ENGINE

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STANDARD SERVICE PROCEDURES

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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 to assure obtaining the desired results. Bead size, continuity, and location are of great importance. Too thin a bead can result in leakage while too much can result in spillover which can break off and obstruct fluid feed lines. A continuous bead of the proper width is essential to obtain a leak-free joint.

Two types of form-in-place gasket materials are used in the engine area. Mopar Silicone Rubber Adhesive Sealant and anaerobic gasket materials, each have different properties and cannot be used interchangeably.

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.

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

FORM-IN-PLACE GASKET APPLICATION

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

MOPAR Gasket Maker material should be applied sparingly 1mm(0.040 inch.) 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 3mm (0.120 inch) in diameter. All mounting holes must be circled. For corner sealing, a 3.17 or 6.35 mm (1/8 or 1/4 inch.) drop is placed in the center of the gasket contact area. Uncured sealant may be removed with a shop towel. Components should be torqued in place while the sealant is still wet to the touch (within 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 proper size socket, extension and rachet, when crankshaft rotation is necessary.

ENGINE PERFORMANCE

If a loss of performance is noticed, ignition timing should be checked. If ignition timing is retarded by 9, 18 or 27° indicating 1, 2 or 3 (timing belt) teeth may have skipped, then, camshaft and accessory shaft timing with the crankshaft should be checked. Refer to Engine Timing Sprockets and Oil Seals of the Engine Section.

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

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

(2) Tighten the intake manifold bolts to specifications.

(3) Perform cylinder compression test.

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

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

(c) Select a route free from traffic and other forms of congestion, observe all traffic laws, and accelerate through the gears several times briskly.

CAUTION: Do not overspeed the engine. The higher engine speed may help clean out valve seat deposits which can prevent accurate compression readings.

(d) 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.

(e) 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.

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

(g) 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.

(h) Repeat Step G for all remaining cylinders.

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

(j) If one or more cylinders have abnormally low compression pressures, repeat steps 4b through 4h.

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

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

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

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

(6) Inspect the primary wire. Test coil output voltage, primary and secondary resistance. Replace parts as necessary. Refer to Ignition System and make necessary adjustment.

(7) Ignition timing should be set to specifications. (See Specification Label in engine compartment).

(8) Test fuel pump for pressure and vacuum. Refer to Fuel System Group 14, Specifications.

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

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

(11) Inspect and adjust accessory belt drives refering to Accessory Belt Drive in Cooling System, Group 7 for the proper adjustments.

(12) Road test vehicle as a final test.

HONING CYLINDER BORES

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

(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 (C-3501-3810) 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. Use a light honing oil available from major oil distributors. **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. 1).

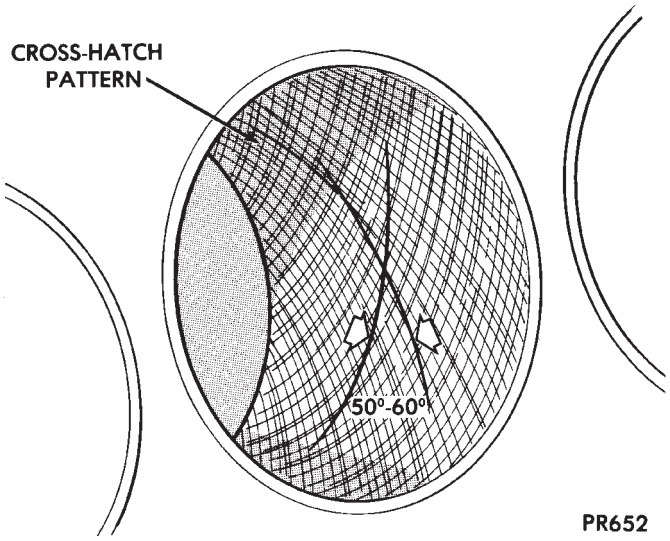

Fig. 1 Cylinder Bore Cross-Hatch Pattern

(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: Be sure all abrasive 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.

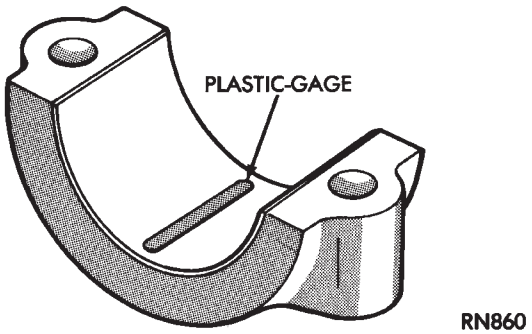

Fig. 2 Plastigage Placed in Lower Shell

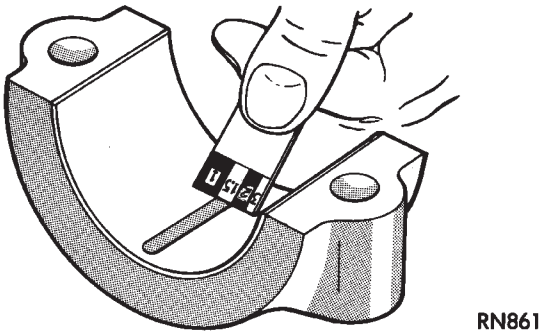

Fig. 3 Clearance Measurement

MEASURING MAIN BEARING CLEARANCE AND CONNECTING ROD BEARING CLEARANCE

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:

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

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

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 0.254mm (.010 inch) shim (e.g. cardboard, matchbook cover, etc.) between the bearing shell and the bearing cap on the adjacent bearings and snuggling bolts to 14-20 N·m (10-15 ft. lb.)

- When checking #1 main brg shim #2 main brg
- When checking #2 main brg shim #1 & 3 main brg
- When checking #3 main brg shim #2 & 4 main brg
- When checking #4 ming brg shim #3 & 5 main brg
- When checking #5 main brg shim #4 main brg

REMOVE ALL SHIMS BEFORE REASSEMBLING ENGINE

ALTERNATIVE METHOD — With the weight of the crankshaft being supported by a jack under the counterweight adjacent to the bearing being checked.

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

(4) Remove the bearing cap and compare the width of the flattened Plastigage (Fig. 3) 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. **Plastic-Gage generally is accompanied by two scales. One scale is in inches, the other is a metric scale.**

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

CONNECTING ROD BEARING CLEARANCE

Engine crankshaft 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 inch.) off center and away from the oil hole (Fig. 2). In addition, suspect areas can be checked by placing plastigage in the suspect area.

(4) Before assembling the rod cap with Plastigage in place, the crankshaft must be rotated until the connecting 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. 3) with the metric scale provided on the package. Locate the band closest to the same width. This band shows the amount of clearance in thousandths of a millimeter. Differences in readings between the ends indicate the amount of taper present. Record all readings taken. Refer to Engine Specifications. **Plastigage generally is accompanied by two scales. One scale is in inches, the other is a metric scale.**

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

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.

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.

(3) Low oil pressure.

(4) The oil restrictor pressed into the vertical oil passage to the cylinder head Balance Shaft Engines Only is plugged with debris.

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

(6) Worn valve guides.

(7) Rocker arm ears contacting valve spring retainer (2.5L engines).

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

(9) Faulty lash adjuster.

(a) Check for sponginess while still installed in cylinder head. Depress part of rocker arm just over adjuster. Normal adjusters should feel very firm. Spongy adjusters can be depressed to the bottomed position easily.

(b) Remove suspected lash adjusters, pry off retainer cap and disassemble. **Do no 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.

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 (or equivalent) Tap, and installing an insert into the tapped hole. This brings the hole back to its original thread size.

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

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

HYDROSTATIC LOCKED ENGINE

When an engine is suspected of hydrostaticly 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 for engine 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 a new oil filter.

(11) Connect negative battery cable.

(12) Start engine and check for any leaks.

ENGINE DIAGNOSIS—PERFORMANCE

CONDITION	POSSIBLE CAUSES	CORRECTION
ENGINE WILL NOT START	1. Weak battery. 2. Corroded or loose battery connections. 3. Faulty starter. 4. Moisture on ignition wires and distributor cap. 5. Faulty ignition cables. 6. Faulty coil or control unit. 7. Incorrect spark plug gap. 8. Incorrect ignition timing. 9. Dirt or water in fuel system. 10. Faulty fuel pump.	1. Test battery specific gravity. Charge or replace as necessary. 2. Clean and tighten battery connections. Apply a coat of light mineral grease to the terminals. 3. Refer to Group 8A, Battery/Starter/Charging System Diagnostics. 4. Wipe wires and cap clean and dry. 5. Replace any cracked or shorted cables. 6. Test and replace, if necessary (refer to Group 8D, Ignition System). 7. Set gap (refer to Group 8D, Ignition System). 8. Refer to Group 8D, Ignition System. 9. Clean system and replace fuel filter. 10. Install new fuel pump (refer to Group 14, Fuel System).
ENGINE STALLS OR ROUGH IDLE	1. Idle speed set too low. 2. Idle mixture too lean or too rich. 3. Leak in intake manifold. 4. Worn or burned distributor rotor. 5. Incorrect ignition wiring. 6. Faulty coil. 7. EGR valve leaking.	1. Refer to Group 14, Fuel System. 2. Refer to Group 14, Fuel System. 3. Inspect intake manifold gasket and vacuum hoses. Replace, if necessary (refer to Group 11, Exhaust System & Intake Manifold). 4. Install new distributor rotor. 5. Install correct wiring. 6. Test and replace, if necessary (refer to Group 8D, Ignition System). 7. Test and replace, if necessary (refer to Group 25, Emissions Control System).
ENGINE LOSS OF POWER	1. Incorrect ignition timing. 2. Worn or burned distributor rotor. 3. Worn distributor shaft. 4. Dirty or incorrectly gapped spark plugs. 5. Dirt or water in fuel system. 6. Faulty fuel pump. 7. Incorrect valve timing. 8. Blown cylinder head gasket. 9. Low compression. 10. Burned, warped or pitted valves. 11. Plugged or restricted exhaust system. 12. Faulty ignition cables. 13. Faulty coil.	1. Refer to Group 8D, Ignition System. 2. Install new distributor rotor. 3. Remove and repair distributor (refer to Group 8D, Ignition System). 4. Clean plugs and set gap (refer to Group 8D, Ignition System). 5. Clean system and replace fuel filter. 6. Install new fuel pump. 7. Correct valve timing. 8. Install new cylinder head gasket. 9. Test compression of each cylinder. 10. Install new valves. 11. Install new parts, as necessary. 12. Replace any cracked or shorted cables. 13. Test and replace, as necessary (refer to Group 8D, Ignition System).
ENGINE MISSES ON ACCELERATION	1. Dirty or gap set too wide in spark plug. 2. Incorrect ignition timing. 3. Dirt in fuel system. 4. Burned, warped or pitted valves. 5. Faulty coil.	1. Clean spark plugs and set gap (refer to Group 8D, Ignition System). 2. Refer to Group 8D, Ignition System. 3. Clean fuel system. 4. Install new valves. 5. Test and replace, if necessary, (refer to Group 8D, Ignition System).
ENGINE MISSES AT HIGH SPEED	1. Dirty or gap set too wide in spark plug. 2. Worn distributor shaft. 3. Worn or burned distributor rotor. 4. Faulty coil. 5. Incorrect ignition timing. 6. Dirty injector in throttle body. 7. Dirt or water in fuel system.	1. Clean spark plugs and set gap (refer to Group 8D, Ignition System). 2. Remove and repair distributor (refer to Group 8D, Ignition System). 3. Install new distributor rotor. 4. Test and replace, as necessary (refer to Group 8D, Ignition System). 5. Refer to Group 8D, Ignition System. 6. Clean injector. 7. Clean system and replace fuel filter.

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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. Bent push rods. 6. Worn rocker arms. 7. Worn tappets/lash adjusters. 8. Worn valve guides. 9. Excessive runout of valve seats on valve faces.	1. Check for correct oil level (refer to Group 0, Lubrication and Maintenance). 2. Change oil (refer to Group 0, Lubrication and Maintenance). 3. Check engine oil level. 4. Clean hydraulic tappets/hydraulic lash adjusters. 5. Install new push rods. 6. Inspect oil supply to rocker arms. 7. Install new hydraulic tappets/hydraulic lash adjusters. 8. Ream and install new valves with oversize stems. 9. Grind valve seats and valves.
CONNECTING ROD NOISE	1. Insufficient oil supply. 2. Low oil pressure. 3. Thin or diluted oil. 4. Excessive bearing clearance. 5. Connecting rod journal out-of-round. 6. Misaligned connecting rods.	1. Check engine oil level (refer to Group 0, Lubrication and Maintenance). 2. Check engine oil level. Inspect oil pump relief valve and spring. 3. Change oil to correct viscosity. 4. Measure bearings for correct clearance. Repair as necessary. 5. Replace crankshaft or grind journals. 6. Replace bent connecting rods.
MAIN BEARING NOISE	1. Insufficient oil supply. 2. Low oil pressure. 3. Thin or diluted oil. 4. Excessive bearing clearance. 5. Excessive end play. 6. Crankshaft journal out-of-round, worn. 7. Loose flywheel or torque converter.	1. Check engine oil level (refer to Group 0, Lubrication and Maintenance). 2. Check engine oil level. Inspect oil pump relief valve and spring. 3. Change oil to correct viscosity. 4. Measure bearings for correct clearance. Repair as necessary. 5. Check No. 3 main bearing for wear on flanges. 6. Grind journals or replace crankshaft. 7. Tighten to correct torque.
OIL PRESSURE DROP	1. Low oil level. 2. Faulty oil pressure sending unit. 3. Low oil pressure. 4. Clogged oil filter. 5. Worn parts in oil pump. 6. Thin or diluted oil. 7. Excessive bearing clearance. 8. Oil pump relief valve stuck. 9. Oil pump suction tube loose, bent or cracked. 10. Oil pump cover warped or cracked.	1. Check engine oil level. 2. Install new sending unit. 3. Check sending unit and check main bearing oil clearance. 4. Install new oil filter. 5. Replace worn parts or pump. 6. Change oil to correct viscosity. 7. Measure bearings for correct clearance. 8. Remove valve and inspect, clean and install. 9. Remove oil pan and install new tube, if necessary. 10. Install new oil pump.
OIL LEAKS	1. Misaligned or deteriorated gaskets. 2. Loose fastener, broken or porous metal part.	1. Replace the gasket. 2. Tighten, repair or replace the part.
OIL CONSUMPTION OR SPARK PLUGS OIL FOULED	1. PCV system malfunction. 2. Worn, scuffed or broken rings. 3. Carbon in oil ring slot. 4. Rings fitted too tightly in grooves. 5. Worn valve guides. 6. Valve stem seal unseated or defective.	1. Check system. Clean and repair, as necessary (refer to Group 25, Emissions Control System). 2. Hone cylinder bores. Install new rings. 3. Install new rings. 4. Remove the rings. Check grooves. If groove is not proper width, replace piston. 5. Ream guides and replace valves with oversize valves and seals. 6. Repair or replace seal.

2.2/2.5L ENGINES

INDEX

2.2/2.5L ENGINE SPECIFICATIONS

Type	In Line 4 Cylinder SOHC
Bore and Stroke	
2.2L	87.5 × 92 mm (3.44 × 3.62 Inch)
2.5L	87.5 × 104 mm (3.44 × 4.09 Inch)
Displacement	
2.2L	2.2 Liters (135 Cubic Inch)
2.5L	2.5 Liters (153 Cubic Inch)
Compression Ratio (Fuel Induction System)	
2.2L	9.5:1 (TBI)
2.2L Turbo III	8.1:1 Nominal (MPI-EFI Intercooled)
2.5L	8.9:1 (TBI)
2.5L Turbo I	7.8:1 (MPI-EFI)
Torque	
2.2L	165 N·m (122 Lbs. Ft.) @ 3200 RPM
2.2L Turbo III	286 N·m (217 Lbs. Ft.) @ 2800 RPM
2.5L	183 N·m (135 Lbs. Ft.) @ 2000 RPM
2.5L Turbo I	244 N·m (180 Lbs. Ft.) @ 2000 RPM
2.5L Turbo I (opt)	284 N·m (210 Lbs. Ft.) @ 2400 RPM
Firing Order	1-3-4-2
Lubrication	Pressure Feed-Full Flow Filtration
Engine Oil Capacity	3.8 Liters (4.0 qts.) without oil filter change, 4.25 Liters (4.5 qts.) with oil filter change.
Cooling System	Liquid Cooled-Forced Circulation
Cylinder Block	Cast Iron
Crankshaft	Cast Nodular Iron Forged Steel Turbo III Engine
Cylinder Head	Aluminum Alloy
Pistons	Cast Aluminum Alloy, Forged Aluminum Alloy (Turbo III)
Connecting Rods	Forged Steel

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GENERAL INFORMATION

ENGINE IDENTIFICATION NUMBER OR CODE

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

BLOCK: All four cylinder cast iron blocks have cast-in recesses in the bottom of each cylinder bore to provide connecting rod clearance; especially for 2.5L engines. The bores are also siamese to minimize engine length. A partial open deck is used for cooling and weight reduction with oil filter, water pump, and distributor mounting bosses molded into the front

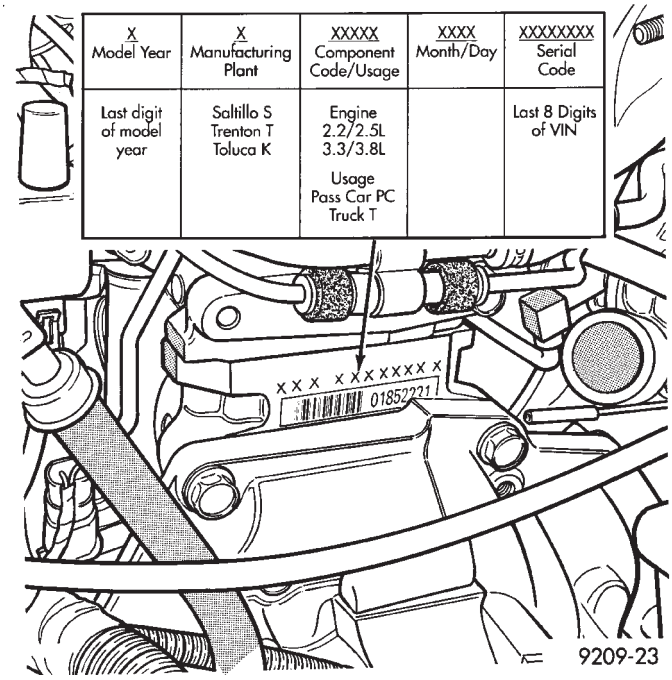

Fig. 1 Engine Identification

(radiator side) of the block. Nominal wall thickness is 4.5 mm. Five main bearing bulkheads and a block skirt extending 3 mm below the crankshaft center line add to the blocks high rigidity with light weight.

CRANKSHAFT: A nodular cast iron crankshaft that is used in TBI and Turbo I engines. A forged steel crankshaft is used in Turbo III engines. All engines have 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 radiuses fillets that are deep rolled for added strength. To optimize bearing loading 4 counterweights are used. Hydrodynamic seals (installed in diecast aluminum retainers) provides end sealing, where the crankshaft exits the block. Anaerobic gasket material is used for retainer-to-block sealing. No vibration damper is used.

A sintered iron timing belt sprocket is mounted on the crankshaft nose. This sprocket provides motive power; via timing belt to the camshaft and intermediate shaft sprockets (also sintered iron) providing timed valve, distributor, and oil pump actuation.

PISTONS: Some Chrysler pistons have cast-in steel struts at the pin bosses for autothermic control. All 2.2L and 2.5L pistons have valve cuts to provide valve clearance. Some pistons are dished to provide various compression ratios. Standard 2.2L and 2.5L engines are designed for 9.5:1 and 8.9:1 compression ratios respectively. The standard 2.5L piston is dished and is a new lightweight design to further enhance engine smoothness. 2.2L turbo III and 2.5L turbo engines use dished pistons providing 8.1:1 and 7.8:1 (nominal) compression ratios respectively. All standard 2.2L and 2.5L engines use pressed-in piston pins to attach forged steel connecting rods, while all 2.5L turbo and high-output 2.2L turbo III engines use a full floating piston pin and connecting rod assembly.

CYLINDER HEAD: The cylinder head is cast aluminum with in-line valves arranged with alternating exhaust and intake. The intake and exhaust ports are located in the rearward, facing side of the head. The intake ports feed fast-burn design combustion chambers with spark plugs located close to the center line of the combustion chamber for optimum efficiency. An integral oil gallery within the cylinder head supplies oil to the hydraulic lash adjusters, camshaft, and valve mechanisims.

CAMSHAFT: The nodular iron camshaft has five bearing journals. Flanges at the rear journal control camshaft end play. A sintered iron timing belt sprocket is mounted on the cam nose, and a hydrodynamic oil seal is used for oil control at the front of the camshaft.

ACCESSORY SHAFT: The iron accessory shaft has two bearing journals and is housed in the forward facing side of the block. A hydrodynamic seal, installed in an aluminum housing attached to the block, provides retention, shaft thrust, and oil control. The accessory shaft is driven by the timing belt through a sintered iron sprocket mounted on the nose of the accessory shaft. The accessory shaft in turn drives the oil pump and distributor.

VALVES: The valves are actuated by roller cam followers which pivot on stationary hydraulic lash adjusters.

The valve train with 40.6 mm (1.60 inch) diameter intake valves and 35.4 mm (1.39 inch) diameter exhaust valves employ viton rubber valve stem seals. Valve springs, spring retainers, and locks are conventional.

BALANCE SHAFTS: 2.2 Turbo III and 2.5L 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.

INTAKE MANIFOLDS: All intake manifolds are aluminum castings. N.A. engines use a four branch design. This long branch fan design enhances low and midspeed torque. It also features an integrally cast water crossover passage to warm incoming fuel/air mixture, plus EGR mounting boss and PCV inlet.

Turbocharged engine intake manifolds are log type with upper plenum and lower runners with a primary tuned length of 13.5 inches and secondary tuned length (feeding the plenum) of 12 inches. The manifold is machined for fuel injectors with runners

supplying each cylinder. Manifolds are attached to the cylinder head with eight bolts.

EXHAUST MANIFOLDS: All exhaust manifolds are made of nodular cast iron for strength and high temperatures. All naturally aspirated (N.A.) and turbocharged engines exit exhaust gasses through a machined, articulated joint connection to the exhaust pipe. All manifolds intermesh with the intake manifold at the cylinder head.

N.A. engines use a four branch design with cylinders on and four joined and cylinders two and three joined to exit at the outlet.

Turbocharged engine exhaust manifold also carry the turbocharger. This manifold is a modified log type collector with exhaust gasses directed to and through the turbocharger to exit the conical (articulated joint) outlet machined into the turbocharger housing.

ENGINE LUBRICATION: System is full flow filtration, pressure feed type. The oil pump is mounted within the crankcase and driven by the auxiliary shaft. 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 (for 2.5L engines) to the lower balance shaft assemblies. Pistons are lubricated from directed holes in connecting rod assemblies. Camshaft and valve mechanisms are lubricated from a full-length cylinder head oil gallery supplied from the crankcase main oil gallery.

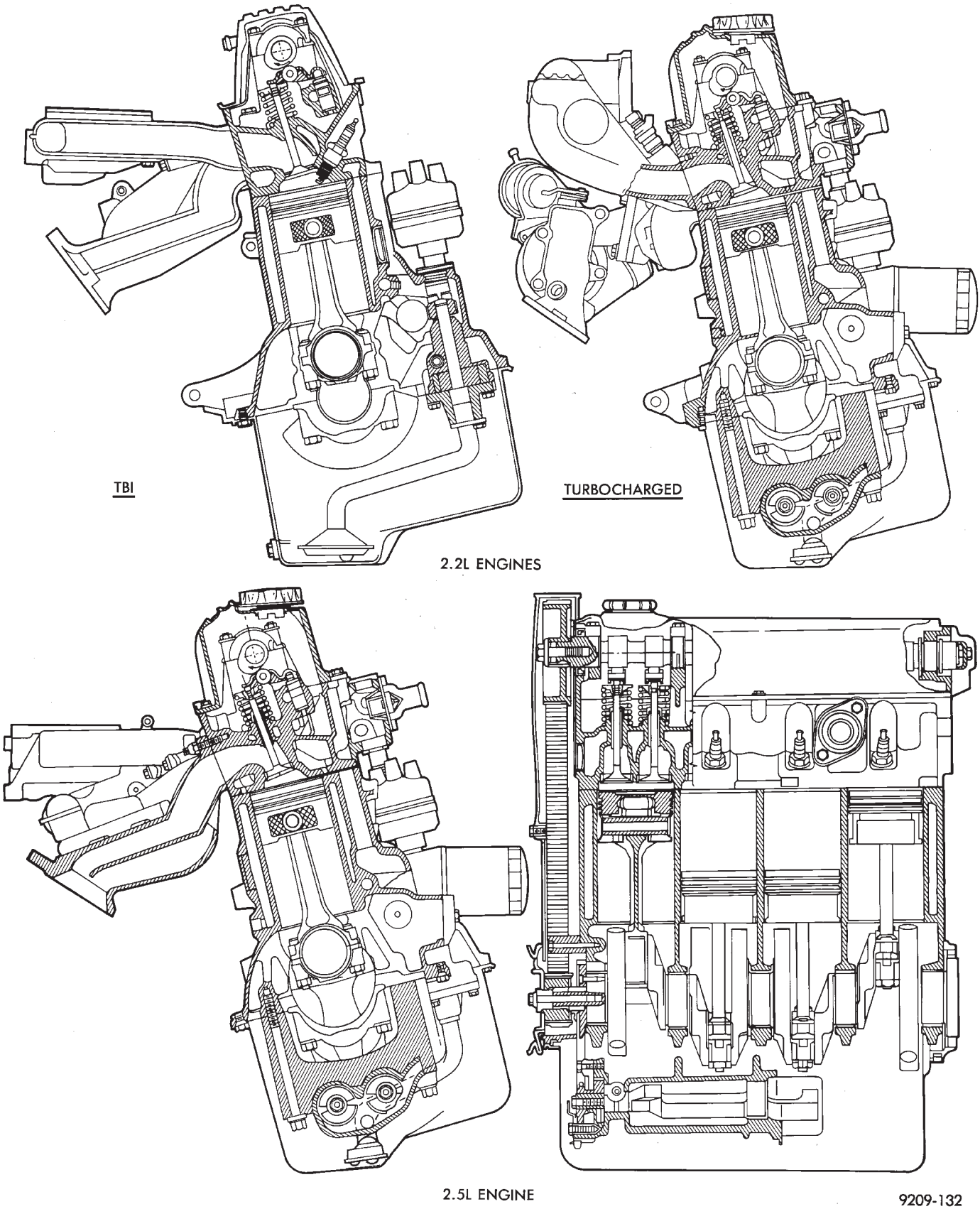

Fig. 2 Engines

ENGINE MOUNTS

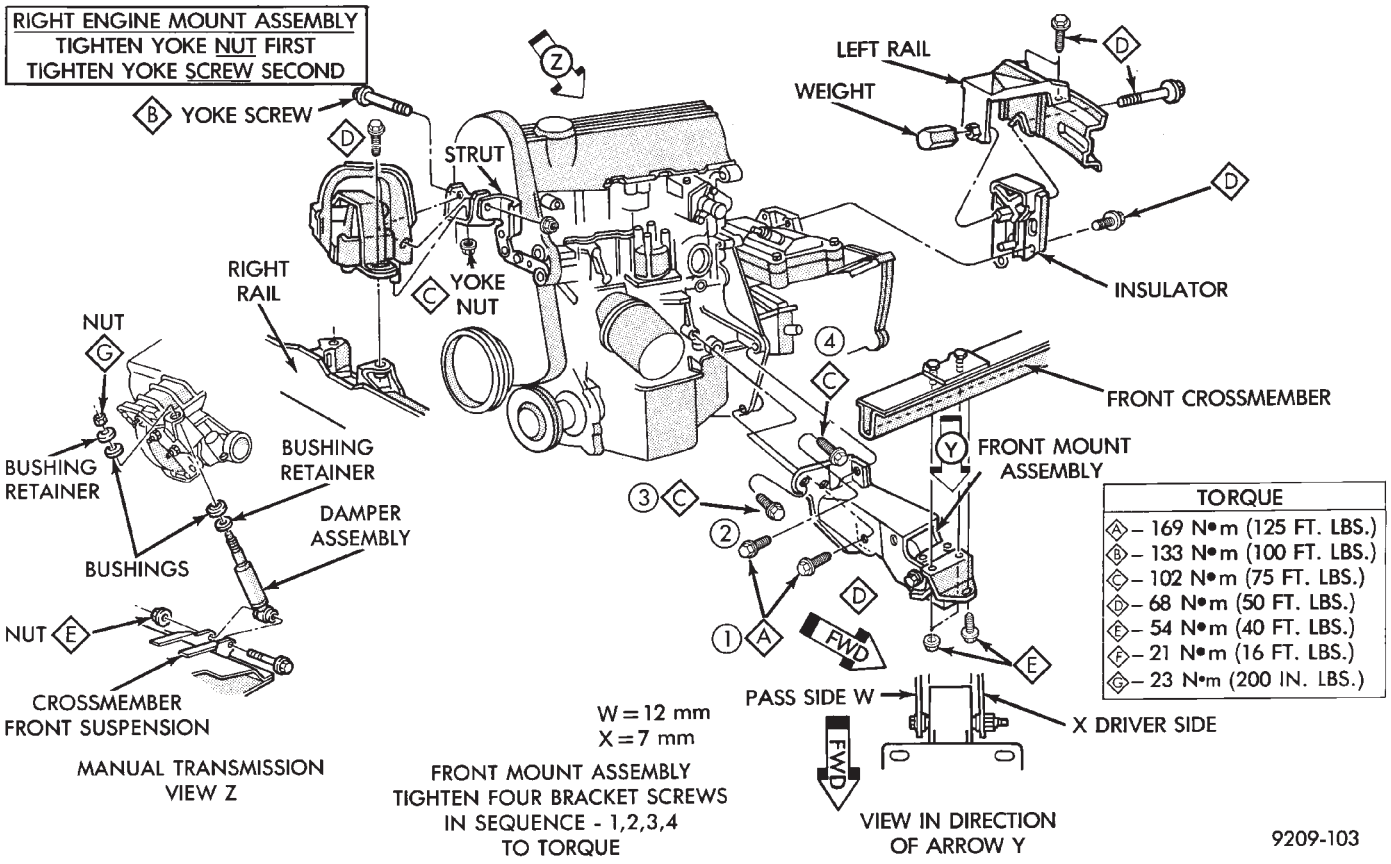

Fig. 3 Engine Mounting

REMOVAL AND INSTALLATION

RIGHT SIDE MOUNT

(1) Remove the right engine mount insulator vertical fasteners from frame rail.

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

(3) Remove the thru bolt from the insulator assembly. Remove insulator.

(4) Reverse removal procedure for installation. Refer to (Fig. 3) for bolt tightening specifications.

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

FRONT MOUNT

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

(2) Remove the thru bolt from the insulator and front crossmember mounting bracket.

(3) Remove the front engine mount bracket to front crossmember screws and nuts. Remove the insulator assembly.

(4) Reverse removal procedure for installation. Refer to (Fig. 3) for bolt tightening specifications.

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

LEFT SIDE MOUNT

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

(2) Remove inter splash shield.

(3) Support the transmission with a transmission jack.

(4) Remove the insulator thru bolt from the mount.

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

(6) Reverse removal procedure for installation. Refer to (Fig. 3) for bolt tightening specifications.

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

ENGINE MOUNT RUBBER INSULATORS

Insulator location on frame rail (right side) and transmission bracket (left side) are adjustable to allow right/left drive train adjustment in relation to drive shaft assembly length.

Check and reposition right engine mount insulator (left engine mount insulator is floating type and will adjust automatically (Fig. 4). Adjust drive train position, if required, for the following conditions:

- Drive shaft distress: See Driveshaft in Suspension, Group 2.
- Any front end structural damage (after repair).
- Insulator replacement. 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 fasteners, and the front engine mount bracket to front crossmember screws and nuts.

Left engine mount insulator is sleeved over shaft and long support bolt to provide lateral movement adjustment with engine weight removed or not.

(3) Pry the engine right or left as required to achieve the proper drive shaft assembly length. See Drive Shaft in suspension Group 2 for driveshaft identification and related assembly length measuring.

(4) Tighten right engine mount insulator vertical bolts to 37 N·m (27 ft. lbs.). Then tighten front engine mount screws and nuts to 54 N·m (40 ft. lbs.) and center left engine mount insulator.

(5) Recheck drive shaft length.

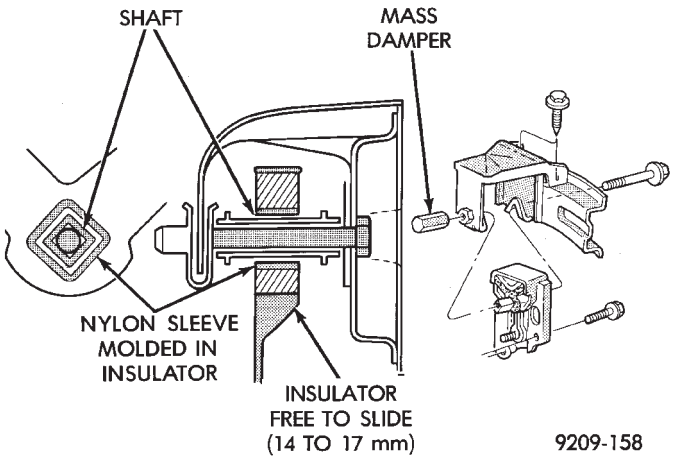

Fig. 4 Left Insulator Movement

ENGINE ASSEMBLY

REMOVAL

(1) Disconnect battery.

(2) Scribe hood hinge outline on hood and remove hood.

(3) Drain cooling system.

(4) Remove hoses from radiator and engine.

(5) Remove radiator and fan assembly.

(6) Remove air cleaner and hoses.

(7) Remove air conditioning compressor mounting bolts and set compressor aside, if equipped.

(8) Remove power steering pump mounting bolts and set pump aside.

(9) Remove oil filter.

(10) Disconnect fuel line, heater hose and accelerator cable.

(11) Disconnect all electrical connections and harnesses at throttle body and engine.

(12) **Manual Transmission**

(a) Disconnect clutch cable.

(b) Remove transmission case lower cover.

(c) Disconnect exhaust pipe at manifold.

(d) Disconnect starter and lay aside.

(e) Install transmission holding fixture.

(13) **Automatic Transmission**

(a) Disconnect exhaust pipe at manifold.

(b) Disconnect starter and lay aside.

(c) Remove transmission case lower cover.

(d) Mark flex plate to torque converter.

(e) Remove screws holding torque converter to flex plate.

(14) Attach C clamp on front bottom of torque converter housing to prevent torque converter from coming out.

(15) Install transmission holding fixture.

(16) Remove right inner splash shield (Fig. 5).

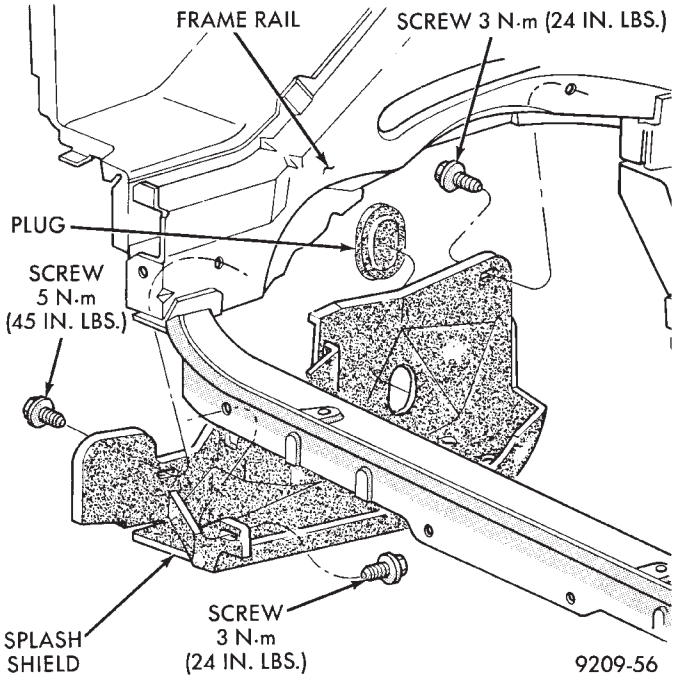

Fig. 5 Right Inner Splash Shield

(17) Remove ground strap.

(18) To **lower** engine separate right engine bracket from yoke bracket. To **raise** engine remove long bolt through yoke and insulator. IF INSULATOR TO RAIL SCREWS ARE TO BE REMOVED, MARK INSULATOR POSITION ON SIDE RAIL TO INSURE EXACT INSTALLATION (Fig. 4).

(19) Remove transmission case to cylinder block mounting screws.

CAUTION: Make sure clutch cable has been disconnected.

(20) Remove front engine mount screw and nut.

(21) Remove manual transmission damper.

(22) Remove left insulator through bolt from inside wheelhouse or insulator bracket to transmission screws.

(23) Remove engine from vehicle.

INSTALLATION

(1) Install hoist to the engine and lower engine into the engine compartment.

SEE: ENGINE MOUNT RUBBER INSULATORS, THIS GROUP.

(2) Align engine mounts and install but **do not tighten** until all mounting bolts have been installed.

(3) Install transmission case to cylinder block mounting screws. Tighten to 95 N·m (70 ft. lbs.) torque.

(4) Remove engine hoist and transmission holding fixture.

(5) Install ground strap.

(6) Remove right inner splash shield.

(7) Connect starter. See Electrical Group 8 for installation.

(8) Connect exhaust system. See Exhaust Systems Group 11 for installation.

(9) **Manual Transmission** Install transmission case lower cover.

Automatic Transmission Remove C clamp from torque converter housing. Align flexplate to torque converter and install mounting screws. Tighten to 75 N·m (55 ft. lbs.) torque.

(10) **Manual Transmission** Connect clutch cable. See Clutch Group 6.

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

(12) Connect fuel line, heater hose, and accelerator cable.

(13) Connect all electrical connections and harnesses at throttle body and engine.

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

(15) Install air conditioning compressor (if equipped). See Heater and Air Conditioning, Group 24 for installation.

(16) Install air cleaner and hoses.

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

(18) Install hood.

(19) Connect battery.

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

(21) Adjust transmission linkage, if necessary.

SOLID MOUNT COMPRESSOR BRACKET SERVICE

When service procedures require solid mount bracket removal and installation for example: cylinder head removal, etc., it is important that bracket fasteners numbered 1 through 7 (Fig. 4) be removed and installed in sequence, as instructed in Remove and Install.

ACCESSORIES REMOVAL

(1) Remove (and install/adjust) belts, see Accessory Drive Belts in Cooling System, Group 7.

(2) Remove air conditioning compressor (in vehicle with lines and set aside) (Fig. 6).

(3) Remove alternator pivot bolt and remove alternator (in vehicle: turn wiring side up and disconnect, then rotate alternator, pulley end towards engine and remove).

(4) Remove air conditioner compressor belt idler.

SOLID MOUNT BRACKET–REMOVAL (FIG. 4)

(1) Remove right engine mount yoke screw (see Engine Remove Fig. 3) securing engine mount support strut to engine mount bracket.

(2) Remove five side mounting bolts #1, #4, #5, #6, and #7 (Fig. 4).

(3) Remove front mounting nut, #2, and remove front bolt #3*.

(4) Remove front mounting bolt and strut, rotate solid mount bracket away from engine and slide bracket on stud until #2 nut mounting stud until free. Remove spacer from stud.

SOLID MOUNT BRACKET–INSTALLATION

(1) Put spacer onto stud, then install bracket on front (#2 nut) mounting stud and slide bracket over timing belt cover into position.

(2) Loosen assembly bracket to engine fasteners (numbered #1 through #7 in Fig. 6).

CAUTION: Fasteners MUST BE TIGHTENED IN SEQUENCE and to specified torque as follows:

- First Bolt #1 to 3.3 N·m (30 in. lbs.)
- Second Nut #2 and Bolt #3 to 54 N·m (40 ft. lbs.).
- Third Bolts #1 (second tightening) #4 and #5 to 54 N·m (40 ft. lbs.).
- Fourth Bolts #6 and #7 to 54 N·m (40 ft. lbs.).

(4) Install alternator and compressor. Tighten compressor mounting bracket bolts to 54 N·m (40 ft. lbs.).

SOLID MOUNT COMPRESSOR BRACKET SERVICE–TURBO III ENGINE

REMOVAL

(1) Disconnect negative battery cable

(2) Remove Accessory Drive Belt. Refer to Cooling System Group 7 for procedure.

(3) Remove accessory drive belt idler pulley (Fig. 7).

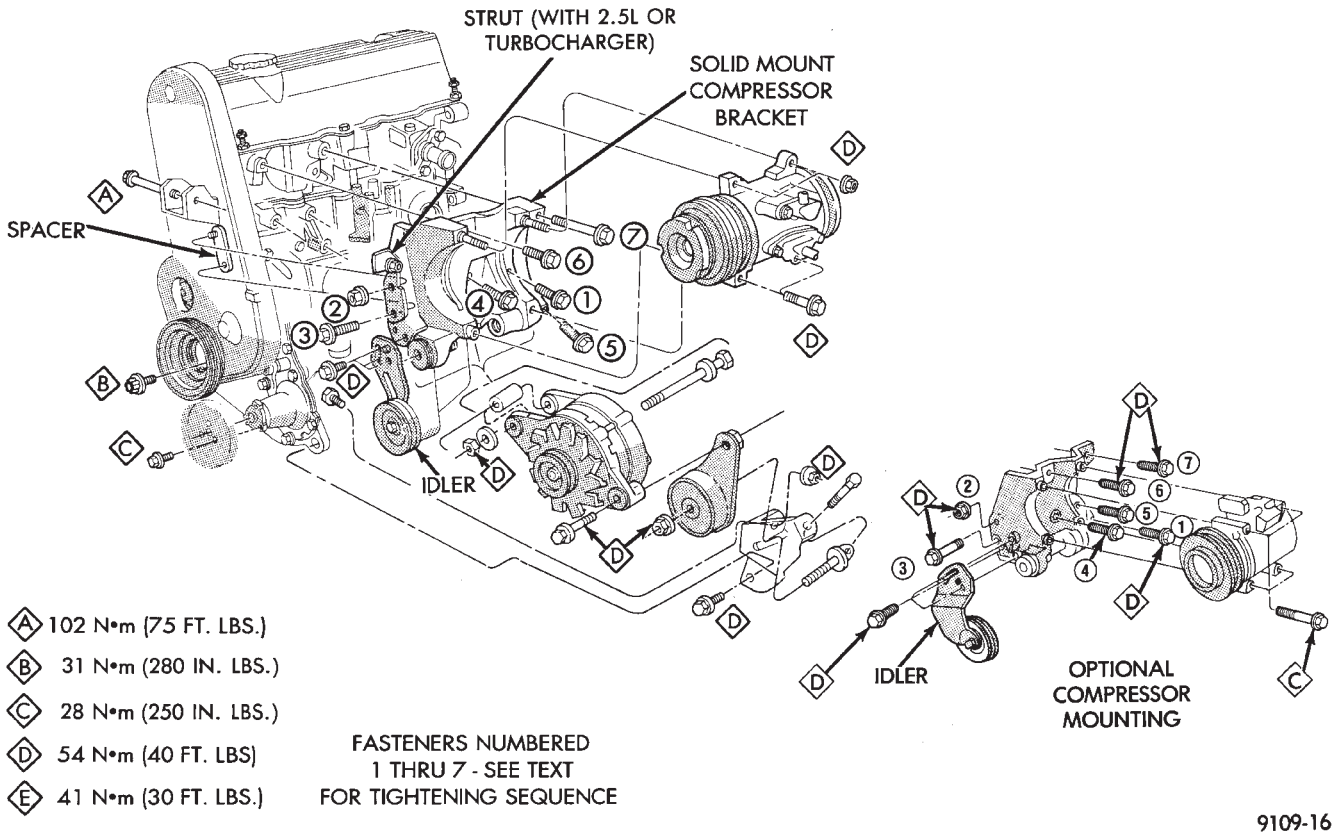

Fig. 6 Solid Mount Compressor Bracket 2.2 & 2.5L Engines

(4) Remove air conditioning compressor and set aside (Fig. 8).

(5) Remove alternator attaching bolts set aside (Fig. 8).

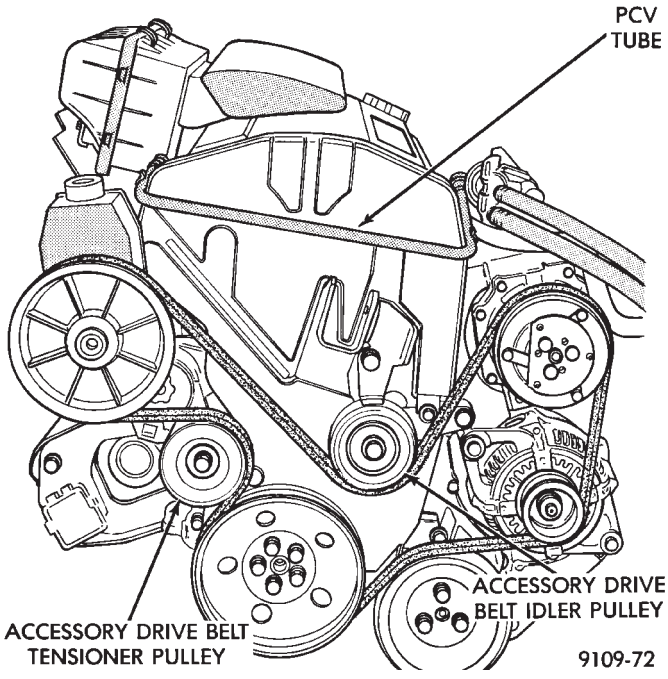

Fig. 7 Accessory Drive System

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

(7) Remove right engine mount yoke bolt. Remove the fasteners holding the strut into place. Remove strut from engine (Fig. 9).

(8) Remove accessory drive belt idler pulley bracket (Fig. 9).

(9) Remove timing belt. Refer to procedure outlined in this section.

(10) Remove 2 bolts holding solid mount compressor into place, Rotate bracket off engine (Fig. 7).

INSTALLATION

(1) Loosely assemble the bracket to engine with #1 and #2 bolts tighten to 3.3 N·m (30 ft. lbs.) (Fig. 8).

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

(3) Install strut on stud. Tighten nut #3 and bolt #4, torque to 54 N·m (40 ft. lbs.) (Fig. 9). Loosen #1 and #2 bolts, then torque to 54 N·m (40 ft. lbs.) (Fig. 10). Install yoke bolt and torque to 102 N·m (75 ft. lbs.).

(4) Install accessory drive belt idler pulley and bracket (Fig. 8).

(5) Install accessory drive belt tensioner pulley (Fig. 7).

(6) Install alternator (Fig. 8).

(7) Install air conditioning compressor (Fig. 8).

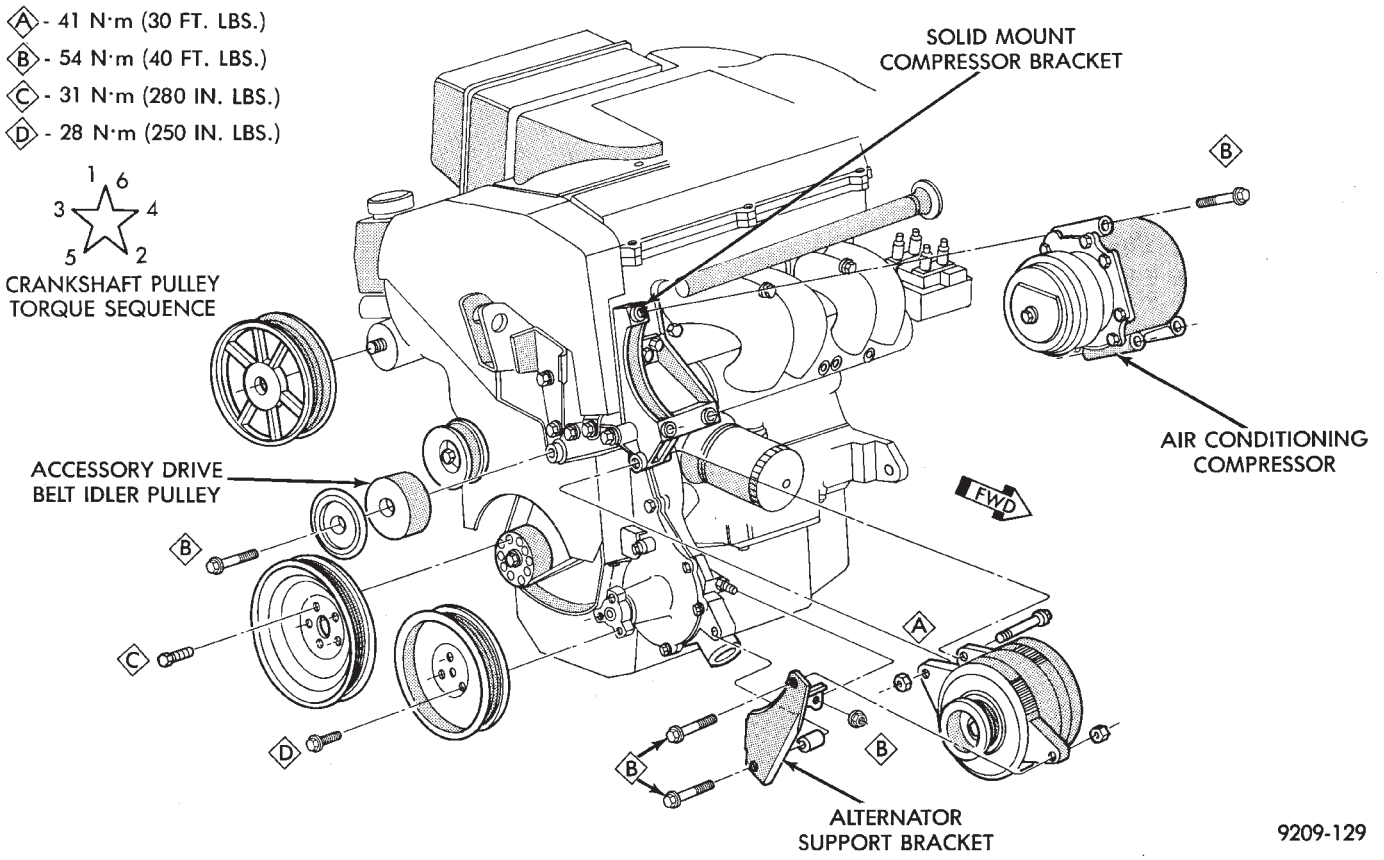

Fig. 8 Solid Mount Compressor Bracket−Turbo III Engine

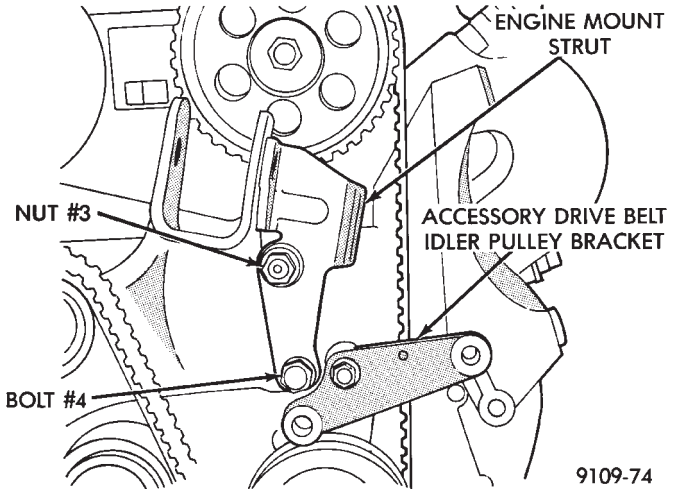

Fig. 9 Accessory Drive Idler Pulley Bracket and Engine Strut

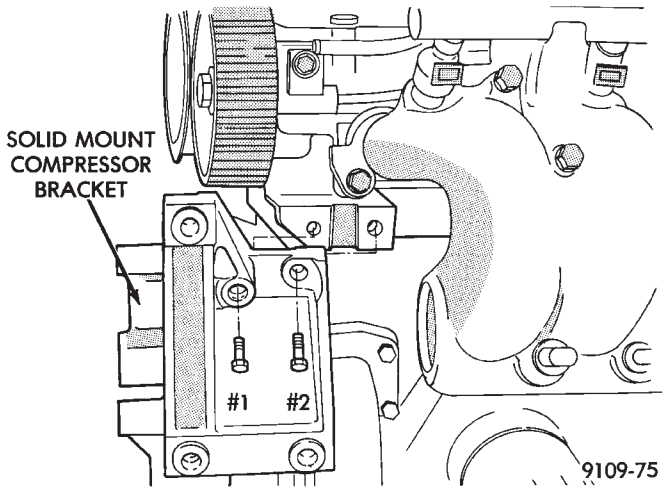

Fig. 10 Compressor Bracket to Cylinder Head Attaching Bolts

(8) Install accessory drive belt. Refer to Cooling System Group 7 for procedure.

(9) Connect negative battery cable.

POWER STEERING/ACCESSORY DRIVE BELT TENSIONER BRACKET

REMOVAL

(1) Remove Accessory Drive Belt. Refer to Cooling System Group 7 for procedure.

(2) Remove accessory drive belt tensioner pulley (Fig. 7).

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

(4) Remove Power Steering Pump bolts set pump aside (Fig. 11).

(5) Loosen timing belt tension. Refer to Camshaft and Crankshaft Timing Service for procedure. Remove timing belt idler pulley bolt (Fig. 12).

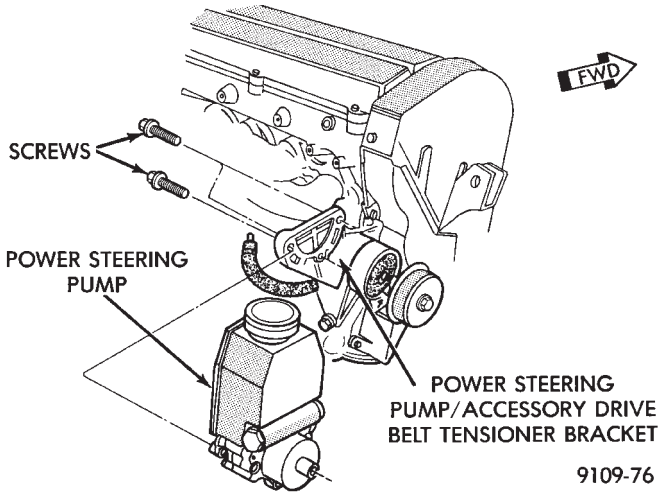

Fig. 11 Power Steering Pump Attaching Bolts

CAUTION: Camshaft and Crankshaft Timing may have to be reset when procedure is completed. Refer to procedure outlined in this section.

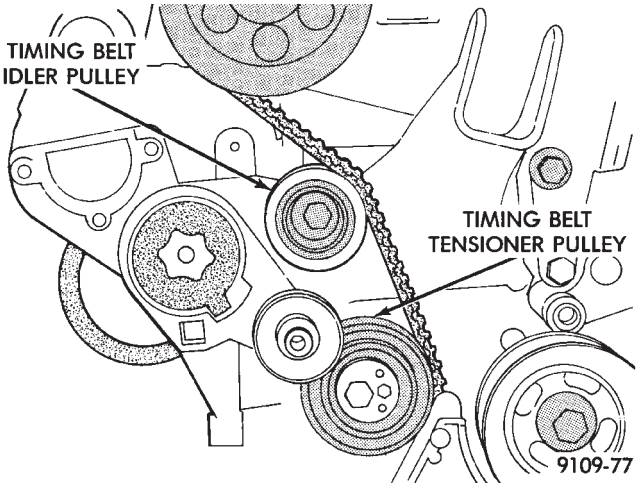

Fig. 12 Power Steering Pump Bracket and Timing Belt Idler Bolt

(6) Remove Bracket bolts #2 and #3 from rear of engine. Remove Bracket (Fig. 13).

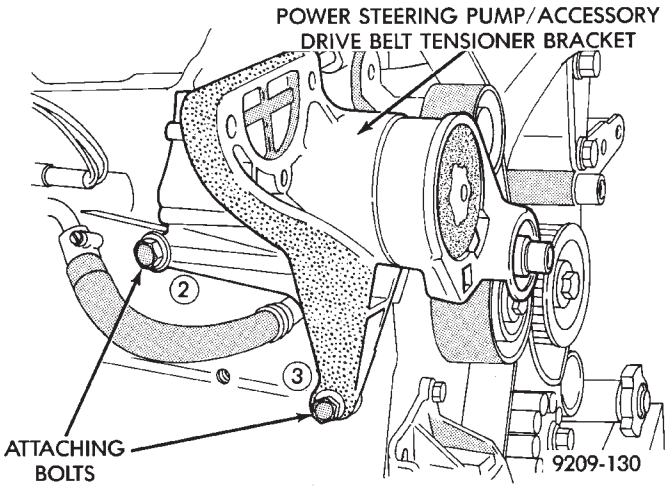

Fig. 13 Power Steering Pump/Accessory Drive Belt Tensioner Bracket Attaching Bolts

INSTALLATION

(1) Loose assemble bracket to engine.

(2) Tighten bolts #2 and #3 to 3.3 N·m (30 in. lbs.) (Fig. 13).

(3) Tighten timing belt idler pulley and tighten to 54 N·m (40 ft. lbs.) (Fig. 12).

(4) Tighten bolts 32 and #3 to 54 N·m (40 ft. lbs.) (Fig. 13).

(5) Camshaft and Crankshaft timing should be checked at this time.

Adjust as necessary following procedure outlined in this section.

(6) Install power steering pump on bracket tighten bolts to 28 N·m (250 in. lbs.) torque (Fig. 11).

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

CAUTION: Do not use impact wrench on accessory drive belt tensioner bolt. It may cause damage to tensioner arm.

(8) Install accessory drive belt tensioner pulley bolt finger tight. Then bolt to 54 N·m (40 ft. lbs.) torque. Install accessory drive belt, Refer to Cooling System Group 7 for procedure.

TIMING SYSTEM AND SEALS SERVICE

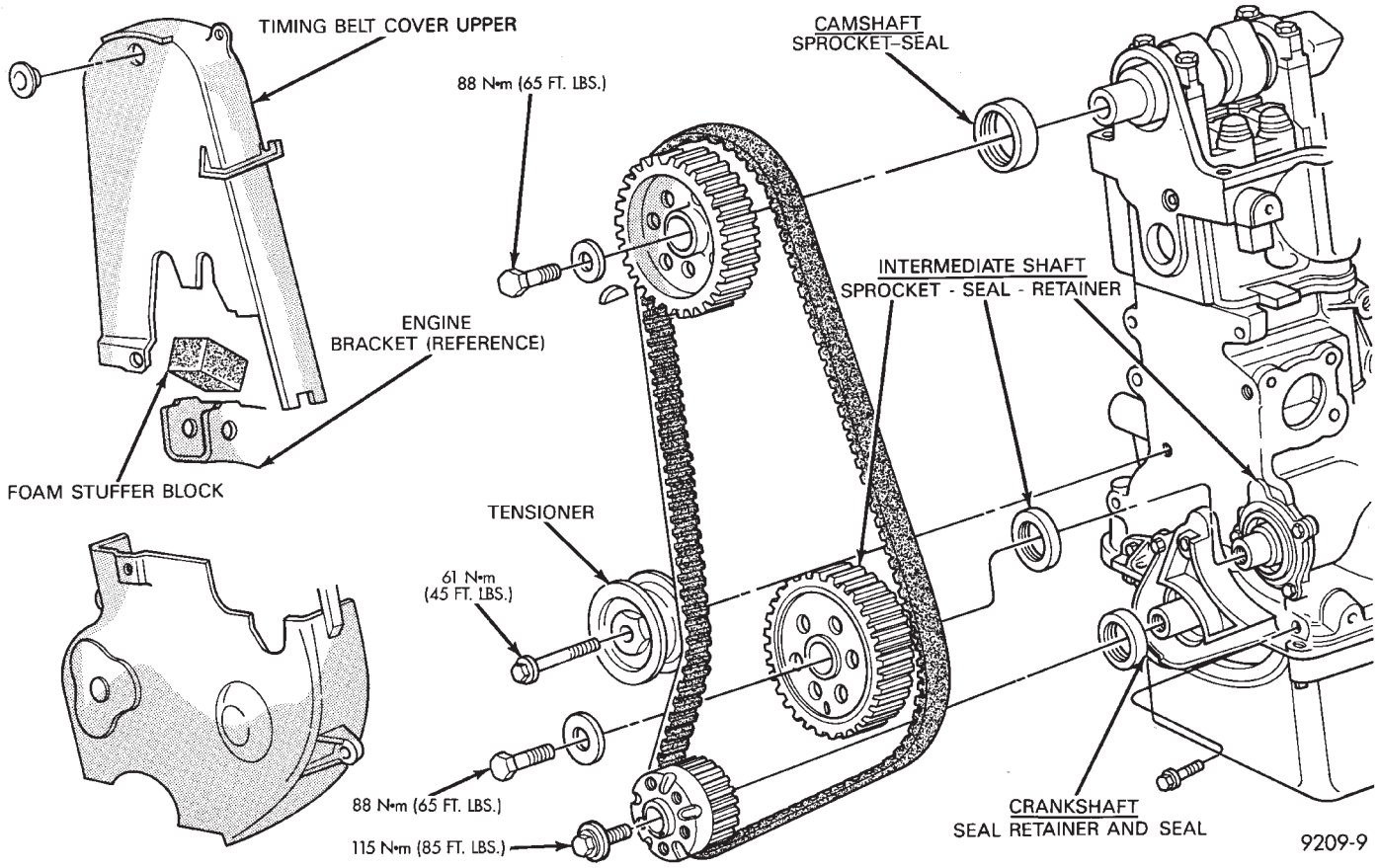

Fig. 1 Timing System and Seals

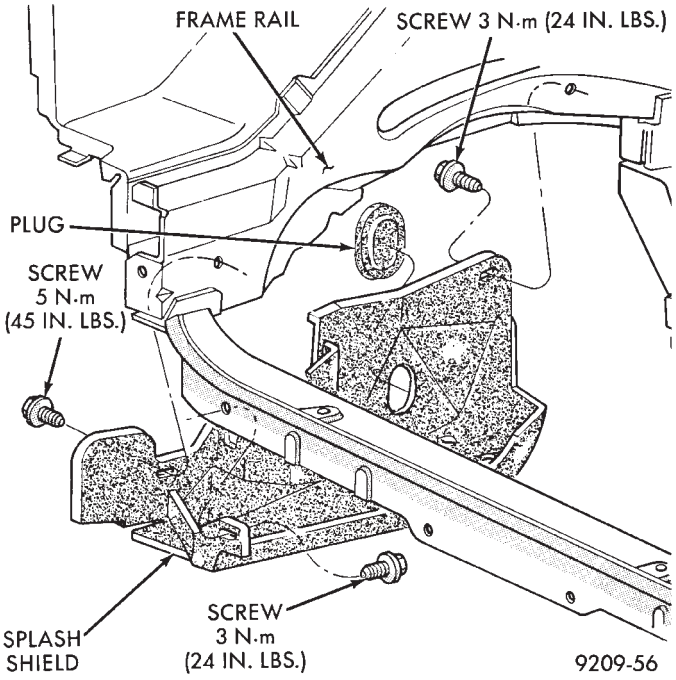

Fig. 2 Right Inner Splash Shield

Refer to (Fig. 1) for parts identification and torque specifications.

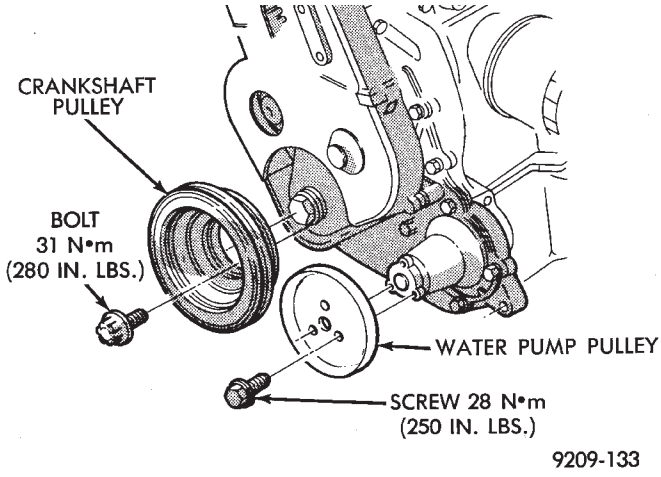

Fig. 3 Crankshaft and Water Pump Pulley

TIMING BELT SERVICE

(1) Remove Solid Mount Compressor Bracket. Refer to procedure outlined in this section.

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

(3) Remove screws retaining water pump pulley and bolts retaining crankshaft pulley (Fig. 3) and lay pulley aside.

(4) Remove nuts holding cover to cylinder head.

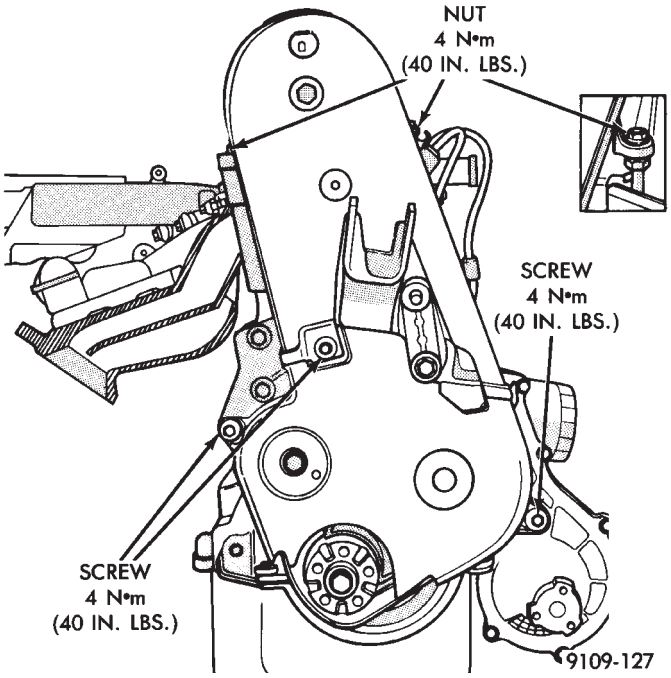

Fig. 4 Timing Belt Cover

(5) Remove screws holding cover to cylinder block.

(6) Remove both halves of timing belt cover and lay aside (Fig. 4)

(7) Place a jack under engine.

(8) Separate right engine mount (Fig. 5) and raise engine slightly.

(9) Loosen timing belt tensioner screw (Fig. 6) and remove timing belt.

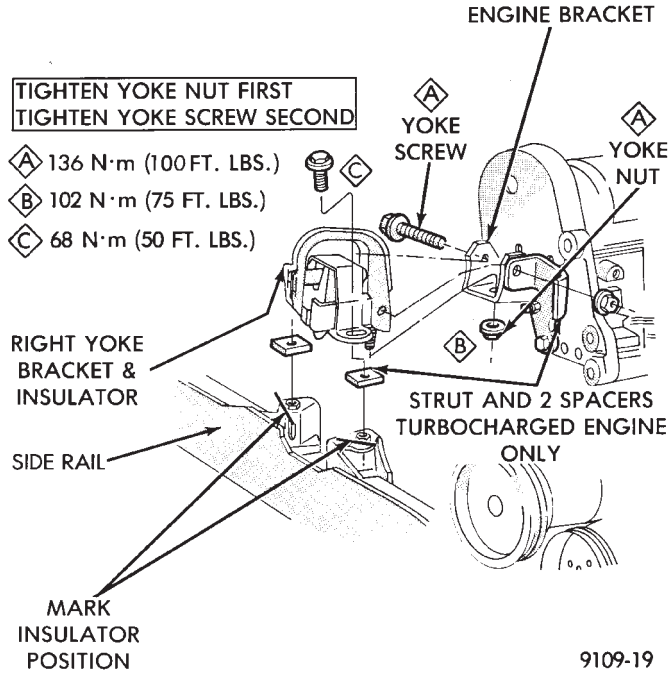

Fig. 5 Right Engine Mount

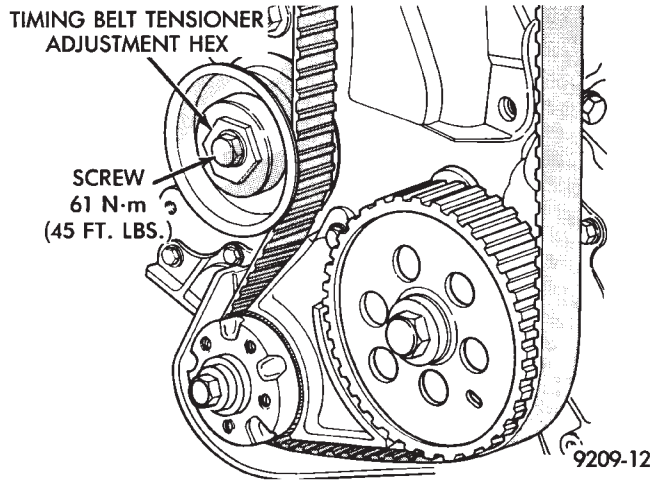

Fig. 6 Remove Timing Belt

SERVICING FRONT OIL SEALS–REPLACEMENT

(1) With timing belt removed, remove crankshaft sprocket bolt.

(2) Remove crankshaft sprocket using Special Tool C-4685, Insert and 5.9 inch long screw (Fig.7).

(3) Install crankshaft sprocket using plate L-4524, Thrust Bearing/washer and 5.9 inch long screw (Fig. 7).

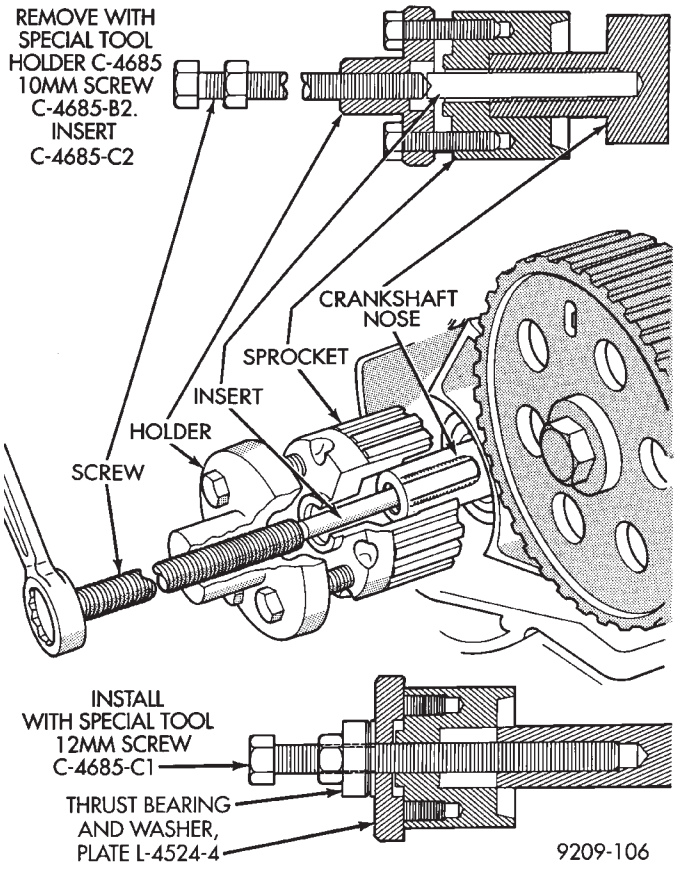

Fig. 7 Crankshaft Sprocket

(4) Hold engine sprocket with Special Tool C-4687 (with adaptor Tool C-4687-1) while removing/installing screw (Fig. 8). The 2.5L Engine camshaft/intermediate shaft sprockets have an off-set hub and are identified with a six-hole pattern.

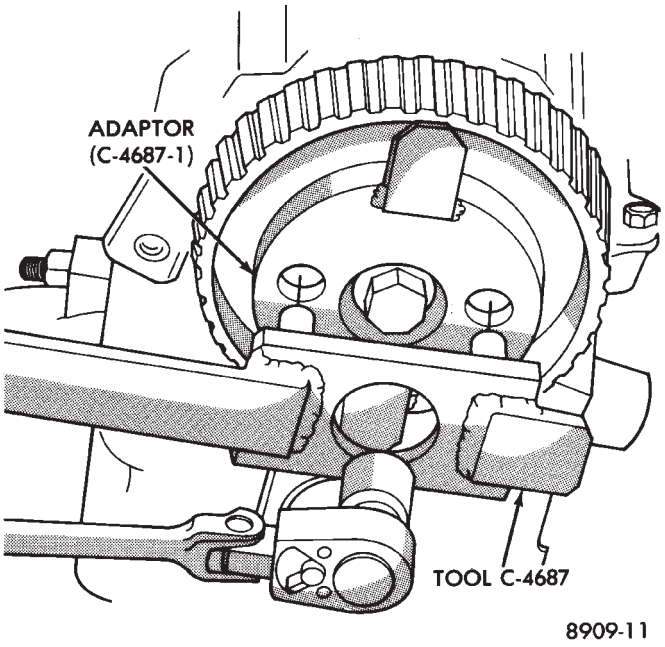

Fig. 8 Removing/Installing Camshaft or Intermediate Shaft Sprocket Screw

(5) Remove crankshaft seal using Special Tool 6341. Remove intermediate and camshaft seals using Special Tool C-4679 (Fig. 10).

