

ENGINES

CONTENTS

Page			Page
GENERAL INFORMATION	1	3.0L ENGINE SERVICE PROCEDURES	11
ENGINE DIAGNOSIS	5		

GENERAL INFORMATION

INDEX

	Page		Page
3.0L Engine	1	Oversize/Undersize Component Codes	3
Engine Identification Code	2	Repair of Damaged or Worn Threads	4
Measuring with Plastic-Gage	3		

3.0L ENGINE

The 3.0 liter (182 CID) six-cylinder engine is a V-Type lightweight, overhead valve engine (Fig. 1).

This engine is designed for unleaded fuel. The cylinder head has hemispherical combustion chambers with raised intake manifold ports and large valves which optimize power and efficiency.

The cylinders are numbered 1 through 3 from rear to front on the left bank. The cylinders are numbered 4 through 6 from rear to front on the right bank. The firing order is 1-6-3-5-2-4 (Fig. 2).

The crankshaft rotation is clockwise, when viewed from the front of the engine. The crankshaft rotates within four (4) main bearings and the camshaft rotates within four (4) line-bored bearings. There are two camshafts in the 3.0L engine.

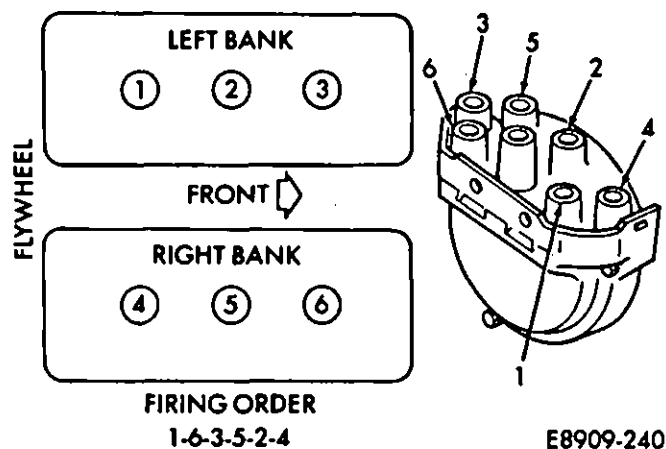


Fig. 2—3.0L Engine Firing Order

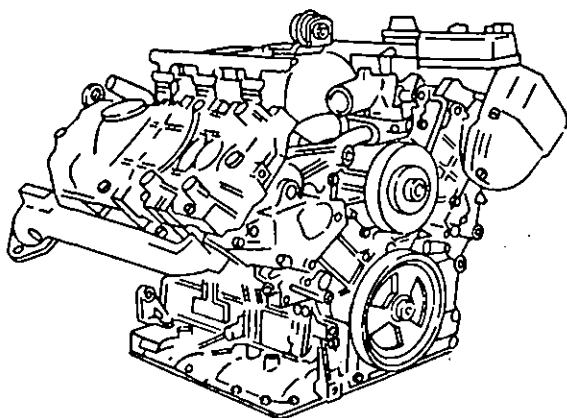


Fig. 1—3.0L Six-Cylinder Engine

TYPE	6 CYLINDER — 90 DEGREE V-BLOCK
BORE AND STROKE	93 x 73 mm (3.66 x 2.87 INCH)
DISPLACEMENT	3.0 LITER (182 CU. INCH)
COMPRESSION RATIO	9.3 : 1
TORQUE	232 N·m (171 FT.-LBS.) @ 3750 RPM
FIRING ORDER	1-6-3-5-2-4
LUBRICATION	PRESSURE FEED-FULL FLOW FILTRATION
ENGINE OIL CAPACITY	5.7 LITERS (6 QUARTS)
COOLING SYSTEM	LIQUID COOLED-FORCED CIRCULATION
COOLING SYSTEM CAPACITY	8.2 LITER (8.6 QUARTS)
CYLINDER BLOCK	ALUMINUM ALLOY
CRANKSHAFT	FORGED STEEL — JOURNAL OFFSET 30°
CYLINDER HEAD	ALUMINUM ALLOY
CAMSHAFT	STEEL
PISTONS	ALUMINUM ALLOY
PISTON COMBUSTION CAVITY	HEMISPHERICAL
CONNECTING RODS	CAST NODULAR IRON

E8909-241

Fig. 3—3.0L Engine Description

3.0L Engine Identification Code

The engine identification number is stamped onto the right-hand side of the cylinder block valley below the intake manifold (Fig. 5).

The engines also have an additional identification number (consisting of the last 8 digits of the VIN), located on the engine block (Fig. 6).

YEAR OF BUILD 1ST DIGIT	MONTH OF BUILD 2ND & 3RD DIGITS
0 = 1990	01-JANUARY 02-FEBRUARY ETC.
ENGINE TYPE 4TH & 5TH DIGITS	DAY OF BUILD 6TH & 7TH DIGITS
UX*	1-31
*UX = MULTIPOINT FUEL INJECTION V-6	
EXAMPLE: 004UX13 ENGINE BUILT ON 13 APRIL '90	

9009-92

Fig. 4—Engine Identification Code (Build Date Code)

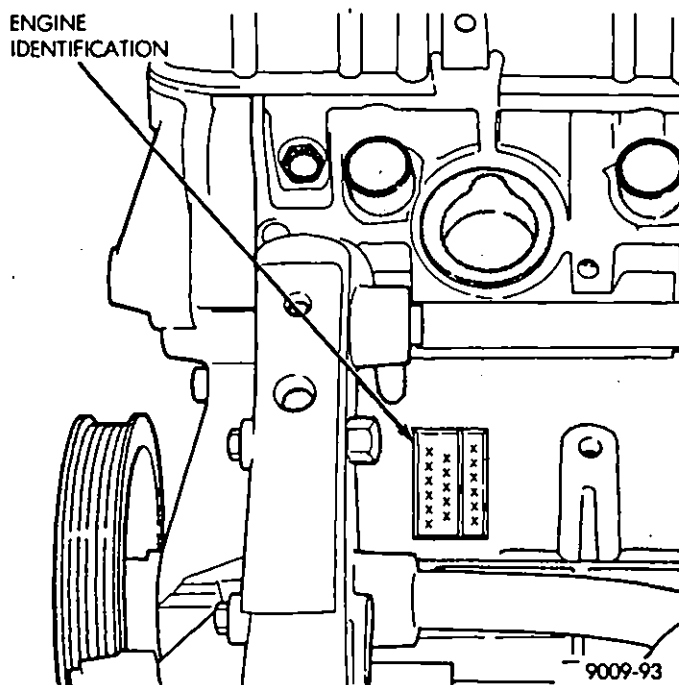
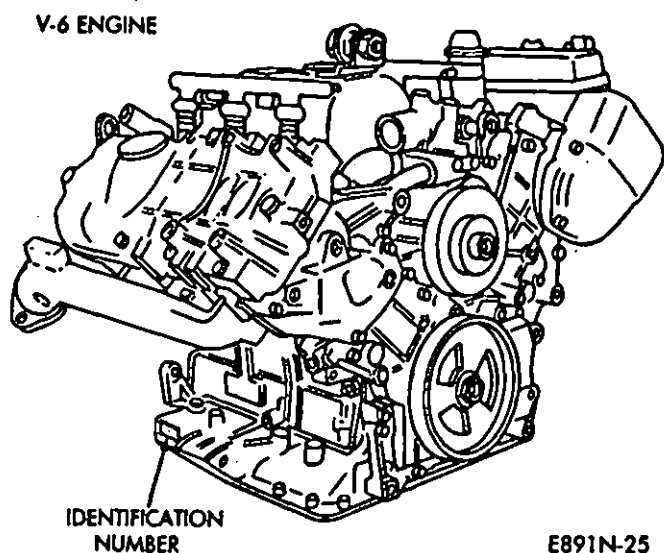


Fig. 5—Engine Identification Under Intake Manifold



E891N-25

Fig. 6—Additional Identification Number Location

CODE	COMPONENT	UNDERSIZE
P	One or more connecting rod bearing journals	0.254 mm (0.010 in)
M	All crankshaft main bearing journals	0.254 mm (0.010 in)
PM	All crankshaft main bearing journals and one or more connecting rod journals	0.254 mm (0.010 in)
CODE	COMPONENT	OVERSIZE
B	All cylinder bores	0.254 mm (0.010 in)
C	All camshaft bearing bores	0.254 mm (0.010 in)

J8909-54

Fig. 7—Oversize/Undersize Component Codes

MEASURING WITH PLASTIC-GAGE

Engine crankshaft bearing clearances can be determined by use of Plastic-Gage or equivalent. The following is the recommended procedures for the use of Plastic-Gage:

(1) Remove oil film from surface to be checked. Plastic-Gage is soluble in oil.

(2) The total clearance of the main bearings can only be determined by removing the weight of the crankshaft. This can be accomplished by either of two methods:

(a) **Preferred Method**—Shimming the bearings adjacent to the bearing to be checked in order to remove the clearance between upper bearing shell and the crankshaft. This can be accomplished by placing a minimum of 0.254 mm (0.010 inch) shim between the bearing shell and the bearing cap on the adjacent bearings and tighten the bolts to 14-20 N·m (10-15 ft-lbs) torque. When checking #1 main bearing, shim #2 main bearing. When checking #2 main bearing, shim #1 and #3 main bearing. Follow the same pattern for the rest of the main bearings. Remove all shims before reassembling engine.

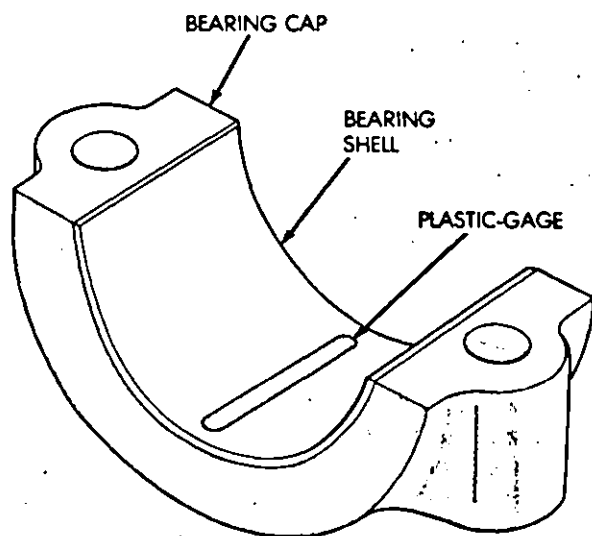
(b) **Alternative Method**—The weight of the crankshaft is supported by a jack under the counterweight adjacent to the bearing being checked.

(3) Place a piece of Plastic-Gage across the entire width of the bearing shell in the cap approximately 6.35 mm (1/4 inch) off center and away from the oil holes (Fig. 8). In addition, suspect areas can be checked by placing the Plastic-Gage in the suspect area. Tighten the bearing cap bolts of the bearing being checked to the proper torque.

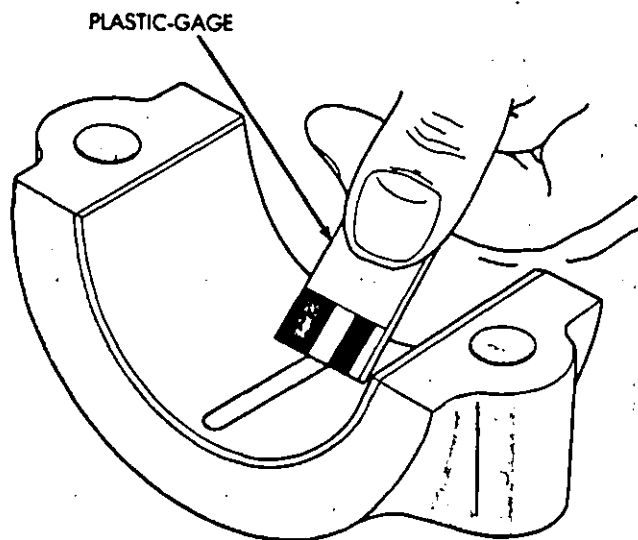
The checking of connecting rod clearances does not require shimming of the crankshaft. However, before assembling the rod cap with Plastic-Gage in place, the crankshaft must be turned until the connecting rod to be checked starts moving toward the top of the engine. Only then should the cap be assembled and tightened to the proper torque. Do not rotate the crankshaft while assembling the cap or the Plastic-Gage may be smeared, giving inaccurate results.

(4) Remove the bearing cap and compare the width of the flattened Plastic-Gage with the metric scale provided on the package (Fig. 9). Locate the band closest to the same width, this band shows the amount of clearance in thousandths of a millimeter. Differences in readings between the ends indicate the amount of taper present. Record all readings taken. Refer to "Engine Specifications" at the end of this section. Plastic-Gage generally is accompanied by two scales. One scale is in inches, the other is a metric scale.

(5) Plastic-Gage is available in a variety of clearance ranges. The 0.025-0.076 mm (0.001-0.003 inch) is usually the most appropriate for checking engine bearing proper specifications.



J8909-59

Fig. 8—Placement of Plastic-Gage In Bearing Shell

J8909-60

Fig. 9—Clearance Measurement**REPAIR OF DAMAGED OR WORN THREADS**

Damaged or worn threads can be repaired. Essentially, this repair consists of drilling out worn or damaged threads, tapping the hole with a special Heli-Coil Tap, (or equivalent), and installing an insert into the tapped hole. This brings the hole back to its original thread size.

Heli-Coil tools and inserts are readily available from automotive parts jobbers.

ENGINE DIAGNOSIS

INDEX

	Page		Page
Cylinder Compression Pressure Test	5	Cylinder Head Gasket Failure Diagnosis	5

Engine diagnosis is helpful in determining the causes of malfunctions not detected and remedied by routine tune-ups.

Refer to the Service Diagnosis—Mechanical chart for possible causes and corrections of malfunctions. Refer to Group 14, "Fuel System" for the fuel system diagnosis.

Additional tests and diagnostic procedures may be necessary for specific engine malfunctions that can not be isolated with the Service Diagnosis charts.

Information concerning additional tests and diagnosis is provided within the following diagnosis:

- Cylinder Compression Pressure Test.
- Cylinder Head Gasket Failure Diagnosis.

CYLINDER COMPRESSION PRESSURE TEST

The results of a cylinder compression pressure test can be utilized to diagnose several engine malfunctions.

Ensure the battery is completely charged and the starter motor is in good operating condition. Otherwise the indicated compression pressures may not be valid for diagnosis purposes.

- (1) Clean the spark plug recesses with compressed air.
- (2) Remove the spark plugs.
- (3) Secure the throttle in the wide-open position.
- (4) Insert a compression pressure gauge and rotate the engine with the starter motor for three revolutions.
- (5) Record the compression pressure on the third revolution. Continue the test for the remaining cylinders.
- (6) Refer to the Specifications chart for the correct engine compression pressures.

CYLINDER HEAD GASKET FAILURE DIAGNOSIS

A leaking cylinder head gasket usually results in a loss of power, loss of coolant and engine misfire.

A cylinder head gasket leak can be located between adjacent cylinders or between a cylinder and the adjacent water jacket.

A cylinder head gasket leaking between two

adjacent cylinders is indicated by a loss of power and/or engine misfire.

A cylinder head gasket leaking between a cylinder and an adjacent water jacket is indicated by coolant foaming or overheating and loss of coolant.

Cylinder-to-Cylinder Leakage Test

To determine if a cylinder head gasket is leaking between any two adjacent cylinders, follow the procedures outlined in Cylinder Compression Pressure Test. A cylinder head gasket leaking between two adjacent cylinders will result in approximately a 50-70% reduction in compression pressure (in comparison to the other cylinders) in the two affected cylinders.

Cylinder-to-Water Jacket Leakage Test

WARNING: USE EXTREME CAUTION WHEN THE ENGINE IS OPERATING. DO NOT STAND IN A DIRECT LINE WITH THE FAN. DO NOT PUT YOUR HANDS NEAR THE PULLEYS, BELTS OR THE FAN. DO NOT WEAR LOOSE CLOTHING.

- (1) Remove the radiator cap.
- (2) Start the engine and allow it to warm up until the thermostat opens.
- (3) If a large combustion/compression pressure leak exists, bubbles will be visible in the coolant.
- (4) If bubbles are not visible, install a radiator pressure tester and pressurize the coolant system.
- (5) If a cylinder is leaking combustion pressure into the water jacket, the tester pointer will pulsate with every combustion stroke of the cylinder.

MECHANICAL DIAGNOSIS

CONDITION	POSSIBLE CAUSE	CORRECTION
EXCESSIVE OIL CONSUMPTION	(1) OIL LEAKS. (2) CLOGGED OIL VAPOR RECIRCULATION SYSTEM. (3) WORN VALVE STEM SEALS. (4) WORN VALVE STEMS. (5) WORN OR DAMAGED PISTON RINGS. (6) LEAK BETWEEN VALVE GUIDE AND CYLINDER HEAD. (7) LOOSE CYLINDER HEAD BOLTS.	(1) REPAIR OIL LEAKS. (2) CLEAN SYSTEM, CHECK ALL ORIFICES FOR CORRECT CALIBRATION AND CONDITION. (3) REPLACE VALVE STEM SEALS. (4) CHECK VALVE STEM TO GUIDE CLEARANCE. REPAIR AS NECESSARY. (5) CHECK PISTON RINGS. REPAIR AS NECESSARY. (6) PRESSURE CHECK HEAD TO ENSURE LEAKAGE BETWEEN HEAD AND GUIDE. REPLACE AS NECESSARY. (7) REPLACE CYLINDER HEAD GASKET. TIGHTEN CYLINDER HEAD TO SPEC.
FUEL MILEAGE	CHECK THESE CONDITIONS BEFORE USING THE DRB II™ (1) ENGINE VACUUM LEAKS. (2) FUEL LEAKS. (3) CLOGGED EXHAUST SYSTEM. (4) EXHAUST SYSTEM LEAKS. (5) LOW COMPRESSION. (6) BRAKES DRAGGING. (7) CLOGGED AIR INTAKE SYSTEM. (8) CLOGGED AIR FILTER ELEMENT.	(1) REPAIR AS NECESSARY. (2) REPAIR AS NECESSARY. (3) REPAIR AS NECESSARY. (4) REPAIR AS NECESSARY. (5) REPAIR AS NECESSARY. (6) REPAIR AS NECESSARY. (7) REPAIR AS NECESSARY. (8) REPLACE AIR FILTER ELEMENT.
LOW COMPRESSION	(1) PISTON RINGS NOT SEALING. (2) LEAKING VALVE, VALVE SEAT. (3) PISTON OR CYLINDER WORN. (4) BLOWN CYLINDER HEAD GASKET.	(1) REPLACE RINGS. (2) GRIND/REPLACE VALVES AND SEATS. (3) REPLACE PISTON AND LINER ASSEMBLY. (4) REPLACE CYLINDER HEAD GASKET.

E8909-244

MECHANICAL DIAGNOSIS (CONT.)

CONDITION	POSSIBLE CAUSE	CORRECTION
HIGH OIL PRESSURE	(1) OIL PRESSURE RELIEF VALVE STUCK IN CLOSED POSITION.	(1) REPAIR RELIEF VALVE.
LOW OIL PRESSURE	(1) LOW ENGINE OIL LEVEL. (2) CLOGGED OIL FILTER OR FILTER SUPPLY/RETURN LINES. (3) WORN OIL PUMP GEARS OR WORN OIL PUMP BODY BORES. (4) EXCESSIVE TAPPET TO BORE CLEARANCE. (5) OIL PRESSURE RELIEF VALVE STUCK OPEN. (6) THIN OIL — DILUTED. (7) EXCESSIVE BEARING CLEARANCE (CAMSHAFT, CONNECTING ROD OR MAIN BEARINGS). (8) LOOSE OIL GALLEY PLUG.	(1) CHECK ENGINE OIL LEVEL. FILL AS NECESSARY. (2) REPLACE CLOGGED COMPONENT. (3) REPLACE THE OIL PUMP. (4) CHECK BORE SIZE & TAPPET SIZE. REPAIR AS NECESSARY. (5) REPAIR OIL PRESSURE RELIEF VALVE. (6) CHANGE ENGINE OIL AND FILTER. USE SPECIFIED VISCOSITY OIL. (7) REPLACE BEARINGS. WORN CAMSHAFT BEARINGS — REPLACE THE CYLINDER HEAD(S). (8) TIGHTEN/REPLACE OIL GALLEY PLUG.
CONNECTING ROD OR CRANKSHAFT MAIN BEARING NOISE	(1) EXCESSIVE BEARING CLEARANCE. (2) THIN OIL — DILUTED OIL. (3) LOW OIL PRESSURE. (4) LOW OIL SUPPLY.	(1) REPLACE BEARINGS. (2) REPLACE OIL WITH SPECIFIED VISCOSITY — REPLACE FILTER. (3) SEE LOW OIL PRESSURE SECTION. (4) CHECK OIL LEVEL.

E8909-245

MECHANICAL DIAGNOSIS (CONT.)

CONDITION	POSSIBLE CAUSE	CORRECTION
VALVE CLATTER (NOISY VALVES)	(1) LOW ENGINE OIL LEVEL. (2) WORN VALVE GUIDE OR VALVE STEM. (3) THIN OIL — DILUTED OIL. (4) WORN ROCKER ARMS AND/OR ROCKER ARM PIVOTS. (5) BENT VALVE. (6) BROKEN VALVE SPRING. (7) TAPPET FACE WORN. (8) LOW OIL PRESSURE.	(1) FILL TO CORRECT OIL LEVEL. (2) REPLACE VALVE AND/OR REPAIR VALVE GUIDE. (3) REPLACE OIL WITH SPECIFIED VISCOSITY. REPLACE OIL FILTER. (4) REPLACE ROCKER ARMS AND/OR PIVOTS. (5) REPLACE VALVE. (6) REPLACE SPRING. (7) REPLACE TAPPET. CHECK THE CORRESPONDING CAMSHAFT LOBE FOR WEAR. (8) SEE LOW OIL PRESSURE DIAGNOSIS CHART.
ENGINE OVERHEATING	(1) LOOSE OR BROKEN DRIVE BELT. (2) FAULTY OPERATING THERMOSTAT. (3) LOW ENGINE COOLANT LEVEL. (4) ANTI-FREEZE CONCENTRATION TOO HIGH. (5) FAULTY OPERATING WATER PUMP. (6) COOLING FANS NOT OPERATING. (7) RADIATOR DAMAGE OR CORE BLOCKAGE. (8) DAMAGED CYLINDER HEAD GASKET. (9) CRACKED CYLINDER HEAD OR CYLINDER BLOCK. (10) FAULTY EXPANSION CAP VALVE. (11) WATER PASSAGES CLOGGED WITH RUST OR CORROSION. (12) ACCESSORY DRIVE BELT INCORRECTLY ROUTED CAUSING WATER PUMP TO RUN BACKWARDS.	(1) TENSION OR REPLACE THE DRIVE BELT. (2) REPLACE THERMOSTAT. (3) FILL COOLANT SYSTEM. (4) CORRECT CONCENTRATION LEVEL. (5) REPLACE WATER PUMP. (6) REFER TO GROUP 07 "COOLING". (7) REPAIR OR REMOVE CORE BLOCKAGE. (8) REPLACE GASKET. CHECK CYLINDER HEAD FOR WARPAGE. (9) REPLACE CRACKED COMPONENT. (10) REPLACE EXPANSION CAP. (11) CLEAN PASSAGES. (12) ROUTE BELT CORRECTLY.

E8909-246

MECHANICAL DIAGNOSIS (CONT.)

CONDITION	POSSIBLE CAUSE	CORRECTION
LOW COMPRESSION	(1) PISTON RINGS NOT SEALING. (2) LEAKING VALVE, VALVE SEAT. (3) WORN VALVE GUIDE. (4) PISTON OR CYLINDER WORN. (5) BLOWN CYLINDER HEAD GASKET (COULD BE CAUSED BY IMPROPER LINER PROTRUSION, WARPED CYLINDER HEAD).	(1) REPLACE RINGS. (2) REGRIND/REPLACE VALVES AND SEATS. (3) REPAIR GUIDES. (4) REPLACE PISTON AND LINER ASSEMBLY. (5) REPLACE CYLINDER HEAD GASKET. CHECK LINER PROTRUSION, CYLINDER HEAD WARPAGE.
HIGH OIL PRESSURE	(1) OIL PRESSURE RELIEF VALVE STUCK IN CLOSED POSITION.	(1) REPAIR RELIEF VALVE.
LOW OIL PRESSURE	(1) LOW ENGINE OIL LEVEL. (2) CLOGGED OIL FILTER OR FILTER SUPPLY/RETURN LINES. (3) WORN OIL PUMP GEARS OR WORN OIL PUMP BODY BORES. (4) OIL PRESSURE RELIEF VALVE STUCK OPEN. (5) THIN OIL — DILUTED. (6) EXCESSIVE BEARING CLEARANCE (CAMSHAFT, CONNECTING ROD OR MAIN BEARING). (7) LOOSE OIL GALLEY PLUG.	(1) CHECK ENGINE OIL LEVEL. FILL AS NECESSARY. (2) REPLACE CLOGGED COMPONENT. (3) REPLACE THE CYLINDER BLOCK IF THE GEAR TO CASE CLEARANCE IS EXCESSIVE. IF JUST THE GEARS ARE WORN, REPLACE THE GEARS AND INSURE CORRECT GEAR TO CASE CLEARANCE. (4) REPAIR OIL PRESSURE RELIEF VALVE. (5) CHANGE ENGINE OIL AND FILTER. USE SPECIFIED VISCOSITY OIL. (6) REPLACE BEARINGS. WORN CAMSHAFT BEARINGS — REPLACE THE CYLINDER HEAD(S). (7) TIGHTEN/REPLACE OIL GALLEY PLUG.
CONNECTING ROD OR CRANKSHAFT MAIN BEARING NOISE.	(1) EXCESSIVE BEARING CLEARANCE. (2) THIN OIL — DILUTED OIL. (3) LOW OIL PRESSURE. (4) LOW OIL SUPPLY.	(1) REPLACE BEARINGS. (2) REPLACE OIL WITH SPECIFIED VISCOSITY — REPLACE FILTER. (3) SEE LOW OIL PRESSURE SECTION. (4) CHECK OIL LEVEL.

E8909-247

MECHANICAL DIAGNOSIS (CONT.)

CONDITION	POSSIBLE CAUSE	CORRECTION
VALVE CLATTER (NOISY VALVES)	(1) LOW ENGINE OIL LEVEL. (2) WORN VALVE GUIDE OR VALVE STEM. (3) THIN OIL — DILUTED OIL. (4) WORN ROCKER ARMS AND/OR ROCKER ARM SHAFTS. (5) FAULTY HYDRAULIC TAPPET OPERATION.	(1) FILL TO CORRECT OIL LEVEL. (2) REPLACE VALVE AND/OR VALVE GUIDE. (3) REPLACE OIL WITH SPECIFIED VISCOSITY. REPLACE OIL FILTER. (4) REPLACE ROCKER ARMS AND/OR SHAFTS. (5) REPAIR AS NECESSARY.
ENGINE OVERHEATING	(1) LOOSE OR BROKEN DRIVE BELT. (2) FAULTY OPERATING THERMOSTAT. (3) LOW ENGINE COOLANT LEVEL. (4) ANTI-FREEZE CONCENTRATION TOO HIGH. (5) FAULTY OPERATING WATER PUMP. (6) COOLING FANS NOT OPERATING. (7) RADIATOR DAMAGE OR CORE BLOCKAGE. (8) DAMAGED CYLINDER HEAD GASKET. (9) CRACKED CYLINDER HEAD OR CYLINDER BLOCK. (10) FAULTY EXPANSION CAP VALVE. (11) WATER PASSAGES CLOGGED WITH RUST OR CORROSION.	(1) TENSION OR REPLACE AND TENSION THE DRIVE BELT. (2) REPLACE THERMOSTAT. (3) FILL COOLANT SYSTEM. (4) CORRECT CONCENTRATION LEVEL. (5) REPLACE WATER PUMP. (6) REFER TO GROUP 07, "COOLING". (7) REPAIR OR REMOVE CORE BLOCKAGE. (8) REPLACE CYLINDER HEAD GASKET. CHECK LINER PROTRUSION, CYLINDER HEAD WARPAGE. (9) REPLACE CRACKED COMPONENT. (10) REPLACE EXPANSION CAP. (11) CLEAN PASSAGES.

E8909-248

3.0L ENGINE SERVICE PROCEDURES

INDEX

	Page		Page
3.0L Engine Specifications	68	Front Engine Mounts	11
3.0L Engine Torque Specifications	71	Hydraulic Tappet and Rocker Arm	38
Camshafts	39	Oil Baffle	54
Crankshaft Pulley/Timing Cover	41	Oil Pan	53
Cylinder Block	54	Oil Pump	46
Cylinder Head Cover—(Engine Installed)	23	Oil Pump Inlet Tube	54
Cylinder Head Covers—(Engine Removed)	25	Piston-Connecting Rod	64
Cylinder Head—(Engine Installed)	26	Piston Ring Replacement	66
Cylinder Head—(Engine Removed)	32	Rear Crankshaft Seal Housing	41
Cylinder Liner	63	Rear Engine Mount/Cushion	11
Distributor Cap/Rotor/Dust Cover	44	Rocker Shaft	37
Distributor Drive Oil Seal Replacement	45	Sealer Specifications	72
Engine Cover	23	Timing Chains/Tensioners/Sprockets	47
Engine Damper	13	Valve and Valve Springs	36
Engine/Transaxle/Cradle	14	Water Pump	41
Front Crankshaft Oil Seal Replacement	43	Water Pump Pulley	41

FRONT ENGINE MOUNTS

Removal

- (1) Disconnect the battery negative cable.
- (2) Loosen the stud locknuts (Fig. 1).
- (3) Raise the engine enough to remove the engine mount. It may be necessary to disconnect the engine damper.
- (4) Remove the engine mount nut (Fig. 1).
- (5) Remove the engine mount (Fig. 1).

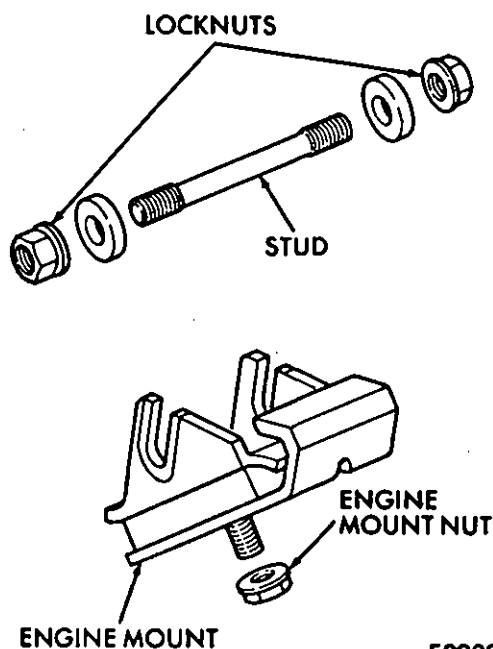


Fig. 1—Front Engine Mount

E8909-189

Installation

- (1) Install the engine mount and nut. Do not tighten the nut at this time.
- (2) Lower the engine in place on the engine mounts.
- (3) Tighten the engine mount nut to 65 N·m (48 ft-lbs) torque.
- (4) Tighten the stud locknuts to 65 N·m (48 ft-lbs) torque.
- (5) Connect the battery negative cable.

REAR ENGINE MOUNT/CUSHION

Removal (ZF-4 Transaxle)

- (1) Disconnect the battery negative cable.
- (2) Support and raise the vehicle.
- (3) Remove the underbody splash shield (Fig. 2).
- (4) Support the transaxle with a jack stand (Fig. 3).
- (5) Take care to avoid damaging the oil pan.

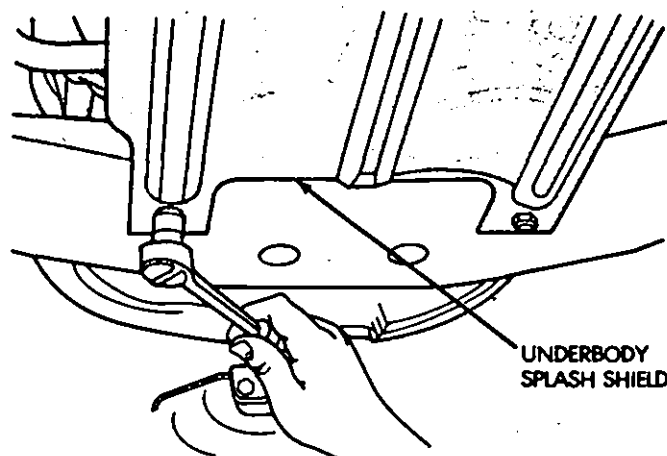


Fig. 2—Underbody Splash Shield

E8909-192

(5) Remove the nuts attaching the crossmember to the engine cradle (Fig. 4).

(6) Remove the large bolt and nut that attaches the rear cushion to the support bracket (Fig. 5).

(7) Remove the bolts that attach the exhaust downpipe bracket to the rear cushion and the downpipe (Fig. 5).

(8) Remove the crossmember and the rear cushion.

(9) Remove the support bracket bolts and remove the bracket from the transaxle (Fig. 6).

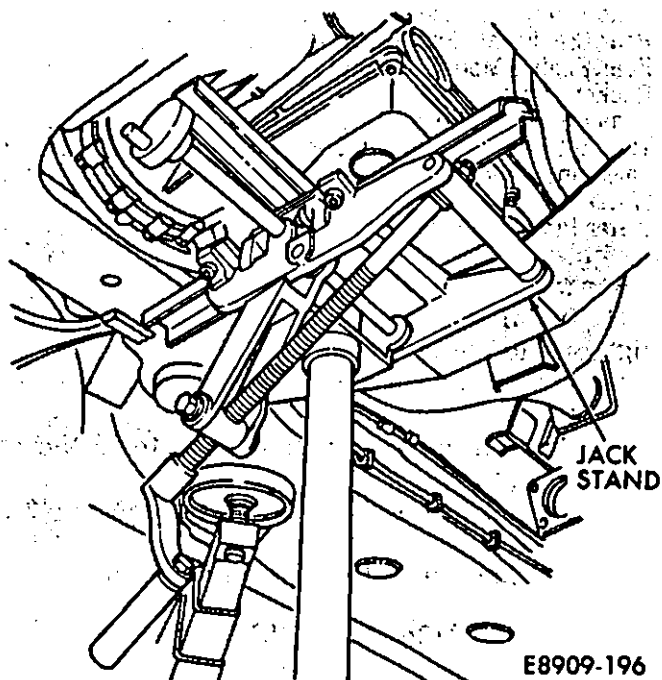


Fig 3—Jack Stand Supporting Transaxle

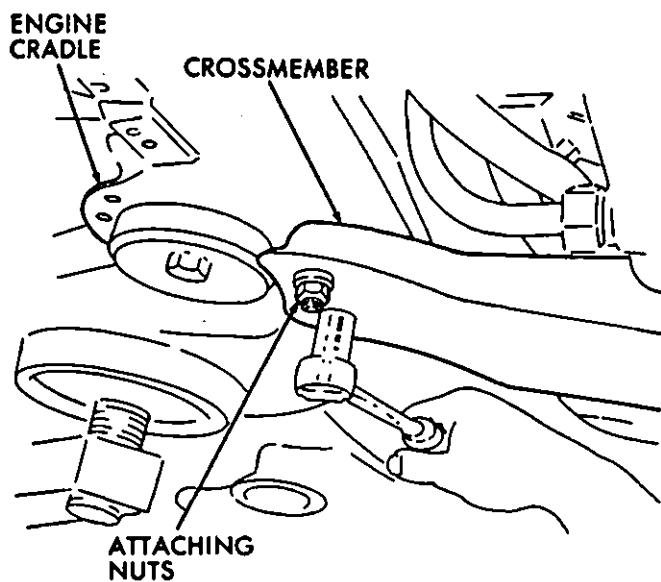


Fig. 4—Crossmember/Engine Cradle

Installation (ZF-4 Transaxle)

(1) Install the support bracket on the transaxle (Fig. 6). Tighten the support bracket bolts to 40 N·m (30 ft-lbs) torque.

(2) Position the exhaust bracket on the rear cushion (Fig. 5).

(3) Install the rear cushion and the crossmember. Align the cushion in the support bracket and install the cushion-to-bracket bolt and nut (Fig. 7) Do not tighten the bolt at this time.

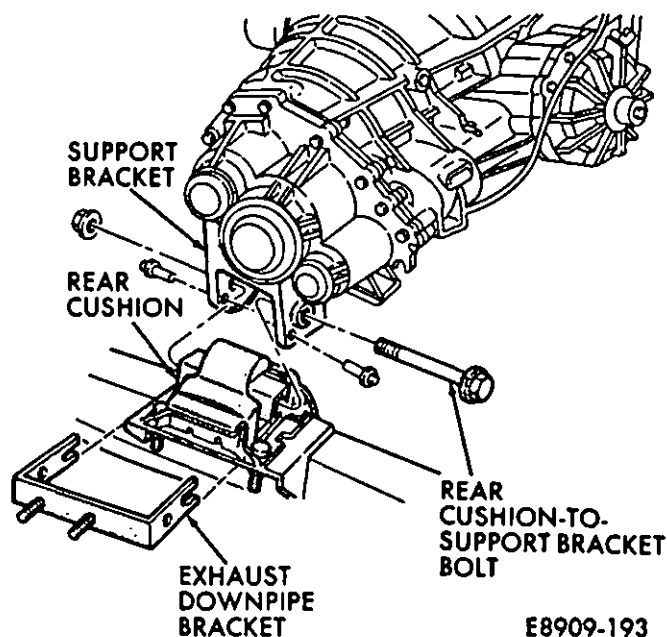


Fig. 5—Engine Rear Mount/Cushion

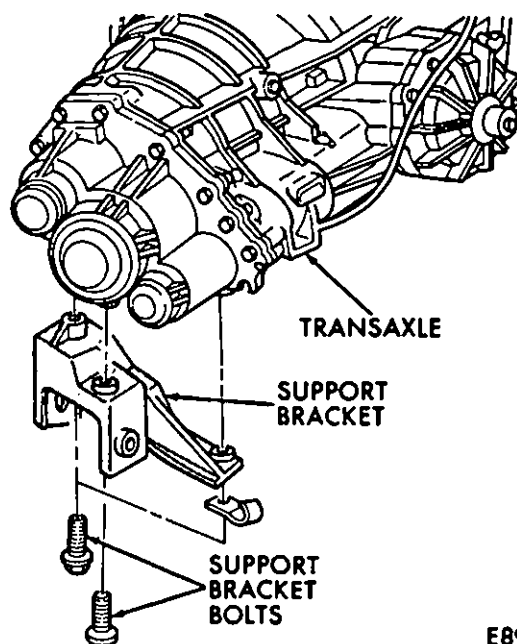


Fig. 6—Transaxle Support Bracket

- (4) Install, but do not tighten the exhaust bracket bolts.
- (5) Tighten the rear cushion-to-support bracket bolt and nut to 67 N·m (49 ft-lbs) torque.
- (6) Tighten the bolts that attach the exhaust bracket to the rear cushion to 31 N·m (23 ft-lbs) torque (Fig. 8).
- (7) Install the bolts and nuts that attach the crossmember to the studs on the engine cradle. Tighten the nuts to 60 N·m (44 ft-lbs) torque.
- (8) Remove the jack stand from the transaxle.
- (9) Install the underbody splash shield. Tighten the shield bolts to 28 N·m (21 ft-lbs) torque.
- (10) Lower the vehicle.
- (11) Connect the battery negative cable.

ENGINE DAMPER

Removal

- (1) Remove the bolt and locknut from the damper mounting bracket (Fig. 9).
- (2) Remove the bolt and nut from the front engine bracket (Fig. 9).
- (3) Discard the engine damper, if damaged.

Installation

- (1) Position the engine damper to the damper mounting bracket with the bottom damper bolt. Tighten the locknuts to 27 N·m (20 ft-lbs) torque.
- (2) Install the engine damper to the front engine bracket with the top damper bolt. Tighten the nut to 43 N·m (32 ft-lbs) torque.

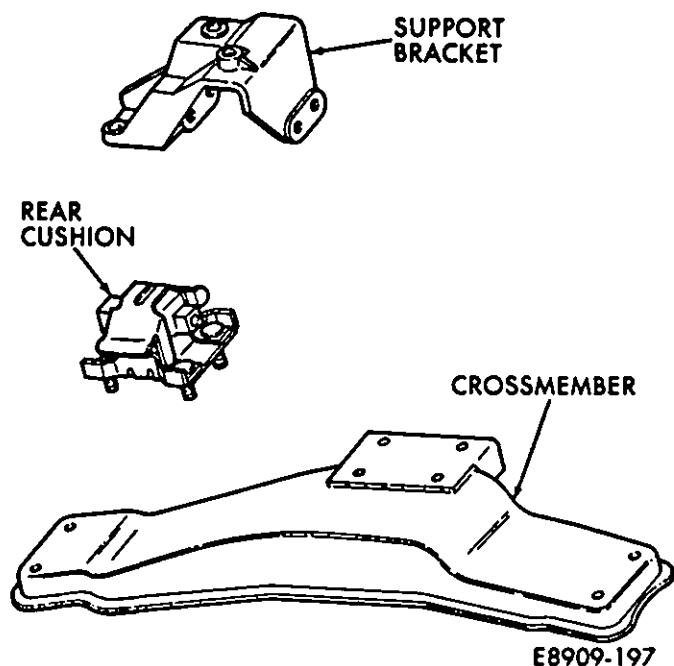


Fig. 7—Rear Cushion/Crossmember/Support Bracket Alignment

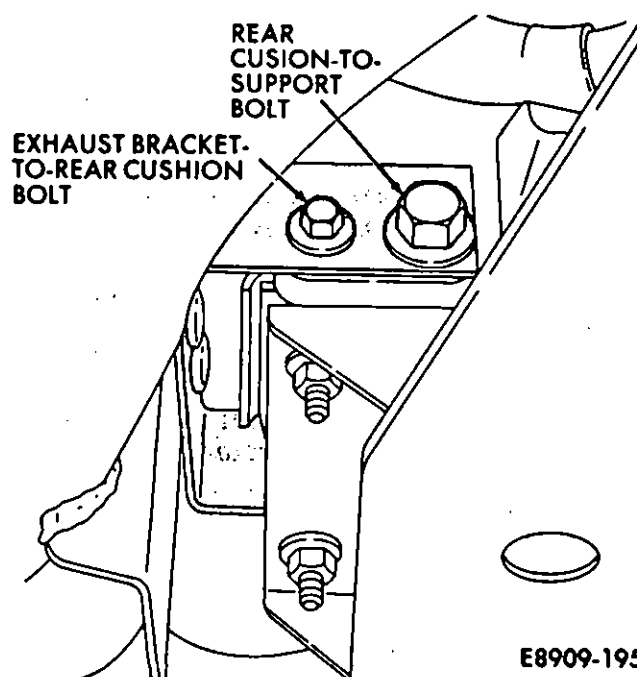


Fig. 8—Attach Exhaust Bracket to Rear Cushion

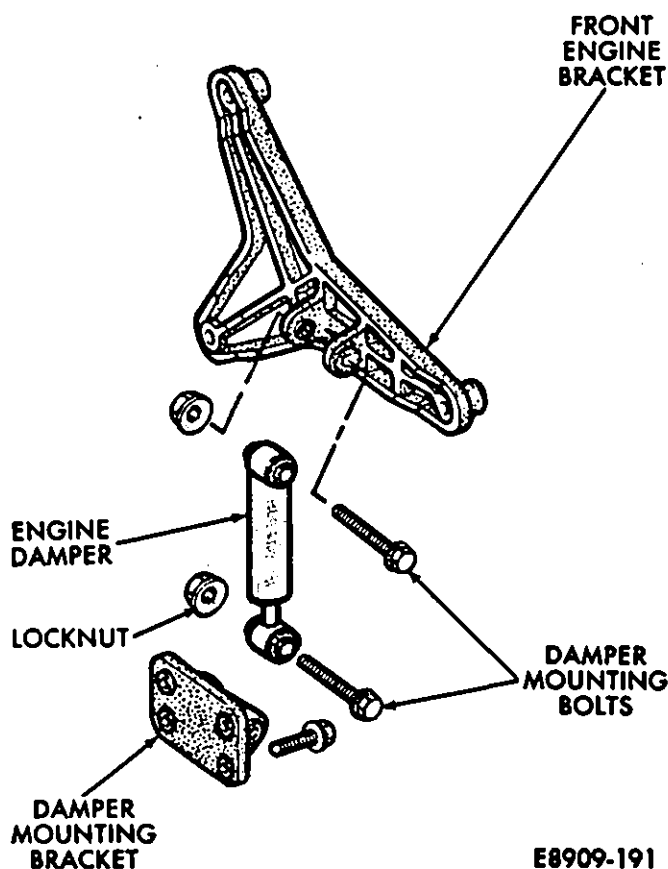


Fig. 9—Engine Damper

ENGINE/TRANSAXLE/CRADLE

Removal

(1) Disconnect the battery negative cable **FIRST** and then disconnect the battery positive cable.

(2) Drain the radiator (refer to Group 07, Cooling System, for the draining procedures).

