ENGINE

CONTENTS

	page		page
2.4L ENGINE	**14**	**ENGINE DIAGNOSIS**	**7**
3.0L ENGINE	**61**	**STANDARD SERVICE PROCEDURES**	**1**
3.3/3.8L ENGINE	**93**		

STANDARD SERVICE PROCEDURES

INDEX

	page		page
GENERAL INFORMATION		FORM-IN-PLACE GASKETS	1
CRANKSHAFT SPROCKET BOLT ACCESS PLUG	2	HONING CYLINDER BORES	3
ENGINE CORE PLUGS	2	HYDROSTATIC LOCKED ENGINE	5
ENGINE OIL SERVICE	5	MEASURING MAIN BEARING AND CONNECTING ROD BEARING CLEARANCES	3
ENGINE OIL	5	REPAIR OF DAMAGED OR WORN THREADS	4
ENGINE PERFORMANCE	2		

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

GENERAL INFORMATION (Continued)

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 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. 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 then using precut 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.

CRANKSHAFT SPROCKET BOLT ACCESS PLUG

An Access plug is located in the right inner fender shield. Remove the plug and insert the proper size socket, extension and ratchet, when crankshaft rotation is necessary.

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.

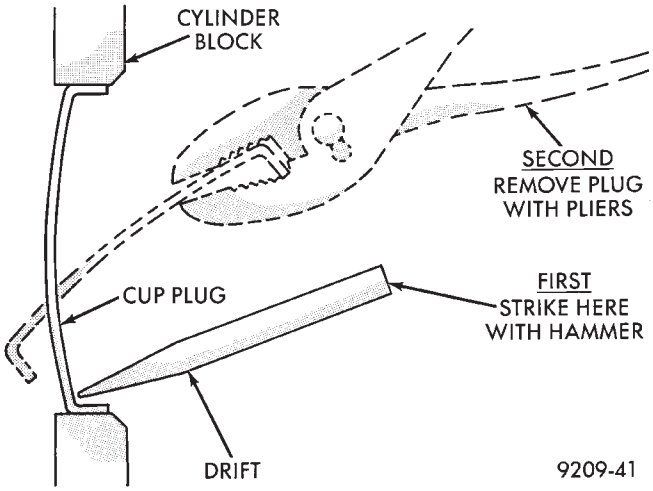


Fig. 1 Core Hole Plug Removal

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 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 in 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, timing belt or chain may have skipped one or two teeth. Camshaft and crankshaft timing should be checked. Refer to Group 9, Engine Timing belt or chain installation.

It is important that the vehicle is operating to its optimum performance level to maintain fuel economy and lowest vehicle emissions. If vehicle is not operating to these standards, refer to Engine Diagnosis outlined is this section. The following procedures can assist in achieving the proper engine diagnosis.

(1) Test cranking amperage draw. Refer to Group 8B, Starting.

(2) Check intake manifold for vacuum leaks.

(3) Perform cylinder compression pressure test. Refer to Engine Diagnosis, outlined in this section.

(4) Clean or replace spark plugs as necessary and adjust gap as specified in Group 8D, Ignition System. Tighten to specifications.

GENERAL INFORMATION (Continued)

(5) Test resistance of spark plug cables. Refer to Group 8D, Ignition System.

(6) Test ignition coils primary and secondary resistance. Replace parts as necessary. Refer to Group 8D, Ignition System.

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

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

(9) Inspect crankcase ventilation system as outlined in Group 25, Emission Control Systems.

(10) 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).

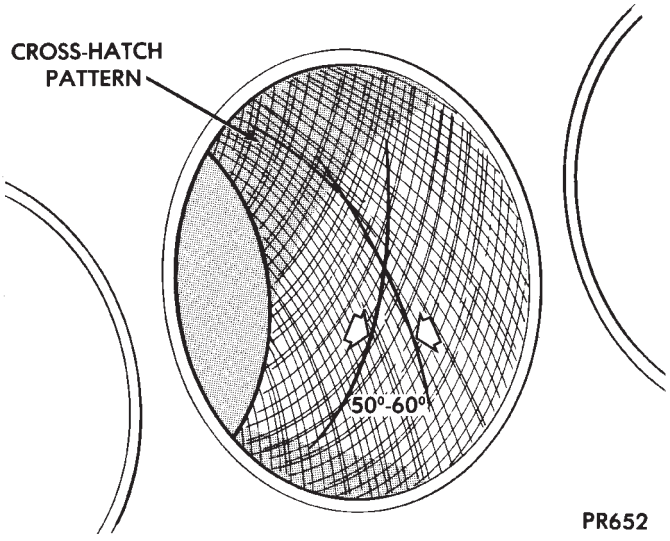


Fig. 2 Cylinder Bore Cross-Hatch Pattern

(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.

MEASURING MAIN BEARING AND CONNECTING ROD BEARING CLEARANCES

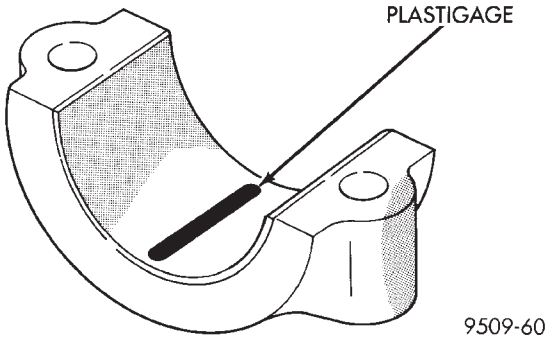


Fig. 3 Plastigage Placed in Lower Shell

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.

GENERAL INFORMATION (Continued)

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

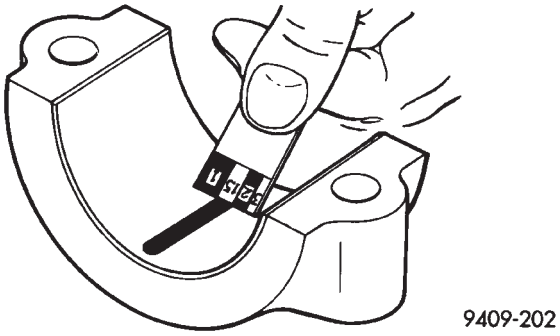


Fig. 4 Clearance Measurement

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:

(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.

GENERAL INFORMATION (Continued)

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.

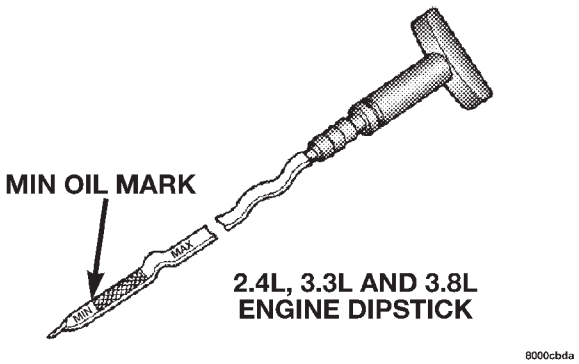
ENGINE OIL

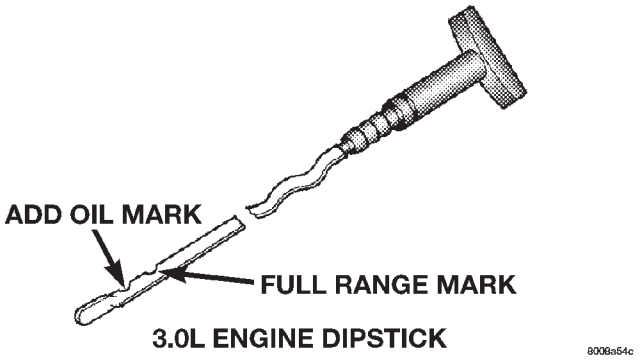
Checking Oil Level

To assure proper engine lubrication, the engine oil must be maintained at the correct level. Check the oil level at regular intervals, such as every fuel stop.

The best time to check the oil level is about 5 minutes after a fully warmed-up engine is shut off, or before starting the vehicle after it has sat overnight.

Checking the oil while the vehicle is on level ground, will improve the accuracy of the oil level readings. For 2.4L, 3.3L and 3.8L engines, maintain the oil level between the MIN and MAX markings on the dipstick. Adding one quart of oil when the reading is at the MIN mark will result in a MAX reading on these engines. For the 3.0L engine, add one full quart when the level on the dipstick is at or below the ADD mark.





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.

ENGINE OIL SPECIFICATION

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

GENERAL INFORMATION (Continued)

API SERVICE GRADE CERTIFIED

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

SAE VISCOSITY

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

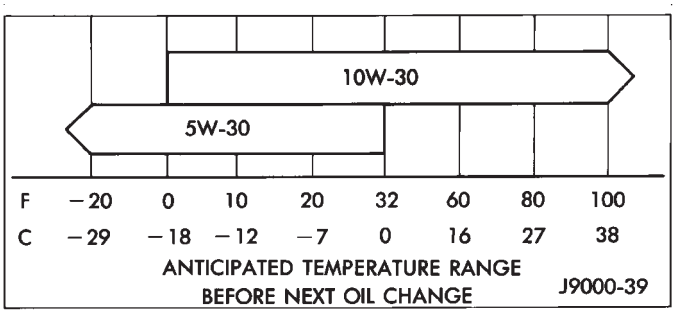


Fig. 5 Temperature/Engine Oil Viscosity

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. 6).

9400-9

Fig. 6 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 DIAGNOSIS

INDEX

page

DIAGNOSIS AND TESTING
CYLINDER COMBUSTION PRESSURE LEAKAGE TEST 8
CYLINDER COMPRESSION PRESSURE TEST . . 7
ENGINE DIAGNOSIS—MECHANICAL 12
ENGINE DIAGNOSIS—PERFORMANCE 10
GENERAL INFORMATION 7
INSPECTION (ENGINE OIL LEAKS IN GENERAL) 8
INTAKE MANIFOLD LEAKAGE DIAGNOSIS 7
LASH ADJUSTER (TAPPET) NOISE DIAGNOSIS 8

DIAGNOSIS AND TESTING

GENERAL INFORMATION

Engine diagnosis is helpful in determining the causes of malfunctions.

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 out lined 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 through 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 CAUSE	CORRECTION
ENGINE WILL NOT START	1. Weak battery.	1. Test battery. Charge or replace as necessary.Refer to Group 8A, Battery.
	2. Corroded or loose battery connections.	2. Clean and tighten battery connections. Apply a coat of light mineral grease to terminals.
	3. Faulty starter.	Test starting system. Refer to Group 8B, Starting.
	4. Moisture on ignition wires.	4. Remove moisture from wires.
	5. Faulty ignition cables.	5. Replace any cracked or shorted cables.
	6. Faulty coil or control unit.	6. Test and replace as needed. Refer to Group 8D, Ignition System
	7. Incorrect spark plug gap.	7. Set gap. Refer to Group 8D, Ignition System.
	8. Contamination in fuel system.	8. Clean system and replace fuel filter.
	9. Faulty fuel pump.	9. Test fuel pump and replace as needed. Refer to Group 14, Fuel System.
ENGINE STALLS OR IDLES ROUGH	1. Idle speed too low.	1. Test minimum air flow. Refer to Group 14, Fuel System.
	2. Incorrect fuel mixture.	2. Refer to Group 14, Fuel System.
	3. Intake manifold leakage.	3. Inspect intake manifold, manifold gasket, and vacuum hoses. Refer to Group 11, Exhaust System and Intake Manifold.
	4. Incorrect ignition wiring.	4. Install correct wiring.
	5. Faulty coil(s)	5. Test and replace as necessary. Refer to Group 8D, Ignition System.
ENGINE LOSS OF POWER	1. Dirty or incorrectly gapped plugs.	1. Clean plugs and set gap. Refer to Group 8D, Ignition System.
	2. Contamination in fuel system.	2. Clean system and replace fuel filter.
	3. Faulty fuel pump.	3. Test and replace as necessary. Refer to Group 14, Fuel System.
	4. Incorrect valve timing.	4. Correct valve timing.
	5. Leaking cylinder head gasket.	5. Replace cylinder head gasket.
	6. Low compression.	6. Test compression of each cylinder.
	7. Burned, warped, or pitted valves.	7. Replace valves.
	8. Plugged or restricted exhaust system.	8. Install new parts, as necessary.
	9. Faulty ignition cables.	9. Replace any cracked or shorted cables.
	10. Faulty coil(s).	10. Test and replace as necessary. Refer to Group 8D, Ignition System.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSE	CORRECTION
ENGINE MISSES ON ACCELERATION	1. Dirty or incorrectly gapped spark plugs. 2. Contamination in Fuel System. 3. Burned, warped, or pitted valves. 4. Faulty coil(s).	1. Clean spark plugs and set gap. Refer to Group 8D, Ignition System. 2. Clean fuel system and replace fuel filter. 3. Replace valves. 4. Test and replace as necessary. Refer to Group 8D, Ignition System.
ENGINE MISSES AT HIGH SPEED	1. Dirty or incorrect spark plug gap. 2. Faulty coil(s). 3. Dirty fuel injector(s). 4. Contamination 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. Test and replace as necessary. Refer to Group 14, Fuel System. 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 on valve faces. 9. Missing adjuster pivot.	1. Check for correct oil level. 2. Change oil to correct viscosity. 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. Insuffient 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. 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 surface. 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 or worn. 7. Loose flywheel or torque converter.	1. Check engine oil level. 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. Check thrust bearing for wear on flanges. 6. Replace crankshaft or grind journals. 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. 10. Oil pump cover warped or cracked.	1. Check engine oil level. 2. Install new sending unit. 3. Check sending unit and 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, or replace. 9. Remove oil pan and install new tube or clean, if necessary. 10. Install new oil pump.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
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 gasket(s). 2. Tighten, repair or replace the part. 3. Replace as necessary.
OIL CONSUMPTION OR SPARK PLUGS FOULED	1. PCV system malfunction. 2. Worn, scuffed or broken rings. 3. Carbon in oil ring slots. 4. Rings fitted too tightly in grooves. 5. Worn valve guides. 6. Valve stem seal unseated or faulty.	1. Check system and repair as necessary. Refer to Group 25, Emission Control Systems. 2. Hone cyinder bores. Install new rings. 3. Install new rings. 4. Remove rings and 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

INDEX

page

DESCRIPTION AND OPERATION
ENGINE COMPONENTS 15
ENGINE IDENTIFICATION 14
ENGINE LUBRICATION SYSTEM 14
DIAGNOSIS AND TESTING
CHECKING ENGINE OIL PRESSURE 16
SERVICE PROCEDURES
CRANKSHAFT END PLAY 20
FITTING CONNECTING ROD BEARINGS 18
FITTING MAIN BEARINGS 19
FITTING PISTON RINGS 16
FITTING PISTONS 16
VALVE SERVICE RECONDITION 21
REMOVAL AND INSTALLATION
BALANCE SHAFTS CARRIER ASSEMBLY 30
CAMSHAFT FOLLOWER 30
CAMSHAFT OIL SEAL—FRONT 41
CAMSHAFT 28
CRANKSHAFT OIL SEAL—FRONT 42
CRANKSHAFT OIL SEAL—REAR 43
CRANKSHAFT 46
CYLINDER HEAD COVER 28
CYLINDER HEAD 34
ENGINE ASSEMBLY 26
ENGINE MOUNT—FRONT 23
ENGINE MOUNT—LEFT 24
ENGINE MOUNT—REAR 25
ENGINE MOUNT—RIGHT 24

page

HYDRAULIC LASH ADJUSTER 33
OIL FILTER 47
OIL PAN 45
OIL PUMP 47
PISTON AND CONNECTING ROD 49
STRUCTURAL COLLAR 25
TIMING BELT COVER 37
TIMING BELT TENSIONER ASSEMBLY 40
TIMING BELT 37
VALVE SPRINGS AND
VALVE SEALS IN VEHICLE 33
VALVES AND VALVE SPRINGS 35
VIBRATION DAMPER 36
DISASSEMBLY AND ASSEMBLY
OIL PUMP 50
CLEANING AND INSPECTION
OIL PUMP 52
CRANKSHAFT 52
CYLINDER BLOCK 54
CYLINDER HEAD 51
VALVE AND VALVE SPRING 51
ADJUSTMENTS
ENGINE MOUNTS 54
SPECIFICATIONS
2.4L ENGINE 55
TORQUE CHART 2.4L 57
SPECIAL TOOLS
2.4L ENGINE 58

DESCRIPTION AND OPERATION

ENGINE IDENTIFICATION

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

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.

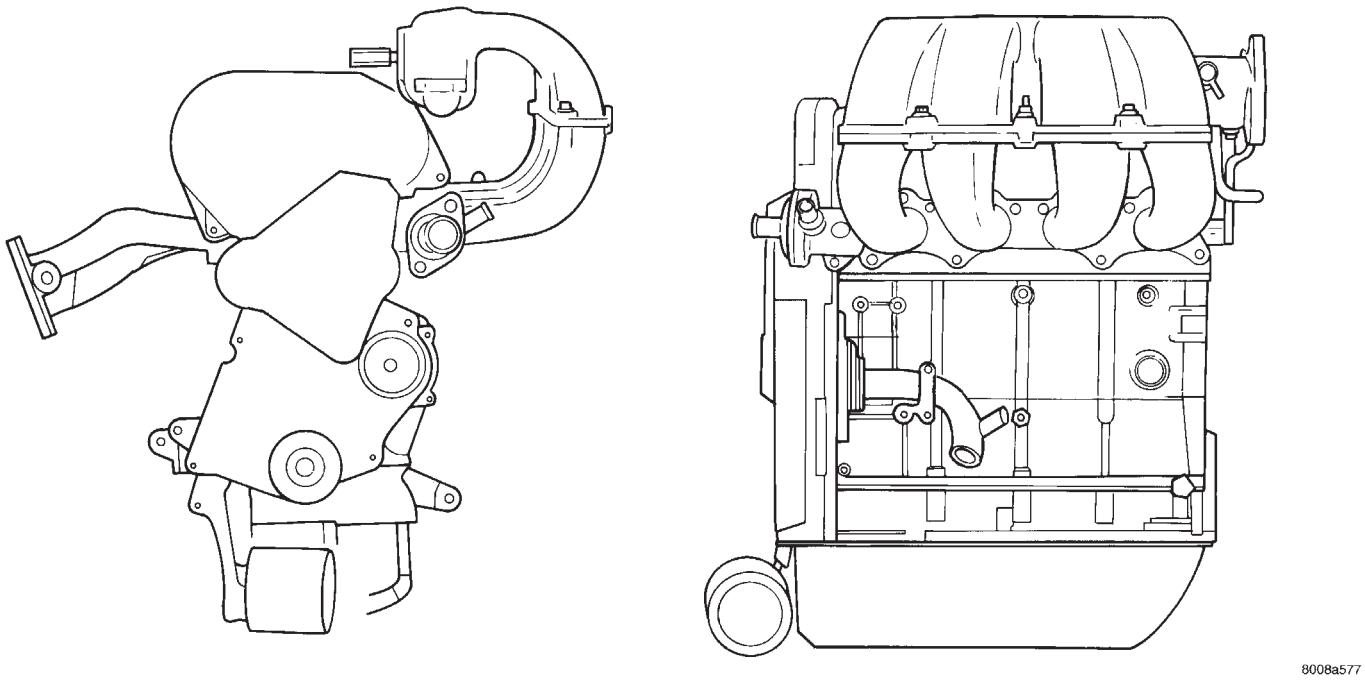
MAIN/ROD BEARINGS

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.

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.

DESCRIPTION AND OPERATION (Continued)



Engine—2.4L

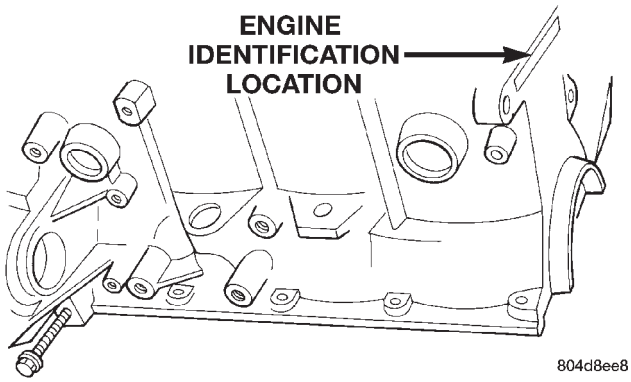


Fig. 1 Engine Identification

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.

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

DESCRIPTION AND OPERATION (Continued)

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 galleys 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 two piece aluminum casting, attached to the cylinder head with ten screws. This long branch fan design enhances low and midspeed torque, while minimizing undesirable inlet noise.

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.

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

FITTING PISTONS

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. 3). Cylinder bores should be measured halfway down the cylinder bore and transverse to the engine crankshaft center line shown in (Fig. 2). Refer to Cylinder Bore and Piston Specification Chart.

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).

FITTING PISTON RINGS

(1) Wipe cylinder bore clean. Insert ring and push down with piston to ensure it is square in bore. The ring gap measurement must be made with the ring positioning at least 12 mm (0.50 inch) from bottom of cylinder bore. Check gap with feeler gauge (Fig. 4). Refer to specification in Piston Ring Specification Chart.

(2) Check piston ring to groove side clearance (Fig. 5). Refer to specification in Piston Ring Specification Chart.

SERVICE PROCEDURES (Continued)

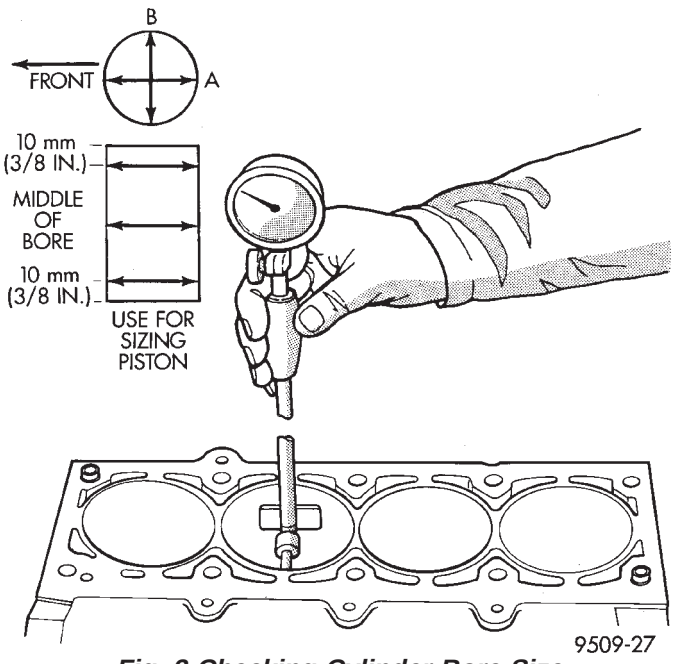


Fig. 2 Checking Cylinder Bore Size

CYLINDER BORE AND PISTON SPECIFICATION CHART

Standard Bore	Maximum Out-Of-Round	Maximum Taper
87.5 mm (3.445 in.)	0.051 mm (0.002 in.)	0.051 mm (0.002 in.)
Standard Piston Size 87.450 - 87.468 mm (3.4434 - 3.4441 in.)		
Piston To Bore Clearance 0.024 - 0.057 mm (0.0009 - 0.0022 in.)		
Note: Measurements taken at Piston Size Location.		

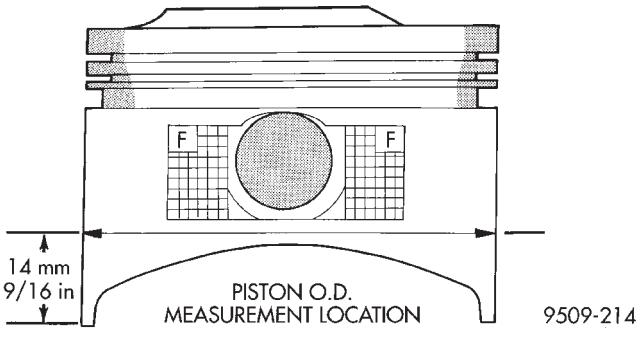


Fig. 3 Piston Measurement

PISTON RINGS—INSTALLATION

(1) Install rings with manufacturers I.D. mark facing up, to the top of the piston (Fig. 6).

CAUTION: Install piston rings in the following order:

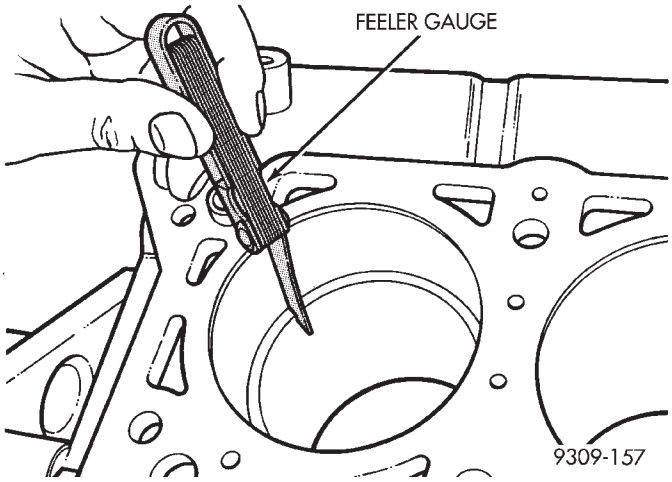


Fig. 4 Piston Ring Gap

PISTON RING SPECIFICATION CHART

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.		

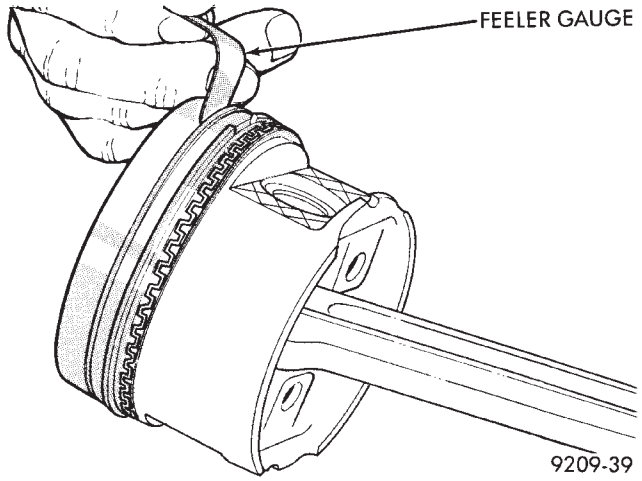


Fig. 5 Piston Ring Side Clearance

SERVICE PROCEDURES (Continued)

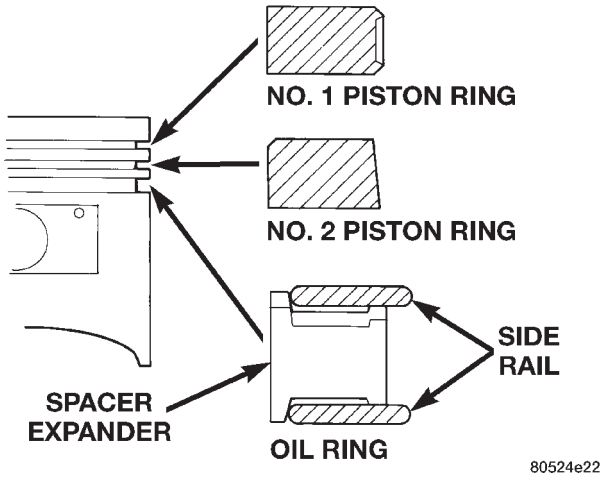


Fig. 6 Piston Ring Installation

a. Oil ring expander.
b. Upper oil ring side rail.
c. Lower oil ring side rail.
d. No. 2 Intermediate piston ring.
e. 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. 7).

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

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

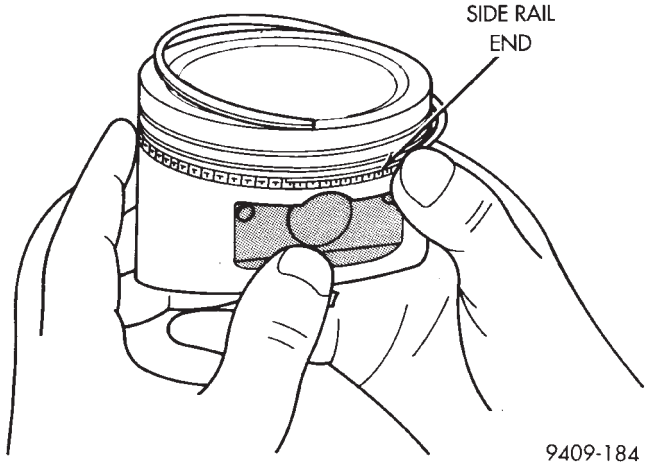


Fig. 7 Installing Side Rail

(5) Position piston ring end gaps as shown in (Fig. 8).

(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.

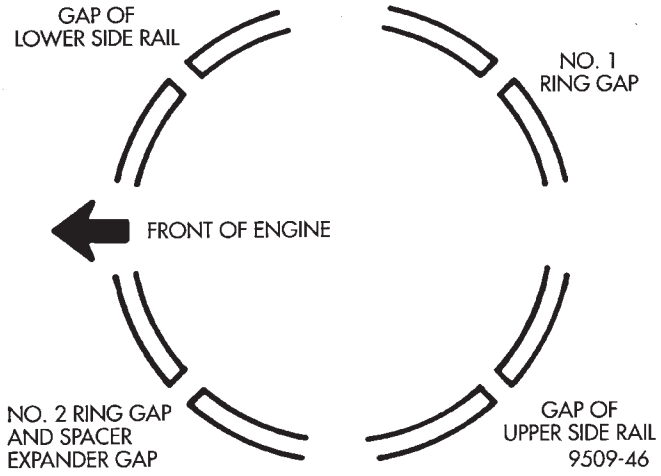


Fig. 8 Piston Ring End Gap Position

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. 9). In addition, suspect areas can be checked by placing plastigage in the suspect area.

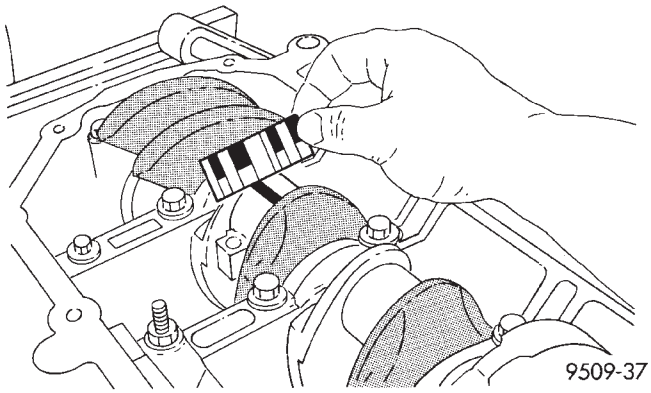


Fig. 9 Measuring Plastigage Width

(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.**

(5) Remove the bearing cap and compare the width of the flattened Plastigage (Fig. 9) with the metric

SERVICE PROCEDURES (Continued)

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 Chart.

CRANKSHAFT SPECIFICATION CHART

Crankshaft End-Play
New Part: 0.09 - 0.24 mm (0.0035 - 0.0094 in.)
Wear Limit: 0.37 mm (0.015 in.)
Main Bearing Clearance
New Part: 0.018 - 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 ± 0.008 mm (2.3622 ± 0.0003 in.)
1 st Undersize 59.975 ± 0.008 mm (2.361 ± 0.0003 in.)
Connecting Rod Journals
Standard 49.992 ± 0.008 mm (1.968 ± 0.0003 in.)
1 st Undersize 49.967 ± 0.008 mm (1.967 ± 0.0003 in.)

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. 10).

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. 10). 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.) and 0.250 mm (0.010 in.). Never install an undersize bearing that will reduce clearance below specifications.

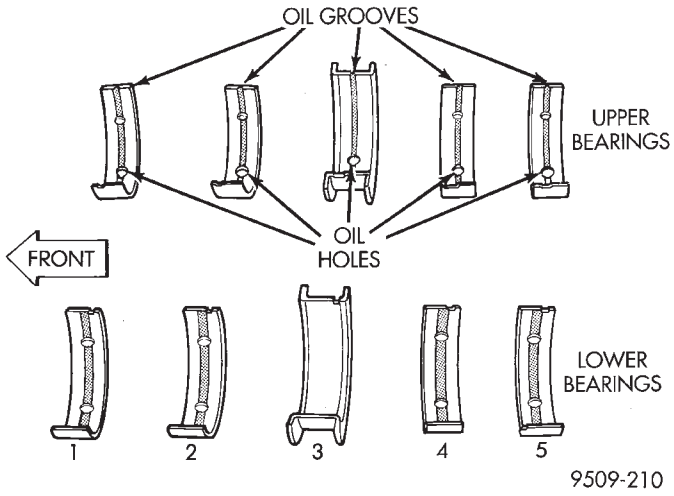


Fig. 10 Main Bearing Identification

MAIN BEARING INSTALLATION

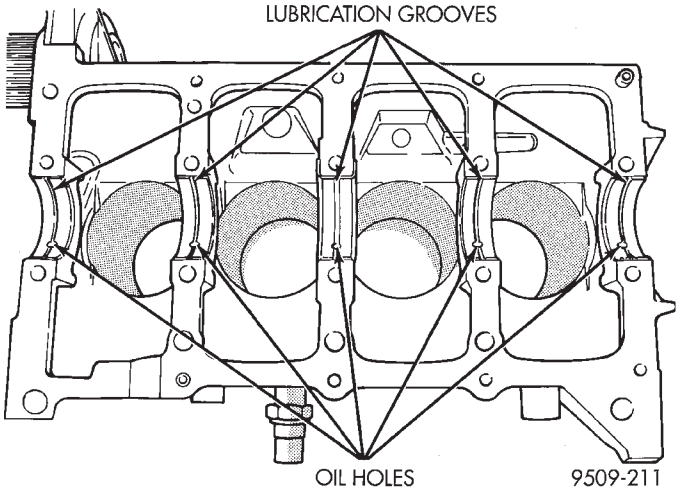


Fig. 11 Installing Main Bearing Upper Shell

(1) Install the main bearing shells with the lubrication groove in the cylinder block (Fig. 11).

(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.

SERVICE PROCEDURES (Continued)

(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. 12).

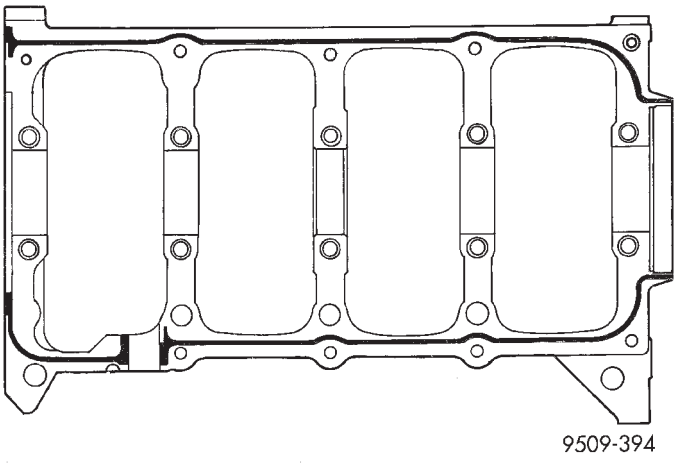


Fig. 12 Main Bearing Caps/Bedplate Sealing

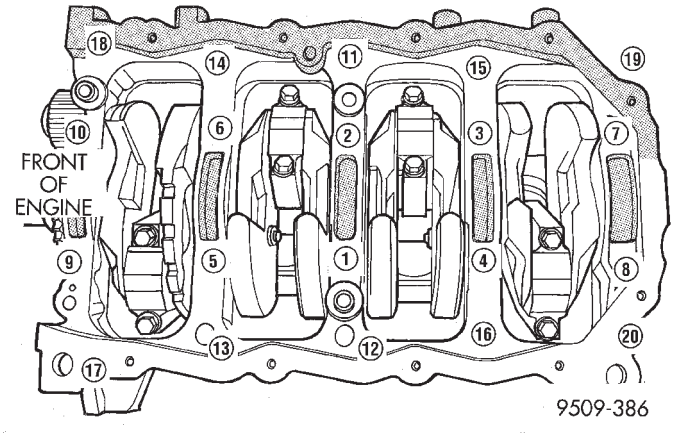


Fig. 13 Main Bearing Caps/Bedplate Torque Sequence

(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 bolts, lubricate the threads with clean engine oil, wipe off any excess oil.

(7) Install main bearing bedplate to engine block bolts 11, 17 and 20 finger tight. Tighten these bolts down together until the bedplate contacts the cylinder block.

(8) To ensure correct thrust bearing alignment, perform the following steps:

- Step 1: Rotate crankshaft until number 4 piston is at TDC.
- Step 2: Move crankshaft rearward to limits of travel.
- Step 3: Then, move crankshaft forward to limits of travel.
- Step 4: Wedge an appropriate tool between the rear of the cylinder block **(NOT BED PLATE)** and the rear crankshaft counterweight. This will hold the crankshaft in it's furthest forward position.
- Step 5: Install and tighten bolts (1 – 10) in sequence shown in (Fig. 13) to 41 N·m (30 ft. lbs.).
- Step 6: Remove wedge tool used to hold crankshaft.

(9) Tighten bolts (1 – 10) again to 41 N·m (30 ft. lbs.) + 1/4 turn in sequence shown in (Fig. 13).

(10) 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. 13).

(11) 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

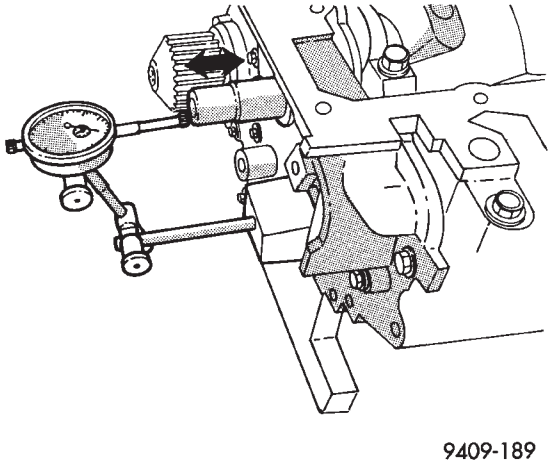


Fig. 14 Checking Crankshaft End Play—Typical

(1) Mount a dial indicator to front of engine, locating probe on nose of crankshaft (Fig. 14).

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

(3) Zero the dial indicator.

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

CRANKSHAFT SPECIFICATION CHART

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

SERVICE PROCEDURES (Continued)

OPTIONAL CRANKSHAFT END PLAY CHECK

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

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

VALVE SERVICE RECONDITION

VALVE REMOVAL

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

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

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

VALVE INSPECTION

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

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

(3) If valve stems are worn more than 0.05 mm (0.002 in.), replace valve.

VALVE GUIDES

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

(2) Using a small hole gauge and a micrometer, measure valve guides in 3 places top, middle and bottom (Fig. 15). Refer to Valve Guide Specification Chart. Replace guides if they are not within specification.

(3) Check valve guide height (Fig. 16).

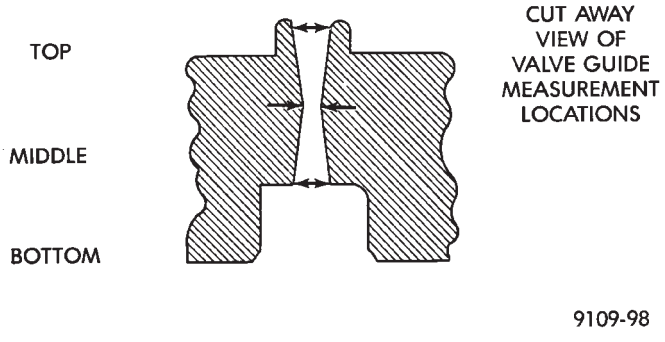


Fig. 15 Checking Wear on Valve Guide—Typical

TESTING VALVE SPRINGS

(1) Whenever valves have been removed for inspection, reconditioning or replacement, valve springs should be tested. As an example, the compression length of the spring to be tested is 33.34 mm (1 5/16 inches). Turn tool table until surface is in line with the 33.34 mm (1 5/16 in.) mark on the threaded stud and the zero mark on the front. Place spring over stud on the table and lift compressing lever to set tone device (Fig. 17). Pull on torque wrench until ping is heard. Take reading on torque wrench at this instant. Multiply this reading by two. This will give the spring load at test length. Fractional measurements are indicated on the table for finer adjustments. Discard the springs that do not meet specifications. The Following specifications apply to both intake and exhaust valve springs;

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

VALVE GUIDE SPECIFICATION CHART

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

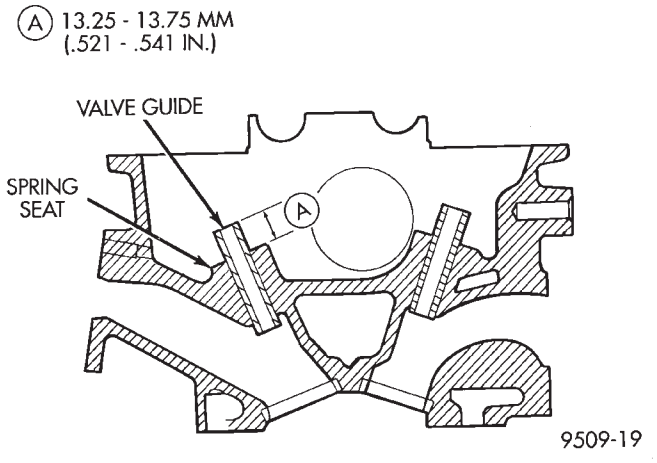


Fig. 16 Valve Guide Height

REFACING VALVES AND VALVE SEATS

(1) The intake and exhaust valve seats and valve face have a 45 and a 45 1/2 degree angles.

SERVICE PROCEDURES (Continued)

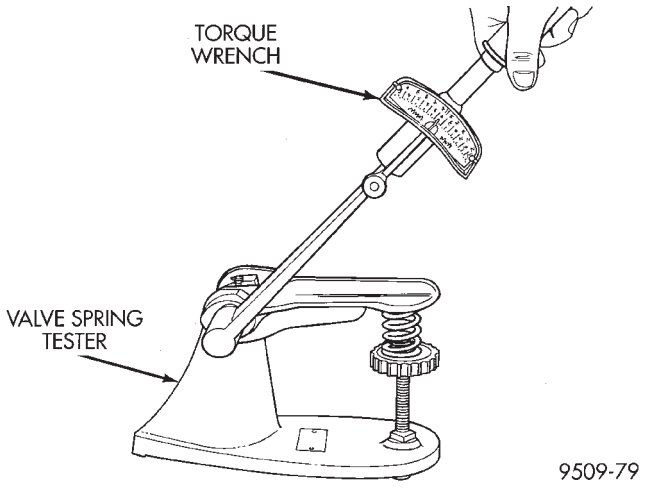
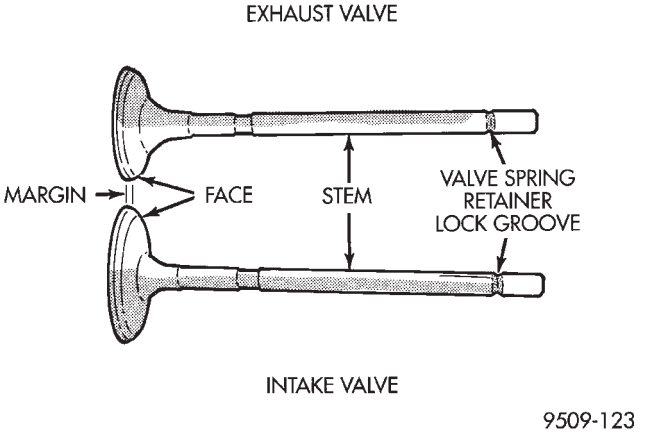


Fig. 17 Testing Valve Springs



Intake and Exhaust Valves

(2) Inspect the remaining margin after the valves are refaced (Fig. 18). Intake valves with less than 1.2 mm (3/64 inch.) margin and Exhaust valves with less than 0.9 mm (1/32 inch.) margin should be discarded.

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

(4) Measure the concentricity of valve seat and valve guide using a valve seat runout dial indicator. Total runout should not exceed. 0.051 mm (0.002 inch.) (total indicator reading).

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

VALVE SPECIFICATION CHART

Face Angle	
Intake and Exhaust:	44.5°-45°
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 (0.2337 - 0.2344 in.)
Exhaust:	5.906 - 5.924 mm (0.2326 - 0.2333 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.)

- Intake valve seat diameter is 34.37 34.63 mm (1.158 1.363 inch.)
- Exhaust valve seat diameter is 29.37 29.63 mm (1.156 1.166 inch.)

(6) Valve seats which are worn or burned can be reworked, provided that correct angle and seat width are maintained. Otherwise the cylinder head must be replaced.

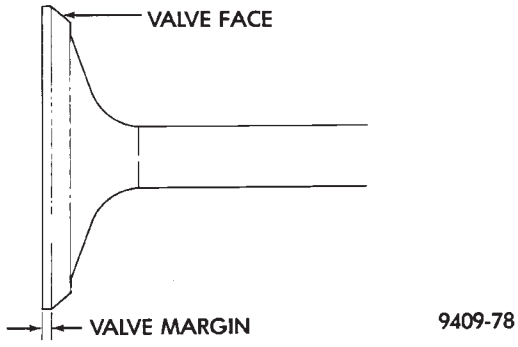


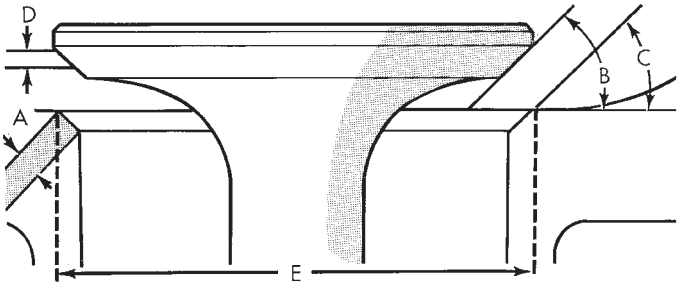
Fig. 18 Refacing Intake and Exhaust Valves

(7) When seat is properly positioned the width of intake and exhaust seats should be 0.9 to 1.3 mm (0.35 to 0.051 inch.) (Fig. 19).

(8) Check valve tip height dimensions A after grinding the valve seats or faces (Fig. 20). Grind valve tip to 47.99 mm (1.889 in.) for exhaust valve and 48.04 mm (1.891 in.) for intake valve when installed in the head. The valve tip chamfer may

SERVICE PROCEDURES (Continued)

need to be reground to prevent seal damage when the valve is installed.



A – SEAT WIDTH (INTAKE AND EXHAUST 0.9 TO 1.3 mm (.035 TO .051 IN.)
B – FACE ANGLE (INTAKE & EXHAUST: 44 1/2°-45°)
C – SEAT ANGLE (INTAKE & EXHAUST: 45°-45 1/2°)
D – SEAT CONTACT AREA
E – SEAT DIAMETER 9509-207

Fig. 19 Refacing Valve Seats

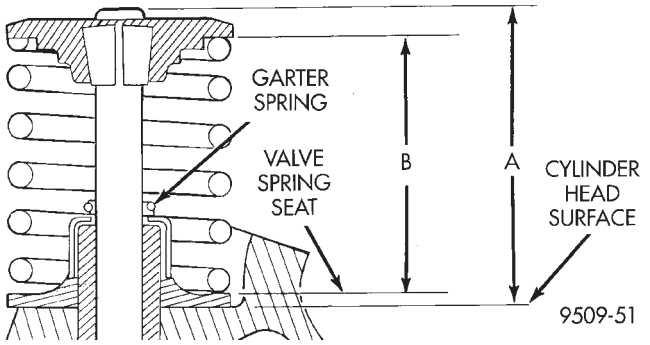


Fig. 20 Checking Spring Installed Height and Valve Tip Height Dimensions

VALVE INSTALLATION

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

(2) Install new valve stem seals on all valves using a valve stem seal tool (Fig. 21). The valve stem seals should be pushed firmly and squarely over valve guide.

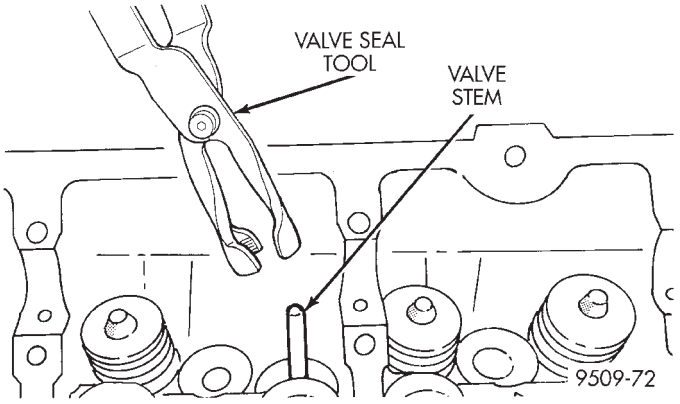


Fig. 21 Valve Stem Oil Seal Special Tool C4745

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.

(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. Check to make sure both locks are in their correct location after removing tool.

(4) Check the valve spring installed height B after refacing the valve and seat (Fig. 20). 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 inch.) spacer under the valve spring seat to bring spring height back within specification.

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

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

REMOVAL AND INSTALLATION

ENGINE MOUNT—FRONT

REMOVAL

(1) Support the engine and transaxle assembly with a floor jack so it will not rotate.

(2) Remove the front engine mount through bolt from the insulator and front crossmember mounting bracket (Fig. 22).

(3) Remove six screws from air dam to allow access to the front mount screws.

(4) Remove the front engine mount screws and remove the insulator assembly.

(5) Remove the front mounting bracket, if necessary (Fig. 22).

INSTALLATION

(1) Reverse removal procedure for installation and tighten fasteners in this order. For engine mount

REMOVAL AND INSTALLATION (Continued)

adjustment procedure, refer to Adjustments, Engine Mounts in this Section.

(a) Tighten bolts 2, 3 and 4 to 108 N·m (80 ft. lbs.)

(b) Tighten bolts 1 and 5 to 54 N·m (40 ft. lbs.).

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

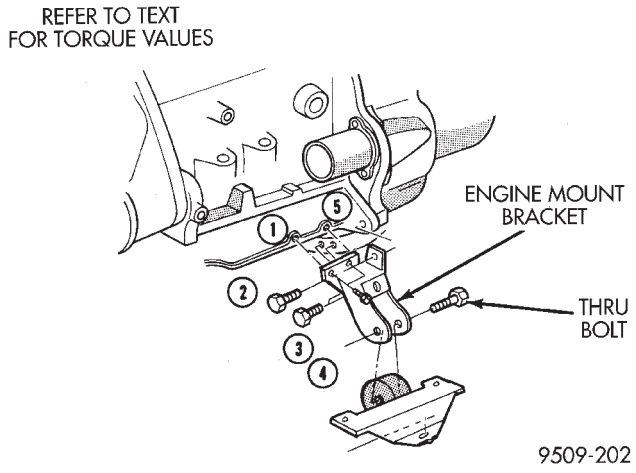


Fig. 22 Engine Mounting-Front

ENGINE MOUNT—LEFT

REMOVAL

(1) Raise vehicle on hoist and remove left front wheel.

(2) Support the transaxle with a jack.

(3) Remove the insulator through bolt from the mount.

(4) Remove the transaxle mount fasteners and remove mount (Fig. 23).

INSTALLATION

(1) Reverse removal procedure for installation.

(2) Tighten mount to transaxle bolts to 55 N·m (40 ft. lbs.)

(3) Tighten through bolt to 75 N·m (55 ft. lbs.) (Fig. 23).

(4) Engine mount adjustment, Refer to Engine Mount Adjustment in this section.

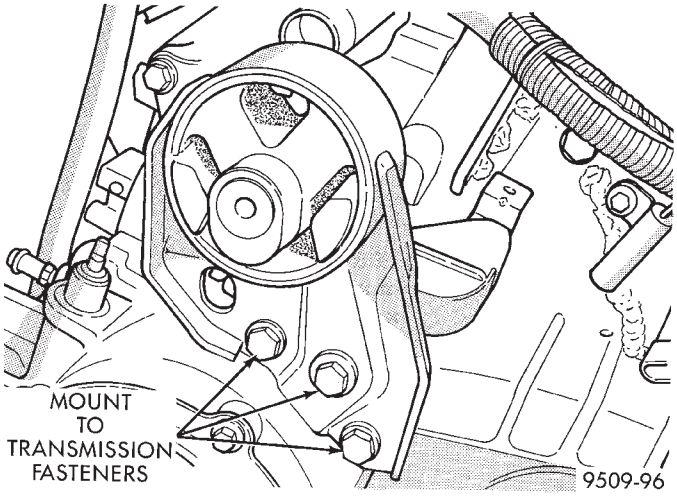


Fig. 23 Typical Engine Mounting—Left

ENGINE MOUNT—RIGHT

REMOVAL

NOTE: Right mount should only be serviced as an assembly to prevent noise, vibration and harshness concerns.

(1) Remove the purge duty solenoid and wiring harness from engine mount bracket.

(2) Remove the two right engine mount insulator vertical fasteners from frame rail and loosen the one horizontal fastener. **Do not remove the large nut located at the end of the core (Fig. 24).**

(3) Remove the load on the engine mounts by carefully supporting the engine and transaxle assembly with a floor jack.

(4) Remove the vertical and horizontal fasteners from the engine side bracket. Remove the mount assembly.

INSTALLATION

(1) Reverse removal procedure for installation. Tighten assembly in the following order:

a. Engine mount to rail fasteners to 68 N·m (50 ft. lbs.).

b. The vertical engine fastener to 102 N·m (75 ft. lbs.).

c. The horizontal fastener to 150 N·m (111 ft. lbs.).

REMOVAL AND INSTALLATION (Continued)

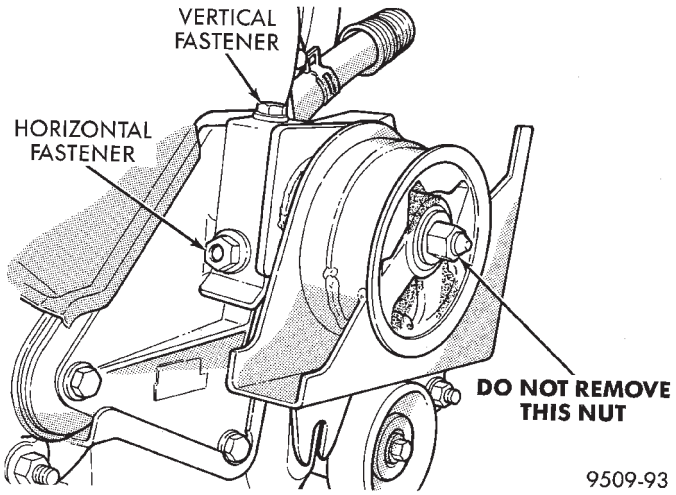


Fig. 24 Engine Mounting—Right Side

ENGINE MOUNT—REAR

REMOVAL

(1) Raise vehicle on hoist and remove the left front wheel.

(2) Support the transaxle with a jack so it will not rotate.

(3) Remove the insulator thru bolt from the mount and rear suspension crossmember.

(4) Remove the four mount fasteners and remove the mount.

INSTALLATION

(1) Reverse the removal procedure for installation. Refer to (Fig. 25).

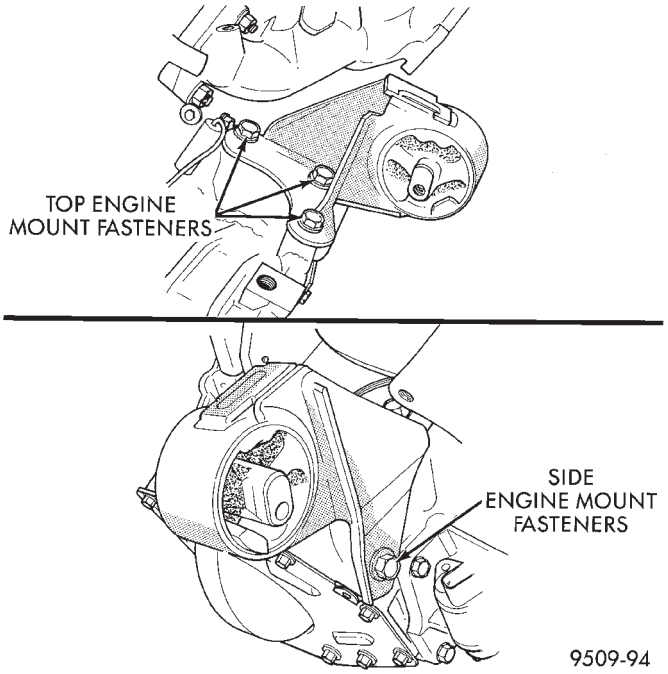


Fig. 25 Engine Mounting—Rear

STRUCTURAL COLLAR

REMOVAL

(1) Raise vehicle on hoist.

(2) Remove front engine mounting bracket from bending strut and front insulator mount.

(3) Remove bolts attaching bending strut to engine and transaxle.

(4) Remove bolts attaching collar and strut to engine, oil pan, and transaxle. Remove strut and collar.

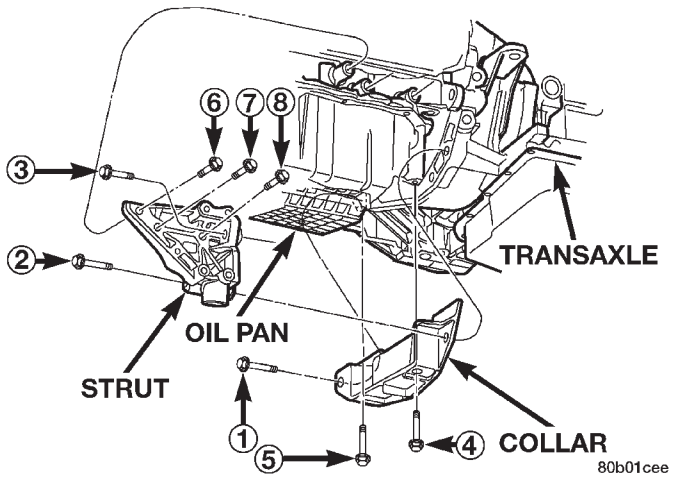


Fig. 26 Structural Collar and Bending Strut—Removal and Installation

INSTALLATION

CAUTION: Torque procedure for the structural collar and bending strut must be followed or damage could occur to oil pan, collar, and/or bending strut.

(1) Perform the following steps for installing structural collar and bending strut. Refer to (Fig. 26):

- Step 1: Place collar into position between transaxle and oil pan. Hand start only, collar to transaxle bolt 1.
- Step 2: Install bolt 4, collar to oil pan, **hand tight only.**
- Step 3: Position bending strut in place and hand start bolt 3 into the upper transaxle hole.
- Step 4: Install bolt 2, through strut and collar. Hand starting only.
- Step 5: Install bolt 6, strut to cylinder block, **hand tight only.**
- Step 6: Install the remaining collar to oil pan bolt 5, **hand tight only.**
- Step 7: Final torque collar to transaxle bolts 1 – 3, to 101 N·m (75 ft. lbs.)
- Step 8: Install bolts 7 and 8, through strut and into cylinder block.
- Step 9: Final torque bolts 4 – 8 to 61 N·m (45 ft. lbs.).

(2) Lower vehicle.

REMOVAL AND INSTALLATION (Continued)

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.

(3) Remove Air cleaner and hoses.

(4) Drain cooling system. Refer to Group 7, Cooling System for procedure.

(5) Remove upper radiator hose and remove radiator fans. Refer to Group 7, Cooling System for procedure.

(6) Remove lower radiator hose.

(7) Disconnect automatic transmission cooler lines and plug, if equipped.

(8) Disconnect transmission shift linkage.

(9) Disconnect throttle body linkage.

(10) Disconnect engine wiring harness.

(11) Disconnect heater hoses.

(12) Discharge Air Conditioning System. Refer to Group 24, Air Conditioning for procedure.

(13) Hoist vehicle and remove right inner splash shield. Remove wheels and tires.

(14) Loosen power steering belt for pump removal. Refer to Group 7, Cooling System for procedure.

(15) Remove axle shafts. Refer to Group 2, Suspension and Driveshafts for procedure.

(16) Disconnect exhaust pipe from manifold.

(17) Remove front and rear engine mount brackets from the body.

(18) Remove bending braces and front engine mount bracket. Remove transmission inspection cover.

(19) Mark flexplate to torque converter and remove torque converter bolts.

(20) Install front engine mount bracket.

(21) Lower vehicle.

(22) Remove power steering pump. Set pump aside.

(23) Remove A/C lines at compressor and cap.

(24) Remove ground straps to body.

(25) Raise vehicle enough to allow engine dolly Special Tool 6135, cradle Special Tool 6710 with Posts Special Tool 6848 and Adaptor Special Tool 8130 to be installed under vehicle (Fig. 27).

(26) Loosen cradle posts to allow movement for proper positioning. Locate two rear posts (right side of engine) into the holes on the engine bedplate. Locate the two front posts (left side of engine) on the front engine bracket and A/C compressor bracket (Fig. 27). 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.

(27) Lower vehicle so the weight of **ONLY THE ENGINE AND TRANSMISSION** are on the cradle.

(28) Remove engine and transmission mount bolts.

(29) Raise vehicle slowly. It may be necessary to move the engine/transmission assembly on the cradle to allow for removal around the body.

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. Refer to Group 2, Suspension and Driveshafts 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. Refer to Cooling System Group 7, Accessory Drive Section for belt tension adjustment.

(8) Install A/C compressor 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, and shift 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 fans. Install radiator hoses. Fill cooling system. Refer to Group 7, Cooling System for filling procedure.

(17) Connect battery.

(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.

REMOVAL AND INSTALLATION (Continued)

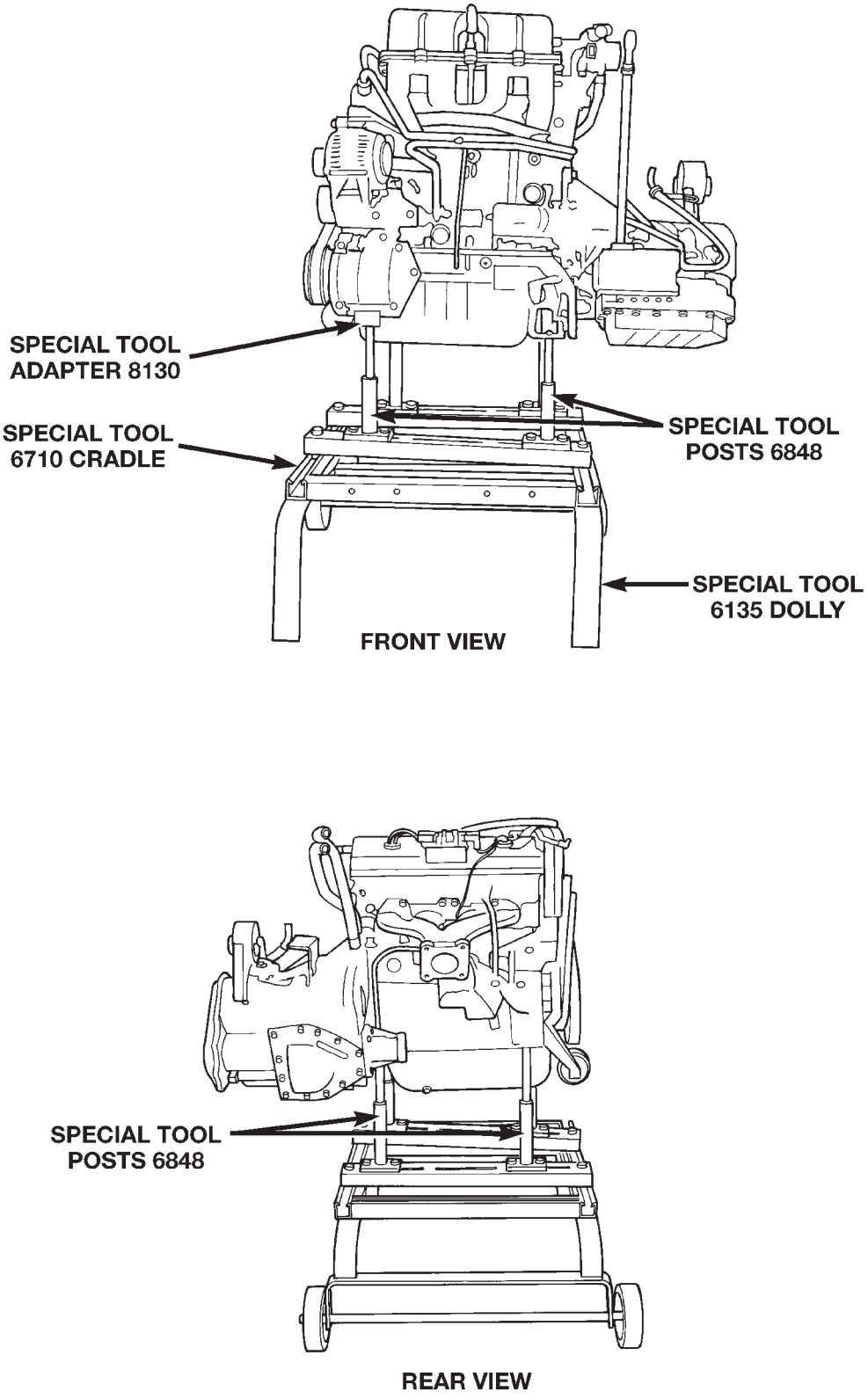


Fig. 27 Positioning Engine Cradle Support Post Mounts—Typical

REMOVAL AND INSTALLATION (Continued)

CYLINDER HEAD COVER

REMOVAL

(1) Remove upper intake manifold. Refer to Group 11, Exhaust System and Intake Manifold.

(2) Remove nuts attaching front and rear intake manifold supports from cylinder head cover attaching studs.

(3) Remove ignition coil pack and plug wires (Fig. 28). Remove ground strap.

(4) Remove the cylinder head cover fasteners.

(5) Remove cylinder head cover from cylinder head.

