

ENGINE

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2.0L SOHC ENGINE

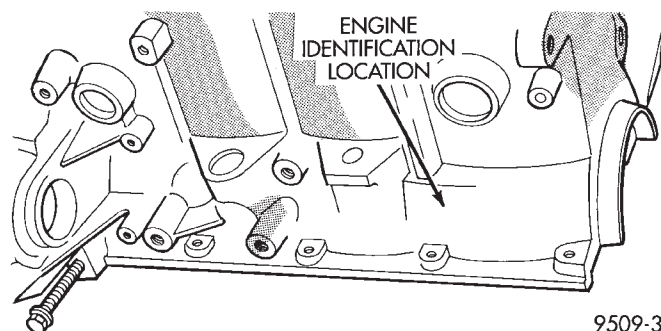
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DESCRIPTION AND OPERATION

ENGINE IDENTIFICATION

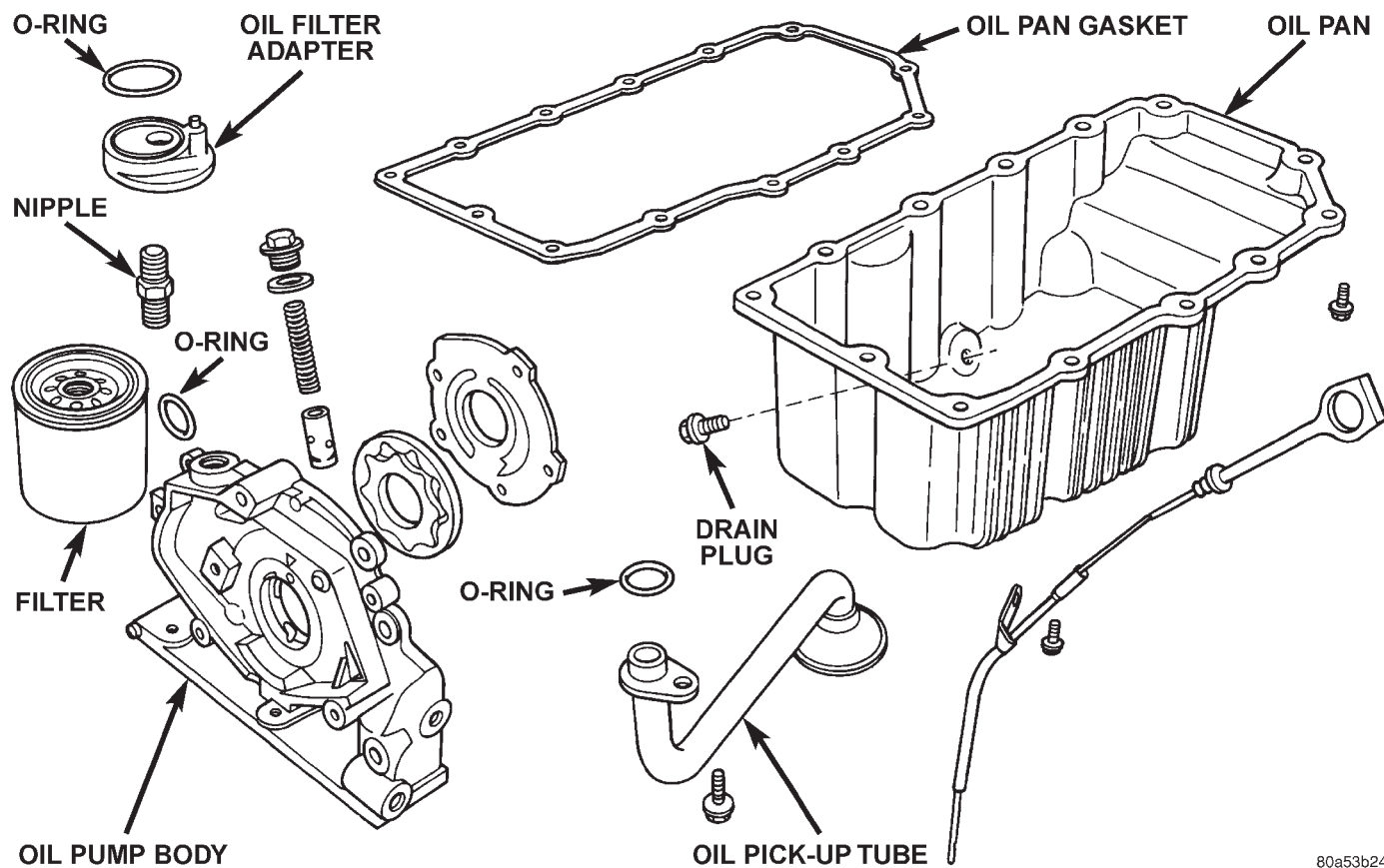
The engine identification number is located on the left rear of the cylinder block behind starter (Fig. 1).



9509-3

Fig. 1 Engine Identification SOHC

DESCRIPTION AND OPERATION (Continued)



Engine Lubrication Components

GENERAL SPECIFICATION

Type In-Line OHV, DOHC & SOHC
Bore 87.5mm (3.445 Inch)
Stroke 83.0mm (3.268 inch)
Compression Ratio DOHC - 9.6:1 SOHC - 9.8:1
Displacement 2.0 Liters (122 Cubic Inch)
Firing Order 1, 3, 4, 2
Compression Pressure 1172 - 1551 kPa
(170 - 225 psi)
Maximum Variation Between Cylinders 25%
Lubrication . . . Pressure Feed - Full Flow Filtration
(Crankshaft Driven Pump)
Engine Oil Capacity . . Refer to Group 0, Lubrication
and Maintenance

ENGINE LUBRICATION SYSTEM

ENGINE LUBRICATION

Refer to Group 0, Lubrication and Maintenance for recommended oil to be used in various engine application. System is full flow filtration, pressure feed type. The oil pump is mounted in the front engine cover and driven by the crankshaft. Pressurized oil is then routed through the main oil gallery, running the length of the cylinder block, supplying main and rod

bearings with further routing. Rod bearing oil throw-off lubricates the pistons from directed slots on the side of the connecting rod assemblies. Camshaft and valve mechanisms are lubricated from a full-length cylinder head oil gallery supplied from the crankcase main oil gallery.

PRESSURE LUBRICATION

Oil drawn up through the pickup tube is pressurized by the pump and routed through the full flow filter to the main oil gallery running the length of the cylinder block. A cylinder head restrictor, located in the block, provides increased oil flow to the main oil gallery (Fig. 2).

MAIN/ROD BEARINGS

A diagonal hole in each bulkhead feeds oil to each main bearing. Drilled passages within the crankshaft route oil from main bearing journals to connecting rod journals.

CAMSHAFT/HYDRAULIC LASH ADJUSTERS

A vertical hole at the number five bulkhead routes pressurized oil through a restrictor up into the cylinder head. The rocker shafts route oil to the rocker arms/hydraulic lash adjuster assemblies.

DESCRIPTION AND OPERATION (Continued)

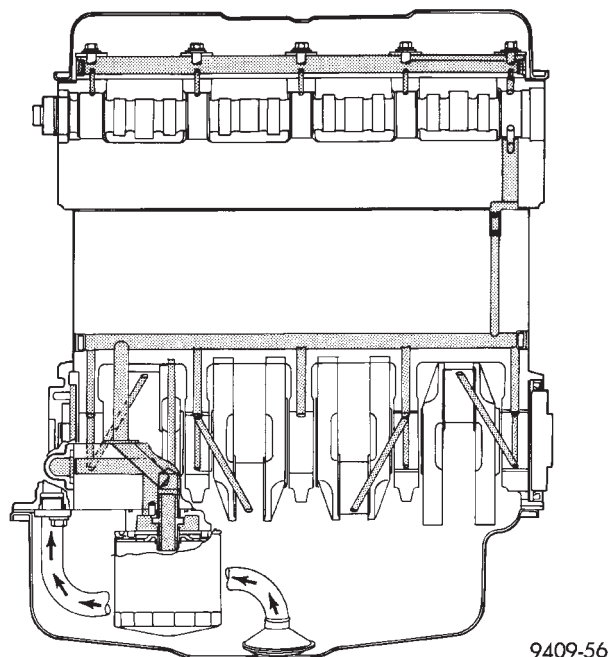


Fig. 2 Engine Lubrication System— SOHC

SPLASH LUBRICATION

Oil returning to the pan from pressurized components supplies lubrication to the valve stems. Cylinder bores and wrist pins are splash lubricated from directed slots on the connecting rod thrust collars.

ENGINE COMPONENTS

CYLINDER BLOCK AND BEDPLATE ASSEMBLY: A partial open deck is used for cooling and weight reduction with water pump molded into the block. Nominal wall thickness is 4 mm. The bedplate incorporates main bearing caps. Rear seal retainer is integral with the block.

CRANKSHAFT: A nodular cast iron crankshaft is used. The engine has 5 main bearings, with number 3 flanged to control thrust. The 52 mm diameter main and 48 mm diameter crank pin journals (all) have undercut fillet radiuses that are deep rolled for added strength. To optimize bearing loading 8 counterweights are used. Hydrodynamic seals provide end sealing, where the crankshaft exits the block. Anaerobic gasket material is used for parting line sealing. A sintered iron timing belt sprocket is mounted on the crankshaft nose. This sprocket transmits crankshaft movement, via timing belt to the camshaft sprocket providing timed valve actuation.

PISTONS: The SOHC Engine **DOES NOT** have provision for a free wheeling valve train. Non free wheeling valve train means, in the event of a broken timing belt Pistons will contact the Valves. All engines use pressed-in piston pins to attach forged powdered metal connecting rods. The connecting rods are a cracked cap design and are not repairable. Hex

head cap screw are used to provide alignment and durability in the assembly. Pistons And Connecting rods are serviced as an assembly.

PISTON RINGS: The piston rings include a molybdenum faced top ring for reliable compression sealing and a taper faced intermediate ring for additional cylinder pressure control. Oil Control Ring Package consist of 2 steel rails and a expander spacer.

CYLINDER HEAD—SOHC: It features a Single Over Head Camshaft, four-valves per cylinder cross flow design. The valves are arranged in two inline banks, with the two intake per cylinder facing toward the radiator. The exhaust valves facing toward the dash panel. Rocker arm shafts mount directly to the cylinder head. It incorporates powder metal valve guides and seats. The hollow rocker arm shafts supplies oil to the hydraulic lash adjusters, camshaft and valve mechanisms.

CAMSHAFT—SOHC: The nodular iron camshaft has five bearing journals and 3 cam lobes per cylinder. Provision for cam position sensor on the cam at the rear of cylinder head which also acts as thrust plate. A hydrodynamic oil seal is used for oil control at the front of the camshaft.

VALVES—SOHC: Four valves per cylinder are actuated by roller rocker arms/hydraulic lash adjusters assemblies which pivot on rocker arm shafts. All valves have 6 mm diameter chrome plated valve stems. The valve train has 33 mm (1.299 inch) diameter intake valves and 28 mm (1.10 inch) diameter exhaust valves. Viton rubber valve stem seals are integral with spring seats. Valve springs, spring retainers, and locks are conventional design.

INTAKE MANIFOLD: The intake manifold is a molded plastic composition, attached to the cylinder head with ten fasteners. This long branch design enhances low and mid-range torque.

EXHAUST MANIFOLD: The exhaust manifold is made of nodular cast iron for strength and high temperatures. Exhaust gasses exit through a machined, articulated joint connection to the exhaust pipe.

DIAGNOSIS AND TESTING

CHECKING ENGINE OIL PRESSURE

- (1) Remove oil pressure switch and install gauge assembly C-3292 with adaptor.
- (2) Run engine until thermostat opens.

CAUTION: If oil pressure is 0 at idle, Do Not perform the 3000 RPM test in the next step.

- (3) Oil Pressure: **Curb Idle** 25 kPa (4 psi) minimum **3000 RPM** 170-550 kPa (25-80 psi).

DIAGNOSIS AND TESTING (Continued)

(4) If oil pressure is 0 at idle. Shut off engine, check for pressure relief valve stuck open, a clogged oil pick-up screen or a damaged oil pick-up tube O-ring.

SERVICE PROCEDURES

CYLINDER BORE AND PISTON SIZING

The cylinder walls should be checked for out-of-round and taper with Tool C-119 (Fig. 3). The cylinder bore out-of-round is 0.050 mm (.002 inch) maximum and cylinder bore taper is 0.051 mm (0.002 inch) maximum. If the cylinder walls are badly scuffed or scored, the cylinder block should be rebored and honed, and new pistons and rings fitted. Whatever type of boring equipment is used, boring and honing operation should be closely coordinated with the fitting of pistons and rings in order that specified clearances may be maintained. **Refer to Honing Cylinder Bores outlined in the Standard Service Procedures for specification and procedures.**

Measure the cylinder bore at three levels in directions A and B (Fig. 3). Top measurement should be 10 mm (3/8 inch) down and bottom measurement should be 10 mm (3/8 inch.) up from bottom of bore. Refer to Cylinder Bore and Piston Specifications Chart.

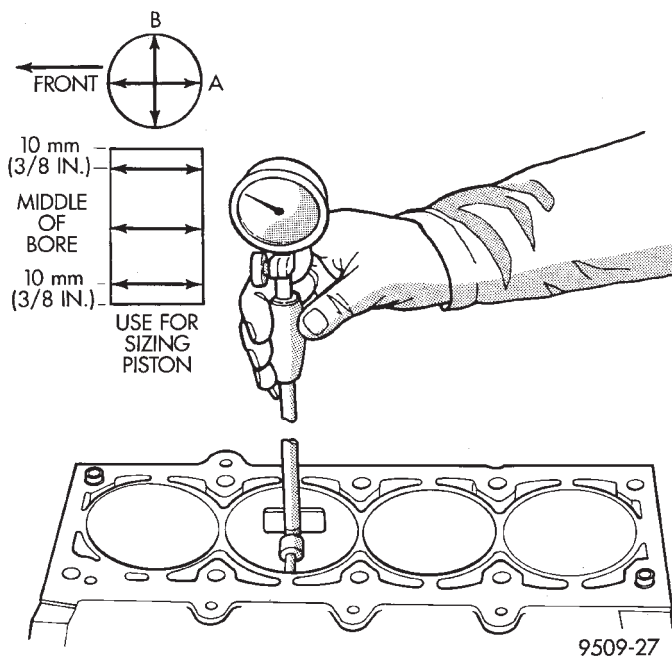


Fig. 3 Checking Cylinder Bore Size

SIZING PISTONS

Piston and cylinder wall must be clean and dry. Piston diameter should be measured 90 degrees to piston pin about 17.5 mm (11/16 inch) from the bot-

CYLINDER BORE AND PISTON SPECIFICATION CHART

Standard Bore	Maximum Out-of-Round	Maximum Taper
87.5 mm (3.445 in.)	0.051 mm (0.002 in.)	0.051 mm (0.002 in.)
Standard Piston Size		
Federal	87.463 - 87.481 mm	
Emission:	(3.4434 - 3.4441 in.)	
Low Emission	87.456 - 87.474 mm	
Vehicle (LEV):	(3.4432 - 3.4439 in.)	
Piston to Bore Clearance		
Federal	0.012 - 0.044 mm	
Emission:	(0.0004 - 0.0017 in.)	
Low Emission	0.18 - 0.050 mm	
Vehicle (LEV):	(0.0008 - 0.0020 in.)	
Measurements Taken at Piston Size Location		

tom of the skirt as shown in (Fig. 4). Cylinder bores should be measured halfway down the cylinder bore and transverse to the engine crankshaft center line shown in (Fig. 3). Refer to Cylinder Bore and Specifications Table. Correct piston to bore clearance must be established in order to assure quiet and economical operation.

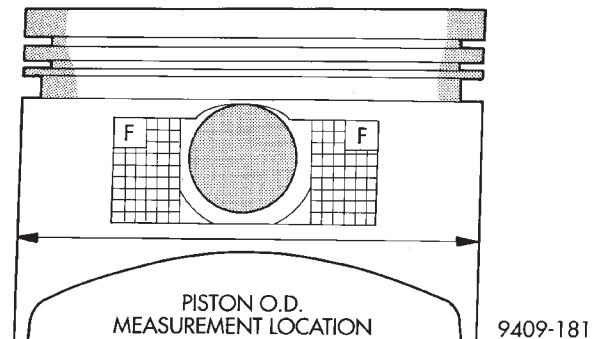


Fig. 4 Piston Measurements

Chrysler engines use pistons designed specifically for each engine model. Clearance and sizing locations vary with respect to engine model.

NOTE: Pistons and cylinder bores should be measured at normal room temperature, 21°C (70°F).

FITTING PISTON RINGS

(1) Wipe cylinder bore clean. Insert ring and push down with piston to ensure it is square in bore. The ring gap measurement must be made with the ring positioning at least 12 mm (0.50 inch) from bottom of cylinder bore. Check gap with feeler gauge (Fig. 5). Refer to Piston Ring Specification Chart.

SERVICE PROCEDURES (Continued)

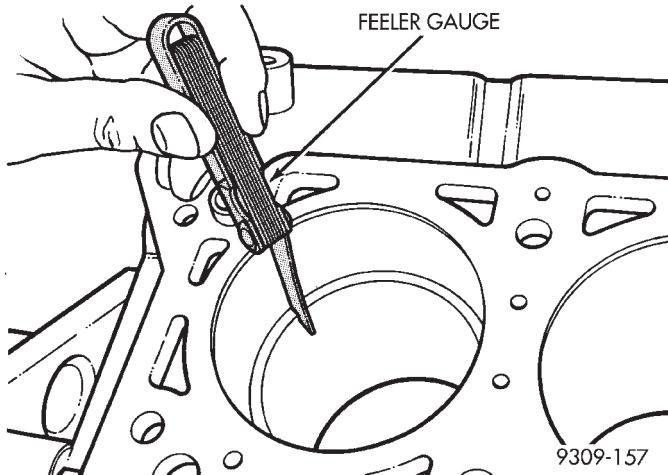


Fig. 5 Piston Ring Gap

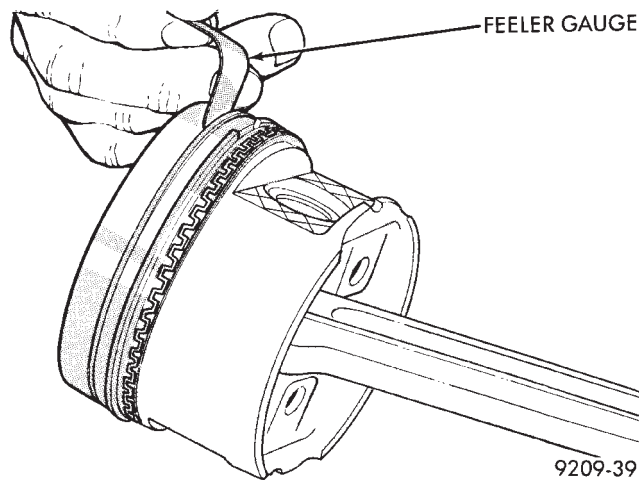


Fig. 6 Piston Ring Side Clearance

(2) Check piston ring to groove side clearance (Fig. 6). Refer to Piston Ring Specification Chart.

FITTING CONNECTING RODS

(1) Follow the procedure specified in the Standard Service Procedures Section for Measuring Main Bearing Clearance and Connecting Rod Bearing Clearance (Fig. 7). Refer to specifications.

CAUTION: Do not rotate crankshaft or the Plastigage may be smeared.

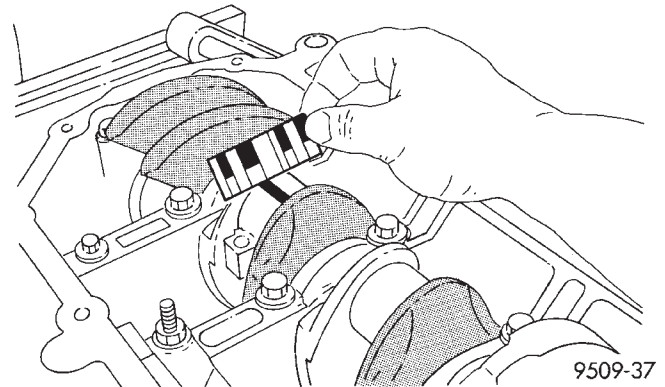


Fig. 7 Connecting Rod Bearing Clearance

NOTE: The rod bearing bolts should not be reused.

(2) Before installing the **NEW** bolts the threads should be oiled with clean engine oil.

(3) Install each bolt finger tight then alternately torque each bolt to assemble the cap properly.

(4) Tighten the bolts to 27 N·m PLUS 1/4 turn (20 ft. lbs. PLUS 1/4 turn) **Do not use a torque wrench for last step.**

(5) Using a feeler gauge, check connecting rod side clearance (Fig. 8). Refer to Connecting Rod Specification Chart for specifications.

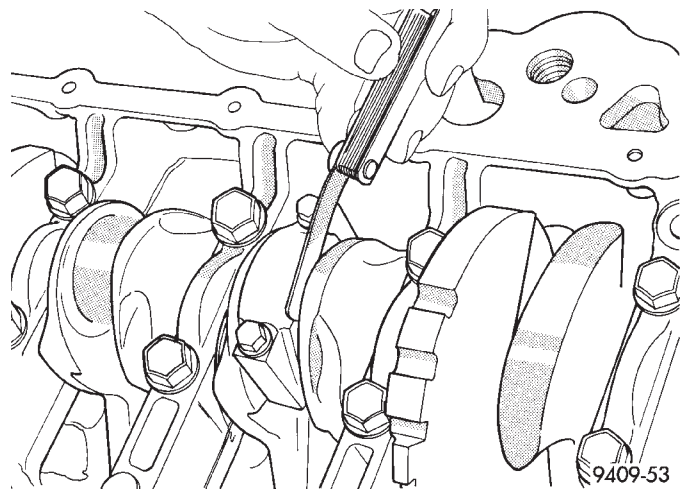


Fig. 8 Connecting Rod Side Clearance

PISTON RING SPECIFICATION CHART

Ring Position	Ring Gap	Ring Gap Wear Limit	Groove Clearance	Maximum Groove Clearance
Upper Ring	0.23 - 0.52 mm (0.009 - 0.020 in.)	0.8 mm (0.031 in.)	0.025 - 0.065 mm (0.0010 - 0.0026 in.)	0.10 mm (0.004 in.)
Intermediate Ring	0.49 - 0.78 mm (0.019 - 0.031 in.)	1.0 mm (0.039 in.)	0.025 - 0.065 mm (0.0010 - 0.0026 in.)	0.10 mm (0.004 in.)
Oil Control Ring	0.23 - 0.66 mm (0.009 - 0.026 in.)	1.0 mm (0.039 in.)	Oil Ring Side Rails Must Be Free To Rotate After Assembly	

SERVICE PROCEDURES (Continued)

CONNECTING ROD SPECIFICATION CHART

Connecting Rod Bearing Oil Clearance		
New Part:	0.026 - 0.059 mm (0.001 - 0.0023 in.)	
Wear Limit:	0.075 mm (0.003 in.)	
Connecting Rod Side Clearance		
New Part:	0.13 - 0.38 mm (0.005 - 0.015 in.)	
Wear Limit:	0.40 mm (0.016 in.)	

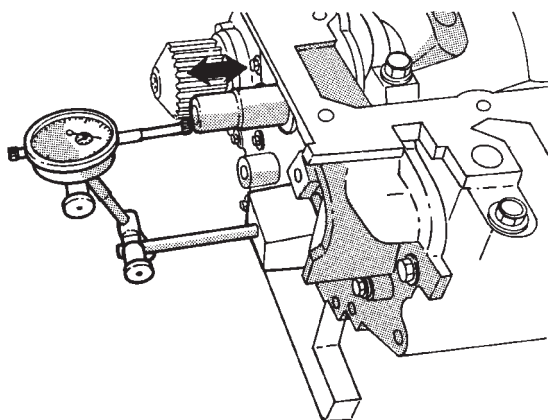
FITTING CRANKSHAFT BEARINGS

Refer to Measuring Main Bearing Clearance in Standard Service Procedures. Refer to Crankshaft Specification Chart for specifications.

CRANKSHAFT END PLAY

DIAL INDICATOR METHOD

(1) Mount a dial indicator to front of engine, locating probe on nose of crankshaft (Fig. 9).



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Fig. 9 Checking Crankshaft End Play— Dial Indicator

(2) Move crankshaft all the way to the rear of its travel.

(3) Zero the dial indicator.

(4) Move crankshaft all the way to the front and read the dial indicator. Refer to Crankshaft Specification Chart for specifications.

FEELER GAGE METHOD

(1) Move crankshaft all the way to the rear of its travel using a lever inserted between a main bearing cap and a crankshaft cheek, using care not to damage any bearing surface. Do **not** loosen main bearing cap.

(2) Use a feeler gauge between number three thrust bearing and machined crankshaft surface to determine end play.

REMOVAL AND INSTALLATION

CYLINDER HEAD COVER

REMOVAL

- (1) Remove ignition coil pack (Fig. 10).
- (2) Remove the cylinder head cover bolts.
- (3) Remove cylinder head cover from cylinder head.

INSTALLATION

Before installation, clean cylinder head and cover mating surfaces. Make certain the cylinder head cover mating surface is flat.

- (1) Install new valve cover gasket.

CAUTION: Do not allow oil or solvents to contact the timing belt as they can deteriorate the rubber and cause tooth skipping.

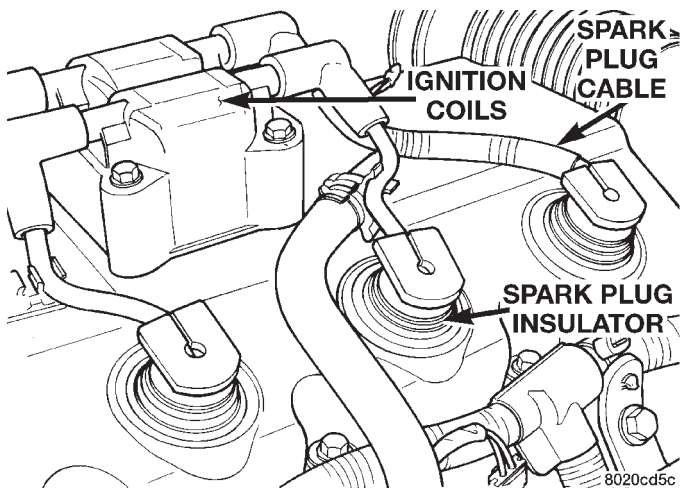
- (2) Install cover assembly to head and tighten fasteners to 12 N·m (105 in. lbs.).

- (3) Install ignition coil pack. Tighten fasteners to 23 N·m (200 in. lbs.).

