ENGINE

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DESCRIPTION AND OPERATION

ENGINE

DESCRIPTION

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

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

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

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

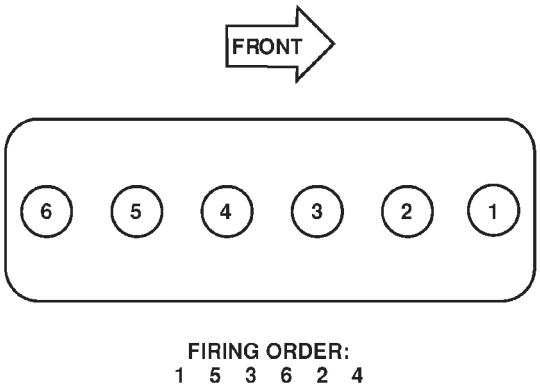


Fig. 1 Engine Firing Order

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

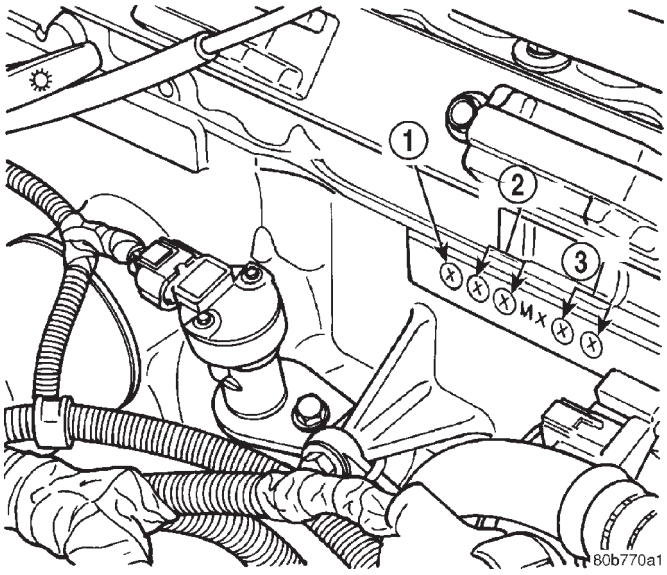


Fig. 2 Build Date Code Location

1 – YEAR
2 – MONTH
3 – DAY

The digits of the code identify:

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

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

DESCRIPTION AND OPERATION (Continued)

LUBRICATION SYSTEM

DESCRIPTION

A gear—type positive displacement pump is mounted at the underside of the block opposite the No. 4 main bearing.

OPERATION

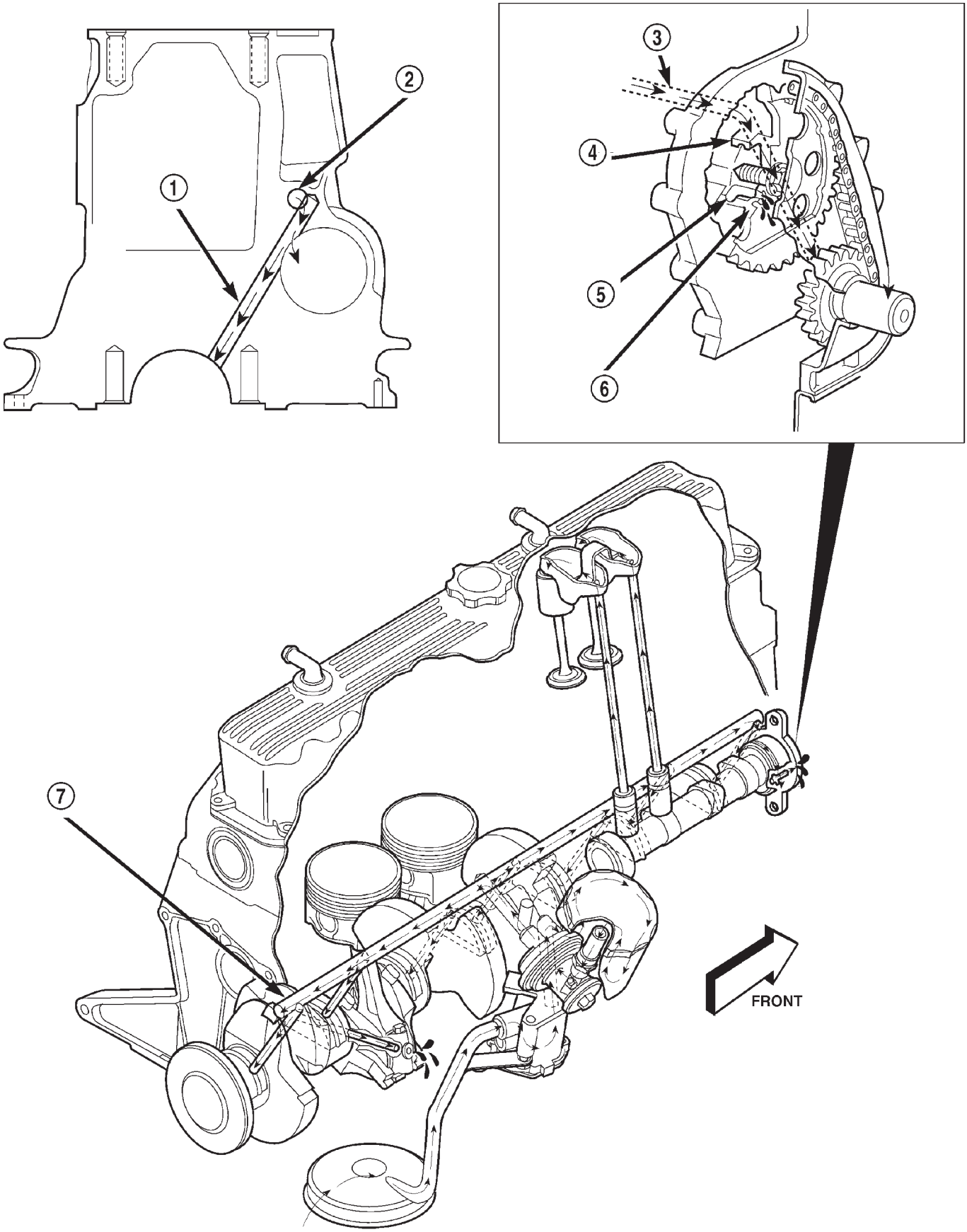
The pump draws oil through the screen and inlet tube from the sump at the rear of the oil pan. The oil is driven between the drive and idler gears and pump body, then forced through the outlet to the block. An oil gallery in the block channels the oil to the inlet side of the full flow oil filter. After passing through the filter element, the oil passes from the center outlet of the filter through an oil gallery that channels the oil up to the main gallery which extends the entire length of the block.

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

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

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

DESCRIPTION AND OPERATION (Continued)



Oil Lubrication System—4.0L Engine

DESCRIPTION AND OPERATION (Continued)

1 – CAM/CRANK MAIN GALLERY (7)
2 – TAPPET GALLERY
3 – TAPPET GALLERY
4 – CAMSHAFT BEARING
5 – NUMBER 1 CAMSHAFT BEARING JOURNAL
6 – CAMSHAFT SPROCKET
7 – TAPPET GALLERY

CYLINDER BLOCK

DESCRIPTION

The cylinder block is a cast iron inline six cylinder design. The cylinder block is drilled forming galleries for both oil and coolant (Fig. 3).

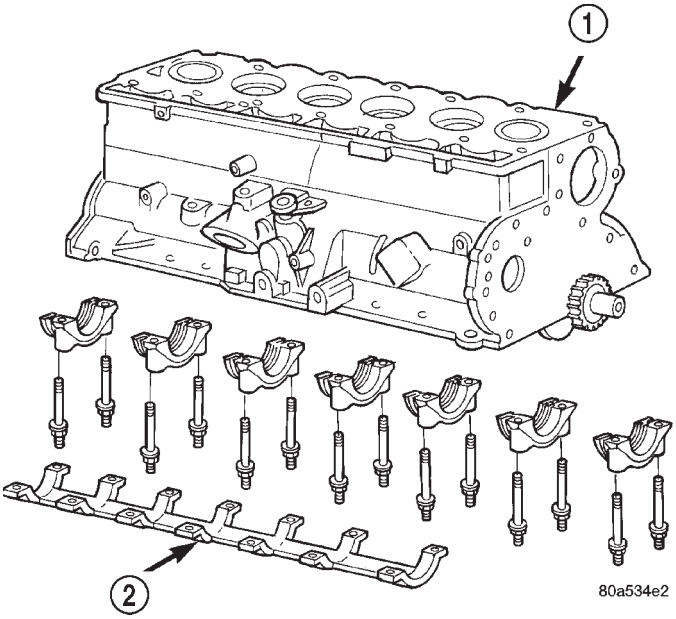


Fig. 3 4.0L Cylinder Block with Main Bearing Caps and Cap Brace

1 – BLOCK
2 – MAIN BEARING CAP BRACE

CYLINDER HEAD

DESCRIPTION

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

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

The cylinder head uses dual quench-type design combustion chambers which cause turbulence in the cylinders allowing faster burning of the air/fuel mixture, resulting in better fuel economy (Fig. 4).

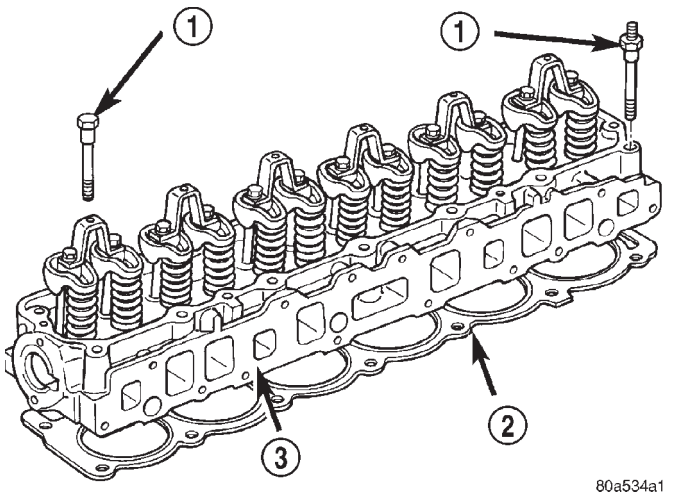


Fig. 4 Cylinder Head 4.0L Engine

1 – CYLINDER HEAD BOLTS
2 – CYLINDER HEAD GASKET
3 – CYLINDER HEAD

CRANKSHAFT

DESCRIPTION

The crankshaft is constructed of nodular cast iron. The crankshaft is a crosshaped four throw design with eight counterweights for balancing purposes. The crankshaft is supported by seven select main bearings with the number three serving as the thrust washer location. The main journals of the crankshaft are cross drilled to improve rod bearing lubrication. The select fit main bearing markings are located on the crankshaft counter weights. The crankshaft rear oil seal is a two piece design. The front oil seal is a one piece design retained in the timing chain cover (Fig. 5).

PISTON AND CONNECTING ROD

DESCRIPTION

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

DESCRIPTION AND OPERATION (Continued)

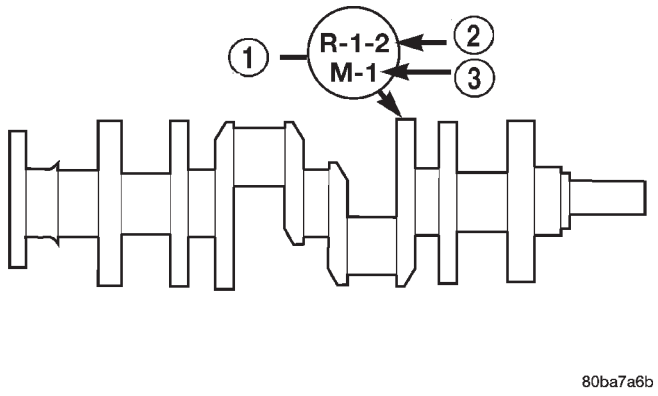


Fig. 5 Crankshaft with Select Fit Marking Location

1 – 1/4" LETTERS
2 – (ROD)
3 – (MAIN)

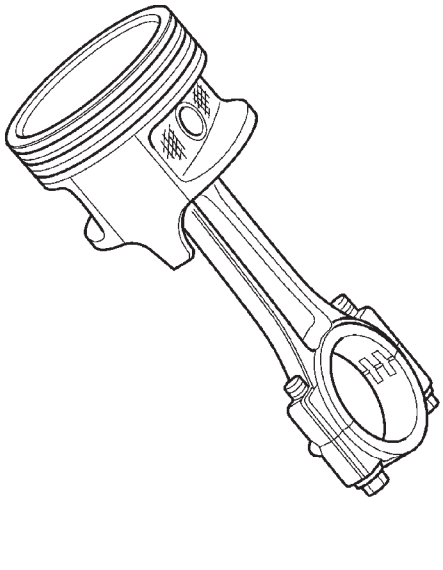


Fig. 6 Piston and Connecting Rod Assembly

CAMSHAFT

DESCRIPTION

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

ROCKER ARM

DESCRIPTION

The rocker arms are made of stamped steel and have a operational ratio of 1.6:1. When the push rods are forced upward by the camshaft lobes the push rod presses upward on the rocker arms, the rocker arms pivot, forcing downward pressure on the valves forcing the valves to move downward and off from their seats (Fig. 8).

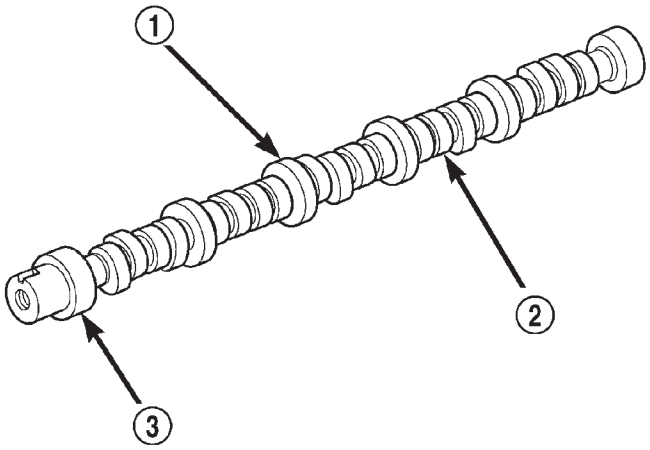


Fig. 7 Camshaft—Typical

1 – CAMSHAFT
2 – LOBES
3 – BEARING JOURNAL

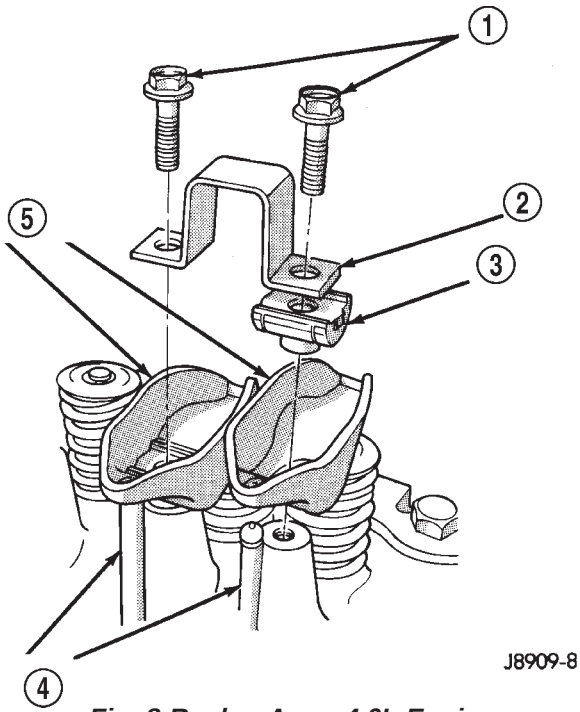


Fig. 8 Rocker Arms 4.0L Engine

1 – CAPSCREWS
2 – BRIDGE
3 – PIVOT ASSEMBLY
4 – PUSH RODS
5 – ROCKER ARMS

DESCRIPTION AND OPERATION (Continued)

VALVES

DESCRIPTION

The valves are made of heat resistant steel and have chrome plated stems to prevent scuffing. All valves use three bead locks to promote valve rotation (Fig. 9).

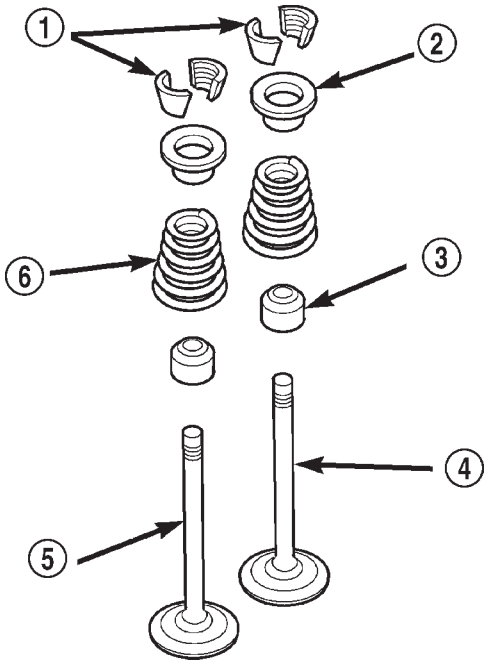


Fig. 9 Valve and Keeper Configuration 4.0L Engine

1 – VALVE LOCKS (3–BEAD)
2 – RETAINER
3 – VALVE STEM OIL SEAL
4 – INTAKE VALVE
5 – EXHAUST VALVE
6 – VALVE SPRING

VALVE SPRING

DESCRIPTION

The valve springs are made of high strength silicon chrome spring steel. The springs are common for both intake and exhaust valves. (Fig. 9).

VALVE STEM SEAL

DESCRIPTION

The valve stem seals are made of rubber and incorporate a garter spring to maintain consistent lubrication control (Fig. 9).

CYLINDER HEAD COVER

DESCRIPTION

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

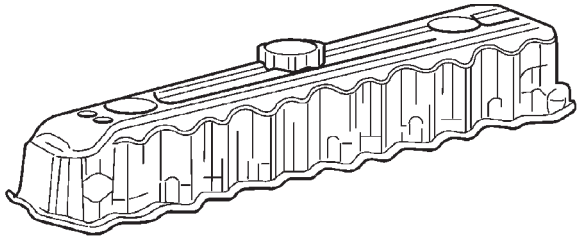


Fig. 10 Cylinder Head Cover

HYDRAULIC TAPPET

DESCRIPTION

Valve lash is controlled by hydraulic tappets located inside the cylinder block, in tappet bores above the camshaft.

OIL PAN

DESCRIPTION

The oil pan is made of stamped steel. The oil pan gasket is a one piece steel backbone silicone coated gasket.

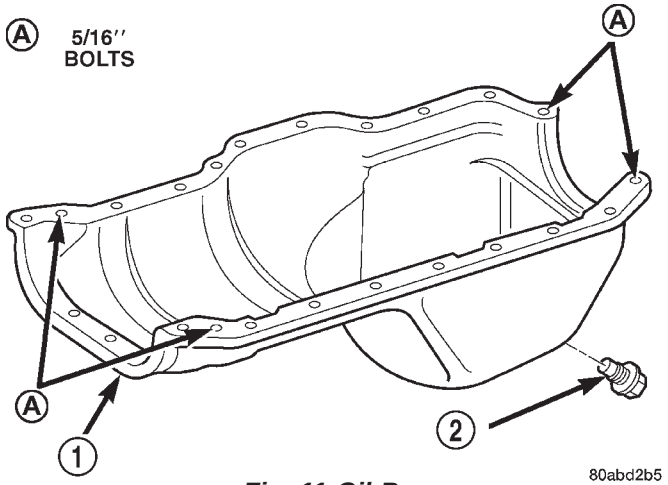


Fig. 11 Oil Pan

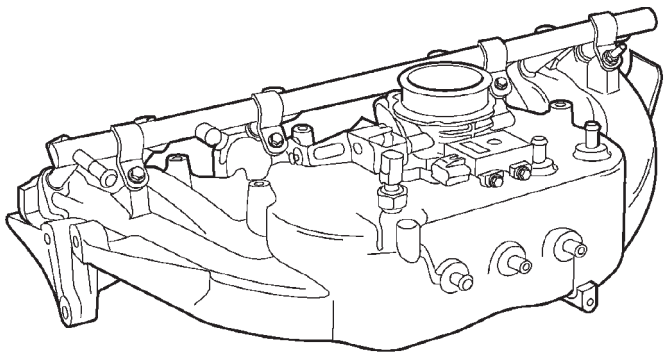
1 – OIL PAN
2 – OIL PAN DRAIN PLUG

DESCRIPTION AND OPERATION (Continued)

INTAKE MANIFOLD

DESCRIPTION

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



80bc4bb8

Fig. 12 Intake Manifold 4.0L Engine

EXHAUST MANIFOLD

DESCRIPTION

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

DIAGNOSIS AND TESTING

ENGINE DIAGNOSIS—INTRODUCTION

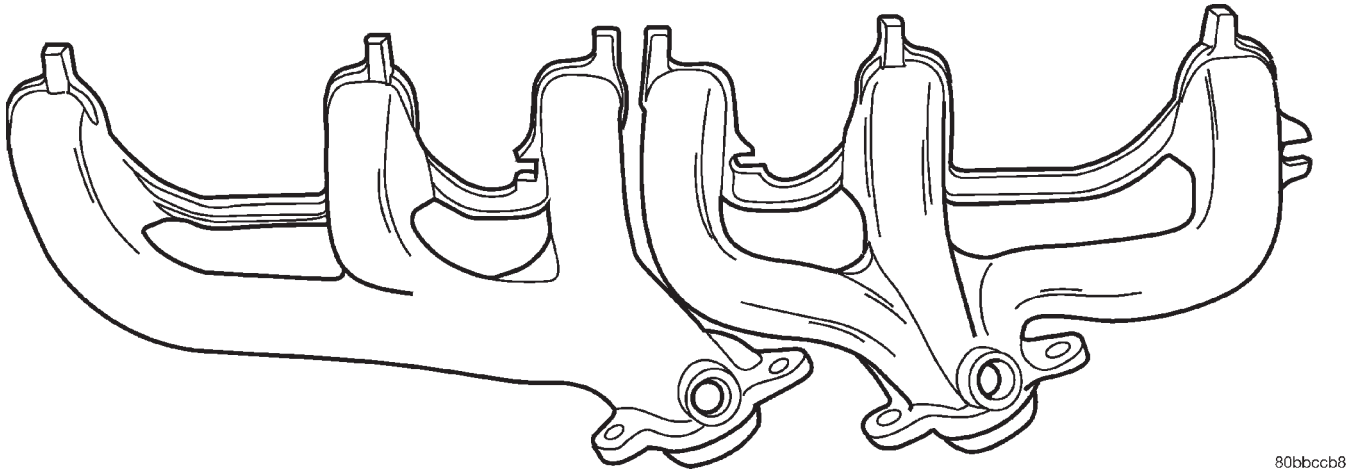
Engine diagnosis is helpful in determining the causes of malfunctions not detected and remedied by routine maintenance.

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

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

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

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



80bbccb8

Fig. 13 Exhaust Manifolds 4.0L Engine

DIAGNOSIS AND TESTING (Continued)

SERVICE DIAGNOSIS—PERFORMANCE

ENGINE PERFORMANCE DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSES	CORRECTION
ENGINE WILL NOT CRANK	1. Weak or dead battery	1. Charge/Replace Battery. Refer to Group 8A, Battery, for correct procedures. Check charging system. Refer to Group 8C, Charging Systems, for correct procedures.
	2. Corroded or loose battery connections	2. Clean/tighten suspect battery/starter connections
	3. Faulty starter or related circuit(s)	3. Check starting system. Refer to Group 8B, Starting Systems, for correct diagnostics/procedures
	4. Siezed accessory drive component	4. Remove accessory drive belt and attempt to start engine. If engine starts, repair/ replace siezed component.
	5. Engine internal mechanical failure or hydro-static lock	5. Refer to Group 9, Engine, for correct diagnostics/procedures
ENGINE CRANKS BUT WILL NOT START	1. No spark	1. Check for spark. Refer to Group 8D, Ignition System, for correct procedures.
	2. No fuel	2. Perform fuel pressure test, and if necessary, inspect fuel injector(s) and driver circuits. Refer to Group 14, Fuel System, for correct procedures.
	3. Low or no engine compression	3. Perform cylinder compression pressure test. Refer to Group 9, Engine, for correct procedures.
ENGINE LOSS OF POWER	1. Worn or burned distributor rotor	1. Install new distributor rotor
	2. Worn distributor shaft	2. Remove and repair distributor (Refer to group 8D, Ignition System
	3. Worn or incorrect gapped spark plugs	3. Clean plugs and set gap. (Refer to group 8D, Ignition System)
	4. Dirt or water in fuel system	4. Clean system and replace fuel filter
	5. Faulty fuel pump	5. Install new fuel pump
	6. Incorrect valve timing	6. Correct valve timing
	7. Blown cylinder head gasket	7. Install new cylinder head gasket
	8. Low compression	8. Test cylinder compression
	9. Burned, warped, or pitted valves	9. Install/Reface valves as necessary
	10. Plugged or restricted exhaust system	10. Install new parts as necessary
	11. Faulty ignition cables	11. Replace any cracked or shorted cables
	12. Faulty ignition coil	12. Test and replace, as necessary (Refer to Group 8D, ignition system)

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
ENGINE STALLS OR ROUGH IDLE	1. Carbon build-up on throttle plate	1. Remove throttle body and de-carbon. (Refer to Group 14 for correct procedures)
	2. Engine idle speed too low	2. Check Idle Air Control circuit. (Refer to Group 14, Fuel System)
	3. Worn or incorrectly gapped spark plugs	3. Replace or clean and re-gap spark plugs (Refer to group 8D, Ignition System)
	4. Worn or burned distributor rotor	4. Install new distributor rotor
	5. Spark plug cables defective or crossed	5. Check for correct firing order or replace spark plug cables. (Refer to Group 8D, Ignition System for correct procedures.)
	6. Faulty coil	6. Test and replace, if necessary (Refer to group 8D, Ignition System)
	7. Intake manifold vacuum leak	7. Inspect intake manifold gasket and vacuum hoses. Replace if necessary (Refer to Group 11, Exhaust System & Intake Manifold)
	8. EGR valve leaking or stuck open	8. Test and replace, if necessary (Refer to group 25, Emission Control Systems)
ENGINE MISSES ON ACCELERATION	1. Worn or incorrectly gapped spark plugs	1. Replace spark plugs or clean and set gap. (Refer to group 8D, Ignition System)
	2. Spark plug cables defective or crossed	2. Check Idle Air Control circuit. (Refer to Group 14, Fuel System)
	3. Dirt in fuel system	3. Clean fuel system
	4. Burned, warped or pitted valves	4. Install new valves
	5. Faulty coil	5. Test and replace as necessary (refer to group 8D, Ignition System)

SERVICE DIAGNOSIS—MECHANICAL

ENGINE MECHANICAL DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSES	CORRECTION
NOISY VALVES/ LIFTERS	1. High or low oil level in crankcase	1. Check for correct oil level. Adjust oil level by draining or adding as needed
	2. Thin or diluted oil	2. Change oil (Refer to Engine Oil Service in this group)
	3. Low oil pressure	3. Check engine oil level. If ok, Perform oil pressure test. Refer to this group for engine oil pressure test/specifications
	4. Dirt in tappets/lash adjusters	4. Clean/replace hydraulic tappets/lash adjusters
	5. Bent push rod(s)	5. Install new push rods
	6. Worn rocker arms	6. Inspect oil supply to rocker arms and replace worn arms as needed
	7. Worn tappets/lash adjusters	7. Install new hydraulic tappets/lash adjusters

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	8. Worn valve guides	8. Inspect all valve guides and replace as necessary
	9. Excessive runout of valve seats or valve faces	9. Grind valves and seats
CONNECTING ROD NOISE	1. Insufficient oil supply	1. Check engine oil level. (Refer to group 0, Lubrication and Maintenance)
	2. Low oil pressure	2. Check engine oil level. If ok, Perform oil pressure test. Refer to this group for engine oil pressure test/specifications
	3. Thin or diluted oil	3. Change oil to correct viscosity. Refer to this group for correct procedure/engine oil specifications
	4. Excessive connecting rod bearing clearance	Measure bearings for correct clearance with plasti-gage. Repair as necessary
	5. Connecting rod journal out of round	5. Replace crankshaft or grind journals
	6. Misaligned connecting rods	6. Replace bent connecting rods
MAIN BEARING NOISE	1. Insufficient oil supply	1. Check engine oil level. (Refer to group 0, Lubrication and Maintenance)
	2. Low oil pressure	2. Check engine oil level. If ok, Perform oil pressure test. Refer to this group for engine oil pressure test/specifications
	3. Thin or diluted oil	3. Change oil to correct viscosity. Refer to this group for correct procedure/engine oil specifications
	4. Excessive main bearing clearance	4. Measure bearings for correct clearance. Repair as necessary
	5. Excessive end play	5. Check crankshaft thrust bearing for excessive wear on flanges
	6. Crankshaft main journal out of round or worn	6. Grind journals or replace crankshaft
	7. Loose flywheel or torque converter	7. Inspect crankshaft, flexplate/flywheel and bolts for damage. Tighten to correct torque
LOW OIL PRESSURE	1. Low oil level	1. Check oil level and fill if necessary
	2. Faulty oil pressure sending unit	2. Install new sending unit
	3. Clogged oil filter	3. Install new oil filter
	4. Worn oil pump	4. Replace worn gears or oil pump assy
	5. Thin or diluted oil	5. Change oil to correct viscosity. Refer to this group for correct procedure/engine oil specifications
	6. Excessive bearing clearance	6. Measure bearings for correct clearance
	7. Oil pump relief valve stuck	7. Remove valve to inspect, clean and reinstall
	8. Oil pump suction tube loose, broken, bent or clogged	8. Inspect suction tube and clean or replace if necessary
	9. Oil pump cover warped or cracked	9. Install new oil pump

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
OIL LEAKS	1. Misaligned or deteriorated gaskets	1. Replace gasket
	2. Loose fastener, broken or porous metal part	2. Tighten, repair or replace the part
	3. Front or rear crankshaft oil seal leaking	3. Replace seal
	4. Leaking oil gallery plug or cup plug	4. Remove and reseal threaded plug. Replace cup style plug
EXCESSIVE OIL CONSUMPTION OR SPARK PLUGS OIL FOULED	1. PCV System malfunction	1. Refer to group 25, Emission Control System for correct operation
	2. Defective valve stem seal(s)	2. Repair or replace seal(s)
	3. Worn or broken piston rings	3. Hone cylinder bores. Install new rings
	4. Scuffed pistons/cylinder walls	4. Hone cylinder bores and replace pistons as required
	5. Carbon in oil control ring groove	5. Remove rings and de-carbon piston
	6. Worn valve guides	6. Inspect/replace valve guides as necessary
	7. Piston rings fitted too tightly in grooves	7. Remove rings and check ring end gap and side clearance. Replace if necessary

HYDRAULIC TAPPETS

LEAK-DOWN TEST

After cleaning and inspection, test each tappet for specified leak-down rate tolerance to ensure zero-lash operation (Fig. 14).

