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GENERAL INFORMATION

FORM-IN-PLACE GASKETS—GASOLINE ENGINES

There are several places where form-in-place gaskets are used on the engine. **DO NOT use form-in-place gasket material unless specified.** Care must be taken when applying form-in-place gaskets. Bead size, continuity, and location are of great importance. Too-thin a bead can result in leakage, while too much can result in spill-over. A continuous bead of the proper width is essential to obtain a leak-free joint.

Two types of form-in-place gasket materials are used in the engine area (Mopar® Silicone Rubber Adhesive Sealant and Mopar® Gasket Maker). Each has different properties and they cannot be used interchangeably.

MOPAR® SILICONE RUBBER ADHESIVE SEALANT

Mopar® Silicone Rubber Adhesive Sealant, normally black in color, is available in both three ounce tubes and four and one-half ounce power tubes. Moisture in the air causes the sealant material to cure. This material is normally used on flexible metal flanges. The regular tubes have a shelf life of one year and the power tubes a two year shelf life, and will not properly cure if over-aged. Always inspect the package for the expiration date before use.

MOPAR® GASKET MAKER

Mopar® Gasket Maker, normally red in color, is available in six-cc tubes. This anaerobic type gasket material cures in the absence of air when squeezed between smooth machined metallic surfaces. It will not cure if left in the uncovered tube. DO NOT use on flexible metal flanges.

SURFACE PREPARATION

Parts assembled with form-in-place gaskets may be disassembled without unusual effort. In some instances, it may be necessary to lightly tap the part with a mallet, or other suitable tool, to break the seal between the mating surfaces. A flat gasket-scraper may also be lightly tapped into the joint, but care must be taken not to damage the mating surfaces.

Scrape or wire brush all gasket surfaces to remove all loose material. Inspect stamped parts to ensure that gasket rails are flat. Flatten rails with a hammer on a flat plate, if required. Gasket surfaces must be free of oil and dirt. Be sure the old gasket material is removed from blind attaching holes.

GASKET APPLICATION

Assembling parts using a form-in-place gasket requires care.

GENERAL INFORMATION (Continued)

Mopar® Silicone Rubber Adhesive Sealant should be applied in a continuous bead approximately 3 mm (0.12 inch) in diameter. All mounting holes must be circled. For corner sealing, a 3 or 6 mm (1/8 or 1/4 inch) drop is placed in the center of the gasket contact area. Uncured sealant may be removed with a shop towel. Components should be torqued in place while the sealant is still wet to the touch (within ten minutes). The use of a locating dowel is recommended during assembly to prevent smearing the material off location.

Mopar® Gasket Maker should be applied sparingly to one gasket surface. The sealant diameter should be 1.00 mm (0.04 inch) or less. Be certain the material surrounds each mounting hole. Excess material can be easily wiped off. Components should be torqued in place within 15 minutes. The use of a locating dowel is recommended during assembly to prevent smearing the material off location.

ENGINE GASKET SURFACE PREPARATION

To ensure engine gasket sealing, proper surface preparation must be performed, especially with the use of aluminum engine components and multi-layer steel cylinder head gaskets.

Never use the following to clean gasket surfaces:

- Never use a metal scraper.
- Never use an abrasive pad or paper to clean cylinder block and head.
- Never use a high speed power tool or wire brush on any gasket sealing surface (Fig. 1)

NOTE: Multi-Layer Steel (MLS) head gaskets require a scratch free sealing surface.

Only use the following for cleaning gasket surfaces:

- use Mopar® Brake and Parts Cleaner
- use only a plastic or wood scraper (Fig. 1)

ENGINE PERFORMANCE

To provide best vehicle performance and lowest vehicle emissions, it is most important that the tune-up be done accurately. Use the specifications listed on the Vehicle Emission Control Information label found on the engine compartment hood.

(1) Test battery specific gravity. Add water, if necessary. Clean and tighten battery connections.

(2) Test cranking amperage draw (refer to Group 8B, Battery/Starter for the proper procedure).

(3) Tighten the intake manifold bolts (refer to Group 11, Exhaust System and Intake Manifold for the proper specifications).

(4) Perform cylinder compression test:

CAUTION: DO NOT overspeed the engine.

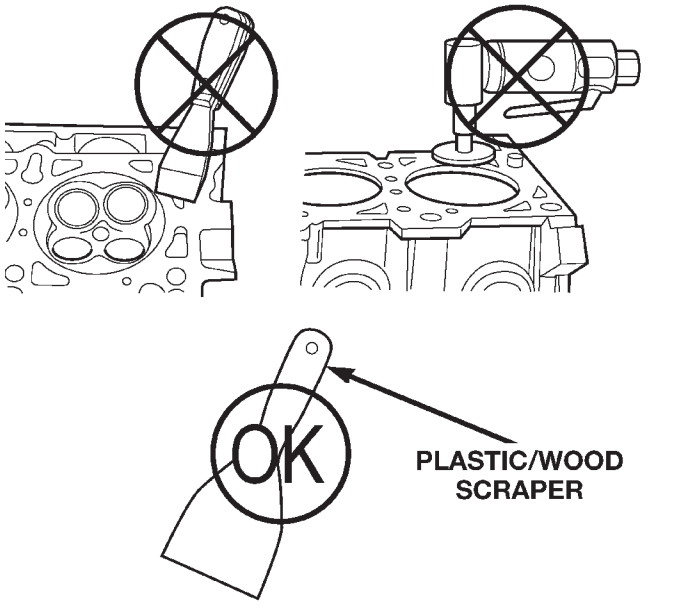

Fig. 1 Proper Tool Usage For Surface Preparation

(a) Check engine oil level and add oil, if necessary.

(b) Drive the vehicle until engine reaches normal operating temperature.

(c) Select a route free from traffic and other forms of congestion, observe all traffic laws and briskly accelerate through the gears several times. The higher engine speed may help clean out valve seat deposits which can prevent accurate compression readings.

(d) Disconnect electrical connectors from coil towers and then remove coil towers.

(e) Remove all spark plugs from engine. As spark plugs are being removed, check electrodes for abnormal firing indicators - fouled, hot, oily, etc. Record cylinder number of spark plug for future reference.

(f) Be sure throttle blades are fully open during the compression check.

(g) Insert compression gauge adaptor into the No.1 spark plug hole. Crank engine until maximum pressure is reached on gauge. Record this pressure as No.1 cylinder pressure.

(h) Repeat for all remaining cylinders.

(i) Record the findings and compare them with the compression standards listed under Engine Specifications.

(j) If cylinder(s) have abnormally low compression pressures, repeat procedure.

(k) If the same cylinder(s) repeat an abnormally low reading, it could indicate the existence of a problem in the cylinder.

GENERAL INFORMATION (Continued)

NOTE: The recommended compression pressures are to be used only as a guide to diagnosing engine problems. An engine should NOT be disassembled to determine the cause of low compression unless some malfunction is present.

(5) Clean or replace spark plugs as necessary. Adjust gap (refer to Group 8D, Ignition System for gap adjustment and torque).

(6) Perform a combustion analysis.

(7) Test fuel pump for pressure (refer to Group 14, Fuel System for the proper specifications).

(8) Inspect air filter element (refer to Group 0, Lubrication and Maintenance for the proper procedure).

(9) Inspect crankcase ventilation system (refer to Group 0, Lubrication and Maintenance for the proper procedure).

(10) For emission controls refer to Group 25, Emission Controls System for service procedures.

(11) Inspect and adjust accessory belt drives (refer to Group 7, Cooling System for the proper adjustments).

(12) Road test vehicle as a final test.

HONING CYLINDER BORES

Before honing, stuff plenty of clean shop towels under the bores and over the crankshaft to keep abrasive materials from entering the crankshaft area.

(1) Used carefully, the Cylinder Bore Sizing Hone C-823 equipped with 220 grit stones, is the best tool for this job. In addition to deglazing, it will reduce taper and out-of-round as well as removing light scuffing, scoring or scratches. Usually a few strokes will clean up a bore and maintain the required limits.

CAUTION: DO NOT use rigid type hones to remove cylinder wall glaze.

(2) Deglazing of the cylinder walls may be done if the cylinder bore is straight and round. Use a cylinder surfacing hone, Honing Tool C-3501, equipped with 280 grit stones (C-3501-3810). 20-60 strokes, depending on the bore condition, will be sufficient to provide a satisfactory surface. Using honing oil C-3501-3880 or a light honing oil available from major oil distributors.

CAUTION: DO NOT use engine or transmission oil, mineral spirits or kerosene.

(3) Honing should be done by moving the hone up and down fast enough to get a crosshatch pattern. The hone marks should INTERSECT at 50° to 60° for proper seating of rings (Fig. 2).

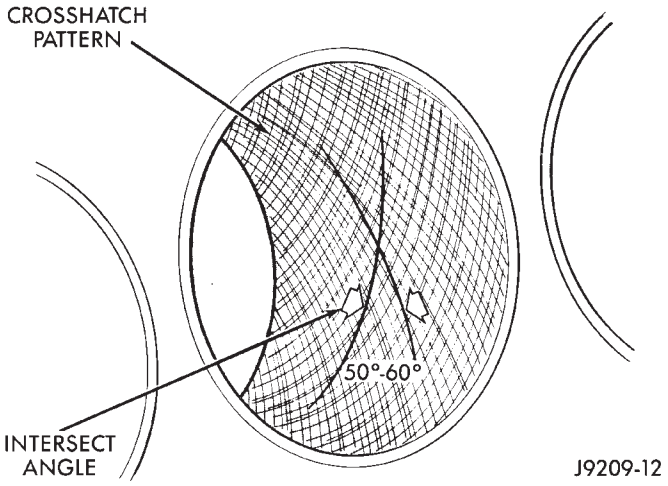

Fig. 2 Cylinder Bore Crosshatch Pattern

(4) A controlled hone motor speed between 200 and 300 RPM is necessary to obtain the proper crosshatch angle. The number of up and down strokes per minute can be regulated to get the desired 50° to 60° angle. Faster up and down strokes increase the crosshatch angle.

(5) After honing, it is necessary that the block be cleaned to remove all traces of abrasive. Use a brush to wash parts with a solution of hot water and detergent. Dry parts thoroughly. Use a clean, white, lint-free cloth to check that the bore is clean. Oil the bores after cleaning to prevent rusting.

MEASURING WITH PLASTIGAGE

CRANKSHAFT MAIN BEARING CLEARANCE—4.0L

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

(1) Remove oil film from surface to be checked. Plastigage is soluble in oil.

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

METHOD - 1 (PREFERRED)

Shim the bearings adjacent to the bearing to be checked. This will remove the clearance between upper bearing shell and the crankshaft. Place a minimum of 0.254 mm (0.010 inch) shim between the bearing shell and the adjacent bearing cap. Tighten the bolts to 18 N·m (13 ft. lbs.) torque.

- **ALL ENGINES** —When checking No.1 main bearing; shim No.2 main bearing.
- **ALL ENGINES** —When checking No.2 main bearing; shim No.1 and No.3 main bearing.

GENERAL INFORMATION (Continued)

- **ALL ENGINES** —When checking No.3 main bearing; shim No.2 and No.4 main bearing.
- **ALL ENGINES** —When checking No.4 main bearing; shim No.3 and No.5 main bearing.
- **ALL ENGINES** —When checking No.5 main bearing; shim No.4 main bearing.

NOTE: Remove all shims before assembling engine.

METHOD - 2 (ALTERNATIVE)

The weight of the crankshaft is supported by a jack under the counterweight adjacent to the bearing being checked.

(1) Place a piece of Plastigage across the entire width of the bearing cap shell (Fig. 3). Position the Plastigage approximately 6.35 mm (1/4 inch) off center and away from the oil holes. In addition, suspect areas can be checked by placing the Plastigage in that area. Tighten the bearing cap bolts of the bearing being checked to the proper specification. **DO NOT rotate the crankshaft or the Plastigage may be smeared, giving inaccurate results.**

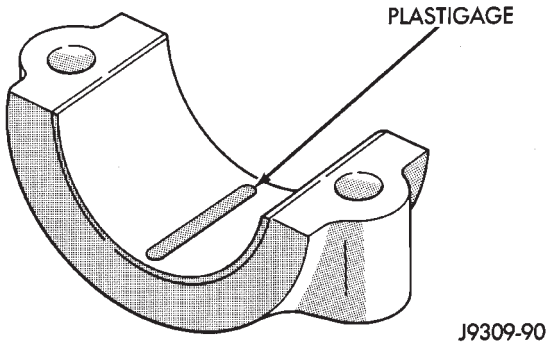

Fig. 3 Placement of Plastigage in Bearing Shell

(2) Remove the bearing cap and compare the width of the flattened Plastigage with the scale provided on the package (Fig. 4). Plastigage generally comes in 2 scales (one scale is in inches and the other is a metric scale). Locate the band closest to the same width. This band shows the amount of clearance. Differences in readings between the ends indicate the amount of taper present. Record all readings taken (refer to Engine Specifications).

(3) Plastigage is available in a variety of clearance ranges. The 0.025-0.076 mm (0.001-0.003 inch) range is usually the most appropriate for checking engine bearing clearances.

CONNECTING ROD BEARING CLEARANCE

Engine connecting rod bearing clearances can be determined by use of Plastigage, or equivalent. The following is the recommended procedures for the use of Plastigage:

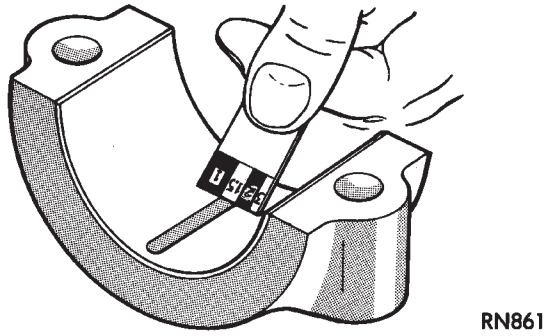

Fig. 4 Clearance Measurement

(1) Remove oil film from surface to be checked. Plastigage is soluble in oil.

(2) Place a piece of Plastigage across the entire width of the bearing cap shell (Fig. 3). Position the Plastigage approximately 6.35 mm (1/4 inch) off center and away from the oil holes. In addition, suspect areas can be checked by placing the Plastigage in the suspect area.

(3) The crankshaft must be turned until the connecting rod to be checked starts moving toward the top of the engine. Only then should the rod cap with Plastigage in place be assembled. Tighten the rod cap nut to the specified torque. **DO NOT rotate the crankshaft or the Plastigage may be smeared, giving inaccurate results.**

(4) Remove the bearing cap and compare the width of the flattened Plastigage with the scale provided on the package (Fig. 4). Plastigage generally comes in 2 scales (one scale is in inches and the other is a metric scale). Locate the band closest to the same width. This band shows the amount of clearance. Differences in readings between the ends indicate the amount of taper present. Record all readings taken (refer to Engine Specifications).

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

REPAIR DAMAGED OR WORN THREADS

Damaged or worn threads can be repaired. Essentially, this repair consists of:

- Drilling out worn or damaged threads.
- Tapping the hole with a special Heli-Coil Tap, or equivalent.
- Installing an insert into the tapped hole to bring the hole back to its original thread size.

CAUTION: Be sure that the tapped holes maintain the original center line.

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

GENERAL INFORMATION (Continued)

HYDROSTATIC LOCK

When an engine is suspected of hydrostatic lock (regardless of what caused the problem), follow the steps below.

(1) Perform the Fuel Pressure Release Procedure (refer to Group 14, Fuel System).

(2) Disconnect the battery negative cable.

(3) Inspect air cleaner, induction system and intake manifold to ensure system is dry and clear of foreign material.

(4) Place a shop towel around the spark plugs to catch any fluid that may possibly be under pressure in the cylinder head. Remove the plugs from the engine.

CAUTION: DO NOT use the starter motor to rotate the crankshaft. Severe damage could occur.

(5) With all spark plugs removed, rotate the crankshaft using a breaker bar and socket.

(6) Identify the fluid in the cylinders (i.e. coolant, fuel, oil, etc.).

(7) Make sure all fluid has been removed from the cylinders.

(8) Repair engine or components as necessary to prevent this problem from occurring again.

(9) Squirt engine oil into the cylinders to lubricate the walls. This will prevent damage on restart.

(10) Install new spark plugs. Tighten the engine spark plugs to the specified torque.

(11) Drain engine oil. Remove and discard the oil filter.

(12) Install the drain plug. Tighten the plug to the recommended torque.

(13) Install a new oil filter.

(14) Fill engine crankcase with the specified amount and grade of oil.

(15) Connect the battery negative cable.

(16) Start the engine and check for any leaks.

ENGINE OIL

WARNING: NEW OR USED ENGINE OIL CAN BE IRRITATING TO THE SKIN. AVOID PROLONGED OR REPEATED SKIN CONTACT WITH ENGINE OIL. CONTAMINANTS IN USED ENGINE OIL, CAUSED BY INTERNAL COMBUSTION, CAN BE HAZARDOUS TO YOUR HEALTH. THOROUGHLY WASH EXPOSED SKIN WITH SOAP AND WATER. DO NOT WASH SKIN WITH GASOLINE, DIESEL FUEL, THINNER, OR SOLVENTS, HEALTH PROBLEMS CAN RESULT. DO NOT POLLUTE, DISPOSE OF USED ENGINE OIL PROPERLY.

ENGINE OIL SPECIFICATION

CAUTION: Do not use non-detergent or straight mineral oil when adding or changing crankcase lubricant. Engine failure can result.

API SERVICE GRADE CERTIFIED

Use an engine oil that is API Service Grade Certified. MOPAR® provides engine oils that conform to this service grade.

SAE VISCOSITY

An SAE viscosity grade is used to specify the viscosity of engine oil. Use only engine oils with multiple viscosities such as 5W-30 or 10W-30 in the 4.0L, and 4.7L engines. These are specified with a dual SAE viscosity grade which indicates the cold-to-hot temperature viscosity range. Select an engine oil that is best suited to your particular temperature range and variation (Fig. 5) (Fig. 6).

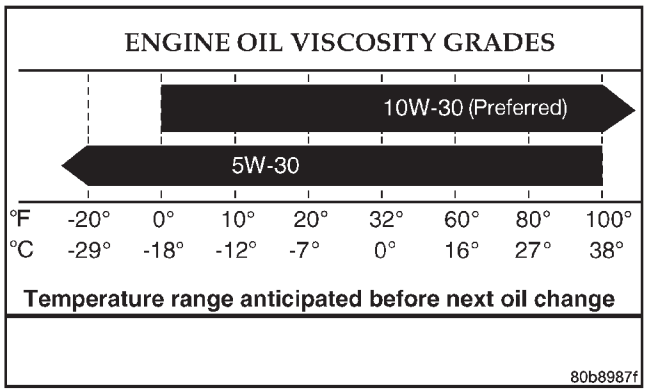

Fig. 5 Temperature/Engine Oil Viscosity—4.0L Engine

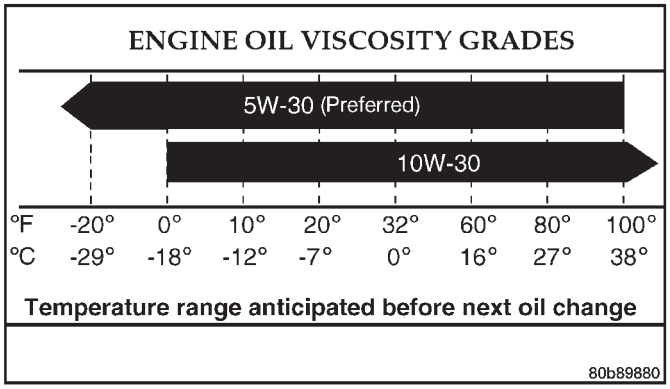

Fig. 6 Temperature/Engine Oil Viscosity—4.7L Engine

GENERAL INFORMATION (Continued)

ENERGY CONSERVING OIL

An Energy Conserving type oil is recommended for gasoline engines. The designation of ENERGY CONSERVING is located on the label of an engine oil container.

CONTAINER IDENTIFICATION

Standard engine oil identification notations have been adopted to aid in the proper selection of engine oil. The identifying notations are located on the label of engine oil plastic bottles and the top of engine oil cans (Fig. 7).

9400-9

Fig. 7 Engine Oil Container Standard Notations

OIL LEVEL INDICATOR (DIPSTICK)

The engine oil level indicator is located at the right rear of the engine on the 4.0L, 4.7L engines. (Fig. 8) (Fig. 9).

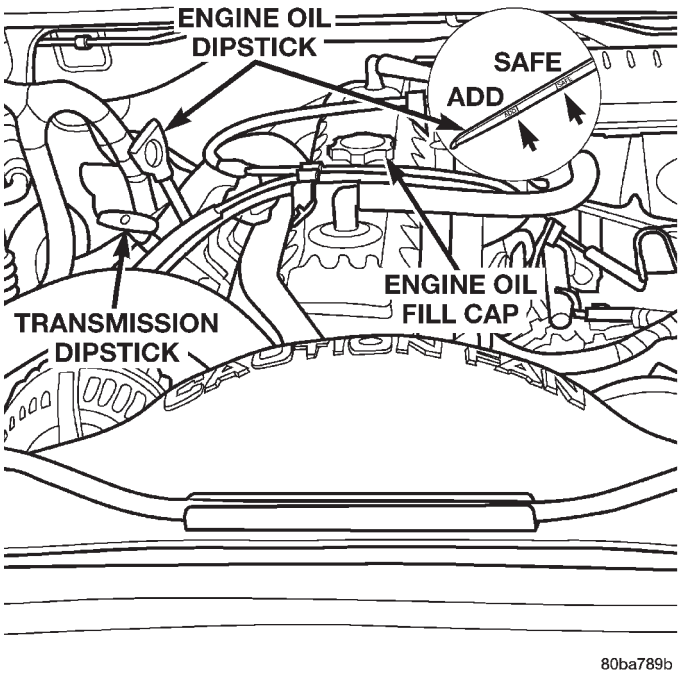

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Fig. 8 Engine Oil Dipstick 4.0L Engine

CRANKCASE OIL LEVEL INSPECTION

CAUTION: Do not overfill crankcase with engine oil, pressure loss or oil foaming can result.

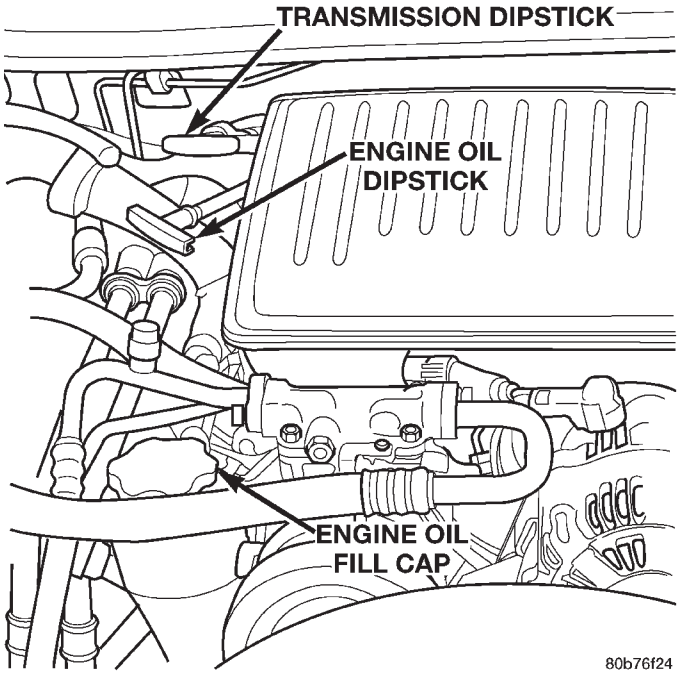

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Fig. 9 Engine Oil Dipstick 4.7L Engine

Inspect engine oil level approximately every 800 kilometers (500 miles). Unless the engine has exhibited loss of oil pressure, run the engine for about five minutes before checking oil level. Checking engine oil level on a cold engine is not accurate.

To ensure proper lubrication of an engine, the engine oil must be maintained at an acceptable level. The acceptable levels are indicated between the ADD and SAFE marks on the engine oil dipstick.

(1) Position vehicle on level surface.

(2) With engine OFF, allow approximately ten minutes for oil to settle to bottom of crankcase, remove engine oil dipstick.

(3) Wipe dipstick clean.

(4) Install dipstick and verify it is seated in the tube.

(5) Remove dipstick, with handle held above the tip, take oil level reading.

(6) Add oil only if level is below the ADD mark on dipstick.

ENGINE OIL CHANGE

Change engine oil at mileage and time intervals described in Maintenance Schedules.

Run engine until achieving normal operating temperature.

(1) Position the vehicle on a level surface and turn engine off.

(2) Hoist and support vehicle on safety stands.

(3) Remove oil fill cap.

(4) Place a suitable drain pan under crankcase drain.

GENERAL INFORMATION (Continued)

(5) Remove drain plug from crankcase and allow oil to drain into pan. Inspect drain plug threads for stretching or other damage. Replace drain plug if damaged.

(6) Install drain plug in crankcase.

(7) Lower vehicle and fill crankcase with specified type and amount of engine oil described in this section.

(8) Install oil fill cap.

(9) Start engine and inspect for leaks.

(10) Stop engine and inspect oil level.

ENGINE OIL FILTER CHANGE

FILTER SPECIFICATION

All engines are equipped with a high quality full-flow, disposable type oil filter. Chrysler Corporation recommends a Mopar or equivalent oil filter be used.

OIL FILTER REMOVAL

(1) Position a drain pan under the oil filter.

(2) Using a suitable oil filter wrench loosen filter.

(3) Rotate the oil filter counterclockwise (Fig. 10) (Fig. 11) to remove it from the cylinder block oil filter boss.

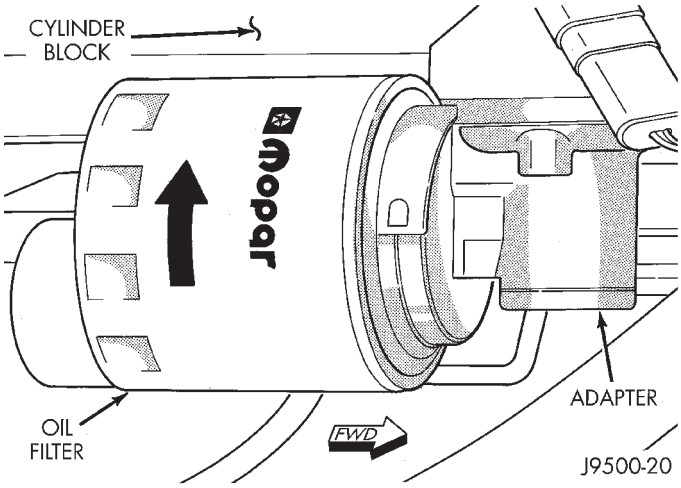

Fig. 10 Oil Filter—4.0L Engine

(4) When filter separates from adapter nipple, tip gasket end upward to minimize oil spill. Remove filter from vehicle.

(5) With a wiping cloth, clean the gasket sealing surface (Fig. 12) of oil and grime.

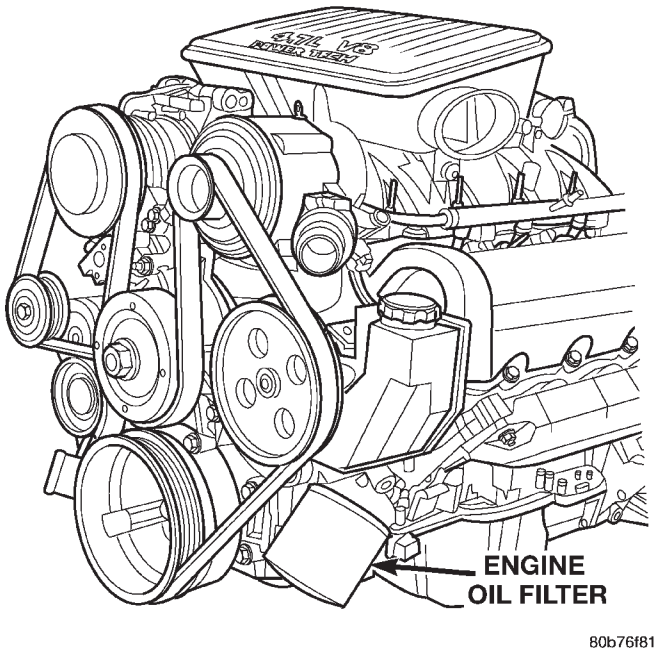

Fig. 11 Oil Filter—4.7L Engine

OIL FILTER INSTALLATION

(1) Lightly lubricate oil filter gasket with engine oil.

(2) Thread filter onto adapter nipple. When gasket makes contact with sealing surface, (Fig. 12) hand tighten filter one full turn, do not over tighten.

(3) Add oil, verify crankcase oil level and start engine. Inspect for oil leaks.

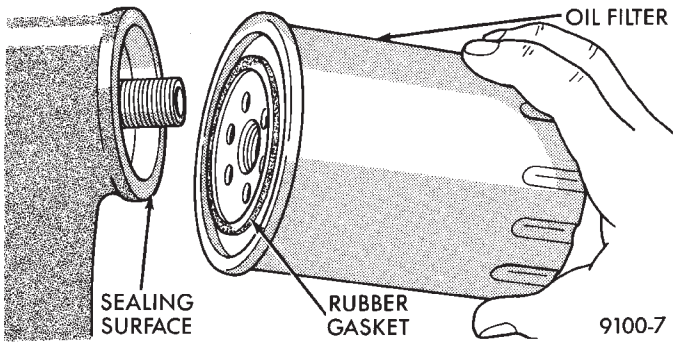

Fig. 12 Oil Filter Sealing Surface—Typical

USED ENGINE OIL DISPOSAL

Care should be exercised when disposing used engine oil after it has been drained from a vehicle engine. Refer to the WARNING at beginning of this section.

ENGINE DIAGNOSIS

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DIAGNOSIS AND TESTING

GENERAL INFORMATION

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

These malfunctions may be classified as either performance (e.g., engine idles rough and stalls) or mechanical (e.g., a strange noise).

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

Additional tests and diagnostic procedures may be necessary for specific engine malfunctions that can not be isolated with the Service Diagnosis charts. Information concerning additional tests and diagnosis is provided within the following diagnosis:

- Cylinder Compression Pressure Test.
- Cylinder Combustion Pressure Leakage Test.
- Engine Cylinder Head Gasket Failure Diagnosis.
- Intake Manifold Leakage Diagnosis.

INTAKE MANIFOLD LEAKAGE DIAGNOSIS

An intake manifold air leak is characterized by lower than normal manifold vacuum. Also, one or more cylinders may not be functioning.

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

(1) Start the engine.
(2) Spray a small stream of water at the suspected leak area.
(3) If a change in RPM is observed the area of the suspected leak has been found.
(4) Repair as required.

CYLINDER COMPRESSION PRESSURE TEST

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

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

(1) Disconnect the ignition coil tower electrical connectors and remove ignition coil towers.
(2) Remove the spark plugs.
(3) Clean the spark plug recesses with compressed air.
(4) Secure the throttle in the wide-open position.
(5) Disable the fuel system. (Refer to Group 14, Fuel System for the correct procedure)
(6) Insert a compression pressure gauge and rotate the engine with the engine starter motor for three revolutions.
(7) Record the compression pressure on the 3rd revolution. Continue the test for the remaining cylinders.

Refer to Engine Specifications for the correct engine compression pressures.

ENGINE CYLINDER HEAD GASKET FAILURE DIAGNOSIS

A leaking engine cylinder head gasket usually results in loss of power, and/or coolant and engine misfiring.

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

- An engine cylinder head gasket leaking between adjacent cylinders is indicated by a loss of power and/or engine misfire.
- An engine cylinder head gasket leaking between a cylinder and an adjacent water jacket is indicated by coolant foaming or overheating and loss of coolant.

DIAGNOSIS AND TESTING (Continued)

CYLINDER-TO-CYLINDER LEAKAGE TEST

To determine if an engine cylinder head gasket is leaking between adjacent cylinders; follow the procedures outlined in Cylinder Compression Pressure Test. An engine cylinder head gasket leaking between adjacent cylinders will result in approximately a 50-70% reduction in compression pressure.

CYLINDER-TO-WATER JACKET LEAKAGE TEST

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

Remove the radiator cap.

Start the engine and allow it to warm up until the engine thermostat opens.

If a large combustion/compression pressure leak exists, bubbles will be visible in the coolant.

If bubbles are not visible, install a radiator pressure tester and pressurize the coolant system.

If a cylinder is leaking combustion pressure into the water jacket, the tester pointer will pulsate with every combustion stroke of the cylinder.

CYLINDER COMBUSTION PRESSURE LEAKAGE TEST

The combustion pressure leakage test provides an accurate means for determining engine condition.

Combustion pressure leakage testing will detect:

- Exhaust and intake valve leaks (improper seating).
- Leaks between adjacent cylinders or into water jacket.
- Any causes for combustion/compression pressure loss.

(1) Check the coolant level and fill as required. DO NOT install the radiator cap.

(2) Start and operate the engine until it attains normal operating temperature, then turn the engine OFF.

(3) Disconnect ignition coil tower electrical connectors.

(4) Remove ignition coil towers.

(5) Remove the spark plugs.

(6) Remove the oil filler cap.

(7) Remove the air cleaner.

(8) Calibrate the tester according to the manufacturer's instructions. The shop air source for testing should maintain 483 kPa (70 psi) minimum, 1,379 kPa (200 psi) maximum and 552 kPa (80 psi) recommended.

(9) Perform the test procedures on each cylinder according to the tester manufacturer's instructions. While testing, listen for pressurized air escaping through the throttle body, tailpipe and oil filler cap opening. Check for bubbles in the radiator coolant.

All gauge pressure indications should be equal, with no more than 25% leakage.

FOR EXAMPLE: At 552 kPa (80 psi) input pressure, a minimum of 414 kPa (60 psi) should be maintained in the cylinder.

Refer to the Cylinder Combustion Pressure Leakage Test Diagnosis chart.

CYLINDER COMBUSTION PRESSURE LEAKAGE DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSE	CORRECTION
AIR ESCAPES THROUGH THROTTLE BODY	Intake valve bent, burnt, or not seated properly	Inspect valve and valve seat. Reface or replace, as necessary
AIR ESCAPES THROUGH TAILPIPE	Exhaust valve bent, burnt, or not seated properly	Inspect valve and valve seat. Reface or replace, as necessary
AIR ESCAPES THROUGH RADIATOR	Head gasket leaking or cracked cylinder head or block	Remove cylinder head and inspect. Replace defective part
MORE THAN 50% LEAKAGE FROM ADJACENT CYLINDERS	Head gasket leaking or crack in cylinder head or block between adjacent cylinders	Remove cylinder head and inspect. Replace gasket, head, or block as necessary
MORE THAN 25% LEAKAGE AND AIR ESCAPES THROUGH OIL FILLER CAP OPENING ONLY	Stuck or broken piston rings; cracked piston; worn rings and/or cylinder wall	Inspect for broken rings or piston. Measure ring gap and cylinder diameter, taper and out-of-round. Replace defective part as necessary

DIAGNOSIS AND TESTING (Continued)

ENGINE OIL LEAK INSPECTION

Begin with a thorough visual inspection of the engine, particularly at the area of the suspected leak. If an oil leak source is not readily identifiable, the following steps should be followed:

(1) Do not clean or degrease the engine at this time because some solvents may cause rubber to swell, temporarily stopping the leak.

(2) Add an oil soluble dye (use as recommended by manufacturer). Start the engine and let idle for approximately 15 minutes. Check the oil dipstick to make sure the dye is thoroughly mixed as indicated with a bright yellow color under a black light.

(3) Using a black light, inspect the entire engine for fluorescent dye, particularly at the suspected area of oil leak. If the oil leak is found and identified, repair per service manual instructions.

(4) If dye is not observed, drive the vehicle at various speeds for approximately 24km (15 miles), and repeat inspection.

(4) **If the oil leak source is not positively identified at this time** , proceed with the air leak detection test method.

Air Leak Detection Test Method

(1) Disconnect the breather cap to air cleaner hose at the breather cap end. Cap or plug breather cap nipple.

(2) Remove the PCV valve from the cylinder head cover. Cap or plug the PCV valve grommet.

(3) Attach an air hose with pressure gauge and regulator to the dipstick tube.

CAUTION: Do not subject the engine assembly to more than 20.6 kpa (3 PSI) of test pressure.

(4) Gradually apply air pressure from 1 psi to 2.5 psi maximum while applying soapy water at the suspected source. Adjust the regulator to the suitable test pressure that provide the best bubbles which will pinpoint the leak source. If the oil leak is detected and identified, repair per service manual procedures.

(5) If the leakage occurs at the rear oil seal area, refer to the section, Inspection for Rear Seal Area Leak.

(6) If no leaks are detected, turn off the air supply and remove the air hose and all plugs and caps. Install the PCV valve and breather cap hose.

(7) Clean the oil off the suspect oil leak area using a suitable solvent. Drive the vehicle at various speeds approximately 24 km (15 miles). Inspect the engine for signs of an oil leak by using a black light.

INSPECTION FOR REAR SEAL AREA LEAKS

Since it is sometimes difficult to determine the source of an oil leak in the rear seal area of the engine, a more involved inspection is necessary. The following steps should be followed to help pinpoint the source of the leak.

If the leakage occurs at the crankshaft rear oil seal area:

(1) Disconnect the battery.

(2) Raise the vehicle.

(3) Remove torque converter or clutch housing cover and inspect rear of block for evidence of oil. Use a black light to check for the oil leak:

(a) Circular spray pattern generally indicates seal leakage or crankshaft damage.

(b) Where leakage tends to run straight down, possible causes are a porous block, camshaft position sensor (4.0L) seal, camshaft bore cup plugs oil galley pipe plugs, oil filter runoff, and main bearing cap to cylinder block mating surfaces.

(4) If no leaks are detected, pressurize the crankcase as outlined in the, Inspection (Engine oil Leaks in general)

CAUTION: Do not exceed 20.6 kPa (3 psi).

(5) If the leak is not detected, very slowly turn the crankshaft and watch for leakage. If a leak is detected between the crankshaft and seal while slowly turning the crankshaft, it is possible the crankshaft seal surface is damaged. The seal area on the crankshaft could have minor nicks or scratches that can be polished out with emery cloth.

CAUTION: Use extreme caution when crankshaft polishing is necessary to remove minor nicks and scratches. The crankshaft seal flange is especially machined to complement the function of the rear oil seal.

(6) For bubbles that remain steady with shaft rotation, no further inspection can be done until disassembled.

HYDRAULIC TAPPETS

Before disassembling any part of the engine to correct tappet noise, check the oil pressure. If vehicle has no oil pressure gauge, install a reliable gauge at the pressure sending-unit. The pressure should be between 207-552 kPa (30-80 psi) at 3,000 RPM.

Check the oil level after the engine reaches normal operating temperature. Allow 5 minutes to stabilize oil level, check dipstick. The oil level in the pan should never be above the FULL mark or below the ADD OIL mark on dipstick. Either of these two conditions could be responsible for noisy tappets.

DIAGNOSIS AND TESTING (Continued)

OIL LEVEL

HIGH

If oil level is above the FULL mark, it is possible for the connecting rods to dip into the oil. With the engine running, this condition could create foam in the oil pan. Foam in oil pan would be fed to the hydraulic tappets by the oil pump causing them to lose length and allow valves to seat noisily.

LOW

Low oil level may allow oil pump to take in air. When air is fed to the tappets, they lose length, which allows valves to seat noisily. Any leaks on intake side of oil pump through which air can be drawn will create the same tappet action. Check the lubrication system from the intake strainer to the pump cover, including the relief valve retainer cap. When tappet noise is due to aeration, it may be intermittent or constant, and usually more than one tappet will be noisy. When oil level and leaks have been corrected, operate the engine at fast idle. Run engine for a sufficient time to allow all of the air inside the tappets to be bled out.

TAPPET NOISE DIAGNOSIS

(1) To determine source of tappet noise, operate engine at idle with cylinder head covers removed.

(2) Feel each valve spring or rocker arm to detect noisy tappet. The noisy tappet will cause the affected spring and/or rocker arm to vibrate or feel rough in operation.

NOTE: Worn valve guides or cocked springs are sometimes mistaken for noisy tappets. If such is the case, noise may be dampened by applying side thrust on the valve spring. If noise is not appreciably reduced, it can be assumed the noise is in the tappet. Inspect the rocker arm push rod sockets and push rod ends for wear.

(3) Valve tappet noise ranges from light noise to a heavy click. A light noise is usually caused by excessive leak-down around the unit plunger, or by the plunger partially sticking in the tappet body cylinder. The tappet should be replaced. A heavy click is caused by a tappet check valve not seating, or by foreign particles wedged between the plunger and the tappet body. This will cause the plunger to stick in the down position. This heavy click will be accompanied by excessive clearance between the valve stem and rocker arm as valve closes. In either case, tappet assembly should be removed for inspection and cleaning.

(4) The valve train generates a noise very much like a light tappet noise during normal operation. Care must be taken to ensure that tappets are making the noise. If more than one tappet seems to be noisy, it's probably not the tappets.

LASH ADJUSTER (TAPPET) NOISE DIAGNOSIS (4.7L ONLY)

A tappet-like noise may be produced from several items. Check the following items.

(1) Engine oil level too high or too low. This may cause aerated oil to enter the adjusters and cause them to be spongy.

(2) Insufficient running time after rebuilding cylinder head. Low speed running up to 1 hour may be required.

(3) During this time, turn engine off and let set for a few minutes before restarting. Repeat this several times after engine has reached normal operating temperature.

(4) Low oil pressure.

(5) The oil restrictor in cylinder head gasket or the oil passage to the cylinder head is plugged with debris.

(6) Air ingested into oil due to broken or cracked oil pump pick up.

(7) Worn valve guides.

(8) Rocker arm ears contacting valve spring retainer.

(9) Rocker arm loose, adjuster stuck or at maximum extension and still leaves lash in the system.

(10) Faulty lash adjuster.

a. Check lash adjusters for sponginess while installed in cylinder head. Depress part of rocker arm over adjuster. Normal adjusters should feel very firm. Spongy adjusters can be bottomed out easily.

b. Remove suspected lash adjusters, and replace.

c. Before installation, make sure adjusters are at least partially full of oil. This can be verified by little or no plunger travel when lash adjuster is depressed.

ENGINE OIL PRESSURE

(1) Disconnect connector and remove oil pressure sending unit.

(2) Install Oil Pressure Line and Gauge Tool C-3292 or equivalent. Start engine and record pressure. Refer to Oil Pressure in Engine Specifications for the correct pressures.

DIAGNOSIS AND TESTING (Continued)

ENGINE DIAGNOSIS—PERFORMANCE

CONDITION	POSSIBLE CAUSE	CORRECTION
ENGINE WILL NOT START	1. Weak battery.	1. Test battery. Charge or replace as necessary. Refer to Group 8A, Battery.
	2. Corroded or loose battery connections.	2. Clean and tighten battery connections. Apply a coat of light mineral grease to terminals.
	3. Faulty starter.	3. Test starting system. Refer to Group 8B, Starting.
	4. Faulty coil towers or coil rail.	4. Test and replace as needed. Refer to Group 8D, Ignition System.
	5. Incorrect spark plug gap.	5. Set gap. Refer to Group 8D, Ignition System.
	6. Contamination in fuel system.	6. Clean system and replace fuel filter.
	7. Faulty fuel pump.	7. Test fuel pump and replace as needed. Refer to Group 14, Fuel System.
	8. Incorrect engine timing.	8. Check for a worn timing chain(s) or a loose camshaft sprocket.
ENGINE STALLS OR IDLES ROUGH	1. Idle speed too low.	1. Test minimum air flow. Refer to Group 14, Fuel System.
	2. Incorrect fuel mixture.	2. Refer to Group 14, Fuel System.
	3. Intake manifold leakage.	3. Inspect intake manifold, manifold gasket, and vacuum hoses. Refer to Intake Manifold in this section.
	4. Faulty coil towers or coil rail.	4. Test and replace as necessary. Refer to Group 8D, Ignition System.
ENGINE LOSS OF POWER	1. Dirty or incorrectly gapped plugs.	1. Clean plugs and set gap. Refer to Group 8D, Ignition System.
	2. Contamination in fuel system.	2. Clean system and replace fuel filter.
	3. Faulty fuel pump.	3. Test and replace as necessary. Refer to Group 14, Fuel System.
	4. Incorrect valve timing.	4. Check for a worn timing chain(s) or a loose camshaft sprocket.
	5. Leaking cylinder head gasket.	5. Replace cylinder head gasket.
	6. Low compression.	6. Test compression of each cylinder.
	7. Burned, warped, or pitted valves.	7. Replace valves.
	8. Plugged or restricted exhaust system.	8. Install new parts, as necessary.
	9. Faulty coil towers or rail coil system.	9. Test and replace as necessary. Refer to Group 8D, Ignition System.
ENGINE MISSES ON ACCELERATION	1. Dirty or incorrectly gapped spark plugs.	1. Clean spark plugs and set gap. Refer to Group 8D, Ignition System.
	2. Contamination in Fuel System.	2. Clean fuel system and replace fuel filter.
	3. Burned, warped, or pitted valves.	3. Replace valves.
	4. Faulty coil towers or rail coil system.	4. Test and replace as necessary. Refer to Group 8D, Ignition System.
ENGINE MISSES AT HIGH SPEED	1. Dirty or incorrect spark plug gap.	1. Clean spark plugs and set gap. Refer to Group 8D, Ignition System.
	2. Faulty coil towers or rail coil system.	2. Test and replace as necessary. Refer to Group 8D, Ignition System.
	3. Dirty fuel injector(s).	Test and replace as necessary. Refer to Group 14, Fuel System.
	4. Contamination in fuel system.	4. Clean system and replace fuel filter.

DIAGNOSIS AND TESTING (Continued)

ENGINE—MECHANICAL

CONDITION	POSSIBLE CAUSES	CORRECTION
NOISY VALVES	1. High or low oil level in crankcase.	1. Check for correct oil level (refer to Group 0, Lubrication and Maintenance.
	2. Thin or diluted oil.	2. Change oil (refer to Group 0, Lubrication and Maintenance).
	3. Low oil pressure.	3. Check engine oil level.
	4. Dirt in tappets/lash adjusters.	4. Clean hydraulic tappets/hydraulic lash adjusters.
	5. Bent push rods.	5. Install new push rods.
	6. Worn rocker arms.	6. Inspect oil supply to rocker arms.
	7. Worn tappets/lash adjusters.	7. Install new hydraulic tappets/ hydraulic lash adjusters.
	8. Worn valve guides.	8. Ream and install new valves with oversize stems.
	9. Excessive runout of valve seats on valve faces.	9. Grind valve seats and valves.
CONNECTING ROD NOISE	1. Insufficient oil supply.	1. Check engine oil level (refer to Group 0, Lubrication and Maintenance).
	2. Low oil pressure.	2. Check engine oil level. Inspect oil pump relief valve and spring.
	3. Thin or diluted oil.	3. Change oil to correct viscosity.
	4. Excessive bearing clearance.	4. Measure bearings for correct clearance. Repair as necessary.
	5. Connecting rod journal out-of-round.	5. Replace crankshaft or grind journals.
	6. Misaligned connecting rods.	6. Replace bent connecting rods.
MAIN BEARING NOISE	1. Insufficient oil supply.	1. Check engine oil level (refer to Group 0, Lubrication and Maintenance).
	2. Low oil pressure.	2. Check engine oil level. Inspect oil pump relief valve and spring.
	3. Thin or diluted oil.	3. Change oil to correct viscosity.
	4. Excessive bearing clearance.	4. Measure bearings for correct clearance. Repair as necessary.
	5. Excessive end play.	5. Check No. 3 main bearing for wear on flanges.
	6. Crankshaft journal out-of-round, worn.	6. Grind journals or replace crankshaft.
	7. Loose flywheel or torque converter.	7. Tighten to correct torque.

DIAGNOSIS AND TESTING (Continued)

ENGINE—LUBRICATION

CONDITION	POSSIBLE CAUSES	CORRECTION
OIL LEAKS	1. Gaskets and O-Rings. (a) Misaligned, deteriorated or torn. (b) Loose fastener, broken or porous metal part. 2. Crankshaft Rear Seal (a) Misinstalled, inverted or torn lip (b) Torn, cut or shaved seal back bead. 3. Crankshaft Seal Flange. Scratched, nicked or grooved. 4. Cylinder block to Cap Mating Surface. (a) Inadequate Loctite sealant. (b) Oil hole burr. 5. Oil Pan to Rear Main Cap Sealant. (a) Inadequate or mislocated sealant. (b) Torn, cut or misinstalled oil pan. (c) Cracked or damaged oil pan flange. 6. Chain Case Cover Seal. (a) Misinstalled, cocked or misaligned. (b) Torn, cut or damaged seal lips. (c) Scratched or damaged seal casing or cover bore. (d) Scratched or damaged vibration damper hub.	1. (a) Replace the part. (b) Tighten, repair or replace the part. 2. (a) Replace the seal. (b) Replace the seal. 3. Replace or polish if necessary. 4. (a) Apply sealant per sealant per service manual. (b) Carefully stone or chamfer hole. 5. (a) Apply sealant per service manual procedures. (b) Replace the gasket. (c) Replace the oil pan. 6. (a) Replace per service manual procedures. (b) Replace the seal. (c) Replace the seal. (d) Minor damage can be polished out; otherwise replace the part.
OIL PRESSURE DROP	1. Low oil level. 2. Faulty oil pressure sending unit. 3. Low oil pressure. 4. Clogged oil filter. 5. Worn parts in oil pump. 6. Thin or diluted oil. 7. Excessive bearing clearance. 8. Oil pump relief valve stuck. 9. Oil pump suction tube loose; bent or cracked. 10. Oil pump cover warped or cracked.	1. Check engine oil level. 2. Install new sending unit. 3. Check sending unit and check main bearing oil clearance. 4. Install new oil filter. 5. Replace worn parts or pump. 6. Change oil to correct viscosity. 7. Measure bearings for correct clearance. 8. Remove valve and inspect, clean and install. 9. Remove oil pan and install new tube, if necessary. 10. Install new oil pump.
OIL PUMPING AT RINGS; SPARK PLUGS FOULING	1. Worn, scuffed or broken rings. 2. Carbon in oil ring slot. 3. Rings fitted too tightly in grooves. 4. Worn valve guides. 5. Leaking intake gasket. 6. Leaking valve guide seals. 7. Dislodged valve guide seals.	1. Hone cylinder bores and install new rings. 2. Install new rings. 3. Remove the rings. Check grooves. If grooves are not proper width, replace piston. 4. Ream guides and replace valves with oversize valves and seals. 5. Replace gasket and tighten intake manifold to proper torque. 6. Replace seals. 7. Seat valve guide seals or replace, as needed.

J9509-61

4.0L ENGINE

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DESCRIPTION AND OPERATION

ENGINE DESCRIPTION

The 4.0 Liter (242 CID) six-cylinder engine is an In-line, lightweight, overhead valve engine. This engine is designed for unleaded fuel.

The engine cylinder head has dual quench-type combustion chambers that create turbulence and fast burning of the air/fuel mixture. This results in better fuel economy.

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

The crankshaft rotation is clockwise, when viewed from the front of the engine. The crankshaft rotates within seven main bearings. The camshaft rotates within four bearings.

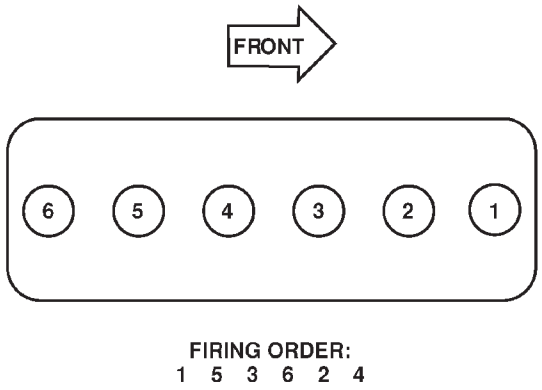


Fig. 1 Engine Firing Order

DESCRIPTION AND OPERATION (Continued)

BUILD DATE CODE

The engine Build Date Code is located on a machined surface on the right side of the cylinder block between the No.2 and No.3 cylinders (Fig. 2).

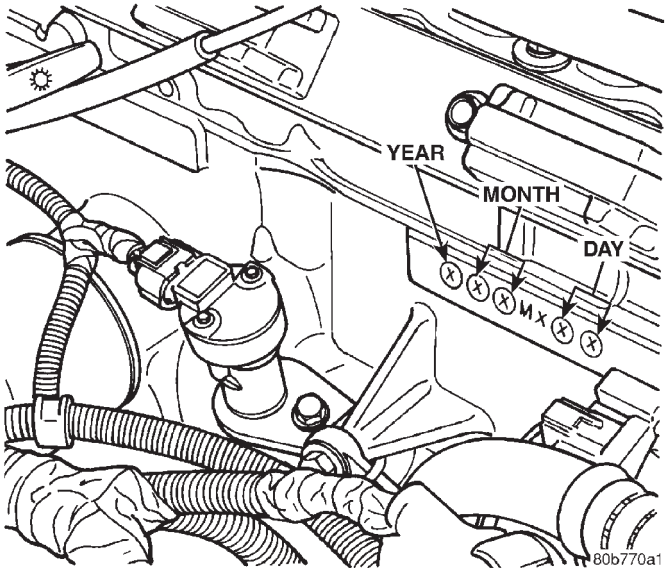


Fig. 2 Build Date Code Location

The digits of the code identify:

- 1st Digit—The year (8 = 1998).
- 2nd & 3rd Digits—The month (01 - 12).
- 4th & 5th Digits—The engine type/fuel system/ compression ratio (MX = A 4.0 Liter (242 CID) 8.7:1 compression ratio engine with a multi-point fuel injection system).
- 6th & 7th Digits—The day of engine build (01 - 31).

(1) **FOR EXAMPLE:** Code * 801MX12 * identifies a 4.0 Liter (242 CID) engine with a multi-point fuel injection system, 8.7:1 compression ratio and built on January 12, 1998.

LUBRICATION SYSTEM

A gear—type positive displacement pump is mounted at the underside of the block opposite the No. 4 main bearing. The pump draws oil through the screen and inlet tube from the sump at the rear of the oil pan. The oil is driven between the drive and idler gears and pump body, then forced through the outlet to the block. An oil gallery in the block channels the oil to the inlet side of the full flow oil filter. After passing through the filter element, the oil passes from the center outlet of the filter through an oil gallery that channels the oil up to the main gallery which extends the entire length of the block.

Galleries extend downward from the main oil gallery to the upper shell of each main bearing. The crankshaft is drilled internally to pass oil from the main bearing journals (except number 4 main bearing journal) to the connecting rod journals. Each connecting rod bearing cap has a small squirt hole, oil passes through the squirt hole and is thrown off as the rod rotates. This oil throwoff lubricates the camshaft lobes, camshaft position sensor drive gear, cylinder walls, and piston pins.

The hydraulic valve tappets receive oil directly from the main oil gallery. Oil is provided to the camshaft bearing through galleries. The front camshaft bearing journal passes oil through the camshaft sprocket to the timing chain. Oil drains back to the oil pan under the number one main bearing cap.

The oil supply for the rocker arms and bridged pivot assemblies is provided by the hydraulic valve tappets which pass oil through hollow push rods to a hole in the corresponding rocker arm. Oil from the rocker arm lubricates the valve train components, then passes down through the push rod guide holes in the cylinder head past the valve tappet area, and returns to the oil pan.

OIL PUMP PRESSURE

The MINIMUM oil pump pressure is 89.6 kPa (13 psi) at 600 rpm. The NORMAL oil pump pressure is 517 kPa (75 psi) at 1600 rpm or more.

ENGINE COMPONENTS

CYLINDER BLOCK

The cylinder block is a cast iron inline six cylinder design. The cylinder block is drilled forming galleries for both oil and coolant.

CYLINDER HEAD

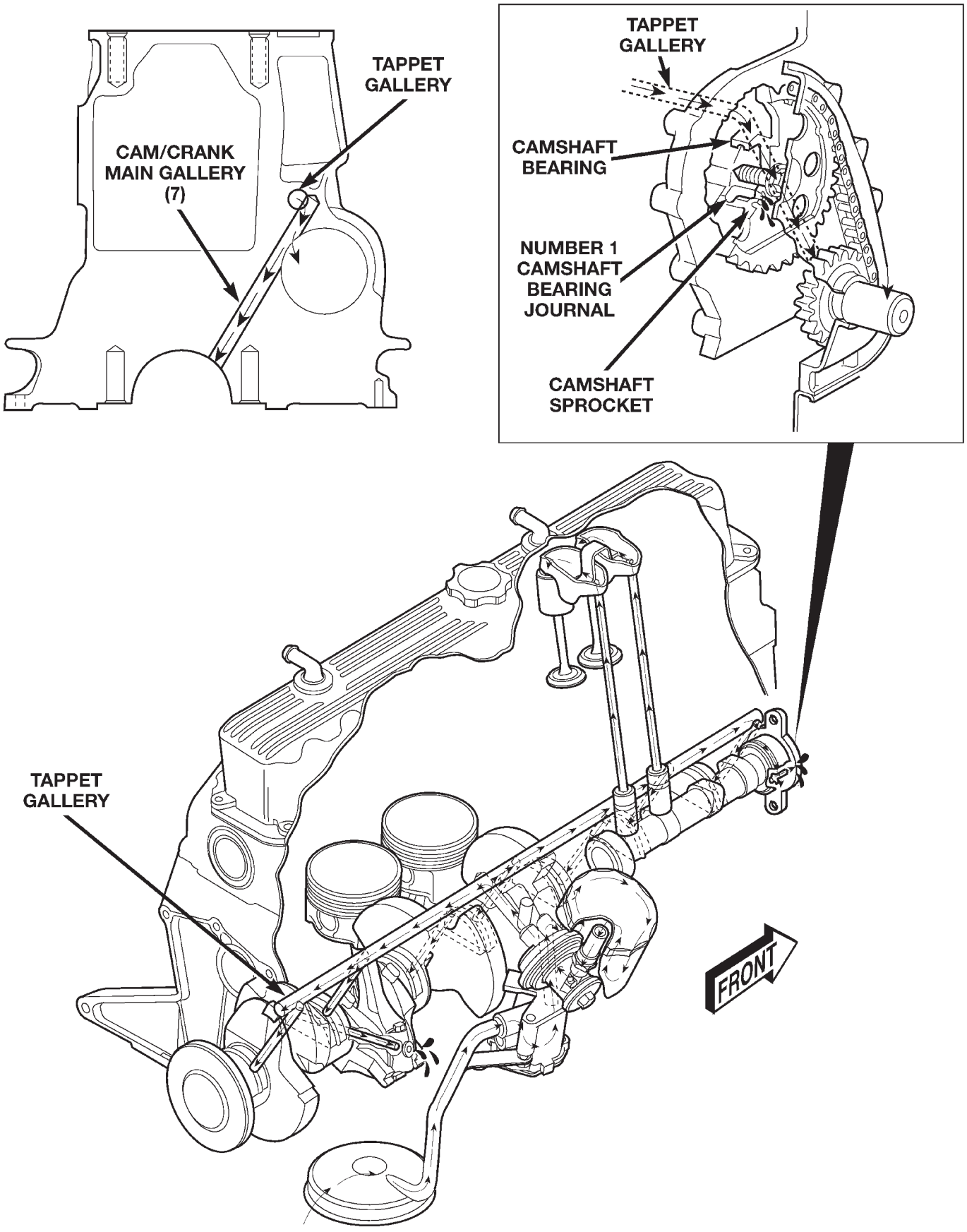
The cylinder head is made of cast iron containing twelve valves made of chrome plated heat resistant steel, valve stem seals, springs, retainers and keepers. The cylinder head, valve seats and guides can be resurfaced for service purposes.

The cylinder head uses dual quench-type design combustion chambers which cause turbulence in the cylinders allowing faster burning of the air/fuel mixture, resulting in better fuel economy.

CRANKSHAFT

The crankshaft is constructed of nodular cast iron. The crankshaft is a crosshaped four throw design with eight counterweights for balancing purposes. The crankshaft is supported by seven select main bearings with the number three serving as the thrust washer location. The main journals of the crankshaft are cross drilled to improve rod bearing lubrication. The select fit main bearing markings are located on the crankshaft counter weights. The crankshaft rear oil seal is a two piece design. The front oil seal is a one piece design retained in the timing chain cover.

DESCRIPTION AND OPERATION (Continued)



Oil Lubrication System—4.0L Engine

DESCRIPTION AND OPERATION (Continued)

PISTONS AND CONNECTING RODS

The pistons are made of a high strength aluminum alloy with an anodized top ring groove and crown. Piston skirts are coated with a solid lubricant (Molykote) to reduce friction and provide scuff resistance. The connecting rods are made of cast malleable iron. A pressed fit piston pin is used to attach the piston and connecting rod.

CAMSHAFT

The camshaft is made of cast iron with twelve machined lobes and four bearing journals. When the camshaft rotates the lobes actuate the push rods forcing upward on the rocker arms which applies downward force on the valves.

ROCKER ARMS

The rocker arms are made of stamped steel and have a operational ratio of 1.6:1. When the push rods are forced upward by the camshaft lobes the push rod presses upward on the rocker arms, the rocker arms pivot, forcing downward pressure on the valves forcing the valves to move downward and off from their seats.

VALVES

The valves are made of heat resistant steel and have chrome plated stems to prevent scuffing. All valves use a three bead lock keeper to retaining the valve spring and promote valve rotation.

VALVE SPRINGS

The valve springs are made of high strength chrome steel. The springs are common between intake and exhaust applications. The valve spring seat is integral with the valve stem seal.

CYLINDER HEAD COVER

The cylinder head cover is made of stamped steel and incorporates the Crankcase Ventilation (CCV) Hoses and the oil fill opening.

HYDRAULIC TAPPETS

Valve lash is controlled by hydraulic tappets located inside the cylinder block, in tappet bores above the camshaft. The tappets have a hole in the tappet body, oil from the cylinder block main bore enters and flows through the tappet exiting the top of the tappet. Oil that exits the tappet enters the hollow push rods, travels up the push rod and exits through a small hole in the rocker arm where it enters the cylinder head and returns to the oil pan.

VALVE GUIDES

The valve guides are integral to the cylinder head, They are not replaceable. However, they are serviceable.

OIL PAN

The oil pan is made of laminated steel and has a single plane sealing surface. The oil pan gasket is a one piece steel backbone silicone coated gasket.

VALVE STEM SEALS

The valve stem seals are made of rubber and incorporate a garter spring to maintain consistent lubrication control.

INTAKE MANIFOLD

The intake manifold is made of cast aluminum and uses eleven bolts to mount to the cylinder head. This mounting style improves sealing and reduces the chance of leaks.

EXHAUST MANIFOLDS

The two exhaust manifolds are log style and are made of high silicon molybdenum cast iron. The exhaust manifolds share a common gasket with the intake manifold. The exhaust manifolds also incorporate ball flange outlets for improved sealing and strain free connections.

SERVICE PROCEDURES

VALVE TIMING

Disconnect the coil rail and remove from engine.

Remove spark plugs.

Remove the engine cylinder head cover.

Remove the capscrews, bridge and pivot assembly, and rocker arms from above the No.1 cylinder.

Alternately loosen each capscrew, one turn at a time, to avoid damaging the bridge.

Rotate the crankshaft until the No.6 piston is at top dead center (TDC) on the compression stroke.

Rotate the crankshaft counterclockwise (viewed from the front of the engine) 90°.

Install a dial indicator on the end of the No.1 cylinder intake valve push rod. Use rubber tubing to secure the indicator stem on the push rod.

Set the dial indicator pointer at zero.

Rotate the crankshaft clockwise (viewed from the front of the engine) until the dial indicator pointer indicates 0.305 mm (0.012 inch) travel distance (lift).

The timing notch index on the vibration damper should be aligned with the TDC mark on the timing degree scale.

SERVICE PROCEDURES (Continued)

If the timing notch is more than 13 mm (1/2 inch) away from the TDC mark in either direction, the valve timing is incorrect.

If the valve timing is incorrect, the cause may be a broken camshaft pin. It is not necessary to replace the camshaft because of pin failure. A spring pin is available for service replacement.

PISTON FITTING

BORE GAGE METHOD

(1) To correctly select the proper size piston, a cylinder bore gauge, capable of reading in 0.003 mm (.0001 in.) INCREMENTS is required. If a bore gauge is not available, do not use an inside micrometer.

(2) Measure the inside diameter of the cylinder bore at a point 49.5 mm (1-15/16 inches) below top of bore. Start perpendicular (across or at 90 degrees) to the axis of the crankshaft at point A and then take an additional bore reading 90 degrees to that at point B (Fig. 4).

(3) The coated pistons will be serviced with the piston pin and connecting rod pre-assembled. **The coated piston connecting rod assembly can be used to service previous built engines and MUST be replaced as complete sets.** Tin coated pistons should not be used as replacements for coated pistons.

(4) The coating material is applied to the piston after the final piston machining process. Measuring the outside diameter of a coated piston will not provide accurate results (Fig. 3). Therefore measuring the inside diameter of the cylinder bore with a dial Bore Gauge is **MANDATORY**. To correctly select the proper size piston, a cylinder bore gauge capable of reading in 0.003 mm (.0001 in.) increments is required.

(5) Piston installation into the cylinder bore requires slightly more pressure than that required for non-coated pistons. The bonded coating on the piston will give the appearance of a line-to-line fit with the cylinder bore.

PISTON SIZE CHART

CYLINDER BORE SIZE	PISTON LETTER SIZE
98.438 to 98.448 mm (3.8755 to 3.8759 in.)	A
98.448 to 98.458 mm (3.8759 to 3.8763 in.)	B
98.458 to 98.468 mm (3.8763 to 3.8767 in.)	C
98.468 to 98.478 mm (3.8767 to 3.8771 in.)	D
98.478 to 98.488 mm (3.8771 to 3.8775 in.)	E
98.488 to 98.498 mm (3.8775 to 3.8779 in.)	F

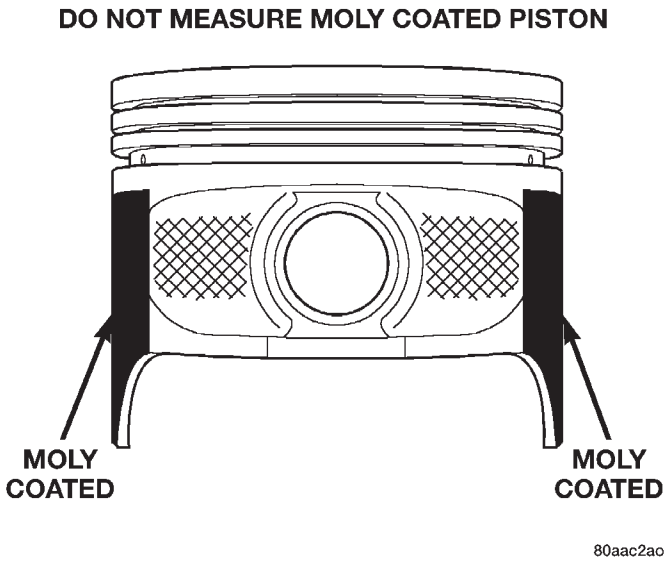


Fig. 3 Moly Coated Piston

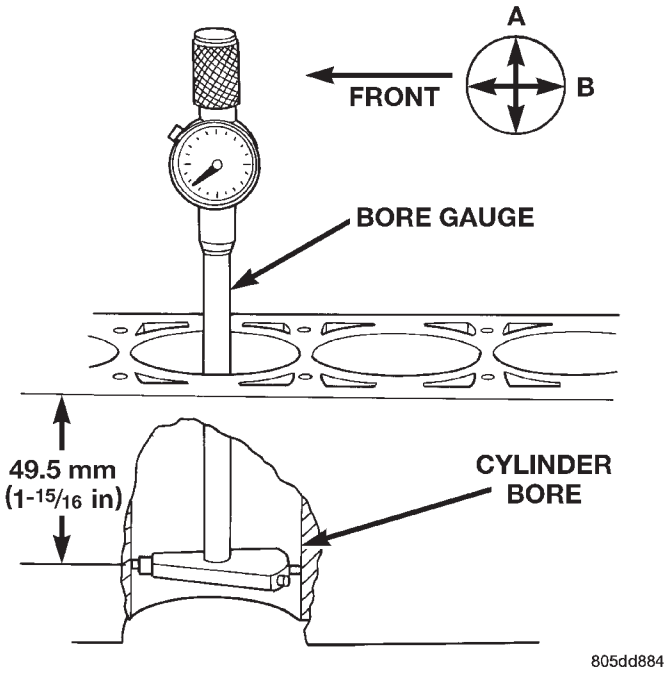


Fig. 4 Bore Gauge

PISTON RING FITTING

(1) Carefully clean the carbon from all ring grooves. Oil drain openings in the oil ring groove and pin boss must be clear. DO NOT remove metal from the grooves or lands. This will change ring-to-groove clearances and will damage the ring-to-land seating.

(2) Be sure the piston ring grooves are free of nicks and burrs.

(3) Measure the ring side clearance with a feeler gauge fitted snugly between the ring land and ring (Fig. 5) (Fig. 6). Rotate the ring in the groove. It must move freely around circumference of the groove.

SERVICE PROCEDURES (Continued)

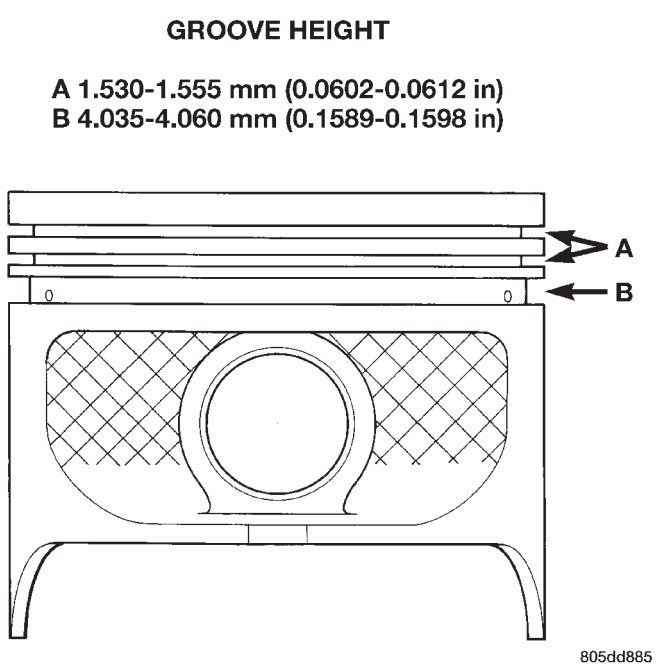


Fig. 5 Piston Dimensions

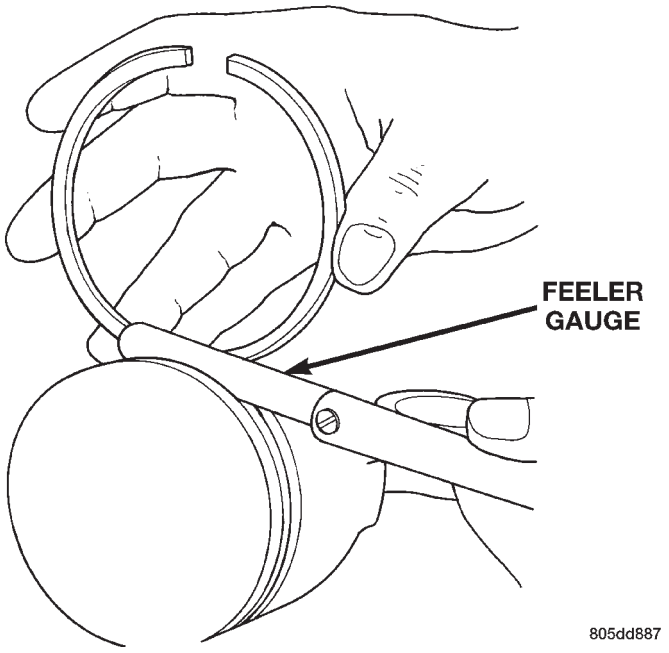


Fig. 6 Ring Side Clearance Measurement

Ring Side Clearance Measurement

Top Compression Ring . . . . . 0.042 to 0.084 mm (0.0017 to 0.0033 in.)
Second Compression Ring . . . . . 0.042 to 0.084 mm (0.0017 to 0.0033 in.)
Oil Control Ring . . . . . 0.06 to 0.21 mm (0.0024 to 0.0083 in.)