(3) Remove the throttle body bonnet mounting bolts (Fig. 1).

(4) Remove the hose from the idle speed regulator (Fig. 1).

(5) Loosen the hose clamp and remove the throttle body bonnet (Fig. 1).

(6) Disconnect crankcase ventilation fresh air inlet hose and remove evaporator canister hose at air cleaner (Fig. 2).

(7) Remove air sensor vacuum hose at air cleaner (Fig. 2).

(8) Remove the distributor coil wire and lay it to the side.

CAUTION: When removing the cruise control cable from the throttle arm, use finger pressure to remove the connector. Use of pliers can damage the connector.

(9) Disconnect cruise control cable and accelerator cable from throttle arm (Fig. 3).

(10) Depress the holding tabs on the cruise control and accelerator cables and push them through the holding bracket. Then lay the cables to the side of the engine compartment.

(11) Disconnect hot air tube at the air cleaner (Fig. 4).

(12) Disconnect the air cleaner retainer clips.

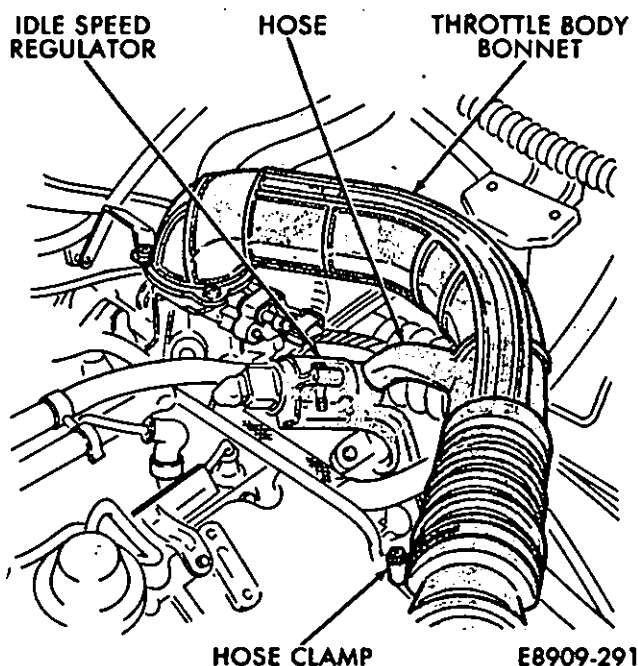
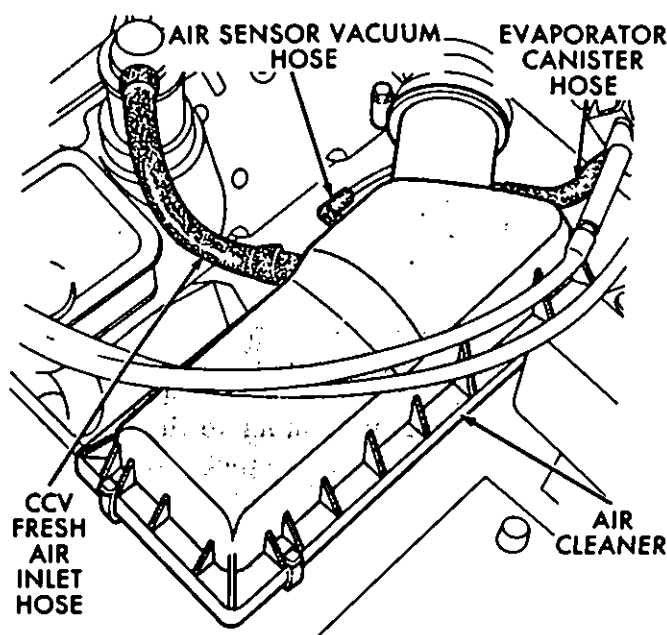


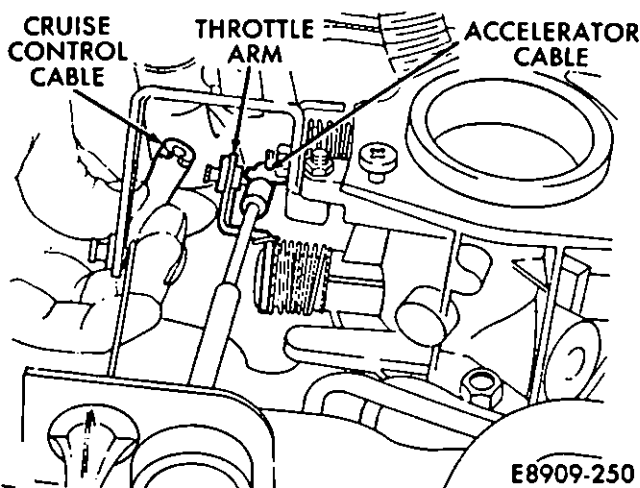
Fig. 1—Throttle Body Bonnet/Idle Speed Regulator

- (13) Remove the air cleaner.
- (14) Remove the battery holddown clamp. Then carefully remove the battery from the vehicle.
- (15) Remove the fuel tank filler cap to relieve the fuel tank pressure.
- (16) Install the fuel tank filler cap.
- (17) Disconnect the grey fuel return tube from the fuel pressure regulator and the black fuel supply tube from the fuel rail (Fig. 5). Squeeze the retainer tabs and pull the connectors apart.
- (18) Disconnect the vacuum hoses from the EGR Solenoid (Fig. 6).
- (19) Disconnect the vacuum hose at the MAP sensor (Fig. 7).
- (20) Disconnect Hevac Vacuum reservoir hose (Fig. 7).



E8909-249

Fig. 2—CCV Hose/Evaporator Hose/Sensor Hose at Air Cleaner



E8909-250

Fig. 3—Cruise Control/Accelerator Cable

(21) Loosen the bulkhead connector bolt and pull the bulkhead connector off (Fig. 7). Lay the bulkhead connector on top of the engine.

(22) Disconnect the vacuum booster hose from the brake vacuum booster (Fig. 8). Lay the hose on top of the engine.

(23) Disconnect the electrical connector at the dash panel (Fig. 8).

(24) Disconnect the heater hoses at the dash panel (Fig. 9).

(25) Disconnect the bottom hose from the coolant pressure bottle (Fig. 9).

(26) Disconnect the radiator hoses from the water pump and stow hoses to the side.

(27) Disconnect the engine damper from engine bracket. Push the shock up against the cooling fan (Fig. 10).

(28) Open the door on the drivers side and remove the bottom instrument panel section under the steering wheel.

(29) Disconnect the shifter cable from the arm on steering column (Fig. 11).

(30) Depress the tabs on the side cable housing and pull the cable through the holding bracket. **CAUTION:** The vehicle must be raised on a side mount hoist. Do not support the vehicle by the lower control arms. Lift the vehicle only at the points shown in Fig. 12.

(31) Raise the vehicle.

(32) Remove the splash shield below the alternator.

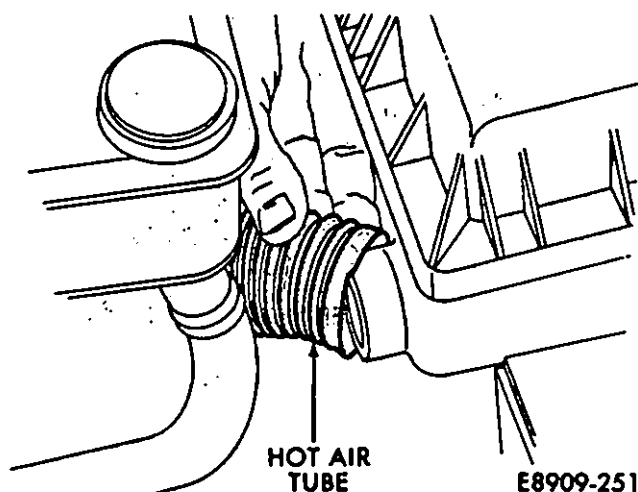


Fig. 4—Hot Air Tube at Air Cleaner

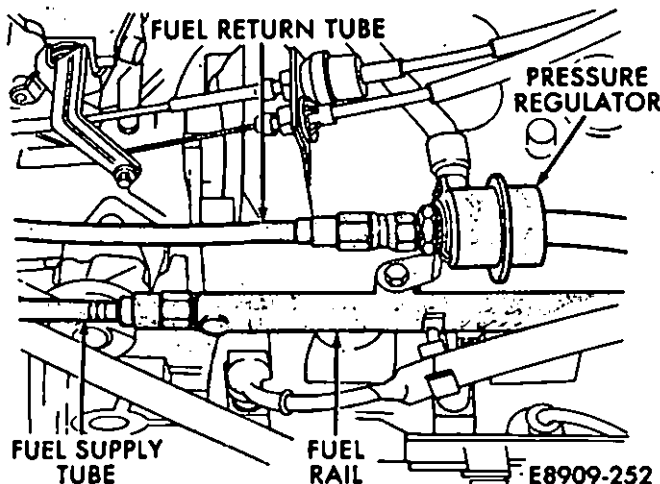


Fig. 5—Fuel Tubes/Regulator/Fuel Rail

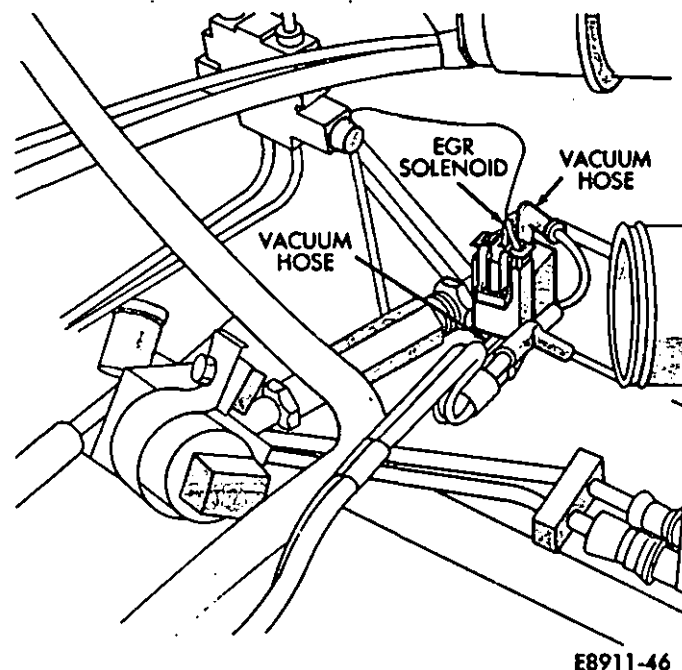


Fig. 6—EGR Solenoid and Vacuum Hoses

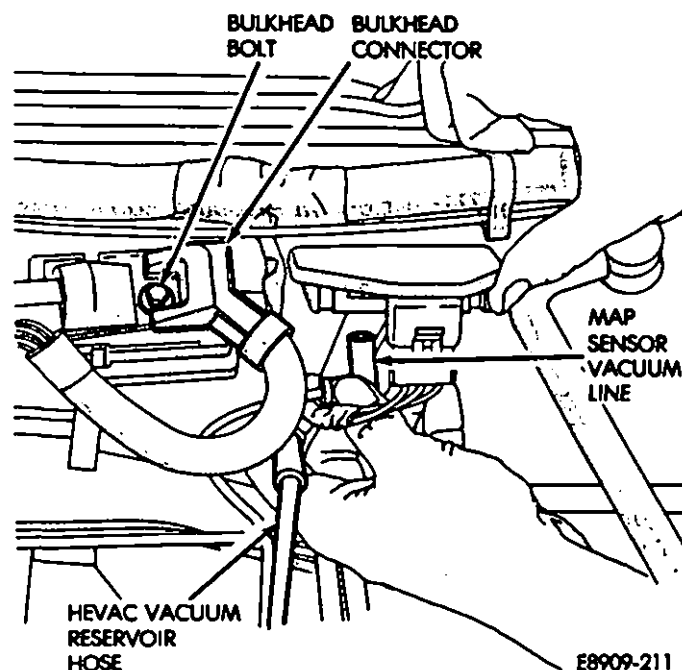
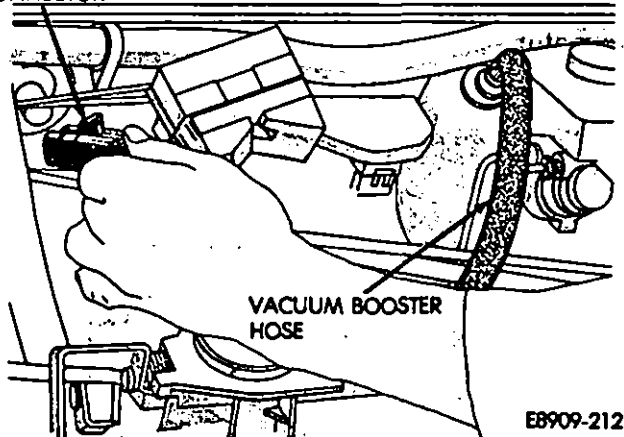


Fig. 7—MAP Line/Hevac Hose/Bulkhead Connector

(33) Disconnect the knock sensor connector, the oil level sensor connector, the oil pressure sender connector and the alternator connector (Fig. 13).

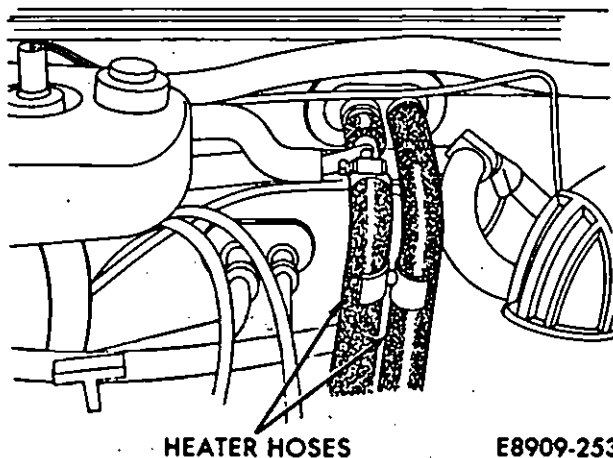
(34) Disconnect the alternator output wire from the back of the alternator (Fig. 13).

ELECTRICAL
CONNECTOR



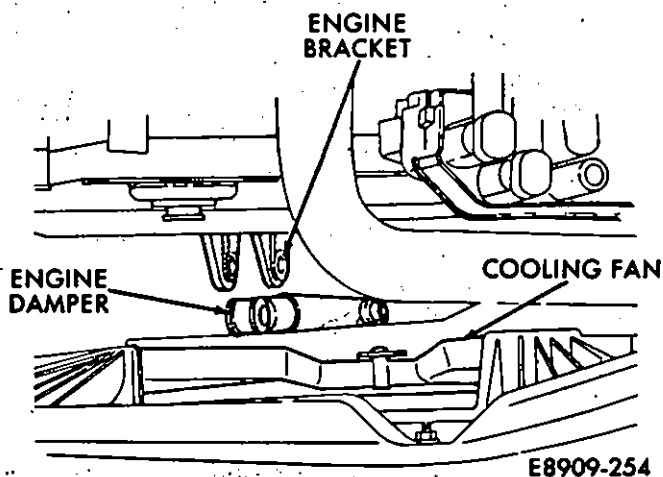
E8909-212

Fig. 8—Electrical Connector/Vacuum Booster Hose



E8909-253

Fig. 9—Heater Hoses/Coolant Pressure Bottle Hose



E8909-254

Fig. 10—Engine Damper

(35) Disconnect the wire harness clip from the back of the alternator (Fig. 13). Stow the wire harness to the side of the engine compartment.

(36) To loosen the accessory drive belt, loosen the pivot bolt, the locking bolt and the adjusting bolt (Fig. 13).

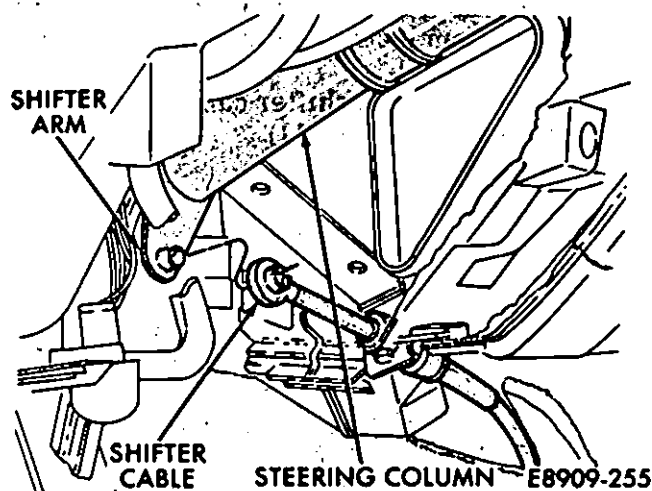
(37) Loosen the power steering pump nuts, and bolts until front bracket drops down (Fig. 14).

(38) Remove the stud bolt behind the front power steering bracket.

(39) Remove the rear power steering pump bracket mounting bolts.

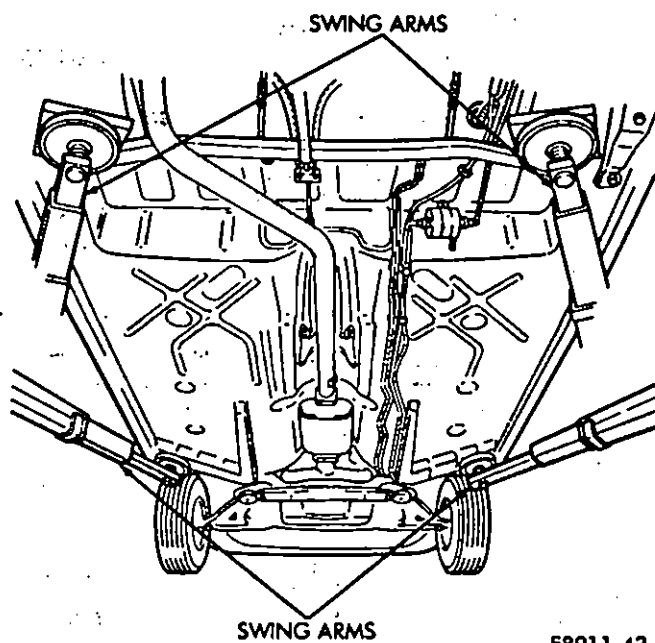
(40) Remove the power steering pump from the engine and temporarily stow it with mechanics wire.

(41) Remove the power steering reservoir mounting bolts.



E8909-255

Fig. 11—Shifter Cable



E8911-42

Fig. 12—Side Mounted Swing Arm Holst

(42) Stow the power steering pump and reservoir in the drivers side of the engine compartment.

(43) Lower the vehicle.

(44) If equipped, remove the air conditioning compressor mounting bolts (Fig. 15). Remove the A/C compressor and stow it in the passengers side of the engine compartment.

(45) Raise the vehicle halfway.

(46) Remove the front tires.

CAUTION: Do not remove the hydraulic brake lines and do not let caliper hang by the hydraulic hose.

(47) Remove the brake calipers and disc pads (refer to Group 5, "Brakes" for the proper procedure).

(48) Use mechanics wire to hang the calipers in the strut springs (Fig. 16).

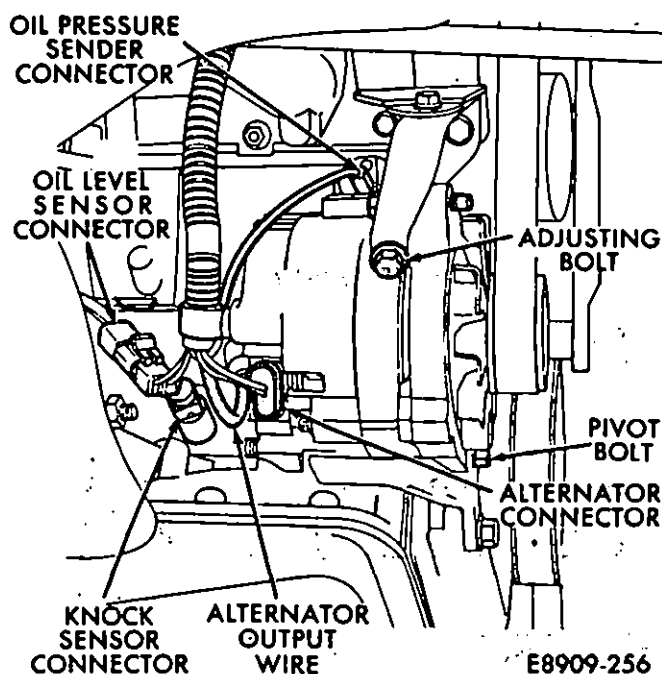


Fig. 13—Alternator Bolt and Sensor Locations

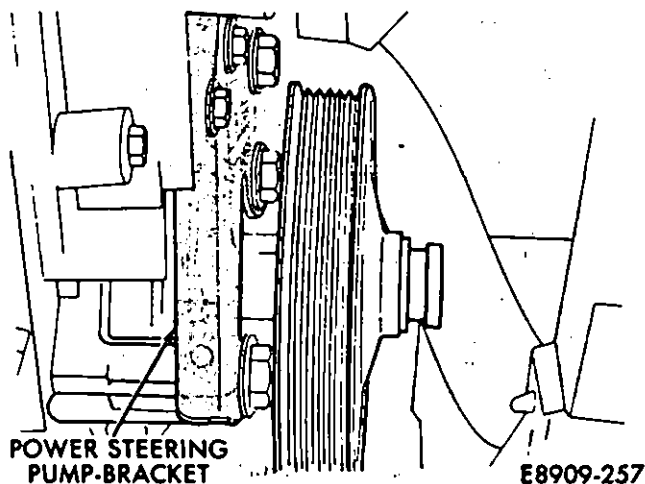


Fig. 14—Power Steering Pump Bracket

(49) Hold the hub in place and loosen the hub nut on both sides.

CAUTION: The steering knuckle bolts are splined into the knuckle. Do not turn the bolts to loosen, instead loosen the nuts.

(50) Remove the steering knuckle to strut attaching bolt nuts on both sides of the vehicle.

CAUTION: Use a brass hammer to tap the steering knuckle bolts out. Do not use a steel hammer as damage to the threads will occur.

(51) On both sides of the vehicle tap the top steering knuckle bolt out first. Pull the strut out, pivoting the steering knuckle on the lower bolt.

(52) Tap the lower steering knuckle bolt out and separate the steering knuckle from the strut (Fig. 17).

(53) Raise the vehicle all the way up.

(54) Disconnect the battery negative cable and solenoid wire at the starter.

(55) Remove the middle starter mounting bolt and disconnect the ground cable.

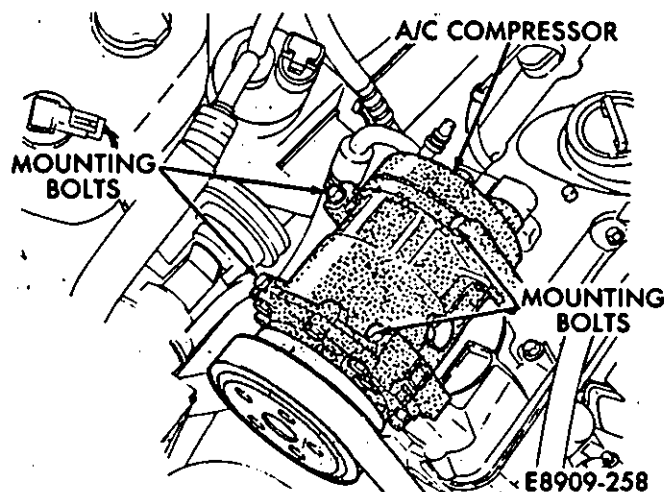


Fig. 15—A/C Compressor Bolts

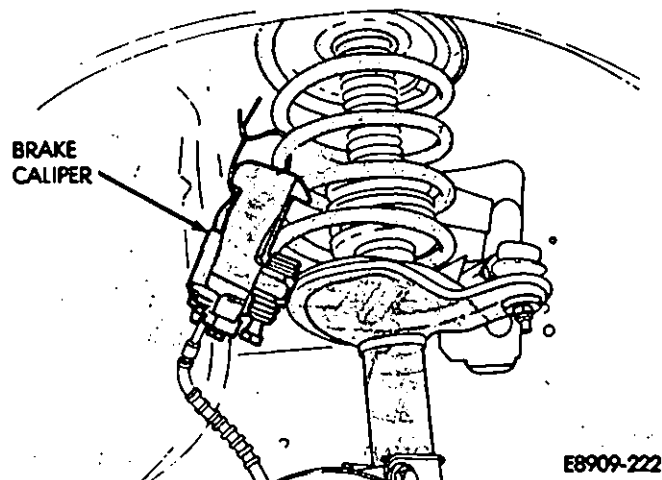


Fig. 16—Hang Brake Caliper

(56) Remove the front sill shield by unscrewing the mounting bolts (Fig. 18).

(57) Disconnect oxygen (O₂) sensor connector at Y-pipe.

(58) Pull the grommet surrounding the shifter cable down (Fig. 19).

(59) Grasp the shifter cable and pull it through the hole in the body (Fig. 19).

(60) Disconnect the catalytic converter from the Y-pipe.

(61) Install special attaching bolts into the cradle by pushing the large end of the channel iron into the hole in the cradle (Fig. 20).

(62) Jiggle the bolt until the channel iron lays flat in the hole. Do the same with the other bolt.

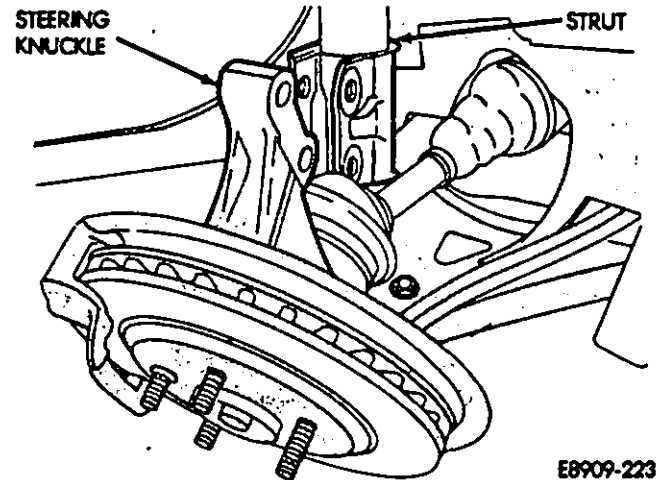


Fig. 17—Steering Knuckle/Strut

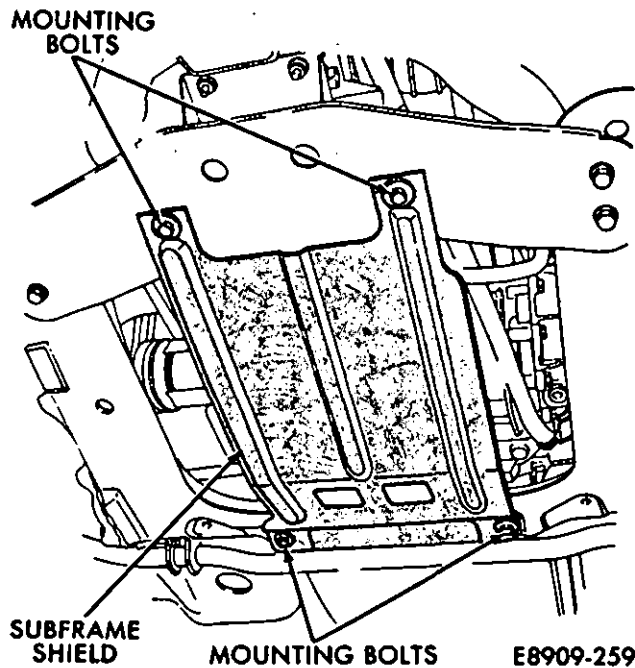


Fig. 18—Front Sill Shield

(63) Install the dolly to the cradle with the dolly wheels towards the rear of the vehicle. Tighten the nuts.

(64) Lower the hoist until the dolly rests on the floor.

(65) Laying on a mechanics creeper or on the floor, remove the four cradle mounting bolts (Fig. 21).

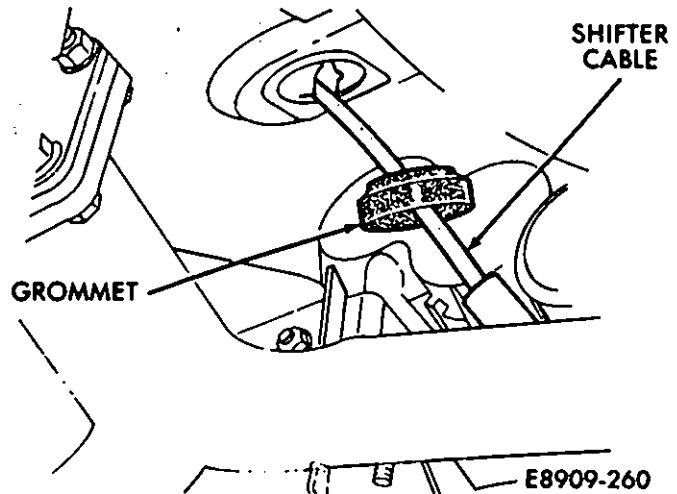


Fig. 19—Shifter Cable

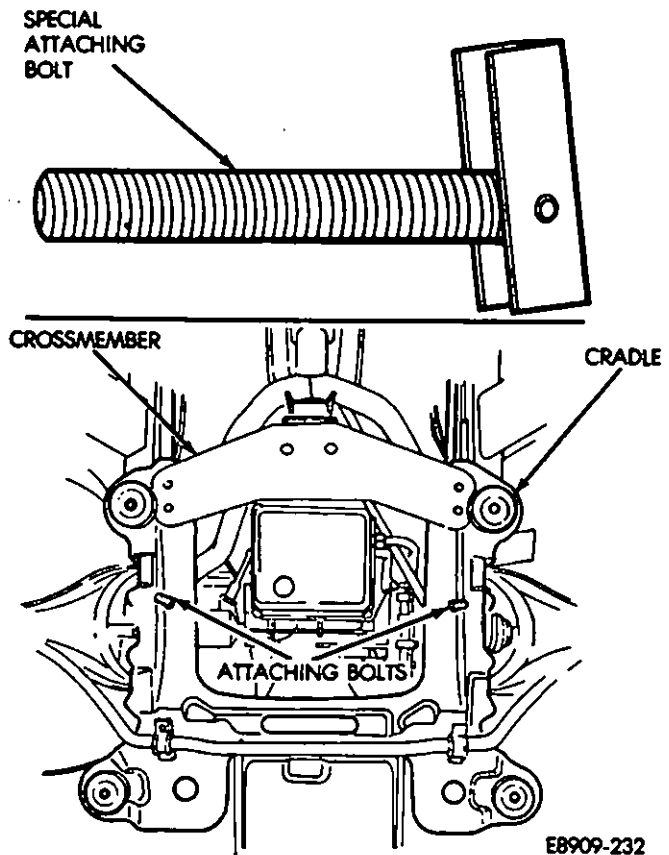


Fig. 20—Special Attaching Bolts

CAUTION: Ensure all hoses, vacuum lines and wire harnesses are positioned so that they will not snag and catch when the vehicle is lifted off the engine.

(66) Slowly raise the vehicle off the engine.

(67) Draw the outline of the dolly legs and the center line of the wheels on the floor. Once the dolly is repositioned under the vehicle, it can be correctly positioned so that it aligns with the vehicle at installation.

(68) To move the dolly, position a floor jack under the center of the front bar of the dolly. Jack up the dolly until the front legs are approximately one inch off the floor. Push the dolly/floor jack to the desired position.

Engine Removal from Transaxle

(1) Support the transaxle with brackets supplied with cradle dolly.

(2) Attach an overhead crane or engine lift to the lift brackets on the cylinder heads.

(3) Loosen the engine mount to cradle stud nuts.

(4) Remove the starter motor.

(5) Remove the access cover bolt (Fig. 22).

(6) Remove torque converter bolts one at a time (Fig. 22). Rotate engine until all bolts are removed.

(7) Remove transaxle road speed sensor (Fig. 22).

(8) Disconnect transaxle oil cooler hoses (Fig. 23).

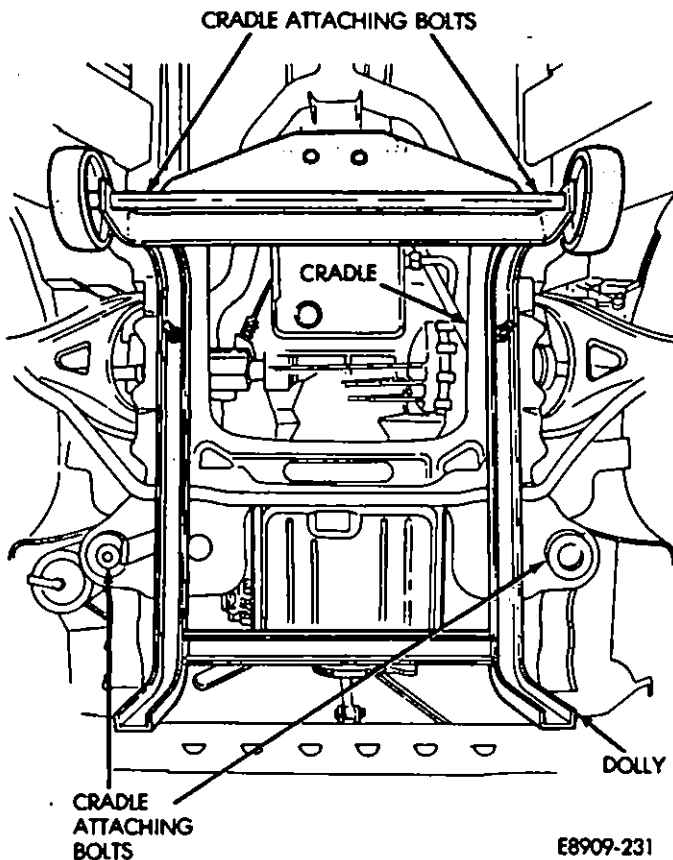


Fig. 21—Dolly Attached to Cradle

(9) Disconnect the transmission kick-down cable at the throttle body (refer to Group 21, Transaxle, for the proper procedure).

(10) Remove the top transaxle mounting bolts (Fig. 24) and the lower nuts from the aligning studs (Fig. 23).

(11) Remove the engine from the transaxle.

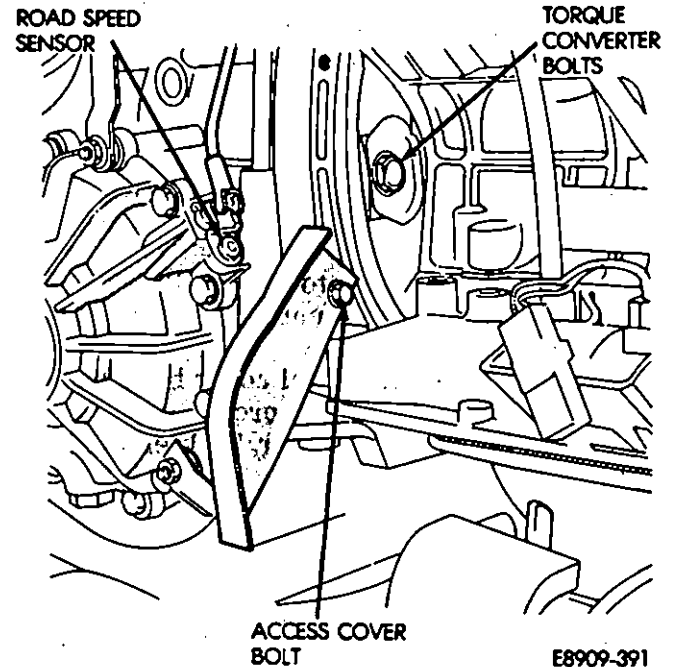


Fig. 22—Access Cover/Torque Converter/Road Speed Sensor

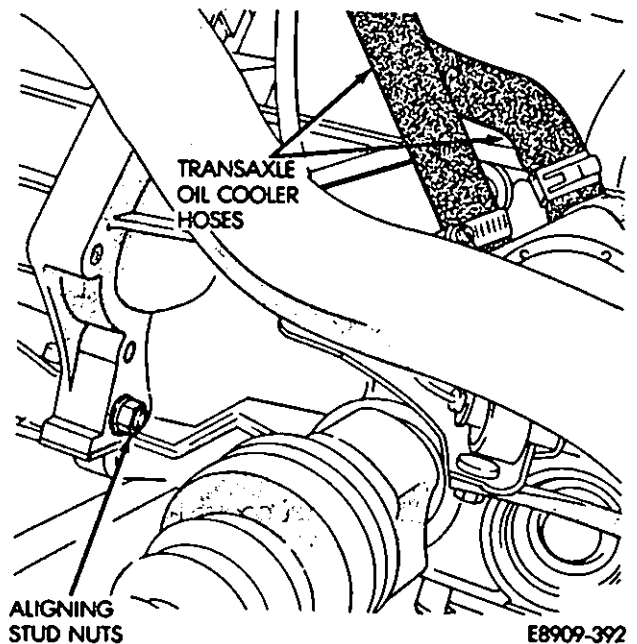


Fig. 23—Oil Cooler Hoses/Aligning Stud Nuts

Engine Installation to Transaxle

- (1) Prior to connecting the engine to the transaxle, ensure that the torque converter is pushed back completely into the pump.
- (2) Install the top transaxle mounting bolts and alignment stud nuts. Tighten the bolts and nuts to 65 N·m (48 ft-lbs) torque.
- (3) Install the transaxle road speed sensor.
- (4) Install and adjust the transmission kick-down cable at the throttle body (refer to Group 21, Transaxle, for the proper procedure).
- (5) Connect the transmission oil cooler hoses.
- (6) Install the torque converter to drive plate bolts. Tighten these bolts to 33 N·m (24 ft-lbs) torque.
- (7) Install the access cover.
- (8) Lower the engine into the cradle.
- (9) Tighten the engine mount stud and nuts to 40 N·m (30 ft-lbs) torque.
- (10) Install the differential cover bolt. Tighten the bolt to 27 N·m (20 ft-lbs) torque.
- (11) Install the starter motor. Tighten the bolts to 42 N·m (31 ft-lbs) torque.
- (12) Disconnect the engine lift or over head crane.

Installation

- (1) Position the engine/transmission/cradle assembly under the vehicle. Align the dolly with the outline of the dolly legs and wheels drawn on the floor when the assembly was removed.
- CAUTION:** Ensure all hoses, vacuum lines and wire harnesses are positioned so that they will not snag and catch when the vehicle is lowered onto the cradle.

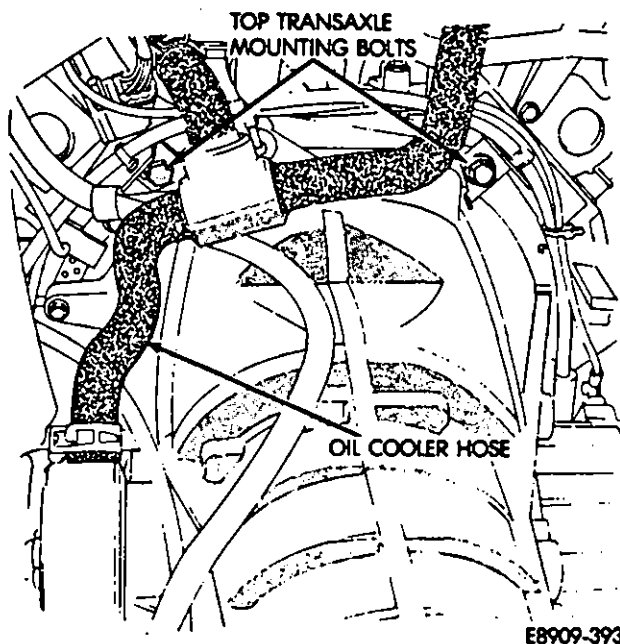


Fig. 24—Top Transaxle Mounting Bolts

- (2) Lower the vehicle onto the cradle. Stop when the vehicle just touches the cradle bolt pads.

- (3) Install cradle mounting bolts (Fig. 25). The cradle bolt has a rubber spacer and metal washer. They must be installed with the rubber spacer between the body and the washer. Tighten the bolts to 125 N·m (92 ft-lbs) torque.

- (4) Raise the vehicle halfway.

- (5) Push the lower control arm down and re-connect the steering knuckle to the strut. Install the top bolt first. Then the lower bolt. The strut bolts are splined to the steering knuckles. Tighten the nuts, not the bolts. Tighten the nuts to 167 N·m (123 ft-lbs) torque.

- (6) Install the disk brake pads and calipers (refer to Group 5, Brakes, for the proper procedure).

- (7) Hold the hub in place and tighten the hub nuts to 245 N·m (181 ft-lbs) torque.

- (8) Raise the vehicle the rest of the way up.

- (9) Remove the dolly from the cradle. Remove the special bolts from the cradle.

- (10) Connect the catalytic converter to the Y-pipe.

- (11) Connect the electrical connector to the oxygen (O₂) sensor.

- (12) Connect the starter wires and the battery negative wire.

- (13) Position the power steering pump against the engine. Finger tighten the rear bracket mounting bolts (Fig. 26).

- (14) Install the stud bolt through the timing cover and thread it into the rear bracket (Fig. 27). Tighten the stud bolt to 40 N·m (30 ft-lbs) torque.

- (15) Tighten the rear mounting bolts to 27 N·m (20 ft-lbs) torque.

- (16) Pivot the power steering pump front bracket up over the stud bolt (Fig. 27).

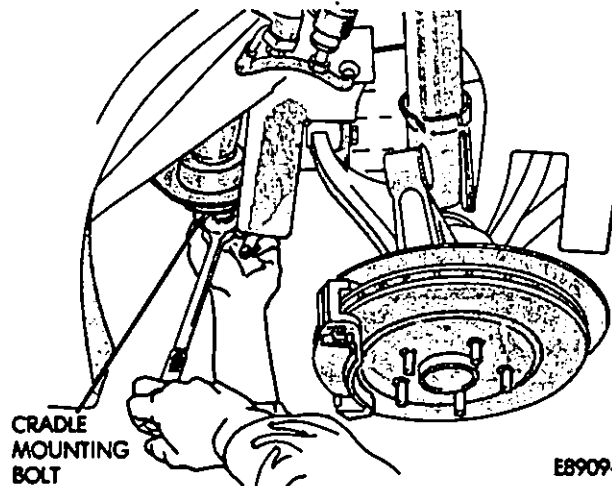


Fig. 25—Cradle Mounting Bolts

(17) Thread the lower front mounting bolt in a couple of threads.

(18) Start the nut on the stud. Finish tightening the lower front mounting bolt to 40 N·m (30 ft-lbs) torque.

(19) Tighten the stud nut to 40 N·m (30 ft-lbs) torque.

(20) Install the upper front mounting bolt. (Fig. 28). Tighten the bolt to 27 N·m (20 ft-lbs) torque.

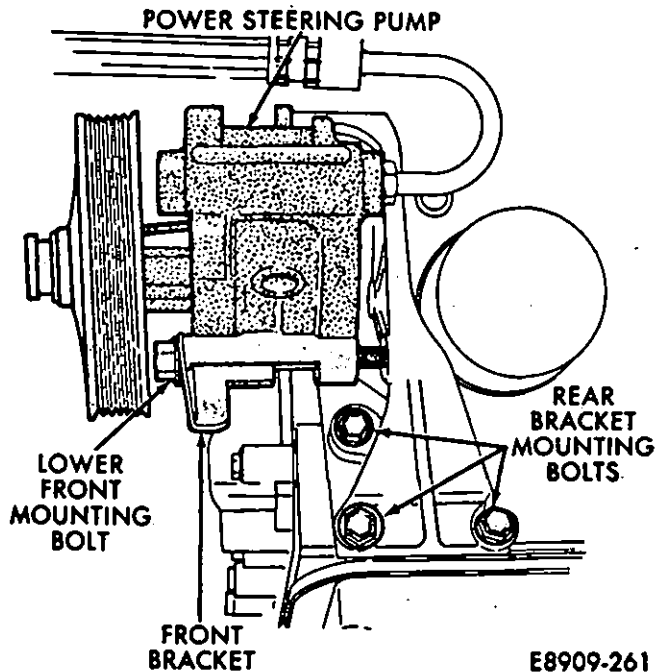


Fig. 26—Power Steering Pump

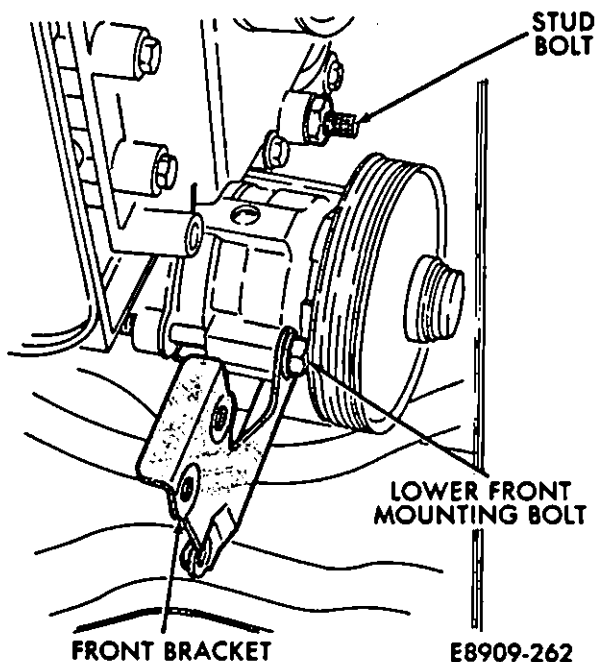


Fig. 27—Power Steering Pump Front Bracket

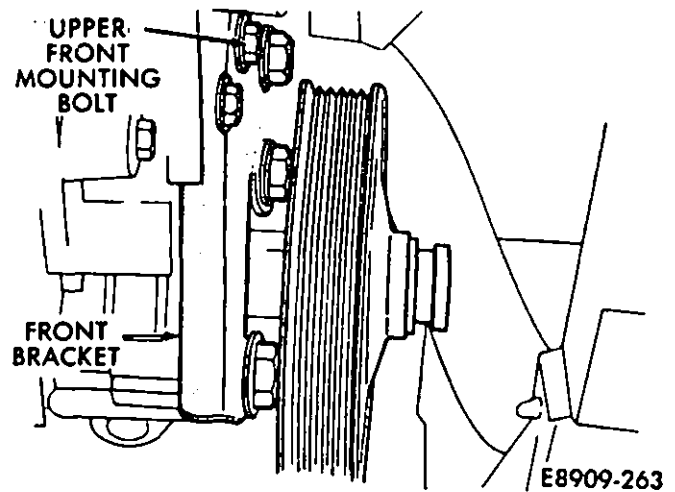


Fig. 28—Upper Front Mounting Bracket Bolt

(21) Connect the alternator output wire, the alternator connector and the wire harness clip at the alternator.