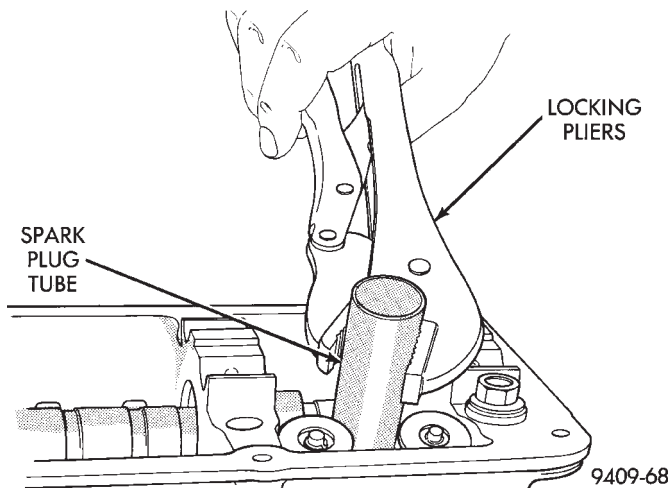
CRANKSHAFT SPECIFICATION CHART

Crankshaft End-Play	New Part:	0.09 - 0.24 mm (0.0035 - 0.0094 in.)
Wear Limit:	0.37 mm (0.015 in.)	
Main Bearing Clearance	New Part:	0.022 - 0.062 mm (0.0008 - 0.0024 in.)
Connecting Rod Bearing Clearance	New Part:	0.026 - 0.059 mm (0.001 - 0.0023 in.)
Wear Limit:	0.075 mm (0.003 in.)	
Main Bearing Journal Diameter	Standard:	52.000 ± 0.008 mm (2.0472 ± 0.0003 in.)
1st Undersize:	51.983 ± 0.008 mm (2.0466 ± 0.0003 in.)	
Connecting Rod Journal Diameter	Standard:	48.000 ± 0.008 mm (1.8897 ± 0.0003 in.)
1st Undersize:	47.983 ± 0.008 mm (1.8891 ± 0.0003 in.)	

REMOVAL AND INSTALLATION (Continued)

**Fig. 10 Ignition Coil Pack****SPARK PLUG TUBE**

- (1) Remove valve cover. Refer to procedure outlined in this section.
- (2) Using locking pliers remove the tube from the cylinder head (Fig. 11). Discard old tube.

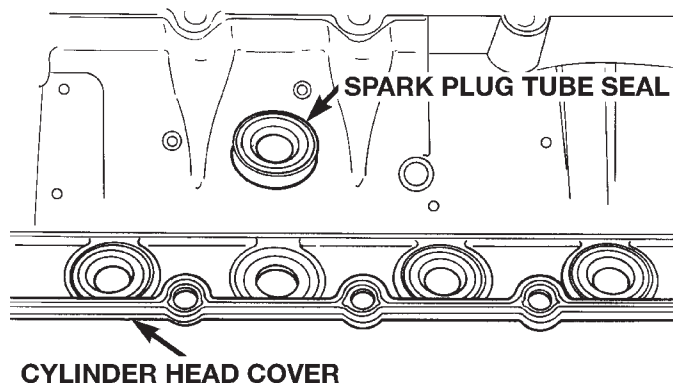
**Fig. 11 Servicing Spark Plug Tubes**

- (3) Clean area around spark plug with Mopar® parts cleaner or equivalent.
- (4) Apply Mopar® Stud and Bearing Mount or equivalent to a new tube approximately 1 mm from the end in a 3 mm wide area.
- (5) Install sealer end of tube into the cylinder head. Then carefully install the tube using a hardwood block and mallet until the tube is seated into the bottom of the bore.
- (6) Install valve cover. Refer to procedure outlined in this section.

SPARK PLUG TUBE SEALS

The spark plug tube seals are located in the cylinder head cover (Fig. 12). These seals are pressed into the cylinder head cover to seal the outside perimeter

of the spark plug tubes. If these seals show signs of hardness and/or cracking they should be replaced.



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Fig. 12 Spark Plug Tube Seals**CAMSHAFT**

NOTE: TO REMOVE CAMSHAFT THE CYLINDER HEAD MUST BE REMOVED.

REMOVAL

- (1) Perform fuel system pressure release procedure **before attempting any repairs**. Refer to Group 14, Fuel System
- (2) Remove the cylinder head cover. Refer to procedure outlined in this section.
- (3) Mark rocker arm shaft assemblies so that they are installed in their original positions.
- (4) Remove rocker arm shaft bolts. Refer to procedure outlined in this section.
- (5) Remove timing belt, timing belt tensioner, and camshaft sprocket. Refer to timing belt service outlined in this section.
- (6) Remove inner timing belt cover.
- (7) Remove cylinder head. Refer to procedure outlined in this section.
- (8) Remove camshaft sensor and camshaft target magnet.
- (9) Remove camshaft from the rear of cylinder head.

INSPECT CYLINDER HEAD FOR THE FOLLOWING:**NOTE:**

- Check oil feed holes for blockage.
- Inspect cylinder head camshaft bearings for wear, Refer to Cylinder Head, Inspection and Cleaning.
- Check camshaft bearing journals for scratches and worn areas. If light scratches are present, they may be removed with 400 grit sand paper. If deep

REMOVAL AND INSTALLATION (Continued)

scratches are present, replace the camshaft and check the cylinder head for damage. Replace the cylinder head if worn or damaged. Check the lobes for pitting and wear. If the lobes show signs of wear, check the corresponding rocker arm roller for wear or damage. Replace rocker arm/hydraulic lash adjuster if worn or damaged. If lobes show signs of pitting on the nose, flank or base circle; replace the camshaft.

INSTALLATION

(1) Lubricate the camshaft journals with oil and install camshaft **without** rocker arm assemblies installed.

(2) Install camshaft target magnet into the end of the camshaft. Tighten mounting screw to 3.4 N·m (30 in. lbs.).

(3) Install camshaft position sensor and tighten mounting screws to 9 N·m (80 in. lbs.).

(4) Measure camshaft end play using the following procedure:

- Mount dial indicator C-3339 or equivalent, to a stationary point on cylinder head (Fig. 13).
- Using a suitable tool, move camshaft to rearward limits of travel.
- Zero the dial indicator.
- Move camshaft forward to limits of travel and read dial indicator.
- End play travel: 0.13 - 0.33 mm (0.005 - 0.013 in.).

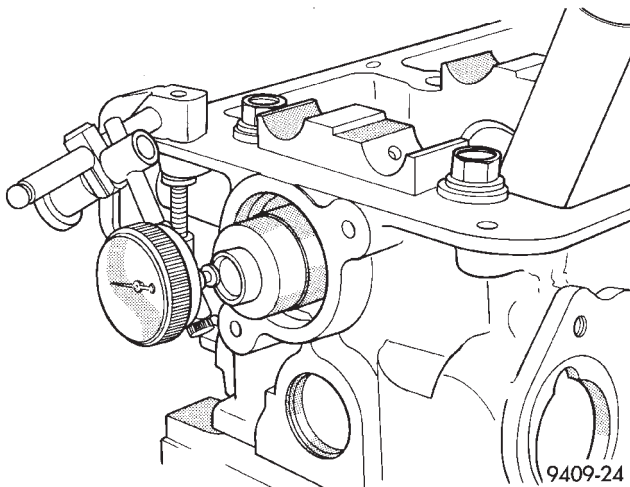


Fig. 13 Camshaft End Play

(5) Install front camshaft seal. Camshaft must be installed before the camshaft seal is installed. Refer to procedure outlined in this section.

(6) Install cylinder head. Refer to procedure outlined in this section.

(7) Install camshaft sprocket and tighten to 115 N·m (85 ft. lbs.).

(8) Install inner timing belt cover.

(9) Install timing belt tensioner and timing belt. Refer to procedures outlined in this section.

(10) Install rocker arm assemblies in correct order as removed. Tighten the rocker arm assemblies in sequence shown in (Fig. 14) to 28 N·m (250 in. lbs.).

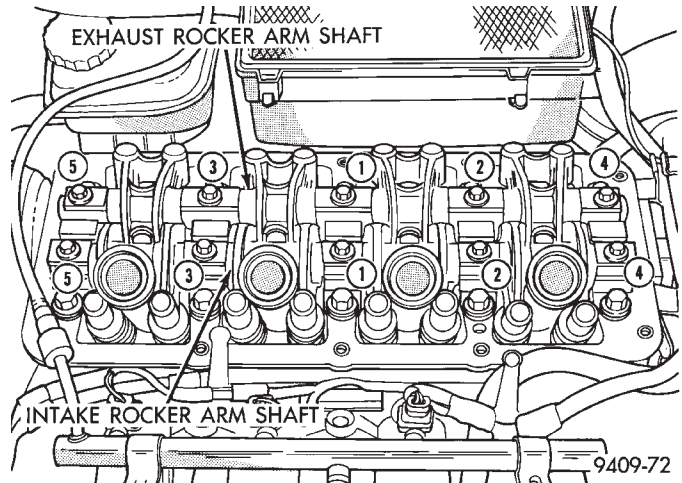


Fig. 14 Rocker Arm Shaft Tightening Sequence

(11) Install cylinder head cover and tighten fasteners to 12 N·m (105 in. lbs.).

(12) Install ignition coil pack and ignition cables.

(13) Perform camshaft and crankshaft timing relearn procedure as follows:

- Connect the DRB scan tool to the data link (diagnostic) connector. This connector is located in the passenger compartment; at the lower edge of instrument panel; near the steering column.
- Turn the ignition switch on and access the "miscellaneous" screen.
- Select "re-learn cam/crank" option and follow directions on DRB screen.

ROCKER ARM/HYDRAULIC LASH ADJUSTER

REMOVAL

(1) Remove valve cover using procedure outlined in this section.

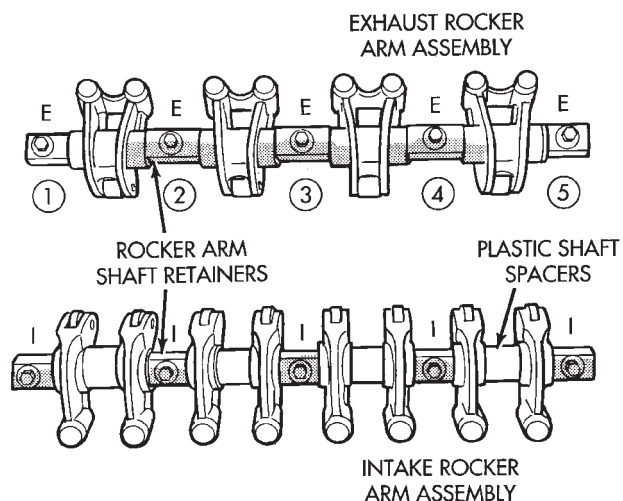
(2) Identify the rocker arm shaft assemblies before removal.

(3) Loosen the attaching fasteners. Remove rocker arm shaft assemblies from cylinder head.

(4) Identify the rocker arms spacers and retainers for reassembly. Disassemble the rocker arm assemblies by removing the attaching bolts from the shaft (Fig. 15).

(5) Slide the rocker arms and spacers off the shaft. Keep the spacers and rocker arms in the same location for reassembly.

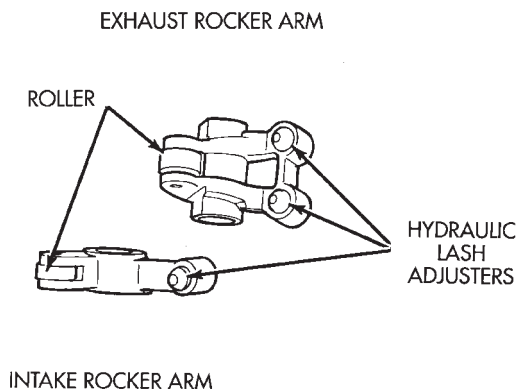
REMOVAL AND INSTALLATION (Continued)



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Fig. 15 Rocker Arm Shaft Assemblies

NOTE: Inspect the rocker arm for scoring, wear on the roller or damage to the rocker arm (Fig. 16) Replace if necessary. Check the location where the rocker arms mount to the shafts for wear or damage. Replace if damaged or worn. The rocker arm shaft is hollow and is used as a lubrication oil duct. Check oil holes for clogging with small wire, clean as required. Lubricate the rocker arms and spacers. Install onto shafts in their original position (Fig. 15).



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Fig. 16 Rocker Arm Assemblies**INSTALLATION**

CAUTION: Set crankshaft to 3 notches before TDC before installing rocker arm shafts. Refer to Timing Belt System and Camshaft Seal Service of this section for procedure.

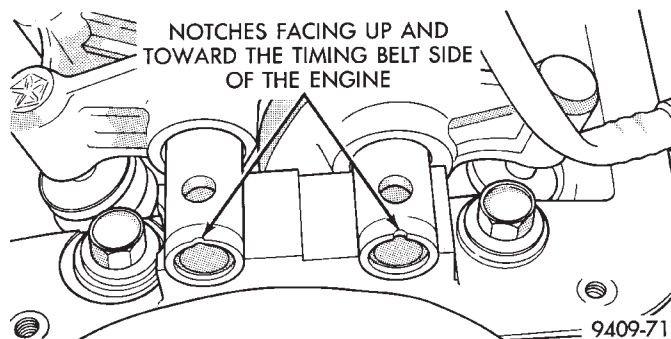
(1) Install rocker arm/hydraulic lash adjuster assembly making sure that adjusters are at least

partially full of oil. This is indicated by little or no plunger travel when the lash adjuster is depressed. If there is excessive plunger travel. Place the rocker arm assembly into clean engine oil and pump the plunger until the lash adjuster travel is taken up. If travel is not reduced, replace the assembly. Hydraulic lash adjuster and rocker arm are serviced as an assembly.

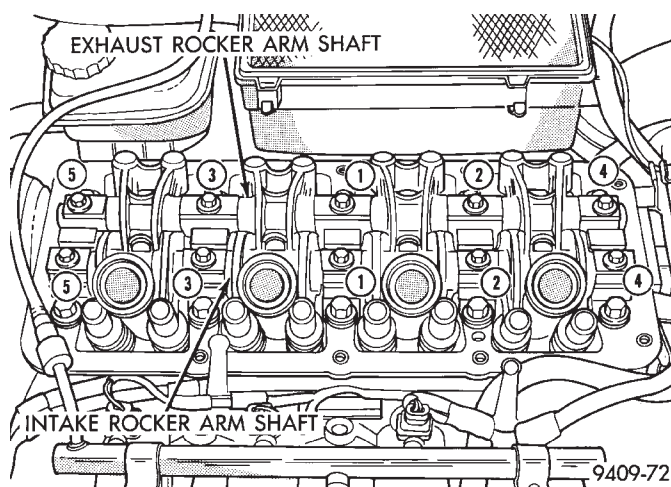
(2) Install rocker arm and shaft assemblies with NOTCH in the rocker arm shafts pointing up and toward the timing belt side of the engine (Fig. 17). Install the retainers in their original positions on the exhaust and intake shafts (Fig. 15).

CAUTION: When installing the intake rocker arm shaft assembly be sure that the plastic spacers do not interfere with the spark plug tubes. If the spacers do interfere rotate until they are at the proper angle. To avoid damaging the spark plug tubes, do not attempt rotating the spacers by forcing down the shaft assembly.

(3) Tighten bolts to 28 N·m (250 in. lbs.) in sequence shown in (Fig. 18).



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Fig. 17 Rocker Arm Shaft Notches

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Fig. 18 Rocker Arm Shaft Tightening Sequence

REMOVAL AND INSTALLATION (Continued)

HYDRAULIC LASH ADJUSTER NOISE

A tappet-like noise may be produced from several items. Refer to Lash Adjuster Noise - Diagnosis in Standard Service Procedures, outlined in this Group. **Lash adjusters are replaced with the rocker arm as an assembly.**

VALVE SEALS AND SPRINGS IN VEHICLE

REMOVAL

- (1) Remove rocker arm shaft assemblies as previously outlined in this section.
- (2) Rotate crankshaft until piston is at TDC on compression.
- (3) With air hose attached to adapter tool installed in spark plug hole, apply 90-120 psi air pressure.
- (4) Using Special Tool MD-998772A with adapter 6779 (Fig. 19) compress valve springs and remove valve locks.

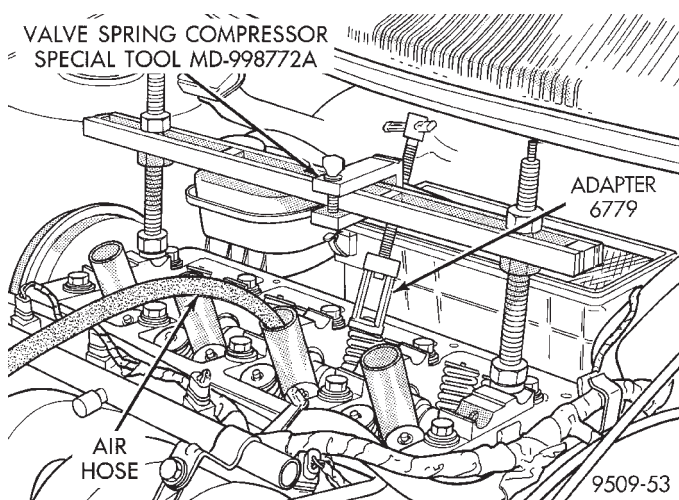


Fig. 19 Removing and Installing Valve Spring

- (5) Remove valve spring.
- (6) Remove valve stem seal by using a valve stem seal tool (Fig. 20).

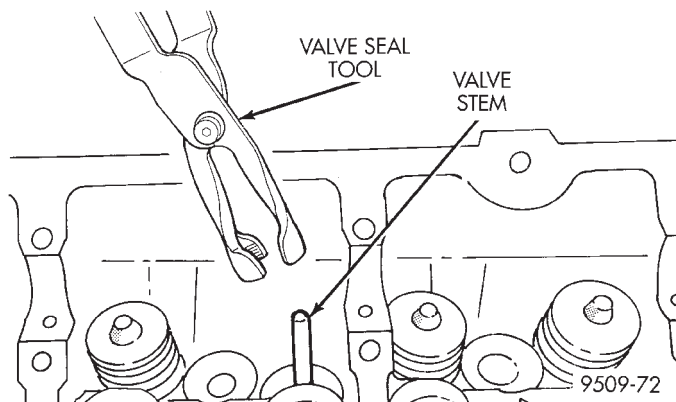


Fig. 20 Valve Stem Oil Seal Tool

INSTALLATION

- (1) Install valve seal/valve spring seat assembly as outlined in the Valve Installation procedure in this section.
- (2) Using Special Tool MD-998772A compress valve springs only enough to install locks. Correct alignment of tool is necessary to avoid nicking valve stems (air pressure required), piston at TDC.

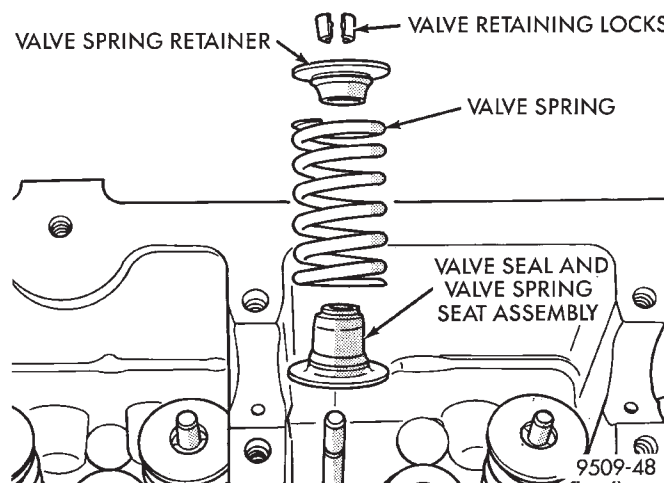


Fig. 21 Valve Spring Assembly

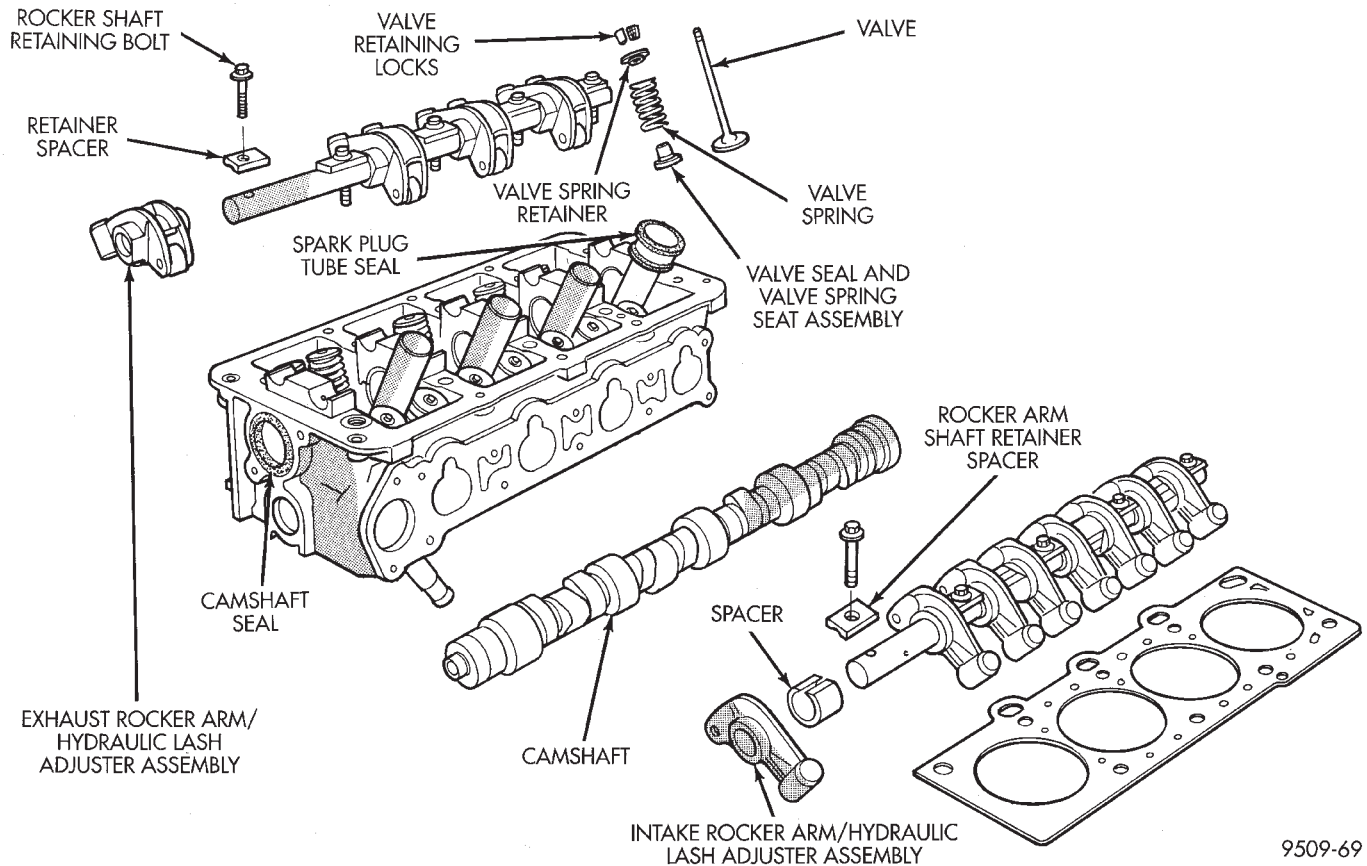
- (3) Install rocker arm shaft assemblies as previously outlined in this section.
- (4) Install valve cover as previously outlined in this section.

CYLINDER HEAD

REMOVAL

- (1) Perform fuel system pressure release procedure **before attempting any repairs**. Refer to Group 14, Fuel System
- (2) Disconnect negative battery cable. Drain cooling system. Refer to Group 7, Cooling System.
- (3) Disconnect all vacuum lines, electrical wiring and fuel lines from throttle body.
- (4) Remove throttle linkage.
- (5) Remove accessory drive belts. Refer to Group 7, Cooling System for procedure.
- (6) Remove power brake vacuum hose from intake manifold.
- (7) Raise vehicle and remove exhaust pipe from manifold.
- (8) Remove power steering pump assembly and set aside.
- (9) Disconnect coil pack wiring connector and remove coil pack and bracket from engine.
- (10) Remove cylinder head cover.
- (11) Remove cam sensor and fuel injectors wiring connectors.
- (12) Remove intake manifold. Removal procedure outline in Group 11.

REMOVAL AND INSTALLATION (Continued)

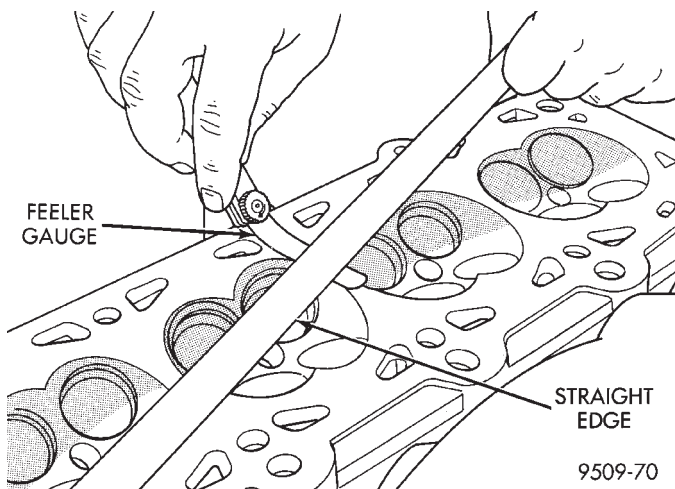


9509-69

Cylinder Head and Valve Assembly

- (13) Remove timing belt and camshaft sprocket. Refer to procedure outlined in this section.
- (14) Remove rocker arm shaft assemblies.
- (15) Remove cylinder head bolts.

NOTE: Inspect camshaft bearing journals for scoring. Cylinder head must be flat within 0.1 mm (0.004 inch) (Fig. 22).



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Fig. 22 Checking Cylinder Head Flatness

INSTALLATION

(1) Before installing the bolts the threads should be oiled with engine oil. The 4 short bolts 110 mm (4.330 in.) are to be installed in positions 7, 8, 9, and 10 (Fig. 23).

(2) Tighten the cylinder head bolts in the sequence shown in (Fig. 23). Using the 4 step torque method, tighten according to the following values:

- First All to 34 N·m (25 ft. lbs.)
- Second All to 68 N·m (50 ft. lbs.)
- Third All to 68 N·m (50 ft. lbs.)
- Fourth Turn an additional 1/4 Turn, **Do not use a torque wrench for this step.**

For the rest of installation, reverse removal procedure.