(4) Place ring in the cylinder bore and push down with inverted piston to position near lower end of the ring travel. Measure ring gap with a feeler gauge fitting snugly between ring ends (Fig. 7).

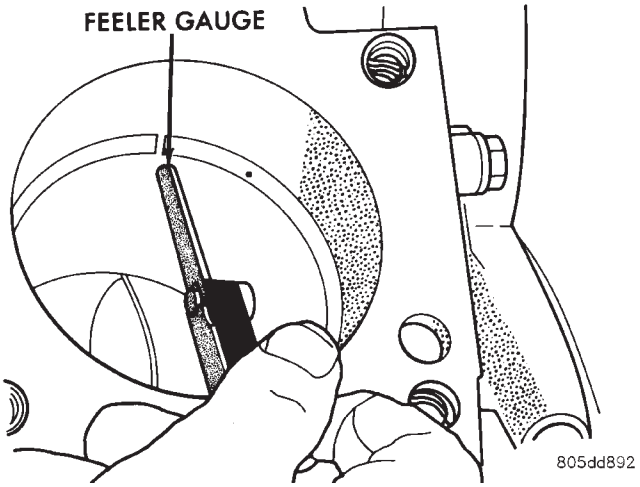


Fig. 7 Gap Measurement

Ring Gap Measurement

Top Compression Ring . . . . . 0.229 to 0.610 mm (0.0090 to 0.0240 inch)
Second Compression Ring . . . . . 0.483 to 0.965 mm (0.0190 to 0.0380 inch)
Oil Control Ring . . . . . 0.254 to 1.500 mm (0.010 to 0.060 inch)

(5) The oil control rings are symmetrical, and can be installed with either side up. It is not necessary to use a tool to install the upper and lower rails. Insert oil rail spacer first, then side rails.

(6) The two compression rings are different and cannot be interchanged. The top compression ring can be identified by the shiny coating on the outer sealing surface and can be installed with either side up. (Fig. 8).

(7) The second compression ring has a slight chamfer on the bottom of the inside edge and a dot on the top for correct installation (Fig. 9).

(8) Using a ring installer, install the second compression ring with the dot facing up (Fig. 9) (Fig. 11).

(9) Using a ring installer, install the top compression ring (either side up).

Ring Gap Orientation

- Position the gaps on the piston as shown (Fig. 12).
- Oil spacer - Gap on center line of piston skirt.
- Oil rails - gap 180° apart on centerline of piston pin bore.
- No. 2 Compression ring - Gap 180° from top oil rail gap.
- No. 1 Compression ring - Gap 180° from No. 2 compression ring gap.

SERVICE PROCEDURES (Continued)

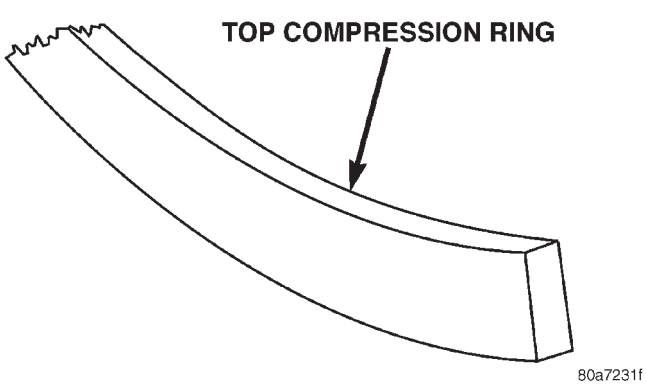


Fig. 8 Top Compression ring identification

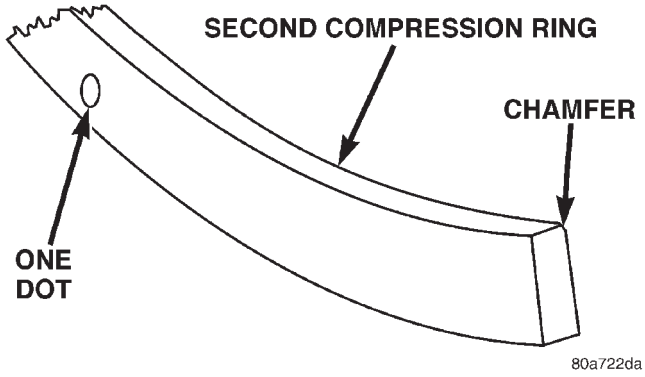


Fig. 9 Second Compression Ring Identification

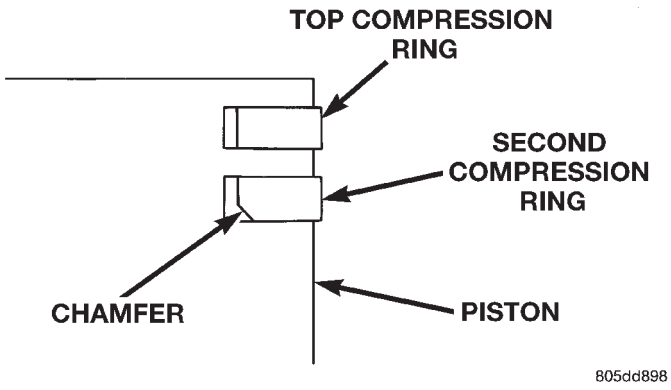


Fig. 10 Compression Ring Chamfer Location

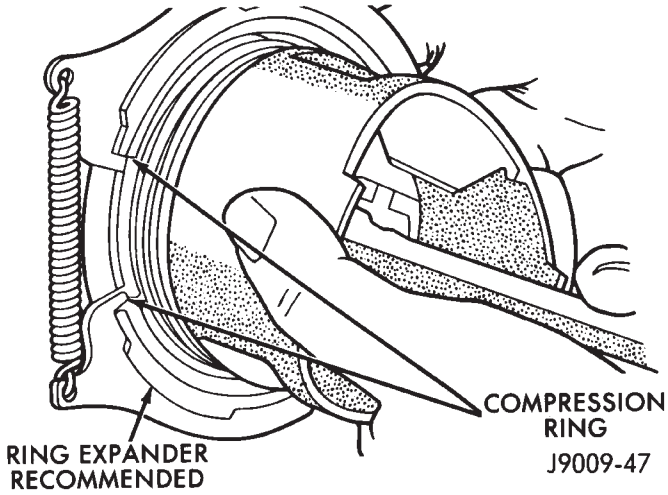


Fig. 11 Compression Ring Installation

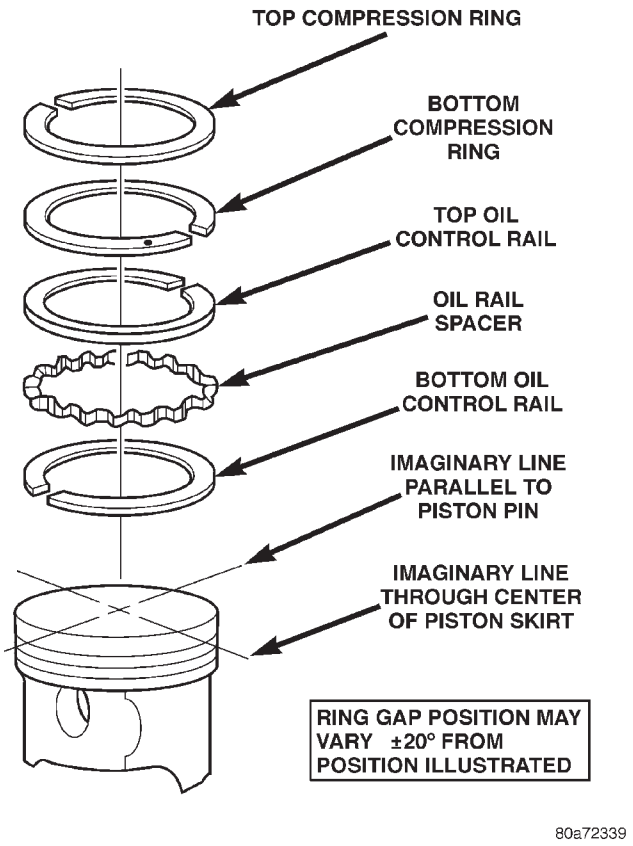


Fig. 12 Ring Gap Orientation

SERVICE PROCEDURES (Continued)

FITTING CONNECTING ROD BEARINGS

INSPECTION

BEARINGS

Inspect the connecting rod bearings for scoring and bent alignment tabs (Fig. 13) (Fig. 14). Check the bearings for normal wear patterns, scoring, grooving, fatigue and pitting (Fig. 15). Replace any bearing that shows abnormal wear.

Inspect the connecting rod journals for signs of scoring, nicks and burrs.

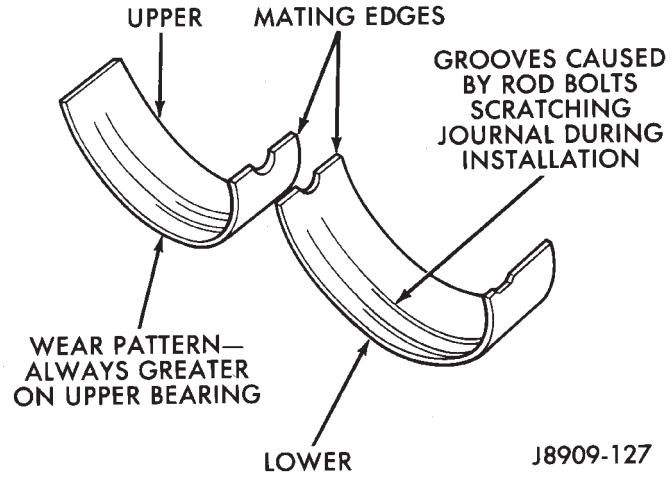


Fig. 13 Connecting Rod Bearing Inspection

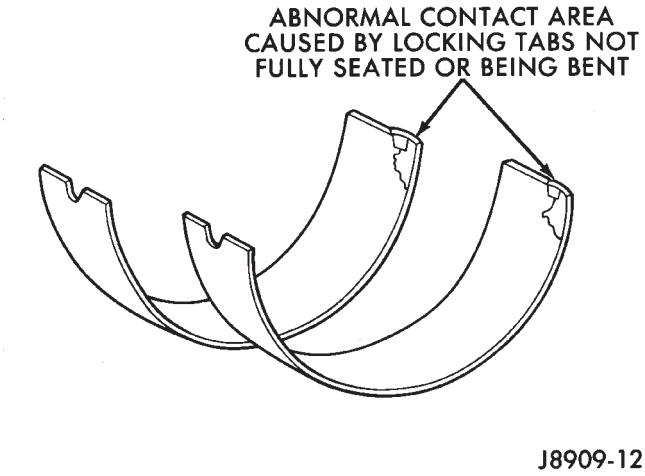


Fig. 14 Locking Tab Inspection

CONNECTING RODS

Misaligned or bent connecting rods can cause abnormal wear on pistons, piston rings, cylinder walls, connecting rod bearings and crankshaft connecting rod journals. If wear patterns or damage to any of these components indicate the probability of a misaligned connecting rod, inspect it for correct rod alignment. Replace misaligned, bent or twisted connecting rods.

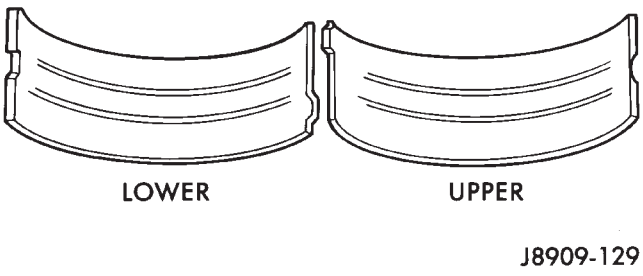


Fig. 15 Scoring Caused by Insufficient Lubrication or by Damaged Crankshaft Pin Journal

BEARING-TO-JOURNAL CLEARANCE

(1) Wipe the oil from the connecting rod journal.

(2) Use short rubber hose sections over rod bolts during installation.

(3) Lubricate the upper bearing insert and install in connecting rod.

(4) Use piston ring compressor to install the rod and piston assemblies. The oil squirt holes in the rods must face the camshaft. The arrow on the piston crown should point to the front of the engine (Fig. 16). Verify that the oil squirt holes in the rods face the camshaft and that the arrows on the pistons face the front of the engine.

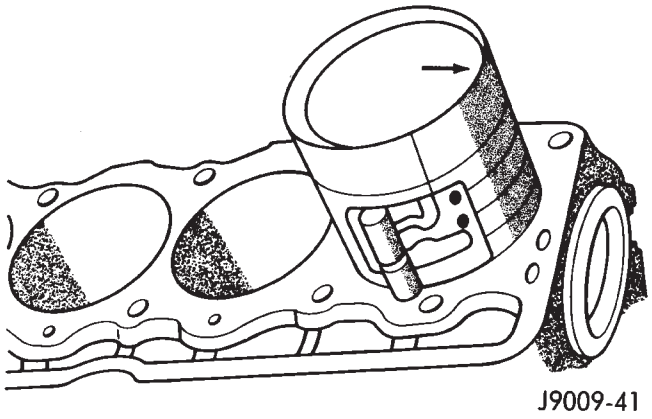


Fig. 16 Rod and Piston Assembly Installation

(5) Install the lower bearing insert in the bearing cap. The lower insert must be dry. Place strip of Plastigage across full width of the lower insert at the center of bearing cap. Plastigage must not crumble in use. If brittle, obtain fresh stock.

(6) Install bearing cap and connecting rod on the journal and tighten nuts to 45 N·m (33 ft. lbs.) torque. DO NOT rotate crankshaft. Plastigage will smear, resulting in inaccurate indication.

(7) Remove the bearing cap and determine amount of bearing-to-journal clearance by measuring the width of compressed Plastigage (Fig. 17). Refer to Engine Specifications for the proper clearance. **Plastigage should indicate the same clearance across the entire width of the insert. If the clearance varies, it may be caused by either a**

SERVICE PROCEDURES (Continued)

tapered journal, bent connecting rod or foreign material trapped between the insert and cap or rod.

(8) If the correct clearance is indicated, replacement of the bearing inserts is not necessary. Remove the Plastigage from crankshaft journal and bearing insert. Proceed with installation.

(9) If bearing-to-journal clearance exceeds the specification, install a pair of 0.0254 mm (0.001 inch) undersize bearing inserts. All the odd size inserts must be on the bottom. The sizes of the service replacement bearing inserts are stamped on the backs of the inserts. Measure the clearance as described in the previous steps.

(10) The clearance is measured with a pair of 0.0254 mm (0.001 inch) undersize bearing inserts installed. This will determine if two 0.0254 mm (0.001 inch) undersize inserts or another combination is needed to provide the correct clearance (refer to Connecting Rod Bearing Fitting Chart).

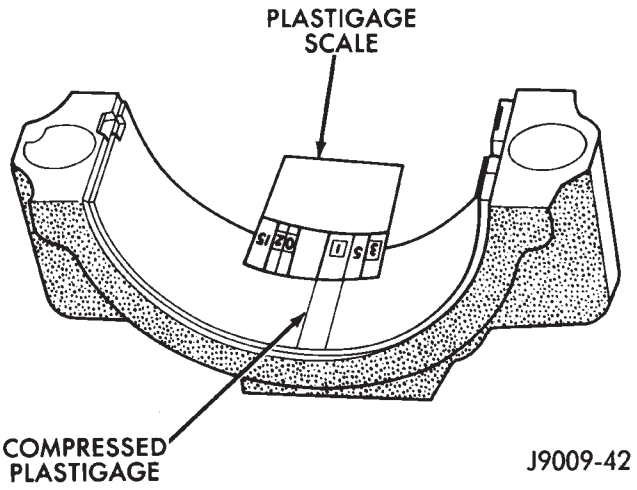


Fig. 17 Measuring Bearing Clearance with Plastigage

CONNECTING ROD BEARING FITTING CHART

CRANKSHAFT JOURNAL		CORRESPONDING ROD BEARING INSERT	
Color Code	**Diameter**	**Upper Insert Size**	**Lower Insert Size**
Yellow	53.2257 - 53.2079 mm (2.0955 - 2.0948 in.)	Yellow - Standard	Yellow - Standard
Orange	53.2079 - 53.1901 mm (2.0948 - 2.0941 in.) 0.0178 mm (0.0007 in.) Undersize	Yellow - Standard	Blue - Undersize 0.025 mm (0.001 in.)
Blue	53.1901 - 53.1724 mm (2.0941 - 2.0934 in.) 0.0356 mm (0.0014 in.) Undersize	Blue - Undersize 0.025 mm (0.001 in.)	Blue - Undersize 0.025 mm (0.001 in.)
Red	52.9717 - 52.9539 mm (2.0855 - 2.0848 in.) 0.254 mm (0.010 in.) Undersize	Red - Undersize 0.254 mm (0.010 in.)	Red - Undersize 0.254 mm (0.010 in.)

(11) **FOR EXAMPLE:** If the initial clearance was 0.0762 mm (0.003 inch), 0.025 mm (0.001 inch) undersize inserts would reduce the clearance by 0.025 mm (0.001 inch). The clearance would be 0.002 inch and within specification. A 0.051 mm (0.002 inch) undersize insert would reduce the initial clearance an additional 0.013 mm (0.0005 inch). The clearance would then be 0.038 mm (0.0015 inch).

(12) Repeat the Plastigage measurement to verify your bearing selection prior to final assembly.

(13) Once you have selected the proper insert, install the insert and cap. Tighten the connecting rod bolts to 45 N·m (33 ft. lbs.) torque.

SIDE CLEARANCE MEASUREMENT

Slide snug-fitting feeler gauge between the connecting rod and crankshaft journal flange (Fig. 18). Refer to Engine Specifications for the proper clearance. Replace the connecting rod if the side clearance is not within specification.

SERVICE PROCEDURES (Continued)

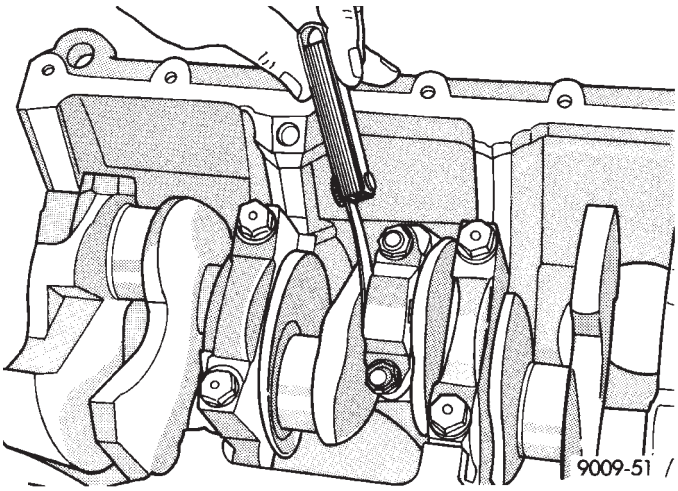


Fig. 18 Checking Connecting Rod Side Clearance—Typical

FITTING CRANKSHAFT MAIN BEARINGS

INSPECTION

Wipe the inserts clean and inspect for abnormal wear patterns and for metal or other foreign material imbedded in the lining. Normal main bearing insert wear patterns are illustrated (Fig. 19).

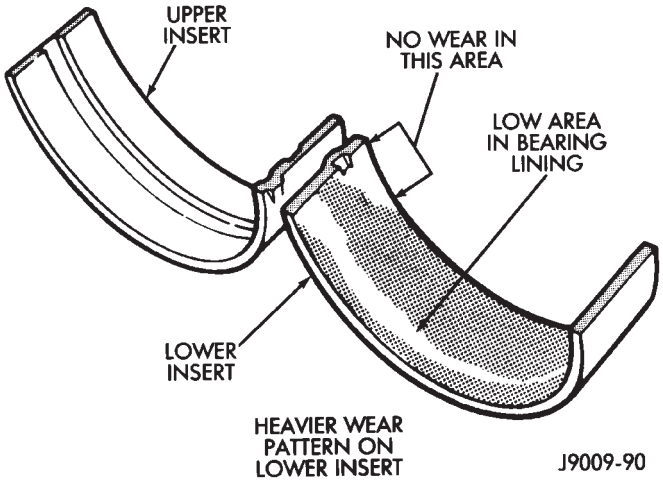


Fig. 19 Main Bearing Wear Patterns

NOTE: If any of the crankshaft journals are scored, remove the engine for crankshaft repair.

Inspect the back of the inserts for fractures, scrapings or irregular wear patterns.

Inspect the upper insert locking tabs for damage.

Replace all damaged or worn bearing inserts.

FITTING BEARINGS (CRANKSHAFT INSTALLED)

The main bearing caps, numbered (front to rear) from 1 through 7 have an arrow to indicate the forward position. The upper main bearing inserts are grooved to provide oil channels while the lower inserts are smooth.

Each bearing insert pair is selectively fitted to its respective journal to obtain the specified operating clearance. In production, the select fit is obtained by using various-sized color-coded bearing insert pairs as listed in the Main Bearing Fitting Chart. The bearing color code appears on the edge of the insert. **The size is not stamped on bearing inserts used for engine production.**

The main bearing journal size (diameter) is identified by a color-coded paint mark (Fig. 20) on the adjacent cheek or counterweight towards the rear of the crankshaft (flange end). The rear main journal, is identified by a color-coded paint mark on the crankshaft rear flange.

When required, upper and lower bearing inserts of different sizes may be used as a pair. A standard size insert is sometimes used in combination with a 0.025 mm (0.001 inch) undersize insert to reduce the clearance by 0.013 mm (0.0005 inch). **Never use a pair of bearing inserts with greater than a 0.025 mm (0.001 inch) difference in size (Fig. 21).**

NOTE: When replacing inserts, the odd size inserts must be either all on the top (in cylinder block) or all on the bottom (in main bearing cap).

Once the bearings have been properly fitted, proceed to Crankshaft Main Bearing—Installation.

BEARING-TO-JOURNAL CLEARANCE (CRANKSHAFT INSTALLED)

When using Plastigage, check only one bearing clearance at a time.

Install the grooved main bearings into the cylinder block and the non-grooved bearings into the bearing caps.

Install the crankshaft into the upper bearings dry.

Place a strip of Plastigage across full width of the crankshaft journal to be checked.

Install the bearing cap and tighten the bolts to 108 N·m (80 ft. lbs.) torque.

NOTE: DO NOT rotate the crankshaft. This will cause the Plastigage to shift, resulting in an inaccurate reading. Plastigage must not be permitted to crumble. If brittle, obtain fresh stock.

SERVICE PROCEDURES (Continued)

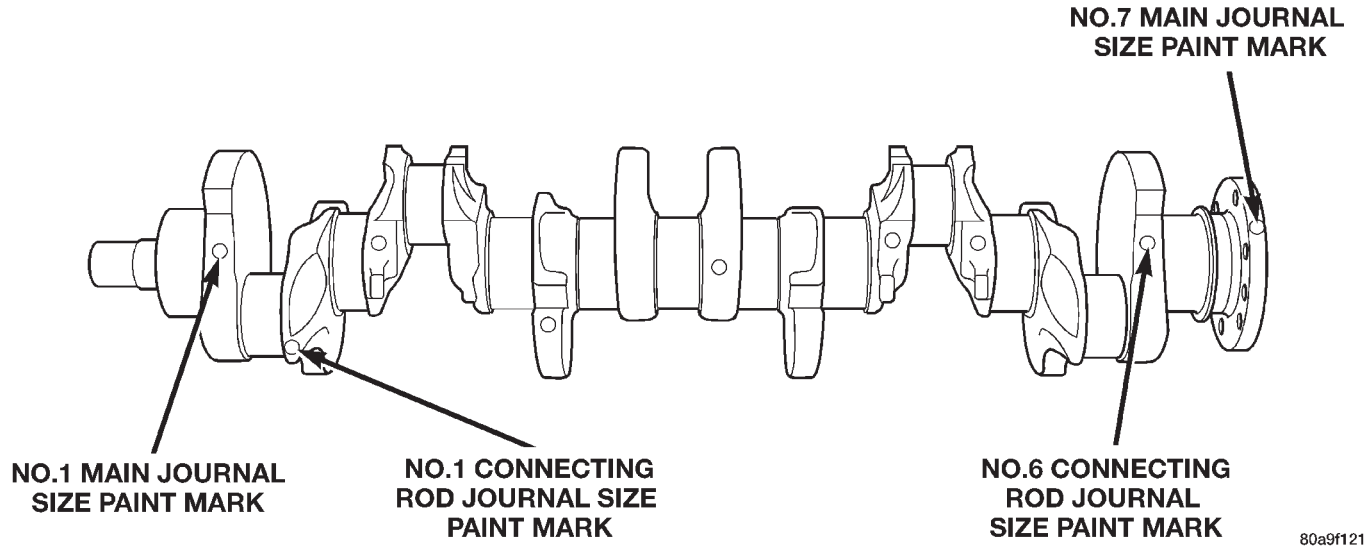


Fig. 20 Crankshaft Journal Size Paint I.D. Location

Insert	Correct	Incorrect
Upper	Standard	Standard
Lower	0.025 mm (0.001 in.) Undersize	0.051 mm (0.002 in.) Undersize

J9109-179

Fig. 21 Bearing Insert Pairs

Remove the bearing cap. Determine the amount of clearance by measuring the width of the compressed Plastigage with the scale on the Plastigage envelope (Fig. 22). Refer to Engine Specifications for the proper clearance.

Plastigage should indicate the same clearance across the entire width of the insert. If clearance varies, it may indicate a tapered journal or foreign material trapped behind the insert.

If the specified clearance is indicated and there are no abnormal wear patterns, replacement of the bearing inserts is not necessary. Remove the Plastigage from the crankshaft journal and bearing insert. Proceed to Crankshaft Main Bearing—Installation.

If the clearance exceeds specification, install a pair of 0.025 mm (0.001 inch) undersize bearing inserts and measure the clearance as described in the previous steps.

The clearance indicate with the 0.025 mm (0.001 inch) undersize insert pair installed will determine if this insert size or some other combination will provide the specified clearance. **FOR EXAMPLE:** If the clearance was 0.0762 mm (0.003 inch) originally, a

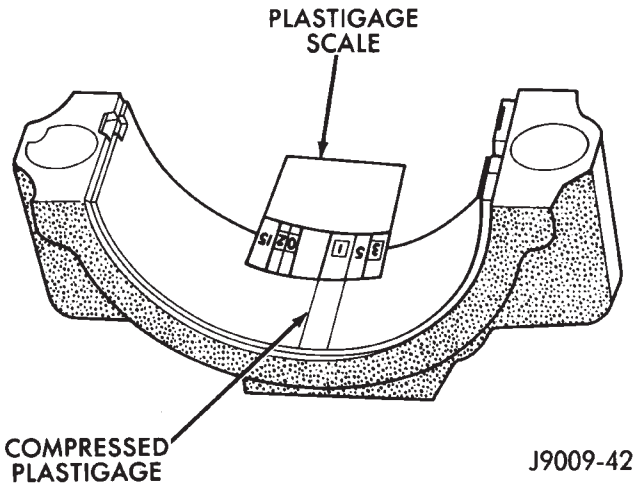


Fig. 22 Measuring Bearing Clearance with Plastigage

pair of 0.0254 mm (0.001 inch) undersize inserts would reduce the clearance by 0.0254 mm (0.001 inch). The clearance would then be 0.0508 mm (0.002 inch) and within the specification. A 0.051 mm (0.002 inch) undersize bearing insert and a 0.0254 mm (0.001 inch) undersize insert would reduce the original clearance an additional 0.0127 mm (0.0005 inch). The clearance would then be 0.0381 mm (0.0015 inch).

CAUTION: Never use a pair of inserts that differ more than one bearing size as a pair.

FOR EXAMPLE: DO NOT use a standard size upper insert and a 0.051 mm (0.002 inch) undersize lower insert.

If the clearance exceeds specification using a pair of 0.051 mm (0.002 inch) undersize bearing inserts,

SERVICE PROCEDURES (Continued)

measure crankshaft journal diameter with a micrometer. If the journal diameter is correct, the crankshaft bore in the cylinder block may be misaligned, which requires cylinder block replacement or machining to true bore.

Replace the crankshaft or grind to accept the appropriate undersize bearing inserts if:

- Journal diameters 1 through 6 are less than 63.4517 mm (2.4981 inches)
- Journal 7 diameter is less than 63.4365 mm (2.4975 inches).

Once the proper clearances have been obtained, proceed to Crankshaft Main Bearing—Installation.

MAIN BEARING JOURNAL DIAMETER (CRANKSHAFT REMOVED)

Remove the crankshaft from the cylinder block (refer to Cylinder Block - Disassemble).

Clean the oil off the main bearing journal.

Determine the maximum diameter of the journal with a micrometer. Measure at two locations 90° apart at each end of the journal.

The maximum allowable taper and out of round is 0.013 mm (0.0005 inch). Compare the measured diameter with the journal diameter specification (Main Bearing Fitting Chart). Select inserts required to obtain the specified bearing-to-journal clearance.

Install the crankshaft into the cylinder block (refer to Cylinder Block - Assemble and Crankshaft Main Bearings - Installation).

SERVICE PROCEDURES (Continued)

MAIN BEARING FITTING CHART

Crankshaft Journals #1-6		Corresponding Crankshaft Bearing Insert	
Color Code	**Diameter**	**Upper Insert Size**	**Lower Insert Size**
Yellow	63.5025 -63.4898 mm (2.5001 - 2.4996 in.)	Yellow - Standard	Yellow - Standard
Orange	63.4898 - 63.4771 mm (2.4996 - 2.4991 in.) 0.0127 mm (0.0015 in.) Undersize	Yellow - Standard	Blue - Undersize 0.025 mm (0.001 in.)
Blue	63.4771 - 63.4644 mm (2.4991 - 2.4986 in.) 0.0254 mm (0.001 in.) Undersize	Blue - Undersize 0.025 mm (0.001 in.)	Blue - Undersize 0.025 mm (0.001 in.)
Green	63.4644 - 63.4517 mm (2.4986 - 2.4981 in.) 0.0381 mm (0.0015 in.) Undersize	Blue - Undersize 0.025 mm (0.001 in.)	Green - Undersize 0.051 mm (0.002 in.)
Red	63.2485 - 63.2358 mm (2.4901 - 2.4896 in.) 0.254 mm (0.010 in.) Undersize	Red - Undersize 0.254 mm (0.010 in.)	Red - Undersize 0.254 mm (0.010 in.)

Crankshaft Journal #7 Only		Corresponding Bearing Insert	
Color Code	**Diameter**	**Upper Insert Size**	**Lower Insert Size**
Yellow	63.4873 - 63.4746 mm (2.4995 - 2.4990 in.)	Yellow - Standard	Yellow - Standard
Orange	63.4746 - 63.4619 mm (2.4996 - 2.4991 in.) 0.0127 mm (0.0005 in.) Undersize	Yellow - Standard	Blue - Undersize 0.025 mm (0.001 in.)
Blue	63.4619 - 63.4492 mm (2.4985 - 2.4980 in.) 0.0254 mm (0.001 in.) Undersize	Blue - Undersize 0.025 mm (0.001 in.)	Blue - Undersize 0.025 mm (0.001 in.)
Green	63.4492 - 63.4365 mm (2.4980 - 2.4975 in.) 0.0381 mm (0.0015 in.) Undersize	Blue - Undersize 0.025 mm (0.001 in.)	Green - Undersize 0.051 mm (0.002 in.)
Red	63.2333 - 63.2206 mm (2.4895 - 2.4890 in.) 0.254 mm (0.010 in.) Undersize	Red - Undersize 0.254 mm (0.010 in.)	Red - Undersize 0.254 mm (0.010 in.)

REMOVAL AND INSTALLATION

ENGINE MOUNTS—FRONT

The front mounts support the engine at each side. These insulators are made of resilient rubber.

REMOVAL

(1) Disconnect the negative cable from the battery.
(2) Raise the vehicle.
(3) Support the engine.
(4) Remove the insulator assembly-to-lower front sill bolts (Fig. 23) (Fig. 24).
(5) Raise the engine slightly.
(6) Remove the through bolt nut and through bolt. Remove the insulator (Fig. 23) (Fig. 24).
(7) If required, remove the engine bracket from the block.

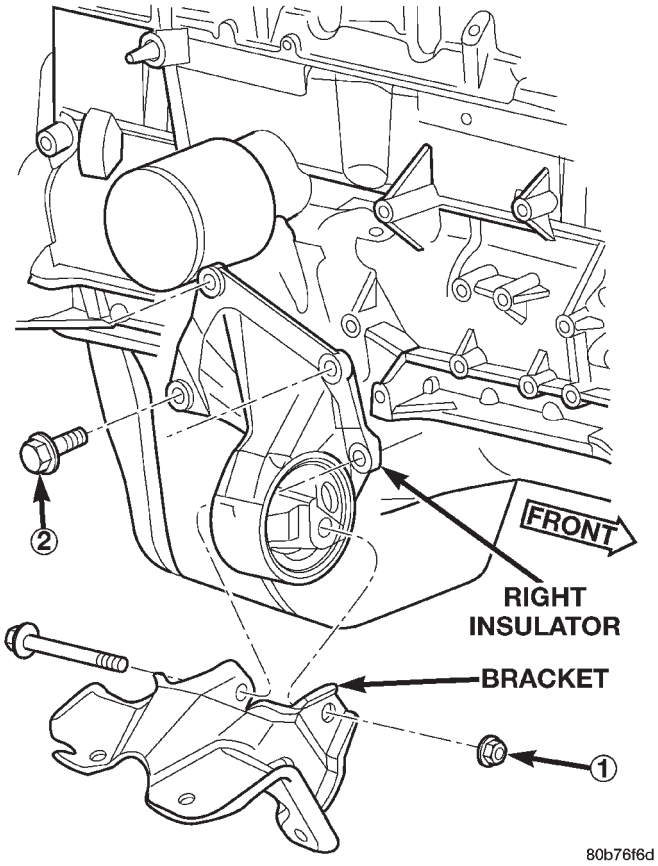


Fig. 23 Front Engine Mount—Right Side

INSTALLATION

(1) If removed, install the engine bracket to the block. Tighten the bolts to 61 N·m (45 ft. lbs.) torque.
(2) Install the insulator assembly to the lower front sill. Tighten the bolts to 61 N·m (45 ft. lbs.) torque.
(3) With the engine insulator assembly and engine bracket in position, install the through bolt and nut . Tighten the through bolt nut to 61 N·m (45 ft. lbs.) torque.
(4) Remove the engine support.
(5) Lower the vehicle.
(6) Connect the negative cable to the battery.

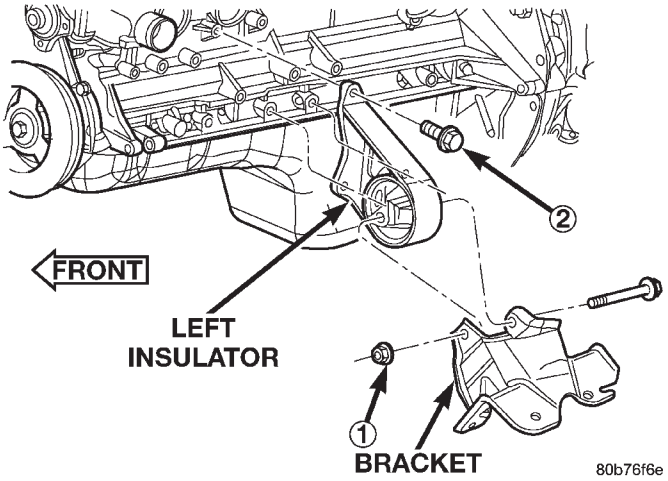


Fig. 24 Front Engine Mount—Left Side

ITEM	DESCRIPTION	TORQUE
1	NUT (Qty 1 Per side)	61 N·m (45 ft. lbs.)
2	Bolt (Qty 4 Per Side)	

ENGINE MOUNT—REAR

A resilient rubber cushion bracket assembly supports the transmission at the rear. This bracket is attached to the crossmember.

REMOVAL

(1) Disconnect the negative cable from the battery.
(2) Raise the vehicle and support the transmission.
(3) Remove the bolts holding the isolator mount assembly to the transmission (Fig. 25) (Fig. 26).
(4) Raise the transmission SLIGHTLY.
(5) Remove the through bolt and nut. Remove the rear isolator mount assembly.
(6) If necessary, remove the bolts holding the rear mount bracket to the crossmember.

INSTALLATION

(1) Position the rear mount bracket assembly onto the crossmember and install the bolts. Tighten the bolts to 46 N·m (34 ft. lbs.)
(2) Position isolator mount into mount bracket and install through bolt and nut. DO NOT tighten the bolt at this time.
(3) Lower the transmission.
(4) Remove the transmission support.

REMOVAL AND INSTALLATION (Continued)

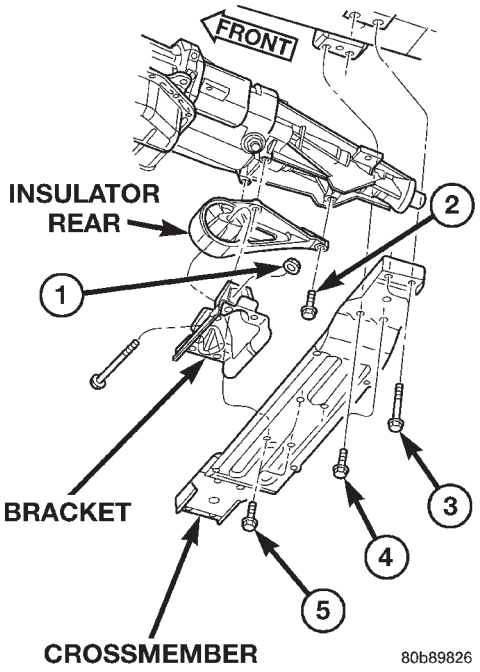


Fig. 25 Rear Engine Mount—(4X2)

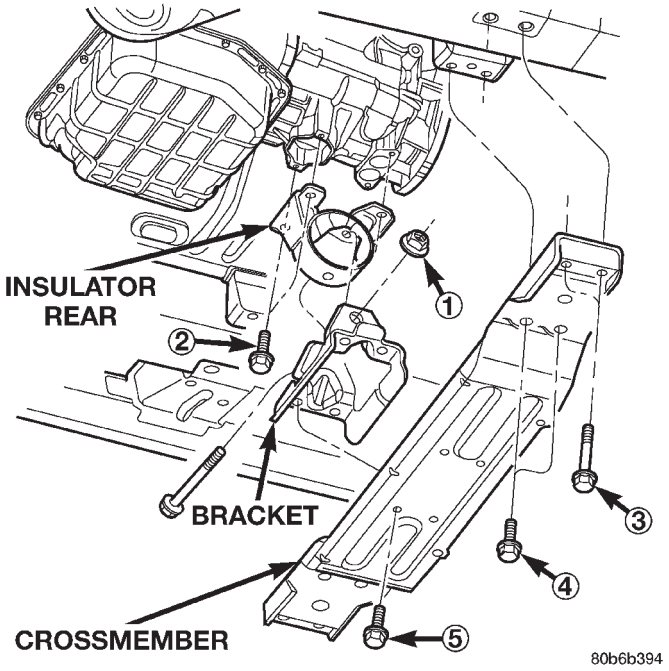


Fig. 26 Rear Engine Mount—(4X4)

(5) Install the mount fastening bolts and tighten to 54 N·m (40 ft. lbs.) torque.

(6) Tighten the through bolt nut to 50 N·m (37 ft. lbs.).

(7) Lower the vehicle.

(8) Connect the negative cable to the battery.

ITEM	DESCRIPTON	TORQUE
1	NUT (Qty 1)	45 N·m (33 ft. lbs.)
2	BOLT (Qty 4)	46 N·m (34 ft. lbs.)
3	BOLT (Qty 2 Per Side)	68 N·m (50 ft. lbs.)
4	BOLT (Qty 2 Per Side)	46 N·m (34 ft. lbs.)
5	BOLT (Qty 4)	46 N·m (34 ft. lbs.)

ENGINE BENDING BRACES

REMOVAL

The engine bending braces are used to add strength to the powertrain and to address some minor NVH concerns.

NOTE: Before the engine or the transmission can be removed the engine bending braces must be removed.

(1) Raise and support vehicle.

NOTE: Both left and right side bending braces are removed the sameway. Only the right side is shown.

NOTE: The exhaust does not require removal to preform this procedure.

(2) Remove the exhaust hanger bracket retaining bolt.

(3) Remove locknut and transmission bending brace bar.

(4) Remove engine-to-bending brace retaining bolt, bending brace bar and cross bar.

INSTALLATION

NOTE: DO NOT tighten the retaining hardware until all bending braces are in place.

(1) Position the cross brace into the engine-to-transmission brace, then position the engine-to-transmission brace and install retaining bolt.

(2) Position the transmission bending brace onto through brace and install new locknut.

(3) Position exhaust hanger and transmission brace, install retaining bolt (Fig. 28).

(4) Tighten engine-to-transmission brace retaining bolt (Fig. 27) to 40 N·m (30 ft. lbs.).

REMOVAL AND INSTALLATION (Continued)

(5) Tighten transmission brace retaining bolts (Fig. 28) to 40 N·m (30 ft. lbs.), then tighten transmission brace retaining lock nuts (Fig. 28) to 108 N·m (80 ft. lbs.).

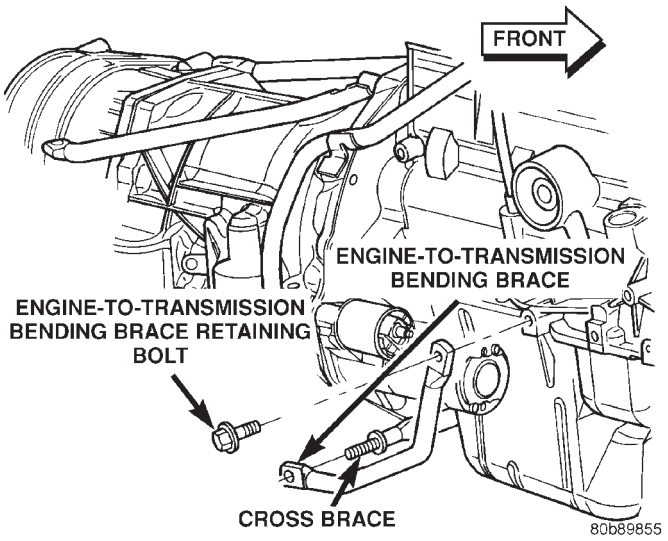


Fig. 27 Engine-to-Transmission Bending Braces

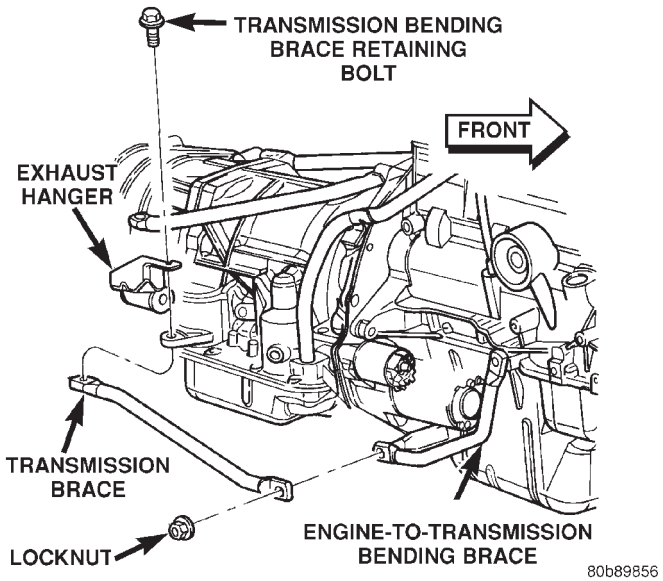


Fig. 28 Transmission Bending Braces and Exhaust Hanger

ENGINE ASSEMBLY

REMOVAL

(1) Disconnect the battery negative cable.

(2) Mark the hinge locations on the hood panel for alignment reference during installation. Remove the engine compartment lamp. Remove the hood.

(3) Remove the radiator drain cock and radiator cap to drain the coolant. DO NOT waste usable coolant. If the solution is clean, drain the coolant into a clean container for reuse.

(4) Remove the upper radiator hose and coolant recovery hose (Fig. 29).

(5) Remove the lower radiator hose.

(6) Remove upper radiator support retaining bolts and remove radiator support.

(7) Remove the fan assembly from the water pump.

(8) Remove the fan shroud (Fig. 29).

(9) Disconnect the transmission fluid cooler lines (automatic transmission).

(10) Discharge the A/C system. (Refer to Group 24, Heating and Air Conditioning)

(11) Remove the service valves and cap the compressor ports.

(12) Remove the radiator or radiator/condenser (if equipped with A/C).

(13) Disconnect the heater hoses at the engine thermostat housing and water pump (Fig. 29).

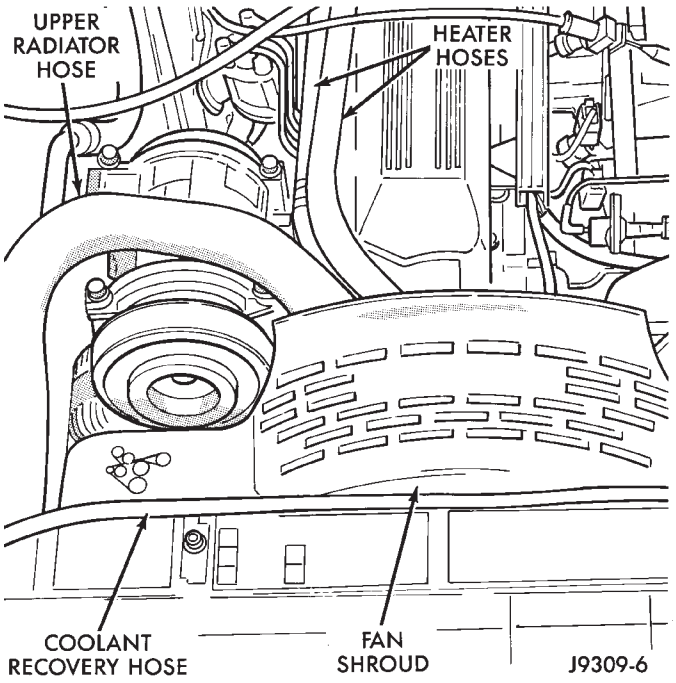


Fig. 29 Upper Radiator Hose, Coolant Recovery Hose, Fan Shroud & Heater hoses

(14) Disconnect the accelerator cable, transmission line pressure cable and speed control cable (if equipped) from the throttle body (Fig. 30).

(15) Remove cables from the bracket and secure out of the way.

(16) Disconnect the body ground at the engine.

(17) Disconnect the following connectors and secure their harness out of the way.

- Power steering pressure switch
- Coolant temperature sensor
- Six (6) fuel injector connectors

REMOVAL AND INSTALLATION (Continued)

- Intake air temperature sensor
- Throttle position sensor
- Map sensor
- Crankshaft position sensor
- Oxygen sensor
- Camshaft position sensor

(18) Disconnect the coil rail electrical connections and the oil pressure switch connector.

(19) Perform the fuel pressure release procedure. (Refer to Group 14, Fuel System for correct procedure)

(20) Disconnect the fuel supply line at the injector rail. (Refer to Group 14, Quick-Connect Fittings for the correct procedure)

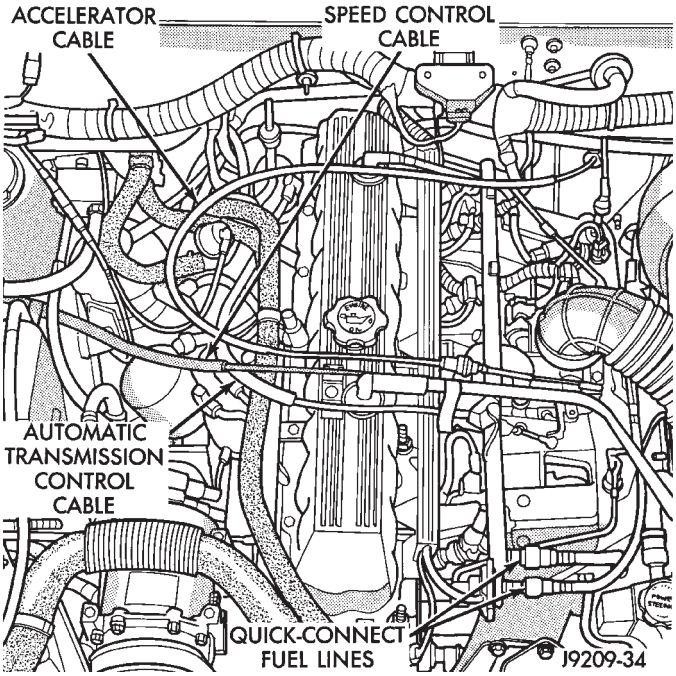


Fig. 30 Accelerator Cable, Vehicle Speed Control Cable, Automatic Transmission Control Cable & Quick-Connect Fuel Lines

(21) Remove the fuel line bracket from the intake manifold.

(22) Remove the air cleaner assembly (Fig. 31).

(23) Disconnect the hoses from the fittings at the steering gear.

(24) Drain the pump reservoir.

(25) Cap the fittings on the hoses and steering gear to prevent foreign objects from entering the system.

(26) Raise and support the vehicle.

(27) Disconnect the wires from the engine starter motor solenoid.

(28) Remove the engine starter motor.

(29) Disconnect the oxygen sensor from the exhaust pipe.

(30) Disconnect the exhaust pipe from the manifold.

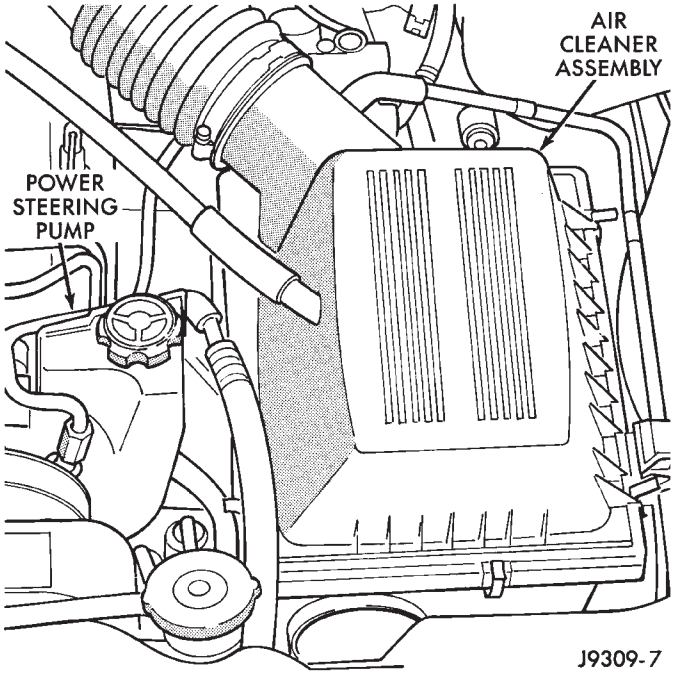


Fig. 31 Air Cleaner Assembly & Power Steering Pump

(31) Remove the exhaust pipe support.

(32) Remove the bending brace. Refer to Engine Bending Brace in this section for procedure.

(33) Remove the engine flywheel/converter housing access cover.

(34) Mark the converter and drive plate location.

(35) Remove the converter-to-drive plate bolts.

(36) Remove the upper engine flywheel/converter housing bolts and loosen the bottom bolts.

(37) Remove the engine mount cushion-to-engine compartment bracket bolts.

(38) Lower the vehicle.

(39) Attach a lifting device to the engine.

(40) Raise the engine off the front supports.

(41) Place a support or floor jack under the converter (or engine flywheel) housing.

(42) Remove the remaining converter (or engine flywheel) housing bolts.

(43) Lift the engine out of the engine compartment.

INSTALLATION

CAUTION: When installing the engine into a vehicle equipped with an automatic transmission, be careful not to damage the trigger wheel on the engine flywheel.

(1) Attach a lifting device to the engine and lower the engine into the engine compartment. For easier installation, it may be necessary to remove the

REMOVAL AND INSTALLATION (Continued)

engine mount bracket as an aid in alignment of the engine to the transmission.

(2) Align the transmission torque converter housing with the engine.

(3) Loosely install the converter housing lower bolts and install the next higher bolt and nut on each side.

(4) Tighten all 4 bolts finger tight.

(5) Install the engine mount brackets (if removed).

(6) Lower the engine and engine mount brackets onto the engine compartment cushions. Install the bolts and finger tighten the nuts.

(7) Remove the engine lifting device.

(8) Raise and support the vehicle.

(9) Install the remaining engine flywheel/converter housing bolts. Tighten all bolts to 38 N·m (28 ft. lbs.) torque.

(10) Install the converter-to-drive plate bolts.

(11) Ensure the installation reference marks are aligned.

(12) Install the engine flywheel/converter housing access cover.

(13) Install the exhaust pipe support and tighten the screw.

(14) Install the engine bending brace.

(15) Tighten the engine mount-to-bracket bolts.

(16) Connect the vehicle speed sensor wire connections and tighten the screws.

(17) Connect the exhaust pipe to the manifold.

(18) Install the engine starter motor and connect the cable.

(19) Connect the wires to the engine starter motor solenoid.

(20) Lower the vehicle.

(21) Connect all the vacuum hoses and wire connectors identified during engine removal.

(22) Remove protective caps from the power steering hoses.

(23) Connect the hoses to the fittings at the steering gear. Tighten the nut to 52 N·m (38 ft. lbs.) torque.

(24) Fill the pump reservoir with fluid.

(25) Inspect the fuel supply line o-ring(s) and replace if necessary. Connect fuel supply line to injectior rail and verify connection by pulling outward on the line.

(26) Install the fuel line bracket to the intake manifold.

(27) Connect the coil rail electrical connectors and oil pressure switch connector.

(28) Connect the following electrical connectors:

- Power steering pressure switch
- Coolant temperature sensor
- Six (6) fuel injector connectors
- Intake air temperature sensor
- Throttle position sensor
- Map sensor
- Crankshaft position sensor
- Oxygen sensor
- Camshaft position sensor

(29) Connect all previously removed vacuum hoses.

(30) Connect the body ground strap.

(31) Install the throttle, transmission line pressure, and speed control cables to their mounting bracket and connect them to the throttle body.

(32) Connect the heater hoses at the engine thermostat housing and water pump.

(33) Install the fan assembly to the water pump.

(34) Place the fan shroud in position over the fan.

(35) Install the radiator or radiator/condenser.

(36) Connect the service valves to the A/C compressor ports, if equipped with A/C.

(37) Charge the air conditioner system (refer to Group 24, Heating and Air Conditioning).

(38) Connect the radiator hoses and automatic transmission fluid cooler pipes, if equipped.

(39) Install the fan shroud to the radiator or radiator/condenser (if equipped with A/C).

(40) Install upper radiator support.

(41) Connect the upper radiator hose and tighten the clamp.

(42) Connect the lower radiator hose and tighten the clamp.

(43) Fill crankcase with engine oil. (Refer to Group 0, Lubrication and Maintenance for correct capacities.)

(44) Fill the cooling system with reusable coolant or new coolant (refer to Group 7, Cooling System).

(45) Align the hood to the scribe marks. Install the hood.

(46) Install the air cleaner assembly.

(47) Install the battery and connect the battery cable.

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

(48) Start the engine, inspect for leaks and correct the fluid levels, as necessary.

INTAKE AND EXHAUST MANIFOLD

REMOVAL

NOTE: THE ENGINE INTAKE AND EXHAUST MANIFOLD MUST BE REMOVED AND INSTALLED TOGETHER. THE MANIFOLDS USE A COMMON GASKET AT THE CYLINDER HEAD.

REMOVAL AND INSTALLATION (Continued)

(1) Disconnect the battery negative cable.
(2) Remove air cleaner inlet hose from throttle body assembly.
(3) Remove the air cleaner assembly.
(4) Remove the throttle cable, vehicle speed control cable (if equipped) and the transmission line pressure cable.
(5) Disconnect the following electrical connections and secure their harness out of the way:
- Throttle Position Sensor
- Idle Air Control Motor
- Coolant Temperature Sensor (at thermostat housing)
- Intake Air Temperature Sensor
- Oxygen Sensor
- Crank Position Sensor
- Six (6) Fuel Injector Connectors

(6) Disconnect the Map Sensor, HVAC, and Brake Booster vacuum supply hoses at the intake manifold.
(7) Perform the fuel pressure release procedure. (Refer to Group 14, Fuel Systems for correct procedure)
(8) Disconnect and remove the fuel system supply line from the fuel rail assembly. (Refer to Group 14, Quick Connect Fittings for correct procedures)
(9) Loosen the accessory drive belt (refer to Group 7, Cooling System). Loosen the tensioner.
(10) Remove the power steering pump and bracket from the intake manifold and set aside.
(11) Raise the vehicle.
(12) Disconnect the exhaust pipe from the engine exhaust manifold. Discard the seal.
(13) Lower the vehicle.
(14) Remove the intake manifold and engine exhaust manifold.

INSTALLATION

If the manifold is being replaced, ensure all the fitting, etc. are transferred to the replacement manifold.
(1) Install a new engine exhaust/intake manifold gasket over the alignment dowels on the cylinder head.
(2) Position the engine exhaust manifold to the cylinder head. Install fastener Number 3 and finger tighten at this time (Fig. 32).
(3) Install intake manifold on the cylinder head dowels.
(4) Install washer and fastener Numbers 1, 2, 4, 5, 8, 9, 10 and 11 (Fig. 32).
(5) Install washer and fastener Numbers 6 and 7 (Fig. 32).
(6) Tighten the fasteners in sequence and to the specified torque (Fig. 32).
- Fastener Numbers 1 through 5—Tighten to 33 N·m (24 ft. lbs.) torque.
- Fastener Numbers 6 and 7—Tighten to 31 N·m (23 ft. lbs.) torque.
- Fastener Numbers 8 through 11—Tighten to 33 N·m (24 ft. lbs.) torque.

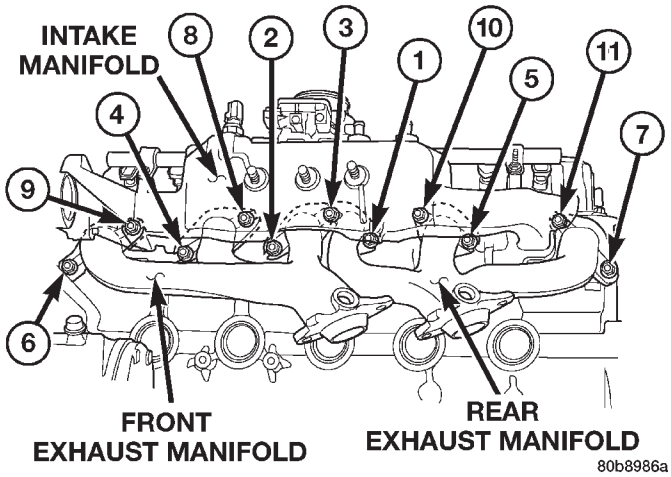


Fig. 32 Intake and Exhaust Manifolds—4.0L

(7) Install the power steering pump and bracket to the intake manifold. Tighten the belt to specification. (Refer to Group 7, Cooling System for the correct procedures)
(8) Install the fuel system supply line to the fuel rail assembly. **Before connecting the fuel supply line to the fuel rail inspect the O-rings and replace if necessary. Refer to Group 14, Fuel System for the correct procedure.**
(9) Connect all electrical connections on the intake manifold.
(10) Connect the vacuum hoses previously removed.
(11) Install throttle cable, vehicle speed control cable (if equipped).
(12) Install the transmission line pressure cable (if equipped). Refer to Group 21, Transmission for the adjustment procedures.
(13) Install air cleaner assembly.
(14) Connect air inlet hose to the throttle body assembly.
(15) Raise the vehicle.
(16) Using a new exhaust manifold seal, connect the exhaust pipe to the engine exhaust manifold. Tighten the bolts to 31 N·m (23 ft. lbs.)
(17) Lower the vehicle.
(18) Connect the battery negative cable.
(19) Start the engine and check for leaks.

CYLINDER HEAD COVER

The cylinder head cover is isolated from the cylinder head via grommets and a reusable molded rubber gasket. The grommet and limiter are retained in the cylinder head cover.

REMOVAL AND INSTALLATION (Continued)

There are two cylinder head bolts that have a pin to locate the cylinder head cover gasket, they are located at position 8 and 9 (Fig. 34)

REMOVAL

(1) Disconnect negative cable from battery.
(2) Disconnect the Crankcase Ventilation (CCV) vacuum hose from engine cylinder head cover.
(3) Disconnect the fresh air inlet hose from the engine cylinder head cover.
(4) Disconnect the accelerator, transmission, and speed (if equipped) control cables from the throttle body (Fig. 33).
(5) Remove the three bolts that fasten the control cable bracket to the intake manifold.
(6) Remove control cables from cylinder head cover clip.
(7) Position control cables and bracket away from cylinder head cover secure with tie straps.
(8) Remove the engine cylinder head cover mounting bolts.
(9) Remove the engine cylinder head cover and gasket.

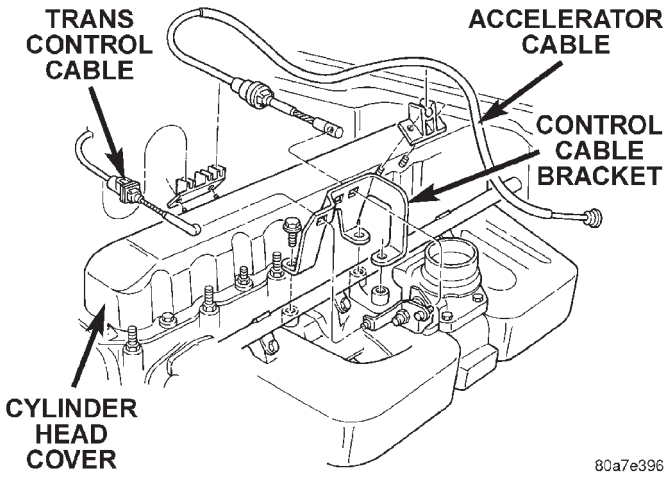


Fig. 33 Engine Cylinder Head Cover

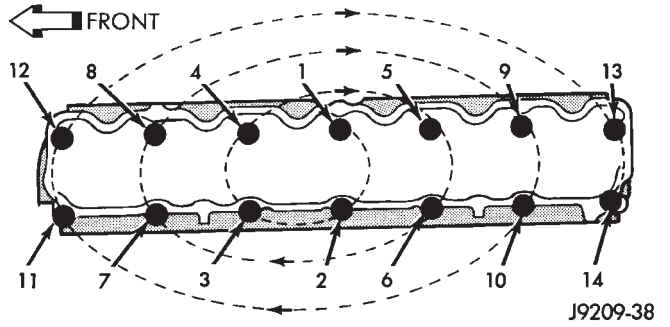


Fig. 34 Cylinder Head Cover Gasket Locator Pins at #8 & #9

INSTALLATION

(1) If a replacement cover is installed, transfer the CCV valve grommet and oil filler cap from the original cover to the replacement cover.
(2) Install cylinder head cover and gasket. Tighten the mounting bolts to 10 N·m (85 in. lbs.) torque.
(3) Connect the CCV hoses.
(4) Install control cables and bracket on intake manifold and tighten bolts to 8.7 N·m (77 in. lbs.) torque.
(5) Connect control cables to throttle body linkage.
(6) Snap control cables into cylinder head cover clip.
(7) Connect negative cable to battery.

ROCKER ARMS AND PUSH RODS

This procedure can be done with the engine in or out of the vehicle.

REMOVAL

(1) Remove the engine cylinder head cover.
(2) Check for rocker arm bridges which are causing misalignment of the rocker arm to valve tip area.
(3) Remove the capscrews at each bridge and pivot assembly (Fig. 35). Alternately loosen the capscrews one turn at a time to avoid damaging the bridges.
(4) Remove the bridges, pivots and corresponding pairs of rocker arms (Fig. 35). Place them on a bench in the same order as removed.
(5) Remove the push rods and place them on a bench in the same order as removed.

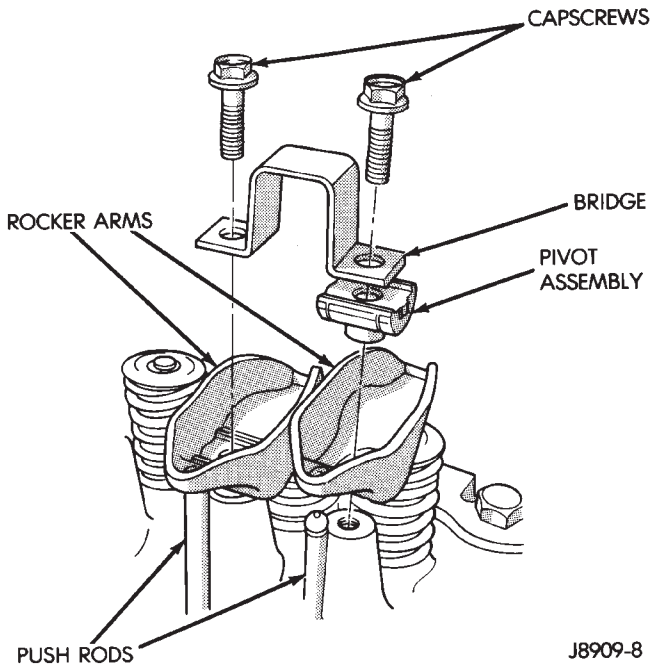


Fig. 35 Rocker Arm Assembly

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Lubricate the ball ends of the push rods with Mopar Engine Oil Supplement, or equivalent and install push rods in their original locations. Ensure that the bottom end of each push rod is centered in the tappet plunger cap seat.

(2) Using Mopar Engine Oil Supplement, or equivalent, lubricate the area of the rocker arm that the pivot contacts. Install rocker arms, pivots and bridge above each cylinder in their originally position.

(3) Loosely install the capscrews through each bridge.

(4) At each bridge, tighten the capscrews alternately, one turn at a time, to avoid damaging the bridge. Tighten the capscrews to 28 N·m (21 ft. lbs.) torque.

(5) Install the engine cylinder head cover.

VALVE STEM SEAL AND SPRING

This procedure can be done with the engine cylinder head installed on the block.

REMOVAL

Inspect the valve stems, especially the grooves for nicks, and high spots. If excessive nicks or high spots are found the valve or valves should be replaced.

Each valve spring is held in place by a retainer and a set of conical valve locks. The locks can be removed only by compressing the valve spring.

(1) Remove the engine cylinder head cover.

(2) Remove capscrews, bridge and pivot assemblies and rocker arms for access to each valve spring to be removed.

(3) Remove push rods. **Retain the push rods, bridges, pivots and rocker arms in the same order and position as removed.**

(4) Inspect the springs and retainer for cracks and possible signs of weakening.

(5) Remove the spark plug(s) adjacent to the cylinder(s) below the valve springs to be removed.

(6) Connect an air hose to the adapter and apply air pressure slowly. Maintain at least 621 kPa (90 psi) of air pressure in the cylinder to hold the valves against their seats. For vehicles equipped with an air conditioner, use a flexible air adaptor when servicing the No.1 cylinder.

(7) Tap the retainer or tip with a rawhide hammer to loosen the lock from the retainer. Use Valve Spring Compressor Tool MD-998772A to compress the spring and remove the locks (Fig. 36).

(8) Remove valve spring and retainer (Fig. 36).

(9) Remove valve stem oil seals (Fig. 36). Note the valve seals are different for intake and exhaust valves. The top of each seal is marked either INT (Intake) or EXH (Exhaust). DO NOT mix the seals.

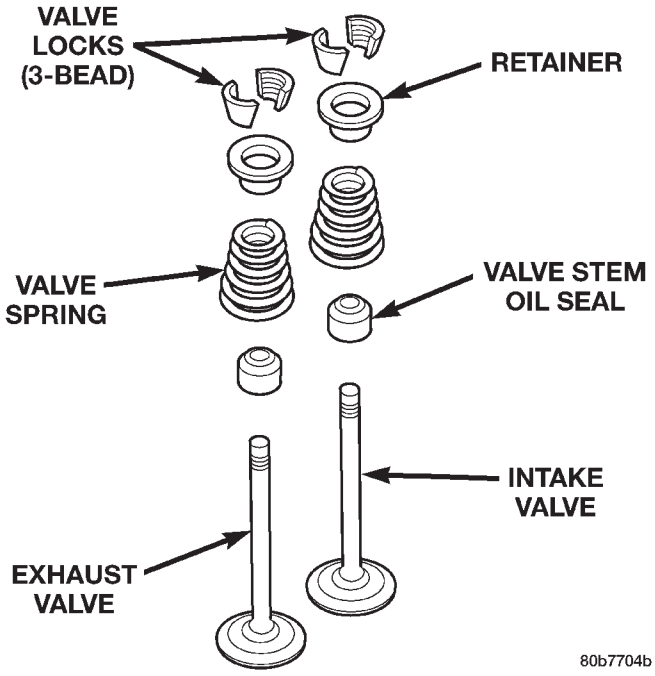


Fig. 36 Valve and Valve Components

INSTALLATION

CAUTION: Install oil seals carefully to prevent damage from the sharp edges of the valve spring lock grove.

(1) Lightly push the valve seal over the valve stem and valve guide boss. Be sure the seal is completely seated on the valve guide boss.

(2) Install valve spring and retainer.

(3) Compress the valve spring with Valve Spring Compressor Tool MD-998772A and insert the valve locks. Release the spring tension and remove the tool. Tap the spring from side-to-side to ensure that the spring is seated properly on the engine cylinder head.

(4) Release air pressure and disconnect the air hose. Remove the adaptor from the spark plug hole and install the spark plug.

(5) Repeat the procedures for each remaining valve spring to be removed.

(6) Install the push rods. Ensure the bottom end of each rod is centered in the plunger cap seat of the hydraulic valve tappet.

(7) Install the rocker arms, pivots and bridge at their original location.

(8) Tighten the bridge capscrews alternately, one at a time, to avoid damaging the bridge. Tighten the capscrews to 28 N·m (21 ft. lbs.) torque.

(9) Install the engine cylinder head cover.

REMOVAL AND INSTALLATION (Continued)

CYLINDER HEAD

This procedure can be done with the engine in or out of the vehicle.

REMOVAL

(1) Disconnect the battery negative cable.

WARNING: DO NOT REMOVE THE CYLINDER BLOCK DRAIN PLUGS OR LOOSEN THE RADIATOR DRAIN COCK WITH THE SYSTEM HOT AND PRESSURIZED BECAUSE SERIOUS BURNS FROM THE COOLANT CAN OCCUR.

(2) Drain the coolant and disconnect the hoses at the engine thermostat housing and the water pump inlet. DO NOT waste reusable coolant. If the solution is clean and is being drained only to service the engine or cooling system, drain the coolant into a clean container for reuse.