(22) Connect the oil pressure sender wire to the sender.

(23) Connect the oil level sensor electrical connectors.

(24) Connect the knock sensor electrical connector to the knock sensor.

(25) Position the splash shields in the wheel wells so that they hang straight down.

(26) Install both front tires and wheels. Tighten the lug nuts to 85 N·m (63 ft-lbs) torque.

(27) Push the transmission shifter cable through the hole in the body and into the passengers compartment. Position the grommet in the hole.

(28) Lower the vehicle.

(29) Install the air conditioning compressor on the valve cover. Tighten the bolts to 27 N·m (20 ft-lbs) torque.

(30) Position the accessory drive belt on the pulleys. Be sure that the belt is routed correctly (refer to Group 7, Cooling System, Drive Belt Adjustments, for the proper procedure).

(31) Raise the vehicle.

(32) Install a belt tension gauge on the accessory drive belt halfway between the air conditioning compressor and the alternator. On vehicles without air conditioning, install the gauge halfway between the water pump and the alternator.

(33) Tighten the adjusting bolt until the correct belt tension is obtained (Fig. 29). If a new accessory drive belt is installed, it must be tensioned after 12 070 km (7500 miles) of usage. Correct belt tension is:

- New Belt—180-200 lbs.
- Used Belt—140-160 lbs.

(34) Tighten the alternator pivot bolt to 50 N·m (37 ft-lbs) torque.

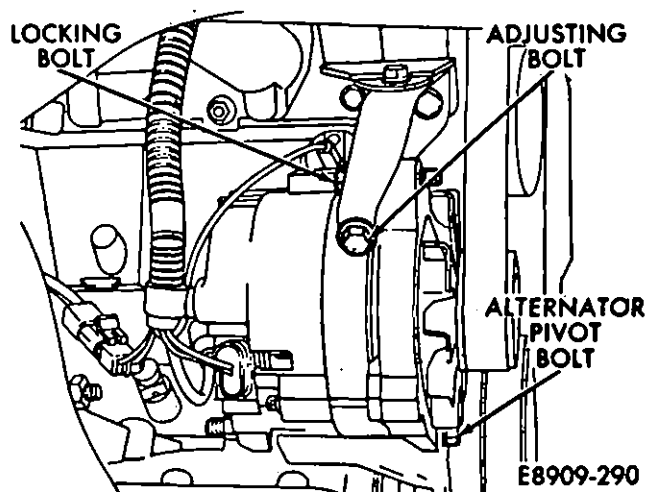


Fig. 29—Belt Tensioning

(35) Tighten the alternator locking bolt to 27 N·m (20 ft-lbs) torque.

(36) Install the splash shield under the alternator.

(37) Lower the vehicle.

(38) Connect the heater hoses at the dash panel.

(39) Connect the coolant bottle lower hose.

(40) Push the black fuel supply tube onto the fuel rail until a audible click is heard (Fig. 30). Pull back to ensure that the connector is locked in place.

(41) Push the grey fuel return tube onto fuel pressure regulator until an audible click is heard. Pull back to ensure that the connector is locked in place.

(42) Connect the MAP sensor vacuum hose and the Hevac vacuum reservoir hoses (Fig. 31).

(43) Connect the bulkhead connector and secure with the bulkhead bolts (Fig. 31). Connect the electrical connector at the dash panel.

(44) Connect the EGR solenoid vacuum hoses (Fig. 32).

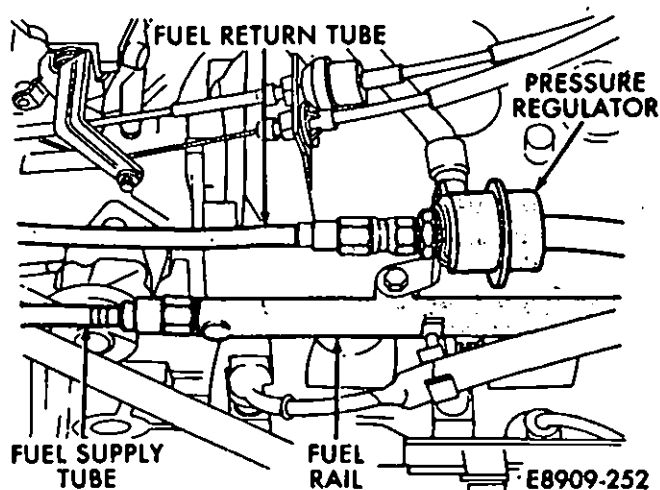


Fig. 30—Fuel Tubes/Regulator/Fuel Rail

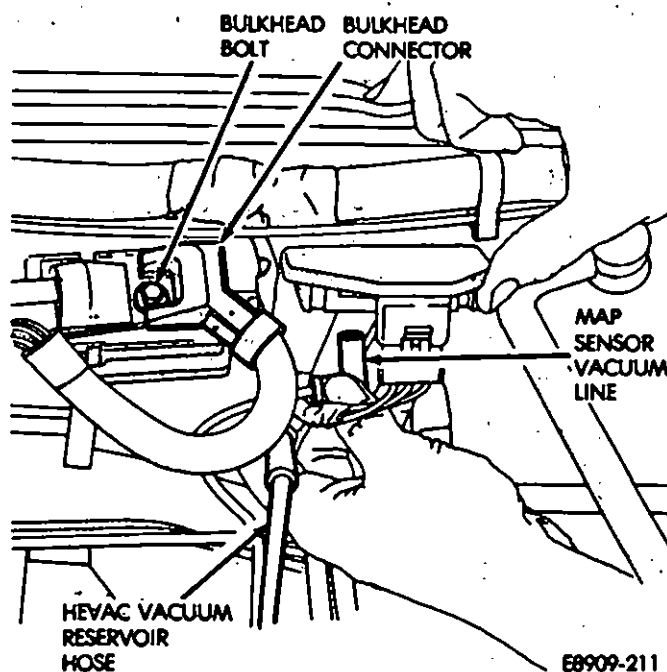


Fig. 31—MAP Line/Hevac Hose/Bulkhead Connector

(45) Connect the front engine shock absorber to the engine bracket.

(46) Install the upper and lower radiator hoses at the water pump.

(47) Install the power steering reservoir to the engine.

(48) Install the battery and battery holddown bracket.

(49) Install the air cleaner.

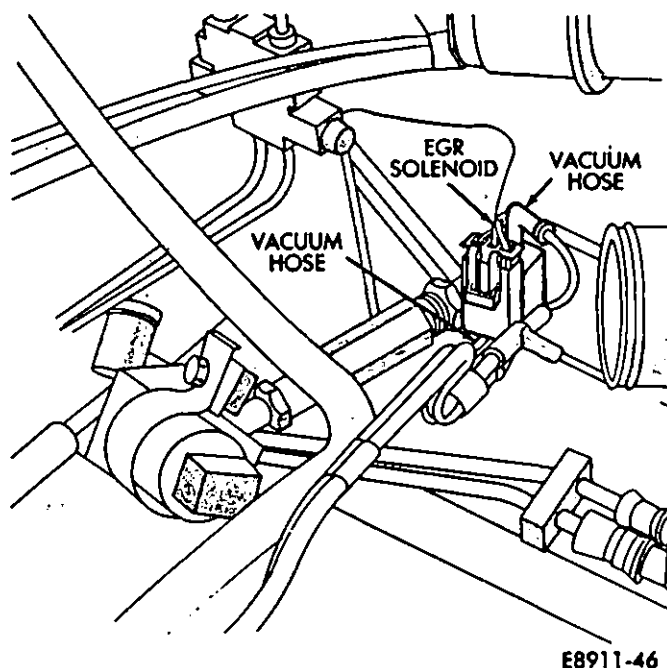
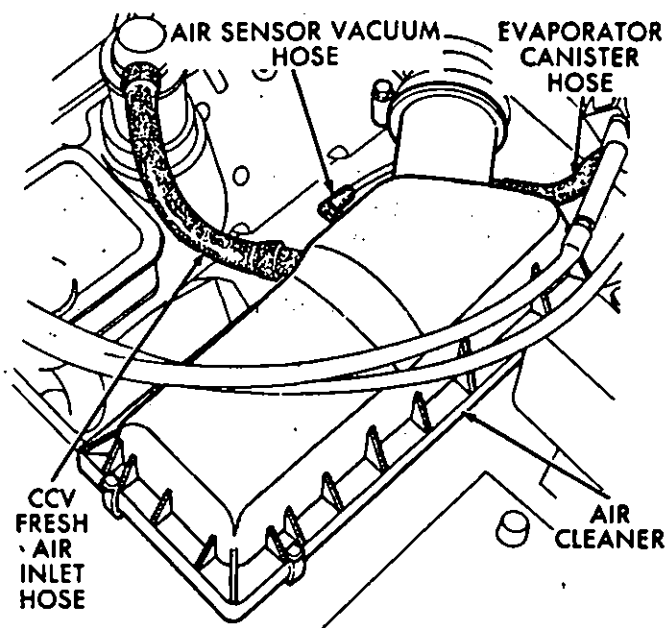


Fig. 32—EGR Solenoid and Vacuum Hoses



E8909-249

Fig. 33—CCV Hose/Evaporator Hose/Sensor Hose at Air Cleaner

(50) Install the air sensor vacuum hose at the air cleaner (Fig. 33).

(51) Route the coil wire through the clips on the air cleaner and install at the distributor cap.

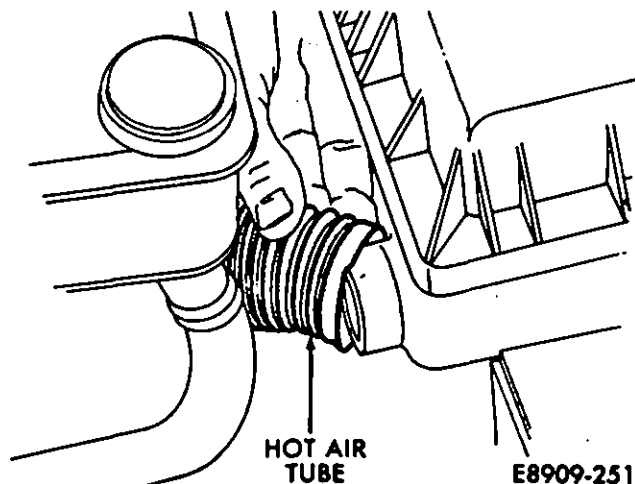
(52) Connect the evaporator canister hose and the crankcase ventilation fresh air inlet hose at the air cleaner (Fig. 33).

(53) Connect the hot air tube to the air cleaner (Fig. 34).

(54) Connect the accelerator cable and cruise control cable to the throttle arm.

(55) Close the radiator drain.

(56) Connect the vacuum booster hose to the brake vacuum booster.



E8909-251

Fig. 34—Hot Air Tube at Air Cleaner

(57) Connect the transmission shifter cable. Slide it through the holding bracket and attach it to the arm on the steering column. Install the section of instrument panel.

(58) Install the throttle body bonnet.

(59) If the engine oil was drained, refill the crankcase with clean oil.

(60) Connect the battery positive cable first, then connect the battery negative cable.

(61) Fill the cooling system and bleed it (refer to Group 7, Cooling System, for the proper procedure).

ENGINE COVER

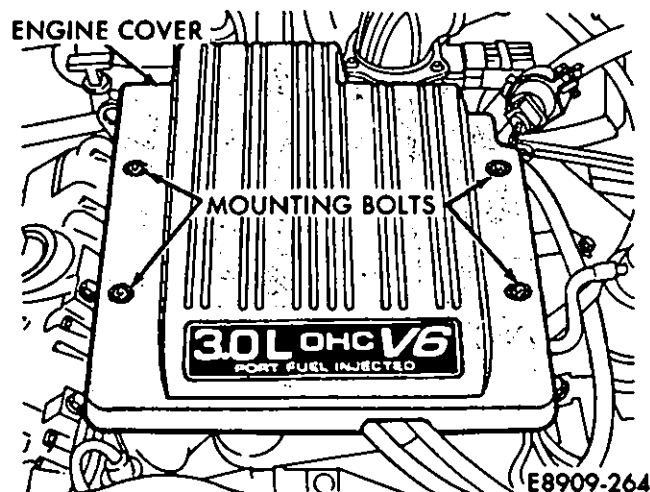
The engine intake manifold is covered by an engine cover which is attached to the fuel rail.

Removal

- (1) Remove the mounting bolts (Fig. 1).
- (2) Remove the engine cover.

Installation

- (1) Install the engine cover over the fuel rails.
- (2) Tighten mounting bolts.



E8909-264

Fig. 1—Engine Cover

CYLINDER HEAD COVER—(ENGINE INSTALLED)

This procedure should be used with the engine installed in the vehicle.

Removal—Right Side

- (1) Disconnect the battery negative cable.
- (2) Loosen the accessory drive belt (refer to Group 7, Cooling System, Drive Belt Adjustments, for the proper procedure).
- (3) Remove the spark plug wire holder.
- (4) Remove the air conditioning compressor mounting bolts. Carefully position the air condi-

tioning compressor in the right side fender well and secure in place (Fig. 2).

(5) Loosen the cylinder head cover mounting bolts (Fig. 3).

(6) Remove the cylinder head cover and the old gasket (Fig. 3).

Installation—Right Side

(1) Clean the cylinder head and cylinder head cover mating surfaces.

(2) Apply a light coating of Jeep Gasket-in-a-Tube Sealer, or equivalent, to the top of the timing case cover to cylinder head joint areas.

(3) Install the cylinder head cover using a new gasket.

(4) Install the spark plug holder.

(5) Tighten the cylinder head cover bolts to 12 N·m (9 ft-lbs) torque.

(6) Install the air conditioning compressor. Tighten the mounting bolts to 27 N·m (20 ft-lbs) torque.

(7) Install the accessory drive belt (refer to

Group 7, Cooling System, Drive Belt Adjustments, for the proper procedure).

(8) Connect the battery negative cable.

Removal—Left Side

(1) Disconnect the battery negative cable.

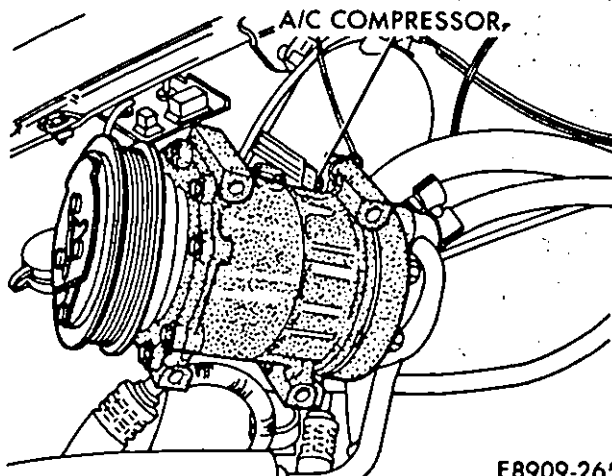
(2) Disconnect the throttle body bonnet/air inlet hose assembly from the throttle body and air cleaner.

(3) Remove the vacuum brake booster hose from the throttle body.

(4) Disconnect the crankcase ventilation (CCV) fresh air hose at the cylinder head cover (Fig. 4).

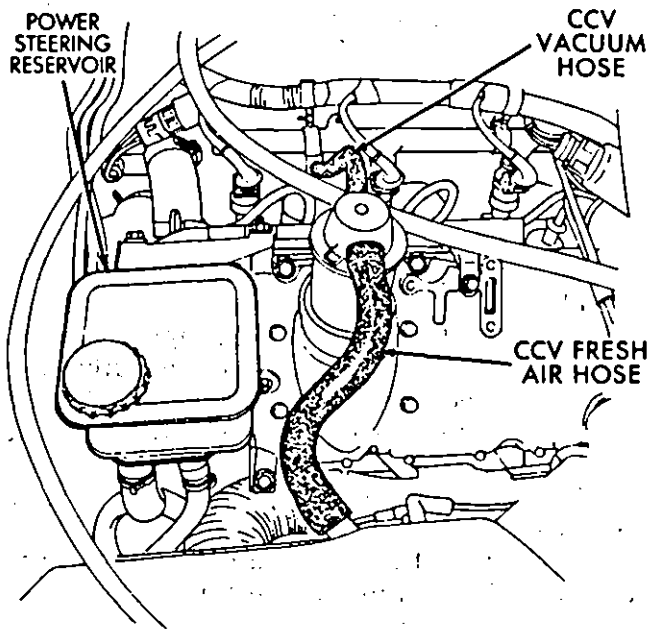
(5) Disconnect the CCV vacuum hose at the cylinder head cover (Fig. 4).

(6) Disconnect the air cleaner and remove it.



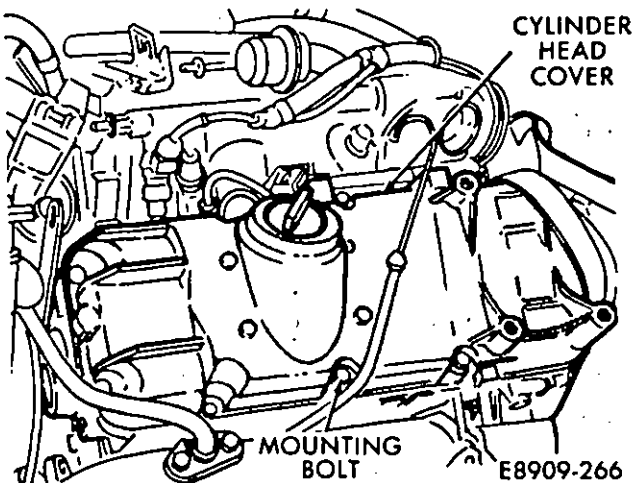
E8909-265

Fig. 2—A/C Compressor



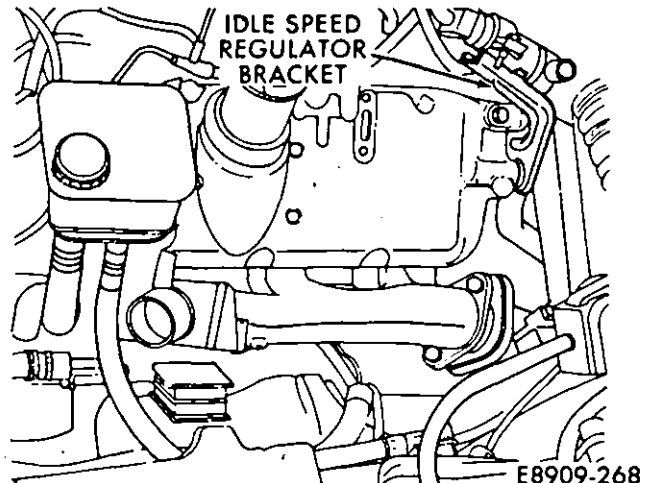
E8909-267

Fig. 4—CCV Hoses/Coolant Pressure Bottle



E8909-266

Fig. 3—Cylinder Head Cover



E8909-268

Fig. 5—Idle Speed Regulator Bracket

(7) Remove the power steering reservoir mounting bolts. Set the coolant pressure bottle (Fig. 4) in the air cleaner position.

(8) Disconnect the accelerator cable at the throttle body and hold down bracket. Lay to the side.

CAUTION: When disconnecting the cruise control cable at the throttle body, do not use pliers to remove the connector. Use finger pressure only. Pliers can break the connector.

(9) Remove idle speed regulator bracket mounting bolts at the rear of the valve cover (Fig. 5).

(10) Remove the spark plug wire holder.

(11) Loosen the cylinder head cover mounting bolts.

(12) Remove the cover and gasket.

Installation—Left Side

(1) Clean the cylinder head and cylinder head cover mating surfaces.

(2) Apply a light coating of Jeep Gasket-in-a-Tube Sealer, or equivalent, to the top of the timing case cover to cylinder head joint areas.

(3) Install the cylinder head cover and new gasket.

(4) Tighten the cylinder head cover mounting bolts to 12 N·m (9 ft-lbs) torque.

(5) Install the spark plug wire holder.

(6) Install the idle speed regulator bracket to the rear of the cylinder head cover.

(7) Connect the accelerator cable and cruise control cable to the holddown bracket and throttle body.

(8) Install the power steering pump reservoir.

(9) Install the air cleaner.

(10) Install CCV fresh air hose and vacuum hose.

(11) Connect vacuum brake booster hose.

(12) Connect the throttle body bonnet/air inlet hose assembly to the air cleaner and throttle body.

(13) Connect the battery negative cable.

CYLINDER HEAD COVERS—(ENGINE REMOVED)

This procedure should be used when the engine is removed from the vehicle.

CAUTION: The right and left hand cylinder head covers and cylinder head cover gasket are not interchangeable.

Removal

(1) Remove cylinder head cover mounting bolts from the left and right sides (Fig. 6).

(2) Remove the covers and gaskets.

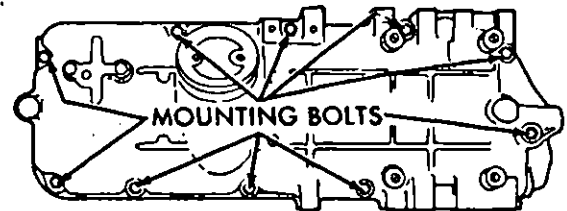
(3) Discard the gaskets. DO NOT reuse the gaskets.

Installation

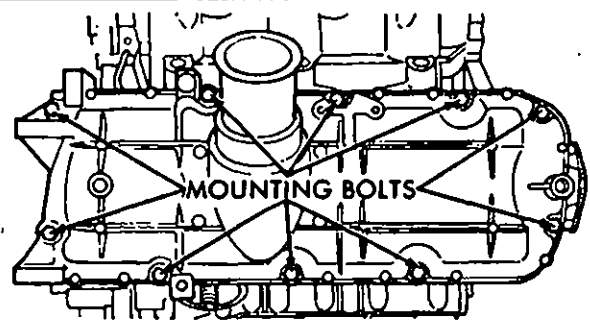
(1) Prior to installing a new cylinder head cover gasket, apply a dab of Jeep/Eagle Gasket-in-a-Tube Sealer at the timing cover to cylinder head mating seams (Fig. 7).

(2) Use new gaskets and install the right cylinder head cover and the left cylinder head cover. The right and left cylinder head gaskets are not identical.

(3) Tighten the mounting bolts to 12 N·m (9 ft-lbs) torque.



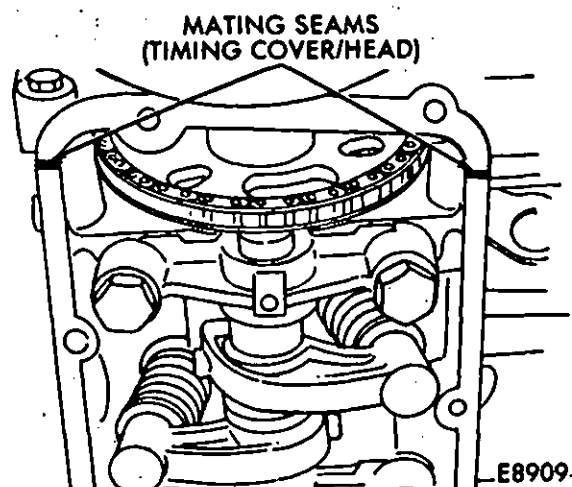
RIGHT SIDE



LEFT SIDE

E8909-269

Fig. 6—Cylinder Head Covers



E8909-270

Fig. 7—Timing Cover to Head Mating Seam

CYLINDER HEAD—(ENGINE INSTALLED)

This procedure should be used with the engine installed in the vehicle.

CAUTION: Before removing the cylinder heads, allow the engine to cool down to room temperature. Never remove a cylinder head from a hot/warm engine. The cylinder head may warp.

When removing the cylinder head, the exhaust manifolds must be removed from the cylinder head. Install the exhaust manifolds **AFTER** the cylinder head and gasket have been installed. This is to prevent damage to the cylinder head gasket tabs.

Removal—Right Side

- (1) Disconnect the battery negative cable.
- (2) Drain the cooling system (refer to Group 7, Cooling System, for the proper procedure).
- (3) Remove the intake manifold.
- (4) Remove A/C Pump (if so equipped) Refer to Accessory Drive Section in Group 7 to remove drive belt.
- (5) Remove the exhaust manifold.
- (6) Remove the cylinder head gasket.
- (7) Remove the spark plug wires from the cylinder head.
- (8) Remove the top alternator mounting bracket that bolts to the cylinder head and the timing case cover.
- (9) Remove the timing case bolts that thread into the cylinder head and those bolts in-line below.

The timing chain and sprocket must be held in place and not allowed to drop down while the cylinder head is removed. If the chain and sprocket slip, the timing case must be removed and the chain tensioners released.

- (10) Turn the engine over until the camshaft sprocket dowel is straight up.

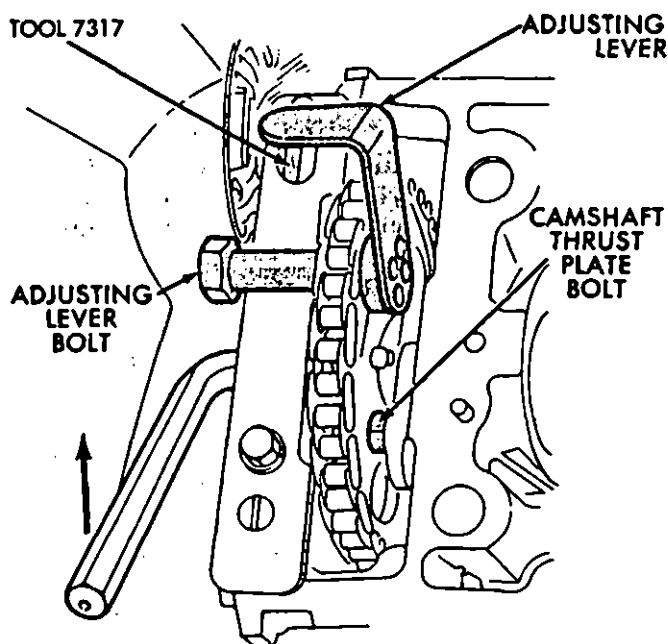
(11) Attach Tool 7317 to the timing case cover. Secure with two short cylinder head cover bolts. The tool consists of a support bracket and a dummy bearing (Fig. 1).

(12) Position the adjusting lever behind the camshaft sprocket. Thread the adjusting lever bolt through the front of the tool, sprocket and into the lever (Fig. 2). Push the lever up as far as possible. Tighten the adjusting lever bolt.

(13) Unthread the plug in the front of the timing case cover (Fig. 3). This will give access to the camshaft sprocket bolt.

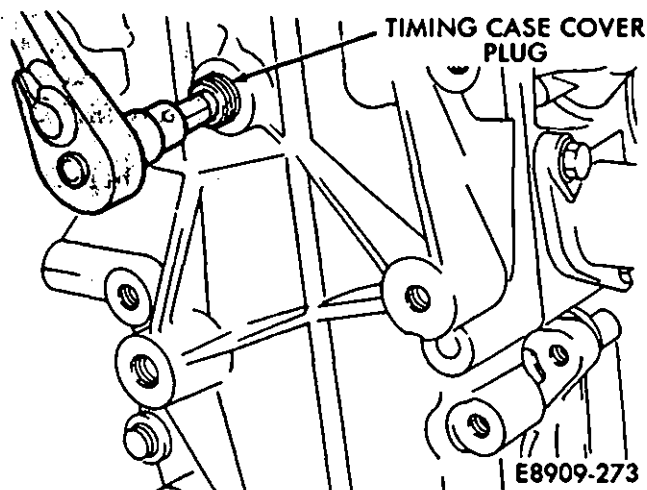
(14) Remove the cylinder head bolts.

(15) Remove the rocker arm shaft assembly (Fig. 4). The caps are pinned into the top of the cylinder head and will only go on in one direction.



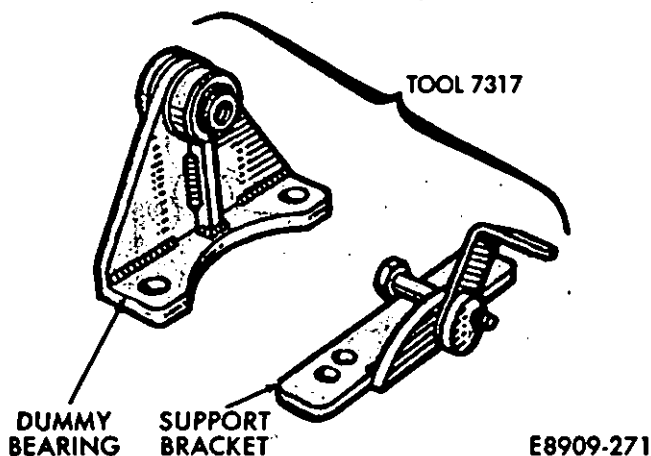
E8909-272

Fig. 2—Positioning Tool 7317



E8909-273

Fig. 3—Timing Case Cover Plug



E8909-271

Fig. 1—Camshaft Sprocket Support—Tool 7317

(16) Install one head bolt in the center and tighten about 2 turns.

(17) Remove the camshaft cover and gasket at the rear of the cylinder head.

(18) Loosen the camshaft thrust plate bolt (Fig. 5). Pull the plate up and tighten the bolt. This will allow the camshaft to move back as the sprocket bolt is removed.

(19) Loosen the camshaft sprocket bolt and pull the camshaft back until the bolt is out of the camshaft. The bolt will stay in the sprocket hole. It will not drop down because the timing case cover is too close for it to come out of the sprocket.

(20) Slide the camshaft back away from the sprocket.

(21) Use an old push rod or a long thin drift punch as a tool and insert it into the front and

rear cylinder head bolt holes on the exhaust manifold side of the head. (Fig. 6). Tap the dowels down below the head gasket.

Do not lift/pry the cylinder head straight up. This will cause the cylinder liners to come up and out of the block.

(22) Position a small piece of wood against the rear intake manifold side of the cylinder head and strike it with a hammer. Now position the piece of wood against the front exhaust manifold side of the cylinder head and strike it with a hammer. Repeat until the cylinder head is loose (Fig. 7).

(23) Remove the cylinder head bolt.

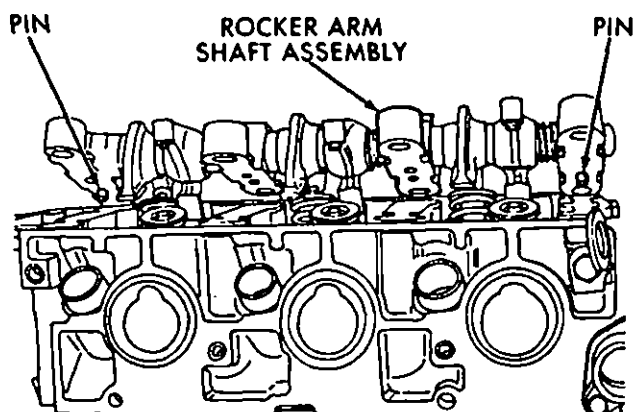
(24) Remove the cylinder head.

(25) Remove the cylinder head gasket.

CAUTION: Never rotate the engine with the support bracket of tool 7317 installed.

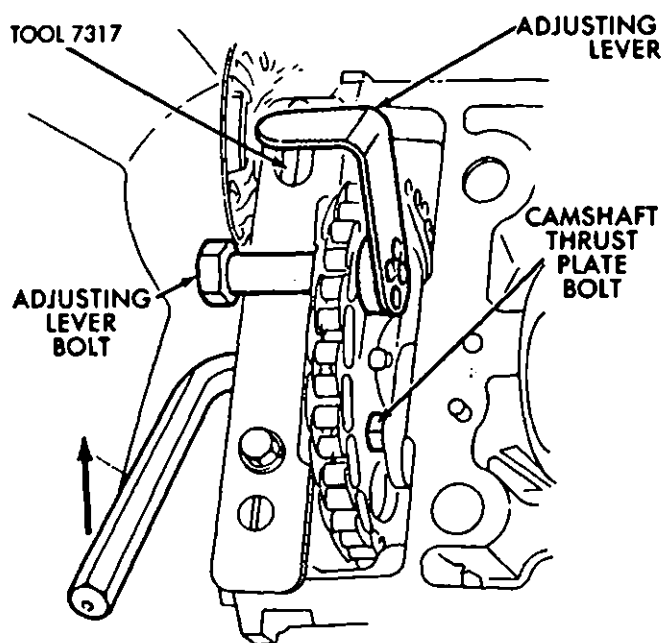
(26) Install liner clamps (Tool 7315) between the cylinder liners to hold them in place.

(27) Use tool 7314 to remove the cylinder head locating dowels (Fig. 8).



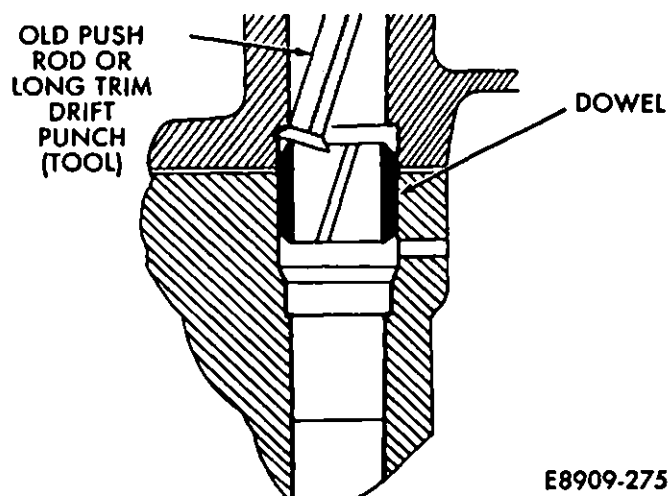
E8909-274

Fig. 4—Rocker Arm Shaft Assembly



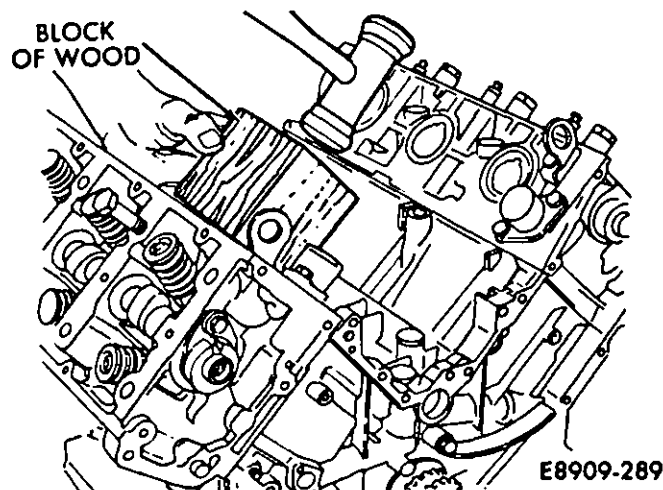
E8909-272

Fig. 5—Camshaft Thrust Plate Bolt



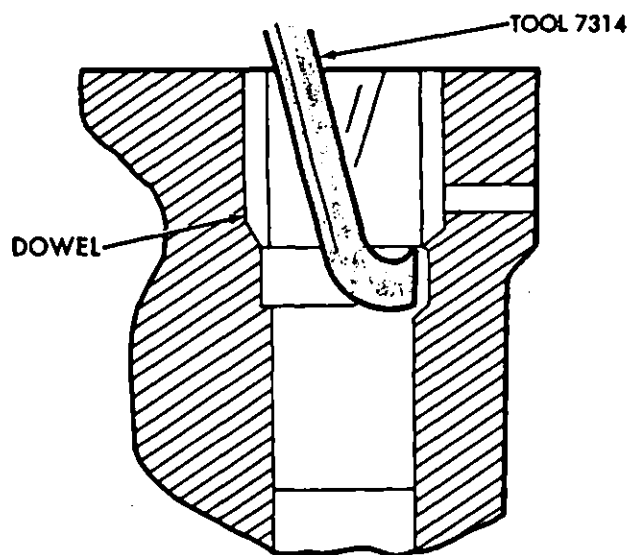
E8909-275

Fig. 6—Tap Dowel into Block



E8909-289

Fig. 7—Cylinder Head Removal



E8909-276

Fig. 8—Dowel Extractor Tool—7314

(28) Stuff the tops of the cylinder bores with clean lint free shop towels.

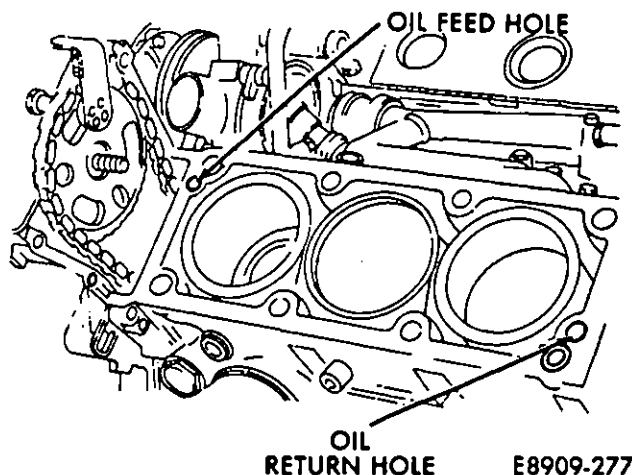
(29) Remove the liner hold down clamps (Tool 7315) to clean the cylinder block, then reinstall the liner clamps.

(30) Use a gasket removal compound to soften the old gasket material.

CAUTION: When cleaning the cylinder head and block mating surfaces, do not use a metal scraper because the surfaces could be cut or ground. Instead, use a wooden or plastic scraper.

(31) Make sure the gasket and/or foreign material does not enter the oil feed hole or the oil return hole (Fig. 9).

(32) Rinse and wipe clean the cylinder block and cylinder head mating surfaces.



E8909-277

Fig. 9—Oil Feed and Return Holes

(33) Check the liner protrusion. The liner protrusion should be between 0.05 mm and 0.12 mm (.002 in and .005 in). Refer the Cylinder Liner—Piston—Connecting Rod Section for the proper procedure.

Installation—Right Side

(1) Cut the timing case cover gasket flush with the cylinder head gasket face.

(2) Cut sections from new gaskets and attach them to the timing case cover. Apply a thin bead of weather strip adhesive. Allow to dry.

(3) Install 3 mm pin punches into the holes in the block below the locating dowel bolt holes. Push the dowels in the holes until they contact the 3 mm pin punches (Fig. 10).

(4) Remove the shop towels from the cylinder bores.

(5) Install a new cylinder head gasket over the alignment dowels.

(6) Place a thin strip of MOPAR Gasket-in-a-Tube Sealer, or equivalent, where the cylinder head gasket contacts the timing case cover gasket.

(7) Install the cylinder head, taking care not to dislodge the timing case cover gasket.

(8) Insert the timing case cover to cylinder head mounting bolts and tighten them finger tight.

(9) Position the camshaft into the sprocket. Line up the dowel to the slot in the camshaft. Install the sprocket bolt and lightly tighten it.

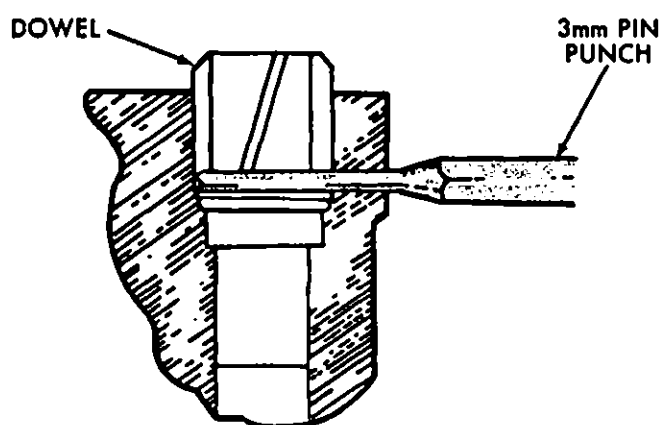
(10) Remove support bracket assembly (Tool 7317).

(11) Loosen the camshaft thrust plate bolt and slide the plate into the groove in the cylinder head. Tighten the bolt to 12 N·m (9 ft-lbs) torque.

(12) Remove the 3 mm pin punches.

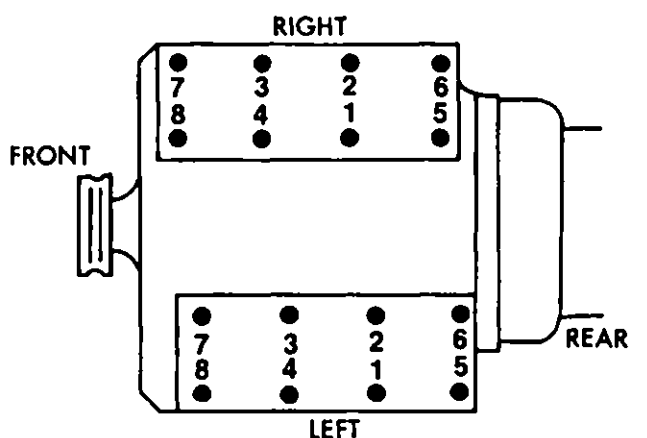
(13) Install the rocker shaft assembly and the cylinder head bolts.

(14) Tighten the cylinder head bolts in the sequence shown (Fig. 11).



E8909-278

Fig. 10—Locating Dowel



9009-95

Fig. 11—Cylinder Head Bolt Tightening Sequence

(15) Starting with bolt No. 1, pre-tighten all bolts to 60 N·m (44 ft-lbs) torque.

(16) The following is performed on all bolts, one bolt at a time.

(a) Starting with bolt No. 1, loosen the bolt completely.

(b) Tighten bolt No. 1 to 40 N·m (30 ft-lbs) torque.

(c) Place the graduated disc (Tool 7321) between the socket and the torque wrench (Fig. 12).

(d) Turn the graduated disc clockwise until the locking stem rests against a solid object which will prevent the disc from turning.

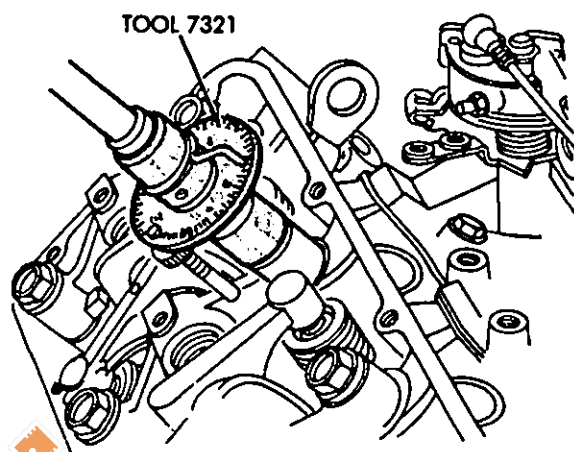
(e) Angle tighten bolt No. 1 to $180^\circ \pm 20^\circ$.

(f) Repeat the procedure for all bolts in the above sequence.

(17) Tighten the timing case cover bolts to 12 N·m (9 ft-lbs) torque.

(18) Tighten the camshaft sprocket bolt to 80 N·m (59 ft-lbs) torque.

(19) Cut off any timing case cover gasket flush with the cylinder head.



E8909-280

Fig. 12—Graduated Disc for Angular Tightening

(20) Install the cylinder head cover(s), exhaust manifold(s) and intake manifold.

(21) Coat the threads of the timing case cover plug with Loctite PST pipe sealant #592 or equivalent.

(22) Install the plug in the front of the timing case cover.

(23) Install the spark plug wires.

(24) Connect the alternator bracket.

(25) Fill and bleed the cooling system (refer to Group 7, Cooling System, for the proper procedure).

(26) Reset the accessory belt tension (refer to Group 7, Cooling System, for the proper procedure).

(27) Connect the battery negative cable.

Removal—Left Side

(1) Disconnect the battery negative cable.

(2) Drain the cooling system (refer to Group 7, Cooling System, for the proper procedure).

(3) Remove the intake manifold.

(4) Remove the exhaust manifold(s).