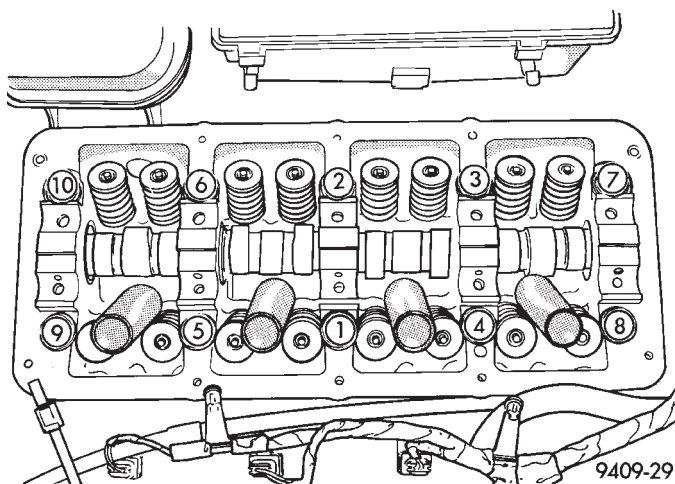
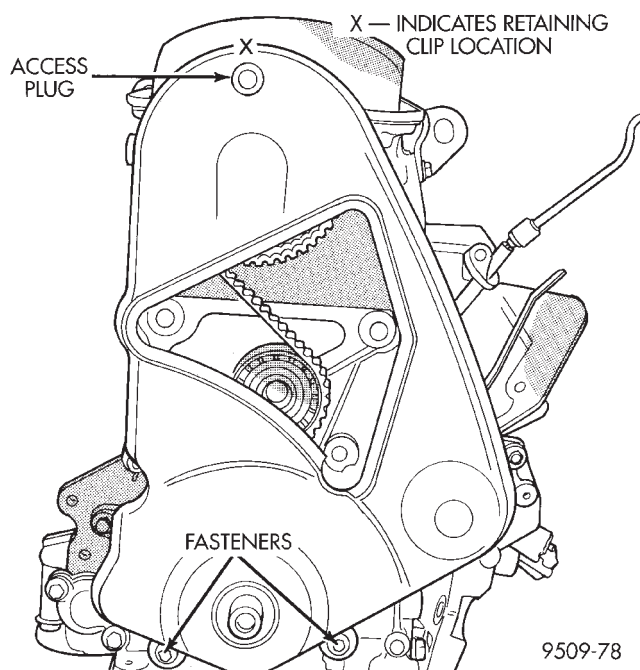
TIMING BELT COVER**REMOVAL**

(1) Remove accessory drive belts. Refer to Group 7, Cooling System for procedure outlined in that section.

(2) Remove crankshaft vibration damper. Refer to procedure outlined in this section for removal.

(3) Remove front timing belt cover (Fig. 24).

REMOVAL AND INSTALLATION (Continued)

**Fig. 23 Cylinder Head Tightening Sequence****Fig. 24 Timing Belt Cover****INSTALLATION**

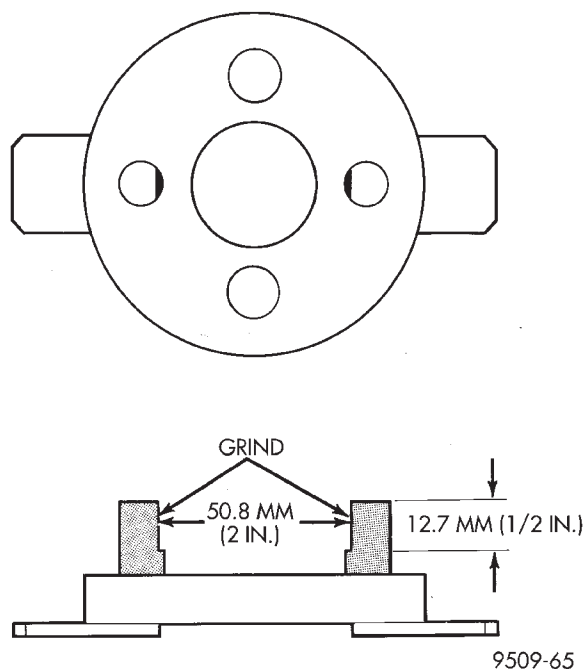
- (1) Install front timing cover.
- (2) Install crankshaft vibration damper. Refer to procedure outlined in this section for installation.
- (3) Install accessory drive belts. Refer to Group 7, Cooling System Accessory Drive section for procedure.

CAMSHAFT OIL SEAL**REMOVAL**

CAUTION: Do Not Rotate the camshaft or crankshaft when timing belt is removed damage to the engine may occur.

- (1) Remove timing belt cover and belt. Removal procedure is outlined in this section. Remove camshaft sprocket bolt, with the Modified Special Tool C-4687-1 as shown in (Fig. 25).

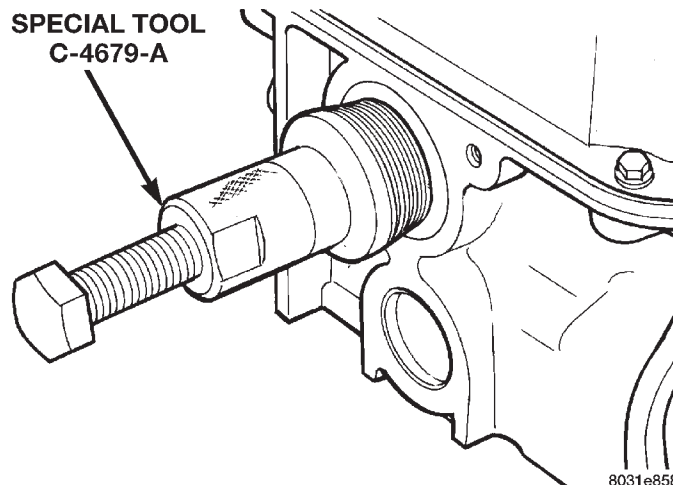
- (2) Hold camshaft sprocket with modified tool while removing bolt. Remove sprocket from camshaft.

**Fig. 25 Modification to Special Tool**

- (3) Remove camshaft seal using Special Tool C-4679-A (Fig. 26).

CAUTION: Do not nick shaft seal surface or seal bore.

- (4) Shaft seal lip surface must be free of varnish, dirt or nicks. Polish with 400 grit paper if necessary.

**Fig. 26 Removing Camshaft Oil Seal**

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Install camshaft seal flush with cylinder head using Special Tool MD 998306 (Fig. 27).

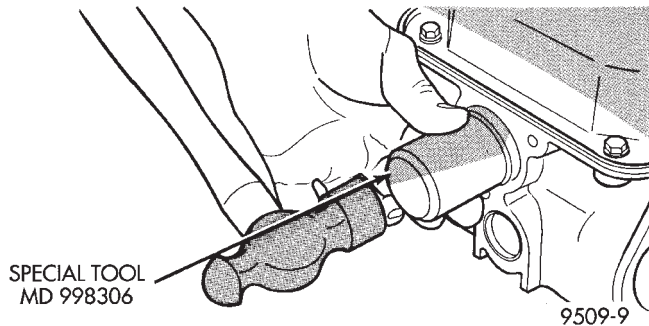


Fig. 27 Installing Camshaft Seal

(2) Install camshaft sprocket retaining bolt. Hold camshaft sprocket with Special Tool C-4687-1 (Fig. 25) and tighten bolt to 115 N·m (85 ft. lbs.).

TIMING BELT SYSTEM

CHECKING BELT TIMING—COVER INSTALLED

- Remove number one spark plug.
- Using a dial indicator, set number one cylinder to TDC on the compression stroke.

- Remove the access plug from the outer timing belt cover (Fig. 28).
- Check the timing mark on the camshaft sprocket, it should align with the arrow on the rear belt cover (Fig. 29).

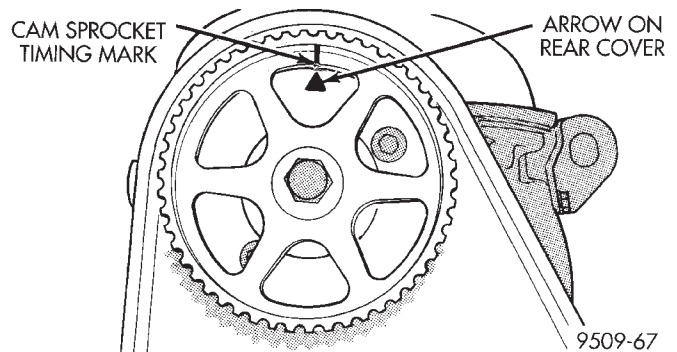


Fig. 29 Camshaft Timing Marks

REMOVAL—TIMING BELT

(1) Remove accessory drive belts. Refer to Group 7, Cooling System for procedure outlined in that section.

(2) Remove crankshaft damper bolt. Remove damper using the large side of Special Tool 1026 and insert 6827-A (Fig. 30).

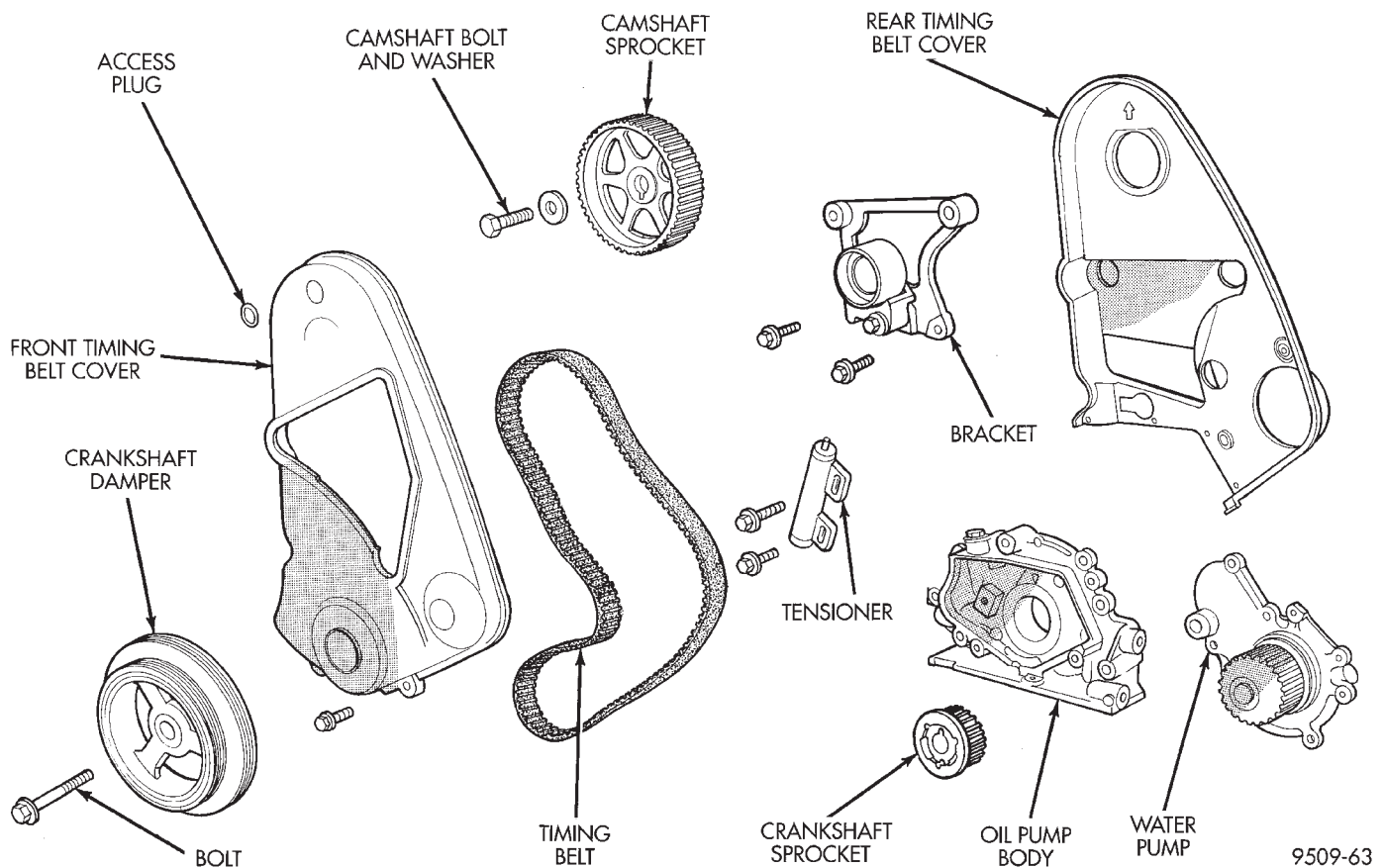
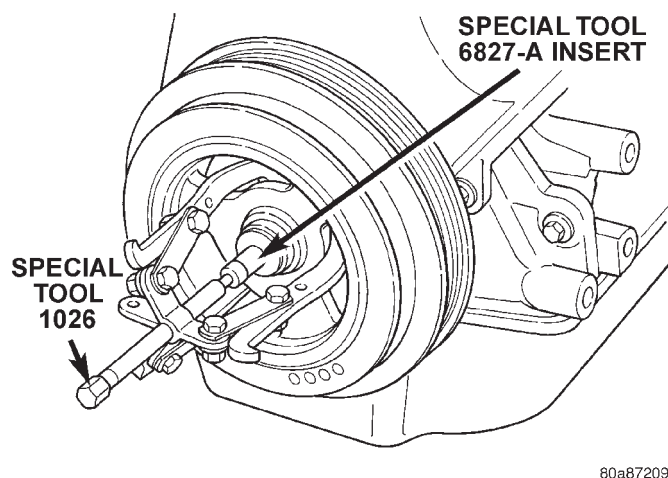


Fig. 28 Timing Belt System

REMOVAL AND INSTALLATION (Continued)



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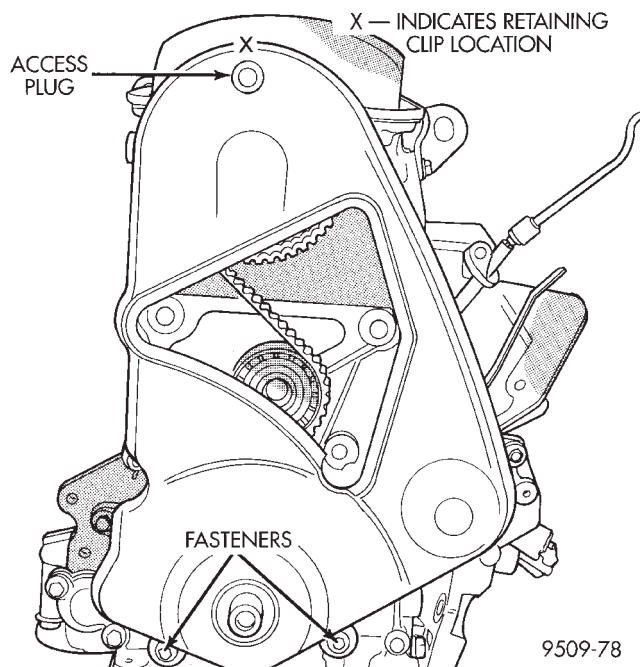
Fig. 30 Crankshaft Damper—Removal

- (3) Remove front timing belt cover (Fig. 31).

CAUTION: Align camshaft and crankshaft timing marks before removing the timing belt.

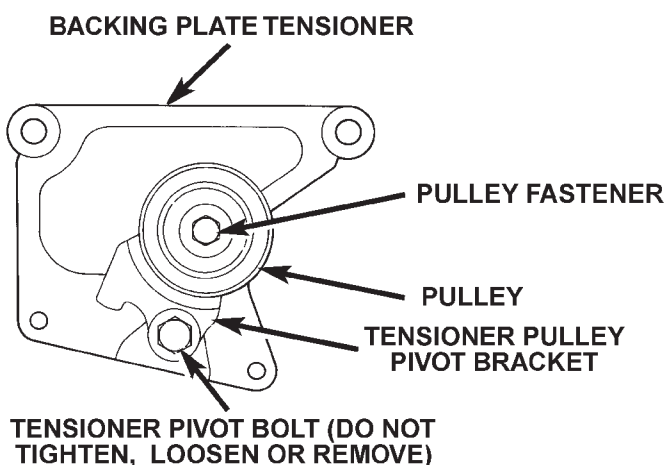
- (4) Loosen timing belt tensioner fasteners (Fig. 33) and remove timing belt and tensioner.

CAUTION: Do not loosen, tighten, or remove the tensioner pivot bolt (Fig. 32).

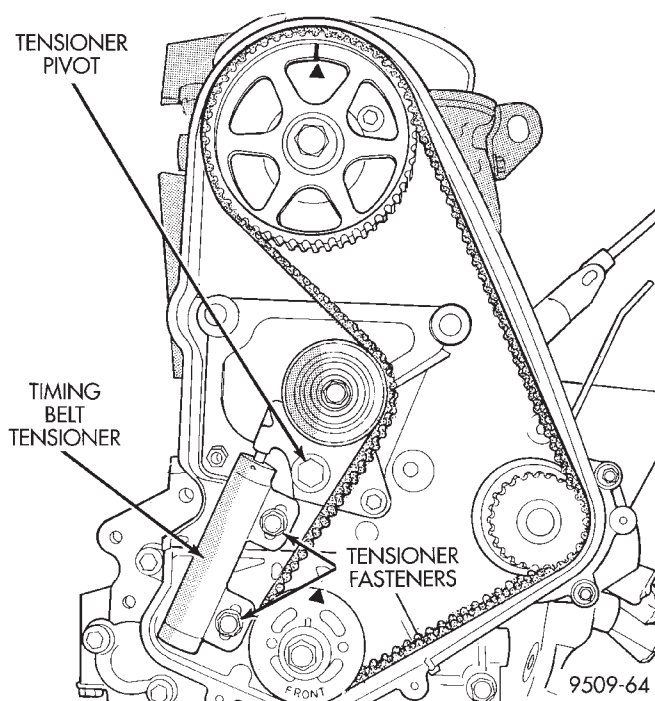
**Fig. 31 Timing Belt Cover**

**CAMSHAFT AND CRANKSHAFT TIMING
PROCEDURE AND BELT INSTALLATION
—SOHC ENGINE**

- (1) When tensioner is removed from the engine it is necessary to compress the plunger into the tensioner body.



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Fig. 32 Tensioner Pulley Assembly**Fig. 33 Remove Timing Belt**

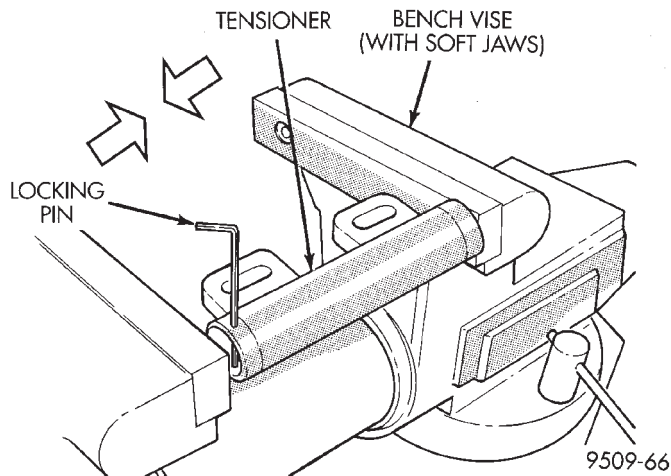
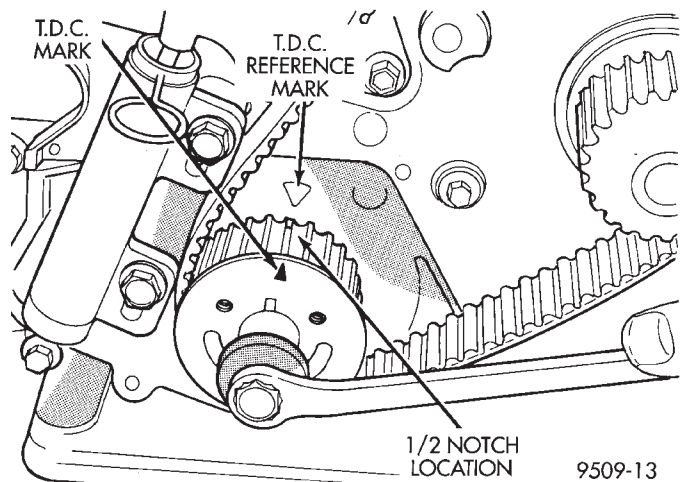
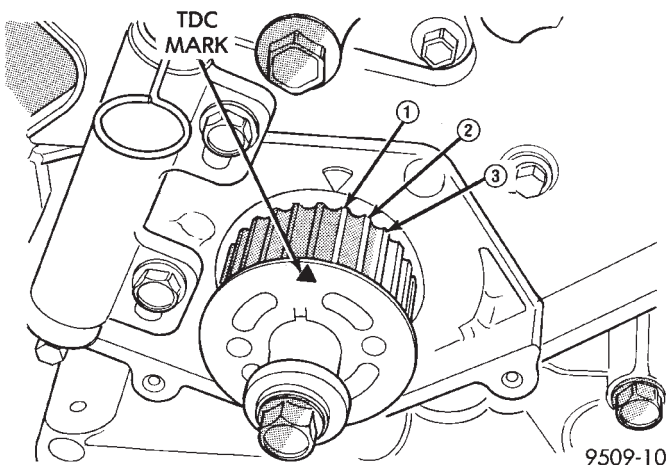
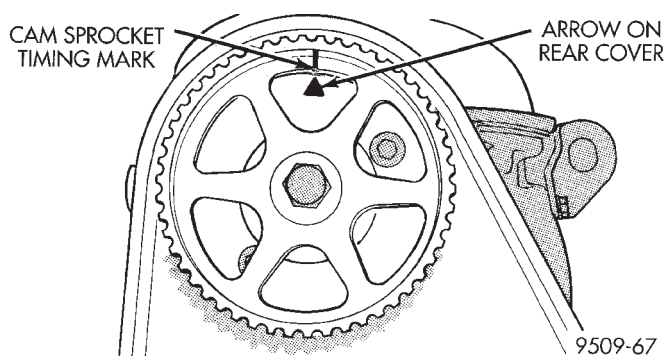
- (2) Place the tensioner into a vise equipped with soft jaws and slowly compress the plunger (Fig. 34).

CAUTION: Index the tensioner in the vise the same way it is installed on the engine. This is to ensure proper pin orientation when tensioner is installed on the engine.

- (3) When plunger is compressed into the tensioner body install a 1.9 mm (5/64) allen wrench or pin through the body and plunger to retain plunger in place until tensioner is installed.

- (4) Set crankshaft sprocket to TDC by aligning the sprocket with the arrow on the oil pump housing, then back off to 3 notches before TDC (Fig. 35).

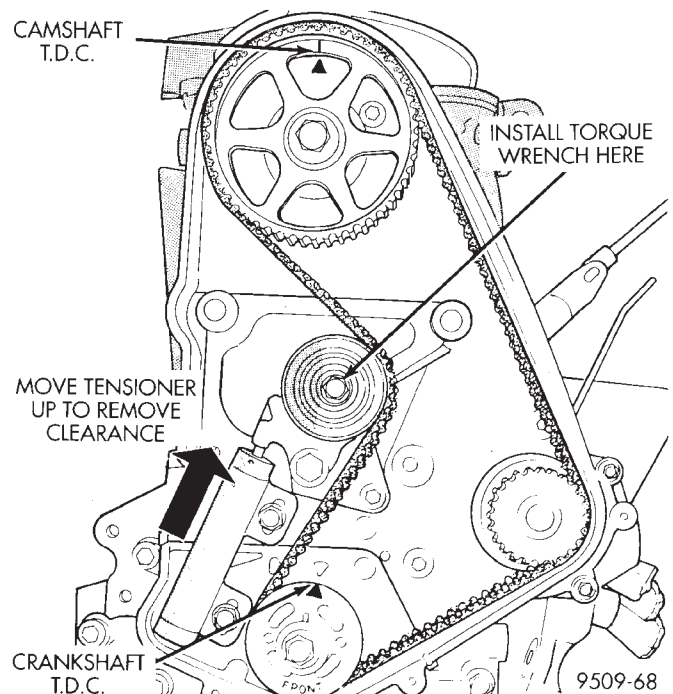
REMOVAL AND INSTALLATION (Continued)

**Fig. 34 Compressing Timing Belt Tensioner****Fig. 37 Adjusting Crankshaft Sprocket for Timing Belt Installation****Fig. 35 Crankshaft Sprocket Timing****Fig. 36 Camshaft Timing Mark**

(5) Set camshaft to TDC by aligning mark on sprocket with the arrow on the rear of timing belt cover (Fig. 36).

(6) Move crankshaft to 1/2 mark before TDC (Fig. 37) for belt installation.

(7) Install timing belt. Starting at the crankshaft, go around the water pump sprocket and then around the camshaft sprocket.

**Fig. 38 Adjusting Timing Belt Tension**

(8) Move crankshaft sprocket to TDC to take up belt slack. Install tensioner to block but do not tighten fasteners.

(9) Using a torque wrench on the tensioner pulley apply 28 N·m (250 in. lbs.) of torque (Fig. 38).

(10) With torque being applied to the tensioner pulley move the tensioner up against the tensioner pulley bracket and tighten fasteners to 31 N·m (275 in. lbs.) (Fig. 38).

(11) Pull tensioner plunger pin. Pretension is correct when pin can be removed and installed.

(12) Rotate crankshaft 2 revolutions and check the alignment of the timing marks (Fig. 38).

(13) Install front half of timing cover.

REMOVAL AND INSTALLATION (Continued)

(14) Install crankshaft damper using M12-1.75 x 150 mm bolt, washer, thrust bearing and nut from Special Tool 6792. Install crankshaft damper bolt and tighten to 142 N·m (105 ft. lbs.) (Fig. 39).

(15) Install accessory drive belts. Refer to Group 7, Cooling System Accessory Drive section for procedure.

(16) Perform camshaft and crankshaft timing relearn. Refer to Group 25, Emission Control Systems for procedure.

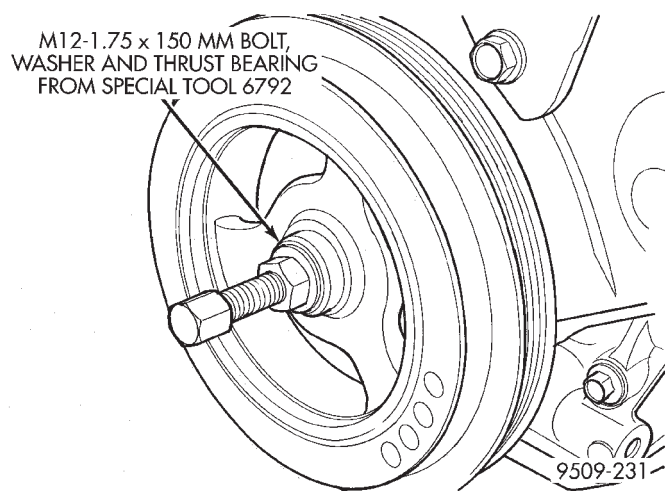


Fig. 39 Crankshaft Damper—Installation

TIMING BELT—w/AUTO TENSIONER—IF EQUIPPED

CHECKING BELT TIMING—COVER INSTALLED

- Remove number one spark plug.
- Using a dial indicator, set number one cylinder to TDC on the compression stroke.
- Remove the access plug from the outer timing belt cover (Fig. 28).
- Check the timing mark on the camshaft sprocket, it should align with the arrow on the rear belt cover (Fig. 29).