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

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

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

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

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

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

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

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

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

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

INTAKE MANIFOLD LEAKAGE DIAGNOSIS

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

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

(1) Start the engine.

(2) Spray a small stream of water at the suspected leak area.

(3) If a change in RPM is observed the area of the suspected leak has been found.

(4) Repair as required.

DIAGNOSIS AND TESTING (Continued)

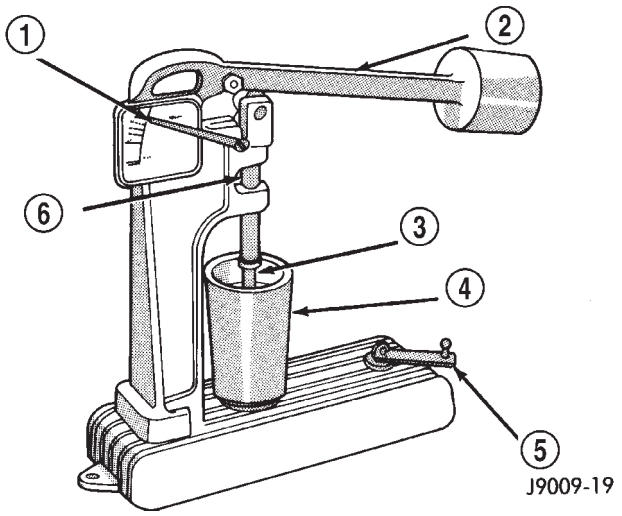


Fig. 14 Leak-Down Tester

1 – POINTER
2 – WEIGHTED ARM
3 – RAM
4 – CUP
5 – HANDLE
6 – PUSH ROD

CYLINDER COMPRESSION PRESSURE TEST

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

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

(1) Clean the spark plug recesses with compressed air.

(2) Remove the spark plugs.

(3) Secure the throttle in the wide-open position.

(4) Disable the fuel system. (Refer to Group 14, Fuel System for the correct procedure)

(5) Disconnect the ignition coil.

(6) Insert a compression pressure gauge and rotate the engine with the engine starter motor for three revolutions.

(7) Record the compression pressure on the 3rd revolution. Continue the test for the remaining cylinders.

Refer to Engine Specifications for the correct engine compression pressures.

CYLINDER HEAD GASKET FAILURE DIAGNOSIS

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

- Possible indications of the cylinder head gasket leaking between adjacent cylinders are:
  - Loss of engine power
  - Engine misfiring
  - Poor fuel economy
- Possible indications of the cylinder head gasket leaking between a cylinder and an adjacent water jacket are:
  - Engine overheating
  - Loss of coolant
  - Excessive steam (white smoke) emitting from exhaust
  - Coolant foaming

CYLINDER-TO-CYLINDER LEAKAGE TEST

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

CYLINDER-TO-WATER JACKET LEAKAGE TEST

WARNING: USE EXTREME CAUTION WHEN THE ENGINE IS OPERATING WITH COOLANT PRESSURE CAP REMOVED.

VISUAL TEST METHOD

With the engine cool, remove the coolant pressure cap. Start the engine and allow it to warm up until thermostat opens.

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

COOLING SYSTEM TESTER METHOD

WARNING: WITH COOLING SYSTEM TESTER IN PLACE, PRESSURE WILL BUILD UP FAST. EXCESSIVE PRESSURE BUILT UP, BY CONTINUOUS ENGINE OPERATION, MUST BE RELEASED TO A SAFE PRESSURE POINT. NEVER PERMIT PRESSURE TO EXCEED 138 kPa (20 psi).

Install Cooling System Tester 7700 or equivalent to pressure cap neck. Start the engine and observe the tester's pressure gauge. If gauge pulsates with every power stroke of a cylinder a combustion pressure leak is evident.

CHEMICAL TEST METHOD

Combustion leaks into the cooling system can also be checked by using Bloc-Chek Kit C-3685-A or equivalent. Perform test following the procedures supplied with the tool kit.

DIAGNOSIS AND TESTING (Continued)

CYLINDER COMBUSTION PRESSURE LEAKAGE TEST

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

Combustion pressure leakage testing will detect:

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

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

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

(3) Remove the spark plugs.

(4) Remove the oil filler cap.

(5) Remove the air cleaner.

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

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

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

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

Refer to the Cylinder Combustion Pressure Leakage Test Diagnosis chart.

CYLINDER COMBUSTION PRESSURE LEAKAGE DIAGNOSIS CHART

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

ENGINE OIL LEAK INSPECTION

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

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

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

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

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

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

Air Leak Detection Test Method

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

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

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

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

DIAGNOSIS AND TESTING (Continued)

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

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

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

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

INSPECTION FOR REAR SEAL AREA LEAKS

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

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

(1) Disconnect the battery.

(2) Raise the vehicle.

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

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

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

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

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

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

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

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

ENGINE OIL PRESSURE

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

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

SERVICE PROCEDURES

FORM-IN-PLACE GASKETS & SEALERS

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. **Do not use form-in-place gasket material unless specified.** Bead size, continuity, and location are of great importance. Too thin a bead can result in leakage while too much can result in spill-over which can break off and obstruct fluid feed lines. A continuous bead of the proper width is essential to obtain a leak-free gasket.

There are numerous types of form-in-place gasket materials that are used in the engine area. Mopar® Engine RTV GEN II, Mopar® ATF-RTV, and Mopar® Gasket Maker gasket materials, each have different properties and can not be used in place of the other.

MOPAR® ENGINE RTV GEN II

Mopar® Engine RTV GEN II is used to seal components exposed to engine oil. This material is a specially designed black silicone rubber RTV that retains adhesion and sealing properties when exposed to engine oil. Moisture in the air causes the material to cure. This material is available in three ounce tubes and has a shelf life of one year. After one year this material will not properly cure. Always inspect the package for the expiration date before use.

MOPAR® ATF RTV

Mopar® ATF RTV is a specifically designed black silicone rubber RTV that retains adhesion and sealing properties to seal components exposed to automatic transmission fluid, engine coolants, and moisture. This material is available in three ounce tubes and has a shelf life of one year. After one year this material will not properly cure. Always inspect the package for the expiration date before use.

MOPAR® GASKET MAKER

Mopar® Gasket Maker is an anaerobic type gasket material. The material cures in the absence of air when squeezed between two metallic surfaces. It will not cure if left in the uncovered tube. The anaerobic

SERVICE PROCEDURES (Continued)

material is for use between two machined surfaces. Do not use on flexible metal flanges.

MOPAR® GASKET SEALANT

Mopar® Gasket Sealant is a slow drying, permanently soft sealer. This material is recommended for sealing threaded fittings and gaskets against leakage of oil and coolant. Can be used on threaded and machined parts under all temperatures. This material is used on engines with multi-layer steel (MLS) cylinder head gaskets. This material also will prevent corrosion. Mopar® Gasket Sealant is available in a 13 oz. aerosol can or 4oz./16 oz. can w/applicator.

FORM-IN-PLACE GASKET AND SEALER APPLICATION

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

Mopar® Gasket Maker material should be applied sparingly 1 mm (0.040 in.) diameter or less of sealant to one gasket surface. Be certain the material surrounds each mounting hole. Excess material can easily be wiped off. Components should be torqued in place within 15 minutes. The use of a locating dowel is recommended during assembly to prevent smearing material off the location.

Mopar® Engine RTV GEN II or ATF RTV gasket material should be applied in a continuous bead approximately 3 mm (0.120 in.) in diameter. All mounting holes must be circled. For corner sealing, a 3.17 or 6.35 mm (1/8 or 1/4 in.) drop is placed in the center of the gasket contact area. Uncured sealant may be removed with a shop 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 material off the location.

Mopar® Gasket Sealant in an aerosol can should be applied using a thin, even coat sprayed completely over both surfaces to be joined, and both sides of a gasket. Then proceed with assembly. Material in a can w/applicator can be brushed on evenly over the sealing surfaces. Material in an aerosol can should be used on engines with multi-layer steel gaskets.

ENGINE GASKET SURFACE PREPARATION

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

Never use the following to clean gasket surfaces:

- Metal scraper
- Abrasive pad or paper to clean cylinder block and head
- High speed power tool with an abrasive pad or a wire brush (Fig. 15)

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

Only use the following for cleaning gasket surfaces:

- Solvent or a commercially available gasket remover
- Plastic or wood scraper (Fig. 15)
- Drill motor with 3M Roloc™ Bristle Disc (white or yellow) (Fig. 15)

CAUTION: Excessive pressure or high RPM (beyond the recommended speed), can damage the sealing surfaces. The mild (white, 120 grit) bristle disc is recommended. If necessary, the medium (yellow, 80 grit) bristle disc may be used on cast iron surfaces with care.

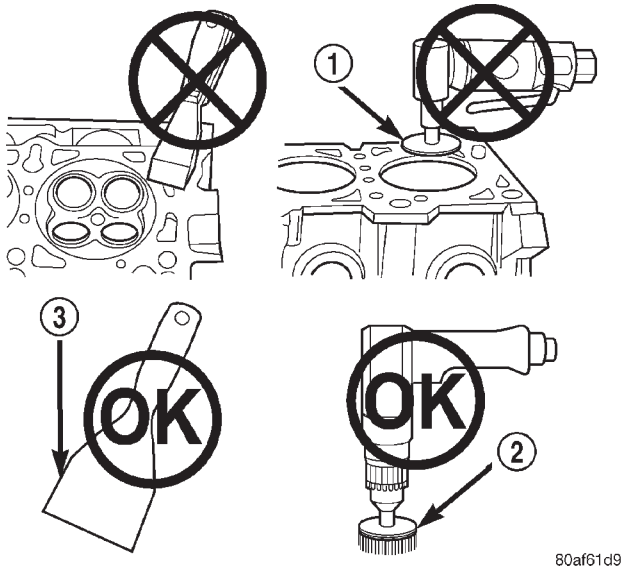


Fig. 15 Proper Tool Usage For Surface Preparation

1 – ABRASIVE PAD
2 – 3M ROLOC™ BRISTLE DISC
3 – PLASTIC/WOOD SCRAPER

ENGINE PERFORMANCE

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

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

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

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

(4) Perform cylinder compression test:

CAUTION: DO NOT overspeed the engine.

SERVICE PROCEDURES (Continued)

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

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

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

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

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

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

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

(h) Repeat for all remaining cylinders.

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

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

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

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

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

(6) Perform a combustion analysis.

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

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

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

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

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

(12) Road test vehicle as a final test.

HONING CYLINDER BORES

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

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

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

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

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

(3) Honing should be done by moving the hone up and down fast enough to get a crosshatch pattern. The hone marks should INTERSECT at 50° to 60° for proper seating of rings (Fig. 16).

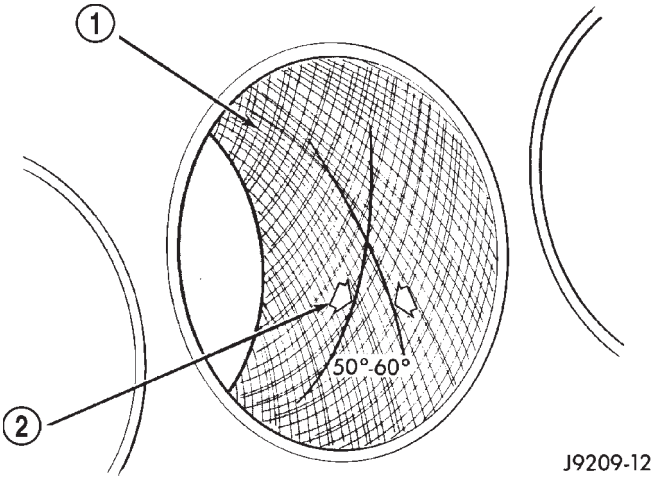


Fig. 16 Cylinder Bore Crosshatch Pattern

1 – CROSSHATCH PATTERN
2 – INTERSECT ANGLE

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

angle. Faster up and down strokes increase the crosshatch angle.

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

REPAIR DAMAGED OR WORN THREADS

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

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

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

HYDROSTATIC LOCK

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

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

(2) Disconnect the battery negative cable.

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

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

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

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

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

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

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

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

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

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

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

(13) Install a new oil filter.

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

(15) Connect the battery negative cable.

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

ENGINE OIL

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

ENGINE OIL SPECIFICATION

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

API SERVICE GRADE CERTIFIED

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

SAE VISCOSITY

An SAE viscosity grade is used to specify the viscosity of engine oil. Use only engine oils with multiple viscosities such as 5W-30 or 10W-30 in the 4.0L, engines. These are specified with a dual SAE viscosity grade which indicates the cold-to-hot temperature viscosity range. Select an engine oil that is best suited to your particular temperature range and variation (Fig. 17).

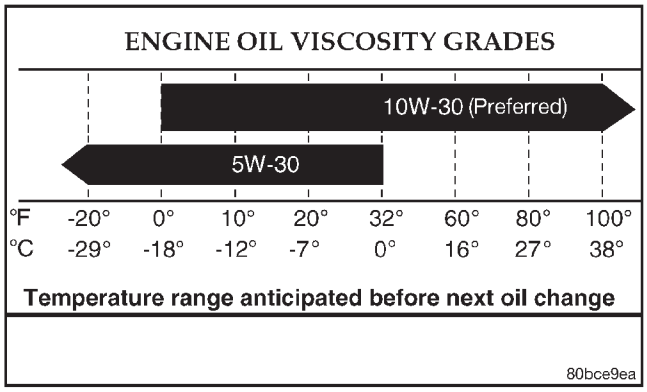


Fig. 17 Temperature/Engine Oil Viscosity—4.0L Engine

SERVICE PROCEDURES (Continued)

ENERGY CONSERVING OIL

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

CONTAINER IDENTIFICATION

Standard engine oil identification notations have been adopted to aid in the proper selection of engine oil. The identifying notations are located on the label of engine oil plastic bottles and the top of engine oil cans (Fig. 18).

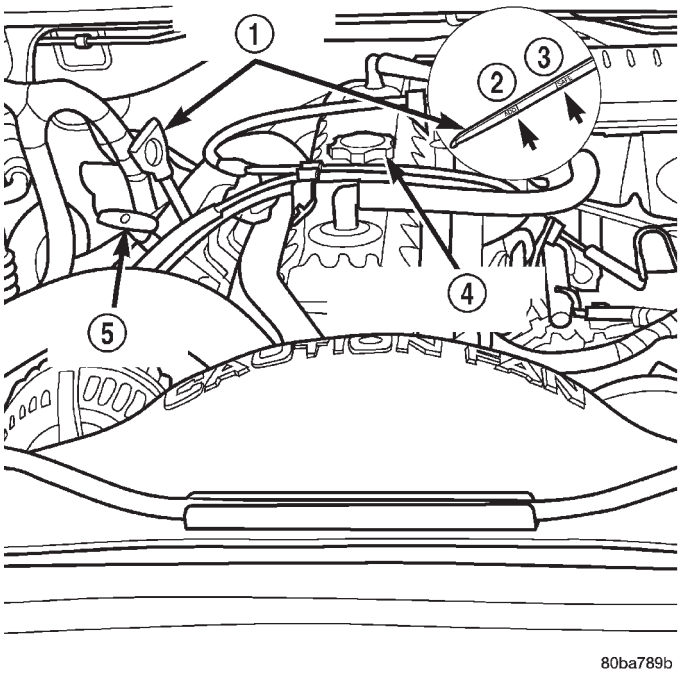


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Fig. 18 Engine Oil Container Standard Notations

OIL LEVEL INDICATOR (DIPSTICK)

The engine oil level indicator is located at the right rear of the engine on the 4.0L engine. (Fig. 19).



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Fig. 19 Engine Oil Dipstick 4.0L Engine

1 – ENGINE OIL DIPSTICK
2 – ADD
3 – SAFE
4 – ENGINE OIL FILL CAP
5 – TRANSMISSION DIPSTICK

CRANKCASE OIL LEVEL INSPECTION

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

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

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

(1) Position vehicle on level surface.
(2) With engine OFF, allow approximately ten minutes for oil to settle to bottom of crankcase, remove engine oil dipstick.
(3) Wipe dipstick clean.
(4) Install dipstick and verify it is seated in the tube.
(5) Remove dipstick, with handle held above the tip, take oil level reading.
(6) Add oil only if level is below the ADD mark on dipstick.

ENGINE OIL CHANGE

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

Run engine until achieving normal operating temperature.

(1) Position the vehicle on a level surface and turn engine off.
(2) Hoist and support vehicle on safety stands.
(3) Remove oil fill cap.
(4) Place a suitable drain pan under crankcase drain.
(5) Remove drain plug from crankcase and allow oil to drain into pan. Inspect drain plug threads for stretching or other damage. Replace drain plug if damaged.
(6) Install drain plug in crankcase.
(7) Lower vehicle and fill crankcase with specified type and amount of engine oil described in this section.
(8) Install oil fill cap.
(9) Start engine and inspect for leaks.
(10) Stop engine and inspect oil level.

ENGINE OIL FILTER CHANGE

FILTER SPECIFICATION

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

SERVICE PROCEDURES (Continued)

OIL FILTER REMOVAL

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

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

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

(4) When filter separates from cylinder block oil filter boss, tip gasket end upward to minimize oil spill. Remove filter from vehicle.

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

OIL FILTER INSTALLATION

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

(2) Thread filter onto adapter nipple. When gasket makes contact with sealing surface, (Fig. 20) hand tighten filter one full turn, do not over tighten.

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

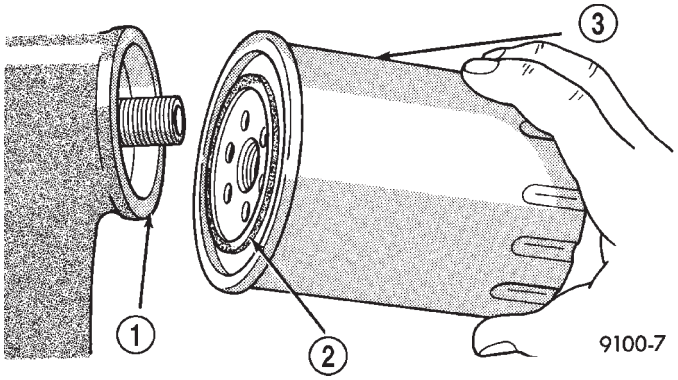


Fig. 20 Oil Filter Sealing Surface—Typical

1 – SEALING SURFACE
2 – RUBBER GASKET
3 – OIL FILTER

USED ENGINE OIL DISPOSAL

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

VALVE TIMING

Disconnect the coil rail and remove from engine.

Remove spark plugs.

Remove the engine cylinder head cover.

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

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

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

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

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

Set the dial indicator pointer at zero.

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

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

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

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

PISTON FITTING

BORE GAGE METHOD

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

(2) Measure the inside diameter of the cylinder bore at a point 49.5 mm (1-15/16 inches) below top of bore. Start perpendicular (across or at 90 degrees) to the axis of the crankshaft at point A and then take an additional bore reading 90 degrees to that at point B (Fig. 22).

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

(4) The coating material is applied to the piston after the final piston machining process. Measuring the outside diameter of a coated piston will not provide accurate results (Fig. 21). Therefore measuring the inside diameter of the cylinder bore with a dial Bore Gauge is **MANDATORY**. To correctly select the proper size piston, a cylinder bore gauge capable of reading in 0.003 mm (.0001 in.) increments is required.

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

SERVICE PROCEDURES (Continued)

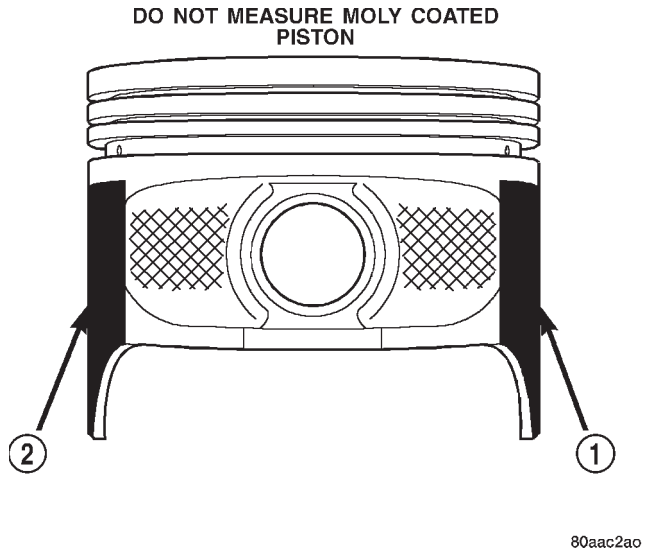


Fig. 21 Moly Coated Piston

1 – MOLY COATED
2 – MOLY COATED

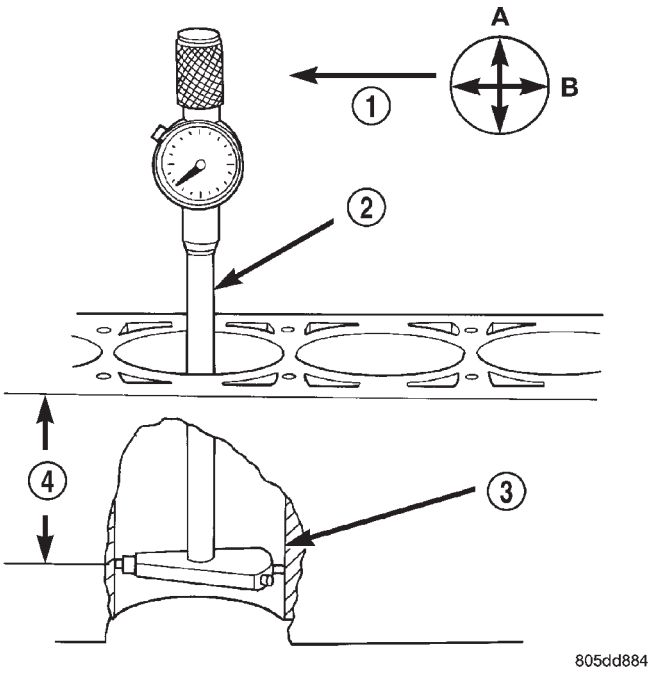


Fig. 22 Bore Gauge

1 – FRONT
2 – BORE GAUGE
3 – CYLINDER BORE
4 – 49.5 MM (1–15/16 in)

PISTON RING—FITTING

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

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

(3) Measure the ring side clearance with a feeler gauge fitted snugly between the ring land and ring (Fig. 23) (Fig. 24). Rotate the ring in the groove. It must move freely around circumference of the groove.

PISTON SIZE CHART

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

GROOVE HEIGHT

A 1.530-1.555 mm (0.0602-0.0612 in)
B 4.035-4.060 mm (0.1589-0.1598 in)

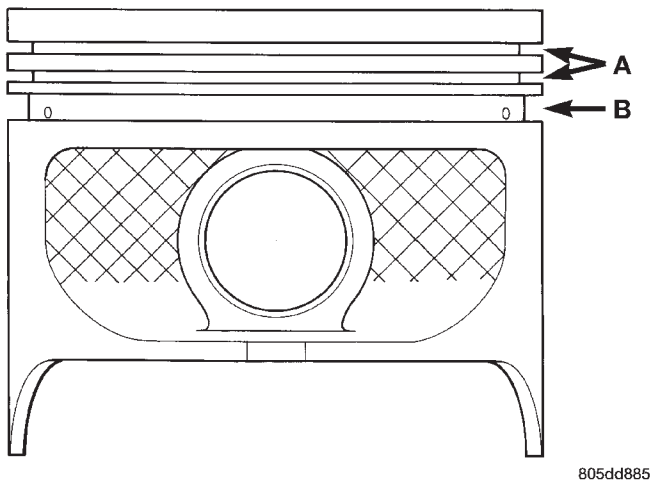


Fig. 23 Piston Dimensions

(4) Place ring in the cylinder bore and push down with inverted piston to position near lower end of the ring travel. Measure ring gap with a feeler gauge fitting snugly between ring ends (Fig. 25).

(5) The oil control rings are symmetrical, and can be installed with either side up. It is not necessary to

SERVICE PROCEDURES (Continued)

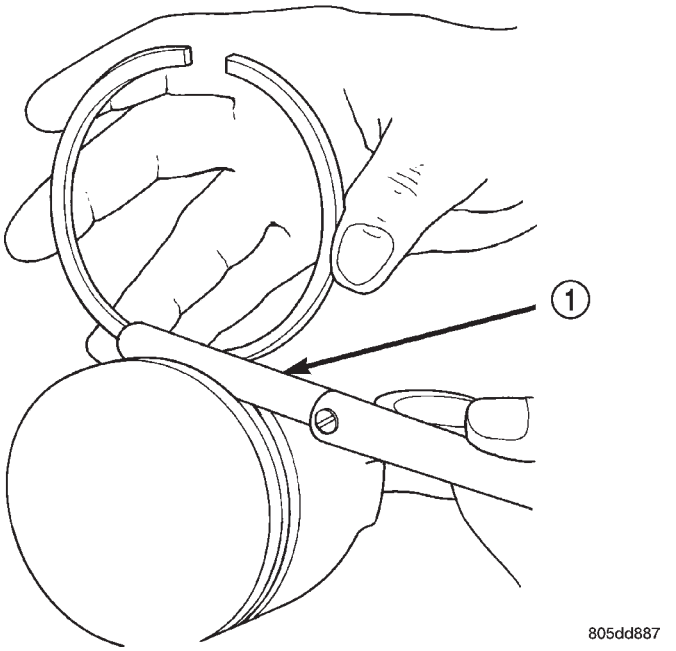


Fig. 24 Ring Side Clearance Measurement

1 – FEELER GAUGE

RING SIDE CLEARANCE CHART

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

use a tool to install the upper and lower rails. Insert oil rail spacer first, then side rails.

(6) The two compression rings are different and cannot be interchanged. The top compression ring can be identified by the shiny coating on the outer sealing surface and can be installed with either side up (Fig. 26).

(7) The second compression ring has a slight chamfer on the bottom of the inside edge and a dot on the top for correct installation (Fig. 27).

(8) Using a ring installer, install the second compression ring with the dot facing up (Fig. 27) (Fig. 29).

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

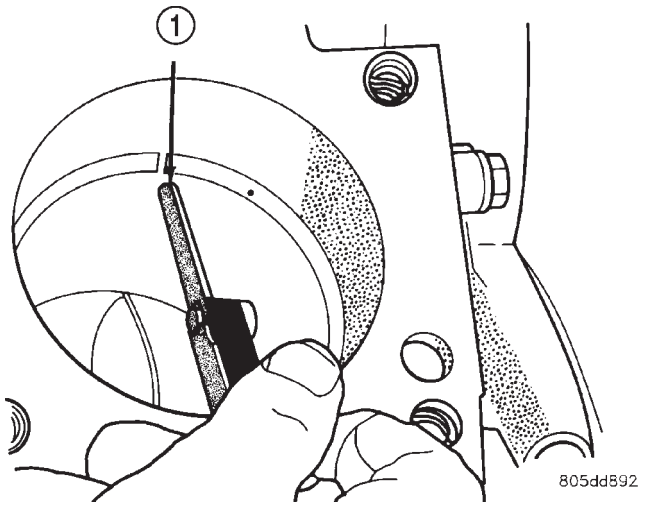


Fig. 25 Gap Measurement

1 – FEELER GAUGE

RING GAP MEASUREMENT CHART

ITEM	SPECIFICATION
Top Compression Ring	0.229 - 0.610 mm (0.0090 - 0.0240 in.)
Second Compression Ring	0.483 - 0.965 mm (0.0190 - 0.080 in.)
Oil Control Ring	0.254 - 1.500 mm (0.010 - 0.060 in.)

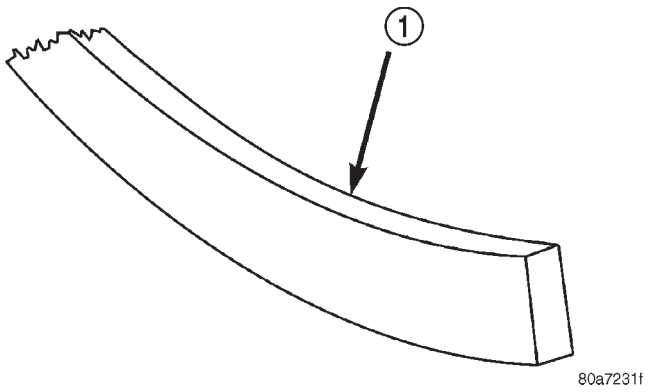


Fig. 26 Top Compression ring identification

1 – TOP COMPRESSION RING

Ring Gap Orientation

- Position the gaps on the piston as shown (Fig. 30).
- Oil spacer - Gap on center line of piston skirt.
- Oil rails - gap 180° apart on centerline of piston pin bore.

SERVICE PROCEDURES (Continued)

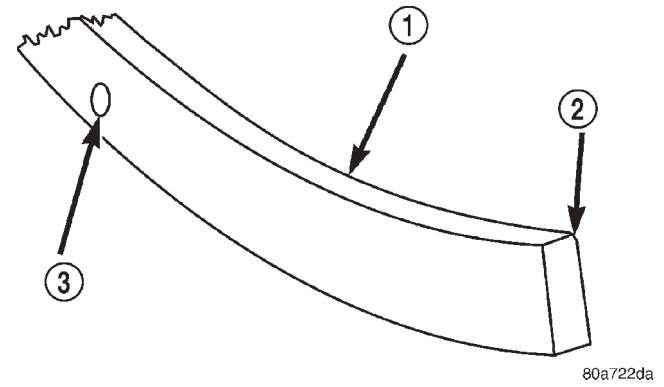


Fig. 27 Second Compression Ring Identification

1 – SECOND COMPRESSION RING
2 – CHAMFER
3 – ONE DOT

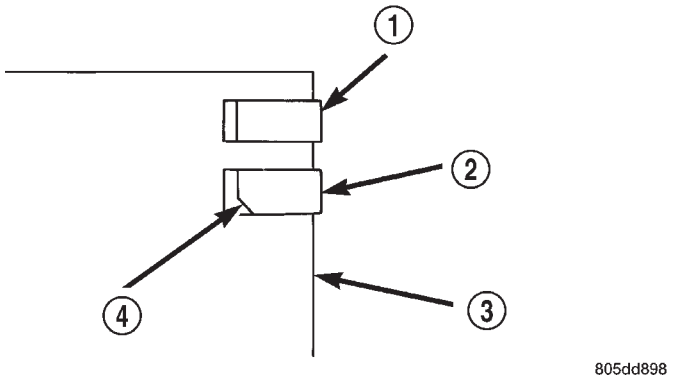


Fig. 28 Compression Ring Chamfer Location

1 – TOP COMPRESSION RING
2 – SECOND COMPRESSION RING
3 – PISTON
4 – CHAMFER

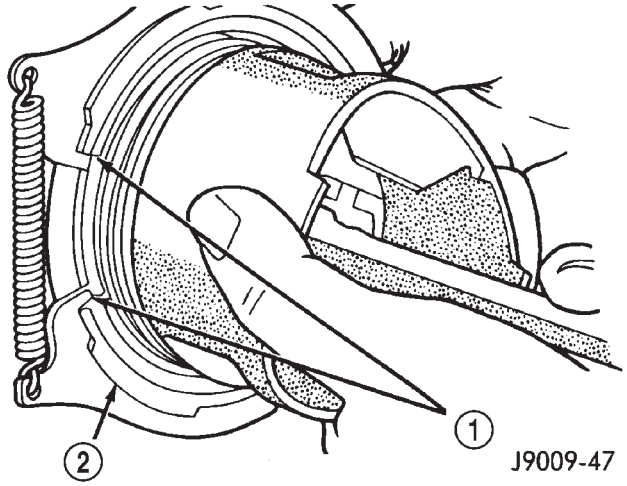


Fig. 29 Compression Ring Installation

1 – COMPRESSION RING
2 – RING EXPANDER RECOMMENDED

- No. 2 Compression ring - Gap 180° from top oil rail gap.
- No. 1 Compression ring - Gap 180° from No. 2 compression ring gap.