(3) Remove the air cleaner assembly.

(4) Remove the engine cylinder head cover.

(5) Remove the capscrews, bridge and pivot assemblies and rocker arms.

(6) Remove the push rods. **Retain the push rods, bridges, pivots and rocker arms in the same order as removed.**

(7) Loosen the accessory drive belt at the power steering pump. (Refer to Group 7, Cooling System for the correct procedure). Slip the belt off of the power steering pulley.

(8) Remove the air conditioning compressor mounting bolts and secure the compressor to the side.

(9) Remove the power steering pump and bracket from the intake manifold and water pump. Set the pump and bracket aside. DO NOT disconnect the hoses.

(10) Perform the Fuel System Pressure Release procedure. (Refer to Group 14, Fuel System)

(11) Disconnect the fuel supply line at the fuel rail. (Refer to Group 14, Quick-Connect Fittings for the correct procedures)

(12) Remove the intake and engine exhaust manifolds from the engine cylinder head. (Refer to Group 11, Exhaust System and Intake Manifold for the proper procedures)

(13) Disconnect the coil rail electrical connectors and remove the coil rail.

(14) Remove spark plugs.

(15) Disconnect the temperature sending unit wire connector.

(16) Remove the engine cylinder head bolts. Bolt No.14 cannot be removed until the head is moved forward (Fig. 37). Pull bolt No.14 out as far as it will go and then suspend the bolt in this position (tape around the bolt).

(17) Remove the engine cylinder head and gasket (Fig. 37).

(18) If this was the first time the bolts were removed, put a paint dab on the top of the bolt. If the bolts have a paint dab on the top of the bolt or it isn't known if they were used before, discard the bolts.

(19) Stuff clean lint free shop towels into the cylinder bores.

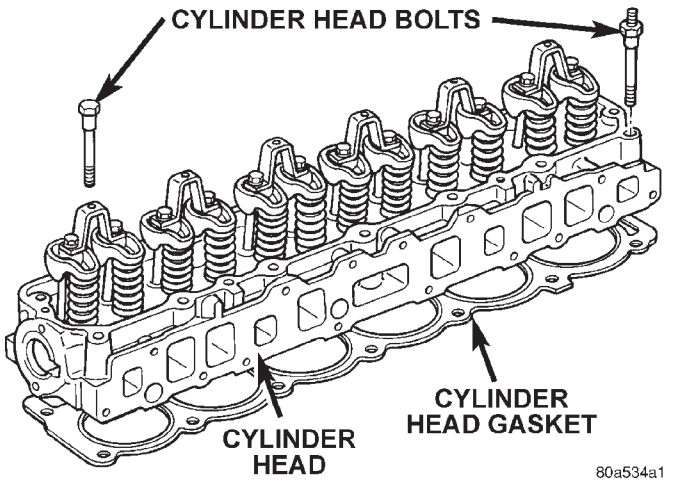


Fig. 37 Engine Cylinder Head Assembly

INSTALLATION

The engine cylinder head gasket is a composition gasket. The gasket is to be installed DRY. **DO NOT use a gasket sealing compound on the gasket.**

If the engine cylinder head is to be replaced and the original valves used, measure the valve stem diameter. Only standard size valves can be used with a service replacement engine cylinder head unless the replacement head valve stem guide bores are reamed to accommodate oversize valve stems. Remove all carbon buildup and reface the valves.

(1) Remove the shop towels from the cylinder bores. Coat the bores with clean engine oil.

(2) Position the engine cylinder head gasket (with the numbers facing up) using the alignment dowels in the cylinder block, to position the gasket.

CAUTION: Engine cylinder head bolts should be reused only once. Replace the head bolts if they were used before or if they have a paint dab on the top of the bolt.

(3) With bolt No.14 held in place (tape around bolt), install the engine cylinder head over the same dowels used to locate the gasket. Remove the tape from bolt No.14.

(4) Coat the threads of stud bolt No.11 with Loctite 592 sealant, or equivalent.

REMOVAL AND INSTALLATION (Continued)

(5) Tighten the engine cylinder head bolts in sequence according to the following procedure (Fig. 38).

CAUTION: During the final tightening sequence, bolt No.11 will be tightened to a lower torque than the rest of the bolts. DO NOT overtighten bolt No.11.

(a) Tighten all bolts in sequence (1 through 14) to 30 N·m (22 ft. lbs.) torque.

(b) Tighten all bolts in sequence (1 through 14) to 61 N·m (45 ft. lbs.) torque.

(c) Check all bolts to verify they are set to 61 N·m (45 ft. lbs.) torque.

(d) Tighten bolts in sequence:

- Bolts 1 through 10 to 149 N·m (110 ft. lbs.) torque.
- Bolt 11 to 13 N·m (100 ft. lbs.) torque.
- Bolts 12 through 14 to 149 N·m (110 ft. lbs.) torque.

CYLINDER HEAD BOLTS

POSITION	DESCRIPTION
1,4,5,12,13	1/2 in.-13 BOLT
8,9	1/2 in.-13 BOLT WITH DOWEL POINT
2,3,6,7,10,11,14	1/2 in.-13 WITH 7/16 in.-14 STUD END
All bolts are 12 point drives for rocker cover clearance	

(e) Check all bolts in sequence to verify the correct torque.

(f) If not already done, clean and mark each bolt with a dab of paint after tightening. Should you encounter bolts which were painted in an earlier service operation, replace them.

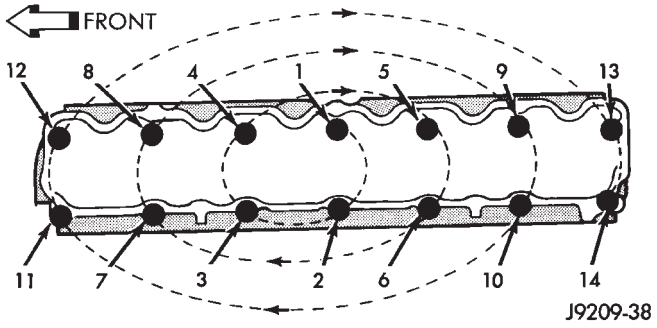


Fig. 38 Engine Cylinder Head Bolt Tightening Sequence

(6) Install the spark plugs and tighten to 37 N·m (27 ft. lbs.) torque.

(7) Connect the temperature sending unit wire connector.

(8) Install the ignition coil rail and coil rail electrical connectors.

(9) Install the intake and engine exhaust manifolds (refer to Group 11, Exhaust System and Intake Manifold for the proper procedures).

(10) Install the fuel lines and the vacuum advance hose.

(11) If equipped, attach the power steering pump and bracket.

(12) Install the push rods, rocker arms, pivots and bridges in the order they were removed (refer to Rocker Arms and Push Rods in this section).

(13) Install the engine cylinder head cover.

(14) Attach the air conditioner compressor mounting bracket to the engine cylinder head and block. Tighten the bolts to 40 N·m (30 ft. lbs.) torque.

(15) Attach the air conditioning compressor to the bracket. Tighten the bolts to 27 N·m (20 ft. lbs.) torque.

CAUTION: The serpentine drive belt must be routed correctly. Incorrect routing can cause the water pump to turn in the opposite direction causing the engine to overheat.

(16) Install the serpentine drive belt and correctly tension the belt (refer to Group 7, Cooling System for the proper procedure).

(17) Install the air cleaner and ducting.

(18) Install the engine cylinder head cover.

(19) Connect the hoses to the engine thermostat housing and fill the cooling system to the specified level (refer to Group 7, Cooling Systems for the proper procedure).

(20) The automatic transmission throttle linkage and cable must be adjusted after completing the engine cylinder head installation (refer to Group 21, Transmissions for the proper procedures).

(21) Install the temperature sending unit and connect the wire connector.

(22) Connect the fuel line.

(23) If equipped with air conditioning, install air compressor and charge A/C system (refer to Group 24 Heating and Air Conditioning).

(24) Connect negative cable to battery.

(25) Connect the upper radiator hose and heater hose at the engine thermostat housing.

(26) Fill the cooling system. Check for leaks.

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

REMOVAL AND INSTALLATION (Continued)

(27) Operate the engine with the radiator cap off. Inspect for leaks and continue operating the engine until the engine thermostat opens. Add coolant, if required.

VALVES AND VALVE SPRINGS

This procedure is done with the engine cylinder head removed from the block.

REMOVAL

(1) Remove the engine cylinder head from the cylinder block.

(2) Use Valve Spring Compressor Tool MD-998772A and compress each valve spring.

(3) Remove the valve locks, retainers, springs and valve stem oil seals. Discard the oil seals.

(4) Use a smooth stone or a jewelers file to remove any burrs on the top of the valve stem, especially around the groove for the locks.

(5) Remove the valves, and place them in a rack in the same order as removed.

INSTALLATION

(1) Thoroughly clean the valve stems and the valve guide bores.

(2) Lightly lubricate the stem.

(3) Install the valve in the original valve guide bore.

(4) Install the replacement valve stem oil seals on the valve stems. If the 0.381 mm (0.015 inch) oversize valve stems are used, oversize oil seals are required.

(5) Position the valve spring and retainer on the engine cylinder head and compress the valve spring with Valve Spring Compressor Tool MD-998772A.

(6) Install the valve locks and release the tool.

(7) Tap the valve spring from side to side with a hammer to ensure that the spring is properly seated at the engine cylinder head. Also tap the top of the retainer to seat the valve locks.

(8) Install the engine cylinder head.

HYDRAULIC TAPPETS

Retain all the components in the same order as removed.

REMOVAL

(1) Remove the engine cylinder head (Refer to cylinder head r&i in this section).

(2) Remove the push rods.

(3) Remove the tappets through the push rod openings in the cylinder block with a Hydraulic Valve Tappet Removal/Installation Tool (Fig. 39).

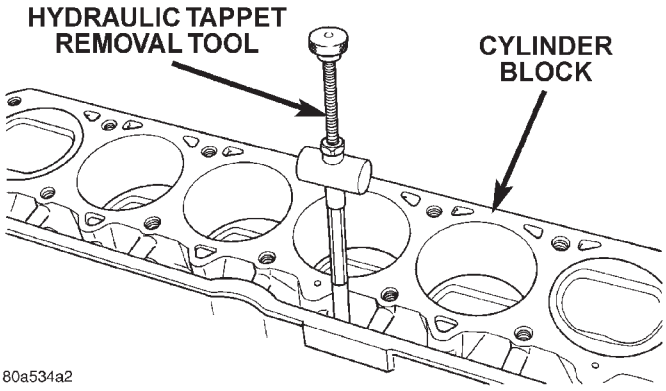


Fig. 39 Hydraulic Valve Tappet Removal—Installation Tool

INSTALLATION

It is not necessary to charge the tappets with engine oil. They will charge themselves within a very short period of engine operation.

(1) Dip each tappet in Mopar Engine Oil Supplement, or equivalent.

(2) Use Hydraulic Valve Tappet Removal/Installation Tool to install each tappet in the same bore from where it was originally removed.

(3) Install the cylinder head assy (Refer to cylinder head r&i in this section).

(4) Install the push rods in their original locations.

(5) Install the rocker arms and bridge and pivot assemblies at their original locations. Loosely install the capscrews at each bridge.

(6) Tighten the capscrews alternately, one turn at a time, to avoid damaging the bridges. Tighten the capscrews to 28 N·m (21 ft. lbs.) torque.

(7) Pour the remaining Mopar Engine Oil Supplement, or equivalent over the entire valve actuating assembly. The Mopar Engine Oil Supplement, or equivalent must remain with the engine oil for at least 1 609 km (1,000 miles). The oil supplement need not be drained until the next scheduled oil change.

(8) Install the engine cylinder head cover.

VIBRATION DAMPER

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove the serpentine drive belt and fan shroud.

(3) Remove the vibration damper retaining bolt and washer.

(4) Use Vibration Damper Removal Tool 7697 to remove the damper from the crankshaft (Fig. 40).

REMOVAL AND INSTALLATION (Continued)

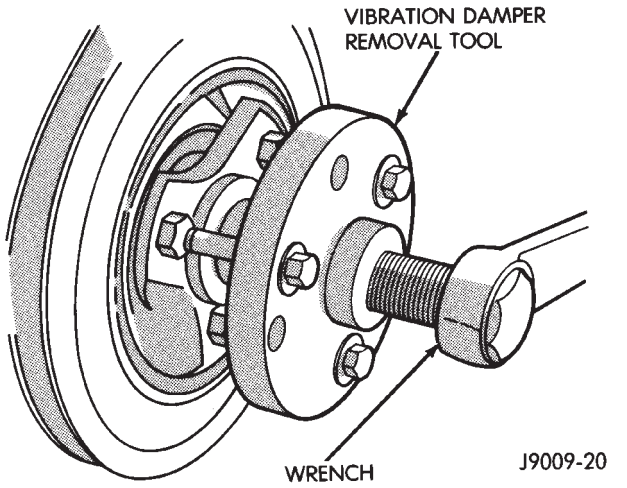


Fig. 40 Vibration Damper Removal Tool 7697

INSTALLATION

(1) Apply Mopar Silicone Rubber Adhesive Sealant to the keyway in the crankshaft and insert the key. With the key in position, align the keyway on the vibration damper hub with the crankshaft key and tap the damper onto the crankshaft.

(2) Install the vibration damper retaining bolt and washer.

(3) Tighten the damper retaining bolt to 108 N·m (80 ft. lbs.) torque.

(4) Install the serpentine drive belt and tighten to the specified tension (refer to Group 7, Cooling Systems for the proper specifications and procedures).

(5) Connect negative cable to battery.

TIMING CASE COVER

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove the vibration damper.

(3) Remove the fan and hub assembly and remove the fan shroud.

(4) Remove the accessory drive brackets that are attached to the timing case cover.

(5) Remove the A/C compressor (if equipped) and generator bracket assembly from the engine cylinder head and move to one side.

(6) Remove the oil pan-to-timing case cover bolts and timing case cover-to-cylinder block bolts.

(7) Remove the timing case cover and gasket from the engine.

(8) Pry the crankshaft oil seal from the front of the timing case cover (Fig. 41).

INSTALLATION

Clean the timing case cover, oil pan and cylinder block gasket surfaces.

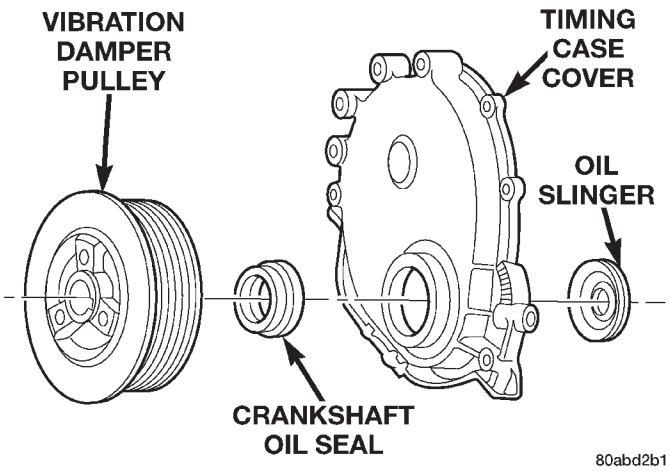


Fig. 41 Timing Case Cover Components

(1) Install a new crankshaft oil seal in the timing case cover. The open end of the seal should be toward the inside of the cover. Support the cover at the seal area while installing the seal. Force it into position with Seal Installation Tool 6139.

(2) Position the gasket on the cylinder block.

(3) Position the timing case cover on the oil pan gasket and the cylinder block.

(4) Insert Timing Case Cover Alignment and Seal Installation Tool 6139 in the crankshaft opening in the cover (Fig. 42).

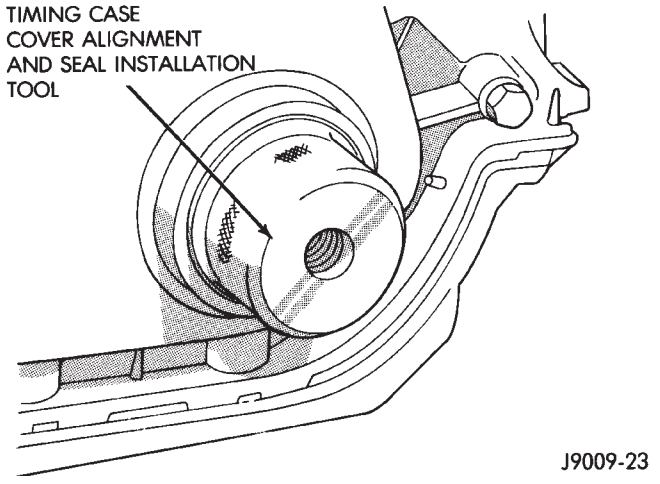


Fig. 42 Timing Case Cover Alignment and Seal Installation Tool 6139

(5) Install the timing case cover-to-cylinder block and the oil pan-to-timing case cover bolts.

(6) Tighten the 1/4 inch cover-to-block bolts to 7 N·m (60 in. lbs.) torque. Tighten the 5/16 inch front cover-to-block bolts to 22 N·m (192 in. lbs.) torque. Tighten the oil pan-to-cover 1/4 inch bolts to 9.5 N·m (84 in. lbs.) torque.

(7) Remove the cover alignment tool.

REMOVAL AND INSTALLATION (Continued)

(8) Apply a light film of engine oil on the vibration damper hub contact surface of the seal.

(9) Apply Mopar Silicone Rubber Adhesive Sealant to the keyway in the crankshaft and insert the key. With the key inserted in the keyway in the crankshaft, install the vibration damper, washer and bolt. Lubricate and tighten the bolt to 108 N·m (80 ft. lbs.) torque.

(10) Install the A/C compressor (if equipped) and generator bracket assembly.

(11) Install the engine fan and hub assembly and shroud.

(12) Install the serpentine drive belt and tighten to obtain the specified tension.

(13) Connect negative cable to battery.

TIMING CHAIN AND SPROCKETS

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove the fan and shroud.

(3) Remove the serpentine drive belt.

(4) Remove the crankshaft vibration damper.

(5) Remove the timing case cover.

(6) Rotate crankshaft until the "0" timing mark is closest to and on the center line with camshaft sprocket timing mark (Fig. 43).

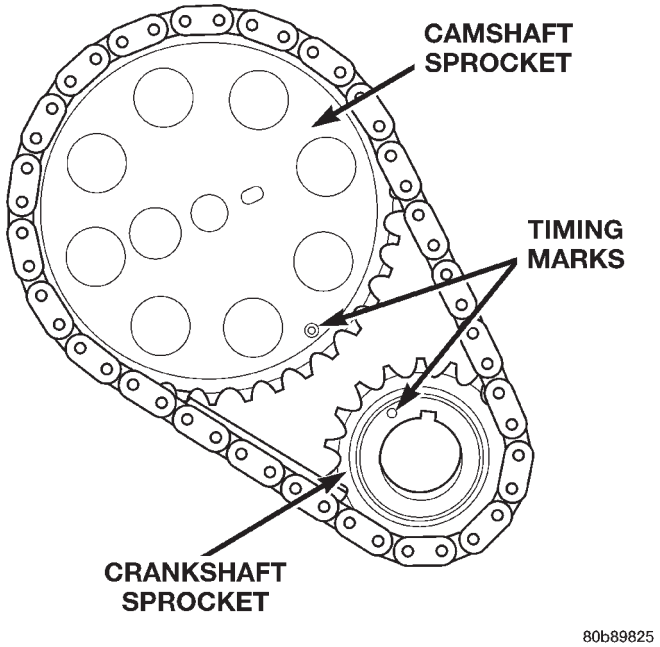


Fig. 43 Crankshaft—Camshaft Alignment

(7) Remove the oil slinger from the crankshaft.

(8) Remove the camshaft sprocket bolt and washer (Fig. 44).

(9) Remove the crankshaft sprocket, camshaft sprocket and timing chain as an assembly.

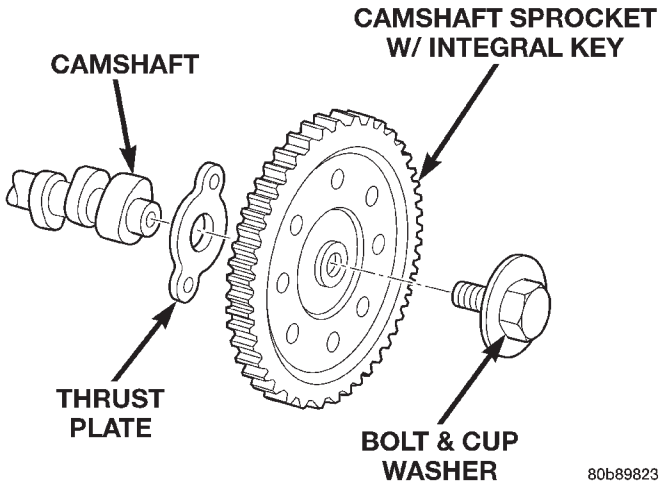


Fig. 44 Camshaft Sprocket and Thrust Plate

(10) Installation of the timing chain with the timing marks on the crankshaft and camshaft sprockets properly aligned ensures correct valve timing. A worn or stretched timing chain will adversely affect valve timing. If the timing chain deflects more than 12.7 mm (1/2 inch) replace it.

INSTALLATION

Assemble the timing chain, crankshaft sprocket and camshaft sprocket with the timing marks aligned (Fig. 43).

(1) Apply Mopar Silicone Rubber Adhesive Sealant to the keyway in the crankshaft and insert the key. With the key in the keyway on the crankshaft, install the assembly on the crankshaft and camshaft.

(2) Install the camshaft sprocket bolt and washer (Fig. 44). Tighten the bolt to 68 N·m (50 ft. lbs.) torque.

(3) To verify correct installation of the timing chain, rotate the crankshaft 2 revolutions. The camshaft and crankshaft sprocket timing mark should align (Fig. 43).

(4) Install the crankshaft oil slinger.

(5) Replace the oil seal in the timing case cover.

(6) Install the timing case cover and gasket.

(7) With the key installed in the crankshaft keyway, install the vibration damper, washer and bolt. Lubricate and tighten the bolt to 108 N·m (80 ft. lbs.) torque.

(8) Install the serpentine drive belt and tighten to the specified tension (refer to Group 7, Cooling System for the proper procedure).

(9) Install the fan and hub assembly. Install the shroud.

(10) Connect negative cable to battery.

REMOVAL AND INSTALLATION (Continued)

CAMSHAFT

REMOVAL

WARNING: THE COOLANT IN A RECENTLY OPERATED ENGINE IS HOT AND PRESSURIZED. RELEASE THE PRESSURE BEFORE REMOVING THE DRAIN COCK, CAP AND DRAIN PLUGS.

(1) Disconnect negative cable from battery.
(2) Drain the cooling system. DO NOT waste reusable coolant. If the solution is clean, drain it into a clean container for reuse.
(3) Remove the radiator or radiator and condenser, if equipped with A/C (refer to Group 7, Cooling System for the proper procedure).
(4) Remove the distributor cap and mark the position of the rotor.
(5) Remove the front fascia and/or grille, as required.
(6) Disconnect camshaft position sensor electrical connector and remove camshaft position sensor.
(7) Remove the engine cylinder head cover.
(8) Remove the rocker arms, bridges and pivots.
(9) Remove the push rods.
(10) Remove the engine cylinder head and gasket.
(11) Remove the hydraulic valve tappets from the engine cylinder block.
(12) Remove the vibration damper.
(13) Remove the timing case cover.
(14) Remove the timing chain and sprockets.
(15) Remove the two thrust plate retaining screws and thrust plate.
(16) Remove the camshaft (Fig. 45).

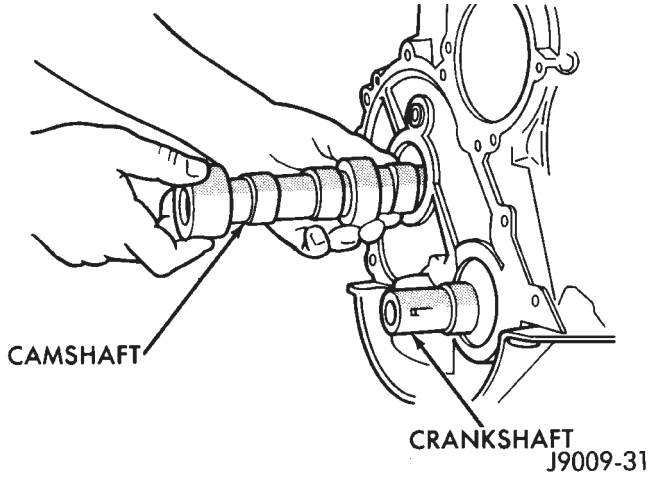


Fig. 45 Camshaft

INSTALLATION

(1) Inspect the cam lobes for wear.
(2) Inspect the bearing journals for uneven wear pattern or finish.
(3) Inspect the bearings for wear.
(4) Inspect the distributor drive gear for wear.
(5) If the camshaft thrust surface appears to have excessive wear, examine the oil pressure relief holes in the rear cam journal. The oil pressure relief holes must be free of debris.
(6) Lubricate the camshaft with Mopar Engine Oil Supplement, or equivalent.
(7) Carefully install the camshaft to prevent damage to the camshaft bearings (Fig. 45).
(8) Inspect thrust plate surfaces for excessive wear, position thrust plate and install retaining screws. Tighten screws to 24 N·m (18 ft. lbs.).
(9) Install the timing chain, crankshaft sprocket and camshaft sprocket with the timing marks aligned.
(10) Install the camshaft sprocket bolt / cup washer. Tighten the bolt to 68 N·m (50 ft. lbs.).
(11) Install the timing case cover with a replacement oil seal (Fig. 46). Refer to Timing Case Cover Installation.
(12) Install the vibration damper (Fig. 46).

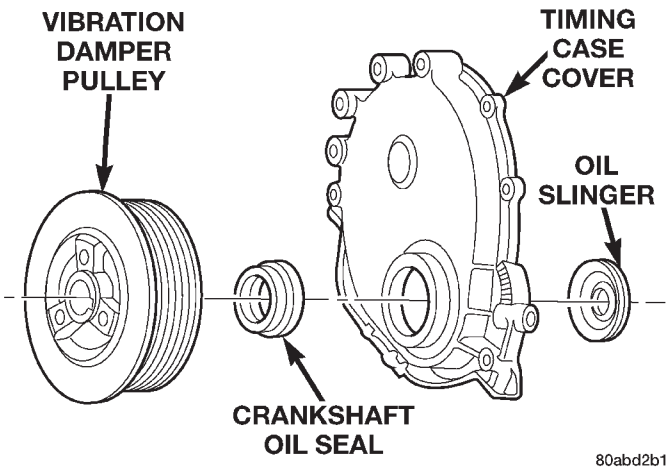


Fig. 46 Timing Case Cover Components

(13) Install the hydraulic valve tappets.
(14) Install the cylinder head gasket with the numbers facing up.
(15) Install the cylinder head and head bolts (Refer to cylinder head R&I in this section for torque values and tightening sequence).
(16) Install the push rods.
(17) Install the rocker arms and pivot and bridge assemblies. Tighten each of the capscrews for each bridge alternately, one turn at a time, to avoid damaging the bridge (Refer to Rocker Arms and Push Rods in this section).
(18) Install the engine cylinder head cover.
(19) Position the oil pump gear. Refer to Camshaft position sensor in the Component Removal/Installation section of Group 14, Fuel Systems.
(20) Install the Camshaft position sensor and ignition coil rail. Refer to Camshaft position sensor in

REMOVAL AND INSTALLATION (Continued)

the Component Removal/Installation section of Group 14, Fuel Systems.

(21) Install the serpentine drive belt and tighten to the specified tension (refer to Group 7, Cooling System for the proper procedure).

NOTE: During installation, lubricate the hydraulic valve tappets and all valve components with Mopar Engine Oil Supplement, or equivalent. The Mopar Engine Oil Supplement, or equivalent must remain with the engine oil for at least 1609 km (1,000 miles). The oil supplement need not be drained until the next scheduled oil change.

(22) Install the A/C condenser and receiver/drier assembly, if equipped (refer to Group 24, Heating and Air Conditioning).

CAUTION: Both service valves must be opened before the air conditioning system is operated.

(23) Install the radiator, connect the hoses and fill the cooling system to the specified level (refer to Group 7, Cooling System for the proper procedure).

(24) Install the grille and fascia, if removed.

(25) Connect negative cable to battery.

CAMSHAFT BEARINGS

REMOVAL

The camshaft rotates within four steel-shelled, babbitt-lined bearings that are pressed into the cylinder block and then line reamed. The camshaft bearing bores and bearing diameters are not the same size. They are stepped down in 0.254 mm (0.010 inch) increments from the front bearing (largest) to the rear bearing (smallest). This permits easier removal and installation of the camshaft. The camshaft bearings are pressure lubricated. Camshaft end play is maintained by the thrust plate.

(1) Remove the camshaft. Refer to Camshaft in this section for procedure.

NOTE: It is not advisable to attempt to replace camshaft bearings unless special removal and installation tools are available.

(2) Using Special tool, remove the camshaft bearings.

INSTALLATION

(1) Inspect the camshaft bearing journals for uneven wear pattern or finish.

(2) Inspect the camshaft lobes and distributor gear for wear.

(3) Inspect the camshaft thrust plate for wear. If the plate shows excessive wear inspect the camshaft oil pressure relief holes in the rear cam jounral. The relief holes must be clean and free of debris.

CAUTION: Make sure outside diameter of number 1 bearing is clean. Make sure that the bearing is properly installed in the engine block, align the oil hole in the bearing with the oil gallery in the bearing bore. Failure to do so will cause inadequate oil supply for the sprockets and timing chain.

(4) Using special tool, install new camshaft bearings.

(5) Lubricate the camshaft with Mopar® engine oil supplement, or equivalent.

(6) Carefully install the camshaft to prevent damage to the camshaft bearings

(7) Position the thrust plate and install the two retaining screws. Tighten screws to 24 N·m (18 ft. lbs.).

(8) Install the camshaft sprocket, crankshaft sprocket and timing chain with the timing marks aligned. Install the sprocket bolt.

(9) Tighten the camshaft sprocket bolt and washer to 68 N·m (50 ft. lbs.).

(10) To verify correct installation of the timing chain, turn the crankshaft two full revolutions then position the camshaft sprocket timing mark as shown in (Fig. 47). Count the number of chain pins between the timing marks of both sprockets. There must be 21 pins.

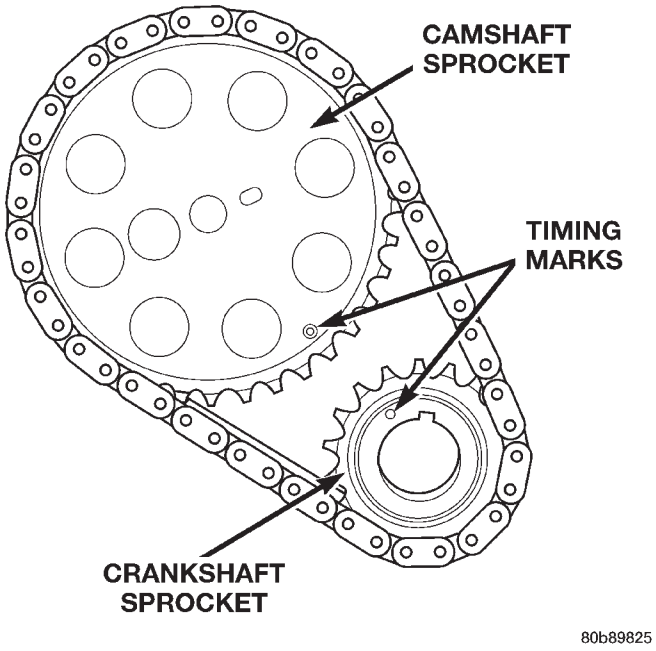


Fig. 47 Verify Crankshaft—Camshaft Installation—Typical

(11) Install the timing chain cover refer to the procedure in this section.

REMOVAL AND INSTALLATION (Continued)

CRANKSHAFT MAIN BEARINGS

REMOVAL

(1) Disconnect negative cable from battery.
(2) Remove the spark plugs.
(3) Raise the vehicle.
(4) Remove the oil pan and oil pump.
(5) Remove main bearing cap brace (Fig. 48).

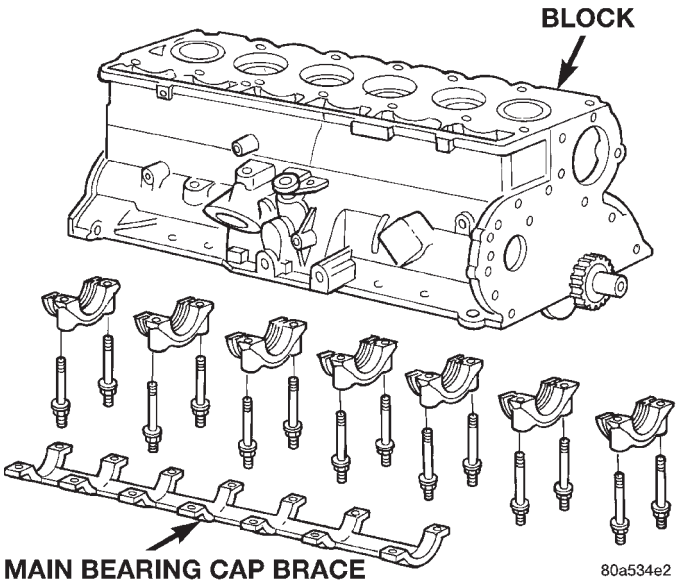


Fig. 48 Main Bearing Caps and Brace.

(6) Remove only one main bearing cap and lower insert at a time (Fig. 49).

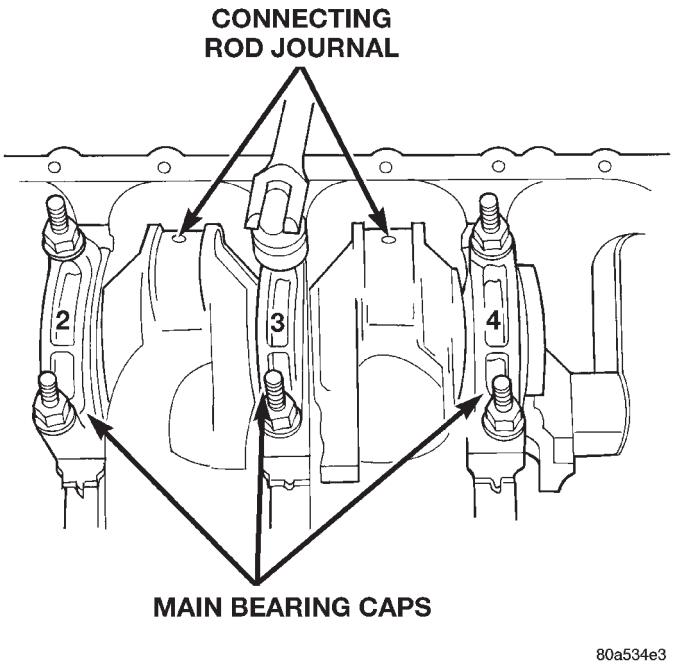


Fig. 49 Removing Main Bearing Caps and Lower Inserts

(7) Remove the lower insert from the bearing cap.
(8) Remove the upper insert by LOOSENING (DO NOT REMOVE) all of the other bearing caps. Now insert a small cotter pin tool in the crankshaft journal oil hole. Bend the cotter pin as illustrated to fabricate the tool (Fig. 50). With the cotter pin tool in place, rotate the crankshaft so that the upper bearing insert will rotate in the direction of its locking tab. Because there is no hole in the No.3 main journal, use a tongue depressor or similar soft-faced tool to remove the bearing insert (Fig. 50). After moving the insert approximately 25 mm (1 inch), it can be removed by applying pressure under the tab.
(9) Using the same procedure described above, remove the remaining bearing inserts one at a time for inspection.

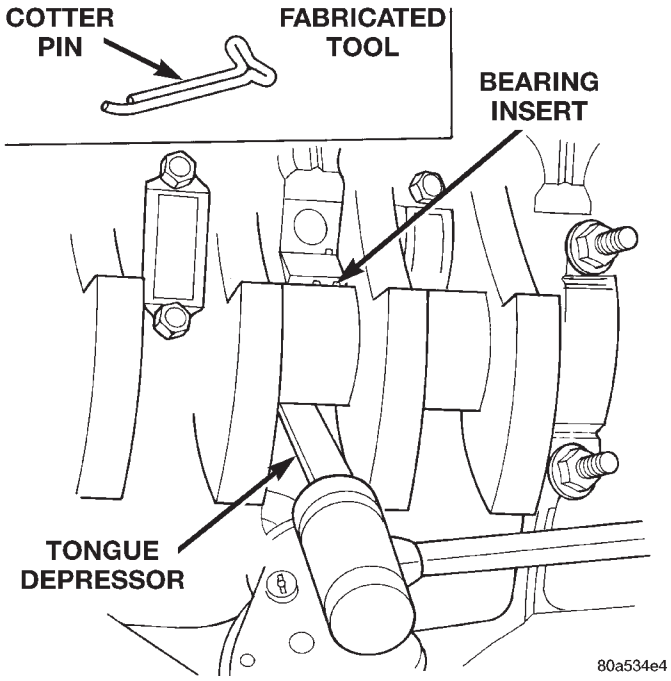


Fig. 50 Removing Upper Inserts

INSTALLATION

(1) Lubricate the bearing surface of each insert with engine oil.
(2) Loosen all the main bearing caps. Install the main bearing upper inserts.
(3) Install the lower bearing inserts into the main bearing caps.
(4) Install the main bearing cap(s) and lower insert(s).
(5) Tighten the bolts of caps 1, 2, 4, 5, 6, and 7 to 54 N·m (40 ft. lbs.) torque. Now tighten these bolts to 95 N·m (70 ft. lbs.) torque. Finally, tighten these bolts to 108 N·m (80 ft. lbs.) torque.
(6) Push the crankshaft forward and backward. Load the crankshaft front or rear and tighten cap bolt No.3 to 54 N·m (40 ft. lbs.) torque. Then tighten

REMOVAL AND INSTALLATION (Continued)

to 95 N·m (70 ft. lbs.) torque and finally tighten to 108 N·m (80 ft. lbs.) torque.

(7) Rotate the crankshaft after tightening each main bearing cap to ensure the crankshaft rotates freely.

(8) Check crankshaft end play. Crankshaft end play is controlled by the thrust bearing which is flange and installed at the No.2 main bearing position.

(a) Attach a magnetic base dial indicator to the cylinder block at either the front or rear of the engine.

(b) Position the dial indicator rod so that it is parallel to the center line of the crankshaft.

(c) Pry the crankshaft forward, position the dial indicator to zero.

(d) Pry the crankshaft forward and backward. Note the dial indicator readings. End play is the difference between the high and low measurements (Fig. 51). Correct end play is 0.038-0.165 mm (0.0015-0.0065 inch). The desired specifications are 0.051-0.064 mm (0.002-0.0025 inch).

(e) If end play is not within specification, inspect crankshaft thrust faces for wear. If no wear is apparent, replace the thrust bearing and measure end play. If end play is still not within specification, replace the crankshaft.

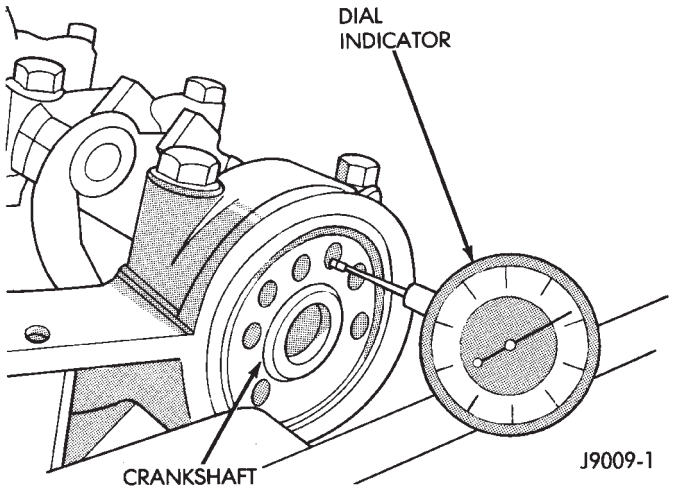


Fig. 51 Crankshaft End Play Measurement

(9) If the crankshaft was removed, install the crankshaft into the cylinder block (refer to Cylinder Block - Assemble).

(10) Install main bearing cap brace tighten nuts to 47 N·m (35 ft. lbs.) torque.

(11) Install oil pump assy. and tighten attaching bolts to 23 N·m (17 ft. lbs.)

(12) Install the oil pan.

(13) Install the drain plug. Tighten the plug to 34 N·m (25 ft. lbs.) torque.

(14) Lower the vehicle.

(15) Install the spark plugs. Tighten the plugs to 37 N·m (27 ft. lbs.) torque.

(16) Fill the oil pan with engine oil to the full mark on the dipstick level.

(17) Connect negative cable to battery.

OIL PAN

REMOVAL

(1) Disconnect negative cable from battery.

(2) Raise the vehicle.

(3) Remove the oil pan drain plug and drain the engine oil.

(4) Disconnect the exhaust pipe at the exhaust manifold.

(5) Disconnect the exhaust hanger at the catalytic converter and lower the pipe.

(6) Remove the starter motor.

(7) Remove the engine flywheel and transmission torque converter housing access cover.

(8) If equipped with an oil level sensor, disconnect the sensor.

(9) Position a jack stand directly under the engine vibration damper.

(10) Place a piece of wood (2 x 2) between the jack stand and the engine vibration damper.

(11) Remove the engine mount through bolts.

(12) Using the jack stand, raise the engine until adequate clearance is obtained to remove the oil pan.

(13) Remove transmission oil cooling lines (if equipped) and oxygen sensor wiring supports that are attached to the oil pan studs.

(14) Remove the oil pan bolts and studs. Carefully slide the oil pan and gasket to the rear. If equipped with an oil level sensor, take care not to damage the sensor.

INSTALLATION

(1) Clean the block and pan gasket surfaces.

(2) Fabricate 4 alignment dowels from 1 1/2 x 1/4 inch bolts. Cut the head off the bolts and cut a slot into the top of the dowel. This will allow easier installation and removal with a screwdriver (Fig. 52).

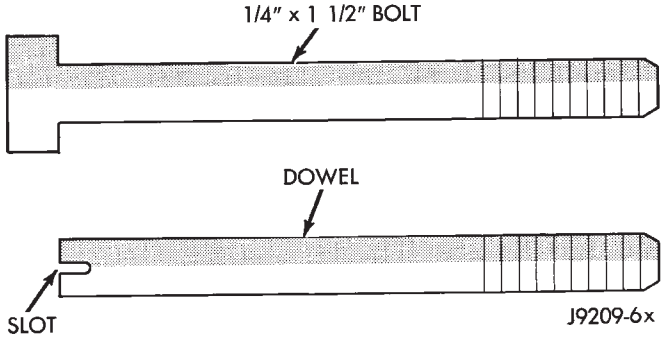


Fig. 52 Fabrication of Alignment Dowels

REMOVAL AND INSTALLATION (Continued)

(3) Install two dowels in the timing case cover. Install the other two dowels in the cylinder block (Fig. 53).

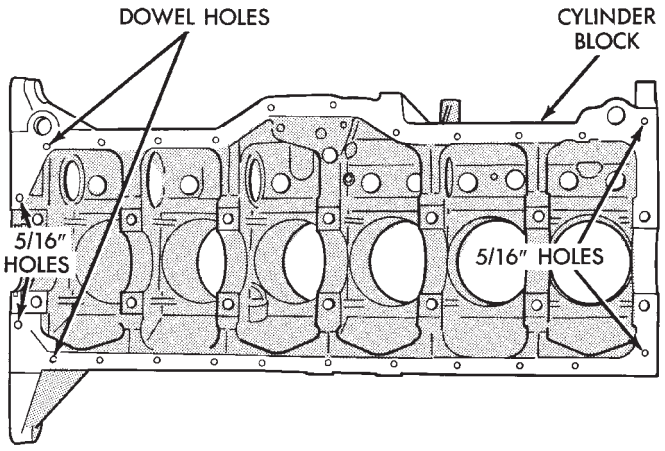


Fig. 53 Position of Dowels in Cylinder Block

(4) Apply Mopar® Silicone Rubber Adhesive Sealant on cylinder block to rear main bearing cap corners and cylinder block to front cover joints (four places) (Fig. 54).

(5) Slide the one-piece gasket over the dowels and onto the block and timing case cover.

(6) Position the oil pan over the dowels and onto the gasket. If equipped with an oil level sensor, take care not to damage the sensor.

(7) Install the 1/4 inch oil pan bolts. Tighten these bolts to 9.5 N·m (84 in. lbs.) torque. Install the 5/16 inch oil pan bolts (Fig. 55). Tighten these bolts to 15 N·m (132 in. lbs.) torque.

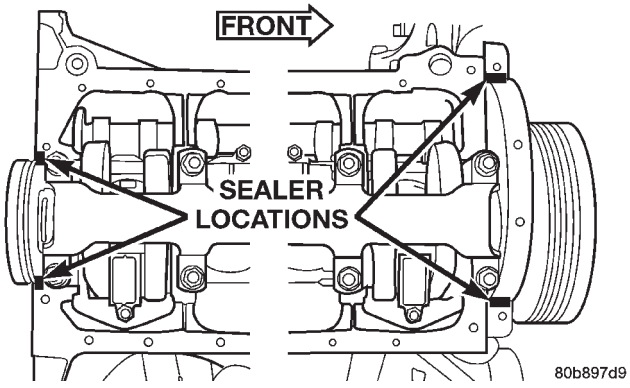


Fig. 54 Oil Pan Sealer Location

(8) Remove the dowels. Install the remaining 1/4 inch oil pan bolts. Tighten these bolts to 9.5 N·m (84 in. lbs.) torque.

(9) Lower the engine until it is properly located on the engine mounts.

(10) Install the through bolts and tighten the nuts.

(11) Lower the jack stand and remove the piece of wood.

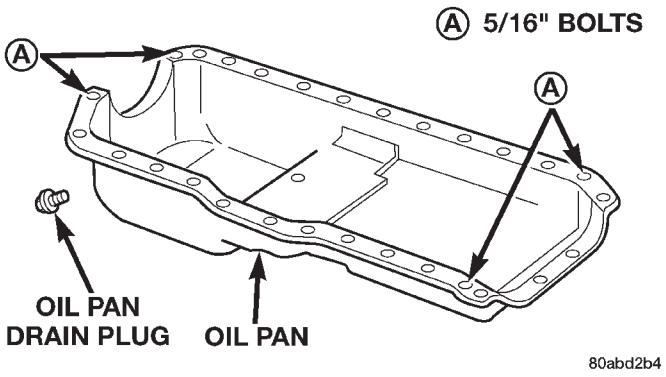


Fig. 55 Position of 5/16 inch Oil Pan Bolts

(12) Install the engine flywheel and transmission torque converter housing access cover.

(13) Install the engine starter motor.

(14) Connect the exhaust pipe to the hanger and to the engine exhaust manifold.

(15) Install transmission oil cooling lines (if equipped) and oxygen sensor wiring supports that attach to the oil pan studs.

(16) Install the oil pan drain plug (Fig. 55). Tighten the plug to 34 N·m (25 ft. lbs.) torque.

(17) Lower the vehicle.

(18) Connect negative cable to battery.

(19) Fill the oil pan with engine oil to the specified level.

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

(20) Start the engine and inspect for leaks.

PISTONS AND CONNECTING RODS

REMOVAL

(1) Remove the engine cylinder head cover.

(2) Remove the rocker arms, bridges and pivots.

(3) Remove the push rods.

(4) Remove the engine cylinder head.

(5) Position the pistons one at a time near the bottom of the stroke. Use a ridge reamer to remove the ridge from the top end of the cylinder walls. Use a protective cloth to collect the cuttings.

(6) Raise the vehicle.

(7) Drain the engine oil.

(8) Remove the oil pan and gasket.

(9) Remove main bearing cap brace (Fig. 56).

(10) Remove the connecting rod bearing caps and inserts. Mark the caps and rods with the cylinder bore location. The connecting rods and caps are stamped with a two letter combination (Fig. 57).

REMOVAL AND INSTALLATION (Continued)

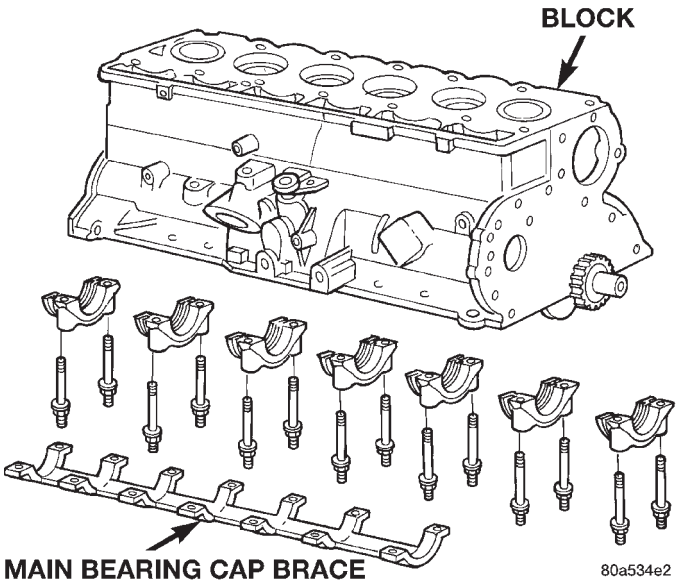


Fig. 56 Main Bearings Caps and Brace

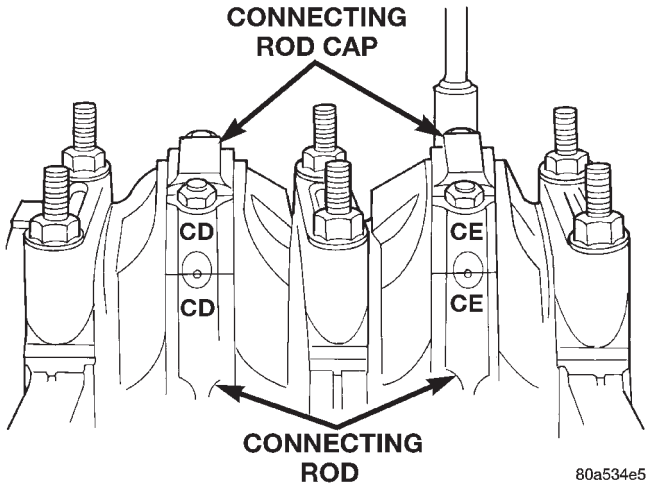


Fig. 57 Stamped Connecting Rods and Caps

(11) Lower the vehicle until it is about 2 feet from the floor.

CAUTION: Ensure that the connecting rod bolts DO NOT scratch the crankshaft journals or cylinder walls. Short pieces of rubber hose, slipped over the rod bolts will provide protection during removal.

(12) Have an assistant push the piston and connecting rod assemblies up and through the top of the cylinder bores (Fig. 58).

INSTALLATION

(1) Clean the cylinder bores thoroughly. Apply a light film of clean engine oil to the bores with a clean lint-free cloth.

(2) Install the piston rings on the pistons if removed.

(3) Lubricate the piston and rings with clean engine oil.

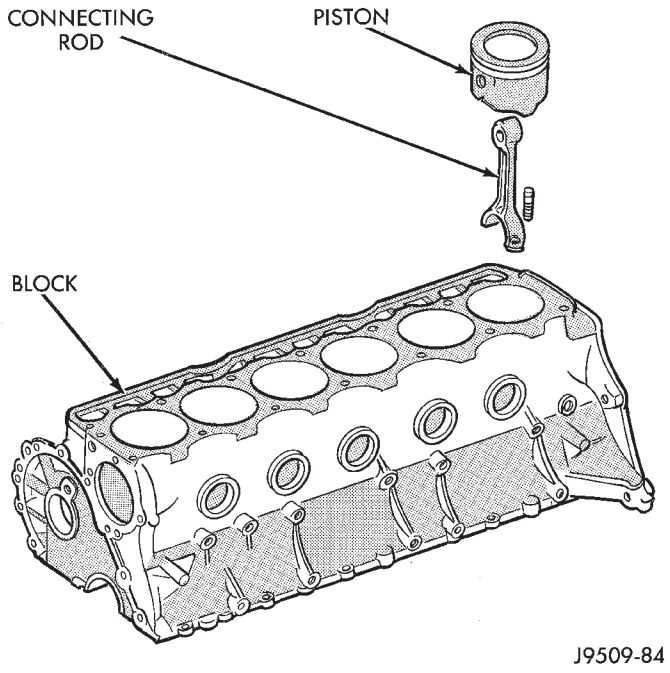


Fig. 58 Removal of Connecting Rod and Piston Assembly

CAUTION: Ensure that connecting rod bolts DO NOT scratch the crankshaft journals or cylinder walls. Short pieces of rubber hose slipped over the connecting rod bolts will provide protection during installation.

(4) Use a piston ring compressor to install the connecting rod and piston assemblies through the top of the cylinder bores (Fig. 59).

(5) Ensure the arrow on the piston top points to the front of the engine (Fig. 59).

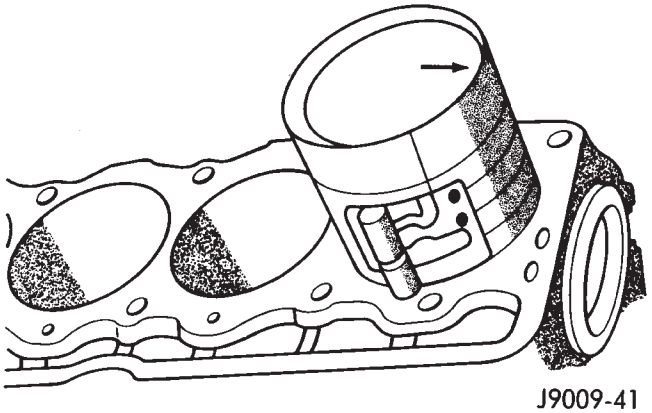


Fig. 59 Rod and Piston Assembly Installation

(6) Raise the vehicle.

(7) Each bearing insert is fitted to its respective journal to obtain the specified clearance between the bearing and the journal. In production, the select fit is obtained by using various-sized, color-coded bearing inserts as listed in the Connecting Rod Bearing

REMOVAL AND INSTALLATION (Continued)

Fitting Chart. The color code appears on the edge of the bearing insert. The size is not stamped on inserts used for production of engines.

(8) The rod journal is identified during the engine production by a color-coded paint mark on the adjacent cheek or counterweight toward the flange (rear) end of the crankshaft. The color codes used to indicate journal sizes are listed in the Connecting Rod Bearing Fitting Chart.

(9) When required, upper and lower bearing inserts of different sizes may be used as a pair (refer to Connecting Rod Bearing Fitting Chart). A standard size insert is sometimes used in combination with a 0.025 mm (0.001 inch) undersize insert to reduce clearance 0.013 mm (0.0005 inch).

CAUTION: DO NOT intermix bearing caps. Each connecting rod and bearing cap are stamped with the cylinder number. The stamp is located on a machined surface adjacent to the oil squirt hole that faces the camshaft side of the cylinder block.

(10) Install the connecting rod bearing caps and inserts in the same positions as removed.

CAUTION: Verify that the oil squirt holes in the rods face the camshaft and that the arrows on the pistons face the front of the engine.

(11) Install main bearing cap brace (Fig. 56). Tighten nuts to 47 N·m (35 ft. lbs.).

(12) Install the oil pan and gaskets as outlined in the installation procedure.

(13) Lower the vehicle.

(14) Install the engine cylinder head, push rods, rocker arms, bridges, pivots and engine cylinder head cover.

(15) Fill the crankcase with engine oil.

CRANKSHAFT OIL SEALS—REAR

The crankshaft rear main bearing oil seal consists of two half pieces of viton with a single lip that effectively seals the rear of the crankshaft. Replace the upper and lower seal halves as a unit to ensure leak-free operation.

REMOVAL

(1) Remove transmission inspection cover.

(2) Remove oil pan. Refer to procedure in this section

(3) Remove main bearing cap brace.

(4) Remove rear main bearing cap (No.7).

(5) Push upper seal out of the groove. Ensure that the crankshaft and seal groove are not damaged.

(6) Remove lower half of the seal from the bearing cap.

INSTALLATION

(1) Wipe the seal surface area of the crankshaft until it is clean.

(2) Apply a thin coat of engine oil.

(3) Coat lip of the seal with engine oil.

(4) Carefully position the upper seal into the groove in the cylinder block. The lip of the seal faces toward the front of the engine.

(5) Apply Mopar® Gasket Maker sealer on both sides of cylinder block as shown in (Fig. 60). The dab of sealer should be 3 mm (0.125 in.) in diameter.

(6) Apply Mopar® Gasket Maker on the rear bearing cap (Fig. 60). The bead should be 2.3 mm (0.09 in.) in diameter. DO NOT apply sealer to the lip of the seal.

(7) Position the lower seal into the bearing cap recess and seat it firmly. Be sure the seal is flush with the cylinder block pan rail.

(8) Coat the outer curved surface of the lower seal with soap and the lip of the seal with engine oil.

(9) Install the rear main bearing cap. DO NOT strike the cap more than twice for proper engagement.

(10) Tighten all main bearing bolts to 108 N·m (80 ft. lbs.) torque.

(11) Install the main bearing cap brace. Tighten nuts to 47 N·m (35 ft. lbs.).

(12) Install the oil pan gasket and oil pan. Tighten 1/4 – 20 screws to 14 N·m (120 in. lbs.). Tighten 5/16 – 18 screws to 18 N·m (156 in. lbs.)

(13) Apply Mopar® Silicone Rubber Adhesive Sealant on cylinder block to rear main bearing cap corners and cylinder block to front cover joints (four places) (Fig. 61)

(14) Install transmission inspection cover.

OIL PUMP

A gear-type oil pump is mounted at the underside of the cylinder block opposite the No.4 main bearing.

The pump incorporates a nonadjustable pressure relief valve to limit maximum pressure to 517 kPa (75 psi). In the relief position, the valve permits oil to bypass through a passage in the pump body to the inlet side of the pump.

Oil pump removal or replacement will not affect the distributor timing because the distributor drive gear remains in mesh with the camshaft gear.

REMOVAL

(1) Drain the engine oil.

(2) Remove the oil pan.

REMOVAL AND INSTALLATION (Continued)

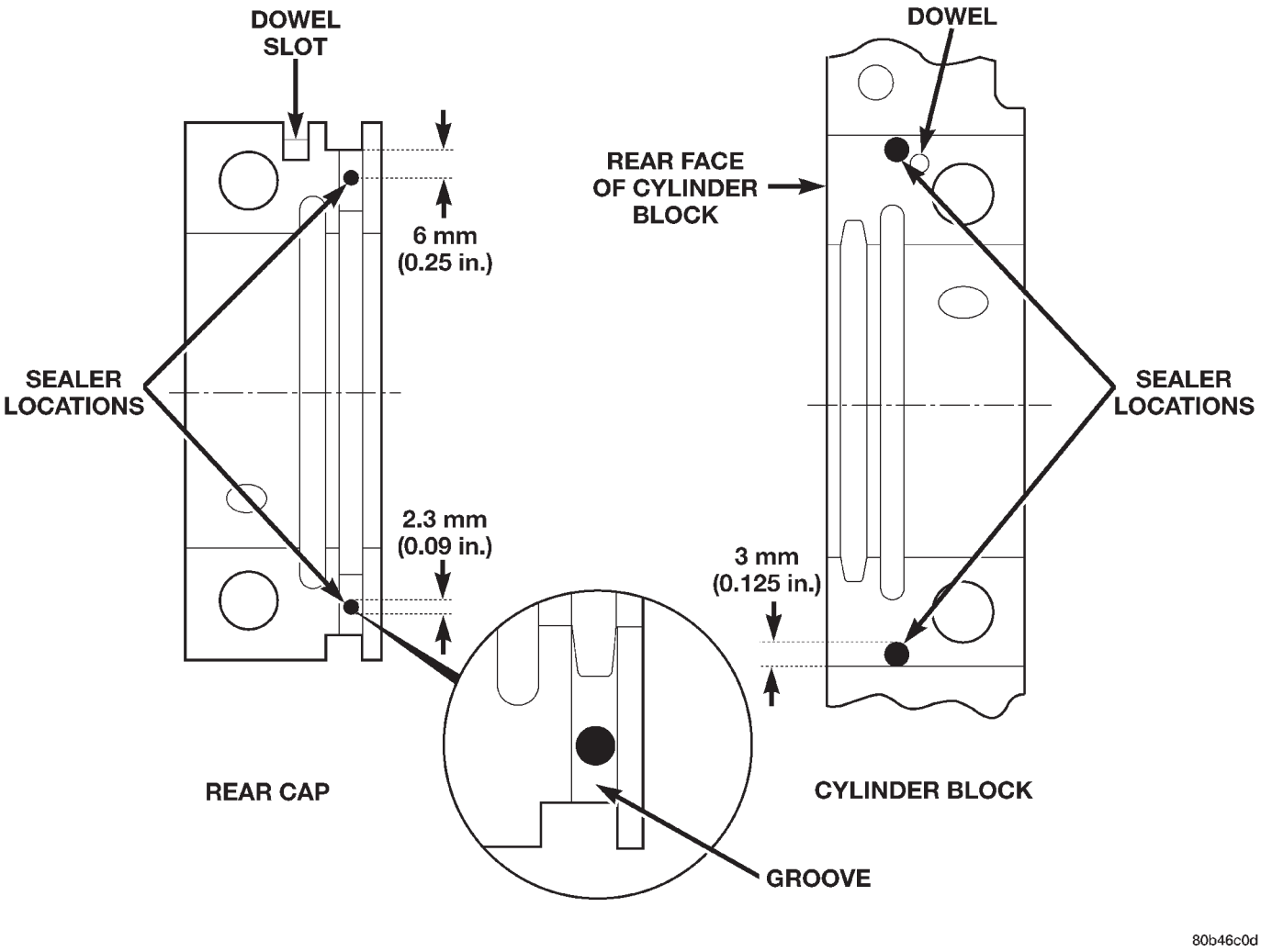


Fig. 60 Location of Sealer

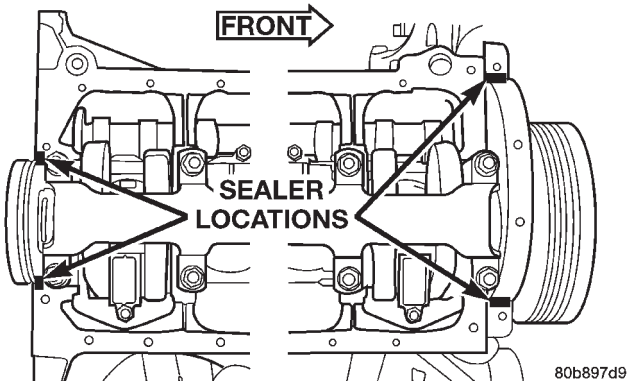


Fig. 61 Oil Pan Sealer Location

(3) Remove the pump-to-cylinder block attaching bolts. Remove the pump assembly with gasket (Fig. 62).

CAUTION: If the oil pump is not to be serviced, DO NOT disturb position of oil inlet tube and strainer assembly in pump body. If the tube is moved within the pump body, a replacement tube and strainer assembly must be installed to assure an airtight seal.

INSTALLATION

(1) Install the oil pump on the cylinder block using a replacement gasket. Tighten the bolts to 23 N·m (17 ft. lbs.) torque.

(2) Install the oil pan.

(3) Fill the oil pan with oil to the specified level.

REMOVAL AND INSTALLATION (Continued)

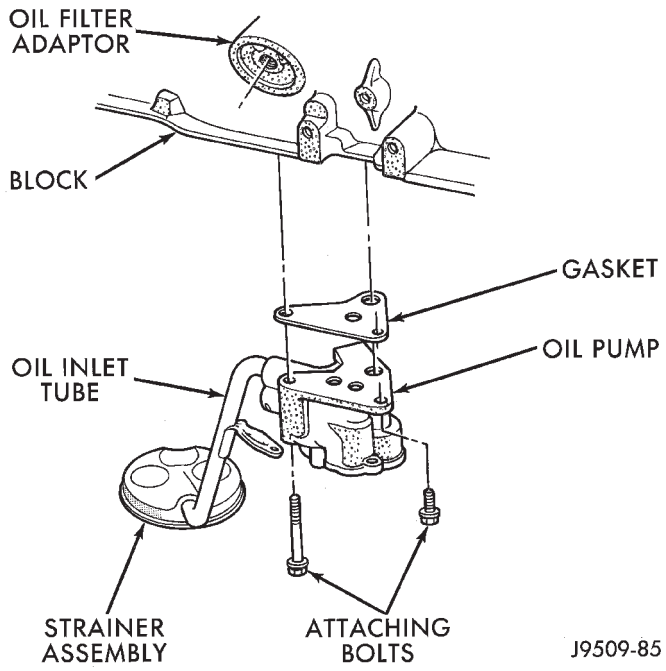


Fig. 62 Oil Pump Assembly

TIMING CASE COVER OIL SEAL

This procedure is done with the timing case cover installed.

REMOVAL

(1) Disconnect negative cable from battery.
(2) Remove the serpentine drive belt.
(3) Remove the vibration damper.
(4) Remove the radiator shroud.
(5) Carefully remove the oil seal. Make sure seal bore is clean.

INSTALLATION

(1) Position the replacement oil seal on Timing Case Cover Alignment and Seal Installation Tool 6139 with seal open end facing inward. Apply a light film of Perfect Seal, or equivalent, on the outside diameter of the seal. Lightly coat the crankshaft with engine oil.

(2) Position the tool and seal over the end of the crankshaft and insert a draw screw tool into Seal Installation Tool 6139 (Fig. 63). Tighten the nut against the tool until it contacts the cover.

(3) Remove the tools. Apply a light film of engine oil on the vibration damper hub contact surface of the seal.

(4) Apply Mopar Silicone Rubber Adhesive Sealant to the keyway in the crankshaft and insert the key. With the key inserted in the keyway in the crankshaft, install the vibration damper, washer and bolt. Lubricate and tighten the bolt to 108 N·m (80 ft. lbs.) torque.

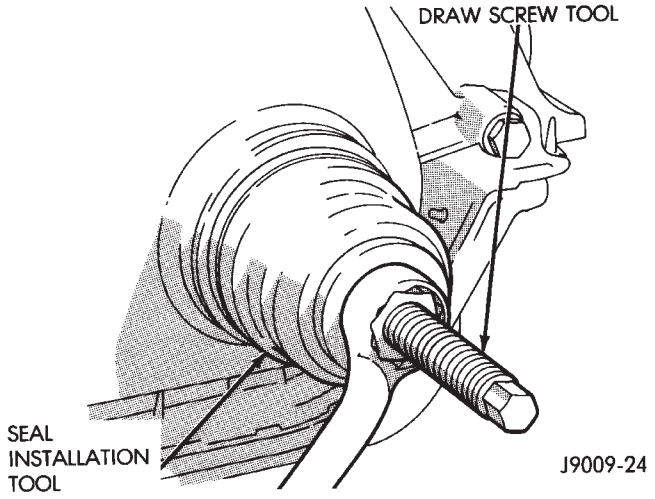


Fig. 63 Timing Case Cover Oil Seal Installation

(5) Install the serpentine belt and tighten to the specified tension (refer to Group 7, Cooling Systems for the proper specifications and procedures).
(6) Install the radiator shroud.
(7) Connect negative cable to battery.

DISASSEMBLY AND ASSEMBLY

VALVE SERVICE

Clean all carbon deposits from the combustion chambers, valve ports, valve stems, valve stem guides and head.

Clean all grime and gasket material from the engine cylinder head machined gasket surface.

Inspect for cracks in the combustion chambers and valve ports.

Inspect for cracks on the exhaust seat.

Inspect for cracks in the gasket surface at each coolant passage.

Inspect valves for burned, cracked or warped heads.

Inspect for scuffed or bent valve stems.

Replace valves displaying any damage.

VALVE REFACING

(1) Use a valve refacing machine to reface the intake and exhaust valves to the specified angle.

(2) After refacing, a margin of at least 0.787 mm (0.031 inch) must remain (Fig. 64). If the margin is less than 0.787 mm (0.031 inch), the valve must be replaced.

VALVE SEAT REFACING

(1) Install a pilot of the correct size in the valve guide bore. Reface the valve seat to the specified angle with a good dressing stone. Remove only enough metal to provide a smooth finish.

DISASSEMBLY AND ASSEMBLY (Continued)

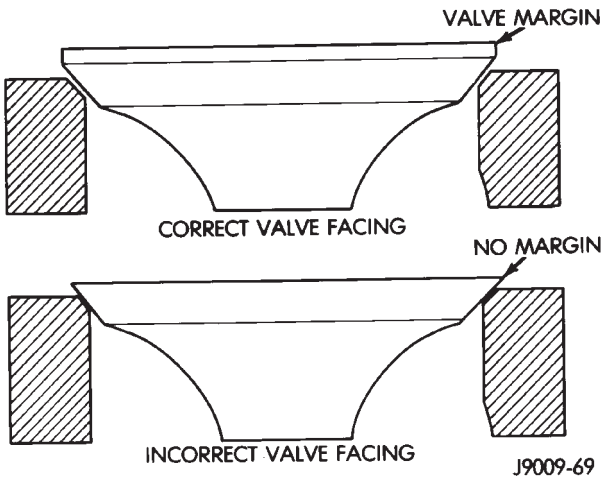


Fig. 64 Valve Facing Margin

(2) Use tapered stones to obtain the specified seat width when required.

(3) Control valve seat runout to a maximum of 0.0635 mm (0.0025 in.) (Fig. 65).

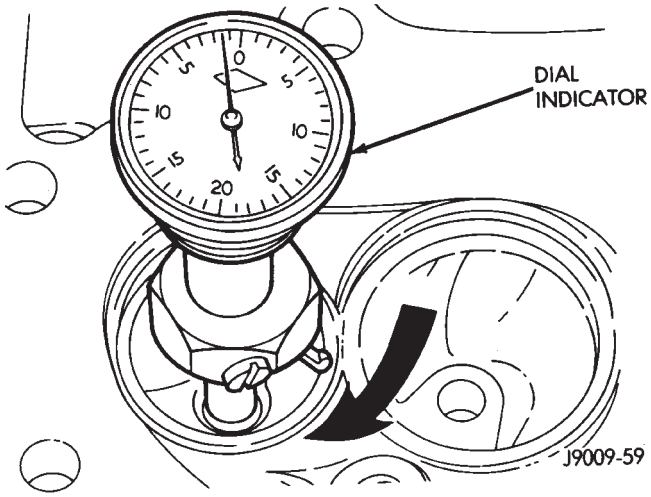


Fig. 65 Measurement of Valve Seat Runout

VALVE STEM OIL SEAL REPLACEMENT

Valve stem oil seals are installed on each valve stem to prevent rocker arm lubricating oil from entering the combustion chamber through the valve guide bores. One seal is marked INT (intake valve) and the other is marked EXH (exhaust valve).

Replace the oil seals whenever valve service is performed or if the seals have deteriorated.

VALVE GUIDES

The valve guides are an integral part of the engine cylinder head and are not replaceable.

When the valve stem guide clearance is excessive, the valve guide bores must be reamed oversize. Service valves with oversize stems are available in 0.076 mm (0.003 inch) and 0.381 mm (0.015 inch) increments.

Corresponding oversize valve stem seals are also available and must be used with valves having 0.381 mm (0.015 inch) oversize stems.

NOTE: If the valve guides are reamed oversize, the valve seats must be ground to ensure that the valve seat is concentric to the valve guide.