REMOVAL—TIMING BELT

(1) Remove accessory drive belts. Refer to Group 7, Cooling System for procedure outlined in that section.

(2) Raise vehicle on a hoist and remove right inner splash shield (Fig. 42).

(3) Remove crankshaft damper bolt. Remove damper using the large side of Special Tool 1026 and insert 6827-A (Fig. 30).

(4) Lower vehicle and place a jack under engine.

(5) Remove right engine mount. Refer to procedure outlined in this section.

(6) Remove right engine mount bracket (Fig. 44).

(7) Remove front timing belt cover (Fig. 31).

CAUTION: Align camshaft and crankshaft timing marks before removing the timing belt by rotating the engine with the crankshaft.

(8) Insert a 8 mm Allen wrench into the belt tensioner. Before rotating the tensioner insert the long end of a 1/8" or 3 mm Allen wrench into the pin hole on the front of the tensioner (Fig. 33). Rotate the tensioner counterclockwise with the Allen wrench, while pushing in lightly on the 1/8 in. or 3 mm Allen wrench, until it slides into the locking hole.

(9) Remove timing belt.

CAUTION: Do not rotate the camshafts once the timing belt has been removed or damage to valve components may occur.

CAMSHAFT AND CRANKSHAFT TIMING PROCEDURE AND BELT INSTALLATION —SOHC ENGINE

(1) Set crankshaft sprocket to TDC by aligning the sprocket with the arrow on the oil pump housing, then back off to 3 notches before TDC (Fig. 35).

(2) Set camshaft to TDC by aligning mark on sprocket with the arrow on the rear of timing belt cover (Fig. 36).

(3) Move crankshaft to 1/2 mark before TDC (Fig. 37) for belt installation.

(4) Install timing belt. Starting at the crankshaft, go around the water pump sprocket and then around the camshaft sprocket.

(5) Move crankshaft sprocket to TDC to take up belt slack.

(6) Remove the pin or 1/8" or 3 mm Allen wrench from belt tensioner.

(7) Rotate crankshaft 2 revolutions and check the alignment of the timing marks (Fig. 50).

(8) Install front half of timing cover.

(9) Install engine mount bracket.

(10) Install Right engine mount. Refer to procedure outlined in this section.

(11) Remove jack from under engine.

(12) Install crankshaft damper using M12-1.75 x 150 mm bolt, washer, thrust bearing and nut from Special Tool 6792. Install crankshaft damper bolt and tighten to 142 N·m (105 ft. lbs.) (Fig. 39).

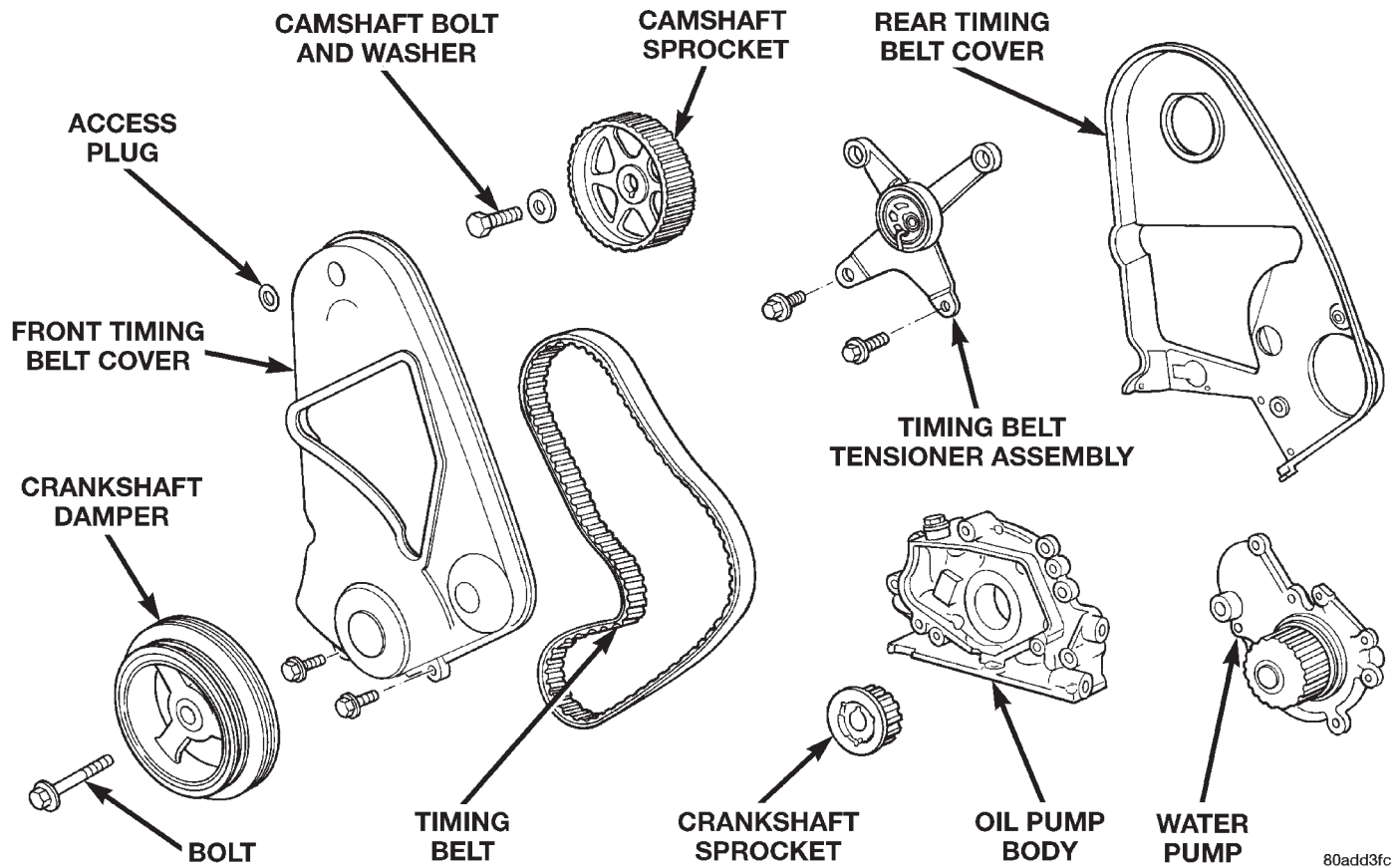
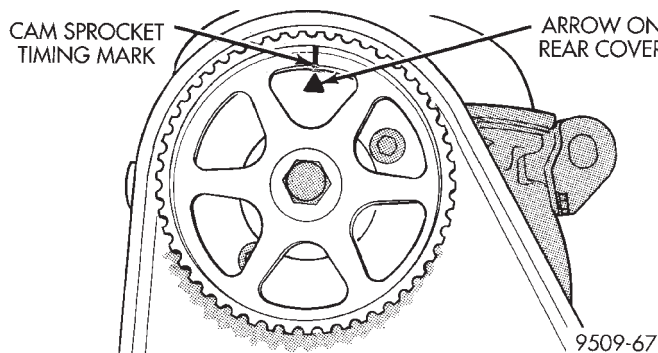
(13) Install accessory drive belts. Refer to Group 7, Cooling System Accessory Drive section for procedure.

(14) Raise vehicle on hoist and install right inner splash shield.

(15) Perform camshaft and crankshaft timing relearn procedure as follows:

- Connect the DRB scan tool to the data link (diagnostic) connector. This connector is located in the passenger compartment; at the lower edge of instrument panel; near the steering column.

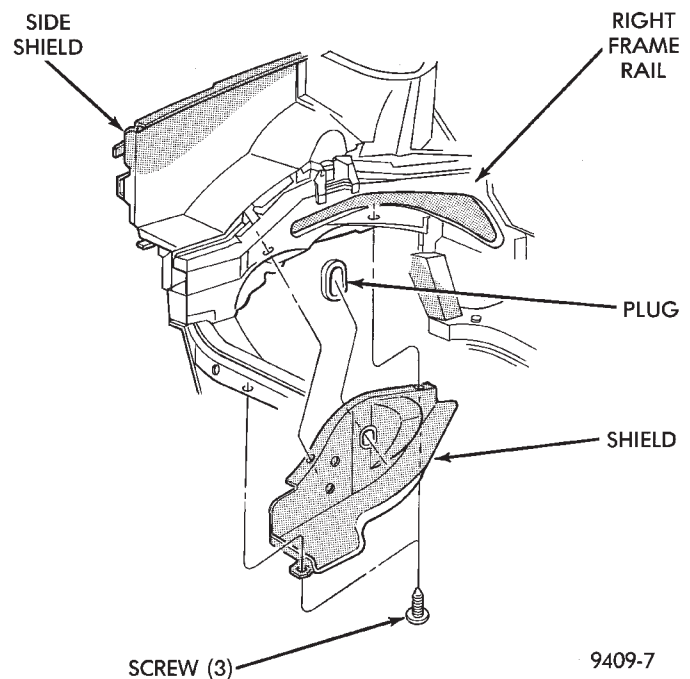
REMOVAL AND INSTALLATION (Continued)

**Fig. 40 Timing Belt System****Fig. 41 Camshaft Timing Marks**

- Turn the ignition switch on and access the "miscellaneous" screen.
- Select "re-learn cam/crank" option and follow directions on DRB screen.

OIL PAN**REMOVAL**

- (1) Drain engine oil.
- (2) Remove transmission inspection cover.
- (3) If equipped with air conditioning remove oil filter and adaptor. Refer to Oil Filter Adaptor Removal and Installation in this section.
- (4) Remove oil pan.

**Fig. 42 Right Inner Splash Shield**

- (5) Clean oil pan and all gasket surfaces.

REMOVAL AND INSTALLATION (Continued)

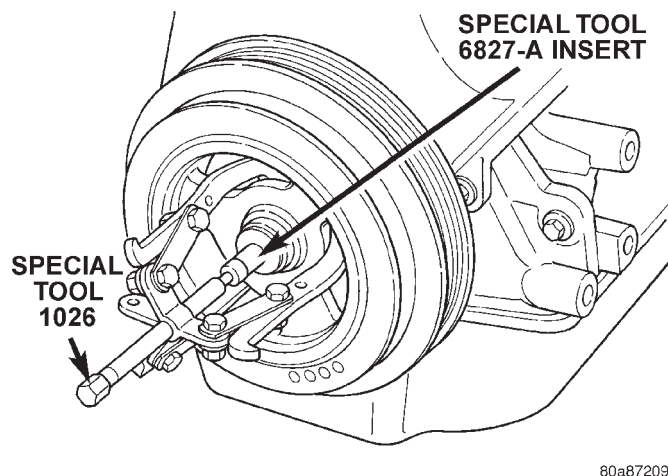


Fig. 43 Crankshaft Damper—Removal

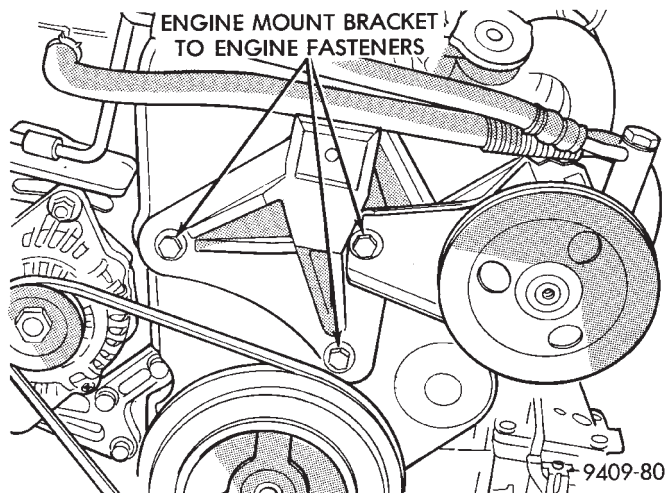


Fig. 44 Right Engine Mount Bracket

INSTALLATION

- (1) Apply Mopar Silicone Rubber Adhesive Sealant or equivalent at the oil pump to engine block parting line (Fig. 52).
- (2) Install a new oil pan gasket to pan.
- (3) Install pan and tighten screws to 12 N·m (105 in. lbs.).
- (4) Install oil filter and adaptor.
- (5) Install proper amount of oil. With oil filter 4.25 Liters (4.5 Qts.). Without oil filter 3.8 Liters (4.0 Qts.).

FRONT CRANKSHAFT OIL SEAL

REMOVAL

- (1) Using Special Tool 1026 and Insert 6827-A, remove crankshaft damper (Fig. 53).
- (2) Remove outer timing belt cover and timing belt. Refer to Timing Belt System outlined in this section.

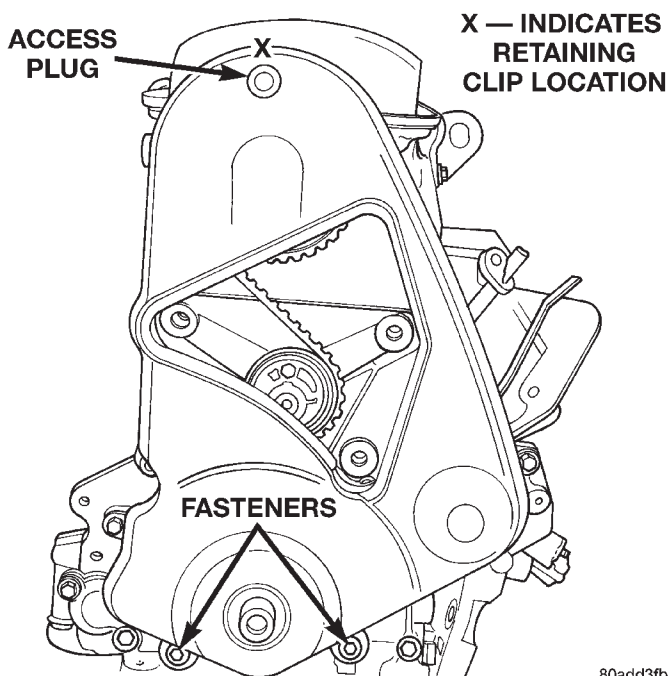


Fig. 45 Timing Belt Cover

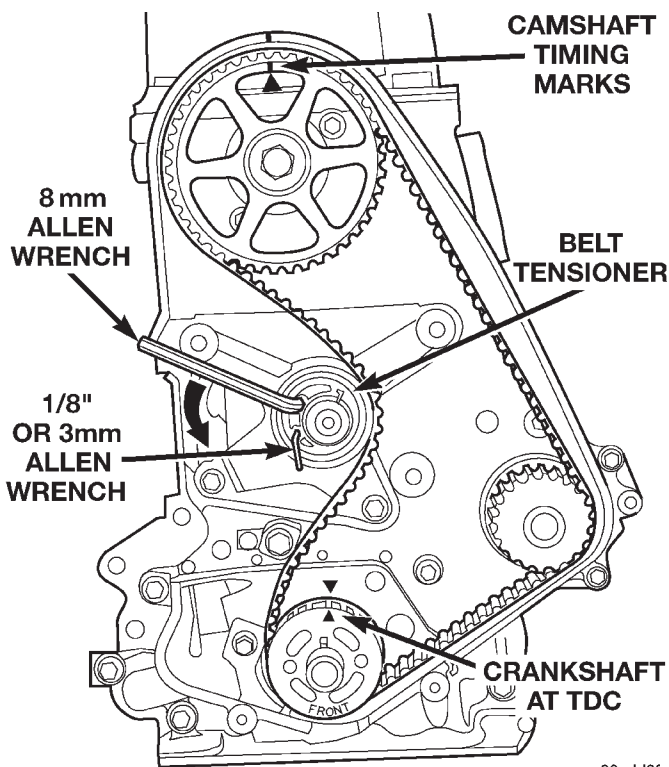
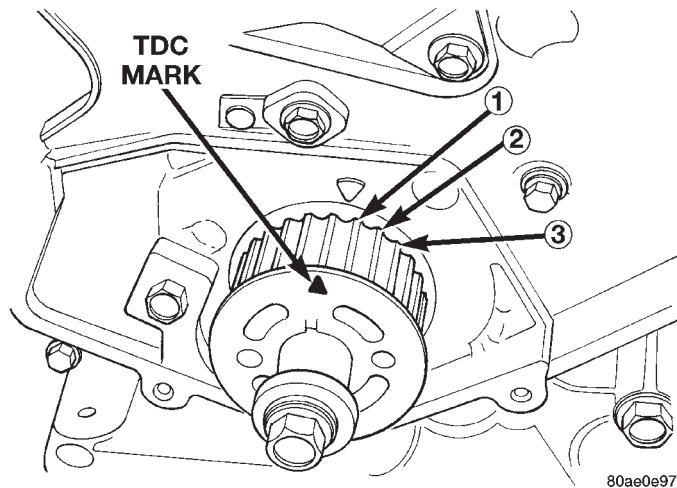
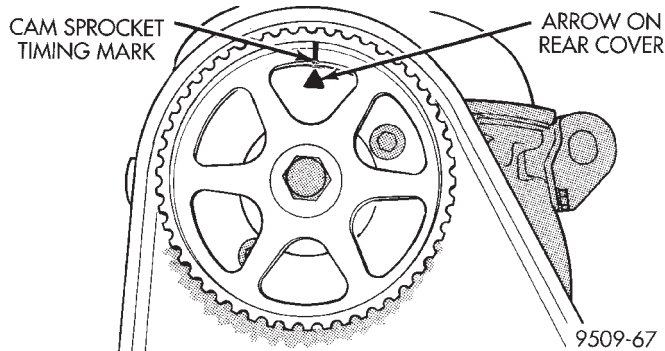
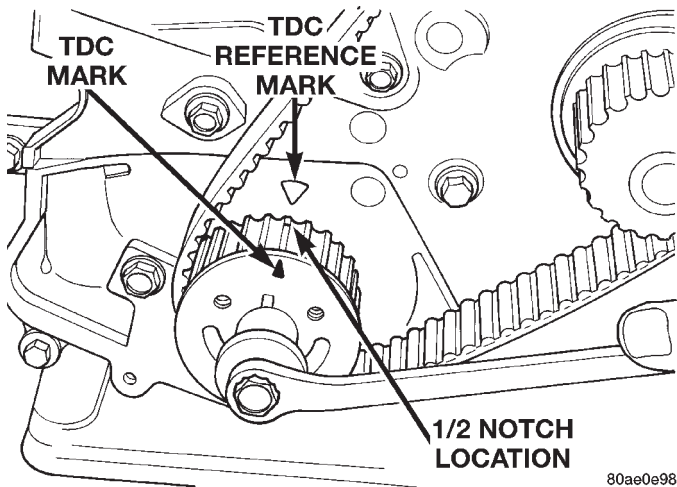


Fig. 46 Timing Belt Removal

- (3) Remove crankshaft sprocket using Special Tool 6793 and insert C-4685-C2 (Fig. 54).

CAUTION: Do not nick shaft seal surface or seal bore.

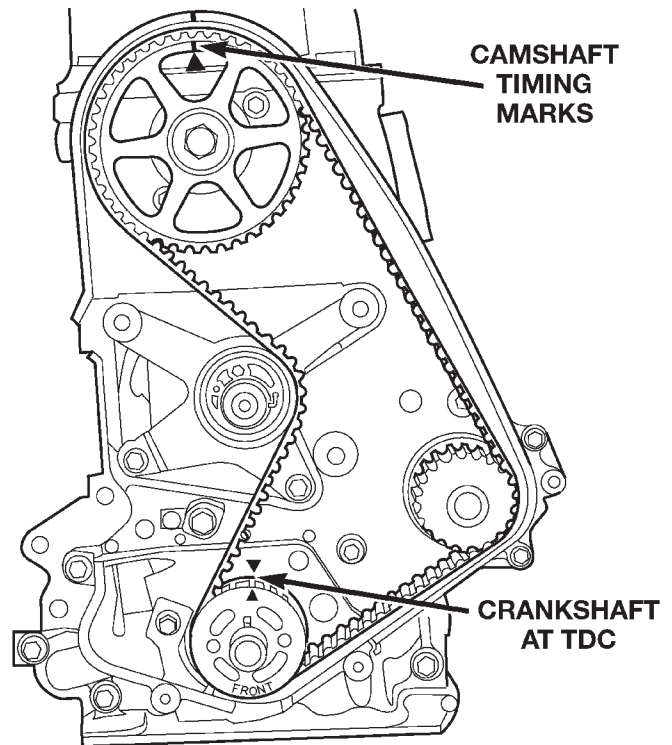
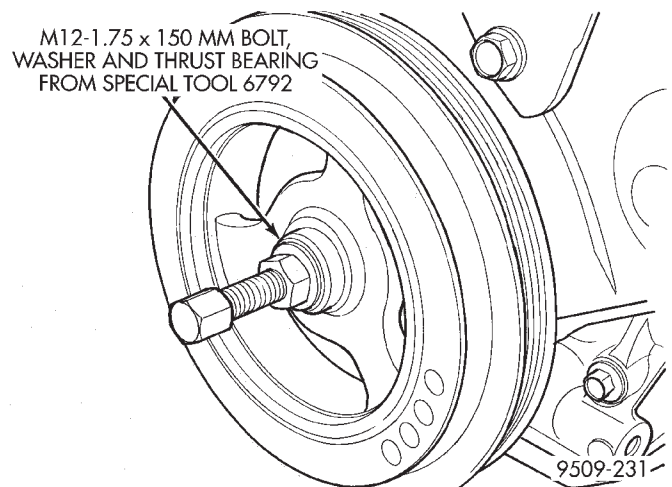
REMOVAL AND INSTALLATION (Continued)

**Fig. 47 Crankshaft Sprocket Timing****Fig. 48 Camshaft Timing Mark****Fig. 49 Adjusting Crankshaft Sprocket for Timing Belt Installation**

(4) Using Tool 6771 to remove front crankshaft oil seal (Fig. 55). Do not damage the seal contact area on the crankshaft.

INSTALLATION

(1) Install new seal by using Tool 6780-1 (Fig. 56).

**Fig. 50 Crankshaft and Camshaft Timing****Fig. 51 Crankshaft Damper—Installation**

(2) Place seal into opening with seal spring towards the inside of engine. Install seal until flush with cover.

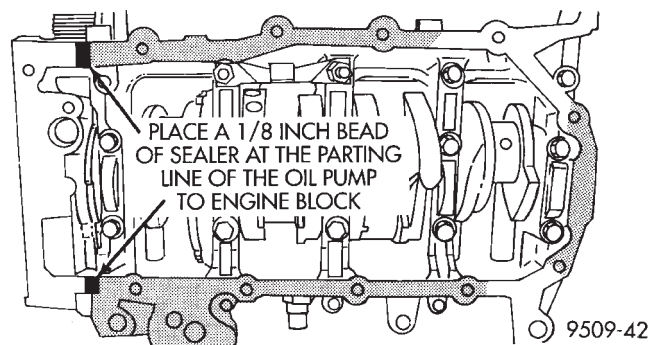
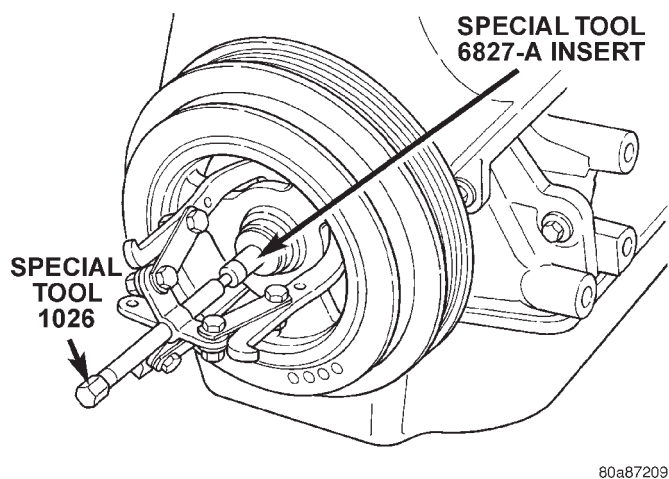
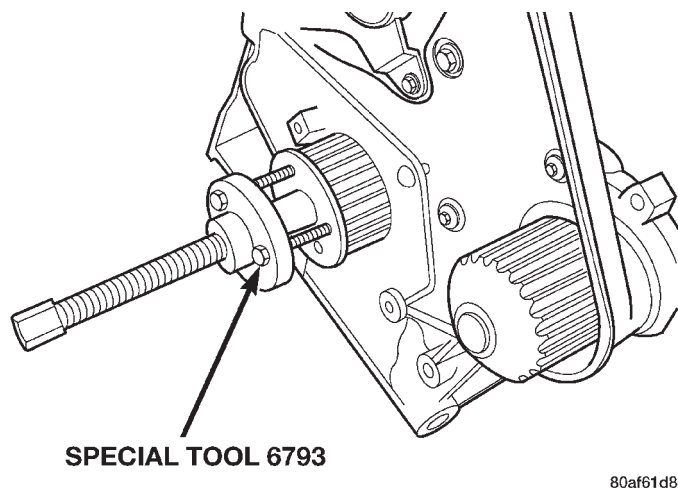
(3) Install crankshaft sprocket (Fig. 57). Using Special Tool 6792.

NOTE: Make sure the word "front" on the sprocket is facing you.

(4) Install timing belt and covers. Refer to Timing Belt System in this section for installation.

(5) Install crankshaft damper (Fig. 58). Use thrust bearing/washer and 12M-1.75 x 150 mm bolt from

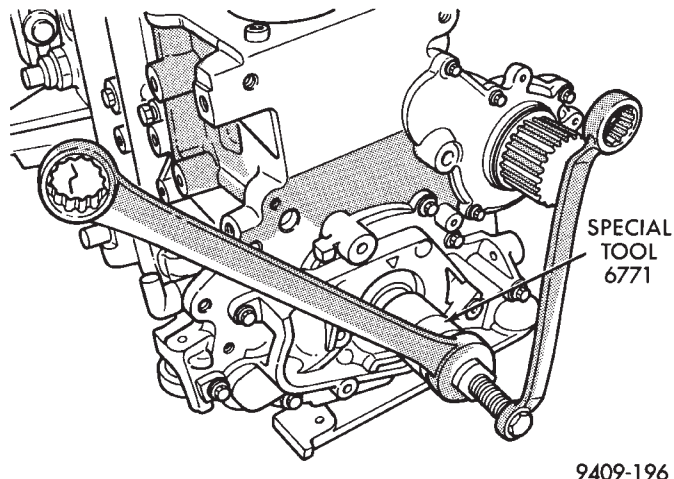
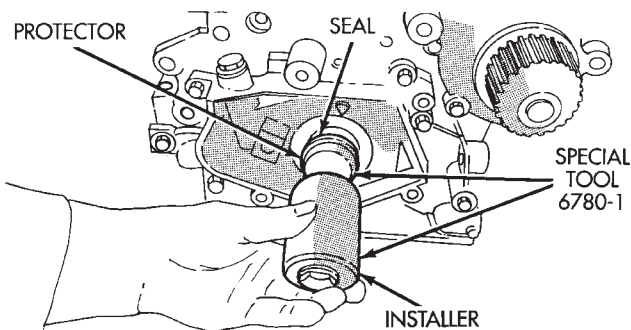
REMOVAL AND INSTALLATION (Continued)

**Fig. 52 Oil Pan Sealing****Fig. 53 Crankshaft Damper—Removal****Fig. 54 Crankshaft Sprocket—Removal**

Special Tool 6792. Install crankshaft damper bolt and tighten to 142 N·m (105 ft. lbs.)