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

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

(7) Install engine crankshaft seal into retainer using Special Tool 6342 and 6343. Install Intermediate and Camshaft seals using Special Tool C-4680. Install seals until flush (Fig. 10).

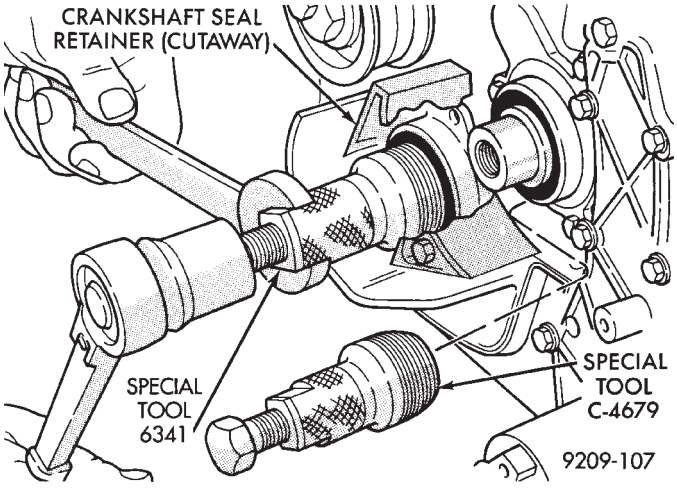

Fig. 9 Removing Crankshaft, Intermediate Shaft and Camshaft Oil Seal

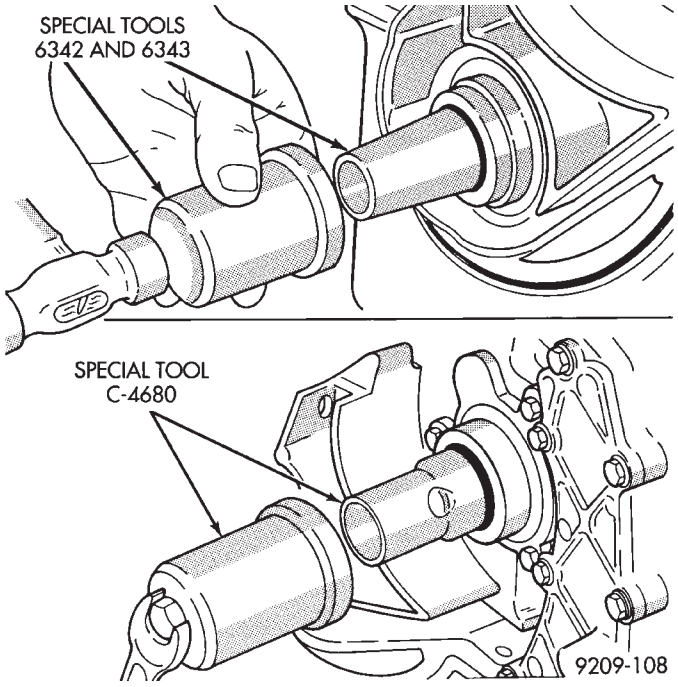

Fig. 10 Installing Crankshaft, Intermediate Shaft, and Camshaft Seal

CAMSHAFT, CRANKSHAFT AND INTERMEDIATE SHAFTS TIMING PROCEDURE

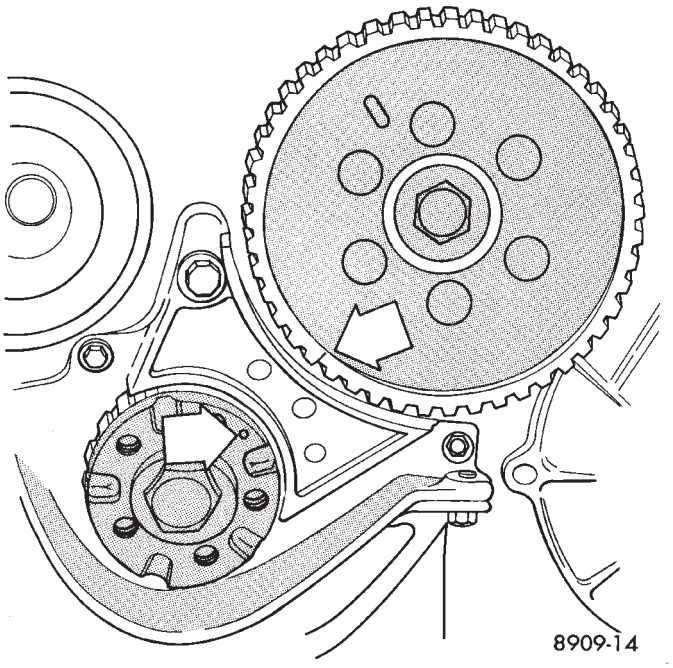

Fig. 11 Crankshaft and Intermediate Shaft Timing

(1) Remove all spark plugs. Turn crankshaft and intermediate shaft until markings on sprockets are in line, see arrows (Fig. 11).

(2) Turn camshaft until arrows on hub are inline with No. 1 camshaft cap to cylinder headline. Small hole (arrow Fig. 12) must be in vertical center line.

(3) Install timing belt.

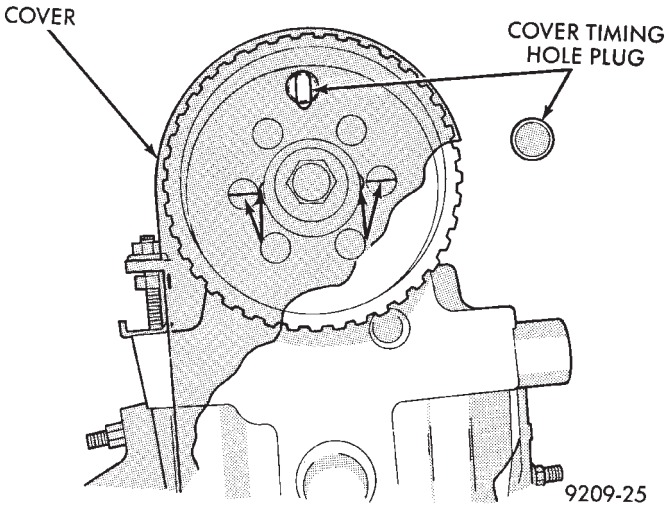

Fig. 12 Camshaft Timing

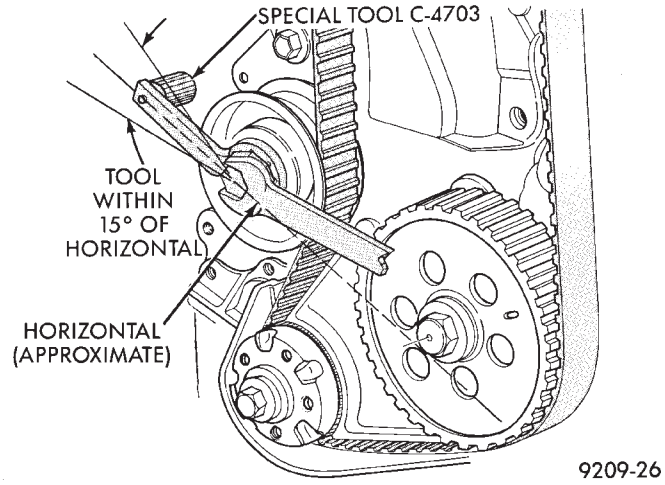

Fig. 13 Adjusting Drive Belt Tension

(4) Rotate crankshaft two full revolutions and recheck timing.

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

(5) Rotate crankshaft till number 1 cylinder is at the TDC position.

(6) Put belt tension Special Tool C-4703 horizontally on large hex of timing belt tensioner pulley and loosen tensioner lock nut.

(7) Reset belt tension Special Tool C-4703 index if necessary to have axis within 15° of horizontal. (Fig. 13)

(8) Turn engine clockwise from TDC two crank revolutions to TDC. **Do not reverse rotate crankshaft or attempt to rotate engine using cam or accessory shaft attaching screw.**

(9) Hold weighted wrench in position while tightening bolt on tensioner to 61 N·m (45 ft. lbs.) torque.

(10) Lower engine onto engine mount install mounting bolts and tighten to specifications refer to (Fig. 3).

(11) Remove jack from under engine.

(12) Position both halves of timing belt cover together (Fig. 4).

(13) Install fasteners holding cover to cylinder head and block. Tighten fasteners to 4 N·m (40 in. lbs.) torque.

(14) Valve Timing Check; (timing belt cover installed). With number one cylinder at TDC, small hole in sprocket must be centered in timing belt cover hole (Fig. 12). If hole is not aligned correctly perform procedure again.

(15) Install spark plugs.

CYLINDER HEAD AND VALVE ASSEMBLY SERVICE

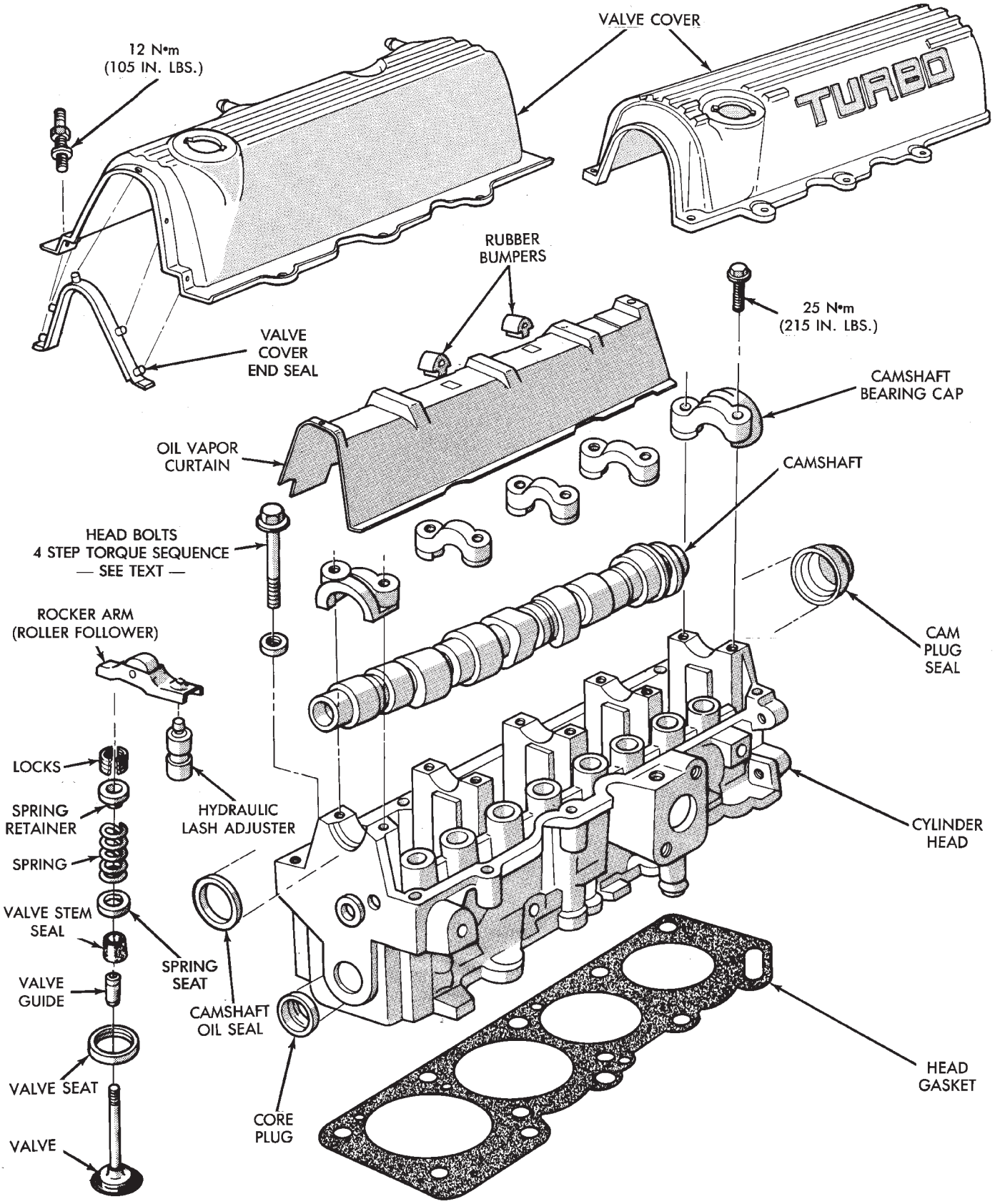

Fig. 1 Cylinder Head and Valve Assembly Service

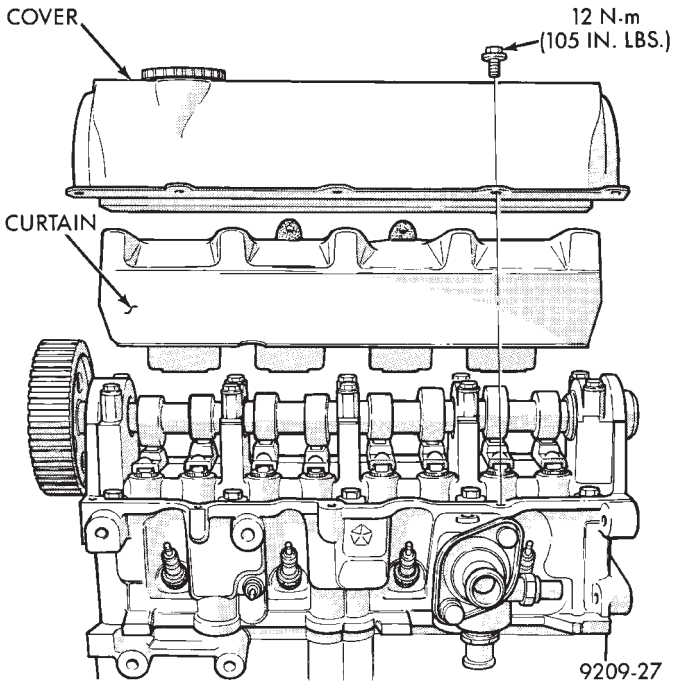

Fig. 2 Cylinder Head Cover and Curtain

CYLINDER HEAD COVER AND CURTAIN

A curtain aiding air/oil separation is installed on the cylinder head below the cylinder head cover (Figs. 1 and 2).

REMOVAL

(1) Remove the cylinder head cover bolts (Fig. 2).

(2) Remove cylinder head cover and curtain from cylinder head. Do not misplace the rubber bumpers on curtain.

CLEANING

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

CURTAIN INSTALLATION

Install curtain manifold side first with cutouts over cam towers and contacting cylinder head floor, then press opposite distributor side into position below cylinder head rail.

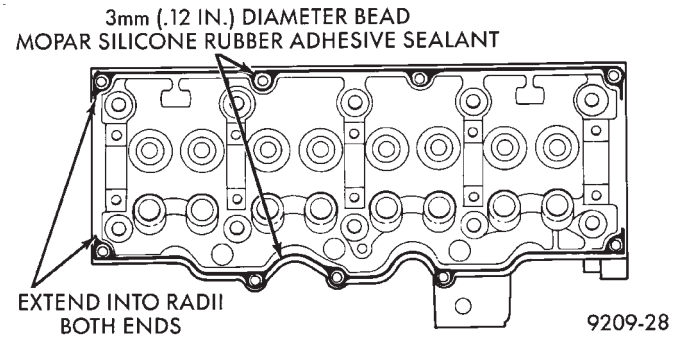

Fig. 3 Cylinder Head Valve Cover Rail Sealing

Curtain is retained in position with rubber bumpers (Fig. 1).

COVER SEALING AND INSTALLATION

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

(1) Install new end seals on valve cover.

(2) Apply form-in-place Mopar Silicone Rubber Adhesive Sealant or equivalent gasket material to cylinder head cover rail (Fig. 3). Refer to procedure detailed in form-in-place gasket section of Standard Service Procedures, in this Group.

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

(3) Install curtain, cover and end seal assembly to head and tighten to 12 N·m (105 in. lbs.) torque.

CYLINDER HEAD COMPONENTS–IN-VEHICLE SERVICE

Removal and installation of cylinder head or camshaft require separation of camshaft timing sprocket from camshaft. To maintain camshaft, intermediate shaft, and crankshaft timing during service procedures, the timing belt is left indexed on the sprocket while the assembly is suspended under light tension (Fig. 4).

When removing the sprocket from the camshaft, you must maintain adequate tension on the sprocket and belt assembly to prevent the belt from disengaging with the intermediate or crankshaft timing sprocket. Refer to Timing System and Seals for re-

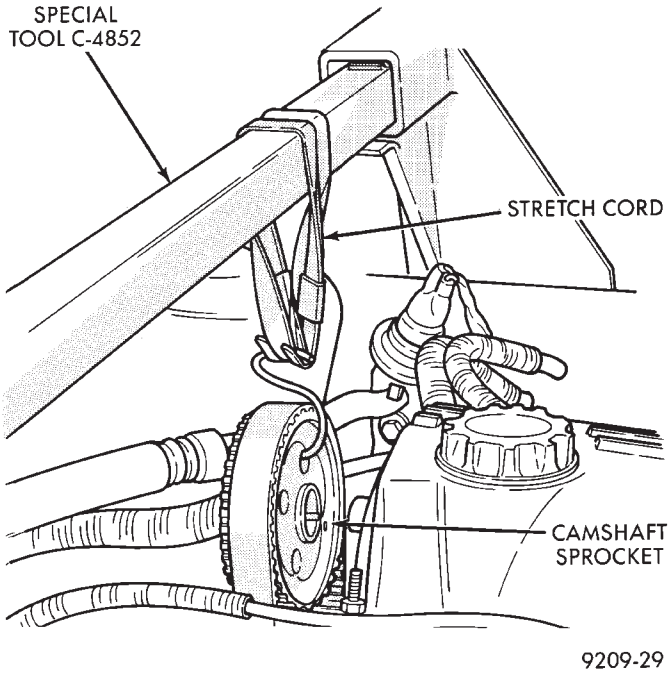

Fig. 4 Suspending Camshaft Sprocket

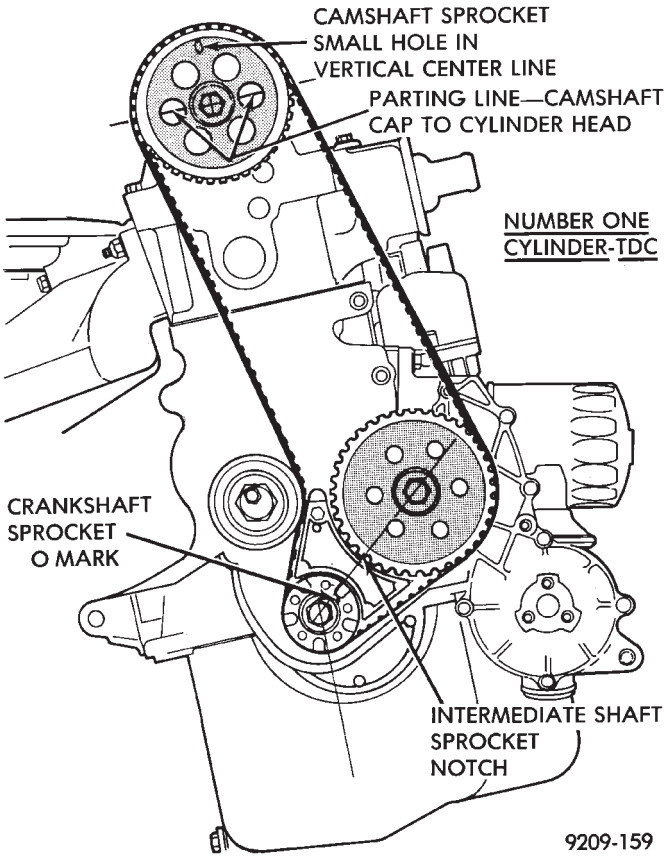

Fig. 5 Engine Sprocket Timing

moval and installation of camshaft sprocket procedure and to Camshaft Service for removal and installation of camshaft procedures.

CAUTION: Failure to maintain adequate tension on camshaft, intermediate, and crankshaft sprocket belt can result in lost engine timing. If timing is lost, refer to Timing System and Seals and (Fig. 4).

CAMSHAFT SERVICE

Refer to TIMING SYSTEM AND SEALS for camshaft timing belt and sprocket removal and installation, and CYLINDER HEAD In Vehicle Service.

REMOVAL

(1) Remove the cylinder head cover and curtain.

(2) Mark rocker arms for reinstallation in the same position (Fig. 6).

(3) Loosen camshaft bearing cap screws several revolutions (Fig. 7).

(4) Jar camshaft at rear of cam to loosen (break free) the bearing caps. **Use a soft faced mallet.**

CAUTION: Care should be exercised not to cock the camshaft during removal. Cocking of the camshaft could cause damage to the cam or bearing thrust surfaces.

(5) Remove screws and caps such that cam does not cock.

INSPECTION

Check bearing cap and oil feed holes for blockage.

Inspect bearing cap and cylinder head journals for wear and/or oversize, Refer to CYLINDER HEAD, **Inspect** and Specifications.

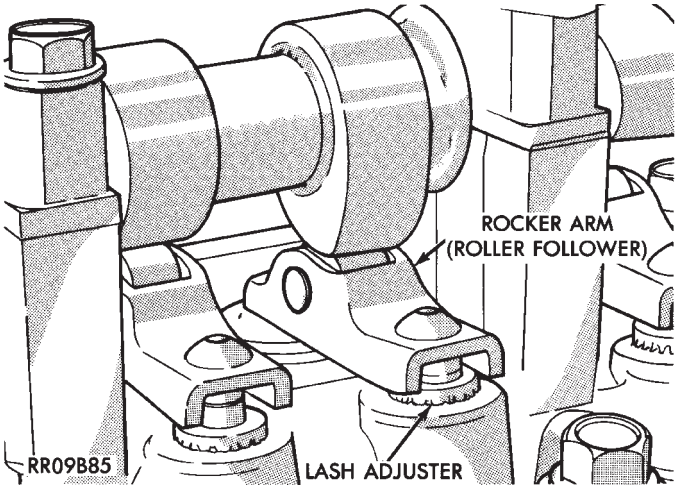

Fig. 6 Rocker Arm and Lash Adjuster

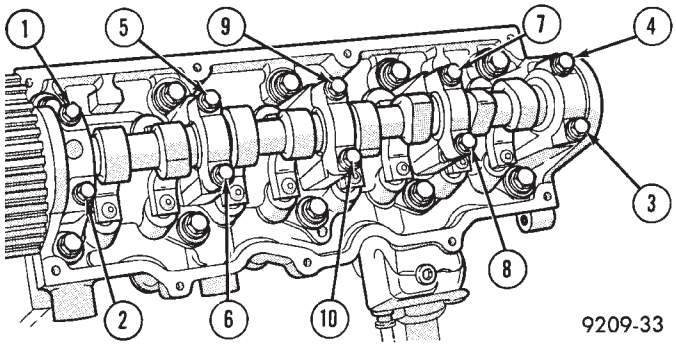

Fig. 7 Camshaft Cap Removal Sequence

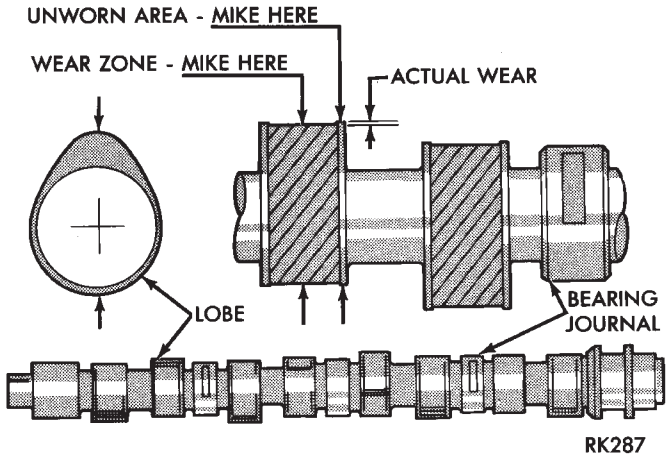

Fig. 8 Camshaft

Chamshaft bearing journals and lobe wear. Lobe wear should not exceed .25mm (.010 inch). To mea-

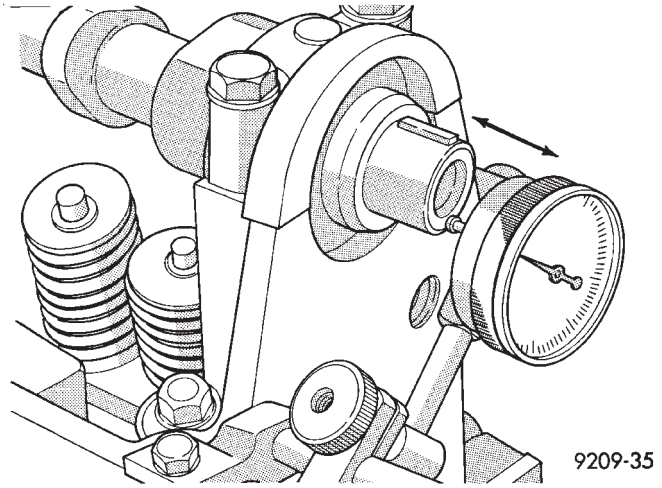

Fig. 9 Camshaft End Play

sure cam lobe wear (Fig. 8), measure lobe diameter in two places at the largest diameter (over the nose). Take first reading with micrometer in unworn area at the edge of the lobe. Take second reading in the worn area where rocker arm contacts the lobe. Subtract second reading from the first. The difference is the cam lobe wear.

CAMSHAFT END PLAY

(1) Oil camshaft journals and install camshaft without cam followers. Tighten screws to specified torque.

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

(3) Zero dial indicator (Fig. 9).

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

(5) End play travel: 0.13 - 0.33mm (0.005 - 0.013 inch.).

(6) Remove bearing caps and camshaft.

INSTALLATION

(1) Install cam followers in correct order as removed.

(2) Align camshaft bearing caps in proper sequence with Cap No. 1 at timing belt end and Cap No. 5 at transmission end. Arrows on Caps No. 1, 2, 3, 4 **must** point toward timing belt to prevent cap breaking (Fig. 11).

(3) Apply Mopar Gasket Maker to No. 1 and No. 5 bearing cap (Fig. 10).

(4) Caps must be installed before camshaft seals are installed.

LASH ADJUSTER (TAPPET) NOISE

A tappet-like noise may be produced from several items. Refer to Lash Adjuster and Tappet Noise - Diagnosis in Standard Service Procedures, this Group.

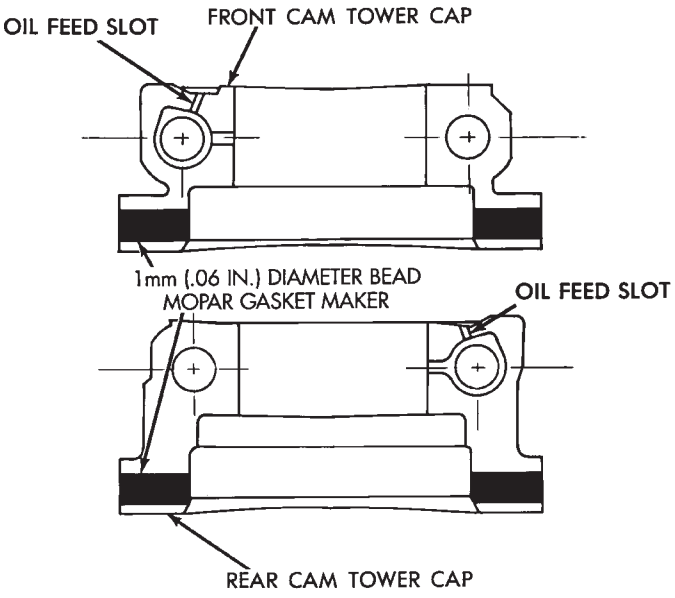

Fig. 10 Cam Tower Cap Sealing

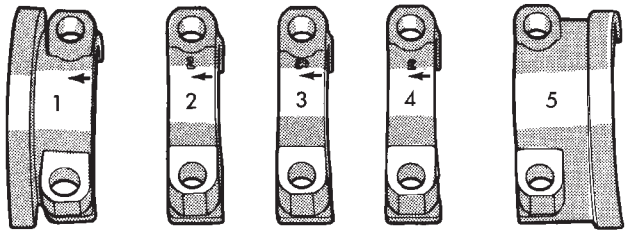

Fig. 11 Camshaft Bearing Caps Installation

VALVE COMPONENTS REPLACE−CYLINDER HEAD NOT REMOVED

ROCKER ARM AND HYDRAULIC LASH ADJUSTER

REMOVAL

(1) Remove valve cover.

(2) For each rocker arm, rotate cam until base circle is in contact with rocker arm. Depress valve spring using Special Tool C-4682 (Fig. 12) and slide rocker arm out. Keep rocker arms in order for reassembly.

(3) Remove hydraulic lash adjuster.

INSTALLATION

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

(2) Rotate cam until base circle is in contact position with rocker arm. Depress valve spring with Special Tool C-4682 (Fig. 12) and slide rocker arm in place. Keep rockers in order. It is possible for the

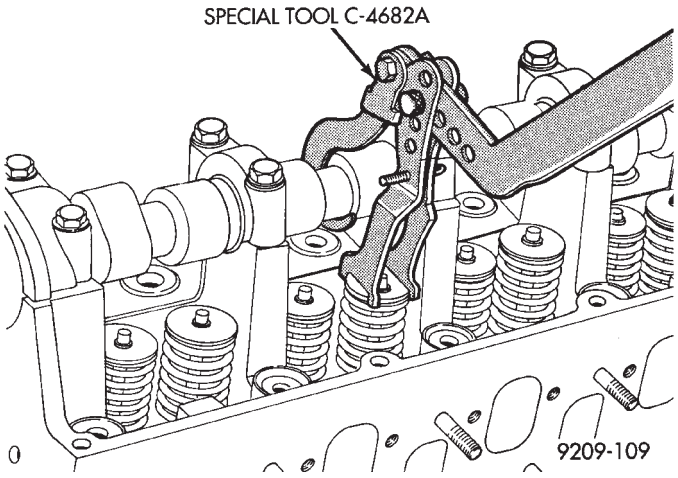

Fig. 12 Removing and Installing Valve Spring

valve spring retainer locks to become dislocated when depressing the valve spring. **Check and make sure the locks are in their proper location.**

(3) Install valve cover as previously outlined in this section.

VALVE SPRINGS AND VALVE STEM SEALS

REMOVAL

(1) Remove rocker arms 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 C-4682 (Fig. 12) compress valve springs and remove valve locks.

(5) Remove valve spring.

(6) Remove valve stem seal by gently prying side-to-side with a screwdriver blade. Once dislodged from guide post, seal may be easily removed.

INSTALLATION

(1) Install valve seals (Fig. 13) as outlined in step (2) of **Valve Gear Reassembly - After Valve Service** in this section.

(2) Using Special Tool C-4682 compress valve springs only enough to install locks. Correct alignment of tool is necessary to avoid nicking valve stems (air pressure required), piston at TDC.

(3) Install rocker arms as previously outlined in this section.

CYLINDER HEAD

REMOVAL

(1) Perform fuel system pressure release procedure **before attempting any repairs.** Refer to Fuel System Group 14.

(2) Disconnect negative battery cable. Drain cooling system. Refer to Cooling System, Group 7.

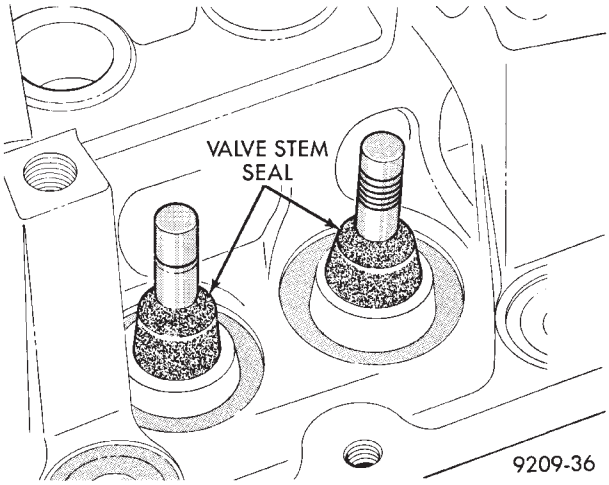

Fig. 13 Valve Stem Seals

(3) Remove air cleaner and disconnect all vacuum lines, electrical wiring and fuel lines from throttle body.

(4) Remove throttle linkage.

(5) Loosen power steering pump and remove belt.

(6) Remove power brake vacuum hose from intake manifold.

(7) Remove water hoses from water crossover.

(8) Raise vehicle and remove exhaust pipe from manifold.

(9) Remove power steering pump assembly and set aside.

(10) Disconnect coil wiring connector and coil wire from coil.

(11) Disconnect dipstick tube from thermostat housing and **ROTATE** bracket from stud. **DO NOT** bend the bracket.

(12) See Solid Mount Compressor Bracket in STANDARD SERVICE PROCEDURES, this Group.

(13) Remove cylinder head bolts.

INSPECT HEAD AND CAMSHAFT BEARING JOURNALS

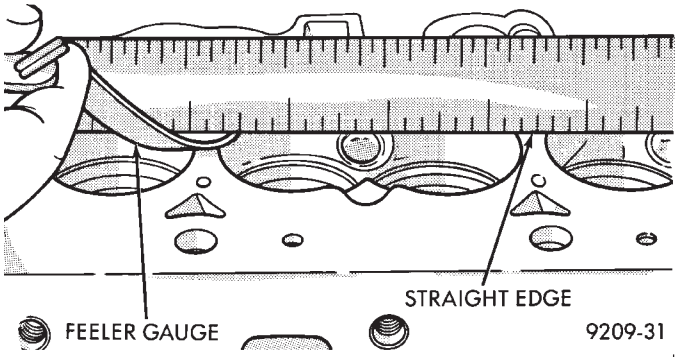

Fig. 14 Checking Cylinder Head Flatness

(1) Cylinder head must be flat within 0.1mm (.004 inch) (Fig. 14).

(2) Inspect camshaft journals for scoring and journal caps for oversize markings. When servicing cylinder head or camshaft, it is necessary to be certain that oversized camshafts are used only in oversized heads. **Identify oversize components as follows:**

Cylinder Head: Top of bearing caps painted **green** and O/SJ stamped rearward of oil gallery plug on end of head.

Camshaft: Barrel of camshaft painted **green** and O/SJ stamped on end of shaft.

CLEANING

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

INSTALLING

CAUTION: 2.5L turbo I engine head gasket is NOT the same as that used for prior years 2.2L turbo I engine (Fig. 15).

CAUTION: Head bolt diameter is 11mm. These bolts are identified with 11 on the head of the bolt. 10mm bolts will thread into the 11mm hole but will strip the cylinder block bolt hole.

Since the Cylinder head bolts are torqued using a new procedure they should be examined BEFORE reuse. If the threads are necked down the bolts should be replaced (Fig. 16).

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.

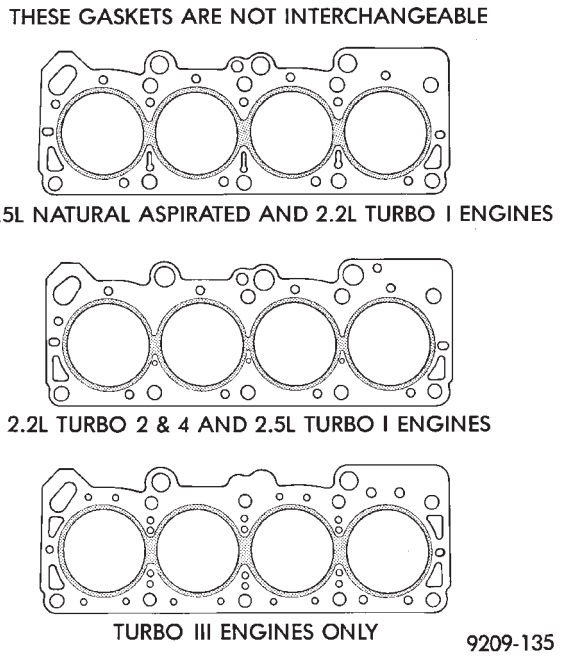

Fig. 15 Cylinder Head Gaskets

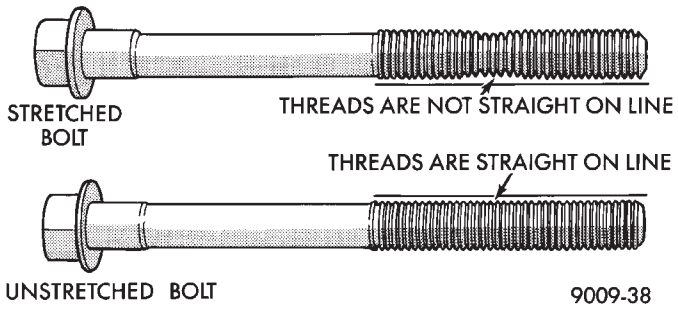

Fig. 16 Checking Bolts for Stretching (Necking)

(1) Before installing the bolts the threads should be oiled with engine oil.

(2) Install both bolts in each cap finger tight, then alternately torque each bolt to assemble the cap properly.

(3) Tighten the cylinder head bolts in the sequence shown in (Fig. 17). Using the 4 step torque turn method, tighten according to the following values:

- First All to 61 N·m (45 ft. lbs.)
- Second All to 88 N·m (65 ft. lbs.)
- Third All (again) to 88 N·m (65 ft. lbs.)
- Fourth + 1/4 Turn **Do not torque wrench for this step.**

Bolt torque after 1/4 turn should be over 90 ft. lbs. If not, replace the bolt.

(4) Rotate dipstick tube on bracket.

(5) Tighten bracket retaining nut to 23 N·m (200 in. lbs.)

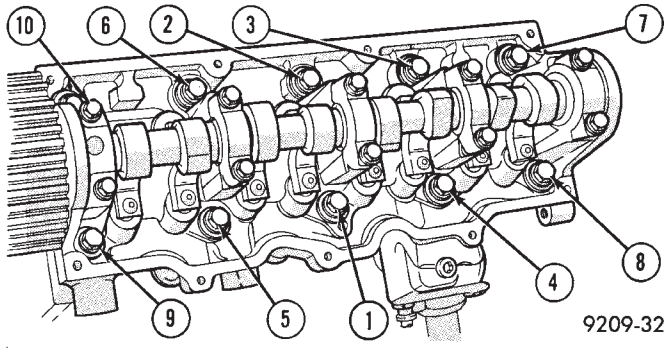

Fig. 17 Cylinder Head Tightening Sequence

VALVE SERVICE–CYLINDER HEAD REMOVED

VALVES AND VALVE SPRINGS

REMOVAL

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

(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.

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

VALVE GUIDES

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

(2) Checking Valve Guide Wear:

- Insert valve with valve head positioned 10 mm (.400 inch) above cylinder head gasket surface.
- Move valve to and from the indicator (Fig. 17). The total dial indicator reading should not exceed the amount specified in (Fig. 18). Readings should be taken for lengthwise and crosswise (with respect to cylinder head) movement for each valve. Ream the guides for valves with oversize stems if dial indicator reading is excessive or if the stems are scuffed or scored.

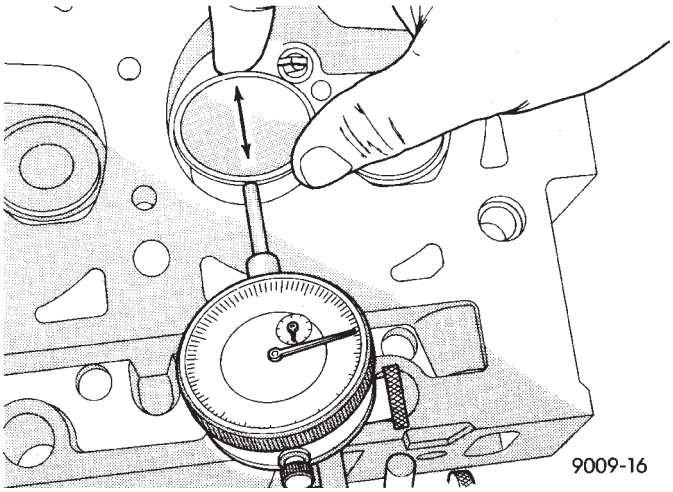

Fig. 18 Checking Wear on Valve Guide–Typical

Valve Guide Dial Indicator Reading, Maximum	Intake Valve 0.5 mm (0.020 in.)	Exhaust Valve 0.7 mm (0.027 in.)
Valve Guide Reamer Oversize	Valve Guide Size	
0.15 mm (.005 in.)	8.125-8.150 mm (.3198-.3208 in.)	
0.40 mm (.015 in.)	8.375-8.400 mm (.3297-.3307 in.)	
0.80 mm (.030 in.)	8.775-8.800 mm (.3454-.3464 in.)	

9109-8

Fig. 19 Valve Guide Specification

(3) Service valves with oversize stems and oversize seals are available in 0.15mm, (.005 inch) 0.40mm, (.015 inch) and 0.80mm (.031 inch) oversize.

Oversize seals must be used with oversize valves.

Reamers sizes to accommodate the oversize valve stem are shown in (Fig. 18).

(4) 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 0.80mm (.030 inch). Use step procedure of 0.15mm (.005 inch), 0.40mm (.015 inch) and 0.80mm (.030 inch) 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.**

Replace cylinder head if guide does not clean up with 0.80 mm (.030 inch) oversize reamer, or if guide is loose in cylinder head.

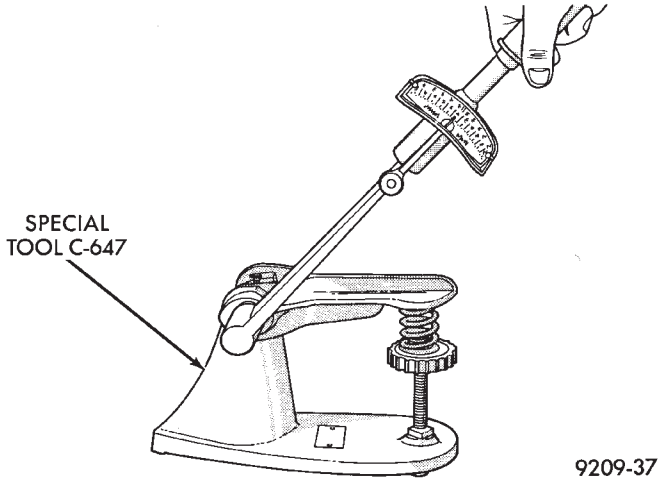

Fig. 20 Testing Valve Spring with Tool C-647

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 33.34mm (1-5/16 inches). Turn table of Tool C-647 until surface is in line with the 33.34mm (1-5/16 inch) mark on the threaded stud and the zero mark on the front. Place spring over stud on the table and lift compressing lever to set tone device (Fig.20). 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.

(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 1.5mm (1/16 inch) out of square, install a new spring.

REFACING VALVES AND VALVE SEATS

(1) The intake and exhaust valve seats and valve face have a 45 degree angle.

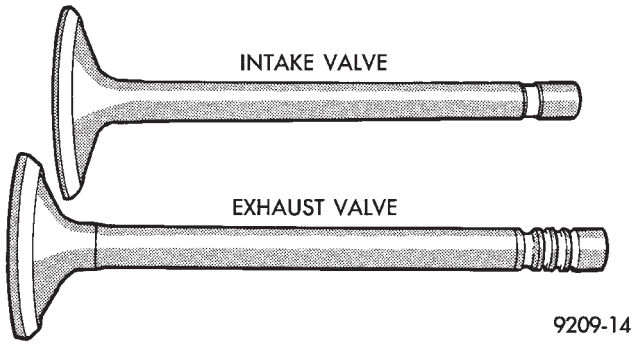

Fig. 21 Intake and Exhaust Valves

Valve Dimensions
Intake Valve (minimum)
Stem diameter: 7.935 mm (.3124 in.)
Face angle: 45°
Valve margin: .794 mm (.031 in.)
Head diameter: 40.6 mm (1.60 in.)
Length: 114.25 mm (4.498 in.)
Exhaust Valve (minimum)
Stem diameter: 7.881 mm (.3103 in.)
Face angle: 44 1/2°
Valve margin: 1.191 mm (.0469 in.)
Head diameter: 35.4 mm (1.39 in.)
Length: 114.87 mm (4.522 in.)

9109-9

Fig. 22 Valve Dimensions

(2) Inspect the remaining margin after the valves are refaced (Fig. 23). Exhaust valves with less than 1.191mm (3/64 inch) margin and intake valves with less than .794mm (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 using a valve seat dial indicator. Total runout should not exceed .051mm (.002 inch) (total indicator reading).

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

- Intake valve seat diameter 40.45mm (1.593 inch)
- Exhaust valve seat diameter 34.84mm (1.371 inch)

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.

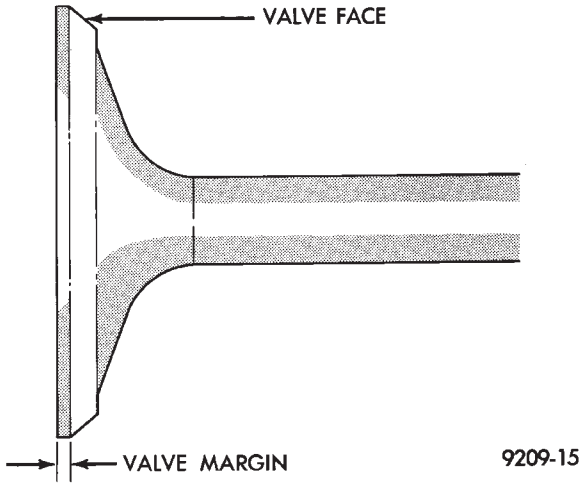

Fig. 23 Refacing Intake and Exhaust Valves

(6) When seat is properly positioned the width of intake seats should be 1.75 to 2.25mm (0.69 to .088 inch). The width of the exhaust seats should be 1.50 to 2.00mm (.059 to .078 inch) (Fig. 24 Dimension 1).

(7) Check valve tip to valve spring seat dimensions after grinding to seats or faces. Grind valve tip to give 49.76 to 51.04mm (1.960 to 2.009 inch) over valve spring seat when installed in the head (Fig. 25). The valve tip diameter should be no less than 7.0mm (0.275 inch), if necessary, the tip chamfer should be reground to prevent seal damage when the valve is installed.

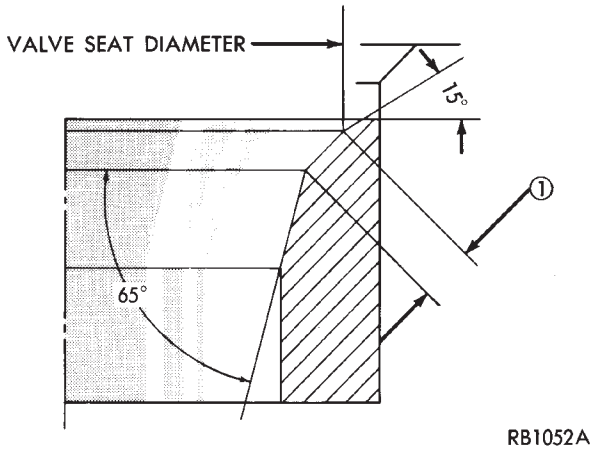

Fig. 24 Refacing Valve Seats

(8) Check the valve spring installed height after refacing the valve and seat (Fig. 26).

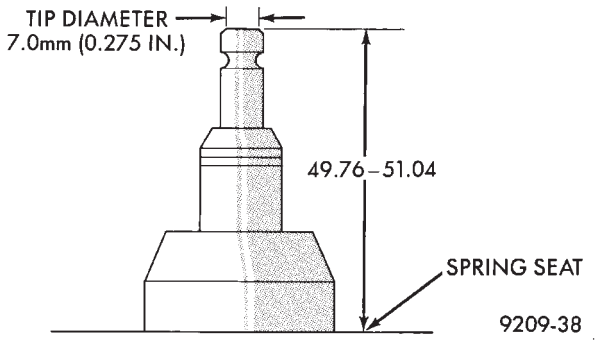

Fig. 25 Valve Tip to Valve Spring Seat Dimensions

CAUTION: If more than .5mm (.020 inch) must be ground from the valve tip, check the clearance between the rocker arm and the valve spring retainer if below 1.25mm (.050 inch), grind the rocker arm ears according to the procedure described in Refacing Valves and Valve Seats.

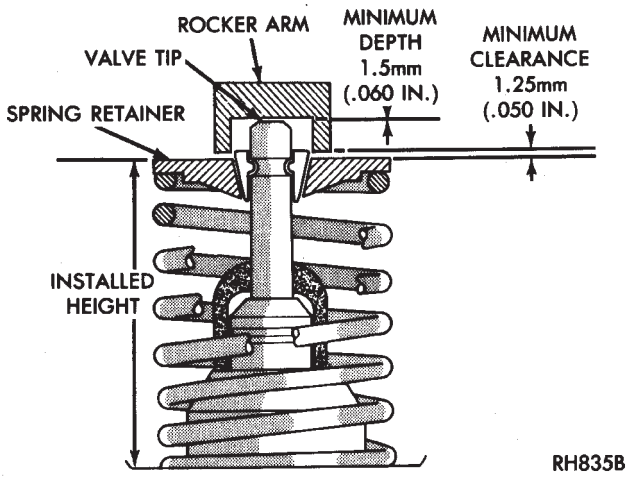

Fig. 26 Checking Spring Installed Height and Spring Retainer Clearance

CLEANING

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

VALVE GEAR REASSEMBLY AFTER VALVE SERVICE

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

(2) Install new valve stem seals on all valves. The valve stem seals should be pushed firmly and squarely over valve guide. The lower edge of the seal should be resting on the valve guide boss.

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 spring seats and 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 Tool C-3422-B the locks can become dislocated. Check to make sure both locks are in their correct location after removing tool.

(4) Check installed height of springs. Measurement is to be taken from the lower edge of the valve spring to its upper edge. Do not include the spring seat or retainer flange. Correct height is 41.2mm to 42.7mm (1.62 to 1.68 inches). If seats have been reground an additional spring seat may be required to maintain correct installed spring height.

(5) Install adjusters, rocker arms in order, and camshaft as previously described, see Camshaft-Install. Check for clearance between the projecting ears (either side of valve tip) of the rocker arms and the valve spring retainers. At least 1.25 mm (.050 inch) clearance must be present, if necessary, the rocker arm ears may be ground to obtain this clearance (Fig. 26).

(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 0.62 to 1.52 mm (.024 to .060 inch). To completely collapse adjuster for dry lash measurement, pry off retainer cap, dissemble, drain the adjuster of oil, reassemble, and install. After performing dry lash check, refill adjuster with oil (do not reuse retainer cap/s) and allow 10 minutes for adjuster/s to bleed down before rotating cam.

CYLINDER HEAD AND VALVE ASSEMBLY SERVICE–TURBO III

CYLINDER HEAD COVER SEALING

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

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

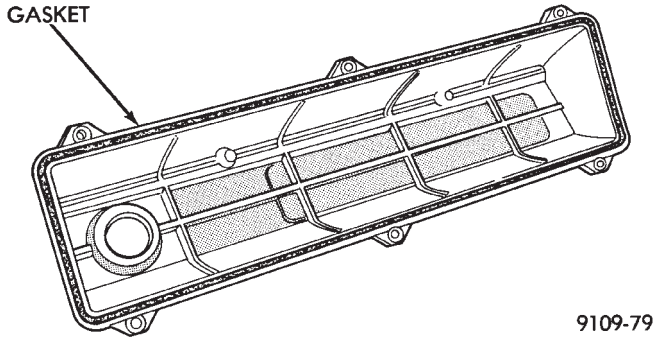

Fig. 1 Cylinder Head Valve Cover and Gasket Assembly

(2) Install covers and gasket assembly to head and torque to 12 N·m (105 in. lbs.).

CYLINDER HEAD

REMOVAL

Refer to Intake and Exhaust Manifold Service in Exhaust Systems and Intake Manifold Group 11 for removal procedure for the intake and exhaust manifolds.

(1) The Timing belt and Solid Mount Compressor Mount Bracket must be removed before the cylinder head can be removed. Refer to procedure outlined in this group for service procedures.

(2) Remove cylinder head bolts.

(3) Cylinder head must be flat within 0.1mm (.004 inch (Fig. 2).

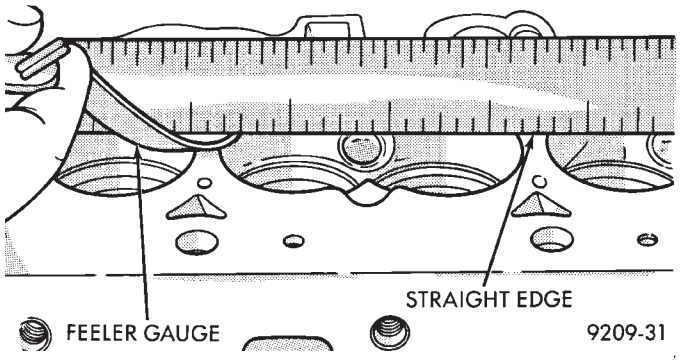

Fig. 2 Checking Cylinder Head Flatness

INSTALLATION

CAUTION: The Turbo III head gasket is not the same as 2.5L turbo engine head gasket (Fig. 3).

CAUTION: Head bolt diameter is 11mm. These bolts are Unique to this engine application they are not interchangeable with other engines.

The Cylinder head bolts are torqued using a new procedure they should be examined BEFORE reuse. If the threads are necked down the bolts should be replaced. (Fig. 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.

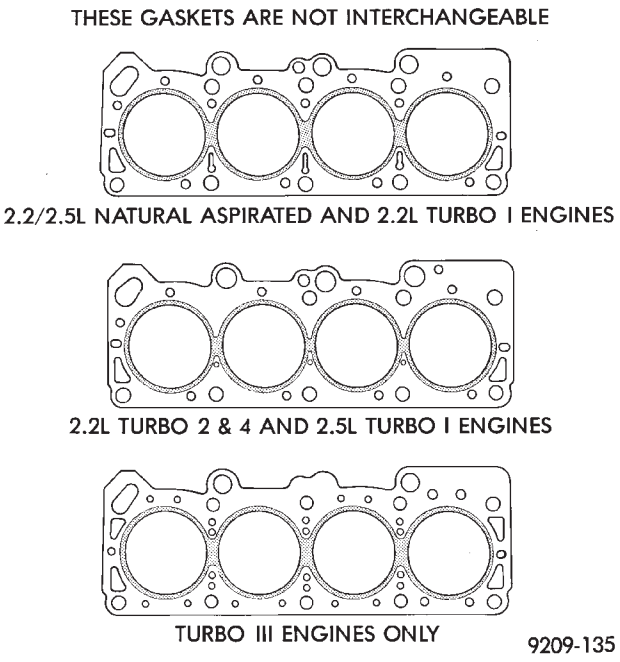

Fig. 3 Cylinder Head Gaskets

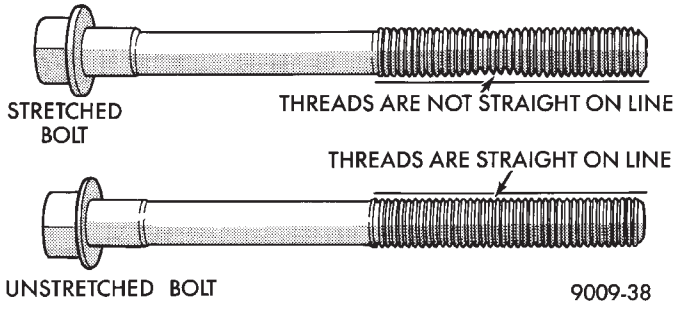

Fig. 4 Checking Bolts for Stretching–Necking

Before installing the bolts, the threads should be cleaned and oiled.

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

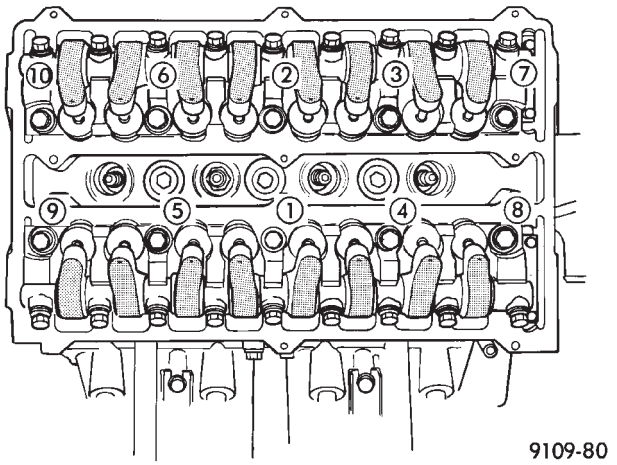

Fig. 5 Cylinder Head Tightening Sequence

- First All to 61 N·m (45 ft. lbs.)
- Second All to 88 N·m (65 ft. lbs.)
- Third All (again) to 88 N·m (65 ft. lbs.)
- Fourth + 1/4 Turn **Do not use torque wrench for this step.**
- Bolt torque after 1/4 turn should be over 90 ft. lbs. If not, replace the bolt.

Refer to Intake and Exhaust Manifold Service in Exhaust Systems and Intake Manifold Group 11 for installation procedure.

Refer to Timing Belt and Solid Mount Compressor Mount Bracket service procedures in this group for installations procedures.

TIMING BELT COVER SERVICE−TURBO III ENGINE

REMOVAL

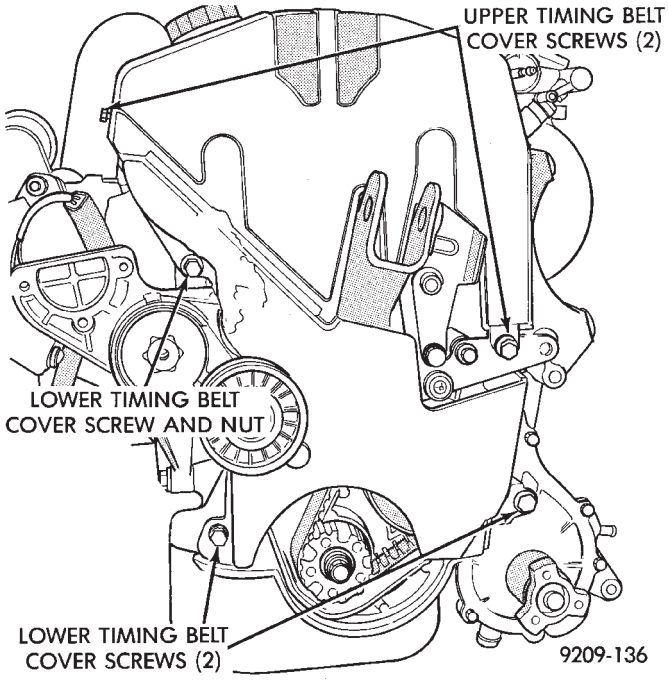

Fig. 1 Timing Belt Cover Screws

(1) Remove PCV tube and upper timing belt cover screws (Fig. 1). Remove upper cover.

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

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

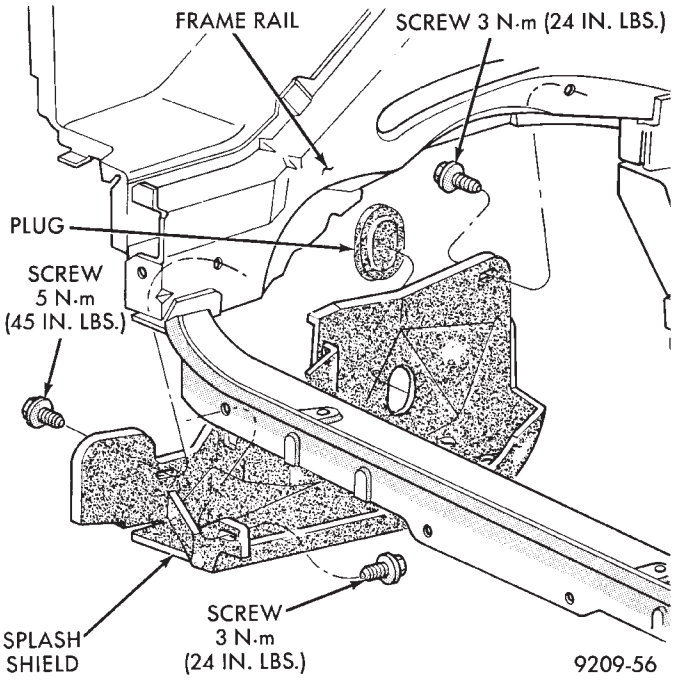

Fig. 2 Right Inner Splash Shield

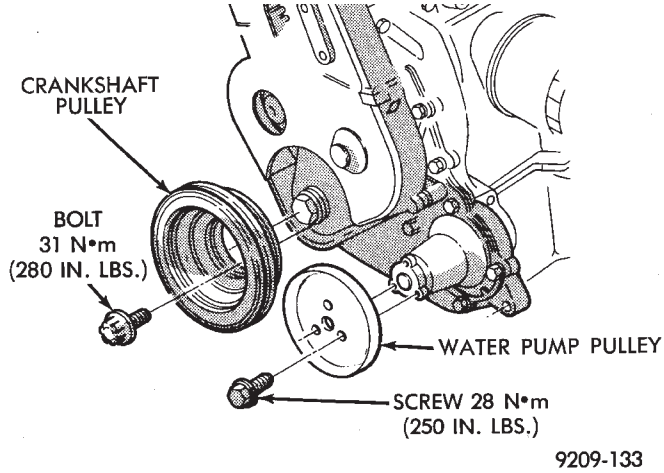

Fig. 3 Crankshaft and Water Pump Pulleys

(4) Remove water pump pulley and crankshaft pulley retaining bolts (Fig. 3), remove pulleys.

(5) Remove lower accessory drive belt idler and tensioner pulley (Fig. 4).

CAUTION: Do not use a impact wrench to remove pulley bolts.

(6) Remove lower timing belt cover fasteners (Fig. 1). Remove cover.

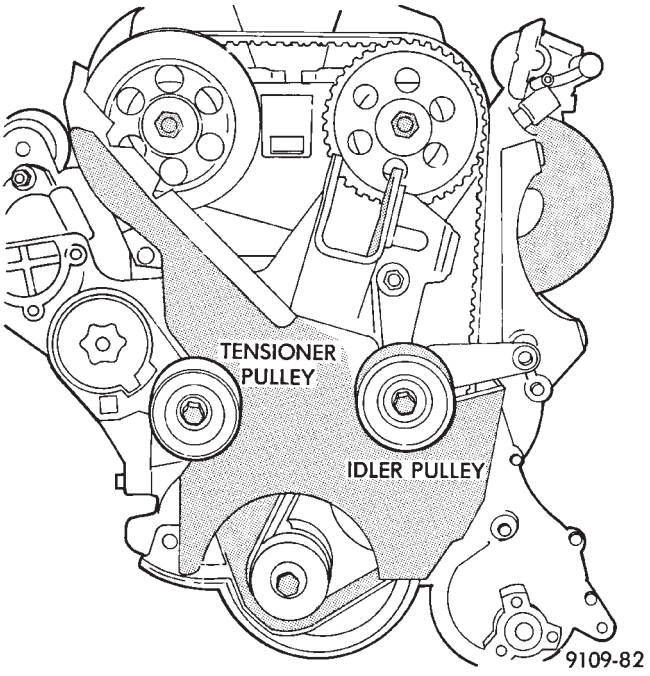

Fig. 4 Timing Belt Cover and Tensioner

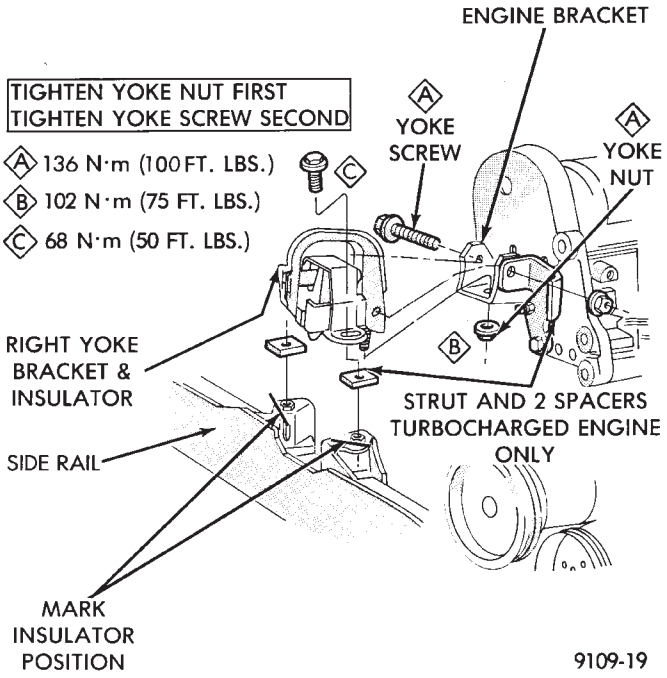

Fig. 5 Right Engine Mount−Typical

INSTALLATION

(1) Raise vehicle on hoist. Install lower timing belt cover and tighten fasteners to 12 N·m (105 in. lbs.) torque (Fig. 4).

CAUTION: Do not use impact wrench on accessory drive belt tensioner bolt. It may cause damage to tensioner arm. Accessory drive belt tensioner pulley bolt must be installed finger tight.

(2) Install accessory drive belt tensioner pulley bolt finger tight. Then tighten bolt to 54 N·m (40 ft. lbs.) torque (Fig. 4).

(3) Install crankshaft and water pump pulleys (Fig. 3).

(4) Install inner splash shield and wheel (Fig. 2).

(5) Install accessory drive belt. Refer to Cooling System Group 7 for procedure.

(6) Install upper timing belt cover and tighten screws to 4 N·m (36 in. lbs.) torque. Install PCV tube (Fig. 1).

TIMING BELT

REMOVAL

(1) Remove timing belt cover refer to timing belt cover service of this section for procedure.

(2) Lift engine with Engine Support Tool C-4852. Separate right engine mount (Fig. 5).

(3) Raise vehicle on a hoist. Remove lower accessory drive belt idler pulley bracket assembly (Fig. 6).

(4) Loosen timing belt tensioner, remove timing belt and idler pulley (Fig. 6).

(5) Lower vehicle

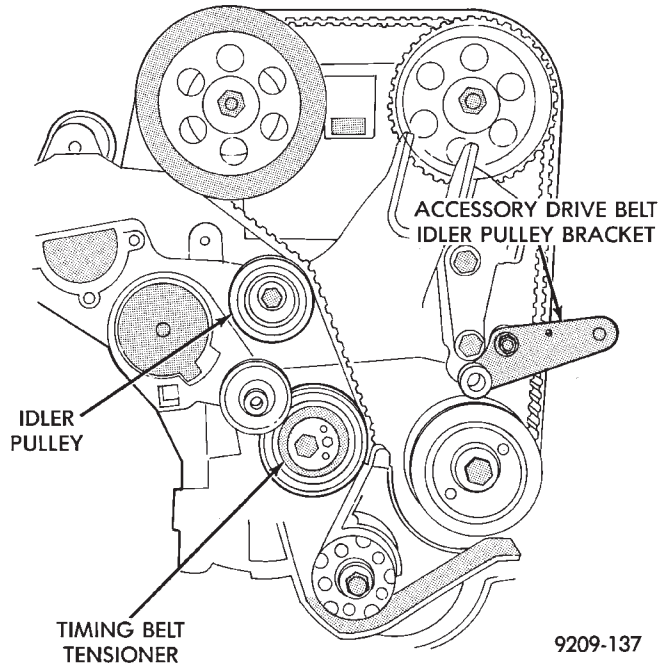

Fig. 6 Remove Timing Belt

CAMSHAFT AND CRANKSHAFT TIMING PROCEDURE

INSTALLATION

(1) Remove air cleaner fresh air duct.

(2) Remove ignition cable cover (Fig. 7).

(3) Remove valve covers and loosen rocker arm assemblies about 3 turns as shown in (Fig. 8).

CAUTION: Check lash adjuster for loose or missing retainers before continuing service procedure.

(4) Align and pin both intake and exhaust cam sprockets with 3/32 drills or pin punches (Fig. 9). **Accessory Shaft does not need to be timed.**

(5) Remove spark plugs.

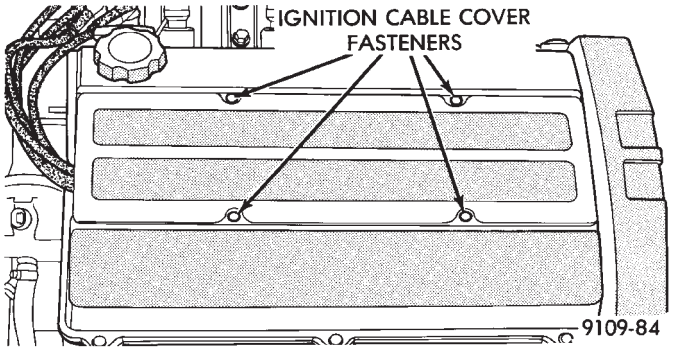

Fig. 7 Ignition Cable Cover

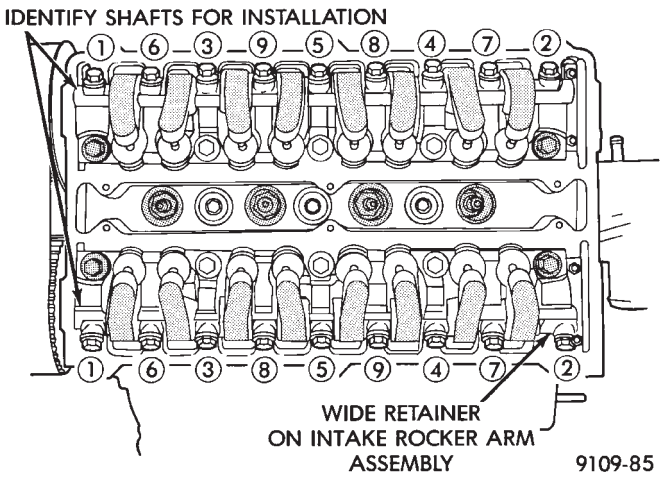

Fig. 8 Rocker Arm Shaft Assemblies

(6) Install a dial indicator in Number 1 spark plug hole (Fig. 10).

(7) Rotate crankshaft till number 1 piston is at Top Dead Center. Mark the engine block for TDC reference.

(8) Install timing belt and idler pulley in sequence shown in (Fig. 11).

(9) Remove dial indicator from cylinder head (Fig. 10). Remove drills or pins from camshaft sprockets (Fig. 11).

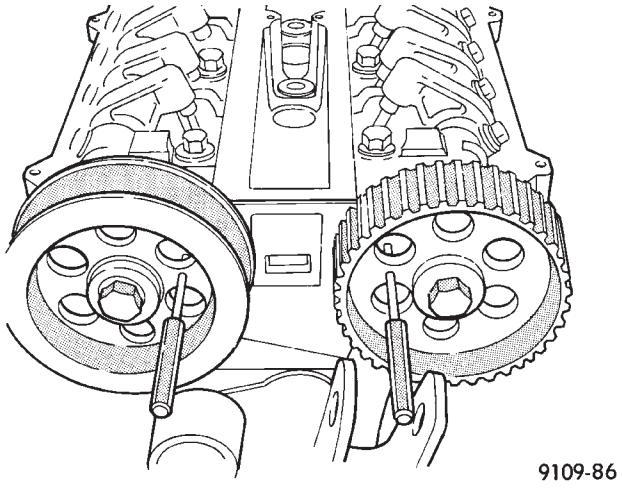

Fig. 9 Camshafts Pinned into Position

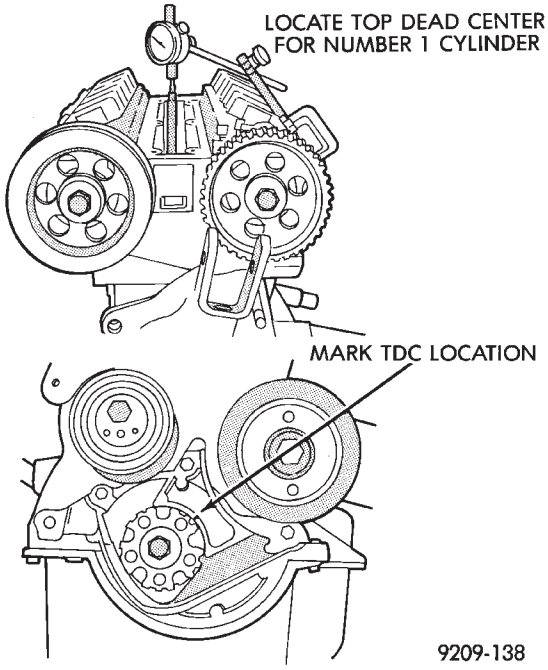

Fig. 10 Dial Indicator Located in Number 1 Cylinder

(10) Adjust tension to 445 N (110 lbs.) **New belt** or 311 N (70 lbs.) **Used belt.** Install belt tension gauge on timing belt (Fig. 12) adjust tensioner until specified tension is achieved.

CAUTION: Belt tension gauge must be installed between the belt teeth to get a accurate reading.