VALVE STEM-TO-GUIDE CLEARANCE MEASUREMENT

Valve stem-to-guide clearance may be measured by either of the following two methods.

PREFERRED METHOD

(1) Remove the valve from the head.

(2) Clean the valve stem guide bore with solvent and a bristle brush.

(3) Insert a telescoping gauge into the valve stem guide bore approximately 9.525 mm (.375 inch) from the valve spring side of the head (Fig. 66).

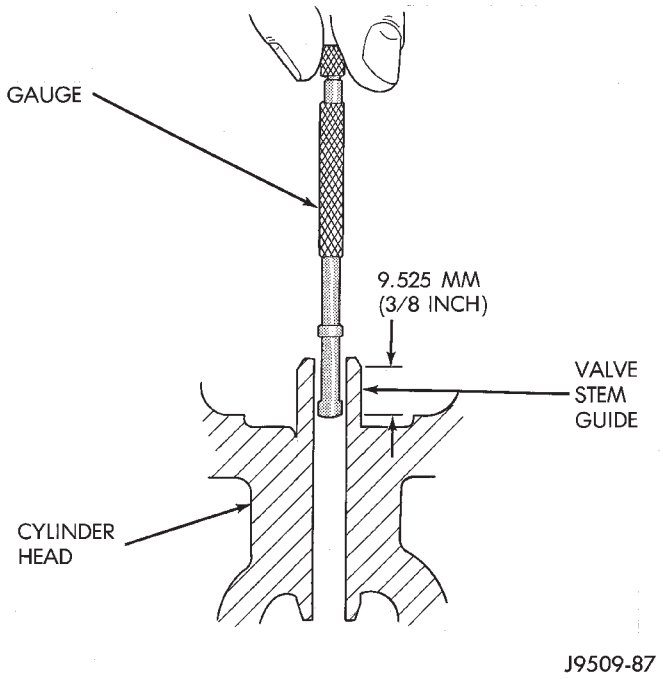


Fig. 66 Measurement of Valve Guide Bore Diameter

(4) Remove and measure telescoping gauge with a micrometer.

(5) Repeat the measurement with contacts lengthwise to engine cylinder head.

(6) Compare the crosswise to lengthwise measurements to determine out-of-roundness. If the measurements differ by more than 0.0635 mm (0.0025 in.), ream the guide bore to accommodate an oversize valve stem.

(7) Compare the measured valve guide bore diameter with specifications (7.95-7.97 mm or 0.313-0.314 inch). If the measurement differs from specification

DISASSEMBLY AND ASSEMBLY (Continued)

by more than 0.076 mm (0.003 inch), ream the guide bore to accommodate an oversize valve stem.

ALTERNATIVE METHOD

(1) Use a dial indicator to measure the lateral movement of the valve stem (stem-to-guide clearance). This must be done with the valve installed in its guide and just off the valve seat (Fig. 67).

(2) Correct clearance is 0.025-0.0762 mm (0.001-0.003 inch). If indicated movement exceeds the specification ream the valve guide to accommodate an oversize valve stem.

NOTE: Valve seats must be ground after reaming the valve guides to ensure that the valve seat is concentric to the valve guide.

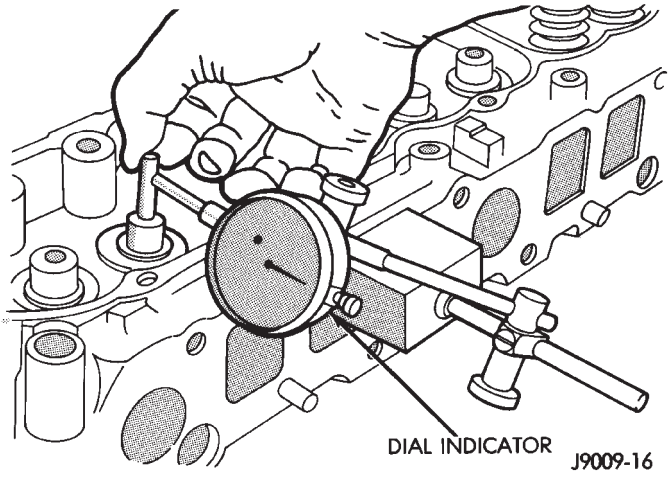


Fig. 67 Measurement of Lateral Movement of Valve Stem

VALVE SPRING TENSION TEST

Use a universal Valve Spring Tester and a torque wrench to test each valve spring for the specified tension value (Fig. 68).

Replace valve springs that are not within specifications.

CYLINDER BLOCK

DISASSEMBLY

Refer to the applicable sections for detailed instructions.

(1) Drain the engine oil. Remove and discard the oil filter.

(2) Remove the water pump from the cylinder block.

(3) Remove the vibration damper.

(4) Remove the timing case cover and lay the cover upside down.

(5) Position a drift punch into the slot in the back of the cover and tap the old seal out.

(6) Remove the oil slinger from crankshaft.

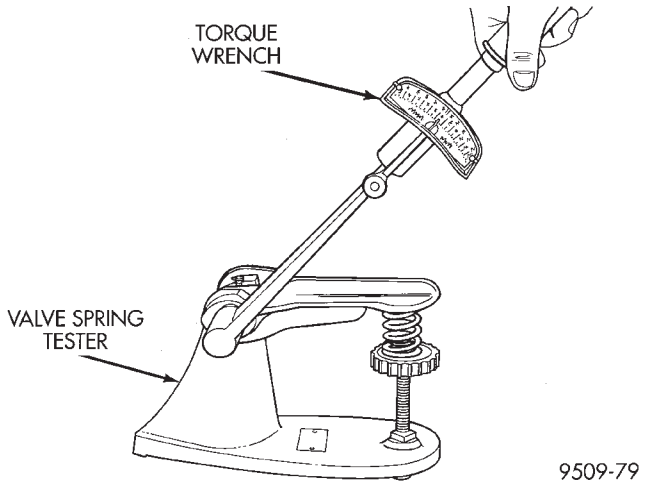


Fig. 68 Valve Spring Tester

(7) Remove the camshaft retaining bolt and remove the sprockets and chain as an assembly.

(8) Remove the camshaft.

(9) Remove the oil pan and gasket.

(10) Remove the front and rear oil galley plugs.

(11) Remove the oil pump.

(12) Remove the connecting rods and the pistons. Remove the connecting rod and piston assemblies through the top of the cylinder bores.

(13) Remove the crankshaft.

ASSEMBLY

Refer to the applicable sections for detailed instructions.

(1) Install the crankshaft.

(2) Install the connecting rods and the pistons through the top of the cylinder bores.

(3) Install the oil pump.

(4) Install the oil pan and gasket.

(5) Install the camshaft.

(6) Install the sprockets and chain as an assembly.

(7) Install the oil slinger from the crankshaft.

(8) Install the timing case cover seal.

(9) Install the timing case cover.

(10) Install the vibration damper.

(11) Install the water pump. Tighten the mounting bolts to 31 N·m (23 ft. lbs.) torque.

(12) Lubricate the oil filter seal with clean engine oil. Tighten oil filter to 18 N·m (156 in. lbs.) torque.

(13) Install the engine into the vehicle.

(14) Fill the engine with clean lubrication oil (refer to Group 0, Lubrication and Maintenance).

(15) Fill the cooling system.

CLEANING AND INSPECTION

INTAKE AND EXHAUST MANIFOLD

Clean the mating surfaces of the cylinder head and the manifold if the original manifold is to be installed.

CYLINDER HEAD

CLEANING

Thoroughly clean the engine cylinder head and cylinder block mating surfaces. Clean the intake and engine exhaust manifold and engine cylinder head mating surfaces. Remove all gasket material and carbon.

Check to ensure that no coolant or foreign material has fallen into the tappet bore area.

Remove the carbon deposits from the combustion chambers and top of the pistons.

INSPECTION

Use a straightedge and feeler gauge to check the flatness of the engine cylinder head and block mating surfaces.

CYLINDER HEAD COVER

CLEANING

Remove any original sealer from the cover sealing surface of the engine cylinder head and clean the surface using a fabric cleaner.

Remove all residue from the sealing surface using a clean, dry cloth.

INSPECTION

Inspect the engine cylinder head cover for cracks. Replace the cover, if cracked.

The original dark grey gasket material should NOT be removed. If sections of the gasket material are missing or are compressed, replace the engine cylinder head cover. However, sections with minor damage such as small cracks, cuts or chips may be repaired with a hand held applicator. The new material must be smoothed over to maintain gasket height. Allow the gasket material to cure prior to engine cylinder head cover installation.

ROCKER ARMS AND PUSH RODS

CLEANING

Clean all the components with cleaning solvent.

Use compressed air to blow out the oil passages in the rocker arms and push rods.

INSPECTION

Inspect the pivot surface area of each rocker arm. Replace any that are scuffed, pitted, cracked or excessively worn.

Inspect the valve stem tip contact surface of each rocker arm and replace any rocker arm that is deeply pitted.

Inspect each push rod end for excessive wear and replace as required. If any push rod is excessively worn because of lack of oil, replace it and inspect the corresponding hydraulic tappet for excessive wear.

Inspect the push rods for straightness by rolling them on a flat surface or by shining a light between the push rod and the flat surface.

A wear pattern along the length of the push rod is not normal. Inspect the engine cylinder head for obstruction if this condition exists.

HYDRAULIC TAPPETS

CLEANING

Clean each tappet assembly in cleaning solvent to remove all varnish, gum and sludge deposits.

INSPECTION

Inspect for indications of scuffing on the side and base of each tappet body.

Inspect each tappet base for concave wear with a straightedge positioned across the base. If the base is concave, the corresponding lobe on the camshaft is also worn. Replace the camshaft and defective tappets.

LEAK-DOWN TEST

After cleaning and inspection, test each tappet for specified leak-down rate tolerance to ensure zero-lash operation (Fig. 69).

Swing the weighted arm of the hydraulic valve tappet tester away from the ram of the Leak-Down Tester.

(1) Place a 7.925-7.950 mm (0.312-0.313 inch) diameter ball bearing on the plunger cap of the tappet.

(2) Lift the ram and position the tappet (with the ball bearing) inside the tester cup.

(3) Lower the ram, then adjust the nose of the ram until it contacts the ball bearing. DO NOT tighten the hex nut on the ram.

(4) Fill the tester cup with hydraulic valve tappet test oil until the tappet is completely submerged.

(5) Swing the weighted arm onto the push rod and pump the tappet plunger up and down to remove air. When the air bubbles cease, swing the weighted arm away and allow the plunger to rise to the normal position.

CLEANING AND INSPECTION (Continued)

(6) Adjust the nose of the ram to align the pointer with the SET mark on the scale of the tester and tighten the hex nut.

(7) Slowly swing the weighted arm onto the push rod.

(8) Rotate the cup by turning the handle at the base of the tester clockwise one revolution every 2 seconds.

(9) Observe the leak-down time interval from the instant the pointer aligns with the START mark on the scale until the pointer aligns with the 0.125 mark. A normally functioning tappet will require 20-110 seconds to leak-down. Discard tappets with leak-down time interval not within this specification.

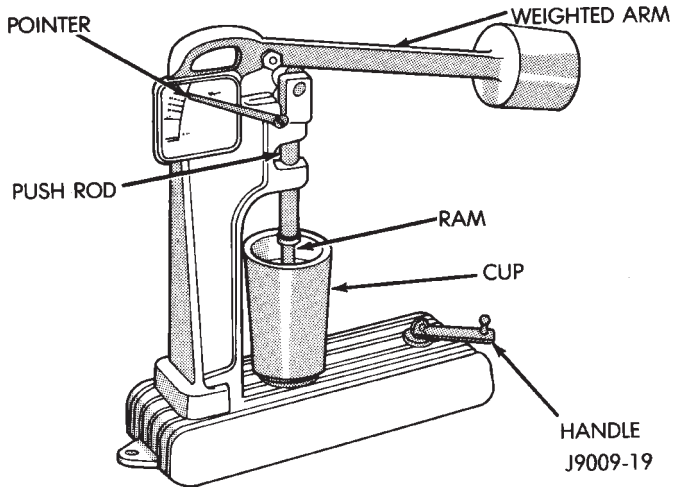


Fig. 69 Leak-Down Tester

CYLINDER BLOCK

CLEANING

Thoroughly clean the oil pan and engine block gasket surfaces.

Use compressed air to clean out:

- The galley at the oil filter adaptor hole.
- The front and rear oil galley holes.
- The feed holes for the crankshaft main bearings.

Once the block has been completely cleaned, apply Loctite PST pipe sealant with Teflon 592 to the threads of the front and rear oil galley plugs. Tighten the plugs to 34 N·m (25 ft. lbs.) torque.

INSPECTION—CYLINDER BORE

(1) It is mandatory to use a dial bore gauge to measure each cylinder bore diameter (Fig. 70). To correctly select the proper size piston, a cylinder bore gauge, capable of reading in 0.003 mm (.0001 in.) INCREMENTS is required. If a bore gauge is not available, do not use an inside micrometer.

(2) Measure the inside diameter of the cylinder bore at three levels below top of bore. Start perpendicular (across or at 90 degrees) to the axis of the crankshaft and then take two additional reading.

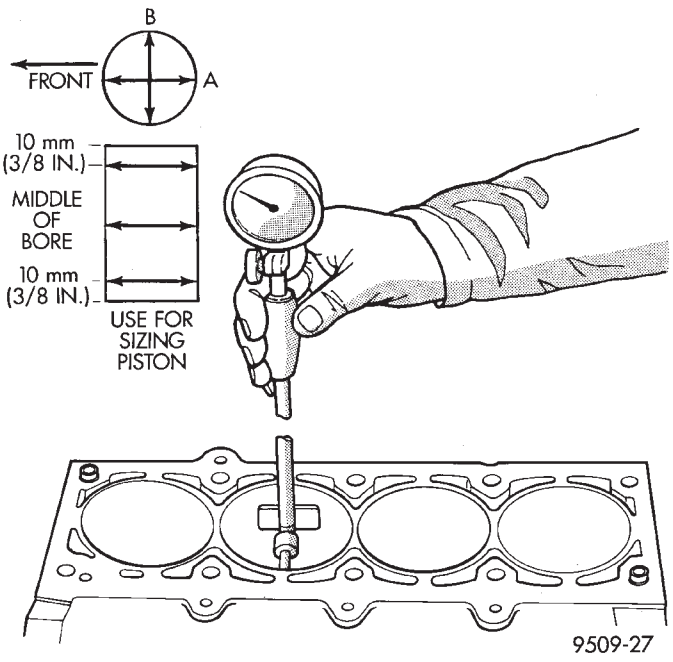


Fig. 70 Cylinder Bore Measurement

(3) Measure the cylinder bore diameter crosswise to the cylinder block near the top of the bore. Repeat the measurement near the middle of the bore, then repeat the measurement near the bottom of the bore.

(4) Determine taper by subtracting the smaller diameter from the larger diameter.

(5) Rotate measuring device 90° and repeat steps above.

(6) Determine out-of-roundness by comparing the difference between each measurement.

(7) If cylinder bore taper does not exceed 0.025 mm (0.001 inch) and out-of-roundness does not exceed 0.025 mm (0.001 inch), the cylinder bore can be honed. If the cylinder bore taper or out- of-round condition exceeds these maximum limits, the cylinder must be bored and then honed to accept an oversize piston. A slight amount of taper always exists in the cylinder bore after the engine has been in use for a period of time.

HONING—CYLINDER BORE

The honing operation should be closely coordinated with the fitting of pistons and rings. This will ensure specified clearances are maintained.

Refer to Standard Service Procedures in the beginning of this Group for the proper honing of cylinder bores.

SPECIFICATIONS

4.0L ENGINE SPECIFICATIONS

Engine Description

Engine Type . . . . . In-line 6 Cylinder
Bore and Stroke . . . . . 98.4 x 86.69 mm (3.88 x 3.413 in.)
Displacement . . . . . 4.0L (242 cu. in.)
Compression Ratio 8.8:1
Firing Order 1–5–3–6–2–4
Lubrication . . . . Pressure Feed–Full Flow Filtration
Cooling System . . Liquid Cooled–Forced Circulation
Cylinder Block . . . . . Cast Iron
Crankshaft . . . . . Cast Nodular Iron
Cylinder Head . . . . . Cast Iron
Camshaft . . . . . Cast Iron
Pistons . . . . . Aluminum Alloy
Combustion Chamber . . . . . Dual-Quench
Connecting Rods . . . . . Cast Malleable Iron

Engine Specifications

Camshaft

Hydraulic Tappet Clearance . . . . . Zero Lash
Bearing Clearance . . . . . 0.025 to 0.076 mm (0.001 to 0.003 in.)

Bearing Journal Diameter

No. 1 . . . . . 51.54 to 51.56 mm (2.029 to 2.030 in.)
No. 2 . . . . . 51.28 to 51.31 mm (2.019 to 2.020 in.)
No. 3 . . . . . 51.03 to 51.05 mm (2.009 to 2.010 in.)
No. 4 . . . . . 50.78 to 50.80 mm (1.999 to 2.000 in.)
Base Circle Runout . . . . . 0.03 mm - max. (0.001 in. - max.)
Valve Lift . . . . . 10.29 mm (0.405 in.)

Intake Valve Timing

Opens . . . . . 12.4° BTDC
Closes . . . . . 60.9° ABDC

Exhaust Valve Timing

Opens . . . . . 49.8 BBDC
Closes . . . . . 29.2° ATDC
Valve Overlap . . . . . 41.6°
Intake Duration . . . . . 253.3°
Exhaust Duration . . . . . 259.°

Crankshaft

End Play . . . . . 0.038 to 0.165 mm (0.0015 to 0.0065 in.)
Main Bearing Journal Diameter No. 1-6 . . . . . 63.489 to 63.502 mm (2.4996 to 2.5001 in.)
Main Bearing Journal Diameter No. 7 . . . . . 63.449 to 63.487 mm (2.4980 to 2.4995 in.)

Camshaft

Main Bearing Journal Width No. 1 . . . . . 27.58 to 27.89 mm (1.086 to 1.098 in.)
Main Bearing Journal Width No. 3 . . . . . 32.28 to 32.33 mm (1.271 to 1.273 in.)
Main Bearing Journal Width No. 2-4-5-6-7 . . . . . 30.02 to 30.18 mm (1.182 to 1.188 in.)
Main Bearing Clearance . . . . . 0.03 to 0.06 mm (0.001 to 0.0025 in.)
Main Bearing Clearance (Preferred) . . . 0.051 mm (0.002 in.)
Connecting Rod Journal Diameter . . . . . 53.17 to 53.23 mm (2.0934 to 2.0955 in.)
Connecting Rod Journal Width . . . . . 27.18 to 27.33 mm (1.070 to 1.076 in.)
Out-of-Round (Max. All Journals) . . . . . 0.013 mm (0.0005 in.)
Taper (Max. – All Journals) . . . . . 0.013 mm (0.0005 in.)

Cylinder Block

Deck Height . . . . . 240.03 to 240.18 mm (9.450 to 9.456 in.)
Deck Clearance (Below Block) . . . . . 0.546 mm (0.0215 in.)
Cylinder Bore Diameter— Standard . . . . . 98.45 to 98.48 mm (3.8759 to 3.8775 in.)
Cylinder Bore Diameter— Taper (Max.) . . . . . 0.025 mm (0.001 in.)
Cylinder Bore Diameter— Out-of-Round . . . . . 0.025 mm (0.001 in.)
Tappet Bore Diameter . . . . . 23.000 to 23.025 mm (0.9055 to 0.9065 in.)
Flatness . . . . . 0.03 mm per 25 mm (0.001 in. per 1 in.)
Flatness . . . . . 0.05 mm per 152 mm (0.002 in. per 6 in.)
Flatness Max. . . . . 0.20 mm max. for total length (0.008 in. max. for total length)
Main Bearing Bore Diameter . . . . . 68.3514 to 68.3768 mm (2.691 to 2.692 in.)

Connecting Rods

Total Weight (Less Bearing) . . . 657 to 665 grams (23.17 to 23.45 oz.)
Length (Center-to-Center) . . 155.52 to 155.62 mm (6.123 to 6.127 in.)

SPECIFICATIONS (Continued)

Camshaft

Piston Pin Bore Diameter . . . . 23.59 to 23.62 mm (0.9288 to 0.9298 in.)
Bore (Less Bearings) . . . . . 56.08 to 56.09 mm (2.2080 to 2.2085 in.)
Bearing Clearance . . . . . 0.025 to 0.076 mm (0.001 to 0.003 in.)
Bearing Clearance (Preferred) . . . . . 0.044 to 0.050 mm (0.0015 to 0.0020 in.)
Side Clearance . . . . . 0.25 to 0.48 mm (0.010 to 0.019 in.)
Twist (Max.) . . . . . 0.001 mm per mm (0.001 in. per inch)
Bend (Max.) . . . . . 0.001 mm per mm (0.001 in. per inch.)

Cylinder Compression Pressure

Ratio 8.8:1
Pressure Range . . . . . 827 to 1,034 kPa (120 to 150 psi)
Max. Variation Between Cylinders . . . . . 206 kPa (30 psi)

Cylinder Head

Combustion Chamber . . . . . 52.22 to 58.22 cc (3.37 to 3.55 cu. in.)
Valve Guide I.D. (Integral) . . . . . 7.95 to 7.97 mm (0.313 to 0.314 in.)
Valve Stem-to-Guide Clearance . . . . . 0.025 to 0.076 mm (0.001 to 0.003 in.)
Intake Valve Seat Angle . . . . . 44.5°
Exhaust Valve Seat Angle . . . . . 44.5°
Valve Seat Width . . . . . 1.02 to 1.52 mm (0.040 to 0.060 in.)
Valve Seat Runout . . . . . 0.064 mm (0.0025 in.)
Flatness . . . . . 0.03 mm per 25 mm (0.001 in. per 1 in.)
Flatness . . . . . 0.05 mm per 152 mm (0.002 in. per 6 in.)
Flatness Max. . . . 0.20 mm - max. for total length (0.008 in. max. for total length)

Rocker Arms, Push Rods & Tappets

Rocker Arm Ratio 1.6:1
Push Rod Length . . . . . 244.856 to 245.364 mm (9.640 to 9.660 in.)
Push Rod Diameter . . . . . 7.92 to 8.00 mm (0.312 to 0.315 in.)
Hydraulic Tappet Diameter . . 22.962 to 22.974 mm (0.904 to 0.9045 in.)
Tappet-to-Bore Clearance . . . . 0.025 to 0.063 mm (0.001 to 0.0025 in.)

Valves

Length (Tip-to-Gauge Dimension Line)
Intake . . . . . 122.479 to 122.860 mm (4.822 to 4.837 in.)

Camshaft

Length (Tip-to-Gauge Dimension Line)
Exhaust . . . . . 122.860 to 123.241 mm (4.837 to 4.852 in.)
Valve Stem Diameter . . . . . 7.899 to 7.925 mm (0.311 to 0.312 in.)
Stem-to-Guide Clearance . . . . . 0.025 to 0.076 mm (0.001 to 0.003 in.)
Valve Head Diameter—ntake . . . . . 48.387 to 48.641 mm (1.905 to 1.915 in.)
Valve Head Diameter—Exhaust . . . . . 37.973 to 38.227 mm (1.495 to 1.505 in.)
Valve Face Angle—Intake . . . . . 45°
Valve Face Angle—Exhaust . . . . . 45°
Tip Refinishing (Max. Allowable) . . . . . 0.25 mm (0.010 in.)

Valve Springs

Free Length (Approx.) . . . . . 47.65 mm (1.876 in.)
Spring Tension—Valve Closed . . . . . 316 to 351 N @ 41.656 mm (71 to 79 lbf. @ 1.64 in.)
Spring Tension—Valve Open . . . . . 898.6 to 969.7 N 30.89 mm (202 to 218 lbf @ 1.216 in.)
Inside Diameter . . . . . 21.0 mm to 21.51 mm (0.827 to 0.847 in.)

Pistons

Weight (Less Pin) . . . . . 417 to 429 grams (14.7 to 15.1 oz.)
Piston Pin Bore (Centerline to Piston Top) . . . . 40.61 to 40.72 mm (1.599 to 1.603 in.)
Piston-to-Bore Clearance . . . . . 0.018 to 0.038 mm (0.0008 to 0.0015 in.)
Ring Gap Clearance—op Compression Ring . . . . . 0.229 to 0.610 mm (0.0090 to 0.0240 in.)
Ring Gap Clearance—2nd Compression Ring . . . . . 0.483 to 0.965 mm (0.0190 to 0.0380 in.)
Ring Gap Clearance—Oil Control Steel Rails . . . . . 0.254 to 1.500 mm (0.010 to 0.060 in.)
Ring Side Clearance—Compression Rings . . . . . 0.042 to 0.084 mm (0.0017 to 0.0033 in.)
Ring Side Clearance—Oil Control Rings . . . . . 0.06 to 0.21 mm (0.0024 to 0.0083 in.)
Piston Ring Groove Height—Compression Rings . . . . . 1.530 to 1.555 mm (0.0602 to 0.0612 in.)

SPECIFICATIONS (Continued)

Camshaft
Piston Ring Groove Height—
Oil Control Ring . . . . . 4.035 to 4.060 mm (0.1589 to 0.1598 in.)
Piston Ring Groove Diameter—
No.1 Compression Ring . . . . . 88.39 to 88.65 mm (3.48 to 3.49 in.)
Piston Ring Groove Diameter—
No.2 Compression Ring . . . . . 87.63 to 87.88 mm (3.45 to 3.46 in.)
Piston Ring Groove Diameter—
Oil Control Ring . . . . . 89.66 to 89.92 mm (3.53 to 3.54 in.)
Piston Pin Bore Diameter . . 23.650 to 23.658 mm (0.9312 to 0.9315 in.)
Piston Pin Diameter . . . . . 23.637 to 23.640 mm (0.9306 to 0.9307 in.)
Piston-to-Pin Clearance . . . . 0.0102 to 0.0208 mm (0.0005 to 0.0009 in.)
Piston-to-Pin Connecting Rod
(Press Fit) . . . . . 8.9 kN (2000 lbf.)

Oil Pump
Gear-to-Body Clearance
(Radial) . . . . . 0.051 to 0.102 mm (0.002 to 0.004 in.)
Gear-to-Body Clearance
(Radial) (Preferred) . . . . . 0.051 mm (0.002 in.)
Gear End Clearance—
Plastigage . . . . . 0.051 to 0.152 mm (0.002 to 0.006 in.)
Gear End Clearance—
Plastigage (Preferred) . . . . . 0.051 mm (0.002 in.)
Gear End Clearance—
Feeler Gauge . . . . . 0.1016 to 0.2032 mm (0.004 to 0.008 in.)
Gear End Clearance—
Feeler Gauge (Preferred) . . 0.1778 mm (0.007 in.)

Oil Pressure
At Idle Speed (600 rpm) . . . . . 89.6 kPa (13 psi)
At 1600 rpm & Higher . . . . . 255 to 517 kPa (37 to 75 psi)
Oil Pressure Relief . . . . . 517 kPa (75 psi)

4.0L TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

DESCRIPTION	TORQUE
A/C Compressor Bracket-to-Engine	
Bolts	34 N·m (25 ft. lbs.)
A/C Compressor	
Mounting Bolts	27 N·m (20 ft. lbs.)
A/C Low Pressure Service Valve	
Nut	38 N·m (28 ft. lbs.)
Block Heater	
Nut	2 N·m (16 in. lbs.)

TORQUE SPECIFICATIONS

Camshaft Sprocket	
Bolt	68 N·m (50 ft. lbs.)
Camshaft Thrust Plate to Cylinder Block	
Screws	24 N·m (18 ft. lbs.)
Clutch Cover to Flywheel	
Bolts	54 N·m (40 ft. lbs.)
Coil Bracket to Block	
Bolts	22 N·m (192 in. lbs.)
Connecting Rod	
Nuts	45 N·m (33 ft. lbs.)
Cylinder Block	
Drain Plugs	34 N·m (25 ft. lbs.)
Cylinder Head	
Bolts	135 N·m (100 ft. lbs.)
Cylinder Head Cover	
Bolts	10 N·m (85 in. lbs.)
Distributor Clamp	
Bolt	23 N·m (204 in. lbs.)
Engine Mounts—Front	
Support Bracket Bolts	61 N·m (45 ft. lbs.)
Support Cushion Bolts/Nuts	41 N·m (30 ft. lbs.)
Support Cushion Bracket Bolts	54 N·m (40 ft. lbs.)
Support Cushion Bracket Stud Nuts	41 N·m (30 ft. lbs.)
Support Cushion Thru-Bolt	65 N·m (48 ft. lbs.)
Engine Mounts—Rear	
Crossmember-to-Sill Bolts (Automatic)	41 N·m (30 ft. lbs.)
Insulator Stud Assembly Nut	41 N·m (30 ft. lbs.)
Support Cushion/Crossmember Nuts	22 N·m (192 in. lbs.)
Support Cushion/Bracket Nuts (Manual)	75 N·m (55 ft. lbs.)
Transmission Support Bracket Bolt (Manual)	46 N·m (34 ft. lbs.)
Transmission Support Bracket/Cushion Bolt (4WD Auto)	75 N·m (55 ft. lbs.)
Transmission Support Adaptor Bracket Bolts (2WD Auto)	75 N·m (55 ft. lbs.)
Exhaust Manifold/Pipe	
Nuts	27 N·m (20 ft. lbs.)
Flywheel to Converter Housing	
Bolts	38 N·m (28 ft. lbs.)
Flywheel to Crankshaft	
Bolts	143 N·m (105 ft. lbs.)
Front Cover-to-Block	
Bolts 1/4–20	7 N·m (60 in. lbs.)
Bolts 5/16–18	22 N·m (192 in. lbs.)
Fuel Rail	
Bolts/Stud	12 N·m (108 in. lbs.)
Generator	
Fixed Bolt	24 N·m (18 ft. lbs.)
Thru Bolt/Nut	38 N·m (28 ft. lbs.)

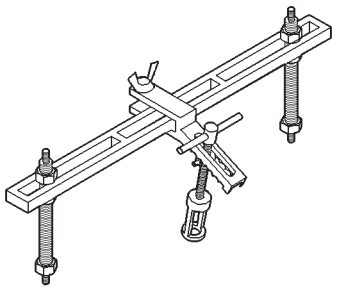
SPECIFICATIONS (Continued)

TORQUE SPECIFICATIONS

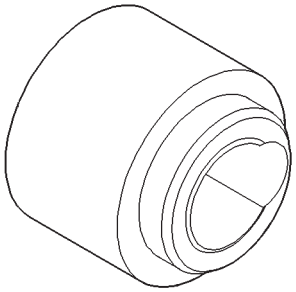
Main Bearing Cap
Bolts . . . . . 108 N·m (80 ft. lbs.)
Main Bearing Brace
Nuts . . . . . 47 N·m (35 ft. lbs.)
Oil Filter
Filter . . . . . 18 N·m (156 in. lbs.)
Connector (to adaptor) . . . . . 47 N·m (35 ft. lbs.)
Connector (to block) . . . . . 68 N·m (50 ft. lbs.)
Adaptor Bolts . . . . . 102 N·m (50 ft. lbs.)
Oil Galley
Plug . . . . . 41 N·m (30 ft. lbs.)
Oil Pan
1/4–20 Bolts . . . . . 9.5 N·m (84 in. lbs.)
5/16–18 Bolts . . . . . 15 N·m (132 in. lbs.)
Drain Plug . . . . . 34 N·m (25 ft. lbs.)
Oil Pump
Short Attaching Bolts . . . . . 23 N·m (204 in. lbs.)
Long Attaching Bolts . . . . . 23 N·m (204 in. lbs.)
Cover Bolts . . . . . 8 N·m (70 in. lbs.)
Power Steering Pump Pressure Hose
Nut . . . . . 52 N·m (38 ft. lbs.)
Rocker Arm Assembly-to-Cylinder Head
Capscrews . . . . . 30 N·m (21ft. lbs.)
Spark Plugs
Plugs . . . . . 37 N·m (27 ft. lbs.)
Starter Motor
Mounting Bolts . . . . . 45 N·m (33 ft. lbs.)
Thermostat Housing
Bolts . . . . . 18 N·m (156 in. lbs.)
Throttle Body
Bolts . . . . . 10 N·m (90 in.lbs.)
Vibration Damper
Bolts . . . . . 108 N·m (80 ft. lbs.)
Water Pump/Block
Bolts . . . . . 23 N·m (17 ft. lbs.)

SPECIAL TOOLS

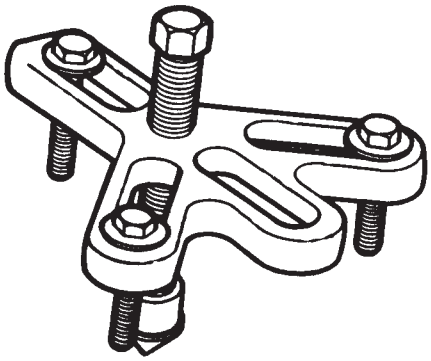
4.0L ENGINE



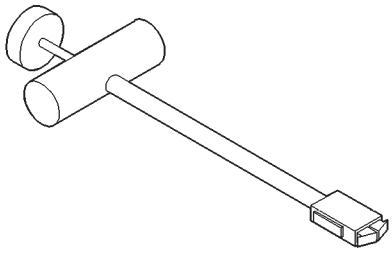
Valve Spring Compressor Tool MD-998772A



Timing Case Cover Alignment and Seal installation Tool 6139



Vibration Damper Removal Tool 7697



Hydraulic Valve Tappet Removal/Installation Tool C-4129–A

4.7L ENGINE

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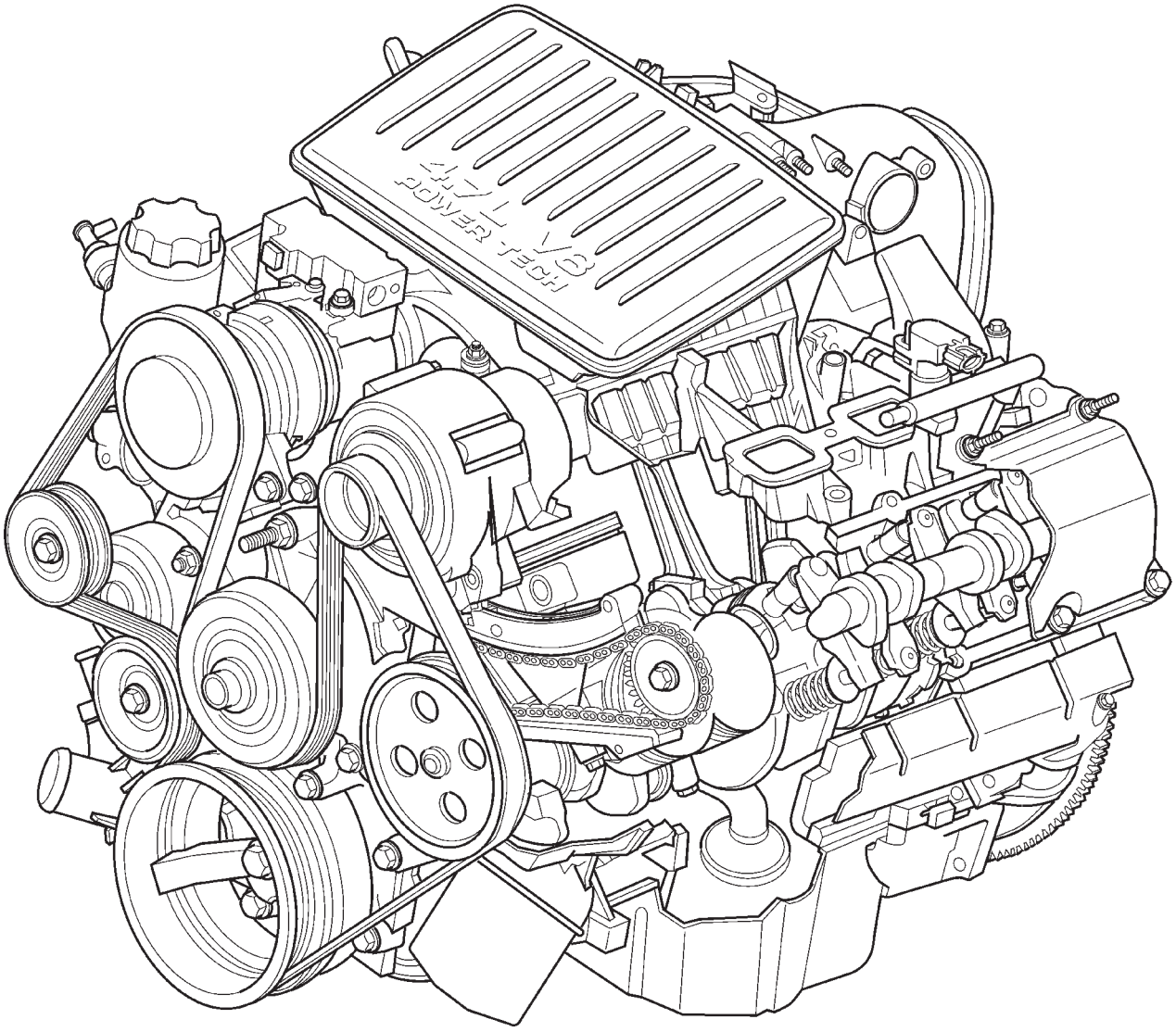
DESCRIPTION AND OPERATION

4.7L ENGINE



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4.7L GENERAL SPECIFICATIONS

Type	90° SOHC V-8
Displacement	4.7 Liters 4701cc (287 Cubic Inches)
Bore	93.0 mm (3.66 in.)
Stroke	86.5 mm (3.40 in.)
Compression Ratio	9.0:1
Horsepower	230 BHP @ 4600 RPM
Torque	300 LB-FT @ 3200 RPM
Lead Cylinder	#1 Left Bank
Firing Order	1-8-4-3-6-5-7-2
Cylinder Block	Cast Iron
Cylinder Head	Aluminum
Connecting Rod	Powdered Metal With Cracked Cap
Piston	Aluminum (Press-Fit Wrist Pin)
Lubrication	Pressure Feed-Full Flow Filtration (Direct Crankshaft Driven Pump)
Cooling System	Liquid Cooled-forced Circulation

DESCRIPTION AND OPERATION (Continued)

ENGINE IDENTIFICATION

The engine is stamped with the vehicles identification number. This area is located at the right front side of the engine block. The engine build date code is included in the yellow bar code sticker on the oil fill housing. (Fig. 1).

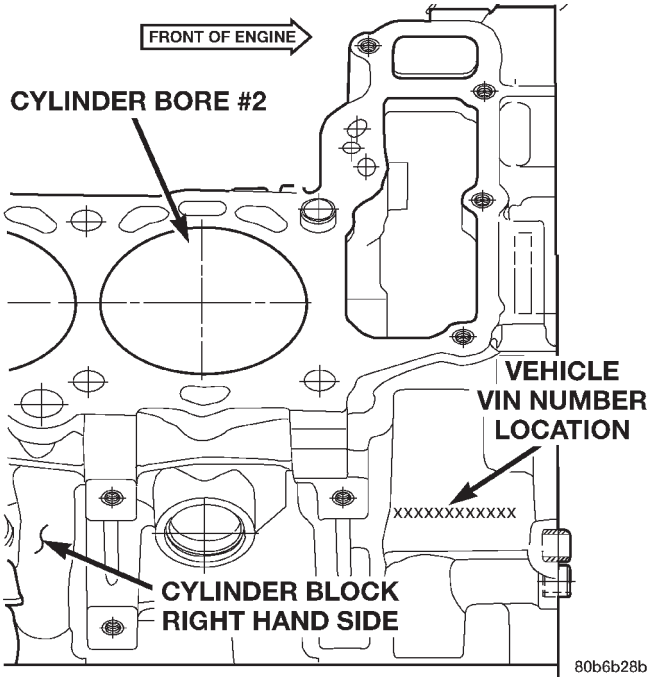

Fig. 1 4.7L Engine Identification

LUBRICATION SYSTEM

The lubrication system (Fig. 2) is a full flow filtration pressure feed type. Oil from the oil pan is pumped by a geroter type oil pump directly mounted to the crankshaft nose. Oil pressure is controlled by a relief valve mounted inside the oil pump housing. For lubrication flow refer to the chart below.

The camshaft exhaust valve lobes and rocker arms are lubed through a small hole in the rocker arm, oil flows through the lash adjuster then through the rocker arm and onto the camshaft lobe. Due to the design of the rocker arm configuration the camshaft intake lobes are not lubed in the same manner as the exhaust lobes, So the intake lobes are lubed through internal passages in the camshaft. Oil flows through a bore in the number 3 camshaft bearing bore, as the camshaft turns, a hole in the camshaft aligns with the hole in the camshaft bore allowing engine oil to enter the camshaft tube. The oil then exits through 1.6mm (0.063 in.) holes drilled into the intake lobes, lubing the lobes and the rocker arms.

ENGINE LUBRICATION FLOW CHART— BLOCK: TABLE 1

FROM	TO
Oil Pickup Tube	Oil Pump
Oil Pump	Oil Filter
Oil Filter	Block Main Oil Gallery
Block Main Oil Gallery	1. Crankshaft Main Journal 2. Left Cylinder Head* 3. Right Cylinder Head*
Crankshaft Main Journals	Crankshaft Rod Journals
Crankshaft Number One Main Journal	1. Front Timing Chain Idler Shaft 2. Both Secondary Chain Tensioners
Left Cylinder Head	See Table 2
Right Cylinder Head	See Table 2
* The cylinder head gaskets have an oil restricter to control oil flow to the cylinder heads.	

4.7L ENGINE COMPONENTS

ENGINE LUBRICATION FLOW CHART— CYLINDER HEADS: TABLE 2

Cylinder Head Oil Port (in bolt hole)	Diagonal Cross Drilling to Main Oil Gallery
Main Oil Gallery (drilled through head from rear to front)	1. Base of Camshaft Towers 2. Lash Adjuster Towers
Base of Camshaft Towers	Vertical Drilling Through Tower to Camshaft Bearings**
Lash Adjuster Towers	Diagonal Drillings to Hydraulic Lash Adjuster Pockets
** The number three camshaft bearing journal feeds oil into the hollow camshaft tubes. Oil is routed to the intake lobes, which have oil passages drilled into them to lubricate the rocker arms.	

DESCRIPTION AND OPERATION (Continued)

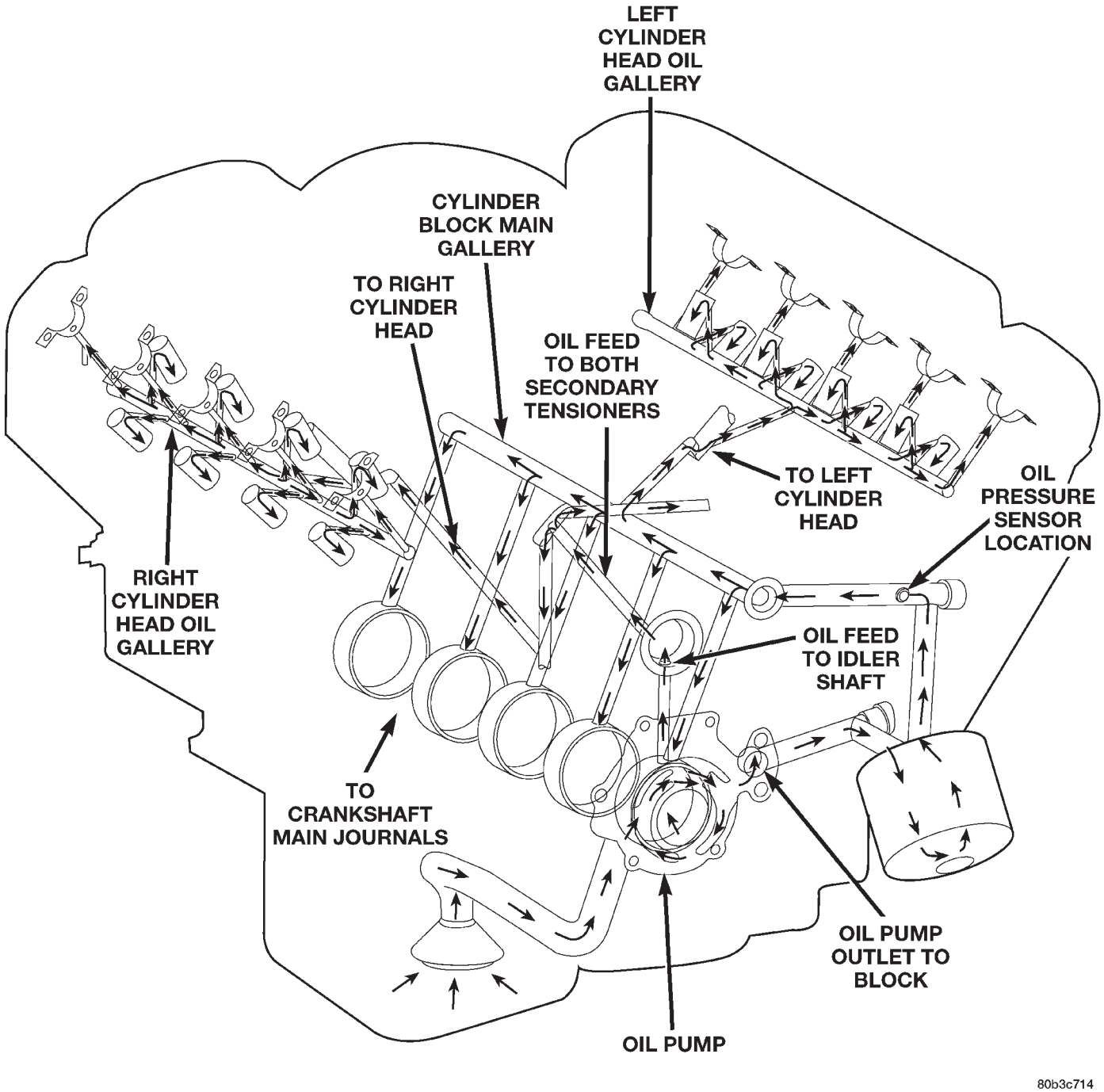

Fig. 2 Engine Oil Lubrication System

CYLINDER BLOCK

The cylinder block is made of cast iron. The block is a closed deck design with the left bank forward. To provide high rigidity and improved NVH an enhanced compacted graphite bedplate is bolted to the block. The block design allows coolant flow between the cylinders bores, and an internal coolant by pass to a dual poppet inlet thermostat is included in the cast aluminum front cover.

CRANKSHAFT

The crankshaft is constructed of nodular cast iron. The crankshaft is a crosshaped four throw design with eight counterweights for balancing purposes. The crankshaft is supported by five select main bearings with the number three serving as the thrust washer location. The main journals of the crankshaft are cross drilled to improve rod bearing lubrication. The number eight counterweight has provisions for crankshaft position sensor target wheel mounting.

DESCRIPTION AND OPERATION (Continued)

The select fit main bearing markings are located on the rear side of the target wheel. The crankshaft oil seals are one piece design. The front oil seal is retained in the timing chain cover, and the rear seal is pressed in to a bore formed by the cylinder block and the bedplate assembly.

PISTONS AND CONNECTING RODS

The pistons are made of a high strength aluminum alloy with an anodized top ring groove and crown. Piston skirts are coated with a solid lubricant (Molykote) to reduce friction and provide scuff resistance. The connecting rods are made of powdered metal, with a “fractured cap” design. A pressed fit piston pin is used to attach the piston and connecting rod.

NOTE: Do not use a metal stamp to mark connecting rods as damage may result, instead use ink or a scratch awl.

CYLINDER HEADS

The cylinder heads are made of an aluminum alloy. The cylinder head features two valves per cylinder with pressed in powdered metal valve guides. The cylinder heads also provide enclosures for the timing chain drain, necessitating unique left and right cylinder heads.

TIMING DRIVE SYSTEM

The timing drive system has been designed to provide quiet performance and reliability to support a **non-free wheeling** engine. Specifically the intake valves are non free wheeling and can be easily damaged with forceful engine rotation if camshaft-to-crankshaft timing is incorrect. The timing drive system consist of a primary chain and two secondary timing chain drives.

The primary timing chain is a single inverted tooth type. The primary chain drives the large fifty tooth idler sprocket directly from a 25 tooth crankshaft sprocket. Primary chain motion is controlled by a pivoting leaf spring tensioner arm and a fixed guide. The arm and the guide both use nylon plastic wear faces for low friction and long wear. The primary chain receives oil splash lubrication from the secondary chain drive and oil pump leakage. The idler sprocket assembly connects the primary and secondary chain drives. The idler sprocket assembly consists of two integral thirty tooth sprockets and a fifty tooth sprocket that is splined to the assembly. The spline joint is a press fit anti rattle type. A spiral ring is installed on the outboard side of the fifty tooth sprocket to prevent spline disengagement. The idler sprocket assembly spins on a stationary idler shaft. The idler shaft is press fit into the cylinder block. A large washer on the idler shaft bolt and the rear flange of the idler shaft are used to control sprocket thrust movement. Pressurized oil is routed through the center of the idler shaft to provide lubrication for the two bushings used in the idler sprocket assembly.

There are two secondary drive chains, both are inverted tooth type, one to drive the camshaft in each SOHC cylinder head. There are no shaft speed changes in the secondary chain drive system. Each secondary chain drives a thirty tooth cam sprocket directly from the a thirty tooth sprocket on the idler sprocket assembly. A fixed chain guide and a hydraulic oil damped tensioner are used to maintain tightness in each secondary chain system. The hydraulic tensioners for the secondary chain systems are fed pressurized oil from oil reservoir pockets in the block. Each tensioner also has a mechanical ratchet system that limits chain slack if the tensioner piston bleeds down after engine shut down. The tensioner arms and guides also utilize nylon wear faces for low friction and long wear. The secondary timing chains receive lubrication from a small orifice in the tensioners. This orifice is protected from clogging by a fine mesh screen which is located on the back of the hydraulic tensioners.

CAMSHAFTS

The camshafts consist of powdered metal steel lobes which are sinter-bonded to a steel tube. A steel post or nose piece is friction welded to the camshaft steel tube. Five bearing journals are machined into the camshaft, four on the steel tube and one on the steel nose piece. Camshaft end play is controlled by two thrust walls that border the nose piece journal. Engine oil enters the hollow camshafts at the third journal and lubricates every intake lobe rocker through a drilled passage in the intake lobe.

ROCKER ARMS

The rocker arms are steel stampings with an integral roller bearing. The rocker arms incorporate a 2.8 mm (0.11 inch) oil hole in the lash adjuster socket for roller and camshaft lubrication.

VALVES

The valves are made of heat resistant steel and have chrome plated stems to prevent scuffing. Each valve is actuated by a roller rocker arm which pivots on a stationary lash adjuster. All valves use three bead lock keepers to retain the springs and promote valve rotation.

VALVE SPRINGS

The valve springs are made from high strength chrome silicon steel. The springs are common for

DESCRIPTION AND OPERATION (Continued)

intake and exhaust applications. The valve spring seat is integral with the valve stem seal, which is a positive type seal to control lubrication.

CYLINDER HEAD COVERS

The cylinder head covers are made of die cast magnesium, and are not interchangeable from side-to-side. It is imperative that nothing rest on the cylinder head covers. Prolonged contact with other items may wear a hole in the cylinder head cover.

HYDRAULIC LASH ADJUSTERS

Valve lash is controlled by hydraulic lash adjusters that are stationary mounted in the cylinder heads. The lash adjusters have a hole in the ball plunger that feeds oil through the rocker arm squirt holes for rocker arm roller and camshaft lobe lubrication.

VALVE GUIDES

The valve guides are made of powered metal and are pressed into the cylinder head. The guides are not replaceable or serviceable, valve guide reaming is not recommended. If the guides are worn beyond acceptable limits, replace the cylinder heads.

OIL PAN

The engine oil pan is made of laminated steel and has a single plane sealing surface. The sandwich style oil pan gasket has an integrated windage tray and steel carrier. The sealing area of the gasket is molded with rubber and is designed to be reused as long as the gasket is not cut, torn or ripped.

STRUCTURAL DUST COVER

The structural dust cover is made of die cast aluminum and joins the lower half of the transmission bell housing to the engine bedplate. The structural cover provides additional powertrain stiffness and reduces noise and vibration.

VALVE STEM SEALS

The valve stem seals are made of rubber and incorporate an integral steel valve spring seat. The integral garter spring maintains consistent lubrication control to the valve stems.

INTAKE MANIFOLD

The intake manifold is made of a composite material and features long runners which maximizes low end torque. The intake manifold uses single plane sealing which consist of eight individual press in place port gaskets to prevent leaks. Eight studs and two bolts are used to fasten the intake to the head.

EXHAUST MANIFOLD

The exhaust manifolds are log style with a patented flow enhancing design to maximize performance. The exhaust manifolds are made of high silicon molybdenum cast iron. A perforated core graphite exhaust manifold gasket is used to improve sealing to the cylinder head. The exhaust manifolds are covered by a three layer laminated heat shield for thermal protection and noise reduction. The heat shields are fastened with a torque prevailing nut that is backed off slightly to allow for the thermal expansion of the exhaust manifold.

DIAGNOSIS AND TESTING

CHECKING ENGINE OIL PRESSURE

(1) Remove oil pressure sending unit (Fig. 3) and install gauge assembly C-3292.

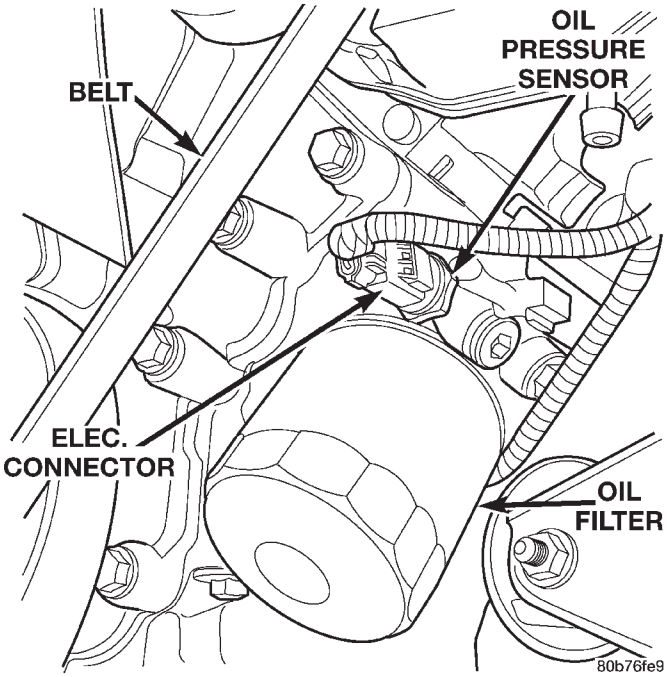

Fig. 3 Oil Pressure Sending Unit

(2) Run engine until thermostat opens.
(3) Oil Pressure:
- Curb Idle—25 Kpa (4 psi) minimum
- 3000 rpm—170 - 550 KPa (25 - 80 psi)

(4) If oil pressure is 0 at idle, shut off engine. Check for a clogged oil pick-up screen or a pressure relief valve stuck open.

SERVICE PROCEDURES

ENGINE TIMING—VERIFICATION

CAUTION: The 4.7L is a non free-wheeling design engine. Therefore, correct engine timing is critical.

NOTE: Components referred to as left hand or right hand are as viewed from the drivers position inside the vehicle.

NOTE: The blue link plates on the chains and the dots on the camshaft drive sprockets may not line up during the timing verification procedure. The blue link plates are lined up with the sprocket dots only when re-timing the complete timing drive. Once the timing drive is rotated blue link-to-dot alignment is no longer valid.

Engine base timing can be verified by the following procedure:

(1) Remove the cylinder head covers. Refer to the procedure in this section.

(2) Using a mirror, locate the TDC arrow on the front cover (Fig. 4). Rotate the crankshaft until the mark on the crankshaft damper is aligned with the TDC arrow on the front cover. The engine is now at TDC.

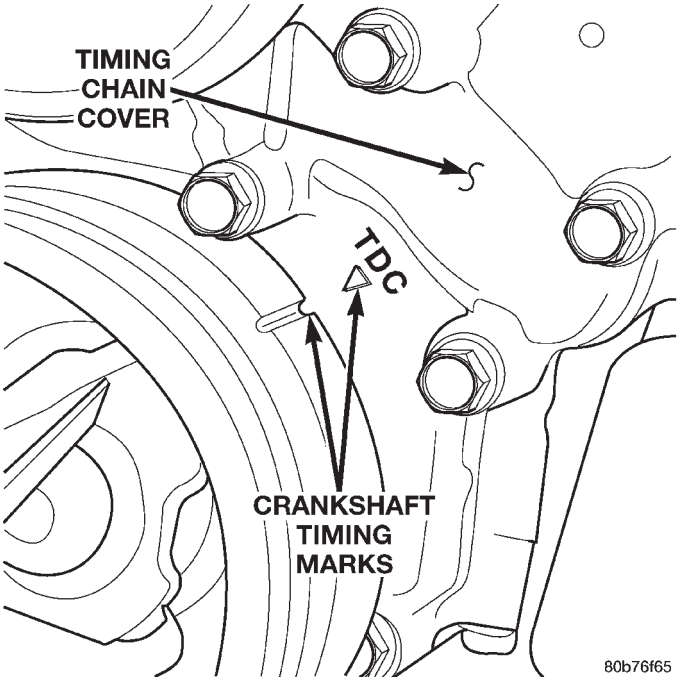

Fig. 4 Engine Top Dead Center (TDC) Indicator Mark

(3) Note the location of the V8 mark stamped into the camshaft drive gears (Fig. 5). If the V8 mark on each camshaft drive gear is at the twelve o'clock position, the engine is at TDC on the exhaust stroke. If the V8 mark on each gear is at the six o'clock position, the engine is at TDC on the compression stroke.

(4) If both of the camshaft drive gears are off in the same or opposite directions, the primary chain or both secondary chains are at fault. Refer to Timing Chain and Sprockets procedure in this section.

(5) If only one of the camshaft drive gears is off and the other is correct, the problem is confined to one secondary chain. Refer to Single camshaft timing, in this procedure.

(6) If both camshaft drive gear V8 marks are at the twelve o'clock or the six o' clock position the engine base timing is correct. Reinstall the cylinder head covers.

SINGLE CAMSHAFT TIMING

NOTE: to adjust the timing on one camshaft, preform the following procedure.

(1) Using Chain Tensioner Wedge, special tool 8350, stablize the secondary chain drive. For reference purposes, mark the chain-to-sprocket position.

(2) Remove the camshaft drive gear retaining bolt.

(3) Carefully remove the camshaft drive gear from the camshaft.

(4) Re-index the camshaft drive gear in the chain until the V8 mark is at the same position as the V8 mark on the opposite camshaft drive gear.

NOTE: When gripping the camshaft, place the pliers on the tube portion of the camshaft only. Do not grip the lobes or the sprocket areas.

(5) Using a suitable pair of adjustable pliers, rotate the camshaft until the alignment dowel on the camshaft is aligned with the slot in the camshaft drive gear (Fig. 6).

(6) Position the camshaft drive gear onto the camshaft, and install the retaining bolt. Using Special Tools, Spanner Wrench 6958 with Adapter Pins 8346 and a suitable torque wrench, Tighten retaining bolt to 122N·m (90 ft. Lbs.) (Fig. 7) (Fig. 8).

(7) Remove special tool 8350.

(8) Rotate the crankshaft two full revolutions, then reverify that the camshaft drive gear V8 marks are in fact aligned.

(9) Install the cylinder head covers. Refer to Cylinder Head Cover in this section.

MEASURING TIMING CHAIN WEAR

NOTE: This procedure must be performed with the timing chain cover removed.

SERVICE PROCEDURES (Continued)

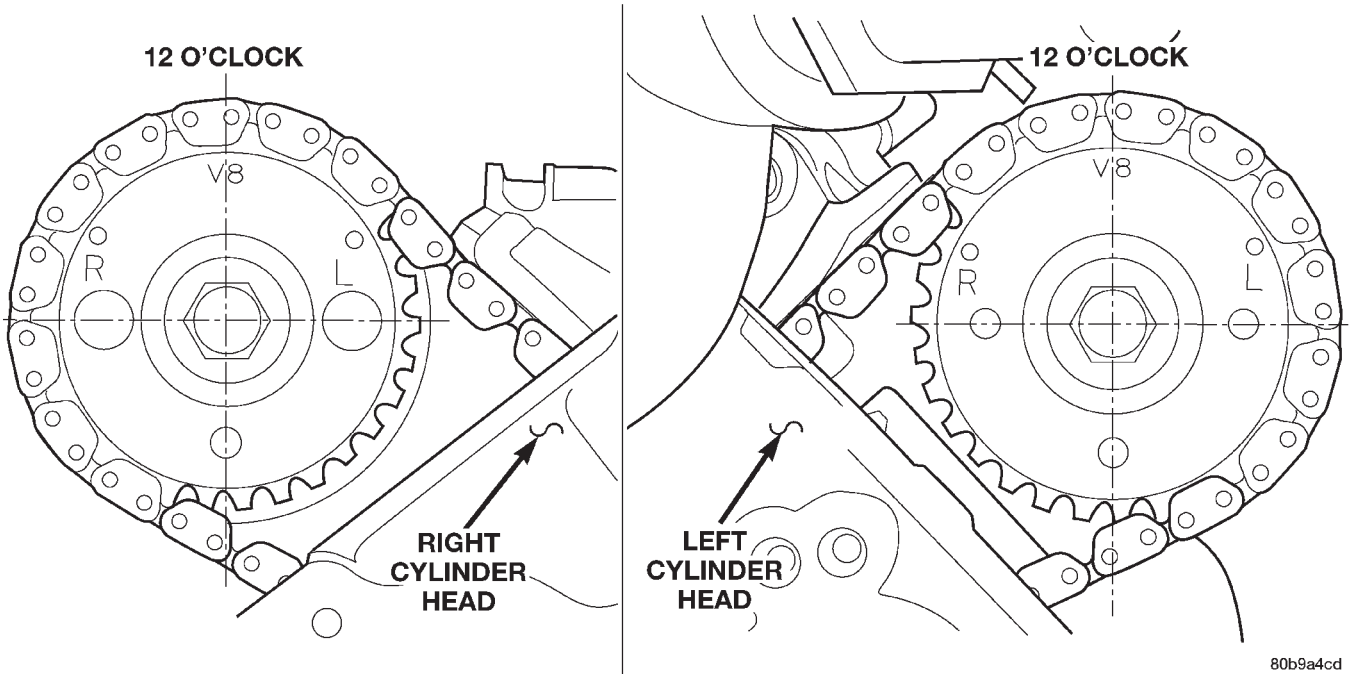

Fig. 5 Camshaft Sprocket V8 Marks

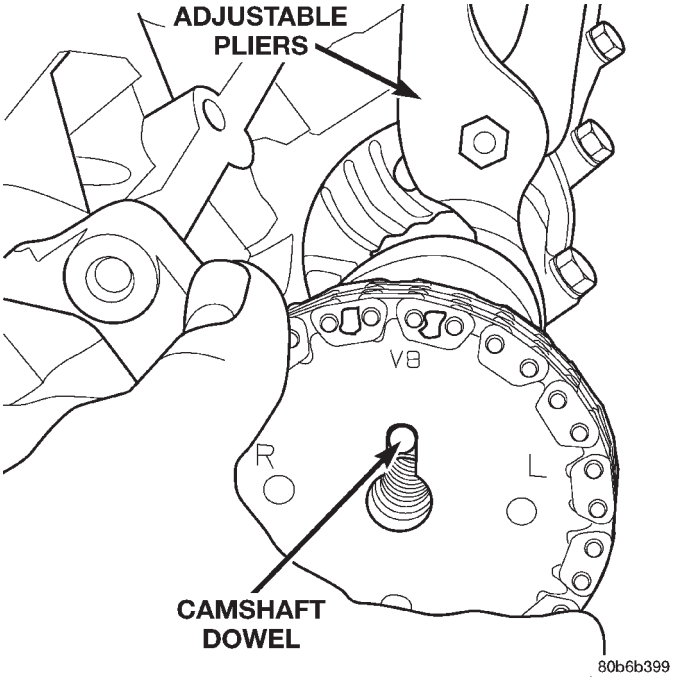

Fig. 6 Camshaft Dowel To Sprocket Alignment

(1) Remove the timing chain cover. Refer to Timing Chain Cover in this section for procedure.

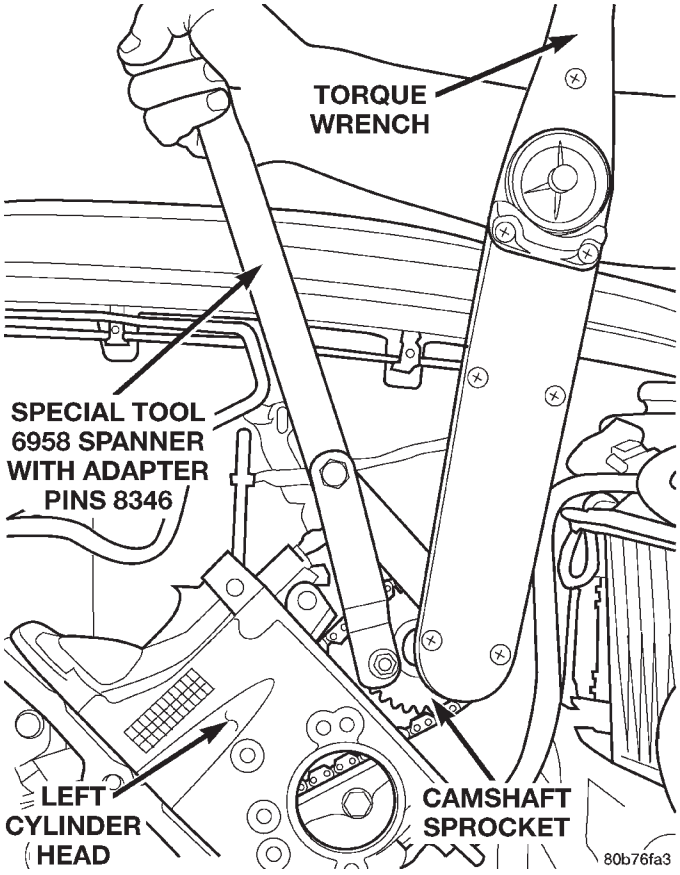

Fig. 7 Camshaft Sprocket Installation—Left Cylinder Head

SERVICE PROCEDURES (Continued)

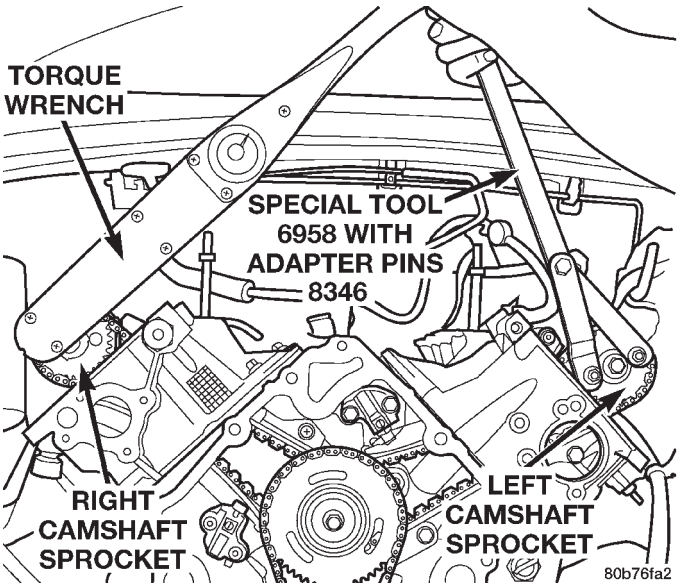

Fig. 8 Camshaft Sprocket Installation—Right Cylinder Head

(2) To determine if the secondary timing chains are worn, rotate the engine clockwise until maximum tensioner piston extension is obtained. Measure the distance between the secondary timing chain tensioner housing and the step ledge on the piston (Fig. 9). The measurement at point (A) must be less than 15mm (.5906 inches).

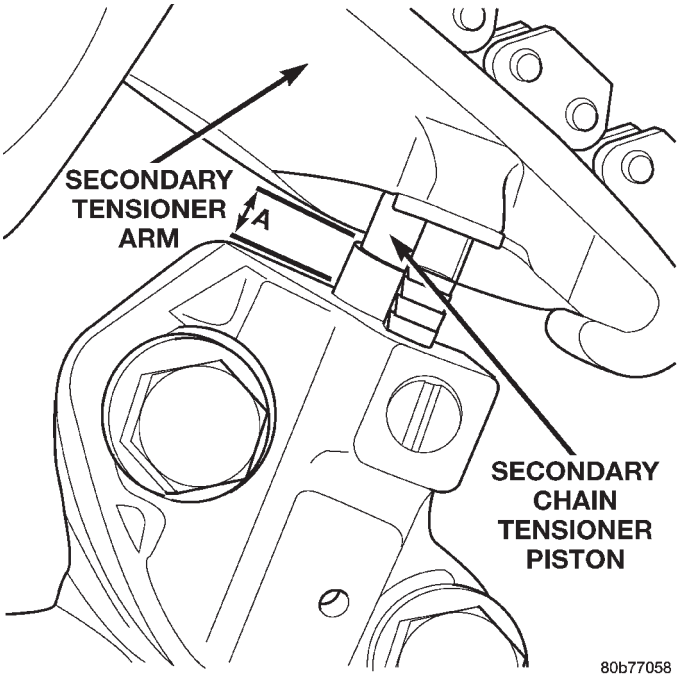

Fig. 9 Measuring Secondary Timing Chains For Stretch

(3) If the measurement exceeds the specification the secondary timing chains are worn and require replacement. Refer to Timing Chain and Sprockets in this section for procedure.

FITTING PISTONS

BORE GAGE METHOD

(1) To correctly select the proper size piston, a cylinder bore gauge, capable of reading in 0.003 mm (.0001 in.) INCREMENTS is required. If a bore gauge is not available, do not use an inside micrometer.

(2) Measure the inside diameter of the cylinder bore at a point 49.5 mm (1-15/16 inches) below top of bore. Start perpendicular (across or at 90 degrees) to the axis of the crankshaft at point A and then take an additional bore reading 90 degrees to that at point B (Fig. 11).

(3) The coated pistons will be serviced with the piston pin and connecting rod pre-assembled. Tin coated pistons should not be used as replacements for coated pistons.

(4) The coating material is applied to the piston after the final piston machining process. Measuring the outside diameter of a coated piston will not provide accurate results (Fig. 10). Therefore measuring the inside diameter of the cylinder bore with a dial Bore Gauge is **MANDATORY** . To correctly select the proper size piston, a cylinder bore gauge capable of reading in 0.003 mm (.0001 in.) increments is required.

(5) Piston installation into the cylinder bore requires slightly more pressure than that required for non-coated pistons. The bonded coating on the piston will give the appearance of a line-to-line fit with the cylinder bore.