CRANKSHAFT OIL SEAL—REAR**REMOVAL**

(1) Insert a 3/16 flat bladed screwdriver between the dust lip and the metal case of the crankshaft

**Fig. 55 Front Crankshaft Oil Seal—Removal****Fig. 56 Front Crankshaft Oil Seal—Installation**

seal. Angle the screwdriver (Fig. 59) through the dust lip against metal case of the seal. Pry out seal.

CAUTION: Do not permit the screwdriver blade to contact crankshaft seal surface. Contact of the screwdriver blade against crankshaft edge (chamfer) is permitted.

INSTALLATION

CAUTION: If burr or scratch is present on the crankshaft edge (chamfer), cleanup with 400 grit sand paper to prevent seal damage during installation of new seal.

REMOVAL AND INSTALLATION (Continued)

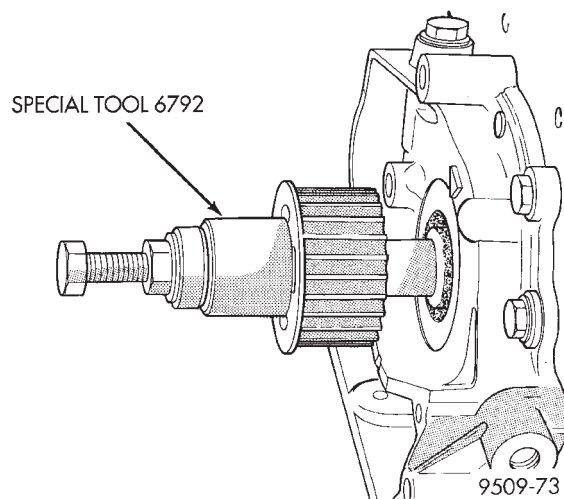


Fig. 57 Crankshaft Sprocket—Installation

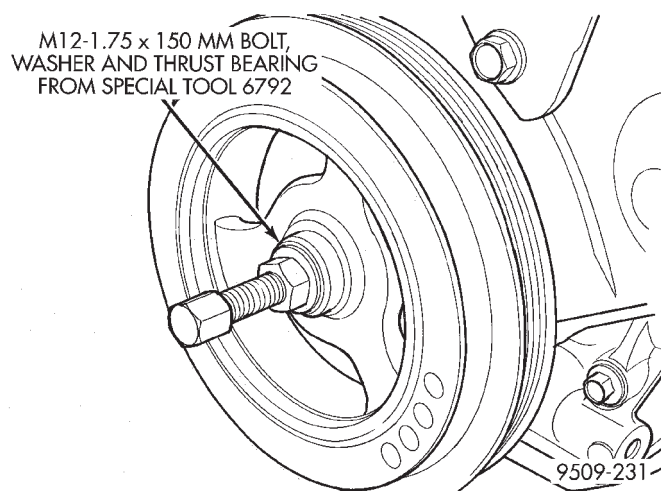


Fig. 58 Crankshaft Damper—Installation

NOTE: When installing seal, no lube on seal is needed.

- (1) Place Special Tool 6926-1 on crankshaft. This is a pilot tool with a magnetic base (Fig. 60).
- (2) Position seal over pilot tool. Make sure you can read the words **THIS SIDE OUT** on seal (Fig. 60). Pilot tool should remain on crankshaft during installation of seal. Ensure that the lip of the seal is facing towards the crankcase during installation.

CAUTION: If the seal is driven into the block past flush, this may cause an oil leak.

- (3) Drive the seal into the block using Special Tool 6926-2 and handle C-4171 (Fig. 61) until the tool bottoms out against the block (Fig. 62).

CRANKSHAFT

REMOVAL

- (1) Remove oil filter and adapter from bedplate.

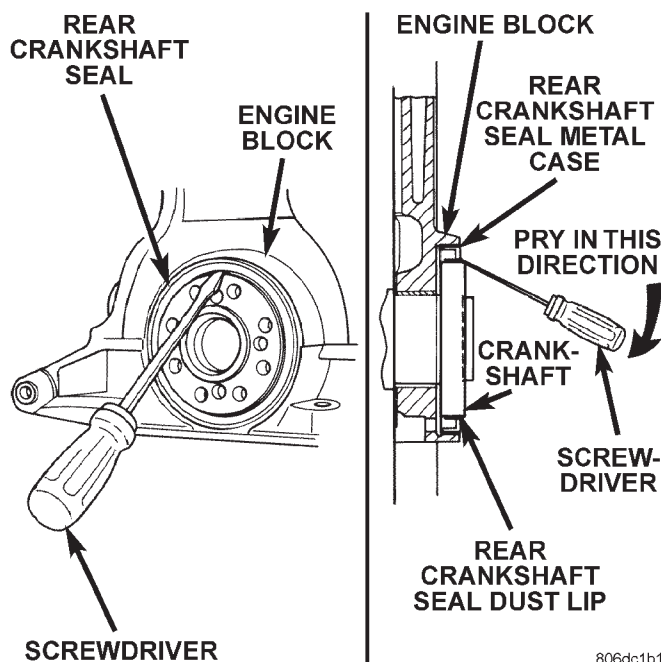


Fig. 59 Rear Crankshaft Oil Seal—Removal

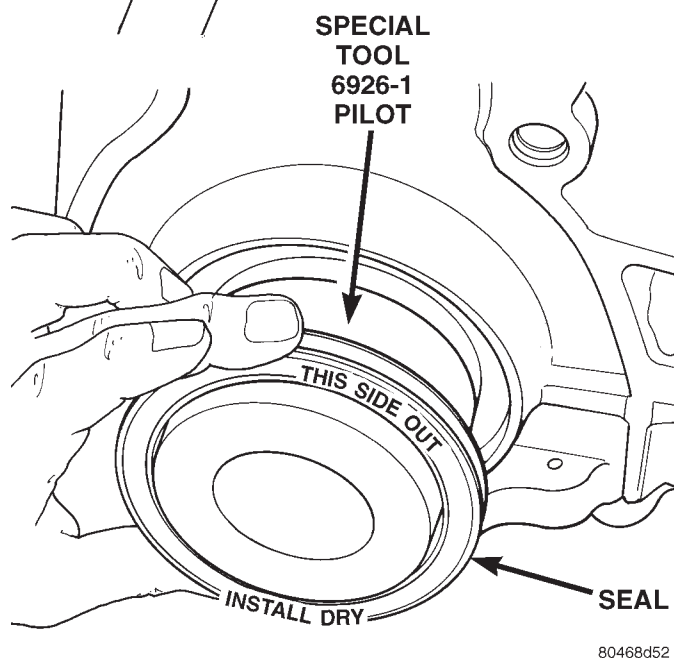


Fig. 60 Rear Crankshaft Seal and Special Tool 6926-1

- (2) Remove collar from oil pan to transmission housing.
- (3) Remove oil pan.
- (4) Remove crankshaft sprocket and oil pump both procedures outlined in this section.
- (5) Remove all main bearing cap and bedplate bolts from the engine block (Fig. 63).
- (6) Using a mallet tap the bedplate loose from the engine block dowel pins.

REMOVAL AND INSTALLATION (Continued)

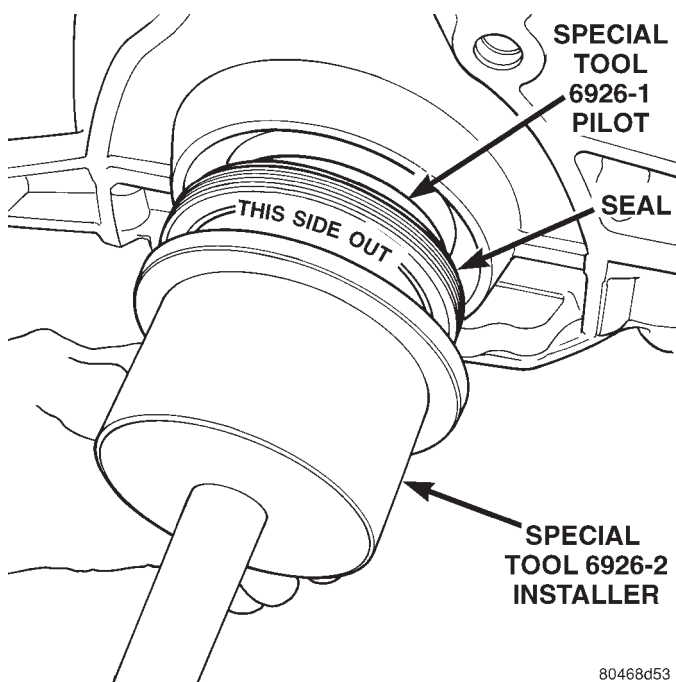


Fig. 61 Crankshaft Seal Special Tool 6926-2

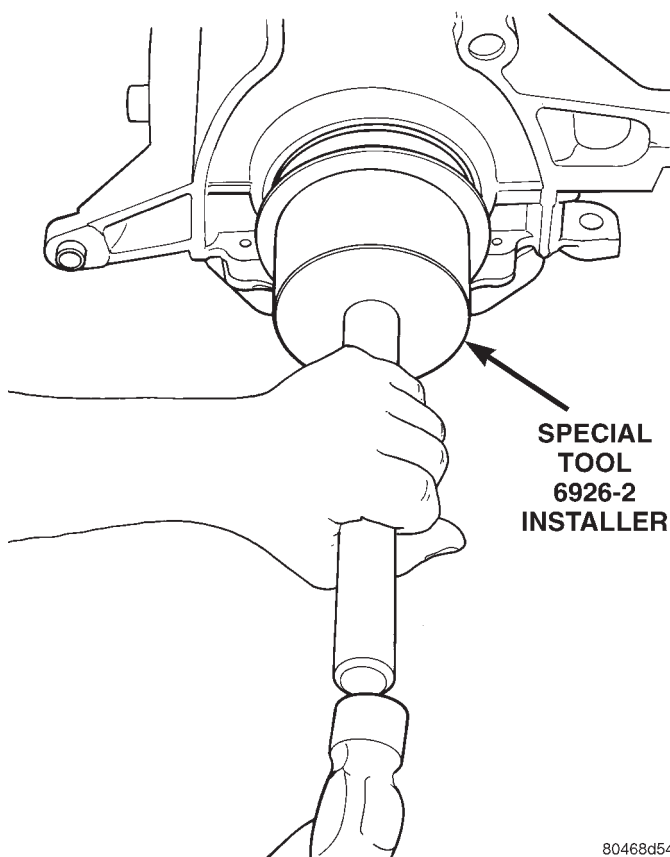


Fig. 62 Rear Crankshaft Seal—Installation

CAUTION: Do not pry up on one side of the bedplate. Damage may occur to cylinder block and bedplate alignment.

(7) Bedplate should be removed evenly from the cylinder block dowel pins.

(8) Lift out crankshaft from cylinder block. Be sure not to damage the main bearings or journals when removing the crankshaft.

CRANKSHAFT MAIN BEARINGS LOCATION

The crankshaft is supported in five main bearings. All upper bearing shells in the crankcase have oil grooves. All lower bearing shells installed in the (bedplate) main bearing cap are plain. Crankshaft end play is controlled by a flanged bearing on the number three main bearing journal (Fig. 64).

NOTE: The upper and lower main Bearing shells are Not interchangeable. The lower shells have a revised tab to prevent improper installation.

CRANKSHAFT MAIN JOURNALS INSPECTION

The crankshaft journals should be checked for excessive wear, taper and scoring. Limits of taper or out-of-round on any crankshaft journals should be held to .025 mm (.001 inch). Journal grinding should not exceed .305 mm (.012 inch) under the standard journal diameter. DO NOT grind thrust faces of Number 3 main bearing. DO NOT nick crank pin or bearing fillets. After grinding, remove rough edges from crankshaft oil holes and clean out all passages.

CAUTION: With the nodular cast iron crankshafts used it is important that the final paper or cloth polish after any journal regrind be in the same direction as normal rotation in the engine.

Upper and lower Number 3 bearing halves are flanged to carry the crankshaft thrust loads and are NOT interchangeable with any other bearing halves in the engine (Fig. 64). All bearing cap bolts removed during service procedures are to be cleaned and oiled before installation. Bearing shells are available in standard and the following undersized: 0.016 mm (.0006 inch), .032 mm (.0012 inch), .250 mm (.010 inch). Never install an undersize bearing that will reduce clearance below specifications.

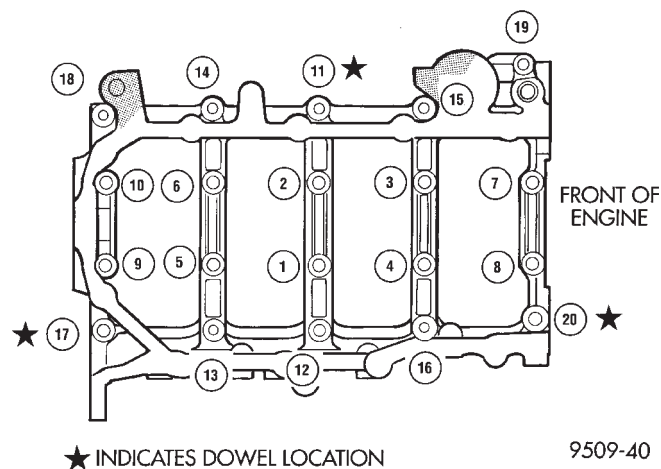
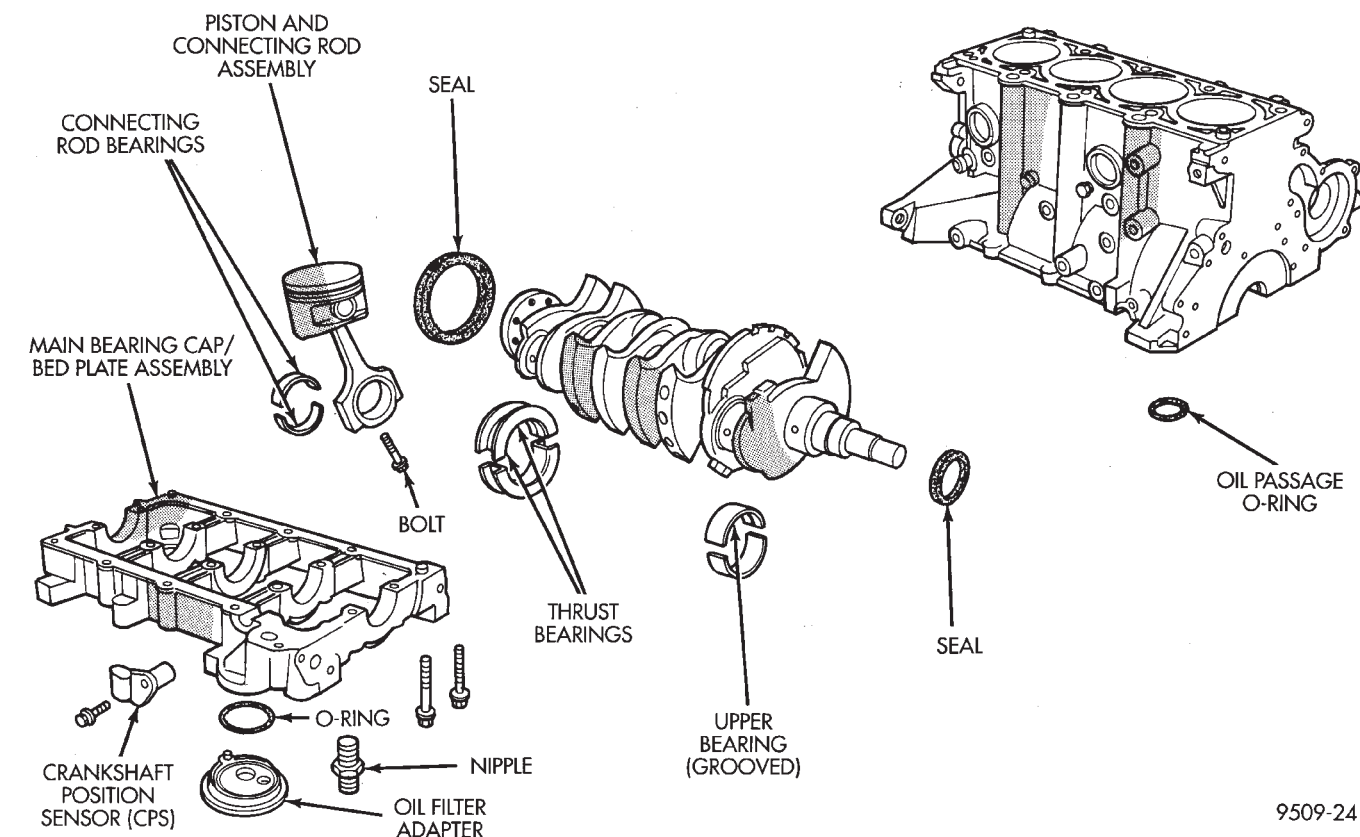
INSTALLATION

(1) Install the main bearing shells with the lubrication groove in the cylinder block. Install O-ring into recess in the block (Fig. 65).

(2) Make certain oil holes in block line up with oil hole in bearings and bearing tabs seat in the block tab slots.

CAUTION: Do Not get oil on the bedplate mating surface. It will affect the sealer ability to seal the bedplate to cylinder block.

REMOVAL AND INSTALLATION (Continued)

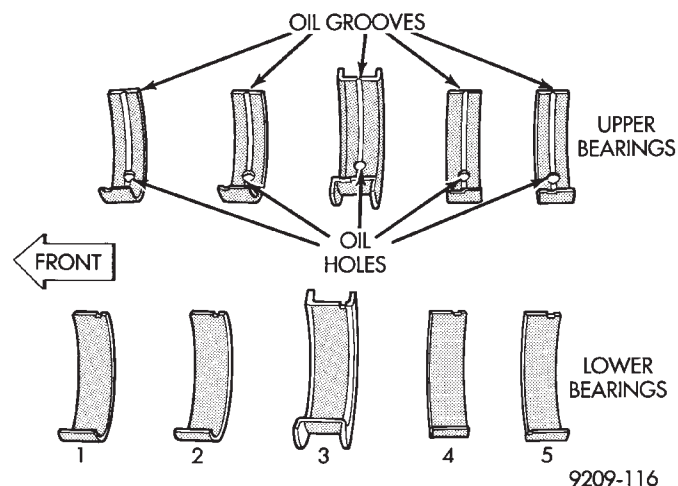
**Fig. 63 Bedplate Bolts**

(3) Oil the bearings and journals and install crankshaft and O-ring in cylinder block.

CAUTION: Use only the specified anaerobic sealer on the bedplate or damage may occur to the engine.

(4) Apply 1.5 to 2.0 mm (0.059 to 0.078 in.) bead of Mopar Torque Cure Gasket Maker to cylinder block as shown in (Fig. 66).

(5) Install lower main bearings into main bearing cap/bedplate. Make certain the bearing tabs are

**Fig. 64 Main Bearing Identification**

seated into the bedplate slots. Install the main bearing/bedplate into engine block.

(6) Before installing the bolts oil threads with clean engine oil, wipe off any excess oil.

(7) Install main bearing bedplate to engine block bolts 11, 17 and 20 finger tight. Tighten this bolts down together until the bedplate contacts the cylinder block. Torque bolts to 30 N·m (22 ft. lbs.) (Fig. 67).

REMOVAL AND INSTALLATION (Continued)

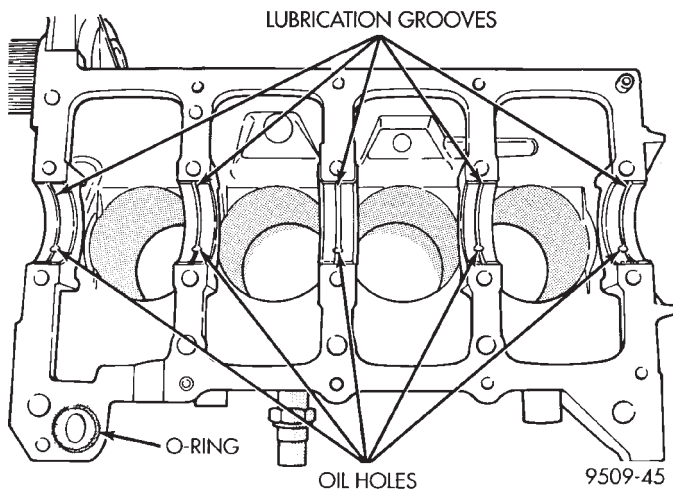


Fig. 65 Installing Main Bearing Upper Shell

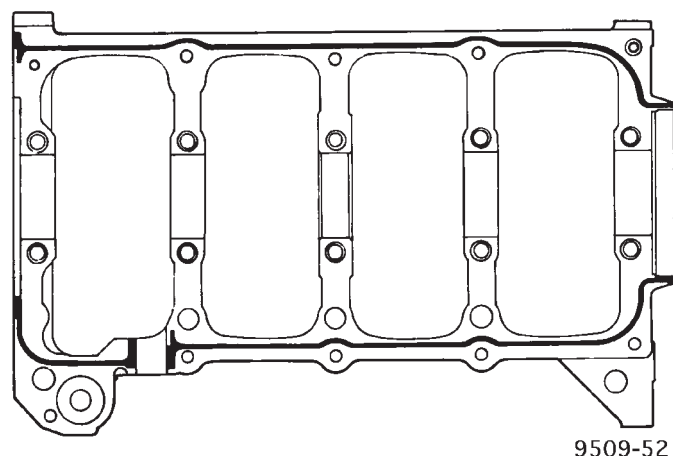


Fig. 66 Main Bearing Caps/Bedplate Sealing

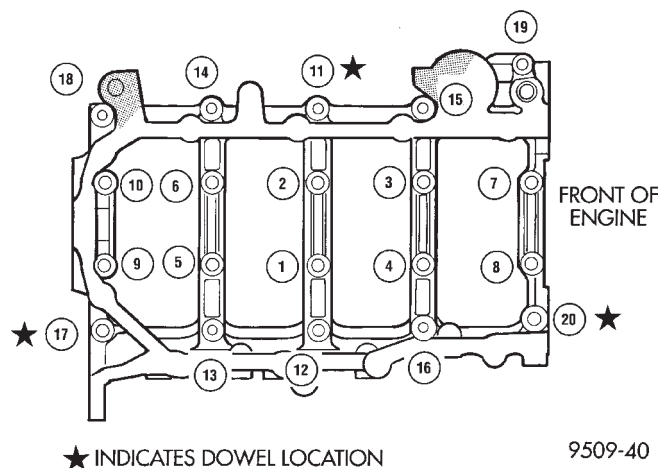


Fig. 67 Main Bearing Caps/Bedplate Torque Sequence

(8) Install main bearing bedplate to engine block bolts (1 thru 10) and torque each bolt to 81 N·m (60 ft. lbs.) in sequence shown in (Fig. 67).

(9) Install main bearing bedplate to engine block bolts (11 thru 20), with baffle studs in positions 12, 13 and 16 and torque each bolt to 30 N·m (22 ft. lbs.) in sequence shown in (Fig. 67).

(10) After the main bearing bedplate is installed, check the crankshaft turning torque. The turning torque should not exceed 5.6 N·m (50 in. lbs.).

(11) Install oil pump. If crankshaft end play is to be checked refer to service procedures in this section.

(12) Install crankshaft sprocket.

(13) Install oil filter adapter and filter.

(14) Install oil pan and collar. Refer to procedures outlined in the section.

(15) Perform camshaft and crankshaft timing relearn procedure as follows:

- Connect the DRB scan tool to the data link (diagnostic) connector. This connector is located in the passenger compartment; at the lower edge of instrument panel; near the steering column.

- Turn the ignition switch on and access the "miscellaneous" screen.

- Select "re-learn cam/crank" option and follow directions on DRB screen.

OIL FILTER ADAPTER

REMOVE AND INSTALL

Ensure O-ring is in the groove on adapter. Align roll pin into engine block and tighten assembly to 80 N·m (60 ft. lbs.) (Fig. 68).

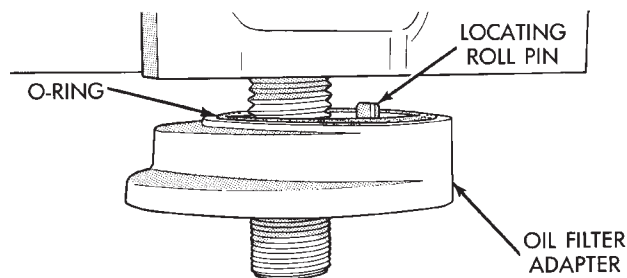


Fig. 68 Engine Oil Filter Adapter to Engine Block

REMOVE AND INSTALL

CAUTION: When servicing the oil filter (Fig. 69) avoid deforming the filter, install tool band strap against the seam at the base of the filter. The seam, joining the can to the base is reinforced by the base plate.

(1) Turn counterclockwise to remove.

(2) To install, lubricate new filter gasket. Check filter mounting surface. The surface must be smooth, flat and free of debris or old pieces of rubber. Screw

REMOVAL AND INSTALLATION (Continued)

filter on until gasket contacts base. Tighten to 21 N·m (15 ft. lbs.).

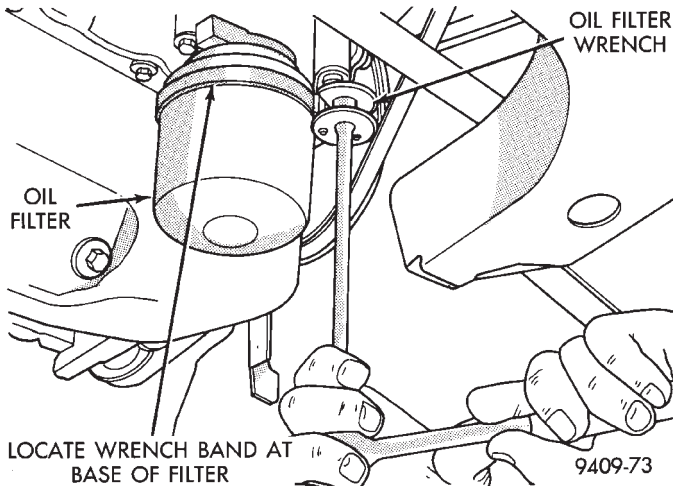


Fig. 69 Engine Oil Filter

OIL PUMP

REMOVAL

- (1) Disconnect negative cable from battery.
- (2) Remove Timing Belt. Refer to Timing Belt System, in this section.
- (3) Remove Oil Pan. Refer to Oil Pan Removal in this section.
- (4) Remove Crankshaft Sprocket using Special Tool 6793 and insert C-4685-C2 (Fig. 70).