(11) Rotate crankshaft clockwise 2 full revolutions and check alignment of camshaft and crankshaft timing marks. **Do not reverse rotate crankshaft or attempt to rotate engine using cam or accessory shaft attaching screw.**

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

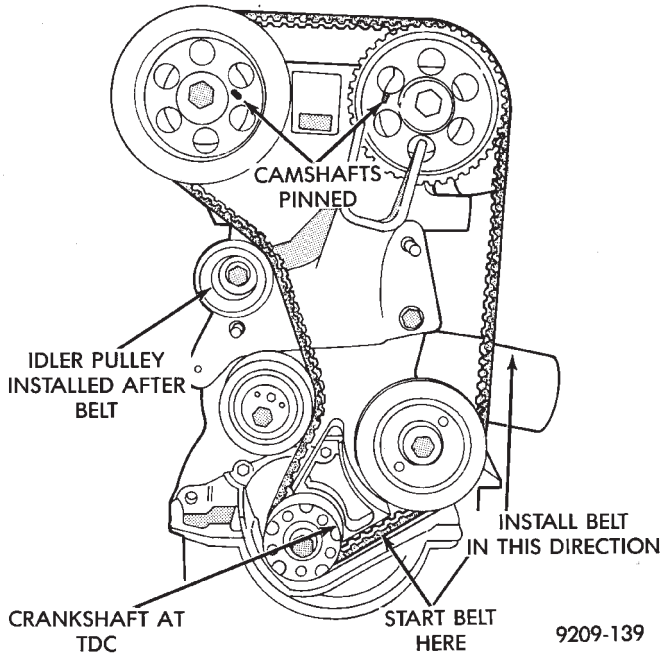

Fig. 11 Camshafts and Crankshaft Timing Marks

(12) Recheck belt tension, adjust if necessary.

(13) Torque rocker arm shafts in sequence shown (Fig. 13) to 12 N·m (105 in. lbs.) then to 24 N·m (210 in. lbs.).

(14) Install valve covers, spark plugs, ignition cables and ignition cable cover.

(15) Install air cleaner fresh air duct.

(16) Raise vehicle. Install lower timing belt cover and accessory drive belt tensioner pulley. Refer to procedure in this section.

(17) Lower vehicle. Install right engine mount (Fig. 5).

(18) Install upper timing belt cover and PCV tube. Refer to procedure in this section.

(19) Install accessory drive belt. Refer to procedure in this section.

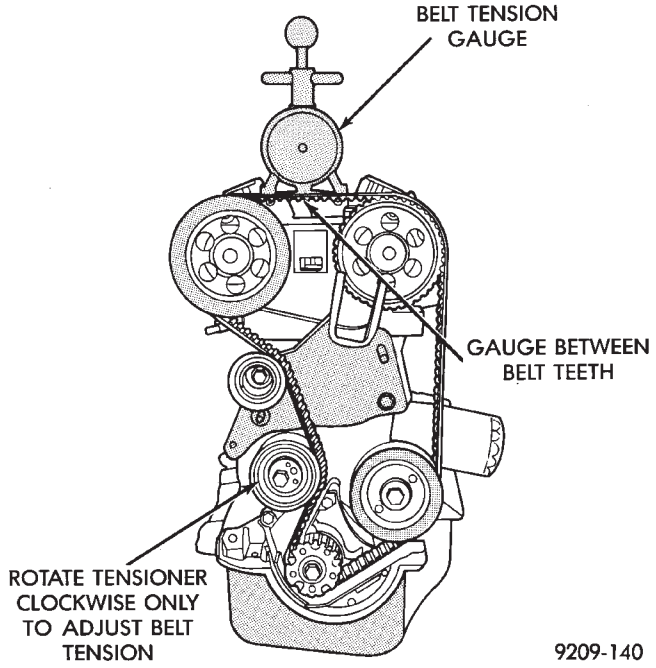

Fig. 12 Belt Tension Gauge Location

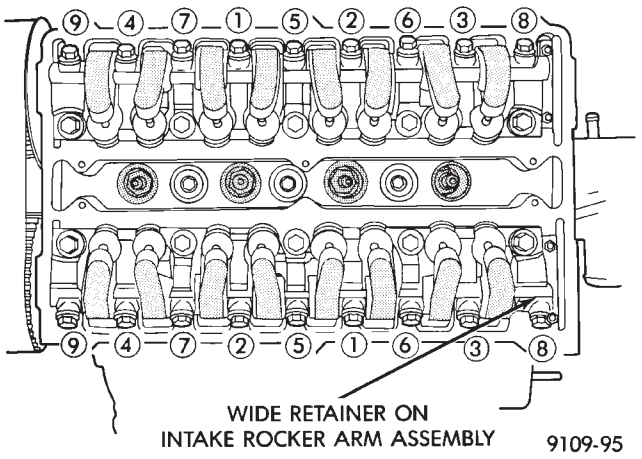

Fig. 13 Rocker Arm Shaft–Installation

SERVICING OIL SEALS

Refer to servicing oil seals in this group for procedures.

To service the intake cam seal (Turbo III) the right engine mount must be removed. Refer to engine mount removal of this Group.

CAMSHAFTS SERVICE

Cylinder Head must be removed from vehicle. Refer to cylinder head removal for procedure.

REMOVAL

(1) Mark rocker arms shafts for reinstallation in the same position (Fig. 1).

(2) Remove rocker arm assembly attaching bolts in sequence (Fig. 1).

(3) Remove thrust plates from rear of camshafts (Fig. 2). The intake camshaft uses a wider thrust plate than exhaust camshaft.

CAUTION: Thrust plates are not the same thickness and cannot be interchanged.

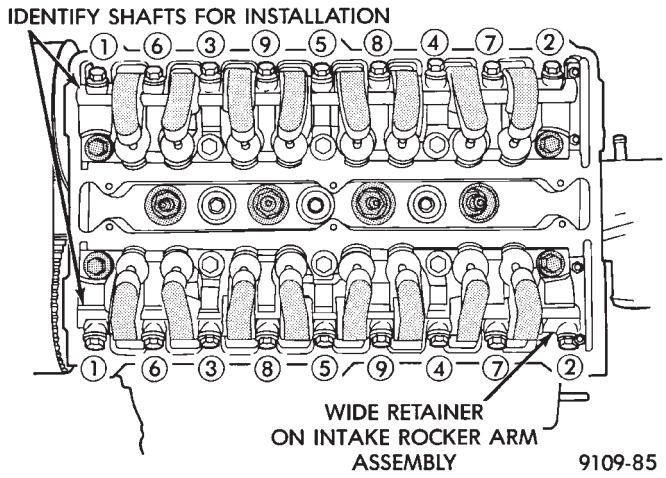

Fig. 1 Rocker Arm Shaft Removal Sequence

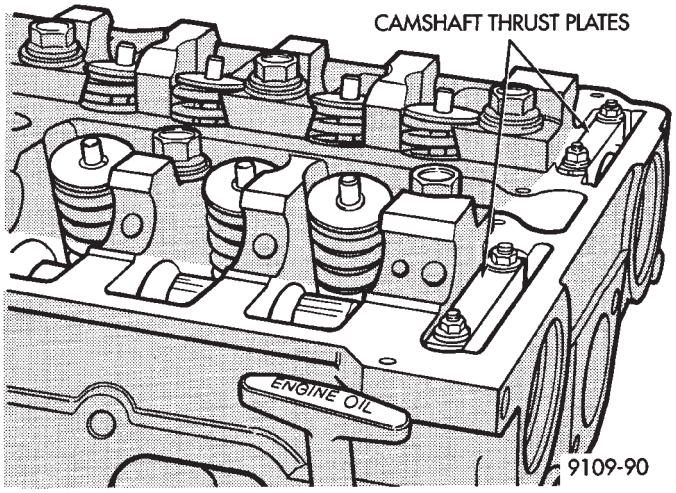

Fig. 2 Camshaft Thrust Plates

(4) Before camshaft can be removed from cylinder head the cam seal must be removed first. Be careful not to damage seal surface of the camshaft.

(5) Using a screwdriver place it against the side of the cam lobe push the cam out of the head. The cam seal will be pushed out by the cam (Fig. 3).

(6) Slide the camshaft out of the cylinder head. Be careful not scratch the bearing surfaces in the head (Fig. 4).

CAUTION: Intake and Exhaust camshafts are not interchangeable.

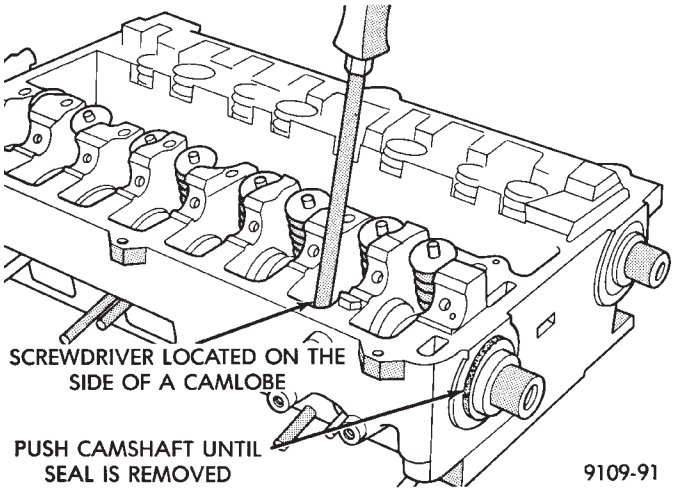

Fig. 3 Removing Camshaft Oil Seal

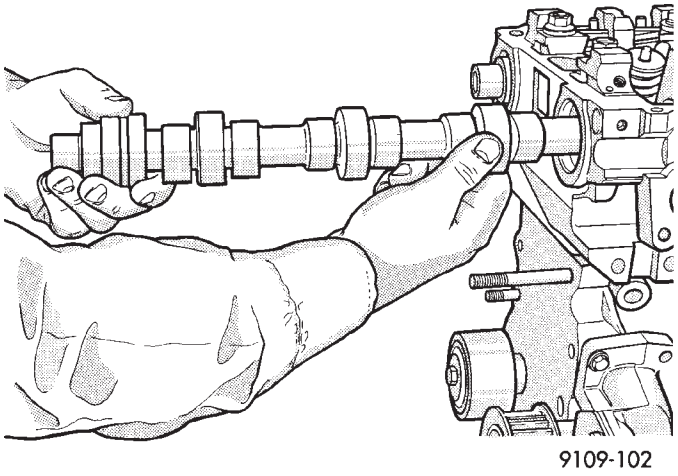

Fig. 4 Camshaft–Removal or Installation

INSPECTION

Camshaft lobe wear should not exceed .25mm (.010 inch). To measure cam lobe wear (Fig. 4), measure lobe diameter in two places at the largest diameter (over the nose). Take first reading with micrometer in unworn area at the edge of the lobe. Take second reading in the worn area where rocker arm contacts the lobe. Subtract second reading from the first. The difference is the cam lobe wear.

INSTALLATION

(1) Lubricate camshaft journals with clean engine oil. Carefully install camshaft into the head.

CAUTION: Camshafts are not interchangeable. The intake cam has a wider thrust plate groove.

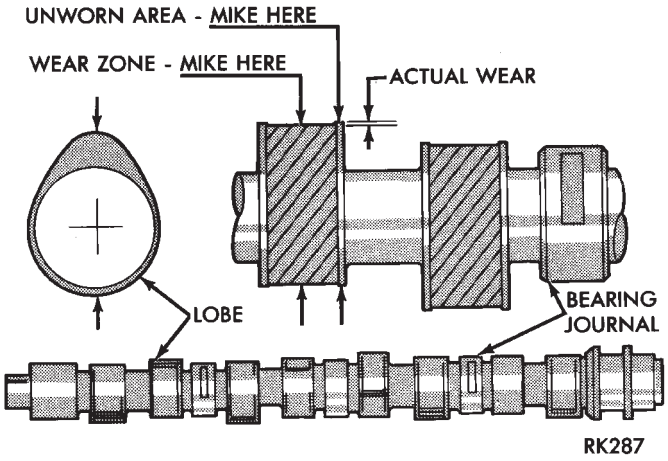

Fig. 5 Measuring Camshaft Lobe Wear

(2) Install thrust plates and tighten retaining nuts to 6 N·m (55 in. lbs.).

(3) Install new camshaft oil seals flush with cylinder head surface.

Using seal installing special tool C-4680.

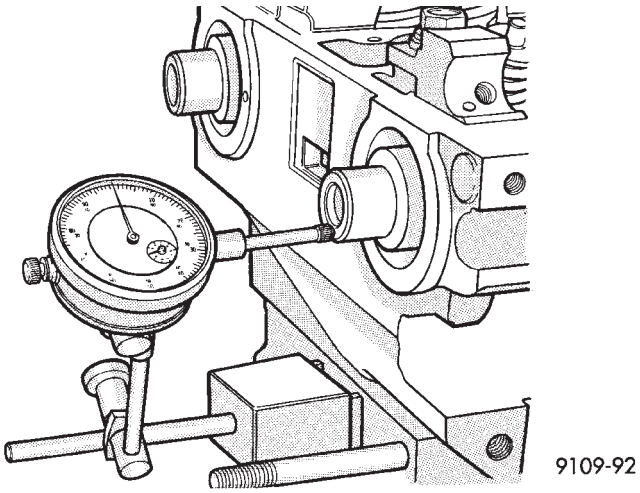

Fig. 6 Checking Camshaft End Play

CAMSHAFT END PLAY

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

(2) Zero dial indicator (Fig. 6).

(3) Move as far forward and backward as camshaft will go.

(4) End play travel: 0.025-0.200mm (.001-.008 inch).

LASH ADJUSTER (TAPPET) NOISE

A tappet-like noise may be produced from several items. See Lash Adjuster and Tappet Noise-DIAGNOSIS in STANDARD SERVICE PROCEDURES, this Group.

VALVE COMPONENTS REPLACE–CYLINDER HEAD NOT REMOVED

ROCKER ARM AND HYDRAULIC LASH ADJUSTER

REMOVAL

(1) Remove valve cover. Refer to procedure previously outlined in this section.

(2) Remove rocker arm shaft(s) in sequence shown in (Fig. 6). Slide rocker off the shaft. Keep rocker arms in order for reassembly.

CAUTION: Check lash adjuster for loose or missing retainers before continuing service procedure.

(3) Remove hydraulic lash adjuster.

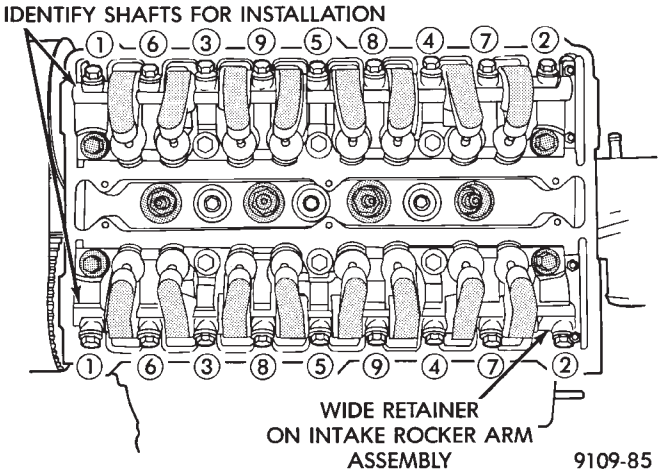

Fig. 7 Rocker Arm Shaft–Removal

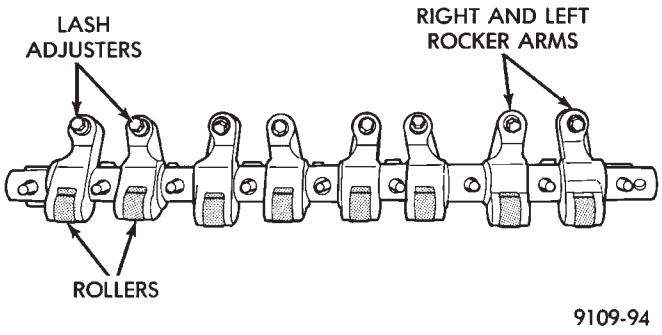

Fig. 8 Rocker Arm and Lash Adjuster Assembly–Right and Left

INSTALLATION

(1) Install rocker arm on the shaft in there original position (Fig. 9).

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

(3) Install rocker arm shaft assembly tighten in sequence shown in (Fig. 10).

(4) Install valve cover as previously outlined.

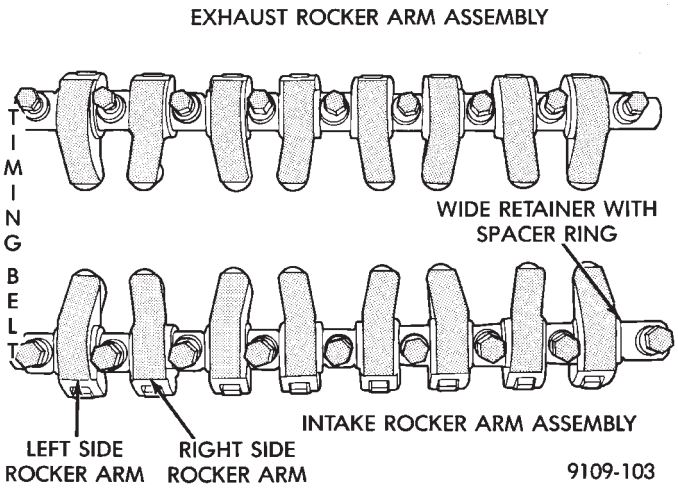

Fig. 9 Intake and Exhaust Rocker Arm Assemblies

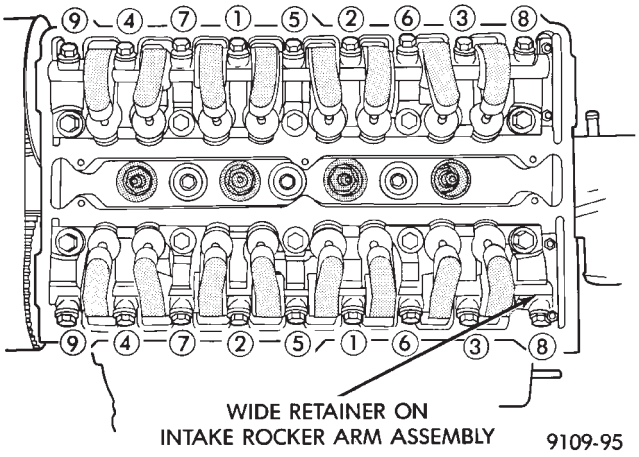

Fig. 10 Rocker Arm Shaft–Installation

VALVE SPRINGS AND VALVE STEM SEALS

VALVE SERVICE

• CYLINDER HEAD MUST BE REMOVED TO SERVICE VALVE SPRINGS AND VALVE STEM SEALS.

VALVE AND VALVE SPRINGS

REMOVAL

(1) With cylinder head removed, compress valve springs using Valve Spring Compressor Tool C-3422-B with adopters 6537 and 6526 (Fig. 11).

(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.

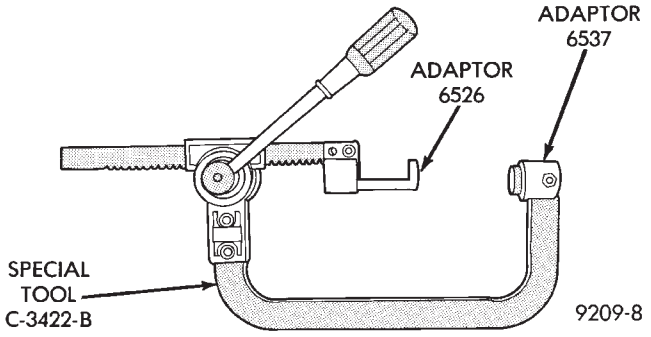

Fig. 11 Valve Spring Compressor

Intake/Exhaust Valve Guide Diameters	7.00/7.015 mm (.2755/.2761 in.)	
Clearance	**New**	**Service Limit**
Intake	0.03 to 0.06mm (.001 to .0023 in.)	.1 mm .004 in.
Exhaust	0.05 to 0.08mm (.002 to .0031 in.)	.1 mm .004 in.

9109-97

Fig. 12 Valve Guide Specificaton

VALVE INSPECTION

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

(2) Measure valve stems for wear. Refer to (Fig. 14) for specifications.

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

VALVE GUIDES

Measure valve guides in 3 places top, middle and bottom (Fig. 13). Using a small hole gauge and a micrometer, refer to (Fig. 12) for specifications.

Replace cylinder head if guides are not within specifications.

TESTING VALVE SPRINGS

(1) Refer to Testing Valve previously described in this Group for procedure. Test springs at 36.8mm (1-7/16 to 1-15/32 in.) 1000 N 225 lbs.) ± 40 N (9 lbs.). Discard the springs that do not meet specifications.

(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 1.65mm (1/16 inch) out of square, install a new spring. Spring free length is 53.2 mm ± .25 mm (2.094 in. ± .010 in.)

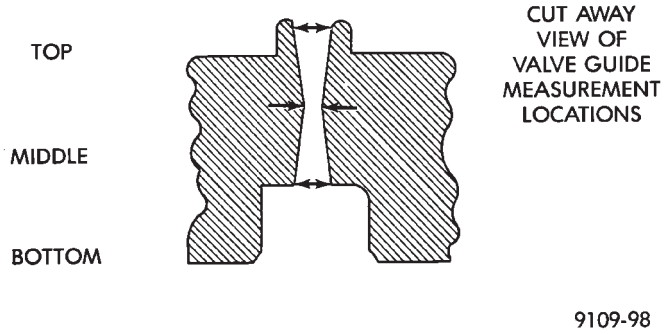

Fig. 13 Measuring Valve Guides

Intake Valve (minimum)
Stem diameter: 6.955mm (.274 in.) Face angle: 45 Valve margin: 1.06 mm .041 in. Length: 143.4 mm 5.645 in.
Exhaust Valve (minimum)
Stem diameter: 6.935mm (.273 in.) Face angle: 45 Valve margin: 1.07 mm .042 in. Length: 141.6 mm 5.57 in.

9109-99

Fig. 14 Valve Dimensions

REFACING VALVES AND VALVE SEATS

(1) The intake and exhaust valve seats and valve face have a 45 degree angle.

(2) Inspect the remaining margin after the valves are refaced (Fig. 11). Exhaust valves with less than 1.07mm (3/64 inch) margin and intake valves with less than 1.06mm (3/64 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 using a valve seat dial indicator. Total runout should not exceed 0.1 mm (.004 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 degree stone. If the blue is transferred to the bottom edge of valve face raise valve seat with a 65 degrees stone.

- Intake valve seat diameter 34.0mm (1.338 inch)
- Exhaust valve seat diameter 29.4mm (1.157 inch)

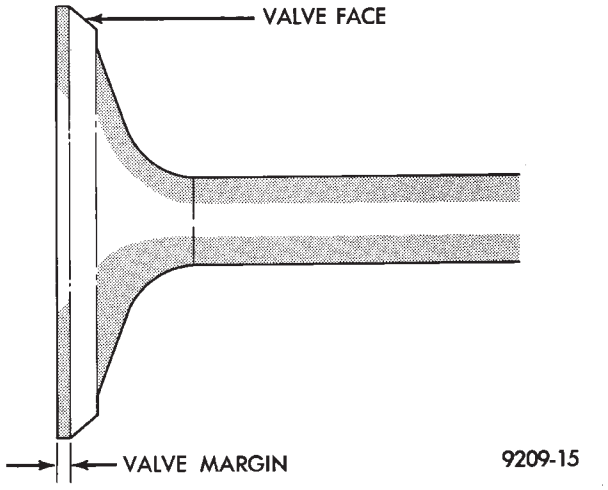

Fig. 15 Refacing Intake and Exhaust Valves

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.

(6) When seat is properly positioned the width of intake seats should be 1.87mm (0.73 inch) The width of the exhaust seats should be 2.00mm (.078 inch) (Fig. 16 Dimension 1).

(7) Check valve tip for scoring, if necessary, the tip chamfer should be reground to prevent seal damage when the valve is installed.

(8) Check the valve spring installed height after refacing the valve and seat (Fig. 17).

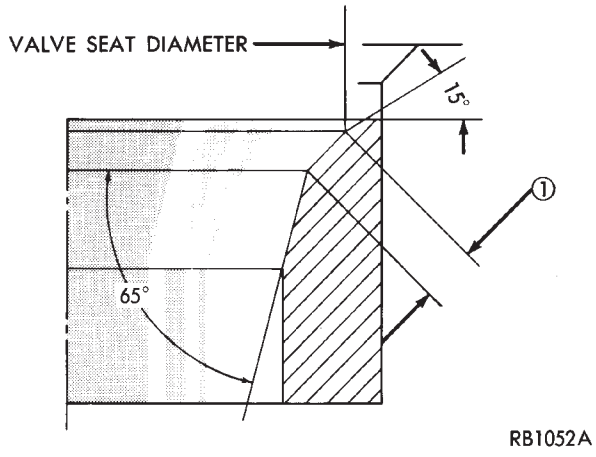

Fig. 16 Refacing Valve Seats

VALVE GEAR REASSEMBLY AFTER VALVE SERVICE

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

(2) Install new valve stem seals on all valves. The valve stem seals should be pushed firmly and squarely over valve guide. The lower edge of the seal should be resting on the valve guide boss.

(3) Install valve spring seats and springs and retainers. Compress valve springs only enough to in-

stall 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 Tool C-3422-B with adopters 6537 and 6526 (Fig. 11) the locks can become dislocated. Check to make sure both locks are in teir correct location after removing tool.

(4) Check installed height of springs. Measurement is to be taken from the lower edge of the valve spring to its upper edge. Do not include the spring seat or retainer flange. Correct height is 44.0mm (1.73 inches). If seats have been reground an additional spring seat may be required to maintain correct installed spring height (Fig. 17).

(5) Install camshaft and rocker arms as previously described, see Camshaft-Install.

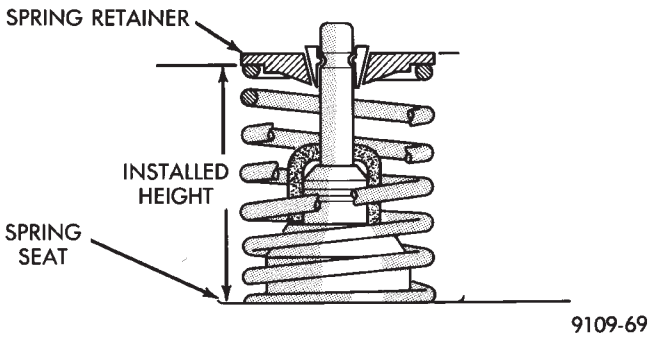

Fig. 17 Checking Spring Installed Height

CRANKSHAFT, INTERMEDIATE AND BALANCE SHAFT SERVICE

FASTENER TORQUE			
LETTER	N·m	IN. LBS.	FT. LBS.
A	12	105	–
B	28	250	–
C	54	–	40
★ D	★41	–	★30
E	95	–	70
F	(PLUG - LOCTITE 277)		
G	15	130	–

★SPECIFIED TORQUE PLUS 1/4 TURN

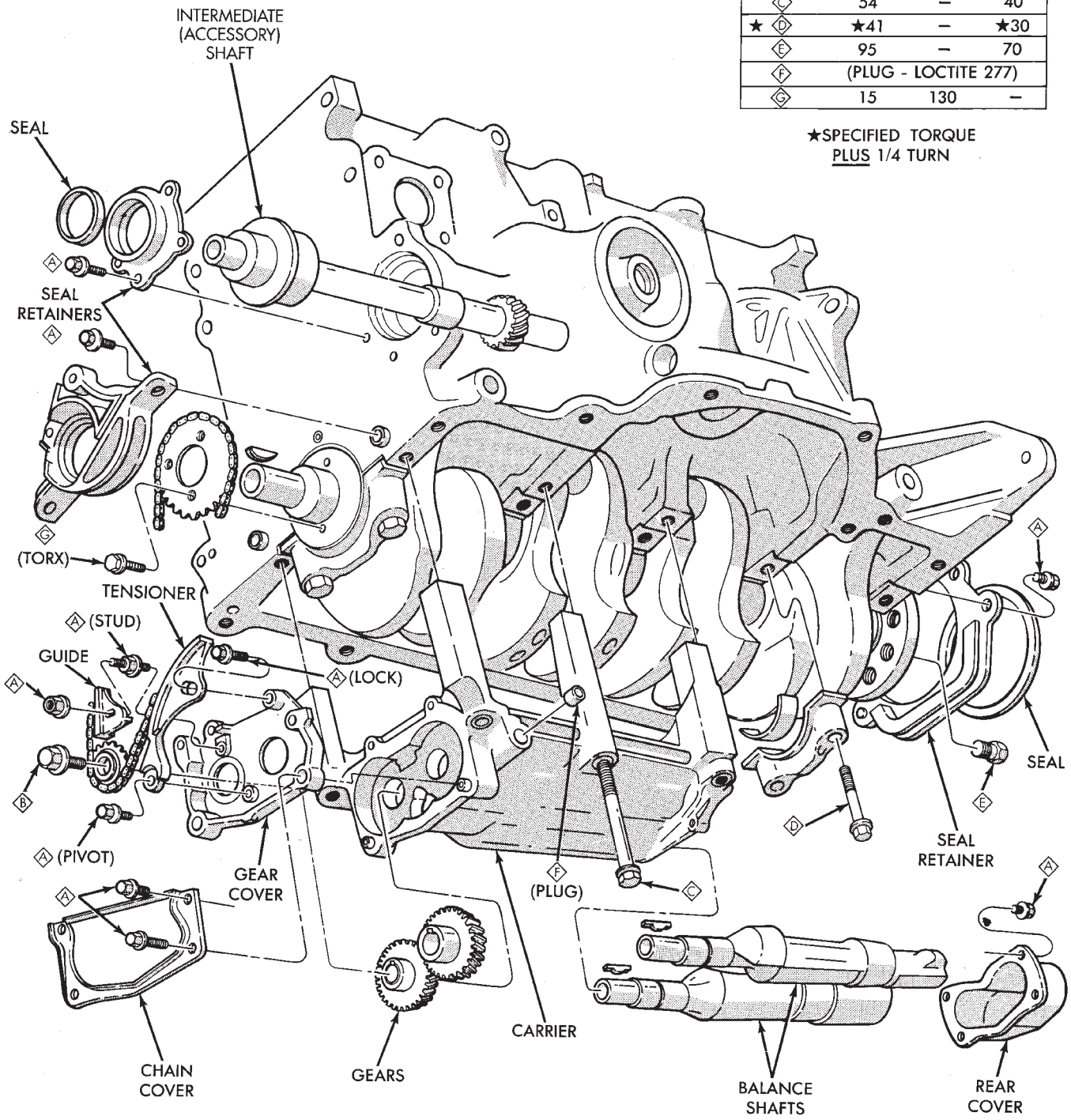

Fig. 1 Crankshaft Intermediate and Balance Shaft Assemblies and Oil Seals

CRANKSHAFT OIL SEALS SERVICE

(1) Pry out rear seal with screwdriver. Be careful not to nick or damage crankshaft flange seal surface or retainer bore (Fig. 2).

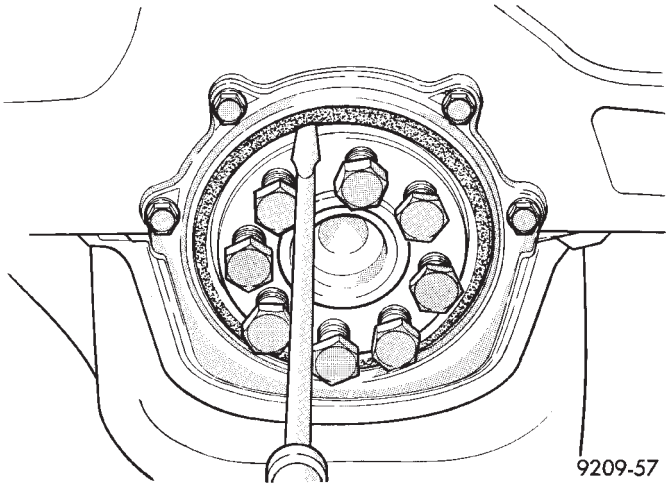

Fig. 2 Removing Rear Crankshaft Oil Seal

(2) Place Special Tool C-4681 on crankshaft (Fig. 3).

(3) Lightly coat seal O.D. with Loctite Stud N' Bearing Mount or equivalent.

(4) Place seal over Tool C-4681 and tap in place with a plastic hammer.

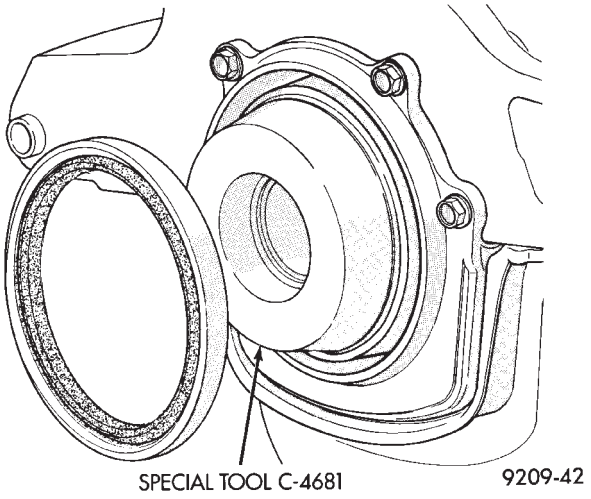

Fig. 3 Installing Rear Crankshaft Oil Seal

REAR CRANKSHAFT SEAL RETAINER AND OIL SEAL

When retainer removal is required, use Mopar Gasket Maker applied as shown in (Fig. 4) to provide retainer to block sealing during re-installation.

FRONT CRANKSHAFT SEAL RETAINER

See Timing System and Seals Section for timing belt covers, belt crankshaft sprocket and oil seals removal and installation.

(1) Remove retainer screws (Fig.5).

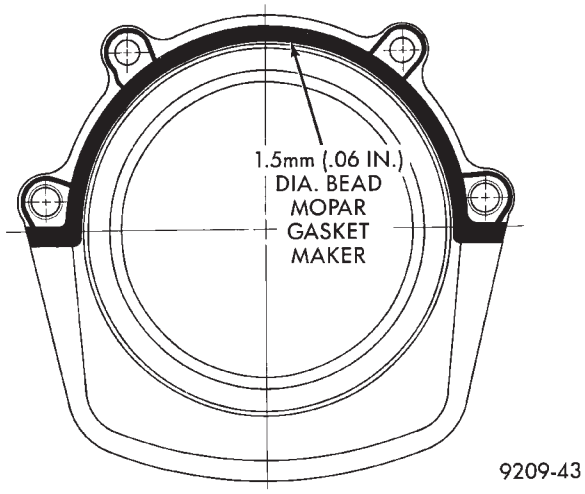

Fig. 4 Rear Crankshaft Seal Retainer Sealing

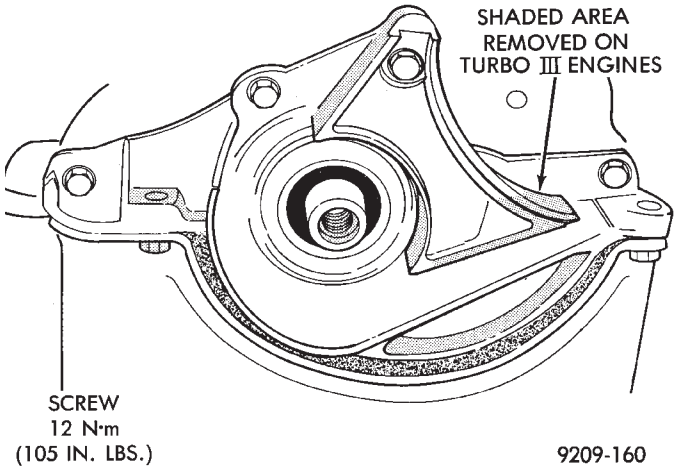

Fig. 5 Front Crankshaft Oil Seal Retainer

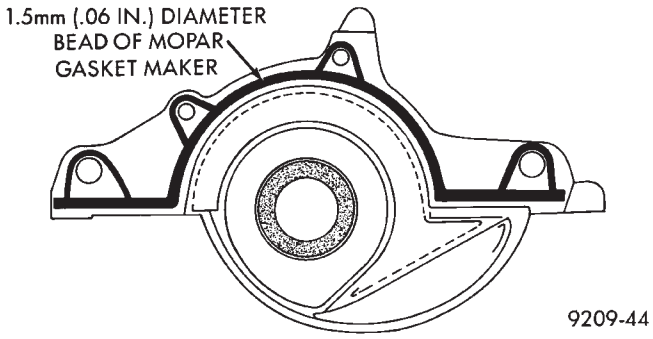

Fig. 6 Front Crankshaft Seal Retainer Sealing

For reassembly Mopar Gasket Maker is applied to the retainer as shown in (Fig. 6). This material cures in the absence of air providing retainer to block sealing.

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

CRANKSHAFT SERVICE

CRANKSHAFT MAIN BEARINGS

Bearing caps are not interchangeable and should be marked at removal to insure correct assembly. Upper and lower bearing halves are NOT interchangeable. Lower main bearing halves of 1, 2, 4 and 5 are interchangeable. Upper main bearing halves of 1, 2, 4 and 5 are interchangeable (Fig. 7).

CRANKSHAFT MAIN JOURNALS

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

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

Upper and lower Number 3 bearing halves are flanged to carry the crankshaft thrust loads and are NOT interchangeable with any other bearing halves in the engine (Fig. 7). 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: 0.025mm (.001 inch), .051mm (.002 inch), .076mm (.003 inch), .254mm (.010 inch), and .305mm (.012 inch). Never install an undersized bearing that will reduce clearance below specifications.

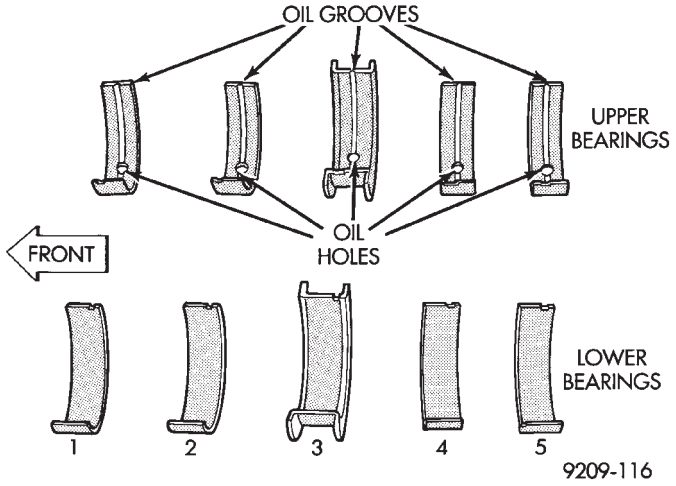

Fig. 7 Main Bearing Identification

MAIN BEARING SERVICE–CRANKSHAFT NOT REMOVED

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.8) into the oil hole of crankshaft.

(3) Slowly rotate crankshaft clockwise, forcing out upper half of bearing shell.

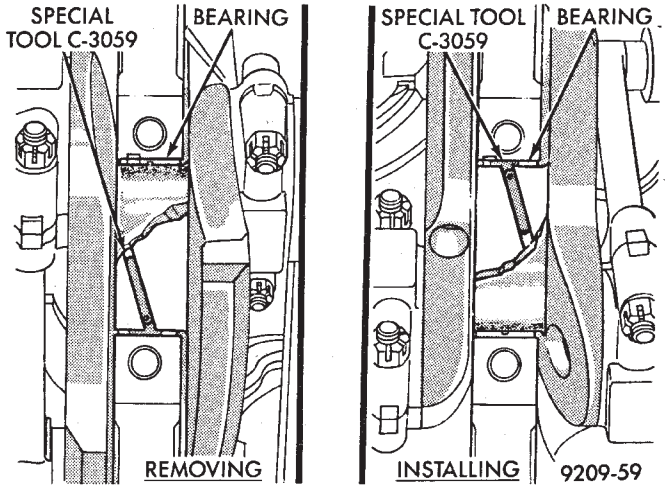

Fig. 8 Removing and Installing Upper Main Bearing With Special Tool C-3059

INSTALLATION

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. 8).

(2) Slowly rotate crankshaft counter-clockwise sliding the bearing into position. Remove Special Main Bearing Tool C-3059.

CHECKING CRANKSHAFT END PLAY

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

(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 (Fig. 10) for specifications.

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

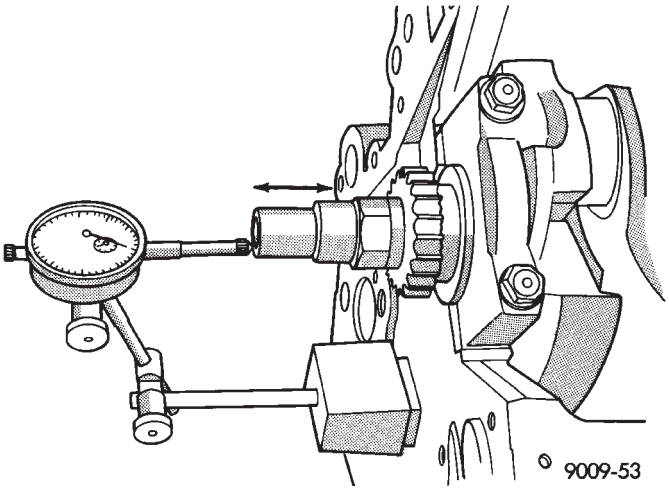

Fig. 9 Checking Crankshaft End Play

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.

Crankshaft End-Play	
New Part: .05 to 0.018 mm (.002 to .007 in.)	
Wear Limit: 0.37 mm (.015 in.)	
Main Bearing Clearance: 0.011 to 0.072 mm (0.0004 to 0.0028 in.)	
Connecting Rod Bearing Clearance: 0.019 to 0.075 mm (0.0007 to 0.0029 in.)	
Wear Limit: .102 mm (0.004 in.)	
Crankshaft Journal Sizes	
Crankshaft Main Bearing Journal	
ALL	Diameter
Standard	60.000 ± 0.013 mm (2.3622 ± .0005 in.)
1st Undersize	59.75 ± 0.013 mm (2.3523 ± .0005 in.)
Crankshaft Connecting Rod Journal	
ALL	Diameter
Standard	49.992 ± 0.013 (1.9685 ± .0005 in.)
1st Undersize	49.75 ± 0.013 in. (1.9586 ± .0005 in.)

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Fig. 10 Crankshaft Specifications

CRANKSHAFT BEARING CLEARANCE

(1) Refer to Measuring Main, Connecting Rod Bearing Clearance in Standard Service Procedures. Refer to (Fig. 10) for specifications.

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

(2) Install the main bearing shells with the lubrication groove in the cylinder block (Fig. 12). **The 1, 2, 4 and 5 main bearings are full groove to provide full time oiling to the connecting rod. Only the number 3 is half-groove.**

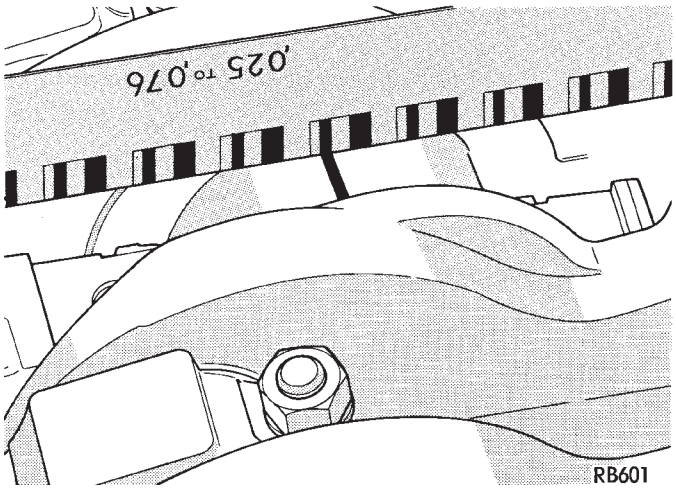

Fig. 11 Checking Crankshaft Oil Clearance with Plastigage

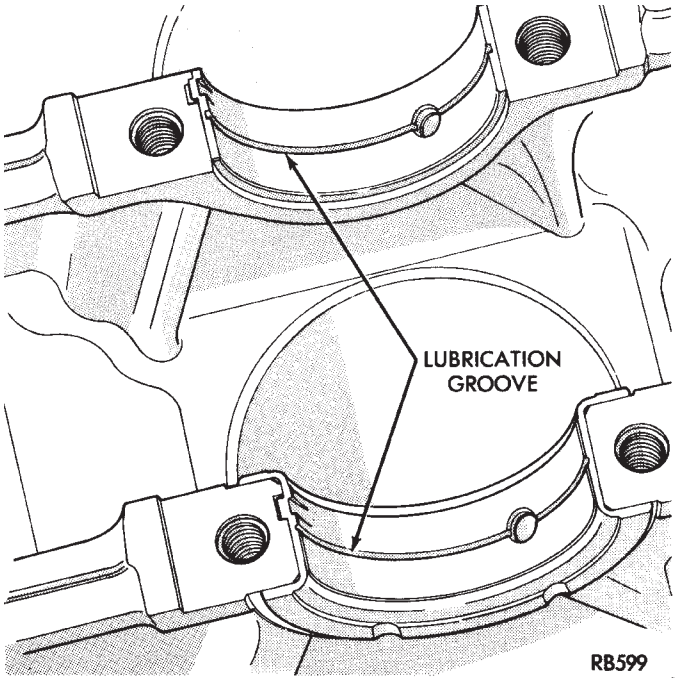

Fig. 12 Installing Main Bearing Upper Shell

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

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

(5) Install main bearing cap No.1 on timing belt end.

(6) Install main bearing cap No. 5 on transmission end.

Since the main bearing bolts are torqued using a new procedure they should be examined BEFORE reuse. If the threads are necked down the bolts should be replaced (Fig. 15).

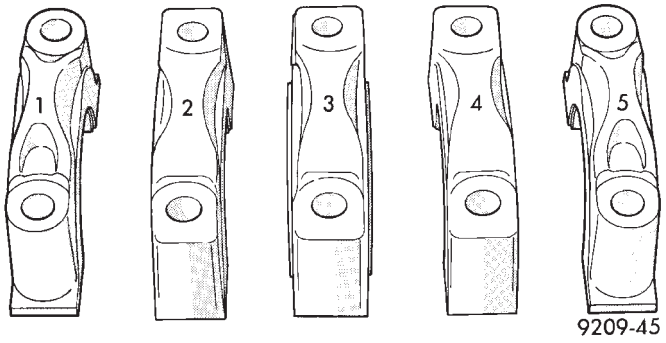

Fig. 13 Main Bearing Caps

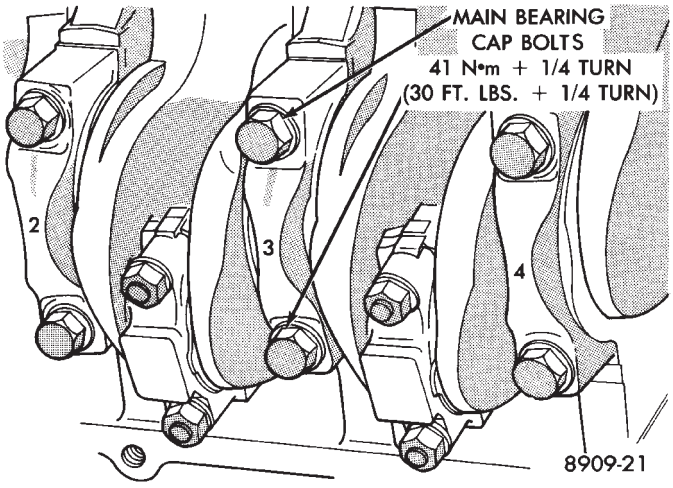

Fig. 14 Installing Main Bearing Caps

Necking can be checked by holding a scale or straight edge against the threads or by running a **M11 x 1.50 nut the full length of the thread. If all the threads do not contact the scale or if the nut does not run down smoothly the bolt should be replaced.**

(7) Before installing the bolts the threads should be oiled with engine oil.

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

(9) Tighten the bolts to 41 N·m plus 1/4 turn (30 ft. lbs. plus 1/4 turn). (Fig. 14)

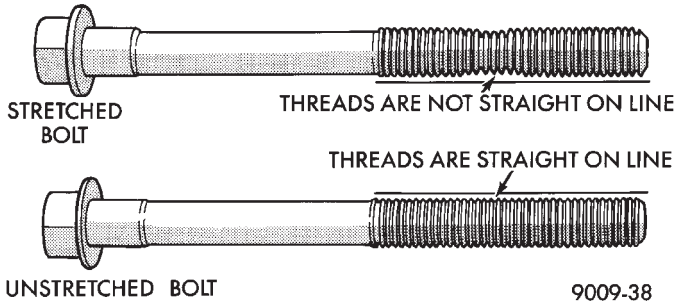

Fig. 15 Checking Bolts For Stretching (Necked down)

BALANCE SHAFTS

2.2L Turbo III and 2.5L engines are equipped with two balance shafts installed in a carrier attached to the lower crankcase (Fig. 1).

The shafts are interconnected 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.

REMOVAL

Refer to Engine Lubrication and Timing System and Seals Service of this group for removal procedure of necessary components to repair balance shafts.

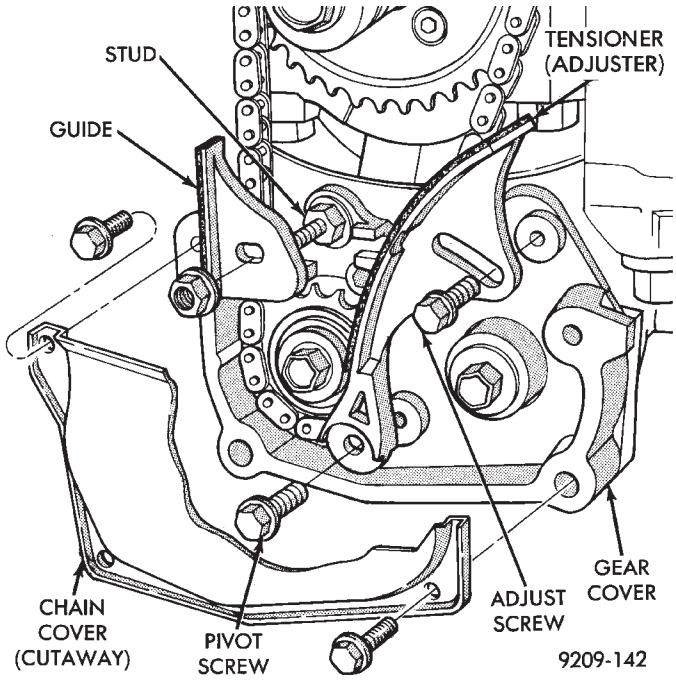

Fig. 16 Chain Cover, Guide and Tensioner

(1) Remove chain cover, guide and tensioner (Fig. 16). Also see Carrier Assembly Removal for service procedures requiring only temporary relocation of assembly.

(2) Remove balance shaft gear and chain sprocket retaining screws and crankshaft chain sprocket torx screws. Remove chain and sprocket assembly. (Fig. 17)

(3) Remove gear cover retaining stud (double ended to also retain chain guide). Remove cover and balance shaft gears (Fig. 18).

(4) Remove carrier rear cover and balance shafts. (Fig. 19).

(5) Remove six carrier to crankcase attaching bolts to separate carrier (Fig. 1).

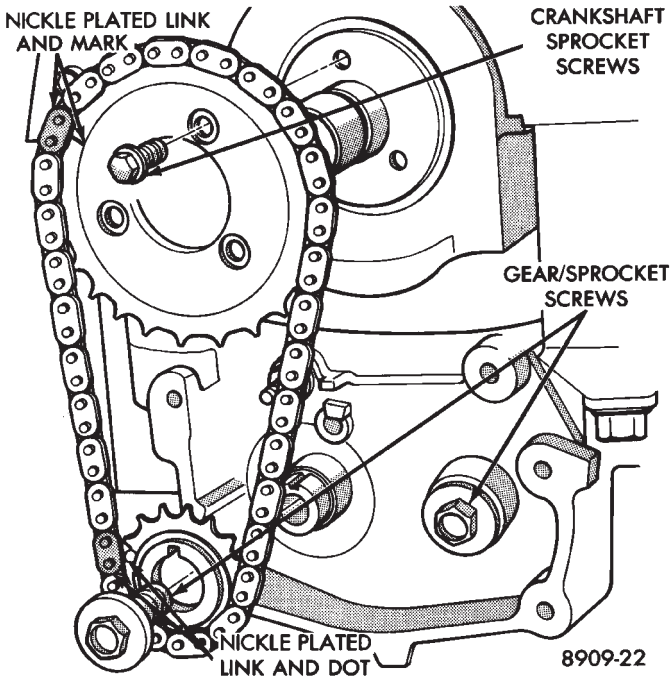

Fig. 17 Drive Chain and Sprockets

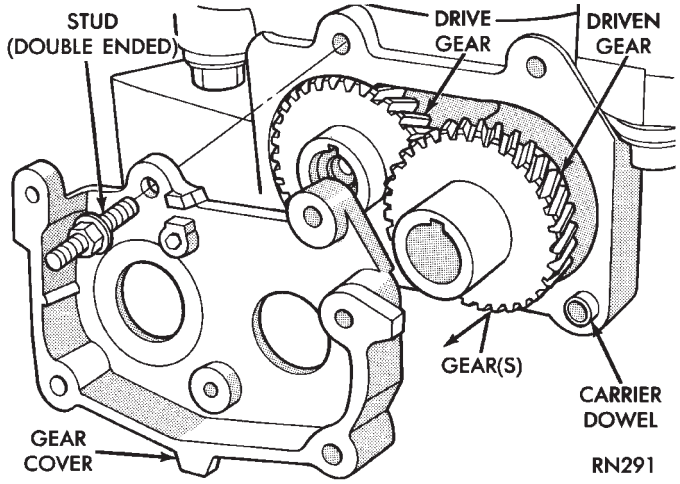

Fig. 18 Gear Cover and Gears

BALANCE SHAFTS CARRIER ASSEMBLY

REMOVAL

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

(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.

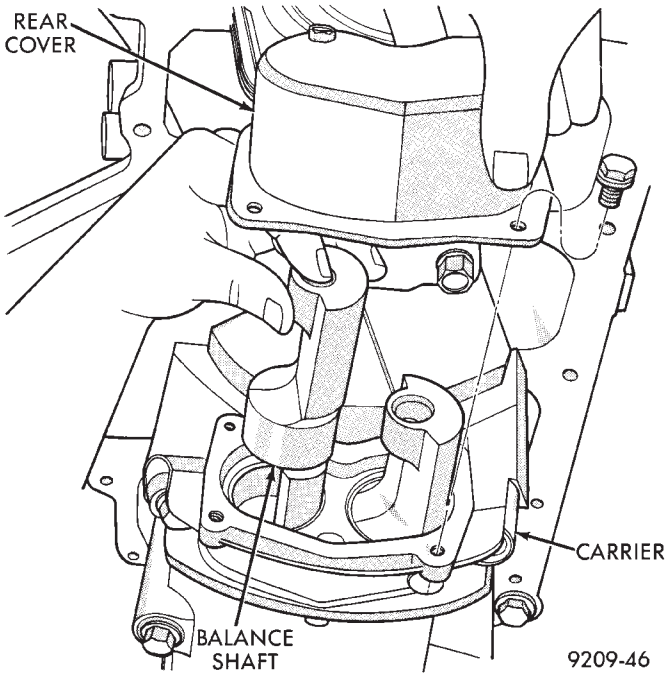

Fig. 19 Balance Shaft(s) Remove/Install

INSTALLATION

Balance shaft and carrier assembly installation is the reverse of the removal procedure. **During installation crankshaft to balance shaft timing must be established.**

TIMING

(1) With balance shafts installed in carrier (Fig. 19) position carrier on crankcase and install six 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. 20).

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

(4) Install crankshaft sprocket and tighten socket head torx screws to 13 N·m (130 in. lbs.).

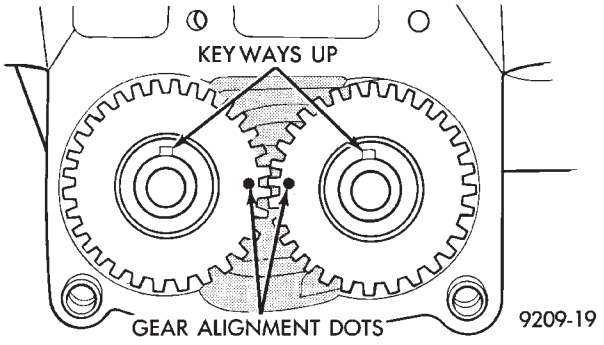

Fig. 20 Gear Timing

(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. 21).

(6) Place chain over crankshaft sprocket so that the nickel plated link of the chain is over the timing mark on the crankshaft sprocket (Fig. 21).

(7) Place balance shaft sprocket into the timing chain (Fig. 17) so that the timing mark on the sprocket (yellow dot) mates with the (lower) nickel plated link on the chain.

(8) With balance shaft keyways pointing up (12 o'clock) slide the balance shaft sprocket onto the nose of the balance shaft. The balance shaft may have to be pushed in slightly to allow for clearance.

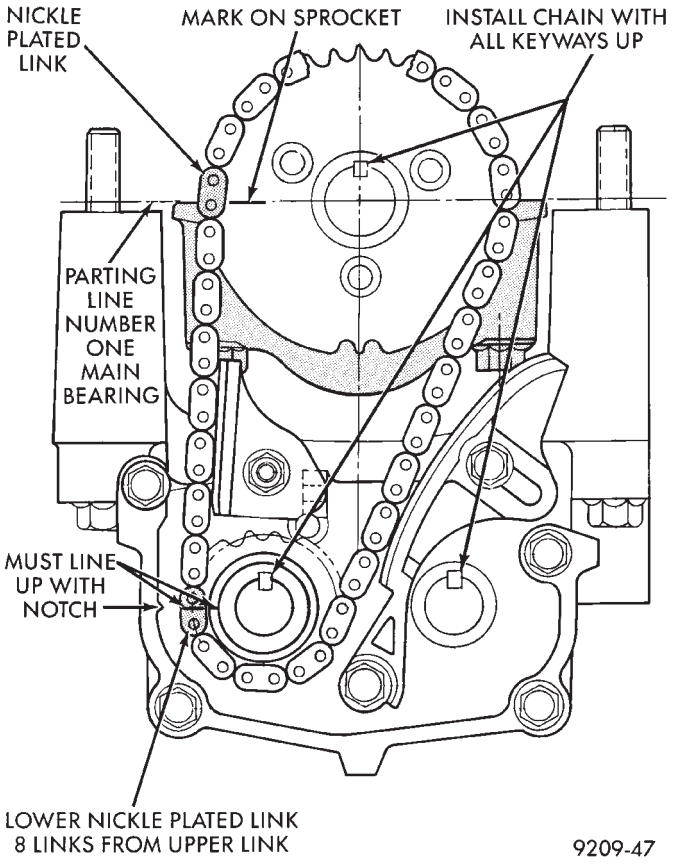

Fig. 21 Balance Shaft Timing

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 1mm (.039 inch) thick x 70mm (2.75 inch) 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. 22).

(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.).

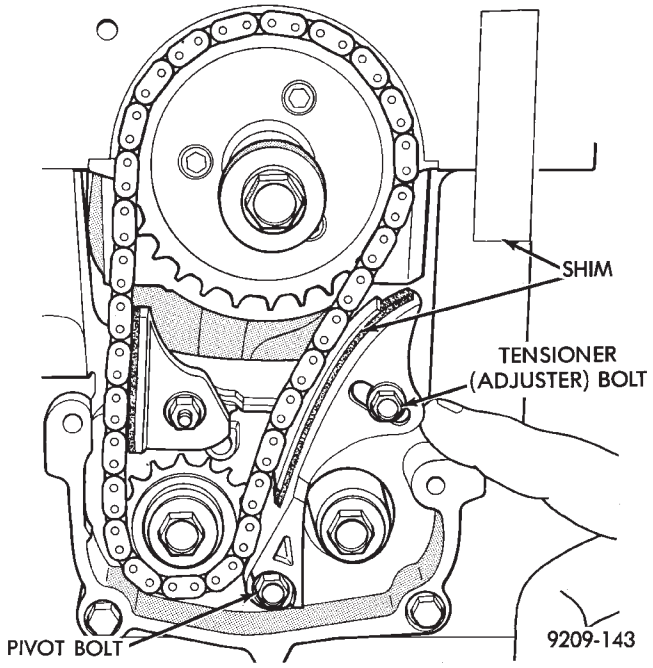

Fig. 22 Chain Tensioner Adjustment

INTERMEDIATE SHAFT SERVICE

REMOVAL

CAUTION: The oil pump and distributor must be removed before attempting to remove intermediate shaft.

(1) Hold sprocket with Tool C-4687 and adaptor Tool C-4687-1 when removing or installing screw (Fig. 23).

(2) See Timing System and Seals for intermediate seal removal and replacement.

(3) Remove retainer screws (Fig. 24).

(4) Remove retainer and lay aside.

(5) Remove intermediate shaft.

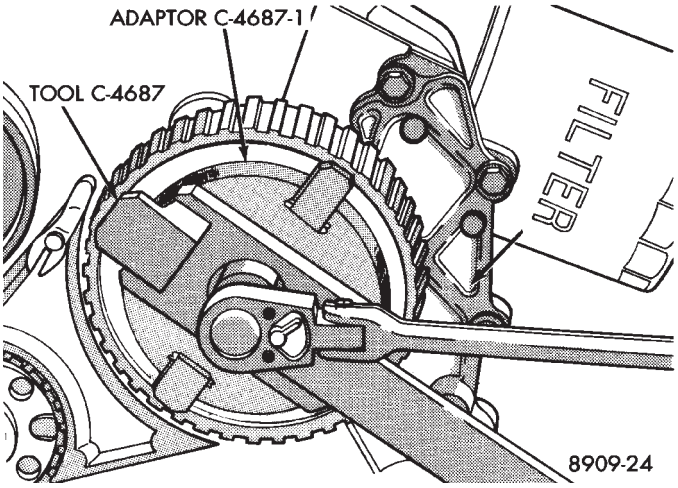

Fig. 23 Removing/Installing Intermediate Shaft Sprocket

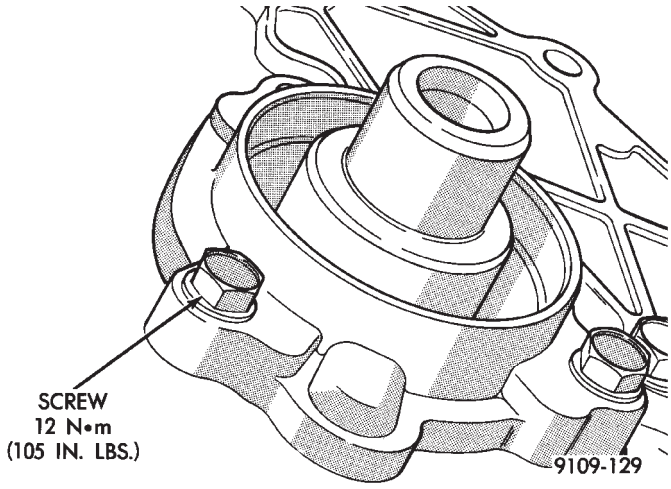

Fig. 24 Intermediate Shaft Retainer

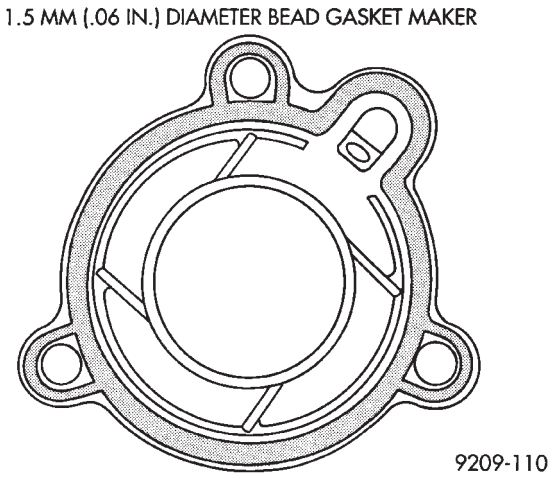

Fig. 25 Intermediate Shaft Retainer Sealing

INSTALLATION

(1) Lubricate distributor drive gear when installing.

(2) Apply Mopar Gasket Maker as shown in (Fig. 25) and install intermediate shaft retainer.

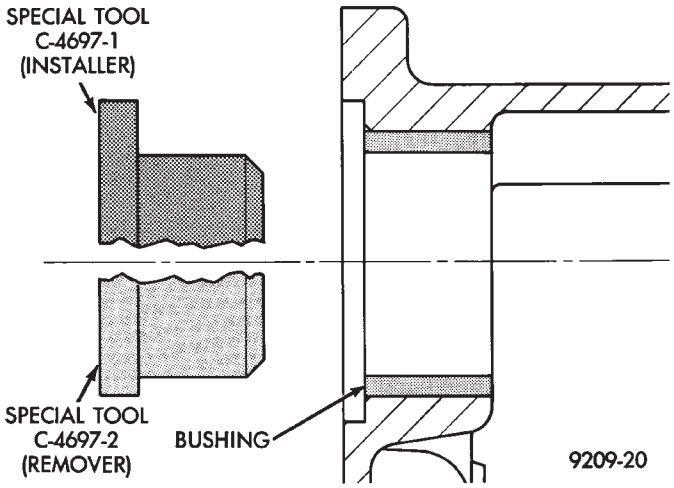

Fig. 26 Intermediate Shaft Bushing, Front

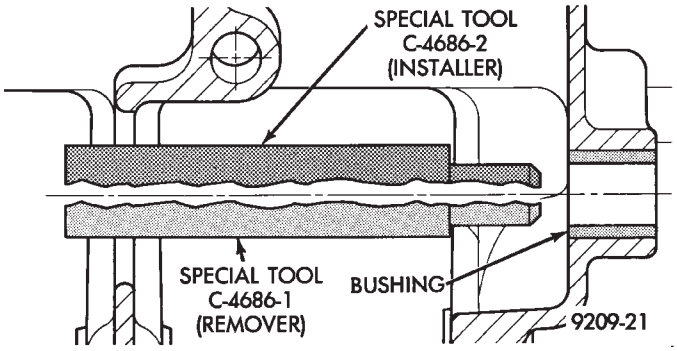

Fig. 27 Intermediate Shaft Bushing–Rear

Intermediate Shaft Journal and Bushing Sizes	
Intermediate Shaft	
Large Journal	42.670/42.703 mm (1.679/1.681 in.)
Small Journal	19.670/19.703 mm (.774/.776 in.)
Bushing-Bore Diameter	
Large Bushing	42.720/42.750 mm (1.682/1.683 in.)
Small Bushing	19.720/19.750 mm (.776/.777 in.)
Clearance Allowed	
Large	.017/.080 mm (.0006/.003 in.)
Small	.017/.080 mm (.0006/.003 in.)

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Fig. 28 Intermediate Shaft Journal Specifications

(3) Install retaining screws and torque to 12 N·m (105 in. lbs.).

INTERMEDIATE SHAFT BUSHING SERVICE

(1) Remove front bushing using Special Tool C-4697-2 with Special Tool Handle C-4171 (Fig.26).

(2) Install front bushing using Special Tool C-4697-1 and Special Tool Handle C-4171 until tool is flush with block.

(3) Remove rear bushing using Special Tool C-4686-2 and Special Tool Handle C-4171 (Fig. 27).

(4) Install rear bushing using Special Tool C-4686-1 and Special Tool Handle C-4171 until tool is flush with block.

CYLINDER BLOCK, PISTON AND CONNECTING ROD ASSEMBLY SERVICE

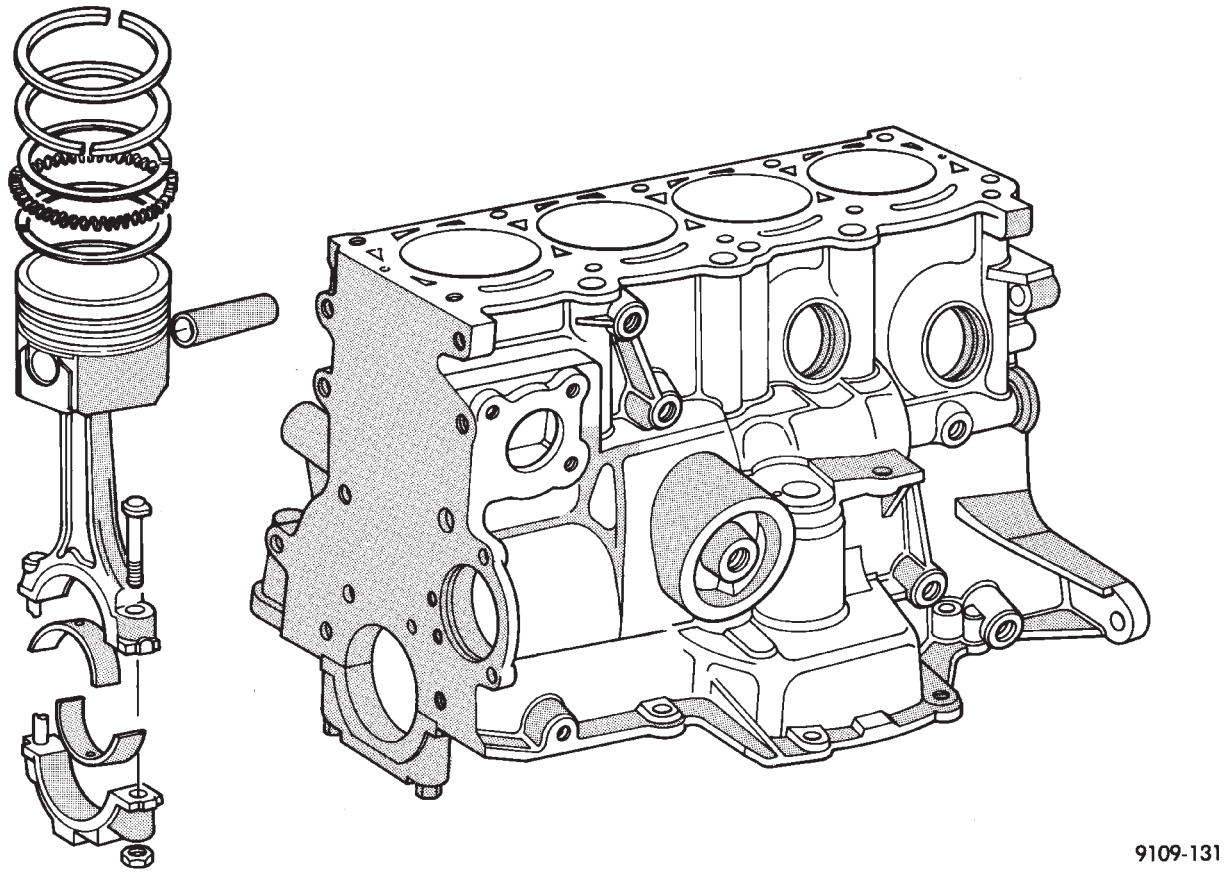

Fig. 1 Cylinder Block, Piston and Connecting Rod Assembly

PISTON AND CONNECTOING ROD−REMOVAL

(1) Remove top ridge of cylinder bores with a reliable ridge reamer before removing pistons from cylinder block. **Be sure to keep tops of pistons covered during this operation.** Mark piston with matching cylinder number (Fig. 2).

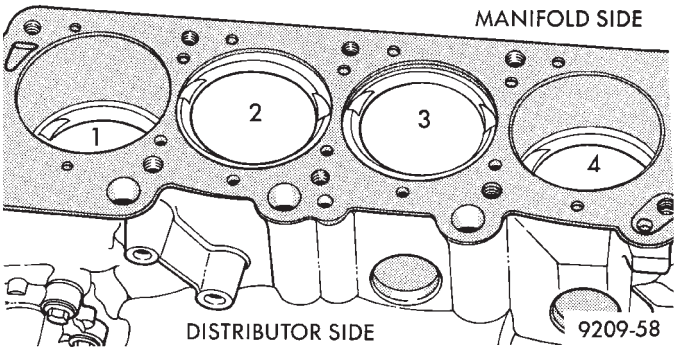

Fig. 2 Piston Marking

(2) Remove oil pan. Ensure connecting rods and connecting rod caps for cylinder identification. Identify them if necessary (Fig. 3).

(3) Valve relief toward manifold side of engine. Turbocharged engine pistons will have arrow towards **front** of engine.

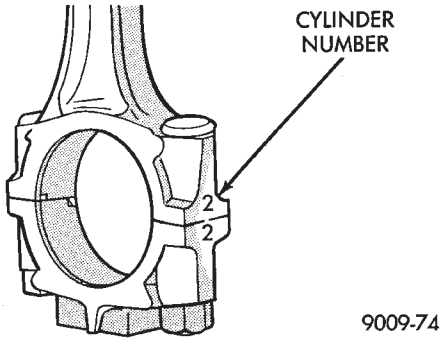

Fig. 3 Identify Connecting Rod to Cylinder

(4) Squirt hole on connecting rod must face timing belt end of engine.

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

(6) Remove connecting rod cap. Install connecting rod bolt protectors on connecting rod bolts (Fig. 4). Push each piston and rod assembly out of cylinder bore.

Be careful not to nick crankshaft journals.

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

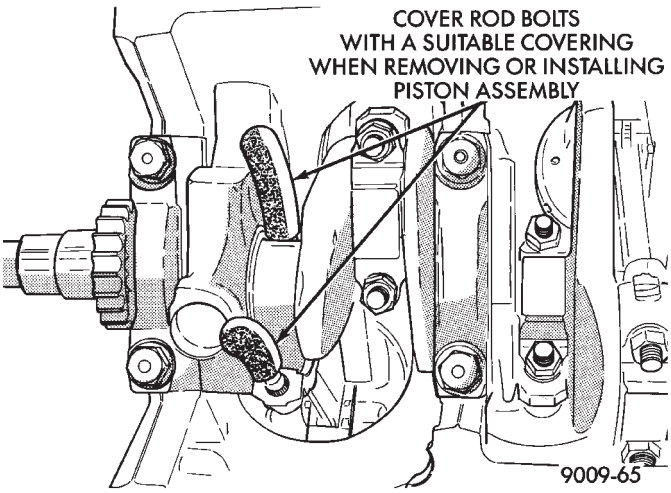

Fig. 4 Connecting Rod Protectors

CYLINDER BLOCK CLEANING AND INSPECTION

(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 Oil and Cam Plugs.