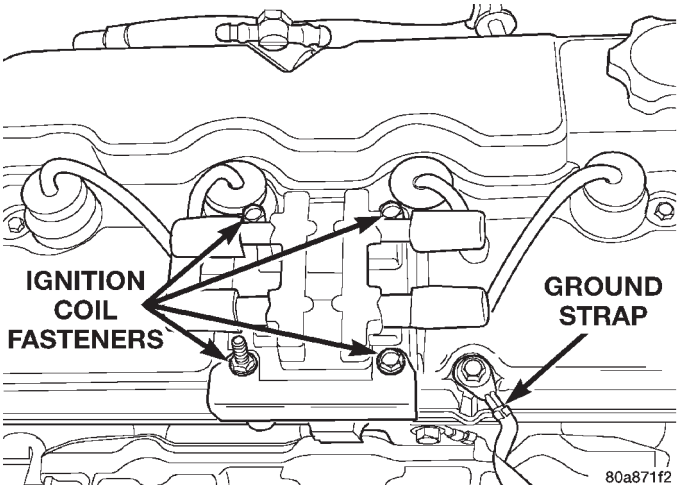


Fig. 28 Ignition Coil Pack and Ground Strap

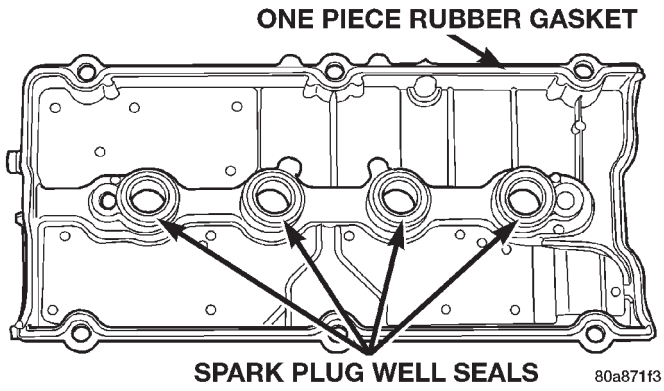


Fig. 29 Cylinder Head Cover Gasket and Spark Plug Seals

INSTALLATION

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

(1) Clean all sealing surfaces.

(2) Install new cylinder head cover gaskets and spark plug seals (Fig. 29).

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

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

(4) Install cylinder head cover assembly to head and tighten fasteners in sequence shown in (Fig. 30). 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.)

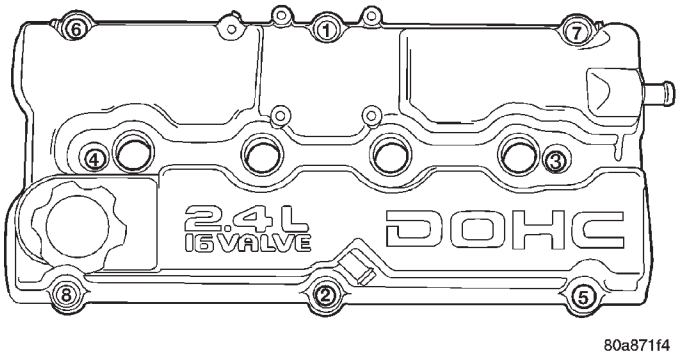


Fig. 30 Cylinder Head Cover Tightening Sequence

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

(6) Install ground strap.

(7) Install front and rear intake manifold support brackets and attaching nuts, but do not tighten at this time.

(8) Install upper intake manifold. Refer to Group 11, Exhaust System and Intake Manifold for procedure.

(9) Final torque intake manifold support nuts to 28 N·m (250 in. lbs.).

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. 31).

(4) Loosen the camshaft bearing cap attaching fasteners in sequence shown (Fig. 32) one camshaft at a time.

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

REMOVAL AND INSTALLATION (Continued)

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

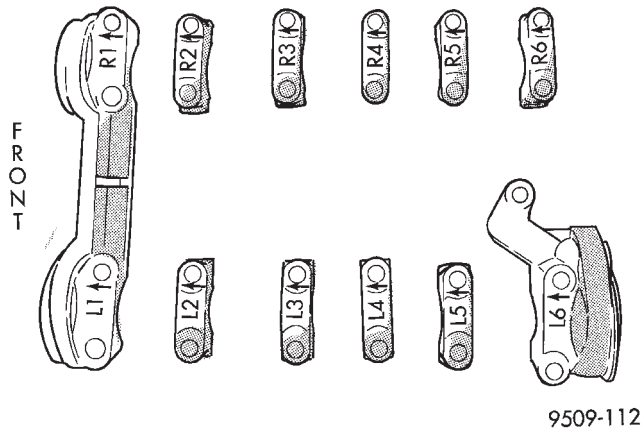


Fig. 31 Camshaft Bearing Cap Identification

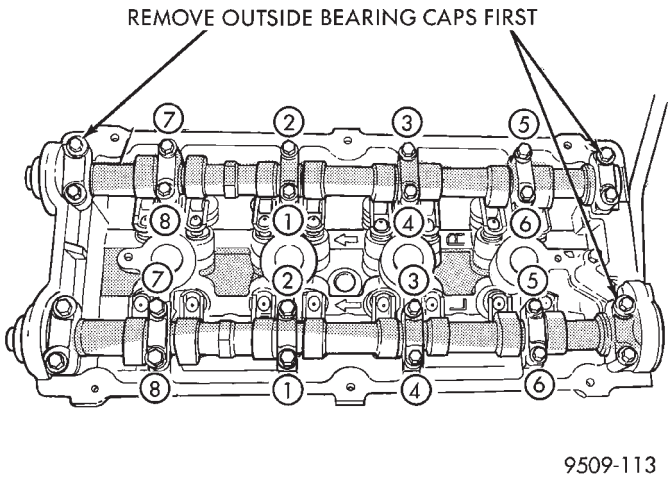


Fig. 32 Camshaft Bearing Cap— Removal

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. 33).

(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.

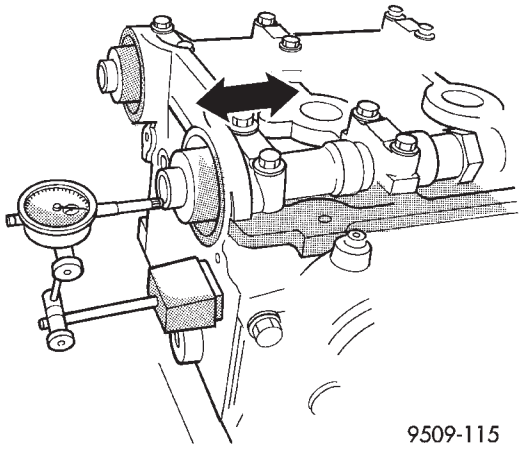


Fig. 33 Camshaft End Play

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. 34).

(2) Apply Mopar® Gasket Maker to No. 1 and No. 6 bearing caps (Fig. 35). 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.

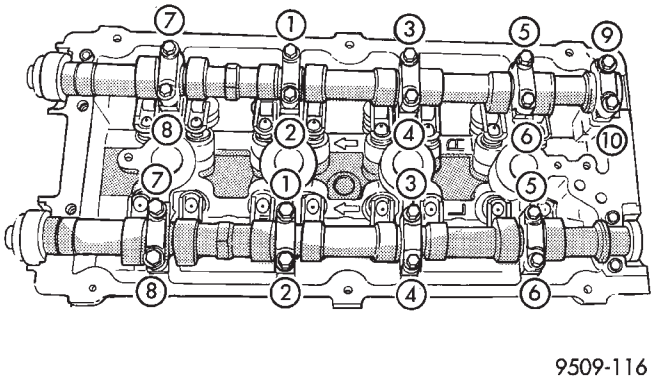


Fig. 34 Camshaft Bearing Cap Tightening Sequence

REMOVAL AND INSTALLATION (Continued)

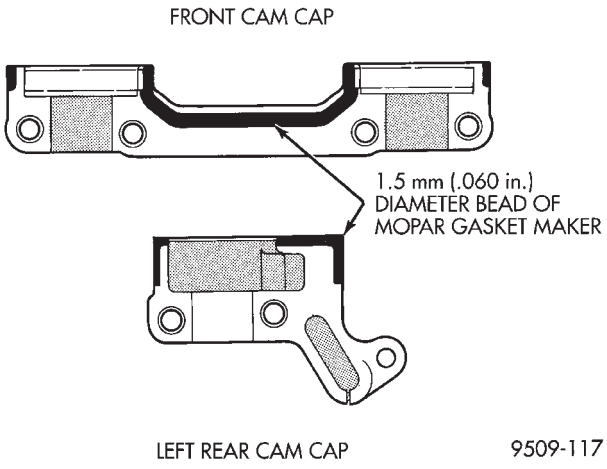


Fig. 35 Camshaft Bearing Cap Sealing

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. 36). Replace as necessary.

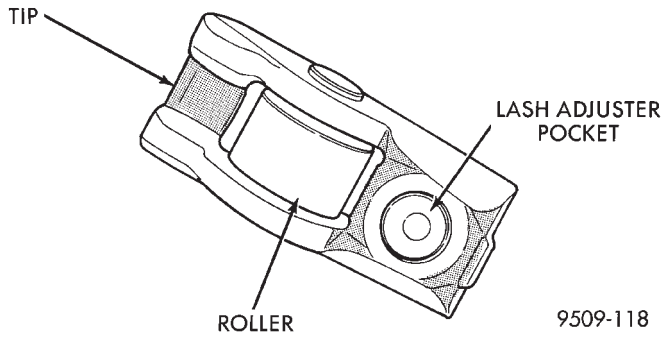


Fig. 36 Cam Follower Assembly

INSTALLATION

(1) Lubricate with clean oil and install cam follower assemblies in their original position on the hydraulic adjuster and valve stem (Fig. 37).

(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.

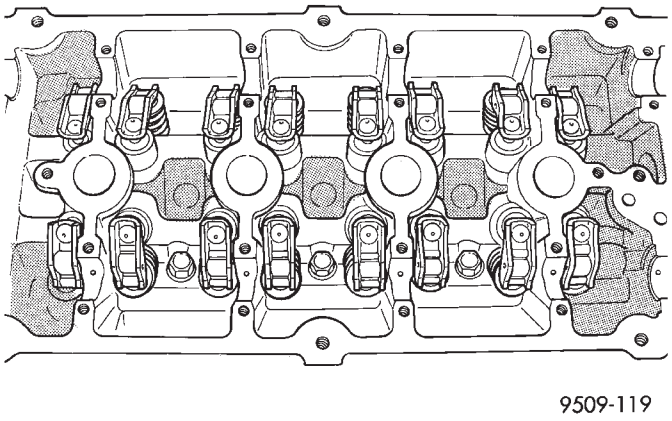


Fig. 37 Cam Follower Assemblies—Installation

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.

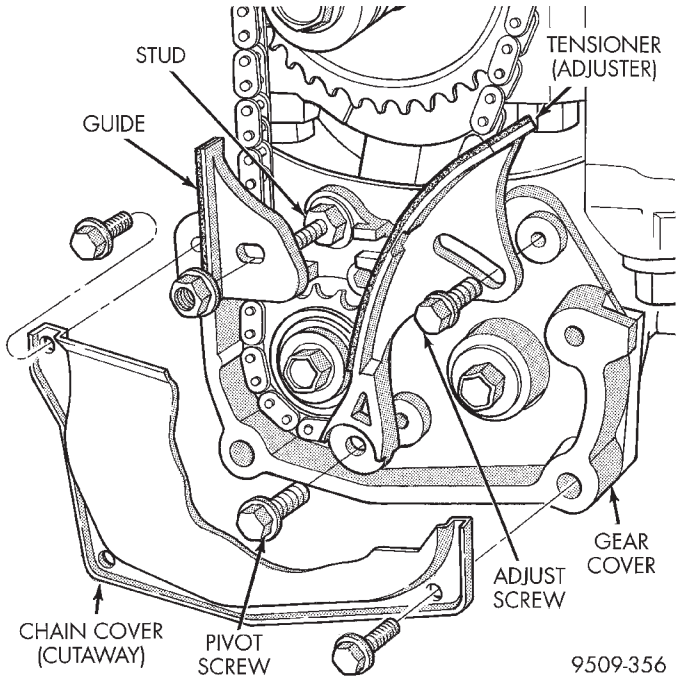


Fig. 38 Chain Cover, Guide and Tensioner

(1) Remove chain cover, guide and tensioner (Fig. 38). 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. 38).

REMOVAL AND INSTALLATION (Continued)

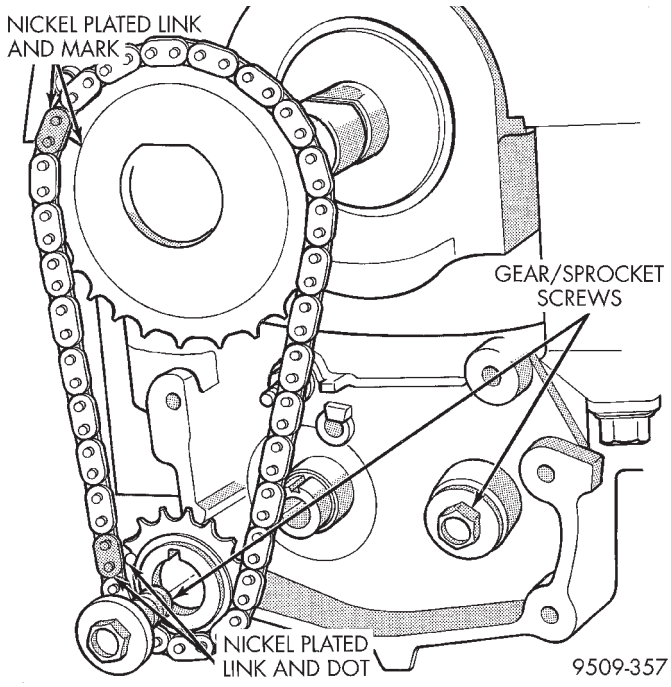


Fig. 39 Drive Chain and Sprockets

(3) Remove balance shaft gear and chain sprocket retaining screws and crankshaft chain sprocket. Remove chain and sprocket assembly (Fig. 39). Using two wide pry bars, work the sprocket back and forth until it is off the shaft.

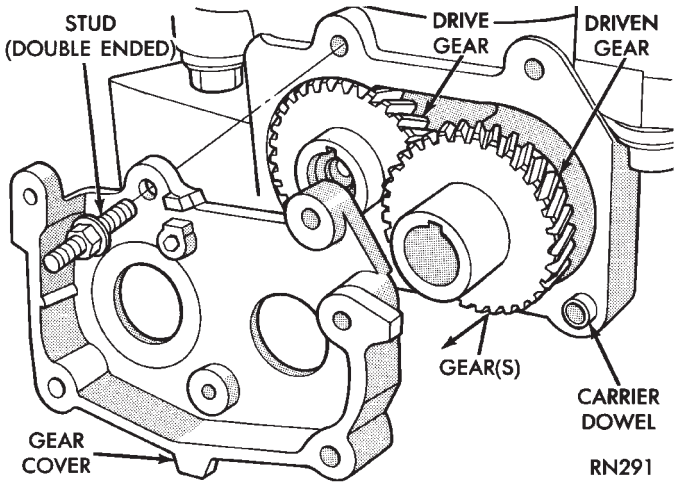


Fig. 40 Gear Cover and Gears

(4) Remove carrier gear cover and balance shafts (Fig. 40).

(5) Remove four carrier to crankcase attaching bolts to separate carrier from engine bedplate.

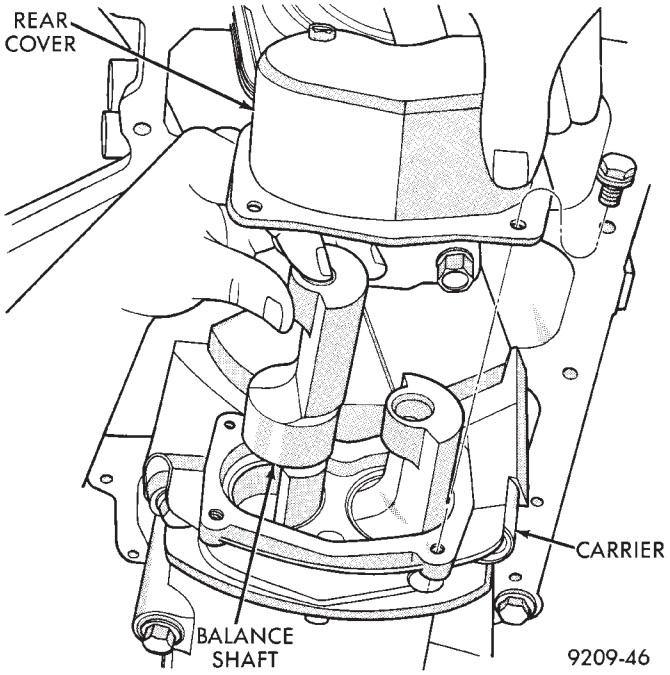


Fig. 41 Balance Shaft(s)—Removal/Installation

BALANCE SHAFT CARRIER

REMOVAL

The following components will remain intact during carrier removal. Gear cover, gears, balance shafts and the rear cover (Fig. 41).

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

(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.**

BALANCE SHAFT TIMING

(1) With balance shafts installed in carrier (Fig. 42) 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. 43).

REMOVAL AND INSTALLATION (Continued)

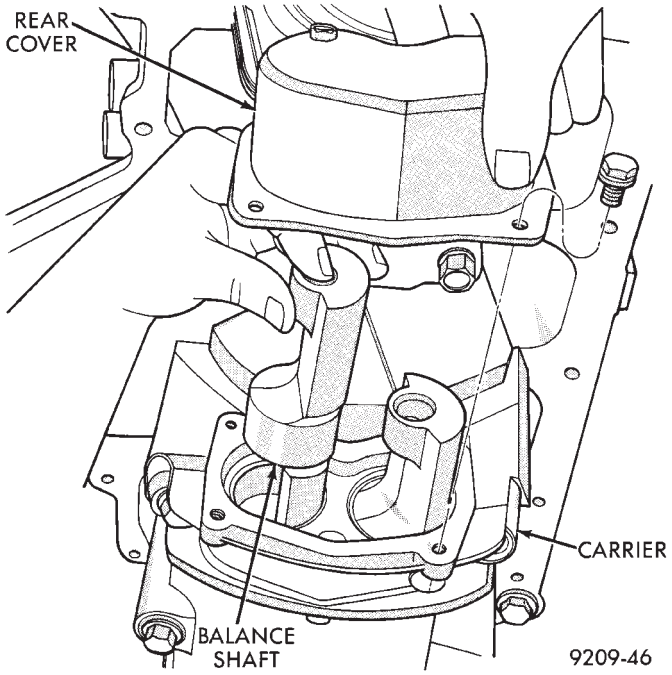


Fig. 42 Balance Shaft(s)—Removal/Installation

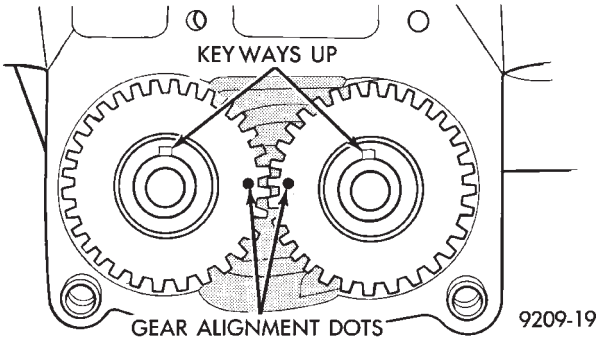


Fig. 43 Gear Timing

(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. 44).

(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. 45).

(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. 45).

(7) Place balance shaft sprocket into the timing chain (Fig. 45) 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

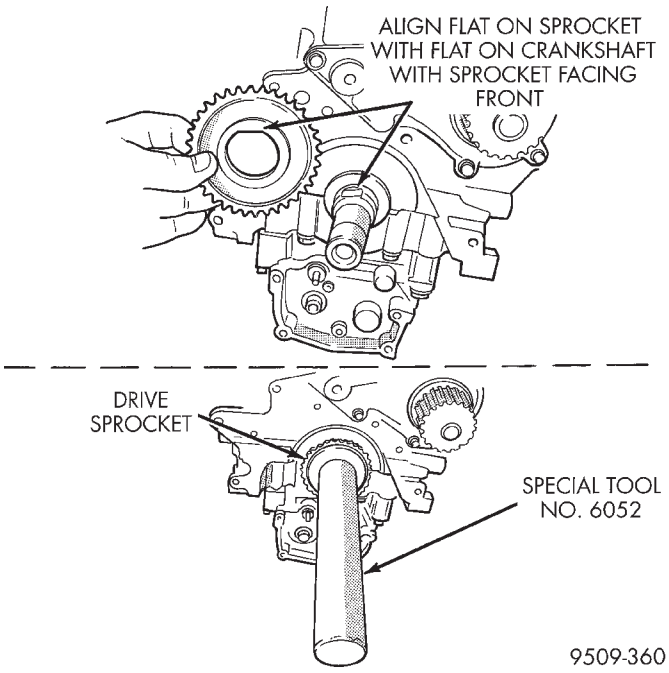


Fig. 44 Crankshaft Sprocket—Installation

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

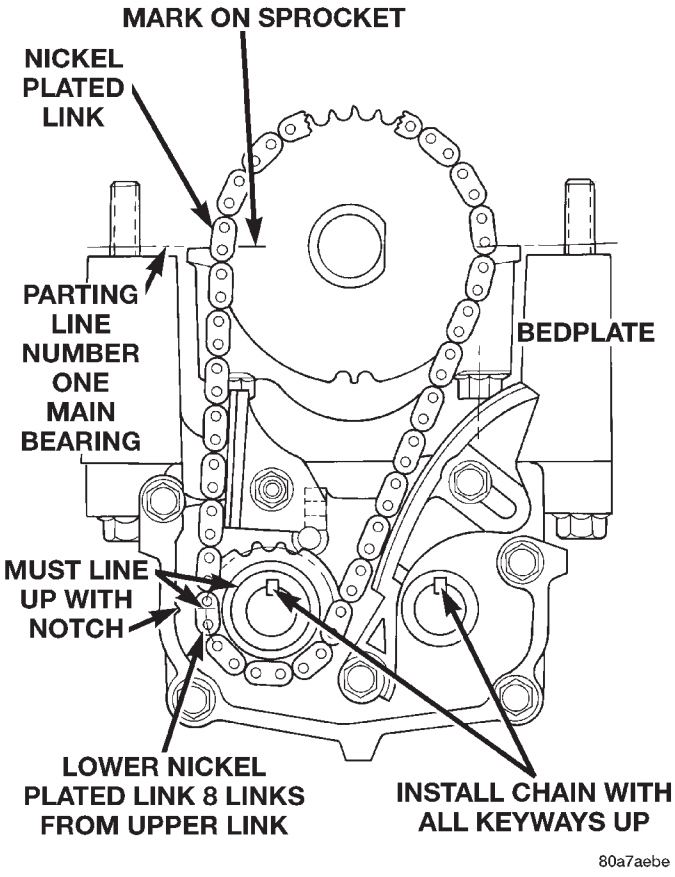


Fig. 45 Balance Shaft Timing

REMOVAL AND INSTALLATION (Continued)

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. 46).

(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.).

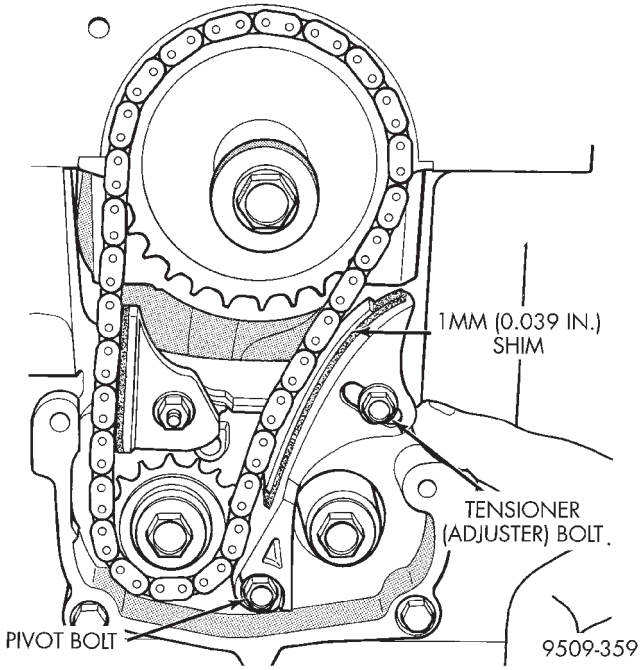


Fig. 46 Chain Tension Adjustment

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 an 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. 47) compress valve springs and remove valve locks.

(5) Remove valve spring.

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

INSTALLATION

(1) Install valve seal/valve spring seat assembly (Fig. 48). 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. 47). 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)

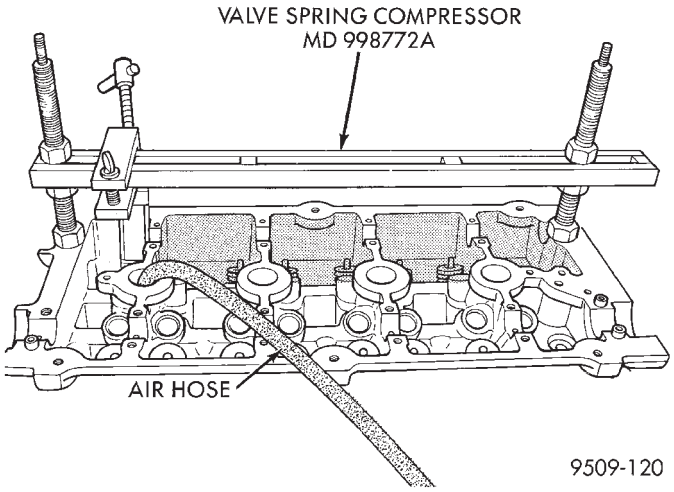


Fig. 47 Valve Spring—Removal/Installation

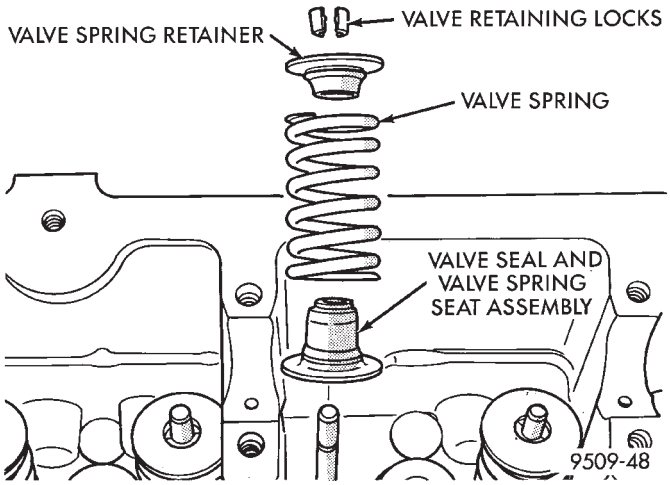


Fig. 48 Valve Stem Seal/Valve Spring Seat

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. 49).

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.

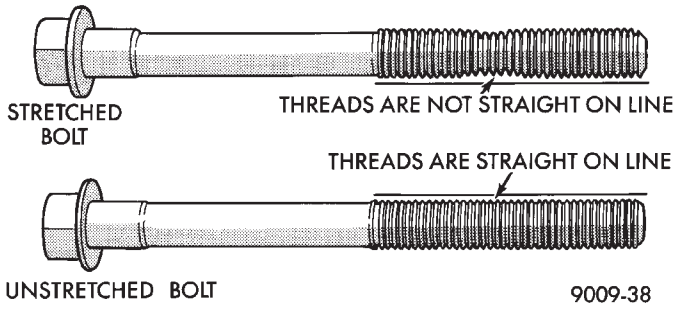


Fig. 49 Checking Bolts for Stretching (Necking)

(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. 50). Using the 4 step torque turn method, tighten according to the following values:

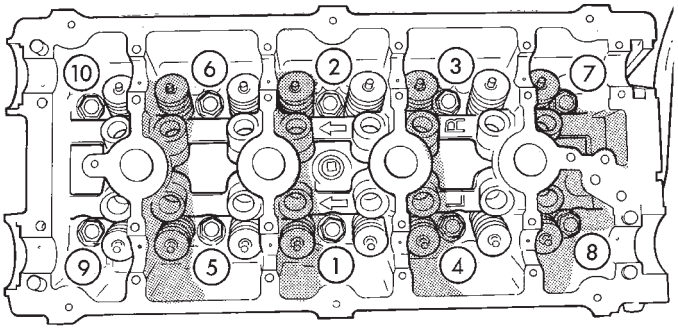
- First All to 34 N·m (25 ft. lbs.)
- Second All to 68 N·m (50 ft. lbs.)
- Third All to 68 N·m (50 ft. lbs.)

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

- Fourth Turn an additional 1/4 Turn,

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

REMOVAL AND INSTALLATION (Continued)



9509-122

Fig. 50 Cylinder Head Tightening Sequence

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

(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. 51). 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.

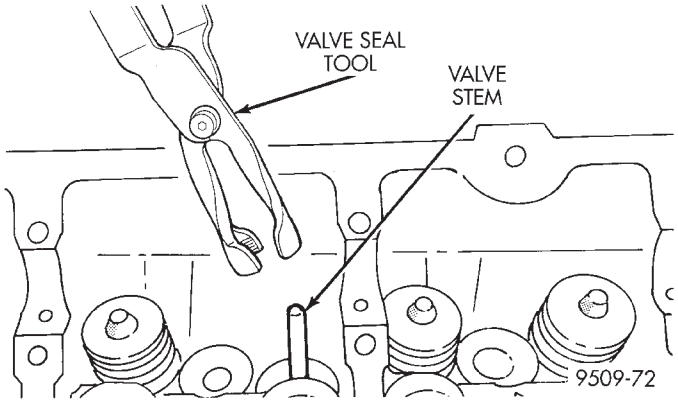


Fig. 51 Valve Stem Oil Seal Tool

(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. 52). 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.

REMOVAL AND INSTALLATION (Continued)

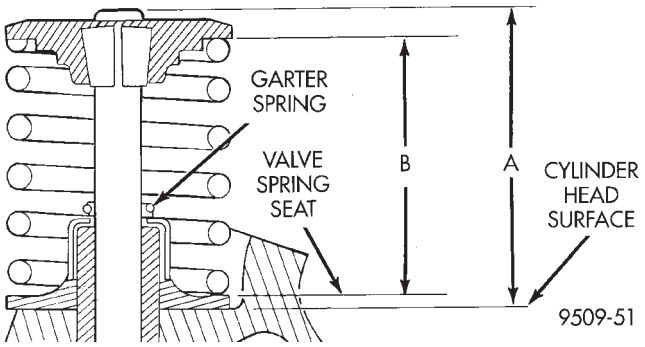


Fig. 52 Checking Spring Installed Height and Valve Tip Height Dimensions

VIBRATION DAMPER

REMOVAL

Remove crankshaft vibration damper bolt. Remove damper by using Special Tool 1026 and Insert 6827–A (Fig. 53).

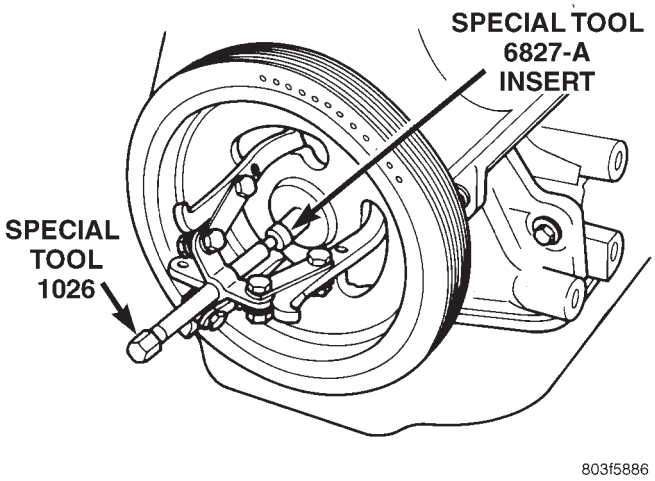


Fig. 53 Crankshaft Vibration Damper—Removal

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. 54).

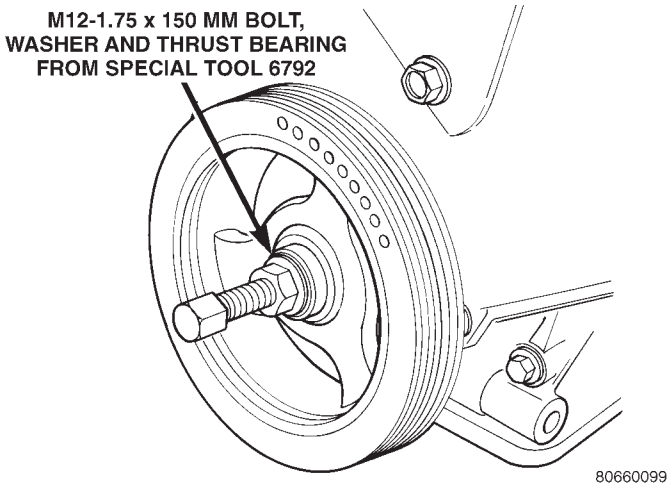


Fig. 54 Crankshaft Vibration Damper—Installation

REMOVAL AND INSTALLATION (Continued)

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. 55) and remove covers.

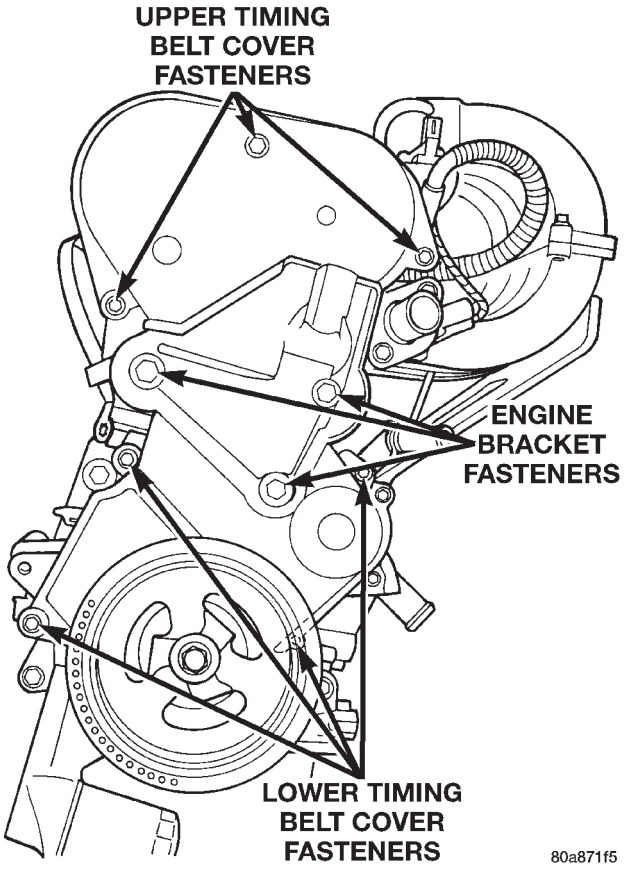


Fig. 55 Front Timing Belt Cover

INSTALLATION

(1) Install front timing belt covers (Fig. 55). Tighten bolts to 4.5 N·m (40 in. lbs.).

(2) Install crankshaft damper. Refer to crankshaft damper installation for procedure.

REAR COVER

REMOVAL

(1) Remove front covers.

(2) Remove engine mount bracket (Fig. 55).

(3) Remove Timing Belt, Idler Pulley, and Camshaft Sprockets. Refer to procedure outlined in this section.

(4) Remove rear cover fasteners and remove cover from engine (Fig. 56).

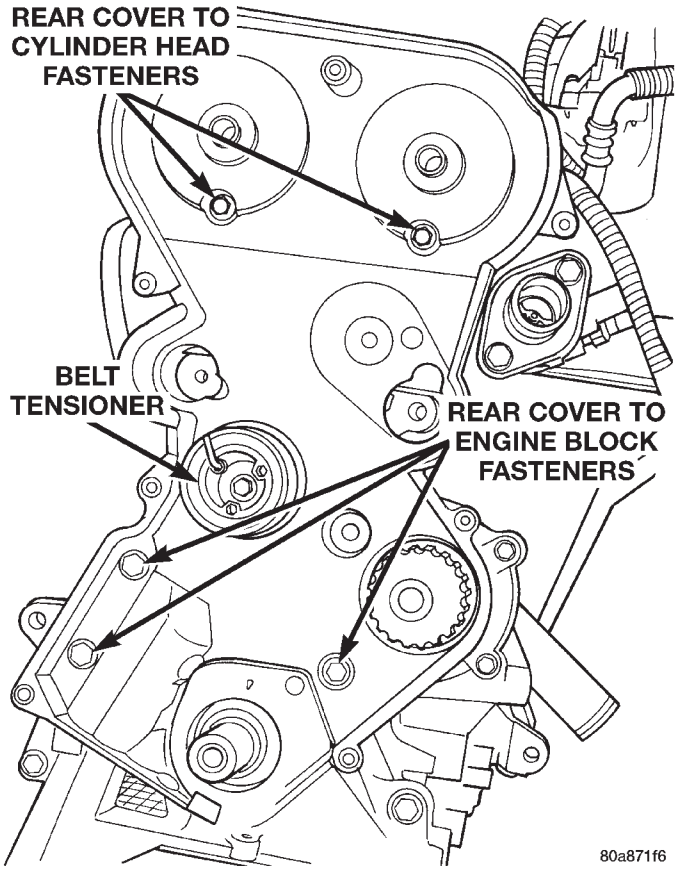


Fig. 56 Rear Timing Belt Cover Fasteners

INSTALLATION

(1) Install rear timing belt cover and fasteners (Fig. 56).

(2) Install camshaft sprockets. While holding sprocket with Special Tools C-4687 and C-4687-1, tighten center bolt to 101 N·m (75 ft. lbs.).

(3) Install timing belt idler pulley and tighten mounting bolt to 61 N·m (45 ft. lbs.).

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

(5) Install engine mount bracket and tighten bolts to 61 N·m (45 ft. lbs.).

(6) Install front covers.

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. 57).

REMOVAL AND INSTALLATION (Continued)

(6) Lower vehicle and remove upper timing belt cover fasteners and remove cover.

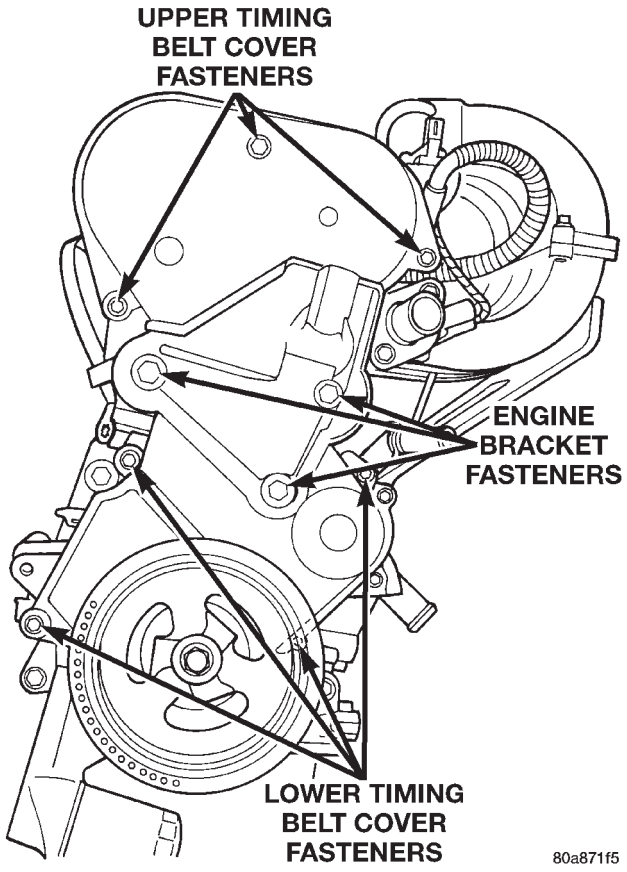


Fig. 57 Timing Belt Covers

(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.

(8) Before the removal of the timing belt, rotate crankshaft until TDC mark on oil pump housing aligns with TDC mark on crankshaft sprocket (trailing edge of sprocket tooth) (Fig. 58).

NOTE: The crankshaft sprocket mark is located on the trailing edge of the sprocket tooth. Failure to align trailing edge of sprocket tooth to mark on oil pump housing will cause the camshaft marks to be misaligned (Fig. 58).

(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. 59). 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.

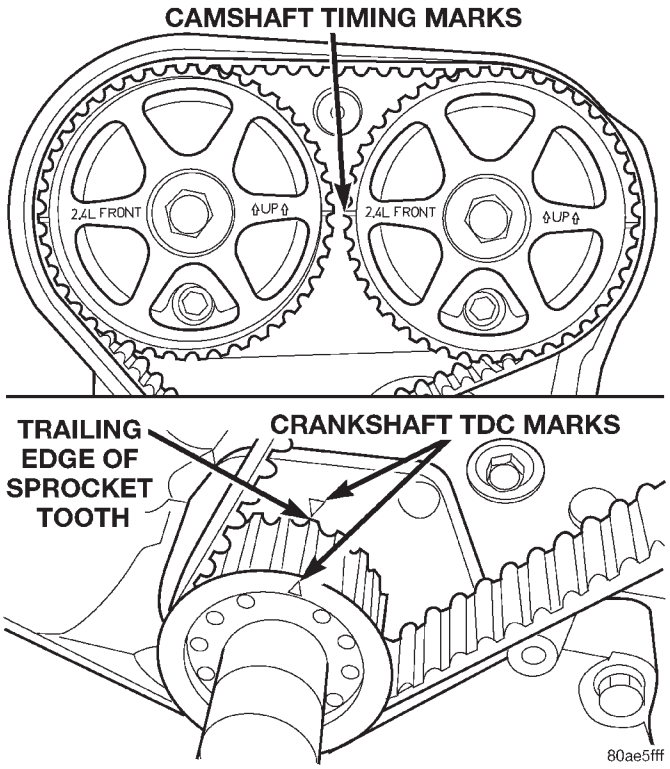


Fig. 58 Crankshaft and Camshaft Timing

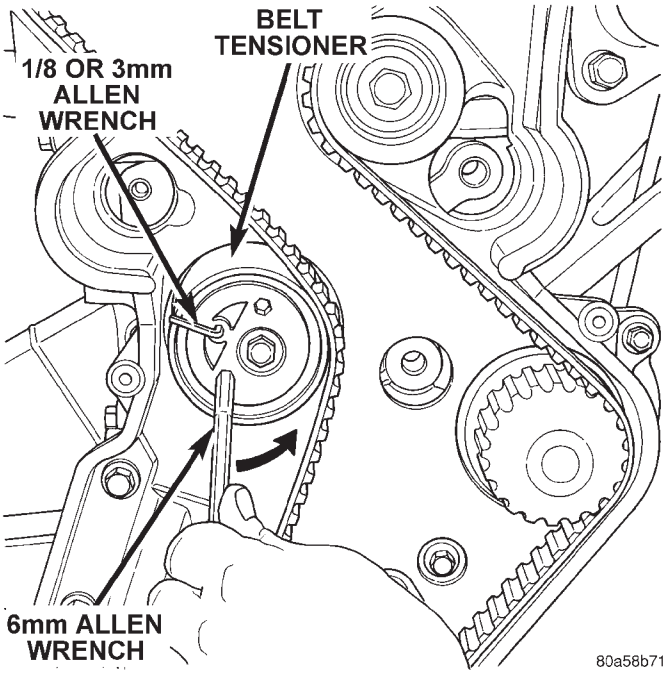


Fig. 59 Locking Timing Belt Tensioner

REMOVAL AND INSTALLATION (Continued)

CAUTION: If timing belt was damaged due to incorrect tracking (alignment), the belt tensioner assembly must be replace. Refer to Timing Belt Tensioner Assembly Removal and Installation procedure outlined in this section.

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. 61).

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. 62).

(4) Move the exhaust camshaft sprocket counterclockwise (Fig. 62) 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) Once timing belt has been installed and tensioner released, rotate crankshaft two (2) complete revolutions. Verify that the TDC marks on crankshaft and timing marks on the camshafts are aligned as shown in (Fig. 60).

(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 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.

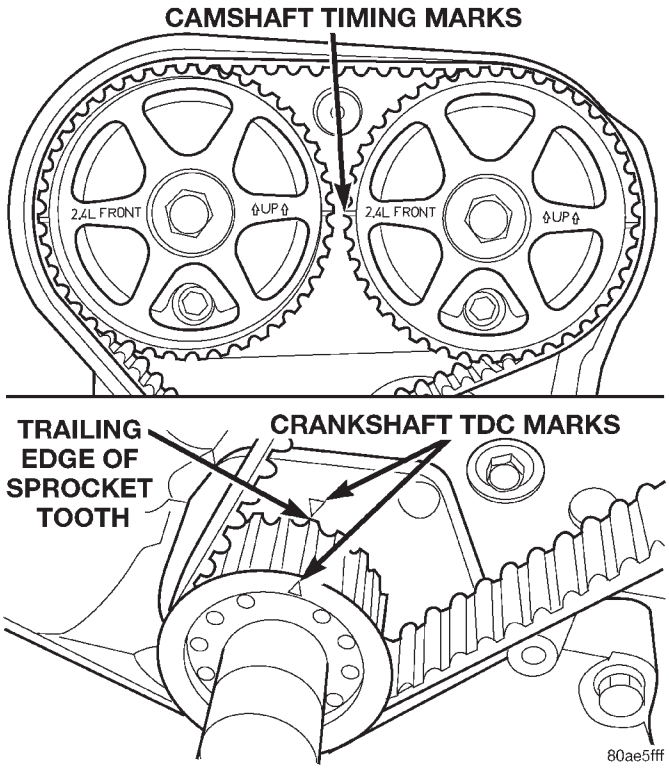


Fig. 60 Crankshaft and Camshaft Timing

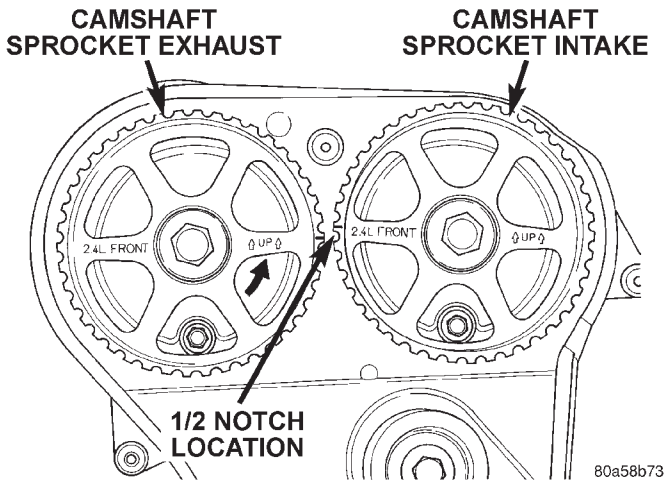


Fig. 61 Camshaft Sprocket Alignment

REMOVAL AND INSTALLATION (Continued)

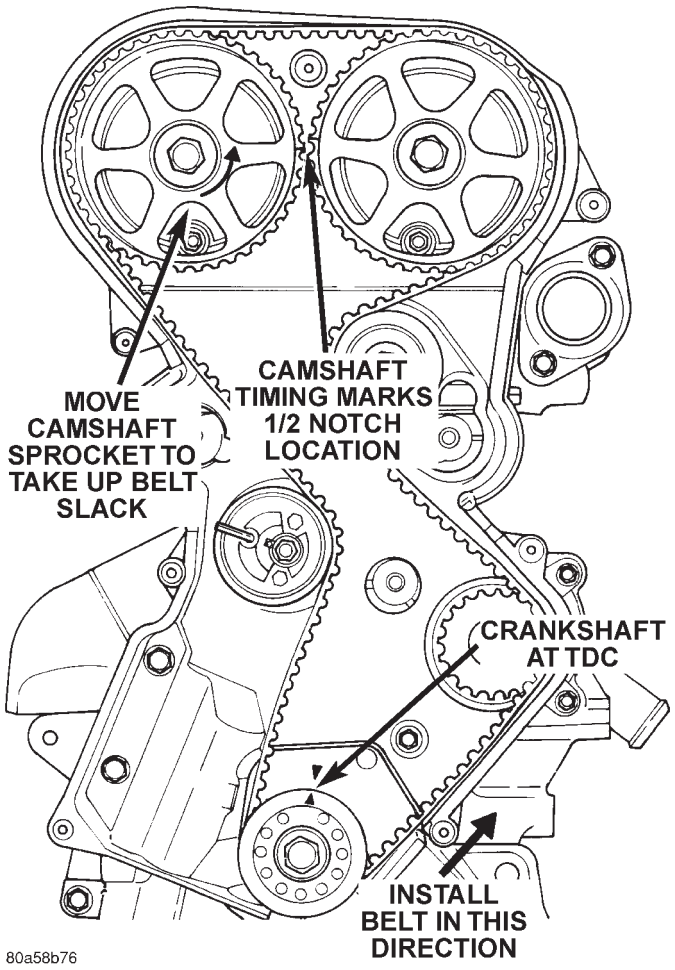


Fig. 62 Timing Belt—Installation

TIMING BELT TENSIONER ASSEMBLY

REMOVAL

(1) Remove timing belt. Refer to Removal and Installation procedure in this section.

(2) Remove timing belt idler pulley.

(3) Hold camshaft sprocket with Special Tools C-4687 and C-4687-1 Adapter, while removing bolt (Fig. 63). Remove both cam sprockets.

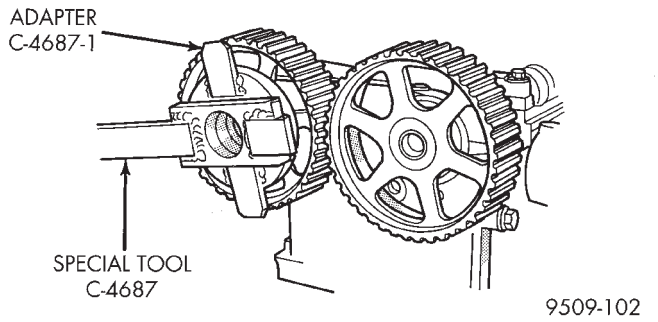


Fig. 63 Camshaft Sprockets—Removal/Installation

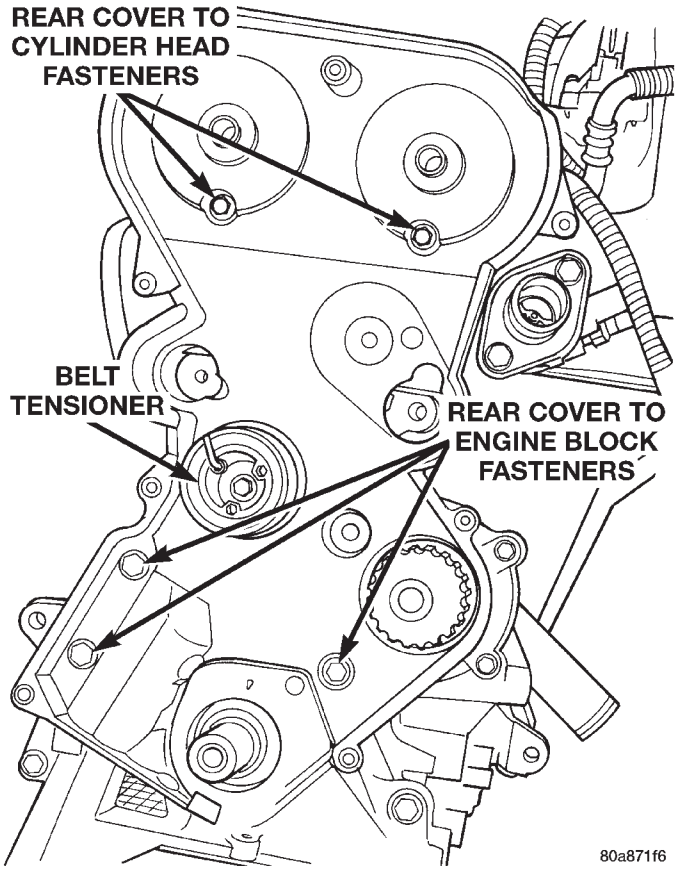


Fig. 64 Rear Timing Belt Cover Fasteners

(4) Remove rear timing belt cover fasteners and remove cover from engine (Fig. 64).

(5) Remove lower bolt attaching timing belt tensioner assembly to engine and remove tensioner **as an assembly** (Fig. 65).

INSTALLATION

(1) Align timing belt tensioner assembly to engine and install lower mounting bolt **but do not tighten** (Fig. 65). To properly align tensioner assembly—install one of the engine bracket mounting bolts (M10) 5 to 7 turns into the tensioner's upper mounting location (Fig. 65).

(2) Torque the tensioner's lower mounting bolt to 61 N·m (45 ft. lbs.). Remove the upper bolt used for tensioner alignment.

(3) Install rear timing belt cover and fasteners.

(4) Install timing belt idler pulley and tighten mounting bolt to 61 N·m (45 ft. lbs.).

(5) Install camshaft sprockets. Use Special Tools C-4687 and C-4687-1 Adapter to hold camshaft sprockets (Fig. 63) and tighten attaching bolts to 101 N·m (75 ft. lbs.).

(6) Install timing belt. Refer to procedure outlined in this section.

REMOVAL AND INSTALLATION (Continued)

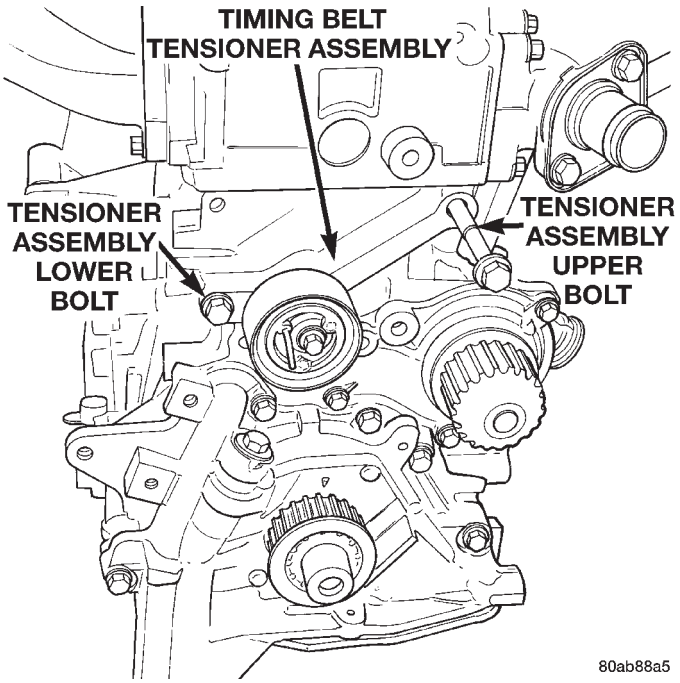


Fig. 65 Timing Belt Tensioner Assembly—Removal/ Installation

CAMSHAFT OIL SEAL—FRONT

REMOVAL

(1) Remove front timing belt covers and timing belt. Refer to procedures outlined in this section.

(2) Hold camshaft sprocket with Special Tools C-4687 and 4687-1 while removing center bolt (Fig. 66).

(3) Remove camshaft seal using Special Tool C-4679-A (Fig. 67).

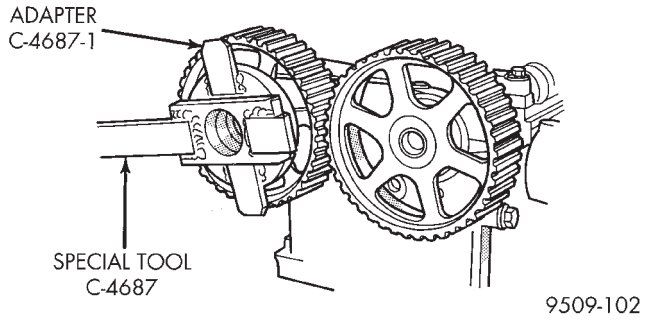


Fig. 66 Camshaft Sprocket—Removal/Installation

CAUTION: Do not nick shaft seal surface or seal bore

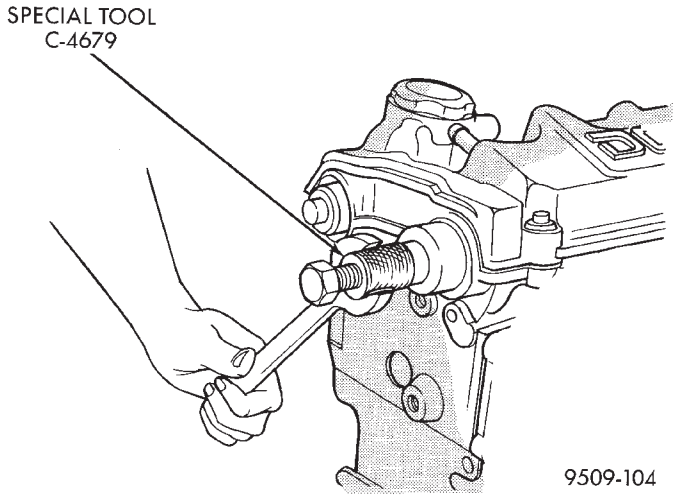


Fig. 67 Camshaft Oil Seal—Removal With C-4679–A

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. 68).

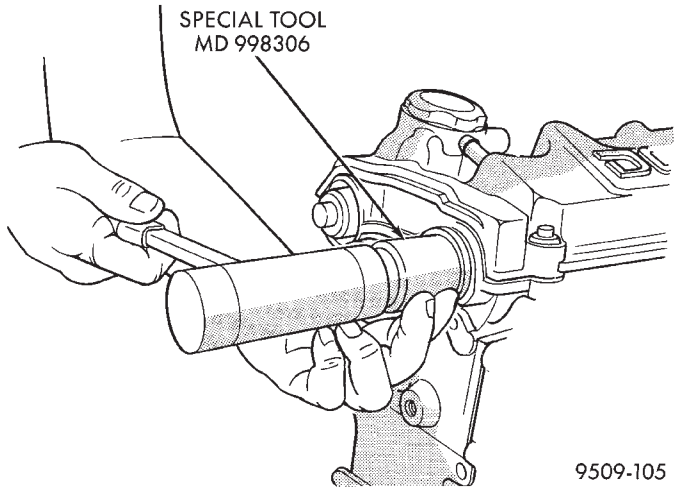


Fig. 68 Camshaft Seal—Installation

(3) Install camshaft sprocket. While holding sprocket with Special Tools C-4687 and 4687-1, tighten center bolt to 101 N·m (75 ft. lbs.) (Fig. 66).

REMOVAL AND INSTALLATION (Continued)

CRANKSHAFT OIL SEAL—FRONT

REMOVAL

(1) Using Special Tool 1026 and Insert 6827-A, remove crankshaft damper (Fig. 69).

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

(3) Remove crankshaft sprocket using Special Tool 6793 and insert C-4685-C2 (Fig. 70).

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

(4) Using Tool 6771 to remove front crankshaft oil seal (Fig. 71). Be careful not to damage the seal surface of cover.

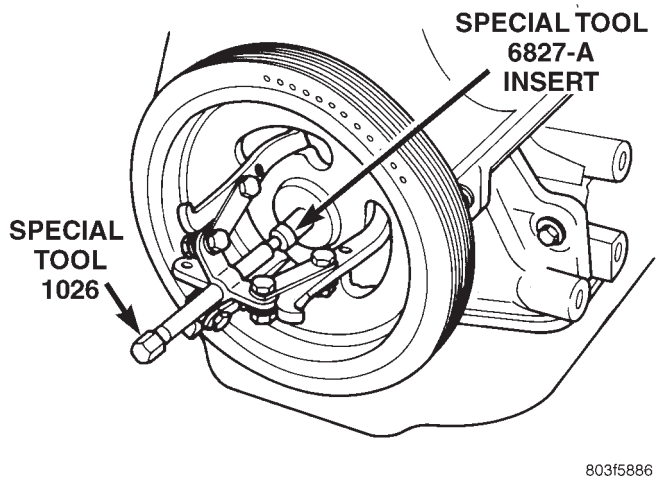


Fig. 69 Crankshaft Damper—Removal

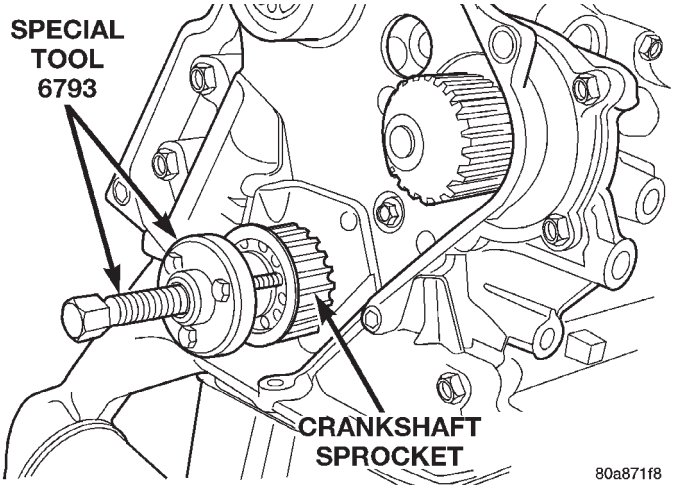


Fig. 70 Crankshaft Sprocket—Removal

INSTALLATION

(1) Install new seal by using Tool 6780 (Fig. 72).

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

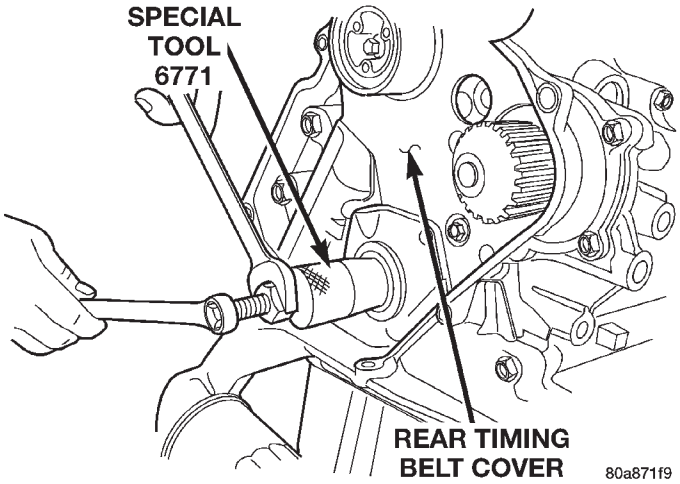


Fig. 71 Front Crankshaft Oil Seal—Removal

(3) Install crankshaft sprocket (Fig. 73). 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. 74). 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.)

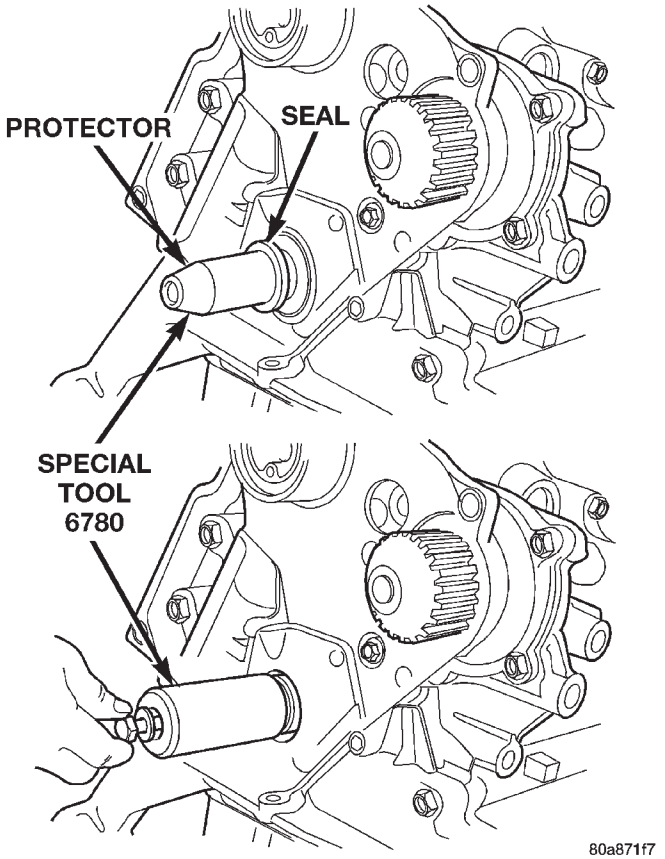


Fig. 72 Front Crankshaft Oil Seal—Installation

REMOVAL AND INSTALLATION (Continued)

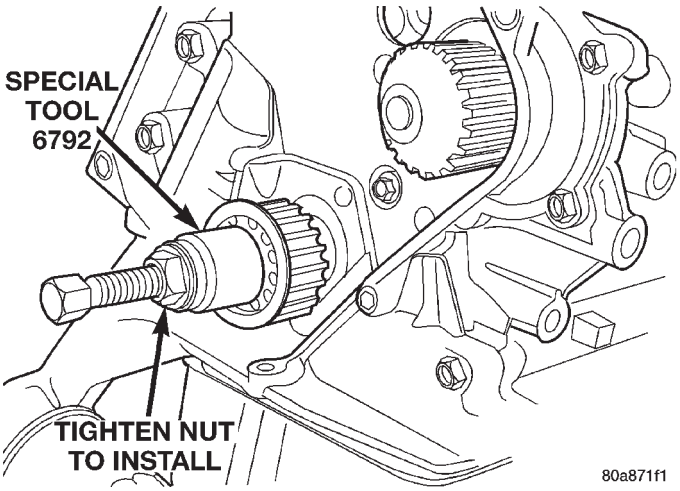


Fig. 73 Crankshaft Sprocket—Installation

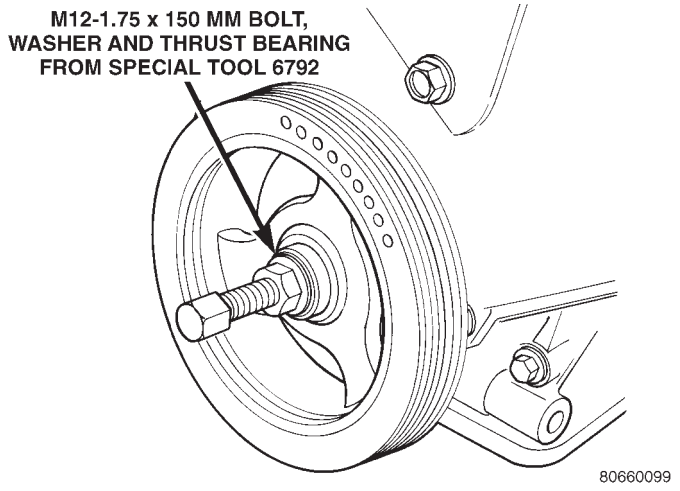


Fig. 74 Crankshaft Damper—Installation

CRANKSHAFT OIL SEAL—REAR

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. 75) through the dust lip against metal case of the seal. Pry out seal.

