

ENGINE

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STANDARD SERVICE PROCEDURES

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GENERAL INFORMATION

FORM-IN-PLACE GASKETS

There are numerous places where form-in-place gaskets are used on the engine. Care must be taken when applying form-in-place gaskets. **Do not use form-in-place gasket material unless specified** . 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. **Mopar** Silicone Rubber Adhesive Sealant and **Mopar** Gasket Maker, (anaerobic) each have different properties and cannot be used interchangeably.

CAUTION: Silicone sealer and anaerobic sealers each will inhibit the cure of the other and care should be taken to keep usages separated as much as possible.

MOPAR SILICONE RUBBER ADHESIVE SEALANT

Mopar Silicone Rubber Adhesive Sealant or equivalent, normally black in color, is available in three ounce tubes. Moisture in the air causes the **Mopar**

Silicone Rubber Adhesive Sealant material to cure. This material is normally used on flexible metal flanges. It has a shelf life of one year and will not properly cure if over age. Always inspect the package for the expiration date before use.

MOPAR GASKET MAKER

Mopar Gasket Maker is an anaerobic type gasket material normally red in color. The material cures in the absence of air when squeezed between two metallic surfaces. It will not cure if left in the uncovered tube. It is normally red in color. The anaerobic material is for use between two machined surfaces. Do not use on flexible metal flanges.

MOPAR TORQUE CURE GASKET MAKER

Mopar Torque Cure Gasket Maker is a unique anaerobic type gasket material to be used **ONLY** between the bedplate and engine block. The material cures in the absence of air when torqued between two metallic surfaces. It will not cure if left in the uncovered tube. This anaerobic material is specially made to seal the area between the bedplate and cylinder block without disturbing the bearing clearance or alignment of these components.

GASKET DISASSEMBLY

Parts assembled with form-in-place gaskets may be disassembled without unusual effort. In some

GENERAL INFORMATION (Continued)

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.

SURFACE PREPARATION

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

FORM-IN-PLACE GASKET APPLICATION

Assembling parts using a form-in-place gasket requires care but it's easier than using pre-cut gaskets.

Mopar Gasket Maker material should be applied sparingly 1 mm (0.040 in.) diameter or less of sealant to one gasket surface. Be certain the material surrounds each mounting hole. Excess material can easily be 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.

The **Mopar** Silicone Rubber Adhesive Sealant gasket material or equivalent should be applied in a continuous bead approximately 3 mm (0.120 in.) in diameter. All mounting holes must be circled. For corner sealing, a 3.17 or 6.35 mm (1/8 or 1/4 in.) drop is placed in the center of the gasket contact area. Uncured sealant may be removed with a shop towels. Components should be torqued in place while the sealant is still wet to the touch (within 10 minutes). The usage of a locating dowel is recommended during assembly to prevent smearing of material off location.

ENGINE CORE PLUGS

REMOVAL

Using a blunt tool such as a drift or a screwdriver and a hammer, strike the bottom edge of the cup plug (Fig. 1). With the cup plug rotated, grasp firmly with pliers or other suitable tool and remove plug (Fig. 1).

CAUTION: Do not drive cup plug into the casting as restricted cooling can result and cause serious engine problems.

INSTALLATION

Thoroughly remove all rust and clean inside of cup plug hole in cylinder block or head. Be sure to remove old sealer. Lightly coat inside of cup plug hole

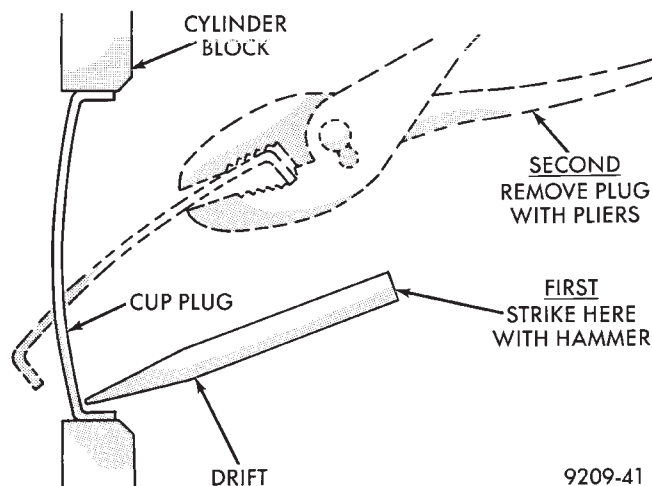


Fig. 1 Core Hole Plug Removal

with sealer. Make certain the new plug is cleaned of all oil or grease. Using proper drive plug, drive plug into hole so that the sharp edge of the plug is at least 0.5 mm (0.020 inch.) inside the lead in chamfer (Fig. 1).

It is not necessary to wait for curing of the sealant. The cooling system can be refilled and the vehicle placed in service immediately.

ENGINE PERFORMANCE

If a loss of performance is noticed, ignition timing should be checked. timing belt or chain may have skipped one or two teeth. Camshaft and crankshaft timing should also be checked. Refer to Group 9, Engine Timing belt or chain installation.

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 in the engine compartment.

(1) Test cranking amperage draw. See Starting Motor Cranking Amperage Draw Electrical Section of this manual.

(2) Check intake manifold for vacuum leaks.

PERFORM CYLINDER COMPRESSION TEST

(1) Check engine oil level and add oil if necessary.

(2) Drive the vehicle until engine reaches normal operating temperature. Select a route free from traffic and other forms of congestion, observe all traffic laws, and accelerate through the gears several times briskly.

(3) 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.

(4) Disconnect coil wire from distributor and secure to good ground to prevent a spark from start-

GENERAL INFORMATION (Continued)

ing a fire (Conventional Ignition System). For Direct Ignition System DIS disconnect the coil connector.

(5) Be sure throttle blade is fully open during the compression check.

(6) Insert compression gage adaptor into the #1 spark plug hole in cylinder head. Crank engine until maximum pressure is reached on gage. Record this pressure as #1 cylinder pressure.

(7) Repeat the previous step for all remaining cylinders.

(8) Compression should not be less than (689kPa) 100 psi and not vary more than 25 percent from cylinder to cylinder.

(9) If one or more cylinders have abnormally low compression pressures, repeat the compression test.

(10) If the same cylinder or cylinders repeat an abnormally low reading on the second compression test, it could indicate the existence of a problem in the cylinder in question. **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.**

(11) Clean or replace spark plugs as necessary and adjust gap as specified in Group 8, Electrical. Tighten to specifications.

(1) Test resistance of spark plug cables. Refer to Group 8, Electrical Ignition System Secondary Circuit Inspection.

(2) Test coil output voltage, primary and secondary resistance. Replace parts as necessary. Refer to Group 8, Electrical Ignition System.

(3) Check fuel pump pressure at idle and different RPM ranges. Refer to Group 14, Fuel System for Specifications.

(4) The air filter elements should be replaced as specified in Group 0, Lubrication and Maintenance,.

(5) Inspect crankcase ventilation system as outlined in Group 0, Lubrication and Maintenance. For emission controls see Group 25, Emission Controls for service procedures.

(6) Inspect and adjust accessory belt drives referring to Group 7, Cooling System, Accessory Drive Belts for proper adjustments.

(7) Road test vehicle as a final test.

HONING CYLINDER BORES

(1) Used carefully, the cylinder bore resizing 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.

(2) Deglazing of the cylinder walls may be done using a cylinder surfacing hone, Tool C-3501, equipped with 280 grit stones, if the cylinder bore is straight and round. 20-60 strokes depending on the bore condition, will be sufficient to provide a satisfactory surface. Inspect cylinder walls after each 20 strokes, using a light honing oil. **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 cross-hatch pattern. When hone marks **intersect** at 50-60 degrees, the cross hatch angle is most satisfactory for proper seating of rings (Fig. 2).

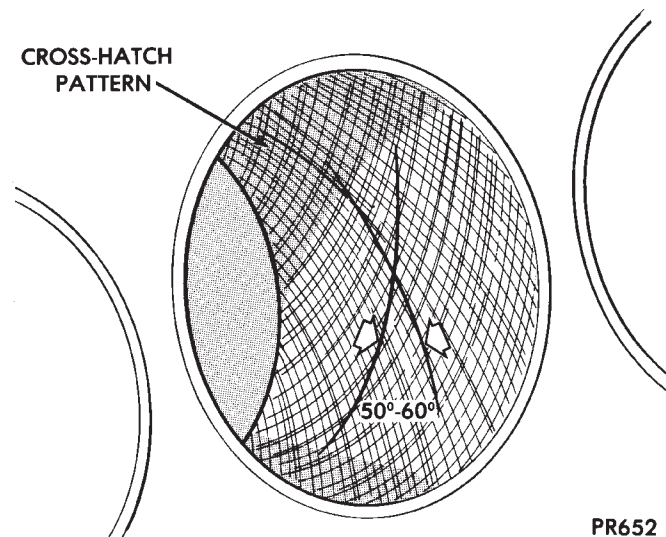


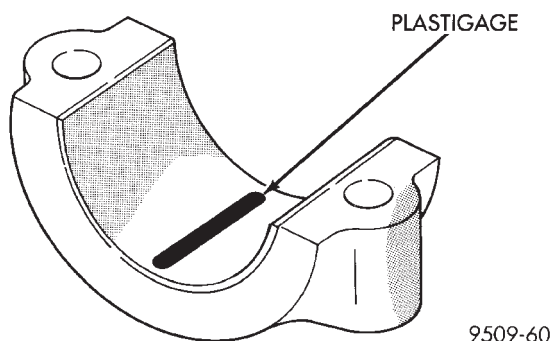
Fig. 2 Cylinder Bore Cross-Hatch Pattern

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

(5) After honing, it is necessary that the block be cleaned again to remove all traces of abrasive.

CAUTION: Ensure all abrasives are removed from engine parts after honing. It is recommended that a solution of soap and hot water be used with a brush and the parts then thoroughly dried. The bore can be considered clean when it can be wiped clean with a white cloth and cloth remains clean. Oil the bores after cleaning to prevent rusting.

GENERAL INFORMATION (Continued)

MEASURING MAIN BEARING AND CONNECTING ROD BEARING CLEARANCES**Fig. 3 Plastigage Placed in Lower Shell****PLASTIGAGE METHOD**

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

NOTE: 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:

PREFERRED METHOD

Shimming the bearings adjacent to the bearing to be checked in order to remove the clearance between upper bearing shell and the crankshaft. This can be accomplished by placing a minimum of 0.254 mm (0.010 in.) shim (e. g. cardboard, matchbook cover, etc.) between the bearing shell and the bearing cap on the adjacent bearings and tightening bolts to 14-20 N·m (10-15 ft. lbs.). The number of main bearing will vary from engine to engine.

ENGINE WITH 5 MAIN BEARINGS

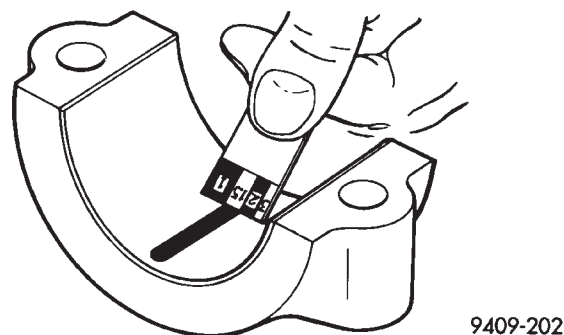
- When checking #1 main bearing shim #2 main bearing.
- When checking #2 main bearing shim #1 & 3 main bearing.
- When checking #3 main bearing shim #2 & 4 main bearing.
- When checking #4 main bearing shim #3 & 5 main bearing.
- When checking #5 main bearing shim #4 main bearing.

ENGINE WITH 4 MAIN BEARING

- When checking #1 main bearing shim # 2 main bearing.
- When checking #2 main bearing shim #1 & #3 main bearing.

- When checking #3 main bearing shim #2 & #4 main bearing.
- When checking #4 main bearing shim #3 main bearing.

NOTE: REMOVE ALL SHIMS BEFORE REASSEMBLING ENGINE

**Fig. 4 Clearance Measurement****ALTERNATIVE METHOD**

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

PLASTIGAGE PROCEDURE

- (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 shell in the cap approximately 6.35 mm (1/4 in.) off center and away from the oil holes (Fig. 3). (In addition, suspected areas can be checked by placing the Plastigage in the suspected area). Torque the bearing cap bolts of the bearing being checked to the proper specifications.
- (3) Remove the bearing cap and compare the width of the flattened Plastigage (Fig. 4) with the metric scale provided on the package. Locate the band closest to the same width. This band shows the amount of clearance in thousandths of a millimeter. Differences in readings between the ends indicate the amount of taper present. Record all readings taken. Refer to Engine Specifications. **Plastigage generally is accompanied by two scales. One scale is in inches, the other is a metric scale.**

NOTE: Plastigage is available in a variety of clearance ranges. Use the most appropriate range for the specifications you are checking.

CONNECTING ROD BEARING CLEARANCE

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

GENERAL INFORMATION (Continued)

(1) Rotate the crankshaft until the connecting rod to be checked is at the bottom of its stroke.

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

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

(4) Assemble the rod cap with Plastigage in place. Tighten the rod cap to the specified torque. **Do not rotate the crankshaft while assembling the cap or the Plastigage may be smeared, giving inaccurate results.**

(5) Remove the bearing cap and compare the width of the flattened Plastigage (Fig. 4) with the scale provided on the package. Locate the band closest to the same width. This band indicates the amount of oil clearance. Differences in readings between the ends indicate the amount of taper present. Record all readings taken. Refer to Engine Specifications. **Plastigage generally is accompanied by two scales. One scale is in inches, the other is a metric scale. If the bearing clearance exceeds 0.076 mm (0.003 in.) replace bearing.**

NOTE: Plastigage is available in a variety of clearance ranges. Use the most appropriate range for the specifications you are checking.

REPAIR OF DAMAGED OR WORN THREADS

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

CAUTION: Be sure that the tapped holes maintain the original centerline.

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

HYDROSTATIC LOCKED ENGINE

When an engine is suspected to be hydrostatically locked, regardless of what caused the problem, these steps should be used.

CAUTION: Do Not Use Starter Motor To Rotate Engine, severe damage may occur.

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

(2) Remove negative battery cable.

(3) Place a shop towel around the spark plugs when removing them from the engine. This will catch any fluid that may possibly be in the cylinder under pressure.

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

(5) Identify the fluid in the cylinder(s) (i.e., coolant, fuel, oil or other).

(6) Make sure all fluid has been removed from the cylinders. Inspect engine for damage (i.e., Connecting Rods, Pistons, Valves etc.)

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

CAUTION: Squirt approximately 1 teaspoon of oil into cylinders, rotate engine to lubricate the cylinder walls to prevent damage on restart.

(8) Install new spark plugs.

(9) Drain engine oil and remove oil filter.

(10) Fill engine with specified amount of approved oil and install new oil filter.

(11) Connect negative battery cable.

(12) Start engine and check for any leaks.

CHECKING ENGINE OIL LEVEL

The best time to check engine oil level is after it has sat overnight, or if the engine has been running, allow the engine to be shut off for at least 5 minutes before checking oil level.

Checking the oil while the vehicle is on level ground will improve the accuracy of the oil level reading. Add only when the level is at or below the ADD mark (Fig. 5).

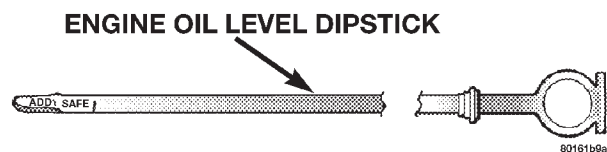


Fig. 5 Oil Level

GENERAL INFORMATION (Continued)

ENGINE OIL SERVICE

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. CONTACT YOUR DEALER OR GOVERNMENT AGENCY FOR LOCATION OF COLLECTION CENTER IN YOUR AREA.

API SERVICE GRADE CERTIFIED

Use an engine oil that is API Service Grade Certified or an oil that conforms to the API Service Grade SH or SH/CD. MOPAR provides engine oils that conform to all of these service grades.

SAE VISCOSITY

An SAE viscosity grade is used to specify the viscosity of engine oil. SAE 30 specifies a single viscosity engine oil. Engine oils also have multiple viscosities. 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. 6).

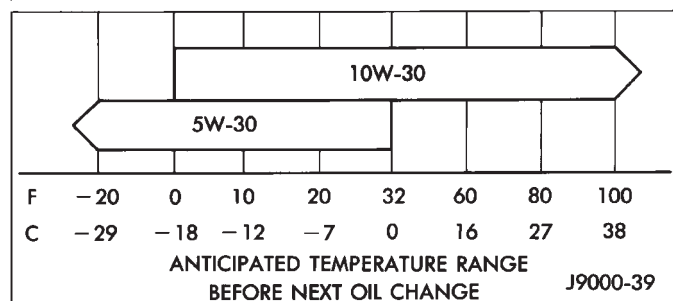


Fig. 6 Temperature/Engine Oil Viscosity

ENERGY CONSERVING OIL

An Energy Conserving type oil is recommended for gasoline engines. They are designated as either ENERGY CONSERVING or ENERGY CONSERVING II.

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).



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Fig. 7 Engine Oil Container Standard Notations

ENGINE OIL CHANGE

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

TO CHANGE ENGINE OIL

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. Refer to Hoisting and Jacking Recommendations.
- (3) Remove oil fill cap.
- (4) Place a suitable drain pan under crankcase drain.
- (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 and gasket 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

Refer to Removal and Installation Section in Group 9, Engine for procedure.

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 listed above.

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 tune-ups.

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

Refer to the Service Diagnosis—Mechanical Chart and the Service Diagnosis—Performance 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 cannot be isolated with the Service Diagnosis charts. Information concerning additional tests and diagnosis is provided within the following:

- 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 (Spray Bottle) at the suspected leak area.
- (3) If a change in RPM'S, 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) Check engine oil level and add oil if necessary.
- (2) Drive the vehicle until engine reaches normal operating temperature. Select a route free from traffic and other forms of congestion, observe all traffic laws, and accelerate through the gears several times briskly.
- (3) 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.
- (4) Disconnect coil wire from distributor and secure to good ground to prevent a spark from starting a fire (Conventional Ignition System). For Direct Ignition System DIS disconnect the coil connector.
- (5) Be sure throttle blade is fully open during the compression check.

(6) Insert compression gage adaptor into the #1 spark plug hole in cylinder head. Crank engine until maximum pressure is reached on gage. Record this pressure as #1 cylinder pressure.

(7) Repeat the previous step for all remaining cylinders.

(8) Compression should not be less than (689kPa) 100 psi and not vary more than 25 percent from cylinder to cylinder.

(9) If one or more cylinders have abnormally low compression pressures, repeat the compression test.

(10) If the same cylinder or cylinders repeat an abnormally low reading on the second compression test, it could indicate the existence of a problem in the cylinder in question. **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**

DIAGNOSIS AND TESTING (Continued)

cause of low compression unless some malfunction is present.

(11) Clean or replace spark plugs as necessary and adjust gap as specified in Group 8, Electrical. Tighten to specifications.

(12) Test resistance of spark plug cables. Refer to Group 8, Electrical Ignition System Secondary Circuit Inspection.

(13) Test coil output voltage, primary and secondary resistance. Replace parts as necessary. Refer to Group 8, Electrical Ignition System.

(14) Check fuel pump pressure at idle and different RPM ranges. Refer to Group 14, Fuel System for Specifications.

(15) The air filter elements should be replaced as specified in Group 0, Lubrication and Maintenance,.

(16) Inspect crankcase ventilation system as outlined in Group 0, Lubrication and Maintenance. For emission controls see Group 25, Emission Controls for service procedures.

(17) Inspect and adjust accessory belt drives referring to Group 7, Cooling System, Accessory Drive Belts for proper adjustments.

(18) Road test vehicle as a final test.

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.

WARNING: DO NOT REMOVE THE RADIATOR CAP WITH THE SYSTEM HOT AND UNDER PRESSURE BECAUSE SERIOUS BURNS FROM COOLANT CAN OCCUR.

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

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

Clean spark plug recesses with compressed air.

Remove the spark plugs.

Remove the oil filler cap.

Remove the air cleaner.

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.

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.

LASH ADJUSTER (TAPPET) NOISE DIAGNOSIS

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 pressed into the vertical 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 disassemble **Do not reuse retainer caps**. Do not interchange parts and make sure that care and cleanliness is exercised in the handling of parts.

c. Clean out dirt and varnish with solvent.

d. Reassemble with engine oil.

e. Check for sponginess.

f. If still spongy, replace with new adjuster.

INSPECTION (ENGINE OIL LEAKS IN GENERAL)

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.

DIAGNOSIS AND TESTING (Continued)

(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.

(5) **If the oil leak source is not positively identified at this time**, proceed with the air leak detection test method as follows:

(6) Disconnect the fresh air hose (makeup air) at the cylinder head cover and plug or cap the nipple on the cover.

(7) Remove the PCV valve hose from the cylinder head cover. Cap or plug the PCV valve nipple on the cover.

(8) 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.

(9) 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.

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

(11) 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. Proceed to next step.

(12) 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. If a leak is present in this area remove transmission for further inspection.

(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, oil galley cup plug, bedplate to cylinder block mating surfaces and seal bore. See proper repair procedures for these items.

(4) If no leaks are detected, pressurized 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.

(7) After the oil leak root cause and appropriate corrective action have been identified. Refer to Rear Crankshaft Seals, for proper replacement procedures.

DIAGNOSIS AND TESTING (Continued)

ENGINE DIAGNOSIS—PERFORMANCE

CONDITION	POSSIBLE CAUSES	CORRECTION
ENGINE WILL NOT START	1. Weak battery. 2. Corroded or loose battery connections. 3. Faulty starter. 4. Moisture on ignition wires. 5. Faulty ignition cables. 6. Faulty coil or control unit. 7. Incorrect spark plug gap. 8. Dirt or water in fuel system. 9. Faulty fuel pump.	1. Test battery specific gravity. Charge or replace as necessary. 2. Clean and tighten battery connections. Apply a coat of light mineral grease to the terminals. 3. Refer to Group 8A, Battery/Starter/Charging System Diagnostics. 4. Wipe wires clean and dry. 5. Replace any cracked or shorted cables. 6. Test and replace, if necessary (refer to Group 8D, Ignition System). 7. Set gap (refer to Group 8D, Ignition System). 8. Clean system and replace fuel filter. 9. Install new fuel pump (refer to Group 14, Fuel System).
ENGINE STALLS OR ROUGH IDLE	1. Idle speed set too low. 2. Idle mixture too lean or too rich. 3. Leak in intake manifold. 4. Incorrect ignition wiring. 5. Faulty coil.	1. Refer to Group 14, Fuel System. 2. Refer to Group 14, Fuel System. 3. Inspect intake manifold gasket and vacuum hoses. Replace, if necessary (refer to Group 11), Exhaust System & Intake Manifold). 4. Install correct wiring. 5. Test and replace, if necessary (refer to Group 8D, Ignition System).
ENGINE LOSS OF POWER	1. Dirty or incorrectly gapped spark plugs. 2. Dirt or water in fuel system. 3. Faulty fuel pump. 4. Incorrect valve timing. 5. Blown cylinder head gasket. 6. Low compression. 7. Burned, warped or pitted valves. 8. Plugged or restricted exhaust system. 9. Faulty ignition cables. 10. Faulty coil.	1. Clean plugs and set gap (refer to Group 8D, Ignition System). 2. Clean system and replace fuel filter. 3. Install new fuel pump. 4. Correct valve timing. 5. Install new cylinder head gasket. 6. Test compression of each cylinder. 7. Install new valves. 8. Install new parts, as necessary. 9. Replace any cracked or shorted cables. 10. Test and replace, as necessary (refer to Group 8D, Ignition System).
ENGINE MISSES ON ACCELERATION	1. Dirty or gap set too wide in spark plug. 2. Dirt in fuel system. 3. Burned, warped or pitted valves. 4. Faulty coil.	1. Clean spark plugs and set gap (refer to Group 8D, Ignition System). 2. Clean fuel system. 3. Install new valves. 4. Test and replace, if necessary (refer to Group 8D, Ignition System).
ENGINE MISSES AT HIGH SPEED	1. Dirty or gap set too wide in spark plug. 2. Faulty coil. 3. Dirty injector. 4. Dirt or water in fuel system.	1. Clean spark plugs and set gap (refer to Group 8D, Ignition System). 2. Test and replace, as necessary (refer to Group 8D, Ignition System). 3. Clean injectors. 4. Clean system and replace fuel filter.

DIAGNOSIS AND TESTING (Continued)**ENGINE DIAGNOSIS—MECHANICAL**

CONDITION	POSSIBLE CAUSES	CORRECTION
NOISY VALVES	1. High or low oil level in crankcase. 2. Thin or diluted oil. 3. Low oil pressure. 4. Dirt in tappets/lash adjusters. 5. Worn rocker arms. 6. Worn tappets/lash adjusters. 7. Worn valve guides. 8. Excessive runout of valve seats. 9. Missing adjuster pivot.	1. Check for correct oil level (refer to Group 0, Lubrication and Maintenance). 2. Change oil (refer to Group 0, Lubrication and Maintenance). 3. Check engine oil level. 4. Replace rocker arm/hydraulic lash adjuster assembly. 5. Inspect oil supply to rocker arms. 6. Install new rocker arm/hydraulic lash adjuster assembly. 7. Ream and install new valves with oversize stems. 8. Grind valve seats and valves. 9. Replace rocker arm/hydraulic lash adjuster assembly.
CONNECTING ROD NOISE	1. Insufficient oil supply. 2. Low oil pressure. 3. Thin or diluted oil. 4. Excessive bearing clearance. 5. Connecting rod journal out-of-round. 6. Misaligned connecting rods.	1. Check engine oil level (refer to Group 0, Lubrication and Maintenance). 2. Check engine oil level. Inspect oil pump relief valve and spring. 3. Change oil to correct viscosity. 4. Measure bearings for correct clearance. Repair as necessary. 5. Replace crankshaft or grind journals. 6. Replace bent connecting rods.
MAIN BEARING NOISE	1. Insufficient oil supply. 2. Low oil pressure. 3. Thin or diluted oil. 4. Excessive bearing clearance. 5. Excessive end play. 6. Crankshaft journal out-of-round, worn. 7. Loose flywheel or torque converter.	1. Check engine oil level (refer to Group 0, Lubrication and Maintenance). 2. Check engine oil level. Inspect oil pump relief valve. 3. Change oil to correct viscosity. 4. Measure bearings for correct clearance. Repair as necessary. 5. Check thrust bearing for wear on flanges. 6. Grind journals or replace crankshaft. 7. Tighten to correct torque.
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 cracked, or blocked. 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, or clean if necessary. 10. Install new oil pump.
OIL LEAKS	1. Misaligned or deteriorated gaskets. 2. Loose fastener, broken or porous metal part. 3. Misaligned or deteriorated cup or threaded plug.	1. Replace the gasket. 2. Tighten, repair or replace the part. 3. Replace.
OIL CONSUMPTION OR SPARK PLUGS OIL FOULED	1. PCV system malfunction. 2. Worn, scuffed or broken rings. 3. Carbon in oil ring slot. 4. Rings fitted too tightly in grooves. 5. Worn valve guides. 6. Valve stem unseated or defective.	1. Check system. Clean and repair, as necessary (refer to Group 25, Emissions Control System). 2. Hone cylinder bores. Install new rings. 3. Install new rings. 4. Remove the rings. Check grooves. If groove is not proper width, replace piston. 5. Ream guides and replace valves with oversize valves and seals. 6. Repair or replace seal.

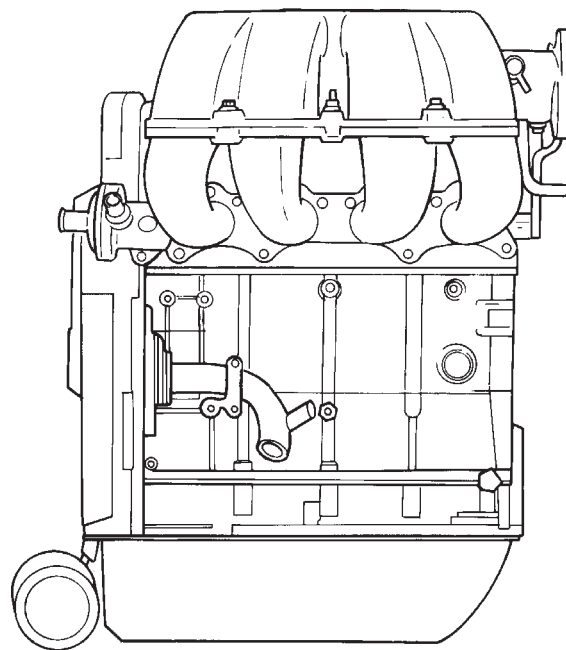
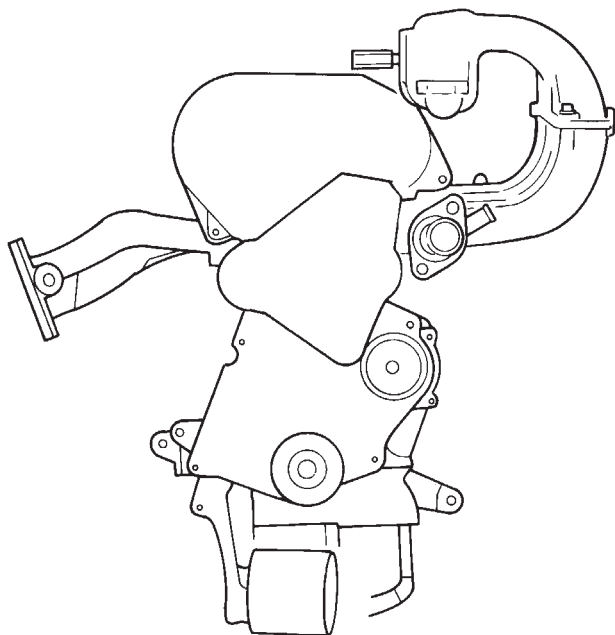
2.4L ENGINE

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DESCRIPTION AND OPERATION

ENGINE

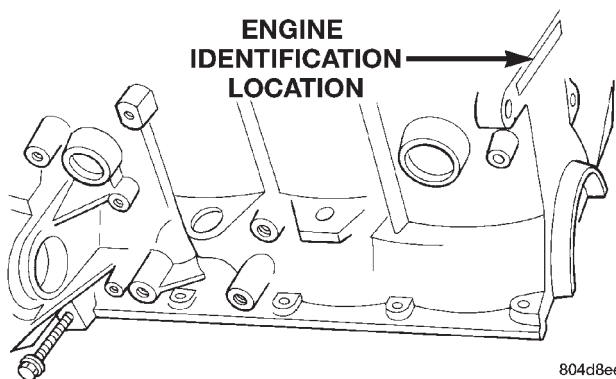


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Engine—2.4L

ENGINE IDENTIFICATION

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



804d8ee8

Fig. 1 Engine Identification

GENERAL SPECIFICATIONS

Type	In-Line OHV, DOHC
Bore	87.5 mm (3.444 Inch)
Stroke	101 mm (3.976 Inches)
Compression Ratio	9.4:1
Displacement	2.4 Liters (148 Cubic Inches)
Firing Order	1, 3, 4, 2
Compression Pressure	1069 - 1172 kPa (170 - 225 psi)
Maximum Variation Between Cylinders	25%
Lubrication	Pressure Feed-Full Flow Filtration
(Direct Crankshaft Driven Pump Engine Oil Capacity . Including Oil Filter	4.25 Liter (4.5 Qts.)
Without Oil Filter	3.8 Liter (4.0 Qts.)

DESCRIPTION AND OPERATION (Continued)

ENGINE COMPONENTS

BALANCE SHAFTS: 2.4L engines are equipped with two balance shafts installed in a carrier attached to the lower crankcase. The shafts interconnect through gears to rotate in opposite directions. These gears are driven by a short chain from the crankshaft, to rotate at two times crankshaft speed. This counterbalances certain engine reciprocating masses.

CYLINDER BLOCK AND BEDPLATE ASSEMBLY: A closed deck design is used for cooling and weight reduction with water pump molded into the block. Nominal wall thickness is 4.5 mm. The bedplate incorporates main bearing caps. Rear seal retainer is integral with the block.

CRANKSHAFT: A nodular cast iron crankshaft is used. The engine has 5 main bearings, with number 3 flanged to control thrust. The 60 mm diameter main and 50 mm diameter crank pin journals (all) have undercut fillets that are deep rolled for added strength. To evenly distribute bearing loads and minimize internal stress, 8 counterweights are used. Hydrodynamic seals provide end sealing, where the crankshaft exits the block. Anaerobic gasket material is used for parting line sealing in the block. A sintered powder metal timing belt sprocket is mounted on the crankshaft nose. This sprocket provides motive power; via timing belt to the camshaft sprockets (providing timed valve actuation) and to the water pump.

PISTONS: There is provisions for free wheeling valve train. Piston has a unique height. All engines use pressed in piston pins to attach forged powder metal connecting rods. Incorporate hex head cap screw threaded into the connecting rod. Piston and Rods are serviced as a assembly.

PISTONS RINGS: The piston rings include a molybdenum faced top ring for reliable compression sealing and a chrome plated taper faced intermediate ring for additional cylinder pressure control. There are also standard oil control rings.

CYLINDER HEAD: Features a Dual Over Head Camshaft (DOHC) 4 valves per cylinder cross flow design. The valves are arranged in two inline banks, with the ports of the bank of two intake valves per cylinder facing toward the radiator side of engine and ports of the bank of two exhaust valves per cylinder facing toward the dash panel. Incorporates powder metal valve guides and seats. Integral oil galleries within the cylinder head supplies oil to the hydraulic lash adjusters, camshaft and valve mechanisms.

CAMSHAFTS: The nodular iron camshafts have six bearing journals and 2 cam lobes per cylinder. Flanges at the rear journals control camshaft end play. Provision for cam position sensor is located on

the intake camshaft at the rear of cylinder head. A hydrodynamic oil seal is used for oil control at the front of the camshaft.

VALVES: 4 valves per cylinder are actuated by roller cam followers which pivot on stationary hydraulic lash adjusters. All valves have 6 mm diameter chrome plated valve stems. The valve sizes are 34.8 mm (1.370 inch.) diameter intake valves and 30.5 mm (1.20 inch.) diameter exhaust valves. Viton rubber valve stem seals are integral with the spring seats. Valve springs, spring retainers, and locks are conventional.

INTAKE MANIFOLD: The intake manifold is a one piece aluminum casting, attached to the cylinder head with ten screws. This long branch fan design enhances low and midspeed torque.

EXHAUST MANIFOLD: The exhaust manifold is made of cast iron for strength and high temperatures.

ENGINE LUBRICATION: Refer to Group 0 Lubrication and Maintenance for recommended oil to be used in various engine application. System is full flow filtration, pressure feed type. The oil pump is mounted in the front engine cover and driven by the crankshaft. Pressurized oil is then routed through the main oil gallery, running the length of the cylinder block, supplying main and rod bearings with further routing. Pistons are lubricated from rod bearing throw off and lubricating slots on the connecting rod assemblies. Camshaft and valve mechanisms are lubricated from a full length cylinder head oil gallery supplied from the crankcase main oil gallery.

ENGINE LUBRICATION SYSTEM**OIL PAN**

A structural die cast aluminum oil pan provides lower engine protection as well as serving as the engine oil reservoir. Oil pan is attached to block and sealed with a gasket. The oil pickup tube has a strainer and cover.

PRESSURE LUBRICATION

Oil drawn up through the pickup tube is pressurized by the pump and routed through the full flow filter to the main oil gallery running the length of the cylinder block. Oil pickup, pump and check valve provide oil flow to the main oil gallery.

MAIN/ROD BEARINGS

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

DESCRIPTION AND OPERATION (Continued)

CAMSHAFT/HYDRAULIC LASH ADJUSTERS

A vertical hole at the number five bulkhead routes pressurized oil through a restrictor up past a cylinder head bolt to an oil gallery running the length of the cylinder head. The camshaft journals are partially slotted to allow a predetermined amount of pressurized oil to pass into the bearing cap cavities with small holes directed to spray lubricate the camshaft lobes.

BALANCE SHAFTS

Balance shaft lubrication is provided through an oil passage from the number 1 main bearing cap through the balance shaft carrier support leg. This passage directly supplies oil to the front bearings and internal machined passages in the shafts that routes oil from front to rear shaft bearing journals

SPLASH LUBRICATION

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

DIAGNOSIS AND TESTING

CHECKING ENGINE OIL PRESSURE

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

CAUTION: If oil pressure is 0 at idle, Do Not Run engine at 3000 RPM

- (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 pressure relief valve stuck open or a clogged oil pickup screen.

SERVICE PROCEDURES

CYLINDER BORE AND SIZING PISTON

Piston and cylinder wall must be clean and dry. Piston diameter should be measured 90 degrees to piston pin about 14 mm (9/16 inch.) from the bottom of the skirt as shown in (Fig. 4). Cylinder bores should be measured halfway down the cylinder bore and transverse to the engine crankshaft center line shown in (Fig. 2). Refer to (Fig. 3) for specifications. Correct piston to bore clearance must be established in order to assure quiet and economical operation.

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

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

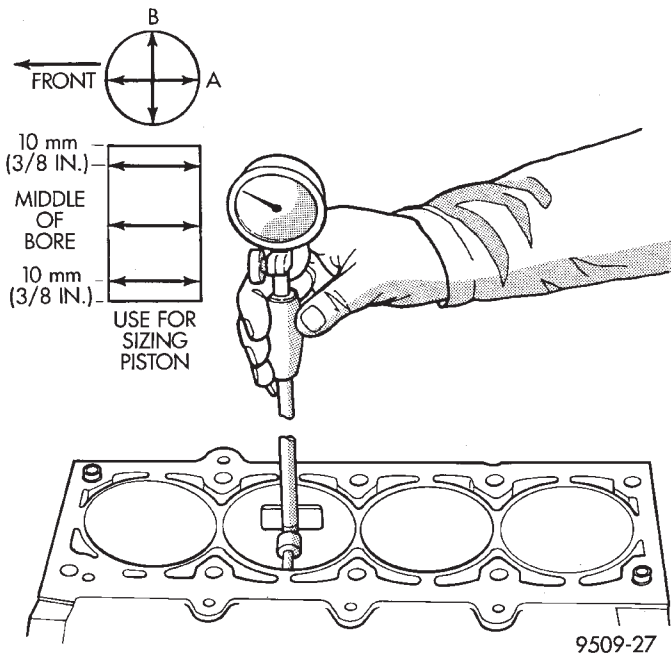


Fig. 2 Checking Cylinder Bore Size

Standard Bore	Maximum Out-of-Round	Maximum Taper
87.5 mm (3.445 in.)	0.051 mm (0.002 in.)	0.051 mm (0.002 in.)
Standard Piston Size		
87.450 - 87.468 mm (3.4434 - 3.4441 in.)		
Piston to Bore Clearance: 0.024 - 0.057 mm (.0009 to .0022 in.)		
Measurements taken at Piston Size location.		

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Fig. 3 Cylinder Bore and Piston Specifications

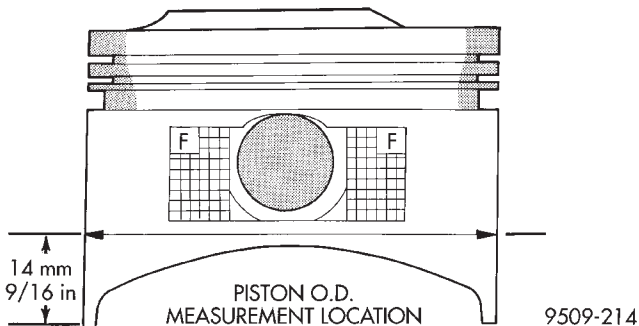


Fig. 4 Piston Measurement

FITTING PISTON RINGS

- (1) Wipe cylinder bore clean. Insert ring and push down with piston to ensure it is square in bore. The ring gap measurement must be made with the ring

SERVICE PROCEDURES (Continued)

positioning at least 12 mm (0.50 inch) from bottom of cylinder bore. Check gap with feeler gauge (Fig. 5). Refer to specification in piston ring specifications table.

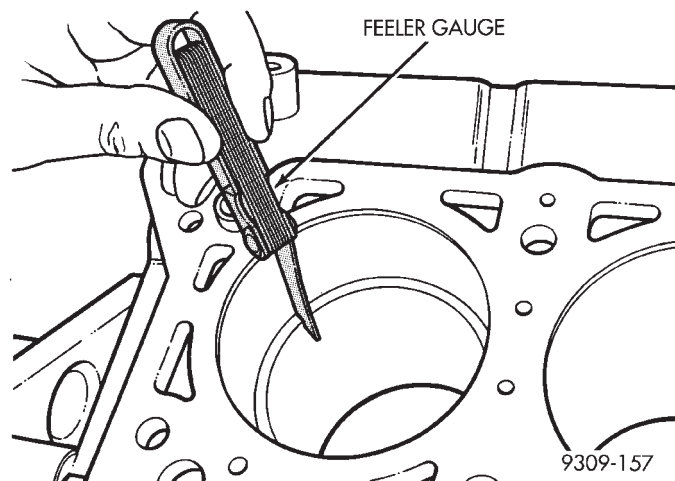


Fig. 5 Piston Ring Gap

PISTON RING SPECIFICATIONS

Ring Position	Ring Gap	Wear Limit
Upper Ring	0.025 to 0.51 mm (0.0098 to 0.020 in.)	0.8 mm (0.031 in.)
Intermediate Ring	0.23 to 0.48 mm (0.009 to 0.018 in.)	0.8 mm (0.031 in.)
Oil Control Ring	0.25 to 0.64 mm (0.0098 to 0.025 in.)	1.0 mm (0.039 in.)
Ring Position	Groove Clearance	Max. Clearance
Upper Ring	0.030 to 0.080 mm (0.0011 to 0.0031 in.)	0.10 mm (0.004 in.)
Intermediate Ring	0.025 to 0.065 mm (0.0010 to 0.0026 in.)	0.10 mm (0.004 in.)
Oil Control Ring - Three Piece. Oil Ring Side Rails Must Be Free To Rotate After Assembly.		

(2) Check piston ring to groove side clearance (Fig. 6). Refer to specification in piston ring specifications table.

PISTON RINGS—INSTALLATION

(1) Install rings with manufacturers I.D. mark facing up, to the top of the piston (Fig. 7).

CAUTION: Install piston rings in the following order:

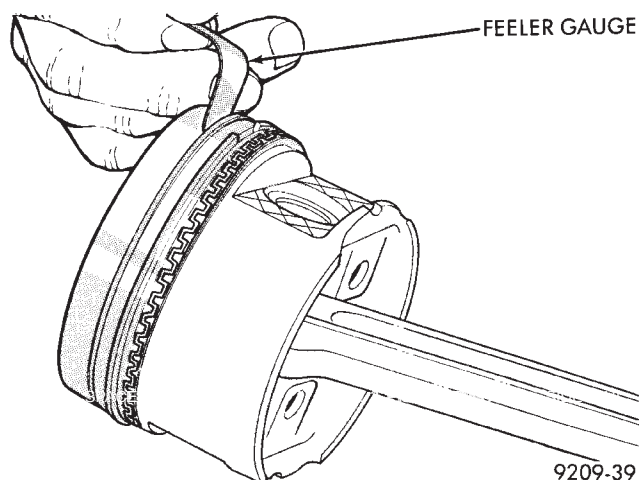


Fig. 6 Piston Ring Side Clearance

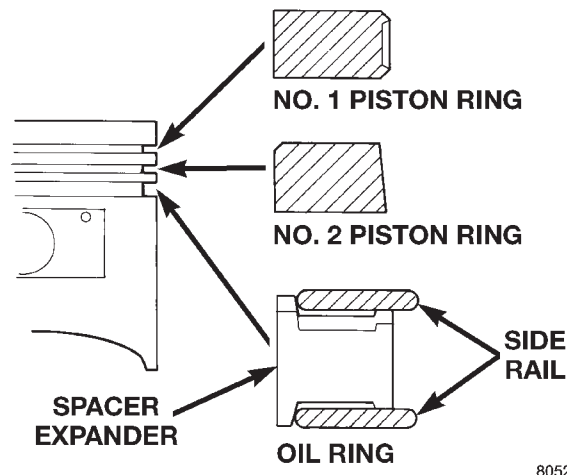


Fig. 7 Piston Ring Installation

- 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 side rail by placing one end between the piston ring groove and the expander. Hold end firmly and press down the portion to be installed until side rail is in position. **Do not use a piston ring expander** (Fig. 8).

(3) Install upper side rail first and then the lower side rail.

(4) Install No. 2 piston ring and then No. 1 piston ring.

(5) Position piston ring end gaps as shown in (Fig. 9).

(6) Position oil ring expander gap at least 45° from the side rail gaps but **not** on the piston pin center or on the thrust direction. Staggering ring gap is important for oil control.

SERVICE PROCEDURES (Continued)

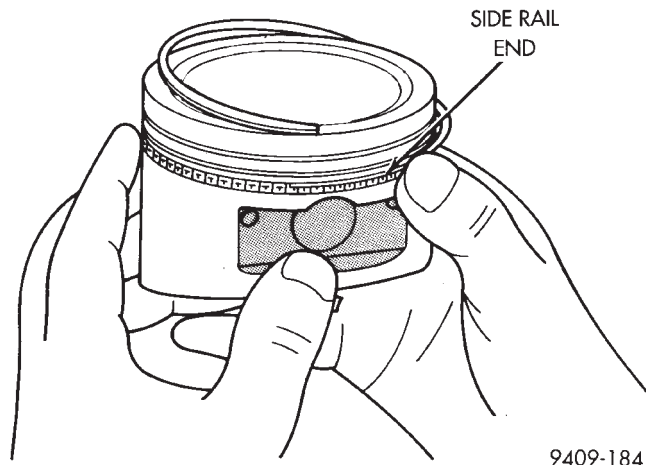


Fig. 8 Installing Side Rail

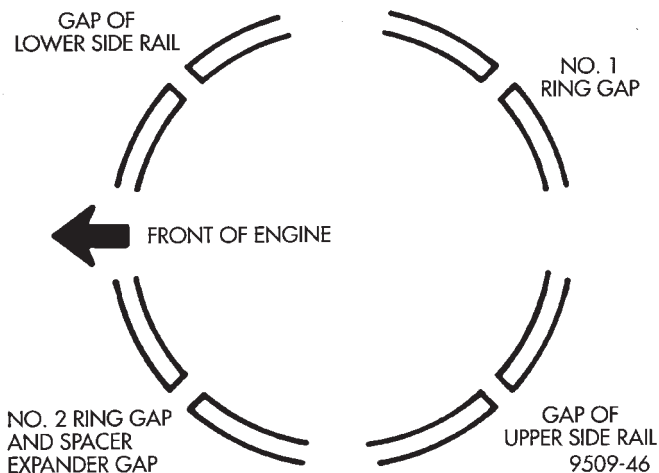


Fig. 9 Piston Ring End Gap Position

FITTING CONNECTING ROD BEARINGS

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

- (1) Rotate the crankshaft until the connecting rod to be checked is at the bottom of its stroke.
- (2) Remove oil film from surface to be checked. Plastigage is soluble in oil.
- (3) Place a piece of Plastigage across the entire width of the bearing shell in the bearing cap approximately 6.35 mm (1/4 in.) off center and away from the oil hole (Fig. 10). In addition, suspect areas can be checked by placing plastigage in the suspect area.
- (4) Before assembling the rod cap with Plastigage in place, the crankshaft must be rotated until the connecting rod being checked starts moving toward the top of the engine. Only then should the cap be assembled and torqued to specifications. **Do not rotate the crankshaft while assembling the cap or the Plastigage may be smeared, giving inaccurate results.**

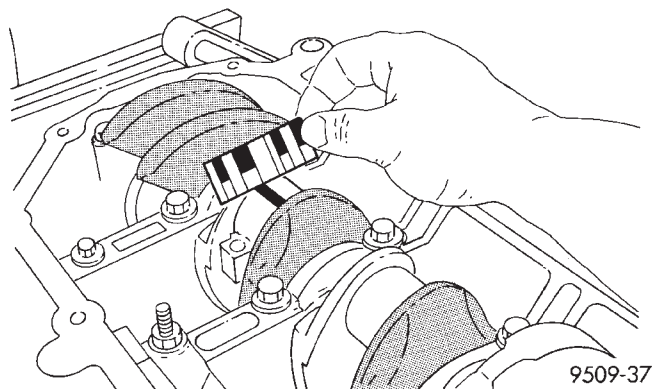


Fig. 10 Measuring Plastigage Width

(5) Remove the bearing cap and compare the width of the flattened Plastigage (Fig. 10) with the metric scale provided on the package. Locate the band closest to the same width. This band shows the amount of clearance in thousandths of a millimeter. Differences in readings between the ends indicate the amount of taper present. Record all readings taken. Refer to Engine Specifications. **Plastigage generally is accompanied by two scales. One scale is in inches, the other is a metric scale.**

(6) Plastigage is available in a variety of clearance ranges. The 0.025-0.076 mm (.001-.003 in.) is usually the most appropriate for checking engine bearing proper specifications.

FITTING MAIN BEARINGS

Refer to the Engine General Information Section for Measuring Main Bearings. For Crankshaft specifications refer to Crankshaft Specification Table.

CRANKSHAFT SPECIFICATION TABLE

Crankshaft End-Play

New Part: 0.09 - 0.24 mm (0.0035 - 0.0094 in.)
Wear Limit: 0.37 mm (0.015 in.)

Main Bearing Clearance

New Part: 0.018 - 0.058 mm (0.0007 - 0.0023 in.)

Connecting Rod Bearing Clearance

New Part: 0.025 - 0.071 mm (0.001 - 0.003 in.)
Wear Limit: 0.075 mm (0.003 in.)

Crankshaft Journal Sizes

Main Bearing Journal Diameter
Standard 60.000 $\pm$ 0.008 mm (2.3622 $\pm$ 0.0003 in.)
1 st Undersize 59.975 $\pm$ 0.008 mm (2.361 $\pm$ 0.0003 in.)

Connecting Rod Journals

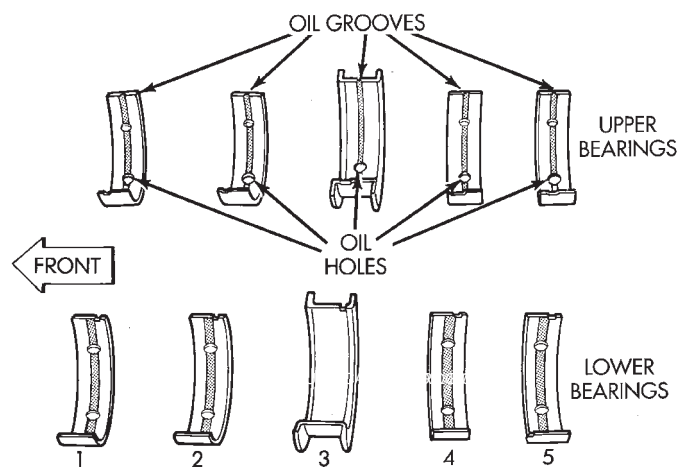
Standard 49.992 $\pm$ 0.008 mm (1.968 $\pm$ 0.0003 in.)
1 st Undersize 49.967 $\pm$ 0.008 mm (1.967 $\pm$ 0.0003 in.)

SERVICE PROCEDURES (Continued)

CRANKSHAFT MAIN BEARINGS

The crankshaft is supported in five main bearings. All upper and lower bearing shells in the crankcase have oil grooves. The number three lower main thrust bearing is plain. Crankshaft end play is controlled by a flanged bearing on the number three main bearing journal (Fig. 11).

