine cooling fan motor is controlled by the Engine Coolant Temperature (ECT) sensor.

WARNING: TO AVOID THE POSSIBILITY OF PERSONAL INJURY OR DAMAGE TO THE VEHICLE, DO NOT OPERATE THE ENGINE WITH THE CARGO BOX OR ACCESS COVER OPEN UNTIL THE FAN BLADE HAS BEEN FIRST EXAMINED FOR POSSIBLE CRACKS AND SEPARATION.

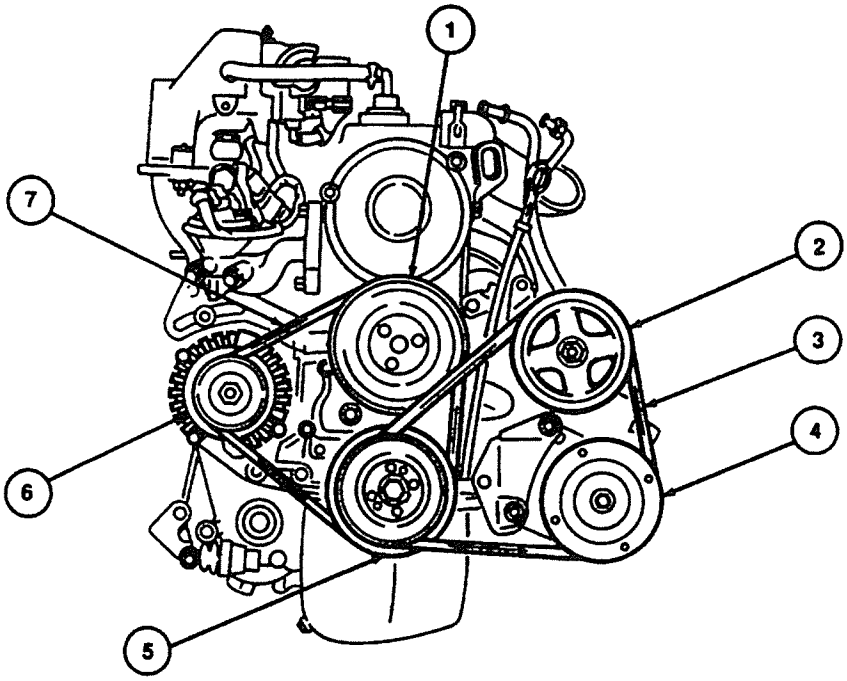
WARNING: THE ELECTRIC COOLING FAN WILL OPERATE WHENEVER THE KEY IS ON AND THE COOLANT IS HOT (ABOVE 207° F (97°C), EVEN THOUGH THE ENGINE MAY NOT BE RUNNING. AVOID PLACING HANDS, CLOTHING, TOOLS, OR OTHER OBJECTS IN THE FAN BLADES AT ANY TIME. THE FAN BLADE WILL ALSO OPERATE IF THE ENGINE COOLANT TEMPERATURE (ECT) SENSOR IS DISCONNECTED.

Drive Belt System

The alternator is driven by a drive belt that also drives the water pump. If the vehicle is equipped with air conditioning, the A/C compressor is driven by a second drive belt.

The alternator drive belt is adjusted using the alternator bolt and the alternator adjustment bolt. The A/C compressor is adjusted by a separately mounted idler pulley.

Drive Belt Location



Item	Part Number	Description
1	154010	Water Pump Pulley
2	613493	Drive Belt Idler Pulley - A/C Compressor Belt (If Equipped)
3	613893	Drive Belt - A/C Compressor
4	-	A/C Clutch Pulley, for A/C Compressor (if Equipped)

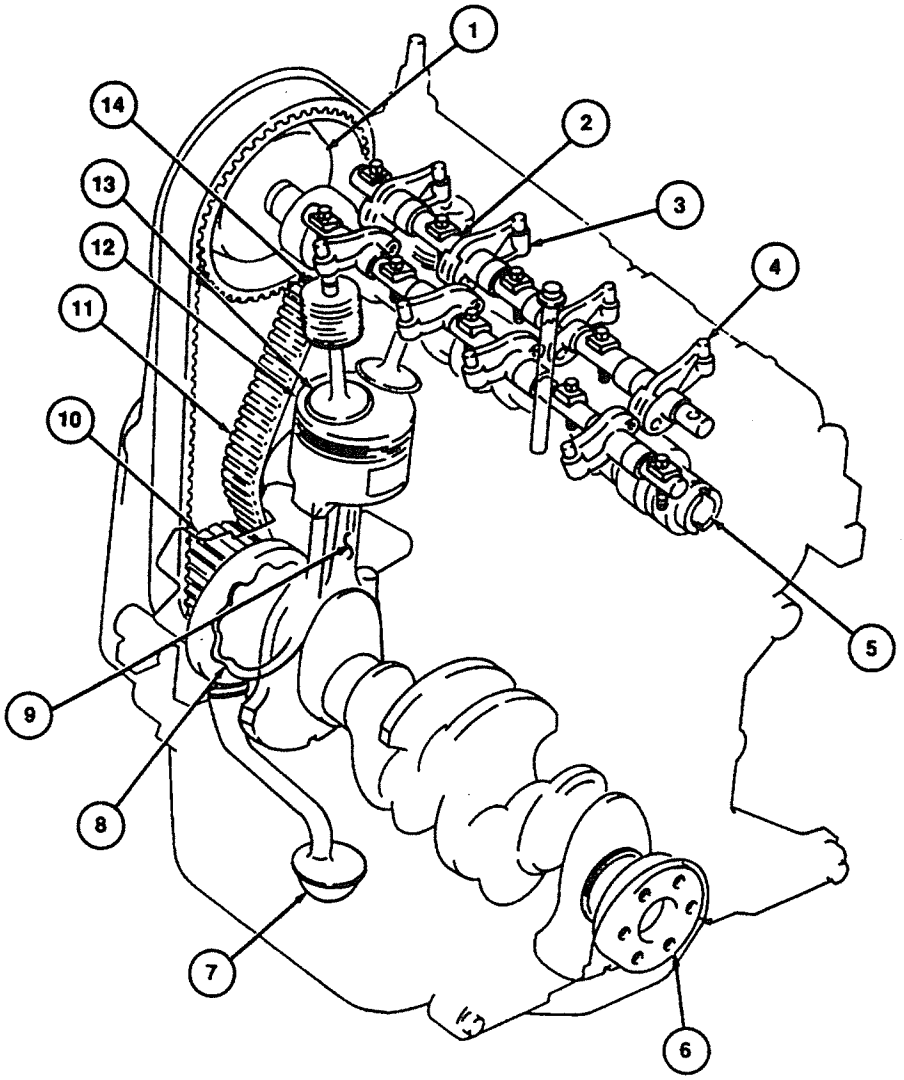
Item	Part Number	Description
5	114005	Crankshaft Pulley
6	184024	Alternator Pulley
7	184044	Drive Belt, Alternator

IN-VEHICLE SERVICE

Engine Components

The following illustration shows the engine and its major internal components.

Internal Component Location



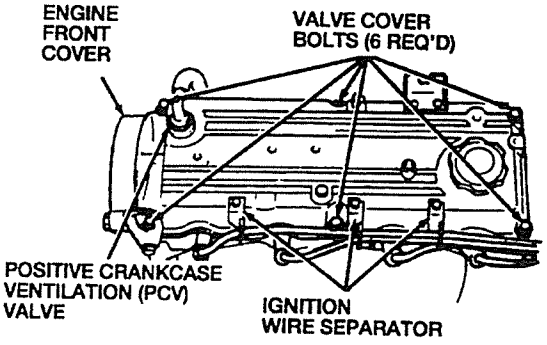
Item	Part Number	Description
1	-	Camshaft Sprocket
2	-	Rocker Arm Shaft
3	-	Hydraulic Lash Adjuster
4	-	Rocker Arm
6	-	Camshaft
7	-	Oil Pump Screen Cover and Tube

Item	Part Number	Description
8	-	Oil Pump
9	114000	Connecting Rod
10	-	Crankshaft Sprocket
11		Timing Chain/Belt
12	-	Piston
13	-	Exhaust Valve
14		Valve Spring

Valve Cover and Valve Cover Gasket

Removal

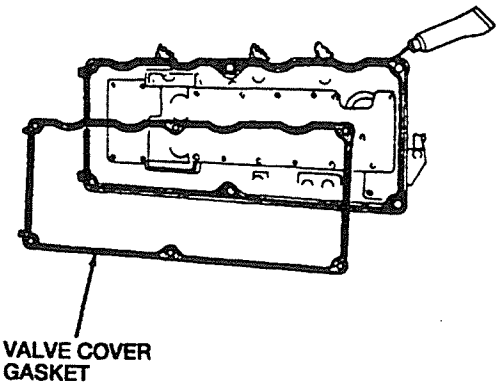
1. Disconnect the Positive Crankcase Ventilation (PCV) valve hose.
2. Disconnect the accelerator cable from the throttle control lever and accelerator cable bracket.
3. Remove the air cleaner to intake manifold tube. Refer to this section for the removal procedure.
4. Remove the oil separator hose from the valve cover.
5. Pull the PCV valve out of the valve cover.



6. Remove the distributor to spark plug wires from the spark plug wire separators.
7. Remove the upper engine front cover. Refer to the removal procedure in this section.
8. Remove the six valve cover bolts.
9. Remove the valve cover.
10. Remove the valve cover gasket.

Installation

1. **CAUTION: Do not use abrasive grinding discs to remove engine gasket material. Use manual gasket scrapers. Take added care to prevent scratching or gouging aluminum sealing surfaces.**



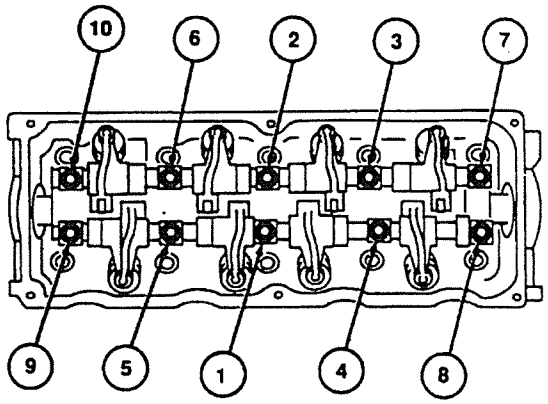
2. Install the valve cover.
3. Install the six valve cover bolts. Tighten the six valve cover bolts to 44-80 lb-in. (5-9 N-m).
4. Install the upper engine front cover. Refer to the installation procedure in this section.
5. Install the distributor to spark plug wires into the spark plug wire separators.
6. Install the oil separator hose onto the valve cover.
7. Install the PCV valve into the valve cover.
8. Install the accelerator cable.
9. Install the air cleaner to intake manifold tube. Refer to this section for the installation procedure.
10. Install the PCV valve hose.

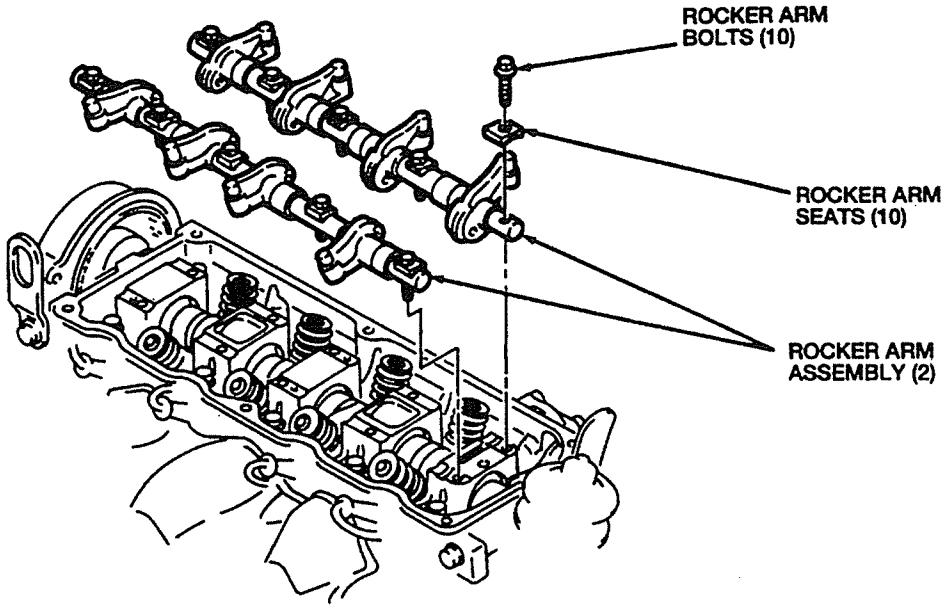
Rocker Arms and Rocker Arm Shafts

Removal

1. Remove the valve cover. Refer to the removal procedure in this section.

2. Remove the 10 rocker arm bolts and rocker arm seats in the sequence shown.

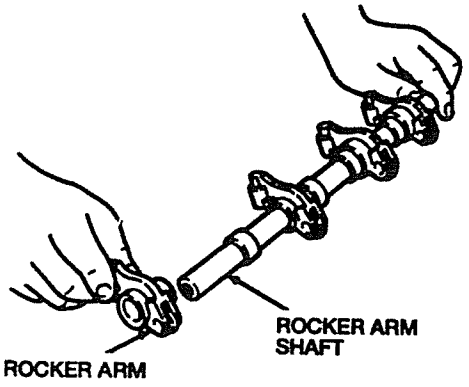




3. Remove the rocker arm and shaft assemblies.

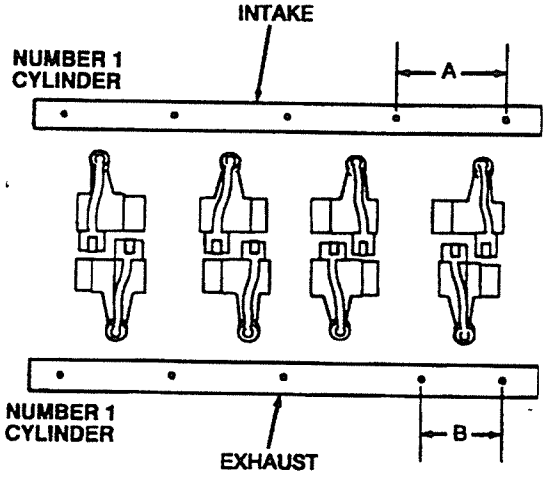
4. NOTE: Mark rocker arms and rocker arm spacers so that they can be installed in the exact place they were removed from.

   Remove the rocker arms and rocker arm spacers from the rocker arm shafts.

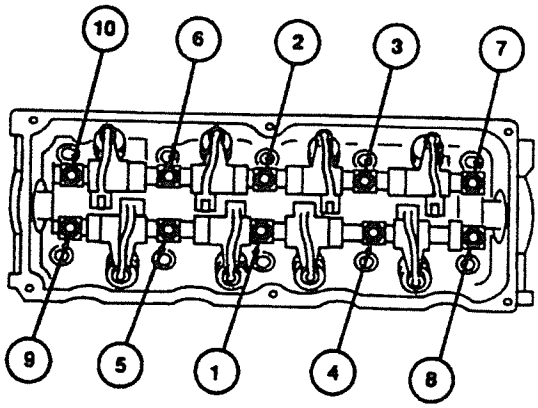


Installation

1. Assemble the rocker arm spacers and rocker arms to obtain the proper arrangement for the rocker arm shaft assemblies. See the illustration.



2. Install the 10 rocker arm bolts and rocker arm seats. Tighten the rocker arm bolts to 16-21 lb-ft (22-28 N-m) in the sequence shown.



TIGHTENING SEQUENCE

3. Install the valve cover. Refer to the installation procedure in this section.

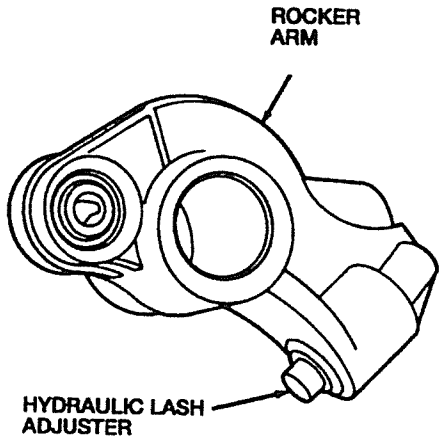
Hydraulic Lash Adjuster

Removal

1. Remove the valve cover. Refer to the removal procedure in this section.

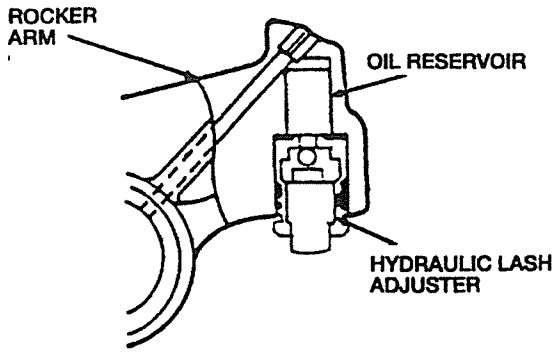
2. Remove the rocker arm shaft assemblies. Refer to the removal procedure in this section.

3. Pull the Hydraulic Lash Adjuster (HLA) from the rocker arm.



Installation

1. Pour clean engine oil into the oil reservoir in the rocker arm.



2. Apply engine oil to the new Hydraulic Lash Adjuster.

3. **CAUTION: Be careful not to damage the O-ring when installing the Hydraulic Lash Adjuster.**

   Install the Hydraulic Lash Adjuster.

4. Install the rocker arm and rocker arm shaft assemblies. Refer to the installation procedure in this section.

5. Install the valve cover. Refer to the installation procedure in this section.

Valve Spring, Valve Spring Retainer and Valve Stem Seal

If the valve or valve seat has not been damaged, valve springs and valve stem seals may be replaced by holding the affected valve against its seat using compressed air.

Use a compressed air line and an adapter installed in a spark plug hole. A minimum of 140 psi (965 kPa) line pressure is required. If air pressure does not hold the valve shut, the valve is damaged or burnt and the cylinder head must be removed and serviced.

SERVICE TOOL(S) REQUIRED

- Valve Seal Replacer
- Valve Spring Compressor
- Valve Spring Compressor Set

Removal

1. Remove the valve cover. Refer to the removal procedure in this section.

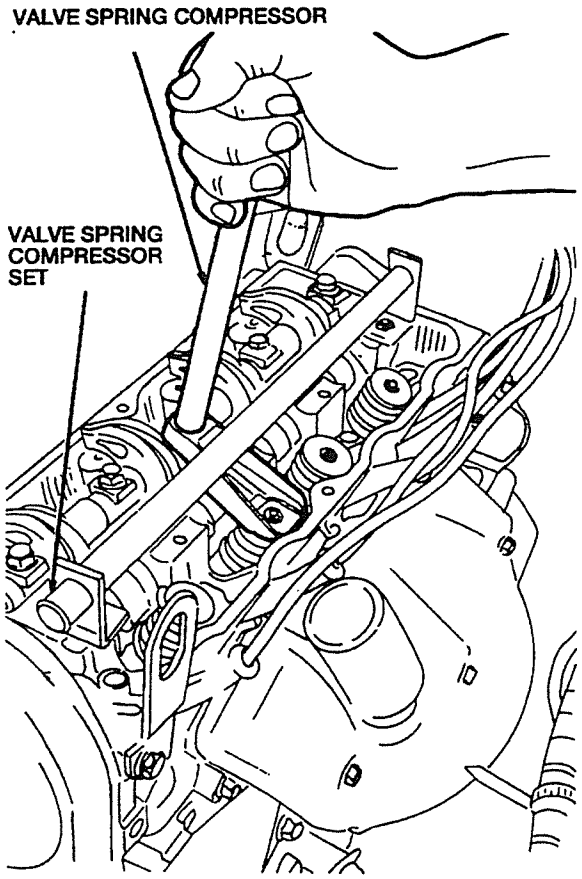
2. Remove the rocker arm shafts. Refer to the removal procedure in this section.

3. NOTE: The appropriate piston must be at Top Dead Center (TDC) to prevent the valves from falling down into the cylinder.

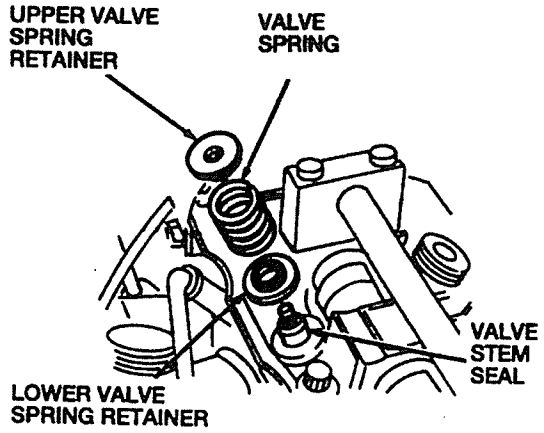
   Turn the crankshaft until the piston of the cylinder to be worked on is at the TDC.

4. Remove the appropriate spark plug and install a pressurized air line fitted with the proper adapter. Apply a minimum of 140 psi (965 kPa) of compressed air.

5. Use Valve Spring Compressor and Valve Spring Compressor Set to compress the valve spring and remove the valve spring retainers.

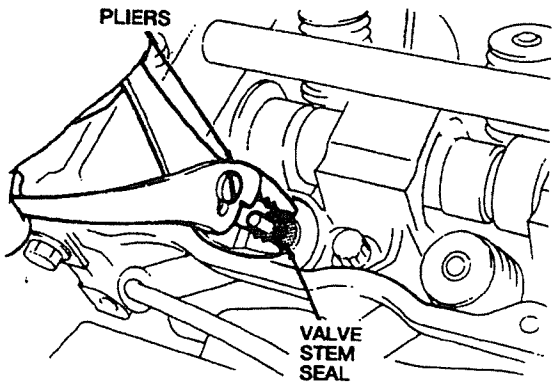


6. Remove the upper valve spring retainer, valve spring and the lower valve spring retainer.



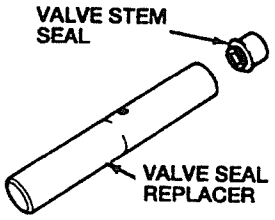
7. NOTE: If air pressure has forced the piston to the bottom of the cylinder, any loss of air pressure will allow the valves to fall into the cylinder. A rubber band, tape, or string wrapped around the end of the valve stem will prevent this condition and will still allow enough travel to check the valve for binds.

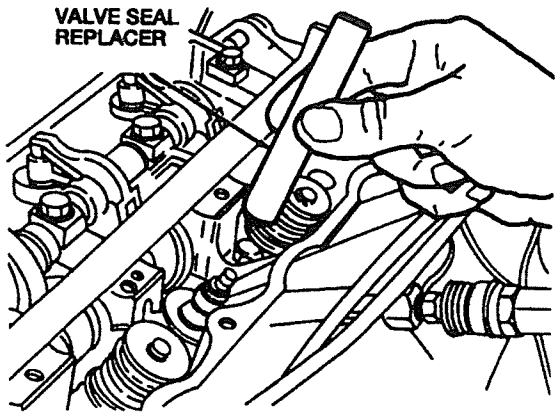
   Remove the valve stem seal.



Installation

1. Install a new valve stem seal using Valve Seal Replacer.





2. Install the lower valve spring retainers, valve spring, and upper valve spring retainers.

3. Use Valve Spring Compressor and Valve Spring Compressor Set to compress the valve spring and install the valve spring retainer key.

4. Turn off the compressed air. Remove the air line and adapter.

5. Repeat steps 1 through 3 as required.

6. Install the rocker arm shafts. Refer to the installation procedure in this section.

7. Install the valve cover. Refer to the installation procedure in this section.

Crankshaft Pulley Hub

Removal

1. Remove the crankshaft pulleys. Refer to the removal procedure in this section.

2. Remove the crankshaft pulley bolt.

3. Remove the crankshaft pulley hub.

Installation

To install, reverse the removal procedure.

Crankshaft Pulley

Removal

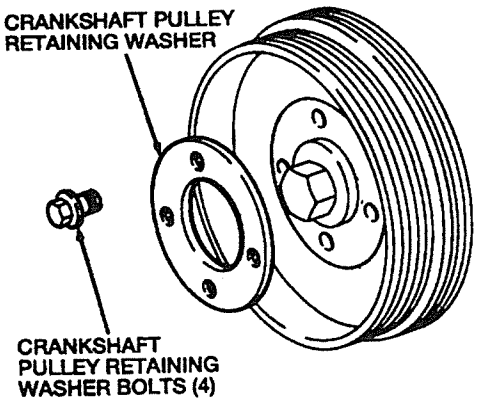
1. Remove the accessory drive belts. Refer to this section for the removal and installation procedure.

2. Remove the wheel and tire assembly on the right rear side of the vehicle.

3. Install Strap Wrench or equivalent, on the outer crankshaft pulley.

4. Loosen the crankshaft pulley bolt.

5. Remove the four crankshaft pulley retaining washer bolts.

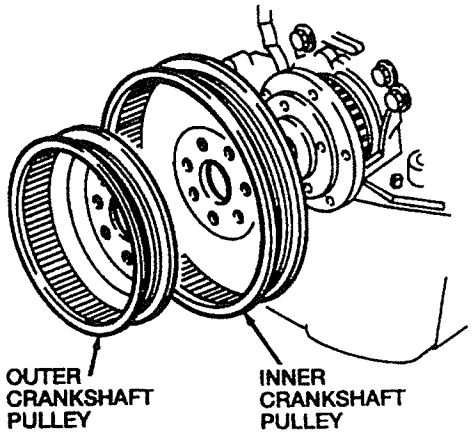


6. Remove the crankshaft pulley retaining washer.

7. Remove the crankshaft pulley bolt.

8. Remove the strap wrench.

9. Remove the outer crankshaft pulley (if equipped) and the inner crankshaft pulley.



Installation

To install, reverse the removal procedure.

Tighten the four crankshaft pulley retaining washer bolts to 109-152 lb-in., (12-17 N-m).

Crankshaft Front Oil Seal

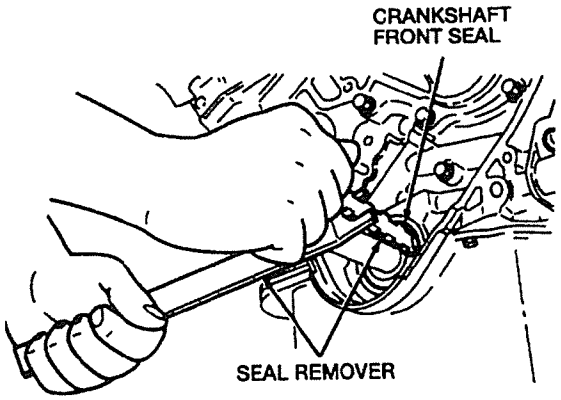
SERVICE TOOL(S) REQUIRED

- Front Seal Replacer
- Seal Remover

Removal

1. Remove the timing chain/belt. Refer to the removal procedure in this section.
2. Remove the crankshaft sprocket.

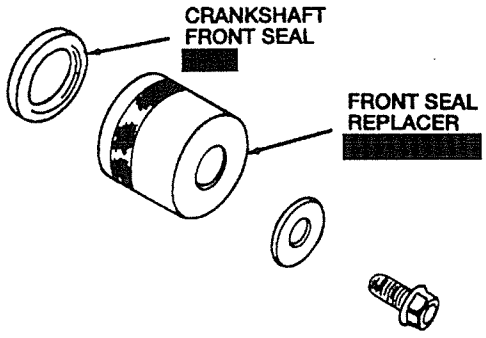
3. Using Seal Remover, remove the crankshaft front seal.

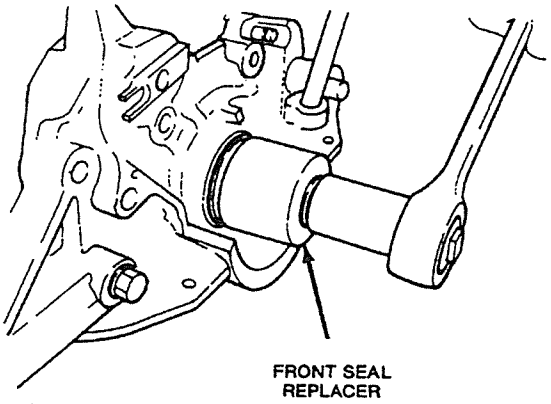


Installation

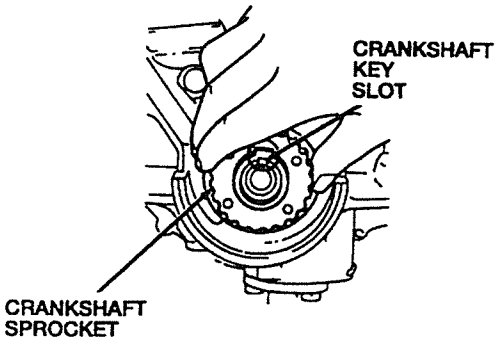
1. Lubricate the lip of the new crankshaft front seal with clean engine oil.

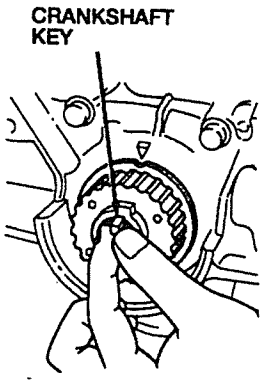
2. Using Front Seal Replacer, draw the crankshaft front seal into the oil pump.





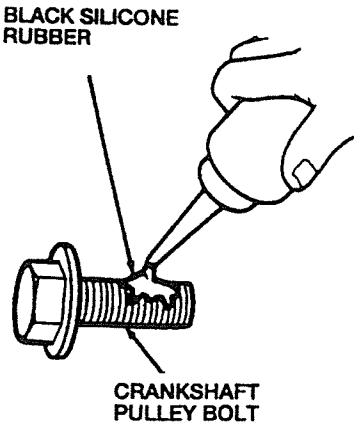
3. Install the crankshaft sprocket and crankshaft key.





4. Install the crankshaft pulley hub.

5. NOTE: Before installing the crankshaft pulley bolt, coat the bolt threads with Black Silicone Rubber or equivalent.



Install the crankshaft pulley bolt. Tighten the crankshaft pulley bolt to 80-85 ft-lb (108-118 N-m).

6. Install the crankshaft pulleys. Refer to the installation procedure in this section.

7. Install the timing chain/belt. Refer to the installation procedure in this section.

Engine Front Covers

Removal

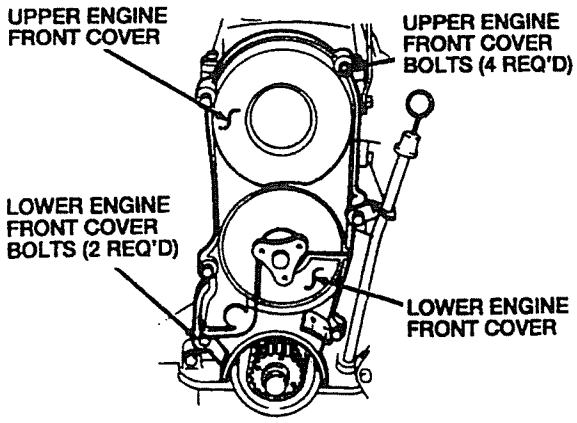
1. Remove the accessory drive belts. Refer to this section for the removal and installation procedure.

2. Remove the three water pump pulley retaining bolts and the water pump pulley.

3. Remove the crankshaft pulleys. Refer to the removal procedure in this section.

4. Remove the four bolts and the upper engine front cover.

5. Remove the two bolts and the lower engine front cover.



Installation

To install, reverse the removal procedure.

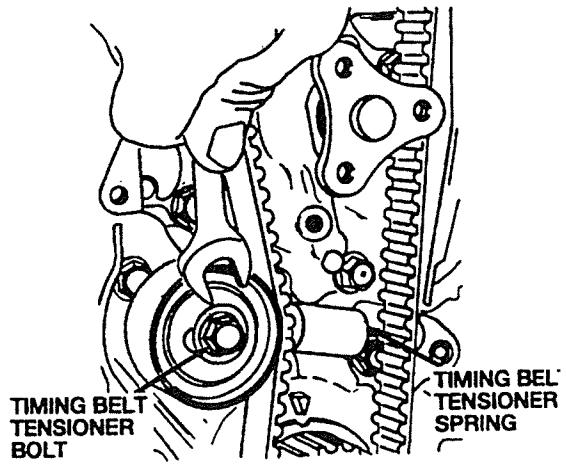
Tighten the water pump pulley retaining bolts to 36-45 lb-ft (49-61 N-m).

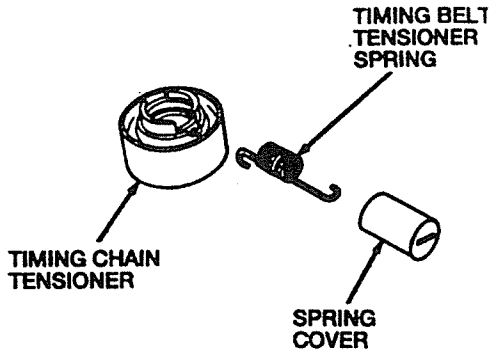
Tighten the upper and lower engine front cover bolts to 71-97 lb-in. (8-11N-m).

Timing Chain/Belt

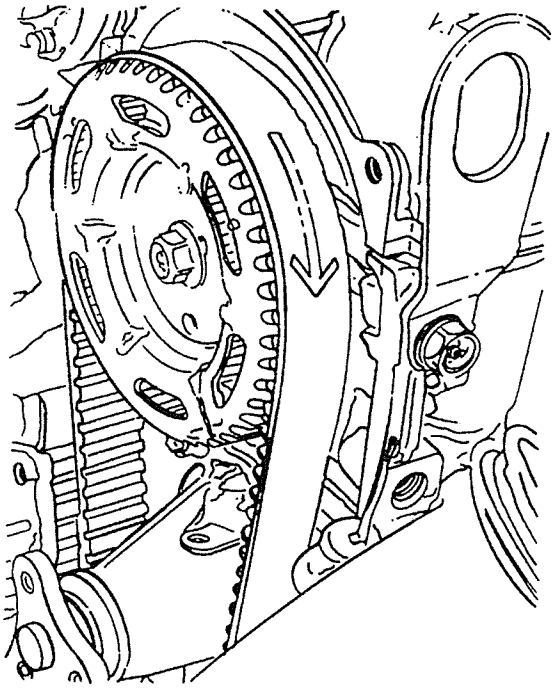
Removal

1. Remove wheel and tire assembly. Refer to the removal procedure in Section 3.
2. Remove the timing chain/belt tensioner spring, spring cover, and timing belt tensioner bolt.





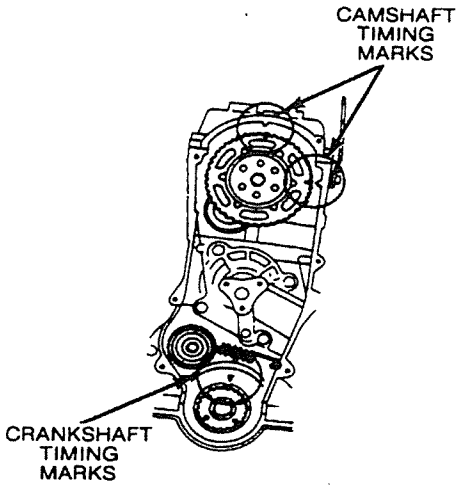
3. Mark the direction of rotation on the timing chain/belt.



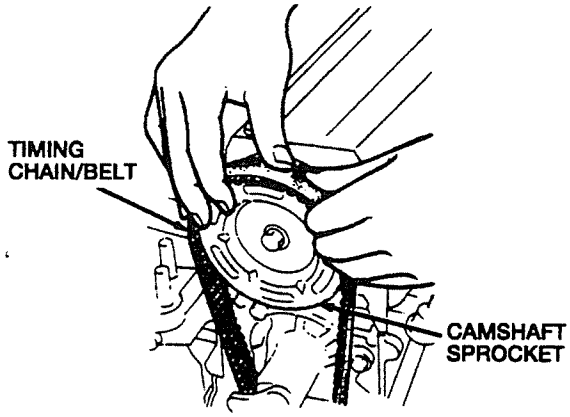
4. Remove the timing chain/belt.

Installation

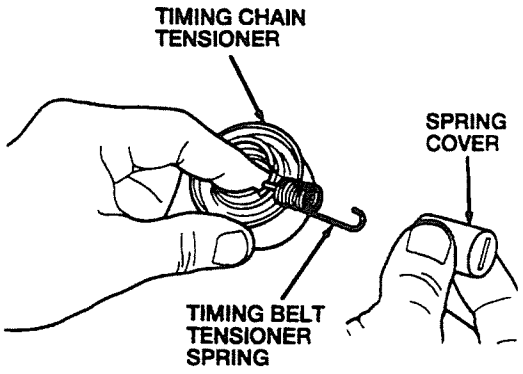
1. Align the camshaft sprocket and crankshaft sprocket with the timing marks on the cylinder head and the oil pump.



2. Install the timing chain/belt making sure the direction mark faces the same way as noted in removal. Use a counterclockwise motion to install the timing chain/belt. Start at the crankshaft and move up to the camshaft sprocket. There can be no slack between the crankshaft sprocket and the camshaft sprocket.



3. Install the timing chain/belt tensioner spring and spring cover on the timing chain/belt tensioner



4. Position the timing chain tensioner and timing belt tensioner spring assembly on the engine and install the timing belt tensioner bolt. Do not tighten the timing belt tensioner bolt.

5. Install the timing chain/belt tensioner spring on the anchor.

6. Rotate the crankshaft two turns in the direction of normal rotation and align the timing marks.

   Ensure all marks are still correctly aligned.

7. Tighten the timing belt tensioner bolt to 14-19 lb-ft (19-26 N-m).

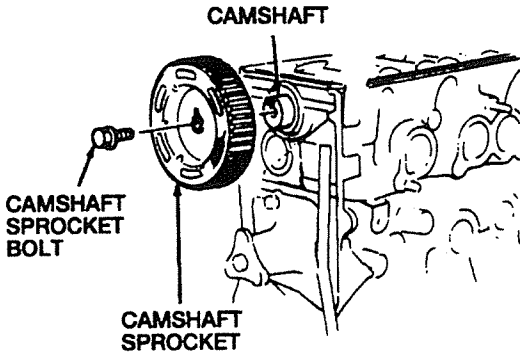
8. Install the wheel and tire assembly. Refer to the installation procedure in Section 3.

Timing Sprockets

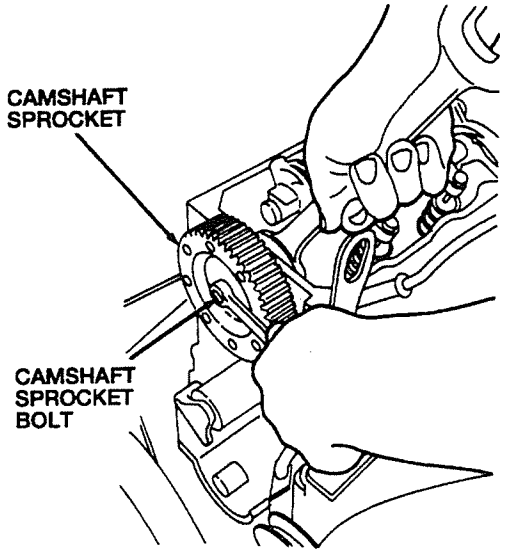
Camshaft

Removal

The following illustration is an exploded view of the camshaft sprocket.



1. Remove the valve cover. Refer to the removal and installation procedure in this section.
2. Remove the timing chain/belt. Refer to the removal and installation procedure in this section.
3. Remove the camshaft sprocket bolt, camshaft sprocket, and dowel pin. Use an open-end wrench to hold the camshaft.



Installation

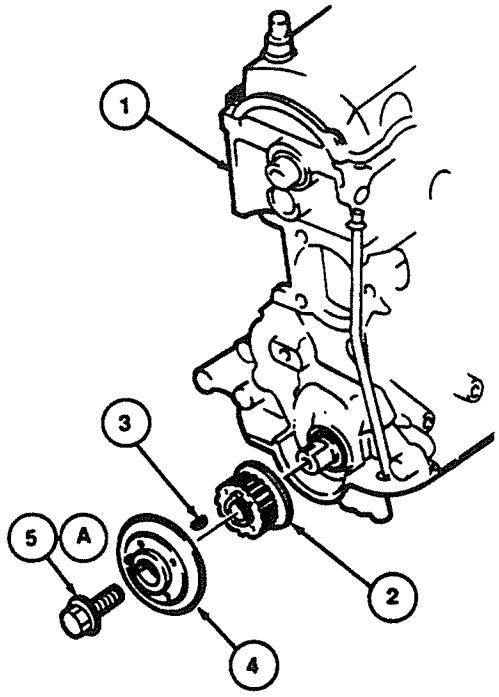
To install, reverse the removal procedure.

Hold the camshaft with an open-end wrench. Tighten the camshaft sprocket bolt to 36-45 lb-ft., (49-61 N-m).

Crankshaft

Removal

The following illustration is an exploded view of the crankshaft sprocket.

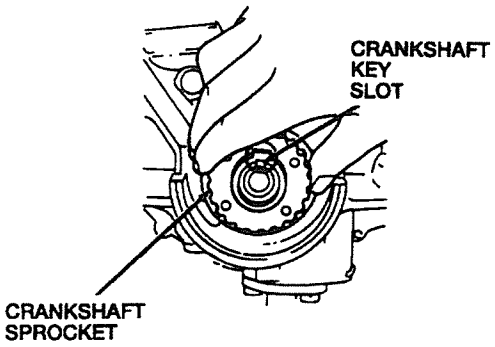


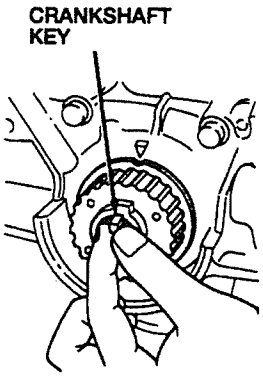
Item	Part Number	Description
1	104014	Cylinder Block
2	114004	Crankshaft Sprocket
3	114003	Crankshaft Key
4	-	Crankshaft Pulley Hub
5	114008	Crankshaft Pulley Bolt
A	-	Tighten to 80-85 lb-ft (108-118 N-m)

1. Remove the timing chain/belt. Refer to the removal procedure in this section.
2. Remove the crankshaft pulleys. Refer to the removal procedure in this section.
3. Remove the crankshaft sprocket, crankshaft pulley hub, and crankshaft key.

Installation

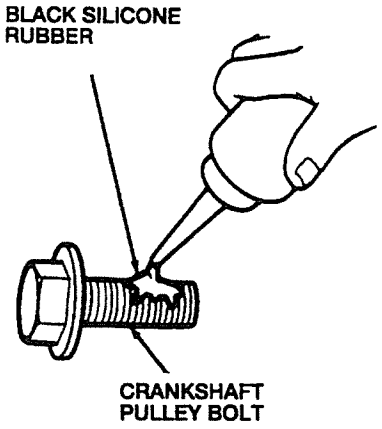
1. Install the crankshaft sprocket and crankshaft key.





2. Install the crankshaft pulley hub.

3. NOTE: Before installing the crankshaft pulley bolt, coat the bolt threads with Black Silicone Rubber or equivalent.



Install the crankshaft pulley bolt. Tighten the crankshaft pulley bolt to 80-85 lb-ft (108-118 N-m).

4. Install the timing chain/belt. Refer to the installation procedure in this section.

5. Install the crankshaft pulleys. Refer to the installation procedure in this section.

Timing Chain/Belt Tensioner

Removal

1. Remove the upper engine front cover). Refer to the removal procedure in this section.

2. Remove the timing chain/belt tensioner spring, spring cover, timing belt tensioner bolt, and timing chain/belt tensioner.

Installation

1. Install the spring cover in the timing chain/belt tensioner spring and install the timing chain/belt tensioner spring on the timing chain/belt tensioner.
2. Position the timing chain/belt tensioner and the timing chain/belt tensioner spring assembly on the engine. Install the timing belt tensioner bolt.

3. Install the timing chain/belt tensioner spring on its anchor.

4. Rotate the crankshaft clockwise and align the timing marks. Ensure that all timing marks are still correctly aligned.
5. Tighten the timing belt tensioner bolt to 14-19 lb-ft (19-26 N-m).

6. Install the upper engine front cover. Refer to the installation procedure in this section.

Camshaft

Removal

1. Remove the battery. Refer to Section 17 for the removal procedure.

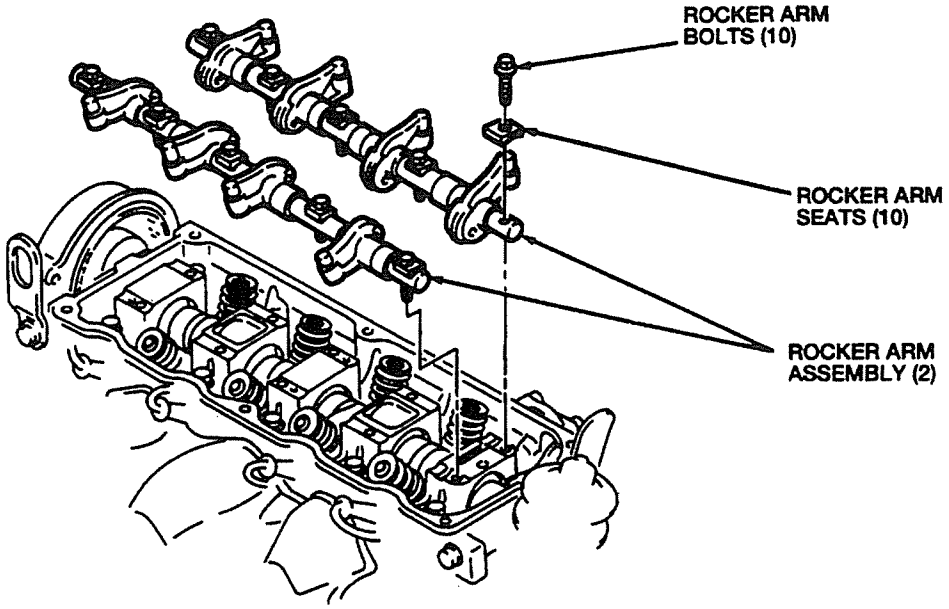
2. Remove the timing chain/belt. Refer to the removal procedure in this section.

3. Remove the valve cover. Refer to the removal procedure in this section.

4. Remove the camshaft sprocket. Refer to the removal procedure in this section.

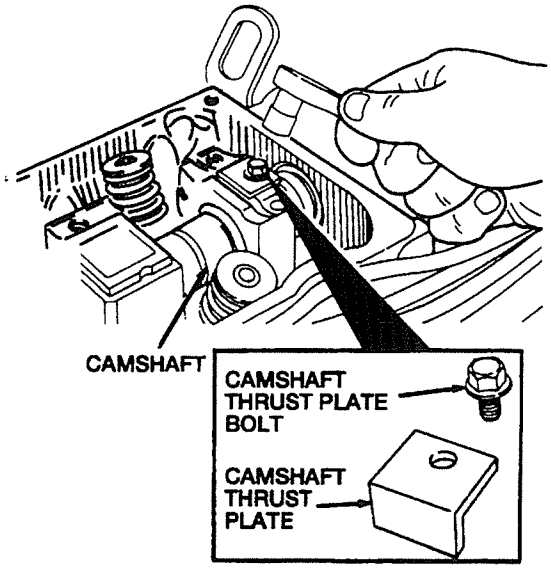
5. Remove the distributor. Refer to Section 12 for the removal procedure.

6. Remove the 10 (ten) rocker arm bolts and rocker arm seats.

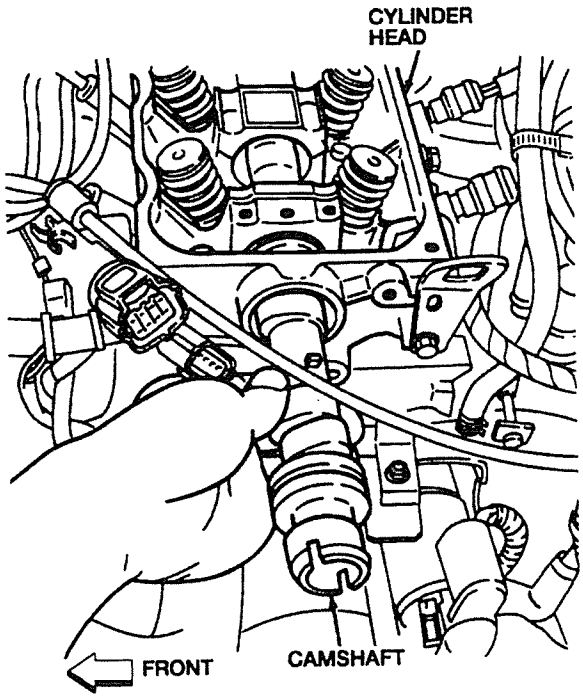


7. Remove the two rocker arm assemblies.

8. Remove the camshaft thrust plate bolt. Remove the camshaft thrust plate.



9. Gently pull the camshaft out of the LH side of the cylinder head.



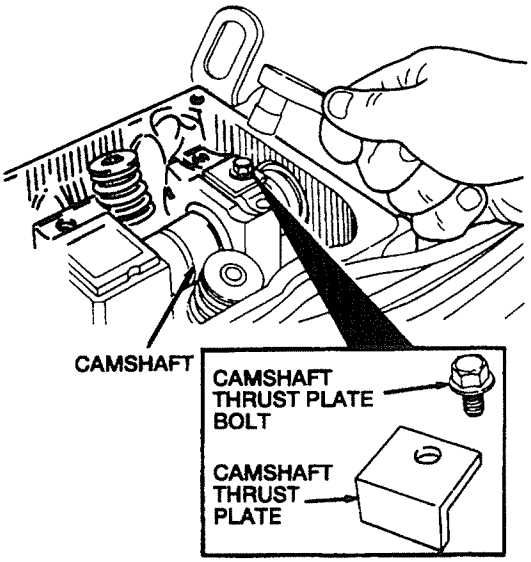
Installation

1. Clean the camshaft and cylinder head surface.

2. NOTE: Inspect the camshaft oil seal. Replace if necessary. Refer to the procedure in this section.

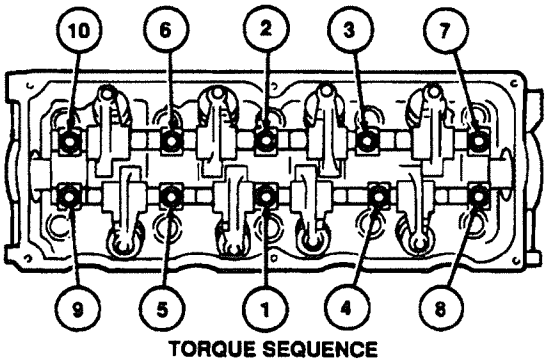
   Coat the friction surfaces of the camshaft with clean engine oil. Gently install the camshaft through the LH side of the cylinder head.

3. Install the camshaft thrust plate. Install the camshaft thrust plate bolt. Tighten the camshaft thrust plate bolt to 71-88 lb-in (8-10 N-m).



4. Install the two rocker arm assemblies.

5. Install the 10 (ten) rocker arm seats and the rocker arm bolts. Tighten the rocker arm bolts to 16-21 lb-ft (22-28 N-m) in the sequence shown.



TORQUE SEQUENCE

6. Install the distributor. Refer to Section 12 for the installation procedure.

7. Install the camshaft sprocket. Refer to the installation procedure in this section.

8. Install the valve cover. Refer to the installation procedure in this section.

9. Install the timing chain/belt. Refer to the installation procedure in this section.

10. Adjust the camshaft timing. Refer to the adjustment procedure in this section.

11. Install the battery. Refer to Section 17 for the installation procedure.

Camshaft Front Seal

SPECIAL SERVICE TOOL(S) REQUIRED

- Dust Boot Replacer

Removal

1. Disconnect the battery ground cable.

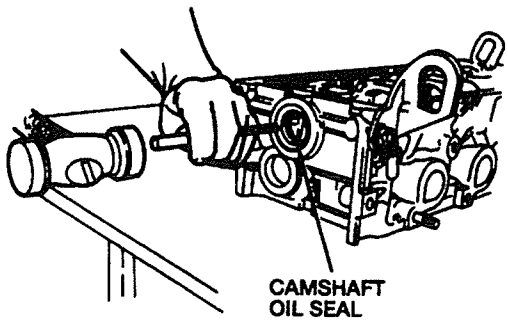
2. Remove the engine air cleaner. Refer to this section for the removal procedure.

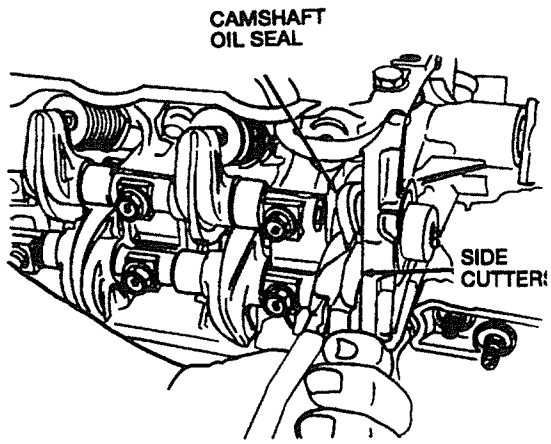
3. Remove the timing chain/belt. Refer to the removal procedure in this section.

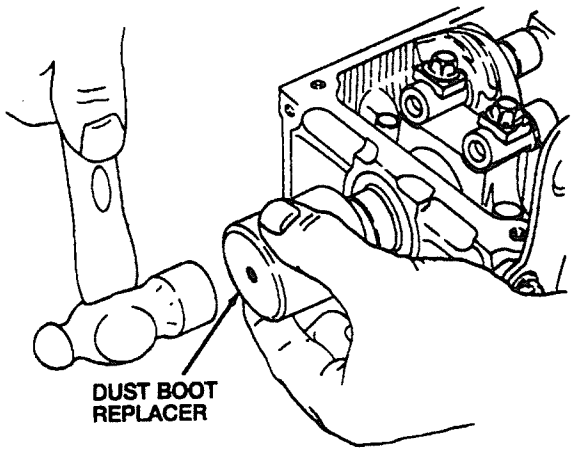
4. Remove the valve cover. Refer to the removal procedure in this section.

5. Remove the camshaft sprocket. Refer to the removal procedure in this section.

6. Drive the camshaft oil seal through the cylinder head with a suitable tool. Cut the seal with side cutters and remove the camshaft oil seal.







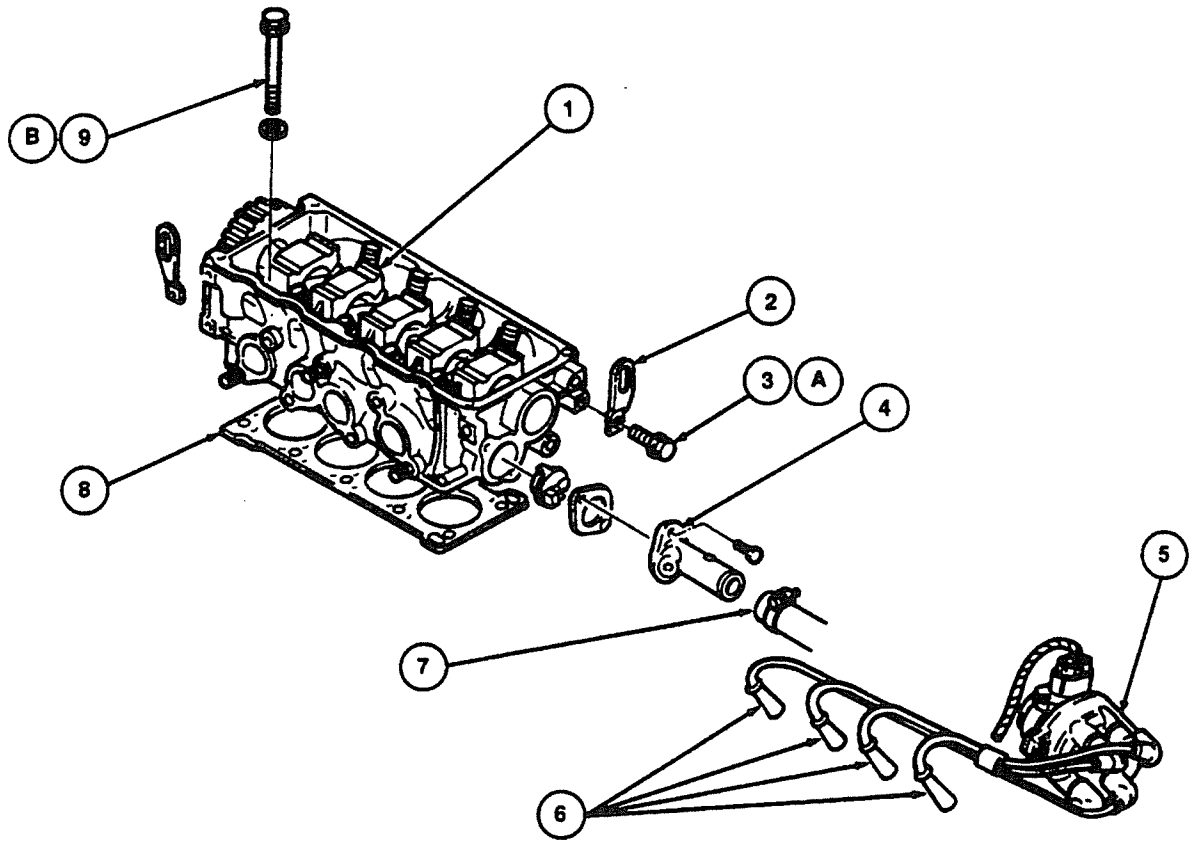
Installation

1. Lubricate the camshaft front seal lip and the camshaft front seal surface of the cylinder head with engine oil.
2. Install the new camshaft oil seal using Dust Boot Replacer.
3. Install the distributor. Refer to Section 12 for the installation procedure.
4. Install the camshaft sprocket. Refer to the installation procedure in this section.
5. Install the valve cover. Refer to the installation procedure in this section.
6. Install the timing chain/belt. Refer to the installation procedure in this section.
7. Connect the battery ground cable.

Cylinder Head

Removal

Cylinder Head and Related Components



Item	Part Number	Description
1	104026	Cylinder Head
2	104040	Lift Hanger
3	774050	Water Outlet Connection Bolt (2 Req'd)
4	-	Water Hose Connection
5	184000	Distributor
6	184046	Distributor to Spark Plug Wires

Item	Part Number	Description
7	153347	Upper Radiator Hose
8	104038	Head Gasket
9	104028	Cylinder Head Bolts (10 Req'd)
A	-	Tighten to 14-22 lb-ft (19-30 N-m)
B	-	Tighten to 56-60 lb-ft (75-81 N-m)

1. Disconnect the battery ground cable.
2. Drain the cooling system. Refer to Section 11-1 for the draining procedure.
3. Remove the distributor to spark plug wires and spark plugs. Refer to Section 12 for the removal procedure.
4. Remove the distributor. Refer to Section 12 for the removal procedure.
5. Remove the timing chain/belt. Refer to the removal procedure in this section.
6. Remove the valve cover. Refer to the removal procedure in this section.

7. Remove the exhaust manifold. Refer to removal procedure in this section.

8. Remove the intake manifold. Refer to the removal procedure in this section.

9. Remove the front and rear engine lift handers and the engine ground wire.

10. Remove the wire harness connectors.

11. Remove the upper radiator hose.

12. Remove the water bypass tube or hose and bracket.

13. Remove the ten (10) cylinder head bolts.

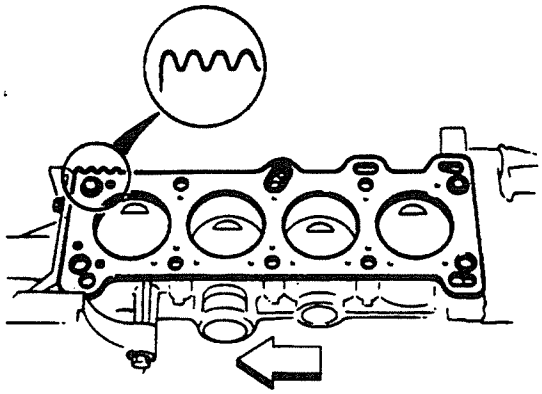
14. Remove the cylinder head and head gasket.

Installation

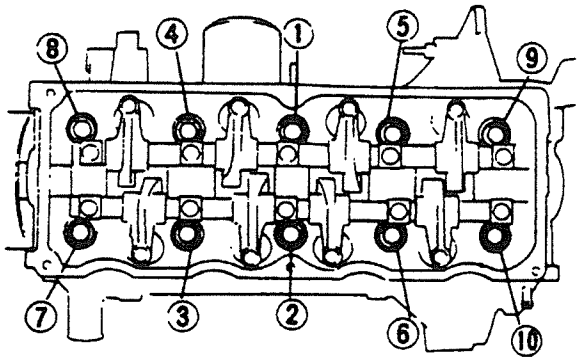
1. Clean the gasket surfaces on the cylinder head and cylinder block.

2. NOTE: Ensure the cylinder head and head gasket surfaces are clean before installing the head gasket.

   Install a new head gasket.



3. Install the cylinder head and the cylinder head bolts. Tighten the cylinder head bolts, in the order shown, to 35-40 lb-ft (50-60 N-m).Repeat the tightening sequence and tighten the cylinder head bolts to 56-60 lb-ft (75-81 N-m).



4. Install the water bypass tube or hose and bracket.

5. Install the upper radiator hose.

6. Install the wiring harness connectors.

7. Install the front and rear engine lift hangers and the engine ground wire.

8. Install the distributor. Refer to Section 12 for the installation procedure.

9. Install the intake manifold. Refer to the installation procedure in this section.

10. Install the exhaust manifold. Refer to the installation procedure in this section.

11. Install the valve cover. Refer to the installation procedure in this section.

12. Install the timing chain/belt. Refer to the installation procedure in this section.

13. Install the distributor to spark plug wires and spark plugs. Refer to this section for the installation procedures.

14. Fill the cooling system. Refer to Section 11-1 for the filling procedure.

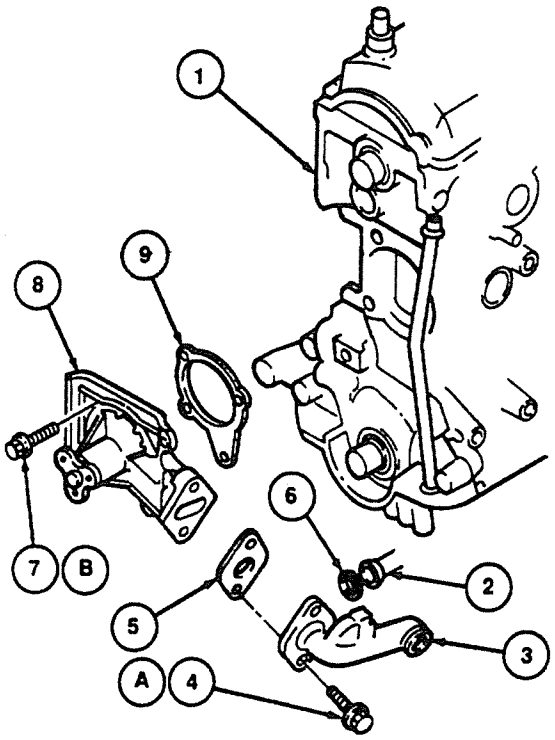
15. Connect the battery cable.

Water Pump

Removal

1. Remove the timing chain/belt. Refer to the removal procedure in this section.

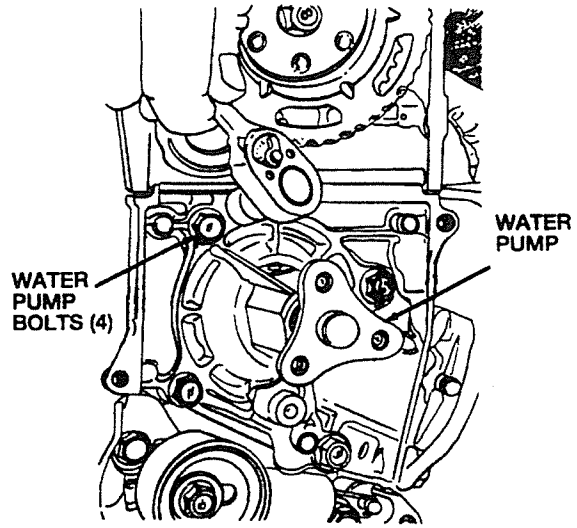
2. Drain the coolant from the radiator. Refer to Section 11-1 for the draining procedure.



Item	Part Number	Description
1	104014	Cylinder Block (assembly)
2	-	Heater Water Hose
3	154011	Water Pump Inlet Connector
4	774066	Hot Water Heater Elbow Connector Bolt (2 req'd)
5	154006	Water Pump Inlet Gasket
6	154017	O-Ring
7	773169	Water Pump Bolt (4 req'd)
8	154008	Water Pump
9	154009	Water Pump Housing Gasket
A	-	Tighten to 14-22 lb-ft(19-30 N-m)
B	-	Tighten to 36-45 lb-ft(49-61 N-m)

3. Remove the two water pump inlet connector-to-water pump bolts.

4. Remove the four water pump bolts and the water pump.



5. Remove and discard the water pump housing gasket and water pump inlet gasket.

Installation

1. Clean the gasket surfaces on the water and the cylinder block.

2. Coat a new water pump housing gasket and water pump inlet gasket with Perfect Seal Sealing Compound or equivalent.

3. Position the water pump housing gasket on the cylinder block and the water pump inlet gasket on the water pump inlet connector.

4. Carefully position the water pump on the cylinder block, using care to align the bolt holes and not to shift the position of the water pump housing gasket.

5. Install the four water pump bolts. Tighten the four water pump bolts to 14-19 lb-ft (19-26 N-m).

6. Install the water pump inlet connector and the water pump inlet connector-to-water pump bolts. Tighten the two water pump inlet connector-to-water pump bolts to 14-22 lb-ft (19-30 N-m).

7. Install the timing chain/belt. Refer to the installation procedure in this section.

8. Fill the cooling system. Refer to Section 15 for the filling procedure.

9. Warm the engine and check for leaks.

Intake Manifold

Upper

Removal

1. Release the fuel system pressure. Refer to Section 13 for the fuel pressure relief procedure.
2. Disconnect the battery ground cable.
3. Drain the cooling system. Refer to Section 15 for the draining procedure.
4. Remove the intake manifold support bolts and the upper intake manifold.
5. Disconnect the accelerator cable from the throttle control lever.
6. Remove the air cleaner to intake manifold tube. Refer to this section for the removal procedure.
7. Remove the coolant hoses from the upper intake manifold.
8. Tag and disconnect the necessary wiring and vacuum hoses.
9. Remove the upper intake manifold to lower intake manifold bolts.
10. Remove the upper intake manifold and intake manifold upper gasket.

Installation

1. Clean all traces of gasket material from the upper and lower intake manifold gasket surfaces.
2. Place a new intake manifold upper gasket onto the gasket surface of the lower intake manifold.
3. Install the upper intake manifold to lower intake manifold bolts. Tighten the intake manifold bolts to 14-20 lb-ft (19-26 N-m).
4. Connect the coolant hoses to the upper intake manifold.
5. Connect the vacuum hoses and wiring as tagged during removal.
6. Install the air cleaner to intake manifold tube.
7. Connect the accelerator cable to the throttle control lever.
8. Install the intake manifold support bolts. Tighten the intake manifold support bolts to 22-34 lb-ft (31-46 N-m).
9. Fill the cooling system. Refer to Section 15 for the filling procedure.
10. Connect the battery ground cable.

Lower

Removal

1. Release the fuel system pressure. Refer to Section 13 for the fuel pressure relief procedure.
2. Disconnect the battery ground cable.
3. Drain the cooling system. Refer to Section 15 for the draining procedure.
4. Remove the intake manifold support bolts and the intake manifold support.
5. Disconnect the accelerator cable from the throttle control lever.
6. Remove the air cleaner to intake manifold tube. Refer to this section for the removal procedure.
7. Remove the coolant hoses from the intake manifold.
8. Tag and disconnect the necessary wiring and vacuum hoses.
9. Remove the intake manifold to cylinder head bolts and nuts.
10. Remove the intake manifold and intake manifold gasket.

Installation

1. Clean all traces of gasket material from the cylinder head and intake manifold.
2. Position a new intake manifold gasket and the intake manifold on the cylinder head.

3. Install the intake manifold to cylinder head bolts and nuts. Tighten the intake manifold bolts and nuts to 19-26 N-m (14-20 lb-ft).

4. Connect the vacuum hoses and wiring as tagged during removal.

5. Connect the coolant hoses to the intake manifold.

6. Install the air cleaner to intake manifold tube. Refer to this section for the installation procedure.

7. Remove the coolant hoses from the intake manifold.

8. Tag and disconnect the necessary wiring and vacuum hoses.

9. Remove the intake manifold to cylinder head bolts and nuts.

10. Remove the intake manifold and intake manifold gasket.

Installation

1. Clean all traces of gasket material from the cylinder head and intake manifold.

2. Position a new intake manifold gasket and the intake manifold on the cylinder head.

3. Install the intake manifold to cylinder head bolts and nuts. Tighten the intake manifold bolts and nuts to 14-20 lb-ft (19-26 N-m).

4. Connect the vacuum hoses and wiring as tagged during removal.

5. Connect the coolant hoses to the intake manifold.

6. Install the air cleaner to intake manifold tube. Refer to this section for the installation procedure.

7. Connect the accelerator cable to the throttle control lever.

8. Install the intake manifold support and intake manifold support bolts. Tighten the intake manifold support bolts to 22-34 lb-ft (31-46 N-m).

9. Fill the cooling system. Refer to Section 15 for the filling procedure.

10. Connect the battery ground cable.

Exhaust Manifold

SERVICE TOOLS REQUIRED

- Oxygen Sensor Wrench

Removal

1. Raise and support the vehicle.

2. Remove the exhaust inlet pipe-to-exhaust manifold nuts and washers.

3. Remove the muffler pipe bracket bolts.

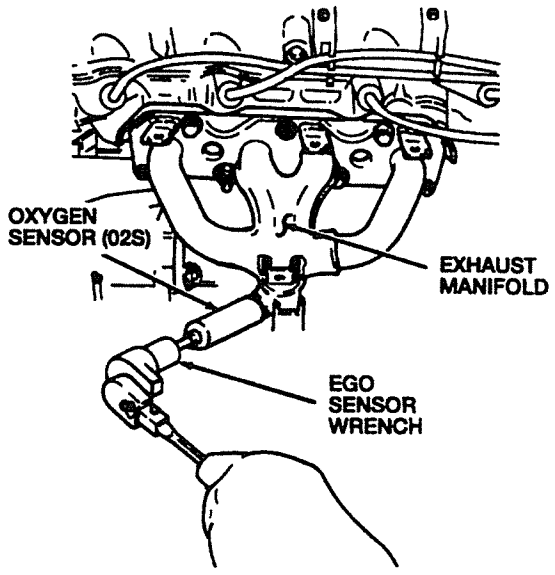
4. Lower the vehicle.

5. Remove the air cleaner to intake manifold tube. Refer to this section for the removal procedure.

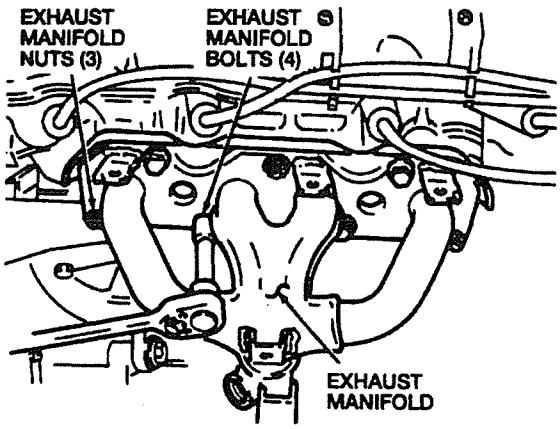
6. Remove the exhaust manifold shield bolts and the exhaust manifold shield.

7. Remove the Oxygen Sensor electrical connector from its routing bracket and disconnect the electrical connector.

8. Use the Oxygen Sensor Wrench to remove the Oxygen Sensor.



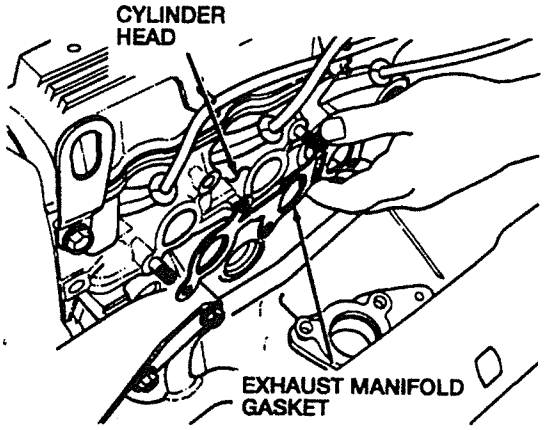
9. Remove the four exhaust manifold bolts and three exhaust manifold nuts.



10. Remove the exhaust manifold.

11. Remove the muffler inlet pipe gasket from the exhaust inlet pipe.

12. Remove the exhaust manifold gasket from the cylinder head.

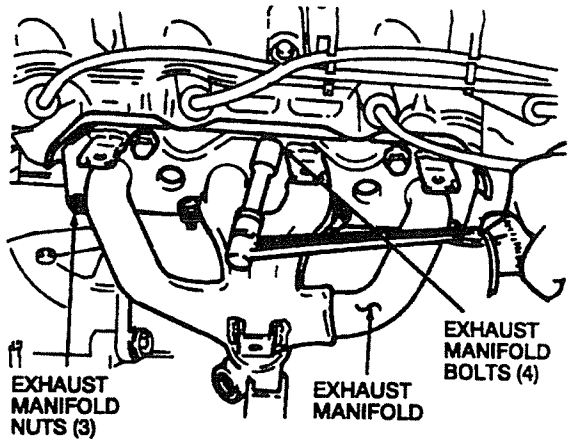


Installation

1. Clean all traces of exhaust manifold gasket material from cylinder head and exhaust manifold.

2. Position a new exhaust manifold gasket on the cylinder head studs.

3. Install the exhaust manifold, three exhaust manifold nuts and four exhaust manifold bolts. Tighten the four exhaust manifold bolts to 12-17 lb-ft (16-23 N-m). Tighten the three exhaust manifold nuts to 12-17 lb-ft (16-23 N-m).



4. NOTE: Before installing the Oxygen Sensor, make sure the exhaust manifold is in position.

   Use Oxygen Sensor (02S) Wrench (EGO Sensor Wrench) to install the Oxygen Sensor (02S).

5. Position the exhaust manifold shield and install the exhaust manifold shield bolts. Tighten the exhaust manifold shield bolts to 12-17 lb-ft (12-17 lb-ft).

6. Connect the 02S electrical connector and install the connector in the routing bracket.

7. Install the air cleaner to intake manifold tube.

8. Raise and support the vehicle.

9. Position a muffler inlet pipe gasket on the exhaust manifold studs.

10. Push the exhaust inlet pipe upward onto the exhaust manifold studs.

11. Install the exhaust inlet pipe-to-exhaust manifold nuts and washers. Tighten the exhaust inlet pipe-to-exhaust manifold nuts to 23-34 lb-ft (31-46 N-m).

12. Position the muffler pipe bracket and install the bolts.

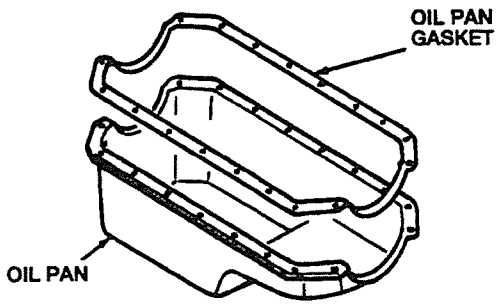
13. Lower the vehicle.

14. Start the engine and inspect for leaks.

Oil Pan

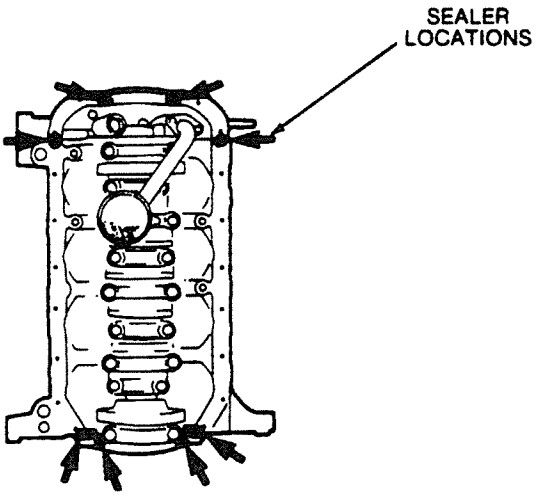
Removal

1. Disconnect the battery ground cable.
2. Drain the engine oil.
3. Remove the exhaust inlet pipe. Refer to Section 14 for the removal procedure.
4. Remove the oil pan nuts and bolts.
5. Remove the oil pan.
6. Remove the oil pan gasket.



Installation

1. Clean the oil pan gasket surfaces on the oil pan and cylinder block.
2. Apply oil resistant sealer across the joint line of the cylinder block and the oil pump and the crankshaft rear oil seal retainer.

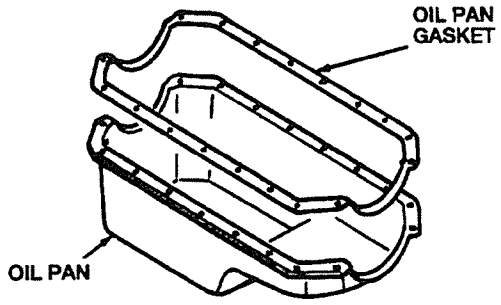


3. Install the oil pan gasket and oil pan.
4. Tighten the oil pan bolts and nuts to 69-78 lb-in. (69-78 lb-in).
5. Install the oil pan drain plug. Tighten the oil pan drain plug to 22-30 lb-ft (29-41N-m).
6. Add specified type and amount of engine oil. Refer to the procedure in this section.
7. Install the exhaust inlet pipe. Refer to Section 14 for the installation procedure.
8. Connect the battery ground cable.

Oil Pump Screen Cover and Tube

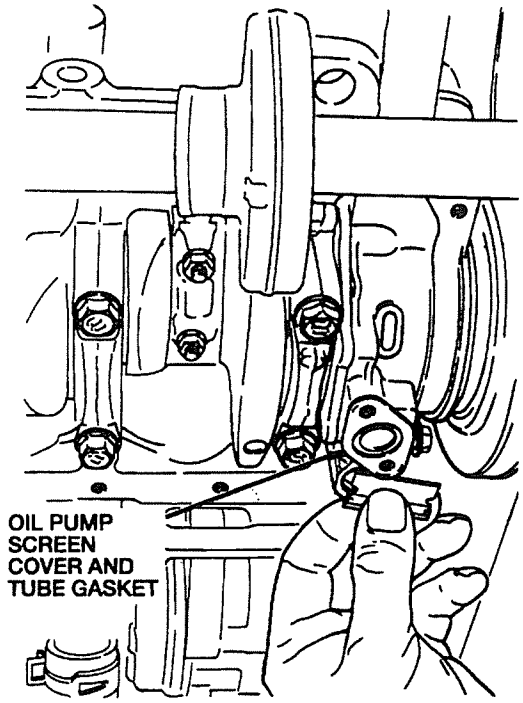
Removal

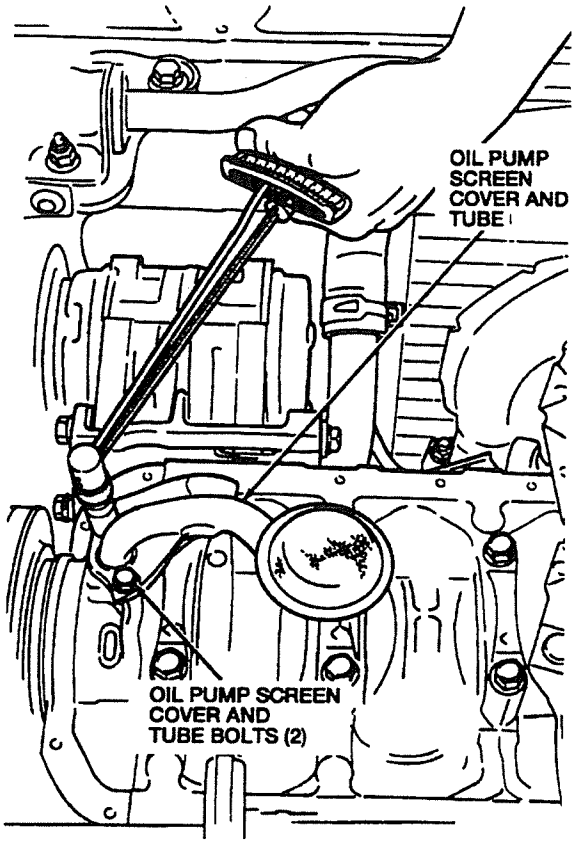
1. Disconnect the battery ground cable.
2. Drain the engine oil.
3. Remove the exhaust inlet pipe. Refer to Section 14 for the removal procedure.
4. Remove the oil pan nuts and bolts.
5. Remove the oil pan.
6. Remove the oil pan gasket.



7. Remove the oil pump screen cover and tube bolts and the oil pump screen cover and tube.
8. **CAUTION: Do not damage the oil pump when removing the oil pump screen cover and tube gasket.**

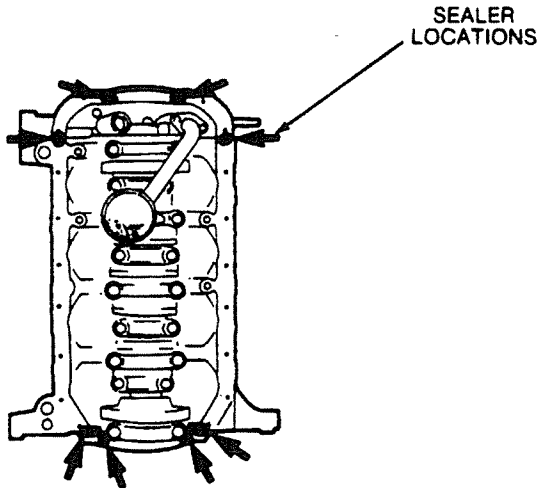
   Remove the oil pump screen cover and tube gasket.





Installation

1. Clean the oil pan gasket surfaces on the oil pan and cylinder block.
2. Clean the gasket surfaces of the oil pump and oil pump screen cover and tube.
3. Install a new oil pump screen cover and tube gasket onto the oil pump.
4. Install the oil pump screen cover and tube.
5. Install the two oil pump screen cover and tube bolts. Tighten the two oil pump screen cover and tube bolts to 71-97 lb-in (8-11N-m).
6. Apply oil resistant sealer across the joint line of the cylinder block and the oil pump and the crankshaft rear oil seal retainer.



7. Install the oil pan gasket and oil pan.
8. Tighten the oil pan bolts and nuts to 69-78 lb-in (8-9 N-m).

9. Install the oil pan drain plug. Tighten the oil pan drain plug to 22-30 lb-ft (29-41N-m).

10. Add specified type and amount of engine oil. Refer to the procedure in this section.

11. Install the exhaust inlet pipe. Refer to Section 14 for the installation procedure.

12. Connect the battery ground cable.

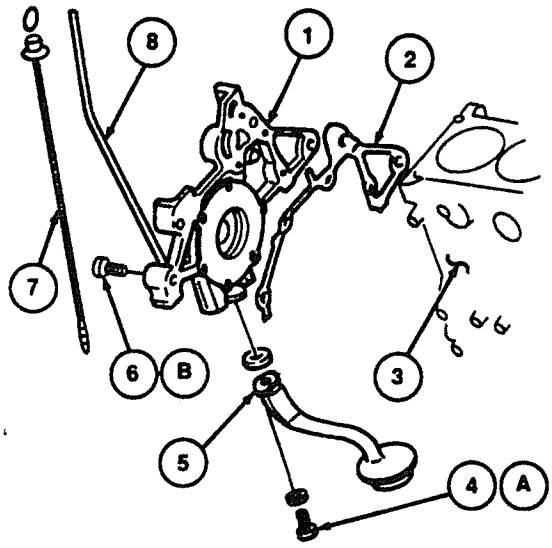
Oil Pump

SPECIAL SERVICE TOOL(S) REQUIRED

- Impact Slide Hammer

Removal

The following illustration is an exploded view of the oil pump and related components.



Item	Part Number	Description
1	-	Oil Pump
2	-	Oil Pump to Cylinder Block Gasket
3	104014	Cylinder Block, Assembly
4	-	Oil Pump Screen Cover and Tube Bolt (2 Req'd)
5		Oil Pump Screen Cover and Tube

Continued

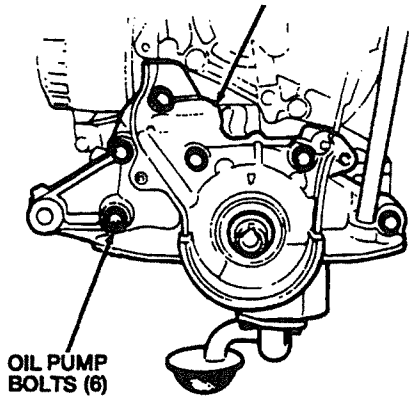
Item	Part Number	Description
6	-	Oil Pump Bolt (6 Req'd)
7	104020	Oil Level Dipstick
8	104017	Oil Level Indicator Tube
A	-	Tighten to 71-97 lb-in (8-11 N-m)
B	-	Tighten to 14-19 lb-ft (19-25 N-m)

1. Remove the crankshaft sprocket. Refer to the removal procedure in this section.

2. Remove the oil pan. Refer to the removal procedure in this section.

3. Remove the six oil pump bolts.

OIL PUMP



4. Remove the oil pump and oil pump to cylinder block gasket.

5. If necessary, remove the oil pump screen cover and tube.

Installation

1. Clean the oil pump mounting surface on the cylinder block.

2. **CAUTION: Do not allow sealing compound to squeeze into the oil pump outlet hole in the oil pump or cylinder block.**

   Apply Perfect Seal Sealing Compound or equivalent to each side of the new oil pump to cylinder block gasket and install the oil pump to cylinder block gasket.

3. Install the oil pump onto the cylinder block.

4. Install the six oil pump bolts. Tighten the oil pump bolts to 14-19 lb-ft (19-25 N-m).

5. If necessary, install the oil pump screen cover and tube.

6. Install the oil pan. Refer to the installation procedure in this section.

7. Install the crankshaft sprocket. Refer to the installation procedure.

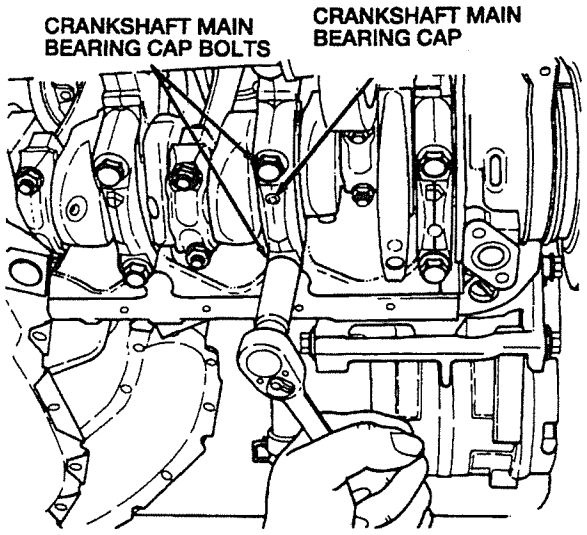
Crankshaft Main Bearings

Removal

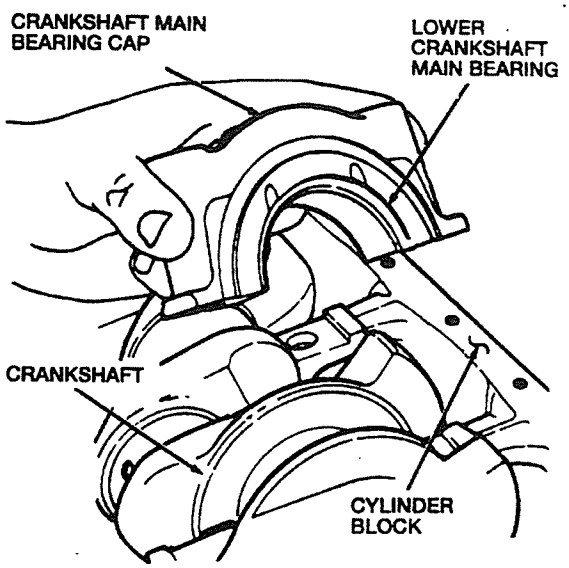
1. Remove the oil pan. Refer to the removal procedure in this section.

2. **CAUTION: If crankshaft main bearings are to be replaced with the engine in the vehicle, keep at least two crankshaft main bearing caps tight while servicing the others.**

   Remove the crankshaft main bearing cap bolts

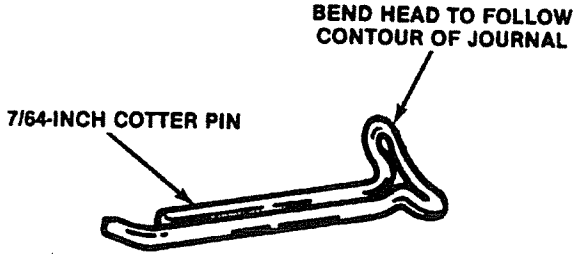


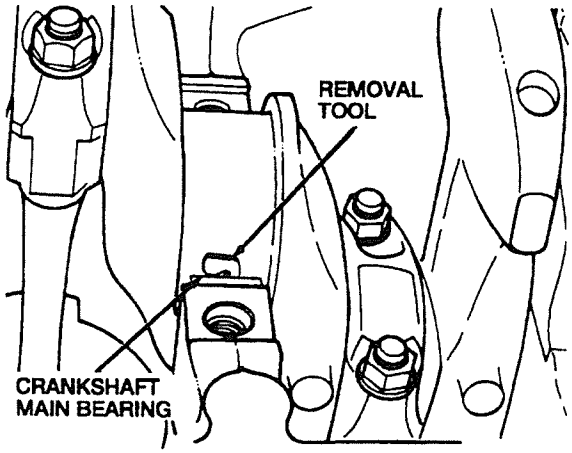
3. Remove the crankshaft main bearing caps and the lower crankshaft main bearings.



4. **CAUTION: Always turn the crankshaft clockwise. The timing chain/belt is designed to turn in its original direction of installation.**

   Remove the upper crankshaft main bearings, using a tool or bent cotterpin, Insert the tool or pin into the crankshaft journal oil hole and turn the crankshaft in the normal direction of rotation to remove the upper crankshaft main bearing.





Installation

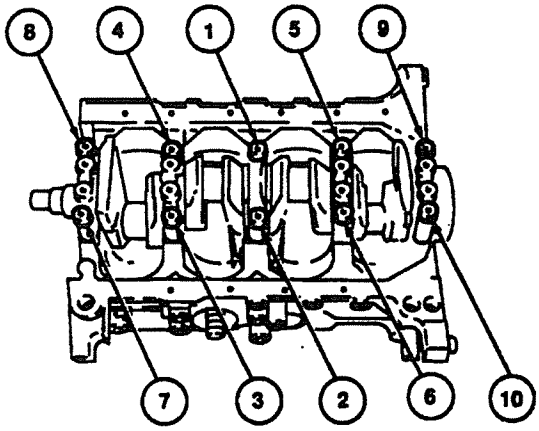
1. Measure the crankshaft main bearing-to-journal clearance. Refer to this section for the procedure.

2. **CAUTION: Always turn the engine in the normal direction of rotation to prevent damage to the crankshaft main bearings.**

   Use a bearing installing tool or bent cotter pin to help install the upper crankshaft main bearings.

3. Install the new lower crankshaft main bearings in the main bearing caps. Match the crankshaft main bearing tangs with the notch in the main bearing cap.

4. Be sure the crankshaft main bearings are in their proper position by observing numbers and/or arrows on the main bearing cap. Install the main bearing caps and tighten the crankshaft main bearing cap bolts to 40-43 lb-ft (54-59 N-m) in the order shown.



5. After each crankshaft main bearing cap bolt is tightened, be sure that the crankshaft can be rotated clockwise by hand. If not, remove that crankshaft main bearing cap and investigate for the source of interference. Tighten all crankshaft main bearing cap bolts and check again for proper crankshaft rotation.

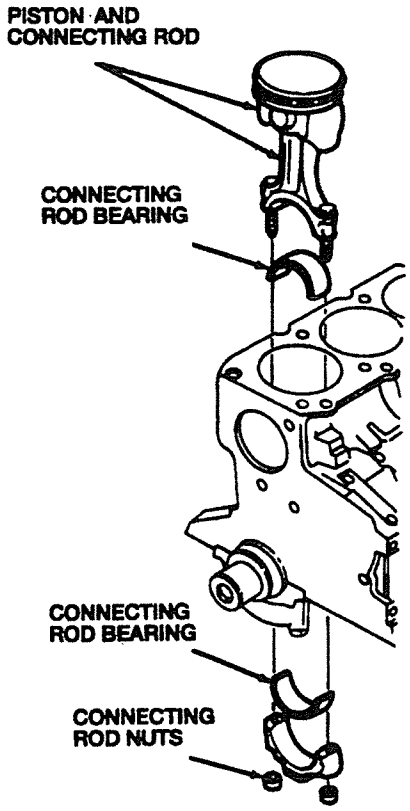
6. Install the oil pan. Refer to the installation procedure in this section.

Pistons and Connecting Rods

Service Tool(s) Required

- Cylinder Ridge Retainer

Removal



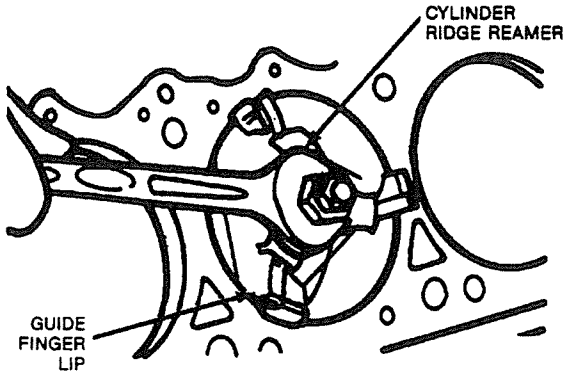
1. Remove the cylinder head. Refer to the removal procedure in this section.

2. Remove the oil pan. Refer to the removal procedure in this section.

3. Turn the crankshaft clockwise until the piston to be removed is at Bottom Dead Center.

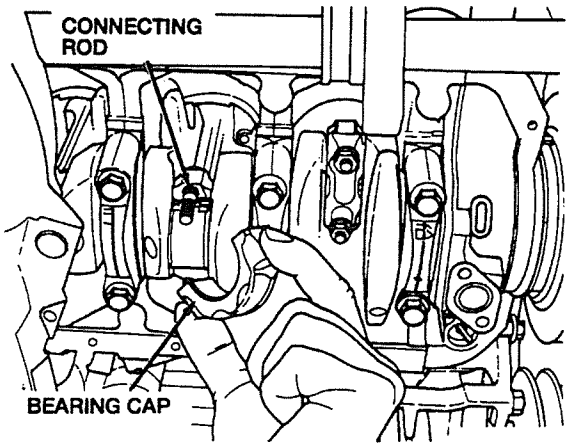
4. NOTE: Following directions of the ridge reamer manufacturer, remove the ridge until the bore is straight to the top edge of the cylinder.

   If necessary, remove the carbon from the upper portion of the cylinder bore using the Cylinder Ridge Reamer.

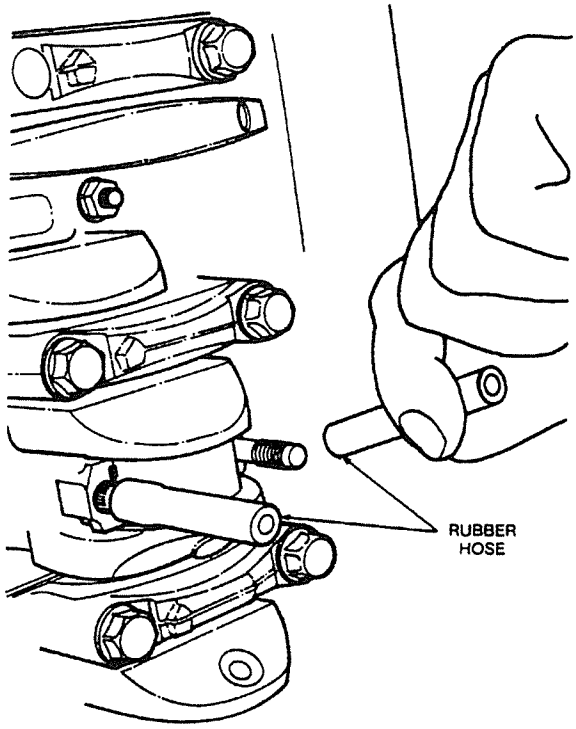


5. Remove the connecting rod nuts.

6. Remove the bearing cap and connecting rod bearing.



7. To prevent scratching of the crankshaft journal surface, install a piece of rubber hose on the connecting rod studs.

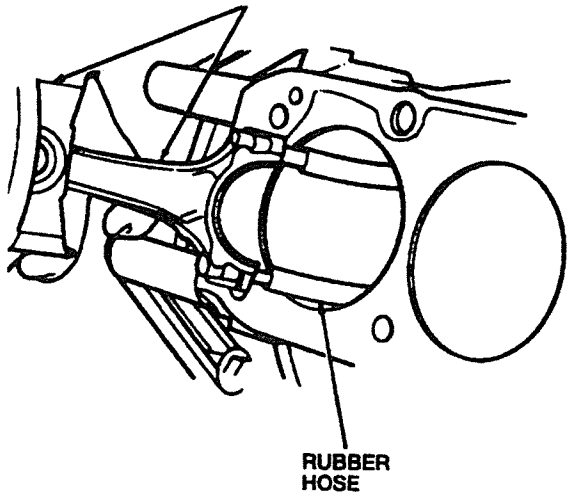


8. Use a hammer handle or piece of wood to tap the connecting rod and piston upward until the piston rings clear the top of the cylinder block.

9. NOTE: If removing more that one piston and connecting rod, mark each with the applicable cylinder number to aid in installation.

   Remove the connecting rod and piston assembly from the top of the cylinder bore.

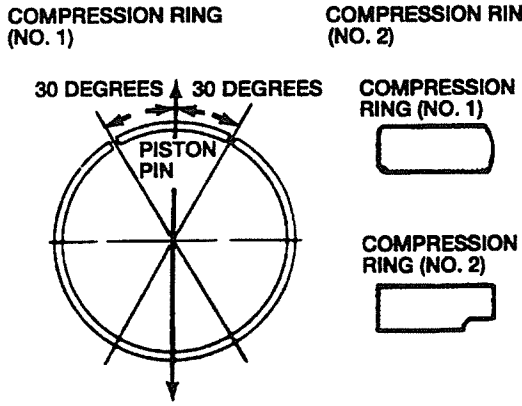
PISTON AND
CONNECTING ROD



Installation

1. Install the connecting rod bearing into the connecting rod and coat it with engine oil.

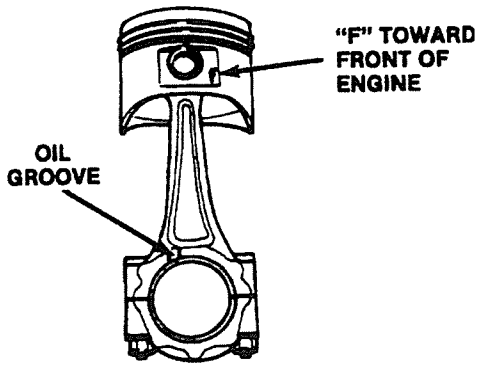
2. Properly space the piston ring gaps. Dip the piston in engine oil and install and tighten Piston Ring Compressor or equivalent.



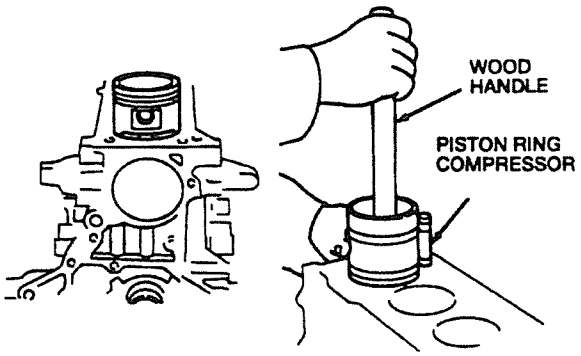
3. Slip two pieces of snug-fitting rubber hose over the connecting rod studs to prevent bolt-to-crankshaft journal contact during installation.

4. NOTE: Cylinder numbering starts at the front of the engine.

   Start the connecting rod/piston assembly into the cylinder bore, keeping the F mark on the piston toward the front of the engine. Be sure the connecting rod number and the cylinder bore number match.

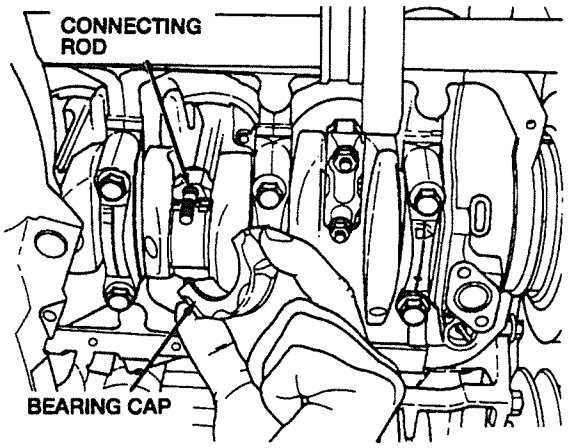


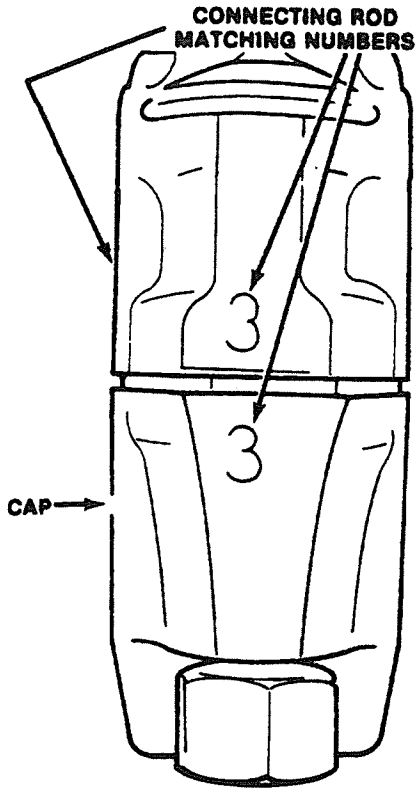
5. Use a hammer handle or piece of wood to tap the piston/rod assembly into the cylinder bore. Guide the connecting rod studs over the crankshaft journal. Remove the rubber hose from the connecting rod studs.



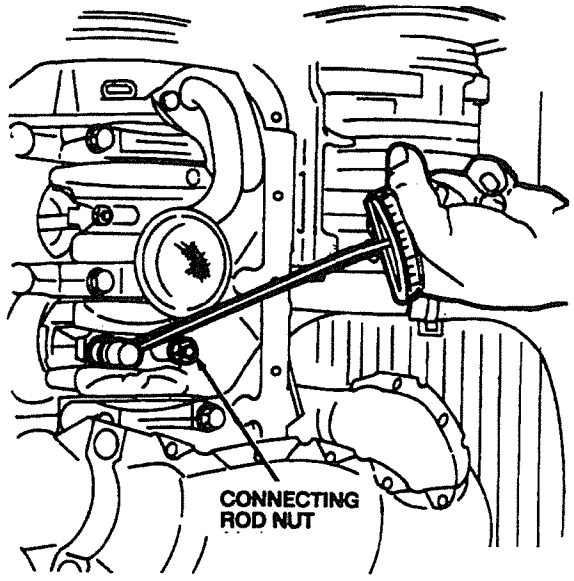
6. Measure the connecting rod bearing-to-journal clearance. Refer to this section for the procedure.

7. Insert the proper size connecting rod bearing into the connecting rod cap. Install the connecting rod cap, making sure that the number on the connecting rod cap and connecting rod are on the same side and that they match.





8. Install the connecting rod nuts. Tighten the connecting rod nuts evenly to 11-13 lb-ft (15-17 N-m).



9. Repeat steps 1 through to 8 as necessary on the remainder of the rod/piston assemblies. Tighten the connecting rods nuts to 22-25 lb-ft. (29-34 N-m).

10. Check the connecting rod side clearance. The clearance is 0.0043-0.0103 inch (0.110-0.262mm) with a limit of 0.012 inch (0.30mm).

11. Install the oil pan. Refer to the installation procedure in this section.

12. Install the cylinder head. Refer to the installation procedure in this section.

Connecting Rod Bearings

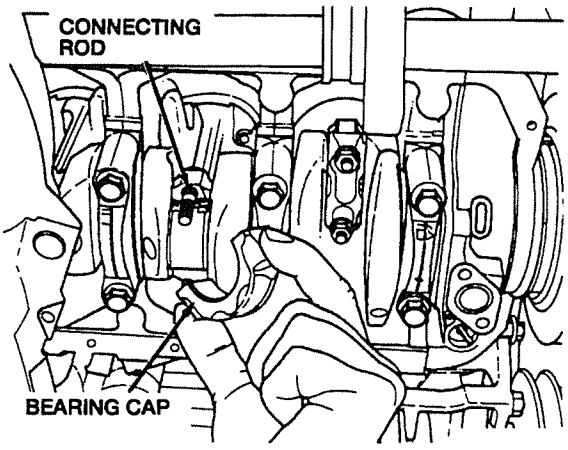
Removal

1. Remove the oil pan. Refer to the removal procedure in this section.

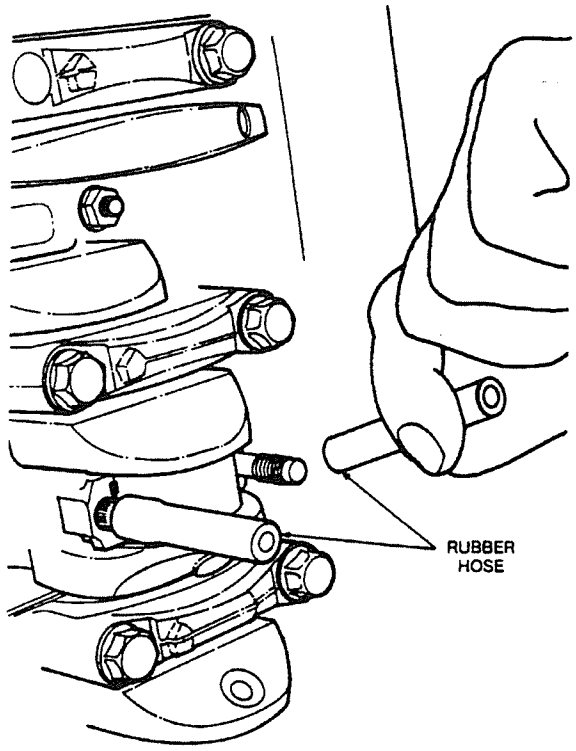
2. Turn the crankshaft clockwise, until the connecting rod and the piston assembly to be removed are at Bottom Dead Center (BDC).

3. Remove the connecting rod nuts.

4. Remove the bearing cap and connecting rod bearing.



5. To prevent scratching of the crankshaft journal surface, install a piece of rubber hose on the connecting rod studs.



6. NOTE: Push the piston up into the cylinder bore slightly to provide clearance for the upper connecting rod bearing removal.

   Remove the upper connecting rod bearing.

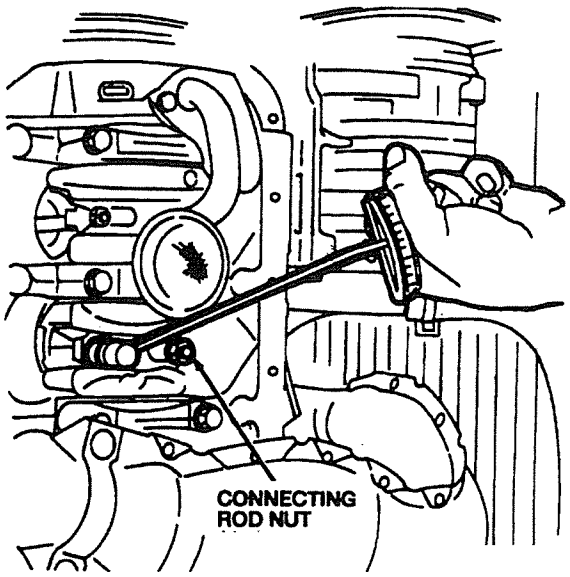
Installation

1. Thoroughly clean the connecting rod bearings, connecting rod cap, and connecting rod.

2. Clean the crankshaft journal and lubricate with clean, heavy engine oil.

3. Install the upper connecting rod bearing in the connecting rod, then pull the connecting rod down until it seats on the crankshaft.
4. Install the lower connecting rod bearing in the connecting rod cap. Remove the two pieces of rubber hoses from the connecting rod studs and install the connecting rod cap.

5. Install the connecting rod nuts. Tighten the connecting rod nuts to 11-13 lb-ft (15-17 N-m). Tighten the connecting rod nuts a second time to 22025 lb-ft (29-34 N-m).



6. Check the connecting rod side clearance. The clearance is 0.0043-0.0103 inch (0.110-0.262mm) with a limit of 0.012 inch (0.30mm).

7. Install the oil pan. Refer to the installation procedure in this section.

Flywheel

Service Tool(s) Required

- Flywheel Holding Tool

Removal

1. Remove the transaxle. Refer to Section 8 for the removal procedure.

2. Use the Flywheel Holding Tool to lock the flywheel.

3. Remove the flywheel attaching bolts.

4. Remove the flywheel.

Installation

1. Install the flywheel onto the crankshaft.

2. Remove any old sealant from the flywheel bolt holes. If reusing flywheel attaching bolts remove any old sealant.

3. NOTE: Coat the flywheel attaching bolt threads with Stud and Bearing Mount or equivalent, prior to installation.

4. Use the Flywheel Holding Tool to lock the flywheel.

5. Tighten the flywheel attaching bolts to 71-76 lb-ft (96-103 N-m).

6. Install the transaxle. Refer to Section 8 for the installation procedure.

Pilot Bearing

Removal

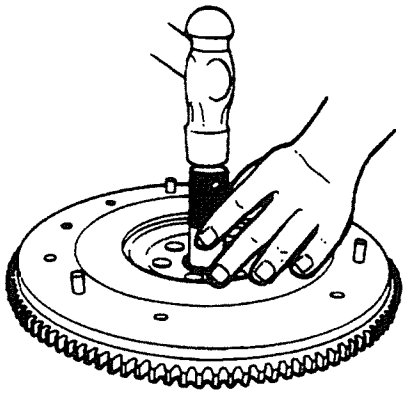
1. Remove the flywheel. Refer to the removal procedure in this section.

2. Use a suitable driver to remove the pilot bearing from the flywheel.

Installation

1. **CAUTION: Make sure the driver contacts the bearing outer race. Any contact to the inner race will damage the pilot bearing.**

   Install the pilot bearing using a suitable driver.



2. Install the flywheel. Refer to the installation procedure in this section

Removal

1. Remove the flywheel. Refer to the removal procedure in this section.

2. Remove the flywheel reinforcing plate bolt and the flywheel reinforcing plate.

3. Remove the crankshaft rear oil seal, using Seal Remover.

Crankshaft Rear Cover and Oil Seal

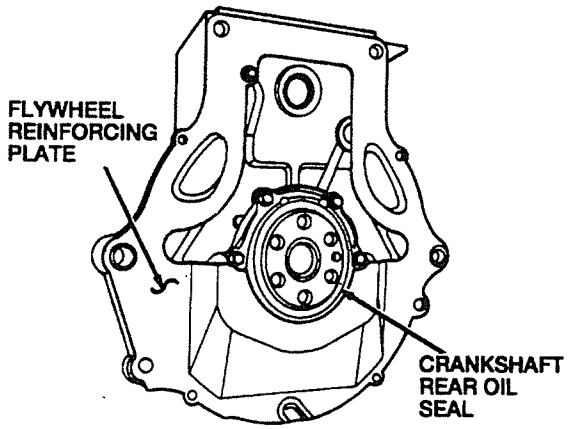
SPECIAL SERVICE TOOL(S) REQUIRED

- Seal Remover
- Seat Replacer

Removal

1. Remove the flywheel. Refer to the removal procedure in this section.

2. Remove the flywheel reinforcing plate bolt and the flywheel reinforcing plate.



3. Remove the crankshaft rear oil seal, using Seal Remover.

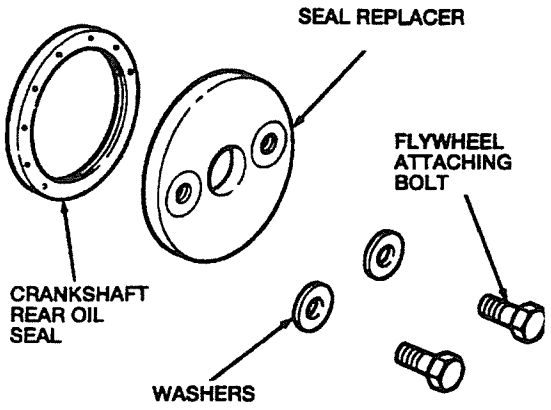
Installation

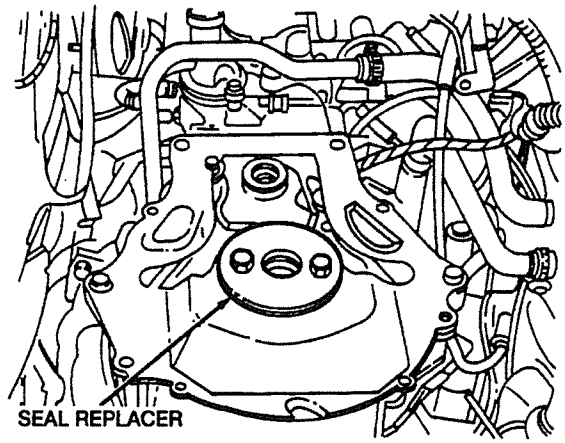
1. Clean the sealing surface on the crankshaft rear oil seal retainer.

2. Apply engine oil to the inside and the outside of a new crankshaft rear oil seal.

3. NOTE: The flywheel attaching bolts may be used to press the seal replacer and crankshaft rear oil seal into the crankshaft rear oil seal retainer.

   Use Seal Replacer to install the crankshaft rear oil seal with the lip of the crankshaft rear oil seal facing the engine.





4. Install the flywheel reinforcing plate. Tighten the flywheel reinforcing plate bolt to 71-97 lb-in., (8-11N-m).

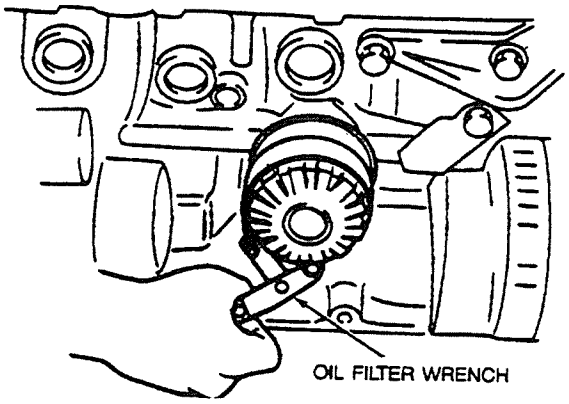
5. Install the flywheel. Refer to the installation procedure in this section.

Oil Filter

Removal

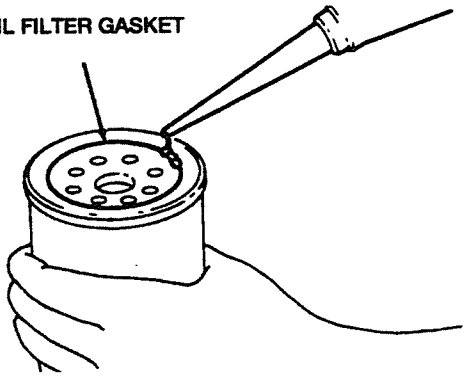
1. Raise and support the vehicle.
2. **WARNING: IF THE ENGINE IS HOT, THE OIL WILL BE HOT.**

   Place a drain pan under the oil filter area.
3. Use an Oil Filter Wrench to remove the oil filter. Ensure that the old filter gasket is removed from the seating surfaces of the engine.



Installation

1. Be sure all parts are clean. Coat the oil filter gasket with clean engine oil.



2. Install the oil filter by hand. After the oil filter gasket contacts the cylinder block surface, tighten the oil filter one-half turn.
3. Lower the vehicle.
4. Check the engine oil level and add oil if necessary.
5. Start the engine and check for leaks.
6. Check the engine oil level and add oil if necessary.

Oil Level Indicator Tube

Removal

1. Remove the oil level dipstick.
2. Remove the oil level indicator tube bracket bolt, and then pull the oil level indicator tube from the engine. Discard the O-ring.

Installation

1. Install a new O-ring, then install the oil level indicator tube.
2. Install the oil level indicator tube bolt.
3. Install the oil level dipstick.

Sensors

Oil Pressure Sensor

Removal

The oil pressure sensor is located on the rear of the engine near the oil filter.

1. Raise and support the vehicle.
2. Disconnect the oil pressure sensor electrical connector.
3. **CAUTION: Do not use locking-type pliers to remove or install the oil pressure sensor. The diaphragm In the oil pressure sensor can be damaged by the use of locking-type pliers.**

   Using a suitable tool, remove the oil pressure sensor from the engine.

Installation

1. Apply Teflon® tape to the threads of the oil pressure sensor.
2. Install the oil pressure sensor.
3. Tighten the oil pressure sensor to 9-13 lb-ft (12-18 N-m).
4. Connect the oil pressure sensor electrical connector.

5. Check the engine oil level and add oil if necessary.

REMOVAL AND INSTALLATION

Engine

SPECIAL SERVICE TOOL(S) REQUIRED

- Differential Plugs

Removal

1. Disconnect the battery to ground cable and starter relay cable.
2. Remove the battery tray and battery. Refer to Section 17 for the removal procedure.
3. Remove the cargo box assembly. Refer to Section 26 for the removal procedure.
4. Remove the engine air cleaner to intake manifold tube. Refer to this section for the removal procedure.
5. Remove the radiator and electric cooling fan. Refer to this section or Section 15 for the removal procedure.
6. Disconnect the accelerator cable from the throttle body. Remove the two accelerator shaft bracket bolts from the valve cover. Remove the accelerator cable bracket.
7. Disconnect the speedometer from the transaxle.
8. NOTE: Plug the fuel hoses to prevent fuel leakage and contamination.

   Disconnect the fuel tube hose and fuel tube from the fuel injection supply manifold.
9. Disconnect the heater water hoses from the engine.
10. Disconnect the power brake booster vacuum hose.
11. Disconnect main harness from engine harness
12. Disconnect the Park/Neutral Position Switch (PNP switch), starter alternator and distributor.
13. Remove the shift-to-manual shaft bolt.
14. Disconnect the shift cable and bracket from the transaxle.
15. Remove the accessory drive belts. Refer to this section for the removal procedure.
16. If equipped, disconnect the power steering lines from the engine.
17. Raise and support the vehicle.
18. Drain the engine oil. Refer to the draining procedure in this section.
19. Drain the transmission fluid. Refer to Section 8 for the draining procedure.
20. Remove the rear tire and wheel assemblies.
21. Remove the RH access panel and LH front splash shield.
22. Remove the rear suspension lower arm clamp bolts and nuts. Pull the rear suspension lower arms downward, separating the rear suspension lower arms from the rear wheel knuckles.
23. Remove the RH rear wheel driveshaft and joint and LH rear wheel driveshaft and joint and install Differential Plugs into the differential side gears. Refer to Section 7 for the removal procedure.
24. If equipped, remove the A/C compressor. Refer to Section 22 for the removal procedure.
25. Remove the exhaust inlet pipe. Refer to Section 14 for the removal procedure.
26. Remove the starter motor. Refer to Section 16 for the removal procedure.
27. Remove the two rear transaxle support insulator nuts.
28. Remove the two rear transaxle support insulator nuts.
29. Remove the two muffler pipe bracket bolts. Remove the muffler pipe bracket.

30. Remove the six transmission case to cylinder block front bracket and case rear bracket bolts. Remove the transmission case to cylinder block front bracket and case rear bracket.

31. Remove the engine rear plate bolt. Remove the engine rear plate.

32. Remove the four flywheel-to-torque converter nuts.

33. Lower the vehicle.

34. Disconnect the vacuum lines from the intake manifold vacuum outlet fitting and cap and the evaporative emission canister.

35. Attach lifting hooks to the engine lifting eyes and remove any slack in the chains.

36. Remove the engine support insulator through bolt and nut from engine support insulator.

37. Raise and remove engine and transaxle assembly from the vehicle.

38. Remove the four engine-to-transaxle bolts.

39. Separate the transaxle from the engine.

40. Remove the flywheel. Refer to the removal procedure in this section.

41. Mount the engine on an engine stand.

42. Remove the lifting hooks from the engine lifting eyes

Installation

1. Attach lifting hooks to the engine lifting eyes and remove any slack in the chain.

2. Remove the engine from the engine stand .

3. Install the flywheel. Refer to the installation procedure in this section.

4. Connect the transaxle to the engine.

5. Install the four engine-to-transaxle bolts. Tighten the engine-to-transaxle bolts to 41-59 lb-ft (55-80 N-m).

6. Lower and install engine and transaxle assembly into vehicle.

7. Install the engine support insulator through bolt and nut into the engine support insulator. Tighten the engine support insulator through bolt to 39-47 lb-ft (53-64 N-m).

8. Remove the lifting cables from the engine lifting eyes.

9. Connect the vacuum lines to the intake manifold vacuum outlet fitting and cap and the evaporative emission canister.

10. Raise and support the vehicle.

11. Install the four flywheel-to-torque converter nuts. Tighten the flywheel-to-torque converter nuts to 25-36 lb-ft (34-49 N-m).

12. Install the engine rear plate and the engine rear plate bolt. Tighten the engine rear plate bolt to 61-87 lb-in (7-10 N-m).

13. Install the transmission case to cylinder block front bracket and the transmission case to cylinder block front bracket bolts. Tighten the transmission case to cylinder block front bracket bolts to 27-38 lb-ft (37-52 N-m).

14. Install the case rear bracket and case rear bracket bolts. Tighten the case rear bracket bolts to 27-38 lb-ft. (37-52 N-m).

15. Install the muffler pipe bracket. Install the two muffler pipe bracket bolts. Tighten the muffler pipe bracket bolts to 28-41 lb-ft (38-56 N-m).

16. Install the two rear transaxle support insulator nuts. Tighten the nuts to 21-34 lb-ft (28-46 N-m).

17. Install the two front transaxle support insulator nuts. Tighten the nuts to 27-38 lb-ft (37-52 N-m).

18. Install the starter motor. Refer to Section 16 for the installation procedure.

19. Install the exhaust inlet pipe. Refer to Section 14 for the installation procedure.

20. Remove the Differential Plugs from the differential side gears and install the RH rear wheel driveshaft and joint and LH rear wheel driveshaft and joint. Refer to Section 7 for the installation procedure.

21. Install the rear suspension lower arms into the rear wheel knuckles and install the clamp bolts and nuts. Tighten the clamp bolts and nuts to 32-40 lb-ft (43-54 N-m).

22. Install RH rear access shield and LH rear access shield.

23. Install the rear tire and wheel assemblies. Tighten the wheel hub bolt to 65-87 lb-ft (88-118 N-m).

24. Lower the vehicle.

25. Install the accessory drive belts. Refer to this section for the installation procedure.

26. Connect the shift cable and bracket from the transaxle. Refer to Section 8 for the installation procedure.

27. Connect the PNP switch, kickdown solenoid electrical connector, and transaxle ground.

28. Connect all engine harness electrical connectors and grounds.

29. Connect the vacuum modulator hose and governor vacuum hose.

30. Connect the power brake booster vacuum hose.

31. Connect the heater water hoses to the heater core.

32. Connect the fuel tube hose and fuel tube to the fuel injection supply manifold.

33. Connect the speedometer cable to the transaxle.

34. Install the accelerator cable bracket to the valve cover. Install the two accelerator shaft bracket bolts. Connect the accelerator cable to the throttle body.

35. Install the radiator and electric cooling fan. Refer to Section 15 for the installation procedure.

36. Install the ACL and air cleaner to intake manifold tube. Refer to this section for the installation procedure.

37. Install the cargo box. Refer to Section 26 for the installation procedure.

38. Install the battery tray and the battery. Refer to Section 17 for the installation procedure.

39. Connect the battery to starter relay cable and battery ground cable.

40. Refill the transmission fluid. Refer to Section 8 for the installation procedure.

41. Refill the engine with oil. Refer to the procedure in this section.

42. Refill the cooling system with specified type and mixture of antifreeze and water. Refer to Section 15 for the filling procedure.

Crankshaft

Removal

1. Remove the engine. Refer to the removal procedure in this section.

2. Remove the cylinder head. Refer to the removal procedure in this section.

3. Remove the oil pump. Refer to the removal procedure in this section.

4. Remove the oil pan. Refer to the removal procedure in this section.

5. Remove the crankshaft rear oil seal. Refer to the removal procedure in this section.

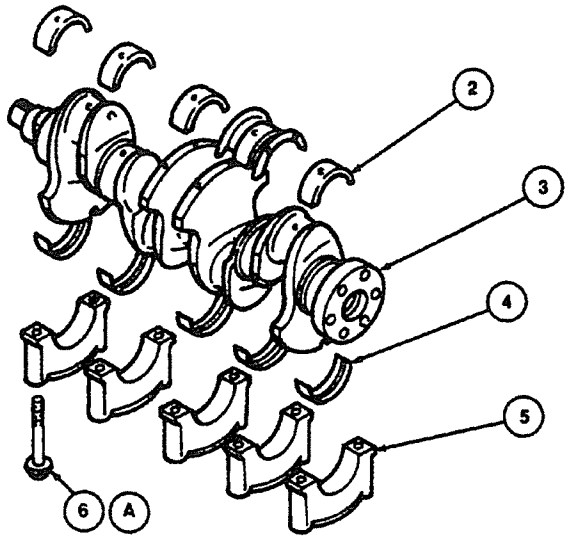
6. Remove the connecting rods and pistons. Refer to the removal procedure in this section.

7. Remove the main bearing caps and the lower crankshaft main bearings.

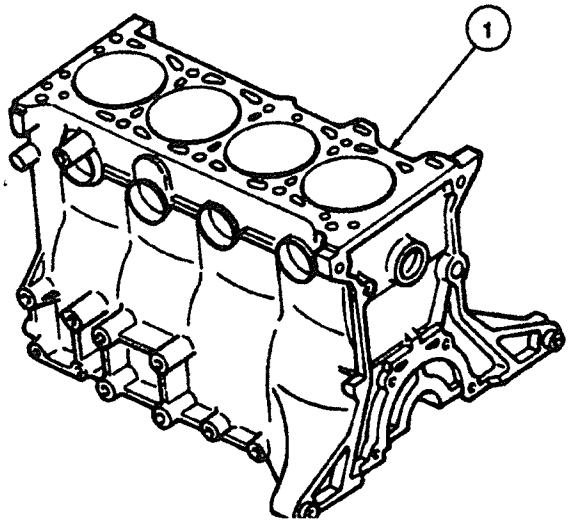
8. **CAUTION: Use care not to damage the bearing journals while removing the crankshaft.**

   Remove the crankshaft.

9. Remove the upper crankshaft main bearings.



Item	Part Number	Description
1	104014	Cylinder Block
2		Crankshaft Main Bearings, Upper
3	114002	Crankshaft
4		Crankshaft Main Bearings, Lower



Item	Part Number	Description
5	-	Main Bearings Caps
6	-	Crankshaft Main Bearing Cap Bolt (10 req'd)
A	-	Tighten to 40-43 lb-ft (54-59 N-m)

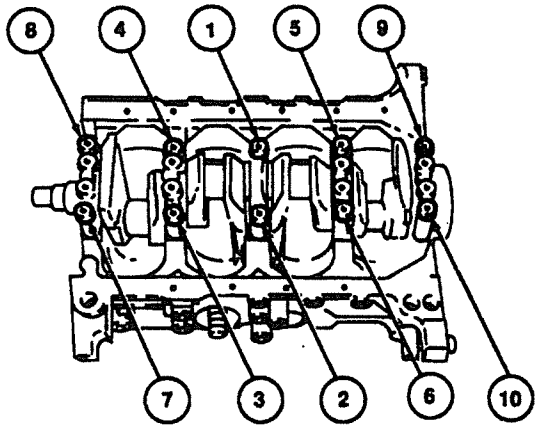
Installation

1. Install the proper size crankshaft main bearings in the cylinder block and bearing caps. Refer to this section for the installation procedure.

2. Install the crankshaft.

3. NOTE: After each bearing cap is tightened, make sure that the crankshaft can be rotated by hand. If not, remove that bearing cap and determine the source of interference.

   Be sure the crankshaft main bearings are in their proper position. Install the crankshaft main bearing caps. Tighten the crankshaft main bearing cap bolts to 40-43 lb-ft (54-59 N-m) in the order shown.



4. Measure the crankshaft bearing-to-journal clearance. Refer to Section 11 for the procedure.

5. NOTE: The end play is adjustable through the use of variable thickness crankshaft thrust bearings located at the number four upper crankshaft main bearing location.

   Measure crankshaft end play. Refer to Section 11 for the procedure.

6. Install the crankshaft rear oil seal. Refer to the installation procedure in this section.

7. Install the connecting rods and pistons. Refer to the installation procedure in this section.

8. Install the oil pump. Refer to the installation procedure in this section.

9. Install the oil pan. Refer to the installation procedure in this section.

10. Install the cylinder head. Refer to the installation procedure in this section.

11. Install the engine. Refer to the installation procedure in this section.

DISASSEMBLY AND ASSEMBLY

Engine

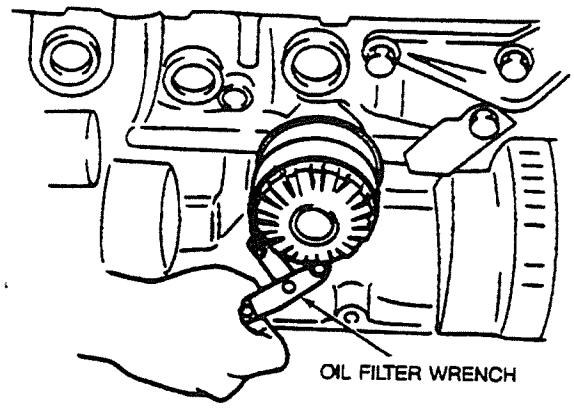
SERVICE TOOLS REQUIRED

- Cylinder Ridge Reamer

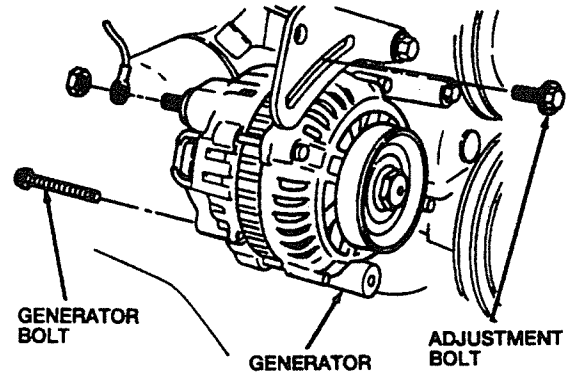
Disassembly

1. Remove the engine from the vehicle. Refer to the removal procedure in this section.

2. Use Oil Filter Wrench to remove the oil filter.



3. Remove the adjustment bolt and the alternator bolt.

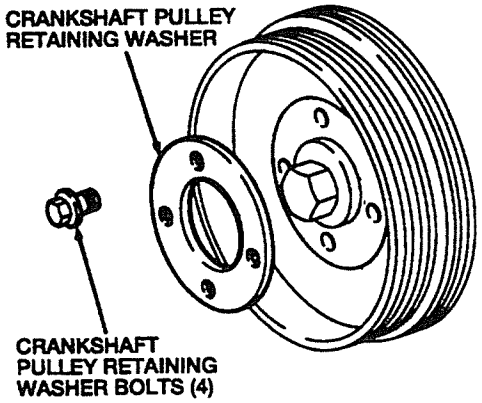


4. Remove the alternator.

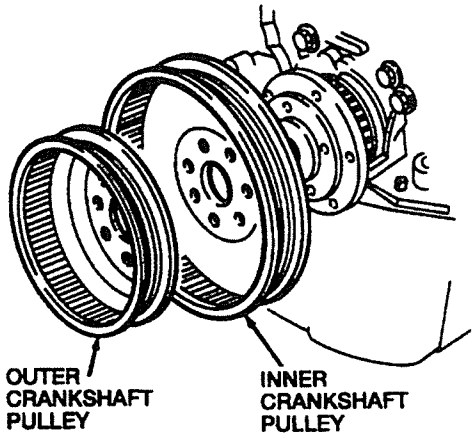
5. Use Strap Wrench or equivalent to remove the three water pump pulley bolts.

6. Remove the water pump pulley.

7. Remove the four crankshaft pulley retaining washer bolts and the crankshaft pulley retaining washer.

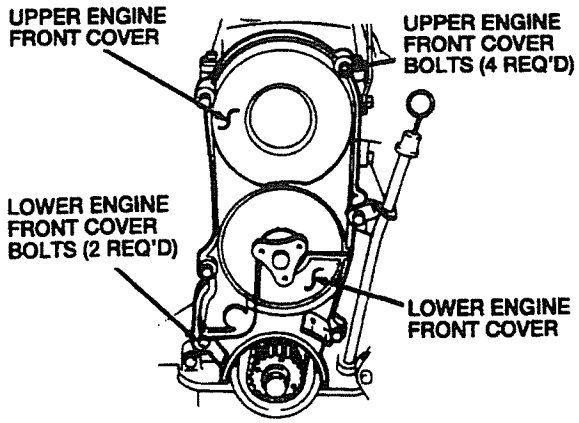


8. Remove the outer crankshaft pulley (if equipped) and the inner crankshaft pulley.

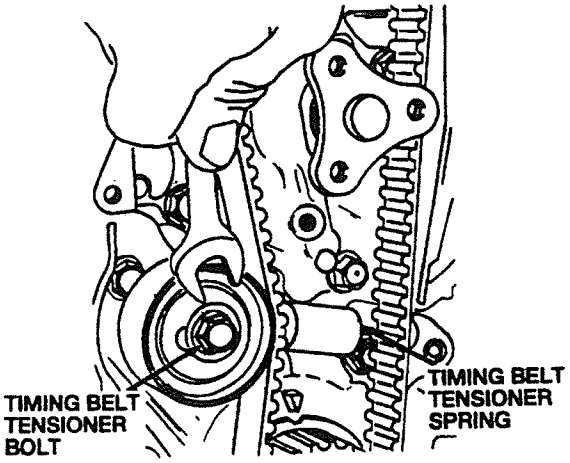


9. Remove the four upper engine front cover bolts and the upper engine front cover.

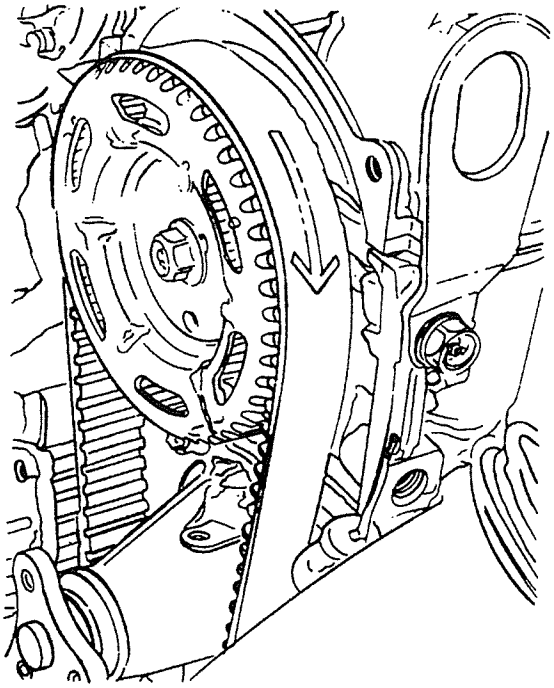
10. Remove the two lower engine front cover bolts and lower engine front cover.



11. Remove the timing chain/belt tensioner spring, spring cover, and the timing belt tensioner bolt.



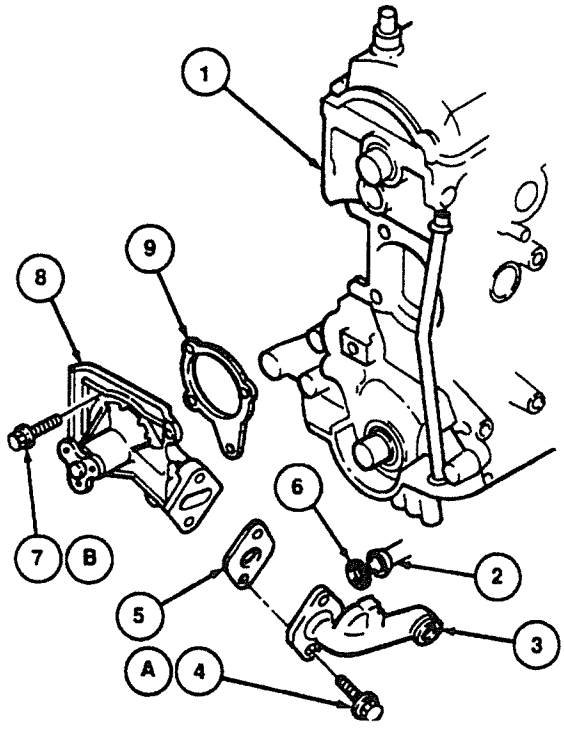
12. Mark the direction of the rotation on the timing chain/belt.



13. Remove the timing chain/belt.

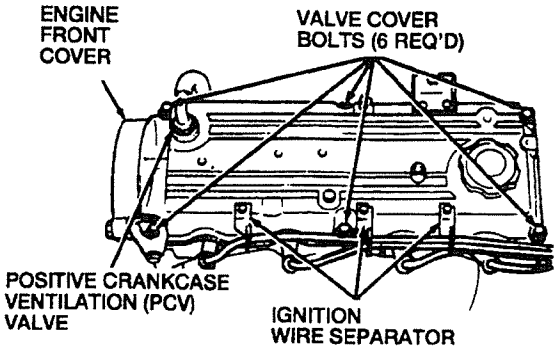
14. Remove the four water pump bolts and remove the water pump and water pump inlet connector.

15. Remove the water pump housing gasket.



Item	Part Number	Description
1	104014	Cylinder Block
2	-	Heater Water Hose
3	154011	Water Pump Inlet Connector
4	774066	Water Pump Inlet Connector-to-Water Pump Bolts
5	154006	Water Pump Inlet Gasket
6	-	O-Ring
7	133803	Water Pump Bolt (4 req'd)
8	154008	Water Pump
9	154009	Water Pump Housing Gasket
A	-	Tighten to 14-22 lb-ft (19-30 N-m)
B	-	Tighten to 14-19 lb-ft (19-26 N-m)

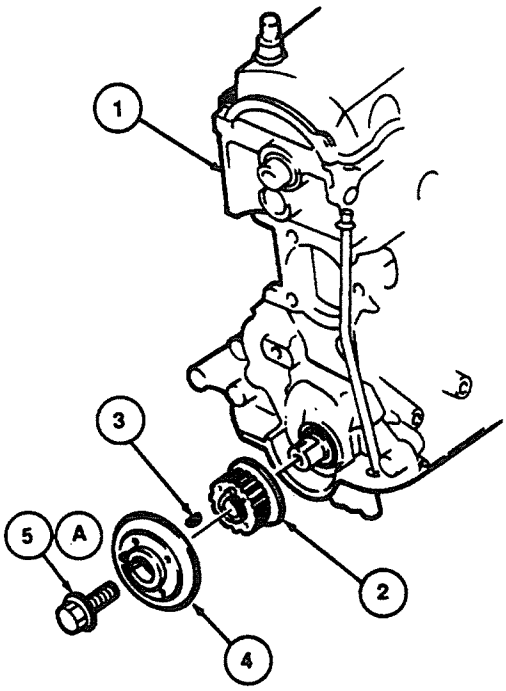
16. Remove the six (6) valve cover bolts.



17. Remove the valve cover and valve cover gasket.

18. Remove the crankshaft pulley bolt.

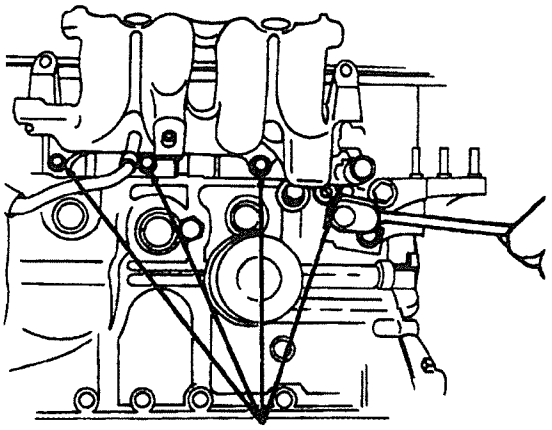
19. Remove the crankshaft sprocket, crankshaft pulley hub, and crankshaft key.



Item	Part Number	Description
1	104014	Cylinder Block
2	114004	Crankshaft Sprocket
3	114003	Crankshaft Key
4	-	Timing Chain/Belt Guide
5	114008	Crankshaft Pulley Bolt
A	-	Tighten to 80-85 lb-ft (108-118 N-m)

20. Remove the intake manifold support bolts and the intake manifold support.

21. Remove the eight intake manifold bolts and nuts.

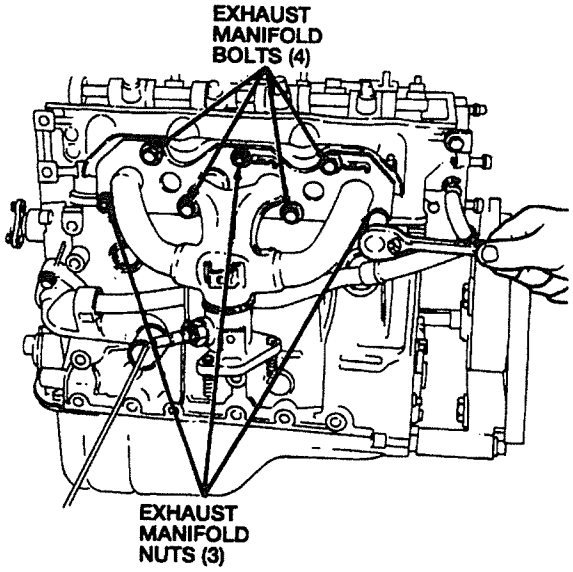


INTAKE MANIFOLD BOLTS AND NUTS (8) (4 UPPER BOLTS HIDDEN FROM VIEW BY INTAKE RUNNERS)

22. Remove the intake manifold and intake manifold gasket.

23. Remove the exhaust manifold shield bolts. Remove the exhaust manifold shield.

24. Remove the four exhaust manifold bolts and three exhaust manifold nuts.



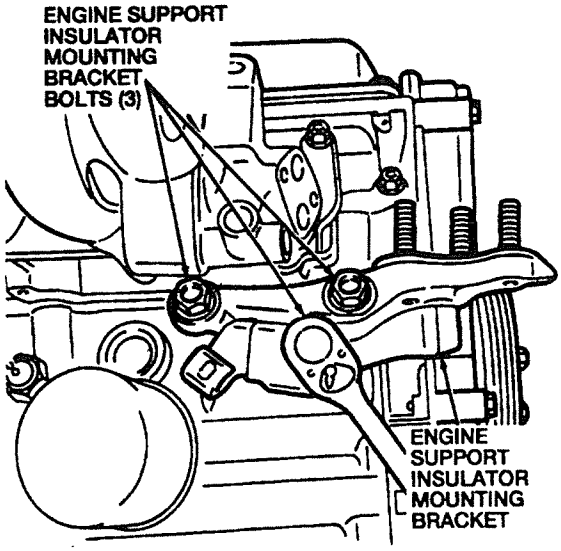
25. Remove the exhaust manifold and exhaust manifold gasket.

26. Remove the cylinder head bolts.

27. Remove the cylinder head and head gasket.

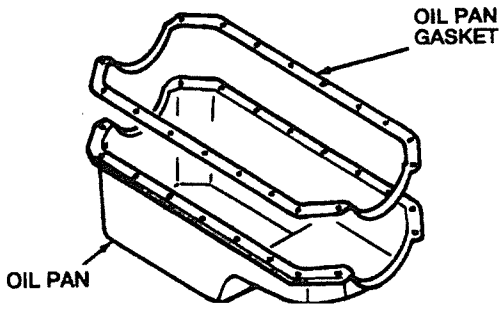
28. Remove the oil pressure sensor.

29. Remove the three engine support insulator mounting bracket bolts and the engine support insulator mounting bracket.

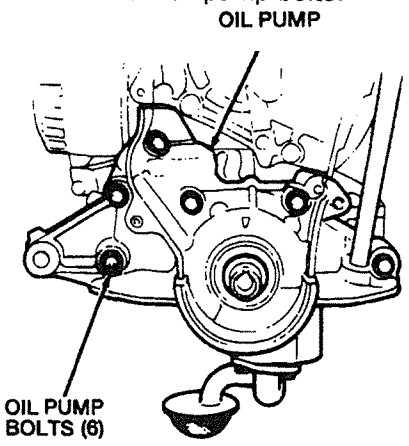


30. Remove the oil pan bolts and nuts.

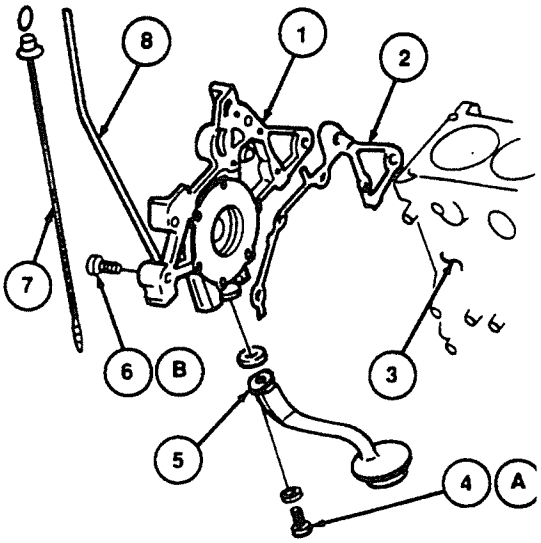
31. Remove the oil pan and oil pan gasket.



32. Remove the six oil pump bolts.



33. Remove the oil pump, oil pump screen cover and tube, oil level indicator tube assembly, and gasket.

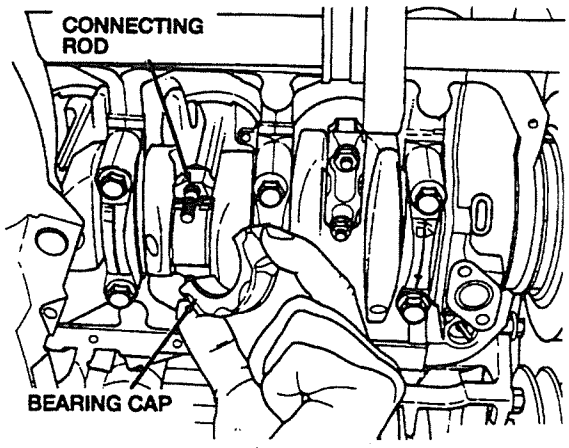


Item	Part Number	Description
1	-	Oil Pump
2	-	Oil Pump to Cylinder Block Gasket
3	104014	Cylinder Block
4	-	Oil Pump Cover and Tube Bolt (2 Req'd)
5	-	Oil Pump Screen Cover and Tube
6	-	Oil Pump Bolt (6 Req'd)
7	104020	Oil Level Dipstick
8	104017	Oil Level Indicator Tube
A	-	Tighten to 71-97 lb-in (8-11N-m)
B	-	Tighten to 14-19 lb-ft (19-25 N-m)

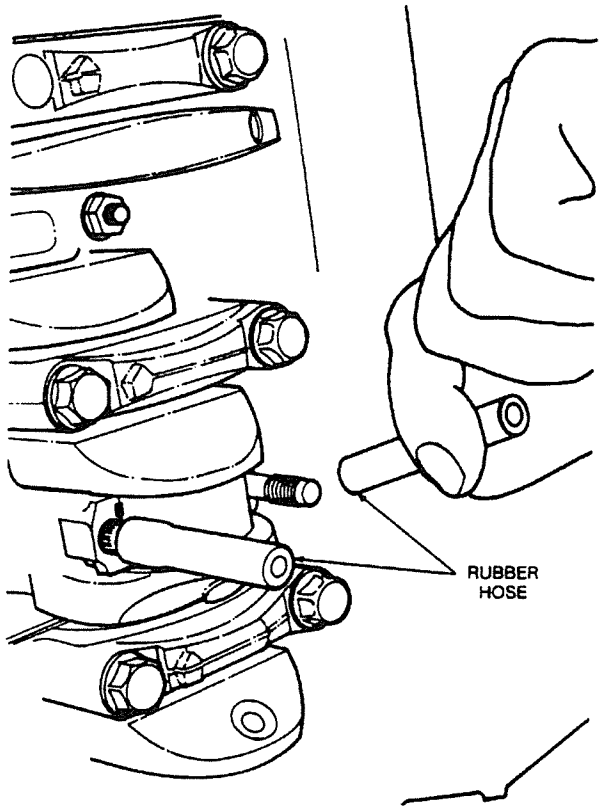
34. NOTE: Repeat the following five steps for each of the connecting rod and piston assemblies. Mark each connecting rod and piston assembly with its applicable cylinder number to aid in installation.

    Remove the connecting rod nuts.

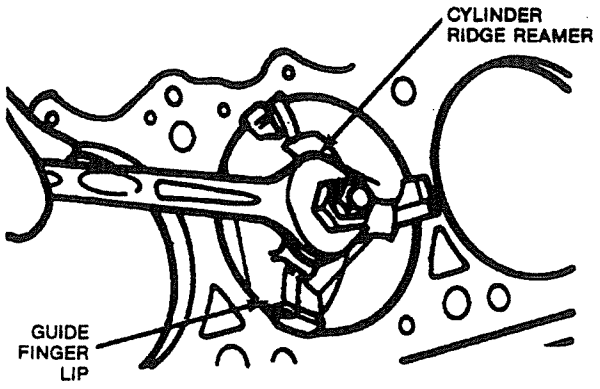
35. Remove the connecting rod caps and the lower connecting rod bearings.