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

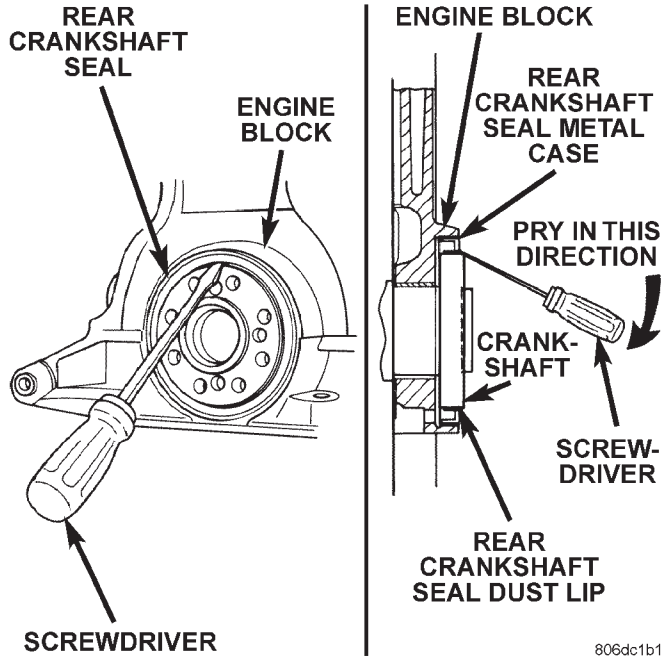


Fig. 75 Rear Crankshaft Oil Seal—Removal

REMOVAL AND INSTALLATION (Continued)

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. 76).

(2) Position seal over pilot tool. Make sure you can read the words **THIS SIDE OUT** on seal (Fig. 76). Pilot tool should remain on crankshaft during installation of seal. Ensure that the lip of the seal is facing towards the crankcase during installation.

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

(3) Drive the seal into the block using Special Tool 6926-2 and handle C-4171 (Fig. 77) until the tool bottoms out against the block (Fig. 78).

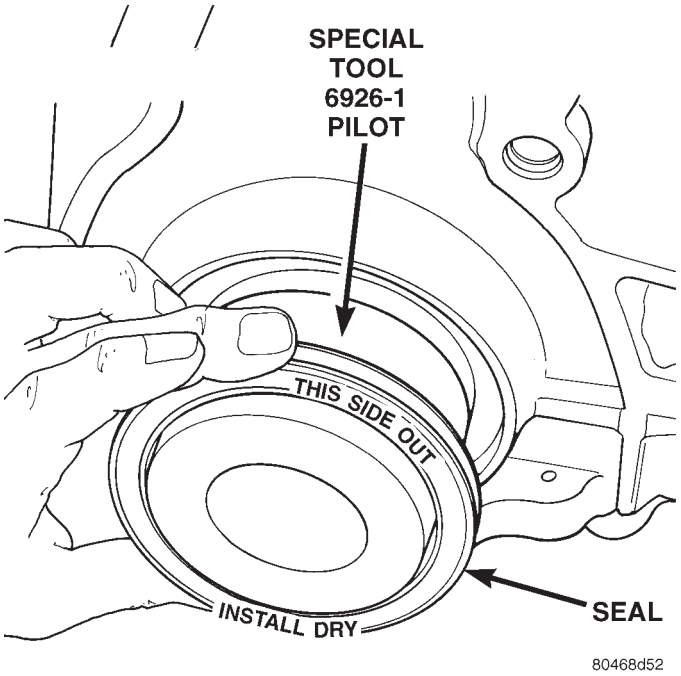


Fig. 76 Rear Crankshaft Seal and Special Tool 6926-1

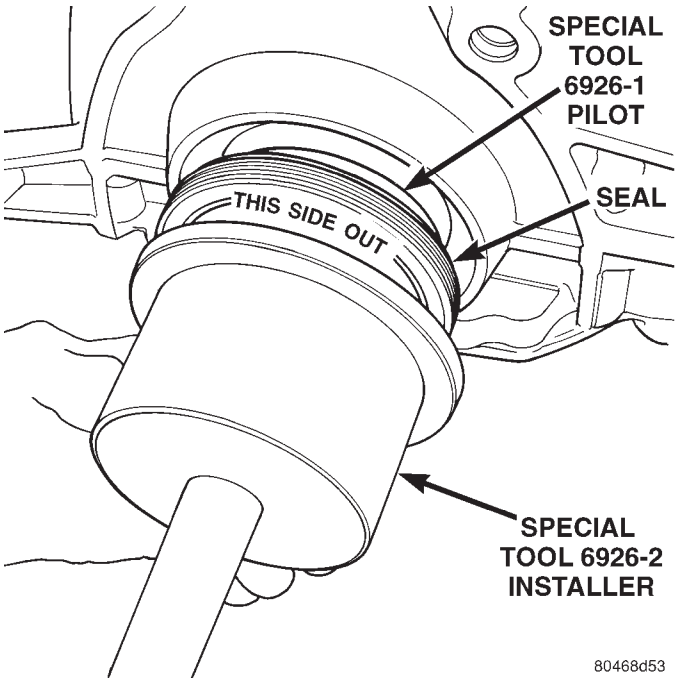


Fig. 77 Crankshaft Seal Special Tool 6926-2

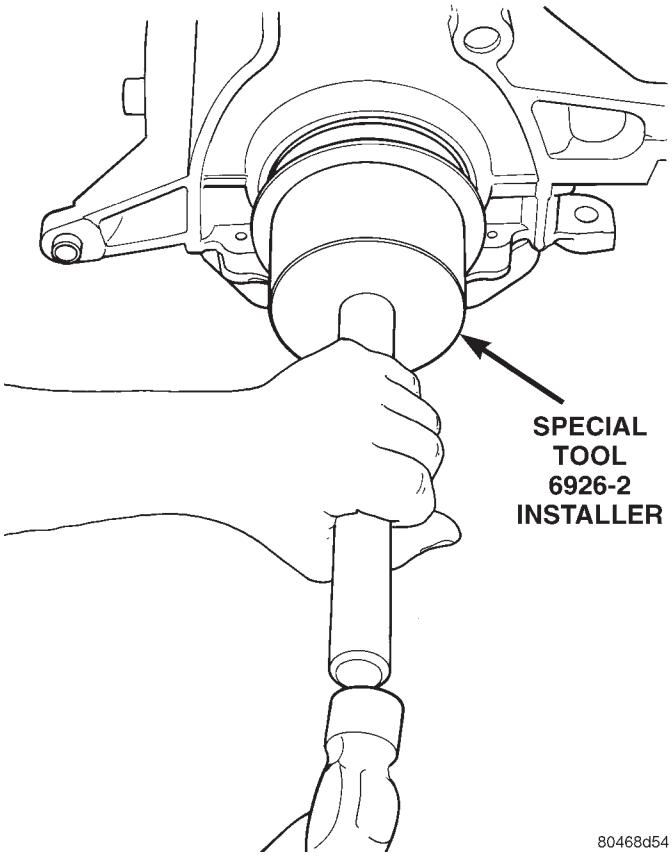


Fig. 78 Rear Crankshaft Seal—Installation

REMOVAL AND INSTALLATION (Continued)

OIL PAN

REMOVAL

(1) Raise vehicle on hoist and drain engine oil.

(2) Remove front engine mount bracket from engine and insulator mount.

(3) Remove bolts attaching bending strut to engine and transaxle.

(4) Remove bolts attaching collar and bending strut to engine, oil pan, and transaxle (Fig. 79). Remove strut and collar.

(5) Remove oil pan.

(6) Clean oil pan and all gasket surfaces.

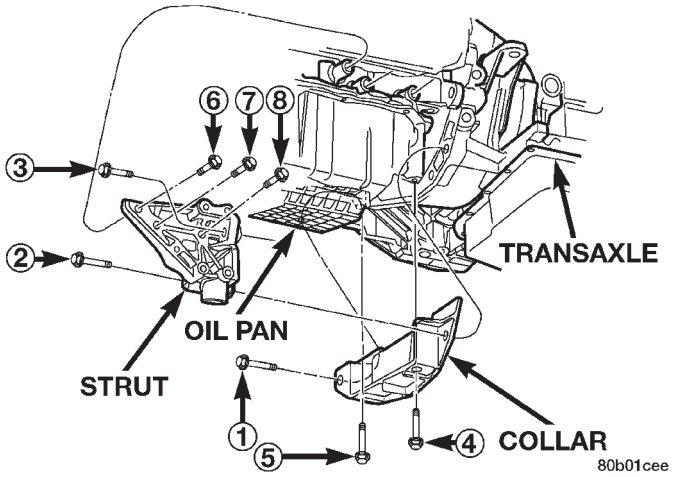


Fig. 79 Structural Collar and Bending Strut— Removal and Installation

INSTALLATION

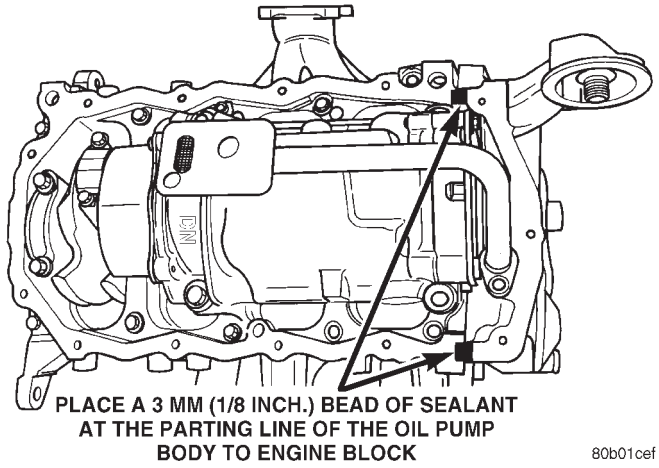


Fig. 80 Oil Pan Sealing

(1) Apply Mopar® Silicone Rubber Adhesive Sealant or equivalent at the oil pump to engine block parting line (Fig. 80).

(2) Install the oil pan gasket to the block (Fig. 81).

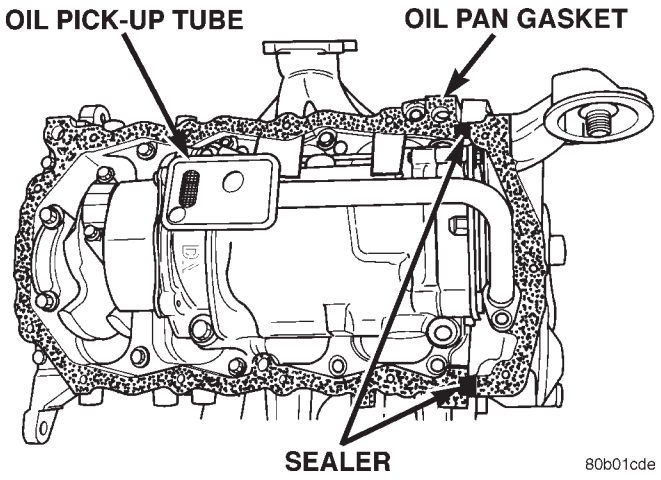


Fig. 81 Oil Pan Gasket Installation

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

CAUTION: Torque procedure for the structural collar and bending strut must be followed or damage could occur to oil pan, collar, and/or bending strut.

(4) Perform the following steps for installing structural collar and bending strut. Refer to (Fig. 79):

- Step 1: Place collar into position between transaxle and oil pan. Hand start only, collar to transaxle bolt 1.
- Step 2: Install bolt 4, collar to oil pan, **hand tight only.**
- Step 3: Position bending strut in place and hand start bolt 3 into the upper transaxle hole.
- Step 4: Install bolt 2, through strut and collar. Hand starting only.
- Step 5: Install bolt 6, strut to cylinder block, **hand tight only.**
- Step 6: Install the remaining collar to oil pan bolt 5, **hand tight only.**
- Step 7: Final torque collar to transaxle bolts 1 – 3, to 101 N·m (75 ft. lbs.)
- Step 8: Install bolts 7 and 8, through strut and into cylinder block.
- Step 9: Final torque bolts 4 – 8 to 61 N·m (45 ft. lbs.).

(5) Install front mount bracket to engine and front insulator. Refer to procedure in the section.

(6) Lower vehicle and fill engine crankcase with proper oil to correct level.

REMOVAL AND INSTALLATION (Continued)

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

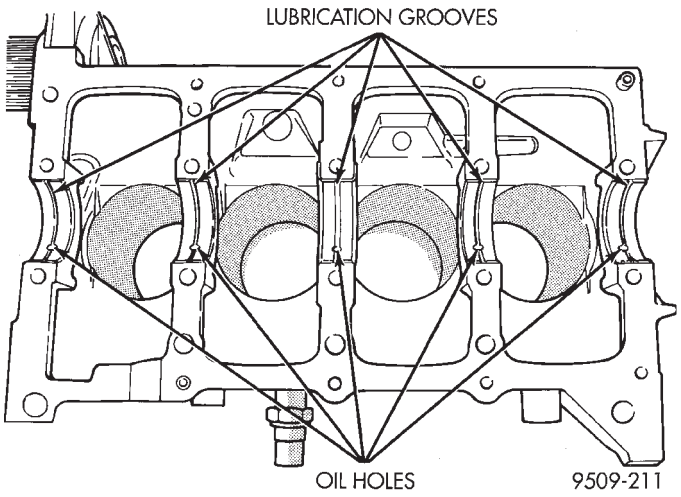


Fig. 82 Installing Main Bearing Upper Shell

(1) Install the main bearing shells with the lubrication groove in the cylinder block (Fig. 82).
(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. 83).

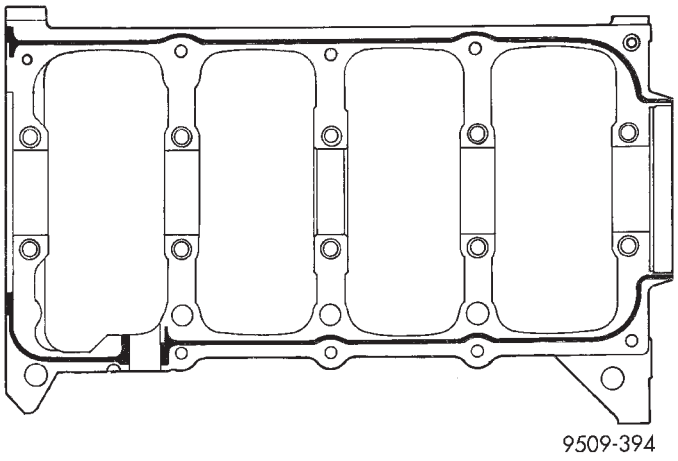


Fig. 83 Main Bearing Caps/Bedplate Sealing

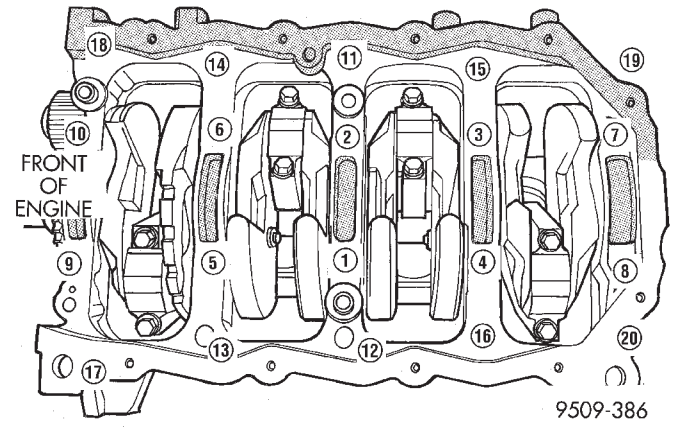


Fig. 84 Main Bearing Caps/Bedplate Torque Sequence

(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.

REMOVAL AND INSTALLATION (Continued)

(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.

(8) To ensure correct thrust bearing alignment perform the following steps:

- Step 1: Rotate crankshaft until number 4 piston is at TDC.
- Step 2: Move crankshaft rearward to limits of travel.
- Step 3: Then, move crankshaft forward to limits of travel.
- Step 4: Wedge an appropraite tool between the rear of the cylinder block **(NOT BED PLATE)** and the rear crankshaft counterweight. This will hold the crankshaft in it's furthest forward position.
- Step 5: Install and tighten bolts (1-10) in sequence shown in (Fig. 84) to 41 N·m (30 ft. lbs.).
- Step 6: Remove wedge tool used to hold crankshaft.

(9) Tighten bolts (1-10) again to 41 N·m (30 ft. lbs) + 1/4 turn in sequence shown in (Fig. 84).

(10) Install main bearing bedplate to engine block bolts (11-20), and torque each bolt to 28 N·m (20 ft. lbs.) in sequence shown in (Fig. 84).

(11) 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 cable from battery.

(2) Remove Timing Belt. Refer to procedure outlined in this section.

(3) Remove Oil Pan. Refer to procedure outlined in this section.

(4) Remove Crankshaft Sprocket using Special Tool 6793 and insert C-4685-C2 (Fig. 85).

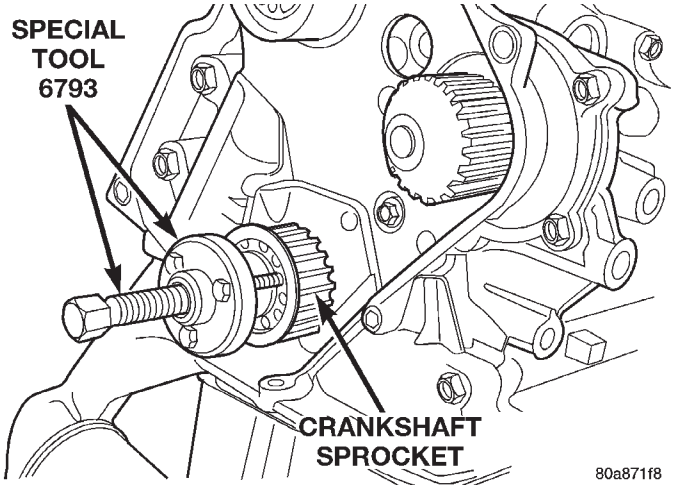


Fig. 85 Crankshaft Sprocket—Removal

(5) Remove oil pick-up tube.

(6) Remove oil pump, (Fig. 86) and front crankshaft seal.

REMOVAL AND INSTALLATION (Continued)

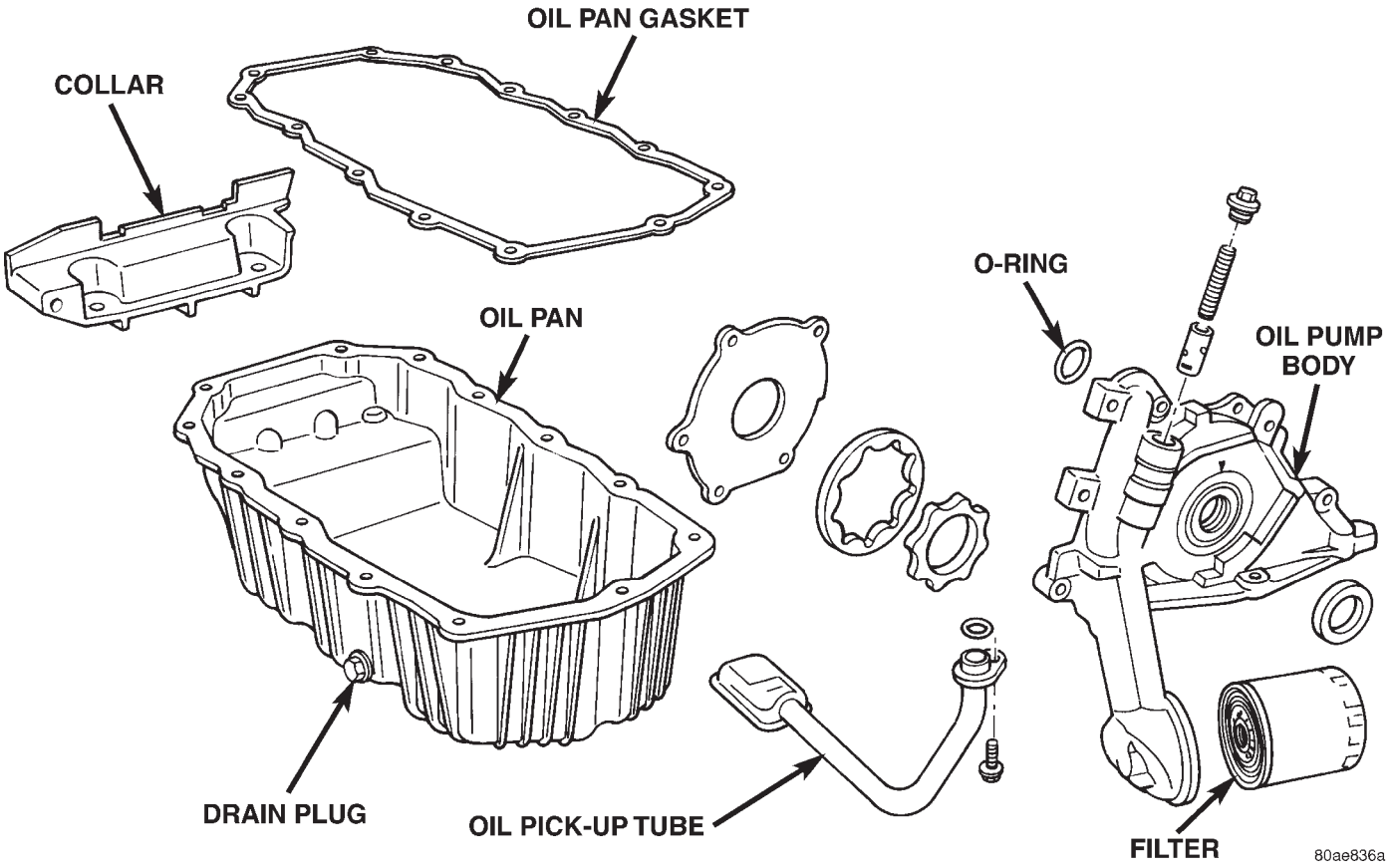


Fig. 86 Oil Pump and Pick-up Tube

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. 87). Install oil ring into oil pump body discharge passage.

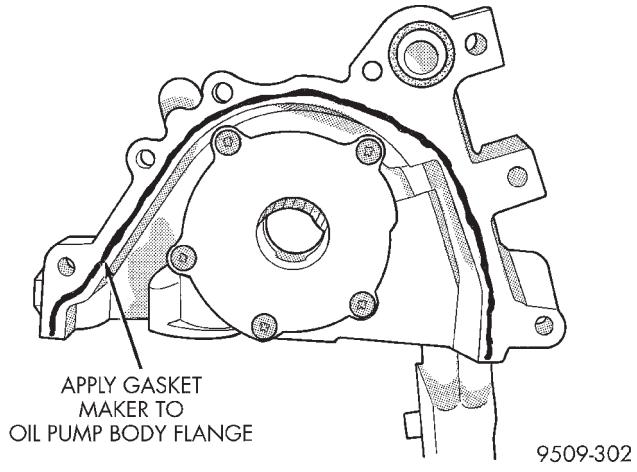


Fig. 87 Oil Pump Sealing

(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. 88).

(6) Install crankshaft sprocket, using Special Tool 6792 (Fig. 89).

(7) Install oil pump pick-up tube.

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

(8) Install oil pan and collar. Refer to procedure outlined in this section.

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

REMOVAL AND INSTALLATION (Continued)

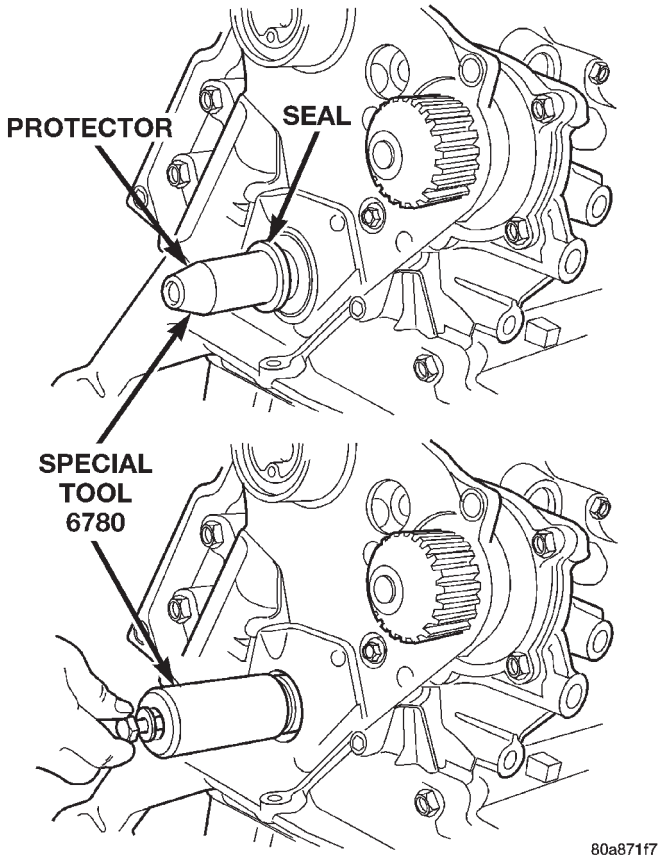


Fig. 88 Front Crankshaft Seal—Installation

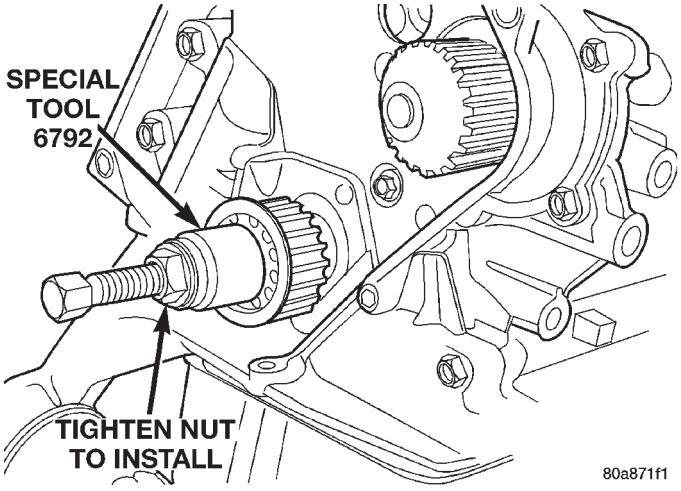


Fig. 89 Crankshaft Sprocket—Installation

PISTON AND CONNECTING ROD

REMOVAL

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. 90).

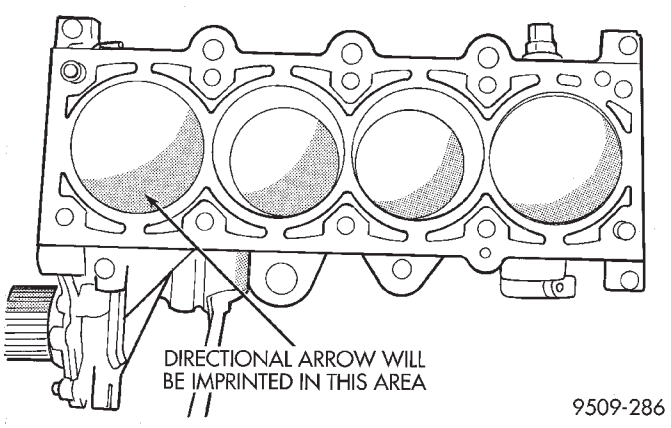


Fig. 90 Piston Markings

(2) Remove oil pan. Scribe the cylinder number on the side of the rod and cap (Fig. 91) 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.

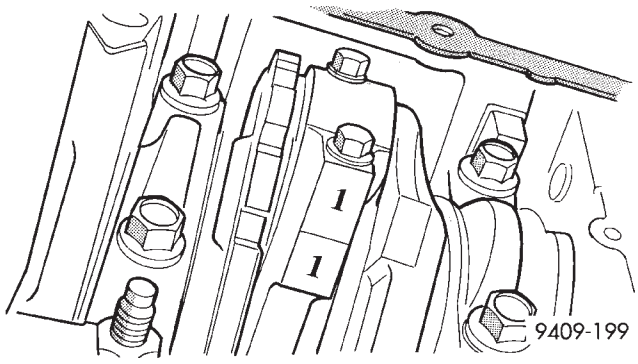


Fig. 91 Identify Connecting Rod to Cylinder

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.

REMOVAL AND INSTALLATION (Continued)

(2) Before installing the ring compressor, make sure the oil ring expander ends are butted and the rail gaps located as shown in (Fig. 92). As viewed from top.

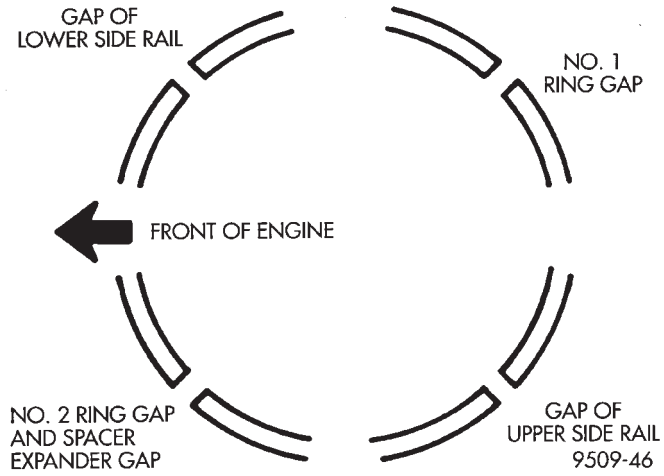


Fig. 92 Piston Ring End Gap Position

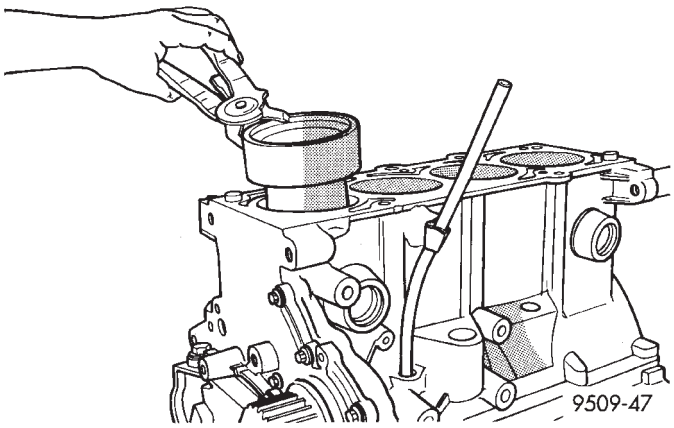


Fig. 93 Piston—Installation

(3) Immerse the piston head and rings in clean engine oil, slide the ring compressor, over the piston (Fig. 93). **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. 90).

(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 than 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. 94).

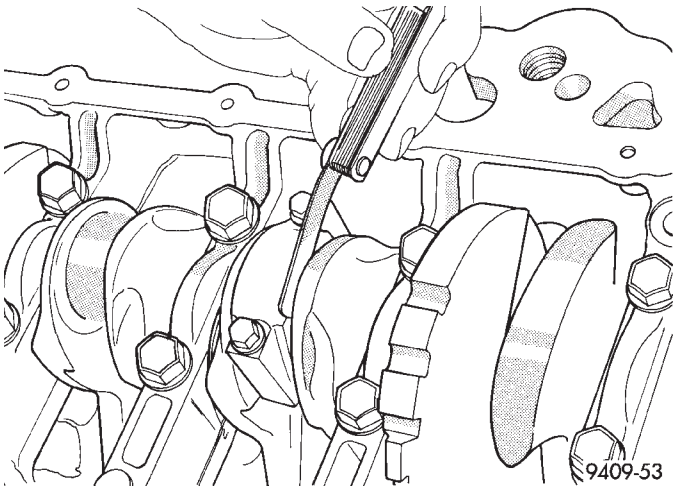


Fig. 94 Checking Connecting Rod Side Clearance

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. 95).

(b) Remove spring and relief valve.

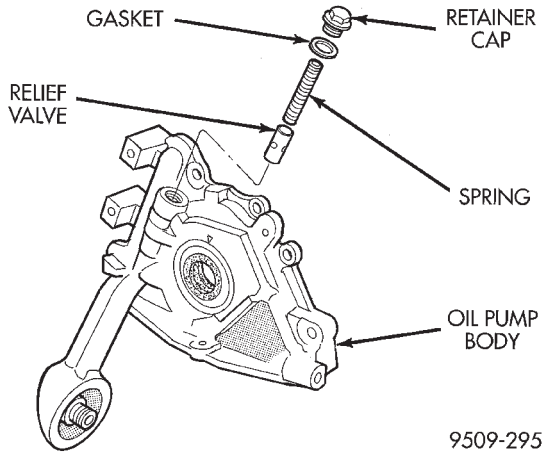


Fig. 95 Oil Pressure Relief Valve

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

(3) Remove pump rotors.

DISASSEMBLY AND ASSEMBLY (Continued)

(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. 95) or serious damage may occur.

(4) Install relief valve, spring, gasket and cap as shown in (Fig. 95). 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. 96).

(2) Inspect camshaft bearing journals for scoring.

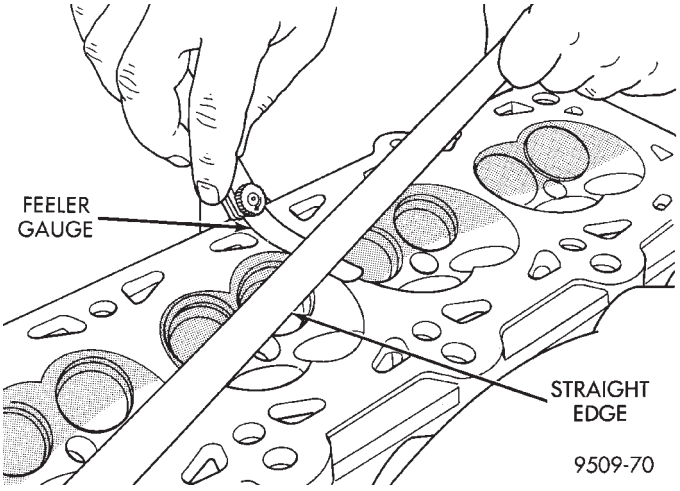


Fig. 96 Checking Cylinder Head Flatness

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. 97). Refer to Valve Guide Specification Chart. Replace guides if they are not within specification.

(3) Check valve guide height (Fig. 98).

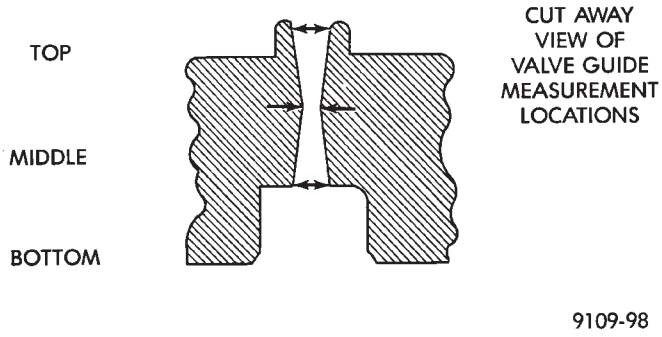


Fig. 97 Checking Wear on Valve Guide—Typical

VALVE GUIDE SPECIFICATION CHART

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

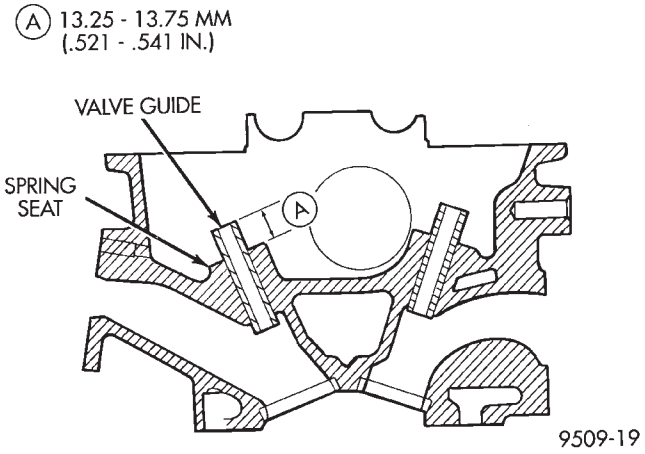


Fig. 98 Valve Guide Height

VALVE AND VALVE SPRING

VALVES

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

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

CLEANING AND INSPECTION (Continued)

(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 lbs. @ 38.0 mm (1.50 in.)
- Valve Open Nominal Tension— 136 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.

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.

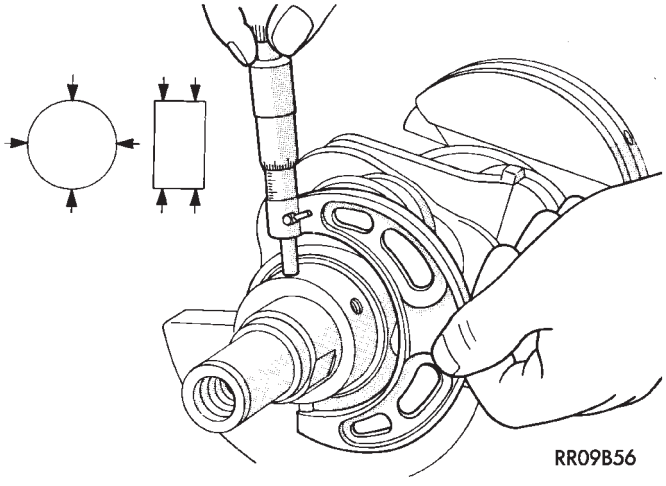


Fig. 99 Crankshaft Journal Measurements

OIL PUMP

(1) Clean all parts thoroughly. Mating surface of the oil pump should be smooth (Fig. 100). Replace pump cover if scratched or grooved.

(2) Lay a straightedge across the pump cover surface (Fig. 101). If a 0.025 mm (0.001 in.) 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 in.) or less (Fig. 102), or if the diameter is 79.95 mm (3.148 in.) or less, replace outer rotor.

(4) If inner rotor measures 9.40 mm (0.370 in.) or less replace inner rotor (Fig. 103).

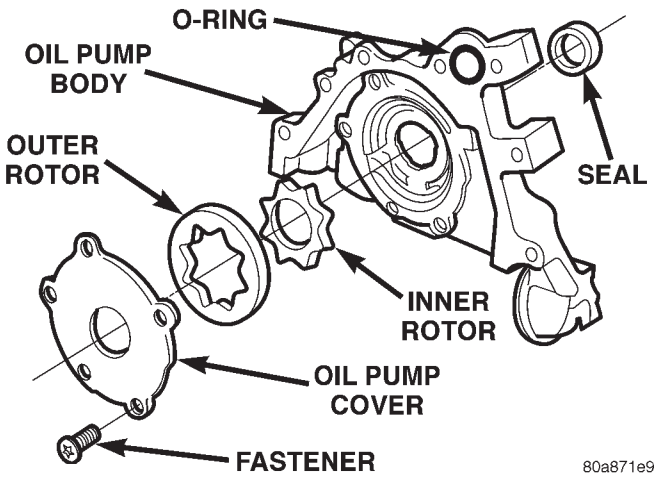


Fig. 100 Oil Pump

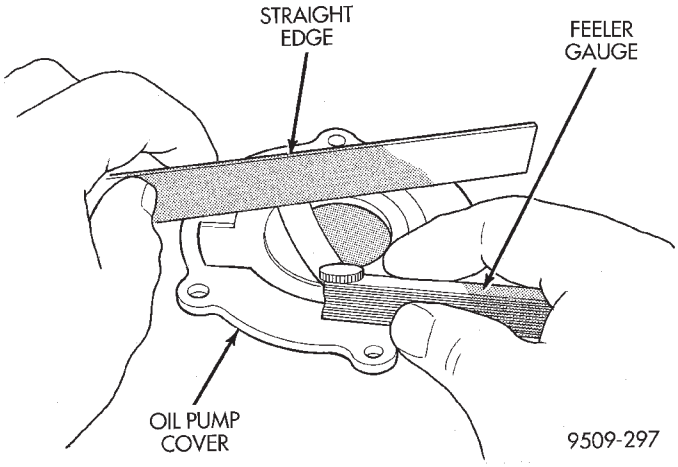


Fig. 101 Checking Oil Pump Cover Flatness

(5) Slide outer rotor into pump housing, press to one side with fingers and measure clearance between rotor and housing (Fig. 104). If measurement is 0.39 mm (0.015 in.) 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. 105) is 0.203 mm (0.008 in.) or more, replace both rotors.

(7) Place a straightedge across the face of the pump housing, between bolt holes. If a feeler gauge of 0.102 mm (0.004 in.), or more can be inserted

CLEANING AND INSPECTION (Continued)

between rotors and the straightedge, replace pump assembly (Fig. 106), **ONLY** if rotors are in specs.

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

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

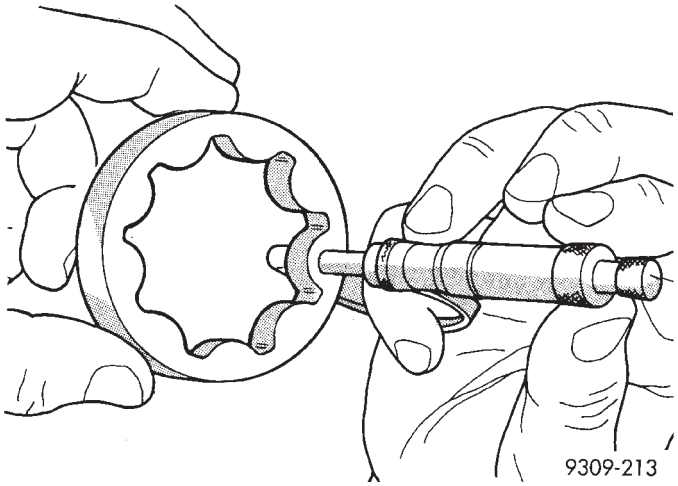


Fig. 102 Measuring Outer Rotor Thickness

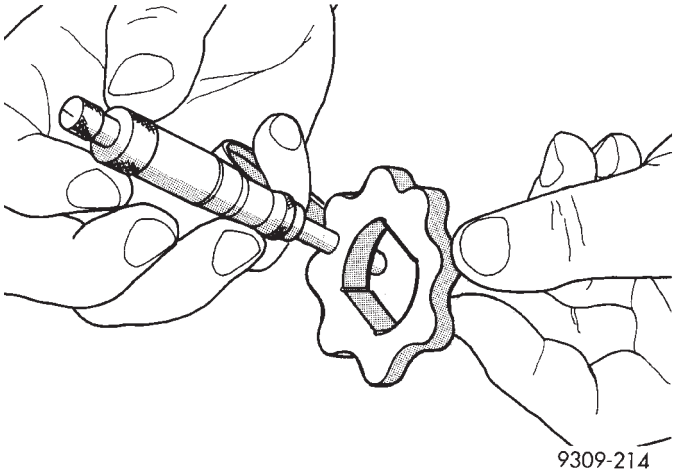


Fig. 103 Measuring Inner Rotor Thickness

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

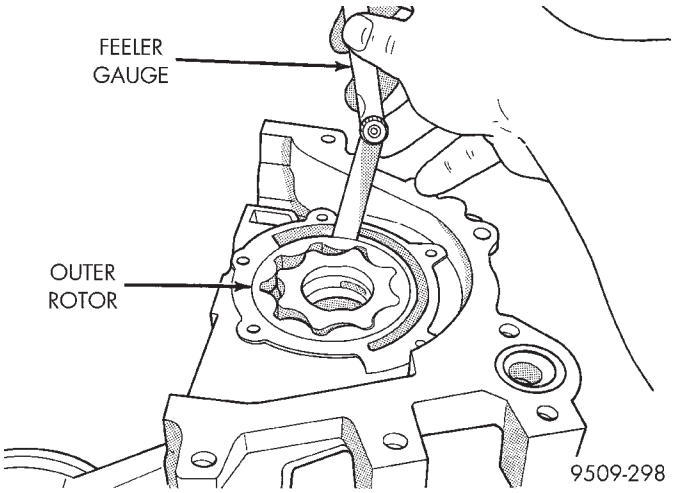


Fig. 104 Measuring Outer Rotor Clearance in Housing

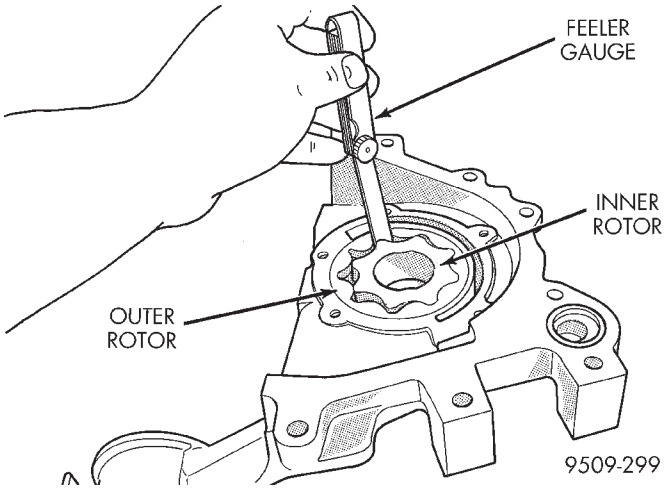


Fig. 105 Measuring Clearance Between Rotors

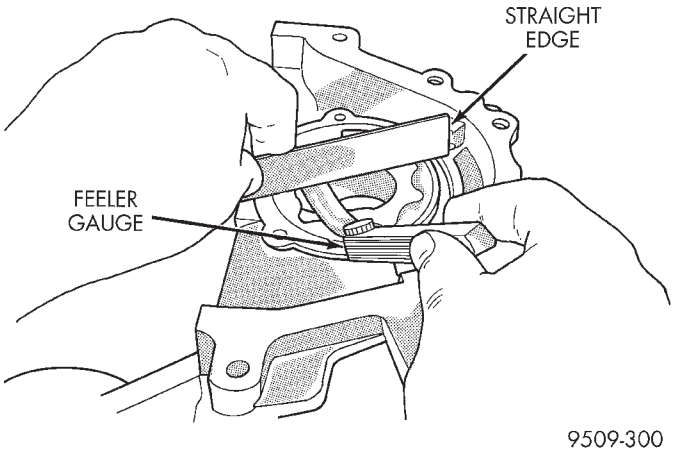


Fig. 106 Measuring Clearance Over Rotors

CLEANING AND INSPECTION (Continued)

CYLINDER BLOCK

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

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

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

CYLINDER BORE INSPECTION

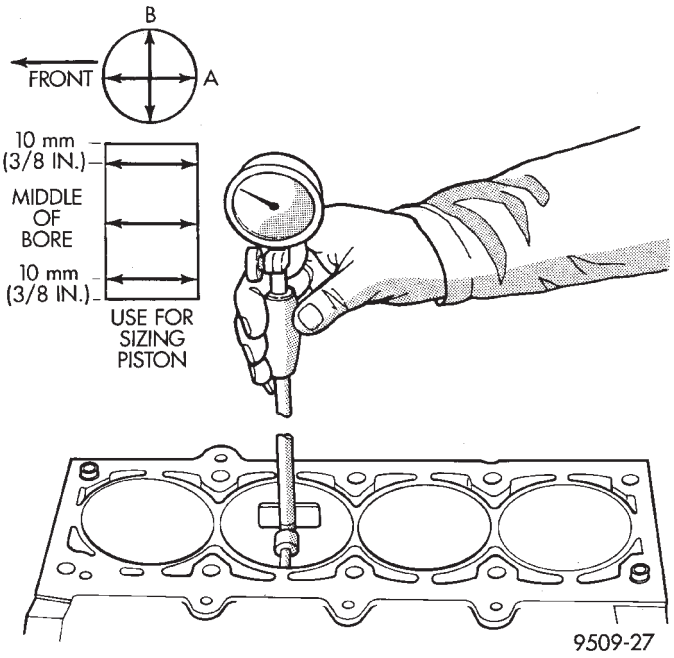


Fig. 107 Checking Cylinder Bore Size

The cylinder walls should be checked for out-of-round and taper with Tool C119 (Fig. 107). The cylinder bore out-of-round is 0.050 mm (0.002 in.) maximum and cylinder bore taper is 0.051 mm (0.002 in.) 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. 107). 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 Cylinder Bore and Piston Specification Chart.

CYLINDER BORE AND PISTON SPECIFICATION CHART

Standard Bore	Maximum Out-Of-Round	Maximum-Taper
87.5 mm (3.445 in.)	0.051 mm (0.002 in.)	0.051 mm (0.002 in.)
Standard Piston Size 87.450 - 87.468 mm (3.4434 - 3.4441 in.)		
Piston To Bore Clearance 0.024 - 0.057 mm (0.0009 - 0.0022 in.)		
Measurements taken at Piston Size Location.		

ADJUSTMENTS

ENGINE MOUNTS

ENGINE MOUNT INSULATOR 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 mount insulator vertical fastener and the fore and aft fasteners, and the front engine mount bracket to front crossmember screws.

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

(4) Tighten engine mounts and fasteners in the following order:

(a) Right engine mount insulator vertical bolts to 102 N·m (75 ft. lbs.) and the fore and aft bolts to 150 N·m (110 ft. lbs.).

(b) Front engine mount screws to 54 N·m (40 ft. lbs.) the clearance between the snubbers and the engine should be 2 mm (0.078 inch.) each side.

(c) Left engine mount through bolt to 75 N·m (55 ft. lbs.).

(5) Recheck driveshaft length.

SPECIFICATIONS

2.4L ENGINE

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)

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.)

Camshaft
Bearing Bore Diameters 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.)
Lift (Zero Lash) Exhaust . . . . .6.52 mm (0.256 in.)

Valve Timing – Intake Valve
Closes (ABDC) . . . . . .51°
Opens (BTDC) . . . . . .1°

SPECIFICATIONS (Continued)

Duration . . . . . .232°

Valve Timing – Exhaust Valve

Closes (ATDC) . . . . . .8°
Opens (BBDC) . . . . . .52°
Duration . . . . . .240°

Valve Timing

Valve Overlap . . . . . .9°

Cylinder Head

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

Cylinder Head 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.)
Finish Guide Bore ID. . . . . .5.975 - 6.000 mm (0.235 - 0.236 in.)

Valves

Face Angle . . . . . .44-1/2° - 45°
Head Diameter Intake . . . . . .34.67 - 34.93 mm (1.364 - 1.375 in.)
Head Diameter Exhaust . . . . . .30.37 - 30.63 mm (1.195 - 1.205 in.)
Length–Intake (Overall). . . . . .112.76 - 113.32 mm (4.439 - 4.461 in.)
Length–Exhaust (Overall) . . . .109.59 - 110.09 mm (4.314 - 4.334 in.)
Valve Margin–Intake . . . . . .1.285 - 1.615 mm (0.050 - 0.063 in.)
Valve Margin–Exhaust . . . . . .0.985 - 1.315 mm (0.038 - 0.051 in.)
Valve Stem Tip Height–Intake . . . . . .48.04 mm (1.891 in.)

Valves

Valve Stem Tip Height–Exhaust . . . . . .47.99 mm (1.889 in.)
Stem Diameter–Intake . . . . . .5.934 - 5.952 mm (0.234 - 0.234 in.)
Stem Diameter–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.)
Stem-to-Guide Clearance–Exhaust . . . . . .0.0736 - 0.094 mm (0.0029 - 0.0037 in.)
Max. Allowable Stem-to-Guide Clearance–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 @ 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 (Oil Pump)

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)

CAUTION: * If pressure is ZERO at curb Idle, DO NOT run engine at 3,000 rpm.

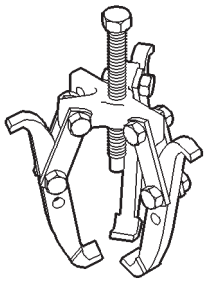
SPECIFICATIONS (Continued)

TORQUE CHART 2.4L

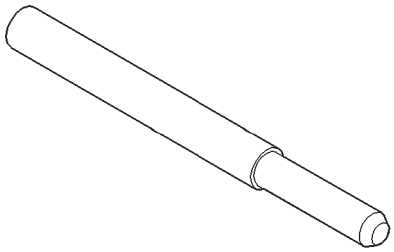
DESCRIPTION	TORQUE
Balance Shaft Carrier to Block	
Bolts	54 N·m (40 ft. lbs.)
Balance Shaft Gear Cover	
Double Ended Fastener	12 N·m (105 in. lbs.)
Balance Shaft Sprockets	
Bolts	28 N·m (250 in. lbs.)
Balance Shaft Chain Tensioner	
Bolts	12 N·m (105 in. lbs.)
Balance Shaft Carrier Cover	
Fasteners	12 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	61 N·m (45 ft. lbs.)
Engine Mount—Front and Rear	
Through Bolt	61 N·m (45 ft. lbs.)
Exhaust Manifold to Cylinder Head	
Bolts	23 N·m (200 in. lbs.)
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	
Oil Pan Bolts	12 N·m (105 in. lbs.)
Drain Plug	27 N·m (20 ft. lbs.)
Oil Pump Attaching	
Bolts	28 N·m (250 in. lbs.)
Oil Pump Cover Fastener	12 N·m (105 in. lbs.)
Oil Pump Pick-up Tube Bolt	28 N·m (250 in. lbs.)
Oil Pump Relief Valve Cap	41 N·m (30 ft. lbs.)
Rear Torque Bracket	
Bolts	110 N·m (80 ft. lbs.)
Spark Plugs	
Plugs	28 N·m (20 ft. lbs.)
Thermostat Housing	
Bolts	23 N·m (200 in lbs.)
Timing Belt Tensioner Assembly	
Bolts	61 N·m (45 ft. lbs.)
Water Pump Mounting	
Bolts	12 N·m (105 in. lbs.)

SPECIAL TOOLS

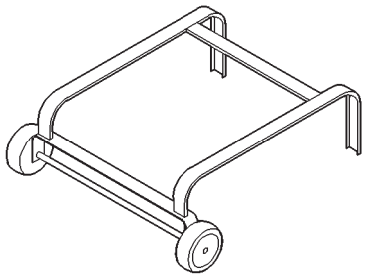
2.4L ENGINE



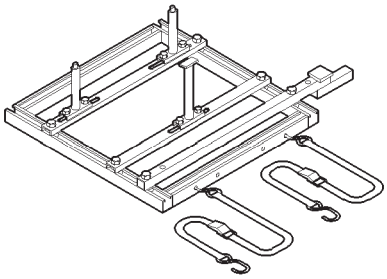
Puller 1026



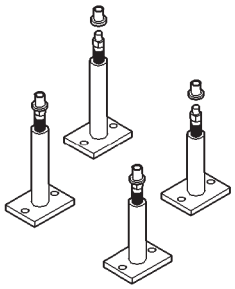
Crankshaft Damper Removal Insert 6827-A



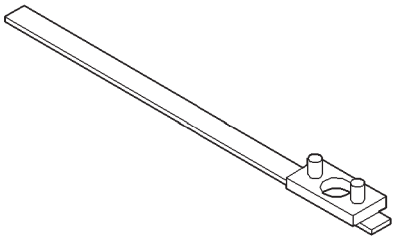
Dolly 6135



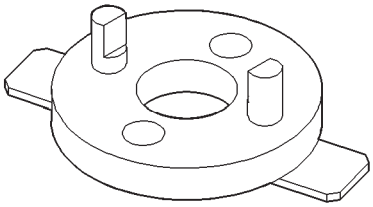
Cradle 6710



Post Kit Engine Cradle 6848

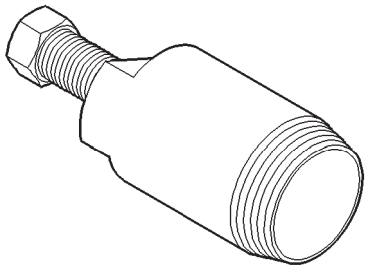


Camshaft Sprocket Remover/Installer C-4687

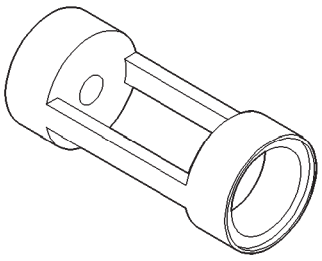


Camshaft Sprocket Remover/Installer Adapter C-4687-1

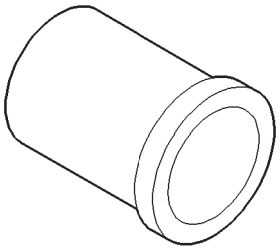
SPECIAL TOOLS (Continued)



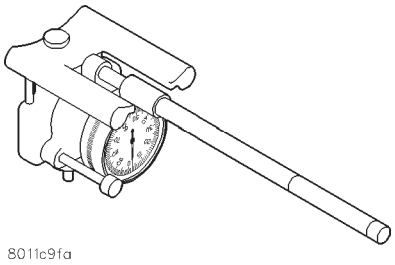
Camshaft Seal Remover C-4679-A



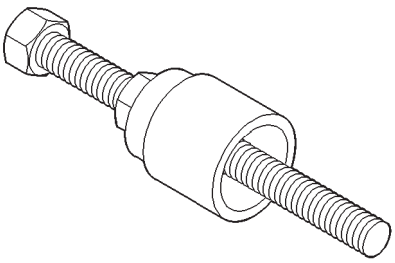
Valve Spring Compressor Adapter 6779



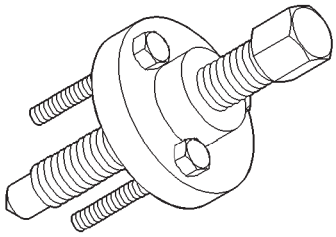
Camshaft Seal Installer MD-998306



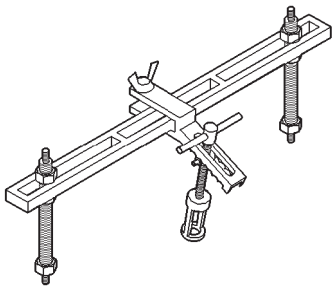
Cylinder Bore Gage C-119



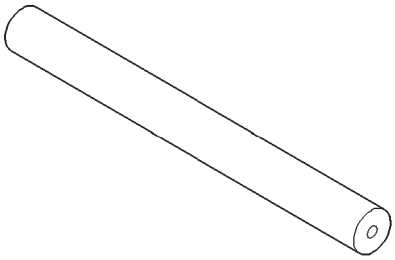
Crankshaft Damper Installer 6792



Crankshaft Sprocket Remover 6793

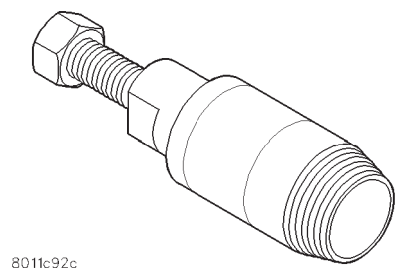


Valve Spring Compressor MD-998772-A

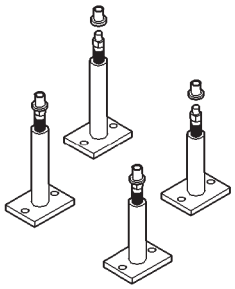


Crankshaft Sprocket Remover Insert C-4685-C2

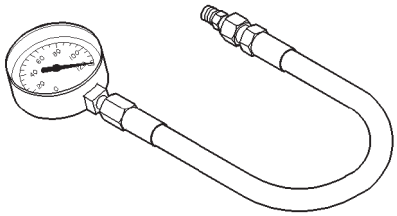
SPECIAL TOOLS (Continued)



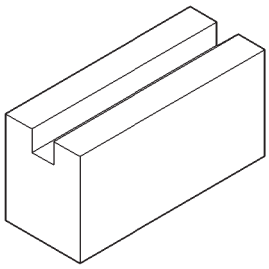
Crankshaft Seal Remover 6771



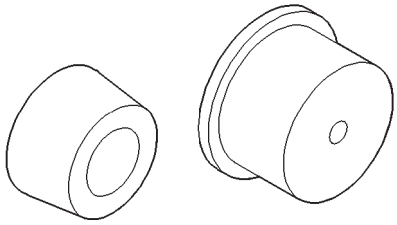
Post Kit Engine Cradle 6848



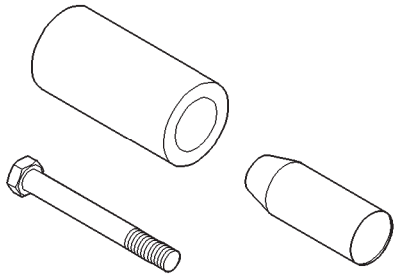
Oil Pressure Gage C-3292



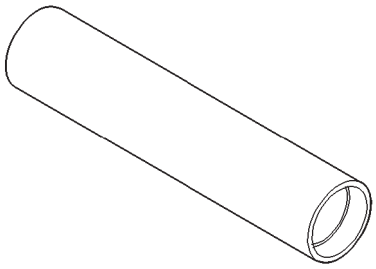
Post Adapter 8130



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



Front Crankshaft Oil Seal Installer 6780



Balance Shaft Sprocket Installer 6052

3.0L ENGINE

INDEX

	page
DESCRIPTION AND OPERATION	
ENGINE COMPONENTS	61
ENGINE IDENTIFICATION NUMBER	61
ENGINE LUBRICATION	61
DIAGNOSIS AND TESTING	
CHECKING ENGINE OIL PRESSURE	62
SERVICE PROCEDURES	
AUTO LASH ADJUSTER	62
CHECKING CRANKSHAFT END PLAY	65
FITTING CONNECTING ROD BEARINGS	63
FITTING MAIN BEARING	63
VALVE SERVICE RECONDITION	66
REMOVAL AND INSTALLATION	
CAMSHAFT SEAL	72
CAMSHAFT	71
CRANKSHAFT	81
CYLINDER HEAD COVER	70
CYLINDER HEAD	73
ENGINE ASSEMBLY	69
ENGINE MOUNTS	68
FRONT CRANKSHAFT OIL SEAL	83
OIL FILTER AND ADAPTOR	84
OIL PAN	77
OIL PUMP	84
PISTON AND CONNECTING ROD	78
REAR CRANKSHAFT SEAL	83
ROCKER ARMS	72
TIMING BELT	75
DISASSEMBLY AND ASSEMBLY	
ROCKER ARMS AND SHAFTS	85
CLEANING AND INSPECTION	
CYLINDER BORE	87
CYLINDER HEAD	86
OIL PUMP	87
TIMING BELT	86
ADJUSTMENTS	
ENGINE MOUNTS	88
SPECIFICATIONS	
3.0L ENGINE	89
TORQUE CHART 3.0L	90
SPECIAL TOOLS	
3.0L ENGINE	91

DESCRIPTION AND OPERATION

ENGINE IDENTIFICATION NUMBER

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

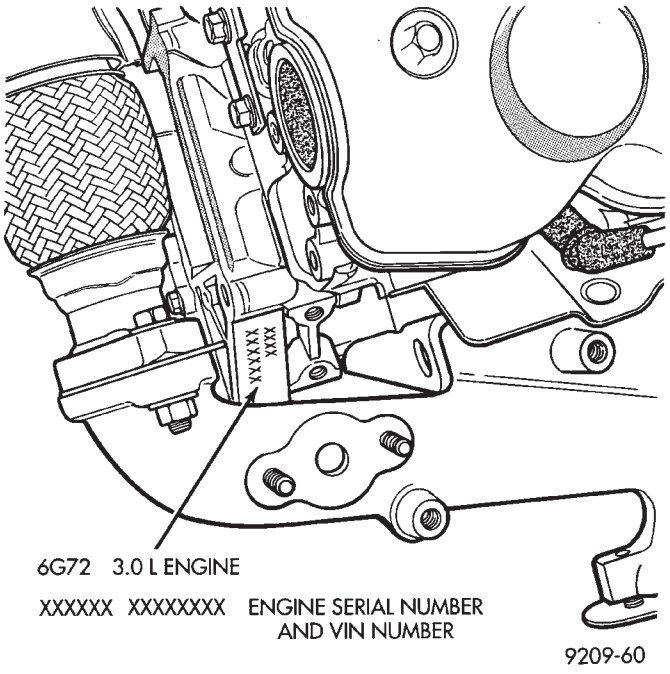


Fig. 1 Engine Identification

ENGINE LUBRICATION

System is a full flow filtration, pressure feed type. The oil pump is mounted behind the timing belt cover. The pump inner rotor is driven by the crankshaft. The engine oil pan contains a baffle plate to control oil level fluctuation during engine operation.

ENGINE COMPONENTS

BLOCK: The cylinder block is a light weight design created by reducing thickness in many parts and a short 10 mm (3/8 in.) block skirt. High rigidity is provided with ribs cast in the outer wall, a full length water jacket, and a mono-block or beam type, main bearing cap. This single unit four bearing cap is designed to control vibration of the cylinder block partition walls.

CRANKSHAFT: A six throw, five weight crankshaft 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 torsional vibration damper is used to control torsion caused vibration of the crankshaft. Rubber lipped seals are used at front and rear. The

DESCRIPTION AND OPERATION (Continued)

front seal is retained in the oil pump case and the rear is retained in a block-mounted housing.

PISTONS: Are aluminum alloy with a steel strut, short height, and thin wall so as to be autothermic and light weight. The piston head with valve recesses, in combination with the cylinder head, forms a compact spherical head with clearance for total valve lift with pistons at top dead center. The piston skirt, top and second ring lands are finished to a tapered roughness for oil retention and high resistance to scuffing. Piston pins, pressed into place, join the pistons to the connecting rods.

CYLINDER HEAD: The alloy cylinder heads feature cross-flow type intake and exhaust ports. Valve guides and inserts are hardened cast iron. Valves of heat resistance steel are arranged in a V with each camshaft on center. To improve combustion speed the chambers are a compact spherical design with a squish area of approximately 30 percent of the piston top area. The cylinder heads are common to either cylinder bank by reversing the direction of installation.