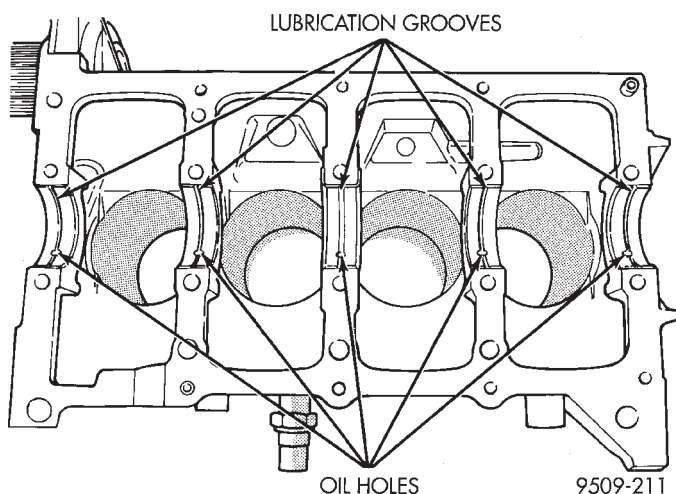
Upper and lower Number 3 bearing halves are flanged to carry the crankshaft thrust loads and are NOT interchangeable with any other bearing halves in the engine (Fig. 11). All bearing cap bolts removed during service procedures are to be cleaned and oiled before installation. Bearing shells are available in standard and the following undersized: 0.025 mm (0.001 in.), 0.050 mm (0.002 in.), 0.250 mm (0.010 inch.) 0.275 mm (0.011 inch.) 0.300 mm (0.012 inch.). Never install an undersize bearing that will reduce clearance below specifications.



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Fig. 11 Main Bearing Identification

MAIN BEARING INSTALLATION



9509-211

Fig. 12 Installing Main Bearing Upper Shell

(1) Install the main bearing shells with the lubrication groove in the cylinder block (Fig. 12).

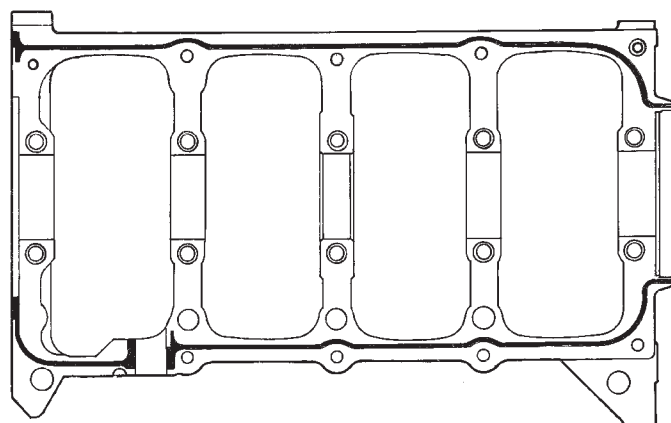
(2) Make certain oil holes in block line up with oil holes in bearings. Bearing tabs must seat in the block tab slots.

CAUTION: Do not get oil on the bedplate mating surface. It will may effect the sealer ability to seal the bedplate to cylinder block.

(3) Oil the bearings and journals and install crankshaft.

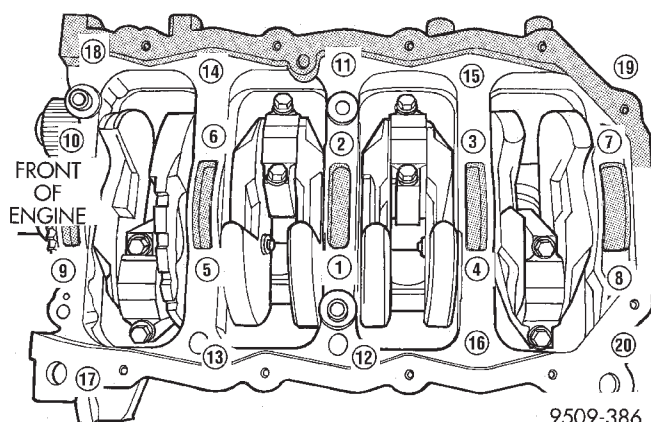
CAUTION: Use only the specified anaerobic sealer on the bedplate or damage may occur to the engine. Ensure that both cylinder block and bedplate surfaces are clean.

(4) Apply 1.5 to 2.0 mm (0.059 to 0.078 in.) bead of anaerobic sealer Mopar Torque Cure Gasket Maker to cylinder block as shown in (Fig. 13).



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Fig. 13 Main Bearing Caps/Bedplate Sealing



9509-386

Fig. 14 Main Bearing Caps/Bedplate TorqueSequence

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

SERVICE PROCEDURES (Continued)

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

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

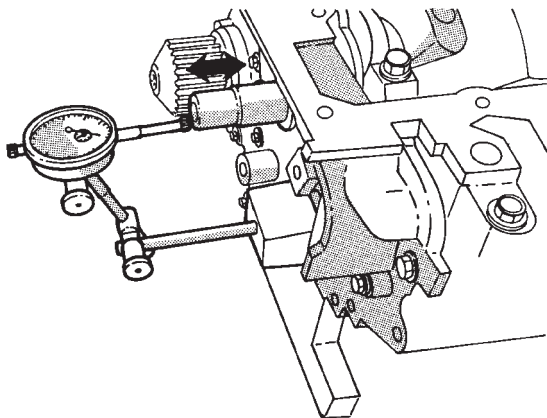
(7) Install main bearing bedplate to engine block bolts 11, 17 and 20 finger tight. Tighten these bolts down together until the bedplate contacts the cylinder block. Then torque these bolts to 28 N·m (20 ft. lbs.).

(8) Install main bearing bedplate to engine block bolts (1 through 10) and torque each bolt to 41 N·m (30 ft. lbs.) in sequence then in sequence turn each bolt 1/4 turn shown in (Fig. 14).

(9) Install main bearing bedplate to engine block bolts (11 through 20), and torque each bolt to 28 N·m (20 ft. lbs.) in sequence shown in (Fig. 14).

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

CRANKSHAFT END PLAY



9409-189

Fig. 15 Checking Crankshaft End Play—Typical

- Mount a dial indicator to front of engine, locating probe on nose of crankshaft (Fig. 15).
- Move crankshaft all the way to the rear of its travel.
- Zero the dial indicator.
- Move crankshaft all the way to the front and read the dial indicator. Refer to Crankshaft Specification Table for end-play specification.

CRANKSHAFT SPECIFICATION TABLE

Crankshaft End-Play
New Part: 0.09 - 0.24mm (0.0035 - 0.0094 in.)
Wear Limit: 0.37 mm (0.015 in.)

OPTIONAL CRANKSHAFT END PLAY CHECK

- Move crankshaft all the way to the rear of its travel using a lever inserted between a main bearing

cap and a crankshaft cheek, using care not to damage any bearing surface. **DO NOT** loosen main bearing cap.

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

CAMSHAFT END PLAY

(1) Oil camshaft journals and install camshaft **WITHOUT** cam follower assemblies. Install rear cam caps and tighten screws to specified torque.

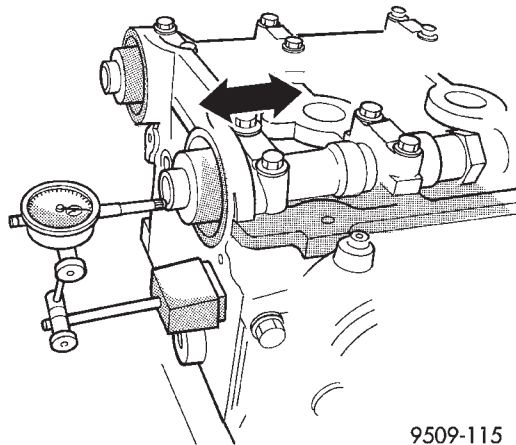
(2) Using a suitable tool, move camshaft as far rearward as it will go.

(3) Zero dial indicator (Fig. 16).

(4) Move camshaft as far forward as it will go.

(5) End play travel: 0.05 - 0.15 mm (0.002 - 0.010 in.).

(6) If end play is excessive check cylinder head and camshaft for wear; replace as necessary.



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Fig. 16 Camshaft End Play

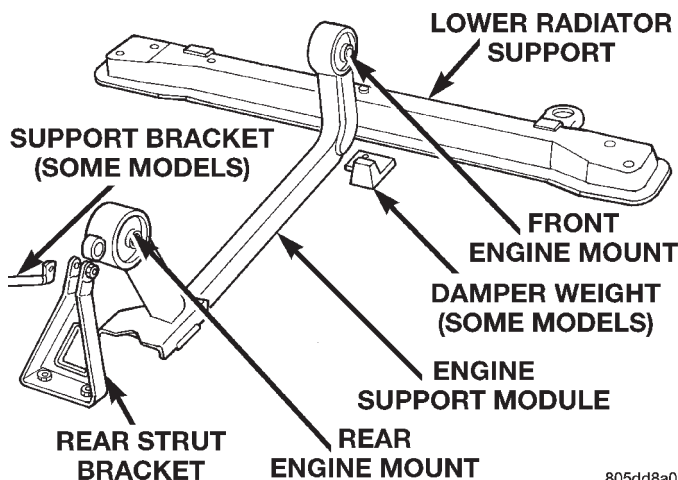
REMOVAL AND INSTALLATION

ENGINE SUPPORT MODULE (FRONT AND REAR MOUNTS)

REMOVAL

- Raise vehicle on hoist.
- Remove thru bolt at rear mount and remove bolts attaching module to crossmember.
- Remove upper attaching bolt from rear support strut bracket (Fig. 17).
- Remove front attaching bolts from support module to lower radiator support.
- Support cooling module.
- Remove lower radiator support bolts, and remove support.
- Remove thru bolt at front mount and remove support module.

REMOVAL AND INSTALLATION (Continued)

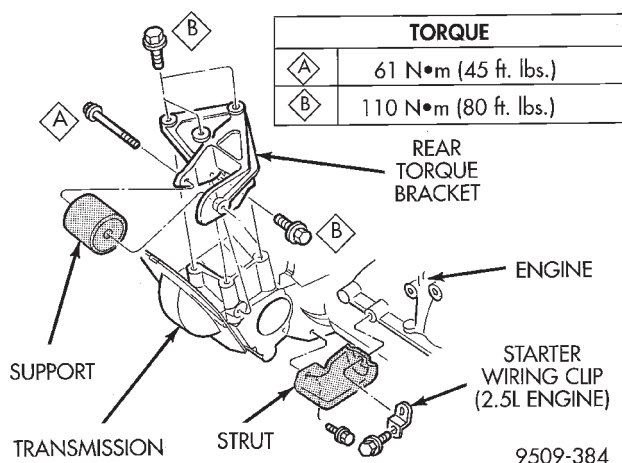


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Fig. 17 Engine Support Module

INSTALLATION

- (1) Install thru bolt at front mount. Do not tighten at this time.
- (2) Install lower radiator support.
- (3) Install attaching bolts from support module to lower radiator support.
- (4) Install upper bolt at rear support strut bracket.
- (5) Install thru bolt at rear mount see (Fig. 18) or (Fig. 19) tighten to 61 N·m (45 ft. lbs.).
- (6) Tighten thru bolt at front mount see (Fig. 20) tighten to 61 N·m (45 ft. lbs.).



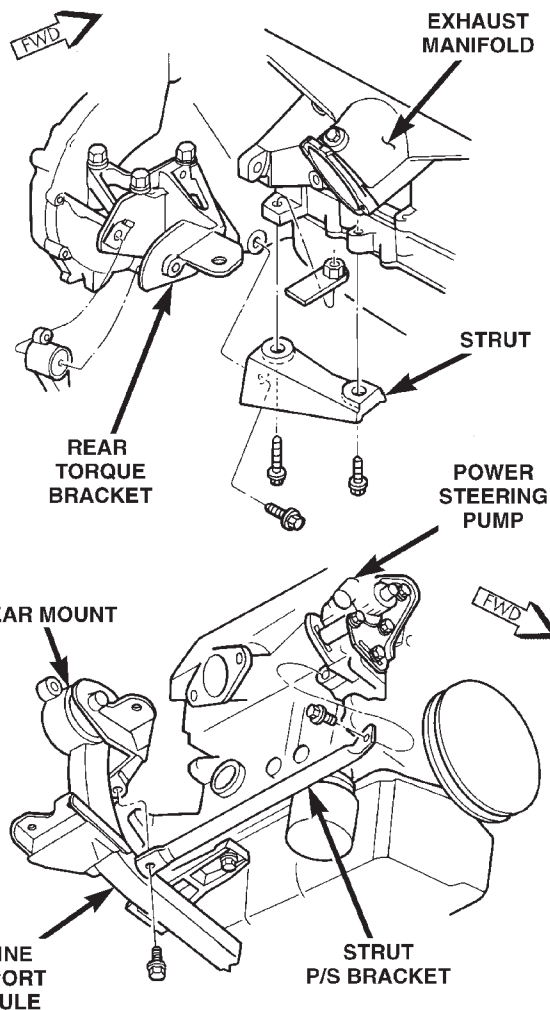
9509-384

Fig. 18 Engine Mounting—Rear 2.4 and 2.5L

LEFT SIDE MOUNT

NOTE: If centering or adjusting the engine/transmission assembly is needed refer to Adjustments, in this section.

The left side engine mount is a Hydro-Mount and may show surface cracks this will not effect it's performance and should not be replaced. Only replace the Hydro-Mount when it's leaking fluid.



8066007b

Fig. 19 Engine Mounting—Rear 2.0L

- (1) Support the transmission with a transmission jack.
- (2) Remove the three vertical bolts, from the mount to the transmission.
- (3) Remove the transmission mount fasteners and remove mount.
- (4) Reverse removal procedure for installation. Refer to (Fig. 21) for bolt tightening specifications.
- (5) Engine support assemblies adjustment, Refer to Engine Support Assembly Adjustment of this section.

ENGINE MOUNT—RIGHT/ENGINE SUPPORT BRACKET

NOTE: The right side engine mount is a Hydro-Mount and may show surface cracks this will not effect it's performance and should not be replaced. Only replace the Hydro-Mount when it's leaking fluid.

REMOVAL AND INSTALLATION (Continued)

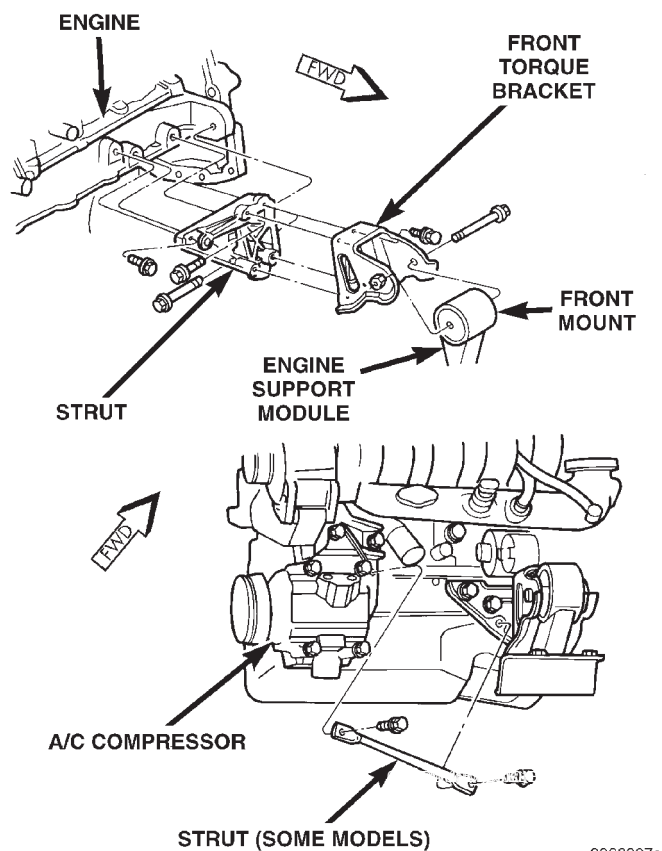


Fig. 20 Engine Mounting—Front 2.0 and 2.4L

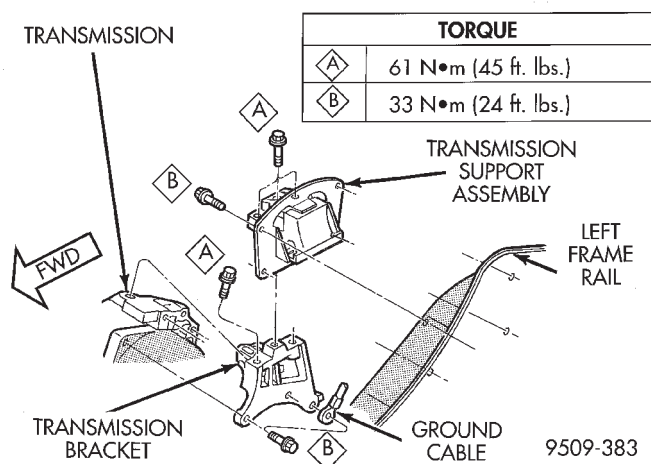


Fig. 21 Typical Engine Mounting—Left

- (1) Raise vehicle on a hoist and remove inner splash shield. Remove the right engine support assembly vertical fasteners from frame rail (Fig. 22).
- (2) Lower vehicle. Remove the load on the engine motor mounts by carefully supporting the engine assembly with a floor jack.
- (3) Remove the three bolts attaching the engine support assembly to the engine bracket.
- (4) Move the air conditioning dryer aside.

- (5) Remove coolant recovery system tank. Refer to Group 7, Cooling System for procedure.
- (6) Remove right engine support.
- (7) Remove the three bolts attaching the engine support bracket to the cylinder block.

NOTE: If centering or adjusting the engine/transmission assembly is needed refer to Adjustments, in this section.

- (8) Reverse removal procedure for installation. Refer to (Fig. 22) for torque specifications.

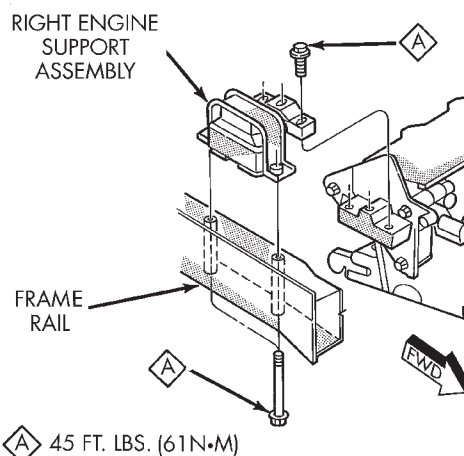


Fig. 22 Engine Mounting—Right Side

ENGINE ASSEMBLY

REMOVAL

- (1) Perform fuel pressure release procedure. Refer to Group 14, Fuel System for procedure. Remove fuel line to fuel rail.
- (2) Disconnect battery and remove air cleaner and hoses.
- (3) Drain cooling system. Refer to Draining Cooling System in Group 7.
- (4) Discharge Air Conditioning System.
- (5) Disconnect automatic transmission cooler lines and plug, if equipped.
- (6) Remove cooling module assembly (radiator, fan module, and condenser).
- (7) Disconnect transmission shift linkage.
- (8) Disconnect throttle body linkage.
- (9) Disconnect engine and transmission wiring harness.
- (10) Disconnect heater hoses.
- (11) Hoist vehicle and remove right inner splash shield. Remove battery splash shield.
- (12) Drain engine oil.
- (13) Remove accessory drive belts. Refer to Accessory Drive Belt Removal in Group 7.
- (14) Remove axle shafts.
- (15) Disconnect exhaust pipe from manifold.

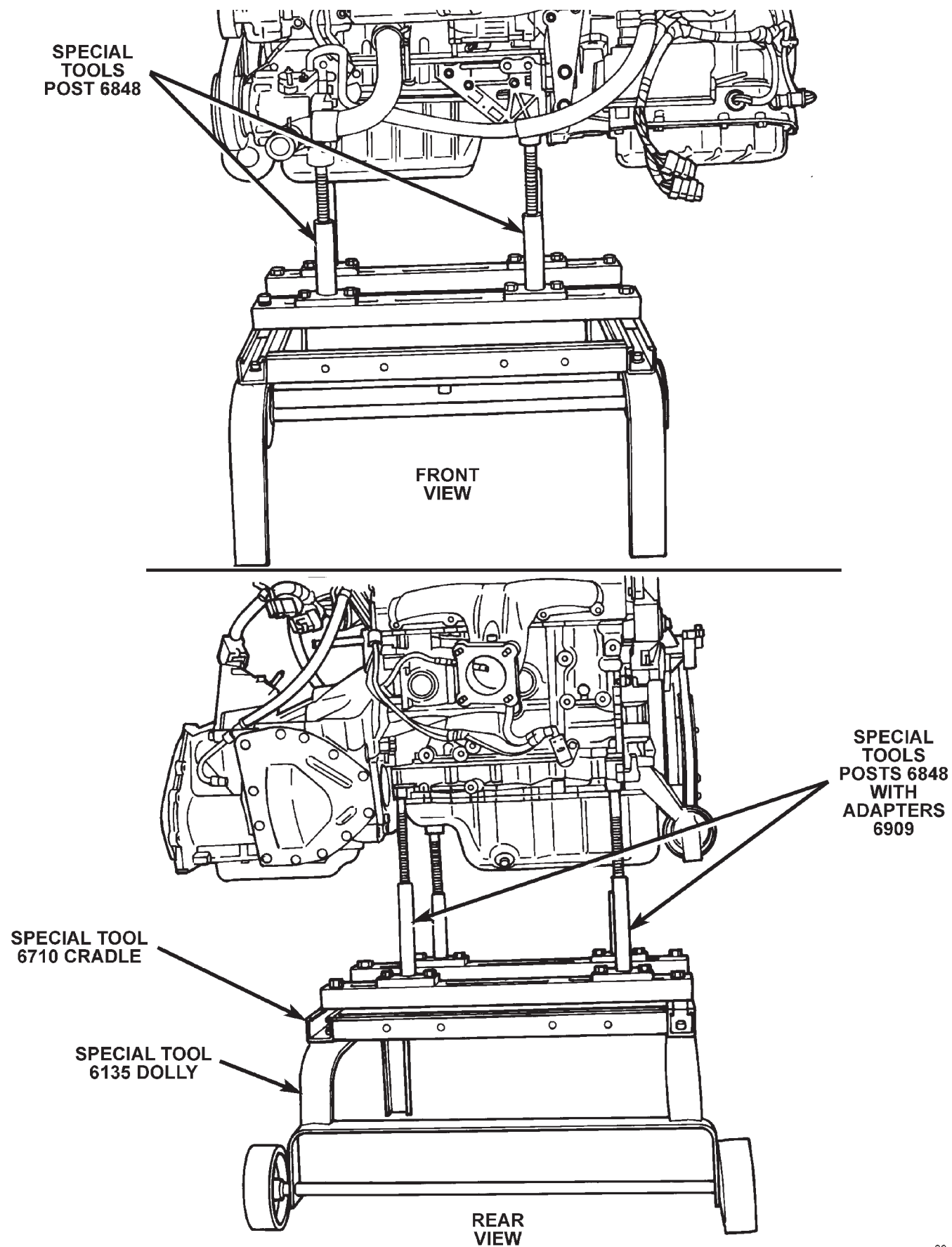
REMOVAL AND INSTALLATION (Continued)

- (16) Remove engine support module.
- (17) Remove front and rear mount brackets from the engine and transmission.
- (18) Remove rear engine/transmission bending brace. Remove flex plate cover. Remove converter bolts and mark converter for reassembly.
- (19) Lower vehicle.
- (20) Remove power steering pump, reservoir and hoses. Position components for engine removal.
- (21) Remove A/C suction line at compressor. Cap suction port and line.
- (22) Remove ground straps to body.
- (23) Raise vehicle enough to allow engine dolly 6135 and cradle 6710 with posts 6848 to be installed under vehicle (Fig. 23).
- (24) Loosen cradle engine mounts to allow movement for positioning onto engine locating holes on the engine bedplate, compressor and support bracket. Install adapters 6909 to the two post at rear of engine. Lower vehicle and position cradle mounts until the engine is resting on mounts. Tighten mounts to cradle frame. This will keep mounts from moving when removing or installing engine and transmission.
- (25) Lower vehicle so weight of the engine and transmission ONLY is on the cradle.
- (26) Remove engine and transmission mount bolts.
- (27) Raise vehicle slowly. It may be necessary to move the engine/transmission assembly on the cradle to allow for removal around body flanges.

INSTALLATION

- (1) Position engine and transmission assembly under vehicle and slowly lower the vehicle over the engine and transmission.
- (2) Align engine and transmission mounts to attaching points. Install mounting bolts at the right engine and left transmission mounts. Refer to procedures outlined in this section.
- (3) Slowly raise vehicle enough to remove the engine dolly and cradle Special Tools 6135 and 6710.
- (4) Install axle shafts.
- (5) Install front and rear mount brackets.
- (6) Install transmission and engine bending brace.
- (7) Install engine support module.
- (8) Connect exhaust system to manifold.
- (9) Install power steering pump, reservoir and hoses.
- (10) Install A/C suction line at compressor.
- (11) Install accessory drive belts. Refer to Accessory Drive Belt Installation in Group 7.
- (12) Install right inner splash shield and battery splash shield. Install wheels and tires.
- (13) Install cooling module assembly (radiator, fan module, and condenser).
- (14) Connect automatic transmission cooler lines and shifter linkage.
- (15) Connect fuel line and heater hoses.
- (16) Install ground straps. Connect engine and throttle body connections and harnesses.
- (17) Connect throttle body linkage.
- (18) Fill cooling system.
- (19) Connect battery.
- (20) Install air cleaner and hoses.
- (21) Install oil filter. Fill engine crankcase with proper oil to correct level.
- (22) Start engine and run until operating temperature is reached.
- (23) Adjust transmission linkage, if necessary.

REMOVAL AND INSTALLATION (Continued)



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Fig. 23 Positioning Engine Cradle Support Post Mounts

REMOVAL AND INSTALLATION (Continued)

CYLINDER HEAD COVER

REMOVAL

- (1) Remove ignition coil pack and plug wires (Fig. 24). Remove ground strap.
- (2) Remove the cylinder head cover fasteners.
- (3) Remove cylinder head cover from cylinder head.

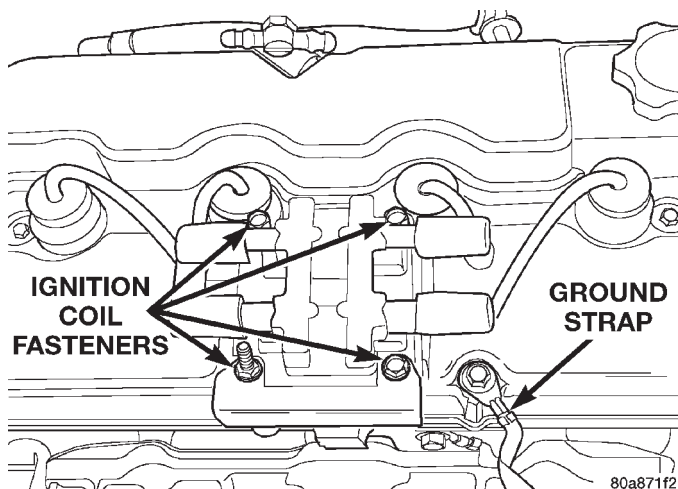


Fig. 24 Ignition Coil Pack and Ground Strap

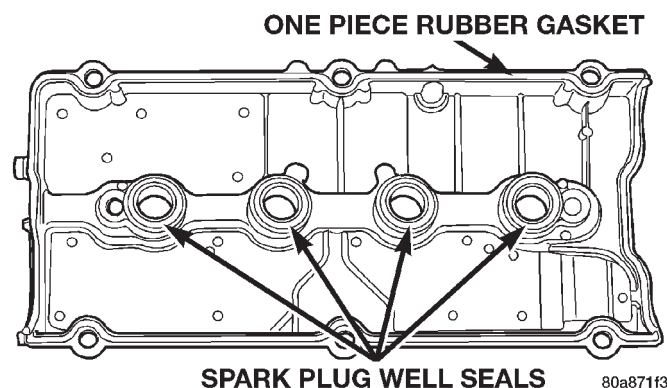


Fig. 25 Cylinder Head Cover Gasket and Spark Plug Seals

INSTALLATION

NOTE: Replace spark plug well seals when installing a new cylinder head cover gasket.

- (1) Install new cylinder head cover gaskets and spark plug seals (Fig. 25).

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

- (2) Apply Mopar Silicone Rubber Adhesive Sealant at the camshaft cap corners and at the top edge of the 1/2 round seal.

- (3) Install cylinder head cover assembly to head and tighten fasteners in sequence shown in (Fig. 26). Using the 3 step torque method:

- (a) Tighten all fasteners to 4.5 N·m (40 in. lbs.)

- (b) Tighten all fasteners to 9.0 N·m (80 in. lbs.)
- (c) Tighten all fasteners to 12 N·m (105 in. lbs.)

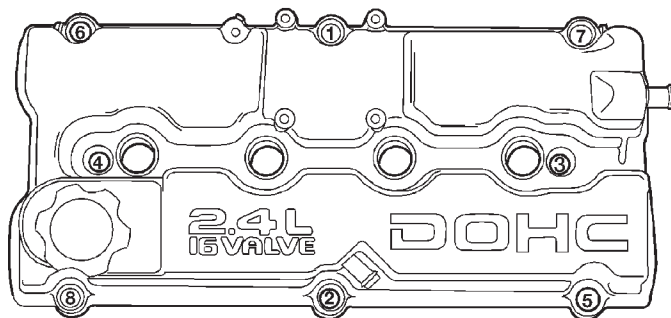


Fig. 26 Cylinder Head Cover Tightening Sequence

- (4) Install ignition coil pack and plug wires. Tighten fasteners to 12 N·m (105 in. lbs.).
- (5) Install ground strap.

CAMSHAFT

REMOVAL

- (1) Remove cylinder head cover using procedure outlined in this section.
- (2) Remove timing belt, sprockets and covers. Refer to Timing Belt Service outlined in this section.
- (3) Bearing caps are identified for location. Remove the outside bearing caps first (Fig. 27).
- (4) Loosen the camshaft bearing cap attaching fasteners in sequence shown (Fig. 28) one camshaft at a time.

CAUTION: Camshafts are not interchangeable. The intake cam number 6 thrust bearing face spacing is wider.

- (5) Identify the camshafts before removing from the head. The camshafts are not interchangeable.

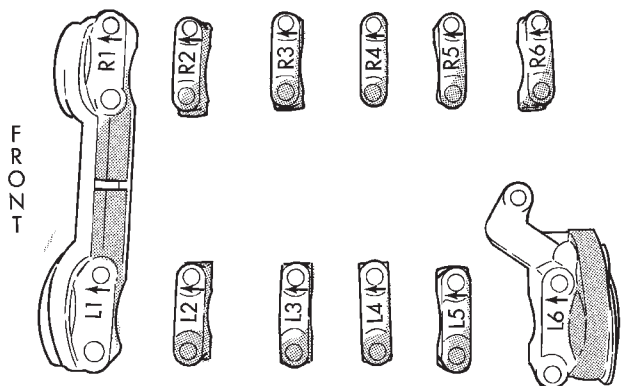
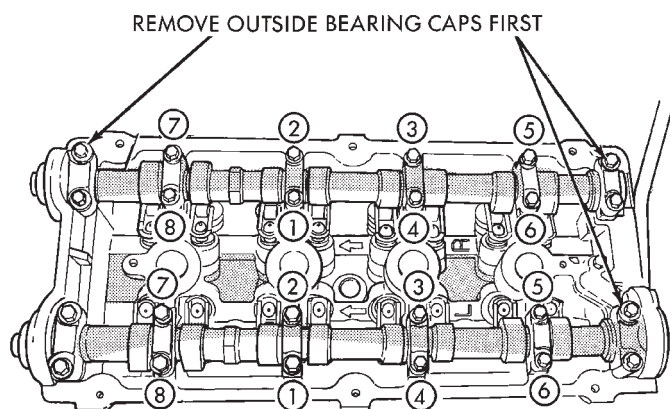


Fig. 27 Camshaft Bearing Cap Identification

REMOVAL AND INSTALLATION (Continued)

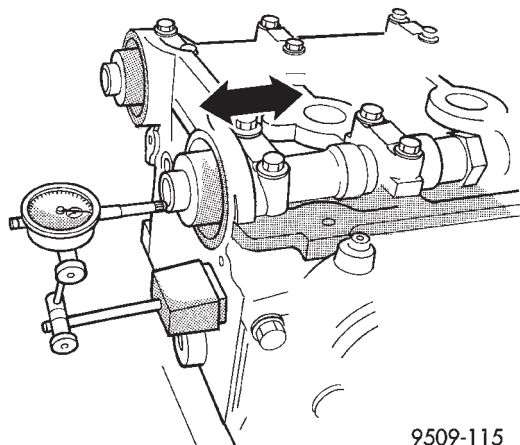


9509-113

Fig. 28 Camshaft Bearing Cap— Removal

CAMSHAFT END PLAY

- (1) Oil camshaft journals and install camshaft **WITHOUT** cam follower assemblies. Install rear cam caps and tighten screws to specified torque.
- (2) Using a suitable tool, move camshaft as far rearward as it will go.
- (3) Zero dial indicator (Fig. 29).
- (4) Move camshaft as far forward as it will go.
- (5) End play travel: 0.05–0.15 mm (0.002–0.010 in.).
- (6) If end play is excessive check cylinder head and camshaft for wear; replace as necessary.



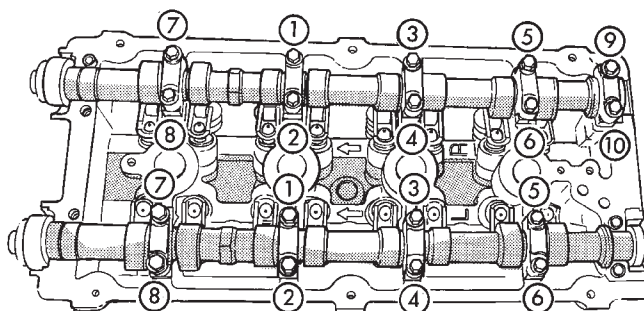
9509-115

Fig. 29 Camshaft End Play

INSTALLATION

CAUTION: Ensure that **NONE** of the pistons are at top dead center when installing the camshafts.

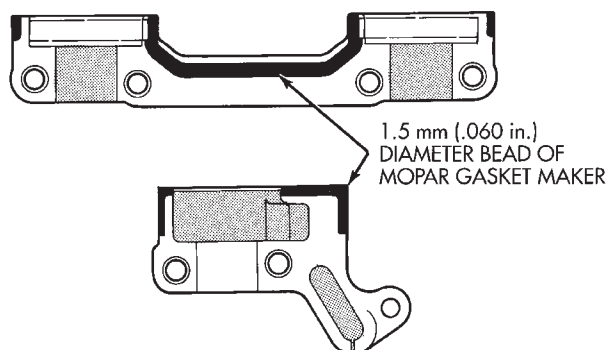
- (1) Remove camshaft retaining caps and lubricate bearing journals. Install cam followers and camshafts with clean oil. Install right and left camshaft bearing caps #2 thru #5 and right #6. Tighten M6 fasteners to 12 N·m (105 in. lbs.) in sequence shown in (Fig. 30).
- (2) Apply Mopar Gasket Maker to No. 1 and No. 6 bearing caps (Fig. 31). Install bearing caps and tighten M8 fasteners to 28 N·m (250 in. lbs.).
- (3) Bearing end caps must be installed before seals can be installed.
- (4) Install timing belt, sprockets and covers. Refer to timing belt service outlined in this section.
- (5) Install cylinder head cover using procedure outlined in this section.



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Fig. 30 Camshaft Bearing Cap Tightening Sequence

FRONT CAM CAP



LEFT REAR CAM CAP

9509-117

Fig. 31 Camshaft Bearing Cap Sealing

REMOVAL AND INSTALLATION (Continued)

CAMSHAFT FOLLOWER

REMOVAL

- (1) Remove cylinder head cover using procedure outlined in this section.
- (2) Remove timing belt, sprockets and covers using procedure outlined in this section.
- (3) Remove camshaft. Refer to procedure previously outline this section.
- (4) Remove cam follower assemblies from cylinder head. Keep the cam followers in the order they have been removed from the head for reassembly.

INSPECTION

Inspect the cam follower assembly for wear or damage (Fig. 32). Replace as necessary.

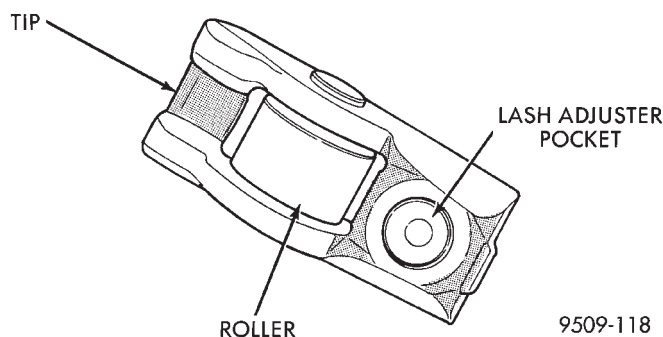


Fig. 32 Cam Follower Assembly

INSTALLATION

- (1) Lubricate with clean oil and install cam follower assemblies in their original position on the hydraulic adjuster and valve stem (Fig. 33).
- (2) Install the camshafts. Refer to procedure previously outlined in this section.
- (3) Install timing belt, sprockets and covers using procedure outlined in this section.
- (4) Install cylinder head cover using procedure outlined in this section.

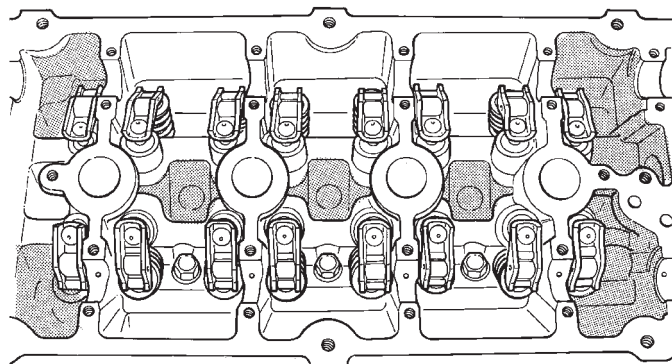


Fig. 33 Cam Follower Assemblies—Installation

BALANCE SHAFTS CARRIER ASSEMBLY

BALANCE SHAFTS

REMOVAL

Refer to Timing Belt Cover, and Timing Belt removal procedure in this section. To repair balance shafts carrier assembly.

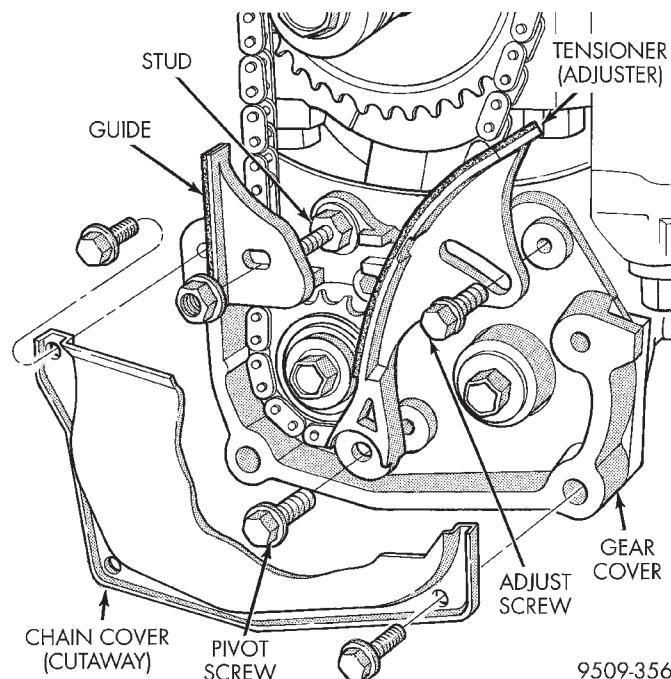


Fig. 34 Chain Cover, Guide and Tensioner

- (1) Remove chain cover, guide and tensioner (Fig. 34). Also see Carrier Assembly Removal for service procedures requiring only temporary relocation of assembly.
- (2) Remove gear cover retaining stud (double ended to also retain chain guide). Remove cover and balance shaft gears (Fig. 34).
- (3) Remove balance shaft gear and chain sprocket retaining screws and crankshaft chain sprocket. Remove chain and sprocket assembly (Fig. 35). Using two wide pry bars, work the sprocket back and forth until it is off the shaft.
- (4) Remove carrier gear cover and balance shafts (Fig. 36).
- (5) Remove four carrier to crankcase attaching bolts to separate carrier from engine bedplate.

BALANCE SHAFT CARRIER

REMOVAL

The following components will remain intact during carrier removal. Gear cover, gears, balance shafts and the rear cover (Fig. 37).

- (1) Remove chain cover and driven balance shaft chain sprocket screw.

REMOVAL AND INSTALLATION (Continued)

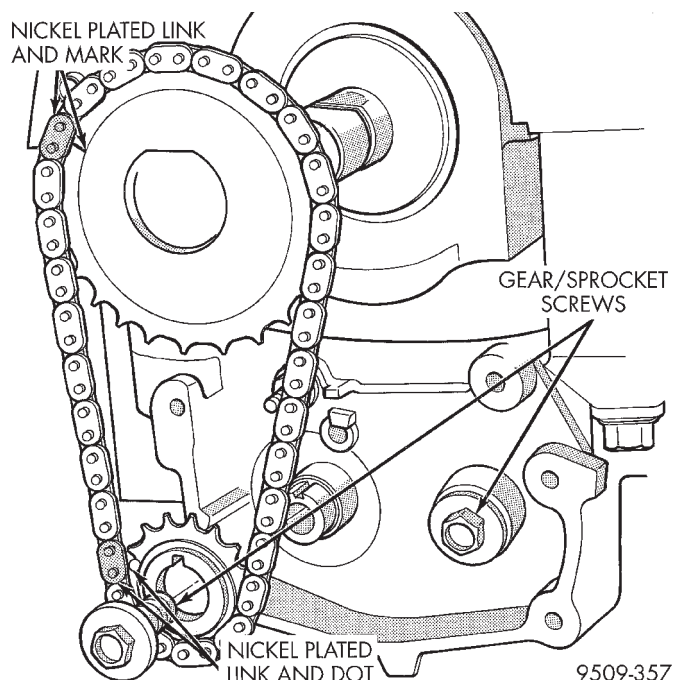


Fig. 35 Drive Chain and Sprockets

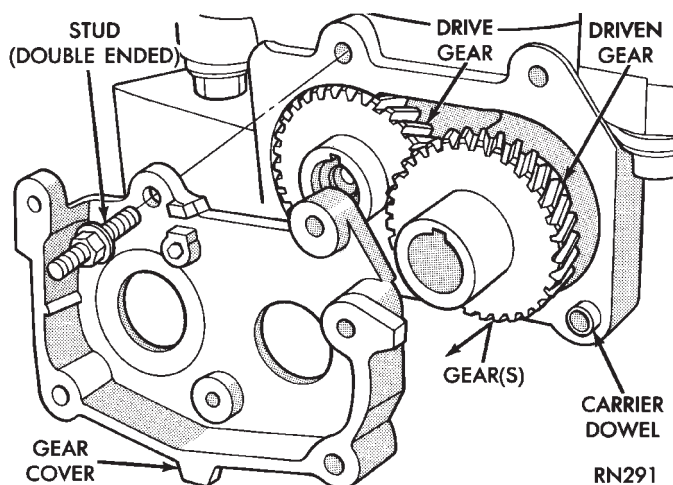


Fig. 36 Gear Cover and Gears

(2) Loosen tensioner pivot and adjusting screws, move driven balance shaft inboard through driven chain sprocket. Sprocket will hang in lower chain loop.

(3) Remove carrier to crankcase attaching bolts to remove carrier.

Balance Shaft Installation

Balance shaft and carrier assembly installation is the reverse of the removal procedure. **During installation crankshaft to balance shaft timing must be established. Refer to Timing procedure outlined in this section.**

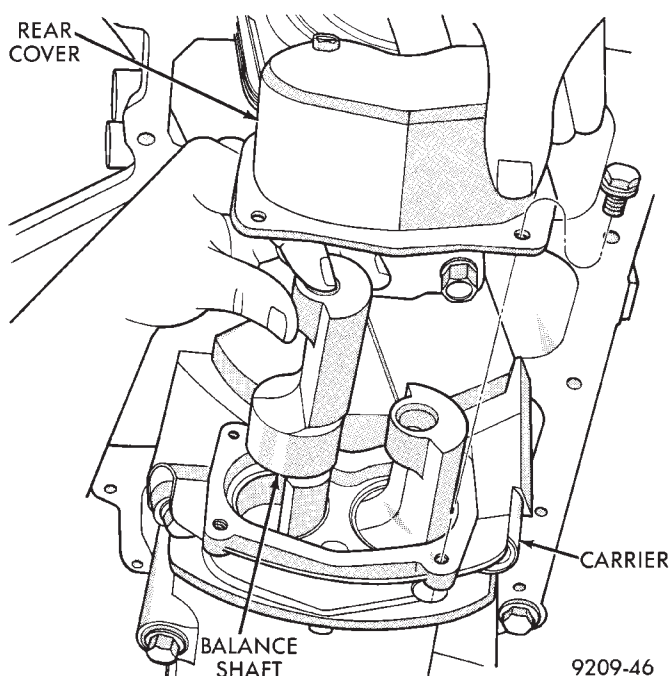


Fig. 37 Balance Shaft(s)—Removal/Installation

TIMING

(1) With balance shafts installed in carrier (Fig. 38) position carrier on crankcase and install four attaching bolts and tighten to 54 N·m (40 ft. lbs.).

(2) Turn balance shafts until both shaft key ways are up Parallel to vertical centerline of engine. Install short hub drive gear on sprocket driven shaft and long hub gear on gear driven shaft. After installation gear and balance shaft keyways must be up with gear timing marks meshed as shown in (Fig. 39).

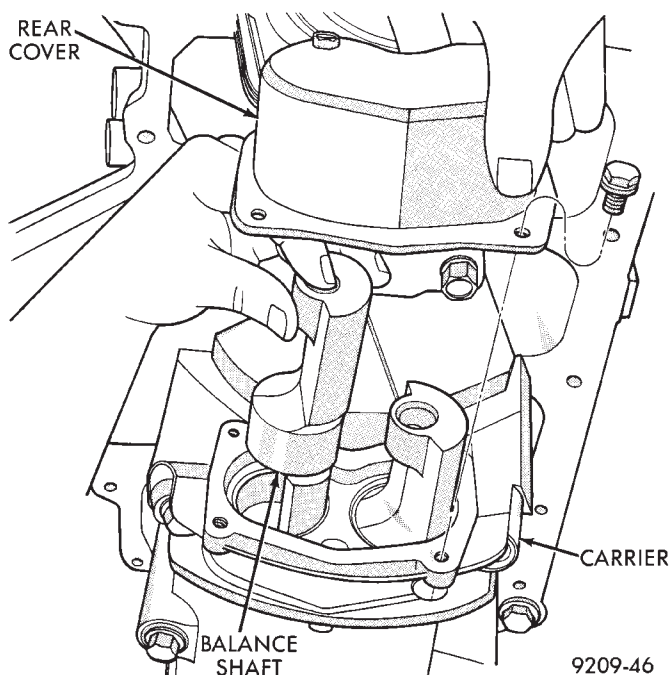
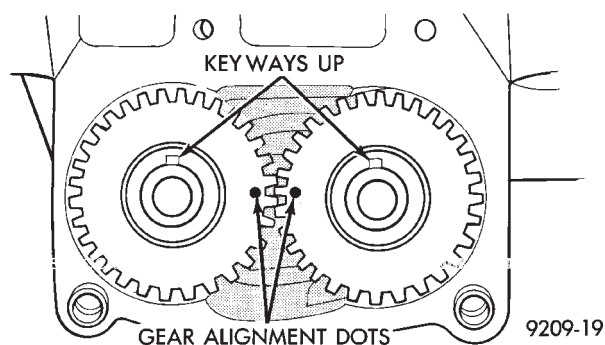
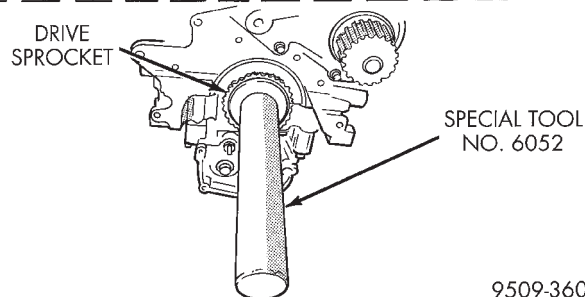
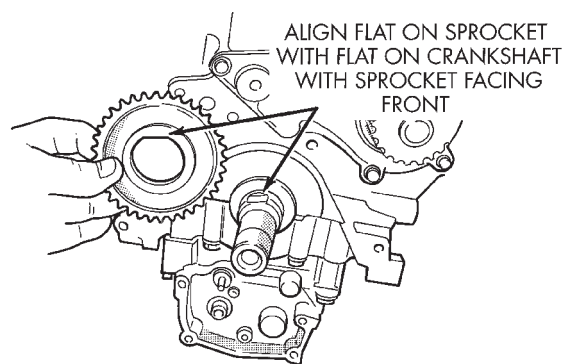


Fig. 38 Balance Shaft(s)—Removal/Installation

REMOVAL AND INSTALLATION (Continued)

**Fig. 39 Gear Timing****Fig. 40 Crankshaft Sprocket—Installation**

(3) Install gear cover and tighten double ended stud/washer fastener to 12 N·m (105 in. lbs.).

(4) Install crankshaft sprocket using Special Tool 6052 (Fig. 40).

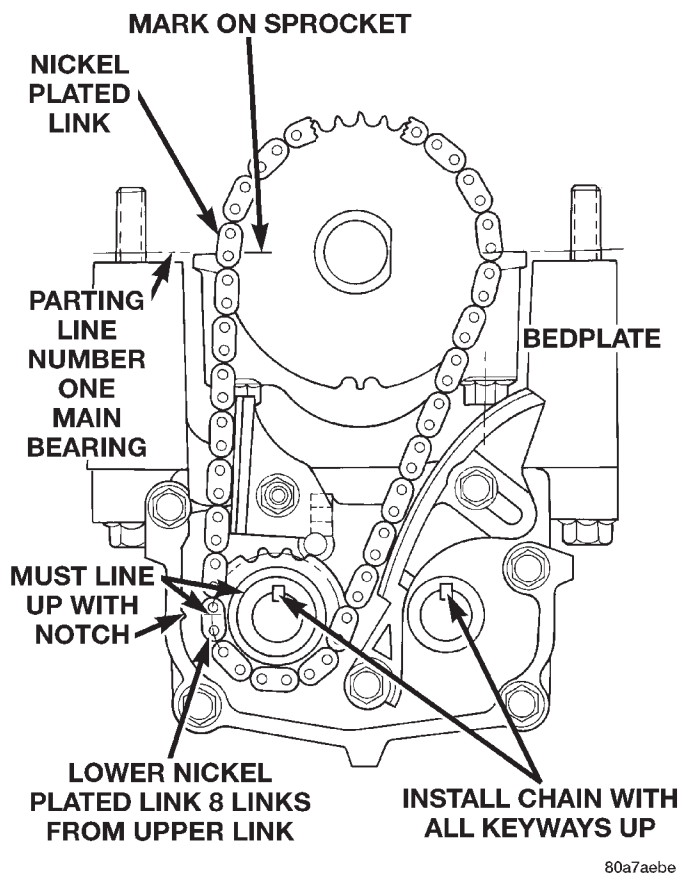
(5) Turn crankshaft until number one cylinder is at Top Dead Center (TDC). The timing marks on the chain sprocket should line up with the parting line on the left side of number one main bearing cap. (Fig. 41).

(6) Place chain over crankshaft sprocket so that the nickel plated link of the chain is over the number 1 cylinder timing mark on the crankshaft sprocket (Fig. 41).

(7) Place balance shaft sprocket into the timing chain (Fig. 41) so that the timing mark on the sprocket (yellow dot) mates with the (lower) nickel plated link on the chain

(8) With balance shaft keyways pointing up (12 o'clock) slide the balance shaft sprocket onto the nose

of the balance shaft. The balance shaft may have to be pushed in slightly to allow for clearance.

**Fig. 41 Balance Shaft Timing**

NOTE: THE TIMING MARK ON THE SPROCKET, THE (LOWER) NICKEL PLATED LINK, AND THE ARROW ON THE SIDE OF THE GEAR COVER SHOULD LINE UP WHEN THE BALANCE SHAFTS ARE TIMED CORRECTLY.

(9) If the sprockets are timed correctly install the balance shaft bolts and tighten to 28 N·m (250 in. lbs.). A wood block placed between crankcase and crankshaft counterbalance will prevent crankshaft and gear rotation.

CHAIN TENSIONING

(1) Install chain tensioner loosely assembled.

(2) Position guide on double ended stud making sure tab on the guide fits into slot on the gear cover. Install and tighten nut/washer assembly to 12 N·m (105 in. lbs.).