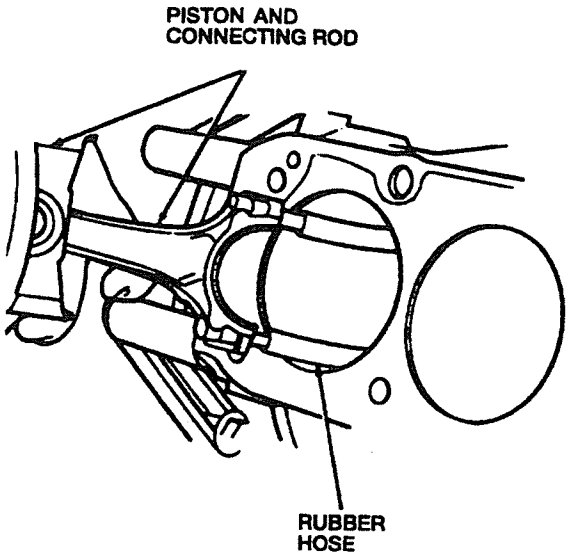
36. To prevent scratching of the crank shaft journal surface, install a piece of rubber hose on the connecting rod studs.



37. If necessary, install Cylinder Ridge Reamer in the cylinder bore. Remove the ridge at the top of the cylinder bore.

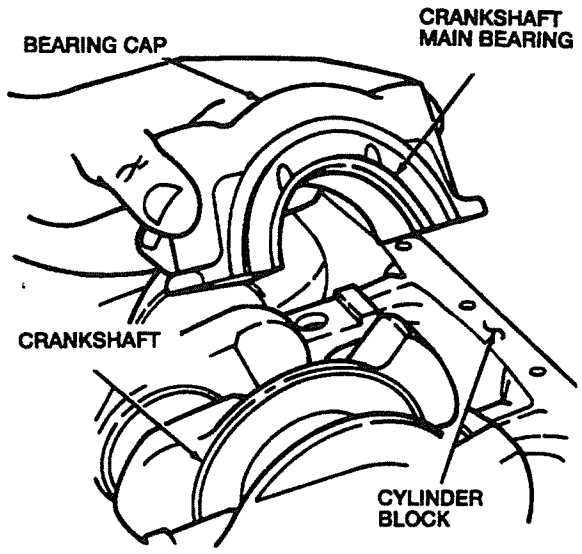


38. Use a hammer handle or a piece of wood to tap the connecting rod and piston assembly upward until the piston rings clear the top of the cylinder block.



39. Remove the 10 (ten) crankshaft main bearing cap bolts.

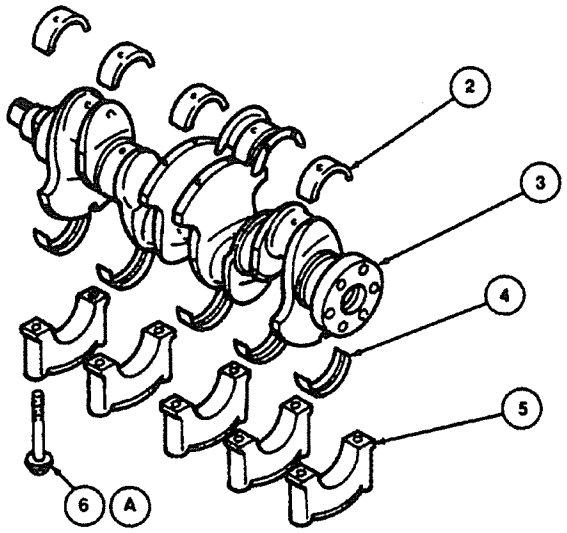
40. Remove the crankshaft main bearing caps and the lower crankshaft main bearings.



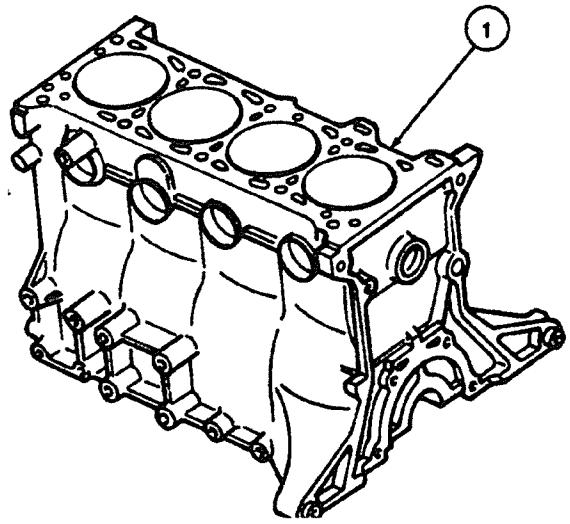
41. CAUTION: Use care not to damage the bearing journals while removing the crankshaft.

    Remove the crankshaft from the cylinder block.

42. Remove the upper crankshaft main bearings from the cylinder block.



Item	Part Number	Description
1	104014	Cylinder Block
2		Crankshaft Main Bearings, Upper
3	114002	Crankshaft
4		Crankshaft Main Bearings, Lower



Item	Part Number	Description
5	-	Main Bearings Caps
6	104019	Crankshaft Main Bearing Cap Bolt (10 req'd)
A	-	Tighten to 40-43 lb-ft (54-59 N-m)

Assembly

1. Install the upper crankshaft main bearings into the cylinder block.

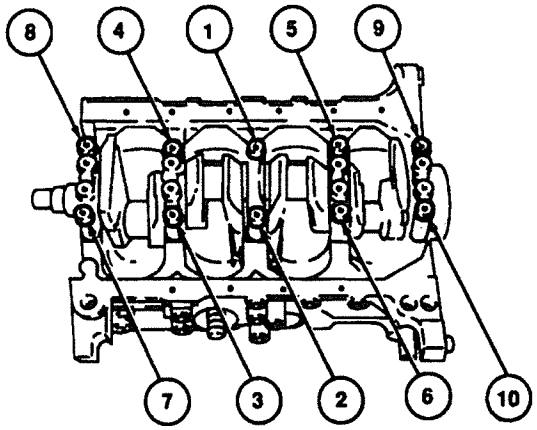
2. **CAUTION: Use care not to damage the bearing journals while installing the crankshaft.**

   Install the crankshaft into the cylinder block.

3. Install the lower crankshaft main bearings and the crankshaft main bearing caps.

4. Measure the crankshaft main bearing-to-crankshaft journal clearance with Plastigage or equivalent. Refer to this section for the procedure.

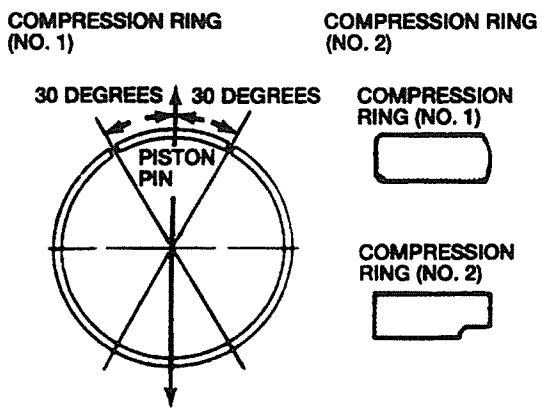
5. Tighten the crankshaft main bearing cap bolts to 40-43 lb-ft (54-59 N-m) in the order shown.



6. NOTE: The end play is adjustable through the use of variable thickness crankshaft thrust bearings, located at the number four upper main journal location.

   Measure the crankshaft end play. Refer to this section for the procedure.

7. Properly space the piston ring gaps.

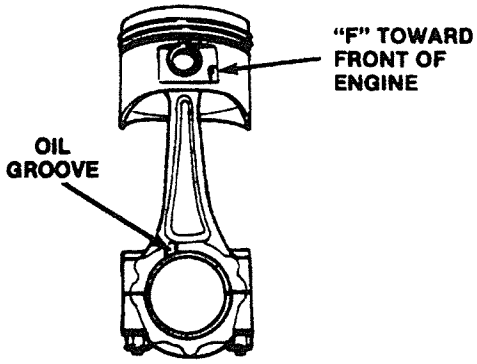


8. Dip the piston in clean engine oil and install Piston Ring Compressor.

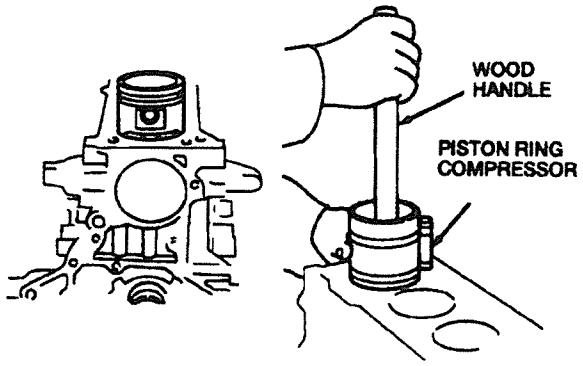
9. Slip two pieces of snug fitting rubber hose over the connecting rod bolts to prevent bolt-to-crankshaft journal contact during installation.

10. NOTE: Cylinder numbering starts at the front of the engine.

    Start the connecting rod and piston assembly into the cylinder bore, keeping the F mark on the piston toward the front of the engine. Be sure the connecting rod number and cylinder bore number match.



11. Use a hammer handle or a piece of wood to tap the connecting rod and piston assembly into the cylinder bore. Guide the connecting rod bolts over the crankshaft journal.



12. Insert the connecting rod bearing into the connecting rod cap.

13. Measure the connecting rod bearing-to-crankshaft journal clearance with Plastigage or equivalent. Refer to this section for the procedure.

14. **CAUTION: Ensure that the number on the connecting rod and the connecting rod cap are on the same side and that they match.**

    Install the connecting rod cap.

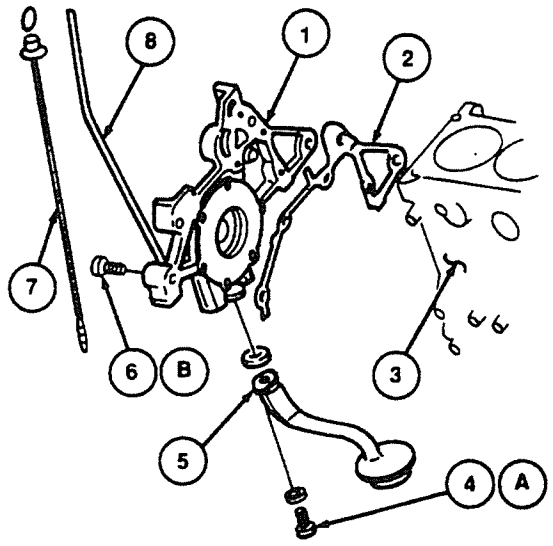
15. Install the connecting rod nuts. Tighten the connecting rod nuts to 11-13 lb-ft (15-17 N-m). Tighten the connecting rod nuts a second time to 22-25 lb-ft (29-34 N-m).

16. Check the connecting rod side clearance. The clearance is 0.0043-0.0103 inch (0.110-0.262mm) with a limit of 0.012 inch (0.30mm).

17. Repeat steps 7-15 for each of the connecting rod and piston assemblies.

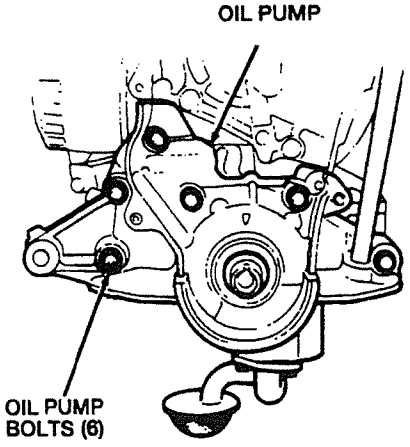
18. Apply Perfect Seal Sealing Compound or equivalent to each side of the oil pump to cylinder block gasket and install the oil pump to cylinder block gasket on the oil pump.

19. Install the oil pump, oil pump screen cover and tube, and oil level indicator tube assembly and gasket.

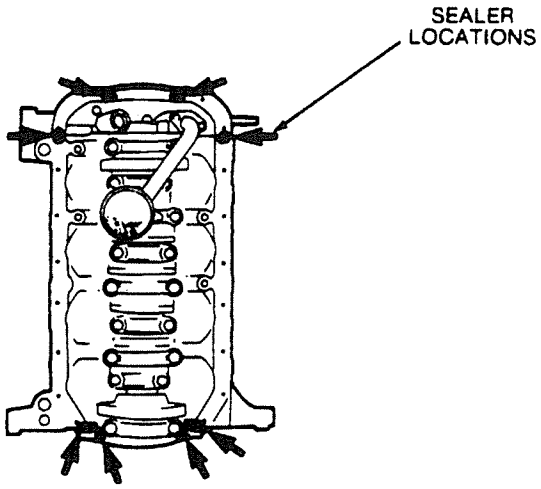


Item	Part Number	Description
1	-	Oil Pump
2	-	Oil Pump to Cylinder Block Gasket
3	104014	Cylinder Block
4	-	Oil Pump Screen Cover and Tube Bolt (2 Req'd)
5	-	Oil Pump Screen Cover and Tube
6	-	Oil Pump Bolt (6 Req'd)
7	104020	Oil Level Dipstick
8	104017	Oil Level Indicator Tube
A	-	Tighten to 71-97 lb-in (8-11 N-m)
B	-	Tighten to 14-19 lb-ft (19-25 N-m)

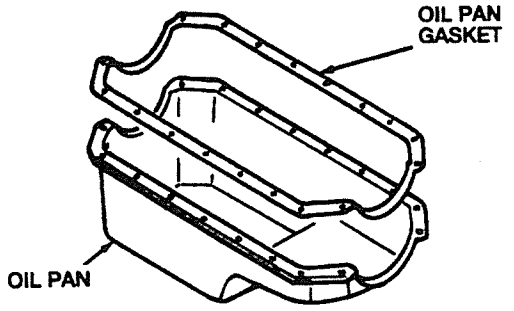
20. Install the six oil pump bolts. Tighten the oil pump bolts to 14-19 lb-ft (19-25 N-m).



21. Apply oil resistant sealer across the joint line of the cylinder block and the oil pump and crankshaft rear oil seal retainer.

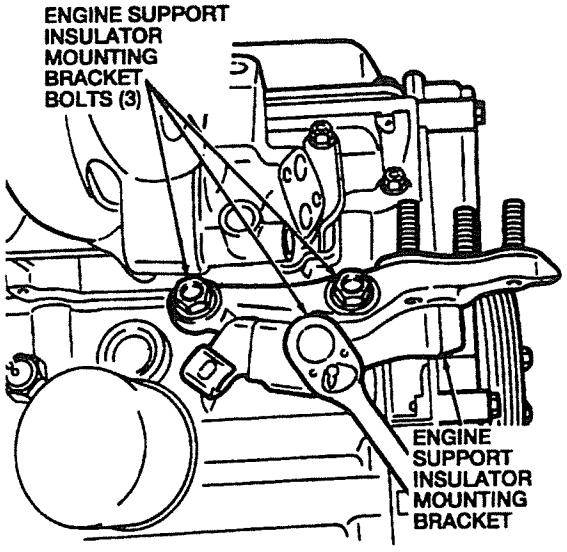


22. Install the oil pan and oil pan gasket.



23. Install the oil pan bolts and nuts. Tighten the oil pan bolts and nuts to 69-78 lb-in (8-9 N-m).

24. Install the engine support insulator mounting bracket. Install the three engine support insulator mounting bracket bolts. Tighten the three engine support insulator mounting bracket bolts to 29-40 lb-ft (39-54 N-m).

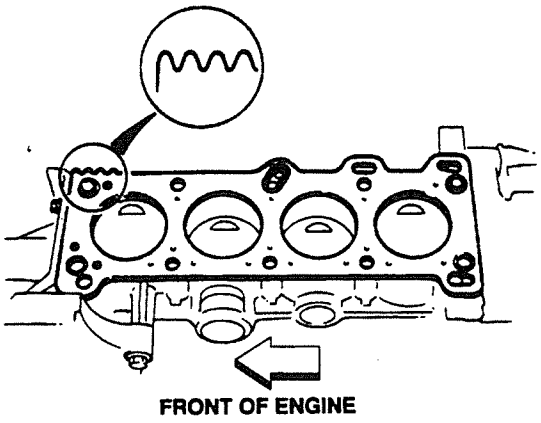


25. Install the oil pressure sensor.

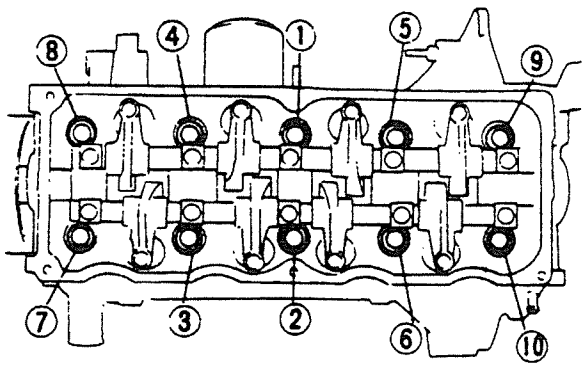
26. NOTE: Ensure the cylinder head and cylinder block gasket surfaces are clean before installing the head gasket.

    Clean the cylinder head and cylinder block gasket surfaces.

27. Install a new head gasket.



28. Install the cylinder head and cylinder head bolts. Tighten the cylinder head bolts in the order shown, to 35-40 lb-ft (50-60 N-m). Repeat the tightening sequence, tighten the cylinder head bolts to 56-60 lb-ft (75-81 N-m).



29. Install the exhaust manifold and the seven exhaust manifold bolts and nuts. Tighten the exhaust manifold bolts and nuts to 12-17 lb-ft (16-23 N-m).

30. Position the exhaust manifold shield and install the exhaust manifold shield bolts. Tighten the exhaust manifold shield bolts to 12-17 lb-ft (16-23 N-m).

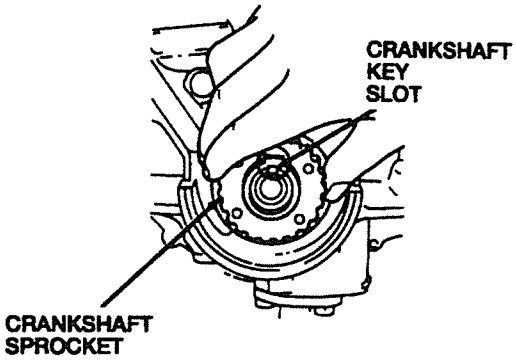
31. Clean all traces of intake manifold gasket material from the intake manifold and the cylinder head.

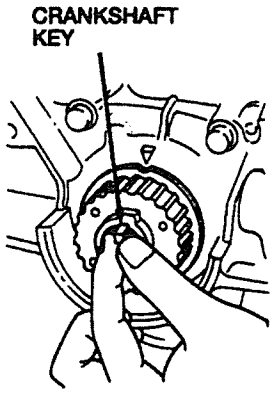
32. Position the intake manifold and the intake manifold gasket on the cylinder head.

33. Install the intake manifold bolts and nuts. Tighten the intake manifold bolts and nuts to 14-20 lb-ft (19-26 N-m).

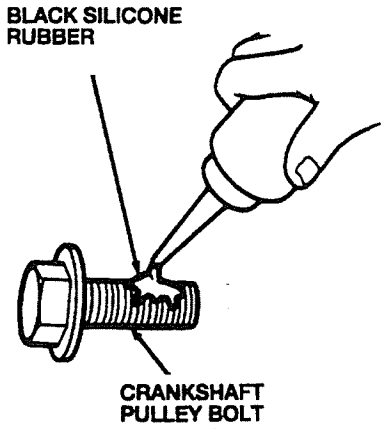
34. Install the intake manifold support and the intake manifold support bolts.

35. Align the crankshaft sprocket and crankshaft key.





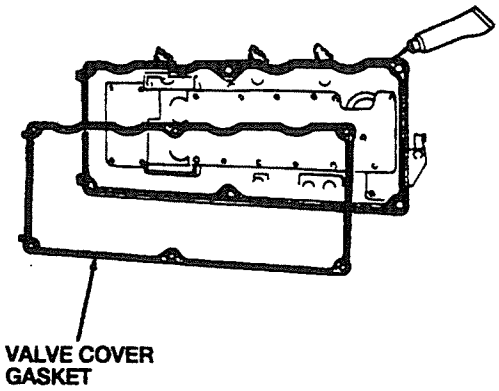
36. NOTE: Before installing the crankshaft pulley bolt, coat the crankshaft pulley bolt threads with Black Silicone Rubber or equivalent.



Install the crankshaft sprocket, crankshaft pulley hub, and crankshaft pulley bolt.

Tighten the crankshaft pulley bolt to 80-85 lb-ft (108-118 N-m).

37. Clean the valve cover and cylinder head sealing surfaces. Apply Threadlock and Sealer or equivalent to the valve cover sealing surface and install a new valve cover gasket as shown.



38. Install the valve cover.

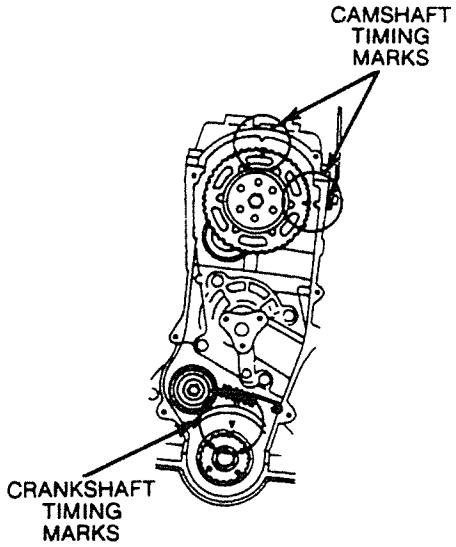
39. Install the six (6) valve cover bolts. Tighten the six (6) valve cover bolts to 44-80 lb-in (5-9 N-m).

40. Clean the gasket surfaces of the water pump and the cylinder block. Coat a new water pump housing gasket with Perfect Seal Sealing Compound or equivalent.

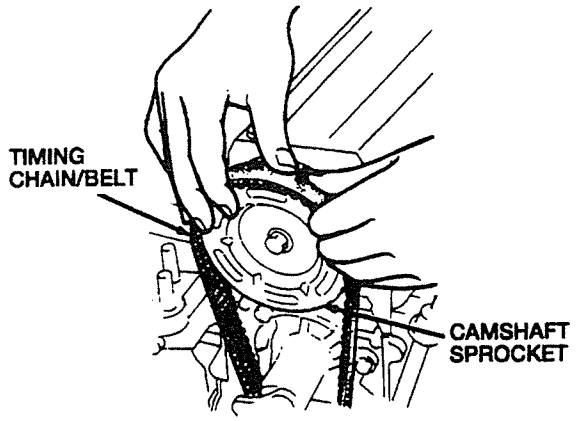
41. Position the water pump and water pump housing gasket on the cylinder block.

42. Install the four (4) water pump bolts. Tighten the four (4) water pump bolts to 14-19 lb-ft (19-26 N-m).

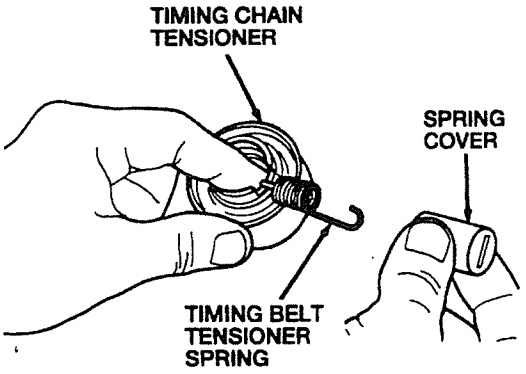
43. Align the camshaft sprocket and crankshaft sprocket with the timing marks on the cylinder head and the oil pump housing.



44. Install the timing chain/belt. Ensure the direction mark faces the same way as noted in removal.



45. Install the timing chain/belt tensioner spring and spring cover on the timing chain/belt tensioner.



46. Position the timing belt tensioner and timing belt tensioner spring assembly on the engine and install the timing belt tensioner bolt. Do not tighten the timing belt tensioner bolt.

47. Install the timing chain/belt tensioner spring on the anchor.

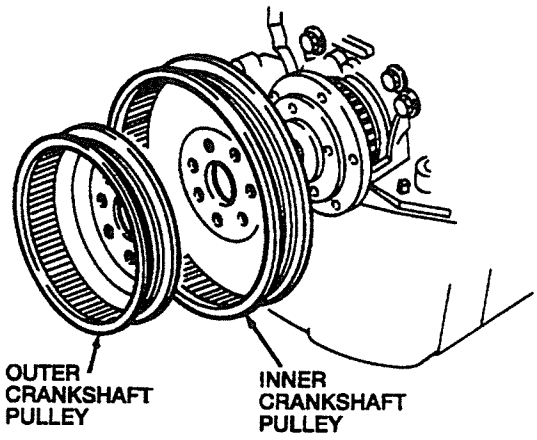
48. Rotate the crankshaft two turns clockwise and align the timing marks. Ensure all marks are still correctly aligned.

49. Tighten the timing belt tensioner bolt to 14-19 lb-ft (19-26 N-m).

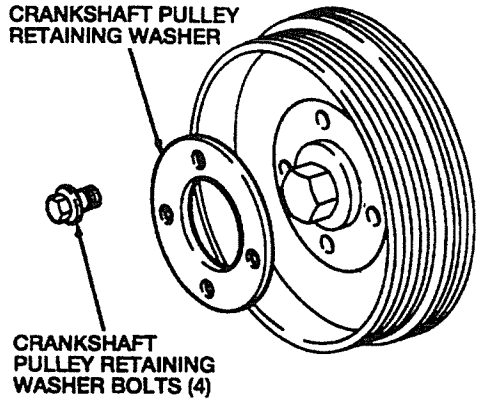
50. Install the lower engine front cover and two lower engine front cover bolts. Tighten the lower engine front cover bolts to 71-97 lb-in (8-11 N-m).

51. Install the upper engine front cover and four upper engine front cover bolts. Tighten the upper engine front cover bolts to 71-97 lb-in (8-11 N-m).

52. Install the inner crankshaft pulley and the outer crankshaft pulley (if equipped).



53. Install the crankshaft pulley retaining washer and the four crankshaft pulley retaining washer bolts.

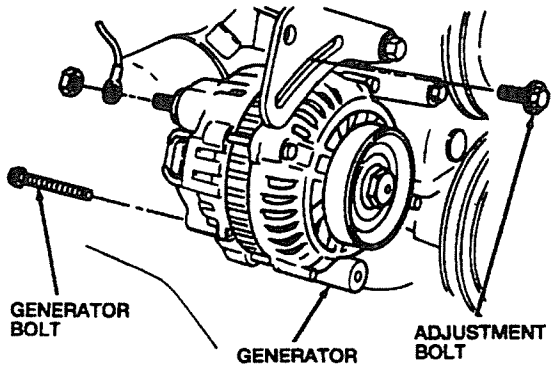


54. Install the water pump pulley.

55. Use a Strap Wrench or equivalent to install the three water pump pulley bolts. Tighten the three water pump pulley bolts to 36-45 lb-ft (49-61 N-m).

56. Install the alternator.

57. Install the adjustment bolt and alternator bolt.



58. Install the oil filter by hand. After the oil filter gasket contacts the cylinder block surface, tighten the oil filter one-half turn.

59. Install the engine in the vehicle. Refer to the installation procedure in this section.

Subassemblies

Cylinder Head

Service Tool(s) Required

- Valve Spring Compressor Set
- Valve Seal Replacer
- Dust Boot Replacer
- Valve Spring Compressor

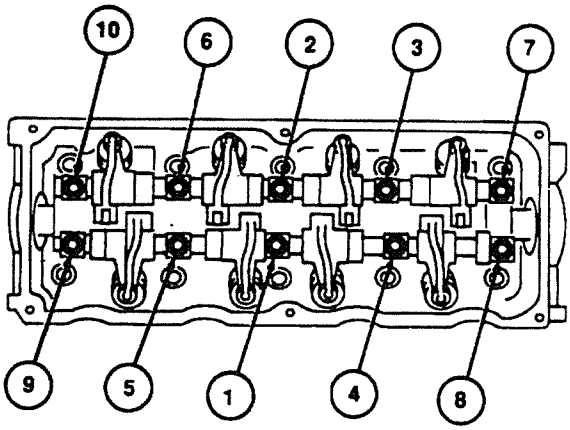
Disassembly

1. Remove the cylinder head . Refer to the removal procedure in this section.

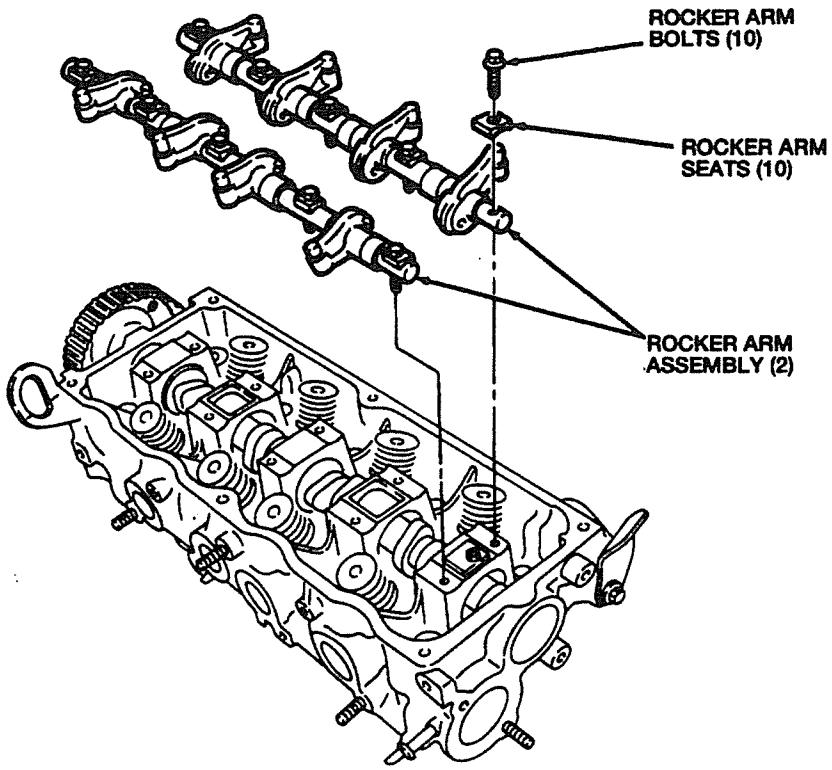
2. Support the cylinder head assembly with the head gasket surface facing upward on a table or bench. Use blocks or pins to prevent valve or camshaft parts from contacting the table or bench.

3. Clean the combustion chamber deposits with a wire wheel and a drill motor. Leave the valves in place to prevent damage to the valves or valve seats.

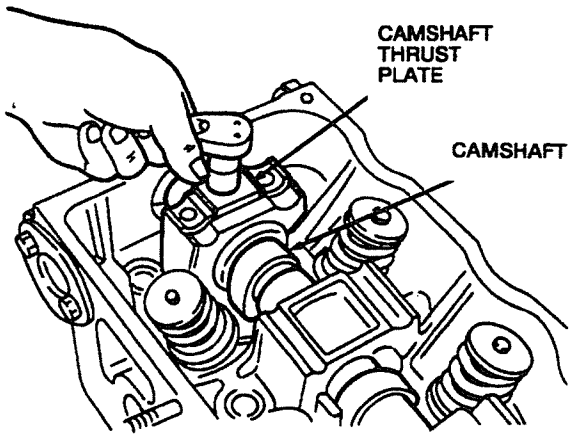
4. Turn the cylinder head with the camshaft side facing upward and remove the ten (10) rocker arm bolts in the order shown. Remove the rocker arm and shaft assemblies.



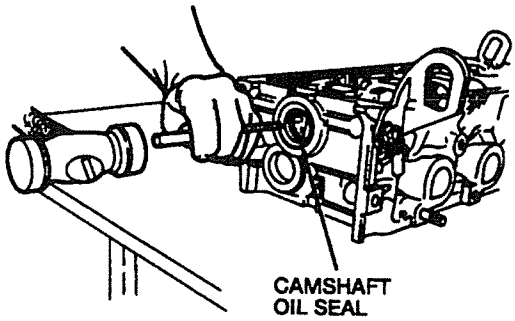
REMOVAL SEQUENCE



5. Remove the camshaft thrust plate and camshaft.

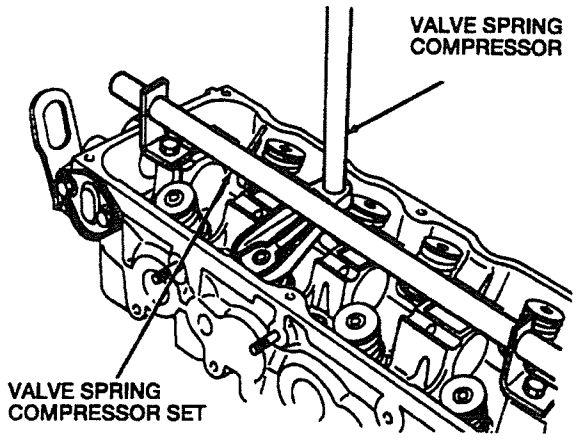


6. Drive the camshaft oil seal through the cylinder head with a suitable tool.



7. NOTE: Mark the valves or keep the valves matched to their original locations.

   Compress the valve springs using Valve Spring Compressor and Valve Spring Compressor Set to remove the valve spring retainer keys, upper valve spring retainer, valve springs, lower valve spring retainer, valves, and valve stem seals.



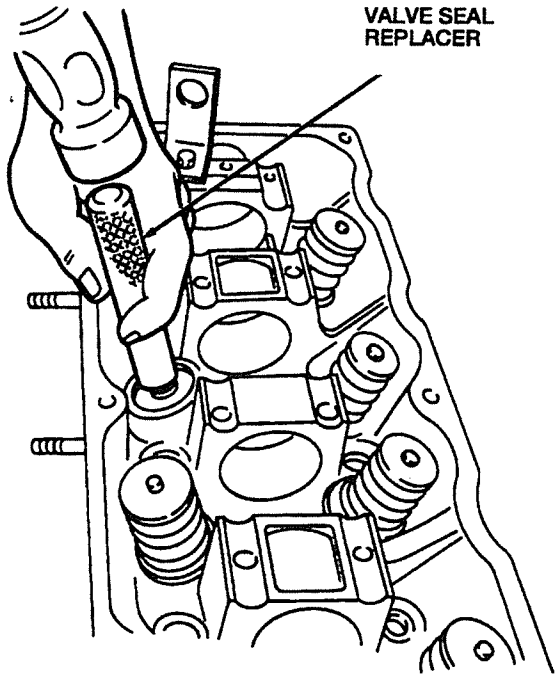
8. Remove the oil passage plugs from the ends of the cylinder head.

9. Remove the engine block plug from the rear of the cylinder head by drilling a hole in it and prying it out with a drift or pointed bar.

Assembly

1. Clean the cylinder head thoroughly with detergent and hot water or solvent.

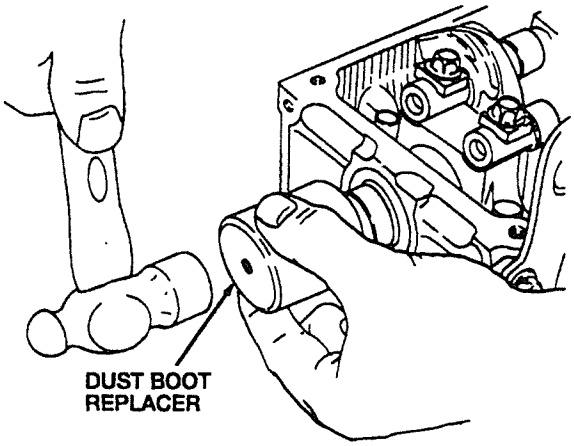
2. Install the valve seals using Valve Seal Replacer.



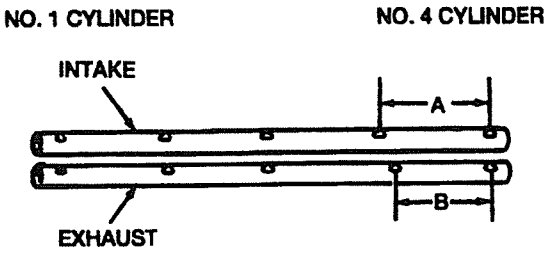
3. Assemble the valves, lower valve spring retainer, shims (if used), valve springs, upper valve spring retainer, and valve spring retainer keys in their original locations.

4. Install the camshaft and camshaft thrust plate.

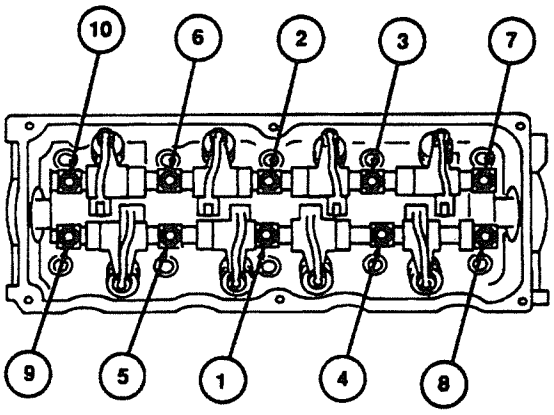
5. Install the front camshaft seal with Dust Boot Replacer.



6. Install the two rocker arm and shaft assemblies.



7. Bolt the two rocker arm and shaft assemblies onto the cylinder head. Be sure the oil holes face down. Tighten the 10 rocker arm bolts evenly to 16-21 lb-ft (22-28 N-m in the sequence shown.



TIGHTENING SEQUENCE

8. Apply Threadlock and Sealer or equivalent to the oil passage plugs and install on the cylinder head.

9. Install a new engine block plug after coating it with Perfect Seal sealing compound or equivalent.

Pistons and Piston Pins

Disassembly and Assembly

Refer to this section for piston and piston pin disassembly and assembly procedures.

Piston Rings

Disassembly and Assembly

Refer to this section for piston ring disassembly and assembly procedures.

Oil Pump

Service Tool(s) Required

- Front Seal Replacer

Disassembly

1. Remove the oil pump. Refer to the removal procedure in this section.

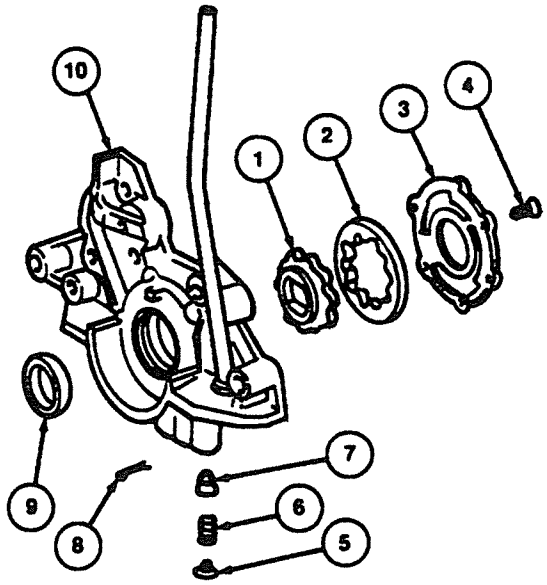
2. Remove the oil pump body cover screws from the oil pump body cover.

3. Remove the oil pump body cover, inner gear and outer gear.

4. Drive or pry the crankshaft front seal from the body. Discard the crankshaft front seal.

5. Remove the cotter pin, retainer, spring, and relief valve from the oil pump body. Discard the cotter pin.

Oil Pump - Exploded View

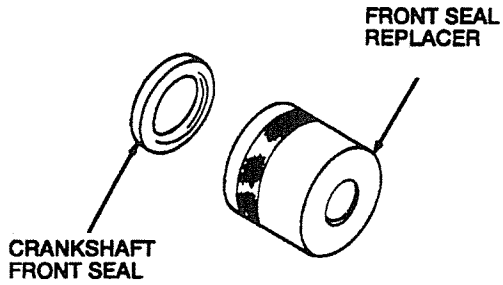


Item	Part Number	Description
1	-	Inner Gear
2	-	Outer Gear
3	-	Oil Pump Body Cover
4	-	Oil Pump Body Cover Screw
5	-	Retainer (Part of 6600)
6	-	Spring
7	-	Relief Valve
8	-	Cotter Pin
9	-	Crankshaft Front Seal
10	-	Oil Pump Body

Assembly

1. Position the relief valve into its bore. Install the spring, retainer, and a new cotter pin.

2. Press or drive a new crankshaft front seal into the oil pump body with Front Seal Replacer and a hammer or press.



3. Install the outer and inner gears in the oil pump body.

4. NOTE: Before installing the oil pump body cover screws, coat the threads of each screw with Threadlock and Sealer.

   Install the oil pump body cover and secure with the oil pump body cover screws.

Cylinder Block Assembly

Disassembly

1. Mount the engine on an engine stand and remove all parts not furnished with the new cylinder block, following the procedures in disassembly and assembly.

2. Remove the used cylinder block from the work stand.

Assembly

1. Clean the gasket and seal the surfaces of all serviceable parts and assemblies.

2. Position the new cylinder block in a work stand.

3. Transfer all serviceable parts removed from the used cylinder block, following the procedures in disassembly and assembly.

4. Check all assembly clearances and correct as necessary.

Cylinder Block, Bore

Before replacing a cylinder block, determine if it is serviceable. If so, perform the necessary service. Refer to this section for the procedure.

Disassembly

1. Completely disassemble the engine, following the procedures in disassembly and assembly.

2. Remember to ridge ream the cylinder bores before removing the piston assemblies.

Assembly

1. Clean the gasket and seal surfaces of all serviceable parts and assemblies.

2. Position the new cylinder block in a work stand.

3. Transfer all serviceable parts removed from the used cylinder block, following the procedures in disassembly and assembly.

4. Check all assembly clearances and correct as necessary.

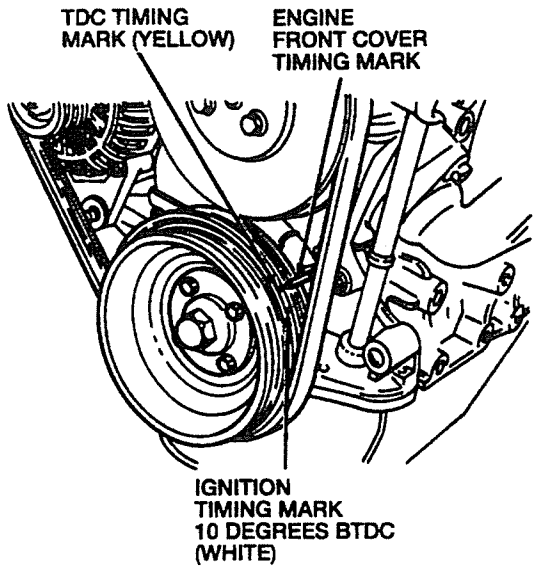
ADJUSTMENTS

Valve Clearance

No valve clearance adjustment is necessary. Hydraulic Lash Adjusters (HLA) provide automatic lash adjustment which maintain a 0 inch (0 mm) clearance between the camshaft lobes and the valve stems.

Camshaft Timing

1. Set the crankshaft to Top Dead Center (TDC) by aligning the TDC timing mark (yellow) on the crankshaft pulley with the timing mark (white) on the engine front cover. To align the timing marks, turn the crankshaft pulley bolt.



2. Disconnect the Mass Airflow (MAF) electrical connector.

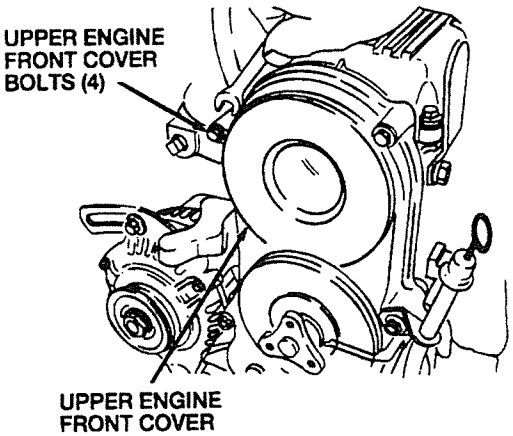
3. Remove the MAF sensor and air cleaner to intake manifold tube. Refer to this section for the removal procedure.

4. Remove the drive belts. Refer to this section for the removal procedure.

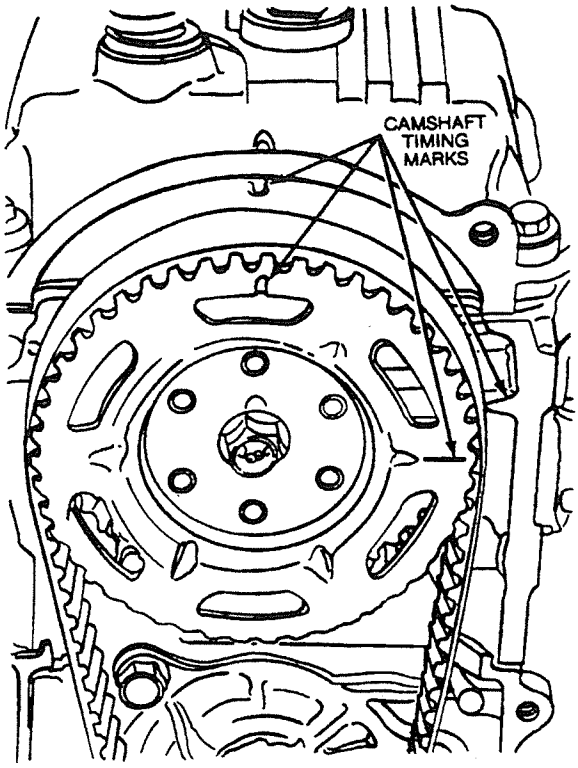
5. Use Strap Wrench or equivalent and remove the three water pump pulley bolts.

6. Remove the water pump pulley.

7. Remove the four upper engine front cover bolts and the upper engine front cover.



8. Ensure that the timing mark on the camshaft sprocket aligns with the pointer on the cylinder head.



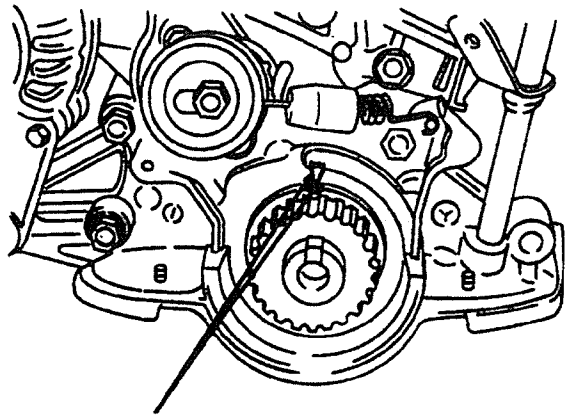
9. If the camshaft mark is not in sight, turn the crankshaft one complete revolution and check the camshaft timing mark alignment.

   - If the timing marks are aligned, the camshaft is properly timed to the crankshaft.
   - If the timing marks are not aligned, continue this adjustment procedure.

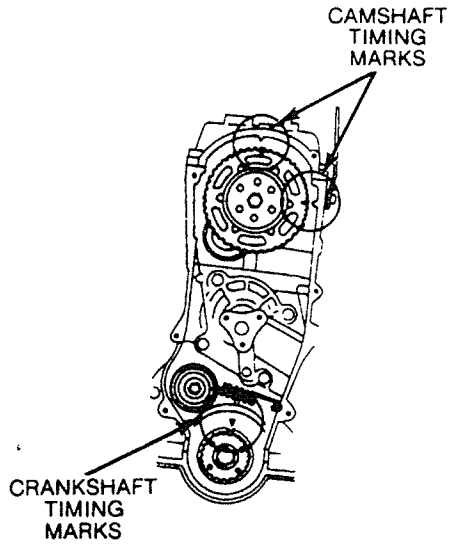
10. Remove the timing chain/belt. Refer to the removal procedure in this section.

11. Remove the spark plugs. Refer to this section for the removal procedure.

12. Turn the crankshaft to align the timing mark on the crankshaft sprocket with the timing mark on the oil pump housing.



13. Turn the camshaft to align the timing mark on the camshaft sprocket with the timing mark on the cylinder head.



14. Install the timing chain/belt. Refer to the installation procedure in this section.

15. Install the spark plugs. Refer to this section for the installation procedure.

16. Install the upper engine front cover. Tighten the upper engine front cover bolts to 71-97 lb-in (8-11 N-m).

17. Install the water pump pulley. Tighten the water pump pulley bolts to 36-45 lb-ft (49-61 N-m).

18. Install the drive belts. Refer to this section for the installation procedure.

19. Install the MAF sensor and air cleaner to intake manifold tube. Refer to this section for the installation procedure.

20. Connect the MAF sensor connector.

SPECIFICATIONS

NOTE: Metric Measurements are used first. This is followed by (Standard or U.S. Measure in Brackets).

ENGINE SPECIFICATIONS

Displacement	1.3L (80.8 cu. in.)
Horsepower	63.5 at 5000 rpm
Number of cylinders	4
Bore and stroke	71 x 83.6mm (2.78 x 3.29 inch)
Firing order	1-3-4-2
Oil pressures (Hot @ 3000 rpm	50-64 psi, 3.5-4.5 kg/cm2 393-411 kPa
GENERAL SPECIFICATIONS	
CYLINDER HEAD AND VALVE TRAIN	
Cylinder head and valve train compression ratio (Compression is 199 psi at 300 rpm)	9.7:1
Valve guide bore diameter	7.01 to 7.03mm (0.2760 to 0.2768 inch)
Valve Guide Height	13.2-13.8mm (0.520-0.543 inch) Limit is 13-14mm (0.5118-0.5512 inch)
Valve seats width-intake and exhaust	1.1 to 1.7mm (0.043 to 0.67 inch)
Angle	45°
Runout limit (T.I.R. max.)	0.0016
Intake valve stem-to-valve guide clearance	0.025-0.060mm (0-0010-0.0024 inches)
Exhaust valve stem-to-valve guide clearance	0.030-0-065mm (0-0012-0.0026 inches)
Valve Stem-to-guide clearance service clearance limit	0.2mm (0.008 inch)
Valve face runout limit	0.0406mm (0.0016 inch)
Valve face angle limit	45°
Valve stem diameter (standard) Intake Exhaust	 6.970 to 6.985mm (0.2744 to 0.2750 inch) 6.965 to 6.980mm (0.2742 to 0.2748 inch)
Valve springs Free-length (approximate) Out-of-square service limit	 43.6mm (1.717 inch) 1.5mm (0.059 inch)

ENGINE SPECIFICATIONS cont'd.

CAMSHAFT	
Lobe height Intake Intake minimum Exhaust Exhaust minimum	 36.124mm (1.4222 inches) 35.624mm (1.4025 inches) 36.404mm (1.4332 inches) 35.904mm (1.4135 inches)
Wear limit	36.253mm (1.4272 inch)
End play Service limit	0.05 to 0.18mm (0-002 to 0.007 inch) 0.20mm (0.008 inch)
Journal diameter #1 and #3	43.440 to 43.465mm (1.7103 to 1.7112 inch)
Journal diameter #2	43.410 to 43.435mm (1.7091 to 1.7100 inch)
Front oil seal Contact surface	29.961 to 30.000mm (1.1796 to 1.811 inch)
Runout limit Out-of-round-limit (wear limit of journal)	0.03mm (0.0012 inch) max. T.I.R. 0.05mm (0.02 inch)
CYLINDER BLOCK	
Head gasket surface flatness	0.15mm (0.006 inch overall)
Cylinder bore Diameter Limit Out-of-round service limit Taper service limit	 71.00 to 71.019 mm (2.7953 to 2.7960 inch) 71.17mm (2.8020 inch) 0.019mm (0.0007 inch) 0.019mm (0.0007 inch)
CRANKSHAFT	
Crankshaft main bearing Journal diameter Out-of-round limit Runout service limit	49.938 to 49.956mm (1.9661 to 1.9688 inch) 0.05mm(0.0020 inch)max 0.04mm (0.0016 inch)
Connecting rod journal Diameter Out-of-round limit	39.940 to 39.966mm (1.5724 to 1.5731 inch) 0.05mm (0.0020 inch)
Crankshaft-to-journal clearance Limit	0.018-0.036mm (0.0007-0.0014 inch) 0.10mm (0.0039 inch)
Crankshaft free End play limit Service limit	 0.08 to 0.282mm (0.0031 to 0.0111 inch) 0.30mm (0.012 inch)
CONNECTING ROD	
Connecting rod bearings Clearance crankshaft - Desired - Allowable	 0.024 to 0.042mm (0.0009 to 0.0017 inch) 0.10mm (0.0039 inch)

ENGINE SPECIFICATIONS cont'd.

Connecting rod Piston pin bore diameter Crankshaft bearing bore diameter Out-of-round limit Taper limit Length (center-to-center)	 19.948 to 19.961mm (1.8897 to 1.8904 inch) 48.00 to 48.016mm (1.8897 to 1.8904 inch) 0.05mm (0.0020 inch) 0.05mm (0.0020 inch) 132.85 to 132.95mm (5.230 to 5.234 inch)
Alignment (bore-to-bore max. difference)[1] Twist/100mm (3.94 inch) Bend/100mm (3.94 inch) Side clearance (assembled to crank) service limit	 0.04mm (0.0016 inch) 0.04mm (0.0016 inch) 0.30mm (0.012 inch)
PISTONS	
Piston Diameter[2] Piston-to-bore clearance (select fit)	70.954 to 70.974mm (2.793 to 2.794 inch) 0.15mm (0.006 inch) limit
Ring groove width Compression (top) Compression (second) Oil	 1.530 to 1.545mm (0.0602 to 0.0608 inch) 1.520 to 1.535mm (0.0598 to 0.0604 inch 4.020 to 4.040mm (0.1583 to 0.1591 inch)
Piston Pin Diameter Piston-to-pin interference	 19.974 to 19.980mm (0.7864 to 0.7866 inch) 0.0 to 0.026mm (0.0 to 0.00102 inch)
Installing pressure	4.9 to 4.7 N (500 to 1,500 kg, 1,100 to 3,300 lb)
Piston rings Ring width Compression (top) Compression (second) Side clearance #1 compression (top) #2 compression (second) Oil ring Ring gap Compression (top) Compression (second) Oil (steel rail) Limit	 1.47 to 1.49mm (0.0579 to 0.0587 inch) 1.47 to 1.49mm (0.0579 to 0.0587 inch) 0.03 to 0.065mm (0.001 to 0.003 inch) 0.03 to 0.065mm (0.001 to 0.003 inch) Snug fit 0.15 to 0.30mm (0.006 to 0.012 inch) 0.16 to 0.30mm (0.006 to 0.012 inch) 0.20 to 0.070mm (0.008 to 0.028 inch) 1.0mm (0.39 inch)

LUBRICATION SYSTEM	
Oil pump	
Rotor assembly and clearance (assembled)	0.14mm(0.005 inch) max.
Outer race-to-housing clearance	0.22mm (0.0087 inch)
Oil capacity	3.4L, 3.6 U.S. qt 3.0L, 3.2 U.S. w/o filter

1. Pin bore and crank bearing bore must be parallel and in the same vertical plane the specified total difference when measured at the ends of an 8" bar - 4" on rod centerline.
2. Measured 16.5mm (0.65 inch) below the oil ring groove.

TORQUE SPECIFICATIONS

Description	N-m	Lb-Ft	Lb-in
Crankshaft Main Bearing Cap Bolts[2]	54-59	40-43	-
Hot Water Heater Elbow Connector	19-30	14-22	-
Water Pump Pulley Bolts	49-61	36-45	-
Crankshaft Pulley Retaining Washer Bolts	12-17	-	109-152
Upper and Lower Engine Front Cover Bolts	8-11	-	71-97
Timing Belt Tensioner Bolt	19-26	14-19	-
Water Pump Bolts	19-26	14-19	-
Water Pump Inlet Connector-to-Water Pump Bolts	19-30	14-22	-
Rocker Arm Bolts	22-28	16-21	-
Camshaft Sprocket Bolt	49-61	36-45	-
Crankshaft Pulley Bolt	108-118	80-85	-
Camshaft Thrust Plate Bolt	8-10	-	71-88
Valve Cover Bolts	5-9	-	44-80
Exhaust Manifold Bolts and Nuts	16-23	12-17	-
Exhaust Manifold Shield Bolts	16-23	12-17	-
Exhaust Inlet Pipe-to-Exhaust Manifold Nuts	31-46	23-34	-
Intake Manifold Bolts and Nuts	19-26	14-20	-
Intake Manifold Support Bolts	31-46	22-34	-
Cylinder Head Bolts[2]	75-81	56-60	-
Oil Pan Bolts and Nuts	8-9	-	69-78
Engine Rear Plate Bolts	7-10	-	61-87
Oil Pump Bolts	19-25	14-19	-
Flywheel-to-Torque Converter Nuts	34-49	25-36	-
Flywheel Reinforcing Plate Bolts	8-11	-	71-97

Torque Specifications (Continued)

Description	N-m	Lb-ft	Lb-in
Oil Pump Screen Cover and Tube Bolts	8-11	-	71-97
Flywheel Attaching Bolt	96-103	71-76	-
Connecting Rod Nuts[2]	29-34	22-25	-
Engine-to-Transaxle Bolts	55-80	41-59	
Transmission Case-to-Cylinder Block Front Bracket Bolts	37-52	27-38	-
Case Rear Bracket Bolts	37-52	27-38	-
Muffler Pipe Bracket Bolts	37-52	27-38	-
Engine Support Insulator Through Bolt	53-64	39-47	-
Front Transaxle Support Insulator Nuts	37-52	27-38	-
Rear Transaxle Support Insulator Nut	28-46	21-34	-
Clamp Nuts and Bolts	43-54	32-40	-
Wheel Hub Bolts	88-118	65-87	-
Oil Pressure Sensor	12-18	9-13	-
Oil Pan Drain Plug	29-41	22-30	-
Engine Support Insulator Mounting Bracket Bolts	39-54	29-40	-

Drive Belt Tension - refer to Operator's Manual or Section 11- .

SERVICE TOOLS/EQUIPMENT

Tool Description	
Impact Slide Hammer	
Cylinder Ridge Reamer	
Flywheel Holding Tool	
Flywheel Holding Tool	
Oxygen Sensor (02S) Wrench (EGO Sensor Wrench)	
Valve Spring Compressor	
Dust Boot Replacer	
Front Seal Replacer	
Valve Seal Replacer	
Valve Spring Compressor Set	
Seal Replacer	
Differential Plugs	
Seal Remover	

SPECIAL SERVICE TOOLS

- Oil Filter Wrench
- Plastigage
- Piston Ring Compressor
- Strap Wrench

SECTION 11-2 - Engine, Drive Belts, Accessory

DESCRIPTION AND OPERATION

Drive Belts, Accessory

The alternator is driven by a vee ribbed accessory drive belt that also drives the water pump. If the vehicle is equipped with air conditioning, the A/C compressor is driven by a separate vee ribbed drive belt.

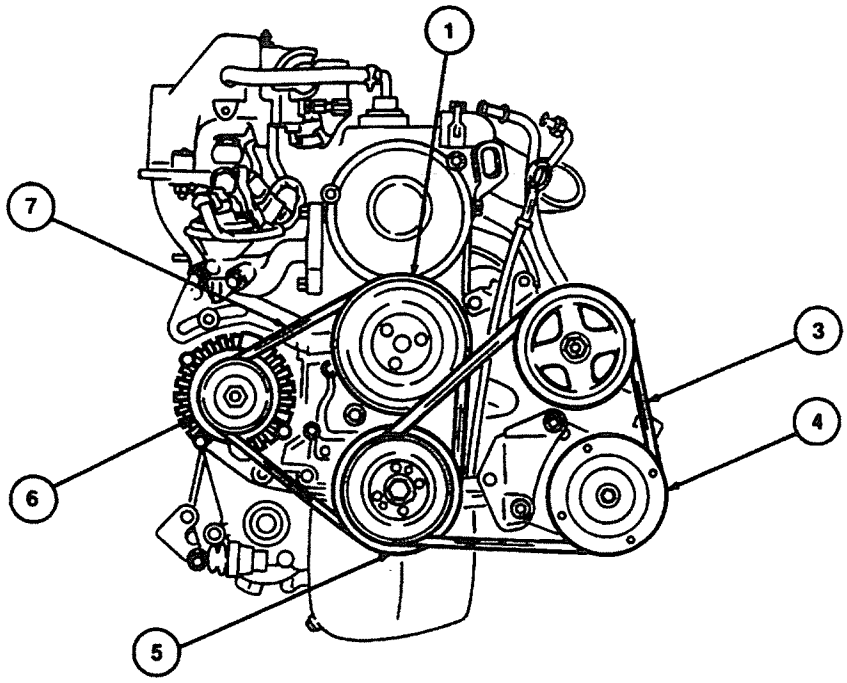
Drive belts must be properly adjusted at all times. Loose drive belts will result in slippage which may cause a noise condition or improper accessory operation (alternator will not charge, etc.). Over-tightened drive belts will place an unnecessary load on the accessory bearings.

The alternator drive belt is adjusted using the alternator lower bolt and the alternator adjustment bolt. The A/C compressor drive belt is adjusted through a separately mounted drive belt idler pulley.

The A/C compressor drive belt, if equipped, is routed around three pulleys: the A/C clutch pulley; the crankshaft pulley; and the drive belt idler pulley.

The alternator drive belt is routed around three pulleys: the water pump pulley; the crankshaft pulley; and the alternator pulley.

Accessory Drive Belt Locations



Item	Part Number	Description
1	-	Water Pump Pulley
3	-	Drive Belt
4	-	A/C Clutch Pulley (If Equipped)

Item	Part Number	Description
5	-	Crankshaft Pulley
6	-	Generator Pulley
7	-	Drive Belt

DIAGNOSIS AND TESTING

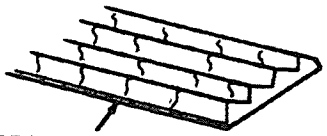
Inspection and Verification - Accessory Drive Belts

1. Verify customer concern by running the engine.
2. Inspect the drive belts for cracks, fraying, and wear.
3. Check that the drive belts are correctly mounted and properly adjusted.

Drive Belt Cracking/Chunking/Wear

Under severe operating conditions (high temperatures, low humidity), drive belt rib cracking can occur at less than 30,000 miles (48,000 km). Drive belt rib cracking is not a reason for concern and has no detrimental effect on drive belt performance. The drive belt is still perfectly functional until rib "chunking" occurs. Drive belt "chunking" is where the rubber material actually falls out between the cracks. The drive belt should be replaced if chunking occurs.

Vee Belt With Cracks Across Backing



CRACKS ACROSS BACKING ARE ACCEPTABLE.
CRACKS PARALLEL TO BACKING ARE NOT.

TROUBLESHOOTING CHART - Accessory Drive Belts

CONDITION	POSSIBLE SOURCE	REMEDY/ACTION
• Excessive Noise (Drive Belt Squeal)	• Seized accessory. • Loose drive belt. • Worn or misaligned pulley.	• CHECK all accessories for free rotation and REPLACE accessory if necessary • REPLACE the drive belt. • CHECK condition and tension of all drive belts. REPLACE drive belts or ADJUST tension of drive belts -as necessary. • REPLACE/ALIGN pulley.
• Rattle	• Loose pulley or accessory. • Worn accessory bearings	• CHECK for looseness and TIGHTEN. • REPLACE accessory bearings if necessary.
• Noisy Drive Belt Idler Pulley Bearing	• Worn bearing	• INSPECT pulley for looseness.
• Drive Belt Chirp	• Misaligned pulley.	• ALIGN pulley.
• Severe Drive Belt Flutter	• Loose drive belt.	• CHECK drive belt tension and ADJUST if necessary. CHECK condition of drive belt and REPLACE if necessary.
• Frayed Drive Belt	• Drive belt not seated correctly • Severely misaligned pulley. • Drive belt too tight. • Drive belt worn out.	• VERIFY correct drive belt seating. REPLACE if necessary. • Use a straightedge to CHECK for severe angular misalignment between adjacent pulleys. CORRECT as necessary. • CHECK drive belt tension. REPLACE if necessary. • CHECK drive belt tension. REPLACE drive belt if necessary.
• Severely Glazed Drive Belt	• Seized accessory. • Loose drive belt.	• CHECK all accessories for free rotation and REPLACE if necessary. REPLACE drive belt. • CHECK drive belt tension and REPLACE or ADJUST tension of drive belts if necessary.
• Improper Accessory Operation (Air Conditioning Does Not Work, Engine Overheats or Battery Does Not Charge)	• Loose drive belt.	• CHECK drive belt and REPLACE or ADJUST tension of drive belts if necessary.
• Drive Belt Jumps Off Pulley	• Misaligned pulleys. • Drive belt not seated correctly. • Pulley wobble. • Excessive crankshaft end play.	• CHECK for misalignment between adjacent pulleys. • VERIFY correct seating. REPLACE drive belt if necessary. • VERIFY that no pulley wobbles during engine operation. Conditions causing wobble are: bent pulley, bent accessory shaft, rear face of pulley not seated flat against mating surface. • INSPECT crankshaft end play. REFER to Section 11.

Component Tests - Accessory Drive Belts

Drive Belt Tension

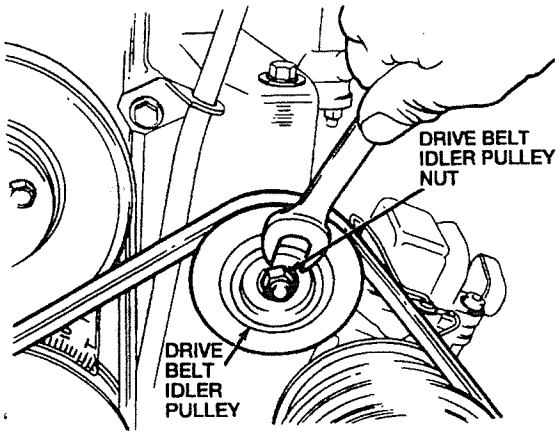
Correct drive belt tension is essential for correct system and accessory operation. Check the tension of all drive belts according to scheduled maintenance. If excessive or insufficient drive belt tension is found during normal scheduled maintenance, inspect the drive belt(s) in question. If the drive belt(s) are found to be in good condition upon inspection, adjust the tension of each drive belt. Refer to adjustment procedures in this section.

REMOVAL AND INSTALLATION

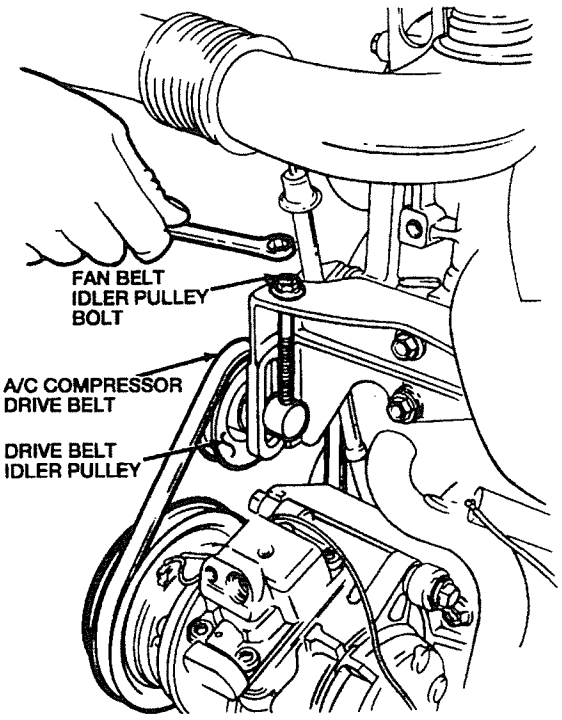
Drive Belt Replacement - A/C Compressor

Removal

1. Loosen the drive belt idler pulley nut.



2. Loosen the fan belt idler pulley bolt until there is enough slack to remove the A/C compressor drive belt.



3. Remove the A/C compressor drive belt from the drive belt idler pulley, A/C clutch pulley, and the crankshaft pulley.

4. Remove the A/C compressor drive belt from the vehicle.

Installation

1. Route the A/C compressor drive belt around the three pulleys.

2. NOTE: Ensure the A/C compressor drive belted is seated properly on all of the pulleys before the tension is adjusted.

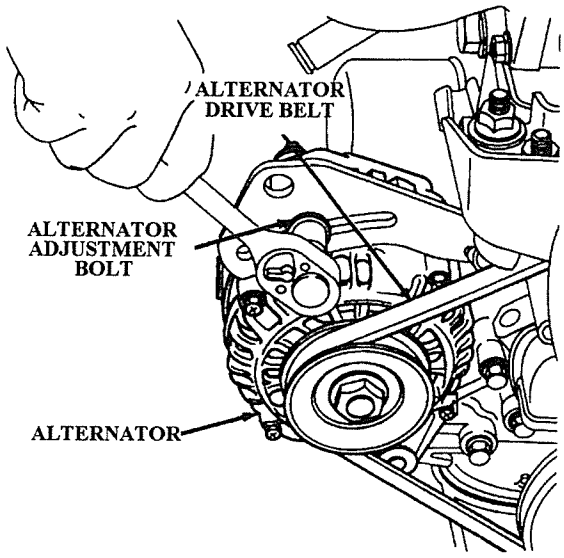
   Adjust the A/C compressor drive belt to the proper tension. Refer to the procedure in this section.

3. Tighten the drive belt idler pulley nut to 27-38 lb-ft (37-52 N-m).

Drive Belt - Alternator

Removal

1. On vehicles equipped with air conditioning, remove the A/C compressor drive belt. Refer to the procedure in this section.
2. Loosen the alternator adjustment bolt until there is enough slack to remove the alternator to remove the alternator drive belt.



3. Loosen the alternator lower bolt.
4. **CAUTION: Do not pry on the alternator rear housing and bearing. Position the pry bar against a stronger point such as the area around a case bolt.**

   Remove the alternator drive belt from the water pump pulley, crankshaft pulley, and alternator pulley.
5. Remove the alternator drive belt from the vehicle.

Installation

1. Route the alternator drive belt around the three pulleys.

INCORRECT CORRECT

2. NOTE: Ensure that the alternator drive belt is seated properly on all the pulleys before the tension is adjusted.

   Adjust the alternator drive belt to the proper tension. Refer to the procedure in this section.
3. Tighten the alternator adjustment bolt to 14-19 lb-ft (19-25 N-m).
4. Raise and support the vehicle.
5. Tighten the alternator lower bolt to 27-38 lb-ft (37-52 N-m).
6. Lower the vehicle.
7. On vehicles equipped with air conditioning, install the A/C compressor drive belt. Refer to the procedure in this section.

ADJUSTMENTS

Drive Belt Tension Adjustment

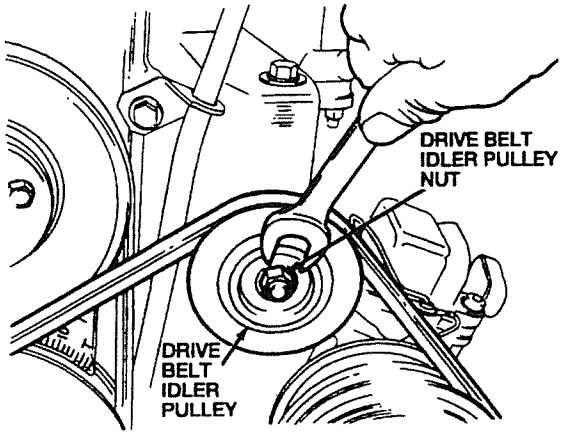
CAUTION: Proper tensioning is important to drive belt life and proper operation of the driven components. A loose, slipping drive belt will rapidly glaze and may cause a noise or improper component operation. An overly tight drive belt exerts unnecessarily high loads on component bearings.

Drive Belt - A/C Compressor

Tension Adjustment

NOTE: If the A/C compressor drive belt has been in service for some time, it should be inspected before adjustment. An A/C compressor drive belt that is severely glazed, frayed, cracked, or contaminated with oil must be replaced. Minor cracks in the back of the A/C compressor drive belt are acceptable as long as no large pieces are missing.

1. Loosen the drive belt idler pulley nut.



2. NOTE: Turn the fan belt idler pulley bolt clockwise to tighten the A/C compressor drive belt, and counterclockwise to loosen it.

   NOTE: Ensure that the A/C compressor drive belt is seated properly on all of the pulleys before the tensioner is adjusted.

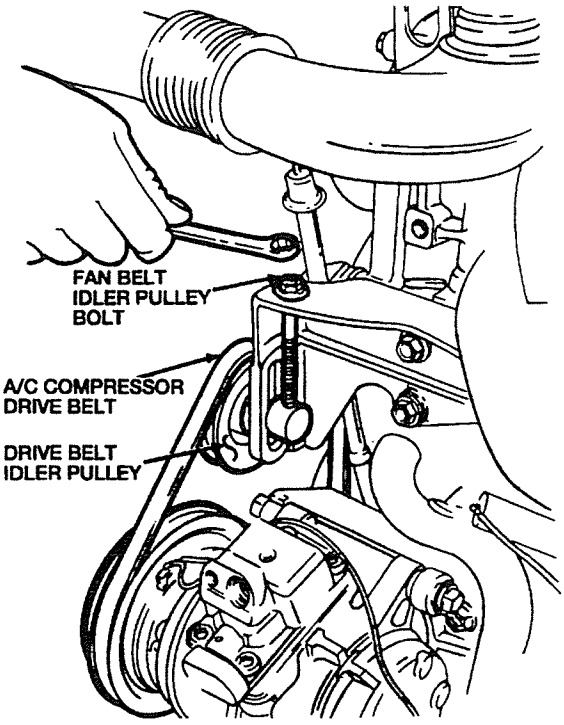
   Adjust the A/C compressor drive belt tension with the fan belt idler pulley bolt. Use the Offset Belt Tension Gauge or equivalent.

INCORRECT CORRECT

NOTE: If using an Offset Belt Tension Gauge or equivalent, use the following specifications:

NEW BELT (no run time): 110-132 lb (50-60 kg). Run the engine for 10 minutes and readjust the A/C compressor drive belt tension as specified above.

USED A/C COMPRESSOR DRIVE BELT (more than 10 minutes of run time): 95-110 lb (43-50 kg).



3. Tighten the drive belt idler pulley nut to 27-38 lb-ft (37-52 N-m).

3. Tighten the drive belt idler pulley nut to 27-38 lb-ft (37-52 N-m).

Deflection Adjustment

NOTE: If the drive belt has been in service for some time, it should be inspected for adjustment. A drive belt that is severely glazed, frayed, cracked or contaminated with oil must be replaced. Minor cracks in the back of the drive belt are acceptable as long as no large pieces are missing.

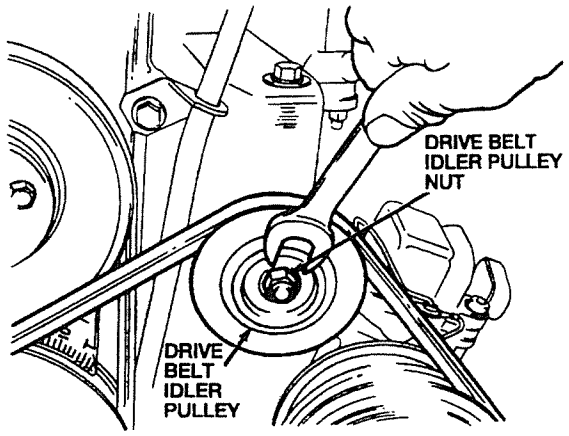
1. Apply 22 lb (98 N) of pressure to the A/C compressor drive belt at a point midway between the drive belt idler pulley and the crankshaft pulley.

2. NOTE: Always check the drive belt deflection when the engine is cold, or has been stopped for at least 30 minutes. A drive belt is considered new if it has been used on a running engine for less than five minutes.

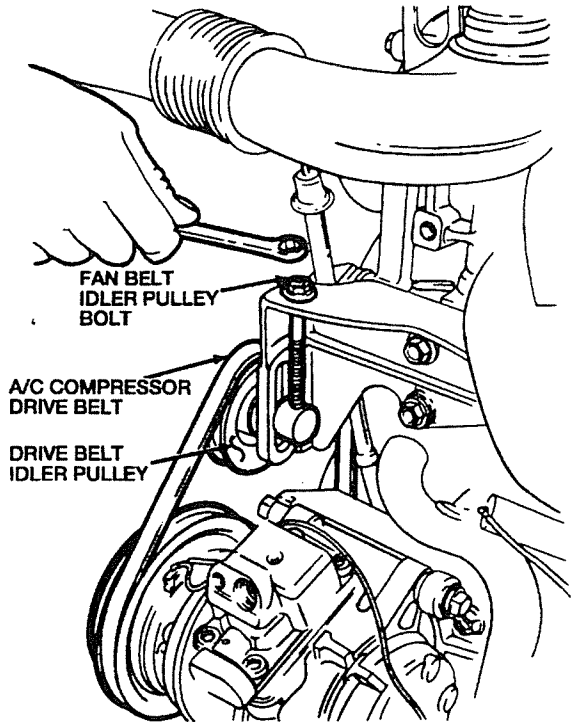
   The A/C compressor drive belt deflection should measure 0.31-0.35 inch (8-9mm) for a new A/C compressor drive belt or 0.35-

0.39 inch (9-10mm) for a used A/C compressor drive belt.

3. Loosen the drive belt idler pulley nut.



4. Adjust the deflection of the A/C compressor drive belt with the fan belt idler pulley bolt.



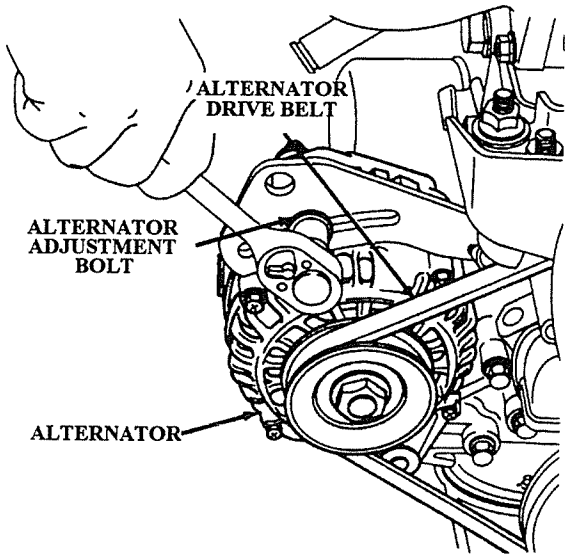
5. Tighten the drive belt idler pulley nut to 27-38 lb-ft (37-52 N-m).

Drive Belt - Alternator

Tension Adjustment

NOTE: If the alternator drive belt has been in service for some time, it should be inspected before adjustment. A alternator drive belt that is severely glazed, frayed, cracked, or contaminated with oil must be replaced. Minor cracks in the back of the alternator drive belt are acceptable as long as no large pieces are missing.

1. Loosen the alternator adjustment bolt.



2. Raise and support the vehicle.

3. Loosen the alternator lower bolt.

4. Lower the vehicle.

5. **CAUTION: Do not pry on the alternator rear housing and bearing. Position the pry bar against a stronger point such as the area around a case bolt.**

   NOTE: Ensure that the alternator drive belt is seated properly on all of the pulleys before the tension is adjusted.

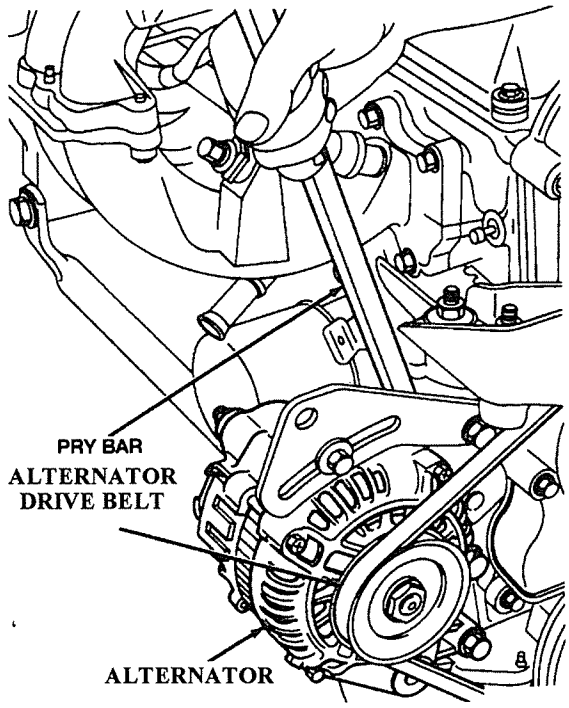
   Adjust the tension of the alternator drive belt. Use an Offset Belt Tension Gauge or equivalent.

INCORRECT CORRECT

NOTE: If using an Offset Belt Tension Gauge or equivalent, position the gauge on the longest accessible span of the alternator drive belt and use the following specifications:

NEW ALTERNATOR DRIVE BELT (no run time): Install the alternator drive belt and tension to 86-103 lb (39-47 kg). Run the engine for 10 minutes and readjust the alternator drive belt tension as specified above.

USED ALTERNATOR DRIVE BELT (more than 10 minutes of run time): 68-86 lb (31-39 kg).



6. Tighten the alternator adjustment bolt to 14-19 lb-ft (19-25 N-m).

7. Lower bolt can be reached without lifting vehicle up and down.

8. Tighten the alternator lower bolt to 27-38 lb-ft (37-52 N-m).

Deflection Adjustment

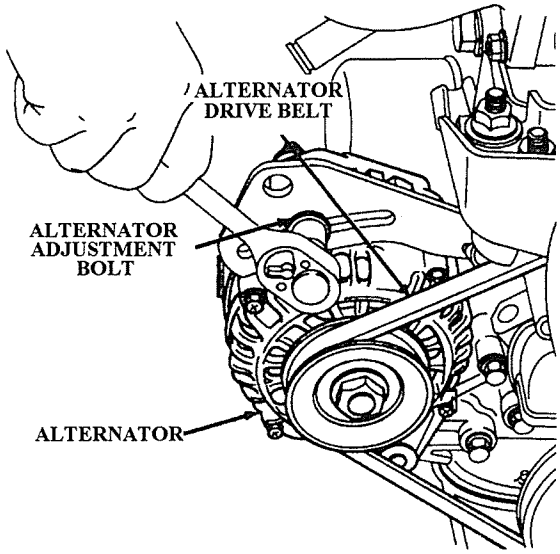
NOTE: If the drive belt has been in service for some time, it should be inspected before adjustment. A drive belt that is severely glazed, frayed, cracked, or contaminated with oil must be replaced. Minor cracks in the back of the drive belt are acceptable as long as no large pieces are missing.

1. Apply 22 lb (98 N) of pressure to the drive belt at a point midway between the alternator pulley and the crankshaft pulley.

2. NOTE: Always check the drive belt deflection when the engine is cold, or has been stopped for at least 30 minutes. A drive belt is considered new if it has been used on a running engine for less than five minutes.

   The drive belt deflection should measure 0.31-0.35 inch (8-9mm) for a new drive belt, or 0.35-0.39 inch (9-10mm) for a used drive belt.

3. Adjust the drive belt deflection by loosening the alternator adjustment bolt.



4. Raise and support the vehicle.

5. Loosen the alternator upper mounting bolt.

6. Lower the vehicle.

7. Adjust the deflection of the alternator drive belt by tightening the alternator adjusting bolt. Tighten the alternator adjusting bolt to 14-19 lb-ft (19-25 N-m).

8. Lower bolt can be reached without lifting vehicle up and down.

9. Tighten the alternator lower bolt to 27-38 lb-ft (37-52 N-m).

SPECIFICATIONS

DRIVE BELT SPECIFICATIONS

DEFLECTION		
Drive Belt	**New Belt**	**Used Belt**
A/C Compressor Drive Belt	0.31-0.35 in (8-9 mm)	0.35-0.39 in (9-10mm)
Alternator Drive Belt	0.31-0.35 in (8-9 mm)	0.35-0.39 in (9-10mm)
A/C Compressor Drive Belt	0.31-0.35 in (8-9 mm)	0.35-0.39 in (9-10mm)
TENSION		
A/C Compressor Drive Belt	110-132 lb (50-60 kg)	95-110 lb (43-50 kg)
Alternator Drive Belt	86-103 lb (39-47 kg)	68-86 lb (31-39 kg)

TORQUE SPECIFICATIONS

Description	Lb-ft	N-m
Alternator Adjustment Bolt	14-19	19-25
Alternator Lower Bolt	27-38	37-52
Drive Belt Idler Pulley Nut	27-38	37-52

SERVICE TOOLS/EQUIPMENT

- Offset Belt Tension Gauge

SECTION 11-3 - Engine, Air Intake System

DESCRIPTION AND OPERATION

Air Induction System

The air induction system controls and delivers filtered air to the engine. It consists of:

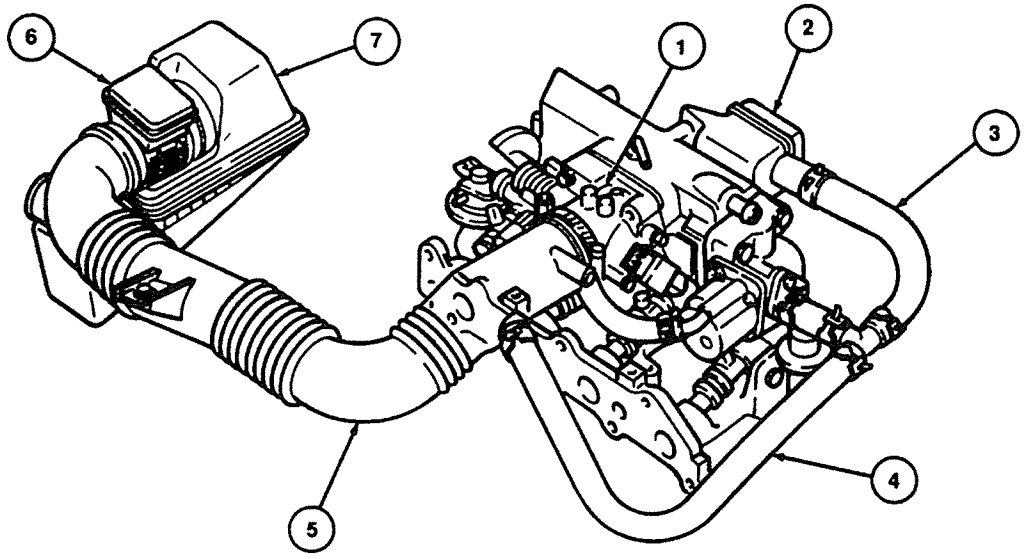
- Engine air cleaner (ACL)(houses the air cleaner element (ACL element).
- Mass Air Flow Sensor (MAF sensor)
- Air cleaner to intake manifold tube
- Engine air intake resonator
- Throttle body

The air induction system contains electronic sensors which are common with other emission and driveability systems and are covered in Section 9.

Air Cleaner Element

The air cleaner element (ACL element) is a dry type air cleaner. The air cleaner element is a chemically treated, pleated paper-air-filtering element which permits air flow through the air induction system, filtering out unwanted dust, dirt, and debris.

Air Induction System Components



Item	Part Number	Description
1	-	Throttle Body
2	-	Engine Air Intake Resonator
3	-	Engine Air Intake Resonator Inlet Hose
4	133021	Idle Air Control Bypass Air (IAC/BPA) Inlet Hose
5	133023	Air Cleaner To Intake Manifold Tube
6	133348	Mass Air Flow Sensor
7	133020	Engine Air Cleaner

DIAGNOSIS AND TESTING

Air Intake System

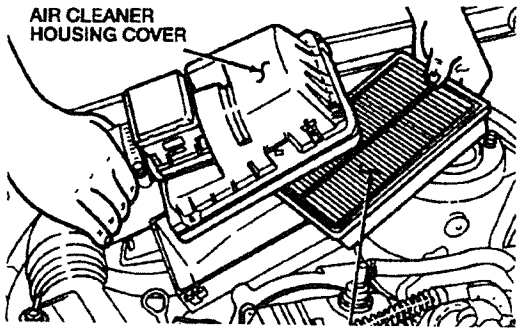
Refer to the Section 9.

REMOVAL AND INSTALLATION

Air Cleaner Element

Removal

1. Remove air intake panel with 2 screws and nuts.
2. Release the air cleaner hold-down clamps.
3. Lift the air cleaner housing cover and the air cleaner element (ACL element).
4. Remove the air cleaner element.



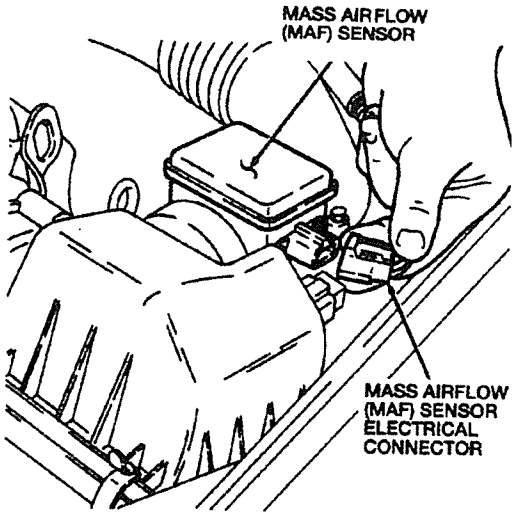
Installation

To install, reverse the removal procedure.

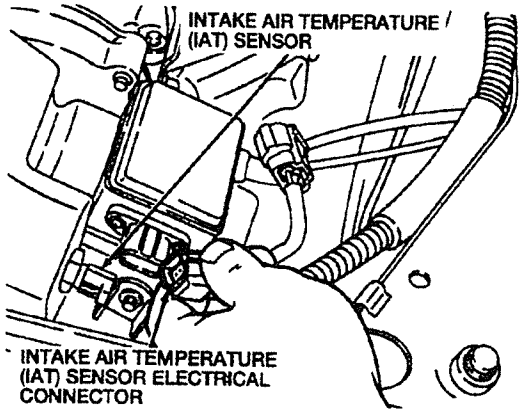
Engine Air Cleaner

Removal

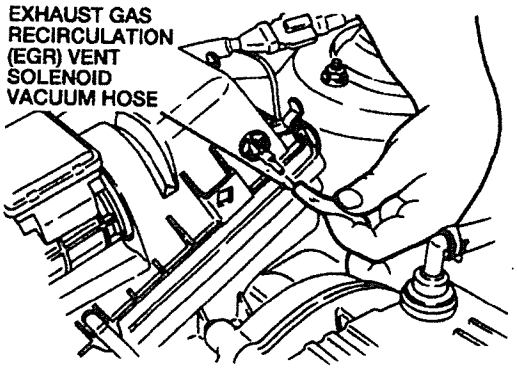
1. Disconnect the battery ground cable.
2. Disconnect the Mass Airflow (MAF) sensor electrical connector.



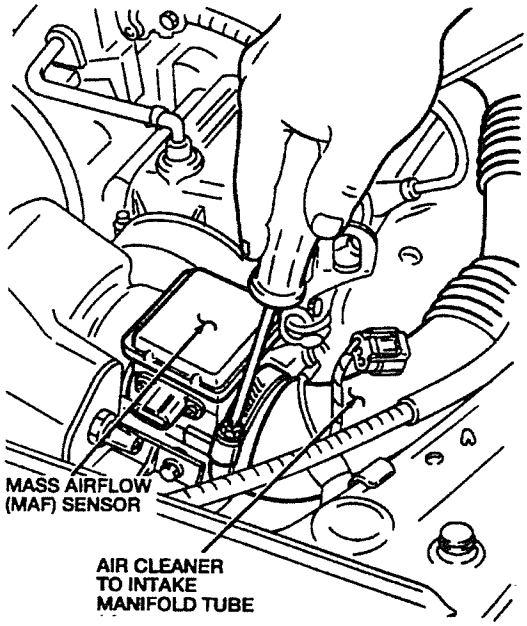
3. Disconnect the Intake Air Temperature (IAT) sensor electrical connector.



4. Disconnect the Exhaust Gas Recirculation (EC vent solenoid vacuum hose.



5. Loosen the clamp securing the air cleaner to intake manifold tube onto the MAF sensor.



6. Disconnect the air cleaner to intake manifold tube at the MAF sensor.

7. Release the air cleaner hold-down clamps.

8. Remove the air cleaner housing cover and the air cleaner element (ACL element).

9. Remove the air cleaner housing bolt and nut.

10. Remove the air cleaner housing.

Installation

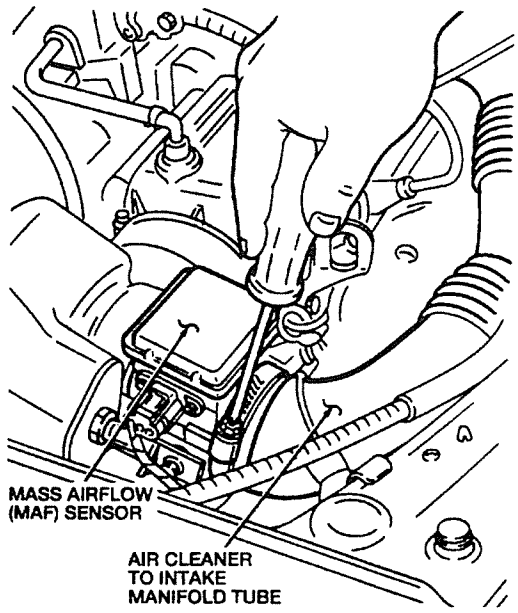
To install, reverse the removal procedure.

Air Cleaner to Intake Manifold Tube

Removal

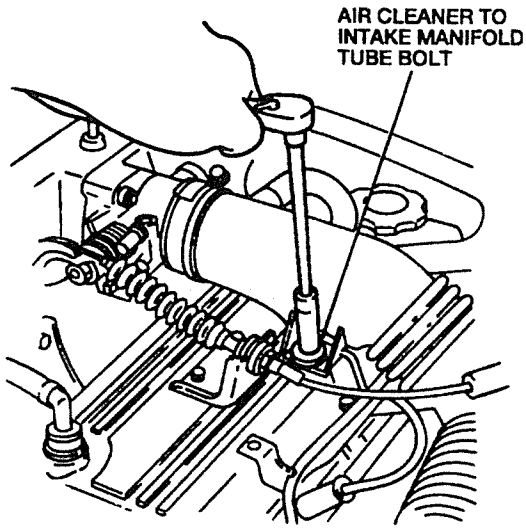
1. Loosen the clamp securing the air cleaner to intake manifold tube onto the Mass Air Flow Sensor (MAF sensor).

2. Disconnect the air cleaner to intake manifold tube at the MAF sensor.

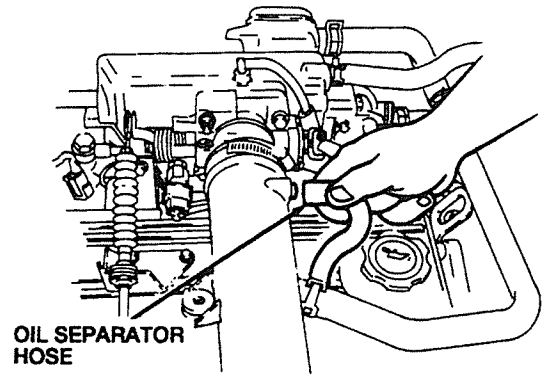


3. Remove the wing nut at the core support.

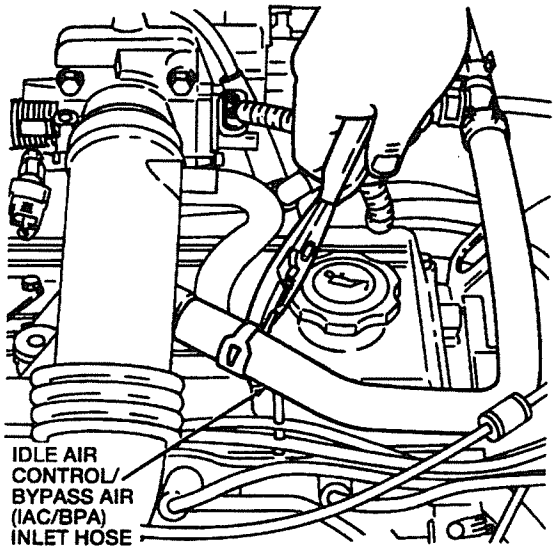
4. Remove the air cleaner to intake manifold tul bolt at the valve cover.



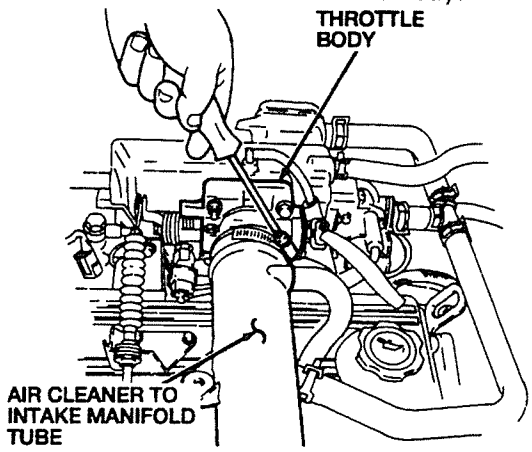
5. Disconnect the oil separator hose.



6. Disconnect the Idle Air Control/Bypass Air (IAC/BPA) inlet hose.



7. Disconnect the air cleaner to intake manifold tube at the throttle body.



Installation

To install, reverse the removal procedure,

Engine Air Intake Resonator

Removal

1. Disconnect the engine air intake resonatc hose.
2. Remove two engine air intake resonator bolt
3. Remove the engine air intake resonator.

Installation

To install, reverse the removal procedure.

CLEANING AND INSPECTION

Air Cleaner Element

CAUTION: Cleaning the air cleaner element (ACL element) is not recommended.

Refer to Section 2 for the recommended ACL elen maintenance mileage interval. The ACL element sl be replaced at the specified mileage intervals. Hol ACL element in front of a light and carefully inspe for any splits or cracks. If the ACL element is split cracked, replace it.

Engine Air Cleaner

Clean the air cleaner housing and cover with a s or compressed air. Wipe them dry if a solvent is Inspect the air cleaner housing and cover for dist or damage. Replace the air cleaner housing and c they are distorted or damaged.

Engine Air Intake Resonator

Clean the engine air intake resonator with a solver compressed air. Wipe the engine air intake resona dry if a solvent is used. Inspect the engine air inta resonator for distortion or damage. Replace the en air intake resonator if it is distorted or damaged.

SECTION 11-4 - Engine, Electronic Controls

DESCRIPTION AND OPERATION

Engine Control Systems, Electronic

The Sequential Multiport Fuel Injection (SFI) system is classified as a multi-point, pulse time, mass airflow, fuel injection system.

WARNING: DO NOT SMOKE, CARRY LIGHTED TOBACCO, OR OPEN FLAME OF ANY TYPE WHEN WORKING ON OR NEAR ANY FUEL RELATED COMPONENT. HIGHLY FLAMMABLE MIXTURES ARE ALWAYS PRESENT AND MAY BE IGNITED, RESULTING IN POSSIBLE PERSONAL INJURY.

To maintain the required exhaust emission levels, the fuel metering system must be kept in good operating condition and adjusted to the specifications listed in/on the following sources:.

- Section 9 - Emission Control System.
- The applicable section of this group.
- The Vehicle Emission Control Information (VECI) decal.

Additional engine performance checks are required to keep the exhaust emissions at the specified minimum pollutant level. Refer to Section 1 for these performance checks and their recommended intervals.

Powertrain Control Module (PCM)

The Powertrain Control Module (PCM) detects engine operating and driving conditions along with exhaust gas oxygen content. Various switches, sensors, and components provide the PCM with information which allows it to control the amount of fuel injected into the engine. The

PCM also has some control of the evaporative emission, ignition, and deceleration systems. Refer to the appropriate section for information on these systems. The following illustration identifies the electronic fuel system inputs and outputs to and from the PCM.

Relation of Inputs and Outputs

Input Device \ Output Device	Fuel Injection Amount	Fuel Injection Timing	Fuel Pump Relay	Ignition Control Module (ICM)	Idle Air Control Bypass Air (IAC BPA) Valve	Engine Cooling Fan Relay	A/C Relay (A/C Cut-off) and Condenser Fan Relay	Evaporative Emissions (EVAP) Canister Purge Solenoid	EGR Control Solenoid	Data Link Connector (DLC) / Malfunction Indicator Lamp
Crankshaft Position (CKP)Sensor Signal	O	O	O	O	O			O	O	O
Cylinder Identification (CID) Sensor		O								O
Idle Switch	O	O		O	O	O		O	O	
Throttle Position (TP) Sensor	O	O		O	O		O		O	O
Mass Airflow (MAF) Sensor	O			O	O	O		O	O	O
Engine Coolant (ECT) Sensor	O			O	O	O		O	O	O
Intake Air Temperature (IAT) Sensor	O				O			O		O
Oxygen Sensor (O2S)	O							O		O
A/C Pressure Cut-off Switch					O	O	O			
Ignition Switch (Start Signal)	O	O	O	O	O	O	O		O	
Park/Neutral Position (PNP) Switch	O			O	O		O	O		
Brake On/Off Switch (BOO) Switch	O									
EGR Valve Position (EVP) Sensor										O
Barometric (BARO) Pressure Sensor	O				O		O	O		O
Data Link Connector (DLC) (Self Test Input [TEN] Terminal)				O	O	O				O
Park/Neutral Position (PNP) Switch	O			O	O		O	O		
E/L Load*	O				O					
Vehicle Speed Sensor (VSS)					O					O

* E/L Load: Blower fan control switch second position or higher, headlamps on.

Throttle Position (TP) Sensor

The Throttle Position Sensor (TP sensor) is a variable resistor-type sensor. It is mounted on the left-hand side of the throttle body. The TP sensor detects the angle the throttle valve has been opened and sends a signal to the Powertrain Control Module (PCM) to regulate the air/fuel mixture.

Mass Airflow (MAF) Sensor

The Mass Air Flow Sensor (MAF sensor) detects the intake air quantity and converts the measurement to a voltage reading by means of a heated resistor. The voltage signal is sent to the Powertrain Control Module (PCM), which in turn determines injection quantities based on this signal, engine speed, etc.

Intake Air Temperature (IAT) Sensor

The Intake Air Temperature Sensor (IAT sensor) is a thermistor. It is mounted on the side of the upper engine air cleaner (ACL) and senses the intake air temperature. It sends information to the Powertrain Control Module (PCM), which

uses the information to calculate the fuel injection amount.

Idle Air Control Bypass Air (IAC BPA) Valve

The Idle Air Control Bypass Air (IAC BPA) Valve consists of the bypass air valve and the idle air control valve.

The bypass air valve functions during cold engine operation to increase engine idle speed. The bypass air valve consists of a thermowax bead and a valve.

Engine coolant is directed around the thermowax, which opens and closes the valve. During cold engine operation (below 140°F [60°C]), the thermowax is contracted enough to allow the air valve to open. As the engine coolant directed around the thermowax heats, the thermowax begins to expand. When the engine coolant reaches temperatures above 140° F (60° C), the thermowax expands and closes the valve.

In order to ensure idle smoothness for all operating conditions, the IAC BPA valve controls the amount of air bypassing the throttle valve. In order to maintain factory-set idle speed when the engine is cold, air also flows through the IAC BPA valve during all modes of engine operation.

Engine Coolant Temperature (ECT) Sensor

The Engine Coolant Temperature Sensor (ECT sensor) is a thermistor that is mounted into the intake manifold coolant passage. It provides engine coolant temperature information to the Powertrain Control Module (PCM).

Barometric Pressure (BARO) Sensor

The Barometric Pressure (BARO) sensor is located inside the Powertrain Control Module (PCM). It provides atmospheric pressure information to the PCM.

Oxygen Sensor (02S)

The Oxygen Sensor (02S) is mounted in the exhaust manifold and senses the oxygen concentration in the exhaust gas. It sends this information to the Powertrain Control Module (PCM), which uses the information to determine fuel injection amounts. The sensing element is made of zirconia ceramic with a platinum coating.

Camshaft Position (CMP) Sensor

The Camshaft Position (CMP) sensor detects the number 1 cylinder when it reaches Top Dead Center (TDC), and signals the Powertrain Control Module (PCM) to control fuel injection.

Crankshaft Position (CKP) Sensor

The Crankshaft Position (CKP) sensor is located in the distributor. The sensor sends engine speed and crankshaft position information to the Powertrain Control Module (PCM).

Vehicle Speed Sensor (VSS)

The Vehicle Speed Sensor (VSS) is integral to the speedometer . When the vehicle is driven, the speedometer gear assembly turns the speedometer cable. The speedometer cable turns the speedometer and VSS. As the VSS rotates, it sends a vehicle speed signal to the Powertrain Control Module (PCM) to control fuel injection.

DIAGNOSIS AND TESTING

Engine Controls, Electronic

Refer to the Powertrain Control/Emissions Diagnosis Manual for detailed diagnosis and testing procedures.

REMOVAL AND INSTALLATION

Safeguards

Removal and Installation

1. Always disconnect the battery ground cable prior to service or replacement of the Powertrain Control Module (PCM).

2. Follow Diagnostic Procedures as outlined in Section 9 - Emission Control Systems, Powertrain Control/Emissions Diagnosis.

3. Disconnect the PCM from the wiring harness before measuring for continuity, resistance, or energizing by way of a 12 volt source.

4. Never measure voltage or resistance directly at the PCM.

Powertrain Control Module (PCM)

Removal

The Powertrain Control Module (PCM) is located on the RH side of the instrument panel.

1. Disconnect the battery ground cable.
2. Remove the instrument panel cover.
3. Remove the three PCM nuts.
4. **CAUTION: Electronic modules are sensitive to static electric charges. If exposed to these charges, damage may result.**
5. Pull the PCM down to access the electrical connectors.
6. Disconnect the PCM electrical connectors.
7. Remove the PCM.

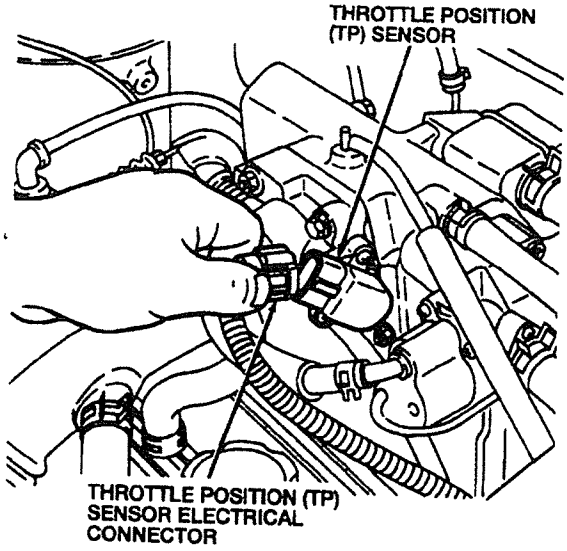
Installation

1. To install, reverse the removal procedure.

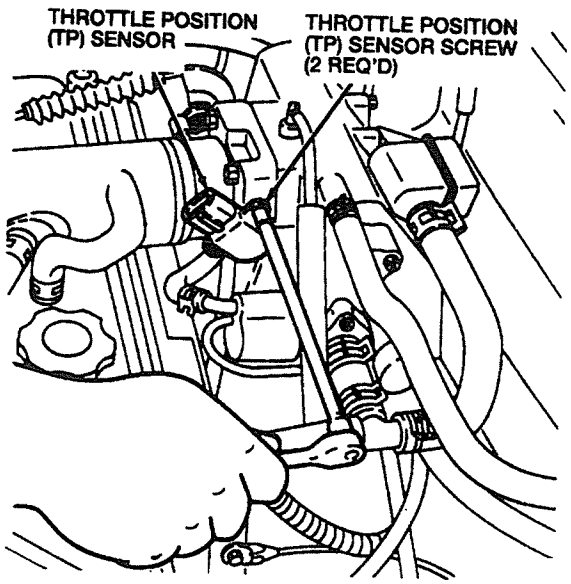
Throttle Position (TP) Sensor

Removal

1. Remove the Throttle Position (TP) sensor electrical connector.



2. Remove the two TP sensor screws.



3. Remove the TP sensor.

Installation

To install, reverse the removal procedure.

Tighten the TP sensor screws to 14.2-20.3 lb-in (1.6-2.3 N-m).

Refer to the TP sensor adjustment procedure in this section.

Idle Switch

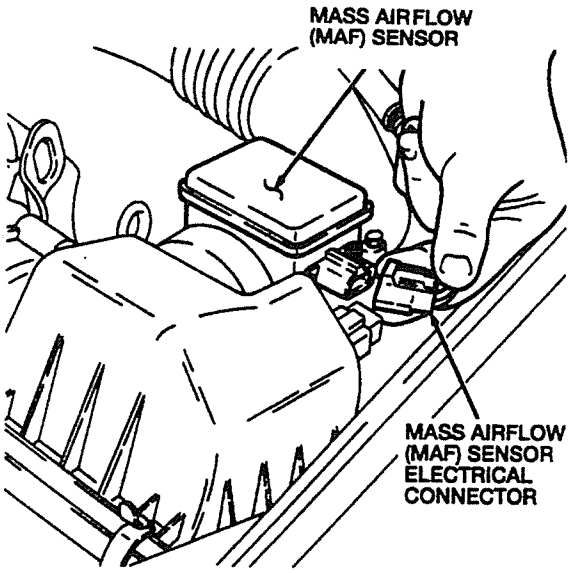
Removal and Installation

The idle switch is not serviceable. If the idle switch requires replacement, replace the throttle body.

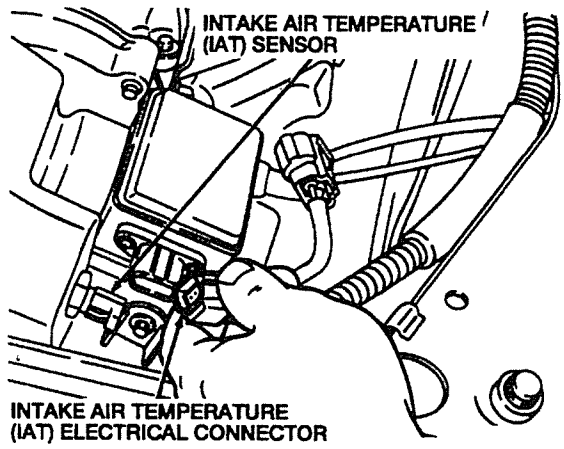
Mass Airflow (MAF) Sensor

Removal

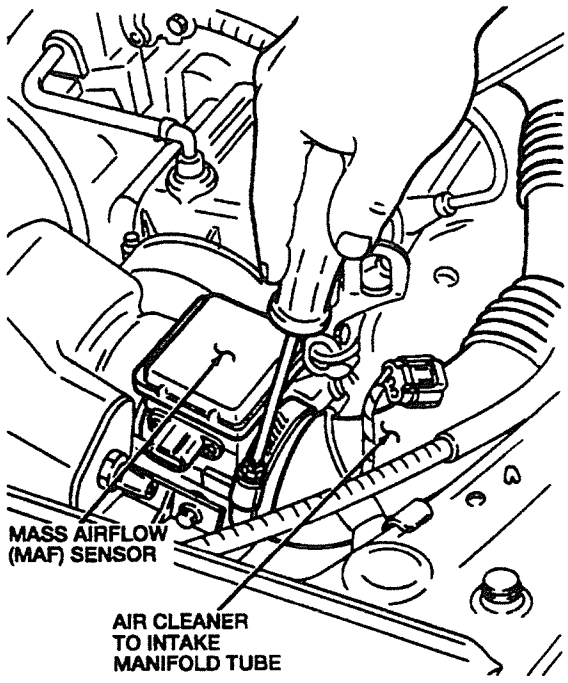
1. Disconnect the battery ground cable.
2. Disconnect the Mass Airflow (MAF) sensor electrical connector.



3. Disconnect the Intake Air Temperature (IAT) sensor electrical connector.



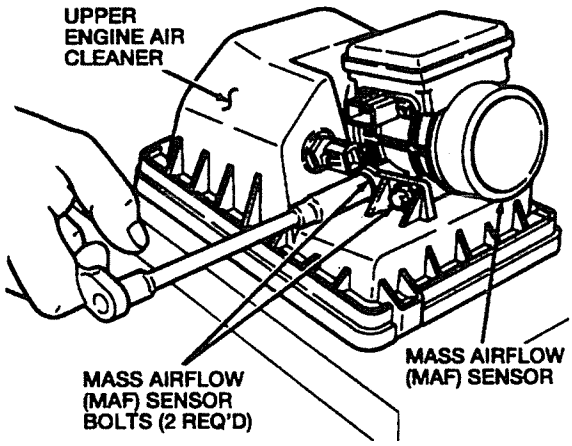
4. Loosen the clamp holding the air cleaner to intake manifold tube to the MAF sensor and remove the air cleaner to intake manifold tube from the MAF sensor.



5. Disconnect the vacuum hose.

6. Remove the upper engine air cleaner (ACL).

7. Remove the two MAF sensor bolts and the MAF sensor.



Installation

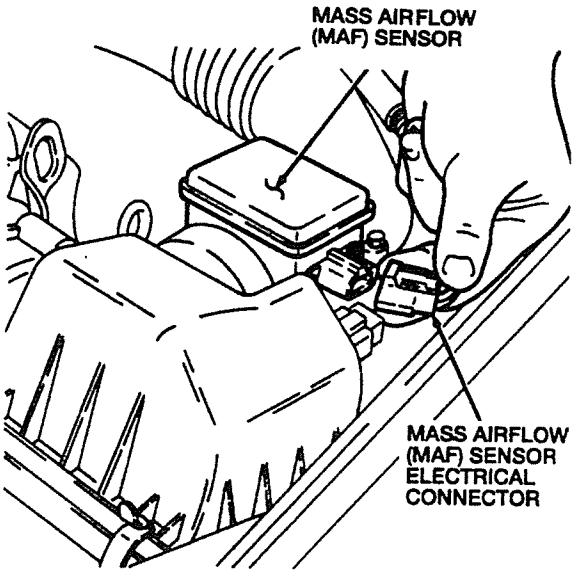
To install, reverse the removal procedure.

Tighten the MAF sensor bolts to 71-88 lb-in (8-10 N-m).

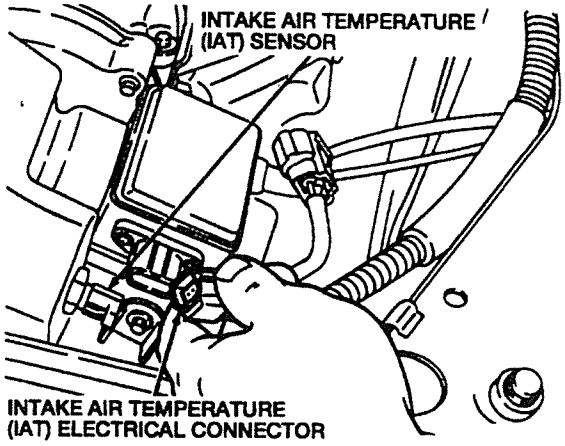
Intake Air Temperature (IAT) Sensor

Removal

1. Disconnect the battery ground cable.
2. Disconnect the Mass Airflow (MAF) sensor electrical connector.

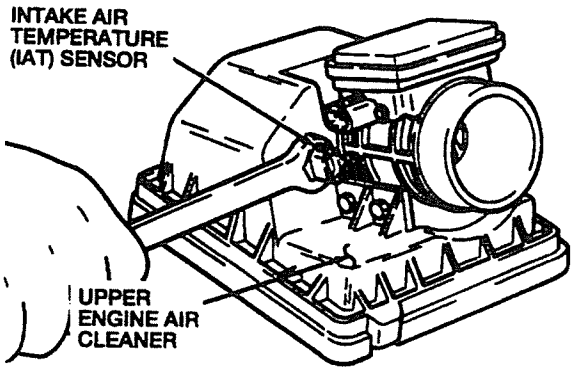


3. Disconnect the Intake Air Temperature (IAT) sensor electrical connector.



4. Remove the IAT sensor.

The upper engine air cleaner (ACL) shown removed for clarity.



Installation

To install, reverse the removal procedure.

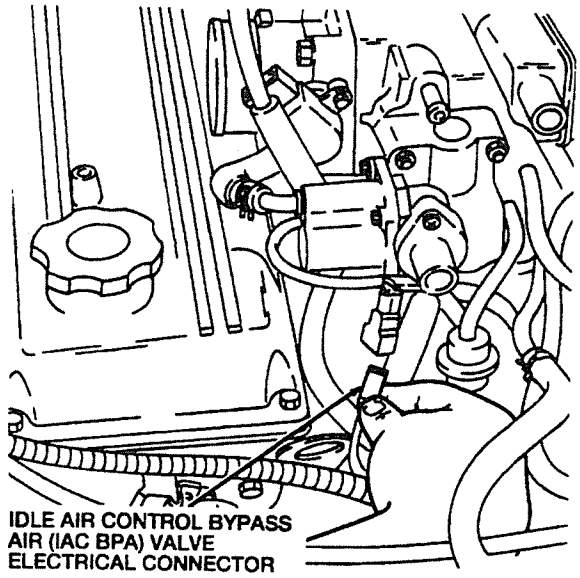
Tighten the IAT sensor to 71-97 lb-in (8-11 N-m).

Idle Air Control Bypass Air (IAC BPA) Valve

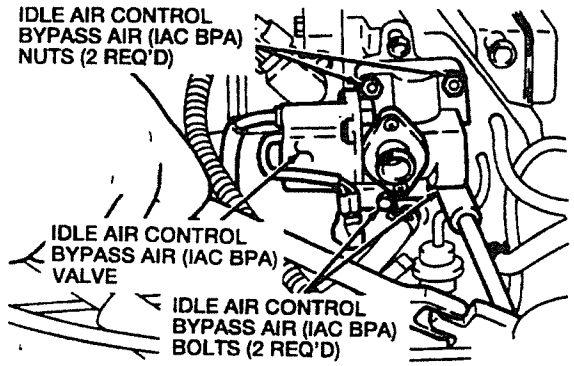
Removal

1. Disconnect the battery ground cable.
2. Drain the cooling system below the level of the Idle Air Control Bypass Air (IAC BPA) valve.
3. NOTE: The lower coolant line should be disconnected after the IAC BPA valve is separated from the upper intake manifold.

   Mark the air and coolant hoses for ease of installation, and remove the hoses from the IAC BPA valve.
4. Disconnect the IAC BPA valve electrical connector.



5. Remove the two IAC BPA nuts and two IAC BPA bolts.



6. Pull the IAC BPA valve from the upper intake manifold. Disconnect the lower coolant line from the IAC BPA valve.

7. Remove the IAC BPA valve and gasket. Discard the gasket.

Installation

To install, reverse the removal procedure.

Install a new gasket.

Tighten the IAC BPA nuts and bolts to 71-88 lb-in (8-10 N-m).

Refer to Section 15 for the cooling system filling procedure.

Engine Coolant Temperature (ECT) Sensor

Removal

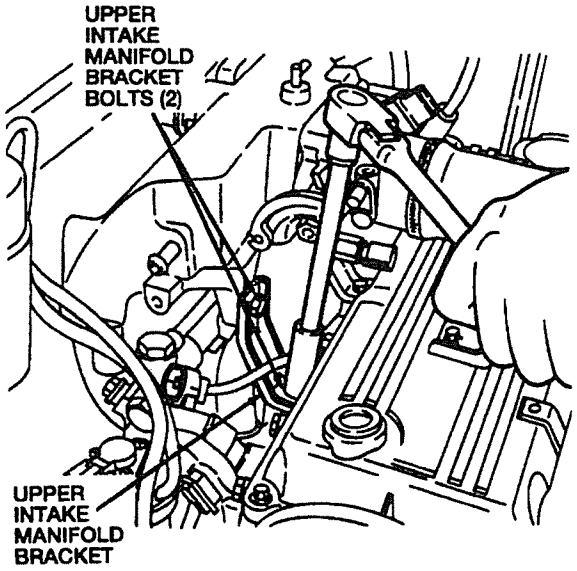
1. Disconnect the battery ground cable.

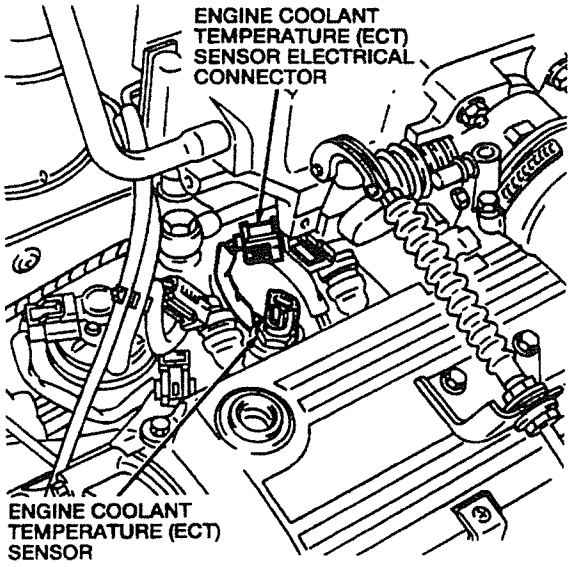
2. Drain the cooling system below the level of the Engine Coolant Temperature Sensor (ECT sensor).

3. Remove the two upper intake manifold bracket bolts and the upper intake manifold bracket.

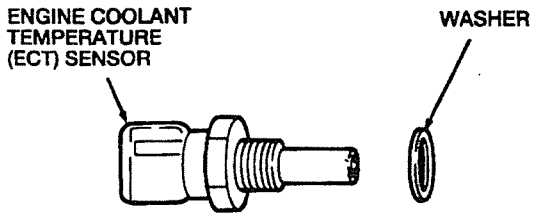
4. Disconnect the ECT sensor electrical connector.

5. Remove the ECT sensor using a deep well socket.





6. Remove the washer from the ECT sensor. Discard the washer.



Installation

To install, reverse the removal procedure.

Install a new washer and then tighten the ECT sensor to 19-21 lb-ft (25-29 N-m).

Tighten the two upper intake manifold bracket bolts to 14-19 lb-ft (19-26 N-m).

Refer to Section 15 for the engine coolant filling procedure.

Barometric Pressure (BARO) Sensor

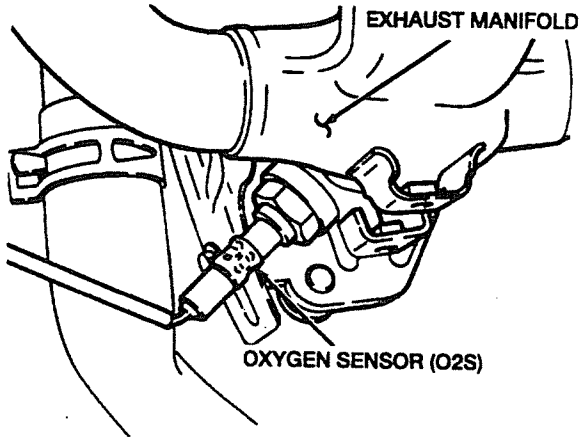
Removal and Installation

The Barometric Pressure (BARO) sensor is integrated into the Powertrain Control Module (PCM) and is not serviceable as a separate item. If the BARO sensor needs to be replaced, the PCM must be replaced. Refer to the procedure in this section.

Oxygen Sensor (02S)

Removal

1. Disconnect the battery ground cable.
2. Remove the air cleaner intake tube. Refer to Section 11 for the removal and installation procedure.
3. Disconnect the Oxygen Sensor (02S) electrical connector.
4. Remove the 02S wire from the hanger.
5. Remove the exhaust manifold heat shield bolts and the exhaust manifold heat shield.
6. Remove the 02S from the exhaust manifold.



Installation

To install, reverse the removal procedure.

Apply an anti-seize compound to the 02S prior to installation.

Tighten the 02S to 22-36 lb-ft (29-49 N-m).

Tighten the exhaust manifold heat shield bolts to 12-17 lb-ft (16-23 N-m).

Camshaft Position (CMP) Sensor

Removal and Installation

The Camshaft Position (CMP) sensor is integral to the distributor. If the CMP sensor requires service, the distributor must be replaced. Refer to Section 11 for the removal and installation procedure.

Crankshaft Position (CKP) Sensor

Removal and Installation

The Crankshaft Position (CKP) sensor is integral to the distributor and is not serviceable as a separate component. It the CKP sensor needs to be replaced, the distributor must be replaced. Refer to Section 11 for the removal and installation procedure.

Vehicle Speed Sensor

Removal and Installation

Refer to Section 8 for the removal and installation procedure.

CLEANING AND INSPECTION

Idle Air Control Bypass Air (IAC BPA) Valve

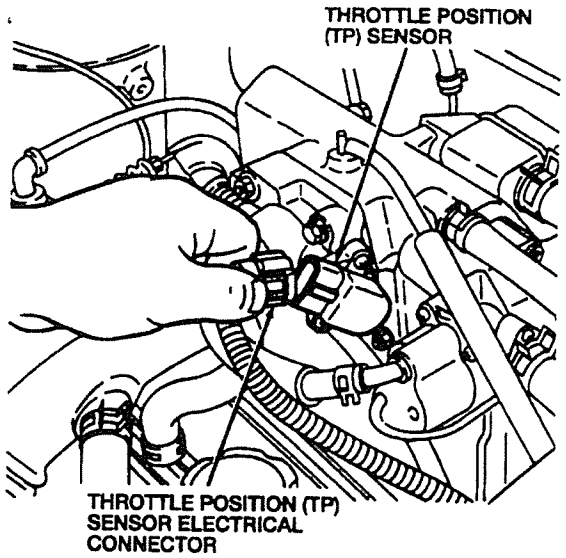
CAUTION: Do not use Carburetor Tune-Up Cleaner or any other type solvent or damage to the valve internal components may result.

The Idle Air Control Bypass Air (IAC BPA) valve used on all 1.3L engines cannot be cleaned. The IAC BPA valve must be replaced.

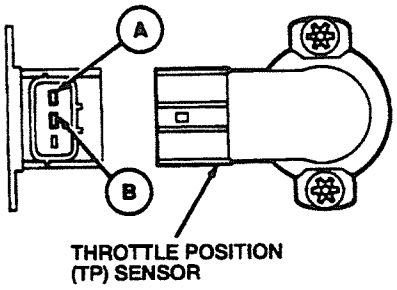
ADJUSTMENTS

Throttle Position (TP) Sensor

1. Disconnect the Throttle Position (TP) sensor electrical connector.



2. Connect a Digital Multimeter, or equivalent, between terminals A and B.

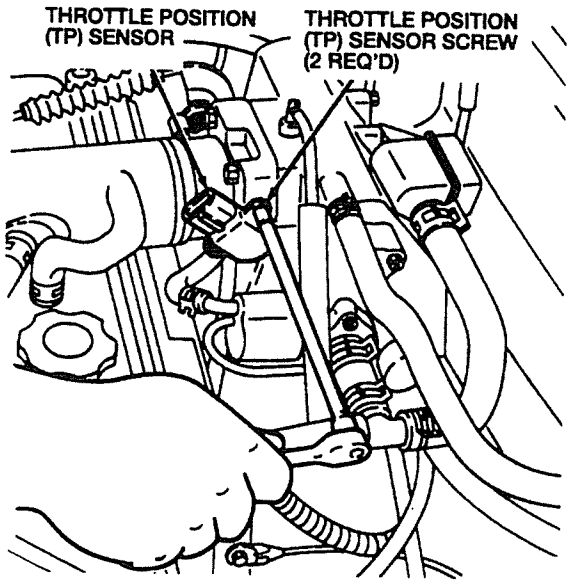


3. Turn the throttle lever to the Wide Open Throttle (WOT) position and check the resistance reading on the multimeter. The reading should be approximately 5 Kohms.

4. Turn the throttle lever to the fully closed position and check the reading on the multimeter. The reading should be below 1 (one) ohm.

If the resistances are not within the specifications, adjust the TP sensor as follows:

- Loosen, but do not remove, the TP sensor screws.



- With the throttle lever in the closed position, adjust the TP sensor until the multimeter reads below 1 ohm.

- Turn the throttle lever to the WOT position and check the resistance. The resistance should be approximately 5 Kohms. If the TP sensor cannot be adjusted to specification,

the throttle body must be replaced. Refer to Section 13 for the removal and installation procedure.

- After the TP sensor resistance readings are to specification, tighten the TP sensor screws to 14.2-20.3 lb-in (1.6-2.3 N-m).

5. Connect the TP sensor electrical connector.

SPECIFICATIONS

TORQUE SPECIFICATIONS

Description	lb-in	lb-ft	N-m
Mass Airflow (MAF) Sensor	71-88	-	8-10
Intake Air Temperature (IAT) Sensor	71-97	-	8-11
Idle Air Control Bypass Air (IAC BPA) Bolts	71-88	-	8-10
Engine Coolant Temperature (ECT) Sensor	-	19-21	25-29
Upper Intake Manifold Bracket Bolts	-	14-19	19-26
Oxygen Sensor (O2S)	-	22-36	29-49
Exhaust Manifold Heat Shield Bolts	-	12-17	16-23
Throttle Position (TP) Sensor Screws	14.2 - 20.3	-	1.6 - 2.3

SERVICE TOOLS/EQUIPMENT

- Digital Multimeter

SECTION 12- Ignition System

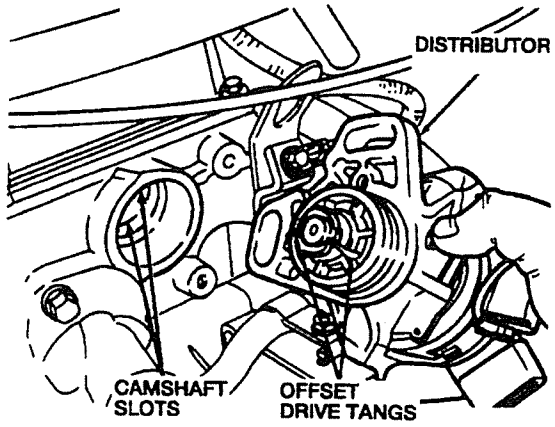
DESCRIPTION AND OPERATION

Ignition System Features

The distributor ignition system features a camshaft driven distributor which uses no centrifugal or vacuum advance. The diecast housing incorporates a Hall effect stator assembly.

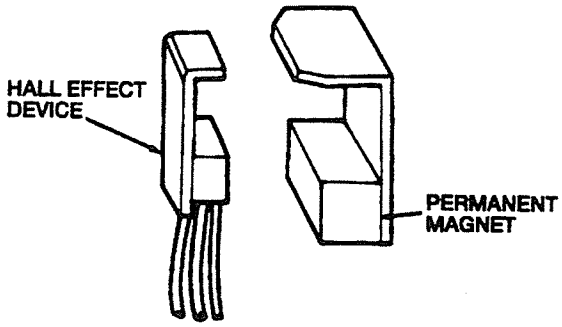
Initial timing adjustments are not required unless the distributor has been moved from its factory setting or removed from the engine. Ignition timing procedures are included in this section.

The distributor is mounted on the rear (flywheel end) of the cylinder head, and is direct-driven by the camshaft at one-half the crankshaft speed. Two offset drive tangs pinned to the distributor shaft engage with the camshaft in only one position. Rotation is counterclockwise as seen from the left of the vehicle. The firing order is 1-3-4-2.

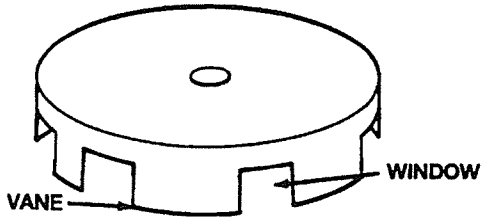


The distributor houses the Camshaft Position (CMP) sensor, Crankshaft Position (CKP) sensor, ignition coil, Ignition Control Module (ICM) and the distributor rotor. Within the distributor, the ignition coil transfers the secondary voltage to the distributor rotor. The distributor rotor transfers the voltage to each distributor to spark plug wire.

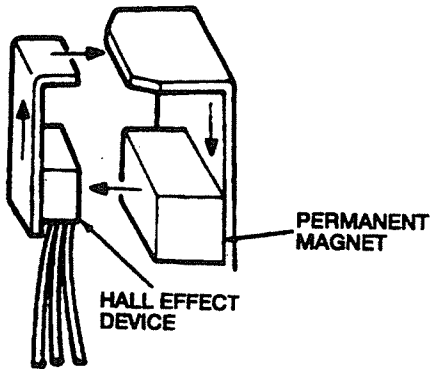
The distributor uses a Hall effect vane switch assembly, causing the ignition coil to be switched off and on by the Powertrain Control Module (PCM) and Ignition Control Module ([CM). The vane switch is an encapsulated package consisting of a Hall effect device on one side and a permanent magnet on the other side.



A rotary vane cup, made of ferrous metal, is used to trigger the signal off and on.

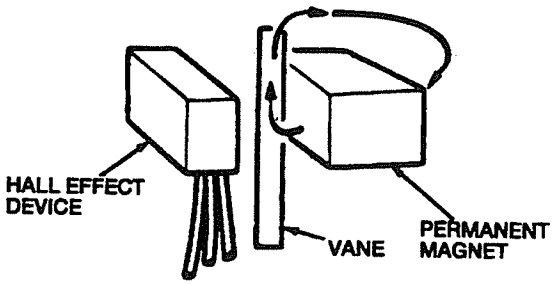


When the window of the vane cup is between the magnet and the Hall effect device, a magnetic flux field is completed from the magnet through the Hall effect device and back to the magnet.

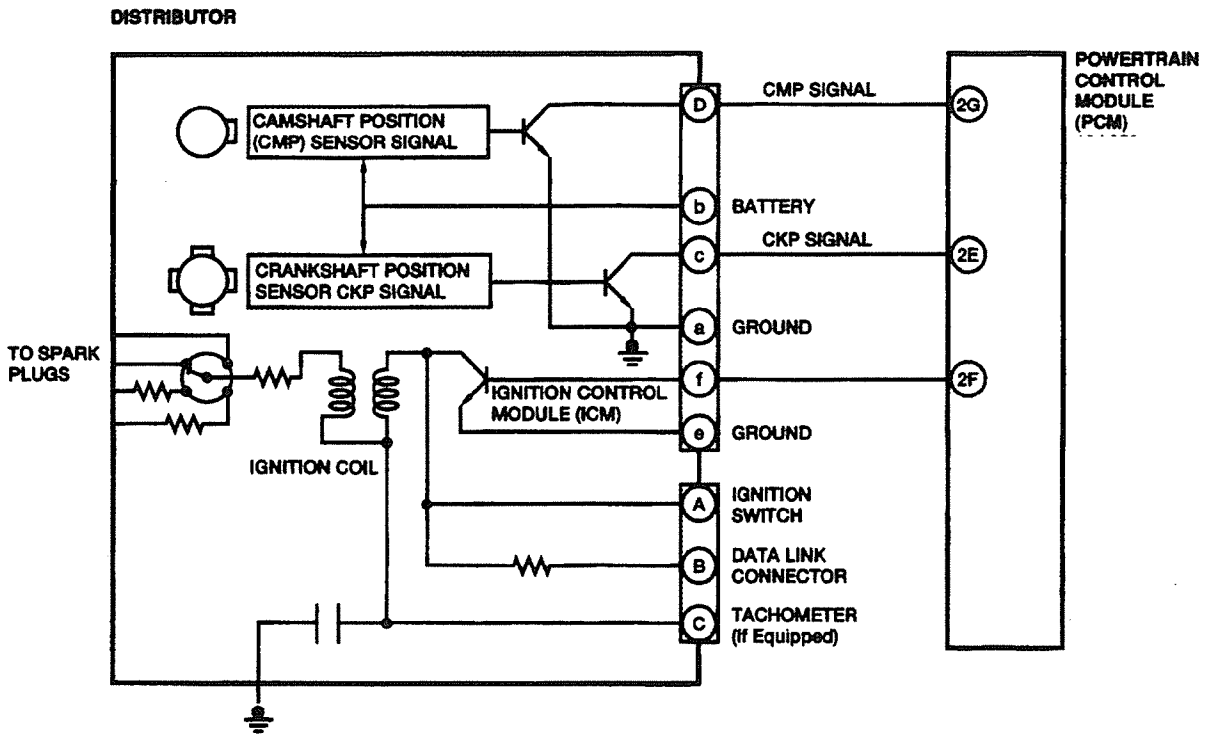


As the vane passes through this opening, the flux lines are shunted through the vane and back to the magnet.

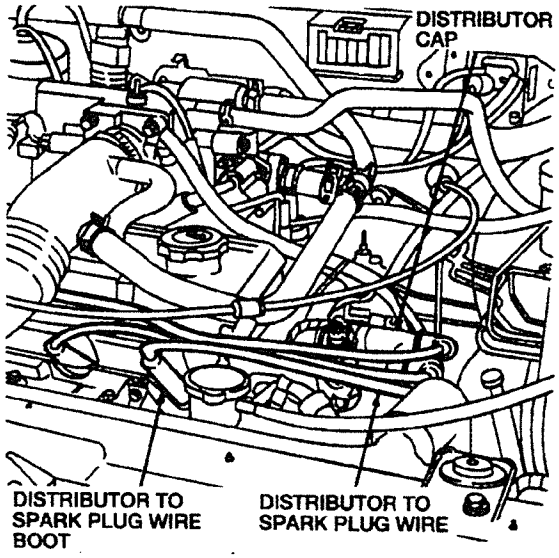
During this time, a voltage is produced as the vane passes through the opening. When the vane clears the opening, the window edge causes the signal to drop to almost zero volts. The signal is then used by the PCM for crankshaft position sensing and the computation of the desired spark advance based on engine demand and calibration. The conditioned spark advance and voltage distribution is accomplished through the distributor rotor, distributor cap and distributor to spark plug wires.



Distributor Ignition System



Ignition timing is controlled entirely by the PCM. Crankshaft position and engine rpm are read by the CKP sensor. This information is sent to the PCM. The PCM then signals the ICM to fire the ignition coil. The ICM controls the current through the ignition coil primary winding. The ICM turns the current on between firing points to build up a magnetic field around the coil windings. Then it turns the current off on a signal from the PCM. Once the current is turned off, the field collapses and a high voltage pulse of about 28,000 volts is induced in the coil secondary winding. This pulse is transmitted to the central terminal in the distributor cap, through the distributor rotor to the distributor cap terminal and through the distributor to spark plug wire to the appropriate spark plug. At the spark plug electrodes in the combustion chamber, the high voltage arcs to ground and ignites the compressed air/fuel charge.



High-altitude spark advance correction is entirely electronic and does not affect the relative positions of the armature or distributor stator. All vehicles are equipped with a Barometric Pressure (BARO) sensor housed in the PCM. When barometric pressure drops below 670mm (26.4 in-Hg), the PCM alters the Spark Output (SPOUT) signal to initiate high altitude spark advance operation.

Ignition Components, Electronic

The electronic components in the ignition system are as follows:

- Camshaft Position (CMP) sensor
- Crankshaft Position (CKP) sensor
- Ignition coil
- Ignition Control Module (ICM)
- Distributor

The CKP sensor, CMP sensor, ignition coil and ICM are not serviceable. If any of these components need to be serviced, the distributor will have to be replaced. Refer to the procedure in this section for the replacement procedure.

Crankshaft Position Sensor

The Crankshaft Position (CKP) sensor reads the crankshaft position and the engine rpm. The CKP sensor is integral with the distributor. If the CKP sensor requires service, the distributor must be replaced.

Camshaft Position Sensor

The camshaft position sensor is part of the distributor. The camshaft position sensor sends a signal to the Powertrain Control Module (POM) when the number one cylinder is at top dead center.

Ignition Coil

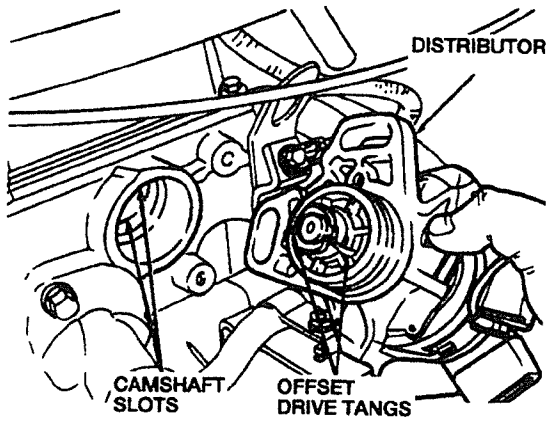
The ignition coil transforms the battery voltage in its primary circuit into approximately 28,000 volts on its secondary circuit each time it receives a signal from the Ignition Control Module ([CM).

Ignition Control Module

The Ignition Control Module (ICM) receives a Spark Output (SPOUT) signal from the Powertrain Control Module (PCM), and opens and closes the ignition coil primary circuit to fire the spark plugs.

Distributor

The distributor is mounted on the rear (flywheel end) of the cylinder head, and is direct-driven by the camshaft at one-half the crankshaft speed. Two offset drive tangs pinned to the distributor shaft engage with the camshaft in only one position. Rotation is counterclockwise as seen from the left of the vehicle.



The distributor houses the Camshaft Position (CMP) sensor, Crankshaft Position (CKP) sensor, ignition coil, Ignition Control Module (ICM) and the distributor rotor. Within the distributor, the ignition coil transfers the secondary voltage to the distributor rotor. The distributor rotor transfers the voltage to each distributor to spark plug wire.

REMOVAL AND INSTALLATION

Crankshaft Position Sensor

Removal and Installation

The Crankshaft Position (CKP) sensor is integral with the distributor. If the CKP sensor requires service, the distributor must be replaced.

Camshaft Position Sensor

Removal and Installation

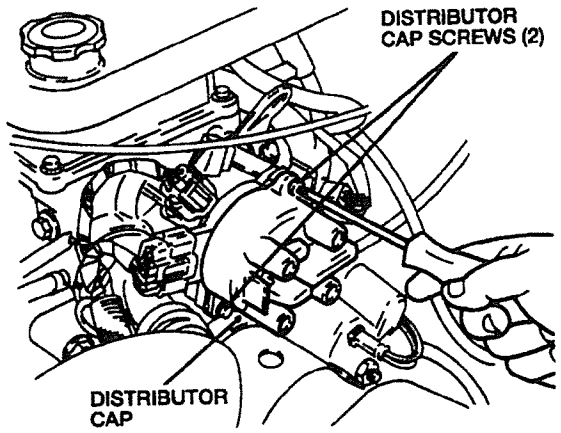
The Camshaft Position (CMP) sensor is integral with the distributor. If the CMP sensor requires service, the distributor must be replaced.

Distributor Cap

Removal

1. Disconnect the battery ground cable.
2. Mark the distributor cap towers with the cylinder numbers to aid in installing the distributor to spark plug wires.
3. Disconnect the distributor to spark plug wires from the distributor cap by twisting and pulling the distributor to spark plug wire boots (not the distributor to spark plug wires) until the distributor to spark plug wires are free.

4. Remove the two distributor cap screws.



5. Remove the distributor cap.

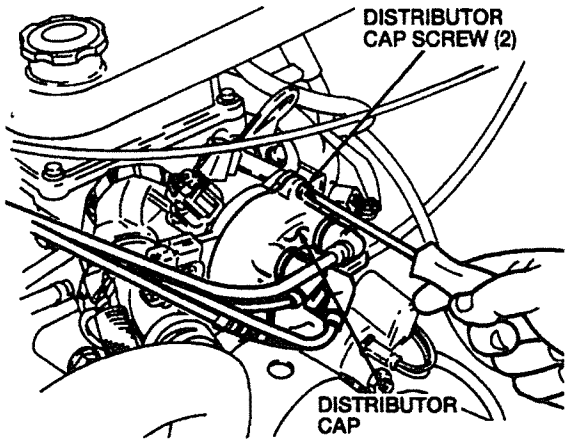
Installation

To install, reverse the removal procedure. Check for proper operation.

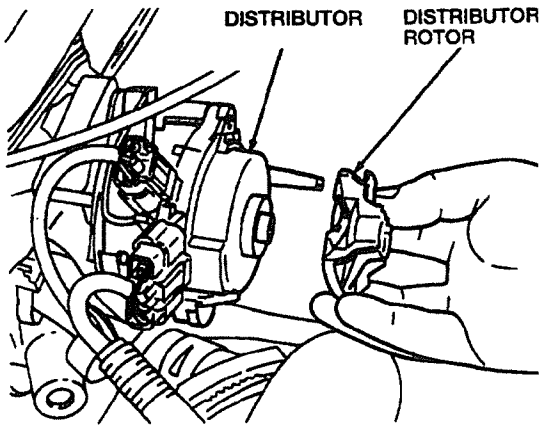
Distributor Rotor

Removal

1. Disconnect the battery ground cable.
2. Remove the two distributor cap screws.



3. Pull the distributor cap off and position it aside.
4. Remove the distributor rotor.



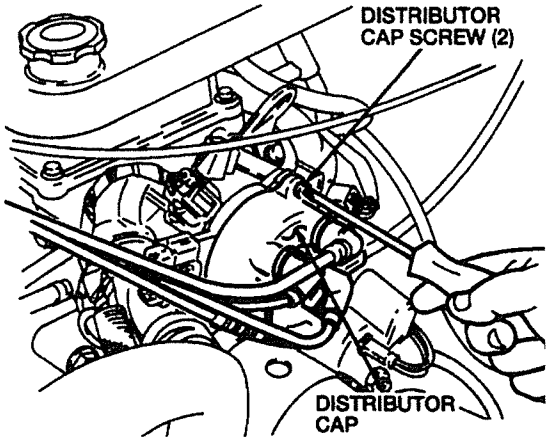
Installation

To install, reverse the removal procedure. Check for proper operation.

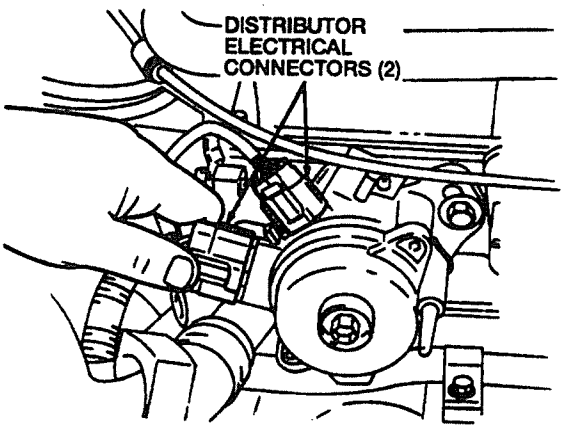
Distributor

Removal

1. Disconnect the battery ground cable.
2. Remove the two distributor cap screws.

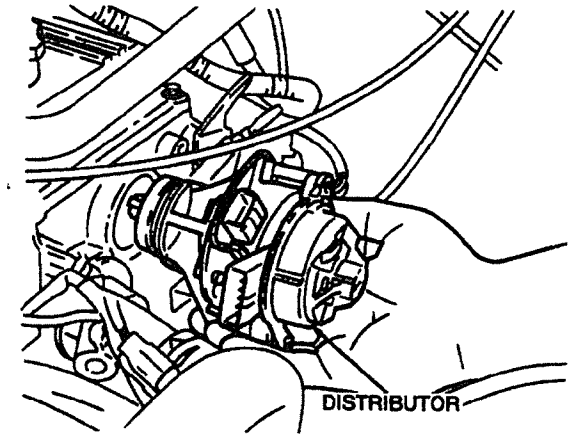


3. Pull the distributor cap off and position it aside.
4. Disconnect the two distributor electrical connectors.

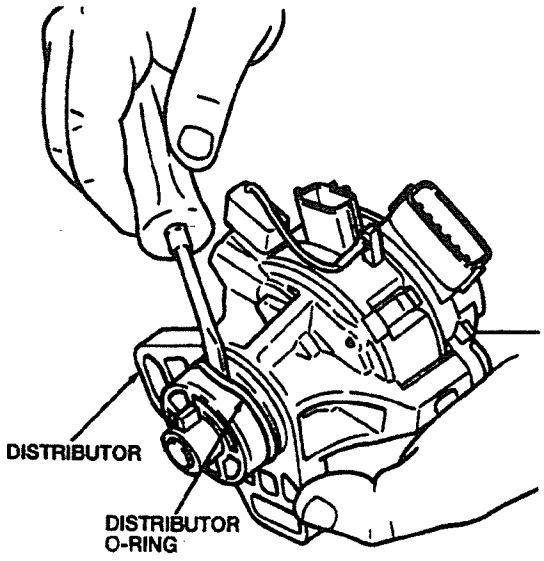


5. If the distributor is not being replaced, scribe a reference mark across the distributor base flange and the cylinder head. This reference mark will allow installation without changing the timing. Note the position of the distributor rotor.

6. Remove the two distributor bolts and remove the distributor.



7. Remove and discard the distributor 0-ring from the distributor.



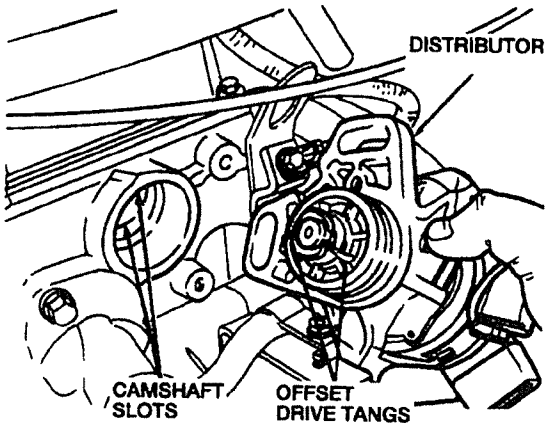
Installation

1. Install a new distributor 0-ring on the distributor.

2. NOTE: When installing the distributor, ensure that the offset drive tangs engage with the camshaft slots.

   NOTE: The rotor position should be the same as when removed.

   Position the distributor and install the two distributor bolts.



- If a replacement distributor is being installed, loosely tighten the distributor bolts.

- If the distributor is not being replaced, align the reference marks made during

removal and tighten the distributor bolts to 14-19 lb-ft (19-25 N-m).

3. Install the two distributor electrical connectors.

4. Install the distributor cap and the two distributor cap screws.

5. Install the battery ground cable.

6. NOTE: If a new distributor has been installed, the ignition timing should be checked and adjusted. Refer to the replacement procedure in this section.

7. Check for proper operation.

Stator

Removal and Installation

The distributor stator is integral with the distributor. If the distributor stator requires service, the distributor must be replaced.

Ignition Coil

Removal and Installation

The ignition coil is integral with the distributor. If the ignition coil requires service, the distributor must be replaced.

Ignition Control Module

Removal and Installation

The Ignition Control Module (ICM) is integral with the distributor. If the ICM requires service, the distributor must be replaced.

Distributor to Spark Plug Wires

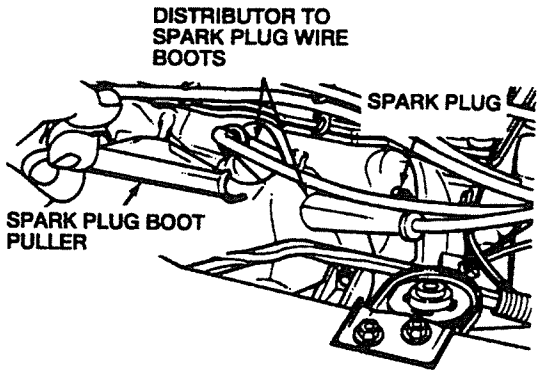
Removal

1. Disconnect the battery ground cable.

2. Mark the distributor cap towers with the cylinder numbers to ensure installation in the correct position. Disconnect the distributor to spark plug wires from the distributor cap by twisting and pulling the distributor to spark plug wire boots (not the distributor to spark plug wires) until the distributor to spark plug wires are free.