CAMSHAFTS: Two overhead camshafts provide valve actuation, one front (radiator side of cylinder bank) and one rear. The front camshaft is provided with a distributor drive and is longer. Both camshafts are supported by four bearing journals, thrust for the front camshaft is taken at journal two and the rear at journal three. Front and rear camshaft driving sprockets are interchangeable. The sprockets and the engine water pump are driven by a single notched timing belt.

ROCKER ARM SHAFTS: The shafts are retained by the camshaft bearing journal caps. 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 ARMS: Are of light weight die-cast with roller type follower operating against the cam shaft. The valve actuating end of the rocker arms are machined to retain hydraulic lash adjusters, eliminating valve lash adjustment.

VALVES: Are made of heat resistant steel, valve springs are especially designed to be short. The valve spring wire cross-section is oval shaped and provides the same spring tension as longer springs. Valve spring retainers, locks and seals are conventional.

INTAKE MANIFOLD: The aluminum alloy manifold is a cross type with long runners to improve inertia. The runners, attaching below at the cylinder head, also attach above and support an air plenum. The air plenum chamber absorbs air pulsations created during the suction phase of each cylinder.

EXHAUST MANIFOLDS: Both manifolds are a log style made of ductile cast iron. Exhaust gasses, collected from the front cylinder bank, leave the front manifold through an end outlet and are fed through an upper crossover tube to the rear manifold. The collected exhaust from both manifolds are combined, and exit to the exhaust pipe through an articulated 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. (Fig. 2).

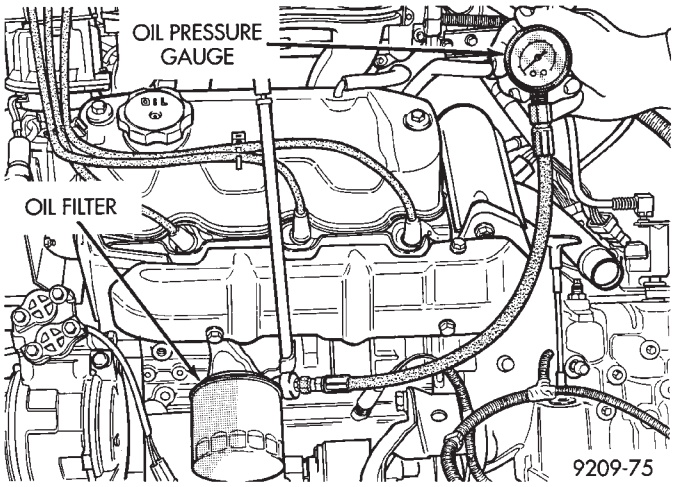


Fig. 2 Checking Engine Oil Pressure

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

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.

FUNCTION CHECK

Check auto adjusters for free play by inserting a small wire through the air bleed hole in the rocker arm and **very lightly** pushing the auto adjuster ball check down (Fig. 3). While lightly holding the check ball down move the rocker up and down to check for free play. If there is no play replace the adjuster.

SERVICE PROCEDURES (Continued)

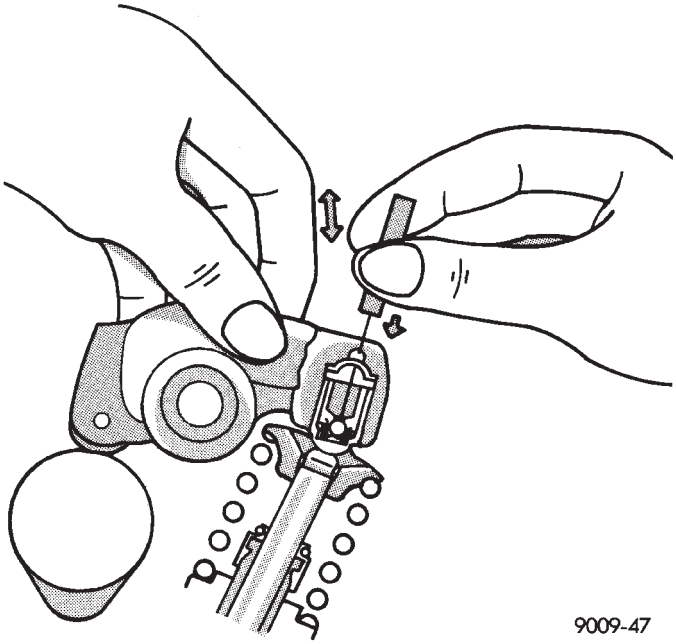


Fig. 3 Auto Lash Adjuster—Function Check

FITTING CONNECTING ROD BEARINGS

CONNECTING ROD CLEARANCE

(1) Following procedures specified in the Standard Service Procedures Section for Measuring Main Bearing Clearance and Connecting Rod Bearing Clearance (Fig. 4). Refer to Connecting Rod Specification Chart.

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

(3) Remove connecting rod cap and measure Plastigage (Fig. 4).

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

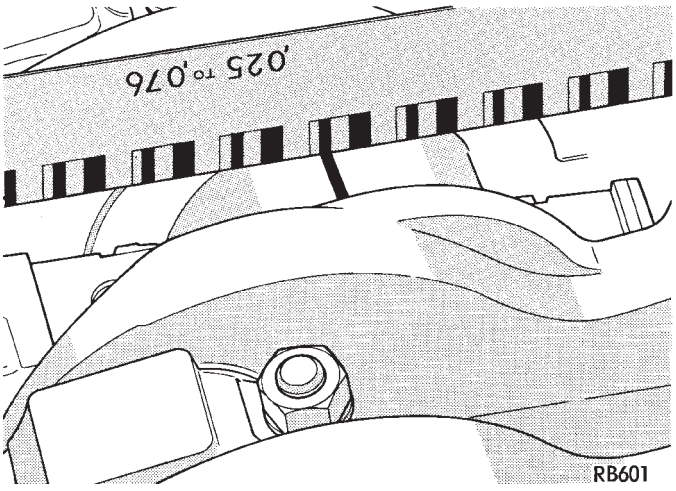


Fig. 4 Connecting Rod—Checking Bearing Clearance

CONNECTING ROD SIDE CLEARANCE

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

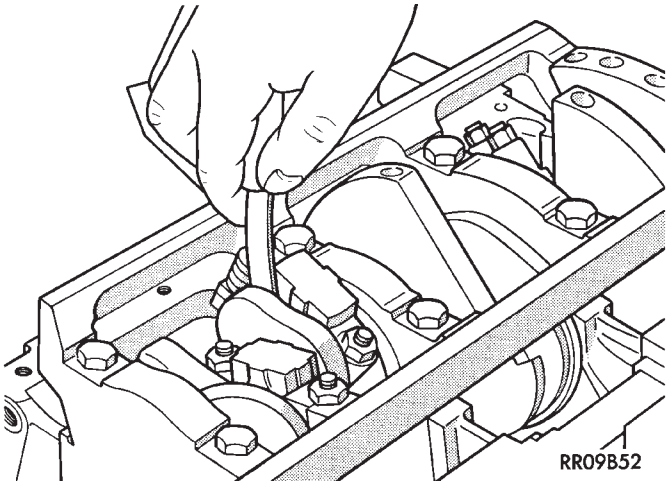


Fig. 5 Checking Connecting Rod Side Clearance

CONNECTING ROD SPECIFICATION CHART

Connecting Rod Bearing Oil Clearance	
New Part:	0.018 - 0.036 mm (0.0007 - 0.0014 in.)
Connecting Rod Side Clearance	
New Part:	0.10 - 0.25 mm (0.004 - 0.010 in.)
Wear Limit:	0.4 mm (0.015 in.)

FITTING MAIN BEARING

INSPECTION

Visually check the main and connecting rod bearing journals for wear, scuffs or scoring and replace if necessary.

CRANKSHAFT OIL CLEARANCE— MECHANICAL MEASUREMENT

Measure the journal outside diameter and the main bearing inside diameter (Fig. 6) & (Fig. 7). If the clearance exceeds the specifications limit, replace the main bearing(s) and if necessary replace the crankshaft. Refer to Crankshaft Clearance Specification Chart.

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. 8).

SERVICE PROCEDURES (Continued)

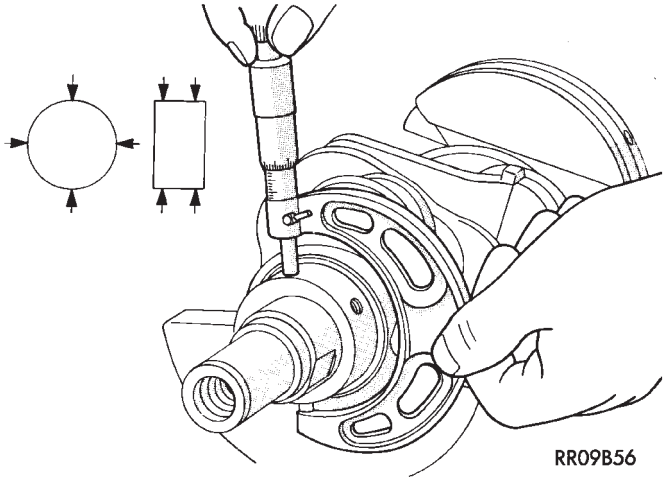


Fig. 6 Measure Crankshaft Journal O.D.

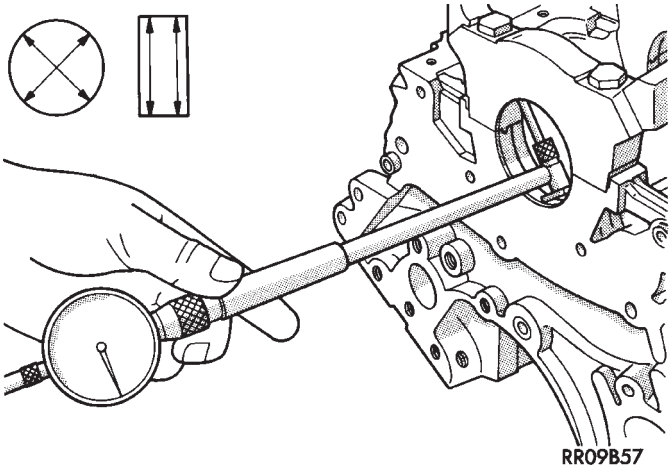


Fig. 7 Measure Main Bearing I.D.

CRANKSHAFT SPECIFICATION CHART

Crankshaft End-Play	
New Part:	0.05 - 0.25 mm (0.002 - 0.001 in.)
Wear Limit:	0.30 mm (0.012 in.)
Main Bearing Oil Clearance	
New Part:	0.018 - 0.036 mm (0.0007 - 0.0014 in.)
Wear Part:	0.10 mm (0.0039 in.)
Crankshaft Main Bearing Journal	
Standard Diameter:	59.980 mm (2.361 in.)
Crankshaft Connecting Rod Journal	
Standard Diameter:	50.00 mm (1.968 in.)

CAUTION: Do not rotate crankshaft or the plastigage will be smeared.

(4) Install the main bearing cap carefully and tighten the bolts to specified torque.

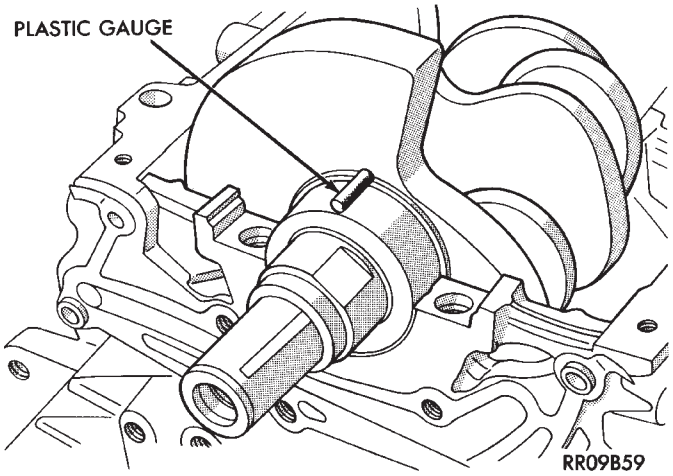


Fig. 8 Measure Oil Clearance with Plastigage

(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. 9). Refer to Crankshaft Clearance Specification Chart for proper clearances. Also see Measuring Main and Connecting Rod Bearing Clearance in Standard Service Procedures.

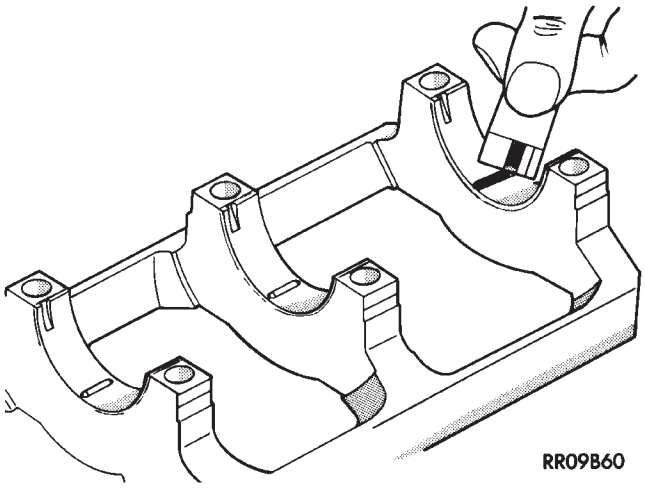


Fig. 9 Measuring Clearance

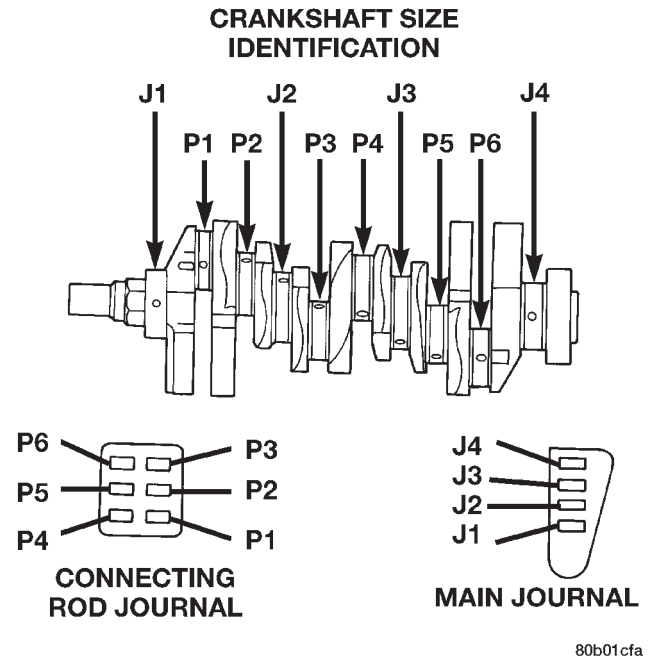
CRANKSHAFT BEARING INSTALLATION

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. In the case of a bearing supplied as a service part, its identification color is painted at the position show in (Fig. 10).

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. Refer to Crankshaft Size Classification Chart.

SERVICE PROCEDURES (Continued)



CRANKSHAFT SIZE CLASSIFICATION CHART

SIZE	NEW	CURRENT
MAIN JOURNAL		
59.982 - 59.988 mm (2.3615 - 2.3617 in.)	2	WHITE ENAMEL
59.988 - 59.994 mm (2.3617 - 2.3620 in.)	1	NONE
59.994 - 60.000 mm (2.3620 - 2.3622 in.)	0	YELLOW ENAMEL
CONNECTING ROD JOURNAL		
49.980 - 49.985 mm (1.9677 - 1.9679 in.)	III	WHITE ENAMEL
49.985 - 49.995 mm (1.9679 - 1.9683 in.)	II	NONE
49.995 - 50.000 mm (1.9683 - 1.9685 in.)	I	YELLOW ENAMEL

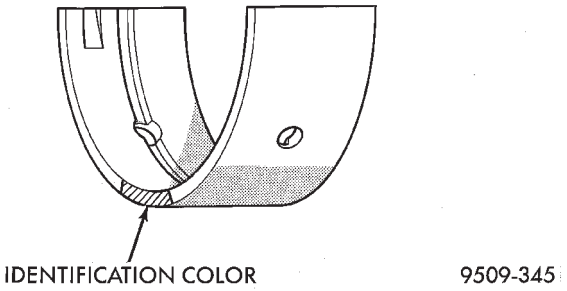


Fig. 10 Bearing Identification

CHECKING CRANKSHAFT END PLAY

(1) Mount a dial indicator to front of engine, locating probe on nose of crankshaft (Fig. 11).

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

(3) Zero the dial indicator.

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

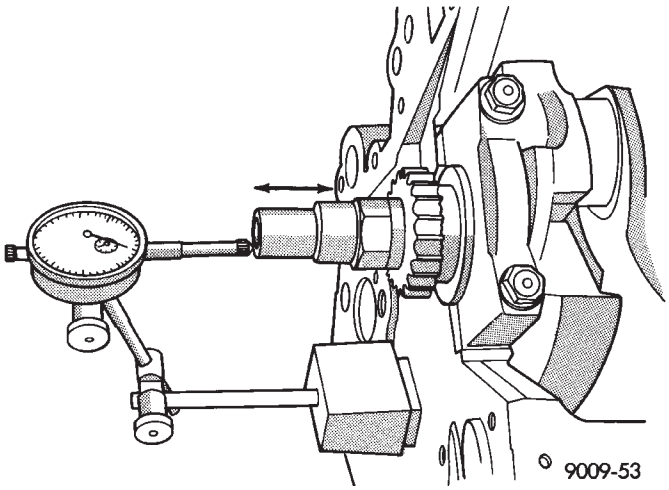


Fig. 11 Checking Crankshaft End Play

CRANKSHAFT SPECIFICATION CHART

Crankshaft End-Play	
New Part:	0.05 - 0.25 mm 0.002 - 0.001 in.)
Wear Limit:	0.30 mm (0.012 in.)
Main Bearing Oil Clearance	
New Part:	0.018 - 0.036 mm (0.0007 - 0.0014 in.)
Wear Part:	0.10 mm (0.0039 in.)
Crankshaft Main Bearing Journal	
Standard Diameter:	59.980 mm (2.361 in.)
Crankshaft Connecting Rod Journal	
Standard Diameter:	50.00 mm (1.968 in.)

SERVICE PROCEDURES (Continued)

VALVE SERVICE RECONDITION

(1) With suitable valve spring compressor, remove spring retainer locks, retainer, valve spring, spring seat and valve (Fig. 12).

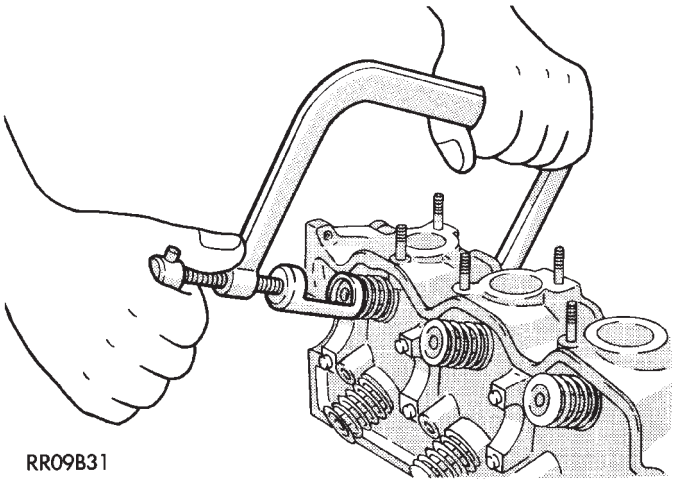


Fig. 12 Remove Valves

(2) Remove valve stem seals with suitable tool (Fig. 13). Do not reuse valve stem seals.

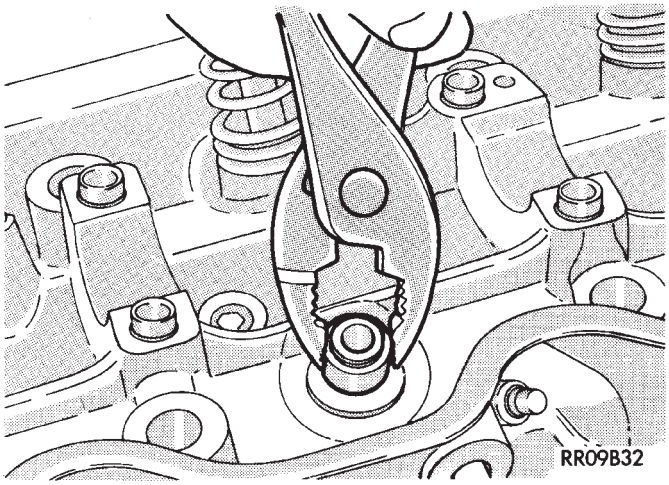


Fig. 13 Remove Valve Stem Seals

VALVES

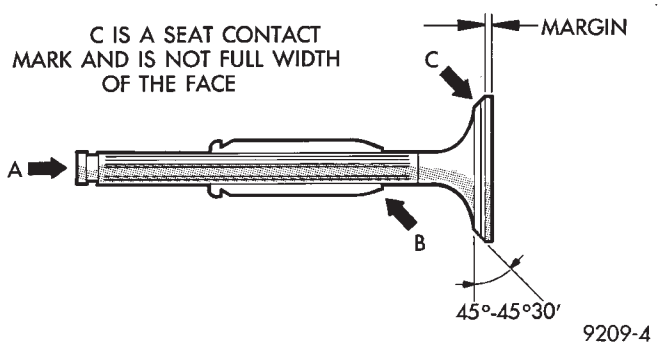


Fig. 14 Valve Inspection

(1) Check valve stem tip for pitting or depression at point A (Fig. 14).

(2) Check for wear and ridge wear at Point B.

(3) Check for even contact (at face center) with valve seat, Point C.

(4) Check margin (Fig. 14). Replace valve if margin is out of specification. Refer to Valve Specification Chart.

(5) Check valve guide height (Fig. 15).

(6) Measure valve stem to guide clearance. Refer to Valve Specification Chart.

(7) Measure Valve spring free length and squareness (Fig. 16). Refer to Valve Specification Chart.

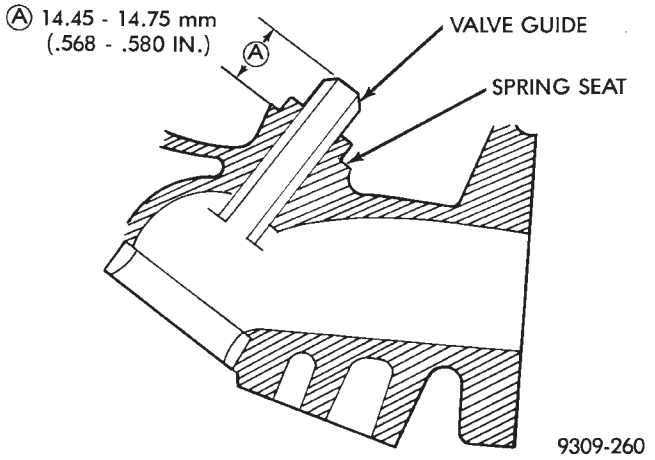


Fig. 15 Valve Guide Height

SERVICE PROCEDURES (Continued)

VALVE SPECIFICATION CHART

Valve Dimensions		
INTAKE VALVE (MINIMUM)		
Stem Diameter:	7.960 mm (0.313 in.)	
Face Angle:	45°	
Valve Margin:	0.700 mm (0.028 in.)	
Length:	103.0 mm (4.055 in.)	
EXHAUST VALVE (MINIMUM)		
Stem Diameter:	7.930 mm (0.312)	
Face Angle:	45°	
Valve Margin:	1.50 mm (0.059 in.)	
Length:	102.70 mm (4.043 in.)	
Valve Guide Clearance	**New**	**Service Limit**
Intake:	0.03 - 0.06 mm (0.001 - 0.002 in.)	0.10 mm (0.004 in.)
Exhaust:	0.05 - 0.09 mm (0.002 - 0.0035 in.)	0.15 mm (0.006 in.)
Valve Springs	**New**	**Service Limit**
Free Length:	49.8 mm (1.960 in.)	48.8 mm (1.921 in.)
Squarness:	2° Maximum	4° Maximum
Spring Tension:	33 Kg @ 40.4 mm (73 lbs. @ 1.59 in.)	

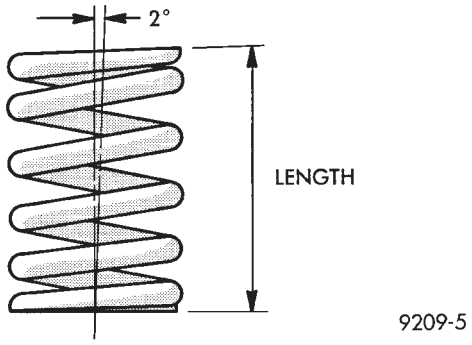


Fig. 16 Valve Spring

VALVE SEAT

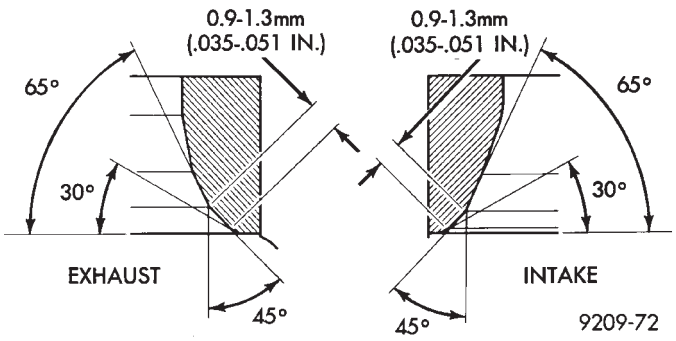


Fig. 17 Valve Seat Reconditioning

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. 17).

INSTALLATION

(1) Install valve spring seat.

(2) Using suitable tool install seal by tapping lightly until seal is in place (Fig. 18).

(3) Install valve spring with the enamelled ends facing the rocker arms (Fig. 19).

CAUTION: During reassembly, compressing the valve spring more than necessary to install valve spring retainer locks can cause the retainer to be forced against the stem seal and damaging it.

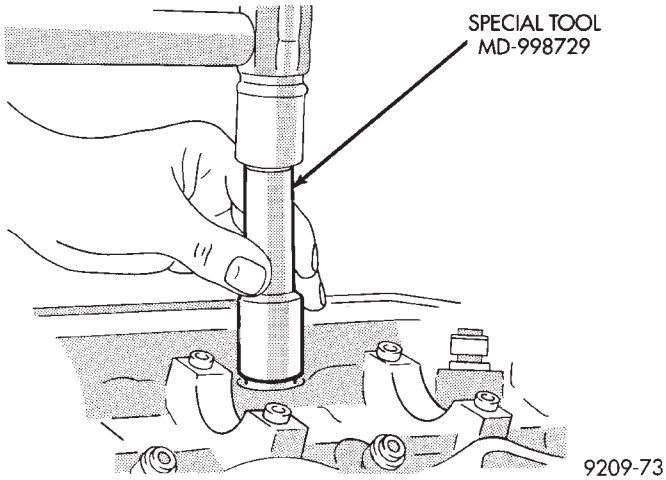


Fig. 18 Install Valve Stem Seals

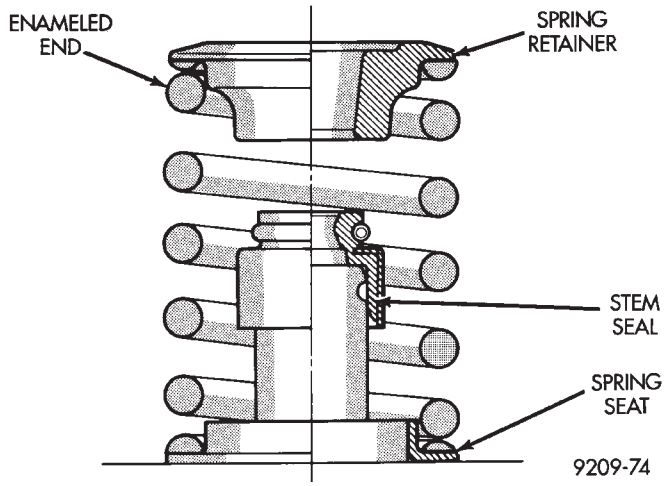


Fig. 19 Installed Valve Spring Position

REMOVAL AND INSTALLATION

ENGINE MOUNTS

RIGHT SIDE MOUNT

REMOVAL

NOTE: Right mount should only be serviced as an assembly to prevent noise, vibration and harshness concerns.

(1) Remove the purge duty solenoid and wiring harness from engine mount.

(2) Remove the two right engine mount insulator vertical fasteners and loosen the horizontal fastener. **Do Not remove the large nut on the end of the core from the frame rail (Fig. 20).**

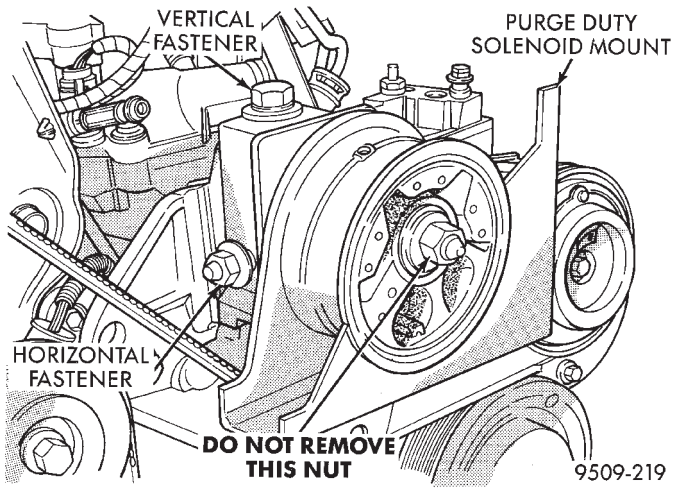


Fig. 20 Engine Mount—Right

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

(4) Remove the vertical and horizontal fasteners from the engine side bracket. Remove the engine mount assembly

INSTALLATION

(1) Reverse removal procedure for installation. Tighten assembly in the following order:

(a) Engine mount to rail fasteners to 68 N·m (50 ft. lbs.).

(b) The vertical engine fastener to 102 N·m (75 ft. lbs.).

(c) The horizontal fastener to 150 N·m (111 ft. lbs.).

(2) Install the purge duty solenoid and wiring harness to the engine mount.

(3) Engine mount adjustment, Refer to Engine Mount Insulator Adjustment.

FRONT MOUNT

REMOVAL

(1) Support the engine and transmission assembly with a floor jack so it will not rotate.

(2) Remove the front engine mount through bolt from the insulator and front crossmember mounting bracket (Fig. 21).

(3) Remove six screws from air dam to allow access to the front mount screws.

(4) Remove the front engine mount screws and remove the insulator assembly.

(5) Remove the front mounting bracket, if necessary (Fig. 21).

INSTALLATION

(1) Reverse removal procedure for installation and tighten fasteners in this order:

(a) Tighten bolts 2, 3, and 4 to 108 N·m (80 ft. lbs.).

(b) Tighten bolts 1 and 5 to 54 N·m (40 ft. lbs.).

(2) Engine mount adjustment. Refer to Engine Mount Insulator Adjustment of this section.

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

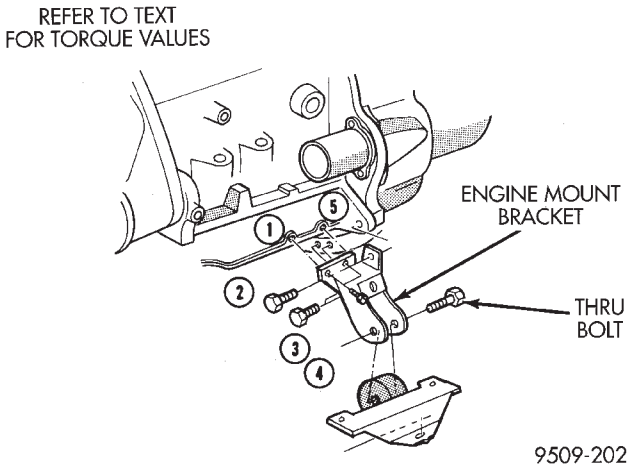


Fig. 21 Engine Mount—Front

LEFT SIDE MOUNT

REMOVAL

(1) Raise vehicle on hoist and remove left front wheel.

(2) Support the transmission with a transmission jack.

(3) Remove the insulator through bolt from the mount.

(4) Remove the transmission mount fasteners and remove mount.

INSTALLATION

(1) Reverse removal procedure for installation.

REMOVAL AND INSTALLATION (Continued)

(2) Tighten mount to transmission bolts to 55 N·m (40 ft. lbs.) (Fig. 22).

Tighten through bolt to 75 N·m (55 ft. lbs.)

(3) Engine mount adjustment, Refer to Engine Mount Insulator Adjustment of this section.

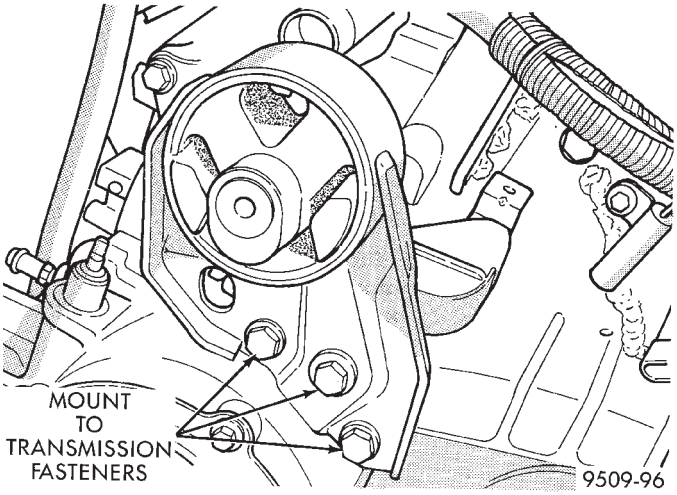


Fig. 22 Engine Mount—Left

REAR MOUNT

(1) Raise vehicle on hoist.

(2) Support the transmission with a transmission jack so it will not rotate.

(3) Remove the insulator through bolt from the mount and rear suspension crossmember.

(4) Remove the four transmission mount fasteners and remove the mount.

(5) Reverse the removal procedure for installation. Refer to (Fig. 23).

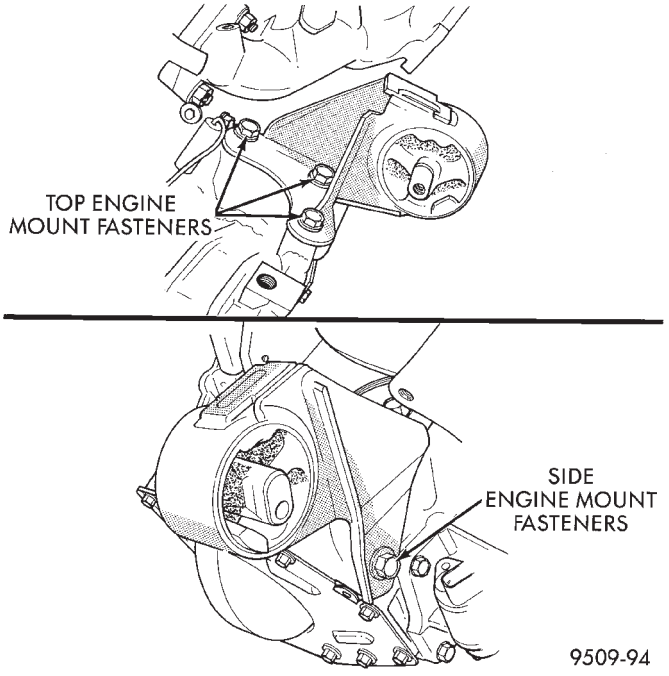


Fig. 23 Engine Mount—Rear

ENGINE MOUNT RUBBER INSULATORS

Insulator location on (right side) is adjustable to allow right/left drive train adjustment in relation to driveshaft assembly length. See Engine Mount Adjustments in this section.

Check and reposition right engine mount insulator. Adjust drive train position, if required, for the following conditions:

- Driveshaft distress: See Group 2, Suspension and Driveshafts.
- Any front end structural damage (after repair).
- Insulator replacement.

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.

(3) Remove Air cleaner and hoses.

(4) Remove battery cover, battery and battery tray, with integral vacuum reservoir, from vehicle.

(5) Block off heater hoses to rear heater assembly, if equipped.

(6) Drain cooling system. Refer to Group 7, Cooling System for procedure.

(7) Disconnect heater hoses.

(8) Remove fan module and radiator. Refer to Group 7, Cooling System for procedure.

(9) Disconnect transmission shift linkage.

(10) Disconnect throttle body linkage and vacuum hoses from throttle body.

(11) Remove accessory drive belts. Refer to Accessory Drive System located in Group 7, Cooling System for procedure.

(12) Remove air conditioning compressor from engine and set it aside.

(13) Disconnect generator wiring harness and remove generator.

(14) Hoist vehicle and remove axle shafts. Refer to Group 2, Driveshaft for procedure.

(15) Remove right and left inner splash shields.

(16) Disconnect exhaust pipe from manifold.

(17) Remove front engine mount and bracket as an assembly.

(18) Remove rear transmission mount and bracket.

(19) Remove power steering pump and bracket assembly.

(20) Remove wiring harness and connectors from front of engine.

(21) Remove bending braces and install tool number 6910 on engine.

(22) Remove trans inspection cover and mark flexplate to torque converter.

(23) Remove driveplate to torque converter bolts.

(24) Lower the vehicle.

REMOVAL AND INSTALLATION (Continued)

(25) Remove ground straps to body.

(26) Raise vehicle enough to allow engine dolly Special Tool 6135 and cradle Special Tool 6710 with post Special Tool 6848 and adaptor Special Tool 6909 to be installed under vehicle (Fig. 24).

(27) Loosen cradle engine mounts to allow movement for positioning onto engine locating holes on the 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.

(28) Lower vehicle so the weight of **ONLY THE ENGINE AND TRANSMISSION** is on the cradle.

(29) Remove right engine mount assembly and left transmission mount through bolt. Refer to Engine Mounts Section of this Group.

(30) Raise vehicle slowly. It may be necessary to move the engine/transmission assembly on the cradle to allow for removal around body flanges.

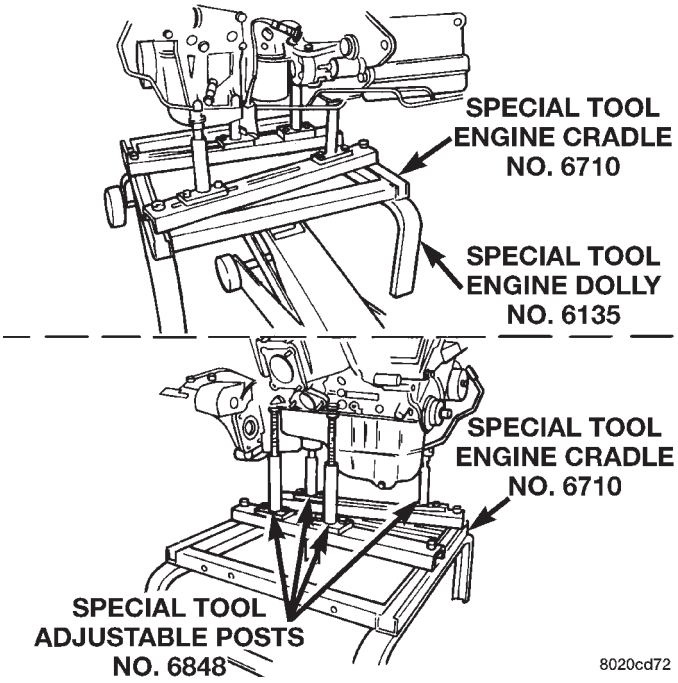


Fig. 24 Positioning Engine Cradle Support Post Mounts—Typical

INSTALLATION

(1) Position engine and transmission assembly under vehicle and slowly lower the vehicle over the engine and transmission. It may be necessary to move the engine/transmission assembly with the cradle for clearance around body flanges.

(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, 6710, 6848 and 6909.

(4) Remove Special tools 6910 and install bending braces.

(5) Lower vehicle. Install generator and wiring harness.

(6) Connect wiring harness on the front of the engine.

(7) Install Air Conditioning Compressor.

(8) Install power steering pump and bracket and accessory drive belt. Refer to Group 7. Accessory Drive Belts Section for installation procedure.

(9) Raise vehicle and install axle shafts. Refer to Group 2, Driveshafts for procedure.

(10) Install transmission and engine mount and bracket assemblies. Refer to Engine Mounts in this section for procedure.

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

(12) Install left and right inner splash shields.

(13) Connect automatic transmission shifter linkage. Refer to Group 21, Transmission for procedures.

(14) Lower vehicle and connect fuel line and heater hoses. Remove plugs from rear heater hoses and install, if equipped.

(15) Install ground straps. Connect engine and throttle body connections and harnesses.

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

(17) Install radiator and fan module assembly. Install radiator hoses. Fill cooling system. Refer to Group 7, Cooling for procedures.

(18) Install battery tray, battery and cover.

(19) Install air cleaner and hoses.

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

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

(22) Adjust transmission linkage, if necessary.

CYLINDER HEAD COVER

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove air inlet resonator when removing left head cover.

(3) When Removing left cylinder head cover, remove dipstick tube.

(4) When removing right cylinder head cover remove wiper unit. Refer to Wiper Unit Removal in Group 8K.

(5) When removing right cylinder head cover, remove accessory drive belt. Refer to Accessory Drive Belt Removal in Group 7.

REMOVAL AND INSTALLATION (Continued)

(6) When removing right cylinder head cover, disconnect generator wiring and remove generator.
(7) Relocate spark plug wires.
(8) Remove vacuum connections.
(9) Remove rocker cover screws and remove cover (Fig. 25).

INSTALLATION

(1) Clean cylinder head and cover mating surfaces. Install new gasket.
(2) See (Fig. 25) and apply sealant such as Mopar Silicone Rubber Adhesive Sealant to cover ends.
(3) Install cover and tighten cover bolt washer and gasket assembly to 10 N·m (88 in. lbs.).
(4) Reverse removal procedures for installation.

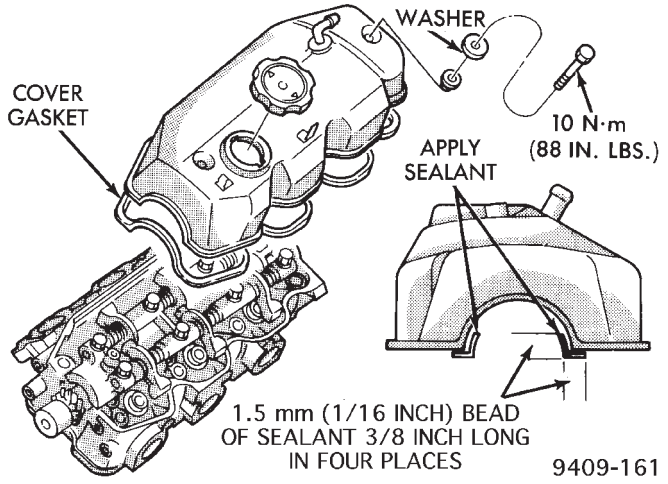


Fig. 25 Rocker Cover

CAMSHAFT

REMOVAL

NOTE: SEE AUTO LASH ADJUSTER FUNCTION CHECK BEFORE DISASSEMBLY

(1) Install auto lash adjuster retainers (Fig. 26).
(2) Remove distributor adaptor (Fig. 27).
(3) When removing camshaft bearing caps do not remove the bolts from the bearing caps. Remove the rocker arm, rocker shafts and bearing cap as an assembly.

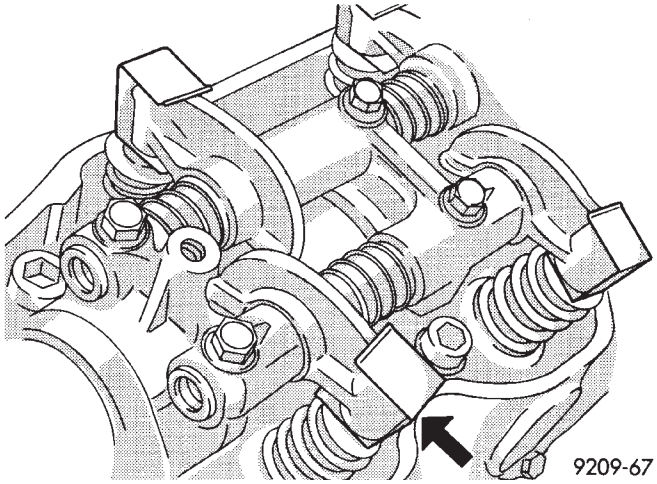


Fig. 26 Auto Lash Adjuster Retainers

CAMSHAFT INSPECTION

(1) Inspect camshaft bearing journals for damage and binding (Fig. 28). If journals are binding, also check the cylinder head for damage. Also check cylinder head oil holes for clogging.
(2) Front cylinder head camshaft check the tooth surface of the distributor drive gear teeth of the camshaft and replace if abnormal wear is evident (Fig. 28).
(3) Check the cam surface for abnormal wear and damage and replace if defective. Also measure the cam height (Fig. 28) and replace if out of limit, standard value is 41.25 mm (1.624 in.), wear **limit** is 40.75 mm (1.604 in.).

CAMSHAFT INSTALL

Lubricate camshaft journals and cams with engine oil and install camshaft on cylinder head.

REMOVAL AND INSTALLATION (Continued)

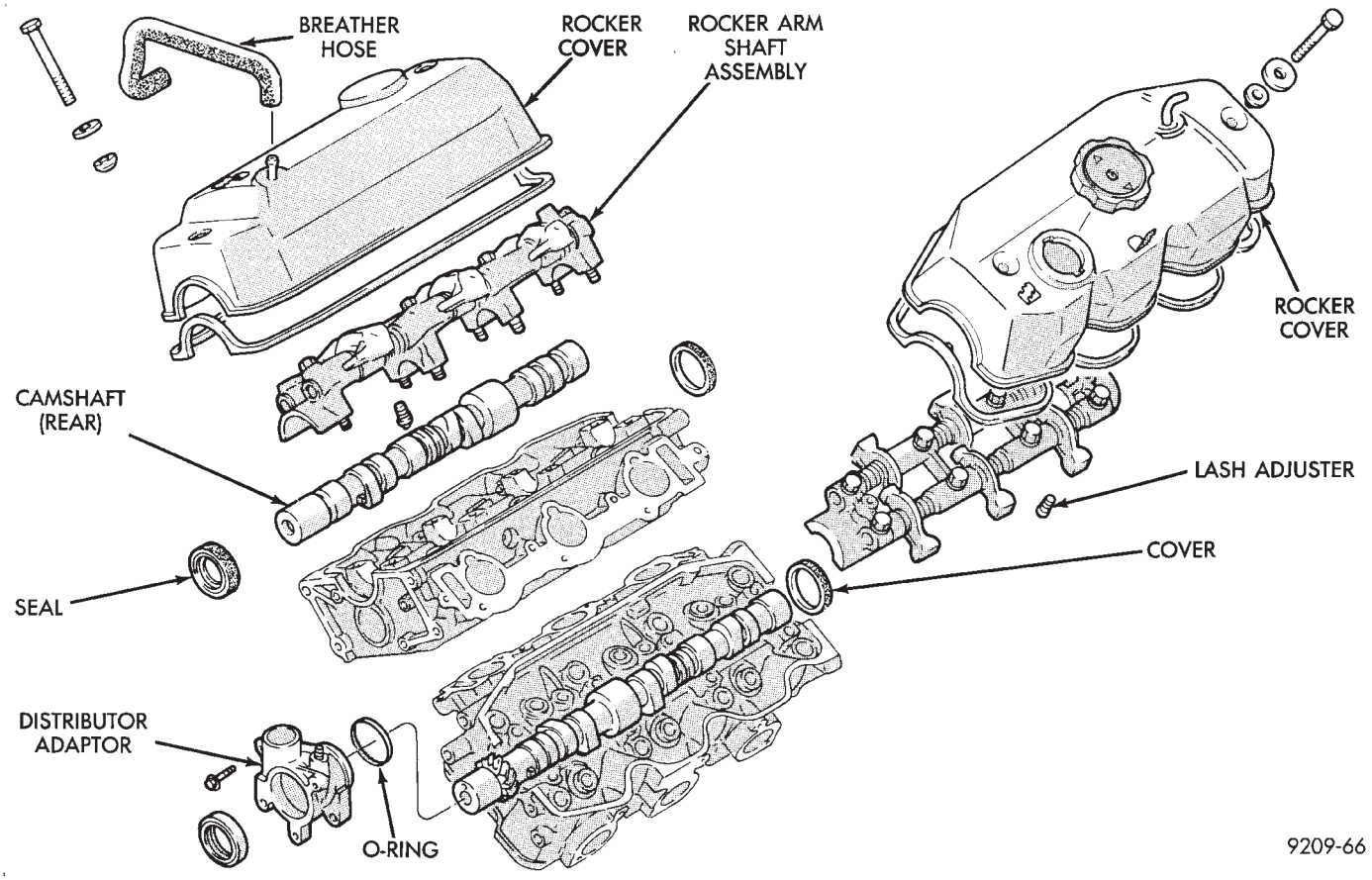


Fig. 27 Cylinder Heads and Camshafts

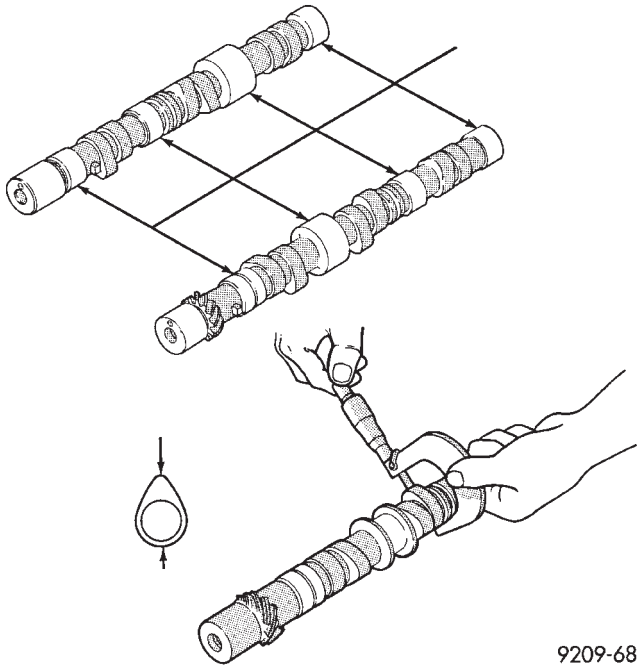


Fig. 28 Checking Camshafts

ROCKER ARMS

INSTALL ROCKER ARM SHAFT ASSEMBLY

(1) Apply Mopar Silicone Rubber Adhesive Sealant at bearing cap ends as shown in (Fig. 29).

(2) Install the rocker arm shaft assembly making sure that the arrow mark on the bearing cap and the arrow mark on the cylinder head are in the same direction (Fig. 29).

NOTE: The direction of arrow marks on the front and rear assemblies are opposite to each other.

(3) Tighten bearing cap bolts in the following order to 10 N·m (85 in. lbs.). First #3, then #2, #1 and #4.

(4) Repeat step 3 increasing the torque to 20 N·m (180 in.lbs.).

(5) Install distributor drive adaptor assembly (Fig. 30).

CAMSHAFT SEAL

CAMSHAFT END SEAL (PLUG)— IN VEHICLE SERVICE

(1) Remove air cleaner assembly from engine.

(2) Use a small punch and a hammer, carefully remove cam plug from cylinder head.

REMOVAL AND INSTALLATION (Continued)

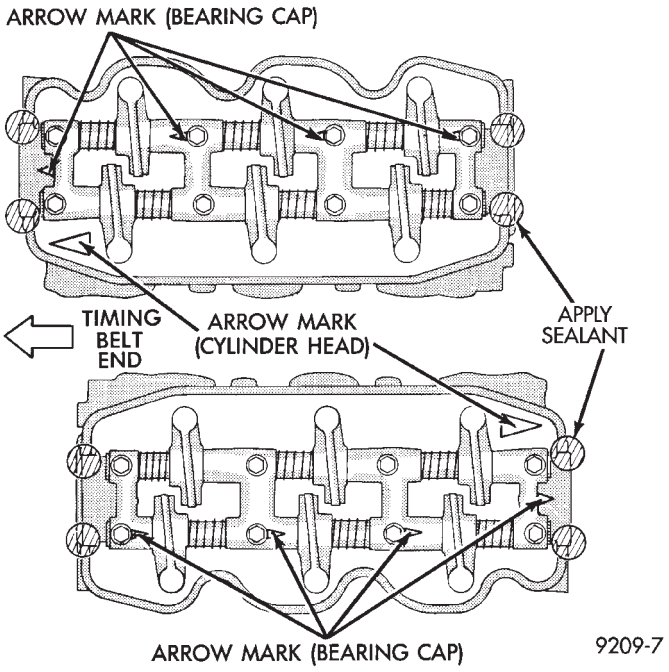


Fig. 29 Rocker Arm Shaft Direction

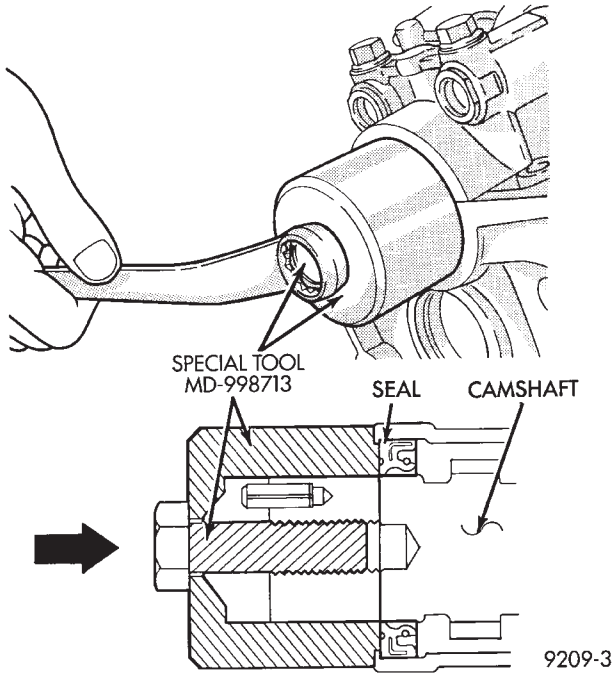


Fig. 31 Camshaft Oil Seal—Installation

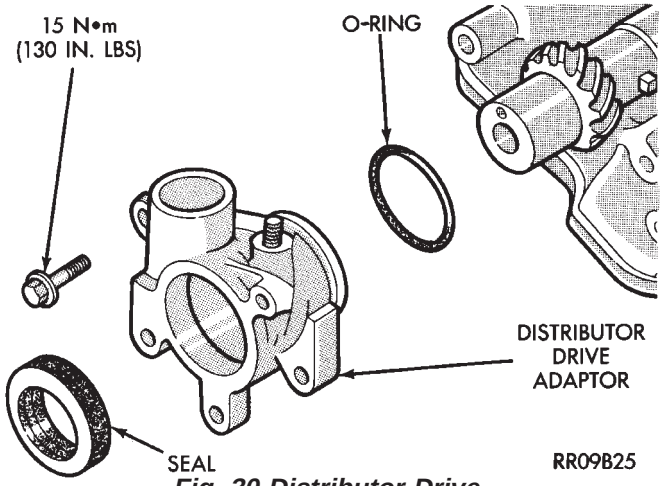


Fig. 30 Distributor Drive

(3) Clean the area of the cylinder head where the new cam plug will be installed.

(4) Apply a light coating of Mopar Silicone Rubber Adhesive Sealant to the outer diameter of the NEW cam plug.

(5) Using a suitable installing tool and a hammer, install the new cam plug to a depth of 0.5 mm (0.020 in.) below the surface of the cylinder head.

(6) Replace air cleaner assembly.

CAMSHAFT OIL SEAL PLUG— OUT OF VEHICLE SERVICE

(1) Apply light coat of engine oil to the camshaft oil seal lip.

(2) Install the oil seal using camshaft oil seal installer tool MD-998713 (Fig. 31).

CAMSHAFT END SEAL (PLUG) SERVICE — OUT OF VEHICLE SERVICE

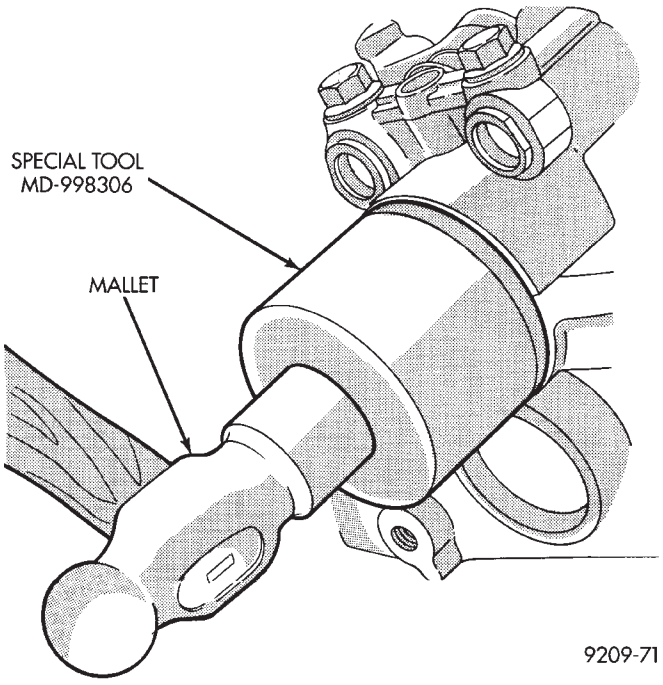


Fig. 32 Camshaft End Seal Plug—Installation

Install end seal plug with Special Tool MD-998306 (Fig. 32).

REMOVAL AND INSTALLATION (Continued)

CYLINDER HEAD

REMOVAL

(1) Remove timing belt and camshaft sprockets. See Timing Belt in this section for procedures.

(2) Remove cylinder head covers and rocker arms and shafts. Refer to procedure outlined in this section.

(3) Remove intake manifolds. Refer to Intake and Exhaust Manifolds, Group 11.

(4) Remove distributor.

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

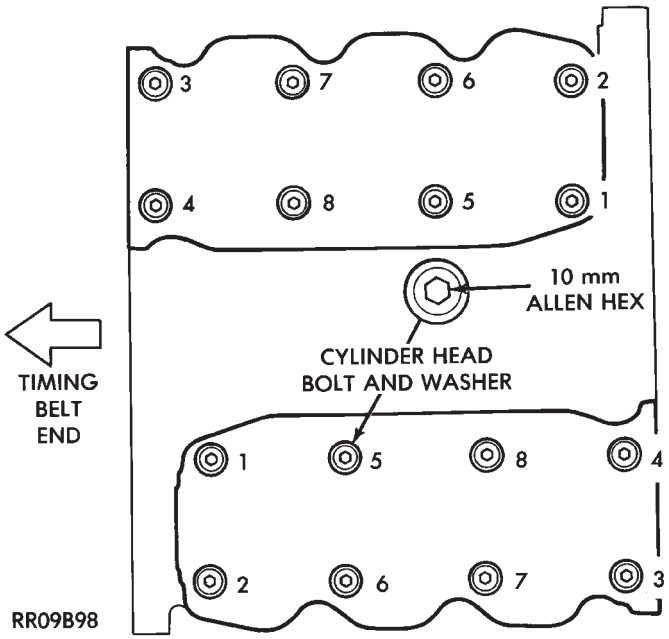


Fig. 33 Cylinder Head Bolt Removal Sequence

(6) Remove cylinder head bolts in sequence shown in (Fig. 33) 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 10 mm Allen hex head bolts with washers.

CAUTION: Attach the cylinder head bolt washer in the direction shown in (Fig. 34).

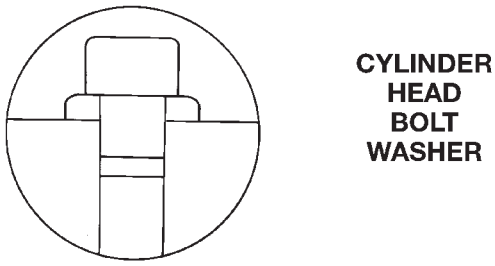


Fig. 34 Cylinder Head Bolt Washer

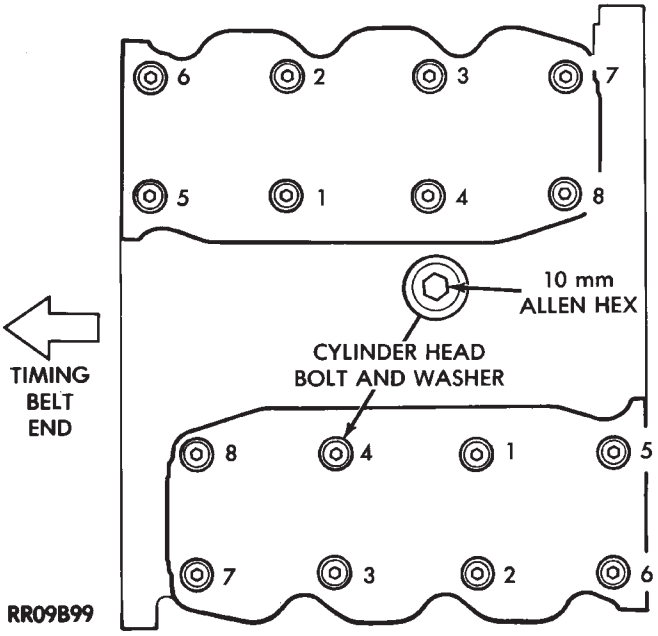


Fig. 35 Cylinder Head Bolt Tightening Sequence

(4) Tighten bolts in the order shown in (Fig. 35). 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.).

(5) Install rocker arms and cylinder head covers.

(6) Install camshaft sprockets and timing belt.

(7) Install exhaust manifolds and cross over pipe.

(8) Install distributor.

(9) Install intake manifolds.

REMOVAL AND INSTALLATION (Continued)

TIMING BELT

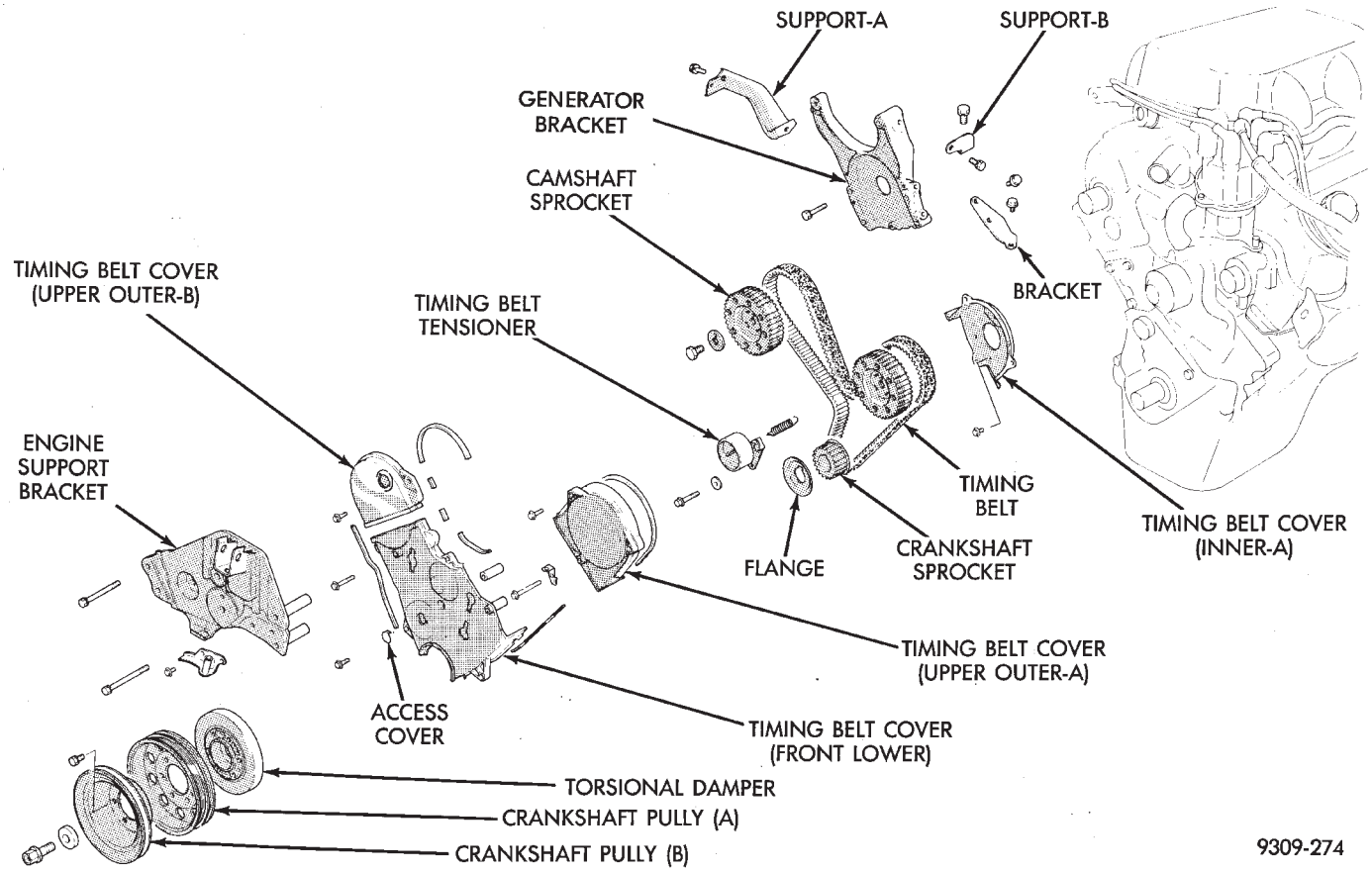


Fig. 36 Timing Belt System

REMOVAL

(1) Mark belt running direction for installation (Fig. 38).

(2) Loosen timing belt tensioner bolt (Fig. 40) and remove timing belt.

(3) Remove crankshaft sprocket flange shield (Fig. 36).