(3) Place a shim 1 mm (0.039 in.) thick x 70 mm (2.75 in.) long or between tensioner and chain. Push tensioner and shim up against the chain. **Apply firm pressure (5.5 to 6.6 lbs.) directly behind the adjustment slot to take up all slack.** Chain must have shoe radius contact as shown in (Fig. 42).

REMOVAL AND INSTALLATION (Continued)

(4) With the load applied, tighten top tensioner bolt first, then bottom pivot bolt. Tighten bolts to 12 N·m (105 in. lbs.). Remove shim.

(5) Install carrier covers and tighten screws to 12 N·m (105 in. lbs.).

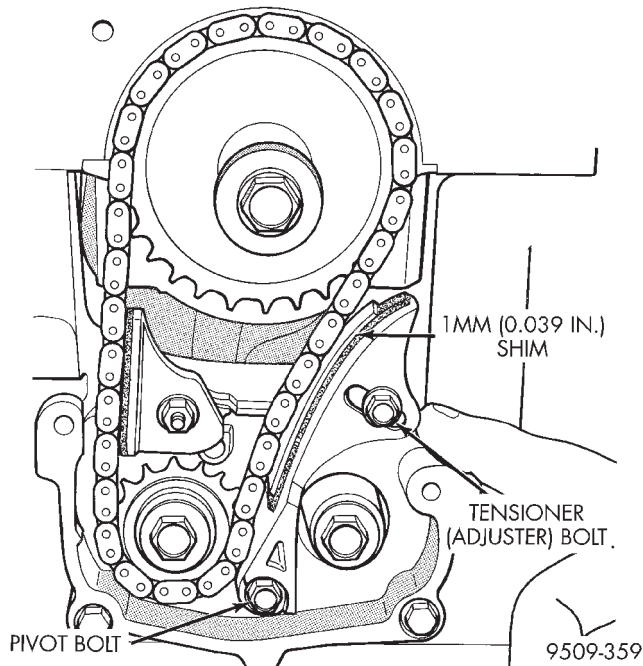


Fig. 42 Chain Tension Adjustment

HYDRAULIC LASH ADJUSTER

REMOVAL

(1) Remove cylinder head cover. Refer to procedure outlined in this section.

(2) Remove cam follower assembly. Refer to camshaft removal procedure outlined in this section to gain access to cam followers and lash adjusters.

(3) Mark hydraulic lash adjusters for reassembly in their original position. Lash adjusters are serviced as a assembly.

INSTALLATION

(1) Install hydraulic lash adjuster assembly making sure adjusters are at least partially full of oil. This is indicated by little or no plunger travel when the lash adjuster is depressed.

(2) Install cam follower assembly as previously outlined in this section.

(3) Install camshaft as previously outlined in this section.

(4) Install cylinder head cover as previously outlined in this section.

VALVE SPRINGS AND VALVE SEALS IN VEHICLE

REMOVAL

(1) Remove camshafts as previously outlined in this section.

(2) Rotate crankshaft until piston is at TDC on compression.

(3) With air hose attached to adapter tool installed in spark plug hole, apply 90-120 psi air pressure.

(4) Using Special Tool MD-998772-A with adapter 6779 (Fig. 43) compress valve springs and remove valve locks.

(5) Remove valve spring.

(6) Remove valve stem seal by using valve stem seal tool.

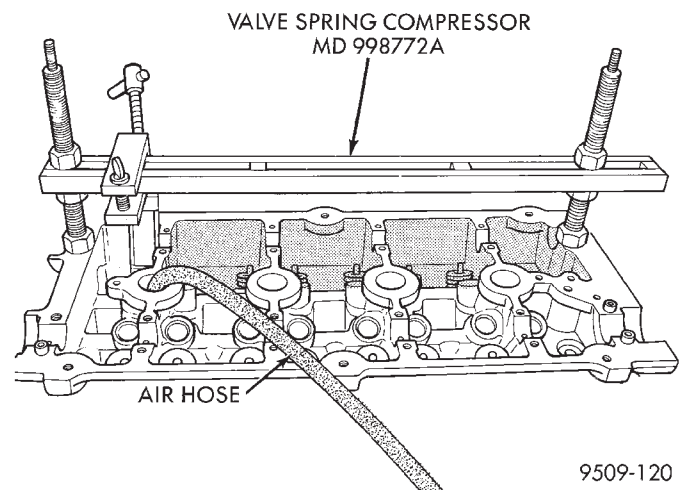


Fig. 43 Valve Spring—Removal/Installation

INSTALLATION

(1) Install valve seal/valve spring seat assembly (Fig. 44). Push the assembly down to seat it onto the valve guide.

(2) Install valve spring and retainer, use Special Tool MD-998772-A with adapter 6779 to compress valve springs only enough to install locks (Fig. 43). Correct alignment of tool is necessary to avoid nicking valve stems.

(3) Remove air hose and install spark plugs.

(4) Install camshafts as previously outlined in this section.

(5) Install cylinder head cover as previously outlined in this section.

REMOVAL AND INSTALLATION (Continued)

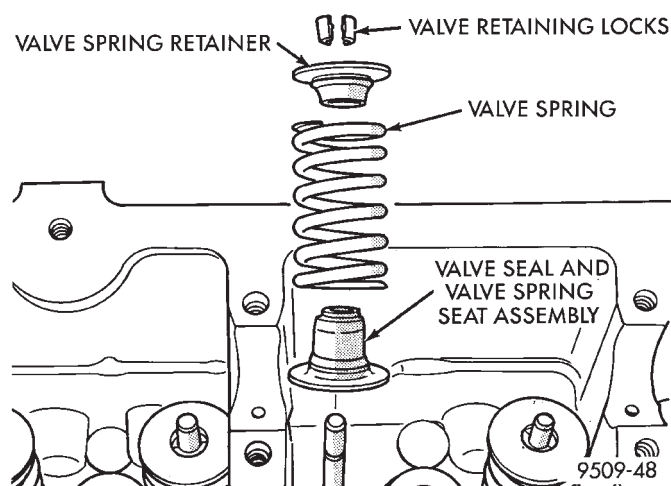


Fig. 44 Valve Stem Seal/Valve Spring Seat

CYLINDER HEAD

REMOVAL

- (1) Perform fuel system pressure release procedure **before attempting any repairs**. Refer to Group 14, Fuel System for procedure.
- (2) Disconnect negative battery cable. Drain cooling system. Refer to Group 7, Cooling System for procedure.
- (3) Remove air cleaner and disconnect all vacuum lines, electrical wiring and fuel lines from throttle body.
- (4) Remove throttle linkage. Refer to Group 14, Fuel System for procedures.
- (5) Remove accessory drive belts. Refer to Group 7, Cooling System for procedure.
- (6) Remove power brake vacuum hose from intake manifold.
- (7) Raise vehicle and remove exhaust pipe from manifold.
- (8) Remove power steering pump assembly and set aside.
- (9) Disconnect coil pack wiring connector and remove coil pack and plug wires from engine.
- (10) Remove cam sensor and fuel injectors wiring connectors.
- (11) Remove timing belt and camshaft sprocket. Refer to procedure outlined in this section.
- (12) Remove timing belt idler pulley and rear timing belt cover.
- (13) Remove cylinder head cover using procedure outlined in this section.
- (14) Remove camshafts and cam followers. Refer to procedures outlined in this section for procedures.
- (15) Remove cylinder head bolts and remove cylinder head from engine block.
- (16) Inspect and clean cylinder head. Refer to Cleaning and Inspection outlined in this section for procedures.

INSTALLATION

NOTE: The Cylinder head bolts should be examined **BEFORE** reuse. If the threads are necked down, the bolts should be replaced (Fig. 45).

Necking can be checked by holding a scale or straight edge against the threads. If all the threads do not contact the scale the bolt should be replaced.

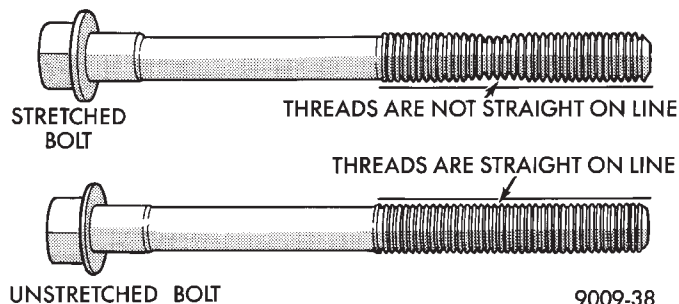


Fig. 45 Checking Bolts for Stretching (Necking)

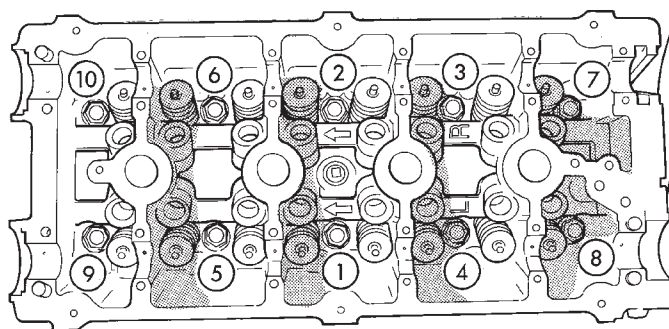
- (1) Before installing the bolts, the threads should be coated with engine oil.

- (2) Tighten the cylinder head bolts in the sequence shown in (Fig. 46). Using the 4 step torque turn method, tighten according to the following values:

- First All to 34 N·m (25 ft. lbs.)
- Second All to 68 N·m (50 ft. lbs.)
- Third All to 68 N·m (50 ft. lbs.)

CAUTION: Do not use a torque wrench for the following step.

- Fourth Turn an additional 1/4 Turn,



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Fig. 46 Cylinder Head Tightening Sequence

- (3) Install camshafts and cam followers. Refer to procedures outlined in this section for procedures.

- (4) Install cylinder head cover using procedure outlined in this section.

REMOVAL AND INSTALLATION (Continued)

- (5) Install rear timing belt cover and timing belt idler pulley.
- (6) Install timing belt and camshaft sprocket. Refer to procedure outlined in this section.
- (7) Install cam sensor and fuel injectors wiring connectors.
- (8) Install coil pack and plug wires onto the engine. Connect coil pack wiring connector.
- (9) Install power steering pump assembly.
- (10) Raise vehicle and install the exhaust pipe to the manifold.
- (11) Install power brake vacuum hose to the intake manifold.
- (12) Install accessory drive belts. Refer to Group 7, Cooling System for procedure.
- (13) Install throttle linkage. Refer to Group 14, Fuel System for procedures.
- (14) Install air cleaner and connect all vacuum lines, electrical wiring and fuel lines to the throttle body.
- (15) Fill cooling system. Refer to Group 7, Cooling System for procedure. Connect negative battery cable.

VALVES AND VALVE SPRINGS

REMOVAL

- (1) With cylinder head removed, compress valve springs using a universal valve spring compressor.
- (2) Remove valve retaining locks, valve spring retainers, valve stem seals and valve springs.
- (3) Before removing valves, **remove any burrs from valve stem lock grooves to prevent damage to the valve guides.** Identify valves to insure installation in original location.
- (4) Inspect and clean the valves. Refer to Cleaning and Inspection outlined in this section for procedure.

INSTALLATION

- (1) Coat valve stems with clean engine oil and insert in cylinder head.
- (2) Install new valve stem seals on all valves using a valve stem seal tool (Fig. 47). The valve stem seals should be pushed firmly and squarely over valve guide.

CAUTION: When oversize valves are used, the corresponding oversize valve seal must also be used. Excessive guide wear may result if oversize seals are not used with oversize valves.

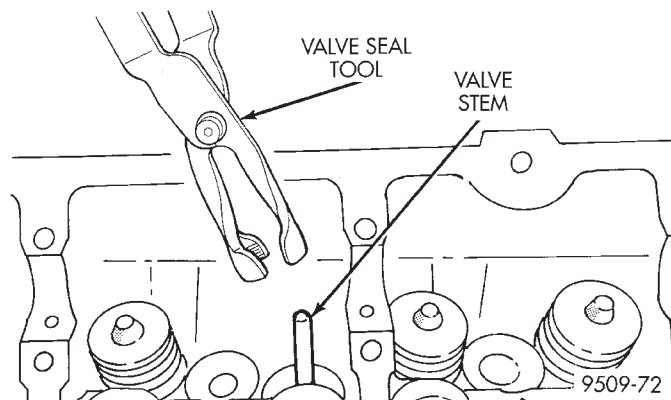


Fig. 47 Valve Stem Oil Seal Tool

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

CAUTION: When depressing the valve spring retainers with valve spring compressor the locks can become dislocated. Ensure both locks are in the correct location after removing tool.

- (4) Check the valve spring installed height B after refacing the valve and seat (Fig. 48). Make sure measurements are taken from top of spring seat to the bottom surface of spring retainer. If height is greater than 38.75 mm (1.525 in.), install a .762 mm (0.030 in.) spacer under the valve spring seat to bring spring height back within specification.

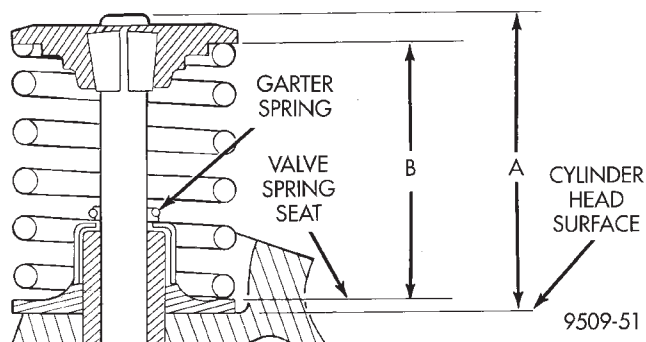


Fig. 48 Checking Spring Installed Height and Valve Tip Height Dimensions

REMOVAL AND INSTALLATION (Continued)

VIBRATION DAMPER**REMOVAL**

Remove crankshaft vibration damper bolt. Remove damper by using Special Tool 1026 and Insert 6827-A (Fig. 49).

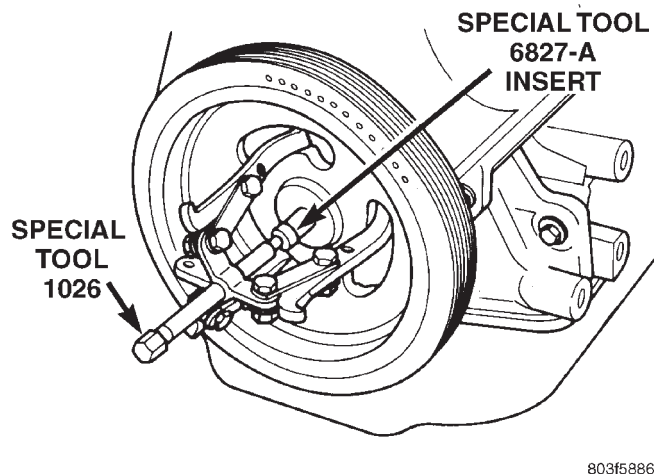


Fig. 49 Crankshaft Vibration Damper—Removal

INSTALLATION

Install crankshaft vibration damper using M12 1.75 x 150 mm bolt, washer, thrust bearing and nut from Special Tool 6792. Install crankshaft vibration damper bolt and tighten to 142 N·m (105 ft. lbs.) (Fig. 50).

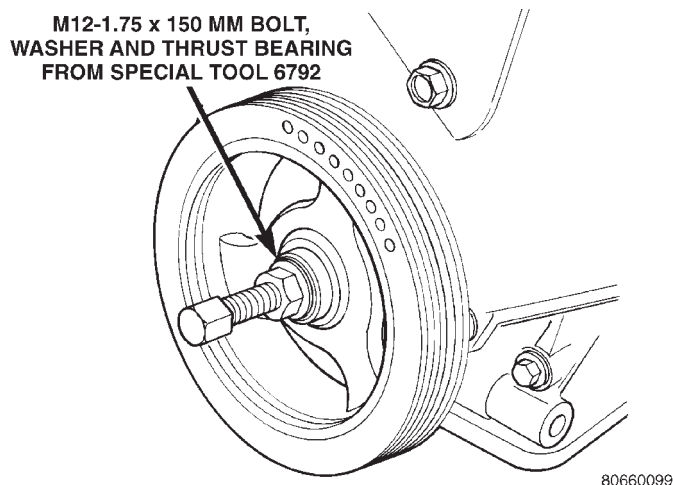


Fig. 50 Crankshaft Vibration Damper—Installation

TIMING BELT COVER**FRONT COVER****REMOVAL**

- (1) Remove crankshaft damper. Refer to crankshaft damper removal for procedure.
- (2) Remove front timing belt cover fasteners (Fig. 51) and remove cover.

- (3) Remove engine mount bracket (Fig. 51).

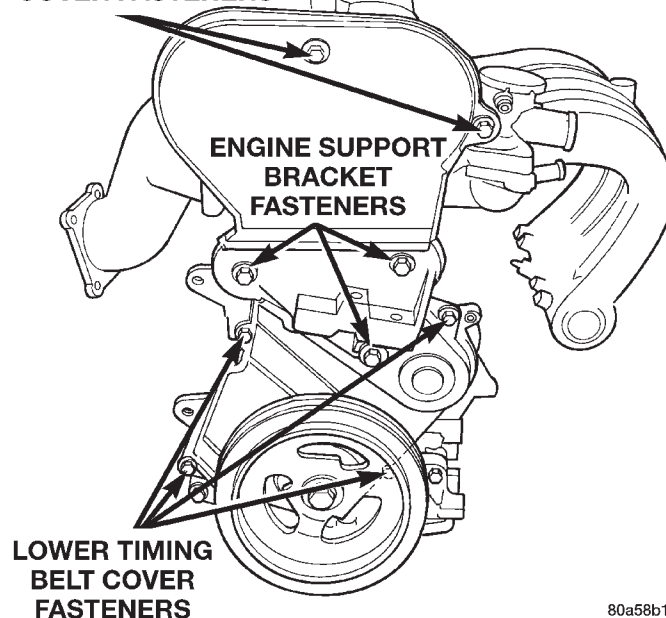
UPPER TIMING BOLT COVER FASTENERS

Fig. 51 Front Timing Belt Covers

INSTALLATION

- (1) Install the engine mount bracket and front timing belt cover (Fig. 51).
- (2) Install crankshaft damper. Refer to crankshaft damper installation for procedure.

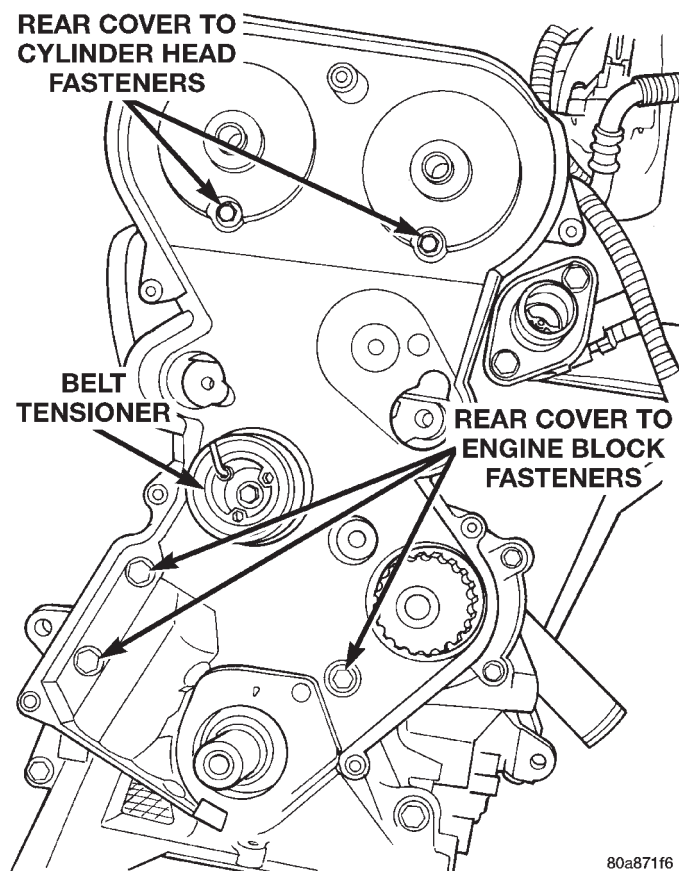
REAR COVER**REMOVAL**

- (1) Remove Front Cover. Refer to Front Cover Removal procedure outlined in this section.
- (2) Remove Timing Belt. Refer to procedure outlined in this section.
- (3) Remove idler pulleys (Fig. 52).
- (4) Remove both camshaft sprockets.
- (5) Remove rear timing belt fasteners and remove cover from engine (Fig. 52).

INSTALLATION

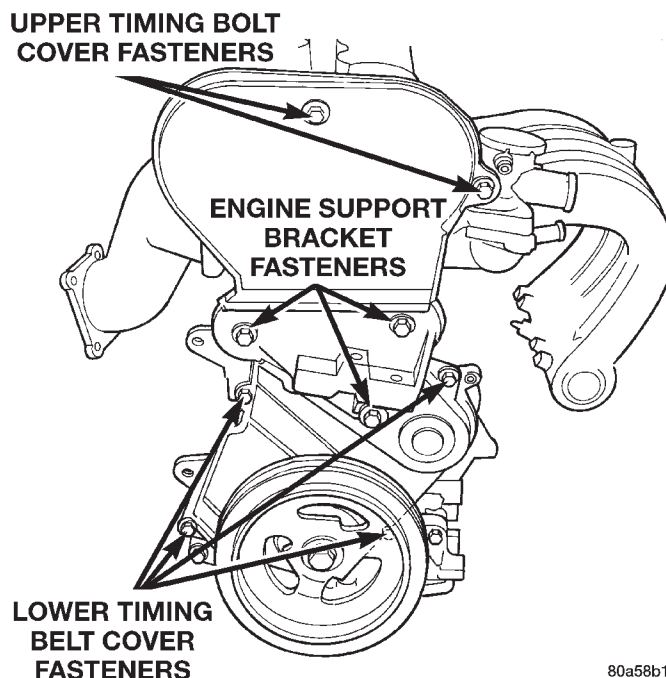
- (1) Install rear timing belt cover and fasteners (Fig. 52).
- (2) Install idler (Fig. 52).
- (3) Install camshaft sprockets.
- (4) Install Timing Belt. Refer to procedure outlined in this section.
- (5) Install front cover. Refer to Front Cover installation procedure outlined in this section.

REMOVAL AND INSTALLATION (Continued)

**Fig. 52 Rear Timing Belt Cover Fasteners****TIMING BELT****REMOVAL**

- (1) Raise vehicle on hoist. Remove right front wheel.
- (2) Remove right inner splash shield.
- (3) Remove accessory drive belts. Refer to Group 7, Cooling System.
- (4) Remove crankshaft damper bolt, and remove damper. Refer to Removal and Installation procedure in this section.
- (5) Remove lower timing belt cover fasteners and remove cover (Fig. 53).
- (6) Lower vehicle and remove upper timing belt cover fasteners and remove cover.
- (7) Remove right engine mount and support bracket. Refer to Removal and Installation procedure in this section.

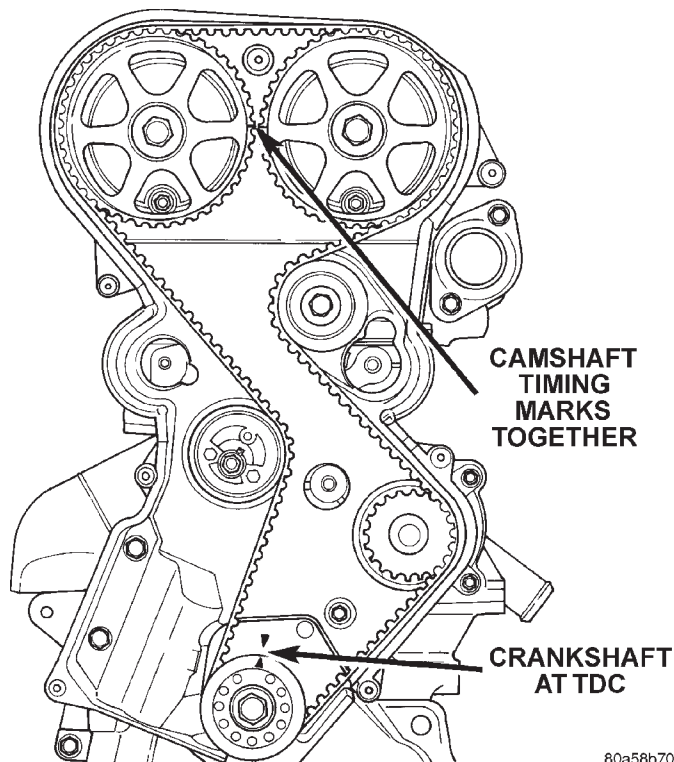
CAUTION: When aligning crankshaft and camshaft timing marks always rotate engine from crankshaft. Camshaft should not be rotated after timing belt is removed. Damage to valve components may occur. Always align timing marks before removing timing belt.



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Fig. 53 Timing Belt Covers

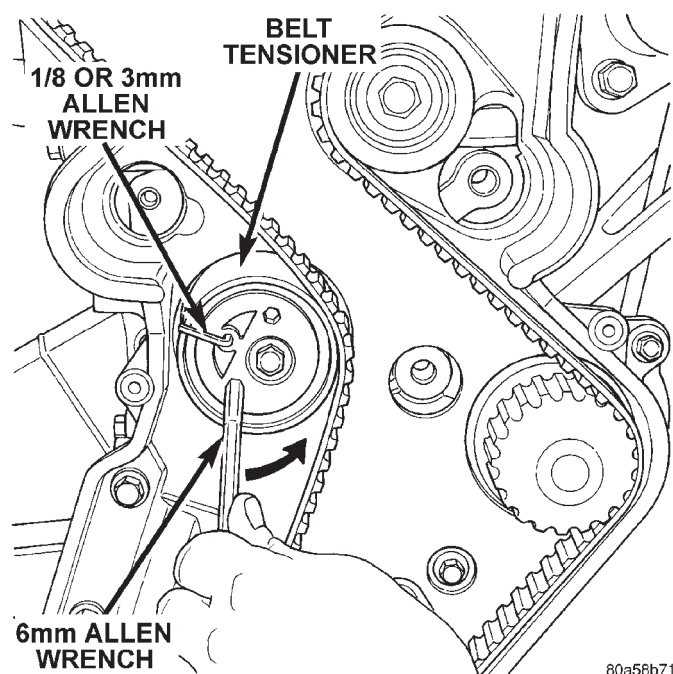
- (8) Align crankshaft and camshafts timing marks (Fig. 54) to TDC.



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Fig. 54 Crankshaft and Camshaft Timing

REMOVAL AND INSTALLATION (Continued)

**Fig. 55 Locking Timing Belt Tensioner**

(9) Install 6 mm Allen wrench into belt tensioner. Before rotating the tensioner insert the long end of a 1/8" or 3 mm Allen wrench into the pin hole on the front of the tensioner (Fig. 55). While rotating the tensioner counterclockwise push in lightly on the 1/8" or 3 mm Allen wrench, until it slides into the locking hole.

(10) Remove timing belt.

TIMING BELT TENSIONER

(1) If replacing timing belt tensioner, remove the bolt from the center of the tensioner. Remove tensioner.

(2) When installing the tensioner align the flat on the tensioner bracket with the flat on the tensioner (Fig. 56).

(3) Torque tensioner center bolt to 28 N·m (252 in. lbs.)

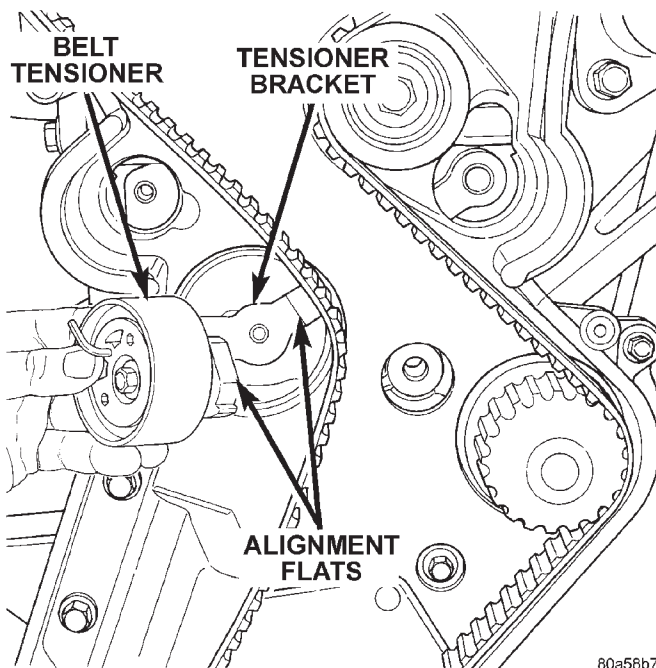
INSTALLATION

(1) Set crankshaft sprocket to TDC by aligning the sprocket with the arrow on the oil pump housing.

(2) Set camshafts timing marks so that the exhaust camshaft sprocket is a 1/2 notch below the intake camshaft sprocket (Fig. 57).

CAUTION: Ensure that the arrows on both camshaft sprockets are facing up.

(3) Install timing belt. Starting at the crankshaft, go around the water pump sprocket, idler pulley, camshaft sprockets and then around the tensioner (Fig. 58).

**Fig. 56 Tensioner to Bracket Alignment**

(4) Move the exhaust camshaft sprocket counterclockwise (Fig. 58) to align marks and take up belt slack.

NOTE: A new tensioner is held in the wound position by a pull pin.

(5) Remove the pull pin or Allen wrench from the belt tensioner.

(6) Rotate crankshaft 2 revolutions and check the alignment of the timing marks (Fig. 54).

(7) Install right engine mount and support bracket. Refer to Removal and Installation procedure in this section.

(8) Install upper timing belt cover bolts 4.5 N·m (40 in. lbs.).

(9) Install the lower timing belt cover bolts 4.5 N·m (40 in. lbs.).

(10) Install crankshaft damper. Refer to Service procedure outlined in this section.

(11) Install accessory drive belts. Refer to Group 7, Cooling System.

(12) Install right inner splash shield.

(13) Install right front wheel.

TIMING BELT TENSIONER

For Removal and Installation procedure for belt tensioner. Refer to Timing Belt Removal and Installation in this section.

OIL PAN**REMOVAL**

(1) Drain engine oil.

REMOVAL AND INSTALLATION (Continued)

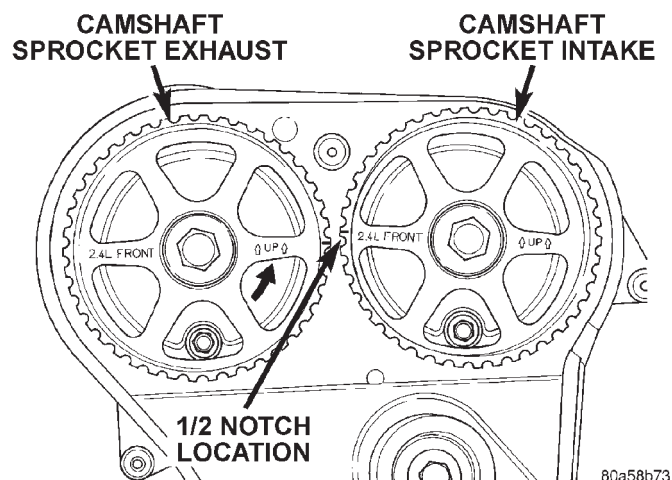


Fig. 57 Camshaft Sprocket Alignment

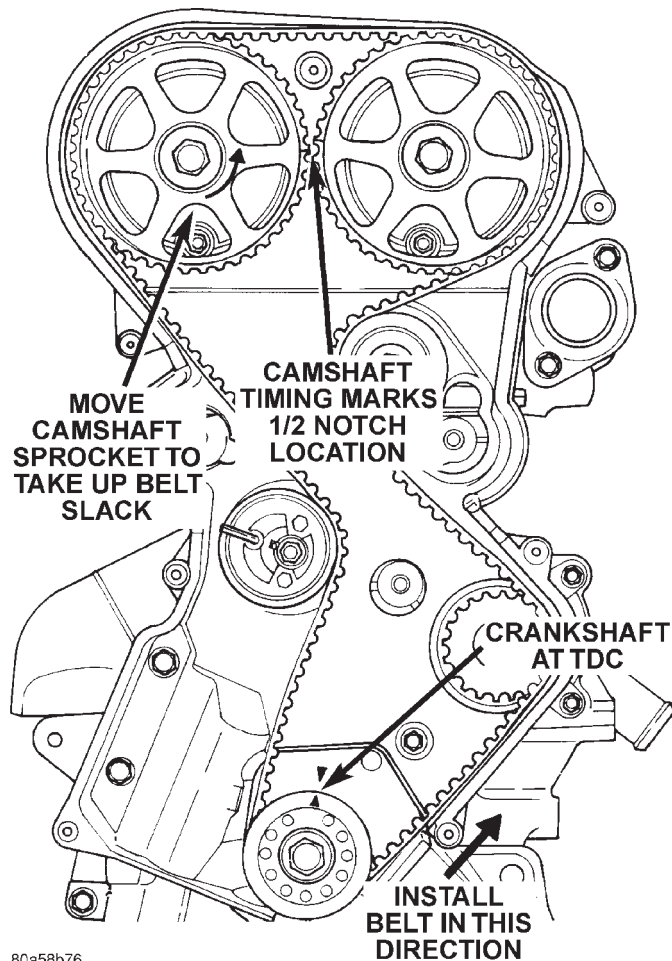


Fig. 58 Timing Belt—Installation

- (2) Remove engine support module. Refer to Removal and Installation procedure in this section.
- (3) Remove collar from rear of pan and transmission.
- (4) Remove oil pan.
- (5) Clean oil pan and all gasket surfaces.

INSTALLATION

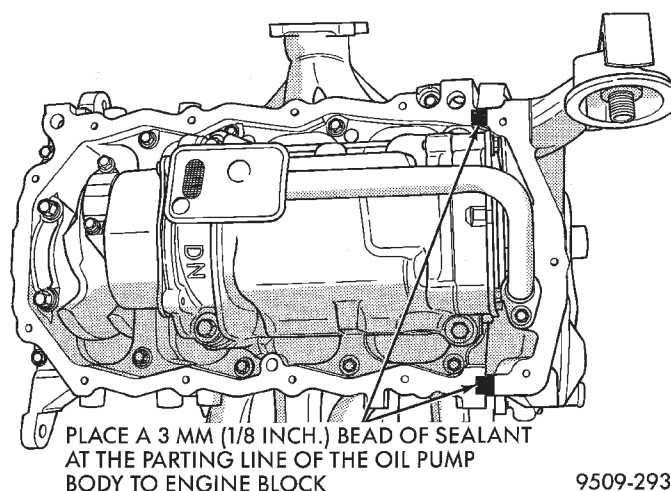


Fig. 59 Oil Pan Sealing

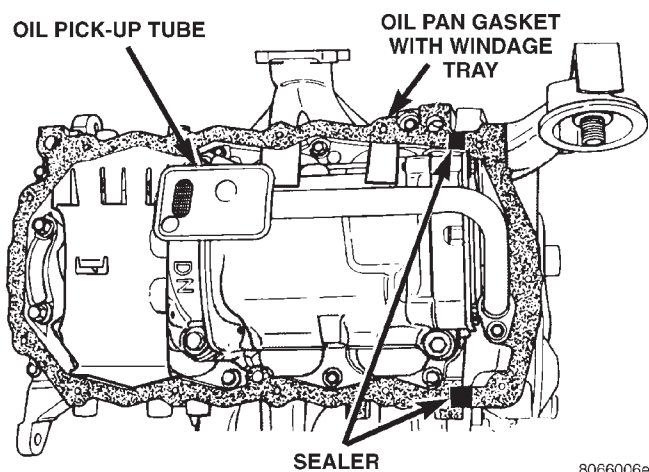


Fig. 60 Oil Pan Gasket Installation

- (1) Apply Mopar Silicone Rubber Adhesive Sealant or equivalent at the oil pump to engine block parting line (Fig. 59).
- (2) Install the oil pan gasket to the block (Fig. 60).
- (3) Install pan and tighten the screws to 12 N·m (105 in. lbs.).

CAUTION: Torque procedure for the collar must be followed or damage could occur to oil pan or collar.

- (4) Install the 2 center collar to oil pan bolts. Torque to 3 N·m (30 in. lbs.).
- (5) Install collar to transmission bolts and tighten to 108 N·m (80 ft. lbs.).
- (6) Install the 2 remaining collar to pan bolts. Starting with the center bolts and working outward torque all 4 bolts to 34 N·m (250 in. lbs.).
- (7) Install engine support module. Refer to Removal and Installation procedure in this section.

REMOVAL AND INSTALLATION (Continued)

FRONT CAMSHAFT OIL SEAL

REMOVAL

(1) Remove front timing belt cover and timing belt. Refer to procedure outlined in this section.

(2) Hold camshaft sprocket with Special Tool C-4687 and adapter C-4687-1 while removing center bolt (Fig. 61).

(3) Remove camshaft seal using Special Tool C-4679-A (Fig. 62).

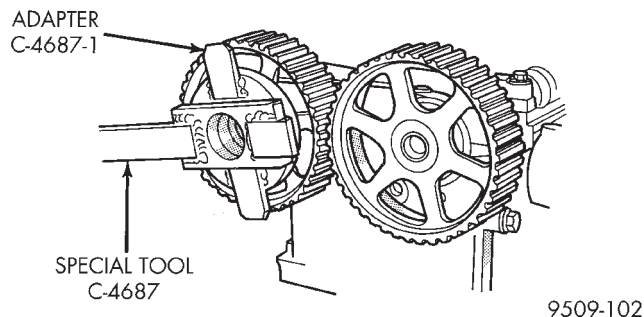


Fig. 61 Camshaft Sprocket—Removal/Installation

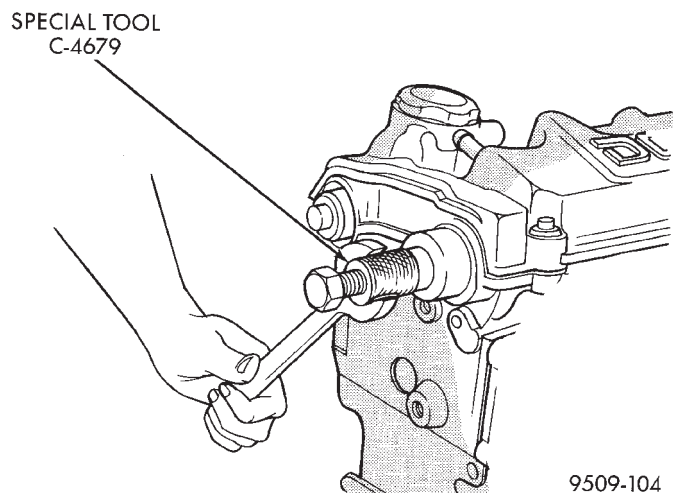


Fig. 62 Camshaft Oil Seal—Removal With C-4679-A

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

INSTALLATION

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

(2) Install camshaft seal into cylinder head using Special Tool MD-998306 until flush with head (Fig. 63).

(3) Install camshaft sprocket and tighten center bolt to 101 N·m (75 ft. lbs.) (Fig. 61).

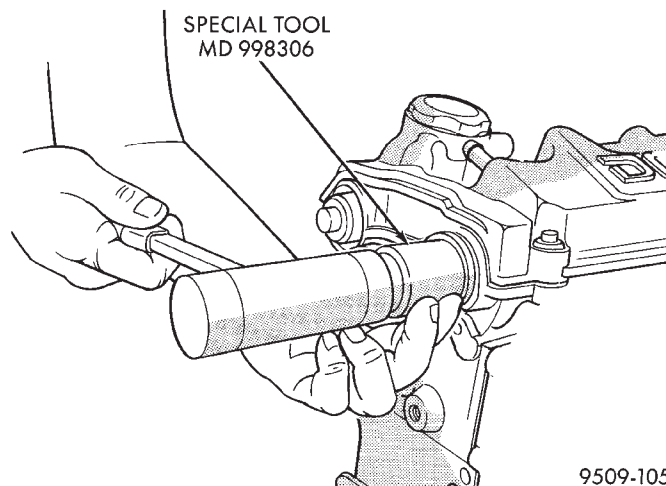


Fig. 63 Camshaft Seal—Installation

FRONT CRANKSHAFT OIL SEAL

REMOVAL

(1) Using large side of Special Tool 1026 and Insert 6827-A, remove crankshaft damper (Fig. 64).

(2) Remove outer timing belt cover and timing belt. Refer to Timing Belt System outlined in this section.

(3) Remove crankshaft sprocket using Special Tool 6793 and insert C-4685-C2 (Fig. 65).

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

(4) Using Tool 6771 to remove front crankshaft oil seal (Fig. 66). Be careful not to damage the seal surface of cover.

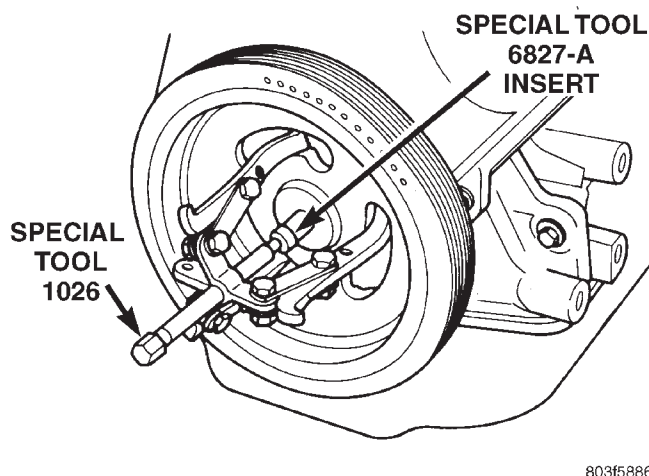


Fig. 64 Crankshaft Damper—Removal

INSTALLATION

(1) Install new seal by using Tool 6780 (Fig. 67).

REMOVAL AND INSTALLATION (Continued)

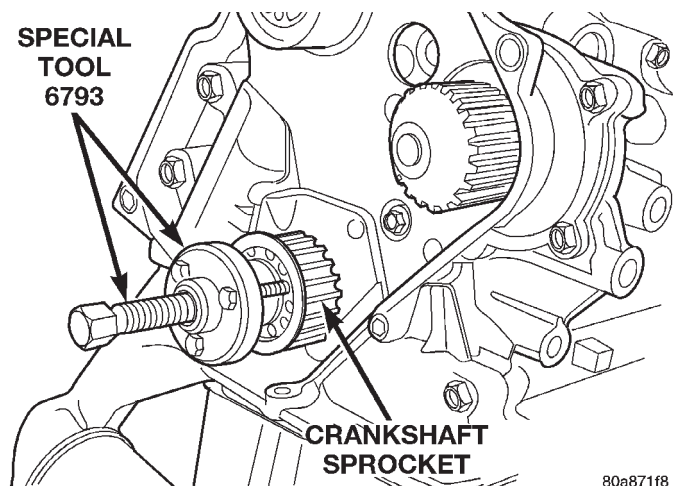


Fig. 65 Crankshaft Sprocket—Removal

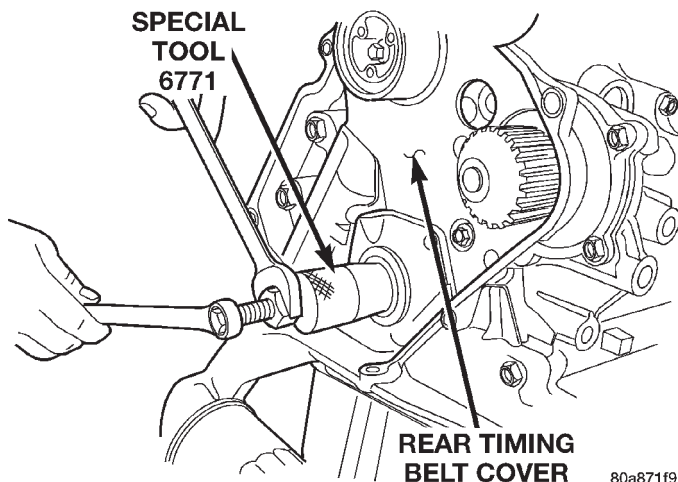


Fig. 66 Front Crankshaft Oil Seal—Removal

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

(3) Install crankshaft sprocket (Fig. 68). Using Special Tool 6792.

(4) Install timing belt and timing belt covers. Refer to Timing System Section for timing belt covers and belt.

(5) Install crankshaft damper (Fig. 69). Use thrust bearing/washer and 12M 1.75 x 150 mm bolt from Special Tool 6792. Install crankshaft damper bolt and tighten to 142 N·m (105 ft. lbs.)

REAR CRANKSHAFT SEAL

REMOVAL

(1) Insert a 3/16 flat bladed screwdriver between the dust lip and the metal case of the crankshaft seal. Angle the screwdriver (Fig. 70) through the dust lip against metal case of the seal. Pry out seal.

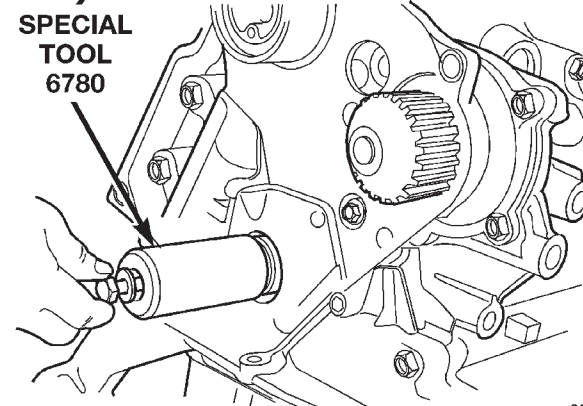
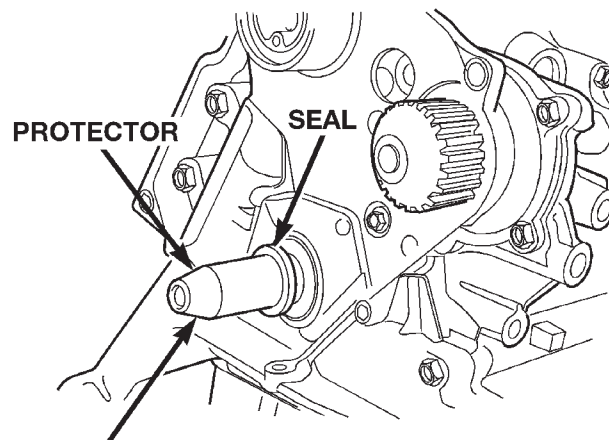


Fig. 67 Front Crankshaft Oil Seal—Installation

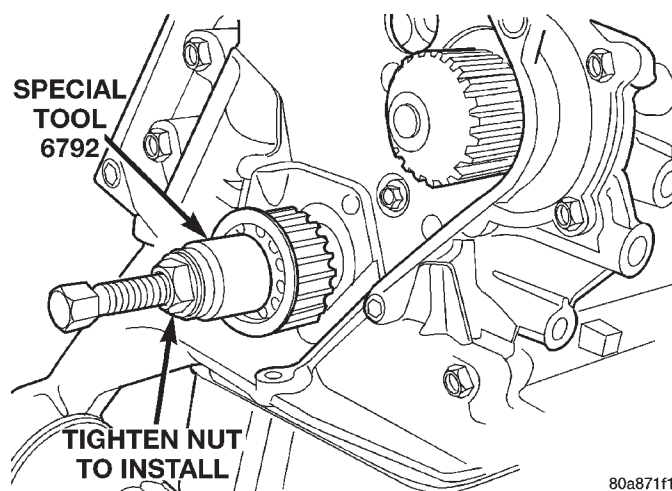


Fig. 68 Crankshaft Sprocket—Installation

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

REMOVAL AND INSTALLATION (Continued)

M12-1.75 x 150 MM BOLT,
WASHER AND THRUST BEARING
FROM SPECIAL TOOL 6792

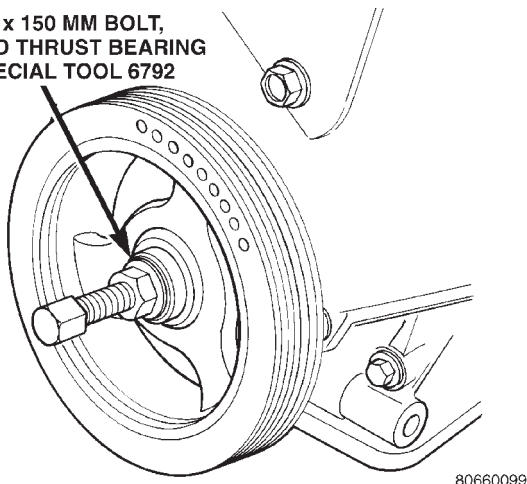


Fig. 69 Crankshaft Damper—Installation

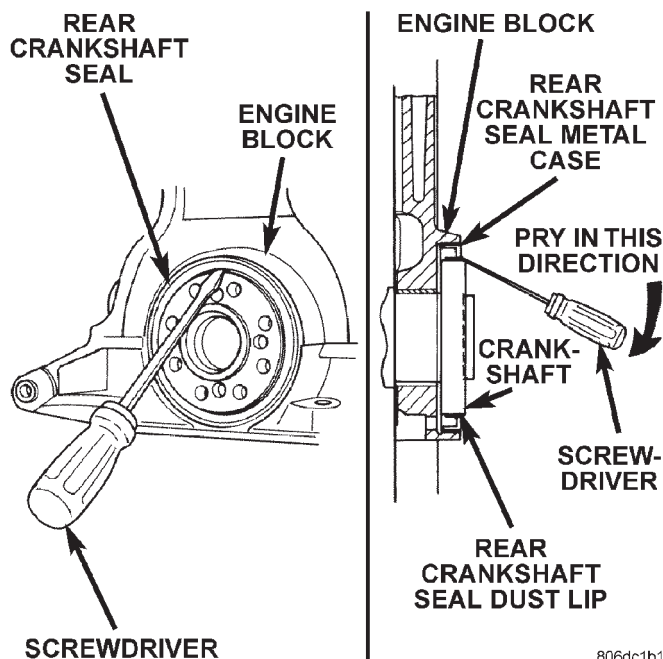


**Fig. 70 Rear Crankshaft Oil Seal—Removal
INSTALLATION**

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

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

(1) Place Special Tool 6926-1 on crankshaft. This is a pilot tool with a magnetic base (Fig. 71).

(2) Position seal over pilot tool. Make sure you can read the words **THIS SIDE OUT** on seal (Fig. 71). Pilot tool should remain on crankshaft during instal-

lation of seal. Ensure that the lip of the seal is facing towards the crankcase during installation.

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

(3) Drive the seal into the block using Special Tool 6926-2 and handle C-4171 (Fig. 72) until the tool bottoms out against the block (Fig. 73).