3. NOTE: Plug wires are numbered for each cylinder. Note the differing lengths and the numbering of distributor to spark plug wires, with Number 1 being the longest wire. This should help prevent confusion when determining the correct wire-to-plug connection.

4. Disengage the distributor to spark plug wires from the ignition wire separator and disconnect the distributor to spark plug wires from the spark plugs using Spark Plug Boot Puller.



Installation

1. Whenever a distributor to spark plug wire is removed for any reason from the spark plug or distributor cap, or a new distributor to spark plug wire is installed, Silicone Dielectric Compound (or equivalent)must be applied to the distributor to spark plug wire boot before the distributor to spark plug wire is connected. Using a small, clean tool, coat the entire interior surface of the distributor to spark plug wire boot with Silicone Dielectric Compound (or equivalent).

2. Connect the longest distributor to spark plug wire to the Number 1 spark plug, then to the Number 1 tower on the distributor cap.

3. Connect progressively shorter wires to the Number 2, 3, and 4 spark plugs and distributor cap towers.

4. Secure the distributor to spark plug wires in the ignition wire separator.

5. Connect the battery ground cable.

6. Check for proper operation.

Radio Ignition Interference Capacitor

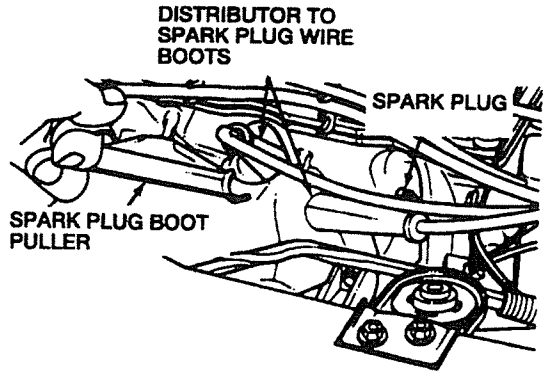
Removal and Installation

The radio ignition interference capacitor is integral with the distributor. If the radio ignition interference capacitor requires service, the distributor must be replaced.

Spark Plugs

Removal

1. Disconnect the battery ground cable.
2. Remove the distributor to spark plug wires from the spark plugs using Spark Plug Boot Puller or equivalent.



3. Loosen the spark plugs with a suitable deep well socket, then blow any loose dirt out of the spark plug wells using compressed air.
4. Remove the spark plugs.

Installation

1. Install the spark plugs into the cylinder head. Tighten to 15-22 lb-ft (20-30 N-m).
2. NOTE: The distributor to spark plug wires are of differing lengths and are numbered to prevent incorrect connection. If in doubt, refer to the distributor cap and the firing order, 1-3-4-2, reading counterclockwise.

   Whenever a distributor to spark plug wire is removed for any reason from the spark plug or distributor cap, or a new distributor to spark plug wire is installed, Silicone Dielectric Compound or equivalent must be applied to the distributor to spark plug wire boot before the distributor to spark plug wire is connected. Using a small, clean tool, coat entire interior surface of the boot with Silicone Dielectric Compound or equivalent.
3. Connect the distributor to spark plug wires, pushing the connector and boot tightly onto each spark plug.
4. Connect the battery ground cable.
5. Check for proper operation.

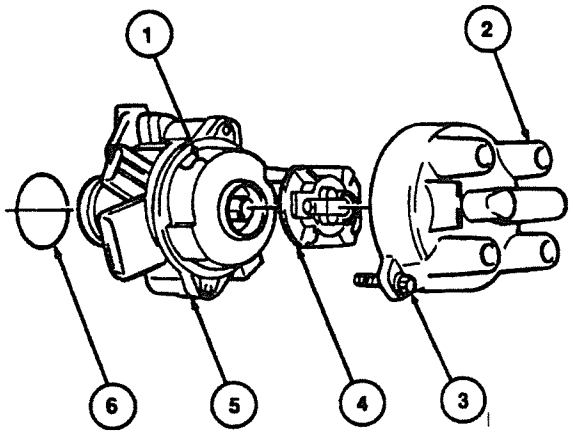
DISASSEMBLY AND ASSEMBLY

Distributor

CAUTION: Do not attempt to disassemble and service the distributor.

The distributor is serviced as an assembly. There is no disassembly or assembly procedure for this component. The distributor cap, distributor rotor, and distributor O-ring are the only serviceable parts on this assembly.

Distributor - Exploded View



Item	Part Number	Description
1		Vane Cover
2		Distributor Cap
3		Distributor Cap Screw (2)
4		Distributor Rotor
5		Distributor
6		Distributor

CLEANING AND INSPECTION

Distributor Cap

Wash the distributor cap with soap and water. Dry the distributor cap with compressed air. Inspect the distributor cap for:

- Cracks
- Broken carbon button
- Carbon tracks
- Dirt and corrosion on the terminals

Replace the distributor cap if it is damaged. Refer to the replacement procedure in this section.

Distributor

- Wipe all parts with a clean soft cloth.
- Inspect the distributor O-ring and replace it if it is damaged or worn.
- Inspect the distributor base for damage.
- Inspect the lower shaft for looseness or binding.

Distributor, Rotor

Wipe the distributor rotor with a clean, damp cloth. Dry it with compressed air. Inspect the distributor rotor and replace it if any of the following conditions exist:

- Cracks
- Carbon tracks
- Burns
- Damaged points
- Damaged spring

Replace the distributor rotor if it is damaged. Refer to the replacement procedure in this section.

Ignition Coil

Note: The ignition coil is integral with the distributor. If the ignition coil requires service, the distributor must be replaced.

Spark Plugs

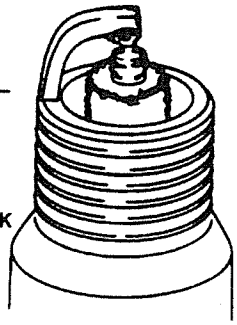
Note: Before cleaning, inspect the spark plug insulators and electrodes for indications of oil fouling, rich mixture, or improper heat range. Refer to the Spark Plug Inspection Chart in this section.

- Clean the spark plugs with a wire brush or sand-blast cleaner, if available.
- Check the electrode gaps. If necessary, adjust the gap clearance to 0.039-0.043 inch (1.0-1.1mm).

Spark Plug Inspection Chart

The following illustrations shows different spark plug conditions and explains the causes for each condition.

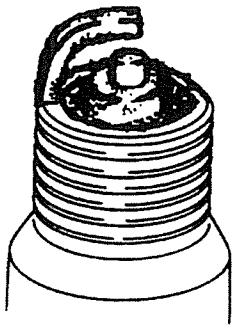
GAP BRIDGED



IDENTIFIED BY DEPOSIT BUILD—UP CLOSING CAP BETWEEN ELECTRODES.

CAUSED BY OIL OR CARBON FOULING. REPLACE THE SPARK PLUG OR, IF DEPOSITS ARE NOT EXCESSIVE THE SPARK PLUG CAN BE CLEANED.

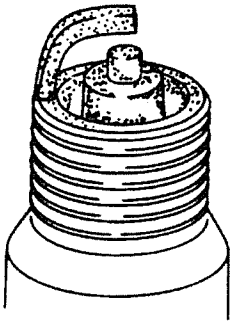
OIL FOULED



IDENTIFIED BY WET BLACK DEPOSITS ON THE INSULATOR SHELL BORE ELECTRODES.

CAUSED BY EXCESSIVE OIL ENTERING COMBUSTION CHAMBEI THROUGH WORN RINGS AND PISTONS, EXCESSIVE CLEARANCE BETWEEN VALVE GUIDES AND STEMS, OR WORN OR LOOSE BEARINGS. CORRECT OIL PROBLEM. REPLACE THE SPARK PLUG.

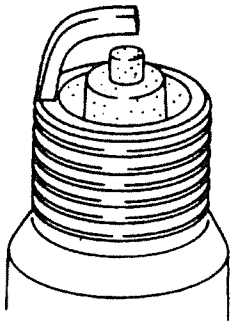
CARBON FOULED



IDENTIFIED BY BLACK, DRY FLUFFY CARBON DEPOSITS ON INSULATOR TIPS, EXPOSED SHELL SURFACES AND ELECTRODES.

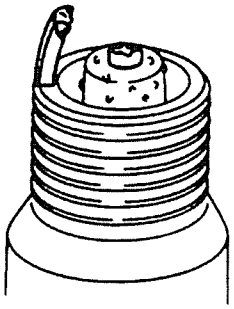
CAUSED BY TOO COLD A SPARK PLUG, WEAK IGNITION, DIRTY AIR CLEANER, DEFECTIVE FUEL PUMP, TOO RICH A FUEL MIXTURE, IMPROPERLY OPERATING HEAT RISER OR EXCESSIVE IDLING. CAN BE CLEANED.

NORMAL



IDENTIFIED BY LIGHT TAN OR GRAY DEPOSITS ON THE FIRING TIP.

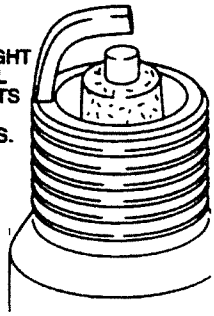
PRE-IGNITION



IDENTIFIED BY MELTED ELECTRODES AND POSSIBLY BLISTERED INSULATOR. METALLIC DEPOSITS ON INSULATOR INDICATE ENGINE DAMAGE.

CAUSED BY WRONG TYPE OF FUEL, INCORRECT IGNITION TIMING OR ADVANCE. TOO HOT A SPARK PLUG BURNT VALVES OR ENGINE OVERHEATING. REPLACE THE SPARK PLUG.

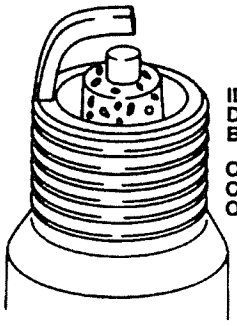
OVERHEATING



IDENTIFIED BY A WHITE OR LIGHT GRAY INSULATOR WITH SMALL BLACK OR GRAY BROWN SPOTS AND WITH BLUISH-BURNT APPEARANCE OF ELECTRODES.

CAUSED BY ENGINE OVER-HEATING, WRONG TYPE OF FUEL, LOOSE SPARK PLUGS TOO HOT A SPARK PLUG LOW FUEL PUMP PRESSURE OR INCORRECT IGNITION TIMING. REPLACE THE SPARK PLUG.

FUSED SPOT DEPOSIT



IDENTIFIED BY MELTED OR SPOTTY DEPOSITS RESEMBLING BUBBLES OR BLISTERS.

CAUSED BY SUDDEN ACCELERATION. CAN BE CLEANED IF NOT EXCESSIVE, OTHERWISE REPLACE SPARK PLUG

Distributor to Spark Plug Wires

Without removing the distributor to spark plug wires, wipe them with a clean, damp cloth. Replace the distributor to spark plug wires if the following conditions exist:

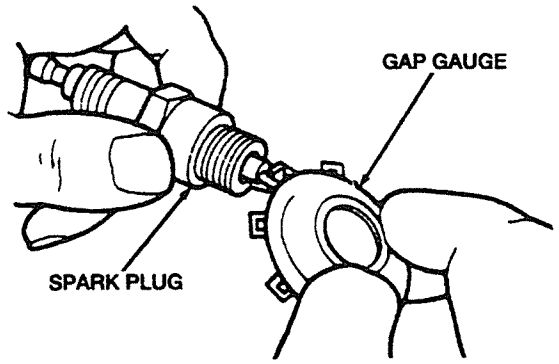
- Cuts
- Pinches
- Cracks
- Torn boots

Replace only the distributor to spark plug wires that are damaged. Refer to the replacement procedure in this section.

ADJUSTMENTS

Spark Plugs

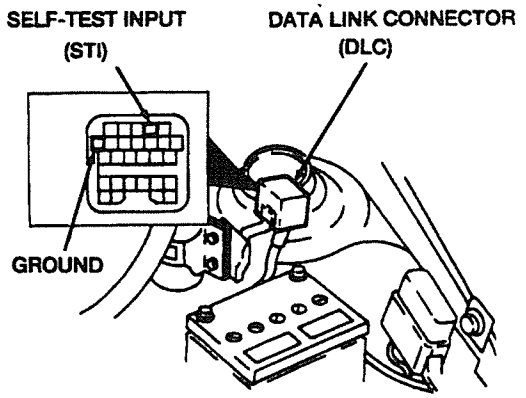
If necessary, adjust the spark plug gap to 0.039-0.043 inch (1.0-1.1mm).



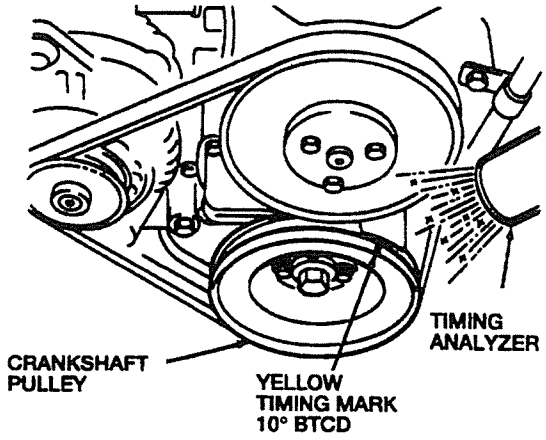
Ignition Timing

Check and adjust the ignition timing using the following procedure:

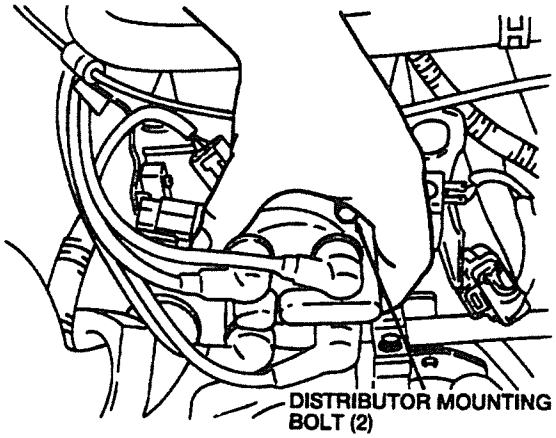
1. Start the engine and allow it to warm up to normal operating temperature.
2. Shut off all of the accessories.
3. Connect Timing Analyzer or equivalent.
4. Using a jumper, ground the Self-Test Input (STI) terminal at the Data Link Connector (DLC).



5. Check the base ignition timing. The yellow ignition timing mark should line up with pointer on the timing belt cover.



6. If the timing marks do not line up, continue with the following steps.
7. Loosen the distributor bolts.
8. Rotate the distributor until the timing marks are properly aligned.



9. Tighten the distributor bolts to 14-19 lb-ft (19-25 N-m).

10. Check the timing marks to ensure they did not move when the distributor bolts were tightened

11. Remove the jumper from the STI terminal at the DLC.

12. Remove the Timing Analyzer or equivalent.

SPECIFICATIONS

IGNITION SYSTEM SPECIFICATIONS

Description	Specification
Spark Plug Type	AGS32C
Spark Plug Gap	0.039-0.043 inches (1.0-1.1mm)
Firing Order	1-3-4-2
Ignition Timing	10 degrees BTDC

TORQUE SPECIFICATIONS

Description	Lb-ft	N-m
Distributor Bolts	14-19	19-25
Spark Plugs	15-22	20-30

SERVICE TOOLS/EQUIPMENT

SERVICE TOOLS

- Spark Plug Boot Puller
- Timing Analyzer

SECTION 13 - Fuel System

DESCRIPTION AND OPERATION

Fuel System Service

This Section covers procedures related directly to the fuel system. Other emissions systems related to the fuel system are covered in the Powertrain Control/Emissions Diagnosis Section of this manual.

WARNING: Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel related component. Highly flammable mixtures are always present and may be ignited, resulting in possible personal injury.

Engine Air Cleaner

Clean the air cleaner housing cover and air cleaner housing with a solvent or compressed air. Wipe the air cleaner housing cover and air cleaner housing dry if a solvent is used. Inspect the air cleaner housing and cleaner housing cover for distortion or damage at the gasket mating surfaces. Replace the air cleaner housing cover and air cleaner housing if damaged beyond service.

Air Cleaner Element

Refer to Section 2 - Maintenance and Lubrication for the recommended air cleaner element maintenance mileage interval. Cleaning the air

cleaner element is not recommended. The air cleaner element should be replaced at the specified mileage interval. Inspect by holding the element in front of a light and carefully check it for splits or cracks. If the air cleaner element is split or cracked, replace it. Refer to Section 11 for the removal and installation procedure.

Accelerator Pedal and Linkage

The position of the throttle plate is regulated by the accelerator cable. A ferrule attached to the accelerator cable end engages the throttle control lever at the throttle body. From the throttle control lever, the accelerator cable enters a casing that routes through the engine compartment and the wiring pan coming through the floor panel. At the accelerator pedal and shaft, a plastic insert with lock tabs is used to secure the accelerator cable.

The accelerator pedal and shaft is mounted on an accelerator shaft retainer that is secured to the front floor pan with two bolts. A pivot pin extending through the accelerator shaft retainer provides the pedal pivot point. When the accelerator pedal and shaft is pressed, its rotation on the pivot pin pulls the accelerator cable and opens the throttle plate. When released, an accelerator shaft spring returns the accelerator pedal and shaft and throttle plate to the idle position.

Valve, Idle Air Control Bypass Air

Caution: The Idle Air Control Bypass Air valve is a sludge-tolerant design and should not be cleaned as damage may occur.

Throttle Body

Check the throttle body for wear, deposits, and coolant leakage.

Verify that the throttle valve moves smoothly when the throttle lever is mover from the fully closed position to the wide open throttle position.

If it is necessary to replace the throttle body, replace the throttle body with the throttle position sensor and idle switch attached. Refer to Section 11 for the removal and installation procedure..

Fuel Pump, Electric

For inspection of the fuel pump, refer to the Powertrain Control/Emissions Diagnosis Manual.

Specifications

FUEL PRESSURE SPECIFICATIONS

Description	Specification
Fuel Pressure at Idle	(210-260 kPa). 30-38 psi.

Fuel Injected Engines

WARNING: DO NOT SMOKE, CARRY LIGHTED TOBACCO OR AN OPEN FLAME OF ANY TYPE WHEN WORKING ON OR NEAR ANY FUEL-RELATED COMPONENT. HIGHLY FLAMMABLE MIXTURES ARE ALWAYS PRESENT AND MAY BE IGNITED, RESULTING IN POSSIBLE PERSONAL INJURY.

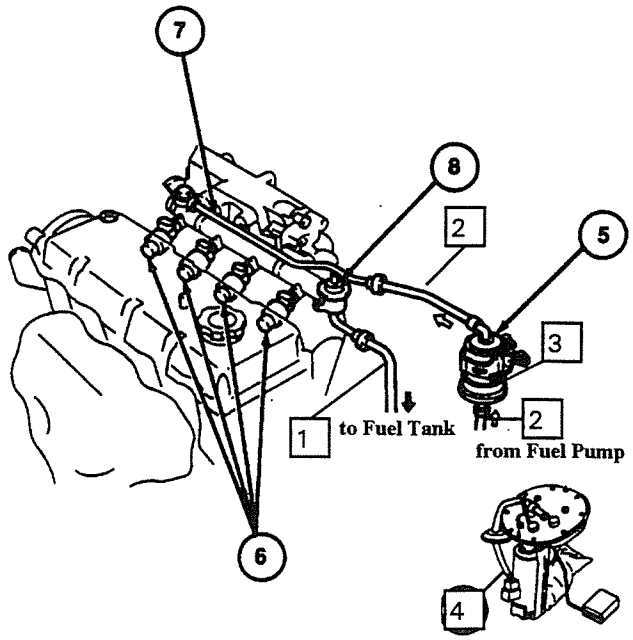
CAUTION: The fuel tubes leading from the fuel tank to the engine are under pressure during vehicle operation. When fuel Injected engines are turned off, the fuel in the fuel tubes remains pressurized for long periods of time to provide quick start-ups. Special procedures for servicing these pressurized fuel systems are outlined in this section.

The GO-4 Interceptor is equipped with a 1.3L Sequential Electronic Fuel Injection engine. The engine is fuel injected through the fuel injection supply manifold to the intake port at each cylinder. The fuel system used with a fuel injected engine has an electric fuel pump to provide high-pressure fuel to the fuel injector nozzle tip.

Fuel Tank and Fuel Tank Filler Pipe

The fuel tank is frame mounted on the rear of the vehicle. A fuel pump draws fuel from the fuel tank and delivers it under pressure through the fuel supply hose and fuel filter to the fuel injectors. Excess fuel is routed back to the fuel tank via a fuel return line. A fuel evaporation line is routed from the fuel tank to the Evaporative Emission canister. All lines underneath the vehicle run parallel along the left hand side of the vehicle. A fuel pressure regulator, mounted at the return side of the fuel injection supply manifold, regulates fuel pressure.

Fuel System Components



All vehicles are equipped with a restricted fuel tank filler pipe that allows only an unleaded fuel nozzle to be inserted. The fuel tank holds 7.0 US gal (26.5 liters) of fuel.

The restrictor consists of a narrow opening in the fuel tank filler pipe, covered by a steel trap door. The smaller unleaded fuel nozzle will fit through the narrow opening and push the trap door aside, allowing normal filling. Leaded fuel nozzles will not fit through the narrow opening. The closing of the trap door causes a fuel backup and automatic nozzle shutoff.

The restricted fuel tank filler pipe is manufactured as an assembly and must be serviced by removal and replacement with a new fuel tank filler pipe. The fuel tank filler pipe is not to be modified in any way.

Item	Part Number	Description
1	421372	Fuel Return Line
2		Main Fuel Hose (Line)
3		Fuel Filter Canister
4		Fuel Pump
5		Fuel Filter
6		Fuel Injectors
7		Fuel Injection Manifold
8		Fuel Pressure Regulator

Fuel Tank Filler Cap

WARNING: THE FUEL TANK FILLER CAP MAY BE PRESSURIZED. TO REMOVE, ROTATE CAP OVER 1/2 TURN COUNTERCLOCKWISE. FUEL TANK FILLER CAP IS VENTING FUEL OR A HISSING SOUND IS HEARD, WAIT UNTIL THE CONDITION STOPS BEFORE REMOVING THE FUEL TANK FILLER CAP. IF THESE PRECAUTIONS ARE NOT FOLLOWED, FUEL MAY SPRAY AND CAUSE PERSONAL INJURY.

WARNING: DO NOT SMOKE OR CARRY LIT TOBACCO OR AN OPEN FLAME OF ANY TYPE WHEN WORKING ON OR NEAR ANY FUEL-RELATED COMPONENT. HIGHLY FLAMMABLE MIXTURES ARE ALWAYS PRESENT AND MAY BE IGNITED, RESULTING PERSONAL INJURY.

The fuel tank filler cap is of a threaded screw-on design with a pre-vent feature that allows the fuel tank to vent for the first three-quarter turn before unthreading. All fuel tank filler caps are attached to the vehicle with a tether using the fuel tank filler to pipe housing screw. The fuel tank filler cap assembly provides pressure and vacuum relief functions, and should be replaced with the proper pressure/vacuum relief fuel tank filler cap to prevent possible system malfunction.

Fuel Filter

The fuel handling components are protected by two fuel filters.

In-Line:

A replaceable fuel filter is located inside the engine compartment in-line between the fuel tank and fuel injection supply manifold.

In-Tank:

A serviceable fuel tank sender filter is located inside the fuel tank at the inlet of the fuel pump.

Fuel Injector Screen

A fuel injector screen filter is located at the top of each fuel injector and is not serviceable. If a fuel injector screen becomes clogged, the fuel injector must be replaced. Refer to Section 11 for fuel injector information.

Fuel Lines

Fuel is drawn from the fuel tank by a fuel tank-mounted fuel pump. Fuel is then delivered under pressure through the fuel supply tube and fuel filter to the fuel injection supply manifold, and then to the fuel injectors. Excess fuel is returned to the fuel tank through the fuel return line. A fuel evaporation pipe is routed from the fuel tank to the Evaporative Emission canister. Fuel pressure is controlled by a fuel pressure regulator mounted at the return side of the fuel injection supply manifold.

Fuel Pump, Electric

NOTE: The fuel pump assembly housing is oval-shaped and secured to the fuel tank with eight screws.

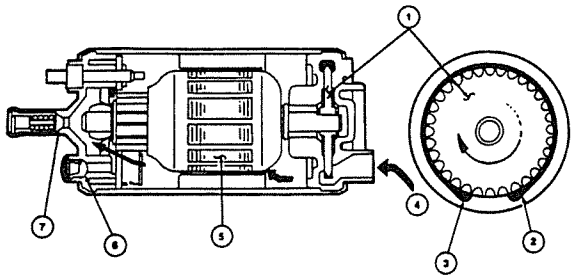
The fuel pump works in conjunction with the following components:

- Fuel pressure regulator
- Fuel pump relay
- Inertia Fuel Shutoff Switch

The fuel pump is mounted to the fuel pump assembly housing inside the fuel tank. The fuel pump includes a check valve located at the fuel pump outlet. The function of this valve is to maintain pressure in the system after the vehicle is shut down. The pressure retention helps prevent hot starting problems. A pressure relief valve is provided to regulate the maximum fuel pump outlet pressure.

The fuel tank sender filter protects the fuel pump at its inlet. This fuel tank sender filter strains dirt and contaminants which could plug or damage the internal fuel pump components.

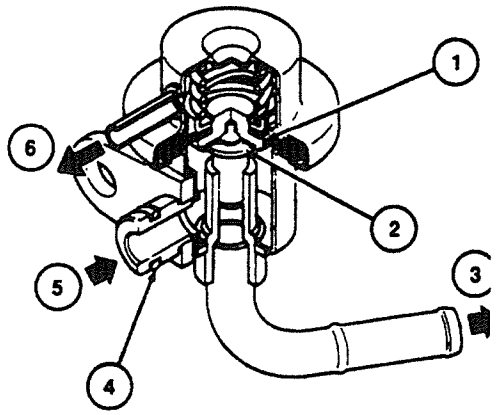
The fuel pump relay controls fuel pump operation. The fuel pump relay is mounted on the electrical rail in the engine compartment. The fuel pump operates only when the engine is cranking or running. It does not operate when the engine is not running, even with the ignition switch turned ON. During cranking, power from the ignition switch causes the fuel pump relay to close the feed circuit to the fuel pump.



Item	Part Number	Description
1	-	Impeller
2	-	Outlet Port
3	-	Inlet Port
4	-	Fuel Inlet
5	-	Motor
6	-	Pressure Relief Valve
7	-	Check Valve

Fuel Pressure Regulator

The fuel pressure regulator is mounted on the return line end of the fuel injection supply manifold. The fuel pressure regulator is controlled by manifold vacuum and maintains fuel pressure at 30-38 psi (210-260 kPa). When intake manifold vacuum is low (fuel demand high), spring pressure inside the fuel pressure regulator causes the valve to close partially, which increases fuel pressure in the fuel injection supply manifold. When intake manifold vacuum is high (fuel demand low), vacuum acting on the diaphragm compresses the spring, opening the valve further. Return fuel flow increases, resulting in lower fuel pressure in the fuel injection supply manifold.



Item	Part Number	Description
1		Diaphragm
2		Valve
3		To Fuel Pump
4		O-Ring Seal
5		From Fuel Line
6		Intake Manifold Vacuum

Fuel Gauge

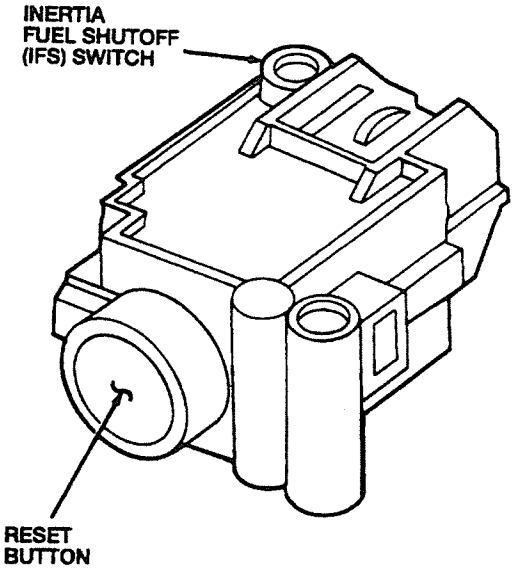
Refer to Section 19 for information on the fuel gauge.

Inertia Fuel Shutoff Switch

CAUTION: Inspect the fuel system for leaks before resetting the Inertia Fuel Shutoff Switch.

An Inertia Fuel Shut-off Switch is connected in series with the fuel pump circuit and will stop fuel pump operation in the event of a major collision or vehicle rollover. The reset button must be pushed to reset the Inertia Fuel Shutoff switch once it has been triggered.

The Inertia Fuel Shut-off Switch is located in the center and under the electrical component rail in the engine compartment. Push the red button to reset.



Fuel Tank, Filters, Lines and Electric Fuel Pump

Refer to the Powertrain Control /Emissions Diagnosis Manual ', Section 9B (Fuel Delivery/ Turbocharger Systems), for diagnosis of the 1.3L fuel system.

DIAGNOSIS AND TESTING

Inspection and Verification - Accelerator Pedal and Linkage

Care should be exercised when performing service on or around the accelerator pedal linkage and controls. Inspect the accelerator pedal rod and attaching linkage for damage or distortion which would bind or limit accelerator pedal travel. Inspect the accelerator cable for kinks or fraying which may cause binding. Also, inspect the engine idle speed adjustment to ensure correct idle speed specification after any accelerator linkage adjustment or repair.

Troubleshooting Chart -

Accelerator Pedal and Linkage

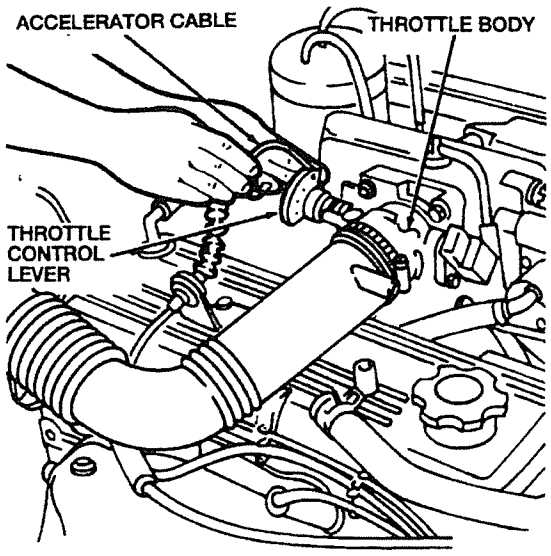
CONDITION	POSSIBLE SOURCE	REMEDY
Hard accelerator pedal effort	• Worn accelerator pins or mount. • Accelerator cable binding.	• Replace the worn accelerator pins or mount. • Replace the accelerator cable.
Accelerator Pedal feels rough or raspy.	• Frayed or binding accelerator cable.	• Replace the accelerator cable.
Accelerator Pedal binds or sticks.	• Kinked accelerator cable. • Foreign object caught in the accelerator pedal linkage.	• Replace the accelerator cable. • Check the accelerator pedal.
High Engine Idle Speed	• Kinked accelerator cable. • Foreign object caught in accelerator pedal. • Misadjusted engine idle speed.	• Replace the accelerator cable. • Check the accelerator pedal. • Adjust idle speed. Refer to Section 11.

REMOVAL AND INSTALLATION

Accelerator Cable

Removal

1. Remove the accelerator cable from the throttle control lever.



2. Loosen the locknuts at the accelerator cable bracket located near the throttle body.
3. Squeeze the lock tabs and remove the accelerator cable from the accelerator pedal.
4. Squeeze the lock tabs securing the accelerator cable housing to the bulkhead.
5. Remove the accelerator cable from the accelerator cable clip on the cylinder head.
6. Remove the accelerator cable from the vehicle.

Installation

To install, reverse the removal procedure.

Adjust the accelerator cable deflection and wide open throttle position. Refer to the accelerator cable deflection and wide open throttle position adjustment procedures in this section.

Accelerator Pedal

The two-piece accelerator pedal is mounted on an accelerator mount that is secured to the floorpan with two bolts. A steel pin extending through the accelerator mount provides the pedal pivot point. When the pedal is pressed, it pulls the cable and opens the throttle. When released, a spring returns the pedal and throttle to the idle position.

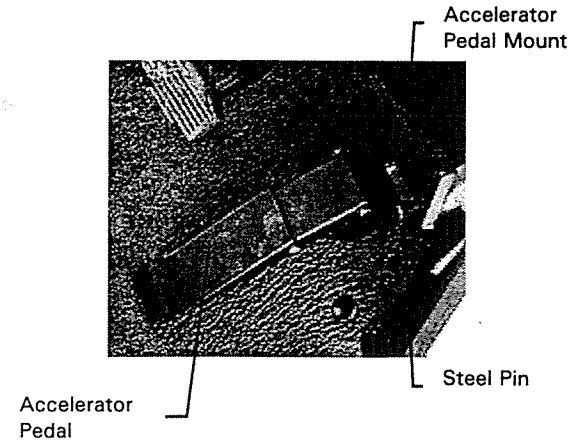
Removal

1. Remove the accelerator pedal by removing the middle cotterpin and 2-1/2 x 3/8 steel pin.

2. Disconnect the cable from the accelerator pedal by removing the top pin on the accelerator pedal.

3. Remove the accelerator cable from the accelerator pedal.

4. Remove the accelerator pedal and mount from the floorboard.



Installation

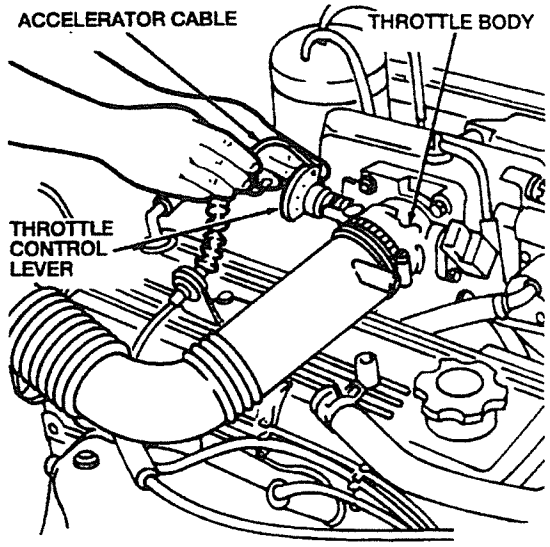
To install, reverse the removal procedure.

Tighten the accelerator mount bolts to 22 lb-ft (30 N-m).

Bracket, Accelerator Cable

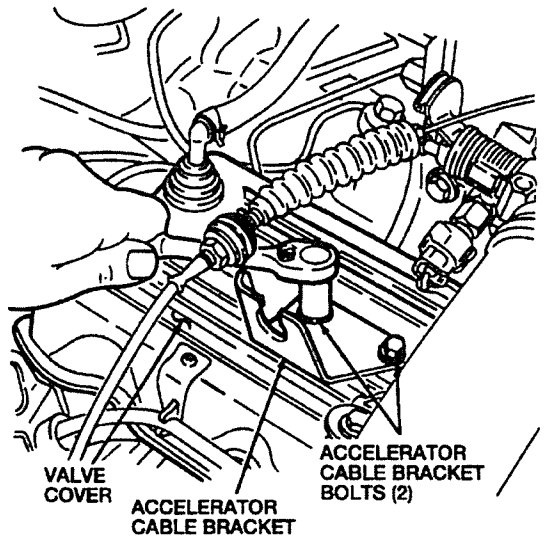
Removal

1. Remove the accelerator cable from the throttle control lever.



2. Loosen the locknuts at the accelerator cable bracket located near the throttle body.

3. Remove the two accelerator cable bracket bolts and the accelerator cable bracket from the valve cover.



Installation

To install, reverse the removal procedure.

Fuel Draining

WARNING: DO NOT SMOKE OR CARRY LIT TOBACCO OR AN OPEN FLAME OF ANY TYPE WHEN WORKING ON OR NEAR ANY FUEL-RELATED COMPONENT. HIGHLY FLAMMABLE

MIXTURES ARE ALWAYS PRESENT AND MAY BE IGNITED, RESULTING IN PERSONAL INJURY.

1. Relieve the fuel system pressure. Refer to the procedure in this section.

2. Use a Fuel Storage Tanker and Fuel Tanker Adapter Hose to siphon or pump the fuel out through the fuel tank filler pipe.

Fuel Filling

CAUTION: Fill the fuel tank with unleaded fuel only. Failure to do so may cause vehicle damage.

The fuel tank capacity is 7 US gal., (26.5 liters). Fuel level is constantly measured by the fuel level sensor within the fuel tank. This amount is registered on the fuel gauge (located on the instrument panel) whenever the key is in the ignition switch and in the ACC or ON position. The fuel gauge is divided into five increments ranging from E (empty) to F (full) to accurately measure the amount of fuel in the fuel tank.

Fuel Tank

WARNING: DO NOT SMOKE OR CARRY LIT TOBACCO OR AN OPEN FLAME OF ANY TYPE WHEN WORKING ON OR NEAR ANY FUEL-RELATED COMPONENT. HIGHLY FLAMMABLE MIXTURES ARE ALWAYS PRESENT AND MAY BE IGNITED, RESULTING IN PERSONAL INJURY.

Removal

1. Remove the cargo box from its position over the engine compartment.

2. Remove four bolts holding lower trunk to the door slide rails.

3. Remove the lower trunk assembly from vehicle frame.

4. Disconnect the battery ground cable.

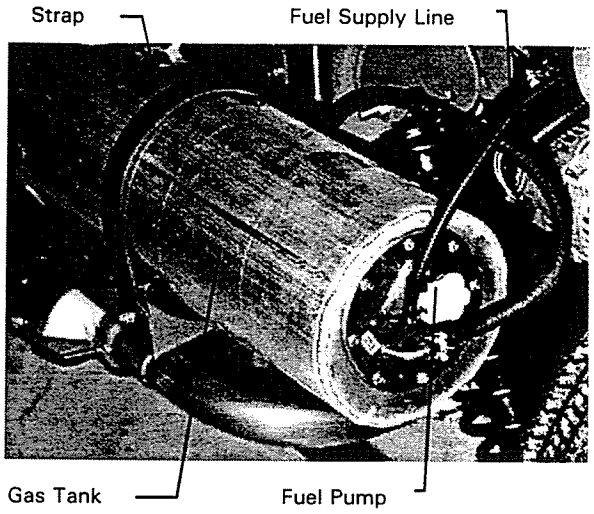
5. Remove the gas straps.

6. Remove the gas tank from vehicle.

7. Remove the fuel pump assembly access plate screws.

8. Lift the fuel pump assembly access plate and disconnect the fuel pump assembly electrical connector.

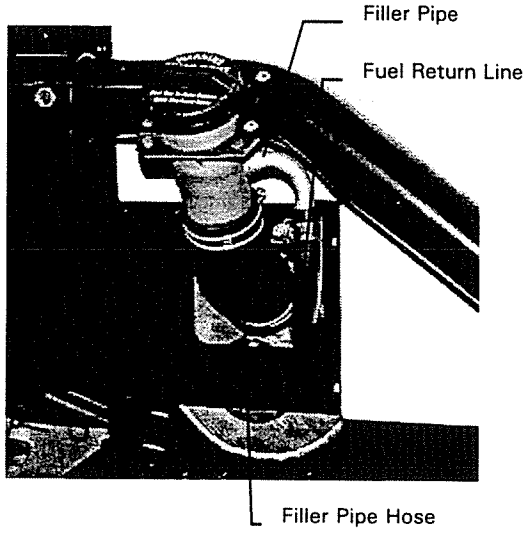
9. Disconnect the fuel supply line from the fuel level sensor.



10. Disconnect the fuel return line from the fuel tank.

11. Loosen the hose clamps and disconnect the fuel tank to filler pipe hose and the evaporative hoses from fuel tank.

12. Disconnect the overflow hose from the fitting on the fuel tank.



13. Squeeze the hose clamp and disconnect the vapor hose from the fuel evaporation pipe.

14. NOTE: The fuel tank bolts are coated with a special thread-lock material. Therefore,

the fuel tank bolts must be replaced, with new bolts whenever removed.

15. Remove the four fuel tank bolts and discard.

16. Move the fuel tank toward the left and remove it from under the vehicle.

Installation

1. Slide the fuel tank into position from the left hand side of the vehicle.

2. Install the four new fuel tank bolts. Tighten the four fuel tank bolts to 20-25 ft-lbs (26-34 N-m).

3. Connect the vapor hose to the fuel evaporation pipe.

4. Connect the evaporative emission hoses to the fittings on the fuel tank.

5. Connect the overflow hose to the fitting on the fuel tank.

6. Connect the fuel tank to filler pipe hose to the fitting on the fuel tank.

7. Connect the fuel return line to the fitting on the top. of the fuel tank.

8. Connect the fuel supply line to the fitting on the fuel level sensor.

9. Add fuel to the fuel tank.

10. Perform a visual inspection for leaks and repair as necessary.

11. Connect the battery ground cable.

12. Start the engine, visually inspect for leaks at all locations, and repair leaks as necessary.

13. Connect the fuel pump assembly electrical connector.

14. Install the fuel pump assembly access plate screws.

15. Install the lower trunk assembly into position and secure to the door slide rails using four bolts, lockwashers and nuts.

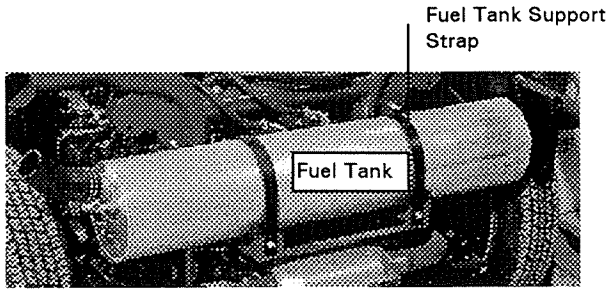
16. Install the cargo box into position over the engine compartment and secure to lower trunk assembly using the retainer and wing nut.

Fuel Tank Support Straps

WARNING: DO NOT SMOKE OR CARRY LIT TOBACCO OR AN OPEN FLAME OF ANY TYPE WHEN WORKING ON OR NEAR ANY FUEL-RELATED COMPONENT. HIGHLY FLAMMABLE MIXTURES ARE ALWAYS PRESENT AND MAY BE IGNITED, RESULTING IN PERSONAL INJURY.

Fuel tank support straps may be removed and/or replaced without removing the fuel tank if the fuel tank support straps are removed and installed one at a time and the fuel tank is supported throughout the procedure.

Remove the two fuel tank support strap bolts and the fuel tank support straps. Unhinge the fuel tank support strap ends and remove the fuel tank support straps from the vehicle.



Installation

Install each fuel tank support strap end into the slot above the fuel tank. Secure the opposite end of each fuel tank support strap with the fuel tank support strap bolts.

Tighten the fuel tank support strap bolts to 33-44 lb-ft (44-60 N-m).

Fuel Tank Filler Pipe

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Removal

1. Remove the fuel tank filler cap.

2. Remove the two gas spout supports.

3. Remove the rear cargo box from vehicle.

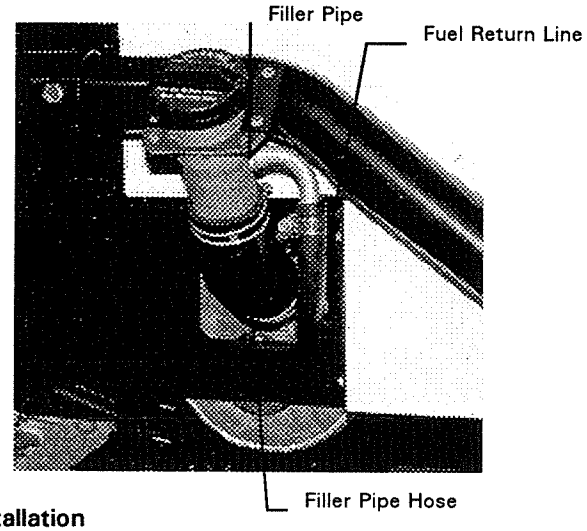
4. Loosen the two hose clamps; one at the fuel tank filler pipe and one at the fuel tank. Separate the filler hose from the fuel tank.

5. Disconnect the overflow hose at the overflow tube.

6. Remove the fuel tank filler pipe from the vehicle, by pulling it out of the filler opening.

7. Remove the routing strap securing the evaporative emission hoses to the overflow tube.

8. Remove the fuel tank filler from the vehicle by pulling it out of the filler opening.



Installation

1. Position the fuel tank filler pipe through the opening in the rear passenger compartment up to the fuel filler door opening.

2. Install the fuel tank filler cap and the two fuel tank filler pipe screws.

3. Install screw and the ground strap wire.

4. Connect the overflow tube to the overflow hose and tighten the hose clamp.

5. Secure the three evaporative emission hoses to the overflow tube with the routing strap.

6. Install the fuel tank to filler pipe hose to the fuel tank filler pipe and tighten the hose clamp.

7. Install the lower trunk assembly onto the frame of the vehicle. Make sure the lower trunk assembly is between the door slides.

8. Secure the lower trunk assembly to the door slides with four bolts, lock-washers and nuts. Tighten bolts to 30 lb-ft (40 N-m).

Fuel Tank to Filler Pipe Hose

Removal

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1. Relieve the fuel system pressure. Refer to the procedure in this section.

2. Drain the fuel from the fuel tank until it is half full. Refer to the procedure in this section.

3. Loosen the hose clamp and remove the fuel tank to filler pipe hose from the fuel tank filler pipe.

4. Loosen the hose clamp and remove the fuel tank to filler pipe hose from the fuel tank and remove the fuel tank to filler pipe hose from the vehicle.

Installation

To install, reverse the removal procedure.

Fuel Filter(s)

In-Tank

Removal

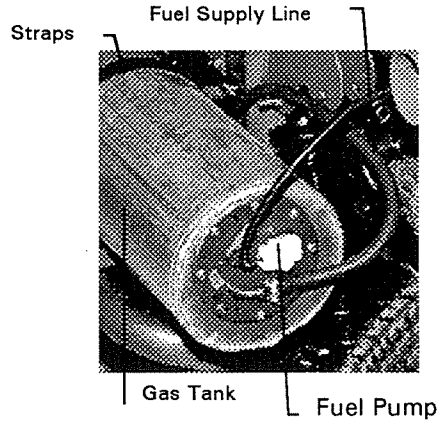
WARNING: DO NOT SMOKE OR CARRY LIT TOBACCO OR AN OPEN FLAME OF ANY TYPE WHEN WORKING ON OR NEAR ANY FUEL-RATED COMPONENT. HIGHLY FLAMMABLE MIXTURES ARE ALWAYS PRESENT AND MAY BE IGNITED, RESULTING IN PERSONAL INJURY.

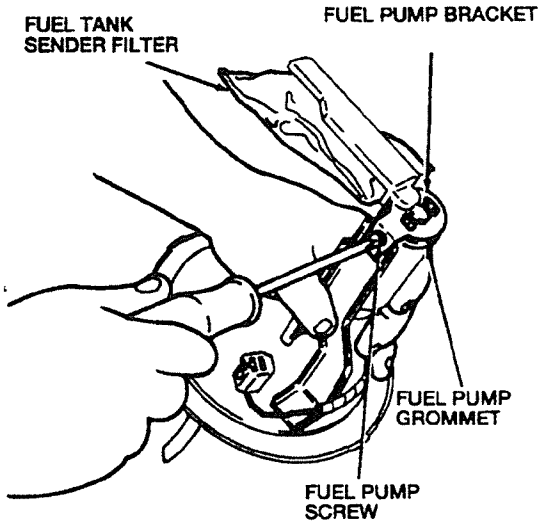
1. Remove the cargo box and lower trunk assembly from the vehicle. Refer to the

removal and installation procedure found earlier in this section.

2. Remove the fuel pump. Refer to the procedure in this section.

3. Pull the fuel tank sender filter from the end of the fuel pickup tube.





Installation

To install, reverse the removal procedure.

In-Line

Removal

WARNING: DO NOT SMOKE OR CARRY LIT TOBACCO OR AN OPEN FLAME OF ANY TYPE WHEN WORKING ON OR NEAR ANY FUEL-RELATED COMPONENT. HIGHLY FLAMMABLE MIXTURES ARE ALWAYS PRESENT AND MAY BE IGNITED, RESULTING IN PERSONAL INJURY.

1. Remove the cargo box from the lower trunk assembly.

2. Relieve the fuel pressure as follows:

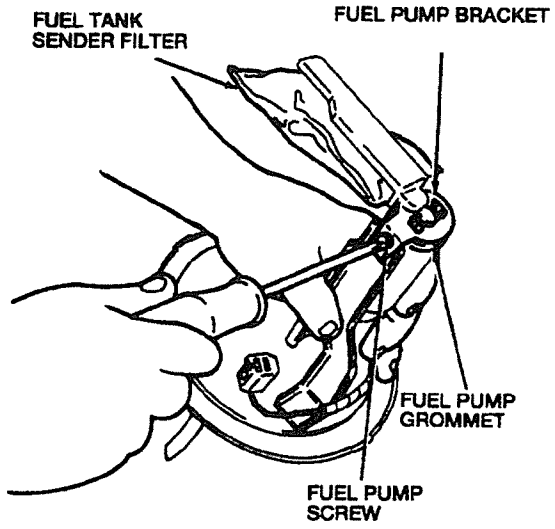
   - Start the engine.
   - Disconnect the fuel pump relay electrical connector.
   - After the engine stalls, turn the ignition to the off position.
   - Connect the fuel pump relay electrical connector.

3. Loosen the clamp and disconnect the fuel supply line at the fuel filter inlet fitting. Plug the end to prevent spillage and contamination.

4. Loosen the clamp and disconnect the fuel return line at the fuel filter outlet fitting.

5. Remove the two fuel filter bracket nuts and the fuel filter bracket bolt.

6. Remove the fuel filter from the fuel filter bracket.



Installation

1. Install the fuel filter to the fuel filter bracket.
2. Connect the fuel return line to the fuel filter outlet fitting.
3. Install the fuel filter bracket bolt and the two fuel filter bracket nuts. Tighten the fuel filter bracket bolt to 71-97 lb-in (8-11 N-m).
4. Connect the fuel supply line to the fuel filter inlet fitting and install the clamp.
5. Connect the fuel pump electrical connector.
6. Install the cargo box onto the slides and slide into place. Install fastener and bracket to secure cargo box to frame.
7. Start the engine and check for leaks.

Sender, Fuel Level

Removal

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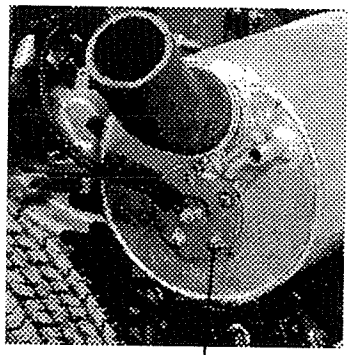
1. Relieve the fuel system pressure. Refer to the procedure in this section.
2. Open the cargo box lid by unlocking the rear latch.
3. Unscrew the fastener and remove bracket which holds the cargo box to the frame.
4. You and another person lift the cargo box slightly, and slide the cargo box back and remove from the vehicle.
5. Remove four bolts which hold the lower trunk assembly to the door slides.
6. Remove the lower trunk assembly from the vehicle frame.
7. Disconnect the electrical connector for the rear signal lights, side markers and tail lights.
8. Disconnect the fuel level sender electrical connector.
9. Remove the five screws and lift the fuel sender assembly from the fuel tank.
10. Remove the two fuel level sender washers and fuel level sender nuts in the fuel level sender.



Fuel Level Sender

11. Position the fuel level sender on the fuel pump assembly housing and install the five fuel level sender washers and nuts.
12. Connect the fuel level sender electrical connector.
13. Place the fuel lever sender assembly into the fuel tank opening and install the five screws.
14. Connect the fuel pump assembly electrical connector.

15. Install the lower trunk assembly to the vehicle frame and secure it to the door slide rails. Use four bolts, lock-washers and nuts.

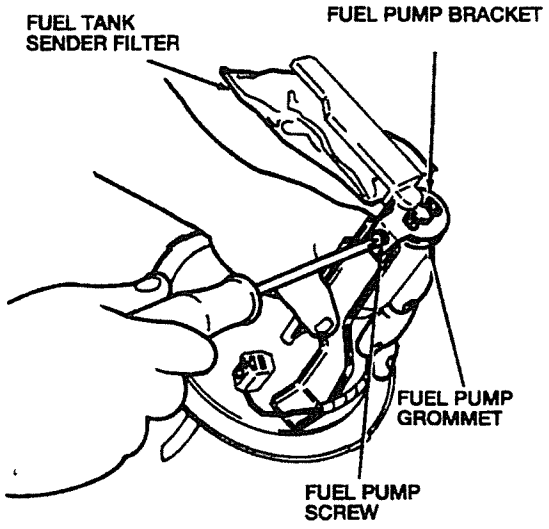
16. Slide the cargo box into position. Attach the cargo box to the frame using retainer bracket and nut.

Fuel Pump (In Tank)

Removal

1. Remove the fuel pump. Refer to the fuel filter (in tank) removal procedure in this section.

2. Remove the fuel pump screw, fuel pump grommet and the fuel pump bracket from the bottom of the fuel pump.



3. Remove the fuel tank sender filter bracket, fuel tank sender filter and the fuel tank sender filter retainer from the fuel pump.

4. Disconnect the fuel pump electrical connector.

5. Remove the clamp and the fuel pump from the fuel pump assembly housing.

Installation

To install, reverse the removal procedure.

Inertia Fuel Shutoff Switch

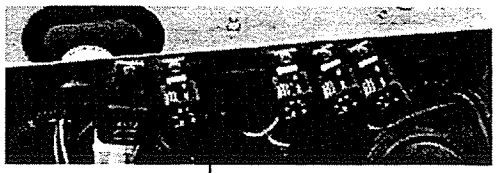
Removal

1. Remove the access cover in the cargo box.

   NOTE: If access is too difficult, slide the cargo box back and remove.

2. Disconnect the Inertia Fuel Shutoff switch electrical connector which is under the electrical component rail in the engine compartment.

3. Remove the two inertia fuel shutoff screws and the inertial fuel shutoff switch.



Inertia Fuel Shutoff Switch

Installation

To install, reverse the removal procedure.

Fuel Return System

Removal and Installation

The fuel return system is used to maintain fuel flow at the fuel charging assembly.

The fuel lines leading from the fuel tank to the engine are under pressure during vehicle operation. Fuel not used by the fuel injectors during operation is routed back to the fuel tank through a fuel return line.

The fuel return system is serviced in the same manner as the fuel lines. Refer to the procedure in this section.

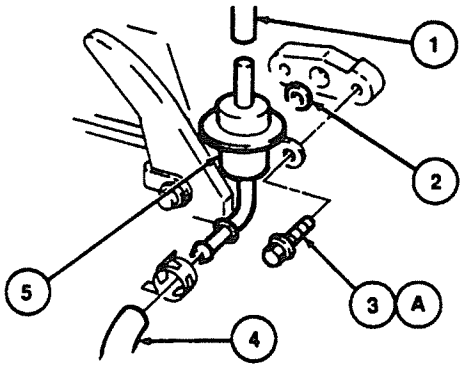
Fuel Pressure Regulator

Removal

WARNING: DO NOT SMOKE OR CARRY LIT TOBACCO OR AN OPEN FLAME OF ANY TYPE WHEN WORKING ON OR NEAR ANY FUEL-RELATED COMPONENT. HIGHLY FLAMMABLE MIXTURES ARE ALWAYS PRESENT AND MAY BE IGNITED, RESULTING IN PERSONAL INJURY.

WARNING: FUEL IN THE FUEL SYSTEM REMAINS UNDER HIGH PRESSURE EVEN WHEN THE ENGINE IS NOT RUNNING.

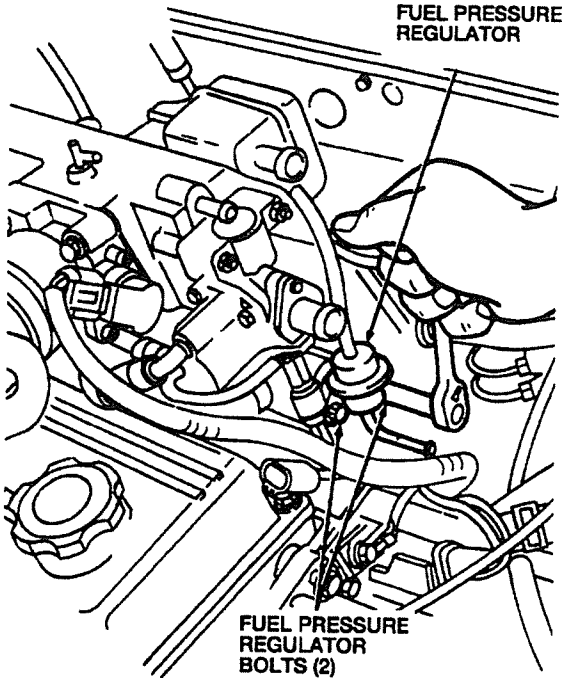
The following illustration shows the fuel pressure regulator and related components.



Item	Part Number	Description
1	-	Vacuum Supply Hose
2	-	O-Ring
3	-	Fuel Pressure Regulator Bolt
	-	(2 required)
4	-	Fuel Hose
5	-	Fuel Pressure Regulator
A		Tighten to 71-97 lb-in (8-11 N-m)

Before disconnecting any fuel line, release the fuel pressure from the fuel system to reduce the possibility of injury or fire.

1. Relieve the fuel pressure as follows:
   - Start the engine.
   - Disconnect the fuel pump relay electrical connector, located on the electrical component rail in the engine compartment.
   - Wait until the vehicle stalls.
   - Connect the fuel pump relay electrical connector.
2. Disconnect the vacuum supply hose from the top of the fuel pressure regulator.
3. Disconnect and plug the fuel line.
4. Remove the two fuel pressure regulator bolts.



5. Remove the fuel pressure regulator.
6. Remove the O-ring from the fuel pressure regulator. Discard the O-ring.

Installation

To install, reverse the removal procedure.

Install a new O-ring and then tighten the fuel pressure regulator bolts to 71-97 lb-in (8-11 N-m).

CLEANING AND INSPECTION

Fuel Tanks

WARNING: FUEL SUPPLY TUBES ON VEHICLES EQUIPPED WITH FUEL INJECTED ENGINES WILL REMAIN PRESSURIZED FOR LONG PERIODS OF TIME AFTER ENGINE SHUTDOWN. THE PRESSURE MUST BE RELIEVED BEFORE SERVICING THE FUEL SYSTEM. REFER TO FUEL SYSTEM PRESSURE RELIEF IN THIS SECTION.

CAUTION: Remove the fuel pump and the fuel level sensor prior to steaming the fuel tank.

The fuel tank does not require special service procedures and may be steam-cleaned and/or serviced using standard procedures.

After steaming, allow the fuel tank to thoroughly air dry. The fuel vapor valve should be replaced. Install the fuel tank.

SERVICE PROCEDURES

Fuel System Pressure Relief

WARNING: FUEL SUPPLY TUBES WILL REMAIN PRESSURIZED FOR LONG PERIODS OF TIME AFTER ENGINE SHUTDOWN. THIS PRESSURE MUST BE RELIEVED BEFORE SERVICING THE FUEL SYSTEM.

1. Start the engine.
2. Disconnect the fuel pump relay electrical connector located on the electrical component rail in the engine compartment.
3. After the engine stalls, turn the ignition switch to the off position. The fuel pressure is now relieved.
4. Connect the fuel pump relay electrical connector.

Fuel System - Pressurized

WARNING: FUEL SUPPLY LINES ON VEHICLES EQUIPPED WITH FUEL INJECTED ENGINES WILL REMAIN PRESSURIZED FOR LONG PERIODS OF TIME AFTER ENGINE SHUTDOWN. THE PRESSURE MUST BE RELIEVED BEFORE SERVICING THE FUEL SYSTEM. REFER TO FUEL SYSTEM PRESSURE RELIEF IN THIS SECTION.

Electronic Fuel Injection systems are equipped with a fuel pump that provides fuel to the engine at higher pressure than conventional fuel systems. A fuel return system is also provided. All fuel hose/ tube connections are made with hose clamps, and all hoses are serviced as assemblies.

All replacement hoses must be serviced as assemblies. Bulk fuel hose must not be used to service tubing in high pressure fuel systems.

Fuel Lines and Return Lines

WARNING: FUEL SUPPLY LINES WILL REMAIN PRESSURIZED FOR LONG PERIODS OF TIME AFTER ENGINE IS SHUTDOWN. THIS PRESSURE MUST BE RELIEVED BEFORE SERVICING OF THE FUEL SYSTEM IS BEGUN.

CAUTION: The use of copper tubing is not recommended due to fuel contamination.

Removal

1. Relieve fuel system pressure. Refer to the procedure in this section.
2. Drain the fuel from the fuel tank. Refer to the procedure in this section.
3. Disconnect the line(s) at the fuel tank and at the engine. Remove all damaged hoses.

Installation

1. Cut a new section of hose approximately the same length as the section to be replaced.
2. Square the ends of the cut hose. Remove ragged ends and threads. Blow out any particles with compressed air.
3. Connect the fuel line hose and secure each end to metal tube end with a hose clip.
4. Fill the fuel tank and check for leaks.

ADJUSTMENTS

Accelerator Cable

Free Play

1. Adjust the idle speed to specification. Refer to Section 11-Engine for the removal procedure.
2. Measure the free play at the accelerator pedal and shaft.
3. Free play should be 0.04-0.12 inch (1-3mm). If necessary, loosen the locknut and adjust at the accelerator cable bracket, located near the throttle body.
4. Tighten the locknut after proper free play is achieved.
5. Adjust the wide open throttle position. Refer to the wide open throttle position adjustment procedure in this section.

Deflection

1. Slide the boot down to expose the accelerator cable.
2. Measure the accelerator cable deflection. The deflection should be 0.04-0.12 inch (1-3mm).
3. If necessary, loosen the locknuts and adjust the accelerator cable tension. Tighten the locknuts after the proper deflection is achieved.
4. Slide the boot up over the accelerator cable.
5. Adjust the wide open throttle position. Refer to the wide open throttle position adjustment procedure in this section.

Wide Open Throttle Position

1. Adjust the accelerator cable deflection. Refer to the accelerator cable deflection adjustment procedure in this section.
2. Depress the accelerator pedal to the floor.
3. Confirm that the throttle plate is in the wide open position in the throttle body.

SPECIFICATIONS

Fuel System Specifications	
Fuel Capacity	7.0 US gals., 26.5 liters

Fuel Pressure	
Fuel Pressure Regulator	30-38 psi., 210-260 kPa.

TORQUE SPECIFICATIONS

Description	Lb-ft	Lb-in	N-m
Fuel Tank Strap Support Bolts	33-44		44-60
Fuel Pressure Regulator Bolts		71-97	8-11
Accelerator Mount Bolts	20-22		30

SERVICE TOOLS/EQUIPMENT

- Fuel Storage Tanker
- Fuel Tanker Adapter Hose

SECTION 13-01 Fuel Charging and Controls

DESCRIPTION AND OPERATION

Fuel System

The Sequential Multiport Fuel Injection (SFI) system is classified as a multi-point, pulse fuel injection system. This system supplies the engine with the air/fuel mixture necessary for combustion. An air induction system and fuel injection system work with an electronic engine control system which consists of various sensors, switches, and a Powertrain Control Module (PCM). All sensors and switches are connected to the PCM, which interprets the data it receives and computes when and for what period of time the electrically-operated fuel injectors are energized.

The PCM accepts inputs from various engine sensors to compute the required fuel flow rate necessary to maintain a prescribed air/fuel ratio throughout the entire engine operational range. The PCM then outputs a signal to the fuel injectors to meter the fuel. The system automatically senses fuel quantity requirements. It increases, decreases, or cuts off fuel delivery to the fuel injector based on engine demands and driving conditions.

The fuel delivery sub-system consists of:

- High-pressure electric fuel pump
- Fuel injection supply manifold with fuel pressure regulator
- Fuel injectors
- Fuel pump relay
- Fuel tank
- Inertia fuel shutoff switch (IFS switch) (IFS)

When the ignition is ON, the Powertrain Control Module Relay (PCM relay) turns on, providing power to the PCM, fuel pump relay, and the fuel injectors. Power to the fuel pump is supplied through the fuel pump relay. The Inertia Fuel Shutoff Switch (IFS) is a safety device used to shut off the fuel pump in the event of a collision. The IFS switch is connected between the fuel pump and the fuel pump relay. If the IFS switch is "tripped", it must be reset by depressing the red button on top of the switch. During engine cranking, the fuel pump circuit is completed by the PCM closing the contacts in the fuel pump relay, energizing the fuel pump.

The basic fuel requirement of the engine is determined from the data supplied to the PCM by the Mass Air Flow Sensor (MAF sensor). The MAF sensor measures the amount of air being drawn into the engine. Other sensors and switches are used to measure:

- Air temperature
- Atmospheric pressure

- Coolant temperature
- Engine speed
- Exhaust oxygen content

The various sensors and switches detect any changes in operating conditions and send signals to the PCM. This controls the opening duration (pulse width) of the fuel injectors in order to maintain optimum exhaust emission control and engine performance for all operating conditions.

The fuel system supplies filtered, pressurized fuel to each fuel injector. The system consists of:

- Fuel pump
- Fuel filter
- Fuel injection supply manifold
- Fuel pressure regulator
- Fuel injectors

An electric fuel pump is mounted in the fuel tank and supplies filtered, pressurized fuel to each fuel injector through the fuel injection supply manifold. Fuel is faltered by an in-line fuel filter. The fuel pressure is regulated by a fuel pressure regulator which is located at the return line side of the fuel injection supply manifold.
Fuel is metered and injected into the intake ports according to the fuel injector signals received from the PCM. When these injection signals are applied to the coil of the fuel injector, the needle valve is pulled off its seat. Fuel is then injected around the back face of the intake valve. The amount of fuel supplied to the engine depends on the length of time that the fuel injectors stay open.

Fuel Injection Timing

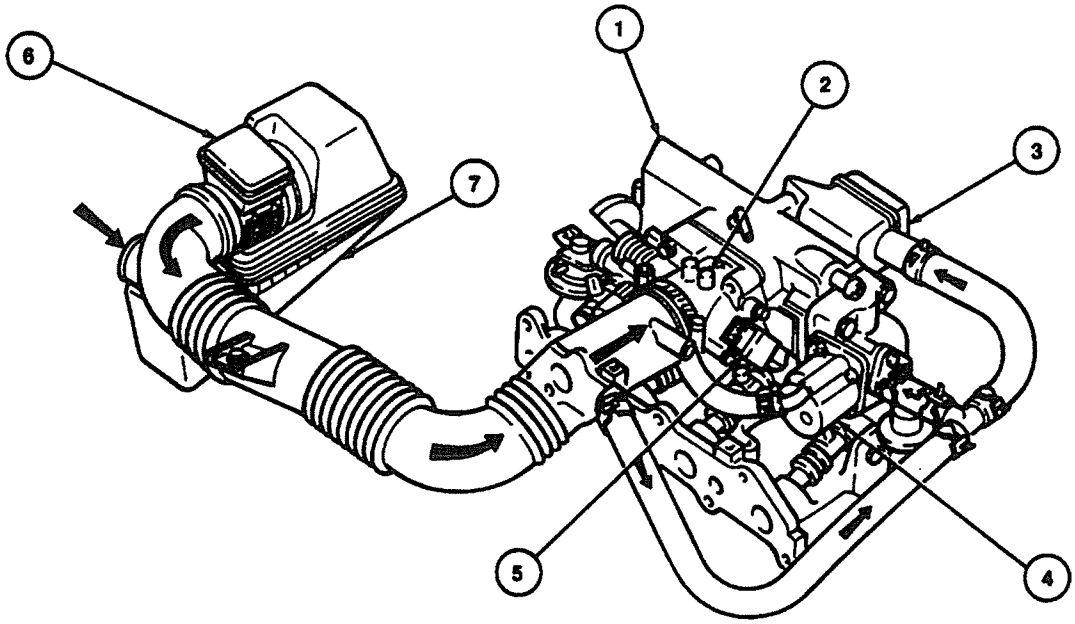
Between idle and 6,500 rpm, fuel is supplied by independently, providing one injection per two crankshaft rotations (one injection per cycle) to all cylinders. When engine speed reaches 6,500 rpm, fuel injection is shut off in order to prevent the engine from over-speeding.

Air induction System

The air induction system supplies filtered air to the engine to mix with the fuel for combustion purposes. It consists of:

- Engine air cleaner (ACL) assembly
- Engine air intake resonator
- Mass Air Flow Sensor (MAF sensor)
- Throttle body
- Upper intake manifold
- Idle Air Control Bypass Air (IAC BPA) valve

Air Induction System



Item	Part Number	Description
1	-	Intake Manifold, Upper
2	-	Throttle Body
3	-	Engine Air Intake Resonator
4	-	Idle Air Control Bypass Air (IAC BPA) Valve
5	-	Throttle Position (TP) Sensor
6	133348	Mass Air Flow Sensor
7	134037	Air Cleaner Element

(Continued)

Throttle Body

The throttle body controls air flow to the engine. The throttle position is controlled by an accelerator cable and a throttle control lever. The throttle body is a single-piece die casting made of aluminum. The throttle body is fitted with an idle switch and Throttle Position Sensor (TP sensor). The idle switch sends a signal to the Powertrain Control Module (PCM) informing the PCM of the vehicle idle conditions. The TP sensor sends a varying signal to the PCM. The PCM uses the signal to measure throttle valve angle and adjust the air/fuel mixture.

Intake Manifold

The intake manifold is a two-piece (upper and lower intake manifold) aluminum casting. Runner lengths are tuned to optimize engine torque and power output. Vacuum taps are provided to support various engine accessories.

Upper

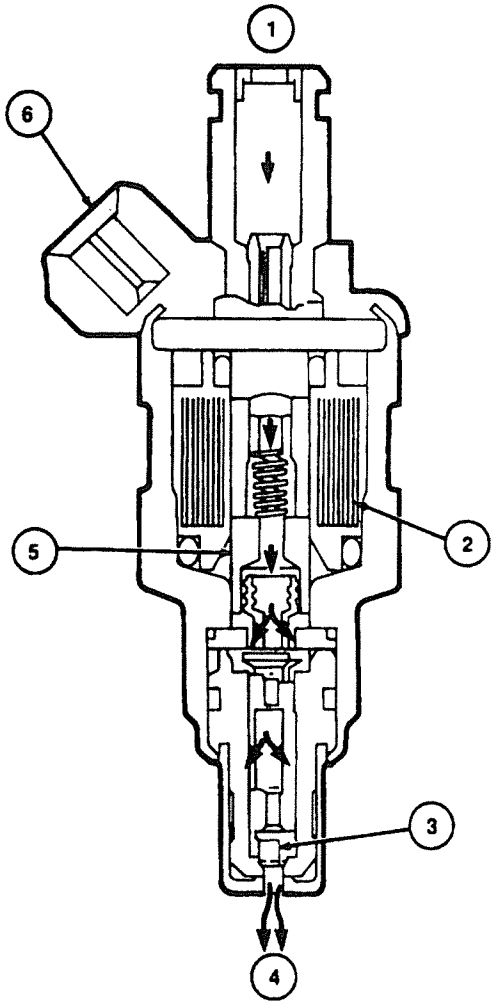
The upper intake manifold provides mounting flanges for the throttle body and Idle Air Control Bypass Air (IAC BPA) valve.

Lower

The lower intake manifold provides mounting flanges for the fuel injection supply manifold, fuel injector, and the Exhaust Gas Recirculation (EGR) valve. The Engine Coolant Temperature (ECT) sensor is threaded into the right-hand side of the lower intake manifold.

Fuel Injectors

The fuel injectors are electromechanical devices which both meter and atomize fuel delivered to the engine. The fuel injectors are mounted in the lower intake manifold and positioned so that their tips are directing fuel at the back face of the intake valve. The body is a solenoid-actuated valve assembly. Therefore, fuel flow to the engine is regulated by how long the solenoid is energized. An electrical signal from the Powertrain Control Module (PCM) activates the solenoid, causing the needle valve to move inward off the seat, allowing the fuel to flow through the orifice. Atomization of the fuel is obtained by a director/metering plate where the fuel leaves the fuel injector.



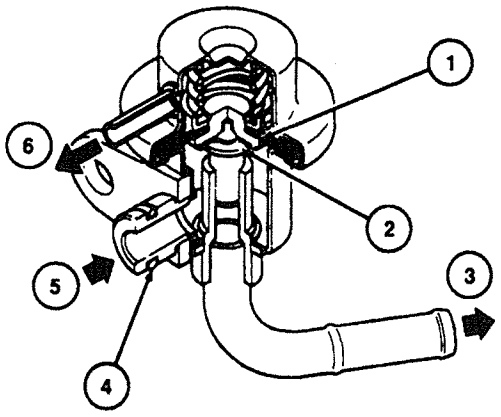
Item	Part Number	Description
1	-	Fuel Injection Supply Manifold
2	-	Coil
3	-	Needle Valve
4	-	Injection
5	-	Armature
6	-	Electrical Connector

Fuel Injection Supply Manifold

The fuel injection supply manifold delivers high-pressure fuel from the fuel supply line to the fuel injectors. The fuel injection supply manifold consists of a tubular rail, fuel injector connectors, a mounting flange for the fuel pressure regulator, and mounting attachments which hold the fuel injection supply manifold and fuel injector.

Fuel Pressure Regulator

The fuel pressure regulator is attached to the fuel injection supply manifold downstream of the fuel injectors. The fuel pressure regulator is a diaphragm-operated relief valve in which one side of the diaphragm senses fuel pressure and the other side is subjected to intake manifold vacuum. The nominal fuel pressure is established by a spring preload applied to the diaphragm. Balancing one side of the diaphragm with manifold pressure maintains a constant fuel pressure across the fuel injectors. Fuel not used by the engine is bypassed through the fuel pressure regulator and returned to the fuel tank.



Item	Part Number	Description
1	-	Diaphragm
2	-	Valve
3	-	To Fuel Tank (Return)
4	-	O-Ring Seal
5	-	Fuel Injection Supply Manifold
6	-	Intake Manifold Vacuum

Fuel Charging Wiring

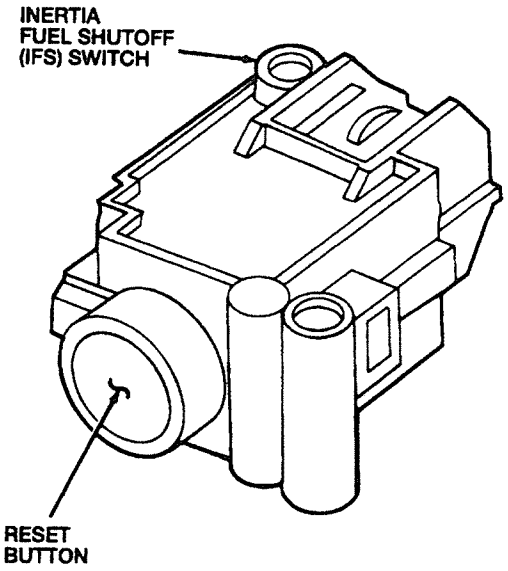
The fuel charging wiring connects the engine wiring harness to each fuel injector and other electronic engine controls, such as the Throttle Position (TP) sensor and Idle Air Control Bypass Air (IAC BPA) valve. The fuel charging wiring sends fuel injector signals from the Powertrain Control Module (PCM) to the fuel injectors. The signals from the PCM determine the fuel injection sequence, and how long each fuel injector will stay open, allowing fuel into the combustion chambers.

Inertia Fuel Shutoff (IFS) Switch

In the event of a collision, the electric contacts in the IFS switch open. With the IFS switch open, the fuel delivery circuit is opened, disabling the fuel system. The engine may continue to run for several seconds after the IFS switch has opened, due to fuel remaining in the fuel supply line. Once the fuel in the supply line has been used, the engine will stall.

CAUTION: Do not reset the Inertia Fuel Shutoff Switch (IFS switch) (IFS) until the entire fuel system has been inspected for leaks.

To reset the IFS switch, depress the reset button on the switch located in the center and under the electrical component rail in the engine compartment.



Fuel Pump Relay

The fuel pump relay supplies power to the fuel pump. During starting and engine running conditions, the Powertrain Control Module (PCM) closes the contacts inside the fuel pump relay, energizing the fuel pump.

A/C Compressor Clutch Control Relay

The A/C compressor clutch control relay is used to improve idle smoothness after engine start-up and to improve acceleration performance.

During engine start-up and while accelerating in automatic transaxle equipped vehicles, the Powertrain Control Module (PCM) opens the ground side of the A/C compressor clutch control relay, disengaging the A/C clutch.

Refer to the chart below for the conditions, purposes and lengths of time A/C operation is cut.

A/C COMPRESSOR CLUTCH CUT-OFF

Engine Condition	Purpose	Cut-Off Period
Engine Starting	Improve Starting	Approx. 4 sec.
Wide Open Throttle	Improve Accelerati on	Approx. 5 sec.
Acceleration From Idle (ATX)	Improve Accelerati on	Approx. 2 sec.
Coolant Temperature above 241°F (116°C)	Reduce Load	Until Coolant Temperature is Below 235°F (113°C)

DIAGNOSIS AND TESTING

Fuel Charging and Controls

Refer to the Powertrain Control/Emissions Diagnosis Manual for diagnosis of the fuel charging system.

REMOVAL AND INSTALLATION

Fuel Charging System

Pre-Service Procedures

The fuel charging system consists of the throttle body, and the upper and lower intake manifolds, fuel injection supply manifold, fuel pressure regulator, and fuel injectors. Prior to service or removal of the fuel charging system, the fuel pressure must be relieved.

Fuel Pressure Relief

1. Remove the fuel tank filler cap and release the fuel tank pressure.
2. **CAUTION: The fuel system is normally pressurized to between 38-46 psi (265-320 kPa).**

   Locate the fuel pump relay electrical connector located under the electrical component rail in the engine compartment.
3. Start the engine.
4. Disconnect the fuel pump relay electrical connector and wait for the engine to stall.
5. Turn the ignition switch to the OFF position. The fuel pressure is now relieved.
6. Connect the fuel pump relay electrical connector.
7. Disconnect the battery ground cable.

Post-Service Procedures

After the service is complete and the fuel charging system is installed on the engine, the following steps must be taken:

1. Install the fuel tank filler cap at the fuel tank.
2. Connect the battery ground cable.
3. If necessary, add engine coolant.
4. **CAUTION: The fuel system Is normally pressurized to between 38-46 kPa (265-320 kPa).**

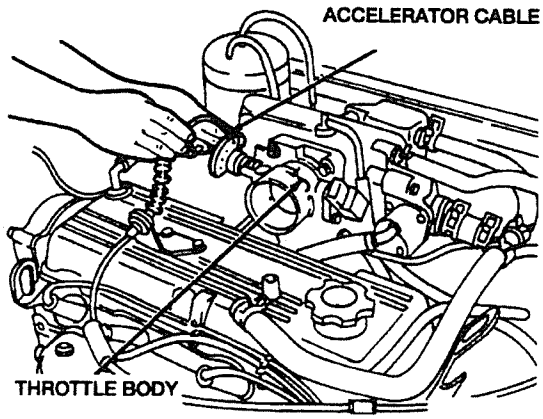
   NOTE: Check all of the connections at the fuel injection supply manifold, and fuel pressure regulator.

   Cycle the ignition switch from ACC to ON several times without starting the engine, to check for fuel leaks.
5. Start the engine and warm to operating temperature. Check for coolant leaks if coolant was removed. Refer to Section 15 for the procedure.
6. Perform the Self Test to check system function. Refer to the Section 9 - Powertrain Control/Emissions Diagnosis Manual.

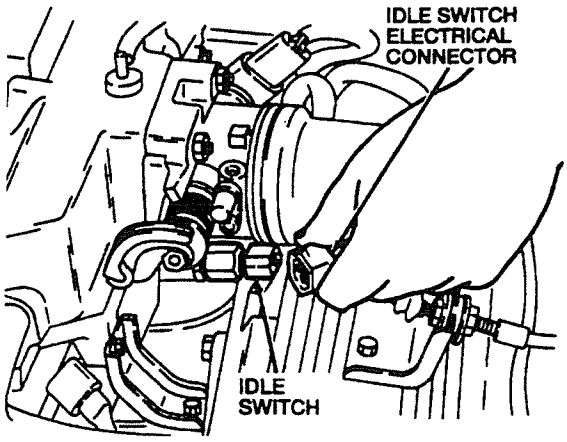
Throttle Body

Removal

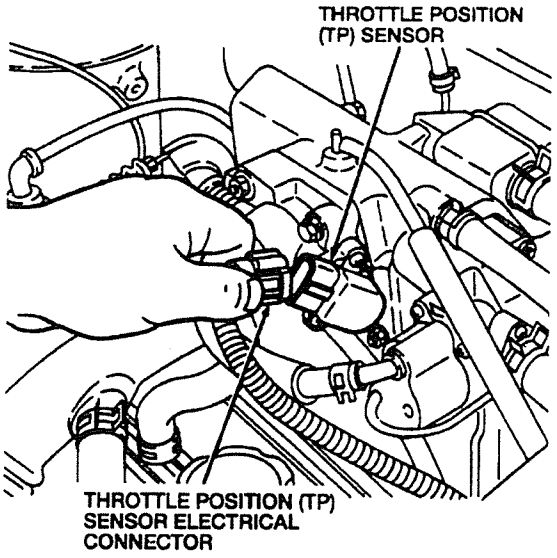
1. Disconnect the battery ground cable.
2. Drain the radiator. Refer to Section 15 for the procedure.
3. Remove the air cleaner intake tube. Refer to Section 11 for the removal procedure.
4. Disconnect the accelerator cable from the throttle lever.



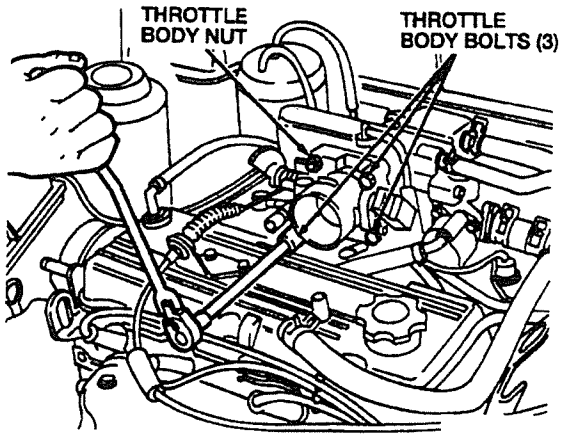
5. Disconnect the idle switch electrical connector.



6. Disconnect the Throttle Position (TP) sensor electrical connector.



7. Remove the throttle body nut and three throttle body bolts.



8. Remove the throttle body.

9. NOTE: Mark the coolant hoses prior to removal to ease installation.

   Tilt the throttle body back and disconnect the two coolant hoses.

10. Remove the throttle body and throttle body gasket (TB gasket). Discard the throttle body gasket.

Installation

To install, reverse the removal procedure. Install a new throttle body gasket.

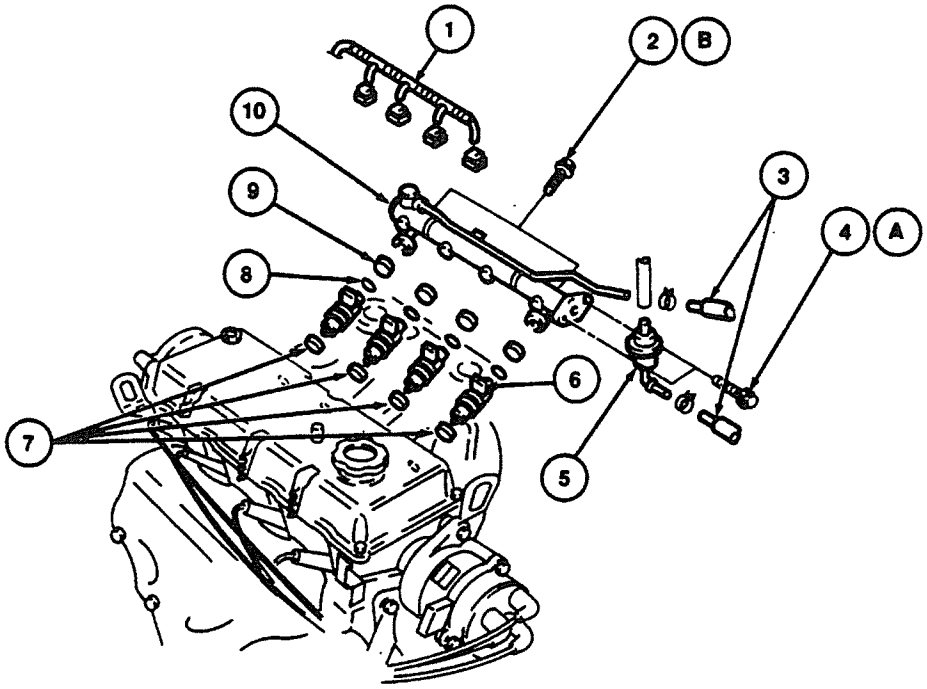
Tighten the throttle body nut and three throttle body bolts to 14-19 lb-ft (19-25 N-m).

Fuel Injector

Removal

The following illustration shows an exploded view of the fuel injectors and related components.

Fuel Injectors and Related Components - Exploded View



Item	Part Number	Description
1	-	Fuel Charging Wiring
2	-	Fuel Injection Supply
		Manifold Bolts (2 Req'd)
3	-	Fuel Tube Hoses
4	-	Fuel Pressure Regulator
		Bolts (2 Req'd)
5	-	Fuel Pressure Regulator
6	-	Fuel Injectors

Item	Part Number	Description
7	-	Fuel Injector O-Rings
8	-	O-Rings
9	-	Fuel Injector Insulators
10	-	Fuel Injection Supply Manifold
A	-	Tighten to 71-97 lb-in (8-11 N-m)
B	-	Tighten to 14-17 lb-ft (19-23 N-m)

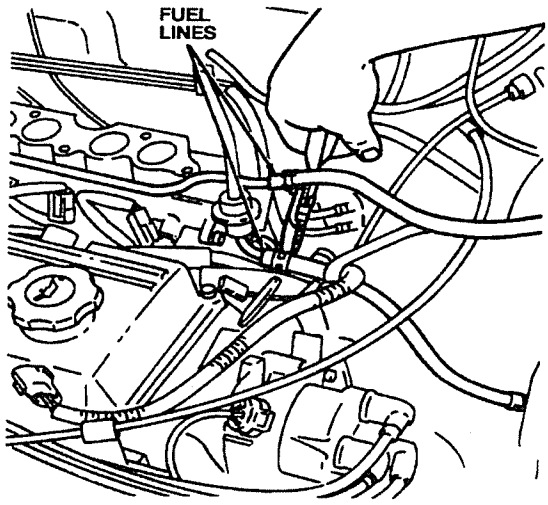
Before disconnecting any fuel line, release the fuel pressure from the fuel system to reduce the possibility of injury or fire.

1. **WARNING: FUEL IN THE FUEL SYSTEM REMAINS UNDER HIGH PRESSURE EVEN WHEN THE ENGINE IS NOT RUNNING.**

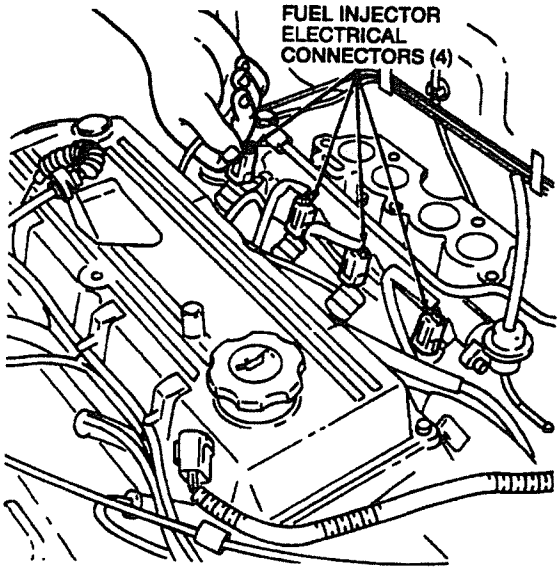
   Relieve the fuel pressure. Refer to the procedure in this section.

2. Remove the upper intake manifold. Refer to Section 11 for the removal procedure.

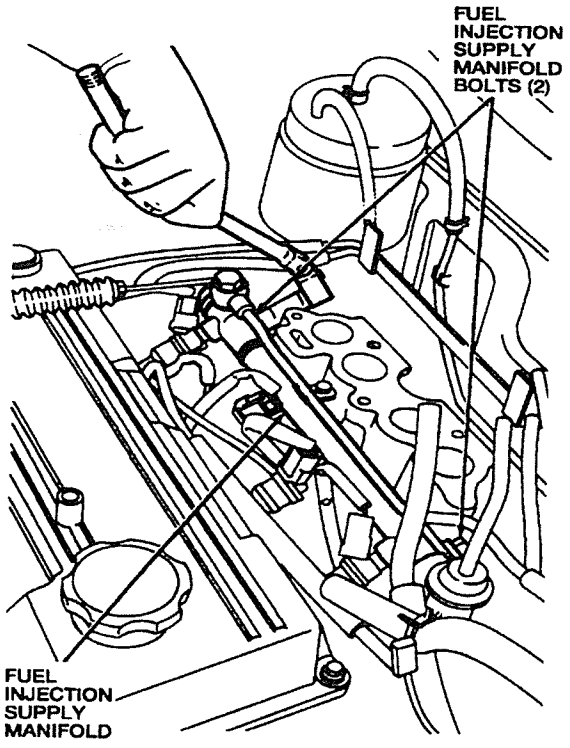
3. Disconnect and plug the fuel lines.



4. Disconnect the four fuel injector electrical connectors.

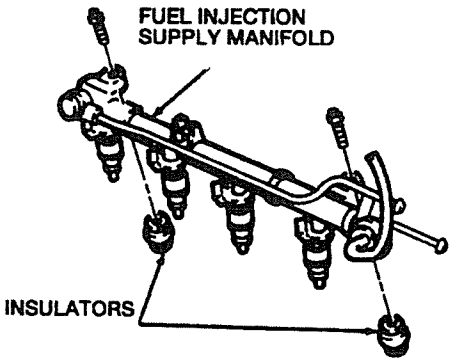


5. Remove the two fuel injection supply manifold bolts.

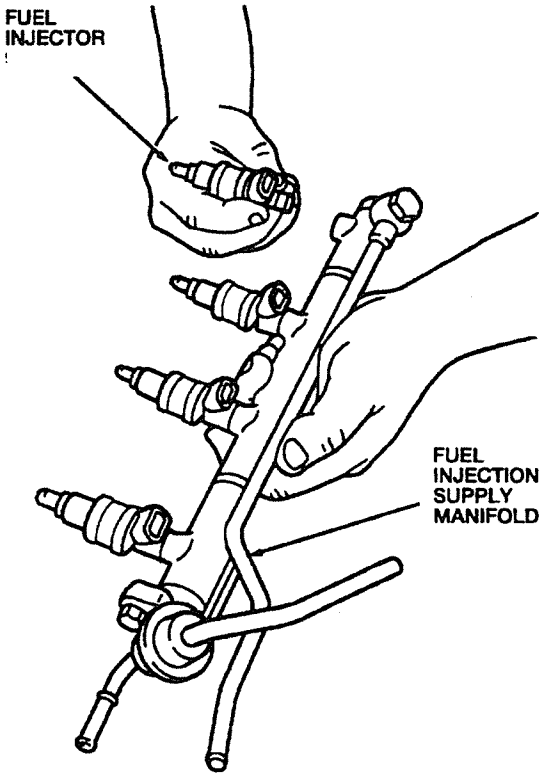


6. NOTE: Ensure that while removing the fuel injection supply manifold the insulators do not get lost.

Remove the fuel injection supply manifold and insulators.



7. Remove the fuel injector from the fuel injection supply manifold.



8. Remove and discard the fuel injector insulators and O-rings from the fuel injectors.

Installation

To install, reverse the removal procedure.

Install new fuel injector O-rings and insulators on the fuel injectors.

Tighten the two fuel injection supply manifold bolts to 14-17 lb-ft (19-23 N-m).

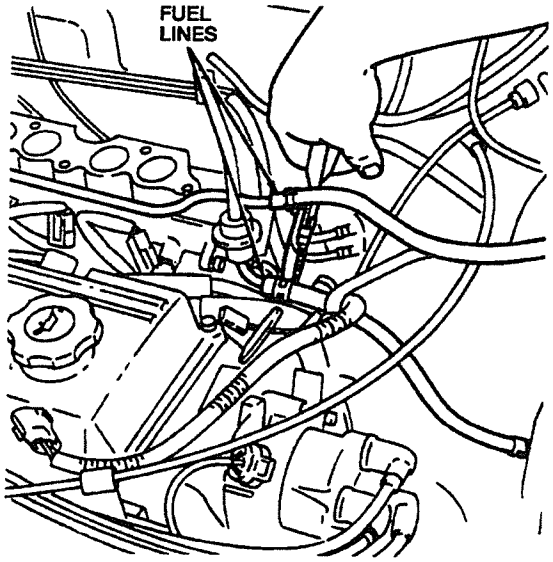
Fuel Injection Supply Manifold

Removal

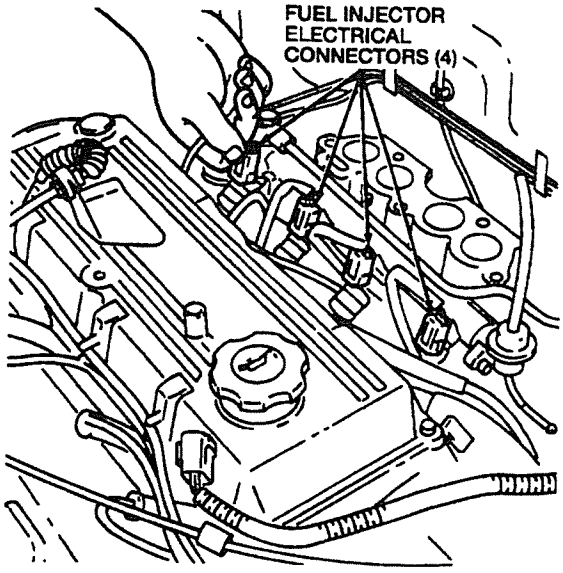
WARNING: FUEL IN THE FUEL SYSTEM REMAINS UNDER HIGH PRESSURE EVEN WHEN THE ENGINE IS NOT RUNNING.

Before disconnecting any fuel line, release the fuel pressure from the fuel system to reduce the possibility of injury or fire.

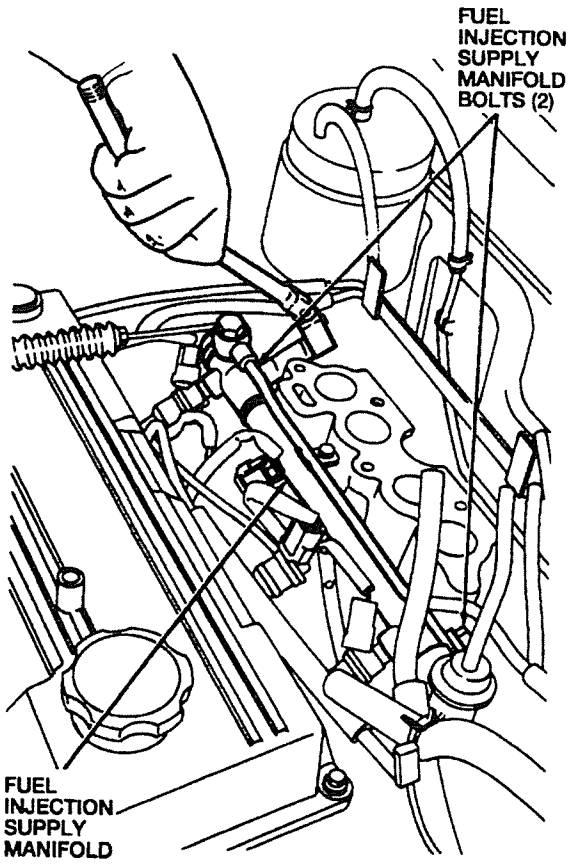
1. Relieve the fuel pressure. Refer to the procedure in this section.
2. Remove the upper intake manifold. Refer to Section 11 for the removal procedure.
3. Disconnect and plug the fuel lines.



4. Disconnect the fuel injector electrical connectors.

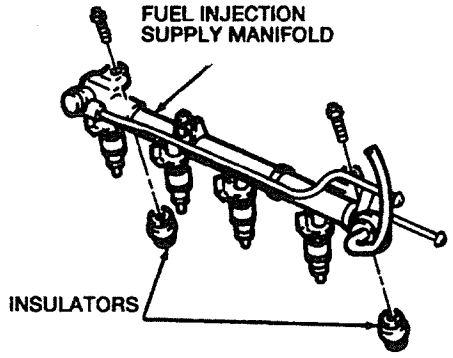


5. Remove the two fuel injection supply manifold bolts.



6. NOTE: Ensure that while removing the fuel injection supply manifold the insulators do not get lost.

   Remove the fuel injection supply manifold and insulators.



Installation

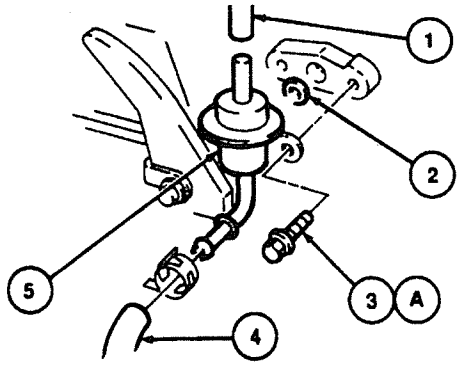
To install, reverse the removal procedure.

Tighten the two fuel injection supply manifold bolts to 14-17 lb-ft (19-23 N-m).

Fuel Pressure Regulator

Removal

The following illustration shows the fuel pressure regulator and related components.

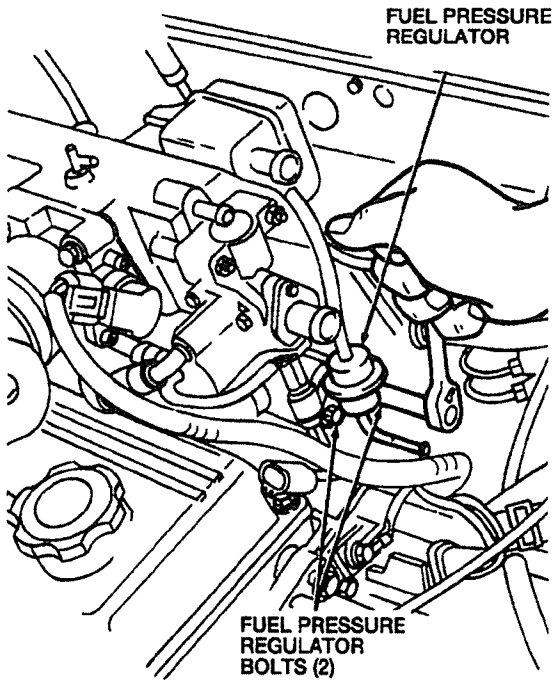


Item	Part Number	Description
1	-	Vacuum Supply Hose
2	-	O-Ring Seal
3	-	Fuel Pressure Regulator Bolt (2 required)
4	-	Fuel Hose
5	-	Fuel Pressure Regulator
A	-	Tighten to 71-97 N-m (8-11 N-m)

WARNING: FUEL IN THE FUEL SYSTEM REMAINS UNDER HIGH PRESSURE EVEN WHEN THE ENGINE IS NOT RUNNING.

Before disconnecting any fuel line, release the fuel pressure from the fuel system to reduce the possibility of injury or fire.

1. Relieve the fuel pressure. Refer to the procedure in this section.
2. Disconnect the vacuum supply hose from the top of the fuel pressure regulator.
3. Disconnect and plug the fuel line.
4. Remove the two fuel pressure regulator bolts.



5. **WARNING: DO NOT SMOKE OR CARRY LIGHTED TOBACCO OR OPEN FLAME OF ANY TYPE WHEN WORKING ON OR NEAR ANY FUEL-RELATED COMPONENT. HIGHLY FLAMMABLE MIXTURES ARE ALWAYS PRESENT AND MAY BE IGNITED, RESULTING IN POSSIBLE PERSONAL INJURY.**

   Remove the fuel pressure regulator.

6. Remove the O-ring seal from the fuel pressure regulator. Discard the O-ring seal.

Installation

To install, reverse the removal procedure. Install a new 0-ring seal.

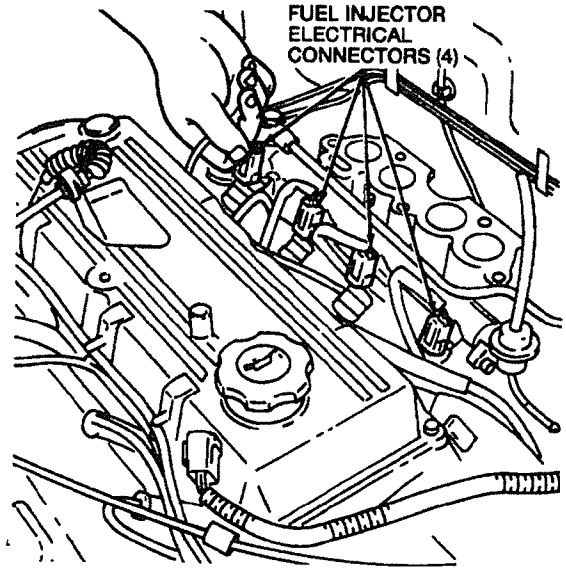
Tighten the fuel pressure regulator bolts to 71-97 lb-in (8-11N-m).

Fuel Charging Wiring

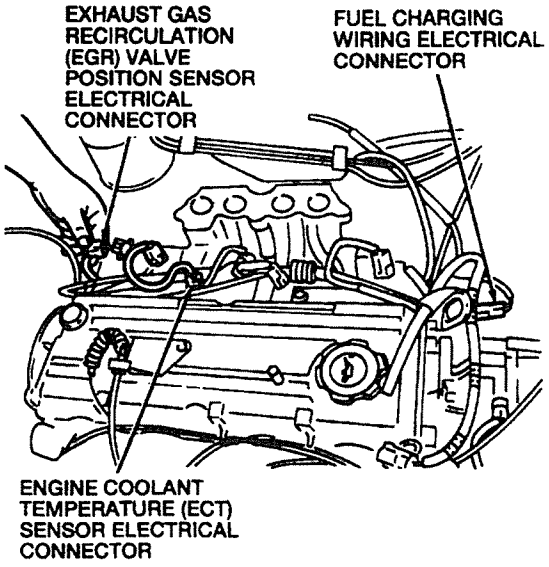
Removal

1. Remove the upper intake manifold. Refer to Section 11 for the removal procedure.

2. Disconnect the fuel injector electrical connectors.



3. Disconnect the Exhaust Gas Recirculation (EGR) valve position sensor electrical connector.



4. Disconnect the Engine Coolant Temperature (ECT) sensor electrical connector.

5. Disconnect the fuel charging wiring electrical connector

Installation

To install, reverse the removal procedure.

Fuel Pump Relay

Removal and Installation

Refer to Section 20 for the removal and installation procedure.

CLEANING AND INSPECTION

Throttle Body

NOTE: The throttle body for this vehicle is of a sludge resistant design and should not be cleaned.

Fuel Injector

Testing/Cleaning

Clean the fuel injectors using Fuel Injector/Tester Cleaner or equivalent. Follow the tool manufacturer's operating instructions

ADJUSTMENTS

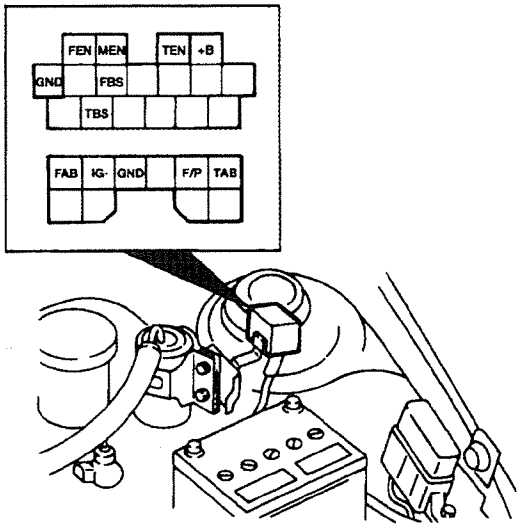
Idle Speed

Before adjusting the idle speed, ensure the ignition timing is adjusted to specification. Refer to Section 11 for the procedure.

Turn off all lamps and other electrical loads. This adjustment must be done when the cooling fan motor is not operating.

1. Connect a Digital Multimeter or equivalent with inductive pickup attached to the number one spark plug wire.

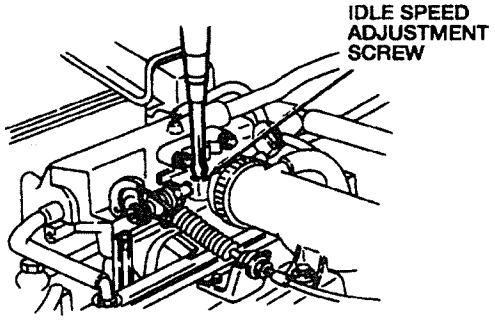
2. Ground the PCM STI (TEN) pin at the Data Link Connector (DLC).



3. Start the engine. Run the engine until it reaches the operating temperature.

4. Make a note of the idle speed.

5. Adjust the idle speed adjustment screw for the correct idle speed.



The idle speed specifications should be as 700-800 rpm (automatic transaxle in PARK [P] position)

6. Turn the engine off and allow the engine to cool.

7. Remove the ground from the PCM STI (TEN) pin at the DLC.

8. After the engine has cooled, start and run the engine until it reaches operating temperature and ensure the idle speed is to specification.

Idle Mixture

The air/fuel mixture is not adjustable due to an automatic compensation function built into the Powertrain Control Module (PCM).

SPECIFICATIONS

TORQUE SPECIFICATIONS

Description	Lb-Ft	Lb-in	N-m
Throttle Body Nut and Bolts	14-19	-	19-25
Fuel Injection Supply Manifold Bolts	14-17	-	19-23
Fuel Pressure Regulator Bolts	-	71-97	8-11

SERVICE TOOLS/EQUIPMENT

- Fuel Injector/Tester Cleaner
- Digital Multimeter

SECTION 14 - Exhaust System

DESCRIPTION AND OPERATION

Catalytic Converter

The catalytic converter mounted in the exhaust system, plays a major role in the emissions control system. The engine exhaust consists mainly of nitrogen; however, it also contains carbon monoxide, carbon dioxide, water vapor, oxygen, nitrogen oxides, and hydrogen as well as various, unburned hydrocarbons. Three of these exhaust components - carbon monoxide, nitrogen oxide, and hydrocarbon - are major air pollutants, so their emission into the atmosphere must be controlled.
The catalytic converter works as a gas reactor to convert and reduce the pollutant levels to within legally prescribed limits.

The catalyst metals are thin-coated onto and supported by a honeycomb-shaped, high-temperature ceramic, mounted inside the three-way catalytic converter shell. The result is a highly effective converter design having minimum exhaust gas flow restriction and good durability.

Precautions

WARNING: EXHAUST GASES CONTAIN CARBON MONOXIDE WHICH CAN BE HARMFUL TO HEALTH AND ARE POTENTIALLY LETHAL. EXHAUST SYSTEM LEAKS SHOULD BE REPAIRED IMMEDIATELY. NEVER OPERATE THE ENGINE IN ENCLOSED AREAS.

CAUTION: Leaded gas must not be used in a vehicle with a catalytic converter - the lead will poison the catalyst.

The following precautions must be observed when operating a vehicle equipped with a catalytic converter.

If a vehicle is continually misfueled, the lead in the fuel will be deposited in the catalytic converter and completely blanket the catalyst. Lead combines chemically with platinum to "poison" the catalyst. Continuous use of leaded fuels can totally destroy the catalyst, and render the three way catalytic converter useless. This addition of lead to the catalytic converter can also solidify the catalyst, causing excessive back pressure in the exhaust system, possibly causing engine damage.

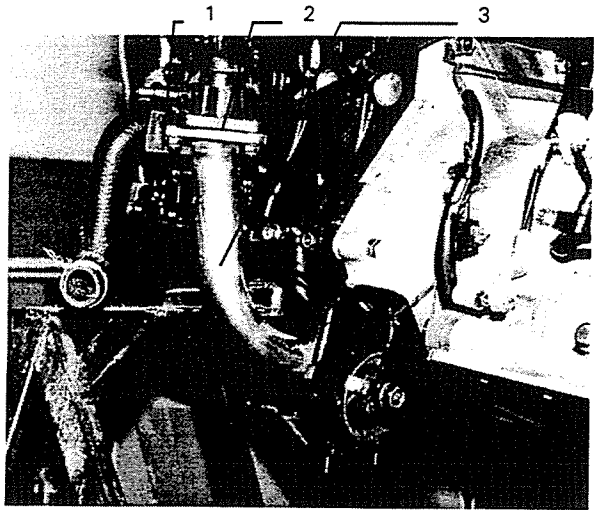
Extremely high temperatures of 2012F (1100C) or above, due to misfiring of over-rich fuel/air mixtures will cause the ceramic base to sinter or burn, destroying the catalytic converter.

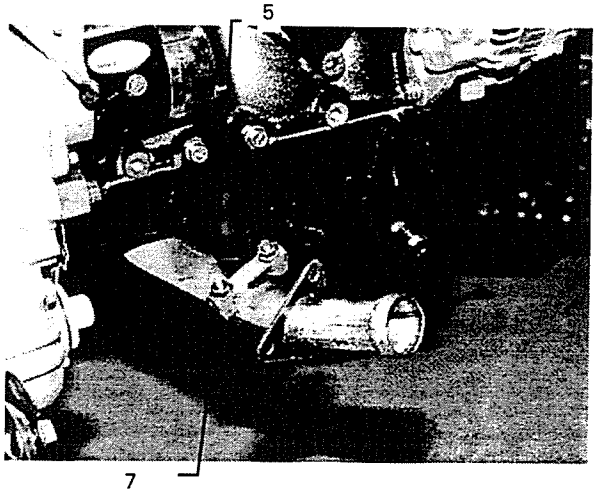
- The catalytic converter has been designed to provide a long service life. No maintenance is necessary for the catalytic converter; however, the following conditions must be avoided:
- Driving or running the engine continuously with a misfiring spark plug. Refer to diagnosis section of the appropriate group when idling is unstable or when the engine lacks power.

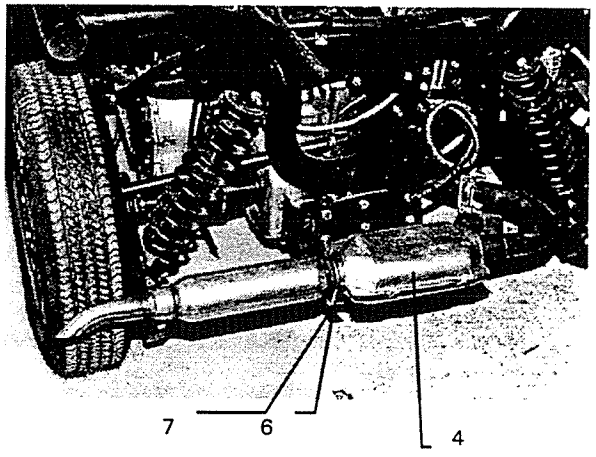
Parking or stopping the vehicle over combustible material. If the vehicle is parked or stopped over combustible material such as dry grass, the material may be ignited by the high temperature of the catalytic converter and/or muffler.

DIAGNOSIS AND TESTING

Exhaust System







Item	Part Number	Description
1	403362	Exhaust Nut
2	403361	Exhaust Gasket
3	404000	Down Pipe
4	404009	Exhaust - main system
5	404005	Hanger Bracket - engine
6	404006	Hanger Bracket - muffler
7	404007	U- Clamps
8	770223	3/8 Locknut, plated
9	770324	5/16 Flatwasher, plated
10	772215	3/8 x 2-1/2 Bolt, Grade 5
11	770898	U-Bolt - Engine

Inspection and Verification - Exhaust System

1. Verify the customer concern or complaint.
2. Visually inspect the components of the exhaust system.

Visual Inspection Chart

Mechanical	Electrical
• Exhaust pipe pinched, crushed. • Damage, loose vacuum hoses. • Incorrect idle speed • Dirty air cleaner element. • Damaged catalytic converter	• Misrouted, damaged wiring. • Corroded, loose connectors.

3. Exercise the wiring and connectors for the solenoids and other components for obvious problems due to looseness, corrosion, or other damage. The engine must be running at operating temperature when performing this procedure so as to activate the system controls.
4. Check the vacuum lines and connections for looseness, pinching, leakage, splitting, blockage, or other damage that may cause malfunction.
5. If a vacuum line or orifice (restrictor) blockage is suspected as the cause of malfunction, correct the cause before proceeding to the next step.

6. Check engine oil for fuel dilution.
7. If all checks are OK, proceed to the Troubleshooting Chart.

Exhaust Leakage or Noise

At idle or during normal driving conditions, a buzz or rattle may be detected which can be traced to the exhaust system. This may be due to a damaged exhaust gaskets or pipes, or a damaged or deteriorated muffler. These components should be repaired or replaced when they are found to be defective to maintain vehicle safety.

Troubleshooting Chart - Exhaust System

CONDITION	POSSIBLE SOURCE	REMEDY/ACTION
Restricted Exhaust System	• Carbon buildup in the catalytic converter. • Engine control malfunction.	• Go to Pinpoint Test A1

Pinpoint Tests - Exhaust System

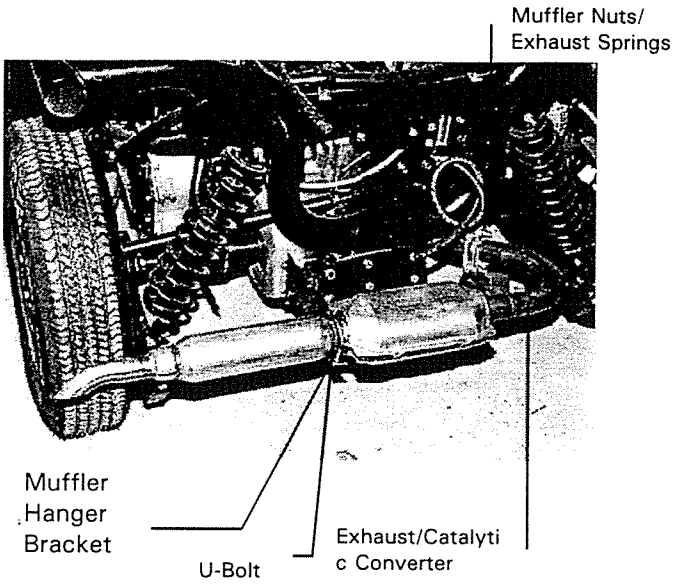
Test Step		Result	Action to Take
A1	*PERFORM VACUUM TEST*		
•	Attach a vacuum pressure tester to the intake manifold vacuum source.	Yes	No restriction in the exhaust system.
•	Start the engine and gradually increase the engine speed to 2000 rpm with the transaxle in neutral and the parking brake set.	No	Go to A2.
•	**Is the manifold vacuum above 406.4 mm-Hg (16 in-Hg)?**		
A2	*PERFORM VACUUM TEST - EXHAUST DISCONNECTED*		
•	Turn the engine off.	Yes	Go to A3.
•	Disconnect the exhaust system at the exhaust manifold.	No	Go to A4.
•	Repeat test step A1.		
•	**Is the manifold vacuum above 406.4mm-Hg (16 in-Hg)?**		
A3	*PERFORM VACUUM TEST - CATALYTIC CONVERTER ON/MUFFLER OFF*		
•	Turn the engine off.	Yes	Replace the muffler.
•	Reconnect the exhaust system at the exhaust manifold	No	Replace the catalytic converter and inspect the muffler to be sure the catalytic converter debris has not entered the muffler.
•	Disconnect the muffler.		
•	Repeat test step A1.		
•	**Is the manifold vacuum above 406.4 mm-Hg (16 in-Hg)?**		
A4	*CHECK EXHAUST MANIFOLD RESTRICTION*		
•	NOTE: Do not use a wire or light to check ports. The restriction may be large enough for them to pass through but small enough to cause excessive back pressure at high engine rpm.	Yes No	Return to the Diagnostic Routines in the PC/ED section of the manual. Replace the exhaust manifold.
•	Remove the exhaust manifold. Inspect the ports for casting flash by dropping a length of chain into each port.		
•	**Is the manifold free of casting flash?**		

REMOVAL AND INSTALLATION

Exhaust/Muffler/Catalytic Converter

Removal

1. Raise and support the vehicle.
2. Remove the u-bolts holding the exhaust assembly to the muffler hanger brackets.
3. Remove the three muffler nuts, exhaust springs and remove the exhaust/muffler/catalytic converter assembly.
4. Remove and discard the exhaust/muffler/catalytic converter assembly.



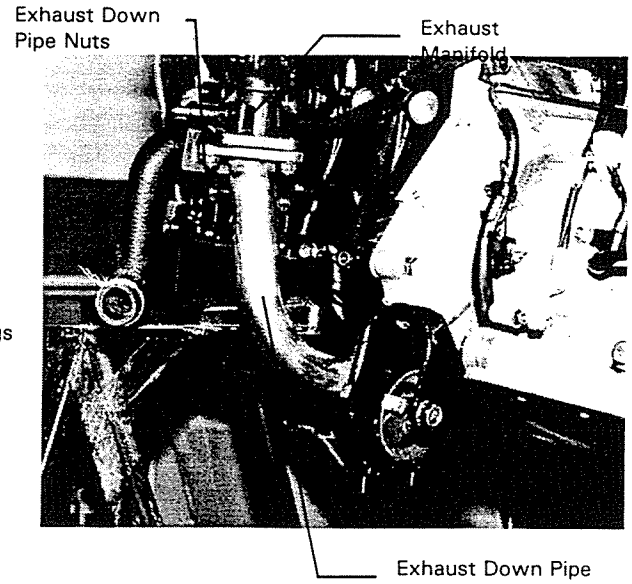
Installation

1. Position a new exhaust system to the down pipe and install the muffler hanger tabs and hangers.
2. Connect the exhaust system to the down pipe using three 3/8 x 2-1/2 bolts, three springs, flatwashers, and locknuts. Tighten the three muffler nuts to 28-38 lb-ft (38-53 N-m).
3. Lower the vehicle.
4. Start the engine and inspect for exhaust leaks.

Exhaust Down Pipe

Removal

1. Raise and support the vehicle.
2. Remove the three exhaust down pipe nuts from the exhaust manifold.



3. Remove and discard the exhaust gasket between the down pipe and manifold.
4. Remove the three 3/8 x 2-1/2 bolts, flatwashers, locknuts and exhaust hold down springs.
5. Remove the exhaust inlet pipe.
6. Inspect the exhaust down pipe. If there is deterioration, replace it.

Installation

1. Install a new exhaust gasket to the inlet end of the down pipe.
2. Install a new down pipe on the vehicle and install the three exhaust nuts.
3. Position the down pipe to the manifold and exhaust system. Tighten the three nuts at the manifold to 28-38 lb-ft (38-53 N-m).
4. Install the down pipe to the exhaust pipe flange and install the three springs.
5. Connect to the exhaust system using three 3/8 x 2-1/2 bolts, flatwashers, and

locknuts. Tighten the three muffler nuts to 28-38 lb-ft (38-53 N-m).

6. Lower the vehicle.

7. Start the engine and inspect for exhaust leaks.

CLEANING AND INSPECTION

Exhaust System

Inspect the exhaust down pipe, exhaust assembly (which consists of the exhaust pipe, catalytic converter, muffler and tail pipe) for cracked joints, broken welds, and corrosion damage that would result in leaking exhaust system. Inspect the connections, hangers, and tabs for cracks and stripped or badly corroded bolt threads.

Insulator Assembly

Inspect the insulator assembly which fits over the exhaust manifold for cracks, corrosion and damage. Replace the insulator assembly if worn or damaged.

ADJUSTMENTS

Exhaust System Alignment

A misaligned exhaust system is usually indicated by vibrating, grounding, rattling, or binding if system components. Often the associated noise is hard to distinguish from other chassis noises. Look for broken of loose hangers and tabs. Replace or tighten as necessary. It is important that exhaust clearances and alignment be maintained.

Perform the following procedure to align the system:

1. Loosen the attaching hardware, hangers and tabs.

2. Align the exhaust system, beginning at the front of the vehicle, to establish maximum clearances

3. NOTE: Tighten the exhaust down pipe nuts at each end evenly and alternately.

   Tighten all attachments.

4. NOTE: Muffler, catalytic converter and exhaust pipe welded assembly should be replaced as a unit. Replace if they are worn or become badly corroded. Do not attempt to service these parts.

   Start the engine and inspect the exhaust system for leaks.

SPECIFICATIONS

Torque Specifications

Description	Lb-ft	N-m
Down Pipe Nuts - at the manifold.	28-38	38-53
Down Pipe Nuts - at the exhaust assembly.	28-38	38-53
Hanger and Tab - exhaust assembly to vehicle	28-38	38-53

SERVICE TOOLS/EQUIPMENT

- Vacuum/Pressure Tester

SECTION 15 - Cooling System

DESCRIPTION AND OPERATION

Cooling System

The cooling system consists of:

- Radiator
- Water pump
- Water thermostat
- Fan blade
- Engine cooling fan motor
- Radiator coolant recovery reservoir
- Interconnecting hoses and pipes
- Block heater, if so equipped

Electrical System

The electrical system consists of:

- Engine cooling fan motor
- Engine Coolant Temperature Sensor (ECT sensor)
- Cooling fan control relay
- Water temperature indicator sender unit
- Block heater wiring
- Instrument cluster temperature gauge

Coolant Recovery System

Included in the engine cooling system is a separate radiator coolant recovery reservoir. It is located beside the radiator and aids in maintaining the correct volume of coolant in the system by storing the excess coolant during engine operation. The excess coolant is drawn, or sucked, back into the system during engine cool down by natural coolant contraction.

Coolant Conditioner

In production, the cooling system is filled with a 50/50 mixture of Cooling System Fluid and water. This mixture is formulated to prevent corrosion, maintain system cleanliness, and provide ant[-freeze protection in ambient temperatures to -36° F (-37°C).The specified mixture of antifreeze and water will also minimize the potential for overheating during hot weather.

For the most effective cooling system operation, the specified mixture should be maintained all year round and in all climates.

CAUTION: All vehicles use an aluminum radiator and require a special unique corrosion-inhibiting coolant formula to avoid radiator damage.

Use only a permanent antifreeze and dilute with tap water Do not use alcohol or methanol antifreeze. Use of the wrong coolant may cause radiator and/or engine damage and may void any applicable engine warranty.

Ordinary tap water may be used in an emergency except in areas where the water is known to be exceptionally hard or to have a high alkali content but should be replaced with the proper mixture of antifreeze and water as soon as possible.

To avoid possible overheating in very hot weather, do not use mixtures with more than 50 percent antifreeze except in areas where antifreeze protection below -40°F (-40°C) is required. In this case, refer to the coolant mixture chart on the Cooling System Fluid container, but in no case exceed 60 percent antifreeze/water mixture.

A standard ethylene glycol hydrometer or Battery/Anti-Freeze Tester or equivalent can be used to check the protection level of the coolant.

To prevent damage to the cooling system or engine during periods of below freezing when water or antifreeze is added to the radiator separately, always drive the vehicle (or operate the engine at fast idle for 30 minutes) before letting the vehicle stand with the engine off for prolonged periods. This will produce a uniform mixture throughout the cooling system and prevent damage when approved antifreeze is used.

Radiator

Aluminum Core, Downflow

Hot coolant flows out of the open water thermostat into the top portion of the radiator. Coolant flows through the radiator tubes and is cooled by air passing through the fins.

Cooling Fan, Electric

WARNING: WHEN WORKING IN THE ENGINE COMPARTMENT, STAY CLEAR OF THE FAN BLADE. BECAUSE IT IS ELECTRIC AND TEMPERATURE SENSITIVE, IT CAN START AT ANY TIME IF THE IGNITION IS ON.

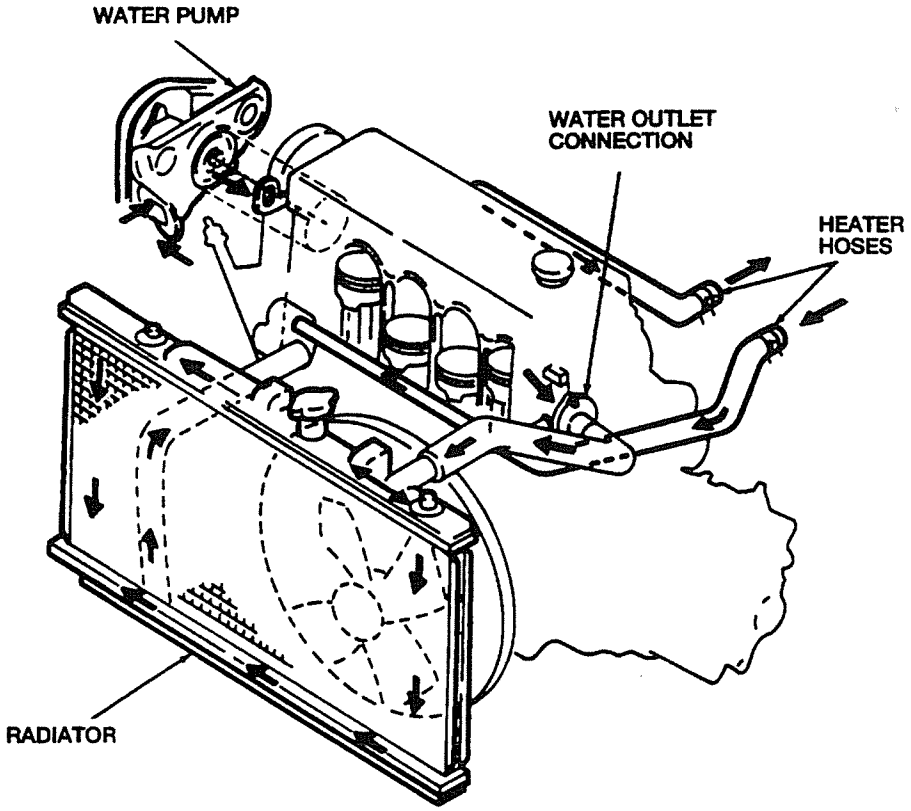
The electric cooling fan is an electro-drive type. its operation depends upon engine temperature and ignition switch position. If engine coolant temperature reaches 207°F (97°C) and the ignition switch is in the ON position, the Engine Coolant Temperature Sensor (ECT sensor) sends a signal to the Powertrain Control Module (PCM) which turns the engine cooling fan motor and fan blade assembly on. Because it cannot operate unless the ignition switch is ON, the engine cooling fan motor and fan blade assembly does not operate after engine shutdown.

The Fan Control relay (FC relay) is located in the LH front corner of the engine compartment, between the battery and the headlamp assembly. Circuit protection is provided by a 15A fuse at the fuse panel labeled COOLING FAN in the main fuse junction panel to the left of the battery.

If the vehicle is equipped with air conditioning, an additional relay is installed in the circuit. The A/C compressor clutch control relay bypasses the engine temperature portion of the circuit. The bypass circuit allows the engine cooling fan motor to operate whenever the A/C switch is engaged.

Thermostat, Water

When coolant temperature is cold, the water thermostat is in the closed position and the coolant flow is restricted to the cylinder block, cylinder head, intake manifold and heater core. As the coolant temperature increases, the water thermostat opens, allowing a portion of the coolant to pass into the radiator. The coolant flows through the radiator tubes and is cooled by air passing over the cooling fins. Coolant is then circulated from the lower radiator outlet through the water pump and into the cylinder block to complete the circuit.



Coolant circulation is provided by a conventional centrifugal water pump which discharges into the front of the cylinder block. The water pump is driven by a drive belt that is driven by the crankshaft.

WARNING: WHEN WORKING IN THE ENGINE COMPARTMENT, STAY CLEAR OF THE FAN BLADE. BECAUSE IT IS ELECTRIC AND TEMPERATURE SENSITIVE, IT CAN START AT ANY TIME IF THE IGNITION IS ON.

Engine Block Heater

NOTE: The block heater is a dealer installed accessory.

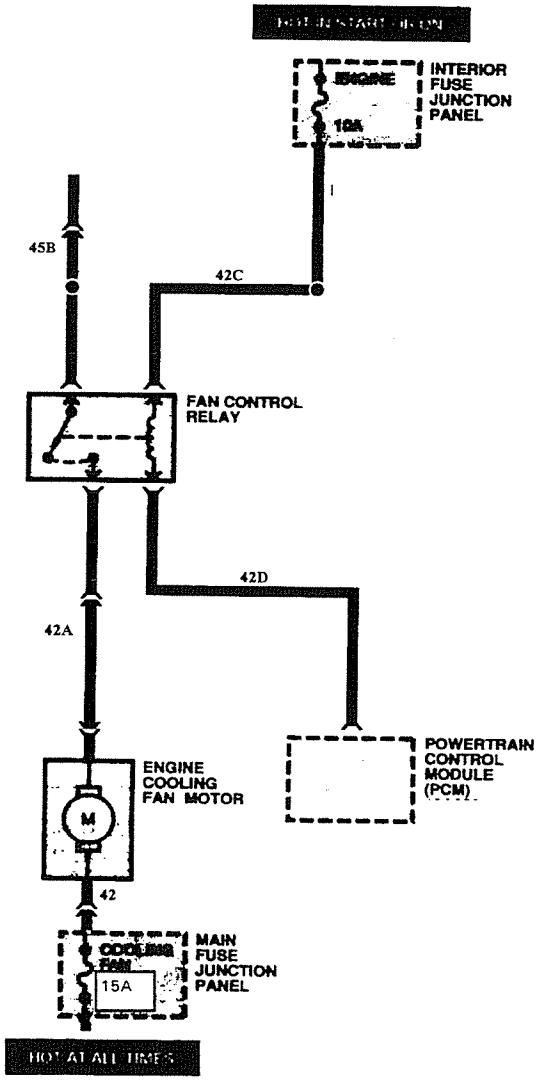
The block heater warms the engine coolant, providing improved starting. The block heater also warms up the engine faster and allows the heater-defrost system to responded more quickly. Block heaters are recommended where winter temperatures are consistently -20°F (-29°C) or below. The block heater should be plugged in at least three hours before starting the vehicle. Using the heater for longer than three hours will not damage the engine, so you can plug it in at night to start your vehicle the following morning. Use a timer to conserve energy.

To operate the block heater, simply plug it into a grounded 110-volt outlet. It is recommended that you use a Ground Fault Interrupter on your 110-volt outlet.

WARNING: Do not use the block heater with ungrounded electrical systems or two-pronged (cheater) adapters. You can be injured by an electrical shock from an ungrounded connection.

DIAGNOSIS AND TESTING

Electrical Schematic - Engine Cooling System



Inspection and Verification - Engine Cooling System

The Powertrain Control Module (PCM) controls the engine cooling fan motor while receiving information from the Engine Coolant Temperature Sensor (ECT sensor).If a malfunction occurs with the ECT sensor, the engine cooling fan motor will run continuously. Refer to the Powertrain Control/Emissions Diagnosis Manual[1], Section 5B (Quick Test Procedures) for diagnosis of the PCM before proceeding.

1. Verify the customer concern by operating the vehicle.
2. Visually inspect the following components of the engine cooling fan motor system.

Mechanical	Electrical
• Coolant level and condition	• Blown fuse(s): - 15A COOLING FAN - 10A ENGINE
• Radiator, water thermostat and hose condition	Damage to wiring harness

3. Shake the wiring harness for the engine cooling fan motor. Look for obvious shorts, opens, or damage.
4. Check the water thermostat operation.
5. If fault is not visually evident, proceed to the Troubleshooting Chart.

VISUAL INSPECTION CHART

Troubleshooting Chart - Engine Cooling System

NOTE: Use a Digital Multimeter or equivalent to perform electrical Pinpoint Tests.

ENGINE COOLING SYSTEM

CONDITION	POSSIBLE SOURCE	REMEDY/ACTION
• Loss of Coolant	• External leaks.	• GO to Pinpoint Test A1.
• Engine Overheats	• Low coolant. • Fuses. • Circuit. • Fan control relay. • Engine cooling fan motor. • External leaks. • Water thermostat. • Radiator.	• Go to Pinpoint Test B1.
• Engine Does Not Reach Normal Operating Temperature	• Water thermostat.	• PERFORM the Water Thermostat Test.
• Engine Block Heater Does Not Operate Properly	• Engine block heater. • Block heater wiring.	• REPLACE the engine block heater • REPLACE the block heater wiring
• Cooling Fan Operates Continuously	• Circuit. • Fan control relay. • Water temperature indicator sender unit.	• GO to Pinpoint Test C1 • REFER to the PC/ED Manual[1] Section 5B.

[1] Can be purchased as a separate item.

Pinpoint Tests - Engine Cooling System

PINPOINT TEST A: LOSS OF COOLANT

TEST STEP		RESULT ⇒	ACTION TO TAKE
A1	VISUAL INSPECTION		
•	Key OFF.	Yes ⇒	SERVICE the component. REFER to the appropriate section in the Service Manual.
•	Visual check for evidence of coolant leakage at:		
	• All hoses and hose connections	No ⇒	PERFORM the Pressure Test and Radiator Cap Pressure Test in this section.
	• Radiator seams, radiator core and radiator draincock.		
	• All block core plugs and drain plugs.		
	• Edges of all cooling system gaskets.		
	• Transmission oil cooler fittings.		
	• Vehicle heating system components		
	• Water pump.		
•	Examine oil dipstick for evidence of coolant in engine oil.		
•	Check radiator for evidence of oil in coolant (leakage at transmission oil cooler).		
•	**Is there evidence of coolant leakage?**		

PINPOINT TEST B: ENGINE OVERHEATS

TEST STEP		RESULT ⇒	ACTION TO TAKE
B1	CHECK COOLANT LEVEL		
•	Verify the coolant level is at the FULL mark on the radiator coolant recovery reservoir.	Yes ⇒	GO to **B2**.
		No ⇒	GO to Pinpoint Test A1.
•	Verify the coolant level is at the top of the filler tube (after removing the radiator cap).		
•	**Is the coolant level OK?**		
B2	CHECK COOLING FAN OPERATION		
•	Key OFF.	Yes ⇒	PERFORM the Water Thermostat Test. RECONNECT the engine coolant temperature sensor.
•	Disconnect the engine coolant temperature sensor connector.		
•	Key ON.		
•	**Does the engine cooling fan motor run?**	No ⇒	GO to **B3**.
B3	CHECK FUSES		
•	Key OFF.	Yes ⇒	GO to **B6**.
•	Check the 10A ENGINE fuse located in the fuse panel and the 15A COOLING FAN fuse located in the main fuse panel.	No ⇒	GO to **B4**.
•	**Are the fuses OK?**		
B4	CHECK SYSTEM		
•	Key OFF.	Yes ⇒	GO to **B5**.
•	Replace the blown fuse(s).	No ⇒	GO to **B6**.
•	Key ON.		
•	**Do(es) the fuse(s) fail again**		

TEST STEP		RESULT ⇒	ACTION TO TAKE
B5	CHECK FOR SHORT(S) TO GROUND		
•	Key OFF.	Yes ⇒	SERVICE the wire(s) in question.
•	Remove the 15A COOLING FAN fuse and or 10A ENGINE fuse.		
•	Disconnect the fan control relay		
•	Use a Digital Multimeter or equivalent to measure the resistance of the "BK/W" wire between the bottom terminal of the 10A ENGINE fuse holder and ground.	No ⇒	REPLACE the 10A ENGINE fuse and/or the 15A COOLING FAN fuse. GO to **B6**.
•	Measure the resistance of the "BK/R" wire between the left terminal of the 15A COOLING FAN fuse holder and ground.		
•	**Are the resistances less than 5 ohms?**		
B6	CHECK ENGINE COOLING FAN MOTOR		
•	Key OFF.	Yes ⇒	GO to **B7**.
•	Disconnect the engine cooling fan motor connector.	No ⇒	REPLACE the engine cooling fan motor.
•	Jumper the "Y" wire terminal to the battery positive terminal.		
•	Jumper the "BK" wire terminal to the battery negative terminal.		
•	**Does the engine cooling fan motor operate?**		
B7	CHECK ENGINE COOLING FAN MOTOR GROUND		
•	Key OFF.	Yes ⇒	GO to **B8**.
•	Disconnect the engine cooling fan motor connector.	No ⇒	SERVICE the "BK" wire for open.
•	Use Rotunda 73 Digital Multimeter 106-00051 or equivalent to measure the resistance of the "BK" wire between the engine cooling fan motor connector and ground.		
•	**Is the resistance lose than 5 ohms**		
B8	CHECK FAN CONTROL RELAY		
•	Key OFF.	Yes ⇒	GO to **B9**.
•	Disconnect the fan control relay connector		
•	Jumper the "BK/W" wire terminal and the "W/BK" wire terminal on the fan control relay to the battery positive terminal.	No ⇒	REPLACE the fan control relay.
•	Use a Digital Multimeter or equivalent to measure the voltage on the "Y" wire terminal on the fan control relay.		
•	Jumper the "BR" wire terminal on the fan control relay to the battery negative terminal.		
•	Measure the voltage on the "Y" wire terminal on the fan control relay.		
•	Is the voltage greater than 10 volts with the "BR" wire Jumper to the battery negative terminal, and less than I volt with the "BR" wire not connected to the battery negative terminal?		

TEST STEP		RESULT ⇒	ACTION TO TAKE
B9	CHECK POWER SUPPLY TO FAN CONTROL RELAY		
•	Key OFF.	Yes ⇒	GO to **B10.**
•	Disconnect the fan control relay connector.		
•	Key ON.	No ⇒	SERVICE the wire(s) in question for opens
•	Use a Digital Multimeter or equivalent to measure the voltage on the "BK/W" wire at the fan control relay connector.		
•	Measure the voltage on the "W/BK" wire at the fan control relay connector.		
•	**Are the voltages greater than 10 volts?**		
B10	CHECK ENGINE COOLING FAN MOTOR CIRCUIT		
•	Key OFF.	Yes ⇒	REFER to the PC/ED Manual[2], Section 6B to diagnose the fan control relay circuit.
•	Disconnect the fan control relay connector.		
•	Reconnect the engine cooling fan motor.		
•	Jumper the "Y" wire at the fan control relay co battery positive terminal.	No ⇒	SERVICE the "Y" wire.
•	**Does the engine cooling fan motor operate?**		

PINPOINT TEST C: COOLING FAN OPERATES CONTINUOUSLY

TEST STEP		RESULT ⇒	ACTION TO TAKE
C1	CHECK FAN CONTROL RELAY		
•	Key OFF.	Yes ⇒	REFER to the PC/ED Manual 3, Section 6B to diagnose the fan control relay circuit.
•	Disconnect the fan control relay connector.		
•	Jumper the "BK/W" wire terminal and the "W BK" wire terminal on the fan control relay to the battery positive terminal.	No ⇒	REPLACE the fan control relay.
•	Use a Digital Multimeter or equivalent to measure the voltage on the "Y" wire terminal on the fan control relay.		
•	Jumper the "BR" wire terminal on the fan control relay to the battery negative terminal.		
•	Measure the voltage on the "Y" wire terminal on the fan control relay.		
•	**Is the voltage greater than 10 volts with the "BR" wire jumper to the battery positive terminal, and less than 1 volt with the "BR" wire not connected to the battery negative terminal?**		

2 Can be purchased as a separate item.

Component Tests - Engine Cooling System

Pressure Test

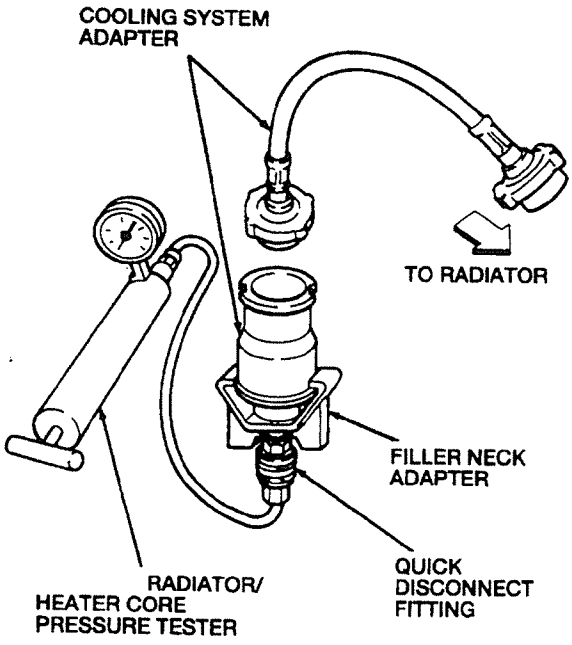
If no problem is found with the vehicle inspection and the radiator cap testing, and there is a coolant loss, the Pressure Test should be performed.

1. Make sure the engine is cool before performing the test.

2. Connect Cooling System Adapter to the Radiator/Heater Core Pressure Tester or equivalent, using the quick disconnect fitting.

3. Connect the filler neck adapter to the radiator cap pressure test adapter.

4. Connect the adapter to the radiator filler neck.



5. **CAUTION: Do not pressurize the system above the given specification.**

   Pressurize the cooling system to 15 psi (103 kPa).

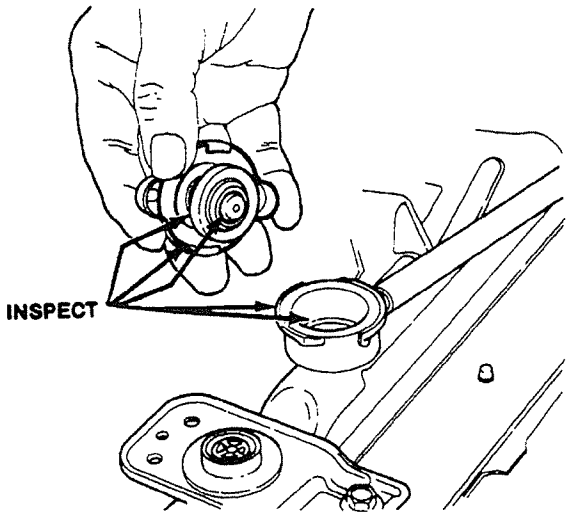
6. Observe the pressure gauge for approximately two minutes.

7. Release the system pressure by depressing the relief valve on the underside of the tester.

8. If the system does not hold pressure, service the system for leaks. If no external leaks are present, refer to Section 11 for engine disassembly and inspection procedures.

Radiator Cap Pressure Test

Inspect both sides of the radiator cap rubber seal and the vacuum valve seat. Check for particles of rust or dirt that could impair sealing. Flush away any foreign material with warm tap water. Also check the sealing shoulder on the filler neck and wipe out any foreign material present.



1. **WARNING: NEVER REMOVE THE RADIATOR CAP UNDER ANY CONDITIONS WHILE THE ENGINE IS OPERATING. FAILURE TO FOLLOW THESE INSTRUCTIONS COULD RESULT IN PERSONAL INJURY AND/OR DAMAGE TO THE COOLING SYSTEM OR ENGINE. TO "AVOID HAVING SCALDING HOT COOLANT OR STEAM BLOW OUT OF THE RADIATOR, USE EXTREME CARE WHEN REMOVING THE RADIATOR CAP FROM A HOT RADIATOR. WAIT UNTIL THE ENGINE HAS COOLED, THEN WRAP A THICK CLOTH AROUND THE RADIATOR CAP AND TURN IT SLOWLY TO THE FIRST STOP. STEP BACK WHILE THE PRESSURE IS RELEASED FROM THE COOLING SYSTEM. WHEN YOU ARE CERTAIN ALL THE PRESSURE HAS BEEN RELEASED, PRESS**

DOWN ON THE RADIATOR CAP (WITH A CLOTH), TURN, AND REMOVE.

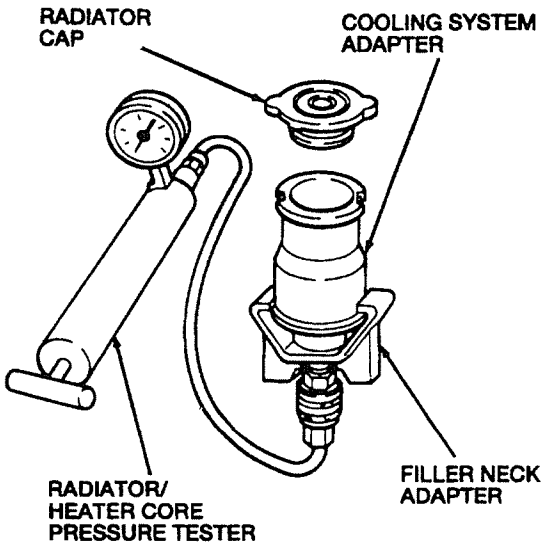
Remove the radiator cap.

2. Install Cooling System Adapter or equivalent, onto the filler neck adapter.

3. Use tap water to clean the radiator cap rubber seal and vacuum relief valve.

4. Install the radiator cap onto the radiator cap pressure test adapter.

5. Connect the female quick disconnect fitting of Radiator/Heater Core Pressure Tester or equivalent to the male quick disconnect fitting of the filler neck adapter.



6. NOTE: If the plunger of the tester is depressed too fast, a false pressure reading will result.

   Slowly depress the plunger of the tester until the pressure gauge reaches 11 psi (74 kPa).

7. Verify the radiator cap maintains pressure.

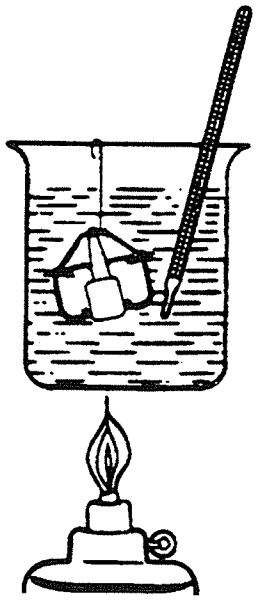
8. Release the pressure by depressing the relief valve on the underside of the tester.

9. Repeat the test at least twice to verify that the pressure reading is acceptable and consistent. If the radiator cap pressure is less than or greater than the specified value, replace the radiator cap.

Thermostat, Water

Overheating or failure to reach normal operating temperature can indicate improper water thermostat operation. The water thermostat must be removed from the vehicle and temperature-tested.

1. Suspend the water thermostat and an accurate thermometer in a suitable container. Do not allow the test pieces to touch the bottom.

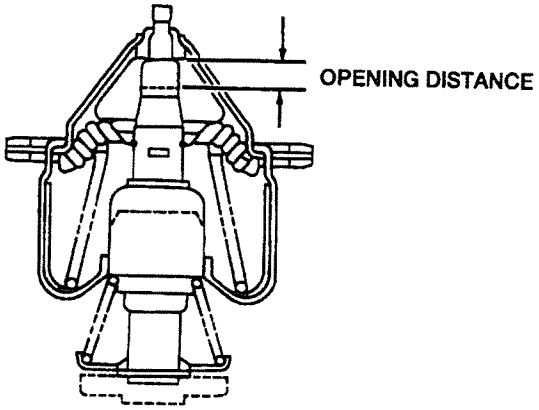


2. Fill the container with water to completely cover the water thermostat.

3. Heat the water until boiling, and observe the thermometer temperature.

4. NOTE: Fully open means the water thermostat lifts a distance of 0.33 inch (8.5mm) or more.

   The water thermostat should initially open at 187.7-193.10° F(86.5-89.5° C), and be fully open at 212°F (100°C).



5. Start to cool the water thermostat.

6. The water thermostat should be closed at 181.4°F (83° C).

7. If the water thermostat does not operate as indicated, replace the water thermostat. Otherwise, return to the Pinpoint Test.

To check for low temperature leakage, cool the water thermostat to room temperature and hold it up against a lighted background. Check for light visible between the valve and the valve seat. If light is visible, replace the water thermostat.

Radiator Leak Test, Removed From Vehicle

CAUTION: Do not leak test the aluminum radiator in the same water that copper/brass radiators are tested in Flux and caustic cleaners may be present in the tank and will affect the aluminum. A separate clean test tank is necessary, if possible, for aluminum radiators. If conditions do not allow for a separate test tank, clean the test tank thoroughly each time before testing an aluminum radiator.

Clean the radiator before leak testing it to prevent contamination of the test tank.

Leak test the radiator in clean water with 20 psi (137 pa) of air pressure.

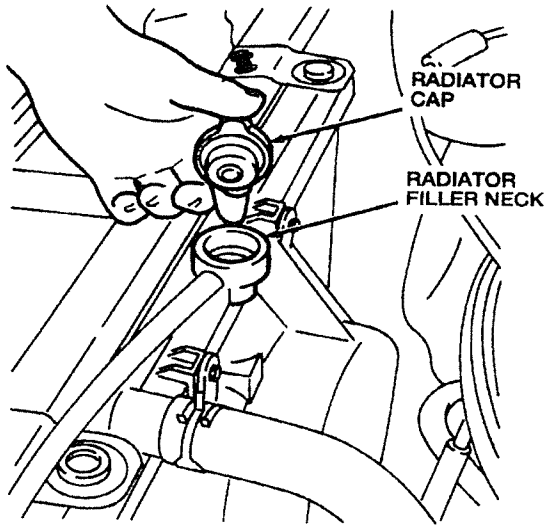
REMOVAL AND INSTALLATION

Thermostat, Water

Removal

1. Disconnect the battery ground cable.

2. Remove the radiator cap from the radiator



3. Drain the coolant to a level that is below the upper radiator hose. Refer to the procedure in this section.

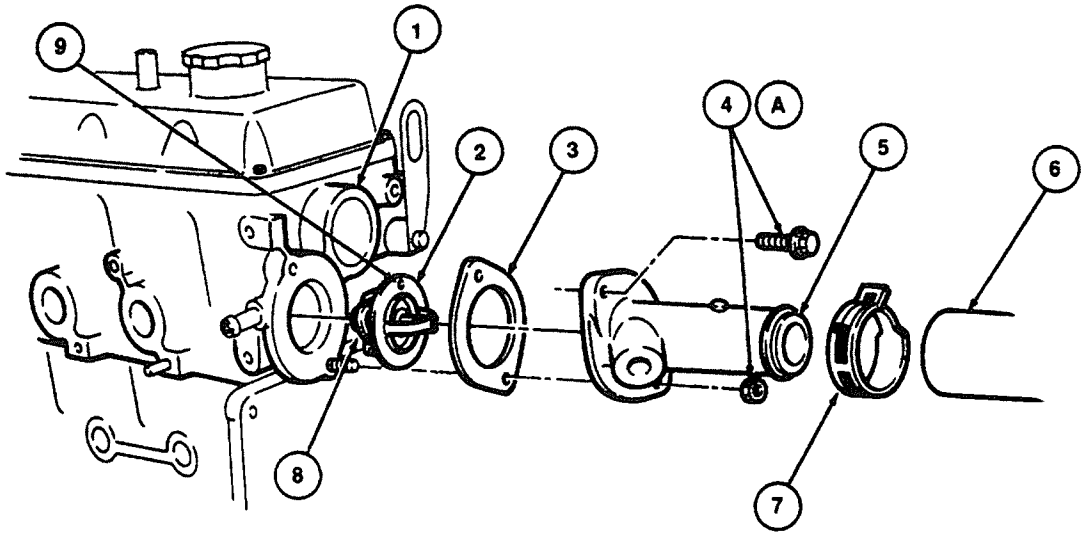
4. Disconnect the upper radiator hose at the water hose connection.