(5) Remove the cylinder head cover(s).

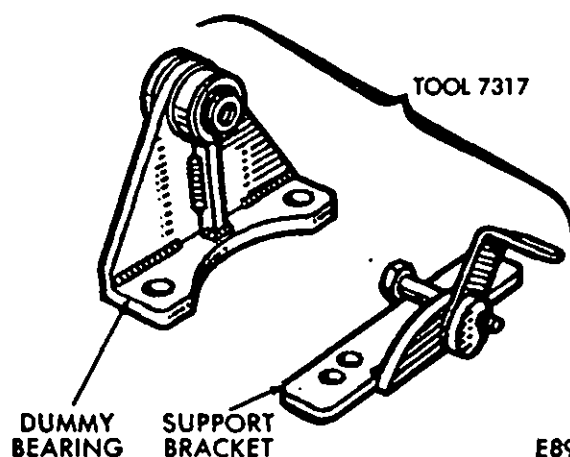
(6) Remove the spark plug wires from the spark plugs.

(7) Remove the distributor cap, rotor and dust shield.

(8) Turn the engine until the camshaft dowel pin is towards the top of the engine.

The timing chain must be held in place and not allowed to drop down when removing the cylinder head. If the chain and sprocket slip, the timing case cover must be removed and the timing chain tensioners released.

(9) Use tool 7317 to support the camshaft sprocket and chain while removing the cylinder head cover. The tool consists of a support bracket and a dummy bearing (Fig. 13).



E8909-271

Fig. 13—Camshaft Sprocket Support—Tool 7317

(10) Remove the bolt and adjusting lever from the bracket(s). Place the bracket on top of the timing case cover. Use two cylinder head cover bolts to mount it.

(11) Thread the adjusting lever bolt through the bracket(s), the sprocket and into the adjusting lever, finger tight.

(12) Pull the adjusting lever up tight. Tighten the adjusting lever bolt.

(13) Loosen the camshaft thrust plate bolt. Pull the thrust plate up and away from the camshaft. Tighten the camshaft thrust plate bolt (Fig. 14).

(14) Remove the timing case cover to cylinder head mounting bolts.

(15) Place a socket or wrench on the crankshaft pulley nut to prevent the engine from turning over.

(16) Loosen the camshaft sprocket bolt (D).

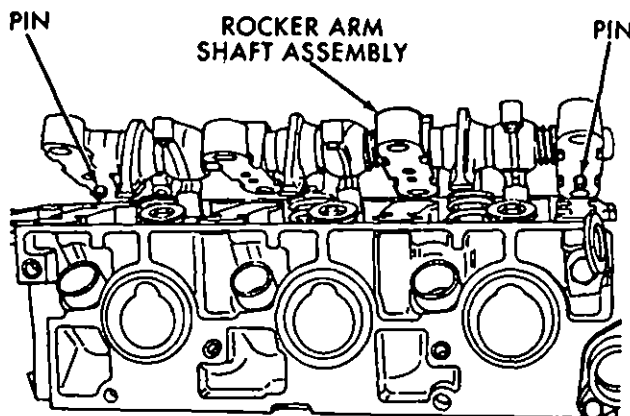
(17) Loosen and remove the cylinder head bolts. Remove the rocker shaft assembly (note that the caps are pinned into the head and will only go on in one direction) (Fig. 15).

(18) Position one head bolt into a middle bolt hole. Tighten the bolt 2 turns.

(19) Use an old push rod or a long thin drift punch as a tool and insert it into the front and rear cylinder head bolt holes on the exhaust manifold side of the head (Fig. 16). Tap the dowels down below the head gasket.

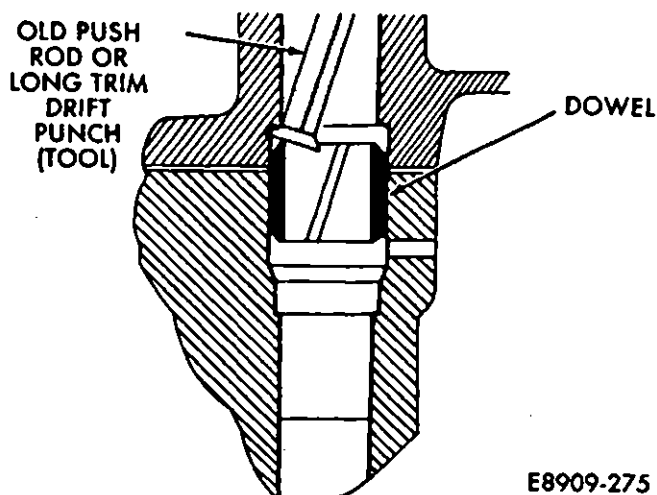
Do not lift/pry the cylinder head straight up. This can cause the cylinder to pull up and out of the block.

(20) Place a piece of wood against the cylinder head and strike it with a hammer. Repeat on all



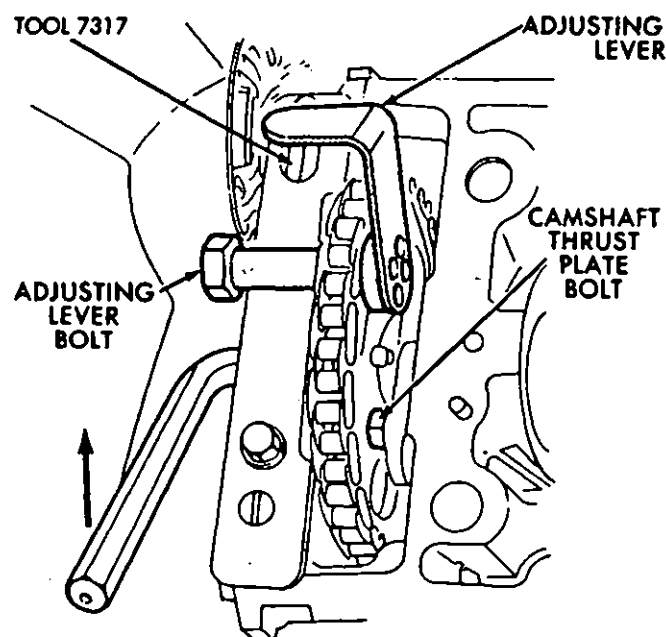
E8909-274

Fig. 15—Rocker Arm Shaft Assembly



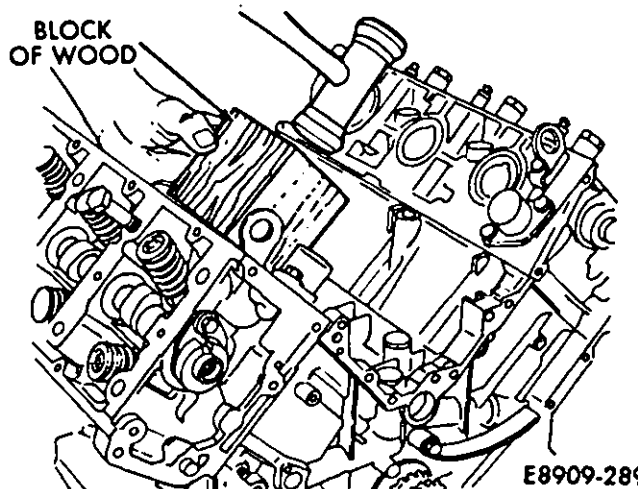
E8909-275

Fig. 16—Tap Dowel into Block



E8909-272

Fig. 14—Positioning Tool 7317



E8909-289

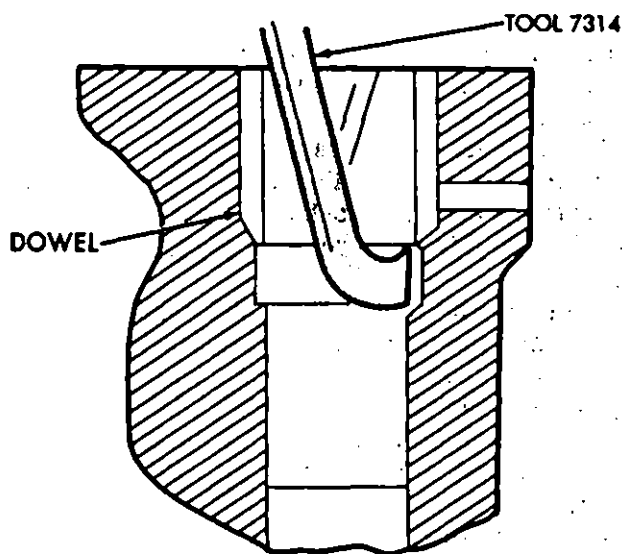
Fig. 17—Cylinder Head Removal

sides of the cylinder head until the head is loose (Fig. 17).

(21) Remove the cylinder head bolt.

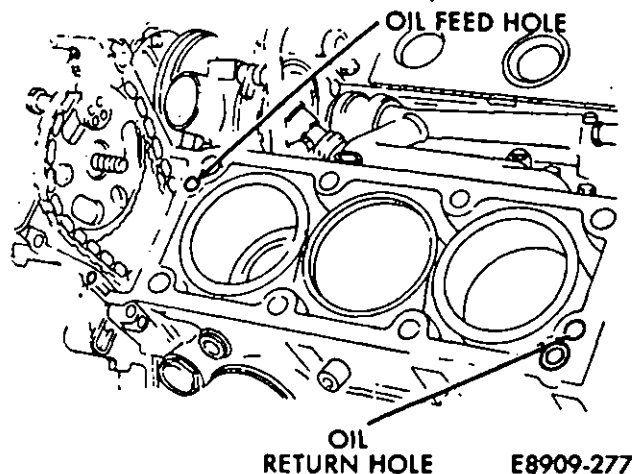
(22) Remove the cylinder head.

- (23) Remove the cylinder head gasket.
 - (24) Use tool 7314 to remove the cylinder head locating dowels (Fig. 18).
 - (25) Stuff the cylinder bores with clean lint free shop towels.
 - (26) Install cylinder liner clamps (Tool 7315) to hold the liners in place.
 - (27) Use a gasket removal compound to soften the old gasket material.
- CAUTION:** When cleaning the cylinder head and block mating surfaces, do not use a metal scraper because the surfaces could be cut or ground. Instead, use a wooden or plastic scraper.
- (28) Make sure that gasket and/or foreign material does not enter the oil feed hole or the oil return hole (Fig. 19).



E8909-276

Fig. 18—Dowel Extractor Tool—7314



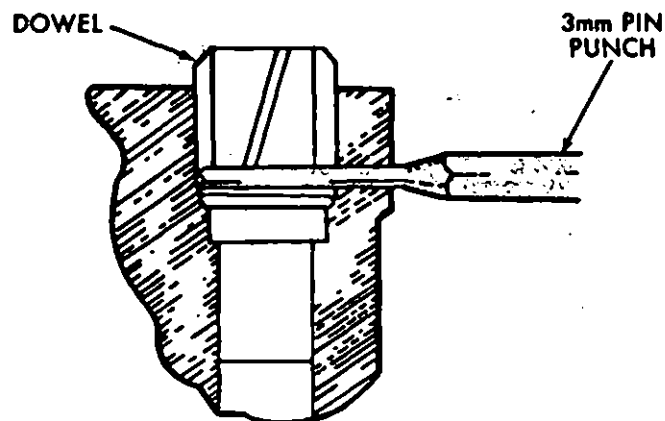
E8909-277

Fig. 19—Oil Feed and Return Holes

- (29) Rinse and wipe clean the cylinder block and cylinder head mating surfaces.
- (30) Check the liner protrusion. The liner protrusion should be between 0.05 mm and 0.12 mm (.002 in and .005 in). Refer to Cylinder Liner—Piston—Connecting Rod Section for the proper procedure.

Installation—Left Side

- (1) Cut the timing case cover gasket flush with the cylinder head gasket face.
- (2) Cut sections from the new gaskets and apply a thin bead of weather strip adhesive to them. Attach them to the timing case cover. Allow to dry.
- (3) Install 3 mm pin punches into the holes in the block below the locating dowel bolt holes (Fig. 20). Push the dowels in the holes until they contact the 3 mm pin punches.
- (4) Remove the shop towels from the cylinder bores.
- (5) Install a new cylinder head gasket over the alignment dowels.
- (6) Place a thin strip of MOPAR Gasket-in-a-Tube Sealer, or equivalent, where the cylinder head gasket contacts the timing case cover gasket.
- (7) Install the cylinder head, taking care not to dislodge the timing case cover gasket.
- (8) Insert the timing case cover to cylinder head mounting bolts and tighten them finger tight.
- (9) Position the camshaft into the sprocket. Line up the dowel to the slot in the camshaft. Install the sprocket bolt and lightly tighten it.
- (10) Remove bracket assembly (Tool 7317).
- (11) Loosen the camshaft thrust plate bolt and slide the plate into the groove in the cylinder head. Tighten the bolt to 12 N·m (9 ft-lbs) torque.
- (12) Remove the 3 mm pin punches.
- (13) Install the rocker shaft assembly and the cylinder head bolts.



E8909-278

Fig. 20—Locating Dowel

(14) Tighten the cylinder head bolts in the sequence shown (Fig. 21).

(15) Starting with bolt No. 1, pre-tighten all bolts to 60 N·m (44 ft-lbs) torque.

(16) The following is performed on all bolts, one bolt at a time.

(a) Starting with bolt No.1, loosen the bolt completely.

(b) Tighten bolt No. 1 to 40 N·m (30 ft-lbs) torque.

(c) Place the graduated disc (Tool 7321) between the socket and the torque wrench (Fig. 22).

(d) Turn the graduated disc clockwise until the locking stem rests against a solid object which will prevent the disc from turning.

(e) Angle tighten bolt No. 1 to $180^\circ \pm 20^\circ$

(f) Repeat the procedure for all bolts in the above sequence.

(17) Tighten the timing case cover bolts to 12 N·m (9 ft-lbs) torque.

(18) Tighten the camshaft sprocket bolt to 80 N·m (59 ft-lbs) torque.

(19) Cut off any timing case cover gasket flush with the cylinder head.

(20) Install the cylinder head cover(s), exhaust manifold(s) and intake manifold.

(21) Install the distributor cap/rotor/dust shield.

(22) Install the spark plug wires.

(23) Fill and bleed the cooling system (refer to Group 7, Cooling System, for the proper procedure).

(24) Connect the battery negative cable.

CYLINDER HEAD—(ENGINE REMOVED)

This procedure should be used when the engine is removed from the vehicle.

Removal

(1) Remove the cylinder head covers.

(2) Remove the timing case cover, timing chains and camshaft sprockets.

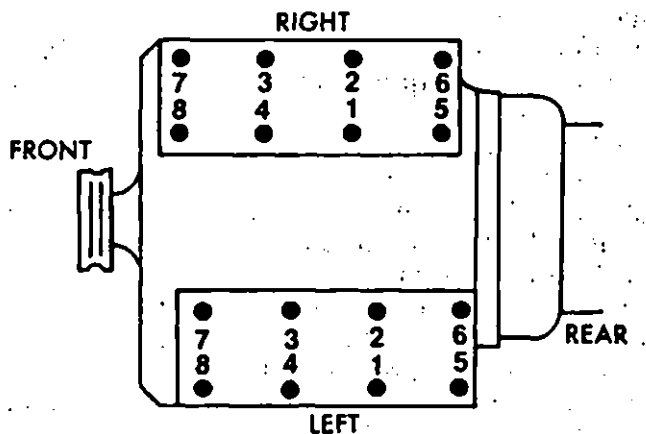
CAUTION: Never use an air impact gun to remove the cylinder head bolts. Damage may result to the threads in the aluminum cylinder block.

(3) Use hand tools to remove the cylinder head bolts.

(4) Remove the rocker arm shaft assembly from the cylinder head. Note that pins in the bottom of front and rear pedestals index the assembly to cylinder head (Fig. 1).

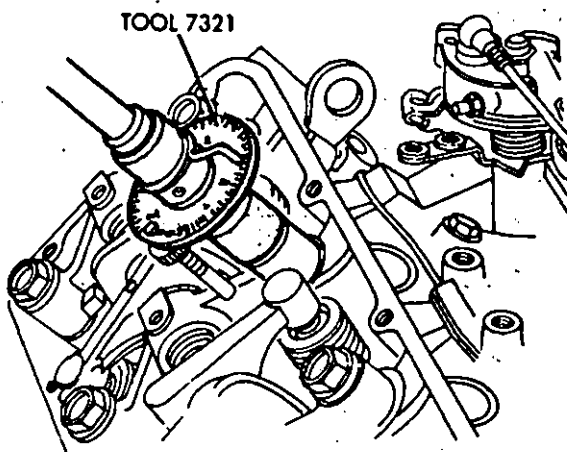
(5) Use an old push rod or a long thin drift punch as a tool and insert it into the front and rear cylinder head bolt holes on the exhaust manifold side of the head (Fig. 2). Tap the dowels down below the head gasket.

Do not lift/pry the cylinder head straight up, this will cause the cylinder liners to come up and out of the block.



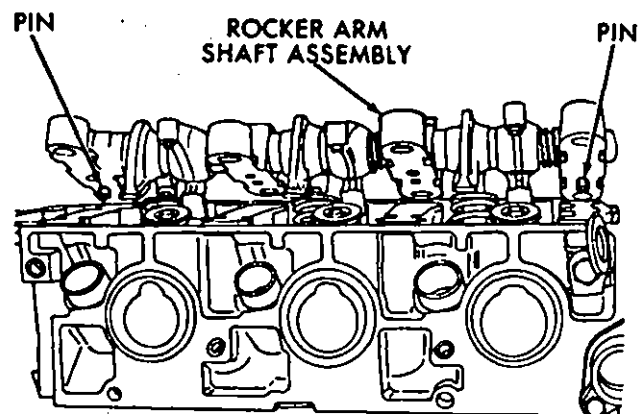
9009-95

Fig. 21—Cylinder Head Bolt Tightening Sequence



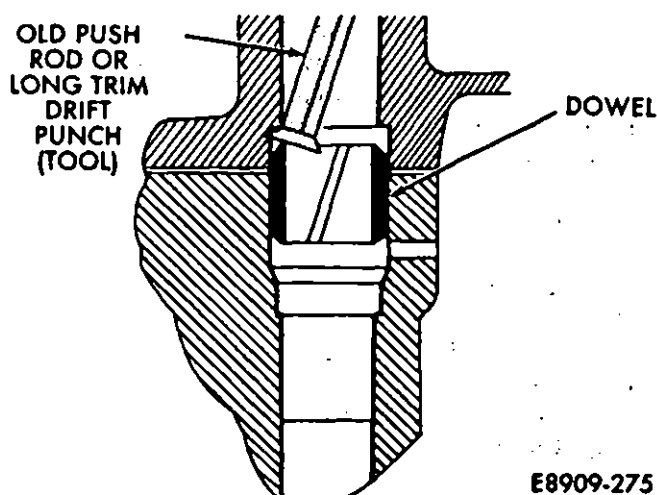
E8909-280

Fig. 22—Graduated Disc for Angular Tightening



E8909-274

Fig. 1—Rocker Arm Shaft Assembly



E8909-275

Fig. 2—Tap Dowel Into Block

(6) Install one cylinder head bolt into a center hole to hold the cylinder head in place.

(7) Position a small piece of wood against the rear intake manifold side of the cylinder head and strike it with a hammer (Fig. 3). Now position the piece of wood against the front exhaust manifold side of the cylinder head and strike it with a hammer. Repeat until the cylinder head is loose.

(8) Remove the cylinder head bolt.

(9) Remove the cylinder head.

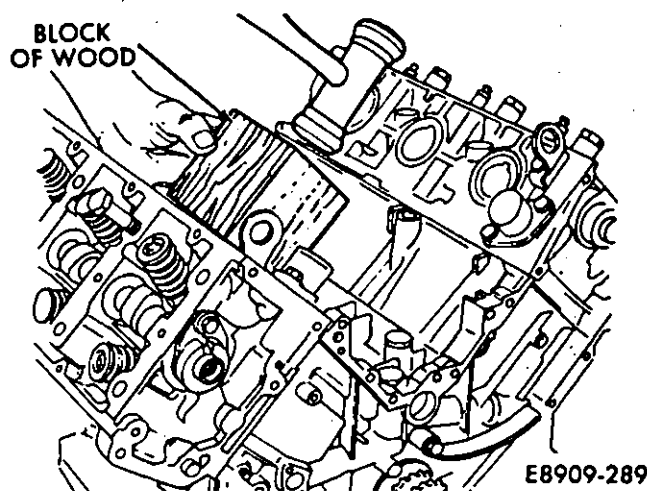
(10) Remove the cylinder head gasket.

(11) Use a gasket removal compound to soften the old gasket material.

CAUTION: When cleaning the cylinder head and block mating surfaces, do not use a metal scraper because the surfaces could be cut or grooved. Instead, use a wooden or plastic scraper.

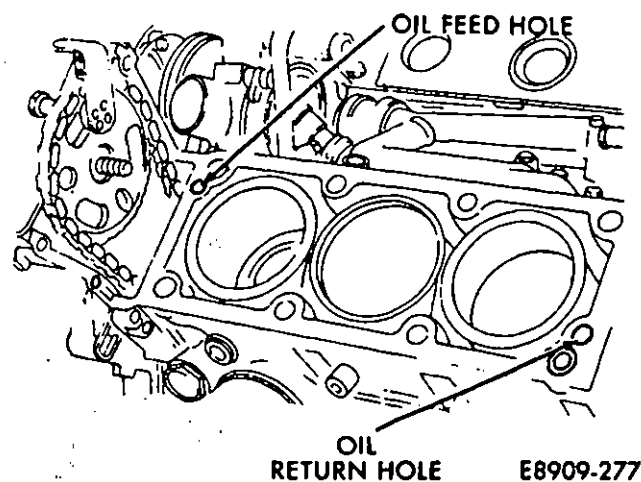
(12) Make sure that gasket and/or foreign material does not enter oil feed hold or oil return hole (Fig. 4).

(13) Rinse and wipe clean the cylinder block and cylinder head mating surfaces.



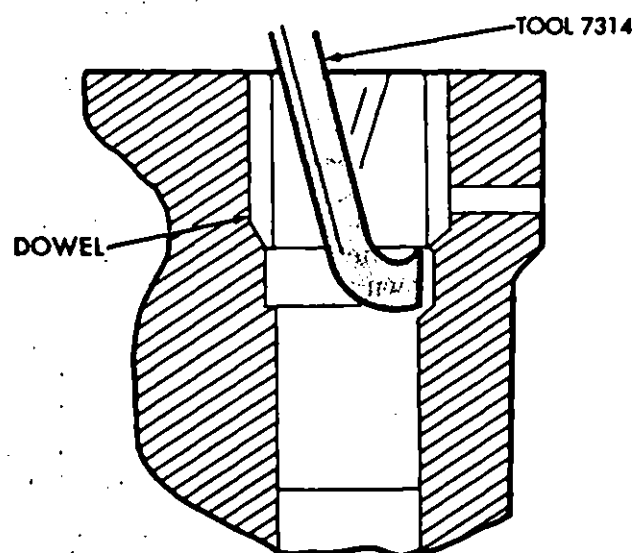
E8909-289

Fig. 3—Cylinder Head Removal



E8909-277

Fig. 4—Oil Feed and Return Holes



E8909-276

Fig. 5—Dowel Extractor Tool—7314

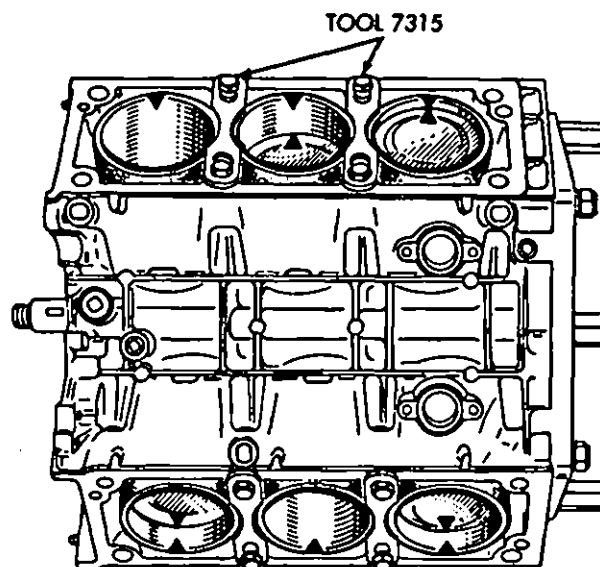
(14) Use Tool 7314 to remove the cylinder head locating dowels (Fig. 5).

(15) Install liner clamps (Tool 7315) between the cylinder liners to hold them in place (Fig. 6).

Installation

The cylinder head gaskets are not identical. The left hand gasket has a larger cut out at the front than the right hand gasket (Fig. 7).

(1) Pull the cylinder head dowels up using extractor (Tool 7314)—(Fig. 5).



E8909-281

Fig. 6—Liner Clamps

(2) Install 3 mm pin punches into the holes in the block below the locating dowel (Fig. 8). Push the dowels down until they contact the pin punches.

(3) Rotate the crankshaft until the keyway slot is pointing straight up (Fig. 9). This will position the No. 1 piston below top dead center (TDC) and prevent contact between pistons and valves.

(4) Remove the liner clamps (Tool 7315) from the left cylinder head (Fig. 9).

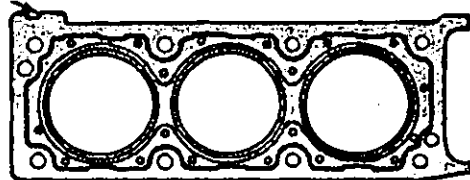
(5) Install dry, a new cylinder head gasket to the left cylinder bank.

(6) Turn the engine on the engine stand until the left bank points straight up.

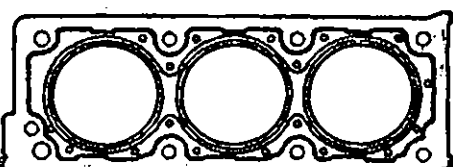
(7) Position the left cylinder head over the new head gasket.

I.D. NOTCH

LEFT



RIGHT



I.D. NOTCH

9009-96

Fig. 7—Cylinder Head Gaskets

(8) Turn the left camshaft until the slot in the front is positioned as shown in (Fig. 10).

(9) Install the rocker arm shaft. Note that the pins in the bottom of the front and rear pedestals index the assembly to the cylinder head (Fig. 11).

(10) Remove the 3 mm pin punches.

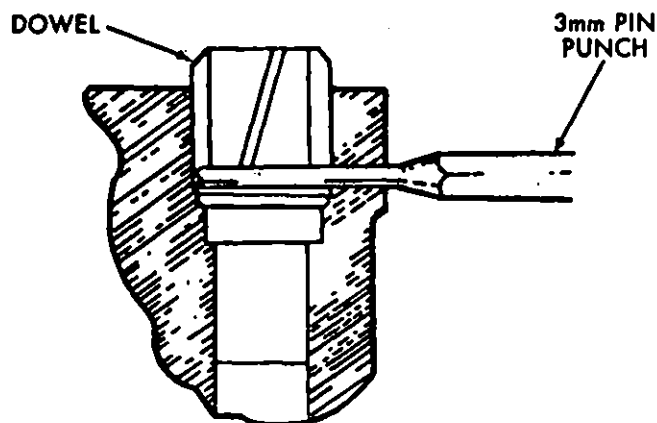
(11) Lightly oil the threads and install the cylinder head bolts.

(12) Starting with bolt No. 1, pretighten all bolts in sequence to 60 N·m (44 ft-lbs) torque (Fig. 12).

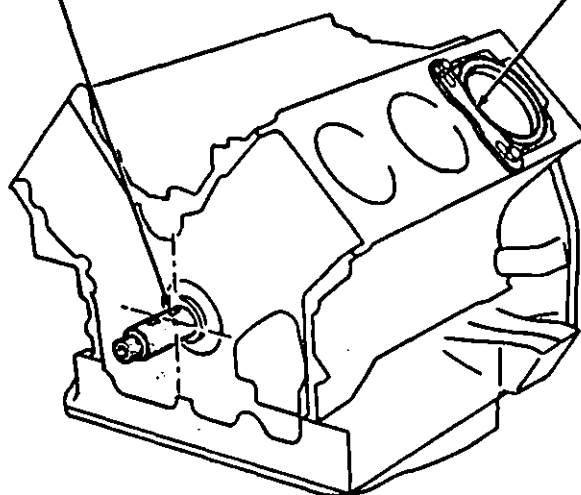
(13) The following procedure is performed on all bolts, one bolt at a time.

(a) Starting with bolt No. 1, loosen the bolt completely.

(b) Tighten bolt No. 1 to 40 N·m (30 ft-lbs) torque.



E8909-278

Fig. 8—Locating DowelKEYWAY
SLOTLINER
CLAMP

E8909-283

Fig. 9—Position of Keyway Slot/Liner Clamps

(c) Place the graduated disc (Tool 7321) between the socket and the torque wrench (Fig. 13).

(d) Turn the graduated disc clockwise until the locking stem rests against a solid object which will prevent the disc from turning.

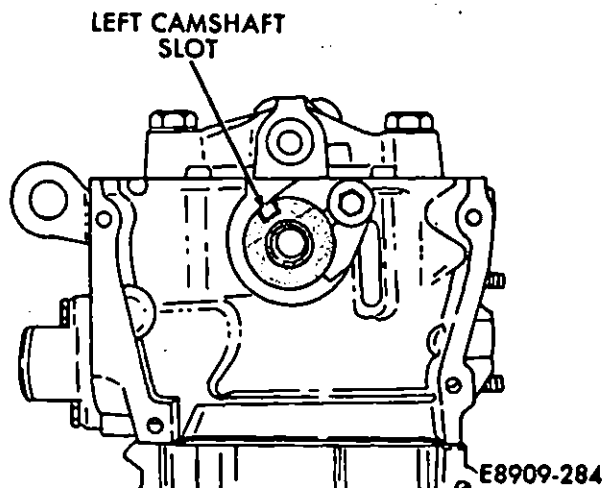


Fig. 10—Position of Left Camshaft Slot

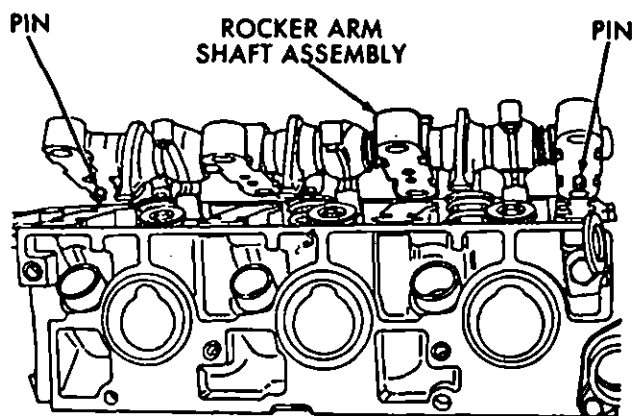


Fig. 11—Rocker Arm Shaft Assembly

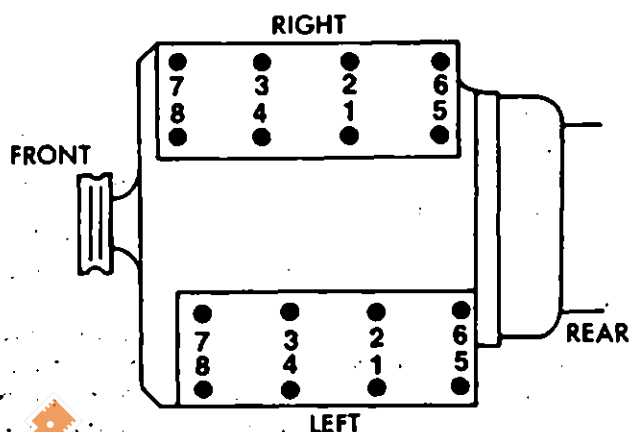


Fig. 12—Cylinder Head Bolt Tightening Sequence

(e) Angle tighten bolt No. 1 $180^\circ \pm 20^\circ$.

(f) Repeat the procedure for all bolts in the above sequence (Steps a-e).

(14) Turn the engine on the stand until the right bank points up.

(15) Pull the cylinder head dowels up using extractor (Tool 7314).

(16) Remove the cylinder liner clamps from the right bank.

(17) Install 3 mm pin punches into the holes in the block below the locating dowels. Push the dowels down until they contact the pin punches.

(18) Install dry, a new cylinder head gasket to the right cylinder head.

(19) Position the right cylinder head over the new head gasket.

(20) Turn the right camshaft until the slot in the front is positioned as shown in (Fig. 14).

(21) Install the rocker arm shaft. Note that the pins in the bottom of the front and rear pedestals index the assembly into the cylinder head (Fig. 8).

(22) Remove the 3 mm pin punches.

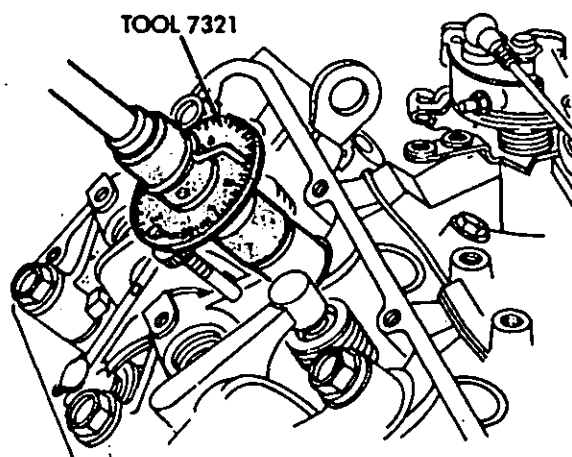


Fig. 13—Graduated Disc for Angular Tightening

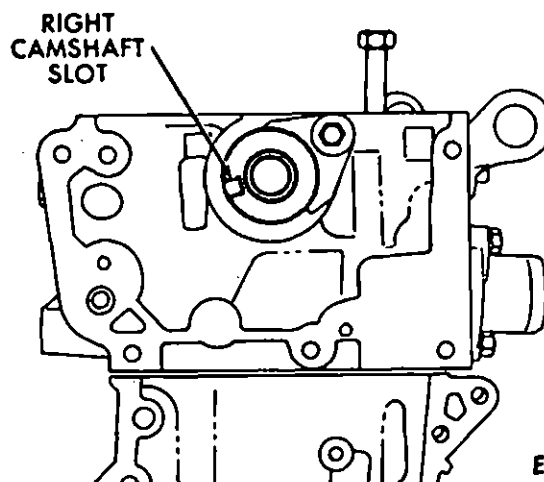


Fig. 14—Position of Keyway Slot

(23) Lightly oil the threads and install the cylinder head bolts.

(24) Starting with bolt No. 1, pretighten all bolts in sequence to 60 N·m (44 ft-lbs) torque (Fig. 12).

(25) The following procedure is performed on all bolts, one bolt at a time.

(a) Starting with bolt No. 1, loosen the bolt completely.

(b) Tighten bolt No. 1 to 40 N·m (30 ft-lbs) torque.

(c) Place the graduated disc (Tool 7321) between the socket and the torque wrench (Fig. 13).

(d) Turn the graduated disc clockwise until the locking stem rests against a solid object which will prevent the disc from turning.

(e) Angle tighten bolt No. 1 $180^\circ \pm 20^\circ$.

(f) Repeat the procedure for all bolts in the above sequence (Steps a-e).

VALVE AND VALVE SPRINGS

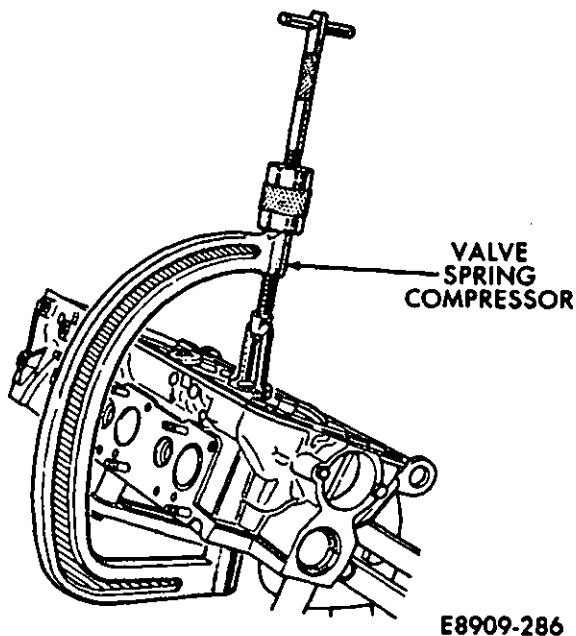
Removal

(1) Remove the cylinder head.

(2) Use a valve spring compressor to compress the valve spring (Fig. 1).

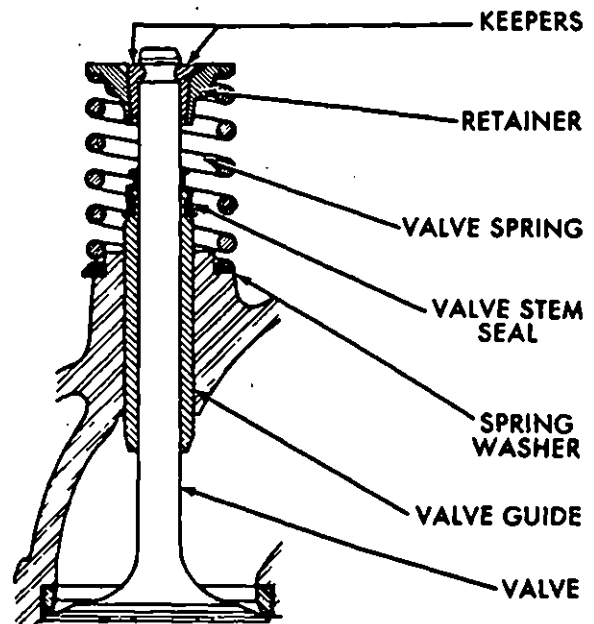
(3) Remove the keepers, retainers, valve springs, spring washers and lay them out in the order that they were removed (Fig. 2).

(4) Check the valve keeper groove in the top of the valve stem for burrs prior to removing the valves. If burrs are found remove them with a jewelers file. Failure to remove the burrs will cause damage to the valve guide when the valve is removed.



E8909-286

Fig. 1—Valve Spring Compressor



E8909-287

Fig. 2—Valve Components

VALVE GUIDES

NORMAL (NO GROOVES) — 13.0 mm (0.512 in.)

REPAIR (TWO GROOVES) — 13.35 mm (0.526 in.)

E8909-292

Fig. 3—Valve Guide Repair

(5) Use a grease pencil to mark the bottom of the valve with its cylinder number.

(6) Remove the valve from the guide and place it with the corresponding valve spring, keepers, retainer and spring washer (Fig. 2).

(7) Remove the valve stem seal from the top of the valve guide (Fig. 2).

Valve Guides

There is one repair size valve guide available. The repair guide outside diameter (size) can be identified by the number of grooves on the outside of the guide (Fig. 3).

(1) Press the old valve guides out of the cylinder head. Do not install the same size guide as the one that was removed.

The new valve guide must be installed with a 0.10 mm (.0039 inch.) interference fit between the guide and the valve guide bore. The valve guide bores in the cylinder head must be machined to the appropriate diameter for the repair valve guide. The angle is 16.5° (Fig. 4).

(2) Press the intake valve guides in until the bottom of the valve guide is 30 mm (1.181 in) from the top of the valve seat (Fig. 4).

(3) Press the exhaust valve guides in until the bottom of the valve guide is 26mm (1.024 in) from the top of the valve seat (Fig. 4).

(4) After the new guides are installed, ream the valve guides to 8 mm (0.315 in) and then grind the valve seats. To insure proper sealing between the valve and valve seats, the valve seats must be ground after a new valve guide has been installed and reamed to 8 mm (0.315 in).

(5) Clean the cylinder heads. Remove all metal chips and grinding dust from the valve guides and combustion chambers.

Installation

(1) Prior to assembling the cylinder head, stick each valve into its appropriate guide and slowly move it in and out. The valve should slide without drag. If a drag is felt, check both the guide and valve stem for burrs.

(2) Using the correct tool, install the valve stem seals. There are two valve stem seal installers. Tool #6187 is silver in color and stamped INTAKE. Tool #6200 is gold in color and stamped EXHAUST (Fig. 5).

(a) Position the seal on the tool pilot (Fig. 5).

(b) Install the pilot into the top of the valve guide and gently push down.

(c) Use a rubber mallet to lightly tap on the top of the seal installer until the tool stops. Remove the tool from the valve guide.

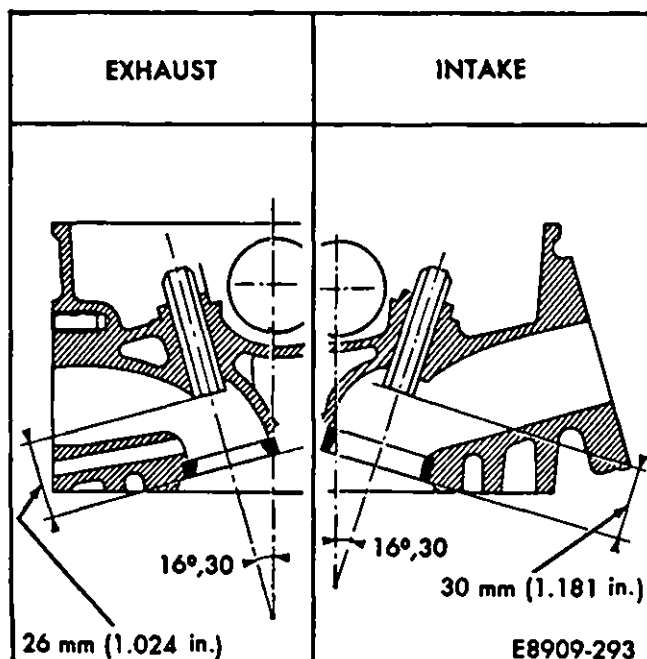


Fig. 4—Valve Guide Dimensions

(d) Lightly oil the valve guide stems and install them into the valve guides.

(3) Install spring washers, valve springs, retainers and keepers (Fig. 6).

ROCKER SHAFT

The left and right hand rocker shaft assemblies are identical and can be used on either cylinder head. When reusing rocker arm assemblies, always install them on the same cylinder head that they were removed from.

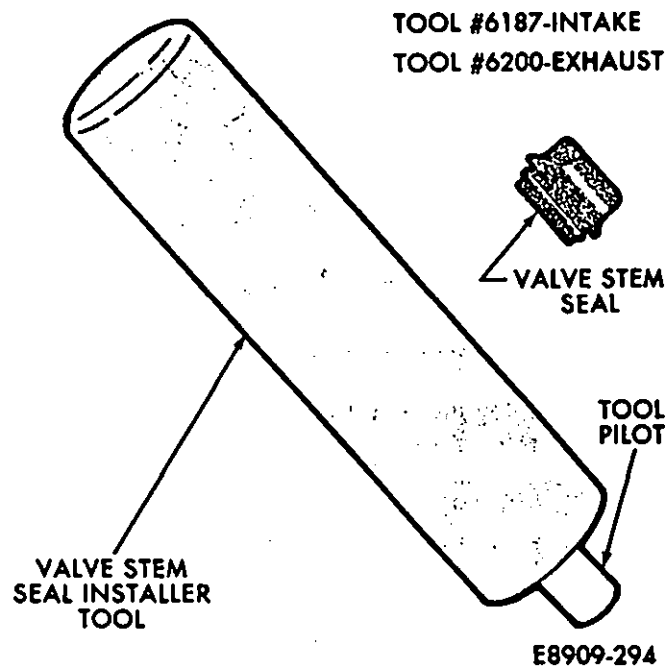


Fig. 5—Valve Stem Installer Tool

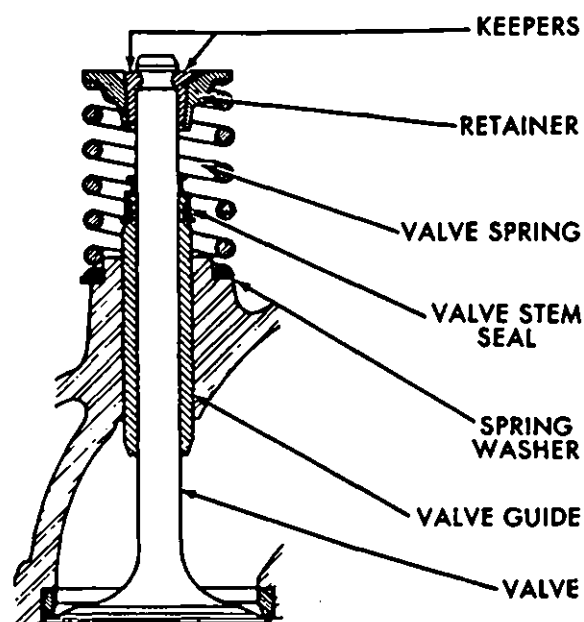


Fig. 6—Valve Components

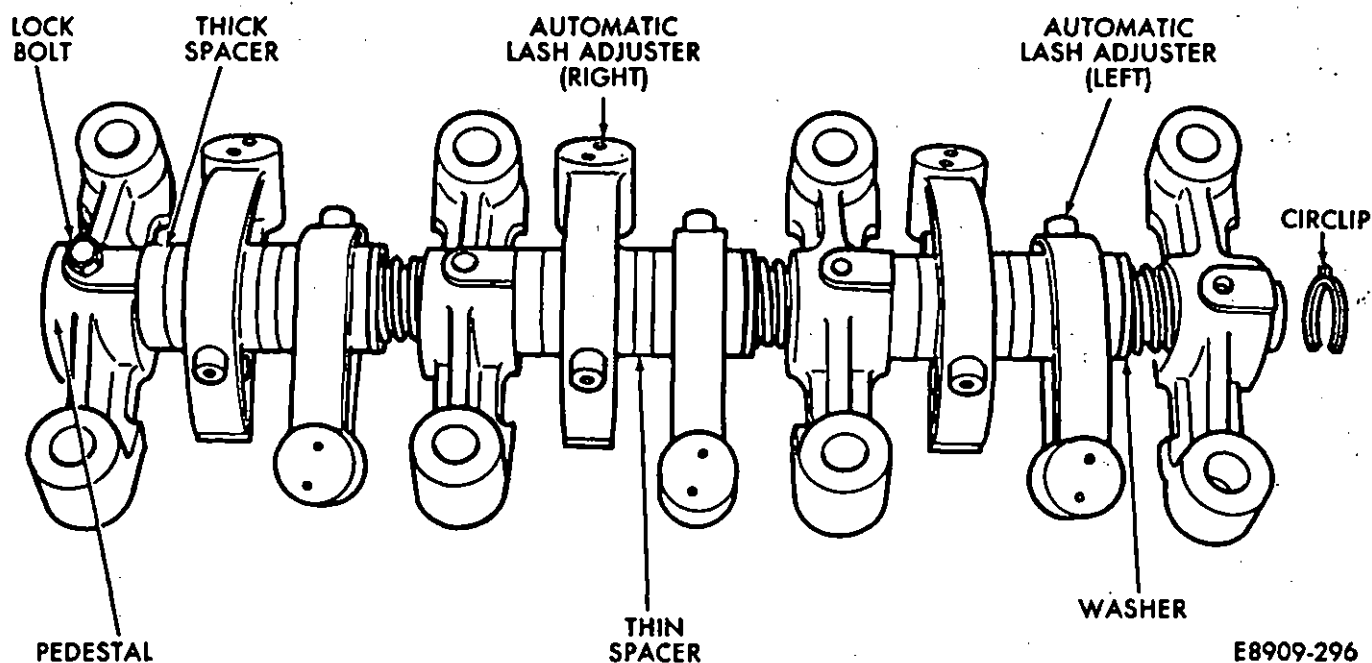


Fig. 7—Rocker Shaft Assembly

Disassembly

The oil galley plugs in the ends of the rocker shaft are pressed in and are not replaceable.