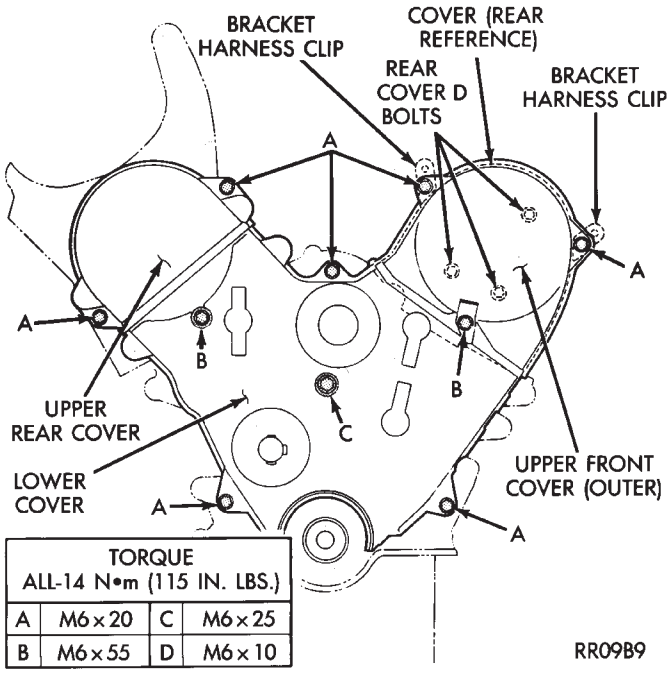


Fig. 37 Timing Belt Covers

REMOVAL AND INSTALLATION (Continued)

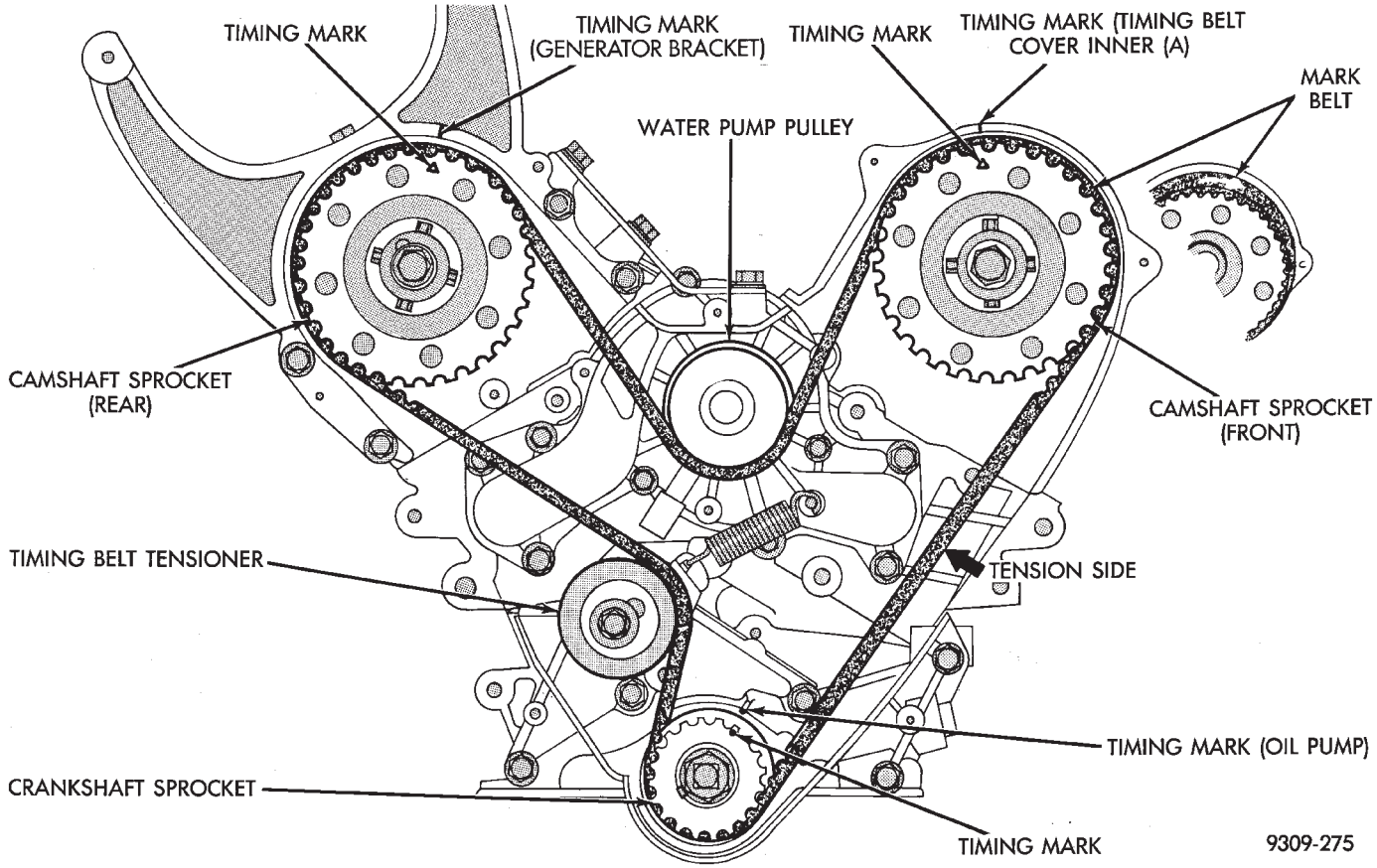


Fig. 38 Timing Belt Engine Sprocket Timing

CAMSHAFT SPROCKETS

To remove camshaft sprockets

1. Hold camshaft sprocket with Spanner Tool MB-990775 loosen and remove bolt and washer (Fig. 39).
2. Remove camshaft sprocket from camshaft.

To install camshaft sprockets

3. Place camshaft sprocket on camshaft.
4. Install bolt and washer to camshaft. Using Spanner Tool MB-990775 hold camshaft sprocket and torque bolt to 95 N·m (70 ft. lbs.) (Fig. 39).

TIMING BELT TENSIONER

(1) Install timing belt tensioner and tensioner spring.

(2) Hook spring upper end to water pump pin and lower end to tensioner bracket with hook out (Fig. 40).

(3) Turn timing belt tensioner counterclockwise full travel in adjustment slot and tighten bolt to temporarily hold this position (Fig. 41).

INSTALLATION—TIMING BELT

(1) Install timing belt on crankshaft sprocket and keep belt tight on tension side (Fig. 38). Install belt on the front (radiator side) camshaft sprocket. Install

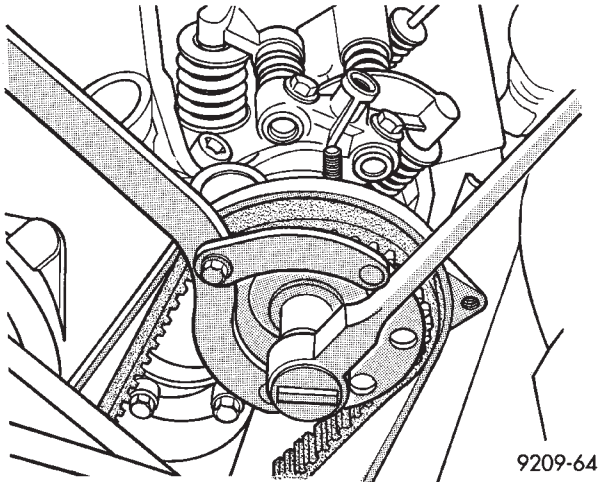


Fig. 39 Camshaft Sprockets

belt on the water pump pulley, rear camshaft sprocket and finally on the timing belt tensioner.

(2) Rotate the front camshaft sprocket in opposite direction to take up belt slack. Check that all timing marks are aligned (Fig. 38).

(3) Install crankshaft sprocket flange (Fig. 36).

(4) Loosen tensioner bolt and allow spring to tension timing belt.

REMOVAL AND INSTALLATION (Continued)

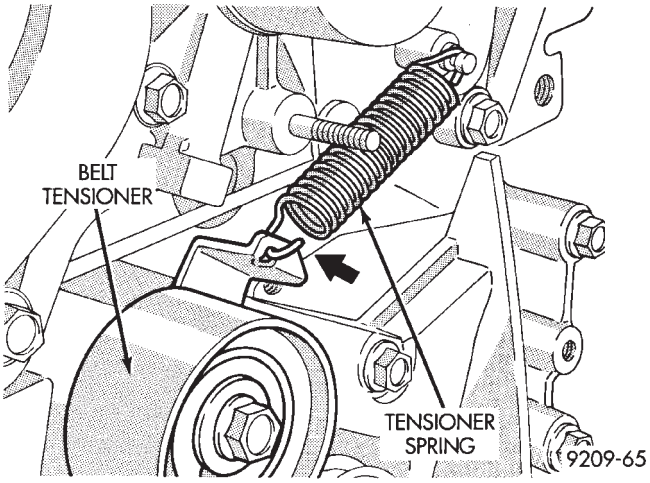


Fig. 40 Timing Belt Tensioner

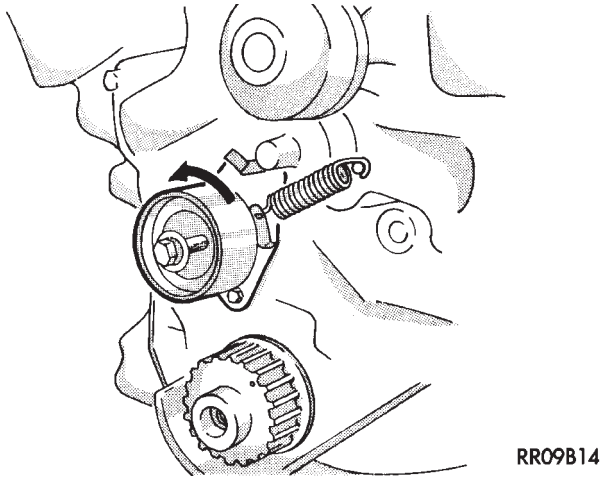


Fig. 41 Positioning Belt Tensioner

(5) Turn crankshaft two full turns in clockwise direction. **Turn smoothly and in clockwise direction ONLY.**

(6) Align the timing marks on the sprockets and tighten the timing belt tensioner locking bolt to 25 N·m (250 in. lbs.) torque.

(7) Reassembly belt covers, engine bracket, insulator, crankshaft pulleys, accessories and accessory drive belts in reverse order.

OIL PAN

Oil pan to crankcase 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. 42).

(2) Install pan and tighten screws to 6 N·m (50 in. lbs.) in sequence shown in (Fig. 43).

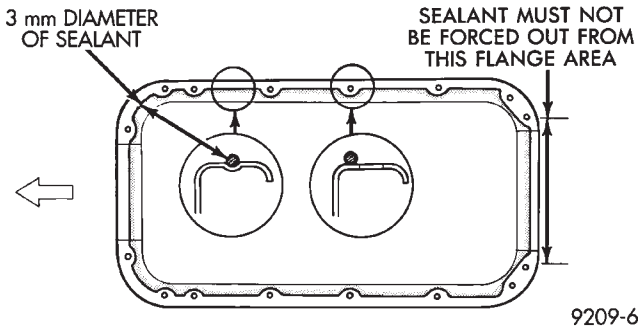


Fig. 42 Oil Pan Sealing

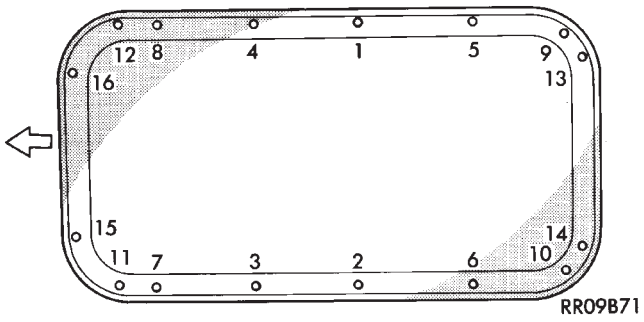


Fig. 43 Oil Pan Screw Tightening Sequence

REMOVAL AND INSTALLATION (Continued)

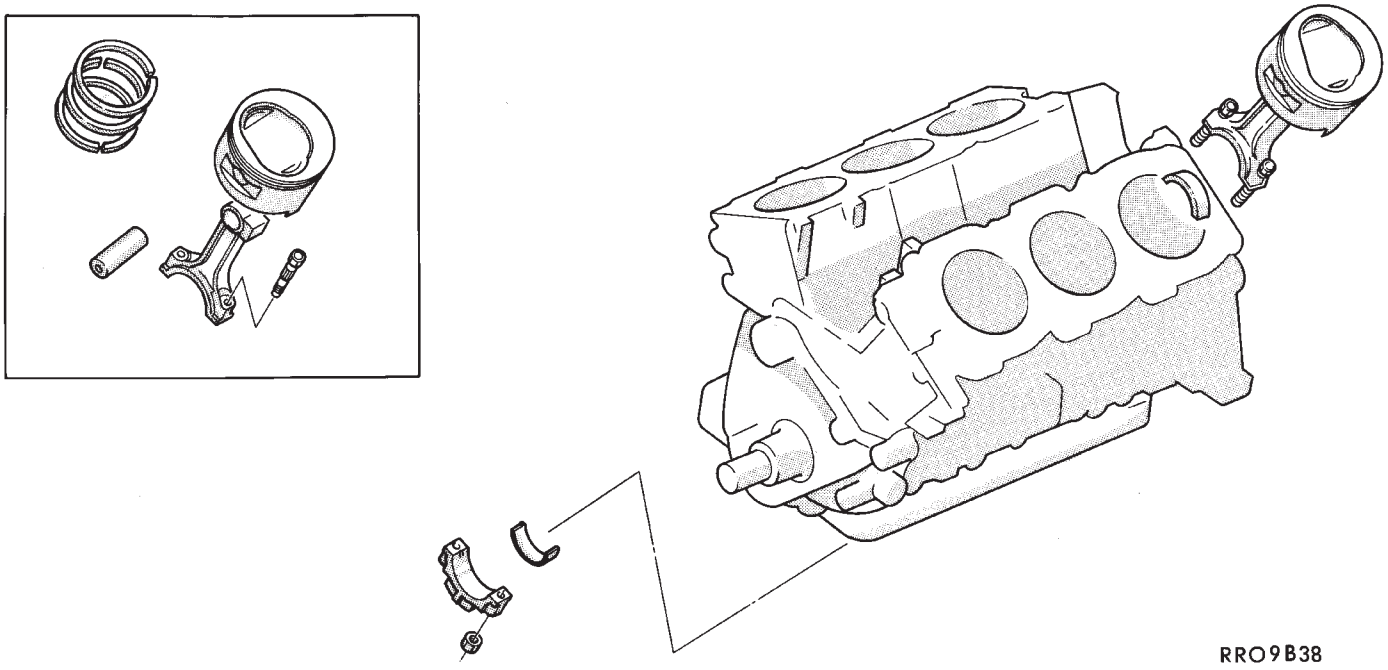


Fig. 44 Pistons and Connecting Rods

PISTON AND CONNECTING ROD

(1) Identify and mark pistons. **The pistons are not interchangeable from bank to bank** (Fig. 45).

(2) 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.

(3) Mark connecting rod and cap with cylinder number (Fig. 46).

(4) Remove piston rings (Fig. 47).

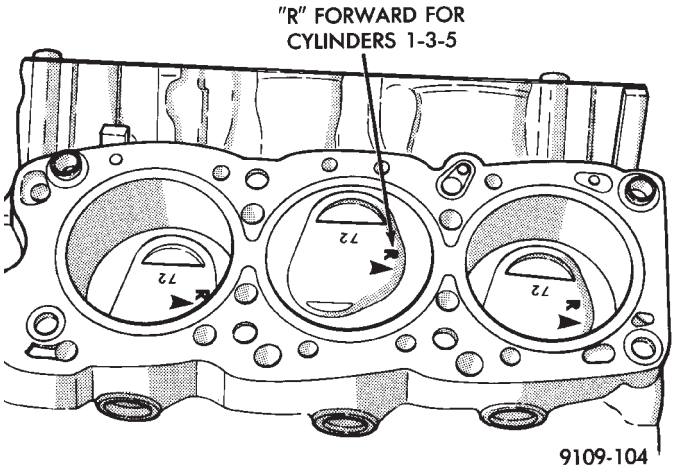


Fig. 45 Mark Pistons

FITTING PISTONS

Measure approximately 2 mm (0.080 in.) above the bottom of the piston skirt and across the thrust face (Fig. 48). See Boring Cylinder in Cylinder Block.

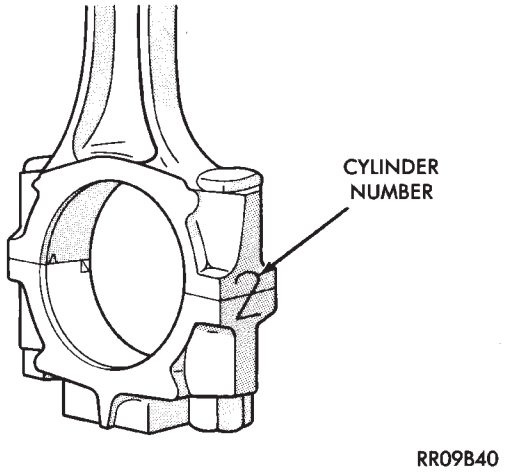


Fig. 46 Mark Matching Parts

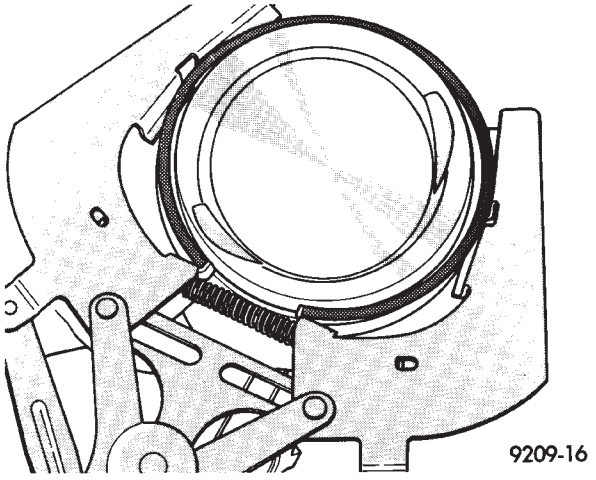


Fig. 47 Remove Piston Rings

REMOVAL AND INSTALLATION (Continued)

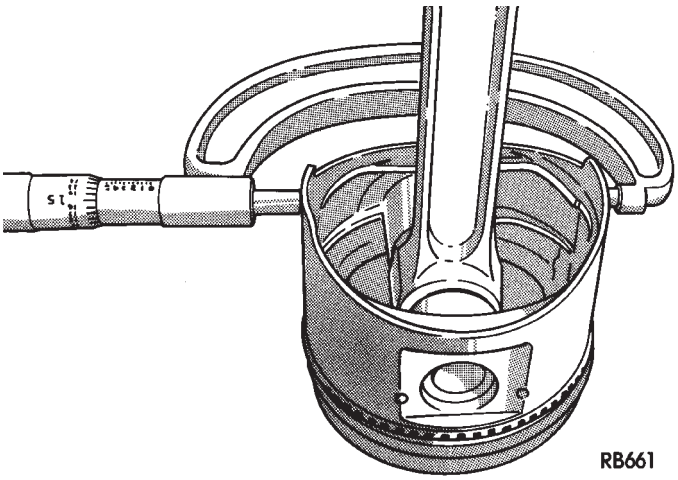


Fig. 48 Piston Clearance and Wear

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 16 mm (0.63 in.) from bottom of cylinder bore. Check gap with feeler gauge (Fig. 49). Refer to Piston Ring Specification Chart.

(2) Check piston ring to groove clearance (Fig. 50). Refer to Piston Ring Specification Chart.

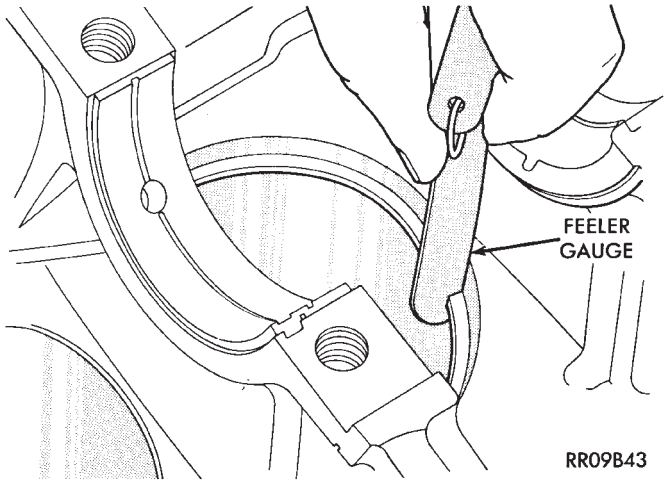


Fig. 49 Check Gap on Piston Rings

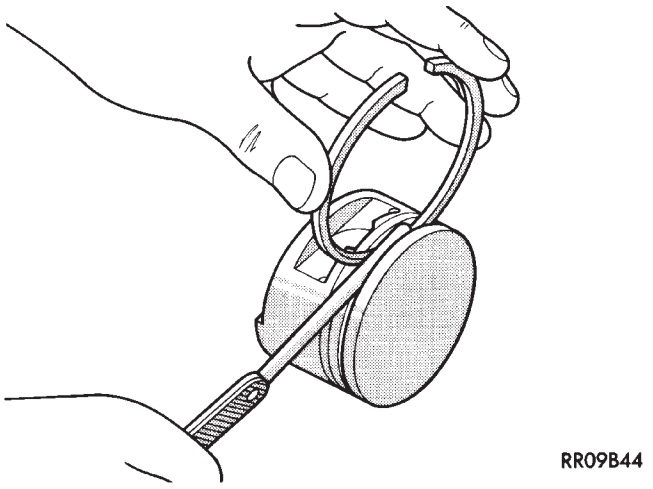


Fig. 50 Piston Ring Clearance

PISTON RINGS—INSTALLATION

(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. 51).

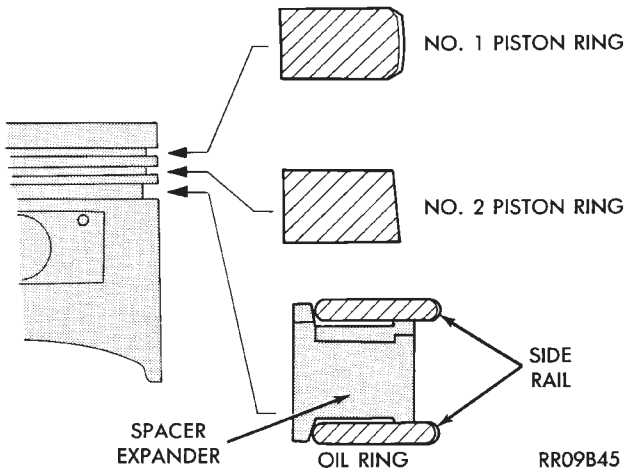


Fig. 51 Piston Ring—Installation

CAUTION: Install piston rings in the following order:

a. Oil ring expander.
b. Upper oil ring side rail.

PISTON RING SPECIFICATION CHART

Ring Position	Ring Gap	Ring Gap Wear Limit	Groove Clearance	Maximum Groove Clearance
Upper Ring	0.30 - 0.45 mm (0.012 - 0.018 in.)	0.8 mm (0.031 in.)	0.05 - 0.09 mm (0.002 - 0.0035 in.)	0.10 mm (0.004 in.)
Intermediate Ring	0.25 - 0.40 mm (0.010 - 0.016 in.)	0.8 mm (0.031 in.)	0.02 - 0.06 mm (0.0007 - 0.002 in.)	0.10 mm (0.004 in.)
Oil Control Ring	0.30 - 0.90 mm (0.012 - 0.035 in.)	1.0 mm (0.039 in.)	Oil Ring Side Rails Must Be Free To Rotate After Assembly	

REMOVAL AND INSTALLATION (Continued)

c. Lower oil ring side rail.
d. No. 2 Intermediate piston ring.
e. No. 1 Upper piston ring.

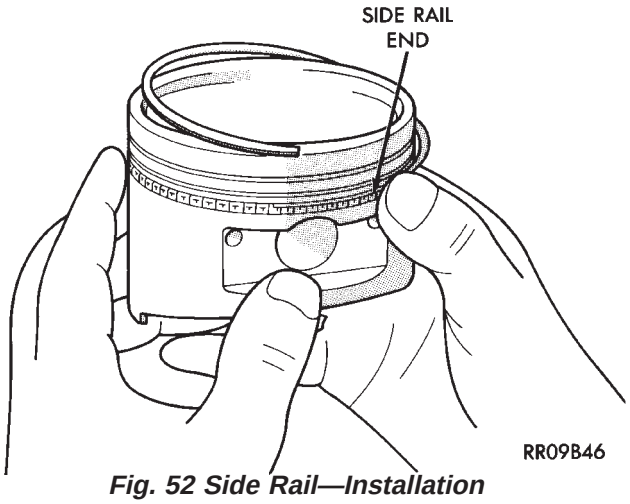


Fig. 52 Side Rail—Installation

(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. 52).

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

(4) Install No. 2 piston ring and then No. 1 piston ring (Fig. 53).

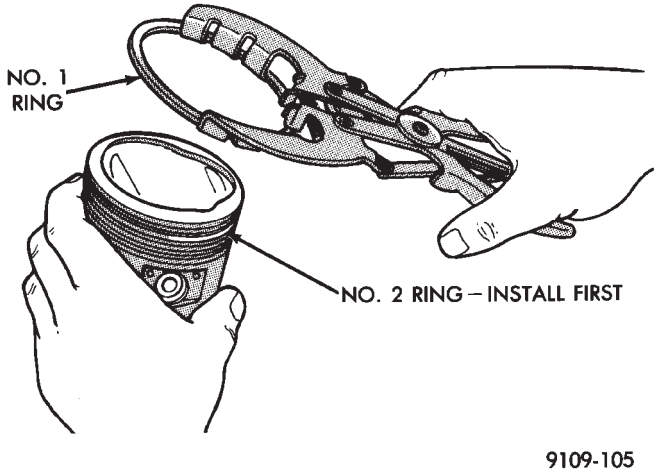


Fig. 53 Installing Upper and Intermediate Rings

(5) Position piston ring end gaps as shown in (Fig. 54).

(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.

(7) Connecting rod front mark 72 must always face forward, toward timing belt end. (Fig. 55)

(8) Install the piston and connecting rod assembly into there respective bore from the cylinder block top.

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

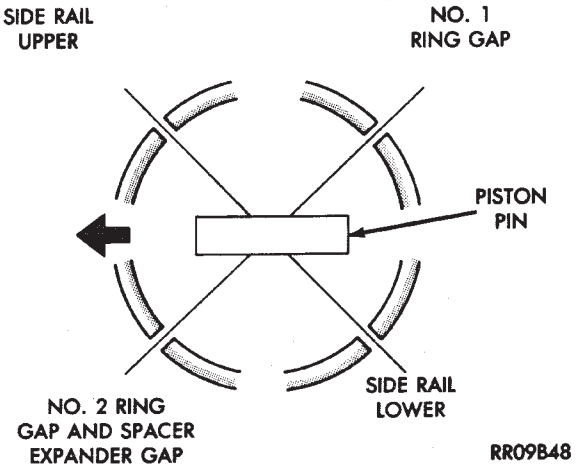


Fig. 54 Piston Ring End Gap Position

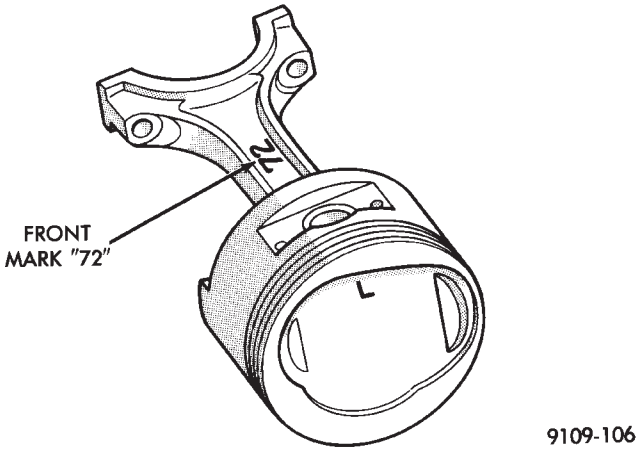


Fig. 55 Identify Piston and Rod Assembly for Cylinder Installation

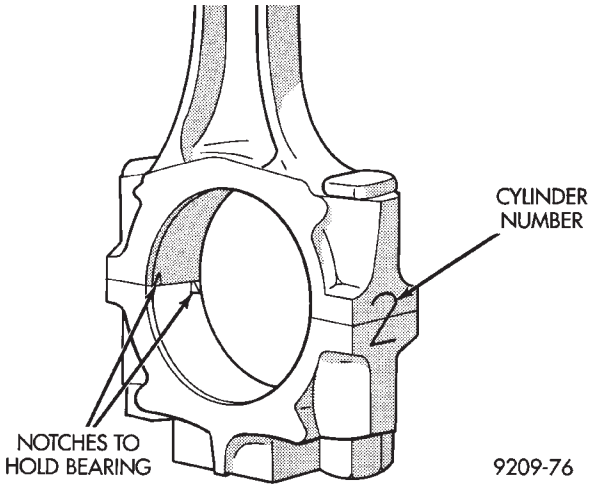


Fig. 56 Connecting Rod and Cap

(9) Check alignment marks made during disassembly and that bearing position notches new or used are on the same side as shown in (Fig. 56).

REMOVAL AND INSTALLATION (Continued)

CRANKSHAFT

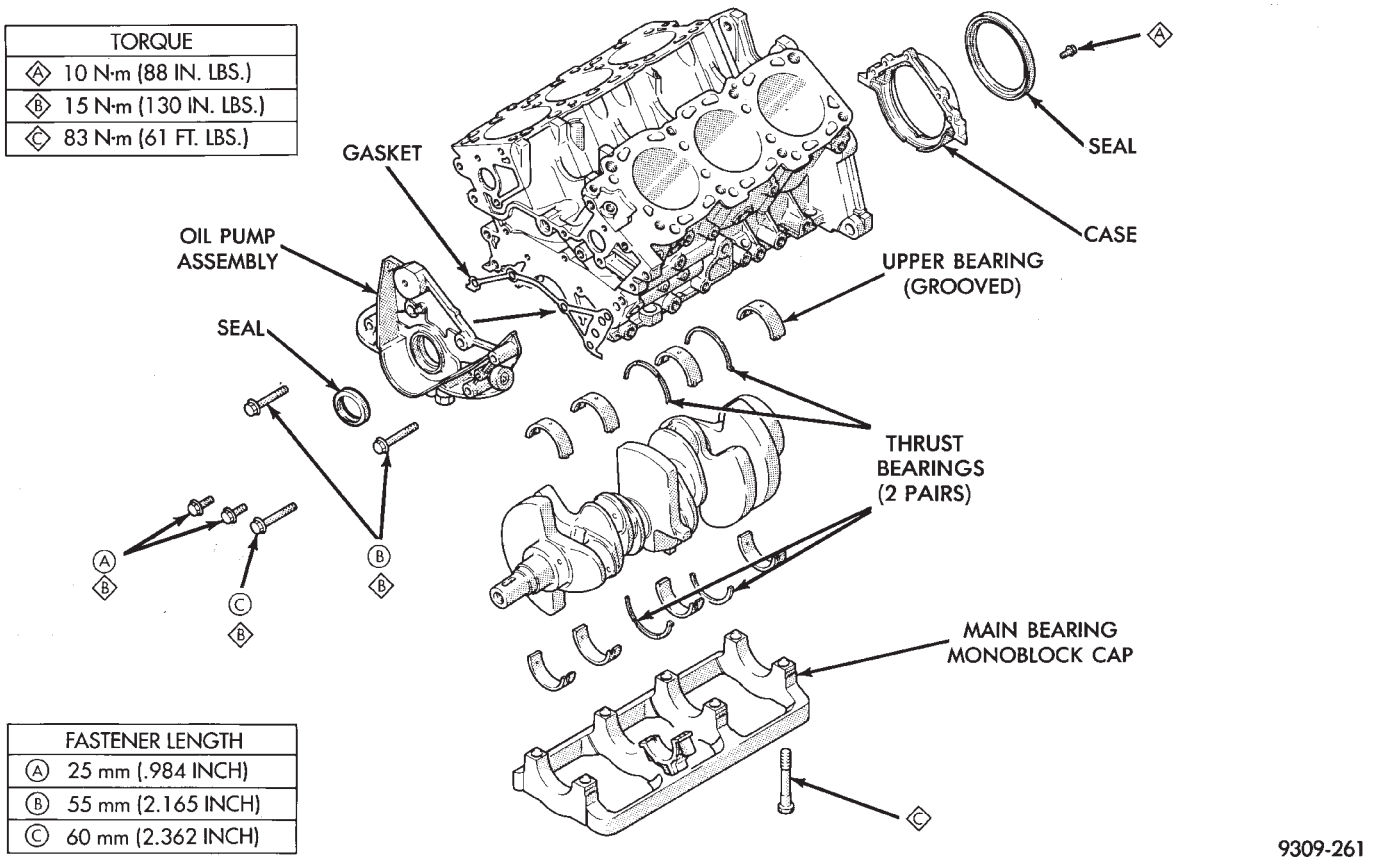


Fig. 57 Crankshaft and Cylinder Block

REMOVAL

(1) Remove front mounted oil pump assembly and gasket (Fig. 57) and (Fig. 58).

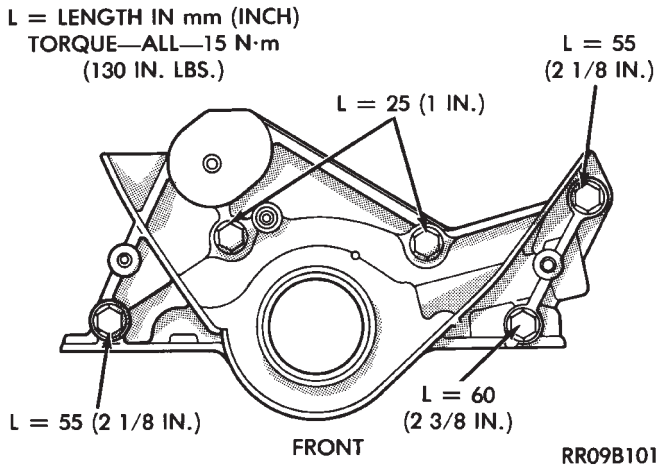


Fig. 58 Oil Pump Assembly

(2) Remove rear oil seal retainer and seal as assembly (Fig. 59).

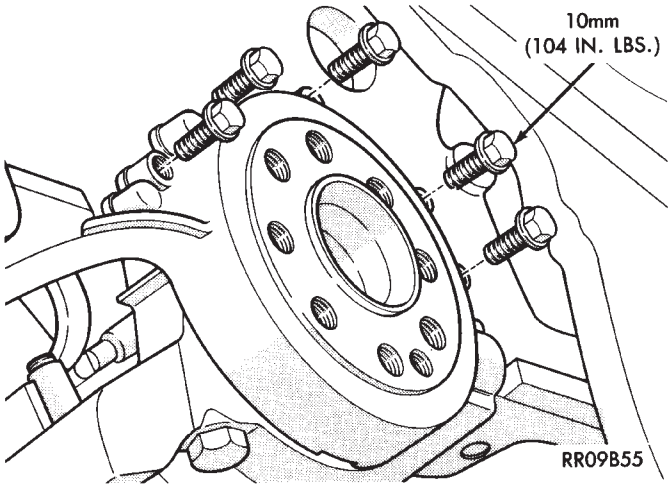


Fig. 59 Rear Seal Assembly

(3) Release mono-block 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. 57).

REMOVAL AND INSTALLATION (Continued)

CRANKSHAFT BEARINGS—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. 60).

(2) **THRUST BEARINGS.** Crankshaft thrust bearings (washers) are installed at journal #3 separately from the radial bearings. Thrust bearings shown in (Fig. 60) 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. 60).

(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 mono-block cap.

(6) Install one pair of thrust washers in cap. Refer to Thrust Bearings (Fig. 60).

(7) Carefully install bearing cap with arrows (Fig. 61) toward timing belt end.

(8) Oil the bearing cap bolt threads, install and tighten bolts progressively in sequence shown in (Fig. 61) to 80 N·m (60 ft. lbs.) torque.

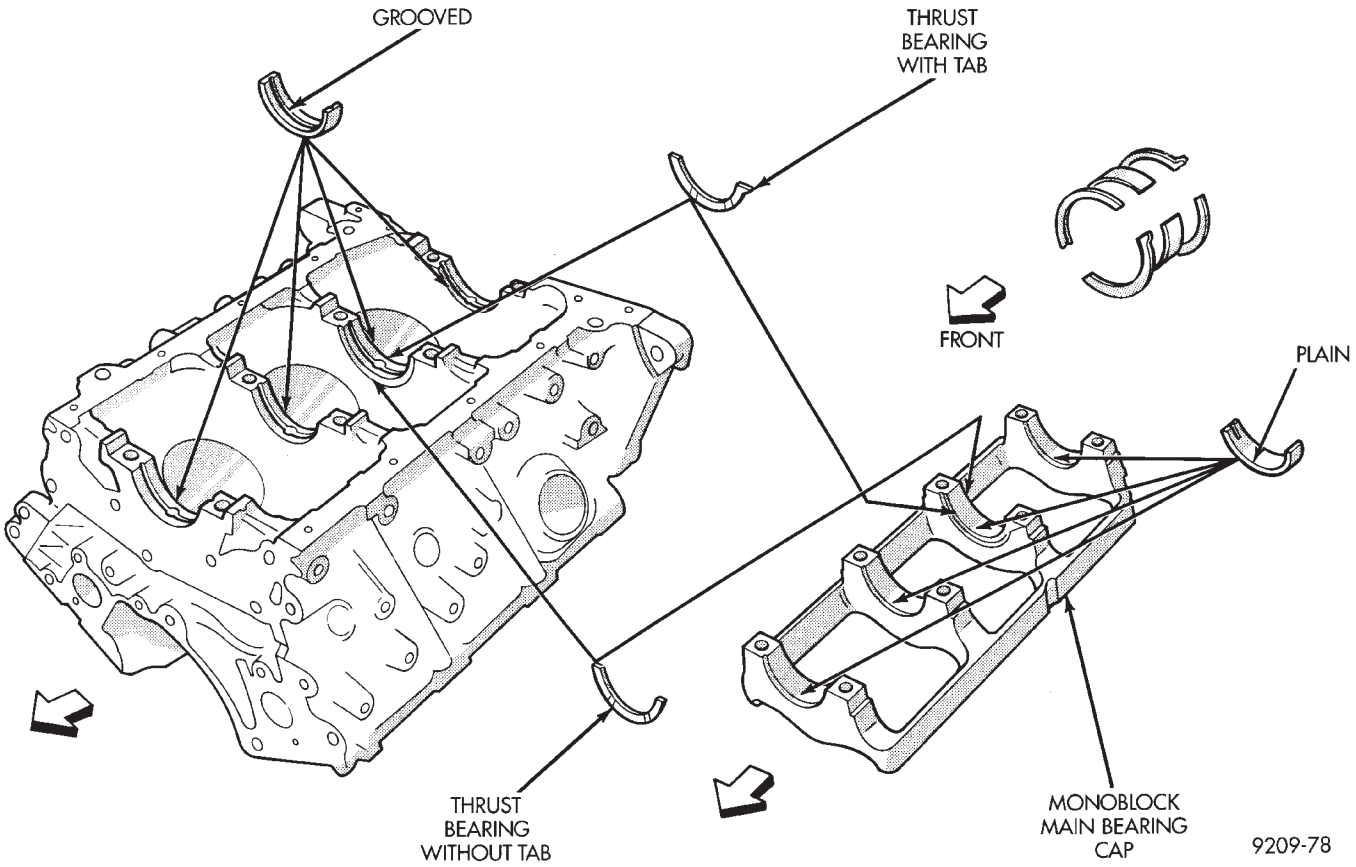


Fig. 60 Main Bearings—Installation

REMOVAL AND INSTALLATION (Continued)

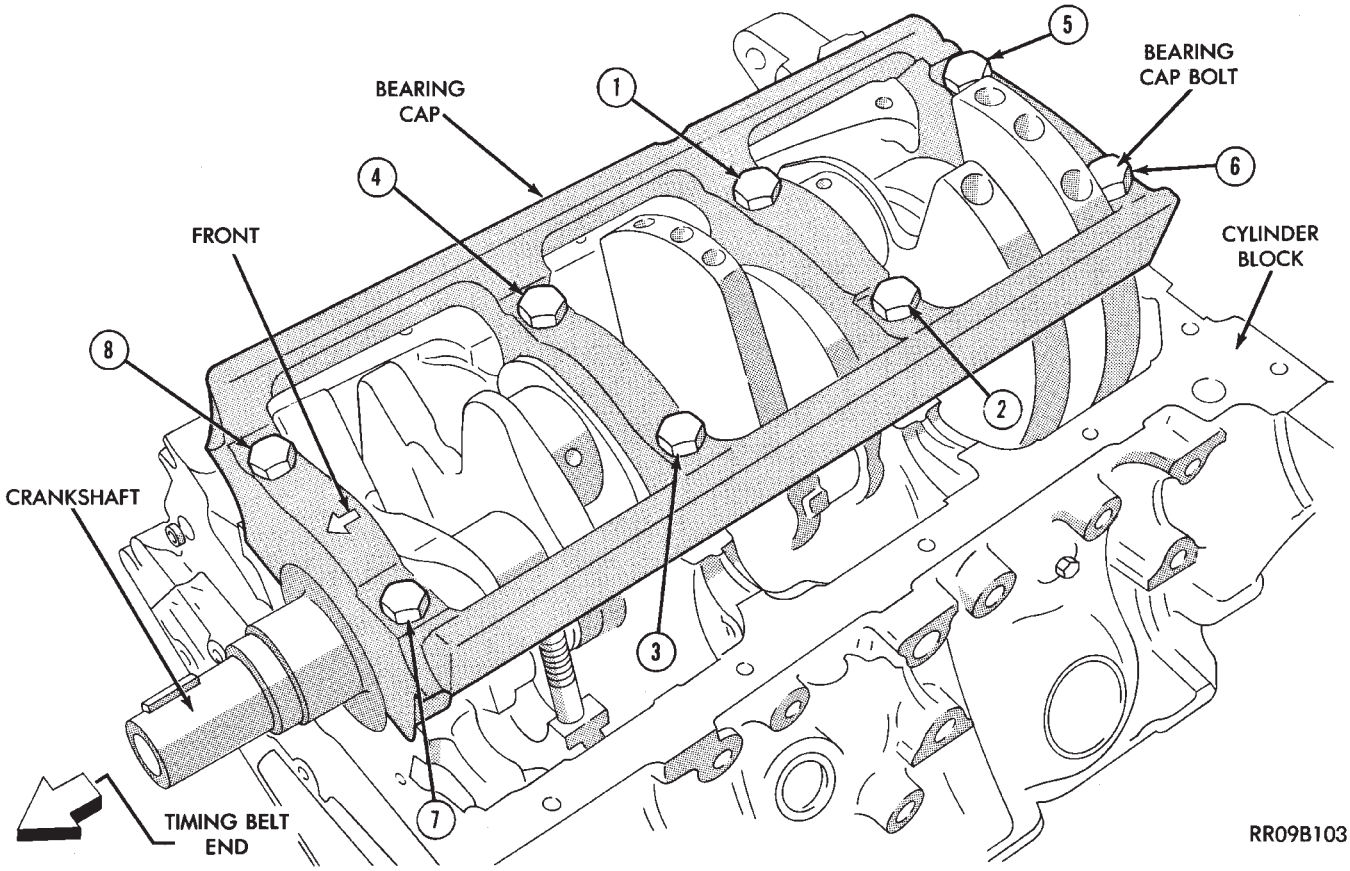


Fig. 61 Crankshaft Main Bearing Cap

REAR CRANKSHAFT SEAL

REAR CRANKSHAFT SEAL RETAINER

(1) Install rear crankshaft oil seal in housing with Special Tool MD-998718 (Fig. 62).

(2) Apply Mopar Silicone Rubber Adhesive Sealant or equivalent to oil seal housing (Fig. 63) per procedure detailed in form-in-place gasket section in Standard Service Procedures.

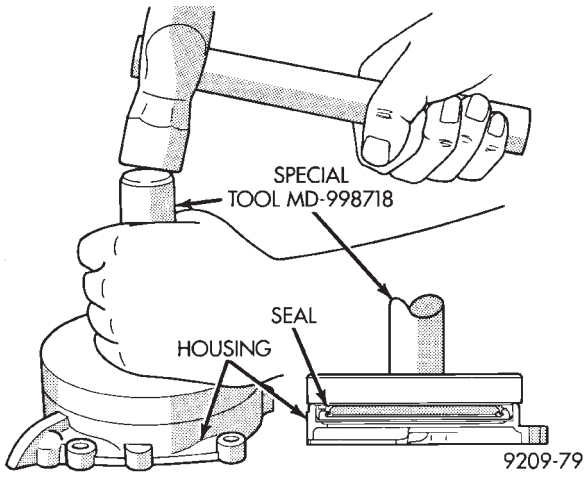


Fig. 62 Rear Crankshaft Oil Seal—Installation

(3) Apply light coating of engine oil to the entire circumference of oil seal lip.

(4) Install seal assembly on cylinder block and tighten bolts to 12 N·m (104 in. lbs.)

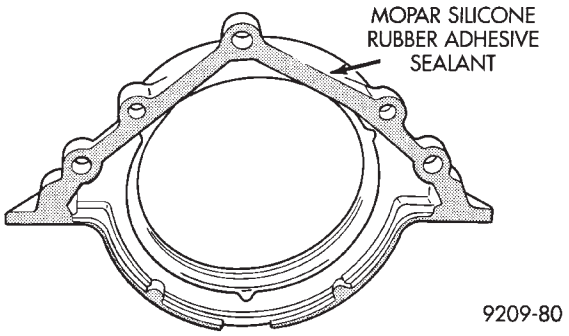


Fig. 63 Apply Sealant to Oil Seal Housing

FRONT CRANKSHAFT OIL SEAL

(1) Install oil pump gasket and oil pump case (Fig. 65) and (Fig. 64).

CAUTION: Install bolts, depending on length in locations shown in (Fig. 64).

(2) Using front crankshaft oil seal installer Special Tool MD-998717 install oil seal in oil pump (Fig. 65).

REMOVAL AND INSTALLATION (Continued)

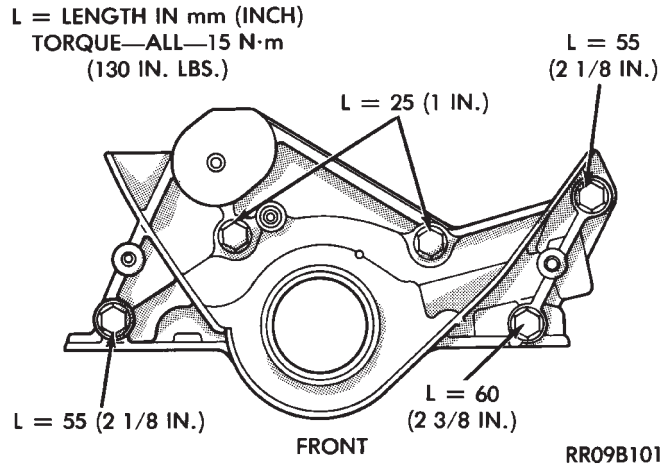


Fig. 64 Oil Pump

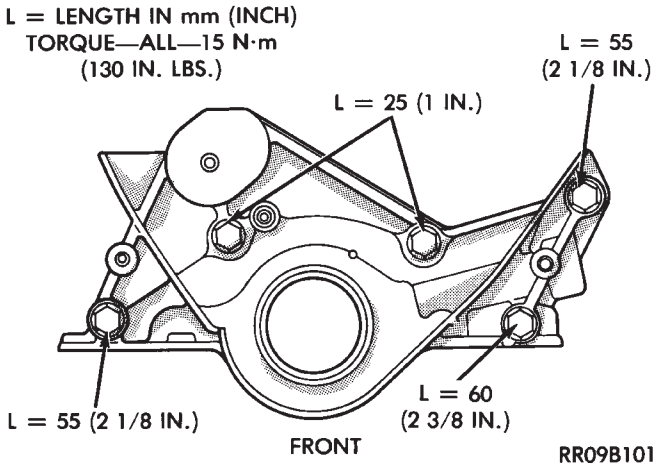


Fig. 66 Oil Pump Assembly

OIL PUMP

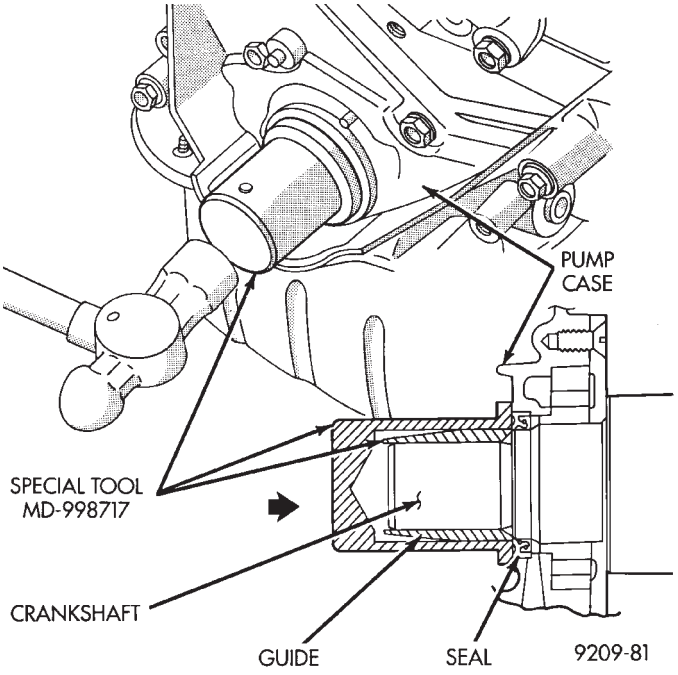


Fig. 65 Front Crankshaft Oil Seal—Installation

REMOVAL

1. Remove accessory drive belts. Refer to Accessory Drive Belts Group 7, Cooling System.
2. Remove Timing Belt. Refer to procedure in this section.
3. Remove 5 bolts that attach oil pump to block (Fig. 66).

INSTALLATION

(1) Clean block and pump surfaces.
(2) Install new gasket (Fig. 67) make sure correct length bolts are used (Fig. 66).
(3) Torque bolts to 13 N·m (120 in. lbs.).

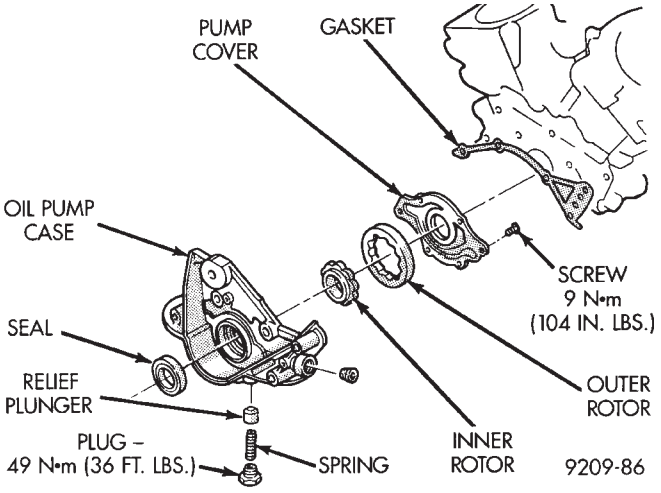


Fig. 67 Oil Pump Components

OIL FILTER AND ADAPTOR

(1) Check the oil filter mounting surface. The surface must be smooth, flat and free of debris or old pieces of rubber (Fig. 68).
(2) Check adaptor for cracks and oil leaks.

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

(3) Using Tool C-4065, turn filter counterclockwise to remove from base. Properly discard filter.
(4) Wipe base clean, then inspect gasket contact surface.
(5) Lubricate gasket of new filter with clean engine oil.

REMOVAL AND INSTALLATION (Continued)

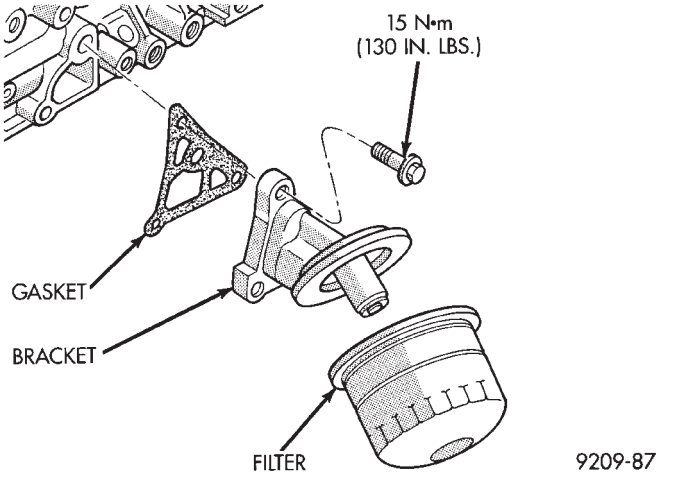


Fig. 68 Oil Filter and Adaptor

(6) Install new filter until gasket contacts base. Tighten filter 1 turn or 20 N·m (15 ft. lbs.). Use filter wrench if necessary.

(7) Start engine and check for leaks.

DISASSEMBLY AND ASSEMBLY

ROCKER ARMS AND SHAFTS

(1) Check rocker arms for wear or damage (Fig. 69). Replace as necessary. Also see Auto Lash Adjuster.

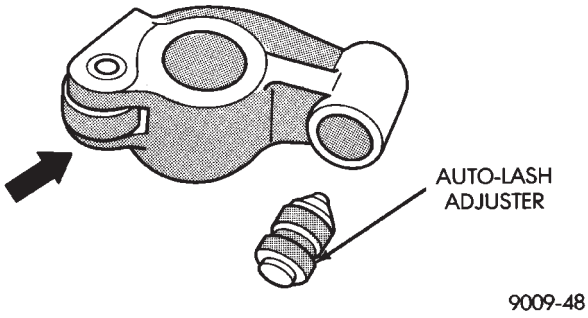


Fig. 69 Inspect Rocker Arms

ROCKER ARM SHAFTS

The rocker arm shaft is hollow and is used as a lubrication oil duct. The rocker arm shaft on the **inlet** side has a 3 mm (0.188 in.) diameter oil passage hole from the cylinder head. The **exhaust** side **does not** have this oil passage (Fig. 70).

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

(2) Check oil holes for clogging with small wire, clean as required (Fig. 70).

REASSEMBLE

(1) Align the camshaft bearing caps with arrows (depending on cylinder bank) directed as shown in

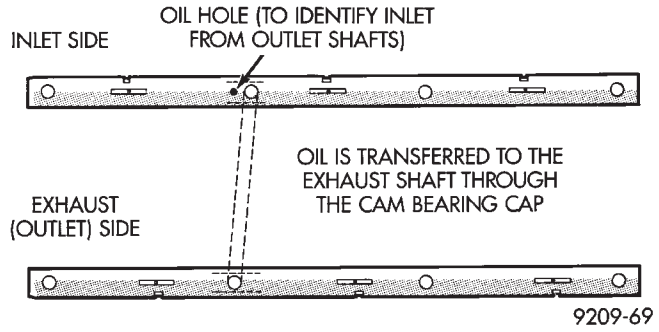


Fig. 70 Rocker Arm Shaft Identification

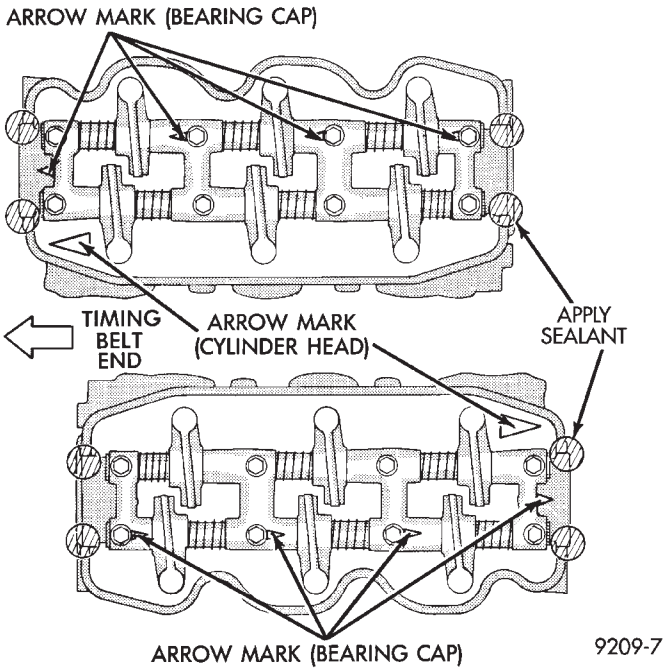


Fig. 71 Camshaft Bearing Caps Position

(Fig. 71) and in numerical order. Identify number one bearing cap number one and number four caps are similar (Fig. 72).

(2) Install rocker shafts so that bearing cap number one with end notches positioned as shown in (Fig. 72) that the machined portion of the rocker shaft is facing down.

(3) Install attaching bolts to retain assembly.

ASSEMBLE ROCKER ASSEMBLY

Install the rocker arms, bearing caps and springs. **Springs are the same and can be used at all locations** on the rocker arm shafts (Fig. 71) and (Fig. 73). Insert bolts in number four bearing cap to retain assembly.

DISASSEMBLY AND ASSEMBLY (Continued)

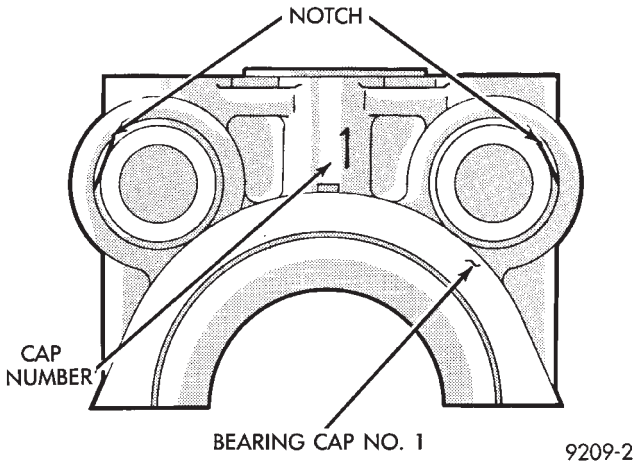


Fig. 72 Number One Camshaft Bearing Cap

CLEANING AND INSPECTION

TIMING BELT

INSPECTION

(1) Remove the upper front outer timing belt cover by loosening the three attaching bolts (Fig. 75).

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

- Rubber back side is glossy, hardened back without resilience and leaves no indent when pressed with fingernail.
- Cracks on rubber back.
- Cracks or peeling of canvas.
- Cracks on rib root.
- Missing teeth.
- The sides are normal if they are sharp as if cut by a knife (Fig. 74).

NOTE: If none of the above conditions are seen on the belt, the belt cover can be installed.

CYLINDER HEAD

CLEANING AND INSPECTION

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

(2) Clean cylinder head and oil passages.

(3) Check cylinder head for flatness (Fig. 76).

(4) Cylinder head must be flat within:

- Standard dimension = less than 0.05 mm (.002 in.)
- Service Limit = 0.2 mm (.008 in.)
- Grinding Limit = Maximum of 0.2 mm (.008 in.) is permitted.

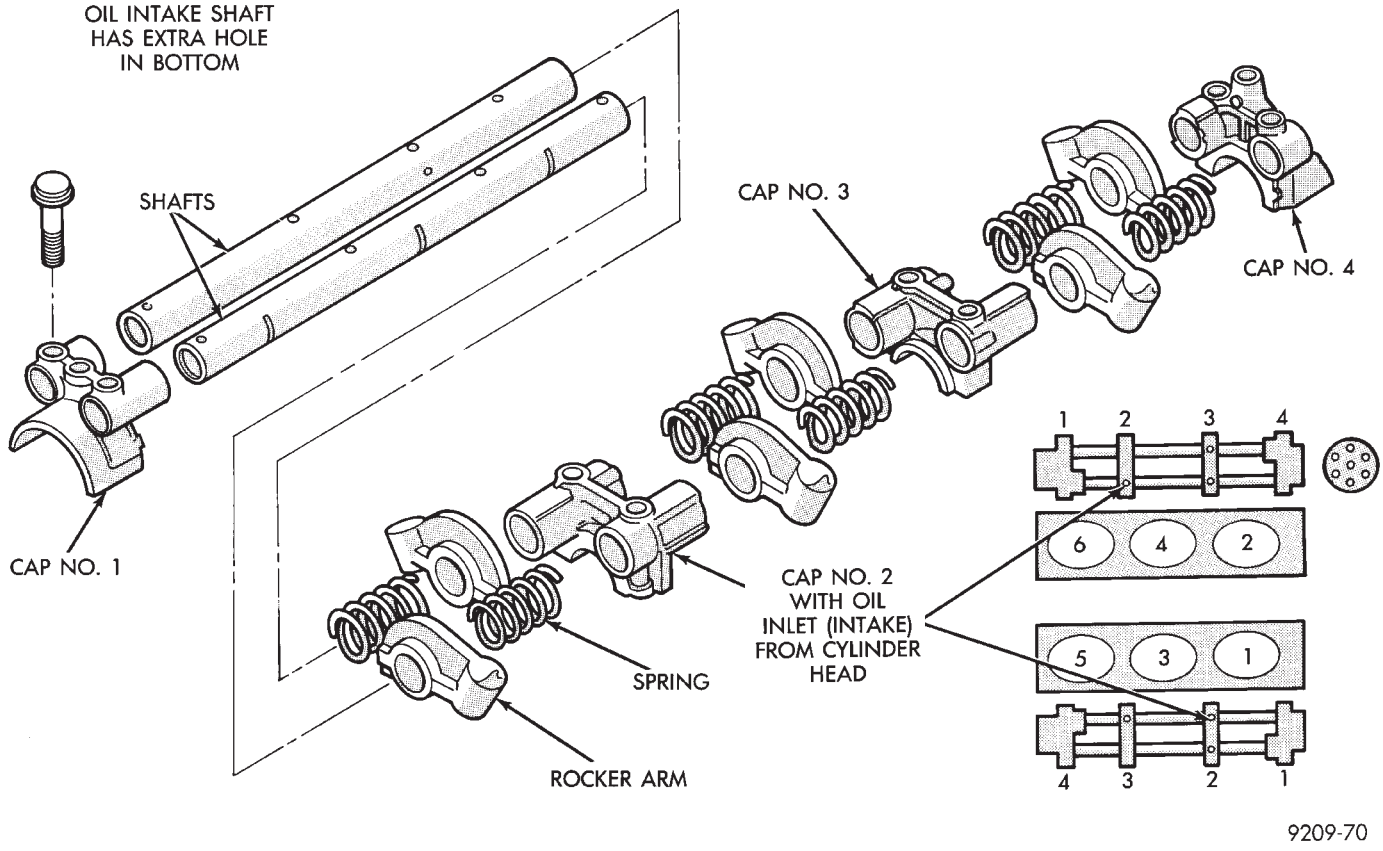


Fig. 73 Rocker Arm and Shafts

CLEANING AND INSPECTION (Continued)

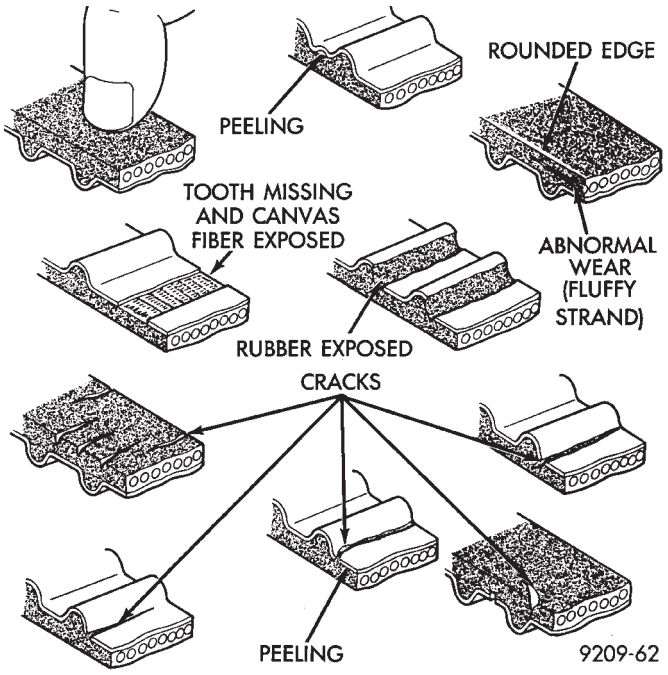
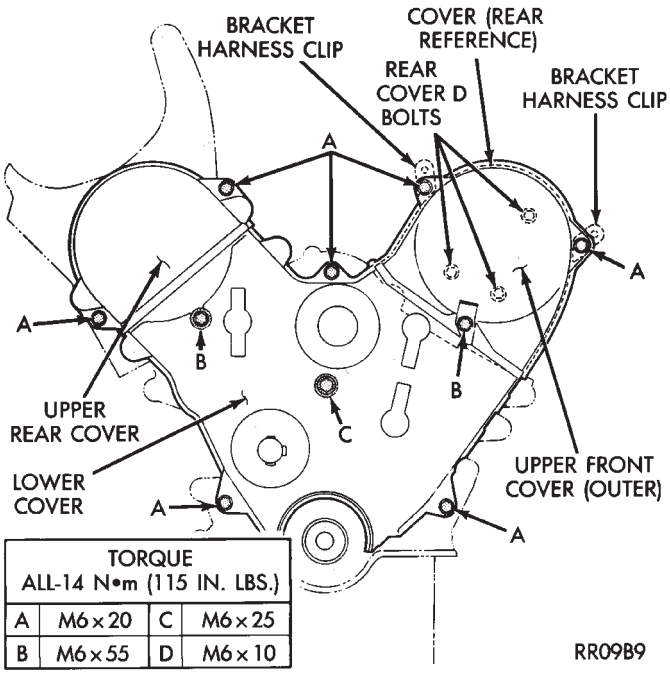


Fig. 74 Timing Belt Inspection



TORQUE ALL-14 N•m (115 IN. LBS.)			
A	M6 x 20	C	M6 x 25
B	M6 x 55	D	M6 x 10

Fig. 75 Timing Belt Covers

CAUTION: This is a combined total dimension of stock removal from cylinder head if any and block top surface.