5. Remove the water hose connection bolt and nut securing the water hose connection to the cylinder head.

6. Remove and discard the water hose connection gasket.

7. Remove the water thermostat.

Water Thermostat Mounting - Exploded View



Item	Part Number	Description
1	104026	Cylinder Head
2	154012	Water Thermostat
3	154014	Water Hose Connection Gasket
4		Water Outlet Connection Bolt and Nut
5	154013	Water Hose Connection
6	153347	Upper Radiator Hose
7	153029	Hose Clamp
8	-	Thermostat Spring
9	-	Air Bleed Valve
.A	-	Tighten to 14-19 lb-ft (19-26 N-m).

Installation

1. Thoroughly clean all gasket material from the water hose connection and cylinder head mating surfaces.

2. Install the water thermostat in the cylinder head, with the valve end first and the subvalve at the top.

3. Coat a new gasket with Perfect Sealing Compound.

4. Position the water connection gasket on the cylinder head with the bolt holes correctly aligned.

5. Position the water hose connection on the cylinder head, using care to align the bolt holes and not to shift the position of the water hose connection gasket.

6. NOTE: Ensure that the thermostat flange is properly seated into the recess in the water hose connection before tightening the bolts.

   Install the water hose connection bolt and nut. Tighten the water hose connection bolt and nut to 14-19 ft-lb (19-26 N-m).

7. Connect the upper radiator hose to the water hose connection.

8. Fill the cooling system to the specified level with the recommended antifreeze/water mixture. Refer to the procedure in this section.

9. Install the radiator cap on the radiator filler neck.

10. Connect the battery ground cable.

11. Warm up the engine and check for leaks.

Water Pump

Removal and Installation

Refer to Section 11 for the water pump removal and installation procedures.

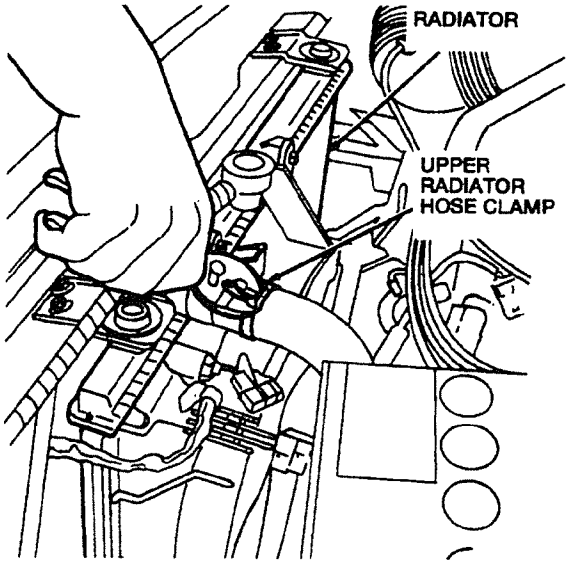
Radiator Hoses

Upper

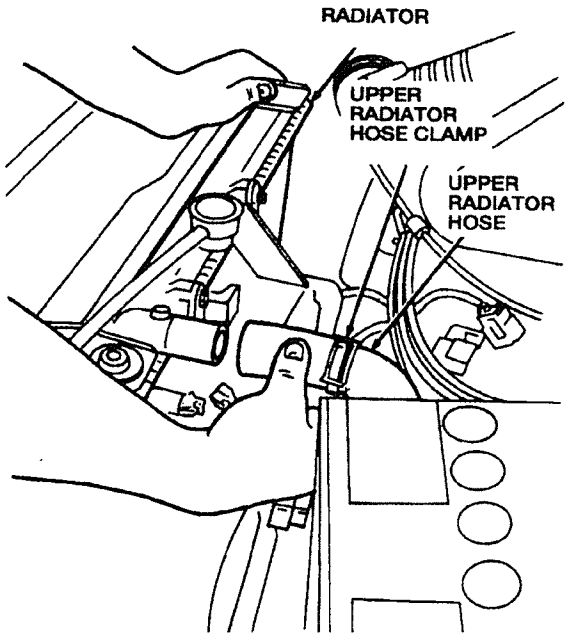
Removal

1. Drain the coolant to a level that is below the upper radiator hose. Refer to the procedure in this section.

2. Squeeze and slide the upper radiator hose clamp away from the radiator outlet fitting.



3. Disconnect the upper radiator hose from the radiator.



4. Disconnect the upper radiator hose from the water thermostat.

5. Remove the upper radiator hose.

Installation

To install, reverse the removal procedure.

Fill the cooling system to the specified level with the recommended antifreeze/water mixture. Refer to the procedure in this section.

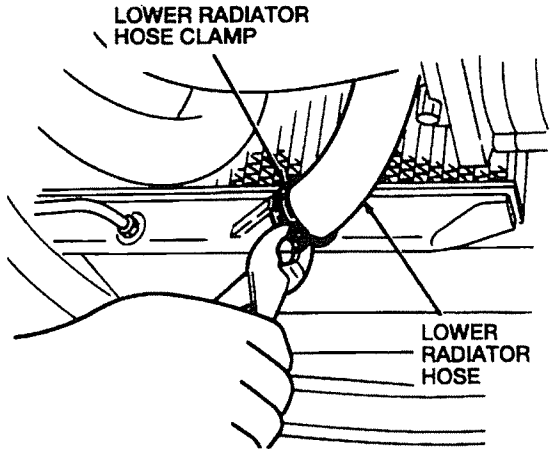
Lower

Removal

1. Drain the cooling system. Refer to the procedure in this section.

2. Remove upper trunk box..

3. Squeeze and slide the lower radiator hose clamp away from the outlet fitting.



4. Disconnect the lower radiator hose from the radiator.

5. Disconnect the lower radiator hose from the water pump inlet connector.

6. Remove the lower radiator hose.

Installation

To install, reverse the removal procedure.

Fill the cooling system to the specified level with recommended antifreeze/water mixture. Refer to the procedure in this section.

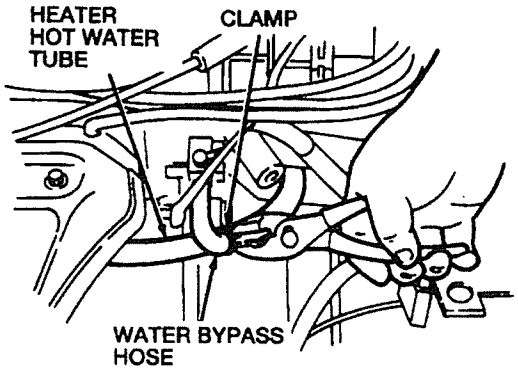
Water Bypass Hose

Removal

1. NOTE: The water bypass hose is located next to the water hose connection.

   Drain the engine coolant. Refer to the procedure in this section.

2. Squeeze the clamps on the water bypass hose and disconnect the water bypass hose from the fittings on the engine and heater hot water tube.



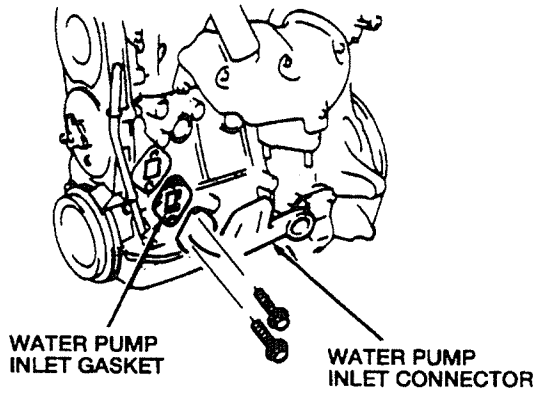
Installation

To install, reverse the removal procedure.

Water Inlet Tube

Removal

The following illustration is an exploded view of the water pump inlet connector.



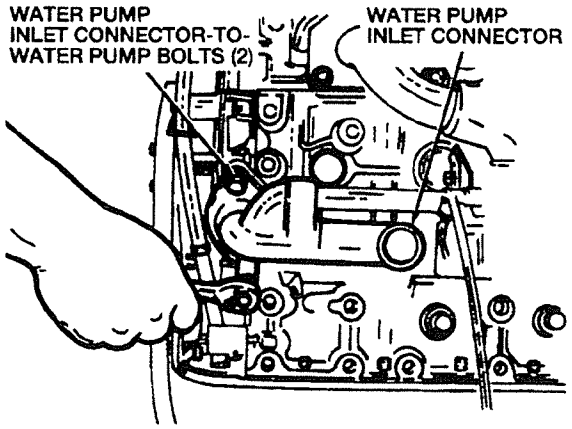
1. Remove upper box and right hand fender.

2. Drain the cooling system. Refer to the procedure in this section.

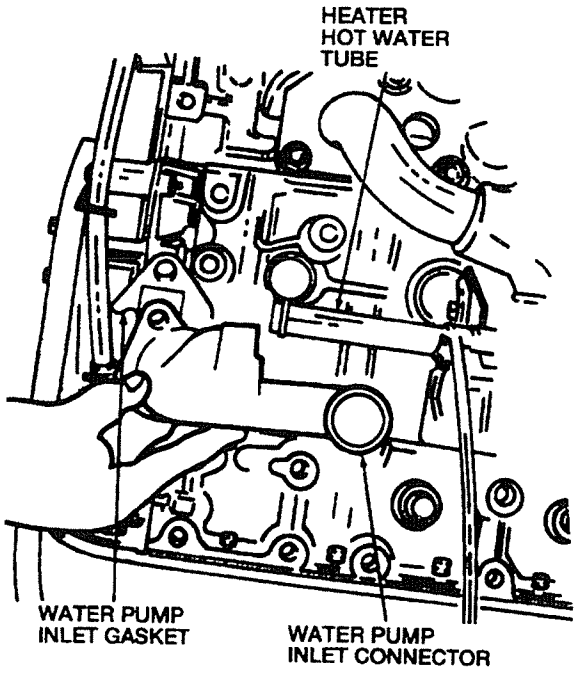
3. On vehicles with air conditioning, remove the A/C compressor. Refer to Section 22 for the removal procedure.

4. Disconnect the lower radiator hose at the water pump inlet connector.

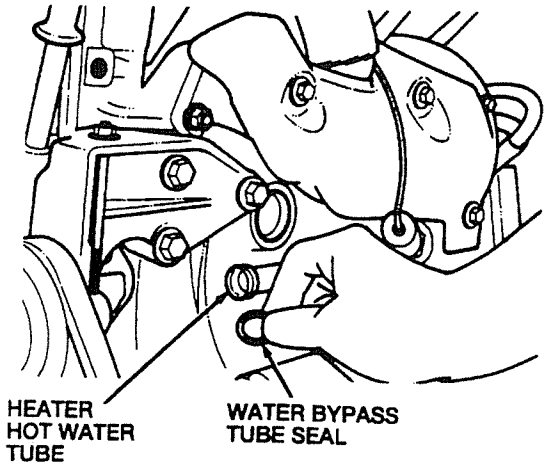
5. Remove the water pump inlet connector-to-water pump bolts.



6. Remove the water pump inlet connector and water pump inlet gasket.



7. Remove the water bypass tube seal from the heater hot water tube.



Installation

1. Install a new water bypass tube seal in position on the heater hot water tube.

2. Coat a new water pump inlet gasket with Perfect Seal Sealing Compound. Position the water pump inlet gasket on the water pump inlet connector. Connect the water pump inlet connector to the heater hot water tube and position the water pump inlet connector on the water pump.

3. Install the water pump inlet connector-to-water pump bolts. Tighten the water pump inlet connector-to-water pump bolts to 14-22 lb-ft (19-30 N-m).

4. Connect the lower radiator hose.

5. On vehicles with air conditioning, install the A/C compressor. Refer to Section 22 for the installation procedure.

6. Fill the radiator to the proper level with the specified antifreeze/water mixture. Refer to the procedure in this section.

7. Assemble fender and box.

8. Check for leaks at the water pump inlet connector.

Radiator

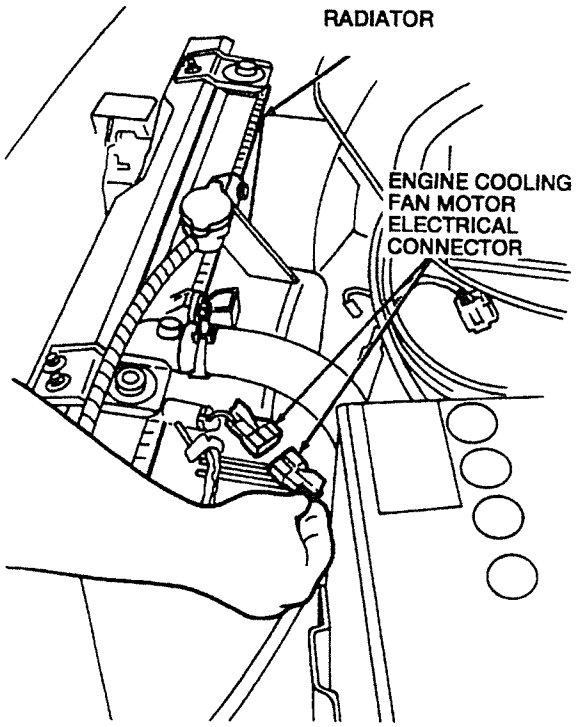
Aluminum Core, Downflow

Removal

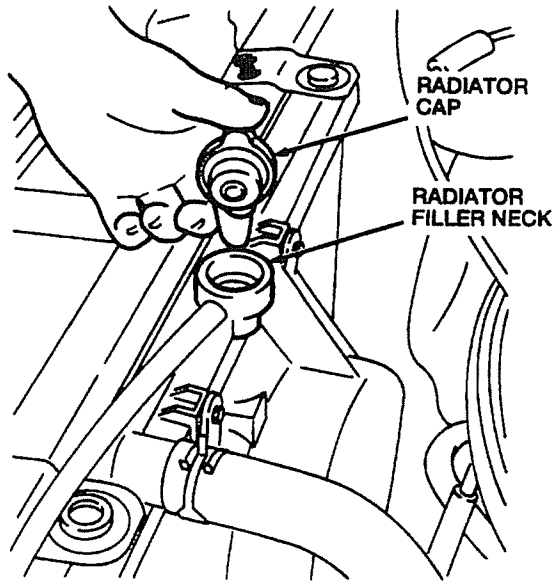
1. **WARNING: NEVER REMOVE THE RADIATOR CAP UNDER ANY CIRCUMSTANCES WHILE THE ENGINE IS RUNNING. FAILURE TO FOLLOW THIS INSTRUCTION COULD RESULT IN PERSONAL INJURY AS WELL AS DAMAGE TO THE COOLING SYSTEM AND ENGINE. TO PREVENT SCALDING COOLANT OR STEAM FROM BLOWING OUT OF THE RADIATOR, USE EXTREME CARE WHEN REMOVING THE RADIATOR CAP. WAIT UNTIL THE ENGINE HAS COOLED, WRAP A THICK CLOTH AROUND THE RADIATOR CAP, AND TURN IT SLOWLY TO THE FIRST STOP. STEP BACK WHILE THE COOLING SYSTEM PRESSURE IS RELEASED. AFTER ALL OF THE PRESSURE HAS BEEN RELEASED, USING THE THICK CLOTH, PRESS DOWN ON THE RADIATOR CAP, TURN IT, AND THEN REMOVE IT.**

   Disconnect the battery ground cable.

2. Disconnect the engine cooling fan motor electrical connector.



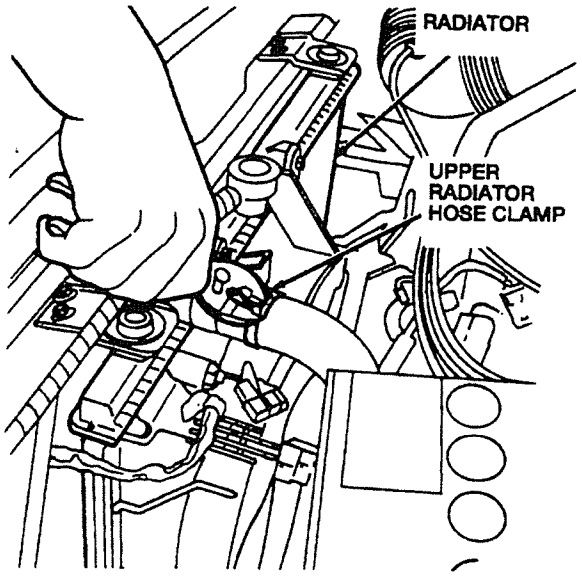
3. Remove the radiator cap from the radiator filler neck.



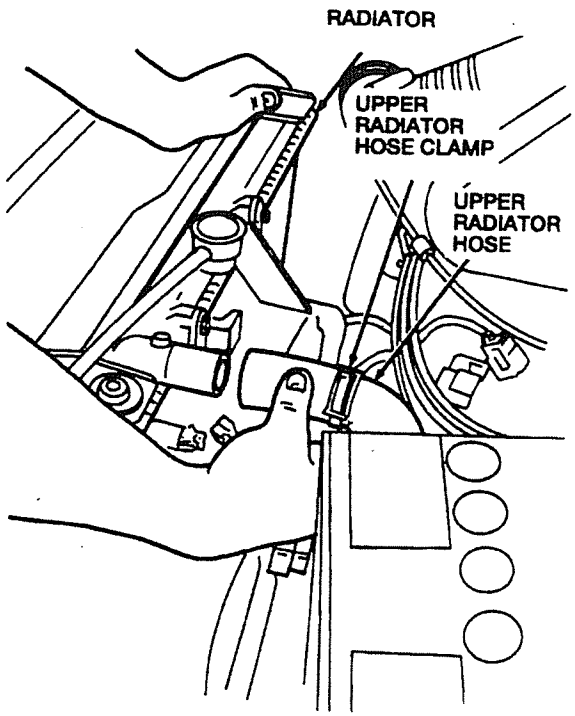
4. Drain the cooling system. Refer to the procedure in this section.

5. Disconnect the overflow hose from the radiator (8005).

6. Squeeze the upper radiator hose clamp and slide the clamp down the upper radiator hose.

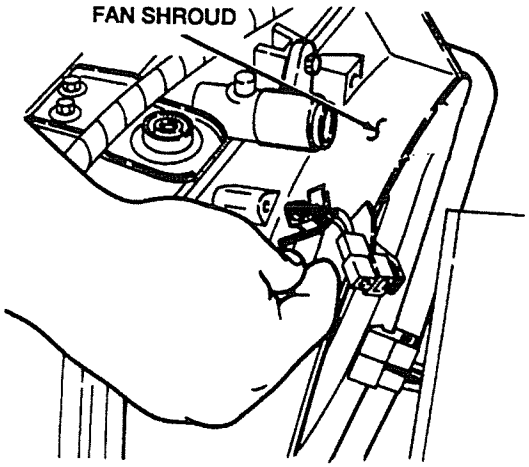


7. Disconnect the upper radiator hose from the radiator.



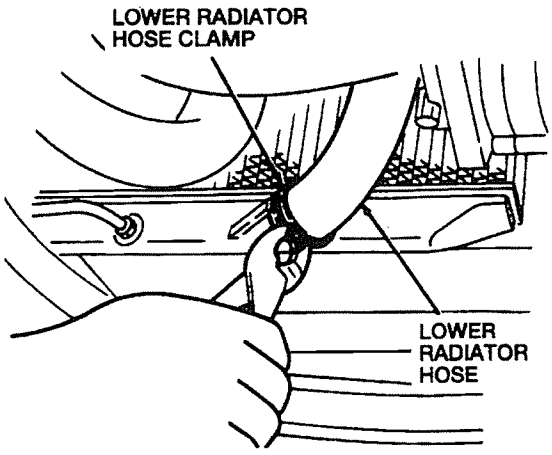
7. Disconnect the upper radiator hose from the radiator.

8. Disengage the wiring harness from the routing clamps on the fan shroud.



9. Squeeze and slide the lower radiator hose clamp away from the radiator.

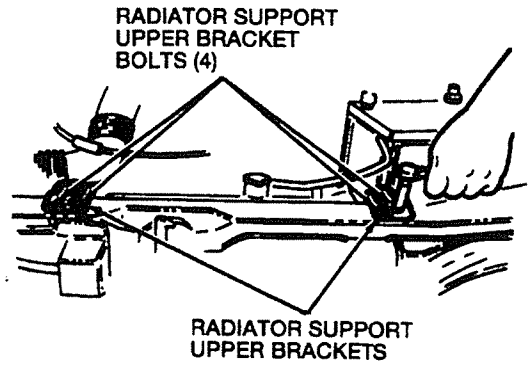
10. Take bolts out of engine wiring panel.



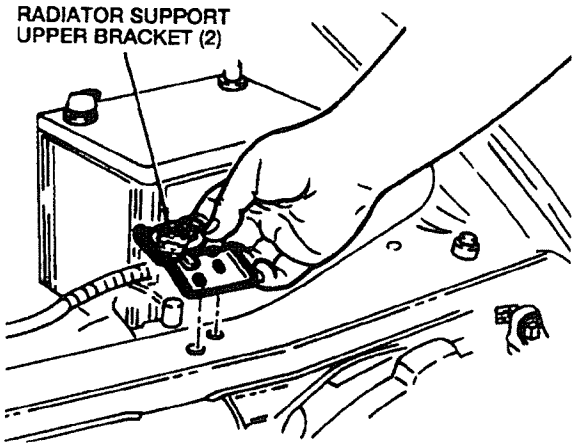
10. Disconnect the lower radiator hose from the radiator.

11. Disconnect the oil cooler hoses. Remove the lower bolt and cooler hose bracket.

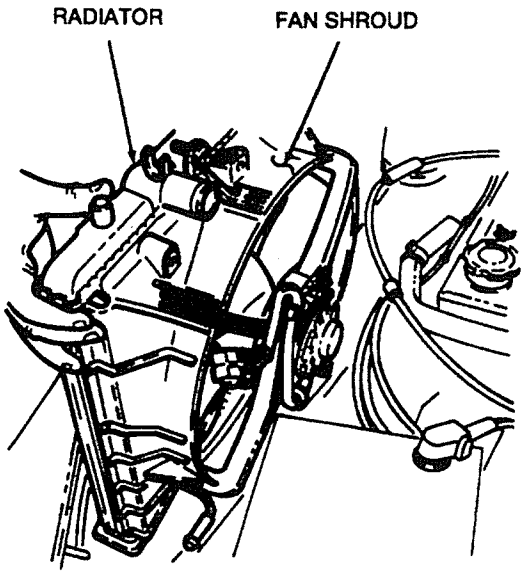
12. Remove the four radiator support upper bracket bolts securing the radiator support upper brackets to the vehicle body.



13. Remove the two radiator support upper brackets.



14. Remove the radiator and fan shroud as an assembly from the engine compartment.



15. If necessary, remove the fan/shroud assembly from the radiator. For vehicles with an automatic transaxle, remove three fan/shroud assembly bolts. For vehicles with a manual transaxle, remove four fan/shroud assembly bolts.

Installation

1. If necessary, install the fan/shroud assembly with three fan/shroud assembly bolts.

2. NOTE: When installing the radiator, ensure the radiator support upper brackets are fully engaged on the radiator and that the mounting pins, located on the lower tank of the radiator, are in their proper slots in the core support crossmember and that the two radiator mounting insulators are in their proper place.

   Install the radiator and fan/shroud assembly as an assembly in the engine compartment.

3. Position the radiator support upper brackets and install the four radiator support upper bracket bolts.

4. Tighten the four radiator support upper bracket bolts to 71-89 lb-in (8-10 N-m).

5. Connect the overflow hose.

6. Install the lower radiator hose and slide the hose clamp in place.

7. Connect the upper radiator hose and slide the hose clamp in place.

8. Connect the oil cooler hoses onto the radiator. Install the cooler hose bracket and the lower bolt.

9. Close the radiator draincock.

10. Connect the engine cooling fan motor electrical connector.

11. Position the wiring harness in the routing clamps on the fan shroud.

12. Fill the cooling system to the specified level with the recommended antifreeze/water mixture. Refer to the procedure in this section.

13. Install the radiator cap on the radiator filler neck.

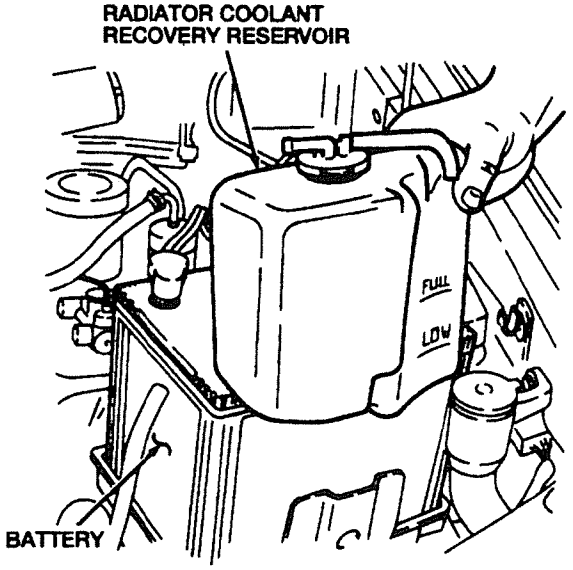
14. Warm up the engine and check for leaks.

Radiator Coolant Recovery Reservoir

Removal

1. Remove the overflow hose from the radiator coolant recovery reservoir.

2. Slide the radiator coolant recovery reservoir up and out of its mounting bracket.



Installation

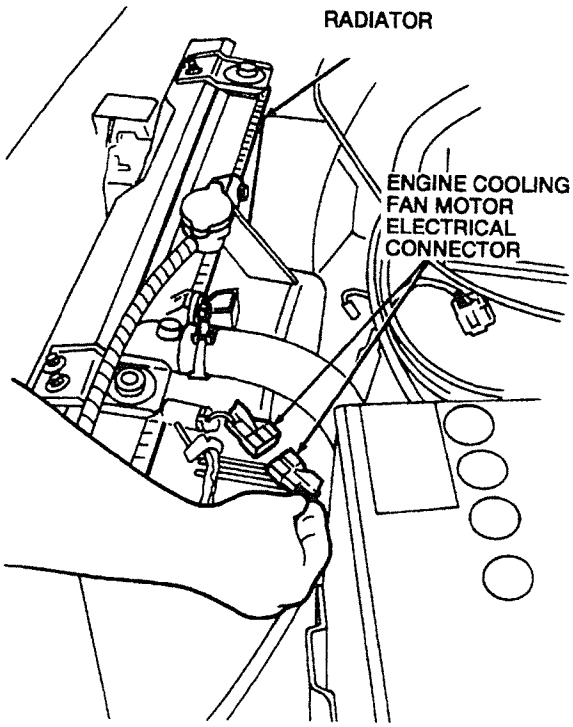
To install, reverse the removal procedure.

Engine Cooling Fan Motor, Fan Blade and Fan Shroud Assembly, Electrical

Removal

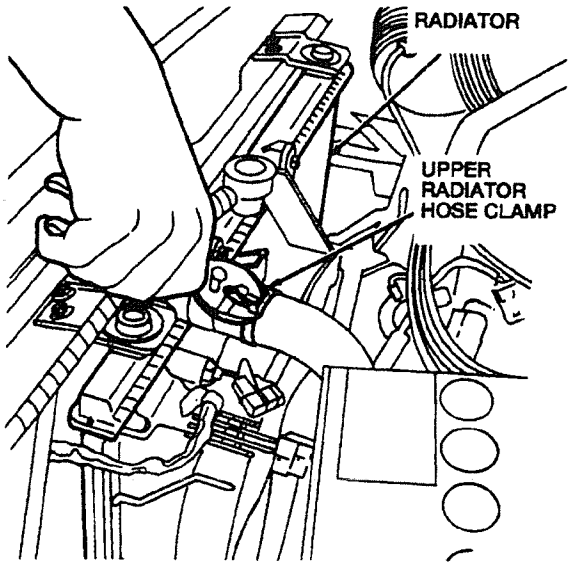
1. Disconnect the battery ground cable.

2. Disconnect the engine cooling fan motor electrical connector.

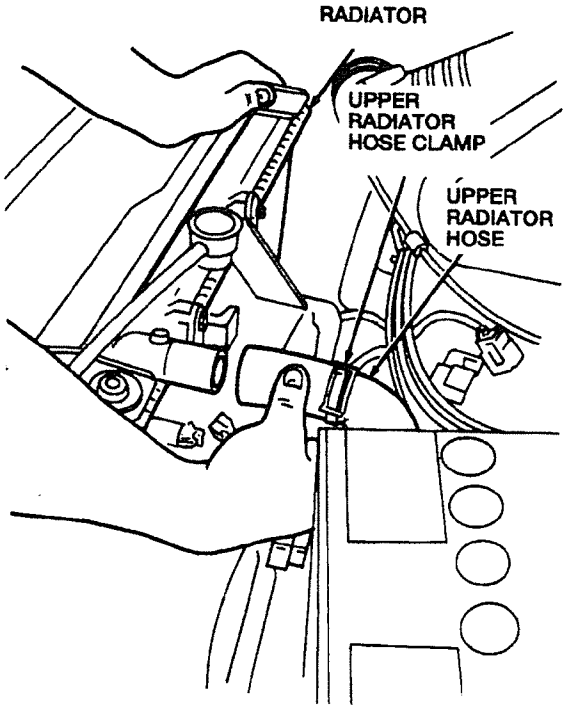


3. Drain the engine coolant. Refer to the procedure in this section.

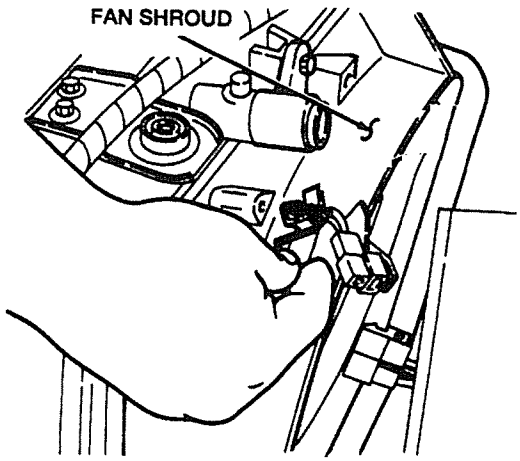
4. Squeeze and slide the upper radiator hose clamp away from the radiator fitting.



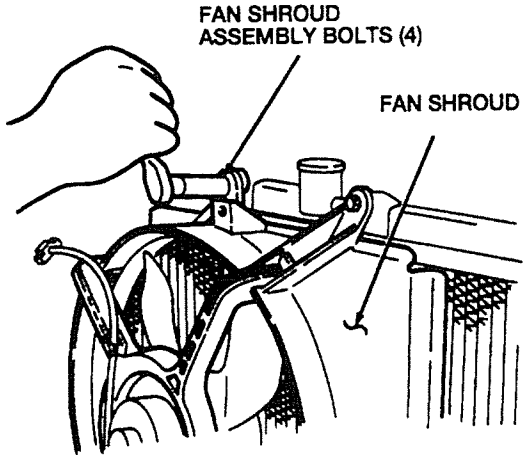
5. Disconnect the upper radiator hose from the radiator.



6. Disengage the wiring harness from the routing clamps attached to the fan shroud.



7. Remove the two fan shroud assembly bolts securing the top of the fan shroud to the radiator.



8. Loosen the two fan shroud assembly bolts securing the bottom of the fan shroud to the radiator.

9. Remove the engine cooling fan motor, fan blade, and fan shroud assembly from the vehicle.

Installation

1. NOTE: When installing the engine cooling fan motor, fan blade, and fan shroud assembly, ensure the bottom of the fan shroud engages the fan shroud lower bolts.

   Position the engine cooling fan motor, fan blade, and fan shroud assembly in the vehicle.

2. Install and tighten the four fan shroud assembly bolts to 71-97 lb-in (8-11N-m).
3. Connect the upper radiator hose.
4. Fill the cooling system. Refer to the procedure in this section.
5. Replace the radiator cap on the radiator filler neck.
6. Position the wiring harness in the routing clamps on the fan shroud.
7. Connect the engine cooling fan motor electrical connector.
8. Warm the engine and check for leaks.

Fan Shroud

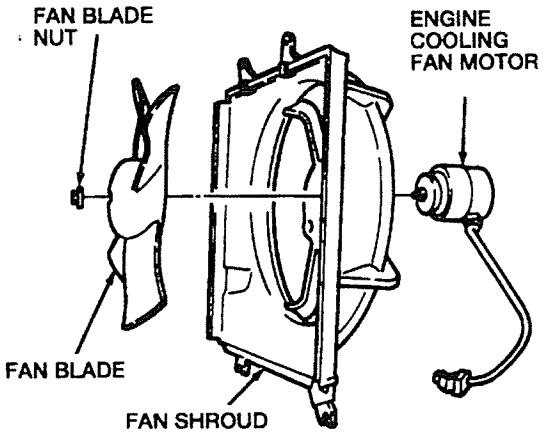
Removal and Installation

Refer to the engine cooling fan motor procedure in this section for removal and installation of the fan shroud.

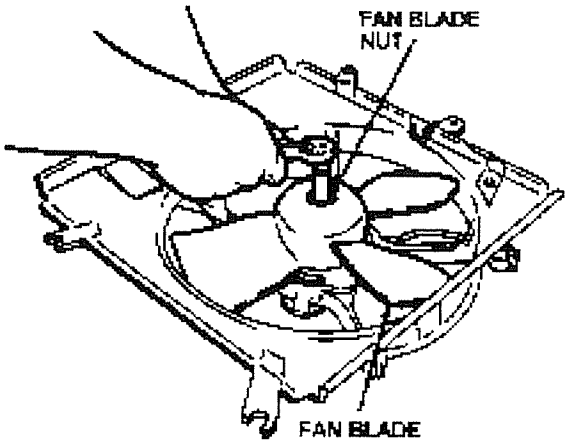
Engine Cooling Fan Motor

Removal

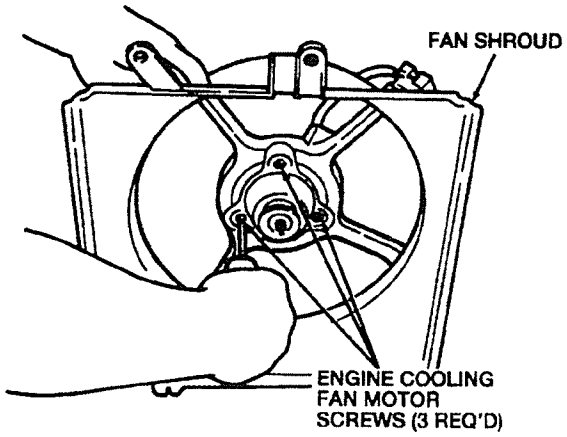
The following illustration is an exploded view of the engine cooling fan motor and fan shroud assembly.



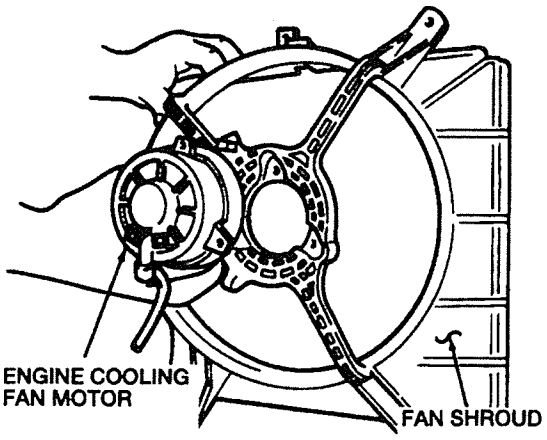
1. Remove the fan blade and shroud assembly. Refer to the procedure in this section.
2. Remove the fan blade nut.



3. Remove the fan blade from the engine
4. Remove the wiring harness routing strap.
5. Remove the three engine cooling fan motor screws.



6. Remove the engine cooling fan motor from the fan shroud.



Installation

To install, reverse the removal procedure.

Tighten the three engine cooling fan motor screws to 0.08-0.17 lb-in (0.01-0.02 N-m).

Tighten the fan blade nut to 0.35-0.53 lb-in (0.04-0.06 N-m).

Fan Control Relay

Removal and Installation

Refer to Section 19 for removal and installation of the fan control relay.

A/C Relay

Removal and Installation

Refer to Section 18 for removal and installation procedures.

Transmission Oil Cooler

Aluminum Core Radiator

Removal and Installation

To service the transmission oil cooler the radiator must be replaced. Refer to the procedure in this section.

Radiator Draincock

Aluminum Core Radiator

Removal

1. Drain the cooling system. Refer to the procedure in this section.
2. Remove the radiator draincock.

Installation

1. NOTE: Be sure that the radiator draincock gasket is in good condition. Replace it if necessary.

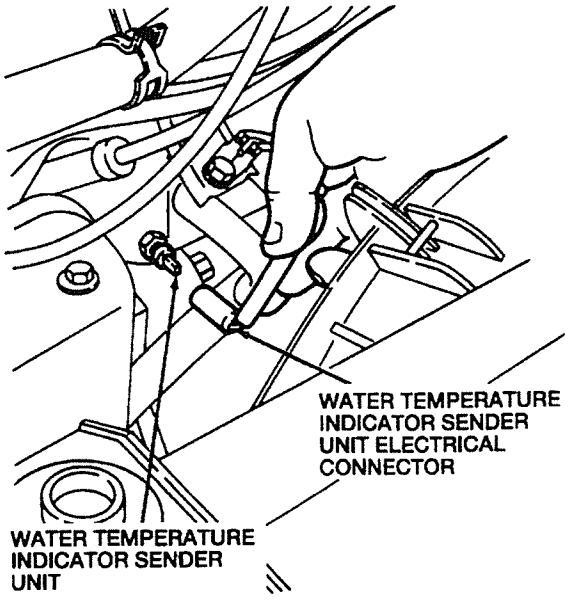
   Install the radiator draincock.
2. Fill the cooling system to the specified level with the recommended antifreeze/water mixture. Refer to the procedure in this section.

Water Temperature Indicator Sender Unit

Removal

1. NOTE: The water temperature indicator sender unit is threaded into the front side of the cylinder block.

   Drain the engine coolant to a level below the water temperature indicator sender unit. Refer to the procedure in this section.
2. Disconnect the water temperature indicator sender unit electrical connector from the water temperature indicator sender unit.



3. Remove the water temperature indicator sender unit.
4. If the water temperature indicator sender unit is to be reused, remove and discard the O-ring.

Installation

1. Install a new O-ring on the water temperature indicator sender unit.
2. Coat the threads of the water temperature indicator sender unit with Pipe Sealant with Teflon® or equivalent.
3. Install the water temperature indicator sender unit. Tighten the water temperature indicator sender unit to 18-22 lb-ft (25-29 N-m).

4. Connect the water temperature indicator sender unit electrical connector.

5. Fill the cooling system. Refer to the procedure in this section.

Engine Coolant Temperature Sensor

Removal and Installation

Refer to Section 11 for removal and installation of the Engine Coolant Temperature Sensor (ECT sensor).

Cable, Electrical - Engine Block Heater (Option)

Removal

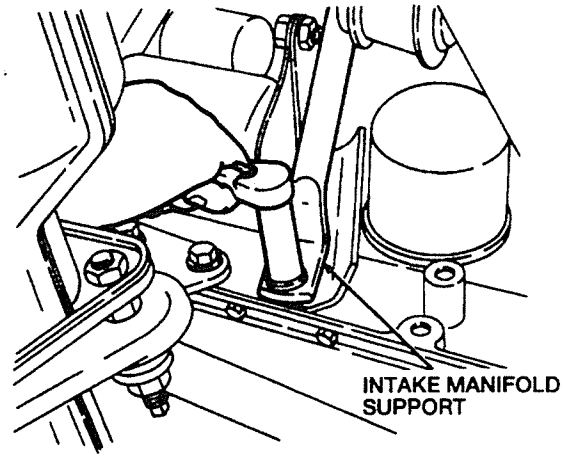
1. NOTE: The block heater wiring is available as option. If equipped, then proceed as follows:

   Disconnect the battery ground cable.

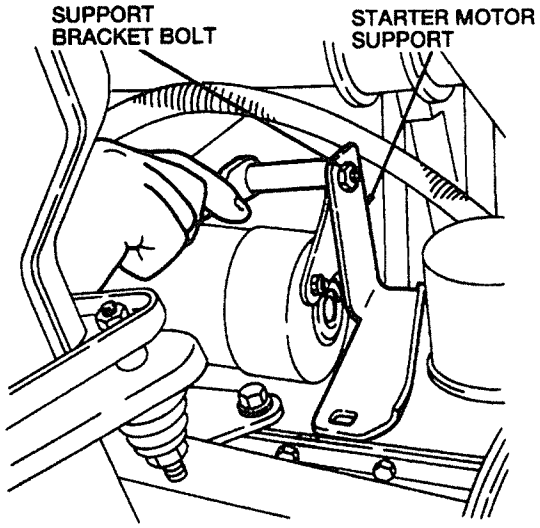
2. Remove the air cleaner element (ACL element). Refer to this section for the removal procedure.

3. Raise and support the vehicle.

4. Remove the two intake manifold support bolts, and remove the intake manifold support.

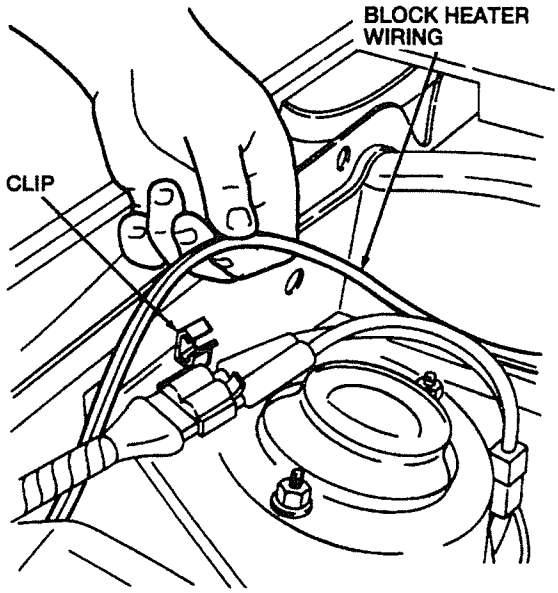


5. Remove the support bracket bolt.

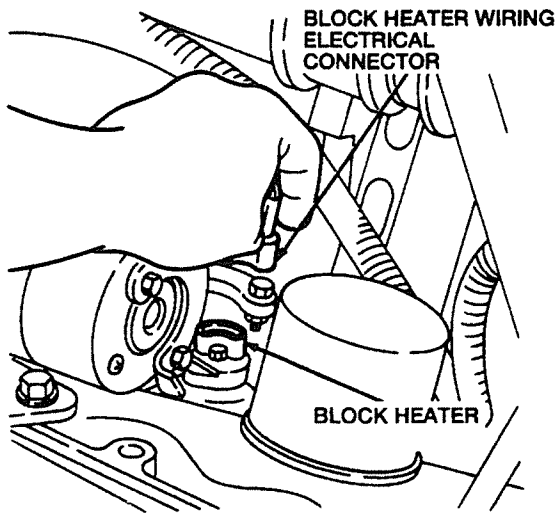


6. Remove the support bracket.

7. Remove the block heater wiring from the clips.



8. Disconnect the block heater wiring electrical connector and remove the block heater wiring.



Installation

To install, reverse the removal procedure.

Tighten the intake manifold support bolts to 12-16 lb-ft (16-22 N-m).

Engine Block Heater (option)

Removal

1. NOTE: The block heater is only available as an option. Refer to the procedure in this section.
2. Remove the engine block heater electrical connector. Refer to the procedure in this section.
3. Remove the block heater screw.
4. Remove the block heater.

Installation

To install, reverse the removal procedure.
Tighten the block heater screw to 5.3 lb-in (0.6 N-m).

SERVICE PROCEDURES

Radiator Core

Refer to the radiator tubes service procedure in this section.

Radiator Tubes

1. **CAUTION: If a radiator tube leak repair is to be repaired within approximately 3/4 inch (20mm) from a tank, do not attempt to solder the area. Soldering heat may damage the plastic tank.**

   Treat leaks close to the tanks with self-leveling, single-component silicone such as Dow Corning 1200 Clear Prime Coat and Silastic 734 RTV or equivalents.
2. If the leak is far enough from the tanks, solder it in the usual manner.
3. If the exact location of the leak cannot be pinpointed, treat a larger area to assure the effectiveness of the repair.

Radiator Tank

The radiator tanks are plastic, and, unlike the core fins, cannot be soldered. To seal minor leaks in the radiator tanks, use self-leveling, single component silicone such as Dow Corning 1200 Clear Prime Coat and Silastic 734 RTV or equivalent. These materials set to a double, elastic, rubber-like, non-adhesive, pressure-resistant surface film.

1. Apply a thin coat of Dow Corning 1200 Clear Prime Coat or equivalent to the area of the leak.
2. Allow the prime coat to dry for 10 minutes at room temperature.
3. Apply a coat of undiluted Dow Corning Silastic 734 RTV or equivalent over the prime coat.
4. Allow the Silastic 734 RTV to dry for one hour at room temperature.
5. Retest for leaks and repair as necessary.

Radiator Tank Flange

1. Use a suitable tool to repress the flanges in the area of the leak.
2. Retest the radiator for leaks.
3. If the flange leak persists, repair with Dow Corning 1200 Clear Prime Coat and Silastic 734 RTV or equivalents as described previously, extending the application area about two (2) inches (50mm) on each side of the leak area.

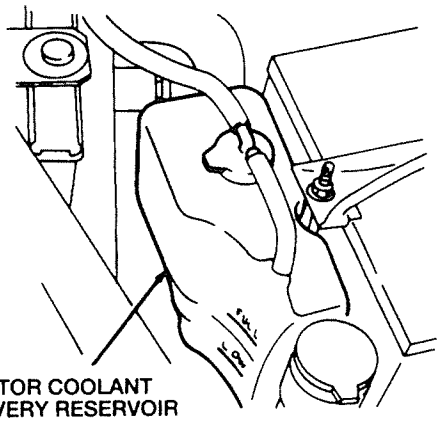
Transmission Oil Cooler Connection Leaks

Check to see that the fitting nut is fully tightened. If the leak persists, apply a thin, even coat of Dow Corning 1200 primer or equivalent, using a brush. Allow to dry for 10 minutes at room temperature. Apply Dow Corning Silastic 734 RTV or equivalent in undiluted form around the leaking connection and allow it to dry for one hour.

CLEANING AND INSPECTION

Radiator Coolant Level Check

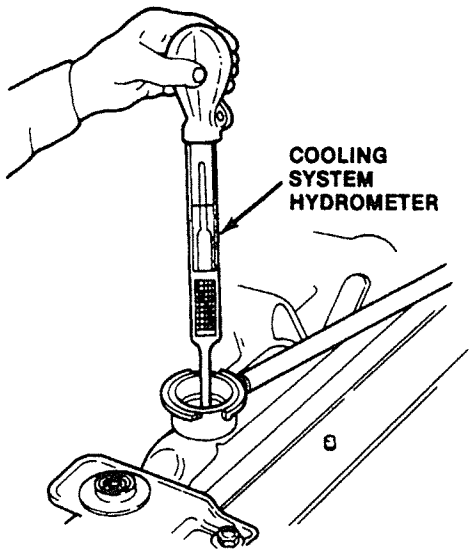
When the coolant is cold, the coolant level in the radiator coolant recovery reservoir should be between the LOW and FULL marks. If the coolant level is low, add coolant to the FULL mark.



Coolant Condition Check

WARNING: NEVER REMOVE THE RADIATOR CAP UNDER ANY CIRCUMSTANCES WHILE THE ENGINE IS RUNNING. FAILURE TO FOLLOW THIS INSTRUCTION COULD RESULT IN PERSONAL INJURY AS WELL AS DAMAGE TO THE COOLING SYSTEM AND ENGINE. TO PREVENT SCALDING COOLANT OR STEAM FROM BLOWING OUT OF THE RADIATOR, USE EXTREME CARE WHEN REMOVING THE RADIATOR CAP. WAIT UNTIL THE ENGINE HAS COOLED, WRAP A THICK CLOTH AROUND THE RADIATOR CAP, AND TURN IT SLOWLY TO THE FIRST STOP. STEP BACK WHILE THE COOLING SYSTEM PRESSURE IS RELEASED. AFTER ALL OF THE PRESSURE HAS BEEN RELEASED, USING THE THICK CLOTH, PRESS DOWN ON THE RADIATOR CAP, TURN IT, AND THEN REMOVE IT.

With the radiator cap off, examine the coolant in the upper tank. Draw a sample with a hydrometer or Battery/Antifreeze Tester or equivalent. Check for rust, dirt, or oil. Also check the freezing point. It should be approximately -35°F (-37°C) if the mixture has not been diluted by adding plain water. Dilution of the mixture below the recommended 50/50 concentration reduces the effectiveness of the corrosion inhibitors in the antifreeze formula. If the mixture is diluted but not rusty, discolored, or weak full protection may be restored by partially draining the system and adding 100% antifreeze coolant Premium Cooling System Fluid or equivalent.



Cooling System Hoses and Clamps

The most frequent cooling system concerns deal with overheating and leakage. To inspect for leaks at the hoses and hose clamps use the following procedure:

1. Key ON and engine running.
2. Run the engine until normal operating temperature is reached.
3. Key OFF.
4. **WARNING: THE RADIATOR COOLING FAN MAY ACTIVATE AT ANY TIME, KEEP HANDS AND TOOLS AWAY FROM THE FAN BLADE.**

   Inspect all hoses and hose clamp connections for leaks. All leaking hoses and hose clamps must be replaced. Refer to the procedure in this section.

5. If no leaks are visible, or if all visible leaks have been repaired, perform a cooling system pressure test to verify there are no more cooling system leaks. Refer to the cooling system pressure test diagnostic procedure in this section.

Cooling System, Draining, Filling and Bleeding

WARNING: NEVER REMOVE THE RADIATOR CAP UNDER ANY CIRCUMSTANCES WHILE THE ENGINE IS RUNNING. FAILURE TO FOLLOW THIS INSTRUCTION COULD RESULT IN PERSONAL INJURY AS WELL AS DAMAGE TO THE COOLING SYSTEM AND ENGINE. TO PREVENT SCALDING COOLANT OR STEAM FROM BLOWING OUT OF THE RADIATOR, USE EXTREME CARE WHEN REMOVING THE RADIATOR CAP. WAIT UNTIL THE ENGINE HAS COOLED, WRAP A THICK CLOTH AROUND THE RADIATOR CAP, AND TURN IT SLOWLY TO THE FIRST STOP. STEP BACK WHILE THE COOLING SYSTEM PRESSURE IS RELEASED. AFTER ALL OF THE PRESSURE HAS BEEN RELEASED, USING THE THICK CLOTH, PRESS DOWN ON THE RADIATOR CAP, TURN IT, AND THEN REMOVE IT.

If coolant is discolored or dirty, or if inspection reveals hoses, gaskets, or other components requiring service or replacement, the coolant must be drained and discarded, or saved for reuse depending on its condition. Remove the radiator cap, observing precautions as previously described if the system is hot and pressurized. reverse-pressure flushed with plain water as follows:

1. Drain the cooling system. Refer to the procedure in this section.

2. Remove the water thermostat. Reinstall the water hose connection without the water thermostat. Refer to the procedure in this section.

3. Disconnect the radiator overflow hose from the radiator coolant recovery reservoir and plug the end of the hose.

4. Disconnect the heater water hoses from the heater core and plug or cap both nipple and hose.

Position a drain pan under the radiator and open the radiator draincock and drain the system.

Clean the cooling system by flushing with clear water. If it is excessively rusty or dirty, reverse-pressure flush or use an approved flushing system. Refer to the flushing procedures in this section.

Refill the system with equal parts of water and antifreeze coolant. Fill to the FULL mark on the radiator coolant recovery reservoir and install the radiator cap only to the first stop (non-pressurizing). Start the engine and run at fast idle only until the upper radiator hose feels warm, indicating the water thermostat has opened.

Stop the engine. Check the coolant level in the radiator and add coolant mixture if required to restore the coolant level. Install and tighten the radiator cap on the radiator, and fill the radiator coolant recovery reservoir to the FULL mark.

Cooling System, Cleaning

Cooling System Flush Procedure

When replacing coolant because of excessive rust or dirt, the system should be vigorously flushed to break up and remove deposits of sludge, rust, and foreign matter.

Radiator Installed

If closed-circuit pressure flushing equipment is not available, the cooling system may be

5. Disconnect the lower radiator hose from the radiator and position the hose to drain clear of the vehicle.

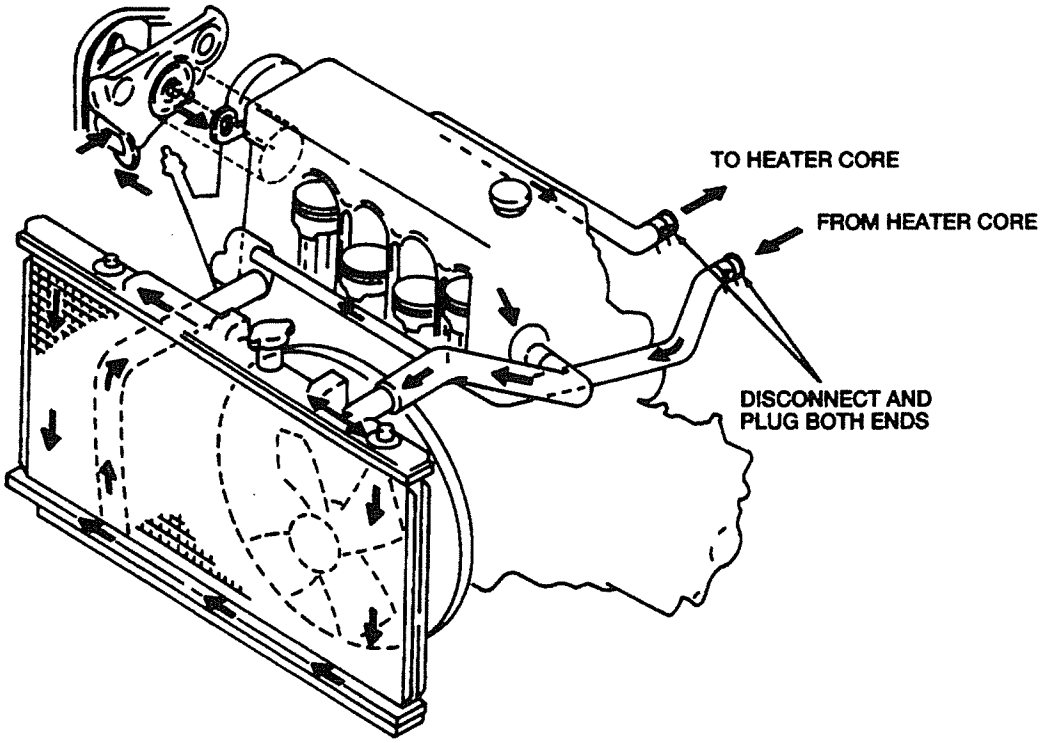
6. **CAUTION: Flushing water flow must be limited so that pressure inside the radiator does not exceed 15 psi (103 kPa).**

   Connect a high-pressure hose to the radiator lower hose outlet. Back-flush the engine until clear water runs out of the lower radiator hose. Turn water on and off several times, pulsing the flow to help break loose sludge deposits.

7. When the water flowing out of the lower radiator hose is clear, unplug the radiator overflow hose. When water flows clear from the overflow hose, replug it.

8. Disconnect the equipment used for the cooling system flush procedure. Before reconnecting the cooling system hoses, the heater loop must be back-flushed separately to remove sediment in the heater core. Refer to the procedure in this section.

9. Install the water thermostat in the water hose connection. Refer to the procedure in this section.



Radiator Removed

If closed-circuit pressure flushing equipment is not available, the cooling system may be reverse-pressure flushed with plain water as follows:

1. Remove the radiator. Refer to the procedure in this section.

2. Position the lower radiator hose to drain into a suitable container.

3. **CAUTION: Flushing water flow must be limited so that pressure inside the radiator does not exceed 15 psi (103 kPa).**

   Connect a high-pressure water hose to the upper radiator hose. Back-flush the engine until clear water runs out of the lower radiator hose. Turn the water on and off several times, pulsing the flow to help break loose sludge deposits.

4. Disconnect the equipment used for the flush procedure. Before installing the radiator, the heater loop must be back-flushed separately to remove sediment in the heater core. Refer to the procedure in this section.

5. Install the radiator. Refer to the procedure in this section.

Heater Core Back-Flushing

Back-flushing the heater core has to be a separate operation to get the required reverse coolant flow.

1. Disconnect the heater hot water tube from the water pump inlet connector and install and clamp a garden hose female end fitting to the heater hot water tube.

2. Remove the RH heater water hose from the lower intake manifold. Position the hose to drain directly into a pan. Connect the water supply hose to the female fitting that was installed in step 1, and flush the heater core circuit until the drain water runs clear. Pulse the flow by turning the water on and off several times. Allow full flow for approximately five (5) minutes.

3. Shut off the flushing water supply and remove the adapters installed for the flushing operation. Reconnect all cooling system connections, tightening all hose clamps to 22-31 lb-in (2.5-3.5 N-m).

4. Refill the cooling system with approved antifreeze coolant mixture. Refer to the coolant replacement procedure in this section.

5. With the cooling system warmed up and pressurized, inspect all system connections for leaks and tighten as necessary.

Radiator Cap

Inspect both sides of the radiator cap rubber seal and the vacuum valve seat. Check for particles of rust or dirt that could impair sealing. Flush away any foreign matter with warm tap water. Also check the sealing shoulder on the filler neck and wipe out any foreign matter present at this point.

Radiator

External

1. **CAUTION: Use low pressure rinsing water to prevent radiator fin damage. Install the radiator cap. If the radiator is removed, plug the radiator inlet and outlet.**

2. Clean the outside of the radiator tanks and core with a soft-bristle brush, warm water, and a mild household detergent.

3. Rinse the radiator tanks and core with clear water.

Internal

CAUTION: Do not use caustic cleaning solutions or copper/brass radiator cleaning agents on aluminum radiators. Internal cleaning of the aluminum tubes can be accomplished with sonic cleaning equipment or by removing one end tank to gain access to the tubes. Then, clean the tubes with a mild household liquid detergent. Rinse the core with clean water when completed. Do not use a metal brush to clean an aluminum core. Use only horsehair, bristle or nylon brushes.

Fan Blade

WARNING: DO NOT ATTEMPT TO STRAIGHTEN OR REPAIR THE FAN BLADE. REPLACE THE FAN BLADE IF DAMAGED.

Check and replace the fan blade if there are cracks or if it is defective.

Corrosion Resistor

(Not Required When Coolant is Replaced)
Check coolant concentration for recommended protection level using Fluid Tester or equivalent. If concentration is low, partially drain the system and add 100 percent coolant, such as a Premium Cooling System Fluid or equivalent to obtain the recommended protection level.

SPECIFICATIONS

COOLING SYSTEM REFILL CAPACITIES

Description	Specification
Complete System	6.3 US qt (6.0 L)

COOLING SYSTEM PRESSURE SPECIFICATIONS

Item	Pressure
Radiator in vehicle	15 psi (103 kPa)
Radiator in test tank	20 psi (137 kPa)
Radiator cap (Replace if)	Less than 11 psi (74 kPa) Greater than 15 psi (103 kPa)

COOLANT MIXTURE

Coolant Protection	Volume Percentage		Gravity at 68°F (20°C)
	Water	Coolant	
Above 3°F (-16°C)	60	40	1.054
Above -15°F (-26°C)	55	45	1.066
Above -40°F (-40°C)	50	50	1.078

WATER THERMOSTAT OPENING TEMPERATURE

Position	Temperature
Starts to open	86.5-89.5°C (188-193°F)
Full open	100°C(212°F)
Closed	83°C(181°F)

COOLING FAN CONTROL RESISTANCE

Coolant Temperature	Resistance (ohms)[1]
68°F (20°C)	2200-2700
104°F (40°C)	1000-1300
176°F (80°C)	290-350
196°F (91°C)	230-240
207°F (97°C)	190-200
228°F (108°C)	146-152

1 The resistance specifications shown refer to the Engine Coolant Temperature (ECT) sensor.

TORQUE SPECIFICATIONS

Description	Lb-Ft	Lb-in	N-m
Hose Clamps	-	22-31	2.5-3.5
Water Hose Connection Bolt and Nut	14-19	-	19-26
Water pump Inlet Connector-to-Water Pump Bolts	14-22	-	19-30
Intake Manifold Support Bolts	12-16	-	16-22
Fan Shroud Assembly Bolts	-	71-97	8-11
Fan Blade Nut	-	0.35-0.53	0.04-0.06
Engine Cooling Fan Motor Screws	-	0.08-0.17	0.01-0.02
Radiator Support Upper Bracket Bolts	-	71-89	8-10
Battery Hold-down Clamp Nuts	-	62-80	7-9
Water Temperature Indicator Sender Unit	18-22	-	25-29
Block Heater Screw	-	5.3	0.6

SERVICE TOOLS/EQUIPMENT

- Radiator/Heater Core Pressure Tester
- Cooling System Adapter
- Digital Multimeter
- Battery/Antifreeze Tester
- Coolant Temperature Monitor Harness

SECTION 16 - Starting System

DESCRIPTION AND OPERATION

Starter System

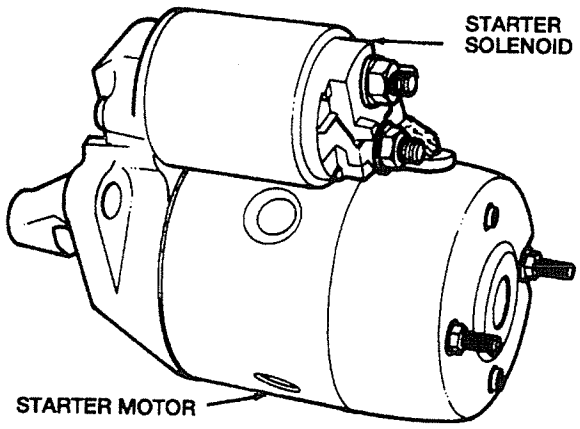
The function of the starting system is to crank the engine at a speed fast enough to permit the engine to start. Heavy cables, connectors, switches, and a starter solenoid (attached to the starter motor housing) are used in the starting system because of the large amount of current the starter motor requires while it is cranking the engine. The amount of resistance in the starting circuit must be kept to an absolute minimum to provide maximum current for starter operation. A discharged battery, loose or corroded connections, or partially broken cables will result in slower than normal cranking speeds and may even prevent the starter motor from cranking the engine.

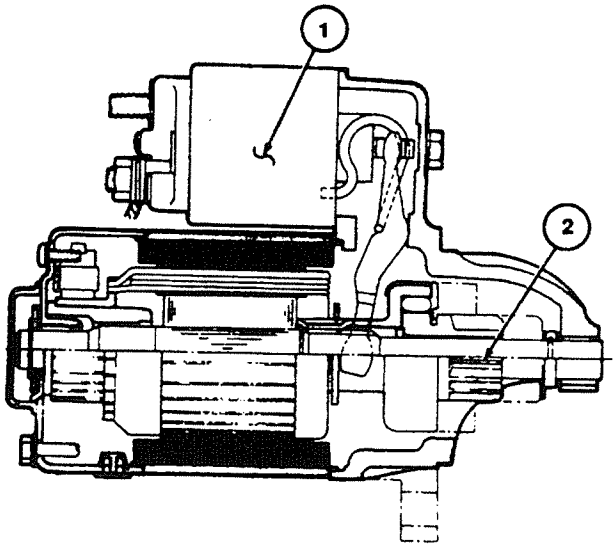
NOTE: Engine oil viscosity can affect engine cranking speed.

If the starter motor or circuit is suspected of causing a no-start condition, use the diagnostic chart and the appropriate tests in this section to isolate the condition.

Starter

The starter motor is a positive engagement type that draws 150 to 250 amperes of current under normal load and 60 amperes under no load. It produces a normal engine cranking speed of 180 to 250 rpm. The starter relay pull winding resistance is 3 to 5 ohms. Total maximum voltage drop is 0.5 volt.





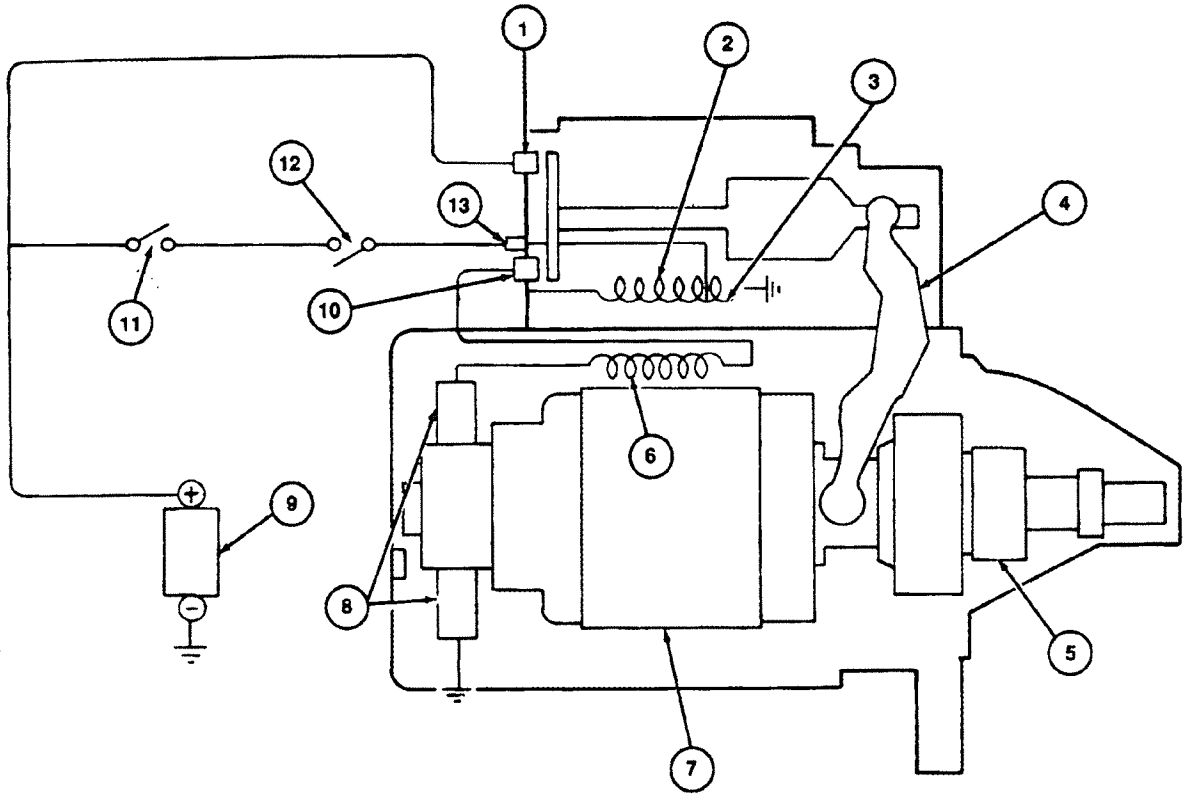
Item	Part Number	Description
1	-	Starter Solenoid
2	-	Starter Drive
3	-	Drive Lever and Pin
4	184012	Starter Motor Armature
5	184021	Brush Set

The starter motor can be considered as having two electrical circuits: a low current circuit and a high current circuit.

The low current circuit is the control circuit and includes the ignition switch, starter solenoid, PARK/NEUTRAL Position Switch and associated wiring. The low current circuit is controlled by the ignition switch.

The high current circuit connects the battery positive terminal to the starter motor. Heavy-gauge wiring is used because of the high current flow required to operate the starter motor. When the ignition switch is turned to the START position while the PNP switch contacts are closed, battery current is applied to the S-terminal on the starter solenoid. The PNP switch is mounted on the transaxle.

Starter motor system components and wiring



Item	Part Number	Description
1	-	B-terminal
2	-	Pull-in Coil
3	-	Hold-in Coil
4	-	Drive Lever and Pin
5	-	Starter Drive
6	-	Starter Field Coil
7	184012	Starter Motor Armature

Item	Part Number	Description
8	184021	Brush Set
9	-	Battery
10	-	M-terminal
11	-	Ignition Switch
12	-	Park Neutral Position Switch
13	-	S-terminal

From the S-terminal of the starter solenoid, current flows through the pull-in coil to ground, energizing the pull-in coil. When energized, the pull-in coil produces an electromagnetic field which pulls the relay armature and contact disc into the closed position. This produces contact between battery terminal and the motor terminal. Contact between these two terminals energizes the high current circuit and applies full battery voltage to the starter field coils and brush set, causing the starter motor to crank.

The relay coil is connected to the starter drive through the drive lever and pin. As the electromagnetic field of the pull-in coil moves the relay armature forward, the starter drive moves toward the ring gear on the flywheel. When contact disc makes contact between the battery and motor terminals, the starter drive gear and flywheel ring are fully engaged, and the starter motor rotation causes the flywheel to rotate. A hold-in coil, energized through the S-terminal of the starter solenoid, supplies additional electromagnetic force to keep the contact disc engaged as the starter motor draws current and the system voltage drops.

Sequence of Operation

1. The ignition switch is turned to the START position.
2. The starter solenoid is energized, creating a magnetic field in the solenoid coil.
3. The iron plunger core is drawn into the solenoid coil.
4. A drive lever and pin connected to drive assembly engages the starter drive to the flywheel ring gear.
5. When the iron plunger core is all the way into the coil, its contact disc closes the circuit between the battery and the starter motor terminals.
6. The current flows to the starter motor, and the starter drive cranks the flywheel and crankshaft.
7. As current flows to the starter motor, and the solenoid pull-in coil is bypassed.
8. The hold-in coil keeps the starter drive engaged with the flywheel.
9. The starter drive remains engaged until the ignition switch is released from the START position.

An overrunning clutch in the drive assembly protects the starter motor from excessive speeds during the brief period before the driver releases the ignition from the START position.

Ignition Switch Connector

Pin Number	Circuit	Circuit Function
1	4 (BK/R)	On Power
2	1C (BK/W)	Hot at all times power supply
3	5 W	START Signal
4	2 (BL)	START and On Power
5	1E (BK/W)	Hot at all times power supply
6	3 (GN)	On and ACC power

DIAGNOSIS AND TESTING

Inspection and Verification - Starting System

1. Check the starter motor by operating it.
2. Inspect the starting system for loose connections.
3. If the system does not operate properly, make note of the condition and go to the Troubleshooting Chart on the next page.

NOTE: Use a digital multimeter to perform electrical tests on the starter.

Troubleshooting Chart - Starting System

CONDITION	POSSIBLE SOURCE	ACTION
• Engine cranks slowly	• Loose connections or corroded battery cable connections. • Under charged battery. • Loose or corroded starter motor connections. • Malfunctioning starter motor.	• GO to Pinpoint TEST A1.
• Engine does not crank	• Under charged battery. • Malfunctioning ignition switch. • Loose or corroded battery cable connections. • Faulty ignition circuit grounds. • Malfunctioning starter motor. • Starter clutch pedal position switch or park/neutral position switch.	• GO to Pinpoint Test B1.
• Unusual starter noise	• Starter motor improperly mounted. • Malfunctioning starter motor.	• GO to Pinpoint Test C1.

PINPOINT TEST A: Engine Cranks Slowly

TEST STEP		RESULT	ACTION
A1	CHECK BATTERY CONNECTIONS		
• Inspect the battery terminals for loose or corroded connections. • **Are the battery terminals clean and tight?**		Yes No	GO to **A2.** Clean and tighten battery cable connections
A2	CHECK BATTERY		
• Check battery. Refer to Section 17 • **Is the battery OK?**		Yes No	GO to **A3.** Charge and replace battery.
A3	CHECK STARTER MOTOR CONNECTIONS		
• Inspect the starter motor terminals for loose or corroded connections. • Are the starter motor terminal connections clean and tight?		Yes No	Perform starter component tests in this section. Clean and tighten starter motor connections.

PINPOINT TEST B: Engine Does Not Crank

TEST STEP		RESULT	ACTION
B1	CHECK BATTERY CONNECTIONS		
•	Inspect the battery terminals for loose or corroded connections. • **Are the battery terminals clean and tight?**	Yes No	GO to **B2**. Clean and tighten battery cable connections.
B2	CHECK BATTERY		
•	Check the battery. Refer to Section • **Is the battery all right?**	Yes No	Go to **B3**. Refer to Section 08 to diagnose Park/Neutral Position Switch (PNP).
B3	CHECK POWER SUPPLY TO STARTER MOTOR		
•	Key OFF. • Disconnect the starter motor connectors. • Key in START position. • Measure the voltage on the "BK/W wire at the starter motor connector. • **Is the voltage greater than 10 volts?**	Yes No	Go to B4.
B4	CHECK STARTER MOTOR GROUND CIRCUIT		
•	Perform the starter motor ground circuit test in this section • **Is the voltage greater than 10 volts?** •	Yes No	Remove the starter motor and perform the motor pinion test. Repair and/or replace the battery ground cable and/or engine ground cable as required.

PINPOINT TEST C - Unusual Starter Noise

TEST STEP		RESULT	ACTION
C1	CHECK STARTER MOTOR MOUNTING		
•	Inspect the starter motor mounting • Check the starter motor bolts for looseness. • Is the starter motor mounted properly?	Yes No	GO to **C2**. Remount or replace starter motor.
C2	CHECK STARTER DRIVE ENGAGEMENT		
•	Remove the starter motor. • Inspect the starter drive and flywheel ring gear for damage. Refer to the inspection procedure in this section. • **Are the starter drive and flywheel ring gear in good condition?**	Yes No	Perform the motor pinion test procedure in this section. Replace as necessary.

COMPONENT TESTS

Starter

Load Test

1. **WARNING: WHEN SERVICING THE STARTER MOTOR OR PERFORMING OTHER WORK AROUND IT, BE AWARE THAT THE HEAVY GAUGE BATTERY INPUT LEAD AT THE STARTER SOLENOID IS "ELECTRICALLY HOT" AT ALL TIMES.**

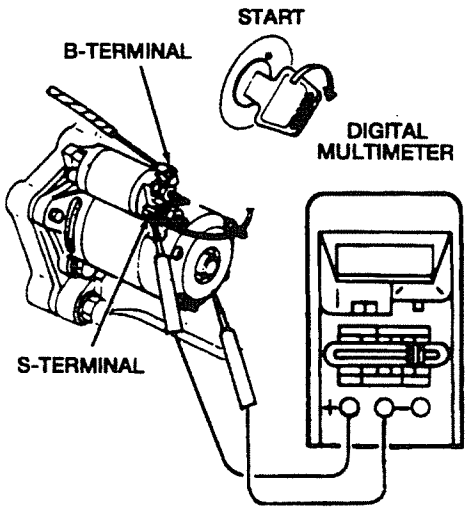
   A PROTECTIVE CAP OR BOOT IS PROVIDED OVER THIS TERMINAL. REPLACE AFTER SERVICING. BE SURE TO DISCONNECT THE NEGATIVE BATTERY CABLE BEFORE THE STARTER MOTOR.

   Before testing, test the battery to find out its state of charge. Perform a load test using a Starting and Charging Tester or equivalent.

   This will determine if the battery is serviceable. Refer to Section 17 - Battery and Charging System for this procedure.

2. NOTE: When disconnecting the hard shell connector at the solenoid S-terminal, grasp the plastic connector, depress the plastic tab and pull off the lead assembly. Do not pull on the lead wire or damage may result.

   If the starter motor won't crank with a fully-charged battery, connect the positive (+) lead to a Digital Multimeter or equivalent. Connect the negative (-) lead to starter motor housing.



3. Turn the ignition switch to the START position while watching the voltage reading.

   If the voltage at the S-terminal is eight (8) volts or more, there is a starter motor or high current circuit malfunction. Perform the starter motor circuit checks explained later in this section.

   If there is no voltage, there is a malfunction in the low current circuit to the S-terminal.

   NOTE: If the starter solenoid is extremely hot, it may not function even though voltage at the S-terminal is eight volts or more. Allow the starter solenoid to cool and test again.

   To find the problem in the low current circuit, refer to Section 08 - Transaxle.

Voltage Drop Tests

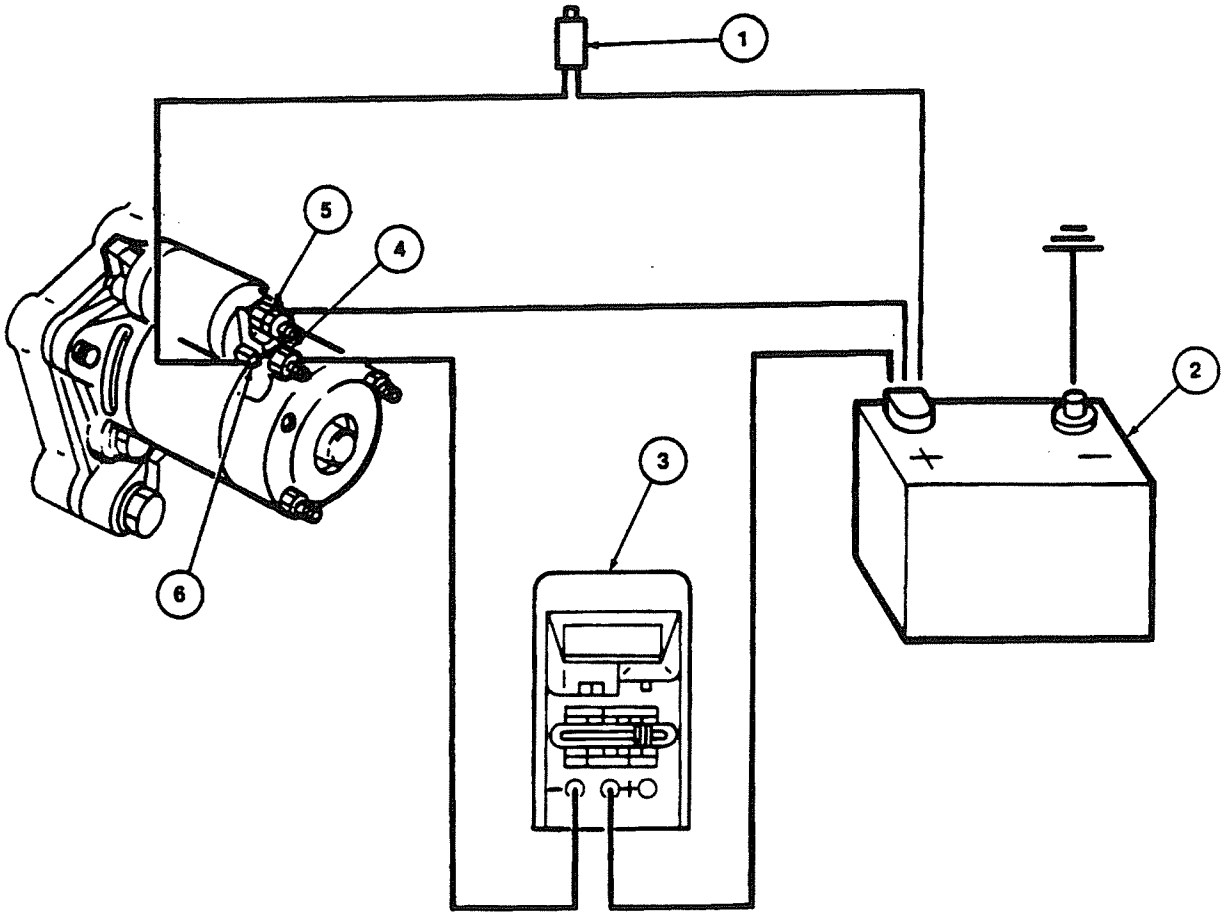
Motor Feed Circuit

1. Prevent the engine from starting by disconnecting the distributor connectors.

2. Connect a remote starter switch between the starter solenoid S-terminal and the battery positive (+) terminal.

3. Connect a voltmeter positive lead to the battery positive (+) post. Connect the voltmeter negative lead to the starter solenoid M-terminal.

4. Engage the remote starter switch. Read and record the voltage on the lowest voltmeter scale. The voltmeter reading should be 0.5 volts or less.



Item	Part Number	Description
1	-	Remote starter switch
2.	182863	Battery
3	-	Digital Multimeter
4	-	M-terminal
5	-	B-terminal
6	-	S-terminal

5. If the voltage at the M-terminal is higher than 0.5 volt, move the voltmeter negative (-) lead to the starter solenoid B-terminal and repeat the test.

6. If the voltage reading at the B-terminal is higher the 0.5 volt, the problem may be in the connections at the starter solenoid, or in the solenoid contacts.

7. Remove the wires from the solenoid's B-terminals, S-terminal, and M-terminals. Clean the cables and connections and reinstall the cables to the proper terminals. Repeat steps 1 (one) through to 6 (six). If the voltage reading is still higher than 0.5 volt at the M-terminal, and 0.5 volt or lower at the B-terminal, the problem is in the starter solenoid contacts. Remove the starter solenoid for repair.

8. If the voltage reading taken at the starter solenoid B-terminal is still higher than 0.5 volt after cleaning the cables and connections at the starter solenoid, the problem is either in the positive (+) battery cable connection, or in the positive battery cable itself. Perform the individual cable test.

Diagnosis and Testing - Motor Feed Circuit

Motor Ground Circuit

NOTE: Make all voltmeter connections at the component terminal rather that the cable or wiring terminal.

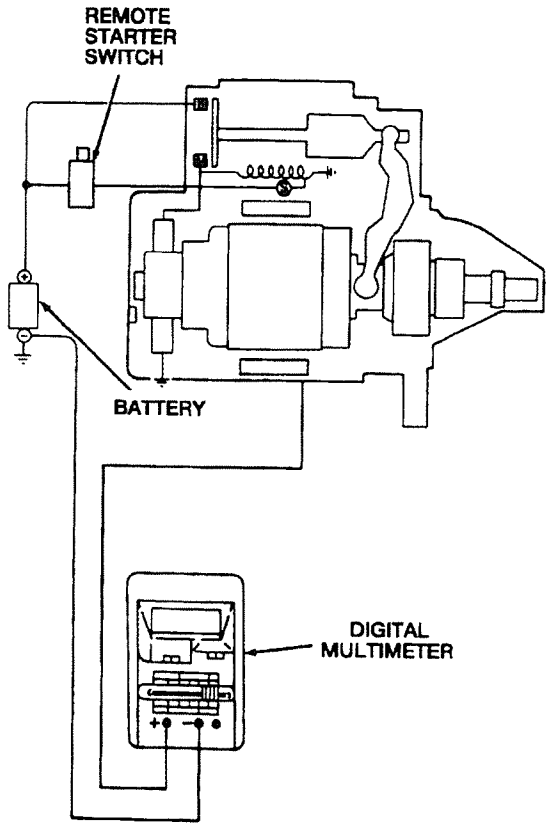
A slow cranking condition can be caused by resistance in the ground or return portion of the cranking circuit as follows:

1. Prevent the engine from starting by disconnecting both connectors from the distributor.

2. Connect a remote starter switch between the starter solenoid S-terminal and the battery positive (+) terminal.

3. Connect the positive (+) lead of the Digital Multimeter to the starter motor housing. The connection must be clean and free of rust, grease. Connect the negative (-) voltmeter lead. Connect the negative (-) voltmeter lead to the battery negative (-) terminal.

4. Engage the remote starter switch and crank the engine. Read and record the voltmeter reading. The reading should be 0.2 volt or less.



5. If the voltage is more than 0.2 volt, clean the negative cable connections at the battery and body connections, and retest it. If the voltage drop is still excessive, repair or replace the battery ground cable and/or the engine ground cable as necessary.

6. Always repeat the starter motor circuit checks after repairs to ensure the problem has been corrected. If the battery and cables test good, and the starter motor still cranks slowly or not at all, remove the starter motor for repair. Refer to removal procedure found in this section.

Individual Cables

1. Connect the positive (+) lead of the Digital Multimeter to the battery positive (+) post. Connect the negative (-) lead to the B-terminal of the starter solenoid.

2. Locate the excessive voltage drop in the cable by moving the voltmeter negative (-) lead toward the battery. Check each mechanical connection point. When the reading disappears, the last mechanical connection point that was checked is the problem.

Motor Pinion Test

1. Remove the starter motor. Refer the removal procedure found in this section.

2. Place the starter motor in a vise and secure.

3. Connect the negative lead to a fully charged battery to the starter motor case.

4. **CAUTION: Do NOT leave the positive lead of the battery connected to the starter motor for more than 10 seconds.**

   Touch the positive (+) lead from the battery to the S-terminal and see that the starter drive ejects.

5. If the starter drive does not eject, repair or replace the starter motor.

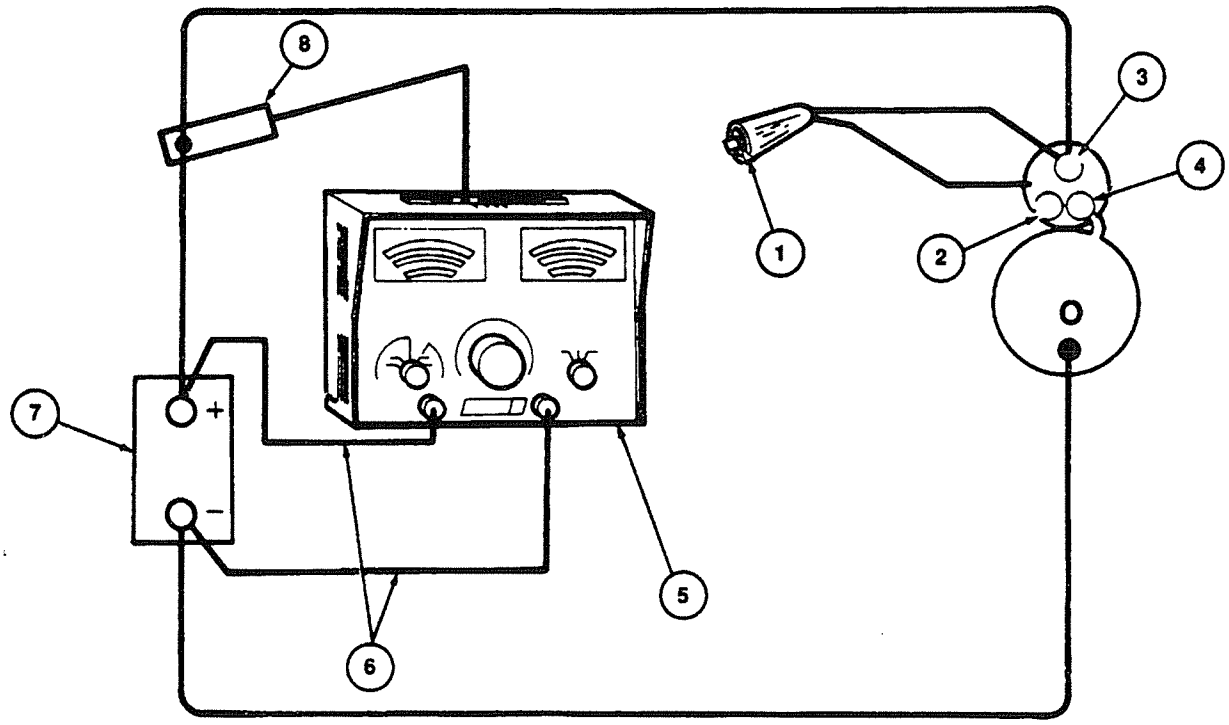
6. Remove the positive lead from the starter motor. The ejected starter drive should return to its original position.

7. If the starter drive does not eject, repair or replace the starter motor.

8. Check the starter drive. It should turn freely in one direction and positively engage to the armature when turned in the opposite direction. If not as specified, repair or replace the starter motor.

No Load Test

1. Connect a remote starter switch between the starter solenoid S-terminal and B-terminal.
2. Connect the positive (+) lead of the Starting and Charging Tester to the positive (+) of a fully battery.
3. Connect the negative lead of the tester to the battery negative (-) post.
4. Connect a heavy wire between the battery positive (+) post the starter solenoid B-terminal.
5. Install the inductive pickup of the test to the wire between the battery positive (+) post and starter solenoid B-terminal.
6. Connect a heavy ground wire between the battery negative (-) post and a good clean ground on the starter motor housing.
7. Press the remote starter switch and observe the starter, ammeter gauge, and voltmeter gauge



Item	Part Number	Description
1	-	Remote Starter Switch
2	-	S - Terminal
3	-	B - Terminal
4	-	M -Terminal
5	-	Starting And Charging Tester
6	-	Voltmeter Leads
7	-	Battery
8	-	Inductive Pickup

8. Disassemble the starter motor to determine the cause if the:

- Starter motor does not run smoothly.
- Voltmeter reads below 11.5 volts.
- Ammeter reads more than 60 amps.

Disassemble the starter motor as outlined in this section to perform the following tests.

Armature

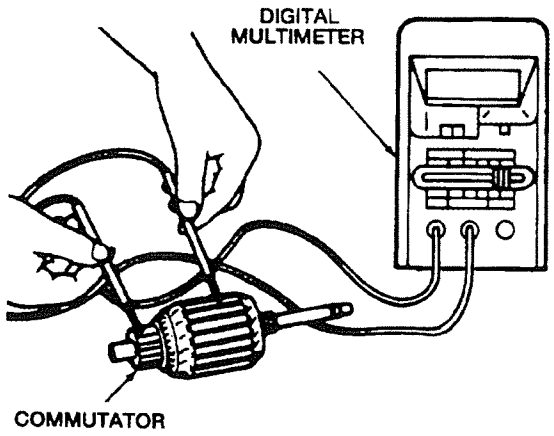
Open Circuit Test

An open circuit in the starter motor armature may be detected by examining the commutator for evidence of burning. A burn spot on the commutator is caused by an arc formed every time the commutator segment, connected to the open circuit winding, passes under a brush.

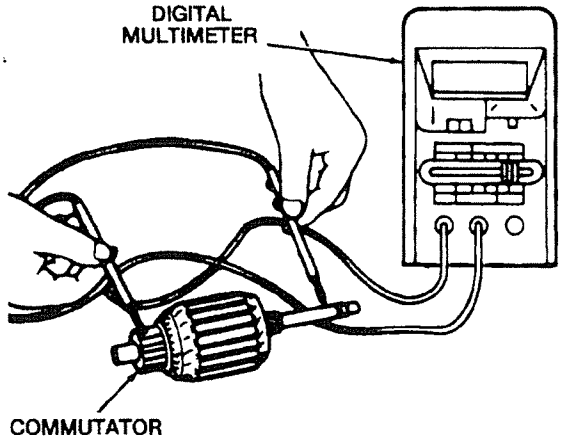
Grounded Circuit Test

1. Use a digital multimeter to find out if the armature is grounded by checking for continuity between the commutator and core.

2. If there is continuity between the commutator and armature, replace the starter motor armature.



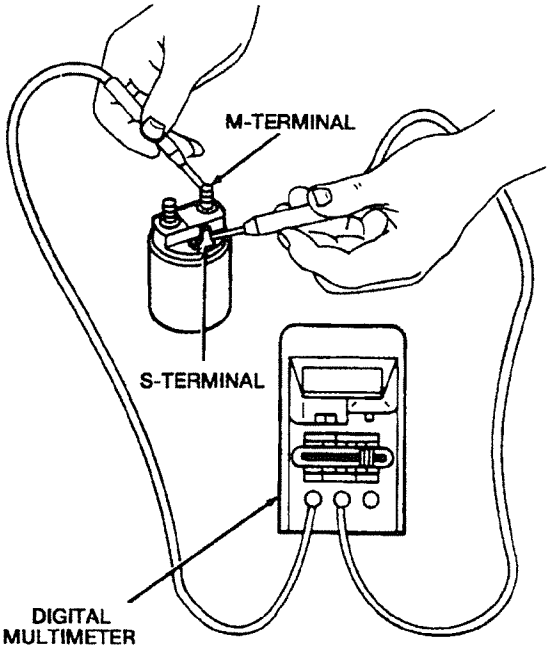
3. Use the digital multimeter to determine if the starter motor armature is insulated by checking for continuity between the commutator and the shaft. If there is continuity, replace the starter motor armature.



Starter Solenoid

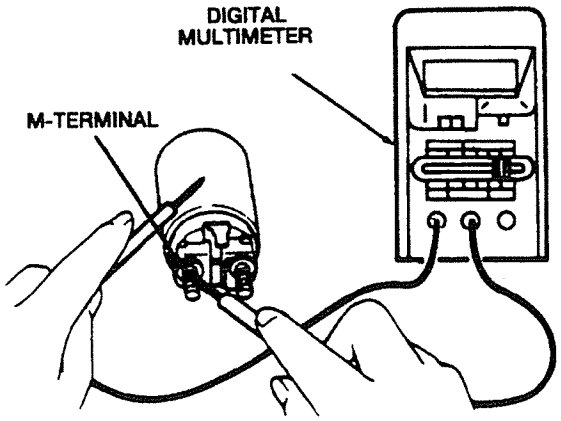
Solenoid S-terminal Circuit Resistance

Use the digital multimeter to check for continuity between the M-terminal and S-terminal. Replace the starter solenoid if there is no continuity.

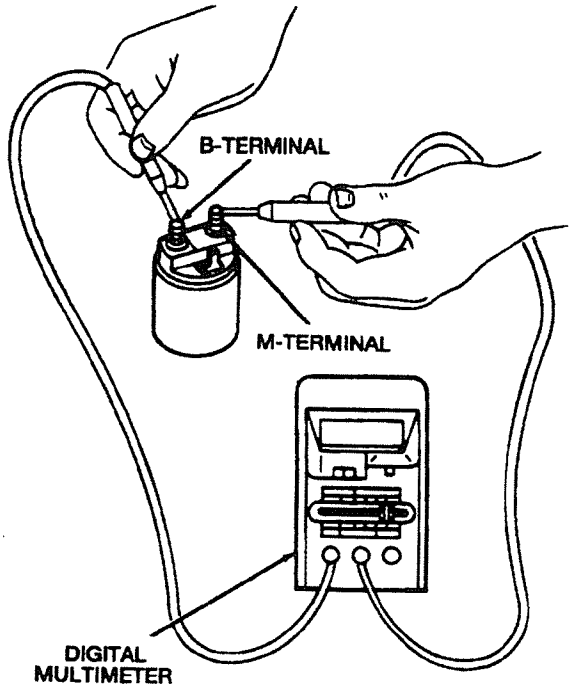


Solenoid M-terminal

1. Check for continuity between M-terminal and the starter solenoid body using the digital multimeter. Replace the starter solenoid if there is no continuity.



2. Check for a ground between the M-terminal and B-terminal using a digital multimeter. Replace the starter solenoid if there is continuity.

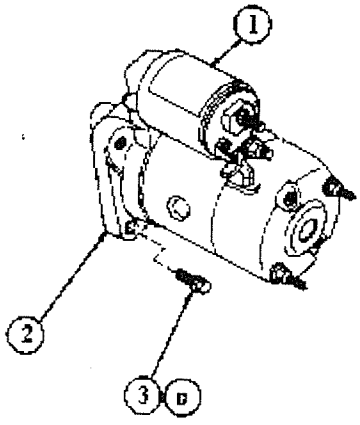


REMOVAL AND INSTALLATION

Starter Motor - Automatic Transaxle

Removal

Starter Motor - Automatic Transaxle



Item	Part Number	Description
1	-	Starter Motor Bolt (3)
2	180410	Starter Motor
3	183041	Starter Solenoid
D	-	Tighten to 23-34 lb-ft (31-46

		N-m)

1. Disconnect the battery ground cable.
2. Remove the two upper starter motor bolts.
3. Raise and support the vehicle.
4. Remove the two intake manifold support bolts, and remove the intake manifold support.
5. Remove the support bracket bolt.
6. Remove the support bracket.
7. Remove the two starter motor support nuts and washers.
8. Remove the starter motor support.
9. Disconnect the S-terminal connector at the starter solenoid.
10. Remove the B-terminal washer and nut.
11. Remove the B-terminal connector from the starter solenoid.
12. Remove the lower starter motor bolt.
13. Remove the starter motor.

Installation

NOTE: Do not tighten the support bracket bolts until the starter motor is installed. Adjustment of the support bracket may be required when the starter motor is installed to the support bracket.

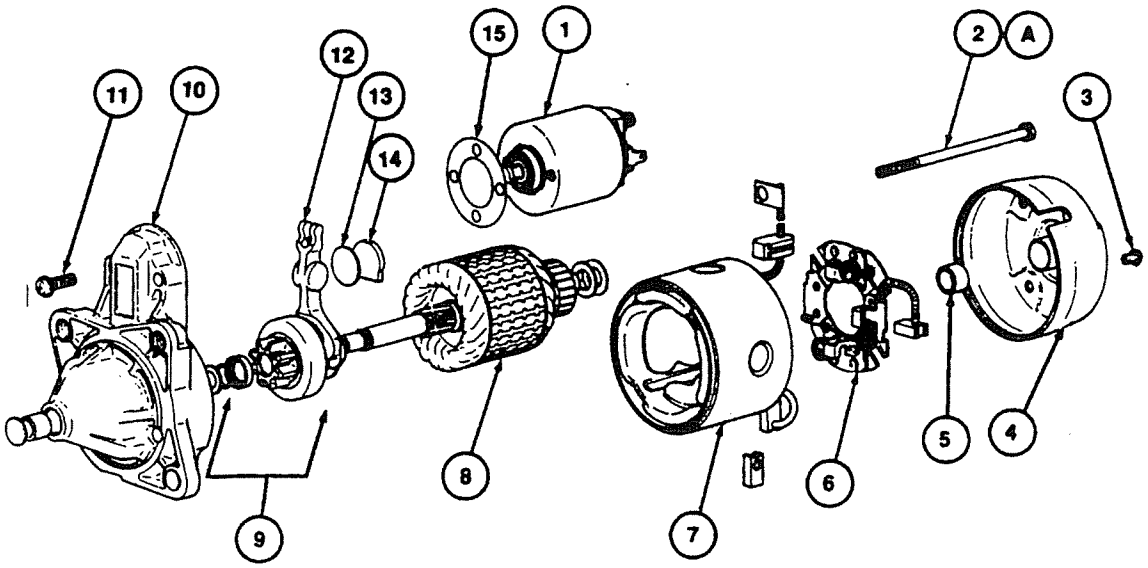
Install starter motor: reverse the removal procedure. Refer to Torque Specifications to ensure all bolts are tightened properly.

DISASSEMBLY AND DISASSEMBLY

Starter Motor

Starter Motor - Exploded View

Callouts for Starter Motor - exploded view



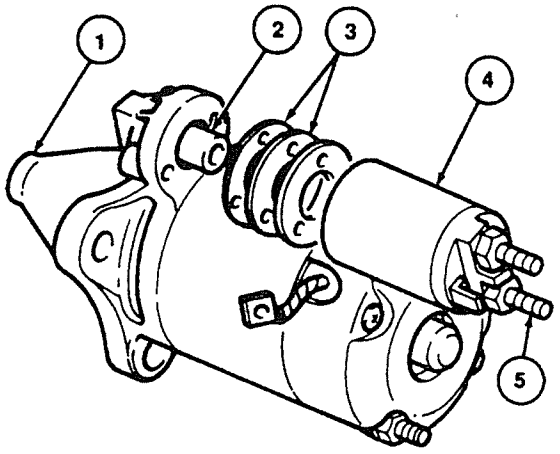
Item	Part Number	Description
1	-	Starter Solenoid
2	184017	Thru Bolt
3	184019	Brush End Plate Screws (2)
4	184015	Brush End Plate and Bushing Brush End Plate Bushing
5	184020	Brush Holder
6.	184014	Starter Field Coil
7	184013	Starter Motor Armature
8	184012	Starter Drive
9	184011	Drive End Housing
10	184006	Starter Solenoid Screws (2)
11	184011	Drive Lever and Pin Drive Lever and Pin Plate
12	184008	Drive Lever and Pin Seal
13	-	Shim
14	-	Tighten to 55-75 lb-in (6-8 N-m)
15	-	
A	-	

1. Remove the starter motor. Refer to the Starter Removal in this section.

2. Remove the M-terminal nut from the M-terminal.

3. Remove the field wire from the M-terminal.

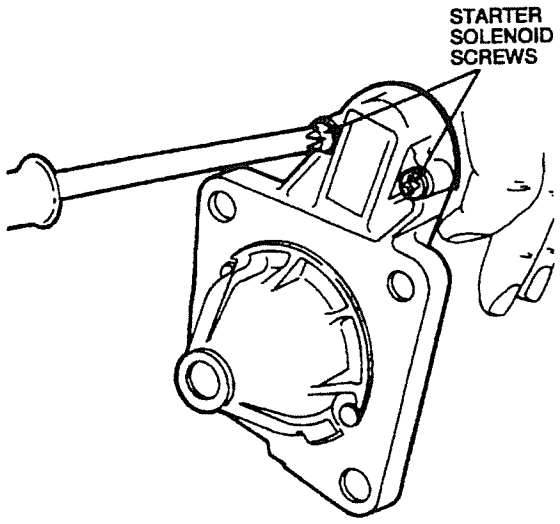
Starter Solenoid and Shim Location



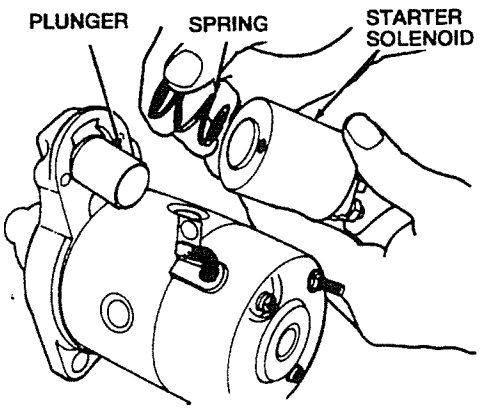
Item	Part Number	Description
1	184006	Drive End Housing
2	-	Plunger
3	-	Shims
4	-	Starter Solenoid
5	-	M-terminal

4. NOTE: If the shims are found between the starter solenoid and the drive end housing, remove them and set aside.

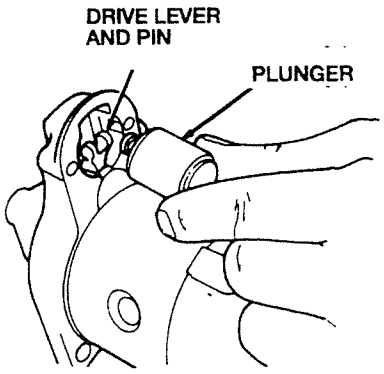
Remove the starter solenoid screws and the starter solenoid.



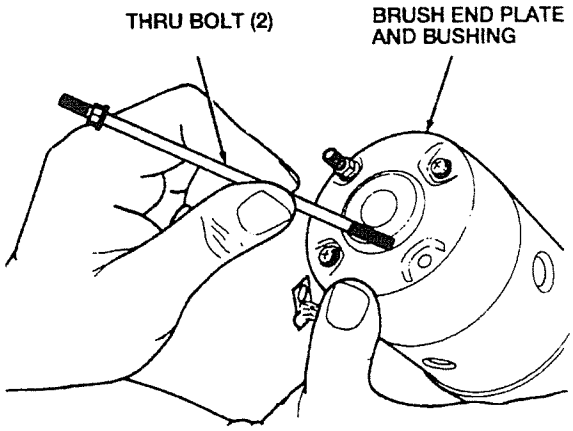
5. Remove the spring.



6. Disengage the plunger from the drive lever and pin and remove the plunger.

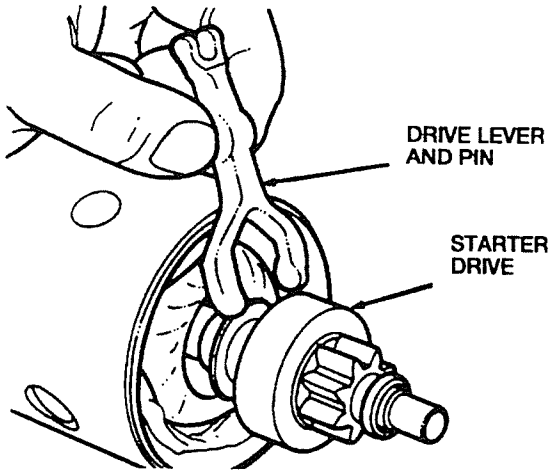


7. Remove the two thru bolts and the brush end plate and bushing.



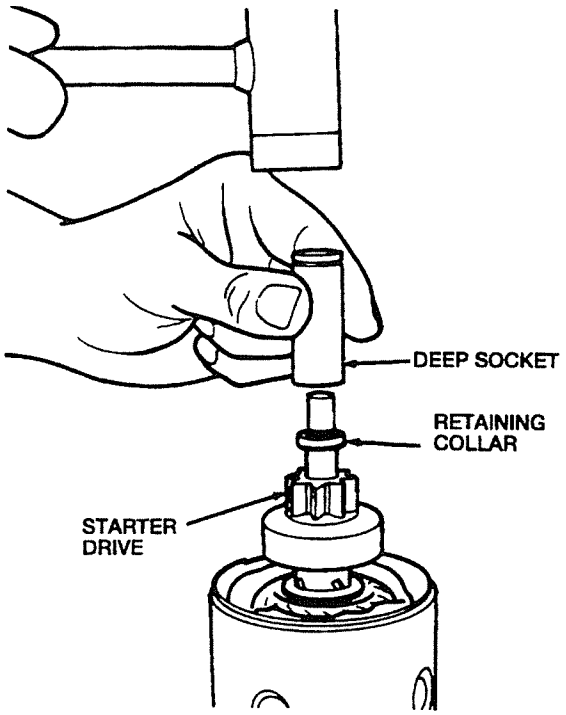
8. NOTE: Note the position of the drive lever and pin at time of removal to ensure the proper installation.

   Remove the drive lever and pin from the starter drive.



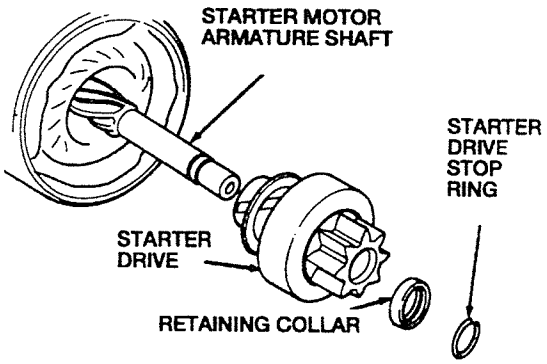
9. Remove the drive lever and pin seal and drive lever and pin plate from the drive plate and pin.

10. Using a deep socket or similar tool, drive the retaining collar from the starter drive stop ring.

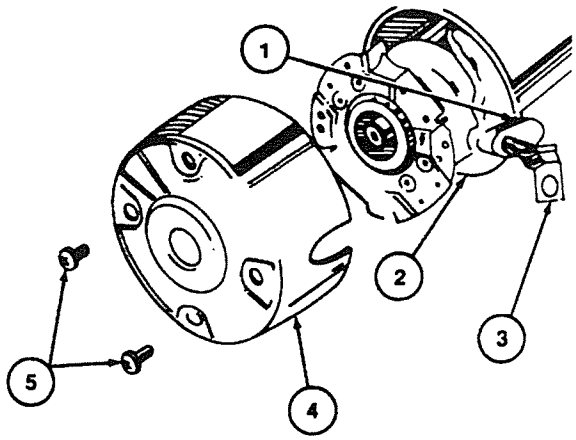


11. Remove the starter drive stop ring from the groove in the starter motor armature shaft.

12. Remove the retaining collar and starter drive from the starter motor armature shaft.



13. Remove the two brush end plate screws and the brush end plate and bushing.

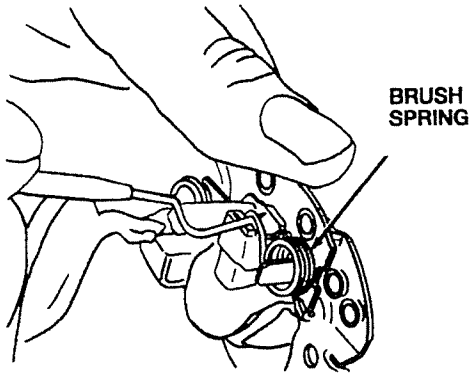


Item	Part Number	Description
1	-	Field Wire Grommet
2	-	Starter Field Coil
3	-	Field Wire Connector
4	184015	Brush End Plate and Bushing
5	184019	Brush End Plate Screws (2)

14. Remove the starter motor armature from the starter field coil.

15. Remove the armature washers from the end of the starter motor armature shaft.

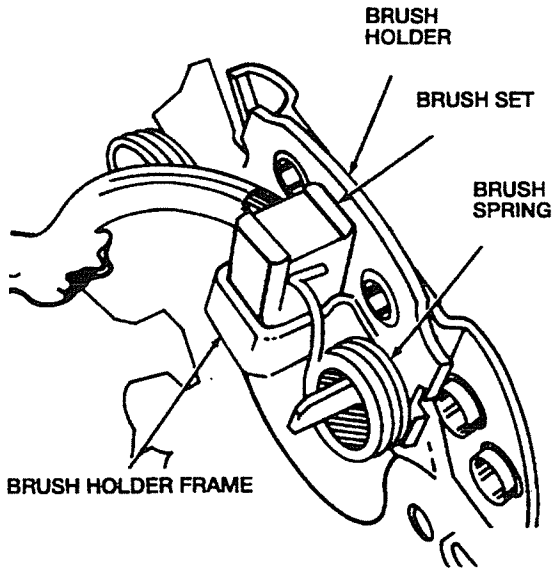
16. Use a suitable tool, pull back on the brush spring while pulling the brush set downward through the brush holder.



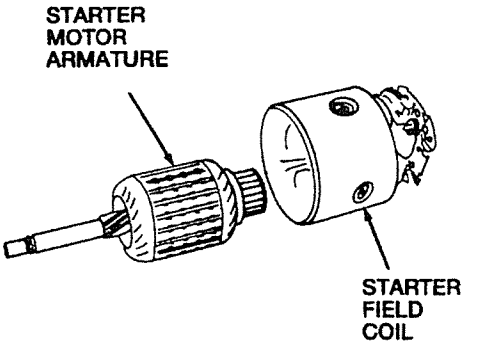
Assembly

1. NOTE: When the brush set extends past the brush spring, release the brush spring. The tension of the brush spring will hold the brush set in a retracted position.

Use a suitable tool to pull back on the brush spring while pushing the brush set upward through the brush holder frame.

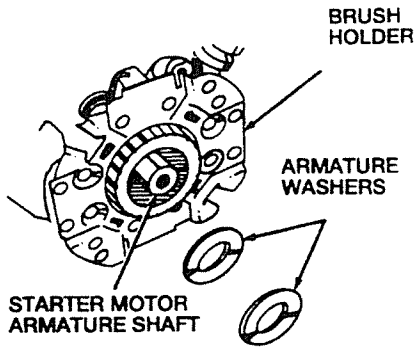


2. Install the starter motor armature into the starter field coil.



3. Release the brush spring tension on the brush set and push it into position against the starter motor armature. Ensure the tension brush springs are properly positioned in the brush holder and against the brush set.

4. Install the armature washers to the starter motor armature shaft.

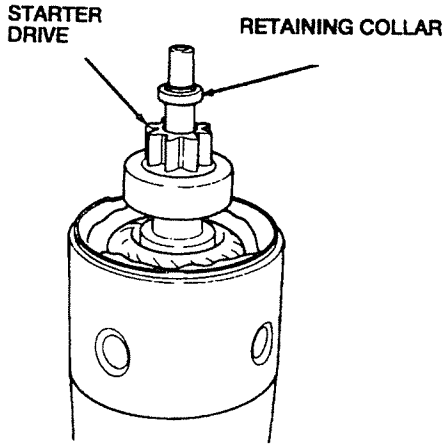


5. Install the two brush end plate screws and the brush end plate and bushing.

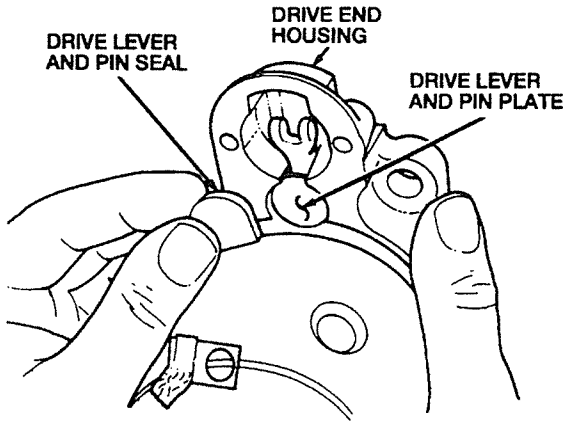
6. Install the starter drive and the retaining collar.

7. Install the starter drive stop ring.

8. Compress the starter drive stop ring and slide the starter stop ring and the retaining collar up. Ensure the retaining collar is firmly seated on the starter drive stop ring.



9. Position the drive lever and pin on the starter drive.



10. Position the drive end housing on the starter motor armature shaft.

11. Coat the drive lever and pin plate, drive lever and pin seal, and drive end housing with a thin film of contact cement.

12. Install the drive lever and pin plate and drive lever and pin seal in the drive end housing. Seat the drive end housing against the starter field coil.

13. Install the thru bolts. Tighten the thru bolts to 55-75 lb-in (6-8 N-m).

14. Install the plunger and spring.

15. NOTE: If shims were removed during disassembly, make sure they are installed with the starter solenoid.

    Position the starter solenoid and install the starter solenoid screws.

16. Connect the field wire to the M-terminal.

17. Install the nut to the M-terminal. Tighten the M-terminal nut to 71-106 lb-in (8-12 N-m).

18. Install the starter motor. Refer to the installation procedure in this section.

Starter Drive Replacement

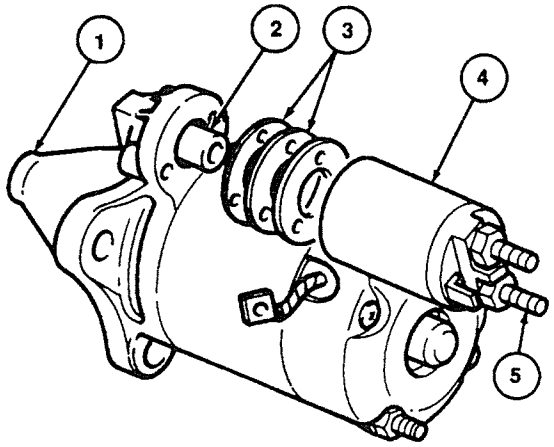
Disassembly

1. Remove the starter motor. Refer to the removal procedure found in this section.

2. Remove the M-terminal nut from the M-terminal.

3. Remove the field wire from the M-terminal.

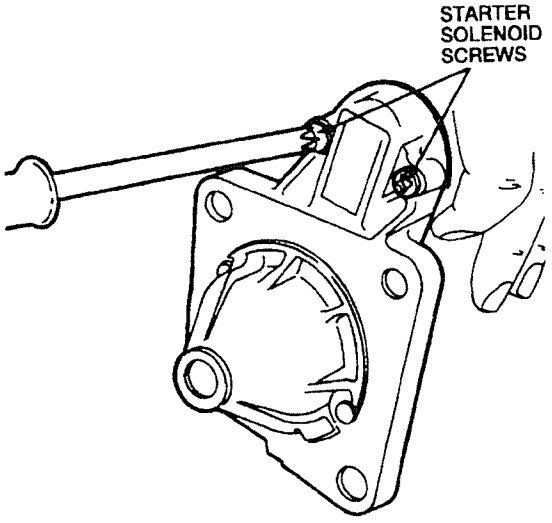
Starter Solenoid and Shim Location



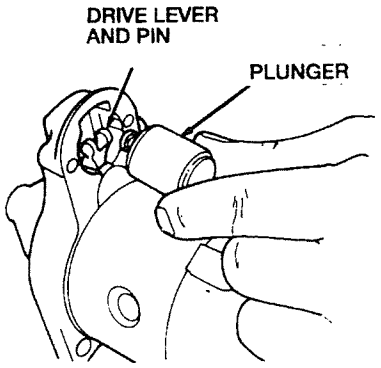
Item	Part Number	Description
1	184006	Drive End Housing
2	-	Plunger
3	-	Shims
4	-	Starter Solenoid
5	-	M-terminal

4. NOTE: If shims are found between the starter solenoid and the drive end housing, remove them and set aside.

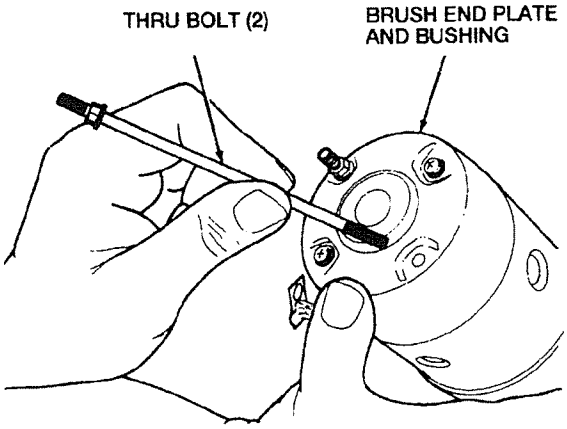
   Remove the starter solenoid screws and the starter solenoid.



5. Disengage the plunger from the drive lever and pin and remove the plunger.

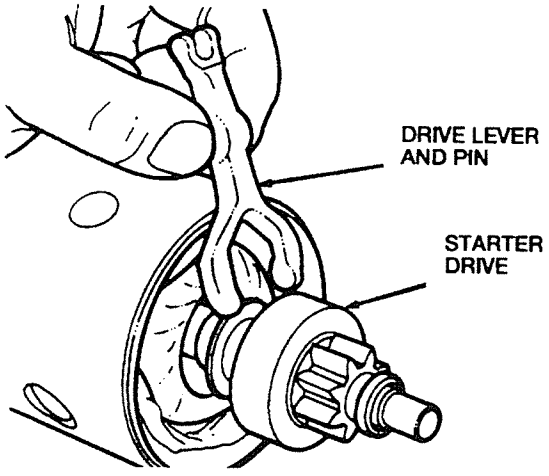


6. Remove the two thru bolts and the brush end plate and bushing.



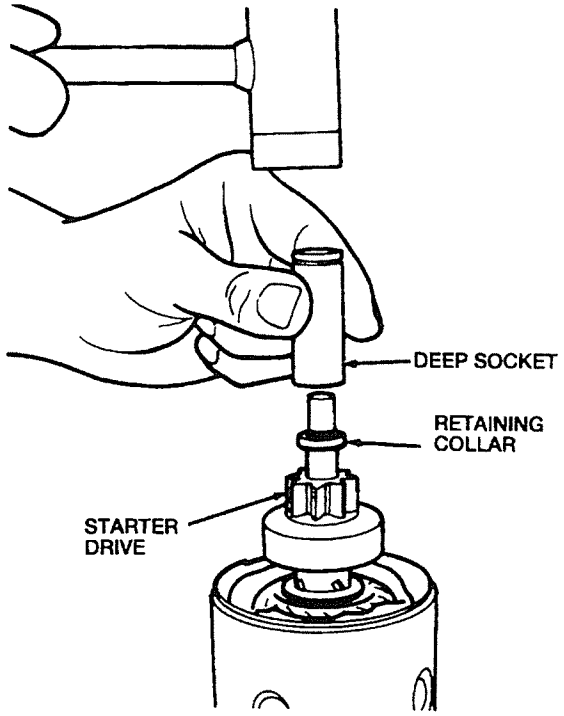
7. NOTE: Note the position of the drive lever and pin at removal to ensure proper installation.

   Remove the drive lever and pin from the starter drive.



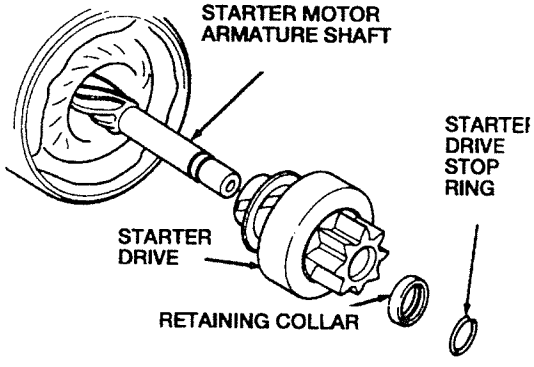
8. Remove the drive lever and pin seal and drive lever and pin plate from the drive lever and pin.

9. Use a deep socket or similar tool to drive the retaining collar from the starter drive stop ring (11222).



10. Remove the starter drive stop ring from the groove in the starter motor armature shaft.

11. Remove the retaining collar and starter drive from the starter motor armature shaft.

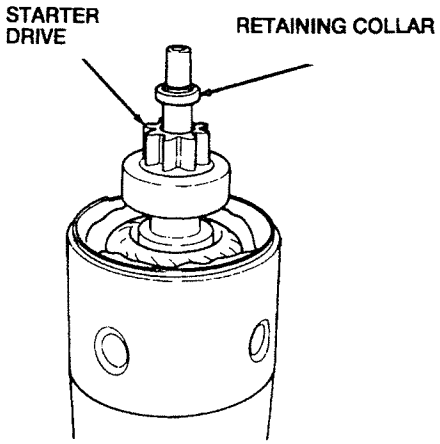


Assembly

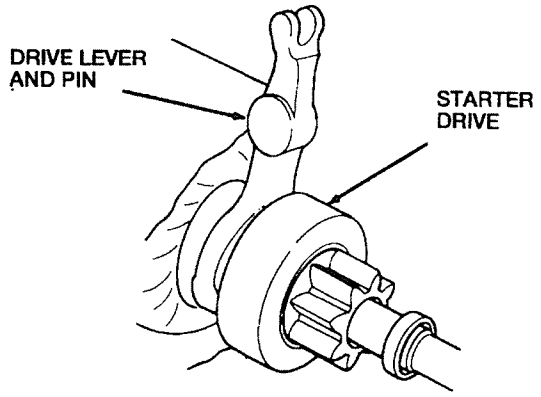
1. Install the starter drive and the retaining collar.

2. Install the starter drive stop ring.

3. Compress the starter drive stop ring and slide the starter drive stop ring and the retaining collar up. Ensure the retaining collar is firmly seated on the starter drive stop ring.

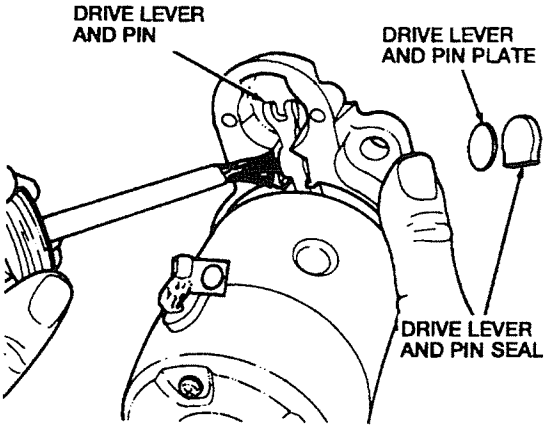


4. Position the drive lever and pin on the starter drive.

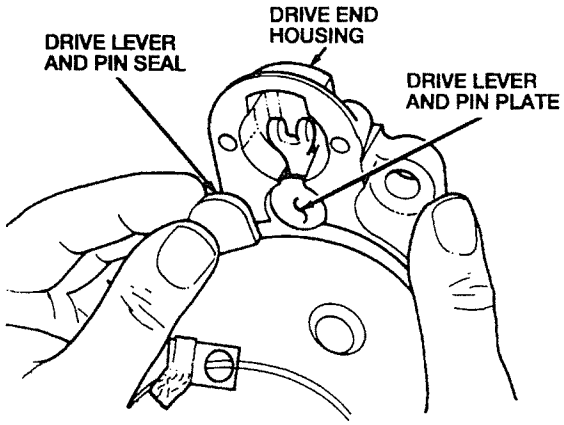


5. Position the drive end housing on the starter motor armature shaft.

6. Coat the drive lever and pin plate, drive lever and pin seal, and drive end housing with a thin film of contact cement.



7. Install the drive lever and pin plate and drive lever and pin seal in the drive end housing against the starter field coil.



8. Install the thru bolts. Tighten the thru bolts 55-75 lb-in (6-8 N-m).

9. Install the plunger and spring.

10. NOTE: If the shims were removed during disassembly, make sure they are installed with the starter solenoid.

    Position the starter solenoid and install the starter solenoid screws.

11. Connect the field wire to the M-terminal.

12. Install the nut on the M-terminal. Tighten the M-terminal nut to 71-106 lb-in (8-12 N-m).

13. Install the starter motor. Refer to the installation procedure found in this section.

Brush Replacement

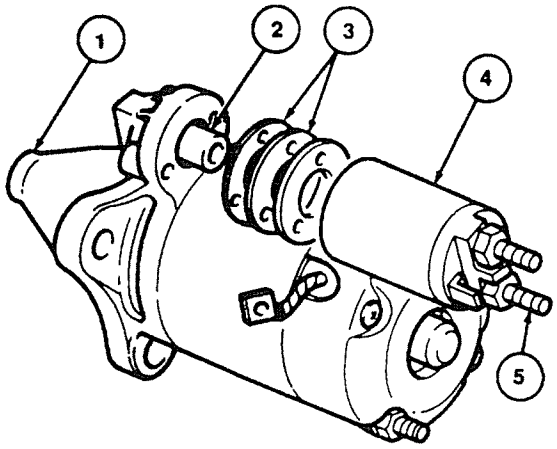
Disassembly

1. Remove the starter motor. Refer to the removal procedure found in this section.

2. Remove the M-terminal nut from the M-terminal.

3. Remove the field wire from the M-terminal.

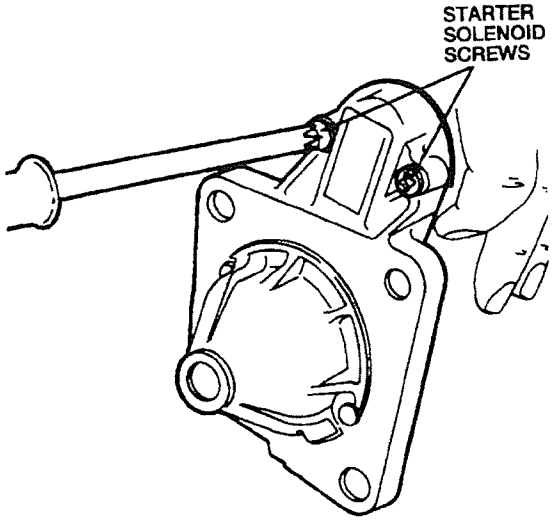
Starter Solenoid and Shim Location



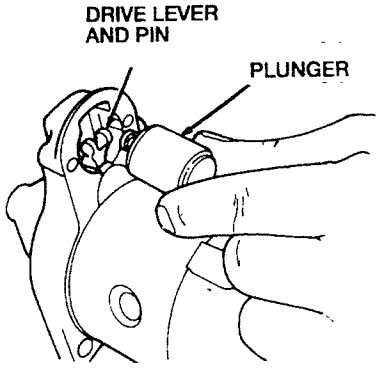
Item	Part Number	Description
1	184006	Drive End Housing
2	-	Plunger
3	-	Shims
4	-	Starter Solenoid
5	-	M-Terminal

4. NOTE: Shims are found between the starter solenoid and the drive end housing, remove them and set aside.

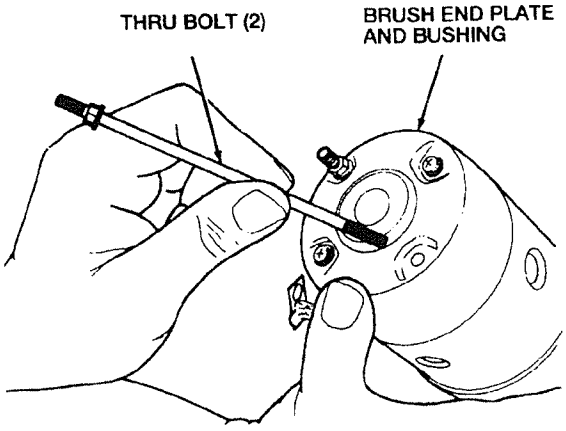
   Remove the starter solenoid screws and the starter solenoid.



5. Disengage the plunger from the drive lever and pin and remove the plunger.

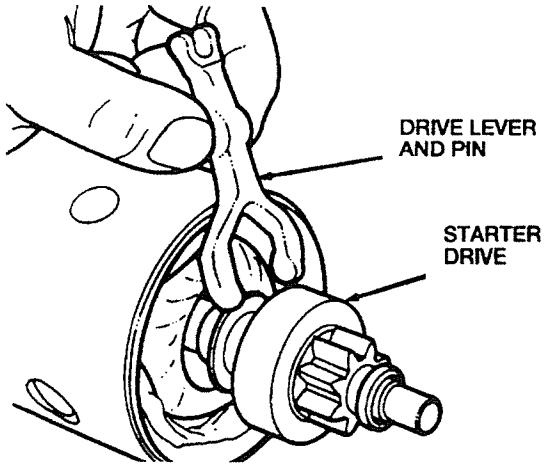


6. Remove the thru bolts and brush end plate and bushing.



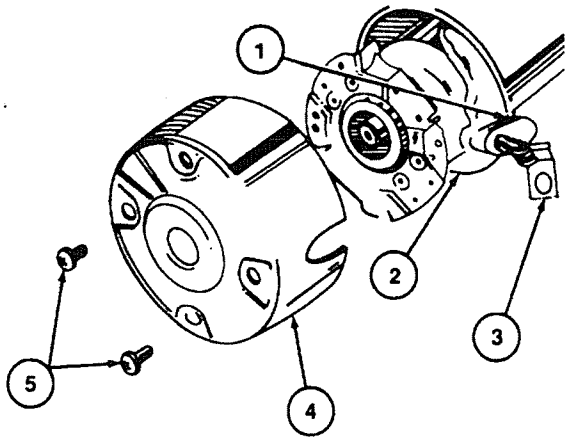
7. NOTE: Note the position of the drive lever and pin at removal to ensure proper installation.

   Remove the drive lever and pin from the starter drive.



8. Remove the drive lever and pin seal and drive lever and pin plate from the drive lever and pin.

9. Remove the two brush end plate screws and the brush end plate and bushing.

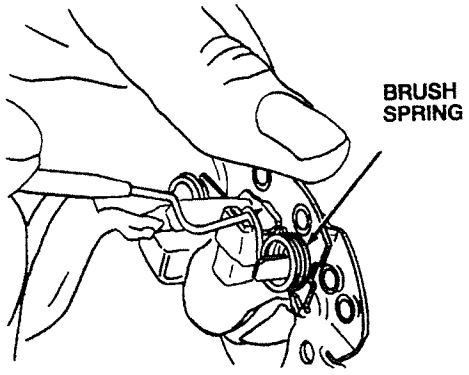


Item	Part Number	Description
1	-	Field Wire Grommet
2	-	Starter Field Coil
3	184014	Field Wire Connector
4	184015	Brush End Plate and Bushing
5	184019	Brush End Plate Screws (2)

10. Remove the starter motor armature from the starter field coil.

11. Remove the armature washers from the end of the starter motor armature shaft.

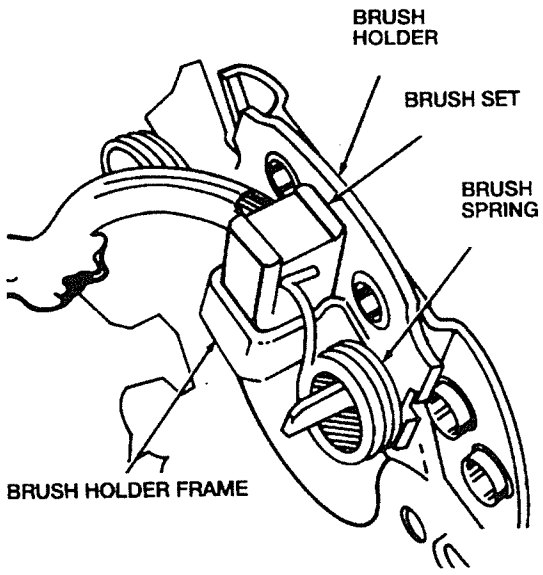
12. Use a suitable tool to pull back on the brush spring while pulling the brush set downward through the brush holder.



Assembly

1. NOTE: When the brush set extends past the brush spring, release the brush spring. The tension of the brush spring will hold the brush set in a retracted position.

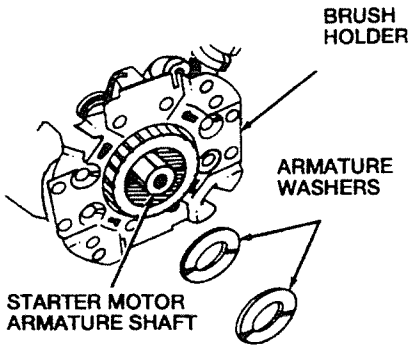
   Use a suitable tool to pull back on the brush spring while pushing the brush set upward through the brush holder.



2. Install the starter motor armature into the starter field coil.

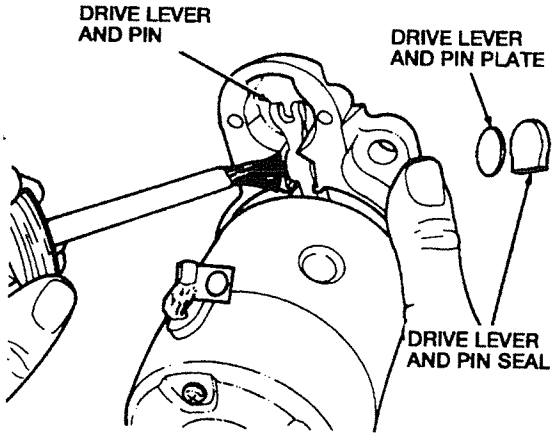
3. Release the brush spring tension on the brush set and push it into position against the starter motor armature. Ensure the tension brush springs are properly positioned in the brush holder and against the brush set.

4. Install the starter motor armature washers onto the starter motor armature shaft.

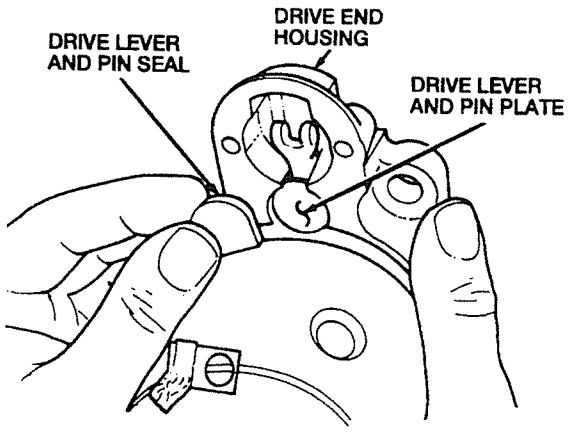


5. Install the two brush end plate screws and the brush end plate and bushing.

6. Coat the drive lever and pin plate, drive lever and pin seal, and drive end housing with a thin film of contact cement.



7. Install the yoke plate and yoke seal in the drive end housing. Seat the drive end housing against the starter field coil.



8. Install the thru bolts. Tighten the thru bolts to 55-75 lb-in (6-8 N-m)

9. Install the plunger.

10. NOTE: If the shims were removed during disassembly, make sure they are installed with the starter solenoid.

11. Connect the field wire to the M-terminal.

12. Install the nut on the M-terminal. Tighten the M-terminal nut to 71-106 lb-in. (8-12 N-m).

13. Install the starter motor. Refer to the installation procedure in this section.

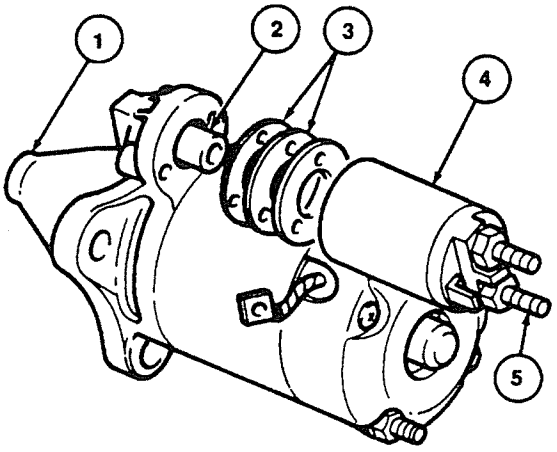
Armature Replacement, Starter Motor

Disassembly

1. Remove the starter motor. Refer to the removal procedure.

2. Remove the M-terminal nut from the M-terminal.

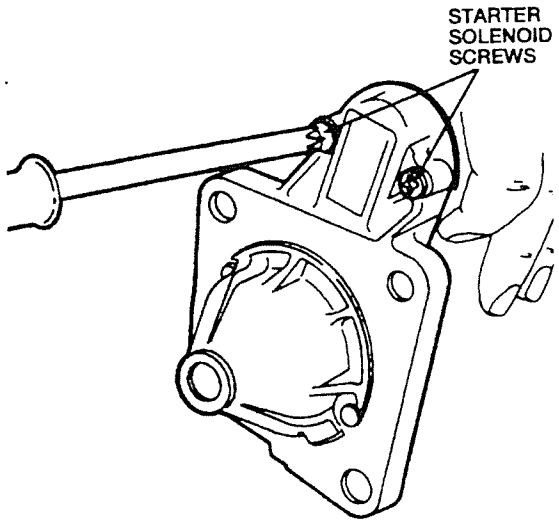
3. Remove the field wire from the M-terminal.



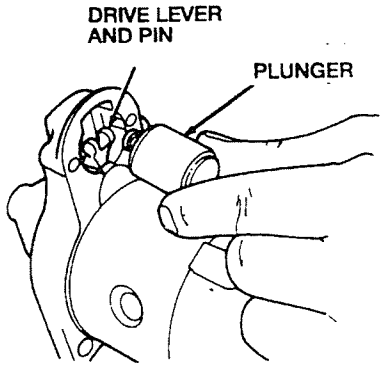
Item	Part Number	Description
1	184006	Drive End Housing
2	-	Plunger
3	-	Shims
4	-	Starter Solenoid
5	-	M-Terminal

4. NOTE: If shims are found between the starter solenoid and the drive end housing, remove them and set aside.

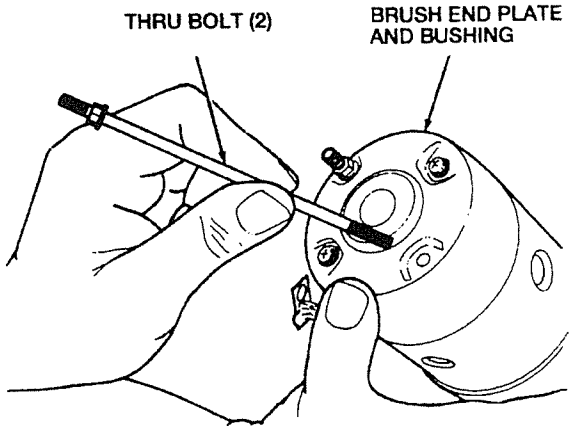
   Remove the starter solenoid screws and the starter solenoid.



5. Disengage the plunger from the drive lever and pin and remove the plunger.

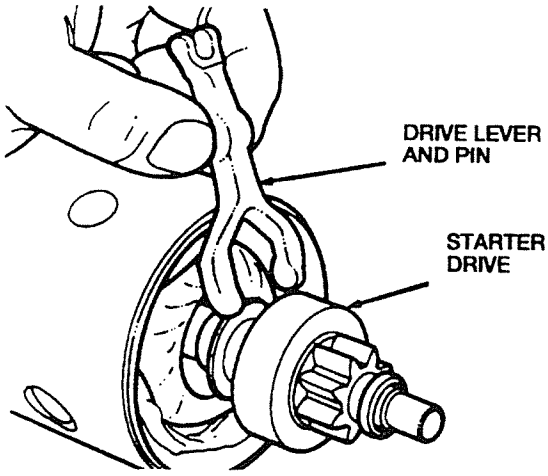


6. Remove the two thru bolts and the brush end plate and bushing.



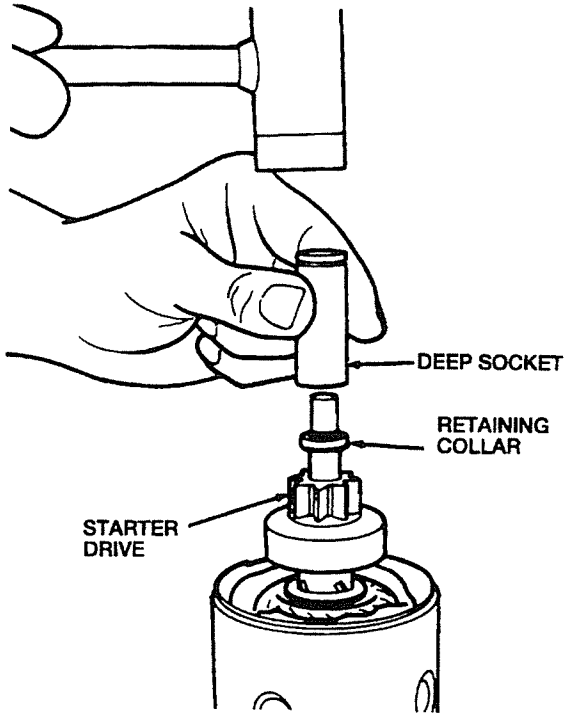
7. NOTE: Note the position of the drive lever and pin at removal to ensure proper installation.

   Remove the drive lever and pin from the starter drive.



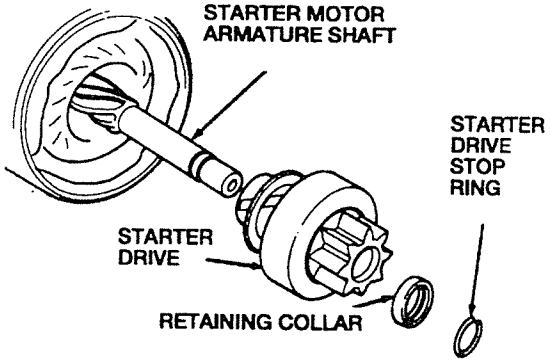
8. Remove the drive lever and pin seal and drive lever and pin plate from the drive lever and pin.

9. Use a deep socket or similar to drive the retaining collar from the starter drive stop ring.

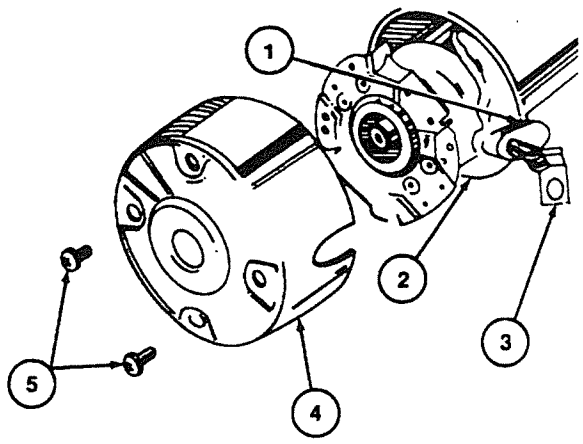


10. Remove the starter drive stop ring from the groove in the starter motor armature shaft.

11. Remove the retaining collar and starter drive from the starter motor armature shaft.



12. Remove the two brush end plate screws and the brush end plate and bushing.

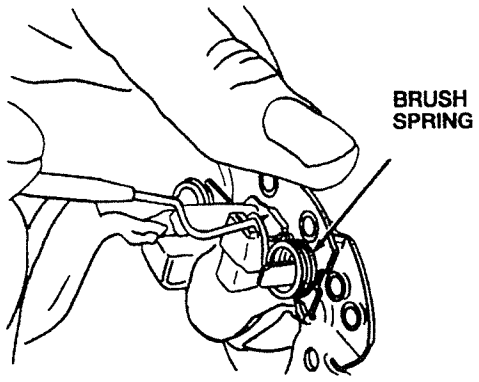


Item	Part Number	Description
1	-	Field Wire Grommet
2	-	Starter Field Coil
3	184014	Field Wire Connector
4	184015	Brush End Plate and Bushing
5	184019	Brush End Plate Screws (2)

13. Remove the starter motor armature from the starter field coil.

14. Remove the armature washers from the end of the starter motor armature shaft.

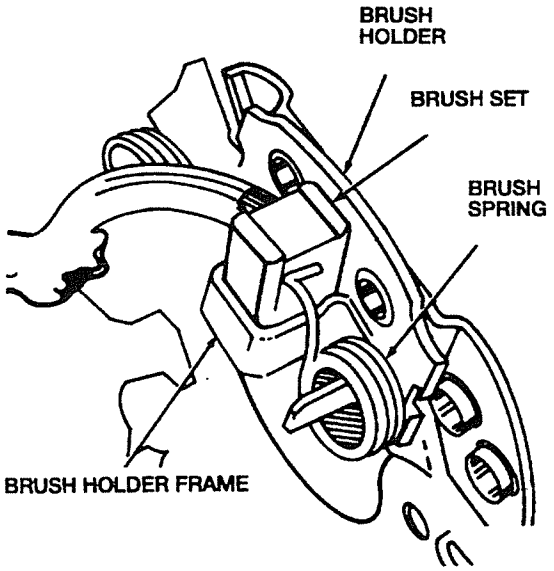
15. Use a suitable tool to pull back on the brush spring while pulling the brush set downward through the brush holder.



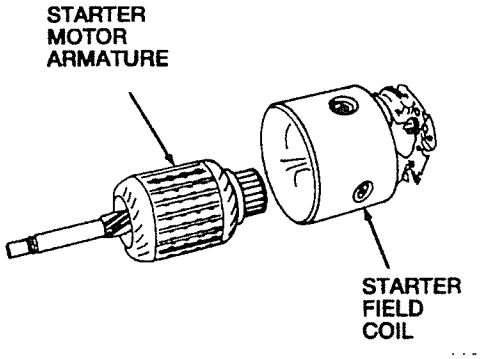
Assembly

1. NOTE: When the brush set extends past the brush spring, release the brush spring. The tension of the brush spring will hold the brush set in a retracted position.

Use a suitable tool to pull back on the brush spring while pushing the brush set upward through the brush holder.

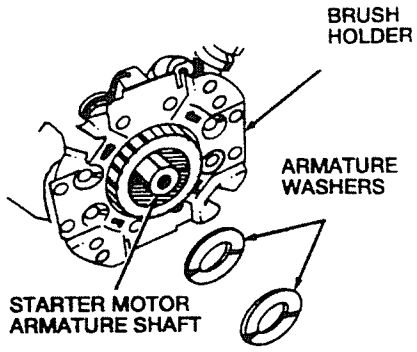


2. Install the starter motor armature into the starter field coil.



3. Release the brush spring tension on the brush set and push it into position against the starter motor armature. Ensure the tension brush springs are properly positioned in the brush holder and against the brush set.

4. Install the starter motor armature washers onto the starter motor armature shaft.

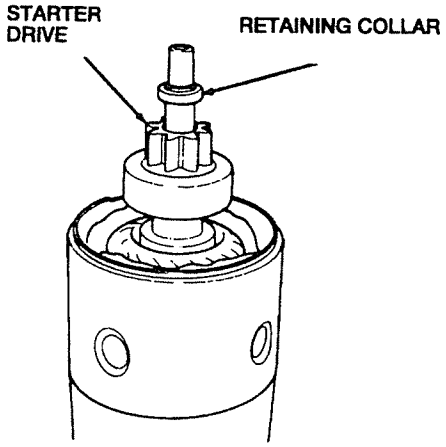


5. Install the two brush end plate screws and the brush end plate and bushing.

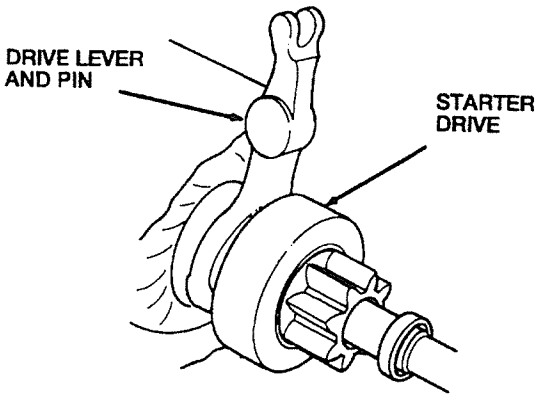
6. Install the starter drive and the retaining collar.

7. Install the starter drive stop ring.

8. Compress the starter drive stop ring and slide the starter drive stop ring and the retaining collar up. Ensure the retaining collar is firmly seated on the starter drive stop ring.

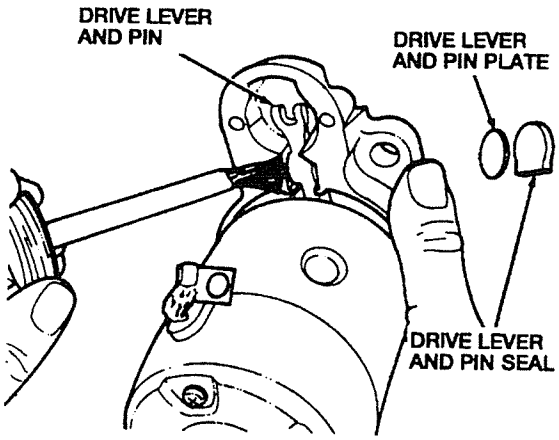


9. Position the drive lever and pin on the starter drive.

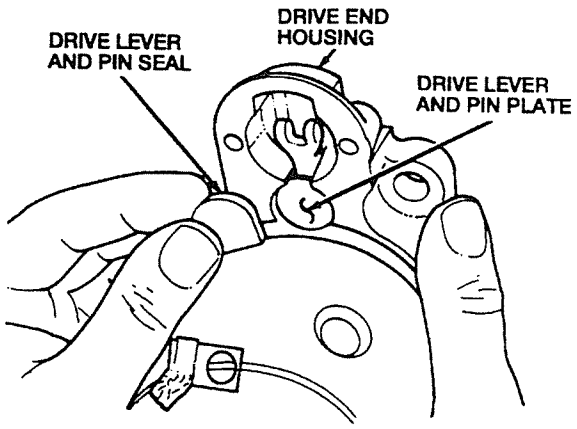


10. Position the drive end housing on the starter motor armature shaft.

11. Coat the drive lever and pin plate, drive lever and pin seal, and drive end housing with a thin film of contact cement.



12. Install the drive lever an pin plate and drive lever and pin seal in the drive end housing. Seat the drive end housing against the starter field coil.



13. Install the thru bolts. Tighten the thru bolts to 55-75 lb-in (6-8 N-m).

14. Install the solenoid plunger.

15. NOTE: If shims were removed during disassembly, make sure they are installed with the starter solenoid.

    Position the starter solenoid and install the starter solenoid screws.