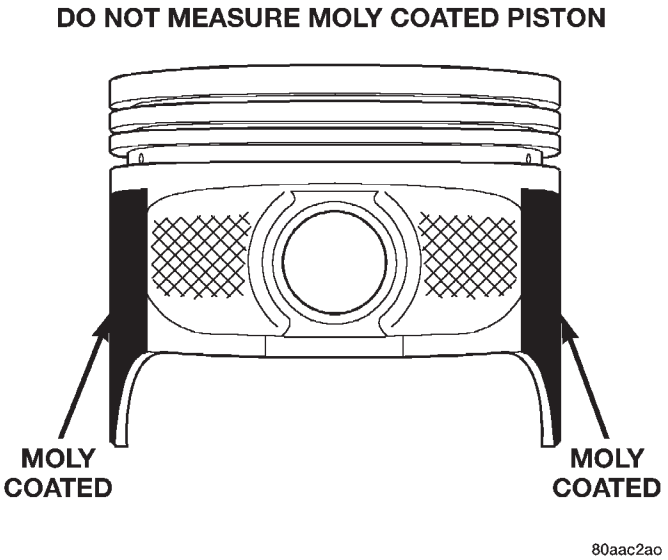

Fig. 10 Moly Coated Piston

SERVICE PROCEDURES (Continued)

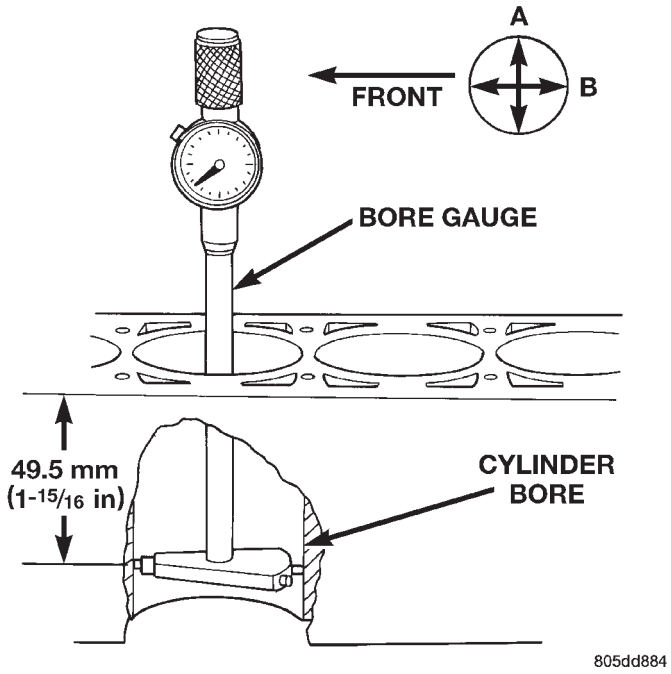

Fig. 11 Bore Gauge—Typical

FITTING PISTON RINGS

MEASUREMENT

RING END GAP

Before reinstalling used rings or installing new rings, the ring clearances must be checked.

(1) Wipe the cylinder bore clean.

(2) Insert the ring in the cylinder bore.

NOTE: The ring gap measurement must be made with the ring positioned at least 12mm (0.50 inch.) from bottom of cylinder bore.

(3) Using a piston, to ensure that the ring is squared in the cylinder bore, slide the ring downward into the cylinder.

(4) Using a feeler gauge check the ring end gap (Fig. 12). Replace any rings not within specification.

MEASURING PISTON RING SIDE CLEARANCE

NOTE: Make sure the piston ring grooves are clean and free of nicks and burrs.

(1) Measure the ring side clearance as shown (Fig. 13) make sure the feeler gauge fits snugly between the ring land and the ring. Replace any ring not within specification.

(2) Rotate the ring around the piston, the ring must rotate in the groove with out binding.

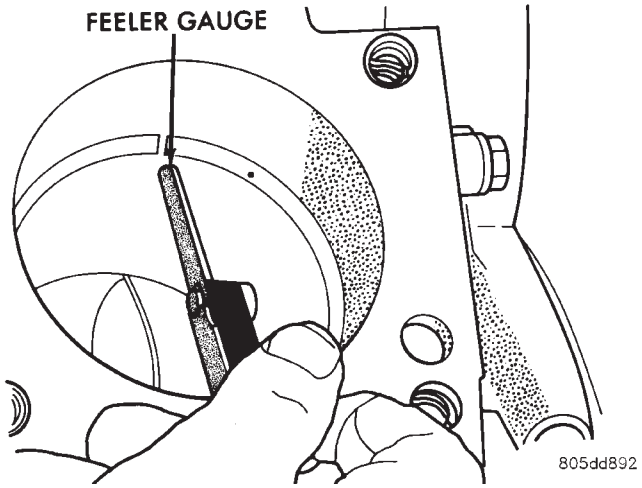

Fig. 12 Ring End Gap Measurement—Typical

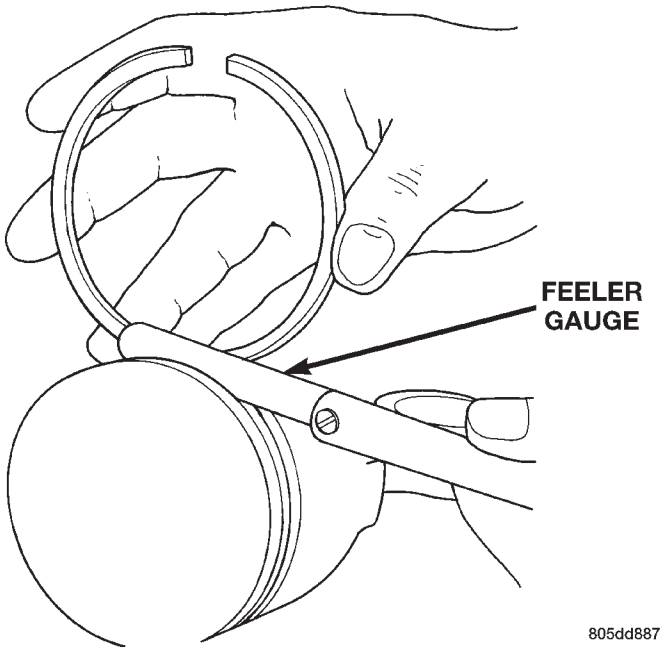

Fig. 13 Measuring Piston Ring Side Clearance

PISTON RINGS—INSTALLATION

(1) The No. 1 and No. 2 piston rings have a different cross section. Ensure No. 2 ring is installed with manufacturers I.D. mark (Dot) facing up, towards top of the piston.

NOTE: Piston rings are installed in the following order:

- **Oil ring expander.**
- **Upper oil ring side rail.**
- **Lower oil ring side rail.**
- **No. 2 Intermediate piston ring.**
- **No. 1 Upper piston ring.**

(2) Install the oil ring expander.

SERVICE PROCEDURES (Continued)

PISTON RING SPECIFICATION CHART

Ring Position	Groove Clearance	Maximum Clearance
Upper Ring	.051-.094mm (0.0020- .0037 in.	0.11mm (0.004 in.)
Intermediate Ring	0.04-0.08mm (0.0016-0.0031 in.)	0.10mm (0.004 in.)
Oil Control Ring (Steel Rails)	.019-.229mm (.0007-.0090 in.)	.25mm (0.010 in.)
Ring Position	**Ring Gap**	**Wear Limit**
Upper Ring:	0.20-0.36mm (0.008-0.014 in.)	0.10mm (0.004 in.)
Intermediate Ring:	0.37-0.63mm (0.014-0.025 in.)	0.10mm (0.004 in.)
Oil Control Ring (Steel Rail):	0.025-0.76mm (0.010- 0.030 in.)	0.23mm (0.0091 in.)

(3) Install upper side rail (Fig. 14) by placing one end between the piston ring groove and the expander ring. Hold end firmly and press down the portion to be installed until side rail is in position. Repeat this step for the lower side rail.

(4) Install No. 2 intermediate piston ring using a piston ring installer (Fig. 15).

(5) Install No. 1 upper piston ring using a piston ring installer (Fig. 15).

(6) Position piston ring end gaps as shown in (Fig. 16). It is important that expander ring gap is at least 45° from the side rail gaps, but not on the piston pin center or on the thrust direction.

FITTING CONNECTING ROD BEARINGS

INSPECTION

BEARINGS

Inspect the connecting rod bearings for scoring and bent alignment tabs (Fig. 17) (Fig. 18). Check the bearings for normal wear patterns, scoring, grooving, fatigue and pitting (Fig. 19). Replace any bearing that shows abnormal wear.

Inspect the connecting rod journals for signs of scoring, nicks and burrs.

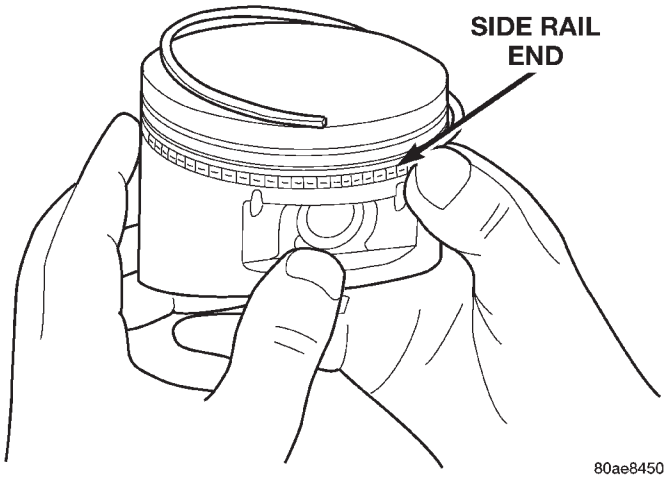

Fig. 14 Side Rail—Installation

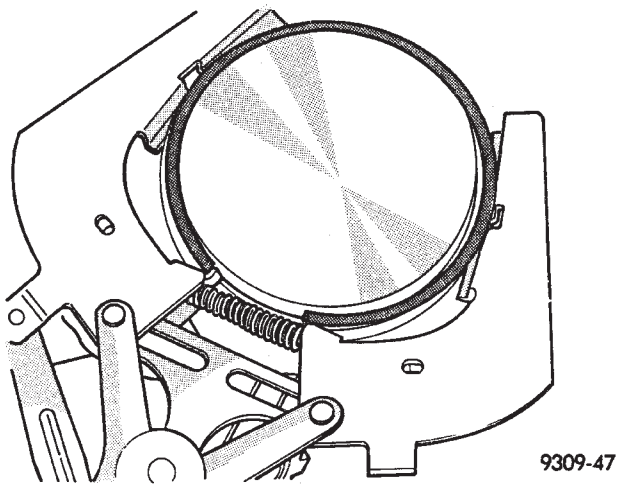

Fig. 15 Upper and Intermediate Rings—Installation

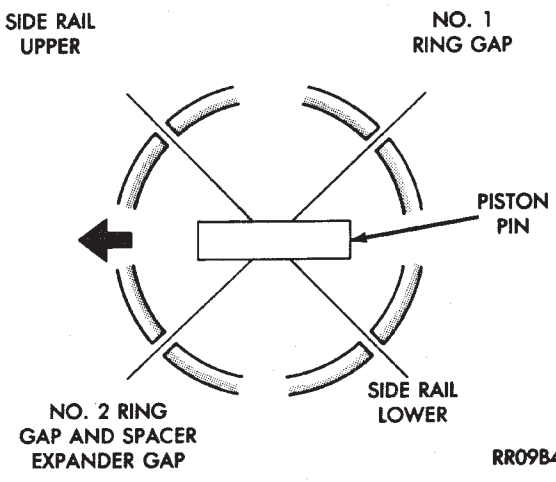

Fig. 16 Piston Ring End Gap Position

CONNECTING RODS

Misaligned or bent connecting rods can cause abnormal wear on pistons, piston rings, cylinder walls, connecting rod bearings and crankshaft con-

SERVICE PROCEDURES (Continued)

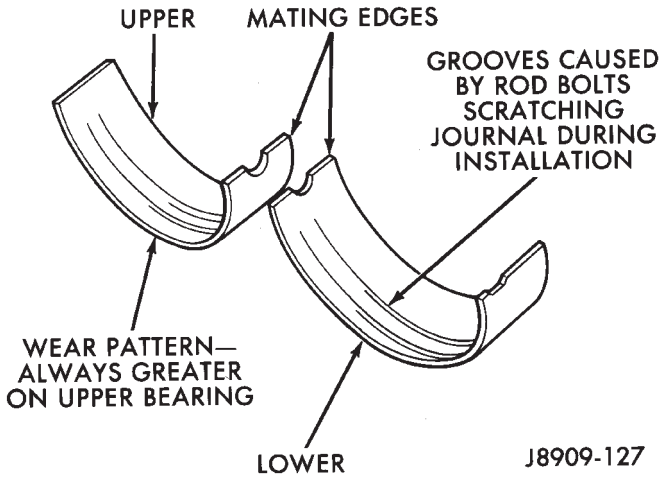

Fig. 17 Connecting Rod Bearing Inspection

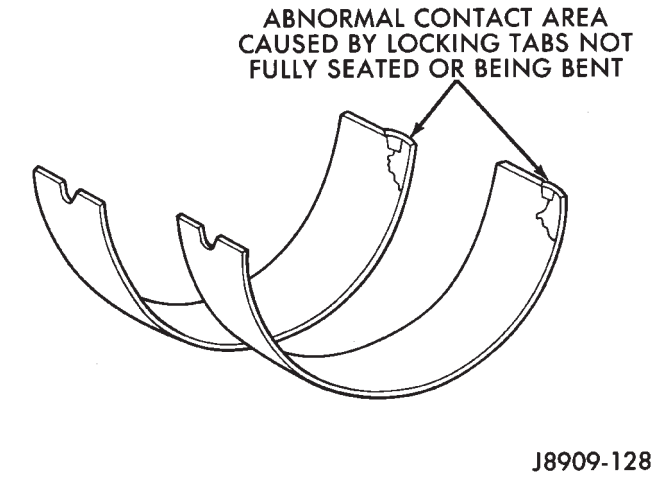

Fig. 18 Locking Tab Inspection

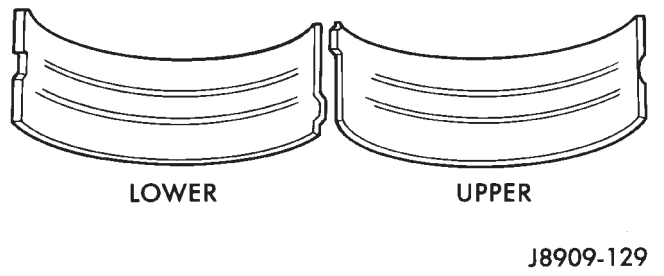

Fig. 19 Scoring Caused by Insufficient Lubrication or by Damaged Crankshaft Pin Journal

necting rod journals. If wear patterns or damage to any of these components indicate the probability of a misaligned connecting rod, inspect it for correct rod alignment. Replace misaligned, bent or twisted connecting rods.

BEARING-TO-JOURNAL CLEARANCE

(1) Wipe the oil from the connecting rod journal.

(2) Lubricate the upper bearing insert and install in connecting rod.

(3) Use piston ring compressor and Guide Pins Special Tool 8507 (Fig. 20) to install the rod and piston assemblies. The oil slinger slots in the rods must face front of the engine. The “F”’s near the piston wrist pin bore should point to the front of the engine.

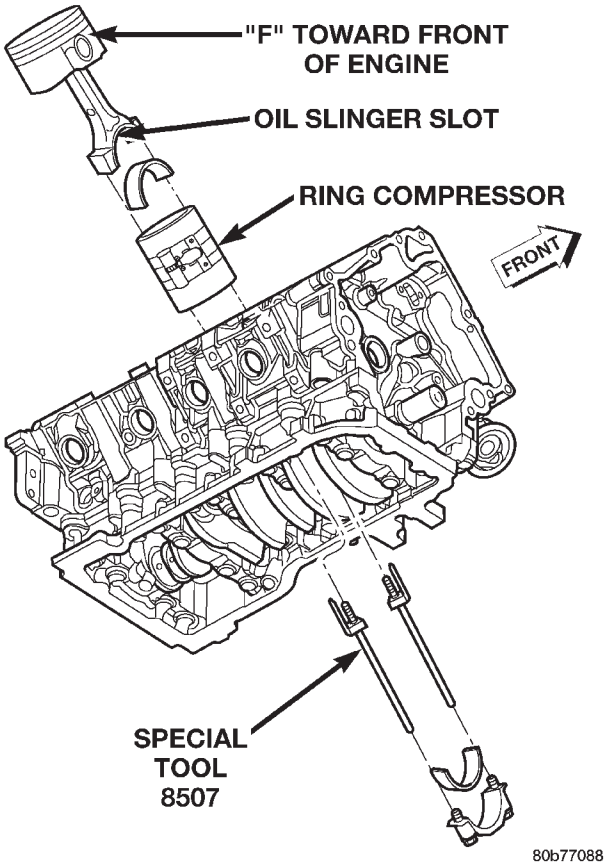

Fig. 20 Piston and Connecting Rod—Installation

(4) Install the lower bearing insert in the bearing cap. The lower insert must be dry. Place strip of Plastigage across full width of the lower insert at the center of bearing cap. Plastigage must not crumble in use. If brittle, obtain fresh stock.

(5) Install bearing cap and connecting rod on the journal and tighten bolts to 45 N·m (33 ft. lbs.) torque. DO NOT rotate crankshaft. Plastigage will smear, resulting in inaccurate indication.

(6) Remove the bearing cap and determine amount of bearing-to-journal clearance by measuring the width of compressed Plastigage (Fig. 21). Refer to Engine Specifications for the proper clearance. **Plastigage should indicate the same clearance across the entire width of the insert. If the clearance varies, it may be caused by either a tapered journal, bent connecting rod or foreign material trapped between the insert and cap or rod.**

(7) If the correct clearance is indicated, replacement of the bearing inserts is not necessary. Remove

SERVICE PROCEDURES (Continued)

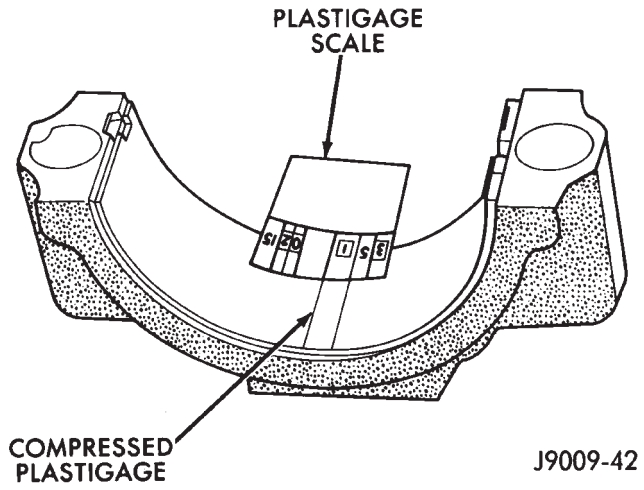

Fig. 21 Measuring Bearing Clearance with Plastigage

the Plastigage from crankshaft journal and bearing insert. Proceed with installation.

(8) If bearing-to-journal clearance exceeds the specification, determin which services bearing set to use the bearing sizes are as follows:

Bearing Mark	SIZE	USED WITH JOURNAL SIZE
.025 US	.025 mm (.001 in.) U/S	50.983-50.967 mm (2.0073-2.0066 in.)
Std.	STANDARD	50.992-51.008 mm (2.0076-2.0082 in.)
.250 US	.250 mm (.010 in.) U/S	50.758-50.742 mm (1.9984-1.9978 in.)

(9) Repeat the Plastigage measurement to verify your bearing selection prior to final assembly.

(10) Once you have selected the proper insert, install the insert and cap. Tighten the connecting rod bolts to 45 N·m (33 ft. lbs.) torque.

SIDE CLEARANCE MEASUREMENT

Slide snug-fitting feeler gauge between the connecting rod and crankshaft journal flange (Fig. 22). Refer to Engine Specifications for the proper clearance. Replace the connecting rod if the side clearance is not within specification.

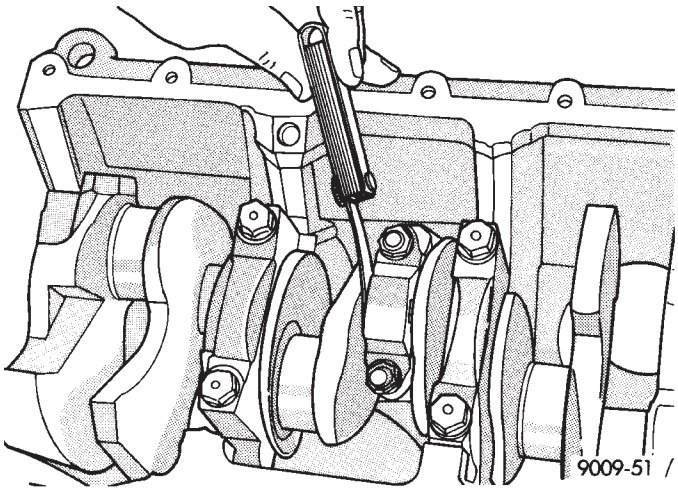

Fig. 22 Checking Connecting Rod Side Clearance—Typical

CRANKSHAFT MAIN BEARINGS

INSPECTION

Wipe the inserts clean and inspect for abnormal wear patterns and for metal or other foreign material imbedded in the lining. Normal main bearing insert wear patterns are illustrated (Fig. 23).

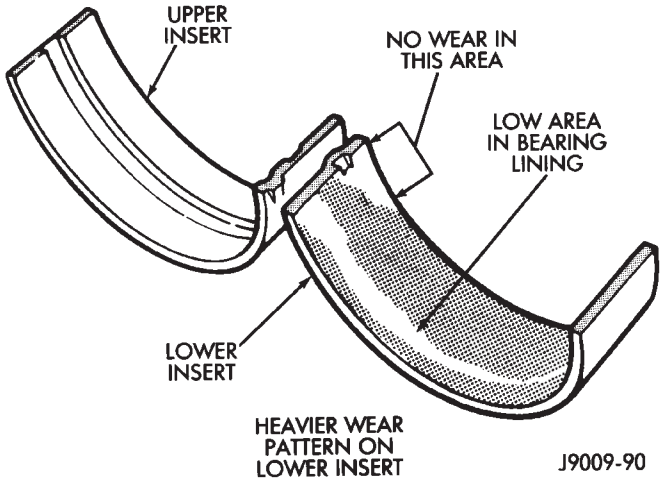

Fig. 23 Main Bearing Wear Patterns

NOTE: If any of the crankshaft journals are scored, remove the engine for crankshaft repair.

Inspect the back of the inserts for fractures, scrapings or irregular wear patterns.

Inspect the upper insert locking tabs for damage.

Replace all damaged or worn bearing inserts.

MAIN BEARING JOURNAL DIAMETER (CRANKSHAFT REMOVED)

Remove the crankshaft from the cylinder block. Refer to Crankshaft in this section for procedure.

Clean the oil off the main bearing journal.

SERVICE PROCEDURES (Continued)

Determine the maximum diameter of the journal with a micrometer. Measure at two locations 90° apart at each end of the journal.

The maximum allowable taper is 0.008mm (0.0004 inch.) and maximum out of round is 0.005mm (0.002 inch). Compare the measured diameter with the journal diameter specification (Main Bearing Fitting Chart). Select inserts required to obtain the specified bearing-to-journal clearance.

Install the crankshaft into the cylinder block. Refer to Crankshaft in this section for procedure.

CRANKSHAFT MAIN BEARING SELECTION

(1) Service main bearings are available in three grades. The chart below identifies the three service grades available.

GRADE MARKING	SIZE mm (in.)	FOR USE WITH JOURNAL SIZE
A	.008 mm (.0004 in.) U/S	63.488-63.496 mm (2.4996-2.4999 in.)
B	STANDARD	63.496-63.504 mm (2.4999-2.5002 in.)
C	.008 mm (.0004 in.) O/S	63.504-63.512 mm (2.5002-2.5005 in.)

REMOVAL AND INSTALLATION

ENGINE MOUNTS—LEFT AND RIGHT

REMOVAL

(1) Disconnect the negative cable from the battery.

CAUTION: Remove the fan blade, fan clutch and fan shroud before raising engine. Failure to do so may cause damage to the fan blade, fan clutch and fan shroud.

(2) Remove the fan blade, fan clutch and fan shroud. Refer to Group 7. for procedure.

(3) Remove the engine oil filter.

(4) Support the engine with a suitable jack and a block of wood across the full width of the engine oil pan.

(5) Remove the four cylinder block-to-insulator mount bolts and the nut form the engine insulator mount through bolt (Fig. 24) (Fig. 25)

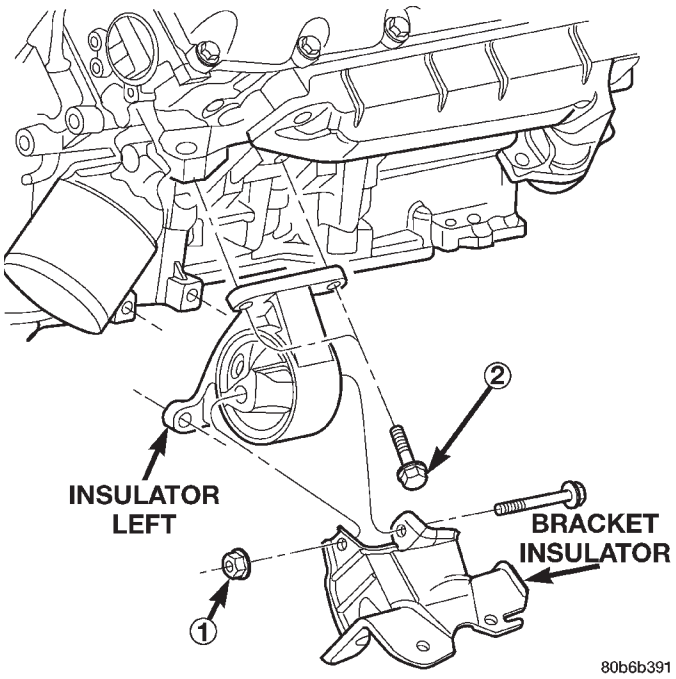

Fig. 24 Engine Insulator Mount—Left

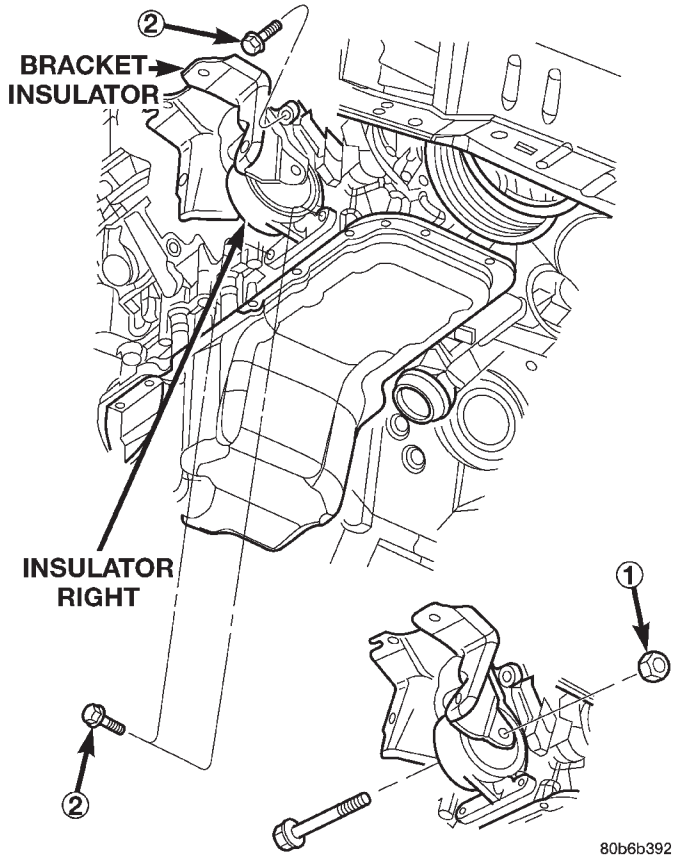

Fig. 25 Engine Insulator Mount—Right

(6) Using the jack, raise the engine high enough to remove the engine insulator mount through bolt and the insulator mount.

REMOVAL AND INSTALLATION (Continued)

ITEM	DESCRIPTION	TORQUE
1	NUT (Qty 1 Per Side)	61N·m (45 ft. lbs)
2	BOLT (Qty 4 Per Side)	61N·m (45 ft. lbs.)

INSTALLATION

(1) Position the insulator mount and install the insulator mount through bolt.

(2) Lower the engine until the four cylinder block-to-insulator mount bolts can be installed.

(3) Remove the jack and block of wood.

(4) Torque the cylinder block-to-insulator mount bolts to 61 N·m (45 ft. lbs.).

(5) Install and torque the through bolt retaining nut to 61 N·m (45 ft. lbs.).

(6) Install the fan blade, fan clutch and fan shroud.

ENGINE MOUNT—REAR

REMOVAL

(1) Raise vehicle on hoist.

(2) Using a suitable jack, support transmission.

(3) Remove the lock nut from the insulator mount through bolt and the four insulator-to-transmission mounting bolts.

(4) Raise the transmission enough to remove the through bolt and insulator mount (Fig. 26) (Fig. 27).

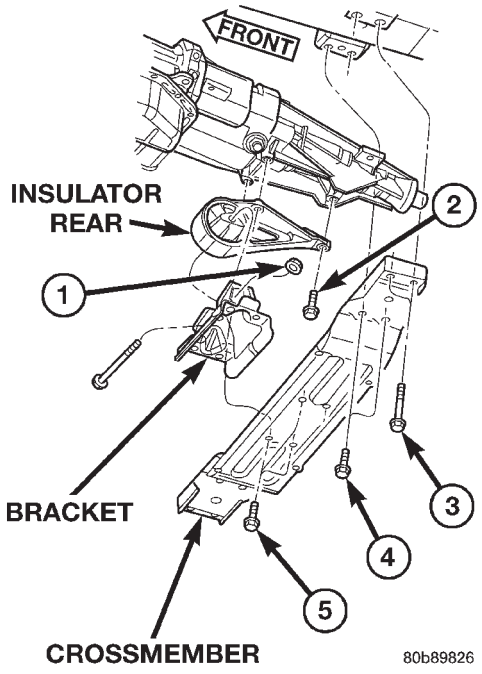

Fig. 26 Engine Rear Mount—4X2

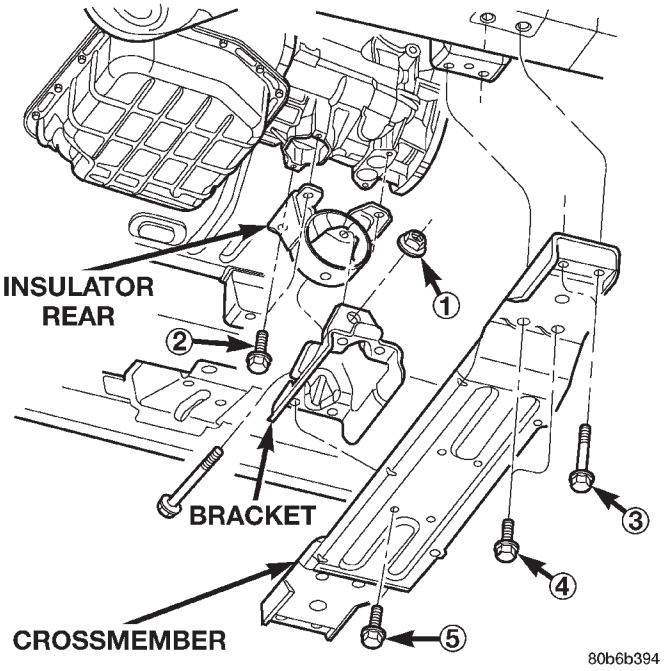

Fig. 27 Engine Rear Mount—4X4

ITEM	DESCRIPTION	TORQUE
1	NUT (Qty 1)	45 N·m (33 ft. lbs)
2	BOLT (Qty 4)	46 N·m (34 ft. lbs.)
3	BOLT (Qty 2 Per Side)	68 N·m (50 ft. lbs.)
4	BOLT (Qty 2 Per Side)	46 N·m (34 ft. lbs.)
5	BOLT (Qty 4)	46 N·m (34 ft. lbs.)

INSTALLATION

(1) Position the insulator mount and install the through bolt.

(2) Lower the transmission enough to install the four insulator-to-transmission mounting bolts. Torque the bolts to 46 N·m (34 ft. lbs.).

(3) Install the through bolt lock nut. Torque nut to 68 N·m (50 ft. lbs.).

(4) Remove jack, lower vehicle.

STRUCTURAL COVER

REMOVAL

(1) Raise vehicle on hoist.

(2) Remove the left hand exhaust pipe from exhaust manifold. Refer to Group 11, Exhaust System.

REMOVAL AND INSTALLATION (Continued)

(3) Loosen the right hand exhaust manifold-to-exhaust pipe retaining bolts.

(4) Remove the eight bolts retaining structural cover (Fig. 28).

(5) Pivot the exhaust pipe downward and remove the structural cover.

INSTALLATION

CAUTION: The structural cover must be installed as described in the following steps. Failure to do so will cause severe damage to the cover.

(1) Position the structural cover in the vehicle.

(2) Install all four bolts retaining the cover-to-engine. DO NOT tighten the bolts at this time.

(3) Install the four cover-to-transmission bolts. Do NOT tighten at this time.

CAUTION: The structural cover must be held tightly against both the engine and the transmission bell housing during tightening sequence. Failure to do so may cause damage to the cover.

(4) Starting with the two rear cover-to-engine bolts, tighten bolts (1) (Fig. 28) to 54 N·m (40 ft. lbs.), then tighten bolts (2) (Fig. 28) and (3) to 54 N·m (40 ft. lbs.) in the sequence shown.

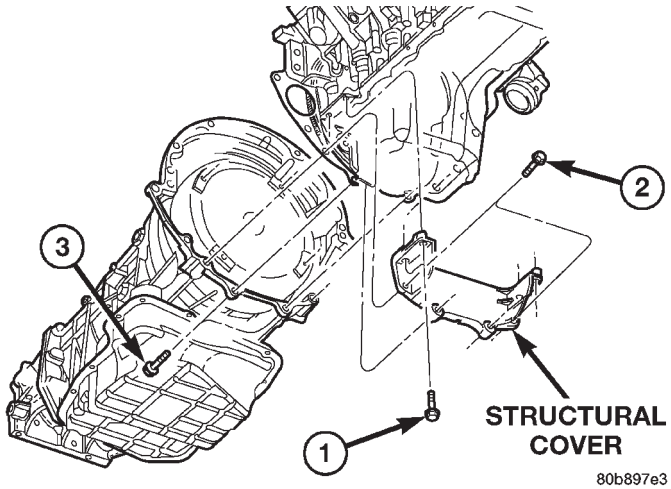

Fig. 28 Structural Cover

SEQUENCE	ITEM	TORQUE
1	BOLT (Qty 4)	54 N·m (40 ft. lbs.)
2	BOLT (Qty 2)	54 N·m (40 ft. lbs.)
3	BOLT (Qty 2)	54 N·m (40 ft. lbs.)

(5) Install the exhaust pipe on left hand exhaust manifold.

(6) Tighten exhaust manifold-to-exhaust pipe retaining bolts to 20–26 N·m (15–20 ft. lbs.).

ENGINE ASSEMBLY

REMOVAL

(1) Disconnect the battery negative cable.

(2) Remove front fascia. Refer to Group 13, Frames and Bumpers for procedure.

(3) Remove the head lamp mounting module (HMM). Refer to Group 23, Body for procedure.

(4) Raise vehicle on hoist.

(5) Disconnect the O2 sensor.

(6) Remove engine oil filter.

(7) Remove exhaust crossover pipe from the vehicle. Refer to Group 11, Exhaust System.

(8) Remove structural cover. Refer to Structural Cover in this section for procedure.

(9) Remove rubber splash shield.

(10) Drain cooling system. Refer to Group 7, Cooling System.

(11) Remove starter. Refer to Group 8B, Starting System.

(12) Disconnect crankshaft position sensor. (Fig. 29)

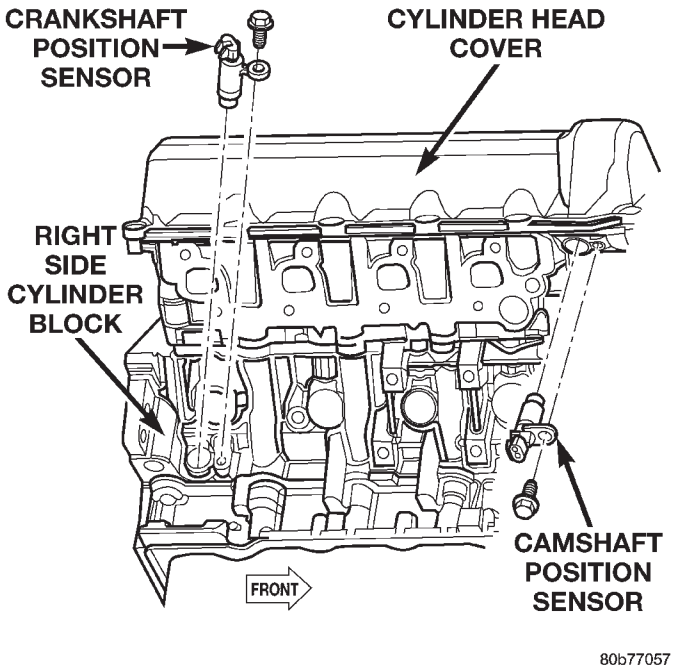

Fig. 29 Crankshaft Position Sensor

(13) Remove torque converter bolts. Refer to Group 21, Transmission.

Remove transmission to engine mounting bolts, all except the two lower bolts.

(14) Disconnect two ground straps from the lower right hand side of the engine.

(15) Lower vehicle.

REMOVAL AND INSTALLATION (Continued)

(16) Remove throttle body resonator assembly and inlet hose (Fig. 30).

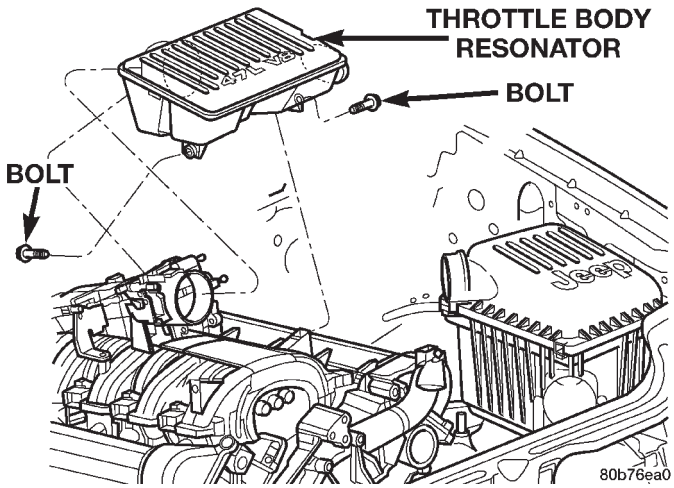

Fig. 30 Throttle Body Resonator

(17) Disconnect throttle and speed control cables.

(18) Disconnect tube from both the left and right side crankcase breathers (Fig. 31).

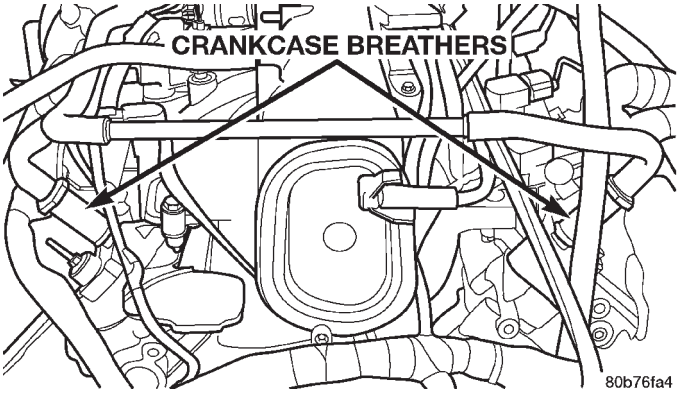

Fig. 31 Crankcase Breather Connection Points

(19) Discharge A/C system. Refer to Group 24, Heating and Air Conditioning.

(20) Remove A/C compressor.

(21) Remove shroud, fan assemblies and accessory drive belt. Refer to Group 7, Cooling System.

(22) Remove oil fill tube.

(23) Disconnect transmission oil cooler lines at the radiator.

(24) Disconnect radiator lower hose at the thermostat housing. Refer to Group 7.

(25) Remove radiator. Refer to Group 7, Cooling System.

(26) Remove A/C condenser. Refer to Group 24, Heating and Air Conditioning.

(27) Remove generator mounting bolts, set the generator aside.

(28) Disconnect the two heater hoses from the timing chain cover.

(29) Disconnect engine harness at the following points:

- Intake air temperature (IAT) sensor (Fig. 32)
- Fuel Injectors
- Throttle Position (TPS) Switch
- Idle Air Control (IAC) Motor
- Engine Oil Pressure Switch
- Engine Coolant Temperature (ECT) Sensor
- Manifold absolute pressure (MAP) Sensor
- Camshaft Position (CMP) Sensor
- Coil Over Plugs

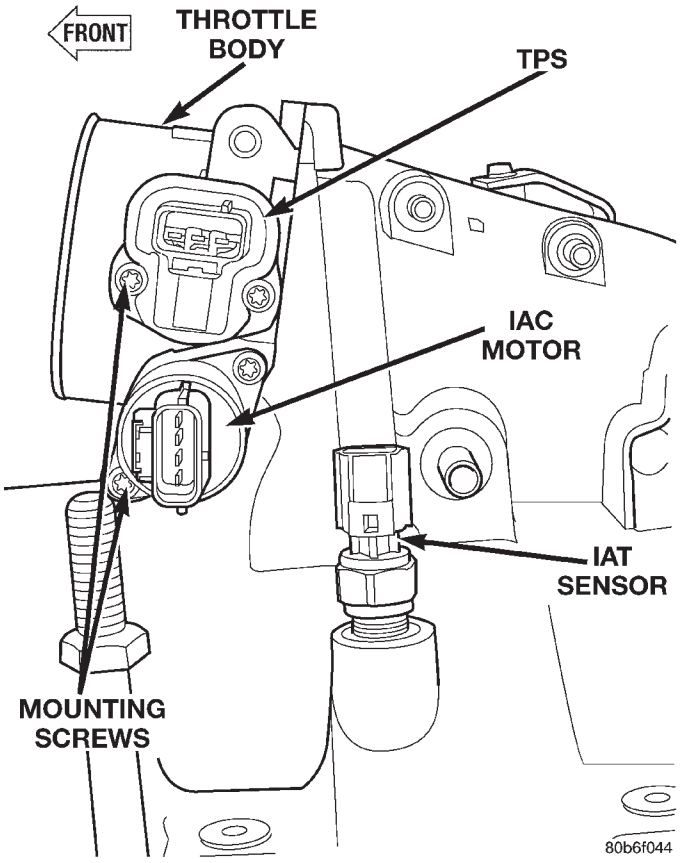

Fig. 32 Throttle Body Connection Points

(30) Release fuel rail pressure then disconnect the fuel supply quick connect fitting at the fuel rail. Refer to Group 14 Fuel System for procedure.

(31) Remove power steering pump and position out of the way.

(32) Disconnect ground straps from the left side of the engine.

(33) Remove oil dipstick tube upper mounting bolt. Then remove the generator wiring from behind the dipstick tube.

(34) Install Engine Lifting Fixture Special Tool 8347 (Fig. 33) following these steps.

- Holding the lifting fixture at a slight angle, slide the large bore in the front plate over the hex portion of the lifting stud.

REMOVAL AND INSTALLATION (Continued)

- Position the two remaining fixture arms onto the two lifting studs in the cylinder heads.
- Pull foward and upward on the lifting fixture so that the lifting stud rest in the slotted area below the large bore.
- Secure the lifting fixture to the three studs using three 7/16 – 14 N/C locknuts.
- Make sure the lifting loop in the lifting fixture is in the last hole (closest to the throttle body) to minimize the angle of engine during removal.

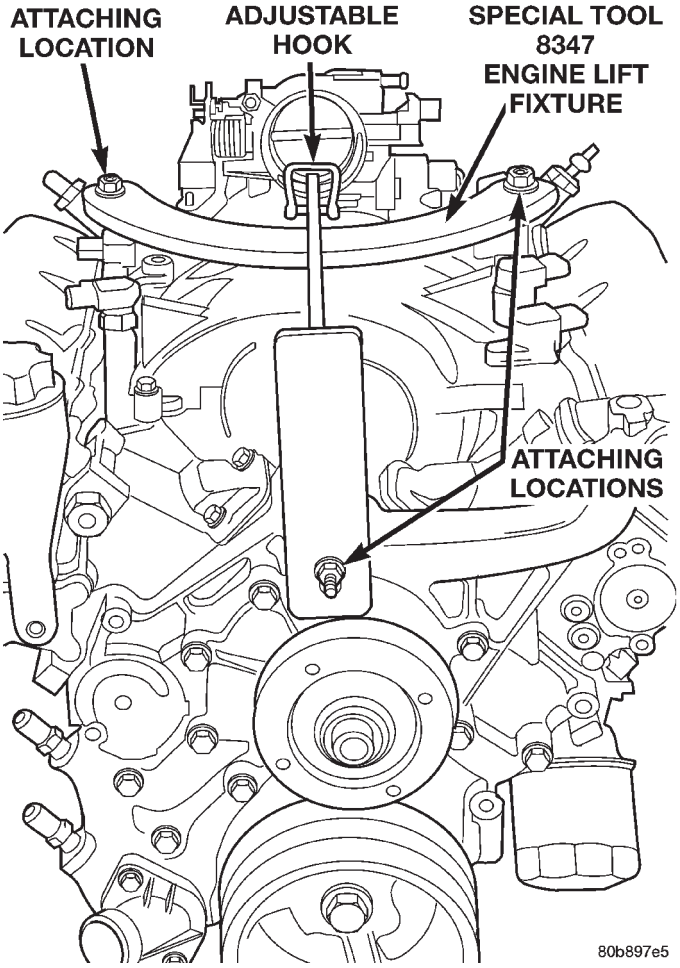

Fig. 33 Engine Lifting Fixture Attachment Locations

(35) Disconnect body ground strap at the right side cowl.

NOTE: In order to remove the engine from the vehicle the engine mount insulators must be removed from the engine.

(36) Remove both left and right side engine mount insulator to engine bolts.

NOTE: It will be necessary to support the transmission in order to remove the engine.

(37) Position a suitable jack under the transmission.

(38) Remove two lower transmission to engine mounting bolts.

(39) Remove the through bolt retaining nut from both the left and right side engine mounts.

(40) Raise engine enough to remove the engine mount through bolts and the engine mount insulators.

(41) Remove engine from the vehicle.

INSTALLATION

(1) Position engine in the vehicle.

Position both the left and right side engine mount insulators and install the through bolts.

(2) Install two lower transmission to engine mounting bolts.

(3) Remove jack from under the transmission.

(4) Install both the left and right side engine mount insulators onto the engine.

(5) Remove engine lifting fixture special tool 8347 (Fig. 33).

(6) Position generator wiring behind the oil dipstick tube, then install the oil dipstick tube upper mounting bolt.

(7) Connect ground straps on the left side of the engine.

(8) Install power steering pump.

(9) Connect fuel supply line quick connect fitting.

(10) Connect engine harness at the following points (Fig. 32):

- Intake Air Temperature (IAT) Sensor
- Idle Air Control (IAC) Motor
- Fuel Injectors
- Throttle Position (TPS) Switch
- Engine Oil Pressure Switch
- Engine Coolant Temperature (ECT) Sensor
- Manifold Absolute Pressure (MAP) Sensor
- Camshaft Position (CMP) Sensor
- Coil Over Plugs

(11) Install generator.

(12) Install A/C condenser.

(13) Install radiator.

(14) Connect radiator lower hose at the thermostat housing.

(15) Connect the transmission oil cooler lines to the radiator.

(16) Install oil fill tube.

(17) Install accessory drive belt, fan assembly and shroud.

(18) Install A/C compressor. Tighten the A/C compressor and generator M10 mounting bolts 40–68N·M (30–50 ft. lbs.) and the M8 bolts 22–34 N·m (200–300 in. lbs.).

(19) Connect tube to both crankcase breathers (Fig. 31).

REMOVAL AND INSTALLATION (Continued)

(20) Connect throttle and speed control cables.
(21) Install throttle body resonator assembly and inlet hose (Fig. 30).
(22) Raise vehicle.
(23) Connect two ground straps on the lower right hand side of the engine.
(24) Install transmission to engine mounting bolts. Tighten the bolts to 41 N·m (30 ft. lbs.).
(25) Install torque converter bolts.
(26) Connect crankshaft position sensor (Fig. 29).
(27) Install starter.
(28) Install rubber splash shield.

CAUTION: The structural cover requires a specific torque sequence. Failure to follow this sequence may cause severe damage to the cover.

(29) Install structural cover. Refer to Structural Cover in this section.
(30) Install exhaust crossover pipe.
(31) Install engine oil filter.
(32) Connect O2 sensor.
(33) Lower vehicle.
(34) Check and fill engine oil.
(35) Recharge the A/C system.
(36) Refill the engine cooling system. Refer to Group 7, Cooling System.
(37) Connect the battery negative cable.
(38) Start the engine and check for leaks.

INTAKE MANIFOLD

REMOVAL

(1) Disconnect negative cable from battery.
(2) Remove air cleaner housing and throttle body resonator (Fig. 34).

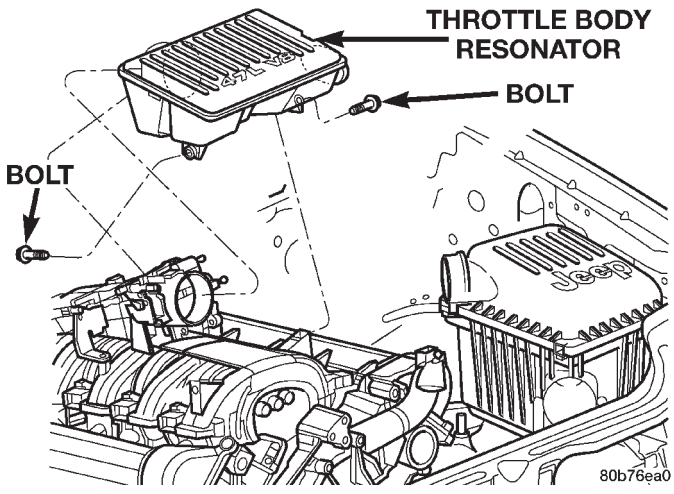

Fig. 34 Throttle Body Resonator

(3) Disconnect throttle and speed control cables.
(4) Disconnect electrical connectors for the following components: (Refer to Group 14, Fuel System for component locations)
- Manifold Absolute Pressure (MAP) Sensor
- Intake Air Temperature (IAT) Sensor
- Throttle Position (TPS) Sensor
- Coolant Temperature (CTS) Sensor
- Idle Air Control (IAC) Motor

(5) Disconnect vapor purge hose, brake booster hose, speed control servo hose, positive ventilation crankcase (PCV) hose.
(6) Remove accessory drive belt. Refer to Group 7, Cooling System for procedure.
(7) Disconnect generator electrical connections.
(8) Unbolt the generator and move it away from the intake manifold for clearance.
(9) Disconnect air conditioning compressor electrical connections.
(10) Unbolt the air conditioning compressor and move it away from the intake manifold for clearance.
(11) Disconnect left and right radio suppressor straps.
(12) Disconnect and remove ignition coil towers.
(13) Remove top oil dipstick tube retaining bolt and ground strap.
(14) Bleed fuel system. Refer to Group 14, Fuel System for bleeding procedures.
(15) Remove fuel rail.
(16) Remove throttle body assembly and mounting bracket.
(17) Drain cooling system below coolant temperature level. Refer to Group 7, Cooling System for procedure.
(18) Remove coolant temperature sensor. Refer to Group 14, Fuel System for component location.
(19) Remove cowl to hood seal. Refer to Group 23, Body for component location and procedure.
(20) Remove right side engine lifting stud.
(21) Remove intake manifold retaining fasteners, in reverse order of tightening sequence (Fig. 35).

NOTE: Intake must be lifted upward and level in the front and rear to clear the cowl. Interference with the cowl will occur during removal.

(22) Remove intake manifold.

INSTALLATION

(1) Install intake manifold gaskets.
(2) Install intake manifold.
(3) Install intake manifold retaining bolts and tighten in sequence shown in (Fig. 35) to 12 N·m (105 in. lbs.).
(4) Install left and right radio suppressor straps.
(5) Install throttle body assembly.
(6) Install throttle cable bracket.

REMOVAL AND INSTALLATION (Continued)

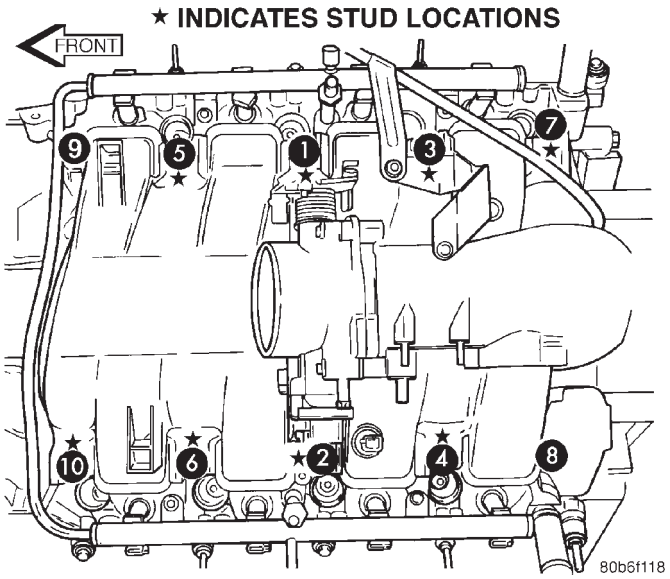

Fig. 35 Intake Manifold Tightening Sequence

(7) Connect throttle cable and speed control cable to throttle body.
(8) Install fuel rail.
(9) Install ignition coil towers.
(10) Install coolant temperature sensor.
(11) Connect electrical connectors for the following components:
- Manifold Absolute Pressure (MAP) Sensor
- Intake Air Temperature (IAT) Sensor
- Throttle Position (TPS) Sensor
- Coolant Temperature (CTS) Sensor
- Idle Air Control (IAC) Motor
- Ignition coil towers
- Fuel injectors

(12) Install top oil dipstick tube retaining bolt and ground strap.
(13) Install right side engine lifting stud.
(14) Install generator including electrical connections.
(15) Connect Vapor purge hose, Brake booster hose, Speed control servo hose, Positive ventilation crankcase (PCV) hose.
(16) Install air conditioning compressor including electrical connections.
(17) Fill cooling system. Refer to Group 7, Cooling System for procedure.
(18) Install accessory drive belt.
(19) Install cowl to hood seal. Refer to Group 23, Body for procedure.
(20) Install air cleaner housing and throttle body resonator.
(21) Connect negative cable to battery.

EXHAUST MANIFOLDS

RIGHT EXHAUST MANIFOLD

REMOVAL

(1) Disconnect negative cable for battery.
(2) Remove battery from vehicle.
(3) Remove Power Distribution Center (PDC) fasteners and set aside.
(4) Remove battery tray assembly.
(5) Remove washer bottle assembly
(6) Remove accessory drive belt. Refer to Group 7, Cooling System for procedures.
(7) Remove A/C compressor from mounting and set aside.
(8) Remove A/C accumulator support bracket fastener.
(9) Drain coolant below heater hose level. Refer to Group 7, Cooling System for procedures.
(10) Remove heater hoses at engine.
(11) Remove fasteners attaching exhaust manifold heat shield.
(12) Remove heat shield.
(13) Remove upper exhaust manifold attaching fasteners.
(14) Raise vehicle on hoist.
(15) Disconnect exhaust pipe from manifold.
(16) Remove fasteners attaching starter. Move starter aside.
(17) Remove lower exhaust manifold attaching fasteners.
(18) Remove exhaust manifold and gasket. Manifold is removed from below the engine compartment.

INSTALLATION

(1) Install exhaust manifold and gasket from below engine compartment.
(2) Install lower exhaust manifold fasteners. DO NOT tighten until all fasteners are in place.
(3) Lower vehicle and install upper exhaust manifold fasteners. Tighten all manifold bolts starting at center and working outward to 25 N·m (18 ft. lbs.).

CAUTION: Over tightening heat shield fasteners, may cause shield to distort and/or crack.

(4) Install exhaust manifold heat shield. Tighten fasteners to 8 N·m (72 in. lbs.), then loosen 45 degrees.
(5) Install starter and fasteners.
(6) Connect exhaust pipe to manifold.
(7) Connect heater hoses at engine.
(8) Install fastener attaching A/C accumulator.
(9) Install A/C compressor and fasteners.
(10) Install accessory drive belt.
(11) Install washer bottle and battery tray assembly.

REMOVAL AND INSTALLATION (Continued)

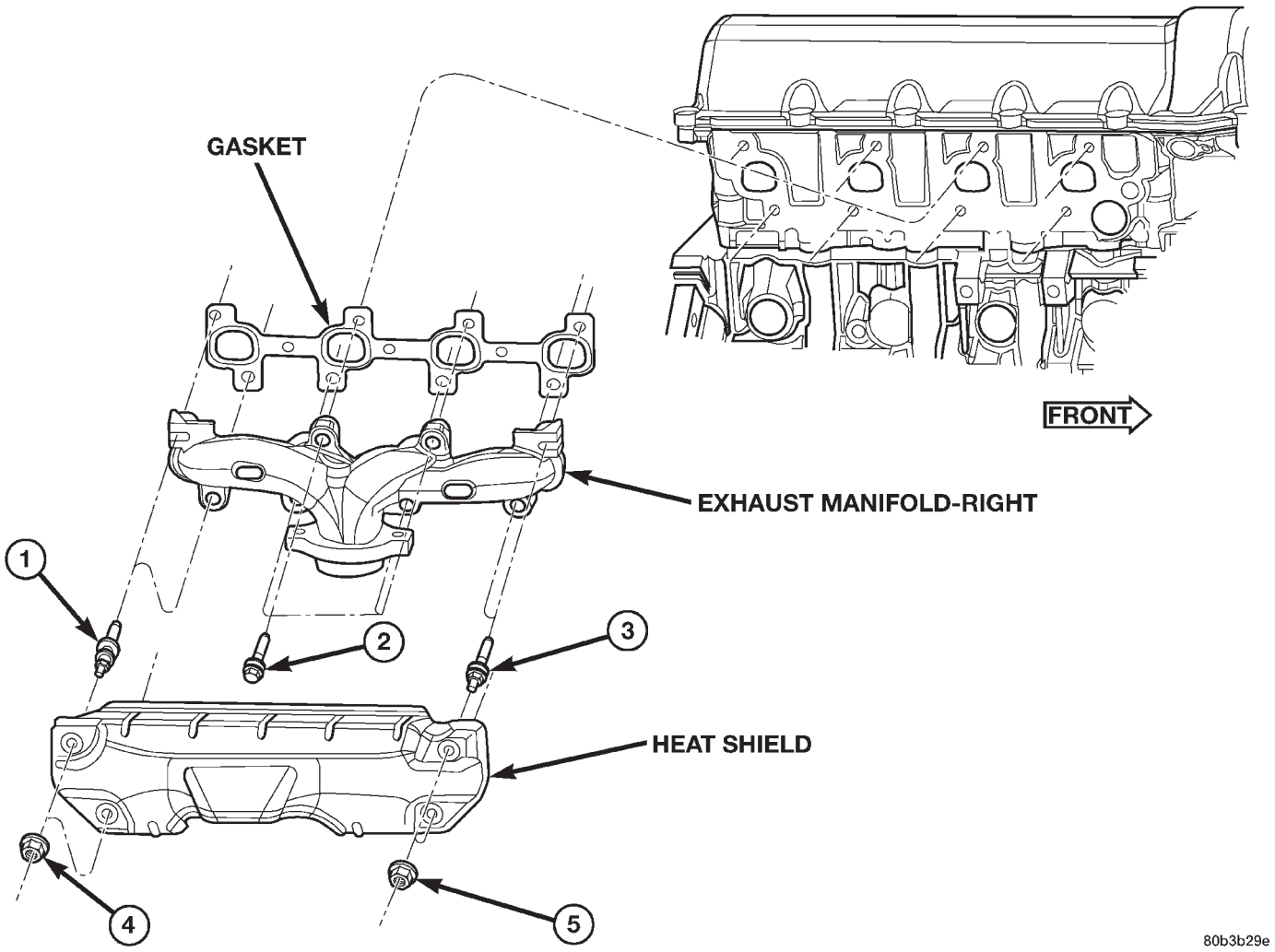

Fig. 36 Exhaust Manifold—Right

ITEM	DESCRIPTION	TORQUE	ITEM	DESCRIPTION	TORQUE
1	Stud (Qty 2)	25 N·m (18 ft. lbs.)	4	Nut (Qty 2)	8 N·m (72 in. lbs.), then loosen 45 degrees
2	Bolt (Qty 4)		5	Nut (Qty 2)	
3	Stud (Qty 2)				

(12) Install PDC.
(13) Install battery and connect cables.
(14) Fill cooling system. Refer to Group 7, Cooling System for procedure.

LEFT EXHAUST MANIFOLD

REMOVAL

(1) Disconnect negative cable for battery.
(2) Hoist vehicle.
(3) Disconnect exhaust pipe at manifold.
(4) Lower vehicle.
(5) Remove air cleaner housing and tube.
(6) Remove the front two exhaust heat shield retaining fasteners. Raise vehicle and remove the fasteners at rear of heat shield.
(7) Remove heat shield (Fig. 37).
(8) Lower vehicle and remove the upper exhaust manifold retaining bolts (Fig. 37).
(9) Raise vehicle and remove the lower exhaust manifold retaining bolts (Fig. 37).
(10) Remove exhaust manifold and gasket (Fig. 37). Manifold is removed from below the engine compartment.

REMOVAL AND INSTALLATION (Continued)

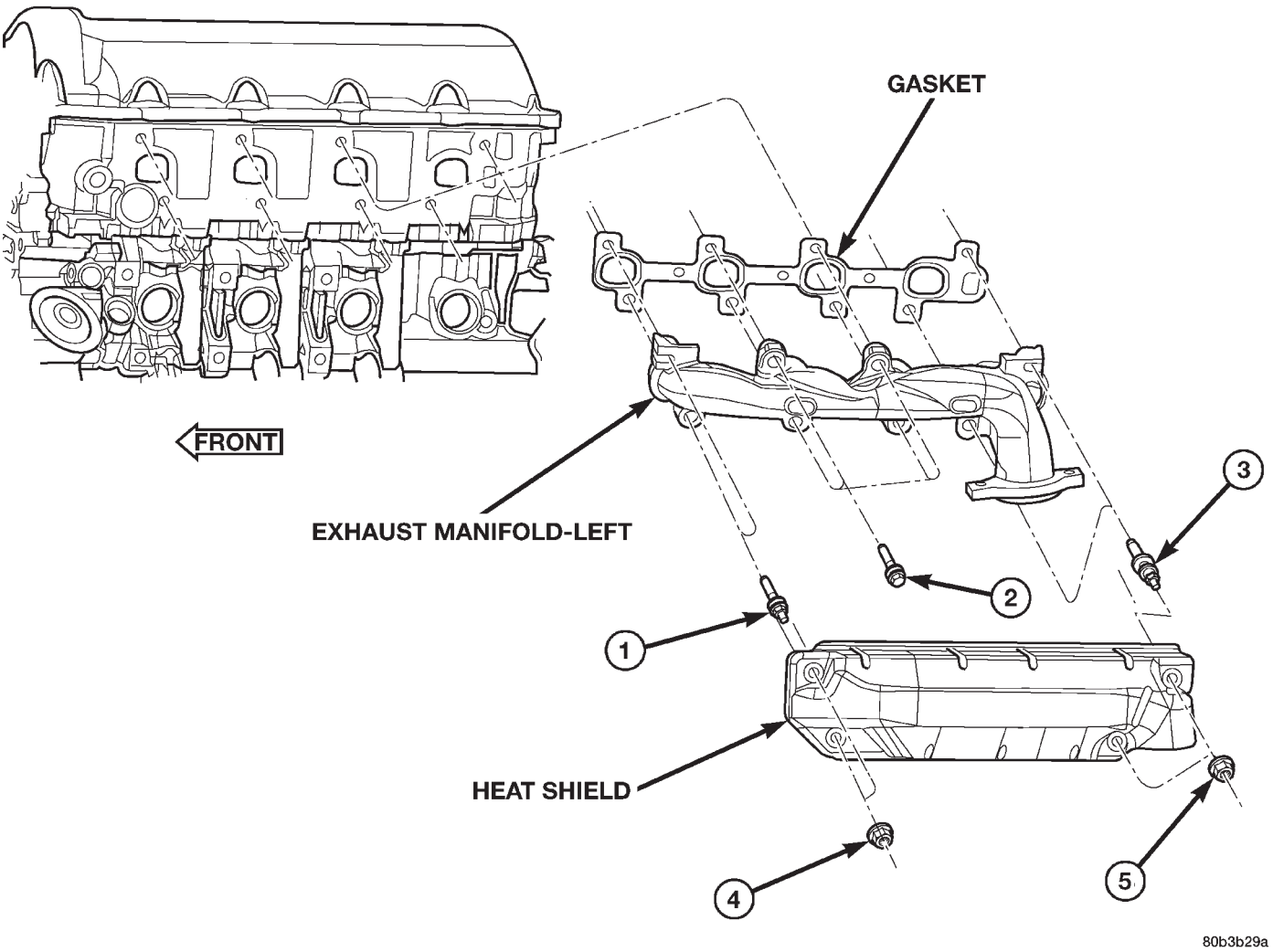

Fig. 37 Exhaust Manifold—Left

ITEM	DESCRIPTION	TORQUE	ITEM	DESCRIPTION	TORQUE
1	Stud (Qty 2)	25 N·m (18 ft. lbs.)	4	Nut (Qty 2)	8 N·m (72 in. lbs.), then loosen 45 degrees
2	Bolt (Qty 4)		5	Nut (Qty 2)	
3	Stud (Qty 2)				

INSTALLATION

(1) Install exhaust manifold and gasket from below engine compartment.

(2) Install lower exhaust manifold fasteners (Fig. 37). DO NOT tighten until all fasteners are in place.

(3) Lower vehicle and install upper exhaust manifold fasteners (Fig. 37). Tighten all manifold bolts starting at center and working outward to 25 N·m (18 ft. lbs.).

CAUTION: Over tightening heat shield fasteners, may cause shield to distort and/or crack.

(4) Install exhaust manifold heat shield (Fig. 37). Tighten fasteners to 8 N·m (72 in. lbs.), then loosen 45 degrees.

(5) Install air cleaner housing and tube.

(6) Connect exhaust pipe to manifold.

(7) Connect negative cable to battery.

CYLINDER HEAD COVERS

CYLINDER HEAD COVER LEFT

REMOVAL

(1) Disconnect negative cable from battery.

REMOVAL AND INSTALLATION (Continued)

(2) Remove air cleaner housing and throttle body resonator (Fig. 38).

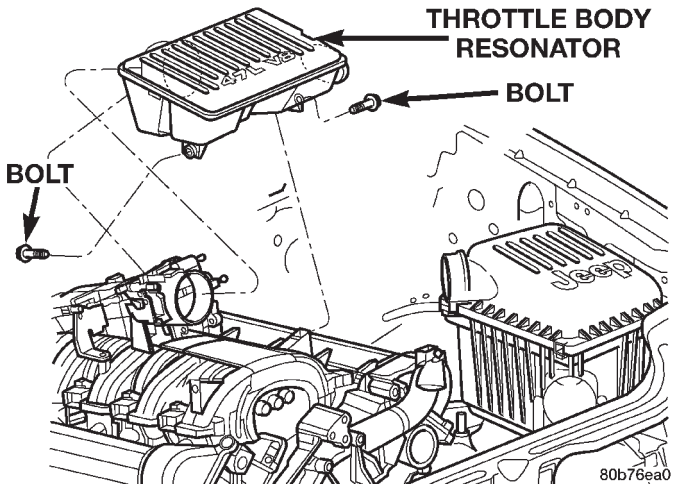

Fig. 38 Throttle Body Resonator

(3) Disconnect injector connectors and un-clip the injector harness.

(4) Route injector harness in front of cylinder head cover.

(5) Remove the cylinder head cover mounting bolts.

(6) Remove cylinder head cover and gasket.

NOTE: The gasket may be used again, provided no cuts, tears, or deformation has occurred.

INSTALLATION

CAUTION: Do not use harsh cleaners to clean the cylinder head covers. Severe damage to covers may occur.

(1) Clean cylinder head cover and both sealing surfaces. Inspect and replace gasket as necessary.

(2) Install cylinder head cover and hand start all fasteners. Verify that all studs are in the correct location shown in (Fig. 39).

(3) Tighten cylinder head cover bolts and double ended studs to 12 N·m (105 in. lbs.).

(4) Connect injector electrical connectors and injector harness retaining clips.

(5) Install air cleaner assembly and throttle body resonator.

(6) Connect negative cable to battery.

CAUTION: DO NOT allow other components including the wire harness to rest on or against the cylinder head cover. Prolonged contact with other objects may wear a hole in the engine cylinder head cover.

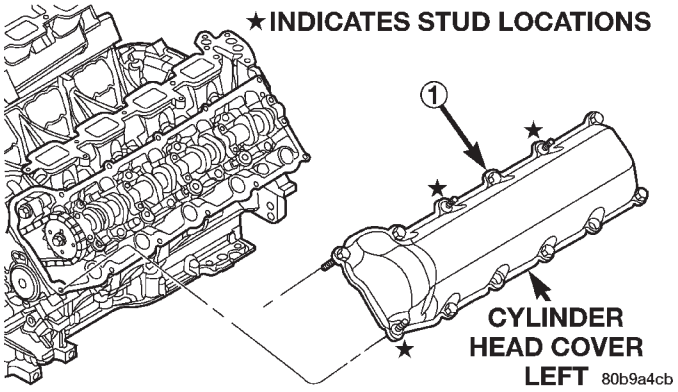

Fig. 39 Cylinder Head Cover—Left

ITEM	DESCRIPTION	TORQUE
1	Cover Fasteners	12 N·m (105 in. lbs.)

CYLINDER HEAD COVER RIGHT

REMOVAL

(1) Disconnect and remove battery from engine compartment.

(2) Remove air cleaner housing and throttle body resonator (Fig. 38).

(3) Disconnect battery lugs from Power Distribution Center (PDC).

(4) Un-clip PDC and move to the left side of the fender well.

(5) Drain cooling system, below the level of the heater hoses. Refer to Group 7, Cooling System.

(6) Remove accessory drive belt.

(7) Remove air conditioning compressor retaining bolts and move compressor to the left.

(8) Remove battery tray and disconnect battery temperature sensor.

(9) Remove heater hoses from front of engine.

(10) Loosen air conditioning accumulator bracket.

(11) Disconnect injector and ignition coil connectors.

(12) Disconnect and remove positive crankcase ventilation (PCV) hose.

(13) Remove oil fill tube.

(14) Un-clip injector and ignition coil harness and move away from cylinder head cover.

(15) Remove right rear breather tube and filter assembly.

(16) Remove cylinder head cover retaining bolts.

(17) Remove cylinder head cover.

NOTE: The gasket may be used again, provided no cuts, tears, or deformation has occurred.

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

CAUTION: Do not use harsh cleaners to clean the cylinder head covers. Severe damage to covers may occur.

(1) Clean cylinder head cover and both sealing surfaces. Inspect and replace gasket as necessary.
(2) Install cylinder head cover and hand start all fasteners. Verify that all double ended studs are in the correct location shown in (Fig. 40).