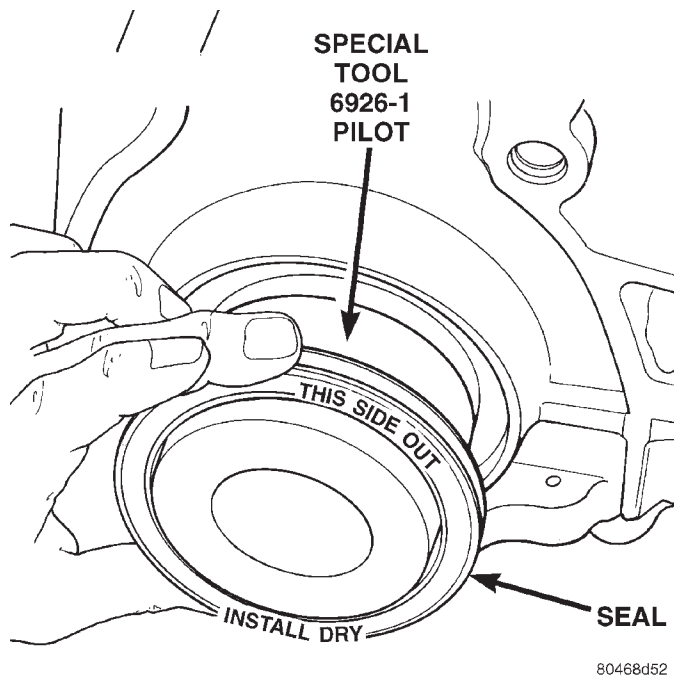


Fig. 71 Rear Crankshaft Seal and Special Tool 6926-1

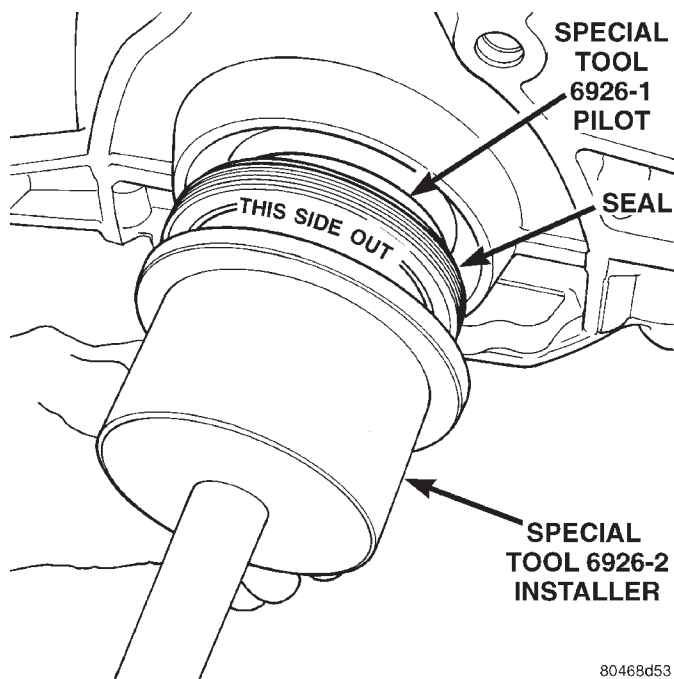
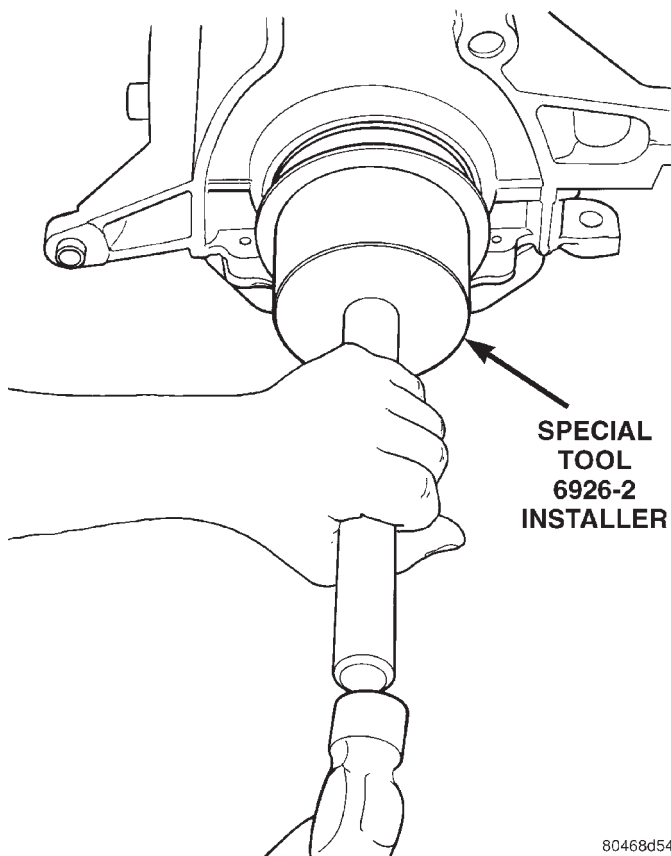


Fig. 72 Crankshaft Seal Special Tool 6926-2

REMOVAL AND INSTALLATION (Continued)

**Fig. 73 Rear Crankshaft Seal—Installation****CRANKSHAFT****REMOVAL**

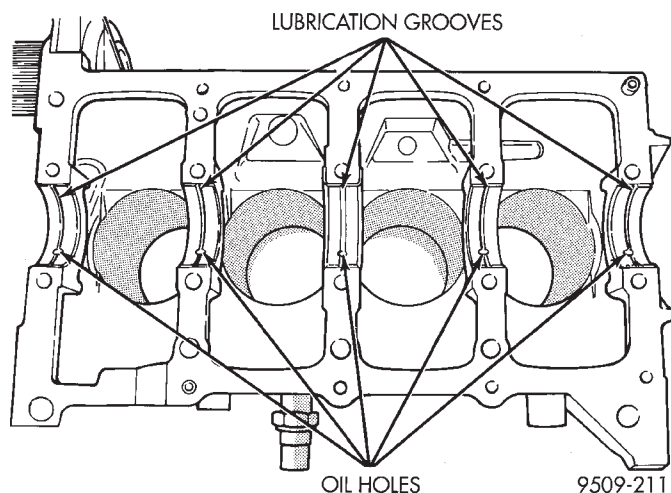
NOTE: Crankshaft can not be removed when engine is in vehicle.

- (1) Remove oil filter and oil pan. Refer to procedure outlined in this section.
- (2) Remove Timing Belt Cover, Timing Belt and Oil Pump. Refer to procedure outlined in this section.
- (3) Remove Balance Shafts Assembly. Refer to procedure outlined in this section.
- (4) Remove all main bearing cap bedplate bolts from the engine block. Refer to procedure outlined in this section.
- (5) Using a mallet gently tap the bedplate loose from the engine block dowel pins.

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

- (6) Bedplate should be removed evenly from the cylinder block dowel pins to prevent damage to the dowel pins and thrust bearing.

- (7) Lift out crankshaft from cylinder block. Do not damage the main bearings or journals when removing the crankshaft.

INSTALLATION**Fig. 74 Installing Main Bearing Upper Shell**

- (1) Install the main bearing shells with the lubrication groove in the cylinder block (Fig. 74).
- (2) Make certain oil holes in block line up with oil hole in bearings and bearing tabs seat in the block tab slots.

CAUTION: Do not get oil on the bedplate mating surface. It will may effect the sealer ability to seal the bedplate to cylinder block.

- (3) Oil the bearings and journals. Install crankshaft.

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

- (4) Apply 1.5 to 2.0 mm (0.059 to 0.078 in.) bead of Mopar Torque Cure Gasket Maker to cylinder block as shown in (Fig. 75).
- (5) Install lower main bearings into main bearing cap/bedplate. Make certain the bearing tabs are seated into the bedplate slots. Install the main bearing/bedplate into engine block.
- (6) Before installing the bolts the threads should be oiled with clean engine oil, wipe off any excess oil.
- (7) Install main bearing bedplate to engine block bolts 11, 17 and 20 finger tight. Tighten this bolts down together until the bedplate contacts the cylinder block. Then torque these bolts to 28 N·m (20 ft. lbs.).
- (8) Install main bearing bedplate to engine block bolts (1 thru 10) and torque each bolt to 41 N·m (30

REMOVAL AND INSTALLATION (Continued)

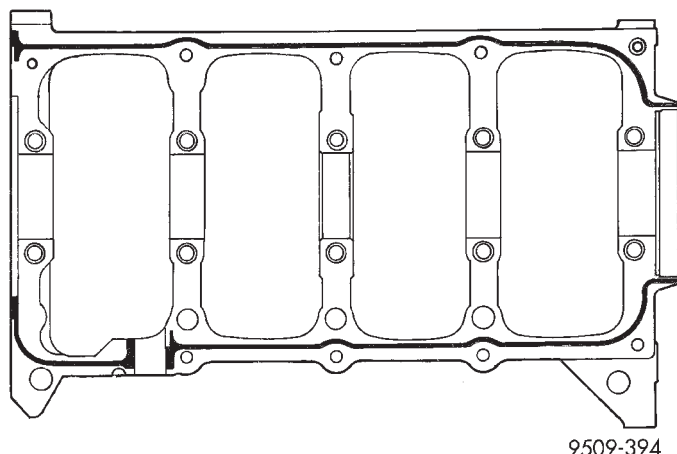


Fig. 75 Main Bearing Caps/Bedplate Sealing

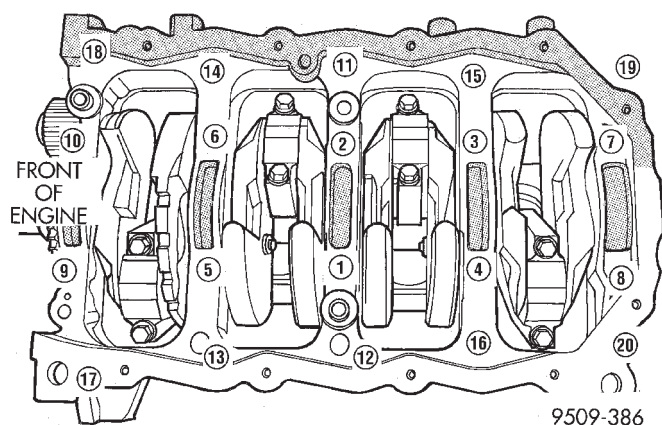


Fig. 76 Main Bearing Caps/Bedplate Torque Sequence

ft. lbs.) in sequence, then in sequence tighten bolts an additional 1/4 turn (Fig. 76).

(9) Install main bearing bedplate to engine block bolts (11 thru 20), and torque each bolt to 28 N·m (20 ft. lbs.) in sequence shown in (Fig. 76).

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

OIL FILTER

CAUTION: When servicing the oil filter avoid deforming the filter can by installing the remove/install tool band strap against the can to base lock seam. The lock seam joining the can to the base is reinforced by the base plate.

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

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

OIL PUMP

REMOVAL

- (1) Disconnect negative battery cable.
- (2) Remove Timing Belt. Refer to Timing Belt Removal in this section.
- (3) Remove collar and Oil Pan. Refer to Oil Pan Removal in this section.
- (4) Remove Crankshaft Sprocket using Special Tool 6793 and insert C-4685-C2 L (Fig. 77).

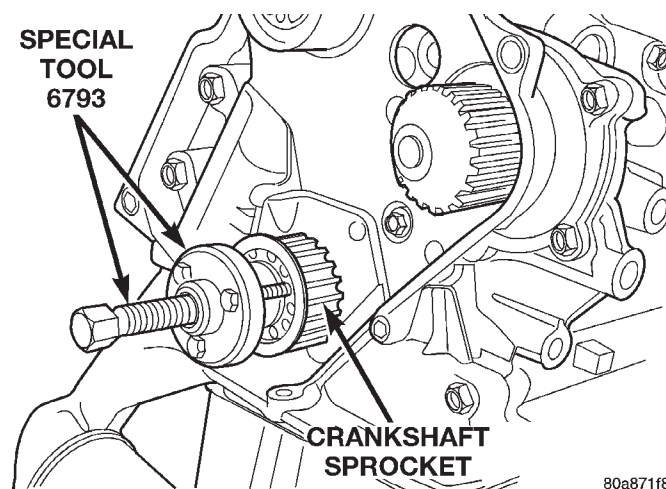


Fig. 77 Crankshaft Sprocket—Removal

- (5) Remove oil pick-up tube.
- (6) Remove oil pump, (Fig. 78) and front crankshaft seal.

INSTALLATION

- (1) Make sure all surfaces are clean and free of oil and dirt.
- (2) Apply Mopar Gasket Maker to oil pump as shown in (Fig. 79). Install oil ring into oil pump body discharge passage.
- (3) Prime oil pump before installation.
- (4) Align oil pump rotor flats with flats on crankshaft as you install the oil pump to the block.

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

- (5) Install new front crankshaft seal using Special Tool 6780 (Fig. 80).

REMOVAL AND INSTALLATION (Continued)

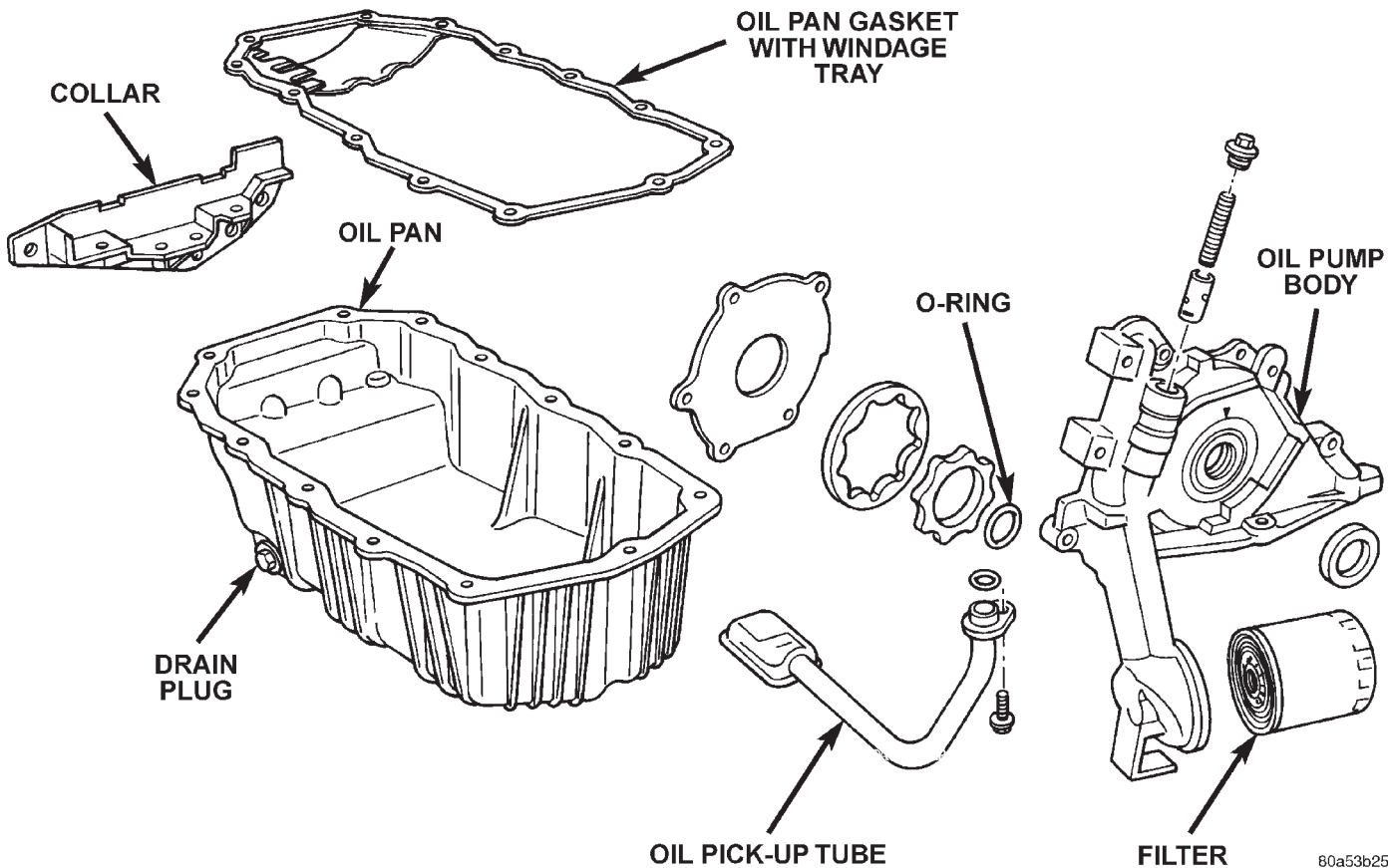


Fig. 78 Oil Pump and Pick-up Tube

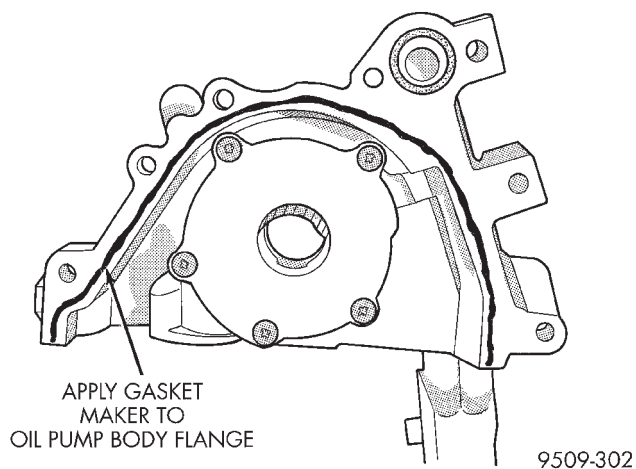


Fig. 79 Oil Pump Sealing

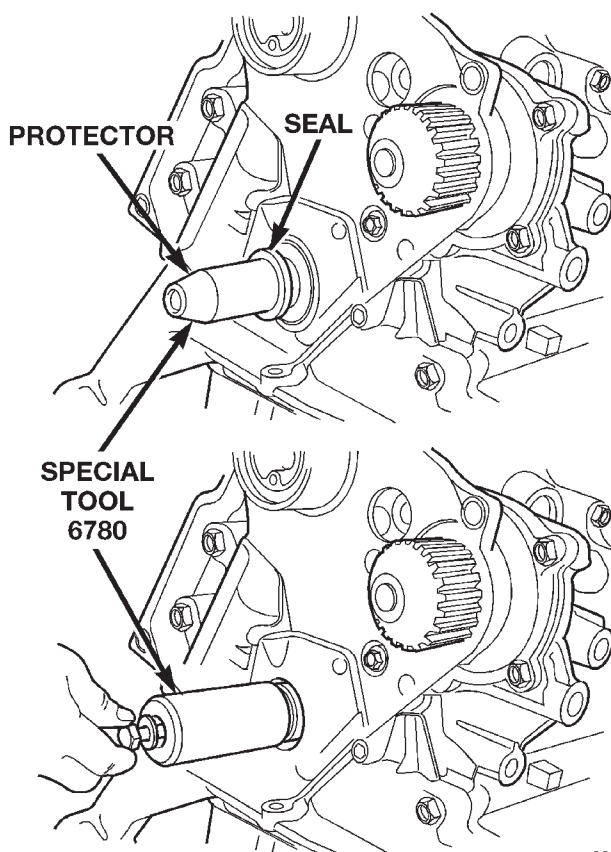


Fig. 80 Front Crankshaft Seal—Installation

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REMOVAL AND INSTALLATION (Continued)

(6) Install crankshaft sprocket, using Special Tool 6792 (Fig. 81).

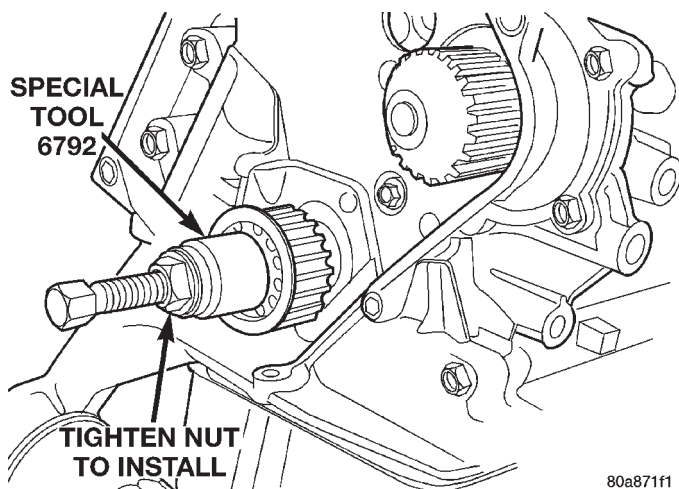


Fig. 81 Crankshaft Sprocket—Installation

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

CAUTION: Torque procedure for the collar must be followed or damage could occur to oil pan or collar.

(8) Install the 2 center collar to oil pan bolts. Torque to 3 N·m (30 in. lbs.).

(9) Install collar to transmission bolts and tighten to 108 N·m (80 ft. lbs.).

(10) Install the 2 remaining collar to pan bolts. Starting with the center bolts and working outward torque all 4 bolts to 34 N·m (250 in. lbs.).

(11) Install Timing Belt. Refer to Timing Belt Installation in this section.

PISTON AND CONNECTING ROD

REMOVAL

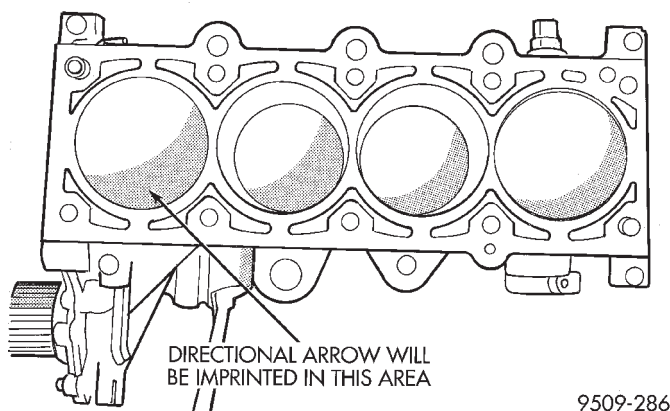


Fig. 82 Piston Markings

NOTE: Cylinder Head must be removed before Pistons and Rods. Refer to Cylinder Head Removal in this section.

(1) Remove top ridge of cylinder bores with a reliable ridge reamer before removing pistons from cylinder block. **Be sure to keep tops of pistons**

covered during this operation. Mark piston with matching cylinder number (Fig. 82).

(2) Remove oil pan. Scribe the cylinder number on the side of the rod and cap (Fig. 83) for identification.

(3) Pistons have a directional stamping in the front half of the piston facing towards the **front** of engine.

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

(5) Remove Balance Shaft Assembly. Refer to Balance Shaft Removal in this section.

(6) Remove connecting rod cap bolts. Push each piston and rod assembly out of cylinder bore.

NOTE: Be careful not to nick crankshaft journals.

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

(8) Piston and Rods are serviced as an assembly.

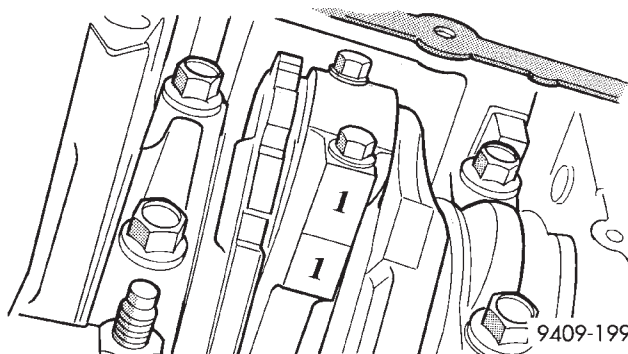


Fig. 83 Identify Connecting Rod to Cylinder

INSTALLATION

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

(2) Before installing the ring compressor, make sure the oil ring expander ends are butted and the rail gaps located as shown in (Fig. 84). As viewed from top.

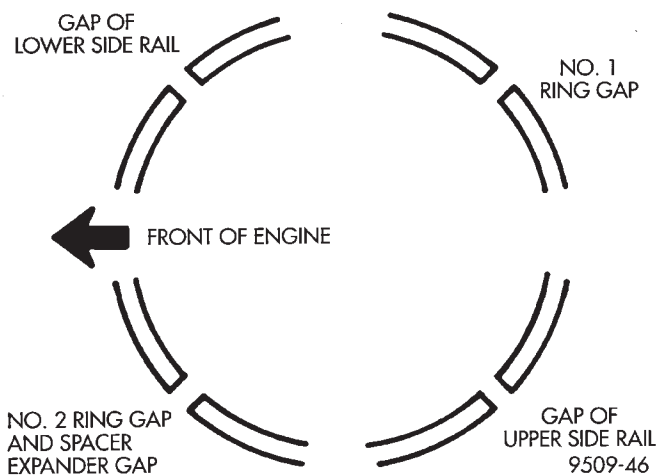
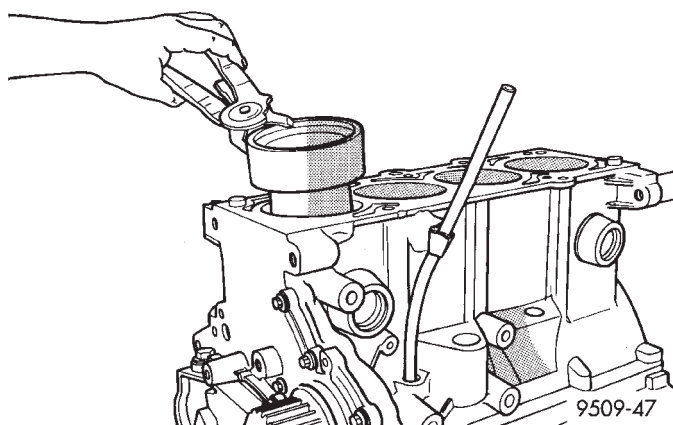


Fig. 84 Piston Ring End Gap Position

REMOVAL AND INSTALLATION (Continued)

**Fig. 85 Piston—Installation**

(3) Immerse the piston head and rings in clean engine oil, slide the ring compressor, over the piston (Fig. 85). **Be sure position of rings does not change during this operation .**

(4) The directional stamp on the piston should face toward the front of the engine (Fig. 82).

(5) Rotate crankshaft so that the connecting rod journal is on the center of the cylinder bore. Insert rod and piston assembly into cylinder bore and guide rod over the crankshaft journal.

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

NOTE: The rod bearing bolts should not be reused.

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

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

CAUTION: Do not use a torque wrench for second part of last step.

(9) Tighten the bolts to 27 N·m PLUS 1/4 turn (20 ft. lbs. PLUS 1/4 turn)

(10) Using a feeler gauge, check connecting rod side clearance (Fig. 86).

DISASSEMBLY AND ASSEMBLY

OIL PUMP

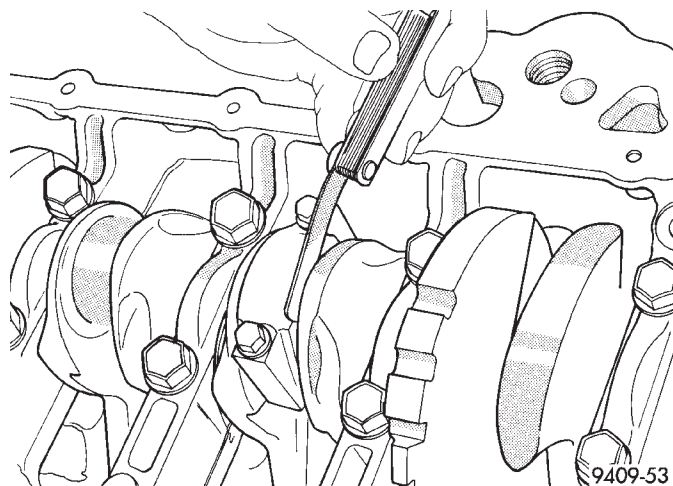
DISASSEMBLY

(1) To remove the relief valve, proceed as follows:

(a) Remove the threaded plug and gasket from the oil pump (Fig. 87).

(b) Remove spring and relief valve (Fig. 87)

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

**Fig. 86 Checking Connecting Rod Side Clearance**

(3) Remove pump rotors.

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

ASSEMBLY

(1) Assemble pump, using new parts as required. **Install the inner rotor with chamfer facing the cast iron oil pump cover.**

(2) Prime oil pump before installation by filling rotor cavity with engine oil.

(3) Install cover and tighten screws to 12 N·m (105 in. lbs.).

CAUTION: Oil pump pressure relief valve must be installed as shown in (Fig. 87) or serious damage may occur.

(4) Install relief valve, spring, gasket and cap as shown in (Fig. 87). Tighten cap to 41 N·m (30 ft. lbs.).

CLEANING AND INSPECTION

CYLINDER HEAD

CLEANING

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

INSPECTION

(1) Cylinder head must be flat within 0.1 mm (0.004 inch) (Fig. 88).

(2) Inspect camshaft bearing journals for scoring.

VALVE GUIDES

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

(2) Using a small hole gauge and a micrometer, measure valve guides in 3 places top, middle and bot-

CLEANING AND INSPECTION (Continued)

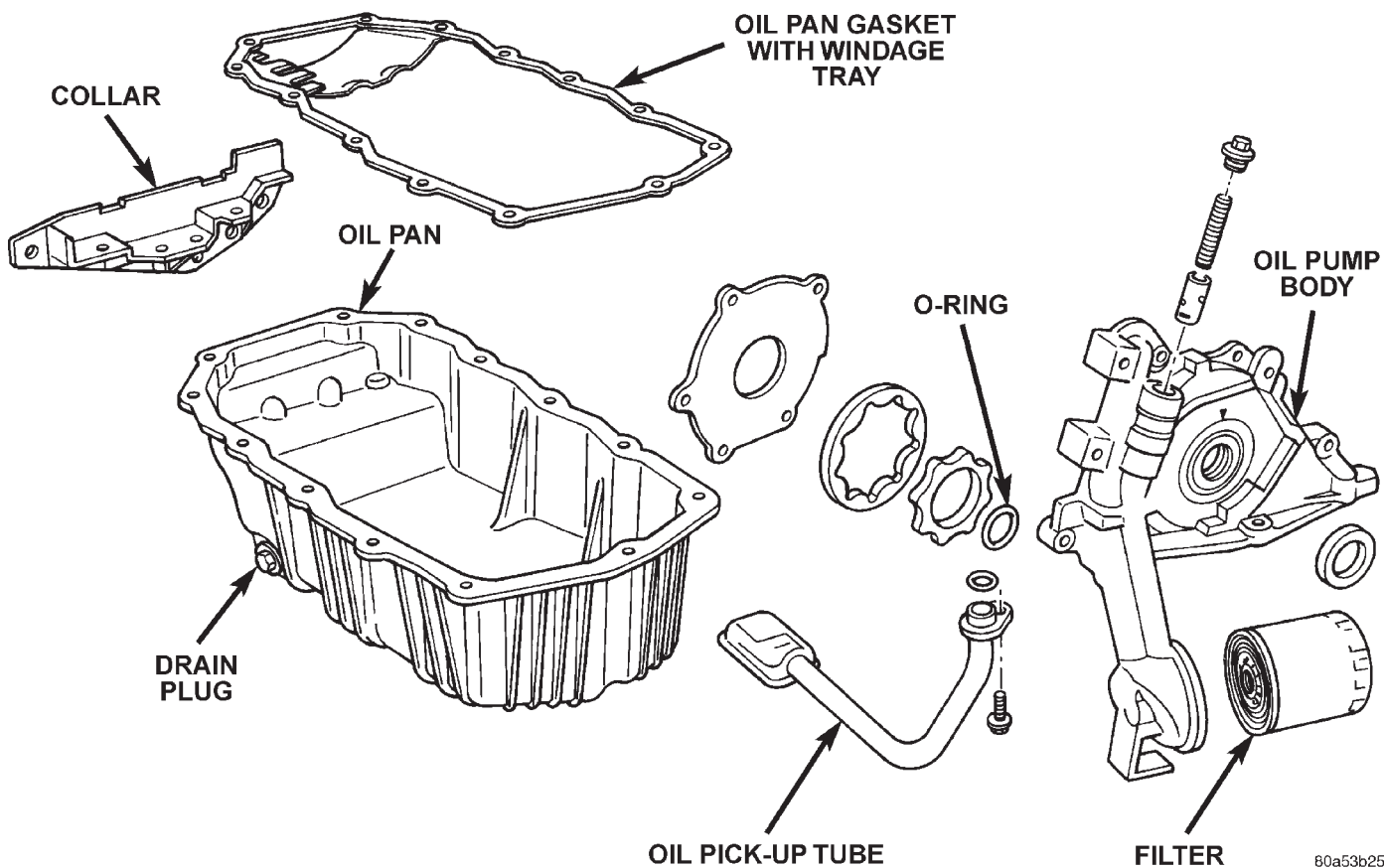


Fig. 87 Oil Pressure Relief Valve

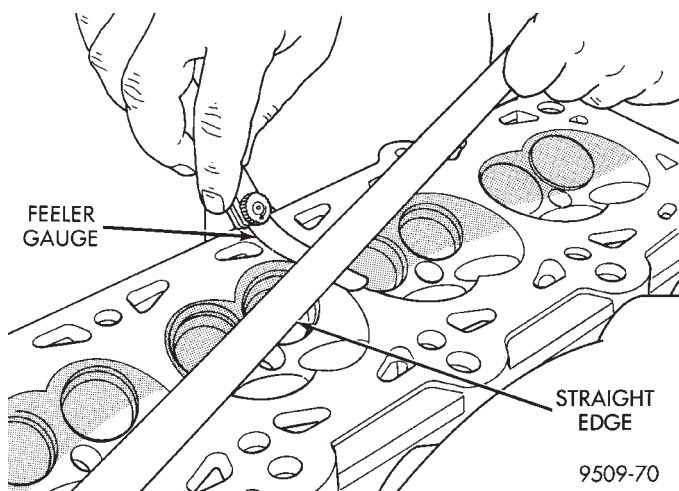


Fig. 88 Checking Cylinder Head Flatness

tom (Fig. 89). Refer to (Fig. 90) for specifications. Replace guides if they are not within specification.

(3) Check valve guide height (Fig. 91).

VALVE AND VALVE SPRING

VALVES

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

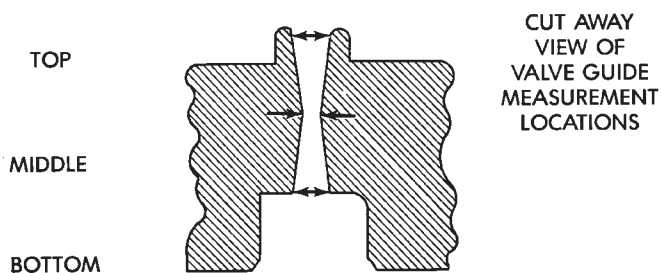


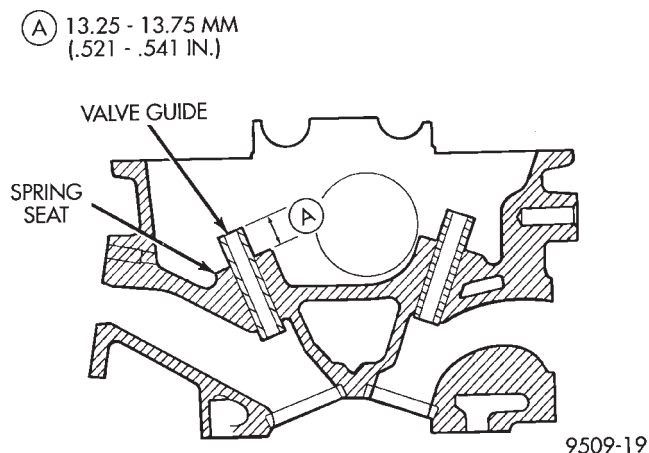
Fig. 89 Checking Wear on Valve Guide—Typical

Valve Guide Diameter	Intake Valve	Exhaust Valve
	5.975 - 6.000 mm (0.2352 - 0.2362 in.)	5.975 - 6.000 mm (0.2352 - 0.2362 in.)
Clearance	New	Service Limit
Intake	0.048 - 0.066 mm (0.0018 - 0.0025 in.)	
Exhaust	0.0736 - 0.094 mm (0.0029 - 0.0037 in.)	0.25 mm (0.010 in.)

9509-205

Fig. 90 Valve Guide Specifications

CLEANING AND INSPECTION (Continued)

**Fig. 91 Valve Guide Height**

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

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

VALVE SPRINGS

(1) Whenever valves have been removed for inspection, reconditioning or replacement, valve springs should be tested for correct tension. Discard the springs that do not meet specifications. The following specifications apply to both intake and exhaust valves springs:

- Valve Closed Nominal Tension— 76 ft. lbs. @ 38.0 mm (1.50 in.)
- Valve Open Nominal Tension— 136 ft. lbs. @ 29.75 mm (1.17 in.)

(2) Inspect each valve spring for squareness with a steel square and surface plate, test springs from both ends. If the spring is more than 1.5 mm (1/16 inch) out of square, install a new spring.

OIL PUMP

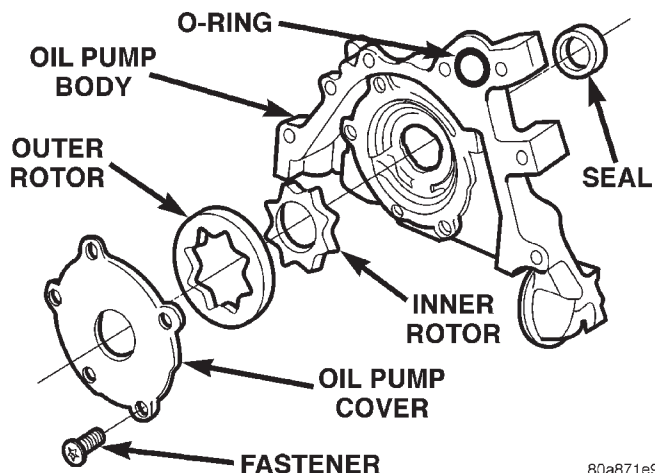
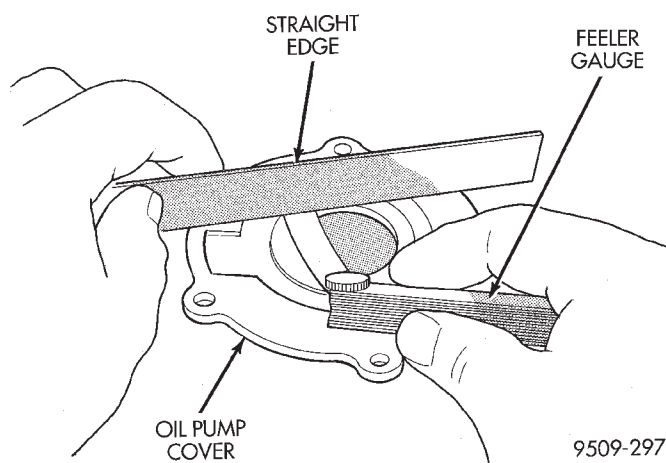
(1) Clean all parts thoroughly. Mating surface of the oil pump should be smooth (Fig. 92). Replace pump cover if scratched or grooved.

(2) Lay a straightedge across the pump cover surface (Fig. 93). If a .076 mm (.003 inch) feeler gauge can be inserted between cover and straight edge, cover should be replaced.

(3) Measure thickness and diameter of outer rotor. If outer rotor thickness measures 9.40 mm (0.370 inch.) or less (Fig. 94), or if the diameter is 79.95 mm (3.148 inches.) or less, replace outer rotor.

(4) If inner rotor measures 9.40 mm (.370 inch.) or less replace inner rotor (Fig. 95).

(5) Slide outer rotor into pump housing, press to one side with fingers and measure clearance between rotor and housing (Fig. 96). If measurement is 0.39

**Fig. 92 Oil Pump****Fig. 93 Checking Oil Pump Cover Flatness**

mm (0.015 inch.) or more, replace housing only if outer rotor is in specification.

(6) Install inner rotor into pump housing. If clearance between inner and outer rotors (Fig. 97) is .203 mm (.008 inch) or more, replace both rotors.

(7) Place a straightedge across the face of the pump housing, between bolt holes. If a feeler gauge of .102 mm (.004 inch) or more can be inserted between rotors and the straightedge, replace pump assembly (Fig. 98), **ONLY** if rotors are in specs.

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

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

CLEANING AND INSPECTION (Continued)

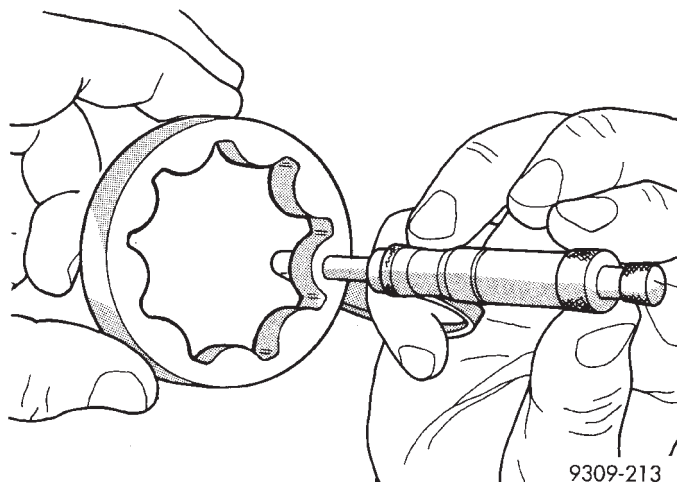


Fig. 94 Measuring Outer Rotor Thickness

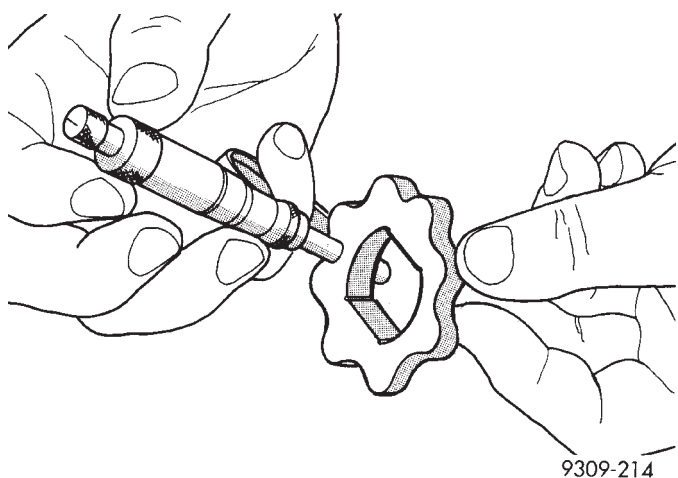


Fig. 95 Measuring Inner Rotor Thickness

(10) If oil pressure is low and pump is within specifications, inspect for worn engine bearings or other reasons for oil pressure loss.

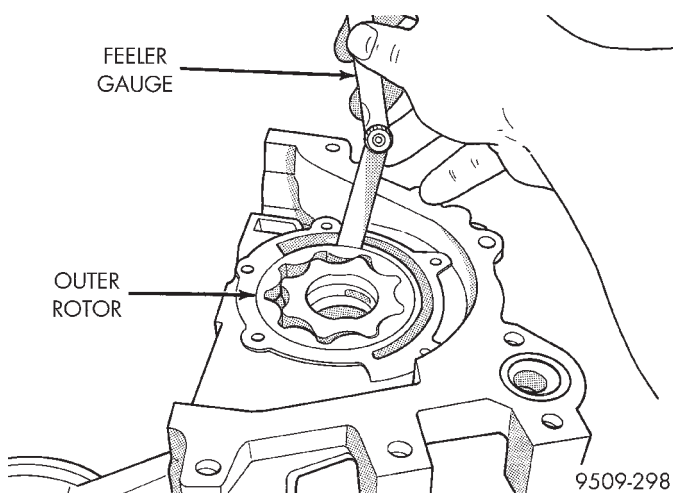


Fig. 96 Measuring Outer Rotor Clearance in Housing

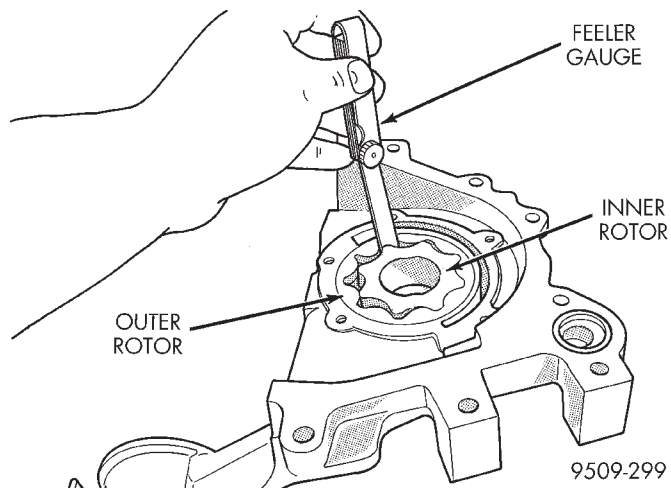


Fig. 97 Measuring Clearance Between Rotors

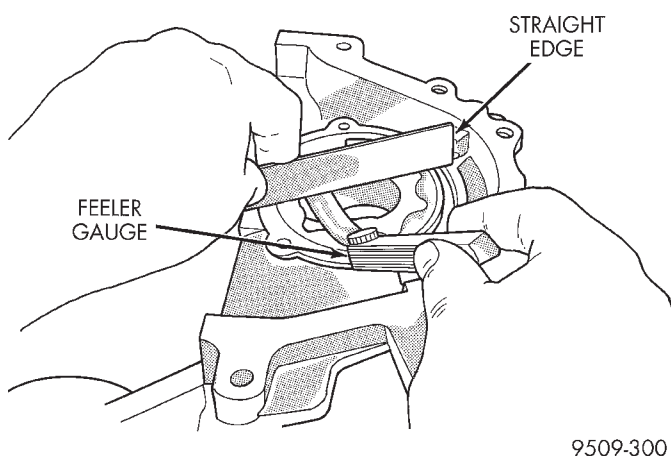


Fig. 98 Measuring Clearance Over Rotors

CRANKSHAFT

The crankshaft journals should be checked for excessive wear, taper and scoring (Fig. 99). Limits of taper or out of round on any crankshaft journals should be held to .025 mm (.001 inch). Journal grinding should not exceed .305 mm (.012 inch) under the standard journal diameter. DO NOT grind thrust faces of Number 3 main bearing. DO NOT nick crank pin or bearing fillets. After grinding, remove rough edges from crankshaft oil holes and clean out all passages.

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

CYLINDER BLOCK

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

CLEANING AND INSPECTION (Continued)

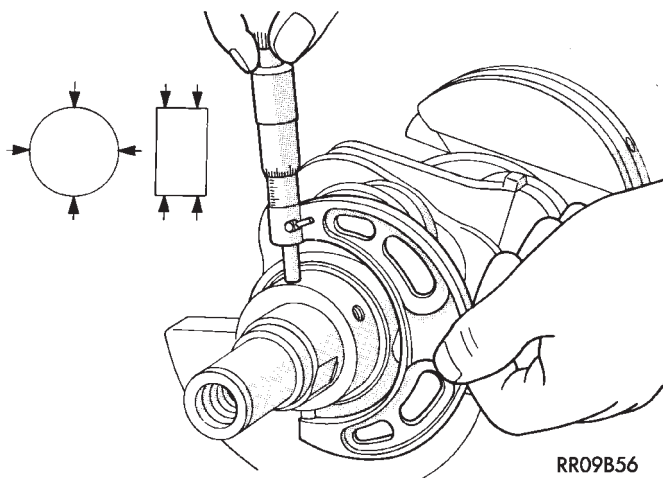


Fig. 99 Crankshaft Journal Measurements

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

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

CYLINDER BORE INSPECTION

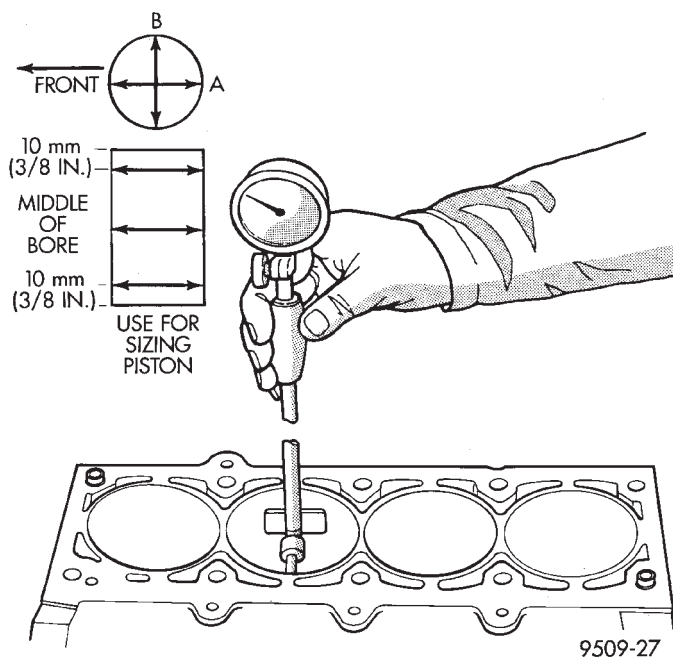


Fig. 100 Checking Cylinder Bore Size

The cylinder walls should be checked for out-of-round and taper with Tool C119 (Fig. 100). The cylinder bore out-of-round is 0.050 mm (.002 inch) maximum and cylinder bore taper is 0.051 mm (0.002 inch) maximum. If the cylinder walls are badly scuffed or scored, the cylinder block should be replaced, and new pistons and rings fitted.

Measure the cylinder bore at three levels in directions A and B (Fig. 100). Top measurement should be

10 mm (3/8 in.) down and bottom measurement should be 10 mm (3/8 in.) up from bottom of bore. Refer to (Fig. 101) for specifications.

Standard Bore	Maximum Out-of-Round	Maximum Taper
87.5 mm (3.445 in.)	0.051 mm (0.002 in.)	0.051 mm (0.002 in.)
Standard Piston Size		
87.450 - 87.468 mm (3.4434 - 3.4441 in.)		
Piston to Bore Clearance: 0.024 - 0.057 mm (.0009 to .0022 in.)		
Measurements taken at Piston Size location.		
9509-208		

Fig. 101 Cylinder Bore and Piston Specifications

CAMSHAFT FOLLOWER

Inspect the cam follower assembly for wear or damage (Fig. 102). Replace as necessary.

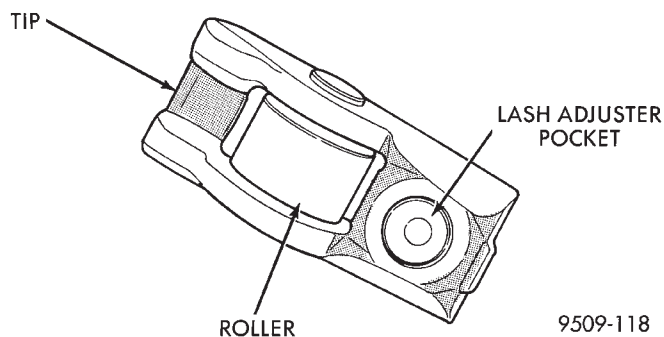


Fig. 102 Cam Follower Assembly

ADJUSTMENTS

ENGINE SUPPORT ADJUSTMENT

The right and left support assemblies are slotted to allow for right/left drive train adjustment in relation to drive shaft assembly length.

Check and reposition right and left engine support assemblies as required. Adjust drive train position, if required, for the following conditions:

- Drive shaft distress: See Group 2, Suspension and Driveshaft.
- Any front end structural damage (after repair).
- Support Assembly replacement.

ENGINE SUPPORT ADJUSTMENT

(1) Remove the load on the engine motor mounts by carefully supporting the engine and transmission assembly with a floor jack.

(2) Loosen the right engine support assembly vertical fasteners.

(3) Loosen the left engine support assembly vertical bolts.

ADJUSTMENTS (Continued)

(4) Pry the engine right or left as required to achieve the proper drive shaft assembly length. Refer to Group 2, Suspension and Driveshaft for driveshaft identification and related assembly length measuring.

(5) Tighten right engine support assembly vertical bolts to 61 N·m (45 ft. lbs.). and tighten left engine support assembly bolts to 61 N·m (45 ft. lbs.).

(6) Recheck drive shaft length.

SPECIFICATIONS

ENGINE 2.4L

Type	In-Line OHV, DOHC
Number of Cylinder	4
Bore	87.5 mm (3.445 in.)
Stroke	101 mm (3.976 in.)
Compression Ratio	9.4:1
Displacement	2.4 Liters (148 Cubic Inches)
Firing Order	1, 3, 4, 2
Compression Pressure	1172-1551 kPa (170-225 psi)
Maximum Variation Between Cylinder	25 %
Lubrication	Pressure Feed-Full Flow Filtration (Direct Crankshaft Driven Pump)
Engine Oil Capacity	With Oil Filter 4.25 Liters (4.5 Qts.)
Engine Oil Capacity	Without Oil Filter 3.8 Liters (4.0 Qts.)

Cylinder Block

Cylinder Bore Diameter	87.4924 - 87.5076 mm (3.4446 - 3.4452 in.)
Out-of-Round (Max.)	0.051 mm (0.002 in.)
Taper (Max.)	0.051 mm (0.002 in.)

Pistons

Clearance at 14 mm (9/16 in.)	
From Bottom of Skirt	0.024 - 0.057 mm (0.0009 - 0.0022 in.)
Weight	332 - 346 grams (11.85 - 12.20 oz.)
Top Land Clearance	
(Diametrical)	0.614 - 0.664 mm (0.024 - 0.026 in.)
Piston Length	60.30 mm (2.374 in.)

Piston Ring Groove Depth

No. 1	4.640 - 4.784 mm (0.182 - 0.188 in.)
No. 2	4.575 - 4.719 mm (0.180 - 0.185 in.)
No.3	4.097 - 4.236 mm (0.161 - 0.166 in.)