CYLINDER BORE

INSPECTION

(1) Measure the cylinder bore at three levels in directions A and B (Fig. 77). Top measurement should be 12 mm (0.50 in.) down and bottom measurement should be 10 mm (0.38 in.) up.

(2) Standard bore dimension: 91.1 mm (3.587 in.)

(3) Maximum out-of-round or taper: 0.02 mm (0.0008 in.).

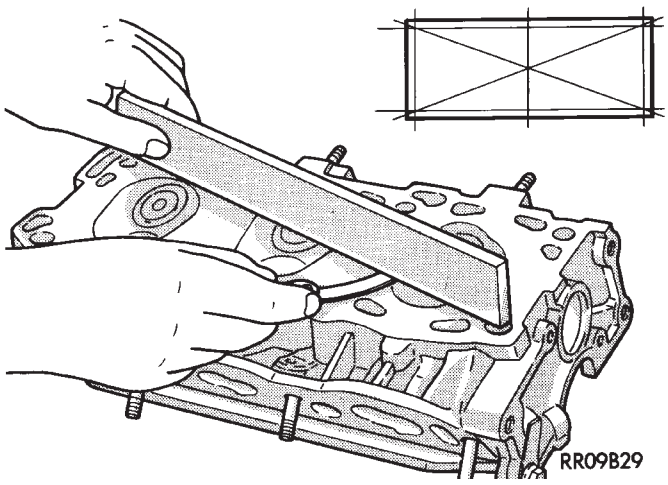


Fig. 76 Check Cylinder Head

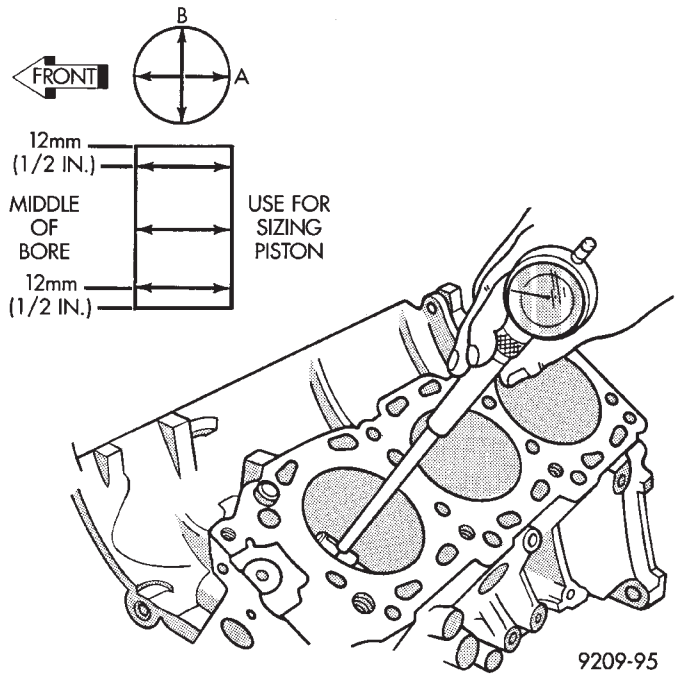


Fig. 77 Checking Cylinder Bore Size

OIL PUMP

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

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

(3) Measure clearance between case and inner rotor (Fig. 78).

(4) Insert the rotor into the oil pump case and measure clearance between outer rotor and case with a feeler gauge (Fig. 79). Replace if out of specifications.

CLEANING AND INSPECTION (Continued)

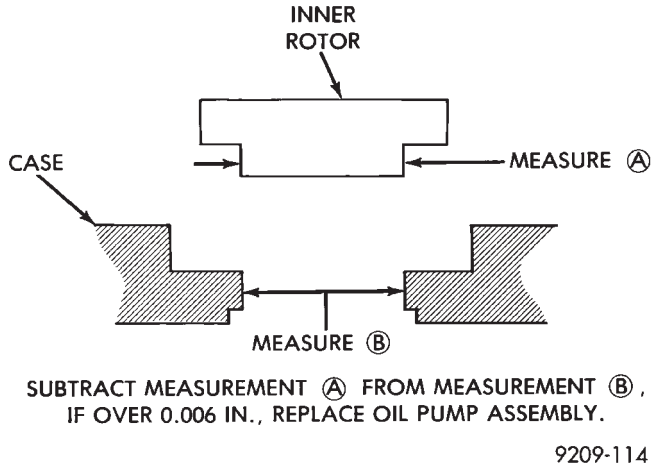


Fig. 78 Inner Rotor to Case

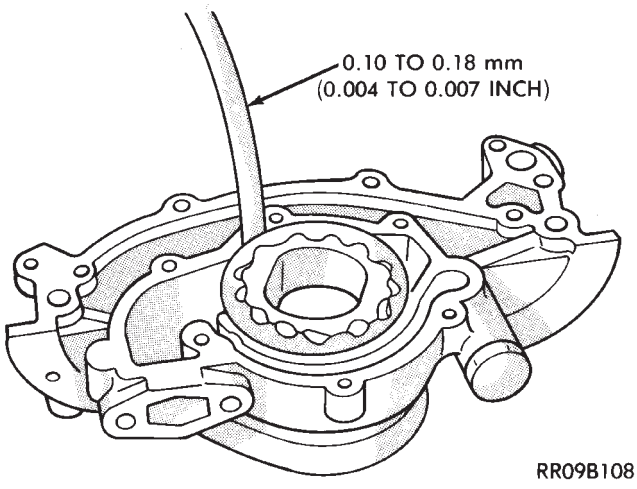


Fig. 79 Measuring Clearance Between Outer Rotor and Case

(5) Using a feeler gauge, measure clearance between inner rotor tip and outer rotor (Fig. 80). Clearance specification is: 0.06 - 0.18 mm (0.003 - 0.007 in.). Replace both rotors if not within specifications

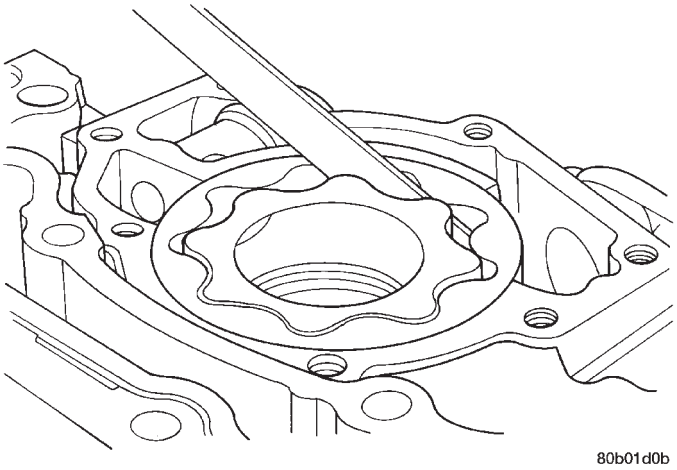


Fig. 80 Measuring Clearance Between Rotors

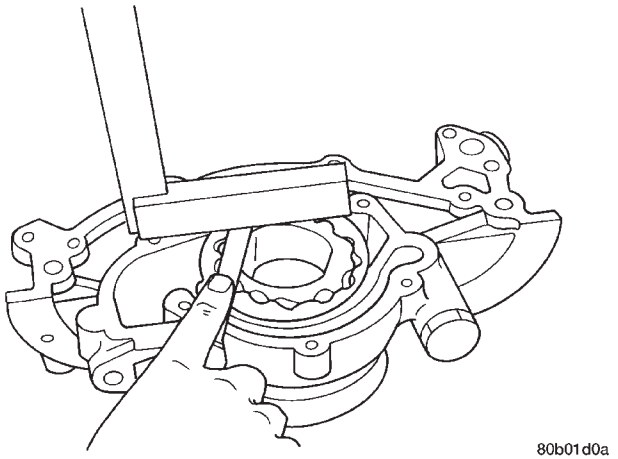


Fig. 81 Measuring Clearance Over Rotors

(6) Place a straightedge across face of pump housing (Fig. 81). Clearance specification is: 0.04 - 0.10 mm (0.0015 - 0.0039 in.). Replace oil pump assembly if not within specifications.

OIL RELIEF PLUNGER

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

(2) Check for broken relief spring.

ADJUSTMENTS

ENGINE MOUNTS

ENGINE MOUNT INSULATOR 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 mount insulator vertical fastener and the fore and aft fasteners, and the front engine mount bracket to front crossmember screws.

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

(4) Tighten engine mounts and fasteners in the following order:

(a) Right engine mount insulator vertical bolts to 102 N·m (75 ft. lbs.) and the fore and aft bolts to 150 N·m (110 ft. lbs.).

(b) Front engine mount screws to 54 N·m (40 ft. lbs.) the clearance between the snubbers and the engine should be 2 mm (0.078 inch.) each side.

(c) Left engine mount through bolt to 75 N·m (55 ft. lbs.).

(5) Recheck driveshaft length.

SPECIFICATIONS

3.0L ENGINE

Type . . . . . .60° V-6 SOHC
Number of Cylinders. 6
Bore . . . . . .91.1 mm (3.587 in.)
Stroke . . . . . .76 mm (2.992 in.)
Compression Ratio. 8.85:1
Displacement . . . . . .3.0L (181 Cubic in.)
Firing Order. 1–2–3–4–5–6
Basic Ignition Timing . . . . . .Refer to Emission Control Information Label on Vehicle
Compression Pressure . . . . . .1227 kPa (178 psi) @ 250 RPM
Maximum Variation Between Cylinders. 25%

Valve Timing

Intake Valve–Open . . . . . .19° BTDC
Intake Valve–Closed . . . . . .59° ABDC
Exhaust Valve–Open. . . . . .59° BBDC
Exhaust Valve–Closed . . . . . .19° ATDC

Cylinder Block

Cylinder Bore Diameter . . . . . .91.1 mm (3.587 in.)
Top Surface Flatness . . . . . .0.05 mm (0.002 in.)
Service Limit. . . . . .0.1 mm (0.0039 in.)
Grinding Limit of Top Surface*. . . . . .0.2 mm (0.008 in.)

*Includes/Combined with cylinder Head Grinding

Pistons

Piston Diameter . . . . . .91.06 - 91.09
Piston to Cylinder Clearance. . . . . .0.03 - 0.05 mm (0.0012 - 0.002 in.)
Piston Ring End Gap No. 1 . . . . . .0.30 - 0.45 mm (0.012 - 0.018 in.)
Service Limit. . . . . .0.8 mm (0.031 in.)
Piston Ring End Gap No. 2 . . . . . .0.45 - 0.60 mm (0.018 - 0.024 in.)
Service Limit. . . . . .0.8 mm (0.031 in.)
Piston Ring End Gap Oil Control . .0.20 - 0.60 mm (0.008 - 0.024 in.)
Service Limit. . . . . .1.0 mm (0.039 in.)
Ring Side Clearance No. 1. . . . . .0.030 - 0.090 mm (0.002 - 0.0035 in.)
Service Limit. . . . . .1.0 mm (0.039 in.)
Ring Side Clearance No. 2. . . . . .0.040 - 0.085 mm (0.0016 - 0.0033 in.)
Service Limit. . . . . .1.0 mm (0.039 in.)
Oversize Service Pistons . . . . . .0.25 - 0.50 mm (0.010 - 0.020 in.), 0.75 - 1.00 mm (0.030 - 0.039 in.)

Connecting Rods

Bearing Clearance . . . . . .0.018 - 0.036 mm (0.0007 - 0.0014 in.)
Side Clearance . . . . . .0.10 - 0.25 mm (0.004 - 0.010 in.)
Wear Limit . . . . . .0.4 mm (0.015 in.)
Length–Center to Center . . . . . .140.9 - 141.0 mm (5.547 - 5.551 in.)
Parallelism–Twist . . . . . .0.05 mm (0.0019 in.)
Torsion . . . . . .0.1 mm (0.0039 in.)

Crankshaft

Main Journal Diameter . . . . . .59.980 - 60.0 mm (2.361 - 2.362 in.)
Connecting Rod Journal Diameter . . . . . .49.980 - 50.000 mm (1.968 - 1.969 in.)
Out-of-Round (Max.). . . . . .0.03 mm (0.001 in.)
Taper (Max.) . . . . . .0.005 mm (0.0002 in.)
Main and Rod Bearing Clearance . . . . . .0.018 - 0.036 mm (0.0007 - 0.0014 in.)
Undersize Service Bearings . . . . . .0.25 - 0.50 - 0.75 mm (0.010 - 0.020 - 0.030 in.)
End Play . . . . . .0.05 - 0.25 mm (0.002 - 0.010 in.)
Service Limit. . . . . .0.3 mm (0.012 in.)

Cylinder Head

Flatness of Gasket Surface. . . .0.05 mm (0.002 in.)
Grinding Limit of Gasket Surface . . . . . .0.2 mm (0.008 in.)

Cylinder Head Valve Seat

Angle–Intake and Exhaust . . . . . .44° - 44°.3'
Contact Width. . . . . .0.9 - 1.3 mm (0.035 - 0.051 in.)
Sinkage–Service Limit . . . . . .0.2 mm (0.078 in.)
Guide Bore Diameter (Std) . . . . . .7.95 - 7.98 mm (0.313 - 0.314 in.)

Valves

Face Angle . . . . . .45° - 45° 30'
Head Diameter Intake. . . . . .48.64 - 48.90 mm (1.915 - 1.925 in.)
Head Diameter Exhaust . . . . . .40.01 - 40.26 mm (1.575 - 1.585 in.)
Length Intake (Overall) . . . . .103.0 mm (4.055 in.)
Length Exhaust (Overall). . . .102.7 mm (4.043 in.)
Valve Margin–Intake . . . . . .1.2 mm (0.047 in.)
Service Limit. . . . . .0.7 mm (0.027 in.)
Valve Margin–Exhaust. . . . . .2.0 mm (0.079 in.)
Service Limit. . . . . .1.5 mm (0.059 in.)
Valve Stem Tip Height . . . . . .49.02 mm (1.929 in.)
Stem Diameter–Intake . . . . . .7.960 - 7.975 mm (0.313 - 0.314 in.)
Stem Diameter–Exhaust . . . . . .7.930 - 7.950 mm (0.312 - 0.3125 in.)
Stem-to-Guide Clearance–Intake. . .0.03 - 0.06 mm (0.001 - 0.002 in.)
Service Limit. . . . . .0.10 mm (0.004 in.)
Stem-to-Guide Clearance–Exhaust . . . . . .0.05 - 0.09 mm (0.0019 - 0.003 in.)

SPECIFICATIONS (Continued)

Service Limit. . . . . .0.15 mm (0.006 in.)

Valve Guide

Overall Length–Intake . . . . . .44 mm (1.732 in.)
Overall Length–Exhaust . . . . . .48 mm (1.889 in.)
Outside Diameter. . . . . .13.055 - 13.065 mm (0.514 - 0.5143 in.)
Inside Diameter. . . . . .8.000 - 8.018 mm (0.314 - 315 in.)

Valve Springs

Free Length (Approx.) . . . . . .49.8 mm (1.960 in.)
Service Limit. . . . . .48.8 mm (1.9213 in.)
Loaded Height . . . . . .40.4 mm @ 33 kg (1.59 in. @73 lbs.)
Perpendicularity–Intake and Exhaust . . .2° (Max.)
Service Limit. . . . . .4° (Max.)

Oil Pump

Clearance Over Rotors (Max.).0.077 mm (0.003 in.)
Cover Out-of-Flat (Max.). . . . .0.076 mm (0.003 in.)
Inner Rotor Thickness (Min.) .18.92 mm (0.744 in.)

Outer Rotor (Oil Pump)

Clearance (Max.) . . . . . .0.19 mm (0.007 in.)
Diameter (Min.) . . . . . .82.45 mm (3.246 in.)
Thickness (Min.). . . . . .18.92 mm (0.744 in.)
Tip Clearance Between Rotors (Max.) . . .0.150 mm (0.0068 in.)

Oil Pressure

At Curb Idle Speed***** . . . . . .68.9 kPa (10 psi)
At 3000 rpm . . . . . .310 - 517 kPa (45 - 75 psi)

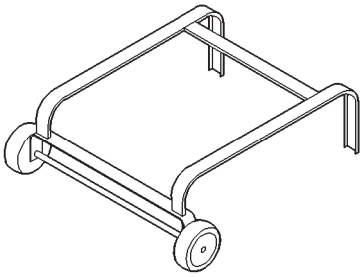
CAUTION: * If pressure is ZERO at curb Idle, DO NOT run engine at 3,000 rpm.

TORQUE CHART 3.0L

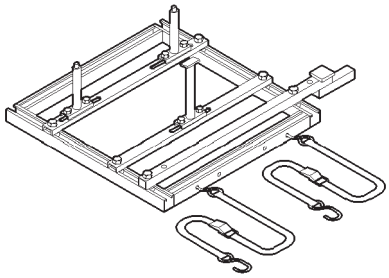
DESCRIPTION	TORQUE
Camshaft Bearing Cap	
Bolts. . .Refer to procedure outlined in this section.	
Camshaft Sensor Pick Up	
Bolts	.27 N·m (20 ft. lbs.)
Timing Belt Cover	
Outer to Inner Attaching Bolts	.4.5 N·m (40 in. lbs.)
Inner Cover to Head/Oil Pump Bolts	.12 N·m (105 in. lbs.)
Camshaft Sprocket	
Bolt	.95 N·m (70 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.)
M11 Main Cap Bolts	.41 N·m (30 ft. lbs.) Plus 1/4 Turn
Crankshaft Vibration 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.)
Engine Mount—Front and Rear	
Through Bolt	.61 N·m (45 ft. lbs.)
Exhaust Manifold to Cylinder Head	
Bolts	.23 N·m (200 in. lbs.)
Exhaust Manifold Heat Shield	
Bolts	.12 N·m (105 in. lbs.)
Intake Manifold	
Bolts	.27 N·m (20 ft. lbs.)
Oil Filter to Engine Block Adapter	
Bolts	.55 N·m (40 ft. lbs.)
Oil Filter	
Filter	.20 N·m (15 ft. lbs.)
Oil Pan	
Oil Pan Bolts	.12 N·m (105 in. lbs.)
Drain Plug.	.39 N·m (29 ft. lbs.)
Oil Pump Attaching	
Bolts	.15 N·m (130 in. lbs.)
Oil Pump Cover Fastener	.9 N·m (104 in. lbs.)
Oil Pump Pick-up Tube Bolt	.28 N·m (250 in. lbs.)
Oil Pump Relief Valve Cap	.49 N·m (36 ft. lbs.)
Spark Plugs	
Plugs	.28 N·m (20 ft. lbs.)
Thermostat Housing	
Bolts	.23 N·m (200 in lbs.)
Timing Belt Tensioner	
Bolt	.28 N·m (20 ft. lbs.)
Timing Belt Tensioner Pulley Assembly	
Bolt	.41 N·m (30 ft. lbs.)
Water Pump Mounting	
Bolts	.12 N·m (105 in. lbs.)

SPECIAL TOOLS

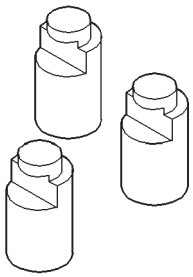
3.0L ENGINE



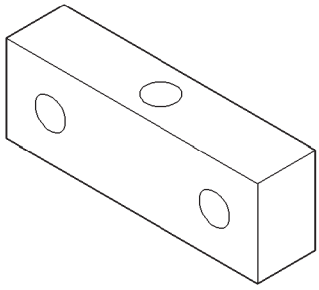
Dolly 6135



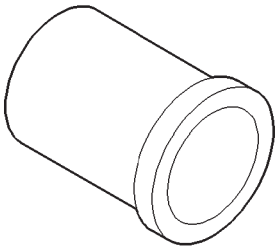
Cradle 6710



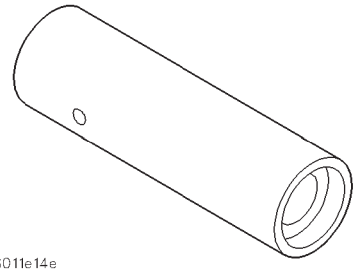
Adaptor 6909



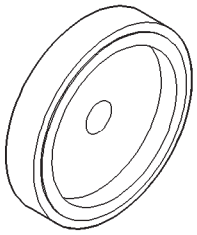
Adaptor 6910



Camshaft End Plug Installer MD-998306

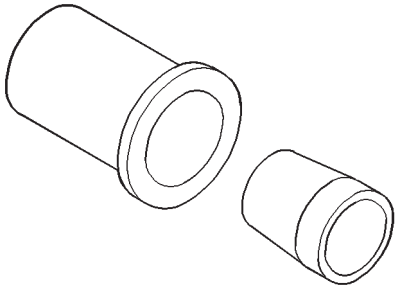


Valve Stem Seal Installer MD-998729

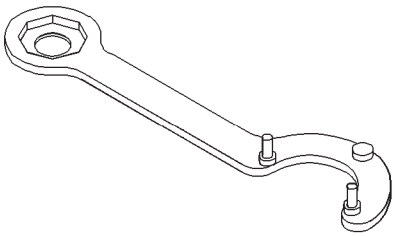


Rear Crankshaft Seal Installer MD-998718

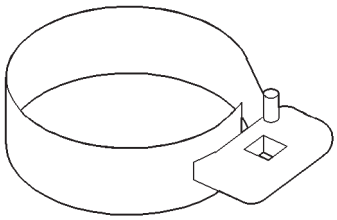
SPECIAL TOOLS (Continued)



Front Crankshaft Seal Installer MD-998717



Spanner Camshaft Sprocket MB-990775



8011d480

Oil Filter Wrench C-4065

3.3/3.8L ENGINE

INDEX

page

DESCRIPTION AND OPERATION
ENGINE COMPONENTS 93
ENGINE IDENTIFICATION 93
ENGINE LUBRICATION SYSTEM 93
DIAGNOSIS AND TESTING
CHECKING ENGINE OIL PRESSURE 96
HYDRAULIC TAPPETS 94
SERVICE PROCEDURES
CRANKSHAFT END PLAY 99
FITTING CONNECTING ROD BEARINGS 97
FITTING MAIN BEARINGS 98
FITTING PISTONS AND RINGS 97
MEASURING TIMING CHAIN FOR STRETCH . . . 96
VALVE SERVICE RECONDITION 100
VALVE TIMING 96
REMOVAL AND INSTALLATION
CAMSHAFT BEARINGS 114
CAMSHAFT 113
CRANKSHAFT DAMPER 106
CRANKSHAFT OIL SEAL—FRONT 117
CRANKSHAFT OIL SEAL—REAR 118
CRANKSHAFT 116
CYLINDER HEAD COVER 107
CYLINDER HEAD 108
ENGINE ASSEMBLY 104
ENGINE MOUNTS 102
ENGINE OIL GALLERY PLUGS 119

page

OIL FILTER 119
OIL PAN 114
PISTON AND CONNECTING ROD 115
ROCKER ARMS AND SHAFT ASSEMBLY 106
TAPPET REMOVAL 110
TIMING CHAIN COVER 111
TIMING CHAIN 112
VALVE STEM SEALS OR SPRINGS, CYLINDER HEAD NOT REMOVED 106
VALVES AND VALVE SPRINGS 109
WIPER UNIT 102
DISASSEMBLY AND ASSEMBLY
HYDRAULIC TAPPETS 120
OIL PUMP 119
CLEANING AND INSPECTION
CYLINDER HEAD 120
ENGINE BLOCK AND BORE 121
OIL PAN 121
OIL PUMP 121
ADJUSTMENTS
ENGINE MOUNTS 123
SPECIFICATIONS
3.3/3.8L ENGINE 123
TORQUE CHART 125
SPECIAL TOOLS
3.3/3.8L ENGINE 127

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).

ENGINE LUBRICATION SYSTEM

The lubrication system is a full flow filtration pressure feed type. Oil from the oil pan is pumped by a internal gear type oil pump directly coupled to the crankshaft. The pressure is regulated by a relief valve located in the chain case cover. The oil is pumped through an oil filter and feeds a main oil galley. This oil gallery feeds oil under pressure to the main and rod bearings, camshaft bearings. Passages in the cylinder block feed oil to the hydraulic lifters and rocker shaft brackets which feeds the rocker arm pivots (Fig. 2).

ENGINE COMPONENTS

ENGINE: The 3.3L (201 Cubic Inches) and 3.8L (231 Cubic Inches) displacement engines are 60° V type six cylinder power plants with cast iron cylinder blocks and aluminum cylinder heads (Fig. 3). Firing order for these engines is 1-2-3-4-5-6. High turbulence cylinder heads allow a 8.9-1 compression ratio.

CRANKSHAFT: The nodular iron crankshaft is supported by four main bearings, with number two being the thrust bearing. Crankshaft end sealing is provided by front and rear rubber seals.

PISTONS: The pistons are cast aluminum alloy. Three rings are used. Piston pins, press fitted into place, join the pistons to forged steel connecting rods.

CAMSHAFT: The nodular iron camshaft is mounted in four steel backed babbitt bearings. A thrust plate located in front of the first bearing, and bolted to the block, controls end play. Silent timing chain drives the camshaft. This chain is enclosed by a cast aluminum cover which also carries a front

DESCRIPTION AND OPERATION (Continued)

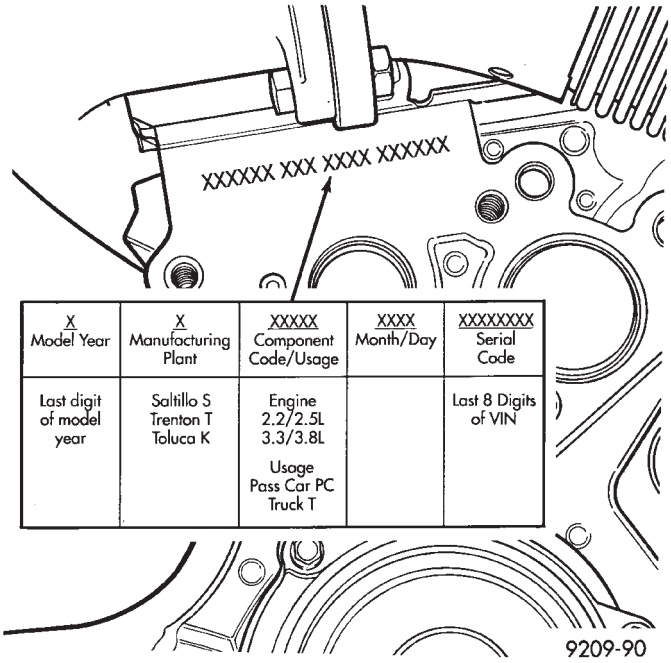


Fig. 1 Engine Identification

crankshaft seal, provides front oil pan closure, water pump mounting.

CYLINDER HEADS: Cylinder heads are designed to create high flow combustion chambers to improve performance, while minimizing the change to the burn rate of the chamber. Valve seat and guides are inserts. A steel flanged composition type gasket is used between head and block.

CYLINDER HEAD COVERS: The covers are sealed with steel reinforced silicon rubber gaskets.

INTAKE MANIFOLD: The intake manifold is a tuned two-piece semi-permanent mold aluminum casting with individual primary runners leading from a plenum to the cylinders. The manifold is designed to boost torque in the 3600 rpm range and contributes to the engine's broad, flat torque curve, which was desired for excellent engine tractability, response and usable power output.

The intake manifold is also cored with upper level EGR passages for balanced cylinder to cylinder EGR distribution.

VALVE TRAIN: Valve train design incorporates the use of hydraulic roller tappets. Rocker arms are installed on a rocker arm shaft attached to the cylinder head with four bolts and retainers. Viton valve stem seals provide valve sealing. Conventional type pushrods, retainers and valve stem locks are used. Unique beehive style valve spring are used with lightweight retainers for improved high RPM performance.

EXHAUST MANIFOLDS: Exhaust manifolds are log type with a crossover and is attached directly to the cylinder heads.

DIAGNOSIS AND TESTING

HYDRAULIC TAPPETS

The valve train includes roller tappet assemblies, aligning yokes and yoke retainer.

Roller tappet alignment is maintained by machined flats on tappet body being fitted in pairs into six

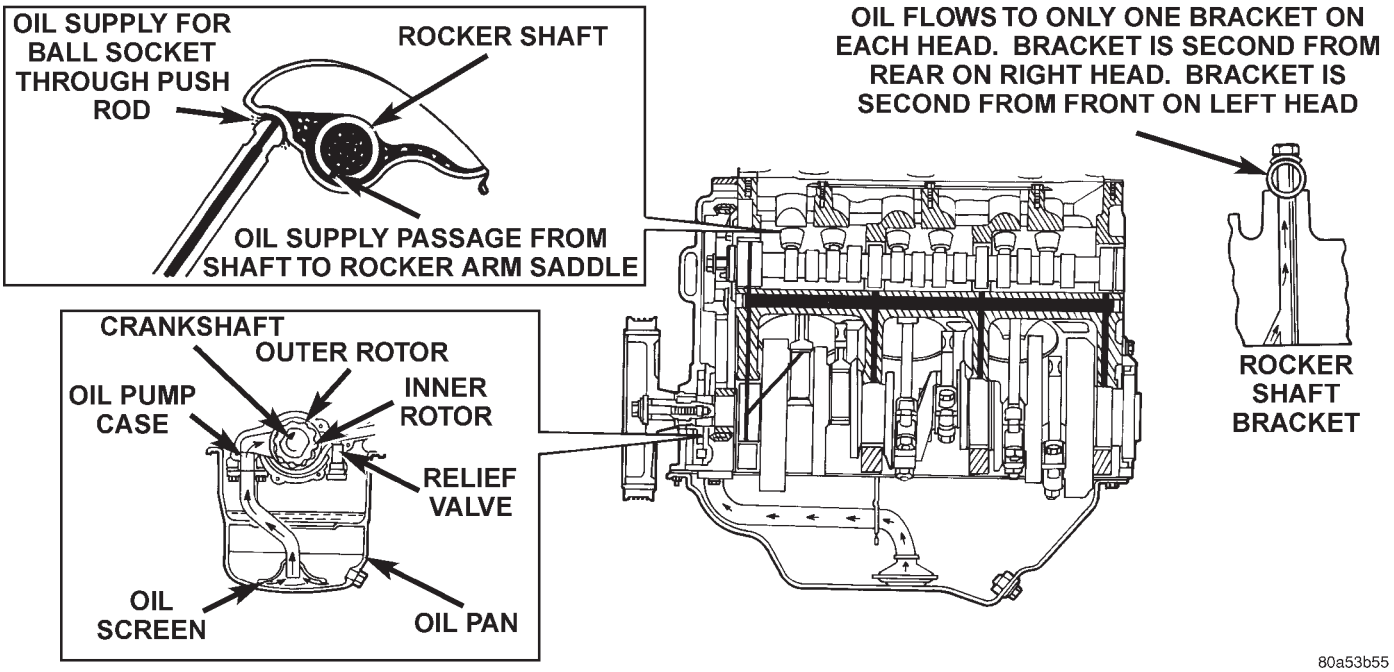


Fig. 2 Engine Oiling System

DIAGNOSIS AND TESTING (Continued)

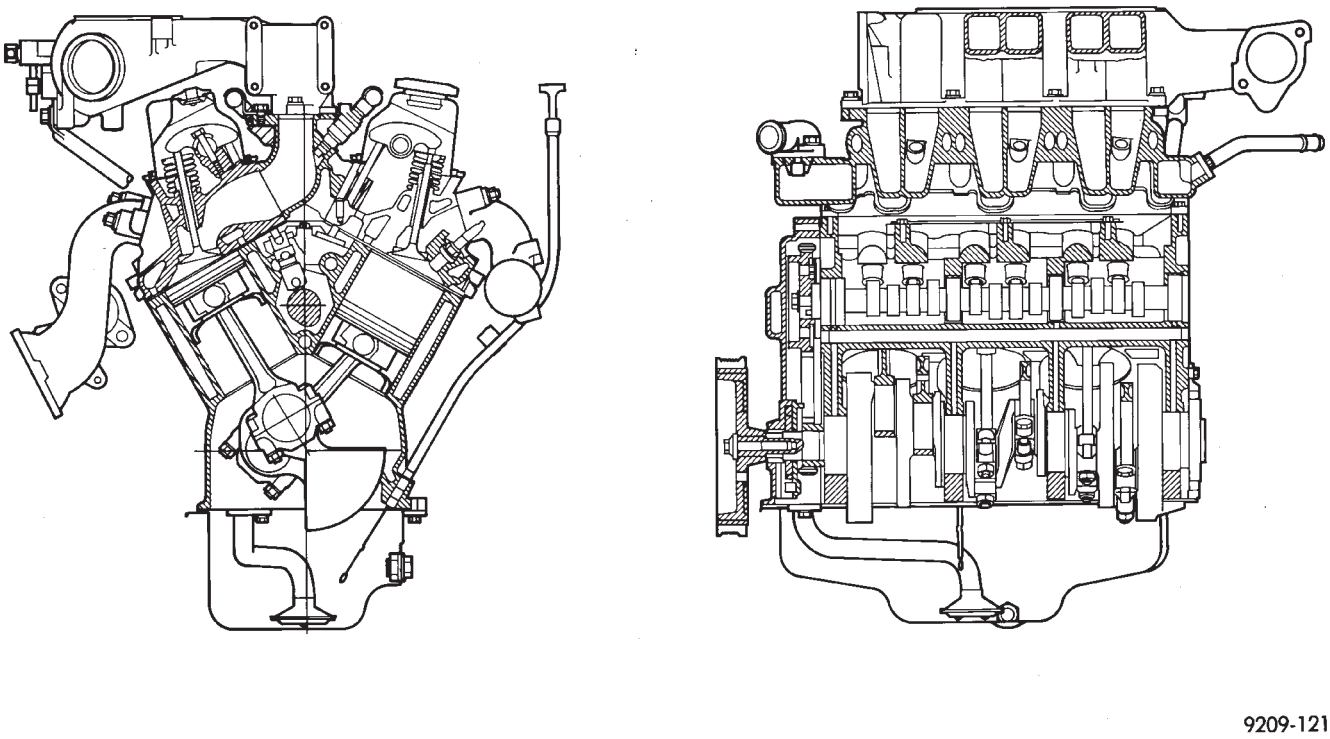


Fig. 3 3.3/3.8L V-6 Engines

aligning yokes. The yokes are secured by an alignment yoke retainer (Fig. 4).

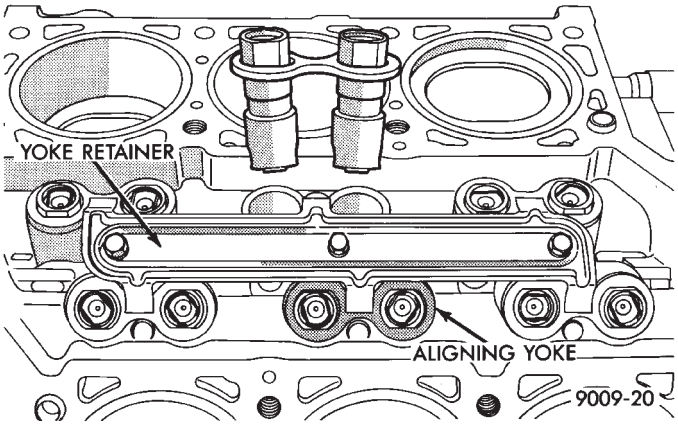


Fig. 4 Roller Tappets Aligning Yoke and Retainer

PRELIMINARY STEP TO CHECKING THE HYDRAULIC TAPPETS

Before disassembling any part of the engine to correct tappet noise, read the oil pressure at the gauge. Install a reliable gauge at pressure sending unit if vehicle has no oil pressure gauge and check the oil level in the oil pan. The pressure should be between 30 and 80 psi (206.8 to 551.6 kPa) at 2000 rpm.

The oil level in the pan should never be above the MAX mark on dipstick, or below the MIN mark. Either of these two conditions could be responsible for noisy tappets. **Oil Level Check: stop engine after reaching normal operating temperature**. Allow 5 minutes to stabilize oil level, check dipstick.

OIL LEVEL TOO HIGH

If oil level is above the MAX mark on dip stick, it is possible for the connecting rods to dip into the oil while engine is running and create foam. Foam in oil pan would be fed to the hydraulic tappets by the oil pump causing them to become soft and allow valves to seat noisily.

OIL LEVEL TOO LOW

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

VALVE TRAIN NOISE DIAGNOSIS

To determine source of valve train noise, operate engine at idle with cylinder head covers removed and listen for source of the noise.

DIAGNOSIS AND TESTING (Continued)

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

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

CHECKING ENGINE OIL PRESSURE

Check oil pressure using gauge at oil pressure switch location. Oil pressure should be 34.47 kPa (5 psi.) at idle or 205 to 551 kPa (30 to 80 psi.) at 3000 RPM.

(1) Remove pressure sending unit and install oil pressure gauge (Fig. 5).

CAUTION: If oil pressure is 0 at idle, do not run engine at 3000 RPM.

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

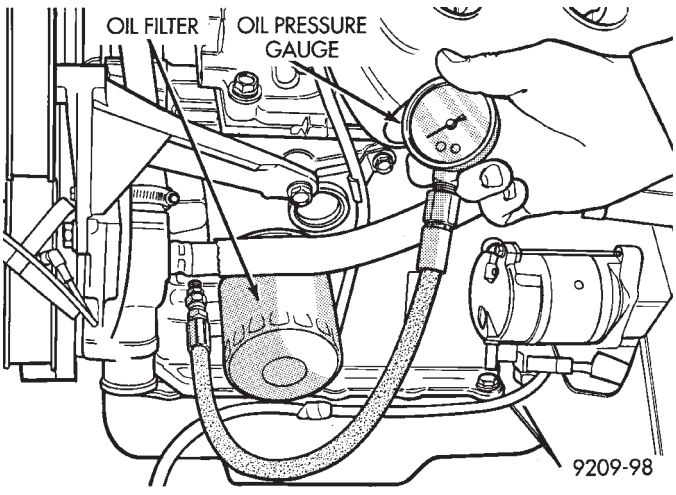


Fig. 5 Checking Oil Pump Pressure

SERVICE PROCEDURES

VALVE TIMING

(1) Remove front cylinder head cover and all 6 spark plugs.

(2) Rotate engine until the #2 piston is at TDC of the compression stroke.

(3) Install a degree wheel on the crankshaft pulley.

(4) With proper adaptor, install a dial indicator into #2 spark plug hole. Using the indicator find TDC on the compression stroke.

(5) Position the degree wheel to zero.

(6) Remove dial indicator from spark plug hole.

(7) Place a 5.08 mm (0.200 in.) spacer between the valve stem tip of #2 intake valve and rocker arm pad. Allow tappet to bleed down to give a solid tappet effect.

(8) Install a dial indicator so plunger contacts the #2 intake valve spring retainer as nearly perpendicular as possible. Zero the indicator.

(9) Rotate the engine clockwise until the intake valve has lifted .254 mm (0.010 in.).

CAUTION: Do not turn crankshaft any further clockwise as intake valve might bottom and result in serious damage.

(10) Degree wheel should read 6 degrees BTDC to 6 degrees ATDC.

MEASURING TIMING CHAIN FOR STRETCH

(1) Place a scale next to timing chain so that any movement of chain may be measured.

(2) Place a torque wrench and socket on camshaft sprocket attaching bolt and apply torque in direction of crankshaft rotation to take up slack; 41 N·m (30 ft. lb.) with cylinder head installed or 20 N·m (15 ft. lb.) with cylinder heads removed. **With a torque applied to the camshaft sprocket bolt, crankshaft should not be permitted to move. It may be necessary to block crankshaft to prevent rotation.**

(3) Holding a scale even, with dimension reading as shown (Fig. 6), along edge of chain links. Apply torque in the reverse direction to 41 N·m (30 ft. lbs.) with cylinder heads installed, or 20 N·m (15 ft. lbs.) with cylinder heads removed. Check amount of chain movement.

(4) Install a new timing chain, if its movement exceeds 3.175 mm (1/8 inch).

(5) If chain is not satisfactory, refer to Timing Chain Removal and Installation in this section.

SERVICE PROCEDURES (Continued)

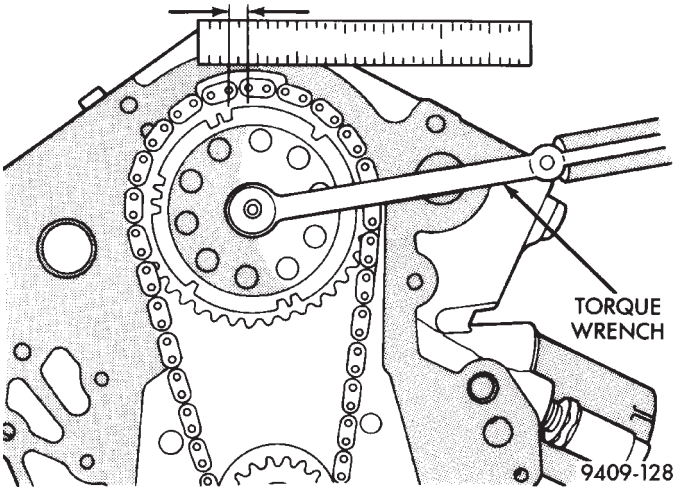


Fig. 6 Measuring Timing Chain Wear and Stretch

FITTING PISTONS AND RINGS

FITTING PISTONS

The piston and cylinder wall must be clean and dry. Piston diameter should be measured 90 degrees to piston pin at size location shown in (Fig. 8). Cylinder bores should be measured halfway down the cylinder bore and transverse to the engine crankshaft center line shown in (Fig. 7). Refer to Cylinder Bore and Piston Specification Chart. **Pistons and cylinder bores should be measured at normal room temperature, 70°F (21°C).**

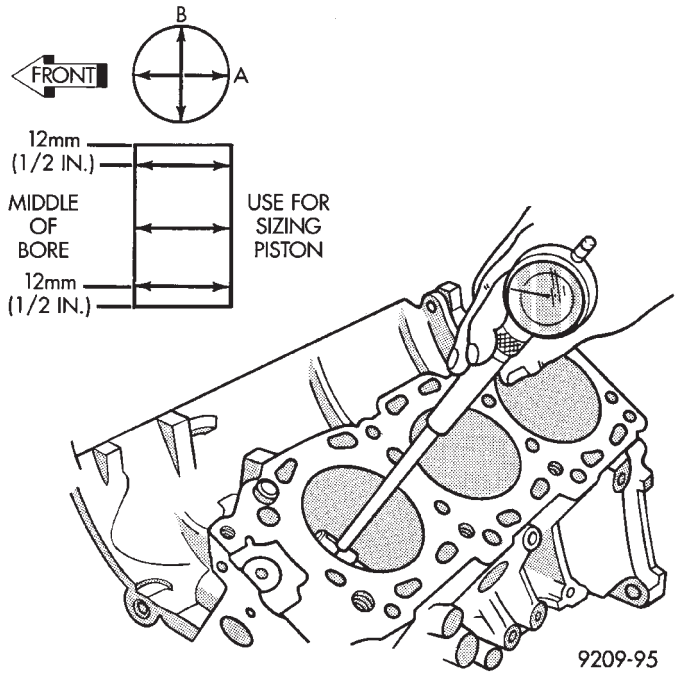


Fig. 7 Checking Cylinder Bore Size

FITTING RINGS

(1) Wipe cylinder bore clean. Insert ring and push down with piston to ensure it is square in bore. The ring gap measurement must be made with the ring positioning at least 12 mm (0.50 in.) from bottom of cylinder bore. Check gap with feeler gauge (Fig. 9). Refer to Piston Ring Specification Chart.

(2) Check piston ring to groove clearance: (Fig. 10). Refer to Piston Ring Specification Chart.

CYLINDER BORE AND PISTON SPECIFICATION CHART

Engine	Standard Bore	Maximum Out-Of-Round	Maximum Taper
3.3L	92.993 - 93.007 mm (3.661 - 3.6617 in.)	0.076 mm (0.003 in.)	0.51 mm (0.002 in.)
3.8L	95.993 - 96.007 mm 3.7792 - 3.780 in.	Same	Same
Standard Piston Size			
3.3L	92.950 - 92.968 mm (3.6594 - 3.6602 in.)		
3.8L	95.950 - 95.968 mm (3.7776 - 3.7783 in.)		
Piston to Bore Clearance: 0.025 - 0.057 mm (0.0009 - 0.0022 in.) Measurements taken at Piston Size Location.			

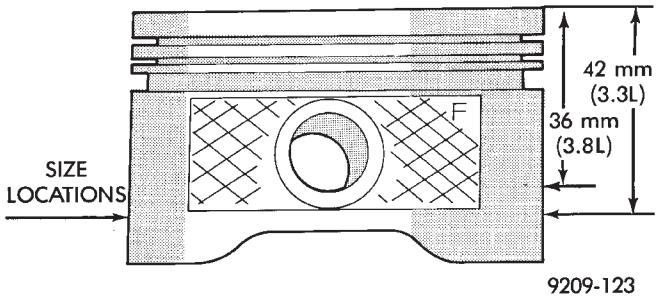


Fig. 8 Piston Measurements

FITTING CONNECTING ROD BEARINGS

Fit all rods on one bank until complete.

The bearing caps are not interchangeable and should be marked at removal to insure correct assembly.

The bearing shells must be installed with the tangs inserted into the machined grooves in the rods and caps. Install cap with the tangs on the same side as the rod.

Limits of taper or out-of-round on any crankshaft journals should be held to 0.025 mm (0.001 in.). Bearings are available in 0.025 mm (0.001 in.) and 0.250 mm (0.010 in.) undersize. **Install the bearings in pairs. Do not use a new bearing half**

SERVICE PROCEDURES (Continued)

PISTON RING SPECIFICATION CHART

Ring Position	Ring Gap	Wear Limit	Groove Clearance	Maximum Clearance
Upper Ring	0.30 - 0.55 mm (0.012 - 0.022 in.)	1.0 mm (0.039 in.)	0.030 - 0.085 mm (0.001 - 0.003 in.)	0.10 mm (0.004 in.)
Intermediate Ring	0.30 - 0.55 mm (0.012 - 0.022 in.)	1.0 mm (0.039 in.)	0.030 - 0.095 mm (0.001 - 0.0037 in.)	0.10 mm (0.004 in.)
Oil Control Ring	0.25 - 1.00 mm (0.010 - 0.039 in.)	1.88 mm (0.074 in.)	0.014 - 0.266 mm (0.0005 - 0.009 in.)	0.266 mm (0.009 in.)

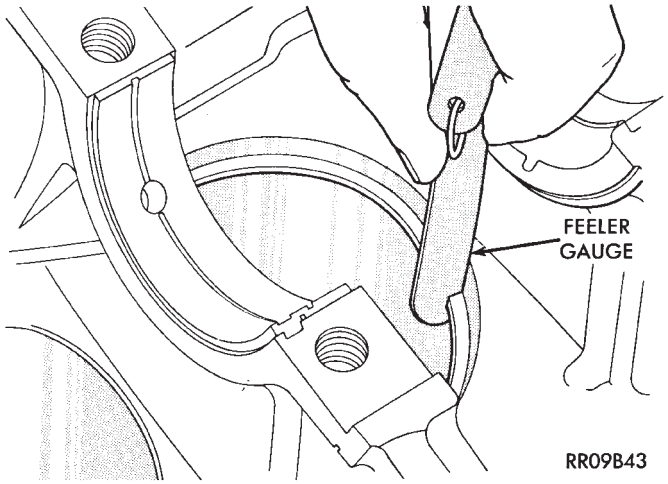


Fig. 9 Check Gap on Piston Rings

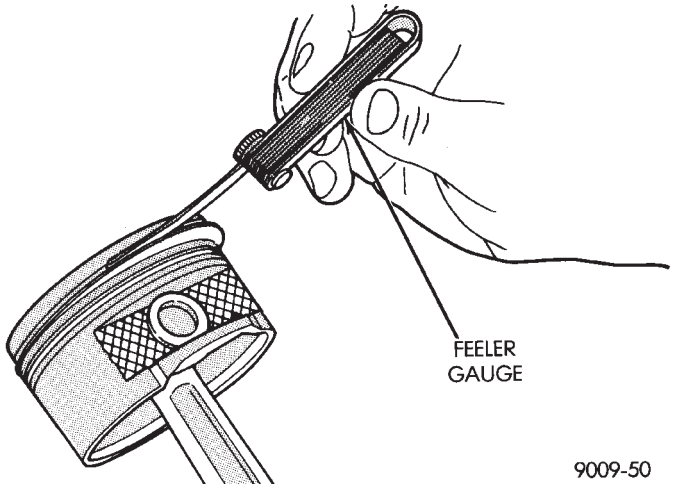


Fig. 10 Measuring Piston Ring Side Clearance

with an old bearing half. Do not file the rods or bearing caps.

(1) Follow procedure specified in the Standard Service Procedure Section for Measuring Main Bearing Clearance and Connecting Rod Bearing Clearance (Fig. 11).

NOTE: The rod bearing bolts should be examined before reuse. If the threads are necked down the bolts should be replaced (Fig. 13). 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.

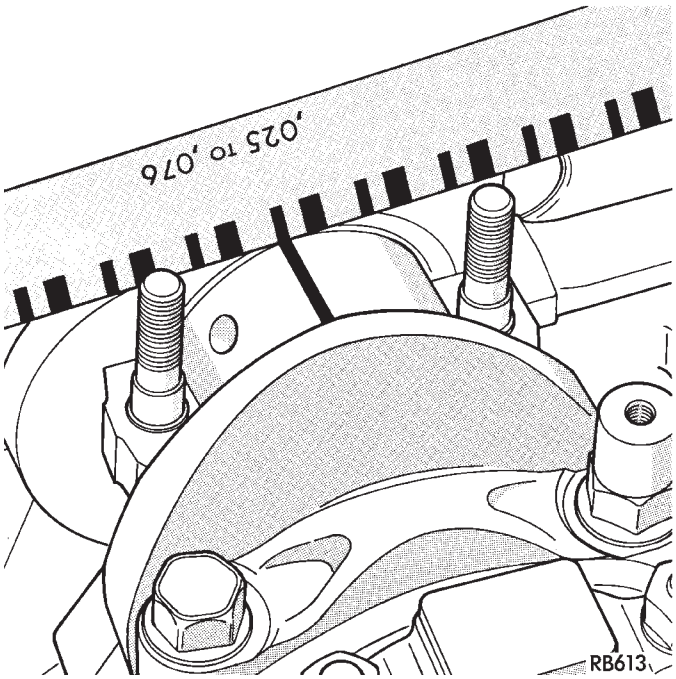


Fig. 11 Checking Connecting Rod Bearing Clearance

(2) Before installing the nuts the threads should be oiled with engine oil.

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

(4) Tighten the nuts to 54 N·m PLUS 1/4 turn (40 ft. lbs. PLUS 1/4 turn).

(5) Using a feeler gauge, check connecting rod side clearance (Fig. 12). Refer to Connecting Rod Specification Chart.

FITTING MAIN BEARINGS

CRANKSHAFT OIL CLEARANCE

Measure the journal outside diameter as shown in (Fig. 14). Refer to Crankshaft Specification Chart.

SERVICE PROCEDURES (Continued)

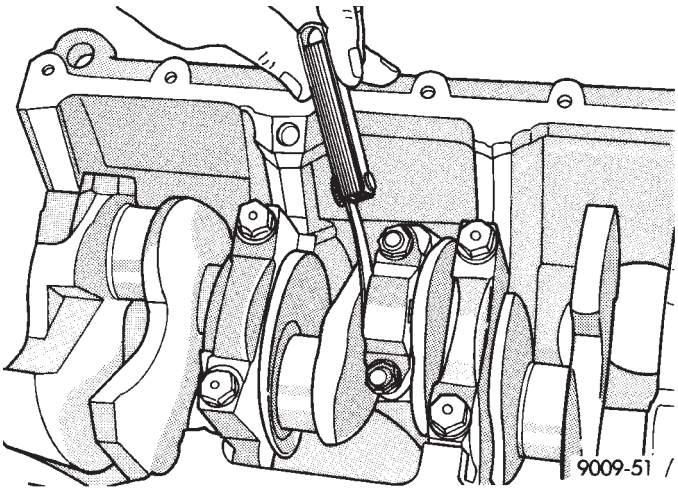


Fig. 12 Checking Connecting Rod Side Clearance

CONNECTING ROD SPECIFICATION CHART

Connecting Rod Bearing Clearance	
New Part:	0.019 - 0.073 mm (0.0008 - 0.0029 in.)
Wear Limit:	0.074 mm (0.003 in.)
Connecting Rod Side Clearance	
New Part:	0.13 - 0.32 mm (0.005 - 0.013 in.)
Wear Limit:	0.38 mm (0.015 in.)

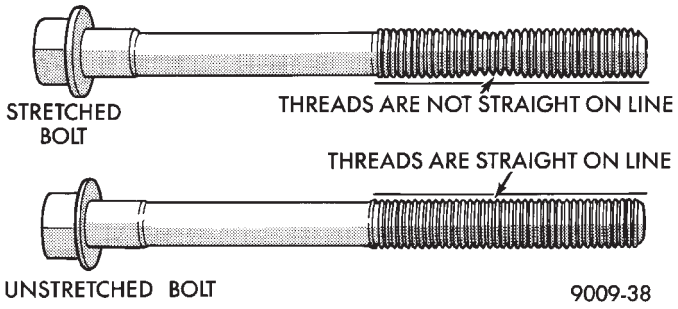


Fig. 13 Check for Stretched (Necked) Bolts

PLASTIGAGE (OIL CLEARANCE) 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. 15).

(4) Install the main bearing cap carefully and tighten the bolts to specified torque.

CAUTION: Do not rotate crankshaft or the plastigage will be smeared.

CRANKSHAFT SPECIFICATION CHART

Crankshaft End-Play	
New Part:	0.09 - 0.24 mm (0.0036 - 0.0095 in.)
Wear Limit:	0.38 mm (0.015 in.)
Main Bearing Clearance	
New Part:	0.011 - 0.059 mm (0.0005 - 0.0024 in.)
Wear Limit:	0.076 mm (0.003 in.)
Crankshaft Main Bearing Journal	
Standard Size:	63.992 - 64.013 mm (2.5194 - 2.5202 in.)
Crankshaft Connecting Rod Journal	
Standard Size:	57.989 - 58.005 mm (2.2831 - 2.2837 in.)

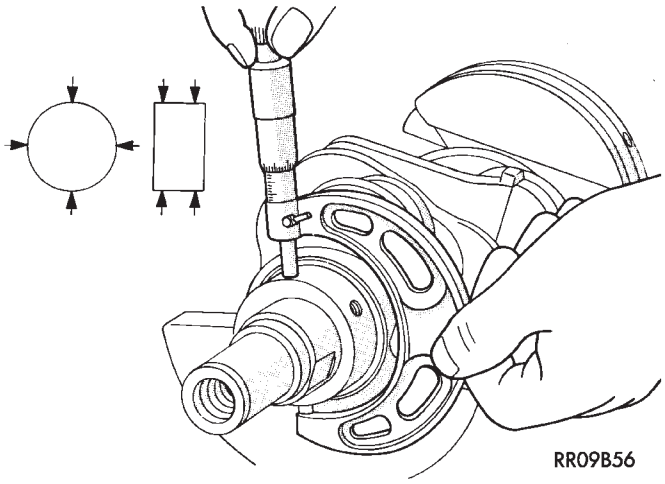


Fig. 14 Measure Crankshaft Journal O.D.

(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. 15). Refer to Crankshaft Specification Chart for proper clearances. If the clearance exceeds the specified limits, replace the main bearing(s) and if necessary, have the crankshaft machined to next undersize.

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

CRANKSHAFT END PLAY

DIAL INDICATOR METHOD

(1) Mount a dial indicator to front of engine, locating probe on nose of crankshaft (Fig. 16).

SERVICE PROCEDURES (Continued)

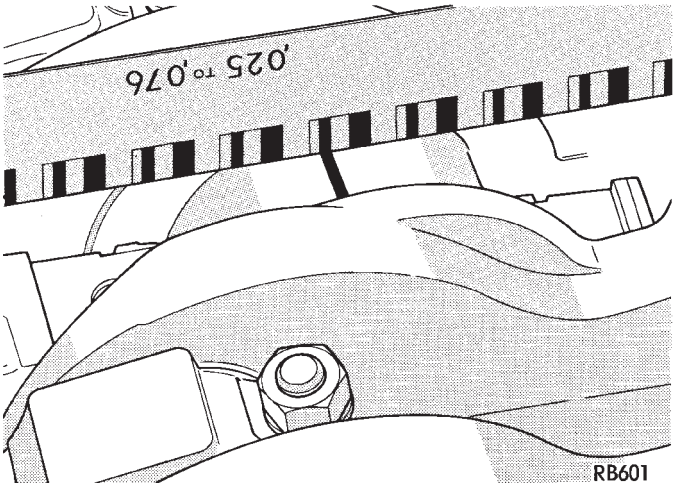


Fig. 15 Measuring Bearing Clearance with Plastigage

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

(3) Zero the dial indicator.

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

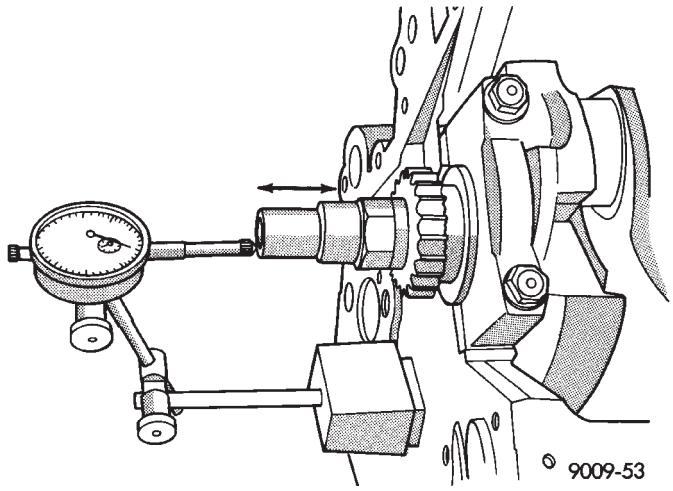


Fig. 16 Checking Crankshaft End Play

FEELER GAUGE METHOD

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

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

VALVE SERVICE RECONDITION

VALVE INSPECTION

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

(2) Measure valve stems for wear. Refer to Valve Dimension Chart.

CAUTION: Valve stems are chrome plated and should not be polished.

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

(4) Measure valve stem guide clearance as follows:

a. Install valve into cylinder head so it is 14 mm (0.551 in.) off the valve seat. A small piece of hose may be used to hold valve in place.

b. Attach dial indicator Tool C-3339 to cylinder head and set it at right angle of valve stem being measured (Fig. 17).

(5) Move valve to and from the indicator. Refer to Valve Guide Specification Chart.

(6) Ream the guides for valves with oversized stems if dial indicator reading is excessive or if the stems are scuffed or scored.

(7) Service valves with oversize stems and over size seals are available in 0.15 mm (0.005 in.), 0.40 mm, (0.015 in.) and 0.80 mm (0.030 in.) oversize.

NOTE: Oversize seals must be used with oversize valves.

(8) Refer to Valve Guide Specification Chart for reamer size to accommodate the oversize valve stems.

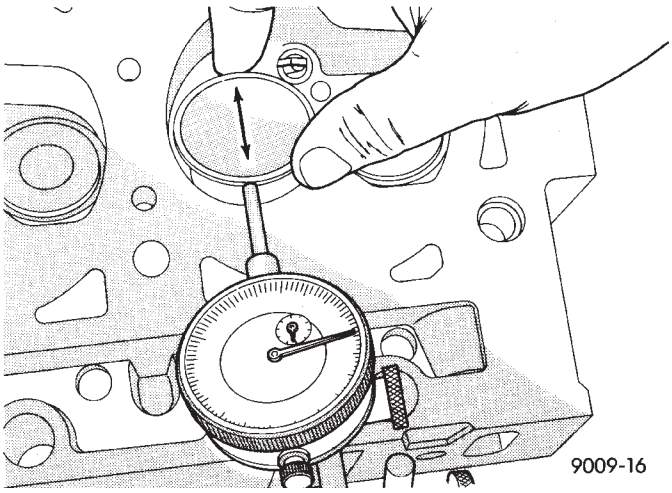


Fig. 17 Measuring Valve Guide Wear

(9) Slowly turn reamer by hand and clean guide thoroughly before installing new valve. **Do not attempt to ream the valve guides from standard directly to 0.80 mm (0.030 in.) Use step proce-**

SERVICE PROCEDURES (Continued)

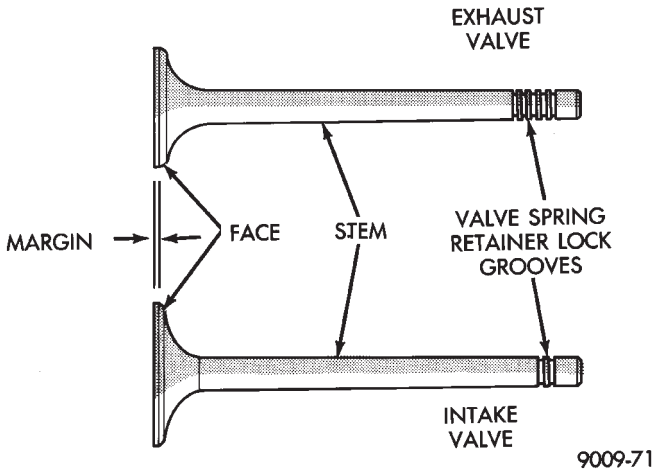


Fig. 18 Intake and Exhaust Valves

VALVE GUIDE SPECIFICATION CHART

	Intake Valve	Exhaust Valve
Dial Indicator Reading (Maximum):	0.247 mm (0.009 in.)	0.414 mm (0.016 in.)
Valve Guide Reamer Oversize	**Valve Guide Size**	
0.15 mm (0.005 in.)	8.125 - 8.150 mm (0.3198 - 0.3208 in.)	
0.40 mm (0.015 in.)	8.375 - 8.400 mm (0.3297 - 0.3307 in.)	
0.80 mm (0.030 in.)	8.775 - 8.800 mm (0.3454 - 0.3464 in.)	

dure of 0.15 mm (0.005 in.), 0.40 mm (0.015 in.) and 0.80 mm (0.030 in.) so the valve guides may be reamed true in relation to the valve seat. After reaming guides, the seat runout should be measured and resurfaced if necessary. See Refacing Valves and Valve Seats.

VALVE SPECIFICATION CHART

Intake Valve (Minimum)	
Stem Diameter:	7.935 mm (0.3124 in.)
Face Angle:	44.5°
Valve Margin:	0.794 mm (0.031 in.)
Head Diameter:	45.5 mm (1.79 in.)
Length:	127.2 mm (5.008 in.)
Exhaust Valve (Minimum)	
Stem Diameter:	7.906 mm (0.3112 in.)
Face Angle:	44.5°
Valve Margin:	1.191 mm (0.0469 in.)
Head Diameter:	37.5 mm (1.476 in.)
Length:	127.82 (5.032 in.)

VALVE GUIDES

NOTE: Replace cylinder head if guide does not clean up with 0.80 mm (0.030 in.) oversize reamer, or if guide is loose in cylinder head.

REFACING VALVES AND VALVE SEATS

The intake and exhaust valves have a 44-1/2 to 45 degree face angle. The valve seats have a 45 to 45-1/2 degree face angle. The valve face and valve seat angles are shown in (Fig. 19).

VALVES

(1) Inspect the remaining margin after the valves are refaced Refer to Valve Dimension Chart.

VALVE SEATS

CAUTION: Remove metal from valve seat only. Do not remove metal from cylinder head (Fig. 20).

(1) When refacing valve seats, it is important that the correct size valve guide pilot be used for reseating stones. A true and complete surface must be obtained.

(2) Measure the concentricity of valve seat using dial indicator. Total runout should not exceed 0.051 mm (0.002 in.) total indicator reading.

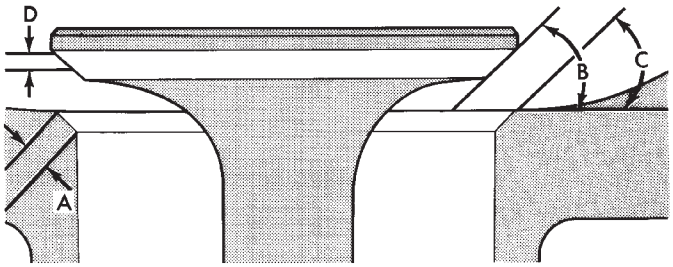


Fig. 19 Valve Seats

(3) Inspect the valve seat using 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 valve face, lower valve seat with a 15 degree stone. If the blue is transferred to the bottom edge of valve face raise valve seat with a 65 degrees stone.

SERVICE PROCEDURES (Continued)

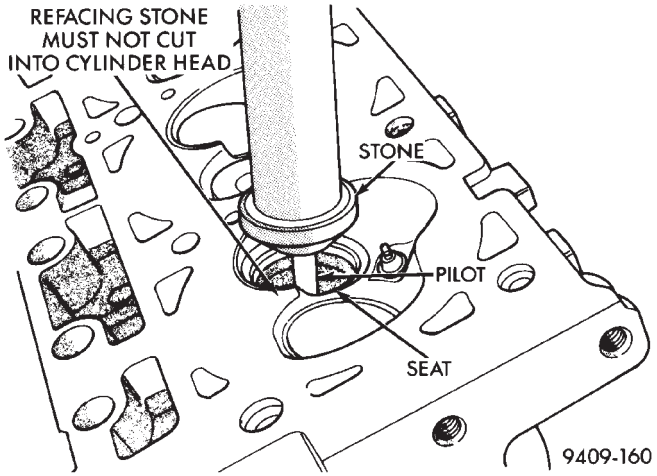


Fig. 20 Refacing Valve Seats

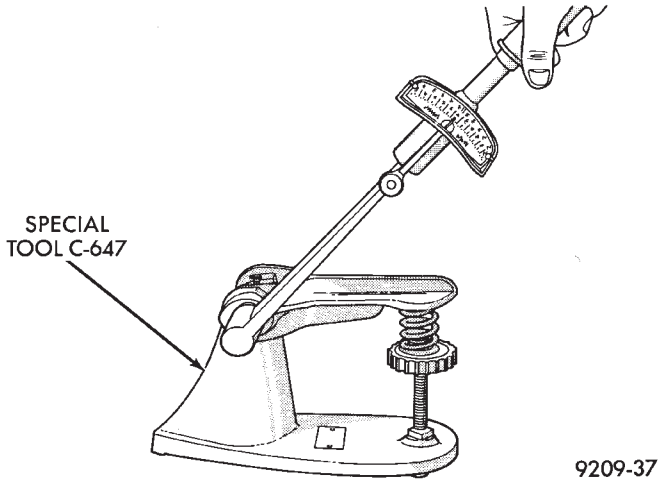


Fig. 21 Testing Valve Springs

NOTE: Valve seats which are worn or burned can be reworked, provided that correct angle and seat width are maintained. Otherwise cylinder head must be replaced.