(1) When disassembling, arrange the parts in the order that they were removed. Remove the lock bolt and carefully remove in order (Fig. 7):

- Pedestal.
- Thick Spacer.
- Rocker arm with automatic lash adjuster on the right.
- Thin spacer.
- Rocker arm with automatic lash adjuster on the left.
- Spring.

(2) Remove the circlip from the end of the rocker shaft.

Assembly

(1) The rocker shaft can be installed only one way. There are two holes in the one end of the rocker shaft (top and bottom). The larger hole is at the top. This hole lines up with the set bolt when screwed into the end pedestal. The lock bolt will not fit into the smaller (bottom) hole. The circlip fits onto the other end of the shaft.

The oil feed holes in the rocker shaft must be clean and unplugged to ensure that oil travels to the rocker arm, automatic lash adjuster and the camshaft.

(2) When assembling, be sure that the flat machined surface of the pedestal faces the circlip (Fig. 8).

(3) Lightly coat the rocker shaft with clean engine oil.

(4) Assemble the rocker shaft in the correct order. Insert the lock bolt and tighten it to 6 N·m (53 in-lbs) torque.

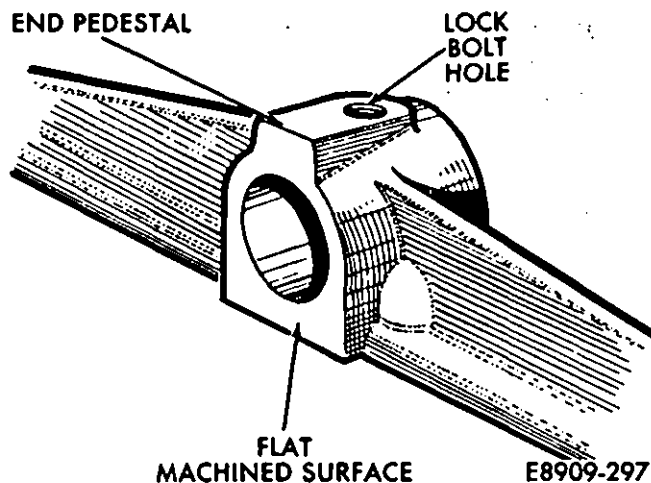


Fig. 8—Flat Machined Surface of Pedestal

HYDRAULIC TAPPET AND ROCKER ARM

A hydraulic tappet is located in each rocker arm. The tappet is in constant contact with the top of the valve stem and is nonadjustable. The rocker arms are serviced with lash adjusters. Valve lash is always zero. Oil pumped through the rocker shaft reaches the tappet through a passage in the rocker arm. The oil passes under slots in the tappet thrust washer and into the tappet body. Air and oil are bled off through two small holes above the thrust washer. A squirt

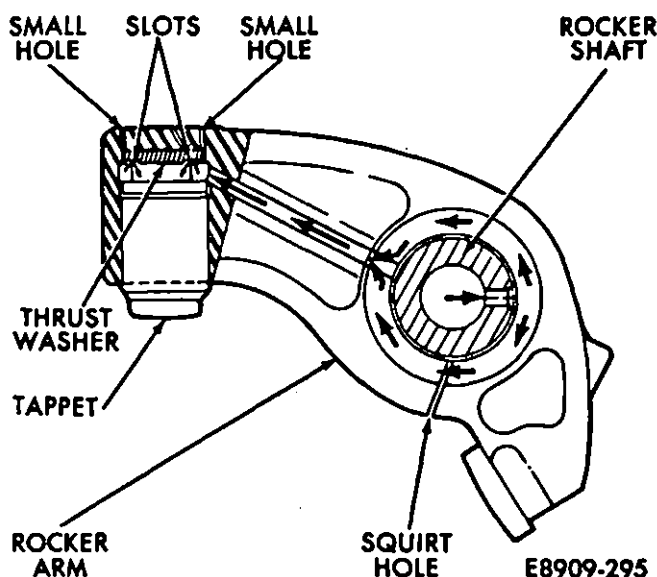


Fig. 9—Hydraulic Tappet and Rocker Arm

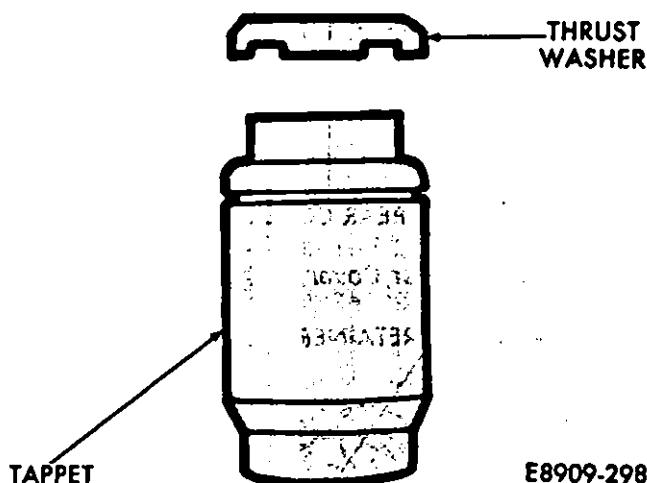


Fig. 10—Thrust Washer

hole lubricates the camshaft lobe (Fig. 9).

Disassembly

- (1) Disassemble the rocker shaft assembly.
- (2) Remove the tappet from the rocker arm (Fig. 9).
- (3) Remove the thrust washer (Fig. 10).
- (4) Use a straight edge to check the bottom of the tappet for a crown. If the tappet is worn flat or dished, replace it.
- (5) Check the oil squirt hole in the rocker arm for blockage (Fig. 11). Use compressed air to clean out any blockage.
- (6) Check the cam follower pad of the rocker arm for wear (Fig. 11). If the pad is flat and does not have a crown, replace the rocker arm and check the accompanying camshaft lobe for wear.
- (7) Clean the rocker arms. Use compressed air

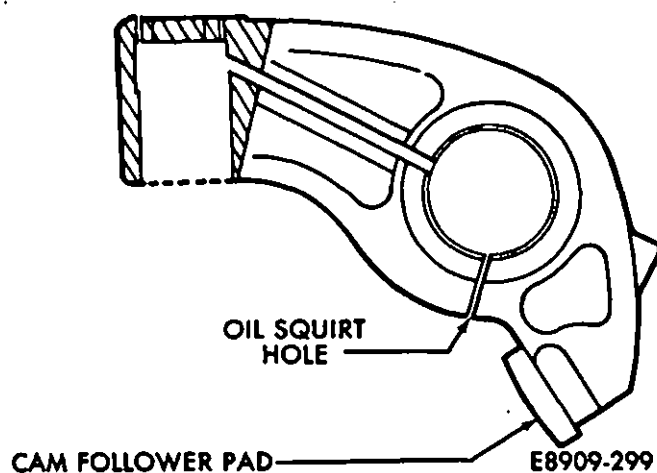


Fig. 11—Oil Squirt Hole/Cam Follower Pad

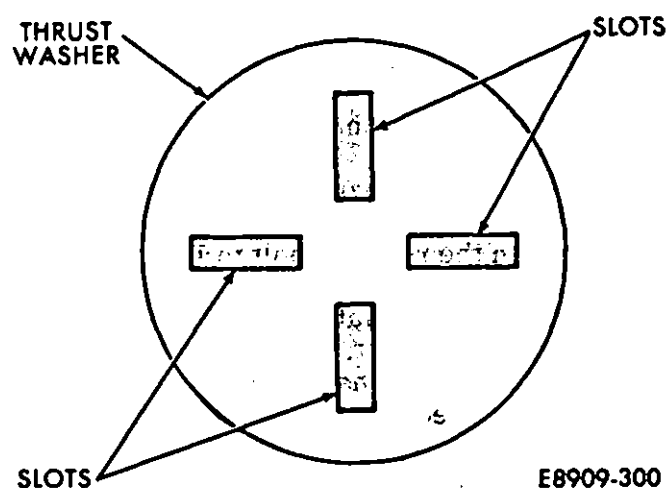


Fig. 12—Slots Face Tappet

to clean out the oil passage from the rocker shaft bore to the tappet bore and the oil squirt hole.

Assembly

- (1) Lightly coat the tappet, thrust washer and tappet bore with clean engine oil.
CAUTION: When installing the thrust washer, the slots must face the tappet (Fig. 12). If the washer is installed incorrectly oil will not enter the tappet.
- (2) Install the thrust washer with the slots toward the tappet.
- (3) Install the tappet. The tappet may tend to fall out of the tappet bore. It may be necessary to use masking tape or tag wire to hold the tappet in place until the rocker shaft assembly is installed on the engine.

CAMSHAFTS

The right and left hand camshafts are not the same and cannot be interchanged. The camshafts can be identified by the location of the lobes.

On left-hand camshaft both lobes for each cylinder are on the same side (Fig. 13).

On right-hand camshaft the lobes for each cylinder are on opposite sides (Fig. 13).

The camshafts are removed and installed from the rear of the cylinder heads once they have been removed.

Removal

(1) Remove the cover at the rear of the cylinder head (Fig. 14).

(2) Loosen the camshaft retainer bolt and slide the retainer up and out of the groove in the camshaft (Fig. 15). Tighten the bolt.

(3) Slide the camshaft out the rear of the cylinder head.

(4) Replace any camshaft with worn lobes.

Installation

(1) Lubricate the camshaft journals with Jeep/Eagle Super Oil Conditioner.

(2) Install the camshaft from the rear of the cylinder head.

(3) Slide the retainer into the groove at the front of the camshaft.

(4) Tighten the retainer bolt to 12 N·m (9 ft-lbs) torque.

(5) Check the camshaft end play using a feeler gauge or dial indicator.

(a) Push the camshaft to the front.

(b) Insert a feeler gauge between the retainer and the front of the camshaft. Select a feeler gauge that drags as it is pulled through.

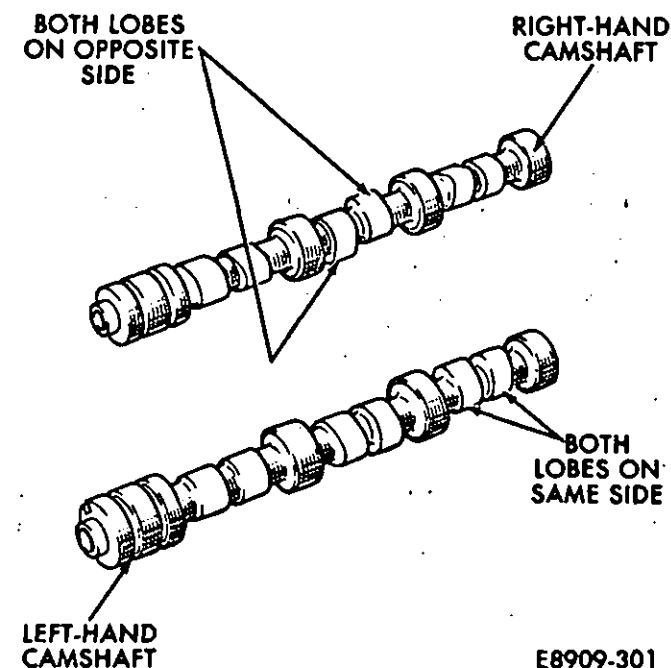


Fig. 13—Camshaft Identification

(c) The end play must be between 0.07 mm and 0.14 mm (.003 in and .0055 in.).

(6) Install the cover with a new gasket at the rear of the cylinder head. Coat the mounting bolt threads with Loctite 271 and tighten them to 6 N·m (53 in-lbs) torque.

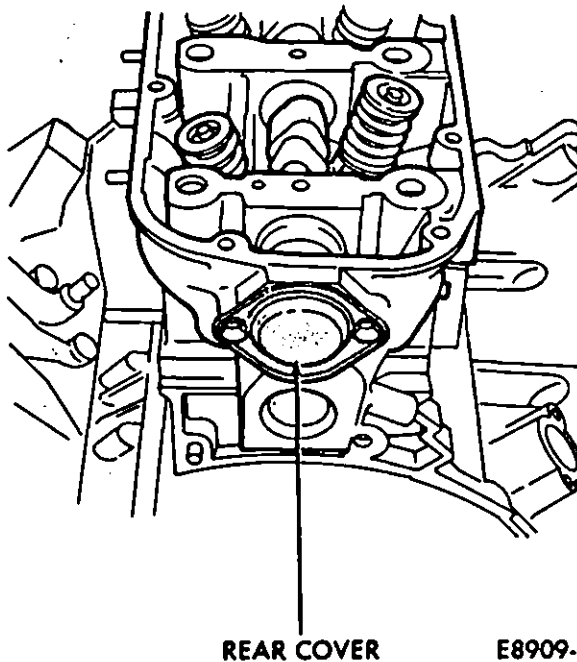


Fig. 14—Rear Cover of Cylinder Head

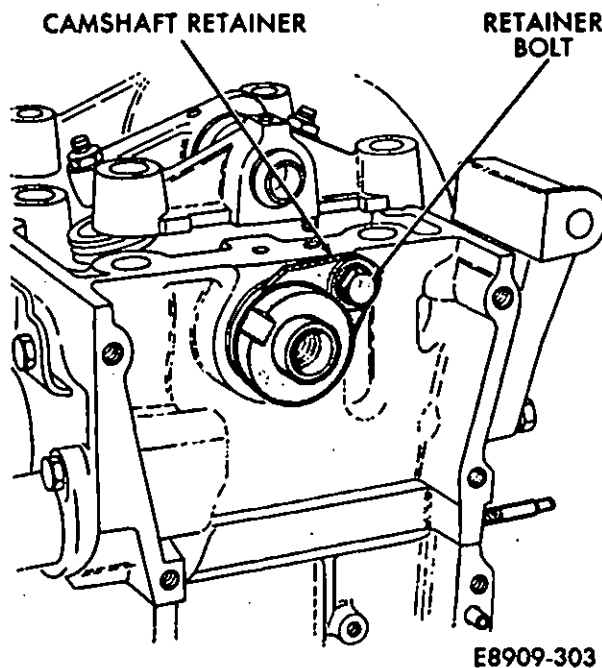


Fig. 15—Camshaft Retainer

WATER PUMP PULLEY

Refer to Group 7, Cooling System, for the proper procedure.

WATER PUMP

Refer to Group 7, Cooling System, for the proper procedure.

REAR CRANKSHAFT SEAL HOUSING

Removal

- (1) Remove the bolts from the lower casing (Fig. 1).
- (2) Remove seal housing mounting bolts (Fig. 1).
- (3) Remove the seal housing and gasket.
- (4) Push the old seal from the housing.

Installation

- (1) Use a new gasket and install the seal housing to the cylinder block.
- (2) Loosely install all bolts including the casing to seal housing bolts.
- (3) Tighten the seal housing to block bolts first. Then tighten the casing to seal housing bolts. Tighten the mounting bolts to 12 N·m (9 ft-lbs) torque.
- (4) Lightly oil the inner and outer edges of the new seal.
- (5) Place the new seal on seal installer (Tool 6482) (Fig. 2).
- (6) Install the new seal by gently tapping the end of Tool 6482 until the tool stops.
- (7) Remove Tool 6482 turning the tool while pulling it out.

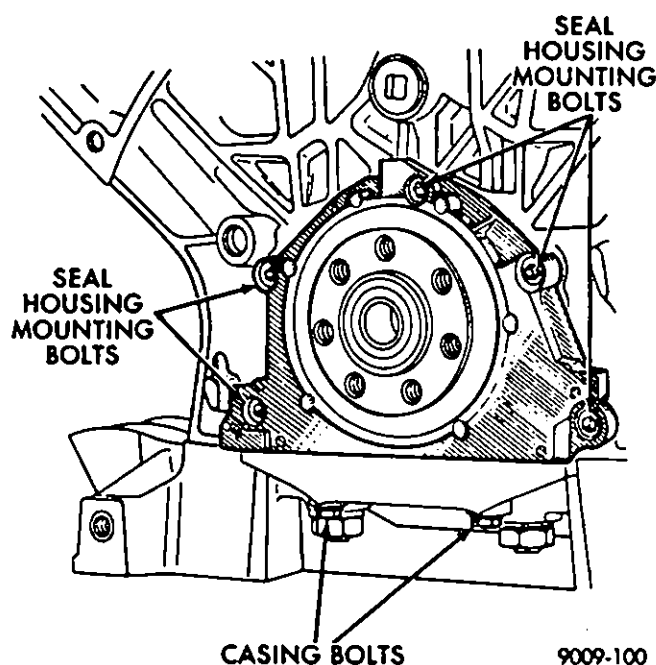


Fig. 1—Rear Crankshaft Seal Housing

CRANKSHAFT PULLEY/TIMING COVER

Removal—Crankshaft Pulley

- (1) With the crankshaft rear main seal housing removed, install crankshaft turning Tool 6072 at the flywheel end of the crankshaft (Fig. 3).

CAUTION: Do not use an impact air gun to remove the crankshaft nut.

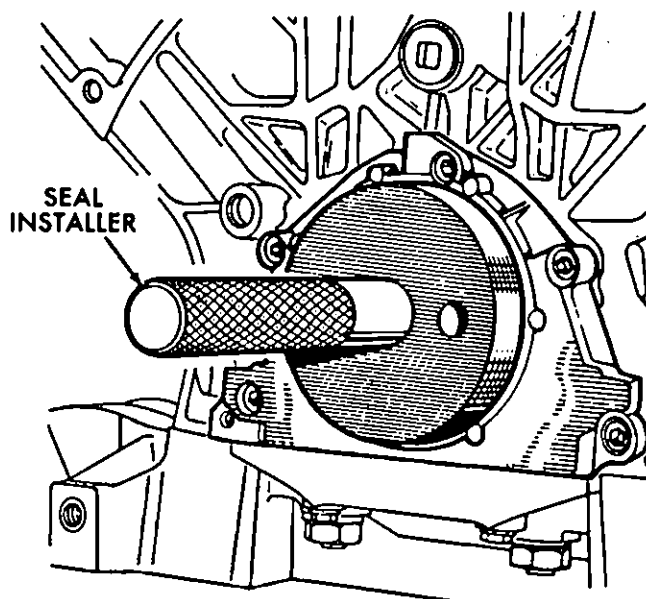


Fig. 2—Seal Installer Tool 6482

CRANKSHAFT TURNING TOOL

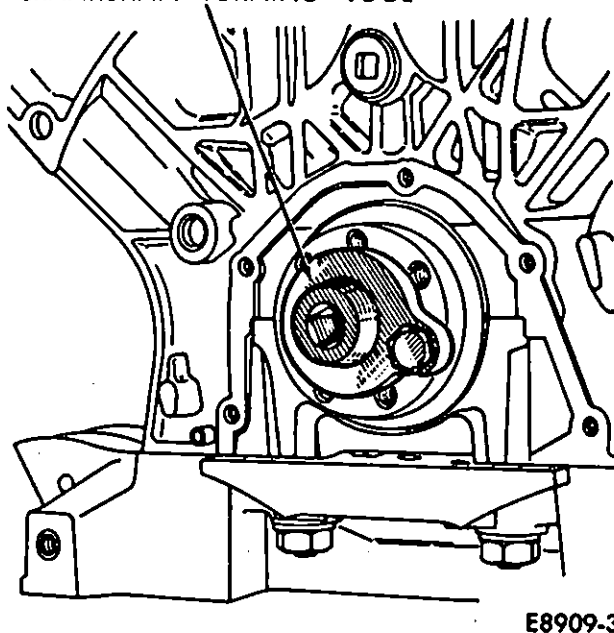


Fig. 3—Crankshaft Turning Tool 6072

(2) A thread lock is applied to the crankshaft pulley nut. Use a BRASS hammer and strike the nut prior to loosening. Remove the pulley nut.

(3) Check the position of the keyway slot (Fig. 4). The keyway slot must point straight up before removing the crankshaft pulley. The key could fall out of the crankshaft if the pulley is removed with the keyway facing down. If it does not point up, turn the crankshaft until it does.

(4) Pull the crankshaft pulley off the crankshaft (Fig. 4).

Removal—Timing Cover

(1) Remove the cylinder head covers.

(2) Hold the camshaft sprocket in place and remove the distributor drive/camshaft sprocket bolt.

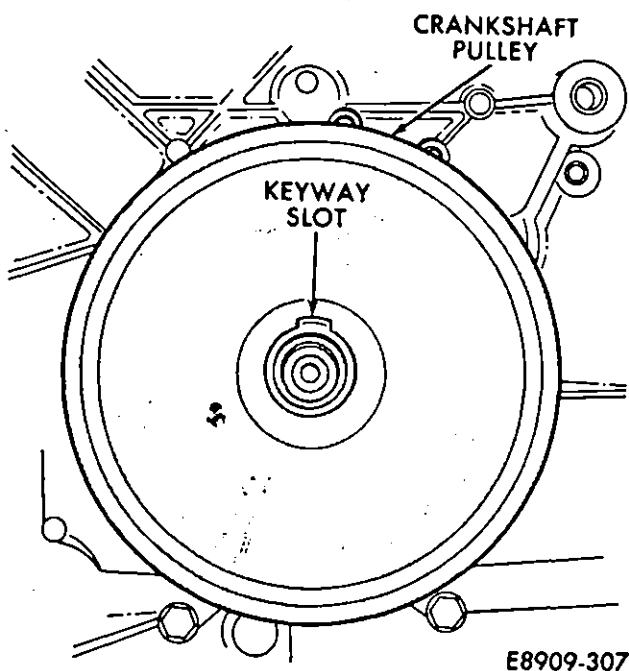


Fig. 4—Keyway Slot Position

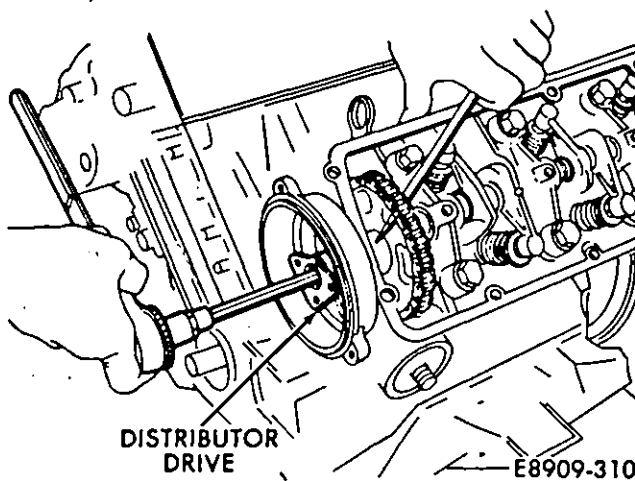


Fig. 5—Distributor Drive

(3) Pull distributor drive forward and off of the camshaft sprocket (Fig. 5).

(4) Remove the timing cover mounting bolt.

(5) Place a pry bar between the cylinder block and boss (Fig. 6) on the front cover and gently pry the cover off.

(6) Remove the gaskets.

Installation

(1) Rotate the crankshaft so that the keyway points up. This will prevent the key from falling into the oil pan.

(2) Put a small amount of Jeep/Eagle Gasket-in-a-Tube Sealer at the mating lines of the cylinder head and block and the lower casing to block.

(3) Install the timing cover with a new gasket over the alignment dowels (Fig. 7).

(4) Install the mounting bolts. On the four bottom bolts, apply Loctite 271 to the bolt threads (Fig. 8). Tighten all front cover bolts to 12 N·m (9 ft-lbs) torque.

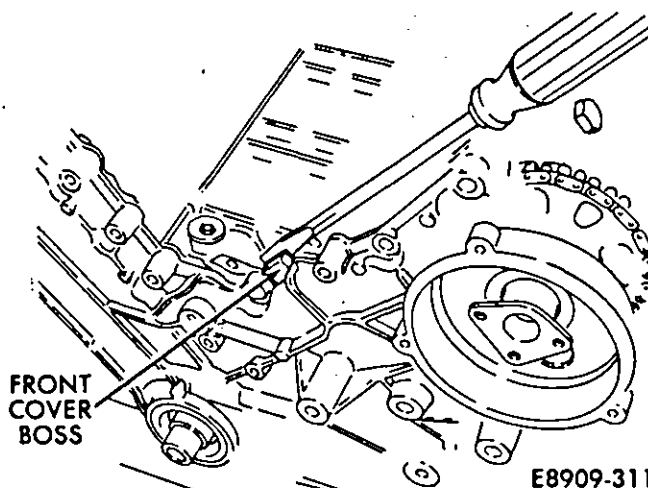


Fig. 6—Cylinder Block and Front Cover Boss

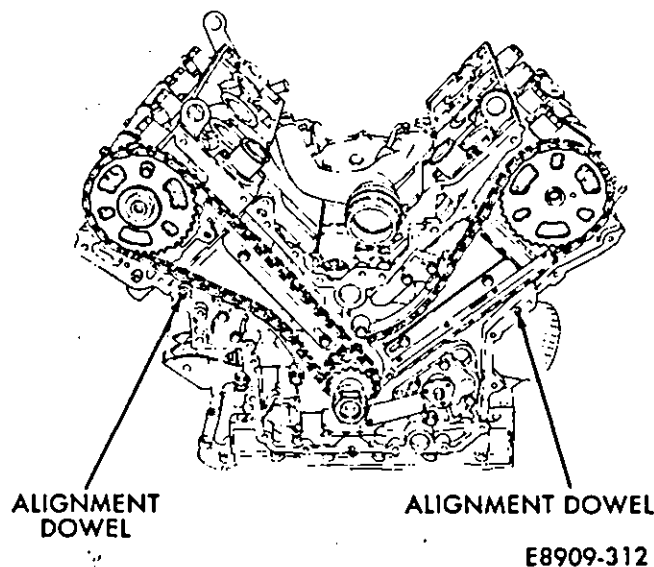


Fig. 7—Alignment Dowels

(5) Install the distributor drive/left camshaft sprocket mounting bolt. Tighten the bolt to 80 N·m (59 ft-lbs) torque.

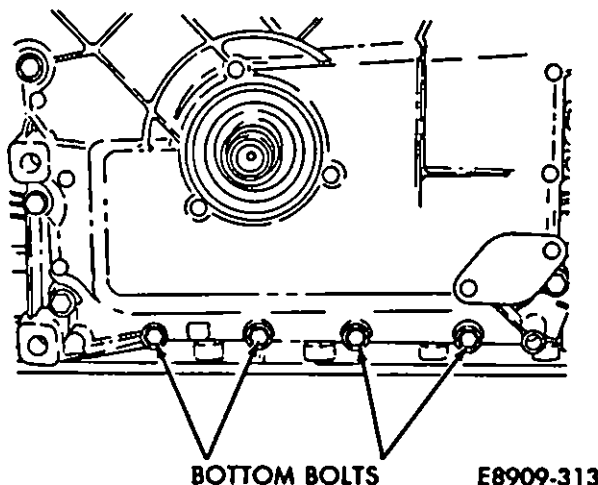


Fig. 8—Loctite 271 on Bottom Bolts

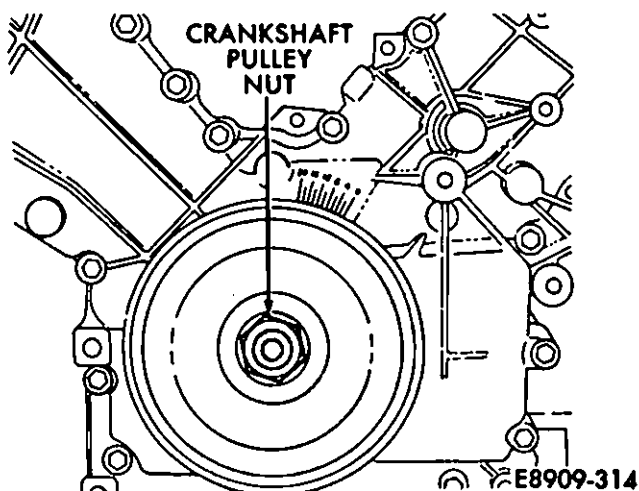


Fig. 9—Loctite 271 on Crankshaft Pulley Nut

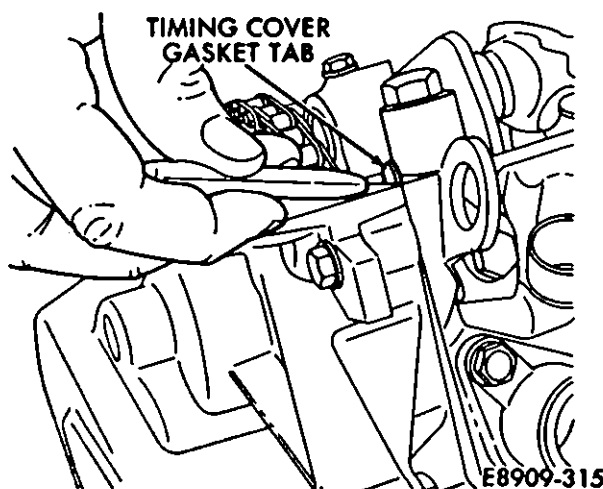


Fig. 10—Timing Cover Gasket Tab

(6) Install the crankshaft pulley. Apply Loctite 271 to the threads of the crankshaft pulley nut (Fig. 9). Tighten the nut to 180 N·m (133 ft-lbs) torque.

(7) Cut the timing cover gasket tabs flush with the head (Fig. 10). The tabs protrude above the front cover and cylinder head.

FRONT CRANKSHAFT OIL SEAL REPLACEMENT

If the front cover is off of the engine, use a socket to push the old seal out of the cover.

If the cover is attached to the engine, use a screwdriver (Fig. 11) and carefully pry the seal out of the cover taking care not to damage the seal locating bore.

Lightly oil the new seal and install it using Tool 6077 (Fig. 12).

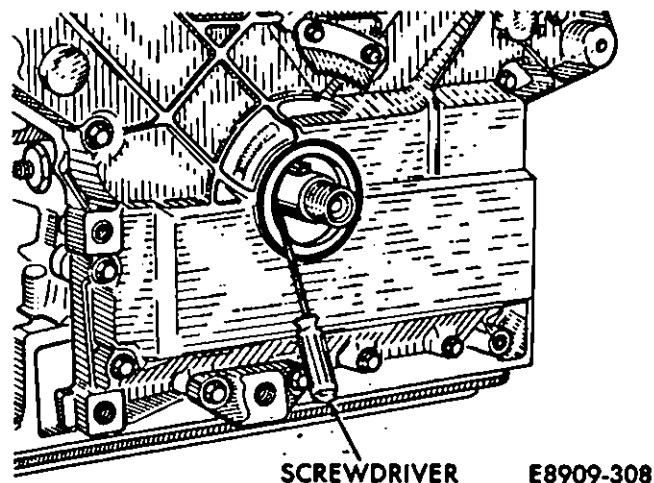


Fig. 11—Seal Removal using Screwdriver

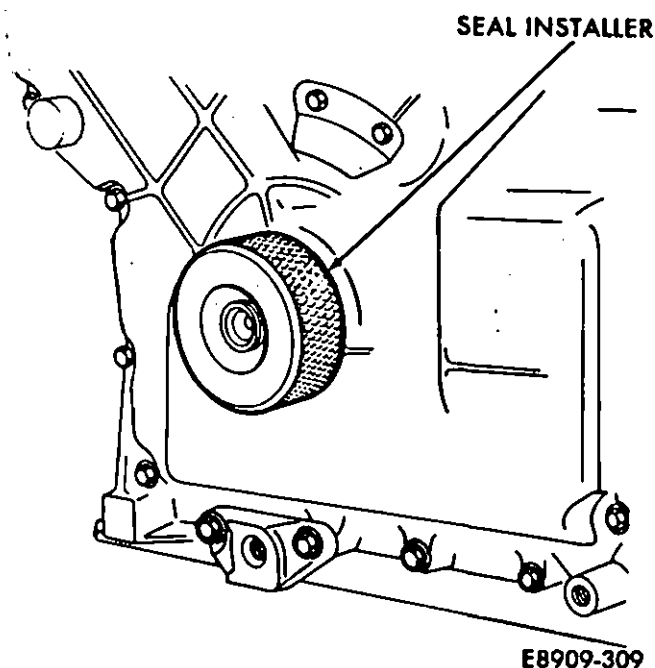


Fig. 12—Seal Installation using Tool 6077

DISTRIBUTOR CAP/ROTOR/DUST COVER

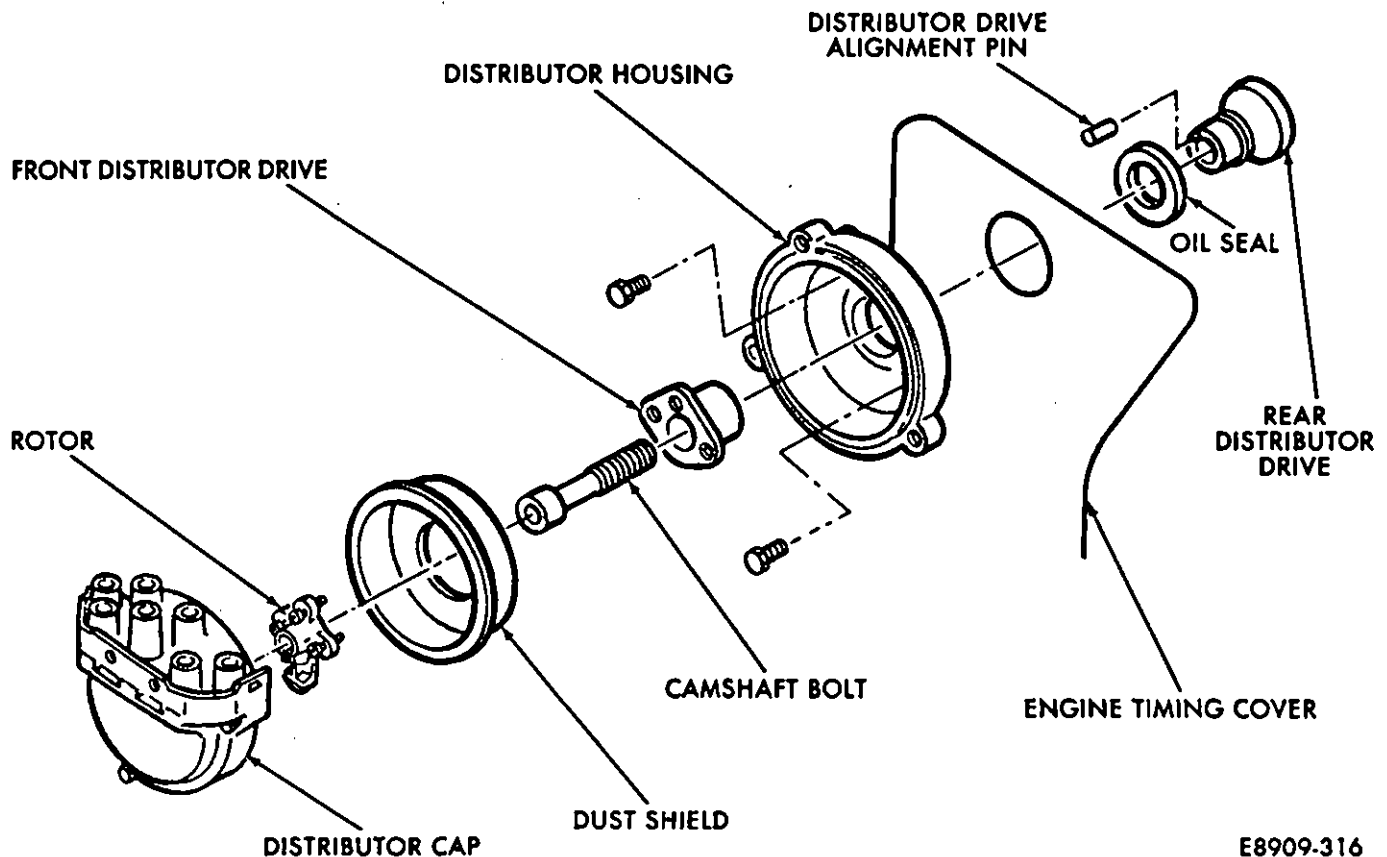
The distributor rotor is attached to the front of the distributor drive which is indexed to the left camshaft (Fig. 1). The distributor drive itself is a two piece assembly that is pinned together. The drive rides in an oil seal located in the engine timing cover behind the distributor housing. The engine timing cover must be removed to service the oil seal.

Removal

- (1) Remove the distributor wires from the spark plugs.
- (2) If necessary, remove distributor cap shield (Fig. 2).
- (3) Completely loosen distributor cap screws (Fig. 2).
- (4) Remove mounting screws that attach the rotor to the distributor drive.
- (5) Remove rotor (Fig. 3).
- (6) Remove dust cover (Fig. 3).

Installation

- (1) Install dust cover into the distributor housing (Fig. 4).
- (2) Install rotor (Fig. 4).
- (3) Tighten the rotor mounting bolts to 3 N·m (26 in-lbs) torque.
- (4) Install distributor cap (Fig. 4).
- (5) Tighten the distributor cap mounting bolts to 4 N·m (35 in-lbs) torque.



E8909-316

Fig. 1—Distributor Cap/Rotor/Dust Cover

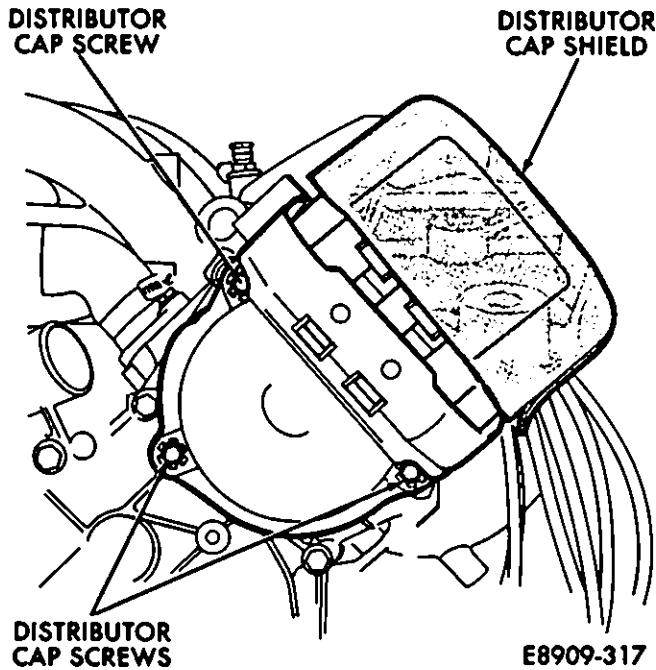


Fig. 2—Distributor Cap

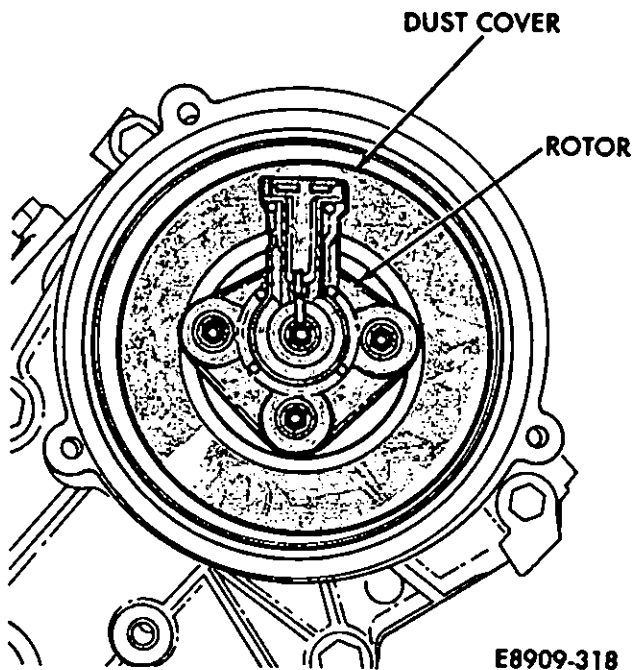


Fig. 3—Dust Cover/Rotor

DISTRIBUTOR DRIVE OIL SEAL REPLACEMENT

(1) The timing cover must be removed to replace the distributor drive seal.

(2) Separate the distributor drive; front and rear sections. It may be necessary to use a small drift punch and tap at the parting line to separate the two sections (Fig. 5).

(3) The distributor drive seal is located behind the distributor housing (Fig. 6).

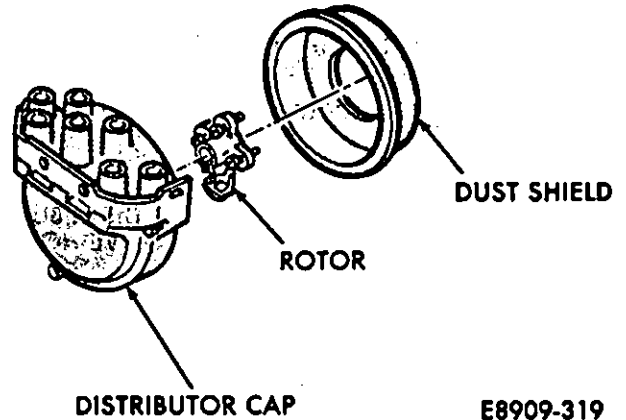


Fig. 4—Distributor Cap/Rotor/Dust Shield

(4) Remove the distributor housing mounting bolts and then remove the housing (Fig. 6).

(5) Use a socket to push the old seal out.

(6) Use special Tool 6126 to install the new seal flush with the cover (Fig. 7). When the distributor housing is reattached, the seal will be seated to the proper depth in the cover.

(7) Install the distributor housing.

(8) Lightly oil the seal lips.