Piston Pins

Clearance in Piston	0.005 - 0.018 mm
In Rod (Interference)	0.018 - 0.043 mm (0.0007 - 0.0017 in.)
Diameter	21.998-22.003 mm (0.8660 - 0.8662 in.)
End Play	None
Length	72.75 - 73.25 mm (2.864 - 2.883 in.)

Piston Ring Gap

Top Compression Ring	0.25 - 0.51 mm (0.0098 - 0.020 in.)
2nd Compression Ring	0.23 - 0.48 mm (0.009 - 0.018 in.)
Oil Control (Steel Rails)	0.25 - 0.64 mm (0.0098 - 0.025 in.)

Piston Ring Side Clearance

Top and Second	
Compression Rings	0.030 - 0.080 mm (0.0011 - 0.0031 in.)
Oil Ring (Pack)	0.012 - 0.178 mm (0.0004 - 0.0070 in.)

Piston Ring Width

Compression Rings	1.47 - 1.50 mm (0.057 - 0.059 in.)
Oil Ring (Pack)	2.72 - 2.88 mm (0.107 - 0.1133 in.)

Connecting Rod

Bearing Clearance	0.025 - 0.071 mm (0.0009 - 0.0027 in.)
Piston Pin Bore Diameter	20.96 - 20.98 mm (0.8252 - 0.8260 in.)
Large End Bore Diameter	53.007 - 52.993 mm (2.0868 - 2.0863)
Side Clearance	0.013 - 0.0150 mm (0.0051 - 0.0150 in.)
Total Weight	
(Less Bearing)	565.8 grams (19.96 oz.)

Crankshaft

Connecting Rod Journal	
Diameter	49.984 - 50.000 mm (1.967 - 1.9685 in.)
Out-of-Round (Max.)	0.0035 mm (0.0001 in.)
Taper (Max.)	0.0038 mm (0.0001 in.)
Main Bearing Diametrical Clearance	
No. 1 - 5	0.018 - 0.058 mm (0.0007 - 0.0023 in.)
End Play	0.09 - 0.24 mm (0.0035 - 0.0094 in.)

Main Bearing Journals

Diameter	59.992 - 60.008 mm (2.361 - 2.3625 in.)
Out-of-Round (Max.)	0.0035 mm (0.0001 in.)
Taper (Max.)	0.0038 (0.0001 in.)

Hydraulic Lash Adjusters

Body Diameter	15.901 - 15.913 mm (0.626 - 0.6264 in.)
Plunger Travel Minimum	
(Dry)	3.0 mm (0.118 in.)

SPECIFICATIONS (Continued)

Camshaft

Bearing Bore Diameter No. 1-6	26.020 - 26.041 mm (1.024 - 1.025 in.)
Diametrical Bearing Clearance	0.069 - 0.071 mm (0.0027 - 0.003 in.)
End Play	0.050 - 0.170 mm (0.0019 - 0.0066 in.)
Bearing Journal Diameter No. 1-6	25.951 - 25.970 mm (1.021 - 1.022 in.)
Lift (Zero Lash) Intake	8.25 mm (0.324 in.)
Exhaust	6.52 mm (0.256 in.)

Valve Timing

Intake Valve Closes (ABDC)	51°
Opens (BTDC)	5°
Duration	236°
Exhaust Valve Closes (ATDC)	10°
Opens (BBDC)	50°
Duration	240°
Valve Overlap	15°

Cylinder Head

Material	Cast Aluminum
Gasket Thickness (Compressed)	1.15 mm (0.045 in.)
Valve Seat Angle	45°
Runout (Max.)	0.050 mm (0.002 in.)
Width (Finish) Intake and Exhaust	0.9 -1.3 mm (0.035 - 0.051 in.)
Guide Bore Diameter (Std)	11.0 - 11.02 mm (0.4330 - 0.4338 in.)
Finished Guide Bore ID	5.975 - 6.000 mm (0.235 - 0.236 in.)

Valves

Face Angle Intake and Exhaust	45 - 44½ °
Head Diameter Intake	34.67 - 34.93 mm (1.364 - 1.375 in.)
Exhaust	30.37 - 30.63 mm (1.195 - 1.205 in.)
Length (Overall) Intake	112.76 - 113.32 mm (4.439 - 4.461 in.)
Exhaust	109.59 -110.09 mm (4.314 - 4.334 in.)
Stem Diameter Intake	5.934 - 5.952 mm (0.233 - 0.234 in.)
Exhaust	5.906 - 5.924 mm (0.233 - 0.233 in.)
Valve Margin Intake	1.285 - 1.615 mm (0.050 - 0.063 in.)
Exhaust	0.985 - 1.315 mm (0.038 - 0.051 in.)
Valve Stem Tip Height Intake	48.04 mm (1.891 in.)
Exhaust	47.99 mm (1.889 in.)
Stem Diameter Intake	5.934 - 5.952 mm (0.234 - 0.234 in.)
Exhaust	5.906 - 5.924 mm (0.233 - 0.233 in.)
Stem-to-Guide Clearance Intake	0.048 - 0.066 mm (0.0018 - 0.0025 in.)
Exhaust	0.0736 - 0.094 mm (0.0029 - 0.0037 in.)
Max. Allowable Intake and Exhaust	0.025 mm (0.010 in.)

Valve Springs

Free Length (Approx.)	48.4 mm (1.905 in.)
Spring Tension (Valve Closed)	338 N ± 20 N @ 38.0 mm (75.98 lbs. ± 4.5 lbs. @ 1.496 in.)
Spring Tension (Valve Open)	607 N ± 30 N @ 29.75 mm (136 lbs. ± 7 lbs. @ 1.172 in.)
Number of Coils	7.82
Wire Diameter	3.86 mm (0.151 in.)
Installed Spring Height	38.00 mm (1.496 in.)

Oil Pump

Clearance over Rotors (Max.)	0.10 mm (0.004 in.)
Cover Out-of-Flat (Max.)	0.025 mm (0.001 in.)
Inner Rotor Thickness (Min.)	9.40 mm (0.370 in.)
Outer Rotor Clearance (Max.)	0.39 mm (0.015 in.)
Diameter (Min.)	79.95 mm (3.148 in.)
Thickness (Min.)	9.40 mm (0.370 in.)
Tip Clearance between Rotors (Max.)	0.20 mm (0.008 in.)

Oil Pressure

At Curb Idle Speed*	25 kPa (4 psi)
At 3000 rpm	170 — 550 kPa (25 — 80 psi)

SPECIFICATIONS (Continued)

TORQUE CHART 2.4L

DESCRIPTION TORQUE**Balance Shaft Carrier to Block**

Bolts 54 N·m (40 ft. lbs.)

Balance Shaft Gear Cover

Double Ended Fastener 12 N·m (105 in. lbs.)

Balance Shaft Sprockets

Bolts 28 N·m (250 in. lbs.)

Balance Shaft Chain Tensioner

Bolts 12 N·m (105 in. lbs.)

Balance Shaft Carrier Cover

Fasteners 12 N·m (105 in. lbs.)

Camshaft Sensor Pick Up

Bolts 27 N·m (20 ft. lbs.)

Timing Belt Cover

Outer to Inner Attaching

Bolts M6 4.5 N·m (40 in. lbs.)

Inner Cover to Head/Oil Pump

Bolts M6 12 N·m (105 in. lbs.)

Camshaft Sprocket

Bolt 101 N·m (75 ft. lbs.)

Connecting Rod Cap

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

Crankshaft Main Bearing Cap/Bedplate

M8 Bedplate Bolts 34 N·m (250 in. lbs.)

Main Cap Bolts M11 41 N·m (30 ft. lbs.)

Plus 1/4 Turn

Crankshaft Damper

Bolt 135 N·m (100 ft. lbs.)

Cylinder Head

Bolts Refer To Cylinder Head Installation

Cylinder Head Cover

Bolts 12 N·m (105 in. lbs.)

Engine Mount Bracket

Bolts 41 N·m (30 ft. lbs.)

Exhaust Manifold to Cylinder Head

Bolts 23 N·m (200 in. lbs.)

DESCRIPTION TORQUE**Exhaust Manifold Heat Shield**

Bolts 12 N·m (105 in. lbs.)

Front Torque Bracket—2.0/2.4L Engine

Bolts 33 N·m (24 ft. lbs.)

Front Torque Bracket Strut—2.0/2.4L Engine

Long Bolts 110 N·m (80 ft. lbs.)

Short Bolt 61 N·m (45 ft. lbs.)

Intake Manifold

Bolts 27 N·m (20 ft. lbs.)

Oil Filter

Filter 20 N·m (15 ft. lbs.)

Oil Pan

Bolts 12 N·m (105 in. lbs.)

Drain Plug 27 N·m (20 ft. lbs.)

Oil Pan Collar

Collar to Pan Bolts 34 N·m (250 in. lbs.)

Collar to Transmission

Bolts 108 N·m (80 ft. lbs.)

Oil Pump Attaching

Bolts 28 N·m (250 in. lbs.)

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

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

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

Rear Torque Bracket

Bolts 110 N·m (80 ft. lbs.)

Spark Plugs

Plugs 28 N·m (20 ft. lbs.)

Support Module—Front and Rear

Thru Bolt 61 N·m (45 ft. lbs.)

Thermostat Housing

Bolts 23 N·m (200 in. lbs.)

Timing Belt Tensioner

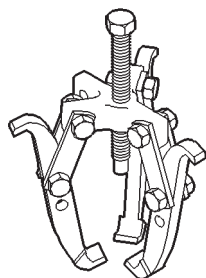
Center Bolt 28 N·m (252 in. lbs.)

Water Pump Mounting

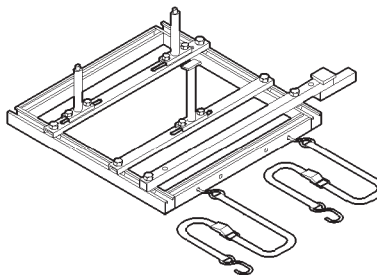
Bolts 12 N·m (105 in. lbs.)

SPECIAL TOOLS

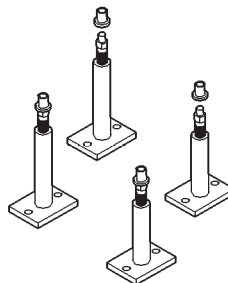
ENGINE 2.4L



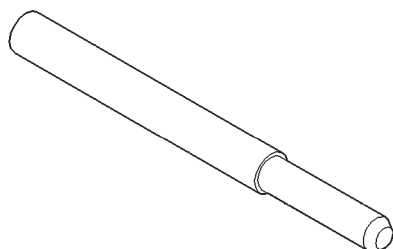
Puller 1026



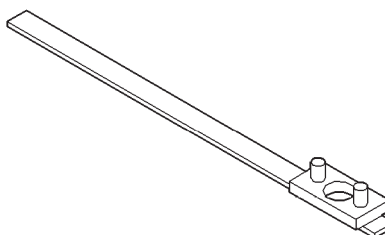
Cradle 6710



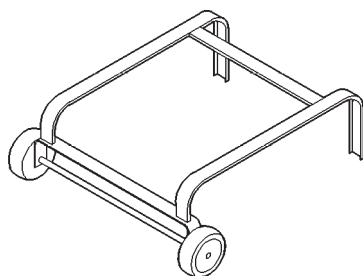
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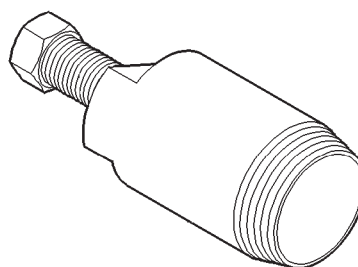
Crankshaft Damper Removal Insert 6827-A



Camshaft Sprocket Remover C-4687

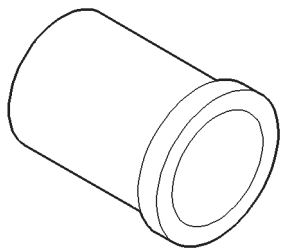


Dolly 6135

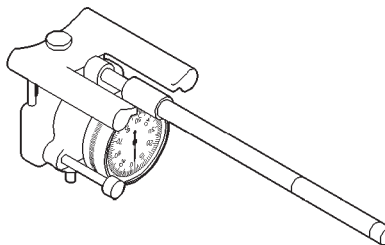


Camshaft Seal Remover C-4679-A

SPECIAL TOOLS (Continued)

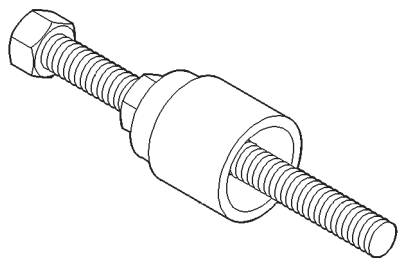


Camshaft Seal Installer MD-998306

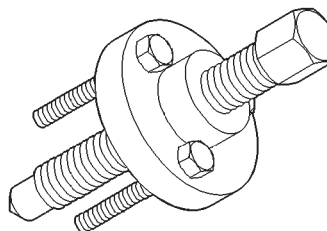


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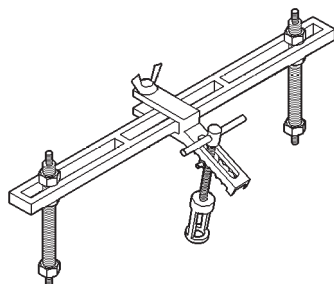
Cylinder Bore Gage C-119



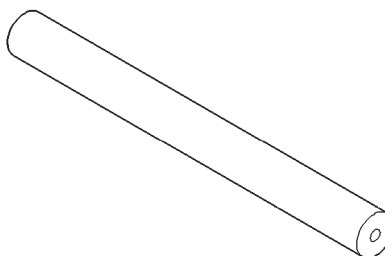
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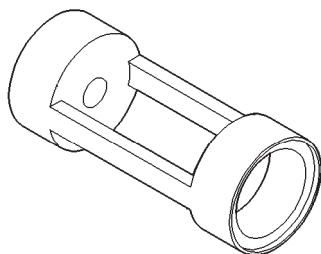
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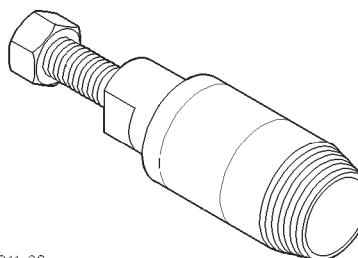
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Crankshaft Sprocket Remover Insert C-4685-C2



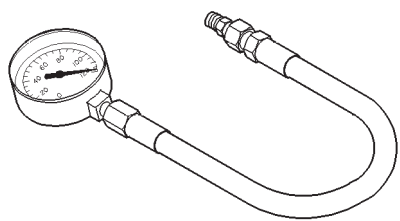
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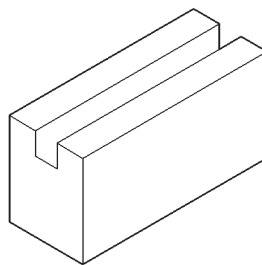
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Crankshaft Seal Remover 6771

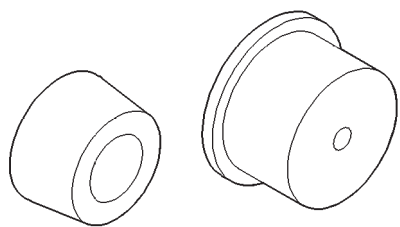
SPECIAL TOOLS (Continued)



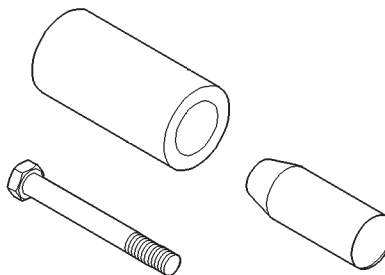
Oil Pressure Gage C-3292



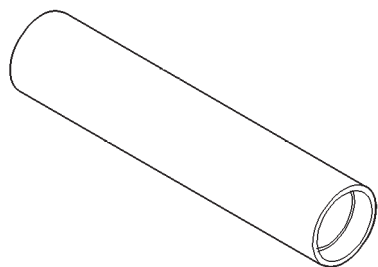
Post Adapter 8130



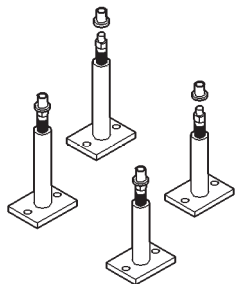
Rear Crankshaft Seal Guide and Installer 6926-1 and 6926-2



Front Crankshaft Oil Seal Installer 6780



Balance Shaft Sprocket Installer 6052



Post Kit Engine Cradle 6848

2.5L ENGINE

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DESCRIPTION AND OPERATION

ENGINE IDENTIFICATION

The engine identification number is located on the rear of the cylinder block just below the cylinder head (Fig. 1).

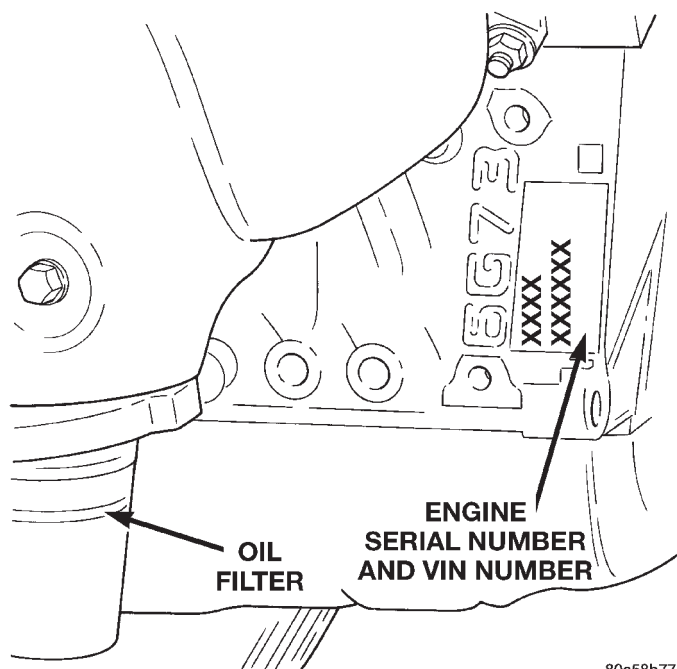
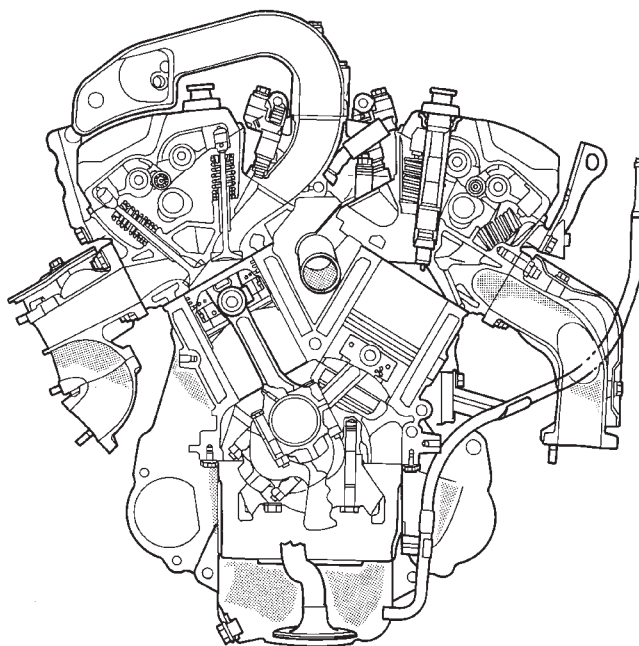


Fig. 1 Engine Identification

80a58b77

ENGINE—2.5L



9509-355

DESCRIPTION AND OPERATION (Continued)

GENERAL SPECIFICATION

2.5L V-6 ENGINE

Type	60°V SOHC (Per Bank)
Bore	83.5 mm (3.29 Inch)
Stroke	76.0 mm (2.992 Inch)
Compression Ratio	9.4:1
Displacement	2.5 Liters (152 Cubic Inch)
Firing Order	1-2-3-4-5-6
Lubrication	Pressure Feed-Full Flow Filtration (Direct Crankshaft Driven Pump)
Engine Oil Capacity	4.25 Liter (4.5 Qts.) Including Oil Filter, 3.8 Liter (4.0 Qts.) Without Filter.
Cooling System	Liquid Cooled-Forced Circulation (Pump-Timing Belt Driven)
Cylinder Block	Cast Iron
Crankshaft	Cast (Nodular Cast Iron)
Cylinder Head	Aluminum Alloy
Connecting Rods	Forged Steel
Pistons	Aluminum Alloy (w/Strut)

ENGINE LUBRICATION SYSTEM

The lubrication system is a full flow filtration pressure feed type. Oil, stored in the oil pan, is taken in and discharged by a trochoid type oil pump directly coupled to the crankshaft and its pressure is regu-

lated by a relief valve. The oil is fed through an oil filter and to the crankshaft journals from the oil gallery in the cylinder block. This gallery also feeds oil under pressure to the cylinder heads and camshaft journals. It then flows from the cylinder head passages to the rocker shafts to the rocker arm pivots and auto lash adjusters (Fig. 2).

ENGINE COMPONENTS

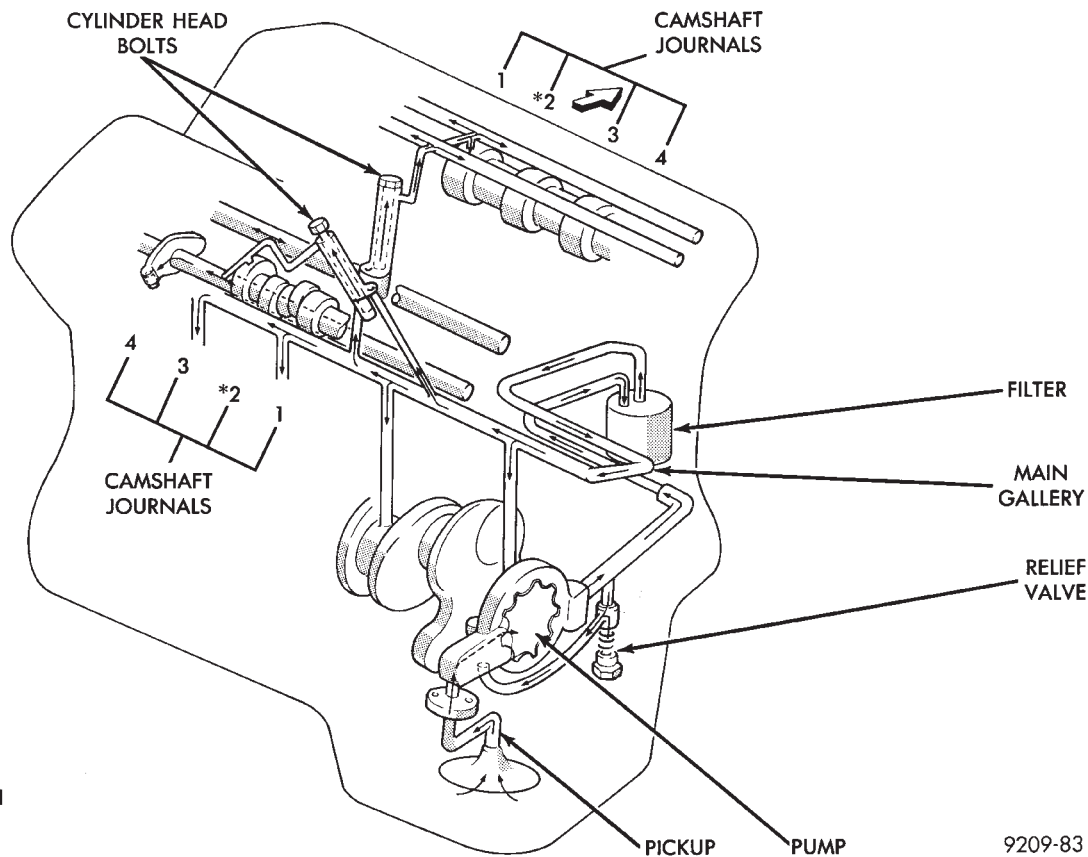
BLOCK

The cylinder block is a partial open deck design to improve cooling and weight reduction. High rigidity is provided with ribs cast in the outer wall, and a monoblock or beam type main bearing cap system. This single unit four bearing cap is designed to control vibration of the cylinder block partition walls.

CRANKSHAFT

The crankshaft is made of nodular cast iron and has six individual throws with five counter weights, it is supported by four main bearings with number three being the thrust bearing. The six separate connecting rod throws pins reduce torque fluctuations while a dynamic damper is used to control torsional vibration of the crankshaft. Rubber lipped seals are used at front and rear. The front seal is retained in

CYLINDER WALLS
SPLASH LUBRICATED
FROM DIRECTED HOLES
IN CONNECTING RODS



* NO. 2 CAMSHAFT
CAP (FRONT AND REAR)
RECEIVES OIL FROM
CYLINDER HEAD TO
SUPPLY ROCKERS, LASH
ADJUSTERS, CAMSHAFT
JOURNALS

Fig. 2 Engine Oiling

DESCRIPTION AND OPERATION (Continued)

the oil pump case and the rear is retained in a die-cast aluminum block-mounted housing.

PISTONS

Are aluminum alloy with cast in steel struts at the pin bosses for autothermic control. The piston head is designed with valve recesses to provide for valve clearance. The piston rings consist of a chrome-plated, barrel faced design for the top ring, the second ring is a cast iron tapered face design and the oil ring is a chrome faced three piece design. Piston pins are press-fitted into place, to join the pistons to the forged steel connecting rods. The large end of the connecting rod has a oil jet hole for lubrication of the thrust side of the cylinder.

CYLINDER HEAD

The aluminum alloy cylinder heads feature a pent-roof design with four valves per cylinder. Valve guides are made of cast iron alloy and seat inserts are made of sintered alloy iron, these are pressed into the head. To improve combustion efficiency the chambers have a compact pent-roof design with a squish area. The cylinder heads are common to either cylinder bank.

CAMSHAFTS

Two overhead camshafts provide valve actuation, one left (radiator side of cylinder bank) and one right. The distributor is directly driven by the right camshaft. Both camshafts are supported by four bearing journals integral with the head. A flange at the rear of the camshaft acts as a thrust collar. Right and Left camshaft driving sprockets are interchangeable. The sprockets and the engine water pump are driven by the timing belt.

ROCKER ARM SHAFTS

The shafts are retained by retaining caps and bolts. Four shafts are used, one for each intake and exhaust rocker arm assembly on each cylinder head. The hollow shafts provide a duct for lubricating oil flow from the cylinder head to the valve mechanisms. Rocker shaft springs are use on the intake shafts ONLY to obtain the proper clearance between the intake rocker arms and the spark plug tubes.

ROCKER ARMS

Are of light weight die-cast with roller type follower operating against the camshaft. The valve actuating end of the rocker arms are machined for hydraulic lash adjusters, eliminating the need for periodic valve lash adjustment.

VALVES

Four valves per cylinder are actuated by die-cast aluminum roller rocker arms and hydraulic lash

adjusters assemblies which pivot on rocker arm shafts. All valves have 6 mm diameter chrome plated valve stems. The valve train has 33 mm (1.299 inch) diameter intake valves and 29 mm (1.141 inch) diameter exhaust valves. The valves have a carbo-nitriding finish for long life. Fluorocarbon valve stem seals are used on both valves. Stamped steel valve spring seat, Valve springs, spring retainers, and locks are conventional.

INTAKE MANIFOLD

This system is composed of a upper plenum (surge tank) and manifold. This aluminum alloy manifold has long runners to improve inertia. The plenum chamber (surge tank) absorbs air pulsations created during the suction phase of each cylinder. The lower intake manifold is machined for six injectors and fuel rail mounting.

EXHAUST MANIFOLDS

Both manifolds are made of cast nodular graphite iron for heat resistance. Exhaust gasses from the left cylinder bank, leave the left manifold through a stainless steel pipe and bellows routed under the engine to the right side manifold. The collected exhaust from both manifolds are combined, and exit to the exhaust pipe through a flex-joint.

DIAGNOSIS AND TESTING

CHECKING ENGINE OIL PRESSURE

Check oil pressure using gauge at oil pressure switch location. Oil pressure should be 41 kPa (6 psi.) at idle or 241 to 517 kPa (35 to 75 psi.) at 3000 RPM.

(1) Remove pressure sending unit and install oil pressure gauge.

CAUTION: If oil pressure is 0 at idle, Do Not Run engine at 3000 RPM.

(2) Warm engine at high idle until thermostat opens.

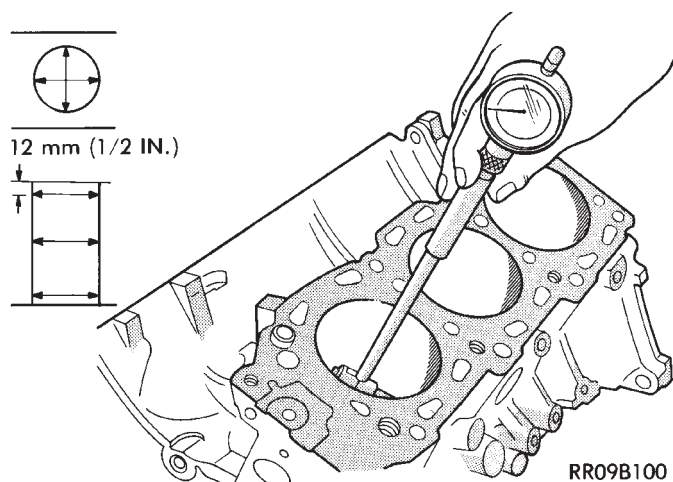
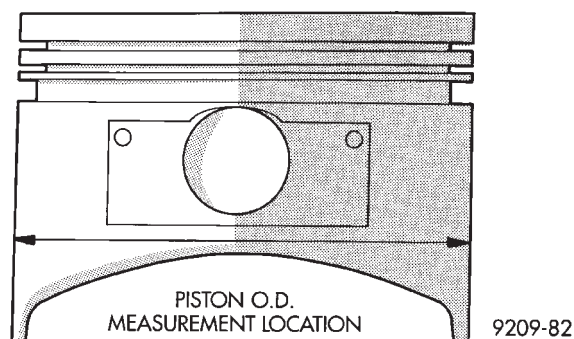
SERVICE PROCEDURES

BORING CYLINDER

Examine cylinder walls for scuffs, scoring and measure cylinder bore for out-of-round or taper. If defective, bore cylinder to oversize. Measure at points shown in (Fig. 3).

Four oversize pistons are available (0.25mm (.010 inch) 0.50mm (.020 inch) 0.75mm (.030 inch) and 1.0mm (.039 inch). Determine oversize piston on basis of largest cylinder bore.

SERVICE PROCEDURES (Continued)

**Fig. 3 Measure Cylinder Bore****Fig. 4 Measure Piston**

(1) Bore to specified clearance between the piston O.D. and cylinder. The measuring point of the piston O.D. is shown in (Fig. 4).

(2) Based on measured piston O.D., calculate boring finish dimension. Boring finish dimension equals piston O.D. plus 0.03 to 0.05 mm (.0012 to .002 inch) (clearance between piston O.D. and cylinder) minus 0.02 mm which is the boring margin.

(3) Bore all cylinders to calculated boring finish dimension. Then bore the final finish dimension (piston O.D. plus cylinder clearance).

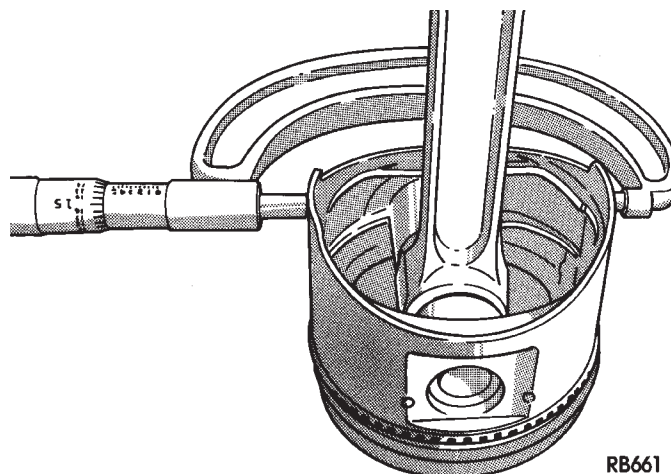
(4) Check clearance between piston and cylinder, clearance should be 0.02 to 0.04 mm (0.0008 to 0.0016 inch).

FITTING PISTONS

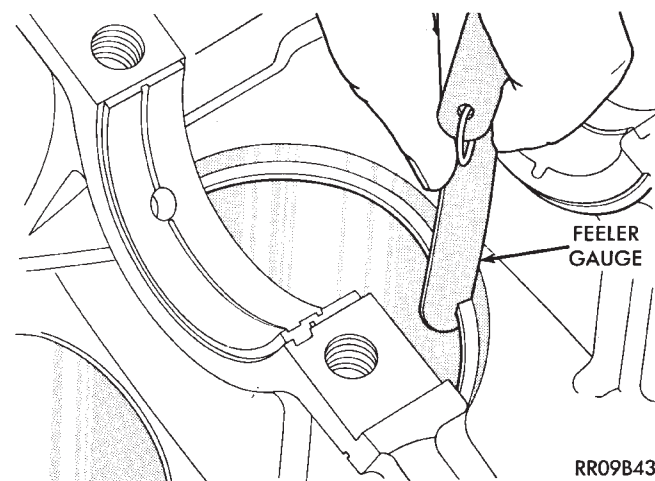
Measure approximately 2mm (.080 inch) above the bottom of the piston skirt and across the thrust face (Fig. 5). See Boring Cylinder Block.

FITTING PISTON RINGS

(1) Wipe cylinder bore clean. Insert ring and push down with piston to ensure it is square in bore. The ring gap measurement must be made with the ring positioning at least 16mm (0.63 in.) from bottom of

**Fig. 5 Measuring Piston for Clearance and Wear**

cylinder bore. Check gap with feeler gauge (Fig. 6). Refer to (Fig. 7) for specification.

**Fig. 6 Check Gap on Piston Rings**

RING POSITION	RING GAP	WEAR LIMIT
UPPER RING	0.25 TO 0.40 mm (.010 TO .016 in.)	0.8 mm (.031 in.)
INTERMEDIATE RING	0.40 TO 0.55 mm (.016 TO .022 in.)	0.8 mm (.031 in.)
OIL CONTROL RING	0.15 TO 0.50 mm (.006 TO .019 in.)	1.0 mm (.039 in.)
RING POSITION	GROOVE CLEARANCE	MAXIMUM CLEARANCE
UPPER RING	0.03 TO 0.07 mm (.0012 TO .0028 in.)	.10 mm (.004 in.)
INTERMEDIATE RING	0.02 TO 0.06 mm (.0007 TO .0024 in.)	.10 mm (.004 in.)
OIL CONTROL RING-THREE PIECE. OIL RING SIDE RAILS MUST BE FREE TO ROTATE AFTER ASSEMBLY.		

9509-388

Fig. 7 Piston Ring Specifications

(2) Check piston ring to groove clearance (Fig. 8); Refer to Piston Ring Specification Chart (Fig. 7).

SERVICE PROCEDURES (Continued)

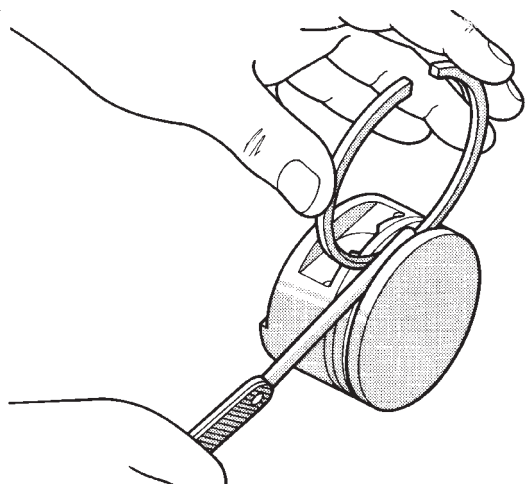


Fig. 8 Piston Ring Groove Clearance

PISTON RINGS

(1) The No. 1 and No. 2 piston rings have a different cross section. Install rings with manufacturers mark and size mark facing up, to the top of the piston (Fig. 9).

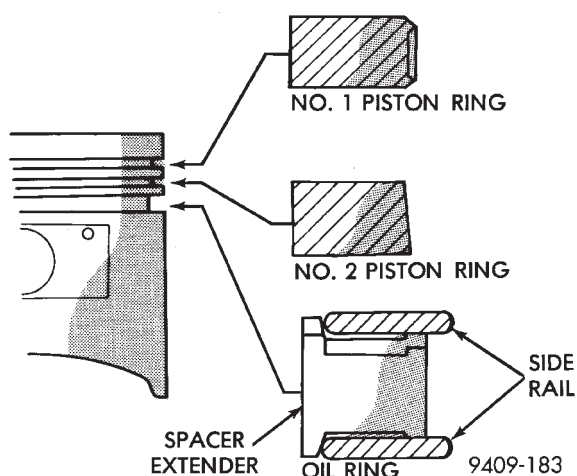


Fig. 9 Piston Ring—Installation

CAUTION: Install piston rings in the following order:

- (2) Oil ring expander.
- (3) Upper oil ring side rail.
- (4) Lower oil ring side rail.
- (5) No. 2 Intermediate piston ring.
- (6) No. 1 Upper piston ring.
- (7) Install the side rail by placing one end between the piston ring groove and the expander. Hold end firmly and press down the portion to be installed until side rail is in position. **Do Not use a piston ring expander** (Fig. 10).
- (8) Install upper side rail first and then the lower side rail.

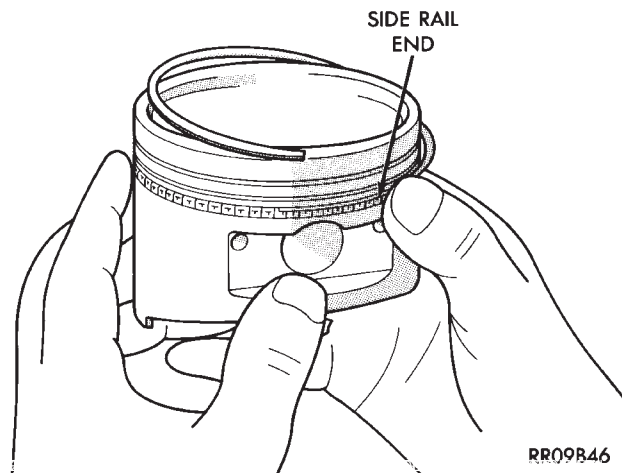


Fig. 10 Side Rail—Installation

(9) Install No. 2 piston ring and then No. 1 piston ring (Fig. 11).

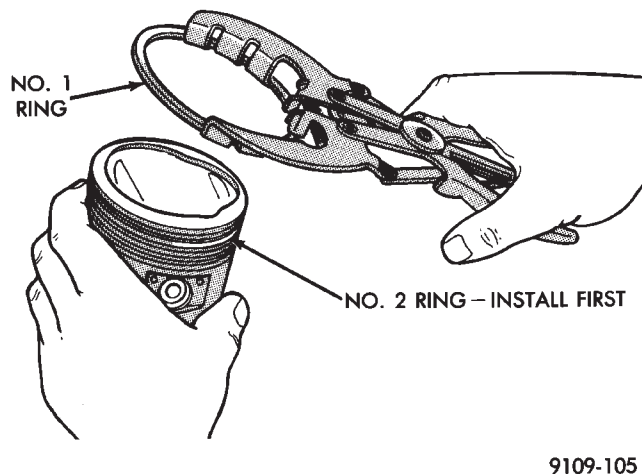


Fig. 11 Upper and Intermediate Rings—Installation

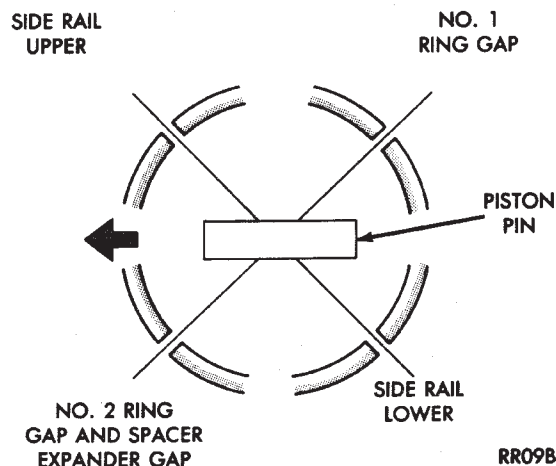


Fig. 12 Piston Ring End Gap Location

(10) Position piston ring end gaps as shown in (Fig. 12).

SERVICE PROCEDURES (Continued)

(11) Position oil ring expander gap at least 45° from the side rail gaps but **not** on the piston pin center or on the thrust direction.

CONNECTING ROD CLEARANCE

(1) Follow the procedures outlined in the Standard Service Procedures Section for Measuring Main Bearing and Connecting Rod Bearing Clearances. (Fig. 13). Refer to (Fig. 15) for specifications.

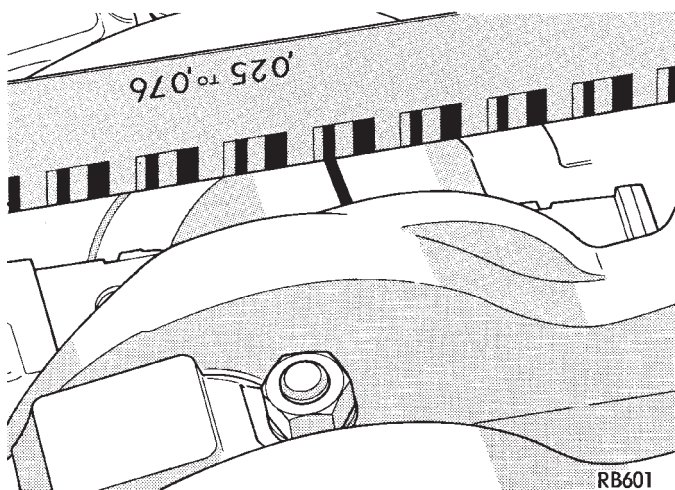


Fig. 13 Checking Connecting Rod Bearing Clearance

(2) Tighten nuts to 52 N·m (38 ft. lbs.).

(3) Remove connecting rod cap and measure Plastigage (Fig. 13).

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

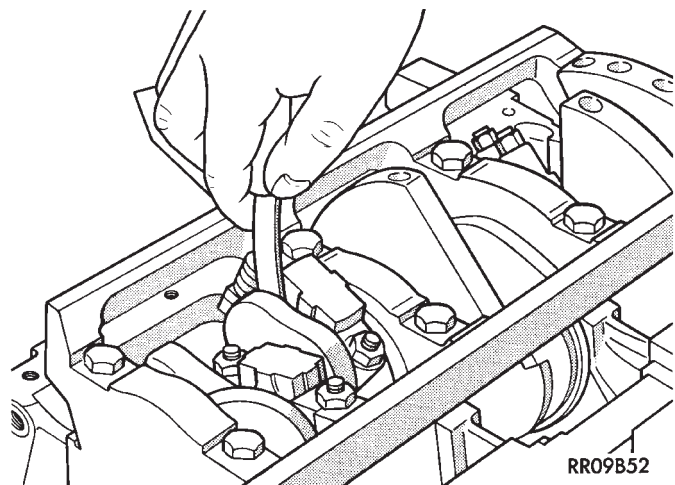
CONNECTING ROD SIDE CLEARANCE

Fig. 14 Checking Connecting Rod Side Clearance

Using a feeler gauge, check connecting rod side clearance (Fig. 14). Refer to (Fig. 15) for specifications.

CONNECTING ROD BEARING OIL CLEARANCE

NEW PART:	.020 TO .067 mm (.0008 TO .0028 in.)
-----------	---

CONNECTING ROD SIDE CLEARANCE

NEW PART:	0.10 TO 0.25 mm (.004 TO .010 in.)
WEAR LIMIT:	0.4 mm (.015 in.)

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Fig. 15 Connecting Rod Clearance Specifications

MAIN BEARING JOURNAL MEASUREMENT

Measure the journal outside diameter (Fig. 16). If the clearance exceeds the specifications limit (Fig. 17). Replace the main bearing(s) and if necessary replace the crankshaft.

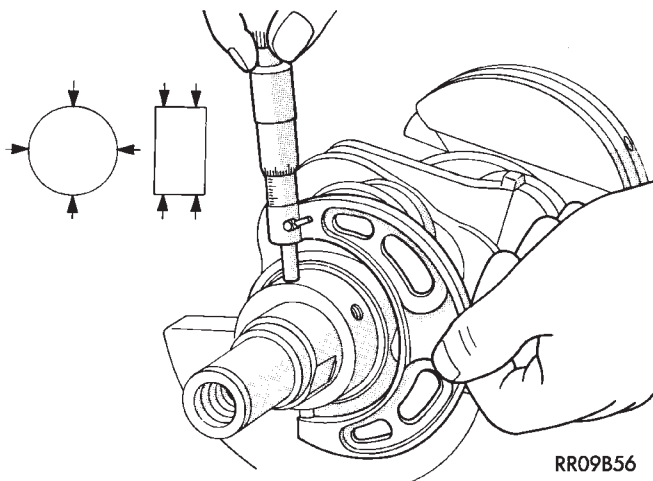


Fig. 16 Measure Crankshaft Journal O.D.

CRANKSHAFT END-PLAY

NEW PART:	.05 TO 0.25 mm (.002 TO .0010 in.)
WEAR LIMIT:	0.30 mm (.012 in.)

MAIN BEARING OIL CLEARANCE

NEW PART:	.020 TO .048 mm (.0008 TO .0018 in.)
WEAR LIMIT:	.10 mm (.0039 in.)

CRANKSHAFT JOURNAL SIZES

CRANKSHAFT MAIN BEARING JOURNAL	
ALL STANDARD	DIAMETER 59.980 mm (2.361 in.)
CRANKSHAFT CONNECTING ROD JOURNAL	
ALL STANDARD	DIAMETER 50.00 mm (1.968 in.)

9109-39

Fig. 17 Crankshaft Clearance Specifications

SERVICE PROCEDURES (Continued)

PLASTIGAGE MEASUREMENT

- (1) Remove oil from journal and bearing shell.
- (2) Install crankshaft.
- (3) Cut plastigage to same length as width of the bearing and place it in parallel with the journal axis (Fig. 18).
- (4) Install the main bearing cap carefully and tighten the bolts to specified torque.

CAUTION: Do not rotate crankshaft or the plasti-gage will be smeared.

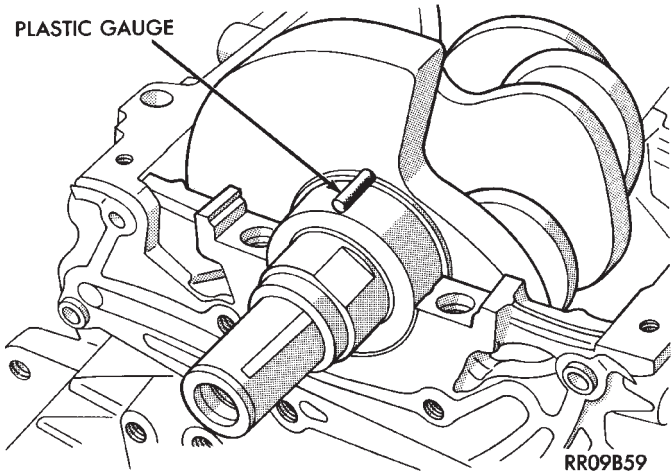


Fig. 18 Measure Oil Clearance with Plastigage

- (5) Carefully remove the bearing cap and measure the width of the plastigage at the widest part using the scale on the plastigage package (Fig. 19). Refer to specifications (Fig. 17) for proper clearance. Also see Measuring Main and Connecting Rod Bearing Clearances in Standard Service Procedures.

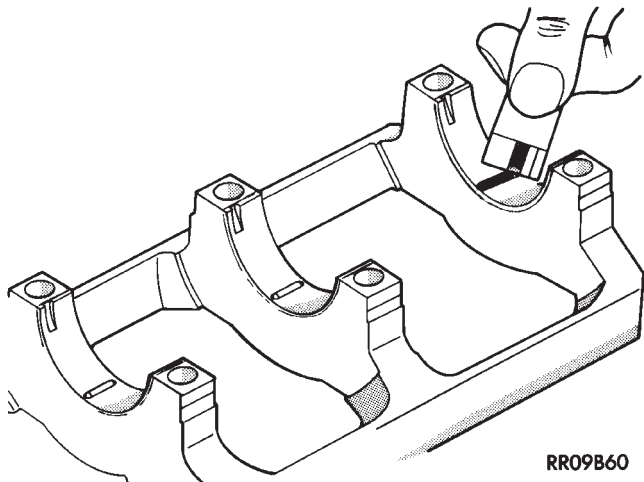


Fig. 19 Measuring Clearance

CRANKSHAFT BEARING INSTALLATION

When the bearings need replacing, select and install the proper bearing by the following procedure.

- (1) Measure the crankshaft journal diameter and confirm its classification from the following (Fig. 20). In the case of a bearing supplied as a service part, its identification color is painted at the position show in (Fig. 21).

NOTE: Service Replacement parts have identification marks, but factory-assembled parts have no identification marks. Service crankshaft identification may have marks or paint at counterweights (Fig. 20).

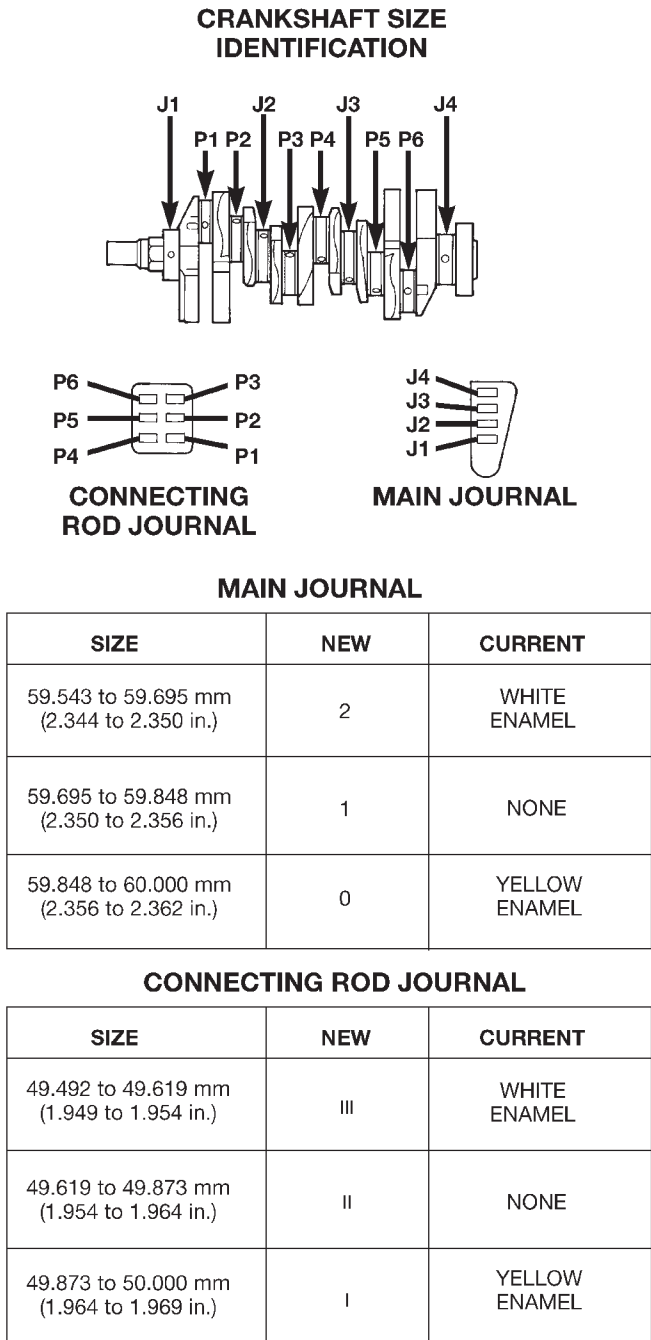
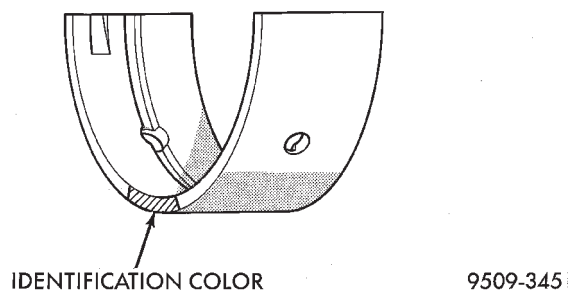
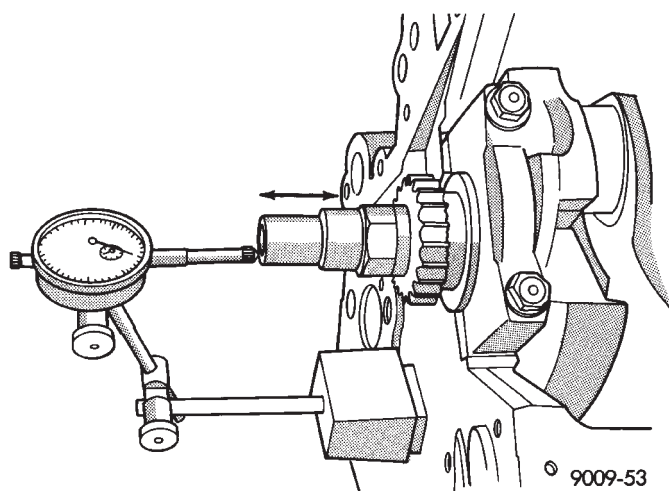


Fig. 20 Crankshaft Size Identification

SERVICE PROCEDURES (Continued)

**Fig. 21 Bearing Identification****CRANKSHAFT END PLAY**

- (1) Mount a dial indicator to front of engine, locating probe on nose of crankshaft (Fig. 22).
- (2) Move crankshaft all the way to the rear of its travel.
- (3) Zero the dial indicator.