(4) When seat is properly positioned the width of intake seats should be 1.75 to 2.25 mm (0.69 to 0.088 in.) The width of the exhaust seats should be 1.50 to 2.00 mm (0.059 to 0.078 in.) (Fig. 19).

(5) Check the valve spring installed height after refacing the valve and seat (Fig. 22).

TESTING VALVE SPRINGS

Whenever valves have been removed for inspection, reconditioning or replacement, valve springs should be tested (Fig. 21). **As an example;** the compression length of the spring to be tested is 33.34 mm (1-5/16 inches). Turn table of Tool C-647 until surface is in line with the 33.34 mm (1-5/16 inch) mark on the threaded stud and the zero mark on the front. Place spring over stud on the table and lift compressing lever to set tone device. Pull on torque wrench until ping is heard. Take reading on torque wrench at this instant. Multiply this reading by two. This will give the spring load at test length. Fractional measurements are indicated on the table for finer adjustments. Refer to specifications to obtain specified height and allowable tensions. Discard the springs that do not meet specifications.

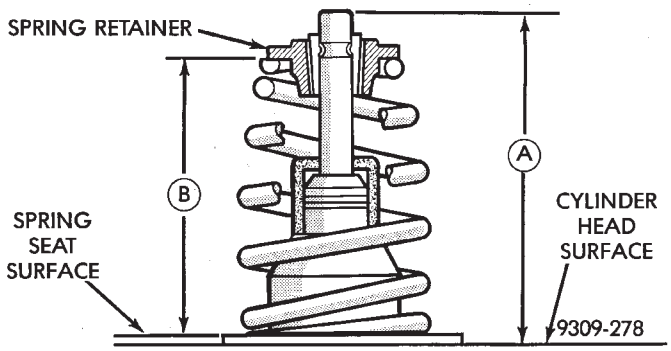


Fig. 22 Checking Valve Installed Height

ITEM	DESCRIPTION
A	Valve Stem Height
B	Valve Installed Height

REMOVAL AND INSTALLATION

WIPER UNIT

When performing work on the upper engine. Refer to Section 8K, Windshield Wipers and Washers for removal of the Wiper Unit.

ENGINE MOUNTS

RIGHT SIDE MOUNT

REMOVAL

NOTE: Right mount should only be serviced as an assembly to prevent noise, vibration and harshness concerns.

(1) Remove the purge duty solenoid and wiring harness from engine mount.

(2) Remove the two right engine mount insulator vertical fasteners and loosen the horizontal fastener, **Do Not** remove the large nut on the end of the core from frame rail (Fig. 23).

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

REMOVAL AND INSTALLATION (Continued)

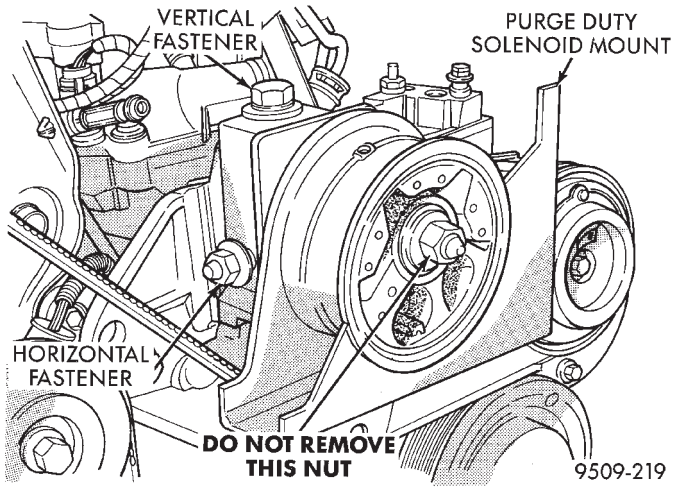


Fig. 23 Engine Mount—Right

(4) Remove the vertical and horizontal fasteners from the engine side bracket. Remove the engine mount assembly

INSTALLATION

(1) Reverse removal procedure for installation. Tighten assembly in the following order:

a. Engine mount to rail fasteners to 68 N·m (50 ft. lbs.).

b. The vertical engine fastener to 102 N·m (75 ft. lbs.)

c. The horizontal fastener to 150 N·m (111 ft. lbs.).

(2) Install the purge duty solenoid and wiring harness to the engine mount.

(3) Engine mount adjustment, Refer to Engine Mount Insulator Adjustment of this section.

FRONT MOUNT

REMOVAL

(1) Support the engine and transmission assembly with a floor jack so it will not rotate.

(2) Remove the front engine mount through bolt from the insulator and front crossmember mounting bracket (Fig. 24).

(3) Remove six screws from air dam to allow access to the front mount screws.

(4) Remove the front engine mount screws and remove the insulator assembly.

(5) Remove the front mounting bracket, if necessary (Fig. 24).

INSTALLATION

(1) Reverse removal procedure for installation and tighten fasteners in this order:

a. Tighten bolts 2,3, and 4 to 108 N·m (80 ft. lbs.).

b. Tighten bolts 1 and 5 to 54 N·m (40 ft. lbs.).

(2) Engine mount adjustment, Refer to Engine Mount Insulator Adjustment of this section.

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

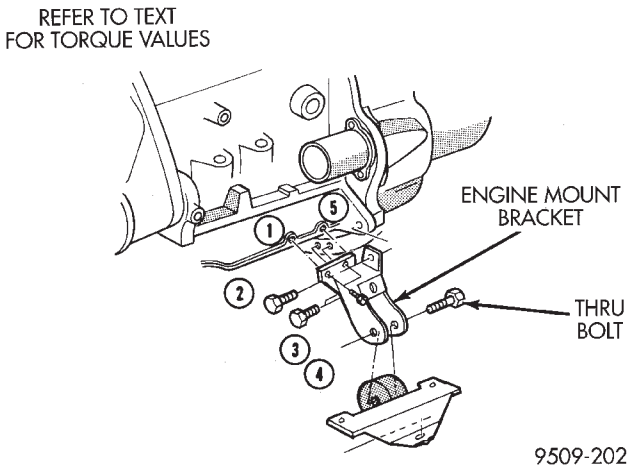


Fig. 24 Engine Mounting—Front

LEFT SIDE MOUNT

REMOVAL

(1) Raise vehicle on hoist and remove left front wheel.

(2) Support the transmission with a transmission jack.

(3) Remove the insulator through bolt from the mount.

(4) Remove the transmission mount fasteners and remove mount.

INSTALLATION

(1) Reverse removal procedure for installation.

(2) Tighten mount to transmission bolts to 55 N·m (40 ft. lbs.)

(3) Tighten through bolt to 75 N·m (55 ft. lbs.) (Fig. 25).

(4) Engine mount adjustment, Refer to Engine Mount Insulator Adjustment of this section.

REAR MOUNT

REMOVAL

(1) Raise vehicle on hoist.

(2) Support the transmission with a transmission jack so it will not rotate.

(3) Remove the insulator through bolt from the mount and rear suspension crossmember.

(4) Remove the four transmission mount fasteners and remove the mount.

INSTALLATION

(1) Reverse the removal procedure for installation. Refer to (Fig. 26). Tighten through bolt to 75 N·m (55 ft. lbs.)

REMOVAL AND INSTALLATION (Continued)

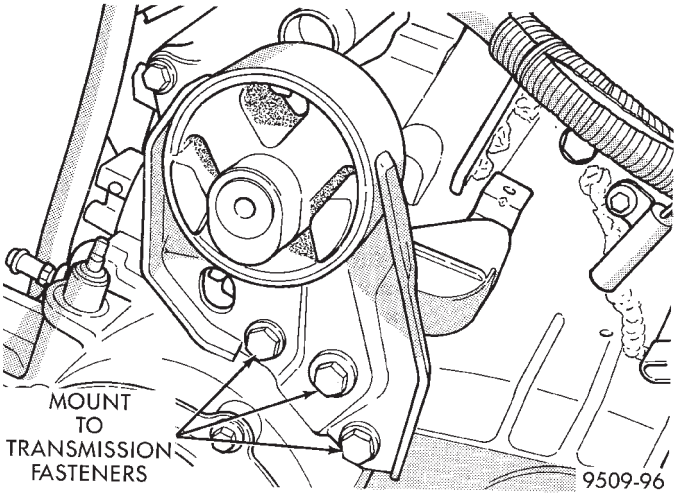


Fig. 25 Engine Mounting—Left

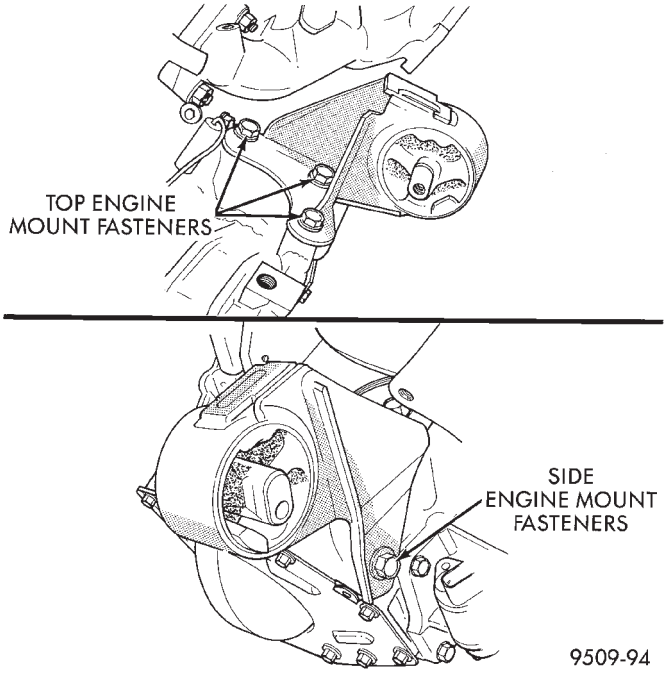


Fig. 26 Engine Mounting—Rear

ENGINE MOUNT RUBBER INSULATORS

Insulator location on (right side) is adjustable to allow right/left drive train adjustment in relation to drive shaft assembly length.

Check and reposition right engine mount insulator. See Adjustments in this section. Adjust drive train position, if required, for the following conditions:

a. Drive shaft distress. See Group 2, Suspension and Driveshafts.

b. Any front end structural damage (after repair).

c. Insulator replacement.

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.

(3) Remove air cleaner and hoses.

(4) Remove battery cover, battery and battery tray, with integral vacuum reservoir, from vehicle.

(5) Block off heater hoses to rear heater assembly, if equipped.

(6) Drain cooling system. Refer to Group 7, Cooling System for procedure.

(7) Disconnect heater hoses.

(8) Remove fan module and radiator. Refer to Group 7 Cooling System for procedure.

(9) Disconnect transmission shift linkage.

(10) Disconnect throttle body linkage and vacuum hoses from throttle body.

(11) Remove accessory drive belts. Refer to Group 7, Accessory Drive Belts located in Cooling System for procedure.

(12) Remove air conditioning compressor from engine and set it aside.

(13) Disconnect generator wiring harness and remove generator.

(14) Hoist vehicle and remove right and left inner splash shields.

(15) Remove crossmember cradle plate (Fig. 27).

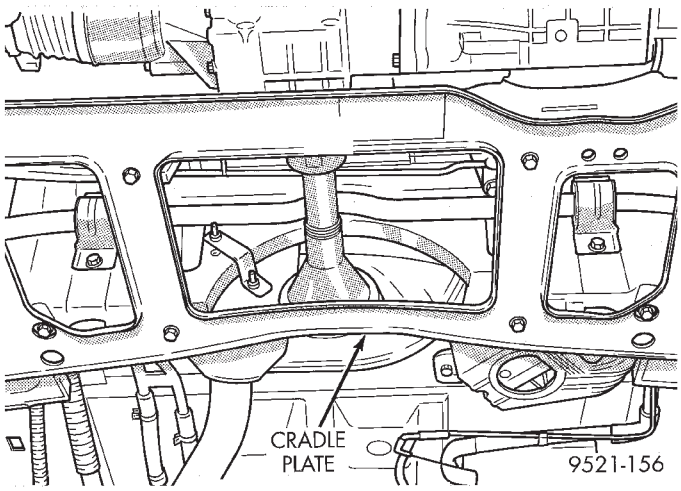


Fig. 27 Crossmember Cradle Plate

(16) Remove axle shafts. Refer to Group 3, Differential and Driveline for procedure.

(17) **(AWD equipped)** Mark orientation and separate propeller shaft from power transfer unit. Refer to Group 3, Differential and Driveline for procedure.

(18) Disconnect exhaust pipe from manifold.

(19) Remove front engine mount and bracket as an assembly.

REMOVAL AND INSTALLATION (Continued)

(20) Remove rear transmission mount and bracket.

(21) Remove power steering pump and bracket assembly.

(22) Remove wiring harness and connectors from front of engine.

(23) Remove bending braces and install tool number 6912 on engine.

(24) Remove transmission inspection cover and mark flexplate to torque converter.

(25) Remove driveplate to torque converter bolts.

(26) Lower the vehicle.

(27) Remove ground straps to body.

(28) Raise vehicle enough to allow engine dolly Special Tool 6135 and cradle Special Tool 6710 with post Special Tool 6848 and adaptor Special Tool 6909 to be installed under vehicle (Fig. 28).

(29) Loosen cradle engine mounts to allow movement for positioning onto engine locating holes on the 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.

(30) Lower vehicle so the weight of **ONLY THE ENGINE AND TRANSMISSION** is on the cradle.

(31) Remove right engine mount assembly and left transmission mount through bolt. Refer to Engine Mounts Section of this Group.

(32) Raise vehicle slowly. It may be necessary to move the engine/transmission assembly on the cradle to allow for removal around body flanges.

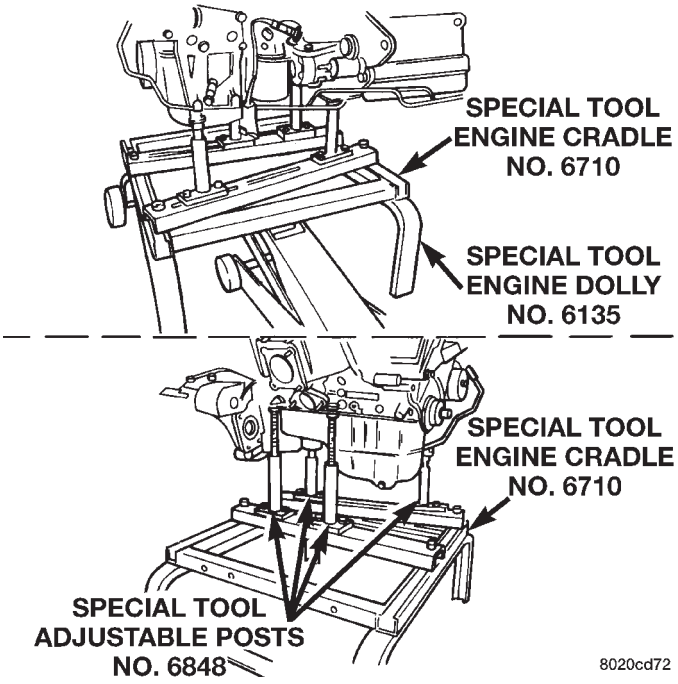


Fig. 28 Positioning Engine Cradle Support Post Mounts—Typical

INSTALLATION

(1) Position engine and transmission assembly under vehicle and slowly lower the vehicle over the engine and transmission. It may be necessary to move the engine/transmission assembly with the cradle for clearance around body flanges.

(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, 6710, 6848 and 6909.

(4) Remove Special tools 6912 and install bending braces.

(5) Lower vehicle. Install generator and wiring harness.

(6) Connect wiring harness on the front of the engine.

(7) Install Air Conditioning Compressor.

(8) Install power steering pump and bracket and accessory drive belt. Refer to Accessory drive Section Located in group 7 for installation procedure.

(9) Raise vehicle and install axle shafts. Refer to Group 3, Differential and Driveline for procedure.

(10) Install transmission and engine mount and bracket assemblies. Refer to Engine Mounts section of this Group.

(11) **(AWD equipped)** Install propeller shaft to power transfer unit. Refer to Group 3, Differential and Driveline for procedure.

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

(13) Install crossmember cradle plate (Fig. 27).

(14) Install left and right inner splash shields.

(15) Connect automatic transmission shifter linkage. Refer to Group 21, Transmission for procedures.

(16) Lower vehicle and connect fuel line and heater hoses. Remove plugs from rear heater hoses and install, if equipped.

(17) Install ground straps. Connect engine and throttle body connections and harnesses.

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

(19) Install radiator and fan module assembly. Install radiator hoses. Fill cooling system. See Group 7 for filling procedure.

(20) Install battery tray, battery and cover.

(21) Install air cleaner and hoses.

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

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

(24) Adjust transmission linkage, if necessary.

REMOVAL AND INSTALLATION (Continued)

CRANKSHAFT DAMPER

REMOVAL

(1) Disconnect negative cable from battery.
(2) Raise vehicle on hoist.
(3) Remove right wheel and inner splash shield.
(4) Remove drive belt. Refer to Group 7, Cooling System for procedure.
(5) Remove crankshaft pulley (Fig. 29).

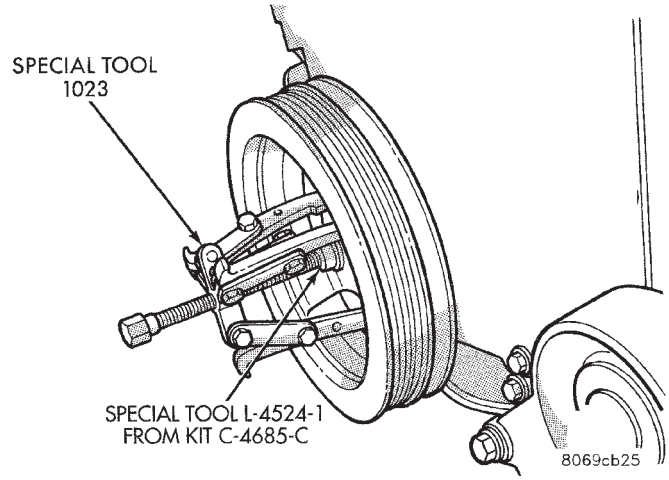


Fig. 29 Crankshaft Damper—Removal

INSTALLATION

(1) Install crankshaft pulley (Fig. 30).
(2) Install drive belt. Refer to Cooling System Group 7 for installation procedure.
(3) Install inner splash shield and wheel.
(4) Connect negative cable to battery.

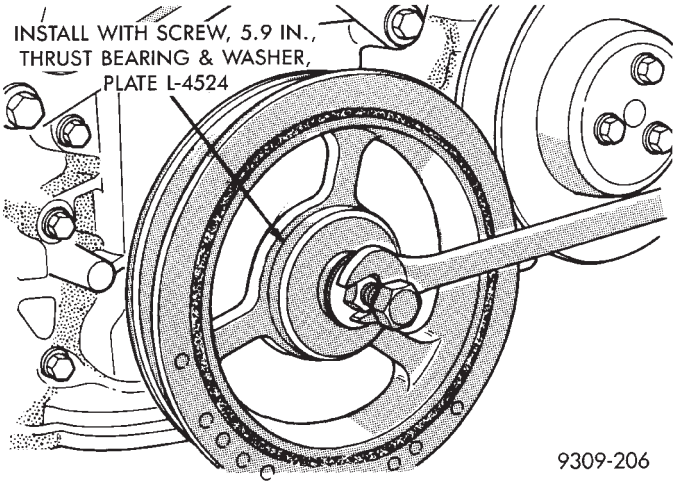


Fig. 30 Crankshaft Damper—Installation

ROCKER ARMS AND SHAFT ASSEMBLY

REMOVAL

(1) Remove upper intake manifold assembly. Refer to Group 11, Intake and Exhaust Manifolds.
(2) Disconnect spark plug wires by pulling on the boot straight out in line with plug.
(3) Disconnect closed ventilation system.
(4) Remove cylinder head cover and gasket.
(5) Remove four rocker shaft bolts and retainers.
(6) Remove rocker arms and shaft assembly.
(7) If rocker arm assemblies are disassembled for cleaning or replacement. Assemble rocker arms in their original position. Refer to (Fig. 31) for rocker arm for positioning on the shaft.

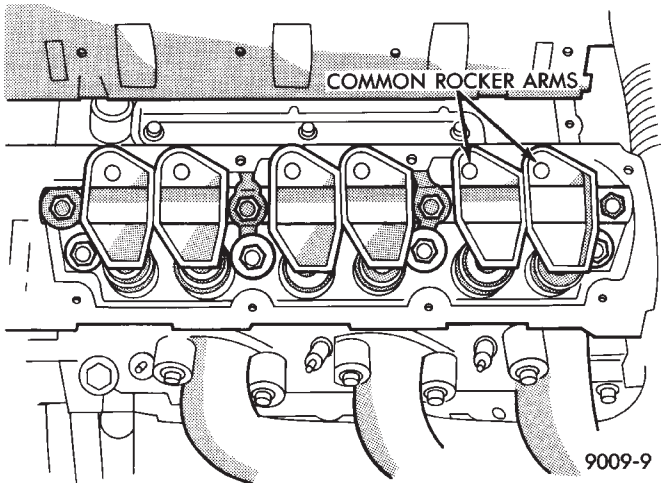


Fig. 31 Rocker Arm Location Left Bank

INSTALLATION

(1) Install rocker arm and shaft assemblies with the stamped steel retainers in the four positions, tighten to 28 N·m (250 in. lbs.) (Fig. 31).

CAUTION: THE ROCKER ARM SHAFT SHOULD BE TORQUED DOWN SLOWLY, STARTING WITH THE CENTER BOLTS. ALLOW 20 MINUTES TAPPET BLEED DOWN TIME AFTER INSTALLATION OF THE ROCKER SHAFTS BEFORE ENGINE OPERATION.

(2) Clean cylinder head cover gasket surface. Inspect cover for distortion and straighten if necessary.
(3) Clean head rail if necessary. Install a new gasket and tighten cylinder head cover fasteners to 12 N·m (105 in. lbs.).
(4) Install closed crankcase ventilation system.
(5) Install spark plug wires.
(6) Install upper intake manifold assembly. Refer to Group 11, Exhaust Systems and Intake Manifolds.

VALVE STEM SEALS OR SPRINGS, CYLINDER HEAD NOT REMOVED

(1) Perform fuel system pressure release procedure **before attempting any repairs.**
(2) Disconnect negative cable from battery.
(3) Remove air cleaner cover and hose assembly.

REMOVAL AND INSTALLATION (Continued)

(4) Remove upper intake manifold. Refer to Group 11, Exhaust System and Intake Manifolds for procedure.
(5) Remove cylinder head covers and spark plugs.
(6) Remove electrical connector from ignition coils.
(7) Using suitable socket and flex handle at crankshaft pulley retaining screw, turn engine so the number 1 piston is at Top Dead Center on the compression stroke.
(8) Remove rocker arms with rocker shaft and install a dummy shaft. The rocker arms should not be disturbed and left on shaft.
(9) With air hose attached to spark plug adapter installed in number 1 spark plug hole, apply 90 to 100 psi air pressure (620.5 to 689 kPa). This is to hold valves in place while servicing components.
(10) Using Tool C-4682 or equivalent, compress valve spring and remove retainer valve locks and valve spring.
(11) The intake valve stem seals should be pushed firmly and squarely over the valve guide using the valve stem as guide. **Do Not Force** seal against top of guide. When installing the valve retainer locks, compress the spring **only enough** to install the locks.

CAUTION: Do not pinch seal between retainer and top of valve guide.

(12) Follow the same procedure on the remaining 5 cylinders using the firing sequence 1-2-3-4-5-6. **Make sure piston in cylinder is at TDC on the valve spring that is being covered.**
(13) Remove spark plug adapter tool.
(14) Remove dummy shaft and install rocker shaft assembly and tighten screws to 28 N·m (250 in. lbs.).
(15) Install cylinder head covers tighten screws to 14 N·m (120 in. lbs.) and electrical connector to ignition coils.
(16) Install Intake Manifold. Refer to Group 11, Exhaust System and Intake Manifold for procedure.
(17) Connect negative cable to battery.

CYLINDER HEAD COVER

REMOVAL

NOTE: The cylinder head cover can be either an isolated type (Fig. 32) or a non-isolated type.

FRONT CYLINDER HEAD COVER

(1) Disconnect ignition cables from spark plugs.
(2) Disconnect crankcase vent hose from cylinder head cover.
(3) Remove front cylinder head cover bolts.
(4) Remove cylinder head cover and gasket.

REAR CYLINDER HEAD COVER

(1) Disconnect negative cable from battery.
(2) Remove Wiper Unit. Refer to Group 8K, Windshield Wipers and Washers for procedure.
(3) Remove intake manifold upper plenum. Refer to Group 11, Exhaust System and Intake Manifold for procedure.
(4) Disconnect PCV hose from cylinder head cover.
(5) Remove rear cylinder head cover bolts
(6) Remove cylinder head cover and gasket.

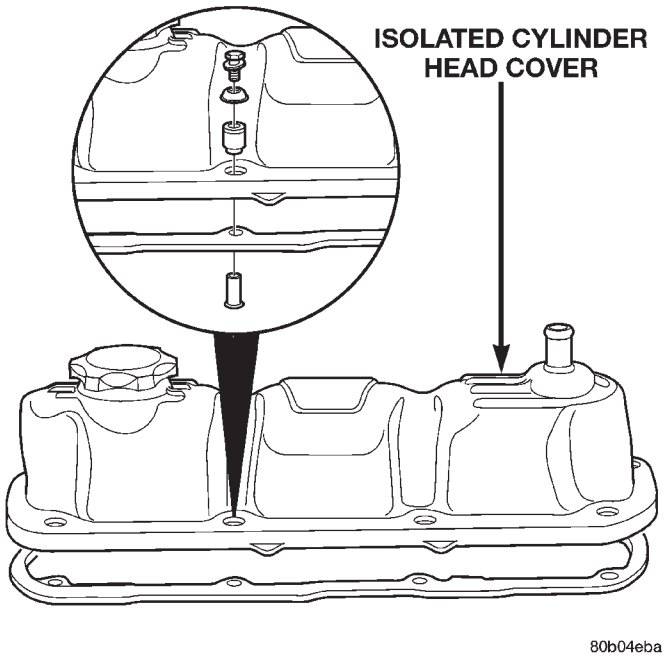


Fig. 32 Cylinder Head Cover—Isolated Type

INSTALLATION

FRONT CYLINDER HEAD COVER

(1) Clean cylinder head and cover mating surfaces. Inspect cylinder head cover surface for flatness. Replace gasket as necessary.
(2) Install cylinder head cover and bolts.
(3) Tighten cylinder head cover bolts to the following specifications:
- **Non–isolated** cylinder head cover to 12 N·m (105 in. lbs.).
- **Isolated** cylinder head cover to 10 N·m (90 in. lbs.) (Fig. 32).

(4) Connect crankcase vent hose.
(5) Connect ignition cables to spark plugs.

REAR CYLINDER HEAD COVER

(1) Clean cylinder head and cover mating surfaces. Inspect cylinder head cover surface for flatness. Replace gasket as necessary.
(2) Install cylinder head cover and bolts.
(3) Tighten cylinder head cover bolts to the following specifications:

REMOVAL AND INSTALLATION (Continued)

• **Non–isolated** cylinder head cover to 12 N·m (105 in. lbs.).
• **Isolated** cylinder head cover to 10 N·m (90 in. lbs.) (Fig. 32).

(4) Connect PCV hose from cylinder head cover.
(5) Install intake manifold upper plenum. Refer to Group 11, Exhaust System and Intake Manifold for procedure.
(6) Install Wiper Unit. Refer to Group 8K, Windshield Wipers and Washers for procedure.
(7) Connect negative cable to battery.

CYLINDER HEAD

REMOVAL

(1) Drain cooling system. Refer to Group 7, Cooling System for procedure and disconnect negative cable from battery.
(2) Remove upper and lower intake manifolds. Refer to Group 11, Exhaust System and Intake Manifold.

WARNING: INTAKE MANIFOLD GASKET IS MADE OF VERY THIN METAL AND MAY CAUSE PERSONAL INJURY, HANDLE WITH CARE.

(3) Disconnect coil wires, sending unit wire, heater hoses and bypass hose.
(4) Remove PCV system hoses, evaporation control system hose and cylinder head covers.
(5) Remove exhaust manifolds.
(6) Remove rocker arm and shaft assemblies. Remove push rods and **mark positions to ensure installation in original locations.**
(7) Remove the 9 head bolts from each cylinder head and remove cylinder heads (Fig. 33).

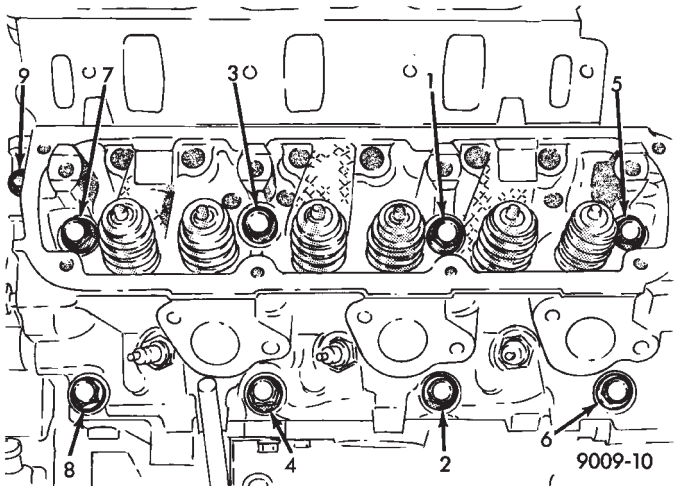


Fig. 33 Cylinder Head Bolts Location and Tightening Sequence

INSTALLATION

(1) Clean all sealing surfaces of cylinder block and cylinder heads.
(2) Install new gaskets on cylinder block (Fig. 34).

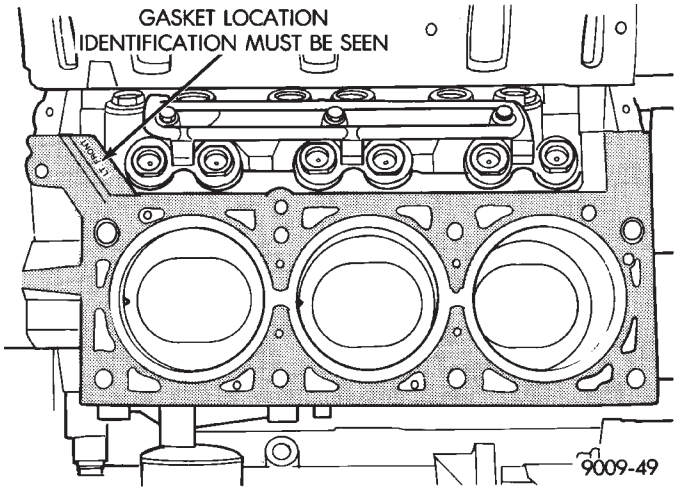


Fig. 34 Head Gasket Installation

(3) **The cylinder head bolts are torqued using the torque yield method, they should be examined BEFORE reuse. If the threads are necked down, the bolts should be replaced** (Fig. 35).
(4) 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.

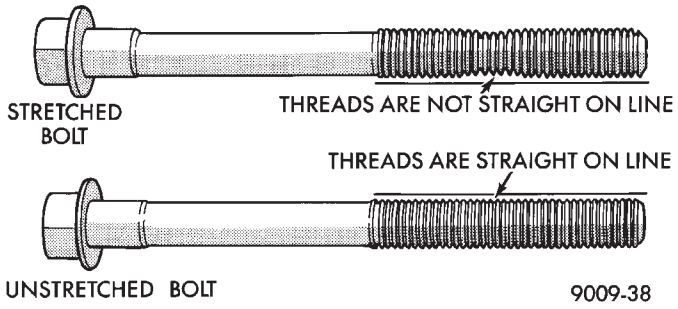


Fig. 35 Checking Bolts for Stretching (Necking)

(5) Tighten the cylinder head bolts 1 - 8 in the sequence shown in (Fig. 33). Using the 4 step torque turn method, tighten according to the following values:

• Step 1: Bolts 1 – 8 to 61 N·m (45 ft. lbs.)
• Step 2: Bolts 1 – 8 to 88 N·m (65 ft. lbs.)
• Step 3: Bolts 1 – 8 (again) to 88 N·m (65 ft. lbs.)
• Step 4: Bolts 1 – 8 turn an additional 1/4 Turn. **(Do not use a torque wrench for this step.)**

NOTE: Bolt torque after 1/4 turn should be over 122 N·m (90 ft. lbs.). If not, replace the bolt.

(6) Tighten head bolt number 9 (Fig. 33) to 33 N·m (25 ft. lbs.) after head bolts 1 – 8 have been tighten to specifications.

REMOVAL AND INSTALLATION (Continued)

(7) Inspect push rods and replace worn or bent rods.

(8) Install push rods, rocker arm and shaft assemblies with the stamped steel retainers in the four positions, tighten to 28 N·m (250 in. lbs.) (Fig. 36).

(9) Place new cylinder head cover gaskets in position and install cylinder head covers. Tighten to 12 N·m (105 in. lbs.).

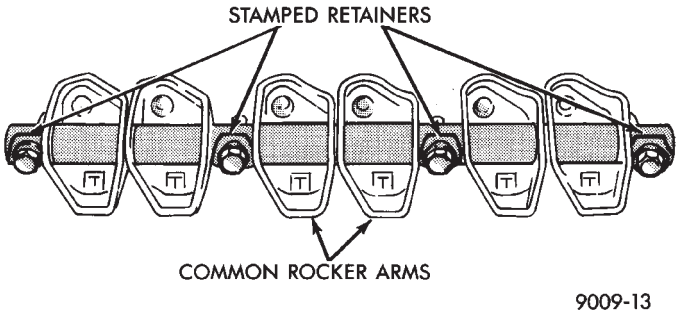


Fig. 36 Rocker Arm Shaft Retainers

INTAKE MANIFOLD SEALING

The intake manifold gasket is a one-piece stamped steel gasket with a sealer applied from the manufacturer. This gasket has end seals incorporated with it.

WARNING: INTAKE MANIFOLD GASKET IS MADE OF VERY THIN METAL AND MAY CAUSE PERSONAL INJURY, HANDLE WITH CARE.

(1) Clean all surfaces of cylinder block and cylinder heads.

(2) Place a drop (about 1/4 in. diameter) of Mopar® Silicone Rubber Adhesive Sealant or equivalent, onto each of the **four** manifold to cylinder head gasket corners (Fig. 37).

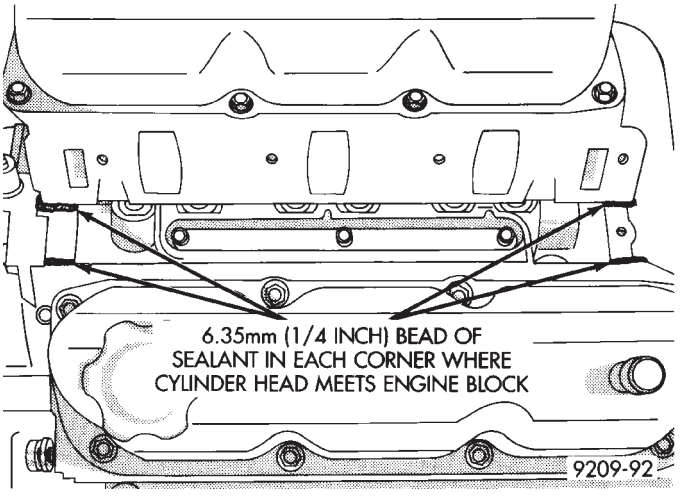


Fig. 37 Intake Manifold Gasket Sealing

(3) Carefully install the intake manifold gasket (Fig. 38). Torque end seal retainer screws to 12 N·m (105 in. lbs.).

(4) Install intake manifold and (8) bolts and torque to 1 N·m (10 in. lbs.). Then tighten bolts to 22 N·m (200 in. lbs.) in sequence shown in (Fig. 39). Then tighten again to 22 N·m (200 in. lbs.). After intake manifold is in place, **inspect to make sure seals are in place.** Refer to Group 11, Exhaust System and Intake Manifold to complete intake manifold installation.

(5) Install exhaust manifolds and tighten bolts to 27 N·m (20 ft. lbs.) and nuts to 20 N·m (15 ft. lbs.).

(6) Adjust spark plugs to specification in Group 8, Electrical Section and install the plugs.

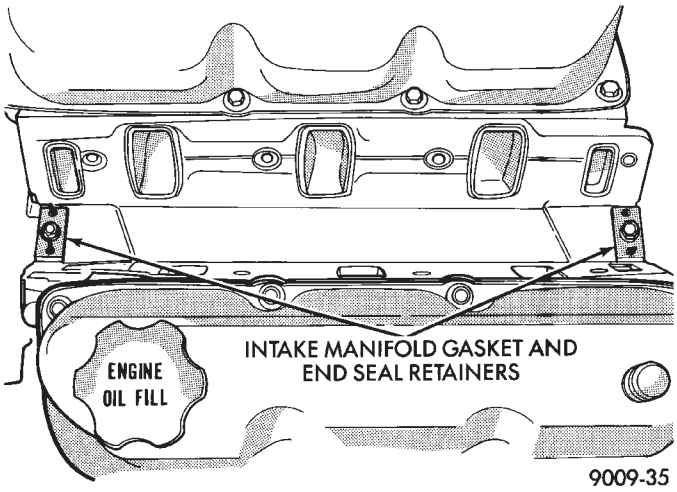


Fig. 38 Intake Manifold Gasket Retainers

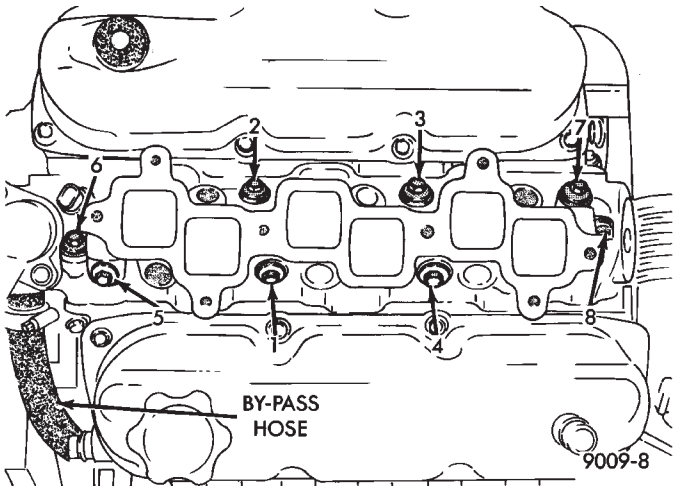


Fig. 39 Intake Manifold Removal and Installation

VALVES AND VALVE SPRINGS

REMOVAL

(1) With cylinder head removed, compress valve springs using Valve Spring Compressor Tool C-3422-B with adapter 6412 as shown in (Fig. 40).

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

REMOVAL AND INSTALLATION (Continued)

(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.

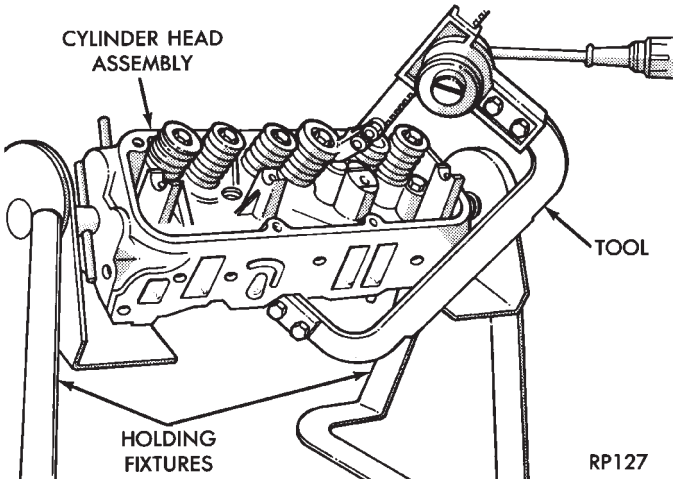


Fig. 40 Compress Valve Springs with Special Tool C-3422-B with Adapter 6412

VALVE INSTALLATION

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

(2) Check valve tip to spring seat dimensions A after grinding the valve seats or faces. Grind valve tip to give 49.541 to 51.271 mm (1.950 to 2.018 in.) over spring seat when installed in the head (Fig. 41). Check valve tip for scoring, if necessary, the tip chamfer should be reground to prevent seal damage when the valve is installed.

(3) Install valve spring seat spacer on head (Fig. 42).

(4) Install new cup seals on all valve stems and over valve guides (Fig. 41). Install valve springs and valve retainers (Fig. 42).

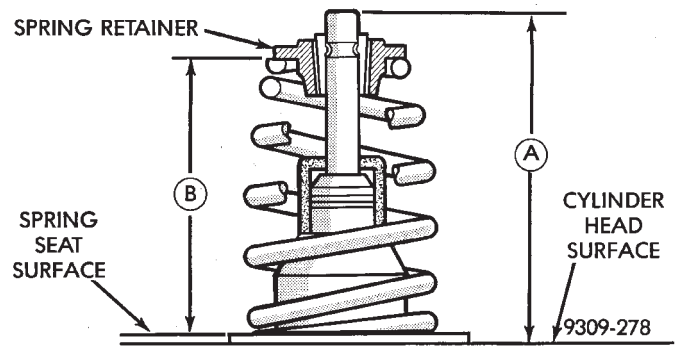


Fig. 41 Checking Valve Installed Height

(5) Compress valve springs with Valve Spring Compressor Tool C-3422-B, with adapter 6412 install locks and release tool. **If valves and/or seats are reground, measure the installed height of springs dimension B, make sure measurements are taken from top of spring seat to the bottom surface of spring retainer. If height is greater than 1-19/32 inches, (40.6 mm), install a 1/32 inch (.794 mm) spacer in head counterbore to bring spring height back to normal 1-17/32 to 1-19/32 inch (39.1 to 40.6 mm).**

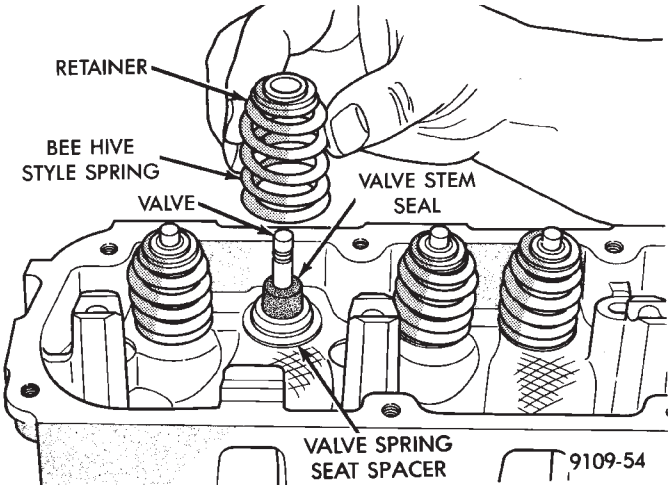


Fig. 42 Valve Seal and Spring—Installation

TAPPET REMOVAL

(1) Refer to Cylinder Head Removal in this section. Cylinder Head must be removed to gain access to tappets for service.

(2) Remove yoke retainer and aligning yokes.

(3) Use Tool C-4129 to remove tappets from their bores. If all tappets are to be removed, identify tappets to insure installation in original location.

NOTE: If the tappet or bore in cylinder block is scored, scuffed, or shows signs of sticking, ream the bore to next oversize and replace with oversize tappet.

CAUTION: The plunger and tappet bodies are not interchangeable. The plunger and valve must always be fitted to the original body. It is advisable to work on one tappet at a time to avoid mixing of parts. Mixed parts are not compatible. Do not disassemble a tappet on a dirty work bench.

INSTALLATION

(1) Lubricate tappets.

(2) Install tappets in their original positions.

(3) With roller tappets, install aligning yokes (Fig. 43).

(4) Install yoke retainer and torque screws to 12 N·m (105 in. lbs.) (Fig. 43).

(5) Install cylinder heads. Refer to cylinder head installation of this section for procedure.

REMOVAL AND INSTALLATION (Continued)

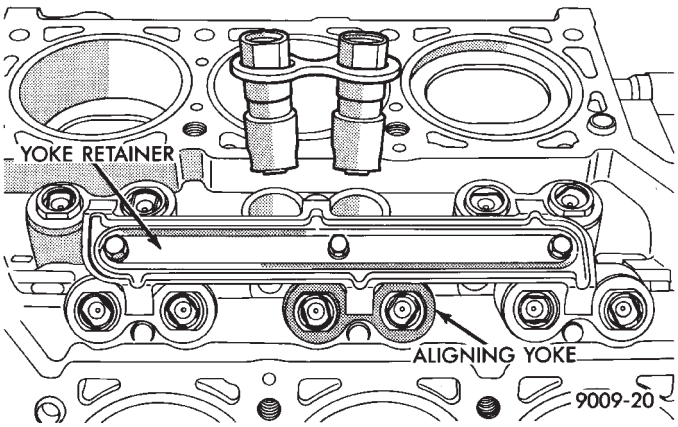


Fig. 43 Roller Tappets Aligning Yoke and Retainer

(6) Start and operate engine. Warm up to normal operating temperature.

CAUTION: To prevent damage to valve mechanism, engine must not be run above fast idle until all hydraulic tappets have filled with oil and have become quiet.

TIMING CHAIN COVER

REMOVAL

(1) Disconnect negative cable from battery.
(2) Drain cooling system. Refer to Cooling System Group 7 for procedure.
(3) Support engine and remove right engine mount.
(4) Raise vehicle on hoist. Drain engine oil.
(5) Remove oil pan and oil pump pick-up. It may necessary to remove transaxle inspection cover.
(6) Remove right wheel and inner splash shield.
(7) Remove drive belt. Refer to Cooling System Group 7 for procedure.
(8) Remove A/C compressor and set aside.
(9) Remove A/C compressor mounting bracket.
(10) Remove crankshaft damper (Fig. 44).
(11) Remove idler pulley from engine bracket.
(12) Remove engine bracket (Fig. 45).
(13) Remove cam sensor from chain case cover (Fig. 46).
(14) Remove chain case cover (Fig. 46).

INSTALLATION

(1) Be sure mating surfaces of chain case cover and cylinder block are clean and free from burrs. Crankshaft oil seal must be removed to insure correct oil pump engagement.

NOTE: DO NOT USE SEALER ON COVER GASKET

(2) Use a new cover gasket, and O-rings (Fig. 47). Adhere new gasket to chain case cover, making sure that the lower edge of the gasket is flush to 0.5 mm (0.020 in.) passed the lower edge of the cover. Refer to Oil Pan sealing outlined in this section.

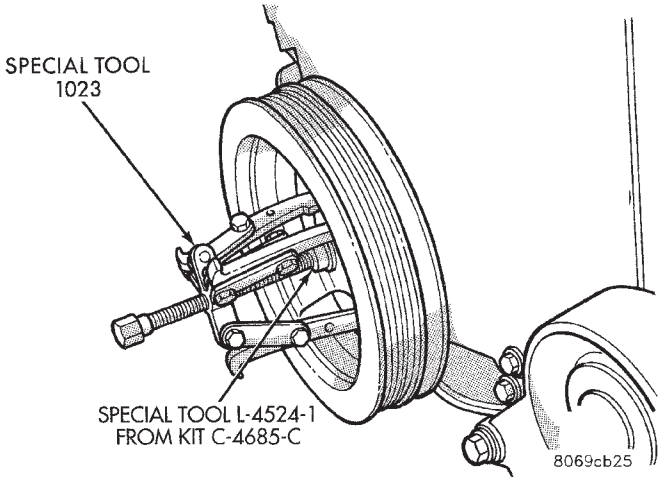


Fig. 44 Crankshaft Damper—Removal

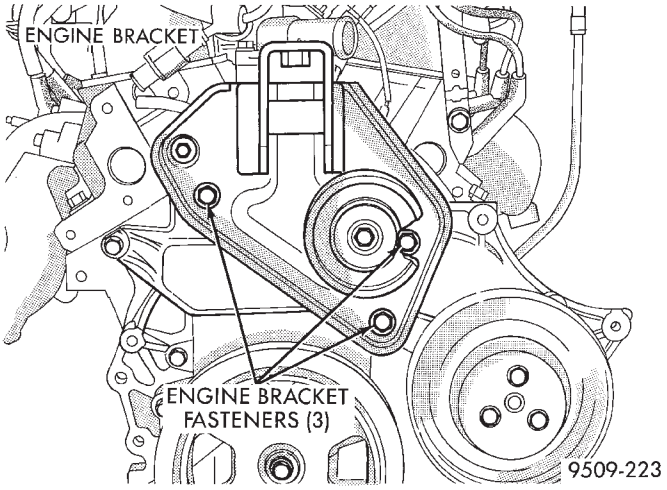


Fig. 45 Engine Bracket

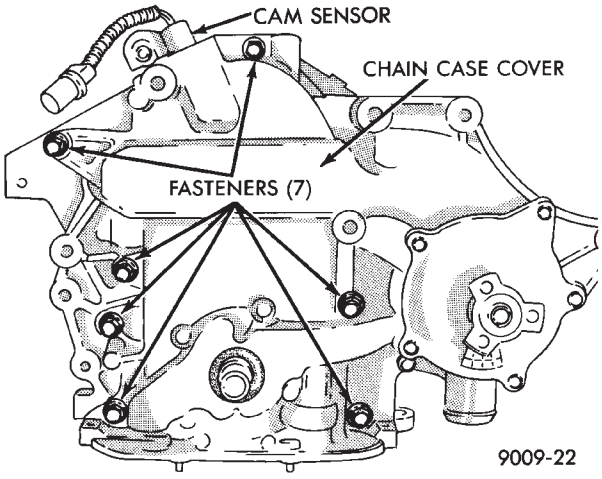


Fig. 46 Timing Chain Case Cover

REMOVAL AND INSTALLATION (Continued)

(3) Rotate crankshaft so that the oil pump drive flats are vertical.

(4) Position oil pump inner rotor so the mating flats are in the same position as the crankshaft drive flats (Fig. 47).

(5) Install cover onto crankshaft. Make sure the oil pump is engaged on the crankshaft correctly or severe damage may result.

(6) Install chain case cover screws and torque to 27 N·m (20 ft. lbs.).

(7) Install crankshaft oil seal (Fig. 48).

(8) Install crankshaft pulley (Fig. 49).

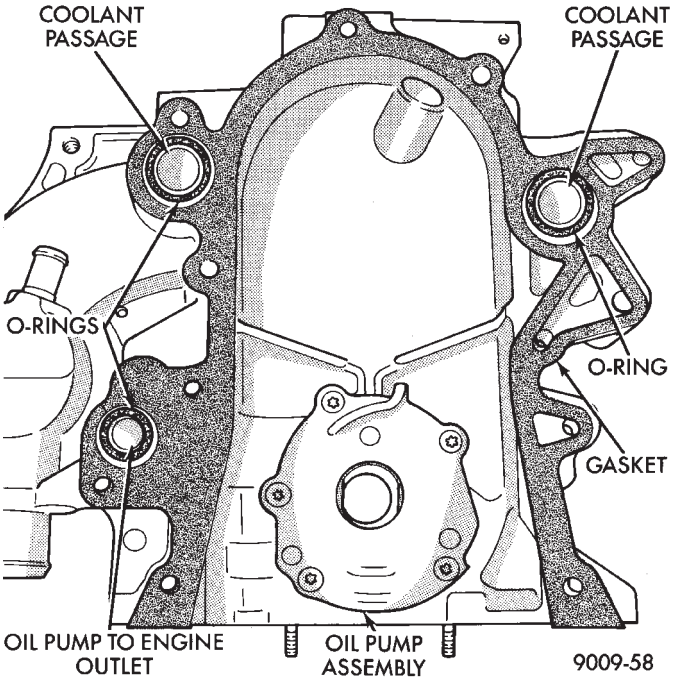


Fig. 47 Timing Chain Case Cover Gaskets and O-Rings

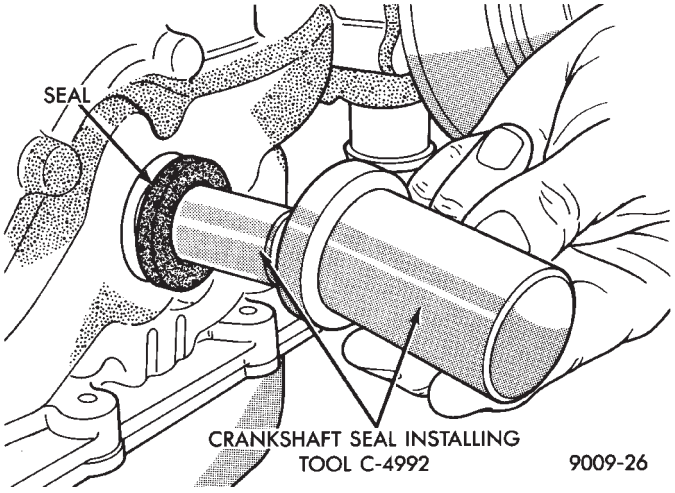


Fig. 48 Crankshaft Oil Seal—Installation

(9) Install engine bracket (Fig. 45) and torque fasteners to 54 N·m (40 ft. lbs.).

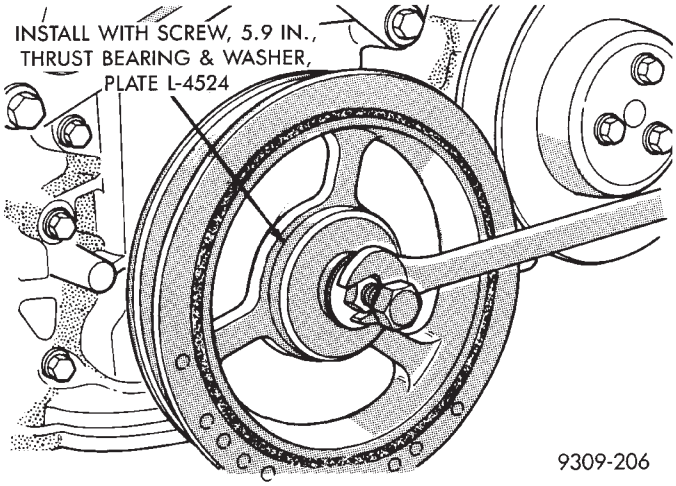


Fig. 49 Crankshaft Damper—Installation

(10) Install idler pulley on engine bracket.

(11) Install cam sensor. Refer to Group 8D, Ignition System for installation procedure.

(12) Install A/C compressor mounting bracket.

(13) Install A/C compressor.

(14) Install drive belt Refer to Group 7, Cooling System for installation procedure.

(15) Install inner splash shield and wheel.

(16) Install oil pump pick-up and oil pan and transaxle inspection cover if removed.

(17) Install engine mount.

(18) Fill crankcase with oil to proper level.

(19) Fill cooling system. Refer to Group 7, Cooling System for procedure.

(20) Connect negative cable to battery.

TIMING CHAIN

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove timing chain cover. Refer to procedure outlined in this section.

(3) Remove camshaft sprocket attaching bolt, and timing chain with camshaft sprocket.

(4) Using a suitable puller remove the crankshaft sprocket. Be careful not to damage the crankshaft surface.

INSTALLATION

(1) Position a new crankshaft sprocket on the shaft, install sprocket with suitable tool and mallet. Be sure sprocket is seated into position.

(2) Rotate crankshaft so the timing arrow is to the 12 o'clock position.

(3) Place timing chain around camshaft sprocket and place the timing mark to the 6 o'clock position.

(4) Align the dark colored links with the dot on the camshaft sprocket, place timing chain around crankshaft sprocket with the dark colored link lined up

REMOVAL AND INSTALLATION (Continued)

with the dot on the sprocket and install camshaft sprocket into position.

(5) Use a straight edge to check alignment of timing marks (Fig. 50).

(6) Install camshaft bolt and washer. Tighten to 54 N·m (40 ft. lbs.).

(7) Rotate crankshaft 2 revolutions. Timing marks should line up. If timing marks do not line up remove cam sprocket and realign.

(8) Check camshaft end play. With new thrust plate the specification is 0.0127 to 0.304 mm (0.005 to 0.012 in.). Old thrust plate specification is 0.31 mm (0.012 in.) maximum. If not within these limits install new thrust plate.

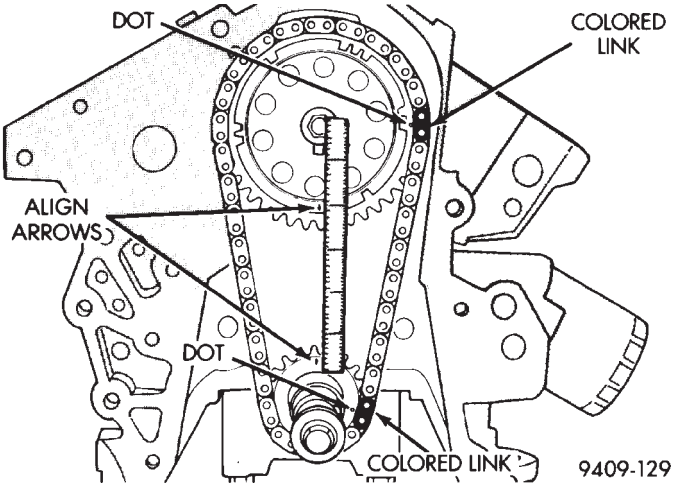


Fig. 50 Timing Marks Alignment

(9) Install timing chain cover and connect negative cable to battery.

CAMSHAFT

REMOVAL—ENGINE REMOVED FROM VEHICLE

Remove intake manifold, cylinder head covers, cylinder heads, timing chain case cover and timing chain.

(1) Remove rocker arm and shaft assemblies.

(2) Remove push rods and tappets; identify so each part will be replaced in its original location.

(3) Remove camshaft thrust plate (Fig. 51).

(4) Install a long bolt into front of camshaft to facilitate removal of the camshaft; remove camshaft, being careful not to damage cam bearings with the cam lobes.

INSTALLATION

(1) Lubricate camshaft lobes and camshaft bearing journals and insert the camshaft to within 2 inches of its final position in cylinder block.

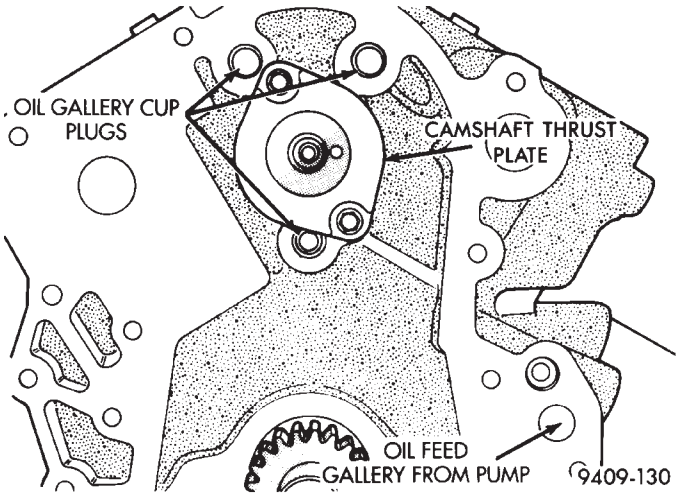


Fig. 51 Camshaft Thrust Plate

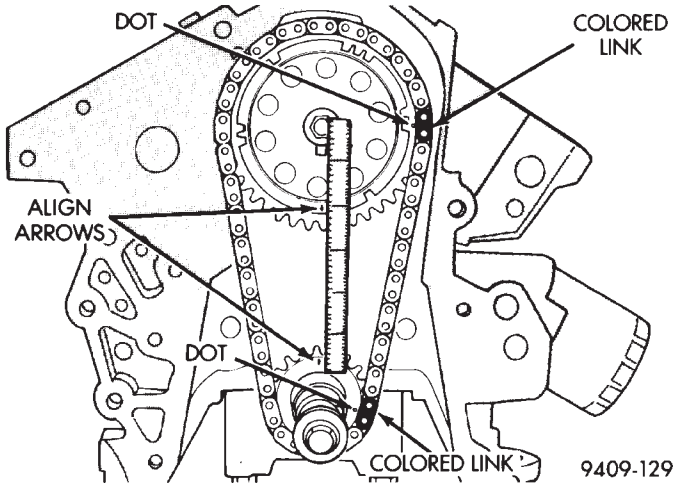


Fig. 52 Alignment of Timing Marks

(2) Install camshaft thrust plate with two screws as shown in (Fig. 51). Tighten to 12 N·m (105 in. lbs.) torque.

(3) Rotate crankshaft so the timing arrow is at the 12 o'clock position.

(4) Place timing chain around camshaft sprocket and place the timing mark to the 6 o'clock position.

(5) Align the dark colored links with the dot on the camshaft sprocket, place timing chain around crankshaft sprocket with the dark colored link lined up with the dot on the sprocket and install camshaft sprocket into position.

(6) Using straight edge to check alignment of timing marks (Fig. 52).

(7) Install the camshaft bolt. Tighten bolt to 54 N·m (40 ft. lbs.).

(8) Rotate crankshaft 2 revolutions. Timing marks should line up. If timing marks do not line up, remove cam sprocket and realign.

(9) Measure camshaft end play. End Play should measure 0.0127 to 0.304 mm (0.005 to 0.012 inches.)

REMOVAL AND INSTALLATION (Continued)

0.310 mm (0.012 in. Max.). If not within limits install a new thrust plate.

(10) Each tappet reused must be installed in the same position from which it was removed. **When camshaft is replaced, all of the tappets must be replaced**.

CAMSHAFT BEARINGS

REMOVAL

(1) With engine removed from vehicle and completely disassembled, drive out rear cam bearing core hole plug.

(2) Install proper size adapters and horseshoe washers (part of Tool C-3132-A) at back of each bearing shell to be removed and drive out bearing shells (Fig. 53).

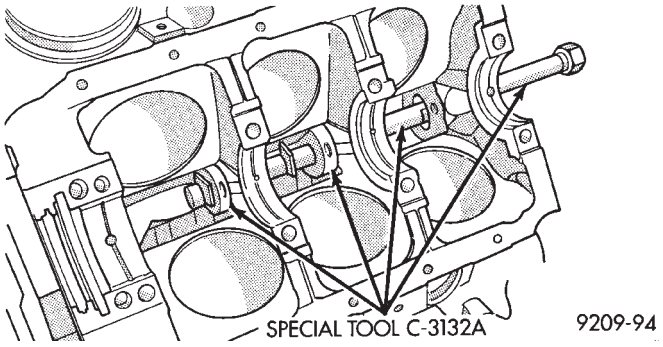


Fig. 53 Removed Installation of Camshaft Bearings with Tool C-3132–A—Typical

INSTALLATION

(1) Install new camshaft bearings with Tool C-3132-A by sliding the new camshaft bearing shell over proper adapter.

(2) Position rear bearing in the tool. Install horseshoe lock and by reversing removal procedure, carefully drive bearing shell into place.

(3) Install remaining bearings in the same manner. Bearings must be carefully aligned to bring oil holes into full register with oil passages from the main bearing. Number two bearing must index with the oil passage to the left cylinder head and Number three bearing must index with the oil passage to the right cylinder head. If the camshaft bearing shell oil holes are not in exact alignment, remove and reinstall them correctly. Install a new core hole plug at the rear of camshaft. **Be sure this plug does not leak.**

OIL PAN

REMOVAL

(1) Disconnect negative cable from battery and remove engine oil dipstick.

(2) Raise vehicle on hoist and drain engine oil.

(3) Remove bending brace to transaxle attaching bolt.

(4) Remove bolts attaching dust cover to transaxle housing. Lower dust cover to gain access to oil pan bolts.

(5) Remove oil pan screws and remove oil pan.

INSTALLATION

(1) Clean surfaces and apply a 1/8 inch bead of Mopar® Silicone Rubber Adhesive Sealant or equivalent, at the parting line of the chain case cover and the rear seal retainer (Fig. 54).

(2) Use a new pan gasket (Fig. 55).

(3) Install pan and tighten screws to 12 N·m (105 in. lb.).

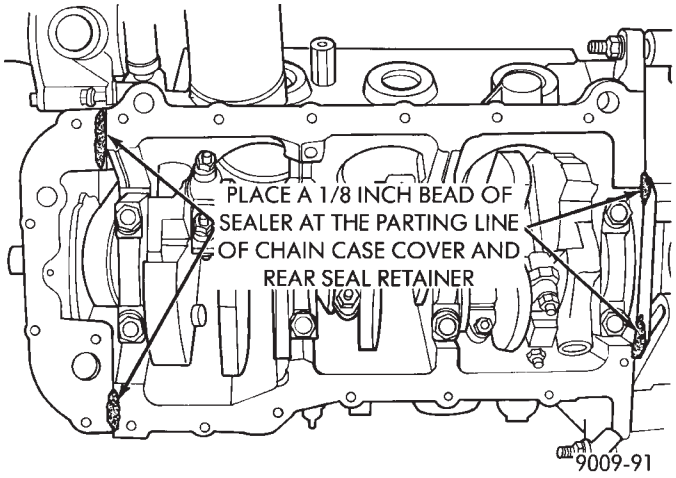


Fig. 54 Oil Pan Sealing

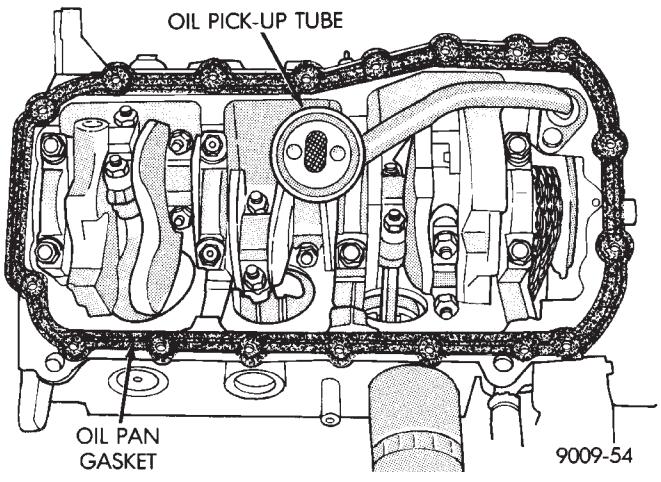


Fig. 55 Oil Pan Gasket Installation

(4) Install dust shield and bending brace to transaxle housing.