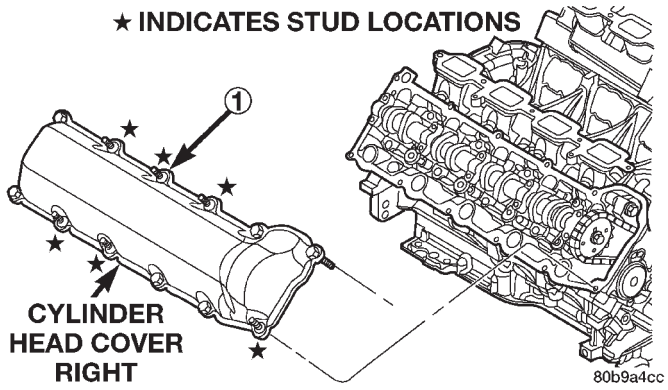

Fig. 40 Cylinder Head Cover—Right

ITEM	DESCRIPTION	TORQUE
1	Cover Fasteners	12 N·m (105 in. lbs.)

(3) Tighten cylinder head cover bolts and double ended studs to 12 N·m (105 in. lbs).
(4) Install right rear breather tube and filter assembly.
(5) Connect injector, ignition coil electrical connectors and harness retaining clips.
(6) Install the oil fill tube.
(7) Install PCV hose.
(8) Tighten air conditioning accumulator bracket.
(9) Install heater hoses.
(10) Connect battery temperature sensor and install battery tray.
(11) Install air conditioning compressor retaining bolts.
(12) Install accessory drive belt. Refer to Group 7, Cooling System.
(13) Fill Cooling system. Refer to Group 7, Cooling System.
(14) Connect PDC and install battery lugs.
(15) Install throttle body resonator and air cleaner housing.
(16) Install battery and connect battery cables.

CAUTION: DO NOT allow other components including the wire harness to rest on or against the engine cylinder head cover. Prolonged contact with other objects may wear a hole in the cylinder head cover.

ROCKER ARMS

REMOVAL

NOTE: Disconnect the battery negative cable to prevent accidental starter engagement.

(1) Remove the cylinder head cover. Refer to Cylinder Head Cover in this section.
(2) For rocker arm removal on cylinders 3 and 5 Rotate the crankshaft until cylinder #1 is at TDC exhaust stroke.
(3) For rocker arm removal on cylinders 2 and 8 Rotate the crankshaft until cylinder #1 is at TDC compression stroke.
(4) For rocker arm removal on cylinders 4 and 6 Rotate the crankshaft until cylinder #3 is at TDC compression stroke.
(5) For rocker arm removal on cylinders 1 and 7 Rotate the crankshaft until cylinder #2 is at TDC compression stroke.
(6) Using special tool 8516 press downward on the valve spring, remove rocker arm (Fig. 41).

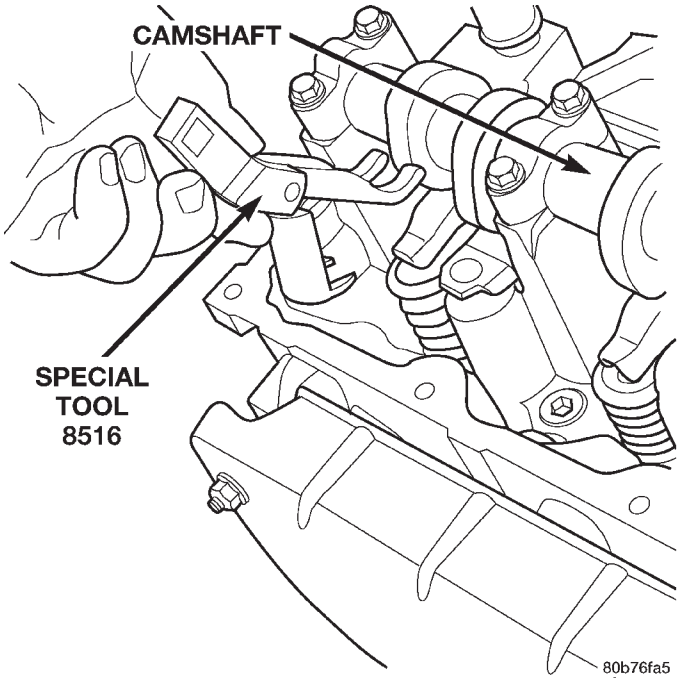

Fig. 41 Rocker Arm—Removal

INSTALLATION

CAUTION: Make sure the rocker arms are installed with the concave pocket over the lash adjusters. Failure to do so may cause severe damage to the rocker arms and/or lash adjusters.

REMOVAL AND INSTALLATION (Continued)

NOTE: Coat the rocker arms with clean engine oil prior to installation.

(1) For rocker arm installation on cylinders 3 and 5 Rotate the crankshaft until cylinder #1 is at TDC exhaust stroke.

(2) For rocker arm installation on cylinders 2 and 8 Rotate the crankshaft until cylinder #1 is at TDC compression stroke.

(3) For rocker arm installation on cylinders 4 and 6 Rotate the crankshaft until cylinder #3 is at TDC compression stroke.

(4) For rocker arm installation on cylinders 1 and 7 Rotate the crankshaft until cylinder #2 is at TDC compression stroke.

(5) Using special tool 8516 press downward on the valve spring, install rocker arm (Fig. 41).

(6) Install the cylinder head cover.

VALVE STEM SEALS AND SPRINGS

To service valve stem seals or springs refer to cylinder head removal procedures outlined in this section.

CYLINDER HEADS

CYLINDER HEAD—LEFT

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Raise the vehicle on a hoist.

(3) Disconnect the exhaust pipe at the left side exhaust manifold.

(4) Drain the engine coolant. Refer to Group 7, Cooling system for procedure.

(5) Lower the vehicle.

(6) Remove the intake manifold. Refer to procedure in this section.

(7) Remove the cylinder head cover. Refer to procedure in this section.

(8) Remove the fan shroud. Refer to Group 7, Cooling System for procedure.

(9) Remove the power steering pump.

(10) Rotate the crankshaft until the damper timing mark is aligned with TDC indicator mark (Fig. 42).

(11) Verify the V8 mark on the camshaft sprocket is at the 12 o'clock position (Fig. 44). Rotate the crankshaft one turn if necessary.

(12) Remove the crankshaft damper. Refer to Crankshaft Damper in this section.

(13) Remove the timing chain cover. Refer to procedure in this section.

(14) Lock the secondary timing chains to the idler sprocket using Special Tool 8515 (Fig. 43).

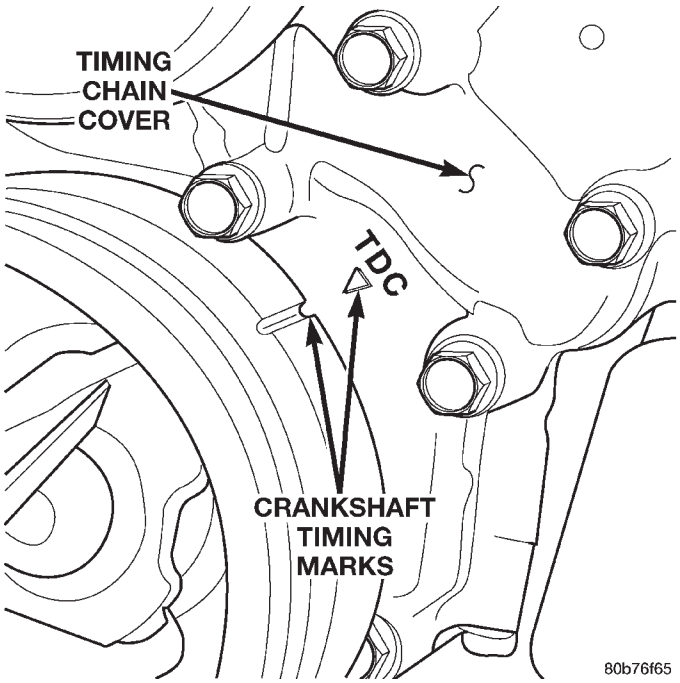

Fig. 42 Engine Top Dead Center (TDC) Indicator Mark

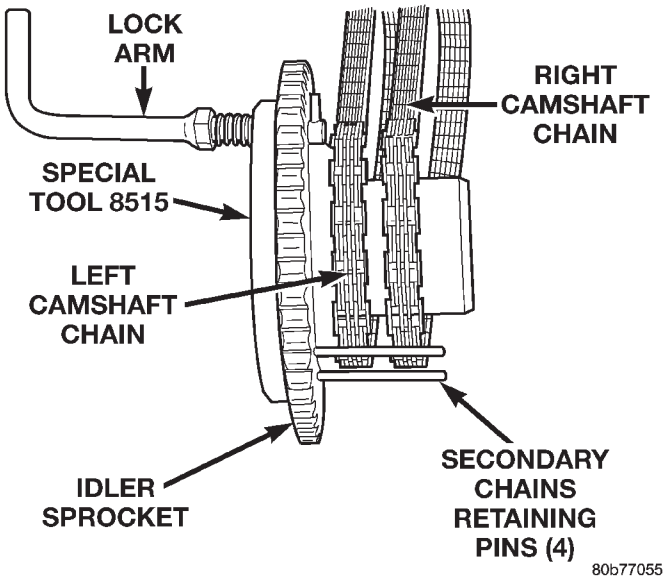

Fig. 43 Using Special Tool 8515 to Hold Chains to Idler Sprocket.

NOTE: Mark the secondary timing chain prior to removal to aid in installation.

(15) Mark the secondary timing chain, one link on each side of the V8 mark on the camshaft drive gear (Fig. 44).

(16) Remove the left side secondary chain tensioner. Refer to Timing Chain and Sprockets in this section.

(17) Remove the cylinder head access plug (Fig. 45).

REMOVAL AND INSTALLATION (Continued)

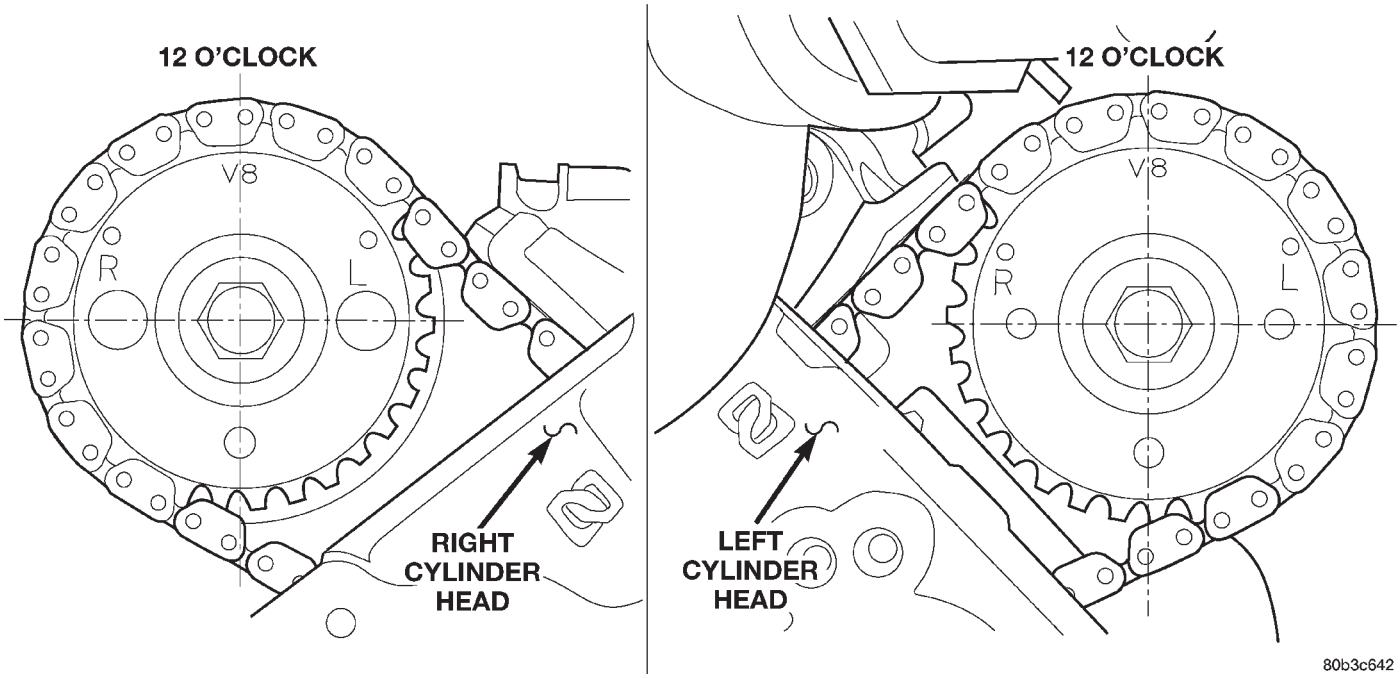

Fig. 44 Camshaft Sprocket V8 Marks

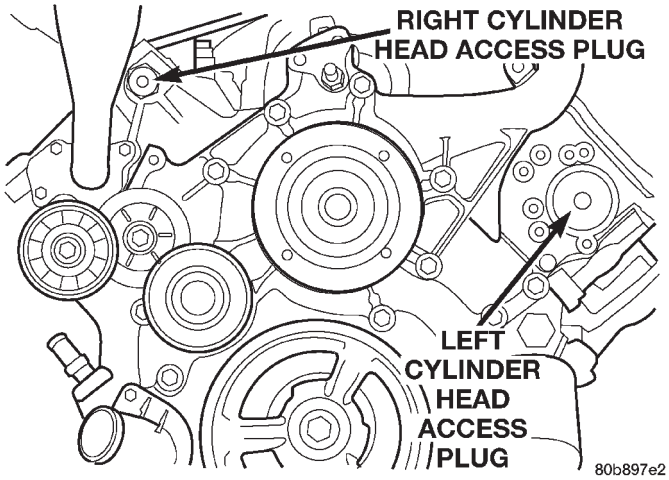

Fig. 45 Cylinder Head Access Plugs

(18) Remove the left side secondary chain guide. Refer to Timing Chain and Sprockets in this section.

(19) Remove the retaining bolt and the camshaft drive gear.

CAUTION: Do not allow the engine to rotate. Severe damage to the valve train can occur.

CAUTION: Do not overlook the four smaller bolts at the front of the cylinder head. Do not attempt to remove the cylinder head without removing these four bolts.

NOTE: The cylinder head is attached to the cylinder block with fourteen bolts.

(20) Remove the cylinder head retaining bolts.

(21) Remove the cylinder head and gasket. Discard the gasket.

CAUTION: Do not lay the cylinder head on it's gasket sealing surface, due to the design of the cylinder head gasket any distortion to the cylinder head sealing surface may prevent the gasket from properly sealing resulting in leaks.

INSTALLATION

NOTE: The cylinder head bolts are tightened using a torque plus angle procedure. The bolts must be examined BEFORE reuse. If the threads are necked down the bolts should be replaced.

Necking can be checked by holding a straight edge against the threads. If all the threads do not contact the scale, the bolt should be replaced (Fig. 46).

CAUTION: When cleaning cylinder head and cylinder block surfaces, DO NOT use a metal scraper because the surfaces could be cut or ground. Use only a wooden or plastic scraper.

(1) Clean the cylinder head and cylinder block mating surfaces (Fig. 47).

(2) Position the new cylinder head gasket on the locating dowels.

REMOVAL AND INSTALLATION (Continued)

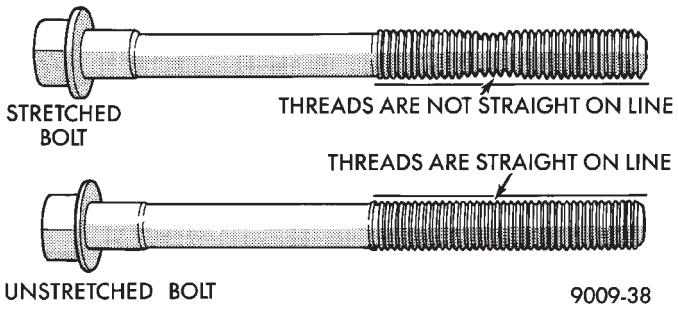

Fig. 46 Checking Cylinder Head Bolts for Stretching (Necking)

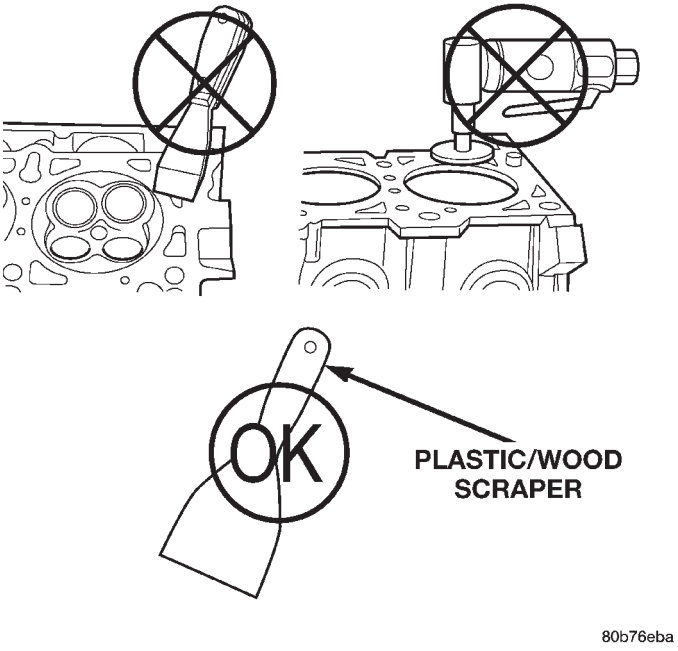

Fig. 47 Proper Tool Usage for Surface Preparation

CAUTION: When installing cylinder head, use care not damage the tensioner arm or the guide arm.

(3) Position the cylinder head onto the cylinder block. Make sure the cylinder head seats fully over the locating dowels.

NOTE: The four smaller cylinder head mounting bolts require sealant to be added to them before installing. Failure to do so may cause leaks.

(4) Lubricate the cylinder head bolt threads with clean engine oil and install the ten M11 bolts.

(5) Coat the four M8 cylinder head bolts with **Mopar® Lock and Seal Adhesive** then install the bolts.

NOTE: The cylinder head bolts are tightened using an angle torque procedure, however, the bolts are not a torque-to-yield design.

(6) Tighten the bolts in sequence (Fig. 48) using the following steps and torque values:

- Step 1: Tighten bolts 1–10, 20 N·m (15 ft. lbs.).
- Step 2: Tighten bolts 1–10, 47 N·m (35 ft. lbs.). Tighten bolts 11–14, 25 N·m (18 ft. lbs.).
- Step 3: Tighten bolts 1–10, 90 degrees. Tighten bolts 11–14, 30 N·m (22 ft. lbs.).

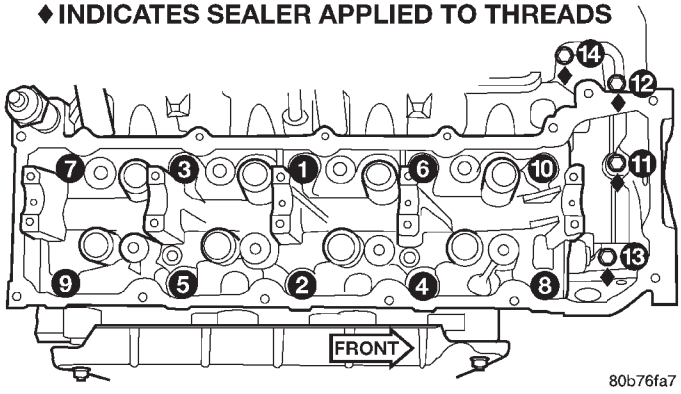

Fig. 48 Cylinder Head Tightening Sequence

(7) Position the secondary chain onto the camshaft drive gear, making sure one marked chain link is on either side of the V8 mark on the gear and position the gear onto the camshaft.

(8) Install the camshaft drive gear retaining bolt.

(9) Re-set and install the left side secondary chain guide.

(10) Install the cylinder head access plug.

(11) Install the left side secondary chain tensioner.

(12) Remove Special Tool 8515.

(13) Install the timing chain cover.

(14) Install the crankshaft damper.

(15) Install the power steering pump.

(16) Install the fan shroud. Refer to Group 7, Cooling System.

(17) Install the cylinder head cover.

(18) Install the intake manifold.

(19) Refill the cooling system. Refer to Group 7, Cooling System.

(20) Raise the vehicle.

(21) Install the exhaust pipe onto the left exhaust manifold.

(22) Lower the vehicle.

(23) Connect the negative cable to the battery.

(24) Start the engine and check for leaks.

CYLINDER HEAD—RIGHT

REMOVAL

(1) Remove the battery and battery tray.

(2) Raise the vehicle on a hoist.

(3) Disconnect the exhaust pipe at the right side exhaust manifold.

REMOVAL AND INSTALLATION (Continued)

(4) Drain the engine coolant. Refer to group 7 Cooling system for procedure.
(5) Lower the vehicle.
(6) Remove the intake manifold. Refer to procedure in this section.
(7) Remove the cylinder head cover. Refer to Cylinder Head Cover in this section.
(8) Remove the fan shroud. Refer to Group 7, Cooling System for procedure.
(9) Rotate the crankshaft until the damper timing mark is aligned with TDC indicator mark (Fig. 42).
(10) Verify the V8 mark on the camshaft sprocket is at the 12 o'clock position (Fig. 44). Rotate the crankshaft one turn if necessary.
(11) Remove the crankshaft damper. Refer to Crankshaft Damper in this section.
(12) Remove the timing chain cover. Refer to Timing Chain Cover in this section.
(13) Lock the secondary timing chains to the idler sprocket using Special Tool 8515 (Fig. 43).

NOTE: Mark the secondary timing chain prior to removal to aid in installation.

(14) Mark the secondary timing chain, one link on each side of the V8 mark on the camshaft drive gear (Fig. 44).
(15) Remove the right side secondary chain tensioner. Refer to Timing Chain and Sprockets in this section.
(16) Remove the cylinder head access plug (Fig. 49).

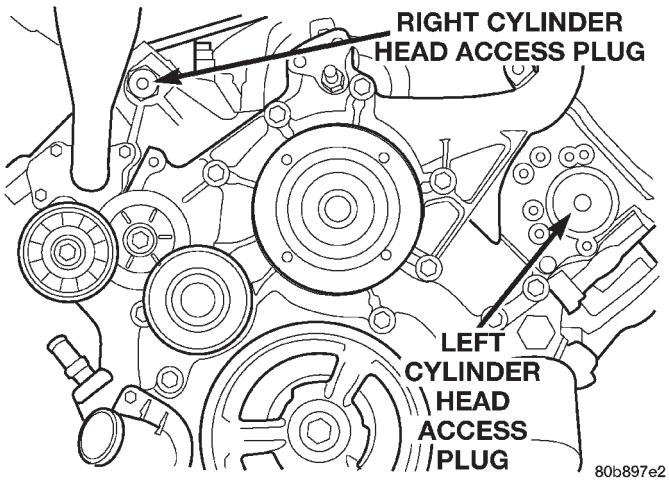

Fig. 49 Cylinder Head Access Plugs

(17) Remove the right side secondary chain guide. Refer to Timing Chain and Sprockets in this section.
(18) Remove the retaining bolt and the camshaft drive gear.

CAUTION: Do not allow the engine to rotate. severe damage to the valve train can occur.

CAUTION: Do not overlook the four smaller bolts at the front of the cylinder head. Do not attempt to remove the cylinder head without removing these four bolts.

CAUTION: Do not hold or pry on the camshaft target wheel for any reason. A damaged target wheel can result in a vehicle no start condition.

NOTE: The cylinder head is attached to the cylinder block with fourteen bolts.

(19) Remove the cylinder head retaining bolts.
(20) Remove the cylinder head and gasket. Discard the gasket.

CAUTION: Do not lay the cylinder head on it's gasket sealing surface, do to the design of the cylinder head gasket any distortion to the cylinder head sealing surface may prevent the gasket from properly sealing resulting in leaks.

INSTALLATION

NOTE: The cylinder head bolts are tightened using a torque plus angle procedure. The bolts must be examined BEFORE reuse. If the threads are necked down the bolts should be replaced.

Necking can be checked by holding a straight edge against the threads. If all the threads do not contact the scale, the bolt should be replaced (Fig. 46).

CAUTION: When cleaning cylinder head and cylinder block surfaces, DO NOT use a metal scraper because the surfaces could be cut or ground. Use only a wooden or plastic scraper.

(1) Clean the cylinder head and cylinder block mating surfaces (Fig. 50).
(2) Position the new cylinder head gasket on the locating dowels.

CAUTION: When installing cylinder head, use care not damage the tensioner arm or the guide arm.

(3) Position the cylinder head onto the cylinder block. Make sure the cylinder head seats fully over the locating dowels.

NOTE: The four smaller cylinder head mounting bolts require sealant to be added to them before installing. Failure to do so may cause leaks.

(4) Lubricate the cylinder head bolt threads with clean engine oil and install the ten M10 bolts.

REMOVAL AND INSTALLATION (Continued)

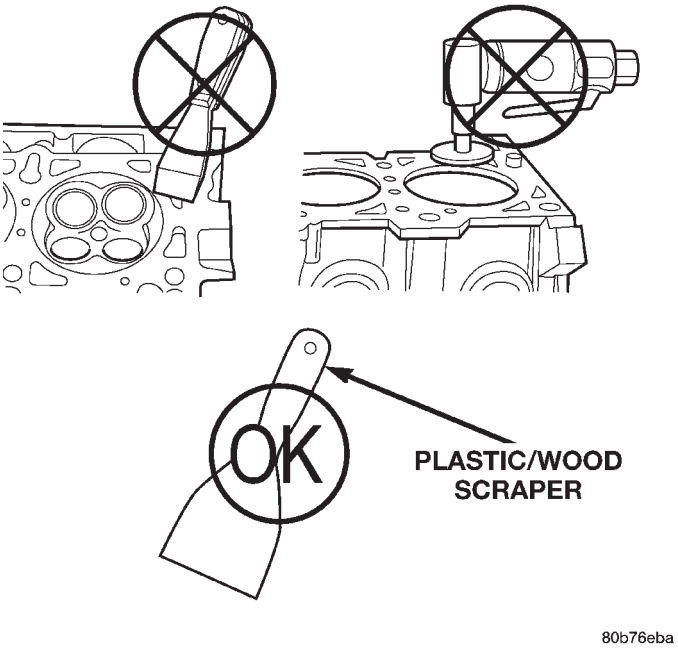

Fig. 50 Proper Tool Usage For Surface Preparation

(5) Coat the four M8 cylinder head bolts with **Mopar Lock and Seal Adhesive** then install the bolts.

NOTE: The cylinder head bolts are tightened using an angle torque procedure, however, the bolts are not a torque-to-yield design.

(6) Tighten the bolts in sequence (Fig. 51) using the following steps and torque values:

- Step 1: Tighten bolts 1–10, 20 N·m (15 ft. lbs.).
- Step 2: Tighten bolts 1–10, 47 N·m (35 ft. lbs.). Tighten bolts 11–14, 25 N·m (18 ft. lbs.).
- Step 3: Tighten bolts 1–10, 90 degrees. Tighten bolts 11–14, 30 N·m (22 ft. lbs.).

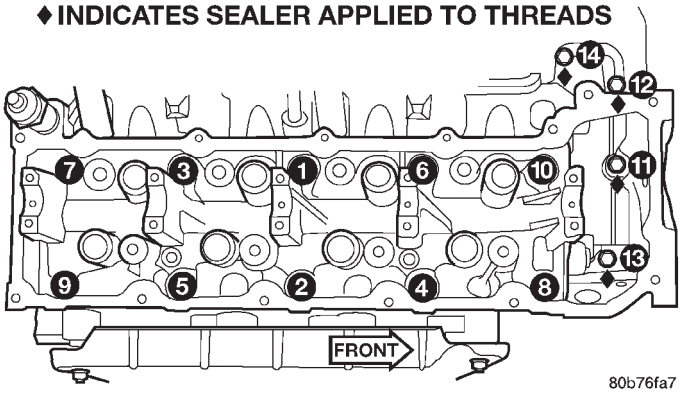

Fig. 51 Cylinder Head Tightening Sequence

(7) Position the secondary chain onto the camshaft drive gear, making sure one plated marked chain link is on either side of the V8 mark on the gear and position the gear onto the camshaft.

(8) Install the camshaft drive gear retaining bolt.

(9) Install the right side secondary chain tensioner arm.

(10) Install the cylinder head access plug.

(11) Re-set and install the right side secondary chain tensioner.

(12) Remove Special Tool 8515.

(13) Install the timing chain cover.

(14) Install the crankshaft damper.

(15) Install the fan shroud. Refer to Group 7, Cooling System.

(16) Install the cylinder head cover.

(17) Install the intake manifold.

(18) Refill the cooling system. Refer to Group 7, Cooling System.

(19) Raise the vehicle.

(20) Install the exhaust pipe onto the right exhaust manifold.

(21) Lower the vehicle.

(22) Install the battery tray and battery.

(23) Start the engine and check for leaks.

VALVES AND VALVE SPRINGS

REMOVAL

NOTE: The cylinder heads must be removed in order to preform this procedure.

(1) Using Special Tool 8516 Valve Spring Compressor, remove the rocker arms and the hydraulic lash adjusters (Fig. 52).

(2) Remove the camshaft bearing caps and the camshaft.

NOTE: All eight valve springs and valve are removed in the same manner; this procedure only covers one valve and valve spring.

(3) Using Special Tool C-3422–B or C-3422–C Valve Spring Compressor and Special tool 8519 Adapter, compress the valve spring.

NOTE: It may be necessary to tap the top of the valve spring to loosen the spring retainers locks enough to be removed.

(4) Remove the two spring retainer lock halves.

NOTE: the valve spring is under tension use care when releasing the valve spring compressor.

(5) Remove the valve spring compressor.

(6) Remove the spring retainer, and the spring.

REMOVAL AND INSTALLATION (Continued)

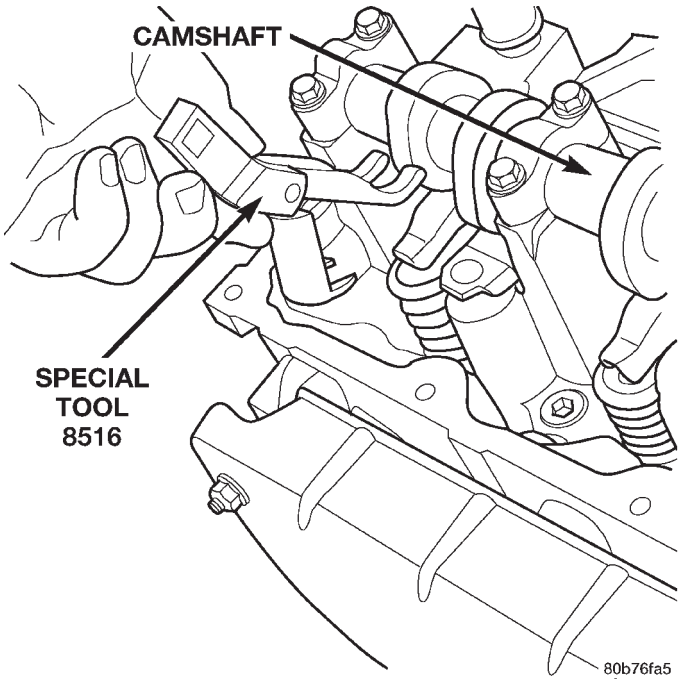

Fig. 52 Rocker Arm—Removal

NOTE: Check for sharp edges on the keeper grooves. Remove any burrs from the valve stem before removing the valve from the cylinder head.

(7) Remove the valve from the cylinder head.

NOTE: The valve stem seals are common between intake and exhaust.

(8) Remove the valve stem seal. Mark the valve for proper installation.

TESTING VALVE SPRINGS

NOTE: Whenever the valves are removed from the cylinder head it is recommended that the valve springs be inspected and tested for reuse.

Inspect the valve springs for physical signs of wear or damage. Turn table of tool C-647 until surface is in line with the 40.69 mm (1.602 in.) mark on the threaded stud and the zero mark on the front. Place spring over the stud on the table and lift compressing lever to set tone device. 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. Refer to Specifications Section to obtain specified height and allowable tensions. Replace any springs that do not meet specifications. (Fig. 53)

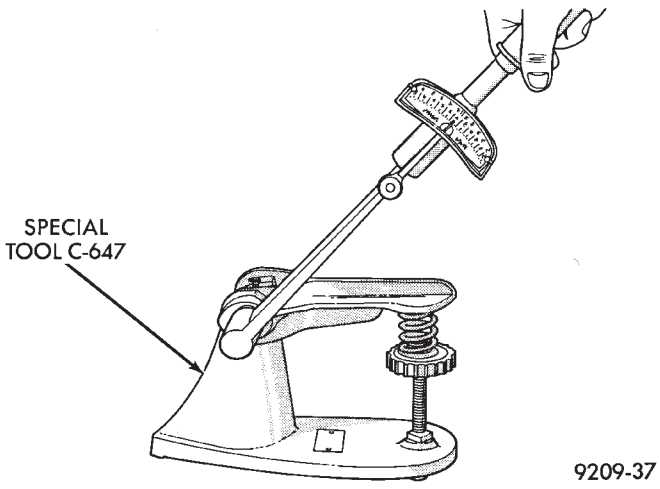

Fig. 53 Testing Valve Springs

INSTALLATION

(1) coat the valve stem with clean engine oil and insert it into the cylinder head.

(2) Install the valve stem seal. make sure the seal is fully seated and that the garter spring at the top of the seal is intact.

(3) Install the spring and the spring retainer.

(4) Using the valve spring compressor, compress the spring and install the two valve spring retainer halves.

(5) Release the valve spring compressor and make sure the two spring retainer halves and the spring retainer are fully seated.

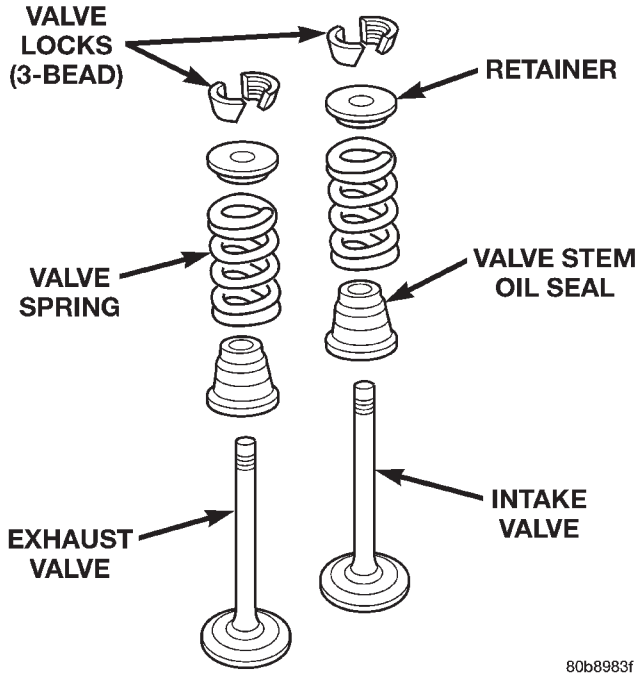

Fig. 54 Valve Assembly Configuration

(6) lubricate the camshaft journal with clean engine oil then Position the camshaft (with the

REMOVAL AND INSTALLATION (Continued)

sprocket dowel on the left camshaft at 11 o'clock and the right camshaft at 12 o'clock), then position the camshaft bearing caps.

(7) Install the camshaft bearing cap retaining bolts. Tighten the bolts 9–13 N·m (100 in. lbs.) in ½ turn increments in the sequence shown (Fig. 55).

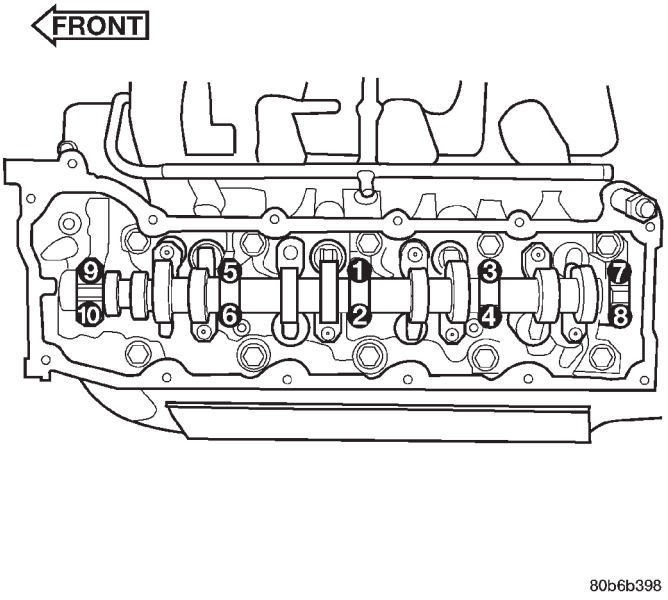

Fig. 55 Camshaft Bearing Caps Tightening Sequence

(8) Position the hydraulic lash adjusters and rocker arms (Fig. 52).

HYDRAULIC LASH ADJUSTER

REMOVAL

(1) Remove cylinder head cover(s). Refer to procedure in this section.

(2) Remove rocker arm(s). Refer to procedure in this section.

CAUTION: If lash adjusters and rocker arms are to be reused, always mark position for reassembly in their original positions.

(3) Remove lash adjuster(s).

INSTALLATION

(1) Install hydraulic lash adjuster making sure adjusters are at least partially full of oil. This can be verified by little or no plunger travel when lash adjuster is depressed.

(2) Install rocker arm(s). Refer to procedure in this section.

(3) Install cylinder head cover(s). Refer to procedure in this section.

CRANKSHAFT DAMPER

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove accessory drive belt. Refer to Group 7, Cooling System for procedure.

(3) Remove A/C compressor mounting bolts and set aside.

(4) Drain cooling system. Refer to Group 7, Cooling System for procedure.

(5) Remove upper radiator hose.

(6) Using Special Tools 6958 spanner with adapter pins 8346, loosen fan and viscous assembly from water pump (Fig. 56).

(7) Remove fan and viscous assembly.

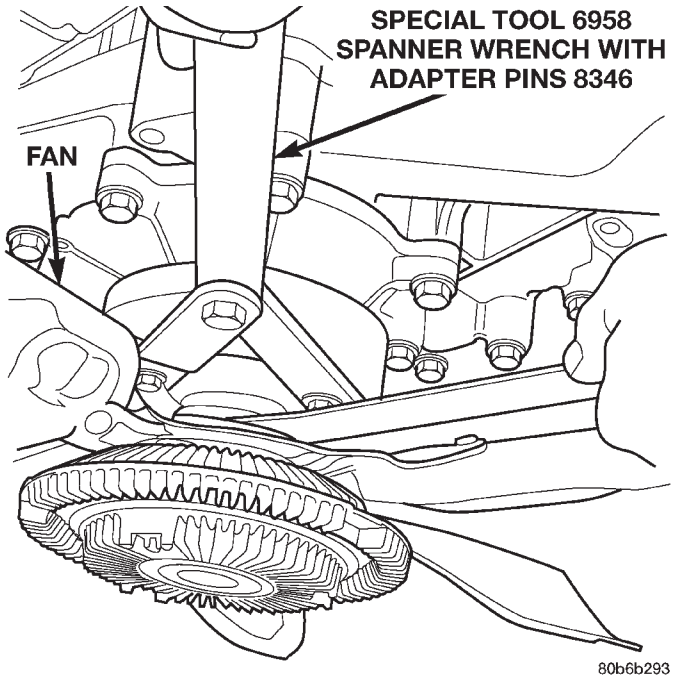

Fig. 56 Fan Assembly—Removal

(8) Disconnect electrical connector for fan mounted inside radiator shroud.

(9) Remove radiator shroud attaching fasteners.

NOTE: Transmission cooler line snaps into shroud lower right hand corner.

(10) Remove radiator shroud.

(11) Remove crankshaft damper bolt.

(12) Remove damper using Special Tools 8513 Insert and 1026 Three Jaw Puller (Fig. 57).

INSTALLATION

(1) Align crankshaft damper slot with key in crankshaft. Slide damper onto crankshaft slightly.

(2) Using Special Tool 8512, press damper onto crankshaft (Fig. 58).

REMOVAL AND INSTALLATION (Continued)

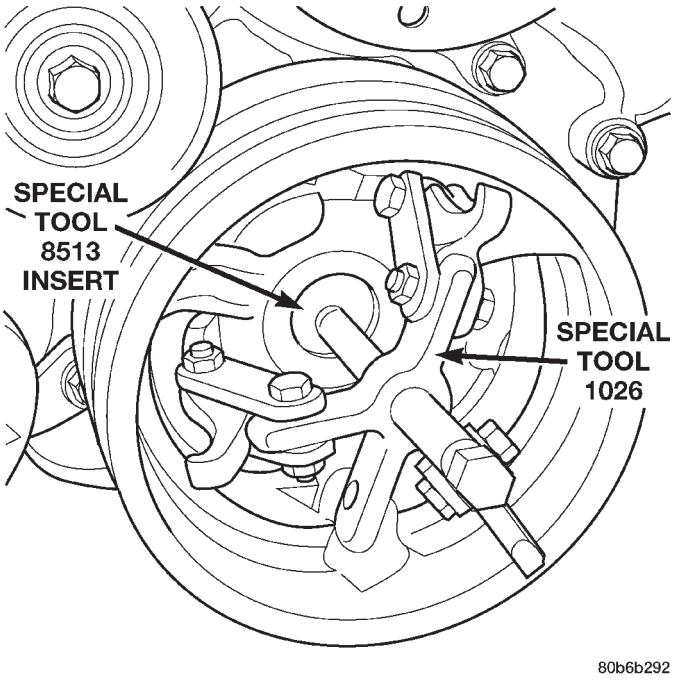

Fig. 57 Crankshaft Damper—Removal

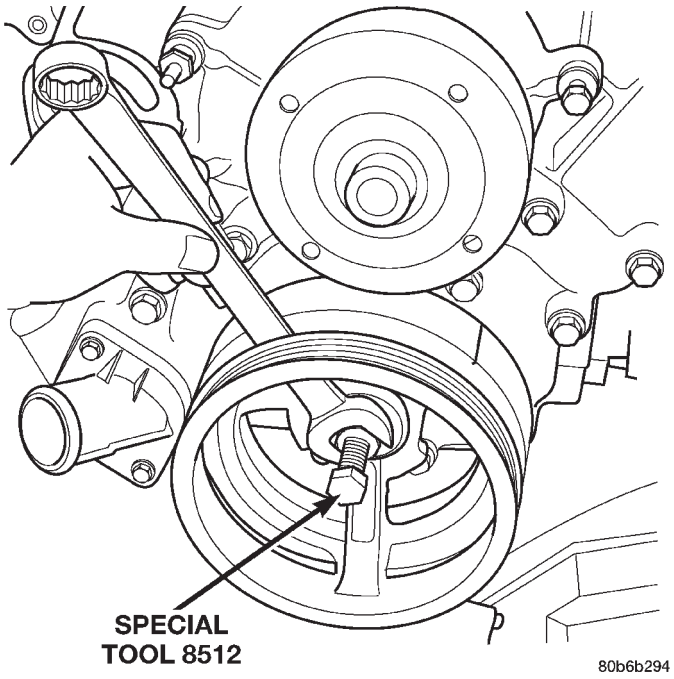

Fig. 58 Crankshaft Damper—Installation

(3) Tighten crankshaft damper bolt to 175 N·m (130 ft. lbs.).

(4) Install radiator shroud and tighten fasteners to 11 N·m (95 in. lbs.).

(5) Connect electrical connector for shroud fan.

(6) Install fan and viscous assembly.

(7) Using Special Tools 6958 spanner with adapter pins 8346, tighten fan and viscous assembly to water pump (Fig. 56).

(8) Install upper radiator hose.

(9) Install A/C compressor and tighten fasteners to 54 N·m (40 ft. lbs.).

(10) Install accessory drive belt. Refer to Group 7, Cooling System for procedure.

(11) Refill cooling system. Refer to Group 7, Cooling System for procedure.

(12) Connect negative cable to battery.

TIMING CHAIN COVER

REMOVAL

(1) Drain cooling system and remove viscous fan drive assembly. Refer to Group 7, Cooling System for procedures.

(2) Remove radiator shroud. Refer to Group 7, Cooling System for procedure.

(3) Disconnect both heater hoses at timing cover.

(4) Disconnect lower radiator hoses at engine.

(5) Remove crankshaft damper. Refer to procedure in this section.

(6) Remove accessory drive belt tensioner assembly (Fig. 59).

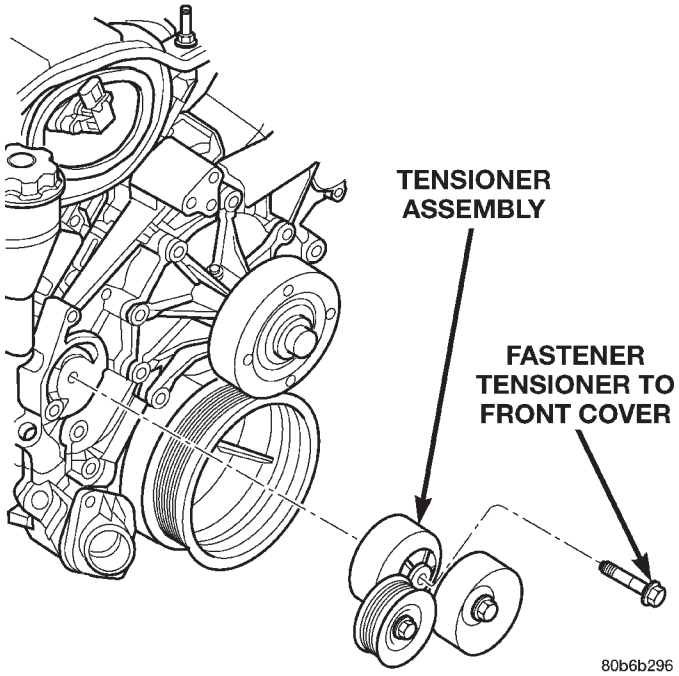

Fig. 59 Accessory Drive Belt Tensioner

(7) Remove cover and gasket (Fig. 60).

INSTALLATION

(1) Clean timing chain cover and block surface. Inspect cover gasket and replace as necessary.

(2) Install cover and gasket. Tighten fasteners in sequence as shown in (Fig. 60) to 54 N·m (40 ft. lbs.).

(3) Install crankshaft damper. Refer to procedure in this section.

(4) Install accessory drive belt tensioner assembly. Tighten fastener to 54 N·m (40 ft. lbs.).

REMOVAL AND INSTALLATION (Continued)

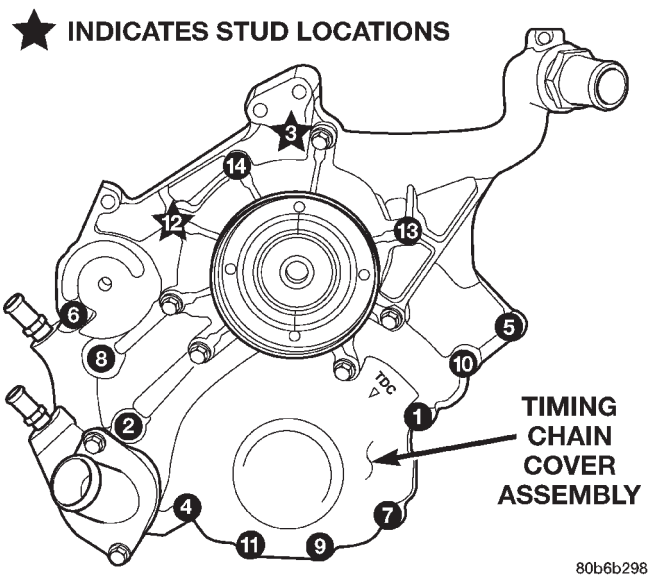

Fig. 60 Timing Chain Cover Fasteners

(5) Install lower radiator hose.
(6) Install both heater hoses.
(7) Install radiator shroud and viscous fan drive assembly. Refer to Group 7, Cooling System for procedure.
(8) Fill cooling system. Refer to Group 7, Cooling System for procedures.

TIMING CHAIN AND SPROCKETS

REMOVAL

(1) Disconnect negative cable from battery.
(2) Drain cooling system. Refer to Group 7, Cooling System for procedures.
(3) Remove right and left cylinder head covers. Refer to procedure in this section.
(4) Remove radiator fan shroud. Refer to Group 7, Cooling System for procedure.
(5) Rotate engine until timing mark on crankshaft damper aligns with TDC mark on timing chain cover (Fig. 61) (#1 cylinder exhaust stroke) and the camshaft sprocket “V8” marks are at the 12 o'clock position (Fig. 62).
(6) Remove power steering pump. Refer to Group 19, Steering for procedures.
(7) Remove access plugs (2) from left and right cylinder heads for access to chain guide fasteners (Fig. 63).
(8) Remove the oil fill housing to gain access to the right side tensioner arm fastener.
(9) Remove crankshaft damper and timing chain cover. Refer to procedures in this section.
(10) Collapse and pin primary chain tensioner (Fig. 64).

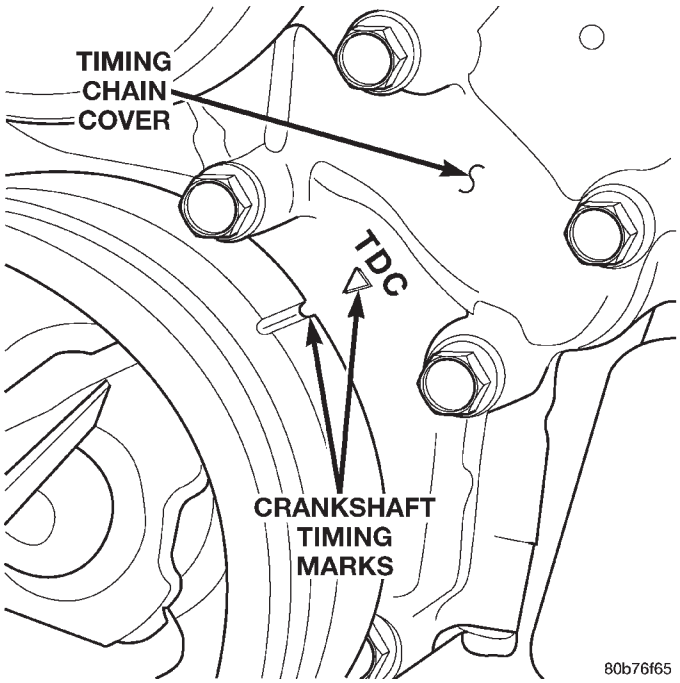

Fig. 61 Engine Top Dead Center (TDC) Indicator Mark

CAUTION: Plate behind left secondary chain tensioner could fall into oil pan. Therefore, cover pan opening.

(11) Remove secondary chain tensioners.
(12) Remove camshaft position sensor from right cylinder head (Fig. 65).

CAUTION: Care should be taken not to damage camshaft target wheel. Do not hold target wheel while loosening or tightening camshaft sprocket. Do not place the target wheel near a magnetic source of any kind. A damaged or magnetized target wheel could cause a vehicle no start condition.

CAUTION: Do not forcefully rotate the camshafts or crankshaft independently of each other. Damaging intake valve to piston contact will occur. Ensure negative battery cable is disconnected to guard against accidental engagement.

(13) Remove left and right camshaft sprocket bolts.
(14) While holding the left camshaft steel tube with adjustable pliers, (Fig. 66) remove the left camshaft sprocket. Slowly rotate the camshaft approximately 15 degrees clockwise to a neutral position.
(15) While holding the right camshaft steel tube with adjustable pliers, (Fig. 67) remove the right camshaft sprocket. Slowly rotate the camshaft approximately 45 degrees counterclockwise to a neutral position.
(16) Remove idler sprocket assembly bolt.

REMOVAL AND INSTALLATION (Continued)

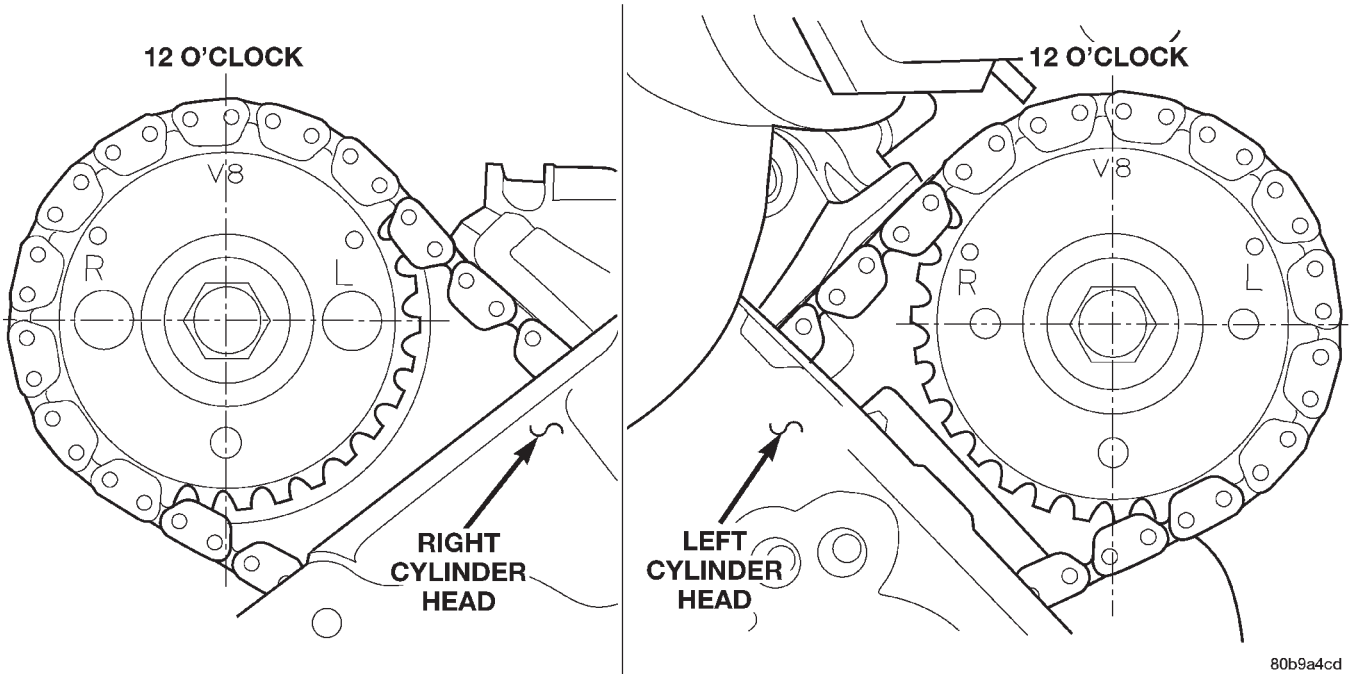

Fig. 62 Camshaft Sprocket V8 Marks

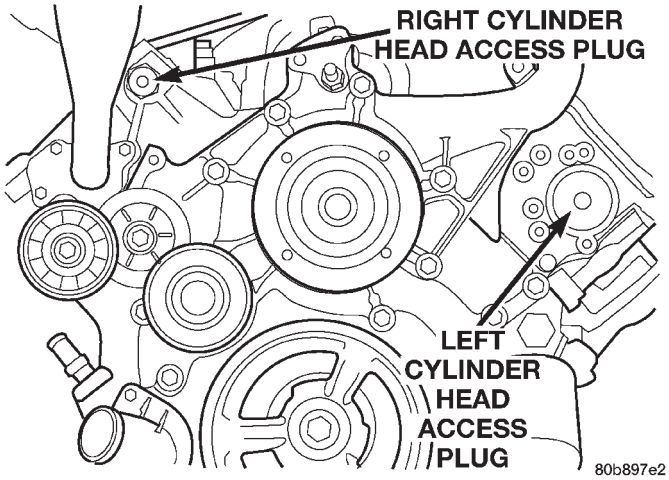

Fig. 63 Cylinder Head Access Plug Location

(17) Slide the idler sprocket assembly and crank sprocket forward simultaneously to remove the primary and secondary chains.

(18) Remove both pivoting tensioner arms and chain guides.

(19) Remove chain tensioner.

INSPECTION OF COMPONENTS

Inspect the following components:

- Sprockets for excessive tooth wear. Some tooth markings are normal and not a cause for sprocket replacement.
- Idler sprocket assembly bushing and shaft for excessive wear.
- Idler sprocket assembly spline joint. The joint should be tight with no backlash or axial movement.

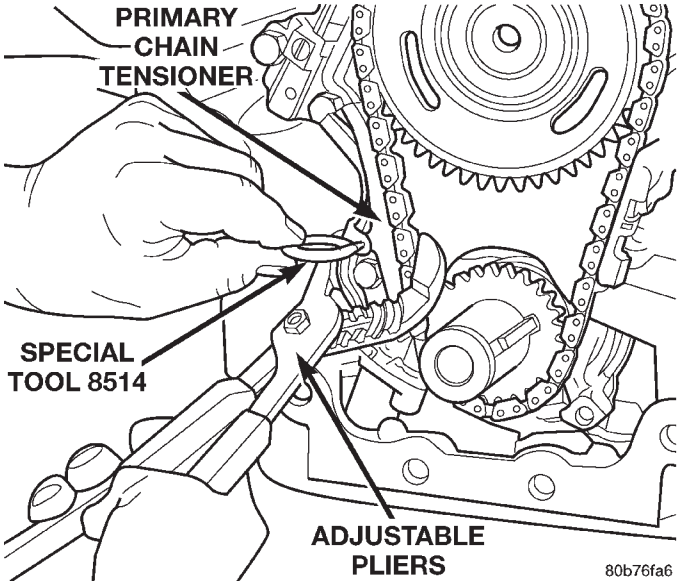

Fig. 64 Collapsing And Pinning Primary Chain Tensioner

- Chain guides and tensioner arms. Replace these parts if grooving in plastic face is more than 1 mm (0.039 in.) deep. If plastic face is severely grooved or melted, the tensioner lube jet may be clogged. The tensioner should be replaced.
- secondary chain tensioner piston and ratcheting device. Inspect for evidence of heavy contact between piston and tensioner arm. If this condition exist the tensioner should be replaced.
- Primary chain tensioner plastic faces. Replace as required.

REMOVAL AND INSTALLATION (Continued)

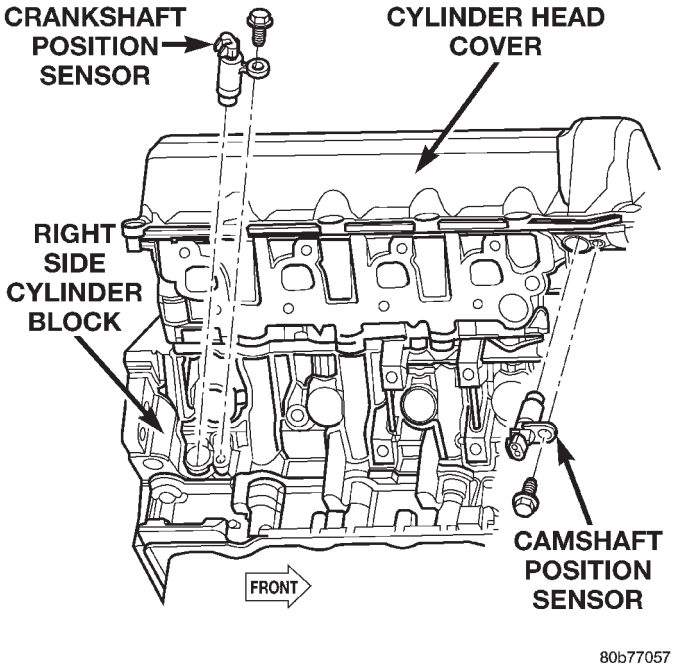

Fig. 65 Camshaft Position Sensor—Removal

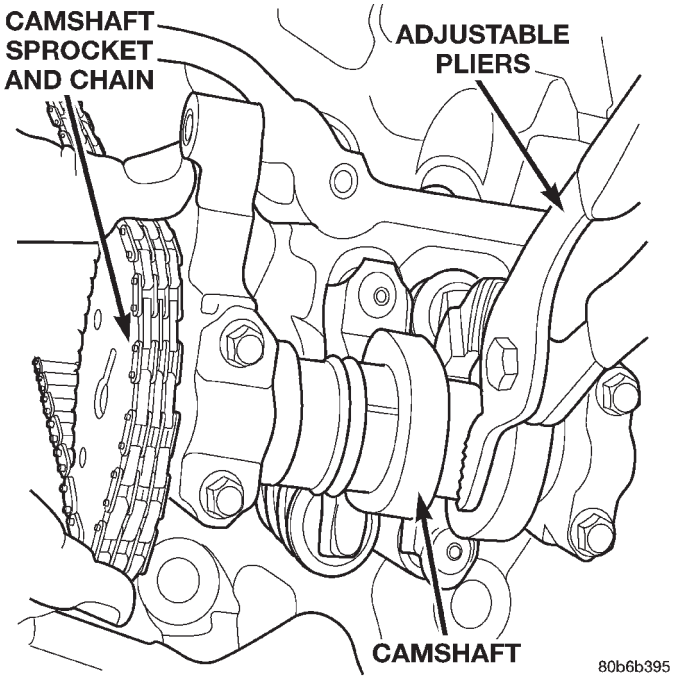

Fig. 66 Camshaft Rotation—Left Side

INSTALLATION

(1) Using a vise, lightly compress the secondary chain tensioner piston until the piston step is flush with the tensioner body. Using a pin or suitable tool, release ratchet pawl by pulling pawl back against spring force through access hole on side of tensioner. While continuing to hold pawl back, Push ratchet device to approximately 2 mm from the tensioner body. Install Special Tool 8514 lock pin into hole on front of tensioner. Slowly open vise to transfer piston spring force to lock pin (Fig. 69).

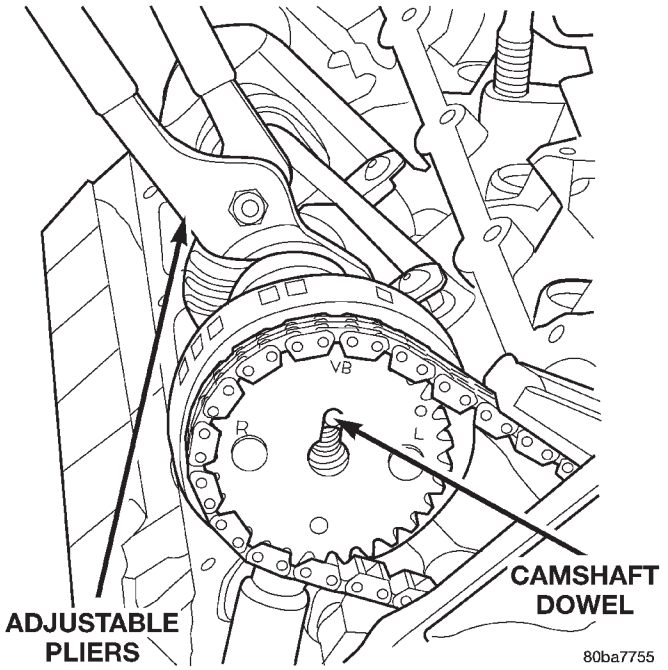

Fig. 67 Camshaft Rotation—Right Side

(2) Position primary chain tensioner over oil pump and insert bolts into lower two holes on tensioner bracket. Tighten bolts to 28 N·m (250 in. lbs.).

(3) Install right side chain tensioner arm. Apply Mopar® lock and seal and tighten bolt to 17 N·m (150 in. lbs.).

NOTE: The silver bolts retain the guides to the cylinder heads and the black bolts retain the guides to the engine block.

(4) Install the left side chain guide. Tighten the bolts to 28 N·m (250 in. lbs.).

(5) Install left side chain tensioner arm. Apply Mopar® lock and seal and tighten bolt to 17 N·m (150 in. lbs.).

(6) Install the right side chain guide. Tighten the bolts to 28 N·m (250 in. lbs.).

(7) Install both secondary chain tensioners. Tighten bolts to 28 N·m (250 in. lbs.).

NOTE: Left and right secondary chain tensioners are not common.

(8) Install both secondary chains onto the idler sprocket. Align two plated links on the secondary chains to be visible through the two lower openings on the idler sprocket (4 o'clock and 8 o'clock). Once the secondary timing chains are installed, position special tool 8515 to hold chains in place for installation (Fig. 70).

REMOVAL AND INSTALLATION (Continued)

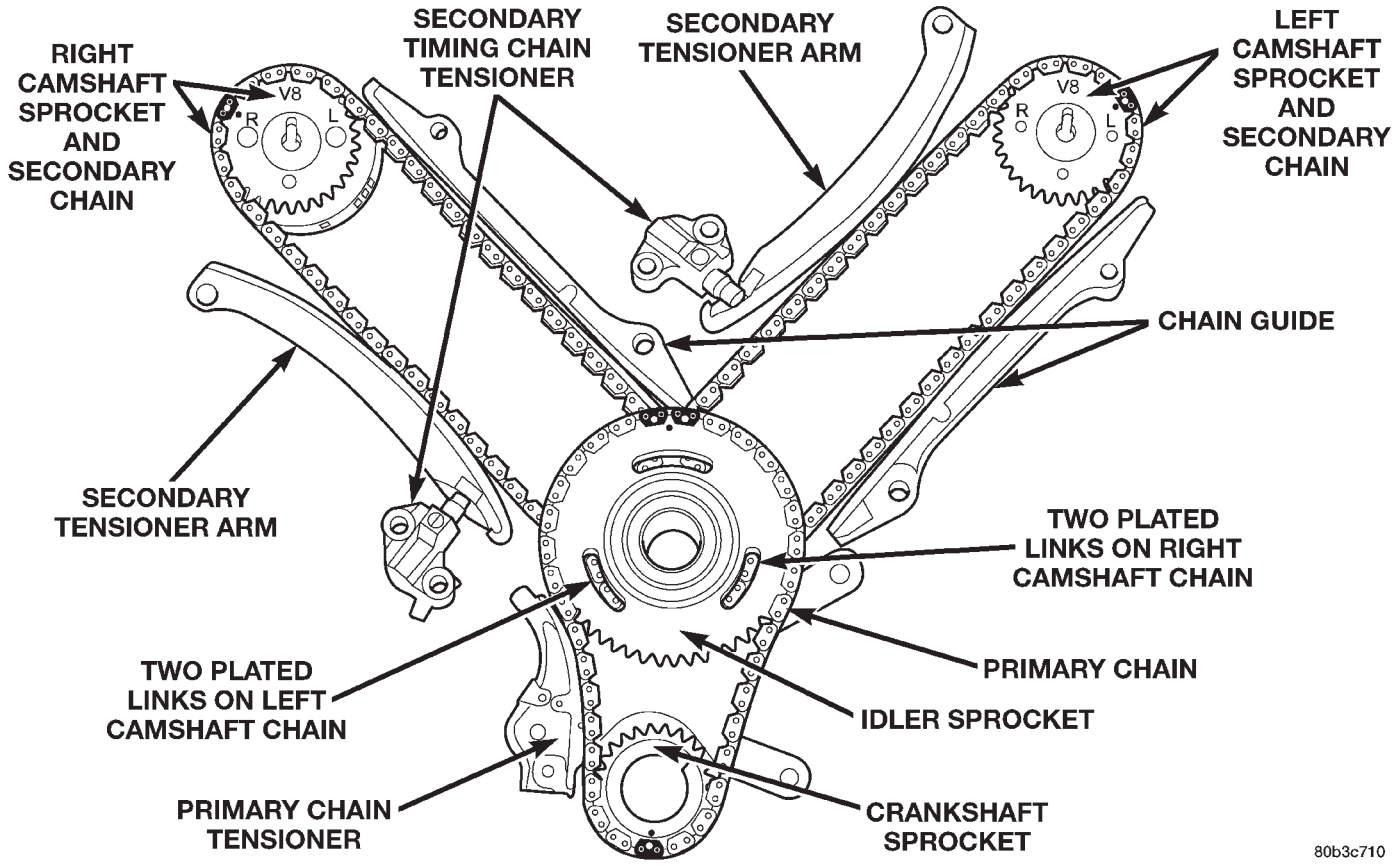

Fig. 68 Timing Chain System

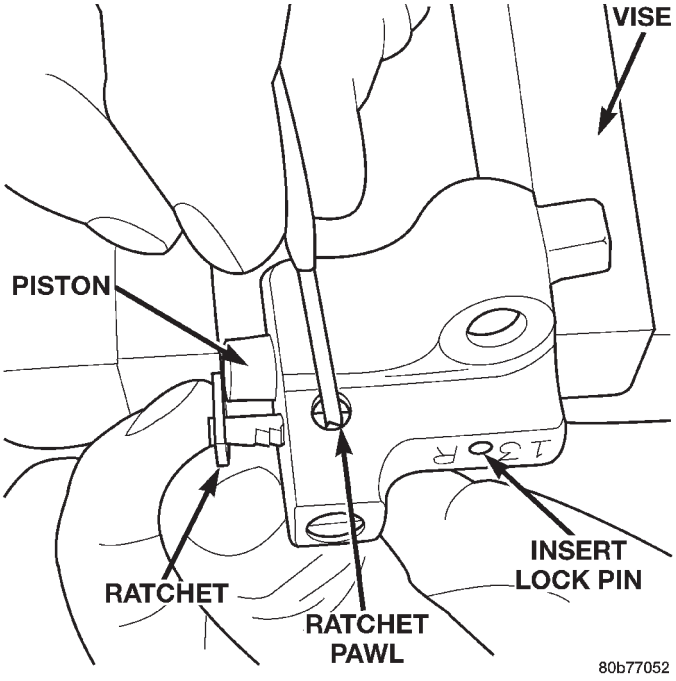

Fig. 69 Resetting Secondary Chain Tensioners

(9) Align primary chain double plated links with the timing mark at 12 o'clock on the idler sprocket. Align the primary chain single plated link with the timing mark at 6 o'clock on the crankshaft sprocket (Fig. 68).

CAUTION: Ensure the plate between the left secondary chain tensioner and block is correctly installed.

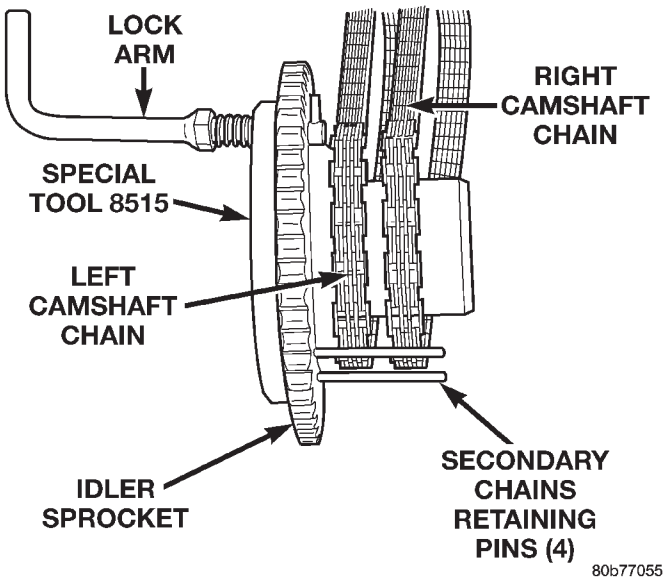

Fig. 70 Installing Secondary Timing Chains on Idler Sprocket

REMOVAL AND INSTALLATION (Continued)

(10) Lubricate idler shaft and bushings with clean engine oil.

(11) Install all chains, crankshaft sprocket, and idler sprocket as an assembly (Fig. 71). After guiding both secondary chains through the block and cylinder head openings, affix chains with a elastic strap or the equivalent, This will maintain tension on chains to aid in installation.