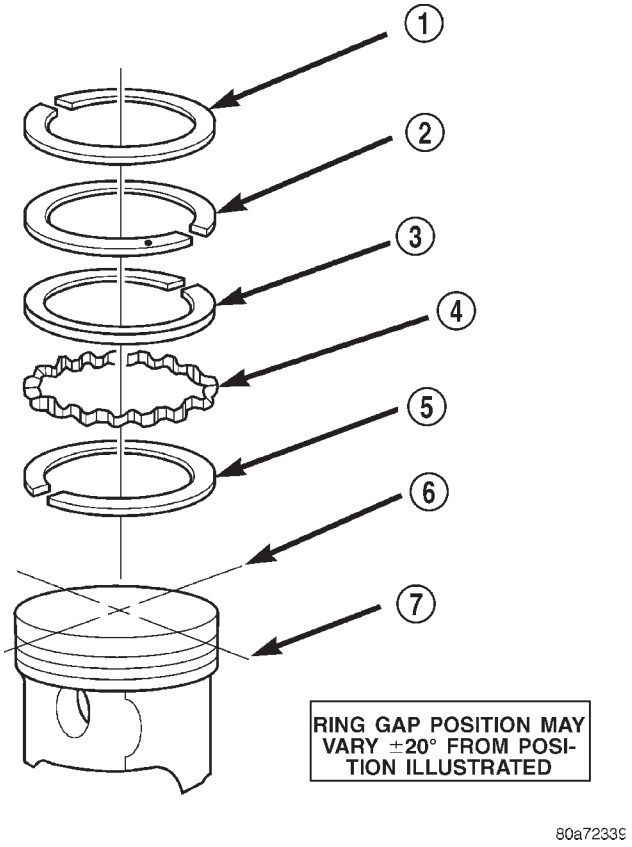


Fig. 30 Ring Gap Orientation

1 – TOP COMPRESSION RING
2 – BOTTOM COMPRESSION RING
3 – TOP OIL CONTROL RAIL
4 – OIL RAIL SPACER
5 – BOTTOM OIL CONTROL RAIL
6 – IMAGINARY LINE PARALLEL TO PISTON PIN
7 – IMAGINARY LINE THROUGH CENTER OF PISTON SKIRT

FITTING CONNECTING ROD BEARINGS

INSPECTION

BEARINGS

Inspect the connecting rod bearings for scoring and bent alignment tabs (Fig. 31) (Fig. 32). Check the bearings for normal wear patterns, scoring, grooving, fatigue and pitting (Fig. 33). Replace any bearing that shows abnormal wear.

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

CONNECTING RODS

Misaligned or bent connecting rods can cause abnormal wear on pistons, piston rings, cylinder

SERVICE PROCEDURES (Continued)

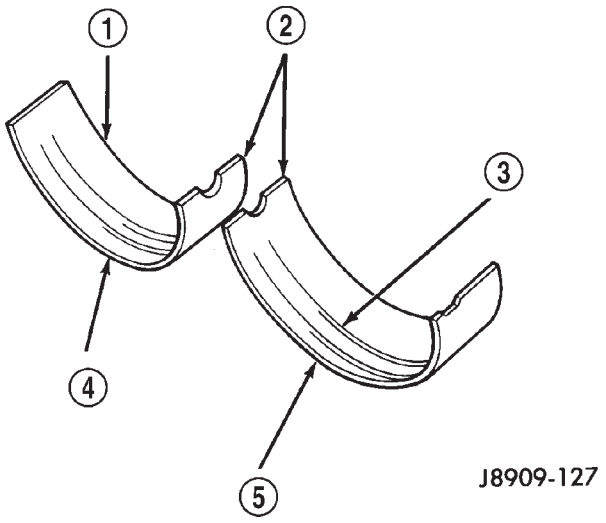


Fig. 31 Connecting Rod Bearing Inspection

1 – UPPER BEARING HALF
2 – MATING EDGES
3 – GROOVES CAUSED BY ROD BOLTS SCRATCHING JOURNAL DURING INSTALLATION
4 – WEAR PATTERN — ALWAYS GREATER ON UPPER BEARING
5 – LOWER BEARING HALF

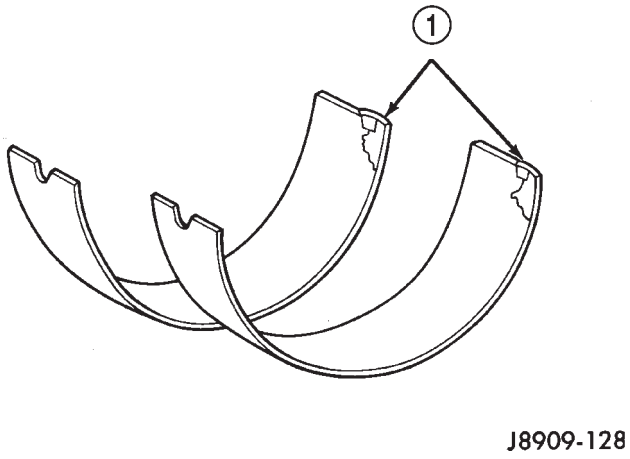


Fig. 32 Locking Tab Inspection

1 – ABNORMAL CONTACT AREA CAUSED BY LOCKING TABS NOT FULLY SEATED OR BEING BENT

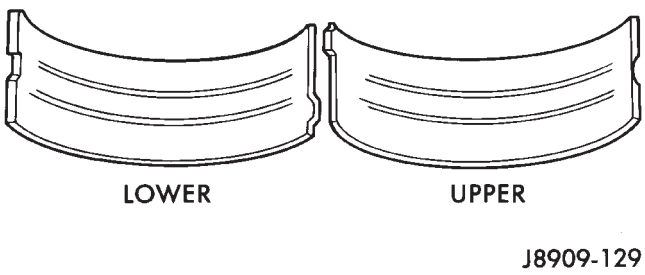


Fig. 33 Scoring Caused by Insufficient Lubrication or by Damaged Crankshaft Pin Journal

walls, connecting rod bearings and crankshaft connecting rod journals. If wear patterns or damage to any of these components indicate the probability of a misaligned connecting rod, inspect it for correct rod alignment. Replace misaligned, bent or twisted connecting rods.

BEARING-TO-JOURNAL CLEARANCE

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

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

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

(4) Use piston ring compressor to install the rod and piston assemblies. The oil squirt holes in the rods must face the camshaft. The arrow on the piston crown should point to the front of the engine (Fig. 34). Verify that the oil squirt holes in the rods face the camshaft and that the arrows on the pistons face the front of the engine.

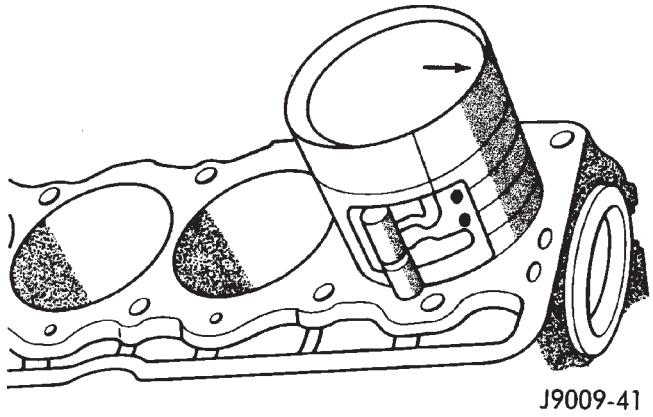


Fig. 34 Rod and Piston Assembly Installation

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

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

(7) Remove the bearing cap and determine amount of bearing-to- journal clearance by measuring the width of compressed Plastigage (Fig. 35). Refer to Engine Specifications for the proper clearance. **Plastigage should indicate the same clearance across the entire width of the insert. If the clearance varies, it may be caused by either a tapered journal, bent connecting rod or foreign material trapped between the insert and cap or rod.**

(8) If the correct clearance is indicated, replacement of the bearing inserts is not necessary. Remove

SERVICE PROCEDURES (Continued)

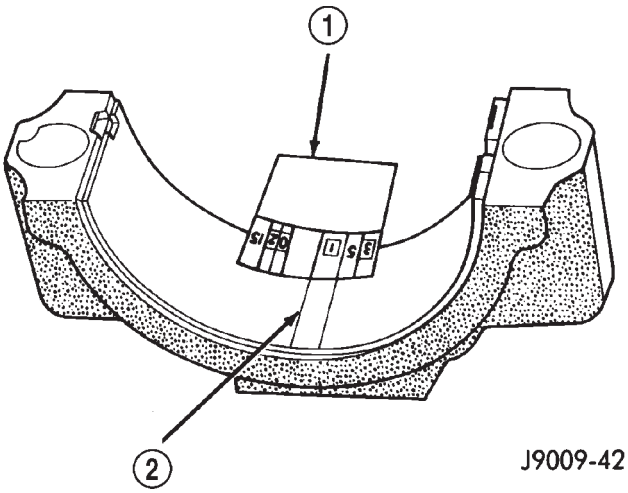


Fig. 35 Measuring Bearing Clearance with Plastigage

1 – PLASTIGAGE SCALE
2 – COMPRESSED PLASTIGAGE

the Plastigage from crankshaft journal and bearing insert. Proceed with installation.

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

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

CONNECTING ROD BEARING FITTING CHART

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

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

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

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

SERVICE PROCEDURES (Continued)

SIDE CLEARANCE MEASUREMENT

Slide snug-fitting feeler gauge between the connecting rod and crankshaft journal flange (Fig. 36). Refer to Engine Specifications for the proper clearance. Replace the connecting rod if the side clearance is not within specification.

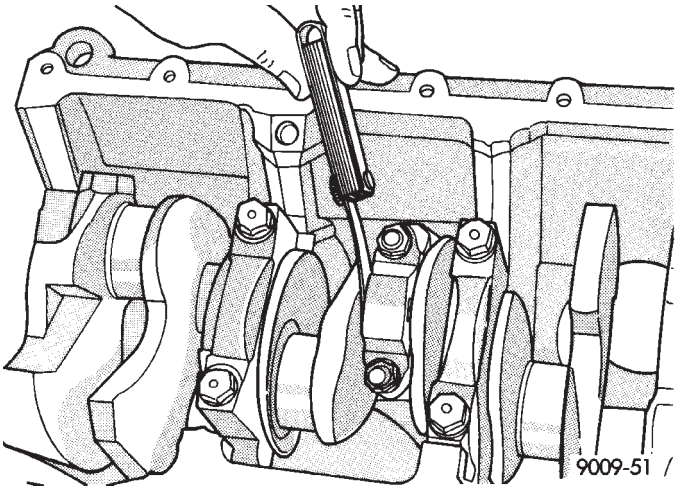


Fig. 36 Checking Connecting Rod Side Clearance—Typical

FITTING CRANKSHAFT MAIN BEARINGS

INSPECTION

Wipe the inserts clean and inspect for abnormal wear patterns and for metal or other foreign material imbedded in the lining. Normal main bearing insert wear patterns are illustrated (Fig. 37). In general the lower bearing half will have a heaver wear pattern.

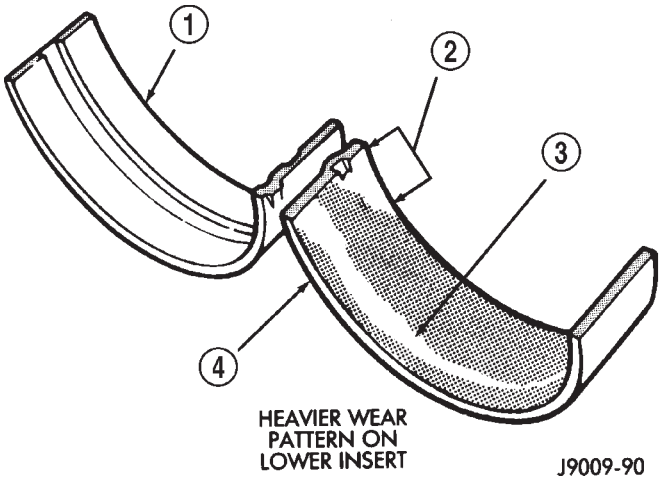


Fig. 37 Main Bearing Wear Patterns

1 – UPPER INSERT
2 – NO WEAR IN THIS AREA
3 – LOW AREA IN BEARING LINING
4 – LOWER INSERT

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

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

Inspect the upper insert locking tabs for damage.

Replace all damaged or worn bearing inserts.

FITTING BEARINGS (CRANKSHAFT INSTALLED)

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

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

The main bearing journal size (diameter) is identified by a color-coded paint mark (Fig. 38) on the adjacent cheek or counterweight towards the rear of the crankshaft (flange end). The rear main journal, is identified by a color-coded paint mark on the crankshaft rear flange.

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

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

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

BEARING-TO-JOURNAL CLEARANCE (CRANKSHAFT INSTALLED)

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

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

Install the crankshaft into the upper bearings dry.

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

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

SERVICE PROCEDURES (Continued)

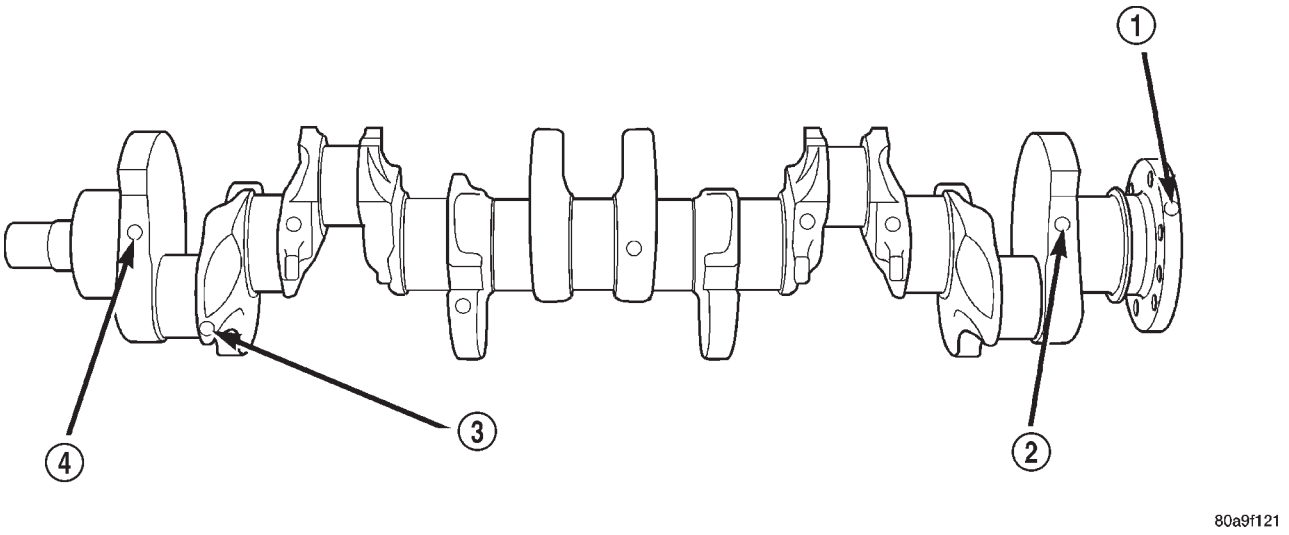


Fig. 38 Crankshaft Journal Size Paint I. D. Location

1 – NO. 7 MAIN JOURNAL SIZE PAINT MARK
2 – NO. 6 CONNECTING ROD JOURNAL SIZE PAINT MARK
3 – NO. 1 CONNECTING ROD JOURNAL SIZE PAINT MARK
4 – NO. 1 MAIN JOURNAL SIZE PAINT MARK

BEARING INSERT PAIRS CHART

INSERT	CORRECT	INCORRECT
UPPER	STANDARD	STANDARD
LOWER	0.025 mm (0.001 in.) UNDERSIZE	0.051 mm (0.002 in.) UNDERSIZE

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

Remove the bearing cap. Determine the amount of clearance by measuring the width of the compressed Plastigage with the scale on the Plastigage envelope (Fig. 39). Refer to Engine Specifications for the proper clearance.

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

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

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

The clearance indicate with the 0.025 mm (0.001 inch) undersize insert pair installed will determine if this insert size or some other combination will provide the specified clearance. **FOR EXAMPLE:** If the clearance was 0.0762 mm (0.003 inch) originally, a pair of 0.0254 mm (0.001 inch) undersize inserts would reduce the clearance by 0.0254 mm (0.001 inch). The clearance would then be 0.0508 mm (0.002 inch) and within the specification. A 0.051 mm (0.002 inch) undersize bearing insert and a 0.0254 mm (0.001 inch) undersize insert would reduce the original clearance an additional 0.0127 mm (0.0005 inch). The clearance would then be 0.0381 mm (0.0015 inch).

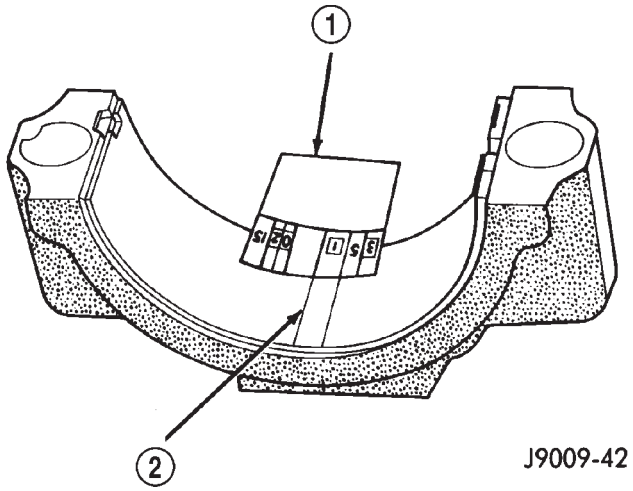


Fig. 39 Measuring Bearing Clearance with Plastigage

1 – PLASTIGAGE SCALE
2 – COMPRESSED PLASTIGAGE

SERVICE PROCEDURES (Continued)

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

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

If the clearance exceeds specification using a pair of 0.051 mm (0.002 inch) undersize bearing inserts, measure crankshaft journal diameter with a micrometer. If the journal diameter is correct, the crankshaft bore in the cylinder block may be misaligned, which requires cylinder block replacement or machining to true bore.

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

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

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

MAIN BEARING JOURNAL DIAMETER (CRANKSHAFT REMOVED)

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

Clean the oil off the main bearing journal.

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

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

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

MAIN BEARING FITTING CHART

Crankshaft Journals #1-6		Corresponding Crankshaft Bearing Insert	
Color Code	**Diameter**	**Upper Insert Size**	**Lower Insert Size**
Yellow	63.5025 -63.4898 mm (2.5001 - 2.4996 in.)	Yellow - Standard	Yellow - Standard
Orange	63.4898 - 63.4771 mm (2.4996 - 2.4991 in.) 0.0127 mm (0.0005 in.) Undersize	Yellow - Standard	Blue - Undersize 0.025 mm (0.001 in.)
Blue	63.4771 - 63.4644 mm (2.4991 - 2.4986 in.) 0.0254 mm (0.001 in.) Undersize	Blue - Undersize 0.025 mm (0.001 in.)	Blue - Undersize 0.025 mm (0.001 in.)
Green	63.4644 - 63.4517 mm (2.4986 - 2.4981 in.) 0.0381 mm (0.0015 in.) Undersize	Blue - Undersize 0.025 mm (0.001 in.)	Green - Undersize 0.051 mm (0.002 in.)
Red	63.2485 - 63.2358 mm (2.4901 - 2.4896 in.) 0.254 mm (0.010 in.) Undersize	Red - Undersize 0.254 mm (0.010 in.)	Red - Undersize 0.254 mm (0.010 in.)

SERVICE PROCEDURES (Continued)

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

REMOVAL AND INSTALLATION

ENGINE MOUNTS—FRONT

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

REMOVAL

(1) Disconnect the negative cable from the battery.
(2) Raise the vehicle.
(3) Support the engine.
(4) Remove the insulator assembly-to-lower front sill bolts (Fig. 40) (Fig. 41).
(5) Raise the engine slightly.
(6) Remove the through bolt nut and through bolt. Remove the insulator (Fig. 40) (Fig. 41).
(7) If required, remove the engine bracket from the block.

INSTALLATION

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

ENGINE MOUNT—REAR

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

REMOVAL

(1) Disconnect the negative cable from the battery.
(2) Raise the vehicle and support the transmission.
(3) Remove the bolts holding the isolator mount assembly to the transmission (Fig. 42) (Fig. 43).
(4) Raise the transmission SLIGHTLY.
(5) Remove the through bolt and nut. Remove the rear isolator mount assembly.
(6) If necessary, remove the bolts holding the rear mount bracket to the crossmember.

INSTALLATION

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

REMOVAL AND INSTALLATION (Continued)

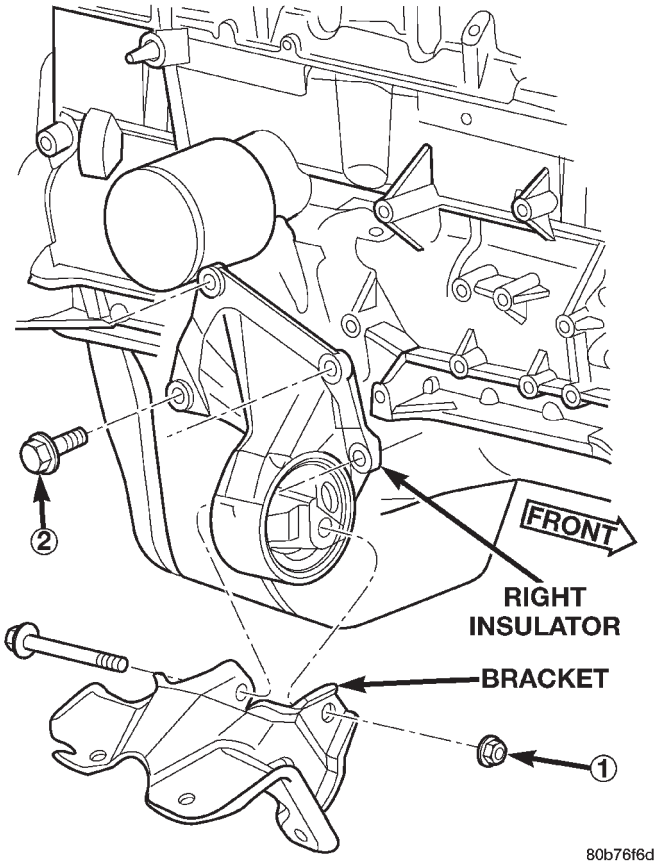


Fig. 40 Front Engine Mount—Right Side

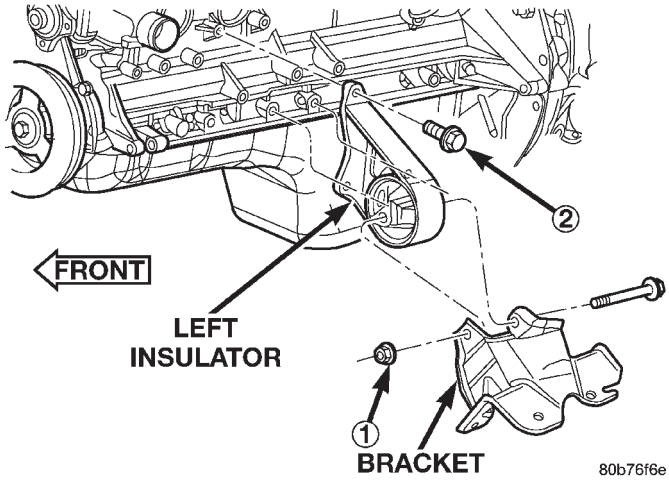


Fig. 41 Front Engine Mount—Left Side

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

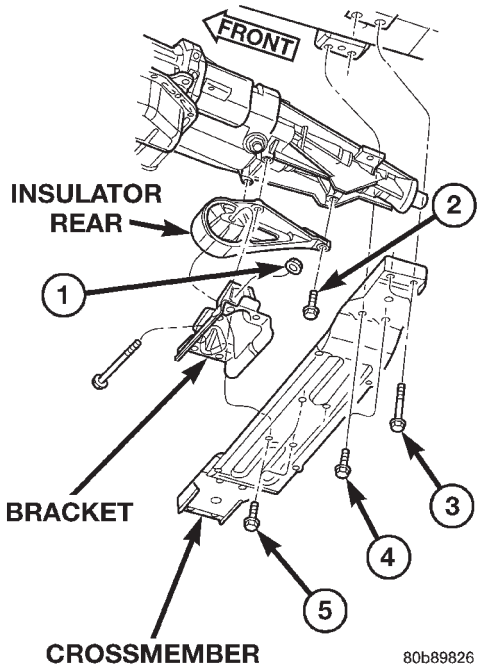


Fig. 42 Rear Engine Mount—(4X2)

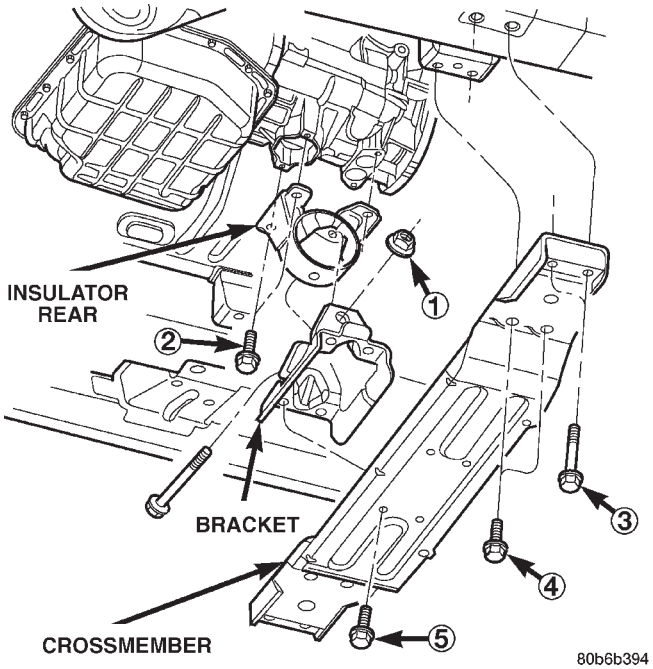


Fig. 43 Rear Engine Mount—(4X4)

REMOVAL AND INSTALLATION (Continued)

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

(4) Remove the transmission support.
(5) Install the mount fastening bolts and tighten to 54 N·m (40 ft. lbs.) torque.
(6) Tighten the through bolt nut to 50 N·m (37 ft. lbs.).
(7) Lower the vehicle.
(8) Connect the negative cable to the battery.

ENGINE BENDING BRACES

REMOVAL

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

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

(1) Raise and support vehicle.

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

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

(2) Remove the exhaust hanger bracket retaining bolt.
(3) Remove locknut and transmission bending brace bar.
(4) Remove engine-to-bending brace retaining bolt, bending brace bar and cross bar.

INSTALLATION

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

(1) Position the cross brace into the engine-to-transmission brace, then position the engine-to-transmission brace and install retaining bolt.
(2) Position the transmission bending brace onto through brace and install new locknut.
(3) Position exhaust hanger and transmission brace, install retaining bolt (Fig. 45).
(4) Tighten engine-to-transmission brace retaining bolt (Fig. 44) to 40 N·m (30 ft. lbs.).
(5) Tighten transmission brace retaining bolts (Fig. 45) to 40 N·m (30 ft. lbs.), then tighten transmission brace retaining lock nuts (Fig. 45) to 108 N·m (80 ft. lbs.).

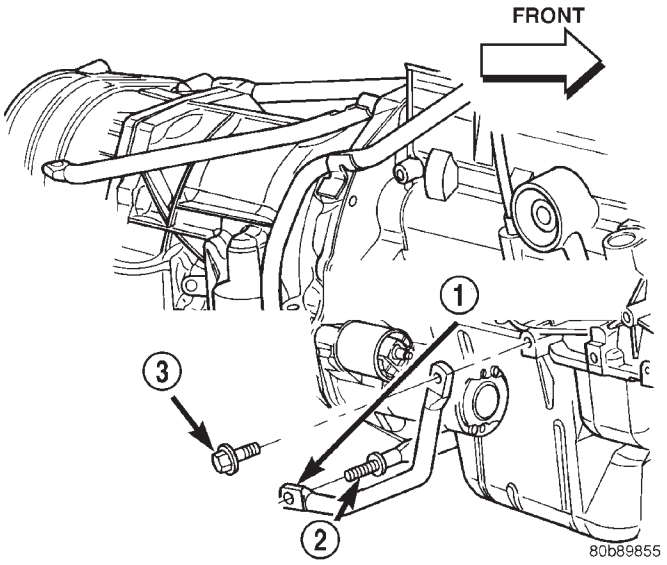


Fig. 44 Engine-to-Transmission Bending Braces
1 – ENGINE-TO-TRANSMISSION BENDING BRACE
2 – CROSS BRACE
3 – ENGINE-TO-TRANSMISSION BENDING BRACE RETAINING BOLT

ENGINE ASSEMBLY

REMOVAL

(1) Disconnect the battery negative cable.
(2) Mark the hinge locations on the hood panel for alignment reference during installation. Remove the engine compartment lamp. Remove the hood.
(3) Remove the radiator drain cock and radiator cap to drain the coolant. DO NOT waste usable coolant. If the solution is clean, drain the coolant into a clean container for reuse.
(4) Remove the upper radiator hose and coolant recovery hose.
(5) Remove the lower radiator hose.
(6) Remove upper radiator support retaining bolts and remove radiator support.
(7) Remove the fan assembly from the water pump. Refer to ENGINE COOLING.