**Fig. 22 Crankshaft End Play—Typical**

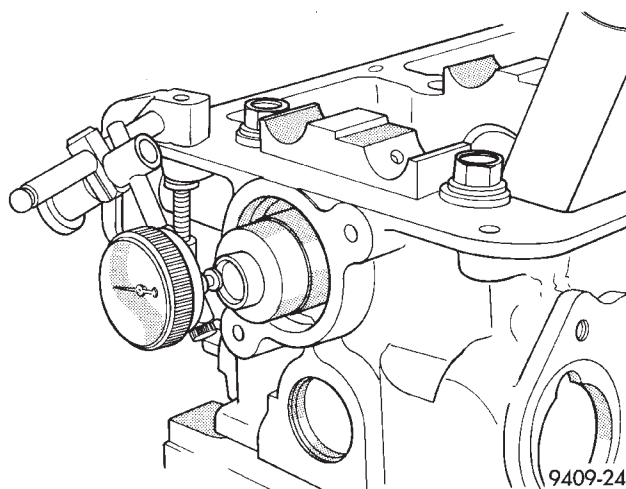
- (4) Move crankshaft all the way to the front and read the dial indicator. Refer to (Fig. 23) for specification.

CRANKSHAFT END-PLAY		
NEW PART:	.05 TO 0.25 mm	(.002 TO .0010 in.)
WEAR LIMIT:	0.30 mm	(.012 in.)
MAIN BEARING OIL CLEARANCE		
NEW PART:	.020 TO .048 mm	(.0008 TO .0018 in.)
WEAR LIMIT:	.10 mm	(.0039 in.)
CRANKSHAFT JOURNAL SIZES		
CRANKSHAFT MAIN BEARING JOURNAL		
ALL		DIAMETER
STANDARD		59.980 mm (2.361 in.)
CRANKSHAFT CONNECTING ROD JOURNAL		
ALL		DIAMETER
STANDARD		50.00 mm (1.968 in.)

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Fig. 23 Crankshaft Specifications**CAMSHAFT END PLAY**

- (1) Oil camshaft journals and install camshaft without rocker arm assemblies.
- (2) Using a suitable tool, move camshaft as far rearward as it will go.
- (3) Zero dial indicator (Fig. 24).
- (4) Move camshaft as far forward as it will go.
- (5) End play travel: 0.1 - 0.2 mm (0.004 - 0.008 in.). Max. Travel: 0.4 mm (0.016 in.)

**Fig. 24 Camshaft End Play****REMOVAL AND INSTALLATION****ENGINE SUPPORT MODULE (FRONT AND REAR MOUNTS)****REMOVAL**

- (1) Raise vehicle on hoist.
- (2) Remove thru bolt at rear mount and remove bolts attaching module to crossmember.
- (3) Remove upper attaching bolt from rear support strut bracket (Fig. 25).
- (4) Remove front attaching bolts from support module to lower radiator support.
- (5) Support cooling module.
- (6) Remove lower radiator support bolts, and remove support.
- (7) Remove thru bolt at front mount and remove support module.

INSTALLATION

- (1) Install thru bolt at front mount. Do not tighten at this time.
- (2) Install lower radiator support.
- (3) Install attaching bolts from support module to lower radiator support.
- (4) Install upper bolt at rear support strut bracket.
- (5) Install thru bolt at rear mount see (Fig. 26) tighten to 61 N·m (45 ft. lbs.).

REMOVAL AND INSTALLATION (Continued)

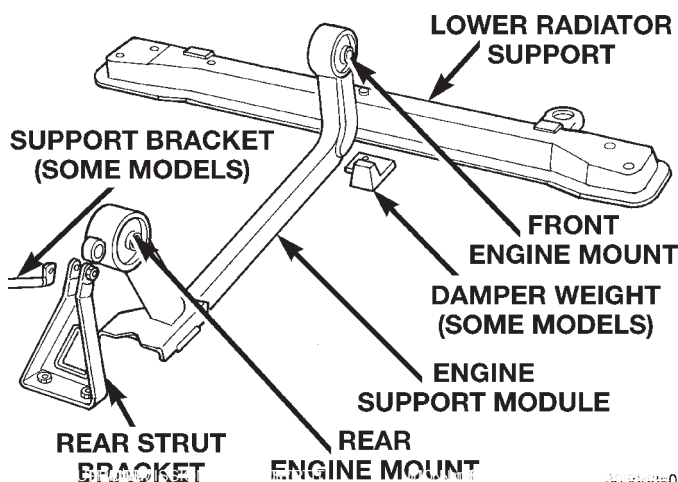


Fig. 25 Engine Support Module

(6) Tighten thru bolt at front mount see (Fig. 27) tighten to 61 N·m (45 ft. lbs.).

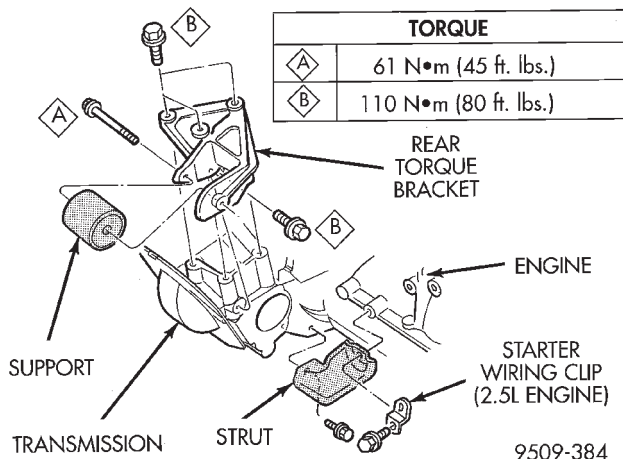


Fig. 26 Engine Mounting—Rear 2.4 and 2.5L

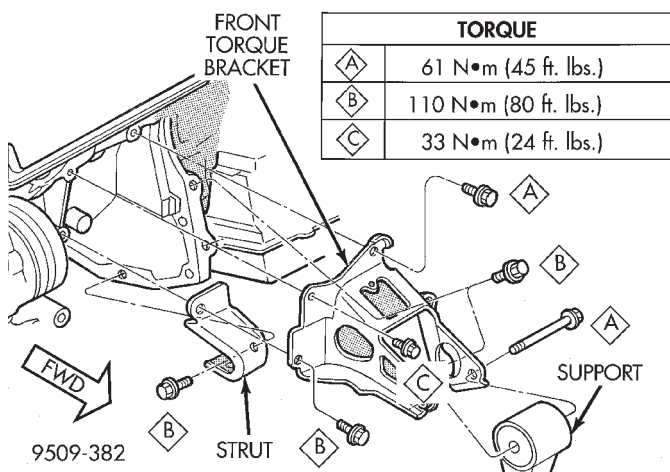


Fig. 27 Engine Mounting—Front 2.5L

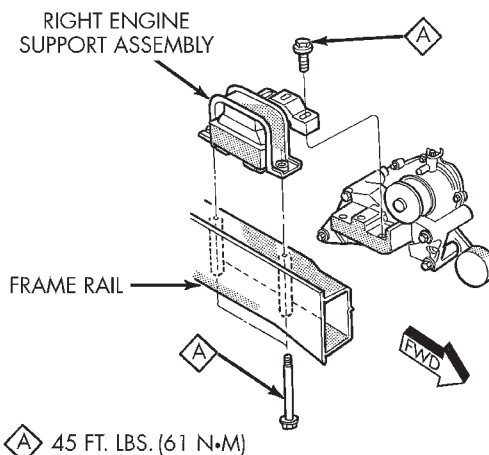
ENGINE MOUNT—RIGHT/ENGINE SUPPORT BRACKET

NOTE: The right side engine mount is a Hydro-Mount and may show surface cracks this will not effect it's performance and should not be replaced. Only replace the Hydro-Mount when it's leaking fluid.

- (1) Raise vehicle on a hoist and remove inner splash. Remove the right engine support assembly vertical fasteners from frame rail (Fig. 28).
- (2) Lower vehicle. Remove the load on the engine motor mounts by carefully supporting the engine assembly with a floor jack.
- (3) Remove the three bolts attaching the engine support assembly to the engine bracket.
- (4) Move the air conditioning dryer aside.
- (5) Remove coolant recovery system tank. Refer to Group 7, Cooling System for procedure.
- (6) Remove right engine support.
- (7) Remove the three bolts attaching the engine support bracket to the cylinder block.

NOTE: If centering or adjusting the engine/transmission assembly is needed refer to Adjustments, in this section.

(8) Reverse removal procedure for installation. Refer to (Fig. 28) for bolt tightening specifications.



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Fig. 28 Engine Mounting—Right Side 2.5L

LEFT SIDE MOUNT

NOTE: If centering or adjusting the engine/transmission assembly is needed refer to Adjustments, in this section.

The left side engine mount is a Hydro-Mount and may show surface cracks this will not effect it's performance and should not be replaced. Only replace the Hydro-Mount when it's leaking fluid.

REMOVAL AND INSTALLATION (Continued)

- (1) Support the transmission with a transmission jack.
- (2) Remove the three vertical bolts, from the mount to the transmission.
- (3) Remove the transmission mount fasteners and remove mount.
- (4) Reverse removal procedure for installation. Refer to (Fig. 29) for bolt tightening specifications.
- (5) Engine support assemblies adjustment, Refer to Engine Support Assembly Adjustment of this section.

- (15) Disconnect exhaust pipe from manifold.
- (16) Remove front and rear engine mount brackets from the body.
- (17) Lower vehicle. Remove air cleaner assembly.
- (18) Remove power steering pump and reservoir, Set them aside.
- (19) Remove A/C compressor.
- (20) Remove ground straps to body.
- (21) Mount the bracket (Special Tool 6973) to the right side of the cylinder block (Fig. 30). Align the front adjustable post with the hole in the bracket.

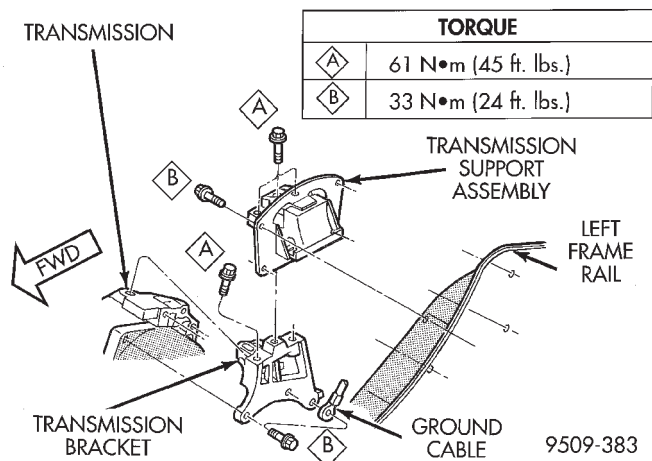


Fig. 29 Left Side Mount—Typical

ENGINE ASSEMBLY

REMOVAL

- (1) Perform fuel pressure release procedure. Refer to Group 14, Fuel System for procedure. Remove fuel line to fuel rail.
- (2) Disconnect battery and set Power Control Module (PCM) aside.
- (3) Drain cooling system. Refer to Group 7, Cooling System for procedure.
- (4) Remove upper radiator hose, radiator and fan module. Refer to Group 7, Cooling System for procedure.
- (5) Remove lower radiator hose.
- (6) Disconnect automatic transmission cooler lines and plug, if equipped.
- (7) Disconnect transmission shift linkage.
- (8) Disconnect throttle body linkage.
- (9) Disconnect engine wiring harness.
- (10) Disconnect heater hoses.
- (11) Discharge Air Conditioning System. Refer to Group 24, Air Conditioning for procedure.
- (12) Hoist vehicle and remove right inner splash shield.
- (13) Remove accessory drive belts. Refer to Group 7, Cooling System for procedure.
- (14) Remove axle shafts. Refer to Group 2, Suspension and Driveshaft for procedure.

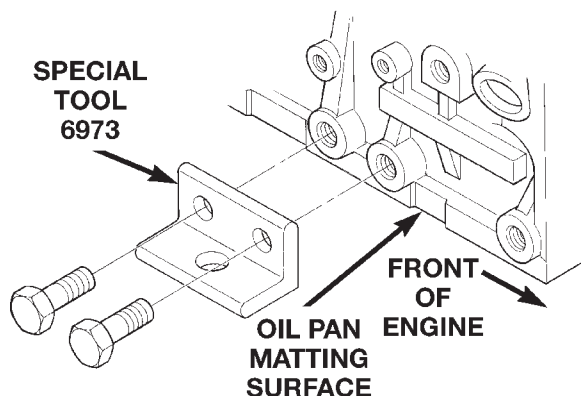


Fig. 30 Bracket for Cradle Post Support

- (22) Raise vehicle enough to allow engine dolly and cradle Special Tools 6135 and 6710 to be installed under vehicle (Fig. 31).
- (23) Loosen cradle engine mounts to allow movement for positioning onto engine locating holes on the engine bedplate. Lower vehicle and position cradle mounts until the engine is resting on mounts. Tighten mounts to cradle frame. This will keep mounts from moving when removing or installing engine and transmission.
- (24) Lower vehicle so weight of the engine and transmission ONLY is on the cradle.
- (25) Remove engine and transmission mount bolts.
- (26) Raise vehicle slowly. It may be necessary to move the engine/transmission assembly on the cradle to allow for removal around body flanges.

INSTALLATION

- (1) Position engine and transmission assembly under vehicle and slowly lower the vehicle over the engine and transmission.
- (2) Align engine and transmission mounts to attaching points. Install mounting bolts at the right engine and left transmission mounts. Refer to procedures outlined in this section.

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REMOVAL AND INSTALLATION (Continued)

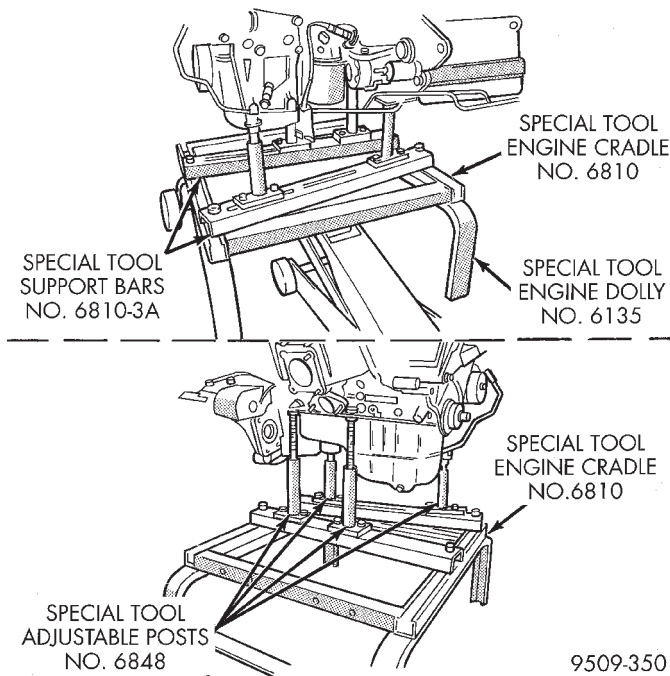


Fig. 31 Positioning Engine Cradle SupportPost Mounts

(3) Slowly raise vehicle enough to remove the engine dolly and cradle Special Tools 6135 and 6710.

(4) Install axle shafts. Refer to Group 2, Suspension and Driveshaft for procedure.

(5) Install transmission and engine braces and splash shields.

(6) Connect exhaust system to manifold. Refer to Group 11, Exhaust System and Intake Manifold for procedure and torque specifications.

(7) Install power steering pump and reservoir. Refer to Group 7, Cooling System Accessory Drive Section for belt tension adjustment.

(8) Install A/C compressor and hoses. Refer to Group 24, Heater and Air Conditioning for procedure.

(9) Install accessory drive belts. Refer to Group 7, Cooling System Accessory Drive Section for belt tension adjustment.

(10) Install front and rear engine mounts. Refer to this section for procedure.

(11) Install inner splash shield. Install wheels and tires.

(12) Connect automatic transmission cooler lines, shifter and kickdown linkage. Refer to Group 21, Transmission for procedures.

(13) Connect fuel line and heater hoses.

(14) Install ground straps. Connect engine and throttle body connections and harnesses. Refer to Group 8, Electrical for procedure.

(15) Connect throttle body linkage. Refer to Group 14, Fuel System for procedure.

(16) Install radiator and shroud assembly. Install radiator hoses. Fill cooling system. See Group 7, Cooling System for filling procedure.

(17) Connect battery and set Power Control Module (PCM) into place.

(18) Install air cleaner and hoses.

(19) Install oil filter. Fill engine crankcase with proper oil to correct level.

(20) Start engine and run until operating temperature is reached.

(21) Adjust transmission linkage, if necessary.

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REMOVAL AND INSTALLATION (Continued)

CYLINDER HEAD COVER

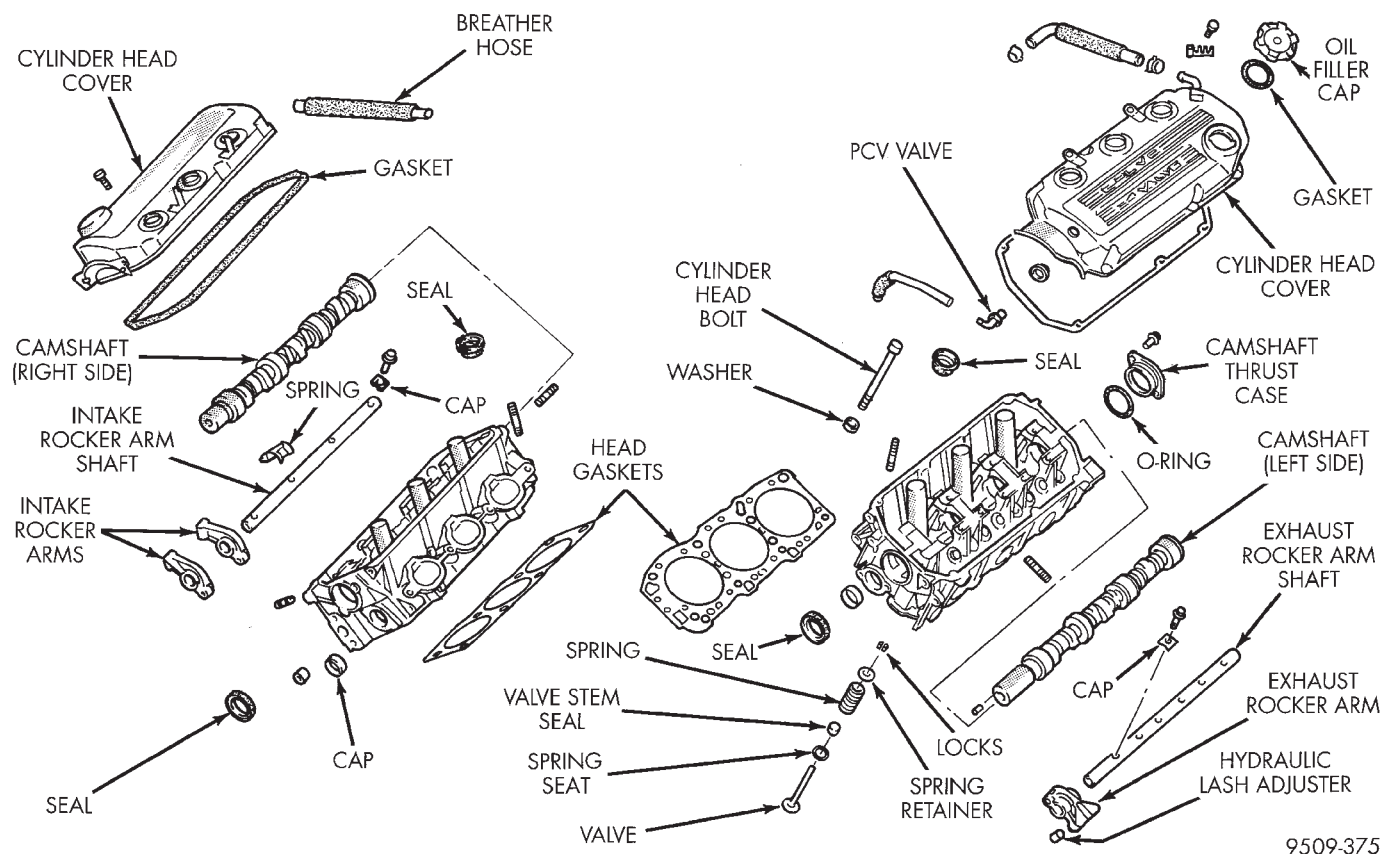


Fig. 32 Cylinder Head Components

REMOVAL

- (1) Remove air intake plenum. Refer to Group 11, Exhaust and Intake Manifolds for procedure.
- (2) Cover lower intake manifold with a suitable cover during service.
- (3) Disconnect and relocate spark plug wires.
- (4) Remove cylinder head cover screws and remove cover (Fig. 32).

INSTALLATION

NOTE: Before installation, clean cylinder head and cover mating surfaces. Make certain the rails are flat.

- (1) Clean cylinder head and cover mating surfaces. Install new gasket.
- (2) Install cover and tighten cover bolt washer and gasket assembly to 10 N·m (88 in. lbs.).

SPARK PLUG TUBE SEALS

The spark plug tube seals are located on the end of each tube (Fig. 33). These seals slide onto each tube to seal the cylinder head cover to spark plug tube. If

these seals show signs of hardness and/or cracks they should be replaced.

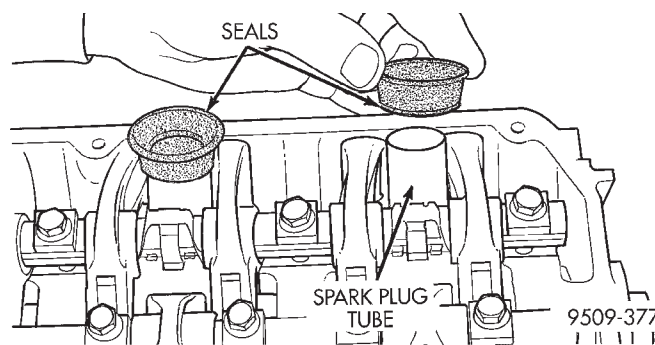


Fig. 33 Spark Plug Tube Seal

CYLINDER HEAD

REMOVAL

- (1) Refer to Timing Belt removal outlined in this section for disassembly, and remove camshaft sprockets.
- (2) Remove rocker arm assemblies. Refer to procedure outline in this section.

REMOVAL AND INSTALLATION (Continued)

(3) Remove upper intake manifold assembly. Refer to Group 11, Intake and Exhaust Manifolds for procedure.

(4) Remove distributor.

(5) Remove exhaust manifolds and cross over Refer to Group 11, Intake and Exhaust Manifolds for procedure.

(6) Remove cylinder head bolts and remove cylinder head.

INSTALLATION

(1) Clean surfaces of head and block, install head gasket over locating dowels.

(2) Install head on locating dowels.

(3) Install 10mm allen hex head bolts with washers.

(4) Tighten bolts in the order shown in (Fig. 34). When tightening the cylinder head bolts, tighten gradually, working in two or three steps and finally tighten to specified torque of 108 N·m (80 ft. lbs.).

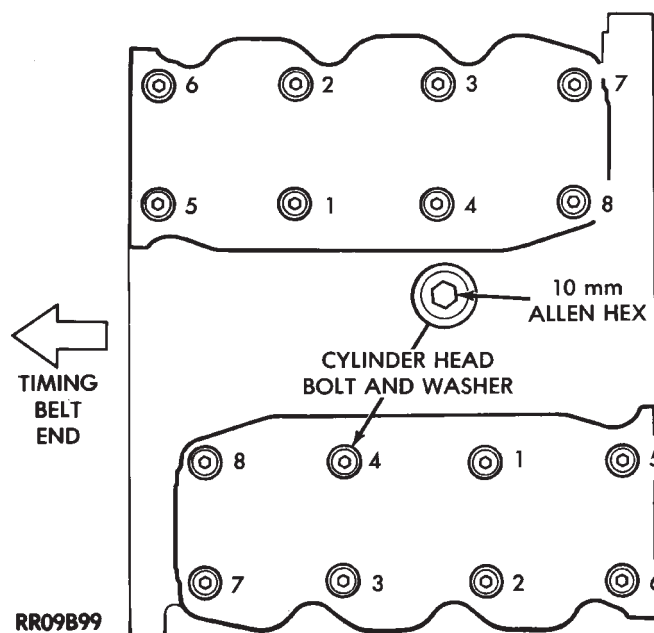


Fig. 34 Cylinder Head Bolt Tightening Sequence

ROCKER ARM AND HYDRAULIC ADJUSTER

REMOVAL

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

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

(3) Install auto lash adjuster retainers, Special Tool MD-998443 onto rocker arms (Fig. 35). These retainers hold the lash adjusters into position when the rocker arms are serviced.

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

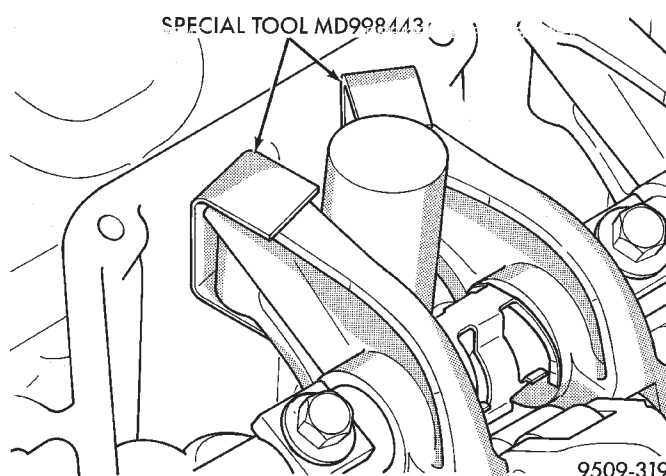


Fig. 35 Auto Lash Adjuster Retainers

(5) Mark rocker arm/hydraulic lash adjuster assemblies for reassembly in their original position. Remove rocker arm/hydraulic lash adjuster assembly. Lash adjusters are serviced as an assembly with the rocker arm (Fig. 36).

NOTE: The automatic lash adjusters are precision units installed in machined openings in the valve actuating ends of the rocker arms. Do not disassemble the auto lash adjuster.

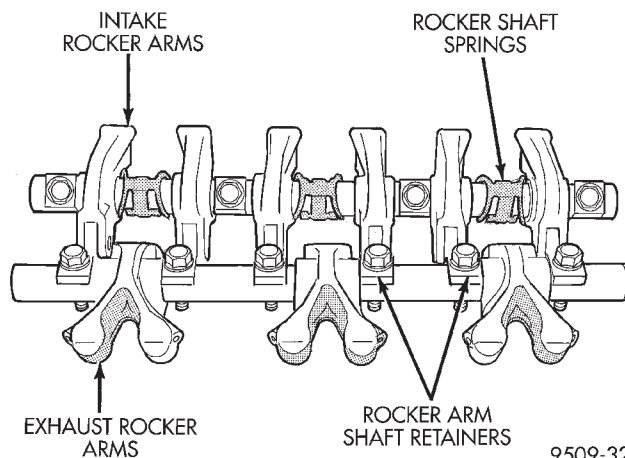


Fig. 36 Rocker Arm Shafts

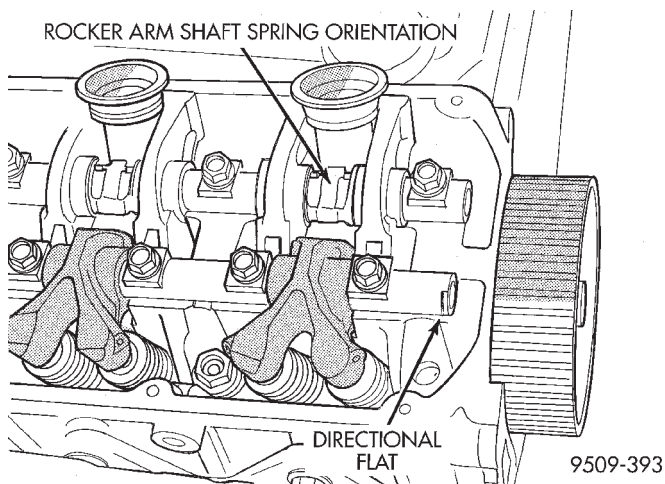
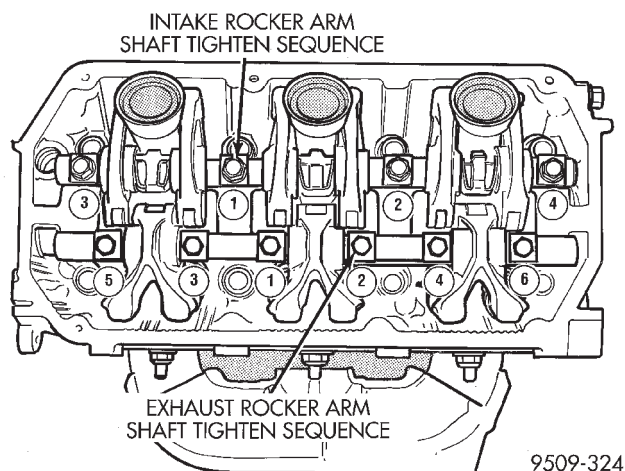
INSTALLATION

(1) Install rocker arm and shafts with the FLAT on the shafts facing the timing belt side of the right cylinder head (Fig. 37). For the left cylinder head, install rocker arm and shafts with the FLAT on the shafts facing the transmission side of the engine. Install the retainers and spring clips in their original positions on the exhaust and intake shafts (Fig. 36).

(2) Tighten bolts to 31 N·m (276 in. lbs.) in sequence shown in (Fig. 38).

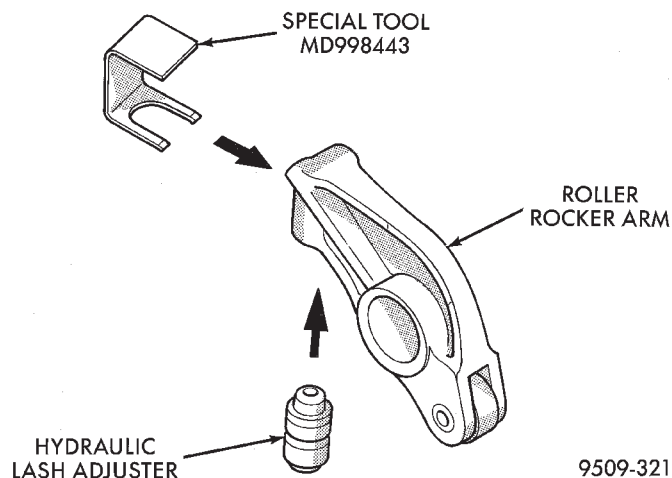
(3) Remove auto lash adjuster retainers Special Tool MD-998443 from rocker arms.

REMOVAL AND INSTALLATION (Continued)

**Fig. 37 Rocker Arm Shaft Flat****Fig. 38 Rocker Arm Shaft Tightening Sequence****CAMSHAFT****REMOVAL**

NOTE: Cylinder Head Must Be Removed

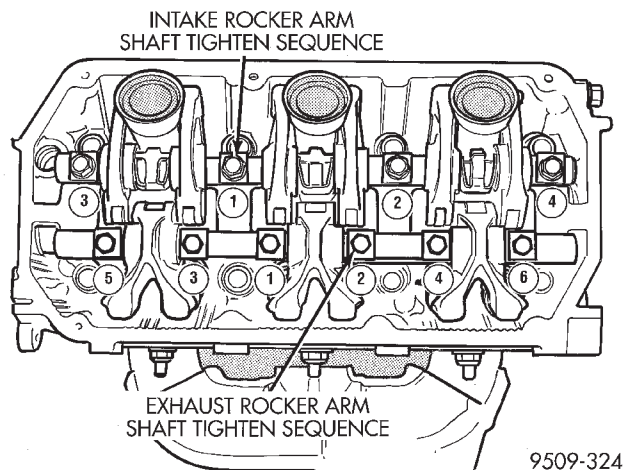
- (1) Remove the cylinder head covers.
- (2) Install auto lash adjuster retainers Special Tool MD-998443 (Fig. 39). These retainers hold the lash adjuster into position when the rocker arms are serviced.
- (3) Mark rocker arm shaft assemblies for installation.
- (4) Remove rocker arm shaft bolts. Refer to procedure outlined in this section.
- (5) Remove the timing belt and camshaft sprocket. Refer to timing belt and sprocket removal outlined in this section.
- (6) Remove cylinder head retaining bolts. Remove cylinder head from vehicle.
- (7) Remove thrust case from left head assembly and remove camshaft from the rear of the head.

**Fig. 39 Retainer Auto Lash Adjuster**

- (8) Remove distributor from right head assembly and remove camshaft from the rear of the head.

INSTALLATION

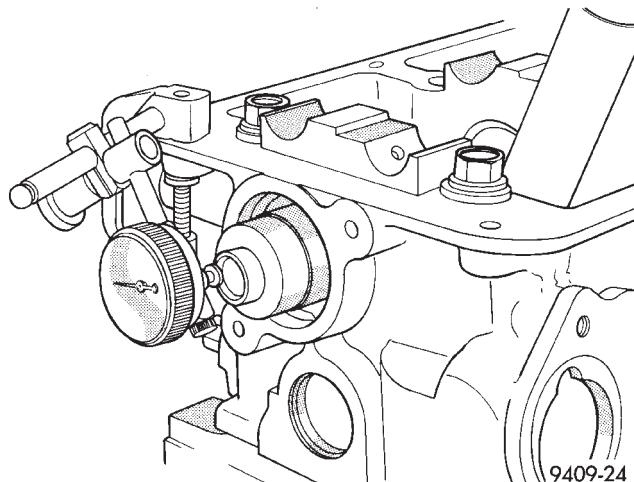
- (1) Lubricate camshaft journals. Install camshaft into the cylinder head carefully.
- (2) Install thrust case and tighten fasteners to 13 N·m (108 in. lbs.).
- (3) Install camshaft seal. Camshaft must be installed before the camshaft seal is installed. Refer to procedure outlined in this section.
- (4) Install camshaft sprocket and tighten to 88 N·m (65 ft. lbs.).
- (5) Install timing belt. (Refer to procedure outlined in this section).
- (6) Install rocker arm assemblies in correct order as removed. Tighten the rocker arm assemblies in sequence shown in (Fig. 40) to 31 N·m (276 in. lbs.).

**Fig. 40 Rocker Arm Shaft Tightening Sequence****CAMSHAFT END PLAY**

- (1) Oil camshaft journals and install camshaft without rocker arm assemblies.

REMOVAL AND INSTALLATION (Continued)

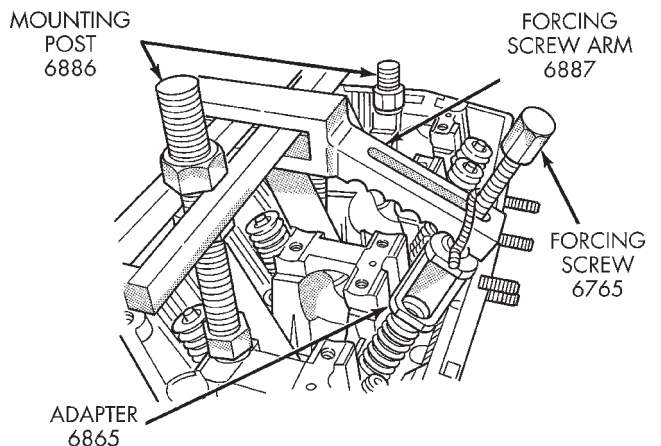
- (2) Using a suitable tool, move camshaft as far rearward as it will go.
- (3) Zero dial indicator (Fig. 41).
- (4) Move camshaft as far forward as it will go.
- (5) End play travel: 0.1 - 0.2 mm (0.004 - 0.008 inch.). Max. Travel: 0.4 mm (0.016 in.)

**Fig. 41 Camshaft End Play**

VALVE SPRINGS AND SEALS IN VEHICLE

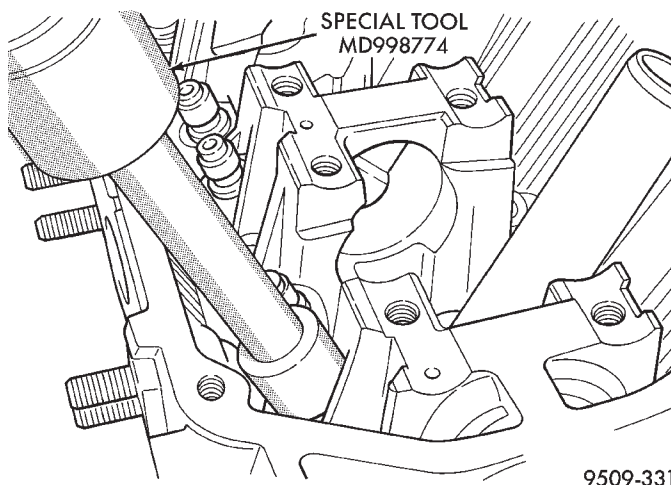
REMOVAL

- (1) Remove rocker arm shafts assemblies as previously outlined in this section.
- (2) Rotate crankshaft until piston is at TDC on compression.
- (3) With air hose attached to adapter tool installed in spark plug hole, apply 90-120 psi air pressure.
- (4) Use Special Tool MD-998772A with Mounting Post 6886, Forcing Screw Arm 6887, Forcing Screw 6765 and adapter 6865 (Fig. 42) to compress valve springs and remove valve locks.
- (5) Remove valve spring.
- (6) Remove valve stem seal by using a valve stem seal tool.

**Fig. 42 Valve Springs—Removing and Installing**

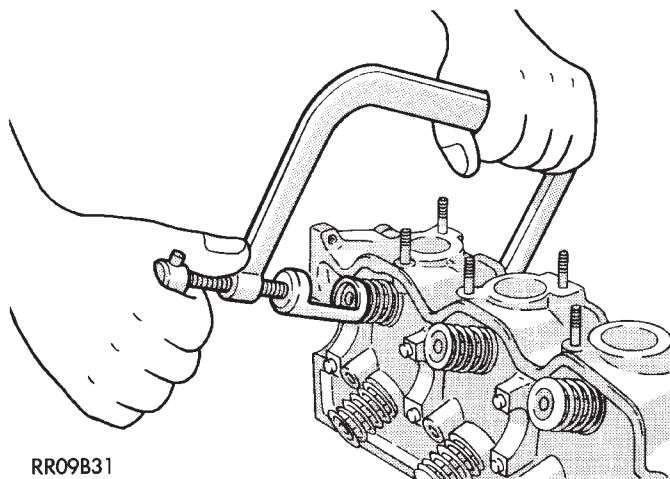
INSTALLATION

- (1) Install valve seal (Fig. 43) as outlined in valve installation outlined in this section.
- (2) Use Special Tool MD-998772A with Mounting Post 6886, Forcing Screw Arm 6887, Forcing Screw 6765 and adapter 6865 (Fig. 42) to compress valve springs only enough to install locks. Correct alignment of tool is necessary to avoid nicking valve stems (air pressure required), piston at TDC.

**Fig. 43 Valve Stem Seals—Installed**

- (3) Install rocker arm and lash adjuster assemblies as previously outlined in this section.
- (4) Install cylinder head cover as previously outlined in this section.

VALVE AND VALVE SEALS—HEAD OFF

**Fig. 44 Valves Removal—Typical**

- (1) With valve spring compressor Special Tool C-3422B with adapter 6526 or equivalent, remove spring retainer locks, retainer, valve spring, and valve (Fig. 44).

REMOVAL AND INSTALLATION (Continued)

(2) Remove valve stem seals with suitable tool (Fig. 45). Do not reuse valve stem seals.

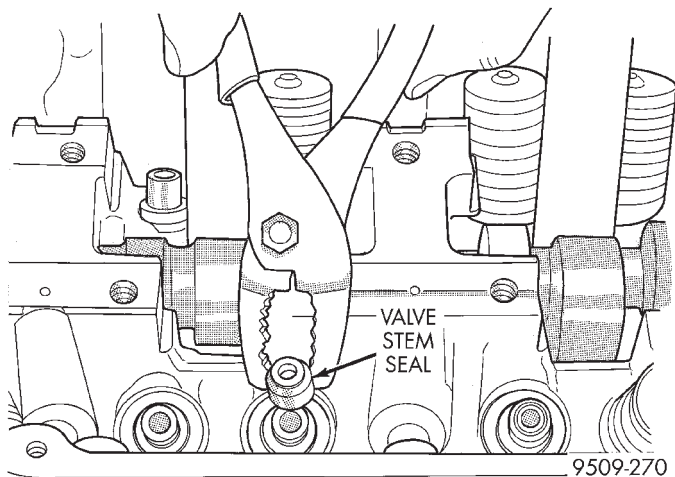


Fig. 45 Valve Stem Seals—Removal

INSTALLATION

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

(2) Install valve spring seat.

(3) Install the silver valve seal onto the intake valve guide and the black seal onto the exhaust valve guide (Fig. 46). Using Special Tool MD-998774 install seal by tapping lightly until seal is in place (Fig. 47).

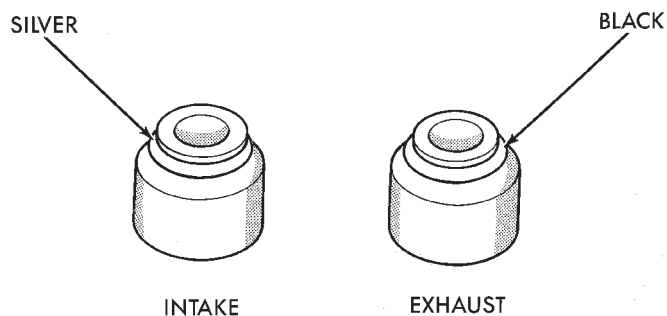


Fig. 46 Valve Stem Seals Identification

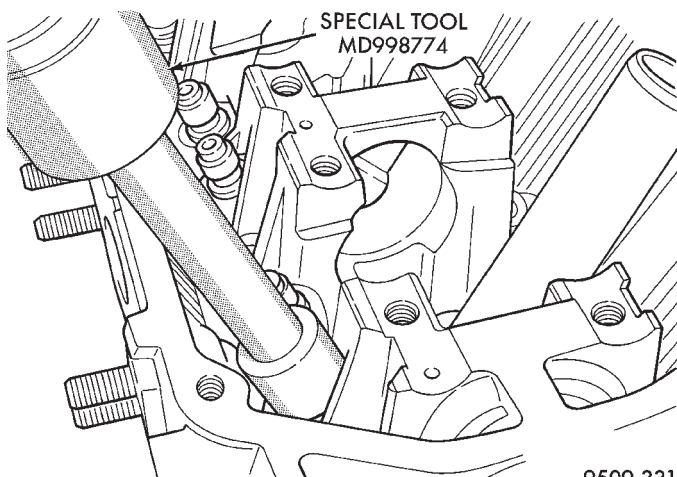


Fig. 47 Valve Stem Seals—Installed

(4) Install valve spring with the enamelled ends facing the rocker arms (Fig. 48). Install valve springs and retainers. Compress valve springs only enough to install locks, taking care not to misalign the direction of compression. Nicked valve stems may result from misalignment of the valve spring compressor.

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

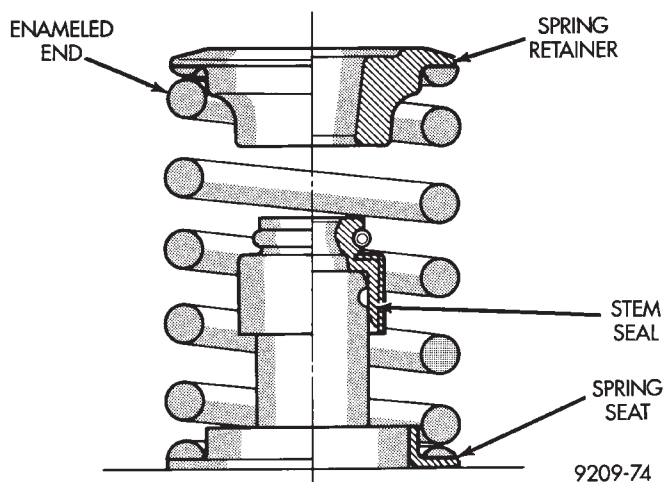


Fig. 48 Valve Spring Position—Installed

CRANKSHAFT DAMPER

(1) Remove drive belt splash shield (Fig. 49).

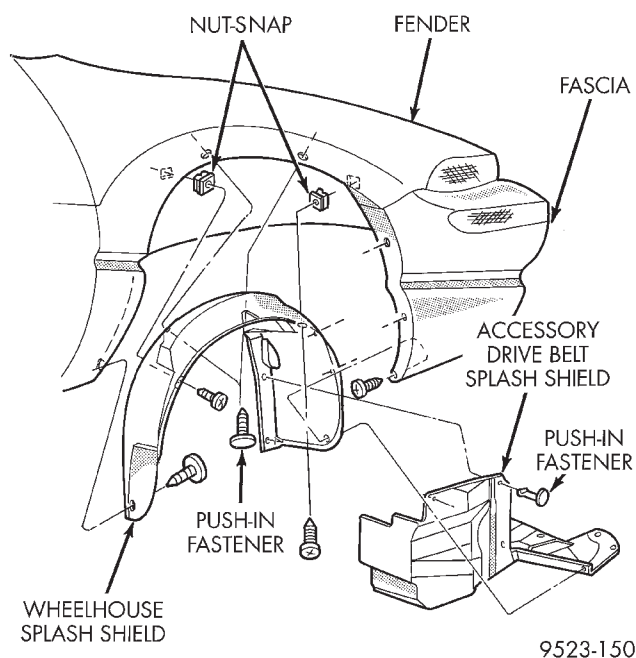


Fig. 49 Drive Belt Splash Shield

(2) Remove accessory drive belts. Refer to Group 7, Cooling System for procedure.

REMOVAL AND INSTALLATION (Continued)

(3) Remove crankshaft center bolt (Fig. 50) and remove crankshaft damper.

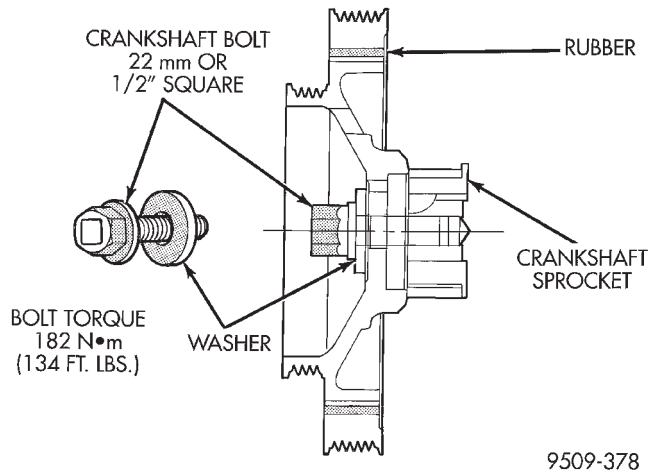


Fig. 50 Crankshaft Damper

(4) Reverse Procedure for Installation. See (Fig. 50) for crankshaft bolt torque.

TIMING BELT COVERS

REMOVAL

(1) Remove right inner slash shield. Refer to Group 23, Body for procedure.

(2) Remove the accessory drive belts. Refer to Group 7, Cooling System in for service procedure.

(3) Remove right engine mount. Refer to Engine Mounts in this section for procedure.

(4) Remove crankshaft damper. Refer to Crankshaft Damper Removal in this section.

NOTE: To remove engine mount bracket the lower timing belt cover must be removed first.

(5) Remove the engine mount bracket (Fig. 51).

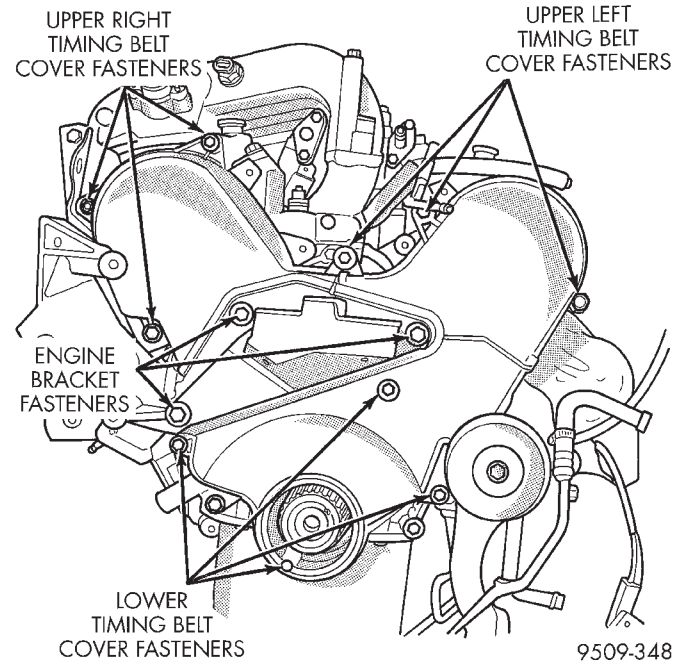


Fig. 51 Timing Belt Covers

(6) Remove the timing belt covers (Fig. 51). Remove covers in this order:

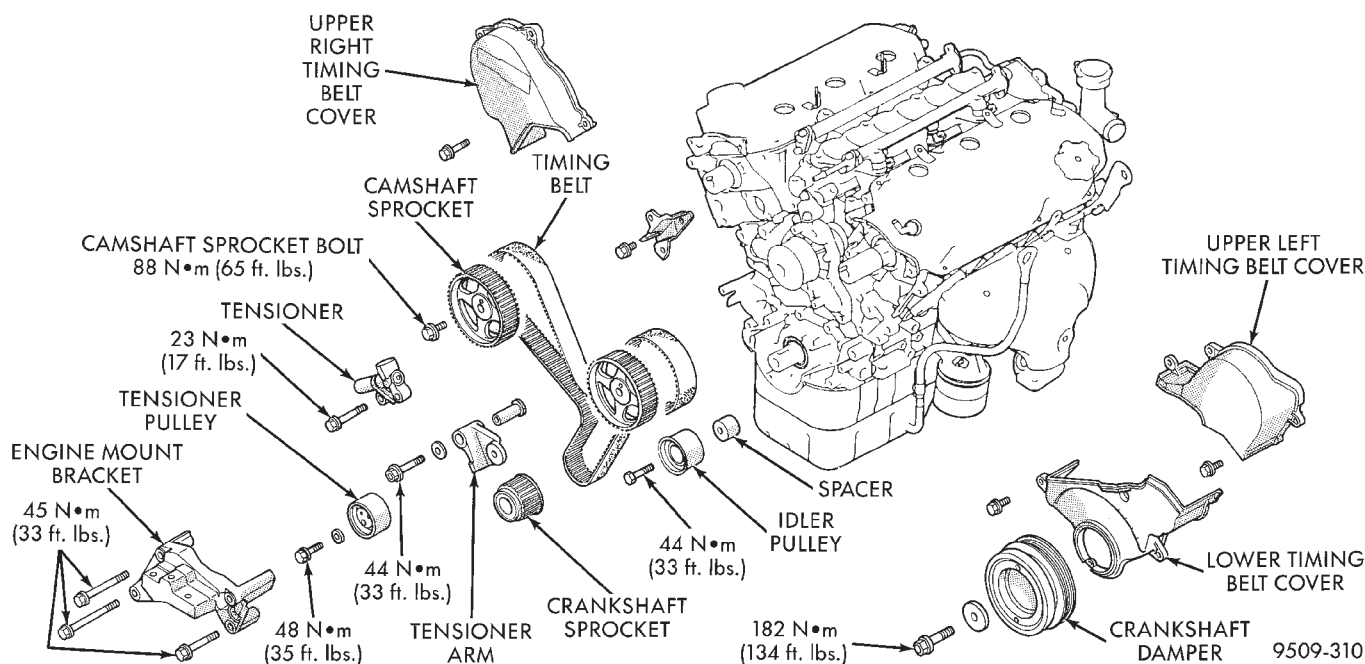
- The upper left cover.
- The lower cover.
- The upper right cover.