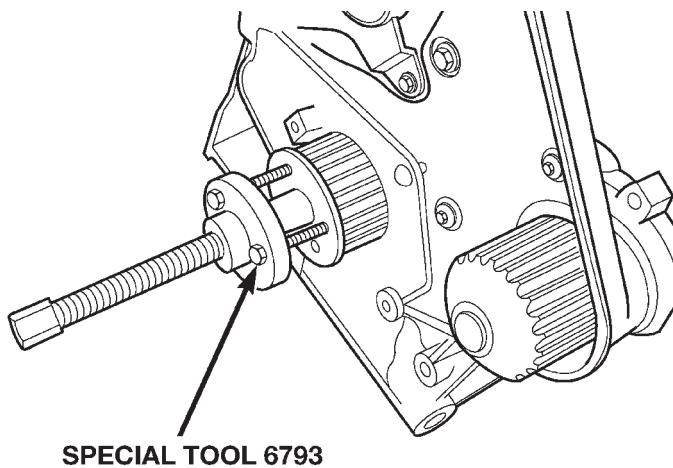


Fig. 70 Crankshaft Sprocket—Removal

- (5) Remove oil pick-up tube.
- (6) Remove oil pump (Fig. 71) and front crankshaft seal.

INSTALLATION

- (1) Make sure all surfaces are clean and free of oil and dirt.

- (2) Apply Mopar® Gasket Maker to oil pump as shown in (Fig. 72). Install o-ring into oil pump body discharge passage.

- (3) Prime oil pump before installation.

- (4) Align oil pump rotor flats with flats on crankshaft as you install the oil pump to the block.

NOTE: Front crankshaft seal **MUST** be out of pump to align, or damage may result.

- (5) Torque all oil pump attaching bolts to 28 N·m (250 in. lbs.).

- (6) Install new front crankshaft seal using Special Tool 6780 (Fig. 73).

- (7) Install crankshaft sprocket, using Special Tool 6792 (Fig. 74).

- (8) Install oil pump pick-up tube and oil pan.

- (9) Install Timing Belt. Refer to procedure outlined in this section.

- (10) Connect negative cable to battery.

PISTON AND CONNECTING ROD

REMOVAL

- (1) Remove top ridge of cylinder bores with a reliable ridge reamer before removing pistons from cylinder block. **Be sure to keep tops of pistons covered during this operation.** Mark piston with matching cylinder number (Fig. 75).

- (2) Remove oil pan. Scribe the cylinder number on the side of the rod and cap (Fig. 76) for identification.

- (3) Pistons will have a stamping in the approximate location shown in (Fig. 75). These stamps will be either a directional arrow or a weight identification for the assembly. L is for light and H is for heavy. These assemblies should all be the same weight class. Service piston assemblies are marked with a S and can be used with either L or H production assemblies. The weight designation stamps should face toward the timing belt side of the engine.

- (4) Pistons and connecting rods must be removed from top of cylinder block. Rotate crankshaft so that each connecting rod is centered in cylinder bore.

- (5) Remove connecting rod cap bolts **Do not use old bolts if reinstalling connecting rod.** Push each piston and rod assembly out of cylinder bore.

NOTE: Be careful not to nick crankshaft journals.

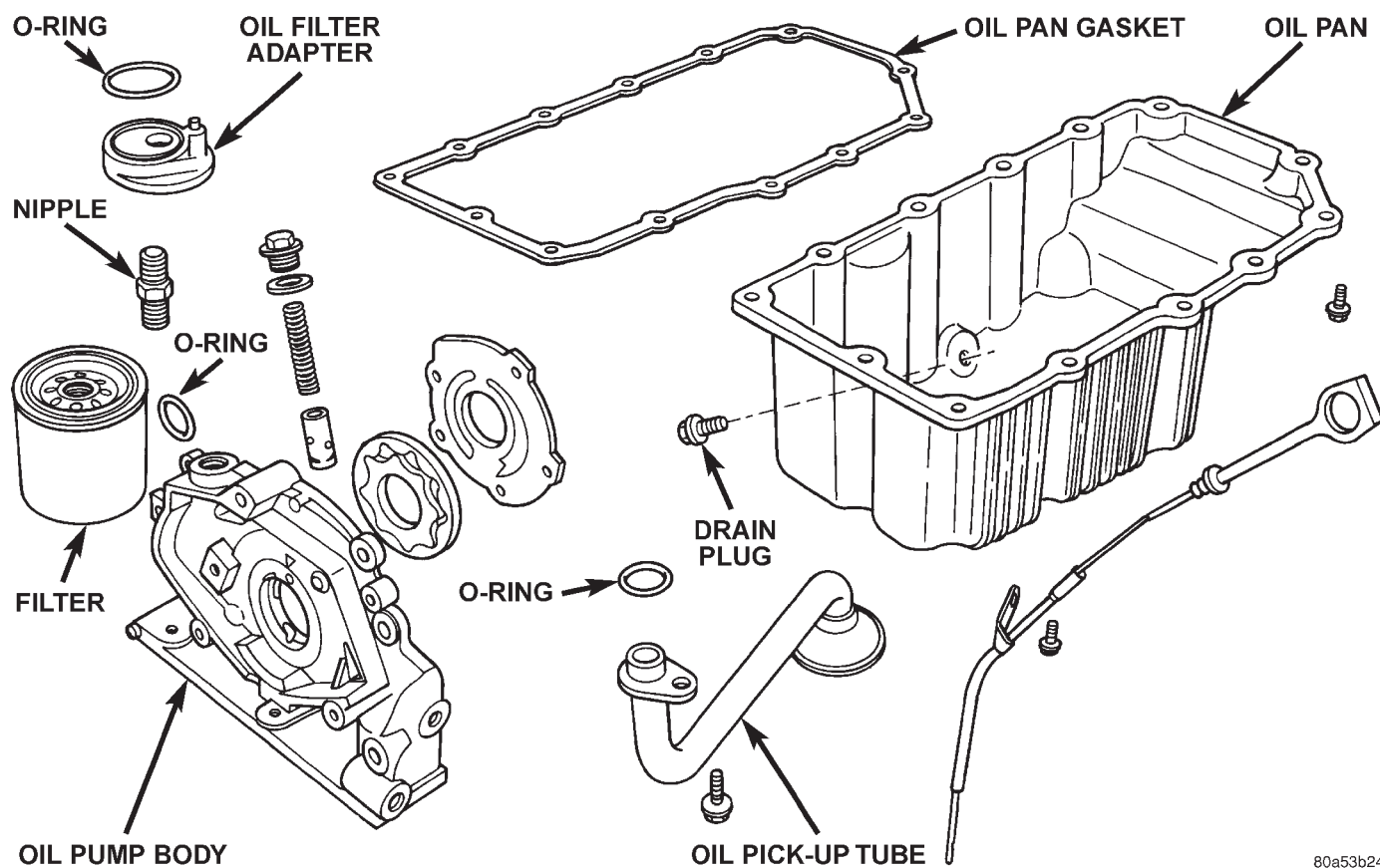
- (6) After removal, install bearing cap on the mating rod.

- (7) Piston and Rods are serviced as an assembly.

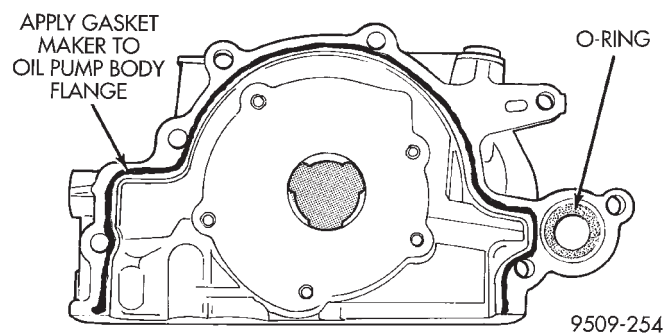
PISTON RING—REMOVAL

- (1) ID mark on face of upper and intermediate piston rings must point toward piston crown.

REMOVAL AND INSTALLATION (Continued)



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Fig. 71 Oil Pump and Tube

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Fig. 72 Oil Pump Sealing

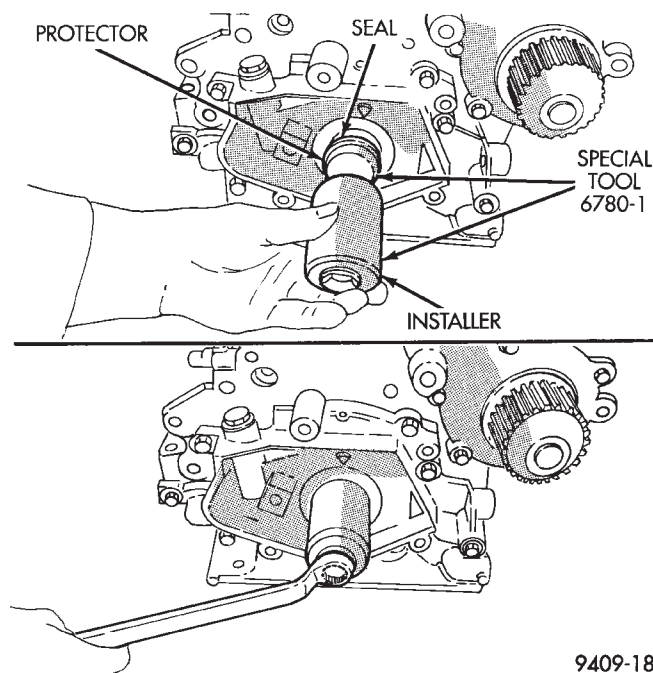
- (2) Using a suitable ring expander, remove upper and intermediate piston rings (Fig. 77).
- (3) Remove the upper oil ring side rail, lower oil ring side rail and then oil ring expander from piston.
- (4) Clean ring grooves of any carbon deposits.

PISTON RINGS—INSTALLATION

- (1) Install rings with manufacturers I.D. mark facing up, to the top of the piston (Fig. 78).

CAUTION: Install piston rings in the following order:

- a. Oil ring expander.



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Fig. 73 Front Crankshaft Seal—Installation

- b. Upper oil ring side rail.
- c. Lower oil ring side rail.
- d. No. 2 Intermediate piston ring.

REMOVAL AND INSTALLATION (Continued)

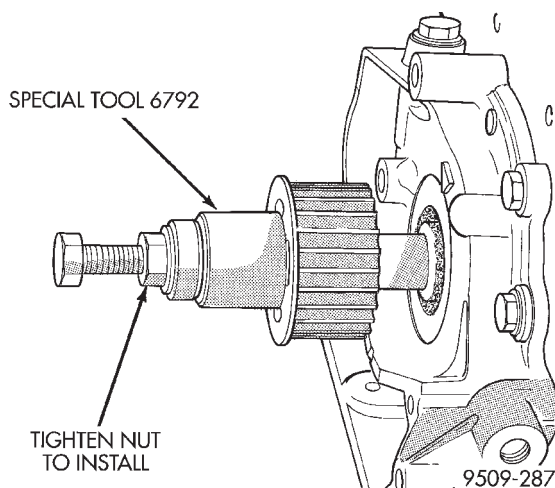


Fig. 74 Crankshaft Sprocket—Installation

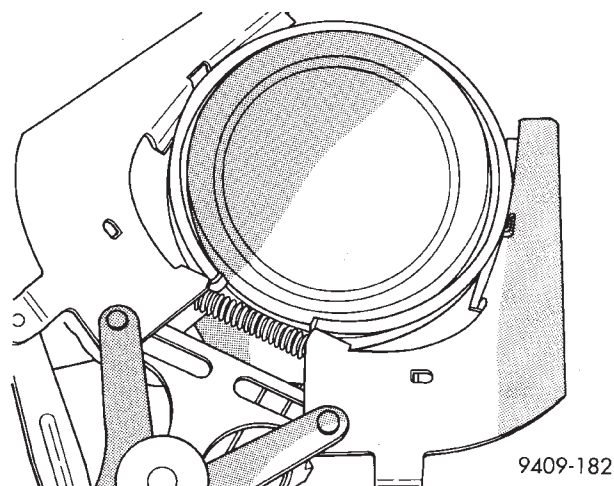


Fig. 77 Piston Rings—Removing and Installing

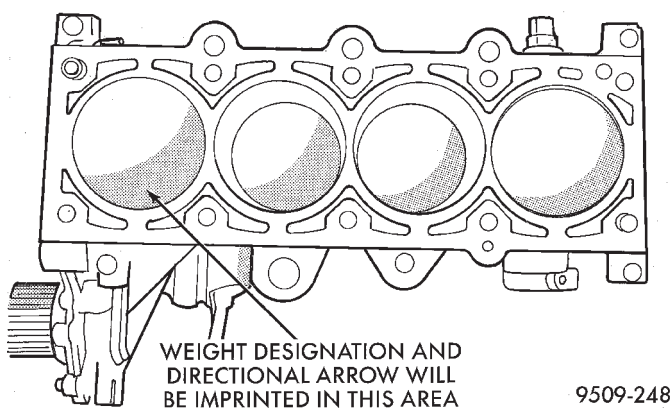


Fig. 75 Piston Markings

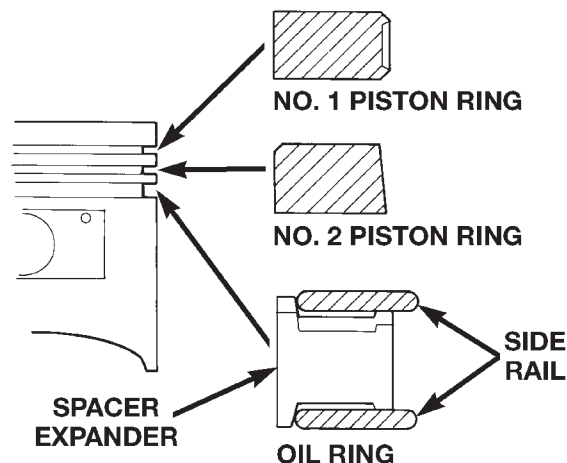


Fig. 78 Piston Ring Installation

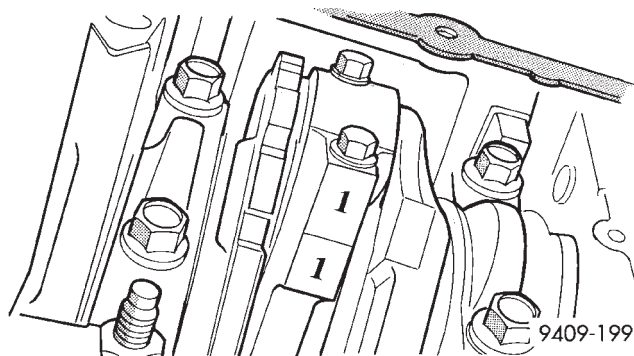


Fig. 76 Identify Connecting Rod to Cylinder

- e. No. 1 Upper piston ring.
- f. Install the side rail by placing one end between the piston ring groove and the expander. Hold end firmly and press down the portion to be installed until side rail is in position. **Do not use a piston ring expander (Fig. 79).**
- (2) Install upper side rail first and then the lower side rail.
- (3) Install No. 2 piston ring and then No. 1 piston ring (Fig. 78).

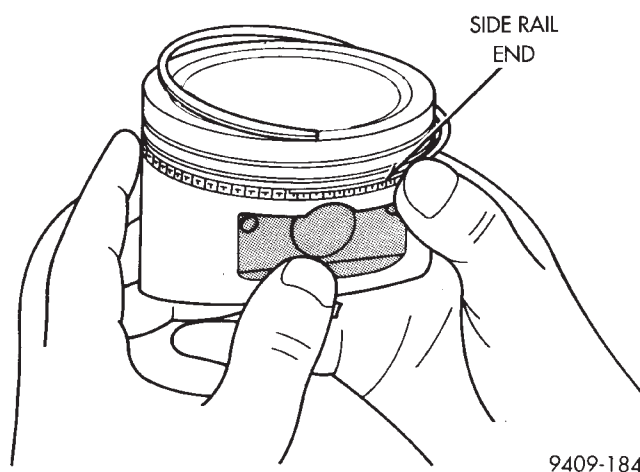


Fig. 79 Installing Side Rail

- (4) Position piston ring end gaps as shown in (Fig. 80).
- (5) Position oil ring expander gap at least 45° from the side rail gaps but **not** on the piston pin center or

REMOVAL AND INSTALLATION (Continued)

on the thrust direction. Staggering ring gap is important for oil control.

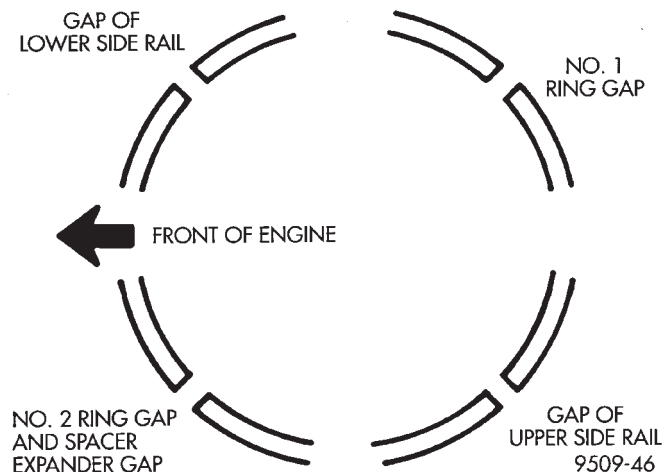


Fig. 80 Piston Ring End Gap Position

PISTON AND ROD —INSTALLATION

(1) Before installing pistons and connecting rod assemblies into the bore, be sure that compression ring gaps are staggered so that neither is in line with oil ring gap.

(2) Before installing the ring compressor, make sure the oil ring expander ends are butted and the rail gaps located as shown in (Fig. 80).

(3) Immerse the piston head and rings in clean engine oil, slide the ring compressor, over the piston (Fig. 81). **Be sure position of rings does not change during this operation.**

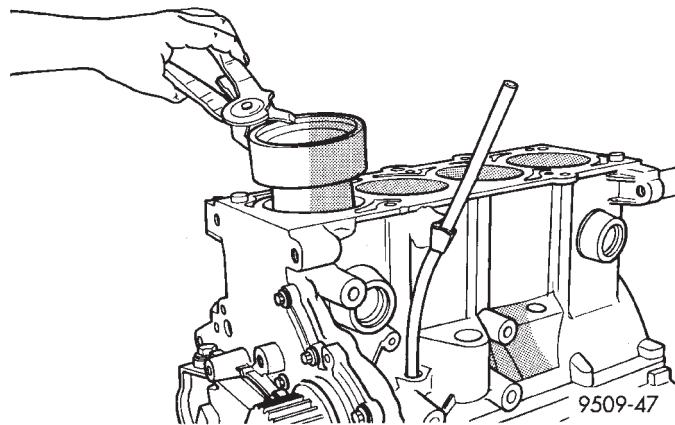


Fig. 81 Installing Piston

(4) The weight stamp designation L or H will be in the front half of the piston should face toward the front of the engine for SOHC engine. The arrow should face toward the front of the engine for DOHC engine (Fig. 75).

(5) Rotate crankshaft so that the connecting rod journal is on the center of the cylinder bore. Insert

rod and piston assembly into cylinder bore and guide rod over the crankshaft journal.

(6) Tap the piston down in cylinder bore, using a hammer handle. At the same time, guide connecting rod into position on connecting rod journal.

(7) Install rod caps. Install **New** bolts and tighten to 27 N·m (20 ft.lb.) Plus 1/4 turn.

VIBRATION DAMPER

NOTE: If a gap is found in the crankshaft damper, in the area where the Poly-V Generator belt rides this is normal and is acceptable (Fig. 82).

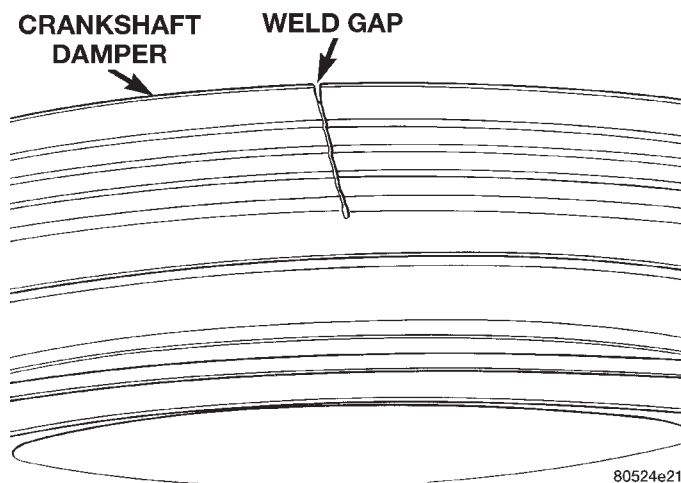


Fig. 82 Weld Gap

REMOVAL

(1) Remove accessory drive belts. Refer to Group 7, Cooling System for procedure outlined in that section.

(2) Remove crankshaft damper bolt. Remove damper using the large side of Special Tool 1026 and insert 6827-A (Fig. 83).

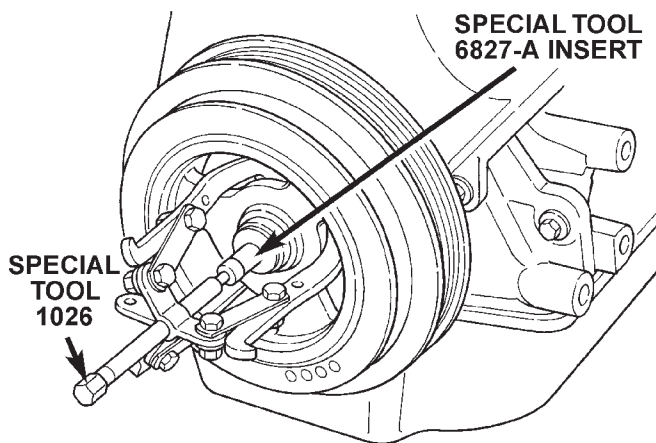


Fig. 83 Crankshaft Damper—Removal

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Install crankshaft damper using M12-1.75 x 150 mm bolt, washer, thrust bearing and nut from Special Tool 6792. Install crankshaft damper bolt and tighten to 142 N·m (105 ft. lbs.) (Fig. 84).

(2) Install accessory drive belts. Refer to Group 7, Cooling System Accessory Drive section for procedure.

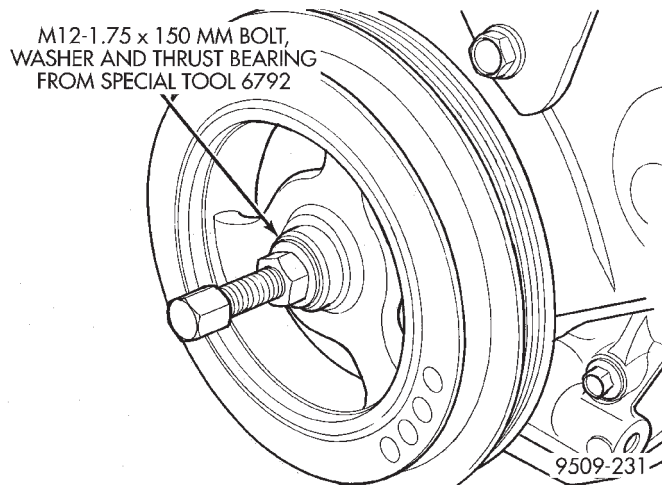


Fig. 84 Crankshaft Damper—Installation

DISASSEMBLY AND ASSEMBLY

OIL PUMP

(1) To remove the relief valve, proceed as follows:
 (2) Remove the threaded plug and gasket from the oil pump (Fig. 85).

CAUTION: Oil pump pressure relief valve must be installed as shown in (Fig. 85) or serious damage may occur.

(3) Remove spring and relief valve (Fig. 85).

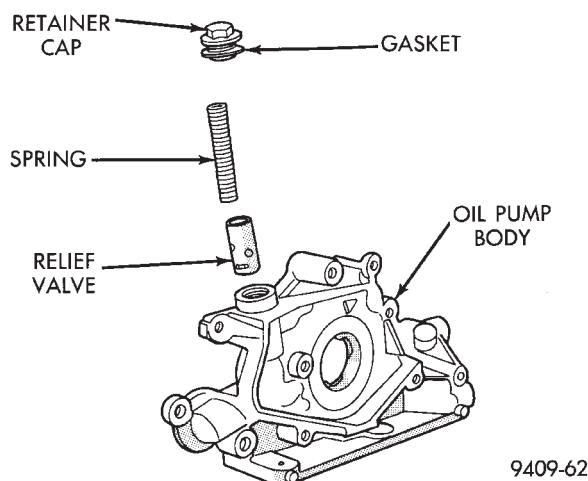


Fig. 85 Oil Pressure Relief Valve

(4) Remove oil pump cover screws, and lift off cover.

(5) Remove pump rotors.

(6) Wash all parts in a suitable solvent and inspect carefully for damage or wear (Fig. 86).

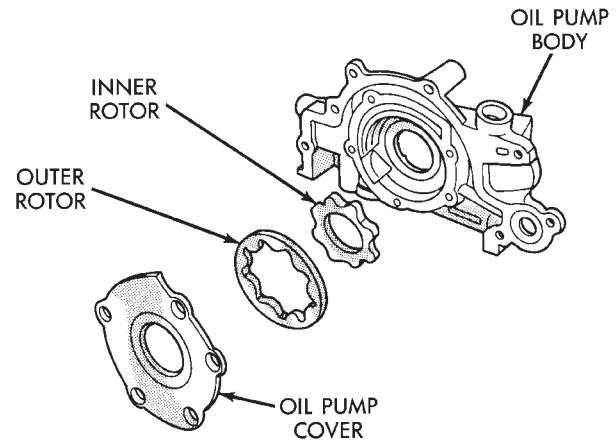


Fig. 86 Oil Pump

VALVE SERVICE WITH THE CYLINDER HEAD REMOVED

REMOVAL

(1) With cylinder head removed, compress valve springs using Special Tool C-3422-B or equivalent.

(2) Remove valve retaining locks, valve spring retainers, valve stem seals and valve springs.

(3) Before removing valves, **remove any burrs from valve stem lock grooves to prevent damage to the valve guides.** Identify valves to insure installation in original location.

VALVE INSPECTION

(1) Clean valves thoroughly and discard burned, warped and cracked valves.

(2) Measure valve stems for wear. Measure stem about 60 mm beneath the valve lock grooves.

(3) If valve stems are worn more than 0.05 mm (.002 in.), replace valve.

VALVE GUIDES

(1) Remove carbon and varnish deposits from inside of valve guides with a reliable guide cleaner.