16. Connect the field wire to the starter solenoid M-terminal.

17. Install the nut on the M-terminal. Tighten the M-terminal nut to 71-106 lb-in (8-12 N-m).

18. Install the starter motor. Refer to the installation procedure in this section.

Bushings

Disassembly and Assembly

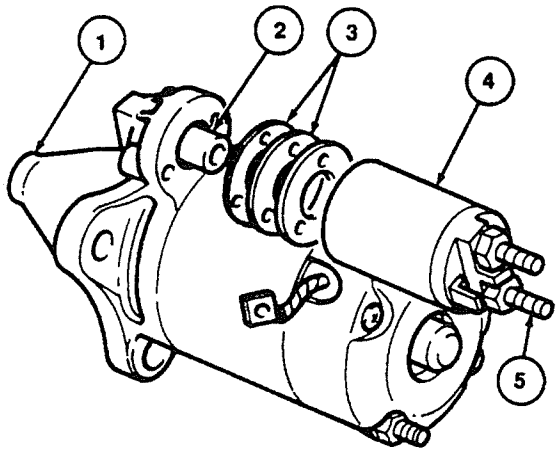
The bushings are replaced as a part of the drive end housing and brush end plate disassembly and assembly procedures. Refer to the disassembly and assembly procedures in this section.

Drive End Housing

Disassembly

1. Remove the starter motor. Refer to the removal procedure in this section.
2. Remove the M-terminal nut from the M-terminal.
3. Remove field wire from the M-terminal.

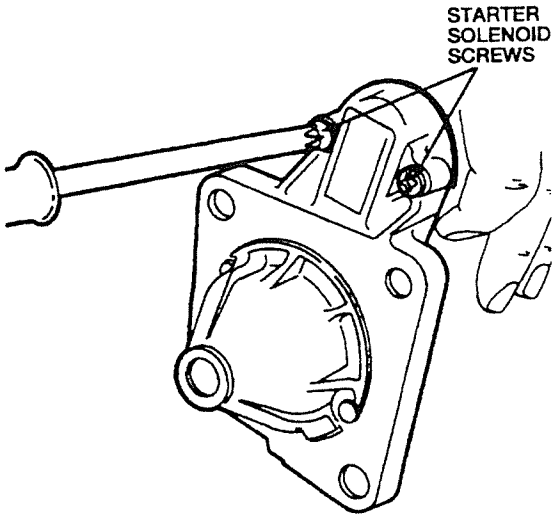
Starter Solenoid and Shim Location



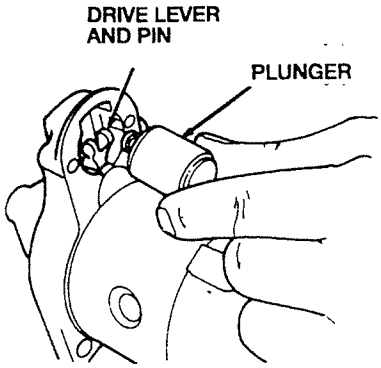
Item	Part Number	Description
1	184006	Drive End Housing
2	-	Plunger
3	-	Shims
4	-	Starter Solenoid
5	-	M-terminal

4. NOTE: If shims are found between the starter solenoid and the drive end housing, remove them and set aside.

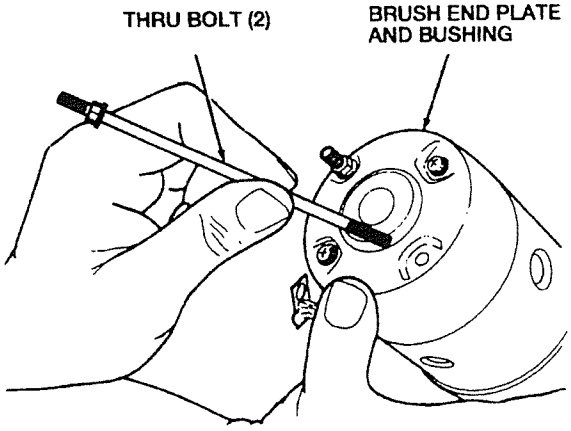
   Remove the starter solenoid screws and the starter solenoid.



5. Disengage the plunger from the drive lever and pin and remove the plunger.



6. Remove the two thru bolts and the brush end plate and bushing.



7. Remove the drive end housing.

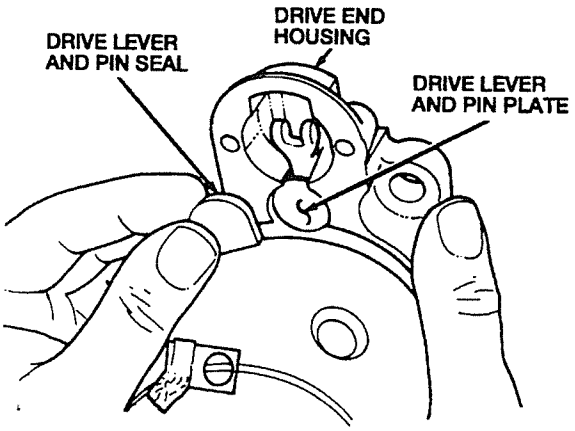
8. Press or tap the drive end housing bushing out of the drive end housing using a driver of the appropriate size. Be sure the drive end housing is well supported.

Assembly

1. NOTE: Immerse the new drive end housing bushing in clean engine oil for at least 20 minutes before installation.

   Do not ream the drive end housing bushing after installation since the self-lubricating qualities of the drive end housing bushing may be damaged.
   Press the new drive end housing bushing into position using a suitable driver.

2. Seat the drive end housing against the starter field coil.



3. Install the thru bolts. Tighten the thru bolts to 55-75 lb-in (6-8 N-m).

4. Install the plunger and spring.

5. NOTE: If shims were removed during disassembly, make sure they are installed with the starter solenoid.

   Position the starter solenoid and install the starter solenoid screws.

6. Connect the field wire to the M-terminal.

7. Install the nut on the M-terminal. Tighten the M-terminal nut to 71-106 lb-in (8-12 N-m).

8. Install the starter motor. Refer to the installation procedure in this section.

Brush End Plate

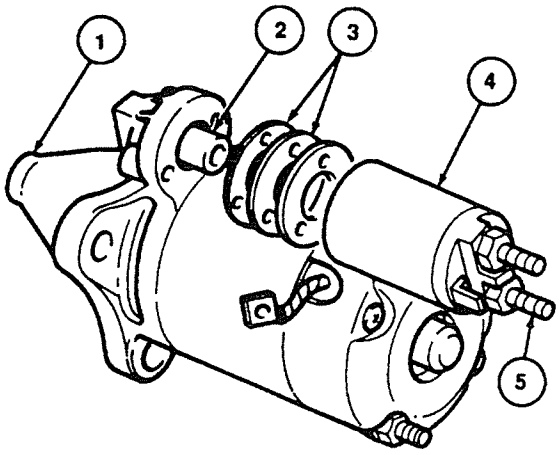
Disassembly

1. Remove the starter motor. Refer to the removal procedure in this section.

2. Remove the M-terminal nut from the M-terminal.

3. Remove the field wire from the M-terminal.

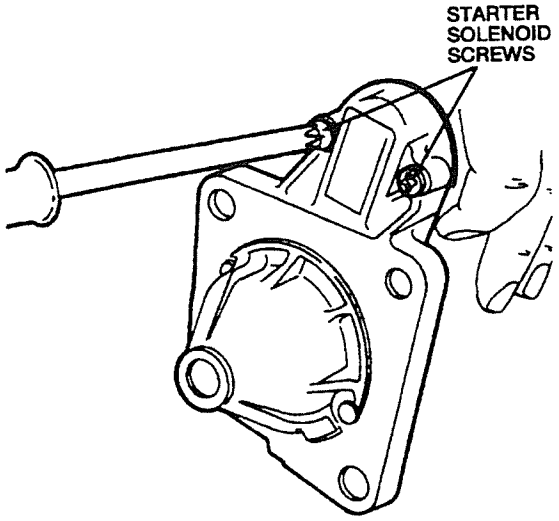
Starter Solenoid and Shim Location



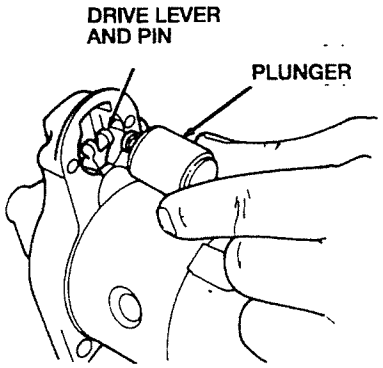
Item	Part Number	Description
1	184006	Drive End Housing
2	-	Plunger
3	-	Shims
4	-	Starter Solenoid
5	-	M-terminal

4. NOTE: If shims are found between the starter solenoid and the drive end housing, remove them and set aside.

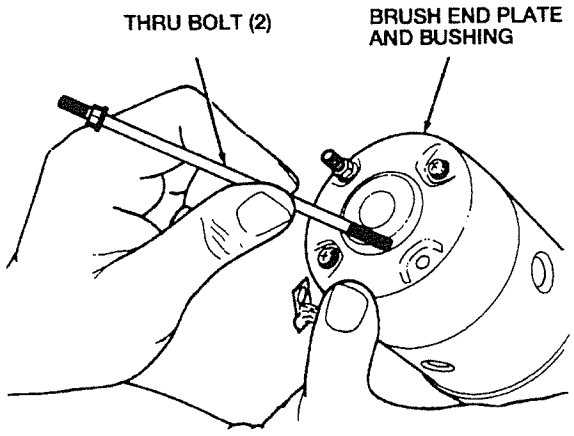
   Remove the starter solenoid screws and the starter solenoid.



5. Disengage the plunger from the drive lever and pin and remove the plunger.

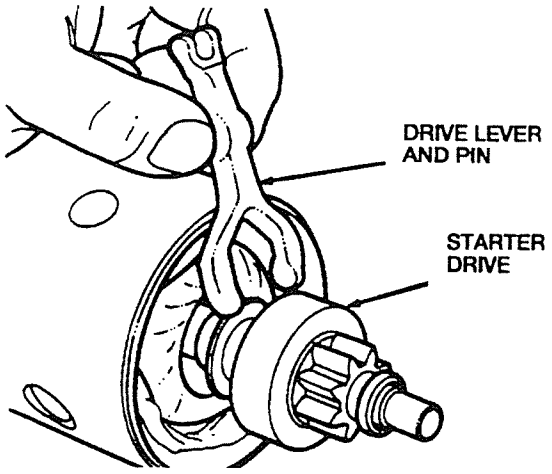


6. Remove two thru bolts and the brush end plate and bushing.



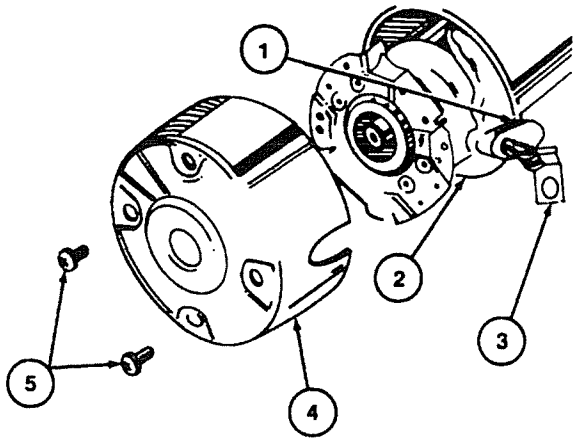
7. NOTE: Note the position of the drive lever and pin at removal to ensure proper installation.

   Remove the drive lever and pin from the starter drive.



8. Remove the drive lever and pin seal and drive lever and pin plate from the drive lever and pin.

9. Remove the two brush end plate screws and the brush end plate and bushing.



Item	Part Number	Description
1	-	Field Wire Grommet
2	-	Starter Field Coil
3	184014	Field Wire Connector
4	184015	Brush End Plate and Bushing
5	184019	Brush End Plate Screws (2)

10. Press or tap the brush end plate bushing from the brush end plate and bushing using a driver of an appropriate size. Be sure the brush end plate and bushing is well supported.

Assembly

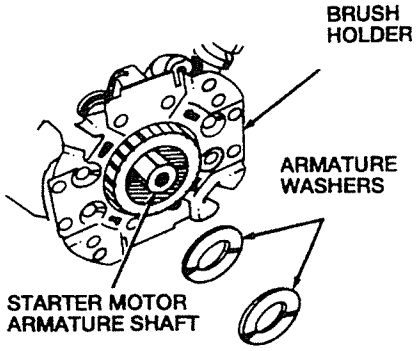
1. NOTE: Immerse the brush end plate bushing in clean engine oil for at least 20 minutes before installation.

   Do not ream the brush end plate bushing after installation since the self-lubricating qualities of the brush end plate bushing may be damaged.

   Press or tap the new brush end plate bushing into position using a driver.

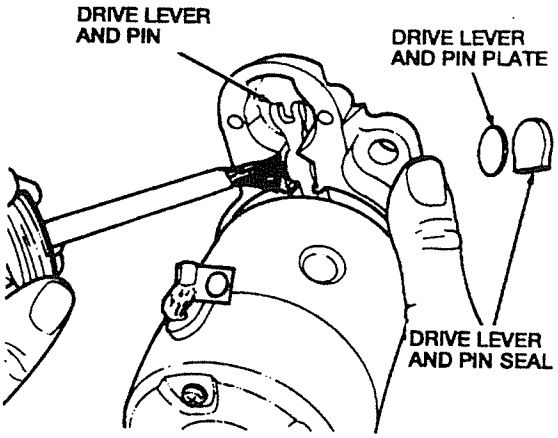
2. Install the starter motor armature into the starter field coil.

3. Install the starter motor armature washers to the starter motor armature shaft.

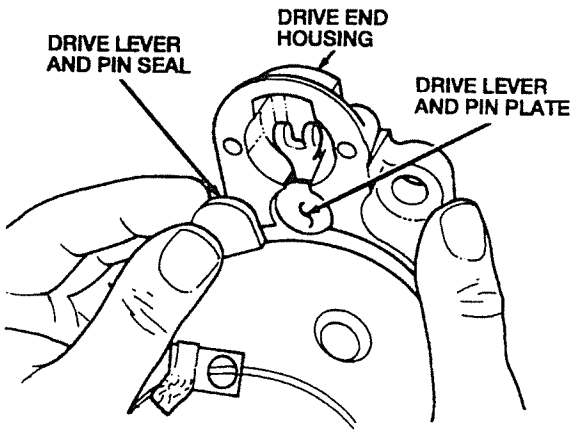


4. Install the two brush end plate screws and the brush end plate and bushing.

5. Coat the drive lever and pin plate, drive lever and pin seal, and drive end housing with a thin film of contact cement.



6. Install the yoke plate and yoke seal in the drive end housing. Seat the drive end housing against the starter field coil.



7. Install the thru bolts. Tighten the thru bolts to 55-75 lb-in (6-8 N-m).

8. Install the plunger.

9. NOTE: If shims were removed during disassembly, make sure they are installed with the starter solenoid.

   Position the starter solenoid and install the starter solenoid screws.

10. Connect the field wire to the M-terminal.

11. Install the nut on the M-terminal. Tighten the M-terminal nut to 71-106 lb-in (8-12 N-m).

12. Install the starter motor. Refer to the procedure in this section.

SERVICE PROCEDURES

Road Service

For cases of a starter motor that cranks the engine very slowly, connect a 12-volt booster battery to the system.

Jump Starting

Prior to jump starting the vehicle, be aware of the following:

WARNING: HYDROGEN AND OXYGEN GASES ARE PRODUCED DURING NORMAL BATTERY OPERATION. THIS GAS MIXTURE CAN EXPLODE IF FLAMES, SPARKS, OR BURNING SUBSTANCES (CIGARETTES, ETC.) ARE BROUGHT NEAR THE BATTERY. WHEN CHARGING OR USING A BATTERY IN AN ENCLOSED AREA (INCLUDING THE VEHICLE ENGINE COMPARTMENT) ALWAYS PROVIDE VENTILATION AND SHIELD YOUR EYES. KEEP CHILDREN AWAY FROM VEHICLE BATTERIES. BATTERIES CONTAIN SULFURIC ACID. "AVOID CONTACT WITH THE SKIN, EYES, OR CLOTHING. IN CASE OF ACID CONTACT WITH SKIN, EYES OR CLOTHING, FLUSH IMMEDIATELY WITH CLEAN WATER FOR A MINIMUM OF FIFTEEN MINUTES. IF ACID IS ACCIDENTALLY SWALLOWED, CONSULT A PHYSICIAN IMMEDIATELY. GIVE THE PERSON LARGE QUANTITIES OF MILK OR WATER, FOLLOWED BY MILK OF MAGNESIA, A BEATEN EGG, OR VEGETABLE OIL.

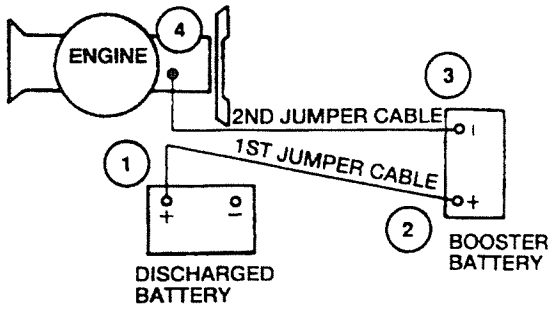
WARNING: TO AVOID ANY POSSIBILITY OF INJURY, EXTREME CARE SHOULD BE EXERCISED WHEN CONNECTING JUMPER CABLES TO A DISCHARGED BATTERY.

When the starter motor will not crank the engine, or does so very slowly, connect a 12-volt booster battery, following these instructions and precautions. Make the connections in the numerical order shown. Disconnect the connections in the reverse order shown.

CAUTION: Do not allow the vehicles to touch.

CAUTION: Do not disconnect the battery of the vehicle to be started. Doing so could damage the operational vehicle's electrical system while jump starting.

NOTE: Make connections in numerical order (disconnect in reverse order 4,3,2, 1).



1. Position the vehicles so the jumper cables will easily reach both batteries and the engine block of the vehicle to be started. Do not allow the vehicles to touch.

2. Ensure all unnecessary electrical accessories on the disabled vehicle are turned off while jump starting.

3. Turn on the blower motor of the operational vehicle to remove voltage surges.

4. Shield your eyes using safety goggles or similar eye protection.

5. NOTE: Ensure the jumper cables are not in the way of moving engine parts.

   Make the jumper cable connections as follows:

   a. Connect one end of the first jumper cable to the positive (+) terminal of the discharged battery.

   b. Connect the other end of the first cable to the positive (+) terminal of the booster battery.

   c. Connect one end of the second jumper cable to the negative (-) terminal of the booster battery.

   d. **WARNING: MAKING THE FINAL CABLE CONNECTION COULD CAUSE AN ELECTRICAL ARC WHICH, IF MADE AT OR NEAR THE BATTERY, COULD CAUSE AN EXPLOSION. REFER TO THE CAUTION AT THE BEGINNING OF THE JUMP STARTING PROCEDURE.**

      Connect the other end of the second cable to the engine block of the

disabled vehicle. Do not connect the cable to the negative battery terminal.

6. Start the engine of the vehicle with the good battery and run the engine at a moderate speed.

7. Start the engine of the vehicle with the discharged battery. Follow the starting instructions in the Operator's Manual.

8. Turn off all of the electrical components and reduce the engine speed to idle on both of the vehicles to prevent possible damage to the vehicle electrical systems.

9. Remove the jumper cables in the exact reverse order from which they were connected. With the jumper cables removed, the vehicle accessories can be used.

If the starter motor does not crank the engine sufficiently with the booster battery attached, further diagnosis of the engine and starting system is required. Refer to diagnosis and testing procedures in this section.

CLEANING AND INSPECTION

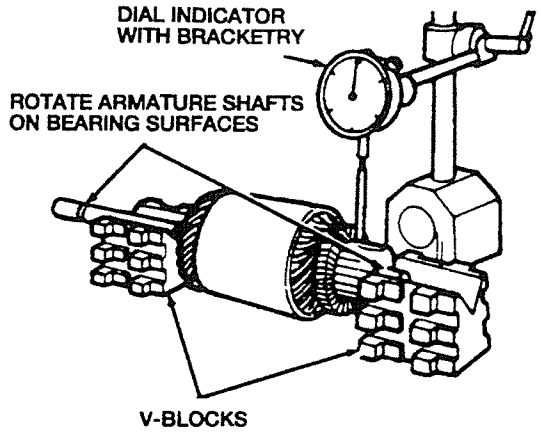
Armature Coil, Starter Motor

1. Inspect the starter motor armature coil windings for broken or burned insulation and unwelded or open connections.

2. Check starter motor armature for open circuits, shorts, and grounds. Check for pole rub or rub on magnetic shunts.

3. Place the starter motor armature on V-blocks.

4. Rotate the starter motor armature and use a Dial Indicator With Bracket Tool to measure the runout of the commutator.

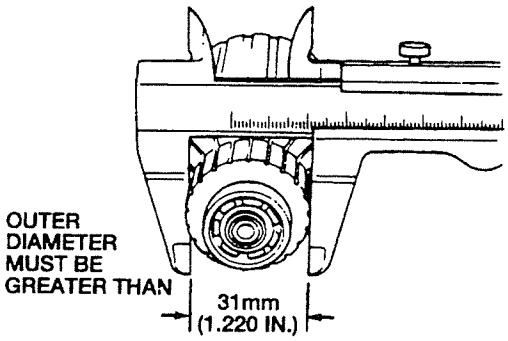


5. If the runout is 0.002 inch (0.05mm or greater, repair the commutator in a lathe. Replace the starter motor armature if the runout is excessive.

6. Verify that there is no play in the bearing surfaces at the V-blocks.

7. Use calipers to measure the outer diameter of the commutator.

8. If the commutator outer diameter is 1.22 inches (31 mm) or less, replace the starter motor armature.



9. Check the surface of the commutator.

10. **CAUTION: Do not use emery cloth on the commutator.**

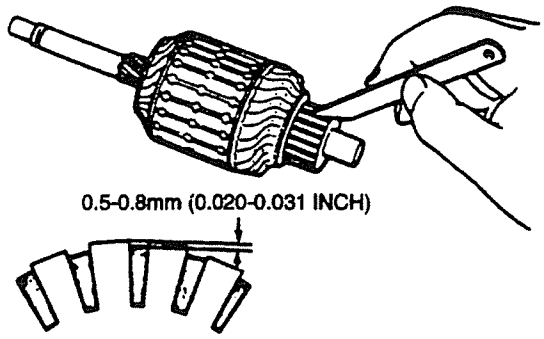
    If the commutator surface is dirty, clean the surface with a clean cloth.

11. If the commutator surface is burned, replace the starter motor armature.

12. If the commutator surface is excessively scored, replace the starter motor armature.

13. Check the depth of insulating material between the commutator segments.

    if the depth of groove between commutator segments is 0.008 inch (0.2mm) or less, use a sharpened section of a hacksaw blade to undercut the insulating material to a depth of 0.020-0.030 inch (0.5-0.8mm).



14. Check the condition of the starter motor armature laminations.

    If the starter motor armature laminations show indications of having contacted the field coil pole pieces, either the armature bushings are worn, the field coil pole pieces are loose, or the starter motor armature shaft is bent, replace the starter motor armature.

15. Verify that the field coil pole pieces are tightly secured in the starter field coil.

    If the field coil pole pieces are loose, replace the starter field coil.

16. Check the starter motor armature shaft side play.

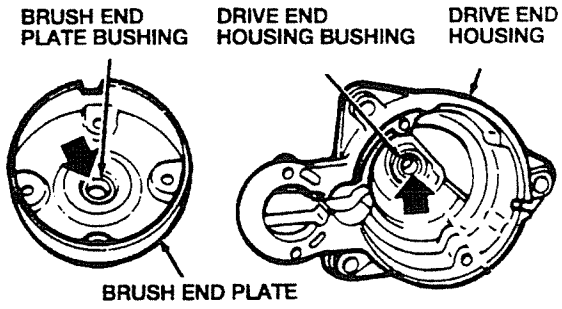
    If the starter motor armature shaft side play exceeds 0.008 inch (0.2mm), the end cover and drive end housing bushings are worn and/or the starter motor armature shaft ends are worn. Replace the bushings.

17. Check the condition of the starter motor armature shaft ends.

    If the starter motor armature shaft ends are worn or damaged, replace the starter motor armature.

Bushings

Check the condition of the brush end plate bushing and the drive end housing bushing.



Replace the drive end housing bushing or the brush end plate bushing if worn or scored. Refer to the procedure in this section.

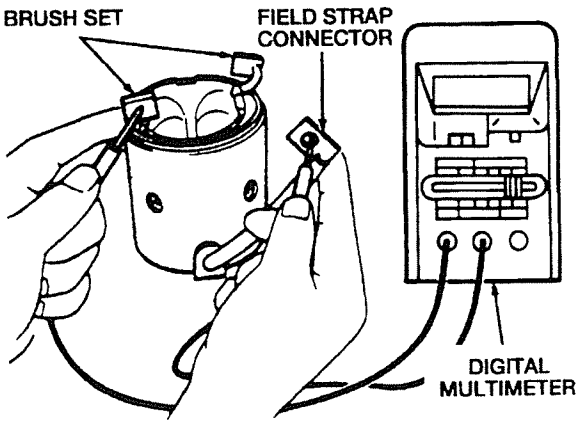
Field Coil Inspection, Starter Motor

1. Inspect the condition of the starter motor field coil windings.

   If the starter motor field coil windings are corroded or bent, or if the insulation is deteriorated and the starter motor field coils show bare spots, replace the starter motor field coils, pole pieces, and starter motor field frame housing as an assembly.

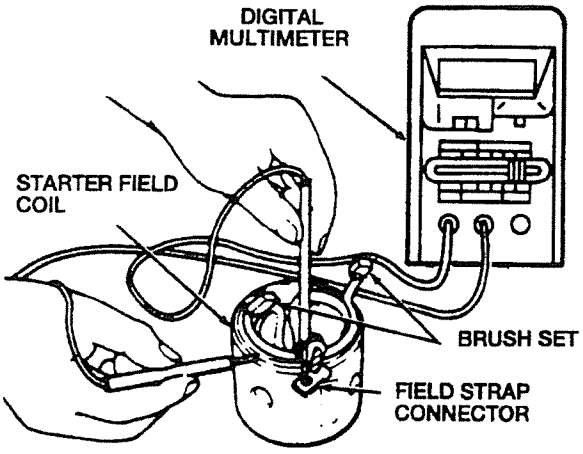
2. NOTE: Do not allow the brush set or brush wires to contact the starter field coil during this test.

   Use a Digital Multimeter to check for continuity between the field strap connector and the positive brush set.



3. If there is no continuity between the field strap connector and the brush set, replace the starter field coil.

4. Use a Digital Multimeter to check for continuity between the field strap connector and the starter field coil.



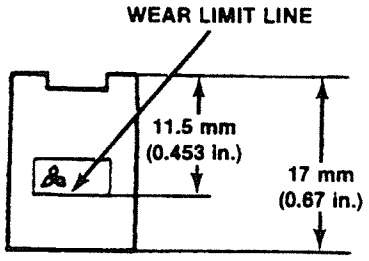
5. If there is continuity between the field strap connector and the starter field coil, replace the field frame housing assembly.

Brush and Brush Holder

1. Measure the amount of usable brush material remaining.

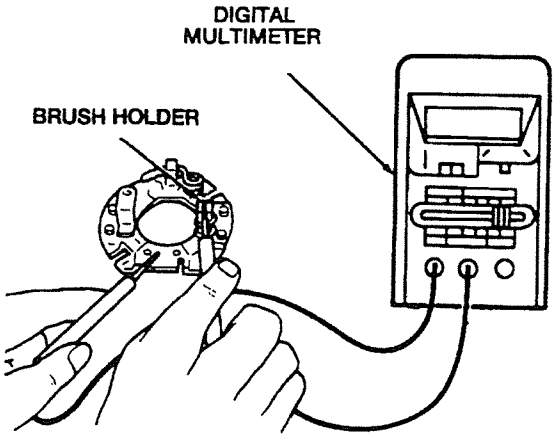
2. If the negative brush is near or beyond the wear limit, replace the brush set.

3. If the positive brush is near or beyond the wear limit, replace the starter field coil.



4. Use Digital Multimeter to check for continuity between the insulated brush holders and the brush set.

   If continuity exists between either insulated brush holder and the brush set, repair or replace the brush set.

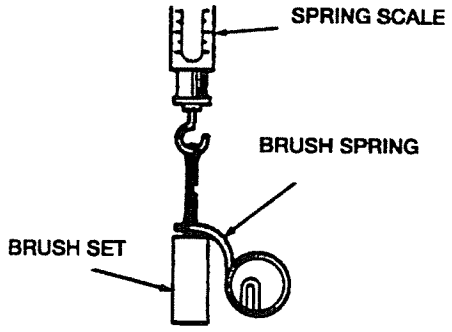


5. Check the sliding action of the brush sets within their brush holders.

   If the brush sets do not slide freely and smoothly in the brush holder, clean the brush holder channels.

Brush Spring Tension Inspection

1. Use Spring Scale to pull on the brush spring. Measure the tension at the moment the brush spring separates from the brush set.

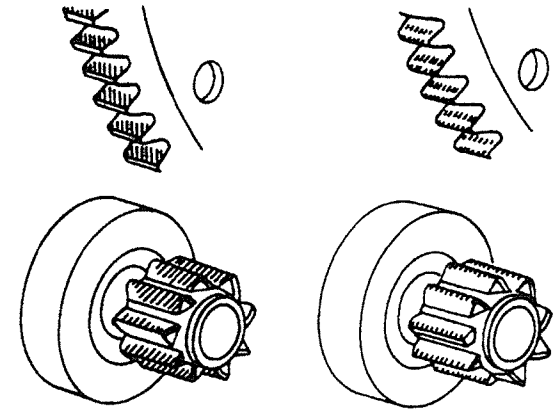


2. Replace the brush spring if the force is 2.0 lb (8.8N).

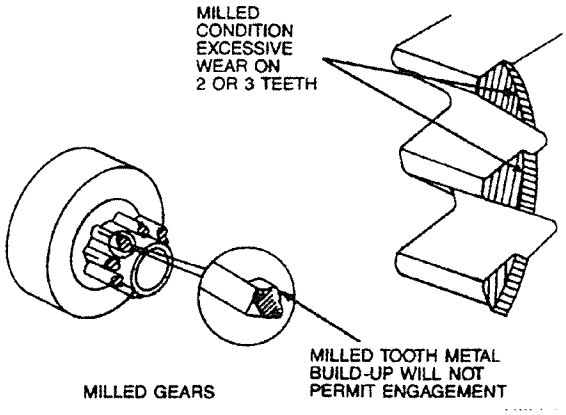
Starter Drive and Flywheel Ring Gear Inspection

CAUTION: Do not wash the starter drive because the solvent will wash out the lubricant and cause the gear to slip.

1. Inspect the wear pattern on the starter drive gear and flywheel ring gear.



NORMAL WEAR PATTERN SMALL WEAR PATTERN



2. If the starter drive gear teeth are damaged, inspect the entire circumference of the flywheel ring gear.
3. If the starter drive gear shows signs of excessive wear of milling, replace the starter drive.
4. To avoid continues damage to the starter drive, replace the flywheel ring gear if the teeth are damaged.
5. To check the one-way clutch of the starter drive gear, grasp the starter drive and attempt to turn the starter drive gear in both directions.
6. If the starter drive gear does not turn freely in one direction and lock up in the opposite direction, replace the starter drive.

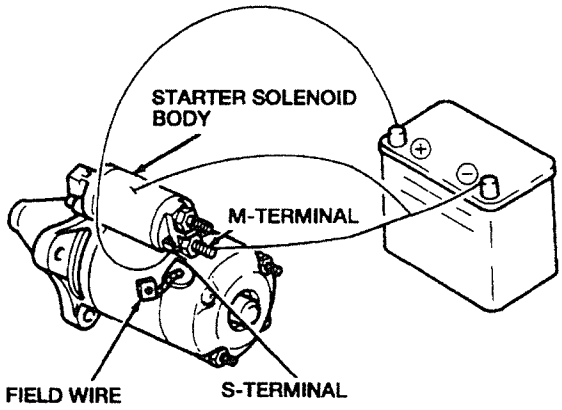
ADJUSTMENTS

Starter Drive Pinion Depth Adjustment

NOTE: This procedure is performed with the starter motor removed from the vehicle. To remove the starter motor, refer to the removal procedure in this section.

1. Remove the M-terminal nut from the M-terminal.
2. Disconnect the field wire connector from the M-terminal.
3. Connect a wire from the positive terminal of a 12-volt battery to the S-terminal.
4. **CAUTION: Do not keep the starter solenoid engaged for longer than 10 seconds. Wait at least three minutes between tests to allow the starter solenoid to cool.**

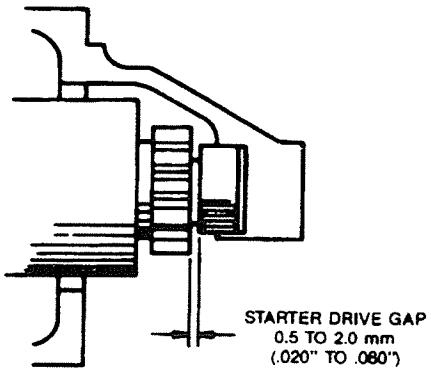
   Connect wires from the negative terminal of a 12-volt battery to the M-terminal and the starter solenoid body.



5. Verify that the starter solenoid activates and kicks out the starter drive.

6. If the starter drive does not kick out when the battery is connected to the starter motor as described in Steps 1 to 3, perform further diagnosis. Refer to Diagnosis and Testing in this section.

7. While the starter drive is extended, measure the gap between the starter drive and the retaining collar.



8. If the starter drive gap is not 0.02-0.08 inch (0.5-2.0 mm), add or subtract shims between the starter solenoid and drive end housing as necessary to achieve the proper gap.

9. Disconnect the battery from the starter motor.

10. Install the field wire connector to the M-terminal of the starter solenoid.

11. Install the M-terminal nut to the M-terminal. Tighten the M-terminal nut to 71-106 lb-in (8-12N-m).

SPECIFICATIONS

Starter Specifications

Description	Specifications
Commutator Runout	0.002 inch (0.05 mm)
Commutator Outer Diameter	1.22 inch (31 mm)
Commutator Segment Depth	0.020-0.30 inch (0.5-0.8 mm)
Brush Wear Limit	0.453 inch (11.5 mm)
Brush Spring Force	2.0-4.3 lb (8.8-19.1 N)
Starter Drive Gap Depth	0.02-0.08 inch (0.5-2.0 mm)
Armature Shaft Side Play	0.008 inch (0.2 mm)

Torque Specifications

Description	Lb-ft	Lb-in	N-m
Starter Motor Bolts	23-34		31-46
Intake Manifold Support Bolts	12-14		16-22
Starter Motor Support Bolts		35-44	4-5
Thru Bolts		55-75	6-8
M-terminal Nut		71-106	8-12
B-terminal Nut		89-106	10-12

SERVICE TOOLS/EQUIPMENT

- Dial Indicator with Bracket
- Digital Multimeter
- Spring Scale
- Starting and Charging Tester

SECTION 17 - Battery and Charging System

BATTERY AND CHARGING SYSTEM - SERVICE

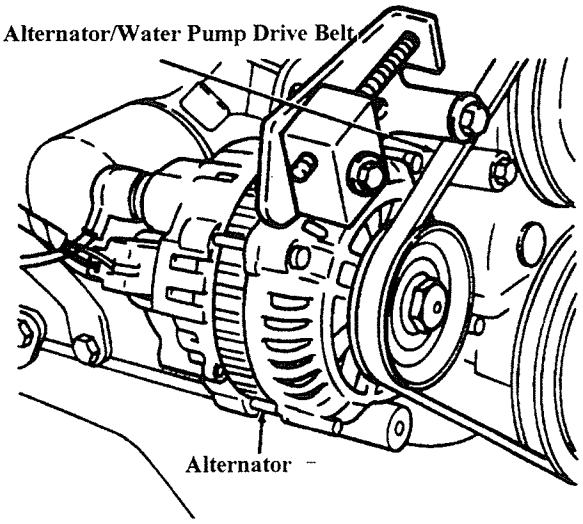
DESCRIPTION AND OPERATION

Charging System

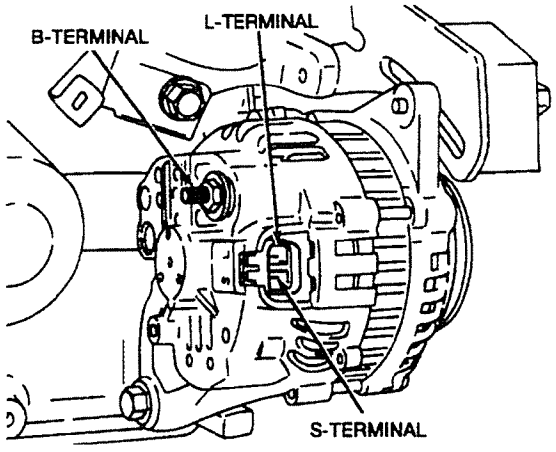
The charging system is a negative ground system consisting of a alternator with an internal electronic voltage regulator, a battery, a volt gauge, battery ground cable, battery to starter relay cable, and the necessary electrical wiring. Refer to the Electrical and Vacuum Troubleshooting Chart in this section.

IGR Alternator with Integral Regulator Internal Fan and Regulator Type

The alternator is mounted on the front of the engine and is driven by the alternator/water pump drive belt.



The alternator produces alternating current (AC) which is changed to direct current (DC) by the rectifier for distribution to the vehicle electrical system.



There are three terminals on the alternator for connection to the vehicle electrical system. The B-(battery) terminal is on the back of the alternator and the L- and S-terminals are on its side. The L- and S-terminals have identification marks on the alternator housing.

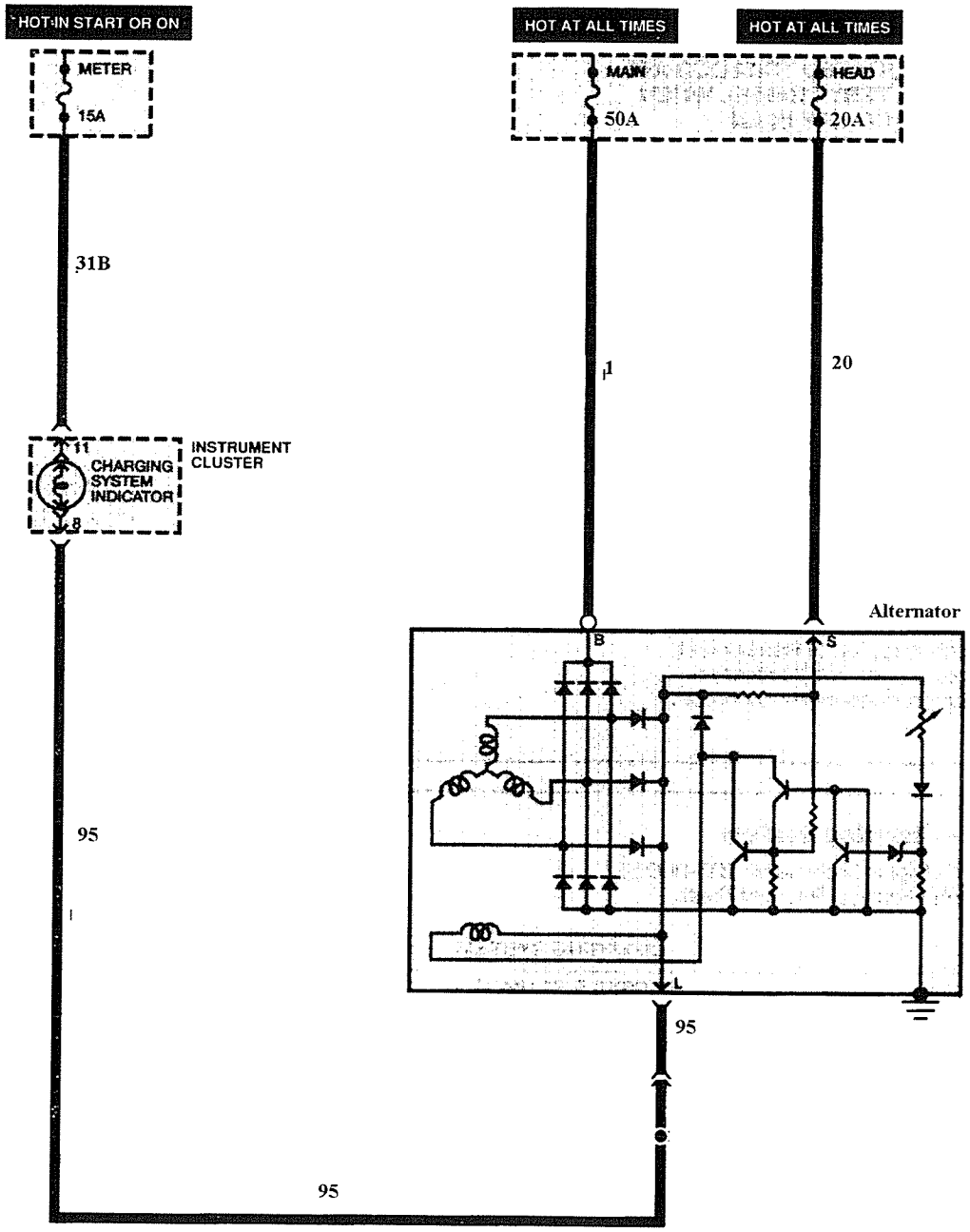
A voltmeter gauge in the instrument panel indicates the normal voltage output of 13-14 volts

to the battery when the engine is running. A lower reading indicates a charging system malfunction.

A 12 volt battery is used to start the vehicle and supplies extra electrical power at times of high system current demand.

DIAGNOSIS AND TESTING

Electrical Schematic - Charging System



Inspection and Verification - Charging System

WARNING: HYDROGEN AND OXYGEN GASES ARE PRODUCED DURING NORMAL BATTERY OPERATION. THIS GAS MIXTURE CAN EXPLODE IF FLAMES, SPARKS OR LIGHTED TOBACCO ARE BROUGHT NEAR THE BATTERY. WHEN CHARGING OR USING A BATTERY IN AN ENCLOSED SPACE, ALWAYS PROVIDE VENTILATION, PROTECT YOUR FACE AND SHIELD YOUR EYES.

WARNING: KEEP OUT OF REACH OF CHILDREN. BATTERIES CONTAIN SULFURIC ACID. AVOID CONTACT WITH SKIN, EYES, OR CLOTHING. ALSO, SHIELD YOUR EYES WHEN WORKING NEAR THE BATTERY TO PROTECT AGAINST POSSIBLE SPLASHING OF THE ACID SOLUTION. IN CASE OF ACID CONTACT WITH SKIN, EYES, OR CLOTHING, FLUSH IMMEDIATELY WITH WATER FOR A MINIMUM OF FIFTEEN MINUTES. IF ACID IS SWALLOWED, DRINK LARGE QUANTITIES OF MILK OR WATER, FOLLOWED BY MILK OF MAGNESIA, A BEATEN EGG, OR VEGETABLE OIL. CALL A PHYSICIAN IMMEDIATELY.

Before performing charging or starting system tests on the vehicle, note the complaint (such as slow cranking, battery discharged, top of battery wet, voltmeter gauge showing discharge) and proceed to the Troubleshooting Chart.

Troubleshooting Chart - Charging System

NOTE: Use Digital Multimeter or equivalent to perform electrical Pinpoint Tests.

CONDITION	POSSIBLE SOURCE	SOLUTION/REMEDY
• System Does Not Charge	• Loose or worn drive belt. • Corroded battery connections. • Battery. • Alternator.	• GO to Pinpoint Test A1.
• System overcharges Battery (battery boils over.	• Alternator	• GO to Pinpoint Test B1.
• Voltmeter Gauge shows high discharge.	• Alternator • Loose or worn drive belt. • Charging system indicator circuit.	• Go to Pinpoint Test C1.
• Voltmeter Gauge does work.	• Charging system indicator circuit. • Battery. • Alternator.	• Perform the charging system indicator diagnosis in Section 19.
• Voltmeter Gauge needle is erratic in operation.	• Loose connections. • Alternator belt slipping. • Alternator.	• Go to Pinpoint Test D1.
• Alternator Noisy	• Loose or worn drive belt. • Bent alternator pulley. • Alternator.	• Go to Pinpoint Test E1.
• Battery Does Not a Hold a Charge.	• Loose or worn drive belt. • Damaged battery cables. • Battery. • Alternator.	• Go to Pinpoint Test F1.

Pinpoint Tests - Charging System

PINPOINT TEST A: SYSTEM DOES NOT CHARGE

TEST STEP		RESULT	ACTION TO TAKE
A1	CHECK BATTERY CONNECTIONS		
•	Inspect the battery cables for loose or corroded connections.	YES	• GO to A2.
•	**Are the battery cables clean and tight?**	NO	• CLEAN and TIGHTEN the battery cables.
A2	CHECK DRIVE BELT TENSION		
•	Perform the drive belt adjustment procedure.	YES	• GO to A3.
•	**Is the drive belt adjusted properly?**	NO	• Adjust or Replace the drive belt.
A3	CHECK THE BATTERY		
•	Perform the battery component tests in this section.	YES	• Perform the alternator components tests in this section.
•	**Is the battery OK?**	NO	• Replace the battery.

PINPOINT TEST B: SYSTEM OVERCHARGES (BATTERY BOILS OVER)

TEST STEP		RESULT	ACTION TO TAKE
B1	CHECK ALTERNATOR		
•	Perform the alternator component tests in this section.	YES	• Charging system OK. Return to the Troubleshooting Chart.
•	**Is the alternator OK?**	NO	• Repair or replace the alternator.

PINPOINT TEST C: INDICATOR LAMP STAYS ON, ENGINE RUNNING

TEST STEP		RESULT	ACTION TO TAKE
C1	CHECK DRIVE BELT TENSION		
•	Perform the drive belt adjustment procedure in Section 11.	YES	• Go to C2.
•	**Is the drive belt adjusted properly?**	NO	• Adjust or Replace the drive belt.
C2	CHECK ALTERNATOR		
•	Perform the alternator component tests in this section.	YES	• Refer to Section 19 to diagnose the charging system.
•	**Is the alternator OK?**	NO	• Repair or Replace the alternator.

PINPOINT TEST D: VOLTMETER GAUGE SHOWS ERRATIC READING

TEST STEP		RESULT	ACTION TO TAKE
D1	CHECK FOR LOOSE CONNECTIONS		
•	Check these connections for corrosion, loose or bent pins, or loose eyelets:	YES	• Go to D2.
•	- 'L' and 'S' connector.	NO	• Clean or Service connections as required.
•	- Alternator 'B' eyelet.		
•	- Battery cables.		
•	**Are all connections clean and tight?**		
D2	• CHECK FOR LOOSE ALTERNATOR BELT		
•	Check alternator drive belt when engine is cold, or has been stopped for at least 30 minutes. The drive belt should measure 0.31-0.35 inch (8-9mm) for a new belt, or 0.35-0.39 inch (9-10mm) for a used belt.	YES	• Perform the charging System Indicator Diagnosis in Section 19.
•	**Is the alternator belt adjusted correctly?**	NO	• Perform the Alternator Belt Adjustment Procedure in Section 11.

PINPOINT TEST E: ALTERNATOR NOISY

TEST STEP		RESULT	ACTION TO TAKE
E1	CHECK DRIVE BELT TENSION		
•	Perform the drive belt adjustment procedure in Section 11.	YES	• Go to E2.
•	**Is the drive belt adjusted properly?**	NO	• Adjust or Replace the drive belt.
E2	CHECK THE ALTERNATOR PULLEY		
•	Remove the drive belt.	YES	• Inspect the alternator bearings.
•	Check the generator pulley for damage.		
•	**Is the alternator pulley OK?**	NO	• Replace the alternator pulley.

PINPOINT TEST F: BATTERY DOES NOT HOLD A CHARGE

TEST STEP		RESULT	ACTION TO TAKE
F1	CHECK THE BATTERY CONDITIONS		
•	Check the battery cables for loose or corroded connections.	YES	• Go to F2.
•	**Are the battery cables clean and tight?**	NO	• Clean and Tighten the battery cables.
F2	CHECK DRIVE BELT TENSION		
•	Perform the drive belt adjustment procedure in Section 11.	YES	• Perform the Battery component tests in this section.
•	**Is the drive belt adjusted properly?**	NO	• Adjust or Replace the drive belt.

Component Tests - Charging System

Battery

Capacity Testing

To perform this test, use a high-rate discharge tester, Starting and Charging Tester or equivalent, in conjunction with a Digital Multimeter.

1. Turn the control knob on the Starting and Charging Tester to the OFF position.

2. Turn the multimeter selector switch to the DC volt position.

3. Connect the Starting and Charging Tester and multimeter positive test leads to the positive battery post and both negative test leads to the negative battery post. The multimeter clips must contact the battery posts and not the tester clips. Unless this is done, the actual battery terminal voltage will not be indicated.

4. Turn the load control knob in a clockwise direction until the ammeter reads approximately half the cold cranking amps.

5. When the ammeter has read the required load for 15 seconds, note the multimeter reading. Avoid leaving the high discharge load on the battery for periods longer than 15 seconds.

6. If the multimeter reading is 9.6 volts at 70°F (21°C) or more, the battery has a good output capacity and will readily accept a charge, if required.

7. If the voltage reading obtained during the capacity test is below 9.6 volts at 70°F (10°C), and the battery is fully charged, the battery is defective and must be replaced. If unsure about the battery's state of charge, charge the battery.

8. After the battery has been charged, repeat the capacity test. If the capacity test battery voltage is still less than 9.6 volts at 70°F (21°C), replace the battery. If the voltage is 9.6 or more at 70°F, (21°C), the battery is satisfactory for service.

9. If the battery is found to be discharged only, check for a loose drive belt, loose electrical connection, charging system performance, and perform a battery drain test.

Base Voltage Test

1. NOTE: Prior to running this test, turn the headlamps on for 10-15 seconds to remove any surface charge from the battery. Then, wait until the voltage stabilizes prior to performing the base voltage test.

   With the ignition off and no electrical loads on, connect the negative (-) lead of the Digital Multimeter, or equivalent, to the battery ground cable clamp.

2. Connect the positive (+) lead of the multimeter to the battery to starter relay cable clamp.

3. Read and record the battery voltage shown on the multimeter. This is called base voltage and will be used in later tests.

No-Load Test

1. Connect Digital Multimeter to monitor engine speed.

2. Connect the leads of the Digital Multimeter across the battery terminals.

3. Read the voltage (base voltage).

4. Start the engine.

5. Run the engine at 1500 rpm with no electrical load.

6. Read the voltage. The voltage should be in the range of 14.1 to 14.7 volts. If the voltage increase is less than 2.5 volts, perform the Load Test. If there is no voltage increase or the voltage increase is greater than 2.5 volts, service or replace the alternator. Refer to this section for service/replacement procedure.

Load Test

1. With the engine running, turn the air conditioner on (if so equipped), turn the blower motor on high speed, and turn the headlamps on high beam.

2. Increase the engine speed to approximately 2000 rpm. The voltage should increase a minimum of 0.5 volts above the base voltage. Refer to the Bench Test procedures to check the alternator if the voltage does not increase as specified.

If the voltage increased as specified, the charging system is operating normally. Proceed to the battery capacity testing.

Drain Testing

With Clamp On DC Ammeter Test

Procedure

1. Turn the ignition off and make sure there are no electrical loads on.

2. NOTE: Do not start vehicle with clip on cable.

   Clamp the meter clip securely around the battery to starter relay cable or battery ground cable.

The current reading (current drain) should be less than 0.05 amps. If it exceeds 0.05 amps it indicates a constant current drain which could cause a discharged battery. Possible sources of current drain are vehicle lamps that do not shut off properly.

If the drain is not caused by a vehicle lamp, remove the fuses from the main fuse junction panel, one at a time, until the cause of the drain is located.

With Voltmeter Test Procedure

This test requires a digital multimeter with an appropriate low voltage scale. The meter must read within 0.01 millivolt. Also required is a shunt assembly similar to that shown in the illustration.

1. Turn the ignition off and make sure there are no electrical loads on.

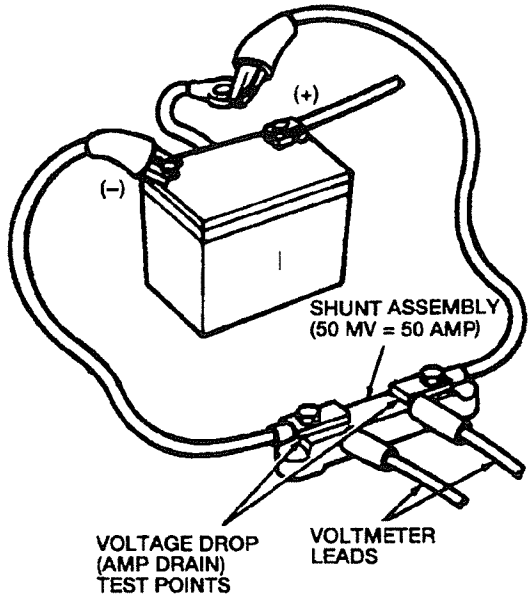
2. Check the battery voltage. If the voltage is under 11.5 volts, charge the battery to above 11.5 volts.

3. Disconnect the battery ground cable.

4. Connect the shunt assembly as shown.

5. **CAUTION: Do not crank the engine, it could destroy the shunt. Also do not use the shunt to measure starting currents.**

Connect multimeter leads to shunt as shown. With this size shunt (50 mV = 50 amps) and multimeter, a direct current drain measurement can be made.



The current reading (current drain) should be less than 0.05 amps. If the reading exceeds 0.05 amps it indicates a constant current drain, which could cause a discharged battery. Possible sources of current drain are vehicle lamps that do not turn off. If the problem is not a lamp, remove the fuses from the main fuse junction panel one at a time until the cause of the drain is located.

Electronic Drains Which Shut Off Whenthe Battery Cable Is Disconnected

1. Repeat Steps 1 through 5 of the Battery Drain Test With Voltmeter.

2. Without starting engine, turn ignition ON for a moment and then off.

3. Connect the Digital Multimeter and read the voltage.

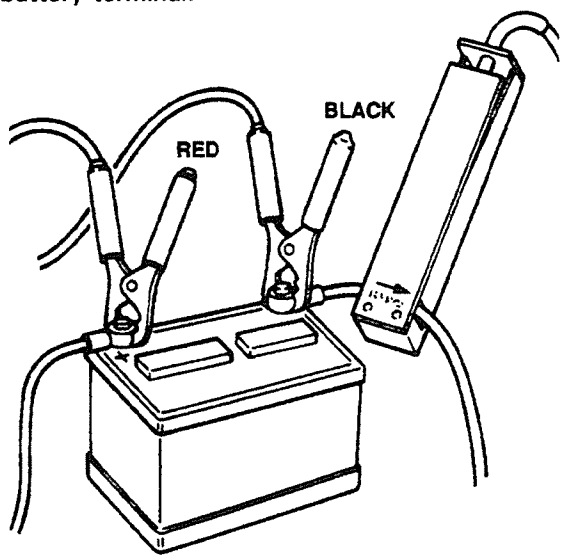
The current reading (current drain) should be less than 0.05 amps. If it exceeds 0.05 amps after a few minutes, and if this drain did not show in previous tests, the drain is most likely caused by a malfunctioning electronic component. As in previous tests, remove the fuses in the junction panel one at a time to located the problem circuit.

Alternator On-Vehicle Tests

Load Test

1. Connect the leads of the Starting and Charging Tester to the vehicle as shown, observing proper polarity.

Red to Positive, Black to Negative. Allow on current probe pointing away from negative battery terminal.



2. Turn all electrical accessories OFF.

3. Turn the ignition switch to ON and read the rate of discharge on the ammeter.

4. Start the engine and run it at 1,500 to 2,000 rpm.

5. **CAUTION: Do not drop the voltage below 12 volts.**

   Slowly increase the load control on the Starting and Charging Tester until the highest amp reading is obtained.

6. Turn off the load control knob.

7. Add the ammeter readings obtained in Step 3 and Step 5 for total alternator output. If the amperage output is within 10 percent of its rated output which is 60A, the alternator is functioning properly. If the amperage

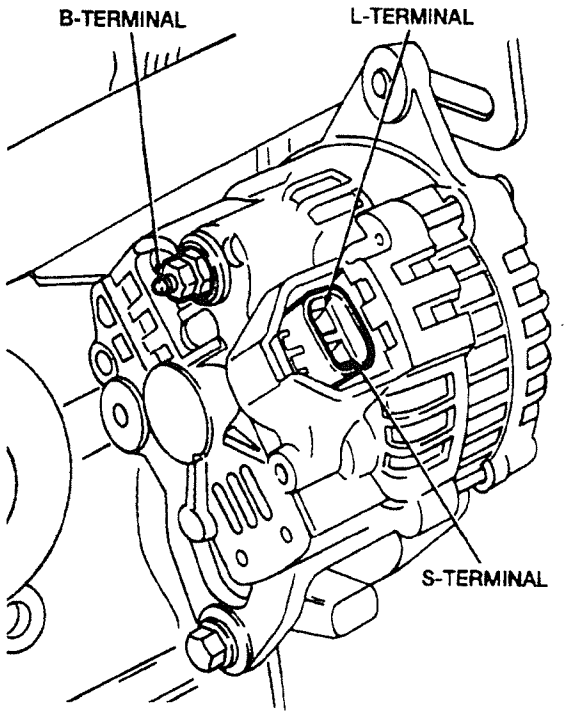
output is below this specification, proceed with the next test.

No-Load Test

1. **CAUTION: Do not ground the B-terminal.**

   With the ignition switch in the ON position and the engine not running, verify that the voltage at the alternator wiring connector terminals are as follows:

- B-terminal = Approximately 12 volts
- L-terminal = Approximately one (1) volt
- S-terminal = Approximately 12 volts



2. Start the engine.

3. With the engine running and at normal curb idle, verify that the voltage at the alternator wiring connector terminals is as follows:

- B-terminal = 14.1 - 14.7 volts
- L-terminal = 13.0 - 14.0 volts
- S-terminal = 14.1 - 14.7 volts

ALTERNATOR VOLTAGE SPECIFICATIONS

Alternator Terminals	Ignition ON/ Engine OFF	Engine at Idle
B	approximately 12 volts	14.1 - 14.7 volts
L	approximately one (1) volt	13.0 - 14.0 volts
S	approximately 12 volts	14.1 - 14.7 volts

4. If the voltages are as specified, check the wiring harness between the battery and the B-terminal. It the voltages are below specification, check the wiring harness. If the wiring harness is in good condition, refer to Alternator Bench Tests in this section.

Alternator Bench Tests

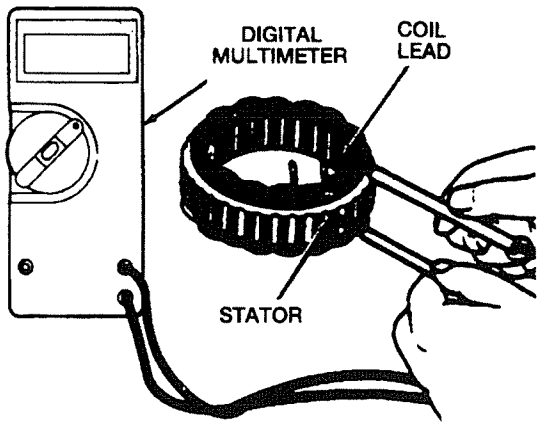
Refer to the Removal and Installation procedures to remove the alternator from the vehicle. After removal, disassemble the alternator and perform the Alternator Bench Tests procedures.

Stator and Coil Grounded Test

1. Inspect the stator laminations for indications of overheating.

2. If burn spots are evident, replace the stator and coil.

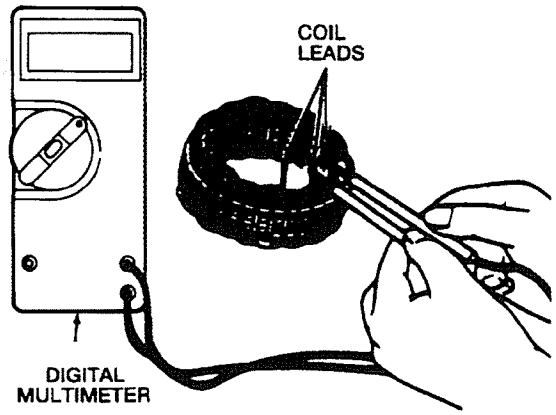
3. Use Digital Multimeter to check for continuity between each of the three coil leads and the stator.



4. If there is continuity, replace the stator and coil.

Stator and Coil Open Test

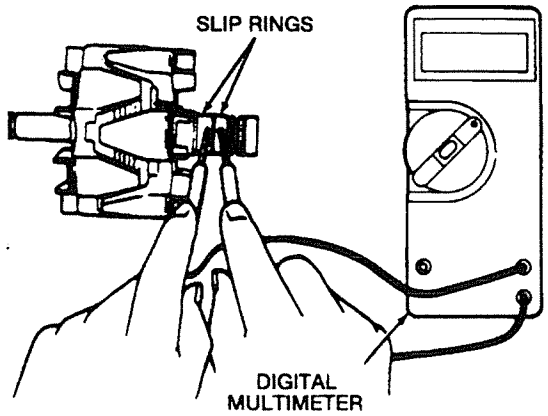
1. Use Digital Multimeter to check for continuity between the coil leads.



2. If there is no continuity, replace the stator and coil.

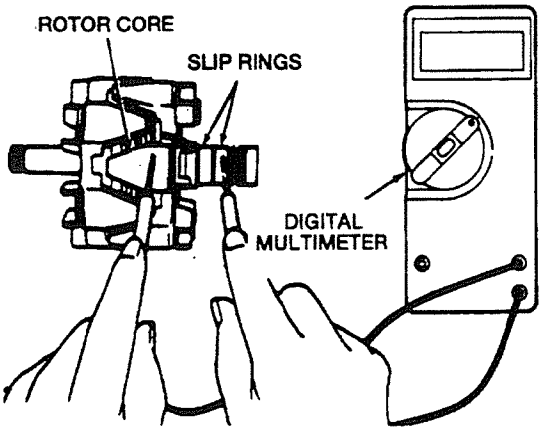
Alternator Rotor Open or Short Test

1. Use Digital Multimeter to measure the resistance between the two slip rings.



2. If the resistance is not between 3.2-3.5 ohms, replace the alternator rotor.

3. Use the Digital Multimeter to check for continuity between each slip ring and the rotor core.



4. If there is continuity, replace the alternator rotor.

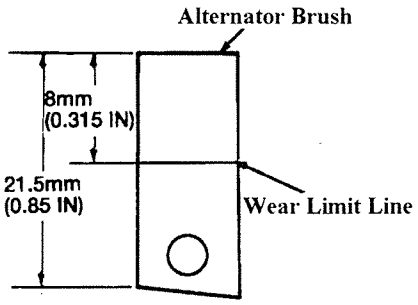
5. Check the color and condition of the slip rings.

6. If the slip rings are dark, clean them with fine sandpaper.

7. If the slip rings are grooved, refinish them in a lathe.

Brushes

1. Inspect the alternator brushes for wear.



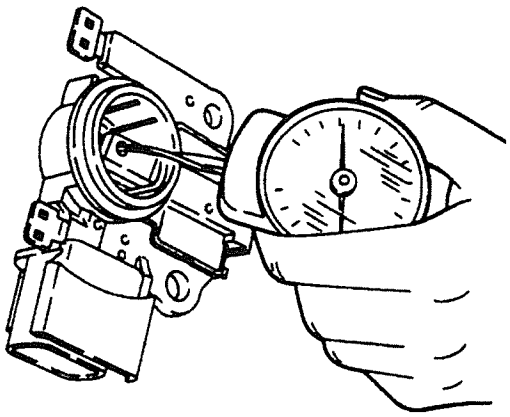
2. If the alternator brushes are worn down to the wear limit line, replace the alternator brushes as follows:

   a) Unsolder the pigtails from the voltage regulator.

   b) Remove the alternator brushes.

   c) Solder the new brush pigtails to the voltage regulator.

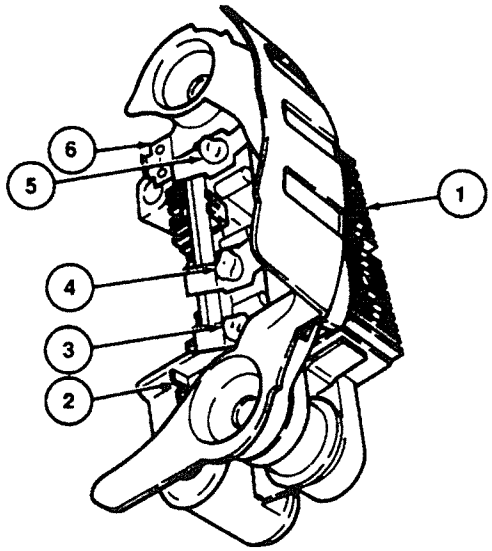
3. Use a spring pressure gauge to push each alternator brush into its holder until the tip of the alternator brush projects 0.079 inch (2mm) and read the pressure.



4. If the spring force is not between 10.6-15.6 oz. (2.9-4.3 N), replace the alternator brush spring.

Rectifier

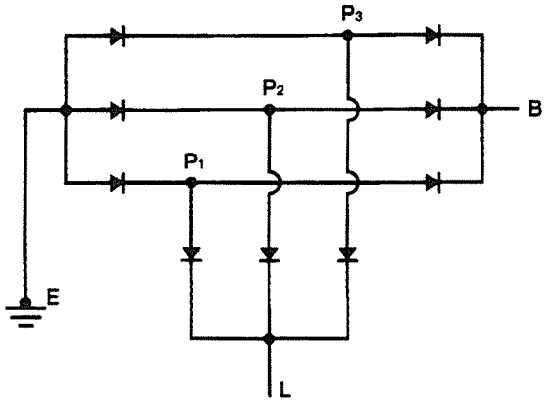
1. Use the Digital Multimeter in the diode test mode to check for continuity between the following terminals of the rectifier.



Item	Part Number	Description
1	-	E - Terminal
2	-	B - Terminal
3	-	P3 - Terminal
4	-	P2 - Terminal
5	-	P1 - Terminal
6	-	L - Terminal

Diode Specification

Negative (Black)	Positive (Red)	Continuity
E	P1,P2,P3	No
B	P1,P2,P3	Yes
L	P1,P2,P3	Yes
P1,P2,P3	E	Yes
P1,P2,P3	B	No
P1,P2,P3	L	No



1. If the rectifier fails any of the above continuity checks, replace the rectifier.

Adjustments

Refer to Section 11 - Engine for adjustment of the alternator/water pump belt.

Service Tools and Equipment

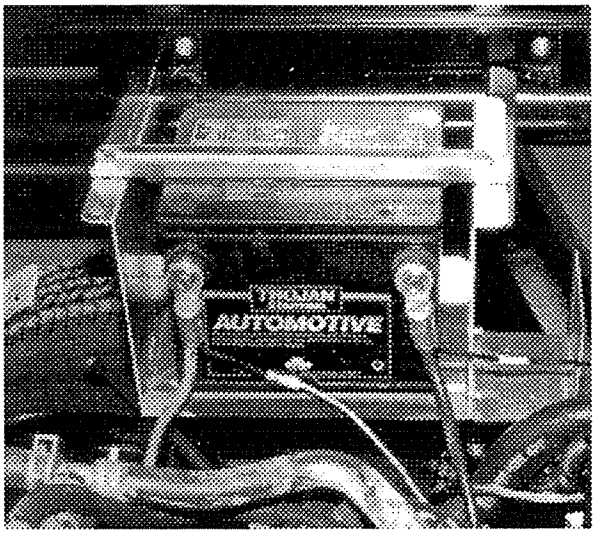
- Digital Multimeter
- Starting and Charging Tester

SECTION 17 -1Battery

DESCRIPTION AND OPERATION

Battery

The original equipment battery is a 12 volt, 50 amp-hour battery. It is rated at 550 CCA (cold cranking amps).



DIAGNOSIS AND TESTING

Battery

Refer to this section for diagnosing the battery.

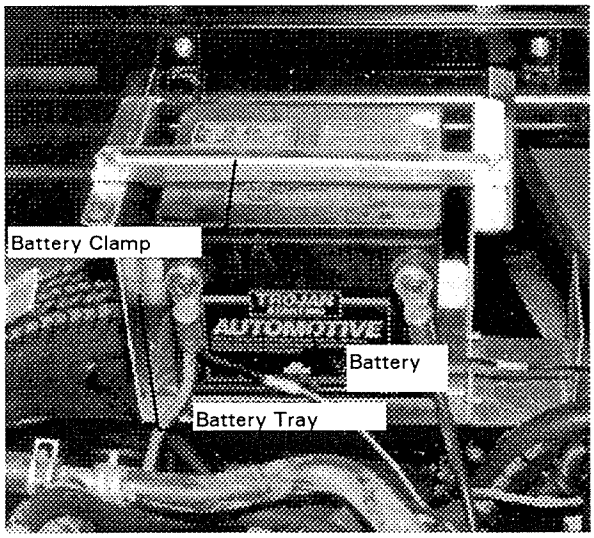
REMOVAL AND INSTALLATION

Environmental Protection

Help Us Protect Our Environment. It is strongly recommended that lead-acid batteries be returned to an authorized recycling facility for disposal.

Battery

The following illustration is a view of a typical battery and related components.



Item	Part Number	Description
1	182863	Battery - 550 CCA
2	181671/184003	Clamp, Battery
3	183799	Battery Tray
4	183043	Bolt, Clamp Not illus.
5	183044	Bolt, Clamp Not illus.
6	770909	Nut Not illus

Removal

1. Disconnect the battery ground cable.
2. Disconnect the battery to starter relay cable.
3. Remove the two battery hold down clamp nuts securing the two battery mounting clamp bolts.
4. Remove the battery hold down clamp.
5. Slip the battery mounting clamp bolts from their recesses.
6. Lift the battery out of the battery tray.

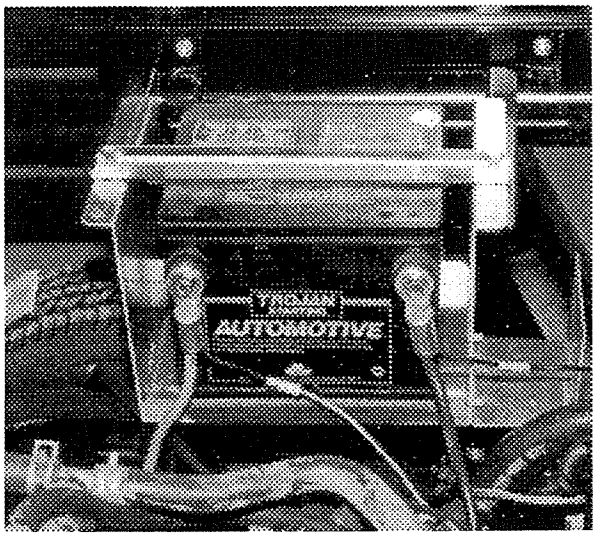
Installation

1. Place the battery onto the battery tray.
2. Slip the two battery mounting clamp bolts into their recesses of the battery tray.
3. Install the battery hold down clamp and the two battery hold down clamp nuts. Tighten the two battery hold down clamp nuts to 5-7 lb-ft (7-9 N-m).
4. Connect and tighten the battery to starter relay cable. Do not over-tighten.
5. Connect and tighten the battery ground cable. Do not over-tighten.
6. Apply petroleum jelly to the terminals.

Battery Tray

Removal

1. Remove the battery. Refer to the removal procedure in this section.



2. Lift the battery tray from the engine compartment.

Installation

1. Position the battery tray in the engine compartment.
2. Install the battery. Refer to the installation procedure in this section.

SERVICE PROCEDURES

WARNING: HYDROGEN AND OXYGEN GASES ARE PRODUCED DURING NORMAL BATTERY OPERATION. THIS GAS MIXTURE CAN EXPLODE IF FLAMES, SPARKS, OR LIGHTED TOBACCO ARE BROUGHT NEAR THE BATTERY. WHEN CHARGING OR USING A BATTERY IN AN ENCLOSED SPACE, ALWAYS PROVIDE VENTILATION AND SHIELD YOUR FACE AND PROTECT YOUR EYES.

WARNING: KEEP BATTERIES OUT OF THE REACH OF CHILDREN. BATTERIES CONTAIN SULFURIC ACID. AVOID CONTACT WITH SKIN OR EYES. ALSO, SHIELD YOUR EYES WHEN WORKING NEAR THE BATTERY TO PROTECT AGAINST POSSIBLE SPLASHING OF THE ACID SOLUTION. IN CASE OF ACID CONTACT WITH SKIN, EYES, OR CLOTHING, FLUSH IMMEDIATELY WITH WATER FOR A PERIOD OF 15 MINUTES AND GET PROMPT MEDICAL ATTENTION. IF ACID IS SWALLOWED, CALL A PHYSICIAN IMMEDIATELY.

Keep the battery and surrounding parts, particularly the top, clean and dry. If electrolyte

is evident on the top of the battery, clean it off immediately. Even a weak electrolyte quickly attacks and corrodes the cable connections, battery hold down clamp and battery mounting clamp bolts. Use a rag soaked in a weak solution of water and ammonia to counteract the action of spilled electrolyte.

Battery Charging

Before recharging a discharged battery, inspect for the following conditions and service as necessary:

1. Loose drive belt
2. Pinched or grounded alternator wiring.
3. Loose wiring connections at the alternator.
4. Loose or corroded connections at the battery or starter motor engine ground.
5. Excessive battery drain due to lamps left on by mistake, damaged or misadjusted switches, etc.

Maintenance-Free Batteries

Cold batteries do not readily accept a charge. Allow batteries to warm up to approximately 41°F (50°C), before charging. The warm-up period may require four to eight hours at room temperature, depending on the initial temperature of the battery and its size.

A battery that has been completely discharged may initially be slow to accept a charge, and in some cases may not accept a charge at the normal charger setting. Charging of batteries in such condition may be started by using the dead battery switch on chargers so equipped.
To determine whether a battery is accepting a charge, follow the charger manufacturer's instructions for use of the dead battery switch. If the dead battery switch is the spring-loaded type, it should be held in the ON position for up to three minutes.

After releasing the dead battery switch and with charger still on, measure battery voltage. It shows 12 volts or higher, the battery is accepting a charge and is capable of being recharged. However, it may require up to two hours of charging with batteries colder than 41°F (5°C) before the charge rate is high enough to show on the charger ammeter. It has been found that all non-damaged batteries can be charged by this procedure. If a battery cannot be charged by this procedure, it should be replaced.

A rapid recharge procedure has been developed for recharging batteries that have passed the Load Test and only need a recharge. This can be due to in-service no-start battery failures (vehicle will not crank due to low battery state of charge), or battery discharged in vehicle due to key-off loads. Refer to this section for the load test procedure.
The battery can be rapidly recharged by using either of the following methods:

- Perform a 2-hour charge using 20A constant current (manual setting on charger).
- Perform a 2-hour charge using a constant potential (automatic setting on charger).

Jump Starting

Refer to Section 11- Engine for the jump starting procedure.

CLEANING AND INSPECTION

Battery Cleaning

1. Clean the battery and terminals with an acid-neutralizing solution.
2. Clean the battery clamps and battery terminals with a terminal cleaning brush.
3. Replace the battery ground cable and battery to starter relay cable if worn or frayed.
4. Test the battery to determine if it should be:
   - placed back in service.
   - recharged before being placed back in service.
   - replaced with a replacement or equivalent battery.
5. Clean the battery tray with a wire brush and scraper.

Tools

Use the proper tools to help prevent personal injury and damage to the battery, battery ground cable, battery to starter relay cable, and battery hold down clamps.

Tools and equipment manufactured for servicing batteries have insulated parts to help prevent arcing should the tool be dropped or placed accidentally between a terminal and some other conducting surface.

Carrier

WARNING: GRIP THE SIDE WALLS RATHER THAN THE END WALLS, BECAUSE THE SIDE WALLS HAVE ADDITIONAL STRENGTH DUE TO INNER CELL PARTITIONS. THIS IS PARTICULARLY IMPORTANT WITH POLYPROPYLENE-CASE BATTERIES WHICH HAVE FLEXIBLE END WALLS. GRIPPING THE END WALLS ON THIS TYPE OF BATTERY COULD CAUSE THE ELECTROLYTE TO SPEW FROM SOME OF THE CELLS AND POSSIBLY CAUSE PERSONAL INJURY AND DAMAGE TO THE VEHICLE.

Use a suitable battery carrier for lifting and transporting the battery.

TORQUE SPECIFICATIONS

Description	N-m	Lb-Ft
Battery Hold Down Clamp Bolts:	7-9	5-7

SECTION 17-2 Alternator, Integral Regulator - Internal Fan and Regulator Type

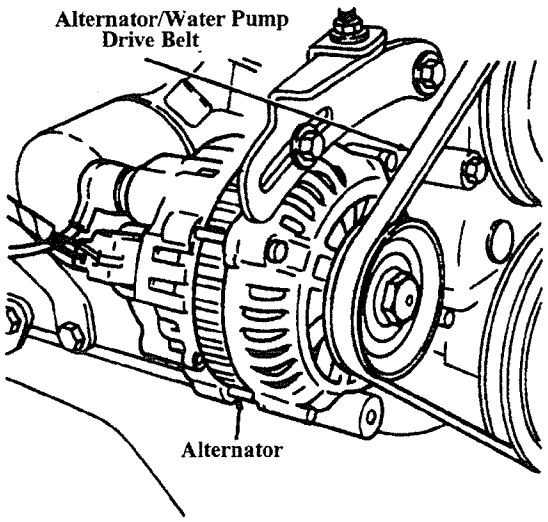
DESCRIPTION AND OPERATION

Charging System

The electrical charging system is a negative ground system consisting of an integral alternator/voltage regulator (IGR), charge indicator, storage battery, and the necessary wiring, battery ground cable and battery to starter relay cable. Refer to the Electrical and Vacuum Troubleshooting Manual for schematics and locations of components and wiring.

Integral Alternator/Regulator

The alternator produces an output current and has an internal electronic voltage regulator. The alternator is mounted on the front of the engine and is driven by the alternator/water pump drive belt.



Alternator Circuit

Circuit Description

Battery Positive Voltage (B+) Output

The alternator output is supplied through the battery positive voltage (B+) output connection to the battery and electrical system. This connection is the 'B' terminal, located on the back of the alternator.

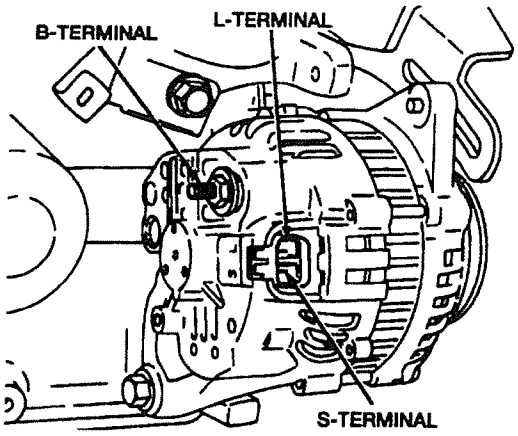
'L' Circuit

The 'L' (lamp) circuit is used to turn on the voltage regulator. This circuit is powered up with the ignition switch in the ON position. This circuit is also used to turn the charge indicator on if there is a fault in the charging system operation or associated wiring circuits.

'S' Circuit

The 'S' (sensing) circuit is used to sense the battery voltage. This voltage is used by the voltage regulator to determine the alternator output. This circuit is also used to supply power to the stator and coil. This circuit is connected back to the load distribution point and is a protected circuit.

DIAGNOSIS AND TESTING



Alternator and Regulator

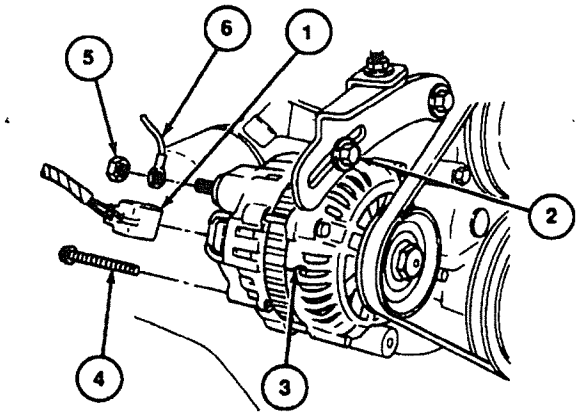
Refer to Section 18 for diagnosis of the alternator and integral regulator.

REMOVAL AND INSTALLATION

Alternator

Removal

The following illustration shows the alternator assembly and related mounting components.



Item	Part Number	Description
1	-	Alternator Electrical Connector
2	-	Adjustment Bolt
3	184022	Alternator
4	-	Alternator Bolt
5	-	B Terminal Nut
6	-	B Terminal Lead

1. Disconnect the battery ground cable.
2. Remove the B terminal nut.
3. Remove the B terminal lead.
4. Disconnect the alternator electrical connector.
5. Remove the adjustment bolt.
6. Raise the vehicle.
7. Remove the alternator bolt.
8. Disconnect the alternator/ water pump drive belt from the alternator pulley.
9. Remove the alternator from the vehicle.

Installation

To install, reverse the removal procedure.

Adjust the alternator/ water pump drive belt. Refer to Section 11 for the adjustment procedure.

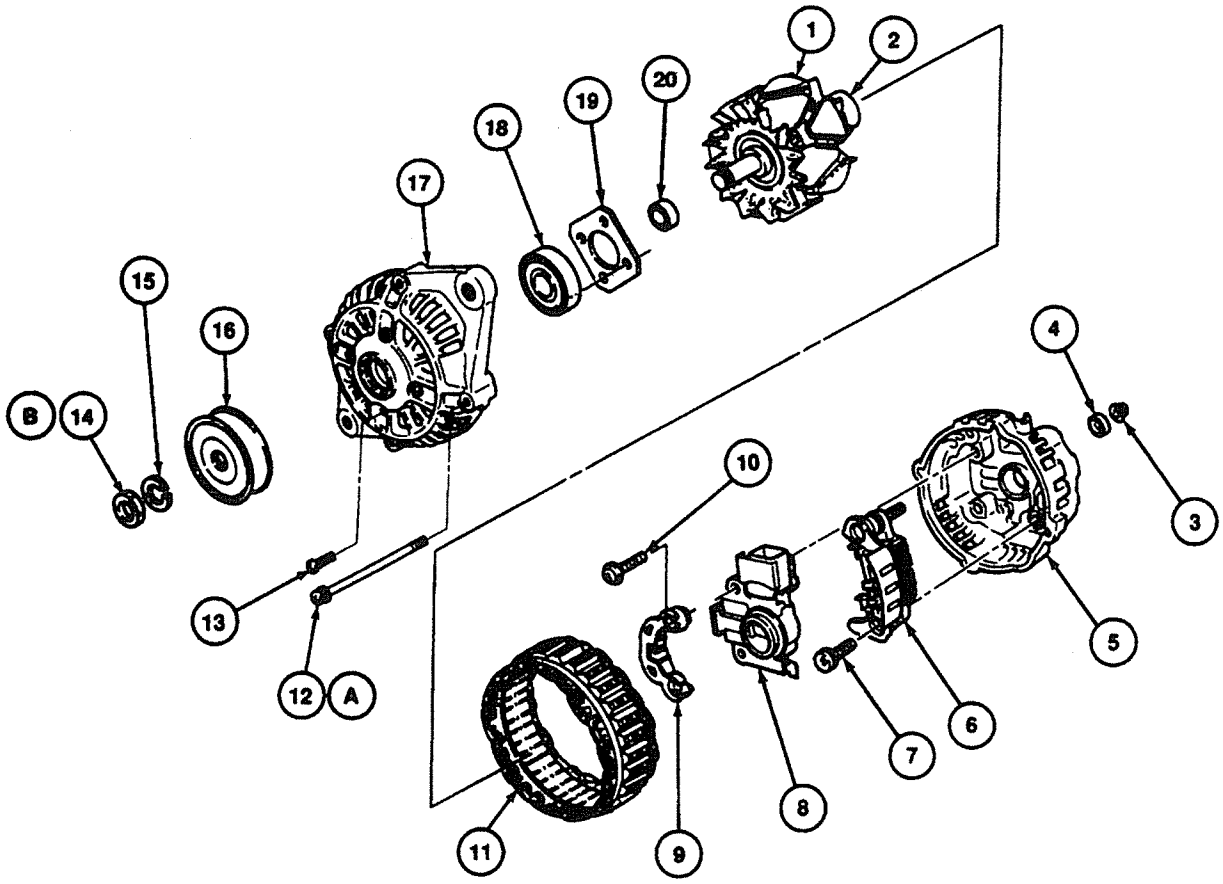
DISASSEMBLY AND ASSEMBLY

Alternator

Disassembly

The following illustration is an exploded view of the alternator assembly.

ALTERNATOR - exploded view

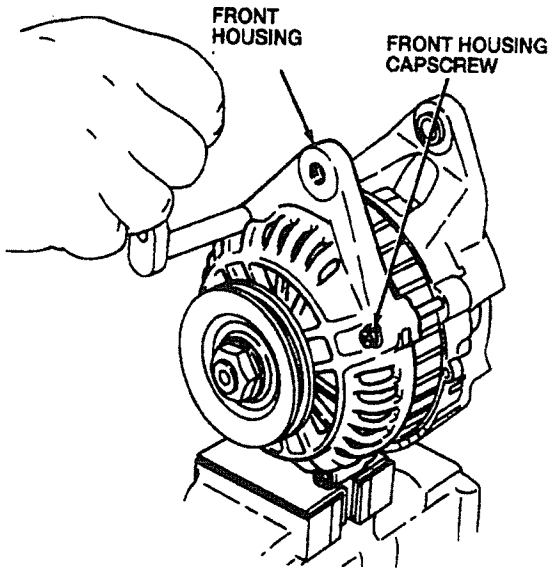


Item	Part Number	Description
1	184029	Alternator Rotor
2	184030	Alternator Rear Bearing
3	184037	Nut
4	-	Insulator (part of 184037)
5	184033	Alternator Rear Housing
6	184034	Rectifier
7	-	Rectifier Screw
8	184035	Voltage Regulator
9	-	Shield
10	-	Alternator Regulator Screws
11	184031	Stator and Coil
12	184025	Alternator Front Housing Capscrews (4 req'd)

Item	Part Number	Description
13	184027	Bearing Retainer Screws (4 req'd)
14	184023	Alternator Pulley Nut
15	-	Lockwasher
16	184024	Alternator Pulley
17	184026	Alternator Front Housing
18	184028	Alternator Front Bearing
19	-	Bearing Retainer
20	-	Alternator Fan/Pulley Spacer
A	-	Tighten to 35-48 lb-in (4-5 N-m)
B	-	Tighten to 43-58 lb-ft (59-78 N-m)

1. Make an alignment mark on the alternator front housing and alternator rear housing and bearing and stator frame for proper assembly alignment.

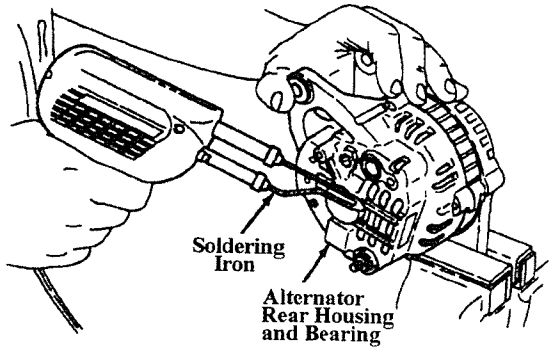
2. Remove the four alternator front housing capscrews.



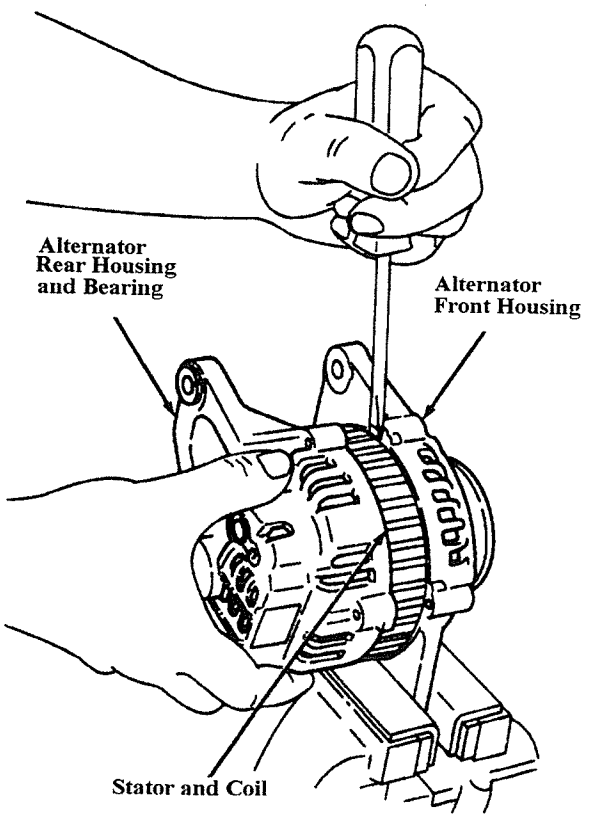
3. **CAUTION: Do not apply excessive direct heat to the alternator rear housing and bearing. Excessive heat could cause the alternator rear bearing grease to melt.**

   NOTE: Do not apply the soldering iron for more than four minutes. Do not heat the alternator rear housing and bearing to temperatures higher than (122-140° F 50-60°C).

   Use a 200-watt soldering iron to heat the alternator rear housing and bearing area to allow the alternator rear bearing to be removed from the alternator rear housing.

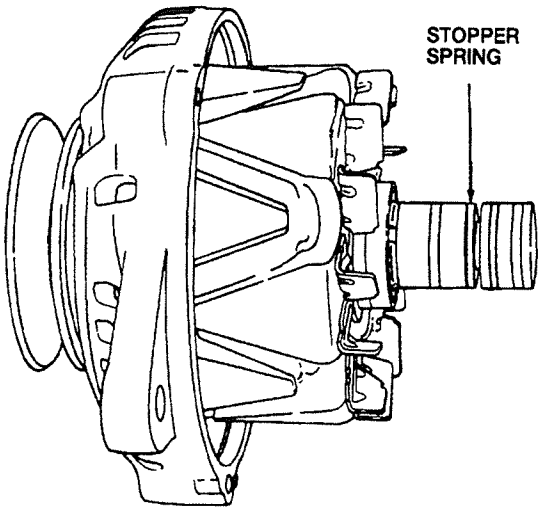


4. Use a flat-blade screwdriver to separate the alternator front housing from the stator and coil.



5. NOTE: Be careful not to lose the stopper spring that fits in the groove of the alternator rotor shaft.

   Remove the alternator front housing and alternator rotor from the alternator rear housing.



6. Secure the alternator rotor in a soft-jawed vise and remove the alternator pulley nut.

7. Remove the lockwasher and alternator pulley.

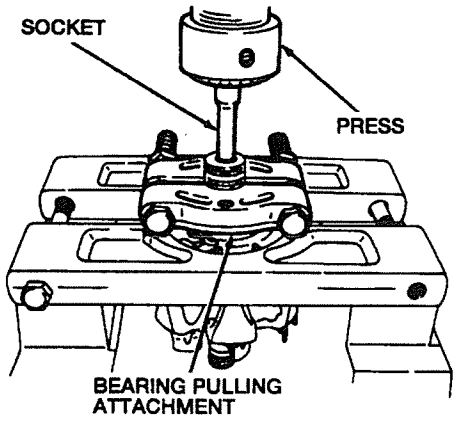
8. Remove the alternator rotor from the alternator front housing.

9. Remove the four bearing retainer screws

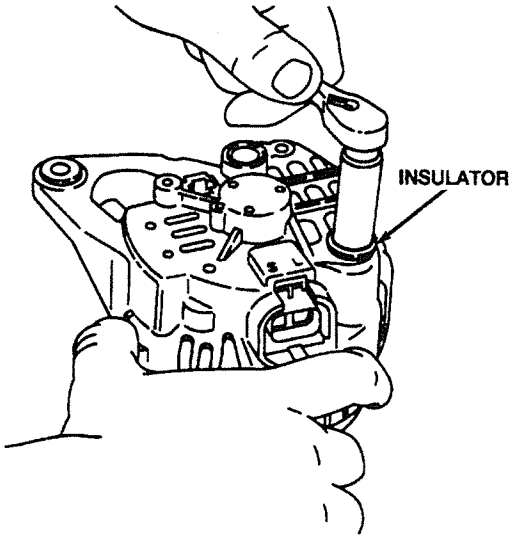
10. Remove the bearing retainer.

11. Use an appropriate socket or driver that fits the outer bearing race to press the alternator front bearing out of the alternator front housing.

12. Use a Bearing Puller or equivalent and a suitable socket to press the alternator rear bearing from the alternator rotor assembly.

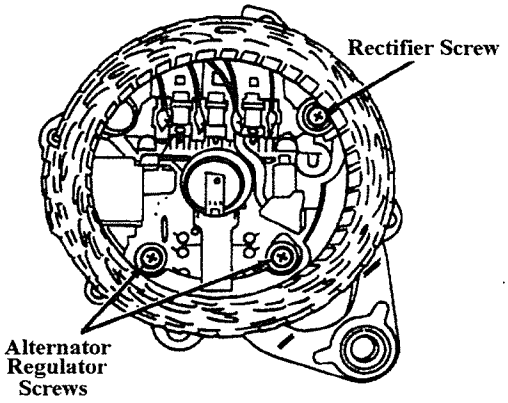


13. Remove the B terminal nut and insulator.

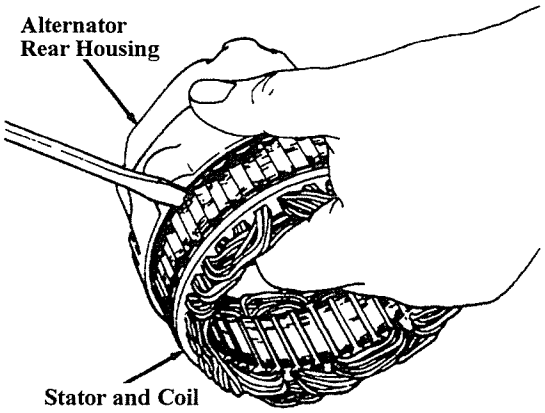


14. Remove the rectifier screw.

15. Remove the two alternator regulator screws.



16. Use a flat-blade screwdriver to separate the stator and coil from the alternator rear housing.



17. Remove the stator and coil, along with the brush holders and rectifier, from the alternator rear housing.

18. Remove the shield from the voltage regulator assembly.

19. **CAUTION: To avoid overheating and damage to the rectifier, work quickly while soldering. Do not apply the soldering iron for more than five seconds at a time.**

    Unsolder the stator and coil leads from the generator rear housing.

20. Unsolder the alternator regulator assembly leads.

21. Separate the rectifier, stator and coil, and voltage regulator.

22. Inspect all components. Refer to the cleaning and inspection procedures in this section.

23. Refer to this section for diagnosis and testing procedures.

Assembly

1. Assemble the rectifier, stator and coil, and voltage regulator.

2. **CAUTION: Use only rosin-core solder. Do not apply soldering heat for longer than four seconds. Hold the stator and coil leads with a pair of needlenose pliers which will act as a heat sink to protect the diodes.**

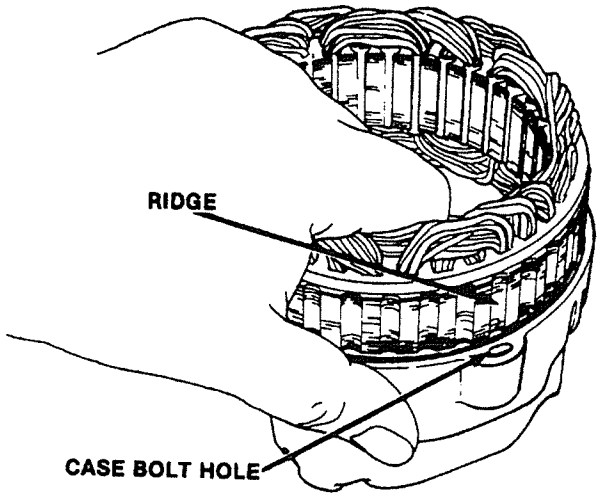
   Solder the alternator regulator assembly leads.

3. Solder the stator and coil leads.

4. Install the shield onto the voltage regulator assembly.

5. Install the stator and coil assembly, along with the rectifier and brush holder, to the alternator rear housing.

6. Position the stator and coil in the alternator rear housing so that one of the shallow ridges in the lamination lines up with the case bolt holes.

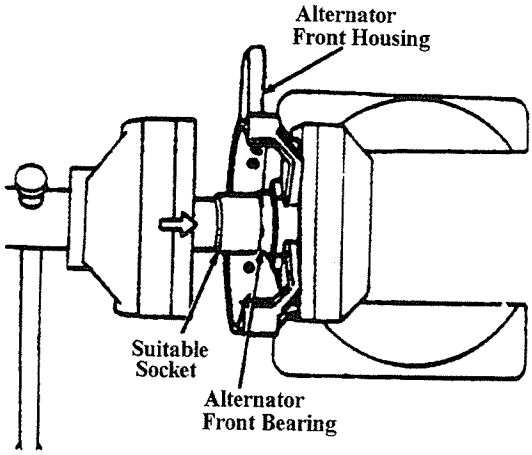


7. Install the rectifier screw.

8. Install the two alternator regulator screws.

9. Install the insulator and the B terminal nut.

10. Use a suitable socket or bearing installer to fit the outer bearing race, then use a vise and press the alternator front bearing into the alternator front housing.

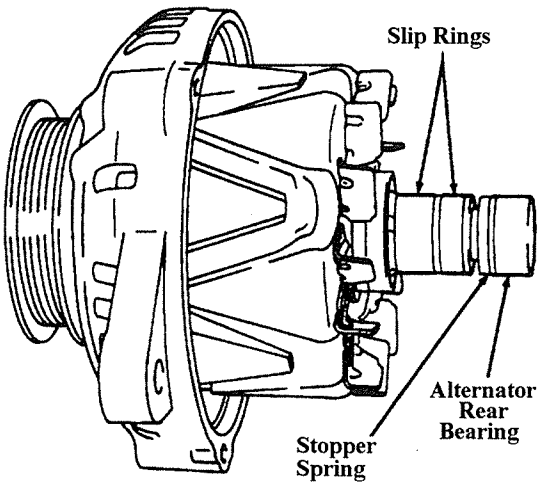


11. Position the bearing retainer and install the four bearing retainer screws.

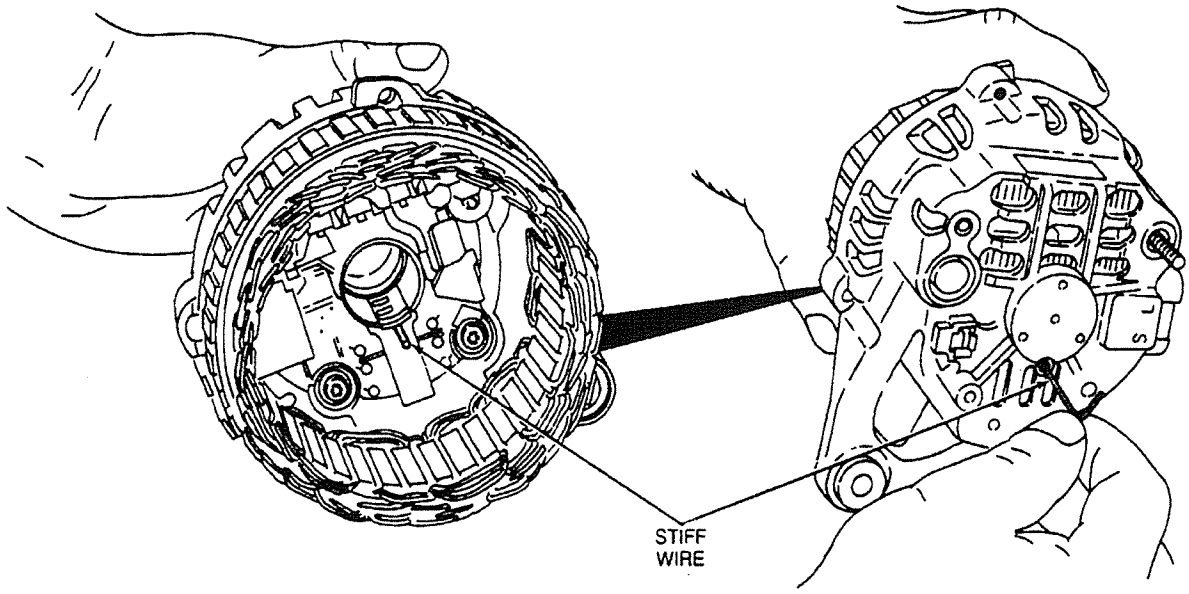
12. **CAUTION: Make certain that the stopper spring is installed in the groove in the alternator rear bearing.**

    NOTE: Install the alternator rear bearing so that the stopper spring is located on the inner side, toward the slip rings.

    Use a suitable driver on the inner bearing race to press the alternator rear bearing onto the rotor shaft.



13. Place the alternator rotor into the alternator front housing.
14. Install alternator pulley and lockwasher.
15. Secure the alternator rotor in a soft-jawed vise and install the alternator pulley nut. Tighten the alternator pulley nut to 43-58 lb-ft (59-78 N-m).
16. Use a stiff wire or straightened paper clip to retain the brushes in their holders.



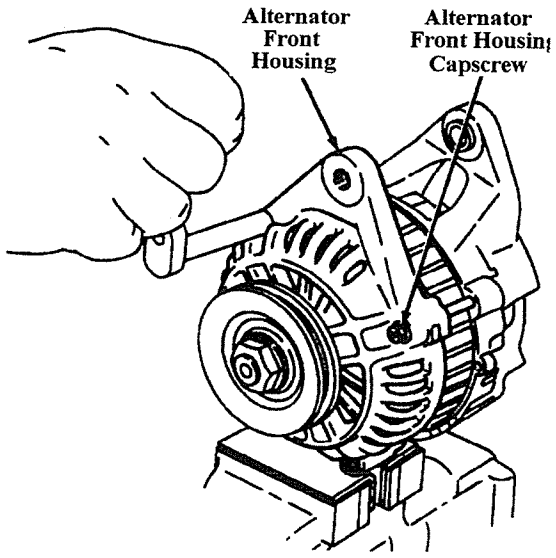
17. Use the alignment marks made during disassembly to attach the front housing and rear housing.
18. Install the four front housing capscrews. Tighten the four alternator front housing capscrews to 35-48 lb-in., (4-5 N-m).
19. Remove the stiff wire or paper clip holding the alternator brushes in the voltage regulator.
20. Rotate the alternator pulley manually through a full 360 degrees to check for ease of rotation.
21. If the alternator rotor drags or does not turn easily, disassemble the alternator to determine the cause. Refer to this section for the diagnosis and testing procedures.

Brush and Terminal Holder Replacement

Disassembly

1. Make an alignment mark on the alternator front housing and alternator rear housing and bearing and stator and coil frame for proper assembly alignment.

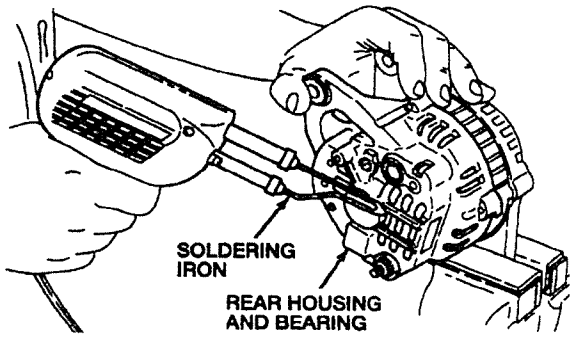
2. Remove the four alternator front housing capscrews.



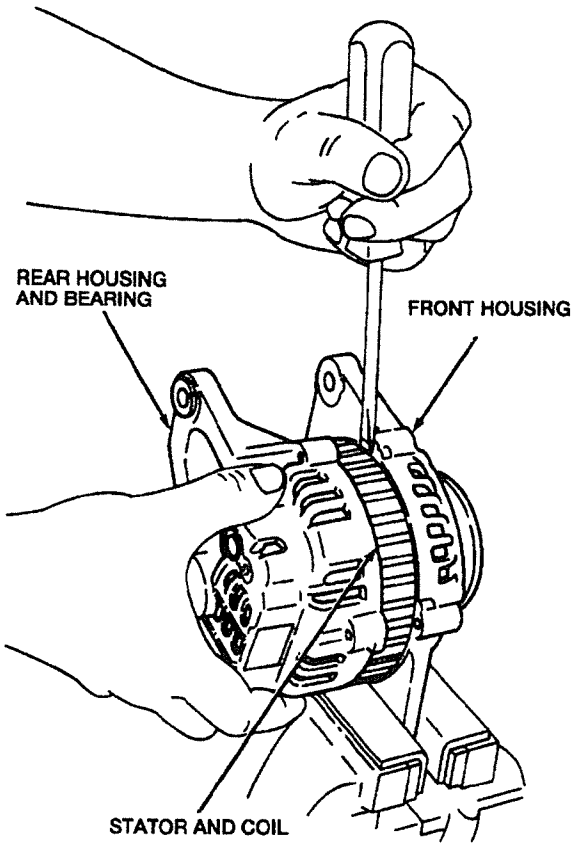
3. **CAUTION: Do not apply direct heat to the alternator rear housing and bearing. Excessive heat could cause the alternator rear bearing grease to melt.**

   NOTE: Do not apply the soldering iron for more than four minutes. Do not heat the alternator rear housing and bearing to temperatures higher than 122-140°F (50 - 60°C).

   Use a 200-watt soldering iron to heat the alternator rear housing and bearing area to allow the alternator rear bearing to be removed from the alternator rear housing.

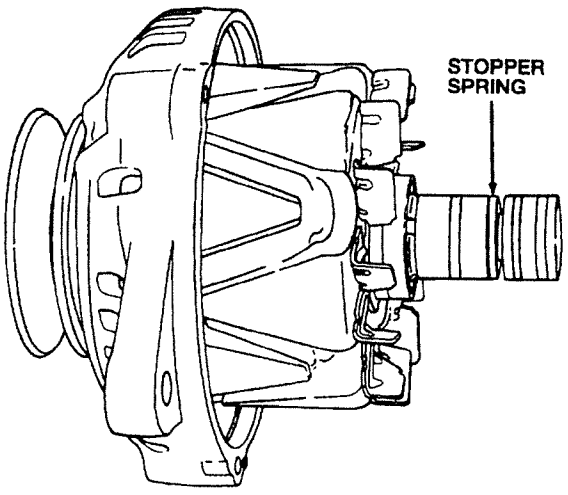


4. Use a flat-blade screwdriver to separate the alternator front housing from the stator and coil.

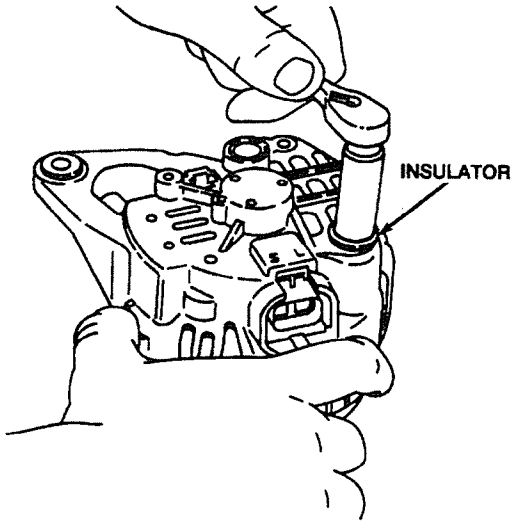


5. NOTE: Be careful not to lose the stopper spring that fits in the groove of the alternator rotor shaft.

   Remove the alternator front housing and alternator rotor from the alternator rear housing.

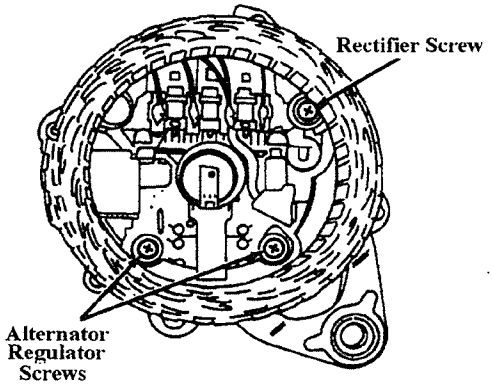


6. Remove the B terminal nut and insulator.

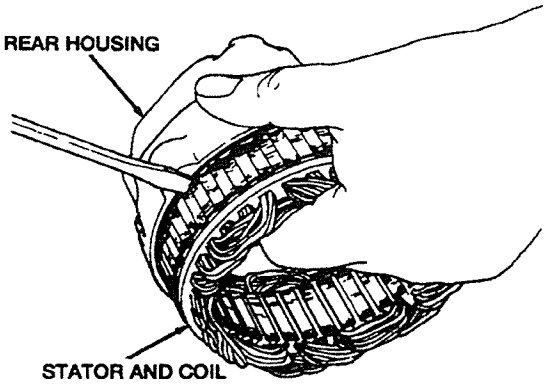


7. Remove the rectifier screw.

8. Remove the two alternator regulator screws.



9. Use a flat-blade screwdriver to separate the stator and coil from the alternator rear housing.



10. Remove the stator and coil assembly, along with the voltage regulator and rectifier, from the alternator rear housing.

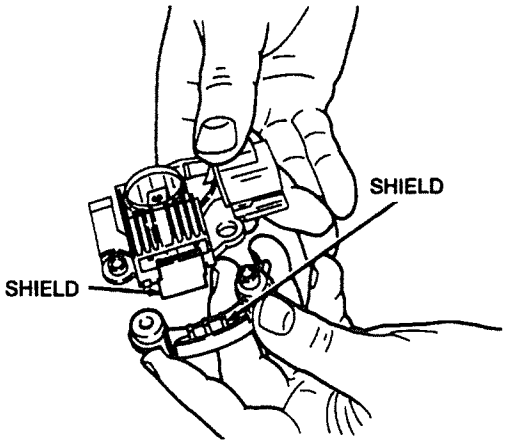
11. Remove the shield from the voltage regulator assembly.

12. **CAUTION: To avoid overheating and damage to the rectifier, work quickly while soldering. Do not apply the soldering iron for more than five seconds at a time.**

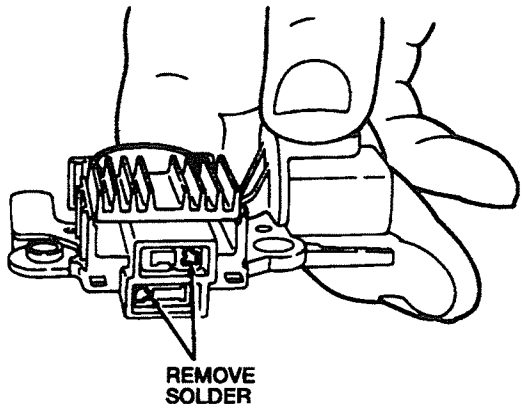
    Unsolder the stator and coil leads from the alternator rear housing.

13. Unsolder the alternator regulator assembly leads.
14. Separate the rectifier. stator and coil, and voltage regulator.

15. Remove the two shields from the voltage regulator.



16. Remove the solder from the voltage regulator and remove the alternator brush.



17. Refer to this section for the diagnosis and testing procedures.

Assembly

1. Solder the alternator brush into the voltage regulator.

2. Assemble the rectifier, stator and coil, and voltage regulator.

3. **CAUTION: Use only rosin-core solder. Do not apply soldering heat for longer than four seconds. Hold the stator and coil leads with a pair of needlenose pliers which will act as a heat sink to protect the diodes.**

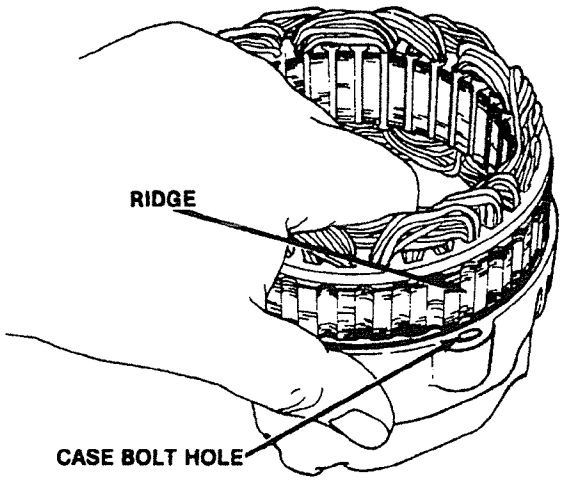
   Solder the alternator regulator assembly leads.

4. Solder the stator and coil leads.

5. Install the shield onto the voltage regulator assembly.

6. Install the stator and coil assembly, along with the rectifier and voltage regulator, to the alternator rear housing.

7. Position the stator and coil in the alternator rear housing so that one of the shallow ridges in the lamination lines up with the case bolt holes.

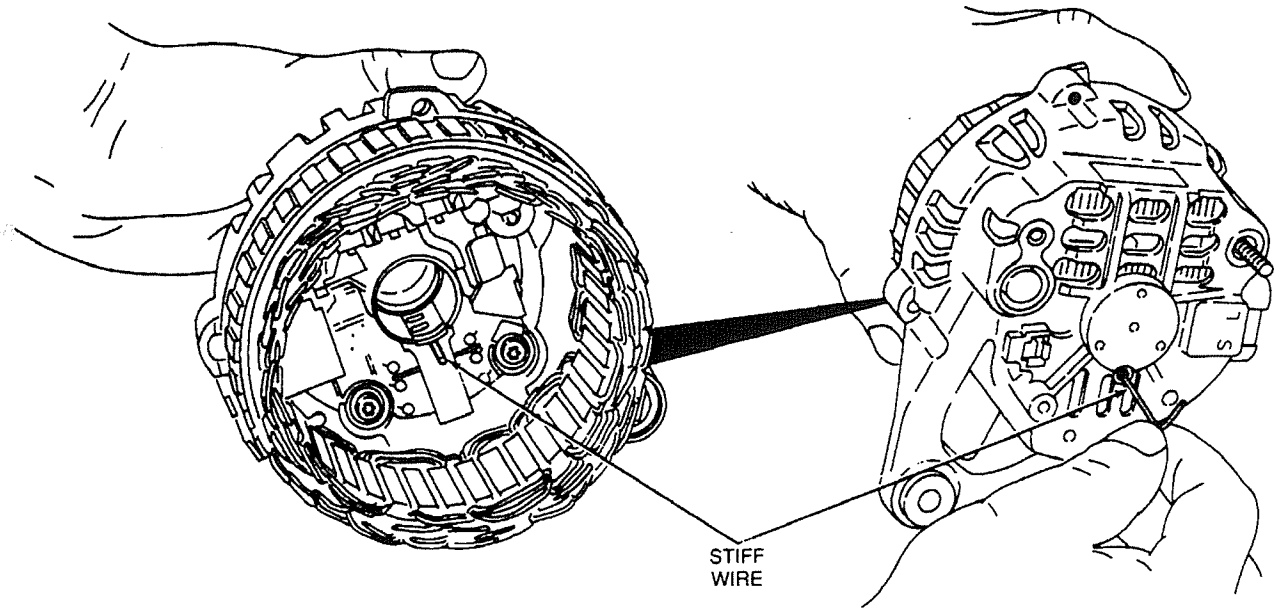


8. Install the rectifier screw.

9. Install the two alternator regulator screws.

10. Install the insulator and the B terminal nut.

11. Use a stiff wire or straightened paper clip to retain the brushes in their holders.



12. Use the alignment marks made during disassembly to attach the alternator front housing and alternator rear housing.

13. Install the four alternator front housing capscrews. Tighten the four alternator front housing capscrews to 35-48 lb-in (4-5 N-m).

14. Remove the stiff wire or paper clip holding the alternator brushes in the voltage regulator.

15. Rotate the alternator pulley manually through a full 360 degrees to check for ease of rotation.

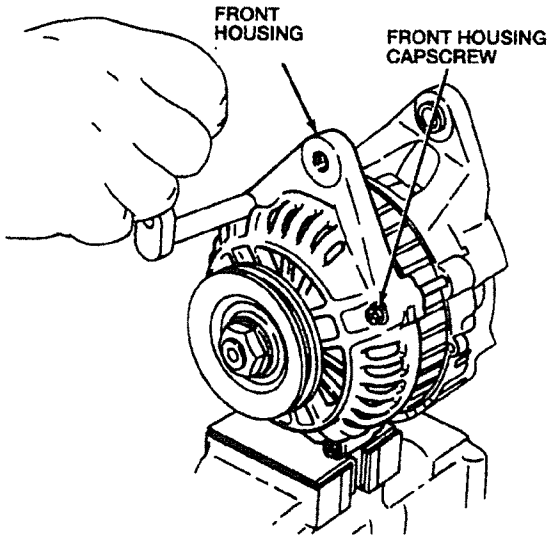
16. If the alternator rotor drags or does not turn easily, disassemble the alternator to determine the cause. Refer to this section for the diagnosis and testing procedures.

Front Bearing Replacement

Disassembly

1. Make an alignment mark on the alternator front housing and alternator rear housing and bearing and stator and coil frame for proper assembly alignment.

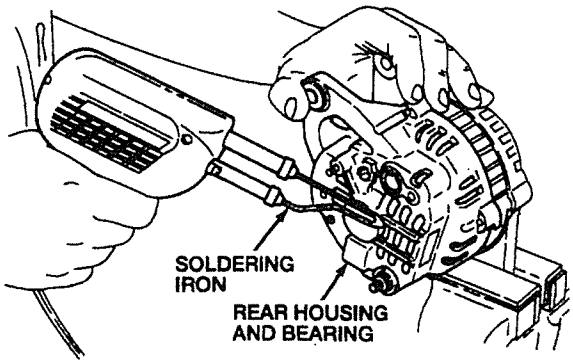
2. Remove the four alternator front housing capscrews.



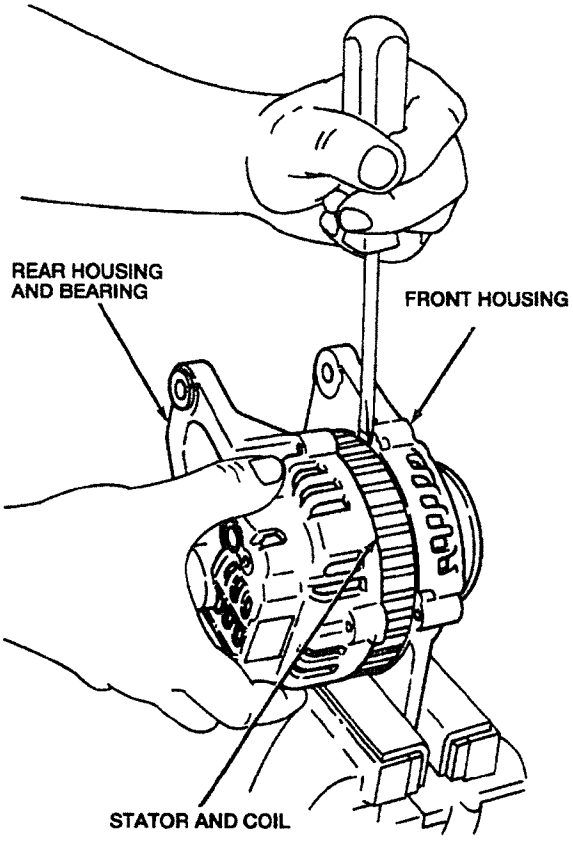
3. **CAUTION: Do not apply direct heat to the alternator rear housing and bearing. Excessive heat could cause the alternator rear bearing grease to melt.**

   NOTE: Do not apply the soldering iron for more than four minutes. Do not heat the alternator rear housing and bearing to temperatures higher than 122-144°F (50 - 60°C).

   Use a 200-watt soldering iron to heat the alternator rear housing and bearing area to allow the alternator rear bearing to be removed from the alternator rear housing.

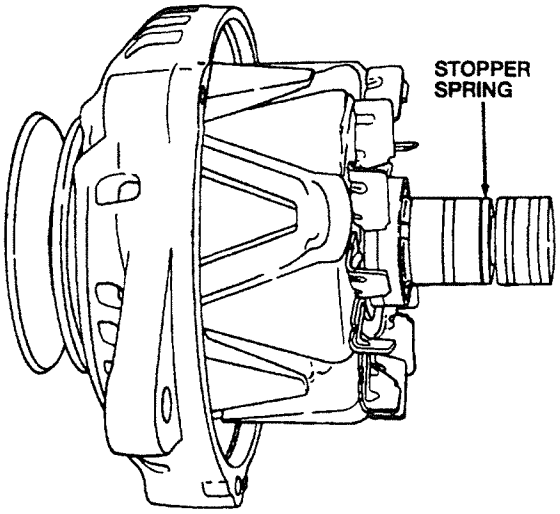


4. Use a flat-blade screwdriver to separate the alternator front housing from the stator and coil.



5. NOTE: Be careful not to lose the stopper spring that fits in the groove of the alternator rotor shaft.

   Remove the alternator front housing and alternator rotor from the alternator rear housing.



6. Secure the alternator rotor in a soft-jawed vise and remove the alternator pulley nut.

7. Remove the lockwasher and alternator pulley.

8. Remove the alternator rotor from the alternator rear housing.

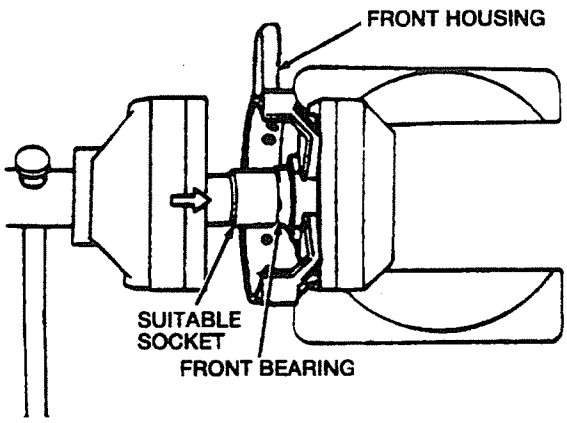
9. Remove the four bearing retainer screws.

10. Remove the bearing retainer,

11. Use an appropriate socket or driver that fits the outer bearing race to press the alternator front bearing out of the alternator front housing.

Assembly

1. Use a suitable socket or bearing installer to fit the outer bearing race, use a vise and press the alternator front bearing into the alternator front housing.

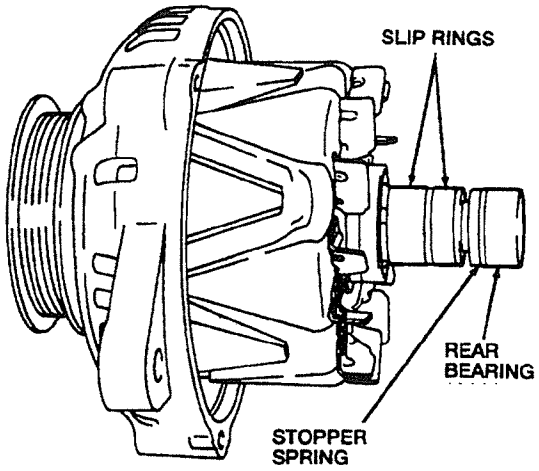


2. Position the bearing retainer and install the four bearing retainer screws.

3. **CAUTION: Make certain that the stopper spring is installed in the groove in the alternator rear bearing.**

   NOTE: Install the alternator rear bearing so that the stop spring is located on the inner side, toward the slip rings.

   Use a suitable driver on the inner bearing race to press the alternator rear bearing onto the rotor shaft.

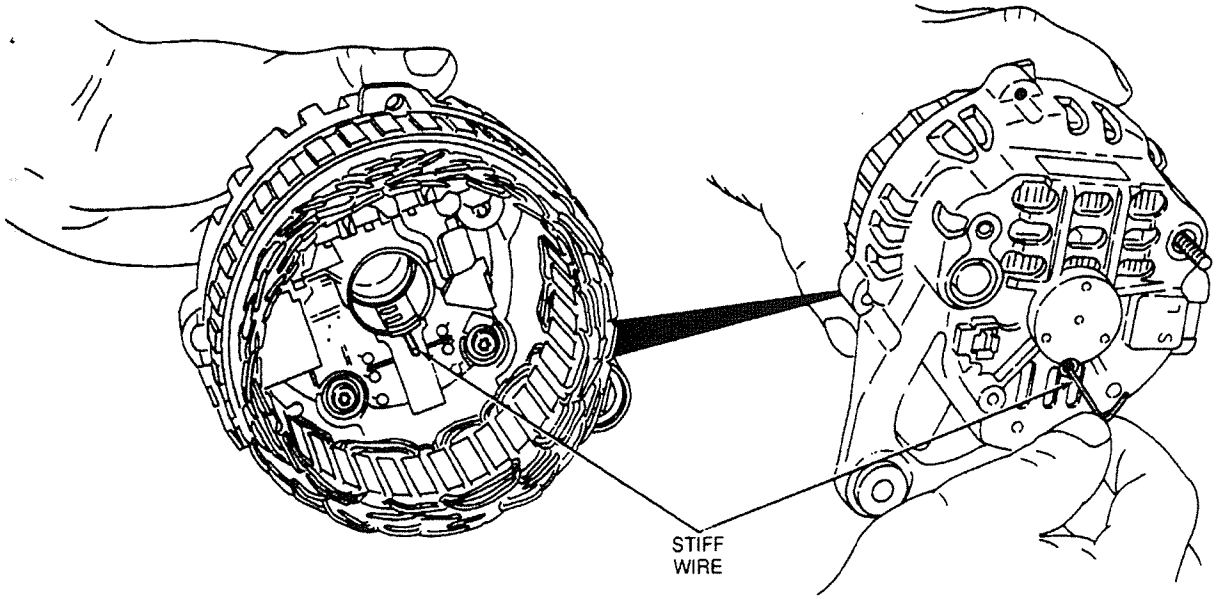


4. Place the alternator rotor into the alternator front housing.

5. Install alternator pulley and lockwasher.

6. Secure the alternator rotor in a soft-jawed vise and install the alternator pulley nut. Tighten the alternator pulley nut to 43-58 lb-ft (59-78 N-m).

7. Use a stiff wire or straightened paper clip to retain the brushes in their holders.



8. Use the alignment marks made during disassembly to attach the alternator front housing and alternator rear housing.

9. Install the four alternator front housing capscrews. Tighten the four alternator front housing capscrews to 35-48 lb-in (4-5 N-m).

10. Remove the stiff wire or paper clip holding the alternator brushes in the voltage regulator.

11. Rotate the alternator pulley manually through a full 360 degrees to check for ease of rotation.

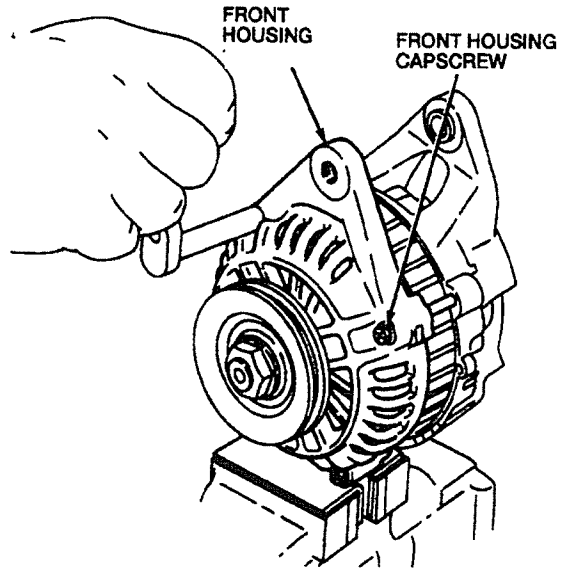
12. If the alternator rotor drags or does not turn easily, disassemble the alternator to determine the cause. Refer to this section for the diagnosis and testing procedures.

Rear Bearing Replacement

Disassembly

1. Make an alignment mark on the alternator front housing and alternator rear housing and bearing and stator and coil frame for proper assembly alignment.

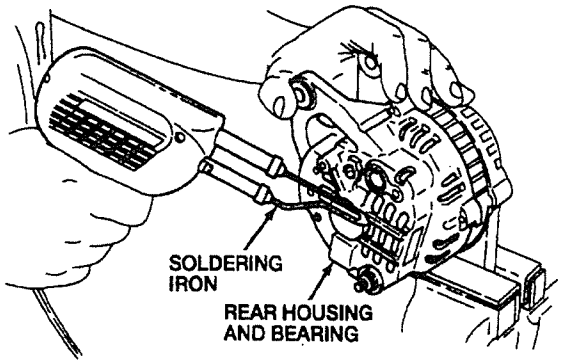
2. Remove the four alternator front housing capscrews.



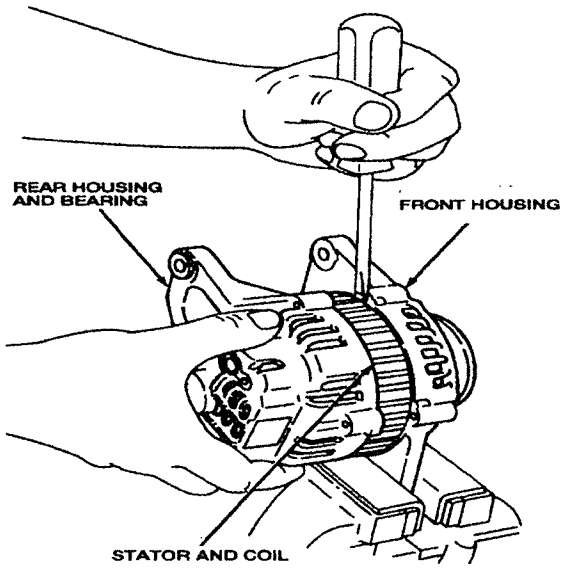
3. **CAUTION: Do not apply direct heat to the alternator rear housing and bearing. Excessive heat could cause the alternator rear bearing grease to melt.**

   NOTE: Do not apply the soldering iron for more than four minutes. Do not heat the alternator rear housing and bearing to temperatures higher than 122-144°F (50-60°C).

   Use a 200-watt soldering iron to heat the alternator rear housing and bearing area to allow the alternator rear bearing to be removed from the alternator rear housing.

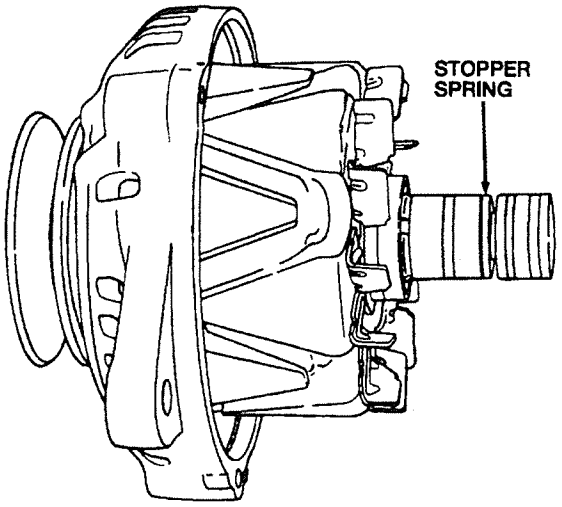


4. Use a flat-blade screwdriver to separate the alternator front housing from the stator and coil.

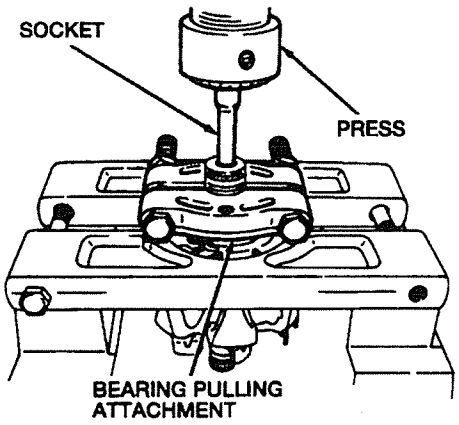


5. NOTE: Be careful not to lose the stopper spring that fits in the groove of the alternator rotor shaft.

   Remove the alternator front housing and alternator rotor from the alternator rear housing.



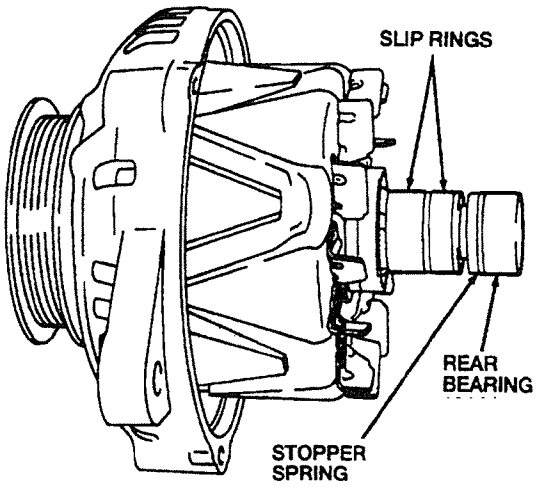
6. Use a Bearing Pulling Attachment or equivalent and a suitable socket to press the alternator rear bearing from the alternator rotor assembly.



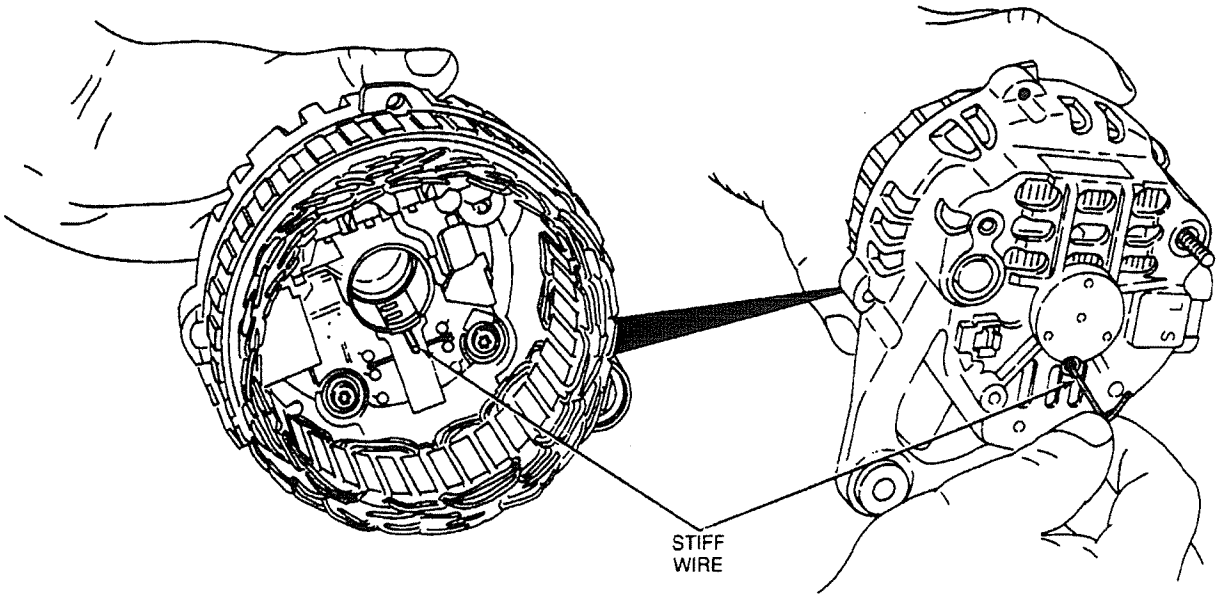
Assembly

1. NOTE: Install the alternator rear bearing so that the stopper spring is located on the inner side, toward the slip rings.

   Use a suitable driver on the inner bearing race to press the alternator rear bearing onto the rotor shaft.



2. Use a stiff wire or straightened paper clip to retain the alternator brushes in the voltage regulator.



3. Use the alignment marks made during disassembly to attach the alternator front housing and alternator rear housing.

4. Install the four alternator front housing capscrews. Tighten the four alternator front housing capscrews to 35-48 lb-in (4-5 N-m).

5. Remove the stiff wire or paper clip holding the alternator brushes in the voltage regulator.

6. Rotate the alternator pulley manually through a full 360 degrees to check for ease of rotation.

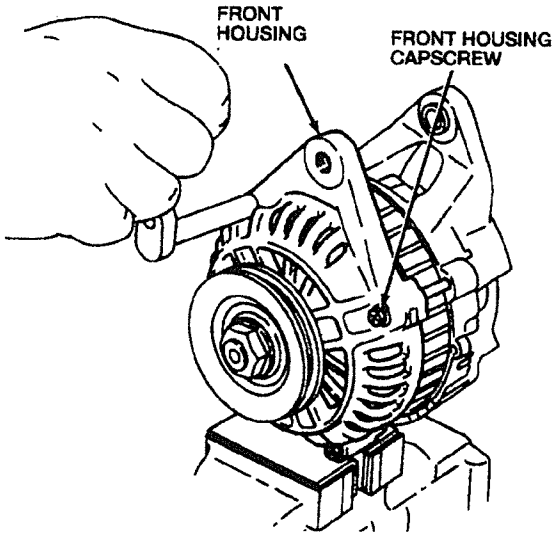
7. If the alternator rotor drags or does not turn easily, disassemble the alternator to determine the cause. Refer to this section for the diagnosis and testing procedures.

Alternator Regulator

Disassembly

1. Make an alignment mark on the alternator front housing and alternator rear housing and bearing and stator and coil frame for proper assembly alignment.

2. Remove the four alternator front housing capscrews.

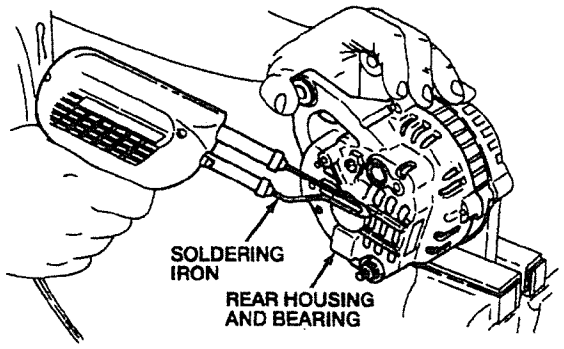


3. **CAUTION: Do not apply direct heat to the alternator rear housing and bearing. Excessive heat could cause the alternator rear bearing grease to melt.**

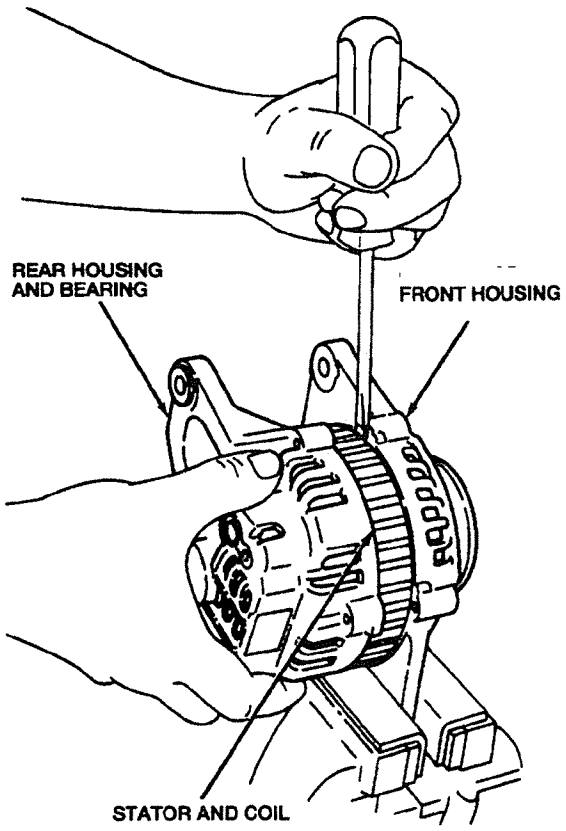
   NOTE: Do not apply the soldering iron for more than four minutes. Do not heat the alternator rear housing and bearing to temperatures higher than 122-140°F (50-60°C).

   Use a 200-watt soldering iron to heat the alternator rear housing and bearing area to

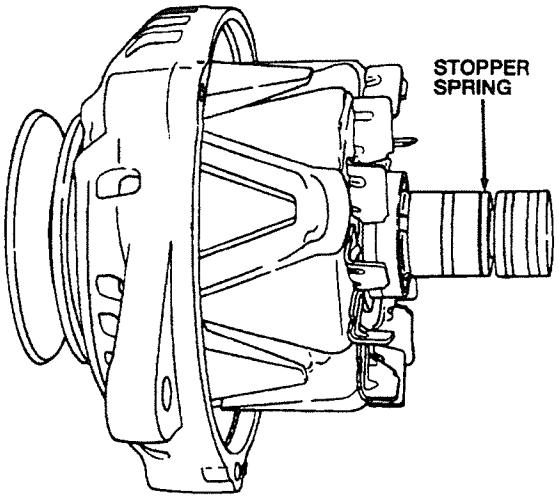
allow the alternator rear bearing to be removed from the alternator rear housing.



4. Use a flat-blade screwdriver to separate the alternator front housing from the stator and coil.

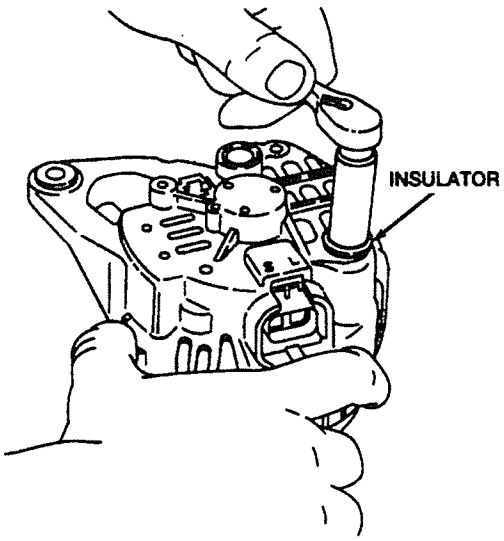


5. NOTE: Be careful not to lose the stopper spring that fits in the groove of the alternator rotor shaft.



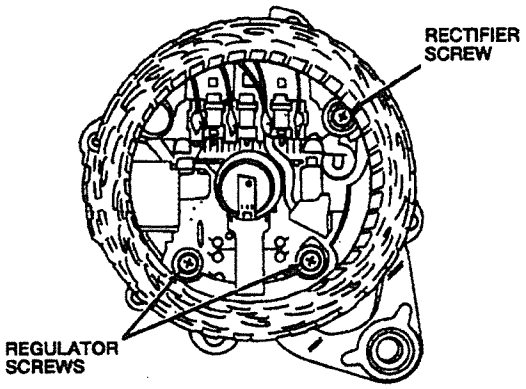
Remove the alternator front housing and alternator rotor from the alternator rear housing and bearing.

6. Remove the B terminal nut and insulator.

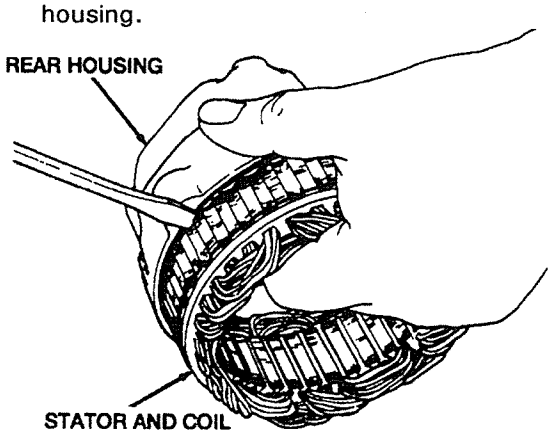


7. Remove the rectifier screw.

8. Remove the two alternator regulator screws.



9. Use a flat-blade screwdriver to separate the stator and coil from the alternator rear housing.



10. Remove the stator and coil, along with the voltage regulator and rectifier, from the alternator rear housing.

11. Remove the shield from the alternator regulator assembly.

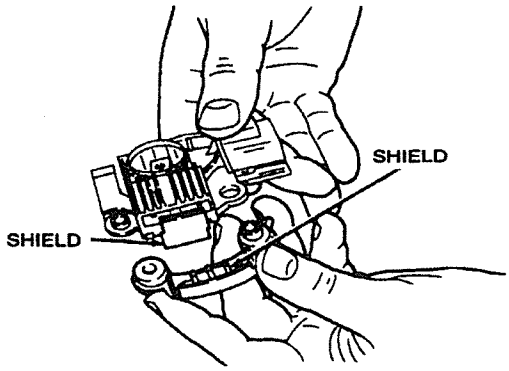
12. **CAUTION: To avoid overheating and damage to the rectifier, work quickly while soldering. Do not apply the soldering iron for more than five seconds at a time.**

    Unsolder the stator and coil leads from the alternator rear housing.

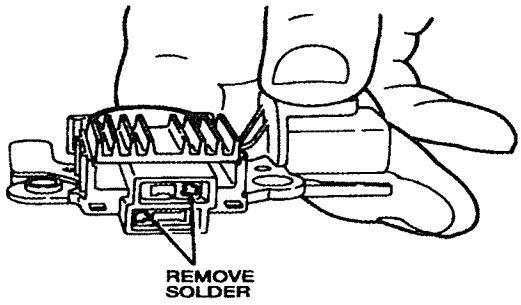
13. Unsolder the alternator regulator assembly leads.

14. Separate the rectifier, stator and coil, and voltage regulator.

15. Remove the two shields from the voltage regulator.



16. Remove the solder from the voltage regulator and remove the alternator brush.



17. Refer to this section for the diagnosis and testing procedures.

Assembly

1. Solder the alternator brush into the voltage regulator.

2. Assemble the rectifier, stator and coil, and voltage regulator.

3. **CAUTION: Use only rosin-core solder. Do not apply soldering heat for longer than four seconds. Hold the stator and coil leads with a pair of needlenose pliers which will act as a heat sink to protect the diodes.**

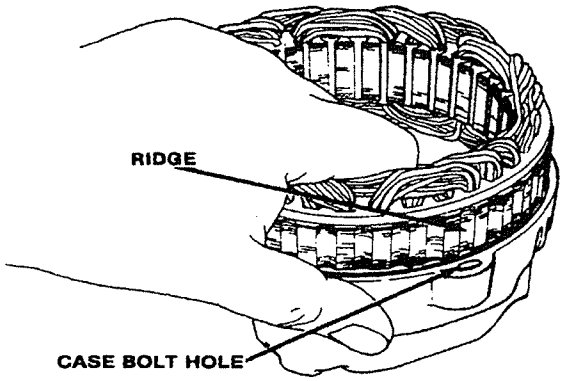
   Solder the alternator regulator assembly leads.

4. Solder the stator and coil leads.

5. Install the shield onto the voltage regulator assembly.

6. Install the stator and coil assembly, along with the rectifier and voltage regulator, to the alternator rear housing.

7. Position the stator and coil in the alternator rear housing so that one of the shallow ridges in the lamination lines up with the case bolt holes.

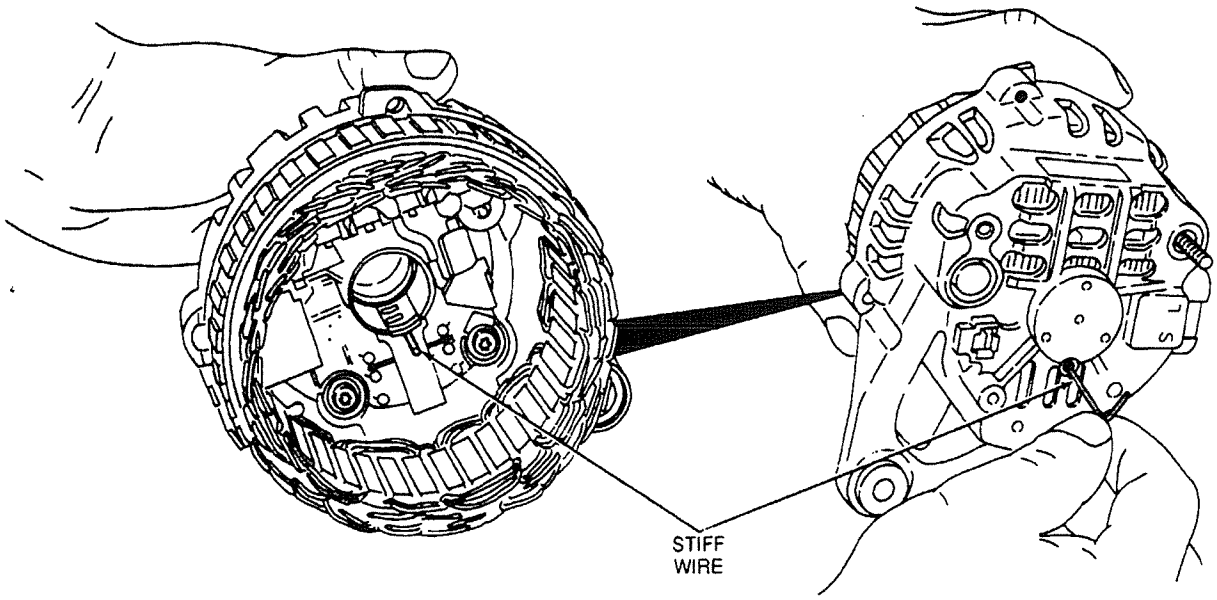


8. Install the rectifier screw.

9. Install the two alternator regulator screws.

10. Install the insulator and the B terminal nut.

11. Use a stiff wire or straightened paper clip to retain the brushes in their holders.



12. Use the alignment marks made during disassembly to attach the alternator front housing and alternator rear housing.

13. Install the four alternator front housing capscrews. Tighten the four alternator front housing capscrews to 35-48 lb-in (4 -5 N-m).

14. Remove the stiff wire or paper clip holding the alternator brush in the voltage regulator.

15. Rotate the alternator pulley manually through a full 360 degrees to check for ease of rotation.

16. If the alternator rotor drags or does not turn easily, disassemble the alternator to determine the cause. Refer to this section for the diagnosis and testing procedures.

CLEANING AND INSPECTION

The following procedures outline Cleaning and Inspection of internal alternator components. Refer to Section 14-00 for diagnosis and testing procedures of individual alternator components.

Alternator

CAUTION: When rebuilding an alternator, use only high temperature alternator front bearings or alternator rear bearings. Use of standard parts will result in alternator failure.

Alternator Rotor

Wipe the alternator rotor with a clean cloth. Do not clean with solvent. Inspect the alternator rotor shaft surface for roughness or severe chatter marks. Replace the alternator rotor if the alternator rotor shaft is not smooth. Check all wire leads on the alternator rotor for poor solder connections or burned insulation. Resolder poor connections and replace the alternator rotor if signs of burned insulation exist.

Stator and Coil

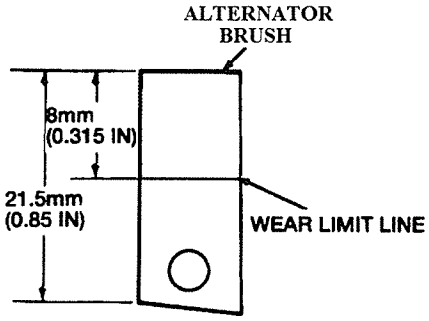
Wipe the stator and coil with a clean cloth. Do not clean with solvent. Check all wire leads on the stator and coil for poor solder connections or burned insulation. Resolder poor connections and replace the stator and coil if signs of burned insulation exist.