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

CYLINDER BORE INSPECTION

The cylinder walls should be checked for out-of-round and taper with Tool C-119 (Fig. 5). The cylinder bore out-of-round is 0.050 mm (.002 inch) maximum and cylinder bore taper is .125 mm (.005 inch) maximum. If the cylinder walls are badly scuffed or scored, the cylinder block should be rebored and honed, and new pistons and rings fitted. Whatever type of boring equipment is used, boring and honing operation should be closely coordinated with the fitting of pistons and rings in order that specified clearances may be maintained. **Refer to Honing Cylinder Bores outlined in the Standard Service Procedures for specification and procedures.**

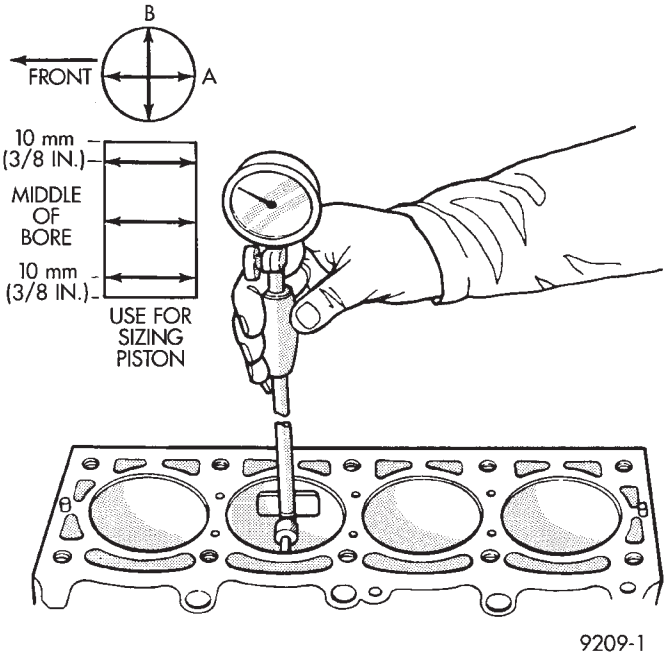

Fig. 5 Checking Cylinder Bore Size

Measure the cylinder bore at three levels in directions A and B (Fig. 5). Top measurement should be 10mm (3/8 inch.) down and bottom measurement should be 10mm (3/8 inch.) up from bottom of bore. Refer to (Fig. 6) for specifications.

SIZING PISTONS

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. 7). Cylinder bores should be measured halfway down the cylinder bore and transverse to the engine crankshaft center line shown in (Fig. 5). Refer to (Fig. 6) for specifica-

Engine Type	Skirt Sizing Location ("SL")**	Piston to Cylinder Clearance (New Part)	Wear Limit
2.2L TBI	28.9mm (1.14 in.)	0.013-0.038mm (0.0005-0.0015 in.)	0.070mm (0.0027 in.)
2.2L Turbo III	55.85mm (2.19 in.)	0.047-0.073mm (0.0018-0.0028 in.)	0.100mm (0.0039 in.)
2.5L TBI	47.5mm (1.87 in.)	0.025-0.050mm (0.0010-0.0020 in.)	0.070mm (0.0027 in.)
2.5L Turbo	37.5mm (1.48 in.)	0.015-0.041mm (.0006-.0016 in.)	0.077mm (0.0030 in.)

*Refer to Specifications for Available Piston Sizes
**"SL" = Sizing Location

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Fig. 6 Piston Size Location and Clearance Chart

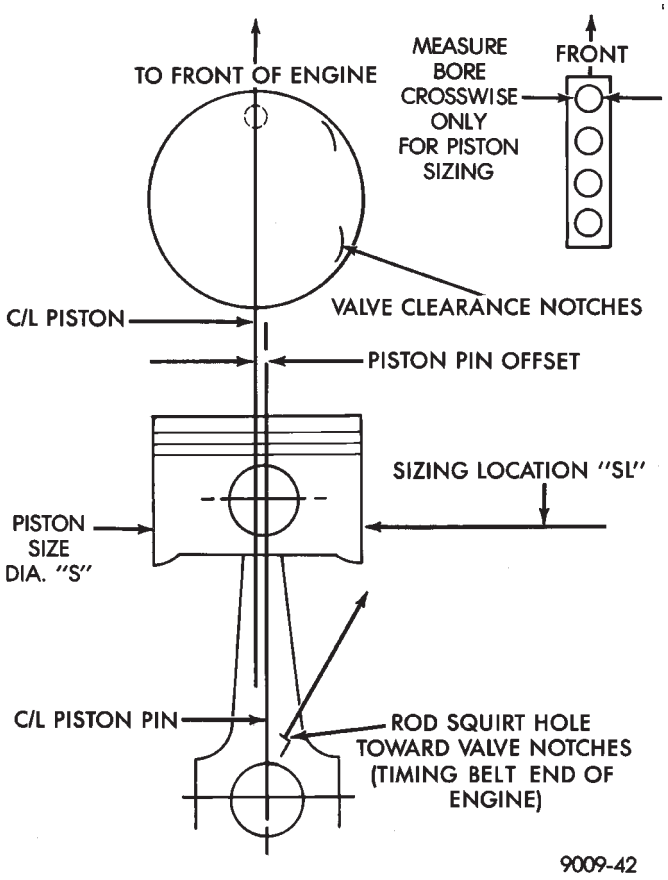

Fig. 7 Piston Installation and Sizing Information

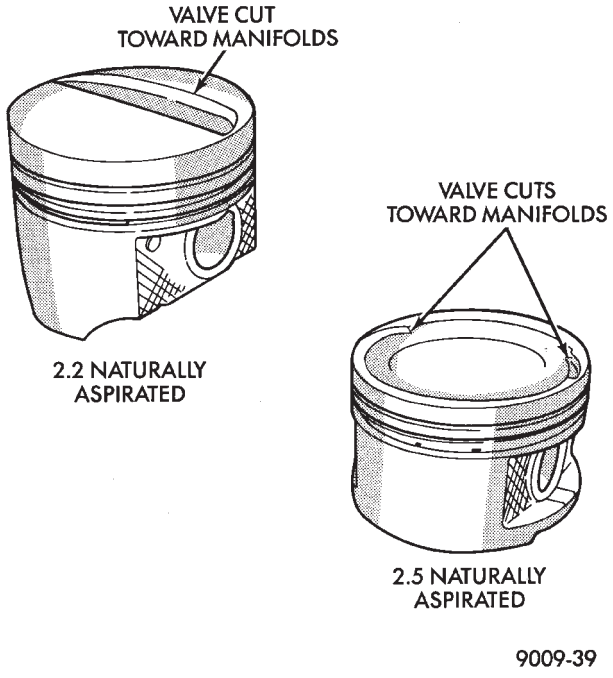

Fig. 8 N.A. (Naturally Aspirated) Pistons

tions. Correct piston to bore clearance must be established in order to assure quiet and economical operation.

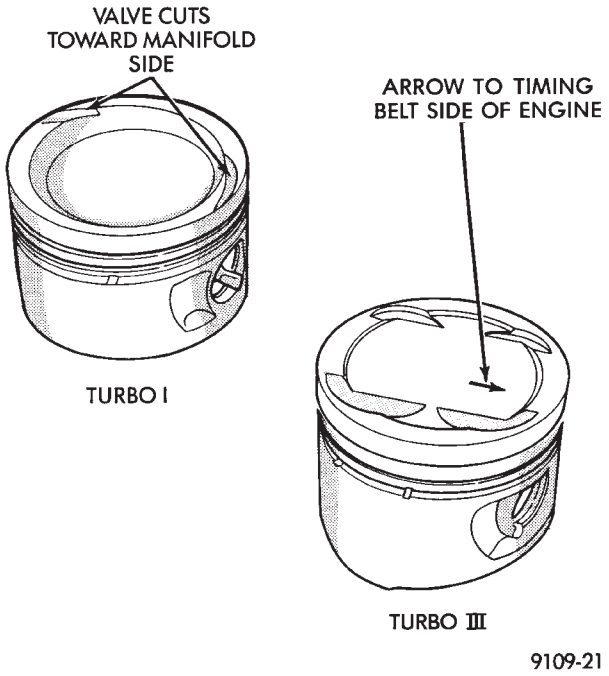

Fig. 9 2.2L Turbo III and 2.5L Turbo I Pistons

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

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

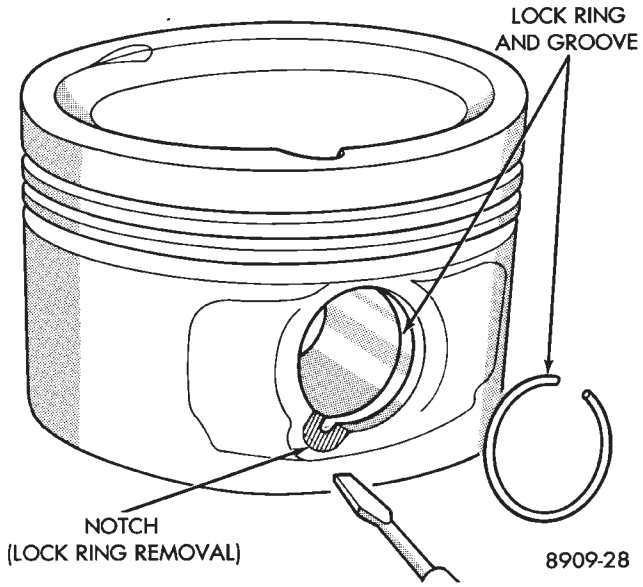

Fig. 10 Piston Pin Lock Ring Removal Notch−Turbocharged Engine

PISTON PINS

DISASSEMBLY

Turborcharged engine piston-pin-connecting rod assemblies should not be disassembled unless a malfunction is present or a damaged assembly component is to be replaced.

WARNING: APPROVED SAFETY GLASSES MUST BE WORN DURING PISTON LOCK RING REMOVAL OR INSTALLATION TO PREVENT POSSIBLE INJURY FROM FLYING PARTS.

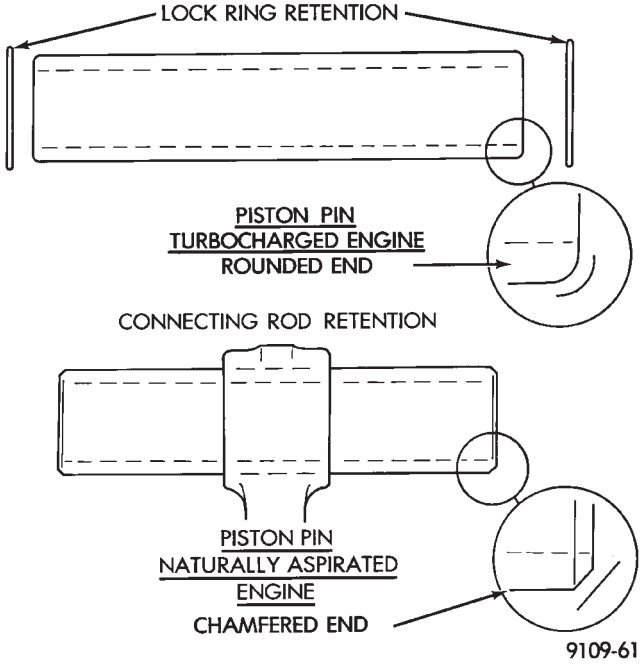

Fig. 11 Engine Piston Pins−Turbo and N.A.

(1) Carefully, remove piston pin lock rings from piston, using a small screwdriver in removal notch (Fig. 10).

(2) Discard used lock ring.

(3) Following lock ring removal, attempt to slide pin out of piston. If pin does not slide out freely by hand;

• Check for burr on outer edge of lock ring groove. If one is present, carefully scrape burr away with a knife or other hand tool, being careful not to damage lock ring retaining groove.

(4) Slide out piston pin to complete disassembly.

(5) Inspect components, discard damaged or excessively worn parts refer to specifications (Fig. 12). If a piston is replaced, a new pin should be used.

PISTON PINS

REASSEMBLY

(1) Two different lock rings are used for turbocharged engine applications. Consult the Service Note, provided with the lock ring service package, to select the correct lock rings from the package for your application.

(2) Carefully, install one **NEW** lock ring with gap towards piston top in lock ring groove. Do not reinstall used lock rings.

(3) Position connecting rod and slide in lightly oil piston pinch

(4) Install second **NEW** lock ring with gap towards piston top in lock ring groove, use small screwdriver if needed.

CAUTION: BOTH lock rings must be FULLY SEATED in lock ring grooves or engine failure will occur.

(5) Check piston pin end play pin movement between lock rings in assembly.

Piston Pin End Play	New Part	Wear Limit
Turbo I	0.00 - 0.88 mm (0.000 - 0.035 in.)	1.20 mm (0.047 in.)
Turbo III	0.04 - 1.02 mm (0.0015 - 0.040 in.)	

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Fig. 12 Piston Pin Specifications

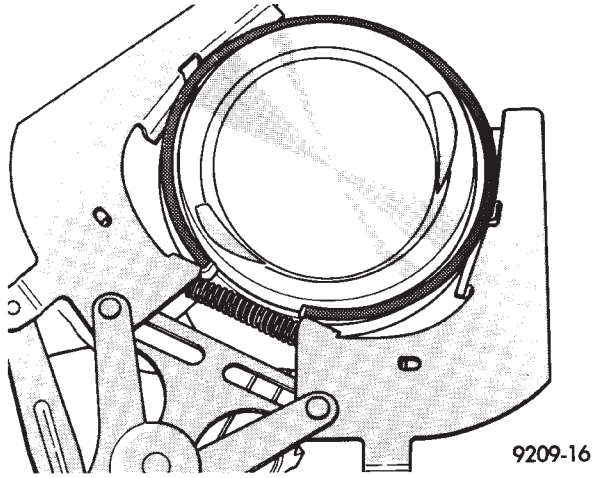

Fig. 13 Piston Rings−Removing and Installing

PISTON RING−REMOVAL

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

(2) Using a suitable ring expander, remove upper and intermediate piston rings (Fig. 13).

(3) Remove the upper oil ring side rail, lower oil ring side rail and then oil ring expander from piston.

(4) Clean ring grooves of any carbon deposits.

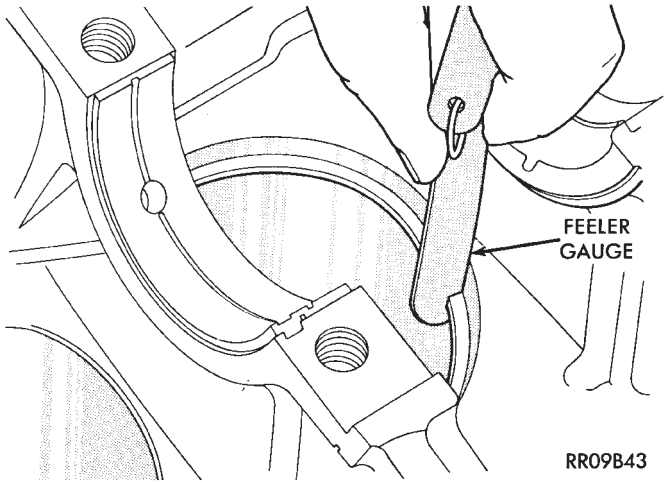

Fig. 14 Piston Ring Gap

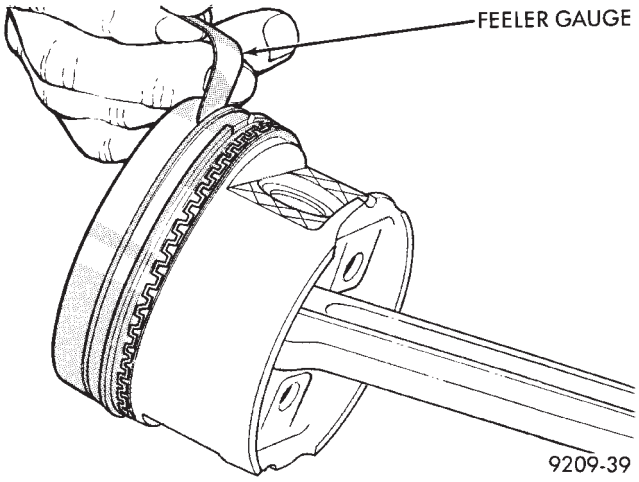

Fig. 15 Piston Ring Groove Clearance

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 12mm (.50 inch) from bottom of cylinder bore. Check gap with feeler gauge (Fig. 14). Refer to specifications (Fig. 16, 17 and 18).

(2) Check piston ring to groove clearance: (Fig. 15). Refer to specification (Fig. 17).

PISTON RINGS–INSTALLATION

(1) The No. 1 and No. 2 piston rings have a different cross section. Install rings with manufacturers I.D. mark facing up, to the top of the piston (Fig. 13).

CAUTION: Install piston rings in the following order:

(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.

Ring Position	Ring Gap	Wear Limit
(1) Upper Piston Ring	0.35 to 0.50 mm (.0138 to .0197 in.)	1.00 mm (.039 in.)
(2) Intermediate Piston Ring	0.35 to 0.50 mm (.0138 to .0197 in.)	1.00 mm (.039 in.)
(3) Oil Control Ring	0.25 to 0.50 mm (.0009 to .0197 in.)	1.00 mm (.039 in.)
Ring Position	**Piston Groove Clearance**	**Wear Limit**
(1) Upper Piston Ring	0.040 to 0.075 mm (.0016 to .0030 in.)	0.10 mm (.004 in.)
(2) Intermediate Piston Ring	0.040 to 0.075 mm (.0016 to .0030 in.)	0.10 mm (.004 in.)
(3) Oil Control Ring	Should be free in groove, not to exceed 0.1 mm (.004 in.) side clearance.	

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Fig. 16 Piston Ring Specifications–Turbo III

Naturally Aspirated	Piston Groove Clearance	Wear Limit
(1) Upper Piston Ring	0.038 to 0.078 mm (.0015 to .0031 in.)	0.10 mm (.004 in.)
(2) Intermediate Piston Ring	0.028 to 0.093 mm (.0015 to .0037 in.)	0.10 mm (.004 in.)
(3) Oil Control Ring	Should be free in groove, not to exceed 0.2 mm (.008 in.) side clearance.	
Turbocharged	**Piston Groove Clearance**	**Wear Limit**
(1) Upper Piston Ring	0.040 to 0.075 mm (.0016 to .0030 in.)	0.10 mm (.004 in.)
(2) Intermediate Piston Ring	0.040 to 0.090 mm (.0016 to .0035 in.)	0.10 mm (.004 in.)
(3) Oil Control Ring	Should be free in groove, not to exceed 0.2 mm (.008 in.) side clearance.	

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Fig. 17 Piston Ring Groove Specifications

Naturally Aspirated	Ring Gap	Wear Limit
Upper Ring	0.25 to 0.51 mm (.010 to .020 in.)	1.0 mm (.039 in.)
Intermediate Ring	0.28 to 0.53 mm (.011 to .021 in.)	1.0 mm (.039 in.)
Oil Control Ring	0.25 to 1.27 mm (.010 to .050 in.)	1.88 mm (.074 in.)
Turbocharged	**Ring Gap**	**Wear Limit**
Upper Ring	0.25 to 0.51 mm (.010 to .020 in.)	.99 mm (.039 in.)
Intermediate Ring	0.23 to 0.48 mm (.009 to .019 in.)	.95 mm (.038 in.)
Oil Control Ring	0.38 to 1.40 mm (.015 to .055 in.)	1.88 mm (.074 in.)

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Fig. 18 Piston Ring Gap Specifications

(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. 19).

(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. 8).

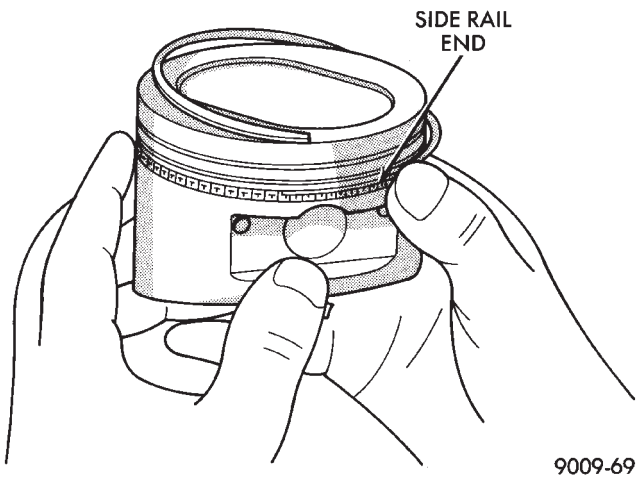

Fig. 19 Installing Side Rail

(5) Position piston ring end gaps as shown in (Fig. 20).

(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.

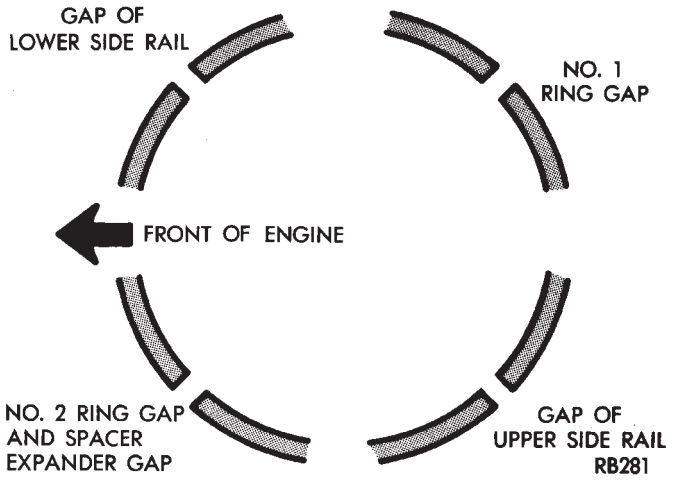

Fig. 20 Piston Ring End Gap Position

PISTON AND CONNECTING ROD ASSEMBLY INSTALLATION

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

(2) Before installing the ring compressor, make sure the oil ring expander ends are butted and the rail gaps located as shown in (Fig. 20).

(3) Immerse the piston head and rings in clean engine oil, slide the ring compressor, over the piston

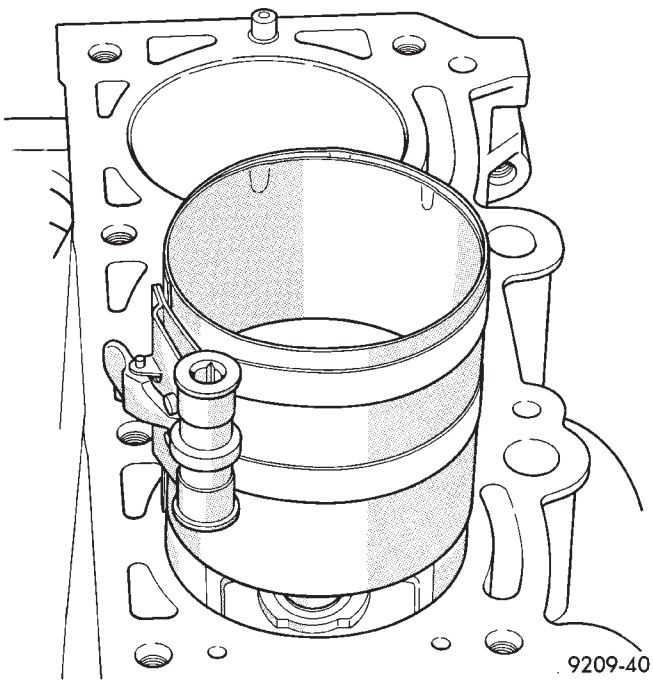

Fig. 21 Installing Piston

and tighten with the special wrench (Fig. 21). **Be sure position of rings does not change during this operaiton.**

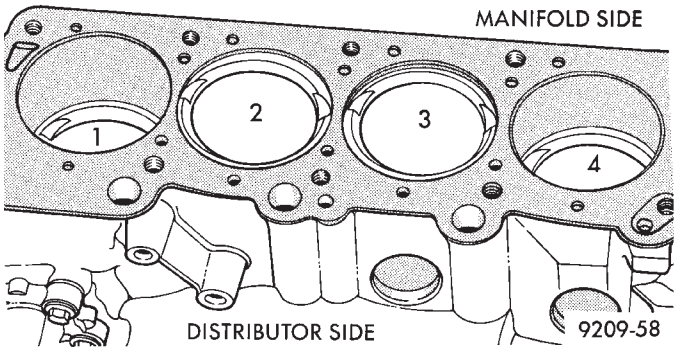

Fig. 22 Piston Markings

(4) The valve cut should be toward the manifold side of the engine (Fig. 22).

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

(6) 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.

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

(8) Intall rod caps. Install nuts on cleaned and oiled rod bolts and tighten nuts to 54 N·m (40 ft. lb.) Plus 1/4 turn.

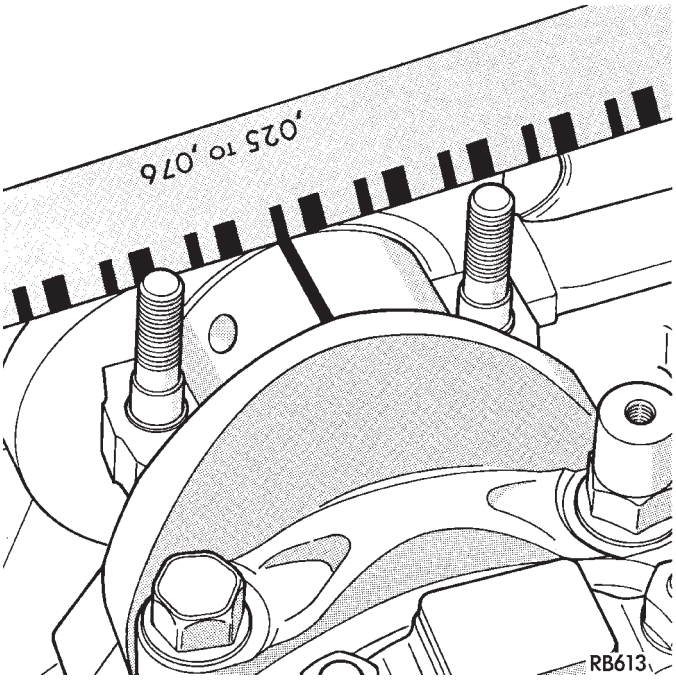

Fig. 23 Checking Connecting Rod Bearing Clearance

CONNECTING RODS

(1) Follow procedure specified in the Standard Service Procedures Sections for Measuring Main Bearing Clearance and Connecting Rod Bearing Clearance (Fig. 23). Refer to specifications. (Fig. 26).

CAUTION: Do not rotate crankshaft or the Plastic-Gage may be smeared.

The rod bearing bolts should be examined before reuse. If the threads are necked down the bolts should be replaced (Fig. 24).

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.

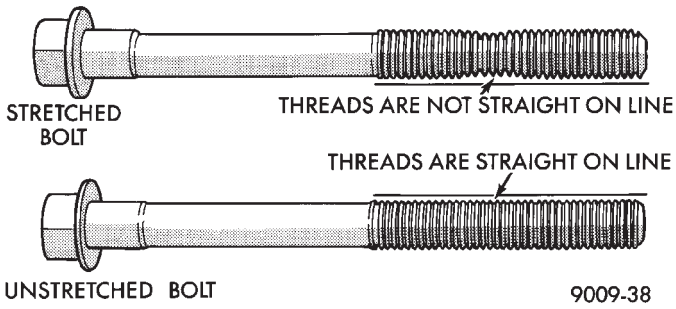

Fig. 24 Checking Bolts for Stretching (Necked)

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

(3) Install nuts on each bolt finger tight 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). **Do not use a torque wrench for last step.**

(5) Using a feeler gauge, check connecting rod side clearance (Fig. 26). Refer to connecting rod specifications (Fig. 26).

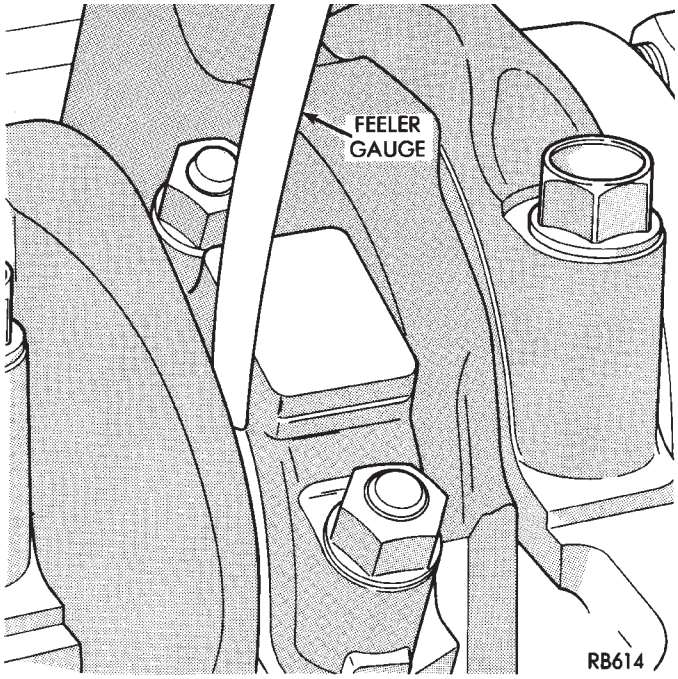

Fig. 25 Checking Connecting Rod Side Clearance

Connecting Rod Bearing Clearance	
New Part	.019 to .075 mm (.0008 to .0034 in.)
Wear Limit	.107 mm (.0042 in.)
Connecting Rod Side Clearance	
New Part	0.13 to 0.38 mm (.005 to .013 in.)
Wear Limit	0.37 (.015 in.)

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Fig. 26 Connecting Rod Specifications

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. 27). With the cup plug rotated, grasp firmly with pliers or other suitable tool and remove plug. (Fig. 27).

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

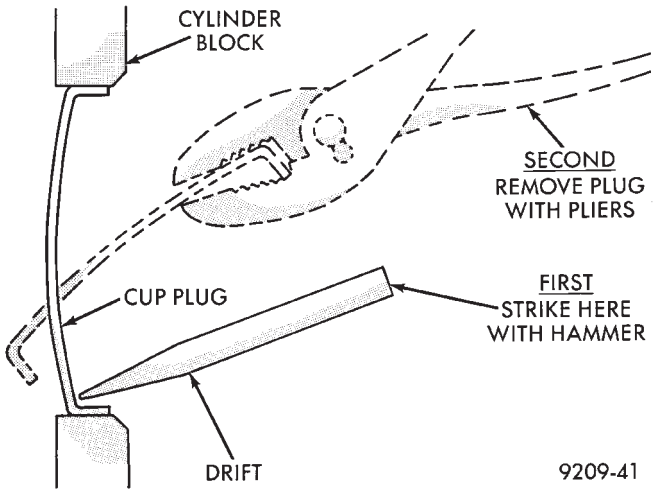

Fig. 27 Core Hole Plug Removal

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 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 0.5mm (.020 inch) inside the lead-in chamfer (Fig. 27).

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

ENGINE LUBRICATION SYSTEM

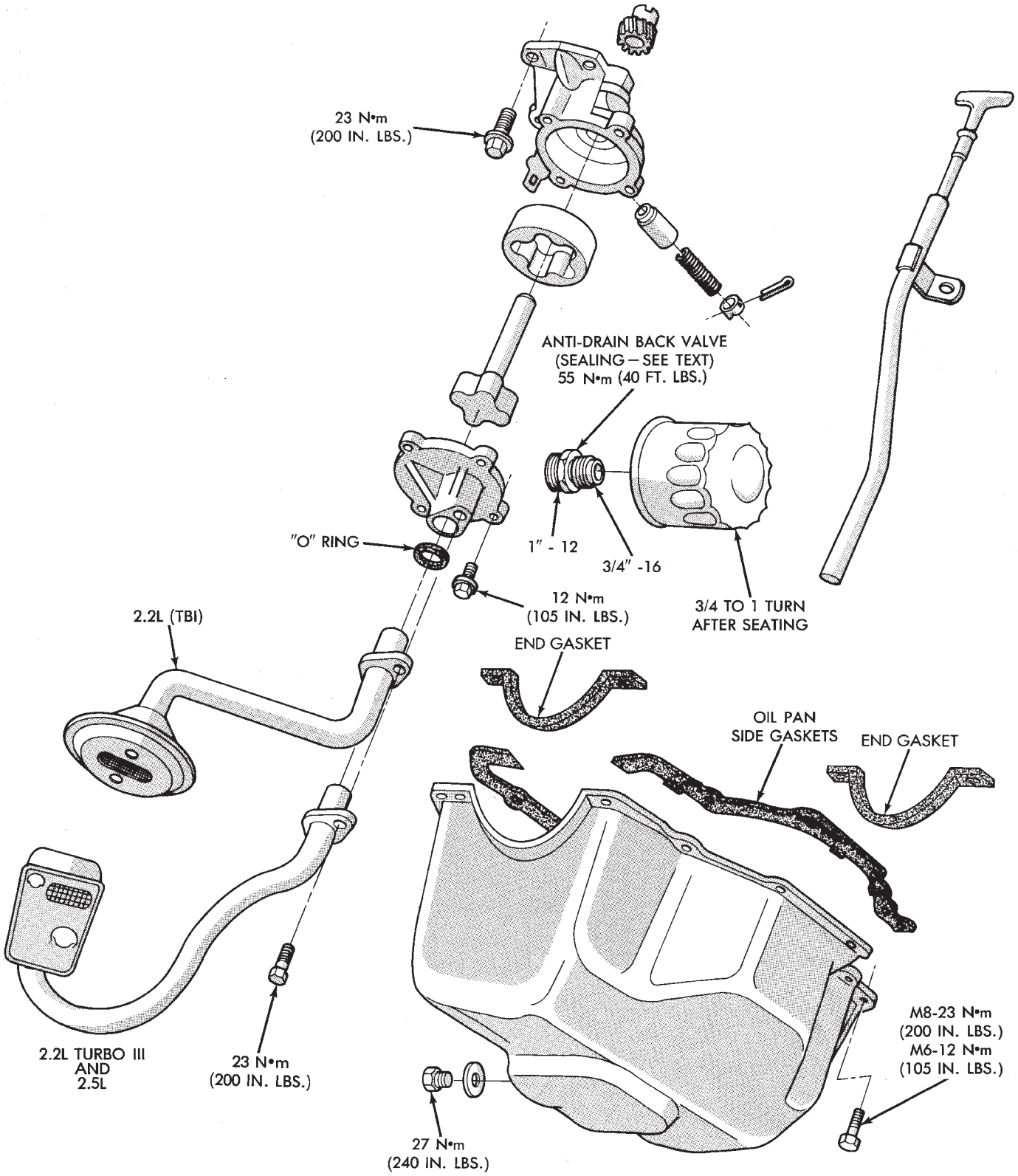

Fig. 1 Engine Lubrication Components

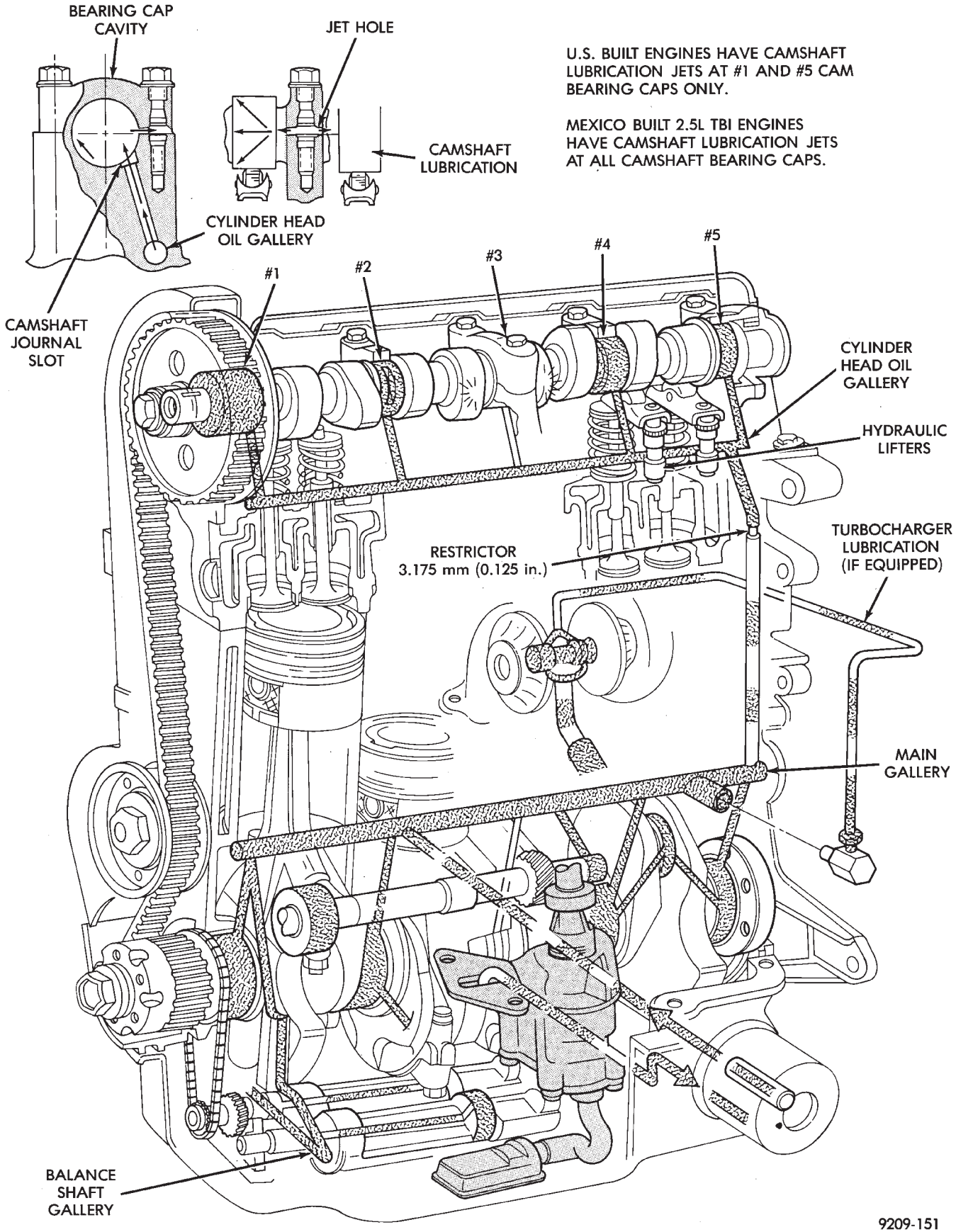

Fig. 2 Engine Lubrication System

OIL PAN

A formed steel oil pan provides lower engine protection as well as serving as the engine oil reservoir (Fig. 1). Pan side flanges to block are sealed with gaskets. The oil pickup tube for some 2.2L engines have a circular strainer and cover. The 2.5L engine pickup is also unsupported and the lower end has a box type strainer (Fig. 4).

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 (Fig. 2). Modified oil pickup, pump and check valve provide increased 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 crankpin journals.

ACCESSORY SHAFT

Two separate holes supply the accessory shaft.

BALANCE SHAFTS

The engine balance shafts are lubricated by an additional hole that interconnects a passage in one leg of the balance shaft carrier to route oil down to the carrier oil gallery. This gallery directly supplies the balance shafts front bearing and internal machined passages in the shafts routes oil from front to rear shaft bearing journals.

TURBOCHARGER (WHERE EQUIPPED)

If turbocharger equipped, pressurized oil from the main gallery to sending unit hex fitting is piped from the fitting to the turbocharger bearing housing. From the housing a hose and tube connection to machined hole in the block provides drainback.

CAMSHAFT/HYDRAULIC LIFTERS

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. Hydraulic adjusters are supplied directly from this gallery while diagonal holes supply oil to the camshaft journals. 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.

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 holes in the connecting rods.

OIL PAN

REMOVAL

(1) Drain engine oil and remove oil pan.
(2) Clean oil pan and all gasket surfaces.

OIL PAN RAIL TO BLOCK SEALING

For all engines side gaskets (Fig. 1) are employed for rail sealing.

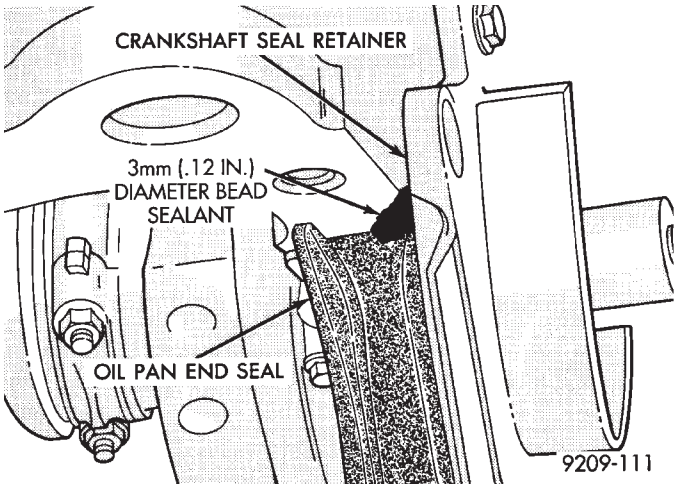

Fig. 3 Sealing, Front and Rear End Seals

INSTALLATION

(1) Apply Mopar Silicone Rubber Adhesive Sealant or equivalent at the front seal retainer parting line (Fig. 3).
(2) Install the oil pan side gaskets to the block. Use heavy grease or Mopar Silicone Rubber Adhesive Sealant or equivalent to hold in place.
(3) Apply Mopar Silicone Rubber Adhesive Sealant or equivalant to ends of new oil pan end seals at junction or cylinder block pan rail gasket (Fig. 3).
(4) Install pan and tighten screws to (12) M8 to 23 N·m (200 in. lbs.) and 1 M6 to 12 N·m (105 in. lbs.).

OIL PUMP SERVICE

OIL PICKUP

(1) Remove screw on pump cover holding oil pick-up tube to oil pump (Fig. 4).
(2) Remove oil pick-up tube. **When reinstalling make sure to use a new O-ring on pickup tube.**

OIL PUMP

REMOVAL

(1) Remove two (2) screws holding oil pump to cylinder block assembly (Fig. 5).

INSTALLATION

(1) Apply Mopar Gasket to pump body-to-block interface (machined surface).
(2) Lubricate oil pump rotor & shaft and drive gear.

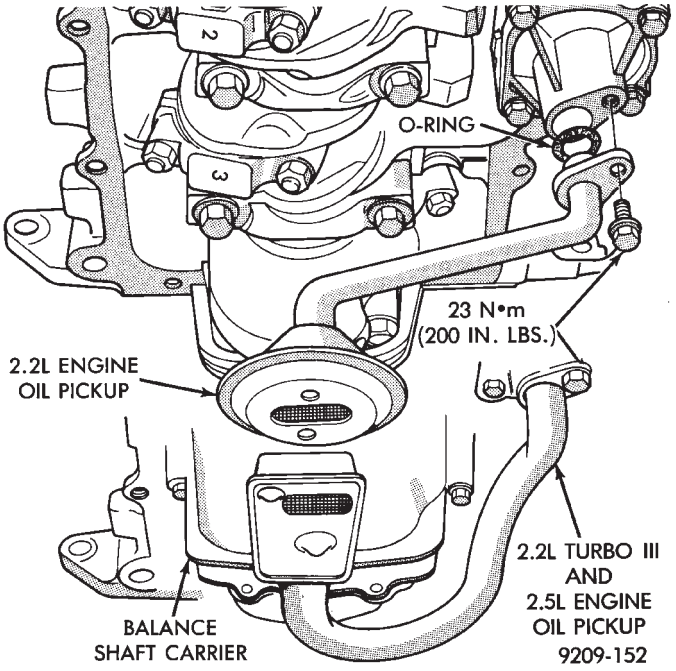

Fig. 4 Oil Pick-Up

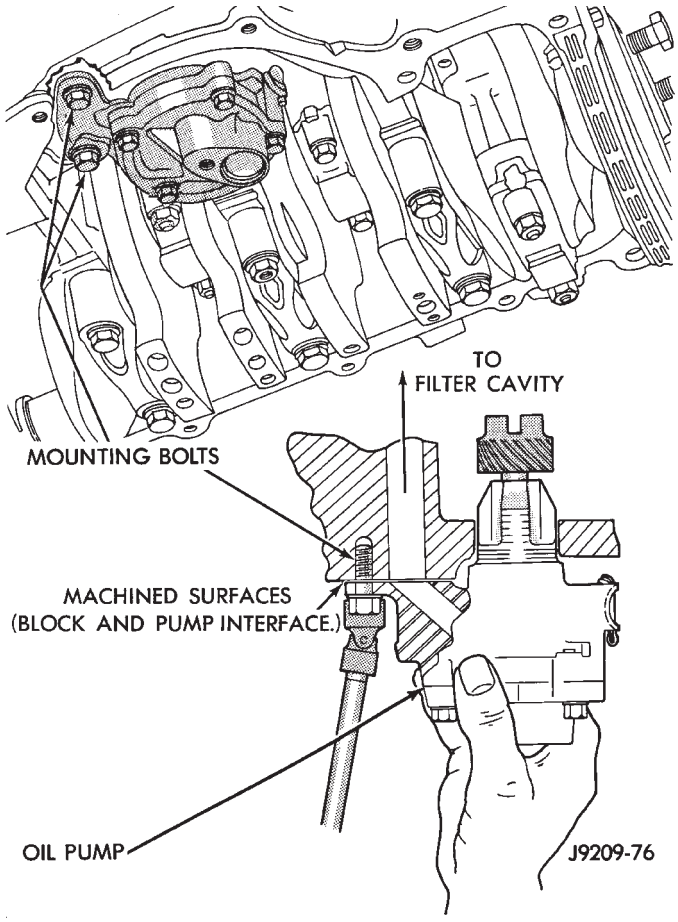

Fig. 5 Oil Pump Assembly

(3) Turn crankshaft and intermediate shaft until markings on sprockets are in line (arrows Fig. 6).

(4) Slot in oil pump shaft **must** be parallel to center line of crankshaft when intermediate shaft and crankshaft are properly timed (Fig. 7).

(5) Install pump full depth and rotate back and forth slightly to ensure proper positioning and alignment through full surface contact of pump and block machined interface surfaces (Fig. 5).

CAUTION: Pump must be held in fully seated position (described above) while installing screws.

(6) Tighten screws to 23 N·m (200 in. lbs.).

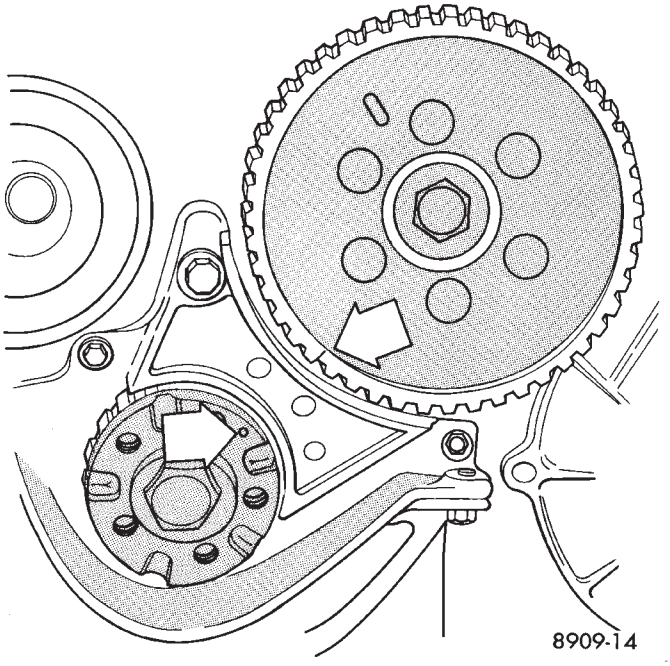

Fig. 6 Crankshaft and Intermediate Shaft Timing

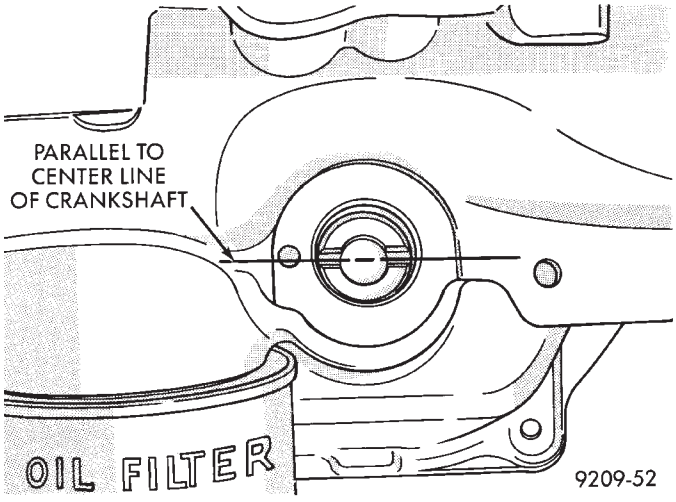

Fig. 7 Oil Pump Shaft Alignment

INSPECTION

(1) Check rotor end clearance with feeler gauge as shown in (Fig. 8).

(2) Limits:

- 0.03mm (.001 inch) minimum.
- 0.09mm (.0035 inch) maximum.

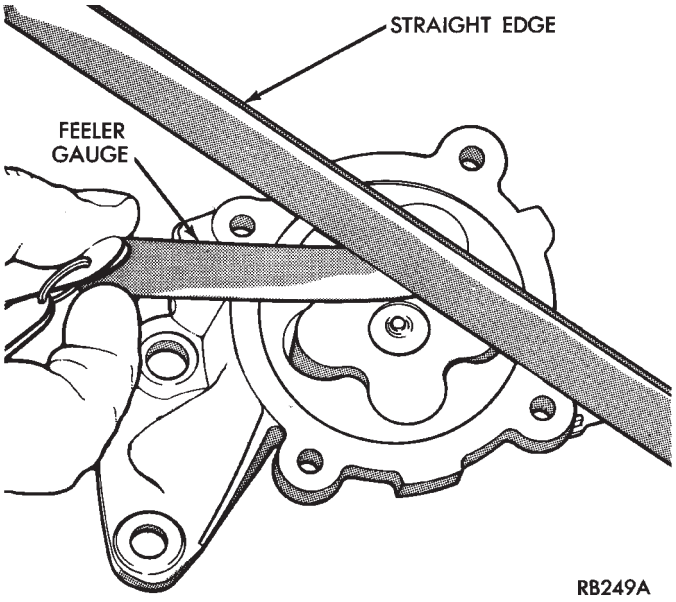

Fig. 8 Checking Rotor End Clearance

(3) Thickness: 23.96mm (.9435 inch) minimum. Outer Diameter: 62.7mm (2.469 inch) minimum (Fig. 9).

(4) Install wiht large chamfered edge in pump body (Fig. 9).

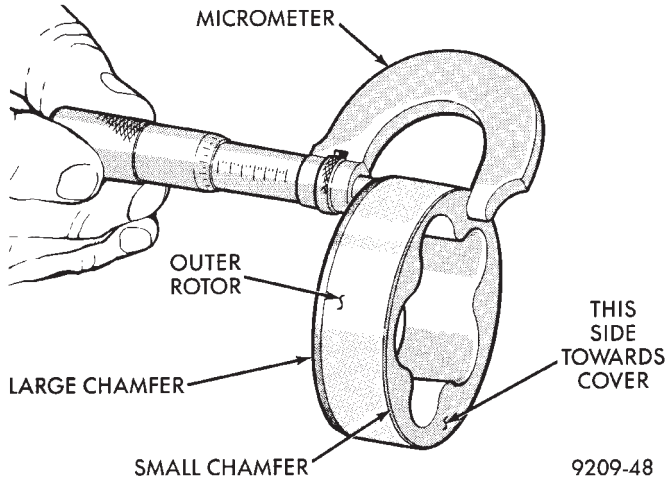

Fig. 9 Measuring Outer Rotor

Clearance: 0.20mm (.008 inch) maximum (Fig. 10).

Clearance: 0.35mm (.014 inch) maximum (Fig. 11).

Clearance: 0.076mm (.003 inch) maximum (Fig. 12).

Oil pressure relief valve spring: Free length: 49.5mm (1.95 inch). Load: 89 N at 34mm. Load: (20 lbs. at 1.34 inch) (Fig. 13).

Thickness: 23.96mm (.9435 inch) Minimum (Fig. 14).

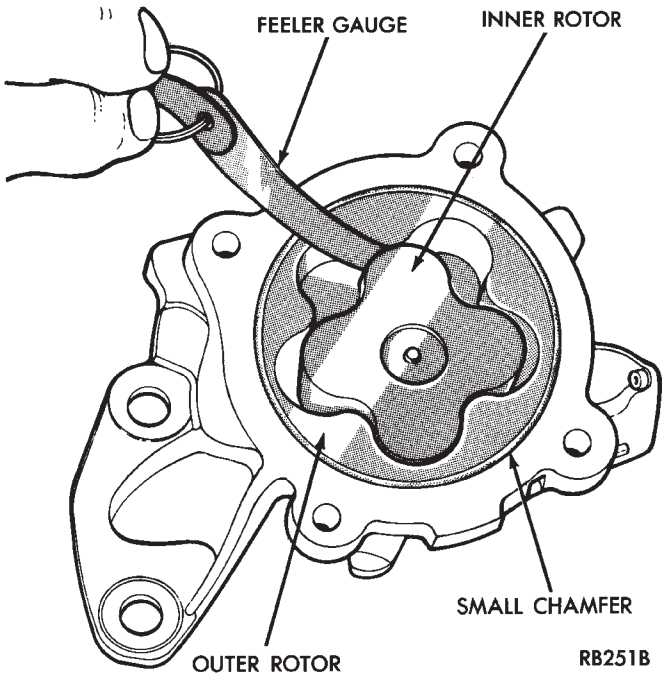

Fig. 10 Clearance Between Rotors

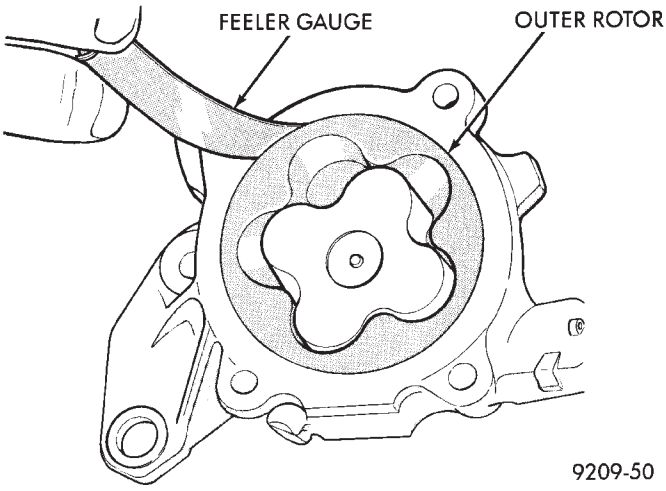

Fig. 11 Outer Rotor Clearance

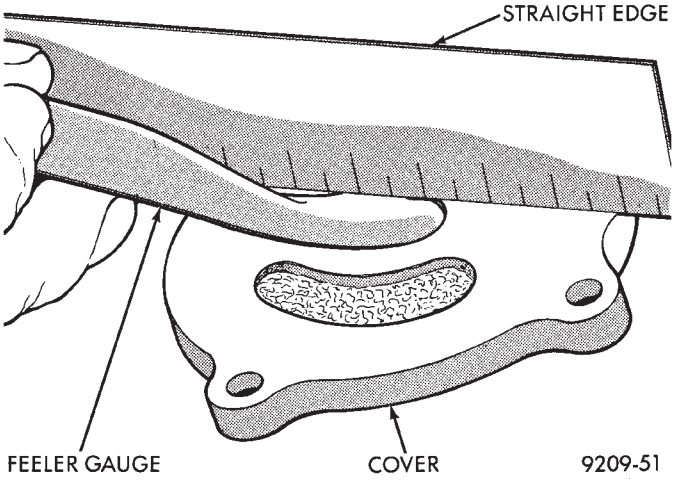

Fig. 12 Oil Pump Cover

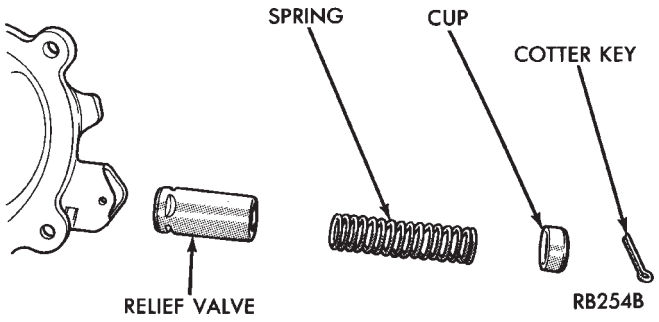

Fig. 13 Oil Pressure Relief Valve

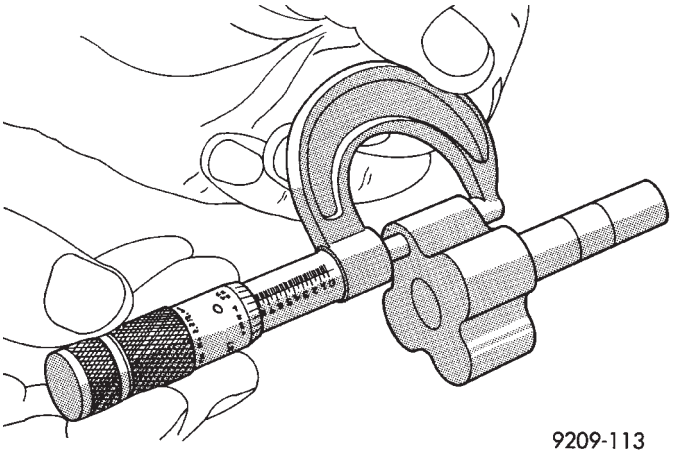

Fig. 14 Measuring Inner Rotor Thickness

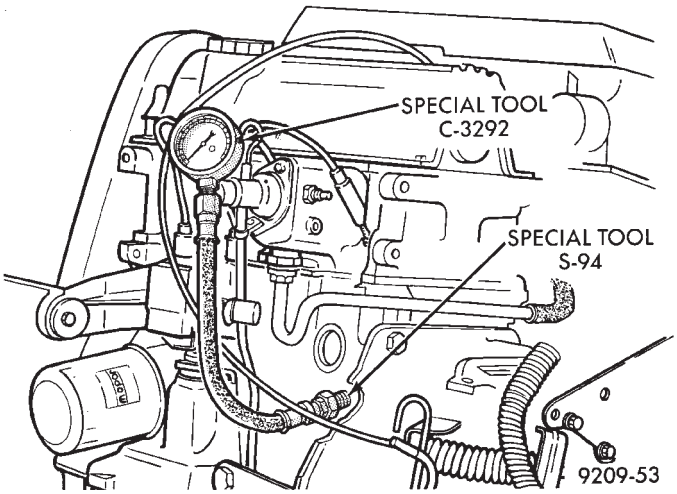

Fig. 15 Checking Oil Pump Pressure–Typical

CHECKING ENGINE OIL PRESSURE

(1) Remove pressure sending unit and install Special tool S-94 with gauge assembly C-3292 (Fig. 15).

(2) Warm engine at high idle 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).

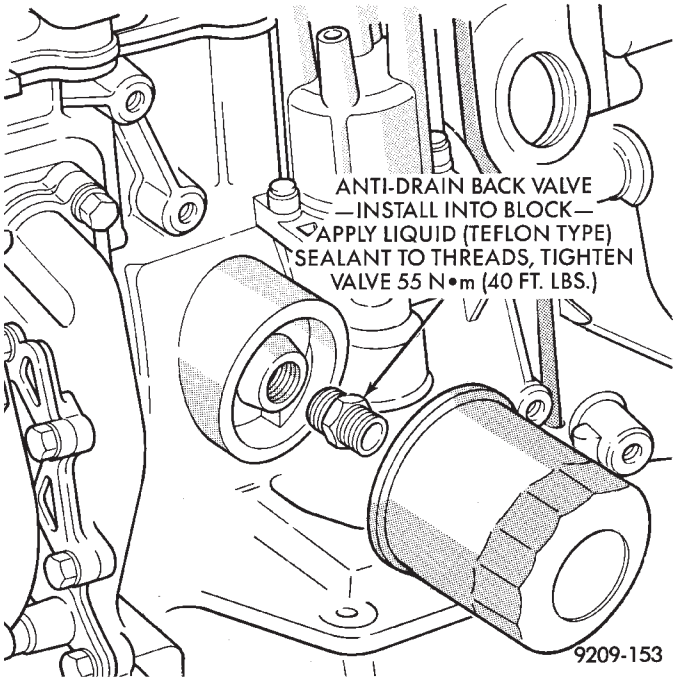

Fig. 16 Engine Oil Filter and Antidrain Back Valve

OIL FILTER

ANTI-DRAIN BACK VALVE

Installation: Apply liquid (Teflon Type) sealant to valve-to-block threads (Fig. 16). Tighten assembly to 55 N·m (40 ft. lbs.).

FILTER

CAUTION: When servicing the oil filter (Fig. 16) avoid deforming the filter can by installing the remove/install tool band strap against the can-to-base lockseam. The lockseam joining the can to the base is reinforced by the base plate.

(1) Turn counter clockwise to remove.

(2) To install, lubricate new filter gasket. Check filter mounting surface. The surface must be smooth, flat and free of debris or old pieces of rubber. Screw filter on until gasket contacts base. Tighten to 3/4 to 1 turn.

SPECIFICATIONS

	2.2L STANDARD	2.2L TURBO III	2.5L STANDARD	2.5L TURBOCHARGED
Type	In-line OHV, OHC	*	*	*
Number of Cylinders	4	*	*	*
Bore	87.5mm (3.44/3.45 in.)	*	*	*
Stroke	92mm (3.62 in.)	*	104mm (4.09 in.)	*
Compression Ratio (Nominal)	9.5:1	8.1:1	8.9:1	7.8:1
Firing Order	1-3-4-2	*	*	
Basic Ignition Timing	Refer to Emission Control Information Label on Vehicle			
Valve Timing				
Intake Valve				
Opens (BTDC)	0°	–	4°	–
Opens (ATDC)	–	25°	–	8°
Closes (ABDC)	56°	35°	60°	56°
Exhaust Valve				
Opens (BBDC)	44°	16°	40°	40°
Closes (ATDC)	8°	75°	12°	8°
Valve Overlap	8°		8°	0°
Intake Valve Duration	236°		236°	228°
Exhaust Valve Duration	232°		232°	228°

*Same as STANDARD

DESCRIPTION	STANDARD DIMENSION	SERVICE LIMIT
Compression Pressure	–	Minimum 689.5 kPa (100 psi)
Maximum Variation Between Cylinders	–	25%
Valve Clearance – Hot Engine	Hydraulic Lash Adjusters	
Flatness of Cylinder Head Gasket Surface	0.1mm (0.004 in.)	
Cylinder Head Gasket (Thickness Compressed)	1.73mm (0.068 in.)	
Camshaft		
Journal Diameter 2.2/2.5L	34.939/34.960mm (1.395/1.396 in.)	
Oversize 2.2/2.5L	35.439/35.460mm (1.395/1.396 in.)	
Turbo III Journal Diameter	47.925/47.950mm (1.886/1.887 in.)	
Cam Lobe Wear (all)		
End Play 2.2/2.5L	0.13/0.33mm (0.005/0.013 in.)	0.25mm (0.010 in.)
Turbo III	0.025/0.200mm (0.001/0.008 in.)	0.50mm (0.020 in.)
Valves		
Margin		
Intake 2.2/2.5L	1.5mm (0.060 in.)	0.793mm (0.030 in.)
Exhaust 2.2/2.5L	1.5mm (0.060 in.)	1.19mm (0.050 in.)
Turbo III		
Intake	1.06mm (0.041 in.)	
Exhaust	1.07mm (0.042 in.)	
Valve Stem-to-Guide Clearance		
Intake	0.022/0.065mm (0.0009/0.0026 in.)	
Exhaust	0.076/0.119mm (0.003/0.0047 in.)	
Turbo III		
Intake	0.03/0.06mm (0.001/0.0023 in.)	0.1mm (0.004 in.)
Exhaust	0.05/0.08mm (0.002/0.0031 in.)	0.1mm (0.004 in.)
Valve Spring Free Length		
2.2/2.5L	60.8mm (2.39 in.)	
Turbo I	57.9mm (2.28 in.)	
Turbo III	53.2mm (2.094 in.)	
Valve Spring Load Intake and Exhaust		
Valve Open at 31.00 mm (1.22 in.) all	890/961 N (195/215 lbs.)	
Turbo III at 34.20 mm (1-11/32 in.)	1133/1227 N (255/275 lbs.)	
Valve Closed at 41.90 mm (1.65 in.) all	480/534 N (108/120 lbs.)	
Turbo III at 44 mm (1.73 in.)	513/567 N (115/127 lbs.)	
Valve Spring Perpendicularity		
Intake and Exhaust (all)	2.0mm (0.079 in.)	
Intake and Exhaust (Turbo III)	1.65mm (0.065 in.)	

*At minimum cranking speed (130 rpm) - starter speed, also See "ENGINE PERFORMANCE" in STANDARD SERVICE PROCEDURES.

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ENGINE SPECIFICATIONS (CONT.)

DESCRIPTION	STANDARD DIMENSION	SERVICE LIMIT
Intermediate Shaft		
Large Journal	42.670/42.703mm (1.679/1.680 in.)	
Bushing (large) inside diameter	42.720/42.750mm (1.682/1.683 in.)	
Small Journal	19.670/19.703mm (0.774/0.775 in.)	
Bushing (small) inside diameter	19.720/19.750mm (0.776/0.777 in.)	
Piston		
Outside diameter	A thru E sizes	
2.2L Standard	87.442/87.507mm (3.443/3.445 in.)	
2.5L Standard	87.442/87.481mm (3.443/3.444 in.)	
2.2L Turbo III	87.407/87.472mm (3.441/3.444 in.)	
2.5L Turbo I	87.453/87.492mm (3.443/3.444 in.)	
Piston Pin End Play		
(Turbocharged Engines Only — Turbo I	0.00/0.088mm (0.000/0.035 in.)	1.20mm (0.047 in.)
Turbo III	0.04/1.02mm (0.0015/0.040 in.)	
Piston Rings		
Ring Side Clearance		
No. 1 Ring – 2.2/2.5L	0.038/0.078mm (0.0015/0.0031 in.)	0.10mm (0.004 in.)
No. 2 Ring – 2.2/2.5L	0.038/0.093mm (0.0015/0.0037 in.)	0.10mm (0.004 in.)
No. 1 Ring – Turbo I	0.040/0.075mm (0.0016/0.0030 in.)	
Oil Control Ring (Except Turbo III)	0.000/0.2mm (0.000/0.008 in.)	
No. 2 Ring – Turbo I	0.040/0.090mm (0.0016/0.0035 in.)	
No. 1 Ring – Turbo III	0.040/0.075mm (0.0016/0.0030 in.)	
No. 2 ring – Turbo III	0.040/0.075mm (0.0016/0.0030 in.)	
Oil Control Ring – Turbo III	0.020/0.055mm (0.0007/0.002 in.)	
Piston Ring End Gap		
No. 1 Ring – 2.2/2.5L	0.25/0.51mm (0.010/0.020 in.)	1.0mm (0.039 in.)
No. 2 Ring – 2.2/2.5L	0.28/0.48mm (0.011/0.021 in.)	1.0mm (0.039 in.)
No. 1 Ring – Turbo I	0.25/0.51mm (0.010/0.020 in.)	1.0mm (0.039 in.)
No. 2 Ring – Turbo I	0.23/0.48mm (0.009/0.019 in.)	1.0mm (0.039 in.)
Oil Control Ring (Except Turbo III)	0.38/1.40mm (0.015/0.055 in.)	1.88mm (0.074 in.)
No. 1 Ring – Turbo III	0.35/0.50mm (0.014/0.020 in.)	1.0mm (0.039 in.)
No. 2 Ring – Turbo III	0.35/0.50mm (0.014/0.020 in.)	1.0mm (0.039 in.)
Oil Control Ring – Turbo III	0.25/0.50mm (0.010/0.020 in.)	1.0mm (0.039 in.)
Connecting Rod		
Parallelism and Twist Combined	0.08mm (0.003 in.)	0.08mm (0.003 in.)
Connecting Rod Side Clearance	0.13/0.32mm (0.005/0.013 in.)	0.10mm (0.004 in.)
Bearing Clearance – Standard and Turbocharged	0.019/0.075mm (0.0008/0.003 in.)	
Cylinder Bore		
Out-of-Round	–	0.050mm (0.002 in.)
Bore Taper	–	0.125mm (0.005 in.)

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ENGINE SPECIFICATIONS (CONT.)

DESCRIPTION	STANDARD DIMENSION	SERVICE LIMIT
Crankshaft		
Connecting Rod Journal O.D.	49.979/50.005mm (1.968/1.969 in.)	
Main Bearing Journal O.D.	59.987/60.013mm (2.362/2.363 in.)	
Bearing Surface Out-of-Round	0.008mm (0.0003 in.)	0.013mm (0.005 in.)
Bearing Surface Taper	0.008mm (0.0003 in.)	0.01mm (0.0004 in.)
Main Bearing Clearance	0.011/0.072mm (0.0004/0.0028 in.)	0.10mm (0.004 in.)
End Play	0.05/0.18mm (0.002/0.007 in.)	0.35mm (0.014 in.)
Oil Pump		
Relief Valve Opening Pressure	414 kPa (60 psi)	550 kPa (80 psi)
Outer Rotor O.D.-to-Housing Bore Clearance	0.25mm (0.010 in.)	0.35mm (0.014 in.)
Outer Rotor Thickness	23.98/24.00mm (0.944/0.945 in.)	23.96mm (0.9435 in.)
Inner Rotor-to-Outer Rotor Tip Clearance	0.10mm (0.004 in.)	0.20mm (0.008 in.)
Inner and Outer Rotor-to-Housing Clearance	0.03/0.08mm (0.001/0.003 in.)	0.09mm (0.0035 in.)
Pump Cover Flatness	0.05mm (0.002 in. max.)	0.076mm (0.003 in.)
Relief Spring Free Length	49.5mm (1.95 in.)	49.5mm (1.95 in.)
Relief Spring Load	89 N at 34mm (20 lbs. at 1.34 in.)	
Oil Pressure Switch		
Minimum Actuating Pressure	14 kPa (2-4 psi)	
Oil Pressure (all)		
Minimum Values – **Engine Fully Warmed**		
At Curb Idle	30 kPa (4 psi)	
At 3000 rpm	170-550 kPa (25-80 psi)	

SPECIFICATIONS

DESCRIPTION	TORQUE
Balance Shaft Carrier; Front Chain Cover Screw	12 N·m (105 in. lbs.)
Chain Tensioner Adjustment Screw	12 N·m (105 in. lbs.)
Chain Tensioner Pivot Screw	12 N·m (105 in. lbs.)
Chain Snubber Stud and Washer	12 N·m (105 in. lbs.)
Chain Snubber Nut	12 N·m (105 in. lbs.)
Gear Cover Screw	12 N·m (105 in. lbs.)
Gear (and Sprocket) to Balance Shaft	28 N·m (250 in. lbs.)
Sprocket to Crankshaft-Torx Drive Cap Screw	15 N·m (130 in. lbs.)
Rear Cover Screw	12 N·m (105 in. lbs.)
Carrier-to-Block Bolt	54 N·m (40 ft. lbs.)
Cup Plug; Sealant Loctite 277	
Camshaft Bearing Cap Bolt	25 N·m (215 in. lbs.)
Camshaft Sprocket Bolt	89 N·m (65 ft. lbs.)
Connecting Rod Bearing Cap Nut	54 N·m (40 ft. lbs.) +1/4 Turn
Crankshaft Sprocket Bolt	115 N·m (85 ft. lbs.)
Cylinder Head Cover Screw	12 N·m (105 in. lbs.)
Cylinder Head Bolt-4 Step Torque Sequence	61 N·m (45 ft. lbs.) 89 N·m (65 ft. lbs.) 89 N·m (65 ft. lbs.) +1/4 Turn
Exhaust Manifold Bolt	23 N·m (200 in. lbs.)
Front Crankshaft Oil Seal Retainer Screw	12 N·m (105 in. lbs.)
Intake Manifold Bolt	23 N·m (200 in. lbs.)
ntermediate Shaft Retainer Screw	12 N·m (105 in. lbs.)
ntermediate Shaft Sprocket Screw	88 N·m (65 ft. lbs.)
.ower Timing Belt Cover Screw	4 N·m (40 in. lbs.)
Main Bearing Cap Bolt	41 N·m (30 ft. lbs.) +1/4 Turn
Oil Pan Screw (M8 Screws)	23 N·m (200 in. lbs.)
Oil Pan Screw (M6 Screws)	12 N·m (105 in. lbs.)
Oil Pump Cover Screw	12 N·m (105 in. lbs.)
Oil Pan Drain Plug	27 N·m (240 in. lbs.)
Oil Pump Strainer-to-Cover Screw	23 N·m (200 in. lbs.)
Oil Pump Mounting Screw	23 N·m (200 in. lbs.)
Rear Crankshaft Oil Seal Retainer Screw	12 N·m (105 in. lbs.)
Spark Plug	27 N·m (20 ft. lbs.)
Timing Belt Tensioner Bolt	61 N·m (45 ft. lbs.)
Thermostat Housing Screw	23 N·m (200 in. lbs.)
Upper Timing Belt Cover Screw	4 N·m (40 in. lbs.)
Water Pump Housing Screw-Upper	28 N·m (250 in. lbs.)
Water Pump Housing Screw-Lower	54 N·m (40 ft. lbs.)
Turbo III	
Camshaft Thrust Plate Retaining Nut	8 N·m (72 in. lbs.)
Connecting Rod Bearing Cap Nut	68 N·m (50 ft. lbs.)
Camshaft Sprocket Bolt	65 N·m (47 ft. lbs.)
Crankshaft Sprocket Bolt	110 N·m (80 ft. lbs.)
Intermediate Shaft Sprocket Bolt	70 N·m (53 ft. lbs.)
Lower Timing Belt Cover	8 N·m (72 in. lbs.)
Exhaust Manifold Studs	24 N·m (210 in. lbs.)
Oil Pan Bolts (M6 Screws)	25 N·m (220 in. lbs.)
Oil Pan Bolts (M8 Screws)	29 N·m (260 in. lbs.)
Rockershaft Retaining Bolts	24 N·m (210 in. lbs.)
Rocker Cover Bolts	12 N·m (105 in. lbs.)
Spark Plugs	25 N·m (220 in. lbs.)
Thermostat Housing Bolts	24 N·m (210 in. lbs.)
Timing Belt Idler Pulley Bolt	54 N·m (40 ft. lbs.)
Timing Belt Tensioner Pulley Bolt	54 N·m (40 ft. lbs.)