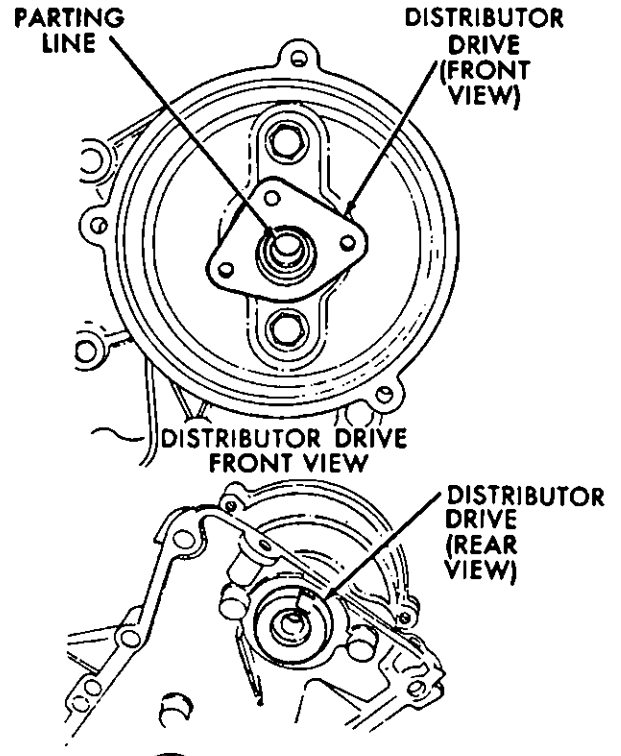
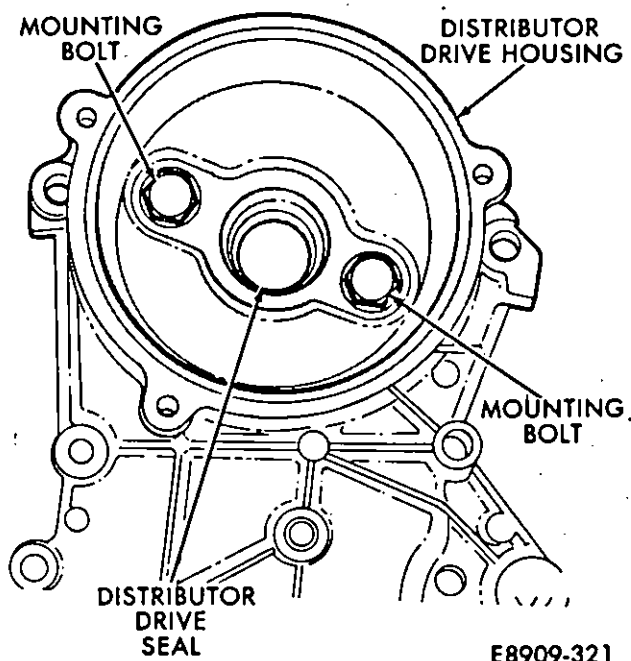


Fig. 5—Distributor Drive

(9) Install the distributor drive rear section through the back of the cover, past the seal and up into the distributor housing.

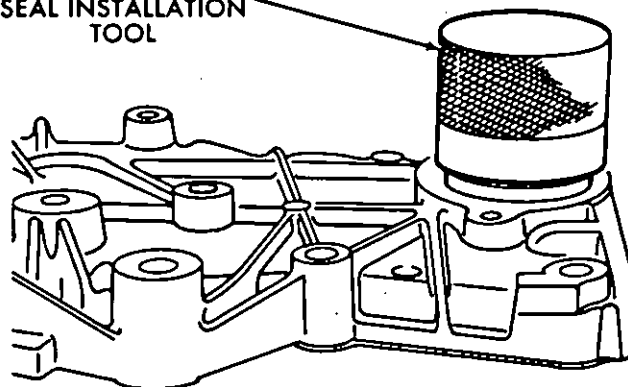
(10) Line up the dowel in the top of the rear section with the dowel hole in the bottom of the distributor drive front section and tap them together.



E8909-321

Fig. 6—Distributor Housing/Distributor Drive Seal

DISTRIBUTOR DRIVE SEAL INSTALLATION TOOL



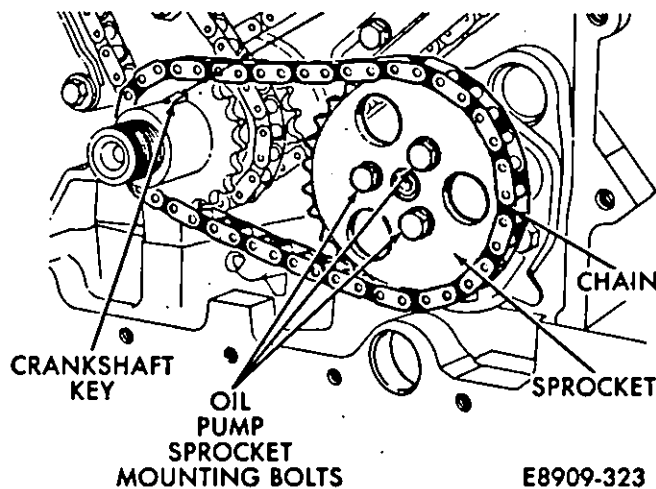
E8909-322

Fig. 7—Distributor Drive Seal Installation—Tool 6126

OIL PUMP

Removal

- (1) Remove the timing cover.
- (2) Rotate the crankshaft until crankshaft key is pointing up (Fig. 1).
- (3) Remove oil pump socket mounting bolts (Fig. 1). Note that they have a thread lock on them.
- (4) Clean the thread lock from the bolts.
- (5) Remove chain sprocket and chain (Fig. 1).



E8909-323

Fig. 1—Oil Pump Sprocket and Chain

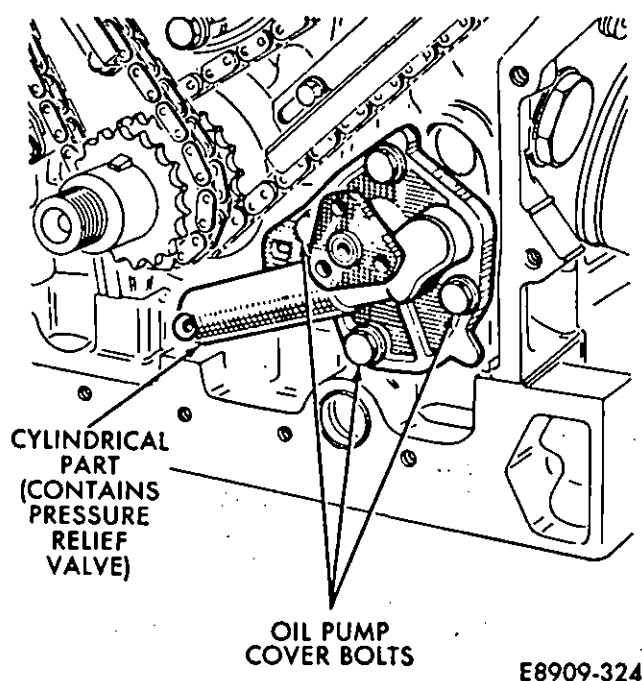


Fig. 2—Oil Pump Cover Bolts

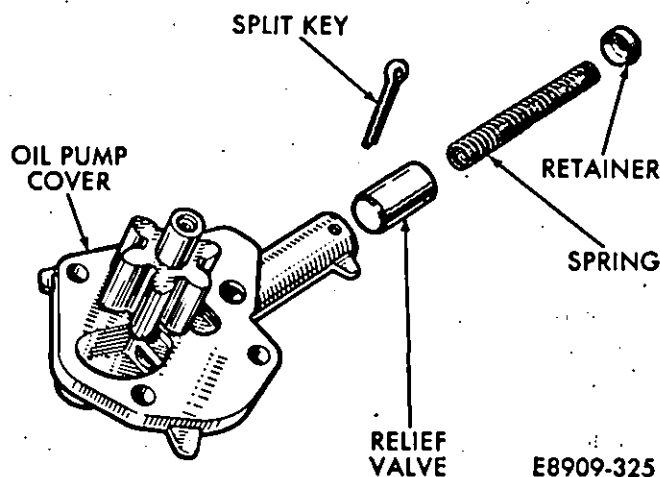


Fig. 3—Relief Valve Components

CAUTION: When removing the oil pump cover, do not strike the cylindrical part that contains the pressure relief valve (Fig. 2).

- (6) Remove oil pump cover bolts (Fig. 2).
- (7) Remove the oil pump cover.
- (8) Remove the split key from the oil pump cover. Remove the retainer, the spring and the relief valve (Fig. 3). Check the condition of all parts. If any part shows excessive wear, the complete oil pump must be replaced.

Installation

- (1) Coat with clean engine oil and install the relief valve, the spring and the retainer into the oil pump cover (Fig. 3). When installing the relief valve, the open end must face the spring.

- (2) Install the split key (Fig. 3).
- (3) Lubricate the driven gear idler shaft with clean engine oil.
- (4) Install the driven gear over the idler shaft.
- (5) Install the oil pump cover. Tighten the bolts to 12 N·m (9 ft-lbs) torque.
- (6) Prime the oil pump by squirting oil through hole (A) below the oil filter connector (Fig. 4).
- (7) Fill the oil filter with clean engine oil and install it on the engine.
- (8) After the timing chains have been installed, install the oil pump sprocket and the chain. Coat the threads of the sprocket mounting bolts with Loctite 271 and tighten the bolts to 6 N· (53 in-lbs) torque.

TIMING CHAINS/TENSIONERS/SPROCKETS

Inspection

Check the timing chain and sprocket for wear. If either side has excessive wear, replace the timing chains, sprockets guide shoes and tensions for BOTH sides.

Remove the cylinder head cover.

Pull on the top of the timing chains. This will produce a gap between the bottom of the timing chain and the bottom of the area between the two sprocket teeth (Fig. 5).

A maximum clearance (gap) of 1.7 mm (.067 in) between the timing chain and sprocket must not be exceeded. A gap of 1.7 mm (.067 in) corresponds to a travel of 22 mm (.866 in) by the timing chain tensioner plunger (Fig. 6).

Use the SOLID END of a number 51 drill bit (1.7 mm-.067in. diameter) to gauge the size of gap (Fig. 7).

If the SOLID END of the drill bit fits into the gap between the timing chain and the two sprocket teeth, then the following components MUST be replaced:

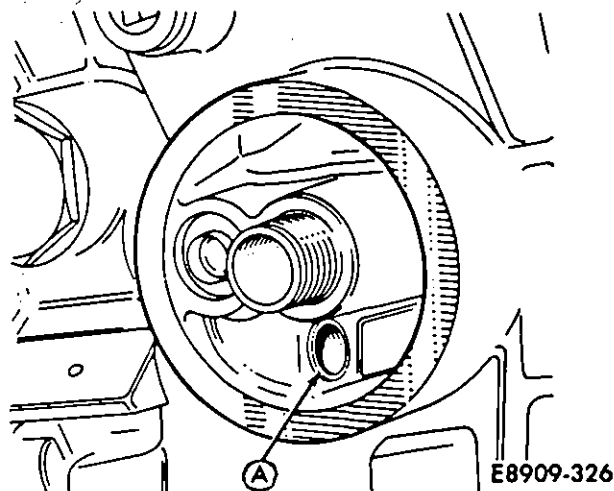
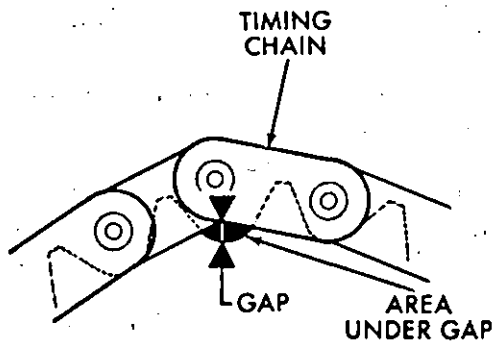
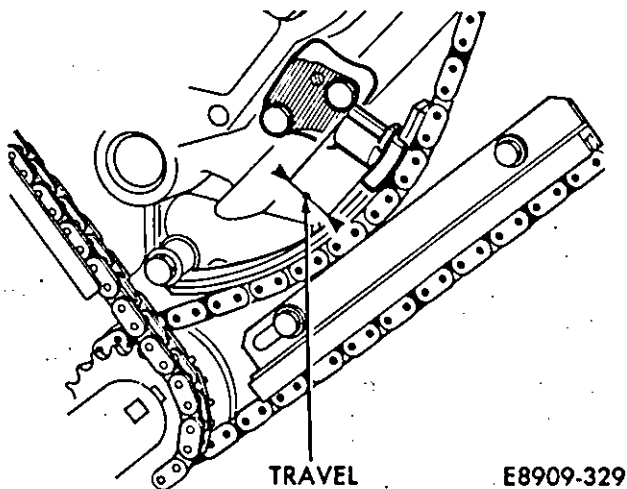


Fig. 4—Prime Oil Pump Through Hole "A"



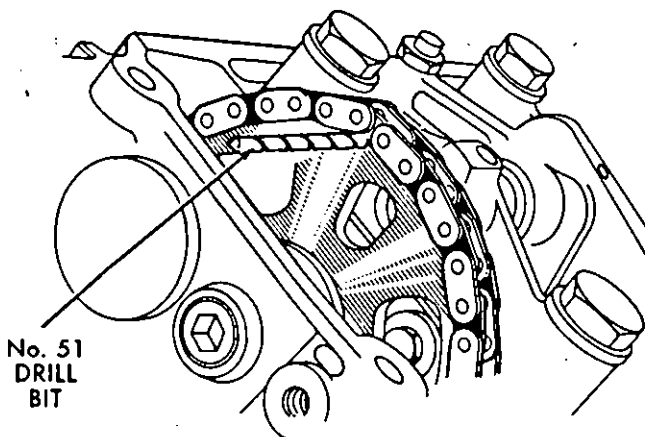
E8909-328

Fig. 5—Timing Chain Gap



E8909-329

Fig. 6—Travel of Tensioner Plunger



E8909-330

Fig. 7—Use of Drill Bit as Gauge

- Timing chain shoes
- Tensioners
- Guides
- Sprockets
- Tensioner Shoes

If the SOLID END of the drill bit does not fit into gap, the wear is not excessive and the components can be reused.

Removal

When removing the timing chains, tensioners, guides, sprockets and tensioner shoes, keep the left and right hand sides separated do not mix them. The components must be put back on the side they were removed from (Fig. 8).

(1) Remove the bolt attaching the right hand side camshaft sprocket to the camshaft (Fig. 8).

(2) Lock the timing chain tensioner.

(3) Remove right hand side timing chain tensioner and let tensioner shoe hang down (Fig. 8). **CAUTION:** The timing chain tensioner lock must be set in the locked position before removing the tensioner. To lock the tensioner, rotate the slotted lock finger counterclockwise with a thin screwdriver.

(4) Remove right hand side timing chain (Fig. 8).

(5) Remove right hand side camshaft sprocket (Fig. 8).

(6) Remove right hand side timing chain guide (Fig. 8).

(7) Remove right hand side tensioner shoe (Fig. 8).

(8) Keep the right hand side components together in a group separate from the left hand side components.

(9) Remove left hand side timing chain tensioner (Fig. 8).

CAUTION: The timing chain tensioner lock must be set in the locked position before removing the tensioner. To lock the tensioner, rotate the slotted lock finger counterclockwise with a thin screwdriver.

(10) Remove left hand side timing chain (Fig. 8).

(11) Remove left hand side camshaft sprocket (Fig. 8).

(12) Remove left hand side timing chain guide (Fig. 8).

(13) Remove left hand side tensioner shoe (Fig. 8).

(14) Remove tensioner filters (Fig. 9).

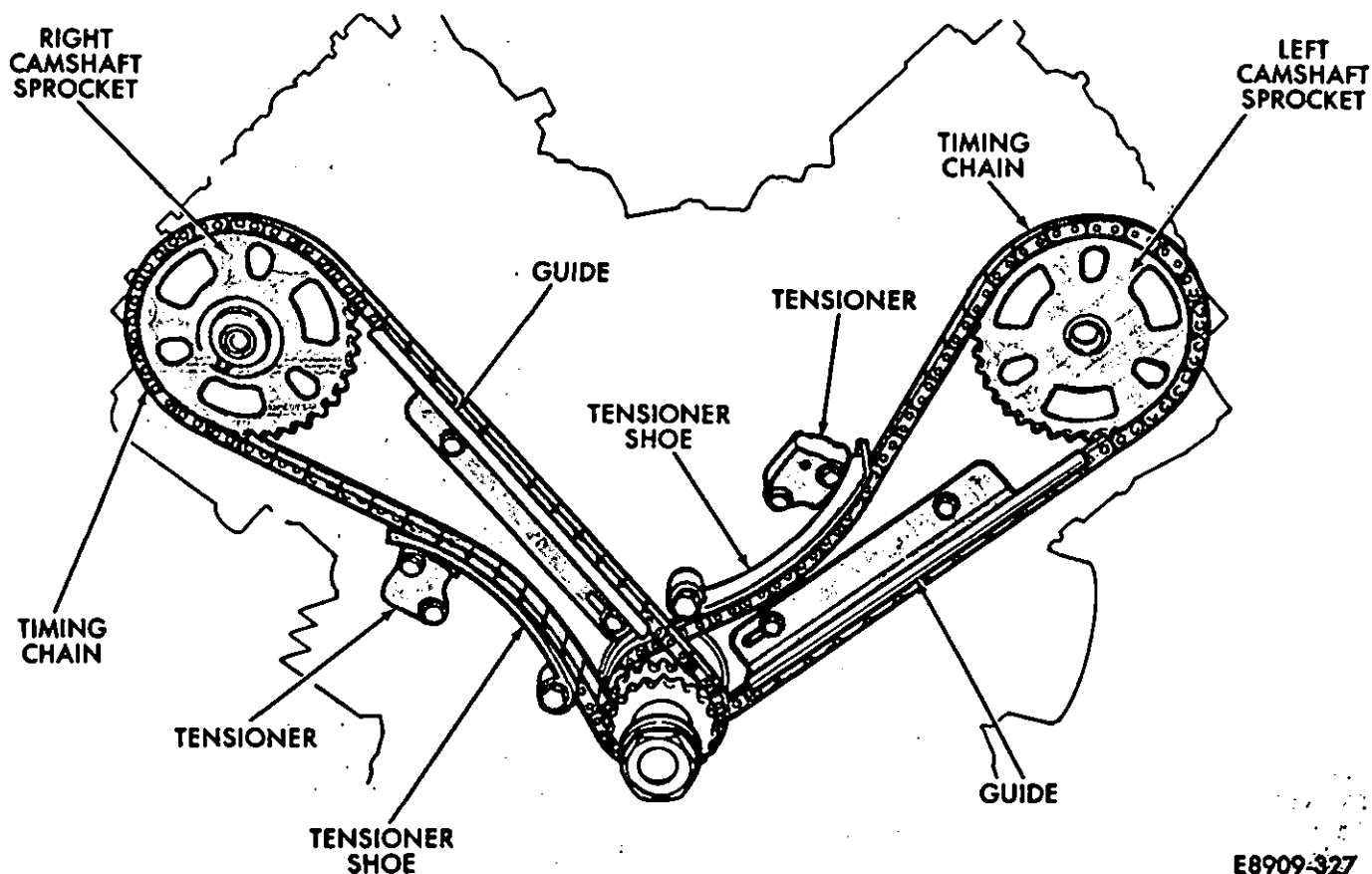


Fig. 8—Timing Chains/Sprockets/Tensioners

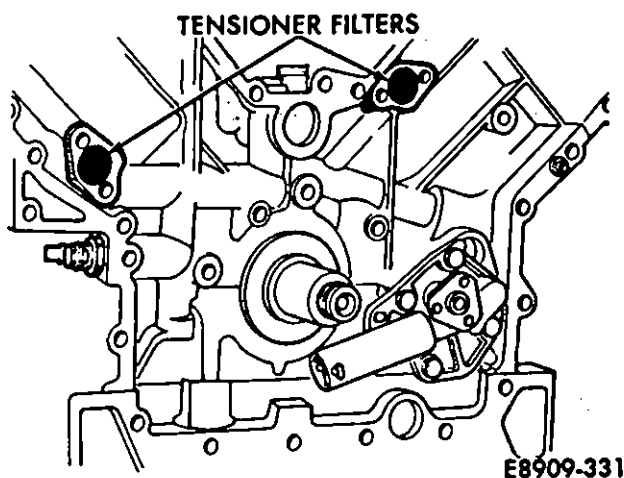


Fig. 9—Tensioner Filters

Installation

The timing chains are identical and when NEW can be used with either camshaft sprocket. Used chains **MUST** be installed on the same side they were removed from.

The camshaft sprockets are not identical. The right camshaft sprocket has a spacer attached to it. The left camshaft sprocket does not have a spacer.

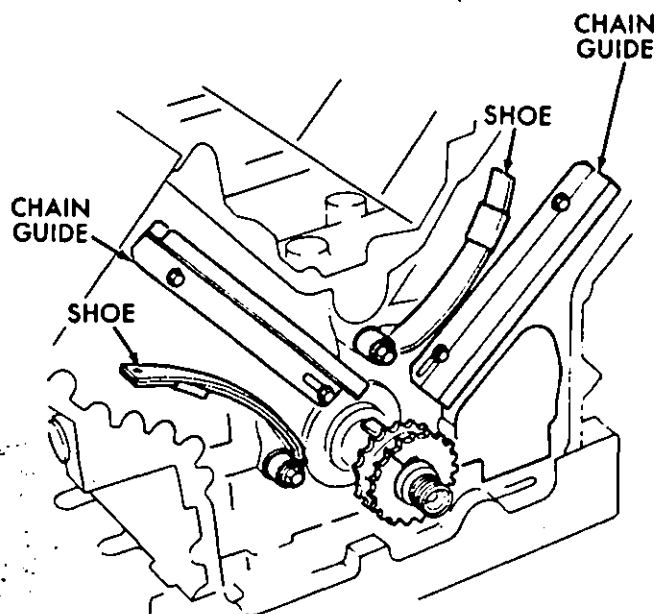
The timing chain tensioners, shoes and guides are identical and when NEW can be used on either timing chain. Used tensioners, shoes and guides **MUST** be installed on the same side they were removed from.

When installing the timing chains and sprockets, the left bank of the engine must be timed first.

- (1) Install the chain guides (Fig. 10). Tighten the bolts to 6 N·m (53 in-lbs) torque.
- (2) Install the tensioner shoes (Fig. 10). Tighten the bolts to 12 N·m (9 ft-lbs) torque.
- (3) Turn the crankshaft so that keyway points straight up (Fig. 11).
- (4) Turn the left camshaft until slot in the front is positioned as shown in Fig. 12.
- (5) Turn the right camshaft until slot in the front is positioned as shown in Fig. 13.
- (6) Install the cleaned tension filters (Fig. 9).
- (7) Turn the crankshaft in a clockwise direction until the crankshaft keyway is aligned with the centerline of the left cylinder bank (Fig. 14).

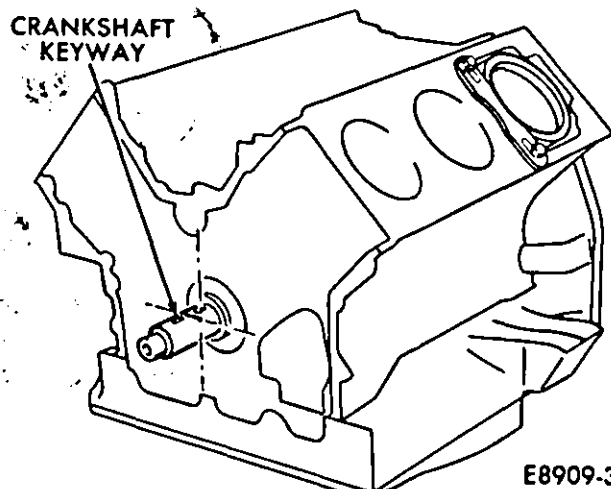
Left Timing Chain

The crankshaft has three separate sprockets. One sprocket is for the left timing chain, one is for the right timing chain and one is for the oil pump chain.



E8909-332

Fig. 10—Chain Guides/Tensioner Shoes



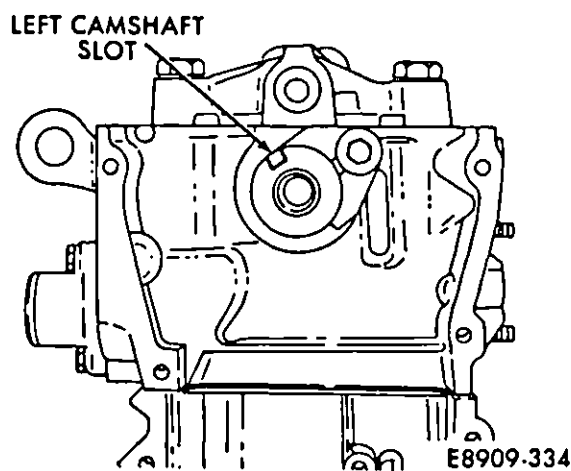
E8909-333

Fig. 11—Crankshaft Keyway Position

(8) The left camshaft sprocket does not have a built-in spacer. Install the left timing chain so that the unpainted link between the two painted links is aligned with the stamped timing mark on the left camshaft sprocket (Fig. 15).

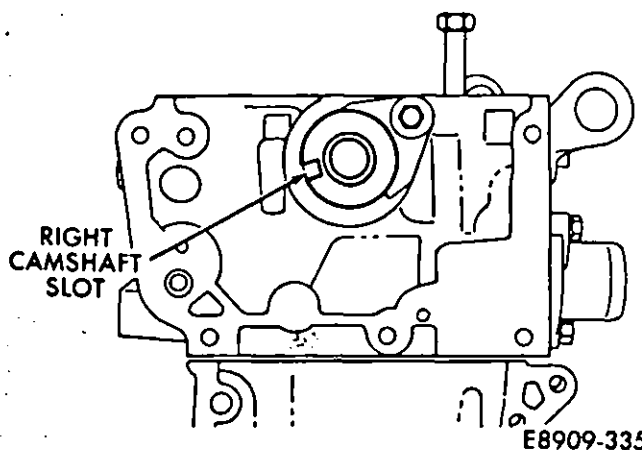
(9) The timing mark is located on the middle (or second) sprocket which is for the RIGHT timing chain. Install the left timing chain by positioning the single painted link of the LEFT timing chain onto the tooth of the rear sprocket. That tooth is directly behind the tooth of the middle sprocket that has the timing mark (Fig. 16).

CAUTION: The timing chain tensioner lock should not be removed. The lock is held in place by a spring that pushes a steel ball against lock finger (Fig. 17) if



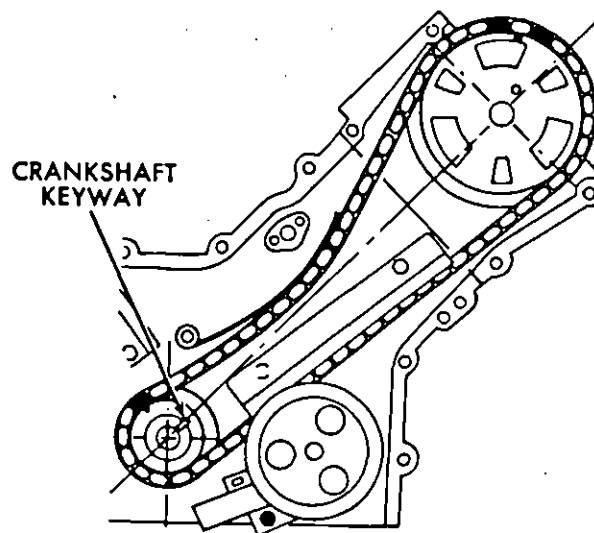
E8909-334

Fig. 12—Left Camshaft Slot Position



E8909-335

Fig. 13—Right Camshaft Slot Position



E8909-336

Fig. 14—Crankshaft Keyway Alignment

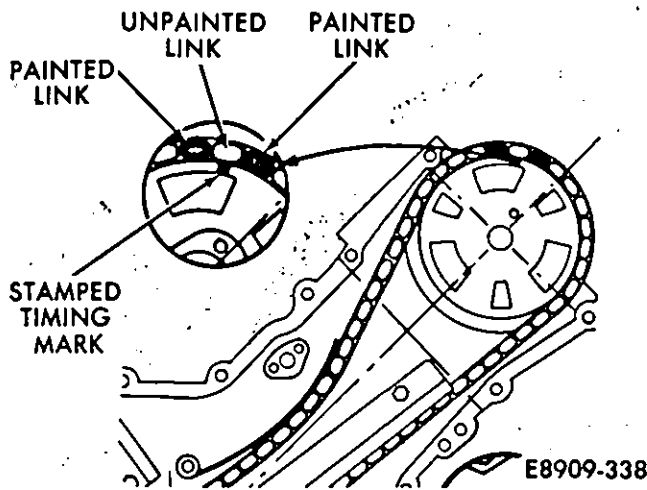


Fig. 15—Left Camshaft Sprocket to Timing Chain Alignment

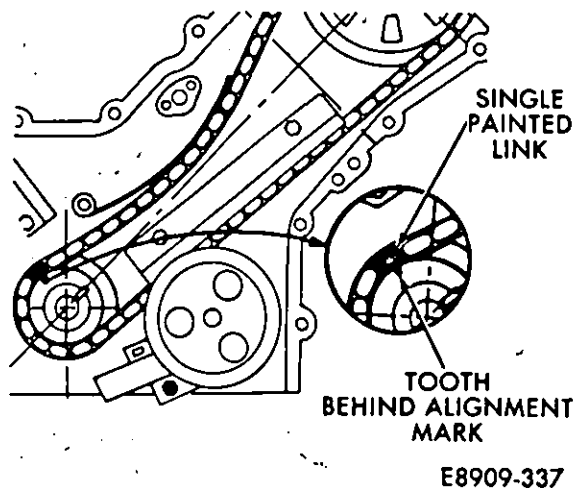


Fig. 16—Crankshaft Sprocket to Chain Alignment

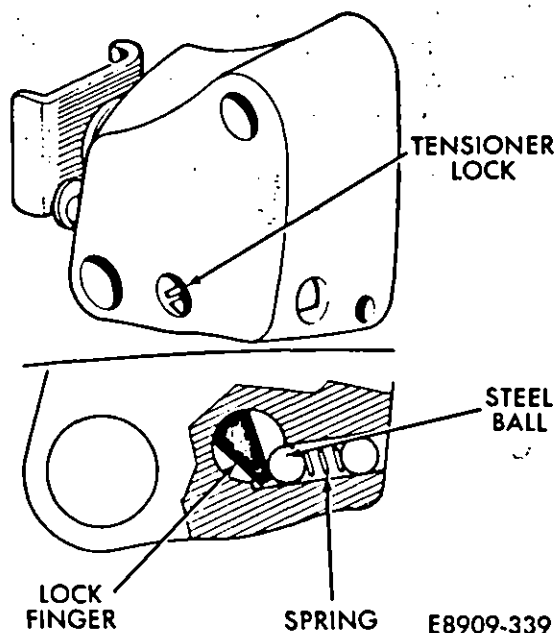


Fig. 17—Tensioner Lock

the lock is removed accidentally, replace the tensioner assembly because there is no way of checking the position of the lock finger in relation to the steel ball.

(10) To install the left timing chain tensioner use a thin blade screwdriver to turn the ratchet counterclockwise. Then push the tensioner arm in. Position the tensioner over the filter and the tensioner shoe into the arm (Fig. 18).

(11) Tighten the mounting bolts to 6 N·m (53 in-lbs) torque.

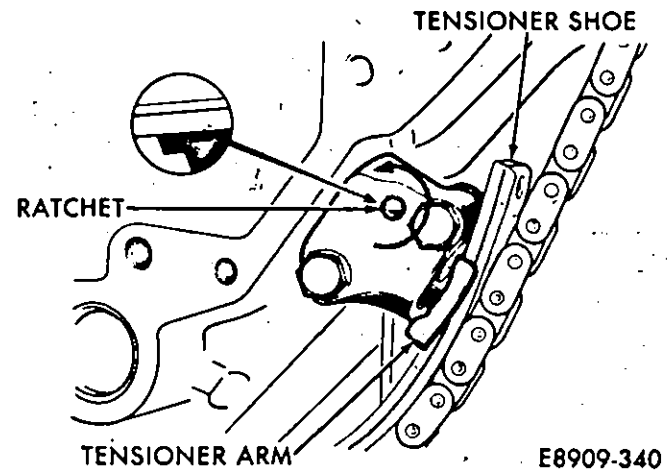


Fig. 18—Left Timing Chain Tensioner

Right Timing Chain

(12) Rotate the crankshaft approximately 150° until the timing mark on the crankshaft middle sprocket is aligned with the lower oil pump cover mounting bolt (Fig. 19).

(13) The right camshaft sprocket has a built-in spacer. Install the right timing chain so that the unpainted link between the two painted links is aligned with the stamped timing mark on the right camshaft sprocket (Fig. 20).

(14) Single painted link on the bottom of the timing chain is aligned with timing mark on the middle sprocket (Fig. 21).

CAUTION: The timing chain tensioner lock should not be removed. The lock is held in place by a spring that pushes a steel ball against lock finger (Fig. 17). If the lock is removed accidentally, replace the tensioner assembly because there is no way of checking the position of the lock finger in relation to the steel ball.

(15) To install the left timing chain tensioner use a thin blade screwdriver to turn the ratchet counterclockwise. Then push the tensioner arm in. Position the tensioner over the filter and the tensioner shoe into the arm (Fig. 22).

(16) Tighten the mounting bolts to 6 N·m (53 in-lbs) torque.

(17) Install the right camshaft sprocket bolt and tighten the bolt to 80 N·m (59 ft-lbs) torque.

(18) Push both tensioner shoes in to release the ratchet of the tensioner from the locked position and then let the shoes out (Fig. 23).

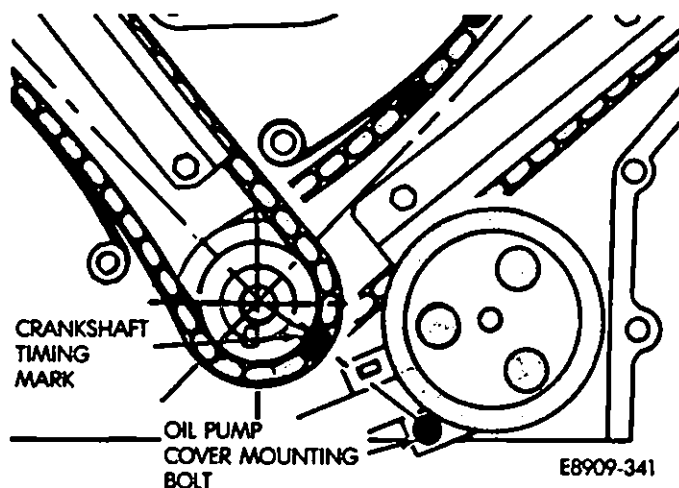


Fig. 19—Crankshaft Alignment

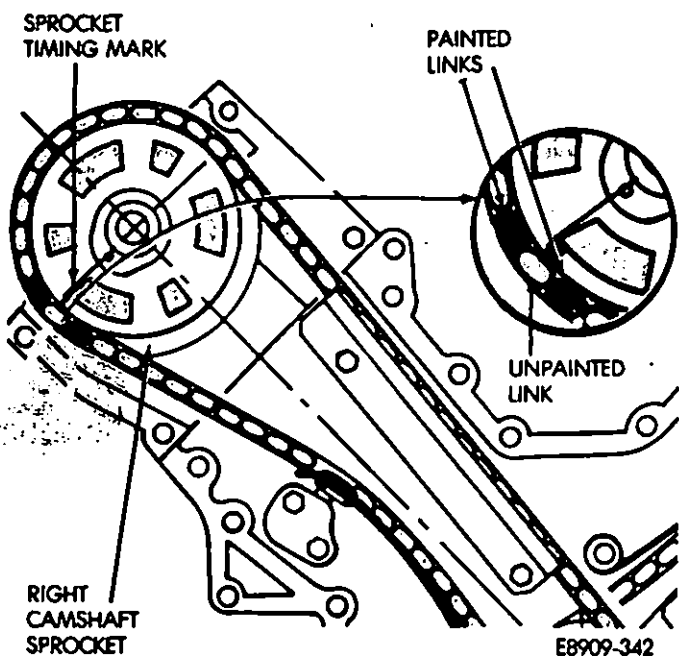


Fig. 20—Right Camshaft Sprocket to Timing Chain Alignment

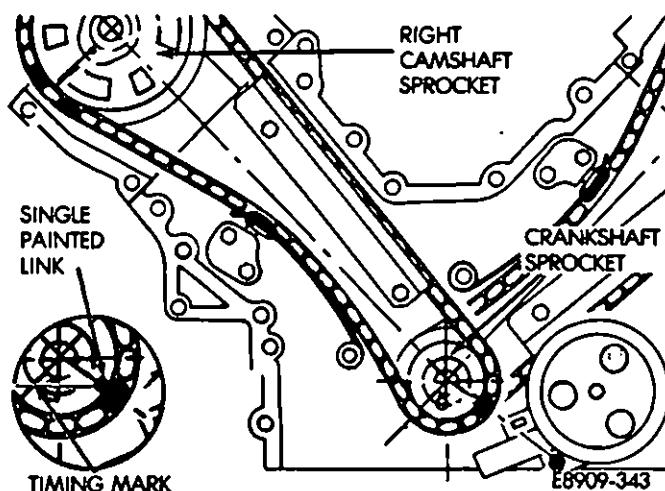


Fig. 21—Crankshaft to Timing Chain Alignment

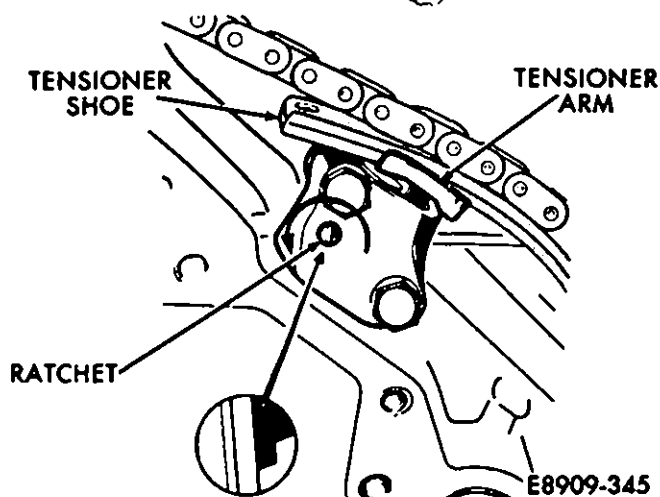


Fig. 22—Right Timing Chain Tensioner

Valve Timing Check

Once the crankshaft is rotated, the paint marks on the timing chains will not align with the marks on the sprockets. When checking valve timing, it is the position of the timing marks in relation to one another that is checked, NOT the position of the paint marks on the chains.

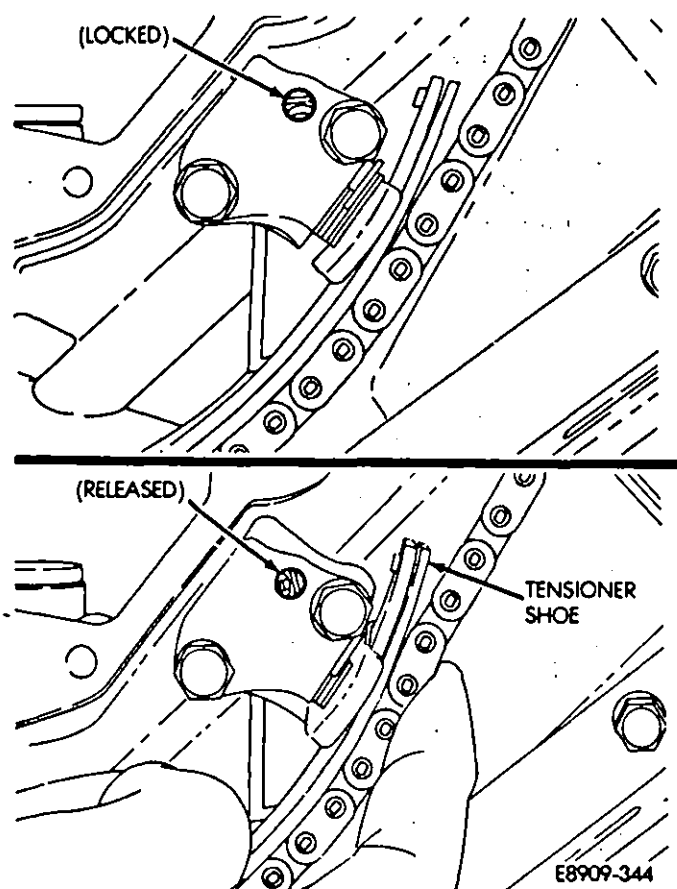


Fig. 23—Tensioner Ratchet

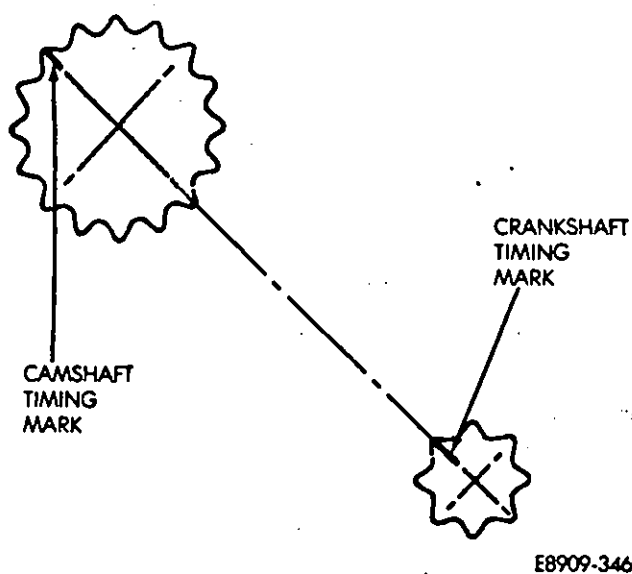
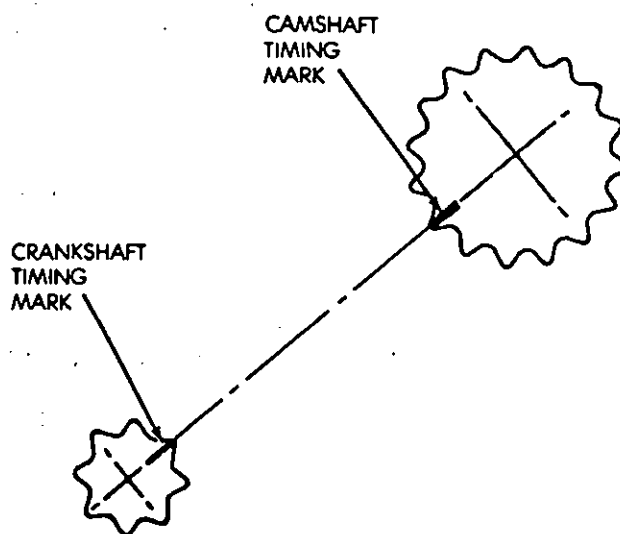


Fig. 24—Right Camshaft/Crankshaft Timing Mark Alignment

(1) Rotate the crankshaft 180°. Check that the right camshaft sprocket timing mark and the crankshaft timing are aligned as shown in (Fig. 24).



E8909-347

Fig. 25—Left Camshaft/Crankshaft Timing Mark Alignment

(2) Rotate the crankshaft another 90°. The left camshaft sprocket timing mark and the crankshaft sprocket timing mark should be aligned as shown in (Fig. 25).

OIL PAN

Removal

- (1) Drain the engine oil.
- (2) If the cylinder head is removed, install liner clamps across the 4 center head bolts to keep the liners in place.
- (3) Rotate the engine on the engine stand until the oil pan points up.
- (4) Remove the oil pan bolts and washers (Fig. 1).
- (5) Remove oil pan (Fig. 1).

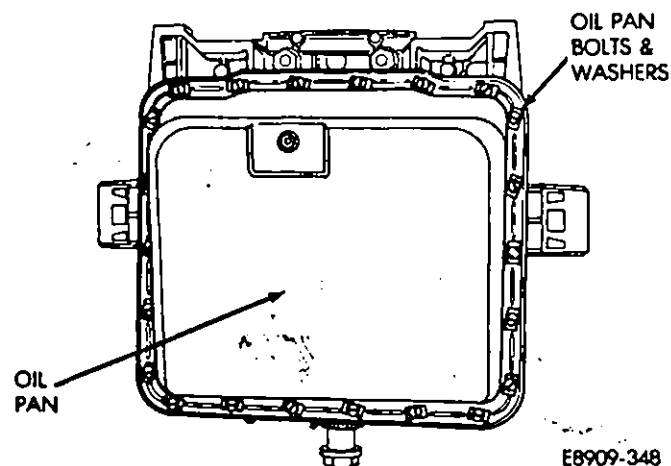


Fig. 1—Oil Pan

CAUTION: Do not use a metal scraper to remove the gasket material from the lower casing, it could cut or grove the casing. Instead, use a wooden or plastic scraper.

Cleaning

Clean old gasket material from the lower casing.
Clean the oil pan.

Installation

- (1) Install dry, a new oil pan gasket.
- (2) Position the oil pan over the lower casing and gasket.
- (3) Tighten the oil pan bolts to 12 N·m (9 ft-lbs) torque.

OIL PUMP INLET TUBE

Removal

- (1) Remove the oil pump inlet tube mounting bolts (Fig. 2).
- (2) Remove the inlet tube (Fig. 2).
- (3) Remove O-ring seal (Fig. 3). Discard the inlet tube O-ring seal.