NOTE: To remove right/rear timing belt cover, the power steering pump bracket must be removed.

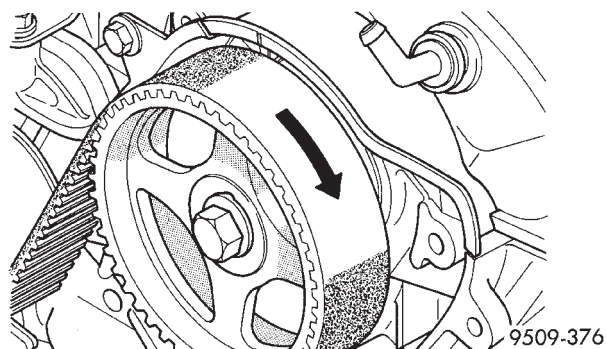
(7) To install reverse previous procedures.

REMOVAL AND INSTALLATION (Continued)

TIMING BELT

**Timing Belt System****TIMING BELT—REMOVAL**

(1) Mark belt running direction for installation (Fig. 52).

**Fig. 52 Mark Direction of Timing Belt**

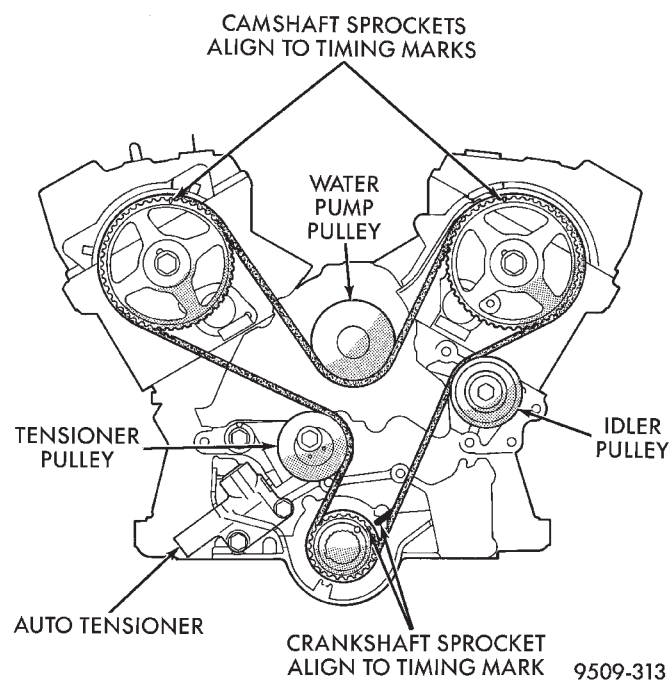
(2) Loosen timing belt auto tensioner bolts (Fig. 53) and remove timing belt.

CAMSHAFT AND CRANKSHAFT TIMING PROCEDURE**TIMING BELT TENSIONER**

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

(2) Place the tensioner into a vise and slowly compress the plunger (Fig. 54).

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

**Fig. 53 Timing Belt Engine Sprocket Timing**

proper pin orientation when tensioner is installed on the engine.

(3) Compress plunger into the tensioner body. Install a pin through the body to retain the plunger.

REMOVAL AND INSTALLATION (Continued)

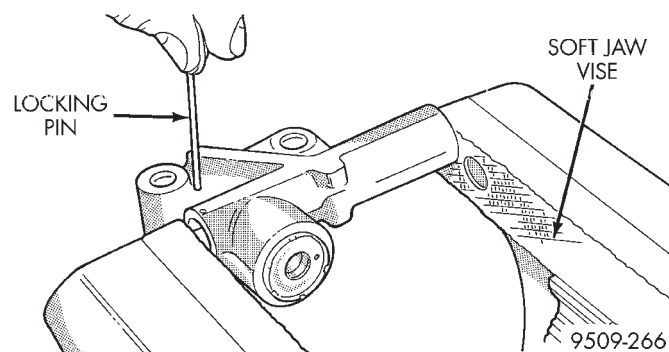


Fig. 54 Compressing Timing Belt Tensioner
TIMING BELT—INSTALLATION

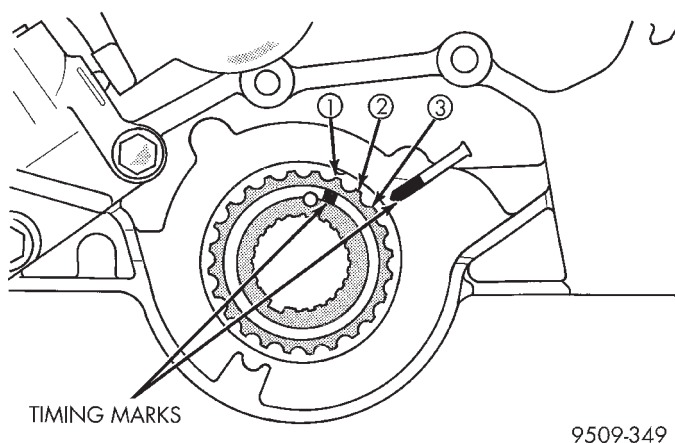


Fig. 55 Crankshaft Sprocket Timing

(1) Set crankshaft sprocket to TDC by aligning the sprocket with the mark on the oil pump housing, then back off to 3 notches before TDC (Fig. 55).

(2) Set camshaft sprockets to the aligning marks on the sprockets with the marks on the rear timing belt cover (Fig. 56).

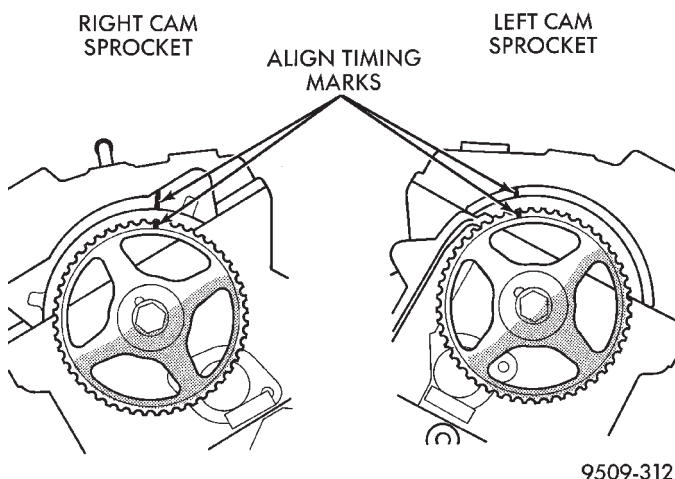


Fig. 56 Camshaft Sprocket Timing

(3) Install timing belt on rear camshaft sprocket first and install a binder clip on the belt and sprocket so the belt will not slip out of position. Keeping the belt taught, install under the water pump pulley and then around the front camshaft sprocket. Install an additional binder clip on the front sprocket and belt.

(4) Rotate the crankshaft to TDC (Fig. 57). Continue routing the belt by the idler pulley and around the crankshaft sprocket to the tensioner pulley.

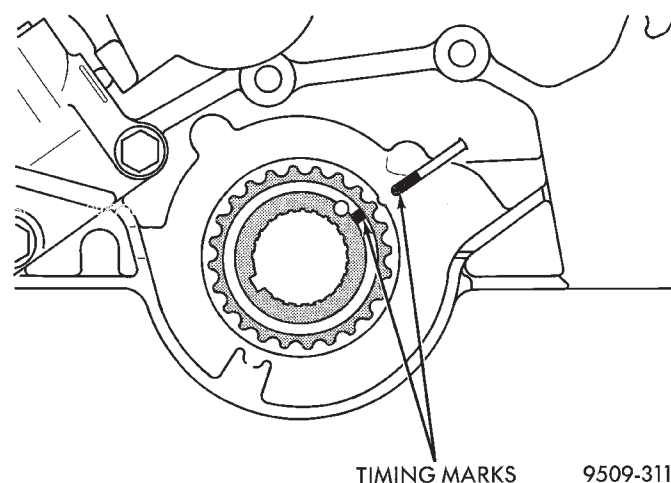


Fig. 57 Adjusting Crankshaft Sprocket for Timing Belt

(5) Apply rotating force to the crankshaft sprocket in the clockwise direction, to tension belt, check that all timing marks are aligned.

(6) Using Special Tool MD 998767 and a torque wrench on the tensioner pulley. Apply 4.4 N·m (38.9 in. lbs.) of torque to tensioner (Fig. 58). Tighten tensioner pulley bolt to 48 N·m (35 ft. lbs.).

(7) With torque being applied to the tensioner pulley install the tensioner to the tensioner pulley bracket and tighten fasteners to 23 N·m (205 in. lbs.).

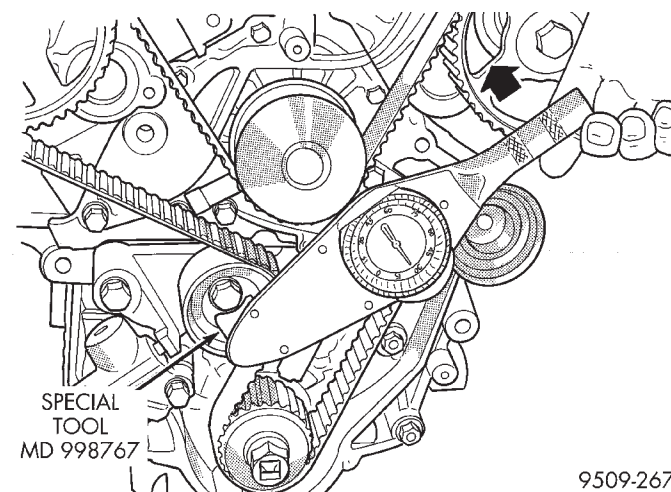


Fig. 58 Adjusting Drive Belt Tension

REMOVAL AND INSTALLATION (Continued)

- (8) Pull tensioner plunger pin.
- (9) Rotate crankshaft 2 revolutions in a clockwise direction ONLY and check the alignment of the timing marks (Fig. 53). Install tensioner pin into assembly. The pin should slide in and out without any resistance. If the pin does not slide freely, perform the procedure again.
- (10) Install front half of timing cover and engine mount bracket (Fig. 51).
- (11) Install right engine mount. Refer to procedure outlined in this section.
- (12) Remove jack from under engine.
- (13) Install crankshaft damper and crankshaft damper bolt and tighten to 182 N·m (134 ft. lbs.). Refer to procedure outline in this section.
- (14) Install accessory drive belts. Refer to the Accessory Drive section located in Group 7 Cooling System, for the procedure.
- (15) Raise vehicle on hoist and install right inner splash shield.

CAMSHAFT SPROCKETS

REMOVAL

- (1) Hold camshaft sprocket with Special Tool 6847 loosen and remove bolt and washer (Fig. 59).
- (2) Remove camshaft sprocket from camshaft.

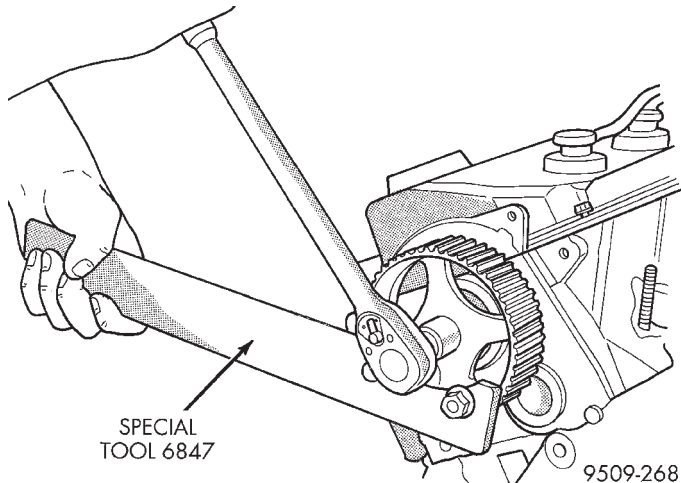


Fig. 59 Camshaft Sprockets—Removal and Installation

INSTALLATION

- (1) Place camshaft sprocket on camshaft.
- (2) Install bolt and washer to camshaft. Using Special Tool 6847 hold camshaft sprocket and torque bolt to 88 N·m (65 ft. lbs.) (Fig. 59).

CAMSHAFT OIL SEAL

- (1) Apply light coat of engine oil to the camshaft oil seal lip.
- (2) Install the oil seal using Special Tool MD998713 or 6863 camshaft oil seal installers (Fig. 60) and (Fig. 61).

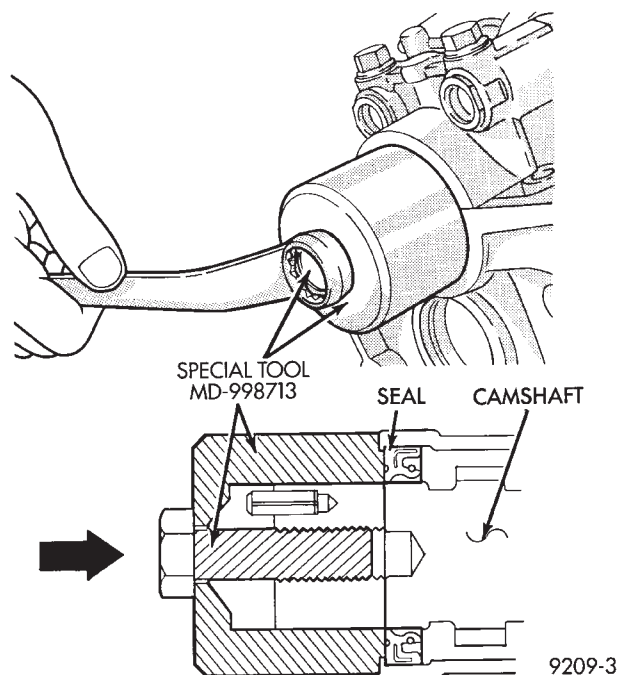


Fig. 60 Right Cylinder Head—Installing Camshaft Oil Seal

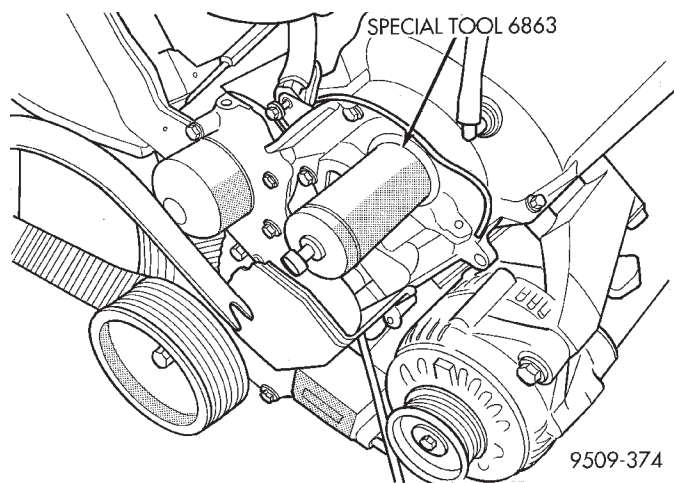


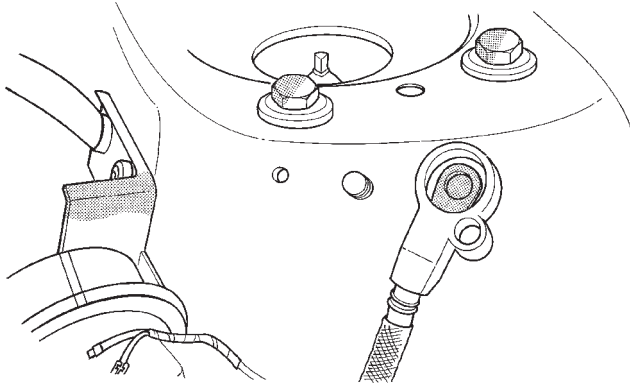
Fig. 61 Left Cylinder Head—Installing Camshaft Oil Seal

REMOVAL AND INSTALLATION (Continued)

OIL PAN

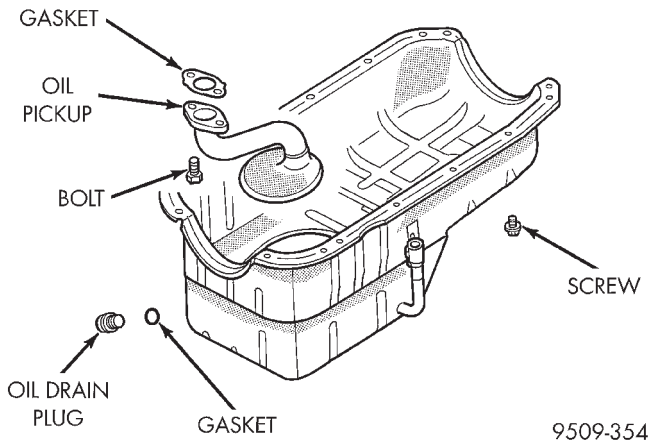
REMOVAL

- (1) Disconnect battery negative remote cable (Fig. 62).
- (2) Remove oil drain plug and drain oil (Fig. 63).



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Fig. 62 Remote Battery Cable Negative



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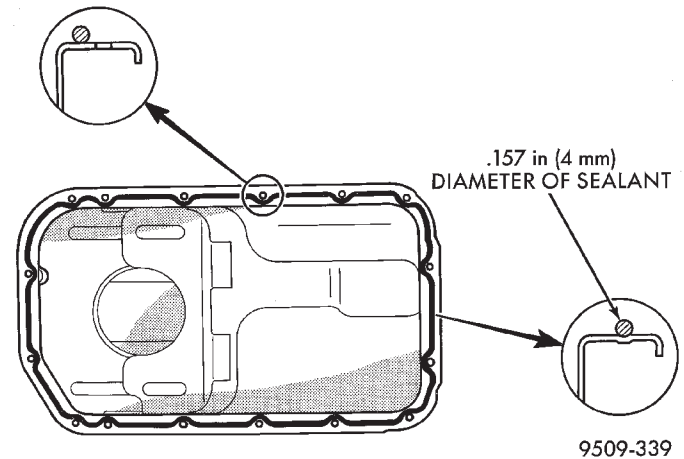
Fig. 63 Oil Pan

- (3) Remove engine support module. Refer to procedure in this section.
- (4) Remove dipstick tube.
- (5) Remove starter motor. Refer to Group 8B, Battery/Starter/Generator Service for procedure.
- (6) Remove engine to transaxle struts.
- (7) Remove transaxle inspection cover.
- (8) Remove oil pan.

INSTALLATION

NOTE: Oil pan to cylinder block sealing is provided with Mopar Silicone Rubber Adhesive Sealant or equivalent gasket material. See Form-In-Place Gaskets in Standard Service Procedures.

- (1) Apply sealant as shown in (Fig. 64).



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Fig. 64 Oil Pan Sealing

- (2) Install pan and tighten screws to 6 N·m (50 in. lbs.).
- (3) Reverse removal procedure for installation.
- (4) Install correct amount of new oil.

REMOVAL AND INSTALLATION (Continued)

FRONT CRANKSHAFT OIL SEAL

REMOVAL

- (1) Remove crankshaft damper. Refer to procedure in this section.
- (2) Remove timing belt. Refer to procedure in this section.
- (3) Remove crankshaft sprocket and key.
- (4) Pry out the front seal with a flat tip screwdriver. Cover the end of the screwdriver with a shop towel.

CAUTION: Be careful not to nick or damage crankshaft flange surface or oil pump housing bore.

INSTALLATION

- (1) Install front crankshaft seal into oil pump housing using Special Tool MD-998717 (Fig. 65).
- (2) Reverse removal procedure for installation.

CRANKSHAFT

The crankshaft is supported in four main bearings. All upper bearing shells in the crankcase have oil grooves. All lower bearing shells in the monoblock main bearing cap are plain. Crankshaft end play is controlled by thrust washers on the number three main bearing journal.

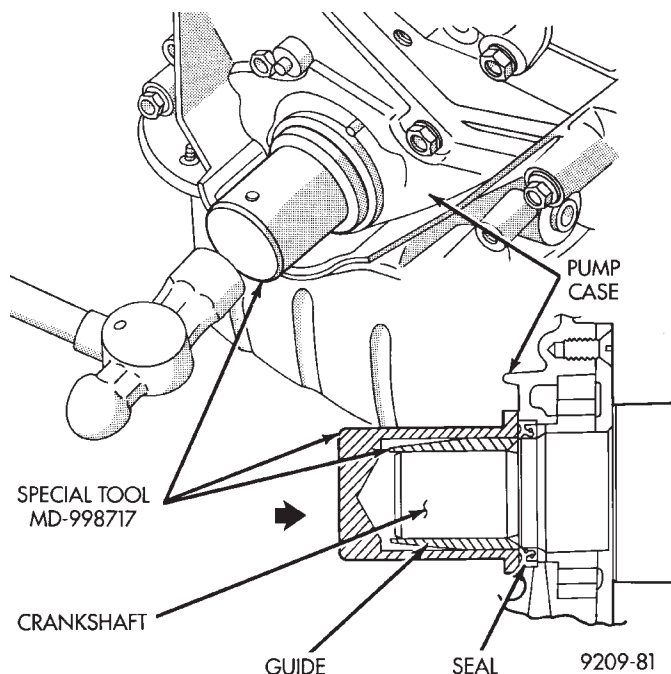


Fig. 65 Front Crankshaft Oil Seal

REMOVAL

- (1) Remove front mounted oil pump assembly and gasket (Fig. 66) and (Fig. 67).

TORQUE	
Ⓐ	10 N·m (88 IN. LBS.)
Ⓑ	15 N·m (130 IN. LBS.)
Ⓒ	83 N·m (61 FT. LBS.)

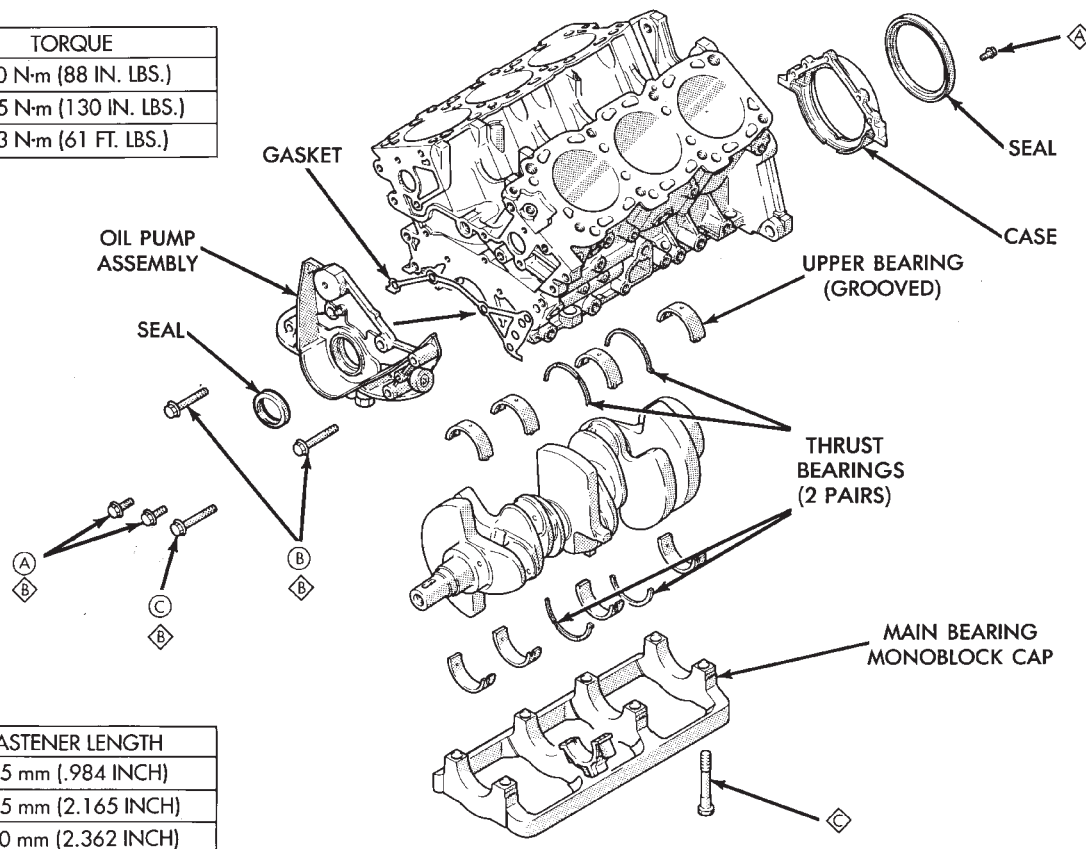
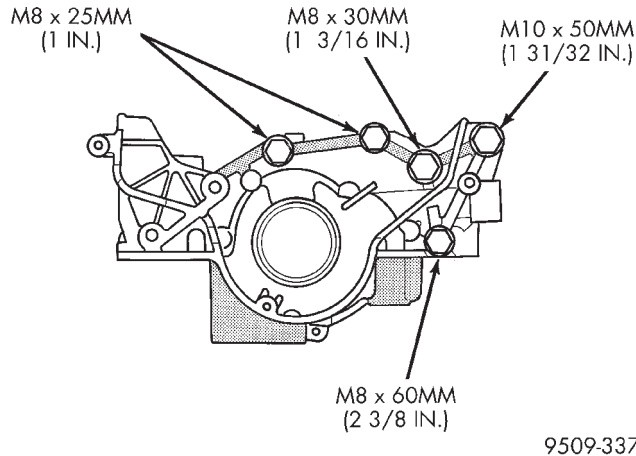


Fig. 66 Crankshaft and Cylinder Block

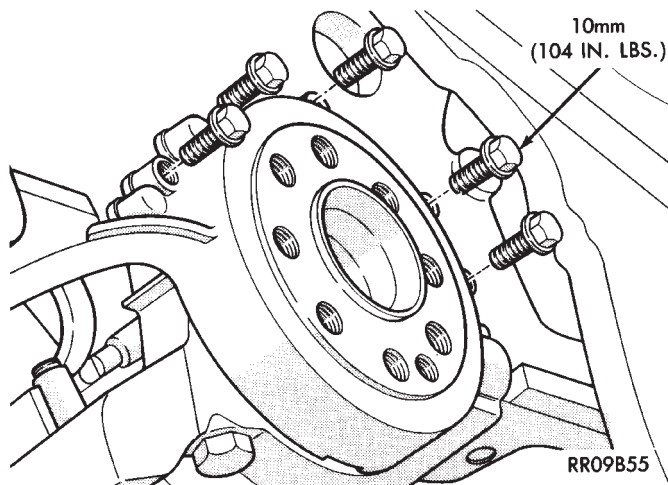
REMOVAL AND INSTALLATION (Continued)

**Fig. 67 Oil Pump**

(2) Remove rear oil seal retainer and seal as assembly (Fig. 68).

(3) Release monoblock main bearing cap bolts evenly. Remove lower bearing shells and identify for reassembly.

(4) Lift out crankshaft and remove upper thrust washers from each side of number three main bearing in the crankcase (Fig. 66).

**Fig. 68 Rear Seal Assembly****INSTALLATION**

(1) Install upper main bearing shells making certain oil holes are in alignment, and bearing tabs seat in block tabs. All upper bearings have oil grooves (Fig. 69).

(2) **THRUST BEARINGS.** Crankshaft thrust bearings (washers) are installed at journal #3 separately from the radial bearings. Thrust bearings are different, one has end positioning tabs, while the other is plain. One **pair** of each thrust washers are installed into the block and one **pair** into the main bearing cap (Fig. 69).

(3) Apply a thin film of grease to plain side of thrust washers and position them on each side of number three main bearing. Grooved surface towards crankshaft.

(4) Oil the bearings and journals and install crankshaft.

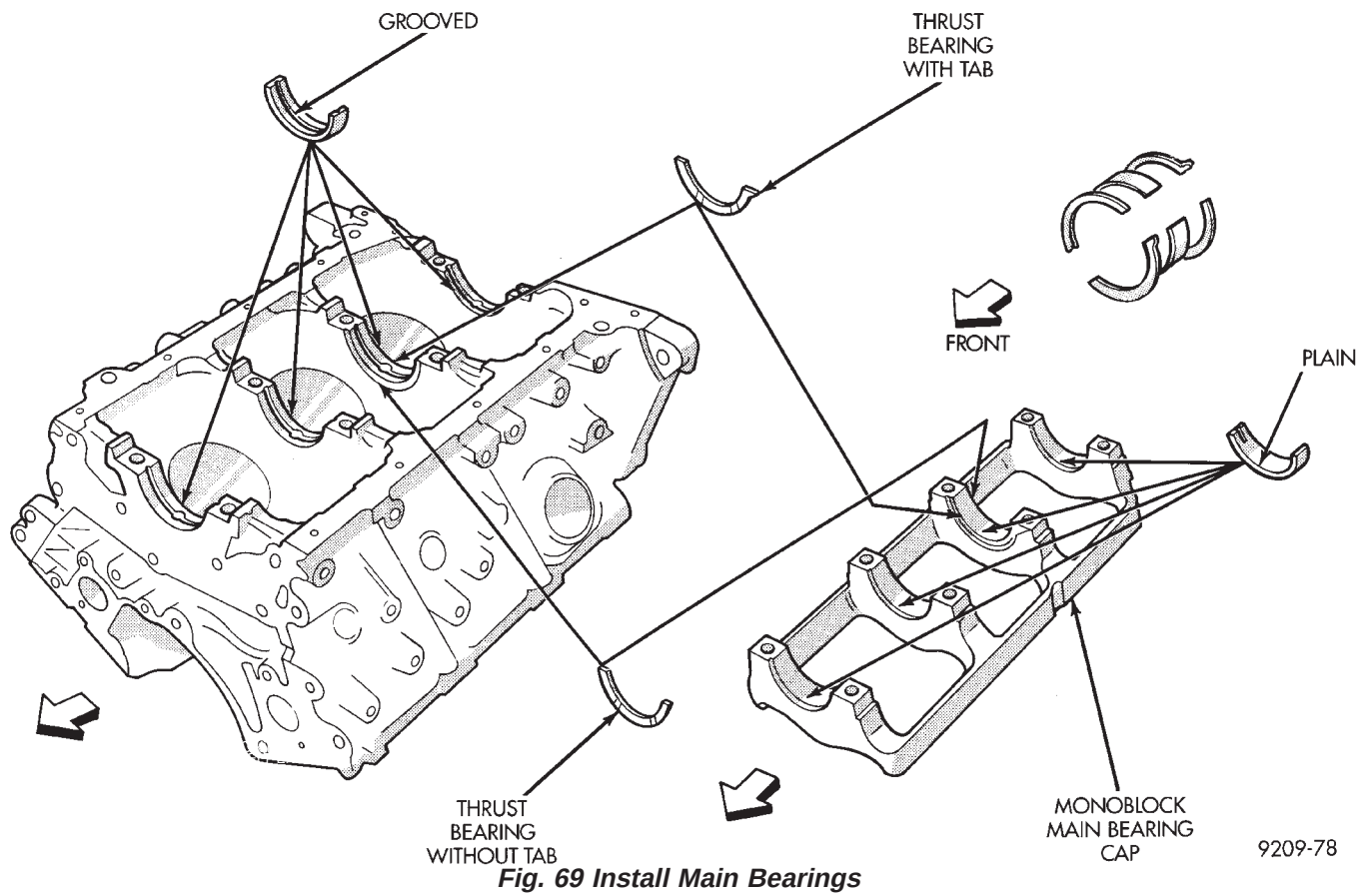
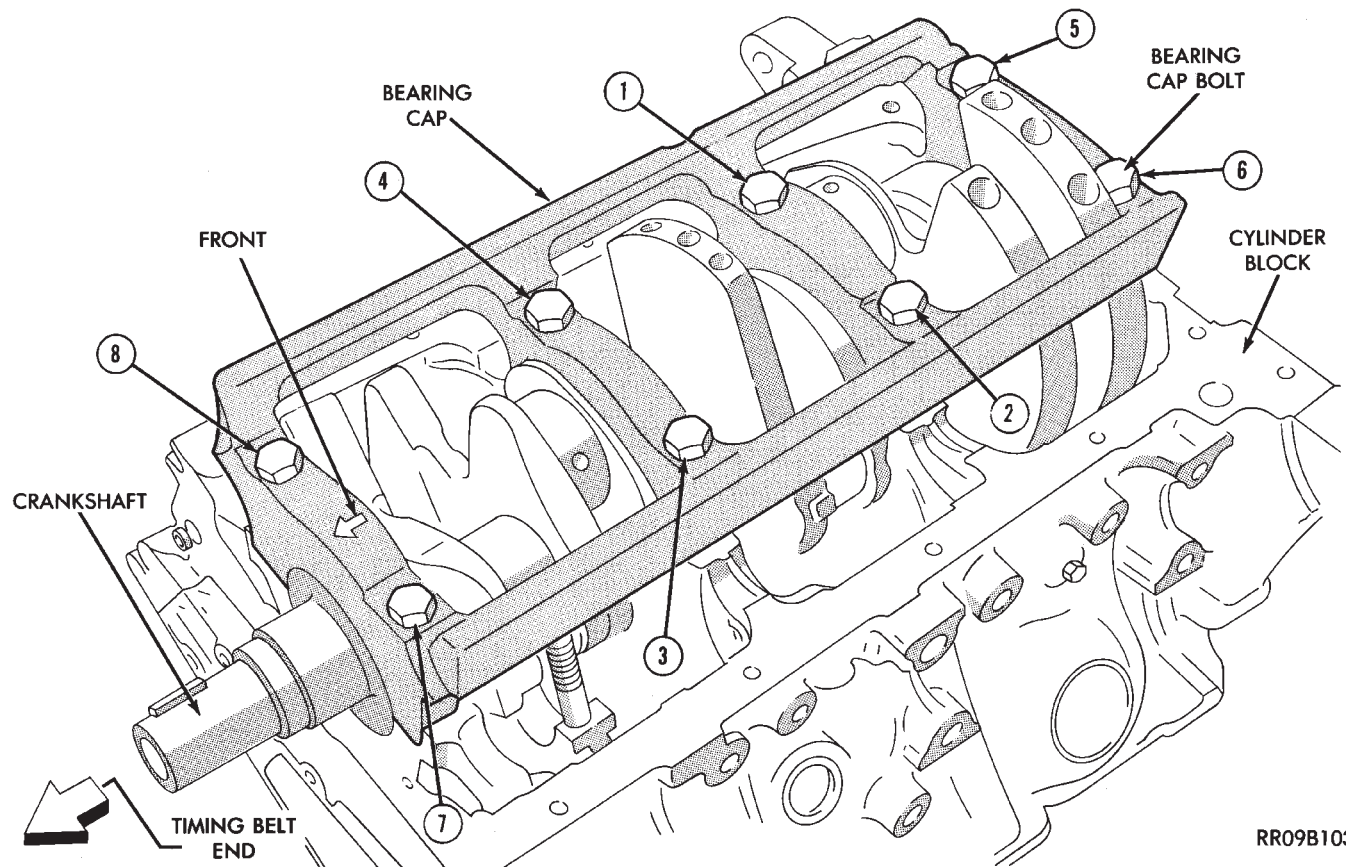
(5) Install lower main bearing shells without oil grooves in monoblock cap.

(6) Install one pair of thrust washers in cap.

(7) Carefully install bearing cap with arrows (Fig. 70) toward timing belt end.

(8) Oil the bearing cap bolt threads, install and tighten bolts progressively in sequence shown in (Fig. 70) to 94 N·m (69 ft. lbs.) torque.

REMOVAL AND INSTALLATION (Continued)

**Fig. 69 Install Main Bearings****Fig. 70 Crankshaft Main Bearing Cap**

REMOVAL AND INSTALLATION (Continued)

CHECKING CRANKSHAFT END PLAY

- (1) Mount a dial indicator to front of engine, locating probe on nose of crankshaft (Fig. 71).
- (2) Move crankshaft all the way to the rear of its travel.
- (3) Zero the dial indicator.

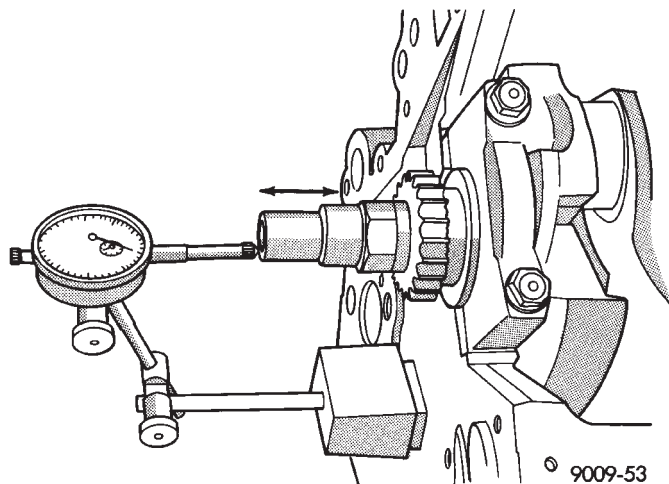


Fig. 71 Crankshaft End Play—Typical

- (4) Move crankshaft all the way to the front and read the dial indicator. Refer to (Fig. 72) for specification.

CRANKSHAFT END-PLAY		
NEW PART:	.05 TO 0.25 mm	(.002 TO .0010 in.)
WEAR LIMIT:	0.30 mm	(.012 in.)
MAIN BEARING OIL CLEARANCE		
NEW PART:	.020 TO .048 mm	(.0008 TO .0018 in.)
WEAR LIMIT:	.10 mm	(.0039 in.)
CRANKSHAFT JOURNAL SIZES		
CRANKSHAFT MAIN BEARING JOURNAL		
ALL	DIAMETER	
STANDARD	59.980 mm	(2.361 in.)
CRANKSHAFT CONNECTING ROD JOURNAL		
ALL	DIAMETER	
STANDARD	50.00 mm	(1.968 in.)

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Fig. 72 Crankshaft Specifications

REAR CRANKSHAFT SEAL AND RETAINER

INSTALLATION

- (1) Install rear crankshaft oil seal in housing with Special Tool MD998718 (Fig. 73).
- (2) Apply (Mopar Silicone Rubber Adhesive Sealant or equivalent) to oil seal housing (Fig. 74) per procedure detailed in form-in-place gasket section in Standard Service Procedures.
- (3) Apply light coating of engine oil to the entire circumference of oil seal lip.

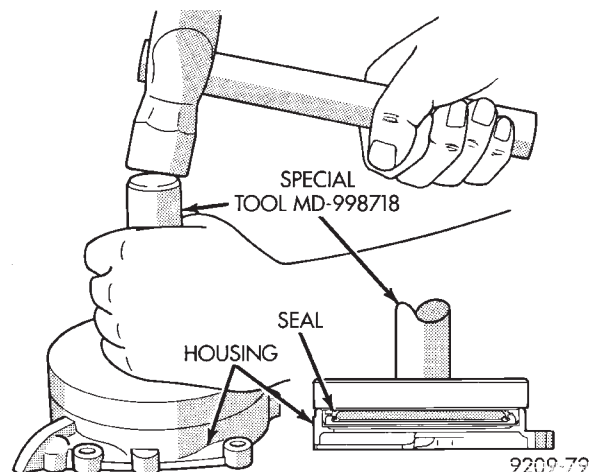


Fig. 73 Install Crankshaft Rear Oil Seal

- (4) Install seal assembly on cylinder block and tighten bolts to 11 N·m (96 in. lbs.)

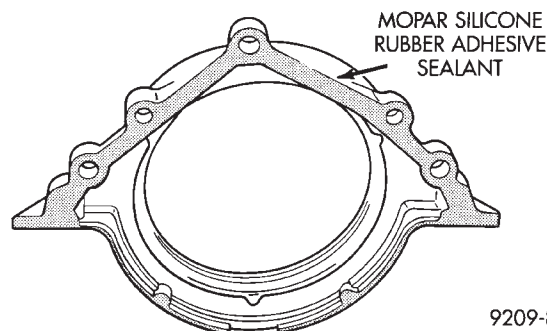


Fig. 74 Apply Sealant to Oil Seal Housing

OIL FILTER

CAUTION: When servicing the oil filter (Fig. 75) avoid deforming the filter can by installing the remove/install tool band strap against the can-to-base lockseam. The lockseam joining the can to the base is reinforced by the base plate.

- (1) Turn counter clockwise to remove.
- (2) To install, lubricate new filter gasket. Screw filter on until gasket contacts base. Tighten to 14 N·m (10 ft.lbs.).

OIL PUMP

REMOVAL

- (1) Remove accessory drive belts. Refer to Group 7, Cooling System for procedure.
- (2) Remove crankshaft damper. Refer to procedure in this section.
- (3) Remove Timing Belt. Refer to procedure in this section.
- (4) Remove bolts that attach oil pump to block (Fig. 76).

REMOVAL AND INSTALLATION (Continued)

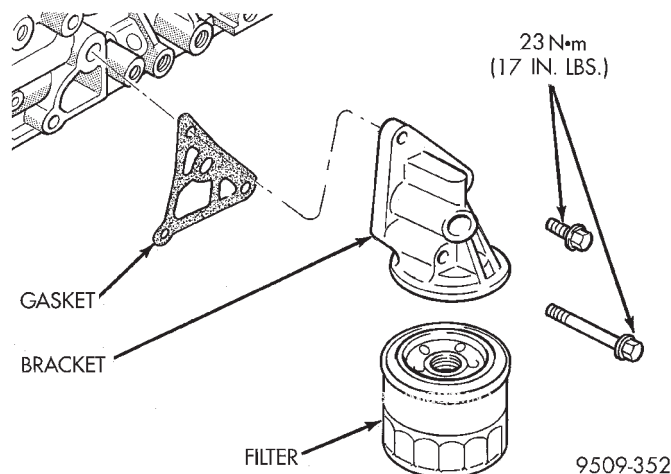


Fig. 75 Oil Filter and Bracket

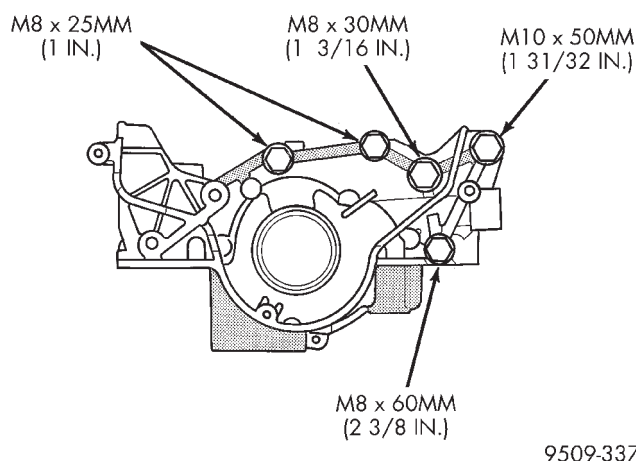


Fig. 76 Oil Pump Assembly

INSTALLATION

- (1) Clean block and pump surfaces.
- (2) Prime oil pump before installation by filling rotor cavity with clean engine oil.
- (3) Apply mopar gasket maker to oil pump as shown in (Fig. 77). Install oil-ring into the counter bore on the oil pump body discharge passage.
- (4) Install oil pump slowly onto crankshaft until seated to engine block. Tighten fasteners to M8 bolts 14 N·m (10 ft. lbs.) M10 bolts 41 N·m (30 ft. lbs.). See (Fig. 76) for bolt location and length.

PISTON AND CONNECTING ROD

REMOVAL

- (1) Identify pistons with matching cylinder. **The pistons are not interchangeable from bank to bank** (Fig. 78). Pistons with the letter R and arrow toward the front of engine are to be installed in cylinders 1-3- 5. Pistons with the letter L and arrow toward the front of engine are to be installed in cylinders 2-4-6.

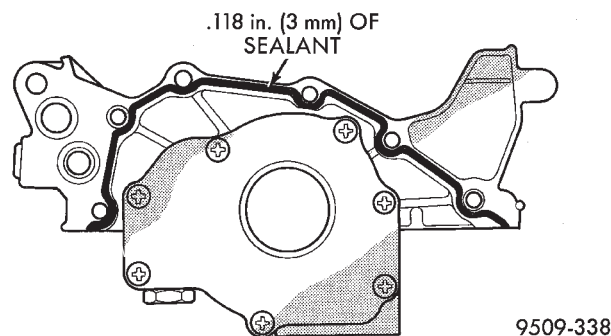


Fig. 77 Oil Pump Sealing

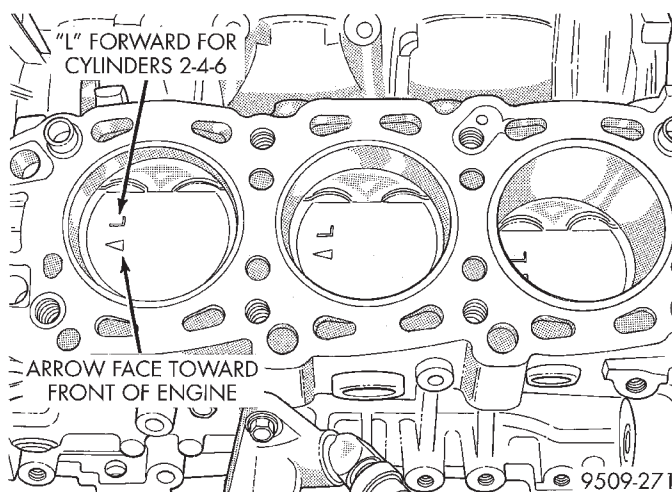


Fig. 78 Mark Pistons

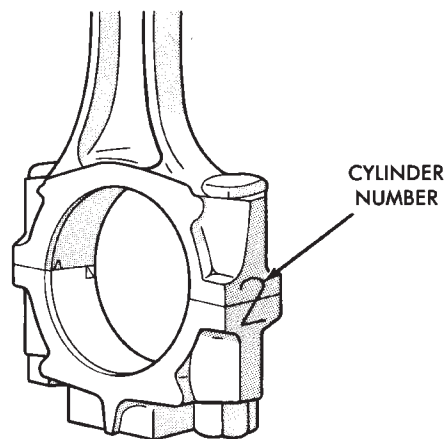


Fig. 79 Mark Matching Parts

- (2) Mark connecting rod and cap with cylinder number (Fig. 79).
- (3) Remove piston rings (Fig. 80).

INSTALLING PISTON RINGS

- (1) The No. 1 and No. 2 piston rings have a different cross section. Install rings with manufacturers mark and size mark facing up, to the top of the piston (Fig. 81).

REMOVAL AND INSTALLATION (Continued)

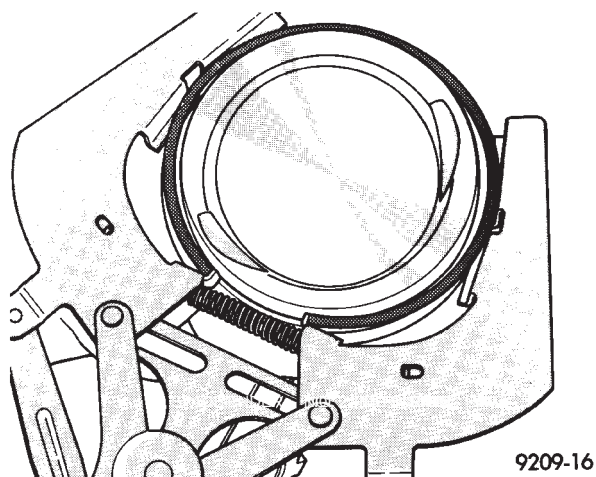


Fig. 80 Piston Ring—Removal

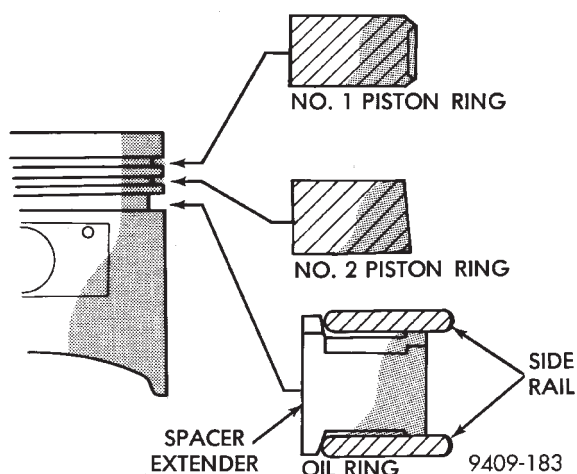


Fig. 81 Piston Ring—Installation

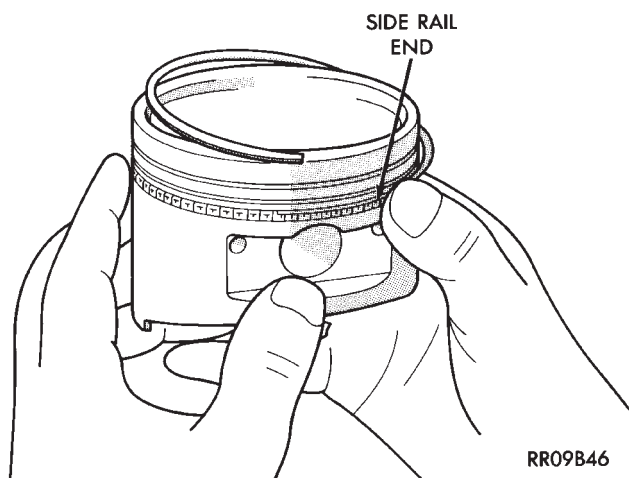


Fig. 82 Side Rail—Installation

CAUTION: Install piston rings in the following order:

- (2) Oil ring expander.

- (3) Upper oil ring side rail.
- (4) Lower oil ring side rail.
- (5) No. 2 Intermediate piston ring.
- (6) No. 1 Upper piston ring.
- (7) Install the side rail by placing one end between the piston ring groove and the expander. Hold end firmly and press down the portion to be installed until side rail is in position. **Do Not use a piston ring expander** (Fig. 82).
- (8) Install upper side rail first and then the lower side rail.
- (9) Install No. 2 piston ring and then No. 1 piston ring (Fig. 83).

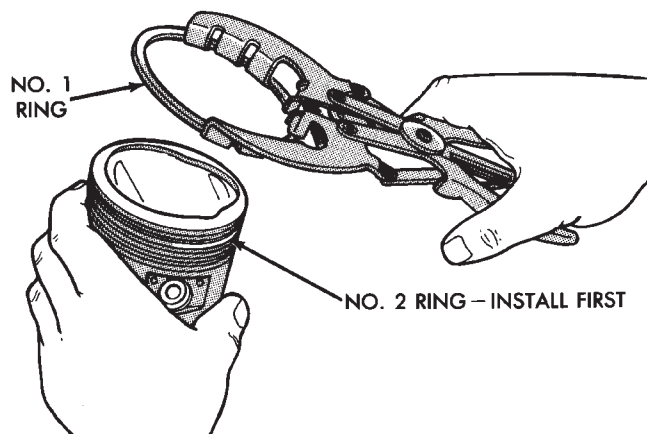


Fig. 83 Upper and Intermediate Ring—Installation

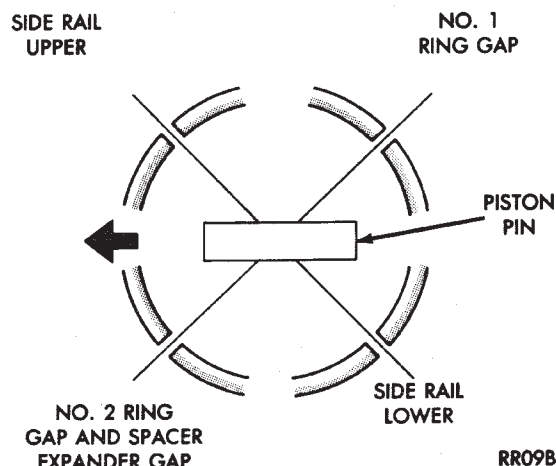


Fig. 84 Piston Ring End Gap Position

- (10) Position piston ring end gaps as shown in (Fig. 84).
- (11) Position oil ring expander gap at least 45° from the side rail gaps but **not** on the piston pin center or on the thrust direction.