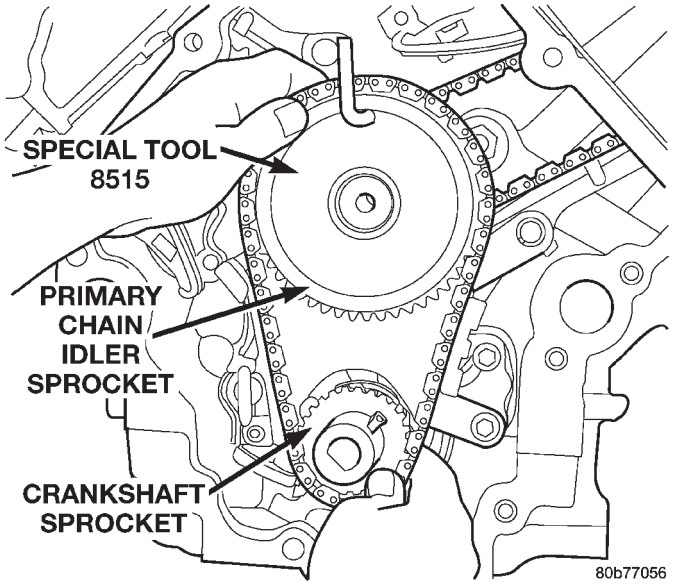

Fig. 71 Installing Idler Gear, Primary and Secondary Timing Chains

NOTE: It will be necessary to slightly rotate camshafts for sprocket installation.

(12) Align left camshaft sprocket "L" dot to plated link on chain.

(13) Align right camshaft sprocket "R" dot to plated link on chain.

(14) Remove Special Tool 8515, then attach both sprockets to camshafts. Install sprocket bolts, but do not tighten at this time.

(15) Verify that all plated links are aligned with the marks on all sprockets and the "V8" marks on camshaft sprockets are at the 12 o'clock position (Fig. 68).

(16) Before installing idler sprocket bolt, lubricate washer with oil, and tighten idler sprocket assembly retaining bolt to 34 N·m (25 ft. lbs.).

(17) Remove all locking pins (3) from tensioners.

CAUTION: After pulling locking pins out of each tensioner, DO NOT manually extend the tensioner(s) ratchet. Doing so will over tension the chains, resulting in noise and/or high timing chain loads.

(18) Using Special Tool 6958, Spanner with Adaptor Pins 8346, tighten left (Fig. 72) and right (Fig. 73). camshaft sprocket bolts to 122 N·m (90 ft. lbs.).

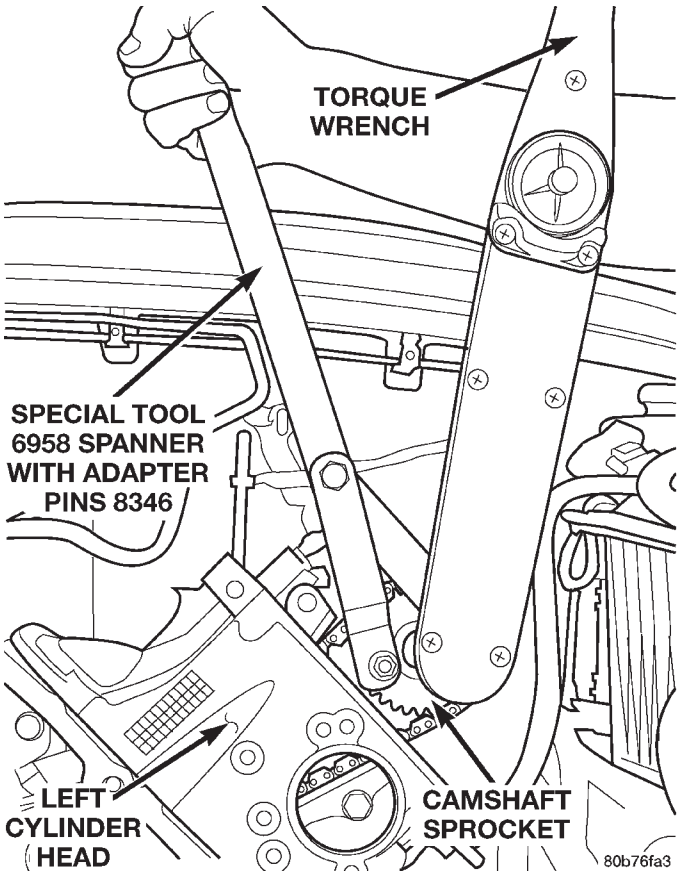

Fig. 72 Tightening Left Side Camshaft Sprocket Bolt

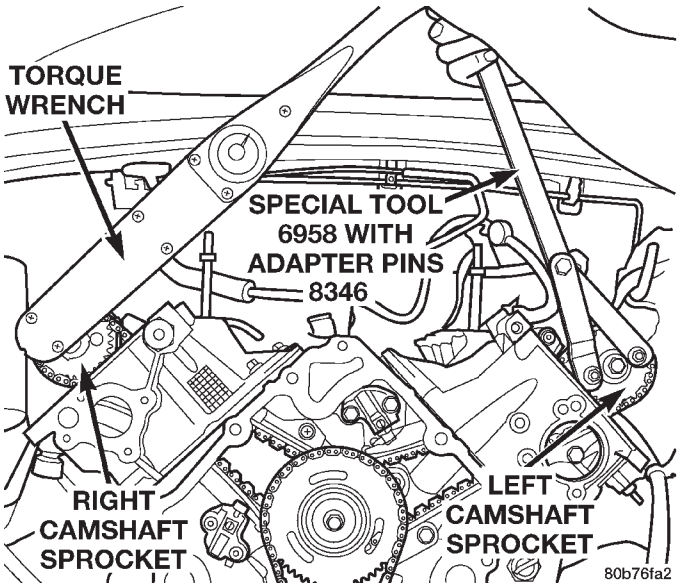

Fig. 73 Tightening Right Side Camshaft Sprocket Bolt

(19) Rotate engine two full revolutions. Verify timing marks are at the follow locations:

- primary chain idler sprocket dot is at 12 o'clock (Fig. 68)
- primary chain crankshaft sprocket dot is at 6 o'clock (Fig. 68)

REMOVAL AND INSTALLATION (Continued)

• secondary chain camshaft sprockets “V8” marks are at 12 o'clock (Fig. 68)

(20) Lubricate all three chains with engine oil.

(21) After installing all chains, it is recommended that the idler gear end play be checked (Fig. 74). The end play must be within 0.10–0.25 mm (0.004–0.010 in.). If not within specification, the idler gear must be replaced.

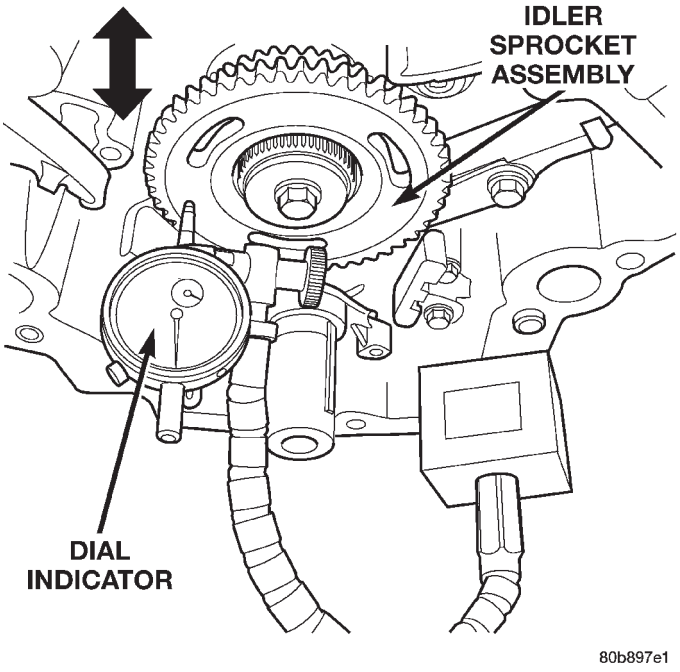

Fig. 74 Measuring Idler Gear End Play

(22) Install timing chain cover and crankshaft damper. Refer to procedures in this section.

(23) Install cylinder head covers. Refer to procedures in this section.

NOTE: Before installing threaded plug in right cylinder head, the plug must be coated with sealant to prevent leaks.

(24) Coat the large threaded access plug with **Mopar® Thread Sealant with Teflon** , then install into the right cylinder head and tighten to 81 N·m (60 ft. lbs.) (Fig. 63).

(25) Install the oil fill housing.

(26) Install access plug in left cylinder head (Fig. 63).

(27) Install power steering pump. Refer to Group 19, Steering for procedure.

(28) Install radiator fan shroud. Refer to Group 7, Cooling System for procedure.

(29) Fill cooling system. Refer to Group 7, Cooling System for coolant fill procedure.

(30) Connect negative cable to battery.

IDLER SHAFT—TIMING DRIVE

REMOVAL

(1) Remove the timing chain and sprockets. Refer to procedure in this section.

NOTE: To remove the idler shaft, it is necessary to tap threads into the shaft to install the removal tool.

(2) Using a 12 mm X 1.75 tap, cut threads in the idler shaft center bore (Fig. 75).

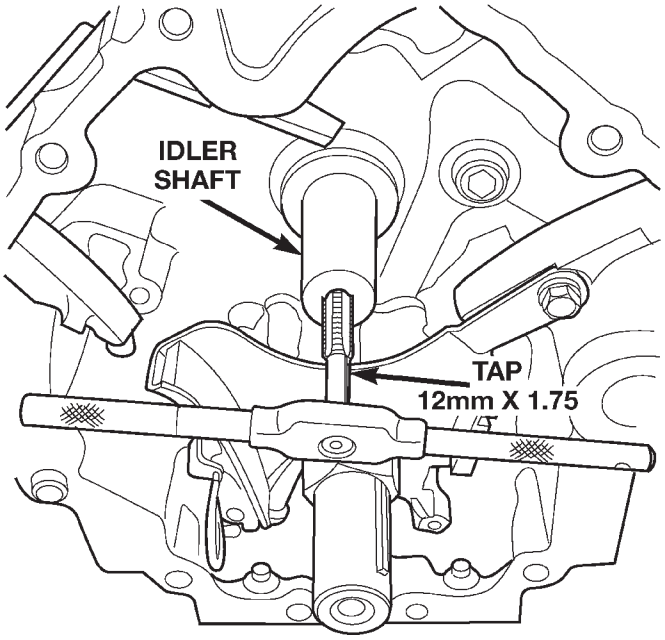

Fig. 75 Tapping Idler Shaft For Special Tool 8517

(3) Cover the radiator core with a suitable cover.

CAUTION: Use care when removing idler shaft, DO NOT strike the radiator cooling fins with the slide hammer.

(4) Using Special Tool 8517 Slide Hammer, remove the idler shaft (Fig. 76).

INSTALLATION

(1) Thoroughly clean the idler shaft bore.

(2) Position the idler shaft in the bore.

NOTE: The two lubrication holes in the idler shaft do not require any special alignment.

NOTE: Before using the retaining bolt to install the idler shaft, coat the threads and the pilot on the idler shaft with clean engine oil.

(3) Using the primary idler sprocket retaining bolt and washer, carefully draw the idler shaft into the bore until fully seated.

REMOVAL AND INSTALLATION (Continued)

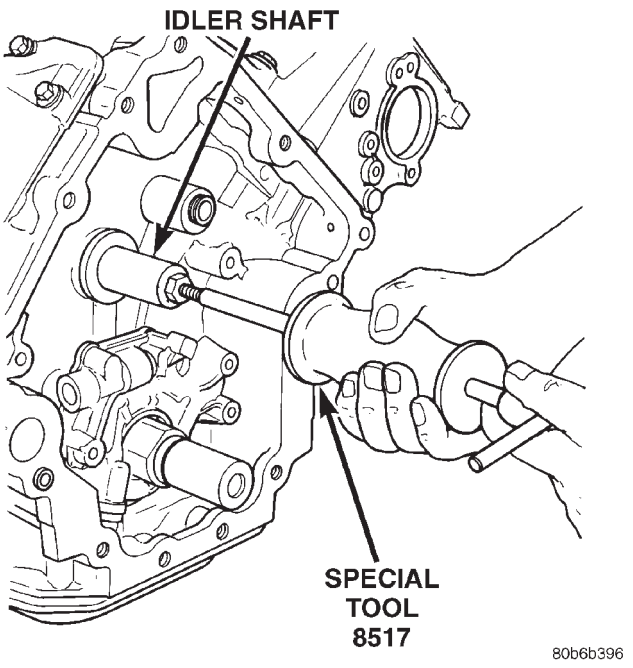

Fig. 76 Removing Idler Shaft

(4) Coat the idler shaft with clean engine oil and install the timing chains and sprockets. Refer to procedure in this section.

CAMSHAFTS—IN VEHICLE

LEFT CAMSHAFT

REMOVAL

CAUTION: When the timing chain is removed and the cylinder heads are still installed, DO NOT forcefully rotate the camshafts or crankshaft independently of each other. Severe valve and/or piston damage can occur.

CAUTION: When removing the cam sprocket, timing chains or camshaft, Failure to use Special Tool 8350 will result in hydraulic tensioner ratchet over extension, requiring timing chain cover removal to reset the tensioner ratchet.

(1) Remove cylinder head cover. Refer to Cylinder Head Cover in this section.

(2) Set engine to TDC cylinder #1, camshaft sprocket V8 marks at the 12 o'clock position.

(3) Mark one link on the secondary timing chain on both sides of the V8 mark on the camshaft sprocket to aid in installation.

CAUTION: Do not hold or pry on the camshaft target wheel (Located on the right side camshaft sprocket) for any reason, Severe damage will occur to the target wheel resulting in a vehicle no start condition.

(4) Loosen but **DO NOT** remove the camshaft sprocket retaining bolt. Leave the bolt snug against the sprocket.

NOTE: The timing chain tensioners must be secured prior to removing the camshaft sprockets. Failure to secure tensioners will allow the tensioners to extend, requiring timing chain cover removal in order to reset tensioners.

CAUTION: Do not force wedge past the narrowest point between the chain strands. Damage to the tensioners may occur.

(5) Position Special Tool 8350 timing chain wedge between the timing chain strands, tap the tool to securely wedge the timing chain against the tensioner arm and guide (Fig. 77).

(6) Hold the camshaft with adjustable pliers while removing the camshaft sprocket bolt and sprocket (Fig. 78).

(7) Using the pliers, gently allow the camshaft to rotate 15° until the camshaft is in the neutral position (no valve load).

(8) Starting at the outside working inward, loosen the camshaft bearing cap retaining bolts 1/2 turn at a time. Repeat until all load is off the bearing caps.

CAUTION: DO NOT STAMP OR STRIKE THE CAMSHAFT BEARING CAPS. SEVERE DAMAGE WILL OCCUR TO THE BEARING CAPS.

NOTE: When the camshaft is removed the rocker arms may slide downward, mark the rocker arms before removing camshaft.

(9) Remove the camshaft bearing caps and the camshaft.

INSTALLATION

(1) Lubricate camshaft journals with clean engine oil.

NOTE: Position the left side camshaft so that the camshaft sprocket dowel is near the 1 o'clock position, This will place the camshaft at the neutral position easing the installation of the camshaft bearing caps.

(2) Position the camshaft into the cylinder head.

(3) Install the camshaft bearing caps, hand tighten the retaining bolts.

REMOVAL AND INSTALLATION (Continued)

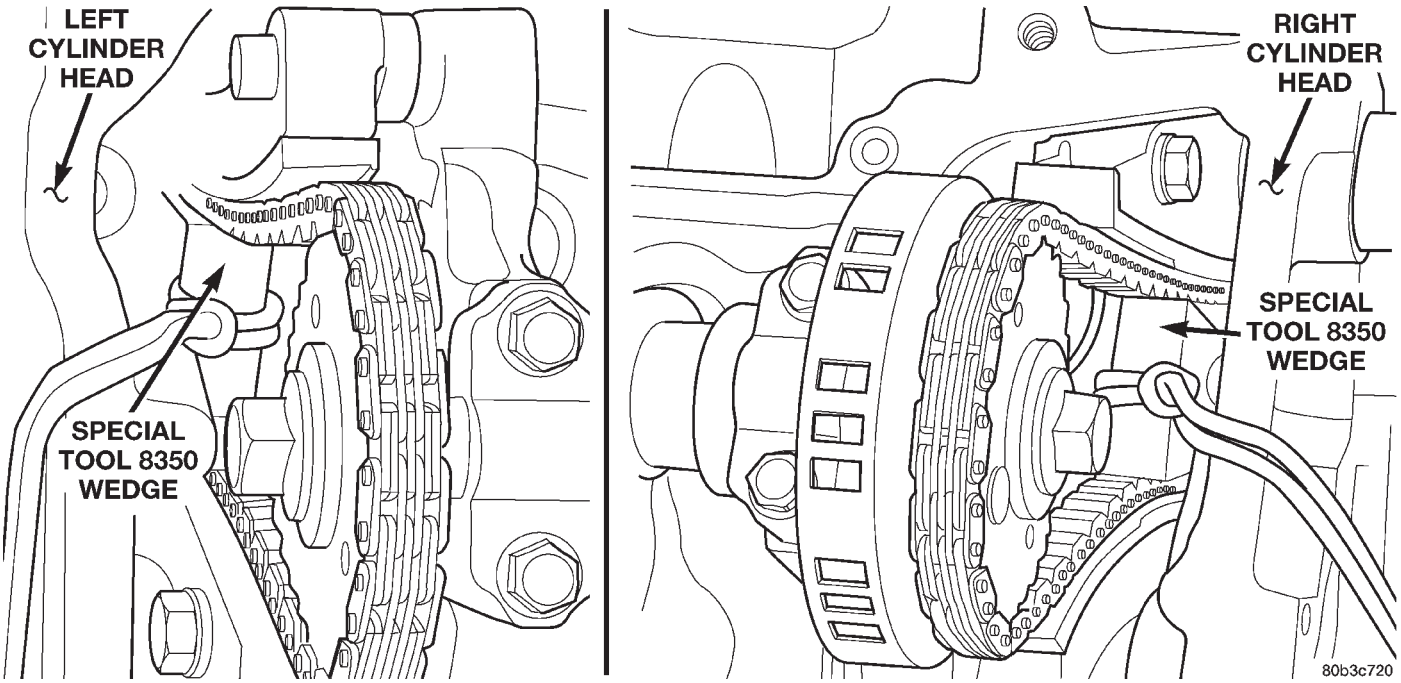

Fig. 77 Securing Timing Chain Tensioners Using Timing Chain Wedge

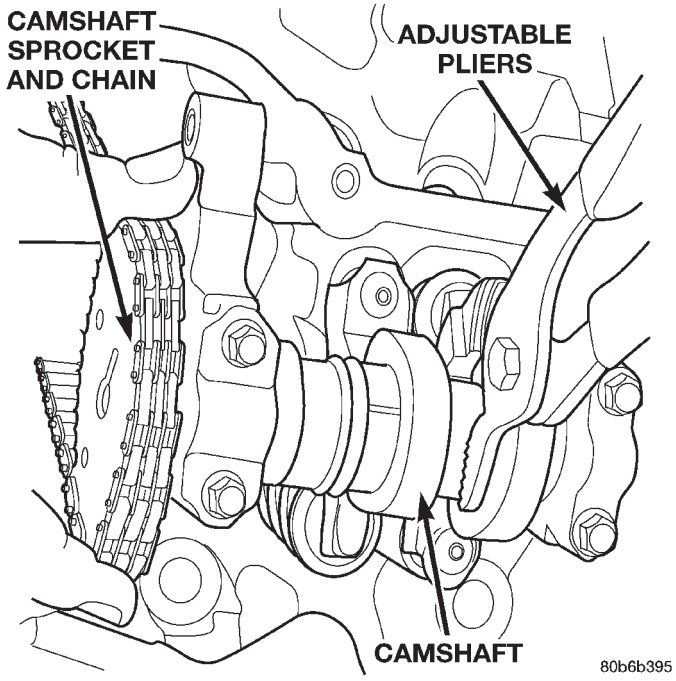

Fig. 78 Camshaft Sprocket and Chain

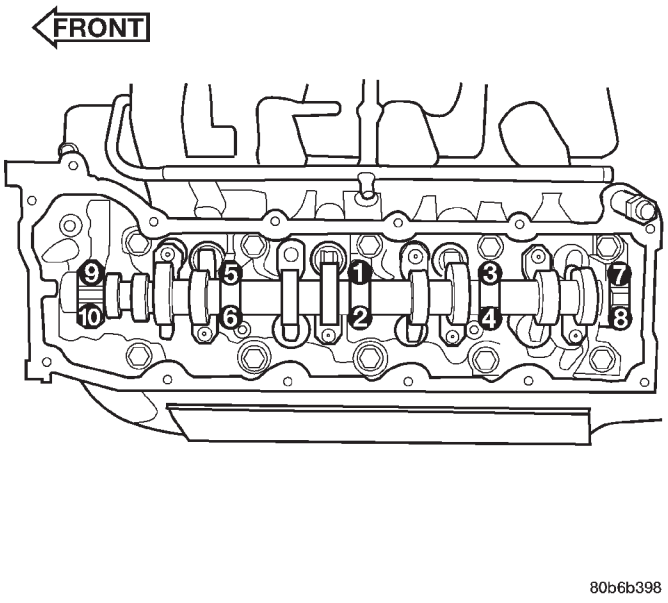

Fig. 79 Camshaft Bearing Caps Tightening Sequence

(4) Working in ½ turn increments, tighten the bearing cap retaining bolts starting with the middle cap working outward (Fig. 79).

(5) Torque the camshaft bearing cap retaining bolts to 11 N·m (100 in. lbs.).

(6) Position the camshaft drive gear into the timing chain aligning the V8 mark between the two marked chain links (Two links marked during removal) (Fig. 80).

(7) Using the adjustable pliers, rotate the camshaft until the camshaft sprocket dowel is aligned with the slot in the camshaft sprocket. Install the sprocket onto the camshaft (Fig. 81).

(8) Install the camshaft sprocket retaining bolt and hand tighten.

(9) Remove Special Tool 8350 timing chain wedge (Fig. 77).

REMOVAL AND INSTALLATION (Continued)

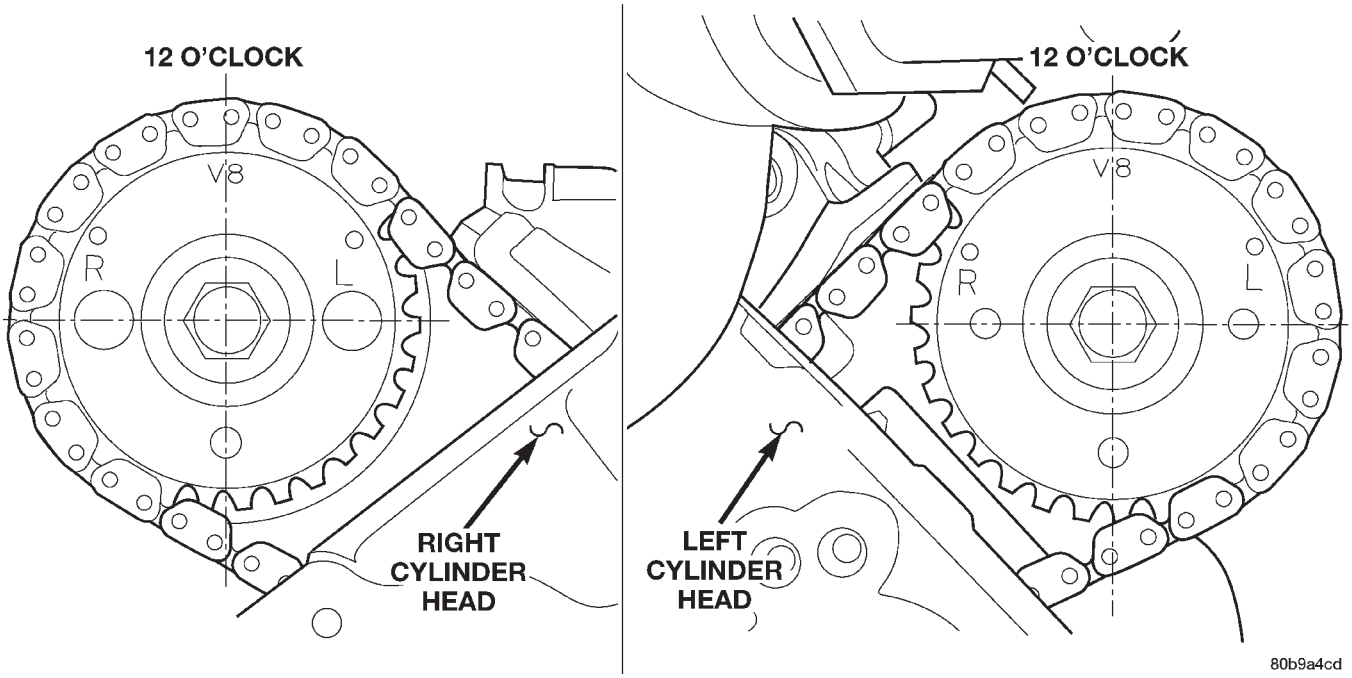

Fig. 80 Timing Chain to Sprocket Alignment

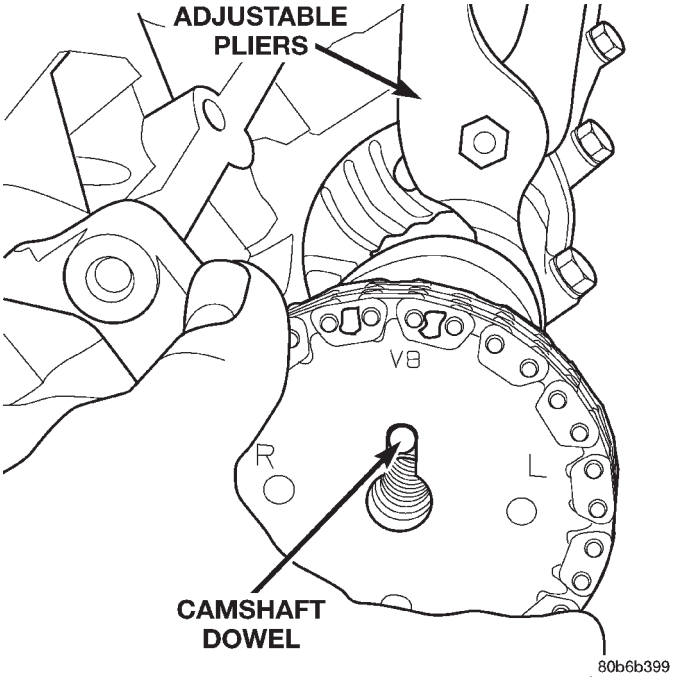

Fig. 81 Camshaft Sprocket Installation

(10) Using Special Tool 6958 spanner wrench with adapter pins 8346 (Fig. 82), torque the camshaft sprocket retaining bolt to 122 N·m (90 ft. lbs.).

(11) Install the cylinder head cover.

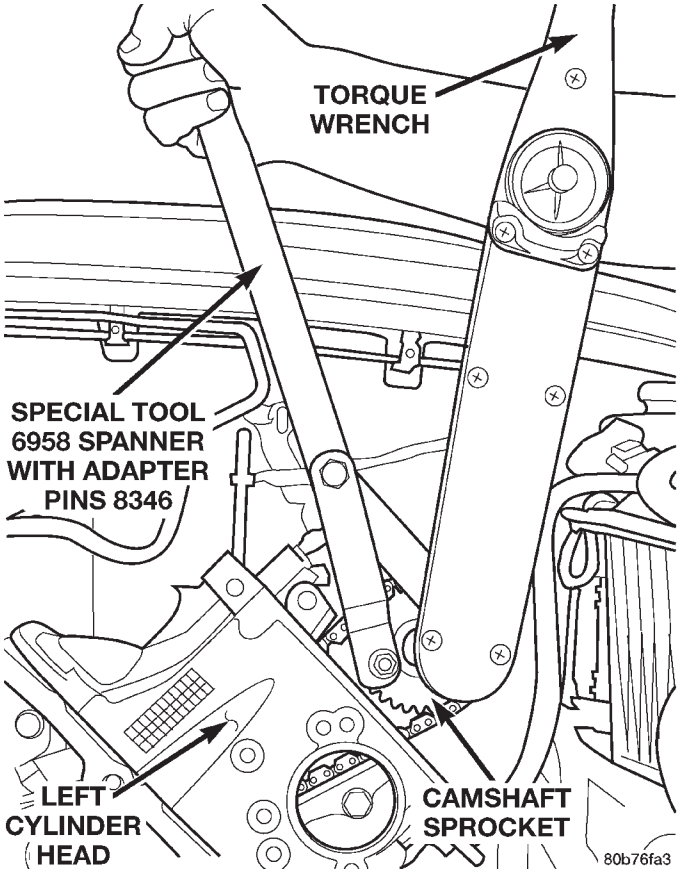

Fig. 82 Tightening Left Side Cam Sprocket Retaining Bolt

REMOVAL AND INSTALLATION (Continued)

RIGHT CAMSHAFT

REMOVAL

CAUTION: When the timing chain is removed and the cylinder heads are still installed, DO NOT forcefully rotate the camshafts or crankshaft independently of each other. Severe valve and/or piston damage can occur.

CAUTION: When removing the cam sprocket, timing chains or camshaft, Failure to use special tool 8350 will result in hydraulic tensioner ratchet over extension, Requiring timing chain cover removal to re-set the tensioner ratchet.

(1) Remove the cylinder head covers. Refer to Cylinder Head Cover in this section.

(2) Set engine to TDC cylinder #1, camshaft sprocket V8 marks at the 12 o'clock position.

(3) Mark one link on the secondary timing chain on both sides of the V8 mark on the camshaft sprocket to aid in installation.

CAUTION: Do not hold or pry on the camshaft target wheel for any reason, Severe damage will occur to the target wheel. A damaged target wheel could cause a vehicle no start condition.

(4) Loosen but **DO NOT** remove the camshaft sprocket retaining bolt. Leave bolt snug against sprocket.

NOTE: The timing chain tensioners must be secured prior to removing the camshaft sprockets. Failure to secure tensioners will allow the tensioners to extend, requiring timing chain cover removal in order to reset tensioners.

CAUTION: Do not force wedge past the narrowest point between the chain strands. Damage to the tensioners may occur.

(5) Position Special Tool 8350 timing chain wedge between the timing chain strands. Tap the tool to securely wedge the timing chain against the tensioner arm and guide (Fig. 83).

(6) Remove the camshaft position sensor (Fig. 84).

(7) Hold the camshaft with adjustable pliers while removing the camshaft sprocket bolt and sprocket (Fig. 85).

(8) Using the pliers, gently allow the camshaft to rotate 45° until the camshaft is in the neutral position (no valve load).

(9) Starting at the outside working inward, loosen the camshaft bearing cap retaining bolts 1/2 turn at a time. Repeat until all load is off the bearing caps.

CAUTION: DO NOT STAMP OR STRIKE THE CAMSHAFT BEARING CAPS. SEVERE DAMAGE WILL OCCUR TO THE BEARING CAPS.

NOTE: When the camshaft is removed the rocker arms may slide downward, mark the rocker arms before removing camshaft.

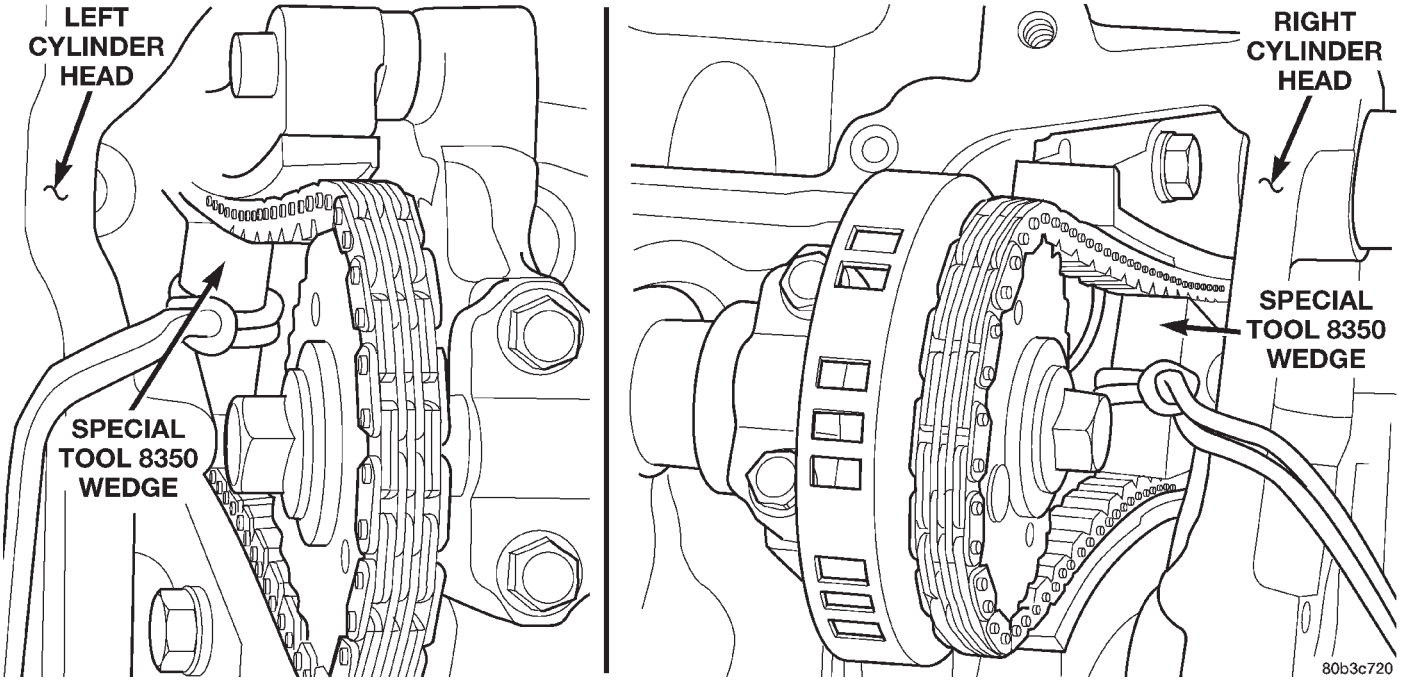

Fig. 83 Securing Timing Chain Tensioners Using Timing Chain Wedge

REMOVAL AND INSTALLATION (Continued)

(10) Remove the camshaft bearing caps and the camshaft.

INSTALLATION

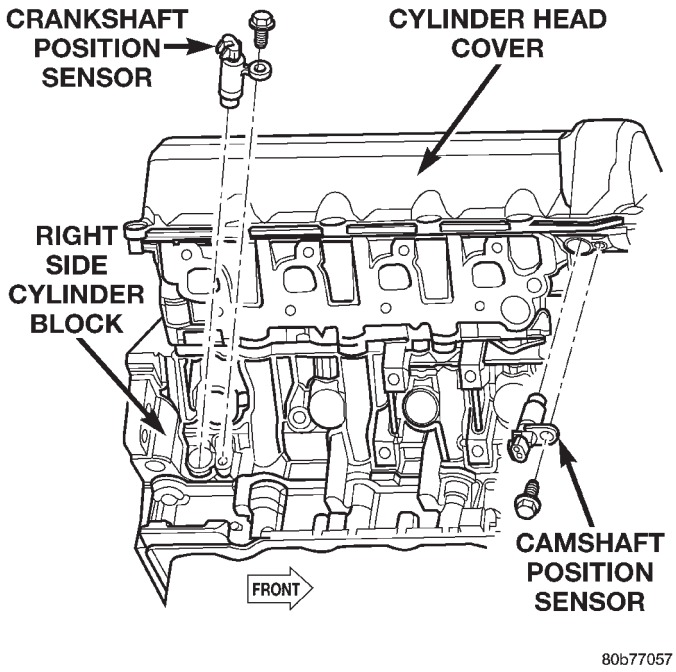

Fig. 84 Camshaft Position Sensor

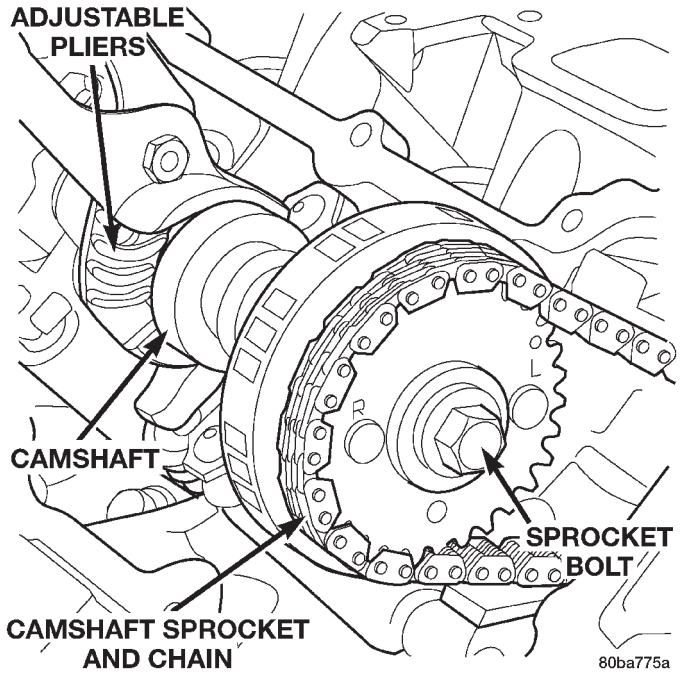

Fig. 85 Camshaft Sprocket and Chain

(1) Lubricate camshaft journals with clean engine oil.

NOTE: Position the right side camshaft so that the camshaft sprocket dowel is near the 10 o'clock position, This will place the camshaft at the neutral position easing the installation of the camshaft bearing caps.

(2) Position the camshaft into the cylinder head.

(3) Install the camshaft bearing caps, hand tighten the retaining bolts.

(4) Working in 1/2 turn increments, tighten the bearing cap retaining bolts starting with the middle cap working outward (Fig. 86).

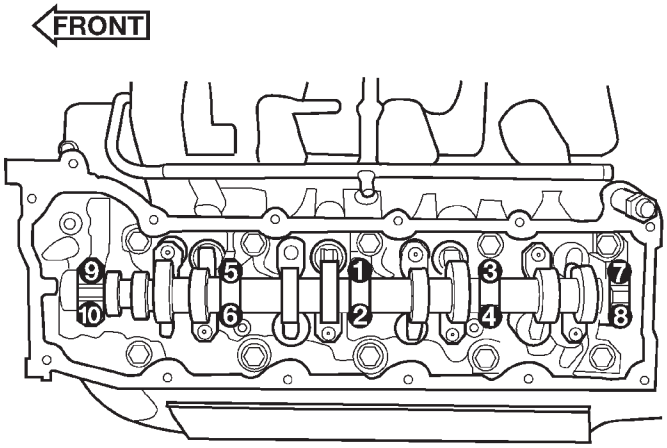

Fig. 86 Camshaft Bearing Caps Tightening Sequence

(5) Torque the camshaft bearing cap retaining bolts to 11 N·m (100 in. lbs.).

(6) Position the camshaft drive gear into the timing chain aligning the V8 mark between the two marked chain links (Two links marked during removal) (Fig. 87).

(7) Using the adjustable pliers, rotate the camshaft until the camshaft sprocket dowel is aligned with the slot in the camshaft sprocket. Install the sprocket onto the camshaft (Fig. 88).

(8) Install the camshaft sprocket retaining bolt and hand tighten.

(9) Remove timing chain wedge special tool 8350 (Fig. 83).

(10) Using Special Tool 6958 spanner wrench with adapter pins 8346 (Fig. 89), torque the camshaft sprocket retaining bolt to 122 N·m (90 ft. lbs.).

(11) Install the camshaft position sensor (Fig. 84).

(12) Install the cylinder head cover.

REMOVAL AND INSTALLATION (Continued)

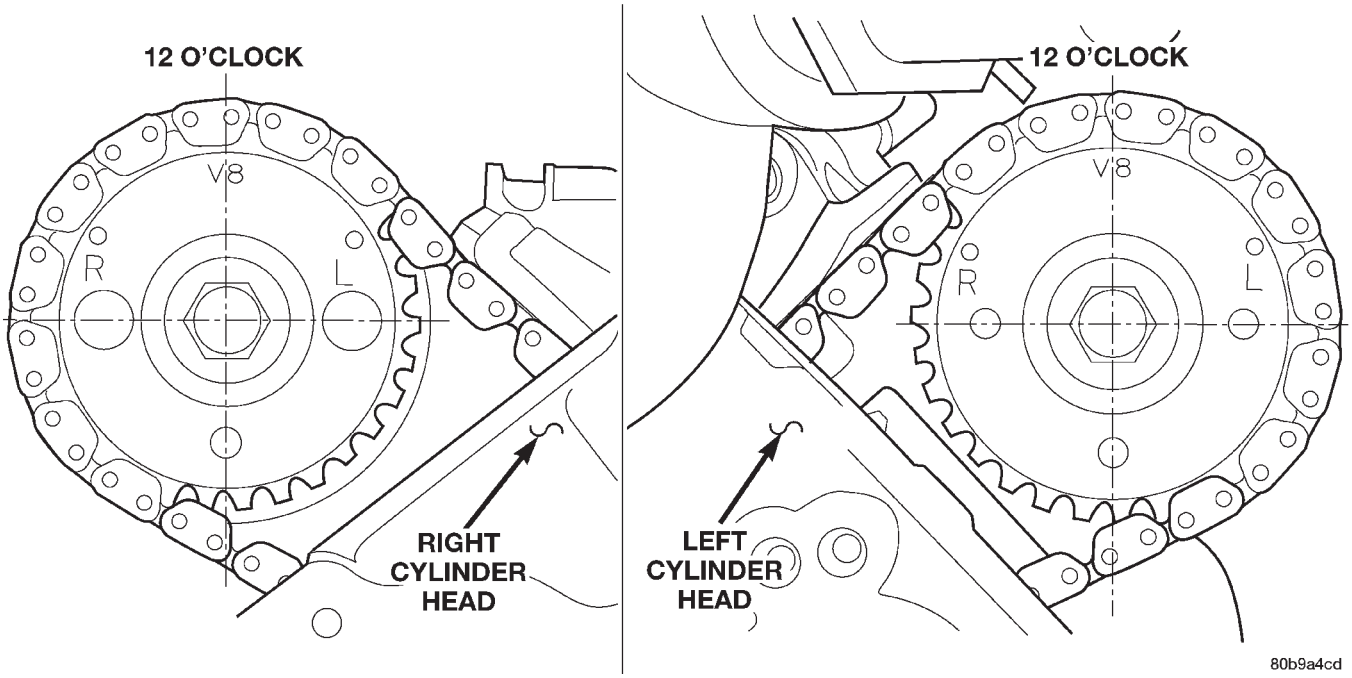

Fig. 87 Timing Chain to Sprocket Alignment

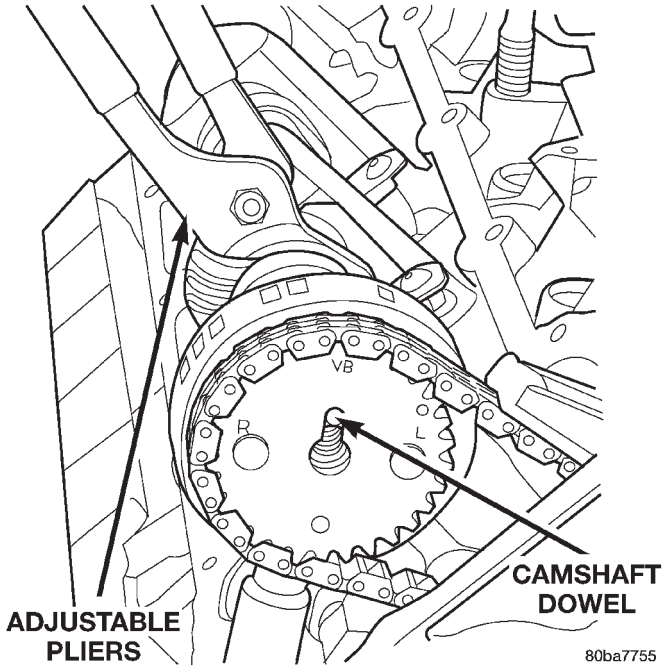

Fig. 88 Camshaft Sprocket Installation

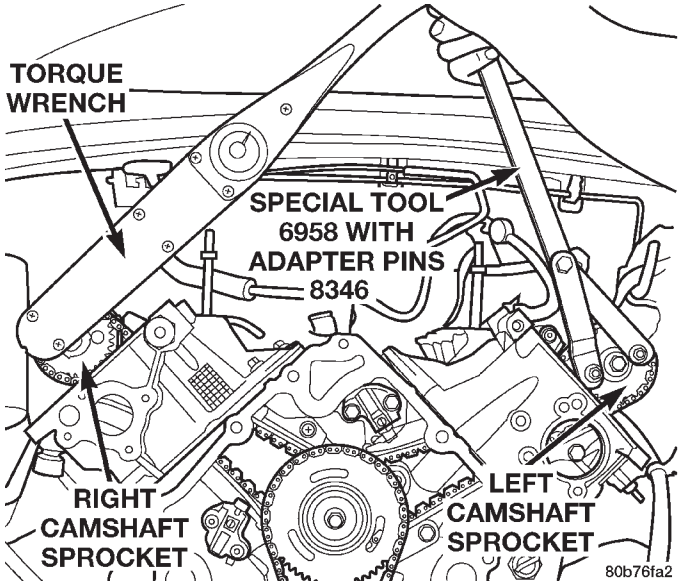

Fig. 89 Tightening Right Side Cam Sprocket Retaining Bolt

CRANKSHAFT MAIN BEARINGS

CRANKSHAFT MAIN BEARING SELECTION

The main bearings are "select fit" to achieve proper oil clearances. For main bearing selection, the crankshaft position sensor target wheel has grade identification marks stamped into it (Fig. 90). These marks are read from left to right, corresponding with journal number 1, 2, 3, 4 and 5. The crankshaft position sensor target wheel is mounted to the number 8 counter weight on the crankshaft.

NOTE: Service main bearings color coded. These color codes identify what size (grade) the bearing is.

CHECKING CRANKSHAFT END PLAY

(1) Mount a dial indicator to a stationary point at front of engine. Locate the probe perpendicular against nose of crankshaft (Fig. 91).

REMOVAL AND INSTALLATION (Continued)

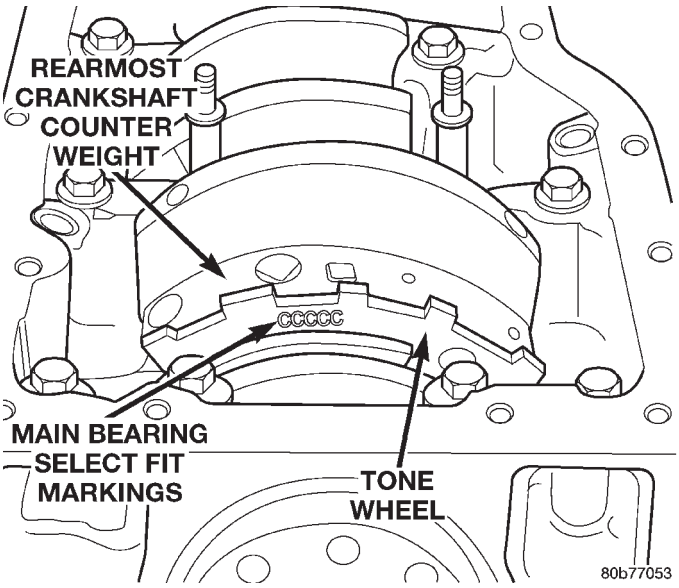

Fig. 90 Main Bearing Markings on Target Wheel

MAIN BEARING SELECTION CHART—4.7L

GRADE MARKING	SIZE mm (in.)	FOR USE WITH JOURNAL SIZE
A	0.008 mm (0.0004 in.) U/S	63.488–63.496 mm (2.4996–2.4999 in.)
B	NOMINAL	63.496–63.504 mm (2.4999–2.5002 in.)
C	0.008 mm (0.0004 in.) O/S	63.504–63.512 mm (2.5002–2.5005 in.)

(2) Move the crankshaft all the way to the rear of it's travel.

(3) Zero the dial indicator.

(4) Move the crankshaft all the way to the front of it's travel and read the dial indicator. Refer to Crankshaft End Play Specification Chart.

OIL PAN

REMOVAL

(1) Disconnect negative cable from battery.

(2) Raise vehicle on hoist.

(3) Remove structural cover. Refer to Structural Cover in this section for procedure.

(4) Remove exhaust system Y-pipe.

(5) Remove starter. Refer to Group 8B, Starting.

(6) Drain engine oil.

(7) Un-clip transmission lines from support on oil pan stud. Move lines for oil pan clearance.

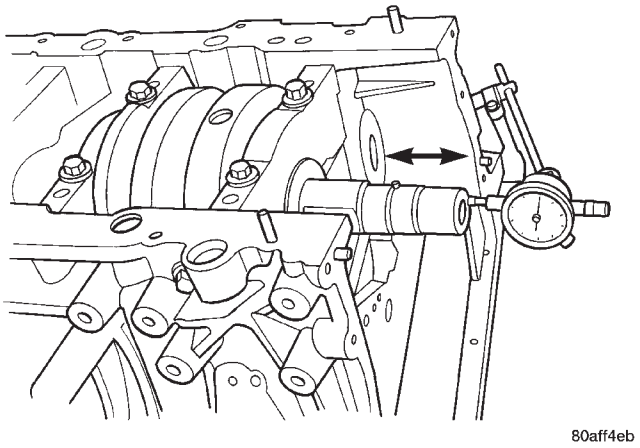

Fig. 91 Checking Crankshaft end Play—Typical

CRANKSHAFT END PLAY SPECIFICATION CHART

New Part:	0.052 - 0.282mm (0.002 - 0.011 in.)
Wear Limit:	0.43mm (0.017 in.)

CAUTION: DO NOT pry on the oil pan gasket when removing the oil pan, The oil pan gasket is mounted to the cylinder block in three locations and will remain attached to block when lowering oil pan. Gasket can not be removed with oil pan.

(8) Remove oil pan bolts and oil pan.

(9) Remove oil pump pickup tube.

(10) Remove oil pan gasket.

INSTALLATION

(1) Clean oil pan and all sealing surfaces. Inspect oil pan gasket and replace as necessary.

(2) Install oil pan gasket.

NOTE: When installing oil pan gasket/windage tray, start four pan bolts at each corner before tightening oil pickup tube. This will keep pan gasket in alignment.

(3) Install oil pump pick-up tube using a new O-ring. First tighten bolt at O-ring end of tube to 28 N·m (20 ft. lbs.). Tighten remain tube support fasteners to 28 N·m (20 ft. lbs.).

(4) Install oil pan and tighten fasteners to 15 N·m (11 ft. lbs.) (Fig. 92).

(5) Reconnect transmission oil cooler lines to oil pan stud bolt.

(6) Install starter.

(7) Install exhaust system Y-pipe.

REMOVAL AND INSTALLATION (Continued)

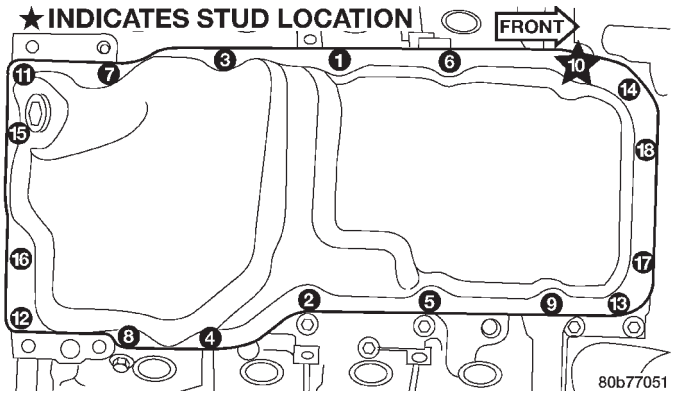

Fig. 92 Oil Pan Tightening Sequence

(8) Install structural cover. Refer to Structural Cover in this section for procedure.

(9) Lower vehicle.

(10) Fill engine with proper amount of oil.

(11) Connect negative cable to battery.

PISTON AND CONNECTING ROD ASSEMBLY

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove the following components: (Refer to procedures in this section)

- Oil pan and gasket/windage tray.
- Cylinder head covers.
- Timing chain cover.
- Cylinder head(s).

(3) If necessary, 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.** Pistons and connecting rods must be removed from top of cylinder block. When removing piston and connecting rod assemblies from the engine, rotate crankshaft so the each connecting rod is centered in cylinder bore.

CAUTION: DO NOT use a number stamp or a punch to mark connecting rods or caps, as damage to connecting rods could occur

NOTE: Connecting rods and bearing caps are not interchangeable and should be marked before removing to ensure correct reassembly.

(4) Mark connecting rod and bearing cap positions using a permanent ink marker or scribe tool (Fig. 93).

CAUTION: Care must be taken not to damage the fractured rod and cap joint face surfaces, as engine damage may occur.

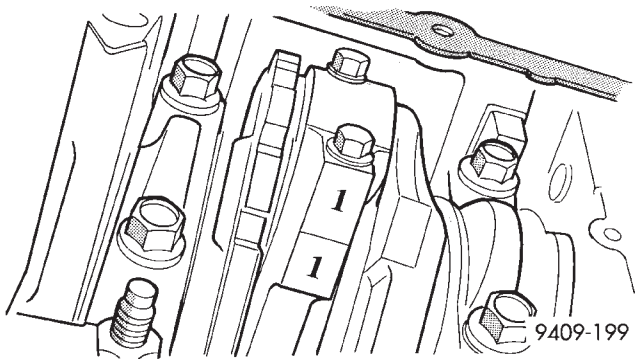

Fig. 93 Identify Connecting Rod to Cylinder Position—Typical

(5) Remove connecting rod cap. Install Special Tool 8507 Connecting Rod Guides into the connecting rod being removed. Remove piston from cylinder bore. Repeat this procedure for each piston being removed.

CAUTION: Care must be taken not to nick crankshaft journals, as engine damage may occur

(6) Immediately after piston and connecting rod removal, install bearing cap on the mating connecting rod to prevent damage to the fractured cap and rod surfaces.

(7) Carefully remove piston rings from piston(s), starting from the top ring down.

PISTON RINGS—INSTALLATION

(1) The No. 1 and No. 2 piston rings have a different cross section. Ensure No. 2 ring is installed with manufacturers I.D. mark (Dot) facing up, towards top of the piston.

NOTE: Piston rings are installed in the following order:

- **Oil ring expander.**
- **Upper oil ring side rail.**
- **Lower oil ring side rail.**
- **No. 2 Intermediate piston ring.**
- **No. 1 Upper piston ring.**

(2) Install the oil ring expander.

(3) Install upper side rail (Fig. 94) by placing one end between the piston ring groove and the expander ring. Hold end firmly and press down the portion to be installed until side rail is in position. Repeat this step for the lower side rail.

(4) Install No. 2 intermediate piston ring using a piston ring installer (Fig. 95).

(5) Install No. 1 upper piston ring using a piston ring installer (Fig. 95).

(6) Position piston ring end gaps as shown in (Fig. 96). It is important that expander ring gap is at least 45° from the side rail gaps, but not on the piston pin center or on the thrust direction.

REMOVAL AND INSTALLATION (Continued)

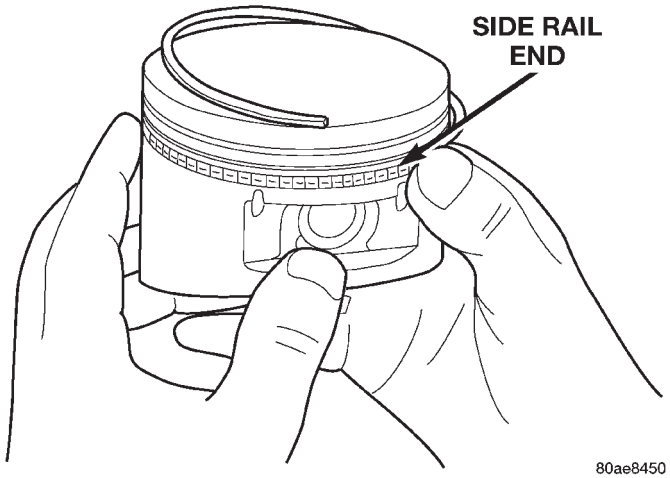

Fig. 94 Side Rail—Installation

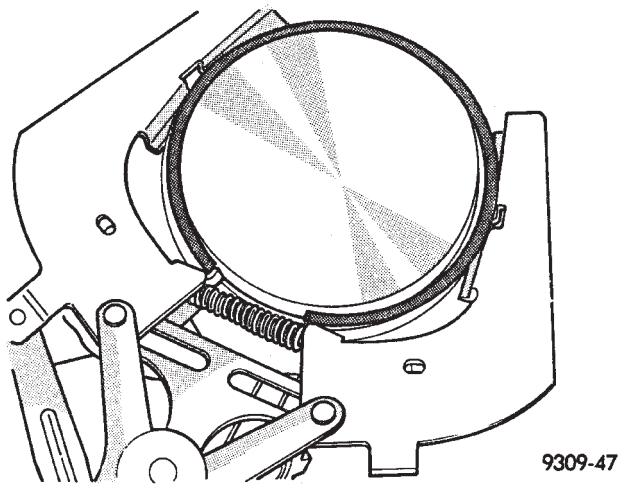

Fig. 95 Upper and Intermediate Rings—Installation

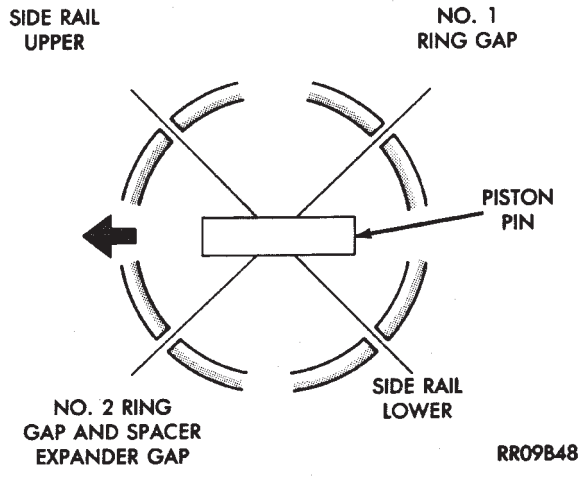

Fig. 96 Piston Ring End Gap Position

INSTALLATION

(1) Before installing piston and connecting rod assemblies in to the bore, ensure all rings are in position shown in (Fig. 96).

(2) Immerse the piston head and rings in clean engine oil. Position a ring compressor over the piston and rings. Tighten ring compressor. **Ensure position of rings do not change during this operation.**

(3) Position bearing onto connecting rod. Ensure that hole in bearing shell aligns with hole in connecting rod. Lubricate bearing surface with clean engine oil.

(4) Install Special Tool 8507 Connecting Rod Guides into connecting rod bolt threads (Fig. 97).

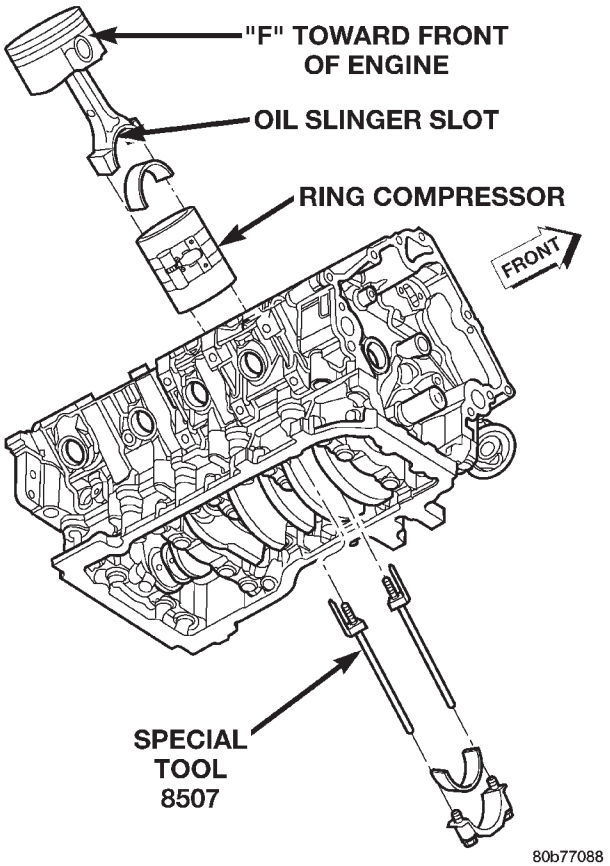

Fig. 97 Piston and Connecting Rod—Installation

(5) The pistons are marked on the piston pin bore surface with an raised “F” indicating installation position. This mark must be pointing toward the front of engine on both cylinder banks. The connecting rod oil slinger slot faces the front of the engine (Fig. 98).

(6) Wipe cylinder bore clean and lubricate with engine oil.

(7) Rotate crankshaft until connecting rod journal is on the center of cylinder bore. Insert rod and piston into cylinder bore and carefully position connecting rod guides over crankshaft journal.

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

REMOVAL AND INSTALLATION (Continued)

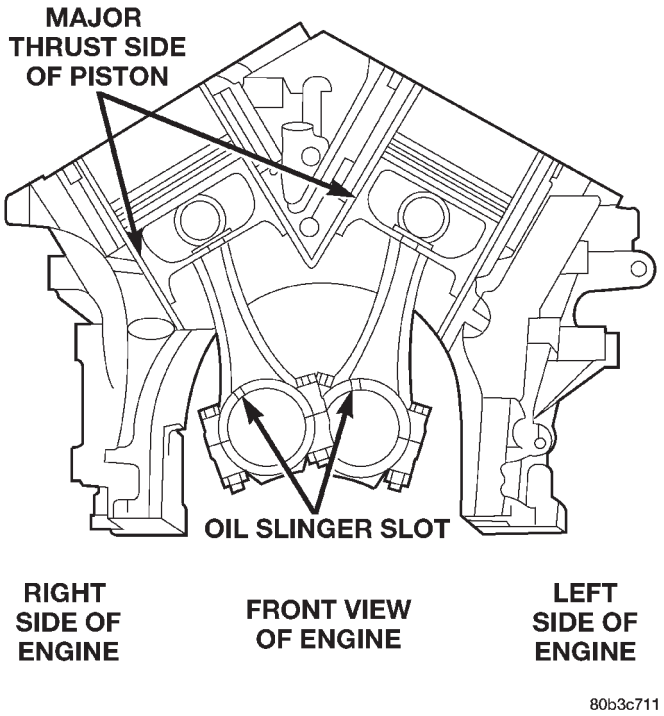

Fig. 98 Piston and Connecting Rod Positioning

CAUTION: Connecting Rod Bolts are Torque to Yield Bolts and Must Not Be Reused. Always replace the Rod Bolts whenever they are loosened or removed.

(9) Lubricate rod bolts and bearing surfaces with engine oil. Install connecting rod cap and bearing. Tighten bolts to 20 N·m (15 ft. lbs.) plus 110 degrees.

(10) Install the following components: (Refer to procedures in this section)

- Cylinder head(s).
- Timing chain and cover.
- Cylinder head covers.
- Oil pan and gasket/windage tray.

(11) Fill crankcase with proper engine oil to correct level.

(12) Connect negative cable to battery.

CRANKSHAFT

REMOVAL

NOTE: To remove the crankshaft from the engine, the engine must be removed from the vehicle.

(1) Remove the engine. Refer to Engine Assembly in this section for procedure.

(2) Remove the engine oil pump. Refer to Oil Pump in this section for procedure.

CAUTION: DO NOT pry on the oil pan gasket when removing the oil pan, The oil pan gasket is mounted to the cylinder block in three locations and will remain attached to block when removing oil pan. Gasket can not be removed with oil pan.

(3) Remove oil pan bolts and oil pan.

(4) Remove the oil pump pickup tube and oil pan gasket /windage tray.

(5) Remove the bedplate mounting bolts. Note the location of the three stud bolts for installation.

(6) Remove the connecting rods from the crankshaft.

CAUTION: The bedplate to cylinder block mating surface is a critical sealing surface. Do not pry on or damage this surface in anyway.

NOTE: The bedplate contains the lower main bearing halves. Use care when handling bedplate as not to drop or damage bearing halves. Installing main bearing halves in the wrong position will cause sever damage to the crankshaft.

(7) Remove the bedplate.

CAUTION: When removing the crankshaft, use care not to damage bearing surfaces on the crankshaft.

(8) Remove the crankshaft.

(9) Remove the crankshaft tone wheel.

INSPECTION

NOTE: Thoroughly inspect the connecting rod bearing bores and main bearing bores for scoring, blueing or severe scratches. Further disassembly may be required.

If connecting rod bearing bores show damage, the cylinder heads must be removed to service the piston and rod assemblies. If the bedplate or the cylinder block main bearing bores show damage the engine must be replaced.

(1) If required, remove the main bearing halves from the cylinder block and bedplate.

(2) Thoroughly clean the bedplate to cylinder block sealing surfaces and main bearing bores. Remove all oil and sealant residue.

(3) Inspect the bedplate main bearing bores for cracks, scoring or severe blueing. If either condition exists the engine must be replaced.

(4) Inspect the crankshaft thrust washer for scoring, scratches or blueing. If either condition exist replace the thrust washer.

REMOVAL AND INSTALLATION (Continued)

(5) Inspect the oil pan gasket/windage tray for splits, tears or cracks in the gasket sealing surfaces. Replace gasket as necessary.

INSTALLATION

CAUTION: Main bearings are select fit. Refer to Crankshaft Main Bearings in this section for proper bearing selections.

(1) Lubricate upper main bearing halves with clean engine oil.

CAUTION: When installing crankshaft, use care not to damage bearing surfaces on the crankshaft.

NOTE: Apply sealant to the tone wheel retaining screws prior to installation.

(2) Install the crankshaft tone wheel. torque the mounting screws to 22 N·m (21 ft. lbs.).

(3) Install the thrust washer (Fig. 99).

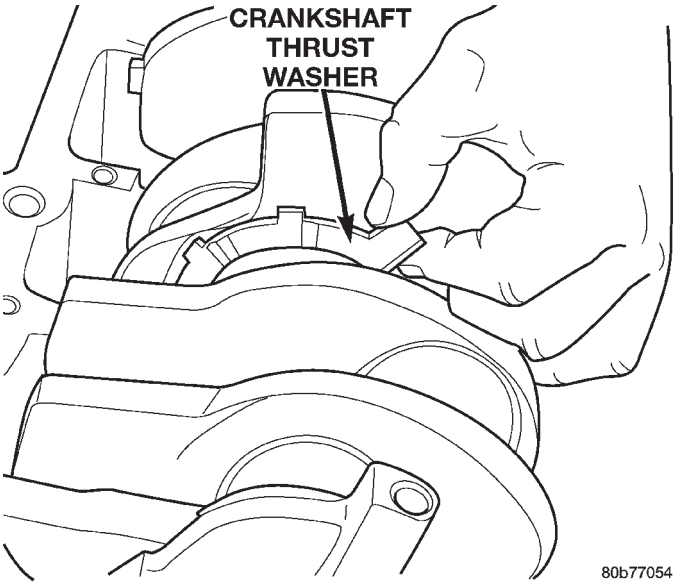

Fig. 99 Crankshaft Thrust Washer Installation

(4) Position crankshaft in cylinder block.

CAUTION: The bedplate to cylinder block mateing surface must be coated with sealant prior to installation. Failure to do so will cause severe oil leaks.

NOTE: The installation time to install the bedplate after the sealant has been applied is critical.

NOTE: Make sure that the bedplate and cylinder block sealing surfaces are clean and free of oil or other contaminants. Contaminants on the sealing surfaces may cause main bearing distortion and/or oil leaks.

(5) Apply a 2.5mm (0.100 inch) (Fig. 100) bead of Mopar® Silicone Rubber Adhesive sealant to the cylinder block-to-bedplate mating surface as shown (Fig. 101).

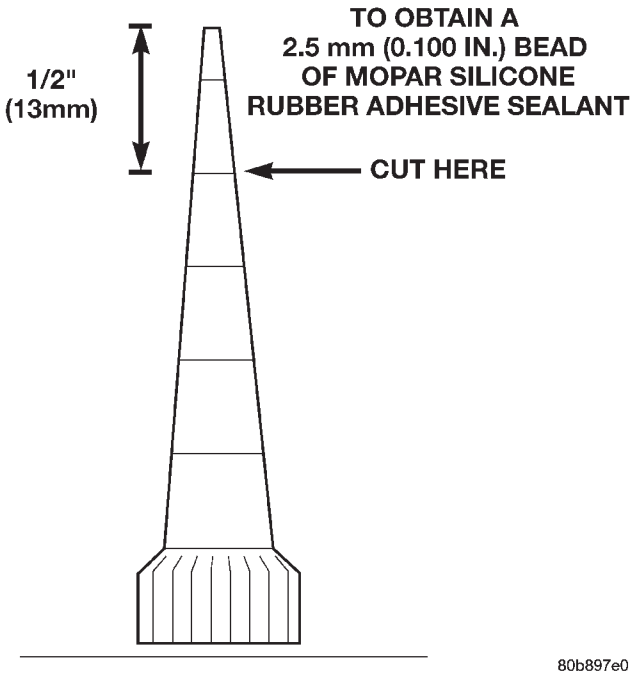

Fig. 100 Cutting Aplicator to Achieve 2.5mm (0.100 in.) Bead

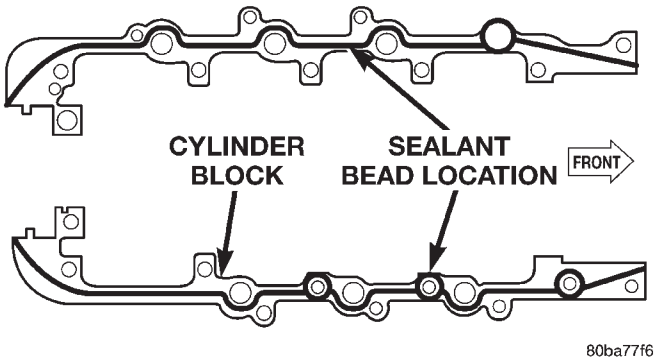

Fig. 101 Cylinder Block-to-Bedplate Sealent Bead Location

(6) Coat the crankshaft main bearing journals with clean engine oil and position the bedplate onto the cylinder block.

NOTE: Lubricate the bedplate retaining bolts with clean engine oil prior to installation.

(7) Install the bedplate retaining bolts, making sure to place the stud bolts in the correct location, Torque the bolts in the sequence shown (Fig. 102).