All fasteners should be thoroughly cleaned and lightly oiled

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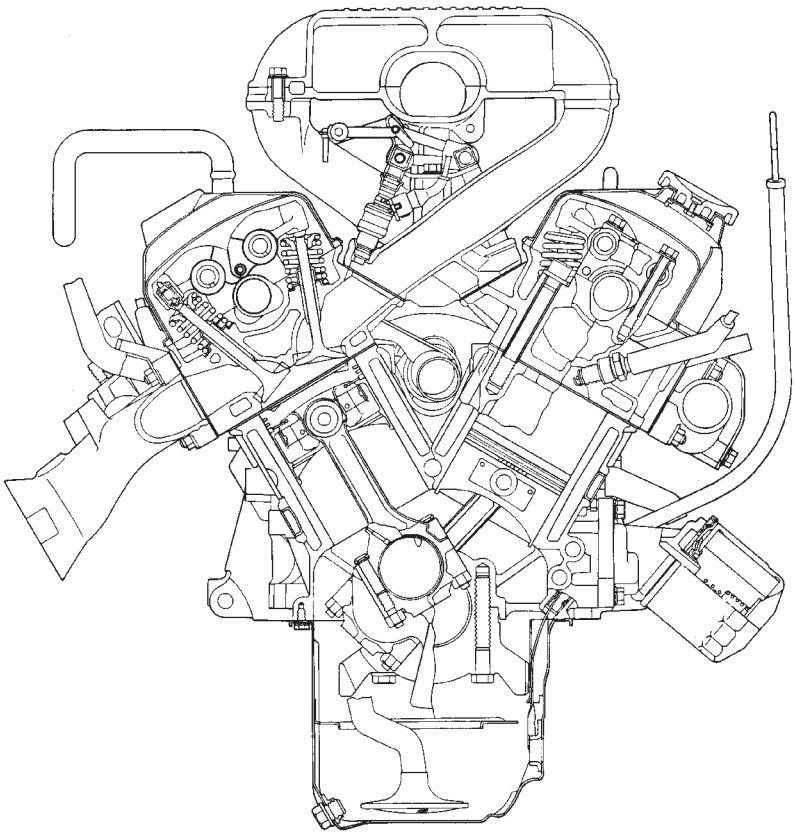
3.0L ENGINE

INDEX

3.0L ENGINE



9009-43

GENERAL INFORMATION

ENGINE IDENTIFICATION NUMBER OR CODE

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

BLOCK: The cylinder block is a light weight design created by reducing thickness in many parts and a short 10 mm (3/8 inch) block skirt. High rigidity is provided with ribs cast in the outer wall, a full length water jacket, and a monoblock 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 front seal is retained in the oil pump case and the rear is retained in a block-mounted housing.

SPECIFICATIONS

3.0L V-6 ENGINE	
Type	60° V SOHC (Per Bank)
Bore	91.1 mm (3.587 Inch)
Stroke	76.0 mm (2.992 Inch)
Compression Ratio	8.85:1
Displacement	3.0 Liters (181 Cubic Inch)
Torque	170 Lb. Ft. @ 2800 RPM
Firing Order	1-2-3-4-5-6
Lubrication	Pressure Feed-Full Flow Filtration (Direct Crankshaft Driven Pump)
Engine Oil Capacity	4.25 Liter (4.5 Qts.) Including Oil Filter, 3.8 Liter (4.0 Qts.) Without Oil Filter.
Cooling System	Liquid Cooled-Forced Circulation (Pump-Timing Belt Driven)
Cylinder Block	Cast Iron
Crankshaft	Cast (Ductile Cast Iron)
Cylinder Head	Aluminum Alloy
Connecting Rods	Forged Steel
Pistons	Aluminum Alloy (w/Strut)

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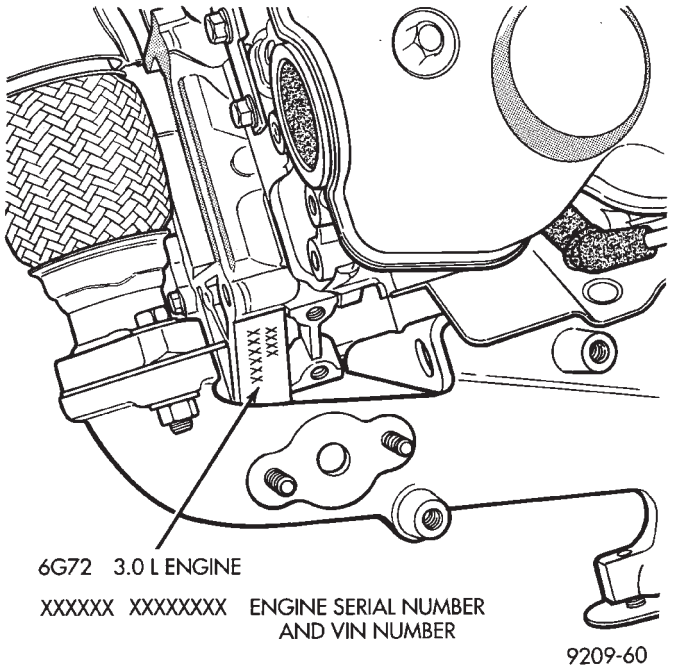


Fig. 1 Engine Identification

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, press-fitted 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 sherical 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.

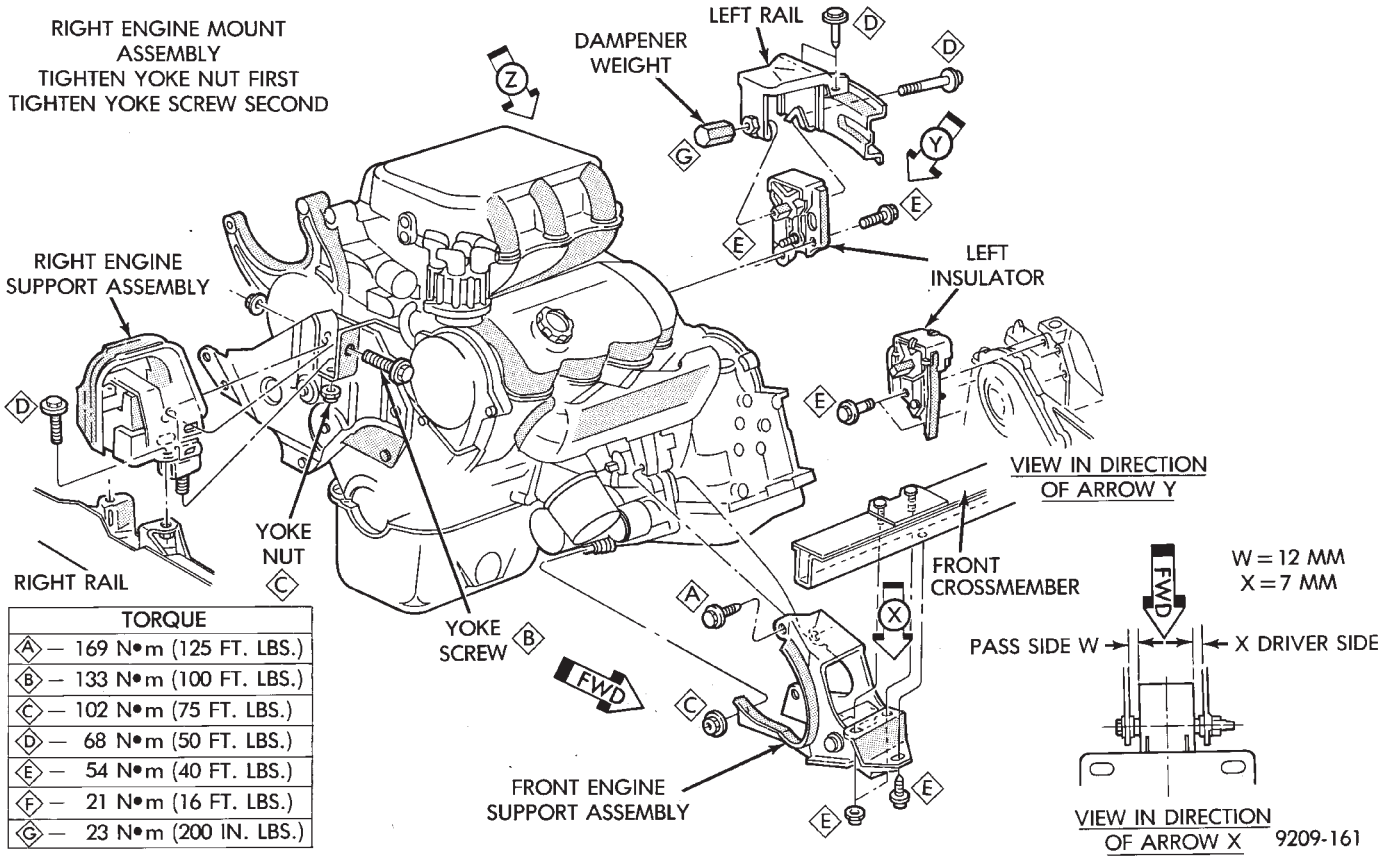
CAMSHAFTS: Two overhead camshafts provide valve actuation, one front (radiator side of cylinder bank) and one rear. The front camshaft is provided with a distributor drive and is longer. Both camshafts are supported by four bearing journals, thrust for the front camshaft is taken at journal two and the 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 and are further treated to resist heat.

VALVE SPRINGS: Are especially designed to be short. The valve spring wire cross-section is oval



TORQUE
A — 169 N•m (125 FT. LBS.)
B — 133 N•m (100 FT. LBS.)
C — 102 N•m (75 FT. LBS.)
D — 68 N•m (50 FT. LBS.)
E — 54 N•m (40 FT. LBS.)
F — 21 N•m (16 FT. LBS.)
G — 23 N•m (200 IN. LBS.)

Fig. 2 Engine Mounting

shaped and provides the same spring tension as longer springs. Valve spring retainers, lock 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. Exhuast 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.

ENGINE LUBRICATION: System is a full flow filtration, pressure feed type. The oil pump is mounted in the chaincase 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 MOUNTS

REMOVAL AND INSTALLATION

RIGHT SIDE MOUNT

(1) Remove the right engine mount insulator vertical fasteners from frame rail.

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

(3) Remove the thru bolt from the insulator assembly. Remove insulator.

(4) Reverse removal procedure for installation. Refer to (Fig. 2) for bolt tightening specifications.

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

FRONT MOUNT

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

(2) Remove the thru bolt from the insulator and front crossmember mounting bracket.

(3) Remove the front engine mount bracket to front crossmember screws and nuts. Remove the insulator assembly.

(4) Reverse removal procedure for installation. Refer to (Fig. 2) for bolt tightening specifications.

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

LEFT SIDE MOUNT

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

(2) Remove inter splash shield.

(3) Support the transmission with a transmission jack.

(4) Remove the insulator thru bolt from the mount.

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

(6) Reverse removal procedure for installation. Refer to (Fig. 3) for bolt tightening specifications.

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

ENGINE MOUNT RUBBER INSULATORS

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

Check and reposition right engine mount insulator (left engine mount insulator is floating type and will adjust automatically (Fig. 3). Adjust drive train position, if required, for the following conditions:

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

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 yoke screw and two turns on yoke nut, then loosen the front engine mount bracket to front crossmember screws and nuts.

Left engine mount insulator is sleeved over shaft and long support bolt to provide lateral movement adjustment with engine weight removed or not.

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

(4) Tighten right engine mount insulator yoke nut to 102 N·m (75 ft. lbs.). Then tighten front engine mount screws and nuts to 54 N·m (40 ft. lbs.) and center left engine mount insulator.

(5) Recheck drive shaft length.

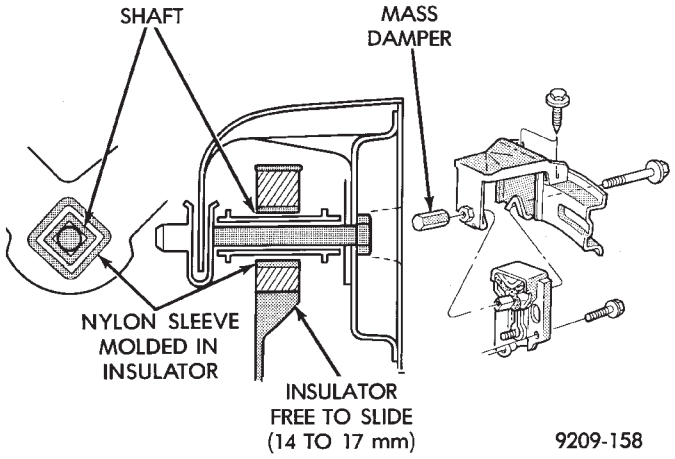


Fig. 3 Left Insulator Movement

ENGINE ASSEMBLY

REMOVAL

(1) Disconnect battery.

(2) Mark hood position at hinges and remove hood.

(3) Drain cooling system. Refer to Cooling System Group 7 for draining procedure.

(4) Disconnect all electrical connections.

(5) Remove coolant hoses from radiator and engine.

(6) Remove radiator and fan assembly.

(7) See Fuel System Group 14, For procedures to release fuel pressure, disconnect fuel lines and accelerator cable.

(8) Remove air cleaner assembly.

(9) Hoist vehicle and drain engine oil.

(10) Remove air conditioning compressor mounting bolts and set compressor aside.

(11) Disconnect exhaust pipe at manifold.

(12) Remove transmission inspection cover and mark flex plate to torque converter position.

(13) Remove screws holding torque converter to flex plate and attach C-clamp on bottom of converter housing to prevent torque converter from coming out.

(14) Remove power steering pump mounting bolts and set pump aside.

(15) Remove two lower transmission to block screws.

(16) Remove starter.

(17) Lower vehicles and disconnect vacuum lined and ground strap.

(18) Install transmission holding fixture.

(19) Attach engine lifting hoist and support engine.

(20) Remove upper transmission case to block bolts.

(21) See Engine Mounting in (Fig. 2) and separate mount/insulators as follows:

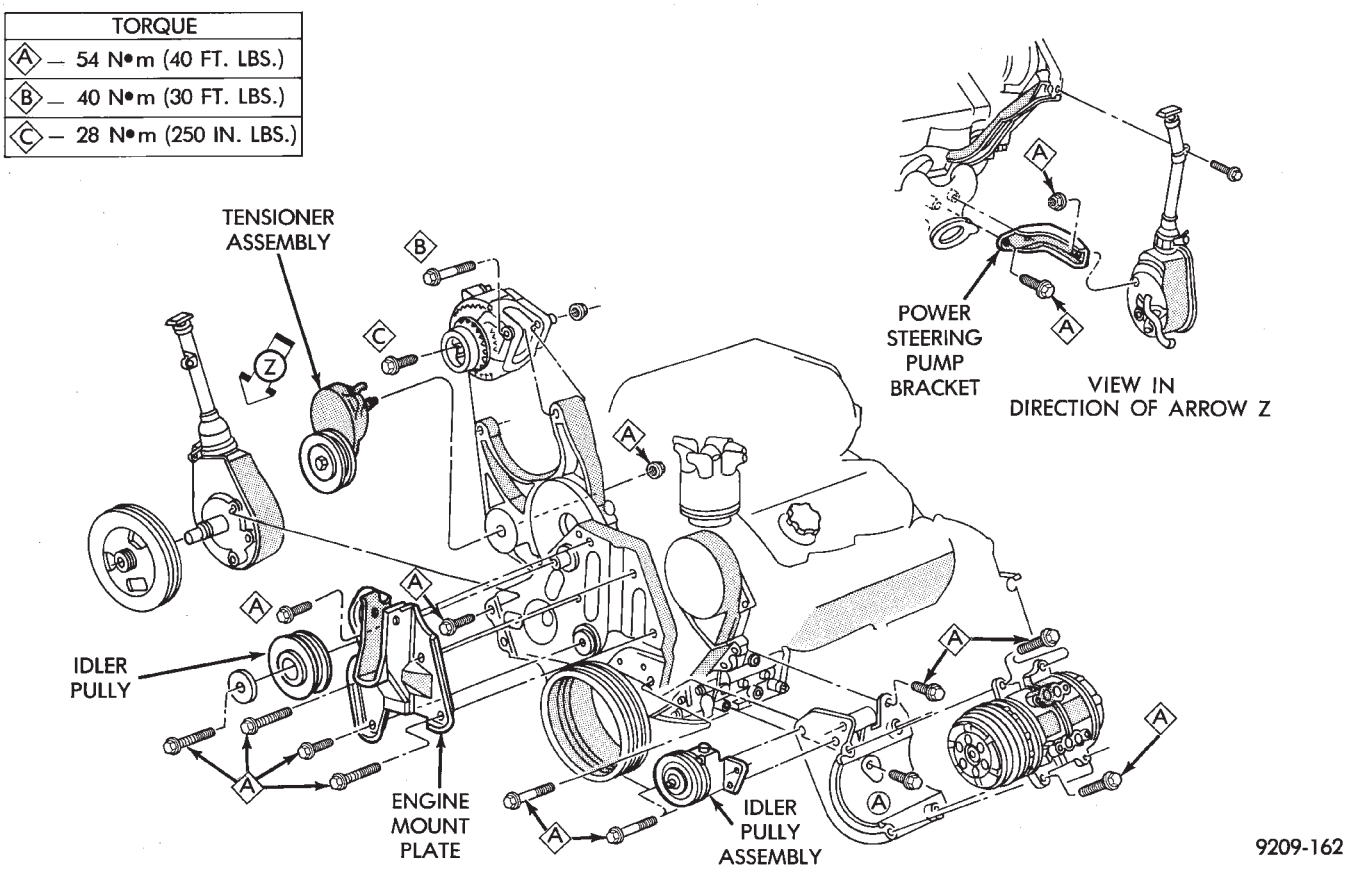


Fig. 4 Accessories Mounting Brackets

(a) Mark RIGHT insulator on right yoke and engine plate supports. Remove insulator to rails screws.

(b) Remove FRONT engine mount through bolt and nut.

(c) Remove LEFT insulator through bolt from inside wheelhouse or insulator bracket to transmission screws.

(11) Remove engine.

INSTALLATION

(1) Attach hoist and lower engine into engine compartment.

(2) Align engine mounts and install but **do not tighten** until all mounting bolts have been installed. Tighten bolts to torque specified in (Fig. 2).

(3) Install transmission case to cylinder block, tighten bolts to 102 N·m (75 ft. lbs.) torque.

(4) Remove engine hoist and transmission holding fixture.

(5) Remove C clamp from torque converter housing. Align flex plate to torque converter and install mounting screws. Tighten to 75 N·m (55 ft. lbs.)

(6) Install transmission inspection cover.

(7) Connect exhaust system at manifold.

(8) Install starter.

(9) Install power steering pump and air conditioning compressor. For belt installation Refer to Accessory Belt Drive in Cooling System Group 7.

(10) Lower vehicle and connect all vacuum lines.

(11) Connect all electrical connections including ground strap.

(12) Connect fuel lines and accelerator cable.

(13) Install radiator and fan assembly. Connect fan motor electrical lead. Install radiator hoses. Fill cooling system. Refer to Cooling System Group 7 for filling procedure.

(14) Fill engine crankcase with proper oil to correct level.

(15) Install hood.

(16) Connect battery.

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

(18) Adjust transmission or linkage if necessary.

ACCESSORY DRIVE BELT SERVICE

REMOVAL

(1) Loosen Adjusting Lock Nut (Fig. 6).

(2) Turn adjusting jack screw counterclockwise to reduce belt tension. Remove belt.

(3) Inspect drive belt for wear and damage (Fig. 5).

(4) Installation: Adjust belt tension to 5/16 deflection between pulleys (Fig. 6).

(5) Install breaker bar into 1/2 square opening in tensioner.

(6) Rotate tensioner clockwise to remove and install belt. (Fig. 7).

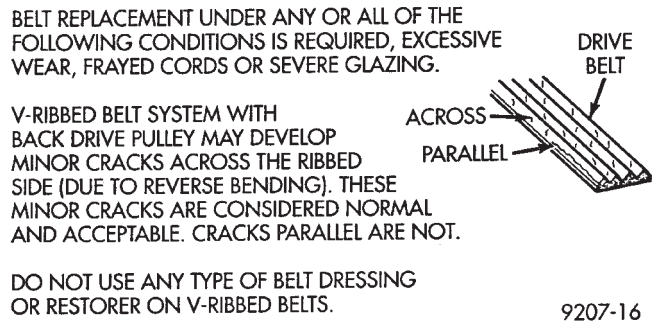


Fig. 5 Drive Belt Inspection

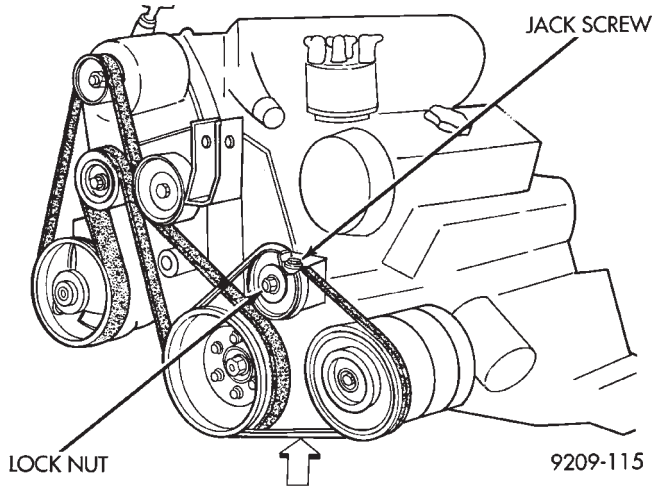


Fig. 6 Air Conditioning Belt

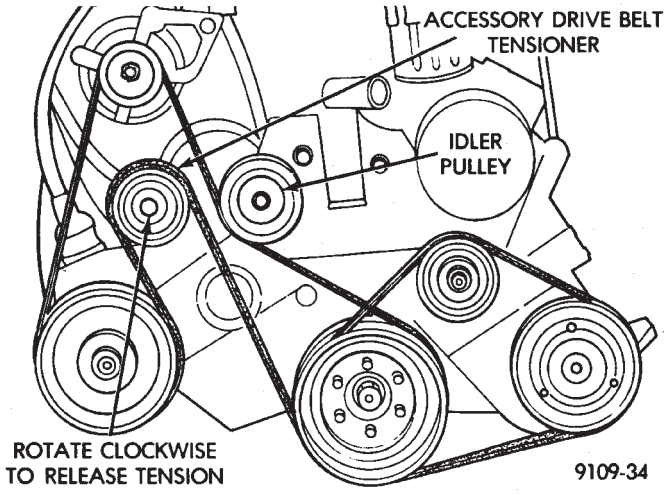


Fig. 7 Alternator/Power Steering Belt

ENGINE MOUNT BRACKET

REMOVAL

(1) Remove air conditioning compressor to mounting bracket screws and lay compressor aside (Fig. 4).

(2) Remove screws attaching air conditioning compressor mounting bracket and adjustable drive belt tensioner from block and engine mounting bracket. Remove both assemblies.

(3) Remove steering pump/alternator belt tensioner mounting bolt and remove automatic belt tensioner.

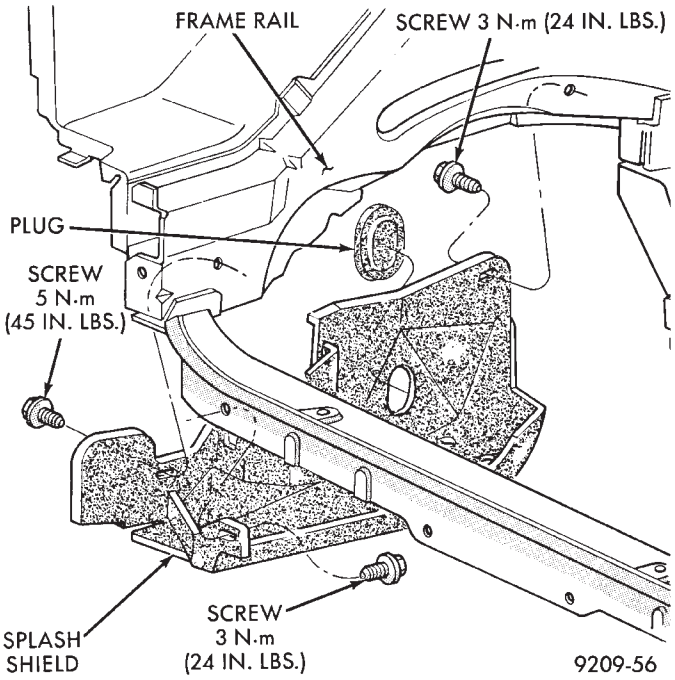


Fig. 8 Right Inner Splash Shield—Typical

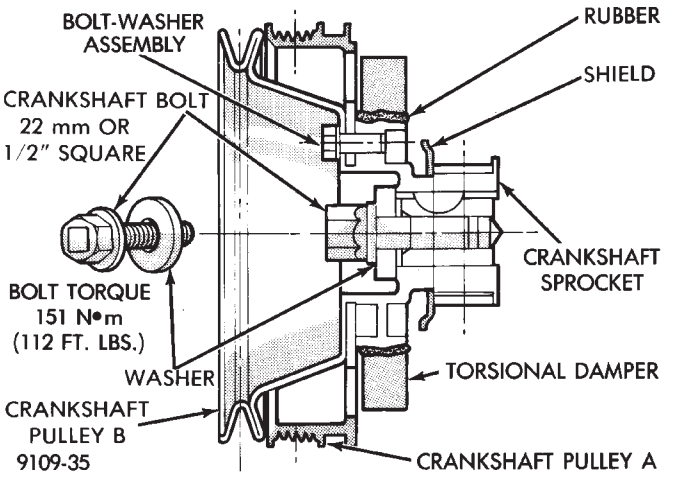


Fig. 9 Crankshaft Drive Pulleys

(4) Remove two steering pump to engine mounting brackets screws and one rear support lock nut.

(5) Lay power steering pump aside.

(6) Raise vehicle and remove right inner splash shield (Fig. 8).

(7) Remove crankshaft drive pulleys and torsional damper (Fig. 9).

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

(9) Mark support assembly to engine bracket if assembly is to be used again. Separate engine mount insulator from engine mount bracket (Fig. 10). Raise engine slightly.

(10) Remove engine mount bracket (Fig. 10).

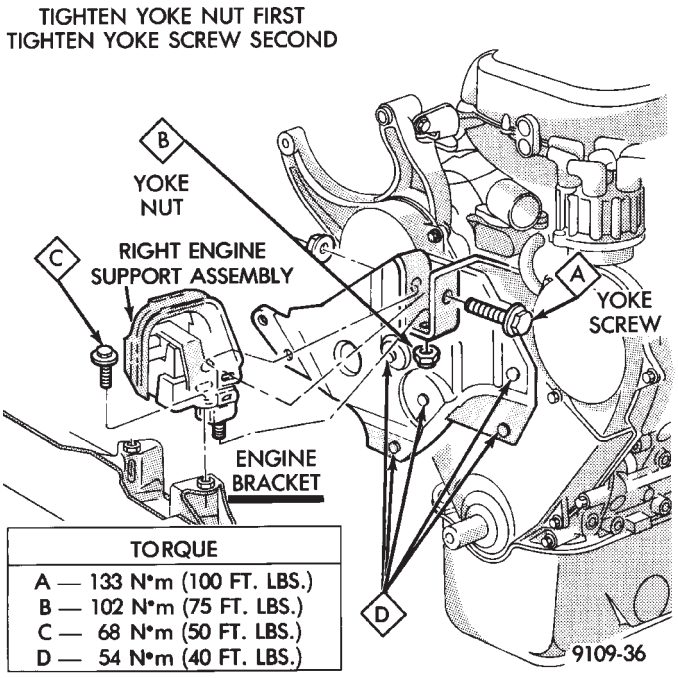


Fig. 10 Right Engine Mount and Engine Mount Bracket

(11) Remove timing belt covers (Fig. 11).

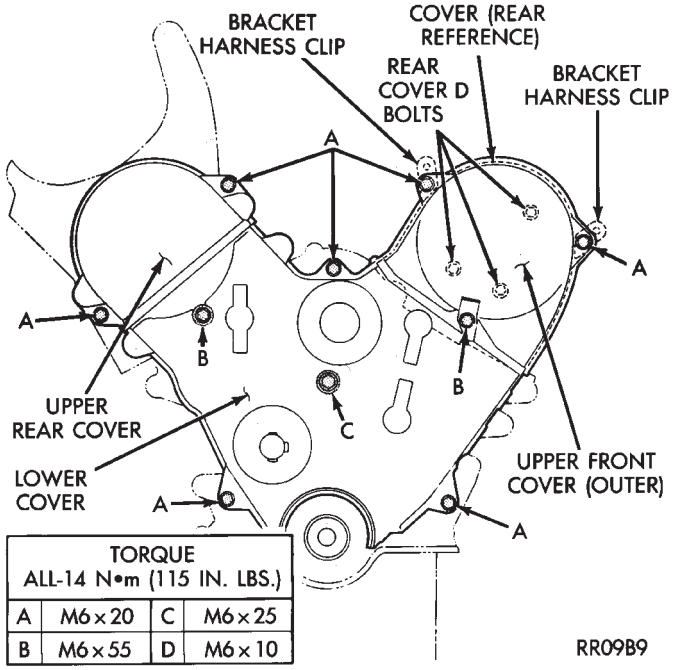


Fig. 11 Timing Belt Covers

TIMING BELT INSPECTION—IN VEHICLE

(1) Remove the upper front outer timing belt cover by loosening the three attaching bolts. (Fig. 11).

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

- Hardening of back rubber back side is glossy without resilience and leaves no indent when pressed with fingernail.
- Cracks on rubber back.
- Cracks or peeling of canvas.
- Cracks on rib root.
- Cracks on belt sides.
- Missing teeth.
- Abnormal wear of belt sides. The sides are normal if they are sharp as if cut by a knife (Fig. 12).

(3) If none of the above conditions are seen on the belt, the belt cover can be reinstalled.

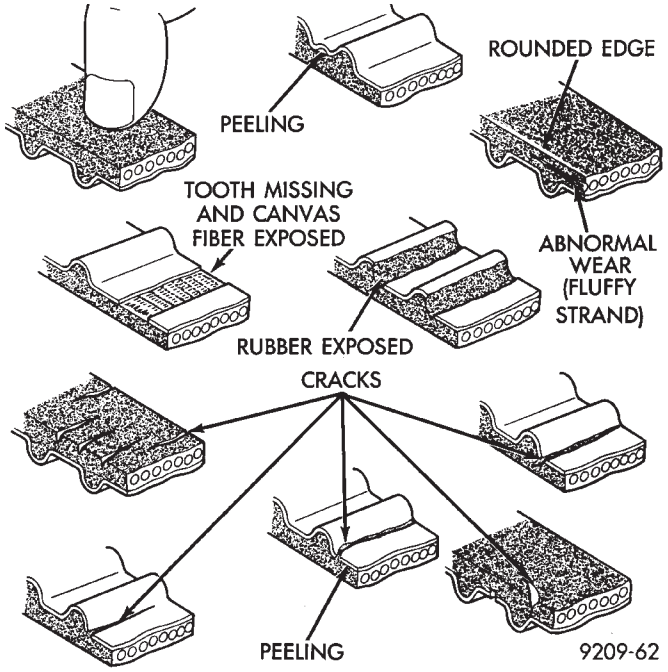


Fig. 12 Timing Belt Inspection

TIMING BELT SERVICE

REMOVAL

(1) Mark belt running direction for installation (Fig. 14).

(2) Loosen timing belt tensioner bolt (Fig. 16) and remove timing belt.

(3) Remove crankshaft sprocket flange shield (Fig. 9).

CAMSHAFT SPROCKETS

REMOVAL

(1) Hold camshaft sprocket with Spanner Tool MB990775 loosen and remove bolt and washer (Fig. 15).

(2) Remove camshaft sprocket from camshaft.

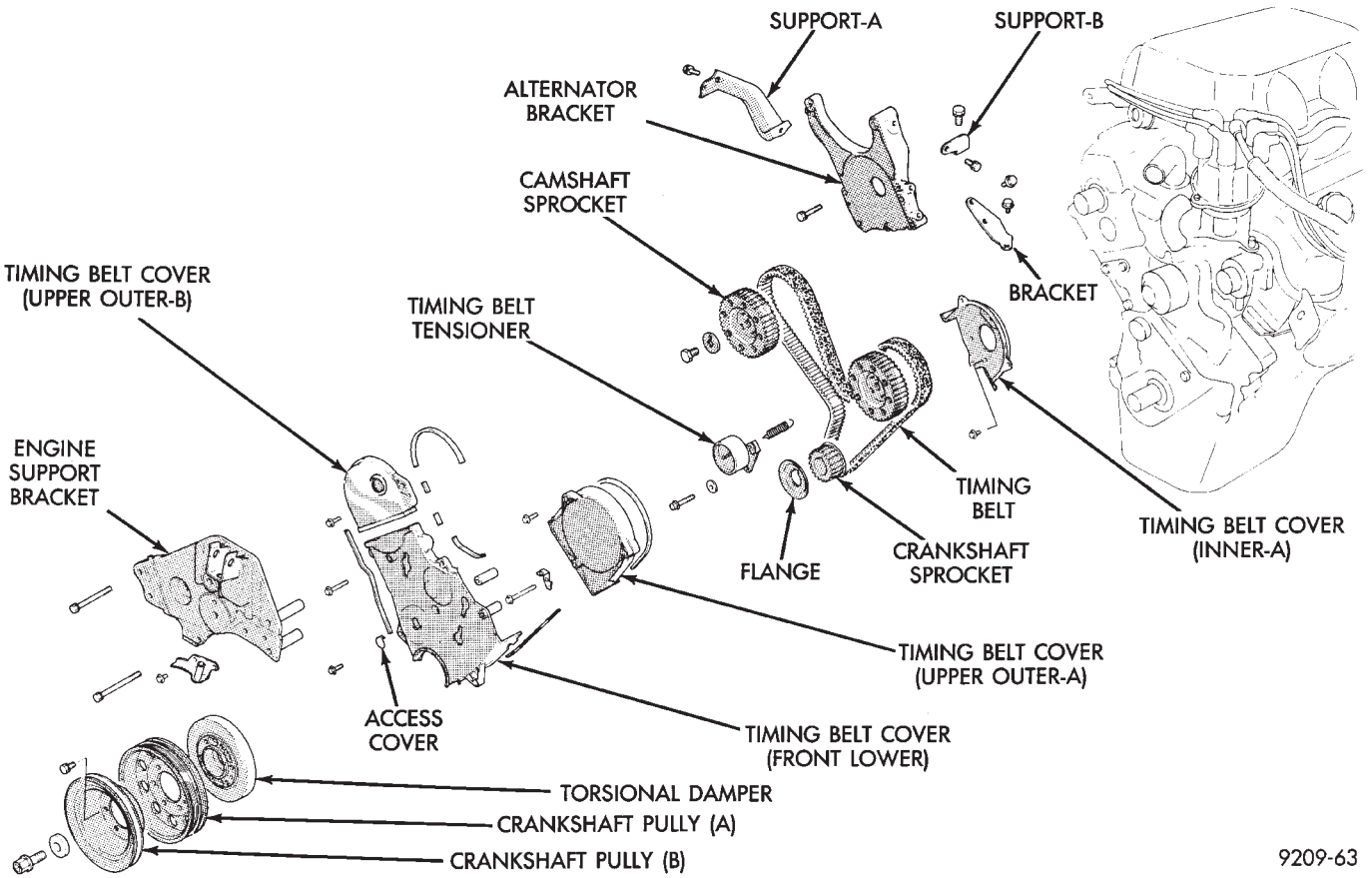


Fig. 13 Timing Belt System

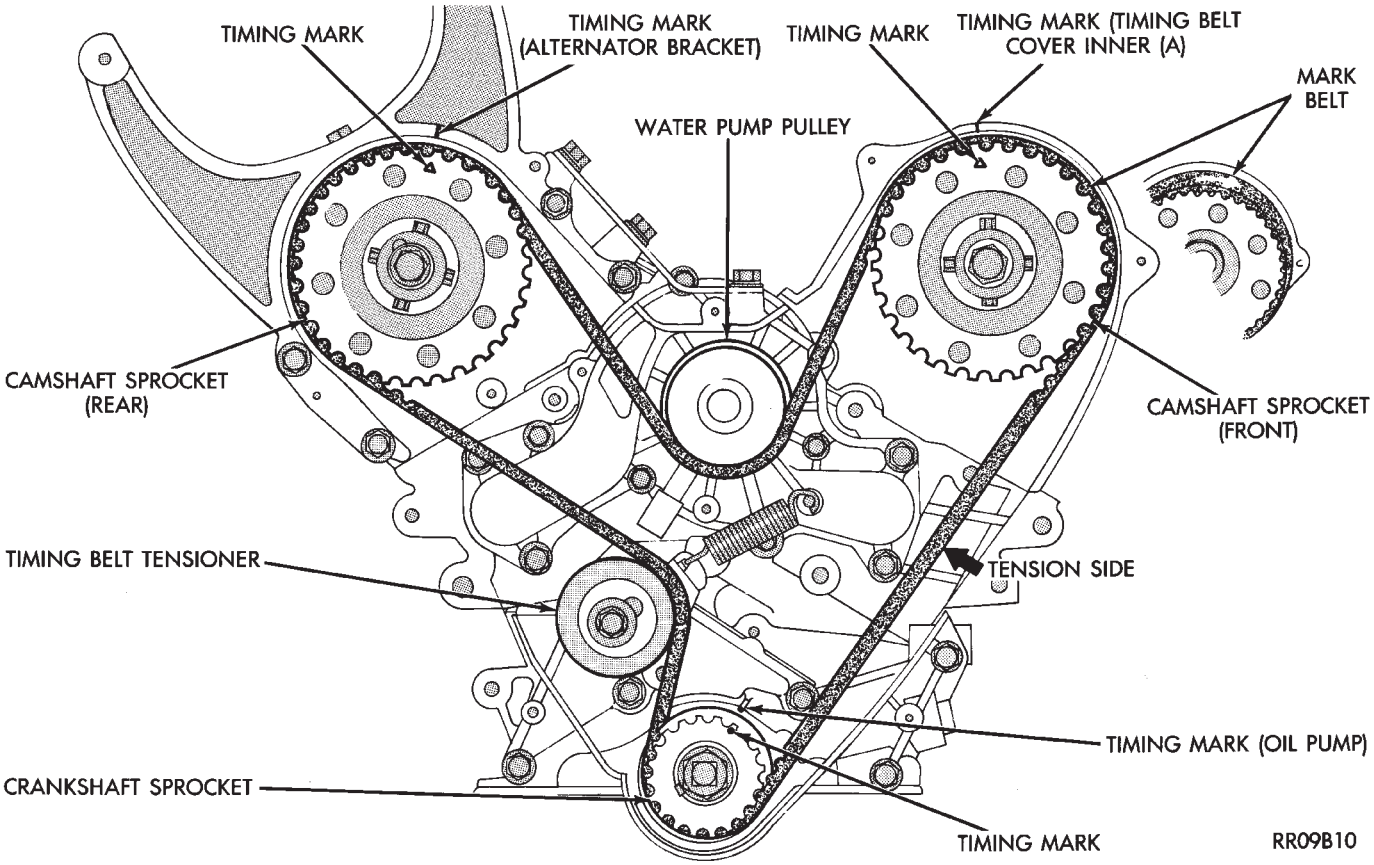


Fig. 14 Timing Belt Engine Sprocket Timing

INSTALLATION

(1) Place camshaft sprocket on camshaft.

(2) Install bolt and washer to camshaft. Using Spanner Tool MB990775 hold camshaft sprocket and torque bolt to 95 N·m (70 ft. lbs.) (Fig. 15).

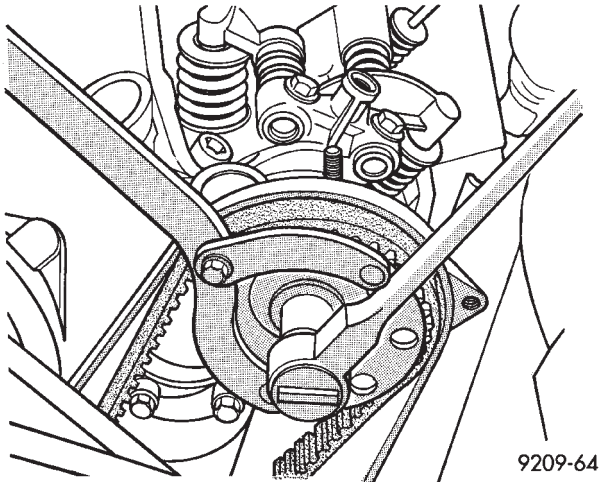


Fig. 15 Camshaft Sprockets

TIMING BELT TENSIONER

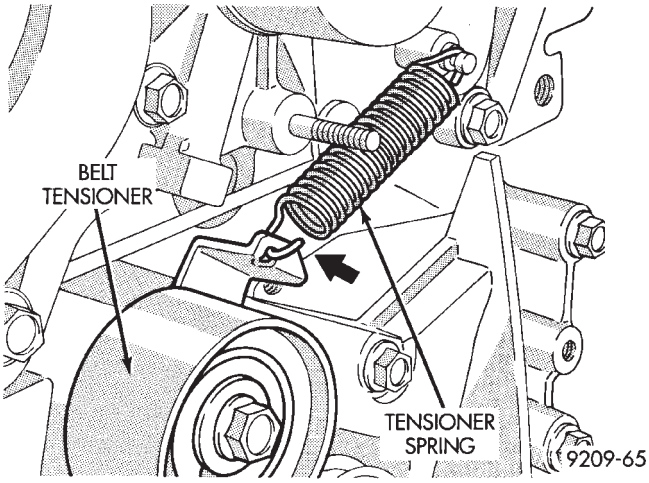


Fig. 16 Timing Belt Tensioner

(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. 16).

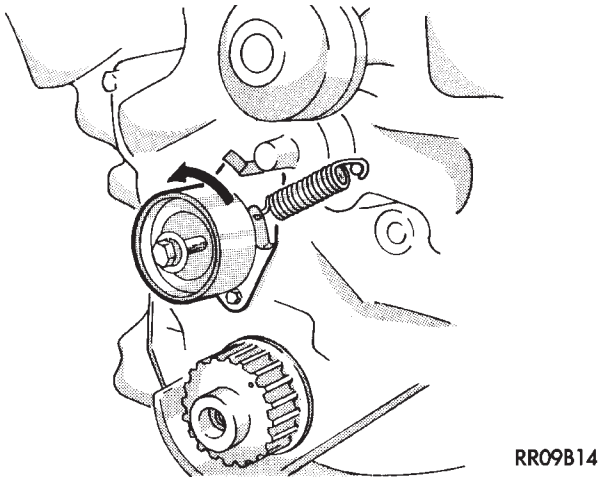


Fig. 17 Positioning Belt Tensioner

(3) Turn timing belt tensioner counter-clockwise full travel in adjustment slot and tighten bolt to temporarily hold this position (Fig. 17).

INSTALLATION—TIMING BELT

(1) Install timing belt on crankshaft sprocket first and while keeping belt tight on tension side (Fig. 14) install belt on the front (radiator side) camshaft sprocket.

(2) Then, install on the water pump pulley and on the rear camshaft sprocket and finally on the timing belt tensioner.

(3) Apply rotating force to the front camshaft sprocket in opposite direction to tension the belt tension side, check that all timing marks are lined up (Fig. 14).

(4) Install crankshaft sprocket flange (Fig. 12).

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

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

(7) Again line up the timing marks on the sprockets and tighten the timing belt tensioner locking bolt to 25 N·m (250 in. lbs.) torque.

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

CYLINDER HEAD AND CAMSHAFT SERVICE

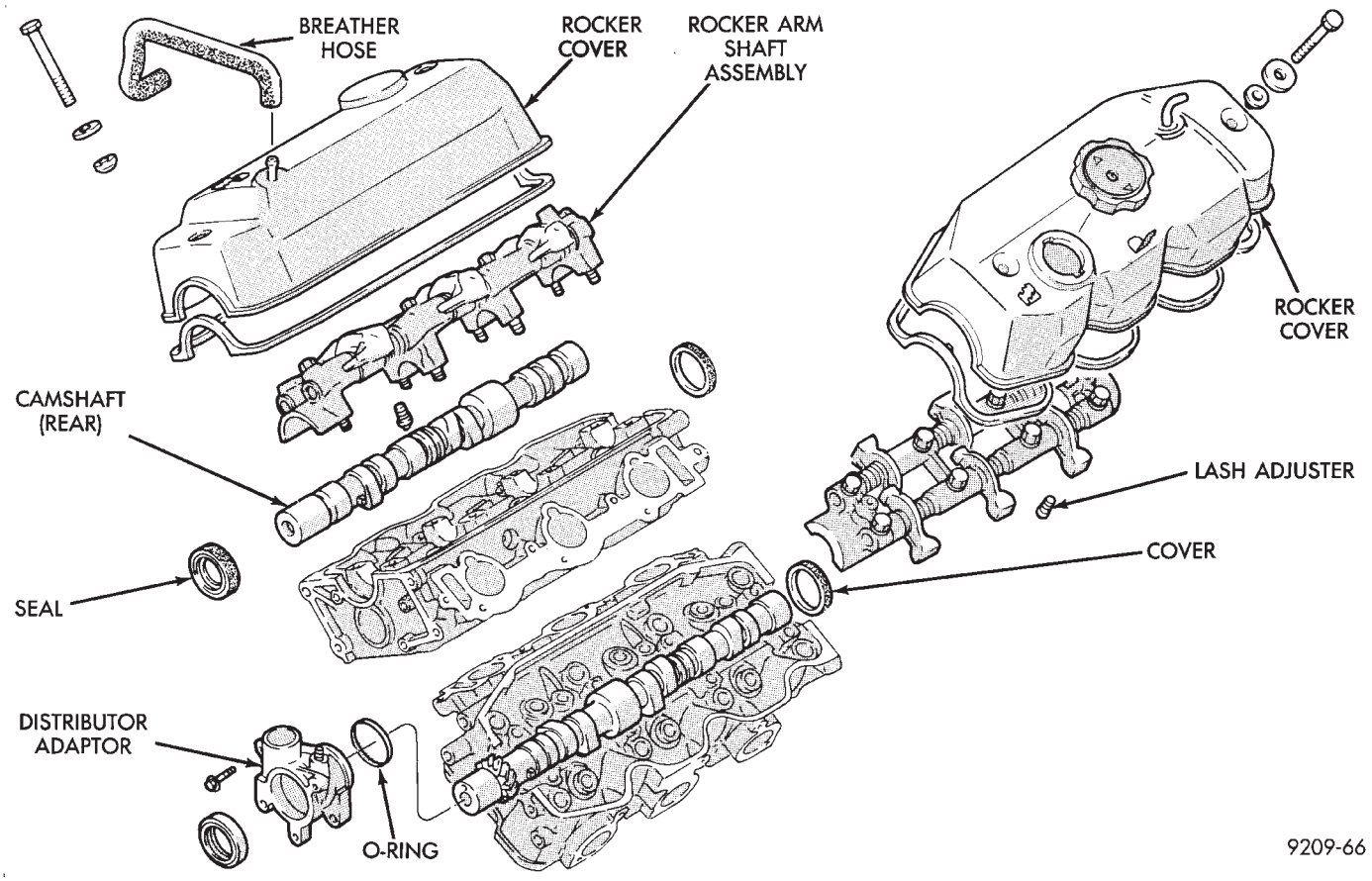


Fig. 1 Cylinder Head-Camshaft-Valves

CYLINDER HEAD COVER

REMOVE

(1) Remove air cleaner assembly.

(2) Disconnect battery and relocate spark plug wires.

(3) Remove vacuum connections.

(4) Remove rocker cover screws and remove cover (Fig. 2).

INSTALL

(1) Clean cylinder head and cover mating surfaces. Install new gasket.

(2) See (Fig. 2) 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.).

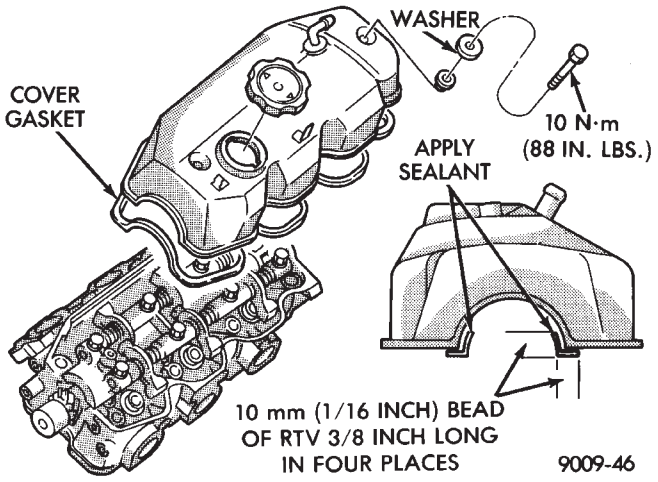


Fig. 2 Rocker Cover

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.

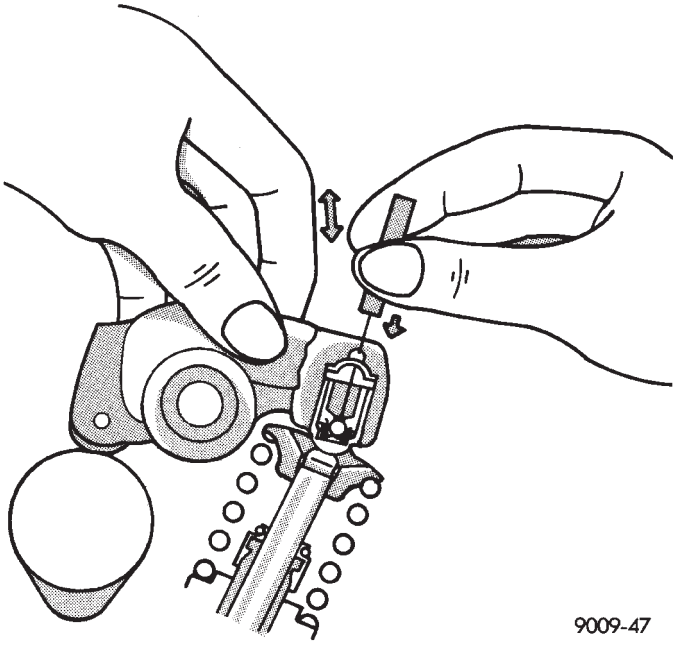


Fig. 3 Auto Lash Adjuster Check

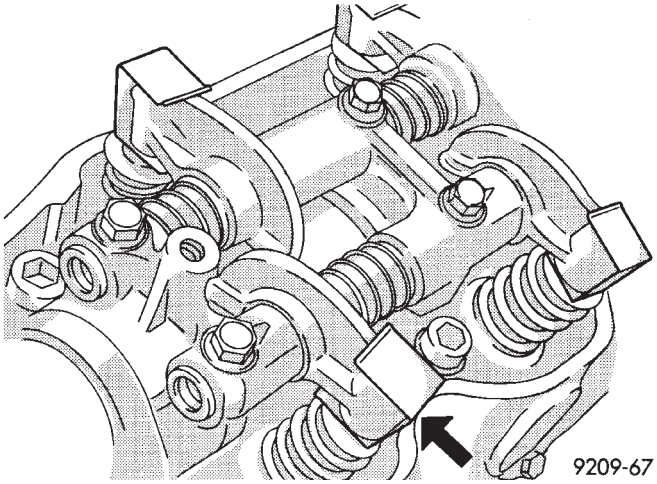


Fig. 4 Auto Lash Adjuster Retainers

CAMSHAFT SERVICE

SEE AUTO LASH ADJUSTER FUNCTION CHECK BEFORE DISASSEMBLY

REMOVAL

(1) Install auto lash adjuster retainers. (Fig. 4).

(2) Remove distributor extension (Fig. 1).

(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.

CAMSHAFT INSPECTION

(1) Inspect camshaft bearing journals for damage and binding (Fig. 5). If journals are binding, also check the cylinder head for damage (Fig. 1). Also check cylinder head oil holes for clogging.

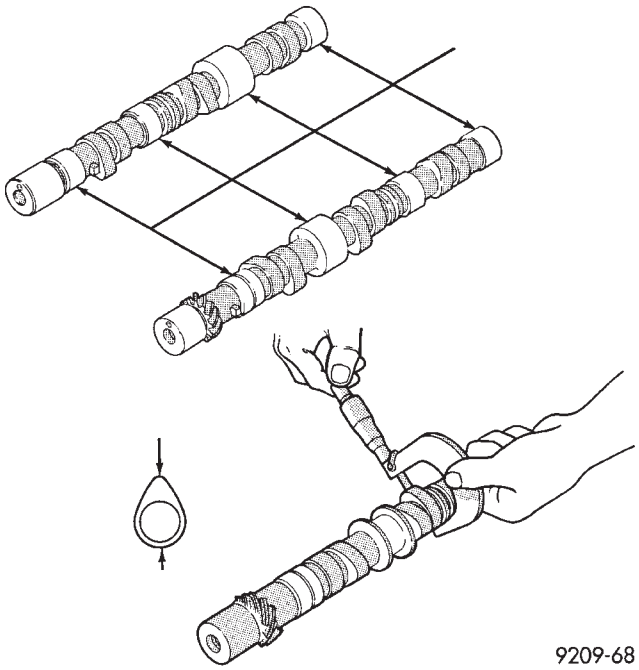


Fig. 5 Check Camshafts

(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. 5).

(3) Check the cam surface for abnormal wear and damage and replace if defective. Also measure the cam height (Fig. 5) and replace if out of limit, standard value is 41.25 mm (1.624 inch), wear **limit** is 40.75 mm (1.604 inch).

CAMSHAFT INSTALL

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

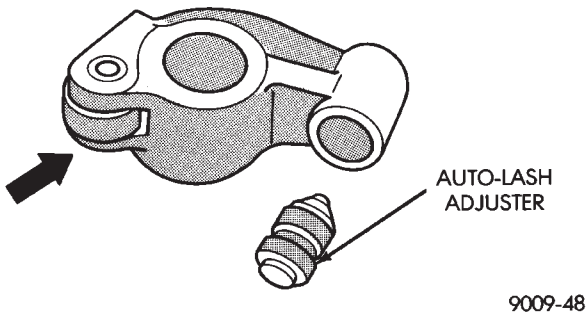


Fig. 6 Inspect Rocker Arms

ROCKER ARMS

(1) Check rocker arms for wear or damage (Fig. 6). Replace as necessary. Also see Auto Lash Adjuster.

ROCKER ARM SHAFTS

The rocker arm shaft is hollow and is used as a lubrication oil duct. The rocker arm shaft on the **inlet**

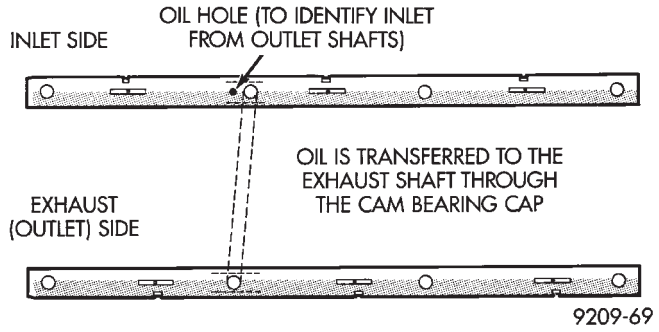


Fig. 7 Rocker Arm Shaft Identification

side has a 3mm diameter oil passage hole from the cylinder head. The **exhaust** side **does not** have this oil passage (Fig. 7).

(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. 7).

REASSEMBLE

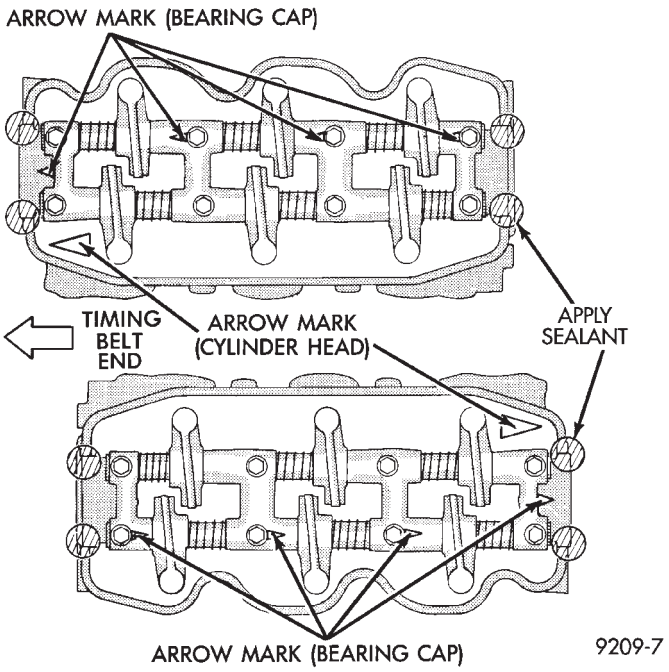


Fig. 8 Camshaft Bearing Caps Position

(1) Align the camshaft bearing caps with arrows (depending on cylinder bank) directed as shown in (Fig. 8) and in numerical order.

Identify number one bearing cap number one and number four caps are similar (Fig. 9).

(2) Install rocker shafts so that bearing cap number one with end notches positioned as shown in Figure 9 that the machined portion of the rocker shaft is facing down.

(3) Insert attaching bolts to retain assembly.

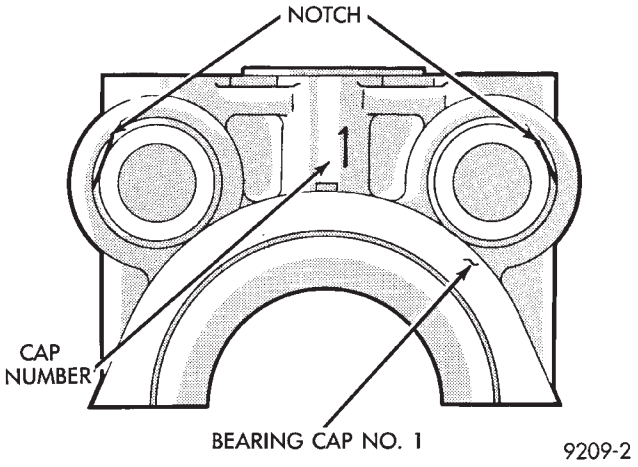


Fig. 9 Number One Camshaft Bearing Cap

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 (Figs. 8 and 10). Insert bolts in number four bearing cap to retain assembly.

INSTALL ROCKER ARM SHAFT ASSEMBLY

(1) Apply Mopar Silicone Rubber Adhesive Sealant at bearing cap ends as shown in (Fig. 8).

(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. 8).

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. 11).

CAMSHAFT OIL SEAL SERVICE—ENGINE OUT OF VEHICLE

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

(2) Install the oil seal using camshaft oil seal installer tool MD998713 (Fig. 12).

CAMSHAFT END SEAL (PLUG) SERVICE—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.

(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,

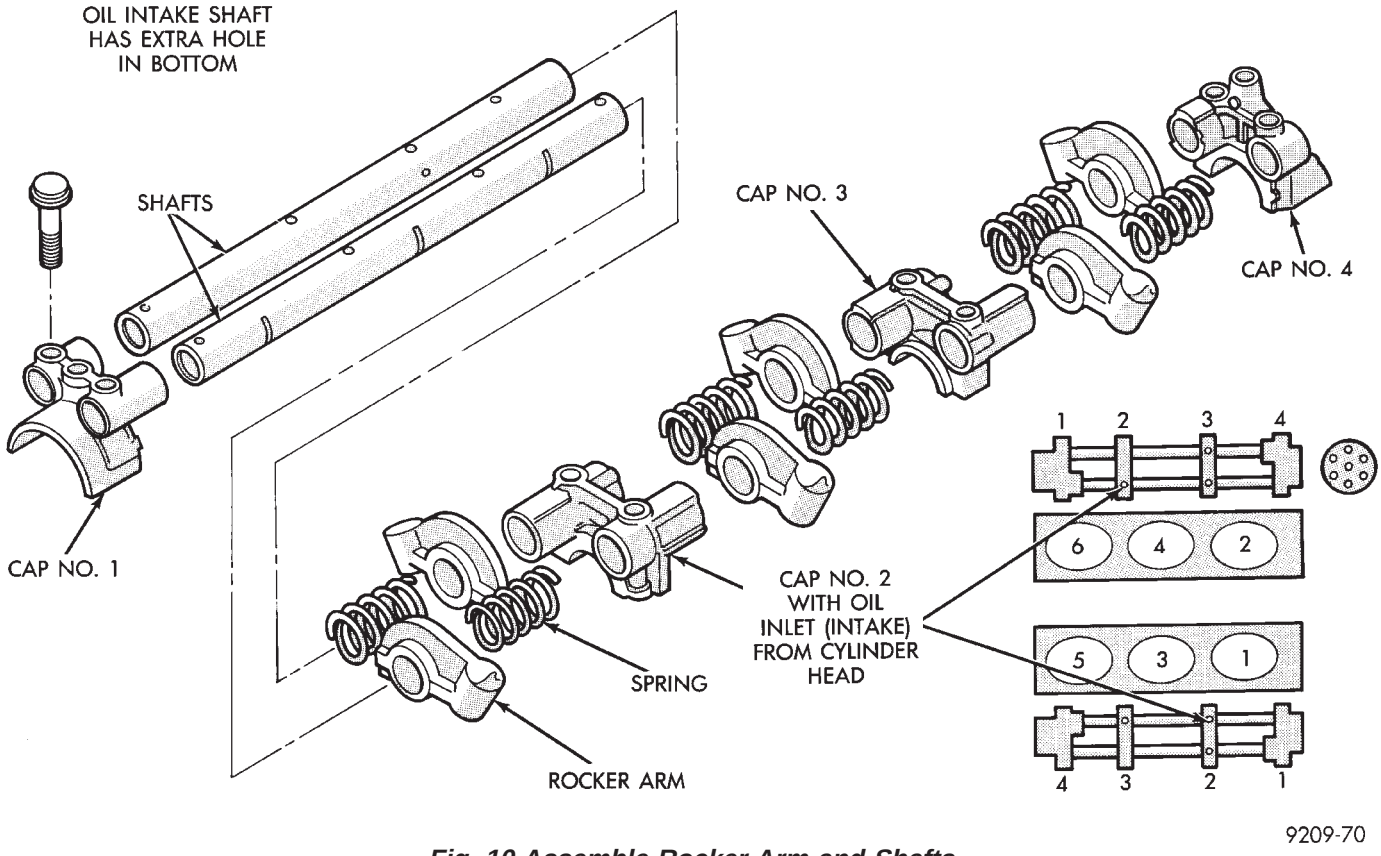


Fig. 10 Assemble Rocker Arm and Shafts

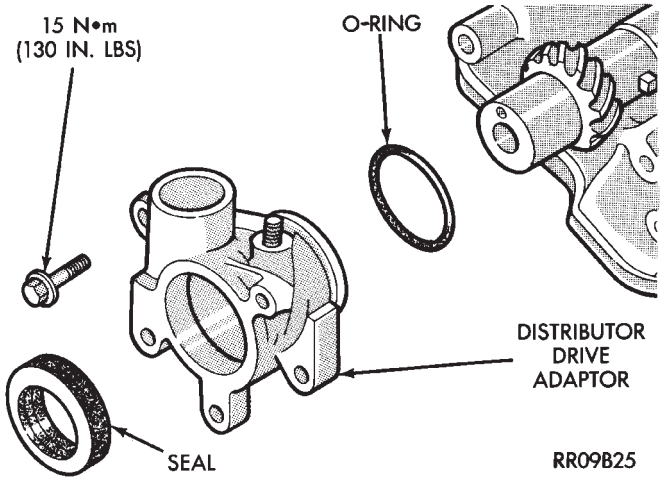


Fig. 11 Distributor Drive

install the new cam plug to a depth of 0.5mm (0.020 inch) below the surface of the cylinder head.

(6) Replace air cleaner assembly.

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

Install end seal plug with Special Tool MD998306. (Fig. 13).

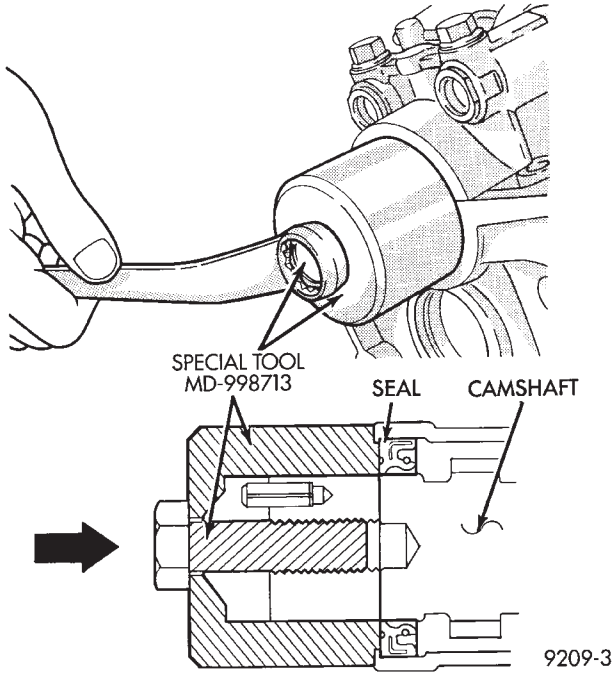


Fig. 12 Install Camshaft Oil Seal

CYLINDER HEAD

REMOVAL

(1) See Timing System this group for disassembly and remove camshaft sprockets.

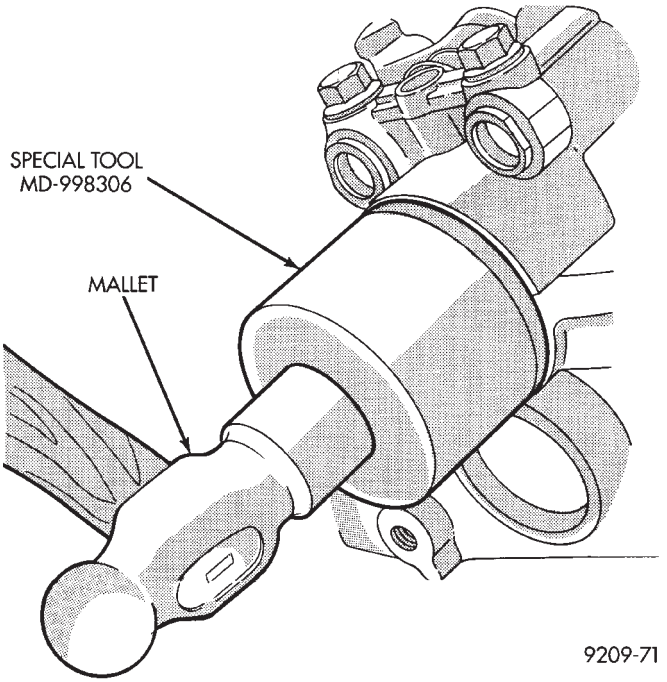


Fig. 13 Install Camshaft End Seal—Plug

(2) See Camshaft Rocker Arms Removal.

(3) Remove upper intake manifold assembly. 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.

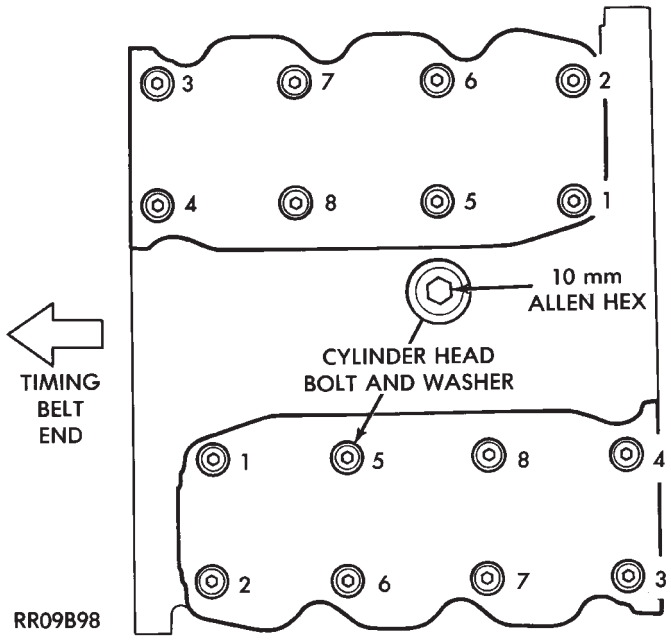


Fig. 14 Cylinder Head Bolt Removal Sequence

(6) Remove cylinder head bolts in sequence shown in (Fig. 14) and remove cylinder head.

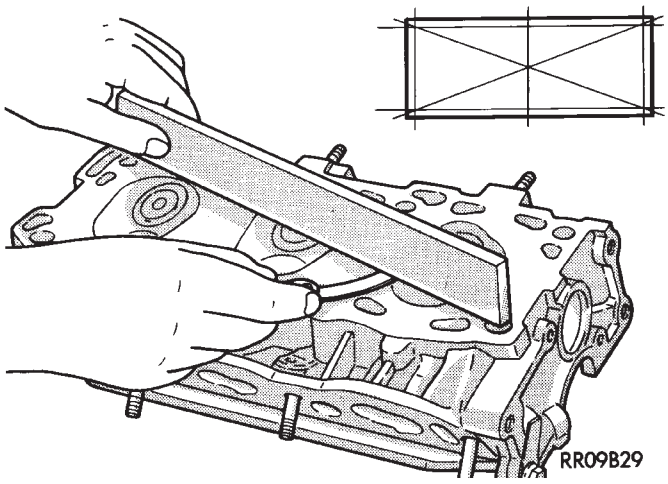


Fig. 15 Check Cylinder Head

INSPECTION

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

(2) Clean cylinder head and oil passages.

(3) Check cylinder head for flatness (Fig. 15).

(4) Cylinder head must be flat within;

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

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

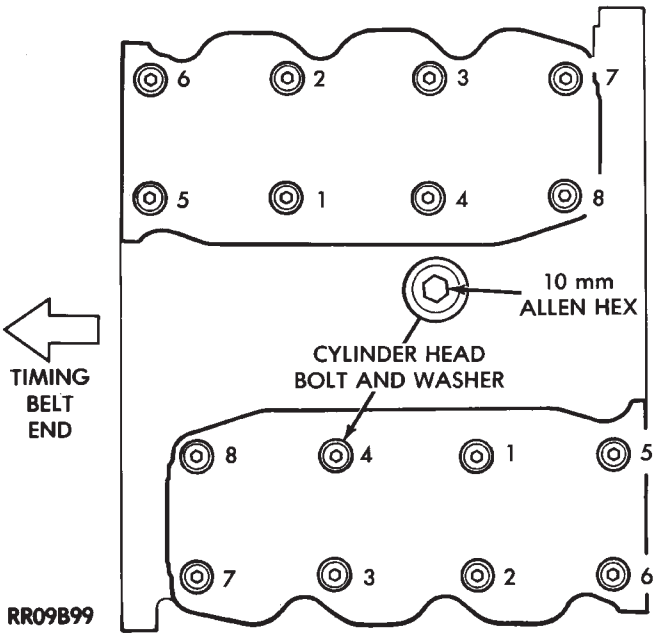


Fig. 16 Cylinder Head Bolt Tightening Sequence

INSTALLATION

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

(2) Install head on locating dowels.

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

(4) Tighten bolts in the order shown in (Fig. 16). 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.).