REMOVAL AND INSTALLATION (Continued)

INSTALLING PISTON AND CONNECTING ROD

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

(2) Before installing the ring compressor, make sure the oil ring expander ends are butted and the rail gaps located as shown in (Fig. 84).

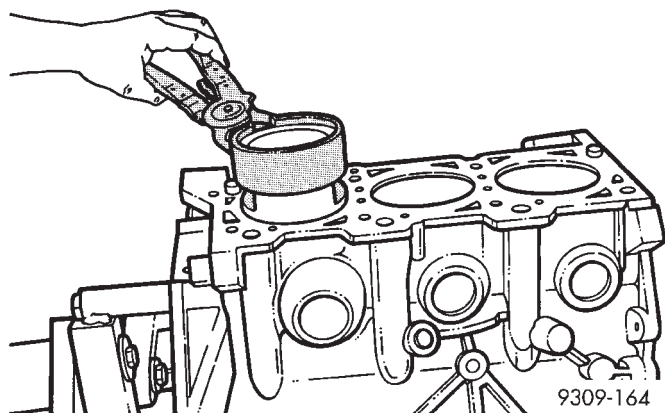


Fig. 85 Piston—Installation

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

(4) Install connecting rod bolt protectors on rod bolts.

(5) Rotate crankshaft so that the connecting rod journal is on the center of the cylinder bore. Insert rod and piston into cylinder bore and guide rod over the crankshaft journal.

(6) Install the piston and connecting rod assembly with the directional letter is located on the top of the piston with the arrow facing toward the camshaft sprocket.

(7) Tap the piston down in cylinder bore, using a hammer handle. At the same time, guide connecting rod into position on connecting rod journal (Fig. 85).

(8) Install rod caps. Install nuts on cleaned and oiled rod bolts and tighten nuts to 51 N·m (37 ft. lb.).

CAUTION: Piston assemblies are not to be interchanged from bank to bank.

(9) Check alignment marks made during disassembly and that bearing position notches new or used are on the same side as shown in (Fig. 86).

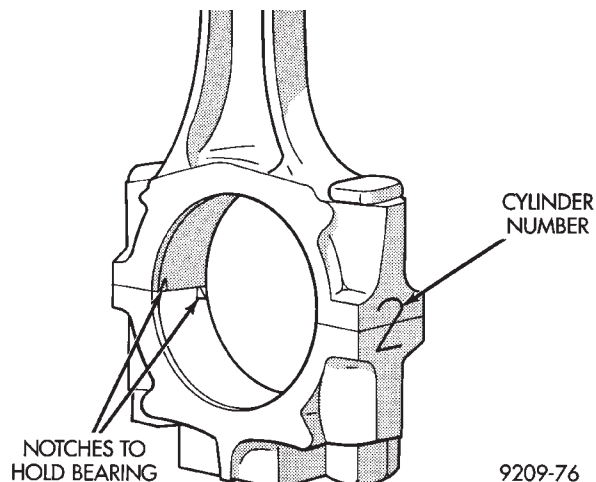


Fig. 86 Connecting Rod and Cap

DISASSEMBLY AND ASSEMBLY

OIL PUMP

(1) Assemble pump, using new parts as required with clean oil. Align marks on the inner and outer rotors when assembling (Fig. 87).

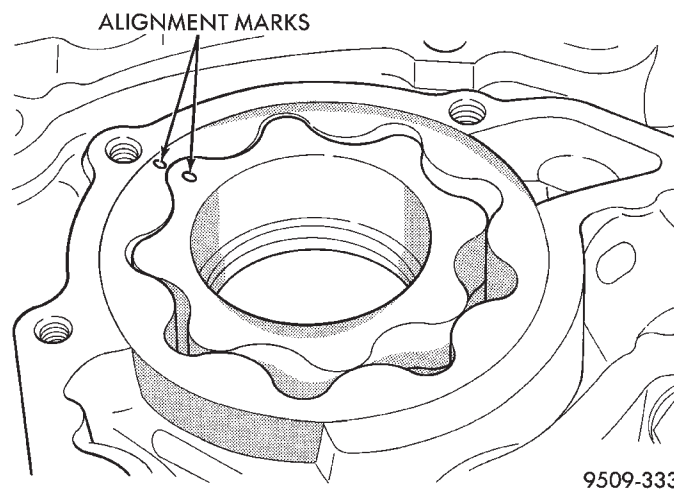


Fig. 87 Inner and Outer Rotor Alignment Marks

(2) Install cover and tighten screws to 10 N·m (85 in. lbs.).

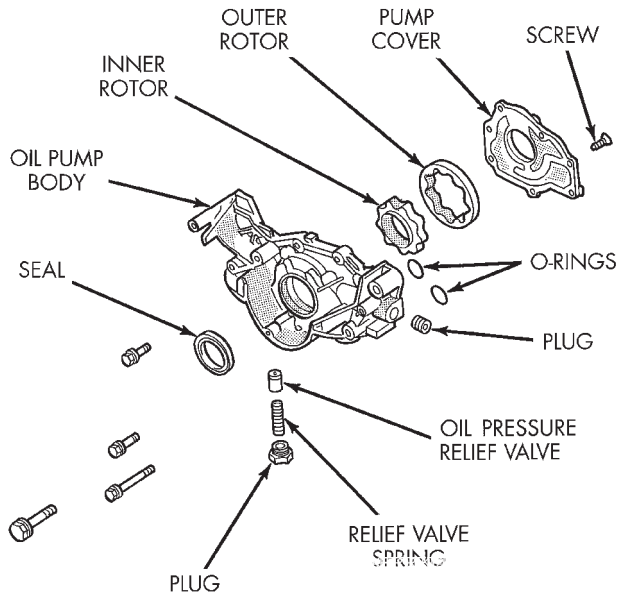
(3) Install relief valve, spring, gasket and cap as shown in (Fig. 88). Tighten cap to 44 N·m (33 ft. lbs.).

ROCKER ARMS

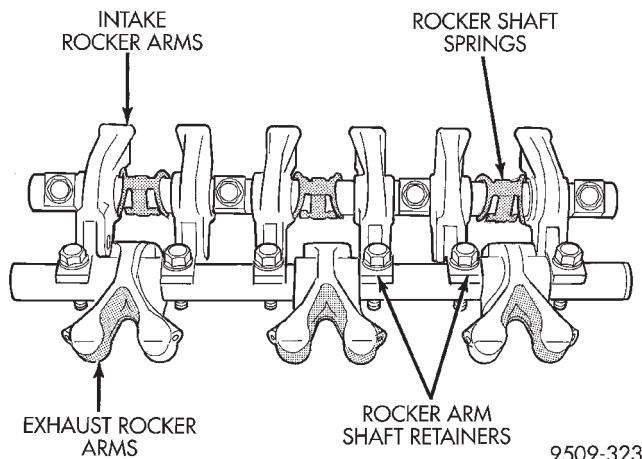
(1) Identify the rocker arms and retainers for reassembly. Disassemble the rocker arm assemblies by removing the attaching bolts and spring clips from the shaft (Fig. 89).

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

DISASSEMBLY AND ASSEMBLY (Continued)



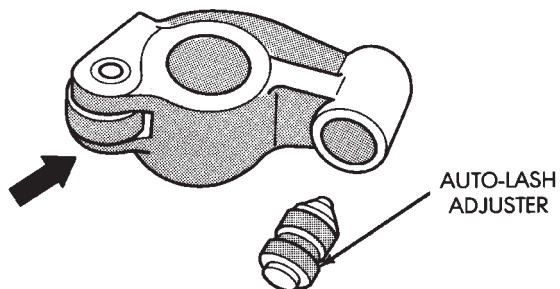
9509-332

Fig. 88 Oil Pump

9509-323

Fig. 89 Rocker Arm Shafts**INSPECTION**

Inspect the rocker arm for scoring, wear of the roller or damage to the rocker arm (Fig. 90). Replace as necessary.



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Fig. 90 Rocker Arm**ROCKER ARM SHAFTS**

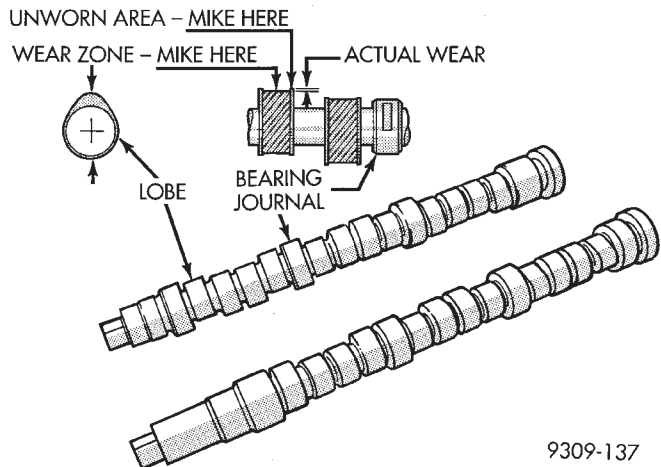
The rocker arm shaft is hollow and is used as a lubrication oil duct.

(1) Check the rocker arm mounting portion of the shafts for wear or damage. Replace if damaged or worn.

(2) Check oil holes for clogging with small wire, clean as required.

REASSEMBLY

Lubricate the rocker arms. Install onto shafts in their original position (Fig. 89).

CLEANING AND INSPECTION**CAMSHAFT INSPECTION**

9309-137

Fig. 91 Checking Camshafts for Wear

Check oil feed holes for blockage.

Inspect cylinder head journals for wear, Refer to **Cylinder Head Inspect** for Specifications.

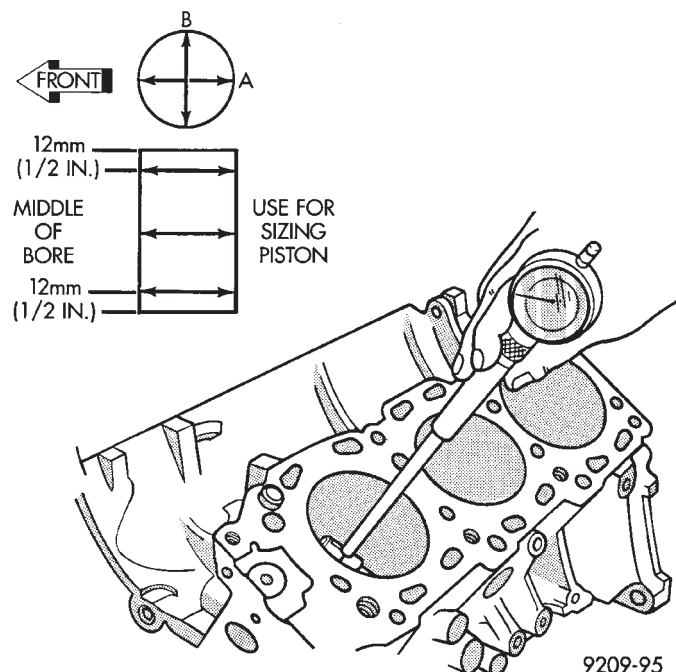
Check camshaft bearing journals for scratches and worn areas (Fig. 91). If light scratches are present, they may be removed with 400 grit sand paper. If deep scratches are present, replace the camshaft and check the cylinder head for damage. Replace the cylinder head if worn or damaged. Check the lobes for pitting and wear. If the lobes show signs of wear, check the corresponding rocker arm roller for wear or damage. Replace rocker arm if worn or damaged. If lobes show signs of pitting on the nose, flank or base circle; replace the camshaft.

CYLINDER BORE AND BLOCK

(1) Measure the cylinder bore at three levels in directions A and B (Fig. 92). Top measurement should be 12 mm (.50 in.) down and bottom measurement should be 10 mm (.38 in.) up.

(2) Standard bore dimension: 83.50 - 83.53 mm (3.2874- 3.2886 in.)

CLEANING AND INSPECTION (Continued)

**Fig. 92 Checking Cylinder Bore Size**

(3) Maximum out-of-round or taper: 0.01 mm (.0004 in.)

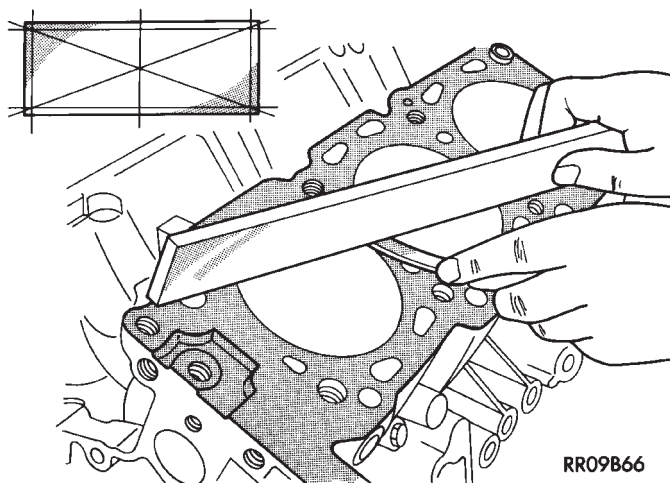
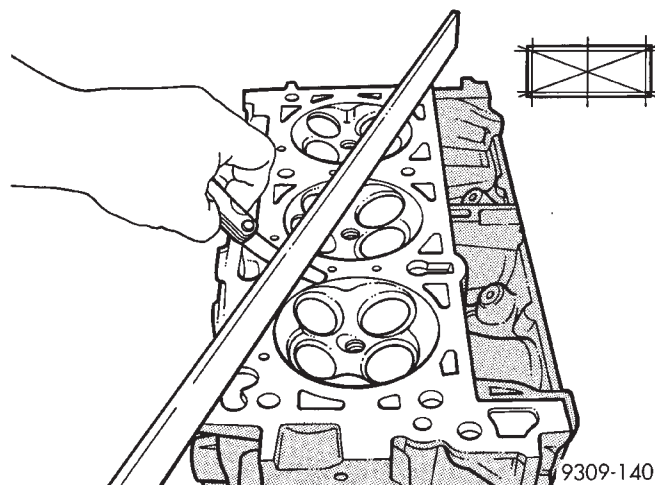
CYLINDER BLOCK

Inspect cylinder block for scratches, cracks and rust or corrosion, and repair or replace as required.

(1) Clean cylinder block and check top surface for distortion with a straight edge and thickness gauge (Fig. 93).

(2) Top surface must be flat within:

- Standard Value: 0.05 mm (0.002 in.)
- Service Limit 0.1 mm (0.0039 in.)

**Fig. 93 Distortion Check****CYLINDER HEAD****Fig. 94 Checking Cylinder Head Flatness**

(1) Before cleaning, check for leaks, damage and cracks.

(2) Clean cylinder head and oil passages.

(3) Check cylinder head for flatness (Fig. 94).

(4) Cylinder head must be flat within;

- Standard dimension: less than 0.03mm (0.0012 inch)
- Service Limit: 0.2mm (.008 inch)
- Grinding Limit: Maximum of 0.2 mm (.008 inch) is permitted.

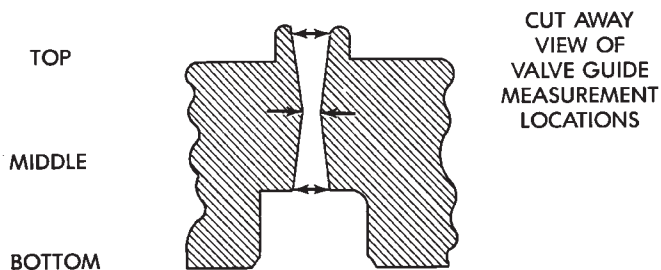
CAUTION: This is a combined total dimension of stock removal from cylinder head if any and block top surface is 0.2 mm (0.0079 in.).

VALVE GUIDES

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

(2) Using a small hole gauge and a micrometer, measure valve guides in 3 places top, middle and bottom (Fig. 95). Refer to (Fig. 96) for specifications. Replace guides if they are not within specification.

(3) Check valve guide height (Fig. 97).

**CUT AWAY VIEW OF VALVE GUIDE MEASUREMENT LOCATIONS**

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Fig. 95 Checking Wear on Valve Guide—Typical

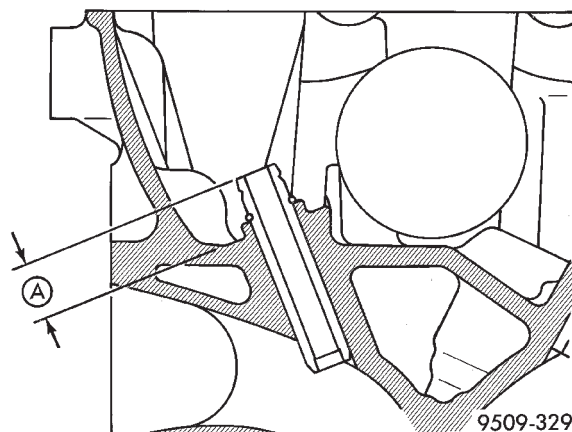
CLEANING AND INSPECTION (Continued)

VALVE DIMENSIONS		
INTAKE VALVE		
STEM DIAMETER:	6.00 mm (.236 in.)	
FACE ANGLE:	45°	
VALVE MARGIN:	1.0 mm (.039 in.)	
EXHAUST VALVE		
STEM DIAMETER:	6.00 mm (.236 in.)	
FACE ANGLE:	45°	
VALVE MARGIN:	1.20 mm (.047 in.)	
VALVE GUIDE CLEARANCE	NEW	SERVICE LIMIT
INTAKE	0.02 TO 0.05 mm (.0008 TO .002 in.)	0.10 mm (.004 in.)
EXHAUST	0.04 TO 0.07 mm (.0016 TO .0028 in.)	0.15 mm (.006 in.)
VALVE SPRING SPECIFICATION		
FREE LENGTH	NEW	51.0 mm (2.01 in.)
	SERVICE LIMIT	50.0 mm (1.971 in.)
SQUARENESS	NEW	2° MAXIMUM
	SERVICE LIMIT	4° MAXIMUM
SPRING TENSION	INSTALLED HEIGHT	44.2 mm AT 267 N (1.74 in. 60 LBS.)

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Fig. 96 Valve Guide Specification

Ⓐ 14.0 mm



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Fig. 97 Valve Guide Height

CYLINDER HEAD COVER

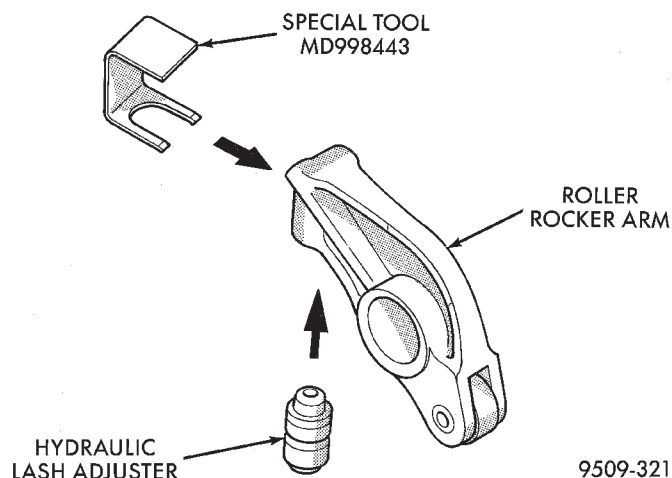
Before installation, clean cylinder head and cover mating surfaces. Make certain the rails are flat.

AUTO LASH ADJUSTER

The automatic lash adjusters are precision units installed in machined openings in the valve actuating ends of the rocker arms. Do not disassemble the auto lash adjuster.

ROCKER ARM

Inspect the rocker arm/hydraulic lash adjuster assembly for wear or damage (Fig. 98). Replace assembly as necessary.



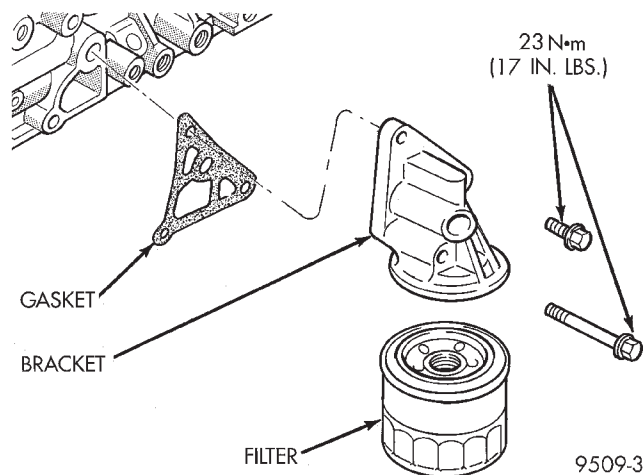
9509-321

Fig. 98 Rocker Arm/Hydraulic Lash Adjuster Assemblies

OIL FILTER BRACKET

(1) Check the oil filter mounting surface. The surface must be smooth, flat and free of debris or old pieces of rubber (Fig. 99).

(2) Check bracket for cracks and oil leaks.



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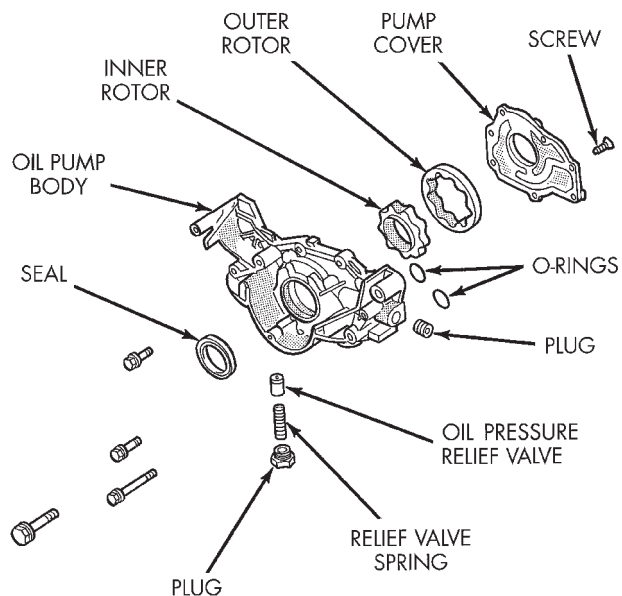
Fig. 99 Oil Filter and Bracket

CLEANING AND INSPECTION (Continued)

OIL PUMP

(1) Check oil pump case for damage and remove rear cover.

(2) Remove pump rotors and inspect case for excessive wear (Fig. 100).

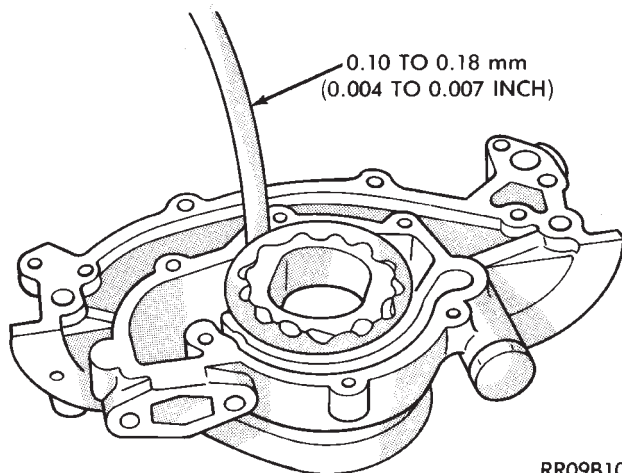


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Fig. 100 Oil Pump Components

(3) Insert the rotor into the oil pump case (Fig. 101) and (Fig. 102) and measure clearance with a feeler gauge as indicated.

(4) Replace if out of limits.

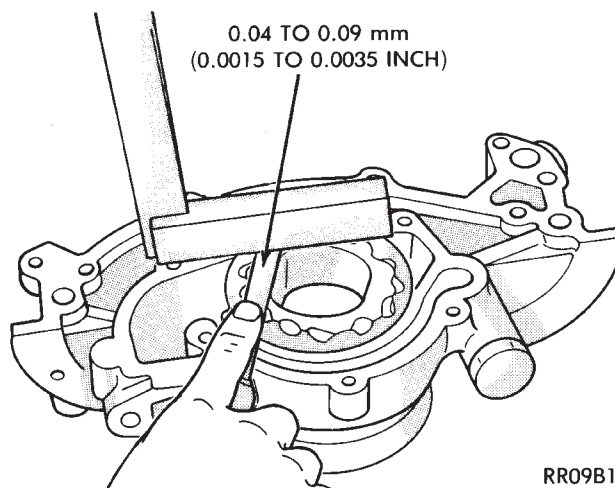


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Fig. 101 Checking Clearance-Between Outer Rotor and Case**OIL RELIEF PLUNGER**

(1) Check that the oil relief plunger slides smoothly (Fig. 100).

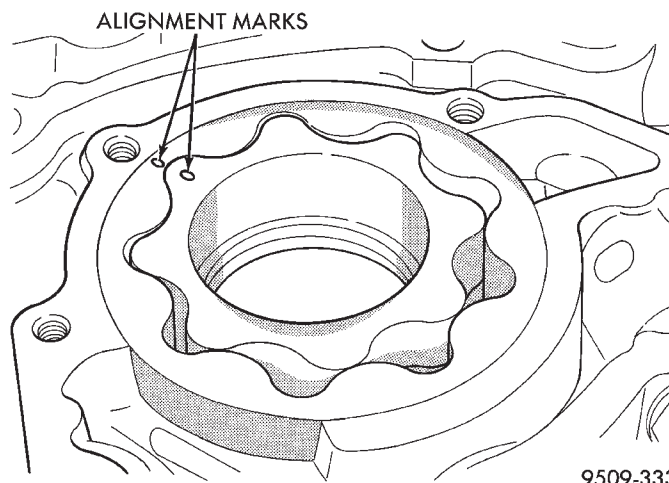
(2) Check for broken relief spring.



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Fig. 102 Checking Rotor End Clearance**OIL PUMP ASSEMBLY**

(1) Assemble pump, using new parts as required with clean oil. Align marks on the inner and outer rotors when assembling (Fig. 103).



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Fig. 103 Inner and Outer Rotor Alignment Marks

(2) Install cover and tighten screws to 12 N·m (105 in. lbs.)

(3) Install relief valve, spring, gasket and cap as shown in (Fig. 100). Tighten cap to 41 N·m (30 ft. lbs.)

TIMING BELT INSPECTION

(1) Remove the upper left timing belt cover (Fig. 104).

(2) Inspect both sides of the timing belt drive & back. Replace belt if any of the following conditions exist.

- Hardening of back rubber back side is glossy without resilience and leaves no indent when pressed with fingernail.
- Cracks on rubber back.
- Cracks or peeling of canvas.

CLEANING AND INSPECTION (Continued)

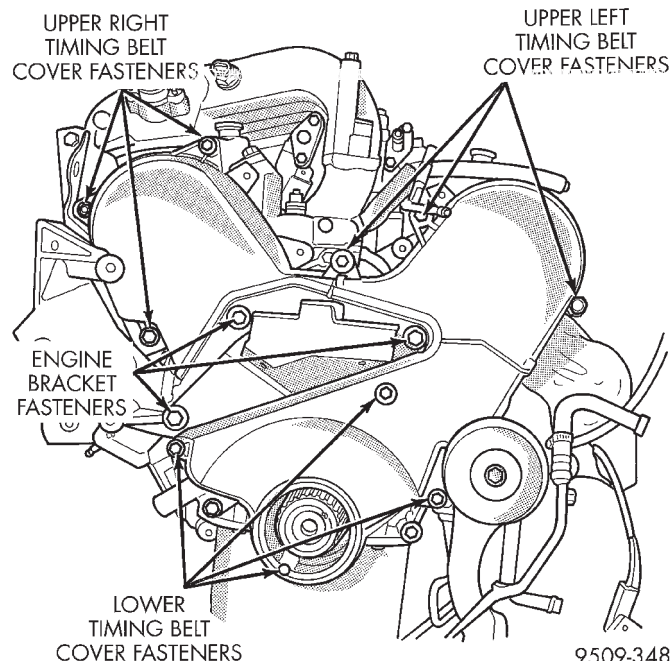


Fig. 104 Timing Belt Covers

- Cracks on rib root.
 - Cracks on belt sides.
 - Missing teeth.
 - Abnormal wear of belt sides. The sides are normal if they are sharp as if cut by a knife (Fig. 105).
- (3) If none of the above conditions are seen on the belt, the belt cover can be reinstalled.

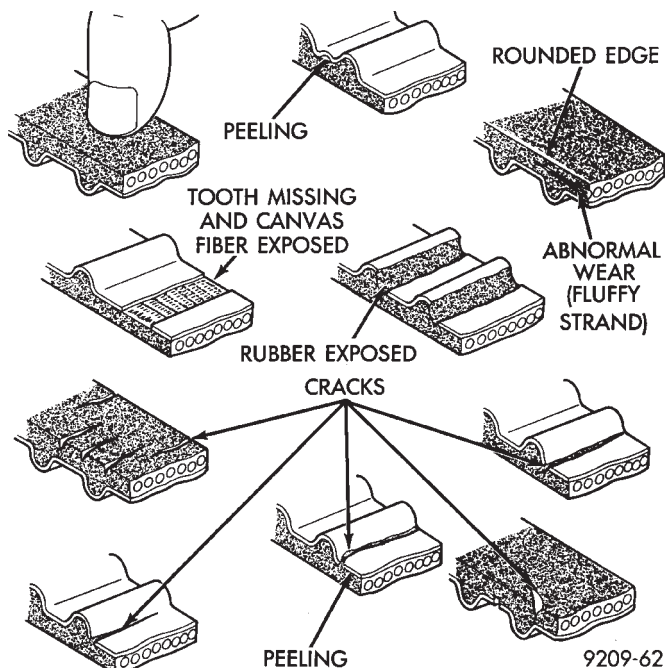


Fig. 105 Timing Belt Inspection

VALVES, SPRINGS, SEATS AND GUIDES

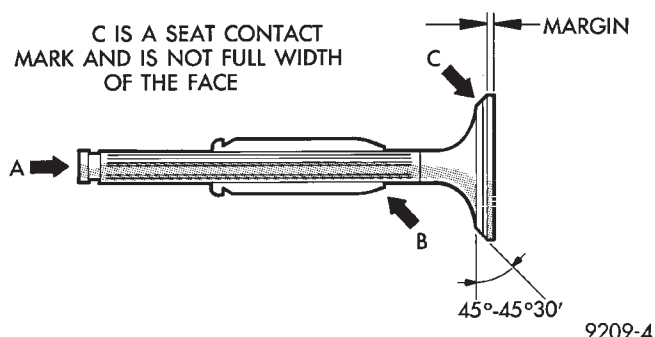


Fig. 106 Valve Inspection

- (1) Check valve stem tip for pitting or depression at point A (Fig. 106).
- (2) Check for wear and ridge wear at Point B.
- (3) Measure the clearance between the valve guide and valve stem. If the service limit is exceeded, replace the valve guides, valves or both.
- (4) Check for even contact (at face center) with valve seat, Point C.
- (5) Check margin. Replace valve if margin is out of specification (Fig. 109).
- (6) Check valve guide height (Fig. 107).

(A) 14.0 mm

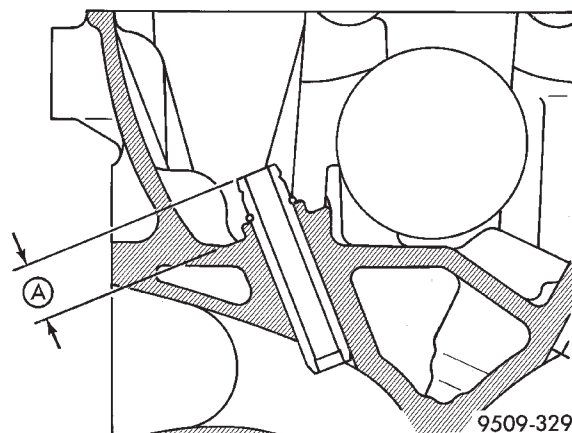


Fig. 107 Valve Guide Height

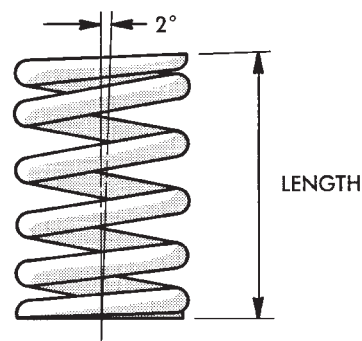


Fig. 108 Valve Spring

CLEANING AND INSPECTION (Continued)

(7) Measure valve stem to guide clearance. Refer to specification (Fig. 109).

(8) Measure Valve spring free length and if the spring is square (Fig. 108). Refer to (Fig. 109) for specifications.

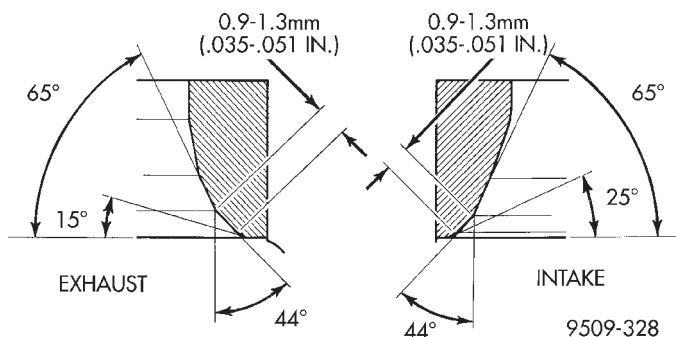
VALVE DIMENSIONS		
INTAKE VALVE		
STEM DIAMETER: 6.00 mm (.236 in.)		
FACE ANGLE: 45°		
VALVE MARGIN: 1.0 mm (.039 in.)		
EXHAUST VALVE		
STEM DIAMETER: 6.00 mm (.236 in.)		
FACE ANGLE: 45°		
VALVE MARGIN: 1.20 mm (.047 in.)		
VALVE GUIDE CLEARANCE	NEW	SERVICE LIMIT
INTAKE	0.02 TO 0.05 mm (.0008 TO .002 in.)	0.10 mm (.004 in.)
EXHAUST	0.04 TO 0.07 mm (.0016 TO .0028 in.)	0.15 mm (.006 in.)
VALVE SPRING SPECIFICATION		
FREE LENGTH	NEW	51.0 mm (2.01 in.)
	SERVICE LIMIT	50.0 mm (1.971 in.)
SQUARENESS	NEW	2° MAXIMUM
	SERVICE LIMIT	4° MAXIMUM
SPRING TENSION	INSTALLED HEIGHT	44.2 mm AT 267 N (1.74 in. 60 LBS.)

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Fig. 109 Valve Specifications

VALVE SEAT INSPECTION

Inspect the valve seat with Prussian blue to determine where the valve contacts the seat. To do this, coat valve seat **LIGHTLY** with Prussian blue then set valve in place. Rotate the valve with light pressure. If the blue is transferred to the center of valve face, contact is satisfactory. If the blue is transferred to top edge of the valve face, lower valve seat with a 15 degrees stone. If the blue is transferred to the bottom edge of valve face raise valve seat with a 65 degree stone (Fig. 110).



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Fig. 110 Valve Seat Reconditioning

ADJUSTMENTS

ENGINE SUPPORT ADJUSTMENT

The right and left support assemblies are slotted to allow for right/left drive train adjustment in relation to drive shaft assembly length.

Check and reposition right and left engine support assemblies as required. Adjust drive train position, if required, for the following conditions:

- Drive shaft distress: See Group 2, Suspension and Driveshaft.
- Any front end structural damage (after repair).
- Support Assembly replacement.

ENGINE SUPPORT ADJUSTMENT

(1) Remove the load on the engine motor mounts by carefully supporting the engine and transmission assembly with a floor jack.

(2) Loosen the right engine support assembly vertical fasteners.

(3) Loosen the left engine support assembly vertical bolts.

(4) Pry the engine right or left as required to achieve the proper drive shaft assembly length. Refer to Group 2, Suspension and Driveshaft for driveshaft identification and related assembly length measuring.

(5) Tighten right engine support assembly vertical bolts to 61 N·m (45 ft. lbs.). and tighten left engine support assembly bolts to 61 N·m (45 ft. lbs.).

(6) Recheck drive shaft length.

SPECIFICATIONS

ENGINE 2.5L

**DESCRIPTION STANDARD DIMENSION
AND SERVICE LIMIT****Valve Timing**

Intake—Open	19° BTDC
Intake—Close	45° ABDC
Exhaust—Open	49° BBDC
Exhaust—Close	15° ATDC
Compression Pressure	178 psi @ 250 RPM
Maximum Variation Between Cylinders	97 kPa (14 PSI)
Service Limit	25%
Valve Clearance—Hot Engine	Hydraulic Lash Adjuster

Cylinder Head

Flatness of Gasket Surface ..	0.03 mm (0.0012 in.)
Service Limit	0.2 mm (0.008 in.)
* Grinding Limit of Gasket Surface	0.2 mm (0.008 in.)

Manifold—Flatness

Intake	0.10 mm (0.004 in.)
Service Limit	0.2 mm (0.008 in.)
Exhaust	0.15 mm (0.006 in.)
Service Limit	0.3 mm (0.12 in.)

Valves—Thickness of Valve Head (Margin)

Intake	1.0 mm (0.039 in.)
Service Limit	0.5 mm (0.019 in.)
Exhaust	1.2 mm (0.047 in.)
Service Limit	0.7 mm (0.028 in.)

Valve Stem to Guide Clearance

Intake	0.02 to 0.05 mm (0.0008 to 0.002 in.)
Service Limit	0.10 mm (0.004 in.)
Exhaust	0.04 to 0.07 mm (0.0016 to 0.0028 in.)
Service Limit	0.15 mm (0.006 in.)
Valve Face Angle	45° to 45-1/2°
Valve Stem Diameter Intake and Exhaust	6.0 mm (0.236 in.)

**DESCRIPTION STANDARD DIMENSION
AND SERVICE LIMIT****Valve Guide**

Height	14.0 mm (0.551 in.)
O.D.	11.0 mm (0.443 in.)
I.D.	6.0 mm (0.236 in.)

Valve Seat

Seat Surface Angle	44° to 44-1/2°
Contact Width	0.9 to 1.3 mm (0.035 to 0.051 in.)
Sinkage (Service Limit)	0.2 mm (0.078 in.)

Valve Spring

Free Height	51.0 mm (2.01 in.)
Service Limit	50.0 mm (1.97 in.)
Loaded Height	44.2 mm at 267 N (1.74 in. at 60 lbs.)
Perpendicularity Intake and Exhaust	2° Maximum
Service Limit	4° Maximum

**NOTE: * Includes/Combined With Cylinder Head
and Block Top Surface Grinding**

SPECIFICATIONS (Continued)

ENGINE SPECIFICATIONS (CONT.)

Description	Standard Dimension	Service Limit
Piston		
O.D.	83.5 mm (3.29 inches)	—
Piston to Cylinder Clearance	0.02 to 0.04 mm (0.0008 to 0.0016 inch)	—
Ring End Gap No. 1	0.25 to 0.40 mm (.010 to .016 inch)	0.8 mm (.031 inch)
No. 2	0.40 to 0.55 mm (.016 to .022 inch)	0.8 mm (.031 inch)
Oil	0.15 to 0.50 mm (.006 to .019 inch)	1.0 mm (.039 inch)
Ring Side Clearance No. 1	0.030 to 0.07 mm (.0012 to .0028 inch)	0.1 mm (.004 inch)
No. 2	(0.002 to 0.06 mm (.0007 to .0024 inch)	0.1 mm (.004 inch)
Connecting Rod		
Length — Center to Center	140.9 to 141.0 mm (5.547 to 5.551 inches)	—
Parallelism — Twist	0.05 mm (0.0019 inch)	—
Torsion	0.1 mm (0.0039 inch)	—
Big End Thrust Clearance	0.10 to 0.25 mm (0.004 to 0.010 inch)	0.4 mm (0.016 inch)
Crankshaft		
End Play	0.05 to 0.25 mm (0.002 to 0.010 inch)	0.4 mm (0.016 inch)
Main Journal Diameter	60.000 mm (2.362 inches)	—
Pin Diameter	50.000 mm (1.969 inches)	—
Bearing Surface Out-of-Round	0.03 mm Max. (0.001 inch) Max.	—
Bearing Surface Taper	0.005 mm Max. (0.0002 inch) Max.	—
Bearing Oil Clearance	0.02 to 0.04 mm (0.0008 to 0.0016 inch)	—
Undersize Service Bearing	0.25 to 0.50 - 0.75 mm (0.010 to 0.020 - 0.030 inch)	—
Cylinder Block		
I.D. (Bore)	83.50 to 83.53 mm (3.29 inches)	—
Flatness of Top Surface	0.05 mm (0.002 inch)	0.1 mm (0.004 inch)
Grinding Limit of Top Surface	0.2 mm* (0.008 inch)	0.2 mm* (0.008 inch)
* Includes/Combined With Cylinder Head Grinding		
Oil Pump		
Relief Valve Opening Pressure	5.0 to 6.0 kg/cm ² (71.45 to 85.76 psi)	—
Outer Rotor to Case Clearance	0.10 to 0.18 mm (0.004 to 0.007 inch)	0.35 mm (0.0138 inch)
Rotor End Clearance	0.06 to 0.18 mm (0.0024 to 0.0071 inch)	0.09 mm (0.0035 inch)
Inner Rotor Pilot to Case Clearance	0.03 to 0.07 mm (0.001 to 0.0028 inch)	0.15 mm (0.006 inch)
Minimum Pressure, Engine Fully Warmed Up at Idle 3000 RPM	41 kPa (6 psi) 241-517 kPa (35-75 psi)	

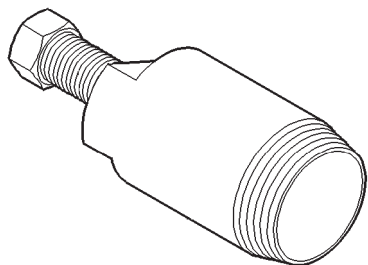
SPECIFICATIONS (Continued)

TORQUE CHART 2.5L

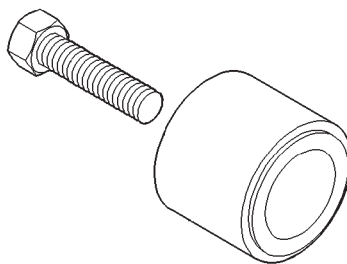
DESCRIPTION	TORQUE
Intake Manifold Plenum Bolt	18 N·m (13 ft. lbs.)
Intake Manifold Plenum Support Bolt M8	18 N·m (13 ft. lbs.)
M10	36 N·m (26 ft. lbs.)
Distributor Nut	13 N·m (9 ft. lbs.)
Spark Plug	25 N·m (18 ft. lbs.)
Crankshaft Bolt	182 N·m (134 ft. lbs.)
Engine Support Bracket Bolt	45 N·m (33 ft. lbs.)
Auto Tensioner Bolt	23 N·m (17 ft. lbs.)
Tensioner Pulley Bolt	48 N·m (35 ft. lbs.)
Tensioner Arm Assembly Bolt	44 N·m (33 ft. lbs.)
Idler Pulley Bolt	44 N·m (33 ft. lbs.)
Camshaft Sprocket Bolt	88 N·m (65 ft. lbs.)
Intake Manifold Nut	21 N·m (16 ft. lbs.)
Exhaust Manifold Nut	30 N·m (22 ft. lbs.)
Heater Pipe Assembly	19 N·m (13 ft. lbs.)
Thermostat Housing Bolt	19 N·m (13 ft. lbs.)
Water Inlet Pipe Bolt	14 N·m (10 ft. lbs.)
Water Pump Bolt	24 N·m (17 ft. lbs.)
Cylinder Head Cover Bolt	3.5 N·m (2.5 ft. lbs.)
Rocker Arm and Rocker Arm Shaft Bolt	31 N·m (23 ft. lbs.)
Thrust Case Bolt	13 N·m (9 ft. lbs.)
Cylinder Head and Valve Cylinder Head Bolt	108 N·m (80 ft. lbs.)
Oil Filter	14 N·m (10 ft. lbs.)
Oil Filter Bracket Bolt	23 N·m (17 ft. lbs.)
Drain Plug	40 N·m (29 ft. lbs.)
Oil Pan Bolt	6 N·m (4 ft. lbs.)
Oil Screen Bolt	19 N·m (13 ft. lbs.)
Plug	44 N·m (33 ft. lbs.)
Oil Pump Case Bolt M8	14 N·m (10 ft. lbs.)
M10	40 N·m (30 ft. lbs.)
Oil Pump Cover Bolt	10 N·m (7 ft. lbs.)
Connecting Rod Cap Nut	51 N·m (37 ft. lbs.)
Oil Seal Retainer Bolt	11 N·m (8 ft. lbs.)
Main Bearing Cap Bolt	94 N·m (69 ft. lbs.)

SPECIAL TOOLS

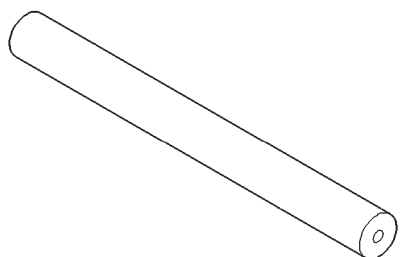
ENGINE 2.5L



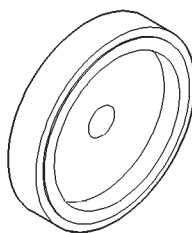
Remover C-4679-A



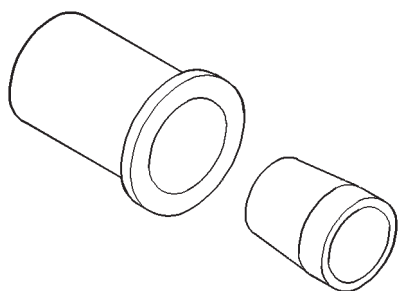
Installer MD-998713



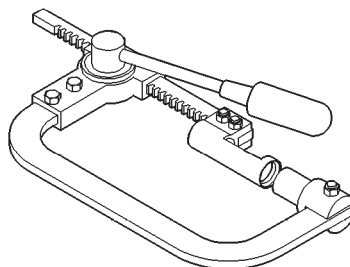
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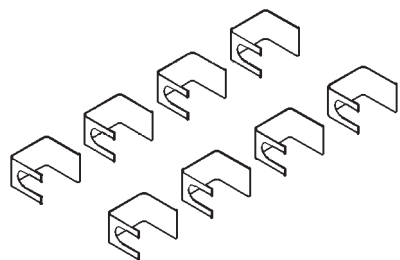
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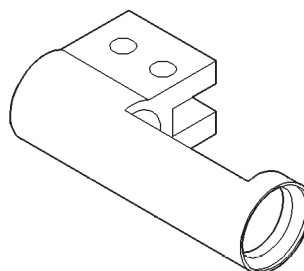
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Compressor C-3422-B

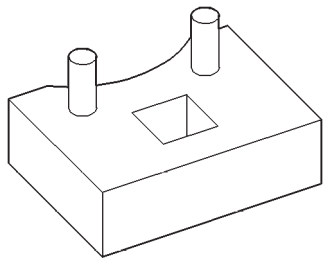


Holders MD-998443

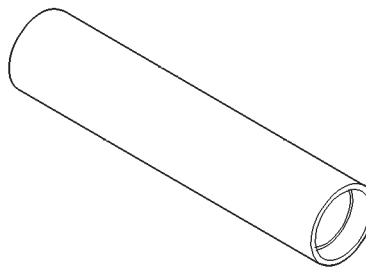


Adapter 6526

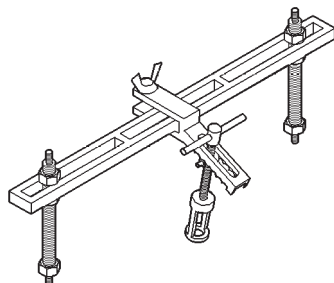
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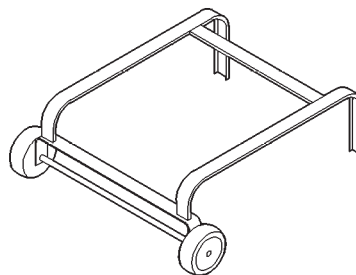
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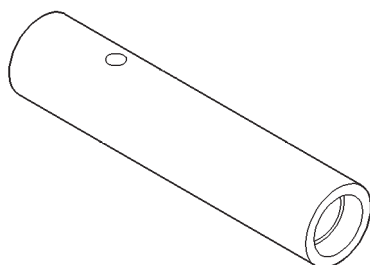
Installer 6052



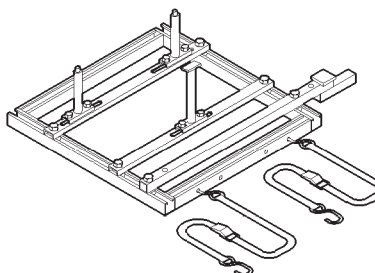
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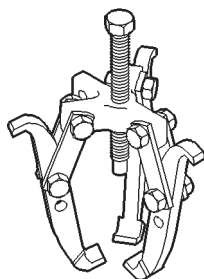
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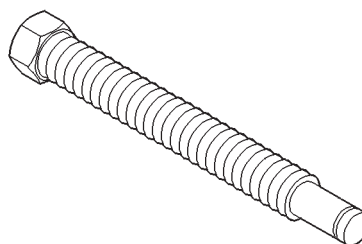
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Fixture Engine 6710

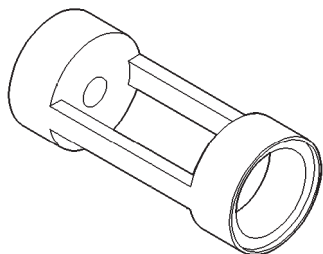


Puller 1026

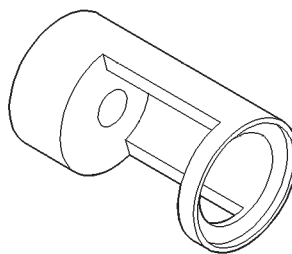


Screw 6765

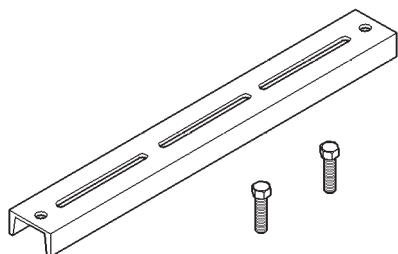
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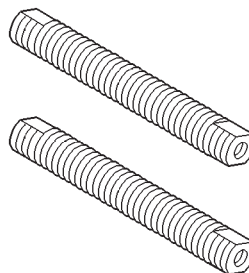
Adapter 6779



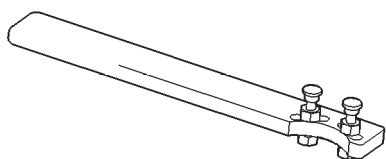
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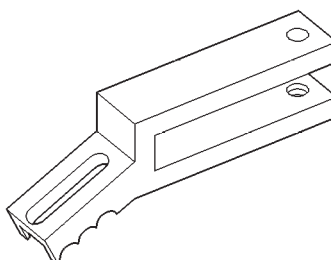
Support Bar Cradle 6710-3A



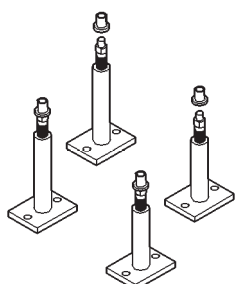
Posts 6886



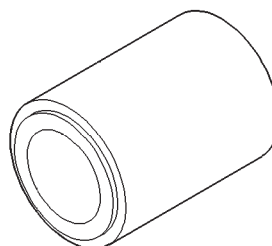
Holder 6847



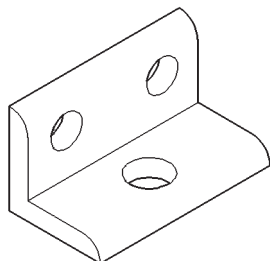
Adapter 6887



Engine Cradle Posts 6848



Camshaft Seal Installer 6863



Bracket Cradle Post Support 6973