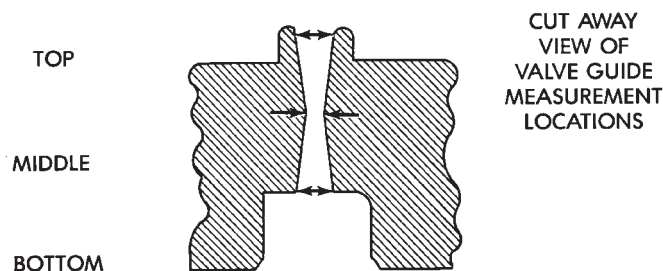
(2) Using a small hole gauge and a micrometer, measure valve guides in 3 places top, middle and bottom (Fig. 87). Refer to Valve Guide Specification Chart for specifications. Replace guides if they are not within specification.

(3) Check valve guide height (Fig. 88).

TESTING VALVE SPRINGS

(1) Whenever valves have been removed for inspection, reconditioning or replacement, valve springs

DISASSEMBLY AND ASSEMBLY (Continued)

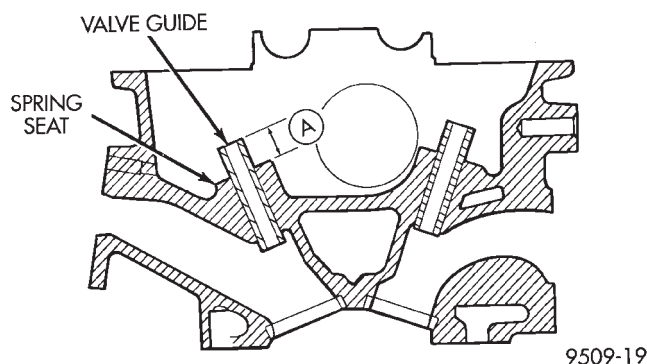


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Fig. 87 Checking Wear on Valve Guide—Typical
VALVE GUIDE SPECIFICATION CHART

Valve Guide Diameter	Intake Valve	Exhaust Valve
	5.975 - 6.000 mm (0.2352 - 0.2362 in.)	5.975 - 6.000 mm (0.2352 - 0.2362 in.)
Valve Guide Clearance		
	Intake Valve	Exhaust Valve
New:	0.023 - 0.066 mm (0.001 - 0.0025 in.)	0.051 - 0.094 mm (0.002 - 0.0037 in.)
Service Limit:	0.25 mm (0.010 in.)	

(A) 13.25 - 13.75 mm
(.521 - .541 in.)

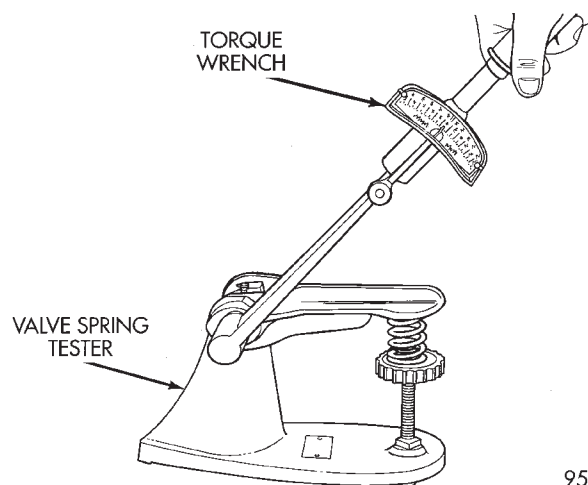


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Fig. 88 Valve Guide Height

should be tested Special Tool C-647. As an example, the compression length of the spring to be tested is 33.34 mm (1-5/16 inches). Turn tool table until surface is in line with the 33.34 mm (1-5/16 inch) mark on the threaded stud and the zero mark on the front. Place spring over stud on the table and lift compressing lever to set tone device (Fig. 89). Pull on torque wrench until ping is heard. Take reading on torque wrench at this instant. Multiply this reading by two. This will give the spring load at test length. Fractional measurements are indicated on the table for finer adjustments. Discard the springs that do not meet specifications. The Following specifications apply to both intake and exhaust valve springs.

- Valve Closed Nominal Force— 67 lbs. @ 39.8 mm (1.57 in.)
- Valve Open Nominal Force— 160 lbs. @ 32.6 mm (1.28 in.)



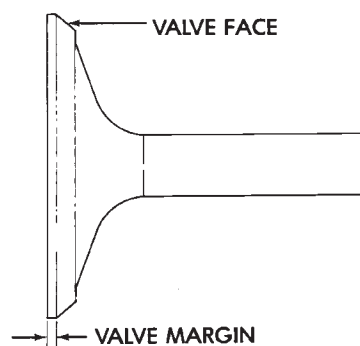
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Fig. 89 Valve Spring Testing

- (2) Verify springs are not distorted with a steel square and surface plate, check springs from both ends. If the spring is more than 1.5 mm (1/16 inch) out of square, install a new spring.

REFACING VALVES AND VALVE SEATS

- (1) The intake and exhaust valve seats and valve face have a 45 degree angle.
- (2) Inspect the remaining margin after the valves are refaced (Fig. 90). Intake valves with less than 0.95 mm (1/32 inch.) margin and Exhaust valves with less than 1.05 mm (3/64 inch) margin should be discarded.



9409-78

Fig. 90 Intake and Exhaust Valve Refacing

- (3) When refacing valve seats, it is important that the correct size valve guide pilot be used for reseating stones. A true and complete surface must be obtained. For valve specifications see Valve Specification Chart.

- (4) Measure the concentricity of valve seat and valve guide using a valve seat runout dial indicator.

DISASSEMBLY AND ASSEMBLY (Continued)

VALVE SPECIFICATION CHART

Face Angle	
Intake and Exhaust:	45 - 45 1/2°
Head Diameter	
Intake:	33.12 - 33.37 mm (1.303 - 1.313 in.)
Exhaust:	28.57 - 28.83 mm (1.124 - 1.135 in.)
Length (Overall)	
Intake:	114.69 - 115.19 mm (4.515 - 4.535 in.)
Exhaust:	116.94 - 117.44 mm (4.603 - 4.623 in.)
Stem Diameter	
Intake:	5.934 - 5.952 mm (0.2337 - 0.2344 in.)
Exhaust:	5.906 - 5.924 mm (0.2326 - 0.2333 in.)
Valve Margin	
Intake:	1.15 - 1.48 mm (0.0452 - 0.0582 in.)
Exhaust:	1.475 - 1.805 mm (0.0580 - 0.0710 in.)

Total runout should not exceed .0051 mm (0.002 inch.) (total indicator reading).

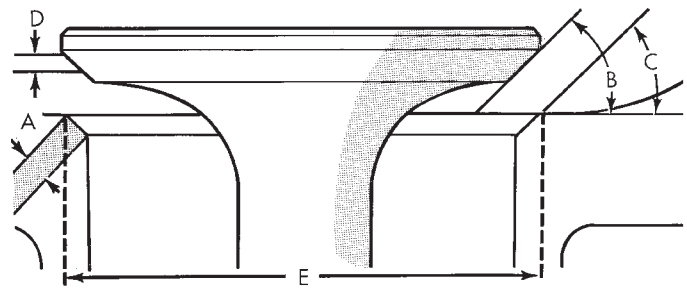
(5) Inspect the valve seat with Prussian blue to determine where the valve contacts the seat. To do this, coat valve seat **LIGHTLY** with Prussian blue then set valve in place. Rotate the valve with light pressure. If the blue is transferred to the center of valve face, contact is satisfactory. If the blue is transferred to top edge of the valve face, lower valve seat with a 15 degrees stone. If the blue is transferred to the bottom edge of valve face raise valve seat with a 65 degrees stone.

- Intake valve seat diameter is 33 mm (1.299 in.)
- Exhaust valve seat diameter is 28 mm (1.102 in.)

(6) Valve seats which are worn or burned can be reworked, provided that correct angle and seat width are maintained. The intake valve seat must be serviced when the valve seat width is 2.0 mm (0.079 in.) or greater. The exhaust valve seat must be serviced when the valve seat width is 2.5 mm (0.098 in.) or greater. Otherwise the cylinder head must be replaced.

(7) When seat is properly positioned the width of intake and exhaust seats should be 0.75 to 1.25 mm (0.030 to 0.049 in.) (Fig. 91).

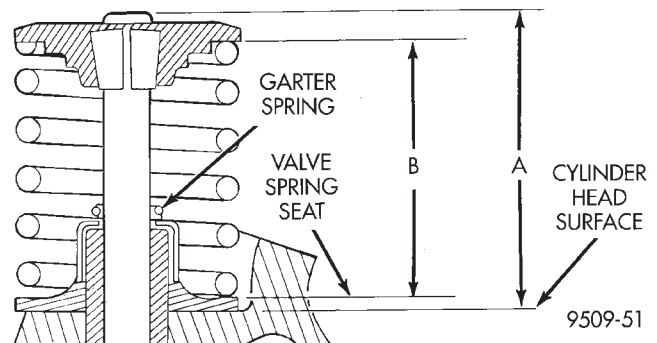
(8) Check valve tip to spring seat dimensions A after grinding the valve seats or faces. Grind valve tip to 43.51 - 44.57 mm (1.71 - 1.75 in.) for exhaust valve and 45.01 - 46.07 mm (1.77 - 1.81 in.) for intake valve over spring seat when installed in the head (Fig. 92). The valve tip chamfer may need to be reground to prevent seal damage when the valve is installed.



A - SEAT WIDTH (INTAKE AND EXHAUST 0.9 TO 1.3 mm (.035 TO .051 IN.)
 B - FACE ANGLE (INTAKE & EXHAUST: 44 1/2°-45°)
 C - SEAT ANGLE (INTAKE & EXHAUST: 45°-45 1/2°)
 D - SEAT CONTACT AREA
 E - SEAT DIAMETER

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Fig. 91 Valve Seat Refacing



9509-51

Fig. 92 Spring Installed Height and Valve Tip to Spring Seat Dimensions

CLEANING

Clean all valve guides, valves and valve spring assemblies thoroughly with suitable cleaning solution before reassembling.

VALVE INSTALLATION

(1) Coat valve stems with clean engine oil and insert in cylinder head.

(2) Install new valve stem seals on all valves using a valve stem seal tool (Fig. 93). The valve stem seals should be pushed firmly and squarely over valve guide.

CAUTION: If oversize valves are used, there is only one oversize valve available. The same stem seal is used on both the standard and oversize valve.

(3) Install valve springs and retainers. Compress valve springs only enough to install locks, taking care not to misalign the direction of compression. Nicked valve stems may result from misalignment of the valve spring compressor.

DISASSEMBLY AND ASSEMBLY (Continued)

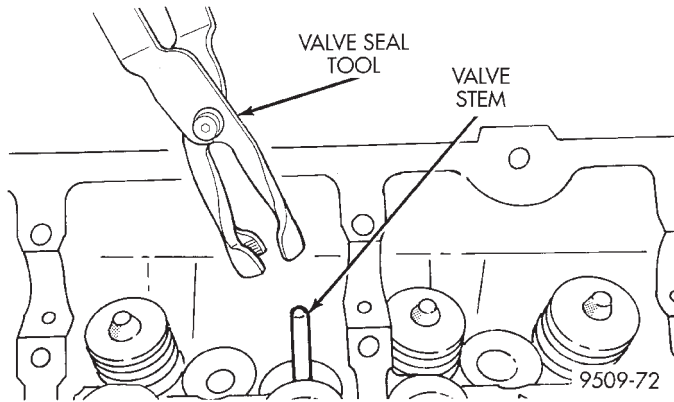


Fig. 93 Valve Stem Oil Seal Tool

CAUTION: When depressing the valve spring retainers with valve spring compressor the locks can become dislocated. Check to make sure both locks are in their correct location after removing tool.

(4) Check the valve spring installed height B after refacing the valve and seat (Fig. 92). Make sure measurements are taken from top of spring seat to the bottom surface of spring retainer. If height is greater than 40.18 mm (1.58 in.), install a 0.762 mm (0.030 in.) spacer under the valve spring seat to bring spring height back within specification.

(5) Install rocker arm shafts as previously described in this section.

(6) Checking dry lash. Dry lash is the amount of clearance that exists between the base circle of an installed cam and the rocker arm roller when the adjuster is drained of oil and completely collapsed. Specified dry lash is 1.17 mm (0.046 in.) for intake and 1.28 mm (0.050 in.) for exhaust. After performing dry lash check, refill adjuster with oil and allow 10 minutes for adjuster/s to bleed down before rotating cam.

CLEANING AND INSPECTION

CYLINDER HEAD AND CAMSHAFT JOURNALS

INSPECTING CYLINDER HEAD

Cylinder head must be flat within 0.1 mm (0.004 inch) (Fig. 94).

Inspect cylinder head camshaft bearings for wear.

Check camshaft journals for scratches and worn areas. If light scratches are present, they may be removed with 400 grit sand paper. If deep scratches are present, replace the camshaft and check the cylinder head for damage. Replace the cylinder head if worn or damaged. Check the lobes for pitting and wear. If the lobes show signs of wear, check the corresponding rocker arm roller for wear or damage.

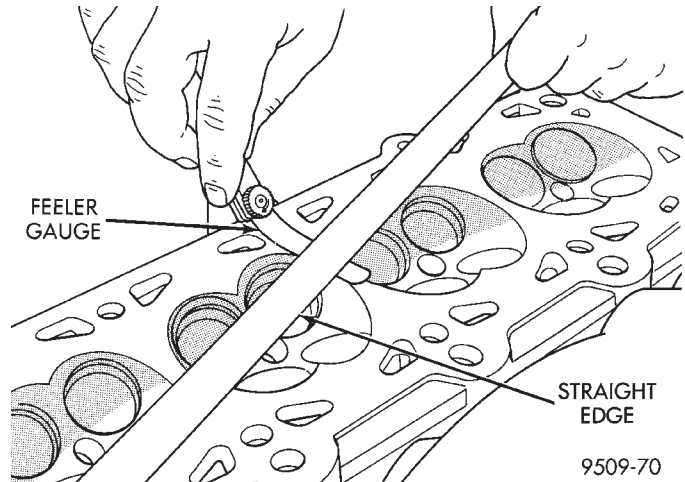


Fig. 94 Checking Cylinder Head Flatness

Replace rocker arm/hydraulic lash adjuster if worn or damaged. If lobes show signs of pitting on the nose, flank or base circle; replace the camshaft.

CLEANING

Remove all gasket material from cylinder head and block. Be careful not to gouge or scratch the aluminum head sealing surface.

OIL PUMP

(1) Clean all parts thoroughly. Mating surface of the oil pump should be smooth. Replace pump cover if scratched or grooved.

(2) Lay a straightedge across the pump cover surface (Fig. 95). If a 0.076 mm (0.003 inch.) feeler gauge can be inserted between cover and straight edge, cover should be replaced.

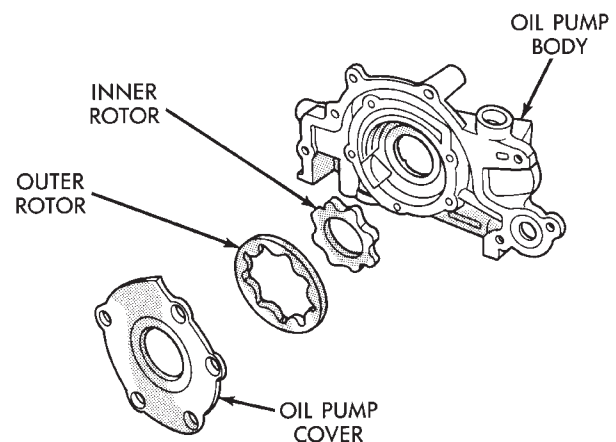


Fig. 95 Checking Oil Pump Cover Flatness

(3) Measure thickness and diameter of outer rotor. If outer rotor thickness measures 7.64 mm (0.301 inch.) or less (Fig. 96), or if the diameter is 79.95 mm (3.148 inches) or less, replace outer rotor.

CLEANING AND INSPECTION (Continued)

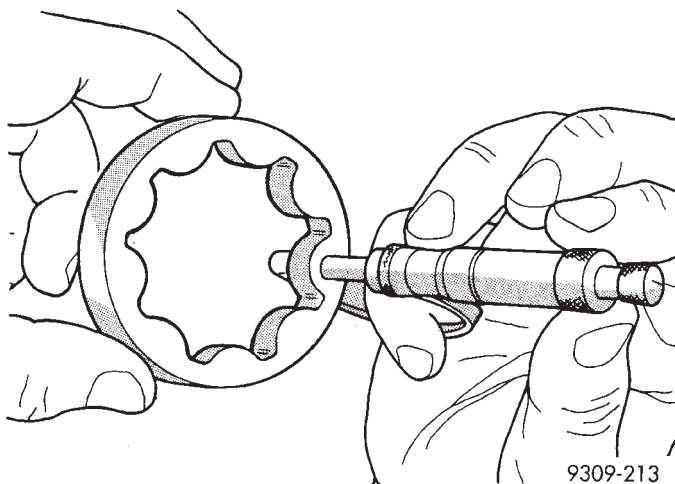


Fig. 96 Measuring Outer Rotor Thickness

(4) If inner rotor measures 7.64 mm (.301 inch) or less replace inner rotor (Fig. 97).

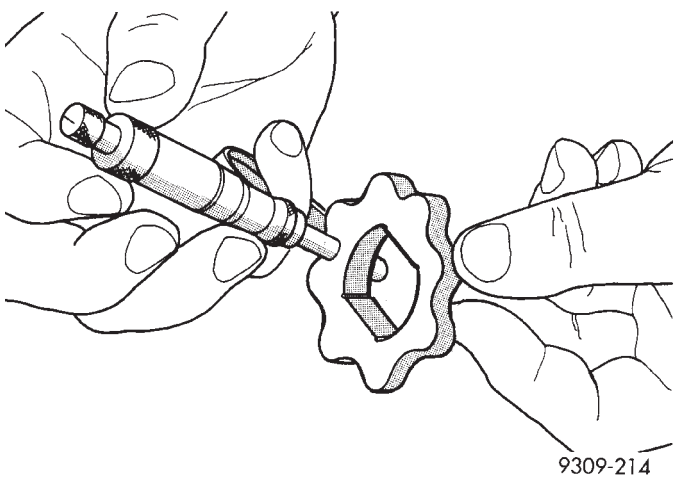


Fig. 97 Measuring Inner Rotor Thickness

(5) Slide outer rotor into pump housing, press to one side with fingers and measure clearance between rotor and housing (Fig. 98). If measurement is 0.39 mm (0.015 inch.) or more, replace housing only if outer rotor is in specification.

(6) Install inner rotor into pump housing. If clearance between inner and outer rotors (Fig. 99) is .203 mm (.008 inch) or more, replace both rotors.

(7) Place a straightedge across the face of the pump housing, between bolt holes. If a feeler gauge of .102 mm (.004 inch) or more can be inserted between rotors and the straightedge, replace pump assembly (Fig. 100). **ONLY** if rotors are in specs.

(8) Inspect oil pressure relief valve plunger for scoring and free operation in its bore. Small marks may be removed with 400-grit wet or dry sandpaper.

(9) The relief valve spring has a free length of approximately 60.7 mm (2.39 inches) it should test between 18 and 19 pounds when compressed to 40.5 mm (1.60 inches). Replace spring that fails to meet specifications.

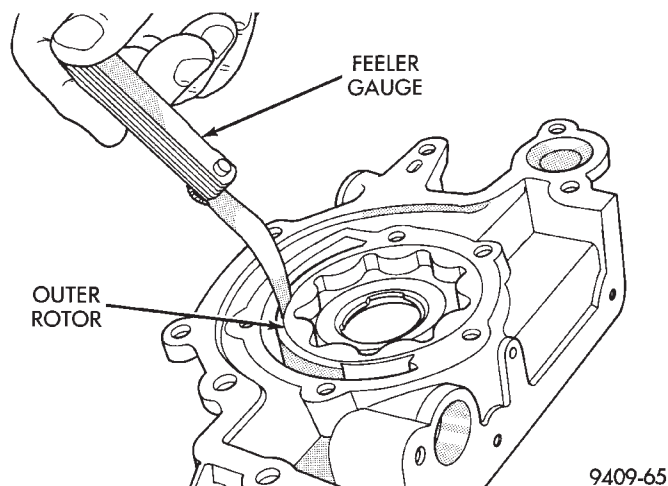


Fig. 98 Measuring Outer Rotor Clearance in Housing

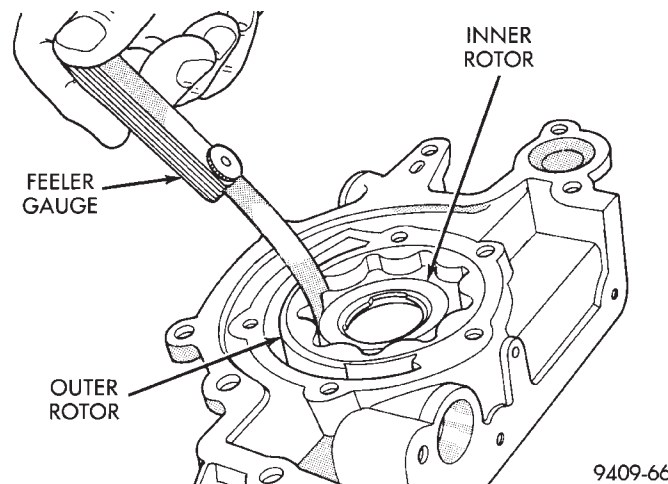


Fig. 99 Measuring Clearance Between Rotors

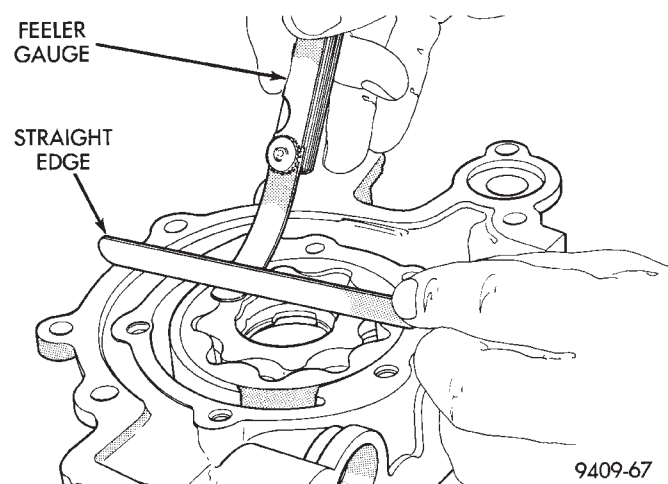


Fig. 100 Measuring Clearance Over Rotors

(10) If oil pressure is low and pump is within specifications, inspect for worn engine bearings, damaged or missing oil pick-up tube o-ring, clogged oil pick-up tube screen, clogged oil filter and stuck open pressure relief valve or other reasons for oil pressure loss.

CLEANING AND INSPECTION (Continued)

CYLINDER BLOCK AND BORE

(1) Clean cylinder block thoroughly and check all core hole plugs for evidence of leaking.

(2) If new core plugs are installed, Refer to Engine Core Plugs outlined in this section.

(3) Examine block and cylinder bores for cracks or fractures.

CYLINDER BORE INSPECTION

The cylinder walls should be checked for out-of-round and taper with Tool C-119 (Fig. 101). The cylinder bore out-of-round is 0.050 mm (.002 inch) maximum and cylinder bore taper is 0.051 mm (0.002 inch) maximum. If the cylinder walls are badly scuffed or scored, the cylinder block should be rebored and honed, and new pistons and rings fitted. Whatever type of boring equipment is used, boring and honing operation should be closely coordinated with the fitting of pistons and rings in order that specified clearances may be maintained. **Refer to Honing Cylinder Bores outlined in the Standard Service Procedures for specification and procedures.**

Measure the cylinder bore at three levels in directions A and B (Fig. 101). Top measurement should be 10 mm (3/8 inch) down and bottom measurement should be 10 mm (3/8 inch.) up from bottom of bore. Refer to Cylinder Bore and Piston Specification Chart for specifications.

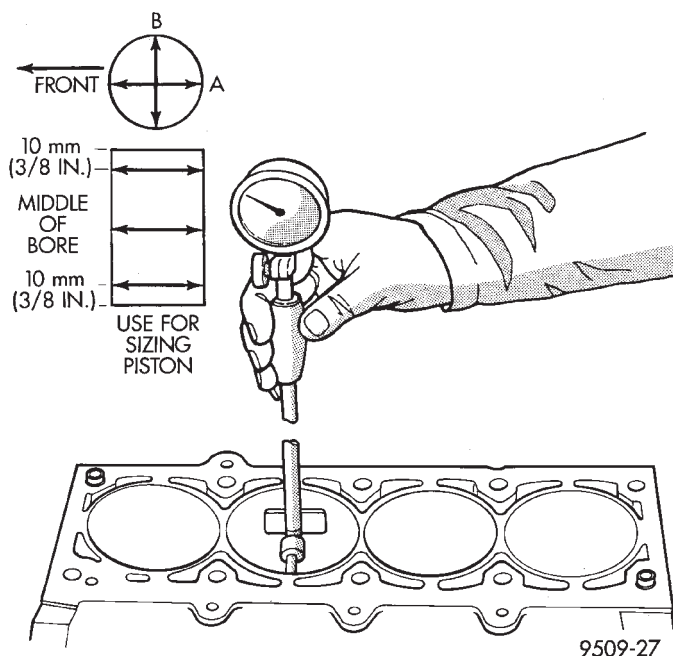


Fig. 101 Checking Cylinder Bore Size

CYLINDER BORE AND PISTON
SPECIFICATION CHART

Standard Bore	Max. Out-of-Round	Max. Taper
87.5 mm (3.445 in.)	0.051 mm (0.002 in.)	0.051 mm (0.002 in.)
Standard Piston Size 87.463 - 87.481 mm (3.4434 - 3.4441 in.)		
Piston to Bore Clearance 0.012 - 0.044 mm (0.0005 - 0.0017 in.) Measurements taken at Piston Size Location.		

SPECIFICATIONS

ENGINE 2.0L SOHC

Cylinder Block

Cylinder Bore Diameter . . . 87.4924 - 87.5076 mm
(3.4446 - 3.4452 in.)

Out-of-Round (Max.) 0.051 mm (0.002 in.)

Taper (Max.) 0.051 mm (0.002 in.)

Pistons (Federal Emission)

Clearance 17.5 mm (11/16 in.) from bottom of skirt 0.012 - 0.044 mm (0.0004 - 0.0017 in.)

Weight 325 - 335 grams (11.47 - 11.82 oz.)

Land Clearance (Diametrical) . . 0.734 - 0.797 mm
(0.029 - 0.031 in.)

Piston Length 64 mm (2.520 in.)

Piston Ring Groove Depth

No. 1 3.989 - 4.188 mm (0.157 - 0.165 in.)

Piston Ring Groove Depth

No. 2 4.462 - 4.661 mm (0.176 - 0.184 in.)

Piston Ring Groove Depth

No. 3 3.847 - 4.131 mm (0.151 - 0.163 in.)