REMOVAL AND INSTALLATION (Continued)

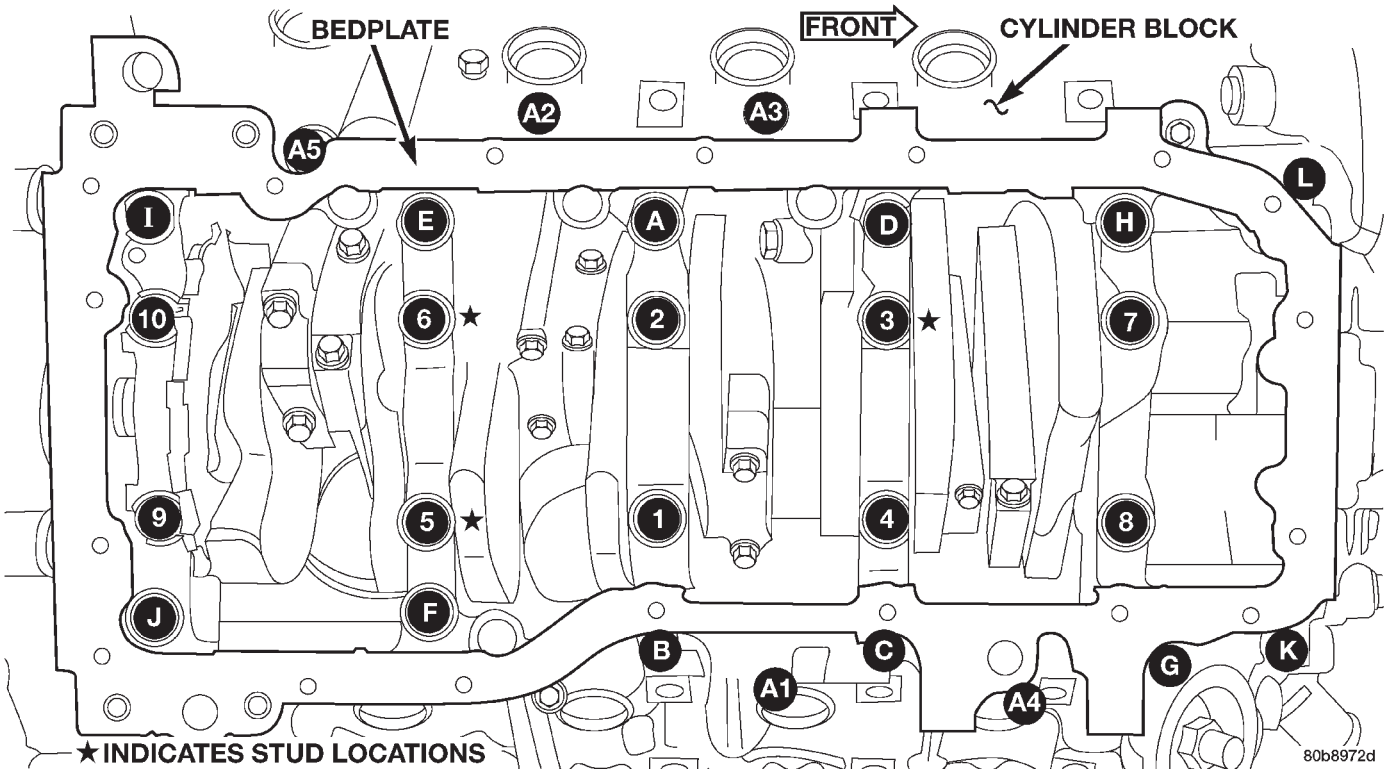

Fig. 102 Bedplate Tightening Sequence

- Tighten bolts **1–10** to 2.8 N·m (25 in. lbs.)
- Turn bolts **1–10** an additional 90°.
- Tighten bolts **A – K** to 54 N·m (40 ft. lbs.)
- Tighten bolts **A1– A5** to 27 N·m (20 ft. lbs.)

(8) Measure crankshaft end play. Refer to Crankshaft Main Bearings in this section for procedure.

(9) Install the connecting rods and measure side clearance. Refer to Connecting Rod Bearings in this section for procedure.

(10) Position the oil pan gasket/windage tray, using a new o-ring, install the oil pickup tube. Torque the bolt to 28N·n (20 ft. lbs.) torque the nuts to 28N·m (20 ft. lbs.).

(11) Install the oil pan. Torque the retaining bolts to 15 N·m (11 ft. lbs.) in the sequence shown (Fig. 103).

(12) Install the engine.

FLEXPLATE

REMOVAL

(1) Remove the transmission. Refer to Group 21, Transmission and Transfer Case for procedure.

(2) Remove the bolts and flexplate.

INSTALLATION

(1) Position the flexplate onto the crankshaft and install the bolts hand tight.

(2) Tighten the flexplate retaining bolts to 60 N·m (45 ft. lbs.) in the sequence shown (Fig. 104).

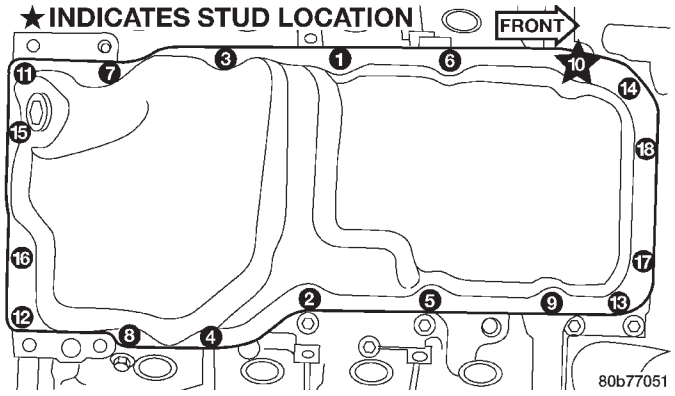

Fig. 103 Oil Pan Tightening Sequence

(3) Install the transmission.

OIL PUMP

REMOVAL

(1) Remove the timing chain cover. Refer to the procedure in this section.

(2) Remove the timing chains and tensioners. Refer to Timing Chain and Sprockets in this section.

(3) Remove the four bolts, primary timing chain tensioner and the oil pump.

REMOVAL AND INSTALLATION (Continued)

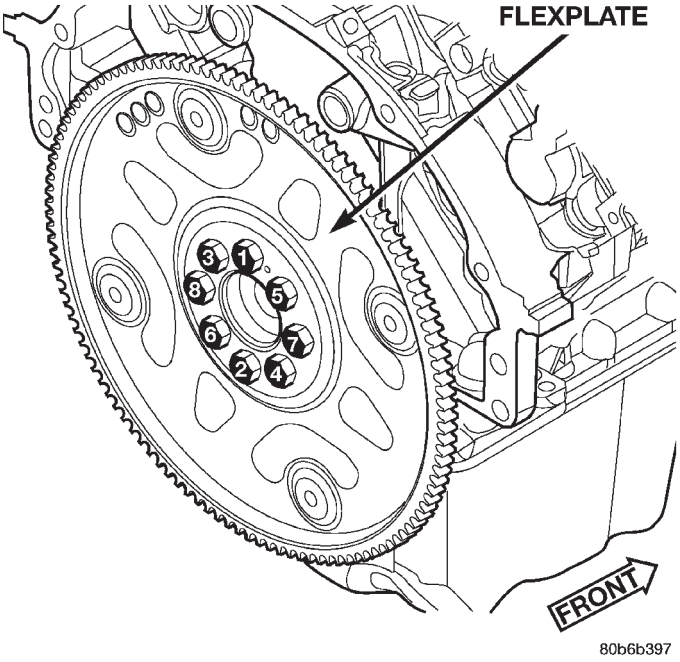

Fig. 104 Flexplate Tightening Sequence

INSTALLATION

(1) Position the oil pump onto the crankshaft and install two oil pump retaining bolts.

(2) Position the primary timing chain tensioner and install the two retaining bolts.

(3) Tighten the oil pump and primary timing chain tensioner retaining bolts to 28 N·m (250 in. lbs.) in the sequence shown (Fig. 105).

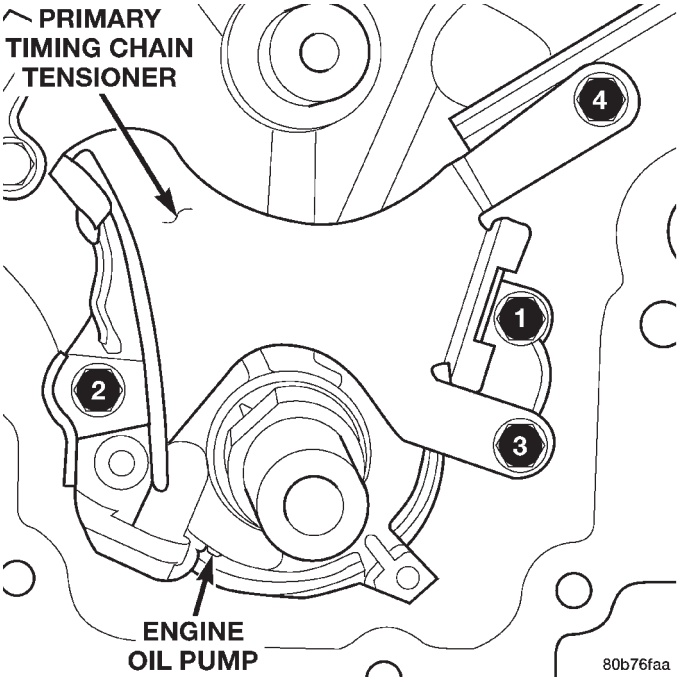

Fig. 105 Oil Pump and Primary Timing Chain Tightening Sequence

(4) Install the secondary timing chain tensioners and timing chains.

(5) Install the timing chain cover.

ENGINE OIL PRESSURE SENDING UNIT

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Raise vehicle on hoist.

(3) Remove front splash shield.

(4) Disconnect oil pressure sender wire (Fig. 106).

(5) Remove the pressure sender (Fig. 106).

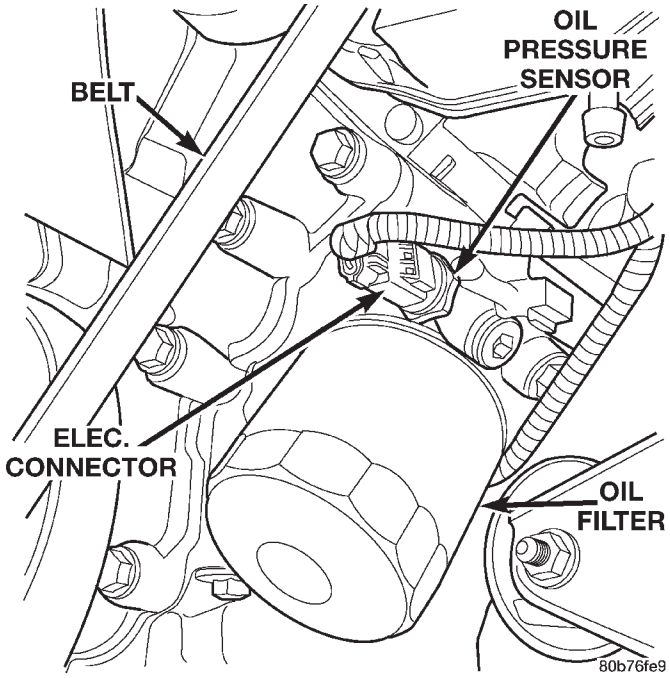

Fig. 106 Oil Pressure Sending Unit

INSTALLATION

(1) Install oil pressure sender.

(2) Connect oil pressure sender wire.

(3) Install front splash shield.

(4) Lower vehicle.

(5) Connect the negative battery cable.

CRANKSHAFT OIL SEAL—FRONT

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove accessory drive belt refer to Group 7, Cooling System for procedure.

(3) Remove A/C compressor mounting bolts and set aside.

(4) Drain cooling system. Refer to Group 7, Cooling System for procedure.

(5) Remove upper radiator hose.

REMOVAL AND INSTALLATION (Continued)

(6) Using Special Tools 6958 spanner with adapter pins 8346 loosen fan and viscous assembly from water pump (Fig. 107).

(7) Remove fan and viscous assembly

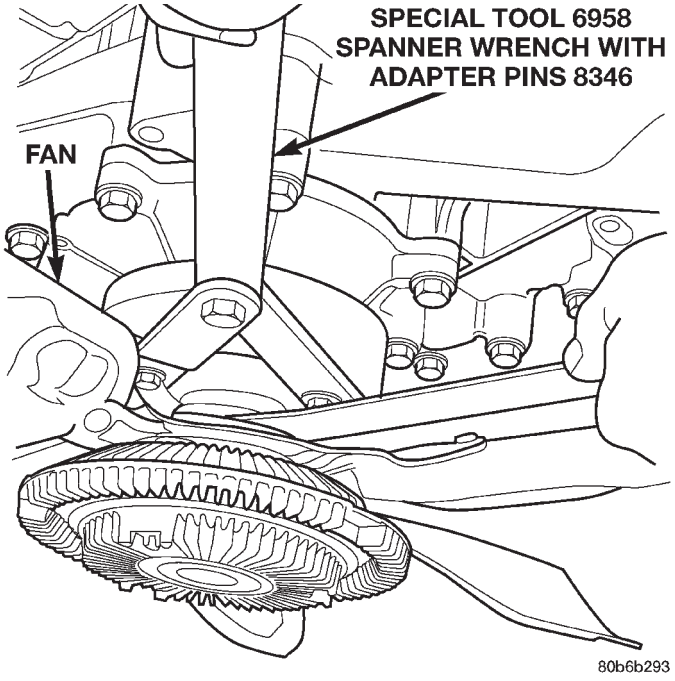

Fig. 107 Fan Assembly—Removal

(8) Disconnect electrical connector for fan mounted inside radiator shroud.

(9) Remove radiator shroud attaching fasteners.

NOTE: Transmission cooler line snaps into shroud lower right hand corner.

(10) Remove radiator shroud.

(11) Remove crankshaft damper bolt.

(12) Remove damper using Special Tools 8513 insert and 1026 three jaw puller (Fig. 108).

(13) Using Special Tool 8511, remove crankshaft front seal (Fig. 109).

INSTALLATION

(1) Using Special Tool 8348 install crankshaft front seal (Fig. 110).

(2) Align crankshaft damper slot with key in crankshaft. Slide damper onto crankshaft slightly.

(3) Using Special Tool 8512 press damper onto crankshaft (Fig. 111).

(4) Tighten crankshaft damper bolt to 175 N·m (130 ft. lbs.).

(5) Install radiator shroud and tighten fasteners to 11 N·m (95 in. lbs.).

(6) Connect electrical connector for shroud fan.

(7) Install fan and viscous assembly.

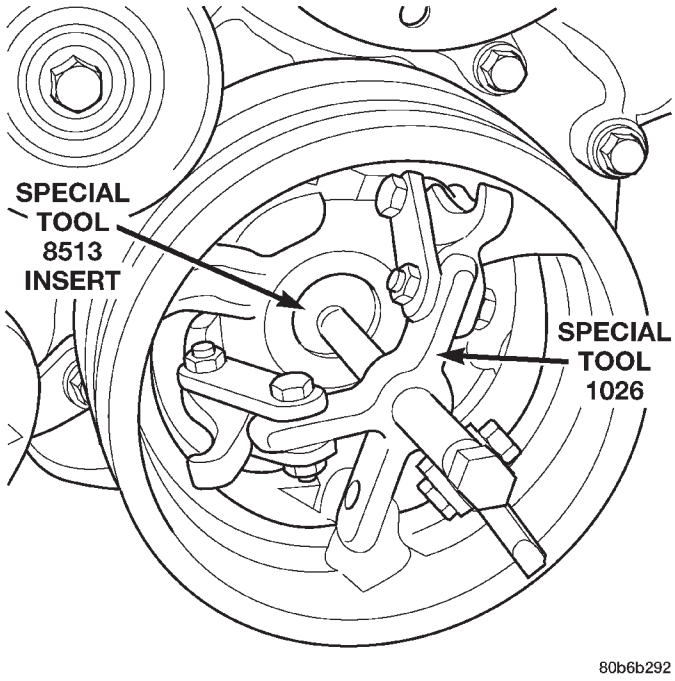

Fig. 108 Crankshaft Damper—Removal

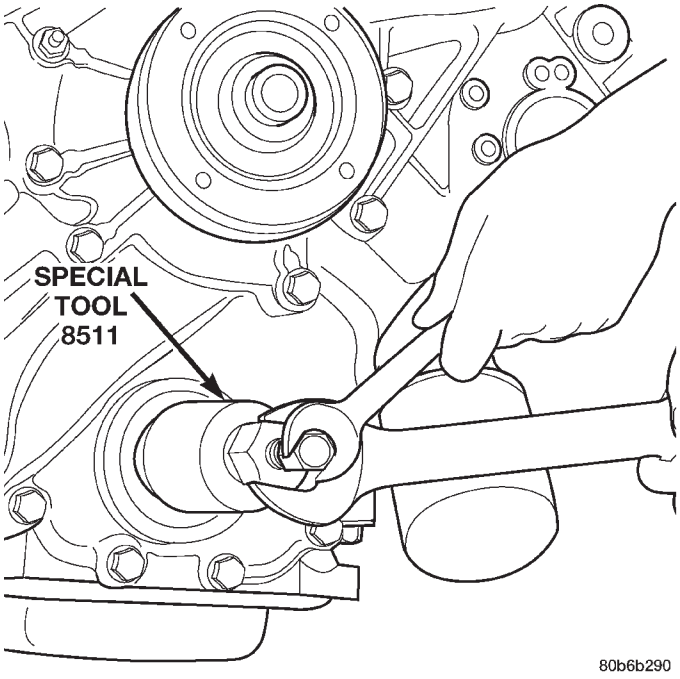

Fig. 109 Crankshaft Front Seal—Removal

(8) Using Special Tools 6958 spanner with adapter pins 8346 tighten fan and viscous assembly to water pump (Fig. 107).

(9) Install upper radiator hose.

(10) Install A/C compressor and tighten fasteners to 54 N·m (40 ft. lbs.).

(11) Install accessory drive belt refer to Group 7, Cooling System for procedure.

(12) Refill cooling system. Refer to Group 7, Cooling System for procedure.

REMOVAL AND INSTALLATION (Continued)

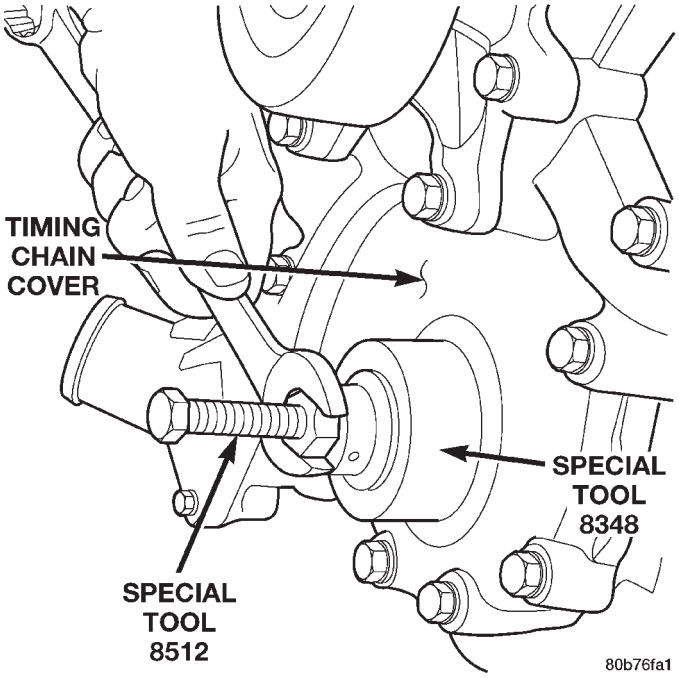

Fig. 110 Crankshaft Front Seal—Installation

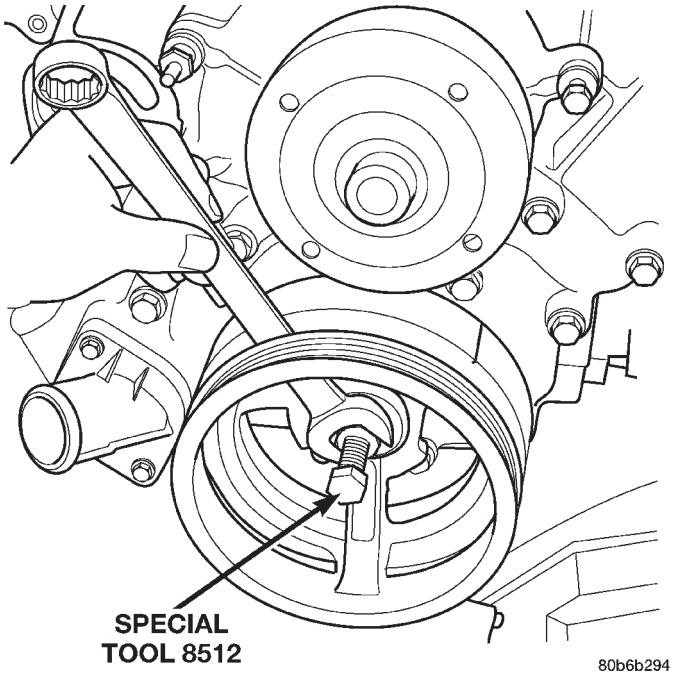

Fig. 111 Crankshaft Damper—Installation

(13) Connect negative cable to battery.

CRANKSHAFT OIL SEAL—REAR

REMOVAL

NOTE: This procedure can be preformed in vehicle.

(1) If being preformed in vehicle, remove the transmission. Refer to Group 21, Transmission and Transfer Case.

(2) Remove the flexplate. Refer to procedure in this section.

NOTE: The crankshaft oil seal CAN NOT be reused after removal.

NOTE: The crankshaft rear oil seal remover Special Tool 8506 must be installed deeply into the seal. Continue to tighten the removal tool into the seal until the tool can not be turned farther. Failure to install tool correctly the first time will cause tool to pull free of seal without removing seal from engine.

(3) Using Special Tool 8506 (Fig. 112), remove the crankshaft rear oil seal.

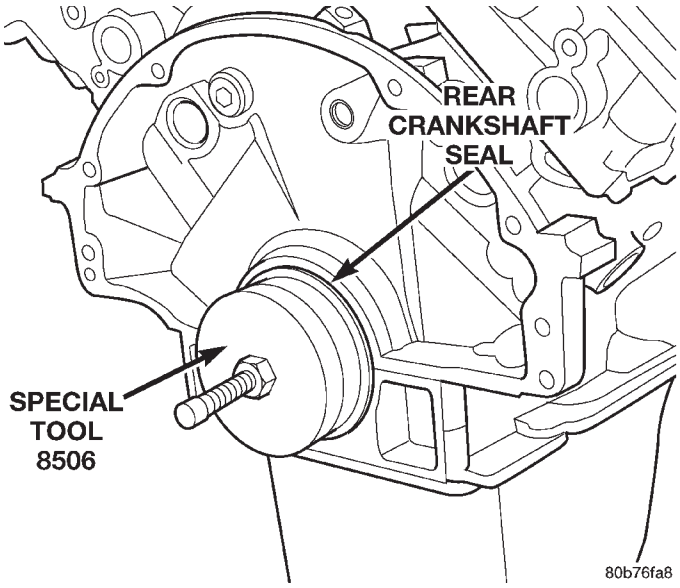

Fig. 112 Crankshaft Rear Oil Seal Removal

INSTALLATION

(1) Position the magnetic seal guide Special Tool 8349–2 (Fig. 113) onto the crankshaft rear face. Then position the crankshaft rear oil seal onto the guide.

(2) Using Special Tools 8349 Crankshaft Rear Oil Seal Installer and C-4171 Driver Handle (Fig. 114), with a hammer, tap the seal into place. Continue to tap on the driver handle until the seal installer seats against the cylinder block crankshaft bore.

(3) Install the flexplate.

(4) If removed, install the transmission.

ENGINE CORE PLUGS

REMOVAL

(1) Drain the cooling system. Refer to Group 7, Cooling System for procedure.

(2) Using a blunt tool such as a drift or a screw driver and a hammer, strike the bottom edge of the cup plug (Fig. 115)

REMOVAL AND INSTALLATION (Continued)

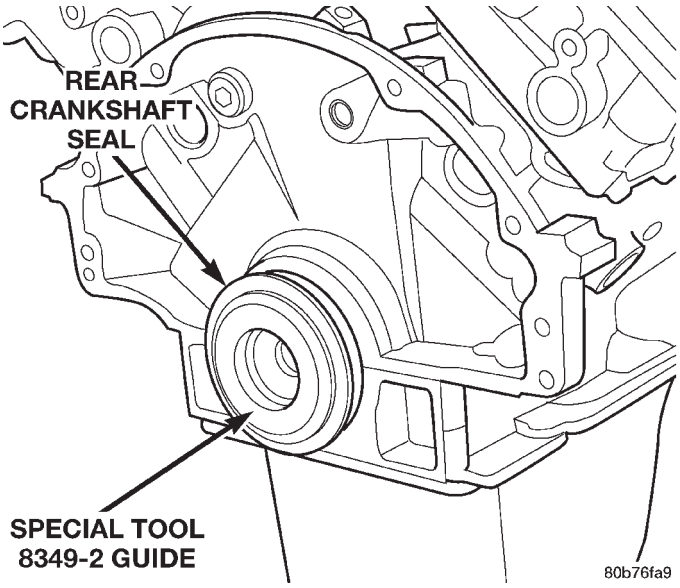

Fig. 113 Crankshaft Rear Oil Seal Guide Special Tool 8349–2 and Oil Seal

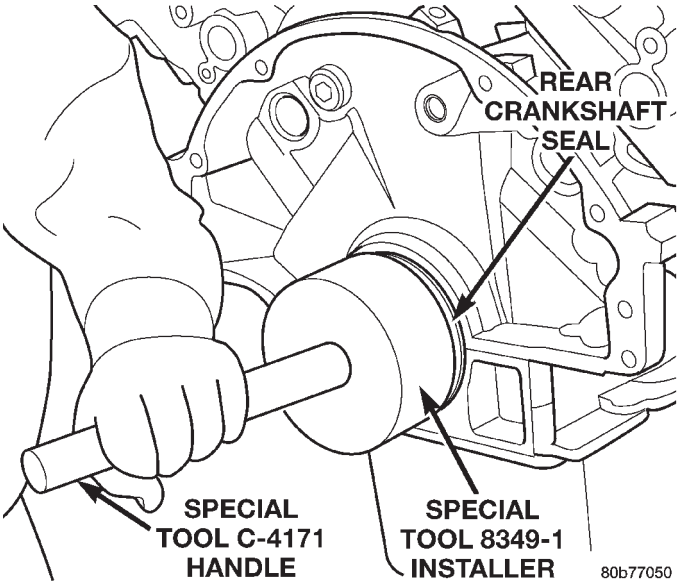

Fig. 114 Crankshaft Rear Oil Seal Installation

(3) Using a suitable pair of pliers, grasp the core plug and remove.

INSTALLATION

NOTE: Thoroughly clean core plug bore, remove all of the old sealer.

(1) Coat the edges of the engine core plug and the core plug bore with Mopar Gasket Maker, or equivalent.

NOTE: It is not necessary to wait for the sealant to cure on the core plugs. The cooling system can be filled and the vehicle returned to service immediately.

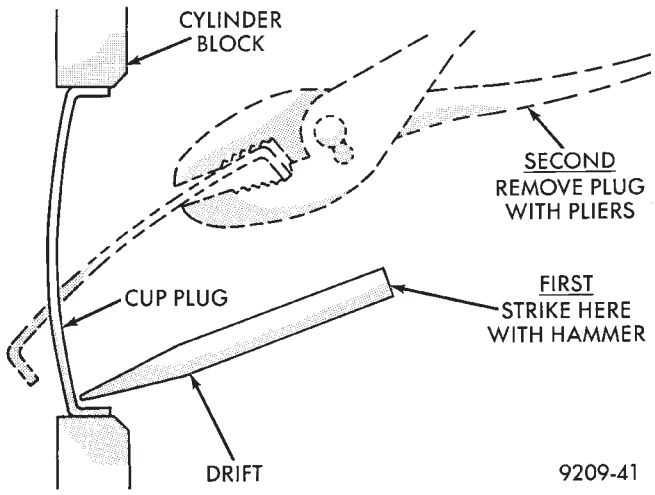

Fig. 115 Engine Core Plug Removal

(2) Using proper plug driver, drive core plug into the core plug bore. The sharp edge of the core plug should be at least 0.50 mm (0.020 in.) inside the lead in chamfer.

(3) Refill the cooling system.

DISASSEMBLY AND ASSEMBLY

VALVE SERVICE

REFACING

NOTE: Valve seats that are worn or burned can be reworked, provided that correct angle and seat width are maintained. Otherwise the cylinder head must be replaced.

NOTE: When refacing valves and 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.

(1) Using a suitable dial indicator measure the center of the valve seat Total run out must not exceed 0.051 mm (0.002 in).

(2) Apply a small amount of Prussian blue to the valve seat, insert the valve into the cylinder head, while applying light pressure on the valve rotate the valve. Remove the valve and examine the valve face. If the blue is transferred to the top edge of the valve face, lower the valve seat using a 15 degree stone. If the blue is transferred to the bottom edge of the valve face, raise the valve seat using a 65 degree stone.

DISASSEMBLY AND ASSEMBLY (Continued)

(3) When the seat is properly positioned the width of the intake seat must be 1.75 – 2.36 mm (0.0689 – 0.0928 in.) and the exhaust seat must be 1.71 – 2.32 mm (0.0673 – 0.0911 in.).

(4) Check the valve spring installed height after refacing the valve and seat. The installed height for both intake and exhaust valve springs must not exceed 40.69 mm (1.6020 in.).

(5) The valve seat and valve face must maintain a face angle of 44.5 – 45 degrees angle.

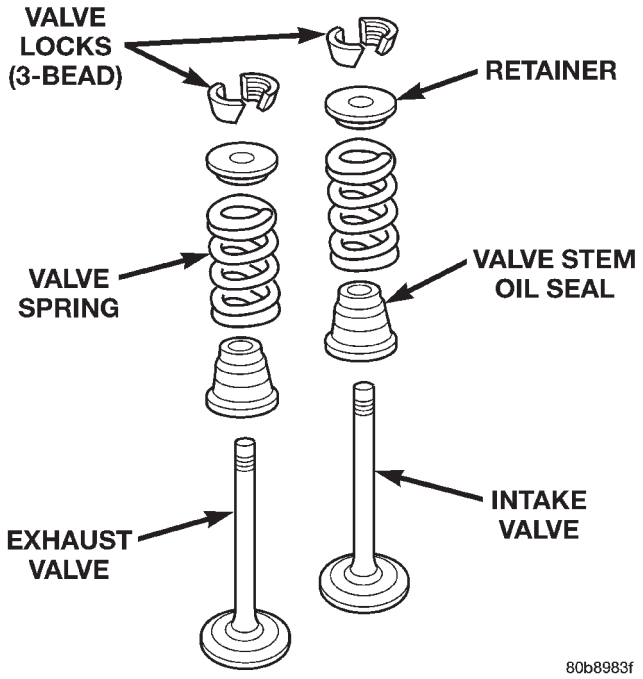

Fig. 116 Valve Assembly Configuration

OIL PUMP

DISASSEMBLE

(1) Remove oil pump cover screws and lift off cover plate.

(2) Remove pump inner and outer rotors.

NOTE: Once the oil pressure relief valve, cup plug, and pin are removed, the pump assembly must be replaced.

(3) If it is necessary to remove the pressure relief valve, drive the roll pin from pump housing and remove cup plug, spring and valve.

ASSEMBLE

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

(2) Install inner and outer rotors

(3) Install oil pump cover plate and install cover bolts and tighten them to 12 N·m (105 in. lbs.).

(4) Prime oil pump before installation by filling rotor cavity with engine oil.

(5) If oil pressure is low and pump is within specifications, inspect for worn engine bearings or other causes for oil pressure loss.

CLEANING AND INSPECTION

INTAKE MANIFOLD

CLEANING

NOTE: There is NO approved repair procedure for the intake manifold. If severe damage is found during inspection, the intake manifold must be replaced.

Before installing the intake manifold thoroughly clean the mating surfaces. Use a suitable cleaning solvent, then air dry.

INSPECTION

(1) Inspect the intake sealing surface for cracks, nicks and distortion.

(2) Inspect the intake manifold vacuum hose fittings for looseness or blockage.

(3) Inspect the manifold to throttle body mating surface for cracks, nicks and distortion.

EXHAUST MANIFOLD

CLEANING

(1) Clean the exhaust manifold using a suitable cleaning solvent, then allow to air dry.

(2) Clean all gasket residue from the manifold mating surface.

INSPECTION

(1) Inspect the exhaust manifold for cracks in the mating surface and at every mounting bolt hole.

(2) Using a straight edge and a feeler gauge, check the mating surface for warp and twist.

(3) Inspect the manifold to exhaust pipe mating surface for cracks, gouges, or other damage that would prevent sealing.

CYLINDER HEADS

CLEANING

CYLINDER HEAD GASKET SURFACE PREPARATION

To ensure engine gasket sealing, proper surface preparation must be performed, especially with the use of aluminum engine components.

Never use the following to clean gasket surfaces:

- never use a metal scraper
- never use an abrasive pad or paper to clean the cylinder block.

CLEANING AND INSPECTION (Continued)

- never use a high speed power tool or wire brush on any gasket sealing surface (Fig. 117)

Only use the following for cleaning gasket surfaces:

- use Mopar® Brake and Parts Cleaner
- use only a plastic or wood scraper (Fig. 117)

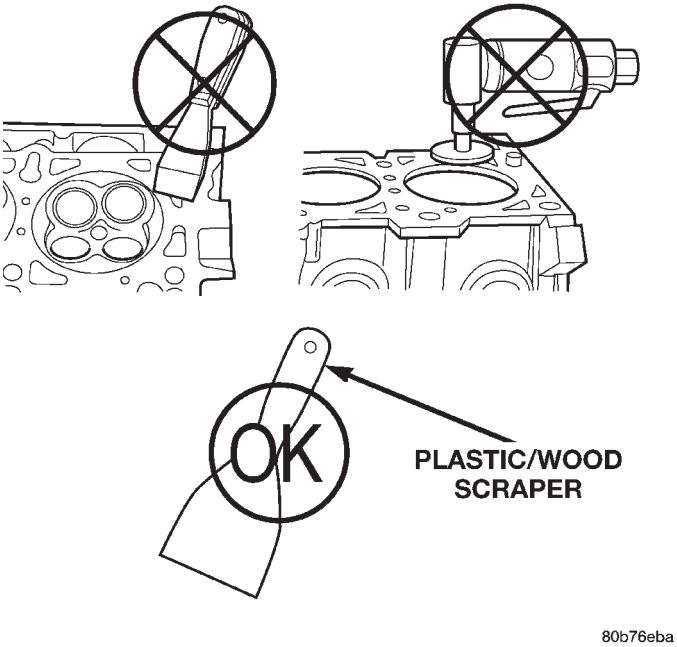

Fig. 117 Proper Tool Usage For Surface Preparation

INSPECTION

(1) Inspect the cylinder head for out-of-flatness, using a straightedge and a feeler gauge. If tolerances exceed 0.0508 mm (0.002 in.) replace the cylinder head.

(2) Inspect the valve seats for damage. Service the valve seats as necessary.

(3) Inspect the valve guides for wear, cracks or looseness. If either condition exist, replace the cylinder head.

PISTON AND CONNECTING ROD ASSEMBLY

CLEANING

CAUTION: DO NOT use a wire wheel or other abrasive cleaning devise to clean the pistons or connecting rods. The pistons have a Moly coating, this coating must not be damaged.

(1) Using a suitable cleaning solvent clean the pistons in warm water and towel dry.

(2) Use a wood or plastic scraper to clean the ring land grooves.

CAUTION: DO NOT remove the piston pin from the piston and connecting rod assembly.

INSPECTION

Check the crankshaft connecting rod journal for excessive wear, taper and scoring.

Check the pistons for taper and elliptical shape before they are fitted into the cylinder bore .

PISTON SPECIFICATION CHART

PISTON DIAMETER	PISTON PIN BORE DIAMETER
92.975mm (3.665 in.)	24.026 - 24.032mm (0.946 - 0.9462 in.)
RING GROOVE WIDTH	**RING GROOVE DIAMETER**
Upper Ring 1.541 - 1.566mm (0.0607 - 0.0617 in.)	Upper Ring 83.73 - 83.97mm (3.2965 - 3.3059 in.)
Middle Ring 1.53 - 1.55 mm (0.0603 - 0.0611 in.)	Middle Ring 82.833 - 83.033 mm (3.2612 - 3.2691 in.)
Oil Rails 3.031 - 3.055 mm (0.1194 - 0.1203 in.)	Oil Rails 83.88 - 84.08 mm (3.3024 - 3.3103 in.)
PISTON OVER ALL HEIGHT	
53.49 - 54.09mm (2.106 - 2.1296 in.)	

Replace any piston and connecting rod not meeting the specifications above.

CRANKSHAFT JOURNALS

The crankshaft connecting rod and main journals should be checked for excessive wear, taper and scoring. The maximum taper or out-of-round on any crankshaft journal is 0.025 mm (0.001 inch).

Journal grinding should not exceed 0.305 mm (0.012 inch) under the standard journal diameter. DO NOT grind thrust faces of No.3 main bearing. DO NOT nick crank pin or bearing fillets. After grinding, remove rough edges from crankshaft oil holes and clean out all oil passages.

CAUTION: After any journal grind, it is important that the final paper or cloth polish be in the same direction as the engine rotates.

OIL PAN

CLEANING

(1) Clean oil pan in solvent and wipe dry with a clean cloth.

(2) Clean the oil pan gasket surface. **DO NOT** use a grinder wheel or other abrasive tool to clean sealing surface.

CLEANING AND INSPECTION (Continued)

(3) Clean oil screen and tube thoroughly in clean solvent.

INSPECTION

(1) Inspect oil drain plug and plug hole for stripped or damaged threads. Repair as necessary.

(2) Inspect the oil pan mounting flange for bends or distortion. Straighten flange, if necessary.

OIL PUMP

INSPECTION

CAUTION: Oil pump pressure relief valve and spring should not be removed from the oil pump. If the these components are disassembled andør removed from the pump the entire oil pump assembly must be replaced.

(1) Clean all parts thoroughly. Mating surface of the oil pump housing should be smooth. If the pump cover is scratched or grooved the oil pump assembly should be replaced.

(2) Lay a straight edge across the pump cover surface (Fig. 118). If a 0.025 mm (0.001 in.) feeler gauge can be inserted between the cover and the straight edge the oil pump assembly should be replaced.

(3) Measure the thickness of the outer rotor (Fig. 119). If the outer rotor thickness measures at 12.005 mm (0.400 in.) or less the oil pump assembly must be replaced.

(4) Measure the diameter of the outer rotor. If the outer rotor diameter measures at 85.925 mm (0.400 in.) or less the oil pump assembly must be replaced.

(5) Measure the thickness of the inner rotor (Fig. 120). If the inner rotor thickness measures at 12.005 mm (0.400 in.) or less then the oil pump assembly must be replaced.

(6) Slide outer rotor into the body of the oil pump. Press the outer rotor to one side of the oil pump body and measure clearance between the outer rotor and the body (Fig. 121). If the measurement is 0.47mm (0.0186 in.) or more the oil pump assembly must be replaced.

(7) Install the inner rotor in the into the oil pump body. Measure the clearance between the inner and outer rotors (Fig. 122). If the clearance between the rotors is .150 mm (0.006 in.) or more the oil pump assembly must be replaced.

(8) Place a straight edge across the body of the oil pump (between the bolt holes), if a feeler gauge of .095 mm (0.0038 in.) or greater can be inserted between the straightedge and the rotors, the pump must be replaced (Fig. 123).

NOTE: 4.7 Oil pump is released as an assembly. There are no Chrysler part numbers for Sub-Assembly components. In the event the oil pump is not functioning or out of specification it must be replaced as an assembly.

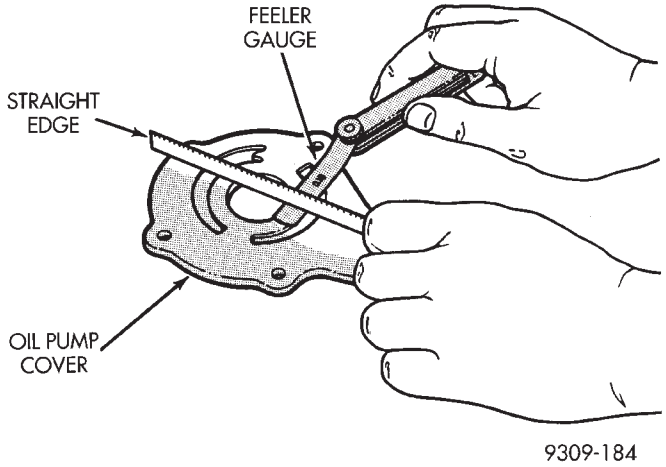

Fig. 118 Checking Oil Pump Cover Flatness

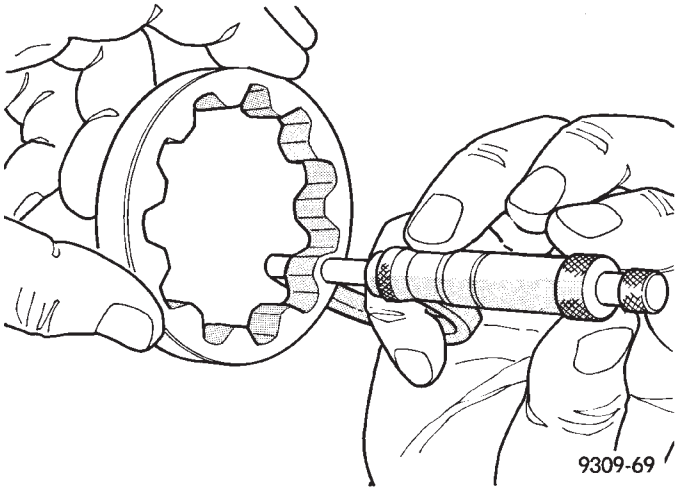

Fig. 119 Measuring Outer Rotor Thickness

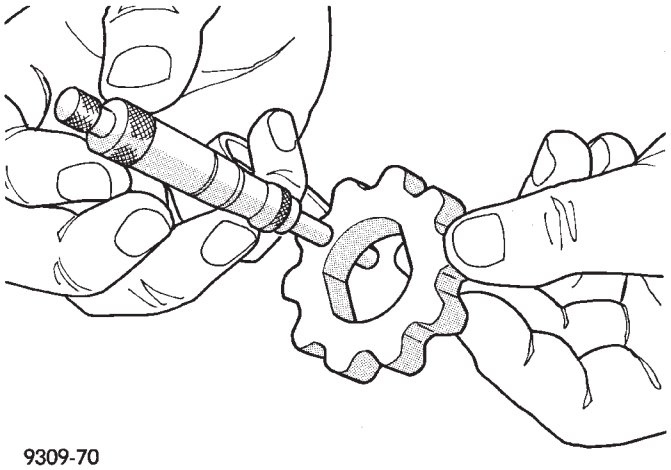

Fig. 120 Measuring Inner Rotor Thickness

CLEANING AND INSPECTION (Continued)

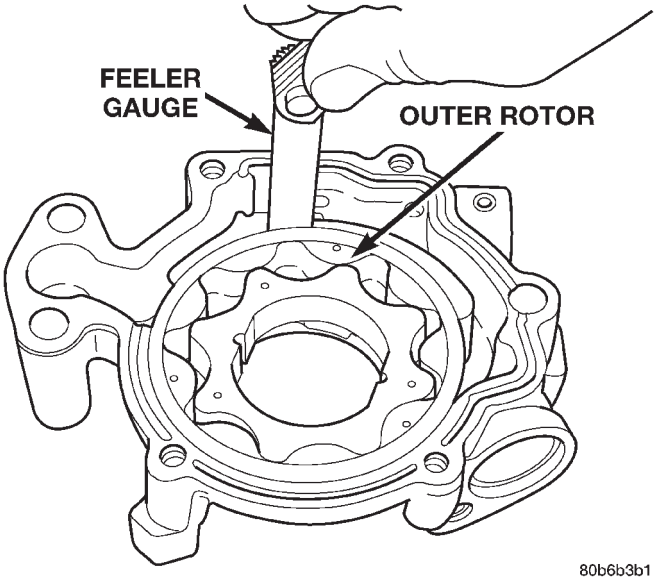

Fig. 121 Measuring Outer Rotor Clearance in Housing

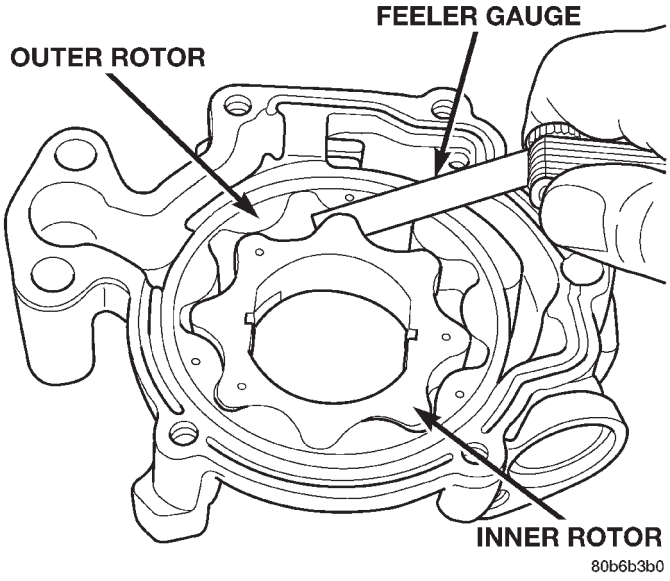

Fig. 122 Measuring Clearance Between Rotors

OIL PUMP ASSEMBLY

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

(2) Install inner and outer rotors

(3) Install oil pump cover plate and install cover bolts and tighten them to 12 N·m (105 in. lbs.).

(4) Prime oil pump before installation by filling rotor cavity with engine oil.

(5) If oil pressure is low and pump is within specifications, inspect for worn engine bearings or other causes for oil pressure loss.

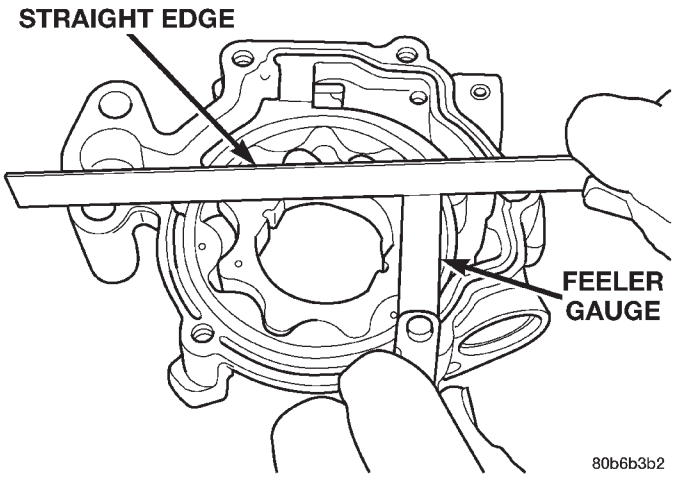

Fig. 123 Measuring Clearance Over Rotors

CYLINDER BLOCK

CLEANING

Thoroughly clean the oil pan and engine block gasket surfaces.

Use compressed air to clean out:

- The galley at the oil filter adaptor hole.
- The front and rear oil galley holes.
- The feed holes for the crankshaft main bearings.

Once the block has been completely cleaned, apply Loctite PST pipe sealant with Teflon 592 to the threads of the front and rear oil galley plugs. Tighten the plugs to 34 N·m (25 ft. lbs.) torque.

INSPECTION—CYLINDER BORE

(1) It is mandatory to use a dial bore gauge to measure each cylinder bore diameter. To correctly select the proper size piston, a cylinder bore gauge, capable of reading in 0.003 mm (.0001 in.) INCREMENTS is required. If a bore gauge is not available, do not use an inside micrometer (Fig. 124).

(2) Measure the inside diameter of the cylinder bore at three levels below top of bore. Start perpendicular (across or at 90 degrees) to the axis of the crankshaft and then take two additional reading.

(3) Measure the cylinder bore diameter crosswise to the cylinder block near the top of the bore. Repeat the measurement near the middle of the bore, then repeat the measurement near the bottom of the bore.

(4) Determine taper by subtracting the smaller diameter from the larger diameter.

(5) Rotate measuring device 90° and repeat steps above.

(6) Determine out-of-roundness by comparing the difference between each measurement.

(7) If cylinder bore taper does not exceed 0.025 mm (0.001 inch) and out-of-roundness does not exceed 0.025 mm (0.001 inch), the cylinder bore can be honed. If the cylinder bore taper or out-of-round

CLEANING AND INSPECTION (Continued)

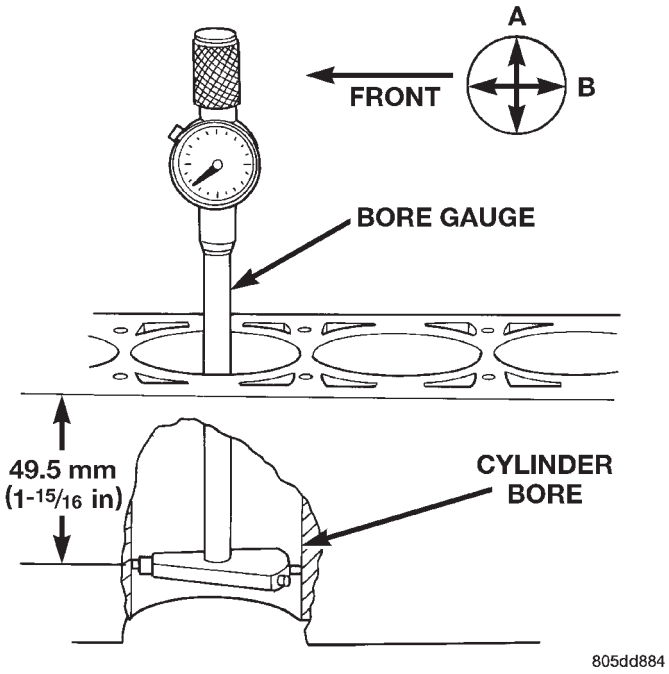

Fig. 124 Bore Gauge—Typical

condition exceeds these maximum limits, the cylinder block must be replaced. A slight amount of taper always exists in the cylinder bore after the engine has been in use for a period of time.

HONING—CYLINDER BORE

The honing operation should be closely coordinated with the fitting of pistons and rings. This will ensure specified clearances are maintained.

Refer to Standard Service Procedures in the beginning of this Group for the proper honing of cylinder bores.

SPECIFICATIONS

4.7L ENGINE

DESCRIPTION	SPECIFICATION
General Specification	
Type	90° SOHC V-8 16-Valve
Displacement	4.7 Liters 4701 cc (287 Cubic Inches)
Bore & Stroke	93.0 mm x 86.5 mm (3.66 in. x 3.40 in.)
Compression Ratio	9.0:1
Lead Cylinder	#1 Left Bank
Firing Order	1,8,4,3,6,5,7,2
Cylinder Block	Cast Iron
Cylinder Head	Aluminum
Cylinder Block	
Cylinder Bore Diameter	93.010 ± .0075 mm (3.6619 ± 0.0003 in.)
Out of Round (Max)	0.076 mm (0.003 in.)
Taper (Max)	0.051 mm (0.002 in.)
Pistons	
Type Material	Aluminum alloy
Piston diameter	92.975 mm (3.6605 in.)
Clearance at Size Location	0.0198 – 0.0501 mm (0.0008 – 0.0020 in.)
Piston Weight	
	367.5 grams (12.96 oz.)
Piston Ring Groove Diameter	
No. 1	83.73 – 83.97 mm (3.296 – 3.269 in.)
No. 2	82.833 – 83.033 mm (3.261 – 3.310 in.)
No. 3	83.88 – 84.08 mm (3.302 – 3.310 in.)
Piston Pins	
Type	Pressed Fit
Clearance In Piston	0.018 – 0.019 mm (0.0008 in.)
Diameter	24.008 – 24.013 mm (0.9452 – 0.9454 in.)
Piston Rings	
Ring Gap Top Compression Ring	0.37 – 0.63 mm (0.0146 – 0.0249 in.)
Ring Gap 2nd Compression Ring	0.37 – 0.63 mm (0.0146 – 0.0249 in.)
Ring Gap Oil Control (Steel Rails)	0.25 – 1.27 mm (0.0099 – 0.05 in.)
Ring Side Clearance	
Top Compression Ring	.051 – .104 mm (0.0020 – 0.0041 in.)
Second Compression Ring	0.040 – 0.080 mm (0.0016 – 0.0032 in.)
Oil Ring (Steel Rails)	.019 – .229 mm (.0007 – .0091 in.)
Ring Width	
Top Compression Ring	1.472 – 1.490 mm (0.057 – 0.058in.)
2nd Compression Ring	1.472 – 1.490 mm (0.057 – 0.058in.)
Oil Ring (Steel Rails)	0.445 – 0.470 mm (0.017 – 0.018 in.)
Connecting Rods	
Bearing Clearance	0.010 – 0.048 mm (0.0004 – 0.0019 in.)
Side Clearance	0.10 – 0.35 mm (0.004 – 0.0138 in.)
Piston Pin Bore Diameter	Interference fit .022 – .045 mm (0.0009 – 0.0018 in.)
Bearing Bore Out of Round (Max. Allowable)	0.004 mm (in.)
Total Weight (Less Bearing)	578 grams (20.388 ounces)

SPECIFICATIONS (Continued)

DESCRIPTION	SPECIFICATION
Crankshaft Main Bearing Journals	
Diameter	63.488 – 63.512 mm (2.4996 – 2.5005 in.)
Bearing Clearance	0.004 – 0.032 mm (0.0002 – 0.0013 in.)
Out of Round (Max.)	0.005 mm (0.0002 in.)
Taper (Max.)	0.008 mm (0.0004 in.)
End Play	0.052 – 0.282 mm (0.0021 – 0.0112 in.)
End Play (Max. Allowable)	0.282 mm (0.0112 in.)
Connecting Rod Journals	
Diameter	50.992 – 51.008 mm (2.0076 – 2.0082 in.)
Bearing Clearance	0.010 – 0.048 mm (0.0004 – 0.0019 in.)
Out Of Round (Max.)	0.005 mm (0.0002 in.)
Taper (Max.)	0.008 mm (0.0004 in.)
Camshaft	
Bore Diameter	26.02 – 26.04 mm (1.0245 – 1.0252 in.)
Bearing Journal Diameter	25.975 – 25.995 mm (1.0227 – 1.0235 in.)
Bearing Clearance	0.025 – 0.065 mm (0.001 – 0.0026 in.)
Bearing Clearance (Max. Allowable)	0.065 mm (0.0026 in.)
End Play	mm (in.)
Valve Timing Intake Valve	
Opens (ATDC)	3.5°
Closes (ATDC)	247°
Duration	243.5°
Valve Timing Exhaust Valve	
Opens (BBDC)	232.5°
Closes (ATDC)	21.25°
Duration	253.75°
Valve Overlap	17.75°
Cylinder Head	
Gasket Thickness (Compressed)	.7 mm (0.0276 in.)
Valve Seat Angle	44.5° – 45.0°
Valve Seat Runout (Max)	0.051 mm (0.002 in.)
Intake Valve Seat Width	1..75 – 2.36 mm (0.0698 – 0.0928 in.)
Exhaust Valve Seat Width	1.71 – 2.32 mm (0.0673 – 0.0911 in.)
Guide Bore Diameter (Std.)	6.975 – 7.00 mm (0.2747 – 0.2756 in.)
Cylinder Head Warpage (Flatness)	0.0508 mm (0.002 in.)
Valves	
Face Angle	45.0° – 45.5°
Head Diameter Intake	47.87 – 48.13 mm (1.8846 – 1.8949 in.)
Head Diameter Exhaust	36.87 – 37.13 mm (1.4516 – 1.4618 in.)
Length—Intake (Overall)	113.13 – 113.89 mm (4.4539 – 4.4839 in.)
Length—Exhaust (Overall)	114.92 – 115.68 mm (4.5244 – 4.5543 in.)
Stem Diameter—Intake	6.931 – 6.957 mm (0.2729 – 0.2739 in.)
Stem Diameter—Exhaust	6.902 – 6.928 mm (0.2717 – 0.2728 in.)
Stem-to-Guide Clearance Intake (New)	.026 – .043 mm (0.0011 – 0.0017 in.)
Stem-to-Guide Clearance—Exhaust (New)	.072 – .073 mm (0.0029 in.)
Max. Allowable (Rocking Method)—Intake	0.069 mm (0.0028 in.)
Max. Allowable (Rocking Method)—Exhaust	0.098 mm (0.0039 in.)
Valve Lift (Zero Lash)—Intake	11.25 mm (0.443 in.)
Valve Lift (Zero Lash)—Exhaust	10.90 mm (0.4292 in.)
Valve Spring	
Free Length (Approx.) Intake & Exhaust	47.5 mm (1.870 in)
Spring Force (Valve Closed) Intake & Exhaust	285.2–320.8 N @ 40.69 mm (64.0–72.0 lbs. @ 1.6020 in.)
Spring Force (Valve Open) Intake	775.3–846.7 N @ 29.29 mm (176.2–192.4 lbs. @ 1.1532 in.)
Spring Force (Valve Open) Exhaust	775.3–846.7 N @ 29.29 mm (176.2–192.4 lbs. @ 1.1532 in.)
Number of Coils—Intake & Exhaust	6.6
Wire Diameter Intake & Exhaust	4.2799 – 4.3561 mm (0.1685 – 0.1715 in.)
Installed Height—Intake (Spring Seat to Bottom of Retainer)	40.97 mm (1.613 in.)
Installed Height—Exhaust (Spring Seat to Bottom of Retainer)	40.81 mm (1.606 in.)
Oil Pump	
Clearance Over Rotors (Max.)	.035 – .095 mm (0.0014 – 0.0038 in.)
Cover Out-of-Flat (Max.)	.025 mm (0.001 in.)
Inner and Outer Rotor Thickness	12.08 mm (0.4756 in.)
Outer Rotor Clearance (Max.)	85.96 mm (3.3843 in.)
Outer Rotor Diameter (Min.)	85.925 mm (0.400 in.)

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SPECIFICATIONS (Continued)

DESCRIPTION	SPECIFICATION
Tip Clearance Between Rotors (Max.)	.150 mm (0.006 in.)
Oil Pressure	
At Curb Idle Speed *	25 kPa (4 psi) minimum
At 3000 rpm	170 – 550 kPa (25 – 80 psi)

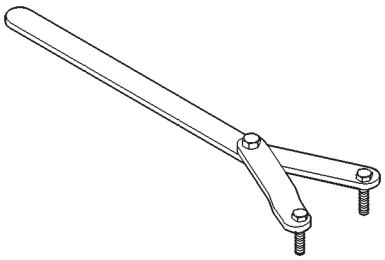
*CAUTION: If pressure is zero at curb idle, DO NOT run engine at 3000 rpm.

TORQUE—4.7L ENGINE

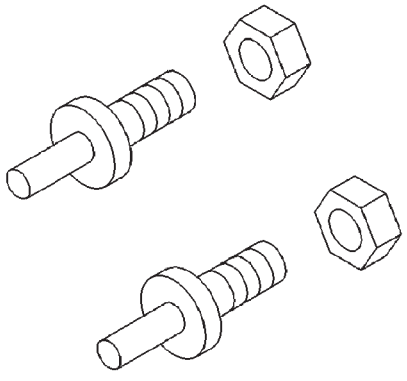
DESCRIPTION	TORQUE
Camshaft Sprocket	
Bolt	122 N·m (90 ft. lbs.)
Camshaft Bearing Caps	
Bolt	11 N·m (100 in. lbs.)
Timing Chain Cover	
Bolt	54 N·m (40 ft. lbs.)
Connecting Rod Cap	
Bolt	20 N·m (15 ft. lbs.), Plus 110°
Crankshaft Main Bearing Cap/Bedplate	
Bolt	Refer to Procedure
Crankshaft Damper	
Bolt	175 N·m (130 ft. lbs.)
Cylinder Head Bolts	
M11 Bolt	81 N·m (60 ft. lbs.)
M8 Bolt	28 N·m (250 in. lbs.)
Cylinder Head Cover	
Bolt	12 N·m (105 in. lbs.)
Exhaust Manifold	
Bolt	25 N·m (18 ft. lbs.)
Exhaust Manifold Heat Shield	
Nut	8 N·m (72 in. lbs.), then loosen 45°
Flexplate	
Bolts	60 N·m (45 ft. lbs.)
Engine Mount Bracket to Block—Front	
Bolts	61 N·m (45 ft. lbs.)
Engine Mount—Rear-to-Transmission	
Bolts	46 N·m (34 ft. lbs.)
Generator Mounting	
M10 Bolts	54 N·m (40 ft. lbs.)
M8 Bolts	28 N·m (250 in. lbs.)
Intake Manifold	
Bolts	12 N·m (105 in. lbs.)—Refer to procedure for tightening sequence.
Oil Pan	
Bolts	15 N·m (130 in. lbs.)
Oil Pan Drain Plug	
Plug	34 N·m (25 ft. lbs.)
Oil Pump	
Bolts	28 N·m (250 in. lbs.)
Oil Pump Cover	
Bolts	12 N·m (105 in. lbs.)
Oil Pickup Tube	
Bolts	28 N·m (250 in. lbs.)
Oil Dipstick Tube	
Bolt	28 N·m (250 in. lbs.)
Oil Fill Tube	
Bolts	12 N·m (105 in. lbs.)
Spark Plugs	
Plugs	27 N·m (20 ft. lbs.)
Starter Mounting	
Bolts	45 N·m (33 ft. lbs.)
Timing Chain Guide	
Bolts	28 N·m (250 in. lbs.)
Timing Chain Tensioner Arm	
Special Pin Bolt	17 N·m (150 in. lbs.)
Secondary Timing Chain Hydraulic Tensioner	
Bolts	28 N·m (250 in. lbs.)
Timing Chain Primary Tensioner	
Bolts	28 N·m (250 in. lbs.)
Timing Drive Idler Sprocket	
Bolt	34 N·m (25 ft. lbs.)
Thermostat Housing	
Bolts	12 N·m (105 in. lbs.)
Torque Converter to Flexplate	
Bolts	38 N·m (28 ft. lbs.)
Water Pump	
Bolts	54 N·m (40 ft. lbs.)

SPECIAL TOOLS

4.7L ENGINE

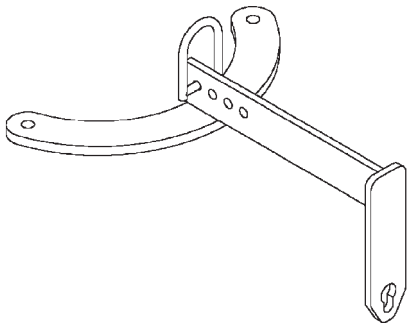


Spanner Wrench 6958

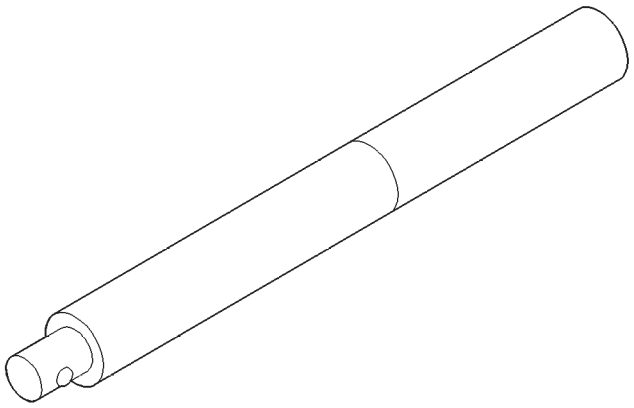


Adapter Pins 8346

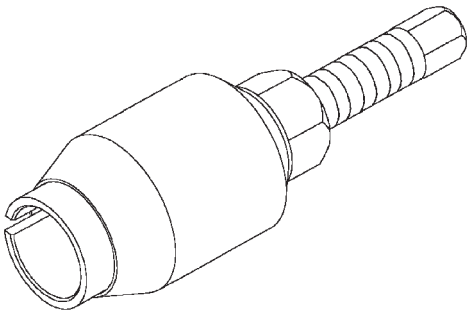
SPECIAL TOOLS (Continued)



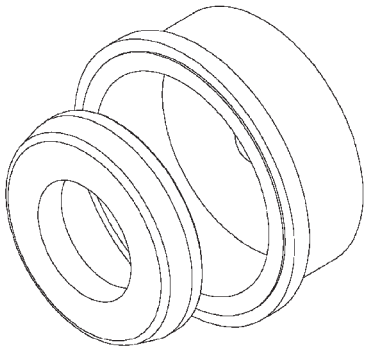
Engine Lift Fixture 8347



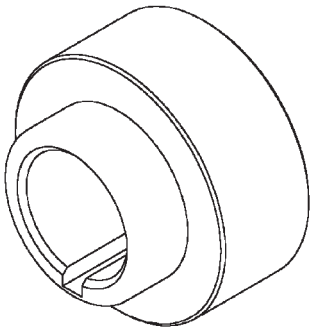
Handle C-4171



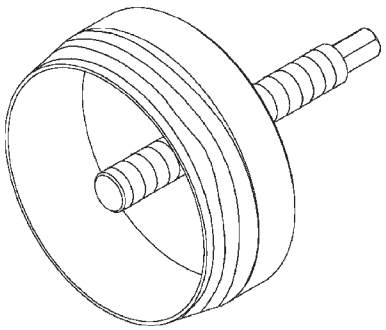
Front Crankshaft Seal Remover 8511



Rear Crankshaft Seal Installer 8349

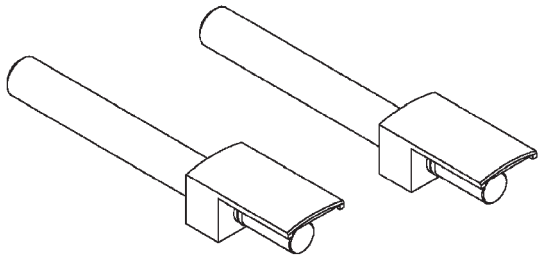


Front Crankshaft Seal Installer 8348

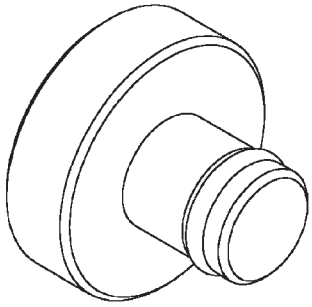


Rear Crankshaft Seal Remover 8506

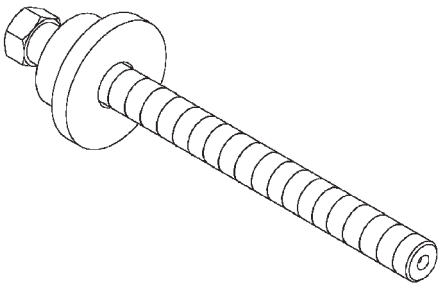
SPECIAL TOOLS (Continued)



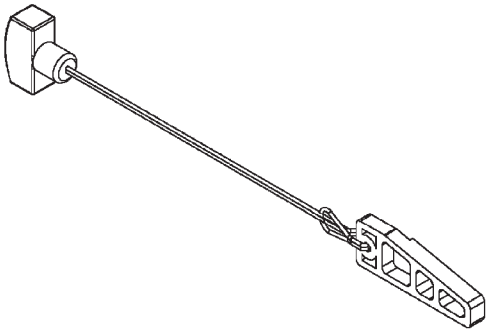
Connecting Rod Guides 8507



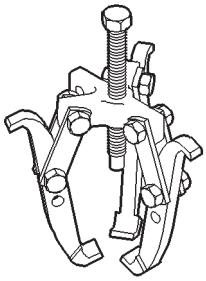
Crankshaft Damper Removal Insert 8513



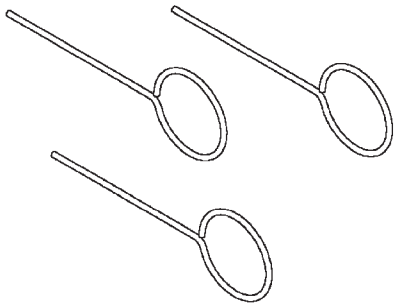
Crankshaft Damper Installer 8512



Chain Tensioner Wedge 8350

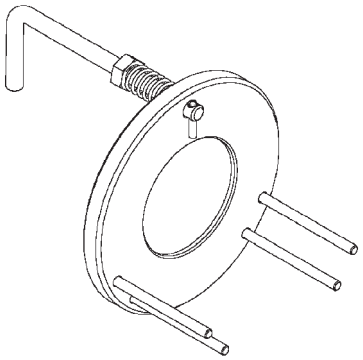


Puller 1026

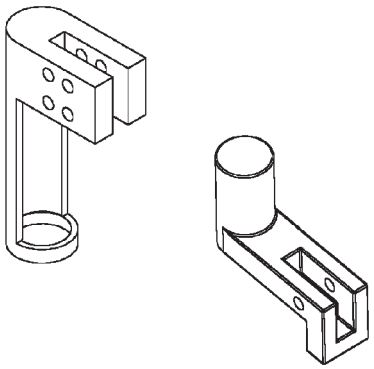


Chain Tensioner Pins 8514

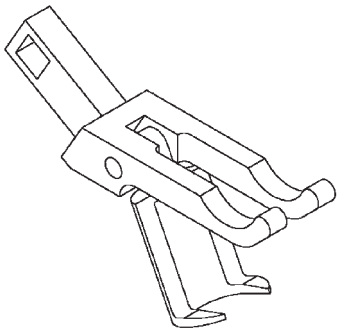
SPECIAL TOOLS (Continued)



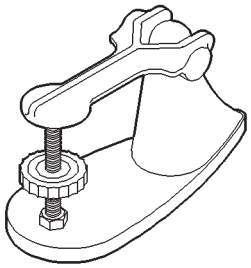
Secondary Chain Holder 8515



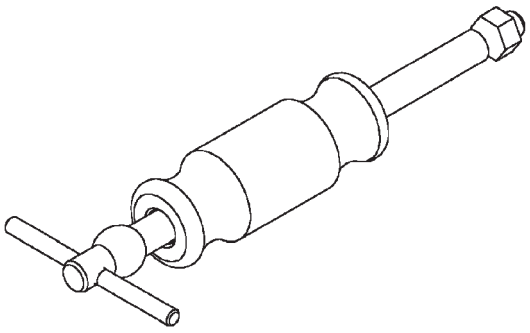
Valve Spring Compressor Adapters 8519



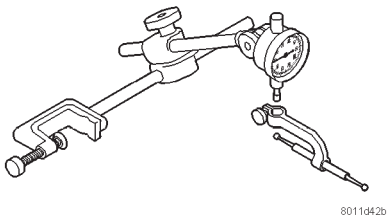
Rocker Arm Removal 8516



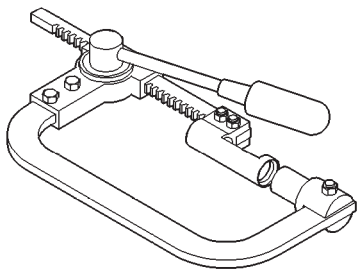
Valve Spring Tester C-647



Idler Shaft Remover 8517

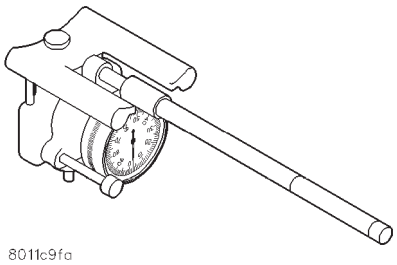


Dial Indicator C-3339

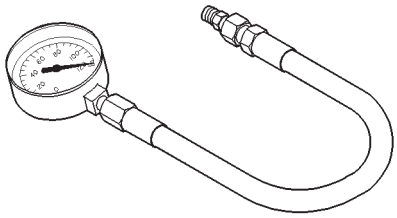


Valve Spring Compressor C-3422-B

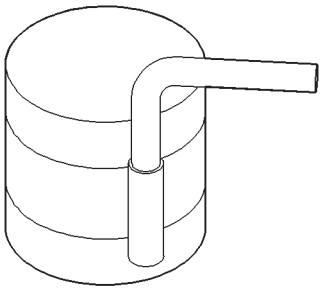
SPECIAL TOOLS (Continued)



Bore Size Indicator C-119



Oil Pressure Gauge C-3292



Piston Ring Compressor C-385