Alternator Bearings

Wipe the alternator front bearing and alternator rear bearing with a clean cloth. Do not clean with solvent. Rotate the alternator front bearing and alternator rear bearing. Check for scraping noise, looseness, or roughness. Inspect the rollers and cages for damage or lost lubricant. Replace the alternator front bearing or alternator rear bearing if these conditions exist. Refer to the alternator front bearing and alternator rear bearing disassembly and assembly procedures in this section.

Alternator Brushes

Replace the alternator brushes if the alternator brushes are at or are worn shorter than the wear limit line of 0.315 inch (8mm).



Rectifier

Wipe the rectifier with a clean cloth. Do not clean with solvent. Check all wire leads on the rectifier for poor solder connections or burned insulation. Resolder poor connections and replace the rectifier if signs of burned insulation exist.

ADJUSTMENTS

Drive Belt, Alternator

Refer to Section 03-05 for the drive belt adjustment procedure.

SPECIFICATIONS

TORQUE SPECIFICATIONS

Description	N-m	Lb-Ft	Lb-In
Alternator Pulley Nut	59-78N	43-58	-
Alternator Front Housing Capscrews	4-5	-	35-48

SERVICE TOOLS AND EQUIPMENT

- Bearing Puller Attachment

SECTION 18 - Lighting Systems

DESCRIPTION AND OPERATION

Headlamps

The headlamps are mounted into the front bumper assembly. The headlamp is attached to the headlamp housing with a trim ring and four screws. Two headlamp adjusting screws and a tension spring are used to the adjust the horizontal and vertical aim of the headlamps

Headlamp Switch/Turn Signal

The headlamp function is part of the multi-function switch mounted on the steering column. The head lamp switch is on the left side of the steering column and is serviced with the multi-function switch as an assembly. The headlamps turn on when the rotary switch at the end of the stalk is rotated counterclockwise to the first position. This activates the clearance, parking, license, and tail lights. Turn the knob to the second position to activate head lights, license, and tail lights.

The headlamp switch stalk provides two additional functions:

- High Beam
- Flash-to-Pass

When the headlamp switch is pushed toward the instrument panel, the high beam headlamps turn on and remain on until the headlamp switch is pulled rearward to the low beam position. The high beam headlamp circuit also illuminates the high beam indicator on the instrument panel. The flash-to-pass function allows the headlamps

to operate independent of the rotary headlamp switch. When the headlamp switch is pulled toward the driver, the high beams will turn on. Releasing the headlamp switch allows spring pressure to return the headlamp switch to the OFF position.

Brake On/Off Switch (BOO)

The brake on/off switch illuminates the rear lamps. The BOO switch sends braking information to the Powertrain Control Module.

Lamps- Parking, Tail and Marker

The parking, side marker lamps, tail lamps, and license plate lamp circuits are controlled by the headlamp switch. When the headlamp switch is rotated to the first detent, only the parking and side marker lamps, tail lamps, and rear license plate lamps are illuminated.

When the headlamp switch is rotated to the second detent, the parking lamps, side marker lamps, tail lights, and license plate lamps remain on, and the head lamps are illuminated.

Brake Lights

The rear brake lamp is a lens and housing assembly containing the backup lamp and tail/ stop lamp. The lenses are screwed to the rear lamp housing and the assembly is attached to the body. The wiring from the rear lamp individual bulbs is contained in a single electrical connector that joins the body wiring harness.

Lamps, License

The single rear license plate lamp is installed in the rear bumper. The wiring from the license plate joins the body wiring harness.

Lamps, Backup

The backup lamp system consists of a backup lamp switch and two backup lamps located at the rear of the vehicle.

When the backup lamp switch is activated, current is directed to the backup lamps. The backup lamps will indicate the vehicle is engaged in the reverse gear. When the transaxle is shifted to any other gear position, the backup lamps are turned off.

Turn Signals and Hazard Lamps

To operate the turn signals, the ignition switch must be in the ON position. Move the turn signal switch stalk in the desired direction (down for left, and up for right) to activate the turn signals. The turn signal switch lever will remain in position without manual effort until the turn is completed. The steering wheel will automatically cancel the turn signal. If the turn signal continues to flash, pull the turn signal switch lever back to the OFF position.

The hazard warning system is operated independently from the ignition switch. All turn signal lamps can be made to flash at the same time by depressing the hazard warning flasher switch. Flashing is discontinued when the hazard warning flasher switch is depressed a second time.

Hazard Warning Flasher Switch

The hazard warning flasher switch is located in the center of the upper steering column cover on top of the steering column, and is an integral part of the multi-function switch.

DIAGNOSIS AND TESTING

Inspection and Verification - Headlamps

1. Verify the customer concern by operating the headlamp system.
2. Visually inspect the components of the headlamp system.

Mechanical	Electrical
• None	• Blown fuse • Damaged headlamp. • Damaged wiring harness. • Loose or corroded connections.

3. Check the wiring harness for obvious signs of shorts, opens, bad connections, or damage.
4. Check for improperly installed accessories.
5. If fault is not visually evident, determine the symptom and proceed to the following Troubleshooting Chart.

Troubleshooting Chart - Headlamps

NOTE: Use a digital multimeter or similar to perform electrical Pinpoint Tests.

Condition	Possible Source	Action
• Headlamps Inoperative	• Fuse. • Headlamp relay. • Circuit. • Multi-function switch. • Headlamps.	• Go to Pinpoint Test A1.
• Headlamps on Continuously	• Headlamp relay. • Circuit. • Multi-function switch.	• Go to Pinpoint Test B1.
• High Beams or Low Beams Inoperative	• Circuit • Multi-function switch.	• Go to Pinpoint Test C1.
• One High or One Low Beam Headlamp Inoperative	• Circuit. • Headlamp bulb.	• Go to Pinpoint Test D1.
• Flash-to-Pass Inoperative	• Circuit. • Multi-function switch.	• Go to Pinpoint Test E1.

Pinpoint Test - Headlamps

PINPOINT TEST A: Headlamps Inoperative

TEST STEP		RESULT	ACTION TO TAKE
A1	CHECK FUSE		
•	Check the fuse located in the main fuse panel.	Yes ⇒	Go to A4.
•	**Is the fuse OK?**	No ⇒	Go to A2.
A2	CHECK THE HEADLAMP SYSTEM		
•	Key OFF.	Yes ⇒	Go to A3.
•	Replace the Fuse.		
•	Inspect the fuse.	No ⇒	Go to A4.
•	**Does the fuse fail again?**		
A3	CHECK FOR SHORT GROUND		
•	Key OFF.	Yes ⇒	Replace the fuse. Go to A4.
•	Remove the fuse	No ⇒	Service the wire.
•	Locate and disconnect the multi-function switch connector.		
•	Locate and disconnect the headlamp relay.		
•	Measure the resistance of the wire between the fuse holder and ground.		
•	**Is the resistance greater than 10,000 ohms?**		
A4	CHECK HEADLAMP RELAY		
•	Perform the Headlamp Relay component test in this section.	Yes ⇒	Go to A5.
•	**Is the headlamp relay OK?**	No ⇒	Replace the headlamp relay.
A5	CHECK POWER SUPPLY TO HEADLAMP RELAY		
•	Key OFF.	Yes ⇒	Go to A6.
•	Disconnect the headlamp relay.		
•	Measure the voltage on the wires at the headlamp relay connector.	No ⇒	Service the wire between the fuse and headlamp relay.
•	**Are the voltages greater than 10 volts?**		

PINPOINT TEST A: Headlamps Inoperative (continued)

TEST STEP		RESULT	ACTION TO TAKE
A6	CHECK HEADLAMP SWITCH		
•	Perform the Headlamp Switch component test in this section.	Yes ⇒	Go to A7.
•	**Is the headlamp switch OK?**	No ⇒	Replace the multi-function switch.
A7	CHECK THE HEADLAMP SWITCH GROUND		
•	Key OFF.	Yes ⇒	Go to A8.
•	Disconnect the multi-function switch connector.		
•	Measure the resistance of the wire between multi-function switch connector and ground.	No ⇒	Service the wire.
•	**Is the resistance less than 5 ohms?**		
A8	CHECK WIRES BETWEEN HEADLAMP RELAY AND MULTI-FUNCTION SWITCH		
•	Key OFF.	Yes ⇒	Service the wire for opens between the headlamps and ground.
•	Disconnect the headlamp relay.		
•	Locate and disconnect the multi-function switch connector.	No ⇒	Service the wire(s) in question.
•	Measure the resistance of the wires between the headlamp relay connector and multi-function switch connector.		
•	**Are the resistance less than 5 ohms between the headlamp relay and the multi-function switch, and greater than 10,000 ohms between the headlamp relay connector and ground?**		

PINPOINT TEST B: Headlamps on Continuously

TEST STEP		RESULT	ACTION TO TAKE
B1	CHECK HEADLAMP RELAY		
•	Perform the Headlamp Relay component test in the section.	Yes ⇒	Go to B2.
•	Is the headlamp relay OK?	No ⇒	Replace the headlamp relay.
B2	CHECK THE HEADLAMP SWITCH		
•	Perform the Headlamp Switch component test in this section.	Yes ⇒	Service the wire between the headlamp relay and the headlamp switch.
•	Is the headlamp switch OK?	No ⇒	Check for short to power on wires. Service as necessary. Otherwise, REPLACE the multi-function switch.

PINPOINT TEST C: High Beams or Low Beams Inoperative

TEST STEP		RESULT	ACTION TO TAKE
C1	CHECK HEADLAMP SWITCH		
•	Perform the Headlamp Switch component test in this section.	Yes ⇒ (High beams inoperative)	Service the wire between the headlamp switch and the headlamps for opens.
•	**Is the headlamp switch OK?**	Yes ⇒ (Low beams inoperative)	Service the wire between the headlamp switch and headlamps for opens.
		No ⇒	Replace the multi-function switch.

PINPOINT TEST D: One High or One Low Beam Headlamp Inoperative

TEST STEP		RESULT	ACTION TO TAKE
D1	CHECK POWER TO INOPERATIVE HEADLAMP		
•	Disconnect the headlamp connector in question.	Yes ⇒	Replace the headlamp in question.
•	Headlamps on.		
•	For high beam inoperative:	No ⇒	Service the wire(s) in question.
•	- High beams on.		
•	- Measure the voltage on the wire at the headlamp connector.		
•	For low beam inoperative:		
•	- Low beams on.		
•	- Measure the voltage on the wire at the headlamp connector.		
•	**Is the voltage greater than 10 volts?**		

PINPOINT TEST E: Flash-to-Pass Inoperative

TEST STEP		RESULT	ACTION TO TAKE
E1	CHECK POWER SUPPLY TO FLASH-TO-PASS		
•	Key OFF.	Yes ⇒	Replace the multi-function switch.
•	Disconnect the multi-function switch connector.		
•	Measure the voltage on the wire at the multi-function switch connector.	No ⇒	Service the wire between the multi-function switch and main fuse panel.
•	**Is the voltage greater than 10 volts?**		

Component Tests - Headlamps

Headlamp Switch

1. Disconnect the multi-function switch connector.

2. Measure the resistance between the terminals on the multi-function switch with the headlamp switch in the following positions.

Headlamp Switch	Terminals	Resistance
Flash to Pass		less than 5 ohms
All Others		Greater than 10,000 ohms
Low Beam		Greater than 10,000 ohms. Less than 5 ohms.
High Beam		Less than 5 ohms. Greater than 10,000 ohms.

3. Measure the resistance between terminals on the multi-function switch with the headlamp switch in the following positions:

Headlamp Switch Positions	Resistance
Off	Greater than 10,000 ohms.
Parking Lamps On	Greater than 10,000 ohms.
Headlamps On	Less than 5 ohms.

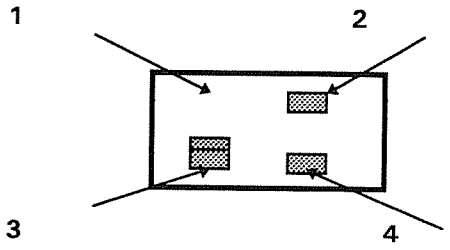
4. Measure the resistance between the terminals in the multi-function switch with the headlamp switch in the following positions:

Headlamp Switch Position	Resistance
Off	Greater than 10,000 ohms.
Parking Lamps or Headlamps On	Less than 5 ohms.

5. If the resistance are not as specified, replace the multi-function switch. Otherwise, return to the Pinpoint Tests.

Headlamp Relay

1. Key OFF.
2. Remove the headlamp relay.
3. Using a jumper, connect terminal 1 and terminal 2 on the headlamp relay to the battery positive terminal.
4. Measure the voltage on terminal 3 on the headlamp relay under the following conditions:



Headlamp Relay

Terminal 4	Voltage on Terminal 3
Grounded	Greater than 10 volts.
Open	Less than one (1) volt.

5. If the headlamp relay is OK, return to the Pinpoint Tests. Otherwise, replace the headlamp relay.

1. Verify the customer concern by operating the brake light system.
2. Visually inspect the components of the brake light system.
3. Check the wiring harness for obvious signs of shorts, opens, bad connections, or damage.
4. If fault is not visually evident, determine the symptom and proceed to the following Troubleshooting Chart.

Visual Inspection Chart

Mechanical	Electrical
None	• Blown fuse: • Damaged brake light bulb(s). • Damaged wiring harness. • Loose or corroded connections.

Troubleshooting Chart - Brake Lights

NOTE: Use a digital multimeter or similar to perform electrical Pinpoint Tests.

BRAKE LIGHTS

CONDITION	POSSIBLE SOURCE	ACTION
• Brake lights Inoperative	• Fuse. • Circuit. • Brake on/off switch. • Brake light bulb.	• Go to Pinpoint Test F1.
• One or more brake lights Inoperative	• Circuit. • Brake light bulb.	• Go to Pinpoint Test G1.
• Brake lights on Continuously	• Circuit. • Brake on/off switch.	• Replace the Brake on/off switch.

Pinpoint Tests - Brake Lights

PINPOINT TEST F: Brake Lights Inoperative

TEST STEP		RESULT	ACTION TO TAKE
F1	CHECK FUSE		
•	Check the fuse in the fuse panel.	Yes ⇒	Go to F4.
•	**Is the fuse OK?**	No ⇒	Go to F2.
F2	CHECK SYSTEM		
•	Replace the fuse.	Yes ⇒	Go to F3.
•	Inspect the fuse.	No ⇒	Go to F4.
•	**Does the fuse fail again?**		
F3	CHECK FOR SHORT TO GROUND		
•	Key OFF.	Yes ⇒	Replace the fuse. Go to F4.
•	Remove the fuse.		Service the wire.
•	Locate and disconnect the brake on/off switch connector.	No ⇒	
•	Measure the resistance of the wire on the fuse panel and ground.		
•	**Is the resistance greater than 10,000 ohms?**		
F4	CHECK POWER SUPPLY TO BRAKE ON/OFF SWITCH		
•	Key OFF.	Yes ⇒	Go to F5.
•	Disconnect the brake on/off switch connector.		
•	Measure the voltage on the wire at the brake on/off switch connector.	No ⇒	Service the wire between the brake on/off switch and the fuse panel.
•	**Is the voltage greater than 10 volts?**		
F5	CHECK BRAKE ON/OFF SWITCH		
•	Key OFF.	Yes ⇒	Service the wire(s) between the brake on/off switch and the brake lights.
•	Disconnect the brake on/off switch connector.		
•	Measure the resistance between the terminals of the brake on/off switch with the brake pedal depressed and released.	No ⇒	Replace the brake on/off switch.
•	**Does the resistance switch between less than 5 ohms with the brake pedal depressed, and greater than 10,000 ohms with the brake pedal released?**		

PINPOINT TEST G: ONE OR MORE BRAKE LIGHTS INOPERATIVE

TEST STEP		RESULT	ACTION TO TAKE
G1	CHECK BRAKE LIGHT BULBS		
•	Remove the inoperative bulb.	Yes ⇒	Go to G2.
•	Check the continuity between the terminals of the brake light bulb.		Replace the brake light bulb.
•	**Does the continuity exist?**	No ⇒	
G2	CHECK POWER SUPPLY TO THE BRAKE LIGHTS		
•	Key OFF.	Yes ⇒	Service the wire(s) in question between the brake lights and the ground.
•	Disconnect the brake light connectors.		
•	Depress the brake pedal.		Service the wires in question.
•	Measure the voltage on the wire(s) at the brake lamp connector(s).		
•	**Is the voltage greater than 10 volts?**	No ⇒	

Inspection and Verification - Turn Signal / Hazard Flashers

1. Verify the customer concern by operating the turn signal/hazard flasher systems.
2. Visually inspect the components of the turn signal/hazard flasher system.
3. Check the wiring harness for obvious signs of short, opens, bad connections, or damage.
4. If fault is not visually evident, determine the symptom and proceed to the following Troubleshooting Chart.

Visual Inspection Chart

Mechanical	Electrical
• Damaged turn signal switch. • Damaged hazard flasher switch.	• Blown fuse(s). • Damaged turn signal bulb. • Damaged wiring harness. • Loose or corroded connections.

Troubleshooting Chart - Turn Signal / Hazard Flashers

NOTE: Use a digital multimeter or equivalent to perform electrical Pinpoint Tests.

Turn Signal / Hazard Flashers

Condition	Possible Source	Action
• Turn Signal Lamps / Hazard Flasher Lamps Inoperative	• Fuse. • Multi-function switch. • Circuit. • Indicator Flasher. • Bulbs.	• Go to Pinpoint Test H1.
• Turn Signal Lamps Inoperative in One Direction.	• Multi-function switch. • Circuit. • Indicator Flasher. • Bulbs.	• Go to Pinpoint Test J1.
• Turn Signal Lamps On Continuously (Flash Continuously)	• Multi-function switch. • Circuit. • Indicator Flasher.	• Go to Pinpoint Test K1.
• One Turn Signal Lamp Inoperative	• Circuit. • Bulb(s).	• Go to Pinpoint Test L1.
• Hazard Flasher Inoperative	• Fuse. • Hazard flasher switch. • Circuit. • Indicator flasher. • Bulbs.	• Go to Pinpoint Test M1.
• Hazard Flasher on Continuously	• Hazard flasher switch. • Circuit. • Indicator flasher.	• Go to Pinpoint Test N1.

Pinpoint Tests - Turn Signals / Hazard Flashers

PINPOINT TEST H: Turn Signals / Hazard Flashers Inoperative

	TEST STEP	RESULT	ACTION TO TAKE
H1	CHECK FUSES		
•	Check the Turn and Hazard Fuses located in the fuse junction panel.	Yes ⇒	Go to H4.
•	**Are the fuses OK?**	No ⇒	Go to H2.
H2	CHECK SYSTEM		
•	Replace the Turn and Hazard fuse(s).		
•	Key ON.	Yes ⇒	Go to H3.
•	Inspect the fuses.	No ⇒	Go to H4.
•	**Did the fuse(s) fail again?**		
H3	CHECK FOR SHORT TO GROUND		
•	Key OFF.	Yes ⇒	Replace the 15A Turn fuse and/or the 15A Hazard fuse. Go to H4.
•	Locate and disconnect the multi-function switch connector.		
•	Locate and disconnect the indicator flasher connector.	No ⇒	Service the wire(s) in question.
•	Remove the Turn and Hazard fuse(s).		
•	Measurer the resistance of the wire between the top terminal of the Hazard fuse holder and ground.		
•	Measure the resistance of the wire between the top terminal of the fuse holder and ground.		
•	**Are the resistances greater than 10,000 ohms?**		
H4	CHECK TURN SIGNAL SWITCH		
•	Perform the Turn Signal Switch component test in this section.	Yes ⇒	Go to H5.
•	Is the turn signal switch OK?	No ⇒	Replace the multi-function switch.
H5	CHECK POWER SUPPLY TO TURN SIGNAL SWITCH		
•	Key OFF.	Yes ⇒	Go to H6.
•	Disconnect the multi-function switch connector.	No ⇒	Service the wire between the multi-function switch and interior fuse junction panel.
•	Key ON.		
•	Measure the voltage on the wire at the multi-function switch connector.		
•	**Is the voltage greater than 10 volts?**		
H6	CHECK POWER SUPPLY TO INDICATOR FLASHER		
•	Key OFF.	Yes ⇒	Go to H7.
•	Disconnect the indicator flasher connector.	No ⇒	Service the wire between the interior fuse junction panel and the indicator flasher.
•	Measure the voltage on the wire at the indicator flasher connector.		
•	**Is the voltage greater than 10 volts?**		
H7	CHECK INDICATOR FLASHER GROUND		
•	Key OFF.		
•	Disconnect the indicator flasher connector	Yes ⇒	Replace the indicator flasher.
•	Measure the resistance of the wire between the indicator flasher connector and ground.	No ⇒	Service the wire.
•	**Is the resistance less than 5 ohms?**		

PINPOINT TEST J: Turn Signal Lamps Inoperative in One Direction

TEST STEP		RESULT	ACTION TO TAKE
J1	CHECK TURN SIGNAL SWITCH		
•	Perform the Turn Signal Switch component test in this section.	Yes ⇒	Go to J2.
•	**Is the turn signal switch OK?**	No ⇒	Replace the multi-function switch.
J2	CHECK WIRES BETWEEN TURN SIGNAL SWITCH AND INDICATOR FLASHER		
•	Key OFF.	Yes ⇒	Go to J3.
•	Disconnect the multi-function switch connector.	No ⇒	Service the wire in question.
•	Disconnect the indicator flasher connector.		
•	For LH and RH signal inoperative: -Measure the resistance of the wire between the multi-function switch connector and the indicator flasher connector. -Measure the resistance of the wire between the multi-function switch connector and ground.		
•	**Is the resistance less than 5 ohms between the multi-function switch and the indicator flasher, and greater than 10,000 ohms between the multi-function switch and ground?**		
J3	CHECK WIRES TO TURN SIGNAL LAMPS		
•	Key OFF.	Yes ⇒	Replace the indicator flasher.
•	Disconnect the indicator flasher connector.	No ⇒	Service the wire(s) in question.
•	Using a jumper, connect the battery positive terminal to the LH turn signal inoperative wire or the RH turn signal inoperative at the indicator flasher connector.		
•	**Do the turn signal lamps illuminate?**		

PINPOINT TEST K: TURN SIGNALS ON CONTINUOUSLY

TEST STEP		RESULT	ACTION TO TAKE
K1	CHECK TURN SIGNAL SWITCH		
•	Perform the Turn Signal Switch component test in this section.	Yes ⇒	Replace the indicator flasher.
•	**Is the turn signal switch OK?**	No ⇒	Replace the multi-function switch.

PINPOINT TEST L: ONE TURN SIGNAL LAMP INOPERATIVE

TEST STEP		RESULT	ACTION TO TAKE
L1	CHECK TURN SIGNAL BULB		
•	Remove the inoperative turn signal bulb.	Yes ⇒	Go to L2.
•	Check the continuity between the terminals of the turn signal bulb.	No ⇒	Replace the turn signal bulb.
•	**Does continuity exist?**		
L2	CHECK TURN SIGNAL LAMP GROUND		
•	Remove the inoperative turn signal bulb.	Yes ⇒	Service the wire for LH turn signal inoperative or RH turn signal inoperative.
•	Measure the resistance of the wire between the turn signal bulb socket and ground.	No ⇒	Service the wire(s).
•	**Is the resistance less than 5 ohms?**		

PINPOINT TEST M: Hazard Flashers Inoperative

TEST STEP		RESULT	ACTION TO TAKE
M1	CHECK HAZARD FLASHERS SWITCH		
•	Key OFF. • Disconnect the multi-function switch connector. • Measure the resistance between the wire terminals on the multi-function switch with the hazard flasher switch in the following positions: **Hazard Flasher Switch Resistance** Off — greater than 10,000 ohms On — less than 5 ohms. • **Are the resistances OK?**	Yes ⇒ No ⇒	Go to M2. Replace the multi-function switch.
M2	CHECK HAZARD FLASHER SWITCH GROUND		
•	Key OFF. • Disconnect the multi-function switch connector. • Measure the resistance of the wire between the multi-function switch connector and the ground. • **Is the resistance less than 5 ohms?**	Yes ⇒ No ⇒	Go to M3. Service the wire.
M3	CHECK WIRE BETWEEN INDICATOR FLASHER AND HAZARD FLASHER SWITCH		
•	Key OFF. • Disconnect the indicator flasher connector. • Disconnect the multi-function switch connector. • Measure the resistance of the wire between multi-function switch connector and indicator flasher connector. • **Is the resistance less than 5 ohms?**	Yes ⇒ No ⇒	Replace the indicator flasher. Service the wire.

PINPOINT TEST N: HAZARD FLASHER ON CONTINUOUSLY

TEST STEP		RESULT	ACTION TO TAKE
N1	CHECK HAZARD FLASHER SWITCH		
•	Key OFF. • Disconnect the multi-function switch connector. • Measure the resistance of the wire terminals on the multi-function switch with the hazard flasher switch in the following positions: **Hazard Flasher Switch Resistance** Off — Greater than 10,000 ohms On — Less than 5 ohms • **Are the resistances OK?**	Yes ⇒ No ⇒	Go to N2. Replace the multi-function switch.
N2	CHECK FOR SHORT BETWEEN HAZARD FLASHER SWITCH AND INDICATOR FLASHER		
•	Key OFF. • Disconnect the multi-function switch connector. • Disconnect the indicator flasher connector. • Measure the resistance of the wire between the multi-function switch connector and ground. • **Is the resistance greater than 10,000 ohms?**	Yes ⇒ No ⇒	Replace the indicator flasher. Service the wire between the multi-function switch and the indicator flasher.

Component Tests - Turn Signals / Hazard Flashers

Turn Signal Switch

1. Key OFF.
2. Disconnect the multi-function switch connectors.
3. Measure the resistance of the following terminals on the multi-function switch.
4. If the turn signal switch is OK, return to the Pinpoint Tests. Otherwise, replace the multi-function switch.

Inspection and Verification - Parking Lamps, Side Marker Lamps, License Lamp

1. Verify customer concern by operating the parking lamps.
2. Visually inspect the components of the parking lamp system.

Mechanical	Electrical
• None	• Blown fuse: • Damaged bulbs: - parking - license • Damaged wiring harness. • Loose or corroded connections.

3. Check the wiring harness for obvious signs of shorts, opens, bad connections, or damage.
4. Check for improperly installed accessories.
5. If fault is not visually evident, determine the symptom and proceed to the following Troubleshooting Chart.

Troubleshooting Chart - Parking Lamps, Side Marker Lamps, License Lamp

NOTE: Use a digital multimeter or equivalent to perform electrical Pinpoint Tests. Refer to Troubleshooting Chart below.

TROUBLE SHOOTING CHART : PARKING LAMPS, SIDE MARKER LAMPS, LICENSE LAMP

CONDITION	POSSIBLE SOURCE	ACTION
• Parking Lamps Inoperative	• Parking lamp bulb. • Fuse. • Circuit. • Parking lamp relay. • Multi-function switch.	• Go to Pinpoint Test P1.
• One or More Parking Lamp(s) Inoperative	• Circuit. • Parking lamp bulb.	• Go to Pinpoint Test Q1.
• Parking Lamps on Continuously	• Parking lamp relay. • Multi-function switch. • Circuit.	• Go to Pinpoint Test R1.
• One or More Side Marker Lamps Inoperative	• Circuit. • Side marker lamp bulb.	• Go to Pinpoint Test S1.
• One or More Tail Lamps Inoperative	• Circuit. • Tail lamp bulb.	• Go to Pinpoint Test T1.
• License Lamp Inoperative	• Circuit • License lamp bulb.	• Go to Pinpoint Test U1.

PINPOINT TESTS - Parking Lamps, Side Marker Lamps, License Plate Lamp

PINPOINT TEST P: PARKING LAMPS INOPERATIVE

TEST STEP		RESULT	ACTION TO TAKE
P1	CHECK FUSE		
•	Check the Stop Light fuse located in the interior fuse panel.	Yes ⇒	Go to P4.
•	**Is the fuse OK?**	No ⇒	Go to P2.
P2	CHECK SYSTEM		
•	Replace the Stop Light fuse.	Yes ⇒	Go to P3.
•	Inspect the fuse.	No ⇒	Go to P4.
•	**Does the fuse fail again?**		
P3	CHECK FOR SHORT TO GROUND		
•	Remove the Stop Light fuse.	Yes ⇒	Replace the Stop Light fuse. Go to P4.
•	Remove the parking lamp relay.		
•	Measure the resistance of the wire between the terminal of the fuse holder and ground.	No ⇒	Service the wire.
•	**Is the resistance greater than 10,000 ohms?**		
P4	CHECK PARKING LAMP RELAY		
•	Perform the Parking Lamp Relay component test in this section.	Yes ⇒	Go to P5.
•	**Is the parking lamp relay OK?**	No ⇒	Replace the parking lamp relay.
P5	CHECK POWER SUPPLY TO RELAY		
•	Key OFF.	Yes ⇒	Go to P6.
•	Remove the parking lamp relay.	No ⇒	Service the wire(s) between the Stop Light fuse and the parking lamp relay.
•	Measure the voltage on the wires at the parking lamp relay connector.		
•	**Are the voltages greater than 10 volts?**		
P6	CHECK HEADLAMP SWITCH		
•	Perform the Headlamp Switch component test in this section.	Yes ⇒	Go to P7.
•	**Is the headlamp switch OK?**	No ⇒	Replace the multi-function switch.
P7	CHECK HEADLAMP SWITCH GROUND		
•	Key OFF.	Yes ⇒	Go to P8.
•	Disconnect the multi-function switch connector.	No ⇒	Service the wire.
•	Measure the resistance of the wire on the multi-function switch connector and ground.		
•	Is the resistance less than 5 ohms?		
P8	CHECK POWER SUPPLY TO HEADLAMP SWITCH		
•	Key OFF.	Yes ⇒	Service the wire(s).
•	Install the parking lamp relay.	No ⇒	Service the wire.
•	Disconnect the multi-function switch connector.		
•	Measure the voltage on the wire at the multi-function switch connector.		
•	Is the voltage greater than 10 volts?		

PINPOINT TEST Q: ONE OR MORE PARKING LAMP INOPERATIVE

TEST STEP		RESULT	ACTION TO TAKE
Q1	CHECK PARKING LAMP BULB(S)		
•	Remove the inoperative parking lamp bulb(s).	Yes ⇒	Go to Q2.
•	Check the continuity between the terminals of the parking lamp bulb(s).	No ⇒	Replace the parking lamp bulb(s).
•	**Does continuity exist?**		
Q2	CHECK POWER TO PARKING LAMPS		
•	Disconnect the rear lamp or front parking lamp connector(s).	Yes ⇒	Go to Q3.
•	Headlamps on.	No ⇒	Service the wire.
•	Measure the voltage on the wire of the rear lamp connector or measure the voltage on the wire on the front parking lamp connector(s).		
•	**Is the voltage greater than 10 volts?**		
Q3	CHECK PARKING LAMP GROUND		
•	Disconnect the rear lamp or front parking lamp connector(s).	Yes ⇒	Replace the parking lamp socket in question.
•	Measure the resistance of the wire between the rear lamp or the front parking lamp connector(s) and ground.	No ⇒	Service the wire(s).
•	**Is the resistance less than 5 ohms?**		

PINPOINT TEST R: PARKING LAMPS ON CONTINUOUSLY

TEST STEP		RESULT	ACTION TO TAKE
R1	CHECK THE HEADLAMP SWITCH		
•	Perform the Headlamp Switch component test in the headlamp diagnosis portion of this section.	Yes ⇒	Go to R2.
•	Is the headlamp switch OK?	No ⇒	Replace the multi-function switch.
R2	CHECK PARKING LAMP RELAY		
•	Perform the Parking Lamp Relay component test in this section.	Yes ⇒	Service the wire between the parking lamp relay and multi-function switch for shorts to ground.
•	Is the parking lamp relay OK?	No ⇒	Replace the parking lamp relay.

PINPOINT TEST S: ONE OR MORE SIDE MARKER LAMPS INOPERATIVE

TEST STEP		RESULT	ACTION TO TAKE
S1	CHECK SIDE MARKER BULBS		
•	Remove the inoperative side marker bulb(s).	Yes ⇒	Go to S2.
•	Check the continuity between the terminals of the side marker bulb(s).	No ⇒	Replace the side marker bulb(s).
S2	CHECK POWER TO SIDE MARKER LAMPS		
•	Disconnect the front side marker lamp connector(s).	Yes ⇒	Go to S3.
•	Headlamps on.	No ⇒	Service the wire.
•	Measure the voltage of the wire at the front parking lamp connector(s).		

PINPOINT TEST S: ONE OR MORE SIDE MARKER LAMPS INOPERATIVE (Continued)

TEST STEP		RESULT	ACTION TO TAKE
S3	CHECK SIDE MARKER LAMP GROUND		
•	Disconnect the front side marker lamp connector(s).	Yes ⇒	Replace the front side marker lamp socket(s).
•	Measure the resistance of the wires between the front side marker lamp connector(s) and ground.	No ⇒	Service the wire(s).
•	Is the resistance less than 5 ohms?		

PINPOINT TEST T: ONE OR MORE TAIL LAMPS INOPERATIVE

TEST STEP		RESULT	ACTION TO TAKE
T1	CHECK TAIL LAMP BULB(S)		
•	Remove the inoperative tail lamp bulb(s).	Yes ⇒	Go to T2.
•	Check the continuity between the terminals of the tail lamp bulb.	No ⇒	Replace the tail lamp bulb.
•	Does continuity exist?		
T2	CHECK POWER TO TAIL LAMPS		
•	Disconnect the rear lamp connector(s).	Yes ⇒	GO to T3.
•	Headlamps on.	No ⇒	Service the wire.
•	Measure the voltage on the wire of the rear lamp connector(s).		
•	Is the voltage greater than 10 volts?		
T3	CHECK TAIL LAMP GROUND		
•	Disconnect the rear lamp connector(s).	Yes ⇒	Replace the tail lamp socket in question.
•	Measure the resistance of the wire between the rear lamp connector(s) and ground.	No ⇒	Service the wire(s).
•	Is the resistance less than 5 ohms?		

PINPOINT TEST U: LICENSE LAMP INOPERATIVE

TEST STEP		RESULT	ACTION TO TAKE
U1	CHECK LICENSE LAMP BULB		
•	Remove inoperative license lamp bulb.	Yes ⇒	Go to U2.
•	Check the continuity between the terminals of bulb.	No ⇒	Replace the bulb(s).
•	**Does continuity exist?**		
U2	CHECK POWER TO LICENSE LAMP		
•	Disconnect the license plate lamp connector.	Yes ⇒	Go to U3.
•	Headlamps on.	No ⇒	Service the wire.
•	Measure the voltage on the wire of the license plate connector.		
•	**Is the voltage greater than 10 volts?**		
U3	CHECK LICENSE PLATE GROUND		
•	Disconnect the license plate lamp connector.	Yes ⇒	Replace the license plate socket.
•	Measure the resistance of the wire between the license plate connector and ground.	No ⇒	Service the wire(s).
•	**Is the resistance less than 5 ohms?**		

Component Test - Parking Lamps

Parking Lamp Relay

1. Key OFF.
2. Remove the parking lamp relay.
3. Using a jumper, connect terminals on the parking lamp relay to the battery positive terminal.
4. Measure the voltage on terminal at the parking lamp relay under the following conditions:

5. If the parking lamp relay is OK, return to the Pinpoint Tests. Otherwise, replace the parking brake relay.

Inspection and Verification - Backup Lamps

1. Verify the customer concern by operating the backup lamps.

2. Visually inspect the components of the backup lamp system.

Visual Inspection Chart

Mechanical	Electrical
• None	• Blown fuse • Damaged backup lamp or bulb. • Damaged wiring harness. • Loose or corroded connections.

3. Check the wiring harness for obvious signs of shorts, opens, bad connections, or damage.

4. If fault is not visually evident, determine the symptom and proceed to the following Troubleshooting Chart.

Troubleshooting Chart - Backup Lamps

NOTE: Use a digital multimeter or equivalent to perform electrical Pinpoint Tests.

TROUBLESHOOTING CHART: BACK UP LAMPS

CONDITION	POSSIBLE SOURCE	ACTION
• Backup Lamps Inoperative	• Fuse. • Circuit. • Park/neutral position switch.	• Go to Pinpoint Test U1.
• Individual Backup Lamp Inoperative	• Circuit. • Backup lamp bulb(s).	• Go to Pinpoint Test V1.
• Backup Lamps on Continuously	• Circuit. • Park/Neutral Position Switch.	• Check for short to power on the wire. Service as necessary. Otherwise, replace the park/neutral position switch.

Pinpoint Tests - Backup Lamps

PINPOINT TEST U: BACKUP LAMPS INOPERATIVE

TEST STEP		RESULT	ACTION TO TAKE
U1	CHECK FUSE		
• Check the fuse in the interior fuse panel. • **Is the fuse OK?**		Yes ⇒ No ⇒	Go to U4. Go to U2.
U2	CHECK SYSTEM		
• Replace the fuse in the interior fuse panel. • Key ON. • Inspect the fuse. • **Does the fuse fail again?**		Yes ⇒ No ⇒	Go to U3. Go to U4.
U3	CHECK FOR SHORT TO GROUND		
• Key OFF. • Remove the 15A fuse. • Locate and disconnect the park/neutral; position switch connector. • Measure the resistance of the wire between the bottom terminal of the fuse holder and ground. • **Is the resistance greater than 10,000 ohms?**		Yes ⇒ No ⇒	Replace the fuse. Go to U4. Service the wire.

PINPOINT TEST U: BACKUP LAMPS INOPERATIVE (Continued)

TEST STEP		RESULT	ACTION TO TAKE
U4	CHECK SWITCH		
•	Perform the Park/Neutral Switch component test in this section.	Yes ⇒	Go to U5.
•	**Is the Park/Neutral position switch OK?**	No ⇒	Replace the park/neutral position switch.
U5	CHECK POWER SUPPLY TO PARK/NEUTRAL POSITION SWITCH		
•	Key OFF.	Yes ⇒	Service the wire between the connector and the backup lamps.
•	Disconnect the park/neutral position switch connector.		
•	Key ON.		
•	Measure the voltage on the wire at the connector.	No ⇒	Service the wire.
•	**Is the voltage greater than 10 volts?**		

PINPOINT TEST V: INDIVIDUAL BACKUP LAMP INOPERATIVE

TEST STEP		RESULT	ACTION TO TAKE
V1	CHECK BACKUP LAMP BULB(S)		
•	Remove the inoperative backup lamp bulb.	Yes ⇒	Go to V2.
•	Check the continuity between the terminals of the backup lamp bulb.	No ⇒	Replace the backup lamp bulb.
•	Does the continuity exist?		
V2	CHECK POWER TO BACKUP LAMP		
•	Disconnect the rear lamp connector(s).	Yes ⇒	Go to V3.
•	Key ON.	No ⇒	Service the wire.
•	Transaxle in REVERSE (R).		
•	Measure the voltage on the wire at the rear of the lamp connector(s).		
V3	CHECK BACKUP LAMP GROUND		
•	Disconnect the rear lamp connector.	Yes ⇒	Replace the backup lamp socket.
•	Measure the resistance of the wire between the rear lamp connector and ground.	No ⇒	Service the wire.
•	Is the resistance less than 5 ohms?		

Inspection and Verification - Dome Light

1. Verify the customer concern by operating the dome light.
2. Visually inspect the following components of the dome light system:
3. Check the wiring harness for obvious signs of shorts, opens, bad connections, or damage.

Visual Inspection Chart

Mechanical	Electrical
• Damaged or corroded switch or connections.	• Blown fuse. • Damaged wiring harness. • Loose or corroded connections.

4. If fault is not visually evident, determine the symptom and proceed to the following Troubleshooting Chart.

Troubleshooting Chart - Dome Light

NOTE: Use a digital multimeter or equivalent to perform electrical Pinpoint Tests.

Dome Light

CONDITION	POSSIBLE SOURCE	ACTION
• Dome light inoperative	• Fuse. • Bulb. • Dome light switch. • Circuit.	Go to Pinpoint Test W1.

Pinpoint Test - Dome Light

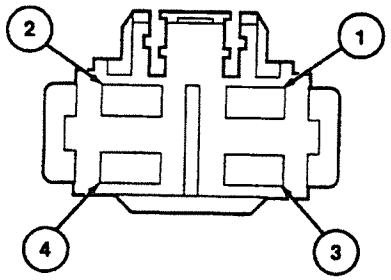
PINPOINT TEST W: DOME LIGHT INOPERATIVE

TEST STEP		RESULT	ACTION TO TAKE
W1	CHECK FUSE		
•	Check the 15A fuse located in the interior fuse panel.	Yes ⇒	Go to W4.
•	**Is the fuse OK?**	No ⇒	Go to W2.
W2	CHECK SYSTEM		
•	Key OFF.	Yes ⇒	Go to W3.
•	Replace the fuse.	No ⇒	Go to W4.
•	**Does the fuse fail again?**		
W3	CHECK FOR SHORT TO GROUND		
•	Key OFF.	Yes ⇒	Replace the fuse. Go to W4.
•	Remove the 15A fuse.	No ⇒	Service the wire.
•	Locate and remove the dome lamp bulb.		
•	Measure the resistance the wire between the terminal of the fuse holder and ground.		
•	**Is the resistance greater than 10,000 ohms?**		
W4	CHECK DOME LAMP BULB		
•	Key OFF.	Yes ⇒	Go to W5.
•	Remove the dome lamp bulb.	No ⇒	Replace the dome light bulb.
•	Check the continuity between the terminals of the dome lamp bulb.		
•	**Does continuity exist?**		
W5	CHECK POWER SUPPLY TO LAMP		
•	Key OFF.	Yes ⇒	Go to W6.
•	Locate and disconnect the dome lamp connector.	No ⇒	Service the wire for open.
•	Measure the voltage on the wire at the dome light connector.		
•	Is the voltage greater than 10 volts?		
W6	CHECK DOME LAMP SWITCH		
•	Key OFF.	Yes ⇒	Service the wire.
•	Disconnect the dome lamp connector.	No ⇒	Replace the dome lamp assembly.
•	Measure the resistance between the terminals of the dome lamp switch.		
•	Place the dome lamp switch in each position and observe the readings.		
•	**Is the resistance greater than 10,000 ohms in the ON and OFF positions?**		

Component Tests - Backup Lamps

Park/Neutral Position Switch (PNP Switch)

1. Key OFF.
2. Disconnect the Park/Neutral Position (PNP) switch connector.
3. Measure the resistance between terminal 2 and 4 of the PNP switch under the following conditions:



PARK/NEUTRAL POSITION SWITCH

Condition	Resistance
Transaxle in R	Less than 5 ohms
Transaxle in P, N, D, 2 or 1.	Greater than 10,000 ohms

4. If the PNP switch is OK, return to the Pinpoint Tests. Otherwise, replace the PNP switch.

REMOVAL AND INSTALLATION

Bulb, Exterior Illumination

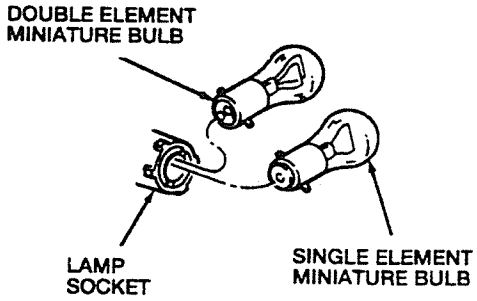
Removal and Installation

All the exterior bulbs on the GO-4 can be removed using the following procedures except when a unique procedure in this section exists:

a. Remove the lens cover to access the bulb. Refer to the appropriate procedure in this section.

b. Remove the bulb from the lamp socket. This can be done one of two ways depending on the type of bulb used for each application. Refer to the following illustrations:

Press in and Rotate to Remove



Switch, Headlamp

Removal and Installation

The headlamp switch is incorporated into the multi-function switch. Refer to Section 19 for multi-function switch removal and installation procedure.

Switch, High Beam

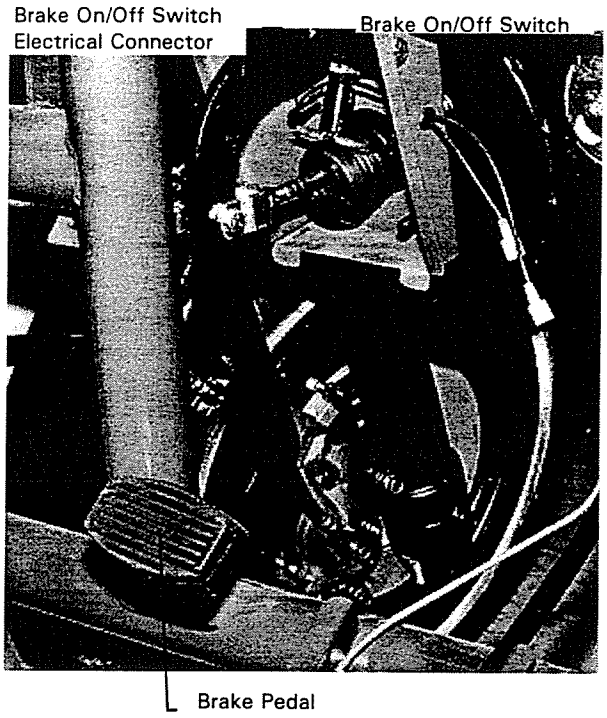
Removal and Installation

The high beam switch is incorporated into the multi-function switch. Refer to Section 19 for the multi-function switch removal and installation.

Brake On/Off (BOO) Switch

Removal

1. Disconnect the Brake On/Off (BOO) switch electrical connector.
2. Remove the nut and remove the BOO switch from the bracket.
3. NOTE: Floor panel is removed for clarity. Remove the nut from the BOO switch.



Installation

To install, reverse the removal procedure.

Adjust the BOO switch. Refer to the procedure in this section.

Lamp Switch, Backup

Removal and Installation

The backup switch function is performed by the Park/Neutral Position Switch (PNP Switch). Refer to Section 8 for the PNP switch removal and installation procedure.

Hazard Switch

Removal and Installation

The hazard warning flasher switch is incorporated into the multi-function switch. Refer to Section 19 for the removal and installation procedure.

Multi-Function Switch

Removal and Installation

Refer to Section 19 for multi-function switch removal and installation procedure.

Headlamp Bulb

Removal

WARNING: THE HALOGEN HEADLAMP CONTAINS GAS UNDER PRESSURE. THE HEADLAMP MAY SHATTER IF THE BULB IS DROPPED. KEEP THE HEADLAMP BULB OUT OF REACH OF CHILDREN.

NOTE: A correctly aimed headlamp should not require reaming after replacement of the headlamp. Never turn on the headlamps with the headlamp removed.

1. Remove the hood panel.
2. Remove the four screws and the headlamp trim ring securing the headlamp to the headlamp housing.
3. Remove headlamp from the headlamp housing.
4. Disconnect the plug from the rear of the headlamp.

Installation

WARNING: THE HALOGEN HEADLAMP CONTAINS GAS UNDER PRESSURE. THE HEADLAMP MAY SHATTER IF THE BULB IS DROPPED. KEEP THE HEADLAMP OUT OF THE REACH OF CHILDREN.

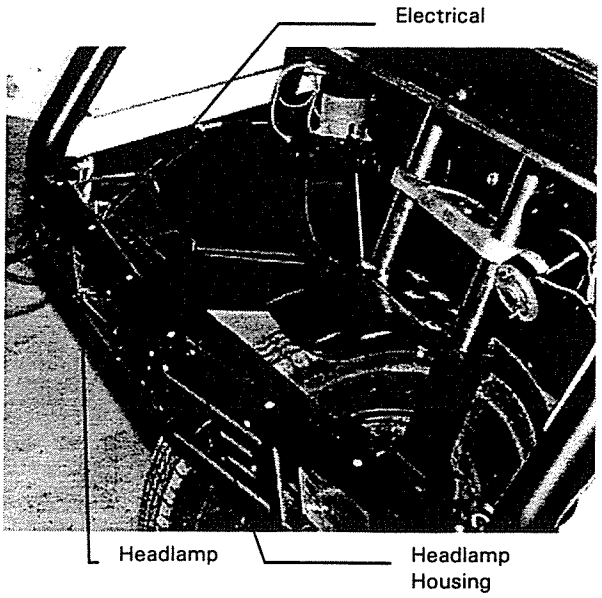
1. Install replacement headlamp in reverse order of removal.
2. Position headlamp so letters and numbers on headlamp are not upside down.
3. Turn the headlamps on and check for proper operation.

Headlamp Housing

Removal

1. Disconnect the battery ground cable.
2. Remove the hood panel.
3. Remove headlamp from the headlamp housing.
4. Remove rivets which secure the headlamp housing to the front bumper.

5. Disconnect the wiring from the headlamp housing to electrical connector.



6. Remove the headlamp housing from the vehicle.

Installation

To install, reverse the removal procedure.

Adjust the headlamp. Refer to the procedure in this section.

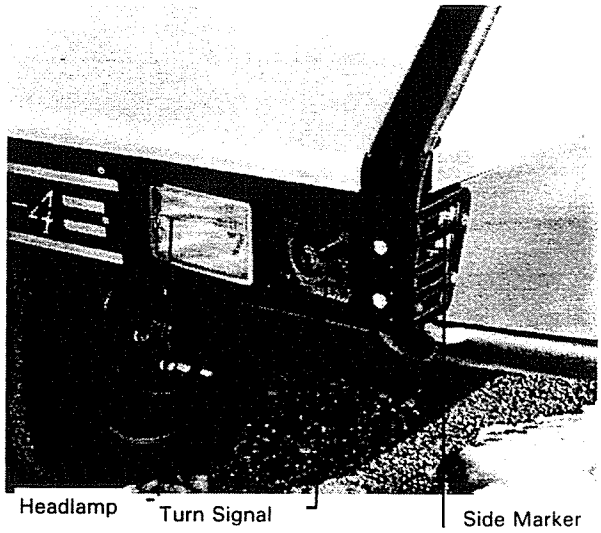
Lamps, Side Marker

Removal

1. Remove hood panel.
2. Insert screwdriver between the lens and tangs of the lamp base.
3. Gently pull tangs away from the lens with the screwdriver blade and pull lens out.
4. Rotate the side marker bulb from its bulb socket and remove it from the front side marker lamp housing.

Installation

To install, reverse the removal procedure.



Front Signal (Turn) Light

Removal

1. Remove two screws securing the amber lens to the housing.
2. Remove the amber lens from its housing.
3. Rotate the front signal bulb in its socket and remove it from the front signal lamp housing.

Installation

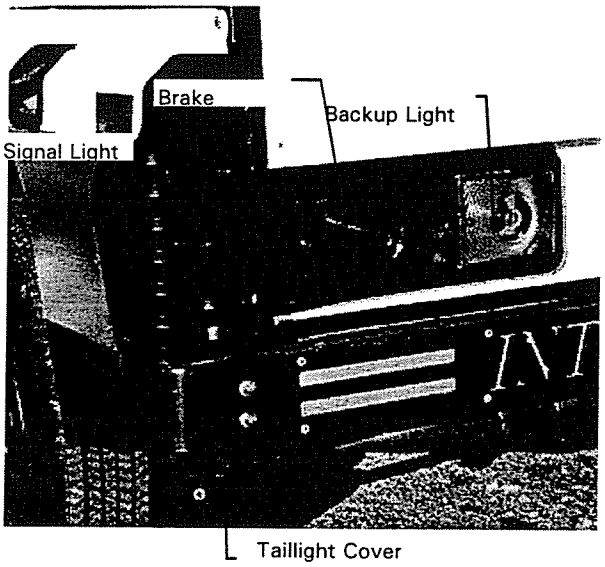
To install, reverse the removal procedure.

Rear Tail Light

The rear tail light assembly consists of rear brake (red) light and back up light (clear lens). The following procedure is the same for both.

Removal

1. Remove two screws securing the lens to the housing.
2. Remove the lens from its housing.
3. Rotate the bulb in its socket and remove it from the lamp housing.



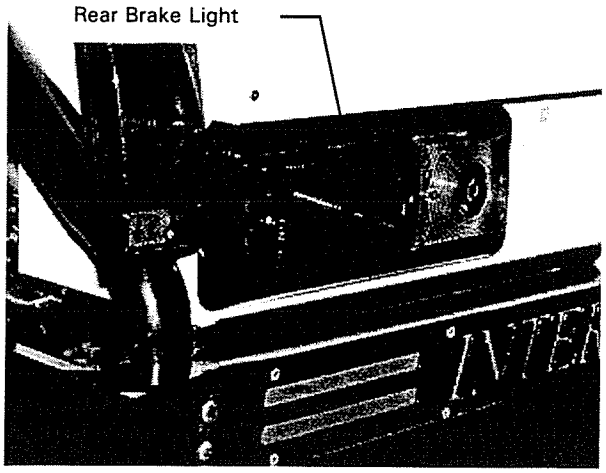
Installation

To install, reverse the removal procedure.

Rear Signal / Brake Light

Removal

1. Remove the rear tail light cover.
2. Remove two screws securing the red lens to the housing.
2. Remove the red lens from its housing.
3. Rotate the rear signal/brake bulb in its socket and remove it from the rear signal/brake lamp housing.



Installation

To install, reverse the removal procedure.

License Plate Lamp

Removal

1. Pull down on the bulb holder.
2. Pull bulb holder with bulb from under the rear bumper. Make sure gasket is with the bulb holder.
3. Rotate the license plate bulb in its socket and remove it from the licensee plate lamp housing.

Installation

To install, reverse the removal procedure.

Clearance Lights

Removal

1. Remove two screws securing the red lens to the housing.
2. Remove the red lens from its housing.
3. Rotate the clearance light bulb in its socket and remove it from the clearance lamp housing.

Installation

To install, reverse the removal procedure.

Dome Light

Removal

1. Remove the dome lamp lens.
2. Rotate the dome lamp bulb in its socket and remove it from the dome lamp housing.

Installation

To install, reverse the removal procedure.

CLEANING AND INSPECTION

Headlamps, Turn Signal Lamps, Brake Lamps

Clean headlamps, turn signals, and brake lamps by spraying with a glass cleaner and wiping with a soft, clean cloth.

ADJUSTMENTS

Headlamp

Headlamp aim adjustment should be made with a headlight aimer kit. To aim the headlamps, use the top center screw for horizontal aim and the side screw to vertically aim the headlamp. Both screws are accessible through the front bumper.

All equipment in the kit can calibrated to accommodate for slight slops in the floor. However, the floor area selected should be reasonably flat and within the calibration range of the equipment.

All headlamp adjustments should be made with the fuel tank half full, the vehicle unloaded and the cargo area empty. Also, check the tires and adjust them to the recommended inflation pressure.

Brake On/Off (BOO) Switch

1. Disconnect the Brake On/Off (BOO) switch electrical connector.
2. Loosen the BOO switch nuts.
3. Connect the digital multimeter across the BOO switch terminals.
4. Position the BOO switch until multimeter indicates continuity.
5. Carefully move the BOO switch toward brake pedal until the multimeter indicates the BOO switch is open (infinite resistance).
6. Rotate the BOO switch toward the brake pedal one-half additional turn and tighten the BOO switch nuts.

SPECIFICATIONS

Lamp/Bulb Chart

Description	Bulb Number
Headlight, front	GE H4656 Halogen
Turn Signal, front	1157
Side Marker, front	1895
Clearance Light	2057
Signal Light, rear	1157
Tail Light, rear	1157
Back Up Light, rear	1156
License Plate Light	-
Dome Light	1141

SERVICE TOOLS/EQUIPMENT

- Headlight Aimer Kit
- Digital Multimeter

SECTION 19 - Instrument Panel, Controls and Warning Systems

DESCRIPTION AND OPERATION

Instrument Panel

The main components of the instrument panel are:

- Instruments
- Gauges
- Warning/Indicator lamps

The instruments consist of a speedometer, an odometer. The gauges include a fuel gauge, voltmeter, and hourmeter. Indicator / warning lamps include turn signals and warning indicators.

Speedometer

The speedometer is an electronic type with a mechanically driven pickup. The speedometer and gear and shaft are contained in a sleeve that is bolted to the transaxle. Electrical connections from the gear and shaft are made to the speedometer.

Odometer

The odometer electronically registers the total distance traveled in miles.

Odometer replacement: The mileage on a replacement odometer cannot be reset. If a replacement odometer is installed, a sticker recording the vehicle's mileage at the date of replacement must be attached to the instrument panel.

Fuel Gauge

The fuel gauge is coupled to a variable resistance fuel level sensor located in the fuel tank. Movement of the gauge needle depends on the amount of current flowing through the cross coil.

When the resistance in the fuel level sensor is low, a high amount of current is sent to the cross coil within the fuel gauge. The high amount of current will create a strong magnetic field causing the fuel gauge to read full.

When the resistance in the fuel level sensor is high, a low amount of current is sent to the cross coil within the fuel gauge. The low amount of current will created a weak magnetic field causing the fuel gauge to read empty.

Fuel Level Sensor

The amount of current flowing through the fuel gauge coil depends on the resistance of the fuel level sensor. The resistance of the fuel level sensor will vary with the amount of fuel in the fuel tank. A float and arm, attached to a rheostat in the fuel level sensor, rides on the surface of the fuel in the fuel tank. As the level rises or falls, the float and arm will change the position of the rheostat contact. Each position of the rheostat contact changes the resistance value of the rheostat and the amount of current flowing in the circuit. The higher the float, the less resistance in the circuit.

Hourmeter

The hourmeter is an electrically operated device to indicate total operating time in hours.

Voltmeter

The voltmeter is coupled to charging system of the vehicle. It indicates the normal voltage output of 13-14 volts to the battery while the engine is running. It will note lower voltage output when the charging system is not working properly.

Indicator/Warning Lights

Governor:

Red indicator light comes on when the vehicle exceeds the governed speed of 45 mph (55 km/h). When this occurs, the engine will run on two cylinders to reduce vehicle speed.

Brake System Warning Light:

The red indicator light illuminates under these two conditions:

- Park Brake Warning Light: This indicates when the parking brake is applied when the engine is started. Release the parking brake and the light will go off.

- Brake Fluid Level Warning Light: It indicates low brake fluid level in the reservoir. The brake master cylinder fluid level sensor is located in the master cylinder reservoir. When the brake fluid drops to a predetermined level, the contact on the float completes the ground for the indicator circuit.

The parking brake signal switch and bracket is located on the parking brake control.

Headlight High Beam Indicator Light:

The blue indicator light comes when the headlights are on and in the high beam position.

Turn Signal Indicators:

Green lights for RH and LH (one indicator light at each side of the dash) indicators flash when the multi-function switch is moved up or down. Both turn signal indicators flash when the hazard flasher warning switch is activated.

Coolant Temperature Warning Light:

When engine coolant temperature becomes extreme, the red warning light will come on. Shut down vehicle to avoid damage.

Oil Pressure Light:

The red oil pressure light indicates low oil pressure in the engine. The oil pressure sensor is calibrated to close when the engine oil pressure falls below 4.3 psi (30kPa). Shut down vehicle to avoid damage.

The indicator light will flash when the engine is started. The engine oil pressure lamp should go out within a few seconds after the engine starts, indicating the engine oil pressure is adequate.

Service:

The red indicator light shows there is a malfunction within the electronic engine control system. The Powertrain Control Module completes the ground path for the indicator circuit. Have the vehicle checked when this condition occurs.

Auxiliary Switches

The illuminated rocker switches (top to bottom) operate the following options:

Top Switch: Rotating Light. Has 40 Amp Relay in circuit.

Middle Switch: Roof-mounted work light.

Bottom Switch: Air Conditioning System. Push to operate. Make sure the heater shutoff valve is closed when using with the air conditioning.

DIAGNOSIS AND TESTING

Refer to electrical schematic drawing which is included with the service manual.

Inspection and Verification - Instrument Panel

1. Verify customer concern by operating the instrument panel system in question.
2. Visually inspect the following components of the instrument panel system.

VISUAL INSPECTION CHART

Mechanical	Electrical
• Malfunctioning speedometer • Damaged fuel gauge. • Damaged fuel level sensor. • Damaged or missing alternator drive belt. • Low brake fluid level. • Damaged brake master cylinder.	• Blown fuse. • Damaged wiring harness. • Loose or corroded connections. • Parking brake signal switch. • Brake fluid level switch. • Damaged bulb.

3. Verify the following systems are working properly:

   - High Beams
   - Turn Signals
   - Hazards

   If the systems are not working properly, refer to the appropriate section of this service manual to diagnose the system in question.

4. Check the wiring harness for obvious signs of shorts, opens, bad connections, or damage.
5. If the fault is not visually evident, determine the symptom and proceed to the following Troubleshooting Chart.

Troubleshooting Chart - Instrument Panel

NOTE: Use a digital multimeter to perform electrical Pinpoint Tests. Refer to the following page for the Troubleshooting Chart.

TROUBLESHOOTING CHART : Instrument Panel

CONDITION	POSSIBLE SOURCE	ACTION
• Fuel Level Always Reads Empty	• Fuel level sensor. • Fuel gauge. • Circuit.	• Go to Pinpoint Test A1.
• Fuel Level Reads Inaccurately	• Fuel level sensor. • Fuel gauge. • Circuit.	• Go to Pinpoint Test B1.
• Fuel Level Always Reads Full	• Fuel level sender. • Fuel gauge. • Circuit.	• Go to Pinpoint Test C1.
• Coolant Temperature Reads Inaccurately	• Water temperature indicator sender unit.	• Go to Pinpoint Test D1.
• Speedometer/Odometer Reads Inaccurately	• Speedometer	• Go to Pinpoint Test E1.
• Speedometer Noisy	• Speedometer	• Go to Pinpoint Test F1.
• Speedometer/Odometer Inoperative	• Circuit. • Fuse. • Speedometer.	• Go to Pinpoint Test G1.

TROUBLESHOOTING CHART : Instrument Panel (Continued)

CONDITION	POSSIBLE SOURCE	ACTION
• All Warning Indicators Inoperative	• Fuse. • Circuit	• Go to Pinpoint Test H1.
• Brake Warning Never/Always on	• Bulb. • Brake fluid level switch. • Parking brake signal switch. • Circuit.	• Go to Pinpoint Test J1.
• Charge System (voltmeter) Never/Always On	• Alternator. • Circuit.	• Go to Pinpoint Test K1.
• Low Oil Pressure Warning Never/Always On	• Low oil pressure. • Oil Pressure sensor. • Circuit.	• Go to Pinpoint Test L1.
• LH and/or RH Turn Indicator Never/Always On	• Bulb. • Circuit.	• Go to Pinpoint Test M1.
• High Beam Warning Never/Always On	• Bulb. • Circuit.	• Go to Pinpoint Test N1.
• Malfunctioning Indicator Lamp Never/Always On	• Bulb. • Powertrain control module. • Circuit.	• Refer to Section 6B in the Powertrain Control / Emissions Diagnosis Manual.

Pinpoint Tests - Instrument Panel

PINPOINT TEST A: FUEL LEVEL ALWAYS READS EMPTY

	TEST STEP	RESULT	ACTION TO TAKE
A1	• CHECK FUEL LEVEL SENSOR		
	• Perform the Fuel Level Sensor component test in this section. • **Is the fuel level sensor OK?**	Yes ⇒ No ⇒	Go to A2. Replace the fuel level sensor.
A2	CHECK FUEL GAUGE		
	• Perform the Fuel Gauge component test in this section. • **Is the fuel gauge OK?**	Yes ⇒ No ⇒	Go to A3. Replace the fuel gauge.
A3	CHECK FUEL GAUGE GROUND		
	• Key OFF. • Disconnect the connector to the fuel gauge. • Measure the resistance of the wire between the instrument panel connector and ground. • **Is the resistance less than 5 ohms?**	Yes ⇒ No ⇒	Go to A4. Service the wire for open.
A4	CHECK FUEL LEVEL SENSOR GROUND		
	• Key OFF. • Disconnect the fuel tank assembly connector. • Measure the resistance of the wire between the fuel tank assembly connector and ground. • **Is the resistance less than 5 ohms?**	Yes ⇒ No ⇒	Go to A5. Service the wire for open.

PINPOINT TEST A: FUEL LEVEL ALWAYS READS EMPTY (continued)

	TEST STEP	RESULT	ACTION TO TAKE
A5	• CHECK WIRE BETWEEN INSTRUMENT PANEL AND FUEL LEVEL SENSOR		
•	Key OFF.	Yes ⇒	Replace the fuel gauge or wire.
•	Disconnect the wire between the gauge and the fuel tank.	No ⇒	Service the wire for open.
•	Measure the resistance of the wire between the gauge and fuel tank.		
•	**Is the resistance less than 5 ohms?**		

PINPOINT TEST B: FUEL LEVEL READS INACCURATELY

	TEST STEP	RESULT	ACTION TO TAKE
B1	• CHECK FUEL LEVEL SENSOR		
•	Perform the Fuel Level Sensor component test in this section.	Yes ⇒	Go to B2.
•	**Is the fuel level sensor OK?**	No ⇒	Replace the fuel level sensor.
B2	CHECK FUEL LEVEL SENSOR GROUND		
•	Key OFF.	Yes ⇒	Go to B3.
•	Disconnect the fuel tank assembly connector.	No ⇒	Service the wire.
•	Measure the resistance of the wire between the fuel tank assembly connector and ground.		
•	**Is the resistance less than 5 ohms?**		
B3	CHECK FUEL GAUGE		
•	Perform the Fuel Gauge component test in this section.	Yes ⇒	Service the wire between the gauge and ground.
•	**Is the fuel gauge OK?**	No ⇒	Replace the fuel gauge.

PINPOINT TEST C: FUEL LEVEL ALWAYS READS FULL

	TEST STEP	RESULT	ACTION TO TAKE
C1	CHECK FUEL LEVEL SENSOR		
•	Perform the Fuel Level Sensor component test in this section.	Yes ⇒	Go to C2.
•	**Is the fuel level sensor OK?**	No ⇒	Replace the fuel level sensor.
C2	CHECK FUEL GAUGE		
•	Perform the Fuel Gauge component test in this section.	Yes ⇒	Service the wire for a short.
•	**Is the fuel gauge OK?**	No ⇒	Replace the fuel gauge.

PINPOINT TEST D: COOLANT TEMPERATURE READS INACCURATELY

	TEST STEP	RESULT	ACTION TO TAKE
D1	CHECK WATER TEMPERATURE INDICATOR SENDER UNIT		
•	Perform the Water Temperature Indicator Sender Unit component test in this section.	Yes ⇒	Go to D2.
•	**Is the water temperature indicator sender unit OK?**	No ⇒	Replace the water temperature indicator sender unit.
D2	CHECK WATER TEMPERATURE INDICATOR LIGHT		
•	Perform the Indicator Light test in this section.	Yes ⇒	Service the wire between the indicator light and ground.
•	**Is the indicator light OK?**	No ⇒	Replace the water temperature indicator light.

PINPOINT TEST E: SPEEDOMETER/ODOMETER READS INACCURATELY

	TEST STEP	RESULT	ACTION TO TAKE
E1	CHECK SPEEDOMETER GEAR ASSEMBLY		
•	Disconnect the electrical connection from the speedometer to the transaxle. • Remove the speedometer gear assembly. • Inspect the speedometer gear. • **Are there any broken teeth on the speedometer gear?**	Yes ⇒ No ⇒	
E2	CHECK SPEEDOMETER CONNECTION		
•	Disconnect the speedometer wire from the speedometer and the transaxle. • Perform a calibration test to check speedometer operation. • **Does the speedometer operate freely?**	Yes ⇒ No ⇒	Replace the speedometer. Service the speedometer wire for shorts.

PINPOINT TEST F: SPEEDOMETER NOISY

	TEST STEP	RESULT	ACTION TO TAKE
F1	CHECK SPEEDOMETER		
•	Disconnect the speedometer wire from the speedometer and the transaxle. • Perform a calibration test to check speedometer operation. • **Does the speedometer operate freely?**	Yes ⇒ No ⇒	Replace the speedometer. Service the speedometer wire for shorts.
F2	CHECK SPEEDOMETER GEAR ASSEMBLY		
•	Remove the speedometer gear assembly from the transaxle. • Inspect the speedometer gear. • **Are there any broken teeth on the speedometer gear?**	Yes ⇒ No ⇒	Replace the speedometer gear assembly. Replace the speedometer.

PINPOINT TEST G: SPEEDOMETER/ODOMETER INOPERATIVE

	TEST STEP	RESULT	ACTION TO TAKE
G1	CHECK SPEEDOMETER WIRE CONNECTION		
•	Check the wire connection between the speedometer and speedometer gear on the transaxle. • **Are the connections in satisfactory condition?**	Yes ⇒ No ⇒	Go to G2. Repair as required.
G2	CHECK SPEEDOMETER		
•	Remove the speedometer. • Perform a calibration test to test speedometer calibration. • **Does the speedometer needle move?**	Yes ⇒ No ⇒	Go to G3. Replace the speedometer.
G3	CHECK SPEEDOMETER GEAR ASSEMBLY		
•	Remove the speedometer gear assembly from the transaxle. • Inspect the speedometer gear. • **Are there any broken teeth on the speedometer gear?**	Yes ⇒ No ⇒	Replace the speedometer gear assembly. Replace the speedometer.

PINPOINT TEST H: ALL WARNING INDICATORS INOPERATIVE

	TEST STEP	RESULT	ACTION TO TAKE
H1	CHECK FUSE		
•	Check the 15A fuse located in the fuse junction panel.	Yes ⇒	Go to H4.
•	**Is the fuse OK?**	No ⇒	Go to H2.
H2	CHECK SYSTEM		
•	Key OFF.	Yes ⇒	Go to H3.
•	Replace the 15A fuse	No ⇒	Go to H4.
•	Key ON.		
•	Inspect the fuse.		
•	**Does the fuse fail again?**		
H3	CHECK FOR SHORT TO GROUND		
•	Key OFF.	Yes ⇒	Service the wire for short.
•	Locate and disconnect the indicator light connector(s).	No ⇒	Replace the 15A fuse. Go to H4.
•	Remove the 15A fuse.		
•	Measure the resistance of the wire between the connector and ground.		
H4	CHECK POWER SUPPLY TO WARNING INDICATORS ON INSTRUMENT PANEL		
•	Key OFF.	Yes ⇒	Go to H5.
•	Locate and disconnect the warning indicator connector.	No ⇒	Service the wire for open.
•	Key ON.		
•	Measure the voltage on the wire at the connector.		
•	**Is the voltage greater than 10 volts?**		
H5	CHECK WARNING INDICATORS GROUND		
•	Key OFF.	Yes ⇒	Replace the warning indicator at the instrument panel.
•	Disconnect warning indicator connector.		
•	Measure the resistance of the wire(s) between the warning indicator(s) and ground.	No ⇒	Service the wire(s) for open.
•	**Are the resistances less than 5 ohms?**		

PINPOINT TEST J: BRAKE WARNING NEVER / ALWAYS ON

	TEST STEP	RESULT	ACTION TO TAKE
J1	CHECK BRAKE SYSTEM INDICATOR LIGHT		
•	Remove the brake system indicator light.	Yes ⇒	Go to J2.
•	Measure the continuity between the terminals of the indicator light.	No ⇒	Replace the brake system warning indicator light.
•	**Does continuity exist?**		
J2	CHECK PROVE OUT SIGNAL		
•	Key OFF.	Yes ⇒	Go to J3.
•	Disconnect the connector to brake indicator light.	No ⇒	Service in question.
•	Disconnect the distributor connectors to prevent the vehicle from starting.		
•	Place the gearshift lever in PARK (P) or NEUTRAL (N).		
•	Key in START.		
•	Measure the voltage on the wire leading to the brake indicator light.		
•	**Is the voltage greater than 10 volts?**		

PINPOINT TEST J: BRAKE WARNING NEVER / ALWAYS ON (Continued)

	TEST STEP	RESULT	ACTION TO TAKE
J3	CHECK BRAKE MASTER CYLINDER FLUID LEVEL SENSOR		
	• Key OFF. • Locate and disconnect the brake master cylinder fluid level sensor. • Measure the continuity between the terminals of the brake master cylinder fluid level sensor under the following conditions: **Brake Fluid Level** — **Resistance** Below MIN. — Less than 5 ohms Above MIN. — Approximately 500 ohms • NOTE: If brake fluid level is below minimum, refer to Section 4 to check the brake system. • **Are the resistances OK?**	Yes ⇒ No ⇒	Go to J4 Replace the brake master cylinder fluid level sensor.
J4	CHECK BRAKE MASTER CYLINDER FLUID LEVEL SENSOR GROUND		
	• Key OFF. • Disconnect the brake master cylinder fluid level sensor connector. • Measure the resistance of the wire between the brake master cylinder fluid level sensor connector and ground. • **Is the resistance less than 5 ohms?**	Yes ⇒ No ⇒	Go to J5. Service the wire.
J5	CHECK PARKING BRAKE SIGNAL SWITCH		
	• Key OFF. • Locate and disconnect the parking brake signal switch connector. • Measure the resistance of the wire between the parking brake signal switch and ground under the following conditions: **Parking Brake** — **Resistance** Engaged — Less than 5 ohms Released — Greater than 10,000 ohms • **Are the resistances correct?**	Yes ⇒ No ⇒	Go to J6. Replace the parking brake signal switch and bracket.
J6	CHECK WIRE BETWEEN BRAKE INDICATOR WARNING LIGHT AND THE PARKING BRAKE SIGNAL SWITCH AND BRAKE MASTER CYLINDER FLUID LEVEL SENSOR		
	• Key OFF. • Locate and disconnect the connector to the brake indicator light. • Disconnect the parking brake master switch. • Measure the resistance of the wire between the brake indicator light, brake master cylinder fluid level connector, and the parking brake signal switch connector. • Measure the resistance of the wire between the brake indicator warning light and ground. • **Is the resistance less than 5 ohms between all the connectors, and greater than 10,000 ohms between the brake indicator warning light and ground?**	Yes ⇒ No ⇒	Replace the brake indicator warning light. Service the wire(s).

PINPOINT TEST K: (VOLTMETER) CHARGE SYSTEM WARNING NEVER/ALWAYS ON

	TEST STEP	RESULT	ACTION TO TAKE
K1	CHECK VOLTMETER		
•	Key OFF.	Yes ⇒	Go to K2.
•	Remove the connection from the voltmeter.	No ⇒	Replace the voltmeter.
•	Check continuity between the terminals of the voltmeter.		
•	**Does continuity exist?**		
K2	CHECK WIRE BETWEEN THE VOLTMETER AND THE ALTERNATOR		
•	Key OFF.	Yes ⇒	Refer to Section 12 to service the alternator.
•	Disconnect the alternator connector.		
•	Key ON.	No ⇒	Go to K3.
•	Ground the wire on the alternator connector.		
•	**Does the charging system show a reading on the voltmeter?**		
K3	CHECK WIRE BETWEEN VOLTMETER AND ALTERNATOR		
•	Key OFF.	Yes ⇒	Replace voltmeter.
•	Disconnect the alternator connector.	No ⇒	Service the wire(s).
•	Measure the resistance of the wire between the voltmeter and the alternator connector.		
•	Measure the resistance of the wire between the voltmeter and ground.		

PINPOINT TEST L: LOW OIL PRESSURE WARNING NEVER/ALWAYS ON

	TEST STEP	RESULT	ACTION TO TAKE
L1	CHECK ENGINE OIL PRESSURE		
•	Check the engine oil pressure. If necessary, refer to Section 11 - Engine.	Yes ⇒	Go to L2.
•	**Is the engine oil pressure within specification?**	No ⇒	Refer to Section 11 - Engine to service the engine.
L2	CHECK LOW OIL PRESSURE INDICATOR LAMP		
•	Key OFF.	Yes ⇒	Go to L3.
•	Remove the low pressure indicator lamp assembly.	No ⇒	Replace the oil pressure indicator assembly.
•	Check the continuity between the terminals of the low oil pressure indicator lamp assembly.		
•	**Does continuity exist?**		
L3	CHECK OIL PRESSURE SENSOR		
•	Key OFF.	Yes ⇒	Go to L4.
•	Locate and disconnect the oil pressure sensor connector.	No ⇒	Replace the oil pressure sender.
•	Measure the resistance between the terminal of the oil pressure sender and ground under the following conditions:		

Engine	Resistance
Running	Greater than 10,000 ohms
Off	Less than 5 ohms

•	**Are the resistances correct?**		

PINPOINT TEST L: LOW OIL PRESSURE WARNING NEVER/ALWAYS ON (Continued)

	TEST STEP	RESULT	ACTION TO TAKE
L4	CHECK WIRE BETWEEN THE INDICATOR LIGHT AND OIL PRESSURE SENSOR		
•	Key OFF.	Yes ⇒	Replace the indicator light.
•	Locate and disconnect the wire connector between the indicator light and oil pressure sender.	No ⇒	Service the wire.
•	Disconnect the oil pressure sensor connector.		
•	Measure the resistance of the wire between the indicator light and oil pressure sensor connector.		
•	Measure the resistance of the wire between the indicator light and ground.		
•	**Is the resistance less than 5 ohms between the instrument panel and the oil pressure sensor, and greater than 10,000 ohms between the instrument and ground?**		

PINPOINT TEST M: RH AND/OR LH TURN INDICATOR(S) NEVER/ALWAYS ON

	TEST STEP	RESULT	ACTION TO TAKE
M1	CHECK LH AND/OR RH TURN SIGNAL OPERATION		
•	Key ON.	Yes ⇒	Go to M2.
•	LH and/or RH turn signal on.	No ⇒	Replace the LH and/or RH turn indicator assembly.
•	**Does the LH and/or RH turn signal operate properly?**		
M2	CHECK LH AND/OR RH INDICATOR BULB		
•	Key OFF.	Yes ⇒	Go to M3.
•	Remove the LH and RH turn indicator lamp assembly.	No ⇒	Replace the LH and/or RH turn indicator assembly.
•	Check the continuity between the terminals of the LH and/or RH turn indicator lamp assembly.		
•	**Does continuity exist?**		
M3	CHECK THE LH AND/OR RH SIGNAL INPUT TO THE INSTRUMENT PANEL		
•	Key OFF.	Yes ⇒	Replace the indicator lamp assembly.
•	Locate and disconnect the connector to the turn signal connector.	No ⇒	Service the wire.
•	Key ON.		
•	LH and/or RH turn signal on.		
•	Measure the voltage of the wire at the turn indicator connector.		
•	**Does the voltage alternate between 0 and 10 volts?**		

PINPOINT TEST N: HIGH BEAM WARNING NEVER/ALWAYS ON

	TEST STEP	RESULT	ACTION TO TAKE
N1	CHECK HIGH BEAM OPERATION		
•	Headlamps on.	Yes ⇒	Go to N2.
•	Operate high beams.	No ⇒	Refer to Section 18 to check high beam circuit.
•	**Do the high beams operate properly?**		
N2	CHECK HIGH BEAM INDICATOR LAMP		
•	Key OFF.	Yes ⇒	Go to N3.
•	Remove the high beam indicator lamp.	No ⇒	Replace the high beam indicator lamp assembly.
•	Check the continuity between the terminals of the inoperative high beam indicator lamp.		
•	**Does continuity exist?**		

PINPOINT N: HIGH BEAM WARNING NEVER/ALWAYS ON (Continued)

	TEST STEP	RESULT	ACTION TO TAKE
N3	CHECK HIGH BEAM INPUT TO INSTRUMENT PANEL		
•	Key OFF.	Yes ⇒	Replace the high beam indicator lamp assembly.
•	Locate and disconnect the connector to the headlamps.	No ⇒	Service the wire.
•	Headlamps on.		
•	High beams on.		
•	Measure the voltage on the wire at the high beam indicator lamp.		
•	**Is the voltage greater than 10 volts?**		

REMOVAL AND INSTALLATION

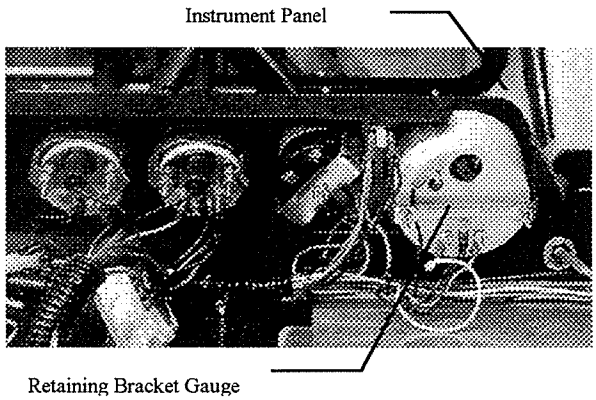
Gauge Removal and Installation

The speedometer, fuel gauge, voltmeter, and hourmeter are each secured to the back of the instrument panel with a retaining bracket. They can be removed as follows:

1. Remove the instrument panel top.
2. Disconnect the wiring to the back of the gauge. Label wires to which connection it goes to on the back of the gauge.
3. Remove the retaining bracket which secures the gauge to the back of the instrument panel.
4. Remove the gauge through the front part of the instrument panel.

Install the replacement gauge into the instrument panel in the reverse order of removal.

Test the gauge for continuity. If the gauge does not operate as specified, replace the gauge.



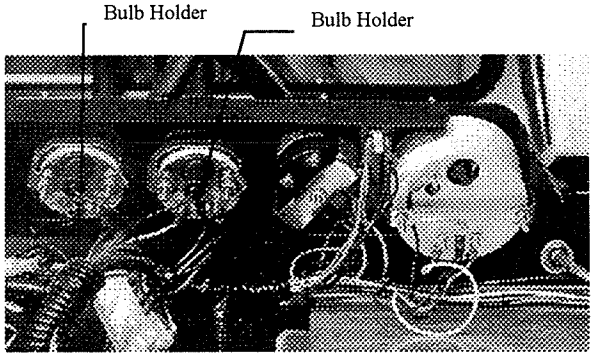
Bulbs - Gauges

Removal

1. Remove the instrument panel top.
2. **Speedometer:** Twist the bulb holder counterclockwise to remove it from the housing of the speedometer. Pull the bulb out from the bulb holder.
3. **Fuel Gauge, Voltmeter, and Hourmeter:** Pull the bulb assembly out from the back of the gauge. Twist the bulb to remove it from the holder.

Installation

To install, reverse the removal procedure.



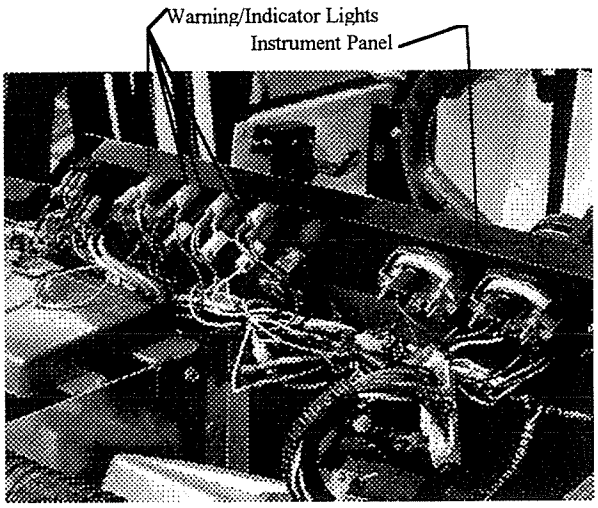
Indicator/Warning Lights

Removal

1. Remove the instrument panel top from the instrument panel.
2. Disconnect the wiring to the back of the indicator/warning light.
3. Label wires to the connections at the back of the indicator/warning light.

4. Compress the two tabs on each side of the indicator/ warning light.

5. Push out the indicator/warning light through the front of the instrument panel.



Installation

To install, reverse the removal procedure.

Auxiliary Switches

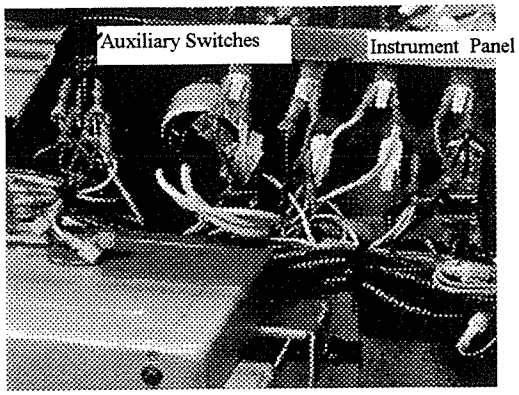
Removal

1. Remove the instrument panel top from the instrument panel.

2. Disconnect the wiring to the back of the auxiliary switch.

3. Label wires to the connections at the back of the auxiliary switch.

4. Compress the two tabs on each side of the auxiliary switch.
5. Push out the auxiliary switch through the front of the instrument panel.

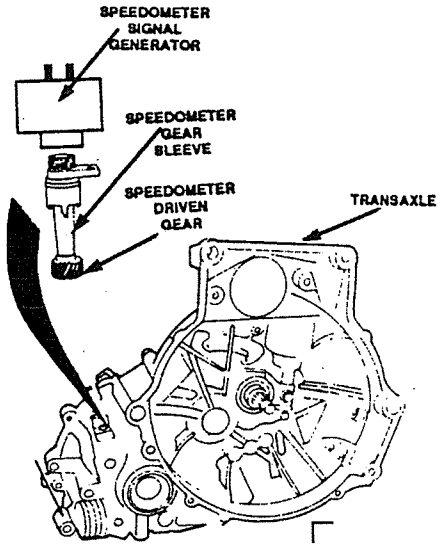


Installation

To install, reverse the removal procedure.

Speedometer Sender Drive

The speedometer sender drive is located at the transaxle where the driven gear meshes with drive gear mounted on the differential. The driven gear and shaft are in a sleeve that is bolted to the transaxle.



Removal

1. Disconnect the electrical connections from the sender.

2. Unscrew the sender unit.

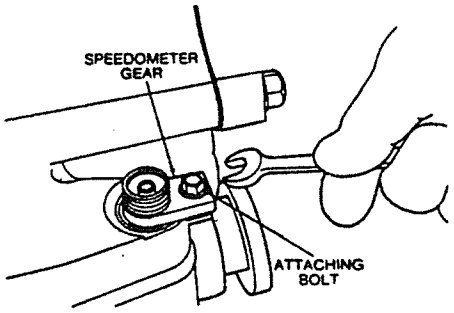
3. Remove the speedometer gear attaching bolt.

   Refer to Section 8 for further information.

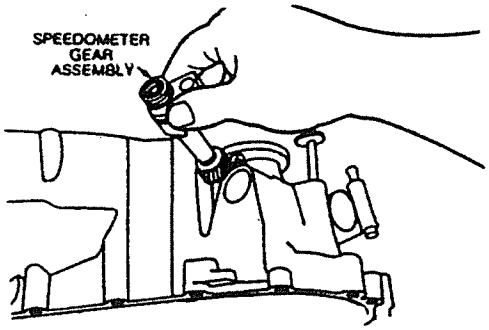
Speedometer Driven Gear

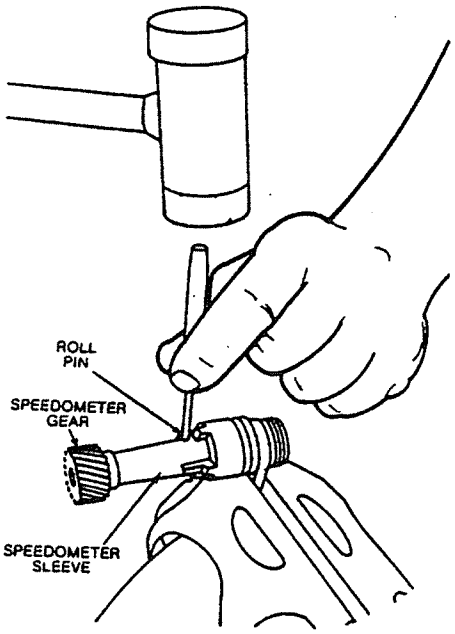
Removal

1. Disconnect the electrical leads from the sender.
2. Unscrew the sender unit from the transaxle housing.
3. Remove the speedometer gear attaching bolt.

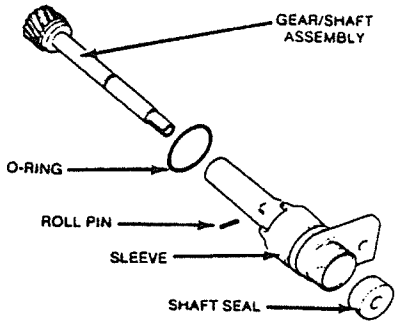


4. Pull the speedometer sleeve and driven gear as an assembly out of the transaxle.
5. Remove the O-ring from the speedometer gear sleeve.
6. Remove the roll pin using a pin punch.



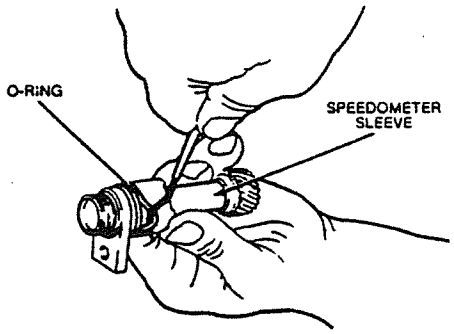


7. Remove the speedometer gear and shaft as an assembly.



Installation

1. Install the speedometer gear and shaft in the sleeve.
2. Install the roll pin.
3. Install a new O-ring on the speedometer sleeve.



4. Install the speedometer gear in the transaxle.
5. Install the speedometer gear attaching bolts.
6. Tighten the sender unit.
7. Connect the electrical leads.
8. If the speedometer doesn't work, replace the speedometer.

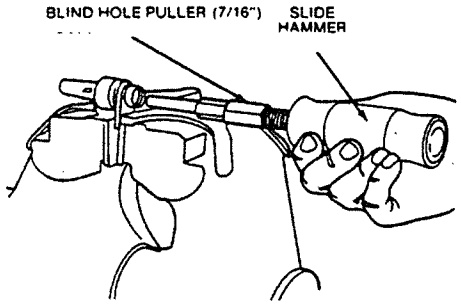
Speedometer Sleeve Seal

Removal

1. Remove the speedometer driven gear from the sleeve.

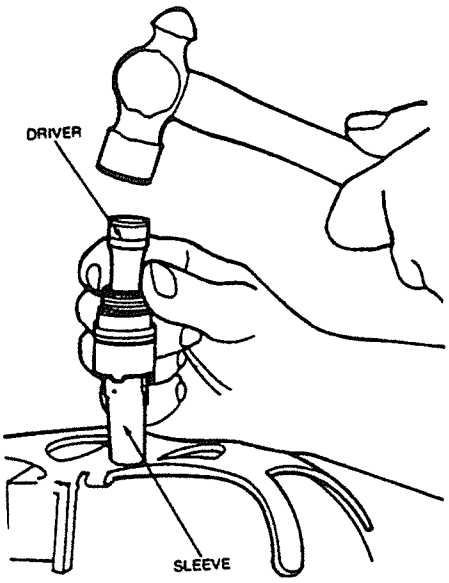
   If necessary, refer to the procedure in this section.

2. The speedometer sleeve seal can be removed using the Blind Hole Puller an Slide Hammer.



Installation

1. Install the seal using a suitable driver.



2. Install the speedometer driven gear to the sleeve. If necessary, refer to the procedure in this section.

SERVICE PROCEDURES

Drive and Driven Gears Damaged

1. A speedometer gear in the speedometer sender drive with two or three adjoining teeth badly scored is indicative of improperly assembly procedure. The gear should be inserted in the transaxle while twisting the speedometer gear assembly back and forth. This will ensure initial gear engagement and prevent gear damage. Never use force.
2. Whenever a speedometer drive gear is replaced, a new speedometer gear should also be installed, regardless of its apparent condition.

CLEANING AND INSPECTION

Gauge Lenses

Clean the gauge lenses with a high quality glass cleaner and a lint-free cloth. Ensure that the gauge lens is clear and free of streaks before assembly. Inspect the lens surface for cracks and scratches. Replace the gauge if the lens surface is broken, cracked or scratched excessively.

ADJUSTMENTS

Speedometer Calibration

As a general rule, the indicated speed is equal to or greater than the actual speed. The speedometer head is an instrument which processes the information sent to it by the speedometer driven gear. If the system components send the wrong number of revolutions per mile to the speedometer head, an inaccurate speed and amount of distance traveled will be displayed. Start by checking the accuracy of the odometer even if the customer concern indicates a speed accuracy problem. Odometer accuracy can be checked by using roads established at mile increments or a known local course. If roads with mile markers are used, a five mile stretch is recommended to allow for inaccuracies. If an error is greater than 3.75 percent, a change to the speedometer drive/driven gear selection, tire size, or tire inflation may need attention. The odometer should be checked again to verify any corrective action. If the indicated speed error exceeds 10 percent, replace the speedometer.

SPECIFICATIONS

OIL PRESSURE SENSOR SPECIFICATIONS

Switch Closed	Switch Open
Oil Pressure	
Below 4.3 psi (30 kPa)	Above 4.3 psi (30 kPa)

SERVICE TOOLS/EQUIPMENT

- Instrument Gauge System Tester
- Digital Multimeter
- Slide Hammer
- Blind Hole Puller

SECTION 19-1 - Instrument Panel, Controls and Warning Systems - Steering Column Switches and Ignition Switch

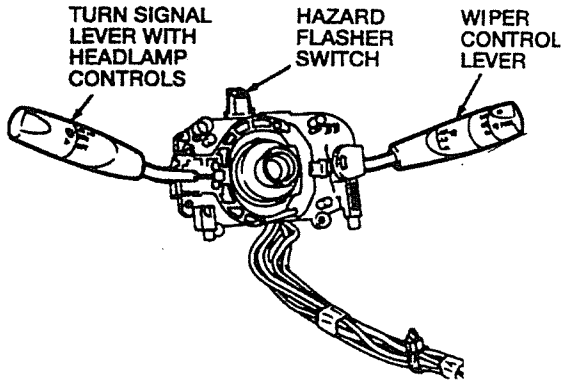
DESCRIPTION AND OPERATION

The multi-function switch is mounted on the steering column and controls the following:

- Head lamps
- Parking Lamps, tail lamps and side marker lamps
- Flash-to-pass switch
- High/ low beam lamps
- Turn signal lamps
- Hazard/flasher lamps
- Windshield wiper

Multi-Function Switch

The multi-function switch incorporates the turn signal switch, head lamp switch, flash-to-pass switch, hazard flasher switch, and windshield wiper into a single assembly.



The windshield wipers are controlled by the wiper control lever, which is integral with the multi-function switch. The wiper control lever is located on the right side of the multi-function side of the multi-function switch. To operate the windshield wipers, the ignition switch must be in ACC or ON position. The windshield wipers have three fixed positions: OFF, LO and HI.

The high beams and the flash-to-pass feature are controlled by the turn signal lever, which is integral with the multi-function switch. To activate the high beams, move the turn signal lever away from the driver to the stop position. Releasing the turn signal lever in this position will maintain the high beam operation. To return to low beams, move the turn signal lever back to its normal position.

To operate the flash-to-pass feature, pull the turn signal lever gently toward the driver. When the turn signal lever is released, the head lamps will

return to the low beams. When driving without the head lamps on, the flash-to-pass feature will automatically turn on the high beams until the turn signal lever is released.

Turn Signals

The turn signals are controlled by the turn signal lever which is an integral part of the multi-function switch. The turn signal lever is mounted on the left side of the multi-function switch. To operate the turn signals, the ignition switch must be in the ON position. To indicate a full turn, move the turn signal lever to the end of travel position for the desired turn. The turn signal lever will remain in this position until the turn is complete. The steering wheel cancel cam automatically releases the turn signal lever.

The turn signal system also a lane change feature. To operate the lane change feature, hold the turn signal lever in the first position when changing lanes. When the lane change is complete, release the turn signal lever and it will return to its original position.

Hazard Flasher Switch

The hazard warning flasher switch is an integral part of the multi-function switch. The hazard flasher system operates independently from the ignition switch. All turn signal lamps will flash in unison when the hazard flasher switch is pressed and released. The hazard flasher switch is located on the top portion of the steering column upper panel. It is identified by the "double triangle" symbol. In the on position, the hazard flasher switch will move out and away from the steering column. The hazard flasher system is turned off by pushing the hazard flasher switch, then releasing it. The hazard flasher switch remains in or toward the steering column while it is in the off position.

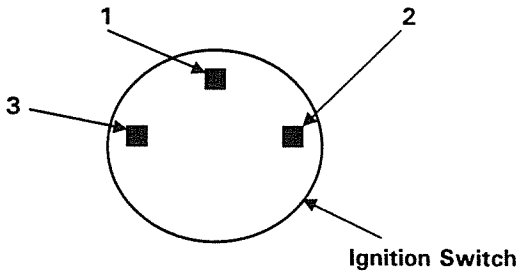
NOTE: The turn signal is system deactivated when the hazard flasher system is on. Turn signal and windshield wiper switch motion does not affect the hazard flasher system.

Flasher, Indicator

The indicator flasher allows the turn signal and hazard flasher switch to complete their circuits. When the turn signal switch is closed, the contacts connect either the left or the right turn signal and hazard circuits to the indicator flasher. When the hazard flasher switch is closed, the contacts connect all four lamps to the indicator flasher. The indicator flasher is located below the instrument panel.

Ignition Switch

The ignition switch is a rotary type switch operated directly by the ignition key lock cylinder. A lug on the end of the lock cylinder engages a matching slot on the switch contact plate. When the ignition is turned to the ACC, ON, or START position, rotation of the contact plate will connect various circuits to battery voltage. In the ACC position, accessories are energized. In the ON position, the circuits required to operate the vehicle are energized. In the START position, the starter solenoid receives voltage, closing the contacts to energize the starter circuit which allows the starter motor to crank the engine.



1. OFF Position
2. Start Position (ON)
3. Accessory (ACC) Position

DIAGNOSIS AND TESTING

Inspection and Verification - Ignition Switch

1. Verify the customer concern by operating the ignition switch.

   Visually inspect the following components of the ignition system:

Visual Inspection Chart

Mechanical	Electrical
Binding condition- key does not turn.- cannot remove key.	• Blown fuse. • Shorted wire(s). • Damaged connections. • Damaged ignition switch.

Troubleshooting Chart - Ignition Switch

NOTE: Use a digital multimeter to perform electrical Pinpoint Tests.

IGNITION SWITCH

CONDITION	POSSIBLE SOURCE	ACTION
• Ignition switch inoperative	• Ignition switch. • Circuit. • Battery discharged.	• Go to Pinpoint Test A1.
• No power In ACC position	• Ignition switch. • Circuit.	• Go to Pinpoint Test B1.
• No power in ON position	• Ignition switch. • Circuit.	• Go to Pinpoint Test C1.
• No power in START position	• Ignition switch. • Circuit.	• Go to Pinpoint Test D1.
• High Key Effort	Ignition switch binding.	• Perform the Ignition Switch Mechanical Test component test in this section.
• Turn Signal Switch Inoperative	• Fuse. • Circuit. • Turn signal switch.	• Refer to Section 18 to diagnose the turn signals.
• Windshield Wiper Switch Inoperative	• Fuse. • Circuit. • Windshield wiper switch.	• Refer to this section to diagnose the wiper system.

Pinpoint Tests - Ignition Switch

PINPOINT TEST A: IGNITION SWITCH INOPERATIVE

TEST STEP		RESULT	ACTION TO TAKE
A1	CHECK POWER SUPPLY TO IGNITION SWITCH		
• Key OFF. • Disconnect the ignition switch connector. • Measure the voltage on the wire at the ignition switch connector. • **Are the voltages greater than 10 volts?**		Yes ⇒ No ⇒	Go to A5. Service the wire(s).
A2	CHECK IGNITION SWITCH		
• Perform the Ignition Switch Continuity Test in this section. • **Is the ignition switch OK?**		Yes ⇒ No ⇒	Go to A6. Replace the ignition switch.
A3	CHECK CONTINUITY TO INTERIOR FUSE PANEL		
• Key OFF. • Disconnect the ignition switch connector. • Locate and remove the 10A Engine, 15A Wiper, 15A Auxiliary fuses. • Measure the resistance of the following wires between the ignition switch connector and the fuse panel terminals. • **Are the resistances less than 5 ohms?**		Yes ⇒ No ⇒	Go to A7. Service the wire(s).

PINPOINT TEST A: IGNITION SWITCH INOPERATIVE

	TEST STEP	RESULT	ACTION TO TAKE
A4	CHECK FOR SHORTS TO GROUND		
•	Key OFF.	Yes ⇒	Inspect/Replace the fuse panel. If interior fuse panel is OK and electrical system symptom still exists, refer to appropriate section for diagnosis and testing.
•	Disconnect the ignition switch connector.		
•	Remove the 10A Engine, 15A Wiper, 15A Auxiliary fuses.		
•	Measure the resistance between the ignition switch connector and ground for the wires.		
•	**Are the resistances greater than 10,000 ohms?**	No ⇒	Service the wire(s) in question.

PINPOINT TEST B: NO POWER IN "ACC" POSITION

	TEST STEP	RESULT	ACTION TO TAKE
B1	CHECK IGNITION SWITCH		
•	Perform the Ignition Switch Continuity Test in this section.	Yes ⇒	Service the wire between the ignition switch and the fuse panel.
•	**Is the ignition switch OK?**	No ⇒	Replace the ignition switch.

PINPOINT TEST C: NO POWER IN "ON" POSITION

	TEST STEP	RESULT	ACTION TO TAKE
C1	CHECK IGNITION SWITCH		
•	Perform the Ignition Switch Continuity Test in this section.	Yes ⇒	Service the wire between the ignition switch and fuse panel.
•	**Is the ignition switch OK?**	No ⇒	Replace the ignition switch.

PINPOINT TEST D: NO POWER IN "START" POSITION

	TEST STEP	RESULT	ACTION TO TAKE
D1	CHECK IGNITION SWITCH		
•		Yes ⇒	Service the wire between the ignition switch and the Park/Neutral Position Switch.
•	Perform the Ignition Switch Continuity Test in this section.	No ⇒	Replace the ignition switch.
•	**Is the ignition switch OK?**		

Component Tests - Ignition Switch

Ignition Switch Continuity Test

Use a digital multimeter or equivalent to check the continuity of the ignition switch. If continuity is not present, replace the ignition switch.

Ignition Switch Mechanical Test

1. Inspect the ignition switch and ignition lock cylinder for signs of binding. If the ignition switch or ignition switch lock is binding, repair or replace the components as necessary.

REMOVAL AND INSTALLATION

Multi-Function Switch

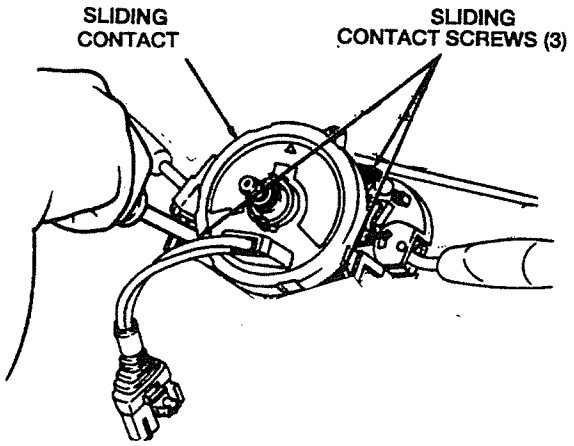
Removal

1. Disconnect the battery ground cable and wait one minute for the backup power supply to be depleted.
2. Remove the steering wheel. Refer to Section 6 - Steering for the removal and installation procedure.
3. Remove the upper and lower steering panel nuts and screws.

4. Separate the upper and lower portion of the steering panels.

5. Remove the steering column panels from the steering column.

6. Remove the three contact screws and pull the sliding contact off the steering column.

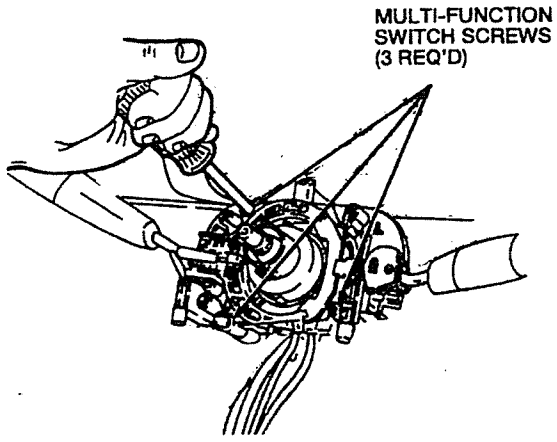


7. Remove the sliding contact ground wire screw.

8. Disconnect the sliding contact electrical connector.

9. Remove the sliding contact.

10. Remove the three multi-function switch screws.



11. Disconnect the multi-function switch electrical connectors.

12. Slide the multi-function switch off the steering column.

Installation

To install, reverse the removal procedure.

Tighten the sliding contact screws to 18-26 lb-in. (2-3 N-m).

Ignition Switch

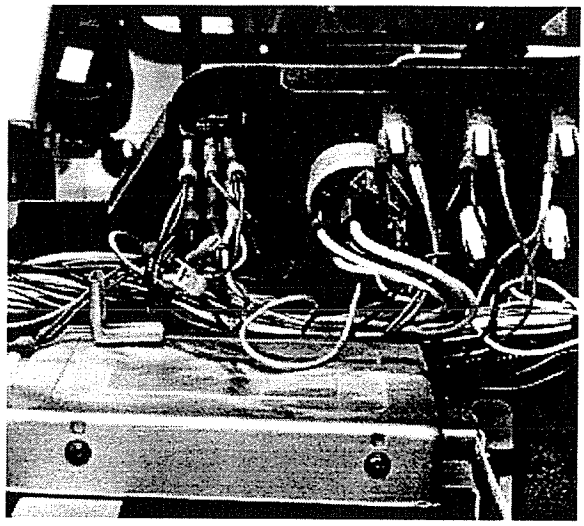
Removal

1. Disconnect the battery ground cable.
2. Remove the instrument top panel from the instrument panel.

3. Mark and then disconnect the electrical connectors at the back of the ignition switch.

4. Remove the ignition retaining nut.

5. Remove the ignition the switch from the instrument panel.



Installation

To install, reverse the removal procedure.

High Beam/Flash-to-Pass Switch

Removal and Installation

The high beam/flash-to-pass switch is an integral part of the multi-function switch. Refer to the procedure in this section.

Flasher, Indicator

For indicator flasher removal and installation, refer to the procedure in Section 18.

SPECIFICATIONS

SERVICE TOOLS/EQUIPMENT

- Digital Multimeter

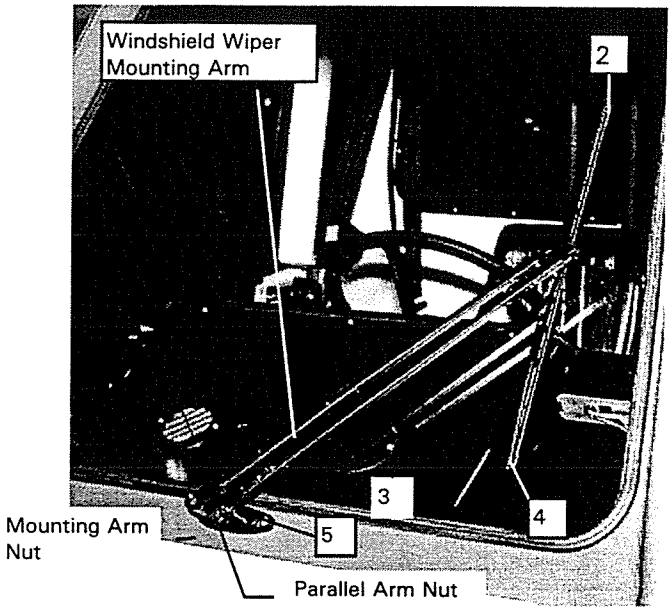
SECTION 19-2 - Instrument Panel, Controls and Warning Systems - Wiper System

DESCRIPTION AND OPERATION

The windshield wiper is operated by an electric wiper motor mounted under the front windshield. The windshield wiper motor is attached to the structure of the vehicle. To prevent metal-to-metal contact and the transmissions of vibrations to the body, the windshield motor is mounted on rubber insulators.

The rotary motion of the windshield motor is transferred to the windshield pivot arm through the windshield wiper mounting arm and parallel arm. The ends of the wind-shield wiper pivot shafts are serrated and cone-shaped to prevent the windshield pivot arm from slipping in the windshield wiper pivot shaft.
The windshield wiper pivot arm is installed in the windshield pivot shaft and windshield parallel arm is installed on the windshield pivot shaft. They are held in position with windshield wiper pivot arm nuts. A retaining clip attaches the windshield wiper blade refill to the windshield wiper blade frame.

Windshield Wiper Assembly



Item	Part Number	Description
1	644000	Two-speed Wiper Motor*
2	644001	Wiper Blade
3	644002	Wiper Parallel Arm
4	-	Locking Tab
5	-	Wiper Mounting Arm

* not shown.

Off/Low/High Speed

The windshield wiper switch is located on the windshield wiper control lever, an integral part of the multi-function switch. The windshield wiper

operate with two speeds. Move the windshield wiper to LO for slow wiping or to HI for faster wiping. To operate the windshield wiper the ignition switch must be in either the ON or ACC position.

Interval

When the windshield wiper are in the interval mode (INT), the windshield wiper makes a single wipe. There is a 10-second pause between the wipes. In the interval mode, a slight ticking sound may be heard. This is normal and caused by the interval relay.

DIAGNOSIS AND TESTING

Inspection and Verification - Wiper System

1. Verify the customer concern by operating the wiper system.
2. Visually inspect the components of the wiper system.
3. Check windshield wiper pivot arms for proper adjustment and proper connection to the motor shaft.
4. Inspect the wiper system wiring harness and connectors for obvious signs of damage.

Visual Inspection Chart

Mechanical	Electrical
• Binding windshield wiper pivot arm. • Damaged windshield wiper motor. • Damaged wiper switch. • Wiper improperly connected to windshield wiper motor.	• Blown fuse. • Loose or corroded connectors. • Damaged windshield motor. • Damaged windshield wiper switch.

5. If the fault is not visually evident, determine the symptom and proceed to the Troubleshooting Chart.

Troubleshooting Chart - Wiper System

NOTE: Use a digital multimeter to perform electrical Pinpoint Tests.

CONDITION	POSSIBLE SOURCE	ACTION
• Windshield Wiper Inoperative - all control switch positions	• Fuse. • Circuit. • Windshield wiper motor. • Windshield wiper switch.	• Go to Pinpoint Test A1.
• Windshield Wiper Inoperative at high speed	• Circuit. • Windshield wiper motor. • Windshield wiper switch.	• Go to Pinpoint Test B1.
• Windshield Wiper Inoperative at low speed	• Circuit. • Windshield wiper motor. • Windshield wiper switch.	• Go to Pinpoint Test C1.
• Windshield Wiper will not park at the proper position	• Windshield wiper motor. • Windshield wiper motor ground.	• Go to Pinpoint Test D1.
• Windshield Wiper continues to run when switch is turned off	• Circuit. • Windshield wiper switch.	• Go to Pinpoint Test E1.
• Windshield Wiper Inoperative at Interval Setting	• Windshield wiper switch	• Replace the multi-function switch.

Pinpoint Tests - Wiper System

PINPOINT TEST A: WINDSHIELD WIPER INOPERATIVE - ALL CONTROL SWITCH POSITIONS

TEST STEP		RESULT	ACTION TO TAKE
A1	CHECK FUSE		
• Key OFF. • Check the wiper fuse located in the fuse panel. • **Is the fuse OK?**		Yes ⇒ No ⇒	Go to A4. Go to A2.
A2	CHECK SYSTEM		
• Key OFF. • Replace the wiper fuse located in the fuse panel. • Key ON. • **Does the fuse fail again?**		Yes ⇒ No ⇒	Go to A3. Go to A4.
A3	CHECK FOR SHORT TO GROUND		
• Key OFF. • Remove the wiper fuse. • Disconnect the windshield wiper connector and the multi-function switch connector. • Measure the resistance of the wire between the terminal of the fuse holder and ground. • **Is the resistance less than 5 ohms?**		Yes ⇒ No ⇒	Service the wire. Replace the wiper fuse. Go to A4.
A4	CHECK POWER SUPPLY TO WINDSHIELD WIPER MOTOR		
• Key OFF. • Disconnect the windshield wiper motor connector and the multi-function switch connector. • Measure the voltage on the wire at the windshield wiper motor connector and the multi-function switch connector. • **Are the voltages greater than 10 volts?**		Yes ⇒ No ⇒	Go to A5. Service the wire.
A5	CHECK WINDSHIELD WIPER MOTOR		
• Perform the windshield wiper motor component test in this section. • **Is the windshield wiper motor OK?**		Yes ⇒ No ⇒	Go to A6. Replace the windshield wiper motor.
A6	CHECK WINDSHIELD WIPER SWITCH		
• Perform the windshield wiper switch test component test in this section. • **Is the windshield wiper switch OK?**		Yes ⇒ No ⇒	Service the wires between the multi-function switch and windshield wiper motor. Replace the multi-function switch.

PINPOINT TEST B: WINDSHIELD WIPERS INOPERATIVE AT HIGH SPEED

TEST STEP		RESULT	ACTION TO TAKE
B1	CHECK WINDSHIELD MOTOR		
• Perform the windshield motor component test in this section. • **Is the windshield wiper motor OK?**		Yes ⇒ No ⇒	Go to B2. Replace the windshield wiper motor.
B2	CHECK WINDSHIELD WIPER SWITCH		
• Perform the windshield wiper switch test component test in this section. • **Is the windshield wiper switch OK?**		Yes ⇒ No ⇒	Service the wire between the multi-function switch and the windshield wiper motor. Replace multi-function switch.

PINPOINT TEST C: WINDSHIELD WIPERS INOPERATIVE AT LOW SPEED

TEST STEP		RESULT	ACTION TO TAKE
C1	CHECK WINDSHIELD WIPER MOTOR		
•	Perform the Windshield Wiper Motor component test in this section.	Yes ⇒	Go to C2.
•	**Is the windshield wiper motor OK?**	No ⇒	Replace the windshield wiper motor.
C2	CHECK WINDSHIELD WIPER SWITCH		
•	Perform the Windshield Wiper/Washer Switch Test component test in this section.	Yes ⇒	Service the wire between the multi-function switch and the windshield wiper motor.
•	**Is the windshield wiper switch OK?**	No ⇒	Replace the multi-function switch.

PINPOINT TEST D: WINDSHIELD WIPER WILL NOT PARK AT PROPER POSITION

TEST STEP		RESULT	ACTION TO TAKE
D1	CHECK WINDSHIELD WIPER MOTOR		
•	Perform the Windshield Wiper Motor component test in this section.	Yes ⇒	Go to D2.
•	**Is the windshield wiper motor OK?**	No ⇒	Replace the windshield wiper motor.
D2	CHECK WIRE BETWEEN WINDSHIELD WIPER SWITCH AND WINDSHIELD WIPER MOTOR		
•	Key OFF.	Yes ⇒	Replace the multi-function switch.
•	Located and disconnect the multi-function switch connector.	No ⇒	Service the wire(s).
•	Disconnect the windshield wiper motor connector.		
•	Measure the resistance of the wire between the multi-function switch connector and the windshield wiper motor connector.		
•	**Is the resistance less than 5 ohms?**		

PINPOINT TEST E: WINDSHIELD WIPERS CONTINUE TO RUN WHEN SWITCH IS TURNED OFF

TEST STEP		RESULT	ACTION TO TAKE
E1	CHECK WINDSHIELD WIPER SWITCH		
•	Perform the Windshield Wiper Test component test in this section.	Yes ⇒	Replace the windshield wiper motor.
•	**Is the windshield wiper switch OK?**	No ⇒	Replace the multi-function switch.

Component Tests - Wiper System

Wiper Switch Test

1. Key OFF.

2. Disconnect the multi-function switch connector.

3. NOTE: Resistance between any terminals not listed on this chart under the listed conditions should be greater than 10,000 ohms.

   Measure the resistance between the following wire terminals of the multi-function switch under the following conditions:

Switch Position	Wire Terminal	Resistance
OFF	1-5	less than 5 ohms
LO	1-5	less than 5 ohms
INT	1-5	less than 5 ohms
HIGH	15-4	less than 5 ohms

4. If the windshield wiper switch checks OK, return to the Pinpoint Tests. Otherwise, replace the multi-function switch.

Windshield Wiper Motor

1. Key OFF.
2. Disconnect the windshield wiper motor connector.
3. Apply 12 volts to terminal 2 of the windshield wiper motor (wiper should operate at low speed).
4. Apply 12 volts to terminal 1 of the windshield wiper motor (wiper should operate at high speed).
5. If the windshield wiper motor tests OK, return to the Pinpoint Tests. Otherwise, replace the windshield wiper motor.

REMOVAL AND INSTALLATION

Windshield Wiper

NOTE: The service manual covers two different versions of the windshield motor assembly used on the GO-4. Units from serial number T001 to T200 use a direct motor to wiper system. Units from serial number T201 and onward use a separate wiper motor and wiper connected by an arm assembly.

Wiper blade, mounting arm/parallel arm and electric motor replacement use the same procedure.

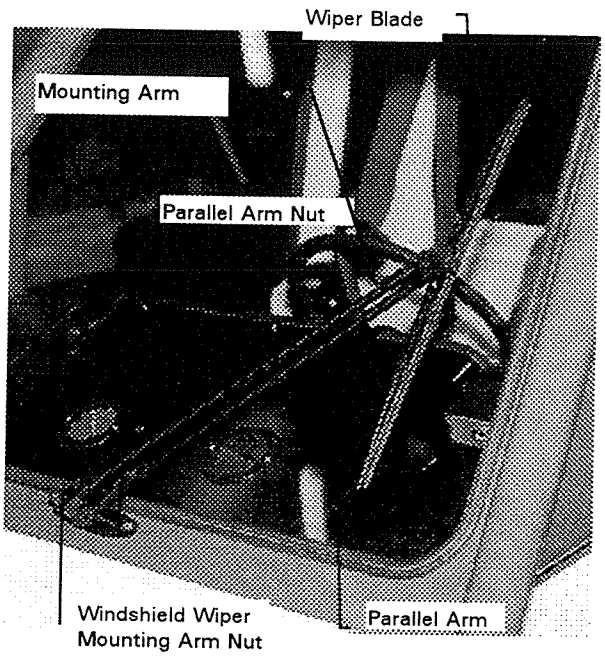
Mounting Arm/Parallel Arm

Removal

1. Remove the windshield wiper parallel arm nut and windshield wiper nut.
2. Carefully pry on the windshield wiper parallel arm to disengage it from the tapered splines on the windshield wiper parallel arm shaft and wiper motor.
3. Remove the wiper assembly including the windshield parallel arm and parallel wiper arm.

Installation

1. Turn the ignition switch to the ON position.
2. NOTE: The on/off cycling of the windshield motor will locate the windshield wiper mounting arm and parallel arm in the park position.



Turn the windshield wiper motor on. Allow it to cycle several times and turn it off.

3. Turn the ignition switch to the OFF position.
4. Install the windshield wiper motor arm and parallel arm onto the windshield wiper parallel shaft and windshield wiper motor.
5. Install the windshield wiper parallel arm nut and windshield wiper motor nut. Tighten the windshield wiper parallel arm nut to 8-10 lb.-ft (12-14 N-m) and windshield wiper motor nut to 12-14 lb.-ft (16-20 N-m).
6. Check and, if necessary, adjust the park position. Refer to the procedure in this section.

Wiper Blade

Removal

1. Lift the wiper arm assembly away from the front windshield until.
2. Pull tab on wiper blade.
3. Pull wiper blade from the windshield wiper blade holder.

NOTE: Should the wiper blade and refill require replacement, do the following:

a) Gently pry off the plastic caps on the wiper arm and parallel arm.
b) Remove the retaining clips from the wiper blade shaft and parallel arm shaft.
c) Remove the wiper blade assembly.

Installation

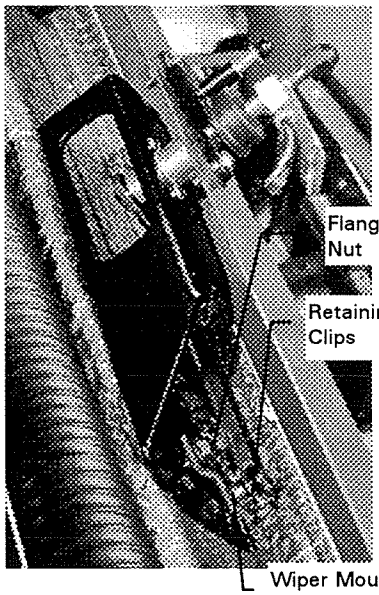
To install, reverse the removal procedure.

NOTE: Install the wiper blade assembly in the reverse of the removal procedure.

Wiper Motor

Removal

1. Disconnect the battery ground cable.
2. Disconnect the windshield wiper motor electrical connector.
3. Loosen and remove three wiper motor mounting nuts.
4. Pull the windshield wiper motor away from the bulkhead.



Installation

To install, reverse the removal procedure.

Tighten the windshield wiper motor bolts to 62-88 lb.-in. (7-10 N-m).

Wiper Motor

Removal (units from T201 and on)

1. Remove the hood panel from the vehicle.
2. Remove the windshield.

   NOTE: Windshield removal may be an optional procedure. Apply this procedure when removal of wiper motor may be very difficult.
3. Remove four screws and the instrument panel top from the instrument panel.
4. Remove rivets and top plate covering the wiper motor pivot arm assembly.

   NOTE: Some models may not have the top plate.
5. Remove the wiper arm and parallel arm assembly from the wiper arm and parallel arm base.
6. Pry and remove retaining clip connecting the pivot arm of the wiper to the wiper arm and parallel arm base.
7. Separate the pivot arms from the wiper motor and the wiper arm and parallel arm base.
8. Remove the wiper motor. Refer to wiper motor removal in this section.

Removal (units from T001 to T200)

1. Remove the hood panel from the vehicle.
2. Remove the windshield.
3. Remove four screws and the instrument panel top from the instrument panel.
4. Remove rivets and top plate covering the wiper motor pivot arm assembly.

   NOTE: The top plate may not installed on all GO-4 vehicles. Proceed to next step.
5. Disconnect the electrical connector to the wiper motor.

Multi-function Switch

Refer to this section for removal and installation of the multi-function switch.

ADJUSTMENTS

Park Position

1. Remove the windshield wiper assembly. Refer to the procedure in this section.
2. Turn the windshield wiper motor on. Allow the windshield wiper mounting arm and parallel arm to move three or four cycles. Turn the windshield wiper motor off.
3. Position the wiper blade assembly on windshield.
4. Measure distance of 4-5 inches (10-13 cm) from the middle of the wiper blade to the left-hand edge of the front window weatherstrip.
5. NOTE: Ensure the windshield wiper mounting arm and parallel arm is aligned with the windshield wiper mounting arm shaft and parallel arm shaft so that the windshield wiper mounting arm and parallel arm shaft splines are fully seated.

   Tighten the windshield wiper parallel arm nut to 8-10 lb-ft (12-14 N-m) and windshield wiper mounting nut to 12-14 lb-ft (16-20 N-m).

SPECIFICATIONS

Description	Lb-ft	Lb-in	N-m
Windshield Wiper Mounting Arm Nut	12-14	-	16-20
Windshield Wiper Parallel Arm Nut	8-10	-	12-14
Windshield Wiper Mount Bolts (3)	-	62-88	7-10

SERVICE TOOLS / EQUIPMENT

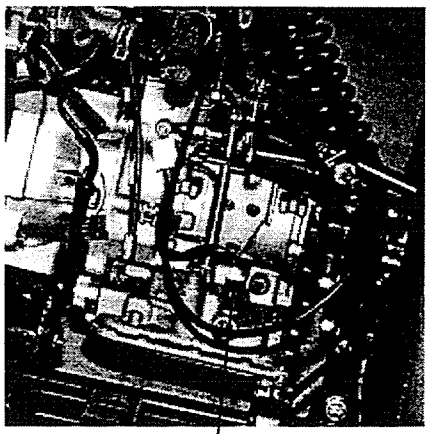
- Digital Multimeter

SECTION 19-4 - Instrument Panel, Controls and Warning Systems - Park/Neutral Position (PNP) Switch

DESCRIPTION AND OPERATION

Park/Neutral Position (PNP) Switch

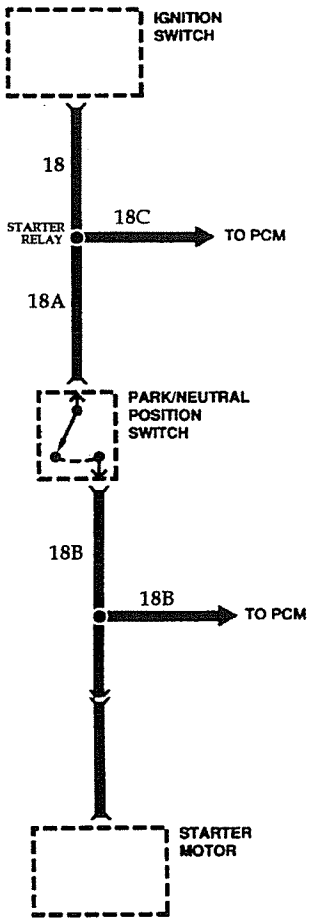
The Park/Neutral Position Switch (PNP switch) is used on the Automatic Transaxle (AT) as a part of the starter interrupt system. As a part of the starter interrupt system, the PNP switch is a safety device, preventing the engine from starting while the AT is in a forward or reverse gear. The PNP switch closes when the gearshift lever is in the PARK (P) or NEUTRAL (N) positions only, allowing the starter motor to operate with the ignition switch in the START position. The PNP switch is not adjustable. The PNP switch is located on the transaxle case.



Park/Neutral Position (PNP)

DIAGNOSIS AND TESTING

Electrical Schematic - Starting Interrupt System



Inspection and Verification - Starting Interrupt System

1. Verify the customer concern by operating the starting system.
2. Visually inspect the following components of the starting interrupt system:

VISUAL INSPECTION CHART

Mechanical Lever	Electrical
• Gearshift lever binding or damaged • Gear shift lever linkage binding or damaged	• Damaged ignition switch • Damaged wiring harness • Loose or corroded connections • Damaged park/neutral position switch • Damaged starter motor

3. If fault is not visually evident, determine the symptom and proceed to the following Troubleshooting Chart.

Troubleshooting Chart - Starting Interrupt System

NOTE: Use a Digital Multimeter to perform electrical Pinpoint Tests.

STARTING INTERRUPT SYSTEM

CONDITION	POSSIBLE SOURCE	ACTION
• Engine Will Not Crank	• Battery. • Circuit. • Ignition switch. • Park/neutral position switch (PNP switch). • Starter motor.	• GO to Pinpoint Test A1.
• Engine Cranks With Gearshift Lever in Ranges Other Than PARK or NEUTRAL	• Circuit. • PNP switch. • Starter motor.	• REPLACE the PNP switch.

Pinpoint Test - Starting Interrupt System

PINPOINT TEST A: ENGINE WILL NOT CRANK

TEST STEP		RESULT	ACTION TO TAKE
A1	CHECK BATTERY		
•	Check the battery. Refer to Section 17.	Yes →	GO to **A2.**
•	**Is the battery OK?**	No →	CHARGE or REPLACE the battery.
A2	CHECK START SIGNAL TO PARK/NEUTRAL POSITION SWITCH		
•	Key OFF.	Yes →	GO to **A3.**
•	Disconnect the Park/Neutral Position (PNP) switch connector.	No →	REFER to this section to diagnose the ignition switch.
•	Key in START position.		
•	Measure the voltage on the "W" wire at the PNP switch connector.		
•	**Is the voltage greater than 10 volts?**		
A3	CHECK PARK/NEUTRAL POSITION SWITCH		
•	Key OFF.	Yes →	GO to **A4.**
•	Disconnect the PNP switch connector.	No →	REPLACE the park/neutral position switch.
•	Measure the resistance between the wire terminal of the PNP switch under the following conditions		

Gear Shift Lever	Resistance
P	Less than 5 ohms
N	Less than 6 ohms
All Others	Greater than 10,000 ohms

•	**Are the resistances correct ?**		

PINPOINT TEST A: ENGINE WILL NOT CRANK (Continued)

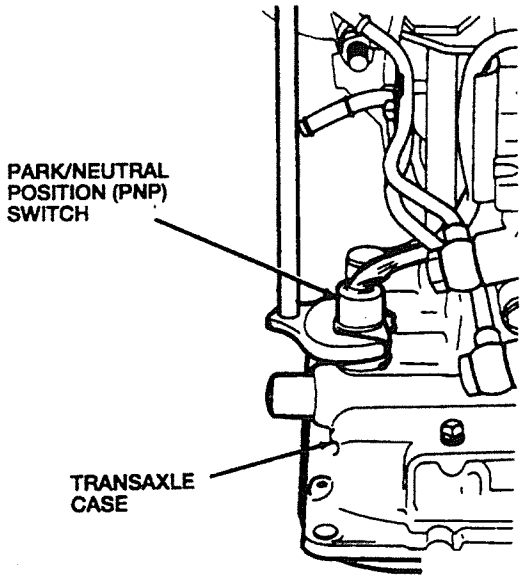
TEST STEP		RESULT	ACTION TO TAKE
A4	CHECK START SIGNAL TO STARTER MOTOR		
•	Key OFF.	Yes →	REFER to Section 16 to diagnose the starter motor.
•	Reconnect the PNP switch		
•	Disconnect the starter motor connectors		
•	Key in START position.	No →	SERVICE the wire between the starter motor and the PNP switch.
•	Measure the voltage on the wire at the starter motor connector		
•	**Is the voltage greater than 10 volts?**		

REMOVAL AND INSTALLATION

Park/Neutral Position (PNP) Switch

Removal

1. Disconnect the battery ground cable.
2. Disconnect the Park/Neutral Position (PNP) switch electrical connector.



3. Use an extension and a crow's foot wrench to remove the PNP switch from the front LH side of the transaxle case.

Installation

1. Apply Gasket Eliminator or equivalent to the threads of the PNP switch.
2. Install the PNP switch onto the transaxle case. Tighten the PNP switch to 14-19 lb-ft (19-26 N-m).
3. Connect the PNP switch electrical connector.
4. Connect the battery ground cable.

SPECIFICATIONS

TORQUE SPECIFICATIONS

Description	Lb-Ft	N-m
Park/Neutral Position (PNP) Switch - Automatic Transaxle)	14-19	19-26

SERVICE TOOLS/EQUIPMENT

- Digital Multimeter

SECTION 19-5 - Instrument Panel, Controls and Warning Lights - Horn

DESCRIPTION AND OPERATION

Horn System

The horn system consists of:

- horn
- horn switch
- horn relay and bracket

Horn power is fed from the 15A fuse to the switched side of the horn relay. The steering wheel mounted horn switch is connected to the control side of the horn relay which turns the horn relay on when the horn switch is depressed.

Horn Switch, Steering Wheel Mounted

The horn switch is located on the center hub of the steering wheel.

Horn Mounting Location

The horn is located on the RH side of the firewall. Only one lead is connected to the horn; the ground circuit is provided through its mounting bracket.

DIAGNOSIS AND TESTING

Inspection and Verification - Horn System

1. Verify customer concern by operating the horn.
2. Visually inspect the components of the horn system.
3. If a fault is not visually evident, determine the symptom and proceed to the following Troubleshooting Chart.

Visual Inspection Chart

Mechanical	Electrical
• Damaged horn • Damaged horn switch • Damaged horn relay	• Blown fuse. • Damage to wiring harness. • Loose/corroded connectors.

Troubleshooting Chart - Horn System

NOTE: Use a digital multimeter or equivalent to perform electrical Pinpoint Tests.

HORN SYSTEM

CONDITION	POSSIBLE SOURCE	ACTION
• Horn System Always On	• Horn Switch. • Horn Relay. • Circuit.	• Go to Pinpoint Test A1.
• Horn System Inoperative	• Fuse. • Circuit. • Horn Switch. • Horn Relay. • Horn.	• Go to Pinpoint Test B1.

Pinpoint Test - Horn System

PINPOINT TEST A: HORN SYSTEM ALWAYS ON

TEST STEP		RESULT	ACTION TO TAKE
A1	CHECK HORN SWITCH		
•	Key OFF.	Yes ⇒	Go to A2.
•	Locate and disconnect the horn switch connector.	No ⇒	Replace the horn switches.
•	**Does the horn continue to sound with the horn switch connector disconnected?**		
A2	CHECK HORN RELAY		
•	Key OFF.	Yes ⇒	Service the wires between the contact and the horn relay.
•	Locate and disconnect the horn relay.		
•	Measure the resistance between the wire terminals of the horn relay.		Replace the horn relay.
•	**Is the resistance greater than 10,000 ohms?**	No ⇒	

PINPOINT TEST B: HORN SYSTEM INOPERATIVE

TEST STEP		RESULT	ACTION TO TAKE
B1	CHECK STOPLAMPS		
•	Check stoplamp operation by depressing the brake pedal.	Yes ⇒	Go to B2.
•	**Do the stoplamps operate properly?**	No ⇒	Refer to Section 18 to diagnose stoplamps.
B2	CHECK POWER SUPPLY TO HORN		
•	Key Off.	Yes ⇒	Go to B8.
•	Locate and disconnect the horn connector.	No ⇒	Go to B3.
•	Depress the horn switch.		
•	Measure the voltage on the wire at the horn connector.		
•	**Is the voltage greater than 10 volts with the horn switch depressed?**		
B3	CHECK HORN SWITCH		
•	Key OFF.	Yes ⇒	Replace the horn switch.
•	Reconnect the horn.		Go to B4.
•	Disconnect the horn switch.	No ⇒	
•	Ground the wire at the horn switch connector.		
•	**Does the horn sound when the wire is grounded?**		
B4	CHECK POWER SUPPLY TO HORN RELAY		
•	Key OFF.	Yes ⇒	Go to B5.
•	Disconnect the horn relay connector.	No ⇒	Service the wire(s) in question.
•	Measure the voltage on the wire at the horn relay connector.		
•	**Are the voltages greater than 10 volts?**		
B5	CHECK HORN SWITCH CIRCUIT		
•	Key OFF.	Yes ⇒	Go to B6.
•	Reconnect the horn switches.	No ⇒	Service the wire(s) in question.
•	Disconnect the horn relay connector.		
•	Depress the horn switch.		
•	Measure the resistance of the wire between the horn relay connector and ground.		
•	**Is the resistance less than 5 ohms with the horn switch depressed, and greater than 10,000 ohms with the horn switch released?**		

PINPOINT TEST B: HORN SYSTEM INOPERATIVE (continued)

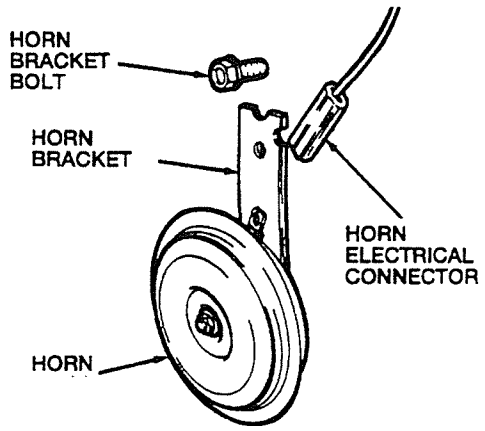
TEST STEP		RESULT	ACTION TO TAKE
B6	CHECK HORN CIRCUIT		
•	Key OFF.	Yes ⇒	Replace the horn relay and bracket.
•	Disconnect the horn relay connector.	No ⇒	Service the wire(s) between the horn relay and the horn.
•	Apply 12 volts to the wire at the horn relay connector.		
•	**Does the horn sound?**		
B7	CHECK HORN GROUND		
•	Measure the resistance between the horn casing and the ground.	Yes ⇒	Replace the horn.
•	**Is the resistance less than 5 ohms?**	No ⇒	Service the horn ground connector.

REMOVAL AND INSTALLATION

Horn Assembly

Removal

1. Disconnect the battery ground cable.
2. NOTE: The horn is located on the RH side of the firewall.
   Disconnect the horn electrical connector.



3. Remove the bracket bolt.
4. Remove the horn.

Installation

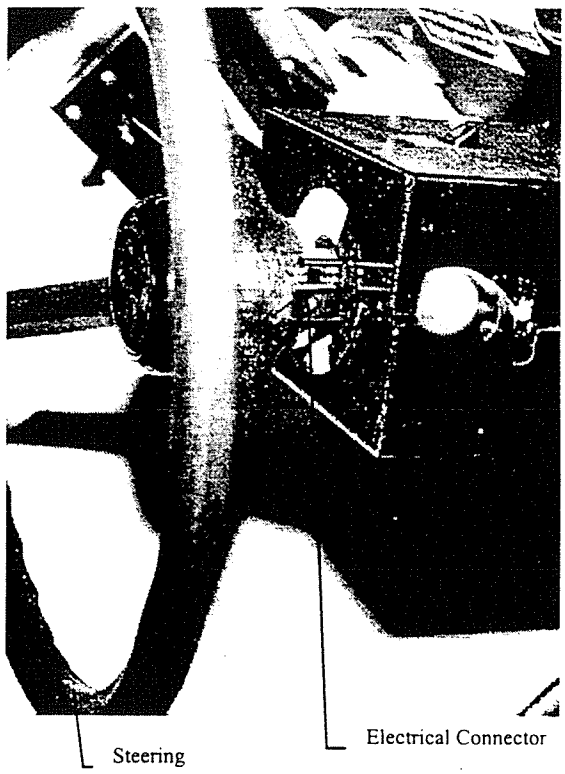
To install, reverse the removal procedure.

Horn Switch

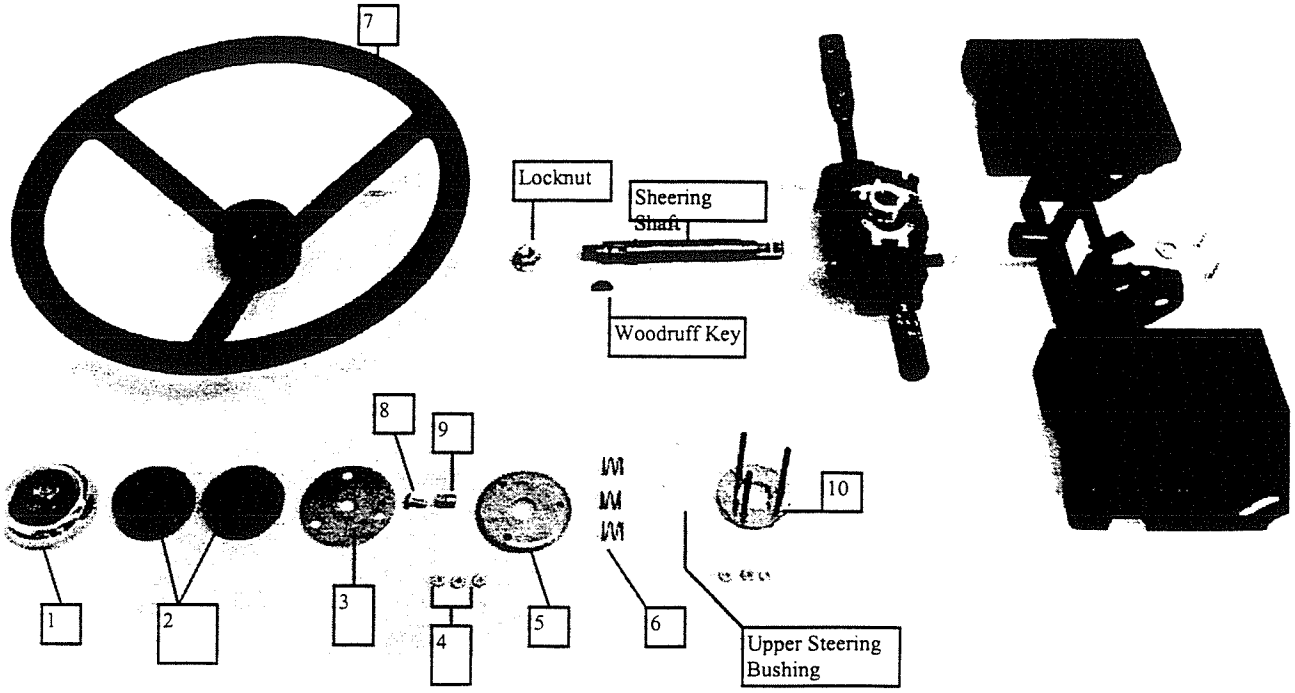
Removal

1. Disconnect the battery ground cable.
2. Disconnect the horn switch electrical connector.
3. Remove the horn button.
4. Remove the horn cup pucks (2).
5. Remove three nuts securing the horn cup plate, three compression springs and upper steering plate to the washer plate assembly.

   NOTE: Apply pressure to the top of the horn cup plate when removing the three nuts. Release the horn cup plate slowly so compression spring pressure is eased.



Horn Assembly - Exploded View



Item	Part Number	Description
1	329004	Horn Button Assembly
2	324000	Horn Cup Pucks (2)
3	322526	Horn Cup Plate
4	-	Nuts (3)
5	323497	Upper Steering Plate
6	323513	Compression Springs (3)
7	322702	Steering Wheel
8	771698	Machine Screw
9	771417	Insert for the Machine Screw
10	323532	Washer Plate Assembly

Installation

To install, reverse the removal procedure.

SERVICE TOOLS/EQUIPMENT

- Digital Multimeter

SECTION 20 - Wiring Harness, Connectors and Circuit Protections Systems

DESCRIPTION AND OPERATION

Fuse Panel

This vehicle is equipped with one fuse panel. This is located inside the passenger compartment. Access is provided by a panel on the right hand side of the instrument panel. The fuse panel contains 12 fuses. These fuses protect the circuits shown on the chart below.

*Top Row (left to right)	*Middle Row (left to right)	*Bottom Row (left to right)
Engine - 10A	Auxiliary	Computer Memory-10A
Radio	A/C (option)	Engine Fan
Hazard / Beacon Lights	Heater	Option
Stop Lights, Horn, Dome	Turn Signal, Running Lights, Dash Lights	Front Wiper

* All fuses are 15 amp unless otherwise indicated in the above chart.

Indicator Flasher Location

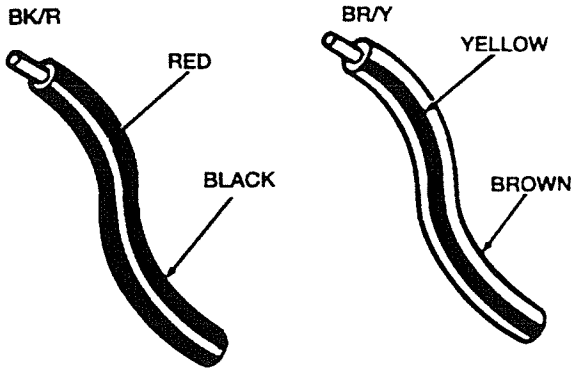
The indicator flasher is located in the instrument panel.

Engine and Instrument Panel Wiring

The engine and instrument panel wiring connects electrical components to their respective relays, fuses, switches, and circuit breakers. The routing of the engine and instrument panel wiring is shown in the wiring harness removal and installation procedure in this section.

Wiring Color Code

Wires numberd for currents. Letters are used for tracers e.g. 47A, 47B. 47B is a branch off of 47A.



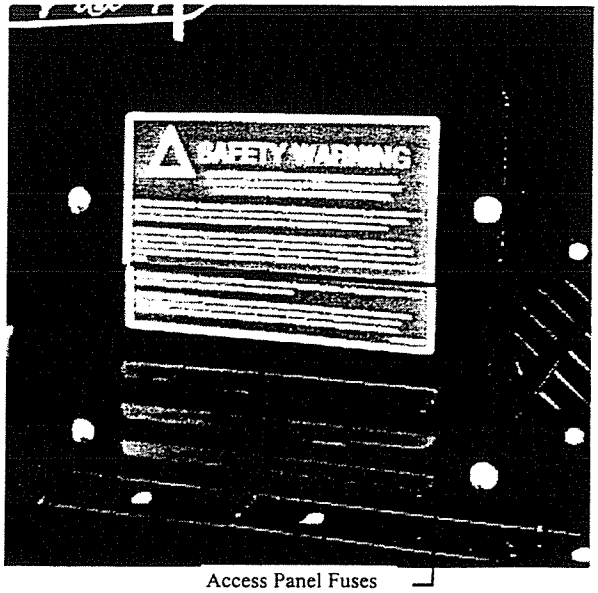
REMOVAL AND INSTALLATION

Fuse Panel

Removal

WARNING: REPLACE THE FUSE WITH ONE OF THE SAME AMPS RATING.

1. Disconnect the battery ground cable.
2. Remove two access panel screws.
3. Open the access panel on the right hand side of the instrument panel.
4. Remove the fuse. The fuses simply unplug from the fuse panel. If necessary, use the fuse puller to remove the fuses from the fuse panel.
5. Inspect the fuse. Replace it if necessary.



Access Panel Fuses

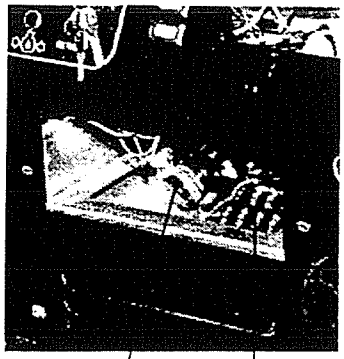
Indicator Flasher

Removal

The indicator is located in the passenger compartment in the instrument panel.

It is accessed by opening the access panel to the fuse panel.

1. Disconnect the battery ground cable.
2. Disconnect the indicator flasher electrical connector.
3. Remove the indicator flasher.



Indicator Flasher

Fuse

Installation

To install, reverse the removal procedure.

Wiring Harnesses

The vehicle consists of the following wiring harnesses

- Main harness
- Rear harness

Removal

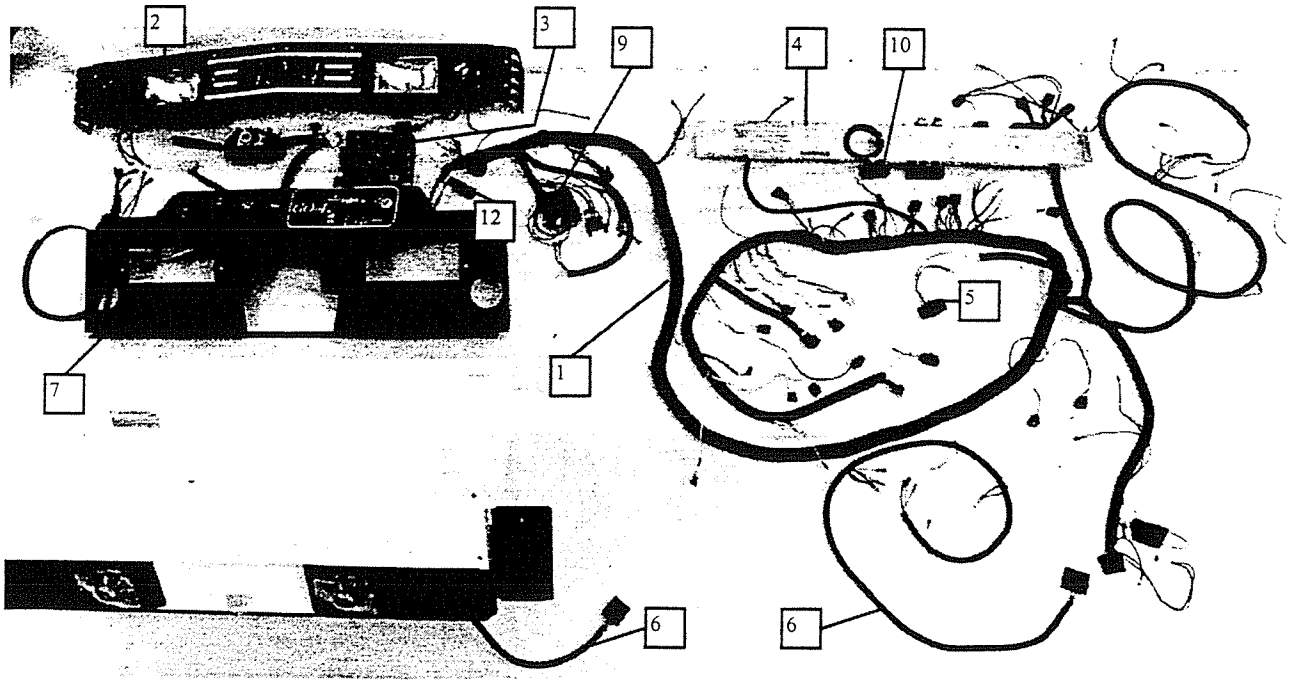
1. Disconnect the battery ground cable.
2. Remove any body panels or trim panels to access the harness.
3. NOTE: Tag all wires before removing to ensure proper installation.

   Disconnect all wiring harness electrical connector
4. Disengage the wiring harness from all locators, straps and/or clips as necessary, including ground wire eyelets.
5. Remove the wiring harness from the vehicle.

Installation

To install, reverse the removal procedure.

Wiring Harness



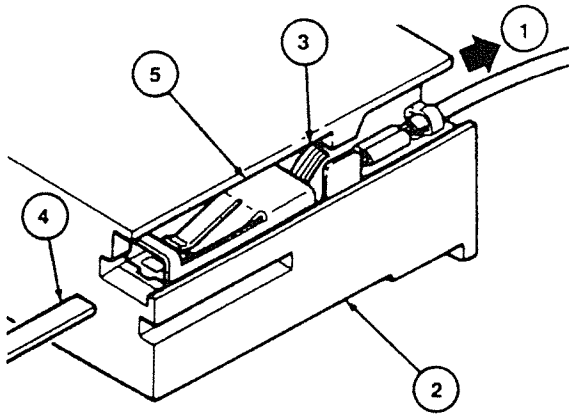
Item	Part Number	Description
1	673667	Main Harness
2	509000	Front Bumper Assembly
3	663110	E.G.I. Unit
4	679000	Electrical Panel Assembly
5	663257	Potted Speed Switch
6	672878	Rear Harness
7	559000	Dash Assembly
8	624000	Bottom Trunk Assembly
9	-	Fuse Panel
10	-	Circuit Breakers
11	-	Diagnostic Connector (engine compartment)
12	-	Diagnostic Connector (instrument panel)

SERVICE PROCEDURES

Wire Terminals

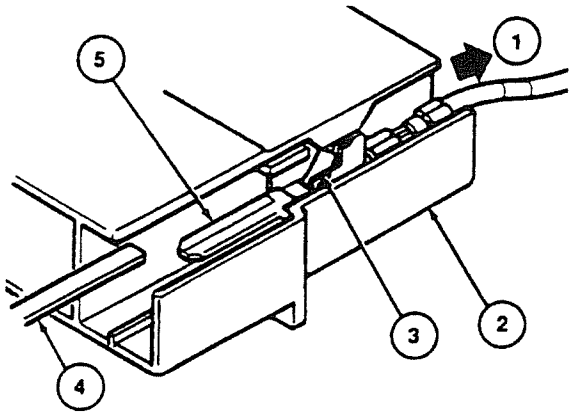
Insert a push-tool or thin metal tool such as a small screwdriver from the terminal side of the connector, and then with the locking tabs pressed down, pull the terminal out from the wire side of the connector.