REMOVAL AND INSTALLATION (Continued)

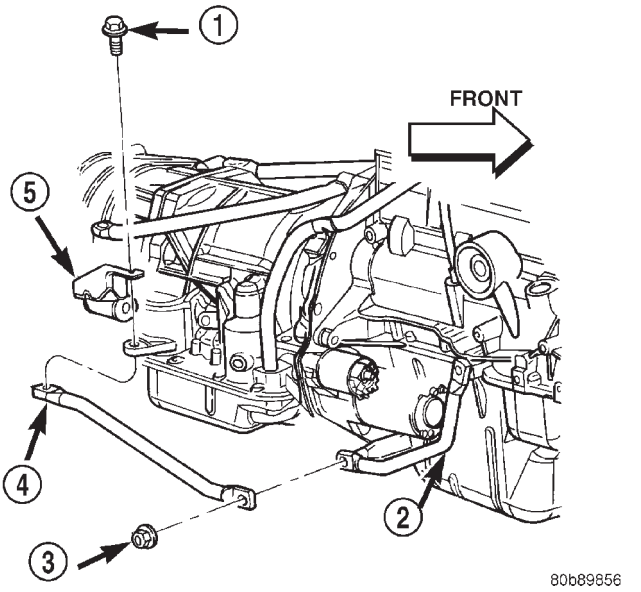


Fig. 45 Transmission Bending Braces and Exhaust Hanger

1 – TRANSMISSION BENDING BRACE RETAINING BOLT
2 – ENGINE-TO-TRANSMISSION BENDING BRACE
3 – LOCKNUT
4 – TRANSMISSION BRACE
5 – EXHAUST HANGER

(8) Remove the fan shroud. Refer to ENGINE COOLING.

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

(10) Discharge the A/C system. Refer to HEATING and AIR CONDITIONING.

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

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

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

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

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

(16) Disconnect the body ground at the engine.

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

- Power steering pressure switch
- Coolant temperature sensor
- Six (6) fuel injector connectors
- Intake air temperature sensor
- Throttle position sensor
- Map sensor
- Crankshaft position sensor
- Oxygen sensor
- Camshaft position sensor
- Generator connector and B+ terminal wire

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

(19) Perform the fuel pressure release procedure. Refer to FUEL SYSTEM for correct procedure.

(20) Disconnect the fuel supply line at the injector rail. (Refer to QUICK-CONNECT FITTINGS for the correct procedure.

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

(22) Remove the air cleaner assembly (Fig. 46).

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

(24) Drain the pump reservoir.

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

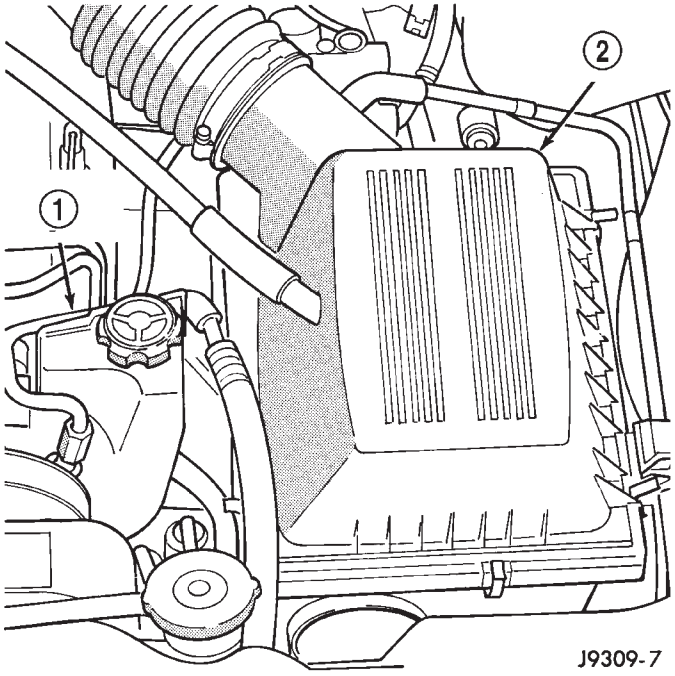


Fig. 46 Air Cleaner Assembly & Power Steering Pump

1 – POWER STEERING PUMP
2 – AIR CLEANER ASSEMBLY

(26) Raise and support the vehicle.

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

(28) Remove the engine starter motor.

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

(30) Disconnect the exhaust pipe from the manifold.

(31) Remove the exhaust pipe support.

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

REMOVAL AND INSTALLATION (Continued)

(33) Remove the engine flywheel/converter housing access cover.
(34) Mark the converter and drive plate location.
(35) Remove the converter-to-drive plate bolts.
(36) Remove the upper engine flywheel/converter housing bolts and loosen the bottom bolts.
(37) Remove the engine mount cushion-to-engine compartment bracket bolts.
(38) Lower the vehicle.
(39) Attach a lifting device to the engine.
(40) Raise the engine off the front supports.
(41) Place a support or floor jack under the converter (or engine flywheel) housing.
(42) Remove the remaining converter (or engine flywheel) housing bolts.
(43) Lift the engine out of the engine compartment.

INSTALLATION

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

(1) Attach a lifting device to the engine and lower the engine into the engine compartment. For easier installation, it may be necessary to remove the engine mount bracket as an aid in alignment of the engine to the transmission.
(2) Align the transmission torque converter housing with the engine.
(3) Loosely install the converter housing lower bolts and install the next higher bolt and nut on each side.
(4) Tighten all 4 bolts finger tight.
(5) Install the engine mount brackets (if removed).
(6) Lower the engine and engine mount brackets onto the engine compartment cushions. Install the bolts and finger tighten the nuts.
(7) Remove the engine lifting device.
(8) Raise and support the vehicle.
(9) Install the remaining engine flywheel/converter housing bolts. Tighten all bolts to 38 N·m (28 ft. lbs.) torque.
(10) Install the converter-to-drive plate bolts.
(11) Ensure the installation reference marks are aligned.
(12) Install the engine flywheel/converter housing access cover.
(13) Install the exhaust pipe support and tighten the screw.
(14) Install the engine bending brace.
(15) Tighten the engine mount-to-bracket bolts.
(16) Connect the vehicle speed sensor wire connections and tighten the screws.
(17) Connect the exhaust pipe to the manifold.
(18) Install the engine starter motor and connect the cable.
(19) Connect the wires to the engine starter motor solenoid.
(20) Lower the vehicle.
(21) Connect all the vacuum hoses and wire connectors identified during engine removal.
(22) Remove protective caps from the power steering hoses.
(23) Connect the hoses to the fittings at the steering gear. Tighten the nut to 52 N·m (38 ft. lbs.) torque.
(24) Fill the pump reservoir with fluid.
(25) Inspect the fuel supply line o-ring(s) and replace if necessary. Connect fuel supply line to injectior rail and verify connection by pulling outward on the line.
(26) Install the fuel line bracket to the intake manifold.
(27) Connect the coil rail electrical connectors and oil pressure switch connector.
(28) Connect the following electrical connectors:
- Power steering pressure switch
- Coolant temperature sensor
- Six (6) fuel injector connectors
- Intake air temperature sensor
- Throttle position sensor
- Map sensor
- Crankshaft position sensor
- Oxygen sensor
- Camshaft position sensor
- Generator connector and B+ terminal wire

(29) Connect all previously removed vacuum hoses.
(30) Connect the body ground strap.
(31) Install the throttle, transmission line pressure, and speed control cables to their mounting bracket and connect them to the throttle body.
(32) Connect the heater hoses at the engine thermostat housing and water pump.
(33) Install the fan assembly to the water pump.
(34) Place the fan shroud in position over the fan.
(35) Install the radiator or radiator/condenser.
(36) Connect the service valves to the A/C compressor ports, if equipped with A/C.
(37) Charge the air conditioner system (refer to HEATING and AIR CONDITIONING.
(38) Connect the radiator hoses and automatic transmission fluid cooler pipes, if equipped.
(39) Install the fan shroud to the radiator or radiator/condenser (if equipped with A/C).
(40) Install upper radiator support.
(41) Connect the upper radiator hose and tighten the clamp.
(42) Connect the lower radiator hose and tighten the clamp.

REMOVAL AND INSTALLATION (Continued)

(43) Fill crankcase with engine oil. Refer to LUBRICATION and MAINTENANCE for correct capacities.

(44) Fill the cooling system with reusable coolant or new coolant Refer to COOLING SYSTEM.

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

(46) Install the air cleaner assembly.

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

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

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

INTAKE AND EXHAUST MANIFOLD

REMOVAL

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

(1) Disconnect the battery negative cable.

(2) Remove air cleaner inlet hose from throttle body assembly.

(3) Remove the air cleaner assembly.

(4) Remove the throttle cable, vehicle speed control cable (if equipped) and the transmission line pressure cable.

(5) Disconnect the following electrical connections and secure their harness out of the way:

- Throttle Position Sensor
- Idle Air Control Motor
- Coolant Temperature Sensor (at thermostat housing)
- Intake Air Temperature Sensor
- Oxygen Sensor
- Crank Position Sensor
- Six (6) Fuel Injector Connectors

(6) Disconnect the Map Sensor, HVAC, and Brake Booster vacuum supply hoses at the intake manifold.

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

(8) Disconnect and remove the fuel system supply line from the fuel rail assembly. (Refer to Group 14, Quick Connect Fittings for correct procedures)

(9) Remove the accessory drive belt (refer to Group 7, Cooling System). Loosen the tensioner.

(10) Remove the power steering pump and bracket from the intake manifold and set aside.

(11) Raise the vehicle.

(12) Disconnect the exhaust pipes from the engine exhaust manifolds.

(13) Lower the vehicle.

(14) Remove the intake manifold and engine exhaust manifolds.

INSTALLATION

If the manifold is being replaced, ensure all the fitting, etc. are transferred to the replacement manifold.

(1) Install a new engine exhaust/intake manifold gasket over the alignment dowels on the cylinder head.

(2) Position the engine exhaust manifolds to the cylinder head. Install fastener Number 3 and finger tighten at this time (Fig. 47).

(3) Install intake manifold on the cylinder head dowels.

(4) Install washer and fastener Numbers 1, 2, 4, 5, 8, 9, 10 and 11 (Fig. 47).

(5) Install washer and fastener Numbers 6 and 7 (Fig. 47).

(6) Tighten the fasteners in sequence and to the specified torque (Fig. 47).

- Fastener Numbers 1 through 5—Tighten to 33 N·m (24 ft. lbs.) torque.
- Fastener Numbers 6 and 7—Tighten to 14 N·m (126 in. lbs.) torque.
- Fastener Numbers 8 through 11—Tighten to 33 N·m (24 ft. lbs.) torque.

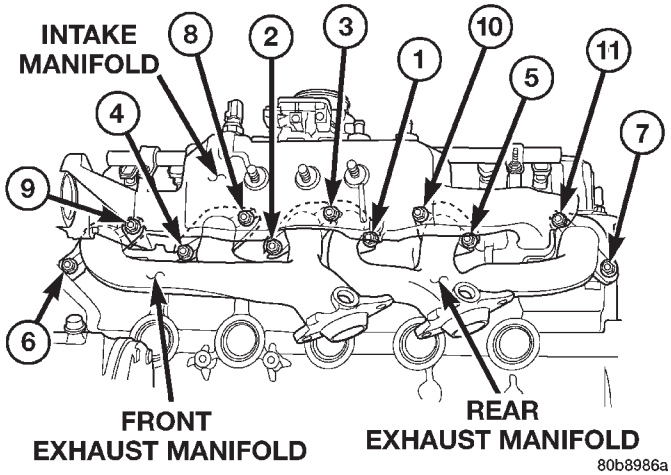


Fig. 47 Intake and Exhaust Manifolds—4.0L

(7) Install the power steering pump and bracket to the intake manifold. Tighten the belt to specification. (Refer to Group 7, Cooling System for the correct procedures)

(8) Install the fuel system supply line to the fuel rail assembly. **Before connecting the fuel supply**

REMOVAL AND INSTALLATION (Continued)

line to the fuel rail inspect the O-rings and replace if necessary. Refer to Group 14, Fuel System for the correct procedure.

(9) Connect all electrical connections on the intake manifold.

(10) Connect the vacuum hoses previously removed.

(11) Install throttle cable, vehicle speed control cable (if equipped).

(12) Install the transmission line pressure cable (if equipped). Refer to Group 21, Transmission for the adjustment procedures.

(13) Install air cleaner assembly.

(14) Connect air inlet hose to the throttle body assembly.

(15) Raise the vehicle.

(16) Connect the exhaust pipes to the engine exhaust manifolds. Tighten the bolts to 31 N·m (23 ft. lbs.)

(17) Lower the vehicle.

(18) Connect the battery negative cable.

(19) Start the engine and check for leaks.

CYLINDER HEAD COVER

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

There are two cylinder head bolts that have a pin to locate the cylinder head cover gasket, they are located at position 8 and 9 (Fig. 49)

REMOVAL

(1) Disconnect negative cable from battery.

(2) Disconnect the Crankcase Ventilation (CCV) vacuum hose from engine cylinder head cover.

(3) Disconnect the fresh air inlet hose from the engine cylinder head cover.

(4) Disconnect the accelerator, transmission, and speed (if equipped) control cables from the throttle body (Fig. 48).

(5) Remove the three bolts that fasten the control cable bracket to the intake manifold.

(6) Remove control cables from cylinder head cover clip.

(7) Position control cables and bracket away from cylinder head cover secure with tie straps.

(8) Remove the engine cylinder head cover mounting bolts.

(9) Remove the engine cylinder head cover and gasket.

INSTALLATION

(1) If a replacement cover is installed, transfer the CCV valve grommet and oil filler cap from the original cover to the replacement cover.

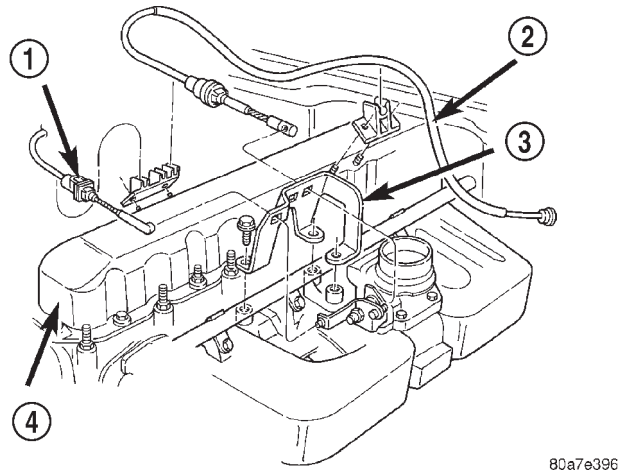


Fig. 48 Engine Cylinder Head Cover

1 – TRANS CONTROL CABLE
2 – ACCELERATOR CABLE
3 – CONTROL CABLE BRACKET
4 – CYLINDER HEAD COVER

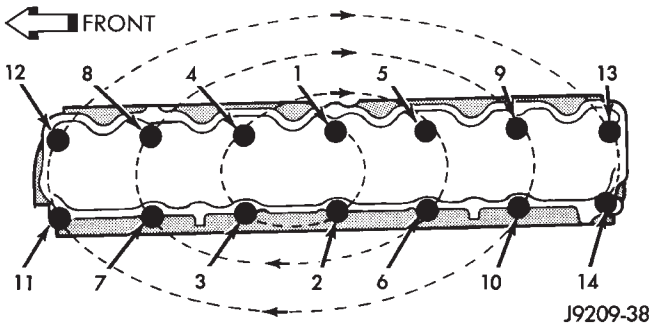


Fig. 49 Cylinder Head Cover Gasket Locator Pins at #8 & #9

(2) Install cylinder head cover and gasket. Tighten the mounting bolts to 10 N·m (85 in. lbs.) torque.

(3) Connect the CCV hoses.

(4) Install control cables and bracket on intake manifold and tighten bolts to 8.7 N·m (77 in. lbs.) torque.

(5) Connect control cables to throttle body linkage.

(6) Snap control cables into cylinder head cover clip.

(7) Connect negative cable to battery.

ROCKER ARMS AND PUSH RODS

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

REMOVAL

(1) Remove the engine cylinder head cover.

(2) Check for rocker arm bridges which are causing misalignment of the rocker arm to valve tip area.

REMOVAL AND INSTALLATION (Continued)

(3) Remove the capscrews at each bridge and pivot assembly (Fig. 50). Alternately loosen the capscrews one turn at a time to avoid damaging the bridges.

(4) Remove the bridges, pivots and corresponding pairs of rocker arms (Fig. 50). Place them on a bench in the same order as removed.

(5) Remove the push rods and place them on a bench in the same order as removed.

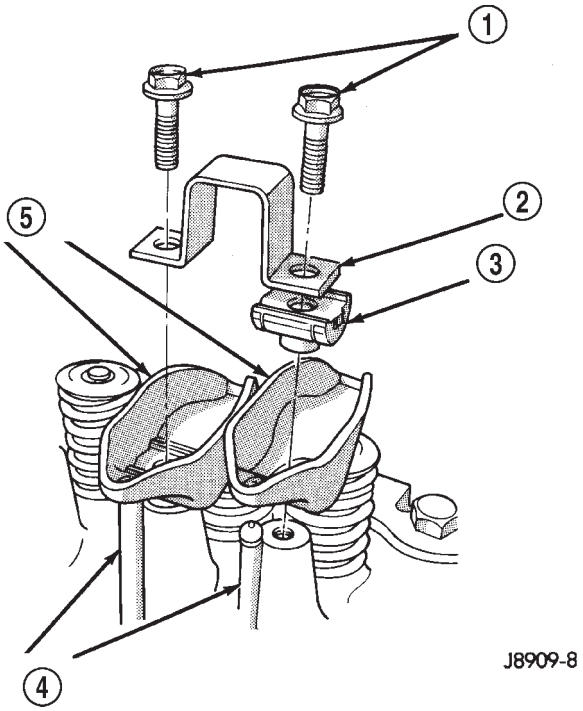


Fig. 50 Rocker Arm Assembly

1 – CAPSCREWS
2 – BRIDGE
3 – PIVOT ASSEMBLY
4 – PUSH RODS
5 – ROCKER ARMS

INSTALLATION

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

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

(3) Loosely install the capscrews through each bridge.

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

(5) Install the engine cylinder head cover.

VALVE STEM SEAL AND SPRING

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

REMOVAL

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

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

(1) Remove the engine cylinder head cover.

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

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

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

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

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

(7) Tap the retainer or tip with a rawhide hammer to loosen the lock from the retainer. Use Valve Spring Compressor Tool MD-998772A to compress the spring and remove the locks (Fig. 51).

(8) Remove valve spring and retainer (Fig. 51).

(9) Remove valve stem oil seals (Fig. 51). Note the valve seals are different for intake and exhaust valves. The top of each seal is marked either INT (Gray) or EXH (Brown). DO NOT mix the seals.

NOTE: If valves, valve springs or seals are to be inspected / replaced at this time, refer to Valves and Valve Springs in this section for proper inspection procedures.

INSTALLATION

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

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

(2) Install valve spring and retainer.

(3) Compress the valve spring with Valve Spring Compressor Tool MD-998772A and insert the valve locks. Release the spring tension and remove the

REMOVAL AND INSTALLATION (Continued)

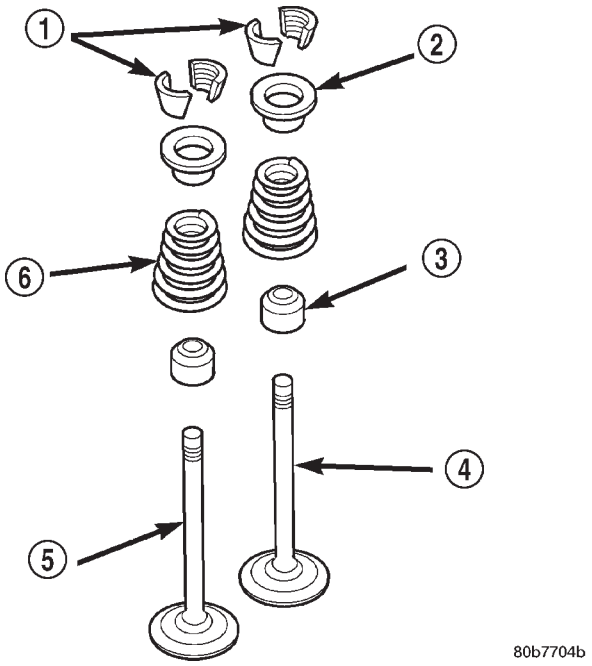


Fig. 51 Valve and Valve Components

1 – VALVE LOCKS (3–BEAD)
2 – RETAINER
3 – VALVE STEM OIL SEAL
4 – INTAKE VALVE
5 – EXHAUST VALVE
6 – VALVE SPRING

tool. Tap the spring from side-to-side to ensure that the spring is seated properly on the engine cylinder head.

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

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

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

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

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

(9) Install the engine cylinder head cover.

CYLINDER HEAD

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

REMOVAL

(1) Disconnect the battery negative cable.

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

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

(3) Remove the air cleaner assembly.

(4) Remove the engine cylinder head cover.

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

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

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

(8) Remove the A/C compressor mounting bolts and secure the compressor to the side.

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

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

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

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

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

(14) Remove spark plugs.

(15) Disconnect the temperature sending unit wire connector.

(16) Remove the engine cylinder head bolts. Bolt No.14 cannot be removed until the head is moved forward (Fig. 52). Pull bolt No.14 out as far as it will go and then suspend the bolt in this position (tape around the bolt).

(17) Remove the engine cylinder head and gasket (Fig. 52).

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

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

REMOVAL AND INSTALLATION (Continued)

NOTE: If the valves, springs, or seals are to be inspected/replaced at this time, refer to Valves and Valve Springs in this section for proper inspection procedures.

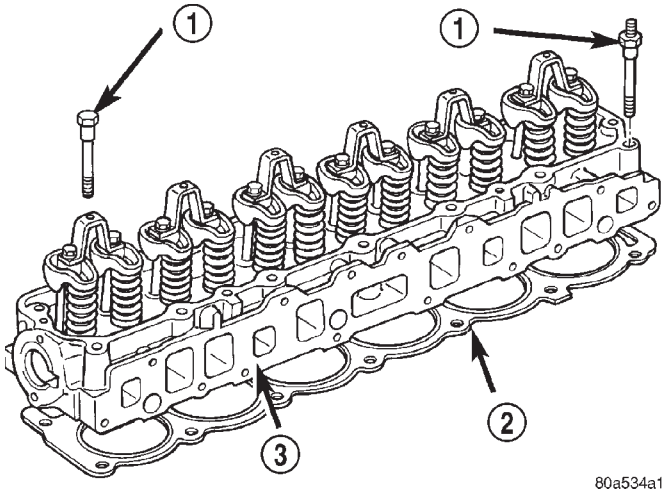


Fig. 52 Engine Cylinder Head Assembly

1 – CYLINDER HEAD BOLTS
2 – CYLINDER HEAD GASKET
3 – CYLINDER HEAD

INSTALLATION

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

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

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

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

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

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

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

(5) Tighten the engine cylinder head bolts in sequence according to the following procedure (Fig. 53).

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

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

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

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

(d) Tighten bolts in sequence:

- Bolts 1 through 10 to 149 N·m (110 ft. lbs.) torque.
- Bolt 11 to 135 N·m (100 ft. lbs.) torque.
- Bolts 12 through 14 to 149 N·m (110 ft. lbs.) torque.

CYLINDER HEAD BOLTS

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

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

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

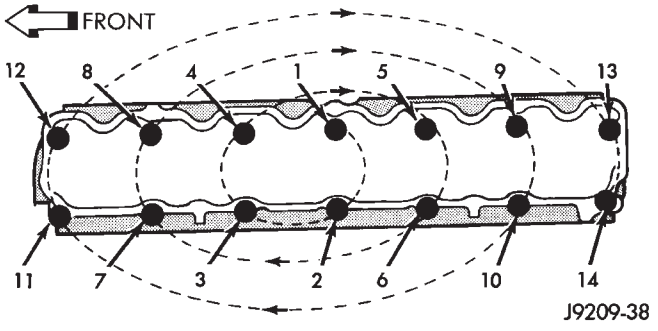


Fig. 53 Engine Cylinder Head Bolt Tightening Sequence

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

(7) Connect the temperature sending unit wire connector.

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

REMOVAL AND INSTALLATION (Continued)

(9) Install the intake and engine exhaust manifolds (refer to procedures in this section).

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

(11) Attach the power steering pump and bracket.

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

(13) Install the engine cylinder head cover.

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

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

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

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

(17) Install the air cleaner and ducting.

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

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

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

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

(22) Connect negative cable to battery.

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

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

VALVES AND VALVE SPRINGS

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

REMOVAL

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

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

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

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

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

INSTALLATION

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

(2) Lightly lubricate the stem.

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

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

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

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

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

(8) Install the engine cylinder head.

HYDRAULIC TAPPETS

Retain all the components in the same order as removed.

REMOVAL

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

(2) Remove the push rods.

(3) Remove the tappets through the push rod openings in the cylinder block with a Hydraulic Valve Tappet Removal/Installation Tool (Fig. 54).

INSTALLATION

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

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

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

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

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

REMOVAL AND INSTALLATION (Continued)

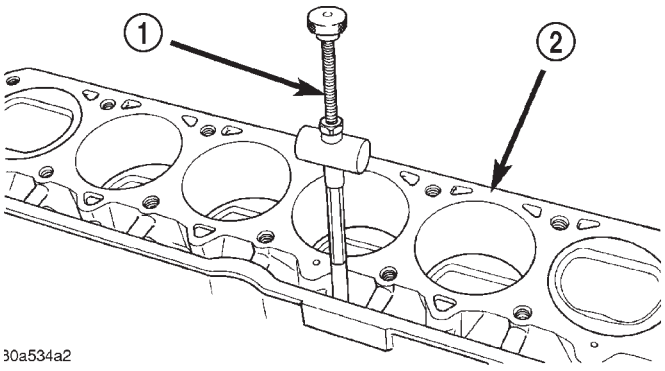


Fig. 54 Hydraulic Valve Tappet Removal—Installation Tool

1 – HYDRAULIC TAPPET REMOVAL TOOL
2 – CYLINDER BLOCK

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

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

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

(8) Install the engine cylinder head cover.

VIBRATION DAMPER

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove the serpentine drive belt and fan shroud. Refer to Group 7, Cooling Systems for the procedures.

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

(4) Use Vibration Damper Removal Tool 7697 to remove the damper from the crankshaft (Fig. 55).

INSTALLATION

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

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

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

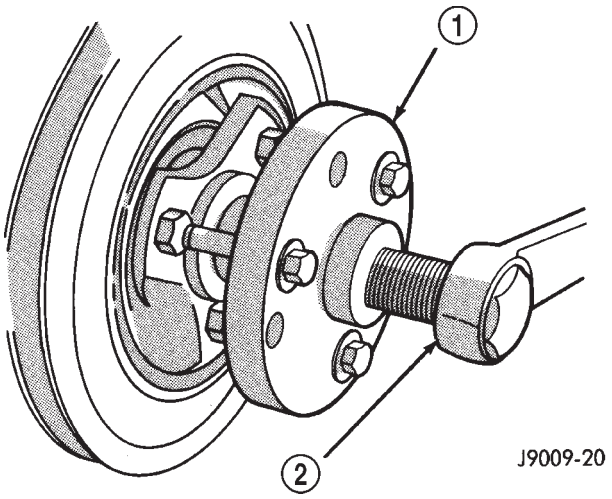


Fig. 55 Vibration Damper Removal Tool 7697

1 – VIBRATION DAMPER REMOVAL TOOL
2 – WRENCH

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

(5) Connect negative cable to battery.

TIMING CASE COVER

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove the vibration damper.

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

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

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

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

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

(8) Pry the crankshaft oil seal from the front of the timing case cover (Fig. 56).

INSTALLATION

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

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

(2) Position the gasket on the cylinder block.

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

REMOVAL AND INSTALLATION (Continued)

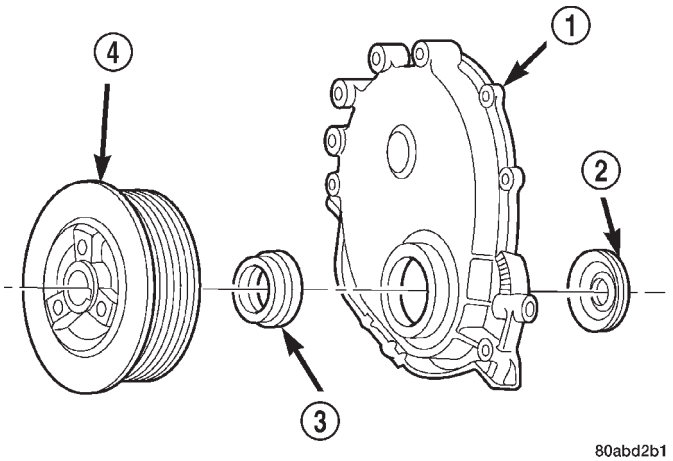


Fig. 56 Timing Case Cover Components

1 – TIMING CASE COVER
2 – OIL SLINGER
3 – CRANKSHAFT OIL SEAL
4 – VIBRATION DAMPER PULLEY

(4) Insert Timing Case Cover Alignment and Seal Installation Tool 6139 in the crankshaft opening in the cover (Fig. 57).

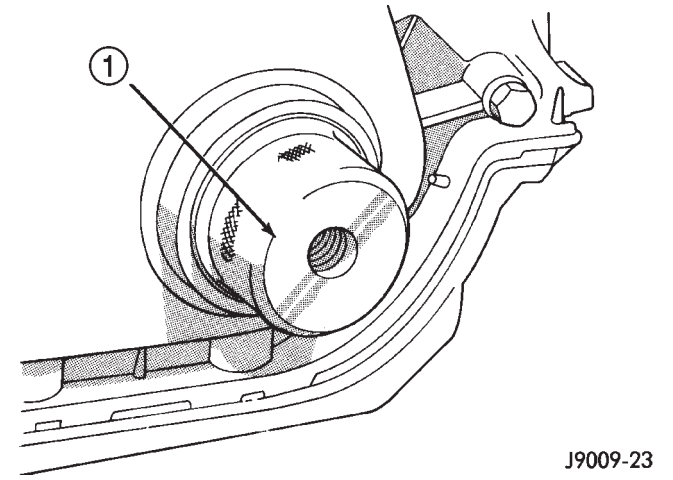


Fig. 57 Timing Case Cover Alignment and Seal Installation Tool 6139

1 – TIMING CASE COVER ALIGNMENT AND SEAL INSTALLATION TOOL

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

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

(7) Remove the cover alignment tool.

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

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

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

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

(12) Install the serpentine drive belt.

(13) Connect negative cable to battery.

TIMING CHAIN AND SPROCKETS

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove the fan and shroud.

(3) Remove the serpentine drive belt.

(4) Remove the crankshaft vibration damper.

(5) Remove the timing case cover.

(6) Rotate crankshaft until the “0” timing mark is closest to and on the center line with camshaft sprocket timing mark (Fig. 58).