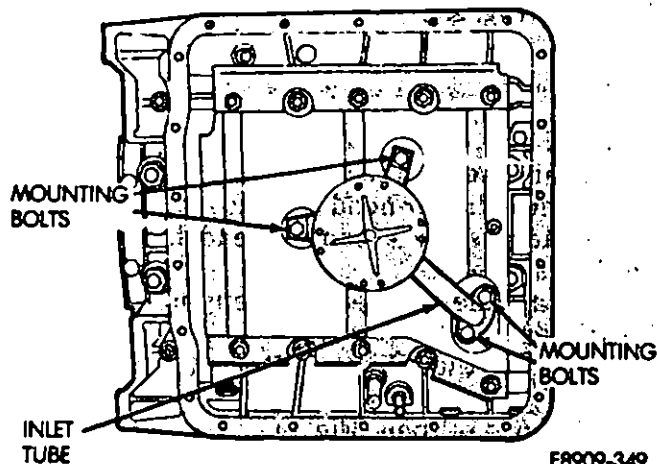


Fig. 2—Oil Pump Inlet Tube

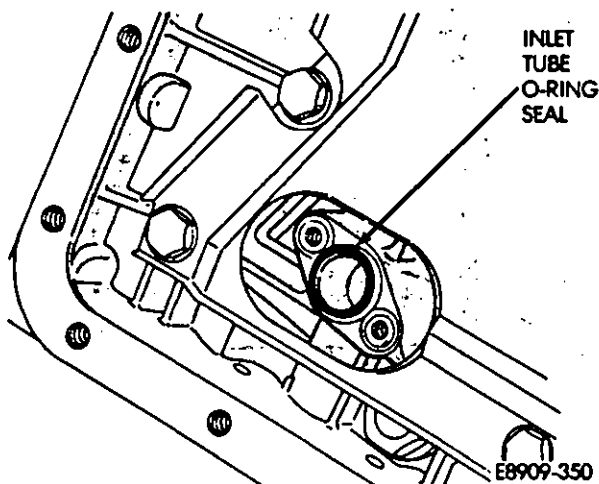


Fig. 3—Inlet Tube O-Ring Seal

Installation

- (1) Use a new inlet tube O-ring seal. Never reuse the inlet tube O-ring seal. Always install a new seal when installing the inlet tube.
- (2) Install inlet tube.
- (3) Tighten inlet tube mounting bolts to 12 N·m (9 ft-lbs) torque.

OIL BAFFLE

Removal

- (1) Remove the oil pan.
- (2) Remove oil baffle mounting bolts (Fig. 4).
- (3) Remove remaining bearing mounting bolts (Fig. 4).
- (4) Remove baffle (Fig. 4).

Installation

- (1) Install baffle.
- (2) Install and tighten the bearing mounting bolts to 17 N·m (13 ft-lbs) torque.
- (3) Install and tighten the oil baffle mounting bolts (A) to 12 N·m (9 ft-lbs) torque.

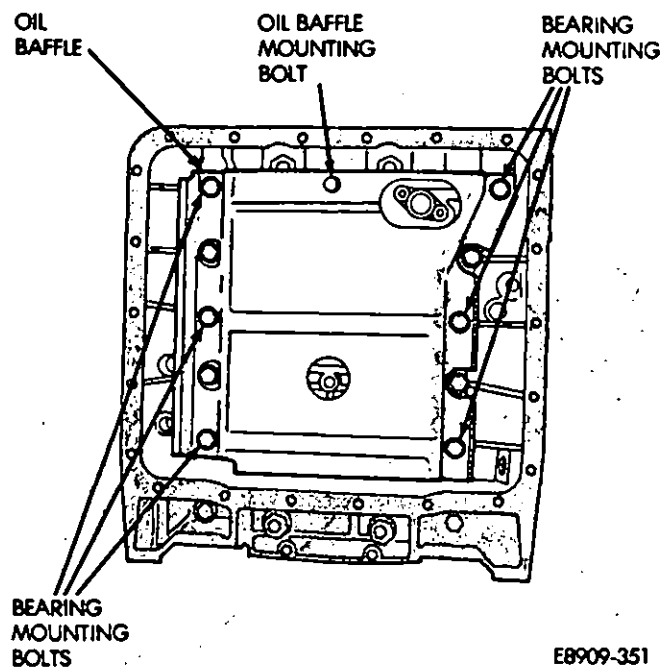


Fig. 4—Oil Baffle

CYLINDER BLOCK

Disassembly

- (1) Remove the oil pan, inlet tube and baffle.
- (2) Remove the bearing mounting bolts and the lower casing to crankshaft rear seal housing bolts (Fig. 5).
- (3) Remove the nuts from the main bearing studs (Fig. 5).

(4) Using a soft rubber hammer, tap the under side of the engine mounts to loosen the lower casing (Fig. 5).

(5) Remove the lower casing.

(6) Remove and discard the oil galley O-ring seal. Never reuse the oil galley O-ring seal between the lower casing and the cylinder block.

CAUTION: When cleaning the gasket surfaces use a gasket remover to soften the old gasket material. Also, to avoid damage to the mating surfaces, do not use a metal scraper. Instead use a plastic or wooden scraper.

(7) When cleaning, ensure that foreign material does not enter the oil galley hole in the cylinder block (Fig. 6).

(8) Install clamps (Tool 6071) over the front and rear main bearing caps (Fig. 7). Use four lower casing nuts to hold the clamps in position.

(9) Turn the engine over on the engine stand and install liner clamps (Tool 7315) to hold the piston-liner assembly in place (Fig. 8).

(10) Turn the engine over on the engine stand.

(11) If the piston-liner assemblies will be reused, reference the piston to cylinder liner to cylinder block positions using a grease pencil.

(12) Mark each connecting rod and cap with the cylinder number on the side that faces out so that the caps can be installed with the proper connecting rods (Fig. 9). Connecting rod caps cannot be interchanged.

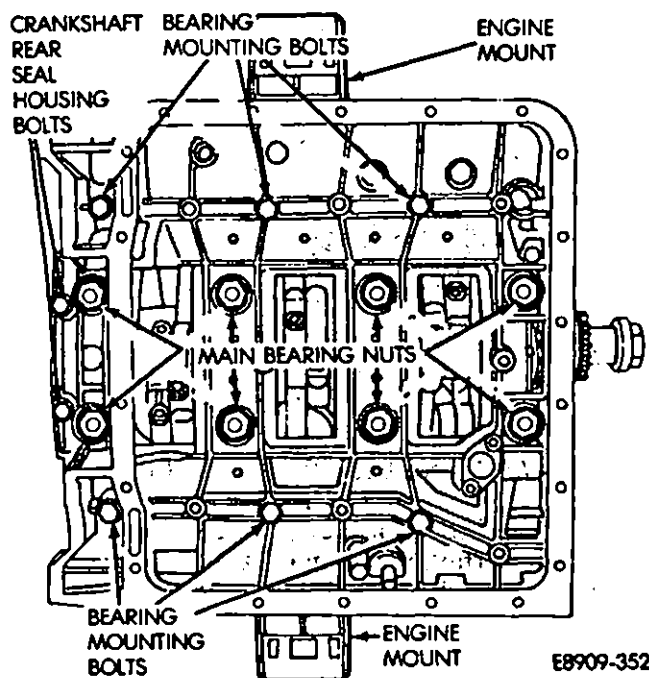
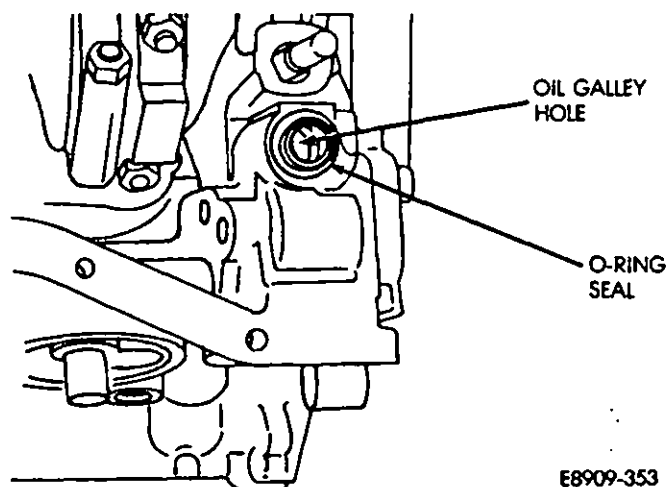


Fig. 5—Lower Casing



E8909-353

Fig. 6—Oil Galley Hole

(13) Loosen all connecting rod nuts. When loosening the connecting rod nuts, loosen the nuts of both connecting rods at each journal before removing either one of the connecting rod-piston-liner assembly. It will be necessary to rotate the crankshaft to provide access to all of the connecting rod nuts.

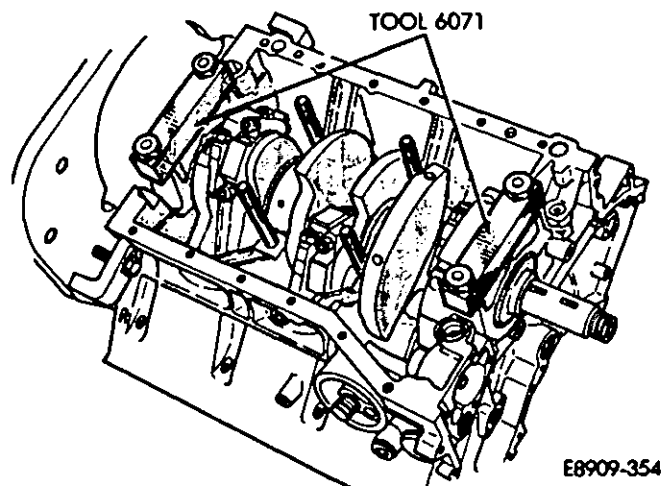
CAUTION: When removing the piston-liner, care must be taken so that the connecting rod bolts do not nick the crankshaft journal. Make Insulators (Fig. 10) out of the rubber hose to fit over the connecting rod bolts once the cap is removed. Then remove the piston-liner assembly.

(14) For each piston-liner assembly, turn the crankshaft until the connecting rod cap is at the bottom of its travel (piston at the bottom of the liner).

(15) Remove the liner clamp(s) holding the liners in place.

(16) Have an assistant hold the liner in place.

(17) Remove the connecting rod nuts and cap.



E8909-354

Fig. 7—Main Bearing Cap Clamps

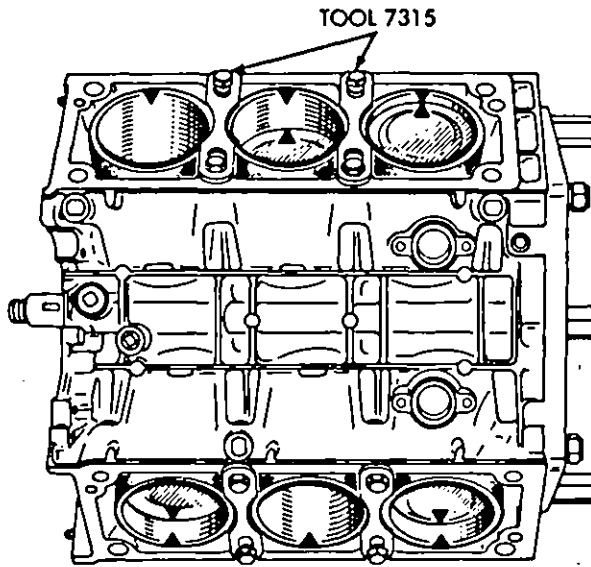


Fig. 8—Cylinder Liner Clamps

- (18) Install rubber insulators over the connecting rod bolts.
- (19) Remove the piston-liner assembly.
- (20) Repeat the procedure on all other assemblies that are to be removed.
- (21) Remove and discard liner seal.
- (22) Remove the piston-connecting rod assembly from the bottom of the liner.
- (23) Remove the oil pump from the front of the engine.
- (24) Remove the clamps from the front and rear main bearing caps.
- (25) Remove number one main bearing cap (fly-

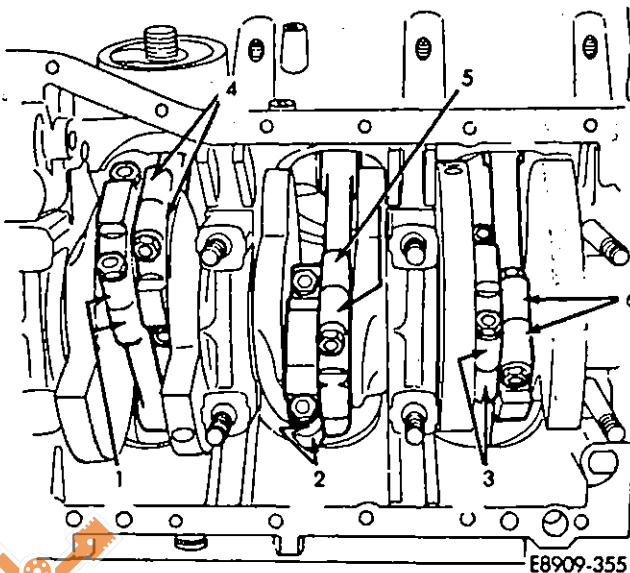


Fig. 9—Marking Connecting Rod and Caps

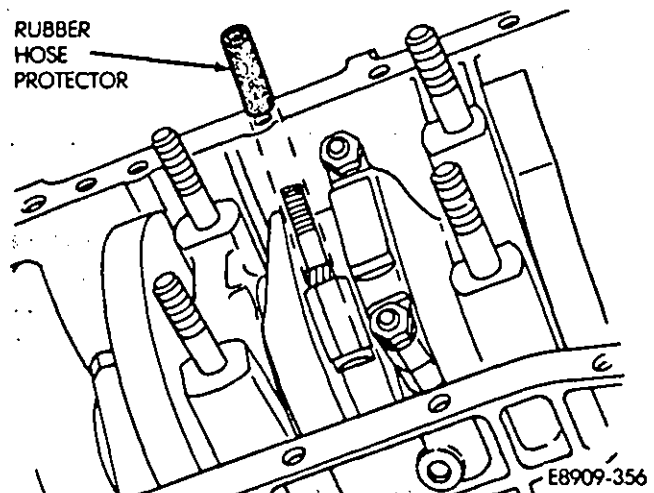


Fig. 10—Rubber Hose Protector

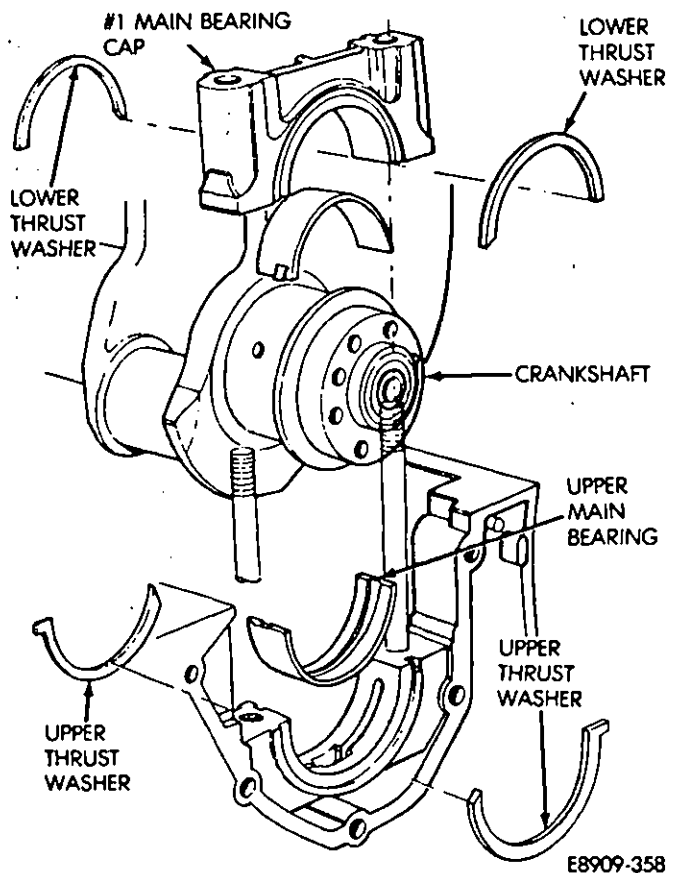


Fig. 11—No. 1 Main Bearing Cap and Components

wheel end of the engine). Remove lower thrust washer from the main cap (Fig. 11).

- (26) Remove the remaining main bearing caps.
- (27) Lift the crankshaft out of the engine.
- (28) Remove upper thrust washers (Fig. 11).
- (29) Remove upper main bearing shells (Fig. 12). When removing the upper main bearing shells, mark the bearing number (1, 2, 3 and 4) on the back of the shell and keep it with the accompanying main bearing cap and lower bearing shell.

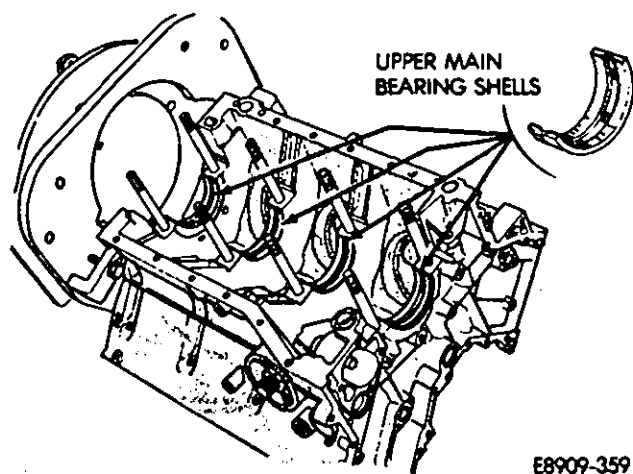


Fig. 12—Upper Main Bearing Shells

Cleaning

(1) Clean the cylinder liner seat. Remove all deposits from the seat and from the water jacket walls of the cylinder liner.

(2) When cleaning the cylinder block, remove the oil galley plug at the rear of the block (Fig. 13).

(3) Remove oil galley plug on the top of the block (Fig. 14).

(4) Remove oil galley plug on the right-hand side of the block (Fig. 15).

(5) Remove oil pressure sender (Fig. 15).

(6) Spray compressed air into all oil galley passages to ensure they are clear of blockage. Refer to the General Information Section—Lubrication System.

(7) Use a gasket removal compound to soften the old gasket material. Use a wooden or plastic scraper to remove the old gasket.

(8) Use fine grade 3M® Scotch Brite or equivalent to remove any small amounts of gasket material.

(9) Clean the oil passages in the crankshaft with a brush.

Inspection

Connecting Rods

The connecting rods are balanced assemblies with bearing inserts at the crankshaft journal end.

A squirt hole in the crankshaft end of the connecting rod provides lubrication for the cylinder walls and piston pins, the squirt hole faces the cylinder on the other bank directly across from it when the connecting rod is installed correctly.

Misaligned or bent connecting rods can cause abnormal wear on pistons, piston rings, cylinder walls, connecting rod bearings and crankshaft connecting rod journals. If wear patterns or dam-

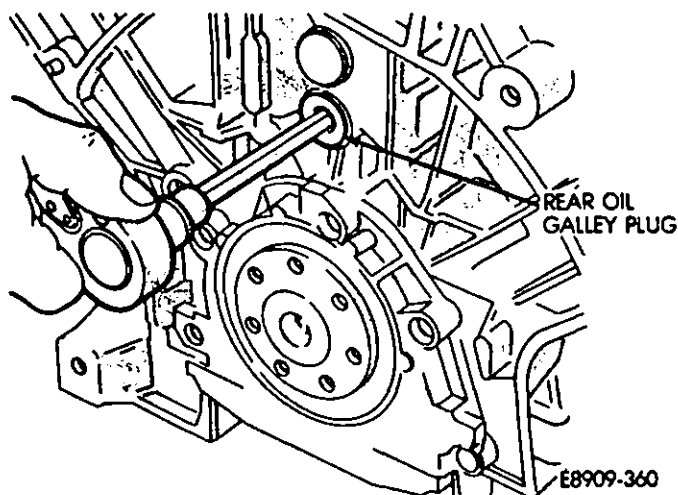


Fig. 13—Rear Oil Galley Plug

age to any of these components indicate the probability of a misaligned connecting rod, inspect it for correct rod alignment. Replace misaligned, bent or twisted rods.

Connecting Rod Bearings

Check the connecting rod bearing for scoring, flaking, scratches and excessive or abnormal wear patterns. The upper (thrust) bearing shell will have a larger wear pattern than the lower shell. If the bearings are scored, scratched or grooved, check the crankshaft connecting rod journal for scratches and nicks. Also check the oil passage from the main journal to the connecting rod journal for blockage. If the bearings are reused, they must be installed in the original position.

Rod Bearings

Check for an abnormal contact area (Fig. 16). This is caused by the locking tabs not fully seated or by being bent.

Check for scoring (Fig. 17). This is caused by insufficient lubrication.

Check for grooves caused by rod bolts or dirt scratching the journal during installation (Fig. 18).

Check the wear pattern (Fig. 18). It should be greater on the upper bearing.

Connecting rod bearings are available in one size only, 59.97 mm (2.36 in.)

Main Bearings

Check the main bearings for scoring, flaking, scratches and excessive or abnormal wear patterns. The lower bearing shell will have a larger wear pattern than the upper (grooved) shell. If the bearings are scored, scratched or grooved, check the main bearing journals of the crankshaft for nicks or scratches. Also check the oil

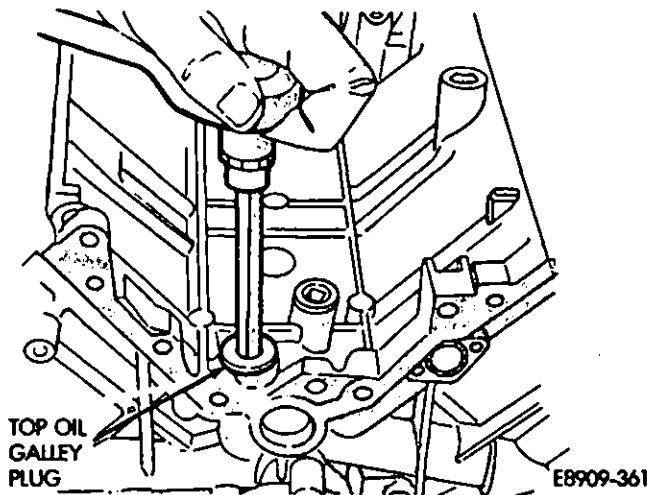


Fig. 14—Top Oil Galley Plug

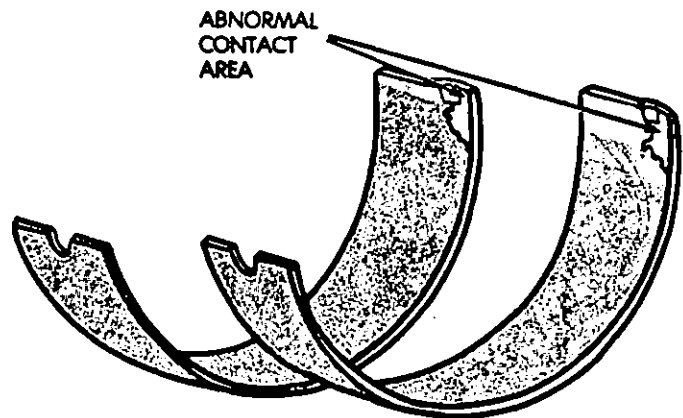


Fig. 16—Rod Bearing Abnormal Contact Area

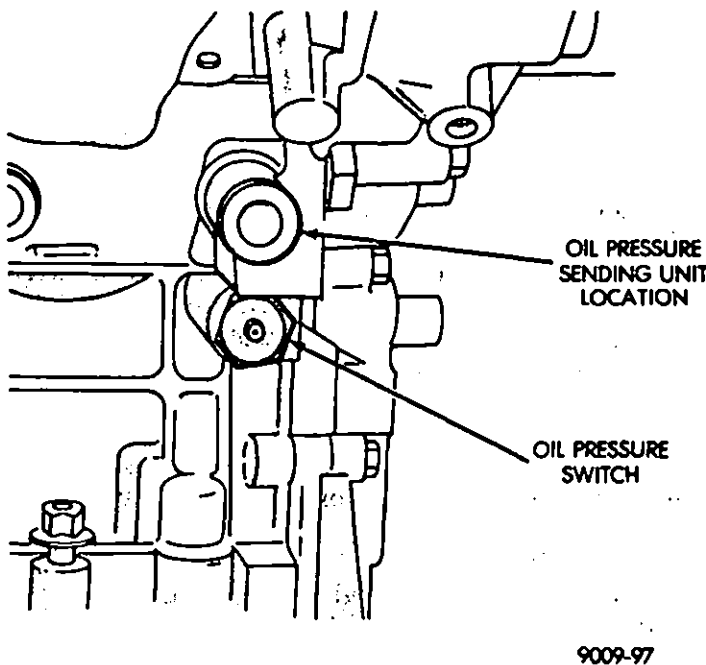


Fig. 15—Right Side Oil Galley Oil Pressure Sender Unit and Switch

passages in the cylinder block that feed the main bearings for blockage (Fig. 19).

Crankshaft

Check the oil passages from the main journals to the connecting rod journals for blockage. Check the journals for nicks and scratches. Polish any nick or scratches smooth.

Main bearings are available in one size only—70.06 mm (2.76 in).

Oil Pump Bores

Check the oil pump bores in the cylinder block for scoring. If the bores are scored, the cylinder block and pump must be replaced.

Assembly

(1) Install the oil galley plugs with new gaskets.
(2) Check that the cylinder head bolts thread in and out of the bolt holes easily. It may be necessary to clean the threads.

(3) Upper main bearing shells have an oil groove down the middle (Fig. 20). Install them with the locating tabs on the back of the bearings positioned in the locating grooves of the cylinder block.

(4) The lower main bearing shells are not grooved. Install them into the main bearing caps.

(5) Thrust bearings are available as kits in four different sizes:

- 2.30-2.35 mm (.091-.093 in).
- 2.40-2.45 mm (.094-.096 in).
- 2.45-2.50 mm (.096-.098 in).
- 2.50-2.55 mm (.098-.100 in).

(6) Install new thrust bearing halves with the oil grooves facing out towards the thrust flanges of the crankshaft. The upper thrust bearing halves have a small tab on one side (Fig. 21). The tab rests in a notch in the cylinder block.

(7) Coat the back of the upper thrust bearing with Jeep/Eagle Super Oil Conditioner and install them to the grooves in the block. The oil groove in the bearings **MUST** face out.

(8) Apply a coating of clean engine oil to all of the upper main bearings (Fig. 21).

(9) Set crankshaft in place (Fig. 21).

(10) Lubricate the main bearing and connecting rod journals with clean engine oil.

(11) Install a set of lower thrust bearings to the rear No. 1 main bearing cap with the oil grooves facing out (Fig. 21).

The main bearing caps are stamped one through four starting at the flywheel end of the engine. They must be installed in the correct order with tabs pointing forward (Fig. 22).

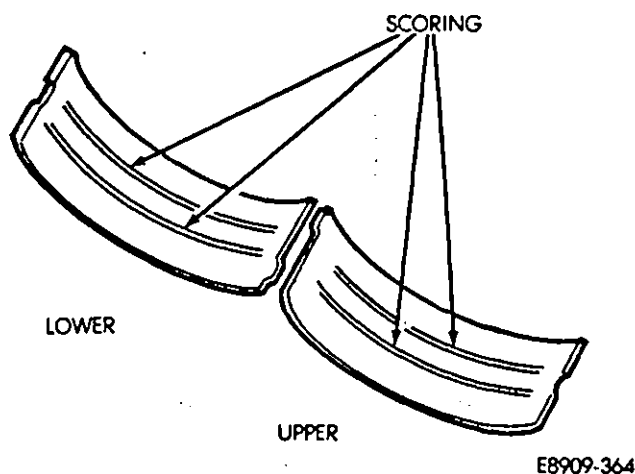


Fig. 17—Rod Bearing Scoring

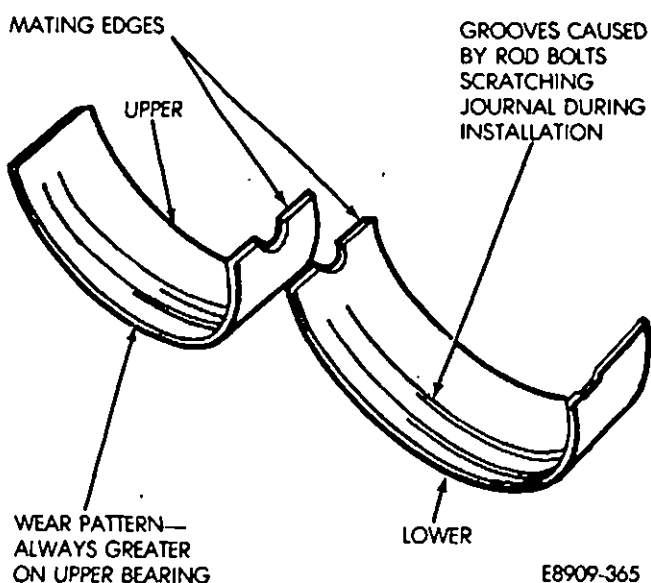


Fig. 18—Rod Bearing Grooves/Wear Pattern

(12) Install the front and rear main bearing caps with the tabs facing the crankshaft pulley end of the engine (Fig. 23).

(13) Install the main bearing clamps (Tool 6071) over the main bearing caps (Fig. 23). Use four of the lower casing mounting nuts to hold them in place. Tighten the nuts to 30 N·m (20 ft-lbs) torque.

(14) Place a magnetic base dial indicator onto the front main bearing cap clamp. Position the gauge against the front end of the crankshaft.

(15) With the crankshaft pushed towards the flywheel end, set the gauge to zero.

(16) Push the crankshaft towards the crankshaft pulley end of the engine until it stops.

(17) Check the amount of end play indicated on the dial. It should be between 0.07 mm and 0.27 mm (.003 in and .011 in).

(18) If the end play is not within this range use

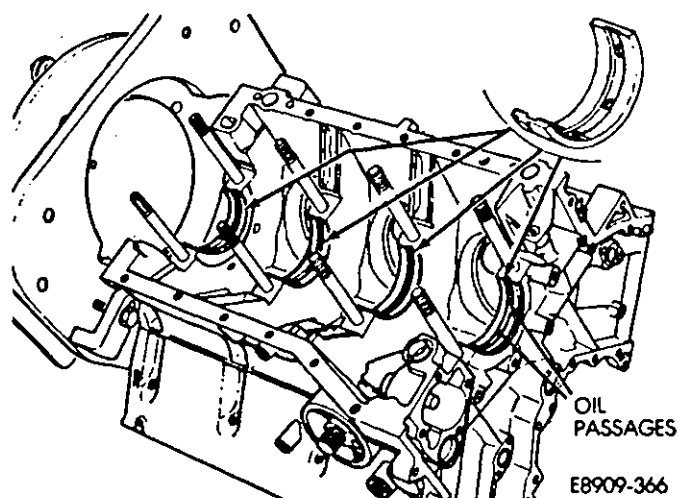


Fig. 19—Cylinder Block Oil Passages

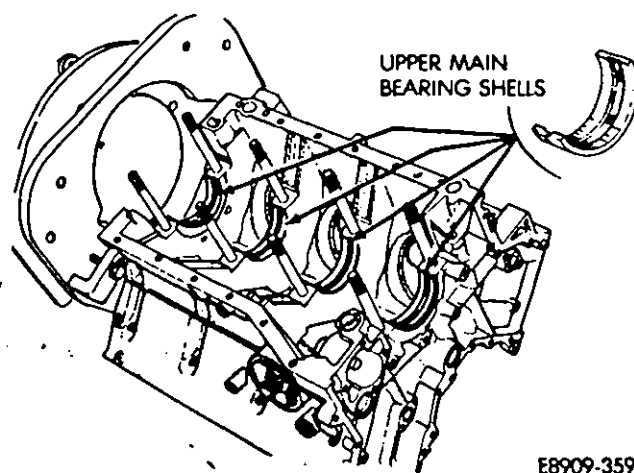


Fig. 20—Upper Main Bearing Shells

thrust bearings of a different thickness until the correct end play is obtained.

(19) Install crankshaft turning tool (Tool 6072).

(20) Remove the main bearing cap clamps.

(21) Install No. 2 and No. 3 main bearing caps with the tabs pointing forward (Fig. 24).

(22) Install a new O-ring seal on the oil pump entry tube (Fig. 24). When assembling the cylinder block, the O-ring seals for the lower casing and oil pump inlet tube **MUST** be replaced. Also replace the oil galley plug gaskets (washers).

(23) Install the crankshaft rear seal housing with a new gasket. Install, finger tight, two mounting bolts at positions (1) and (4).

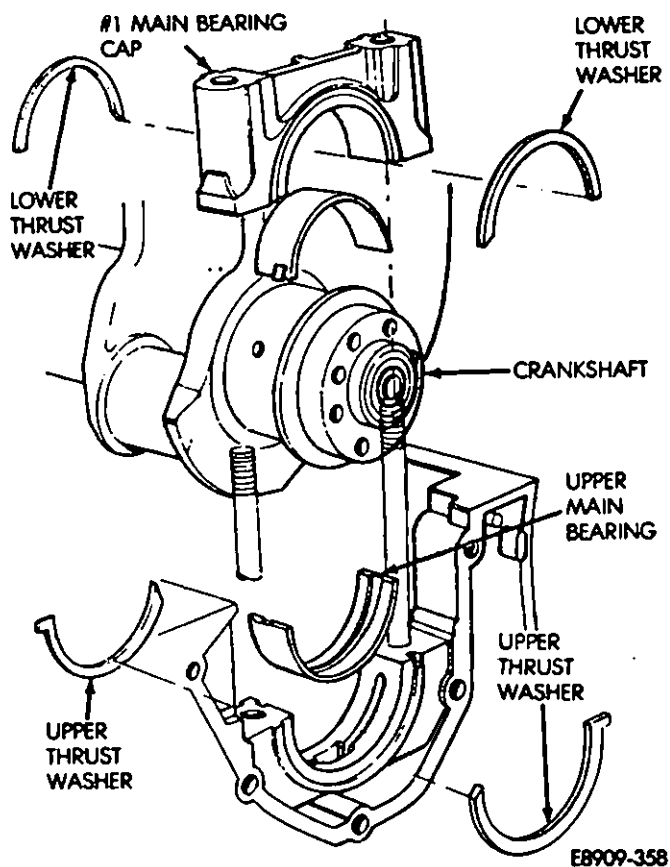


Fig. 21—Main Bearing Cap/Bearing/Thrust Washers

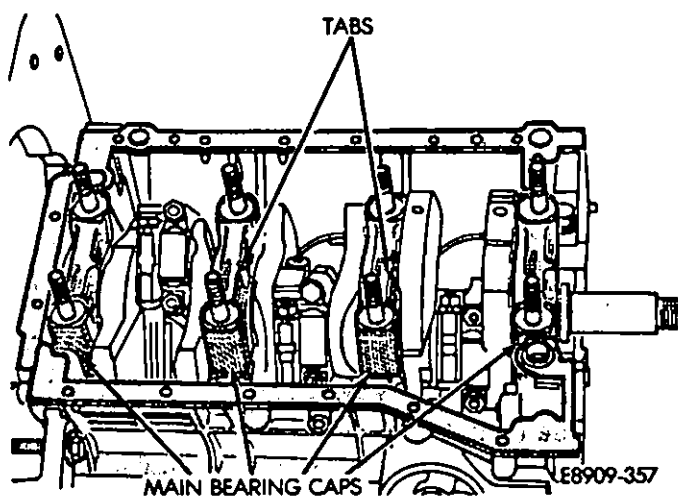


Fig. 22—Position of Main Bearing Caps

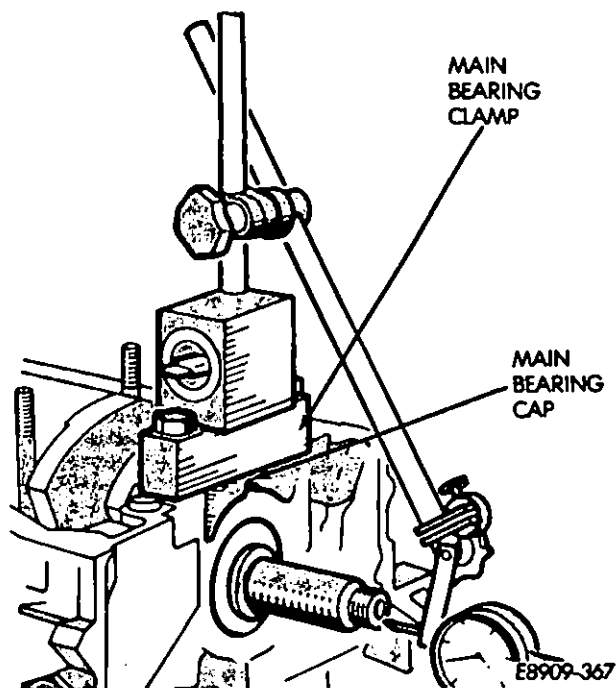


Fig. 23—Main Bearing Cap with Clamp

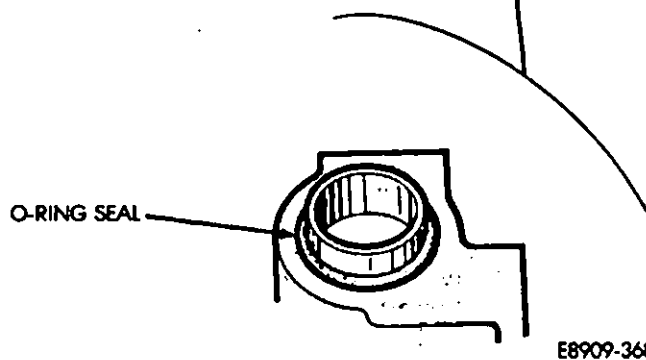
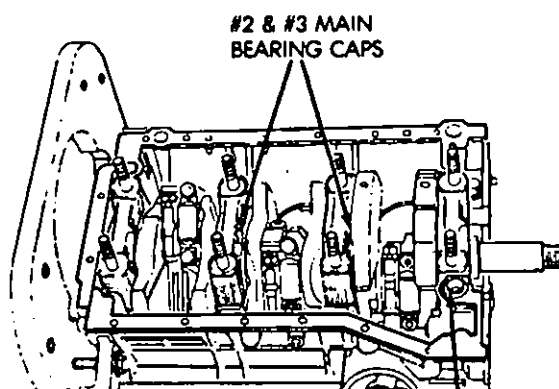


Fig. 24—Main Bearing Caps and O-Ring Seal

CAUTION: When installing the lower casing, alignment plate (Tool 6140) must be used. Use of this alignment plate will ensure correct positioning of the lower casing and will avoid distortion to the converter housing of the transmission.

(24) Apply a bead of Jeep/Eagle Gasket-in-a-Tube to the mating surface of the cylinder block.

(25) Place the lower casing over the cylinder block and install the flat washers. Start the nuts onto the studs, but do not tighten them.

(26) Insert casing bolts into the bolt holes but, do not tighten them.

(27) Insert the casing to the rear seal housing bolts into the bolt holes but, do not tighten them (Fig. 25).

(28) Push the lower casing forward and using the bolts supplied, attach lower casing alignment plate (Tool 6140) with the machined bosses on the plate facing the rear of the engine. The bolts thread into the rear crankshaft seal housing mounting bolt holes. Slightly tighten the bolts.

(29) Pull the lower casing back against the alignment plate then proceed with tightening the casing nuts.

(30) Pretighten the nuts in the sequence shown to 30 N·m (20 ft-lbs) torque (Fig. 26).

(31) Starting at position #1 and proceeding in sequence.

- Attach an angular wrench (Tool 7321) between a socket and ratchet (Fig. 27).
- Turn the angular wrench until the locking arm rests against a solid object.
- Attach the magnetic base of the pointer to another nut or bolt (Fig. 27).

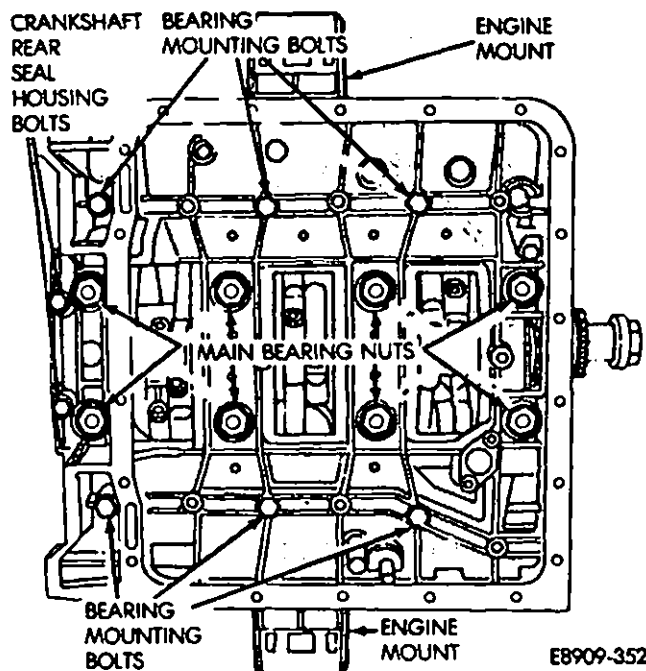


Fig. 25—Lower Casing

- Position the end of the pointer so that it is aligned with the 75° mark on angular wrench.
- Tighten the nuts until the zero on the dial align with the end of the pointer.

(32) Repeat the angular tightening, in sequence, for the remaining nuts.

(33) Remove the alignment plate.

(34) Tighten the lower casing to rear crankshaft seal housing bolts to 12 N·m (9 ft-lbs)—(Fig. 28).

(35) Install the remaining seal housing bolts and tighten them to 15 N·m (11 ft-lbs) torque.

(36) Tighten the casing bolts to 17 N·m (13 ft-lbs).

(37) Install a new rear crankshaft oil seal using Tool 6482 (Fig. 29). Lubricate the seal prior to installing it.

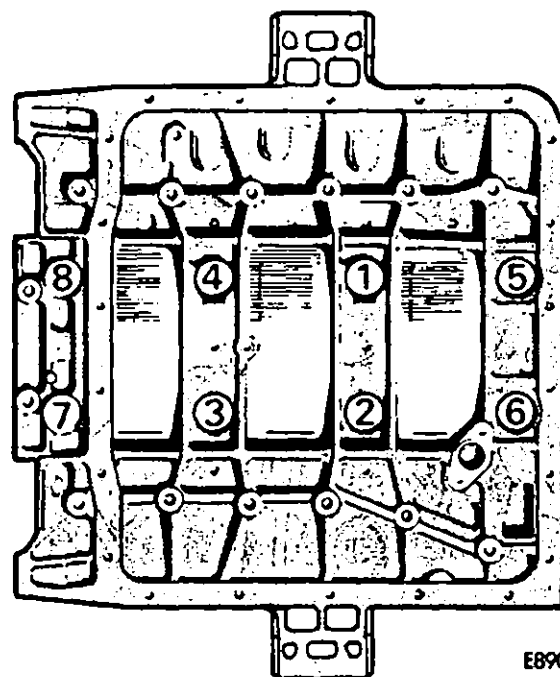


Fig. 26—Lower Casing Nut Tightening Sequence

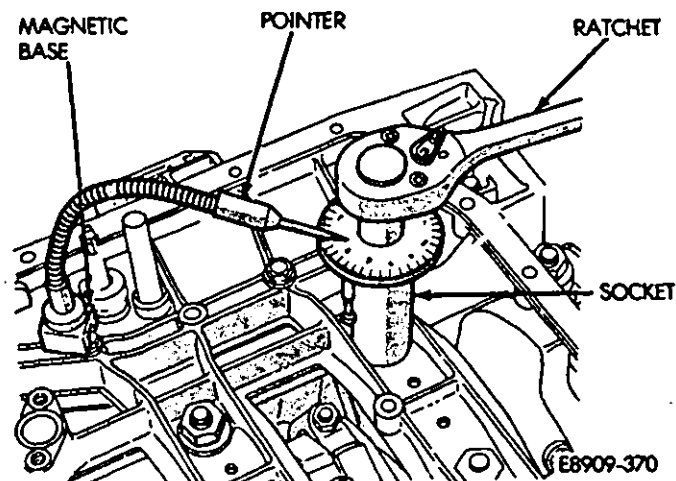


Fig. 27—Lower Casing Angular Tightening

(38) Gently tap the seal into place until the installer stops.

(39) Remove the installer by turning and pulling it at the same time.

(40) Install the oil baffle (Fig. 30). Tighten the oil baffle mounting bolts to 12 N·m (9 ft-lbs) torque. Tighten bearing mounting bolts to 17 N·m (13 ft-lbs) torque.

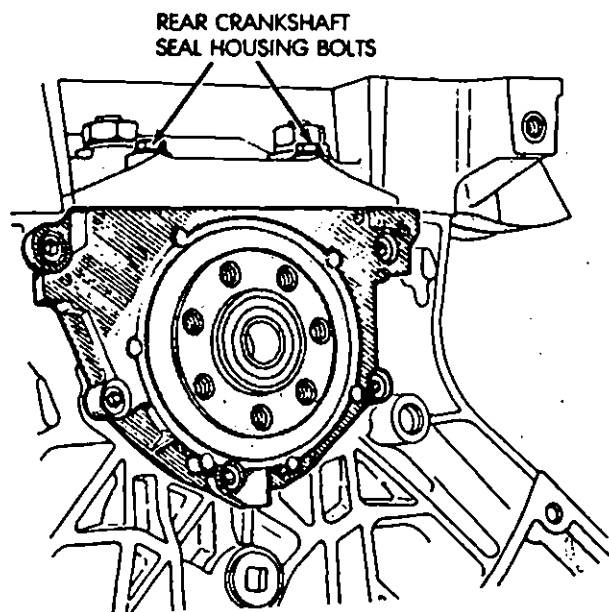
(41) Install a new O-ring seal on the bottom of the oil pump inlet tube (Fig. 31).