Female Type



Item	Part Number	Description
1	-	Pull to Remove.
2	-	Terminal Housing
3	-	Lock Tab
4	-	Thin Metal Tool
5	-	Terminal

Male Type



Item	Part Number	Description
1	-	Pull to Remove
2	-	Terminal Housing
3	-	Lock Tab
4	-	Thin Metal Tool
5	-	Terminal

NOTE: When installing connectors, check to make sure lock tabs can relock into position.

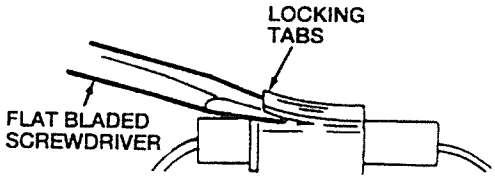
Connectors

The following illustrations show typical electrical connectors and their disengagements.

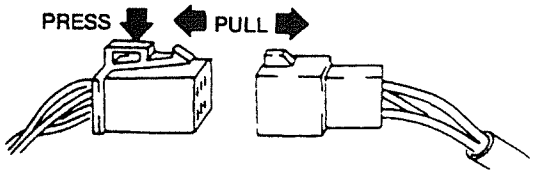
Connectors, In-line

Disconnecting electrical connectors with two locking tabs:

Insert a flat bladed screwdriver in the locking tab and twist. Grasp the connector housing and pull until the locking tab is on the ramp. Turn the connector over and repeat the procedure on the opposite side of the connector. Grasp the connector housing and pull apart.

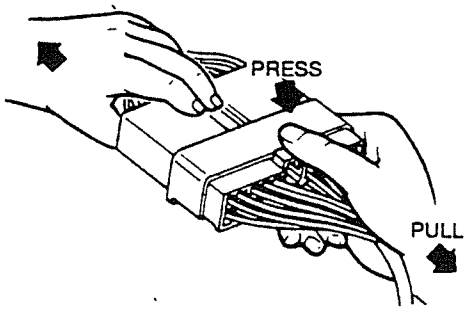


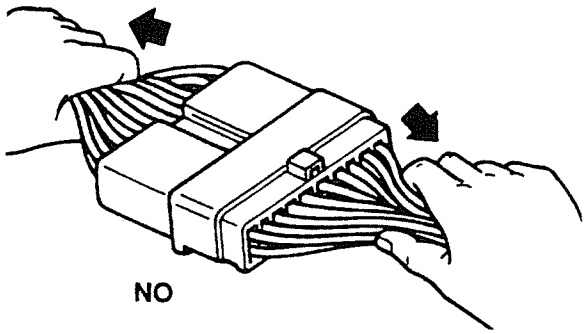
Disconnecting electrical connectors with one locking tab:



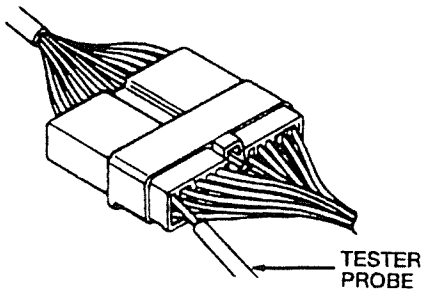
Connector precautions:

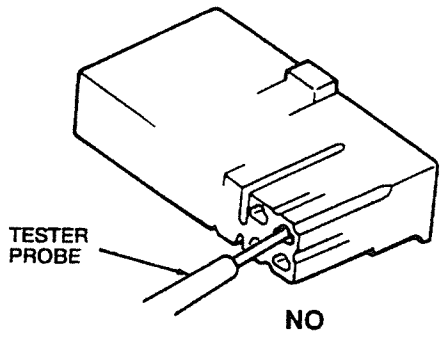
The connector can be disconnected by pressing the lock lever. Do not pull on the wire when disconnecting the connector: Be careful to hold the connector itself when disconnecting it.





When a tester is used to check for continuity or to check the voltage, insert the tester probe from the wire harness side. Do not probe the connector face.





Module Service Precautions

CAUTION: Electronic modules are sensitive to static electrical charges. If exposed to these charges, damage may result.

If service of any module is required, use the following safeguards to avoid damage to components.

NOTE: The following chart shows typical values for static charge generation.

TYPICAL STATIC CHARGE GENERATION VALUES

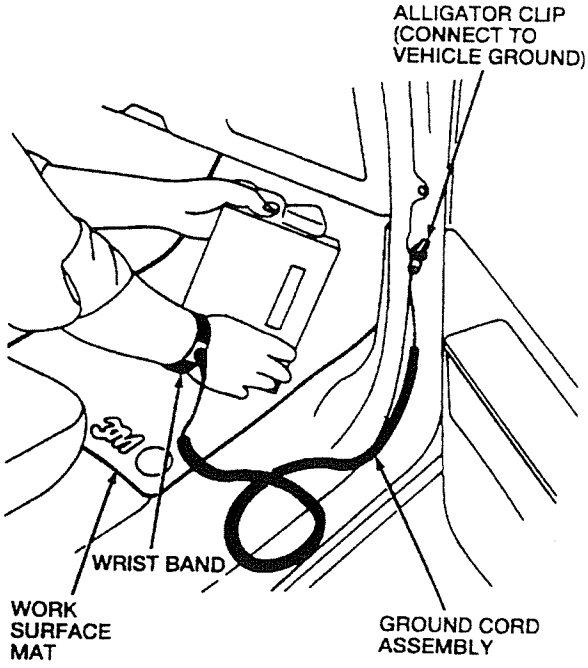
Activity	Relative Humidity	
	Low (10-20%) Volts	High (65-90%) Volts
Walking Across a Carpet	35,000	1,500
Walking Over a Vinyl Floor	12,000	250
Working at a Bench	6,000	100
Sliding Across a Vehicle Seat	25,000	1,000

1. Leave the module in the original packaging until ready to install in a vehicle.

2. Avoid touching the module connector pins.

3. Avoid laying the module on a nonconductive surface.

4. As an added safeguard, use s 3M® Static Protection Kit (3M® part number 18293). This kit contains special wrist straps, a 15 x 24 inch (381 mm x 609.6 mm) flexible conductive mat, grounding cords and full instructions. It is available through local 3M suppliers.



SPECIFICATIONS

Circuit Protection

Circuit protection is provided the fuse panel. The fuse panel contains the various required fuses.

SECTION 21 - Auxiliary Equipment

Attention: Due to various equipment (e.g. lighting, electrical, radios, warning and other equipment) that has been installed on the GO-4 utility vehicle; use this section to insert the supplier instruction, maintenance, service, installation manuals and sheets that are provided with the equipment.

Record the name, manufacturer, serial number, and other information of the auxiliary equipment in the space provided. This will ease reference should the need for servicing and maintenance. Use the chart below:

Description of Equipment	

Record the name, manufacturer, serial number, and other information of the auxiliary equipment. This will ease reference should the need for servicing and maintenance be required. Use the chart below:

Description of Equipment	

SECTION 22 - Heating and Air Conditioning, Service

BASIC PRINCIPLES

Vehicle air conditioning is the cooling or refrigeration of the air in the passenger compartment. Refrigeration is accomplished by making practical use of three laws of nature. These laws are as follows:

Heat Transfer

If two substances of different temperature are placed near each other, the heat in the warmer substance will always travel to the colder substance until both are of equal temperature.

In order to determine the amount of heat that transfers from one substance to another,

science has established a definitive standard of measurement called the British Thermal Unit, or BTU. One BTU is the amount of heat required to raise the temperature of one pound of water 1°F (0.55°C).

For example, to raise the temperature of one pound of water from 32° F (0°C) to 212°F (100°C), one BTU of heat must be added for each 1 F (0.55°C) rise in temperature, or a total of 180 BTUs of heat. Conversely, in order to lower the temperature of one pound of water from 212°F (100°C) to 32°F (0°C), 180 BTUs of heat must be removed from the water.

Latent Heat of Vaporization

When a liquid boils (changes to a gas), it absorbs heat without raising the temperature of the resulting gas. When the gas condenses (changes back to a liquid), it gives off heat without lowering the temperature of the resulting liquid.

Water has a latent heat of vaporization of 970 BTUs and a boiling point of 212°F (100°C). This means that one pound of water at 212°F (100°C) will absorb 970 BTUs of heat in condensing back to water. This tremendous heat transfer that occurs when a liquid boils or a vapor condenses is an important factor for all conventional refrigeration systems.

For a liquid to be a good refrigerant, it must also have a low boiling point. That is, the temperature at which it boils must be lower than the substance to be cooled.

In order to make practical use of that heat transfer that takes place when a liquid boils, we must choose a liquid with low boiling point. Refrigerant 134a is used in auto-motive air conditioning systems because it boils at -21.7°F (-29.8°C) in an open container. Here is a liquid that boils or vaporizes well below passenger compartment temperatures and, in vaporizing, will absorb tremendous amounts of heat without getting any warmer.

Effect of Pressure on Boiling or Condensation

The saturation temperature is the temperature when boiling or condensation of a liquid or vapor occurs. The saturation temperature of a liquid or vapor increases or decreases according to the pressure exerted on it.

In an expansion valve refrigerant system, liquid refrigerant R-134a is stored in the A/C condenser core under high pressure. When the liquid R-134a is released into the A/C evaporator core by the A/C evaporator expansion valve, the resulting decrease in pressure and partial boiling lowers the temperature of the R-134a to its new boiling point. As the R-134a flows through the A/C evaporator core, air passes over the outside surface of the evaporator coils. As it boils, the R-134a absorbs heat from the air and thus cools the passenger compartment. The heat from the passenger compartment is absorbed by the boiling refrigerant and held as latent heat in the vapor. The refrigeration cycle is now underway. The following steps complete the cycle.

1. Dispose of the heat in the vapor.

2. Convert the vapor back to liquid for reuse.

3. Return the liquid to the starting point in the refrigeration cycle.

The A/C compressor and the A/C condenser core perform these functions. The A/C compressor pumps the refrigerant vapor (containing the latent heat) out of the A/C evaporator core, then forces its under high pressure into the A/C condenser core, which is located in the outside airstream at front of the radiator. The increased pressure in the A/C condenser core raises the R-134a condensation or saturation temperature to a point higher than that of the outside air. As the heat transfers from the hot vapor to the cooler air, the R-134a condenses back to a liquid.

The high pressure liquid then passes through the suction receiver/drier to the A/C evaporator expansion valve. The A/C evaporator expansion valve meters the refrigerant into the A/C evaporator core, and the refrigeration cycle begins again.

It may be difficult to understand how heat can be transferred from a comparatively cooler passenger compartment to the hot outside air. The answer lies in the difference between the refrigerant pressure that exists in the A/C evaporator core and the pressure that exists in the A/C condenser core. In the A/C evaporator core, the A/C compressor suction reduces the pressure and the boiling point below the temperature of the passenger compartment. Heat therefore transfers from the passenger

A/C condenser core, the A/C compressor raises the condensation point above the temperature of the outside air. Thus, the heat transfers from the condensing refrigerant to the outside air. Thus, the heat transfers from the condensing refrigerant to the outside air. The A/C compressor simply create pressure conditions that permit the laws of nature to function.

R-134a Refrigerant

Prompted by environmental concerns, GO-4 vehicles are equipped with non-chloroflourocarbon (non-CFC) air conditioning systems. The R-134a refrigerant, a hydro-flourocarbon that has no chlorine molecule, which destroys the atmosphere's ozone layer. R-134a systems function in the same manner as R-12 systems except for minimal operating pressure differences and component variations. This systems uses different components, refrigerant, and refrigerant oil than the traditional R-12 A/C systems used in previous years.

It is important to understand that R-134a and R-12 air conditioning systems are not entirely the same. They have components that are slightly different from one another and in some cases service requirements are also different. However, the most important thing to understand is that R-134a refrigerant, refrigerant oil, and components can only be used in R-134a systems while R-12 refrigerant, refrigerant oil, and components can only be used only on R-12 systems. While these two types of A/C systems operate and function in a nearly identical manner, the refrigerant, refrigerant oil, and components used in these systems are not compatible.

Also, R-134a systems require the use of dedicated service tools and equipment. R-134a special service tools and equipment that come in contact with R-134a refrigerant or refrigerant oil can only be used on R-134a A/C systems. R-12 special service tools and equipment cannot be used on R-134a A/C systems and vice versa.

DESCRIPTION AND OPERATION

Safety Precautions

WARNING: AVOID BREATHING A/C REFRIGERANT AND LUBRICANT VAPOR OR MIST. IF ACCIDENTAL SYSTEM DISCHARGE OCCURS, VENTILATE THE WORK AREA BEFORE RESUMING SERVICE.

WARNING: WEAR IMPERVIOUS GLOVES AND SAFETY GOGGLES AT ALL TIMES WHEN HANDLING LIQUID REFRIGERANT. SHOULD ANY LIQUID REFRIGERANT GET INTO THE EYES OR ON THE SKIN, IMMEDIATELY FLUSH EYES AND SKIN WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES. REMOVE CONTAMINATED CLOTHING AND SHOES. CALL A PHYSICIAN.

WARNING: REFRIGERANT HFC-134a IS ALWAYS UNDER PRESSURE. BECAUSE THE SYSTEM IS TIGHTLY SEALED, HEAT APPLIED TO ANY PART COULD CAUSE THIS PRESSURE TO BUILD UP EXCESSIVELY. TO AVOID A DANGEROUS EXPLOSION, KEEP AWAY FROM OPEN FLAMES, GLOWING METAL SURFACES, BLOW TORCH, STEAM CLEANING AND WELDING. HFC-134a CAN BE DECOMPOSED AT HIGH TEMPERATURES.

WARNING: ALWAYS WEAR SAFETY GOGGLES WHEN SERVICING ANY PART OF THE REFRIGERANT SYSTEM.
WARNING: EXTREME CARE MUST BE TAKE TO PREVENT ANY LIQUID REFRIGERANT FROM COMING IN CONTACT WITH THE SKIN, AND ESPECIALLY THE EYES.

CAUTION: Using R-12 components, refrigerant or refrigerant oil on an R-134a system will cause damage to the A/C system. Do not replace components, refrigerant, or refrigerant oil from an R-134a system with components, refrigerant, or refrigerant oil for an R-12 system or vice versa. R-12 and R-134a components are not interchangeable. Mixing components from these two types of systems will cause component failure and damage to the A/C system.

CAUTION: The refrigerant used in this refrigerant system is HFC-134a (Tetraflouroethane) which is a hydroflourocarbon refrigerant. HFC-134a, is also known as R-134a is non-corrosive, non-explosive, non-flammable and slight ethereal type odor. HFC-134a is heavier than air. Although it is classified as a safe refrigerant, certain precautions must be observed to protect the parts involved and the person working on the unit.

CAUTION: Use only R-134a refrigerant. Due to environment concerns, when the air conditioning system is drained, the refrigerant must be collect using refrigerant recovery/recycling equipment meeting SAE standards J1990 and J2210. HFC-

134a must never removed without the appropriate equipment or release into the atmosphere. Use of a recovery machine dedicated for R-134a is necessary to reduce the possibility of oil and refrigerant incompatibility concerns. Refer to the instructions provided by the equipment manufacturer when removing refrigerant from or installing refrigerant into the air conditioning system.

CAUTION: Liquid R-134a, at normal atmospheric pressures and temperatures, evaporates so quickly that it has a tendency to freeze anything it contacts. Extreme care must be taken to prevent any liquid refrigerant from coming in contact with the skin and especially the eyes.

CAUTION: Ensure that refrigerant containers are never heated to over 125°F (52°C). Refrigerant containers should be stored and installed in accordance with all state and local ordinances.

CAUTION: When admitting R-134a into the refrigerant system, always keep the tank in an upright position. If the tank is on its side or upside down, liquid R-134a will enter the system and may damage the A/C compressor.

CAUTION: Refrigerant R-134a should not be mixed with air for leak testing or used with air for any other purpose above atmospheric pressure. R-134a is combustible when mixed with high concentrations of air and high pressures.

Service Precautions

1. Never open or loosen a connection before discharging the system with a recycling machine such as a R-134a A/C Service Center or equivalent.

2. When loosening a connection, allow any residual pressure to leak off before opening the fitting.

3. A system which has been opened for replacement of a component, or which has discharged through leakage, must be evacuated before charging.

4. Immediately after disconnecting a component from the system, seal open fittings with a cap or plug.

5. Before disconnecting a component from the system, clean the outside of the fittings thoroughly.

6. Do not remove sealing caps from a replacement component until it is ready to be installed.

7. Refrigerant oil will absorb moisture from the atmosphere if left uncapped. Do not open an oil container until ready to use, and install the cap immediately after using. Store oil only in a clean, moisture-free container.

8. Before connecting an open fitting, always install a new O-ring seal. Coat the fitting and O-ring seal with refrigerant oil before making the connection.

9. When installing a refrigerant line, avoid sharp bends. Position the line away from the exhaust or any sharp edges which may chafe the line.

10. Do not open a refrigerant system or uncap a replacement component unless it is close to room temperature. This will prevent condensation from forming inside a component which is cooler than the surrounding air. Whenever a major component such as an A/C evaporator core, A/C condenser core, A/C compressor, or refrigerant line is replaced, it is mandatory that the receiver/drier also be replaced.

11. Keep service tools and work area clean. Contamination of a refrigerant system through careless work habits must be avoided.

12. Whenever components in the engine compartment of instrument panel areas are being serviced, the battery ground cable must be disconnected to eliminate the possibility of electrical shorts, burnt wiring, and dangerous fires. Extreme care must be exercised when performing electrical tests where the battery must be connected to operate the system.

A/C Refrigerant System Operation

The air conditioning system consists of:

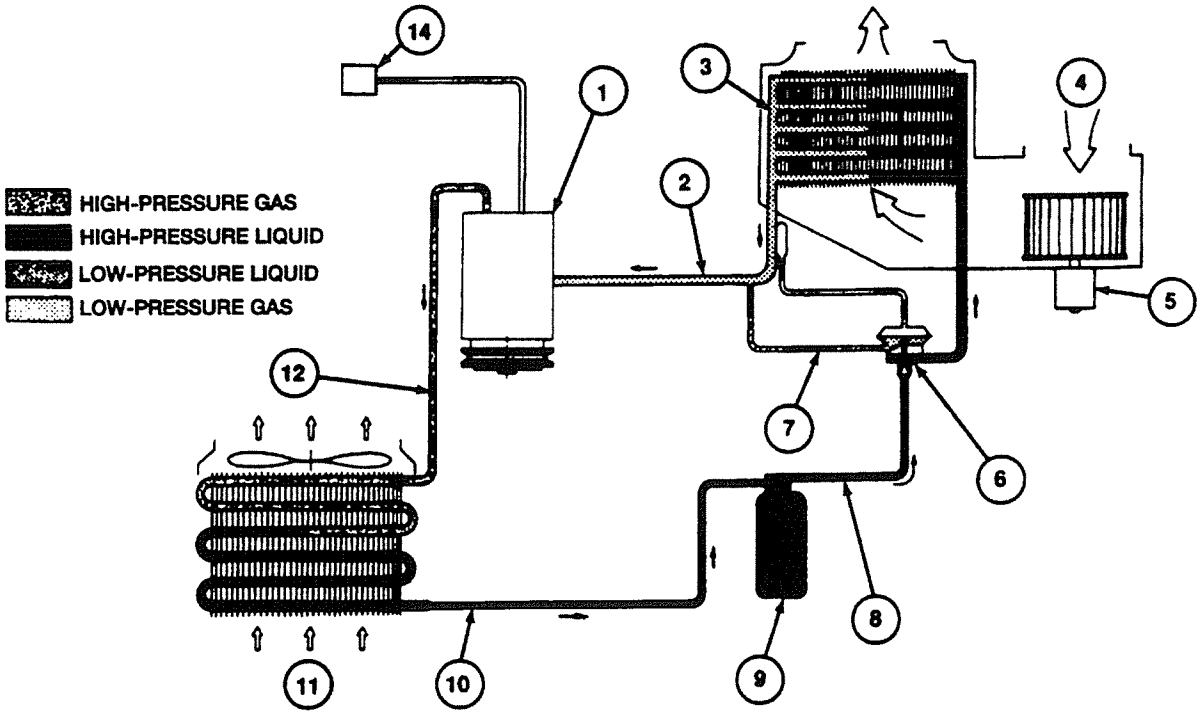
- A/C compressor
- A/C condenser core
- Suction receiver/drier
- A/C evaporator core
- A/C condenser cooling fan
- A/C evaporator expansion valve
- Evaporator to compressor suction line
- A/C compressor to condenser discharge line
- A/C control rocker switch
- A/C pressure cut-off switch
- A/C evaporator temperature control thermostat

The GO-4 uses an expansion valve type of refrigerant control system. The refrigerant cycle is controlled by an A/C evaporator expansion valve mounted inside the A/C evaporator case. The A/C evaporator expansion valve senses A/C evaporator core temperature and opens or closes slightly to control the amount of refrigerant circulating through the A/C evaporator core and A/C compressor.

Refrigerant Flow

The A/C compressor pulls in low-pressure vapor and pumps out high-pressure vapor to the A/C condenser core. The high-pressure vapor entering the A/C condenser core is cooled by outside air passing over the A/C condenser core fooling fins. This heat loss causes the high pressure vapor to become high-pressure liquid. This high-pressure liquid passes through the suction receiver/drier before entering the A/C evaporator expansion valve. The A/C evaporator expansion valve controls the amount of refrigerant entering the A/C evaporator core where hot, humid air passes over the A/C evaporator core coils. The A/C high-pressure liquid. This high-pressure liquid passes through the suction receiver/drier before entering the A/C evaporator expansion valve. The A/C evaporator expansion valve controls the amount of refrigerant entering the A/C evaporator core where hot, humid air passes over the A/C evaporator core coils. The A/C evaporator core coils remove the heat and humidity from the air being circulated in the passenger compartment. When the low-pressure liquid absorbs the heat in the A/C evaporator core, it again becomes a low-pressure gas. The low-pressure gas then returns to the A/C compressor.

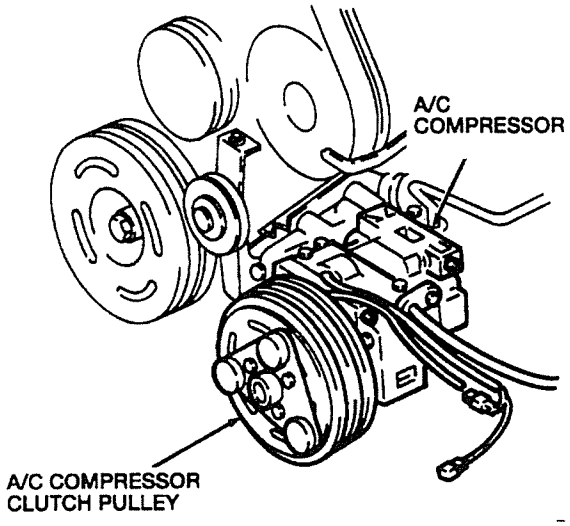
Description and Operation (Continued)



Item	Part Number	Description
1	613109	A/C Compressor
2	619005	Evaporator to Compressor Suction Line
3	613139	A/C Condenser
4	-	Fresh or Recirculated Air
5	614023	Blower Motor
6	614026	A/C Evaporator Expansion Valve
7	614027	A/C Expansion Valve to Evaporation Line
8	613137	A/C Liquid Drier to Evaporator Line
9	613141	A/C Receiver/Drier
10	613136	A/C Condenser to Liquid Drier
11	-	Outside Air
12	613134	Discharge Line - A/C Compressor to Condenser
13	662830	A/C ON/OFF Switch

A/C Compressor and A/C Clutch Assemblies

The A/C compressor is a rotary vane design and is belt-driven by the engine crankshaft. An A/C compressor clutch drives the A/C compressor shaft. When voltage is applied to the A/C compressor clutch field coil, the A/C clutch hub is drawn by magnetic force toward the A/C compressor clutch pulley, which rotates freely on the A/C clutch hub to the A/C compressor clutch pulley to turn the A/C compressor shaft. When voltage is removed from the A/C compressor clutch field coil, the A/C clutch hub moves away from the A/C compressor clutch pulley and the A/C compressor shaft ceases to rotate.



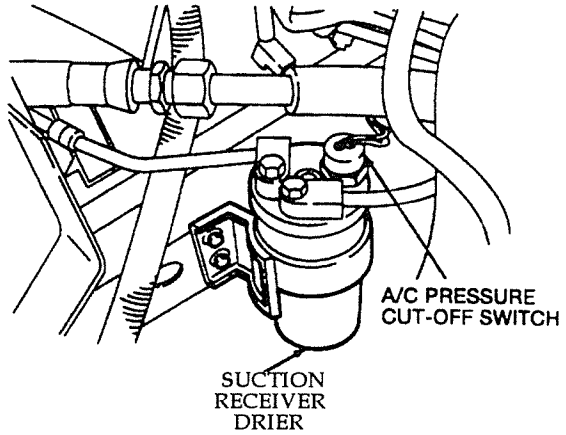
Refrigerant System Protection

A/C Compressor Pressure Relief Valve

The A/C compressor features a pressure relief valve which will discharge high pressure refrigerant to the atmosphere when the pressure exceeds its relief setting of 526 - 640 psi (3626-4413 kPa). The A/C compressor relief valve will reseal itself when the pressure drops below its reset setting of 465 psi (3206 kPa).

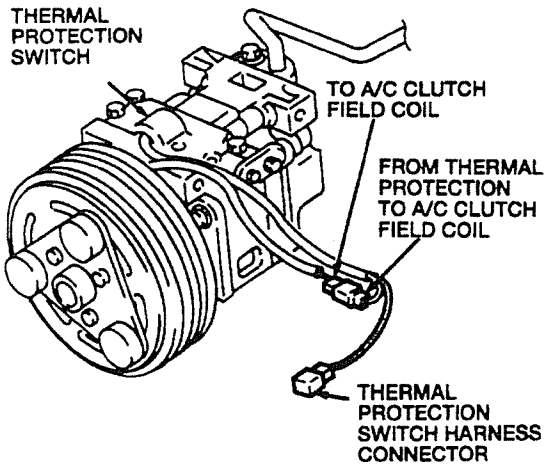
Switch, A/C Pressure Cut-Off

The A/C pressure cut-off switch is a safety device that shuts the A/C compressor clutch off if the pressure on the discharge side of the A/C compressor (at the suction receiver/dryer) drops below 29-35 psi (201-241 kPa) or is above 426-483 psi (2940-3332 kPa). The A/C pressure cut-off switch is wired in series with the A/C switch and the A/C evaporator temperature control thermostat.



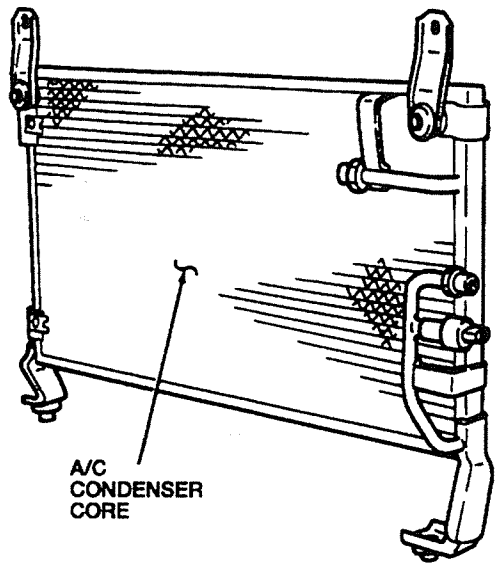
Thermal Protection Switch

A thermal protection switch is mounted in the A/C compressor to protect the A/C compressor to protect the A/C compressor from overheating. The thermal protection switch will open the A/C compressor clutch field coil circuit if the A/C compressor gets too hot.



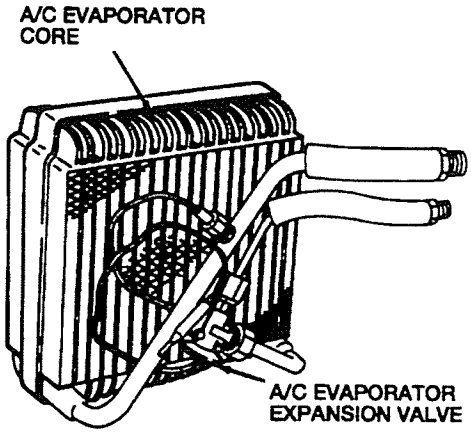
A/C Condenser Core

The A/C condenser core is an aluminum fin and tube design heat exchanger located in front of the vehicle radiator. The A/C condenser core cools compressed refrigerant gas by allowing air to pass over fins and tubes to extract heat and condenses the gas refrigerant to liquid as it cools.



A/C Evaporator Core

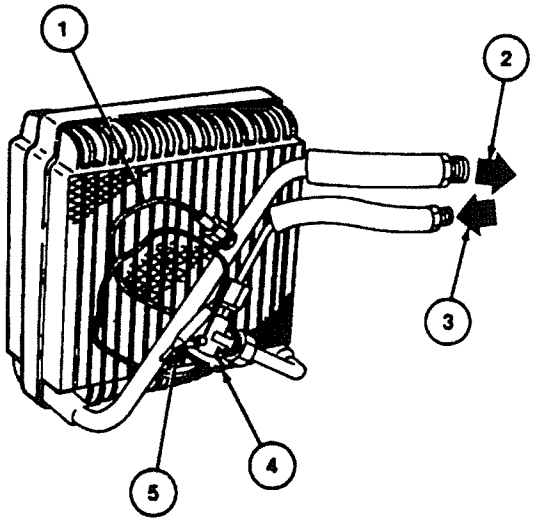
The A/C evaporator core is located in the evaporator housing on the left hand side of the instrument panel. It is a multi-pass plate/fin type design mounted in a horizontal position. Vapor feed refrigerant enters the A/C evaporator core from the A/C evaporator fins. Forced air from the blower motor passing through the A/C evaporator core is cooled and dehumidified, then conducted to the passenger compartment. Excess moisture from the dehumidification process is drained through an A/C evaporator drain hose to the outside of the vehicle.



A/C Evaporator Expansion Valve

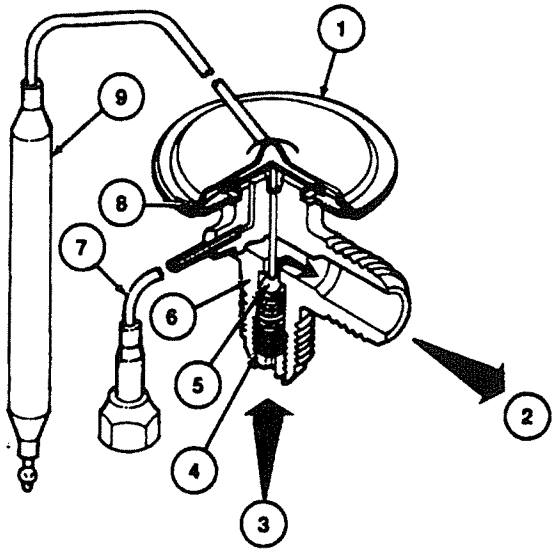
The A/C evaporator expansion valve is located in the A/C evaporator inlet. The A/C evaporator expansion valve senses the temperature and pressure of the refrigerant at the A/C evaporator outlet and meters the refrigerant into the A/C evaporator core. Liquid refrigerant must not be allowed to pass into the A/C compressor or serious damage will result. The A/C evaporator expansion valve is a control device that controls the amount of high-pressure refrigerant that enters the A/C evaporator core. The proper amount of refrigerant allows maximum cooling and provides for complete evaporation of all the liquid refrigerant in the A/C evaporator core.

A/C Evaporator Expansion Valve Location



Item	Part Number	Description
1	-	Equalizer Line
2	-	To A/C Compressor
3	-	From Suction Receiver/Drier
4	614026	A/C Evaporator Expansion Valve
5	-	A/C Evaporator Expansion Valve Sensing Bulb

The amount of refrigerant in the A/C evaporator core determines the temperature and pressure at the A/C evaporator case outlet, inside the A/C evaporator expansion valve sensing bulb, and in the equalizer line. These pressures act on top and bottom of the diaphragm. The diaphragm, along with the super heat spring, opens or closes the valve ball to allow the proper amount of high-pressure refrigerant into the A/C evaporator core inlet.



Item	Part Number	Description
1	614026	A/C Evaporator Expansion Valve
2	-	To A/C Evaporator Core
3	-	From Suction Receiver/Drier
4	-	Superheat Spring
5	-	Valve Ball
6	-	Orifice
7	-	Equalizer Line
8	-	Diaphragm
9	-	A/C Evaporator Expansion Valve Sensing Bulb

A/C Evaporator Temperature Control Thermostat

The A/C evaporator temperature control thermostat is a safety device which shuts the A/C compressor clutch off to prevent the A/C evaporator core from freezing. When the temperature of the A/C evaporator core drops to 32°F + 1.8°F(0°C + 1°C) the A/C evaporator temperature control turns the A/C compressor clutch off.

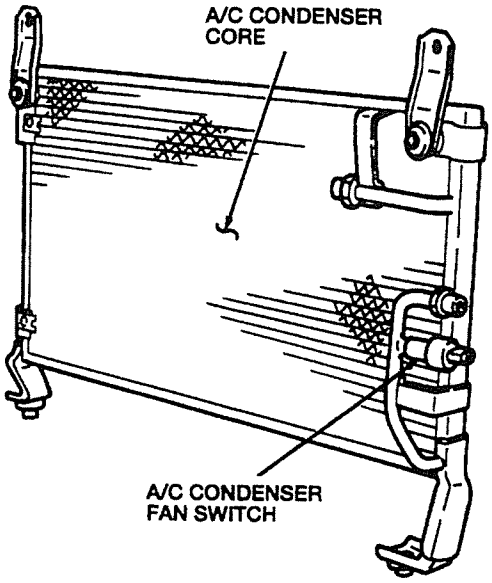
When the A/C evaporator core temperature increases to 37.4-41.0°F (3-5°C) the A/C evaporator temperature control thermostat turns the A/C compressor clutch on. An A/C evaporator temperature control thermostat sensing bulb inside of the A/C evaporator core signals the A/C evaporator temperature control thermostat when to open or close. The A/C evaporator temperature control thermostat is wired in series with the A/C compressor clutch control relay and signals the Powertrain Control Module to turn the A/C compressor clutch on and off.

The A/C evaporator temperature control thermostat is located at the top of the A/C evaporator.

A/C Condenser Fan Switch

NOTE: The A/C condenser cooling fan does not operate whenever the A/C compressor is engaged. The operation of the A/C condenser cooling fan is controlled by the A/C condenser fan switch.

The A/C condenser fan switch is located on the outlet manifold of the A/C condenser core. When manifold pressure exceeds 220 psi (1,519 kPa), the A/C condenser fan switch closes and the A/C condenser cooling fan starts to operate. When manifold pressure drops below 178 psi (1,225 kPa), the/C condenser fan switch opens and the A/C condenser cooling fan turns off.

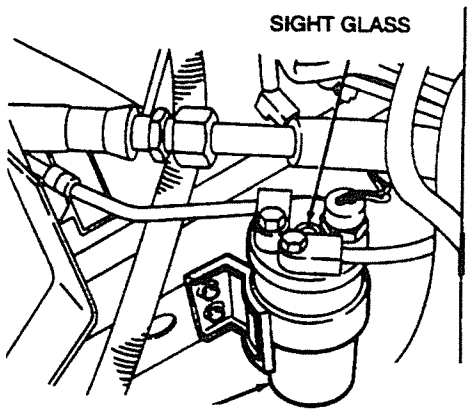


Suction Receiver/Drier

The suction receiverr/drier collects moisture in the refrigerant that was generated during condensation. It prevents the moisture from recirculating through the system.

Refrigerant enters the suction receiver/dryer from the jumper line through the inlet tube. The heavier, oil-laden refrigerant falls to the bottom of the outlet tube near the bottom of the suction receiver/drier. A bleed hole, covered with a filter screen, allows a small amount of the heavier liquid refrigerant and oil mixture to re-enter the liquid line at a controlled rate. When the heavier liquid refrigerant and oil mixture enters the liquid line, it has an opportunity to vaporize and circulate through A/C compressor without causing damage to the A/C compressor due to refrigerant slugging.

A dessicant bag is mounted inside the suction receiver/dryer to absorb any moisture which may be in the refrigerant system. A sight glass is located on the top of the suction receiver/dryer for checking refrigerant condition. The suction receiver/dryer is located to the left of the radiator and is mounted to the vehicle frame.



SUCTION RECEIVER DRIER

Special Service Equipment

CAUTION: Do not use R-12 service tools and equipment when servicing a R-134a system. Doing so may cause damage to the R-134a A/C system.

The refrigerant system has a high-pressure (discharge) and a low-pressure (suction) gauge port valve. They provide access to both sides (high-pressure and low-pressure) of the system for service hoses and a manifold gauge set so system pressures can be read.

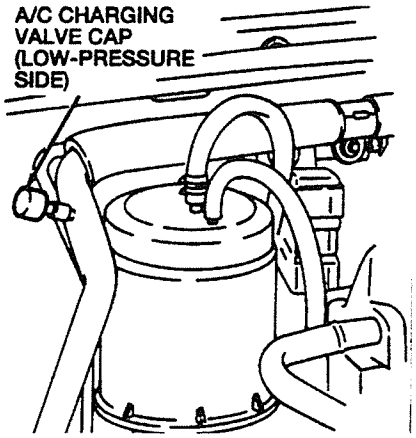
R-134a systems require the use of special servicing equipment designed specifically for R-134a systems. R-12 servicing equipment cannot be used when servicing R-134a A/C systems. The R-134a Service Equipment includes:

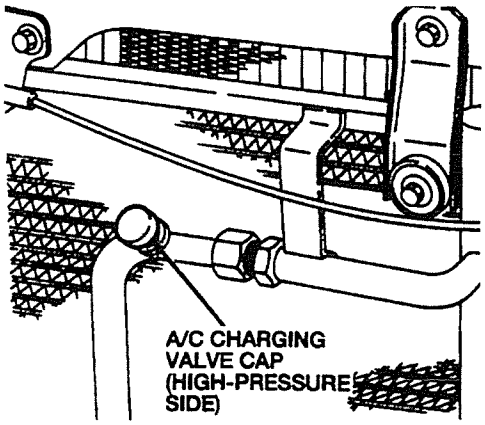
- R-134a Service Center
- R-134a Automatic Calibration Halogen Leak Detector
- R-134a Manifold Gauge Set
- R-134a Vacuum Pump (1.5 CFM)
- R-134a Vacuum Pump (3.0 CFM)
- R-134a Low Side Quick Disconnect
- R-134a High Side Quick Disconnect

Service Gauge Port Valves

The refrigerant system has a high-pressure (discharge) and a low-pressure (suction) gauge port valve. They provide access to both sides (high-pressure and low-pressure) of the system for service hoses and a manifold gauge set so system pressures can be read.

Always replace the A/C charging valve caps on the gauge port valves after servicing the refrigerant system.





DIAGNOSIS AND TESTING

Inspection and Verification - A/C Control System

1. Verify the customer concern by operating the A/C control system.
2. Visually inspect the following components of the climate control system.

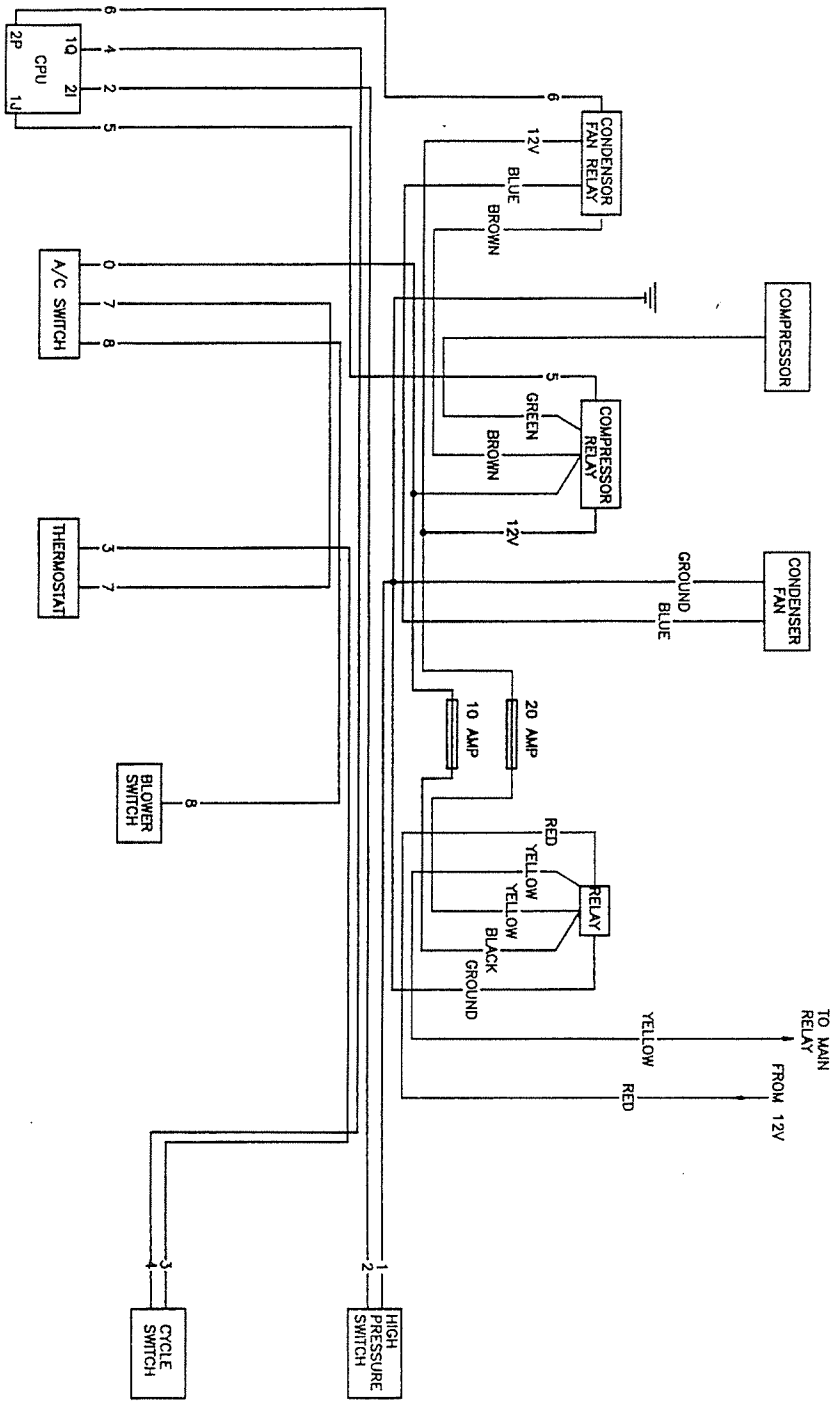
VISUAL INSPECTION CHART

Mechanical	Electrical
• Refrigerant Leakage	• Blown circuit breaker: - 30A blower
• Damaged or loose drive belt	• Blown fuse(s):
• Damaged A/C compressor	• - 30A Cooling Fan
• Damaged A/C compressor clutch	• - 20A Wiper
• Damaged refrigerant hose(s)	• Damaged wiring harness
• Damaged vacuum lines	• Loose or corroded connections
	• Damaged blower motor
	• Damaged heater blower motor switch
	• Damaged A/C compressor clutch control relay

3. Check for damage to the A/C compressor and the A/C compressor clutch.
4. If fault is not visually evident, determine the symptom and proceed to the following Troubleshooting Chart.

DIAGNOSIS AND TESTING

Electrical Schematics - A/C System



Diagnosis and Testing (Continued)

Trouble Shooting Chart - Climate Control System

NOTE: Use a Digital Multimeter or equivalent to perform electrical Pinpoint Tests.

CONDITION	POSSIBLE SOURCE	ACTION/REMEDY
• Heat Always On	• Climate control assembly. • Loose or broken heater cable.	• Go to Pinpoint Test A1.
• Insufficient Heat	• Water thermostat. • Coolant level. • Heater water hoses. • Heater core. • Heater cable. • Temperature control door.	• Go to Pinpoint Test B1.
• Insufficient A/C cooling	• Insufficient refrigerant. • Refrigerant leak(s). • Heater cable. • Temperature control door.	• Go to Pinpoint Test C1.
• No Operation In All Temperature Settings	• Temperature control door. • Loose or broken heater cable. • Ducts broken or leaking.	• Go to Pinpoint Test D1.
• Blower Motor Does Not Operate	• Fuse. • Circuit Breaker. • Circuit. • Blower motor relay. • Blower motor. • Heater blower motor switch.	• Go to Pinpoint Test E1.
• Blower Motor Runs Constantly	• Circuit. • Heater blower motor switch.	• Go To Pinpoint Test F1.
• Blower Motor Does Not Operate Properly	• Circuit. • Heater blower motor switch. • A/C blower motor resistor.	• Go To Pinpoint Test G1.
• No Operation in Low Blower Setting	• Circuit. • A/C blower motor resistor. • Heater blower motor switch.	• Go To Pinpoint Test H1.
• No Operation in High Blower Setting	• Circuit. • Heater blower motor switch.	• Go To Pinpoint Test J1.
• A/C Compressor Clutch Does Not Engage	• Insufficient refrigerant. • Fuse(s). • Circuit. • A/C compressor clutch control relay. • Thermal protection switch. • A/C compressor clutch. • A/C pressure cut-off switch.	• Go To Pinpoint Test K1.
• A/C Compressor Clutch Does Not Disengage	• Circuit. • A/C compressor clutch control relay. • A/C compressor clutch.	• Go To Pinpoint Test L1.
• A/C Compressor Clutch Cycles Rapidly	• Insufficient refrigerant. • A/C compressor clutch. • A/C compressor clutch control relay.	• Go To Pinpoint Test M1.

Diagnosis and Testing (Continued)

Troubleshooting Chart - Climate Control System

CONDITION	POSSIBLE SOURCE	ACTION/REMEDY
• A/C Compressor Clutch Slippage	• A/C compressor clutch. • A/C compressor.	• Inspect the A/C drive belt tension. Refer to Section 11. Adjust or replace A/C drive belt if necessary. Otherwise, replace the A/C compressor.
• Noise While Operating Climate Control System	• Bearings. • Refrigerant components. • Insufficient refrigerant. • Excessive refrigerant.	• Go To Pinpoint Test N1.
• A/C Condenser Cooling Fan Never Runs	• Fuse(s). • Circuit. • Condenser fan relay. • A/C condenser cooling fan.	• Go To Pinpoint Test P1.
• A/C Condenser Cooling Fan Operates Continuously	• Circuit. • Condenser fan relay. • A/C condenser cooling fan. • Engine coolant temperature sensor.	• Go To Pinpoint Test Q1.
• A/C Indicator Not Operating Properly	• Ignition Switch.	• Go To Pinpoint Test R1.
• Heater and A/C Air Inlet Duct Door Does Not Operate	• Heater cable. • Temperature control door.	• Inspect the heater cable for kinks or breaks. Repair or replace the heater cable as necessary. Otherwise, service the temperature control door.
• One or More Modes Do Not Work (Air Outlet Does Not Change)	• Loose or broken air flow control cable. • Air flow control doors • Ducts blocked or leaking.	• Inspect the air flow control cable for kinks or breaks. Repair or replace the air flow control cable as necessary. Otherwise service the air flow control door.
• Engine Cooling Fan Motor Does Not Operate When A/C is Activated.	• Circuit.	• Refer to PC/ED Manual.
• No Air Circulation or Improper Air Circulation (Blower Motor Operates)	• Air flow control door. • Heater and ventilation intake duct blocked. • Ducts blocked or leaking.	• Inspect, Adjust or Replace air flow control door as necessary. • Clear the blockage. • Clear the blockage or Repair the leakage.
• Frost Being Blown out of Ducts	• Evaporator box drain tube. • Refrigerant system.	• Inspect and Clean the evaporator case drain tubes as necessary. Perform the Refrigerant System Tests found in Service Procedures and Service system as necessary.

Diagnosis and Testing (continued)

Pinpoint Tests - Climate Control System

PINPOINT TEST A: HEAT ALWAYS ON

Test Step	Result	Action To Take
A1 CHECK TEMPERATURE CONTROL CABLE • Inspect the heater cable for kinks or breaks. • **Is the heater cable OK?**	Yes > No >	Service the control door. Service the heater cable.

PINPOINT TEST B: INSUFFICIENT HEAT

Test Step	Result	Action To Take
B1 CHECK COOLING SYSTEM • Inspect the cooling system. Refer to Section 15. • **Is the cooling system OK?**	Yes > No >	Go to B2. Service the cooling system as necessary.
B2 CHECK THE HEATER CORE • Perform the Plugged Heater Core tests in this section. • **Is the heater core OK?**	Yes > No >	Go to B3. Service the heater core
B3 CHECK THE TEMPERATURE CONTROL CABLE • Inspect the heater cable for kinks or breaks. • **Is the heater cable OK?**	Yes > No >	Service the temperature control door. Replace the heater cable.

PINPOINT TEST C: INSUFFICIENT A/C COOLING

Test Step	Result	Action To Take
C1 CHECK REFRIGERANT • Perform the Refrigerant System Tests in this section. • **Is the refrigerant system OK?**	Yes > No >	Go to C2. Repair as necessary.
C2 CHECK TEMPERATURE CONTROL CABLE • Inspect the heater cable for kinks or breaks. • **Is the heater cable OK?**	Yes > No >	Service the temperature control door. Replace the heater cable.

PINPOINT TEST D: NO OPERATION IN ALL TEMPERATURE SETTINGS

Test Step	Result	Action To Take
D1 CHECK TEMPERATURE CONTROL CABLE • Inspect the heater cable for kinks or breaks. • **Is the heater cable OK?**	Yes > No >	Service the control door. Service the heater cable.

PINPOINT TEST E: BLOWER MOTOR DOES NOT OPERATE

Test Step	Result	Action To Take
E1 CHECK FUSE • Key OFF. • **Is the fuse OK?**	Yes > No >	Go to E4. Go to E2.
E2 CHECK THE SYSTEM • Key OFF. • Replace the blown fuse. • Key ON. • **Does the fuse fail again?**	Yes > No >	Go to E3. Go to E4.

Diagnosis and Testing (Continued)

PINPOINT TEST E: BLOWER MOTOR DOES NOT OPERATE - continued

Test Step	Result	Action To Take
E3 CHECK FOR SHORT TO GROUND • Key OFF • Disconnect the blower motor relay connector. • Measure the resistance of the "BL/GN " wire between the top terminal of the fuse holder and ground. • **Is the resistance less than 5 ohms?**	Yes >` No >	Service the "BL/GN" wire. Replace the fuse. Reconnect the blower motor relay. Go to E4.
E4 CHECK THE CIRCUIT BREAKER • Key OFF. • Check the BLOWER (fan)circuit breaker located in the interior fuse junction panel. • **Is the circuit breaker OK?**	Yes > No >	Go to E7. Go to E5.
E5 CHECK SYSTEM • Reset circuit breaker • **Does the circuit breaker fail again?**	Yes > No >	Go to E6. Go to E7.
E6 CHECK FOR SHORT TO GROUND • Remove the BLOWER (fan) circuit breaker. • Disconnect the blower motor relay connector. • Measure the resistance of the "W/GN" wire between the top terminal of the BLOWER circuit breaker holder and ground. • **Is the resistance greater than 10,000 ohms?**	Yes > No >	Replace the BLOWER circuit breaker. Service the "W/GN" wire.
E7 CHECK BLOWER MOTOR • Perform the Blower Motor component test in this section. • **Is the blower motor OK?**	Yes > No >	Go to E8. Replace the blower motor.
E8 CHECK HEATER BLOWER MOTOR SWITCH • Perform the Heater Blower Motor Switch component test in this section. **the heater blower motor switch OK?**	Yes > No >	Go to E9. Replace the heater blower motor switch.
E9 CHECK HEATER BLOWER MOTOR SWITCH GROUND • Disconnect the heater blower motor switch connector. • Measure the resistance of the "BK" wire between the heater blower motor switch connector and ground. • **Is the resistance less than 5 ohms?**	Yes > No >	Go to E10. Service the "BK" wire.
E10 CHECK BLOWER MOTOR RELAY • Key OFF. • Locate and disconnect the blower motor relay connector. • Apply 12 volts to the "BL/GN" wire terminal at the blower motor relay. • Measure the resistance between the "WG/GN" wire and "R" wire terminals on the blower motor relay. • **Is the resistance less than 5 ohms?**	Yes > No >	Go to E11. Replace the blower motor relay.

Diagnosis and Testing (Continued)

PINPOINT TEST E: BLOWER MOTOR DOES NOT OPERATE (Continued)

Test Step	Result	Action To Take
E11 CHECK POWER TO BLOWER MOTOR RELAY • Key OFF. • Disconnect the blower motor relay connector. • Key ON. • Measure the voltage on the "BL/GN" and "W/GN" wires at the blower motor relay connector. • **Are the voltages greater than 10 volts?**	Yes > No >	Go to E12. Service the wire(s) in question.
E12 CHECK BLOWER MOTOR RELAY GROUND • Key OFF. • Disconnect the blower motor relay connector. • Measure the resistance of the "BK" wire between the blower motor relay connector and ground. • **Is the resistance less than 5 ohms?**	Yes > No >	Reconnect the blower motor relay. Go to E13. Service the "BK" wire.
E13 CHECK WIRE BETWEEN BLOWER MOTOR RELAY AND BLOWER MOTOR • Key OFF. • Disconnect the blower motor connector. • Key ON. • Measure the voltage on the "R" wire at the blower motor connector. • **Is the voltage greater than 10 volts?**	Yes > No >	Service the "BL/W" wire between the blower motor and the heater blower motor switch. Service the "R" wire.

PINPOINT TEST F: BLOWER MOTOR RUNS CONSTANTLY

Test Step	Result	Action To Take
F1 CHECK HEATER BLOWER MOTOR SWITCH • Key OFF. • Locate and disconnect the heater blower motor switch connector. • Heater blower motor switch OFF. • Measure the resistance between the "BL/W" and the "BK" wire terminals on heater blower motor switch. • **Is the resistance greater than 10,000 ohms?**	Yes > No >	Service the "BL/W" wire for shorts to ground. Replace the heater blower motor switch.

PINPOINT TEST G: BLOWER MOTOR DOES NOT OPERATE PROPERLY

Test Step	Result	Action To Take
G1 CHECK HEATER BLOWER MOTOR SWITCH • Perform the Heater Blower Motor Switch component test in this section. • **Is the heater blower motor switch OK?**	Yes > No >	Go to G2. Replace the heater blower motor switch.
G2 CHECK A/C BLOWER MOTOR RESISTOR • Perform the A/C Blower Motor Resistor component test in this section. • **Is the A/C blower motor resistor OK?**	Yes > No >	Service the "BL/W' wire between the blower motor, the heater blower motor switch, and the A/C blower motor resistor. Replace the A/C blower motor resistor.

Diagnosis and Testing (Continued)

PINPOINT TEST H: NO OPERATION IN LOW BLOWER SETTING

Test Step	Result	Action To Take
H1 CHECK HEATER BLOWER MOTOR SWITCH		
• Perform the Heater Blower Motor Switch component test in this section. • **Is the heater blower motor switch OK?**	Yes > No >	Go to H2. Replace the heater blower motor switch.
H2 CHECK A/C BLOWER MOTOR RESISTOR		
• Perform the A/C Blower Motor Resistor component test in this section. • **Is the A/C blower motor resistor OK?**	Yes > No >	Service the "BL/Y" wire between the A/C blower motor resistor and the heater blower motor switch. Replace the A/C blower motor resistor.

PINPOINT TEST J: NO OPERATION IN HIGH BLOWER SETTING

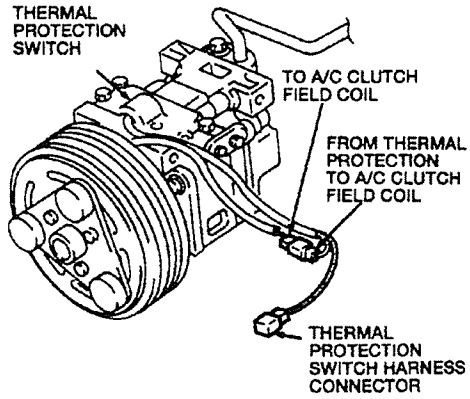
Test Step	Result	Action To Take
J1 CHECK HEATER BLOWER MOTOR SWITCH		
• Perform the Heater Blower Motor Switch component test in this section. • **Is the heater blower motor switch OK?**	Yes > No >	Service the "BL/W" wire between the blower motor and the heater blower motor switch. Replace the heater blower motor switch.

PINPOINT TEST K: A/C COMPRESSOR CLUTCH DOES NOT ENGAGE

Test Step	Result	Action To Take
K1 CHECK REFRIGERANT SYSTEM		
• Perform the Refrigerant System Tests in this section. • **Is the refrigerant pressure OK?**	Yes > No >	Go to K2. Service the refrigerant system as necessary.
K2 CHECK FUSES		
• Key OFF. • Check the Wiper fuse and Engine Fan fuse located in the fuse panel. • **Are the fuses OK?**	Yes > No >	Go to K5. Go to K3.
K3 CHECK SYSTEM		
• Key OFF. • Replace the blown fuse(s).Key ON. • **Do(es) the fuse(s) fail again?**	Yes > No >	Go to K4. Go to K5.
K4 CHECK FOR SHORT(S) TO GROUND		
• Key OFF. • Remove the fuse that blew during K3. • Disconnect the A/C compressor clutch control relay connector. • Measure the resistance of the "BL" wire between the top terminal of the Wiper fuse holder and ground. • Measure the resistance of the "W/BK" wire between the left terminal of the Engine Fan fuse holder and ground. • **Is the heater blower motor switch OK?**	Yes > No >	Service the wire(s) in question. Replace the Wiper fuse and the Engine fan fuse. Go to K5..

Diagnosis and Testing (Continued)

PINPOINT TEST K: A/C COMPRESSOR CLUTCH DOES NOT ENGAGE (continued)

Test Step	Result	Action To Take
K5 CHECK A/C COMPRESSOR CLUTCH OPERATION • Key OFF. • Disconnect the A/C compressor clutch connector from the thermal protection switch.  • Apply 12 volts to the "BK" wire at the A/C compressor clutch connector leading to the A/C compressor clutch. • Disconnect the 12 volt supply to the A/C compressor clutch. • **Does the A/C compressor clutch hub pull in when 12 volts is applied, and released when the 12 volts is removed?**	Yes > No >	Go to K6. Replace the A/C compressor clutch.
K6 CHECK THERMAL PROTECTION SWITCH • Key OFF. • Disconnect both of the thermal protection switch connectors. See illustration in test step K5. • Measure the resistance of the thermal protection switch between the "BK" wires of the terminal protection switch connectors. • **Is the resistance less than 5 ohms?**	Yes > No >	Go to K7. Replace the A/C compressor
K7 CHECK A/C COMPRESSOR CLUTCH CONTROL RELAY • Key OFF. • Remove the A/C compressor clutch control relay. • Apply 12 volts to the "BL" wire terminal and the "W/BK" wire terminal on the A/C compressor clutch control relay. • Measure the voltage on the "GN/W" wire terminal on the A/C compressor clutch control relay during the following conditions: **BL/O Wire Terminal — Voltage on GN/W Wire Terminal** Open — Less than 1 (one) volt Grounded — Greater than 10 volts • **Are the voltage(s) OK?**	Yes > No >	Go to K8. Replace the A/C compressor clutch control relay.

Diagnosis and Testing (Continued)

PINPOINT TEST K: A/C COMPRESSOR CLUTCH DOES NOT ENGAGE (continued)

Test Step	Result	Action To Take
K8 CHECK POWER SUPPLY • Key OFF. • Remove the A/C compressor clutch control relay. • Key ON. • Measure the voltage on the "BL" wire and the "W/BK" wire at the A/C compressor clutch control relay connector. • **Are the voltages greater than 10 volts?**	Yes > No >	Go to K9. Service the wire(s) in question for open.
K9 CHECK A/C SWITCH • Key OFF. • Locate and disconnect the A/C switch connector. • Turn the A/C switch off. • Measure the resistance of the A/C switch between the "BL/Y" wire and the "GN/BK" wire terminal at the A/C switch. • Turn the A/C switch on. • **Is the resistance less than 5 ohms with the A/C switch on, and greater than 10,000 ohms with the A/C switch off?**	Yes >\ No >	Go to K10. Replace the A/C switch.
K10 CHECK A/C SWITCH GROUND • Key OFF. • Disconnect the A/C switch connector. • Turn the heater blower motor switch to the low speed position. • Measure the resistance of the "BL/Y" wire between the A/C switch connector and ground. • **Is the resistance less than 5 ohms?**	Yes >\ No >	Go to K11. Service the "BL/Y" wire for open.
K11 CHECK WIRE BETWEEN A/C SWITCH AND A/C EVAPORATOR TEMPERATURE CONTROL THERMOSTAT • Key OFF. • Disconnect the A/C switch connector. • Locate and disconnect the A/C evaporator temperature control thermostat connectors. • Measure the resistance of the "GN/BK" wire between the A/C switch connector and the A/C evaporator temperature control thermostat. • **Is the resistance less than 5 ohms?**	Yes >\ No >	Go to K12. Service the "GN/BK" wire for open.
K12 CHECK A/C EVAPORATOR TEMPERATURE CONTROL THERMOSTAT • Key OFF. • Disconnect the A/C evaporator temperature control thermostat connectors. • Measure the resistance between the terminals of the A/C evaporator temperature control thermostat. • **Is the resistance less than 5 ohms?**	Yes >\ No >	Go to K13. Replace the A/C evaporator temperature control thermostat.

Diagnosis and Testing (Continued)

PINPOINT TEST K: A/C COMPRESSOR CLUTCH DOES NOT ENGAGE (continued)

Test Step		Result	Action To Take
K13	CHECK WIRE BETWEEN A/C EVAPORATOR TEMPERATURE CONTROL THERMOSTAT AND A/C PRESSURE CUT-OFF SWITCH		
• Key OFF. • Disconnect the A/C evaporator temperature control thermostat connectors. • Locate and disconnect the A/C pressure cut-off switch connector. • Measure the resistance of the "GN/R" wire between the A/C pressure cut-off switch connector and the A/C evaporator temperature control thermostat connector. • **Is the resistance less than 5 ohms?**		Yes >\ No >	Go to K14. Service the "GN/R" wire for open.
K14	CHECK A/C PRESSURE CUT-OFF SWITCH		
• Key OFF. • Disconnect the A/C pressure cut-off switch connector. • Measure the resistance between the terminals of the A/C pressure cut-off switch. • **Is the resistance less than 5 ohms.**		Yes >\ No >	Go to K15. Replace the A/C pressure cut-off switch.
K15	CHECK WIRE BETWEEN A/C COMPRESSOR CLUTCH CONTROL RELAY AND A/C COMPRESSOR CLUTCH		
• Key OFF. • Remove the A/C compressor clutch control relay. • Disconnect the A/C compressor clutch connector. • Measure the resistance of the "GN/W" wire between the A/C compressor clutch control relay connector and A/C clutch connector. • Measure the resistance of the "GN/W" wire between the A/C compressor clutch control relay connector and ground. • **Is the resistance less than 5 ohms between the A/C compressor clutch control relay and the A/C compressor clutch, and greater than 10,000 ohms between the A/C compressor clutch control relay and ground?**		Yes >\ No >	Refer to the PC/ED Manual, Section 6B to diagnose the A/C compressor clutch control relay circuit. Service the "GN/W" wire.

Diagnosis and Testing (Continued)

PINPOINT TEST L: A/C COMPRESSOR CLUTCH DOES NOT ENGAGE

Test Step	Result	Action To Take
L1 CHECK REFRIGERANT SYSTEM • Perform the Refrigerant System Tests in this section.. • **Is the refrigerant system performance OK?**	Yes > No >	Go to L2. Service the refrigerant system as necessary.
L2 CHECK A/C COMPRESSOR CLUTCH • Key OFF. Locate and disconnect the A/C compressor clutch connector. • Start engine. • **Does the A/C compressor clutch disengage?**	Yes > No >	Go to L3. Replace the A/C compressor clutch.
L3 CHECK A/C COMPRESSOR CLUTCH CONTROL RELAY • Key OFF. • Remove the A/C compressor clutch control relay. • Apply 12 volts to the "BL" terminal and the "W/BK" wire terminal in the A/C compressor clutch control relay. • Measure the voltage on the "GN/W" wire terminal in the A/C compressor clutch control relay during the following conditions: **BL/O Wire Terminal Voltage on GN/W Wire Terminal** Open — Less than 1 (one) volt Grounded — Greater than 10 volts • **Are the voltages OK?**	Yes > No >	Go to K4. Replace the A/C compressor clutch control relay.
L4 CHECK A/C MODE SELECTOR SWITCH • Key OFF. • Locate and disconnect the A/C switch connector. • Turn the A/C switch OFF. • Measure the resistance of the A/C switch between the "GN/BK" wire terminal and "BL/Y" wire terminal at the A/C switch. • Turn the A/C switch on. • **Is the resistance less than 5 ohms with the A/C switch on, and greater than 10,000 ohms with the A/C switch off?**	Yes > No >	Go to L5. Replace the A/C switch.
L5 CHECK WIRE BETWEEN A/C SWITCH AND A/C EVAPORATOR TEMPERATURE CONTROL THERMOSTAT • Key OFF. • Disconnect the A/C switch connector. • Locate and disconnect the A/C evaporator temperature control thermostat connector. • Measure the resistance of the "GN/BK" wire between the A/C evaporator temperature control thermostat connector and ground. • **Is the resistance greater than 10,000 ohms?**	Yes > No >	Go to L6. Service the "GN/BK" wire for short.

Diagnosis and Testing (Continued)

PINPOINT TEST L: A/C COMPRESSOR CLUTCH DOES NOT ENGAGE)Continued)

Test Step		Result	Action To Take
L6	CHECK WIRE BETWEEN A/C EVAPORATOR TEMPERATURE CONTROL THERMOSTAT AND A/C PRESSURE CUT-OFF SWITCH		
• Key OFF. • Disconnect the A/C evaporator temperature control thermostat connector. • Locate and disconnect the A/C pressure cut-off switch connector. • Measure the resistance of the "GN/R" wire between the A/C pressure cut-off switch connector and ground. • **Is the resistance greater than 10,000 ohms?**		Yes > No >	Go to L7. Service the "GN/R" wire for short.
L7	CHECK WIRE BETWEEN A/C COMPRESSOR CLUTCH CONTROL RELAY AND POWERTRAIN CONTROL MODULE		
• Key OFF. • Remove the A/C compressor clutch control relay. Locate and disconnect the powertrain control module connectors. • Measure the resistance of the "BL/O" wire between the A/C compressor clutch control relay connector and ground. • **Is the resistance greater than 10,000 ohms?**		Yes > No >	Refer to the PC/ED Manual, Section 6B to diagnose the A/C pressure cut-off switch and A/C compressor clutch control circuits. Service the "BL/O" wire for short.

PINPOINT TEST M: A/C COMPRESSOR CLUTCH CYCLES RAPIDLY

Test Step		Result	Action To Take
M1	CHECK REFRIGERANT SYSTEM		
• Perform the Refrigerant System Tests in this section.. • **Is the refrigerant system performance OK?**		Yes > No >	Refer to the PC/ED Manual, Section 6B to diagnose the A/C pressure cut-off switch. Service the refrigerant system as necessary.

PINPOINT TEST N: NOISE WHILE OPERATING CLIMATE CONTROL SYSTEM

Test Step		Result	Action To Take
N1	CHECK A/C COMPRESSOR		
• Run the engine at a constant 3000-4000 rpm. • Alternately switch the A/C compressor on and off by turning the A/C switch on and off. • **Does the noise disappear?**		Yes > No >	If the system was recently recharged, A/C compressor is OK. Otherwise perform the Refrigerant System Test. Go to N2.
N2	RECHECK A/C COMPRESSOR		
• Turn engine off and let engine sit for 1-2 minutes. • Run the engine and hold the speed at 3000-4000 rpm. • Cycle the A/C compressor on and off as in N1. • **Does the noise disappear?**		Yes > No >	Perform the A/C Compressor service procedures in this section. Replace the A/C compressor.

Diagnosis and Testing (Continued)

PINPOINT TEST P: A/C CONDENSER COOLING FAN NEVER RUNS

Test Step	Result	Action To Take
P1 CHECK A/C CONDENSER FAN OPERATION • Key OFF. • Locate and disconnect the A/C condenser fan switch connector. • Key ON, engine running. • Turn the A/C switch on. • Jump the "PK" wire and the "BK" wire at the A/C condenser fan switch connector. • **Does the A/C condenser fan operate when the "PK" wire is grounded?**	Yes > No >	Check the A/C system high pressure. If the high pressure is above 220 psi, Replace the A/C condenser fan switch. Otherwise, A/C condenser operation is normal. Return to Troubleshooting Chart to service any other concerns. Go to P2.
P2 CHECK FUSES • Key OFF. • Check the Wiper fuse in the fuse junction panel, and the Engine Fan fuse in the fuse junction panel. • **Are the fuses OK?**	Yes > No >	Go to P5. Go to P3
P3 CHECK SYSTEM • Key OFF. • Replace the blown fuse(s). • Key ON. • **Do(es) the fuse(s) fail again?**	Yes > No >	Go to N4. Go to N5.
P4 CHECK FOR SHORT(S) TO GROUND • Key OFF. • Remove the Engine Fan fuse and the Wiper fuse. • Locate and disconnect the condenser fan relay connector. • Measure the resistance of the "BL" wire between the top terminal of the Wiper fuse holder and ground. • **Are the resistances less than 5 ohms?**	Yes > No >	Service the wire(s) in question. Replace the Engine Fan fuse and the Wiper fuse. Reconnect the condenser fan relay. Go to P5.
P5 CHECK A/C CONDENSER COOLING FAN • Key OFF. • Disconnect the A/C condenser cooling fan connector. • Apply 12 volts to the "BL/BK" wire terminal and ground to the "BK" wire terminal. • **Does the A/C condenser fan operate?**	Yes > No >	Go to P6. Replace the A/C condenser cooling fan.
P6 CHECK A/C CONDENSER COOLING FAN GROUND • Key OFF. • Disconnect the A/C condenser cooling fan connector. • Measure the resistance of the "BK" wire between the A/C condenser cooling fan connector and ground. • **Is the resistance less than 5 ohms?**	Yes > No >	Go to P7. Service the "BK" wire.

Diagnosis and Testing (continued)

PINPOINT TEST P: A/C CONDENSER COOLING FAN NEVER RUNS (Continued)

Test Step		Result	Action To Take
P7	CHECK POWER TO CONDENSER FAN RELAY		
• Key OFF. • Disconnect the A/C condenser fan switch connector. • Measure the resistance of the "BL" and "W/BK" wires at the condenser fan relay connector. • **Are the voltages greater than 10 volts?**		Yes >\ No >	Go to P8. Service the wire(s) in question.
P7	CHECK A/C CONDENSER FAN SWITCH GROUND		
• Key OFF. • Disconnect the A/C condenser fan switch connector • Measure the resistance of the "BK" wire between the A/C condenser fan switch connector and ground. • **Is the resistance less than 5 ohms?**		Yes >\ No >	Refer to the PC/ED Manual, Section 6B to diagnose the condenser fan relay control circuit. Service the "BK" wire.

PINPOINT TEST Q: A/C CONDENSER COOLING FAN OPERATES CONTINUOUSLY

Test Step		Result	Action To Take
Q1	CHECK CONDENSER FAN RELAY		
• Key OFF. • Locate and disconnect the condenser fan relay. • Measure the resistance of the "W/BK" and "BL/BK" wires on the condenser fan relay. • **Is the resistance greater than 10,000 ohms?**		Yes >\ No >	Go to Q2. Replace the condenser fan relay.
Q2	CHECK WIRE BETWEEN CONDENSER FAN RELAY AND POWERTRAIN CONTROL MODULE		
• Key OFF. • Disconnect the A/C condenser fan relay connector. • Locate and disconnect the powertrain control module connectors • Measure the resistance of the "LG" wire between the condenser fan relay connector and ground. • **Is the resistance greater than 10,000 ohms?**		Yes >\ No >	Refer to the PC/ED Manual, Section 6B to diagnose the condenser fan relay control circuit. Service the "LG" wire.

PINPOINT TEST R: A/C INDICATOR NOT OPERATING PROPERLY

Test Step		Result	Action To Take
R1	CHECK A/C ON INDICATOR BULB		
• Key OFF. • Locate and remove the A/C on rocker switch. • Check the continuity between the terminals of the A/C on indicator bulb. • **Does continuity?**		Yes >\ No >	Go to R2. Replace the A/C rocker switch.

Diagnosis and Testing (continued)

PINPOINT TEST R: A/C INDICATOR NOT OPERATING PROPERLY (Continued)

R2	CHECK POWER SUPPLY TO A/C SWITCH		
•	Key OFF.	Yes >	Replace the A/C switch.
•	Disconnect the A/C switch connector.	No >	Service the "BL" wire for open.
•	Key ON.		
•	Measure the voltage on the "BL" wire at the A/C switch connector.		
•	**Is the resistance greater than 10,000 ohms?**		

Component Test - Climate Control System

Heater Blower Switch

1. Locate and disconnect the heater blower motor switch connector.

2. Measure the resistance between the following terminals of the heater blower motor switch as indicated:

Switch Position	Terminals	Resistance
OFF	All	Greater than 10,000 ohms
1	2 and 4 All others	Less than 5 ohms Greater than 10,000 ohms
2	2 and 4 4 and 5 All others	Less than 5 ohms Less than 5 ohms Greater than 10,000 ohms

Please check the above chart.

3. If the resistances are correct, return to the Pinpoint Tests. Otherwise, replace the heater blower motor switch.

Heater Core

1. Look for evidence of coolant leakage at the hose-to-heater core attachments.

2. Check the system for loose heater water hose clamps.

3. If a leak is found and the heater water hose clamps are tight, check the heater core tubes for distortion or evidence of being bent out of shape. Severe distortion of the heater core tubes could cause leakage at the heater water hose connection.

Plugged Heater Core

Ensure the engine coolant is at the proper level, then start the engine and feel the outlet heater hose to see if it is hot. If it not warm, flow through the heater core is restricted.

Pressure Test

Heater core leaks can be indicated by wet spots around hose connections, coolant on ground and coolant odor in the passenger compartment.

An inadequate seal between the heater core tubes can allow coolant to follow the tube to the heater core and appear as a leak. If a heater core leak is suspected, use the following procedures.

In-Vehicle Test

1. Drain the coolant from the cooling system. Refer to Section 15 for the procedure.

2. Disconnect the heater water hoses from the heater core tubes.

3. Install a short piece of heater water hose approximately 4 inches (10 cm) in length on each heater core tube.

4. Prepare the heater core as follows:

   a. Fill the heater core and heater water hoses with water.

   b. Install plug in one heater water hose end and adapter from a Radiator/Heater Core Pressure Tester or equivalent in the other heater water hose end.

   c. Secure the hoses, plug, and adapter with hose clamps.

5. Pressure test the heater core as follows:

   a. Attach the Radiator/Heater Core Pressure Tester or equivalent to the adapter on the heater hose.

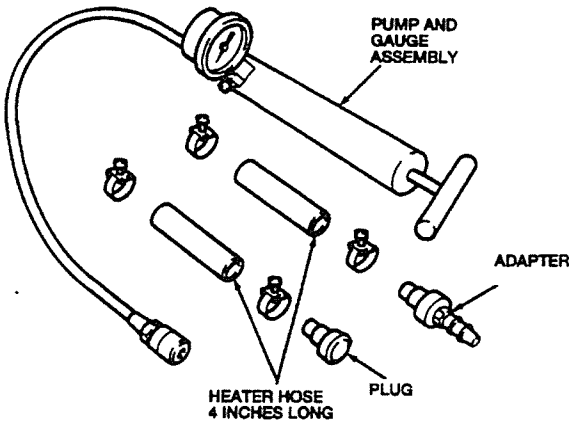
   b. Close the bleed valve at the base of the gauge.

   c. Pump 30 psi (206 kPa) of air pressure into the heater core.

6. Observe the pressure gauge for a minimum of three minutes. The pressure should not drop.

7. If the pressure does not drop, the heater core does not leak.

8. If the pressure drops, check the hose connections to the core tubes for leaks. If the hoses do not leak, remove the heater core from the vehicle and perform the bench pressure test.

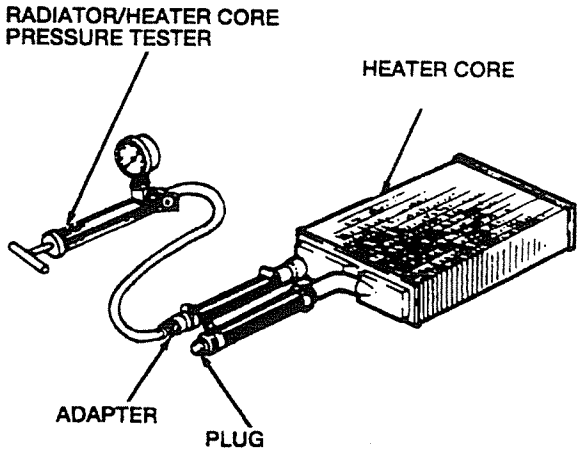


Bench Test

1. Drain all coolant from the heater core.

2. Attach the heater water hoses with the plug and adapter to the heater core tubes as indicated in the in-vehicle pressure test.

3. Attach the Radiator/Heater Core Pressure Tester to the adapter.



4. Pump 30 psi (206 kPa) of air pressure into heater core.

5. Submerge the heater core in water.

6. If a leak is observed, service or replace the heater core.

Blower Motor

1. Locate and disconnect the blower motor connectors.

2. Apply 12 volts to the "R" wire terminal and ground to the "BL/W" wire terminal on the blower motor.

3. If the blower motor dies not operate, replace the blower motor. Otherwise, return to the Pinpoint Test.

A/C Blower Motor Resistor

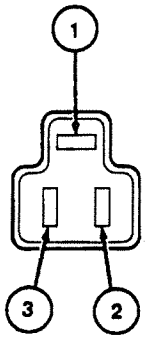
1. Key OFF.

2. Disconnect the A/C blower motor resistor connector.

3. Measure the resistance between the wire terminals of the A/C blower motor resistor according to the chart below.

Terminals	Resistance
1-2	2.1 ohms
1-3	0.8 ohms

Connector pins shown from the outside of housing.



A/C Blower Motor Resistor

4. If the resistances are correct, return to the Pinpoint Test. Otherwise, replace the A/C blower motor resistor.

SERVICE PROCEDURES

Refrigerant System Performance Evaluation

CAUTION: Only equipment designed for R-134a refrigerant systems can be used for refrigerant system diagnosis on the GO-4 vehicle. R-12 refrigerant service equipment should never be substituted or damage to the system or equipment may result.

The best way to diagnose a condition in the refrigerant system is to note the system pressures (shown by the manifold gauges). Then, compare the findings to the charts.

- The system pressures are low (compressor suction) and high (compressor discharge).

The following procedure is recommended for achieving accurate diagnosis results in the least amount of time.

1. Connect a Manifold Gauge Set or equivalent to the system. Purge air from the red and blue hoses by loosening the fittings at the gauge set. Open long enough for air to escape and then tighten the fittings.

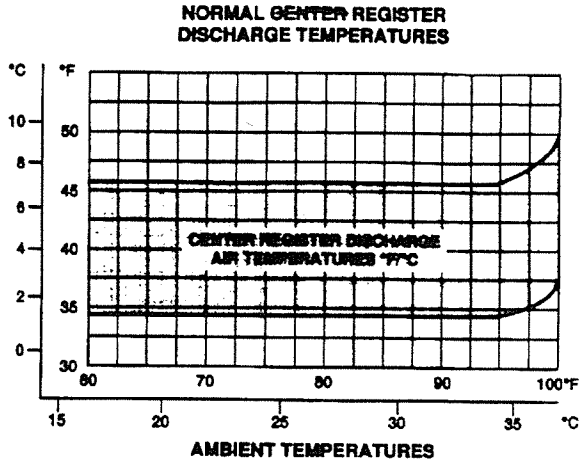
2. Start the engine and turn on the A/C system.

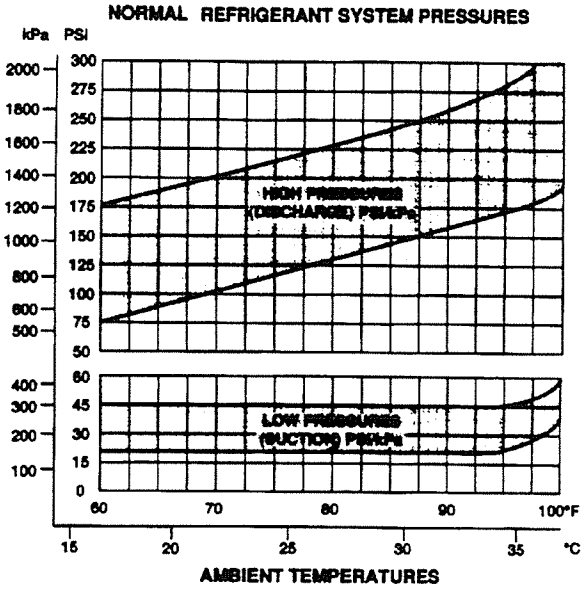
3. As soon as the system is stabilized, record the high and low pressures as shown by the manifold gauges. The low side should be between 20-41 psi (137-284 kPa) and the high side should be between 185-263 psi (1,274-1813 kPa). As low pressure drops, high pressure should rise. As low side pressure rises the high side pressure should drop.

4. Record the duct temperature.

5. Determine and record the ambient temperature.

6. Compare the test readings with applicable chart.





The diagnosis chart provides the most direct and sure way to determine the cause of any concern in a poorly performing refrigerant system.

After servicing and correcting a refrigerant system concern, take additional pressure readings to ensure the concern has been corrected.

REFRIGERANT SYSTEM PRESSURE EVALUATION CHART

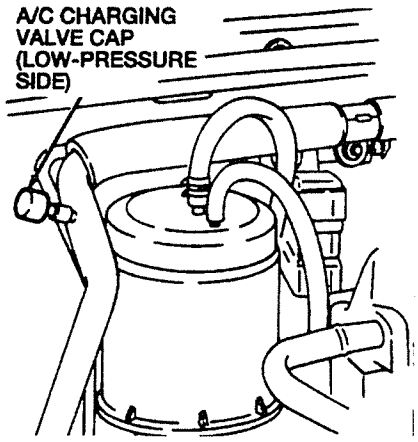
Gauge Reading	Possible Cause	Action to Take
Low: Below 8.5 psi (59 kPa) High: 128-135 psi (882-931 kPa)	• Insufficient refrigerant.	• CHECK the refrigerant system for leaks.
Low: Above 34.1 psi (235 kPa) High: Above 327 psi (2254 kPa)	• Insufficient condenser cooling. • Excessive refrigerant.	• CHECK the A/C condenser core for damage. • DISCHARGE excessive coolant and VERIFY refrigerant pressure is normal.
Low: 2.0 in Hg (50 cm Hg) of vacuum - 34.1 psi (235 kPa) High: 107-263 psi (735-1813 kpa)	• Moisture in system.	• DISCHARGE the system. EVACUATE the system. Recharge the system. CHECK the refrigerant pressure. If high and low pressures are still too high, REPLACE the suction receiver/dryer.
Low: 2.0 in Hg (50 cm Hg) of vacuum - 34.1 psi (235 kPa) High: Below 88 psi (608 kPa)	• No refrigerant circulation. • Restricted components.	• TURN the A/C off for 10 minutes. If A/C operates after 10 minutes, then moisture is in the system. REFER to the procedure above to remove the moisture. If A/C still does not operate, REPLACE the A/C evaporator expansion valve.
Low: Above 35.6 psi (245 kPa) High: 307-327 psi (2117-2254 kPa)	• A/C evaporator expansion valve stuck open.	• CHECK for frost or heavy dew on the suction pipe. If frost or heavy dew is present, DISCHARGE the excessive refrigerant and VERIFY high and low pressures are normal. Otherwise, REPLACE A/C the evaporator expansion valve.
Low: 57-85 psi (392-589 kPa) High: 107-152 psi (735-1049 kPa)	• Faulty A/C compressor.	• VERIFY the A/C clutch is engaged when the A/C and blower motor is ON. If the A/C clutch does not engage, Refer to the Trouble-shooting Chart in this section. Otherwise, replace the A/C compressor.

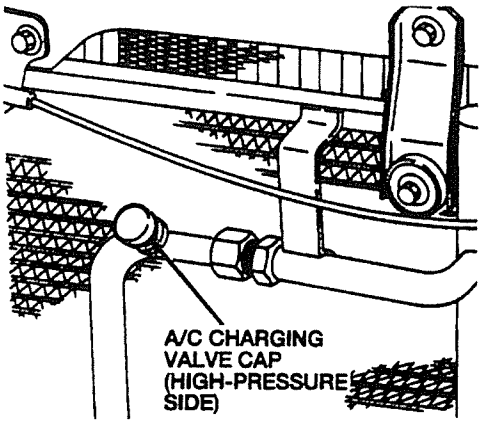
Refrigerant System Tests

Service Access Gauge Port Valves

The refrigerant system has a high pressure (discharge) and a low-pressure (suction) gauge port valve. They provide access to both sides (high-pressure and low-pressure) of the system for service hoses and a manifold gauge set so system pressures can be read.

Always replace the A/C charging valve caps on the gauge port valves after servicing the refrigerant system.





Checking for A/C Leaks

WARNING: GOOD VENTILATION IS NECESSARY IN THE AREA WHERE A/C LEAK TESTING IS TO BE PERFORMED. IF THE SURROUNDING AIR IS CONTAMINATED WITH REFRIGERANT GAS, THE LEAK DETECTOR WILL INDICATE THIS GAS ALL THE TIME. ODORS FROM OTHER CHEMICALS SUCH AS ANTIFREEZE, DIESEL FUEL, DISC BRAKE CLEANER, OR OTHER CLEANING SOLVENTS CAN CAUSE THE SAME PROBLEM. A FAN, EVEN IN A WELL VENTILATED AREA, IS VERY HELPFUL IN REMOVING SMALL TRACES OF CONTAMINATION FROM THE AIR THAT MIGHT AFFECT THE LEAK DETECTOR.

Leak Detector, Electronic

1. Attach a R-134a Manifold Gauge Set to the service gauge port valves as indicated in the instruction manual provided in the A/C service kit.

2. Leave both manifold gauge set valves closed. Both gauges should indicate approximately 60-80 psi (413-551 kPa) at 75°F(24°C) with the engine off.

3. If very little or no pressure in indicated, charge the refrigerant system. Refer to the charging system procedures in this section.

4. Leak test the refrigerant system using a R-134a Automatic Calibration Halogen Leak Detector.

   The R-134a Automatic Calibration Halogen Leak Detector will automatically calibrate itself when switched to the ON position. Move the leak detector probe slowly, approximately 1 (one) inch (25.4 mm) per second, past the suspected area. When escaping refrigerant gas is detected, a ticking or beeping signal will be heard. As the amount of refrigerant gas detected increases, the rate of the ticking or beeping increases. If the refrigerant gas is relatively concentrated, the signal will become increasingly shrill. Follow the instructions included with the leak detector for proper handling and operating techniques.

5. If a leak is found in the refrigerant system, recover the refrigerant and service the system.

A/C Compressor

External Leak Test

1. Key ON, engine running.

2. Turn the A/C system ON.

3. Using a R-134a Automatic Calibration Halogen Leak Detector, check the A/C compressor for leaks.

4. Check the A/C compressor front and rear seals, the center housing seal, the shaft seal, the low- and high-pressure line seals, and around the A/C compressor bolt heads for leakage.

5. After checking the compressor for leaks, turn the A/C system OFF.

6. Key OFF.

7. If an external leak is found at the A/C compressor case, replace the A/C compressor.
   If a new bolt is installed and the A/C compressor still leaks, replace the A/C compressor.

Rotating Torque Check

NOTE: It may be necessary to remove the A/C compressor from the vehicle for this test.

The rotational torque of a used A/C compressor should be checked if excessive A/C compressor drag is suspected.

1. Remove the refrigerant from the system following recommended service procedures. Observe all safety precautions.

2. Remove the refrigerant hose and manifold assembly from the A/C compressor. Use care not to allow dirt to enter the A/C compressor.

3. With the condenser to evaporator tube disengaged, rotate the A/C compressor shaft and note the torque required to rotate the A/C compressor shaft one complete revolution, not the starting torque.

4. If the rotational torque exceeds 7 lb-ft (10 N-m), replace the A/C compressor.

5. If the rotational torque is less than the specified rotational torque, excessive drag does not exist in the A/C compressor. Install the hose and manifold assembly and leak test, evacuate, and charge the system.

6. Check the system for proper operation.

Refrigerant System

The GO-4 vehicle is equipped with non-chloroflourcarbon (non-CFC) air conditioning systems. The new refrigerant used is R-134a, a hydroflourocarbon that has no chlorine molecule, which destroys the atmosphere's ozone layer. R-134a systems function in the same manner as R-12 systems except for minimal operating pressure differences and component variations.

The GO-4 vehicle use the new R-134a A/C system. This system uses different components, refrigerant, and refrigerant oil than the traditional R-12 A/C systems used previously.

It is important to understand that R-134a and R-12 air conditioning systems are not entirely the same. They have components that are slightly different from one another and in some cases service requirements are also different. However, the most important thing to understand is that R-134a refrigerant, refrigerant oil, and components can only be used on R-134a systems while R-12 refrigerant, refrigerant oil, and components can be used only on R-12 systems. While these two types of A/C systems operate and function in a nearly identical manner, the refrigerant, refrigerant oil, and components used in these systems are not compatible.

Also, R-134a systems require the use of dedicated special service tools and equipment. R-134a special service tools and equipment that come in contact with the R-134a refrigerant or refrigerant oil can only be used on R-134a A/C systems. R-12 special service tools and equipment cannot be used on R-134a A/C systems and vice versa.

CAUTION: Using R-12 components, refrigerant or refrigerant oil on an R-134a system will cause damage to the A/C system. Do not replace components, refrigerant, or refrigerant oil from an R-134a system with components, refrigerant, or refrigerant oil for an R-12 system or vice versa. R-12 and R-134a components are not interchangeable. Mixing components from these two types of systems will cause component failure and damage to the A/C system.

Refrigerant System Identification

CAUTION: Do not add R-12 refrigerant to an A/C system that requires the use of R-134a refrigerant. Also, do not add R-134a refrigerant to an A/C system that requires the use of R-12 refrigerant. These two types of refrigerant should be never be mixed. Doing so may cause damage to the A/C system.

Special Service Equipment

CAUTION: Do not use R-12 service tools and equipment when servicing an R-134a system. Also, do not use R-134a service tools and equipment when servicing an R-12 system. Doing so may cause damage to the A/C system.

R-134a systems require the use of special service equipment designed specially for R-134a systems. R-12 servicing equipment cannot be used when servicing R-134a A/C systems. Special servicing equipment includes:

- R-134a Manifold Gauge Set
- R-134a A/C Service Center
- R-134a Automatic Calibration Halogen Leak Detector
- R-134a Vacuum Pump (1.5 CFM)
- R-134a Vacuum Pump (3.0 CFM)
- R-134a Low Side Quick Disconnect
- R-134a High Side Quick Disconnect

For more information on R-134a Service Tools and Equipment, refer to a Tool Equipment Catalog.

Test equipment must be connected to the refrigerant system in order to make system tests. If a charging station is used, follow the instructions of the station manufacturer.

A/C-Heater System Deodorizing

WARNING: AVOID CONTACT WITH EYES AND SKIN. CONTACT WITH EYES AND SKIN WILL CAUSE IRRITATION. WEAR SAFETY GLASSES WHEN USING.

WARNING: THIS PROCEDURE SHOULD ONLY BE PERFORMED IN WELL-VENTILATED AREAS. OPEN ALL WINDOWS AND DOORS OF THE VEHICLE. LEAVE DOORS AND WINDOWS OPEN DURING THE ENTIRE PROCEDURE. AVOID BREATHING VAPORS.

Musty and mildew type odors may come from the air conditioner and heater system. This odor is caused by fungi growth in the A/C evaporator core. It is most noticeable when the A/C is first turned ON. A deodorizer which encapsulates the mildew is available to reduce these odors.

Apply the deodorizer product to the A/C system as directed in the following service procedure.

WARNING: REAL ALL INSTRUCTIONS AND WARNINGS PACKAGED WITH THE DEODORIZER.

WARNING: AVOID FLAMES, SPARKS OR LIT TOBACCO PRODUCTS. THIS PRODUCT IS COMBUSTIBLE.

1. Set the climate control assembly to the A/C position.
2. With the fan blower motor operating in high speed, spray 3 ounces (89 ml) of the deodorizer product into the fresh air inlet at LH front.
3. With the climate control assembly still set to the A/C position:
   a. Move the heat/cold control to the full cold position.
   b. Set the heater valve shutoff for air conditioning.
4. With the blower motor operating in high speed:
   a. Spray about 1-1/2 ounces (44 ml) of the deodorizer produce into the recirculate air opening (located in the ?
   b. Set the temperature control to provide full heat.
   c. Spray an additional 1-1/2 ounces (44 ml) of the deodorizer product into the recirculate air opening.
5. Shut the A/C system blower OFF.
6. Spray equal amounts of the remaining 4 ounces (118 ml) of the deodorizer product into each of the air outlet openings (instrument panel registers and defrosters).
7. Allow the vehicle to sit for about 30 minutes before returning it to the customer.

Refrigerant Recovery

If a R-134a A/C Service Center or equivalent is used, the following general procedures should be observed, in addition to the operating instructions provided by the equipment manufacturer.

WARNING: USE EXTREME CARE AND OBSERVE ALL SAFETY AND SERVICE PRECAUTIONS RELATED TO THE USE OF REFRIGERANTS.

1. Connect the R-134a A/C Service Center or equivalent hose(s) to the vehicle service gauge ports and the recovery station inlet fitting.
2. NOTE: Hoses should have shutoff devices or check valves within 12 inches (305 mm) of the hose end to minimize the introduction of non-condensable gases (air) into the recovery station, as well to minimize the amount of refrigerant released when the hoses are disconnected.

   Turn on the power to the recovery station to start the recovery process. Allow the recovery station to pump the refrigerant from the system until the station pressure goes into a vacuum. On some stations, the pump will be shut off automatically by a low-pressure switch in the electrical system. On other units, it may be necessary to manually turn off the pump.
3. Once the recovery station has recovered the vehicle A/C system refrigerant, close the station inlet valve (if so equipped). Then switch off the power supply.
4. Allow the vehicle A/C system to remain closed for about two minutes. Observe the system vacuum level as shown on the

gauge. If the pressure does not rise, disconnect the recovery station hose(s).

5. If the system pressure rises, repeat steps 2,3, and 4 until the vacuum level remains stable for two minutes.

6. Perform the required service operations, then evacuate and recharge the A/C system. Refer to the procedure in this section.

Refrigerant Reclaiming/Recovery/Recycling Equipment

R-134a A/C Service Center or equivalent allows the recovery and reuse of A/C system refrigerant after contaminants and moisture have been removed from the refrigerant.

A/C Manifold Gauge Set Connection

Test equipment must be connected to the refrigerant system in order to make system tests. If a charging station is used, follow the instructions of the station manufacturer. If a manifold gauge set is used, connect it as outlined.

1. Turn both manifold gauge set valves all the way to the right to close the high- and low-pressure hoses to the center manifold and hose. Use R-134a High Side Quick Disconnect and R-134a Low Side Low Side Disconnect to connect the R-134a Manifold Gauge Set or R-134a A/C Service Center to the service gauge port valves.

2. Remove the caps from the high- and low-pressure service gauge port valves.

3. Connect the high- and low-pressure hoses, or adapters, to the respective high- and low-pressure service gauge port valves.

System Discharging

The following general procedures should be observed in addition to the operating instructions provided by the equipment manufacturer.

WARNING: USE EXTREME CARE AND OBSERVE ALL SAFETY AND SERVICE PRECAUTIONS RELATED TO THE USE OF REFRIGERANTS.

NOTE: Hoses should have shutoff devices or check valves within 12 inches (305 mm) of the hose end to minimize the introduction of non-condensable gases (air) into the recycling station and to minimize the amount of refrigerant released when the hose(s) is disconnected.

1. Connect the hose(s) of the R-134a A/C Service Center or equivalent to the vehicle A/C service ports and the recovery station inlet fitting.

2. Turn the power to the R-134a A/C Service Center or equivalent on to start the recovery process. Allow the R-134a A/C Service Center or equivalent to pump the refrigerant from the system until the station pressure goes into a vacuum. On some stations the pump will be shut off automatically by a low-pressure switch in the electrical system. On some other units, it may be necessary to manually turn off the pump.

3. Once the R-134a A/C Service Center or equivalent has evacuated the vehicle A/C system, close the station inlet valve. Then, switch off the electrical power.

4. Allow the vehicle A/C system to remain closed for about two minutes. Observe system vacuum level as shown on the gauge. If the pressure does not rise, disconnect the hose(s) of the R-134a A/C Service Center or equivalent.

5. If the system pressures rises, repeat steps 2,3, and 4 until the vacuum level remains stable for 2 minutes.

6. Perform required service operations, evacuate and recharge the A/C system.

System Evacuating

1. If not yet connected, connect the R-134a Manifold Gauge Set or equivalent as outlined.

2. Leak test this system. Refer to the procedure in this section.

3. Discharge the refrigerant system. Refer to the procedure in this section.

4. Ensure that both manifold gauge valves are turned all the way to the right.

5. Ensure that the center hose connection at the manifold gauge is tight.

6. Connect the R-134a Manifold Gauge Set or equivalent center hose to a R-134a Vacuum Pump or equivalent.

7. Open the manifold gauge set valves and start the vacuum pump.

8. Evacuate the system with the vacuum pump until the low-pressure gauge reads at least 25 in-Hg (84.2 Kpa) (vacuum) or as close to 30 in-Hg (101.04 kPa) as possible. Continue to operate the vacuum pump for 15 minutes.

   If a part of the system has been replaced, continue to operate the vacuum pump for another 20 to 30 minutes.

9. When the evacuation of the system is complete, close the manifold gauge set valves and turn the vacuum pump off.

10. Observe the low-pressure gauge for 5 minutes to ensure that system vacuum is held. If vacuum is held, charge the system. If vacuum is not held for 5 minutes, leak test the system, service the leaks, and evacuate the system again.

System Flushing

In order to minimize the discharge of refrigerant into to the atmosphere, use efficient methods of recovery and recycling of the refrigerant used in the A/C equipped vehicles. Use a Underwriters Laboratories approved recovery/recycling device which meets the SAE Standard J1991 during any A/C system repair and recharge procedure requiring system discharge.

System Charging Set-Up

Use a R-134a A/C Service Center to perform evacuation and charging of the refrigerant system. Follow the instructions provided with the R-134a AC Service Center.

If an R-134a A/C Service Center or equivalent is not available, system charging may be accomplished using a separate R-134a Vacuum Pump or equivalent, charging cylinder and R-134a Manifold Gauge Set or equivalent. The use of small cans of refrigerant is not recommended.

If the charging cylinder method is used, the center port of the manifold gauge set should have two refrigerant hoses with integral shut-off valves built into the manifold gauge set. The R-134a Manifold Gauge Set is equipped in this manner. If the gauge set is the type that does not have shut-off valves and two hoses at the center port, a tee fitting and two hoses should be installed at the center port.

In addition, the hoses attached to the center port should have shut-off valves at the other ends of the two center hoses to prevent air from entering the hoses when not connected to the vacuum pump and charging cylinder.

System Charging

Charging With a Charging Cylinder

1. With the R-134a Manifold Gauge Set or equivalent valves closed to the center hose, disconnect the vacuum pump from the manifold gauge set.

2. NOTE: Use only a safety-type dispensing valve.

   Connect the center hose of the manifold gauge set to a refrigerant drum.

3. Loosen the center hose at the manifold gauge set and open the refrigerant drum valve. Discharge the refrigerant. Refer to the procedure in this section.

4. Disconnect the wire harness snap lock connector from the A/C pressure cut-off switch and install a jumper wire across the two terminals of the connector.

5. Open the manifold gauge set low side valve to allow refrigerant to enter the system. Keep the refrigerant can in an upright position.

6. When no more refrigerant is being drawn into the system, start the engine, set the heat/cold control to full cool position, turn the fan switch to position 2, and depress the A/C switch to draw the remaining refrigerant into the system. Continue to add refrigerant to the system until the specified weight of the R-134a is in the system. Then close the manifold gauge set low-pressure valve and the refrigerant supply valve.

7. Remove the jumper wire from the refrigerant pressure switch snap-lock connector. Connector the connector to the A/C pressure cut-off switch.

8. Operate the system until the pressures stabilize to verify normal operation and system pressures.

9. In high ambient temperatures, it may be necessary to operate a high volume fan positioned to blow air through the radiator and A/C condenser core to aid in cooling the engine and prevent excessive refrigerant system pressures.

10. When charging is completed and system operating pressures are normal, disconnect the manifold gauge set from the vehicle. Install A/C charging valve caps on the service gauge port valves.

Refrigerant System Filtering After A/C Compressor Replacement

A/C service kit is available to provide the necessary equipment and information to perform the A/C system filtering procedure. Filter kits with the service F2VY-19E773-D is to be used on with rubber lined suction hose.

CAUTION: Follow all refrigerant system safety and service precautions as outlined.

1. To determine that the A/C compressor has failed and must be replaced, remove the A/C evaporator expansion valve and liquid line, if necessary. Look for a dirty A/C evaporator expansion valve and/or a liquid line containing black refrigerant oil and particles.

2. Remove the damaged A/C compressor. Refer the procedure in this section and drain the oil into a calibrated container.

3. NOTE: The proper amount of refrigerant oil must be added to the new A/C compressor before it can be installed.

   NOTE: It will be necessary to transfer the A/C compressor clutch from the old A/C compressor to the new A/C compressor. Install the new A/C compressor. Refer to Section 22-3 for the installation procedure. Be sure the A/C compressor bolts are tightened to the proper specifications. Check the tension of the drive belt.

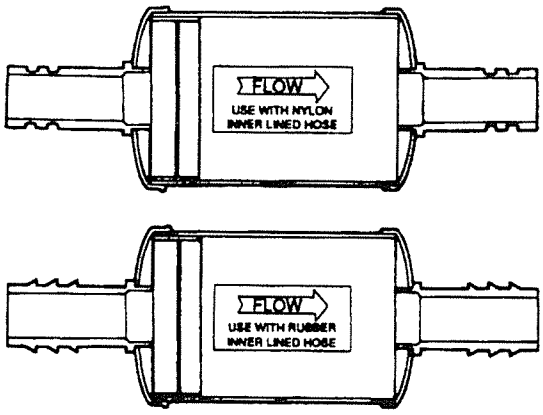
4. Remove the suction receiver/drier and drain the oil in into a calibrated container. Refer to the procedure in this section.

5. Add clean refrigerant oil to the new suction receiver/drier in the same amount that was removed from the old unit, plus an additional 34 oz. (10 ml) of new refrigerant oil.

6. Install the suction receiver/drier in the vehicle. Refer to the procedure in this section.

7. Determine the type of suction hose with which you are working. To do this, cut the suction hose into two pieces (make the cut closer to the A/C compressor that the suction receiver/drier) and measure the hose wall thickness. Rubber lined hose has a wall thickness of 1/4 inch and nylon lined hose has a thickness of 1/8 inch.

8. Obtain the proper service kit for the vehicle being serviced. Filter kits with service part number suffix "C" are used on vehicles with a nylon lined suction hose. Filter kits with the service part number suffix "D" are for vehicles with a rubber lined suction hose. The label on the filter shows with which hose it is to be used.

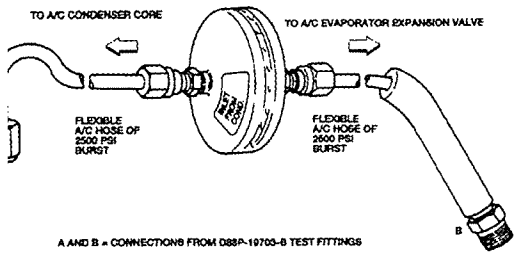


9. Remove the length of suction hose to accommodate the suction filter and install the filter using the hose clamps provided with the kit. Be sure the filter is correctly oriented for refrigerant system flow. Check the label on the filter. On the filter for nylon lined hose, install O-ring seals (two on each

filter tube, being sure they are properly seated in the grooves on the tube). Tighten the hose clamps securely.

10. Install a new A/C evaporator expansion valve.

11. Install a pancake filter in the liquid line between the A/C condenser core and the A/C evaporator expansion valve. Be sure the filter inlet is toward the A/C condenser. Connections can be made using A/C Test Adapter Kit or equivalent and flexible refrigerant hose of 2500 psi burst rating. Individual fittings are also available.



12. Evacuate, charge, and leak test the system. Refer to the procedure in this section.

13. Check all refrigerant system hoses, lines and the positioning of the newly installed filters to be sure they do not interfere with other engine compartment components. If necessary, use tie straps to make adjustments.

14. Provide adequate air flow to the front of the vehicle (with a fan, if necessary) and turn the A/C switch on. Set the heater blower motor switch on maximum and the temperature control lever at full cool. Start the engine and let it idle briefly. Make sure the A/C system is operating properly.

15. Gradually bring the engine speed up to 1200 rpm by running it at lower rpms for short periods (first at 800 rpm, then at 1000 rpm). Set the engine at 1200 rpm and run it for an hour with the A/C system operating.

16. Stop the engine.

17. Allow the engine to cool sufficiently to remove the fittings, flexible hoses and pancake filter from the liquid line. It will be necessary to discharge the system first. Refer to the procedure in this section.

18. Discard the pancake filter. It can be used ONE TIME ONLY.

19. Reconnect the liquid line back into the system.

20. Evacuate, charge, and leak test the system. Refer to the procedure in this section. Make any necessary adjustments.

21. Check the operation of the A/C system in all modes.

Suction Receiver/Drier Replacement Guidelines

Replace the suction receiver/drier when:

- The suction receiver/drier is restricted, plugged or perforated.
- The refrigerant system has been left open for more that four hours or completely discharged for 24 hours or more.
- There is evidence of moisture in the system (for example, internal corrosion of the metal lines or dark, thick refrigerant oil).
- A component such as the A/C condenser core, A/c evaporator core, A/C compressor, or a refrigerant line is replaced.

Refrigerant Oil Addition

NOTE: The R-134a refrigerant oil specification was not available at the time this manual was printed.

When replacing components of the air conditioning refrigeration system, measured quantities of a special polyalkylene glycol (PAG) oil should be added to the replacement components. It is important that only the specified type and quantity of refrigerant oil be used. A surplus of oil will reduce the cooling capacity of the system. Too little oil will result in poor lubrication of the A/C compressor.

During A/C Compressor Replacement

When replacing the A/C compressor, measure quantities of a special polkyalkylene (PAG) refrigerant oil should be added to the A/C compressor. It is important that only the

specified type and quantity of refrigerant oil be used. A surplus of oil will reduce the cooling capacity of the system. Too little oil will result in poor lubrication of the A/C compressor.

When the A/C compressor operates, oil gradually leaves the A/C compressor and circulates through the system with the refrigerant. Eventually a balanced condition is reached in which a certain amount of oil is retained in the A/C compressor and a certain amount is continually circulated. If the A/C compressor is removed after the system has been operated, some oil will go with it. To maintain the original oil charge, it is necessary to compensate for the amount of oil lost with the old A/C compressor by adding an equal amount of the new A/C compressor. Clean refrigerant oil should be added to the replacement A/C compressors as follows:

A new service replacement A/C compressor contains 5.91 fluid ounces (175 ml) of the specified refrigerant oil. Prior to installing the replacement A/C compressor, drain the oil into a clean calibrated container. Then drain the oil from the old A/C compressor into another clean calibrated container. Add the same amount of clean refrigerant oil as removed from the old A/C compressor to the new A/C compressor, plus 0.6762 fluid ounces (20 ml).

R-134a Refrigerant Oil

CAUTION: Do not add R-134a refrigerant oil to an R-12 system. Also, do not add R-12 refrigerant oil YN-9 to an R-134a system. Mixing these two types of refrigerant oils may cause poor lubricant circulation resulting in component failure and damage to the A/C systems.

The refrigerant oil required for R-134a A/C systems is a polyalkylene glycol (PAG) oil. This type of refrigerant oil was made specifically for R-134a systems and is not suitable for use in R-12 systems. Never use an R-134a refrigerant oil in R-12 systems.

R-12 systems require the use of a mineral based refrigerant oil with special additives known as YN-9. This type of refrigerant oil was made specifically for R-12 systems and is not suitable for use in R-134a systems. Never use R-12 refrigerant oil YN-9 in R-134a systems.

During Component Replacement

When the A/C compressor operates, oil gradually leaves the A/C compressor and circulates through the system with the refrigerant. Eventually a balanced condition is reached in which a certain amount of oil is retained in the A/C compressor and a certain amount is continually circulated. If a refrigerant system component is removed after the system has been operated, some oil will go with it. To maintain the original oil charge, it is necessary to compensate for the amount of oil lost with the old component. Clean refrigerant oil should be added to the replacement components as follows:

- A/C evaporator core - Add 1.7 fluid ounces (50 ml).
- A/C condenser core - Add 1 (one) fluid ounces (30 ml).
- Suction receiver/drier - Drain the oil from the old suction receiver/drier. Add the same amount plus 0.34 fluid ounce (10 ml) of clean refrigerant oil to the new suction receiver/drier.

Pour clean refrigerant oil directly into the replacement component.

Other Refrigeration System Components

If any other components or a refrigerant line are replaced, no additional refrigerant oil is necessary.

Inspection and Assembly Requirements

NOTE: Any time a hose or component connection leak is observed, to correctly service the leak, the connector fitting must be separated, cleaned, and a new O-ring installed. The O-ring and connector surfaces should be lubricated with clean refrigerant oil prior to assembly.

O-ring seal surfaces must be free of dirt, lint, burrs, and scratches.

All O-rings must be lubricated with clean refrigerant oil immediately prior to installation.

SPECIFICATIONS

Refrigerant System Specifications

Refer to Section 22-3 for refrigerant system capacities and electrical specifications

SERVICE TOOLS/EQUIPMENT

- A/C Test Adaptor Kit
- Digital Multimeter
- Radiator/Heater Core Pressure Tester
- R-134a A/C Service Center
- R-134a Automatic Calibration Halogen Leak Detector
- R-134a Manifold Gauge Set
- R-134a Low Side Quick Disconnect
- R-134a High Side Quick Disconnect
- R-134a Vacuum Pump (1.5 CFM)
- R-134a Vacuum Pump (3.0 CFM)

SECTION 22 - 1 -Heating and Air Conditioning, Heating and Defrosting

DESCRIPTION AND OPERATION

The heating system heats the ventilating air of the vehicle as required for passenger comfort. The heating system consists of:

- Heater core.
- Blower motor.
- Heater core case.
- Control assembly.
- Interior vehicle warmth.
- Windshield defrosting/defogging.

Fan Speed Control

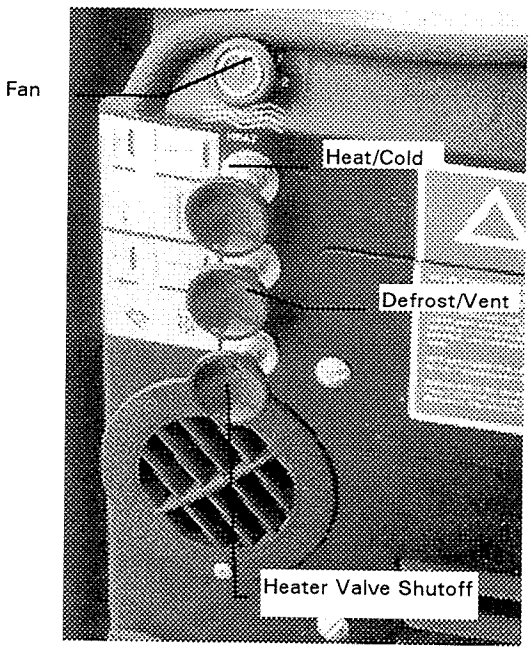
The two speed fan speed control switch determines the speed at which the blower motor operates. Each position of the fan speed control switch is detented for positive engagement of fan speed.

Heat/Cold Control

Temperature is controlled by pulling control for more heat. Push in to reduce heat. The heat/cold control controls the temperature of the heating, defrosting and A/C system (if equipped) between the cool (push in) and the warm (pull out) side

Defrost/Vent Control

Air can be directed to defrost the front window or to heat the passenger compartment. Pull or pushing the control directs the heated or cooled air in the passenger compartment.

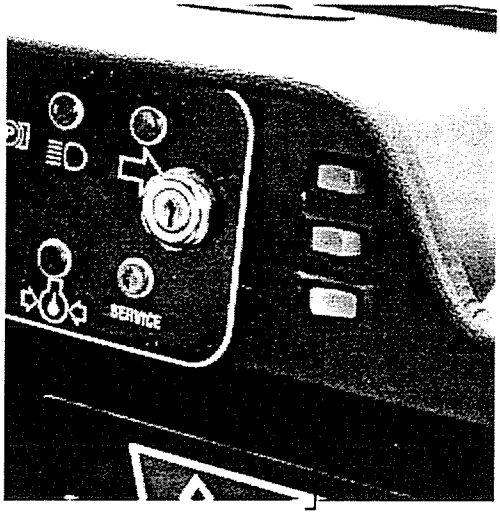


Heater Valve Shutoff Control (A/C only)

The heater valve shutoff control is located below the heater. It is used with air conditioning equipped vehicles. Pull control to shut off the control valve and prevent heat from entering the compartment. Close the Heater Valve Shut- off valve before operating the auxiliary rocker switch for the air conditioner.

Air Conditioner (if equipped)

The air conditioning control switch engages the air conditioning system. Push the bottom illuminated rocker switch to operate the A/C system. Make sure the heater shutoff valve is closed when using the air conditioning.



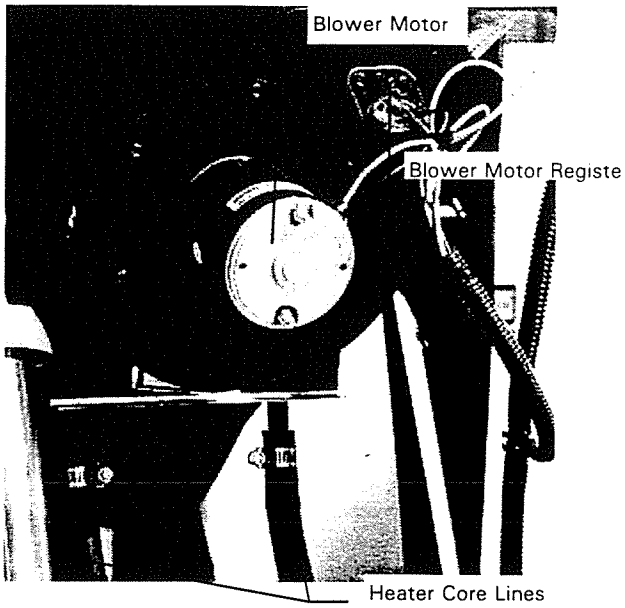
Air Conditioning Switch

Blower Motor

Outside air enters the heater core case through the front of the vehicle and is forced by the blower motor through the heater core case. The blower motor is located under the instrument panel cover. Operation of the blower motor is by the fan speed control mounted on the LH side of the instrument panel. The blower can be operated at one of two speeds.

Blower Motor Resistor

A blower motor resistor controls the two blower motor speeds. It is mounted above the blower motor in the blower motor housing.



Heater Core

The heater core has fins and tubes that are positioned to extract available heat from the engine coolant and transfer that heat to the air that passes through the core.

To modulate the temperature of the discharged air, a portion of the incoming air is bypassed around the heater core by the temperature blend door. When the heat is not required, the air completely bypasses the heater core. Maximum heater output is obtained at 100 percent airflow through the heater core.

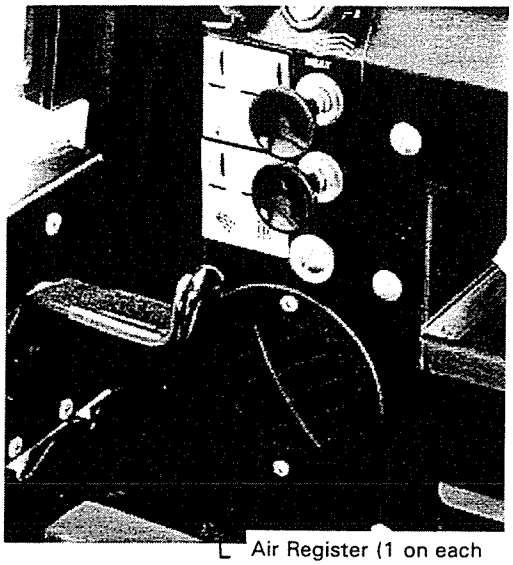
System Airflow

The volume of air moving through the climate control system is controlled by the fan speed switch to the blower motor. The path that the air takes as it moves through the climate control system is controlled by the position of the controls on the climate control assembly. The position of the controls the positions of the air flow doors. When the fan speed is OFF, there is no air flow through the system unless the vehicle is in motion.

Instrument Panel Ducts

The GO-4 has four instrument panel ducts. The ducts are louvered, adjustable type. Two instrument panel top ducts direct air to the front window.

Two panel-mounted ducts direct air to the passenger compartment or side windows.



Air Register (1 on each side of instrument panel

Safety Precautions

Whenever components in the engine compartment or behind the instrument panel are being serviced, the battery ground cable must be disconnected to eliminate the possibility of electrical shorts, burned wiring, and fires. Extreme care must be exercised when performing electrical tests where the battery must be connected to operate the system.

WARNING: CARBON MONOXIDE IS COLORLESS, ODORLESS AND DANGEROUS. IF IT IS NECESSARY TO OPERATE THE ENGINE WITH THE VEHICLE IN A CLOSED AREA SUCH AS A GARAGE, ALWAYS USE AN EXHAUST COLLECTOR TO VENT THE EXHAUST GASES OUTSIDE THE CLOSED AREA.

DIAGNOSIS AND TESTING

Heating and Defrosting

Refer to this section to diagnose the heating and defrosting system.

REMOVAL AND INSTALLATION

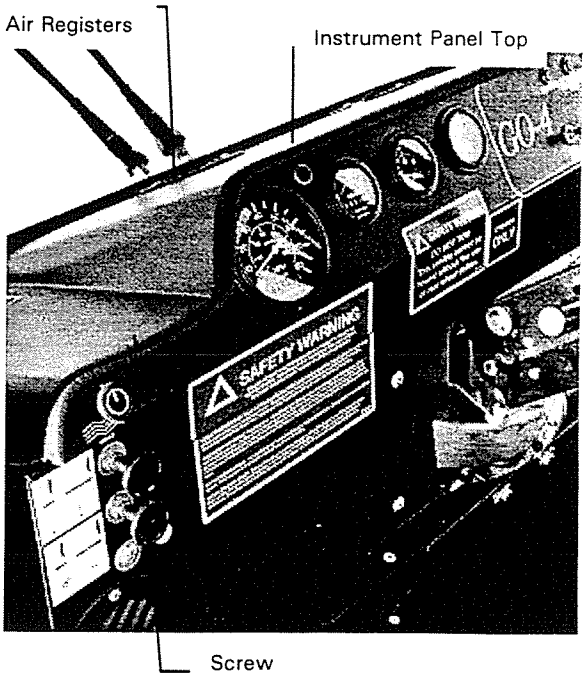
Instrument Panel Top

Removal

1. Remove four screws which secure the instrument panel top to the instrument panel assembly.
2. Remove the instrument panel top from the instrument panel assembly.
2. Disconnect the battery ground cable.

Installation

Install the instrument panel top in reverse order or removal.



Climate Controls

Temperature (Heat/Cold) Control

Removal and Installation

1. Remove the LH upper front filler panel screws. Drill out the pop rivet on the lower RH corner of the filler panel
2. Remove the LH upper front filler panel.
3. Remove the instrument panel top from the instrument panel. Refer to procedure in this section.
4. Disconnect the battery ground cable.
5. Disconnect the temperature cable end to the damper door on the heater core case.

   NOTE: Remove screw and clamp which holds cable to the heater core case.
6. Loosen and remove the nut on the back of the heat/cold control. This secures it to the back of the dash panel.
7. Remove the heat/cold cable assembly.

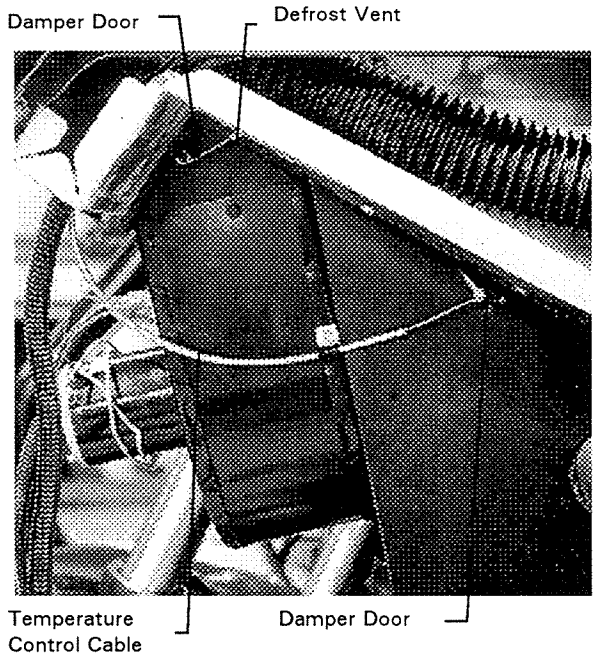
Install the heat/cold cable in the reverse order of removal. Tighten the nut to the back of the dash panel.

Defrost/Vent Control

Removal and Installation

1. Remove the LH upper front filler panel.
2. Remove the LH upper front filler panel screws.
3. Drill out the pop rivet on the lower RH corner of the filler panel.
4. Disconnect the battery ground cable.
5. Disconnect the cable end to the upper damper door on the heater core case.
6. Loosen and remove the nut on the back of the defrost/vent control. This secures it to the back of the dash panel.
7. Remove the defrost/vent cable assembly.

   Install the defrost/vent cable in the reverse order of removal. Tighten the nut to the back of the dash panel.

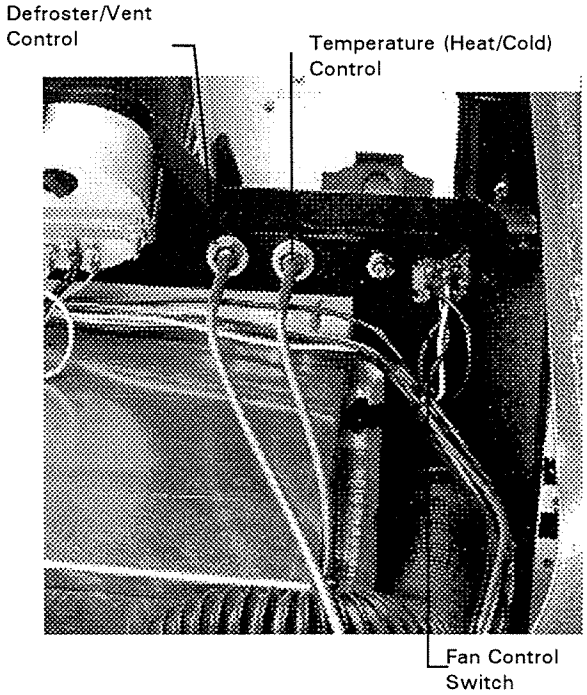


Fan Speed Control

Removal and Installation

1. Disconnect the battery ground cable.
2. Disconnect the wires which connect to the back of the fan speed control switch.
3. Mark each wire connection to the connectors on the back of the fan speed control switch.
4. Pull the knob off the fan speed control switch.
5. Loosen and remove the nut on the front of the fan speed control switch.
6. Remove the fan speed control switch.

   Install the fan speed control switch in the reverse order of removal. Tighten the nut on fan speed control switch to the front of the dash panel.



Heat Valve Shutoff Control (A/C only)

Removal and Installation

1. Remove the LH upper front filler panel screws. Drill out the pop rivet on the lower RH corner of the filler panel.

2. Remove the LH upper front filler panel. Remove the hood.

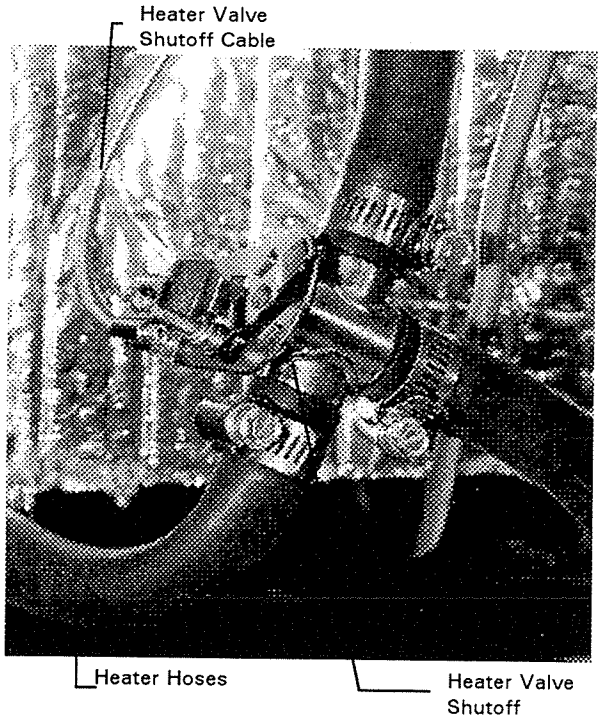
3. Remove instrument panel top from the instrument panel. Refer to removal procedure in this section.
4. Disconnect the battery ground cable.

5. Disconnect the cable end to the heater valve door on the heater valve shutoff

   NOTE: Remove screw and clamp which holds cable to the heater valve shutoff case.
6. Loosen and remove the nut on the back of the heater valve shutoff control. This secures it to the back of the dash panel.

7. Remove the heater valve shutoff cable assembly.

Install the heater valve shutoff in the reverse order of removal. Tighten the nut to the back of the dash panel.



Adjustable Defroster Vents

Removal

1. Remove the instrument panel top screws.

2. Remove the instrument panel top.

3. Remove the defroster vent clamp.

4. Carefully pull away the heater duct from the adjustable defroster vents.

5. Remove two screws on each defroster vent.

6. Remove the defroster vents from the instrument panel or the instrument panel top.

Installation

Install the adjustable defroster vent in the reverse order of removal.

Heater Core Case

Removal

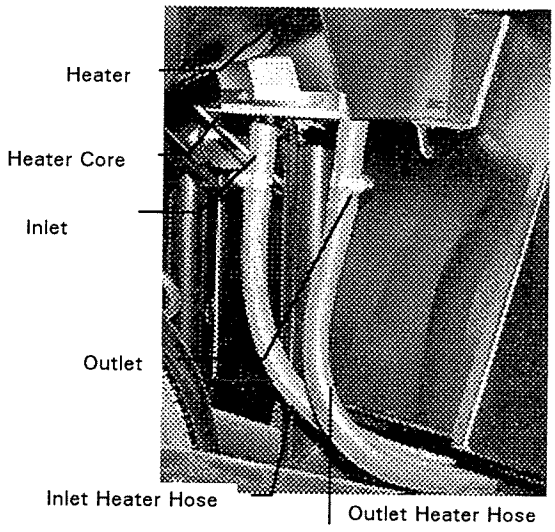
1. Drain the cooling system. Refer to Section 15 for the procedure.

2. Remove the instrument panel top. Refer to the removal procedure in this section.

3. Remove the front hood panel.

4. Remove the LH upper front filler panel.

5. Remove hose clamps. Disconnect the inlet heater hose and outlet heater hose in the front compartment.



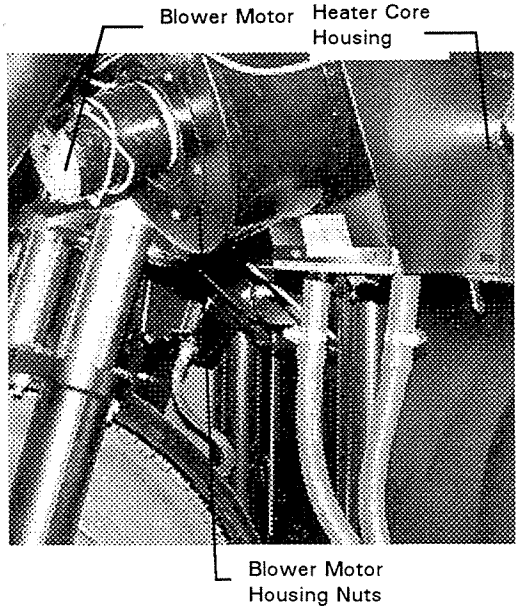
6. Disconnect the heat/cold control and defrost/vent control cables from the heater core case.

7. Remove two screws on the lower front of the heater core housing.

8. Remove the heater core from the bottom of the heater core housing.

Installation

To install, reverse the removal procedure.



Blower Motor and Blower Fan Assembly

Removal

1. Disconnect the battery ground cable.
2. Remove the blower motor housing nuts.
3. Pull the blower motor housing out from the heater core housing.
4. Remove the blower fan circlip
5. Remove the blower fan.

Installation

To install, reverse the removal procedure.

Heater Ducts

Removal and Installation

1. Remove the instrument panel top. Refer to this section for the removal and installation procedure.
2. Remove the clamps holding the heater ducts to the defroster vents and to the heater housing outlets.
3. Remove the heater ducts.

   Install heater ducts in the reverse order of removal.

Heater Water Hoses - Inlet

Removal

1. Drain the cooling system. Refer to Section 15 for the procedure.
2. Loosen the hose clamp nuts and move the hose clamps back onto the inlet heater water hose at both ends of the inlet water hose.
3. Pull the inlet heater water hose off the heater core inlet tube and off the elbow on the intake manifold.
4. Remove the hose tray under the LH side of the vehicle.
5. Remove the inlet heater water hose.

Installation

To install, reverse the removal procedure.

Heater Water Hoses - Outlet

Removal

1. Drain the cooling system. Refer to Section 15 for the procedure.
2. Loosen the hose clamps and move the clamps back onto the outlet heater water hose at both ends of the outlet heater water hose.
3. Pull the outlet heater water hose off the heater core outlet tube and off the heater hot water tube.
4. Remove the hose tray under the LH side of the vehicle.
5. Remove the outlet heater water hose.

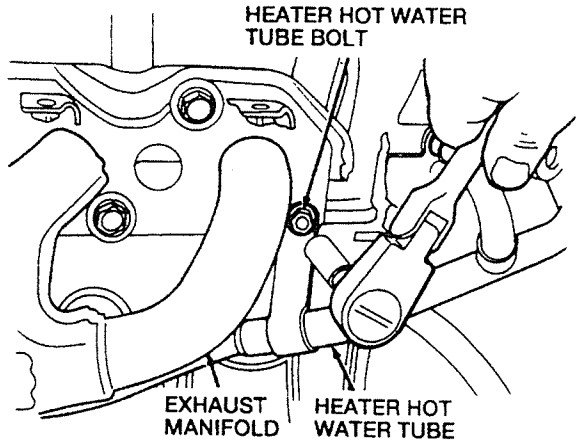
Installation

To install, reverse the removal procedure.

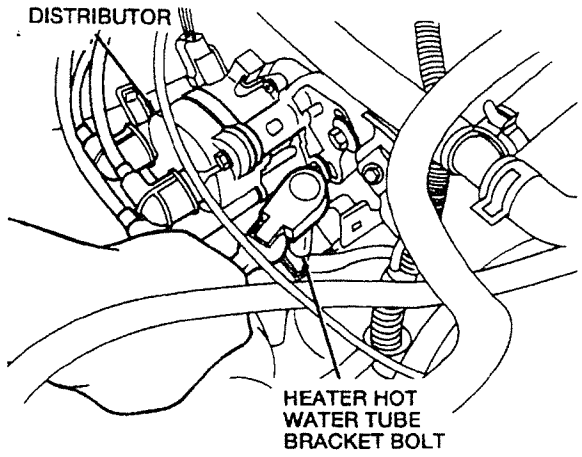
Heater Hot Water Tube

Removal

1. Drain the cooling system. Refer to Section 15 for the procedure.
2. Remove the outlet hose from the heater hot water tube.
3. Remove the coolant bypass tube from the heater hot water tube.
4. Remove the heater hot water tube bolt.



5. Remove the heater hot water tube bracket bolt.



6. Remove the heater hot water tube from the water pump inlet connector.
7. Inspect the heater hot water tube O-ring for damage. Replace, if necessary.

Installation

To install, reverse the removal procedure.

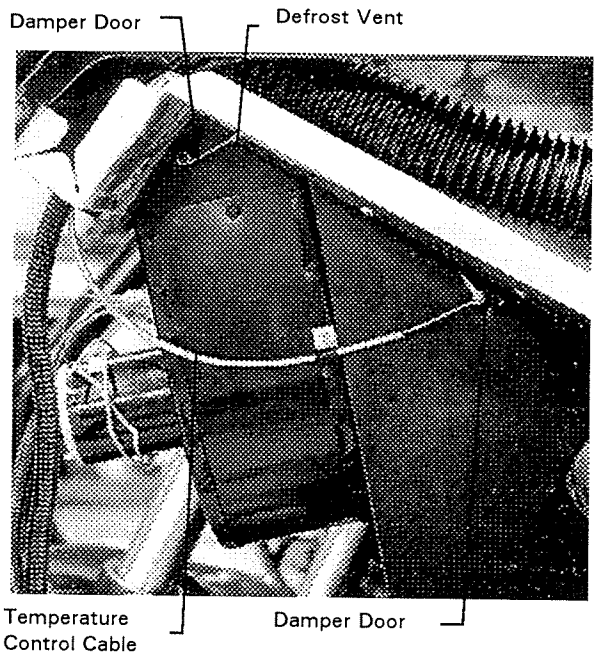
ADJUSTMENTS

Defrost/Vent Control Cable

1. Move the Defrost/Vent cable to the defrost position.
2. While holding down the air flow door against its stop, secure the Defrost/Vent cable over the air flow door arm.
3. Verify that the Defrost/Vent control cable moves it full stroke.

Temperature (Heat/Cold) Control Cable

1. Move the Heat/Cold control to the full hot position.
2. Connect the Heat/Cold control cable to the heat/cold door arm.
3. Set the door to the hot position and secure the Heat/Cold control cable into place.
4. Verify that the Heat/Cold control cable moves its full stroke.



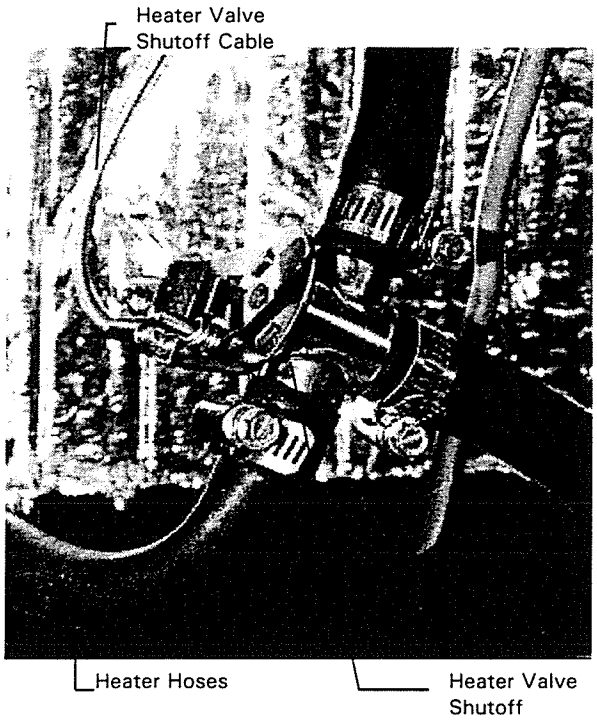
Heater Valve Shutoff Control Cable (air conditioned equipped units only)

1. Move the Heater Valve Shutoff control cable to the full hot position.

2. Connect the Heater Valve Shutoff control cable to the heat/cold door arm on the valve.

3. Secure the Heater Valve Shutoff control cable into place.

4. Verify that the Heater Valve Shutoff control cable moves its full stroke.



SECTION 22 - 2 - Heating and Air Conditioning, Air Conditioning

DESCRIPTION AND OPERATION

R-134a Refrigerant System

WARNING: AVOID BREATHING A/C REFRIGERANT AND LUBRICANT VAPOR OR MIST. IF ACCIDENTAL SYSTEM DISCHARGE OCCURS, VENTILATE THE WORK AREA BEFORE RESUMING SERVICE.

WARNING: WEAR IMPERVIOUS GLOVES AND SAFETY GOGGLES AT ALL TIMES WHEN HANDLING LIQUID REFRIGERANT. SHOULD ANY LIQUID REFRIGERANT GET INTO THE EYES OR ON THE SKIN, IMMEDIATELY FLUSH EYES AND SKIN WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES. REMOVE CONTAMINATED CLOTHING AND SHOES. CALL A PHYSICIAN.

WARNING: REFRIGERANT HFC-134a IS ALWAYS UNDER PRESSURE. BECAUSE THE SYSTEM IS TIGHTLY SEALED, HEAT APPLIED TO ANY PART COULD CAUSE THIS PRESSURE TO BUILD UP EXCESSIVELY. TO AVOID A DANGEROUS EXPLOSION, KEEP AWAY FROM OPEN FLAMES, GLOWING METAL SURFACES, BLOW TORCH, STEAM CLEANING AND WELDING. HFC-134a CAN BE DECOMPOSED AT HIGH TEMPERATURES.

WARNING: ALWAYS WEAR SAFETY GOGGLES WHEN SERVICING ANY PART OF THE REFRIGERANT SYSTEM.

WARNING: EXTREME CARE MUST BE TAKE TO PREVENT ANY LIQUID REFRIGERANT FROM COMING IN CONTACT WITH THE SKIN, AND ESPECIALLY THE EYES.

CAUTION: Using R-12 components, refrigerant or refrigerant oil on an R-134a system will cause damage to the A/C system. Do not replace

damage to the A/C system. Do not replace components, refrigerant, or refrigerant oil from an R-134a system with components, refrigerant, or refrigerant oil for an R-12 system or vice versa. R-12 and R-134a components are not interchangeable. Mixing components from these two types of systems will cause component failure and damage to the A/C system.

CAUTION: The refrigerant used in this refrigerant system is HFC-134a (Tetraflouroethane) which is a hydroflourocarbon refrigerant. HFC-134a, is also known as R-134a is non-corrosive, non-explosive, non-flammable and slight ethereal type odor. HFC-134a is heavier than air. Although it is classified as a safe refrigerant, certain precautions must be observed to protect the parts involved and the person working on the unit.

CAUTION: Use only R-134a refrigerant. Due to environment concerns, when the air conditioning system id drained, the refrigerant must be collect using refrigerant recovery/recycling equipment meeting SAE standards J1990 and J2210. HFC-134a must never removed without the appropriate equipment or release into the atmosphere. Use of a recovery machine dedicated for R-134a is necessary to reduce the possibility of oil and refrigerant incompatibility concerns. Refer to the instructions provided by the equipment manufacturer when removing refrigerant from or installing refrigerant into the air conditioning system.

CAUTION: Liquid R-134a, at normal atmospheric pressures and temperatures, evaporates so quickly that it has a tendency to freeze anything it contacts. Extreme care must be taken to prevent any liquid refrigerant from coming in contact with the skin and especially the eyes.

CAUTION: Ensure that refrigerant containers are never heated to over 125°F (52°C). Refrigerant containers should be stored and installed in accordance with all state and local ordinances.

CAUTION: When admitting R-134a into the refrigerant system, always keep the tank in an upright position. If the tank is on its side or upside down, liquid R-134a will enter the system and may damage the A/C compressor.

CAUTION: Refrigerant R-134a should not be mixed with air for leak testing or used with air for any other purpose above atmospheric pressure. R-134a is combustible when mixed with high concentrations of air and high pressures.

Prompted by environmental concerns, GO-4 vehicles are equipped with non-chloroflourocarbon (non-CFC) air conditioning systems. The R-134a refrigerant, a hydro-flourocarbon that has no chlorine molecule, which destroys the atmosphere's ozone layer. R-134a systems function in the same manner as R-12 systems except for minimal operating pressure differences and component variations. This systems uses different components, refrigerant, and refrigerant oil than the traditional R-12 A/C systems used in previous years.

It is important to understand that R-134a and R-12 air conditioning systems are not entirely the same. They have components that are slightly different from one another and in some cases service requirements are also different. However, the most important thing to understand is that R-134a refrigerant, refrigerant oil, and components can only be used in R-134a systems while R-12 refrigerant, refrigerant oil, and components can only be used only on R-12 systems. While these two types of A/C systems operate and function in a nearly identical manner, the refrigerant, refrigerant oil, and components used in these systems are not compatible.

Also, R-134a systems require the use of dedicated service tools and equipment. R-134a special service tools and equipment that come in contact with R-134a refrigerant or refrigerant oil can only be used on R-134a A/C systems. R-12 special service tools and equipment cannot be used on R-134a A/C systems and vice versa.

A/C Refrigerant System Operation

The air conditioning system consists of:

- A/C compressor
- A/C condenser core
- Suction receiver/drier
- A/C evaporator core
- A/C condenser cooling fan
- A/C evaporator expansion valve
- Evaporator to compressor suction line
- A/C compressor to condenser discharge line
- A/C control rocker switch
- A/C pressure cut-off switch
- A/C evaporator temperature control thermostat
- Heater valve shutoff control

The GO-4 uses an expansion valve type of refrigerant control system. When the passenger compartment cooling is required, depress the A/C rocker switch on the instrument panel. The refrigerant cycle is controlled by an A/C evaporator expansion valve mounted inside the A/C evaporator case. The A/C evaporator expansion valve senses A/C evaporator core temperature and opens or closes slightly to control the amount of refrigerant circulating through the A/C evaporator core and A/C compressor.

The A/C compressor is located in the front RH corner of the engine compartment. A/C compressor protection is provided by an A/C pressure cut-off switch. The A/C pressure cut-off switch terminates power to the A/C compressor clutch in case of a massive discharge of refrigerant or excessive A/C system pressure.

The A/C evaporator temperature control thermostat, located on the top of the evaporator core, is a safety device which shuts the A/C compressor clutch off to prevent the A/C evaporator core from freezing. When the temperature of the A/C evaporator core drops to 32° (± 1.8) F, 0°± 1° C, the A/C evaporator temperature control thermostat turns the A/C compressor clutch off. When the A/C evaporator core temperature increases 37.4 - 41.0°F (3 - 5°C), the A/C evaporator temperature control thermostat turns the A/C compressor clutch on. A sensing bulb inside the A/C evaporator core signals the A/C evaporator temperature control is wired in series with the A/C compressor clutch control relay and signals the Powertrain Control Module to turn the A/C compressor clutch on and off.

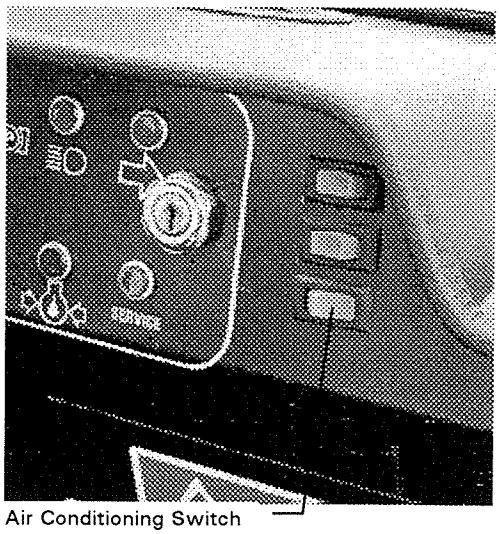
The blower motor operates constantly when the A/C switch is depressed. The A/C system will not operate unless the heater blower switch is on. Additional A/C condenser core cooling is provided by a "push-through" type A/C condenser cooling fan that operates when the A/C system pressure is above 220 psi (1519 kPa).

A/C compressor clutch operation is terminated during Wide Open Throttle driving. The Powertrain Control Module determines when to cease A/C compressor clutch operation by controlling the A/C compressor clutch control relay on a signal from the Throttle Position Sensor (TP sensor).

Climate Control Assembly

All vehicles equipped with air conditioning have a common climate control assembly, but added controls are:

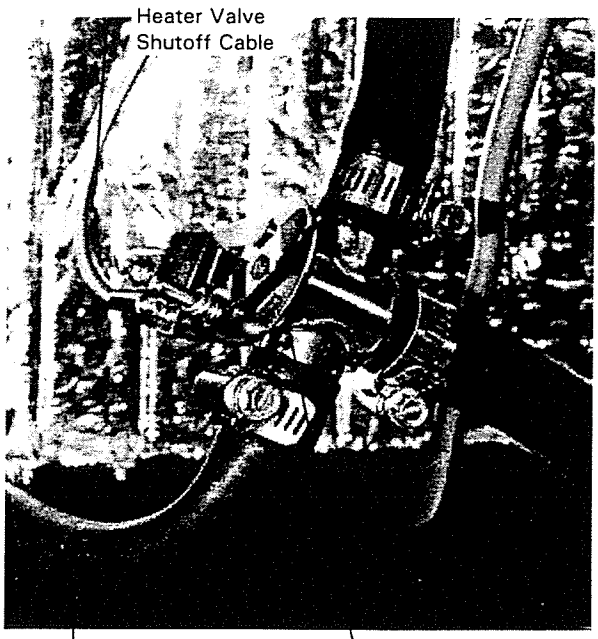
- A/C rocker switch
- Heater Valve Shutoff



Air Conditioning Switch

When the A/C rocker switch is depressed, an indicator bulb on the rocker switch illuminates, indicating that the A/C system is operating. Before the A/C system will operate, the Blower Fan Speed switch must be turned to one to two (1,2) ON positions.

Use the Heater Shutoff Valve with the air conditioning. Pull the control to shut off heat from entering the passenger compartment.



Instrument Panel Ducts

The A/C system shares the same four ducts that are used by the heating/ventilation system. Two ducts are located on the instrument panel top and two ducts are on the instrument panel. All ducts have adjustable registers to direct air to defrost the windshield or throughout the passenger compartment.

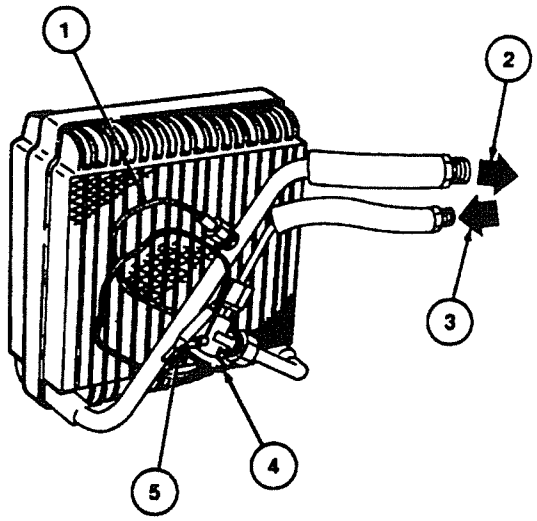
A/C Evaporator Housing

The A/C evaporator housing is made of an A/C evaporator lower case and A/C evaporator upper case containing the A/C evaporator core. The evaporator housing is under the instrument panel top.

A/C Evaporator Expansion Valve

The A/C evaporator expansion valve senses the temperature and pressure of the refrigerant at the A/C evaporator outlet and meters the refrigerant into the A/C evaporator core. The A/C evaporator expansion valve is located in the A/C evaporator inlet. Liquid refrigerant must not be allowed to pass into the A/C compressor or serious damage will result. The A/C evaporator expansion valve is a control device that controls the amount of high-pressure refrigerant that enters the A/C evaporator core. The proper amount of refrigerant allows maximum cooling and provides for complete evaporation of all the liquid refrigerant in the A/C evaporator core.

The amount of refrigerant in the A/C evaporator core determines the temperature and pressure at the A/C evaporator case outlet, inside the A/C evaporator expansion valve sensing bulb, and in the equalizer line. These pressures act on top and bottom of the diaphragm. The diaphragm, along with the super heat spring, opens or closes the valve ball to allow the proper amount of high-pressure refrigerant into the A/C evaporator core inlet.



Item	Part Number	Description
1	-	Equalizer Line
2	-	To A/C Compressor
3	-	From Suction Receiver/Drier
4	614026	A/C Evaporator Expansion Valve
5	-	A/C Evaporator Expansion Valve Sensing Bulb

Evaporator Temperature Control Thermostat

The A/C evaporator temperature control thermostat is a safety device which shuts the A/C compressor clutch off to prevent the A/C evaporator core from freezing. When the temperature of the A/C evaporator core drops to 32°F ± 1.8°F(0°C ± 1°C) the A/C evaporator temperature control turns the A/C compressor clutch off.

When the A/C evaporator core temperature increases to 37.4 - 41.0°F (3-5°C) the A/C evaporator temperature control thermostat turns the A/C compressor clutch on. An A/C evaporator temperature control thermostat sensing bulb inside of the A/C evaporator core signals the A/C

evaporator temperature control thermostat when to open or close. The A/C evaporator temperature control thermostat is wired in series with the A/C compressor clutch control relay and signals the Powertrain Control Module to turn (cycle) the A/C compressor clutch on and off.

The A/C evaporator temperature control thermostat is located at the top of the A/C evaporator.

Electrical System

NOTE: Refer to diagnosis and testing earlier in this section for a schematic of the electrical system.

The electrical system in the climate control system uses the following additional components for the air conditioning system:

- A/C compressor clutch control relay - located in the RH engine compartment.
- A/C evaporator temperature control thermostat - located on the top of the A/C evaporator upper case.
- Powertrain Control Module - located on the LH side of the passenger compartment, under the instrument panel top.
- A/C pressure cut-off switch - located on the top of the suction receiver/drier.
- A/C rocker switch - located on the instrument panel.
- A/C compressor clutch - located on the A/C compressor.

Relays

The A/C system is equipped with three relays:

- *A/C relay*. It is located in the engine compartment. The heater blower motor relay supplies power to the blower motor.
- *A/C compressor clutch control relay*. It is located in the RH engine compartment, along the electrical component rail. The A/C compressor clutch control relay supplies power to the A/C compressor and is controlled by the Powertrain Control Module.
- *Condenser fan relay*. It is located in the front of the engine compartment, on the RH side of the A/C condenser core. The condenser fan relay supplies power to the A/C condenser cooling fan and is controlled by the Powertrain Control Module.

Refrigerant System

WARNING: AVOID BREATHING A/C REFRIGERANT AND LUBRICANT VAPOR OR MIST. IF ACCIDENTAL SYSTEM DISCHARGE OCCURS, VENTILATE THE WORK AREA BEFORE RESUMING SERVICE.

WARNING: WEAR IMPERVIOUS GLOVES AND SAFETY GOGGLES AT ALL TIMES WHEN HANDLING LIQUID REFRIGERANT. SHOULD ANY LIQUID REFRIGERANT GET INTO THE EYES OR ON THE SKIN, IMMEDIATELY FLUSH EYES AND SKIN WITH PLENTY OF WATER FOR AT LEAST 15 MINUTES. REMOVE CONTAMINATED CLOTHING AND SHOES. CALL A PHYSICIAN.