VALVE SPRINGS

VALVE AND VALVE SPRINGS

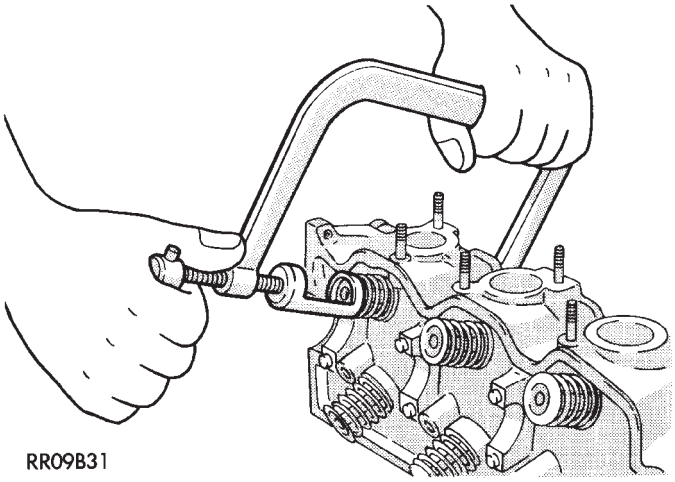


Fig. 17 Remove Valves

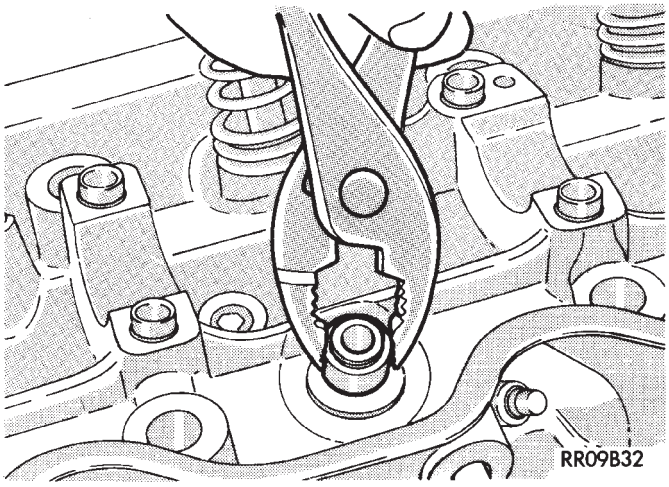


Fig. 18 Remove Valve Stem Seals

(1) With suitable valve spring compressor, remove spring retainer locks, retainer, valve spring, spring seat and valve (Fig. 17).

(2) Remove valve stem seals with suitable tool (Fig. 18). Do not reuse valve stem seals.

VALVES

(1) Check valve stem tip for pitting or depression at point A (Fig. 19).

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

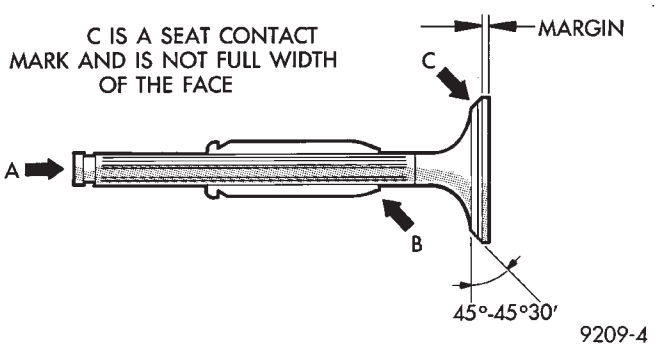


Fig. 19 Valve Inspection

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

(4) Check margin. Replace valve if margin is out of specification (Fig. 20).

(5) Measure valve stem to guide clearance.

(6) Measure Valve spring free length and squareness (Fig. 21). Refer to (Fig. 20) for specifications.

VALVE DIMENSIONS		
INTAKE VALVE (MINIMUM)		
STEM DIAMETER: 7.960 mm (.313 in.) FACE ANGLE: 45° VALVE MARGIN: .700 mm (.028 in.) LENGTH: 103.0 mm (4.055 in.)		
EXHAUST VALVE (MINIMUM)		
STEM DIAMETER: 7.930 mm (.312 in.) FACE ANGLE: 45° VALVE MARGIN: 1.50 mm (.059 in.) LENGTH: 102.70 mm (4.043 in.)		
VALVE GUIDE CLEARANCE	**NEW**	**SERVICE LIMIT**
INTAKE	0.03 TO 0.06 mm (.001 TO .002 in.)	0.10 mm (.004 in.)
EXHAUST	0.05 TO 0.09 mm (.002 TO .0035 in.)	0.15 mm (.006 in.)
VALVE SPRING SPECIFICATION		
FREE LENGTH	NEW	49.8 mm (1.960 in.)
	SERVICE LIMIT	48.8 mm (1.921 in.)
SQUARENESS	NEW	2° MAXIMUM
	SERVICE LIMIT	4° MAXIMUM
SPRING TENSION	INSTALLED HEIGHT	40.4 mm AT 33 KG (1.59 in. 73 LBS.)

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Fig. 20 Valve Specification

VALVE SEAT INSPECTION

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

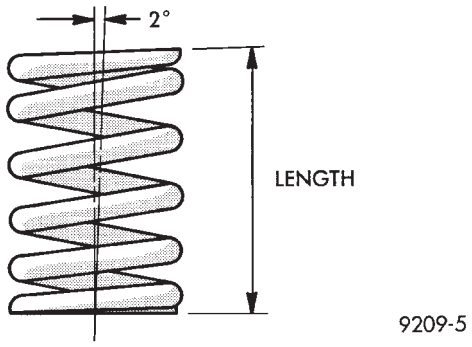

Fig. 21 Valve Spring

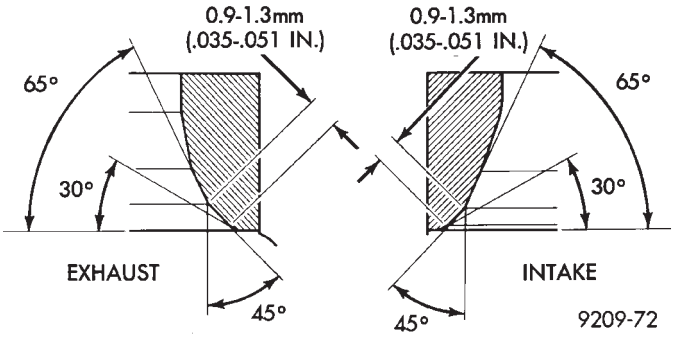

Fig. 22 Valve Seat Reconditioning

15 degrees stone. If the blue is transferred to the bottom edge of valve face raise valve seat with a 65 degree stone.

(1) Install valve spring seat.

(2) Using suitable tool install seal by tapping lightly until seal is in place. (Fig. 23).

(3) Install valve spring with the enamelled ends facing the rocker arms (Fig. 24).

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.

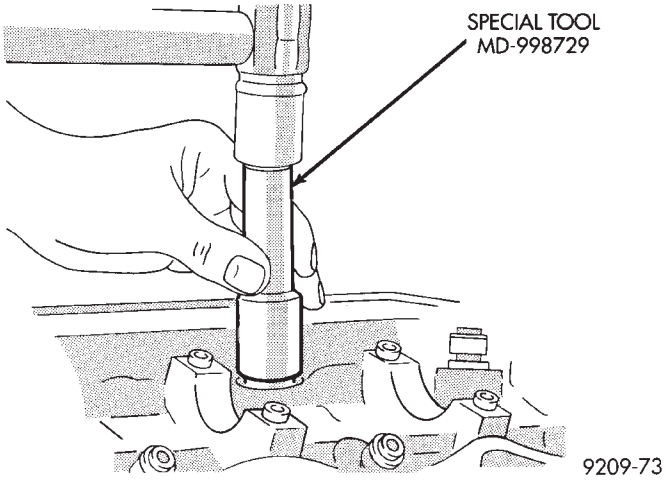

Fig. 23 Install Valve Stem Seals

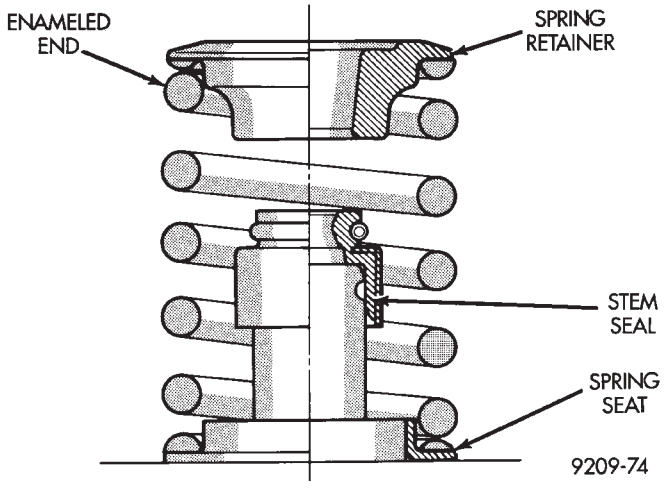

Fig. 24 Installed Valve Spring Position

PISTON AND CONNECTING ROD ASSEMBLY SERVICE

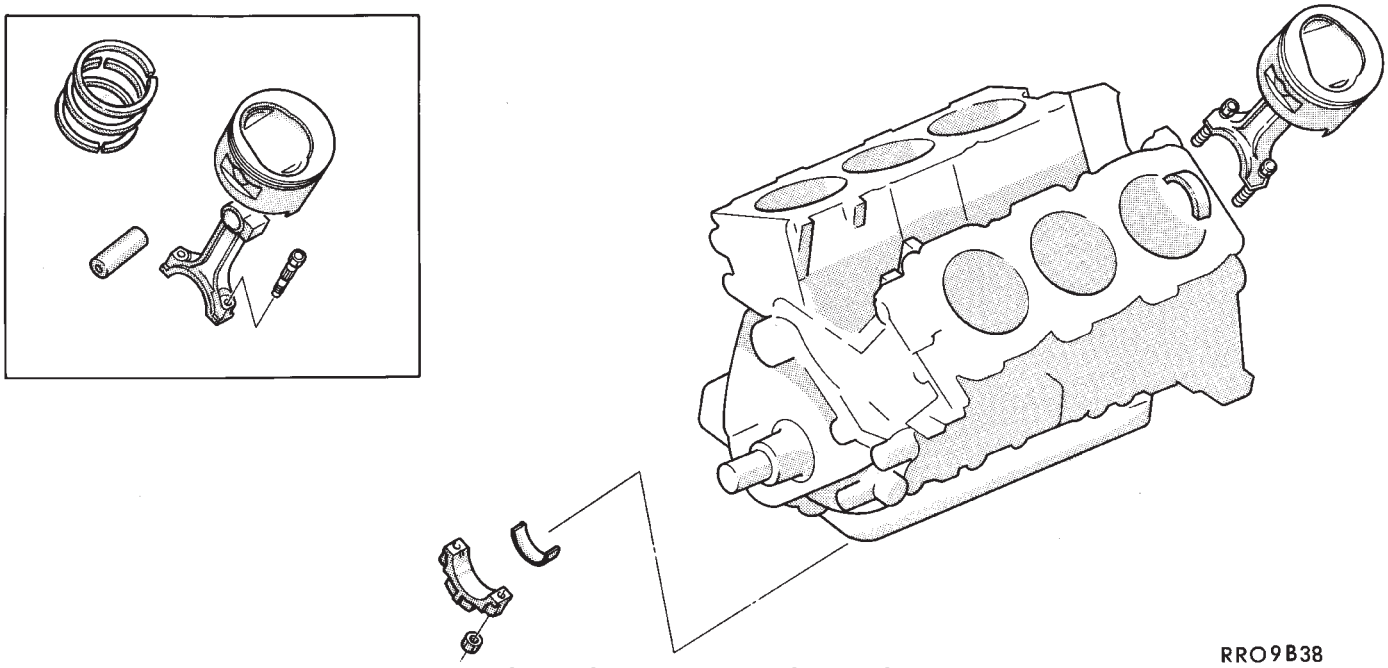

Fig. 1 Pistons, Connecting Rods

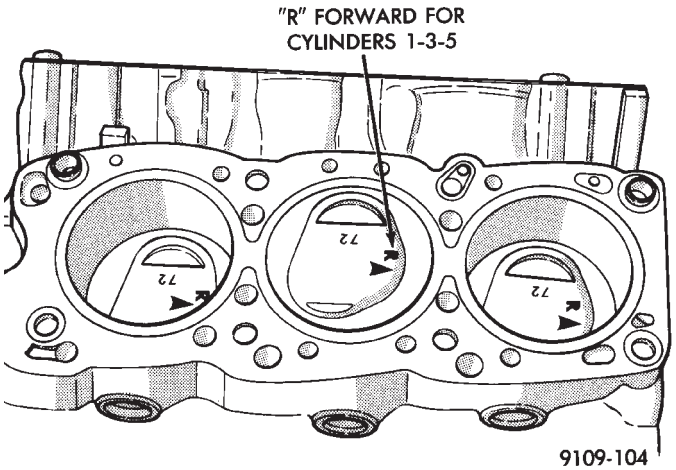

Fig. 2 Mark Pistons

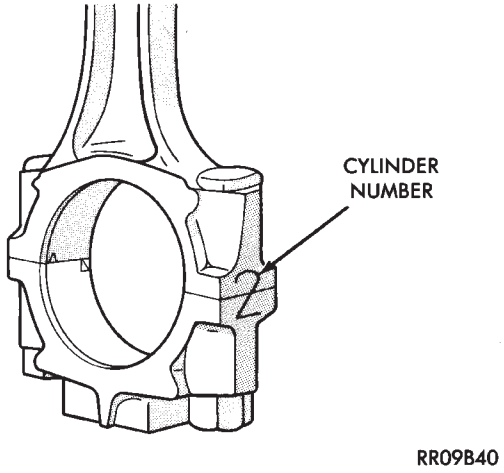

Fig. 3 Mark Matching Parts

(1) Mark Identify Pistons. **The pistons are not interchangeable from bank to bank** (Fig. 2).

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

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

CYLINDER BORE INSPECTION

(1) Measure the cylinder bore at three levels in directions A and B (Fig. 5). Top measurement should be 12mm (.50 inch) down and bottom measurement should be 10mm (.38 inch) up.

(2) Standard bore dimension: 91.1mm (3.587 inch)

(3) Maximum out-of-round or taper: 0.02mm (.0008 inch)

FITTING PISTONS

Measure approximately 2mm (.080 inch) above the bottom of the piston skirt and across the thrust face. (Fig. 6), See Boring Cylinder in Cylinder Block.

FITTING PISTON RINGS

(1) Wipe cylinder bore clean. Insert ring and push down with piston to ensure it is square in bore. The ring gap measurement must be made with the ring positioning at least 16mm (0.63 inch) from bottom of cylinder bore. Check gap with feeler gauge (Fig. 7). Refer to (Fig. 8) for specification.

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

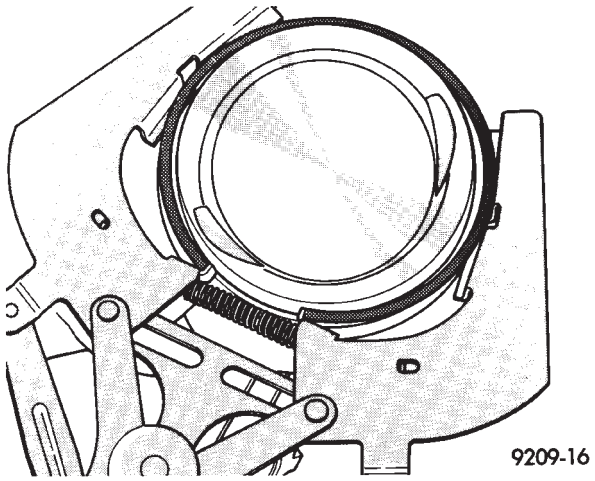

Fig. 4 Removing Piston Rings

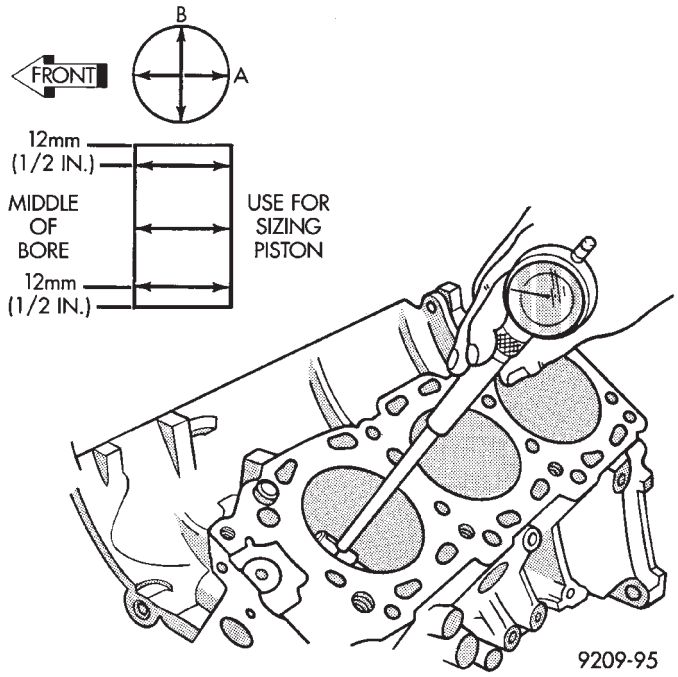

Fig. 5 Checking Cylinder Bore Size

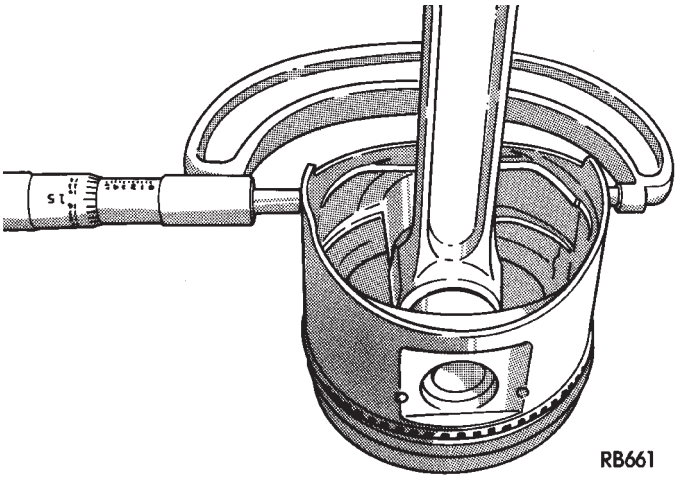

Fig. 6 Piston Clearance and Wear

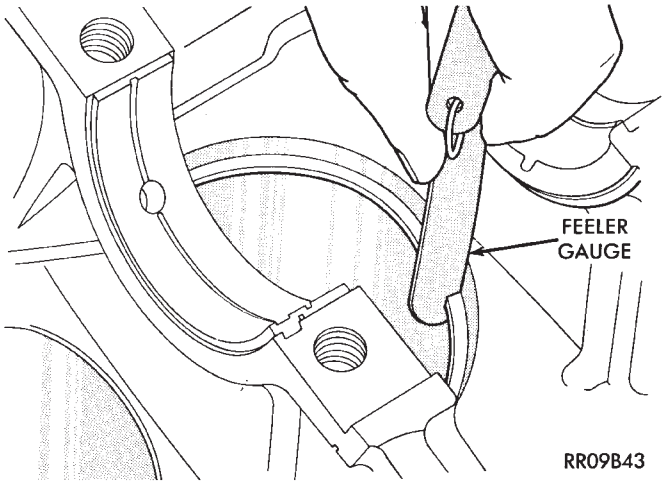

Fig. 7 Check Gap on Piston Rings

RING POSITION	RING GAP	WEAR LIMIT
UPPER RING	0.30 TO 0.45 mm (.012 TO .018 in.)	0.8 mm (.031 in.)
INTERMEDIATE RING	0.25 TO 0.40 mm (.010 TO .016 in.)	0.8 mm (.031 in.)
OIL CONTROL RING	0.30 TO 0.90 mm (.012 TO .035 in.)	1.0 mm (.039 in.)
RING POSITION	**GROOVE CLEARANCE**	**MAXIMUM CLEARANCE**
UPPER RING	0.05 TO 0.09 mm (.002 TO .0035 in.)	.10 mm (.004 in.)
INTERMEDIATE RING	0.02 TO 0.06 mm (.0007 TO .002 in.)	.10 mm (.004 in.)
OIL CONTROL RING-THREE PIECE. OIL RING SIDE RAILS MUST BE FREE TO ROTATE AFTER ASSEMBLY.		

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Fig. 8 Piston Ring Specification Chart

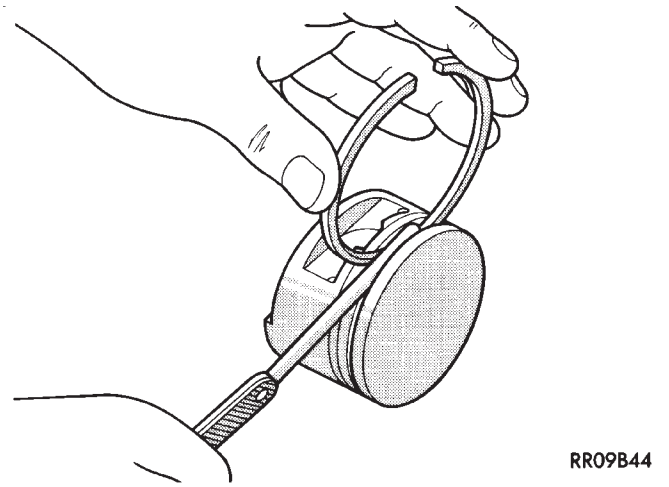

Fig. 9 Piston Ring Clearance

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. 10).

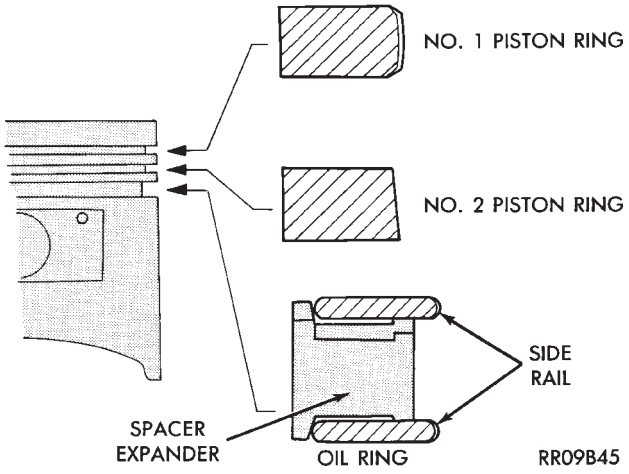

Fig. 10 Piston Ring Installation

CAUTION: Install piston rings in the following order:

(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.

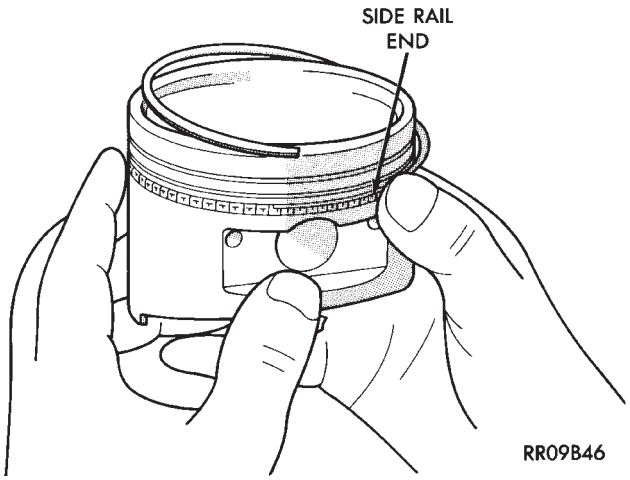

Fig. 11 Installing Side Rail

(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. 11).

(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. 12).

(5) Position piston ring end gaps as shown in (Fig. 13).

(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.

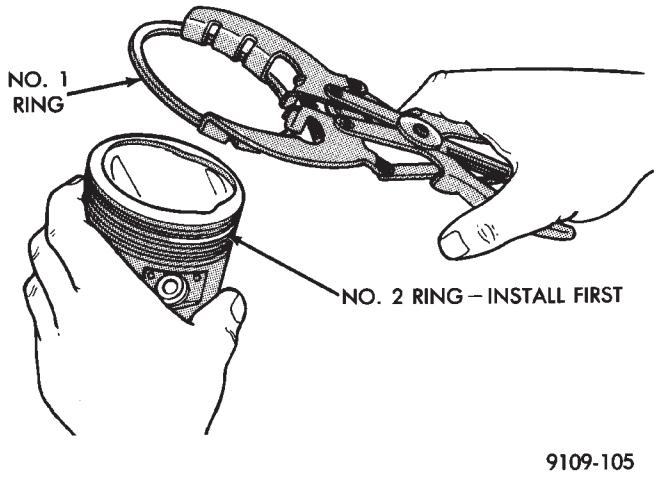

Fig. 12 Installing Upper and Intermediate Rings

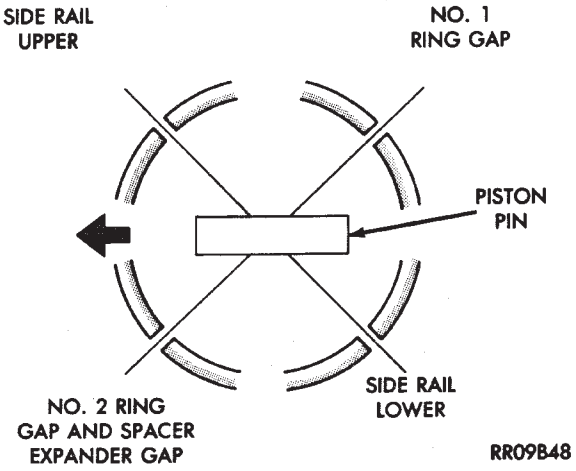

Fig. 13 Piston Ring End Gap Position

(7) Connecting rod front mark 72 must always face forward, toward timing belt end. (Fig. 14)

(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.

(9) Check alignment marks made during disassembly and that bearing position notches new or used are on the same side as shown in (Fig. 15).

CONNECTING ROD CLEARANCE

(1) Following procedures specified in the Standard Service Procedures Section for Measuring Main Bearing Clearance and Connecting Rod Bearing Clearance. (Fig. 16). Refer to (Fig. 18) for specifications.

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

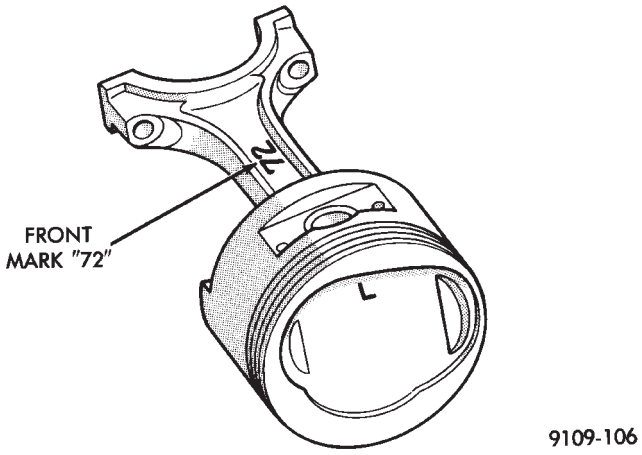

Fig. 14 Identify Piston/Rod Assembly for Cylinder Installation

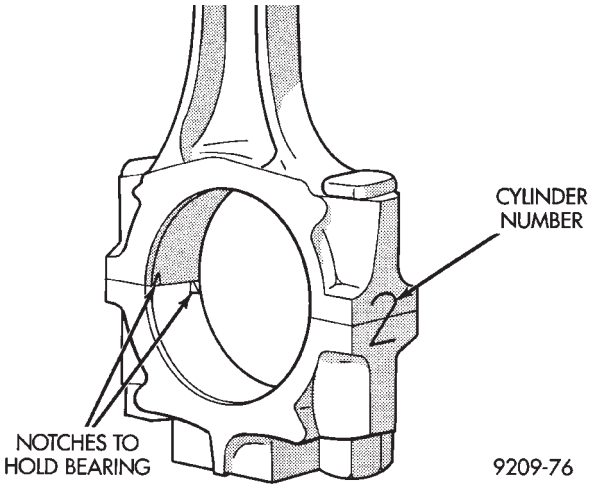

Fig. 15 Connecting Rod and Cap

(3) Remove connecting rod cap and measure Plastigage (Fig. 16).

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

CONNECTING ROD SIDE CLEARANCE

Using a feeler gauge, check connecting rod side clearance (Fig. 17). Refer to (Fig. 18) for specification.

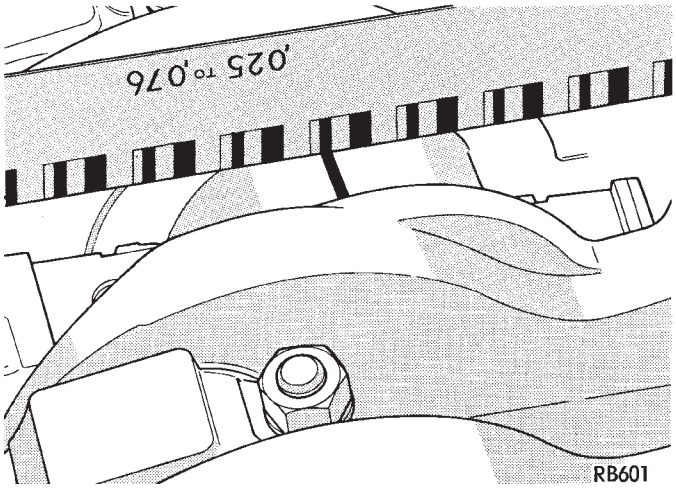

Fig. 16 Connecting Rod Checking Bearing Clearance

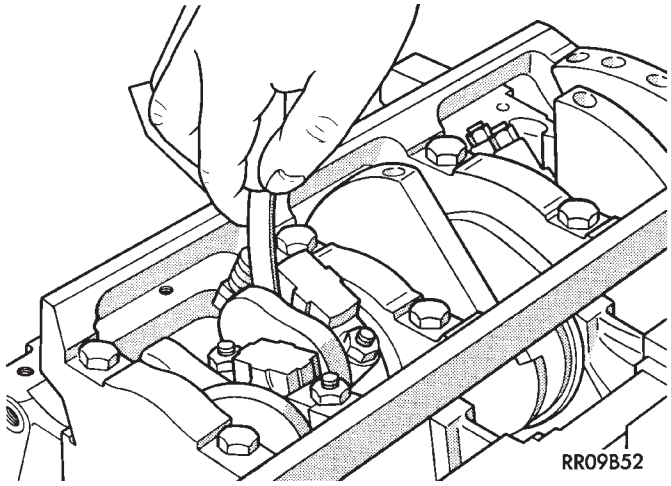

Fig. 17 Checking Connecting Rod Side Clearance

CONNECTING ROD BEARING OIL CLEARANCE	
NEW PART:	.020 TO .067 mm (.0008 TO .0028 in.)
CONNECTING ROD SIDE CLEARANCE	
NEW PART:	0.10 TO 0.25 mm (.004 TO .010 in.)
WEAR LIMIT:	0.4 mm (.015 in.)

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Fig. 18 Connecting Rod Clearance Specifications

CRANKSHAFT AND CYLINDER BLOCK, ASSEMBLY SERVICE

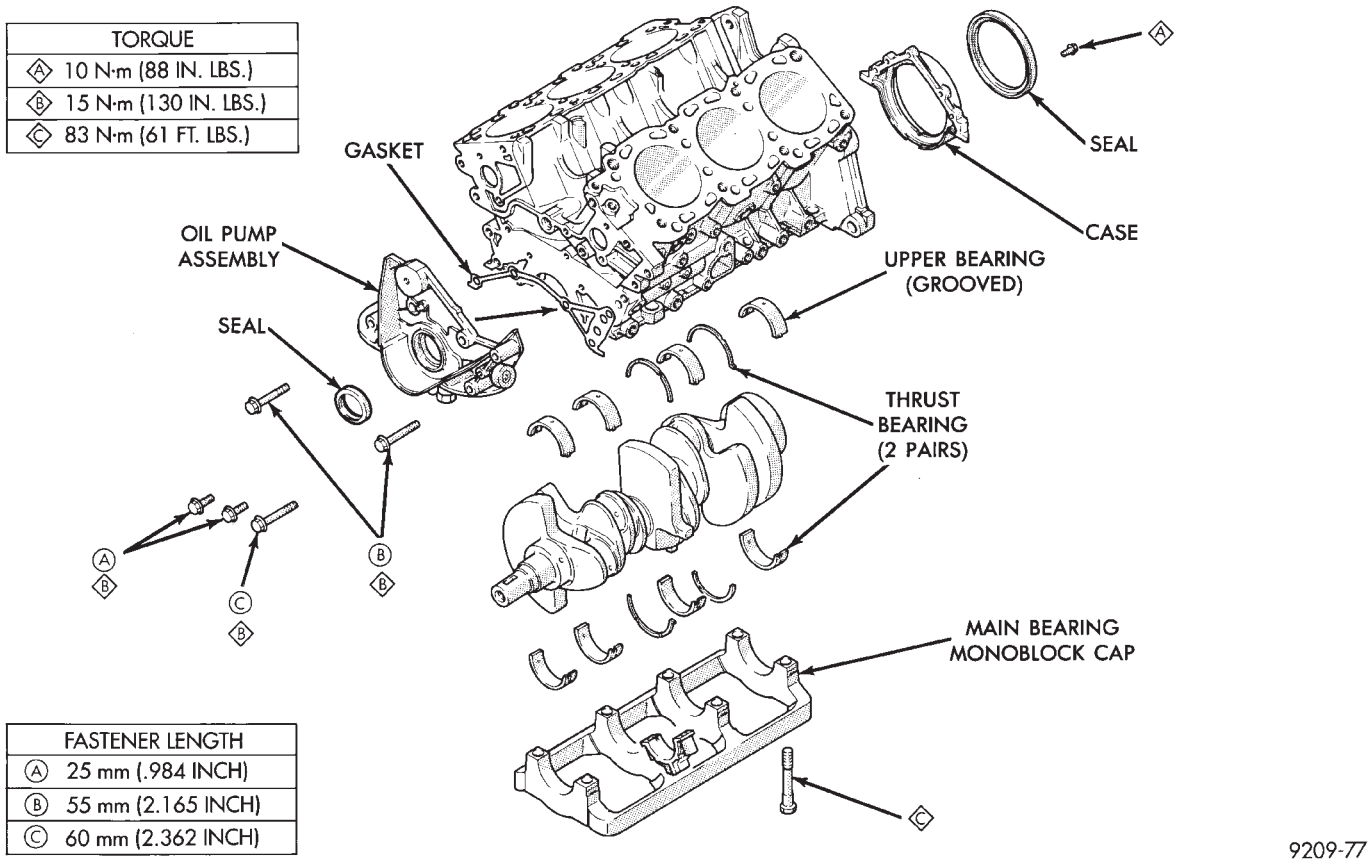

Fig. 1 Crankshaft and Cylinder Block

CRANKSHAFT SERVICE

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

CRANKSHAFT—REMOVAL

(1) Remove front mounted oil pump assembly and gasket (Figs. 1 and 2).

(2) Remove rear oil seal retainer and seal as assembly (Fig. 3).

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

(4) Lift out crankshaft and remove upper thrust washers from each side of number three main bearing in the crankcase (Fig. 1).

INSPECTION

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

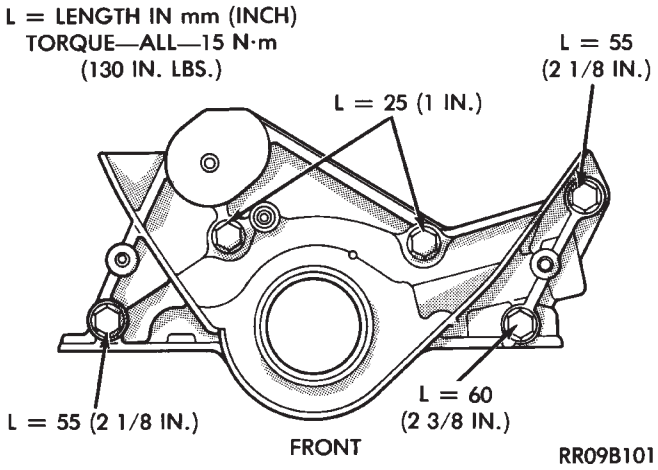

Fig. 2 Oil Pump Assembly

CRANKSHAFT OIL CLEARANCE

MECHANICAL MEASUREMENT

Measure the journal outside diameter and the main bearing inside diameter (Figs. 4 and 5). If the clearance exceeds the specifications limit (Fig. 6). Replace the main bearing(s) and if necessary replace the crankshaft.

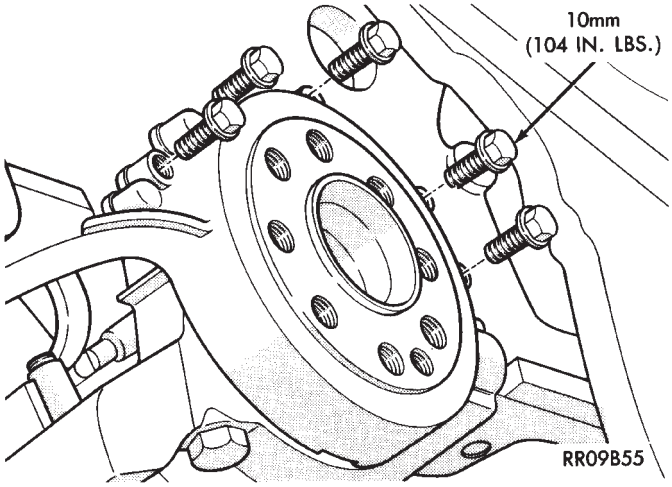

Fig. 3 Rear Seal Assembly

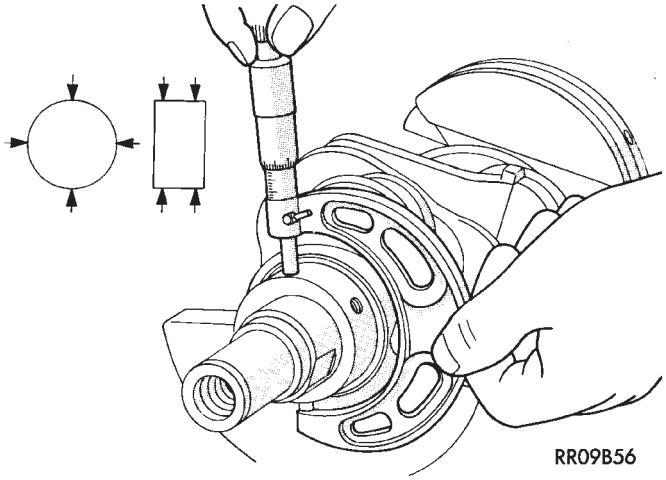

Fig. 4 Measure Crankshaft Journal O.D.

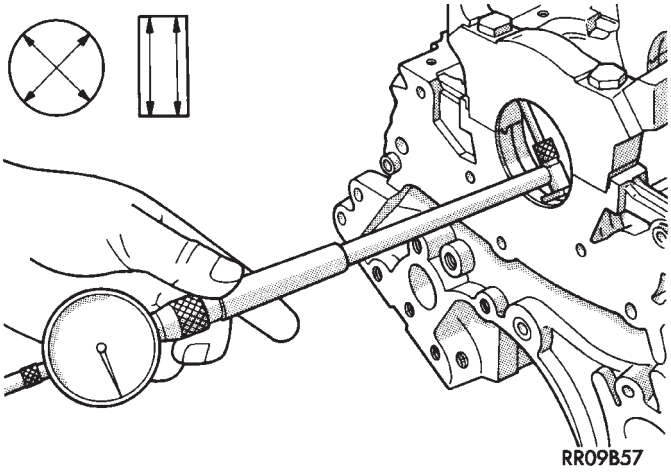

Fig. 5 Measure Main Bearing I.D.

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. 7).

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

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Fig. 6 Crankshaft Clearance Specification

(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.

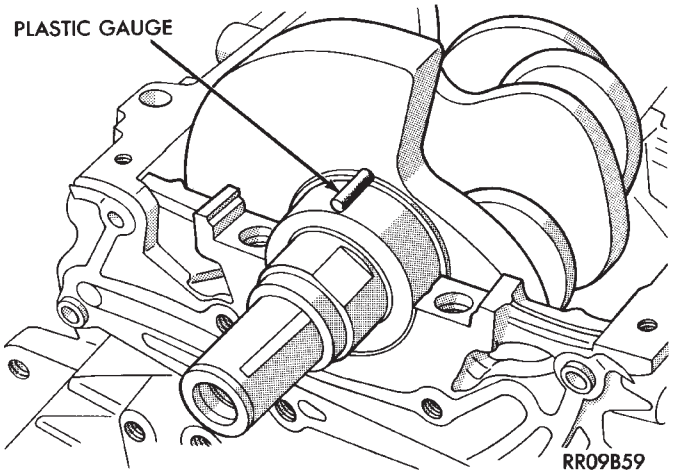

Fig. 7 Measure Oil Clearance with Plastigage

(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. 8). Refer to specification (Fig. 6) for proper clearances. Also see Measuring Main and Connecting Rod Bearing Clearance in Standard Service Procedures.

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. 9).

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

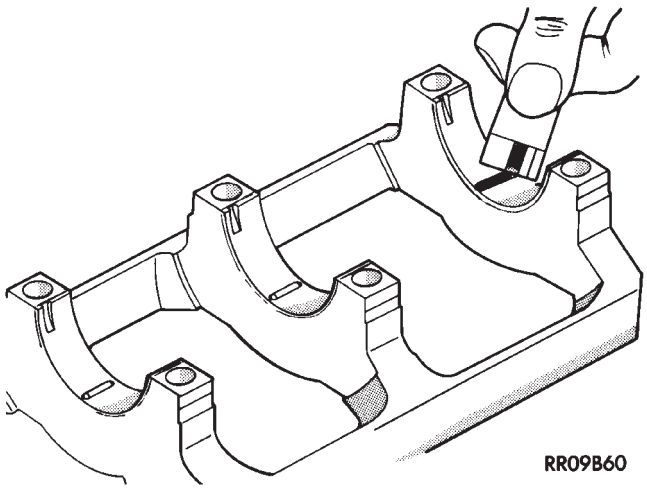

Fig. 8 Measuring Clearance

(Fig. 9) 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. 9).

(2) 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.

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

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

(5) Install one pair of thrust washers in cap. Refer to Thrust Bearings (Fig. 9).

(6) Carefully install bearing cap with arrows (Fig. 10) toward timing belt end.

(7) Oil the bearing cap bolt threads, install and tighten bolts progressively in sequence shown in (Fig. 9) to 80 N·m (60 ft. lbs.) torque.

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 (Fig. 6) for specification.

CRANKSHAFT OIL SEALS SERVICE

REAR CRANKSHAFT SEAL RETAINER

(1) Install rear crankshaft oil seal in housing with Special Tool MD998718 (Fig. 12).

(2) Apply (Mopar Silcone Rubber Adhesive Sealant or equivalent) to oil seal housing (Fig. 13) per procedure detailed in form-in-place gasket section in Standard Service Procedures.

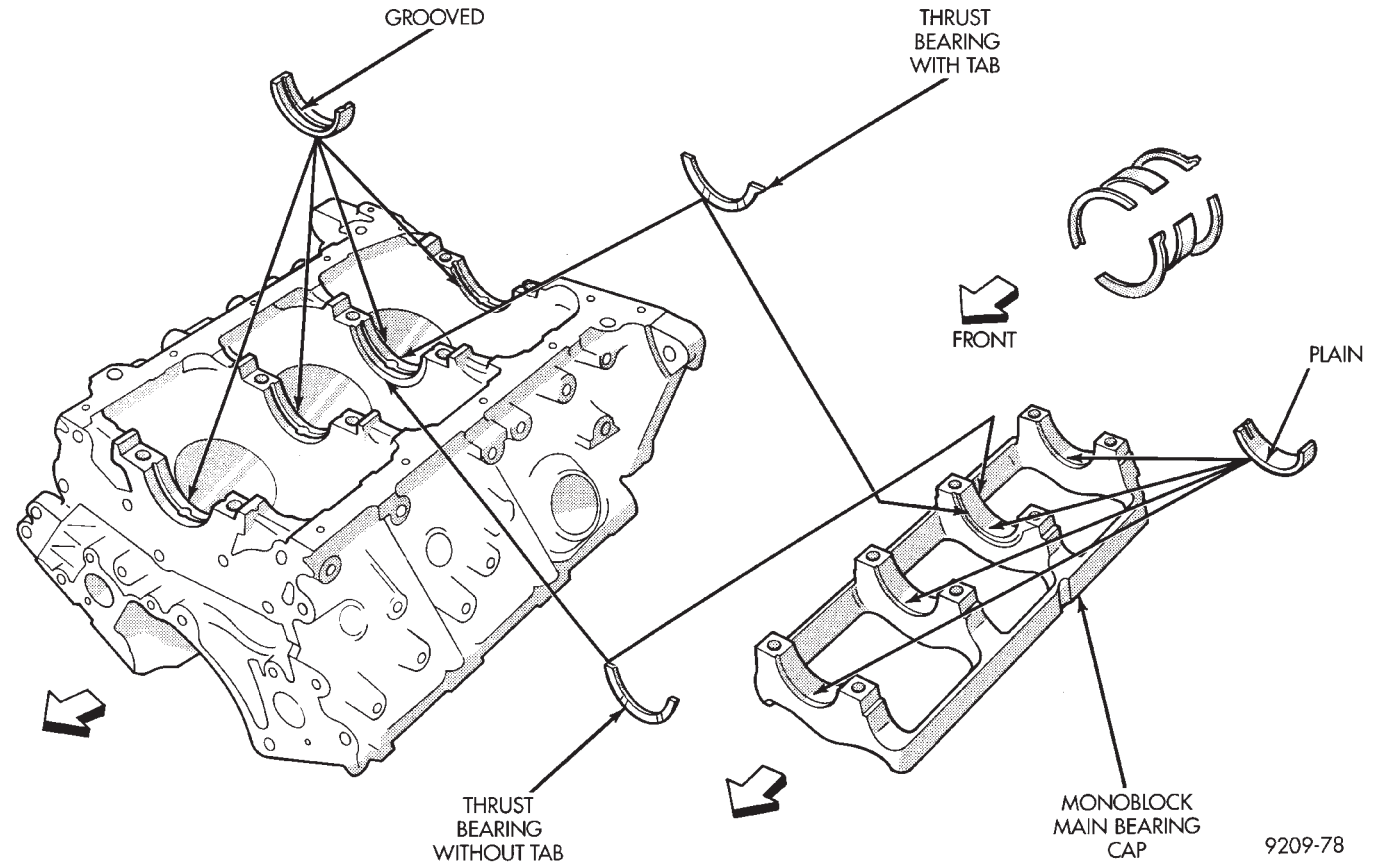

Fig. 9 Install Main Bearings

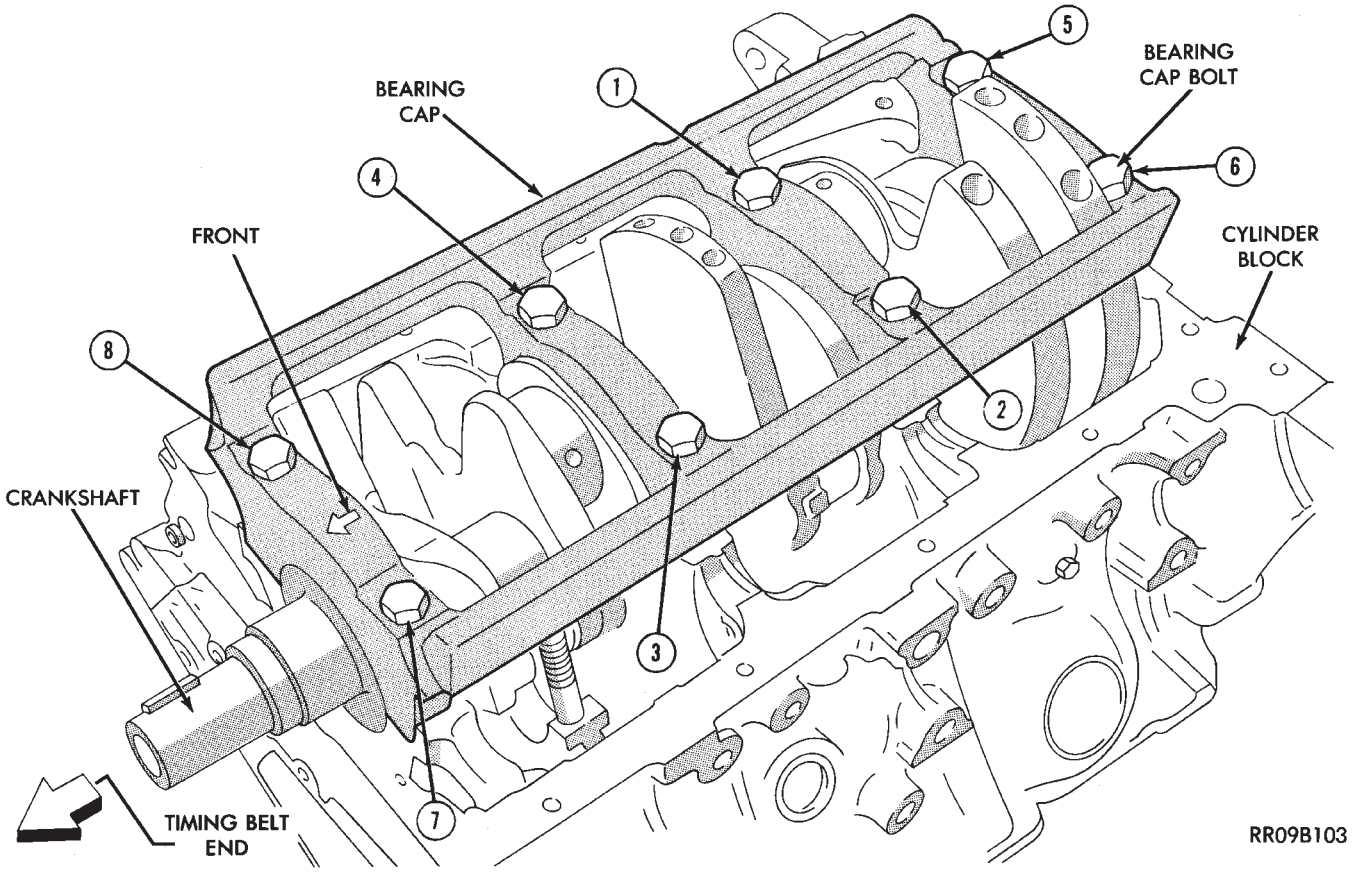

Fig. 10 Crankshaft Main Bearing Cap

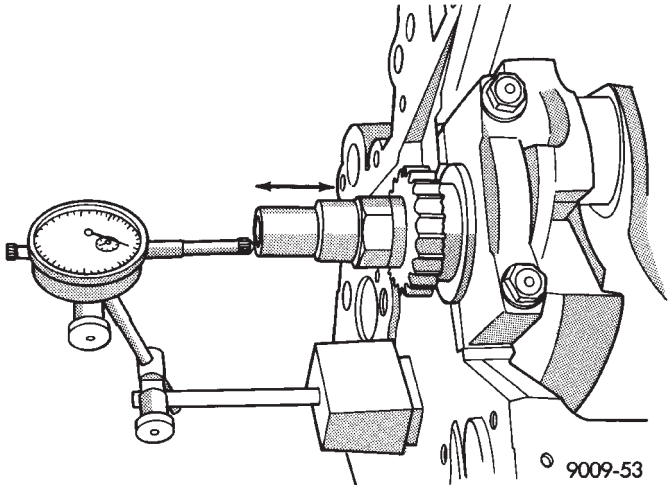

Fig. 11 Checking Crankshaft End Play

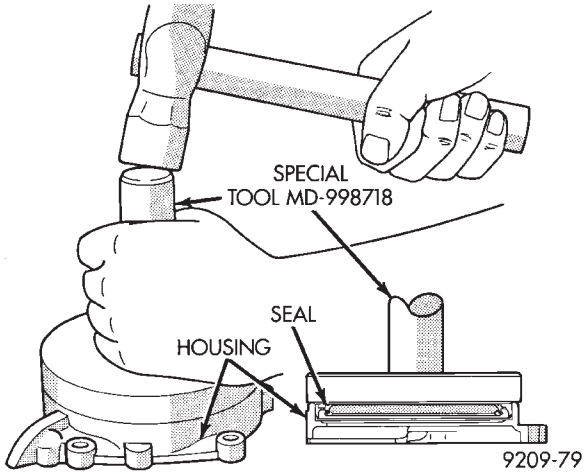

Fig. 12 Install Crankshaft Rear Oil Seal

(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.)

FRONT CRANKSHAFT OIL PUMP AND OIL SEAL

(1) Install oil pump gasket and oil pump case (Figs. 1 and 14).

CAUTION: Install bolts, depending on length in locations shown in (Fig. 14).

(2) Using front crankshaft oil seal installer Special Tool MB998306 install oil seal in oil pump (Fig. 15).

CYLINDER BLOCK

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

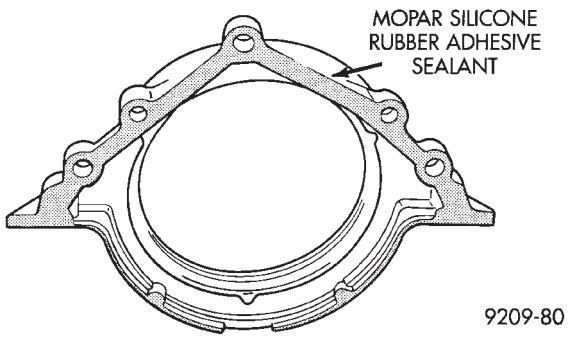

Fig. 13 Apply Sealant to Oil Seal Housing

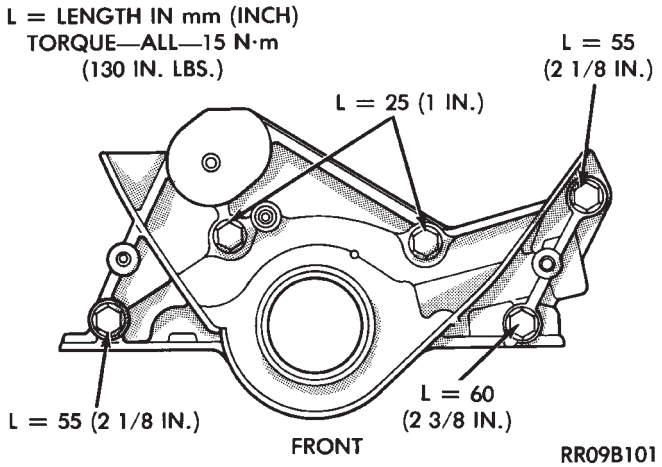

Fig. 14 Oil Pump

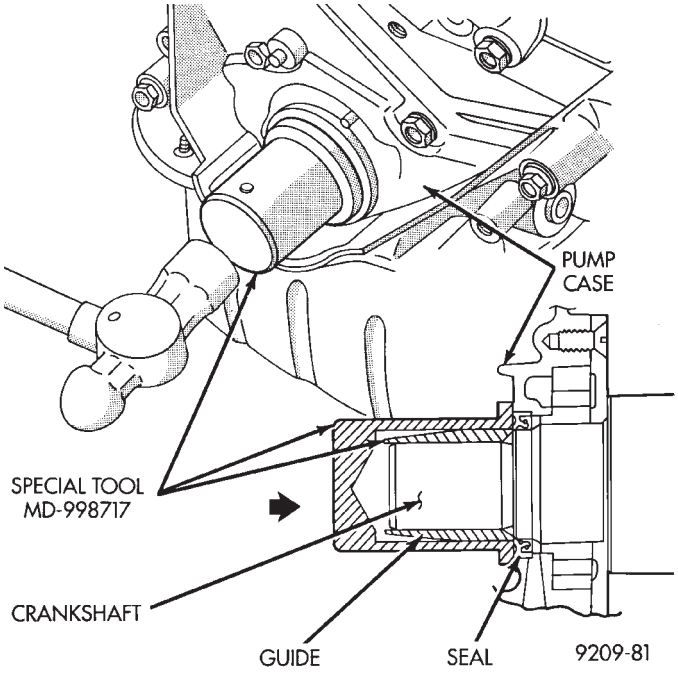

Fig. 15 Crankshaft Front Oil Seal

(2) Clean cylinder block and check top surface for distortion with a straight edge and thickness gauge (Fig. 16).

(3) Top surface must be flat within:

- Standard Value: 0.05 mm (.002 inch)
- Service Limit 0.1 mm (.003 inch)

CAUTION: Maximum of 0.2mm (.008 inch) is permitted. This is a combined total dimension of stock removal from cylinder head (if any) and block top surface.

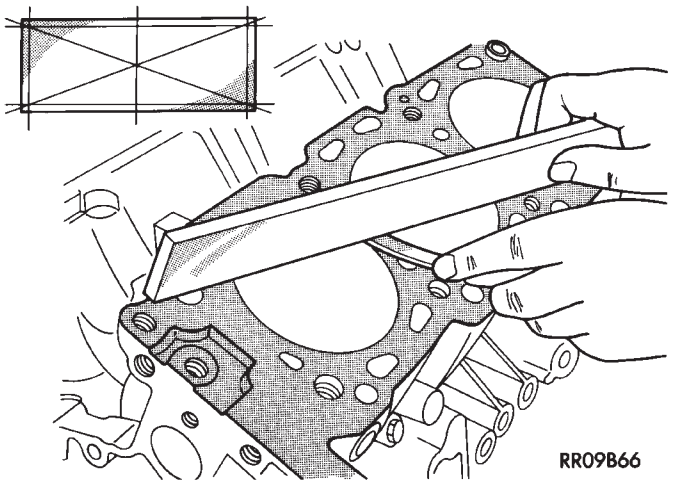

Fig. 16 Distortion Check

BORING CYLINDER

Examine cylinder wall for scuffs, scoring and measure cylinder bore for out-of-round or taper. If defective, bore cylinder to oversize. Measure at points shown in (Fig. 17).

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

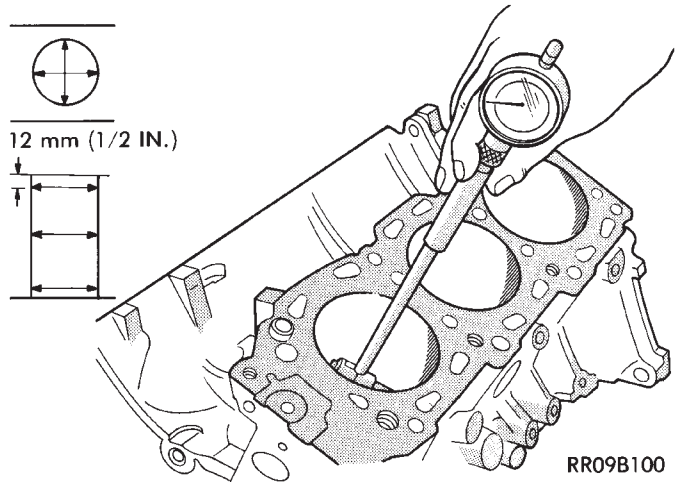

Fig. 17 Measure Cylinder Bore

(1) Bore to specified clearance between the piston O.D. and cylinder. The measuring point of the piston O.D. is shown in (Fig. 18).

(2) Based on measured piston O.D., calculate boring finish dimension. Boring finish dimension equals piston O.D. plus 0.03 to 0.05 mm (.0012 to .002 inch)

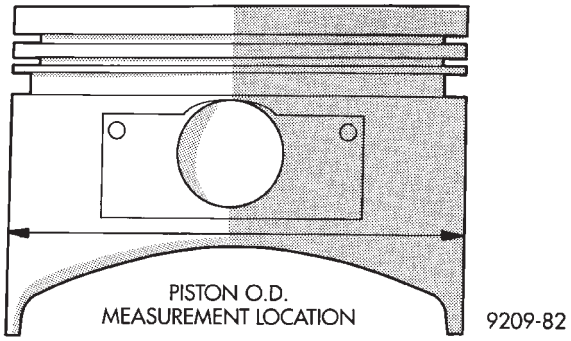

Fig. 18 Measure Piston

(clearance between piston O.D. and cylinder) minus 0.02 mm which is the boring margin.

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

(4) Check clearance between piston and cylinder, clearance should be 0.03 to 0.05 mm (.0012 to .002 inch).

ENGINE LUBRICATION SYSTEM

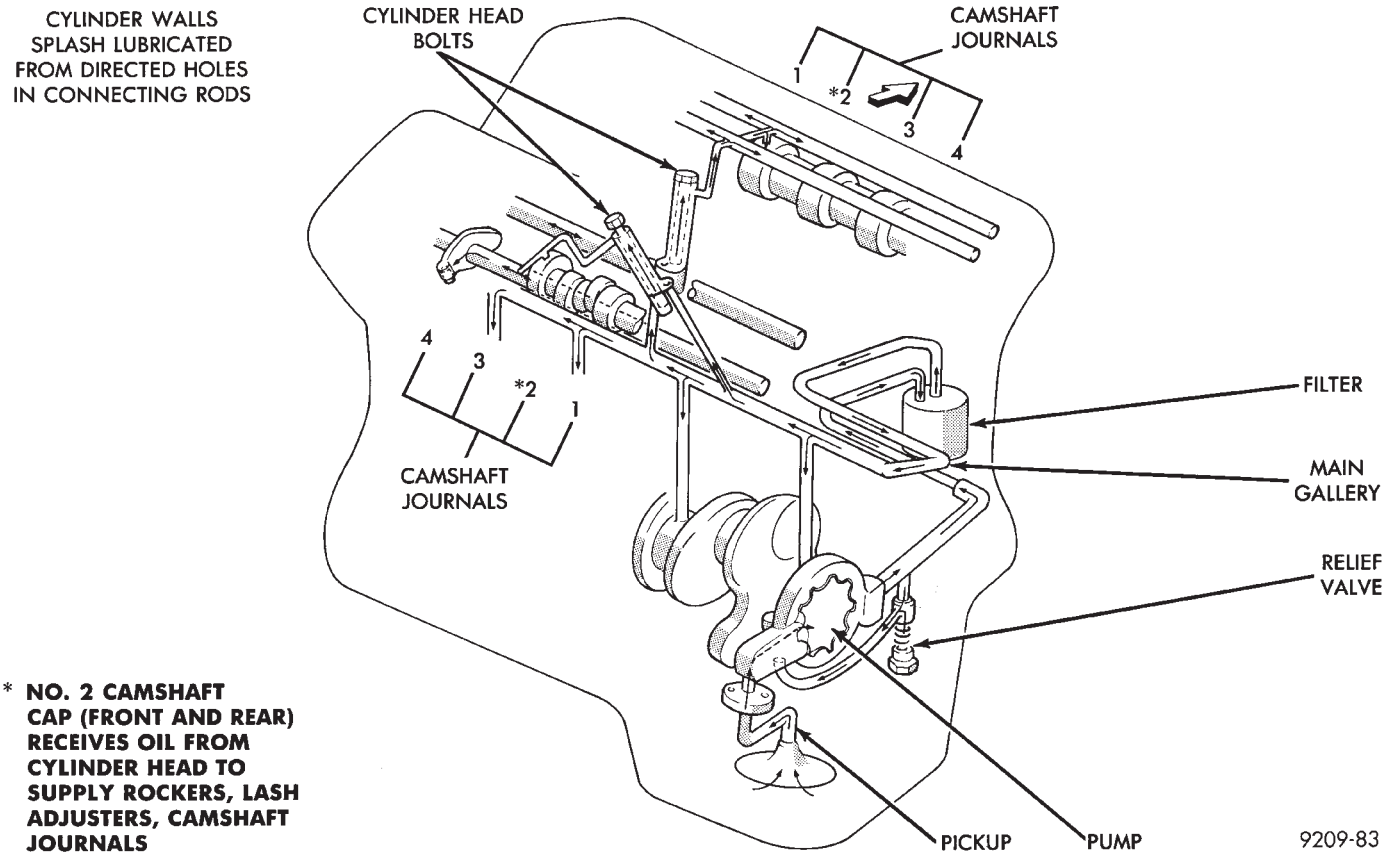

Fig. 1 Engine Oiling

The lubrication system is a full flow filtration pressure feed type. Oil, stored in the oil pan, is taken in and discharged by a internal gear type oil pump directly coupled to the crankshaft and its pressure is regulated by a relief valve. The oil is fed through an oil filter and to the crankshaft journals from the oil gallery in the cylinder block. This gallery also feeds oil under pressure to the cylinder heads. It then flows from a camshaft bearing cap on each cylinder head through passages in the rocker shafts to the rocker arm pivots, auto lash adjusters, and camshaft journals. (Fig. 1).

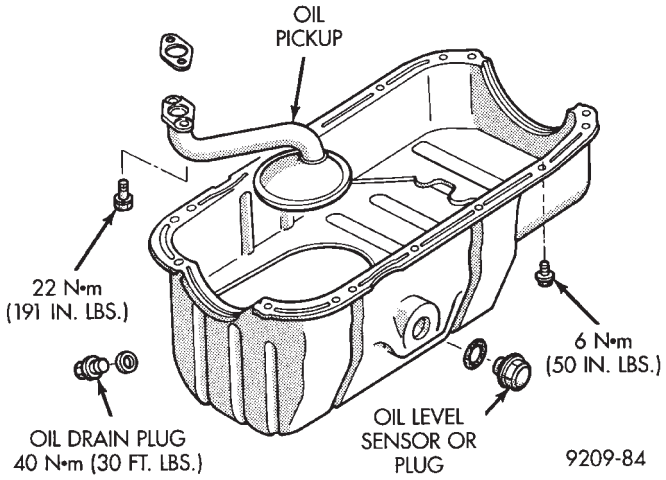

Fig. 2 Oil Pan

OIL PAN

The oil pan is made of sheet metal and is provided with a baffle-plate to prevent fluctuations in the oil level while the vehicle is running (Fig. 2).

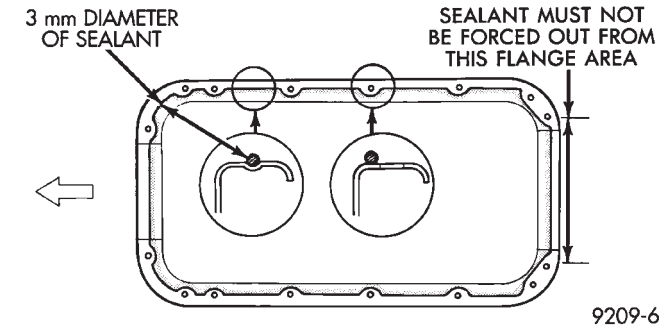

Fig. 3 Oil Pan Sealing

OIL PAN SEALING AND INSTALLATION

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. 3).

(2) Install pan and tighten screws to 6 N·m (50 in. lbs.) in sequence shown in (Fig. 4).

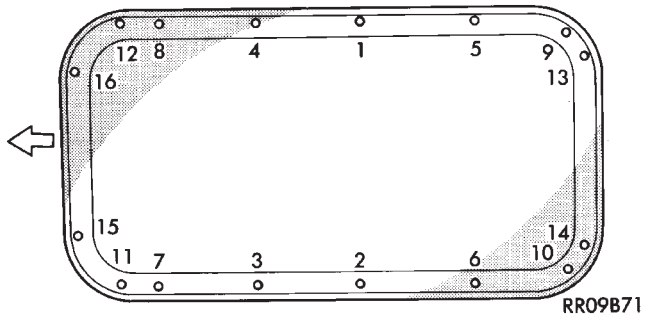

Fig. 4 Oil Pan Screw Tightening Sequence

OIL PUMP SERVICE

The oil pump assembly is mounted on the timing belt end of the cylinder block with the inner pump rotor indexed and installed on the crankshaft nose. (Fig. 5).

The oil pump case also retains the crankshaft front oil seal and provides oil pan front end closure.

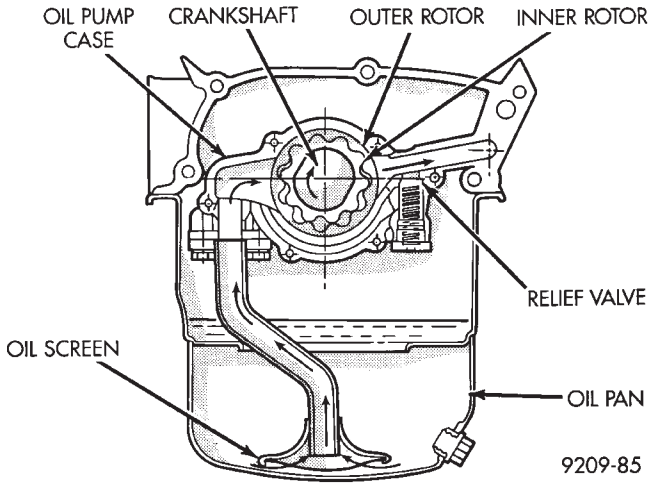

Fig. 5 Oil Pump-Installed

REMOVAL

Remove accessory drive system. Refer to Accessory Drive Service in this group.

Remove 5 bolts that attach oil pump to block (Fig. 6).

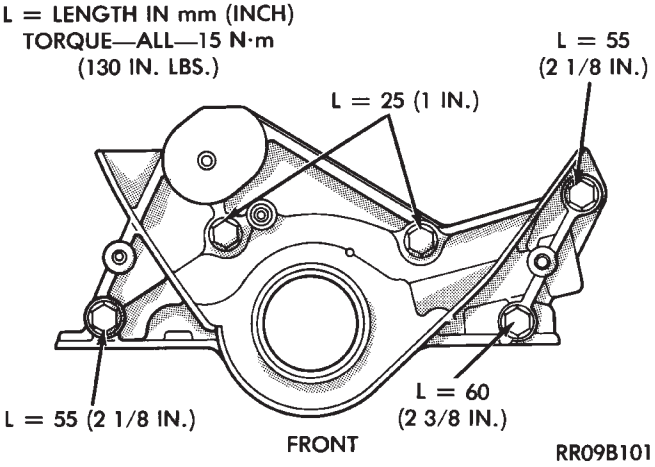

Fig. 6 Oil Pump Assembly

INSPECTION OIL PUMP

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

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

(3) Measure clearance between case and inner rotor (Fig. 8).

(4) Insert the rotor into the oil pump case (Figs. 9 and 10) and measure clearance with a feeler gauge as indicated.

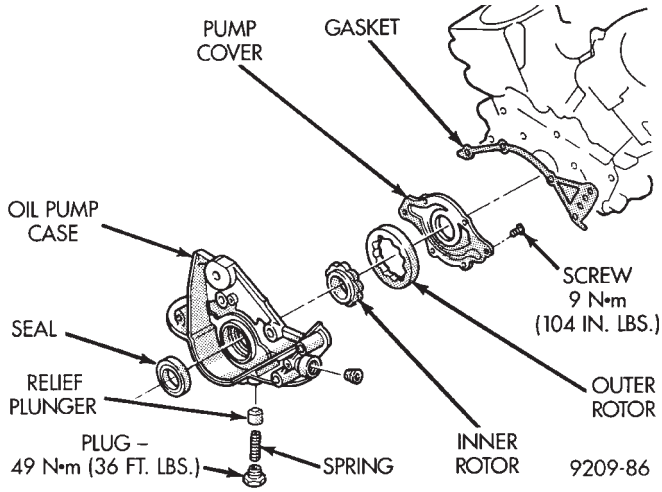

Fig. 7 Oil Pump Components

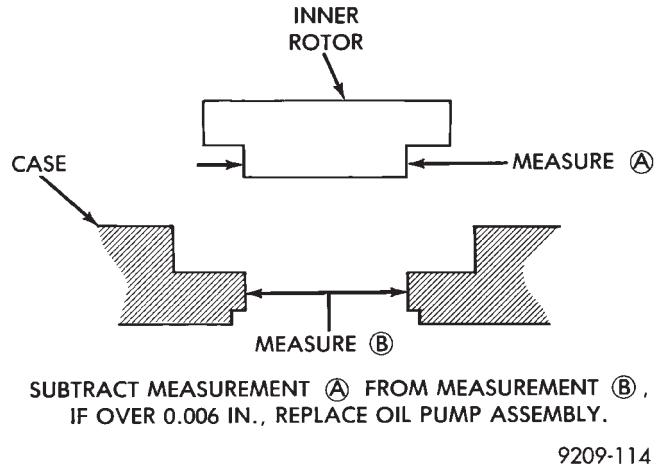

Fig. 8 Inner Rotor to Case

(5) Replace if out of limits.

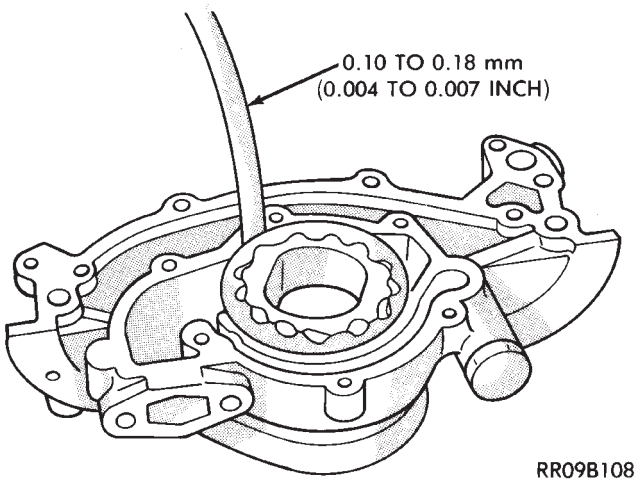

Fig. 9 Checking Clearance-Between Outer Rotor and Case

OIL RELIEF PLUNGER

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

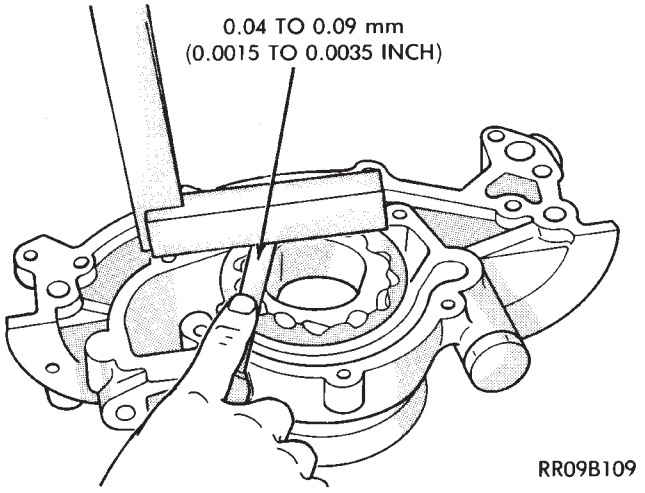

Fig. 10 Checking Rotor End Clearance

(2) Check for broken relief spring.