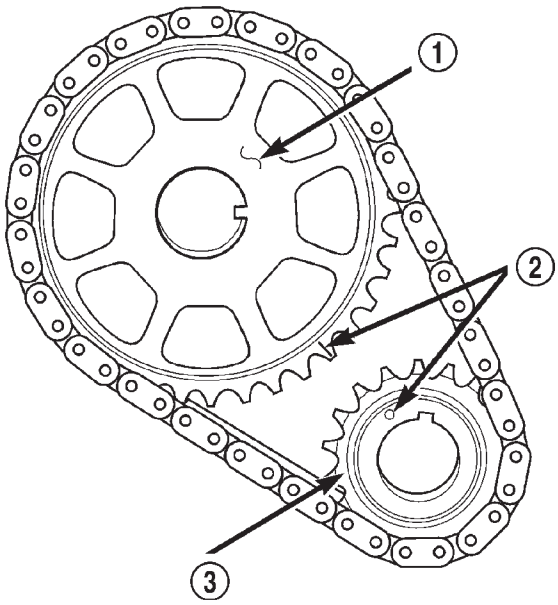


Fig. 58 Crankshaft—Camshaft Alignment

1 – CAMSHAFT SPROCKET
2 – TIMING MARKS
3 – CRANKSHAFT SPROCKET

(7) Remove the oil slinger from the crankshaft.

(8) Remove the camshaft sprocket bolt and washer (Fig. 59).

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

REMOVAL AND INSTALLATION (Continued)

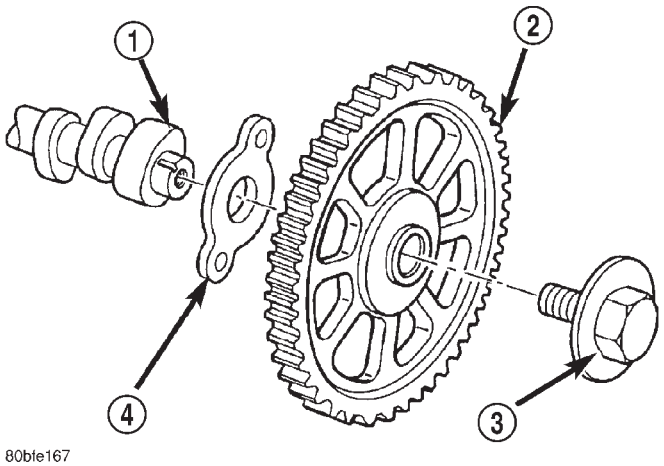


Fig. 59 Camshaft Sprocket and Thrust Plate

1 – CAMSHAFT
2 – CAMSHAFT SPROCKET W/INTEGRAL KEY
3 – BOLT & CUP WASHER
4 – THRUST PLATE

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

INSTALLATION

Assemble the timing chain, crankshaft sprocket and camshaft sprocket with the timing marks aligned (Fig. 58).

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

(2) Install the camshaft sprocket bolt and washer (Fig. 59). Tighten the bolt to 68 N·m (50 ft. lbs.) torque.

(3) To verify correct installation of the timing chain, rotate the crankshaft 2 revolutions. The camshaft and crankshaft sprocket timing mark should align (Fig. 58).

(4) Install the crankshaft oil slinger.

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

(6) Install the timing case cover and gasket.

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

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

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

(10) Connect negative cable to battery.

CAMSHAFT

REMOVAL

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

(1) Disconnect negative cable from battery.

(2) Drain the cooling system. DO NOT waste reusable coolant. If the solution is clean, drain it into a clean container for reuse.

(3) Remove the radiator or radiator and condenser, if equipped with A/C (refer to Group 7, Cooling System for the proper procedure).

(4) Remove the distributor cap and mark the position of the rotor.

(5) Remove the front fascia and/or grille, as required.

(6) Disconnect camshaft position sensor electrical connector and remove camshaft position sensor.

(7) Remove the engine cylinder head cover.

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

(9) Remove the push rods.

(10) Remove the engine cylinder head and gasket.

(11) Remove the hydraulic valve tappets from the engine cylinder block.

(12) Remove the vibration damper.

(13) Remove the timing case cover.

(14) Remove the timing chain and sprockets.

(15) Remove the two thrust plate retaining screws and thrust plate.

(16) Remove the camshaft (Fig. 60).

INSTALLATION

(1) Inspect the cam lobes for wear.

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

(3) Inspect the bearings for wear.

(4) Inspect the distributor drive gear for wear.

(5) If the camshaft thrust surface appears to have excessive wear, examine the oil pressure relief holes in the rear cam journal. The oil pressure relief holes must be free of debris.

(6) Lubricate the camshaft with Mopar Engine Oil Supplement, or equivalent.

(7) Carefully install the camshaft to prevent damage to the camshaft bearings (Fig. 60).

(8) Inspect thrust plate surfaces for excessive wear, position thrust plate and install retaining screws. Tighten screws to 24 N·m (18 ft. lbs.).

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

REMOVAL AND INSTALLATION (Continued)

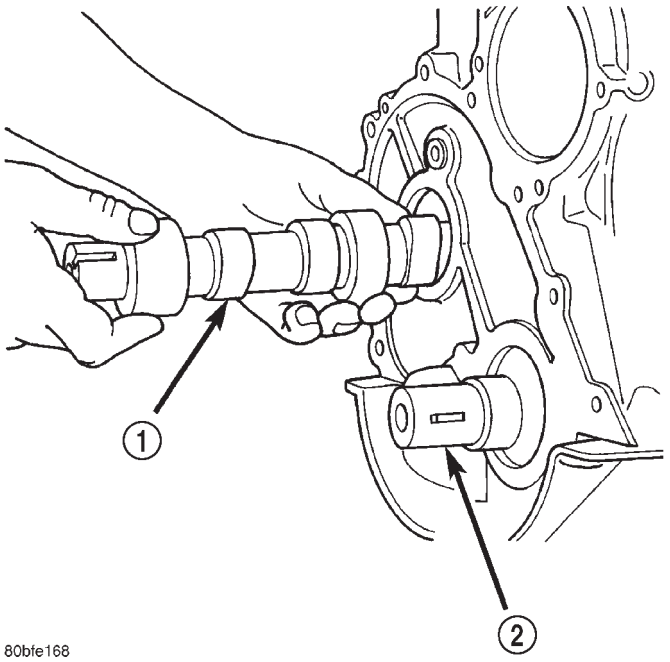


Fig. 60 Camshaft

1 – CAMSHAFT
2 – CRANKSHAFT

(10) Install the camshaft sprocket bolt / cup washer. Tighten the bolt to 68 N·m (50 ft. lbs.).

(11) Install the timing case cover with a replacement oil seal (Fig. 61). Refer to Timing Case Cover Installation.

(12) Install the vibration damper (Fig. 61).

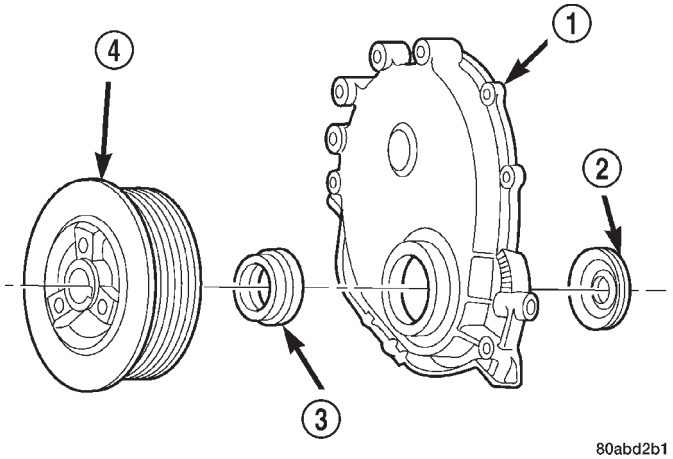


Fig. 61 Timing Case Cover Components

1 – TIMING CASE COVER
2 – OIL SLINGER
3 – CRANKSHAFT OIL SEAL
4 – VIBRATION DAMPER PULLEY

(13) Install the hydraulic valve tappets.

(14) Install the cylinder head gasket with the numbers facing up.

(15) Install the cylinder head and head bolts (Refer to cylinder head R&I in this section for torque values and tightening sequence).

(16) Install the push rods.

(17) Install the rocker arms and pivot and bridge assemblies. Tighten each of the capscrews for each bridge alternately, one turn at a time, to avoid damaging the bridge (Refer to Rocker Arms and Push Rods in this section).

(18) Install the engine cylinder head cover.

(19) Position the oil pump gear. Refer to Camshaft position sensor in the Component Removal/Installation section of Group 14, Fuel Systems.

(20) Install the Camshaft position sensor and ignition coil rail. Refer to Camshaft position sensor in the Component Removal/Installation section of Group 14, Fuel Systems.

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

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

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

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

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

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

(25) Connect negative cable to battery.

CAMSHAFT BEARINGS

REMOVAL

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

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

REMOVAL AND INSTALLATION (Continued)

NOTE: It is not advisable to attempt to replace camshaft bearings unless special removal and installation tools are available, such as recommended tool 8544 Camshaft Bushing Remover Installer.

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

INSTALLATION

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

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

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

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

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

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

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

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

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

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

(10) To verify correct installation of the timing chain, turn the crankshaft two full revolutions then position the camshaft sprocket timing mark as shown in (Fig. 62).

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

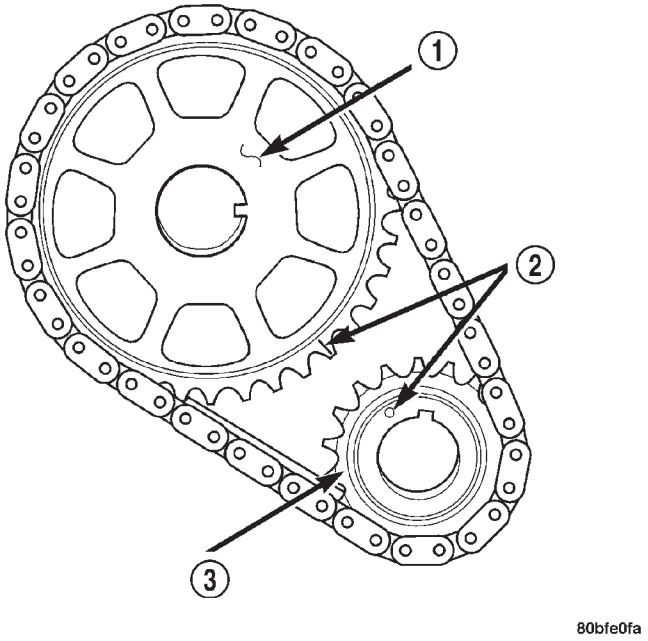


Fig. 62 Crankshaft / Camshaft Chain Drive Installation—Typical

1 – CAMSHAFT SPROCKET
2 – TIMING MARKS
3 – CRANKSHAFT SPROCKET

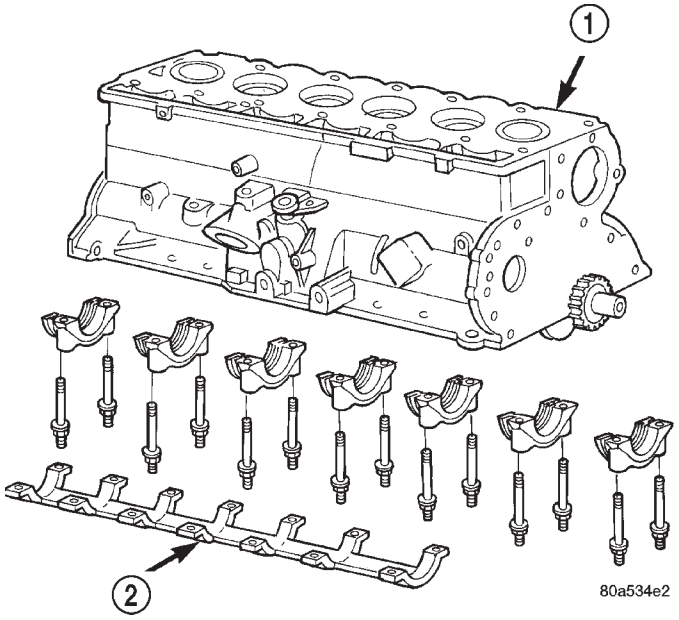


Fig. 63 Main Bearing Caps and Brace.

1 – BLOCK
2 – MAIN BEARING CAP BRACE

CRANKSHAFT MAIN BEARINGS

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove the spark plugs.

(3) Raise the vehicle.

(4) Remove the oil pan and oil pump.

(5) Remove main bearing cap brace (Fig. 63).

(6) Remove only one main bearing cap and lower insert at a time (Fig. 64).

(7) Remove the lower insert from the bearing cap.

(8) Remove the upper insert by LOOSENING (DO NOT REMOVE) all of the other bearing caps. Now insert a small cotter pin tool in the crankshaft jour-

REMOVAL AND INSTALLATION (Continued)

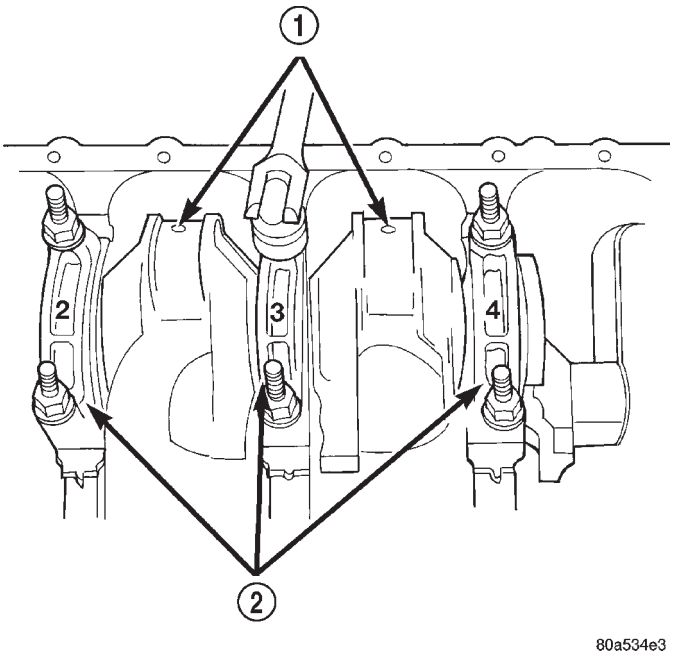


Fig. 64 Removing Main Bearing Caps and Lower Inserts

1 – CONNECTING ROD JOURNAL
2 – MAIN BEARING CAPS

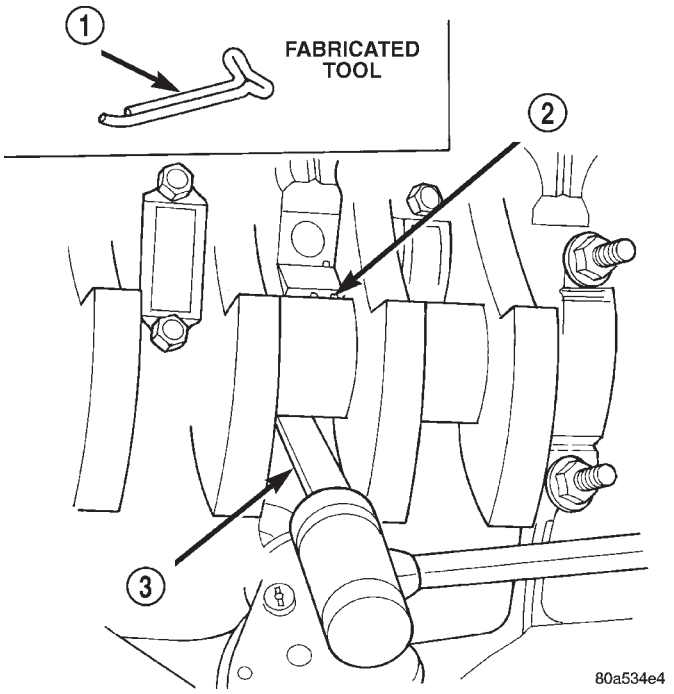


Fig. 65 Removing Upper Inserts

1 – COTTER PIN
2 – BEARING INSERT
3 – TONGUE DEPRESSOR

nal oil hole. Bend the cotter pin as illustrated to fabricate the tool (Fig. 65). With the cotter pin tool in place, rotate the crankshaft so that the upper bearing insert will rotate in the direction of its locking tab. Because there is no hole in the No.3 main journal, use a tongue depressor or similar soft-faced tool to remove the bearing insert (Fig. 65). After moving the insert approximately 25 mm (1 inch), it can be removed by applying pressure under the tab.

(9) Using the same procedure described above, remove the remaining bearing inserts one at a time for inspection.

INSTALLATION

(1) Lubricate the bearing surface of each insert with engine oil.

(2) Loosen all the main bearing caps. Install the main bearing upper inserts.

(3) Install the lower bearing inserts into the main bearing caps.

(4) On the rear main cap, apply Mopar® Gasket Maker sealer on both sides of cylinder block as shown in (Fig. 66). The dab of sealer should be 3 mm (0.125 in.) in diameter.

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

(6) Install the main bearing cap(s) and lower insert(s).

(7) Tighten the bolts of caps 1, 2, 4, 5, 6, and 7 to 54 N·m (40 ft. lbs.) torque. Now tighten these bolts to 95 N·m (70 ft. lbs.) torque. Finally, tighten these bolts to 108 N·m (80 ft. lbs.) torque.

(8) Push the crankshaft forward and backward. Load the crankshaft front or rear and tighten cap bolt No.3 to 54 N·m (40 ft. lbs.) torque. Then tighten to 95 N·m (70 ft. lbs.) torque and finally tighten to 108 N·m (80 ft. lbs.) torque.

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

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

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

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

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

(d) Pry the crankshaft forward and backward. Note the dial indicator readings. End play is the difference between the high and low measurements (Fig. 67). Correct end play is 0.038-0.165 mm (0.0015-0.0065 inch). The desired specifications are 0.051-0.064 mm (0.002-0.0025 inch).

REMOVAL AND INSTALLATION (Continued)

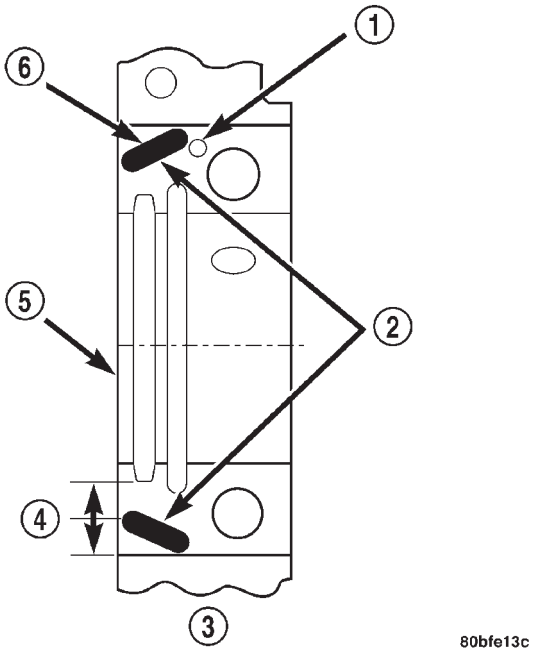


Fig. 66 Location of Sealer

1 – **DOWEL**
2 – **SEALER LOCATIONS**
3 – **CYLINDER BLOCK**
4 – **HALFWAY BETWEEN**
5 – **REAR FACE OF CYLINDER BLOCK**
6 – **3mm (0.125 in.)**

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

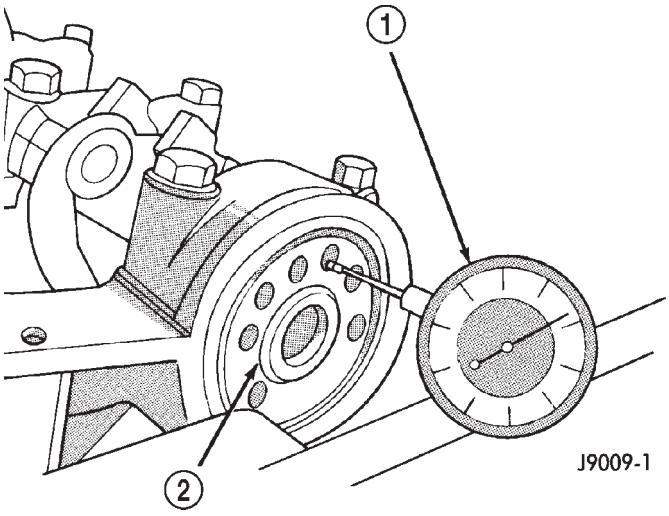


Fig. 67 Crankshaft End Play Measurement

1 – DIAL INDICATOR
2 – CRANKSHAFT

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

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

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

(14) Install the oil pan.

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

(16) Lower the vehicle.

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

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

(19) Connect negative cable to battery.

OIL PAN

REMOVAL

(1) Disconnect negative cable from battery.

(2) Raise the vehicle.

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

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

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

(6) Remove the starter motor.

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

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

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

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

(11) Remove the engine mount through bolts.

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

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

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

INSTALLATION

(1) Clean the block and pan gasket surfaces.

(2) Fabricate 4 alignment dowels from 1 1/2 x 1/4 inch bolts. Cut the head off the bolts and cut a slot into the top of the dowel. This will allow easier installation and removal with a screwdriver (Fig. 68).

REMOVAL AND INSTALLATION (Continued)

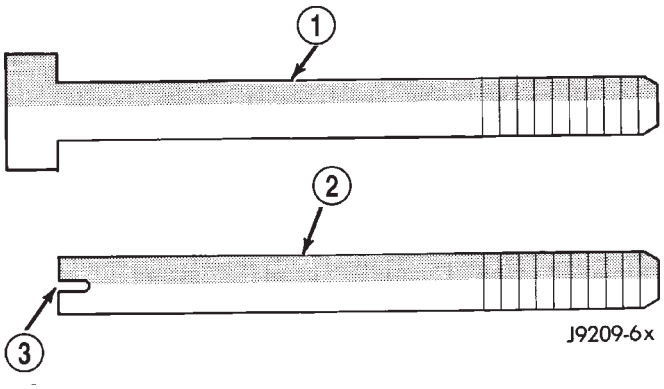


Fig. 68 Fabrication of Alignment Dowels

1 – 1/4'' × 1 1/2'' BOLT
2 – DOWEL
3 – SLOT

(3) Install two dowels in the timing case cover. Install the other two dowels in the cylinder block (Fig. 69).

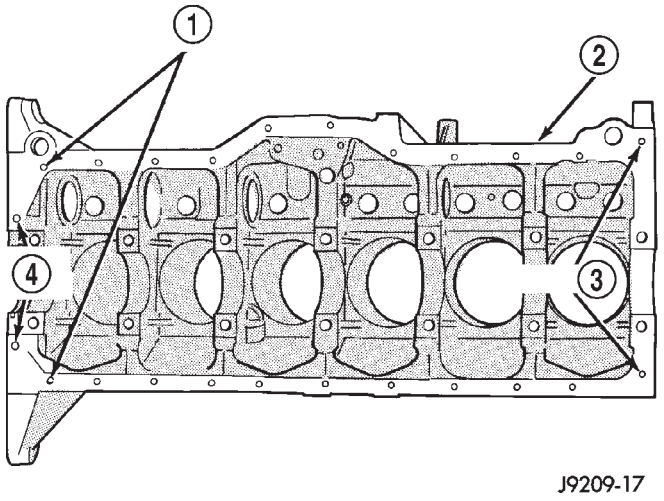


Fig. 69 Position of Dowels in Cylinder Block

1 – DOWEL HOLES
2 – CYLINDER BLOCK
3 – 5/16'' HOLES
4 – 5/16'' HOLES

(4) Apply Mopar® Silicone Rubber Adhesive Sealant on cylinder block to rear main bearing cap corners and cylinder block to front cover joints (four places) (Fig. 70).

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

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

(7) Install the 1/4 inch oil pan bolts. Tighten these bolts to 9.5 N·m (84 in. lbs.) torque. Install the 5/16 inch oil pan bolts (Fig. 71). Tighten these bolts to 15 N·m (132 in. lbs.) torque.

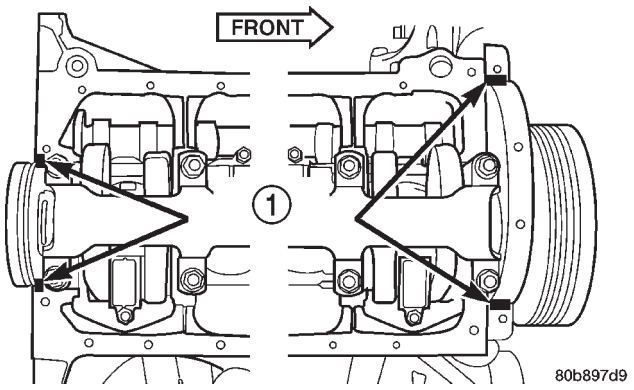


Fig. 70 Oil Pan Sealer Location

1 – SEALER LOCATIONS

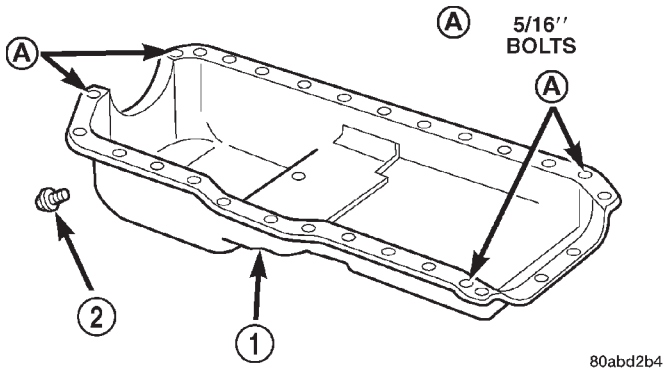


Fig. 71 Position of 5/16 inch Oil Pan Bolts

1 – OIL PAN
2 – OIL PAN DRAIN PLUG

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

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

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

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

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

(13) Install the engine starter motor.

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

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

(16) Install the oil pan drain plug (Fig. 71). Tighten the plug to 34 N·m (25 ft. lbs.) torque.

(17) Lower the vehicle.

(18) Connect negative cable to battery.

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

REMOVAL AND INSTALLATION (Continued)

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

(20) Start the engine and inspect for leaks.

PISTONS AND CONNECTING RODS

REMOVAL

(1) Remove the engine cylinder head cover.
(2) Remove the rocker arms, bridges and pivots.
(3) Remove the push rods.
(4) Remove the engine cylinder head.
(5) Position the pistons one at a time near the bottom of the stroke. Use a ridge reamer to remove the ridge from the top end of the cylinder walls. Use a protective cloth to collect the cuttings.
(6) Raise the vehicle.
(7) Drain the engine oil.
(8) Remove the oil pan and gasket.
(9) Remove main bearing cap brace (Fig. 72).

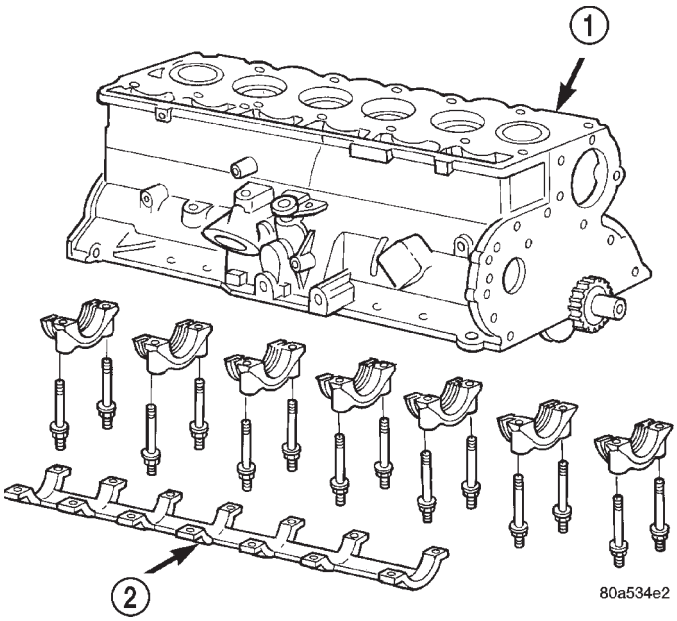


Fig. 72 Main Bearings Caps and Brace

1 – BLOCK
2 – MAIN BEARING CAP BRACE

(10) Remove the connecting rod bearing caps and inserts. Mark the caps and rods with the cylinder bore location. The connecting rods and caps are stamped with a two letter combination (Fig. 73).
(11) Lower the vehicle until it is about 2 feet from the floor.

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

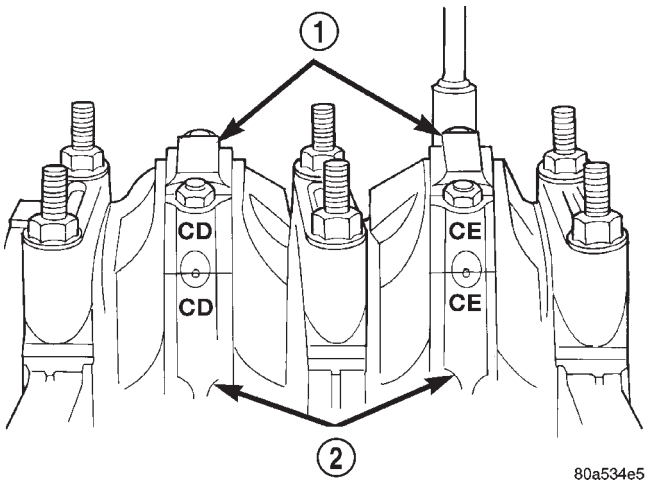


Fig. 73 Stamped Connecting Rods and Caps

1 – CONNECTING ROD CAP
2 – CONNECTING ROD

(12) Have an assistant push the piston and connecting rod assemblies up and through the top of the cylinder bores (Fig. 74).

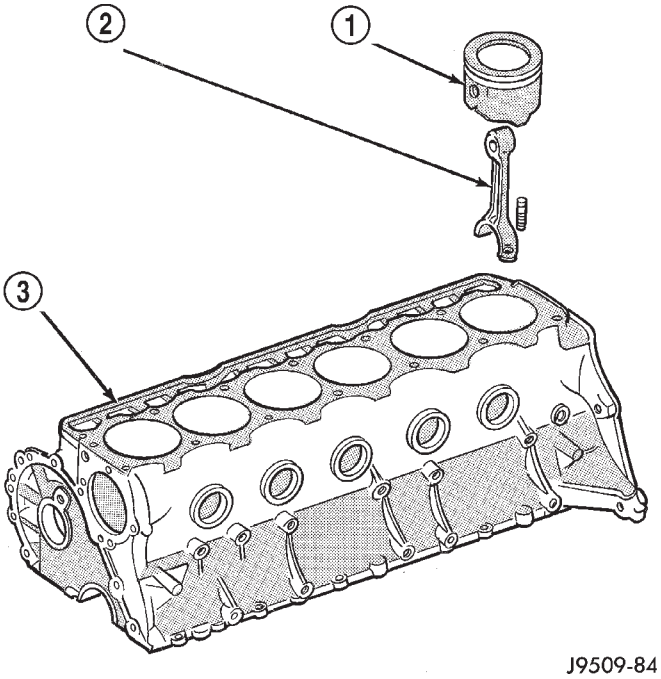


Fig. 74 Removal of Connecting Rod and Piston Assembly

1 – PISTON
2 – CONNECTING ROD
3 – BLOCK

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

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

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

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

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

(4) Use a piston ring compressor to install the connecting rod and piston assemblies through the top of the cylinder bores (Fig. 75).