Pistons (Low Emission Vehicle—LEV)

Clearance 10.42 mm (0.42 in.) from bottom of skirt 0.018 - 0.50 mm (0.0008 - 0.0020 in.)

Weight 320 - 329 grams (11.29 - 11.60 oz.)

Land Clearance (Diametrical) . . 0.758 - 0.790 mm
(0.0299 - 0.0312 in.)

Piston Length 55.8 mm (2.197 in.)

Piston Ring Groove Depth

No. 1 3.989 - 4.188 mm (0.157 - 0.165 in.)

Piston Ring Groove Depth

No. 2 4.462 - 4.661 mm (0.176 - 0.184 in.)

Piston Ring Groove Depth

No. 3 3.847 - 4.131 mm (0.151 - 0.163 in.)

Piston Pins

Clearance in Piston 0.008 - 0.020 mm
(0.0003 - 0.0008 in.)

In Rod (Interference) 0.018 - 0.043 mm
(0.0007 - 0.0017 in.)

SPECIFICATIONS (Continued)

Cylinder Block

Diameter	20.998 - 21.003 mm (0.8267 - 0.8269 in.)
End Play	None
Length	74.75 - 75.25 mm (2.943 - 2.963 in.)

Piston Rings

Ring Gap Top Compression Ring	0.23 - 0.52 mm (0.009 - 0.020 in.)
Ring Gap 2nd Compression Ring	0.49 - 0.78 mm (0.019 - 0.031 in.)
Ring Gap Oil Control (Steel Rails)	0.23 - 0.66 mm (0.009 - 0.026 in.)
Ring Side Clearance Both Compression Rings	0.025 - 0.065 mm (0.0010 - 0.0026 in.)
Oil Ring (Pack)	0.004 - 0.178 mm (0.0002 - 0.0070 in.)
Ring Width Compression Rings	1.17 - 1.19 mm (0.046 - 0.047 in.)
Oil Ring (Pack)	2.854 - 3.008 mm (0.1124 - 0.1184 in.)

Connecting Rod

Bearing Clearance	0.026 - 0.059 mm (0.001 - 0.0023 in.)
Piston Pin Bore Diameter	20.96 - 20.98 mm (0.8252 - 0.8260 in.)
Large End Bore Diameter	50.991 - 51.005 mm (2.0075 - 2.0081 in.)
Side Clearance	0.13 - 0.38 mm (0.005 - 0.015 in.)
Total Weight (Less Bearing)	543 grams (1.20 lbs.)

Crankshaft

Connecting Rod Journal Diameter	47.9924 - 48.0076 mm (1.8894 - 1.8900 in.)
Out-of-Round (Max.)	0.0035 mm (0.0001 in.)
Taper (Max.)	0.0038 mm (0.0001 in.)
Main Bearing Diametrical Clearance No. 1 - 5	0.022 - 0.062 mm (0.0008 - 0.0024 in.)
End Play	0.09 - 0.24 mm (0.0035 - 0.0094 in.)

Main Bearing Journals

Diameter	51.9924 - 52.0076 mm (2.0469 - 2.0475 in.)
Out-of-Round (Max.)	0.0035 mm (0.0001 in.)
Taper (Max.)	0.0038 mm (0.0001 in.)

ENGINE 2.0L SOHC**Rocker Arm Shaft**

Rocker Arm Shaft Diameter	19.996 - 19.984 mm (0.786 - 0.7867 in.)
---------------------------	--

Rocker Arm Shaft Retainers (Width)

Intake (All)	28.46 mm (1.12 in.)
Exhaust	1 & 5 29.20 mm (1.14 in.) 2, 3, and 4 - 40.45 mm (1.59 in.)

Rocker Arm/Hydraulic Lash Adjuster *

Rocker Arm Inside Diameter	20.00 - 20.02 mm (0.787 - 0.788 in.)
----------------------------	---

Rocker Arm Shaft Clearance	0.016 - 0.054 mm (0.0006 - 0.0021 in.)
----------------------------	---

Body Diameter	22.949 - 22.962 mm (0.9035 - 0.9040 in.)
---------------	---

Plunger Travel Minimum (Dry)	2.2 mm (0.087 in.)
------------------------------	-----------------------

Rocker Arm Ratio	1.4 to 1
------------------	----------

Cylinder Head Camshaft Bearing Diameter

No. 1	41.20 - 41.221 mm (1.622 - 1.6228 in.)
No. 2	41.6 - 41.621 mm (1.637 - 1.638 in.)
No. 3	42.0 - 42.021 mm (1.653 - 1.654 in.)
No. 4	42.4 - 42.421 mm (1.669 - 1.670 in.)
No. 5	42.8 - 42.821 mm (1.685 - 1.6858 in.)

Camshaft Journal Diameter

No. 1	41.128 - 41.147 mm (1.619 - 1.6199 in.)
No. 2	41.528 - 41.547 mm (1.634 - 1.635 in.)
No. 3	41.928 - 41.947 mm (1.650 - 1.651 in.)
No. 4	42.328 - 42.374 mm (1.666 - 1.668 in.)
No. 5	42.728 - 42.747 mm (1.682 - 1.6829 in.)
Diametrical Bearing Clearance	0.053 - 0.093 mm (0.0027 - 0.003 in.)

Max. Allowable	0.12 mm (0.0047 in.)
End Play	0.05 - 0.39 mm (0.0059 in.)

Lift (Zero Lash)

Intake	7.2 mm (0.283 in.)
Exhaust	7.03 mm (0.277 in.)

Valve Timing Exhaust Valve**

Closes (ATDC)	5.4°
Opens (BBDC)	43.7°
Duration	229.1°

Valve Timing Intake Valve **

Closes (ABDC)	41.1°
Opens (ATDC)	13.9°
Duration	207.2°
Valve Overlap	0°

Cylinder Head

Material	Cast Aluminum
Gasket Thickness (Compressed)	1.15 mm (0.045 in.)

Valve Seat

Angle	45°
Runout (Max.)	0.050 mm (0.002)
Width (Finish) Intake and Exhaust	0.75 - 1.25 mm (0.030 - 0.049 in.)

Valve Guide Finished

Diameter I.D.	5.975 - 6.000 mm (.235 - .236 in.)
Guide Bore Diameter (Std.)	11.0 - 11.02 mm (0.4330 - 0.4338 in.)

Valves

Face Angle Intake and Exhaust	45 - 45-1/2°
Head Diameter Intake	32.12 - 33.37 mm (1.303 - 1.313 in.)
Head Diameter Exhaust	28.57 - 28.83 mm (1.124 - 1.135 in.)

SPECIFICATIONS (Continued)

Valve Margin

Intake 1.15 – 1.48 mm (0.0452 – 0.0582 in.)

Exhaust 1.475 – 1.805 mm (0.058 – 0.071 in.)

Valve Length (Overall)

Intake 114.69 – 115.19 mm (4.515 – 4.535 in.)

Exhaust 109.59 – 110.09 mm (4.603 – 4.623 in.)

Valve Stem Tip Height

Intake 45.01 – 46.07 mm (1.77 – 1.81 in.)

Exhaust 43.51 – 44.57 mm (1.71 – 1.75 in.)

Stem Diameter

Intake 5.934 – 5.952 mm (0.234 – 0.234 in.)

Exhaust 5.906 – 5.924 mm (0.233 – 0.233 in.)

Stem to Guide Clearance

Intake 0.048 – 0.066 mm (0.0018 – 0.0025 in.)

Exhaust 0.0736 – 0.094 mm (0.0029 – 0.0037 in.)

Max. Allowable Intake 0.076 mm (0.003 in.)

Max. Allowable Exhaust 0.101 mm (0.004 in.)

Valve Springs

Free Length (Approx.) 44.4 mm (1.747 in.)

Nominal Force (Valve closed) 91 N·m @ 39.8 mm
(67 ft. lbs. @ 1.57 in.)Nominal Force (Valve open) 239 N·m @ 32.6 mm
(176 lbs. @ 1.28 in.)

Installed Height 40.18 mm (1.580 in.)

* SERVICE AS AN ASSEMBLY WITH ROCKER ARM.

** ALL READINGS IN CRANKSHAFT DEGREES, AT 0.5 mm (0.019 in.) OF VALVE LIFT.

TORQUE CHART 2.0L SOHC

DESCRIPTION TORQUE**Camshaft Sensor Pick Up**

Bolts 9.6 N·m (85 in. lbs.)

Camshaft Sprocket

Bolt 115 N·m (85 ft. lbs.)

Connecting Rod Cap

Bolts 27 N·m (20 ft. lbs.) Plus 1/4 Turn

Collar—Oil Pan to Transaxle

Step 1: Collar to Oil Pan Bolts 3 N·m (30 in. lbs.)

Step 2: Collar to Transaxle

Bolts 108 N·m (80 ft. lbs.)

Step 3: Collar to Oil Pan

Bolts 54 N·m (40 ft. lbs.)

Crankshaft Main Bearing Cap/Bedplate

M8 Bedplate Bolts 30 N·m (22 ft. lbs.)

M11 Main Cap Bolts 81 N·m (60 ft. lbs.)

Crankshaft Damper

Bolt 142 N·m (105 ft. lbs.)

Cylinder Head

Bolts Refer To Cylinder Head Installation

Cylinder Head Cover

Bolts 12 N·m (105 in. lbs.)

Engine Mount Bracket—Right

Bolts 61 N·m (45 ft. lbs.)

DESCRIPTION TORQUE**Engine Mounting**

Bolts Refer to Engine Mount Installation

Exhaust Manifold to Cylinder Head

Bolts 23 N·m (200 in. lbs.)

Exhaust Manifold Heat Shield

Bolts 12 N·m (105 in. lbs.)

Intake Manifold

Bolts 12 N·m (105 in. lbs.)

Oil Filter Adapter

Fastener 80 N·m (60 ft. lbs.)

Oil Filter 20 N·m (15 ft. lbs.)

Oil Pan

Bolts 12 N·m (105 in. lbs.)

Drain Plug 27 N·m (20 ft. lbs.)

Oil Pump Attaching

Bolts 28 N·m (250 in. lbs.)

Oil Pump Cover Fastener 12 N·m (105 in. lbs.)

Oil Pump Pick-up Tube Bolt 28 N·m (250 in. lbs.)

Oil Pump Relief Valve Cap 41 N·m (30 ft. lbs.)

Rocker Arm Shaft

Bolts 28 N·m (250 in. lbs.)

Spark Plugs 28 N·m (20 ft. lbs.)

Thermostat Housing

Bolts 23 N·m (200 in. lbs.)

Timing Belt Cover

Bolts M6 12 N·m (105 in. lbs.)

Timing Belt Mechanical Tensioner Assembly

Bolts 28 N·m (250 in. lbs.)

Timing Belt Hydraulic Tensioner

Pulley Bolt 68 N·m (50 ft. lbs.)

Pivot Bracket Bolt 31 N·m (23 ft. lbs.)

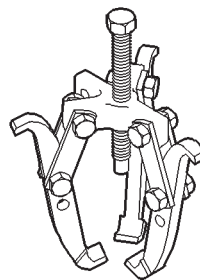
Tensioner Bolts 31 N·m (23 ft. lbs.)

Water Pump Mounting

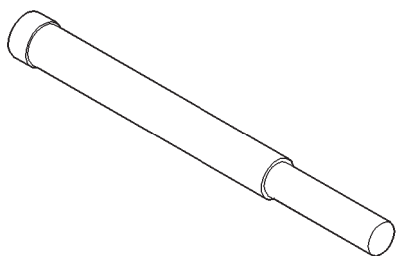
Bolts 12 N·m (105 in. lbs.)

SPECIAL TOOLS

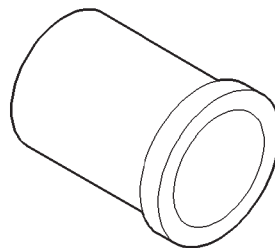
ENGINE 2.0L SOHC

*Puller 1026*

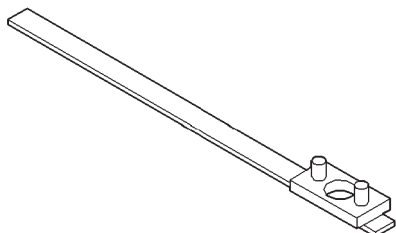
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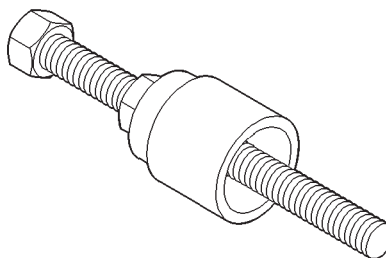
Crankshaft Damper Removal Insert 6827-A



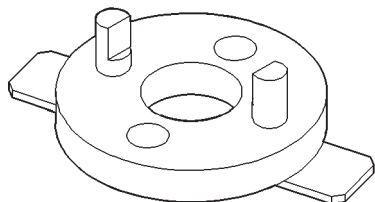
Camshaft Seal Installer MD-998306



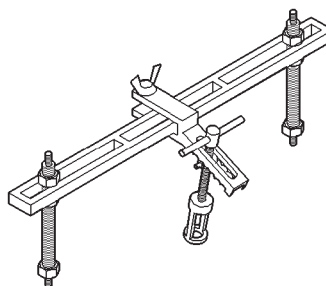
Camshaft Sprocket Remover/Installer C-4687



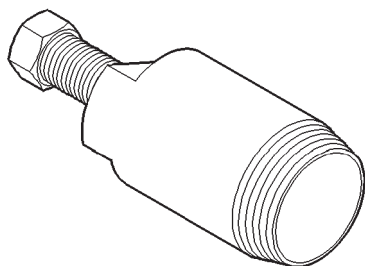
Crankshaft Damper Installer 6792



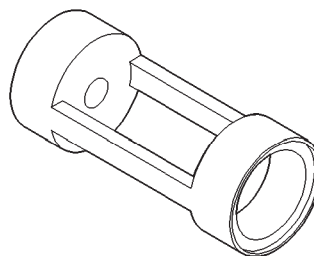
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C-4687-1***



Valve Spring Compressor MD-998772-A

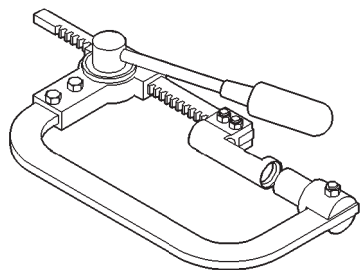


Camshaft Seal Remover C-4679-A

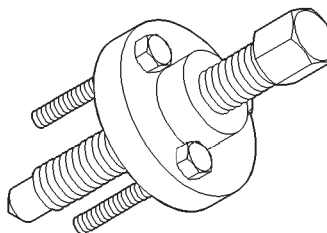


Spring Compressor Adapter 6779

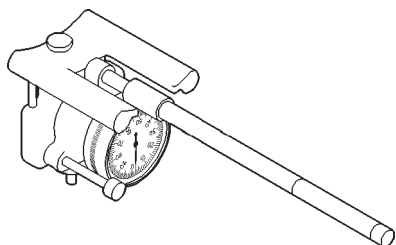
SPECIAL TOOLS (Continued)



Valve Spring Compressor C-3422-B

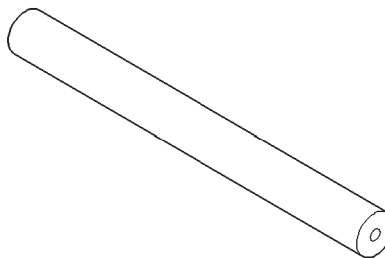


Crankshaft Sprocket Remover 6793

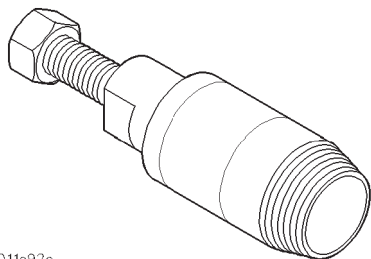


8011c91a

Cylinder Bore Indicator C-119

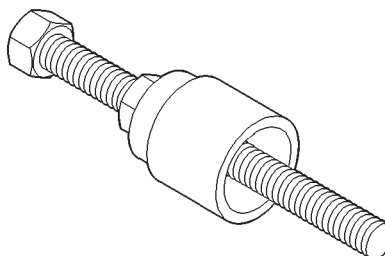


Crankshaft Sprocket Remover Insert C-4685-C2

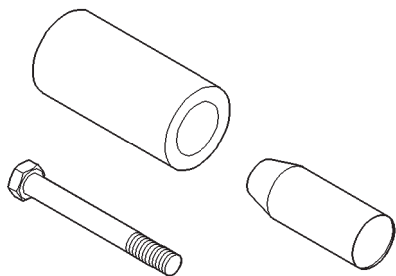


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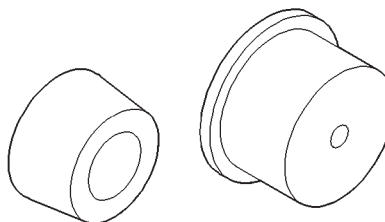
Front Crankshaft Seal Remover 6771



Crankshaft Sprocket Installer 6792

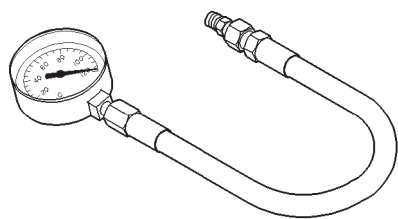
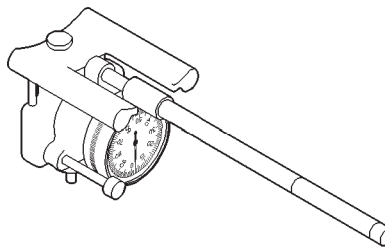


Front Crankshaft Seal Installer 6780

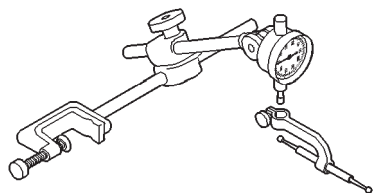


Rear Crankshaft Seal Guide and Installer 6926-1 and 6926-2

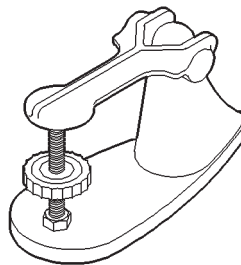
SPECIAL TOOLS (Continued)

***Pressure Gage C-3292***

8011c9fa

Indicator Bore Size C-119

8011d42b

Dial Indicator C-3339***Valve Spring Tester C-647***

2.5L VM DIESEL

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HYDRAULIC TAPPETS	60	TORQUE	80
INJECTION PUMP	61	SPECIAL TOOLS	
MOUNT—LEFT SIDE	51	2.5L VM DIESEL	81
OIL FILTER ADAPTER AND OIL COOLER	68		
OIL PAN	66		

GENERAL INFORMATION

GENERAL SPECIFICATION

Type	425CLIEE (36B)
Displacement	2.5L (2499 cc)
Bore	92.00 mm
Stroke	94.00 mm
Compression Ratio	20.95:1
Vacuum at Idle	600 mm/Hg (23.6 In/Hg)
Thermostat Opening	80°C±2°C
Generator Rating	Bosch 50/120 Amp
Cooling System Capacity	9.5 Liter
Power Steering Capacity	0.75 Liter

Type	425CLIEE (36B)
Engine Oil Capacity	6.5 Liters With Oil Filter Change
Timing System	Pushrod Operated Overhead valves, With Gear-Driven Camshaft.
Air Intake	Dry Filter
Fuel Feed	Vacuum Pump Incorporated in Injection Pump.
Fuel System	Indirect Fuel Injection (Precombustion Chamber)
Combustion Cycle	4 Stroke
Cooling System	Water Cooled
Injection Pump	Rotary Pump Electronically Controlled.

GENERAL INFORMATION (Continued)

Type 425CLIEE (36B)
 Lubrication . Pressure Lubrication by Rotary Pump,
 Full-Flow Filtration
 Engine Rotation Clockwise Viewed From Front
 Cover

ENGINE IDENTIFICATION

The engine model code (3-digit number/letter code) and serial number are stamped on the forward facing side of the engine block (Fig. 1).

DESCRIPTION AND OPERATION

LUBRICATION SYSTEM

The pressurized system (Fig. 2) uses a rotary pump (3) located in the front of the engine block, driven by a gear which meshes directly with the crankshaft gear. All the oil sent to every lubricated part is filtered. The pump sends the oil through a pressure relief valve (2) to the filter (7) and through galleries in the crankcase to the crankshaft bearings (8), camshaft bearings (11) and turbocharger (10). The piston pins, connecting rod small ends and insides of the pistons are lubricated and cooled by oil sprayed out from jets (9) in the crankshaft mounting blocks. The lubricating oil is sent to the rockers (12) through an

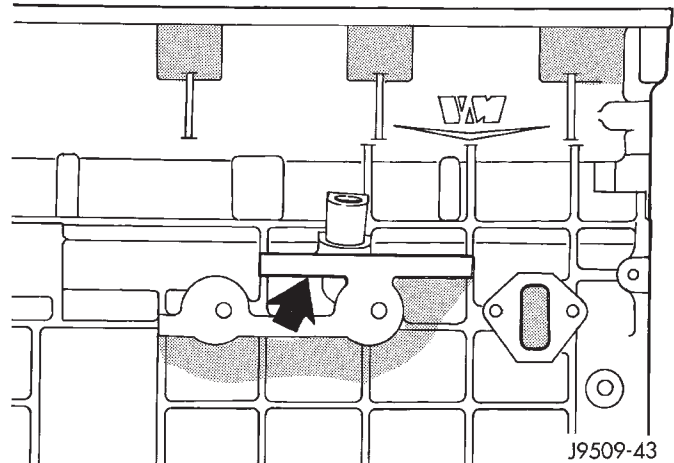


Fig. 1 Engine Code Location

external pipe (Fig. 3). A valve in the filter cartridge enables the oil to be circulated even when the cartridge is clogged.

Sump inlet (1). Pressure relief valve (2). Oil pump (3). Oil cooler (6). Filter cartridge (7). Crankshaft bearings (8). Jet valve (9). Turbocharger bearings (10). Camshaft bearings (11). Rockers (12).

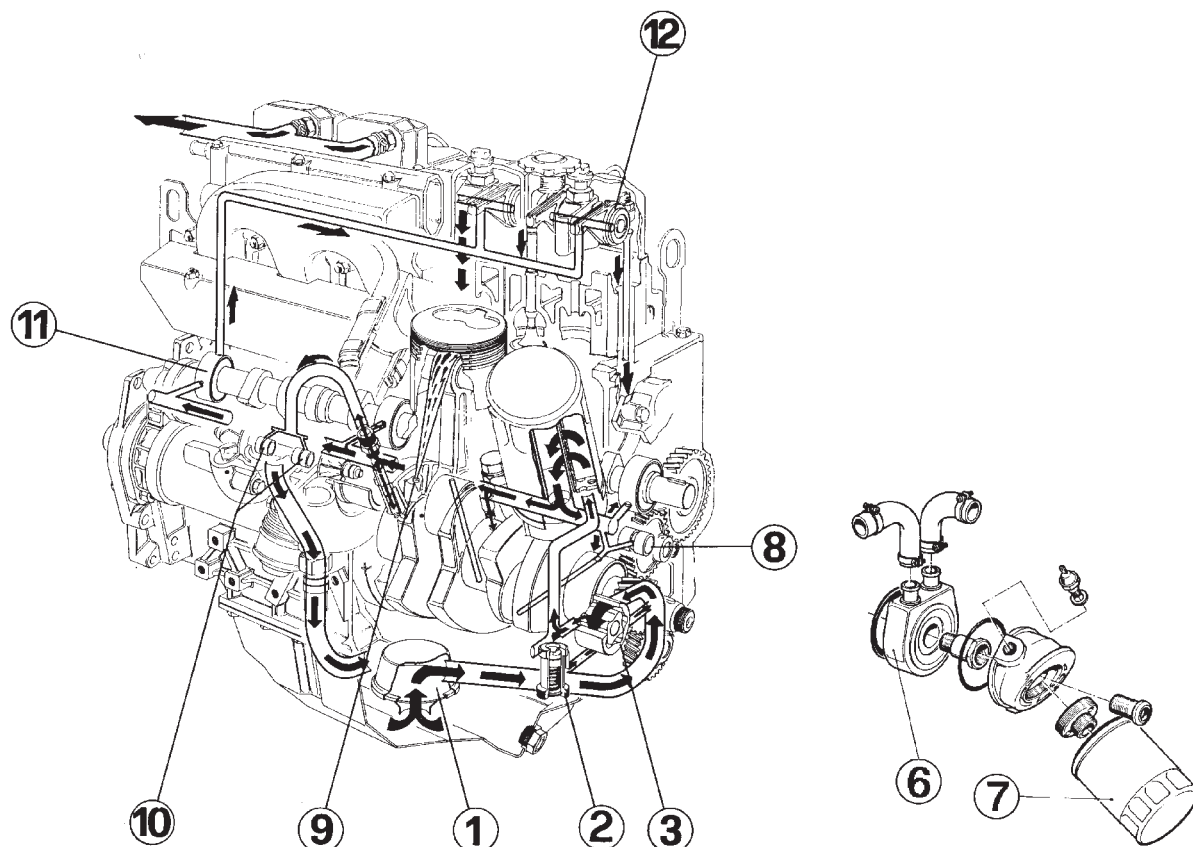
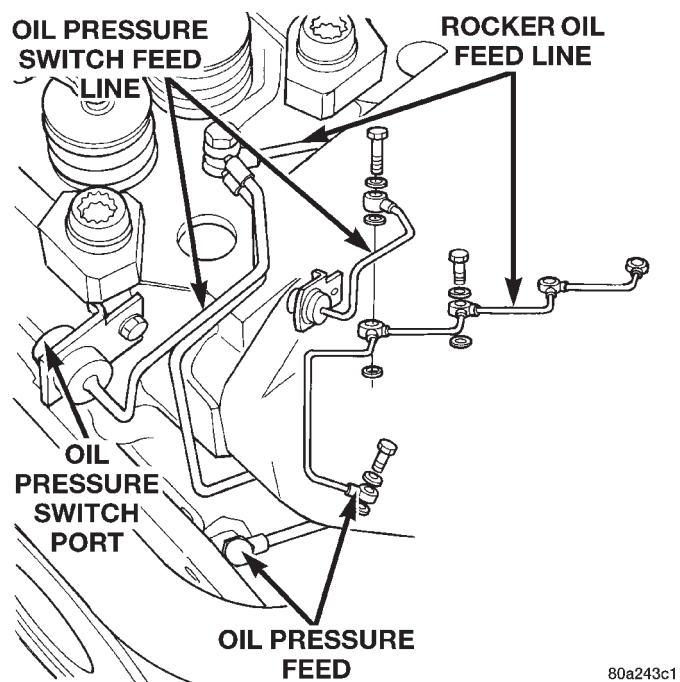


Fig. 2 Lubrication System

DESCRIPTION AND OPERATION (Continued)

*Fig. 3 Lubrication Lines*