INSTALLATION

(1) Clean block and pump surfaces.

(2) Install new gasket (Fig. 7) make sure correct length bolts are used (Fig. 6).

(3) Torque bolts to 13 N·m (120 in. lbs.).

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. 11)

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

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

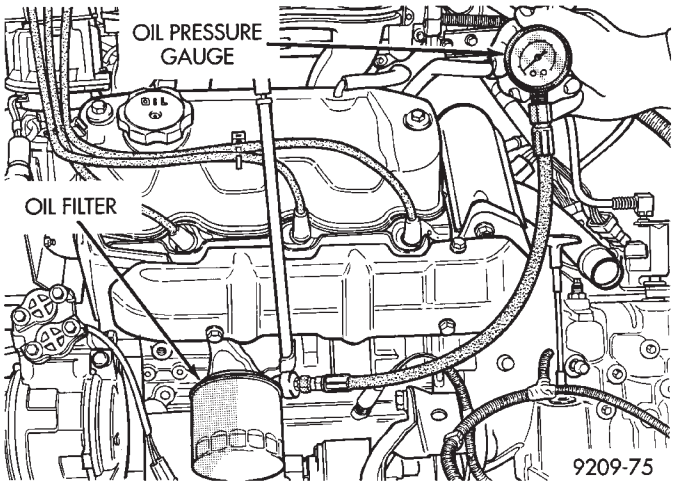

Fig. 11 Checking Oil Pump Pressure

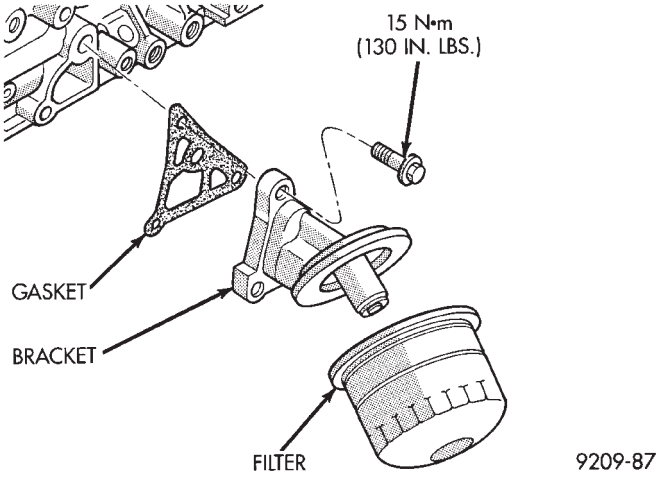

Fig. 12 Oil Filter and Bracket

OIL FILTER AND BRACKET

BRACKET

INSPECTION

(1) Check the oil filter mounting surface. The surface must be smooth, flat and free of debris or old pieces of rubber (Fig. 12).

(2) Check bracket for cracks and oil leaks.

OIL FILTER

(1) Turn counter clockwise to remove.

(2) To install, lubricate new filter gasket. Screw filter on until gasket contacts base. Tighten 1 turn.

ENGINE SPECIFICATIONS

	Standard
Type	60° V SOHC (Per Bank)
Number of Cylinders	6
Bore	91.1 mm (3.587 inches)
Stroke	76 mm (2.992 inches)
Compression Ratio	8.85:1
Displacement	3.0 Liters (181 Cubic inches)
Firing Order	1-2-3-4-5-6
Basic Ignition Timing	Refer to Emission Control Information on Label in Vehicle
Valve Timing	
Intake —Open	19° BTDC
—Close	59° ABDC
Exhaust —Open	59° BBDC
—Close	19° ATDC

Description	Standard Dimension	Service Limit
Compression Pressure	178 psi @ 250 RPM	—
Maximum Variation Between Cylinders	1.0 Kg/cm² (14 PSI)	25%
Valve Clearance—Hot Engine	Hydraulic Lash Adjusters	—
Cylinder Head		
Flatness of Gasket Surface	0.05 mm (0.002 inch)	—
Grinding Limit of Gasket Surface	—	0.2 mm (0.008 inch)
Manifold—Flatness of Installing Surface		
Intake	0.10 mm (0.004 inch)	0.2 mm (0.0008 inch)
Exhaust	0.15 mm (0.006 inch)	0.3 mm (0.001 inch)
Valves		
Thickness of Valve Head (Margin)		
Intake	1.2 mm (0.047 inch)	0.7 mm (0.027 inch)
Exhaust	2.0 mm (0.079 inch)	1.5 mm (0.059 inch)
Valve Stem to Guide Clearance		
Intake	0.03 to 0.06 mm (0.001 to 0.002 inch)	0.10 (0.004 inch)
Exhaust	0.05 to 0.09 mm (0.0019 to 0.003 inch)	0.15 mm (0.006 inch)
Valve Face Angle	45° to 45° 30′	—
Valve Overall Length		
Intake	103.0 mm (4.055 inches)	—
Exhaust	102.7 mm (4.043 inches)	—
Valve Stem Diameter		
Intake	7.960 to 7.975 mm (0.313 to 0.314 inch)	—
Exhaust	7.930 to 7.950 mm (0.312 to 0.3125 inch)	—
Valve Guide		
Overall Length		
Intake	44 mm (1.732 inches)	—
Exhaust	48 mm (1.889 inches)	—
O.D.	13.055 to 13.065 mm (0.514 to 0.5143 inch)	—
I.D.	8.000 to 8.018 mm (0.314 to 0.315 inch)	—
Valve Seat		
Seat Surface Angle	44° to 44°.3′	—
Contact Width	0.9 to 1.3 mm (0.035 to 0.051 inch)	—
Sinkage	—	0.2 mm (0.078 inch)
Valve Spring		
Free Height	49.8 mm (1.960 inches)	48.8
Loaded Height	40.4 mm at 33 kg (1.59 inch at 73 lbs.)	—
Perpendicularity		
Intake and Exhaust	2° Maximum	4° Maximum

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ENGINE SPECIFICATIONS (CONT.)

Description	Standard Dimension	Service Limit
Piston		
O.D.	91.06 to 91.09mm (3.585 to 3.586 inches)	—
Piston to Cylinder Clearance	0.03 to 0.05mm (0.0012 to 0.002 inch)	—
Ring End Gap		
No. 1	0.30 to 0.45mm (0.012 to 0.018 inch)	0.8mm (0.03 inch)
No. 2	0.25 to 0.40mm (0.010 to 0.016 inch)	0.8mm (0.03 inch)
Oil	0.30 to 0.90mm (0.012 to 0.035 inch)	1.0mm (0.039 inch)
Ring Side Clearance		
No. 1	0.05 to 0.09mm (0.002 to 0.0035 inch)	0.1mm (0.0039 inch)
No. 2	0.02 to 0.06mm (0.0008 to 0.002 inch)	0.1mm (0.0039 inch)
Oversize Service Pistons	0.25 to 0.50mm (0.010 to 0.020 inch) 0.75 to 1.00mm (0.030 to 0.039 inch)	
Connecting Rod		
Length—Center to Center	140.9 to 141.0mm (5.547 to 5.551 inches)	—
Parallelism—Twist	0.05mm (0.0019 inch)	—
Torsion	0.1mm (0.0039 inch)	—
Big End Thrust Clearance	0.10 to 0.25mm (0.004 to 0.010 inch)	0.4mm (0.016 inch)
Crankshaft		
End Play	0.05 to 0.25mm (0.002 to 0.010 inch)	0.3mm (0.012 inch)
Main Journal Diameter	59.980 to 60.000mm (2.361 to 2.362 inches)	—
Pin Diameter	49.980 to 50.000mm (1.968 to 1.969 inches)	—
Bearing Surface Out-of-Round	0.03mm Max. (0.001 inch) Max.	—
Bearing Surface Taper	0.005mm Max. (0.0002 inch) Max.	—
Bearing Oil Clearance	(0.015 to 0.050 mm) (0.0006 to 0.002 inch)	—
Undersize Service Bearings	0.25 to 0.50—0.75mm (0.010 to 0.020—0.030 inch)	
Cylinder Block		
I.D. (Bore)	91.1 mm (3.587 inches)	—
Flatness of Top Surface	0.05mm (0.002 inch)	0.1mm (0.0039 inch)
Grinding Limit of Top Surface	0.2mm* (0.008 inch)	0.2mm* (0.008 inch)
*Includes/Combined With Cylinder Head Grinding		
Oil Pump		
Relief Valve Opening Pressure	5.0 to 6.0 kg/cm² (71.45 to 85.75 psi)	—
Outer Rotor to Case Clearance	0.10 to 0.18mm (0.004 to 0.007 inch)	0.18mm (0.007 inch)
Rotor End Clearance	0.04 to 0.09mm (0.0015 to 0.0035 inch)	0.09mm (0.0035 inch)
Inner Rotor Pilot to Case Clearance	0.03 to 0.07mm (0.001 to 0.0028 inch)	0.15mm (0.006 inch)

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TORQUE

DESCRIPTION	TORQUE
Engine Support Bracket	47 N·m (35 ft. lbs.)
Crankshaft Pully A (Crankshaft Bolt)	151 N·m (112 ft. lbs.)
Crankshaft Pully B	28 N·m (250 in. lbs.)
Crankshaft Bearing Cap	80 N·m (60 ft. lbs.)
Connecting Rod Cap	52 N·m (38 ft. lbs.)
Camshaft Sprocket	95 N·m (70 ft. lbs.)
Timing Belt Tensioner	28 N·m (250 in. lbs.)
Alternator Bracket	28 N·m (250 in. lbs.)

DESCRIPTION	TORQUE
Rocker Cover	10 N·m (88 in. lbs.)
Distributor Adaptor	13 N·m (120 in. lbs.)
Camshaft Bearing Cap	20 N·m (180 in. lbs.)
Cylinder Head Bolt (Cold)	108 N·m (80 ft. lbs.)
Oil Pan	6 N·m (50 in. lbs.)
Oil Drain Plug	40 N·m (30 ft. lbs.)
Oil Pickup	22 N·m (191 in. lbs.)
Oil Pump Assembly	15 N·m (130 in. lbs.)
Oil Seal Rear Housing	11 N·m (95 in. lbs.)

9209-118

3.3/3.8L ENGINE

INDEX

SPECIFICATIONS

	3.3L Engine	3.8L Engine
Type	60° V-6 Engine	
Bore	93.0 mm (3.661 Inch)	96.0 mm (3.779 Inch)
Stroke	81.0 mm (3.188 Inch)	87.0 mm (3.425 Inch)
Compression Ratio	8.9:1	
Displacement	3.3 Liters (201 Cubic Inch)	3.8 Liters (231 Cubic Inch)
Brake Horsepower	147 @ 4800 RPM	151 @ 4400 RPM
Torque	185 Lb. Ft. @ 3600 RPM	204 Lb. Ft. @ 3200 RPM
Firing Order	1-2-3-4-5-6	
Lubrication	Pressure Feed-Full Flow Filtration (Direct Crankshaft Driven Pump)	
Engine Oil Capacity	4.25 Liters (4.5 Qts.) Including Oil Filter, 3.8 Liter (4.0 Qts.) Without Oil Filter	
Cooling System	Liquid Cooled-Forced Circulation	
Cylinder Block	Cast Iron	
Crankshaft	Nodular Iron	
Cylinder Head	Aluminum Alloy	
Connecting Rods	Forged Steel	
Pistons	Aluminum Alloy	

9209-120

GENERAL INFORMATION

ENGINE INDENTIFICATION NUMBER OR CODE

The engine identification number is located on the rear of the cylinder block just below the cylinder head (Fig. 2).

ENGINE: The 3.3L (201 Cubic. Inches.) and 3.8L (231 Cubic. Inches.) displacement engines are 60° V type six cylinder power plant with cast iron cylinder block and aluminum cylinder heads. (Fig. 1). 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 seal.

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

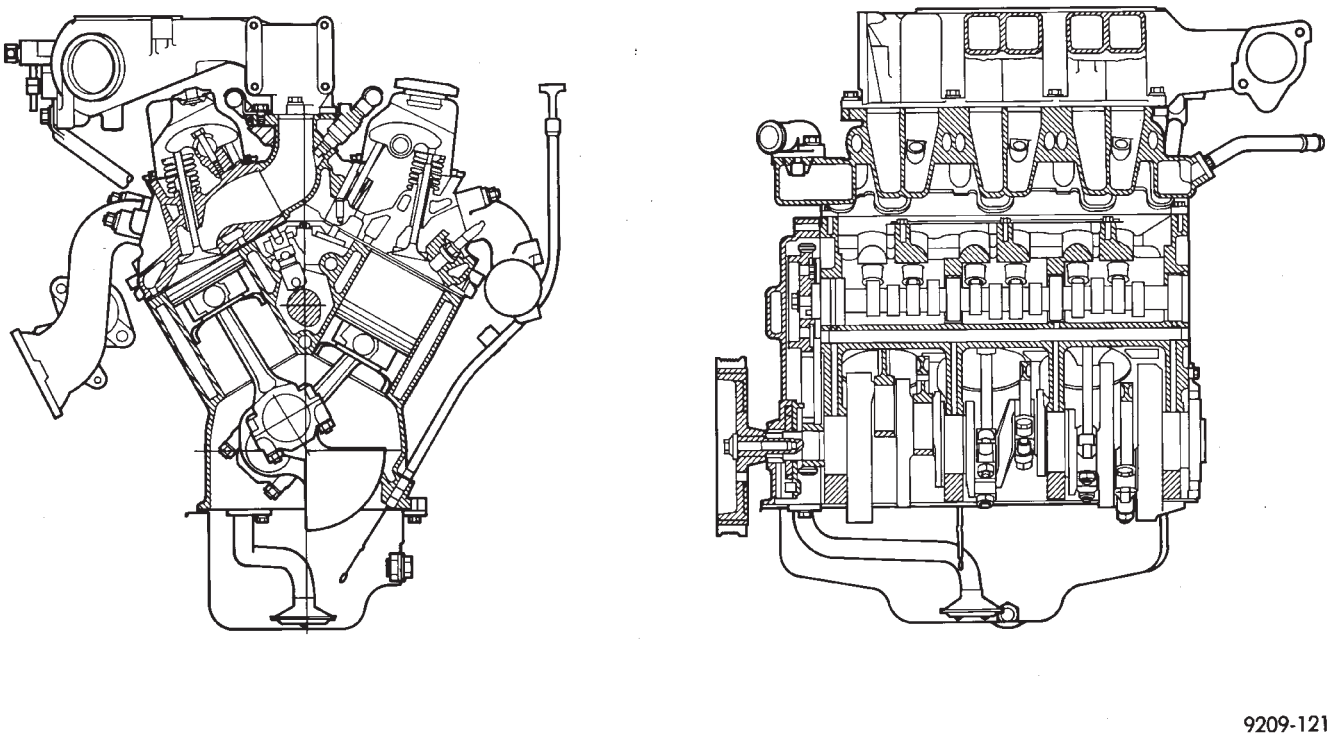


Fig. 1 3.3/3.8L V-6 Engine

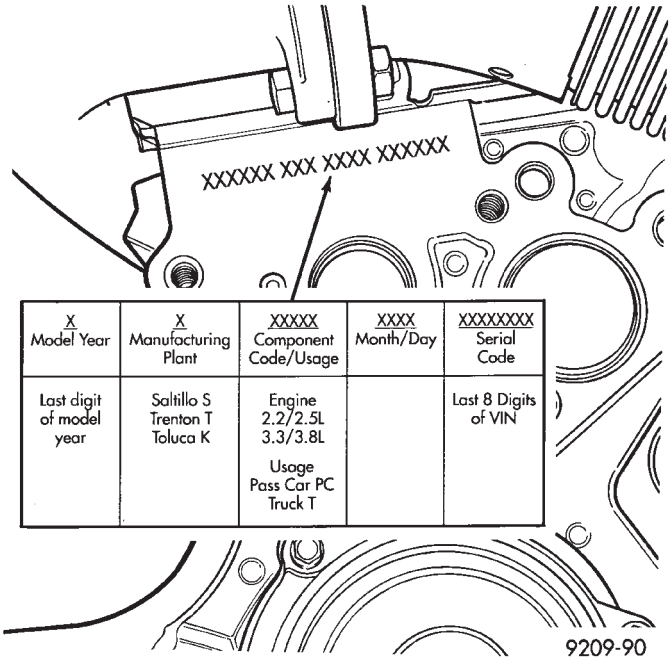


Fig. 2 Engine Identification

CYLINDER HEADS: Cylinder heads incorporate valve shrouding to create turbulence-producing combustion chambers, described as fast burn. Valve seat and guides are inserts. A steel flanged composition type gasket is used between head and block.

VALVE 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.

ENGINE MOUNTS

REMOVAL AND INSTALLATION

RIGHT SIDE MOUNT

(1) Remove the right engine mount insulator vertical fasteners from frame rail.

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

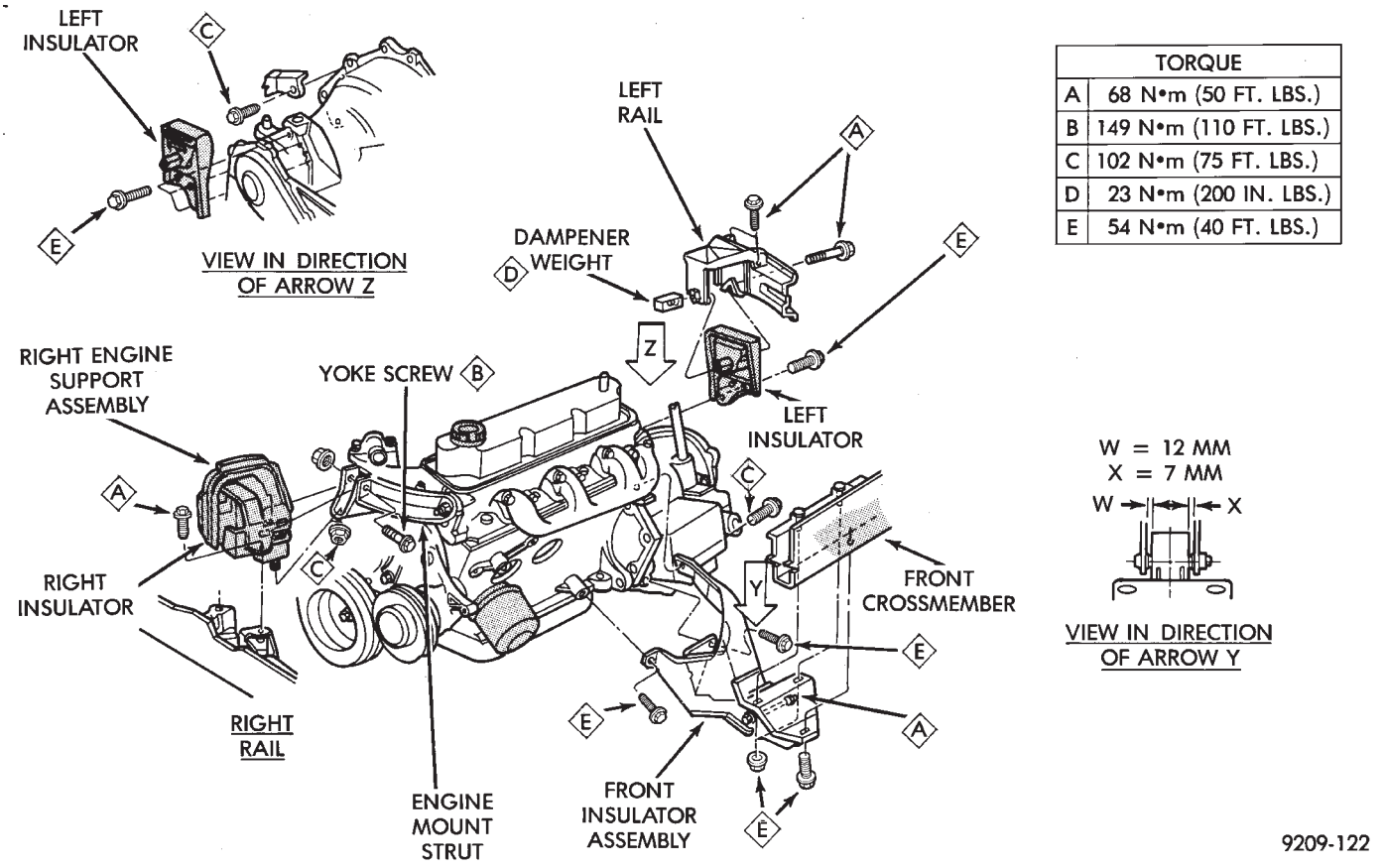


Fig. 3 Engine Mounting

(3) Remove the thru bolt from the insulator assembly. Remove insulator.

(4) Reverse removal procedure for installation. Refer to (Fig. 3) for bolt tightening specifications.

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

FRONT MOUNT

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

(2) Remove the thru bolt from the insulator and front crossmember mounting bracket.

(3) Remove the front engine mount bracket to front crossmember screws and nuts. Remove the insulator assembly.

(4) Reverse removal procedure for installation. Refer to (Fig. 3) for bolt tightening specifications.

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

LEFT SIDE MOUNT

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

(2) Remove inter splash shield.

(3) Support the transmission with a transmission jack.

(4) Remove the insulator thru bolt from the mount.

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

(6) Reverse removal procedure for installation. Refer to (Fig. 3) for bolt tightening specifications.

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

ENGINE MOUNT RUBBER INSULATORS

Insulator location on yoke bracket to engine plate (right side) and transmission bracket (left side) are adjustable to allow right/left drive train adjustment in relation to drive shaft assembly length.

Check and reposition right engine mount insulator (left engine mount insulator is floating type and will adjust automatically (Fig. 4). Adjust drive train position, if required, for the following conditions:

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

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 yoke screw and 2 turns on yoke nut, then loosen the front engine mount bracket to front crossmember screws and nuts.

Left engine mount insulator is sleeved over shaft and long support bolt to provide lateral movement adjustment with engine weight removed or not.

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

(4) Tighten right engine mount insulator yoke nut to 102 N·m (75 ft. lbs.). Then tighten front engine mount screws and nuts to 54 N·m (40 ft. lbs.) and center left engine mount insulator.

(5) Recheck drive shaft length.

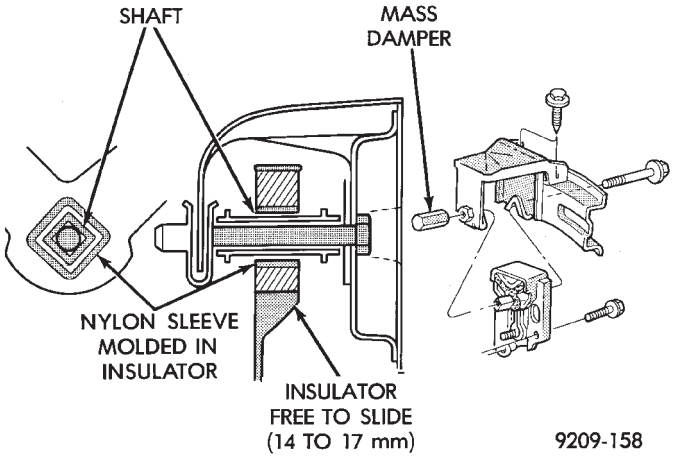


Fig. 4 Left Insulator Movement

ENGINE ASSEMBLY

REMOVAL

(1) Disconnect battery.

(2) Mark hood position at hinges and remove hood.

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

(4) Disconnect all electrical connections.

(5) Remove coolant hoses from radiator and engine.

(6) Remove radiator and fan assembly.

(7) See Fuel System, Group 14, to release fuel pressure. Disconnect fuel lines and accelerator cable.

(8) Remove air cleaner assembly.

(9) Hoist vehicle and drain engine oil.

(10) Remove air conditioning compressor mounting bolts and set compressor aside.

(11) Disconnect exhaust pipe at manifold.

(12) Remove transmission inspection cover and mark flex plate to torque converter position. For disassembly procedure for the all wheel drive vehicle refer to Group 21 Transaxle.

(13) Remove screws holding torque converter to flex plate and attach C-clamp on bottom of converter housing to prevent torque converter from counting out.

(14) Remove power steering pump mounting bolts and set pump aside.

(15) Remove two lower transmission to block screws.

(16) Remove starter.

(17) Lower vehicles and disconnect vacuum lines and ground strap.

(18) Install transmission holding fixture.

(19) Attach engine lifting hoist and support engine.

(20) Remove upper transmission case to block bolts.

(21) See Engine Mounting in (Fig. 3) and separate mount/insulators as follows:

(a) Mark RIGHT insulator on right rails supports. Remove insulator to rails screws.

(b) Remove FRONT engine mount through bolt and nut.

(c) Remove LEFT insulator through bolt from inside wheelhouse or insulator bracket to transmission screws.

(22) Remove engine.

INSTALLATION

(1) Attach hoist and lower engine into engine compartment.

(2) Align engine mounts and install but **do not tighten** until all mounting bolts have been installed. Tighten bolts to torque specified in (Fig. 3).

(3) Install transmission case to cylinder block, tighten bolts to 102 N·m (75 ft. lbs.) torque.

(4) Remove engine hoist and transmission holding fixture.

(5) Remove C-clamp from torque converter housing. Align flex plate to torque converter and install mounting screws. Tighten to 75 N·m (55 ft. lbs.) torque. Refer to Group 21 transaxle for the all wheel drive installation procedure.

(6) Install transmission inspection cover.

(7) Connect exhaust system at manifold.

(8) Install starter.

(9) Install power steering pump and air conditioning compressor. For belt installation see Accessory Belt Drive in Cooling System Group 7.

(10) Lower vehicle and connect all vacuum lines.

(11) Connect all electrical connections including ground strap.

(12) Connect fuel lines and accelerator cable.

(13) Install radiator and fan assembly. Reconnect fan motor electrical lead. Reinstall radiator hoses. Fill cooling system. See Cooling System Group 7 for filling procedure.

(14) Fill engine crankcase with proper oil to correct level.

(15) Install hood.
(16) Connect battery.
(17) Start engine and run until operating temperature is reached.
(18) Adjust transmission or linkage if necessary.

ROCKER ARMS AND SHAFT ASSEMBLY

REMOVAL

(1) Remove upper intake manifold assembly. Refer to Intake and Exhaust Manifolds, Group 11.
(2) Disconnect spark plug wires by pulling on the boot straight out in line with plug.
(3) Disconnect closed ventilation system and evaporation control system from cylinder head cover.
(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. 5) for rocker arm for positioning on the shaft.

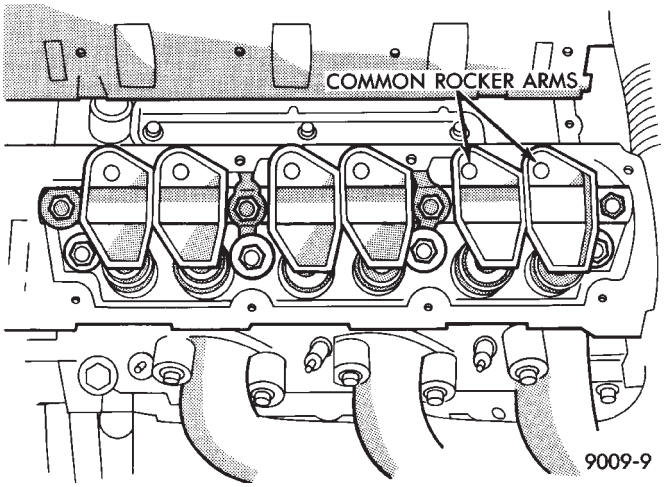


Fig. 5 Rocker Arm Location Left Blank

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. 5).

WARNING: THE ROCKER ARM SHAFT SHOULD BE TORQUED DOWN SLOWLY, STARTING WITH THE CENTERMOST 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 and evaporation control system.
(5) Install spark plug wires.
(6) Install upper intake manifold assembly. Refer to Exhaust Systems and Intake Manifolds Group 11.

CYLINDER HEADS

The alloy aluminum cylinder heads shown in (Fig. 6) are held in place by 9 bolts. The spark plugs are located in peak of the wedge between the valves.

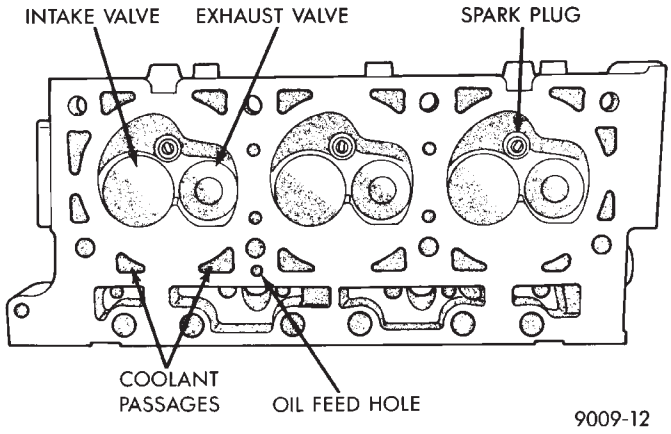


Fig. 6 Cylinder Head Assembly

REMOVAL

(1) Drain cooling system refer to Cooling System Group 7 for procedure and disconnect negative battery cable.

Remove intake manifold, and throttle body. Refer to Group 11 Exhaust System and Intake Manifold.

(2) Disconnect coil wires, sending unit wire, heater hoses and by-pass hose.
(3) Remove closed ventilation system, evaporation control system and cylinder head covers.
(4) Remove exhaust manifolds.
(5) Remove rocker arm and shaft assemblies. Remove push rods and **identify to insure installation in original locations.**
(6) Remove the 9 head bolts from each cylinder head and remove cylinder heads (Fig. 7).

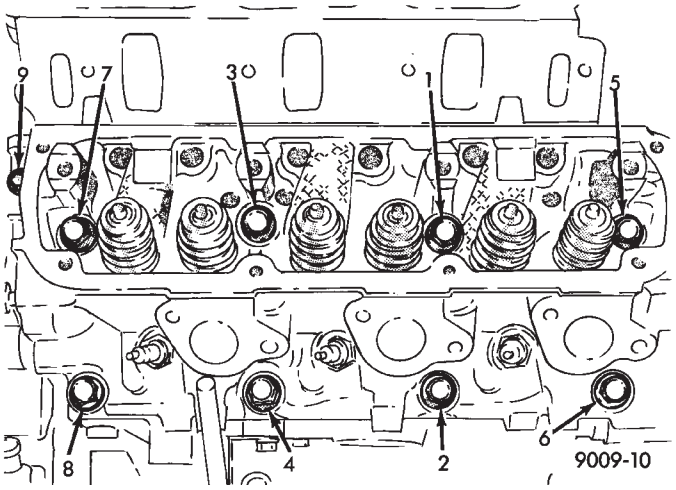


Fig. 7 Cylinder Head Bolts Location

INSPECTION

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

(2) Clean cylinder head and oil passages.

(3) Check cylinder head for flatness (Fig. 8).

(4) Inspect all surfaces with a straightedge if there is any reason to suspect leakage. If out of flatness exceeds .019mm (.00075 inch) 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 1mm (.004 inch) out of flat, allowable is 12 x .019mm (.00075 inch) equals .22mm (.009 in.). This amount of out of flat is acceptable.

*Maximum of 0.2 mm (.008 inch) for grinding is permitted.

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

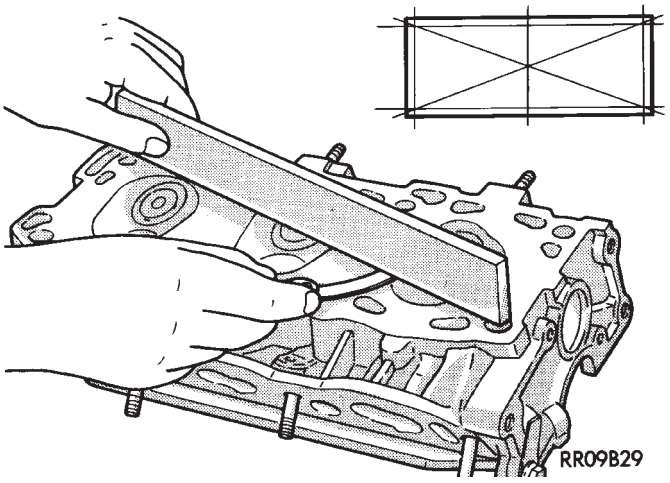


Fig. 8 Check Cylinder Head

INSTALLATION

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

(2) Install new gaskets on cylinder block (Fig. 9).

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. 10).

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.

(3) Tighten the cylinder head bolts 1 thru 8 in the sequence shown in (Fig. 11). Using the 4 step torque turn method, tighten according to the following values:

- First-All to 61 N·m (45 ft. lbs.)
- Second-All to 88 N·m (65 ft. lbs.)
- Third-All (again) to 88 N·m (65 ft. lbs.)
- Fourth + 1/4 Turn **Do not use a torque wrench for this step**

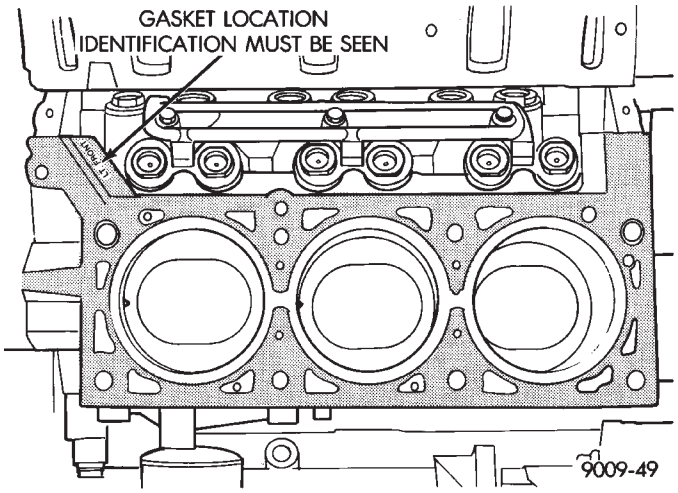


Fig. 9 Head Gasket Installation

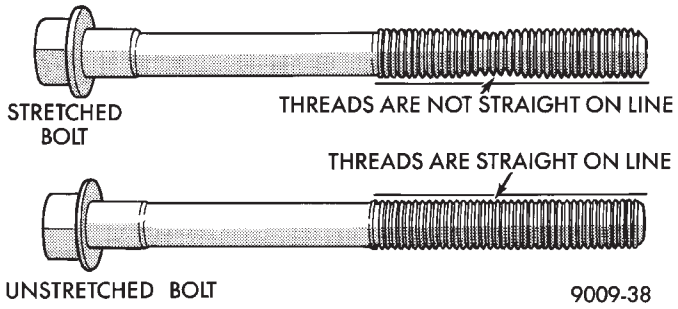


Fig. 10 Checking Bolts for Stretching (Necking)

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

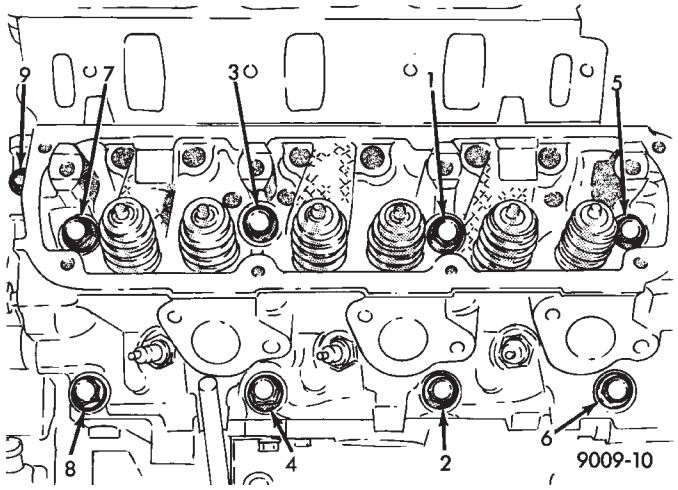


Fig. 11 Cylinder Head Tightening Sequence

(5) Tighten head bolt number 9 (Fig. 11) to 33 N·m (25 ft. lbs.) after head bolts 1 thru 8 have been tighten to specifications.

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

(7) 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. 12).

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

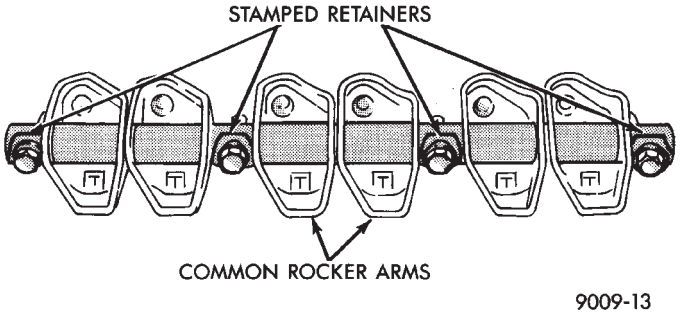


Fig. 12 Rocker Arm Shaft Retainers

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. 13).

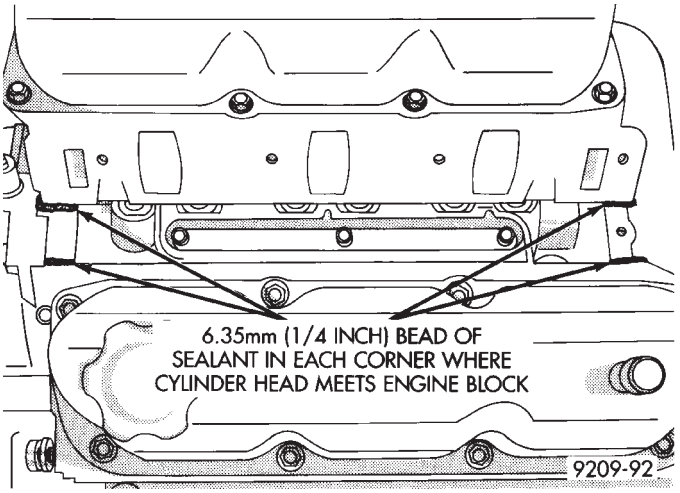


Fig. 13 Intake Manifold Gasket Sealing

(3) Carefully install the intake manifold gasket (Fig. 14). 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 retorque bolts to 22 N·m (200 in. lbs.) in sequence shown in (Fig. 15). Then retorque 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 Assembly.

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

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

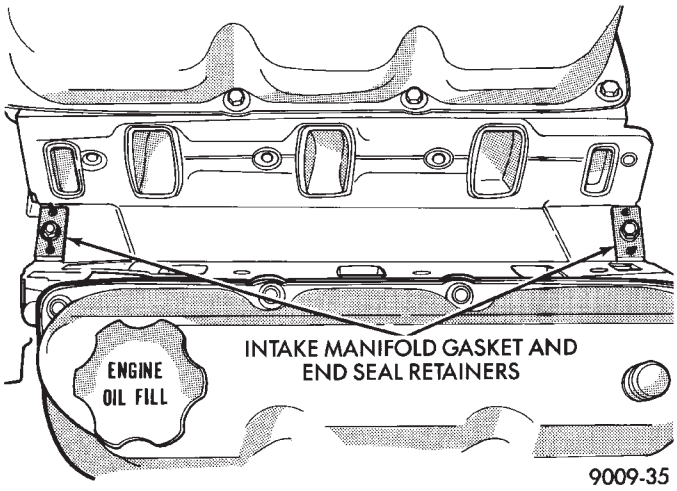


Fig. 14 Intake Manifold Gasket Retainers

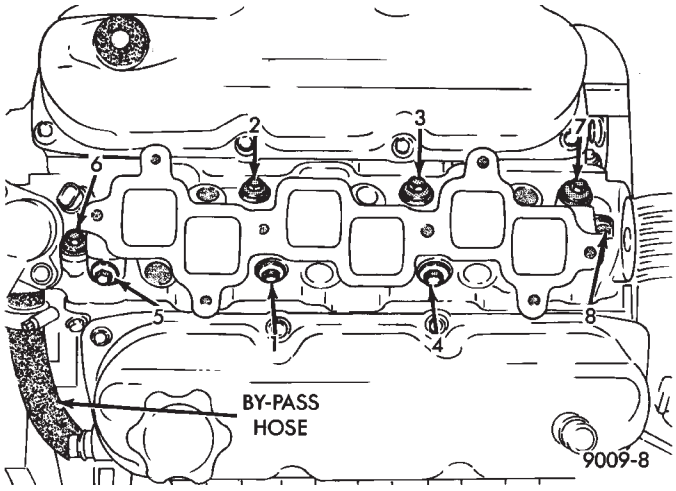


Fig. 15 Intake Manifold Removal and Installation

VALVE SERVICE

VALVES AND VALVE SPRINGS

The valves are arranged in line in the cylinder heads and inclined 18 degrees. The rocker shaft support are cast integral with the heads.

REMOVAL

(1) With cylinder head removed, compress valve springs using Valve Spring Compressor Tool C-3422-B with adapter 6412 as shown in (Fig. 16).

(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.

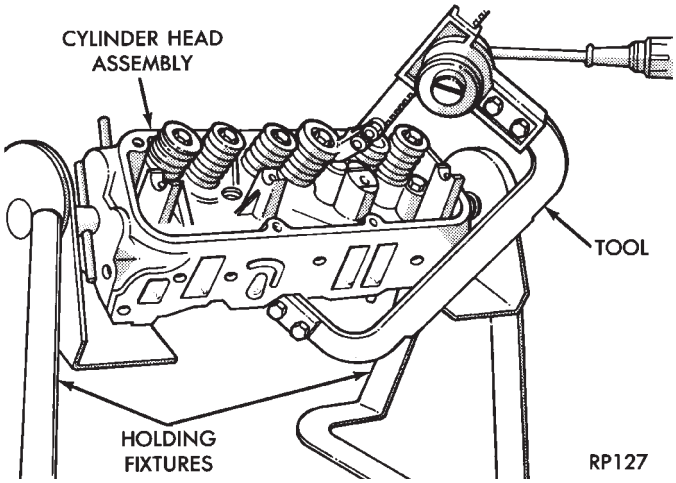


Fig. 16 Compress Valve Springs with Special Tool C-3422B with adapter 6412

VALVE INSPECTION

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

(2) Measure valve stems for wear. Refer to specifications (Fig. 19).

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 14mm (.551 inch) 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).

(c) Move valve to and from the indicator. Refer to specifications (Fig. 19).

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

(5) Service valves with oversize stems and over size seals are available in 0.15mm (.005 inch), 0.40mm, (.015 inch) and 0.80mm (.030 inch) oversize.

Oversize seals must be used with oversize valves.

Reamers to accommodate the oversize valve stem are as follows:

(6) 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 0.80mm (.030 inch) Use step procedure of 0.15mm (.005 inch), 0.40mm (.015 inch) and 0.80mm (.030 inch) so the valve guides may be reamed true in relation to the valve seat.**

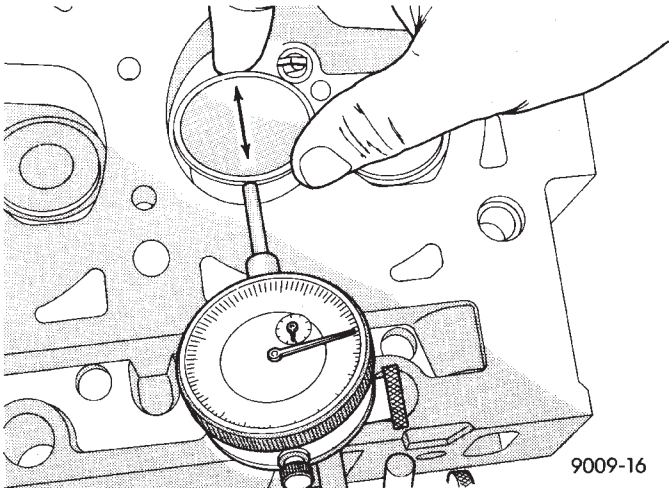


Fig. 17 Measuring Valve Guide Wear

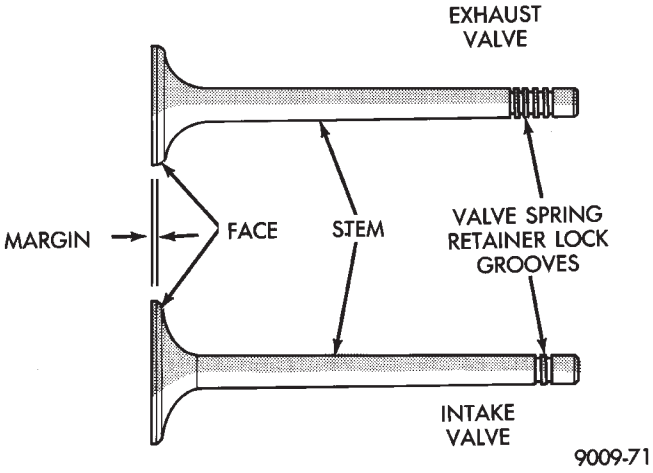


Fig. 18 Intake and Exhaust Valves

Valve Guide Dial Indicator Reading, Maximum	Intake Valve 0.247 mm (0.009 in.)	Exhaust Valve 0.414 mm (0.016 in.)
Valve Guide Reamer Oversize	**Valve Guide Size**	
0.15 mm (.005 in.)	8.125-8.150 mm (.3198-.3208 in.)	
0.40 mm (.015 in.)	8.375-8.400 mm (.3297-.3307 in.)	
0.80 mm (.030 in.)	8.775-8.800 mm (.3454-.3464 in.)	

9109-46

Fig. 19 Valve Guide Specifications

After reaming guides, the seat runout should be measured and resurfaced if necessary. See Refacing Valves and Valve Seats.

VALVE GUIDES

Replace cylinder head if guide does not clean up with 0.80mm (.030 inch) oversize reamer, or if guide is loose in cylinder head.

Valve Dimensions

Intake Valve (minimum)
Stem diameter: 7.935 mm (.3124 in.)
Face angle: 44 1/2°
Valve margin: .794 mm (.031 in.)
Head diameter: 45.5 mm (1.79 in.)
Length: 125.38 mm (4.936 in.)

Exhaust Valve (minimum)
Stem diameter: 7.906 mm (.3112 in.)
Face angle: 44 1/2°
Valve margin: 1.191 mm (.0469 in.)
Head diameter: 37.5 mm (1.476 in.)
Length: 126.00 mm (4.964 in.)

9109-47

Fig. 20 Valve Dimensions

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. 21).

VALVES

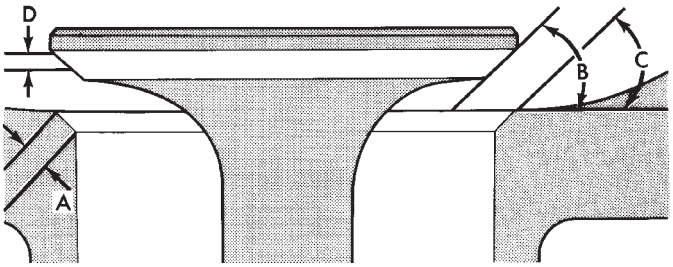
(1) Inspect the remaining margin after the valves are refaced Refer to specifications (Fig. 20).

VALVE SEATS

CAUTION: Do not un-shroud cylinder head from around the valve during valve seat refacing (Fig. 22).

(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 .051mm (.002 inch) total indicator reading.



A- SEAT WIDTH (INTAKE 1.75 TO 2.25mm (.069 TO .088 IN.)
EXHAUST: 1.50 TO 2.00mm (.059 TO .078 IN.)
B- FACE ANGLE (INTAKE & EXHAUST: 44 1/2°)
C- SEAT ANGLE (INTAKE & EXHAUST: 45°-45 1/2°)
D- SEAT CONTACT AREA

9009-88

Fig. 21 Valve Seats

(3) 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

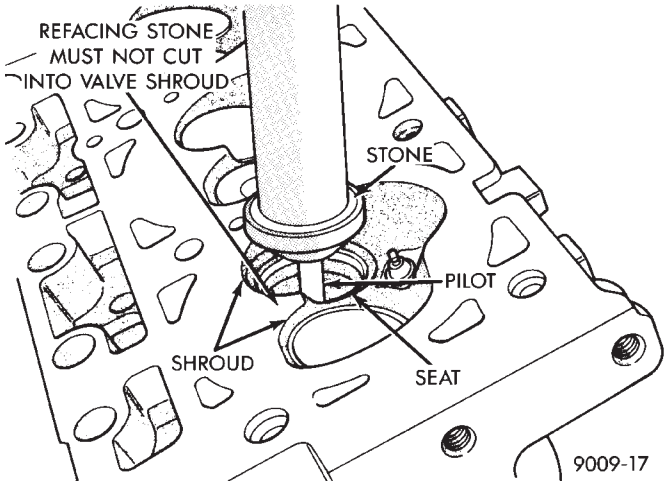


Fig. 22 Refacing Valve Seats

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.

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 2.25mm (0.69 to .088 inch) The width of the exhaust seats should be 1.50 to 2.00mm (.059 to .078 inch) (Fig. 21)

(5) Check the valve spring installed height after refacing the valve and seat (Fig. 24).

TESTING VALVE SPRINGS

Whenever valves have been removed for inspection, reconditioning or replacement, valve springs should be tested (Fig. 23). **As an example:** the compression length of the spring to be tested is 33.34mm (1-5/16 inches). Turn table of Tool C-647 until surface is in line with the 33.34mm (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.

VALVE INSTALLATION

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

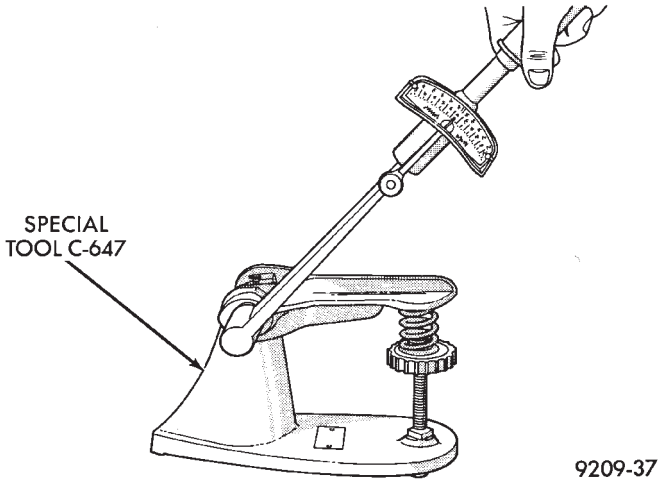


Fig. 23 Testing Valve Spring with Tool C-647

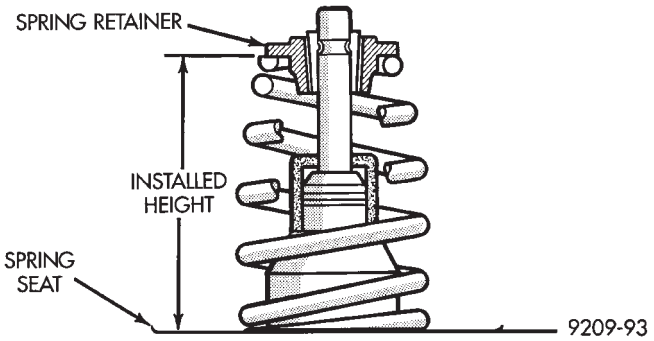


Fig. 24 Checking Valve Installed Height

(2) If valves or seats are reground, check installed valve spring height (Fig. 24).

(3) Install new cup seals on all valve stems and over valve guides (Fig. 24). Install valve springs and valve retainers.

(4) 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, make sure measurements is taken from top of spring seat to the bottom surface of spring retainer. If height is greater than 1-19/32 inches, (40.6mm), install a 1/32 inch (.794mm) spacer in head counterbore to bring spring height back to normal 1-17/32 to 1-19/32 inch (39.1 to 40.6mm).**

REPLACE VALVE STEM SEALS OR VALVE SPRINGS, CYLINDER HEAD NOT REMOVED

(1) Perform fuel system pressure release procedure **before attempting any repairs.**

(2) Disconnect negative battery cable.

(3) Remove Air Cleaner Cover and hose assembly.

(4) Remove Intake Manifold; Refer to Intake/Exhaust Manifold 3.3/3.8L Engine Group 11 Exhaust System and Intake Manifolds of this manual for removal procedure.

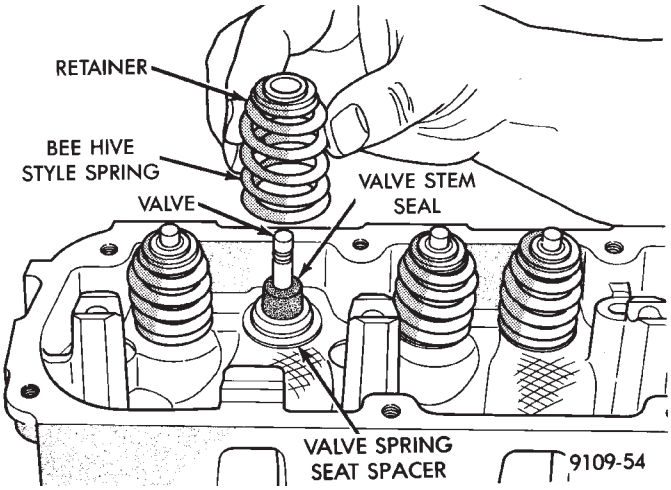


Fig. 25 Installing Valve, Cup Seal, Spring and Retainer

(5) Remove cylinder head covers and spark plugs.

(6) Remove connector wire 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 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 into 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 a 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 shaft and install rocker shaft assembly and tighten screws to 28 N·m (250 in lbs.).

(15) Install rocker arm covers tighten screws to 14 N·m (120 in. lbs.) and connector to ignition coils.

(16) Install Intake Manifold; Refer to Intake Manifold Installation 3.3/3.8L Engine, Group 11 Exhaust System and Intake Manifold.

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 aligning yokes. The yokes are secured by an alignment yoke retainer (Fig. 26).

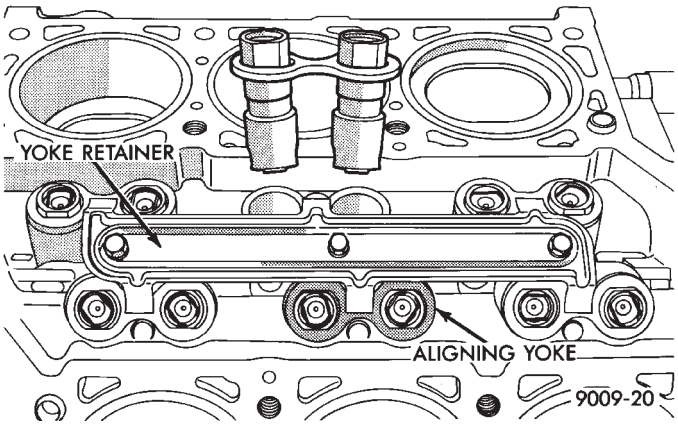


Fig. 26 Roller Tappets Aligning Yoke and Retainer

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.

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 leakdown 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.

TAPPET REMOVAL

(1) Refer to Cylinder Head Removal of this section to remove intake manifold and cylinder heads for 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.

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.

DISASSEMBLY (FIG. 27)

(1) Pry out plunger retainer spring clip.

(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.

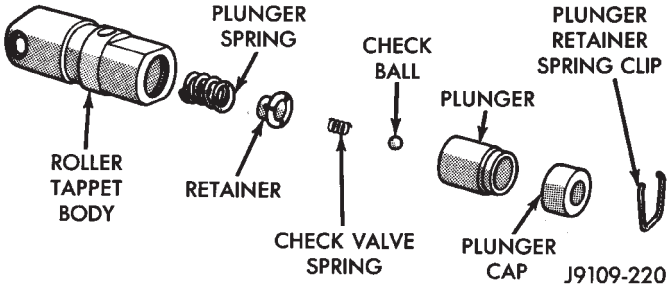


Fig. 27 Hydraulic Roller Tappet Assembly

CLEANING AND 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.

(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. 27).

INSTALLATION

(1) Lubricate tappets.

(2) Install tappets in their original positions.

(3) With roller tappets, install aligning yokes with (Fig. 26).

(4) Install yoke retainer and torque screws to 12 N·m (105 in. lbs.) (Fig. 26).

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

(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.

VALVE TIMING

(1) Remove front valve 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 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 5.08mm (.200 inch) 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 .254mm (0.010 inch).

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

(10) Degree wheel should read 3 degrees BTDC to 4 degrees ATDC.

TIMING CHAIN COVER, OIL SEAL AND CHAIN

COVER

REMOVAL

(1) Disconnect 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 transmission 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 pulley (Fig. 1).

(11) Remove idler pulley from engine bracket.

(12) Remove engine bracket (Fig. 2).

(13) Remove cam sensor from chain case cover (Fig. 3).

(14) Remove chain case cover (Fig. 3).

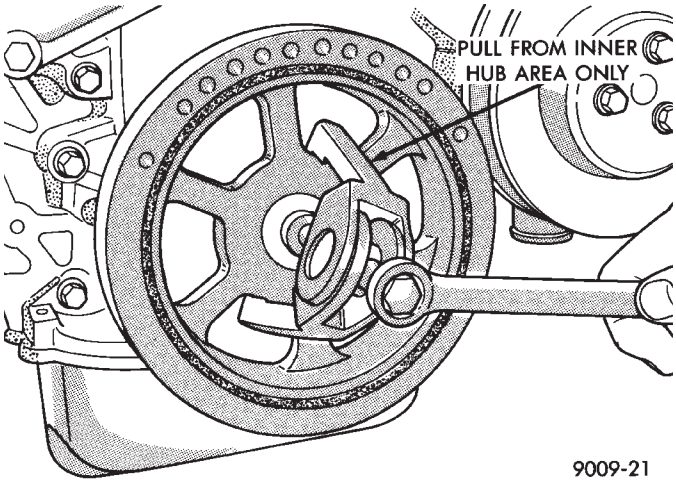


Fig. 1 Removing Crankshaft Pulley

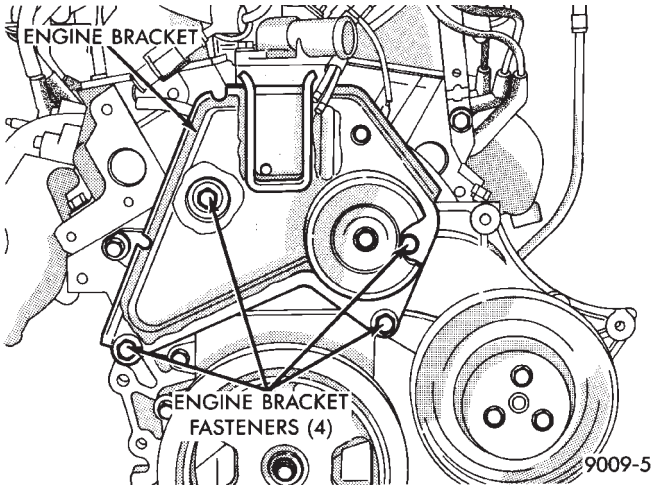


Fig. 2. Engine Bracket

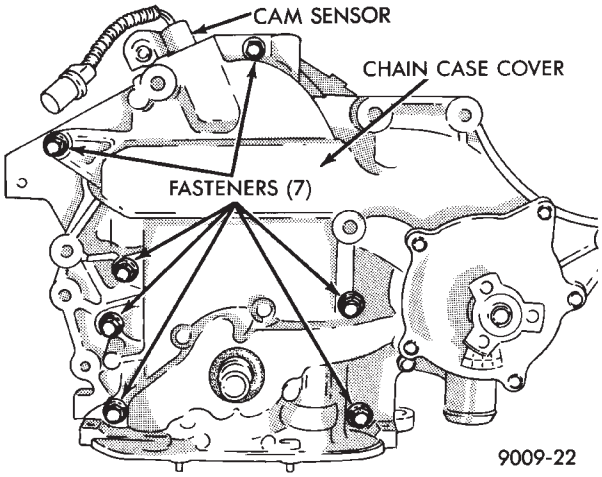


Fig. 3 Timing Chain Case Cover

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. 4), 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 (Fig. 4).

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

(5) If chain is not satisfactory, remove camshaft sprocket attaching bolt, and remove timing chain with camshaft sprocket.

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

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

(8) Rotate crankshaft sprocket so the timing mark is to the 12 o'clock position.

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

(10) Place timing chain around crankshaft sprocket and install camshaft sprocket into position.

(11) Using straight edge to check alignment of timing marks (Fig. 5).

(12) Install camshaft bolt and washer. Tighten to 47 N·m (35 ft. lbs.).

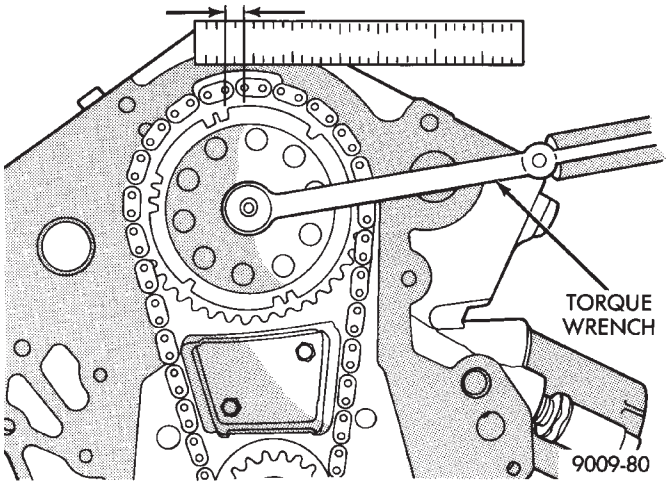


Fig. 4 Measuring Timing Chain Wear and Stretch

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

(14) Check camshaft endplay. With new thrust plate specification is .0127 to .304 mm (.005 to .012 inches.). Old thrust plate specification is .31 mm (.012 inch.) maximum. If not within these limits install new thrust plate.

(15) Install timing chain snubber. Tighten retaining screws to 12 N·m (105 in lbs.). **These bolts are 20mm long for this model year, they should not be interchanged with previous year engines.**

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.

(2) Use a new cover gasket, O-rings. (Fig. 6).

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

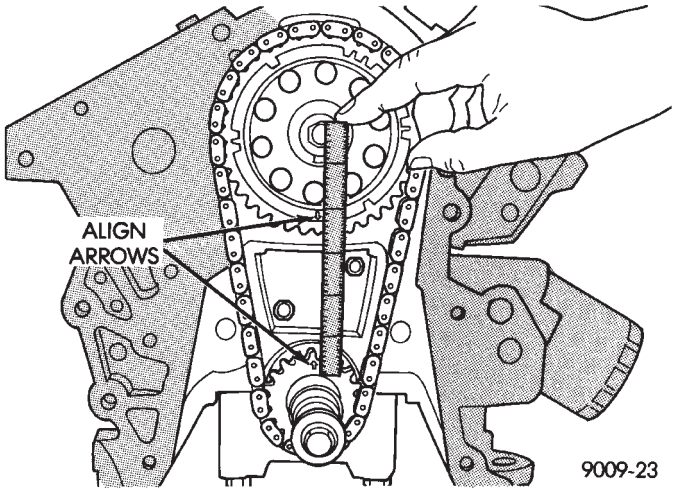


Fig. 5 Alignment of Timing Marks

(4) Position oil pump inner rotor so the mating flats are in the same position as the crankshaft drive flats (Fig. 6).

(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. 7).

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

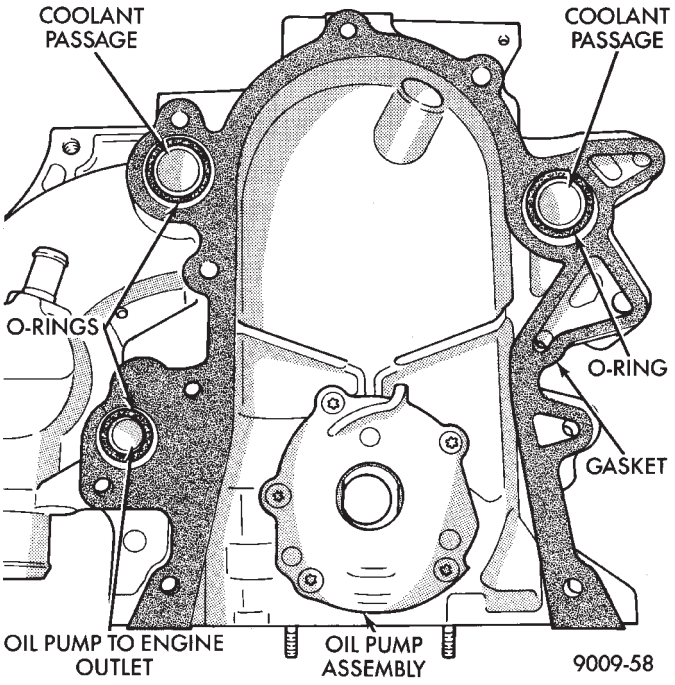


Fig. 6 Timing Chain Case Cover Gaskets and O-Rings

(9) Install engine bracket (Fig. 2) torque screws to 54 N·m (40 ft. lbs.).

(10) Install idler pulley on engine bracket.

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

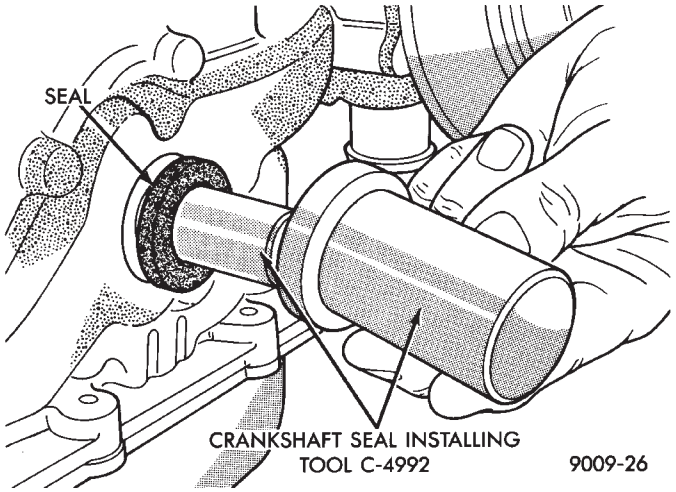


Fig. 7 Install Crankshaft Oil Seal

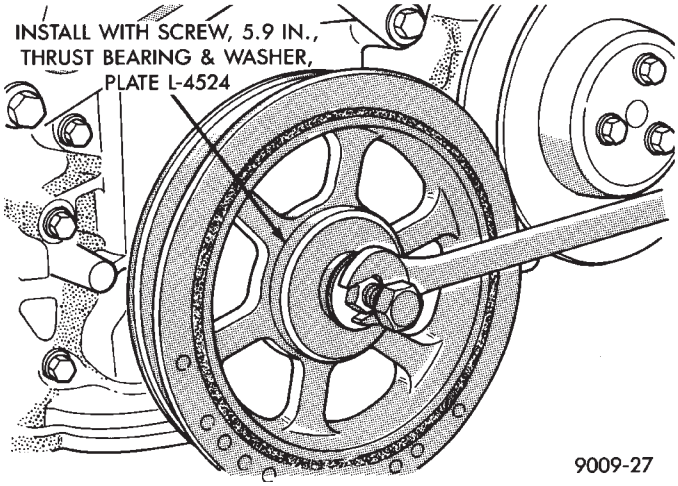


Fig. 8 Installing Crankshaft Pulley

(12) Install A/C compressor mounting bracket.

(13) Install A/C compressor.

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

(15) Install inner splash shield and wheel.

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

(17) Install engine mount.

(18) Fill crankcase with oil to proper level.

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

(3) Connect battery.

TIMING CHAIN COVER EXTERNAL OIL SEAL

REMOVAL

(1) Raise vehicle on hoist. Remove right wheel and inner splash shield.

(2) Remove drive belt. (Refer to Cooling System Group 7) for procedure.

(3) Remove crankshaft pulley (Fig. 1).

(4) Using Tool C-4991 to remove oil seal (Fig 9). Be careful not to damage that crankshaft seal surface of cover.

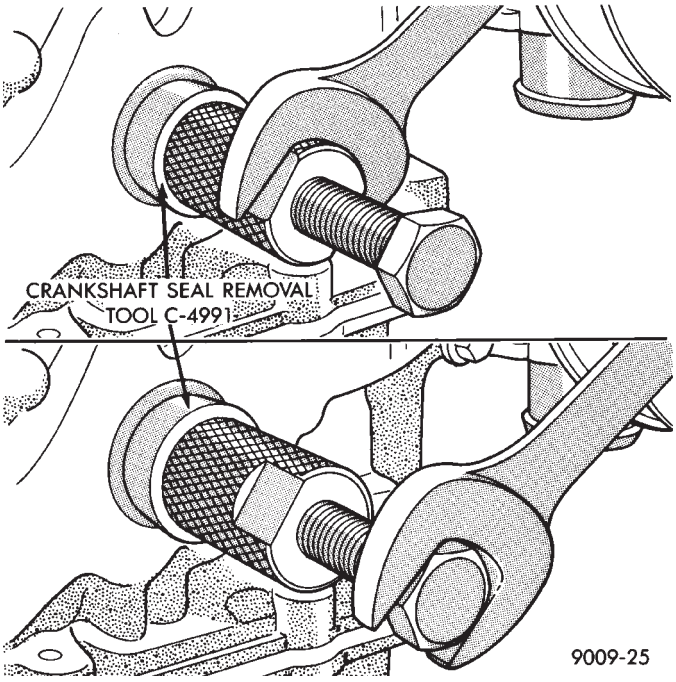


Fig. 9 Removing Crankshaft Oil Seal

INSTALLATION

(1) Install new seal by using Tool C-4992 (Fig. 7).

(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. Thurst Bearing/washer and 5.9 inch screw (Fig. 8).

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

(5) Install inner splash shield and wheel.

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 10).

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

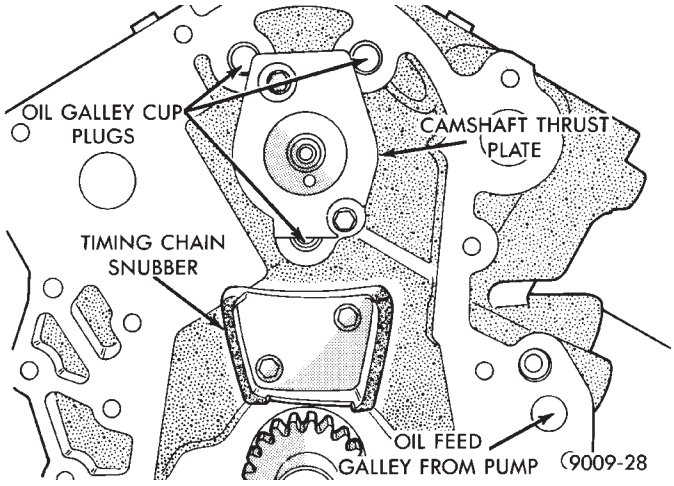


Fig. 10 Camshaft Thrust Plate

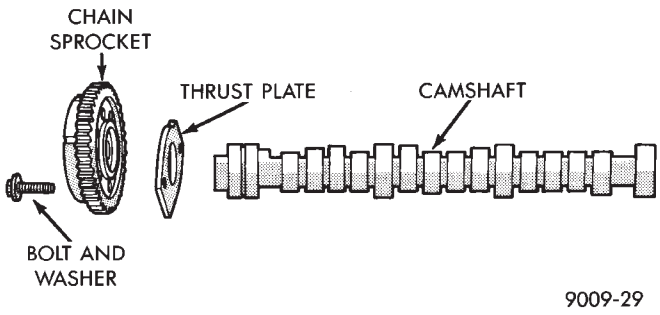


Fig. 11 Camshaft and Sprocket Assembly

Whenever an engine has been rebuilt or a new camshaft or tappets have been installed, add one pint of Chrysler Crankcase Conditioner or equivalent to engine oil to aid in break in. The oil mixture should be left in engine for a minimum of 805km (500 miles) and drained at the next normal oil change.

(2) Install camshaft thrust plate with two screws as shown in (Fig. 10). Tighten to 12 N·m (105 in. lbs.) torque.

(3) Place both camshaft sprocket and crankshaft sprocket on the bench with timing marks on exact imaginary center line through both camshaft and crankshaft bores.

(4) Place timing chain around both sprockets.

(5) Turn crankshaft and camshaft to line up with keyway location in crankshaft sprocket and in camshaft sprocket.

(6) Lift sprockets and chain keep sprockets tight against the chain in position as described.

(7) Slide both sprockets evenly over their respective shafts use a straightedge to check alignment of timing marks (Fig. 12).

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

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

(10) Measure camshaft end play. End Play should measure .0127 to .304 mm (.005 to .012 inches.) .310 mm (.012 inch. Max.). If not within limits install a new thrust plate.