(5) Ensure the arrow on the piston top points to the front of the engine (Fig. 75).

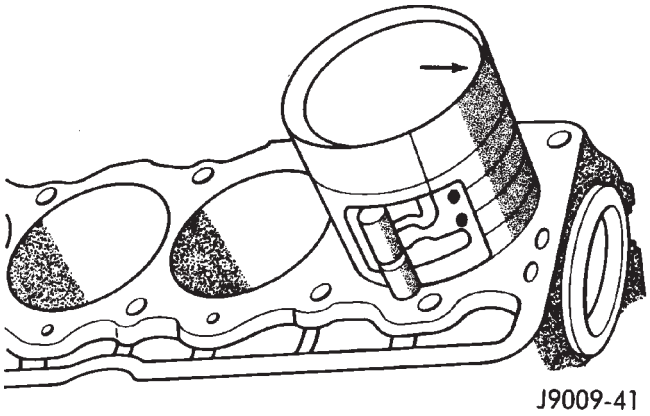


Fig. 75 Rod and Piston Assembly Installation

(6) Raise the vehicle.

(7) Each bearing insert is fitted to its respective journal to obtain the specified clearance between the bearing and the journal. In production, the select fit is obtained by using various-sized, color-coded bearing inserts as listed in the Connecting Rod Bearing Fitting Chart. The color code appears on the edge of the bearing insert. The size is not stamped on inserts used for production of engines.

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

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

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

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

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

(11) Install main bearing cap brace (Fig. 72). Tighten nuts to 47 N·m (35 ft. lbs.).

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

(13) Lower the vehicle.

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

(15) Fill the crankcase with engine oil.

CRANKSHAFT OIL SEALS—REAR

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

REMOVAL

(1) Remove transmission inspection cover.

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

(3) Remove main bearing cap brace.

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

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

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

INSTALLATION

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

(2) Apply a thin coat of engine oil.

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

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

(5) Apply Mopar® Gasket Maker sealer on both sides of cylinder block as shown in (Fig. 76). The dab of sealer should be 3 mm (0.125 in.) in diameter.

(6) Apply Mopar® Gasket Maker on the rear bearing cap (Fig. 76). The bead should be 2.3 mm (0.09 in.) in diameter. DO NOT apply sealer to the lip of the seal.

REMOVAL AND INSTALLATION (Continued)

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

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

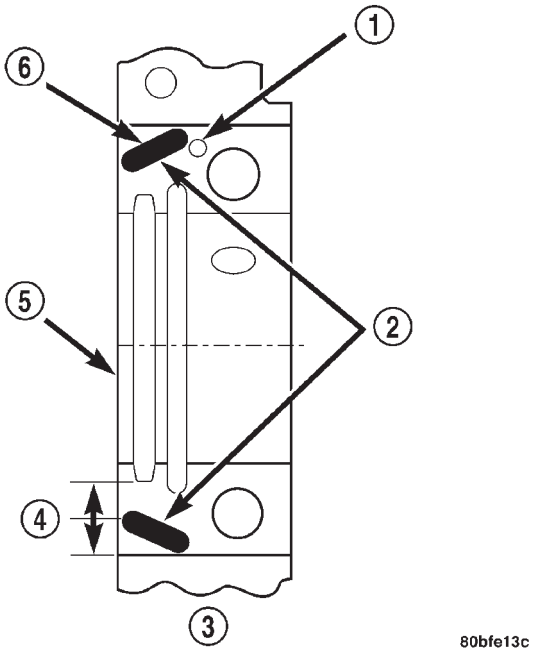


Fig. 76 Location of Sealer

1 – **DOWEL**
2 – **SEALER LOCATIONS**
3 – **CYLINDER BLOCK**
4 – **HALFWAY BETWEEN**
5 – **REAR FACE OF CYLINDER BLOCK**
6 – **3mm (0.125 in.)**

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

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

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

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

(13) Apply Mopar® Silicone Rubber Adhesive Sealant on cylinder block to rear main bearing cap corners and cylinder block to front cover joints (four places) (Fig. 77)

(14) Install transmission inspection cover.

OIL PUMP

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

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

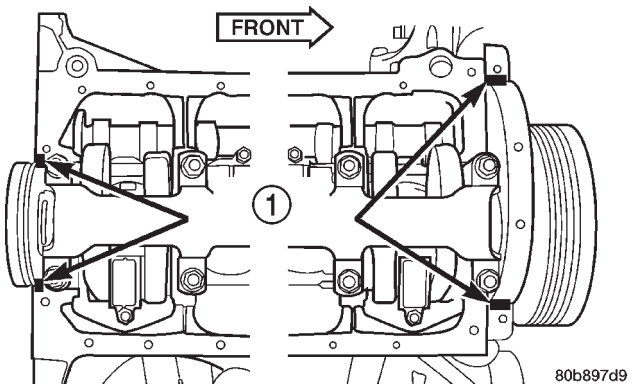


Fig. 77 Oil Pan Sealer Location

1 – SEALER LOCATIONS

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

REMOVAL

(1) Drain the engine oil.

(2) Remove the oil pan.

(3) Remove the pump-to-cylinder block attaching bolts. Remove the pump assembly with gasket (Fig. 78).

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

INSTALLATION

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

(2) Install the oil pan.

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

TIMING CASE COVER OIL SEAL

This procedure is done with the timing case cover installed.

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove the serpentine drive belt.

(3) Remove the vibration damper.

(4) Remove the radiator shroud.

(5) Carefully remove the oil seal. Make sure seal bore is clean.

REMOVAL AND INSTALLATION (Continued)

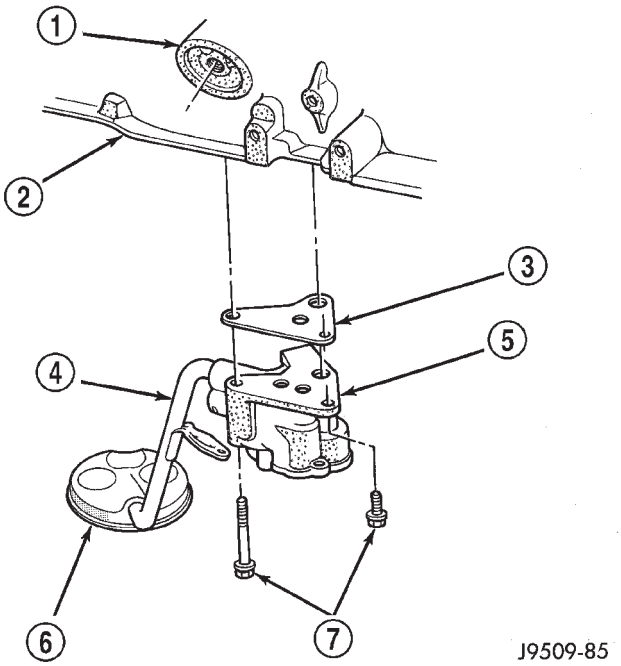


Fig. 78 Oil Pump Assembly

1 – OIL FILTER ADAPTOR
2 – BLOCK
3 – GASKET
4 – OIL INLET TUBE
5 – OIL PUMP
6 – STRAINER ASSEMBLY
7 – ATTACHING BOLTS

INSTALLATION

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

(2) Position the tool and seal over the end of the crankshaft and insert a draw screw tool into Seal Installation Tool 6139 (Fig. 79). Tighten the nut against the tool until it contacts the cover.

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

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

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

(6) Install the radiator shroud.

(7) Connect negative cable to battery.

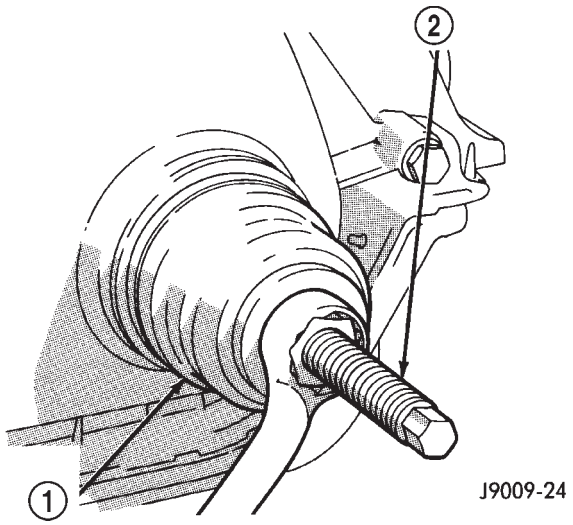


Fig. 79 Timing Case Cover Oil Seal Installation

1 – SEAL INSTALLATION TOOL
2 – DRAW SCREW TOOL

DISASSEMBLY AND ASSEMBLY

VALVE SERVICE

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

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

Inspect for cracks in the combustion chambers and valve ports.

Inspect for cracks on the exhaust seat.

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

Inspect valves for burned, cracked or warped heads.

Inspect for scuffed or bent valve stems.

Replace valves displaying any damage.

VALVE REFACING

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

(2) After refacing, a margin of at least 0.787 mm (0.031 inch) must remain (Fig. 80). If the margin is less than 0.787 mm (0.031 inch), the valve must be replaced.

VALVE SEAT REFACING

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

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

(3) Control valve seat runout to a maximum of 0.0635 mm (0.0025 in.) (Fig. 81).

DISASSEMBLY AND ASSEMBLY (Continued)

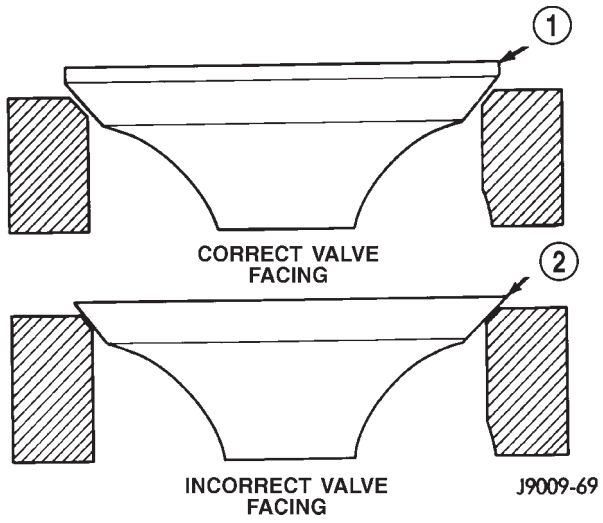


Fig. 80 Valve Facing Margin

1 – VALVE MARGIN
2 – NO MARGIN

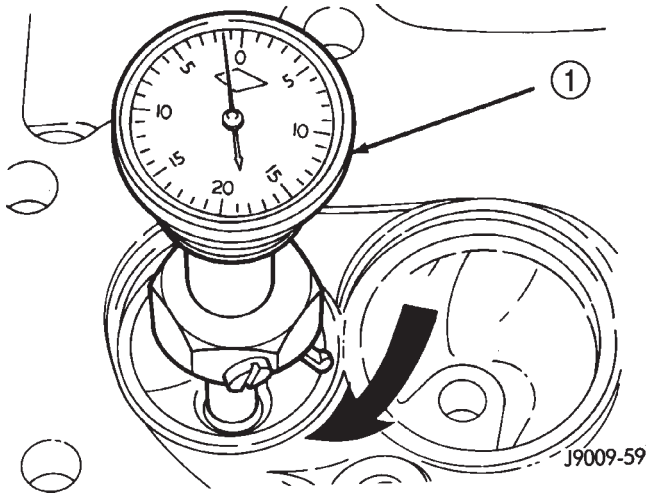


Fig. 81 Measurement of Valve Seat Runout

1 – DIAL INDICATOR

VALVE STEM OIL SEAL REPLACEMENT

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

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

VALVE GUIDES

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

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

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

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

VALVE STEM-TO-GUIDE CLEARANCE MEASUREMENT

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

PREFERRED METHOD

(1) Remove the valve from the head.

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

(3) Insert a telescoping gauge into the valve stem guide bore approximately 9.525 mm (.375 inch) from the valve spring side of the head (Fig. 82).

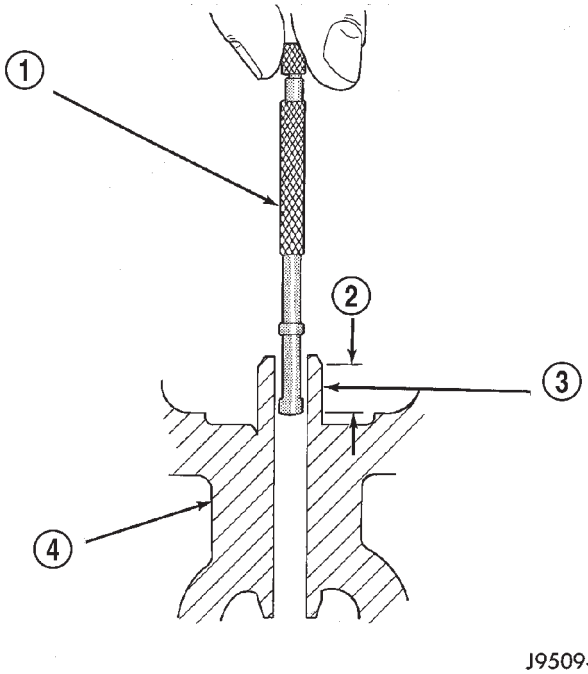


Fig. 82 Measurement of Valve Guide Bore Diameter

1 – GAUGE
2 – 9.525 MM (3/8 INCH)
3 – VALVE STEM GUIDE
4 – CYLINDER HEAD

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

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

DISASSEMBLY AND ASSEMBLY (Continued)

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

(7) Compare the measured valve guide bore diameter with specifications (7.95-7.97 mm or 0.313-0.314 inch). If the measurement differs from specification by more than 0.076 mm (0.003 inch), ream the guide bore to accommodate an oversize valve stem.

ALTERNATIVE METHOD

(1) Use a dial indicator to measure the lateral movement of the valve stem (stem-to-guide clearance). This must be done with the valve installed in its guide and just off the valve seat (Fig. 83).

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

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

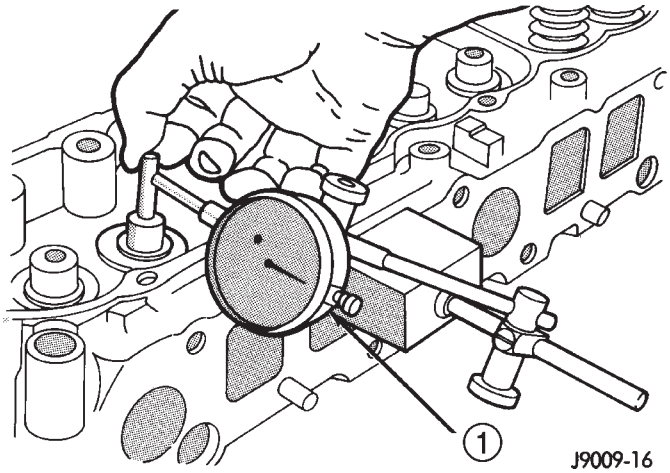


Fig. 83 Measurement of Lateral Movement of Valve Stem

1 – DIAL INDICATOR

VALVE SPRING TENSION TEST

Use a universal Valve Spring Tester and a torque wrench to test each valve spring for the specified tension value (Fig. 84).

Replace valve springs that are not within specifications.

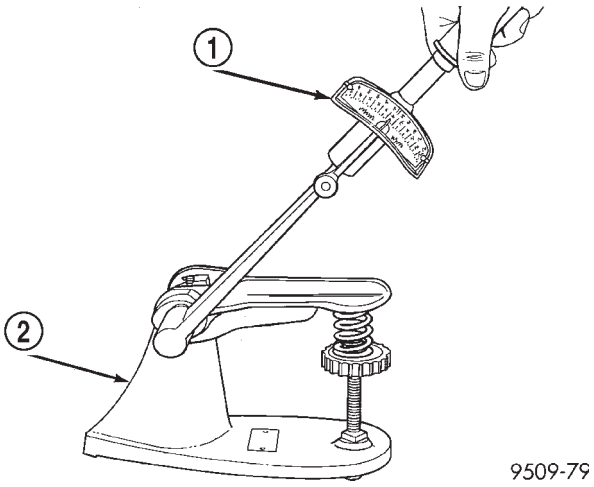


Fig. 84 Valve Spring Tester

1 – TORQUE WRENCH
2 – VALVE SPRING TESTER

CYLINDER BLOCK

DISASSEMBLY

Refer to the applicable sections for detailed instructions.

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

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

(3) Remove the vibration damper.

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

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

(6) Remove the oil slinger from crankshaft.

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

(8) Remove the camshaft.

(9) Remove the oil pan and gasket.

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

(11) Remove the oil pump.

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

(13) Remove the crankshaft.

ASSEMBLY

Refer to the applicable sections for detailed instructions.

(1) Install the crankshaft.

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

(3) Install the oil pump.

(4) Install the oil pan and gasket.

(5) Install the camshaft.

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

(7) Install the oil slinger from the crankshaft.

(8) Install the timing case cover seal.

(9) Install the timing case cover.

(10) Install the vibration damper.

DISASSEMBLY AND ASSEMBLY (Continued)

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

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

(13) Install the engine into the vehicle.

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

(15) Fill the cooling system.

CLEANING AND INSPECTION

INTAKE AND EXHAUST MANIFOLD

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

CYLINDER HEAD

CLEANING

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

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

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

INSPECTION

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

CYLINDER HEAD COVER

CLEANING

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

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

INSPECTION

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

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

ROCKER ARMS AND PUSH RODS

CLEANING

Clean all the components with cleaning solvent.

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

INSPECTION

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

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

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

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

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

HYDRAULIC TAPPETS

CLEANING

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

INSPECTION

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

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

After cleaning and inspection, test each tappet for specified leak-down rate tolerance to ensure zero-lash operation (Fig. 85).

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

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

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

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

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

CLEANING AND INSPECTION (Continued)

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

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

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

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

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

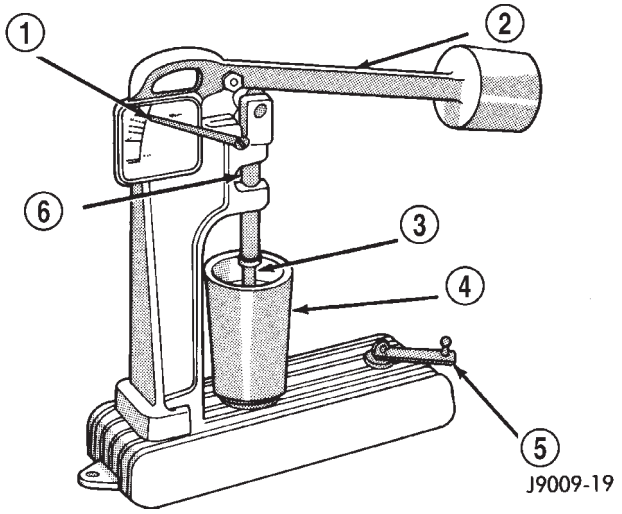


Fig. 85 Leak-Down Tester

1 – POINTER
2 – WEIGHTED ARM
3 – RAM
4 – CUP
5 – HANDLE
6 – PUSH ROD

CYLINDER BLOCK

CLEANING

Thoroughly clean the oil pan and engine block gasket surfaces.

Use compressed air to clean out:

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

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

INSPECTION

(1) It is mandatory to use a dial bore gauge to measure each cylinder bore diameter (Fig. 86). To correctly select the proper size piston, a cylinder bore gauge, capable of reading in 0.003 mm (.0001 in.) INCREMENTS is required. If a bore gauge is not available, do not use an inside micrometer.

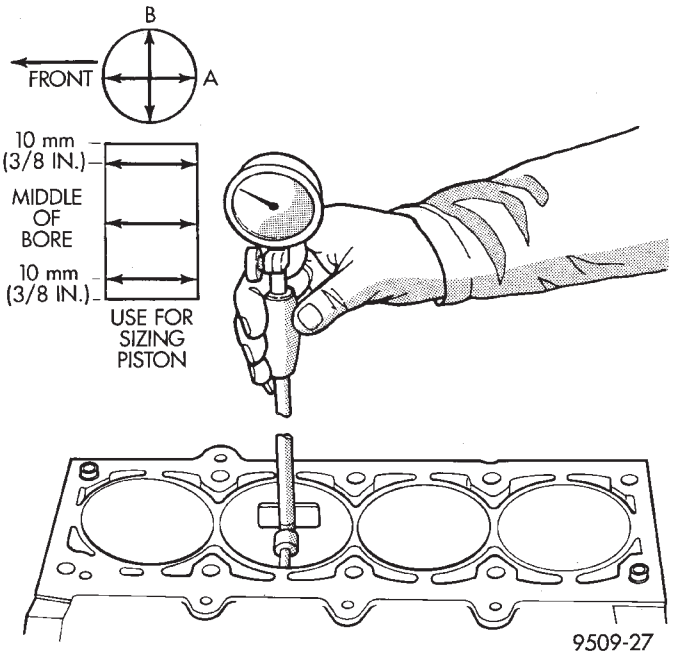


Fig. 86 Cylinder Bore Measurement

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

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

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

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

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

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

SPECIFICATIONS

SPECIFICATIONS

4.0L ENGINE

DESCRIPTION	SPECIFICATION
Engine Type	In-line 6 Cylinder
Bore and Stroke	98.4 x 86.69 mm (3.88 x 3.413 in.)
Displacement	4.0L (242 cu. in.)
Compression Ratio	8.8:1
Firing Order	1–5–3–6–2–4
Lubrication	Pressure Feed–Full Flow Filtration
Cooling System	Liquid Cooled–Forced Circulation
Cylinder Block	Cast Iron
Crankshaft	Cast Nodular Iron
Cylinder Head	Cast Iron
Camshaft	Cast Iron
Pistons	Aluminum Alloy
Combustion Chamber	Dual-Quench
Connecting Rods	Cast Iron
CAMSHAFT	
Hydraulic Tappet Clearance	Zero Lash
Bearing Clearance	0.025 to 0.076 mm (0.001 to 0.003 in.)
Bearing Journal Diameter	
No. 1	51.54 to 51.56 mm (2.029 to 2.030 in.)
No. 2	51.28 to 51.31 mm (2.019 to 2.020 in.)
No. 3	51.03 to 51.05 mm (2.009 to 2.010 in.)
No. 4	50.78 to 50.80 mm (1.999 to 2.000 in.)
Base Circle Runout (MAX)	0.03 mm (0.001 in.)
Valve Lift	
Intake	10.350 mm (0.4075 in.)
Exhaust	10.528 mm (0.4145 in.)

DESCRIPTION	SPECIFICATION
Valve Timing	
Intake	
Opens	12.4° BTDC
Closes	60.9° ABDC
Exhaust	
Opens	49.8 BBDC
Closes	29.2° ATDC
Valve Overlap	41.6°
Intake Duration	253.3°
Exhaust Duration	259.°
CRANKSHAFT	
End Play	0.038 to 0.165 mm (0.0015 to 0.0065 in.)
Main Bearing Journal Diameter	
No. 1-6	63.489 to 63.502 mm (2.4996 to 2.5001 in.)
No. 7	63.449 to 63.487 mm (2.4980 to 2.4995 in.)
Main Bearing Journal Width	
No. 1	27.58 to 27.89 mm (1.086 to 1.098 in.)
No. 3	32.28 to 32.33 mm (1.271 to 1.273 in.)
No. 2-4-5-6-7	30.02 to 30.18 mm (1.182 to 1.188 in.)
Main Bearing Clearance	0.03 to 0.06 mm (0.001 to 0.0025 in.)
Preferred	0.051 mm (0.002 in.)
Connecting Rod Journal Diameter	53.17 to 53.23 mm (2.0934 to 2.0955 in.)
Connecting Rod Journal Width	27.18 to 27.33 mm (1.070 to 1.076 in.)
Out-of-Round (MAX)	0.013 mm (0.0005 in.)
Taper (MAX)	0.013 mm (0.0005 in.)
CYLINDER BLOCK	
Deck Height	240.03 to 240.18 mm (9.450 to 9.456 in.)
Deck Clearance (Below Block)	0.546 mm (0.0215 in.)

SPECIFICATIONS (Continued)

DESCRIPTION	SPECIFICATION
Cylinder Bore Diameter	
Standard	98.45 to 98.48 mm (3.8759 to 3.8775 in.)
Taper	0.025 mm (0.001 in.)
Out-ofRound	0.025 mm (0.001 in.)
Tappet Bore Diameter	23.000 to 23.025 mm (0.9055 to 0.9065 in.)
Flatness	0.03 mm per 25 mm (0.001 in. per 1 in.) 0.05 mm per 152 mm (0.002 in. per 6 in.)
Flatness Max.	0.20 mm max. for total length (0.008 in. max. for total length)
Main Bearing Bore Diameter	68.3514 to 68.3768 mm (2.691 to 2.692 in.)
CONNECTING ROD	
Total Weight (Less Bearing)	663 to 671 grams (23.39 to 23.67 oz.)
Length (Center-to-Center)	155.52 to 155.62 mm (6.123 to 6.127 in.)
Piston Pin Bore Diameter	23.59 to 23.62 mm (0.9288 to 0.9298 in.)
Bore (Less Bearings)	56.08 to 56.09 mm (2.2080 to 2.2085 in.)
Bearing Clearance	0.025 to 0.076 mm (0.001 to 0.003 in.)
Preferred	0.044 to 0.050 mm (0.0015 to 0.0020 in.)
Side Clearance	0.25 to 0.48 mm (0.010 to 0.019 in.)
Twist (Max.)	0.006 mm per mm (0.002 in. per inch)
Bend (Max.)	0.002 mm per mm (0.006 in. per inch.)
CYLINDER COMPRESSION PRESSURE	
Pressure Range	827 to 1,034 kPa (120 to 150 psi)
Max. Variation Between Cylinders	206 kPa (30 psi)

DESCRIPTION	SPECIFICATION
CYLINDER HEAD	
Combustion Chamber	55.22 to 58.22 cc (3.37 to 3.55 cu. in.)
Valve Guide I. D. (Integral)	7.95 to 7.97 mm (0.313 to 0.314 in.)
Valve Stem-to-Guide Clearance	0.025 to 0.076 mm (0.001 to 0.003 in.)
Valve Seat Angle	
Intake	44.5°
Exhaust	44.5°
Valve Seat Width	1.02 to 1.52 mm (0.040 to 0.060 in.)
Valve Seat Runout	0.064 mm (0.0025 in.)
Flatness	0.03 mm per 25 mm (0.001 in. per 1 in.) 0.05 mm per 152 mm (0.002 in. per 6 in.)
Flatness Max.	0.20 mm - max. for total length (0.008 in. max. for total length)
ROCKER ARMS, PUSH RODS & TAPPETS	
Rocker Arm Ratio	1.6:1
Push Rod Length (Pink)	244.856 to 245.364 mm (9.640 to 9.660 in.)
Push Rod Diameter	7.92 to 8.00 mm (0.312 to 0.315 in.)
Hydraulic Tappet Diameter	22.962 to 22.974 mm (0.904 to 0.9045 in.)
Tappet-to-Bore Clearance	0.025 to 0.063 mm (0.001 to 0.0025 in.)
VALVES	
Valve Length (Overall)	
Intake	122.479 to 122.860 mm (4.822 to 4.837 in.)
Exhaust	122.860 to 123.241 mm (4.837 to 4.852 in.)
Valve Stem Diameter	7.899 to 7.925 mm (0.311 to 0.312 in.)
Stem-to-Guide Clearance	0.025 to 0.076 mm (0.001 to 0.003 in.)

SPECIFICATIONS (Continued)

DESCRIPTION	SPECIFICATION
Valve Head Diameter	
Intake	48.387 to 48.641 mm (1.905 to 1.915 in.)
Exhaust	37.973 to 38.227 mm (1.495 to 1.505 in.)
Valve Face Angle	
Intake	46.5°
Exhaust	46.5°
Tip Refinishing (Max. Allowable)	0.25 mm (0.010 in.)
VALVE SPRINGS	
Free Length (Approx.)	48 mm (1.890 in.)
Spring Load	
Valve Closed	316 to 351 N @ 41.656 mm (71 to 79 lbf. @ 1.64 in.)
Valve Open	898.6 to 969.7 N @ 30.89 mm (202 to 218 lbf @ 1.216 in.)
Inside Diameter	21.0 mm to 21.51 mm (0.827 to 0.847 in.)
Installed Height	41.656 mm (1.64 in.)
PISTONS	
Weight (Less Pin)	417 to 429 grams (14.7 to 15.1 oz.)
Piston Pin Bore (Centerline to Piston Top)	40.61 to 40.72 mm (1.599 to 1.603 in.)
Piston-to-Bore Clearance	0.018 to 0.038 mm (0.0008 to 0.0015 in.)
Ring Gap Clearance	
Top Compression Ring	0.229 to 0.610 mm (0.0090 to 0.0240 in.)
2nd Compression Ring	0.483 to 0.965 mm (0.0190 to 0.0380 in.)
Oil Control Steel Rails	0.254 to 1.500 mm (0.010 to 0.060 in.)
Ring Side Clearance	
Compression Rings	0.042 to 0.084 mm (0.0017 to 0.0033 in.)
Oil Control Rings	0.06 to 0.21 mm (0.0024 to 0.0083 in.)