(5) Lower vehicle and install oil dipstick.

(6) Connect negative cable to battery.

(7) Fill crankcase with oil to proper level.

REMOVAL AND INSTALLATION (Continued)

PISTON AND CONNECTING ROD

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove cylinder heads and oil pan. Refer to procedure outlined in this section.

(3) Remove top ridge of cylinder bores with a reliable ridge reamer before removing pistons from cylinder block. **Be sure to keep tops of pistons covered during this operation. Pistons and connecting rods must be removed from top of cylinder block. When removing piston and connecting rod assemblies from the engine, rotate crankshaft so that each connecting rod is centered in cylinder bore.**

(4) Inspect connecting rods and connecting rod caps for cylinder identification. Identify them if necessary (Fig. 56).

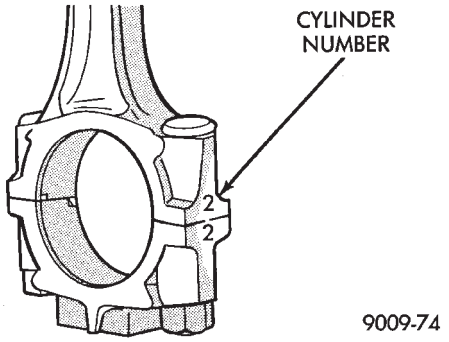


Fig. 56 Identify Connecting Rod to Cylinder

(5) Remove connecting rod cap. Install connecting rod bolt protectors on connecting rod bolts (Fig. 57). Push each piston and rod assembly out of cylinder bore.

NOTE: Be careful not to nick crankshaft journals.

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

INSTALLING PISTON AND CONNECTING ROD ASSEMBLY

(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 (Fig. 58).

(2) Before installing the ring compressor, make sure the oil ring expander ends are butted and the rail gaps located as shown in (Fig. 58).

(3) Lubricate the piston and rings with clean engine oil. Position a ring compressor over the piston and rings, and tighten the compressor. **Be sure position of rings does not change during this operation.**

(4) Install connecting rod bolt protectors on rod bolts (Fig. 57).

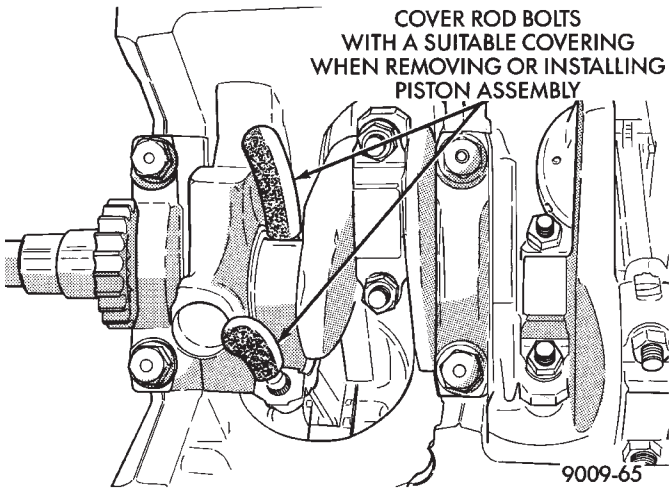


Fig. 57 Connecting Rod Protectors

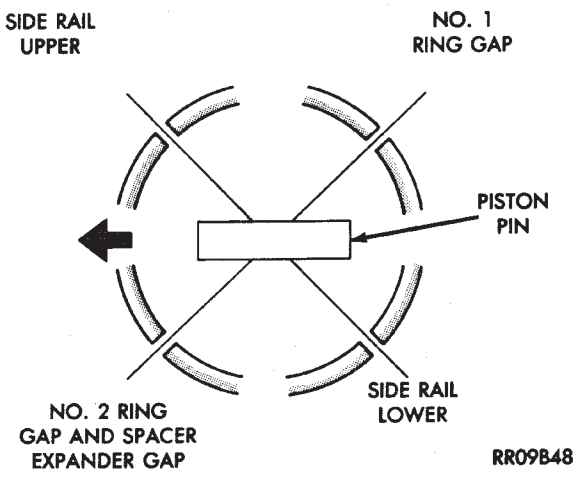


Fig. 58 Piston Ring End Gap Position

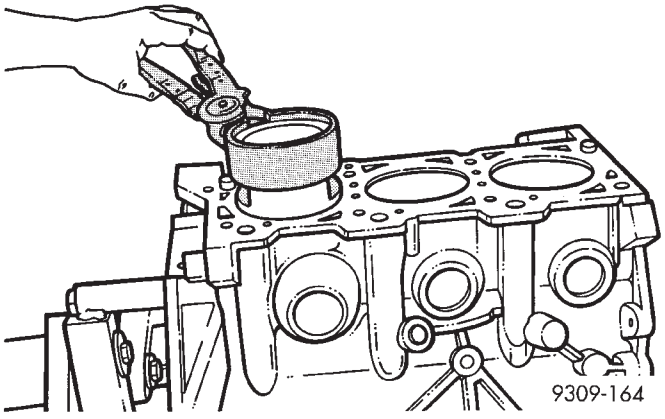


Fig. 59 Piston—Installation

(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.

REMOVAL AND INSTALLATION (Continued)

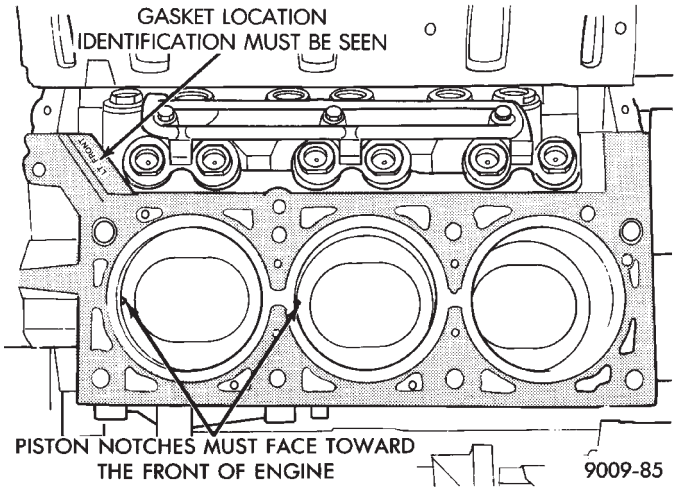


Fig. 60 Piston I.D. Notches

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

(7) The notch or groove on top of piston must be pointing toward front of engine (Fig. 60).

(8) Install rod caps. Install nuts on cleaned and oiled rod bolts and tighten nuts to 54 N·m (40 ft. lb.) Plus 1/4 turn.

(9) Repeat procedure for each piston and rod installation.

(10) Install cylinder heads and oil pan.

(11) Fill engine crankcase with proper oil to correct level.

(12) Connect negative cable to battery.

CRANKSHAFT

MAIN BEARINGS

Bearing caps are not interchangeable and should be marked at removal to insure correct assembly (Fig. 62). Upper and lower bearing halves are NOT interchangeable. Lower main bearing halves of 1, 3 and 4 are interchangeable. Upper main bearing halves of 1, 3 and 4 are interchangeable.

CRANKSHAFT MAIN JOURNALS

The crankshaft journals should be checked for excessive wear, taper and scoring. (Fig. 61) Limits of taper or out-of-round on any crankshaft journals should be held to 0.025 mm (0.001 in.). Journal grinding should not exceed 0.305 mm (0.012 in.) under the standard journal diameter. Do NOT grind thrust faces of Number 2 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.

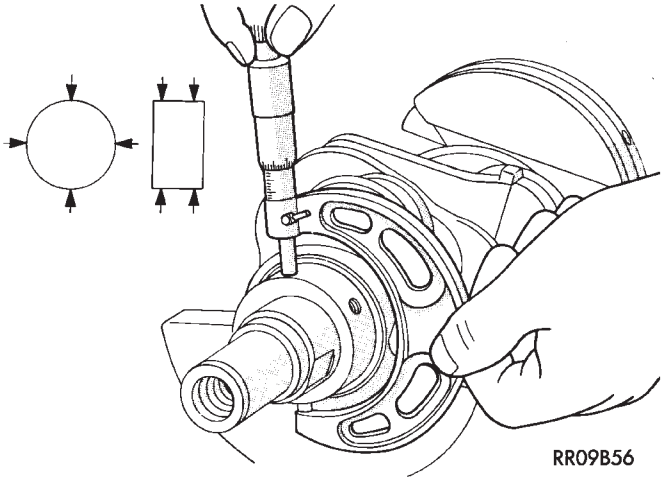


Fig. 61 Measure Crankshaft Journal O.D.

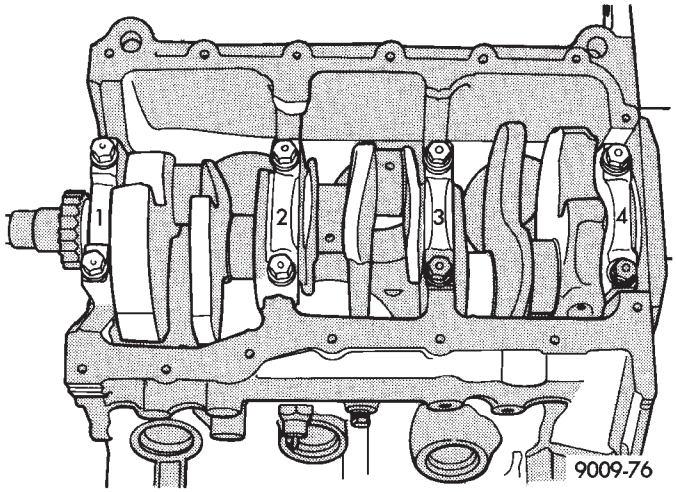


Fig. 62 Main Bearing Cap Identification

Upper and lower Number 2 bearing halves are flanged to carry the crankshaft thrust loads and are NOT interchangeable with any other bearing halves in the engine (Fig. 63). 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 undersizes: 0.025 mm (0.001 in.) and 0.254 mm (0.010 in). Never install an undersize bearing that will reduce clearance below specifications.

REMOVAL

(1) Remove oil pan and identify bearing caps before removal.

(2) Remove bearing caps one at a time. Remove upper half of bearing by inserting Special Main Bearing Tool C-3059. (Fig. 64) into the oil hole of crankshaft.

REMOVAL AND INSTALLATION (Continued)

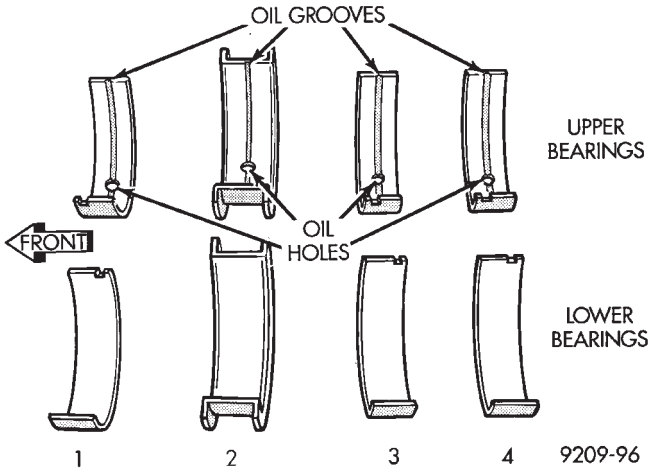


Fig. 63 Main Bearing Identification

(3) Slowly rotate crankshaft clockwise, forcing out upper half of bearing shell.

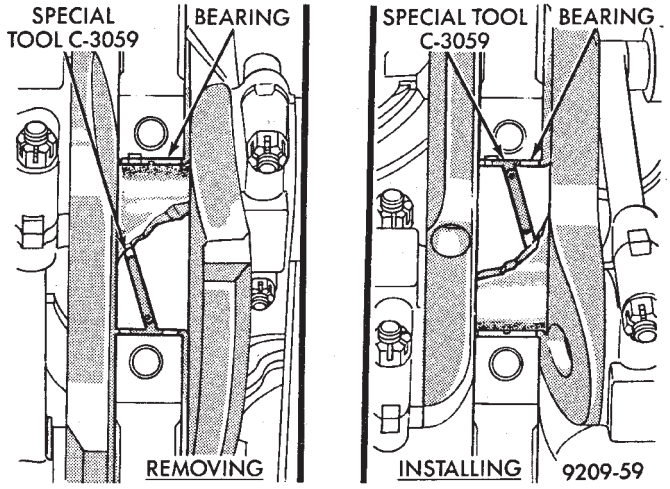


Fig. 64 Removing and Installing Upper Main Bearing With Special Tool C-3059

INSTALLATION

NOTE: Only one main bearing should be selectively fitted while all other main bearing caps are properly tightened.

When installing a new upper bearing shell, slightly chamfer the sharp edges from the plain side.

(1) Start bearing in place, and insert Main Bearing Tool C-3059 into oil hole of crankshaft (Fig. 64).

(2) Slowly rotate crankshaft counterclockwise sliding the bearing into position. Remove Special Main Bearing Tool C-3059.

(3) Install each main cap and tighten bolts finger tight.

(4) Tighten number 1, 3 and 4 main cap bolts to 41 N·m + 1/4 Turn (30 ft. lbs.+ 1/4 Turn).

(5) Rotate the crankshaft until number 6 piston is at TDC.

(6) To ensure correct thrust bearing alignment the following procedure must be done:

a. Move crankshaft all the way to the rear of its travel.

b. Then, move crankshaft all the way to the front of its travel.

c. Wedge a appropriate tool between the rear of the cylinder block and rear crankshaft counterweight. This will hold the crankshaft in it's most forward position.

d. Tighten the #2 Thrust Bearing cap bolts to 41 N·m + 1/4 Turn (30 ft. lbs.+ 1/4 Turn). Remove the holding tool.

(7) Install oil pan.

(8) Fill engine crankcase with proper oil to correct level.

CRANKSHAFT OIL SEAL—FRONT

REMOVAL

(1) Disconnect negative cable from battery.

(2) Raise vehicle on hoist. Remove right wheel and inner splash shield.

(3) Remove drive belt. Refer to Group 7, Cooling System for procedure.

(4) Remove crankshaft damper (Fig. 65).

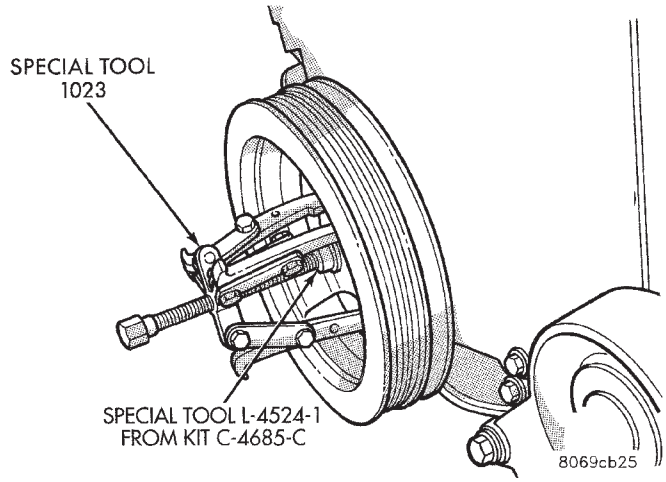


Fig. 65 Crankshaft Damper—Removal

(5) Using Tool 6341A to remove oil seal (Fig. 66). Be careful not to damage that crankshaft seal surface of cover.

INSTALLATION

(1) Install new seal by using Tool C-4992 (Fig. 67).

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

(3) Install crankshaft pulley using plate L-4524. Thrust Bearing/washer and 5.9 inch screw (Fig. 68).

REMOVAL AND INSTALLATION (Continued)

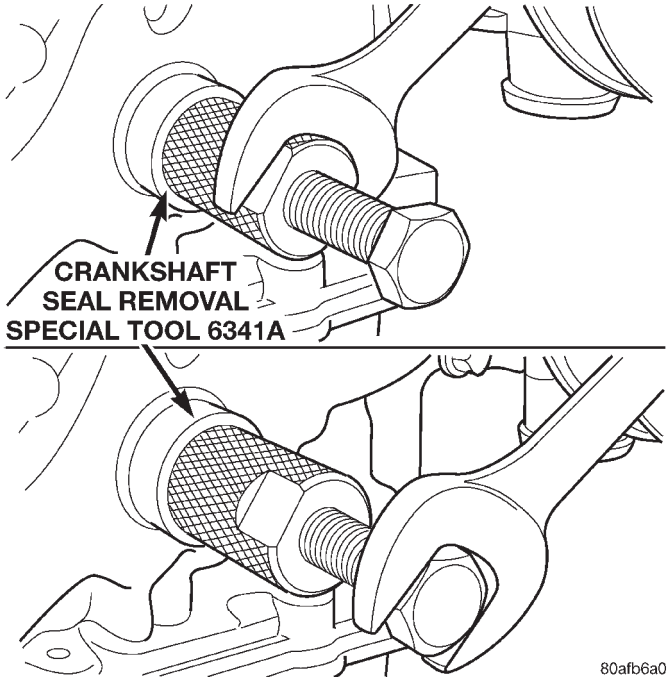


Fig. 66 Front Crankshaft Oil Seal—Removal

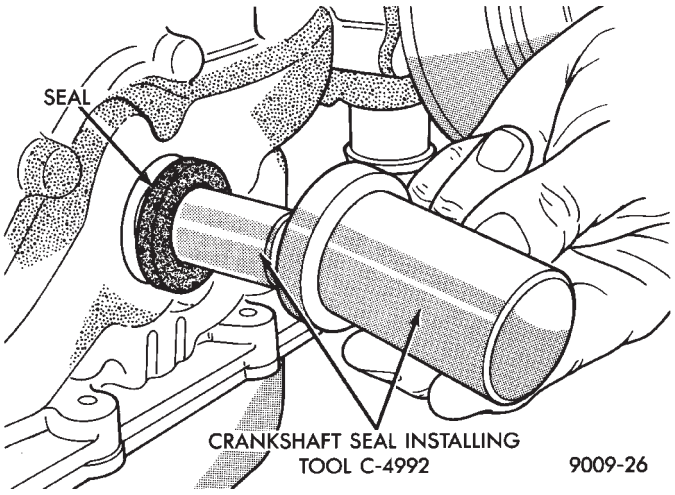


Fig. 67 Crankshaft Oil Seal—Installation

(4) Install drive belt Refer to Group 7, Cooling System for installation procedure.

(5) Install inner splash shield and wheel.

(6) Lower vehicle and connect negative cable to battery.

CRANKSHAFT OIL SEAL—REAR

REMOVAL

(1) Insert a 3/16 flat bladed pry tool between the dust lip and the metal case of the crankshaft seal. Angle the pry tool (Fig. 69) through the dust lip against metal case of the seal. Pry out seal.

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

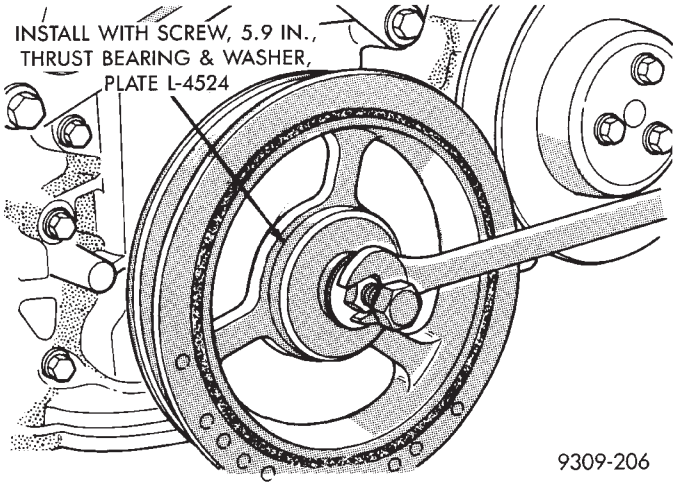


Fig. 68 Crankshaft Damper—Installation

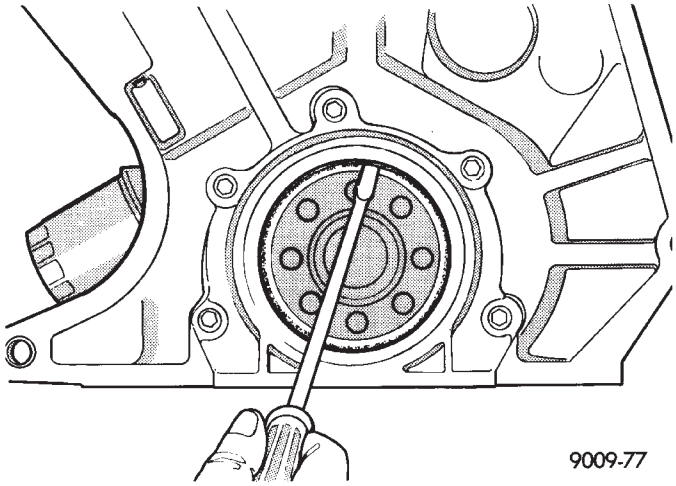


Fig. 69 Rear Crankshaft Oil Seal—Removal

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.

(1) Place Special Tool 6926-1 magnetic pilot tool on crankshaft (Fig. 70).

(2) Lightly coat seal O.D. with Mopar® Stud N' Bearing Mount Adhesive or equivalent.

(3) Place seal over Special Tool 6926-1 Pilot. Using Special Tool 6926-2 Installer with C-4171 Handle, drive seal into the retainer housing (Fig. 70).

REAR CRANKSHAFT SEAL RETAINER

When retainer removal is required, remove retainer and clean engine block and retainer of old gasket. Make sure surfaces are clean and free of oil.

REMOVAL AND INSTALLATION (Continued)

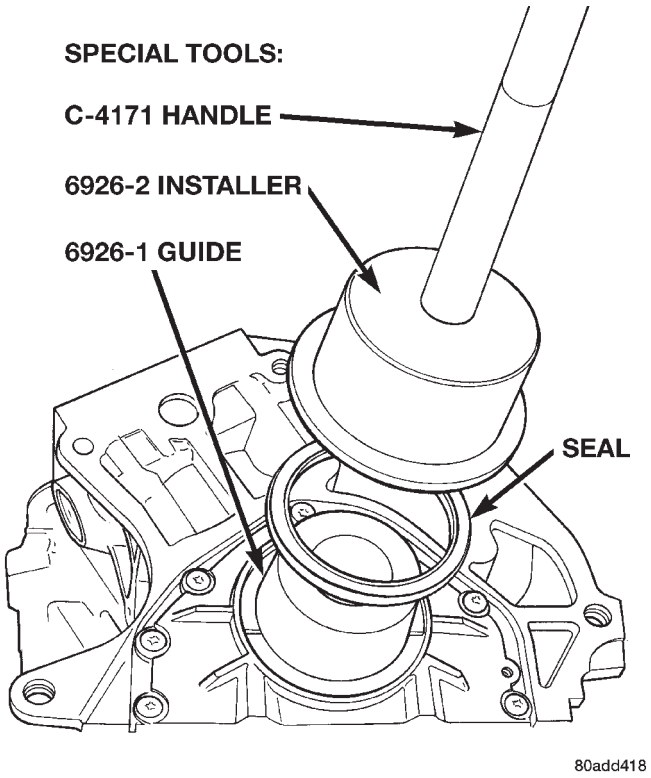


Fig. 70 Rear Crankshaft Oil Seal—Installation

Install new gasket and tighten screws to 12 N·m (105 in. lbs.).

OIL FILTER

CAUTION: When servicing the oil filter (Fig. 71) 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) Using Tool C-4065, turn filter counterclockwise to remove from base. Properly discard filter.

(2) Wipe base clean, then inspect gasket contact surface.

(3) Lubricate gasket of new filter with clean engine oil.

(4) Install new filter until gasket contacts base. Tighten filter 1 turn or 20 N·m (15 ft. lbs.). Use filter wrench if necessary.

(5) Start engine and check for leaks.

ENGINE OIL GALLERY PLUGS

REMOVAL

Using a blunt tool such as a drift and a hammer, strike the bottom edge of the cup plug. With the cup plug rotated, grasp firmly with pliers or other suitable tool and remove plug (Fig. 72).

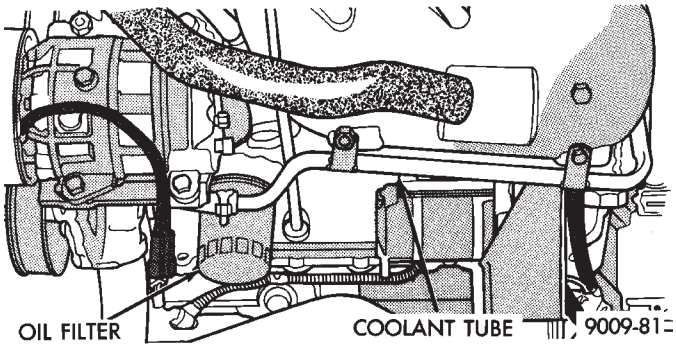


Fig. 71 Oil Filter

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

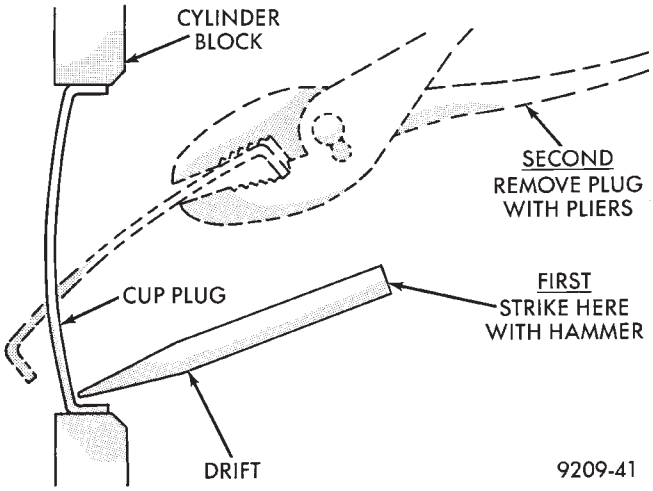


Fig. 72 Core Hole Plug Removal

INSTALLATION

Thoroughly clean inside of cup plug hole in cylinder block or head. Be sure to remove old sealer. Lightly coat inside of cup plug hole with Loctite Stud N' Bearing Mount or equivalent. 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 in.) inside the lead-in chamfer.

DISASSEMBLY AND ASSEMBLY

OIL PUMP

It is necessary to remove the oil pan, oil pickup and chain case cover to service the oil pump rotors. The oil pump pressure relief valve can be serviced by removing the oil pan and oil pickup tube. Refer to Timing Chain Cover Removal and Installation of this section for procedures.

DISASSEMBLY

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

DISASSEMBLY AND ASSEMBLY (Continued)

(2) Drill a 3.175 mm (1/8 inch) hole into the relief valve retainer cap and insert a self-threading sheet metal screw into cap.

(3) Clamp screw into a vise and while supporting chain case cover, remove cap by tapping chain case cover using a soft hammer. Discard retainer cap and remove spring and relief valve (Fig. 73).

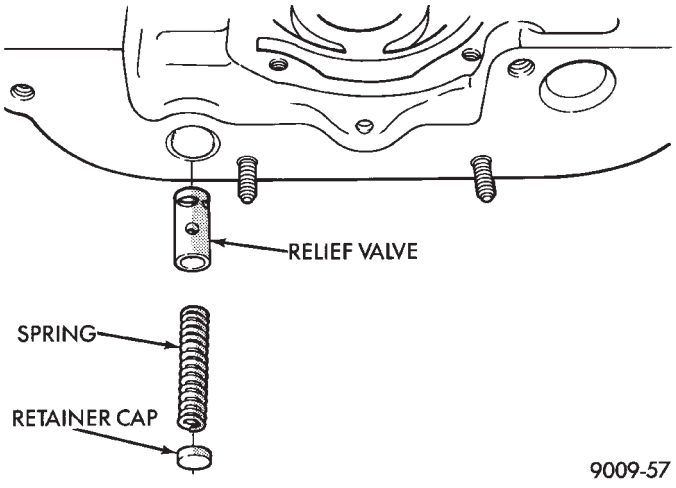


Fig. 73 Oil Pressure Relief Valve

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

(5) Remove pump rotors.

(6) Wash all parts in a suitable solvent and inspect carefully for damage or wear (Fig. 76).

OIL PUMP ASSEMBLY

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

(2) Tighten cover screws to 12 N·m (105 in. lbs.).

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

(4) Install chain case cover. Refer to Timing Chain Cover Installation of this section.

HYDRAULIC TAPPETS

DISASSEMBLY

(1) Pry out plunger retainer spring clip (Fig. 74).

(2) Clean varnish deposits from inside of tappet body above plunger cap.

(3) Invert tappet body and remove plunger cap, plunger, flat or ball check valve, check valve spring, check valve retainer and plunger spring. Check valve could be flat or ball.

ASSEMBLY

(1) Clean all tappet parts in a solvent that will remove all varnish and carbon.

(2) Replace tappets that are unfit for further service with new assemblies.

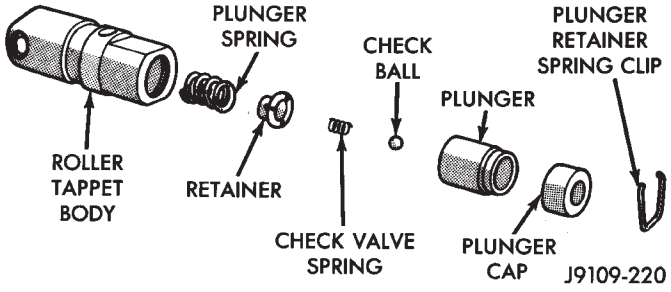


Fig. 74 Hydraulic Roller Tappet Assembly

(3) If plunger shows signs of scoring or wear, valve is pitted, or valve seat on end of plunger indicates any condition that would prevent valve from seating, install a new tappet assembly.

(4) Assemble tappets (Fig. 74).

CLEANING AND INSPECTION

CYLINDER HEAD

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

(2) Clean cylinder head and oil passages.

(3) Check cylinder head for flatness (Fig. 75).

(4) Inspect all surfaces with a straightedge if there is any reason to suspect leakage. If out of flatness exceeds 0.019 mm (0.00075 in.) times the span length in inches, in any direction, either replace head or lightly machine the head surface. As an example, if a 12 inch span is 0.1 mm (.004 in.) out of flat, allowable is 12 x .019 mm (.00075 in.) equals .22 mm (.009 in.) This amount of out of flat is acceptable. Maximum of 0.2 mm (.008 in.) for grinding is permitted.

CAUTION: This is a combined total dimension of stock removal from cylinder head and block top surface.

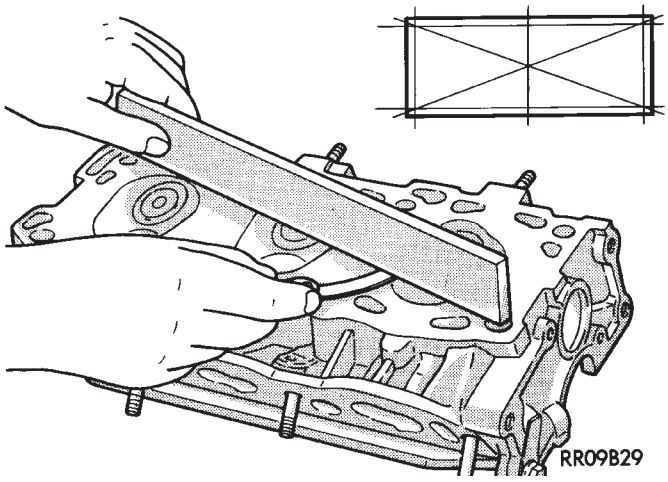


Fig. 75 Check Cylinder Head

CLEANING AND INSPECTION (Continued)

OIL PAN

(1) Clean oil pan in solvent and wipe dry with a clean cloth. Clean all gasket material from mounting surfaces of pan and block.

(2) Inspect oil drain plug and plug hole for stripped or damaged threads and repair as necessary. Install a new drain plug gasket. Tighten to 27 N·m (20 ft. lbs.).

(3) Inspect oil pan mounting flange for bends or distortion. Straighten flange if necessary.

(4) Clean oil screen and pipe in clean solvent. Inspect condition of screen.

OIL PUMP

INSPECTION AND REPAIR

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

(2) Lay a straightedge across the pump cover surface (Fig. 77). If a 0.025 mm (0.001 in.) 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 7.64 mm (0.301 in.) or less (Fig. 78), or if the diameter is 79.95 mm (3.148 inches.) or less, replace outer rotor.

(4) If inner rotor measures 7.64 mm (0.301 in.) or less replace inner rotor (Fig. 79).

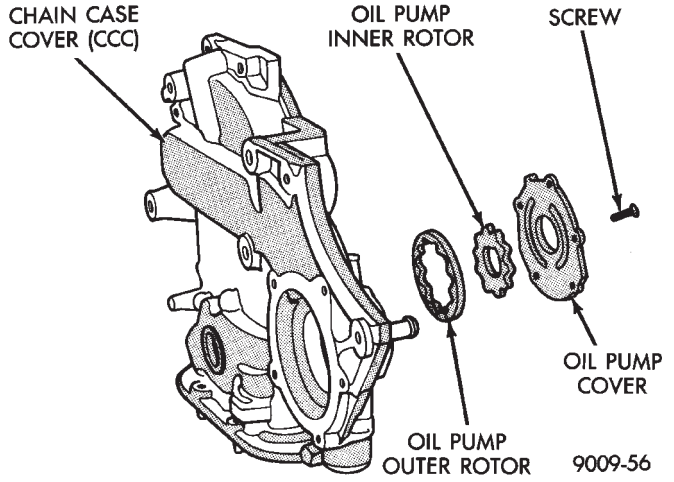


Fig. 76 Oil Pump

(5) Slide outer rotor into chain case cover, press to one side with fingers and measure clearance between rotor and chain case cover (Fig. 80). If measurement is 0.39 mm (0.015 in.) or more, replace CCC only if outer rotor is in specification.

(6) Install inner rotor into chain case cover. If clearance between inner and outer rotors (Fig. 81) is 0.203 mm (0.008 in.) or more, replace both rotors.

(7) Place a straightedge across the face of the chain case cover, between bolt holes. If a feeler gauge

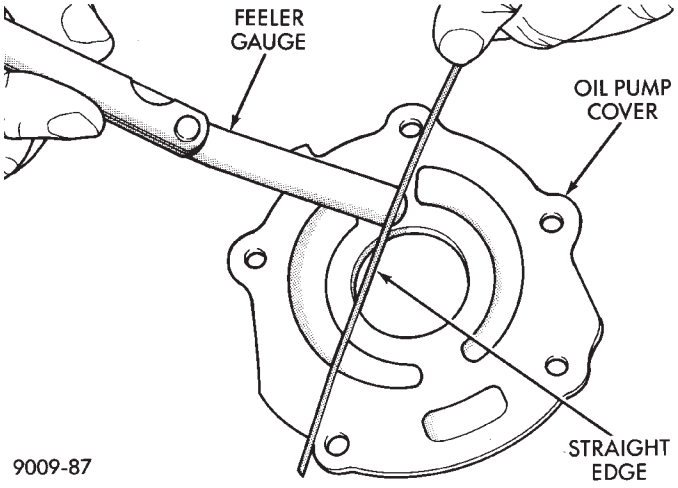


Fig. 77 Checking Oil Pump Cover Flatness

of 0.10 mm (0.004 in.) or more can be inserted between rotors and the straightedge, replace pump assembly (Fig. 82). **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 49.5 mm (1.95 inches) it should test between 19.5 and 20.5 pounds when compressed to 34 mm (1-11/32 inches). Replace spring that fails to meet specifications (Fig. 73).

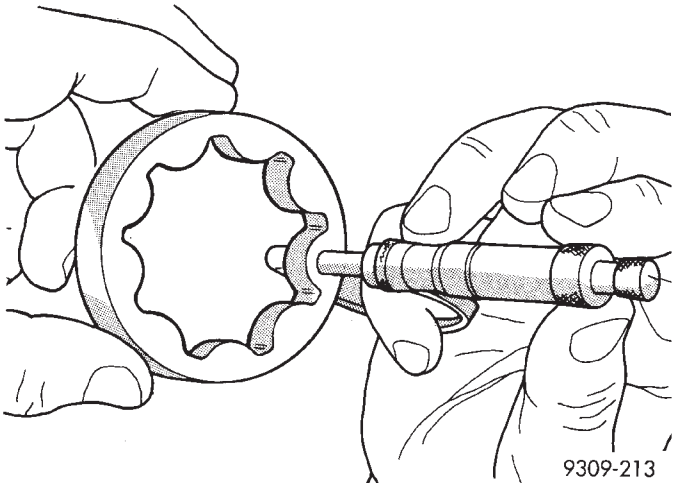


Fig. 78 Measuring Outer Rotor Thickness

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

ENGINE BLOCK AND BORE

CLEANING AND INSPECTION

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

CLEANING AND INSPECTION (Continued)

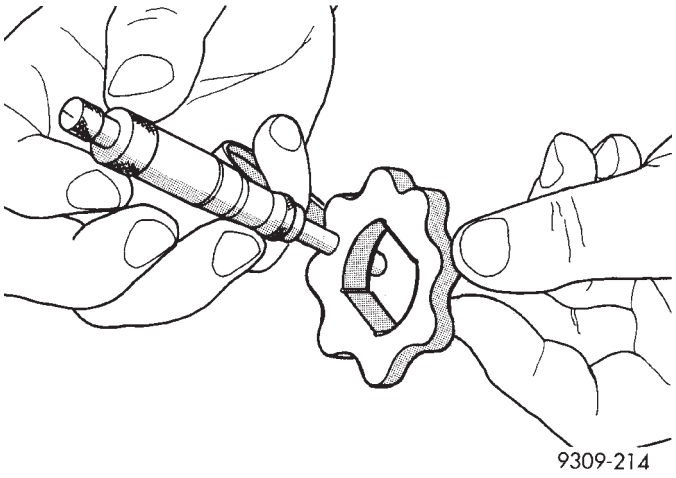


Fig. 79 Measuring Inner Rotor Thickness

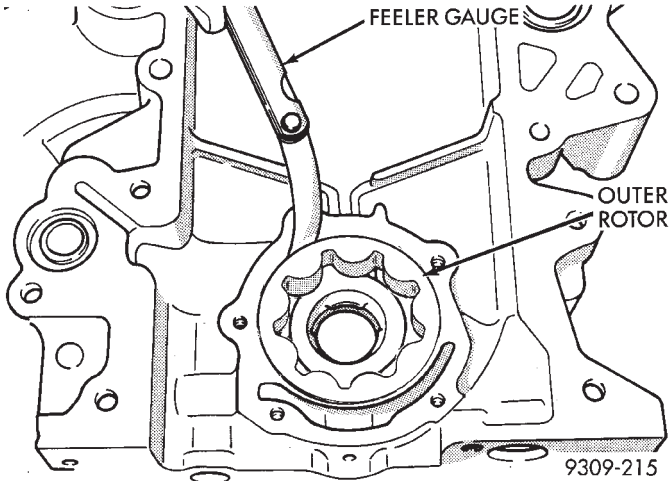


Fig. 80 Measuring Outer Rotor Clearance in Housing

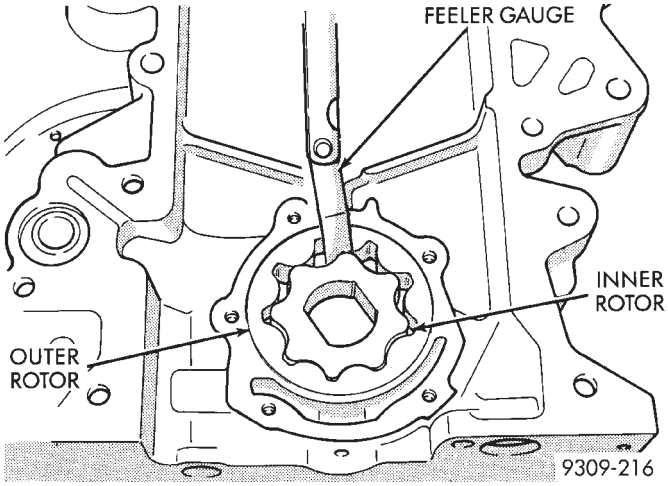


Fig. 81 Measuring Clearance Between Rotors

(2) If new core plugs are installed, see Engine Core Oil and Cam Plugs.

(3) Examine block for cracks or fractures.

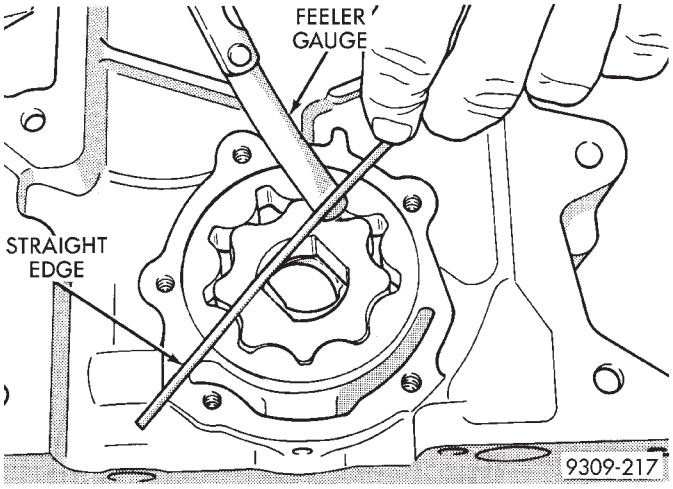


Fig. 82 Measuring Clearance Over Rotors

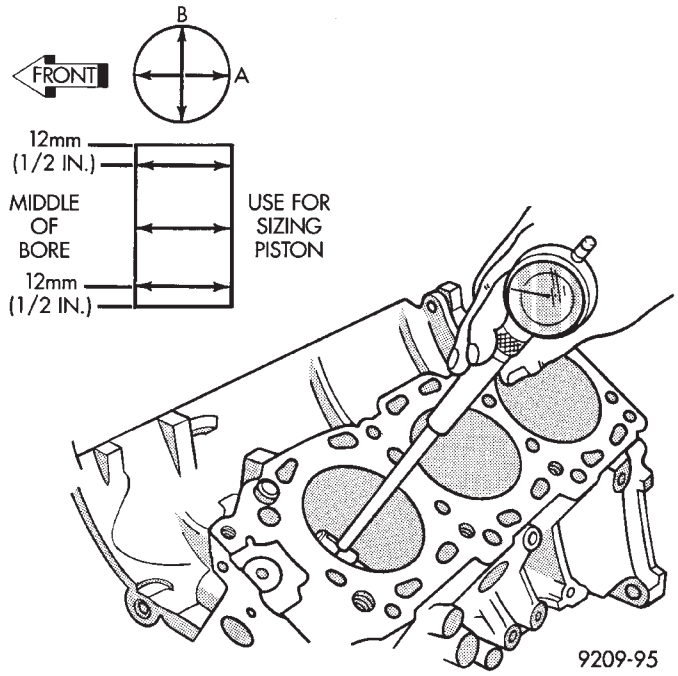


Fig. 83 Checking Cylinder Bore Size

CYLINDER BORE INSPECTION

The cylinder walls should be checked for out-of-round and taper with Tool C-119 (Fig. 83). If the cylinder walls are badly scuffed or scored, the cylinder block should be replaced.

Measure the cylinder bore at three levels in directions A and B (Fig. 83). Top measurement should be 12 mm (0.50 in.) down and bottom measurement should be 12 mm (0.50 in.) up from bottom of bore. Refer to Cylinder Bore and Piston Specification Chart.

CLEANING AND INSPECTION (Continued)

CYLINDER BORE AND PISTON SPECIFICATION CHART

Engine	Standard Bore	Maximum Out-Of-Round	Maximum Taper
3.3L	92.993 - 93.007 mm (3.661 - 3.6617 in.)	0.076 mm (0.003 in.)	0.51 mm (0.002 in.)
3.8L	95.993 - 96.007 mm 3.7792 - 3.780 in.	Same	Same
Standard Piston Size			
3.3L	92.950 - 92.968 mm (3.6594 - 3.6602 in.)		
3.8L	95.950 - 95.968 mm (3.7776 - 3.7783 in.)		
Piston to Bore Clearance: 0.025 - 0.057 mm (0.0009 - 0.0022 in.)			
Measurements taken at Piston Size Location.			

ADJUSTMENTS

ENGINE MOUNTS

ENGINE MOUNT INSULATOR 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 mount insulator vertical fastener and the fore and aft fasteners, and the front engine mount bracket to front crossmember screws.

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

(4) Tighten engine mounts and fasteners in the following order:

(a) Right engine mount insulator vertical bolts to 102 N·m (75 ft. lbs.) and the fore and aft bolts to 150 N·m (110 ft. lbs.).

(b) Front engine mount screws to 54 N·m (40 ft. lbs.) the clearance between the snubbers and the engine should be 2 mm (0.078 inch.) each side.

(c) Left engine mount through bolt to 75 N·m (55 ft. lbs.).

(5) Recheck driveshaft length.

SPECIFICATIONS

3.3/3.8L ENGINE

Type. . . . . .60° V-6 Engine
Bore–3.3L. . . . . .93.0 mm (3.66 in.)
Bore–3.8L. . . . . .96.0 mm (3.779 in.)
Stroke–3.3L . . . . . .81.0 mm (3.188 in.)
Stroke–3.8L . . . . . .87.0 mm (3.425 in.)
Compression Ratio–3.3L 8.9:1
Compression Ratio–3.8L 9.6:1
Displacement–3.3L. . . . . .3.3L (201 Cubic in.)
Displacement–3.8L. . . . . .3.8L (231 Cubic in.)
Brake Horsepower–3.3L. . . . . .158 @ 4850 RPM
Brake Horsepower–3.8L. . . . . .180 @ 4400 RPM
Torque–3.3L . . . . . .203 lb. ft. @ 3600 RPM
Torque–3.8L . . . . . .240 lb. ft. @ 3600 RPM
Firing Order. 1–2–3–4–5–6
Compression Pressure.Refer to Engine Performance in Standard Service Procedures.

Cylinder Number (Front to Rear)

Front Bank 2,4,6
Rear Bank. 1,3,6

Cylinder Block

Cylinder Bore (Standard)–3.3L . . . . . .93.0 mm (3.66 in.)
Cylinder Bore (Standard)–3.8L . . . . . .96.0 mm (3.779 in.)
Out-of-Round (Max.). . . . . .0.076 mm (0.003 in.)
Taper (Max.). . . . . .0.051 mm (0.002 in.)
Cylinder Bore Oversize (Max.). . . . . .0.508 mm (0.020 in.)
Tappet Bore Diameter . . . . .22.9896 - 23.0099 mm (0.9051 - 0.9059 in.)

Pistons

Type Material . . . . . .Aluminum Alloy Tin Coated
Clearance at Size Location. . . . . .0.025 - 0.057 mm (0.001 - 0.0022 in.)
Weight (Standard Only)–3.3L . . . . . .381 ±5 grams (13.4394 ±0.1764 oz.)
Weight (Standard Only)–3.8L . . . . . .438 ±5 grams (15.4501 ±0.1764 oz.)
Pistons for Service. . . . . .Standard Only

Piston Pins

Type . . . . . .Press Fit in Rod (Serviced as an Assembly)
Diameter . . . . . .22.88 mm (0.9009 - 0.9007 in.)
Length–3.3L . . . . . .67.25 - 67.75 mm (2.648 - 2.667 in.)
Lenth–3.8L . . . . . .71.25 - 71.75 mm (2.805 - 2.824 in.)
Clearance in Piston @ 70° . . . . . .0.006 - 0.019 mm (0.0002 - 0.0007 in.)
Clearance in Rod . . . . . .(Interference)

SPECIFICATIONS (Continued)

Piston Rings
Number of Rings 3
Compression 2
Oil Control 1
Oil Ring Type . . .3–Piece, Steel Rail, Chrome Face

Piston Ring Gap
Top & 2nd Compression ing. . . . . .0.30 - 0.55 mm (0.0118 - 0.0217 in.)
Oil Control (Steel Rails) . . . . . .0.25 - 1.00 mm (0.0098 - 0.0394 in.)

Service Rings
Ring Gap–Compression . . . . . .0.300 - 0.550 mm (0.0118 - 0.0217 in.)
Ring Gap–Oil Control . . . . . .0.250 - 1.00 mm (0.0098 - 0.0394 in.)

Piston Ring Side Clearance
Top & 2nd Compression Rings . . .0.030 - 0.095 mm (0.0012 - 0.0037 in.)
Oil Ring (Steel Rails). . . . . .0.014 - 0.226 mm (0.0005 - 0.0089 in.)

Piston Ring Width
Compression Rings . . . . . .1.46 - 1.50 mm (0.0575 - 0.0591 in.)
Oil Ring (Steel Rails). . . . . .0.510 mm (0.0201 in.)

Connecting Rods
Bearing Type . . . . . .Aluminum Lead (Bimetal)
Bearing Clearance . . . . . .0.019 - 0.065 mm (0.00075 - 0.0026 in.)
Max. Allowable . . . . . .0.076 mm (0.003 in.)
Side Clearance . . . . . .0.127 - 0.381 mm (0.005 - 0.015 in.)

Crankshaft
Type . . . . . .Cast Nodular Iron
Bearing Type . . . . . .Aluminum Lead (Bimetal)
Thrust Location. . . . . .No. 2 Bearing
Connecting Rod
Journal Diameter . . . . . .53.950 - 53.975 mm (2.124 - 2.125 in.)
Main Bearing Diametrical
Clearance No. 1- 4. . . . . .0.011 - 0.059 mm (0.0043 - 0.0023 in.)
Max. Allowable . . . . . .0.102 mm (0.004 in.)
End Play . . . . .0.09 - 0.24 mm (0.0036 - 0.0095 in.)
Max. Allowable . . . . . .0.381 mm (0.015 in.)

Main Bearing Journals
Diameter . . . . . .64.013 - 63.993 mm (2.5202 - 2.5195 in.)
Out-of-Round (Max.). . . . . .0.025 mm (0.001 in.)
Taper (Max.). . . . . .0.025 mm (0.001 in.)

Connecting Rod Journals
Diameter . . . . . .58.005 - 57.979 mm (2.2837 - 2.2827 in.)
Out-of-Round (Max.). . . . . .0.025 mm (0.001 in.)
Taper (Max.). . . . . .0.025 mm (0.001 in.)

Camshaft
Drive . . . . . .Chain
Bearings. . . . . .Steel Backed Babbitt
Number. 4
Diametrical Clearance . . . . . .0.025 - 0.101 mm (0.001 - 0.004 in.)
Max. Allowable . . . . . .0.127 mm (0.005 in.)
Thrust Taken By. . . . . .Thrust Plate
End Play . . . . . .0.127 - 0.304 mm (0.005 - 0.012 in.)
Max. Allowable . . . . . .0.304 mm (0.012 in.)

Camshaft Journals
Bearing Journal
Diameter No. 1 . . . . . .50.724 - 50.775 mm (1.997 - 1.999 in.)
Bearing Journal
Diameter No. 2 . . . . . .50.317 - 50.368 mm (1.9809 - 1.9829 in.)
Bearing Journal
Diameter No. 3 . . . . . .49.936 - 49.987 mm (1.9659 - 1.9679 in.)
Bearing Journal
Diameter No. 4 . . . . . .49.530 - 49.581 mm (1.9499 - 1.9520 in.)

Camshaft Bearings
Diameter No. 1. . . . . .50.825 - 50.800 mm (2.0009 - 1.9999 in.)
Diameter No. 2. . . . . .50.419 - 50.393 mm (1.9849 - 1.9839 in.)
Diameter No. 3. . . . . .50.038 - 50.013 mm (1.9699 - 1.9690 in.)
Diameter No. 4. . . . . .49.632 - 49.606 mm (1.954 - 1.9529 in.)
Oil Clearance . . . . . .0.0254 - 0.0762 mm (0.001 - 0.003 in.)

Valve Timing Exhaust Valve
Closes (ATC) . . . . . .12°
Opens (BBC) . . . . . .48°
Duration . . . . . .240°

Valve Timing Intake Valve
Closes (BTDC) . . . . . .58°
Opens . . . . . .2°
Duration . . . . . .240°
Valve Overlap . . . . . .14°

Timing Chain
Number of Links 64
Pitch . . . . . .0.375 inch
Width . . . . . .0.750 inch

Hydraulic Tappets
Type . . . . . .Roller Hydraulic
Body Diameter. . . . . .22.95 - 22.96 mm (0.9035 - 0.9040 in.)
Clearance in Block. . . . . .0.02 - 0.06 mm (0.0007 - 0.0024 in.)

SPECIFICATIONS (Continued)

Service Tappets Available . . . . . .Std., 0.025 mm (0.001), 0.20 mm (0.008 in.), 0.762 mm (0.030 in.)

Cylinder Head

Gasket Thickness (Compressed) . . . . . .1.78 mm (0.070 in.)

Cylinder Head Valve Seat

Angle–Intake and Exhaust . . . . . .45 - 45.5°
Runout (Max) . . . . . .0.0762 mm (0.003 in.)
Width (Finish)–Intake . . . . . .1.75 - 2.25 mm (0.069 - 0.088 in.)
Width (Finish)–Exhaust . . . . . .1.50 - 2.00 mm (0.057 - 0.078 in.)

Valve Guides

Type. . . . . .Powdered Metal Inserts
Guide Bore Diameter. . . . . .7.975 - 8.00 mm (0.314 - 0.315 in.)

Valves—Intake

Face Angle . . . . . .44.5°
Head Diameter. . . . . .45.5 mm (1.79 in.)
Length (Overall). . . . . .127.005 - 128.036 mm (5.000 - 5.041 in.)
Minimum Valve Length After Tip Grinding . . . . . .124.892 (4.916 in.)
Lift (Zero Lash) . . . . . .10.16 mm (0.400 in.)
Stem Diameter (Standard). . . . . .7.935 - 7.953 mm (0.312 - 0.313 in.)
Valve Tip Height (From Cylinder Head Surface) . . . . . .49.541 - 51.271 mm (1.950 - 2.018 in.)
Stem-to-Guide Clearance . . . . . .0.025 - 0.095 mm (0.001 - 0.003 in.)
Max. Allowable (Rocking Method) . . . .0.247 mm (0.010 in.)
Valves for Service (Oversize Stem Diameters). . . . . .Std., 0.015 mm (0.005 in.), 0.40 mm (0.015 in.), 0.80 mm (0.030 in.)

Valves—Exhaust

Face Angle . . . . . .45°
Head Diameter . . . . . .37.5 mm (1.476 in.)
Length Overall . . . . . .127.825 - 128.465 (5.032 - 5.058 in.)
Minimum Valve Length After Tip Grinding . . . . . .125.512 mm (4.941 in.)
Lift (Zero Lash) . . . . . .10.16 mm (0.40 in.)
Valve Tip Height (From Cylinder Head Surface) . . . . . .49.541 - 51.271 mm (1.950 - 2.018 in.)
Stem Diameter (Standar). . . . . .7.906 - 7.924 mm (0.3112 - 0.3119 in.)
Stem to Guide Clearance . . . . . .0.051 - 0.175 mm (0.002 - 0.006 in.)
Max. Allowable (Rocking Method) . . . . . .0.414 mm (0.016 in.)
Valves for Service (Oversize Stem Diameters). . . . . .Std., 0.015 mm (0.005 in.), 0.40 mm (0.015 in.), 0.80 mm (0.030 in.)

Valve Springs

Free Length (Approx.) . . . . . .48.5 mm (1.909 in.)
Wire Diameter . . . . . .4.75 mm (0.187 in.)
Number of Coils 6.8
Spring Tension (Valve Closed) . . . . . .95 - 100 lbs. @ 1.57 in.
Spring Tension (Valve Open) . . . . . .207 - 229 lbs. @ 1.169 in.
Installed Height (Spring Seat to Bottom of Retainer) . . . . . 41.2 - 42.7 mm (1.622 - 1.681 in.)

Oil Pump

Pump Type. . . . . .Rotary Full Pressure
Clearance Over Rotors (Inner & Outer Max.). . . . . .0.10 mm (0.004 in.)
Cover Out-of-Flat (Max.). . . . .0.025 mm (0.001 in.)
Inner Rotor Thickness (Min.) . .7.64 mm (0.301 in.)
Outer Rotor Thickness (Min.) . .7.64 mm (0.301 in.)
Outer Rotor Diameter (Min.) .79.95 mm (3.148 in.)
Outer Rotor Clearance . . . . . .0.39 mm (0.015 in.)
Tip Clearance Between Rotors (Max.) . . . .0.20 mm (0.008 in.)

Oil Pressure

Minimum Pressure at Idle (Engine Fully Warmed Up) *. . . . . .34.47 kPa (5 psi)
At 3000 rpm . . . . . .205 - 551 kPa (30 - 80 psi)
Oil Filter Bypass Valve Setting. . . . . .62 - 103 kPa (9 - 15 psi)
Oil Filter Type . . . . . .Full Flow
Oil Pressure Switch Actuating Pressure (Min.). . . . . .14 - 28 kPa (2 - 4 psi)

CAUTION: * If pressure is ZERO at curb Idle, DO NOT run engine at 3,000 rpm.

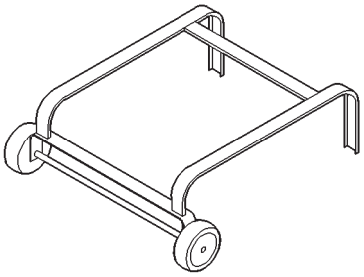
SPECIFICATIONS (Continued)

TORQUE CHART

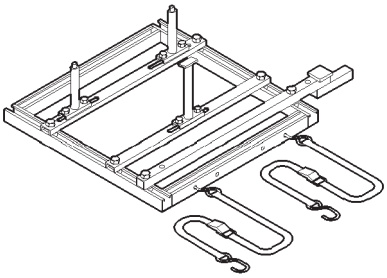
DESCRIPTION	TORQUE
A/C Compressor Mounting	
Compressor Bracket to Water Pump Bolt	.41 N·m (30 ft. lbs.)
Compressor to Bracket Bolt	.68 N·m (50 ft. lbs.)
Compressor Support Bolt	.41 N·m (30 ft. lbs.)
Camshaft Sprocket	
Bolt	.54 N·m (40 ft. lbs.)
Camshaft Thrust Plate	
Bolt	.12 N·m (105 in. lbs.)
Connecting Rod	
Nut	.54 N·m (40 ft. lbs.) +¼ Turn
Crankshaft Damper Pulley to Crankshaft	
Bolt	.54 N·m (40 ft. lbs.)
Cylinder Head	
Bolts	.Refer to Cylinder Head Removal and Installation Procedure in this Section
Cylinder Head Cover	
Bolts	.12 N·m (105 in. lbs.)
Exhaust Manifold	
Bolts	.23 N·m (200 in. lbs.)
Exhaust Crossover Pipe Flange	
Fasteners	.33 N·m (25 ft. lbs.)
Generator Mounting	
Adjusting Strap Bolt	.23 N·m (200 in. lbs.)
Adjusting Strap Mounting Bolt	.41 N·m (30 ft. lbs.)
Bracket Bolt	.41 N·m (30 ft. lbs.)
Pivot Nut	.41 N·m (30 ft. lbs.)
Intake Manifold	
Bolts	.23 N·m (200 in. lbs.)
Intake Manifold Gasket Retaining	
Screws	.12 N·m (105 in. lbs.)
Intake Manifold Plenum	
Bolts	.28 N·m (250 in. lbs.)
Main Bearing Cap	
Bolts	.41 N·m (30 ft. lbs.) +¼ Turn
Oil Filter Attaching	
Nipple	.41 N·m (30 ft. lbs.)
Oil Pan	
Bolts	.12 N·m (105 in. lbs.)
Drain Plug	.27 N·m (20 ft. lbs.)
Level Sensor Plug	.41 N·m (30 ft. lbs.)
Oil Pressure Gauge Sending Unit	.7 N·m (60 in. lbs.)
Oil Pump	
Cover Bolts	.12 N·m (105 in. lbs.)
Pick-up Tube Bolt	.28 N·m (250 in. lbs.)
Rocker Shaft Bracket	
Bolts	.28 N·m (250 in. lbs.)
Spark Plug	.27 N·m (20 ft. lbs.)
Starter Mounting	
Bolt	.68 N·m (50 ft. lbs.)
Strut—Intake Manifold to Cylinder Head	
Bolt	.54 N·m (40 ft. lbs.)
Tappet Retainer Yoke	
Bolt	.12 N·m (105 in. lbs.)
Temperature Gauge Sending Unit	.7 N·m (60 in. lbs.)
Timing Chain Case Cover	
Bolt–M8 × 1.25	.27 N·m (20 ft. lbs.)
Bolt–M10 × 1.5	.54 N·m (40 ft. lbs.)
Water Pump to Chain Case Cover	
Bolts	.12 N·m (105 in. lbs.)

SPECIAL TOOLS

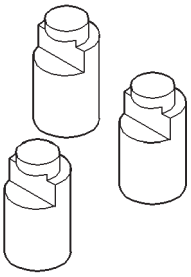
3.3/3.8L ENGINE



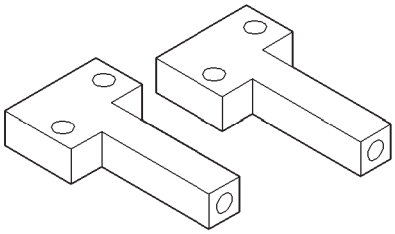
Dolly 6135



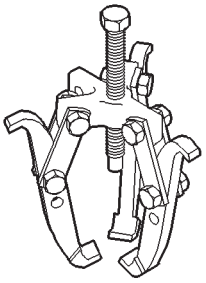
Cradle 6710



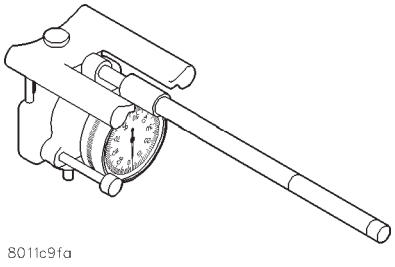
Adaptor 6909



Adaptor 6912

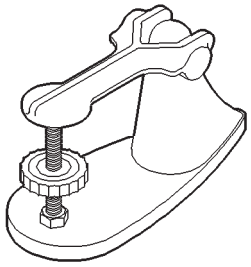


Puller 1023

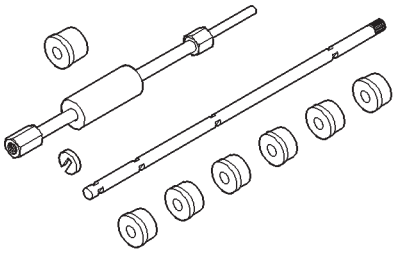


Indicator, Cylinder Bore C-119

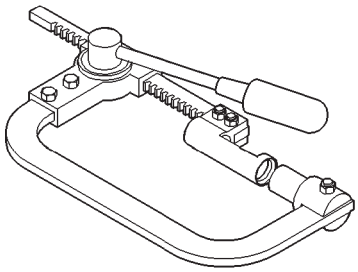
SPECIAL TOOLS (Continued)



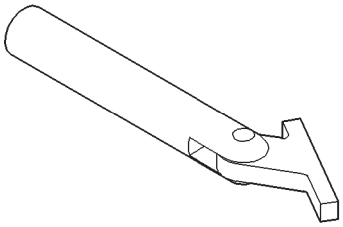
Tester Valve Spring C-647



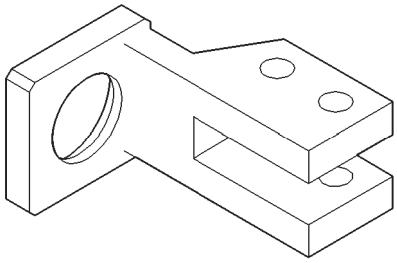
Camshaft Bearing Remover and Installer C-3132–A



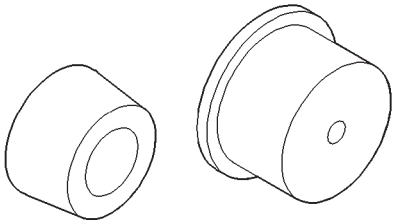
Valve Spring Compressor C-3422–B



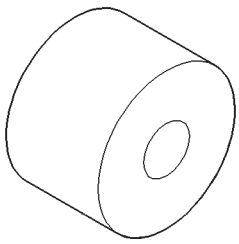
Crankshaft Main Bearing Remover and Installer C-3059



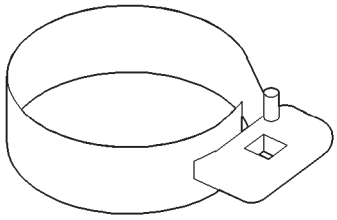
Adaptor Valve Compressor 6412



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

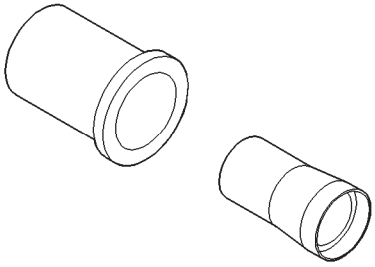


Insert Crankshaft Pulley Remover L-4524-1



8011d480

Oil Filter Wrench C-4065



Front Crankshaft Seal Installer C-4992