(11) 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.**

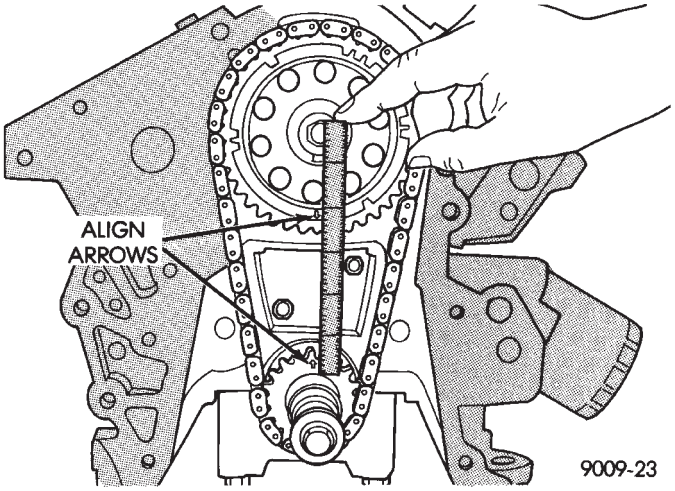


Fig. 12 Alignment of Timing Marks

CAMSHAFT BEARINGS–ENGINE REMOVED FROM VEHICLE

REMOVAL

(1) With engine 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. 13).

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.**

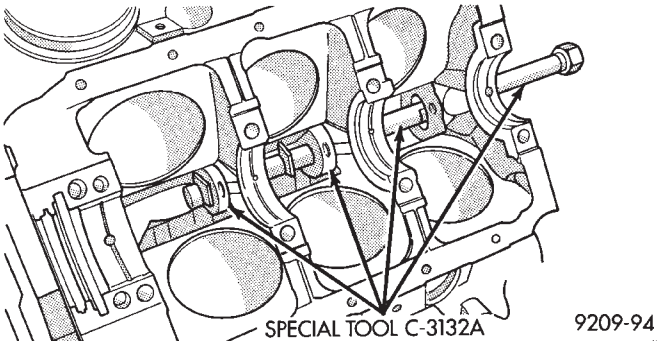


Fig. 13 Removed Installation of Camshaft Bearings with Tool C-3132A—Typical

ENGINE CORE OIL AND CAM 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. 14).

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

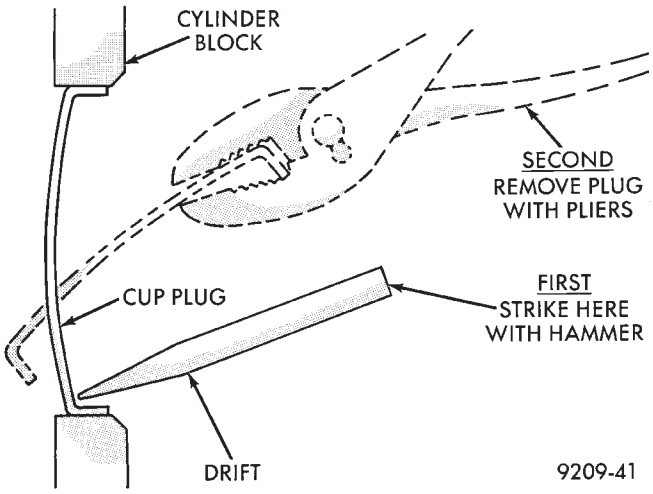


Fig. 14 Core Hole Plug Removal

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 0.5mm (.020 inch) inside the lead-in chamfer.

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

CYLINDER BLOCK, PISTON AND CONNECTING ROD ASSEMBLY SERVICE

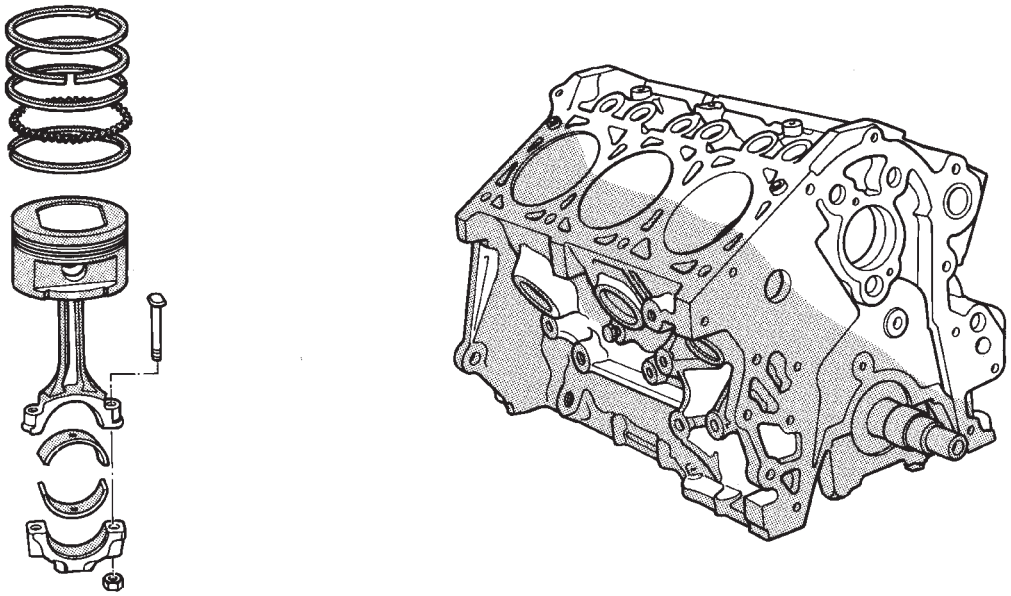


Fig. 1 Cylinder Block, Piston and Connecting Rod Assembly

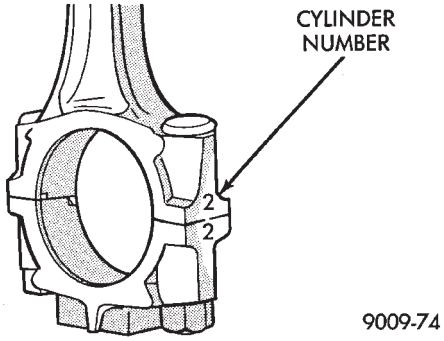


Fig. 2 Identify Connecting Rod to Cylinder

CYLINDER BLOCK

PISTON–REMOVAL

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

(2) Inspect connecting rods and connecting rod caps for cylinder identification. Identify them if necessary. (Fig. 2)

(3) Remove connecting rod cap. Install connecting rod bolt protectors on connecting rod bolts (Fig. 3).

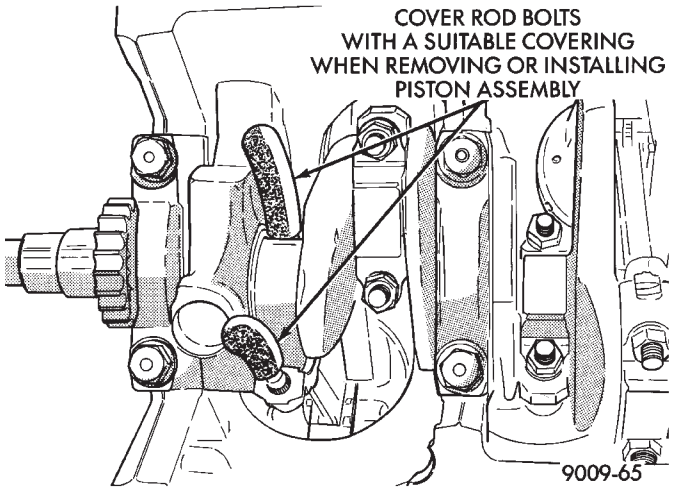


Fig. 3 Connecting Rod Protectors

Push each piston and rod assembly out of cylinder bore.

Be careful not to nick crankshaft journals.

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

CLEANING AND INSPECTION

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

(2) If new core plugs are installed, see Engine Core Oil and Cam Plugs.

(3) Examine block for cracks or fractures.

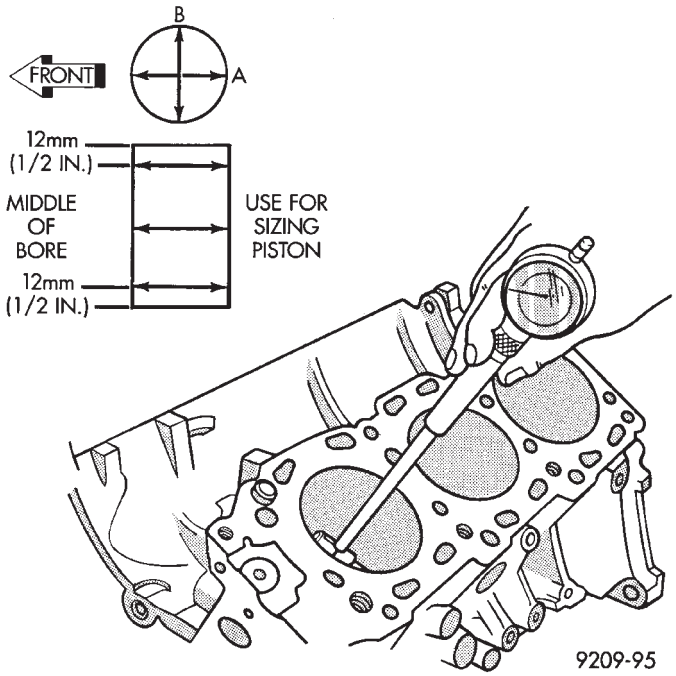


Fig. 4 Checking Cylinder Bore Size

CYLINDER BORE INSPECTION

The cylinder walls should be checked for out-of-round and taper with Tool C-119 (Fig. 4). If the cylinder walls are badly scuffed or scored, the cylinder block should be rebored and honed, and new pistons and rings fitted. Whatever type of boring equipment is used, boring and honing operation should be closely coordinated with the fitting of pistons and rings in order that specified clearances may be maintained.

Refer to Honing Cylinder Bores outlined in the Standard Service Procedures for specification and procedures.

Measure the cylinder bore at three levels in directions A and B (Fig. 4). Top measurement should be 12mm (.50 inch) down and bottom measurement should be 12mm (.50 inch.) up from bottom of bore. Refer to (Fig. 5) for specifications.

FINISHED PISTONS

All pistons are machined to the same weight in grams, to maintain piston balance. For cylinder bores which have been honed, new pistons and connecting rod assemblies are available for service.

FITTING PISTONS

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. 6). Cylinder bores should be measured halfway down the cylinder bore and transverse to the engine crankshaft center line shown in (Fig. 4). Refer to (Fig. 5) for specifications.

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

Engine	Standard Bore	Maximum Out-of-Round	Maximum Taper
3.3L	92.993-93.007 mm 3.3661-3.6617 inch.	.076 mm (.003 inch.)	.51 mm (.002 inch.)
3.8L	95.993-96.007 mm 3.7792-3.780 inch.	Same	Same
Standard Piston Size			
3.3L	92.950-92.968 mm (3.6594-3.6602 inch.)		
3.8L	95.950-95.968 mm (3.7776-3.7783 inch.)		
Piston to Bore Clearance: .025-.057 mm (.0009 to .0022 inches .) Measurements taken at Piston Size location. Maximum Allowable Oversize Bore is .508 mm (.020 inches.)			

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Fig. 5 Cylinder Bore and Piston Specifications

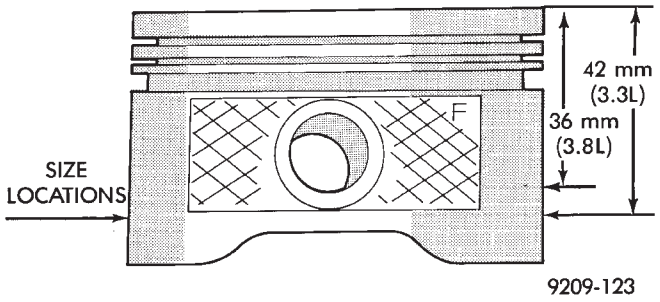

Fig. 6 Piston Measurements

PISTON PINS

The piston pin rotates in the piston only, and is retained by the press interference fit of the piston pin in the connecting rod. **The piston pin is not to be removed damage to the piston may result.**

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 12mm (.50 inch) from bottom of cylinder bore. Check gap with feeler gauge (Fig. 7).

Refer to specifications (Fig. 8).

(2) Check piston ring to groove clearance: (Fig. 9). Refer to specification (Fig. 8).

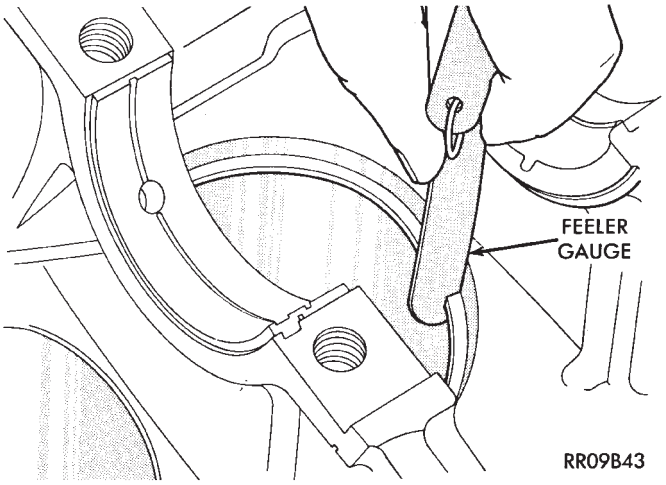

Fig. 7 Check Gap on Piston Rings

Ring Position	Ring Gap	Wear Limit
Upper Ring	0.30 to 0.55 mm (.012 to .022 in.)	1.0 mm (.039 in.)
Intermediate Ring	0.30 to 0.55 mm (.012 to .022 in.)	1.0 mm (.039 in.)
Oil Control Ring	0.25 to 1.00 mm (.010 to .039 in.)	1.88 mm (.074 in.)
Ring Position	**Groove Clearance**	**Maximum Clearance**
Upper Ring	0.030 to 0.085 mm (.001 to .0030 in.)	.10 mm (.004 in.)
Intermediate Ring	0.030 to 0.095 mm (.001 to .0037 in.)	.10 mm (.004 in.)
Oil Control Ring	0.014 to .266 mm (.0005 to .009 in.)	.266 mm (.009 in.)

9109-48

Fig. 8 Piston Ring Specifications

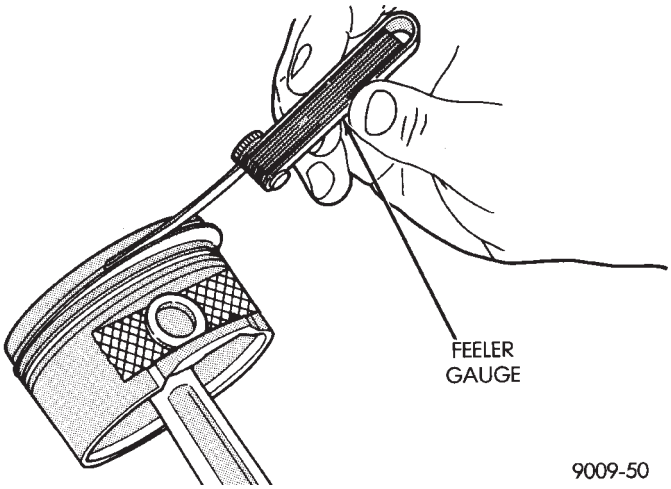

Fig. 9 Measuring Piston Ring Side Clearance

PISTON RINGS–INSTALLATION

(1) The No. 1 and No. 2 piston rings have a different cross section. Install rings with manufacturers I.D. mark facing up, to the top of the piston (Fig. 10).

CAUTION: Install piston rings in the following order:

(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. 11).

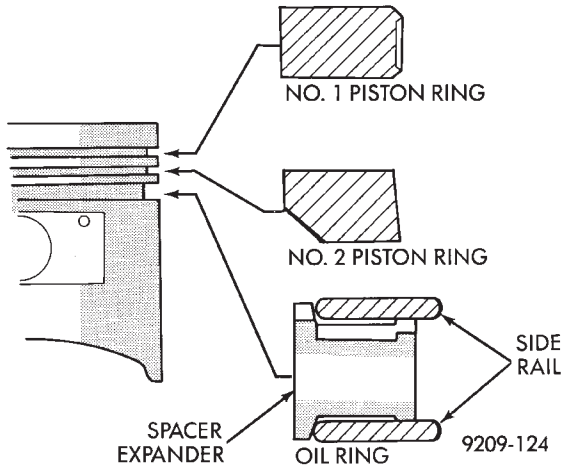

Fig. 10 Piston Ring Installation

(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. 12).

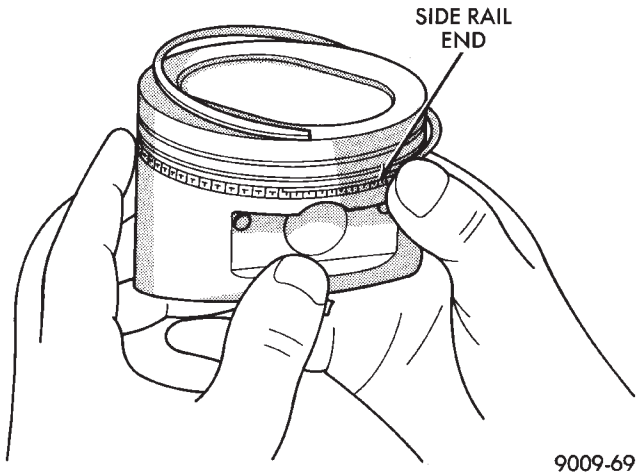

Fig. 11 Installing Side Rail

(5) Position piston ring end gaps as shown in (Fig. 13).

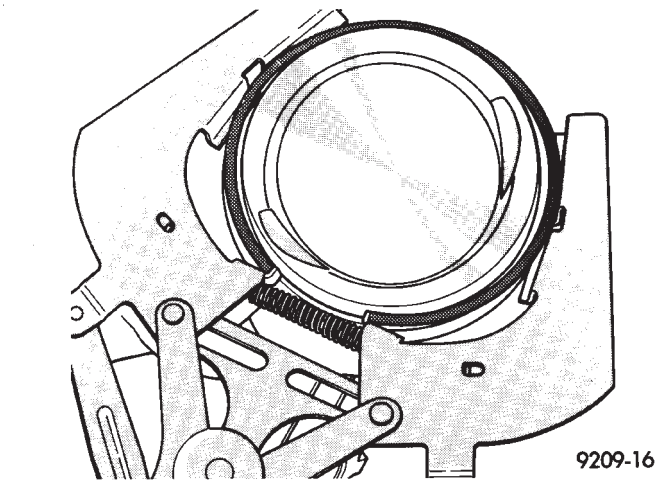

Fig. 12 Installing Upper and Intermediate Rings

(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.

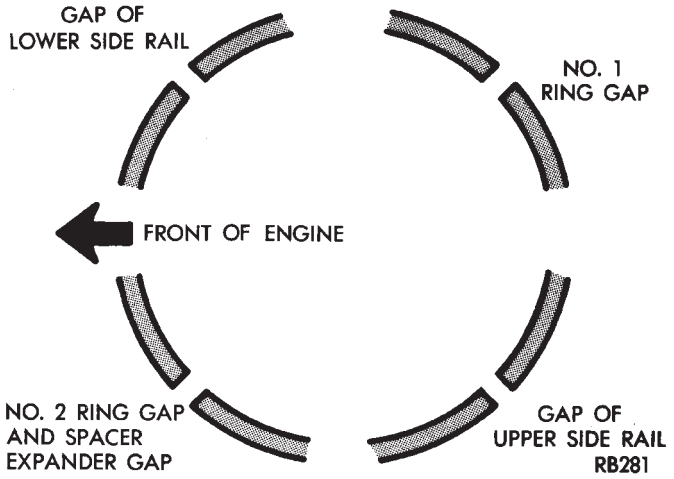

Fig. 13 Piston Ring End Gap Position

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.

(2) Before installing the ring compressor, make sure the oil ring expander ends are butted and the rail gaps located as shown in (Fig. 14).

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

(4) Install connecting rod bolt protectors on rod bolts. (Fig. 3).

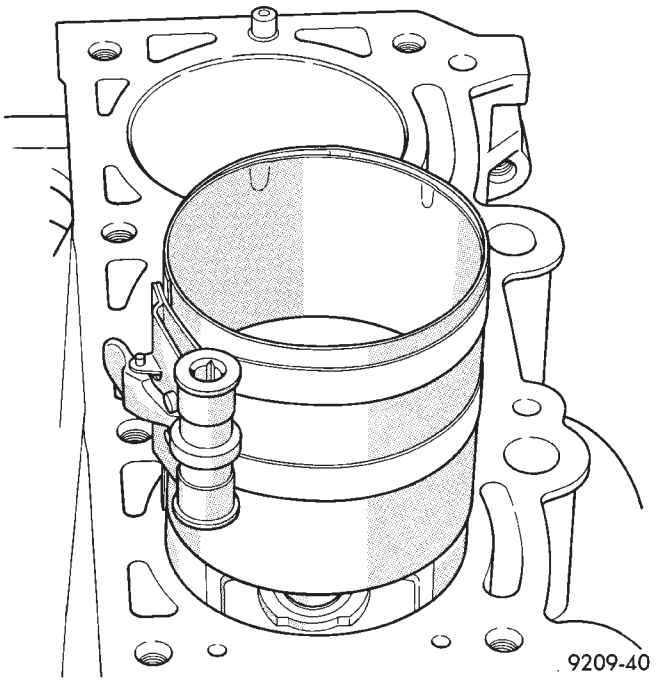

Fig. 14 Installing Piston

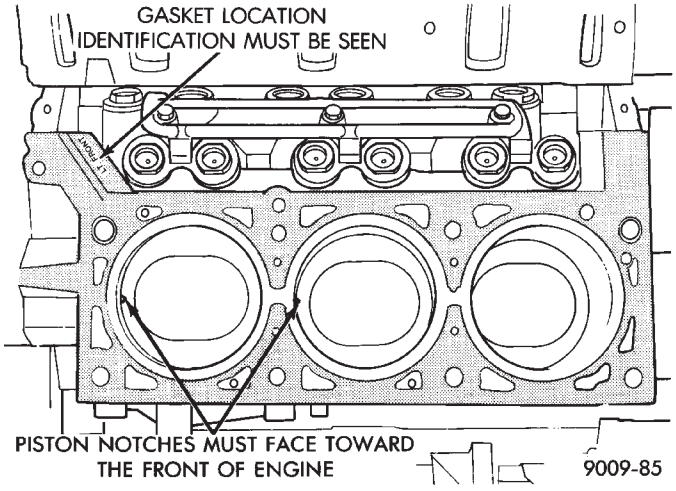

Fig. 15 Piston I.D. Notches

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

(6) 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. 15).

(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.

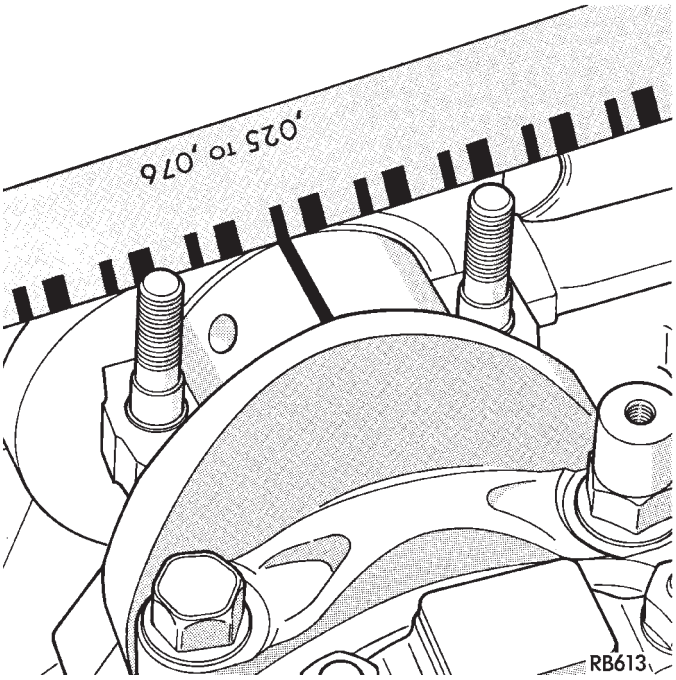

Fig. 16 Checking Connecting Rod Bearing Clearance

CONNECTING RODS

INSTALLATION OF 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 .025mm (.001 inch). Bearings are available in .025mm (.001 inch), .051mm (.002 inch), .076mm (.003 inch), .254mm (.010 inch) and .305mm (.012 inch) undersize. **Install the bearings in pairs. Do not use a new bearing half 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. 16).

The rod bearing bolts should be examined before reuse. If the threads are necked down the bolts should be replaced (Fig. 19).

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.

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

(3) Install nuts on each bolt finger tight 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. 17). Refer to (Fig. 18) for specifications.

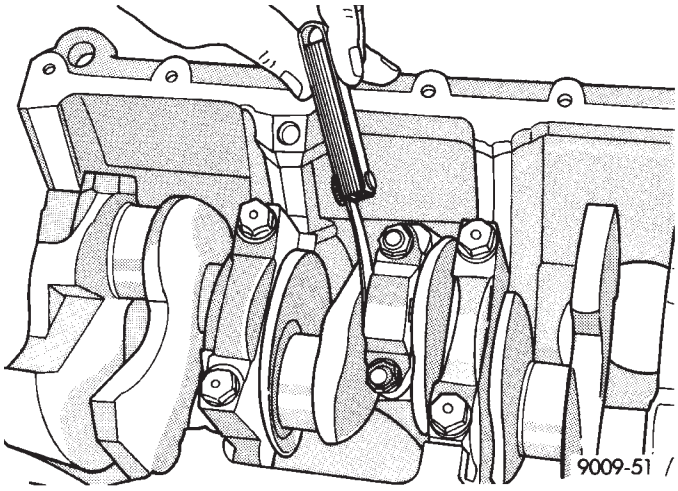

Fig. 17 Checking Connecting Rod Side Clearance

Connecting Rod Bearing Clearance	
New Part:	.019 to .087 mm (.0008 to .0034 in.)
Wear Limit:	.104 mm (.0041 in.)
Connecting Rod Side Clearance	
New Part:	0.13 to 0.32 mm (.005 to .013 in.)
Wear Limit:	0.38 mm (.015 in.)

9109-49

Fig. 18 Connecting Rod Specifications

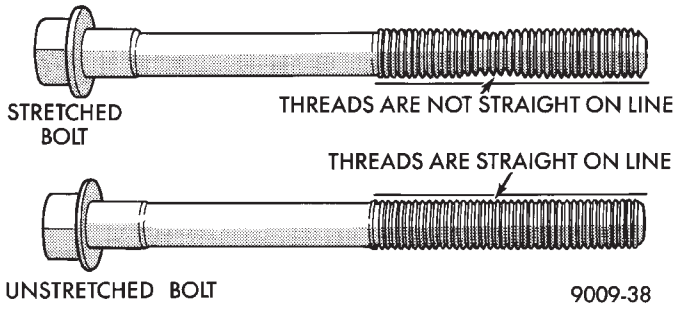

Fig. 19 Check for Stretched Rod Bolts

CRANKSHAFT SERVICE

CRANKSHAFT MAIN BEARINGS

Bearing caps are not interchangeable and should be marked at removal to insure correct assembly. (Fig. 1) 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 interchangeable.

CRANKSHAFT MAIN JOURNALS

The crankshaft journals should be checked for excessive wear, taper and scoring (Fig. 6). Limits of taper or out-of-round on any crankshaft journals should be held to .025mm (.001 inch). Journal grinding should not exceed .305mm (.012 inch) 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.

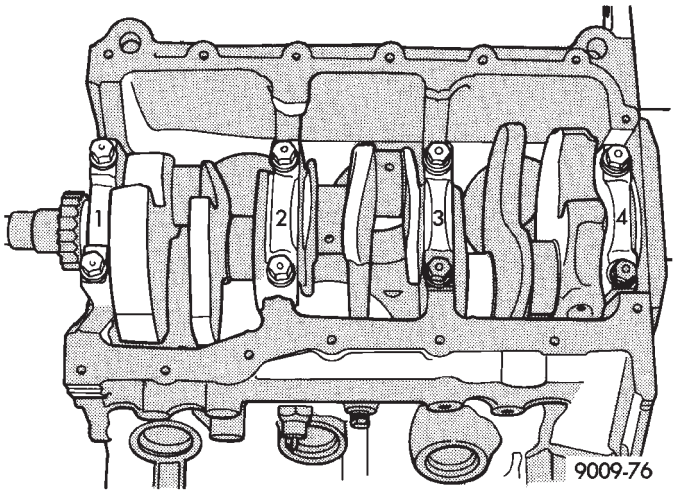

Fig. 1 Main Bearing Cap Identification

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. 2). 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: 0.025mm (.001 inch), .051mm (.002 inch), .076mm (.003 inch), .254mm (.010 inch), and .305mm (.012 inch). 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. 3) into the oil hole of crankshaft.

(3) Slowly rotate crankshaft clockwise, forcing out upper half of bearing shell.

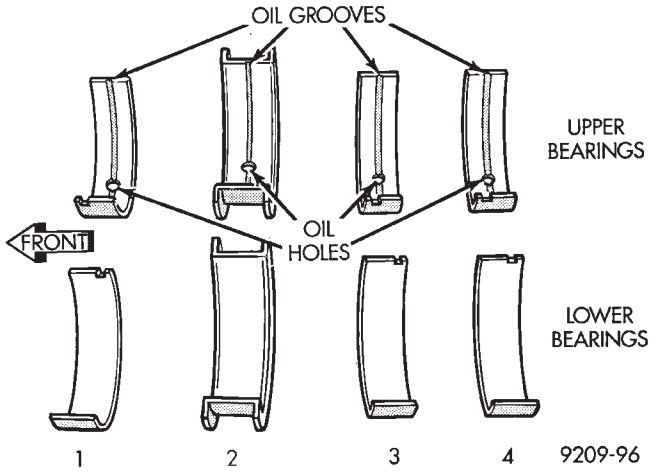

Fig. 2 Main Bearing Identification

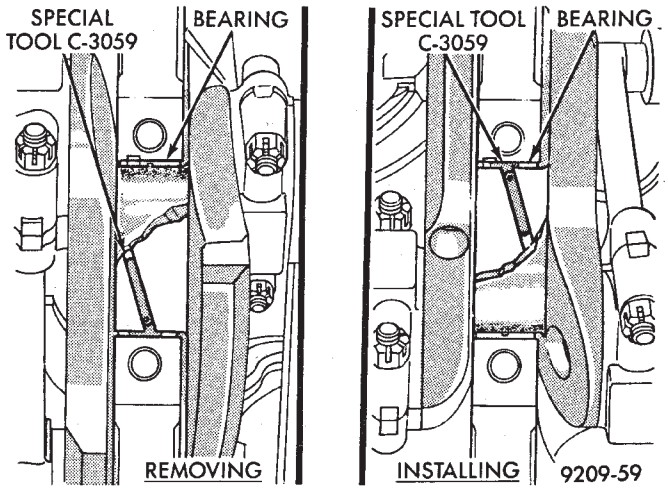

Fig. 3 Removing and Installing Upper Main Bearing With Special Tool C-3059

INSTALLATION

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. 3).

(2) Slowly rotate crankshaft counter-clockwise 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.

CHECKING CRANKSHAFT END PLAY

(1) Mount a dial indicator to front of engine, locating probe on nose of crankshaft (Fig. 4).

(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 (Fig. 5) for specifications.

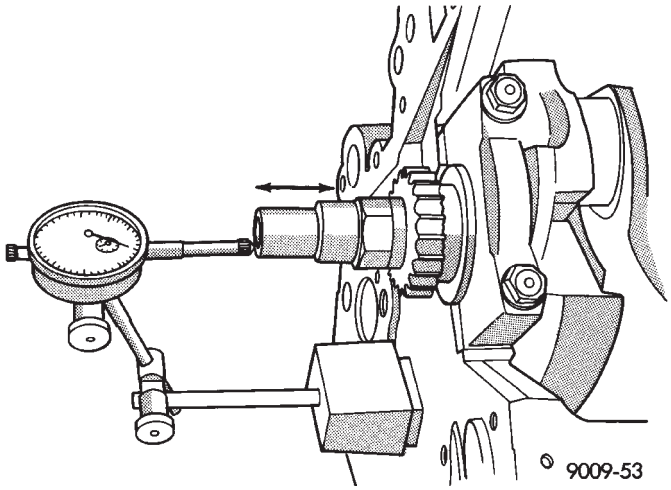

Fig. 4 Checking Crankshaft End Play

CRANKSHAFT END PLAY CHECK–OPTIONAL

(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 (Fig. 5) for specification.

CRANKSHAFT OIL CLEARANCE

(1) Measure the journal outside diameter as shown in (Fig. 6). Refer to specification (Fig. 5).

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. 7).

Crankshaft End-Play
New Part: .09 to 0.24 mm (.003 to .009 in.) Wear Limit: 0.37 mm (.015 in.)
Main and Connecting Rod Bearing Clearance
New Part: .019 to .077 mm (.0007 to .0030 in.) Wear Limit: .102 mm (.004 in.)
Crankshaft Journal Sizes
Crankshaft Main Bearing Journal
ALL — Diameter
Standard — 64.00 ± 0.013 mm (2.519 ± .0005 in.)
Crankshaft Connecting Rod Journal
ALL — Diameter
Standard — 58.00 ± 0.013 (2.283 ± .0005 in.)
9109-123

Fig. 5 Crankshaft specification

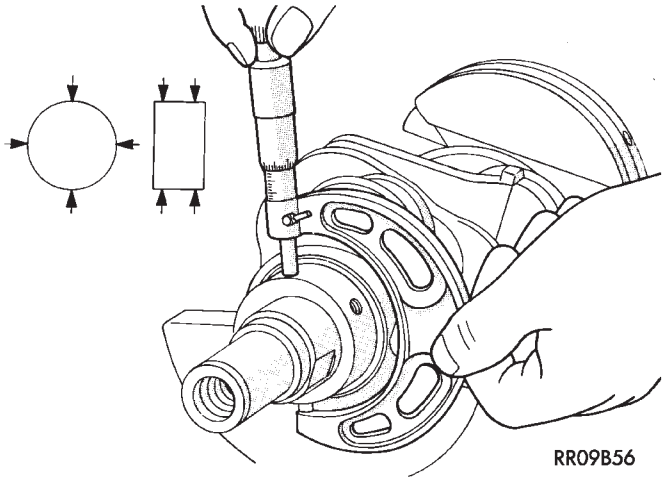

Fig. 6 Measure Crankshaft Journal O.D.

(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.

(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. 7). Refer to specification (Fig. 5) 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. Also see Measuring Main and Connecting Rod Bearing Clearance in Standard Service Procedures.

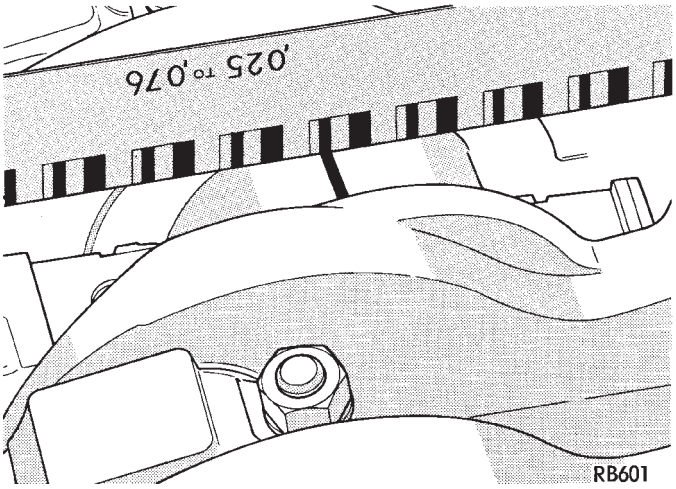

Fig. 7 Measuring Bearing Clearance with Plastigage

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

CRANKSHAFT OIL SEALS SERVICE

REMOVAL

Pry out rear seal with screwdriver. Be careful not to nick or damage crankshaft flange seal surface or retainer bore (Fig. 8).

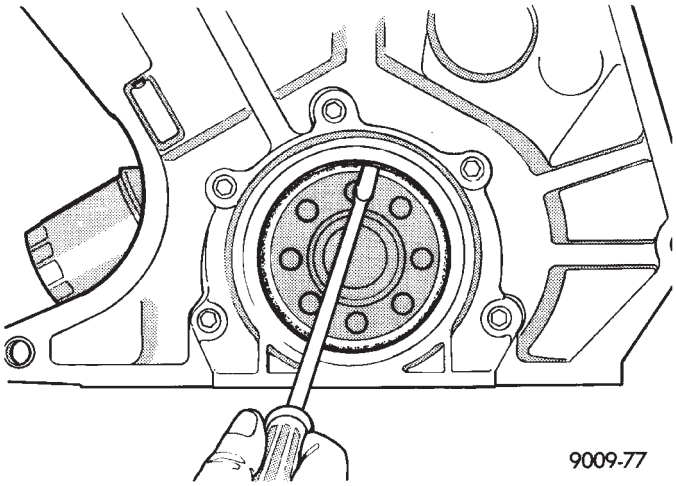

Fig. 8 Removing Rear Crankshaft Oil Seal

INSTALLATION

(1) Place Special Seal Pilot Tool C-4681 on crankshaft (Fig. 9).

(2) Lightly coat seal O.D. with Loctite Stud N' Bearing Mount or equivalent.

(3) Place seal over Special Seal Pilot Tool C-4681 and tap in place with a plastic hammer.

REAR CRANKSHAFT SEAL RETAINER

When retainer removal is required, remove retainer clean engine block and retainer of old gasket. Make sure surfaces are clean and free of oil. Install new gasket and tighten screws to 12 N·m (105 in. lbs.).

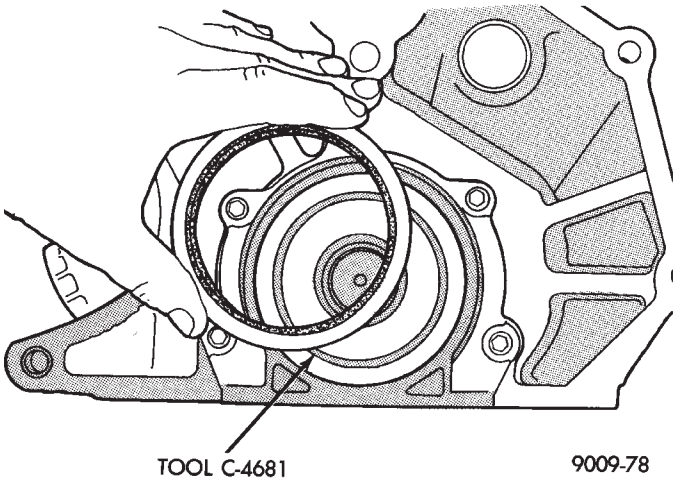

Fig. 9 Installing Rear Crankshaft Oil Seal

ENGINE LUBRICATING SYSTEM

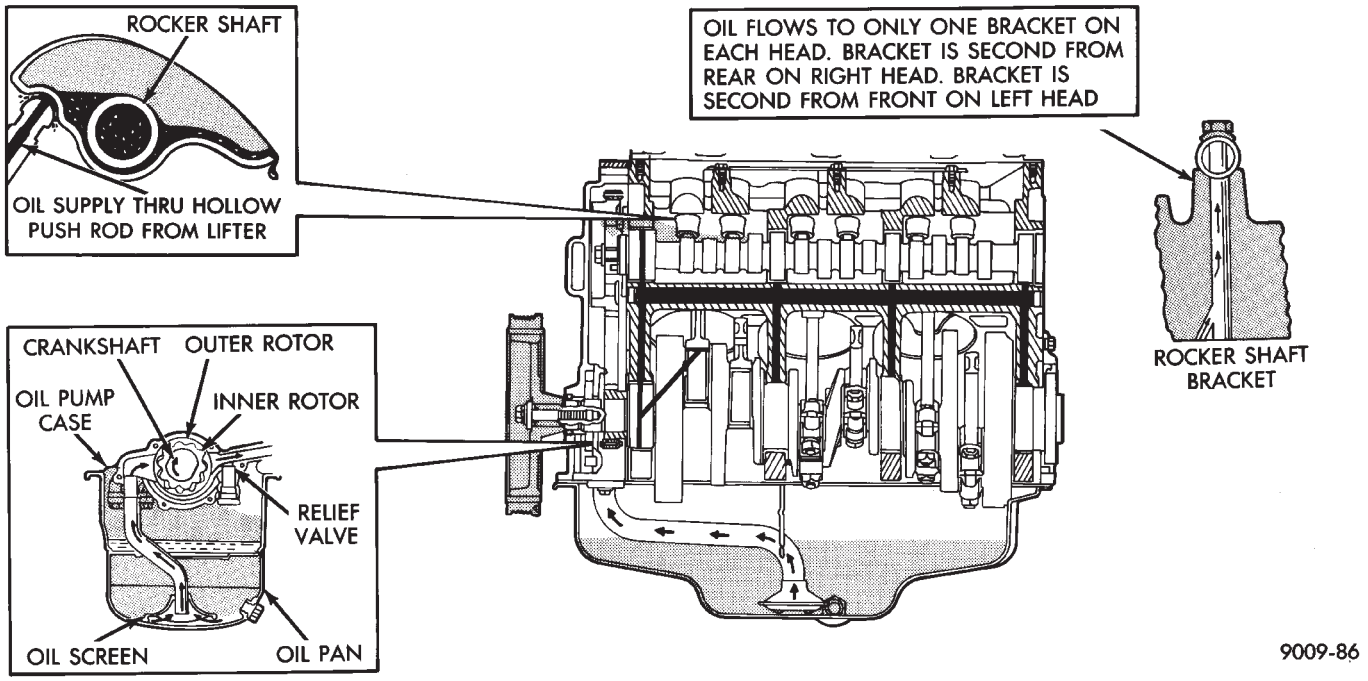

Fig. 1 Engine Oiling System

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. Its 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. 1).

OIL PAN SERVICE

REMOVAL

(1) Disconnect negative battery cable, remove engine oil dipstick.
(2) Raise vehicle. Drain engine oil.
(3) Remove oil pan screws and remove oil pan.

CLEANING AND INSPECTION

(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. lb.).
(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.

INSTALLATION

(1) Install oil pick-up tube into Chain Case Cover tighten screw to 28 N·m (250 in.lbs.) (Fig. 2).
(2) 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. 3).
(3) Use a new pan gasket (Fig. 4).
(4) Install pan and tighten screws to 23 N·m (200 in. lb.).

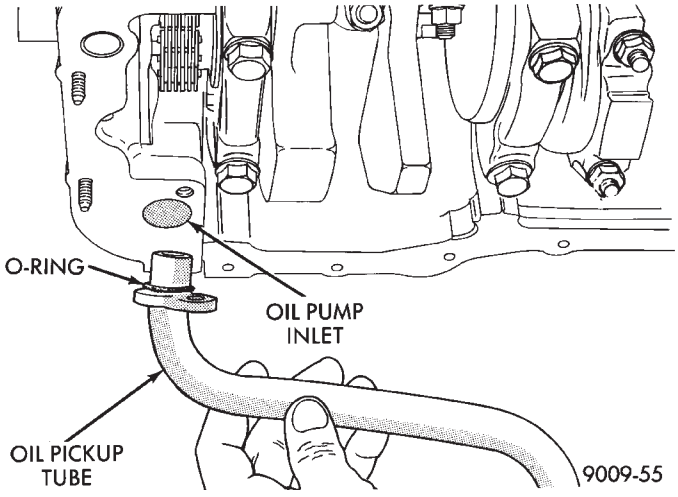

Fig. 2 Oil Pump Pick-up Tube Service

(5) Lower vehicle and install oil dipstick.
(6) Connect negative battery cable.

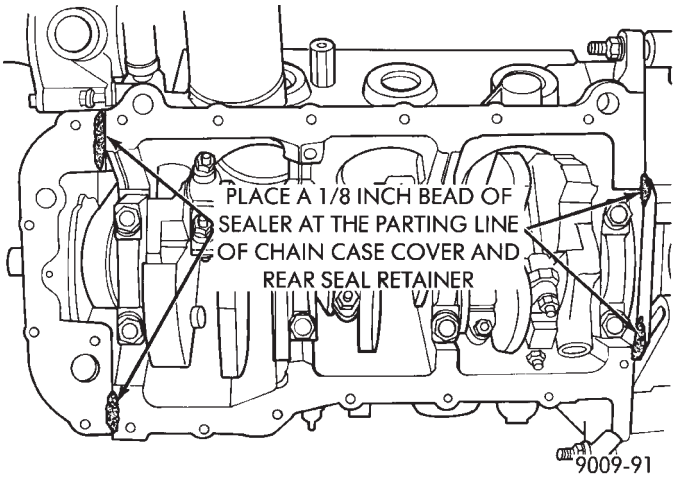

Fig. 3 Oil Pan Sealing

(7) Fill crankcase with oil to proper level.

OIL PUMP SERVICE

It is necessary to remove the oil pan, oil pickup and chain case cover (CCC) 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:

(a) Drill a 3.175mm (1/8 inch) hole into the relief valve retainer cap and insert a self-threading sheet metal screw into cap.

(b) Clamp screw into a vise and while supporting chain case cover (CCC), remove cap by tapping CCC using a soft hammer. Discard retainer cap and remove spring and relief valve (Fig. 5).

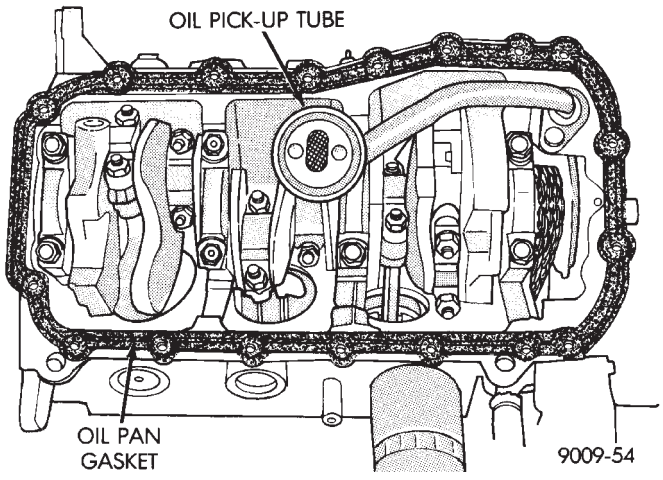

Fig. 4 Oil Pan Gasket Installation

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

(3) Remove pump rotors.

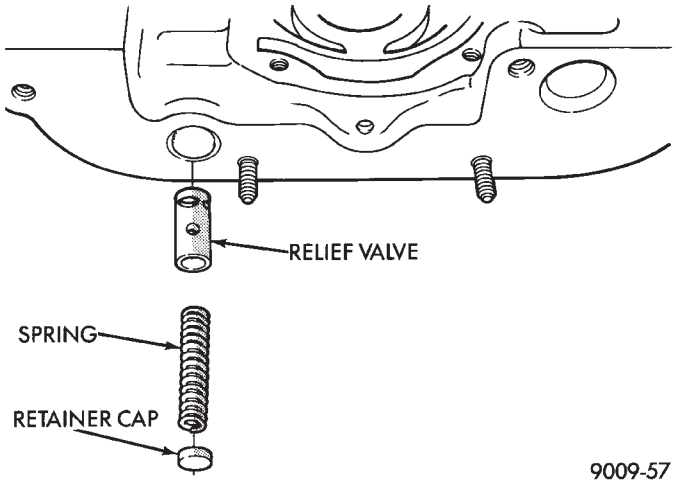

Fig. 5 Oil Pressure Relief Valve

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

INSPECTION AND REPAIR

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

(2) Lay a straightedge across the pump cover surface (Fig. 7). If a .076mm (.003 inch) feeler gauge can be inserted between cover and straight edge, cover should be replaced.

(3) Measure thickness and diameter of outer rotor. If outer rotor thickness measures 7.36mm (.3005 inch) or less (Fig. 8), or if the diameter is 79.78mm (3.141 inches) or less, replace outer rotor. For nichols rotors (8 lobes on inner rotor). If outer rotor thickness measures 7.64mm (0.0301 inch) or less (Fig. 8), or if the diameter is 79.95mm (3.148 inches) or less, replace outer rotor.

(4) If inner rotor measures 7.64mm (.301 inch) or less replace inner rotor, this specification applies to either rotor (Fig. 9).

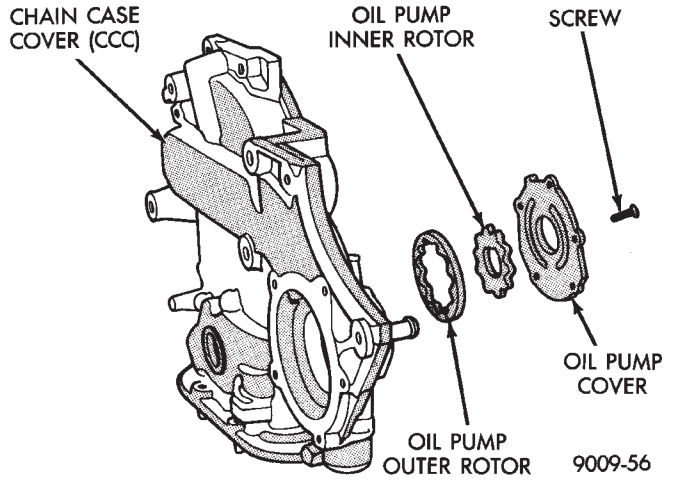

Fig. 6 Oil Pump

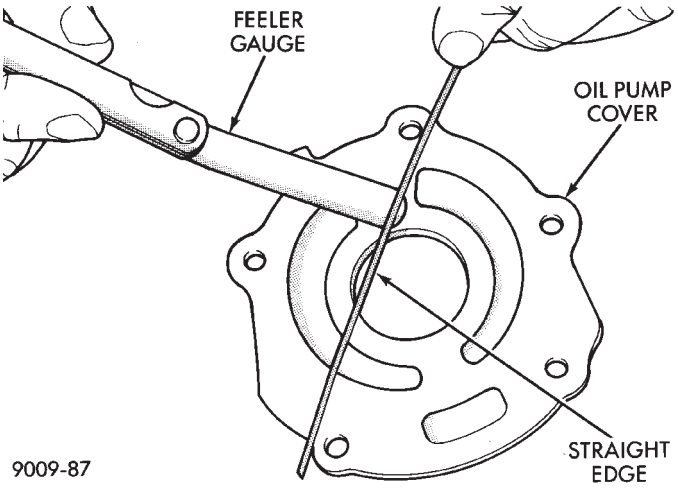

Fig. 7 Checking Oil Pump Cover Flatness

(5) Slide outer rotor into CCC, press to one side with fingers and measure clearance between rotor and CCC (Fig. 10). If measurement is 3.9mm (0.015 inch) for the nichols rotor (8 lobe rotor), 5.6mm (.022 inch) or more, replace CCC only if outer rotor is in spec.

(6) Install inner rotor into CCC. If clearance between inner and outer rotors (Fig. 11) is .203mm (.008 inch) or more, replace both rotors.

(7) Place a straightedge across the face of the CCC, between bolt holes. If a feeler gauge of .102mm (.004 inch) or more can be inserted between rotors and the straightedge, replace pump assembly (Fig. 12). **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 49.5mm (1.95 inches) it should test between 19.5 and 20.5 pounds when compressed to 34mm (1-11/32 inches). Replace spring that fails to meet specifications (Fig. 5).

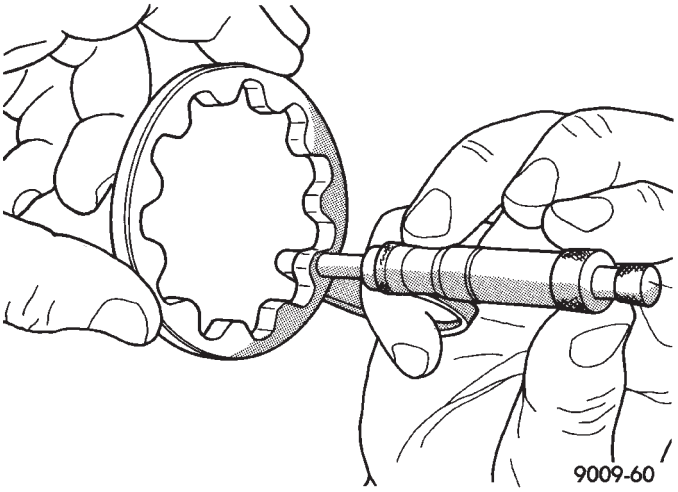

Fig. 8 Measuring Outer Rotor Thickness

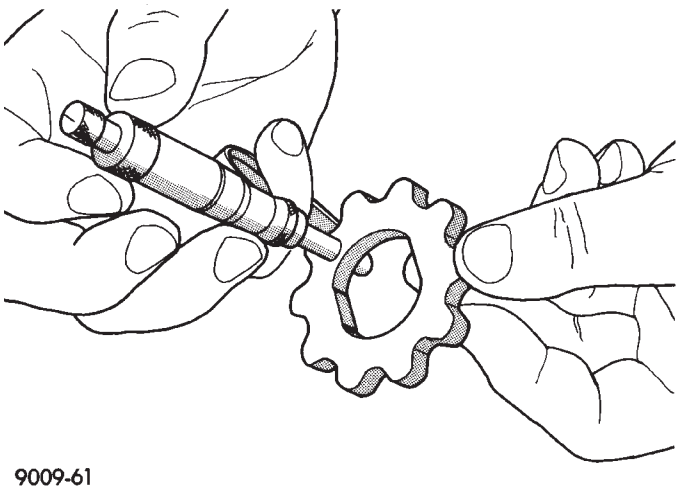

Fig. 9 Measuring Inner Rotor Thickness

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

OIL PUMP ASSEMBLY AND INSTALLATION

(1) Assemble pump, using new parts as required. **Pumps equipped with nichols rotors install the inner rotor with chamfer facing the 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 slowly refer to Timing Chain Cover Installation of this section.

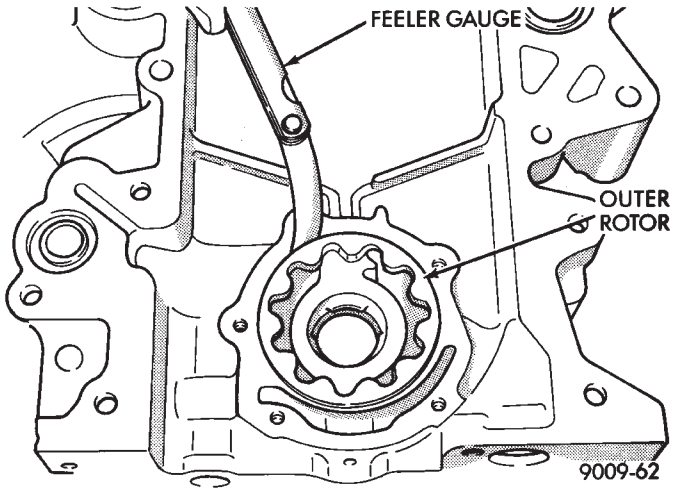

Fig. 10 Measuring Outer Rotor Clearance in Housing

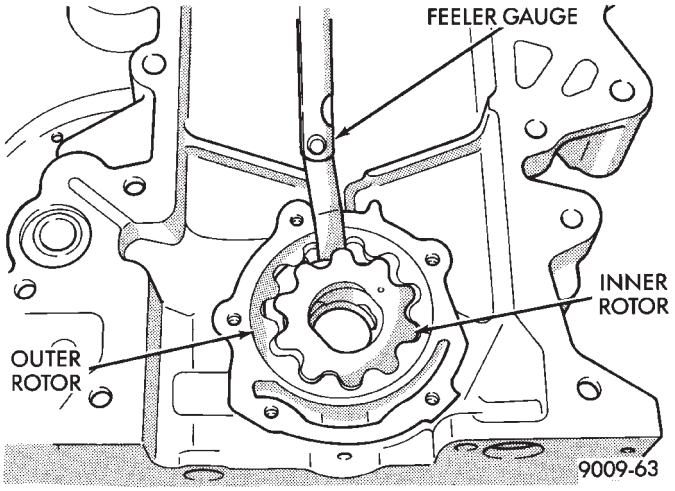

Fig. 11 Measuring Clearance Between Rotors

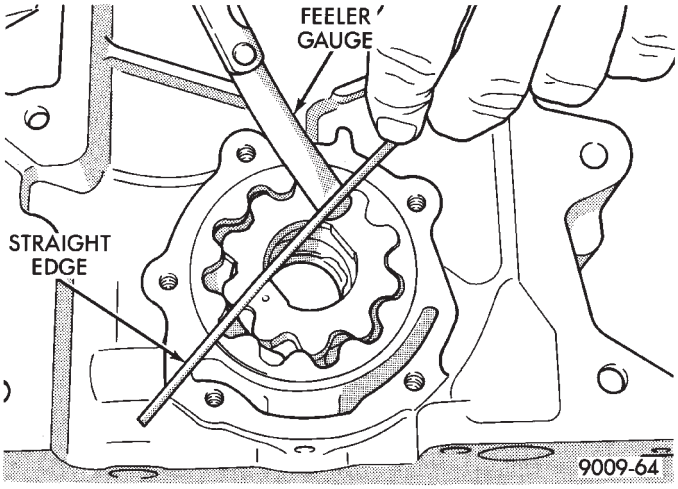

Fig. 12 Measuring Clearance Over Rotors

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. 13).

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

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

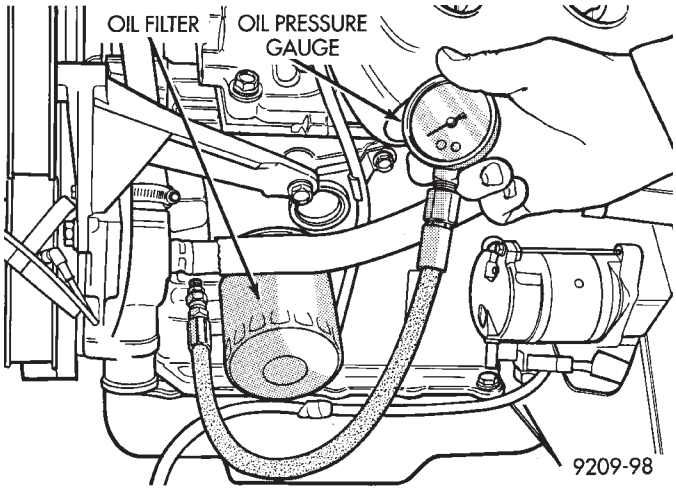

Fig. 13 Checking Oil Pump Pressure

OIL FILTER

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

(1) Using Tool C-4065, unscrew filter from base and discard (Fig. 14).

(2) Wipe base clean, then inspect gasket contact surface.

(3) Lubricate gasket of new filter with clean engine oil.

(4) Install and tighten filter to 20 N·m (15 ft. lbs.) torque after gasket contact base. Use filter wrench if necessary.

(5) Start engine and check for leaks.

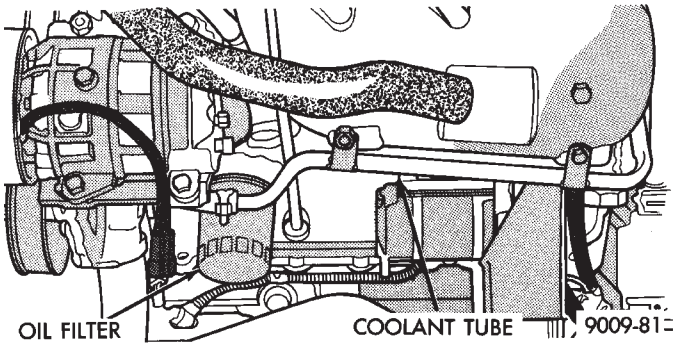

Fig. 14 Oil Filter

ENGINE SPECIFICATIONS

	3.3L Engine	3.8L Engine
Type	60° V-6 Engine	
Bore	93.0 mm (3.661 inches)	96.0 mm (3.779 inches)
Stroke	81.0 mm (3.188 inches)	87.0 mm (3.425 inches)
Compression Ratio	8.9:1	
Displacement	3.3 Liters (201 cubic inches)	3.8 Liters (231 cubic inches)
Brake Horsepower	147 @4800 RPM	151 @4400 RPM
Torque	185 lbs.-ft. @3600 RPM	204 lbs.-ft. @3200 RPM
Firing Order	1-2-3-4-5-6	
Minimum Compression Pressure, see "Engine Performance" in Standard Service Procedures	689.5 kPa (100 psi)	
Maximum Variation Between Cylinders	25%	
Cylinder Number (Front to Rear)		
Front Bank	2, 4, 6	
Rear Bank	1, 3, 5	
Cylinder Block		
Cylinder Bore (Standard)	93.0 mm (3.660 inches)	96.0 mm (3.779 inches)
Cylinder Bore Out-of-Round (Maximum Allowable Before Reconditioning)	0.076 mm (0.003 inch)	
Cylinder Bore Taper (Maximum Allowable Before Reconditioning)	0.051 mm (0.002 inch)	
Reconditioning Working Limits (For Taper and Out-of-Round)	0.001 inch	
Maximum Allowable Oversize (Cylinder Bores)	0.020 inch	
Tappet Bore Diameter	0.9051 inch–0.9059 inch	
Pistons		
Type Material	Aluminum Alloy Tin Coated	
Clearance at Size Location	0.025–0.057 mm (0.001 to 0.0022 inch)	
Weight (Std. Only)	381±5 gms	438 ± 5 gms
Pistons For Service	Standard Only	
Piston Pins		
Type	Press Fit in Rod (Serviced as an Assembly)	
Diameter	22.88 mm (0.9009–0.9007 inch)	
Length	67.25–67.75 mm (2.648–2.667 inches)	71.25–71.75 mm (2.805–2.824 inches)
Clearance in Piston (Light Thumb Push @70°F)	0.006–0.019 mm (0.0002–0.0007 inch)	
Clearance in Rod	(Interference)	
Piston Rings		
Number of Rings Per Piston	3	
Compression	2	
Oil	1	
Oil Ring Type	3-Piece, Steel Rail, Chrome-Face	
Ring Width		
Compression	1.46–1.5 mm (0.0575–0.0591 inch)	
Oil—Steel Rails	0.510 mm (0.0201 inch)	
Ring Gap		
Compression	0.300–0.550 mm (0.0118–0.0217 inch)	
Oil—Steel Rails	0.250–1.00 mm (0.0098–0.0394 inch)	
Ring Side Clearance		
Compression	0.030–0.095 mm (0.0012–0.0037 inch)	
Oil—Steel Rails	0.014–0.226 mm (0.0005–0.0089 inch)	
Service Rings		
Ring Gap		
Compression	0.300–0.550 mm (0.0018–0.0217 inch)	
Oil—Steel Rails	0.250–1.00 mm (0.0098–0.0394 inch)	
Ring Side Clearance		
Compression	0.030–0.095 mm (0.0012–0.0037 inch)	
Oil—Steel Rails	0.014–0.226 mm (0.0005–0.0089 inch)	

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ENGINE SPECIFICATIONS (CONT.)

Engine	3.3 /3.8L
CONNECTING RODS	
Side Clearance	0.127–0.381mm (0.005–0.015 inch)
CONNECTING ROD BEARINGS	
Type	Aluminum Lead (Bi-Metal)
Clearance Desired	0.019–0.076mm (0.00075–0.003 inch.)
Maximum Allowable	0.076mm (0.003 inch.)
Bearings for Service	Std., 0.025mm (0.001), 0.051mm (0.002) 0.076mm (0.003), 0.254mm (0.010), 0.305 mm (0.012 inches.)
CRANKSHAFT	
Type	Cast Nodular Iron
Bearings	Aluminum Lead (Bi-Metal)
Thrust Taken By	No. 2 Main Bearing
End Play	0.076–0.228mm (0.003–0.009 inch.)
Maximum Allowable	0.381mm (0.015 inch.)
Diametral Clearance Desired #1, 2, 3 and 4	0.018-0.076mm (0.0007-0.003 inch.)
Maximum Diametral Clearance #1, 2, 3 and 4	0.076mm (0.003 inch.)
MAIN BEARING JOURNALS	
Diameter	64mm (2.519 inch.)
Maximum Allowable Out-of-Round and/or Taper	0.025mm (0.001 inch.)
Bearings for Service	Std., 0.025mm (0.001), 0.051mm (0.002) 0.076mm (0.003), 0.254mm (0.010), 0.305mm (0.012 inches.)
CONNECTING ROD JOURNALS	
Diameter	58mm (2.283 inch.)
Maximum Allowable Out-of-Round and/or Taper	0.025mm (0.001 inch.)
CAMSHAFT	
Drive	Chain
Bearings	Steel Backed Babbitt
Number	4
Diametral Clearance	0.025–0.101mm (0.001–0.004 inch.)
Maximum Allowable Before Reconditioning	0.127mm (0.005 inch.)
Thrust Taken By	Thrust Plate
End Play	0.127–0.304mm (0.005–0.012 inch.)
Maximum Allowable	0.304mm (0.012 inch.)
CAMSHAFT JOURNALS	
Diameter	
No. 1	50.724–50.755mm (1.997–1.999 inch.)
No. 2	50.317–50.368mm (1.980–1.982 inch.)
No. 3	49.936–49.987mm (1.965–1.967 inch.)
No. 4	49.530–49.581mm (1.949–1.952 inch.)

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ENGINE SPECIFICATIONS (CONT.)

Engine	3.3 /3.8L
Camshaft Bearings	
Diameter	
No. 1	50.80–50.82 mm (2.000–2.001 inches)
No. 2	50.39–50.41 mm (1.984–1.985 inches)
No. 3	49.60–49.63 mm (1.953–1.954 inches)
No. 4	49.53–49.58 mm (1.950–1.951 inches)
Valve Timing	
Intake Opens (BTC)	0°
Intake Closes (ABC)	60°
Exhaust Opens (BBC)	48°
Exhaust Closes (ATC)	12°
Valve Overlap	12°
Intake Valve Duration	240°
Exhaust Valve Duration	240°
Timing Chain	
Number of Links	64
Pitch	.375 inch
Width	.750 inch
Tappets	
Type	Roller Hydraulic
Body Diameter	22.94–22.96 mm (0.9035–0.9040 inch)
Clearance to Block	0.027–0.060 mm (0.0011–0.0024 inch)
Service Tappets Available	Std., 0.025 mm (0.001), 0.20 mm (0.008), 0.762 mm (0.030 inches)
Cylinder Head	
Valve Seat Type	Powdered Metal Inserts
Valve Seat Run-Out (Maximum)	0.760 mm (0.003 inch)
Intake Valve Seat Angle	45–45-1/2°
Seat Width (Finished)	1.75–2.25 mm (0.069–0.088 inch)
Exhaust Valve Seat Angle	45–45-1/2°
Seat Width (Finished)	1.50–2.00 mm (0.057–0.078 inch)
Cylinder Head Gasket (Thickness Compressed)	1.78 mm (0.070 inch)
Valve Guides	
Type	Powdered Metal Inserts
Guide Bore Diameter	7.795–8.000 mm (0.313–0.3149 inch)
Valves—(Intake)	
Head Diameter	45.5 mm (1.79 inches)
Length Overall (New)	125.385–126.025 mm (4.936–4.961 inches)
Stem Diameter (Standard)	7.935–7.953 mm (0.312–0.313 inch)
Stem to Guide Clearance	0.025–0.095 mm (0.001–0.003 inch)
Maximum Allowable (By Rocking Method)	0.247 mm (0.010 inch)
Face Angle	44-1/2°
Valves for Service (Oversized Stem Diameter)	Std., 0.015 mm (0.005), 0.40 mm (0.015), 0.80 mm (0.030 inches)
Lift (Zero Lash)	10.16 mm (0.400 inch)
Minimum Valve Length After Grinding Tip	124.892 (4.916 inches)

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ENGINE SPECIFICATIONS (CONT.)

Engine	3.3 /3.8L

VALVES (EXHAUST)

Head Diameter	37.5mm (1.476 inch.)
Length Overall (New)	126.095–126.645mm (4.964–4.986 inch.)
Stem Diameter (Standard)	7.906–7.924mm (0.3112–0.3119 inch.)
Stem to Guide Clearance	0.051–0.175mm (0.002–0.006 inch.)
Maximum Allowable by Rocking Method	0.414mm (0.016 inch.)
Face Angle	44-1/2°
Valves for Service (Oversize Stem Diameter)	Std., 0.015mm (0.005), 0.40mm (0.015), 0.80mm (0.030 inches.)
Lift (Zero Lash)	10.16mm (0.400 inch.)
Minimum Valve Length After Grinding Tip	125.512mm (4.941 inch.)

ENGINE VALVE SPRINGS — Intake/Exhaust

Number	12
Free Length (Approx.)	48.5mm (1.909 inch.)
Wire Diameter	4.75mm (0.187 inch.)
Number of coils	6.8
Load When Compressed to — Valve Closed	401.5 - 443.7 N @ 39.88 mm 90 - 100 lbs. @ 1.57 inches.
— Valve Open	921.2 - 1018.2 N @ 29.72 mm 207 - 229 lbs. @ 1.17 inches.
Valve Spring Installed Height (Spring Seat to Retainer)	39.1–40.6mm (1-17/32–1-19/32 inch.)

ENGINE LUBRICATION

Pump Type	Rotary Full Pressure
Capacity	3.8 Liters (4 qts.) Without Oil Filter Change, 4.25 Liters (4.5 qts.) With Oil Filter Change.
Pump Drive	Crankshaft
Minimum Pressure, Engine Fully Warmed Up at Idle	34.47 kPa (5 psi)
3000 RPM	205–551 kPa (30–80 psi)
Oil Filter Bypass Valve Setting	62–103 kPa (9–15 psi)
Oil Pressure Switch Minimum Actuating Pressure	13.79–27.58 kPa (2–4 psi)
Oil Filter Type	Full Flow

Note: If Pressure Is 0 at Idle, Do Not Run Engine at 3000 RPM.

OIL PUMP — INSPECTION LIMITS FOR REPLACEMENT

Oil Pump Cover Out of Flat	0.076mm (0.003 inch or more)
Outer Rotor Thickness	7.63mm (0.3005 inch or less)
Outer Rotor Diameter	79.78 (3.141 inch or less)
Inner Rotor Thickness	7.64mm (0.301 inch or less)
Clearance Over Rotors — Outer	0.10mm (0.004 inch or more)
— Inner	0.10mm (0.004 inch or more)
Outer Rotor Clearance	0.56mm (0.022 inch or more)
Tip Clearance Between Rotors	0.20mm (0.008 inch or more)

Engines Equipped with Nichols Rotors (8 Lobes on inner rotor)

Inner Rotor Thickness	7.64 mm (0.301 inch or less)
Outer Rotor Thickness	7.64 mm (0.301 inch or less)
Outer Rotor Diameter	79.95 mm (3.148 inch or less)
Outer Tip Rotor Clearance	0.39 mm (0.015 inch or less)

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TORQUE

DESCRIPTION	TORQUE
A/C Compressor Bracket to Water Pump Bolt 41	41 N·m (30 ft. lbs.)
A/C Compressor to Bracket Bolt	68 N·m (50 ft. lbs.)
A/C Compressor Support Bolts	41 N·m (30 ft. lbs.)
Alternator Adjusting Strap Bolt	23 N·m (200 in. lbs.)
Alternator Adjusting Strap Mounting Bolt	41 N·m (30 ft. lbs.)
Alternator Bracket Bolt	41 N·m (30 ft. lbs.)
Alternator Mounting Pivot Nut	41 N·m (30 ft. lbs.)
Camshaft Sprocket Lockbolt	54 N·m (40 ft. lbs.)
Camshaft Thrust Plate	12 N·m (105 in. lbs.)
Chain Case Cover Bolt M8x1.25 M10x1.5	 27 N·m (20 ft. lbs.) 54 N·m (40 ft. lbs.)
Connecting Rod Nut	54 N·m (40 ft. lbs.) +1/4 Turn
Crankshaft Pulley Screw to Crankshaft	54 N·m (40 ft. lbs.)
Cylinder Head Bolt	33 N·m (25 ft. lbs.)
Cylinder Head Bolt	61, 88, 88 N·m (45, 65, 65 ft. lbs.) +1/4 Turn
Cylinder Head Covers – Bolt	12 N·m (105 in. lbs.)
Exhaust Manifold Screw	23 N·m (200 in. lbs.)
Exhaust Crossover Pipe Flange Nut/Bolt	33 N·m (25 ft. lbs.)

DESCRIPTION	TORQUE
Intake Manifold Bolt	23 N·m (200 in. lbs.)
Intake Manifold Gasket Retaining Screws	12 N·m (105 in. lbs.)
Intake Manifold Plenum Bolt	28 N·m (250 in. lbs.)
Main Bearing Cap Bolt	41 N·m (30 ft. lbs.) +1/4 Turn
Oil Filter Attaching Nipple	41 N·m (30 ft. lbs.)
Oil Lever Sensor Plug	27 N·m (20 ft. lbs.)
Oil Pan Drain Plug	27 N·m (20 ft. lbs.)
Oil Pan Screw	12 N·m (105 in. lbs.)
Oil Pressure Gauge Sending Unit	7 N·m (60 in. lbs.)
Oil Pump Cover Bolt T-30	12 N·m (105 in. lbs.)
Oil Pump Pick-up Tube Screw	28 N·m (250 in. lbs.)
Rocker Shaft Bracket Bolt	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 Toke Screw	12 N·m (105 in. lbs.)
Temperature Gauge Sending Unit	7 N·m (60 in. lbs.)
Timing Chain Snubber Screw	12 N·m (105 in. lbs.)
Water Pump to (Chain Case Cover) Bolt	12 N·m (105 in. lbs.)

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