DESCRIPTION	SPECIFICATION
Piston Ring Groove Height	
Compression Rings	1.530 to 1.555 mm (0.0602 to 0.0612 in.)
Oil Control Ring	4.035 to 4.060 mm (0.1589 to 0.1598 in.)
Piston Ring Groove Diameter	
No.1 Compression Ring	88.39 to 88.65 mm (3.48 to 3.49 in.)
No.2 Compression Ring	87.63 to 87.88 mm (3.45 to 3.46 in.)
Oil Control Ring	89.66 to 89.92 mm (3.53 to 3.54 in.)
Piston Pin Bore Diameter	23.650 to 23.658 mm (0.9312 to 0.9315 in.)
Piston Pin Diameter	23.637 to 23.640 mm (0.9306 to 0.9307 in.)
Piston-to-Pin Clearance	0.0102 to 0.0208 mm (0.0005 to 0.0009 in.)
Piston-to-Pin Connecting Rod (Press Fit)	8.9 kN (2000 lbf.)
OIL PUMP	
Gear-to-Body Clearance	0.051 to 0.102 mm
(Radial)	(0.002 to 0.004 in.)
Gear-to-Body Clearance (Radial) Preferred	0.051 mm (0.002 in.)
Gear End Clearance Plastigage	0.051 to 0.152 mm (0.002 to 0.006 in.)
Gear End Clearance Plastigage (Preferred)	0.051 mm (0.002 in.)
Gear End Clearance Feeler Gauge	0.1016 to 0.2032 mm (0.004 to 0.008 in.)
Gear End Clearance Feeler Gauge (Preferred)	0.1778 mm (0.007 in.)
Oil Pressure	
At Idle Speed	89.6 kPa (13 psi)
At 1600 rpm & Higher	255 to 517 kPa (37 to 75 psi)
Oil Pressure Relief	517 kPa (75 psi)

SPECIFICATIONS (Continued)

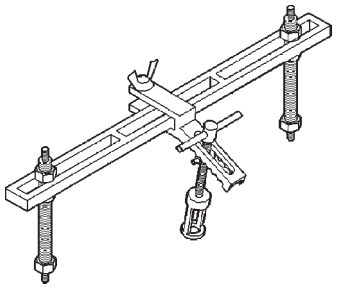
TORQUE SPECIFICATIONS

4.0L ENGINE

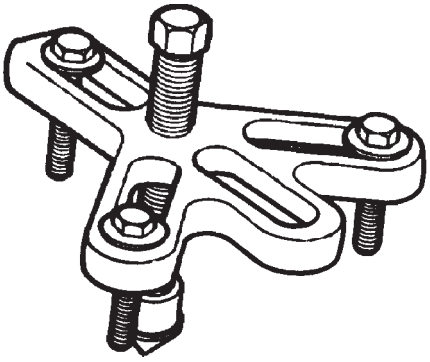
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
A/C Compressor—Bolts	28	—	250
Block Heater—Nut	2	—	16
Camshaft Sprocket—Bolt	68	50	—
Camshaft Thrust Plate to Cylinder Block—Screws	24	18	—
Clutch Cover to Flywheel—Bolts	54	40	—
Coil Bracket to Block—Bolts	22	—	192
Connecting Rod—Nuts	45	33	—
Cylinder Block—Drain Plugs	34	25	—
Cylinder Head—Bolts	135	100	—
Cylinder Head Cover—Bolts	10	—	85
Distributor Clamp—Bolts	23	—	204
Engine Mounts—Front			
Support Bracket Bolts	61	45	—
Support Cushion Bolts/Nuts	41	30	—
Support Cushion Bracket Bolts	54	40	—
Support Cushion Bracket Stud Nuts	41	30	—
Support Cushion Thru-Bolt	65	48	—
Engine Mounts—Rear			
Crossmember to Sill Bolts—(Automatic)	41	30	—
Insulator Stud Assembly—Nut	41	30	—
Support Cushion/Crossmember—Nuts	22	—	192
Support Cushion/Bracket—Nuts (Manual)	75	55	—
Transmission Support Bracket—Bolt (Manual)	46	34	—
Transmission Support Bracket/Cushion—Bolt (4WD Auto)	75	55	—
Transmission Support Adaptor Bracket—Bolts (2WD Auto)	75	55	—
Exhaust Manifold/Pipe—Nuts	27	20	—
Intake/Exhaust Manifold			
Fasteners #1-5	33	24	—
Fasteners #6 and 7	14	—	126
Fasteners #8-11	33	24	—
Flywheel to Converter Housing—Bolts	38	28	—
Flywheel to Crankshaft—Bolts	143	105	—
Front Cover to Block—Bolts			
1/4-20	7	—	60
5/16-18	22	—	192
Fuel Rail—Bolts/Stud	12	—	108
Generator—Bolts	57	42	—
Generator Bracket to Engine—Bolts	47	35	—
Idler Pulley to Cylinder Head—Bolt	47	35	—
Main Bearing Cap—Bolts	108	80	—
Oil Filter	18	—	156
Oil Filter Connector to			
Adaptor	47	35	—
Block	68	50	—
Adaptor Bolts	102	50	—
Oil Galley—Plug	41	30	—
Oil Pan—Bolts			
1/4-20	9.5	—	84
5/16-18	15	—	132
Oil Pan—Drain Plug	34	25	—
Oil Pump			
Mounting Bolts	23	—	204
Cover Bolts	8	—	70
Rocker Arm Assembly to Cylinder Head—Capscrews	30	21	—
Spark Plugs	37	27	—
Starter Motor—Mounting Bolts	45	33	—
Thermostat Housing—Bolts	18	—	156
Throttle Body—Bolts	10	—	90
Vibration Damper—Bolt	108	80	—
Water Pump to Block—Bolts	23	17	—

SPECIAL TOOLS

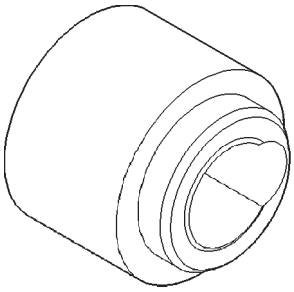
4.0L ENGINE



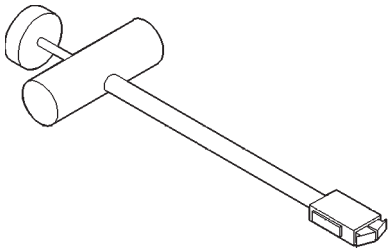
Valve Spring Compressor Tool MD-998772A



Vibration Damper Removal Tool 7697



Timing Case Cover Alignment and Seal installation Tool 6139



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

4.7L ENGINE

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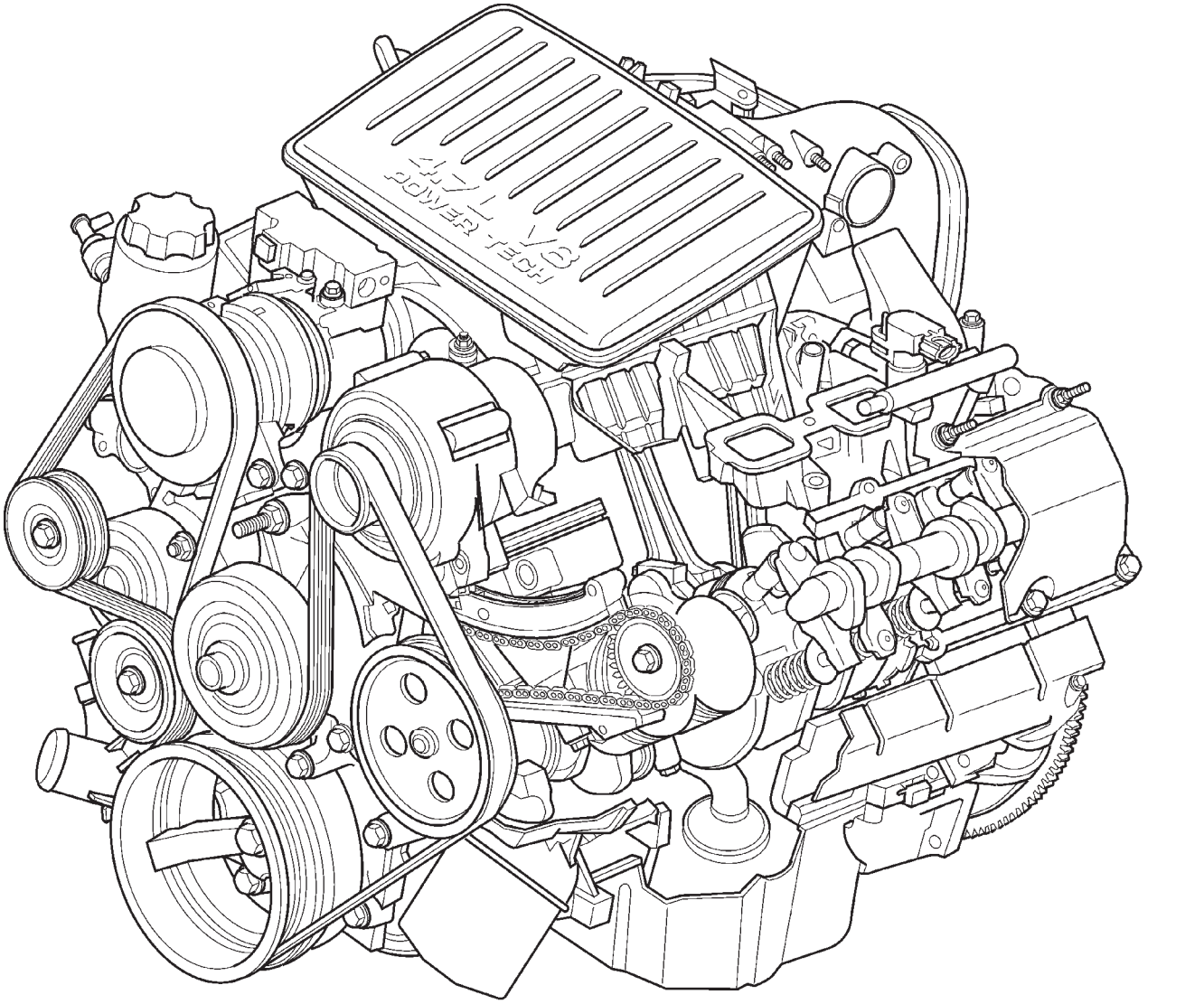
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DESCRIPTION AND OPERATION

ENGINE

DESCRIPTION



80b3b148

The 4.7 liter (287 CID) eight-cylinder engine is an 90° single overhead camshaft engine. The cast iron cylinder block is made up of two different components; the first component is the cylinder bore and upper block, the second component is the bedplate that comprises the lower portion of the cylinder block and houses the lower half of the crankshaft main bearings. The cylinders are numbered from front to rear with the left bank being numbered 1,3,5 and 7, and the right bank being numbered 2,4,6 and 8. The firing order is 1–8–4–3–6–5–7–2. The engine serial number is located at the right front side of the engine block (Fig. 1)

ENGINE IDENTIFICATION

DESCRIPTION

The engine is stamped with the vehicles identification number. This area is located at the right front side of the engine block. The engine build date code is included in the yellow bar code sticker on the oil fill housing (Fig. 2).

DESCRIPTION AND OPERATION (Continued)

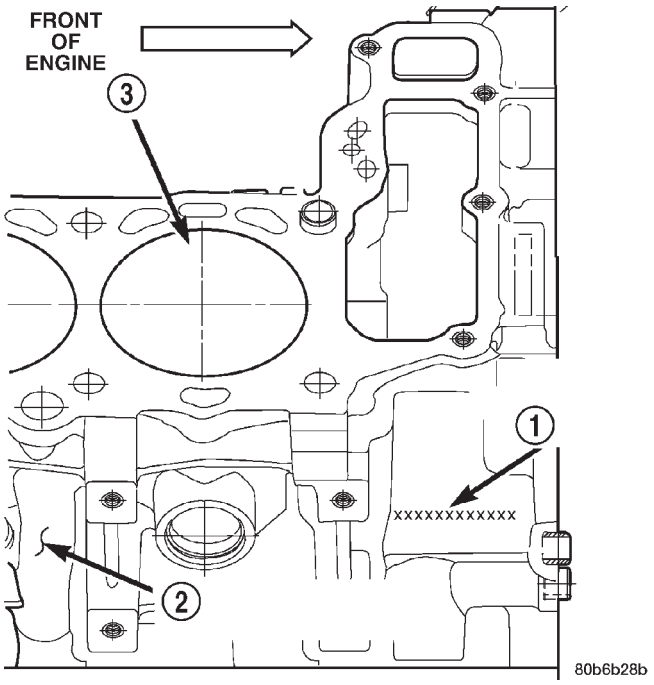


Fig. 1 Engine Identification Location.

1 – VEHICLE VIN NUMBER LOCATION
2 – CYLINDER BLOCK RIGHT HAND SIDE
3 – CYLINDER BORE #2

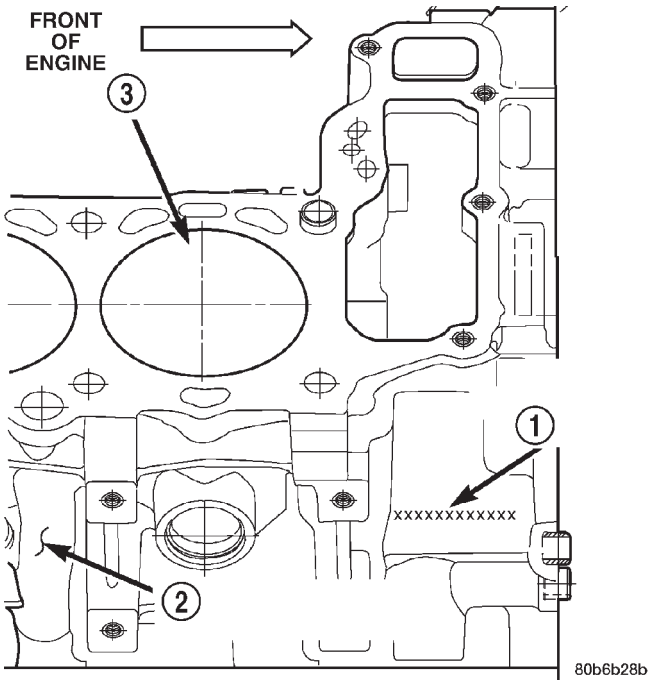


Fig. 2 4.7L Engine Identification

1 – VEHICLE VIN NUMBER LOCATION
2 – CYLINDER BLOCK RIGHT HAND SIDE
3 – CYLINDER BORE #2

ENGINE LUBRICATION SYSTEM

DESCRIPTION

The lubrication system (Fig. 3) is a full flow filtration pressure feed type.

OPERATION

Oil from the oil pan is pumped by a gerotor type oil pump directly mounted to the crankshaft nose. Oil pressure is controlled by a relief valve mounted inside the oil pump housing. For lubrication flow refer to (Fig. 3).

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

DESCRIPTION AND OPERATION (Continued)

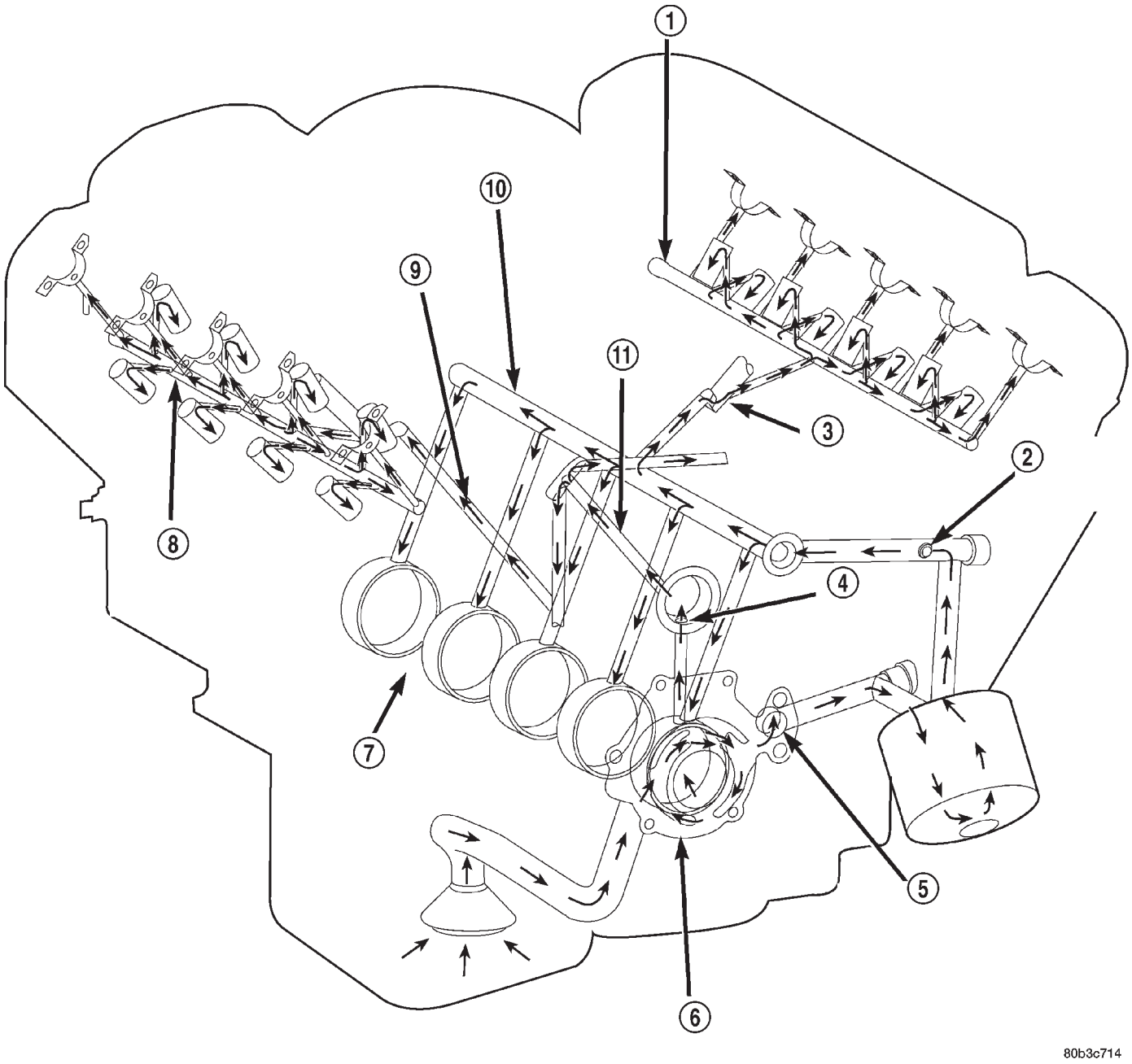


Fig. 3 Engine Oil Lubrication System

1 – LEFT CYLINDER HEAD OIL GALLERY
2 – OIL PRESSURE SENSOR LOCATION
3 – TO LEFT CYLINDER HEAD
4 – OIL FEED TO IDLER SHAFT
5 – OIL PUMP OUTLET TO BLOCK
6 – OIL PUMP
7 – TO CRANKSHAFT MAIN JOURNALS
8 – RIGHT CYLINDER HEAD OIL GALLERY
9 – TO RIGHT CYLINDER HEAD
10 – CYLINDER BLOCK MAIN GALLERY
11 – OIL FEED TO BOTH SECONDARY TENSIONERS

DESCRIPTION AND OPERATION (Continued)

ENGINE LUBRICATION FLOW CHART—BLOCK: TABLE 1

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

ENGINE LUBRICATION FLOW CHART—CYLINDER HEADS: TABLE 2

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

CYLINDER BLOCK

DESCRIPTION

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

CRANKSHAFT

DESCRIPTION

The crankshaft is constructed of nodular cast iron. The crankshaft is a crosshaped four throw design with eight counterweights for balancing purposes. The crankshaft is supported by five select main bearings with the number three serving as the thrust washer location. The main journals of the crankshaft are cross drilled to improve rod bearing lubrication. The number eight counterweight has provisions for crankshaft position sensor target wheel mounting. The select fit main bearing markings are located on the rear side of the target wheel. The crankshaft oil seals are one piece design. The front oil seal is retained in the timing chain cover, and the rear seal is pressed in to a bore formed by the cylinder block and the bedplate assembly.

DESCRIPTION AND OPERATION (Continued)

PISTON AND CONNECTING ROD

DESCRIPTION

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

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

CYLINDER HEAD

DESCRIPTION

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

VALVE GUIDES

DESCRIPTION

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

VALVES

DESCRIPTION

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

VALVE STEM SEAL

DESCRIPTION

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

VALVE SPRING

DESCRIPTION

The valve springs are made from high strength chrome silicon steel. The springs are common for intake and exhaust applications. The valve spring seat is integral with the valve stem seal, which is a positive type seal to control lubrication.

HYDRAULIC LASH ADJUSTER

DESCRIPTION

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

TIMING DRIVE SYSTEM

DESCRIPTION

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

OPERATION

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

DESCRIPTION AND OPERATION (Continued)

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

CAMSHAFT

DESCRIPTION

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

ROCKER ARM

DESCRIPTION

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

CYLINDER HEAD COVER

DESCRIPTION

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

OIL PAN

DESCRIPTION

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

STRUCTURAL DUST COVER

DESCRIPTION

The structural dust cover is made of die cast aluminum and joins the lower half of the transmission bell housing to the engine bedplate.

OPERATION

The structural cover provides additional powertrain stiffness and reduces noise and vibration.

INTAKE MANIFOLD

DESCRIPTION

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

EXHAUST MANIFOLD

DESCRIPTION

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

DIAGNOSIS AND TESTING

ENGINE DIAGNOSIS—INTRODUCTION

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

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

DIAGNOSIS AND TESTING (Continued)

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

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

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

INTAKE MANIFOLD LEAKAGE DIAGNOSIS

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

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

(1) Start the engine.

(2) Spray a small stream of water at the suspected leak area.

(3) If a change in RPM is observed the area of the suspected leak has been found.

(4) Repair as required.

CYLINDER COMPRESSION PRESSURE TEST

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

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

(1) Disconnect the ignition coil tower electrical connectors and remove ignition coil towers.

(2) Remove the spark plugs.

(3) Clean the spark plug recesses with compressed air.

(4) Secure the throttle in the wide-open position.

(5) Disable the fuel system. (Refer to Group 14, Fuel System for the correct procedure)

(6) Insert a compression pressure gauge and rotate the engine with the engine starter motor for three revolutions.

(7) Record the compression pressure on the 3rd revolution. Continue the test for the remaining cylinders.

Refer to Engine Specifications for the correct engine compression pressures.

CYLINDER HEAD GASKET FAILURE DIAGNOSIS

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

- Possible indications of the cylinder head gasket leaking between adjacent cylinders are:
  - Loss of engine power
  - Engine misfiring
  - Poor fuel economy
- Possible indications of the cylinder head gasket leaking between a cylinder and an adjacent water jacket are:
  - Engine overheating
  - Loss of coolant
  - Excessive steam (white smoke) emitting from exhaust
  - Coolant foaming

CYLINDER-TO-CYLINDER LEAKAGE TEST

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

CYLINDER-TO-WATER JACKET LEAKAGE TEST

WARNING: USE EXTREME CAUTION WHEN THE ENGINE IS OPERATING WITH COOLANT PRESSURE CAP REMOVED.

VISUAL TEST METHOD

With the engine cool, remove the coolant pressure cap. Start the engine and allow it to warm up until thermostat opens.

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

COOLING SYSTEM TESTER METHOD

WARNING: WITH COOLING SYSTEM TESTER IN PLACE, PRESSURE WILL BUILD UP FAST. EXCESSIVE PRESSURE BUILT UP, BY CONTINUOUS ENGINE OPERATION, MUST BE RELEASED TO A SAFE PRESSURE POINT. NEVER PERMIT PRESSURE TO EXCEED 138 kPa (20 psi).

Install Cooling System Tester 7700 or equivalent to pressure cap neck. Start the engine and observe the tester's pressure gauge. If gauge pulsates with every power stroke of a cylinder a combustion pressure leak is evident.

DIAGNOSIS AND TESTING (Continued)

CHEMICAL TEST METHOD

Combustion leaks into the cooling system can also be checked by using Bloc-Chek Kit C-3685-A or equivalent. Perform test following the procedures supplied with the tool kit.

CYLINDER COMBUSTION PRESSURE LEAKAGE TEST

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

Combustion pressure leakage testing will detect:

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

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

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

(3) Disconnect ignition coil tower electrical connectors.

(4) Remove ignition coil towers.

(5) Remove the spark plugs.

(6) Remove the oil filler cap.

(7) Remove the air cleaner.

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

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

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

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

Refer to the Cylinder Combustion Pressure Leakage Test Diagnosis chart.

CYLINDER COMBUSTION PRESSURE LEAKAGE DIAGNOSIS CHART

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

ENGINE OIL LEAK INSPECTION

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

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

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

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

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

DIAGNOSIS AND TESTING (Continued)

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

Air Leak Detection Test Method

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

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

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

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

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

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

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

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

INSPECTION FOR REAR SEAL AREA LEAKS

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

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

(1) Disconnect the battery.

(2) Raise the vehicle.

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

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

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

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

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

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

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

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

CHECKING ENGINE OIL PRESSURE

(1) Remove oil pressure sending unit (Fig. 4) and install gauge assembly C-3292.

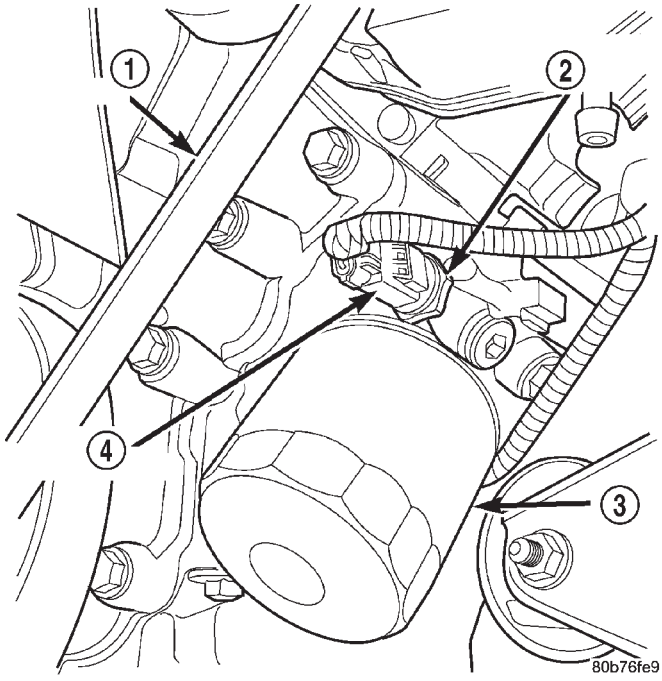


Fig. 4 Oil Pressure Sending Unit

1 – BELT
2 – OIL PRESSURE SENSOR
3 – OIL FILTER
4 – ELEC. CONNECTOR

(2) Run engine until thermostat opens.

(3) Oil Pressure:

- Curb Idle—25 Kpa (4 psi) minimum
- 3000 rpm—170 - 550 KPa (25 - 80 psi)

DIAGNOSIS AND TESTING (Continued)

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

HYDRAULIC LASH ADJUSTER NOISE DIAGNOSIS

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

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

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

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

(4) Low oil pressure.

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

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

(7) Worn valve guides.

(8) Rocker arm ears contacting valve spring retainer.

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

(10) Faulty lash adjuster.

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

b. Remove suspected lash adjusters, and replace.

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

ENGINE DIAGNOSIS—PERFORMANCE

CONDITION	POSSIBLE CAUSE	CORRECTION
ENGINE WILL NOT START	1. Weak battery.	1. Test battery. Charge or replace as necessary. Refer to Group 8A, Battery.
	2. Corroded or loose battery connections.	2. Clean and tighten battery connections. Apply a coat of light mineral grease to terminals.
	3. Faulty starter.	3. Test starting system. Refer to Group 8B, Starting.
	4. Faulty coil towers or coil rail.	4. Test and replace as needed. Refer to Group 8D, Ignition System.
	5. Incorrect spark plug gap.	5. Set gap. Refer to Group 8D, Ignition System.
	6. Contamination in fuel system.	6. Clean system and replace fuel filter.
	7. Faulty fuel pump.	7. Test fuel pump and replace as needed. Refer to Group 14, Fuel System.
	8. Incorrect engine timing.	8. Check for a worn timing chain(s) or a loose camshaft sprocket.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSE	CORRECTION
ENGINE STALLS OR IDLES ROUGH	1. Idle speed too low.	1. Test minimum air flow. Refer to Group 14, Fuel System.
	2. Incorrect fuel mixture.	2. Refer to Group 14, Fuel System.
	3. Intake manifold leakage.	3. Inspect intake manifold, manifold gasket, and vacuum hoses. Refer to Intake Manifold in this section.
	4. Faulty coil towers or coil rail.	4. Test and replace as necessary. Refer to Group 8D, Ignition System.
ENGINE LOSS OF POWER	1. Dirty or incorrectly gapped plugs.	1. Clean plugs and set gap. Refer to Group 8D, Ignition System.
	2. Contamination in fuel system.	2. Clean system and replace fuel filter.
	3. Faulty fuel pump.	3. Test and replace as necessary. Refer to Group 14, Fuel System.
	4. Incorrect valve timing.	4. Check for a worn timing chain(s) or a loose camshaft sprocket.
	5. Leaking cylinder head gasket.	5. Replace cylinder head gasket.
	6. Low compression.	6. Test compression of each cylinder.
	7. Burned, warped, or pitted valves.	7. Replace valves.
	8. Plugged or restricted exhaust system.	8. Install new parts, as necessary.
	9. Faulty coil towers or rail coil system.	9. Test and replace as necessary. Refer to Group 8D, Ignition System.
ENGINE MISSES ON ACCELERATION	1. Dirty or incorrectly gapped spark plugs.	1. Clean spark plugs and set gap. Refer to Group 8D, Ignition System.
	2. Contamination in Fuel System.	2. Clean fuel system and replace fuel filter.
	3. Burned, warped, or pitted valves.	3. Replace valves.
	4. Faulty coil towers or rail coil system.	4. Test and replace as necessary. Refer to Group 8D, Ignition System.
ENGINE MISSES AT HIGH SPEED	1. Dirty or incorrect spark plug gap.	1. Clean spark plugs and set gap. Refer to Group 8D, Ignition System.
	2. Faulty coil towers or rail coil system.	2. Test and replace as necessary. Refer to Group 8D, Ignition System.
	3. Dirty fuel injector(s).	Test and replace as necessary. Refer to Group 14, Fuel System.
	4. Contamination in fuel system.	4. Clean system and replace fuel filter.

DIAGNOSIS AND TESTING (Continued)

ENGINE—MECHANICAL

CONDITION	POSSIBLE CAUSES	CORRECTION
NOISY VALVES	1. High or low oil level in crankcase	1. Check for correct oil level.
	2. Thin or diluted oil.	2. Change oil and filter.
	3. Low oil pressure.	3. Check oil pump output pressure
	4. Dirt in lash adjusters.	4. Clean lash adjusters.
	5. Worn rocker arms.	5. Replace rocker arm. Inspect camshaft and lash adjuster for wear. Replace as necessary.
	6. Worn lash adjusters.	6. Replace lash adjusters.
	7. Worn valve guides.	7. Replace cylinder head.
	8. Excessive runout of valve seats or valve faces.	8. Grind valve seats and valves.
CONNECTING ROD NOISE	1. Insufficient oil supply.	1. Verify oil level.
	2. Low oil pressure.	2. Check oil pump output pressure.
	3. Thin or diluted oil.	3. Change oil and filter.
	4. Excessive bearing clearance.	4. Measure bearing clearance. Replace as necessary.
	5. Connecting rod journal out-of-round.	5. Repair or replace crankshaft.
	6. Bent connecting rod.	6. Replace bent connecting rod.
MAIN BEARING NOISE	1. Insufficient oil supply.	1. Check and correct oil level.
	2. Low oil pressure.	2. Check oil pump output pressure.
	3. Thin or diluted oil.	Change oil and filter.
	4. Excessive bearing clearance.	4. Replace bearings.
	5. Excessive end play.	6. Check front and rear thrust washers at No. 3 main bearing location.
	6. Crankshaft journal out-of-round, worn.	6. Grind journals or replace crankshaft.
	7. Loose flywheel or torque converter.	7. Tighten to correct torque.