WARNING: REFRIGERANT HFC-134a IS ALWAYS UNDER PRESSURE. BECAUSE THE SYSTEM IS TIGHTLY SEALED, HEAT APPLIED TO ANY PART COULD CAUSE THIS PRESSURE TO BUILD UP EXCESSIVELY. TO AVOID A DANGEROUS EXPLOSION, KEEP AWAY FROM OPEN FLAMES, GLOWING METAL SURFACES, BLOW TORCH, STEAM CLEANING AND WELDING. HFC-134a CAN BE DECOMPOSED AT HIGH TEMPERATURES.

WARNING: ALWAYS WEAR SAFETY GOGGLES WHEN SERVICING ANY PART OF THE REFRIGERANT SYSTEM.

WARNING: EXTREME CARE MUST BE TAKE TO PREVENT ANY LIQUID REFRIGERANT FROM COMING IN CONTACT WITH THE SKIN, AND ESPECIALLY THE EYES.

CAUTION: Using R-12 components, refrigerant or refrigerant oil on an R-134a system will cause damage to the A/C system. Do not replace components, refrigerant, or refrigerant oil from an R-134a system with components, refrigerant, or refrigerant oil for an R-12 system or vice versa. R-12 and R-134a components are not interchangeable. Mixing components from these two types of systems will cause component failure and damage to the A/C system.

CAUTION: Liquid R-134a, at normal atmospheric pressures and temperatures, evaporates so quickly that it has a tendency to freeze anything it contacts. Extreme care must be taken to

prevent any liquid refrigerant from coming in contact with the skin and especially the eyes.

CAUTION: Ensure that refrigerant containers are never heated to over 125°F (52°C). Refrigerant containers should be stored and installed in accordance with all state and local ordinances.

CAUTION: When admitting R-134a into the refrigerant system, always keep the tank in an upright position. If the tank is on its side or upside down, liquid R-134a will enter the system and may damage the A/C compressor.

CAUTION: Refrigerant R-134a should not be mixed with air for leak testing or used with air for any other purpose above atmospheric pressure. R-134a is combustible when mixed with high concentrations of air and high pressures.

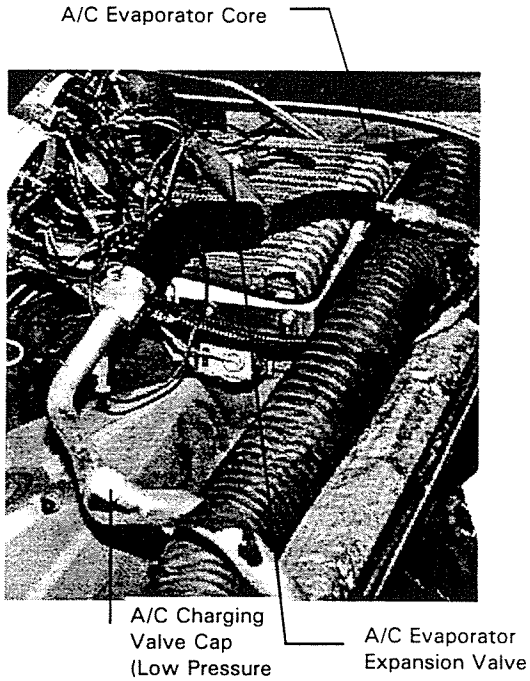
The liquid refrigerant evaporates so rapidly that the resulting refrigerant gas will displace the air surrounding the area where the refrigerant is released.

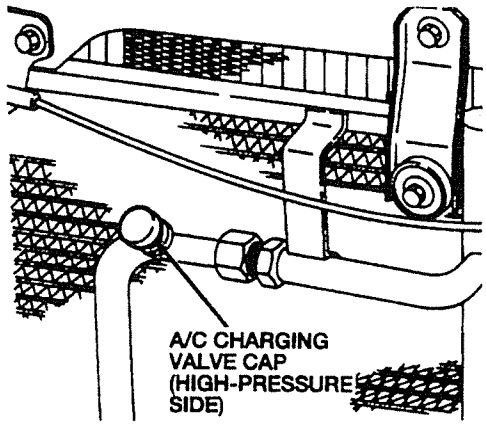
Ensure that Refrigerant R-134a is both stored and installed in accordance with all state and local ordinances.

Service Access Gauge Port Valves

The refrigerant system has a high-pressure (discharge) and a low-pressure (suction) gauge port valve. These are Schrader valves, which provide access to both sides (high-pressure and low-pressure) of the system for service hoses and a manifold gauge set so system pressures can be read.

Always replace the A/C charging valve caps on the service access gauge port valves after servicing the refrigerant system.





A/C Evaporator Core

The A/C evaporator core is located in the A/C evaporator housing on the LH side of the instrument panel. Remove the instrument panel top to access the A/C evaporator core.

The A/C evaporator core is a multi-pass plate/fin type design mounted in a horizontal position. Vapor feed refrigerant enters the A/C evaporator core from the A/C expansion valve and cools the A/C evaporator core fins. Forced air from the blower motor passing through the A/C evaporator core is cooled and dehumidified, then conducted to the passenger compartment. Excess moisture from the dehumidification process is drained through the A/C evaporator drain hose to the outside of the vehicle.

Suction Receiver/Drier

The suction receiver/drier collects moisture in the refrigerant that was generated during condensation. It prevents the moisture from recirculating through the system.

Refrigerant enters the suction receiver/drier from the jumper line through the inlet tube. The heavier, oil-laden refrigerant falls to the bottom of the outlet tube near the bottom of the suction receiver/drier. A bleed hole, covered with a filter screen, allows a small amount of the heavier liquid refrigerant and oil mixture to re-enter the liquid line at a controlled rate. When the heavier liquid refrigerant and oil mixture enters the liquid line, it has an opportunity to vaporize and circulate through A/C compressor without causing damage to the A/C compressor due to refrigerant slugging.

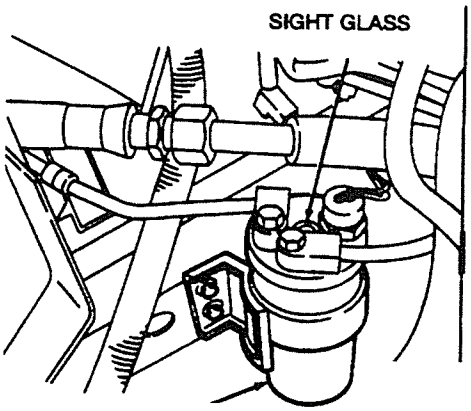
A desiccant bag is mounted inside the suction receiver/drier to absorb any moisture which may be in the refrigerant system. A sight glass is located on the top of the suction receiver/dryer for checking refrigerant condition. The suction receiver/drier is located to the lower left of the radiator and is mounted to the vehicle frame.

Replace the suction receiver/drier when:

- The suction receiver/drier is restricted, plugged or perforated.
- The refrigerant system has been left open for more than four hours or completely discharged for 24 hours or more.

There is evidence of moisture in the system (for example, internal corrosion of metal lines or dark, thick refrigerant oil).

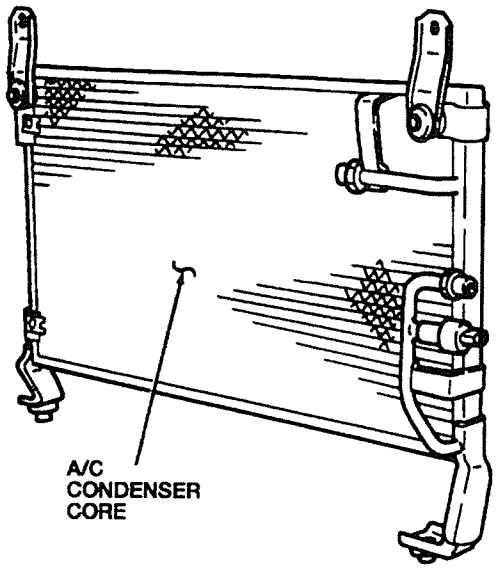
- A component such as A/C condenser core, evaporator, A/C compressor, or refrigerant line is replaced.



SUCTION RECEIVER DRIER

A/C Condenser Core

The A/C condenser core is an aluminum fin and tube design heat exchanger located in front of the vehicle radiator. The A/C condenser core cools compressed refrigerant gas by allowing air to pass over fins and tubes to extract heat and condenses the gas refrigerant to liquid as it cools.



A/C Compressor

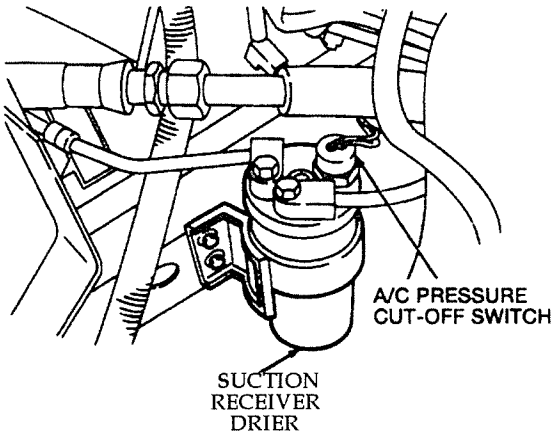
A swash-plate design A/C compressor is used on all models equipped with air conditioning. The A/C compressor is belt-driven from the crankshaft. The A/C compressor clutch pulley and an electromagnetic clutch armature rotate continuously with the engine. The compressor pulley and electromagnetic A/C clutch are ball bearing mounted onto the A/C compressor shaft and drive hub, which are stationary when the A/C compressor clutch is disengaged. When cooling is required, the A/C compressor clutch is energized electrically, and it magnetically pulls the rotating armature into the drive hub. The resulting friction

the rotating armature into the drive hub. The resulting friction between the armature and hub causes the A/C compressor to reach pulley speed rapidly. The A/C compressor draws low-pressure gaseous refrigerant from the A/C evaporator core. The A/C compressor increases the temperature of the refrigerant, pressurizes it, and then pumps it to the A/C condenser core for cooling. The A/C compressor is cycled on and off when the A/C switch is depressed. Operation of the A/C compressor is terminated by the A/C pressure cut-off switch during a massive discharge. A/C condenser core operation is also terminated during Wide Open Throttle (WOT) driving by the Powertrain Control Module (PCM).

The A/C compressor is located on the lower RH side of the engine compartment and is mounted to the lower LH side of the engine. An evaporator to compressor suction line and an A/C compressor to condenser discharge line attach to the A/C compressor along with a black power lead for the A/C compressor clutch.

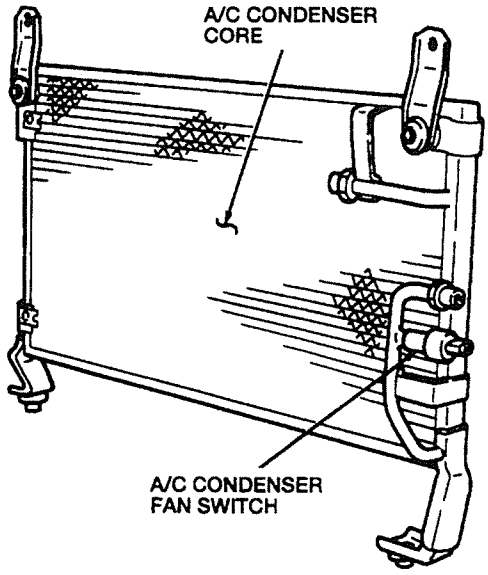
A/C Pressure Cut-Off Switch

The A/C pressure cut-off switch is a safety device that shuts the A/C compressor clutch off if the pressure on the discharge side of the A/C compressor (at the suction receiver/dryer) drops below 29-35 psi (201-241 kPa) or is above 426-483 psi (2940-3332 kPa). The A/C pressure cut-off switch is wired in series with the A/C switch and the A/C evaporator temperature control thermostat.



A/C Condenser Fan Switch

The A/C condenser fan switch is located on the outlet manifold of the A/C condenser core. When manifold pressure exceeds 220 psi (1,519 kPa), the A/C condenser fan switch closes and the A/C condenser cooling fan starts to operate. When manifold pressure drops below 178 psi (1,225 kPa), the A/C condenser fan switch opens and the A/C condenser cooling fan turns off.



REMOVAL AND INSTALLATION

Refrigerant Oil Addition

NOTE: The R-134a refrigerant oil specification was not available at the time this manual was printed.

During A/C Compressor Replacement

When replacing the A/C compressor measured quantities of a special polyalkylene glycol (PAG) oil should be added to the A/C compressor. It is important that only the specified type and quantity of refrigerant oil be used. A surplus of oil will reduce the cooling capacity of the system. Too little oil will result in poor lubrication of the A/C compressor.

When the A/C compressor operates, oil gradually leaves the A/C compressor and circulates through the system with the refrigerant. Eventually a balanced condition is reached in which a certain amount of oil is retained in the A/C compressor and a certain amount is continually circulated. If the A/C compressor is removed after the system has been operated, some oil will go with it. To maintain the original oil charge, it is necessary to compensate for the amount of oil lost with the old A/C compressor by adding an equal amount of the new A/C

compressor. Clean refrigerant oil should be added to the replacement A/C compressors as follows:

A new service replacement A/C compressor contains 5.91 fluid ounces (175 ml) of the specified refrigerant oil. Prior to installing the replacement A/C compressor, drain the oil into a clean calibrated container. Then drain the oil from the old A/C compressor into another clean calibrated container. Add the same amount of clean refrigerant oil as removed from the old A/C compressor to the new A/C compressor, plus 0.6762 fluid ounces (20 ml).

During Component Replacement

When replacing components of the air conditioning refrigerant system, measured quantities of a special refrigerant oil should be added to the replacement components. It is important that only the specified type and quantity of the refrigerant oil be used. A surplus of oil will reduce the cooling capacity of the system. Too little oil will result in poor lubrication of the A/C compressor.

When the A/C compressor operates, oil gradually leaves the A/C compressor and circulates through the system with the refrigerant. Eventually a balanced condition is reached in which a certain amount of oil is retained in the A/C compressor and a certain amount is continually circulated. If a refrigerant system component is removed after the system has been operated, some oil will go with it. To maintain the original oil charge, it is necessary to compensate for the amount of oil lost with the old component. Clean refrigerant oil should be added to the replacement components as follows:

- A/C evaporator core - Add 1.7 fluid ounces (50 ml).
- A/C condenser core - Add 1 (one) fluid ounces (30 ml).
- Suction receiver/drier - Drain the oil from the old suction receiver/drier. Add the same amount plus 0.34 fluid ounce (10 ml) of clean refrigerant oil to the new suction receiver/drier.

Pour clean refrigerant oil directly into the replacement component.

If any other components or a refrigerant line are replaced, no additional refrigerant oil is necessary.

Climate Control Assembly

A/C Rocker Switch

Removal

1. Disconnect the battery ground cable.
2. Remove the instrument panel top.
3. Disconnect the wires from the back of the rocker switch. Label each wire to ensure connections are correct.
4. Remove the illuminated A/C rocker switch from the instrument panel.

Installation

To install, reverse the removal procedure.

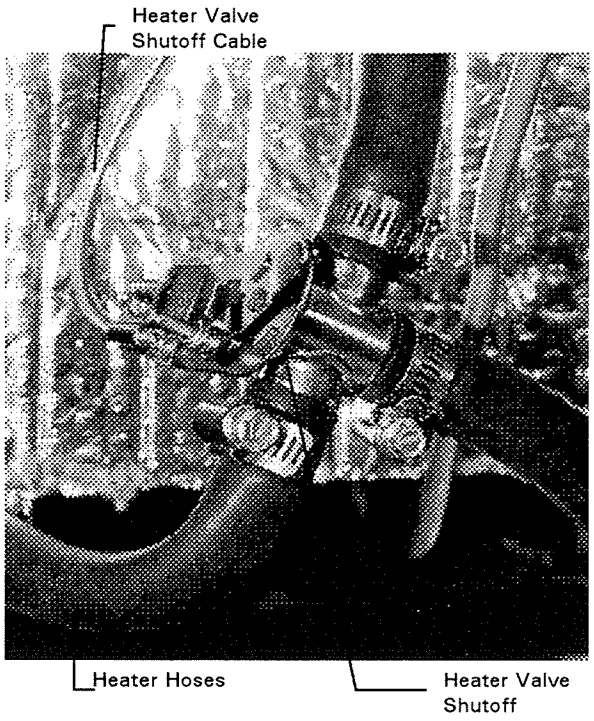
Heater Shutoff Valve Control

Removal and Installation

1. Remove the LH upper front filler panel.
2. Remove the LH upper front filler panel screws.
3. Drill out the pop rivet on the lower RH corner of the filler panel.
4. Disconnect the battery ground cable.
5. Disconnect the cable end to the heater valve door on the heater valve shutoff.

   NOTE: Remove screw and clamp which holds cable to the heater valve shutoff case.
6. Loosen and remove the nut on the back of the heater valve shutoff control. This secures it to the back of the dash panel.
7. Remove the heater valve shutoff cable assembly.

Install the heater valve shutoff in the reverse order of removal. Tighten the nut to the back of the dash panel.



A/C Evaporator Core

1. Disconnect the battery ground cable.
2. Remove the instrument panel top.
3. Discharge the refrigerant system. Refer to Section 22 for the procedure.
4. Disconnect the evaporator to compressor suction line from the A/C evaporator core outlet fitting. Discard the O-ring.
5. Disconnect the liquid line from the A/C evaporator core inlet fitting. Discard the O-ring.
6. Remove two panel screws at the front LH corner of the instrument panel and the panel.
8. Disconnect the two A/C evaporator temperature thermostat electrical connectors.
9. Disconnect the A/C evaporator drain hose from the evaporator drain hose fitting.
10. Pull the tube insulation over the A/C evaporator expansion valve bulb and the evaporator to compressor suction line. Discard the tube insulation.
11. Remove the A/C evaporator expansion valve bulb clamp securing the equalizer line to the evaporator to compressor suction line.
12. Disconnect the A/C evaporator core inlet and outlet fittings and remove the A/C evaporator expansion valve. Discard the O-ring.
13. Remove the A/C evaporator core from the A/C evaporator case.

Installation

NOTE: Replacement A/C evaporator cores do not come equipped with an A/C evaporator core screen. Transfer the evaporator core screen from the old A/C evaporator core to the new A/C evaporator core.

NOTE: If installing a new A/C evaporator core, add the proper amount of refrigerant oil to the A/C evaporator core. Refer to the procedure in this section.

NOTE: Ensure that the A/C evaporator temperature control thermostat capillary tube is installed correctly on the A/C evaporator core as noted during removal.

To install, reverse the removal procedure.

Heater Case/Core

Removal and Installation

Refer to Section 22-1 for removal and installation procedures of the heater case/core.

Heater Blower Motor Assembly

Removal and Installation

Refer to Section 22-1 for removal and installation of the blower motor and fan.

Blower Motor Resistor

Removal and Installation

Refer to Section 22-1 for the removal and installation of the blower motor resistor.

Instrument Panel Ducts (Registers)

Removal and Installation

Refer to Section 22-1 for the removal and installation procedures.

Suction Receiver/Drier

Removal

1. Discharge the A/C system. Refer to Section 22 for the procedure.
2. Remove the battery. Refer to Section 17 for the removal procedure.
3. Remove the radiator coolant recovery reservoir.
4. Disconnect the A/C pressure cut-off switch electrical connector.
5. Remove the LH lower engine intake panel from the vehicle.
6. Disconnect the jumper line and the liquid line from the suction receiver/drier. Discard the O-rings.
7. Remove the two clamp screws and remove the suction receiver/drier.

Installation

NOTE: Apply clean refrigerant oil to the new O-rings prior to installation.

NOTE: If installing a new suction receiver/drier, add the proper amount of refrigerant oil to the high-pressure port of the A/C compressor. Refer to the procedure in this section.

To install, reverse the removal procedure.

Tighten the jumper line at the suction receiver/drier inlet to 69-104 lb-in (8-11N-m).

Tighten the liquid line at the suction receiver/drier outlet fitting to 69-104 lb-in. (8-11 N-m).

A/C Evaporator Expansion Valve

Removal

1. Discharge the A/C system. Refer to Section 22 - Service for the procedure.
2. Remove the evaporator core. Refer to the procedure in this section.
3. Disconnect the equalizer line from the A/C evaporator core outlet fitting.
4. Disconnect the A/C evaporator expansion valve at the A/C evaporator core outlet fitting and A/C evaporator case inlet fitting. Discard the O-ring at each fitting.
5. Remove the A/C evaporator expansion valve.

Installation

NOTE: Apply clean refrigerant oil to the new O-rings prior to installation.

To install, reverse the removal procedure.

Test the system for proper operation. Refer to Section 22 - Service for the procedure.

Tighten the liquid line at the A/C evaporator core inlet fitting to 87-174 lb-in (10-19 N-m).

Tighten the evaporator to compressor suction line fitting to 15-21 lb-ft (20-29 N-m).

A/C Evaporator Temperature Control Thermostat

Removal

1. Remove the instrument panel top.
2. Remove the A/C evaporator. Refer to the procedure in this section.
3. NOTE: Note the position of the A/C evaporator temperature control thermostat capillary tube prior to removal to aid in installation.

   Remove the two A/C evaporator temperature control thermostat screws and the A/C evaporator temperature control thermostat from the A/C evaporator.
4. Carefully pull the A/C evaporator temperature control thermostat end from the A/C evaporator core.

Installation

NOTE: Ensure that the A/C evaporator temperature control thermostat capillary tube is installed correctly in the A/C evaporator core as noted during removal.

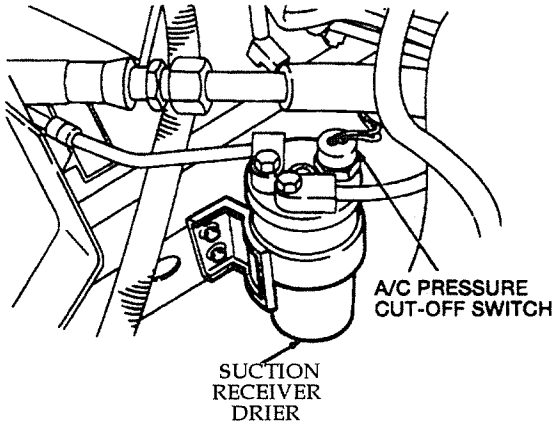
To install, reverse the removal procedure.

Test the system for proper operation. Refer to Section 22 - Service for the procedure.

A/C Pressure Cut-Off Switch

Removal

The following illustration shows the location of the A/C pressure cut-off switch.



1. Discharge the refrigerant system. Refer to Section 22 - Service for the procedure.
2. Disconnect the A/C pressure cut-off switch electrical connector.
3. Remove the A/C pressure cut-off switch.
4. Remove and discard the O-ring.

Installation

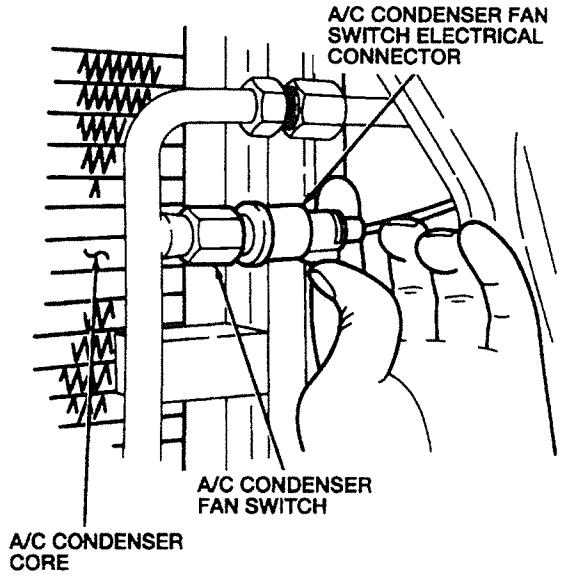
To install, reverse the removal procedure.

Test the system for proper operation.

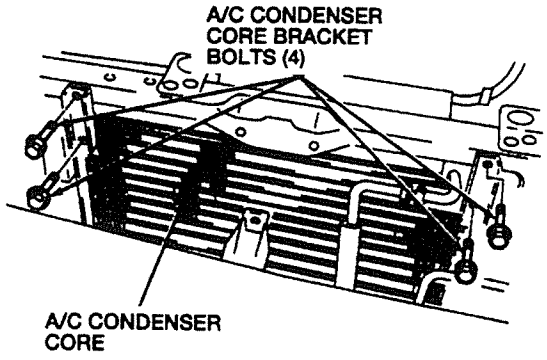
A/C Condenser Core

Removal

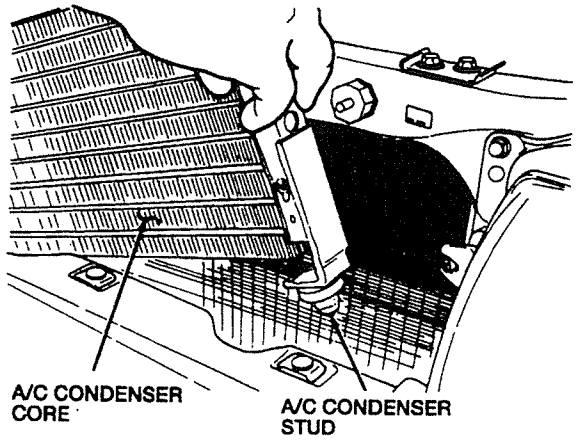
1. Disconnect the battery ground cable.
2. Discharge the A/C system. Refer to Section 22 - Service for the procedure.
3. Remove the LH and RH engine intake panels from the vehicle.
4. Remove the seat from the seat panel in the passenger compartment.
5. Remove the parking brake from the passenger compartment. Refer to Section 4 - Brake System for the removal procedure.
6. Remove the gearshift lever control from the passenger compartment. Refer to Section 19 for the removal procedure.
7. Remove the rivets and slotted bolts and flange nuts which secure the seat panel to the vehicle frame.
8. Remove the slotted bolts and flange nuts which secure the passenger compartment to the vehicle frame.
9. Disconnect the A/C compressor to condenser discharge line at the A/C condenser core inlet fitting. Discard the O-ring.
10. Disconnect the jumper line at the A/C condenser core outlet fitting. Discard the O-ring.
11. Disconnect the A/C condenser fan switch electrical connector.
12. Remove the four A/C condenser core bracket bolts.
13. Disconnect the A/C condenser fan switch electrical connector.



14. Remove the four A/C condenser core bracket bolts.



15. Lift the A/C condenser core to allow the A/C condenser studs to clear their mounts and remove the A/C condenser core from the vehicle.



Installation

NOTE: Apply refrigerant oil to the new O-rings prior to their installation on the A/C condenser inlet and outlet port fittings.

NOTE: If installing a new A/C condenser core, add the proper amount of refrigerant oil to the high-pressure outlet port of the A/C compressor. Refer to the refrigerant system components and capacities chart in this section.

To install, reverse the removal procedure.

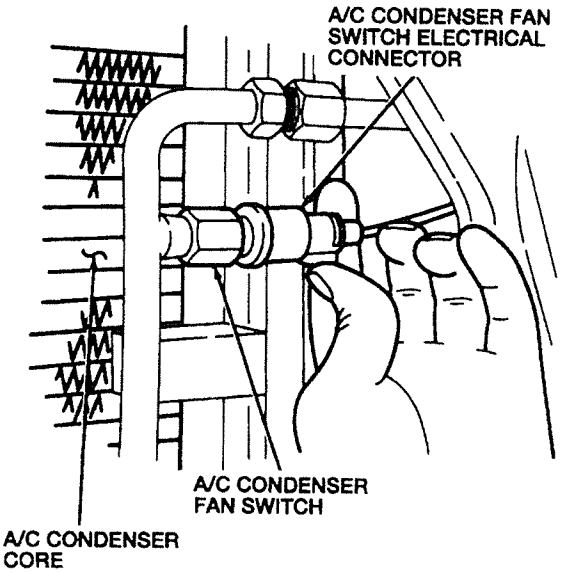
Tighten the jumper line at the A/C condenser core outlet fitting to 87-174 lb-in (10-19 N-m).

Tighten the A/C compressor to condenser discharge line fitting to 11-18 lb-ft (15-25 N-m).

A/C Condenser Fan Switch

Removal

1. Disconnect the battery ground cable.
2. Discharge the A/C system. Refer to Section 22 - Service for the procedure.
3. Remove the LH and RH engine intake panels from the vehicle.
4. Remove the seat from the seat panel in the passenger compartment.
5. Remove the parking brake from the passenger compartment. Refer to Section 4 - Brake System for the removal procedure.
6. Remove the gearshift lever control from the passenger compartment. Refer to Section 19 for the removal procedure.
7. Remove the rivets and slotted bolts and flange nuts which secure the seat panel to the vehicle frame.
8. Remove the slotted bolts and flange nuts which secure the passenger compartment to the vehicle frame.



9. From the engine compartment, remove the A/C condenser fan switch electrical connector.
10. Remove the A/C condenser fan switch from the fitting on the A/C condenser core.

Installation

To install, reverse the removal procedure.

A/C Condenser Core Electric Cooling Fan

Removal

1. Disconnect the battery ground cable.
2. Disconnect the A/C condenser cooling fan electrical connector.
3. Remove the LH and RH engine intake panels from the vehicle.
4. Remove the seat from the seat panel in the passenger compartment.
5. Remove the parking brake from the passenger compartment. Refer to Section 4 - Brake System for the removal procedure.
6. Remove the gearshift lever control from the passenger compartment. Refer to Section 19 for the removal procedure.
7. Remove the rivets and slotted bolts and flange nuts which secure the seat panel to the vehicle frame.
8. Remove the slotted bolts and flange nuts which secure the passenger compartment to the vehicle frame.
9. Remove the two A/C condenser cooling fan bolts and nut and the A/C condenser cooling fan.

Installation

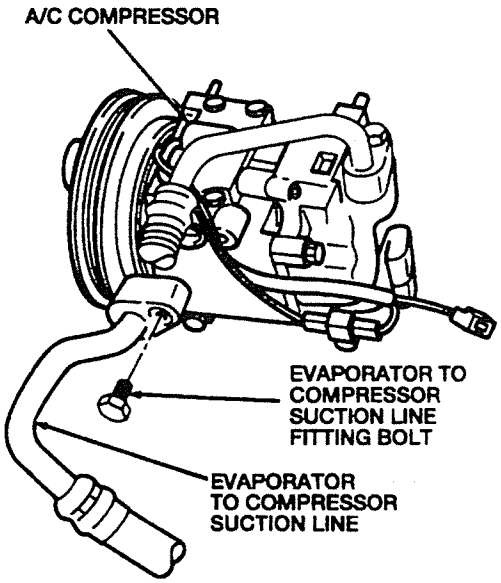
To install, reverse the removal procedure.

Refrigerant Lines

Suction Lines - Evaporator to Compressor

Removal

1. Discharge the A/C system. Refer to Section 22 - Service for the procedure.
2. Remove the battery. Refer to Section 17 for the removal procedure.
3. Remove the radiator coolant recovery reservoir.
4. Disconnect the evaporator to compressor suction line at the front evaporator to compressor suction line fitting.
5. Disconnect the evaporator to compressor suction line at the A/C evaporator core outlet fitting. Plug A/C evaporator core outlet fitting. Plug the A/C evaporator core outlet fitting to prevent moisture from entering the system.
6. Disconnect the three vacuum hoses from the Exhaust Gas Recirculation (EGR) solenoid valve assembly.
7. Plug the A/C compressor inlet fitting to prevent moisture from entering system.
8. Remove the front evaporator to compressor suction line from the vehicle.



Installation

NOTE: Apply clean refrigerant oil to the O-rings prior to installation.

To install, reverse the removal procedure.

Tighten the evaporator to compressor suction line fitting bolt to 8-11 lb-ft (10-15 N-m).

Tighten the evaporator to compressor suction line fitting to 15-21 lb-ft (20-29 N-m).

Liquid Lines

Removal

NOTE: The liquid line is in two pieces - the rear liquid line runs along the bulkhead, from the A/C evaporator core inlet fitting to the LH side of the bulkhead. The front liquid line runs along the LH side of the engine compartment, from the rear liquid line to the suction receiver/drier outlet fitting. This procedure covers the removal of both portions of the liquid line.

1. Discharge the A/C system. Refer to Section 22 - Service for the procedure.
2. Remove the rear liquid line from the A/C evaporator core inlet fitting. Plug the A/C evaporator core inlet fitting to prevent moisture from the entering the system.
3. Disconnect the rear liquid line at the front liquid line fitting. Remove the rear liquid line from the vehicle.
4. Remove the liquid line fitting from the suction receiver/drier outlet fitting. Plug the suction receiver/drier outlet fitting to prevent moisture from entering the system.
5. Remove the front liquid line from the vehicle.

NOTE: Both liquid lines run under the vehicle. They are held in place by a tray. Remove the tray to ease the removal of the liquid lines.

Installation

NOTE: Apply clean refrigerant oil to the O-rings prior to installation.

To install, reverse the removal procedure.

Tighten the liquid line at the suction receiver outlet fitting to 69-104 lb-in (8-11 N-m).

Tighten the liquid line at the A/C evaporator core inlet fitting to 87-174 lb-in (10-19 N-m).

Tighten the rear liquid line to the front liquid line fitting to 94-10.4 lb-ft (12.8-14.2 N-m).

Jumper Lines

Removal

1. Discharge the A/C system. Refer to Section 22 - Service for the procedure.
2. Remove the jumper line at the A/C condenser core outlet fitting. Plug the A/C condenser core outlet fitting to prevent moisture from entering the system.
3. Disconnect the jumper line at the suction receiver/drier inlet fitting. Plug the A/C dehydrator and receiver tank inlet fitting to prevent moisture from entering the system.
4. Remove the jumper line from the vehicle.

Installation

NOTE: Apply clean refrigerant oil to the O-rings prior to installation.

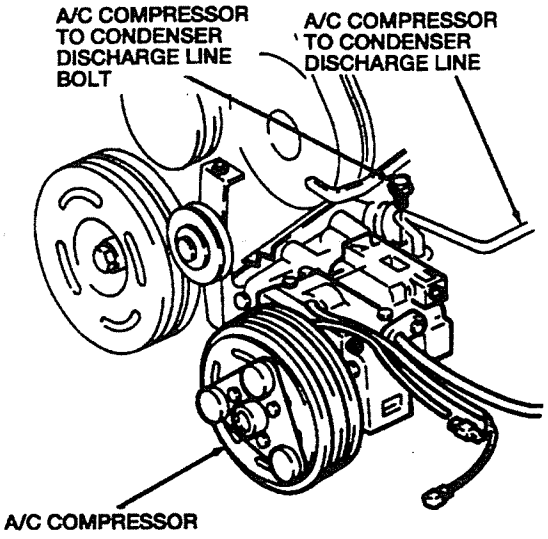
To install, reverse the removal procedure.

Tighten the jumper line at the suction receiver/drier inlet fitting to 69-104 lb-in (8-11 N-m).
Tighten the jumper line at the A/C condenser core outlet fitting to 87-174 lb-in (10-19 N-m).

Discharge Lines - A/C Compressor to Condenser

Removal

1. Discharge the A/C system. Refer to Section 22 - Service for the procedure.
2. Remove the A/C compressor to condenser discharge line bolt. Plug the A/C compressor outlet fitting to prevent moisture from entering the system.



3. Disconnect the A/C compressor to condenser discharge line from the A/C compressor.

4. Disconnect the A/C compressor to condenser discharge line from the A/C condenser core. Plug the A/C condenser core inlet fitting to prevent moisture from entering the system.

5. Remove the A/C compressor to condenser discharge line from the vehicle.

Installation

NOTE: Apply clean refrigerant oil to the O-rings prior to installation.

To install, reverse the removal procedure.

Tighten the A/C compressor to condenser discharge line bolt to 8-11 lb-ft (10-15 N-m).

Tighten the A/C compressor to condenser discharge line fitting to 11-18 lb-ft (15-24 N-m).

Heater Water Hoses

Removal and Installation

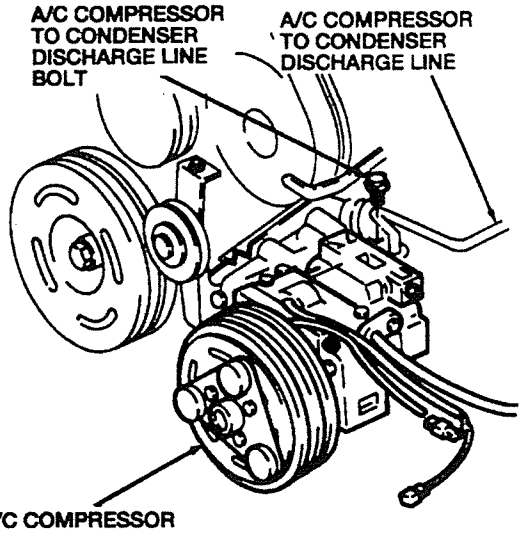
Refer to Section 22 -1 Heating for the heater water hoses for removal and installation procedure.

A/C Compressor

Removal

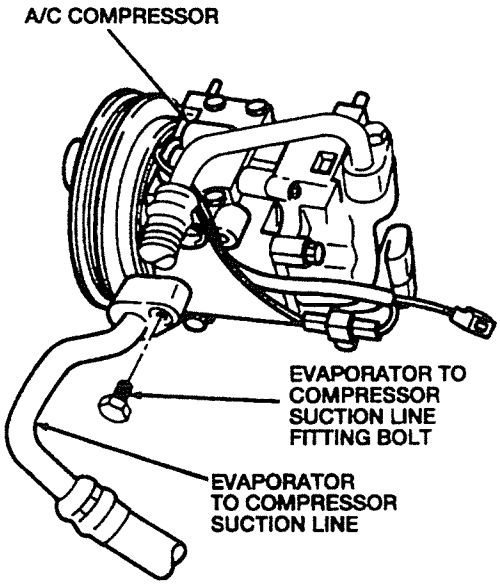
1. Discharge the A/C system. Refer to Section 22 - Service for the procedure.

2. Remove the A/C compressor to condenser discharge line bolt. Plug the A/C compressor outlet fitting to prevent moisture from entering the system.



3. Disconnect the A/C compressor to condenser discharge line from the A/C compressor.

4. Remove the evaporator to compressor suction line fitting bolt from the A/C compressor. Plug the A/C compressor inlet fitting to prevent moisture from entering the system.



5. Loosen the tensioner pulley and belt from the A/C compressor.

6. NOTE: Do not remove the RH front A/C compressor bolt from the A/C compressor so that the RH front bolt will clear the radiator upon A/C compressor removal.

   Loosen the RH top A/C compressor bolt and remove the three remaining A/C compressor bolts.

7. Lift the A/C compressor from the vehicle.

Installation

To install, reverse the removal procedure.

Tighten the A/C compressor to condenser discharge line bolt to 8-11 lb-ft (10-15 N-m).

Tighten the evaporator to compressor suction line fitting bolt to 8-11 lb-ft (10-15 N-m).

A/C Compressor Bracket

Removal

1. Remove the A/C compressor. Refer to the procedure in this section.

2. Remove the five (5) A/C compressor bracket bolts and the A/C compressor bracket.

Installation

To install, reverse the removal procedure.

Tighten the five (5) A/C compressor bracket bolts to 14-19 lb-ft (19-25 N-m).

ADJUSTMENTS

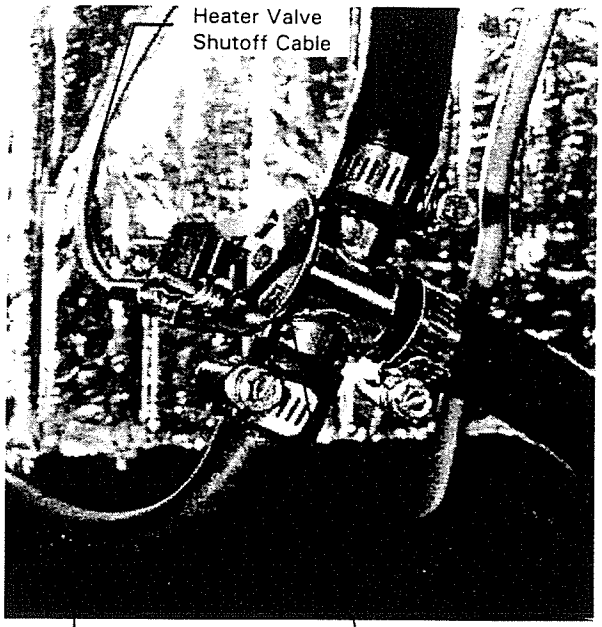
Heater Valve Shutoff Control Cable

1. Move the Heater Valve Shutoff control cable to the full hot position.

2. Connect the Heater Valve Shutoff control cable to the heat/cold door arm on the valve.

3. Secure the Heater Valve Shutoff control cable into place.

4. Verify that the Heater Valve Shutoff control cable moves its full stroke.



A/C Compressor Drive Belt Tension

Refer to Section 11 - Engine for the A/C compressor drive belt tension adjustment procedure.

SPECIFICATIONS

Refrigerant System Components and Capacities

Component	Capacity
A/C Compressor	5.91 oz. (175 ml)
A/C Evaporator Core	1.7 oz. (50 ml)
A/C Condenser Core	1 oz. (30 ml)
Suction Receiver/Drier	0.34 oz (10 ml)
Normal System Pressure	**Specification**
Low pressure Side	18.5-41 psi (127-284 kPa)
High pressure Side	202-263 psi (1392 -1813 kPa)

Refrigerant System

A/C Pressure Cut-off Switch	
Description	**Specification**
Pressure to Open	Below 29-35 psi (201-241 kPa) or Above 428-483 psi (2940-3332 kPa)
Refrigerant R-134a	
Description	**Specification**
Refrigerant Oil	Chloroflourocarbon - colorless gas. Specific gravity - 1.27 (H20 = 1)
Refrigerant Charge	24.9 oz. (736.2 ml)

Electrical System

Fuse Name	Fuse Rating	System Protection
COOLING FAN	15A	A/C Condenser Fan Cooling Motor, A/C Compressor Clutch
Circuit Breaker	**Amp Rating**	**System Protection**
HEATER	15A	Heater Blower Motor

Torque Specifications

Description	Lb-ft	Lb-in	N-m
Liquid Lines at the A/C Evaporator Core Inlet Fitting	-	87-174	10-19
Evaporator to Compressor Suction Line Fitting	15-21	-	20-29
Jumper Line at the Suction Receiver/Drier Inlet Fitting	-	69-104	8-11
Liquid Line at the Suction Receiver/Drier Outlet Fitting	-	69-104	8-11
A/C Compressor to Condenser Discharge Line Fitting	11-18	-	15-24
Jumper Line at the A/C Condenser Core Outlet Fitting	-	87-174	10-19
Evaporator to Compressor Suction Line Fitting Bolt	8-11	-	10-15
Rear Liquid Line to Front Liquid Line	9.4-10.4	-	12.8-14.2
A/C Compressor Bracket Bolts	14-19	-	19-25
A/C Compressor to Condenser Discharge Line Bolt	8-11	-	10-15

R-134a Chemical And Physical Properties

Description	Properties
Appearance	Colorless
Physical State	Gas
Odor	Ether
Specific Gravity	1.27
Vapor Pressure	4268 mmHg @ 20° C
Vapor Density	3.6 :1
% VOC, (% W/W)	100
Freezing Point	-101° C
Boiling Point	-27 °C

SERVICE TOOLS AND EQUIPMENT

- A/C Test Adapter Kit

SECTION 22 - 3 - Heating and Air Conditioning, Compressor and Clutch

DESCRIPTION AND OPERATION

A/C Compressor

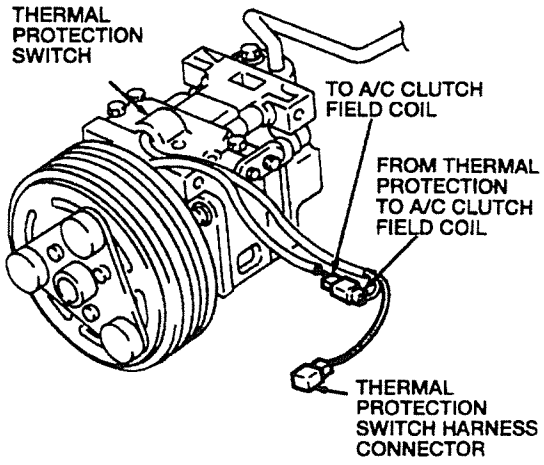
A vane-type A/C compressor is belt-driven by the A/C compressor clutch pulley. A magnetic clutch drives the A/C compressor shaft. When voltage is applied to the A/C compressor clutch field coil, the clutch hub is drawn by magnetic force toward the A/C compressor clutch pulley, which rotates freely on the A/C compressor. The magnetic force locks the clutch hub to the A/C compressor clutch pulley to turn the A/C compressor shaft. When voltage is removed from the A/C compressor clutch field coil, the clutch hub moves away from the A/C compressor clutch pulley and the A/C compressor shaft ceases to rotate. Features of the A/C compressor include:

- Minimal friction loss.
- Compact size.
- Quiet operation.
- Few parts.

Compressor operation is controlled by the A/C compressor clutch control relay and the A/C pressure cut-off switch.

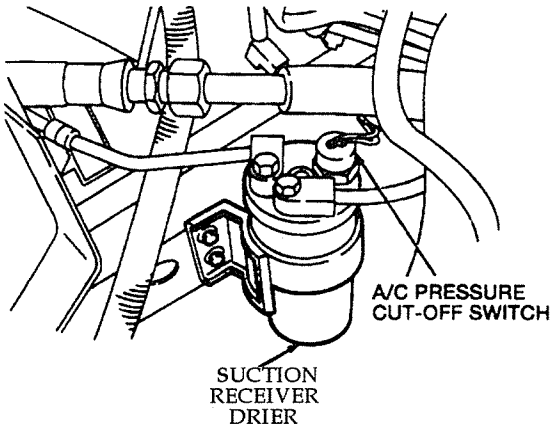
A thermo protection switch is integrated into the A/C compressor to protect the A/C compressor from overheating. The thermo protection switch will open the circuit to the A/C compressor clutch field coil if the A/C compressor gets too hot.

The thermo protection switch cannot be serviced separately and must be replaced with the A/C compressor as an assembly.



The A/C pressure cut-off switch is a safety device that shuts the A/C clutch off it the pressure on the discharge side of the A/C compressor (between the A/C evaporator core and the suction accumulator/drier drops below 29-35 psi (201-241 kPa) or is above 426-483 psi (2940-3332 kPa). The A/C pressure cut-off switch is wired in series with the A/C switch and the A/C evaporator temperature controlled thermostat.

The A/C compressor clutch control relay is located in the RH engine compartment, along the electrical component rail. The A/C compressor clutch control relay supplies power to the A/C compressor and is controlled by the Powertrain Control Module.



DIAGNOSIS AND TESTING

Compressor and Clutch

Refer to Section 22 to diagnose the compressor and clutch.

REMOVAL AND INSTALLATION

A/C Compressor

Removal and Installation

Refer to this section for removal and installation of the A/C compressor.

A/C System Filtering

Refer to this section for A/C system filtering procedures.

A/C Clutch

A/C Clutch and A/C Compressor Clutch Pulley

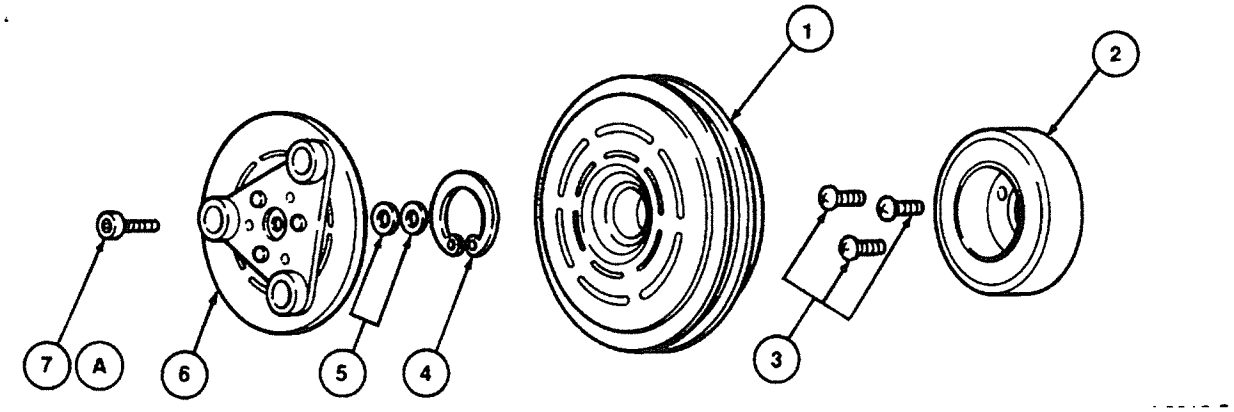
Removal

The following illustration (on next page) shows an exploded view of the A/C compressor clutch and the A/C compressor clutch pulley.

1. Remove the A/C compressor from the vehicle.
2. NOTE: Use a suitable tool to hold the clutch hub while removing the clutch hub bolt.

   Place A/C compressor in a vise and remove the clutch hub bolt.

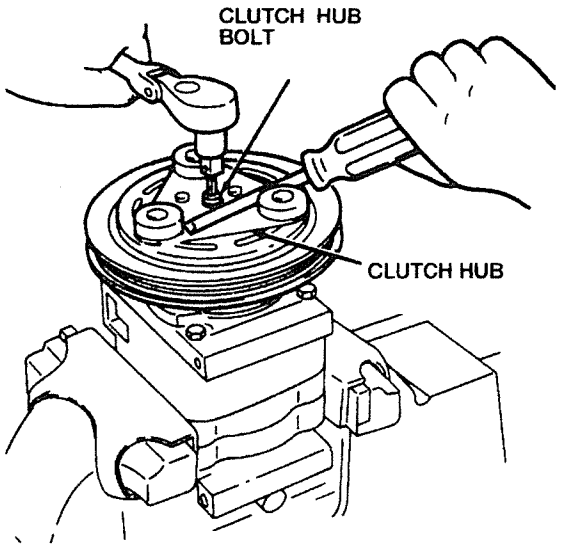
A/C Clutch and A/C Compressor Clutch Pulley - Exploded View



Item	Part Number	Description
1	-	A/C Compressor Clutch Pulley
2	-	A/C Compressor Clutch Field Coil

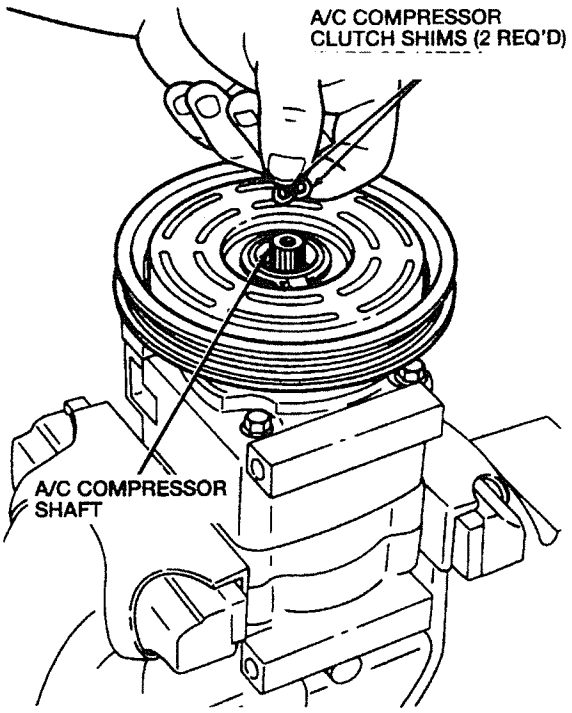
Item	Part Number	Description
3	-	A/C Compressor Clutch Field Coil Screws (3 req'd)
4	-	Clutch Pulley Snap Ring

3. Remove the clutch hub.

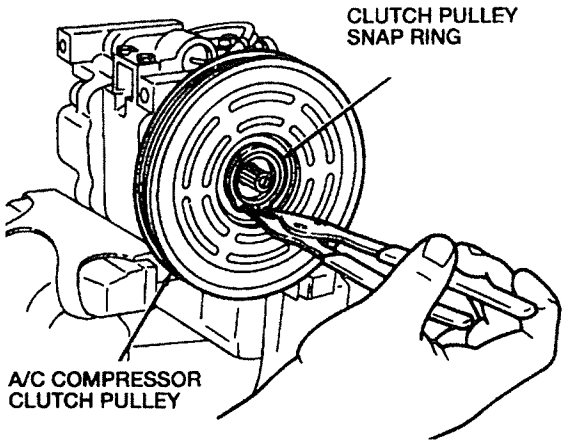


Item	Part Number	Description
5	-	A/C Compressor Clutch Shims
6	-	Clutch Hub
7	-	Clutch Hub Bolt
A	-	Tighten to 10.8 lb-ft (14.7 N-m)

4. Remove the two A/C compressor clutch shims from the A/C compressor belt.



5. Remove the clutch pulley snap ring.



6. Lift the A/C compressor clutch pulley from the A/C compressor.

Installation

To install, reverse the removal procedure.

Tighten the clutch hub bolt to 10.8 lb-ft (14.7 N-m).

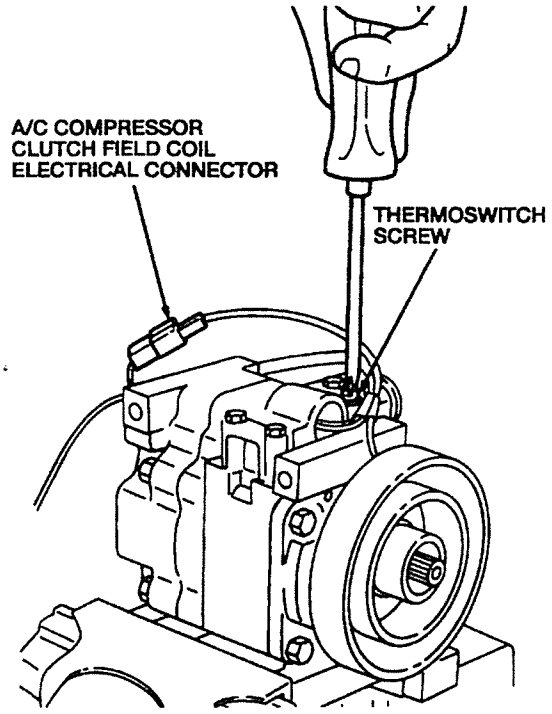
A/C Compressor Clutch Field Coil

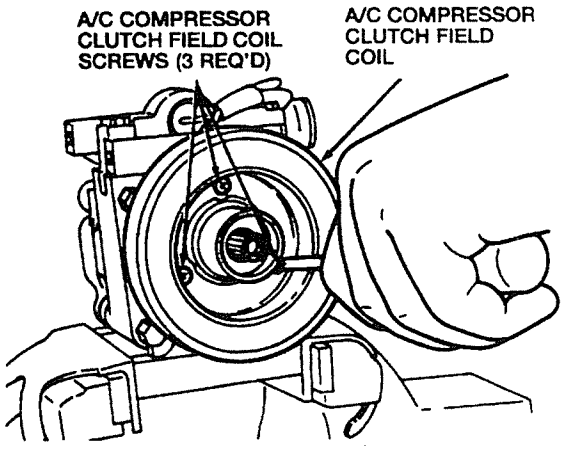
Removal

1. Remove the A/C compressor clutch and A/C compressor clutch pulley. Refer to the procedure in this section.
2. Place the A/C compressor in a vise and remove the thermoswitch screw from the A/C compressor. Disconnect the A/C compressor clutch field coil electrical connector.
3. Remove the three A/C compressor clutch field coil screws.
4. Remove the A/C compressor clutch field coil.

Installation

To install, reverse the removal procedure.





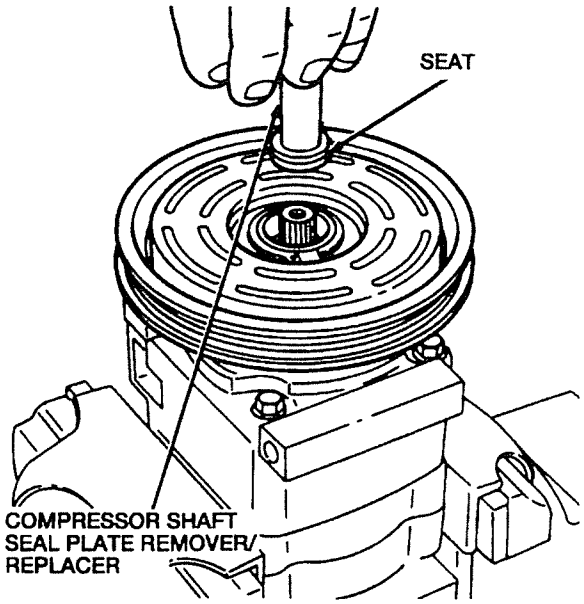
Shaft Seal and Seat

Service Tools Required

- Compressor Shaft Seal Plate Remover/Replacer
- Compressor Shaft Seal Remover/Replacer

Removal

1. Remove the A/C compressor clutch field coil. Refer to the procedure in this section.
2. Remove the felt dust seal.
3. Remove the shaft snap ring.
4. Use the Compressor Shaft Seal Plate Remover/Replacer to remove the seat.



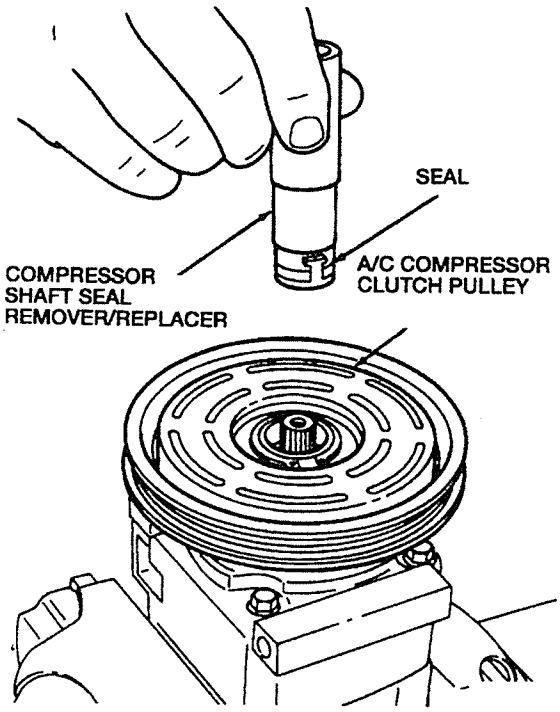
5. Use Compressor Shaft Seal Remover/Replacer to remove the seal.

Installation

NOTE: The R-134a refrigerant oil specifications was not available at the time this manual was printed.

Lubricate the seal with appropriate refrigerant oil prior to installation.

To install, reverse the procedure.



DISASSEMBLY AND ASSEMBLY

A/C Compressor

The A/C compressor is serviced as an assembly. There is no disassembly and assembly of this component. The A/C compressor clutch pulley and A/C compressor clutch field coil are the only serviceable parts on this assembly.

ADJUSTMENTS

A/C Compressor Clutch Air Gap

1. Set the A/C compressor on a level surface.
2. Check the resistance between the clutch field coil electrical connector and a ground with a Digital Multimeter or equivalent. The resistance should be approximately 3 to 4 ohms at 68° F (20° C). If the resistance is not as specified, replace the A/C compressor clutch field coil.
3. Set the measuring probe of the Dial Indicator/Magnetic Base or equivalent, on the clutch hub surface.
4. Apply 12 volts to the clutch field coil electrical connector.
5. The clutch hub to A/C compressor clutch pulley clearance is equal to the difference between the dial indicator readings when applying and removing 12 volts. Clearance should be between 0.016-0.024 inch (0.4-0.6 mm). Add or remove shims as necessary. Refer to the A/C compressor clutch shim selection chart in this section.

A/C Compressor Clutch Shim Selection Chart

Part Number	Thickness
-	0.008 inch (0.2 mm)
-	0.20 inch (0.5 mm)

SPECIFICATIONS

Torque Specifications	
Clutch Hub Bolt	10.8 lb-ft (14.7 N-m)

SERVICE TOOLS/EQUIPMENT

- Compressor Shaft Seal Plate Remover/Replacer
- Compressor Shaft Seal Remover/Replacer
- Dial Indicator/Magnetic Base
- Digital Multimeter

SECTION 23 - Seat and Seat Belts

DESCRIPTION AND OPERATION

Seat Tracks

The seat cushion and back has a seat track secured to the floor by four bolts.

When the seat lever is lifted, the seat can be manually moved forward and rearward on its track.

Seat

The seat is a bucket style. The seat incorporates a latch for adjusting its position on its track. Push or pull on seat until desired position is obtained. Release lever to lock seat to position.

Safety Belt Buckle

The safety belt buckle ends are attached to the vehicle frame or other secure location on the vehicle. The retractor is mounted to the vehicle frame in the passenger compartment and the belt buckle end is mounted onto the seat base and two seat belt anchor straps. Attaching the tongue to the buckle secures the occupant with both lower and upper restraints. The tongue and buckle attachment can be accomplished by a single, continuous movement.

Safety Belt, Shoulder

WARNING: THE VEHICLE OCCUPANT INCLUDING PREGNANT WOMEN, SHOULD WEAR SAFETY BELTS FOR MAXIMUM PROTECTION IN THE EVENT OF AN ACCIDENT. ENSURE THAT THE LAP BELT IS FITTED SNUGLY AND AS LOW AS POSSIBLE AROUND THE HIPS, NOT AROUND THE WAIST. USE THE SHOULD BELT ON THE OUTSIDE SHOULDER ONLY. NEVER WEAR THE SHOULDER BELT UNDER THE ARM OR SWING IT AROUND THE NECK OVER THE OTHER SHOULDER. NEVER USE A SINGLE BELT FOR MORE THAN ONE PERSON OR ACROSS MORE THAN ONE SEATING POSITION. FAILURE TO FOLLOW THESE PRECAUTIONS MAY INCREASE THE CHANCE AND/OR SEVERITY OF INJURY IN THE EVENT OF AN ACCIDENT.

CAUTION: Do not disassemble the buckles or the safety belt retractors.

The active restraint on the seat is a three-point safety belt system. Manual fastening of the continuous safety belt employs both the lap and shoulder restraint. Safety belts should always be worn by the driver/operator.

Always replace the seat belt assemblies in a matched set of safety belt, buckle, safety belt retractor, and tongue, as received. The manufacturer's identification on the label of the retractor webbing must match the manufacturer's identification on the buckle base. Never interchange any part of a safety belt assembly between vehicle models. If any part of the safety belt assembly must be replaced, always replace the entire safety belt assembly.

Always replace the entire safety belt assembly if the assembly has been subjected to loading by use during a collision.

The active restraint system has:
- Safety Belt Buckle End.
- Safety Belt Tongue.
- Continuous Safety Belt.
- Locking Retractor Mechanism.
- Safety Belt Guide.
- Anchor Hardware.

The safety belt system allows freedom of movement, locking only on hard braking, hard cornering, or impacts of 5 mph (8 km/h) or more.

REMOVAL AND INSTALLATION

Seat

Removal

1. Remove the head restraint tube from passenger compartment. Refer to procedure in this section.

2. **CAUTION: To avoid possible damage to seat components, handle the seat with care.**

3. Remove the four seat mounting bolts.

   NOTE: Open compartment door under seat to gain access to flange nuts and bolts securing seat to seat panel.

4. Remove the seat assembly from the passenger compartment.

Installation

1. NOTE: Before installing the seat assembly, ensure the seat adjustment track moves smoothly.

Apply multi-purpose grease to all moving parts prior to installation.

Install the seat assembly in reverse order of removal.

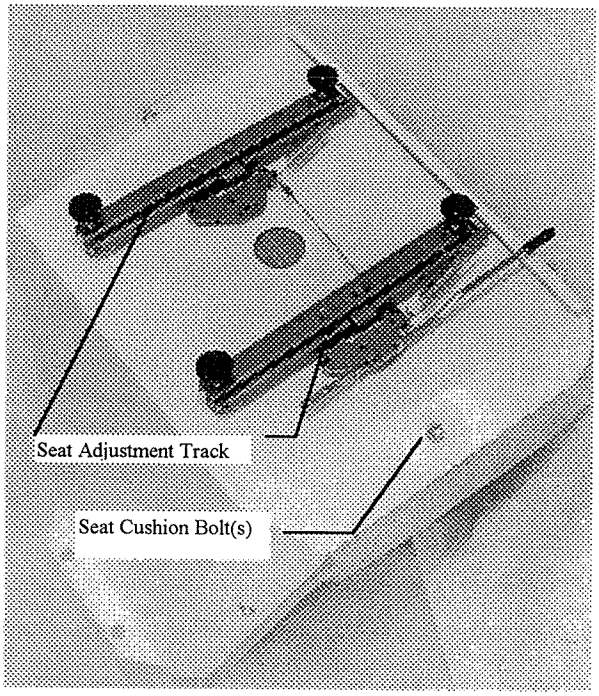
Seat Adjustment Track

The seat adjustment track is not serviceable. Replace seat adjustment track as an assembly when worn or broken.

Removal and Installation

1. Remove seat cushion. Refer to procedure in this section.

2. Slide bottom part of track ahead and back to get access to mounting hardware.



3. Remove four carriage bolts and flange bolts.

Install seat track in reverse order of removal.

Seat Back and Seat Cushion

Removal

1. Remove the two seat back and/or two seat cushion bolts.

2. Remove the seat back and/or seat cushion from the seat shell.

Installation

To install, reverse the removal procedure.

Head Restraint Tube

Removal

1. Remove two flange nuts, two bolts, and clamp.
2. Remove two cotterpins securing head restraint tube to seat back. Discard cotterpins.
3. Remove head restraint tube from passenger compartment.

Installation

To install, reverse the removal procedure.

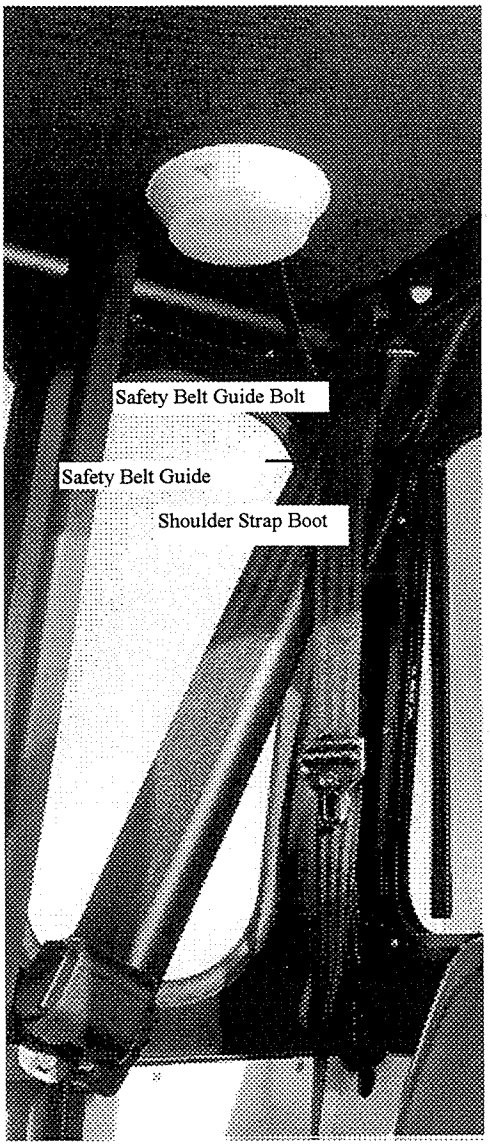
NOTE: Use new 3/16 x 1-1/2 cotterpins when securing head restraint tube to seat back.

NOTE: Install head restraint guards to head restraint tube prior to installation.

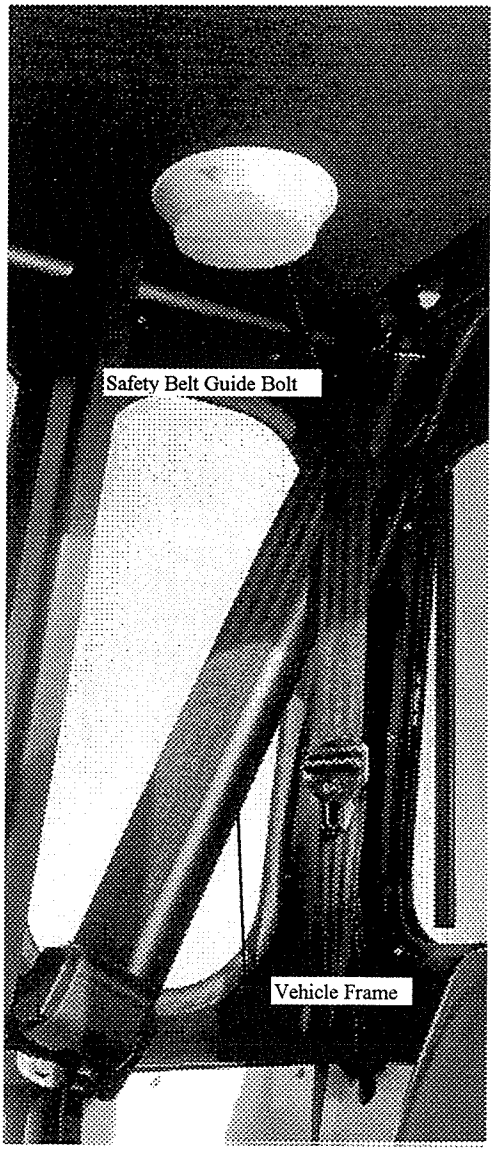
Safety Belt, Retractor and Tongue

Removal

1. Remove the seat shoulder strap boot from the safety belt guide.



2. Remove the safety belt guide bolt and washer from the vehicle frame.



3. Remove the safety belt retractor bolt and washer from the lower part of the vehicle frame.

6. **CAUTION: Do not disassemble the safety belt buckle end or safety belt retractor.**

Installation

1. Position the safety belt retractor and tongue in the vehicle.
2. Install the safety belt retractor bolt and washer. Tighten the safety belt retractor bolt to 28-58 lb-ft (38-78 N-m).
3. Install the safety belt retractor screw.
4. Install the anchor bracket bolt. Tighten the anchor bracket bolt to 25-58 lb-ft (38-78 N-m).
5. Install the safety belt guide bolt and washer. Tighten the safety belt guide bolt to 28-58 lb-ft (38-78 N-m).
6. Install the seat shoulder strap boot over the safety belt guide.

Buckle End

Removal

1. Remove the plastic trim.

2. Remove the safety belt buckle end bolt, washer and spacer.

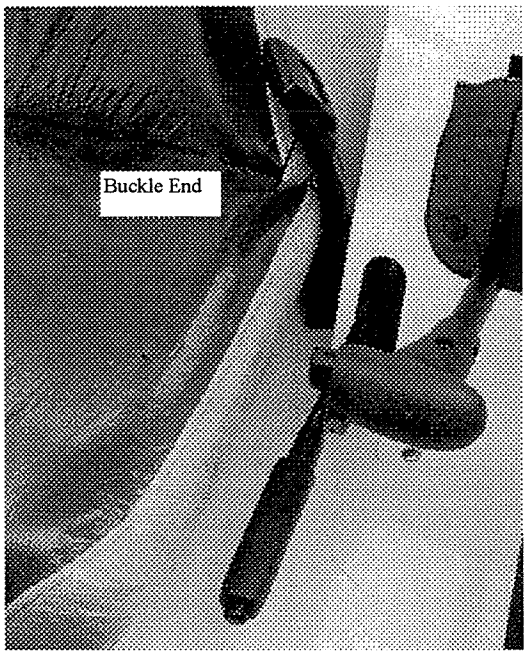
3. Remove the safety belt buckle ends.

Installation

NOTE: Ensure the spacers are in position under the buckle bracket.

To install, reverse the removal procedure.

Tighten the safety belt buckle end bolt to 28-58 lb-ft (38-78 N-m). The safety buckle end bolt must secure the seat belt anchor straps.



SERVICE PROCEDURES

Safety Belt Procedure After a Collision

All parts of the safety belt assembly must be replaced after a collision, provided:

1. The safety belt was in use at the time of the collision.

   OR

2. The safety belt was damaged by the collision (bent retractor, torn webbing, etc.).

   OR

3. Any of the safety belt attaching areas were damaged by the collision.

Before installing the new safety belt assembly, the safety belt attaching areas must be inspected for damage or distortion. If the attaching points are damaged or distorted, the sheet metal must be reworked back to its original shape and structural integrity.

Install the new safety belt. Refer to the installation procedure in this section. Functionally test the new safety belt. Refer to the functional test procedure in this section.

Safety Belt Twisted at Safety Belt Guide

1. Grasp the belt webbing at the safety belt guide.

2. Rotate and fold the belt webbing over itself as required to remove the twist.

3. Feed the fold portion of the belt through the safety belt guide.

4. When completed, the safety belt tongue should face outward.

Safety Belt Tongue Rotated on Belt

1. Rotate and fold the belt webbing over itself

2. Pull the belt webbing through the slot in the safety belt tongue.

3. When completed, the safety belt tongue should face outward.

Functional Test Procedure

NOTE: If the retractor of a new safety belt assembly has been bolted into a damaged or distorted mounting area, the new retractor could be warped and may not function. If this is the case, reshape the sheet metal back to original shape and structural integrity and install another new complete safety belt assembly.

Functionally test the new safety belt assembly using the following procedure.

1. NOTE: The seat belt should not be extended fully to preclude the possibility of a false feeling.

   The driver will buckle up and proceed to a safe test area. This method applies to the 5 mph (8 km/h) test only.

2. After reaching a safe area to perform sudden stops, the driver will attain a speed of approximately 5 mph (8 km/h). The driver should prepare for a severe brake application. At this time, grasp the shoulder harness and prepare to lean slightly forward at the moment the brake application is made.

3. **WARNING: THE DRIVER MUST BE PREPARED TO BRACE HIMSELF IN THE EVENT THE RETRACTOR DOES NOT LOCK.**

   The driver will make a maximum brake application with a tire skid. The maximum brake should be on dry concrete or equivalent hard road surface, never on a wet or gravel road. The driver should lean forward slightly into the shoulder harness. At this instant, the safety belts should lock up without belt webbing payout.

4. If there is a lockup of the shoulder strap, the safety belt assembly is functioning properly. Should the retractor fail to lock up at the 5 mph (8km/h), the test should be repeated at a constant 15 mph (24 km/h).

5. NOTE: If the retractor of a new safety belt assembly has been bolted into a damaged or distorted mounting area, the new retractor could be warped and may not function. In this case, reshape the sheet metal back to its original shape and structural integrity and install another new complete safely belt assembly.

   If the shoulder safety belt does not lock up at 15 mph (24 km/h) test, service the malfunctioning safety belts. Remove the retractor and rework the sheet metal back to its original shape and structural integrity in the retractor's mounting surface. Install the retractor assembly and test the safety belt assembly.

CLEANING AND INSPECTION

Safety Belt Maintenance

WARNING: THE SAFETY BELT ASSEMBLY INCLUDING RETRACTOR AND ATTACHING HARDWARE SHOULD BE INSPECTED AFTER ANY COLLISION. IT IS RECOMMENDED THAT ALL SAFETY BELT ASSEMBLIES BE REPLACED UNLESS THE COLLISION WAS MINOR AND A QUALIFIED TECHNICIAN FINDS THAT THE BELTS SHOW NO DAMAGE AND CONTINUE TO OPERATE PROPERLY. SAFETY BELT ASSEMBLIES NOT IN USE DURING A COLLISION SHOULD ALSO BE INSPECTED AND REPLACED IF EITHER DAMAGE OR IMPROPER OPERATIONS IS NOTED.

Safety belt assemblies should be periodically inspected to assure that they have not become damaged and that they remain in proper operating condition, particularly if they have been subjected to severe stress.

Safety Belt Webbing

The following procedure is recommended for the removal of spots and stains from safety belt webbing. It is important that proper cleaning techniques and cleaning agents be used to prevent setting the stain or affecting the color and/or flame resistance of the safety belt webbing. Avoid bleaching or redyeing the safety belt webbing as this could hinder safety belt webbing strength and performance.

The following materials are needed to clean safety belt webbing:

1. Clean, undyed cotton fabric.
2. Medium hard bristle brush.
3. Spot and Stain Remover.
4. Soil and Spot Lifter.

General Cleaning Method A

NOTE: Spot cleaning as described in Method A will be sufficient when the soiled area is not excessive. In the event of severe soiling or staining, clean the entire safety belt to avoid a "ring" condition.

For spots from grease, oil, tar, water spotting, crayon and lipstick.

1. Remove excess staining material from the fabric by scraping or wiping with a clean cloth.

2. Identify the staining material if possible.

3. CAUTION: Care should be used in application of the spot lifter to prevent it from contacting trim or paint.

   NOTE: Using other than recommended cleaners or procedures may affect flammability or fabric appearance.

Spray the stain with a soil and spot lifter from a distance of 8-10 inches (204-254 mm) as directed by instructions on can.

4. Allow the spot lifter to dry completely, until it forms a white powder on the surface of the fabric.

5. Brush and vacuum the white powder from the fabric.

6. If the soiled is not removed from the fabric, repeat Steps 1 through 5 as necessary.

7. Wipe the cleaned area with a damp cloth to remove any residual cleaner.

General Cleaning Method B

For stains such as grease, oil, tar, adhesive, crayon and lipstick.

1. Remove excess staining material from the fabric by scraping or wiping with a clean cloth.

2. Identify the staining material if possible.

3. If stain is still visible after the spot cleaning procedure (Method A), blot the soiled area with a clean cotton cloth saturated with spot and stain remover (extra strength).

4. Rub in a circular motion while continuously exposing the clean portion of cloth.

5. Gradually widen the area of application to the edges of the safety belt.

6. Repeat Steps 1 through 5 as necessary.

7. Wipe the cleaned area with a clean, damp cloth to remove any residual cleaner.

General Cleaning Method C

For stains from dirt, soil, food, soft drinks, and coffee.

1. Remove excess staining material from the fabric by scraping or wiping with a clean cloth.

2. Identify the staining material if possible.

3. Apply Rosenthal or Bissell or equivalent consumer retail upholstery cleaner with cloth or brush as directed by instructions on container.

4. Rub in a circular manner until the stain is removed.

5. NOTE: Spot cleaning as described in Method A will be sufficient when the soiled area is not excessive. In the event of severe soiling or staining, clean the entire safety belt to avoid a "ring" condition.

   Gradually widen the area of application to the edges of the safety belt.

6. Repeat Steps 1 through 5 as necessary.

7. Rub the cleaned area with a damp cloth to absorb residual cleaner.

8. Allow the safety belt to dry at room temperature.

ADJUSTMENTS

Safety Belts, Shoulder

Fastening Safety Belts

WARNING: USE THE SHOULDER BELT ON THE RH SHOULDER ONLY. NEVER WEAR THE SHOULDER BELT UNDER THE ARM. NEVER SWING IT AROUND YOUR NECK OVER THE LH SHOULDER. NEVER USE A SINGLE BELT FOR MORE THAN ONE PERSON. BE SURE THE LAP PORTION OF THE BELT IS FITTED SNUGLY AND LOW AS POSSIBLE AROUND THE HIPS, NOT ON THE WAIST. FAILURE TO FOLLOW THESE PRECAUTIONS COULD INCREASE THE CHANCE AND/OR SEVERITY OF INJURY IN AN ACCIDENT.

Pull the shoulder safety belt from the retractor so the shoulder portion of the safety belt crosses shoulder and chest. Insert the safety belt tongue into the buckle until a snap is heard and the safety belt is latched. Pull up on the shoulder portion of the safety belt to tighten the lap portion to a snug fit. Be sure the safety belt is as low on the hips as possible.

The safety belt system allows freedom of movement, locking only on hard braking or impacts of approximately 5 mph (8 km/h) or more. The system cannot be made to lock by jerking on the safety belt.

Unfastening Safety Belts

WARNING: ALL SAFETY BELT ASSEMBLIES INCLUDING RETRACTOR AND ATTACHING HARDWARE SHOULD BE INSPECTED AFTER ANY COLLISION. IT IS RECOMMENDED THAT SAFETY BELT ASSEMBLIES IN USE DURING A COLLISION BE REPLACED UNLESS COLLISION WAS MINOR AND A QUALIFIED TECHNICIAN FINDS THAT BELTS SHOW NO DAMAGE AND CONTINUE PROPERLY. SAFETY BELT ASSEMBLIES NOT IN USE DURING A COLLISION SHOULD ALSO BE INSPECTED AND REPLACED IF EITHER DAMAGE OR IMPROPER OPERATION IS NOTED.

Push the release button in the safety belt buckle and allow the safety belt to unlatch.

Shoulder Portion Adjustment

WARNING: DO NOT INTRODUCE SLACK INTO THE SAFETY BELT SYSTEM BECAUSE THE BELT LOCKS UPON IMPACT WHERE IT IS POSITIONED. USE THE SHOULDER SAFETY BELT ON THE RH SHOULDER ONLY. NEVER WEAR THE SHOULDER BELT UNDER THE ARM. NEVER SWING IT AROUND THE NECK OVER THE LH SHOULDER. NEVER USE THE SINGLE BELT FOR MORE THAN ONE PERSON. BE SURE THE LAP PORTION OF THE BELT IS FITTED SNUGLY AND LOW AS POSSIBLE AROUND THE HIPS, NOT ON THE WAIST. FAILURE TO FOLLOW THESE PRECAUTIONS COULD INCREASE THE CHANCE AND/OR SEVERITY OF INJURY IN AN ACCIDENT.

The shoulder restraint portion of the safety belt adjusts automatically to a snug position.

After unbuckling the safety belt, it is recommended that care be taken during retraction to prevent it from hitting trim panels, windows and painted surfaces.

Lap Portion Adjustment

The lap portion of the safety belt adjusts automatically.

Pull up on the shoulder portion of the safety belt to tighten the lap portion to a snug fit. Be sure the safety belt is as low on hips as possible.

Seat

If the seat is moving inconsistently or not moving on the tracks at all when the lever Is engaged, the seat track cable may need adjustment.

Refer to the following procedure:

1. Remove the seat. Refer to the procedure in this section.
2. Remove the spring at one of the cable.
3. Engage lever to release tension on cable and hold.
4. Using long-nose pliers bend the cable and secure with the spring. Continue with adjustment until the seat moves freely on track when lever is pulled.
5. Install seat. Refer to the procedure in this section.

SPECIFICATIONS

TORQUE SPECIFICATIONS

Description	lb-ft	N-m
Safety Belt Retractor Bolt	38-58	38-78
Safety Belt Guide Bolt	28-58	38-78
Safety Belt Buckle End Bolt	28-58	38-78
Seat Assembly to Seat Panel	28-38	38-51

SECTION 24 - Doors, Glass, and Mirrors

DESCRIPTION AND OPERATION

Doors/Windows

The door/window assembly is attached to rails by roller pulleys. The doors slide on tracks to ease opening and closing. The window can be opened separately from the inside.

Door: Open the door from the inside by pulling on red handle and slide door back on its tracks. Close door by firmly pushing on black handle and allowing door to travel forward until click is heard.

Window: Pull back on the black handle and slide window back to first notch (vent position) or fully back until it locks in the fully open position.

Door Glass

The frame-mounted door glass is sealed to the frame with urethane. The frame pieces around the window frame is riveted together.

Mirrors

The outside rear view mirror is a truck-mount design. The mirror base is secured to the mirror bracket on the lower RH and LH front part of the vehicle frame. The four screws attach the mirror to the mirror bracket. The mirror bracket is attached to the vehicle frame.

Rails, Door and/or Window

The door and window rails are mounted to the vehicle frame.

REMOVAL AND INSTALLATION

Door

Removal

1. Remove the upper door (window) assembly. Refer to procedure in this section.
2. Remove 3/8 x 1-1/2 socket head bolts, pulley rollers and locknuts which secures the door to the bottom track.
3. Remove door from the track.

Installation

To install, reverse the removal procedure. Tighten socket head bolts to 25 lb-ft (34 N-m).

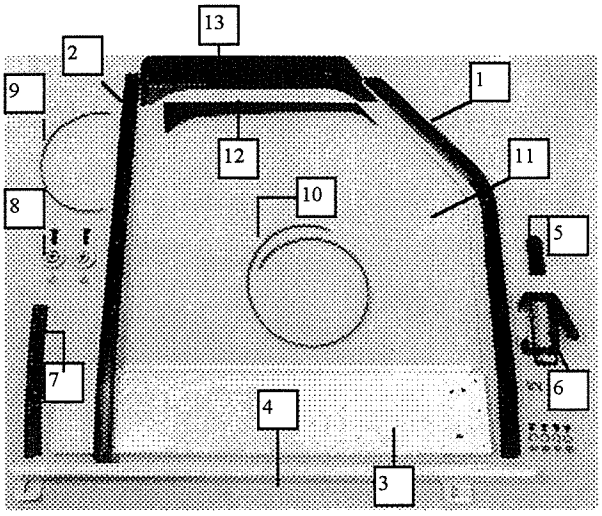
Door Glass

NOTE: The door glass can be replaced by sending the door glass assembly to the manufacturer. This ensures correct installation and sealing of the glass to the frame.

Removal

1. Remove the window assembly.
2. Remove 3/8 x 1 socket head bolts, pulley roller and locknuts which secures the window assembly to the track.
3. Remove rivets from the rear and top rear corner of the rear door window frame.
4. Carefully remove the urethane from the window frame and glass.
5. Carefully remove the rear window frame from the glass and save it for installation and assembly.

   NOTE: Do not bend or twist the window frame.
6. Carefully remove the glass from the window frame.
7. Remove the top and bottom seal.



Item	Part Number	Description
1	584019/20 RH/LH	Frame, Door Window Front
2	584018/17 RH/LH	Frame, Door Window Rear
3	584024/23 RH/LH	Lower Window Frame
4	584022/21 RH/LH	Window Roller Support
5	584005	Window Handle Grip
6	589004	Latch, Inside Window Assembly
7	684015	Window Frame Seal
8	583688	Pulley Roller
9	584026	Top Window Seal
10	584025	Bottom Window Seal
11	633535	Window Glass
12	583825/24 RH/LH	Guide Outer Top Window
13	583635/34 RH/LH	Frame, Window Top

Installation

To install, reverse the removal procedure.

Clean all channels of the window frame before installing a new window.

Allow the urethane to dry before installing the window assembly.

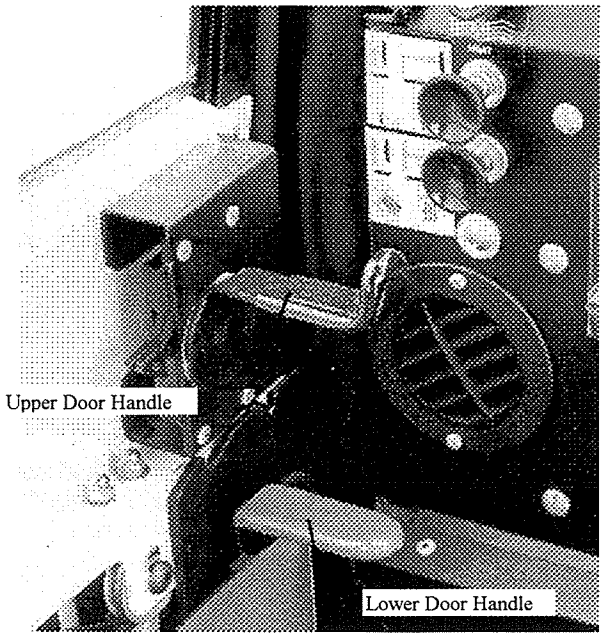
Door Handle

Removal and Installation

Upper Door

1. Remove three Philips head bolts, washers and flange nuts on outside of door panel.
2. Remove the upper door handle assembly on the inside of door panel.

To install, reverse the removal procedure.



Lower Door

1. Remove the upper door assembly. Refer to the removal procedure in this section.

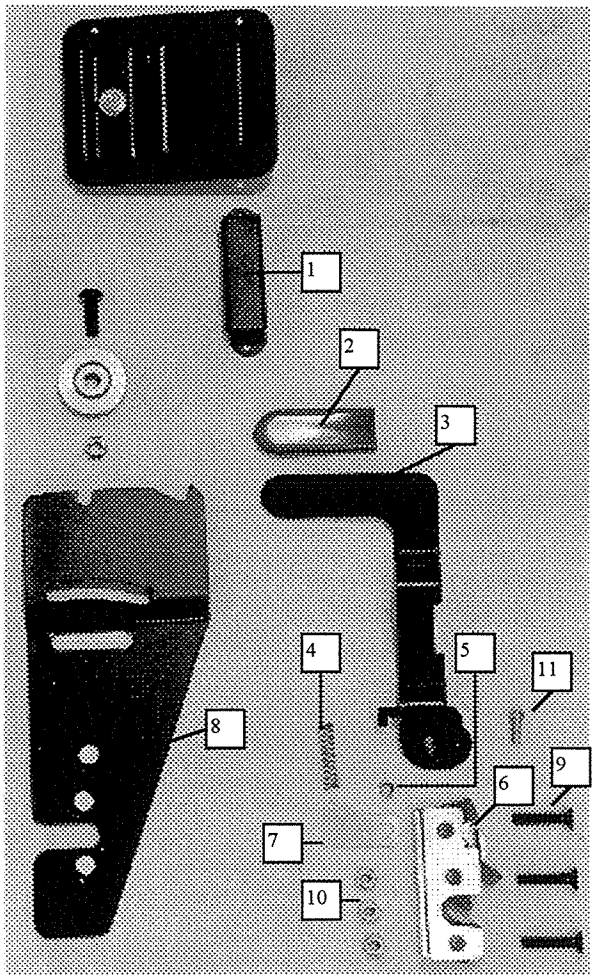
2. Remove the lower door assembly. Refer to the removal procedure in this section.

3. Drill out the rivets which hold the inner and outer door panels together.

4. Remove the 5/16 x 1-1/2 flathead socket bolts holding the door latch assembly to the door panel.

5. Separate the door panels. This allows access to the door latch assembly.

6. Remove the door latch assembly.



Item	Part Number	Description
1	-	Door Handle
2	-	Grip
3	-	Inside Handle (*not exactly as shown*)
4	583812	Inside Handle Spring
5	584008	Door Latch Bushing
6	-	Door Latch
7	584007	Door Handle Spring Support
8	-	Door Latch Stiffener, RH/LH
9	773676	5/16 x 1-1/2 Flathead Socket Head Bolt
10	771040	5/16 Stover Locknut
11	773887	1/4 x 3/4 Machine Screw
A	-	Tighten to 13-20 lb-ft (18-26 N-m)

7. Remove door paddle by drilling out the rivets securing it to the outer door panel.

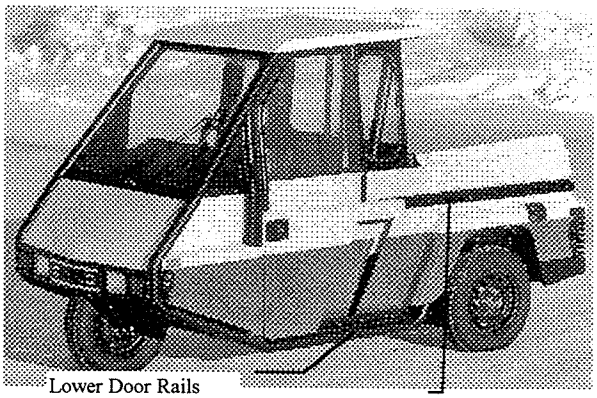
To install, reverse the removal procedure.

Rails, Door and Window

Removal and Installation

NOTE: Remove the rail(s) which needs service or replacement

1. Remove door/ window assembly. Refer to removal procedures in this section.
2. Remove flange nuts and bolts securing tracks to the vehicle frame.
3. Remove the rail(s).



Install the rail(s) in reverse order of removal.

Tighten the flange nuts and bolts 20-25 ft-lb (27-34 N-m).

Weatherstrips

Removal and Installation

CAUTION: When removing the weatherstrip from the around the door frame, take care not to tear the weatherstrip.

Mirrors

Removal and Installation

Remove four screws securing the mirror to the mounting bracket. Remove mirror.

Install replacement mirror to mounting bracket in reverse order of removal.

NOTE: Position mirror so the arm is below the mirror housing.

Windows

Windows, Front and Rear Quarter

The front window and rear quarter windows are mounted in the same manner using a one piece locking rubber mount.

Removal

NOTE: Remove the windshield wiper pivot arm from the front windshield.

1. Using dish soap or equivalent, lightly soap window seal.
2. Using a window trim tool, insert tool from the outside of the vehicle into the trim's top groove and angle it so lock releases. Draw the tool around the window until the lock is completely released.
3. Slowly push out on the glass making sure that someone is on the outside for support.
4. Remove window.
5. Peel off trim and replace, if needed.

Installation

1. Place rubber trim on window frame making sure the lock is to the outside.
2. Coat the seal with dish soap or equivalent.
3. Next place lower edge of window into the groove of the rubber and slowly work window into the groove up the sides and finally across the top.
4. Install lock using trim tool.

Window, Rear Sliding

NOTE: Refer to the procedure for the front window if the vehicle is equipped with a rubber-mounted non-sliding rear window.

1. Remove screws holding the inside ring.
2. Remove the inside ring from the rear window.
3. Carefully push the rear window out, making sure that someone is on the outside for support.

SECTION 25 - Headliner and Flooring

Headliner

The headliner is a layered design. The outer layer is a cleanable surface with holes to allow the sound to pass through into the second layer which is a sound deadening foam.

Removal

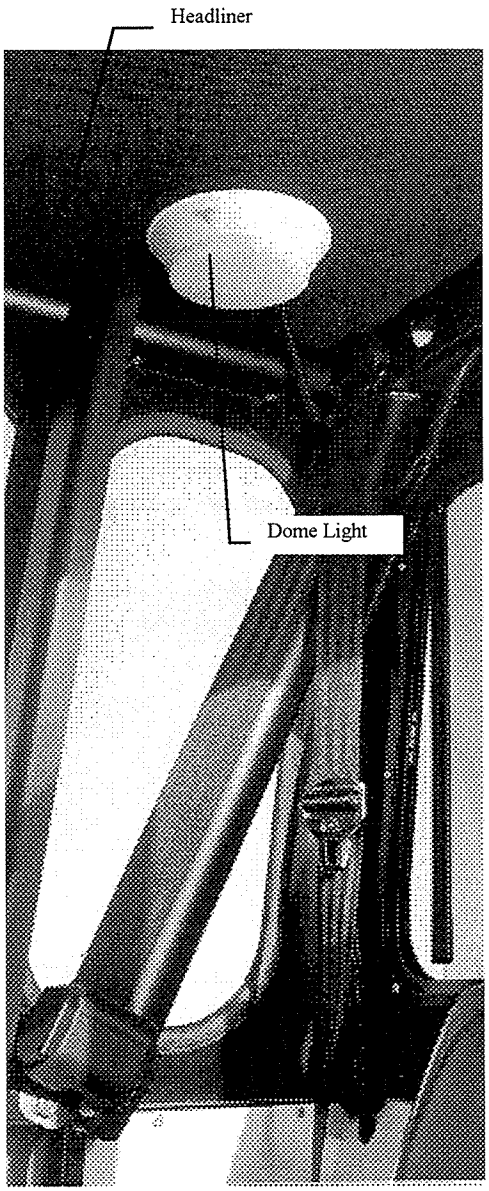
1. Remove the dome light. If necessary, refer to Section 19.

   NOTE: The headliner is glued to the roof panel.

2. Remove the rivets holding roof panel to cab frame.
3. Remove roof panel from vehicle.
4. Using a blunt tool, gently pry a corner of the headliner away from the roof panel.
5. Using your hands, gently pull the headliner away from the roof panel. Be careful not tear or damage the headliner.

Installation

1. Apply glue (PL-200 or equivalent) to roof panel. Smooth out with a putty knife to cover the entire surface.
2. Align the headliner and press onto the roof panel.
3. Install roof panel to cab frame and secure using pop rivets.
4. Install the dome light. If necessary refer to Section 19.



Flooring

The flooring is a one piece design. This piece covers the cab floor area. The flooring in the cab area is secured to the floor pan with push-type retainers.

Removal

1. Remove the flooring retainer pins by prying up with a flat blade screwdriver.

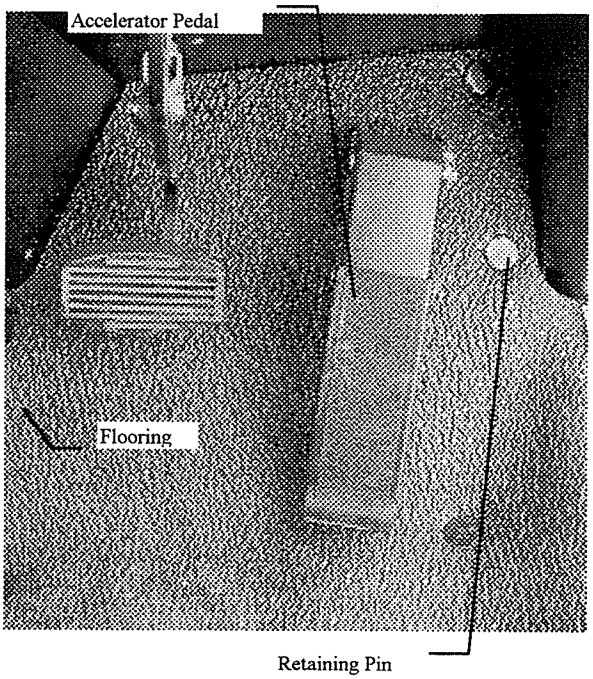
2. Remove cotterpin and steel pin. Remove accelerator pedal from the accelerator mount. Do not disconnect accelerator from cable.

   NOTE: This will ease removal / installation of flooring.

3. Remove the flooring.

Installation

1. Replace and align the flooring into the cab area.
2. Insert edges of flooring by the doors into trim.
3. Secure flooring to cab using the flooring retaining pins.
4. Attach accelerator pedal to accelerator mount using steel pin and cotterpin.



SECTION 26 Cargo Box (Trunk)

DESCRIPTION AND OPERATION

Cargo Box (Trunk)

The cargo box consists of an upper trunk assembly and lower trunk assembly. The upper trunk is mounted to the lower trunk assembly. The upper trunk assembly is attached to the lower trunk by two brackets. The upper trunk has a upper hinged lid which opens at the top. Gas-filled props aid in opening and closing the upper trunk lid. A lockable latch at the bottom center of the upper trunk lid keeps the trunk assembly in the closed position. Weatherstrip (self-adhesive) installed inside the lid prevents leaks between the trunk box and lid. The weatherstrip is held firmly in place with glue. The lower trunk assembly is secured to the frame and provides additional space for storage.

REMOVAL AND INSTALLATION

Cargo Box

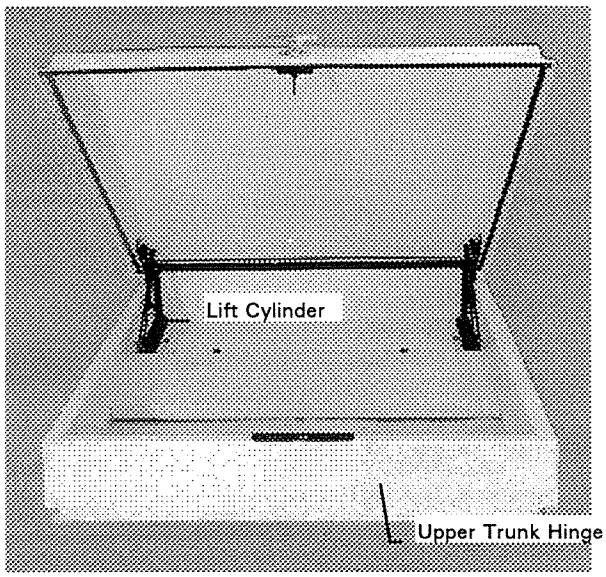
Removal

1. Open the box lid by unlocking the rear latch.
2. Unscrew fastener inside the rear part of box and remove bracket which holds the cargo box to the frame.
3. You and another person lift the cargo box slightly, and slide back, and remove.

Installation

Install the cargo box in the reverse order of removal.

NOTE: Apply a little grease on the slides to ensure the cargo box slides easily.



Upper Trunk Lid

Removal and Installation

1. Open upper trunk lid.
2. Remove four flange bolt and locknuts.
3. Lift and remove the upper trunk lid from the upper trunk hinge.

To install, reverse the removal procedure.

Tighten flange bolts to 14-18 lb-ft (19-25 N-m).

Lift Cylinder (Gas Prop)

Removal and Installation

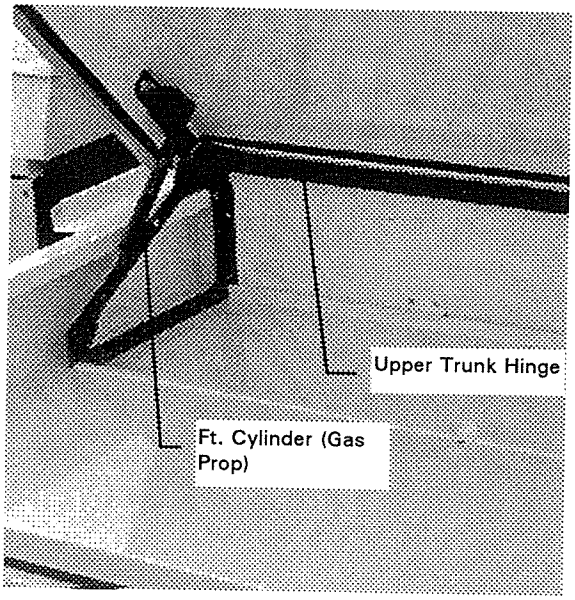
1. Loosen the flange locknuts at each end of the lift cylinder.

2. Place a prop under the upper trunk lid for support.

3. Remove the lift cylinder from upper trunk lid and upper trunk hinge.

To install, reverse the removal procedure.

Tighten flange nuts to 14-18 lb-ft (19-25 N-m).



Upper Trunk Lid Hinge

Removal and Installation

1. Remove the upper trunk lid. Refer to removal procedure in this section.

2. Remove the lift cylinders (gas props). Refer to procedure in this section.

3. Remove rivets.

4. Remove the upper trunk lid hinge.

To install, reverse the removal procedure.

Tighten flange bolts to 14-18 lb-ft (19-25 N-m).

Trunk Handle

Removal

1. Loosen two screws behind the handle

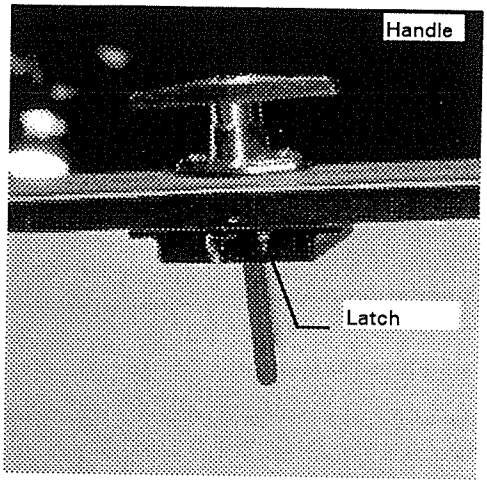
2. Remove handle

3. Remove mounting bolts.

4. Remove lock.

Installation

To install, reverse the removal procedure.



Trunk Lid Latch

Removal

1. Remove the handle. Refer to removal procedure in this section.

2. Drill out the four rivets holding the trunk lid latch to upper trunk lid.

3. Remove the latch.

4. Remove lock.

Installation

To install, reverse the removal procedure.

Upper Trunk Lid Striker Plate

Removal and Installation

1. Remove flathead bolts and locknuts.

2. Remove the upper trunk lid striker plate.

To install, reverse the removal procedure.
Tighten flathead bolts to 6-9 lb-ft (8-12 N-m).

Lower Trunk

Removal

1. Remove the upper trunk.

2. Remove four bolts with flange nuts (two per side) holding the lower trunk to the rails.

3. Remove four bolts with flange nuts (two per side) holding the lower trunk to the inner fender wells.

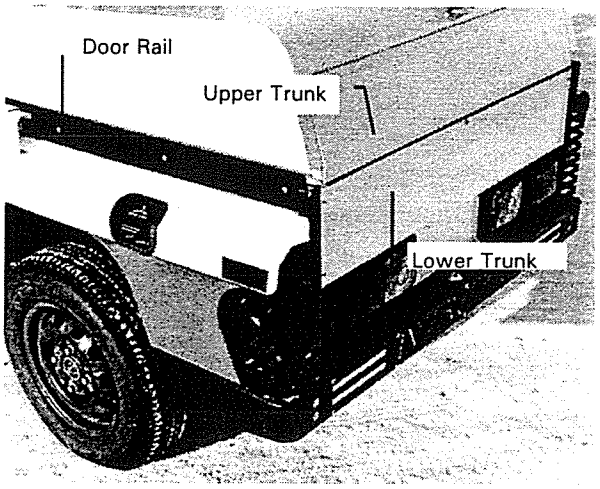
4. Remove three bolts with flange nuts holding the lower trunk to the rear bumper.

5. Disconnect the electrical wiring to the rear tail lights, side marker lights and signal lights.

6. Remove the lower trunk.

To install, reverse the removal procedure.

Tighten flange bolts to 14-18 lb-ft (19-25 N-m).



ADJUSTMENTS

Upper Trunk Lid Striker Plate

1. Open the upper trunk lid.

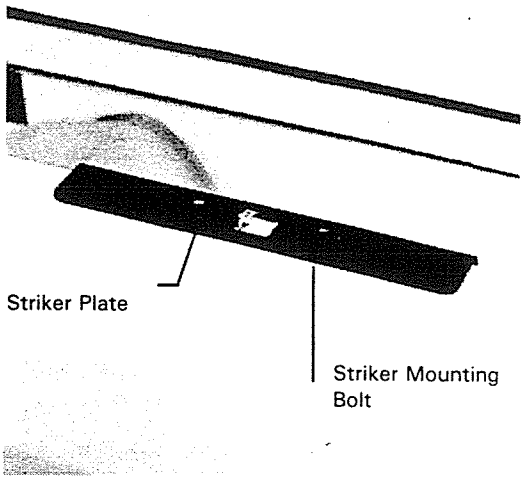
2. Loosen the two striker plate mounting bolts.

3. Slide the striker plate from side to side to position.

4. Tighten the two striker plate mounting bolts.

5. Open and close the upper trunk lid to check for ease of operation and secure.

6. Tighten the two striker mounting bolts to 6-9 lb-ft (8-12 N-m).



SPECIFICATIONS

TORQUE SPECIFICATIONS

Description	lb-ft	lb-in	N-m
Lift Cylinder	14-18	-	19-25
Upper Trunk Lid	14-18	-	19-25
Lower Trunk Bolts	14-18	-	19-25
Upper Trunk Striker Plate	6-9	-	8-12

To install, reverse the removal procedure.

ADJUSTMENTS

Door Inspection

Verify that the door can be closed easily and that there is no looseness in the door as it slides within the rails. Replace the pulley rollers if they are loose. Refer to the procedure in this section.

Verify that there is no play when the door is closed. If play is evident, the door latch striker plate and/or the door pulley rollers need to be adjusted. Refer to the door alignment procedure in this section.

Verify that the clearance between the body and door is not excessive or uneven. If the clearance is excessive or uneven, the door latch striker plate and/or door pulley rollers need to be adjusted. Refer to the door alignment procedure in this section.

Window Inspection

Verify that the window part of the door can be closed easily and that there is no looseness in the window assembly as it slides within the rails. Replace the pulley rollers if they are loose. Refer to the procedure in this section

Verify that there is no play when the window assembly is closed. If play is evident, the window latch striker plate and/or the door pulley rollers need to be adjusted. Refer to the door alignment procedure in this section.

Verify that the clearance between the body and window is not excessive or uneven. If the clearance is excessive or uneven, the window latch striker and/or door pulley rollers need to be adjusted. Refer to the alignment procedure in this section.

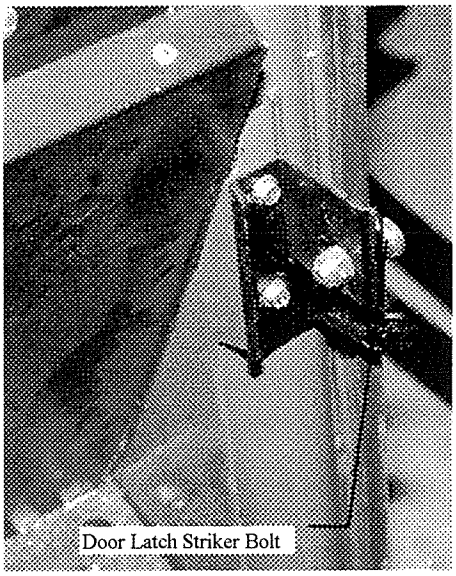
Door Alignment

Door-to-Body Clearance Check

1. If the door-to-body clearance is uneven, loosen the door rail mounting bolts and nuts. Adjust the door.
2. Tighten the door rail bolts and nuts to 20-25 lb-ft (27-34 N-m).

Door Latch Striker Bolt

1. If there is excessive door play or excessive door-to-body clearance when the door is closed, loosen the door latch striker bolt and adjust.
2. Open and close the door assembly to check for ease of operation and secure.
3. Close the door and check for door alignment to the body.
4. Tighten the door latch striker to 13-19 lb-ft (18-26 N-m).



LUBRICATION

Door Latches

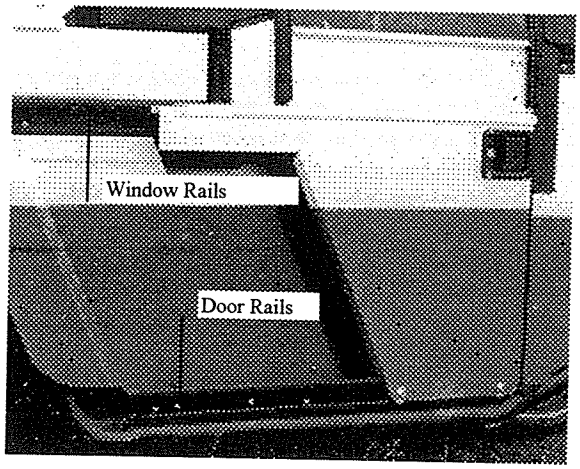
Apply multi-purpose grease to all moving parts of the door latches.

Lock Cylinder Lubricant

Use lock cylinder lubricant to eliminate sticking or binding of all key lock cylinders.

Pulley Rollers/Door Rails

Use a multi-purpose spray to the door rails and pulley rollers to eliminate binding of doors when opening or closing.



CLEANING AND INSPECTION

Glass

CAUTION: Window glass should not be cleaned with a dry cloth or abrasive cleaning powders. Clean the glass with a soft, clean cloth and mild detergent and water or a glass cleaner, otherwise damage to the surface will result.

Clean the glass using a glass cleaner and a clean, lint-free cloth. Follow directions on the container.

Mirrors

CAUTION: Outside rear view mirrors should not be cleaned with a dry cloth or abrasive cleaning powders. Do not remove ice with a scraper. The outside rear view mirrors should only be cleaned with a soft, clean cloth and mild detergent and water or a glass cleaner, otherwise damage to the reflective surface will result.

Frozen Mirrors

CAUTION: Thaw out mirror prior to adjusting the arm or mirror base.

SPECIFICATIONS

Torque Specifications

Description	lb-ft	N-m
Door/Window Rail Flange Nuts	20-25	27-34
Door Latch Striker Bolt	13-19	18-26
Door Latch Sockethead Bolts	13-20	18-26

SERVICE TOOLS/EQUIPMENT

- Window Trim Removal Tool

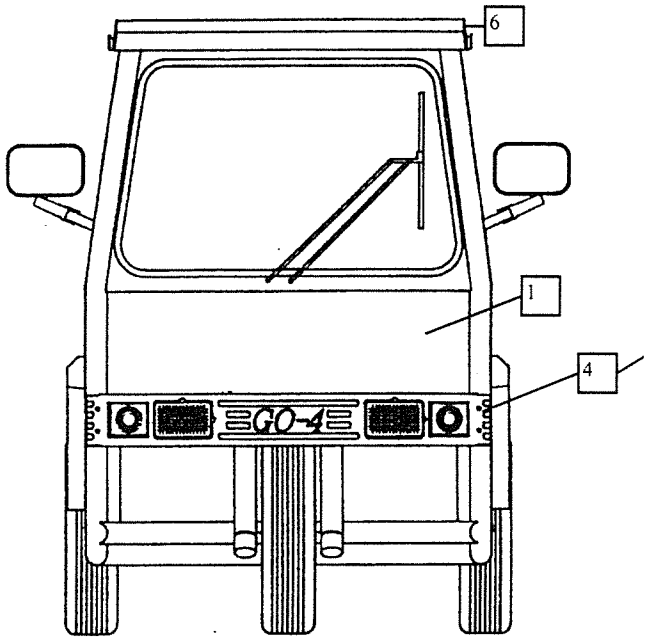
SECTION 27 - Body Shell/Frame and Mounting

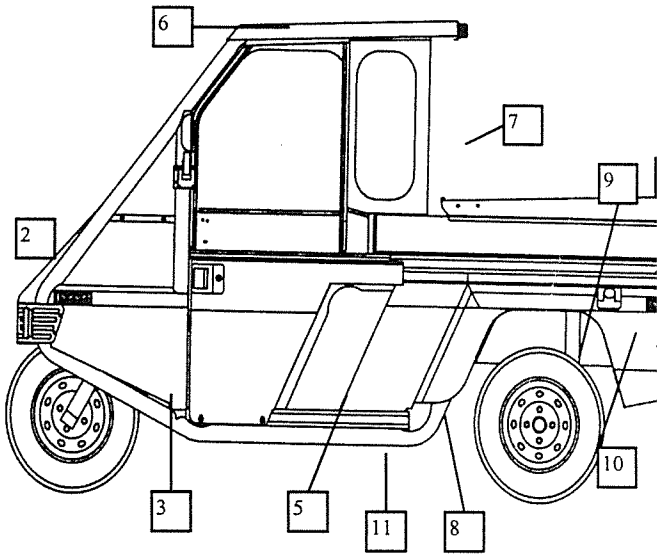
DESCRIPTION AND OPERATION

Body Panels

The GO-4 uses a tubular steel frame. Hood panel, fenders, filler panels and other body panels are bolted or riveted (or a combination) to the tubular steel frame. All body panels are aluminum to resist salt and corrosion.

Item	Part Number	Description
1	533418	Hood Panel
2	533543	LH Upper Front Filler Panel
	533544	RH Upper Front Filler Panel
3	533564	LH Lower Front Filler Panel
	533565	RH Lower Front Filler Panel
4	509000	Front Bumper Assembly
5	534021	Engine Intake Front Panel
6	539001	Roof Assembly
7	533686	Rear Cab Panel
8	539005	LH Rear Fender Assembly
	539004	RH Rear Fender Assembly
9	533729	LH Inner Fender Well
	533730	RH Inner Fender Well
10	509001	Rear Bumper Assembly
11	-	Lower Door Track
12	-	Upper Door Track





Bumpers

The steel front and rear bumper assemblies are bolted to the tubular steel frame.

The front bumper houses the headlights, turn signals, and side marker lights. On some models, it will be equipped with auxiliary equipment suited to its needs.

The rear bumper houses the license plate lamp assembly.

Engine and Transaxle Mounting

The engine and the transaxle are mounted to the vehicle with a series of rubber support insulators. The support insulators support the engine/transaxle assembly within the engine compartment. The support insulators isolate the engine and transaxle from the vehicle body to prevent transferring engine and transaxle vibration to the passenger compartment.

REMOVAL AND INSTALLATION

Body Panels

Hood Panel

Removal

1. Remove the hood panel bolts securing the hood panel to the vehicle frame.
2. Remove the hood panel from the vehicle.

   NOTE: On some models, it may be necessary to disconnect electrical connectors before removing the hood panel from the vehicle.

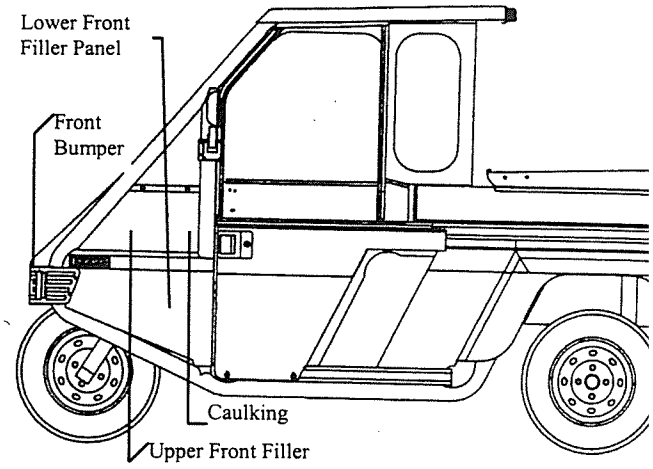
Installation

To install, reverse the order of removal.

Upper Front Filler Panel

Removal

1. Break the caulking around the upper front filler panel.
2. Remove the screws holding the upper part of the front filler panel to the vehicle frame.



3. Remove rivets holding the lower part of the front filler panel to the vehicle.
4. Remove the upper front filler panel from between the tubular frames of the vehicle.

Installation

To install, reverse the order of removal.

Lower Front Filler Panel

Removal

1. Remove the front bumper screws and nuts at the front end of the lower front filler panel.
2. Remove the rivets at the rear of the lower front filler panel.
3. Remove the lower front filler panel from the vehicle.

Installation

To install, reverse the order of removal.

Roof Assembly

Removal

1. Remove the rivets around the roof assembly.

2. Remove the roof assembly. Refer to Section 25 for removal procedure of electrical connectors to dome light and the red clearance lights.

Installation

To install, reverse the order of removal.

Engine Intake Front Panel

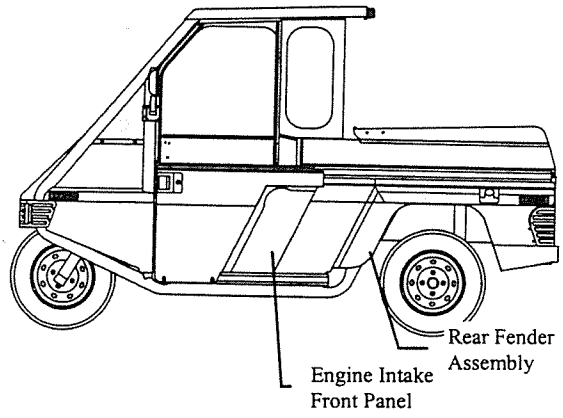
Removal

1. Remove the two engine intake front panel mounting bolts and nuts.

2. Remove the engine intake front panel.

Installation

To install, reverse the order of removal.

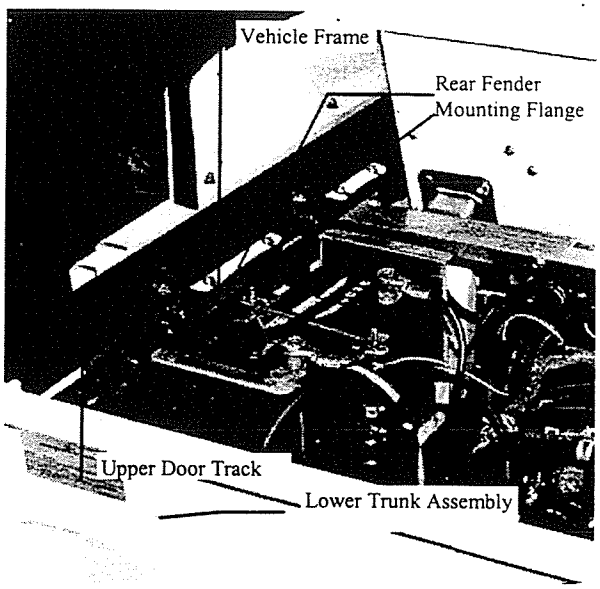


Rear Fender Assembly

Removal

1. Remove the upper cargo box from the rear of the vehicle.

2. Remove the four mounting bolts and nuts securing the upper part (or flanges) of the rear fender assembly to the frame.



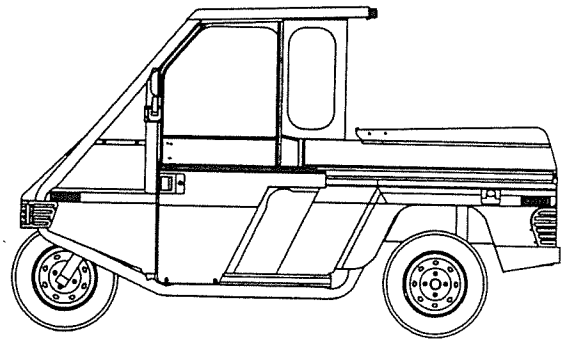
3. Remove two mounting bolts and nuts securing the fender assembly to lower door track.

4. Remove one mounting bolt and nut securing the fender assembly to the lower trunk.

5. Remove the fender assembly from the side of the vehicle.

   NOTE: The rear fender assembly consists of the following pieces: upper side access panel, engine intake panel, splash guard, upper step side fender panel, rear corner fender panel and the tail light cover. All pieces are secured with rivets.

   Remove the rivets securing the panel(s).



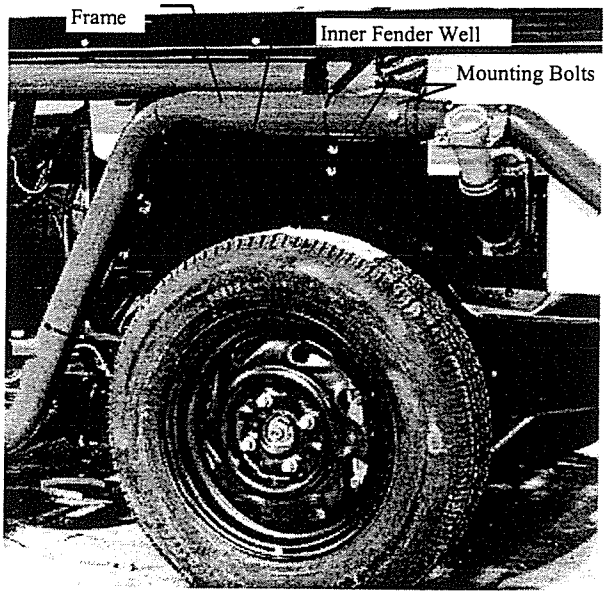
Installation

To install, reverse the order of removal.

Inner Fender Well

Removal

1. Remove the rear fender assembly from the vehicle. Refer to the procedure found in this section.
2. Remove the mounting bolts and nuts securing the inner fender well to the frame.
3. Remove the inner fender well.



Installation

To install, reverse the order of removal.

Rear Cab Panel

Removal

1. Remove the roof assembly from the cab. Refer to the procedure in this section.
2. Remove the rivets securing the rear cab panel to the cab frame.
3. Remove the rear cab panel from the cab section of the vehicle.

Installation

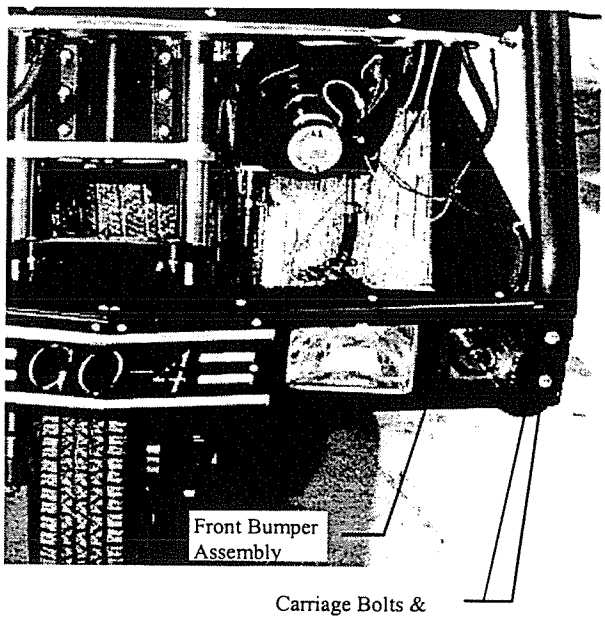
To install, reverse the order of removal.

Bumpers

Front Bumper

Removal

1. Remove hood panel. Refer to the procedure in this section.
2. Label the wiring to head lamps, parking lamps and signal lamps which are in the front bumper.
3. Disconnect the wiring to the head lamps, parking lamps and signal lamps.
4. Remove the two carriage bolts and nuts on each side of the front bumper.
5. Remove the bumper assembly from the front of the vehicle.
6. Remove the headlights and signal lamps from the bumper assembly.
7. Remove the two hood supports from the top of the front bumper assembly.



Installation

To install, reverse the order of removal.

Rear Bumper

Removal

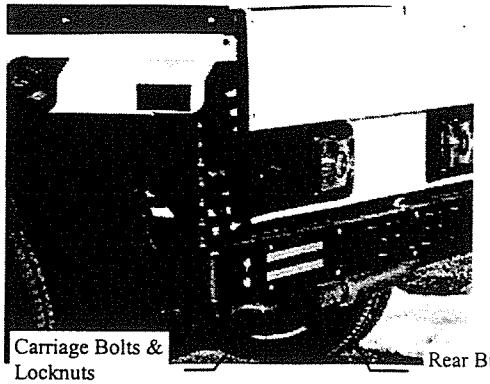
1. Removal two carriage bolts and locknuts on each side of the rear bumper.

2. Disconnect the rear license plate electrical connector to the rear license plate light.

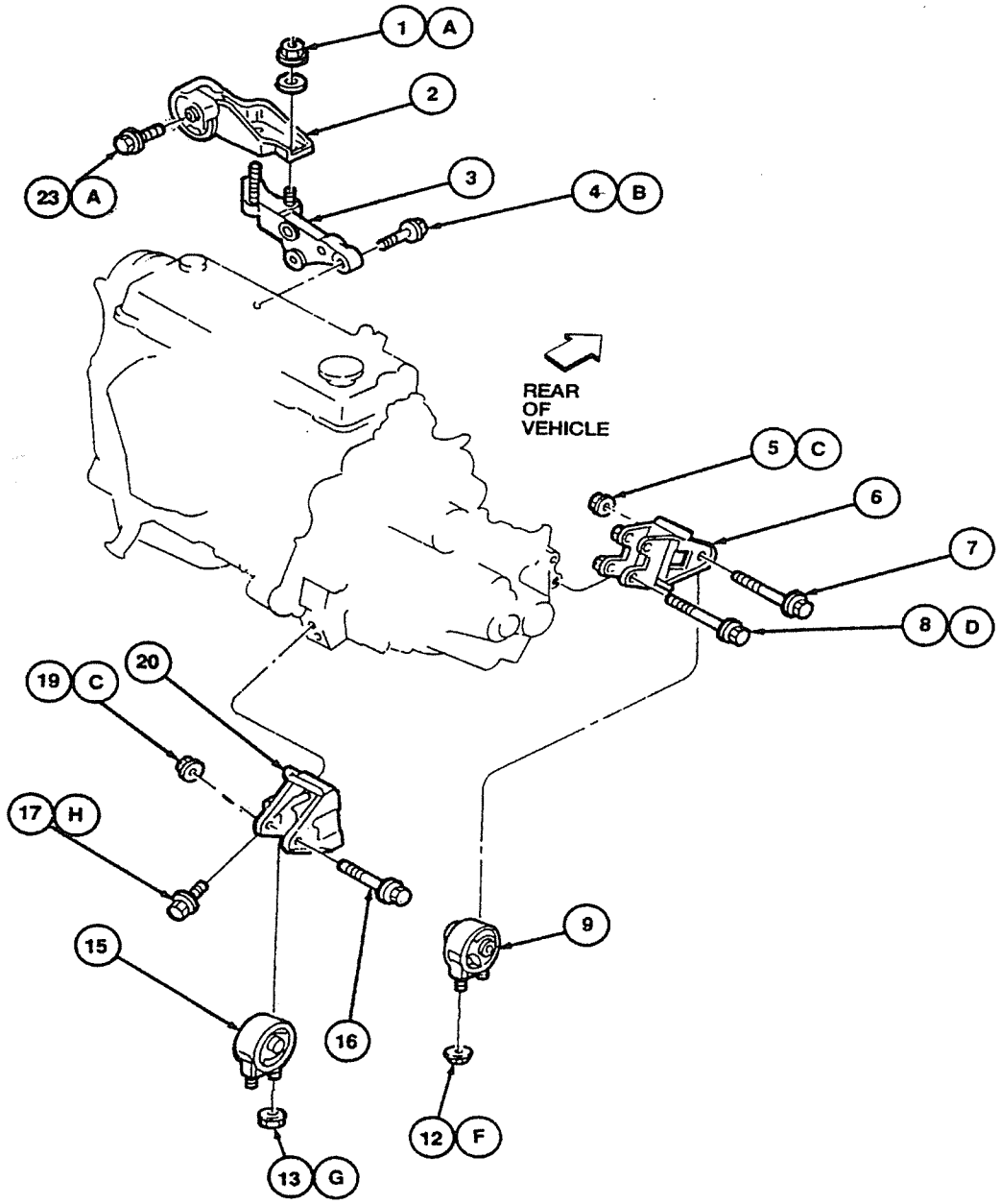
3. Remove the rear bumper from the rear of the vehicle.

Installation

To install, reverse the order of removal.



Engine and Transaxle Mounting - Exploded View

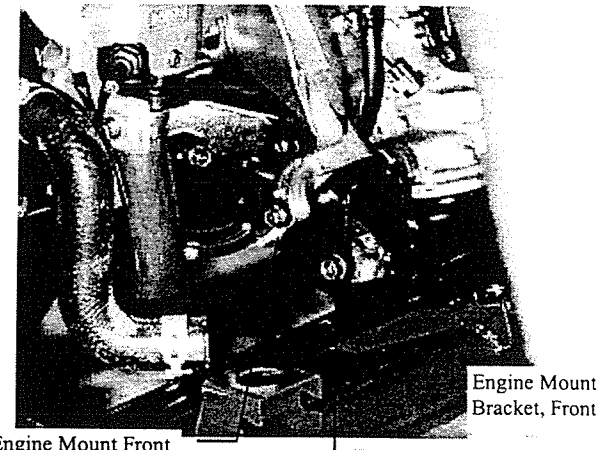


Item	Part Number	Description
1	393084	Nut, Engine Mount #3
2	393771	Upper Engine Mount
3	-	Engine Support Bracket
4	-	Engine Support Bracket Bolt (3 required)
5	773170	Nut
6	393080	Bracket, Engine Mount #1
7	393087	Bolt, Rubber Engine Mounts
8	393698	Bolt, Engine Mount
9	393085	Rubber Engine Mount #1
10	-	Mounts to Bracket on the RH upper side of frame
11	-	Mounts to Bracket on Front Cross Member of frame
12	770900	Nut, Rubber Engine Mount #1 & #2
13	770900	Nut, Rubber Engine Mount #1 & #2
14	-	Mounts to Rear Bracket on Rear Cross Member of frame
15	393086	Rubber Engine Mount #2
16	393087	Bolt, Rubber Engine Mounts
17	770898	Bolt, Bracket, Engine Mount #2
18	-	Front Transaxle Support Insulator Through Bolt Nut
19	773170	Nut
20	393081	Bracket, Engine Mount #2
23	770223	Bolt
A	-	Tighten to 39-47 ft-lb (53-64 N-m)
B	-	Tighten to 29-40 ft-lb (39-54 N-m)
C	-	Tighten to 50-68 ft-lb (67-93 N-m)
D	-	Tighten to 14-19 ft-lb (19-26 N-m)
E	-	Tighten to 21-34 ft-lb (28-46 N-m)
F	-	Tighten to 27-38 ft-lb (37-52 N-m)
G	-	Tighten to 28-37 ft-lb (38-51 N-m)

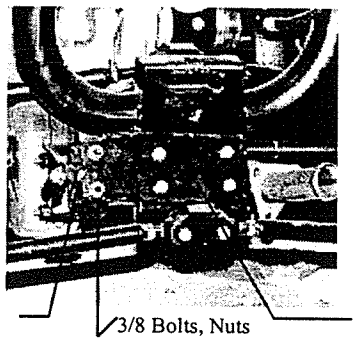
Front Support Insulator, Transaxle

Removal

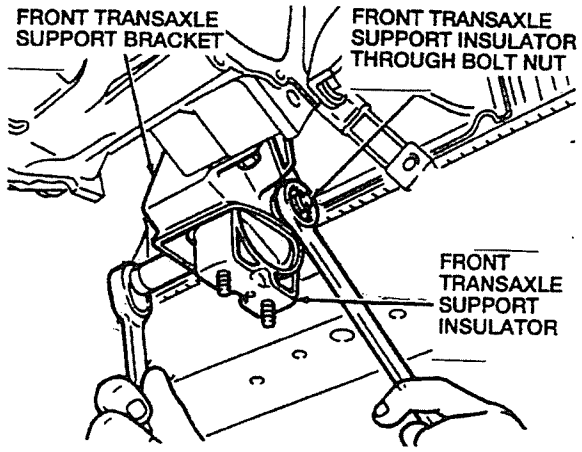
1. Support the engine with an engine support, chain hoist or equivalent.
2. Raise and support the vehicle.
3. Remove the two front transaxle support insulator nuts and two rear transaxle support insulator nuts from the rear engine support.



4. Remove the four rear engine support rebound insulator bolts. Remove the rear engine support.



5. Remove the front transaxle support insulator through bolt nut.



6. Remove the front transaxle support insulator through bolt nut.

7. Remove the front transaxle support insulator.

Installation

To install, reverse the removal procedure.

Refer to Torque Specifications in this section.

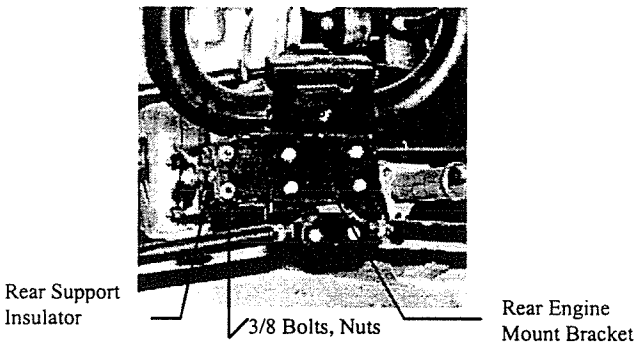
Support Insulator, Rear Transaxle

Removal

1. Support the engine with a three-bar engine support, chain hoist or equivalent.

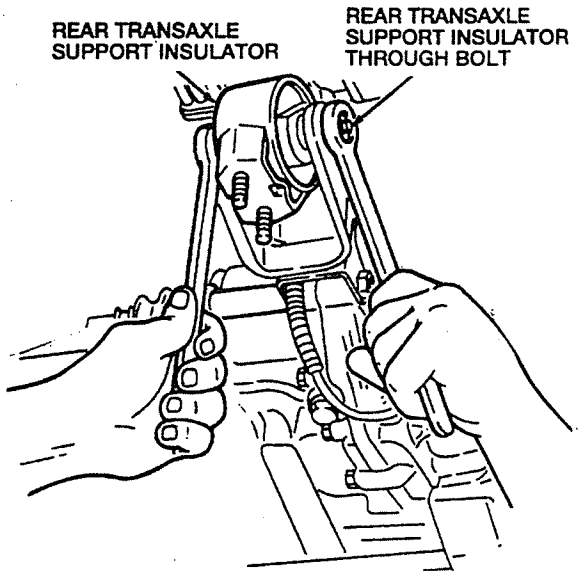
2. Raise and support the vehicle.

3. Remove the two front transaxle support insulator nuts and two rear transaxle support insulator nuts from the rear engine support.



4. Remove the four rear engine support rebound insulator bolts. Remove the rear engine support.

5. Remove the rear transaxle support insulator through bolt and nut.



6. Remove the rear transaxle support insulator.

Installation

To install, reverse the removal procedure.
Refer to Torque Specifications in this section.

Support, Rear Engine

Removal

1. Support the engine with a three-bar support, chain hoist or equivalent.

2. Raise and support the vehicle.

3. Remove the two front transaxle support insulator nuts and two rear transaxle support insulator nuts from the rear engine support.

Installation

To install, reverse the removal procedure.

Tighten the four rear engine support rebound insulator bolts to 47-66 lb-ft (64-89 N-m).

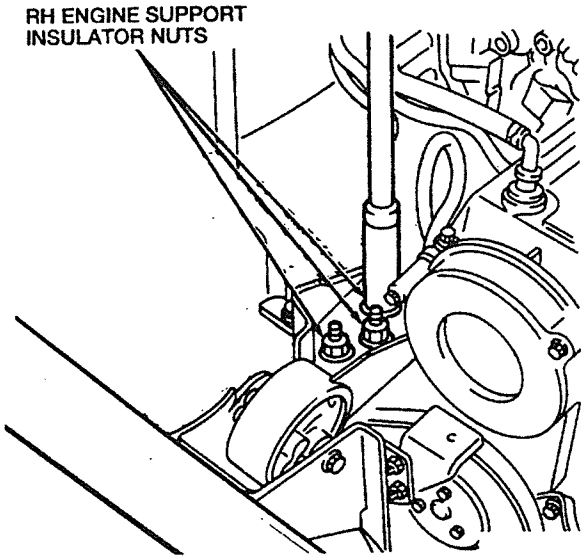
Tighten the two rear transaxle support insulator nuts to 21-34 lb-ft (28-36 N-m).

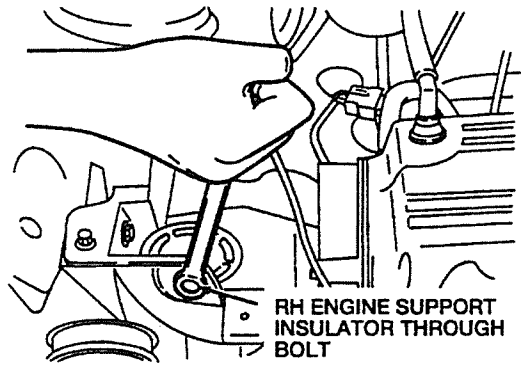
Tighten the two front transaxle support insulator nuts to 27-38 lb-ft (37-52 N-m).

Support Insulator, RH Engine

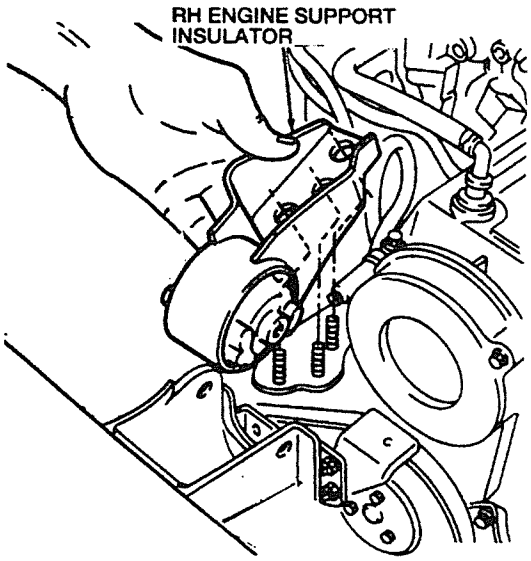
Removal

1. Remove the engine air cleaner. Refer to Section 11 - Engine for the removal procedure.
2. Support the engine with a suitable jack.
3. Remove the three RH engine support insulator nuts and washers.
4. Remove the RH engine support insulator through bolt and nut.





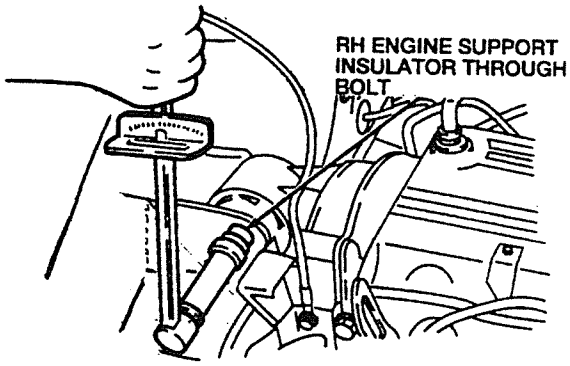
5. Remove the RH engine support insulator.



6. If it is necessary to remove the RH engine support bracket, remove the four RH engine support bracket bolts.
7. Remove the RH engine support bracket.

Installation

1. If removed, position the RH engine support bracket into place and install the four RH engine support bracket bolts. Tighten the four RH engine support bracket bolts to 44-63 lb-ft (59-85 N-m).
2. Position the RH engine support insulator and install the RH engine support insulator through bolt and RH engine support insulator nuts. Tighten the RH engine support insulator through bolt to 48-69 lb-ft (67-93 N-m).



3. Tighten the RH engine support insulator nuts to 39-47 lb-ft (53-64 N-m).

4. Remove the jack from under the engine.

5. Install the engine air cleaner. Refer to Section 11 for the installation procedure.

Support Bracket, Engine

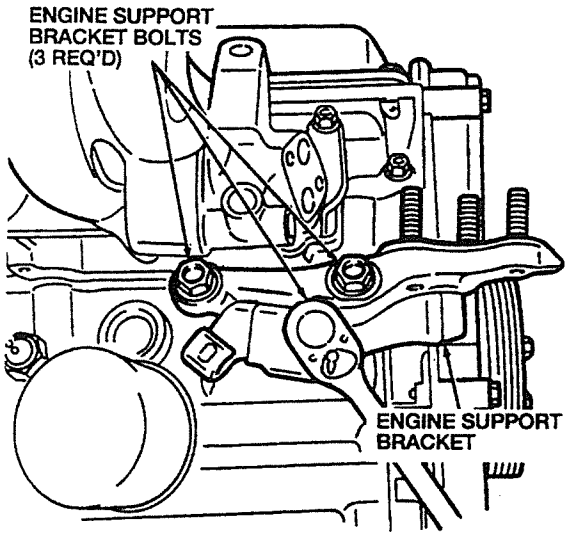
Removal

1. Remove the engine air cleaner. Refer to Section 11 for the removal procedure.

2. Support the engine with a suitable jack.

3. Remove the RH engine support insulator. Refer to the procedure in this section.

4. Remove the three engine support bracket bolts.



5. Remove the engine support bracket.

Installation

1. Position the engine support bracket into place and install the three engine support bracket bolts. Tighten the three engine support bracket bolts to 29-40 lb-ft (39-54 N-m).

2. Install the RH engine support insulator. Refer to the procedure in this section.

3. Remove the jack from under the engine.

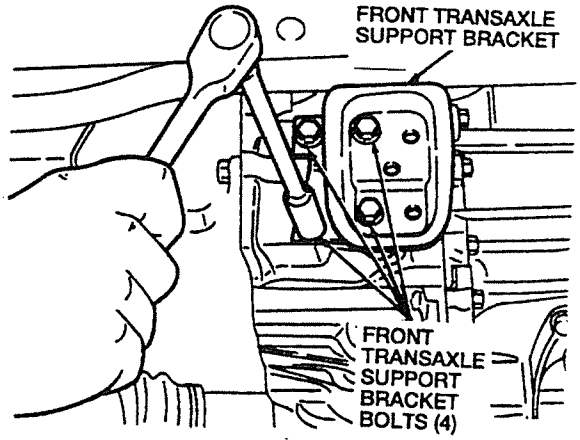
4. Install the engine air cleaner. Refer to Section 11 for the installation procedure.

Support Bracket, Transaxle - Front

Removal

1. Remove the front transaxle support insulator. Refer to the procedure in this section.

2. Remove the four front transaxle support bracket bolts. Remove the front transaxle support bracket.



Installation

1. Position the front transaxle support brackets to the transaxle and install the four transaxle support bracket bolts. Tighten the four front transaxle support bracket bolts to 28-37 lb-ft (38-51 N-m).

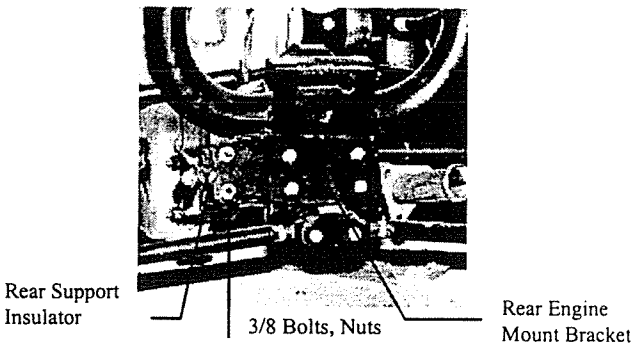
2. Install the front transaxle support insulator. Refer to the procedure in this section.

Support Bracket, Transaxle - Rear

Removal

1. Remove the rear transaxle support insulator. Refer to the procedure in this section.

2. Remove the two rear transaxle support bracket bolts. Remove the rear transaxle support bracket.



Installation

1. Position the rear engine support bracket to the transaxle and install the two rear transaxle support bracket bolts. Tighten the two rear transaxle support bracket bolts to 14-19 lb-ft (19-26 N-m).

2. Install the rear transaxle support insulator. Refer to the procedure in this section.

SPECIFICATIONS

TORQUE SPECIFICATIONS -

Engine and Transaxle

Description	lb-ft	N-m
RH Engine Support Bracket Bolts	44-63	59-85
RH Engine Support Insulator Through Bolt	48-69	67-93
RH Engine Support Insulator Nuts	39-47	53-64
Engine Support Bracket Bolts	29-40	39-54
Rear Engine Support Rebound Insulator Bolts	47-66	64-89
Front Transaxle Support Insulator Nuts	27-38	37-52
Rear Transaxle Support Insulator Nuts	21-34	28-46
Front Transaxle Support Bracket Bolts	28-37	38-51
Rear Transaxle Support Bracket Bolts	14-19	19-26
Front Transaxle Support Insulator Through Bolt Nut	48-69	67-93
Rear Transaxle Support Insulator Through Bolt Nut	48-69	67-93

SERVICE TOOLS/EQUIPMENT

- Three-Bar Engine Support

SECTION 28 - Exterior Finishes

DESCRIPTION AND OPERATION

Body Type

The body is a tubular steel frame and cab. Body panels and cab panels are attached to the frame.

Insulation

Insulation is installed:

1. Under the roof panel.
2. Over the floor pan and rear floor pan areas.
3. Behind the instrument panel.

SERVICE PROCEDURES

Rattle Elimination

Foreign objects such as nuts, bolts, or small pieces of body deadener in the door wells, pillars and quarter panels are often the source of rattles. All bolts and screws should be inspected periodically. In the event that tightening the bolts and screws, located on such assemblies as the doors, cab and trunk, does not eliminate the rattles, the trouble is probably caused by misalignment. If this is the case, follow the adjustment and alignment procedures for these assemblies.

Rattles and squeaks are sometimes caused by weatherstripping and anti-squeak material that has slipped out of position. Apply additional adhesive to these areas.

Vehicle Masking

Suitable covers should be installed over the wheel and glass. Mask off all upper exterior body sheet metal where painting or refinishing is not required.

If the vehicle has break lines in the metal use these in masking off the coating margin line.

Sheet Metal

1. Scuff-sand with No. 180 grit paper to remove glossy surface appearance of dry painted areas to be coated.
2. Remove the sanding dust using a lint-free tack cloth and compressed air.
3. Using a clean, lint-free cloth, solvent wipe area to be coated with multi-purpose paint precleaner and allow to flash-off.

Repainting

Before attempting repainting, determine the surface and overall condition of the existing paint.

Horizontal surfaces usually show the greatest surface deterioration. Carefully inspect the hood, roof panel and trunk to determine the overall condition of the paint.

Clean the areas to be inspected and look carefully for any signs of surface deterioration, or any other form of film breakdown such as checking, cracking, or humidity blistering. In particular, note the gloss level.

Low gloss indicates surface irregularities caused by such defects as checking or blistering.

Look for evidence of brittleness, poor adhesion, or excessive chipping. If in doubt about the condition of the paint, scrape the finish slightly with a penknife and examine further.

If a complete repaint job is necessary, plan a painting sequence, primarily for the sake of continuity so as to avoid dry joint overlaps and minimize unnecessary work, before beginning to spray. First, spray all locations that are not easily accessible (hood and hood edges, drain channels, door jambs). Keep doors slightly ajar to prevent sticking and permit efficient drying. The purpose of this initial spraying is to remove dust which otherwise might be blown about and adversely affect the exterior operation.

Some state and local governments have specific health and safety regulations which recommend the use of special breathing apparatus when using finishing materials containing toxic products.

Body Maintenance

Regular body maintenance preserves vehicle appearance throughout its life. The following steps are suggested as a guide for regular body maintenance.

1. Wash and vacuum the vehicle thoroughly.
2. Check all openings for water leaks, and seal where necessary.
3. Cement all loose weatherstrips which are still usable, using a weatherstrip adhesive.
4. Replace all unfit door and trunk weatherstrips.
5. Apply silicone lubricant to all weatherstrips.
6. Replace all cracked, fogged, or chipped glass.
7. Align the doors and trunk lid, if necessary.
8. Inspect the windshield wiper blade and replace if necessary.
9. Clean the seat and roof headlining.
10. Apply touch-up paint to chipped or scratched areas.

CLEANING AND INSPECTION

Appearance Protection

NOTE: It is very important to remember when using any chemical cleaner or polish to always follow the label directions. Read all warning and caution statements on the label.

Proper maintenance will help keep the vehicle looking factory new for years to come. The following cleaning and care recommendations will provide the vehicle with the necessary appearance protection.

Proper exterior appearance protection includes proper and frequent washing (including underside areas), polishing to shield paint and unpainted metal surfaces, touching up nicks and scratches with proper paint.

Washing

Use a wash and wax concentrate or equivalent, diluted to the proper concentration, followed by a rinse with clear cold water. Do not wash the vehicle with hot water, in the direct rays of the sun, or while sheet metal is hot.

Polishing

Use a silicone gloss polish or similar to remove harmful deposits, and provide added protection on body surfaces.

Underbody

In certain geographical areas which use a heavy concentration of road salt or other corrosive materials for snow removal or road dust control, flush and inspect the complete underside of the vehicle at least twice each year. Include underbody areas in frequent washings of the vehicle.

Particular attention should be given to cleaning out underbody members where dirt and other foreign materials may have collected.

Paint

The outside finish should be washed frequently. Never wipe the painted surface with a dry cloth. Dusting the finish when it is dry tends to rub dust and dirt into the paint, causing scratches on the surfaces. To keep the finish bright and attractive, wash the vehicle whenever it is dirty.

Protect the exterior with frequent washing, including underside areas. Use a wash and wax concentrate or similar, diluted to proper concentration, followed by a rinse with clear cold water. Do not wash with hot water, in direct sunlight, or while sheet metal is hot.

Polish paint with a silicone gloss or wax. This will remove harmful deposits and provide added protection to body surfaces, body hardware, and aluminum parts. Touch up nicks and

scratches with the proper paint. Do not use steel wool, abrasive-type cleaner, gasoline, or strong detergents containing highly alkaline or caustic agents on aluminum parts, as damage to the protective coating, discoloration, or paint deterioration may occur.

Vehicles subjected to airborne pollen, insect droppings, and other organic matter, (especially vehicles subjected to these materials and exposed to high temperatures and sunshine) should be washed as often as necessary to keep them free of organic matter. Similar precautions should be taken where a vehicle may be exposed to chemical industrial fallout. Failure to do so may result in damage to the exterior surfaces.

Glass

Glass should be cleaned with a glass cleaner, using a clean, soft, lint-free cloth. Follow directions on the container.