(42) Install the oil pump inlet tube (Fig. 31). Tighten the mounting bolts to 12 N·m (9 ft-lbs) torque.

(43) Install dry, a new oil pan gasket to the lower casing.

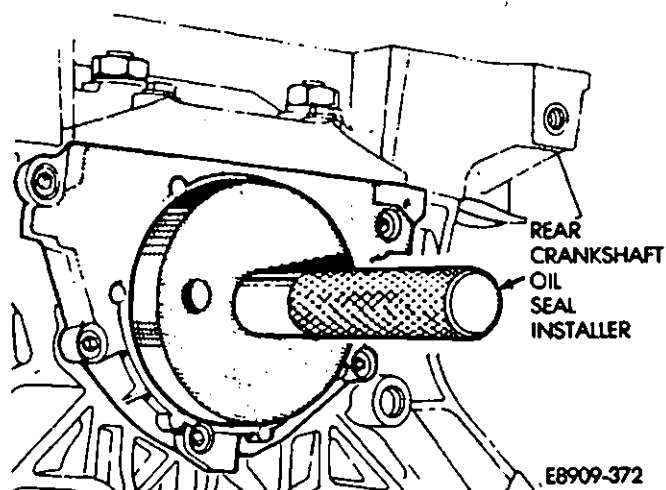
(44) Install the oil pan. Tighten the mounting bolts to 12 N·m (9 ft-lbs) torque.

(45) Install the oil pan drain plug using a new gasket (washer). Tighten the plug to 30 N·m (22 ft-lbs) torque.



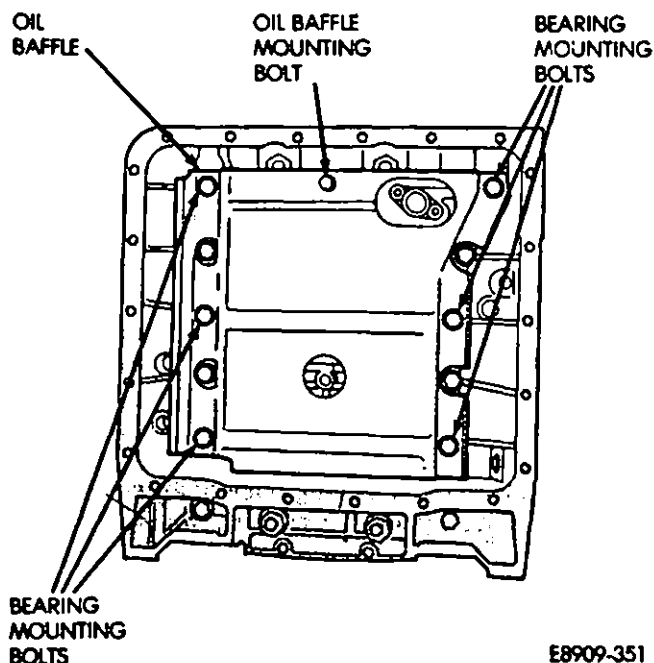
E8909-371

Fig. 28—Crankshaft Seal Housing



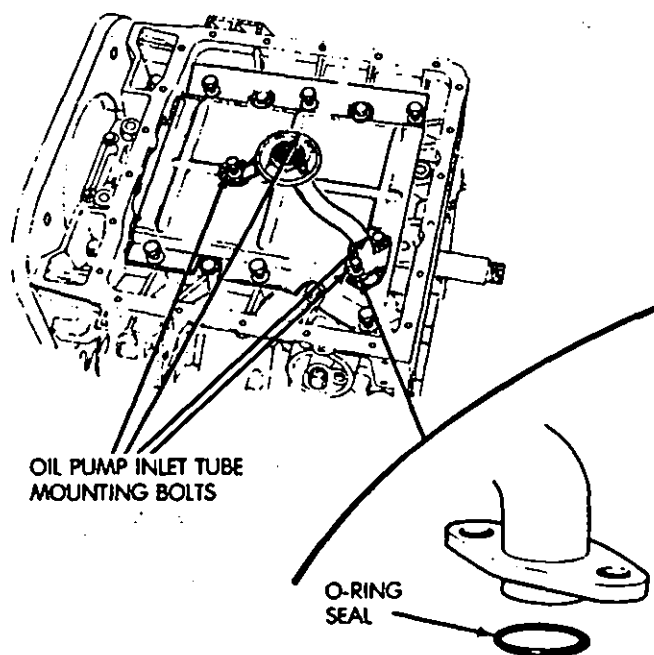
E8909-372

Fig. 29—Install Rear Crankshaft Oil Seal



E8909-351

Fig. 30—Oil Baffle



E8909-373

Fig. 31—Oil Pump Inlet Tube/O-Ring Seal

CYLINDER LINER

Cylinder Liner Kits

Kits containing cylinder liners, pistons, piston pins and piston rings are available (Fig. 1). The components of the kits are pre-measured and matched to each other ensuring correct clearances. Each kit contains one of each component. **CAUTION:** All parts of the kits are coated with a preservative that can be removed with Acetone. Do not scrape the coating off of any component in the kit.

Connecting rods are not part of the kits and are available separately.

Mark the components of each kit with the same letter so that they are not mixed with another kit. For example, if six kits are used mark all components of the first kit with an A, the second kit with a B, etc.

If the old connecting rod(s) are to be reused, press the piston pins out (refer to the Piston-Connecting Rod Section—Disassembly).

Liner Protrusion

When the cylinder liner and liner seal are installed into the cylinder block, the top of liner protrudes above the cylinder block deck. The protrusion specification is 0.05 mm to 0.12 mm (.002 in to .005 in).

The amount of protrusion is adjustable by using different thickness cylinder liner seals.

A steel cylinder liner seal is used to seal between the liner and the cylinder block.

Liner seals are available in 3 thicknesses, iden-

tified by the color of the seal (Fig. 2). The liner seals are made with an anti-corrosion coating that changes the actual seal thickness.

If the original cylinder liner-piston-connecting rod are being reused, position the liners in the same bore from which they were removed. Use a new liner seal of the same thickness (color) as the discarded seal. Align the marks that were made on the cylinder block and liner when the engine was disassembled.

If new cylinder liner-piston assemblies are being used, place the new liners with a new seal into the cylinder block. Check the liner protrusion. Since the liners are new, it is not necessary to place the liners in any particular order or to turn the liner to any specific position when installing.

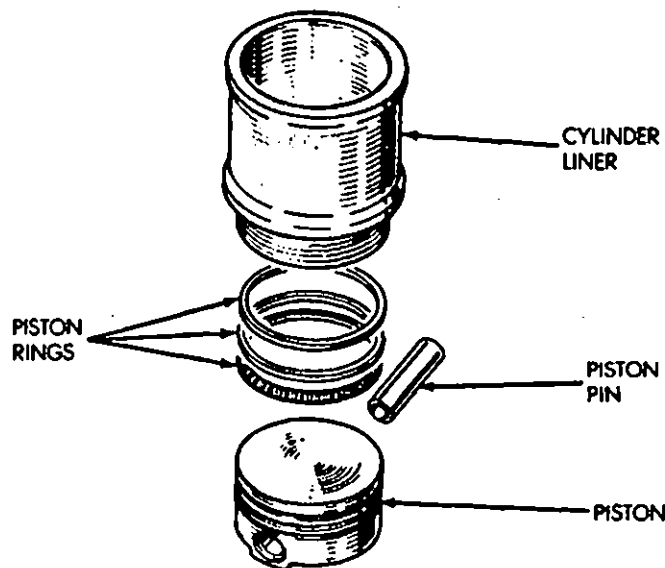
Check the liner protrusion using a dial gauge at positions (L) and (M)—(Fig. 3). The liner protrusion specification is between 0.05 mm and 0.12 mm (.002 in and .005 in).

SEAL COLOR	THICKNESS
RED	0.10 mm (0.004 in)
SILVER	0.12 mm (0.005 in)
BLUE	0.15 mm (0.006 in)

SEAL COLOR	THICKNESS & COATING
RED	0.116 ± 0.018 mm (0.0045 ± 0.0007 in)
SILVER	0.136 ± 0.018 mm (0.0055 ± 0.0007 in)
BLUE	0.166 ± 0.028 mm (0.0065 ± 0.0011 in)

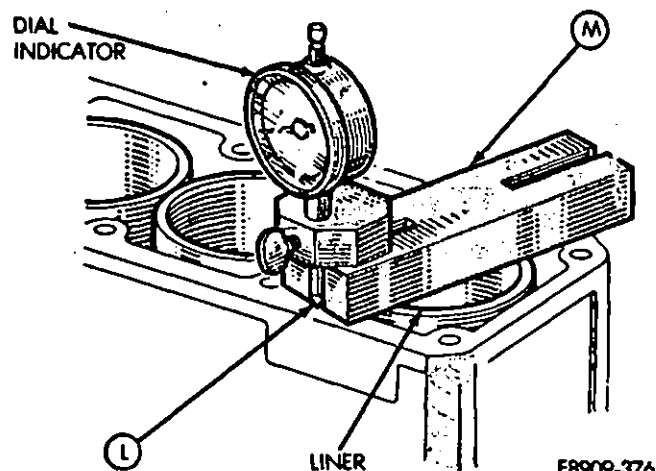
E8909-375

Fig. 2—Liner Seal Identification



E8909-374

Fig. 1—Cylinder Kit



E8909-376

Fig. 3—Measuring Liner Protrusion

The difference in protrusion between any two adjacent cylinder liners is not to exceed 0.04 mm (.0016 in) within the range of 0.05 mm and 0.12 mm (.002 in and .005 in).

Adjust liner protrusion so that the amount of protrusion is greatest at the No. 1 position on the left bank and the No. 4 position on the right bank, and steps down in amounts to No. 3 (left bank) or No. 6 (right bank)—(Fig. 4) Use different thickness liner seals as necessary.

Once the correct protrusions have been obtained, group the assemblies (kits), A, B, C, D, E and F together and then number the cylinder liners, pistons and piston pins from 1 to 6 so that they match the corresponding connecting rod. If the original cylinder liner-piston-connecting rod assemblies are being reused, place the cylinder liner with the corresponding piston assembly.

PISTON-CONNECTING ROD

Disassembly

(1) Remove the piston connecting rod assembly from the cylinder liner by pulling it out the bottom of the liner.

(2) Use the piston support block, the anvil and the extractor rod of the piston pin removal/installation kit (Tool 7305) to press the piston pin from the piston and connecting rod (Fig. 5).

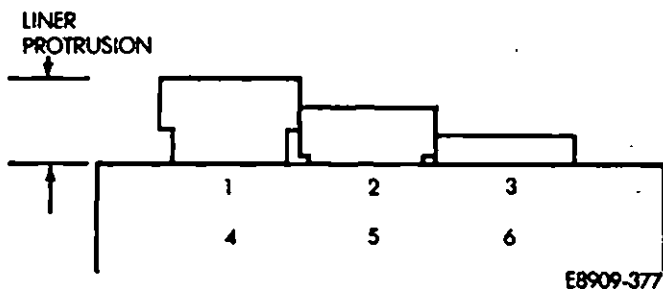


Fig. 4—Liner Protrusion Between Cylinders

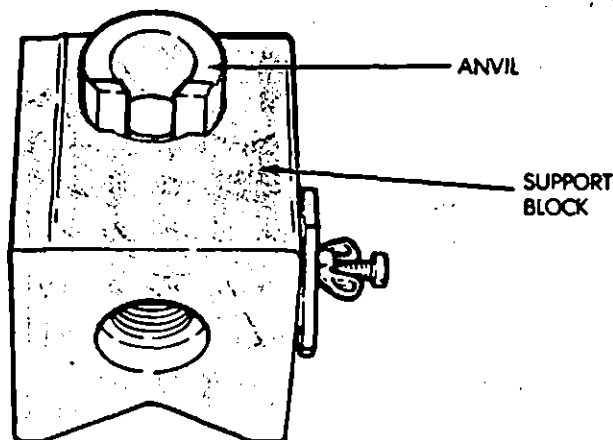


Fig. 5—Piston Pin Removal/Installation

(3) Turn the piston support block so that it rests on the "V" section. Place the anvil into the top of the support.

(4) Position the piston over anvil and pilot the bottom edge of the pin into the anvil to center the piston (Fig. 6). Install extracting rod into the top of the piston. Press the piston pin out of the connecting rod.

Assembly

(1) Check the connecting rods for twist or bend:

- Max. Twist—0.051 mm (.002 in).
- Max. Bend—0.076 mm (.003 in).

(2) Check the condition of the large end. Use Arkansas smooth stone to remove any nicks and burrs that are found.

(3) Check the condition of the pin bore in the small end of the connecting rod. Use an oil stone to remove all nicks and burrs.

(4) Check the diameter of the pin bore. It must be between 24.959 mm and 24.971 mm (.9826 in and .9831 in) to ensure the correct interference fit between the pin bore and the piston pin.

Pistons 1, 2 and 3—Left Bank

The piston, piston pin and connecting rod are assembled by heating the small end of the connecting rod until the piston pin bore expands. Slide the pin through the piston and the connecting rod. As the small end cools the pin bore contracts, forming an interference fit with the piston pin.

Use a 1500 watt hot plate to heat the small end of the connecting rod (Fig. 7).

Place the small end of the connecting rods 1, 2 and 3 squarely on the hot plate with the shoulder of the large end towards the bottom (Fig. 7).

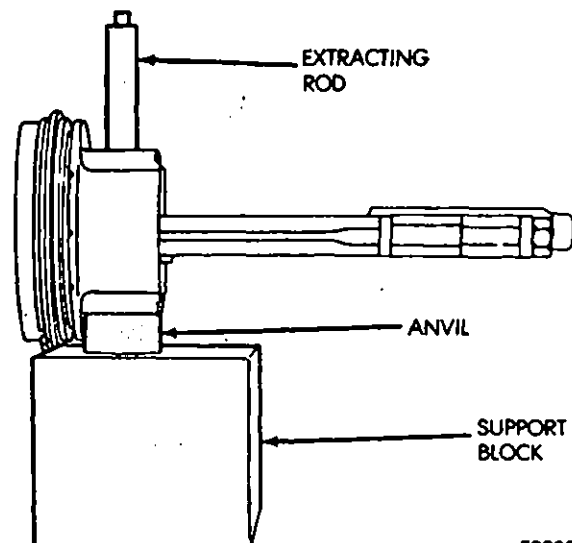


Fig. 6—Support Block/Anvil

Use a small piece of solder with a melting point of 250° C (480°F) as a temperature guide. Place the solder on each small end (Fig. 7).

Heat up the connecting rod small ends until the solder liquefies.

Insert the piston pin into the pin bore of the piston. It should rotate freely.

Use Mandrel A-8 and Guide C-9 from Piston Pin Removal and Installation Kit (Tool 7305) to install the piston pin (Fig. 8).

Position the piston pin in between the mandrel and the guide. Do not tighten the mandrel, back it off one turn from the piston pin so that the pin floats freely between the mandrel and the guide.

Lubricate the guide and piston pin with clean engine oil.

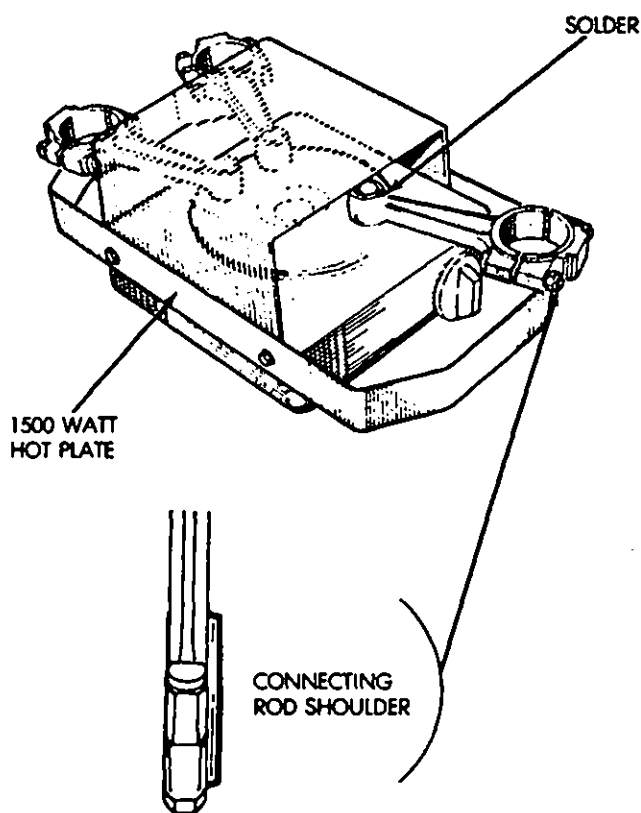


Fig. 7—1500 Watt Hot Plate

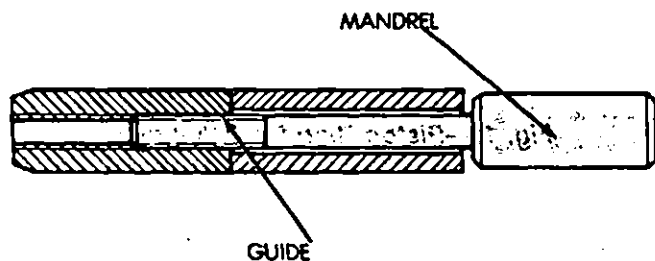


Fig. 8—Install Piston Pin

When assembling the left bank pistons (Nos. 1, 2 and 3) the shoulder on the connecting rod large end must be opposite the arrow on the piston crown (Fig. 9).

From piston pin removal/installation kit (Tool 7305), place the anvil on top of the support block with the flat side opposite the retaining clip clamp (Fig. 10).

Clamp the piston, with the arrow pointing up, to the support. To center the piston to the anvil, slide the mandrel-piston pin-guide through the piston and the anvil. This will align the pin bore and anvil. Lightly tighten the clip. Pull the mandrel-piston pin-guide assembly up and out of the piston.

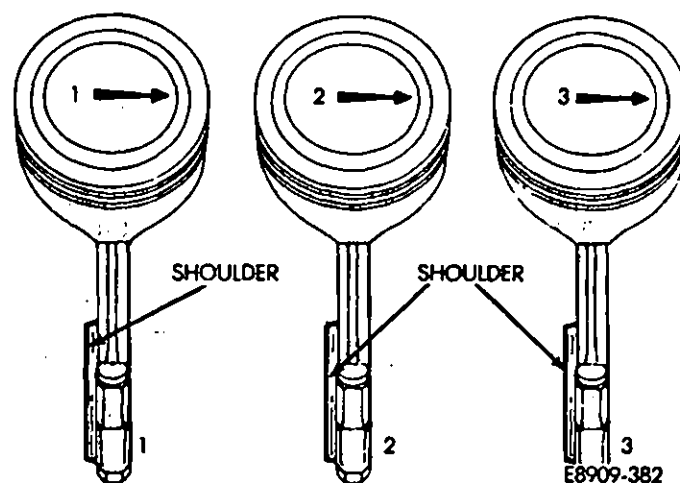


Fig. 9—Position of Shoulder on Conn. Rod

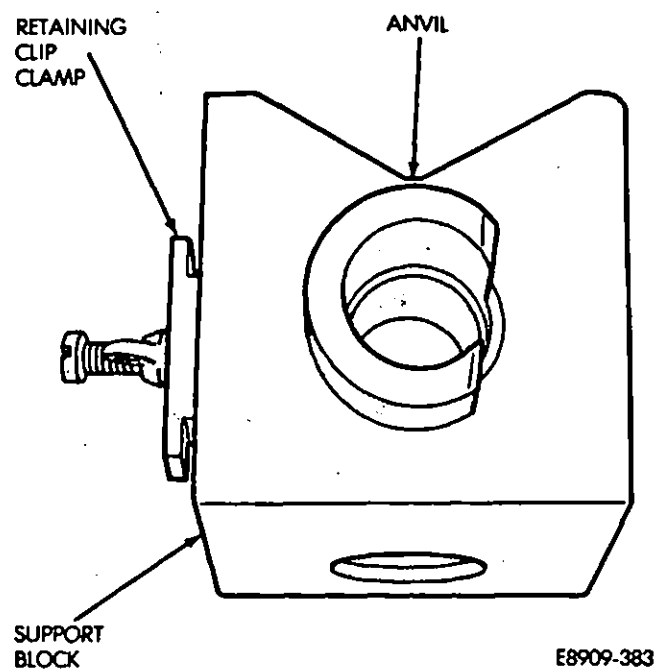


Fig. 10—Position of Anvil on Support Block

The following procedure must be performed as quickly as possible to prevent the connecting rod small end from cooling and contracting before the piston pin is completely installed.

Ensure that the solder is liquefied on the small end of the connecting rod.

When assembling the connecting rods for cylinders 1, 2 and 3, the piston must be clamped in place on support block with the arrow up and the connecting rod installed with the shoulder pointing down (opposite the arrow on the piston).

Wipe the solder from the small end of the connecting rod.

Insert the guide end of the mandrel-piston pin-guide assembly (A-8) into the top of the piston pin bore (but not down into the center of the piston)—(Fig. 11).

Using one hand, remove the connecting rod from the hot plate and, with the shoulder pointing down, insert the connecting rod into the support block (Fig. 11).

With the other hand, quickly press the mandrel-piston pin-guide assembly down until the guide bottoms out in the support bracket.

Wait ten (10) seconds and then remove the connecting rod-piston assembly from the support block. Unscrew the guide and remove the mandrel (A-8).

Check that the connecting rod and piston pin are centered to the piston.

Assemble the other two piston-connecting rods in the same manner.

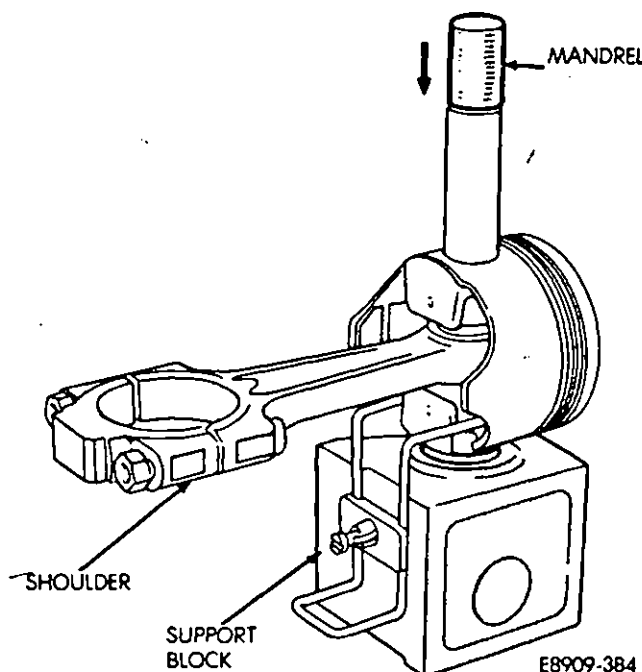


Fig. 11—Piston Pin Installation

Pistons 4, 5 and 6—Right Bank

Place the small ends of the connecting rods 4, 5 and 6 squarely onto the hot plate with the shoulder on the large end pointing up.

Place the piston on the support block with the arrow pointing up.

When installing the right bank pistons (4, 5 and 6), the shoulder on the connecting rod large end must be on the same side as the arrow on the piston crown.

Assemble the piston-connecting rods as described for the left bank except, insert the connecting rods into the piston with the shoulder pointing up (Fig. 12).

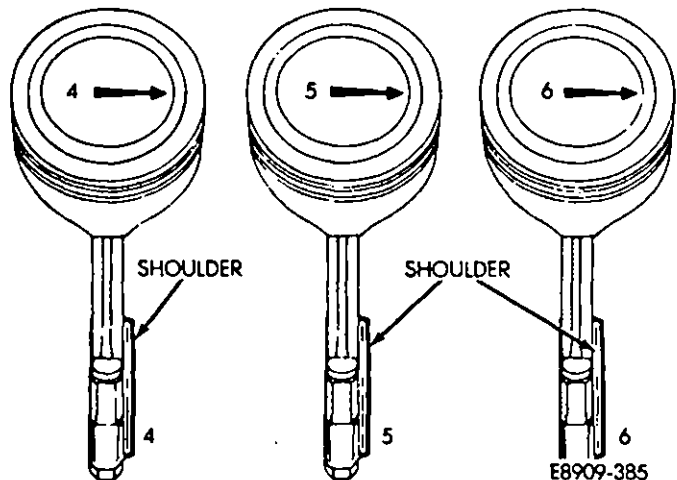


Fig. 12—Position of Conn. Rod Shoulder

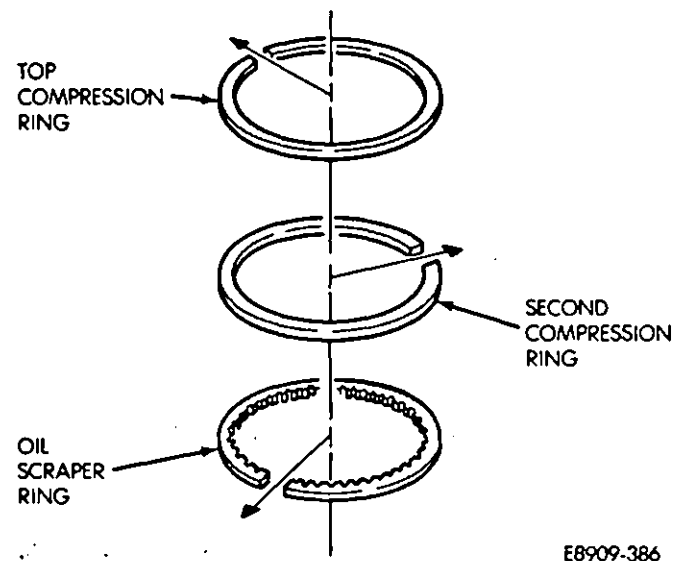


Fig. 13—Piston Ring Gap Alignment

PISTON RING REPLACEMENT

The scraping edge of the top compression ring is not tapered and can be installed with either side up (Fig. 13).

The scraping edge of the second compression ring is tapered and must be installed with the side marked "top" facing up (Fig. 13).

The oil scraper ring is a Goetze design ring and can be installed with either side up (Fig. 13).

Install the rings with each end gap 120° from each other.

The piston ring end gap has been pre-set to the cylinder liner. There is no need to trim the ring ends.

CAUTION: The top of the cylinder liner is not chamfered. Do not install the piston from the top of the liner because damage to the piston rings and ring lands can occur. The piston **MUST** be installed from the bottom of the liner.

Lubricate the piston, piston pin and cylinder liner with clean engine oil.

Use a piston ring compressor to install the piston into the cylinder liner from the bottom (Fig. 14).

Install the connecting rod bearings.

CAUTION: When installing the piston liner assembly into the cylinder block, slide insulators made from rubber hose over the ends of the connecting rod bolts to prevent nicking the crankshaft journals.

Turn the crankshaft so that the connecting rod journal of the cylinder to be installed is at the bottom of its stroke and centered to the liner bore of the cylinder block.

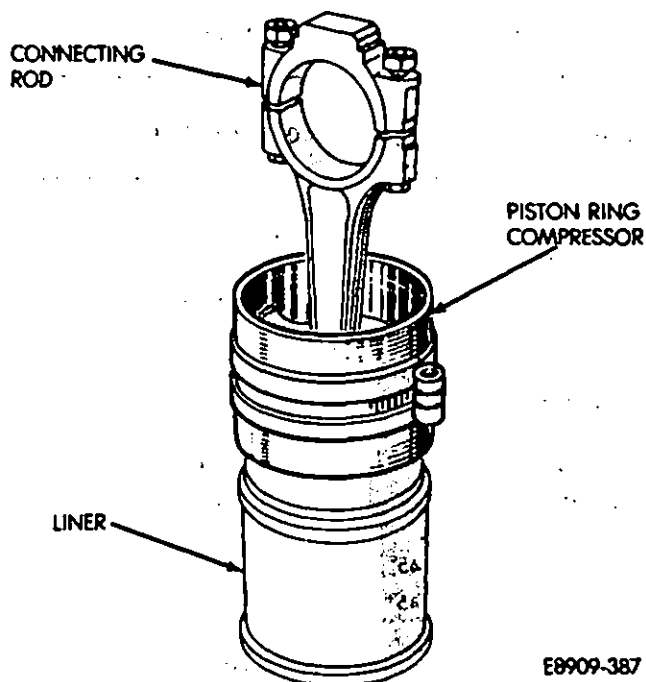


Fig. 14—Piston Ring Compressor

If original cylinder liner and pistons are being reused, be sure to align the marks that were made on both during disassembly.

Install cylinder liner-piston assemblies 1, 2 and 3 on the left bank of the engine with the arrow on the crown of the piston pointing toward crankshaft pulley end and shoulder of the connecting rod pointing to flywheel end of the engine (Fig. 15).

Install the connecting rod cap and finger tighten the connecting rod nuts. Do not tighten the connecting rod nuts until all cylinder liner-piston assemblies are installed.

Use liner clamps (Tool 7315) to hold the liners in place before installing the next assembly.

Install cylinder liner-piston assemblies 4, 5 and 6 on the right bank of the engine with both the arrows on the crown of the piston and shoulder of the connecting facing the crankshaft pulley end of the engine.

Tighten all of the connecting rod nuts to 42 N·m (31 ft-lbs) torque.

Using feeler gauges or a magnetic base dial indicator check the connecting rod side clearance at each journal. The side clearance must be between 0.20 mm and 0.38 mm (.008 in and .015 in).

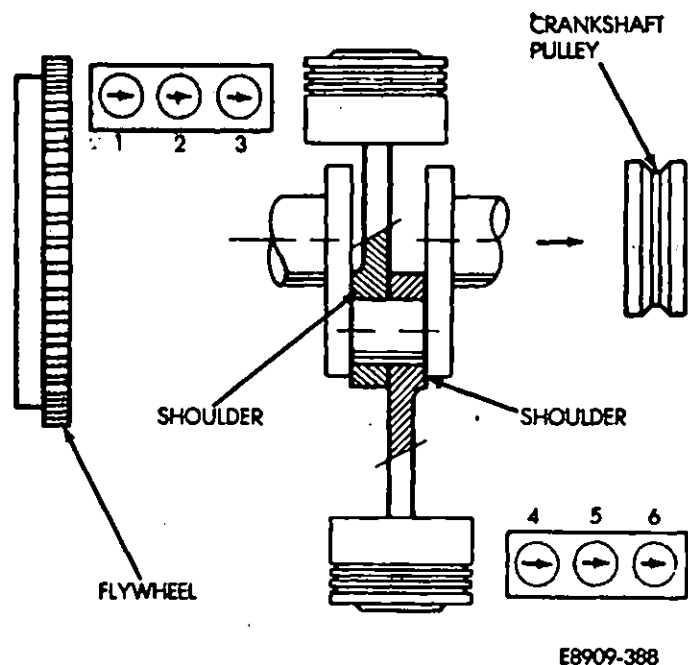


Fig. 15—Positioning of Piston/Conn. Rod

CAMSHAFT

END PLAY	0.07-0.14 MM	.003-.0055 IN.
INTAKE VALVE		
OPEN	14° BTDC (BEFORE TOP DEAD CENTER)	
CLOSES	58° ABDC (AFTER BOTTOM DEAD CENTER)	
EXHAUST VALVE		
OPEN	56° BBDC (BEFORE BOTTOM DEAD CENTER)	
CLOSES	12° ATDC (AFTER TOP DEAD CENTER)	
VALVE OVERLAP	26°	
INTAKE DURATION	252°	
EXHAUST DURATION	248°	

CONNECTING RODS

LENGTH (SMALL END TO LARGE END CENTERLINE)	146.15 MM	5.75 IN.
PISTON PIN BORE DIAMETER	24.959-24.971 MM	0.9826-0.9831 IN.
CONNECTING ROD BEARING BORE (WITHOUT BEARINGS)	63.704 MM	2.508 IN.
SIDE CLEARANCE	0.20-0.38 MM	0.008-0.015 IN.
MAXIMUM TWIST	0.075 MM	0.002 IN.
MAXIMUM PARALLEL (BEND)	0.080 MM	0.003 IN.
WEIGHT	752.5-757.5 G.	26.545-26.721 OZ.

CRANKSHAFT

END PLAY	0.07-0.27 MM	.003-.010 IN.
MAIN BEARING JOURNAL DIAMETER	70.043-70.062 MM	2.7576-2.7583 IN.
MAIN BEARING CLEARANCE	0.038-0.089 MM	0.0015-0.0035 IN.
CONNECTING ROD JOURNAL DIAMETER	59.971-59.990 MM	2.3611-2.3618 IN.
MAIN BEARING BORE IN BLOCK	74.000-74.019 MM	2.9134-2.9141 IN.

CYLINDER BLOCK

LINER PROTRUSION	0.05-0.12 MM	0.002-0.005 IN.
------------------------	--------------	-----------------

CYLINDER HEAD

COMBUSTION CHAMBER VOLUME	50.6 CC	3.09 CU. IN.
VALVE GUIDE I.D. (INSIDE DIAMETER)	8.0 MM	0.315 IN.
VALVE GUIDE O.D. (OUTSIDE DIAMETER)	13.0 MM	0.512 IN.
REPAIR VALVE GUIDE O.D.	13.35 MM	0.526 IN.
VALVE GUIDE LENGTH		
INTAKE	45.0 MM	1.772 IN.
EXHAUST	49.0 MM	1.929 IN.
VALVE SEAT ANGLE		
INTAKE	45°	
EXHAUST	45°	
FLATNESS (MAX. WARPAGE) (NOT RESURFACEABLE)	0.051 MM	0.002 IN.
HEAD GASKET THICKNESS	1.45 MM	0.057 IN.
CYLINDER HEAD HEIGHT	110.83 MM	4.363 IN.

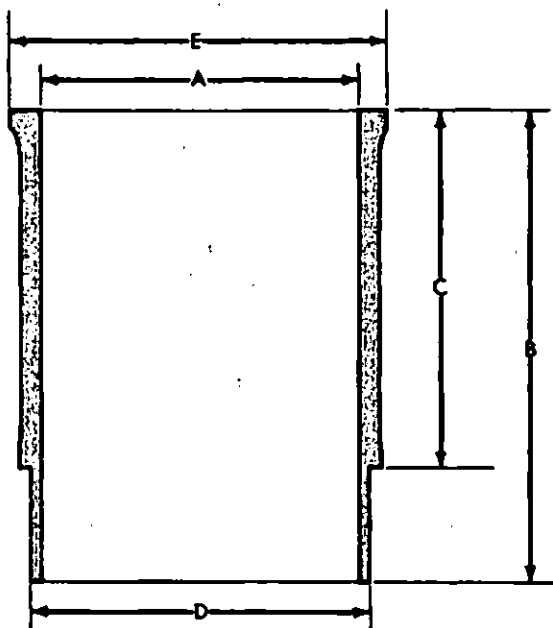
CYLINDER LINER

LINER INSIDE DIAMETER (A)

3 CLASSES OF LINER IDENTIFIED

BY NOTCHES ON LINER TOP

1 NOTCH	93.00-93.01 MM	3.6614-3.6618 IN.
2 NOTCHES	93.01-93.02 MM	3.6618-3.6622 IN.
3 NOTCHES	93.02-93.03 MM	3.6622-3.6626 IN.
LINER TOTAL LENGTH (B)	131.10 MM	5.16 IN.
LINER LENGTH (C) TOP TO BLOCK SEAT	89.975 MM	3.54 IN.
LINER OUTSIDE DIAMETER (D)	97.68 MM	3.85 IN.
LINER OUTSIDE DIAMETER (E)	107.2 MM	4.22 IN.

**CYLINDER LINER SEAL**

LINER SEAL THICKNESS

IDENTIFIED BY TABS ON THE SEAL

RED	0.10 MM	0.004 IN.
SILVER	0.12 MM	0.005 IN.
BLUE	0.15 MM	0.006 IN.

OIL PRESSURE

AT IDLE SPEED (790 RPM)

101 KPA (14.7 PSI)

AT 4000 RPM

414 KPA (60 PSI)

NOTE: CHECK OIL PRESSURE ONLY WHEN
THE THERMOSTAT IS OPEN AND THE
ENGINE COOLANT TEMPERATURE IS AT
89°C (192°F).

ROCKER ARM

ROCKER ARM DIAMETER	19.959-19.976 MM	0.786-0.787 IN.
---------------------------	------------------	-----------------

PISTONS

COMPRESSION HEIGHT (PIN BORE CENTERLINE TO PISTON TOP)	38.7 MM	1.524 IN.
PISTON RING END GAP (CLEARANCE)		
#1 COMPRESSION RING	0.40-0.55 MM	0.016-0.022 IN.
#2 COMPRESSION RING	0.40-0.55 MM	0.016-0.022 IN.
OIL CONTROL RING	N/A — SEGMENTED RING	
PISTON RING SIDE CLEARANCE		
#1 COMPRESSION RING	0.03-0.05 MM	0.001-0.002 IN.
#2 COMPRESSION RING	0.03-0.05 MM	0.001-0.002 IN.
OIL CONTROL RING	0.04-0.09 MM	0.0015-0.0035 IN.
PISTON RING THICKNESS		
#1 COMPRESSION RING	1.75 MM	0.069 IN.
#2 COMPRESSION RING	1.75 MM	0.069 IN.
OIL CONTROL RING	3.44-3.47 MM	0.135-0.137 IN.
PISTON RING GROOVE HEIGHT		
#1 COMPRESSION RING	1.78-1.80 MM	0.070-0.071 IN.
#2 COMPRESSION RING	1.78-1.80 MM	0.070-0.071 IN.
OIL CONTROL RING	3.51-3.53 MM	0.138-0.139 IN.
PISTON RING GROOVE DIAMETER (INSIDE)		
#1 COMP. RING GROOVE	84.30-84.50 MM	3.319-3.327 IN.
#2 COMP. RING GROOVE	83.70-83.90 MM	3.295-3.303 IN.
OIL CONTROL RING GROOVE	82.80-83.00 MM	3.260-3.268 IN.
PISTON RING BORE DIAMETER	25.004-25.013 MM	0.9844-0.9848 IN.
PISTON PIN DIAMETER	24.991-25.000 MM	0.9839-0.9843 IN.
PISTON PIN TO BORE CLEARANCE	0.004-0.022 MM	0.0015-0.0085 IN.
PISTON PIN I.D.	15.0 MM	0.591 IN.
PISTON PIN LENGTH	66.0 MM	2.598 IN.

VALVES

VALVE LENGTH		
INTAKE VALVE	112.45 MM	4.427 IN.
EXHAUST VALVE	111.45 MM	4.388 IN.
VALVE STEM DIAMETER	8.0 MM	0.315 IN.
VALVE HEAD DIAMETER		
INTAKE VALVE	45.3 MM	1.783 IN.
EXHAUST VALVE	38.5 MM	1.516 IN.
VALVE FACE ANGLE	45°	
VALVE FACE WIDTH		
INTAKE VALVE	1.45-2.21 MM	0.057-0.087 IN.
EXHAUST VALVE	1.6-2.64 MM	0.063-0.104 IN.
VALVE MARGIN		
INTAKE VALVE	1.50 MM	0.059 IN.
EXHAUST VALVE	1.70 MM	0.067 IN.

VALVE SPRINGS

FREE LENGTH	48.5 MM	1.909 IN.
SPRING TENSION		
VALVE CLOSED	337 N @ 40 MM	76 LB. @ 1.575 IN.
VALVE OPEN	691 N @ 31 MM	155 LB. @ 1.220 IN.

COMPONENT	TORQUE	
AIR CLEANER HOSE CLAMP	3.4 N·M	30 IN-LBS
A/C COMPRESSOR MOUNTING BOLT	27 N·M	20 FT-LBS
ALTERNATOR LOCKING BOLT	27 N·M	20 FT-LBS
ALTERNATOR PIVOT BOLT	50 N·M	37 FT-LBS
BATTERY CABLE TO STARTER NUT	9 N·M	80 IN-LBS
CAMSHAFT SPROCKET BOLT	80 N·M	59 FT-LBS
CAMSHAFT THRUST PLATE MOUNTING BOLT	12 N·M	9 FT-LBS
CONNECTING ROD NUT	47.5 N·M	35 FT-LBS
CRANKSHAFT PULLEY NUT	180 N·M	133 FT-LBS
CRANKSHAFT REAR SEAL HOUSING BOLT	12 N·M	9 FT-LBS
CROSSMEMBER TO CRADLE NUT	60 N·M	44 FT-LBS
CYLINDER HEAD BOLT (TORQUE VERIFICATION)	70 N·M	52 FT-LBS
CYLINDER HEAD COVER BOLT	12 N·M	9 FT-LBS
CYLINDER HEAD REAR COVER BOLT	6 N·M	53 IN-LBS
DIFFERENTIAL COVER BOLT	27 N·M	20 FT-LBS
DISTRIBUTOR CAP MOUNTING BOLT	9 N·M	80 IN-LBS
DISTRIBUTOR ROTOR MOUNTING BOLT	3 N·M	26 IN-LBS
ENGINE CRADLE MOUNTING BOLT	125 N·M	92 FT-LBS
ENGINE DAMPER BOTTOM LOCKNUT	27 N·M	20 FT-LBS
ENGINE DAMPER TOP NUT	43 N·M	32 FT-LBS
ENGINE MOUNT NUT	65 N·M	48 FT-LBS
ENGINE MOUNT STUD LOCKNUT	65 N·M	48 FT-LBS
HALF SHAFT TO BRAKE HUB NUT	245 N·M	181 FT-LBS
IDLER PULLEY TO TIMING COVER BOLT	40 N·M	30 FT-LBS
LOWER CASING MOUNTING BOLT	12 N·M	9 FT-LBS
OIL BAFFLE BEARING MOUNTING BOLT	17 N·M	13 FT-LBS
OIL BAFFLE MOUNTING BOLT	12 N·M	9 FT-LBS
OIL PAN DRAIN PLUG	30 N·M	22 FT-LBS
OIL PAN MOUNTING BOLT	12 N·M	9 FT-LBS
OIL PUMP COVER BOLT	12 N·M	9 FT-LBS
OIL PUMP SPROCKET BOLT	6 N·M	53 IN-LBS
OIL PUMP SUMP TO BLOCK BOLT	12 N·M	9 FT-LBS
POWER STEERING PUMP FRONT BRACKET/REAR BRACKET NUT	40 N·M	30 FT-LBS
POWER STEERING PUMP FRONT BRACKET/TIMING CASE BOLT	27 N·M	20 FT-LBS
POWER STEERING PUMP REAR MOUNTING BRACKET STUD BOLT	40 N·M	30 FT-LBS
POWER STEERING PUMP REAR MOUNTING BOLT	27 N·M	20 FT-LBS
REAR CUSHION TO SUPPORT BRACKET BOLT	67 N·M	49 FT-LBS
REAR CUSHION TO EXHAUST BRACKET BOLT	31 N·M	23 FT-LBS
ROCKER SHAFT LOCK BOLT	6 N·M	53 IN-LBS
SPLASH SHIELD (UNDERBODY) BOLT	28 N·M	21 FT-LBS
STARTER MOTOR MOUNTING BOLT	42 N·M	31 FT-LBS
STEERING KNUCKLE NUT AT STRUT	167 N·M	123 FT-LBS

COMPONENT	TORQUE	
TIMING CASE COVER BOLT	12 N·M	9 FT-LBS
TIMING CHAIN GUIDE MOUNTING BOLT	6 N·M	53 IN-LBS
TIMING CHAIN TENSIONER MOUNTING BOLT	6 N·M	53 IN-LBS
TIMING CHAIN TENSIONER SHOE BOLT	12 N·M	9 FT-LBS
TORQUE CONVERTER TO DRIVE PLATE BOLT	33 N·M	24 FT-LBS
TRANSAXLE MOUNTING BOLT AND ALIGNMENT STUD	65 N·M	48 FT-LBS
TRANSAXLE SUPPORT BRACKET STUD NUT	40 N·M	30 FT-LBS
WHEEL LUG NUT	85 N·M	63 FT-LBS

E8909-395

Sealer Specifications

SEALER	LOCATION
JEEP/EAGLE GASKET-IN-A-TUBE	● CYLINDER BLOCK TO LOWER CASING MATING SURFACES. ● CYLINDER BLOCK TO TIMING COVER BELOW GASKET AT CYLINDER HEAD COVERS.
LOCTITE 242	● CAMSHAFT COVER PLATE ATTACHING BOLTS AT REAR OF CYLINDER HEAD. ● FRONT COVER — 4 BOTTOM BOLTS.
LOCTITE 271	● CRANKSHAFT PULLEY NUT. ● OIL FILTER ADAPTER. ● OIL PUMP SPROCKET MOUNTING BOLTS.
LOCTITE 277	● CYLINDER HEAD EXPANSION (FREEZE) PLUGS. ● CYLINDER BLOCK OIL GALLEY EXPANSION PLUGS. ● ROCKER ARM SHAFT EXPANSION PLUGS.
LOCTITE 592	● TIMING COVER PIPE PLUG (ACCESS TO RIGHT SIDE CAMSHAFT SPROCKET BOLT).
SUPER OIL CONDITIONER	● ROCKER ARM PADS. ● CAMSHAFT JOURNALS.

E8909-396