DIAGNOSIS AND TESTING (Continued)

ENGINE—LUBRICATION

CONDITION	POSSIBLE CAUSE	CORRECTION
Oil Leaks	1. Gaskets and O-Rings	1.
	(a) Misaligned, Torn or Deteriorated.	(a) Replace.
	(b) Loose fastener, broken or porous metal.	Tighten, repair or replace.
	2. Crankshaft Rear Seal	2.
	(a) Misaligned, inverted or torn lip.	(a) Replace seal.
	(b) Torn, cut or shaved seal back bead.	(b) Replace Seal.
	3. Crankshaft Seal Flange	3.
	(a) Scratched, nicked or grooved.	(a) Replace or polish if necessary.
	4. Cylinder block to mating surface.	4.
	(a) Inadequate sealant.	(a) Apply sealant per service manual.
	(b) Oil hole burr.	(b) Carefully stone or chamfer hole.
	5. Oil Pan to Rear Main Cap Sealant.	5.
	(a) Inadequate or mislocated sealant.	(a) Apply sealant per service manual.
	(b) Torn, cut or damaged oil pan gasket.	(b) Replace gasket.
	(c) Cracked or damaged oil pan.	(c) Replace oil pan.
	6. Chain Case Cover Seal	6.
	(a) Misaligned, or misinstalled.	(a) Replace.
	(b) Torn, cut or damaged seal casing or cover bore.	(b) Replace seal.
	(c) Scratched or damaged vibration damper hub.	(c) Minor damaged can be polished out; otherwise replace vibration damper.
Oil Pressure Drop	1. Low Oil Level.	1. Check engine oil level correct as necessary.
	2. Faulty Oil Pressure Sending Unit.	2. Replace sending unit.
	3. Low Oil Pressure	3. Check main bearing oil clearance.
	4. Clogged Oil Filter.	4. Replace oil filter.
	5. Worn Parts in Oil Pump.	5. Replace oil pump.
	6. Thin or Diluted Oil.	Change oil to correct viscosity.
	7. Oil Pump Relief Valve Stuck.	7. Replace oil pump.
	8. Oil Pump Suction Tube Loose, Bent or Cracked.	8. Replace suction tube.
	9. Oil Pump Cover Warped or Cracked.	9. Replace oil pump.
Oil Pumping at Rings; Spark Plugs Fouling	1. Worn Scuffed or Broken Rings.	1. Hone cylinder bores and replace rings.
	2. Carbon in Oil Ring Slot.	2. Replace Rings.
	3. Rings Fitted too Tightly in Grooves.	3. Measure piston grooves, if incorrect deptch replace piston. Replace rings.
	4. Worn Valve Guides	Service guides per service manual.
	5. Leaking Intake Gasket	5. Replace intake gaskets.
	6. Leaking Valve Guide Seals.	6. Replace seals.

SERVICE PROCEDURES

ENGINE TIMING—VERIFICATION

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

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

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

Engine base timing can be verified by the following procedure:

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

(2) Using a mirror, locate the TDC arrow on the front cover (Fig. 5). Rotate the crankshaft until the mark on the crankshaft damper is aligned with the TDC arrow on the front cover. The engine is now at TDC.

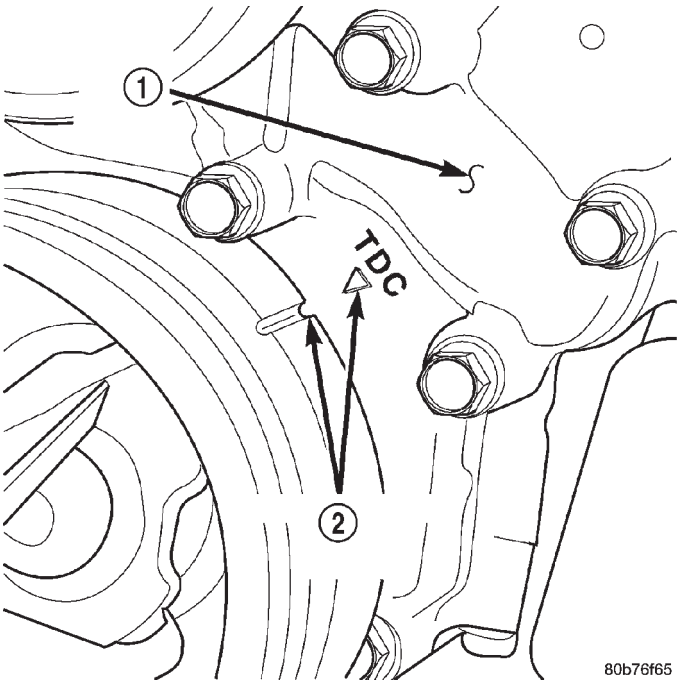


Fig. 5 Engine Top Dead Center (TDC) Indicator Mark

1 – TIMING CHAIN COVER
2 – CRANKSHAFT TIMING MARKS

(3) Note the location of the V8 mark stamped into the camshaft drive gears (Fig. 6). If the V8 mark on each camshaft drive gear is at the twelve o'clock position, the engine is at TDC on the exhaust stroke. If the V8 mark on each gear is at the six o'clock position, the engine is at TDC on the compression stroke.

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

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

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

SINGLE CAMSHAFT TIMING

NOTE: to adjust the timing on one camshaft, preform the following procedure.

(1) Using Chain Tensioner Wedge, special tool 8350, stabilize the secondary chain drive. For reference purposes, mark the chain-to-sprocket position (Fig. 7).

SERVICE PROCEDURES (Continued)

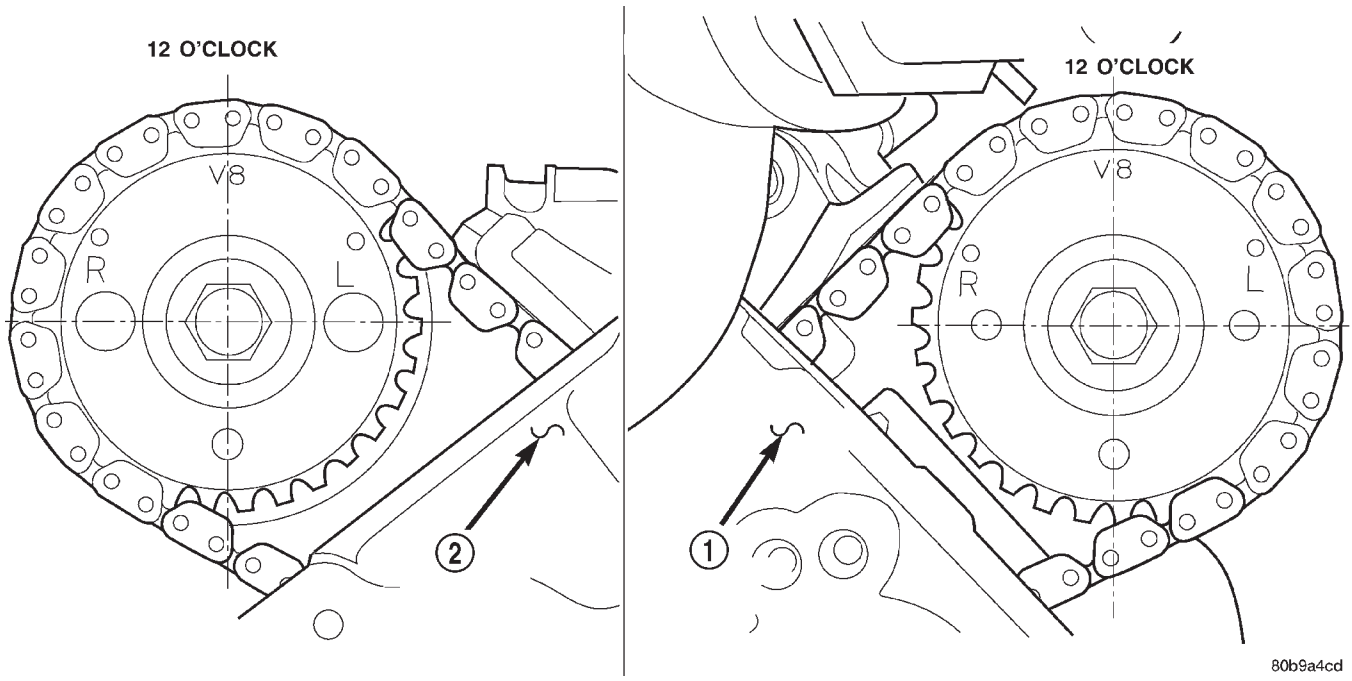


Fig. 6 Camshaft Sprocket V8 Marks

1 – LEFT CYLINDER HEAD
2 – RIGHT CYLINDER HEAD

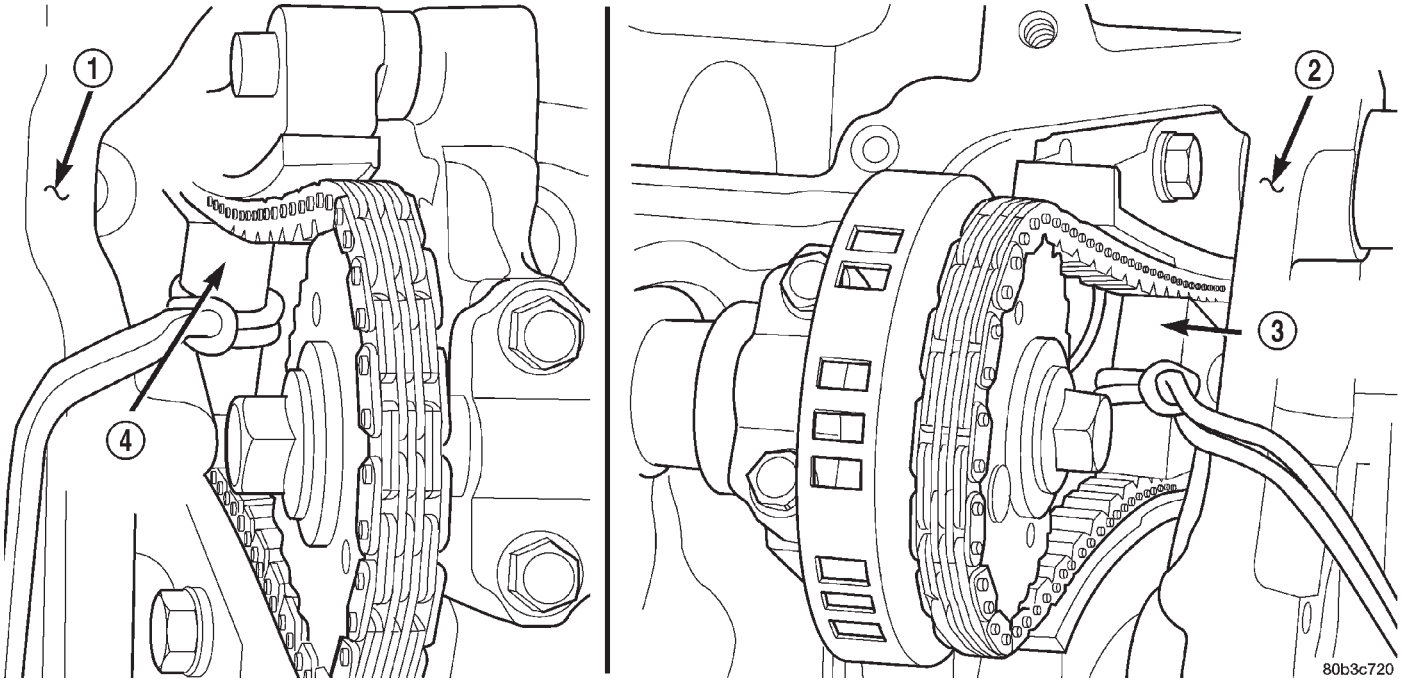


Fig. 7 Securing Timing Chain Tensioners Using Timing Chain Wedge

1 – LEFT CYLINDER HEAD
2 – RIGHT CYLINDER HEAD
3 – SPECIAL TOOL 8350 WEDGE
4 – SPECIAL TOOL 8350 WEDGE

SERVICE PROCEDURES (Continued)

(2) Remove the camshaft drive gear retaining bolt.
(3) Carefully remove the camshaft drive gear from the camshaft.
(4) Re-index the camshaft drive gear in the chain until the V8 mark is at the same position as the V8 mark on the opposite camshaft drive gear.

NOTE: When gripping the camshaft, place the pliers on the tube portion of the camshaft only. Do not grip the lobes or the sprocket areas.

(5) Using a suitable pair of adjustable pliers, rotate the camshaft until the alignment dowel on the camshaft is aligned with the slot in the camshaft drive gear (Fig. 8).

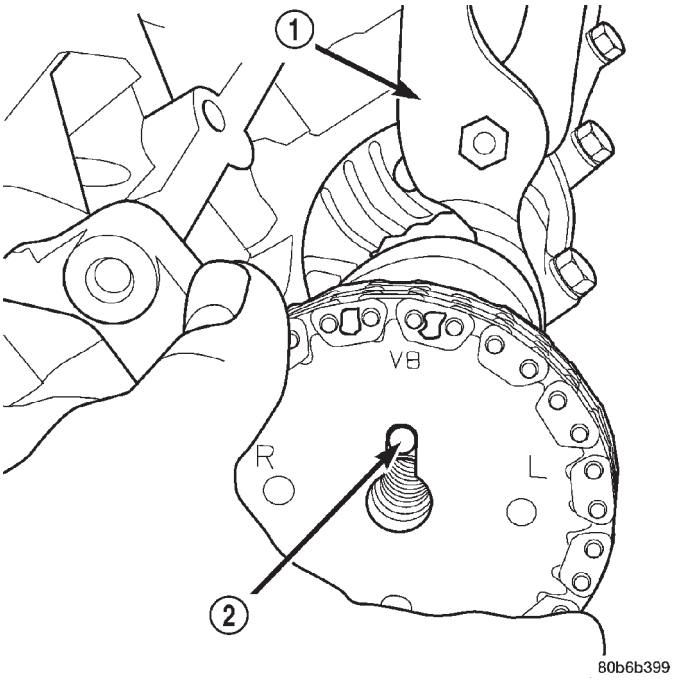


Fig. 8 Camshaft Dowel To Sprocket Alignment

1 – ADJUSTABLE PLIERS
2 – CAMSHAFT DOWEL

CAUTION: Remove excess oil from camshaft sprocket retaining bolt before reinstalling bolt. Failure to do so may cause over-torqueing of bolt resulting in bolt failure.

(6) Position the camshaft drive gear onto the camshaft, remove oil from bolt then install the retaining bolt. Using Special Tools, Spanner Wrench 6958 with Adapter Pins 8346 and a suitable torque wrench, Tighten retaining bolt to 122N·m (90 ft. Lbs.) (Fig. 9) (Fig. 10).
(7) Remove special tool 8350.
(8) Rotate the crankshaft two full revolutions, then reverify that the camshaft drive gear V8 marks are in fact aligned.

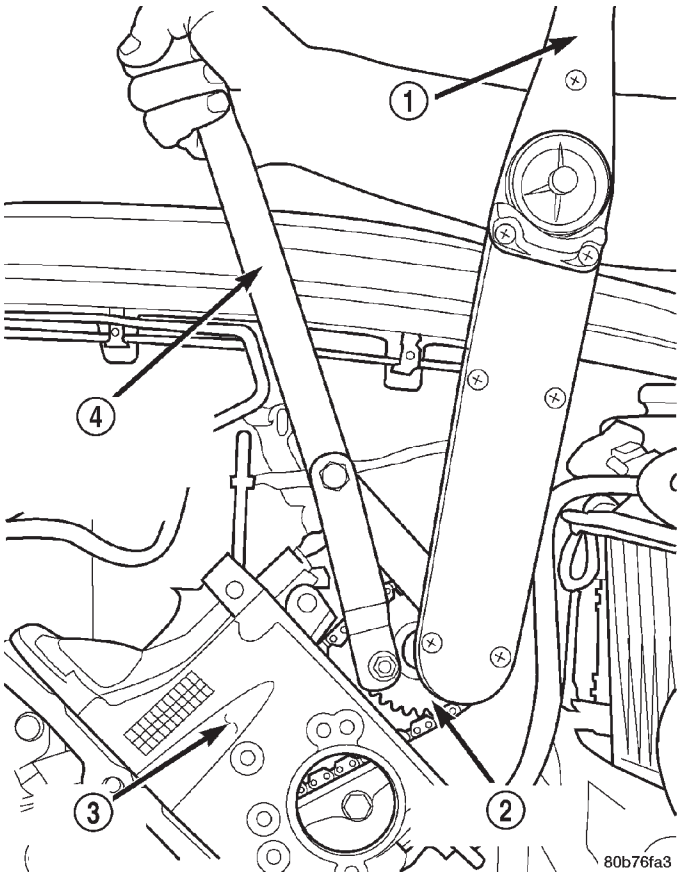


Fig. 9 Camshaft Sprocket Installation—Left Cylinder Head

1 – TORQUE WRENCH
2 – CAMSHAFT SPROCKET
3 – LEFT CYLINDER HEAD
4 – SPECIAL TOOL 6958 SPANNER WITH ADAPTER PINS 8346

(9) Install the cylinder head covers. Refer to Cylinder Head Cover in this section.

TIMING CHAIN—MEASURING WEAR

NOTE: This procedure must be performed with the timing chain cover removed.

(1) Remove the timing chain cover. Refer to Timing Chain Cover in this section for procedure.
(2) To determine if the secondary timing chains are worn, rotate the engine clockwise until maximum tensioner piston extension is obtained. Measure the distance between the secondary timing chain tensioner housing and the step ledge on the piston (Fig. 11). The measurement at point (A) must be less than 15mm (.5906 inches).
(3) If the measurement exceeds the specification the secondary timing chains are worn and require replacement. Refer to Timing Chain and Sprockets in this section for procedure.

SERVICE PROCEDURES (Continued)

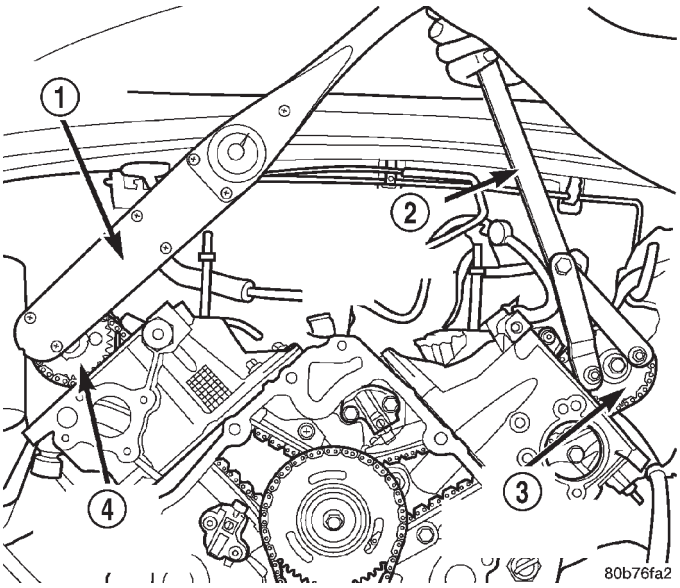


Fig. 10 Camshaft Sprocket Installation—Right Cylinder Head

1 – TORQUE WRENCH
2 – SPECIAL TOOL 6958 WITH ADAPTER PINS 8346
3 – LEFT CAMSHAFT SPROCKET
4 – RIGHT CAMSHAFT SPROCKET

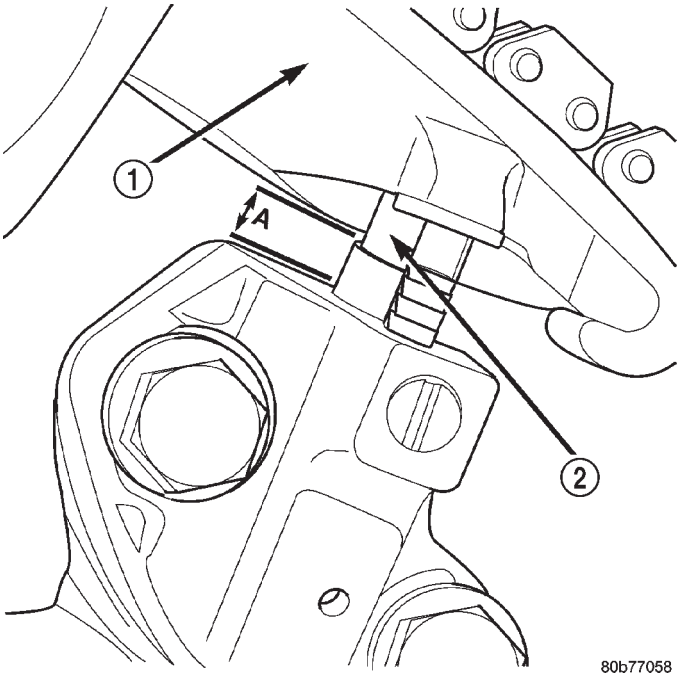


Fig. 11 Measuring Secondary Timing Chains For Stretch

1 – SECONDARY TENSIONER ARM
2 – SECONDARY CHAIN TENSIONER PISTON

PISTONS—FITTING

BORE GAGE METHOD

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

(2) Measure the inside diameter of the cylinder bore at a point 49.5 mm (1-15/16 inches) below top of bore. Start perpendicular (across or at 90 degrees) to the axis of the crankshaft at point A and then take an additional bore reading 90 degrees to that at point B (Fig. 13).

(3) The coated pistons will be serviced with the piston pin and connecting rod pre-assembled. Tin coated pistons should not be used as replacements for coated pistons.

(4) The coating material is applied to the piston after the final piston machining process. Measuring the outside diameter of a coated piston will not provide accurate results (Fig. 12). Therefore measuring the inside diameter of the cylinder bore with a dial Bore Gauge is **MANDATORY**. To correctly select the proper size piston, a cylinder bore gauge capable of reading in 0.003 mm (.0001 in.) increments is required.

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

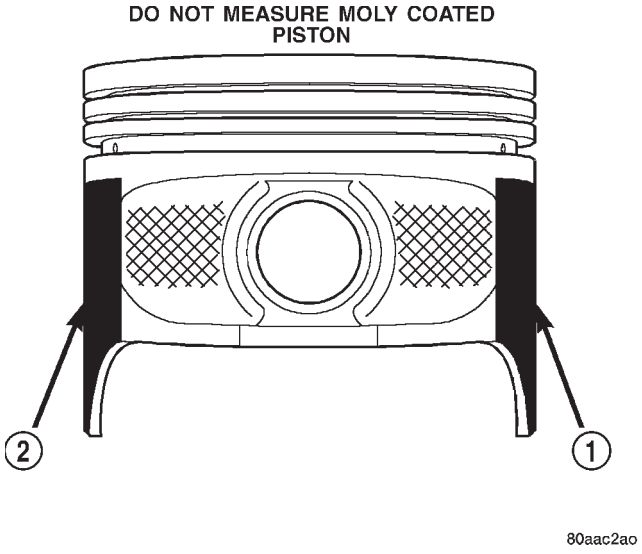


Fig. 12 Moly Coated Piston

1 – MOLY COATED
2 – MOLY COATED

SERVICE PROCEDURES (Continued)

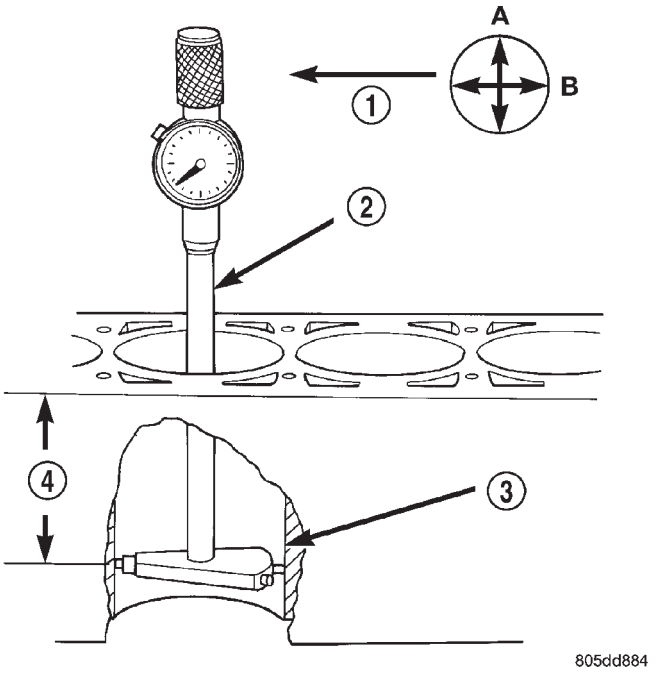


Fig. 13 Bore Gauge—Typical

1 – FRONT
2 – BORE GAUGE
3 – CYLINDER BORE
4 – 49.5 MM (1–15/16 in)

PISTON RINGS—FITTING

RING END GAP

Before reinstalling used rings or installing new rings, the ring clearances must be checked.

(1) Wipe the cylinder bore clean.

(2) Insert the ring in the cylinder bore.

NOTE: The ring gap measurement must be made with the ring positioned at least 12mm (0.50 inch.) from bottom of cylinder bore.

(3) Using a piston, to ensure that the ring is squared in the cylinder bore, slide the ring downward into the cylinder.

(4) Using a feeler gauge check the ring end gap (Fig. 14). Replace any rings not within specification.

PISTON RING SIDE CLEARANCE

NOTE: Make sure the piston ring grooves are clean and free of nicks and burrs.

(5) Measure the ring side clearance as shown (Fig. 15) make sure the feeler gauge fits snugly between the ring land and the ring. Replace any ring not within specification.

(6) Rotate the ring around the piston, the ring must rotate in the groove with out binding.

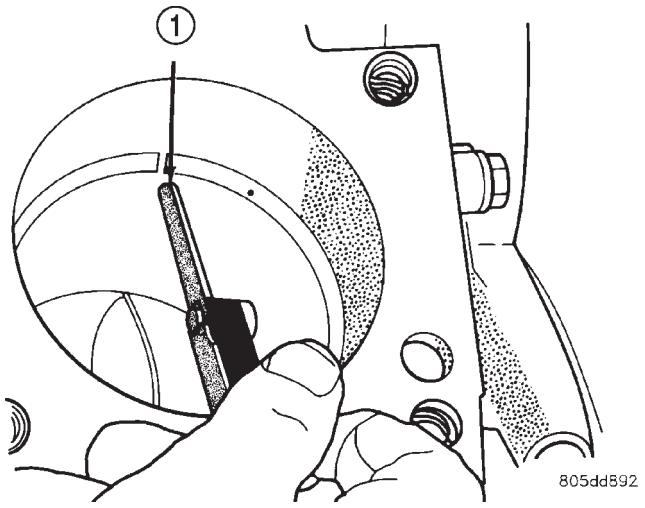


Fig. 14 Ring End Gap Measurement—Typical

1 – FEELER GAUGE

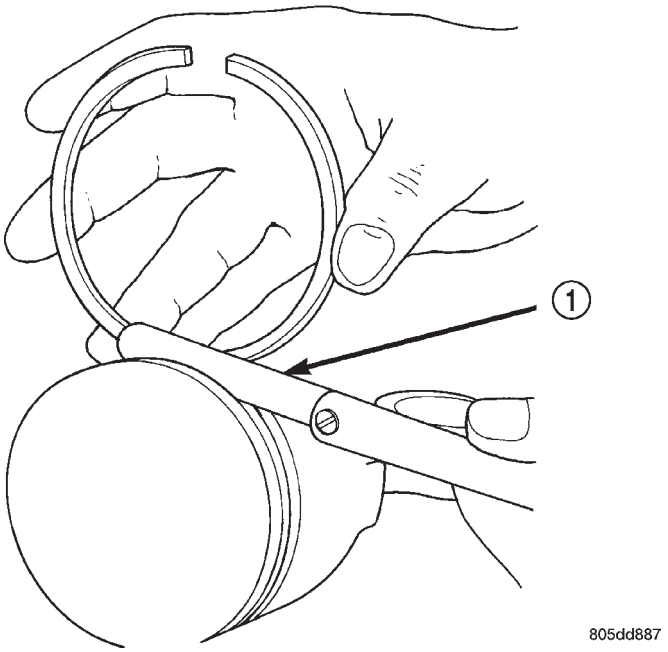


Fig. 15 Measuring Piston Ring Side Clearance

1 – FEELER GAUGE

(7) The No. 1 and No. 2 piston rings have a different cross section. Ensure No. 2 ring is installed with manufacturers I. D. mark (Dot) facing up, towards top of the piston.

NOTE: Piston rings are installed in the following order:

- **Oil ring expander.**
- **Upper oil ring side rail.**
- **Lower oil ring side rail.**
- **No. 2 Intermediate piston ring.**
- **No. 1 Upper piston ring.**

SERVICE PROCEDURES (Continued)

PISTON RING SPECIFICATION CHART

Ring Position	Groove Clearance	Maximum Clearance
Upper Ring	.051-.094mm (0.0020-.0037 in.)	0.11mm (0.004 in.)
Intermediate Ring	0.04-0.08mm (0.0016-0.0031 in.)	0.10mm (0.004 in.)
Oil Control Ring (Steel Rails)	.019-.229mm (.0007-.0090 in.)	.25mm (0.010 in.)
Ring Position	**Ring Gap**	**Wear Limit**
Upper Ring	0.20-0.36mm (0.008-0.014 in.)	0.40mm (0.0016in.)
Intermediate Ring	0.37-0.63mm (0.014-0.025 in.)	0.71mm (0.028in.)
Oil Control Ring (Steel Rail)	0.025-0.76mm (0.010- 0.030 in.)	1.52mm (0.060in.)

(8) Install the oil ring expander.

(9) Install upper side rail (Fig. 16) by placing one end between the piston ring groove and the expander ring. Hold end firmly and press down the portion to be installed until side rail is in position. Repeat this step for the lower side rail.

(10) Install No. 2 intermediate piston ring using a piston ring installer (Fig. 17).

(11) Install No. 1 upper piston ring using a piston ring installer (Fig. 17).

(12) Position piston ring end gaps as shown in (Fig. 18). It is important that expander ring gap is at least 45° from the side rail gaps, but not on the piston pin center or on the thrust direction.

CONNECTING ROD BEARINGS—FITTING

Inspect the connecting rod bearings for scoring and bent alignment tabs (Fig. 19) (Fig. 20). Check the bearings for normal wear patterns, scoring, grooving, fatigue and pitting (Fig. 21). Replace any bearing that shows abnormal wear.

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

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

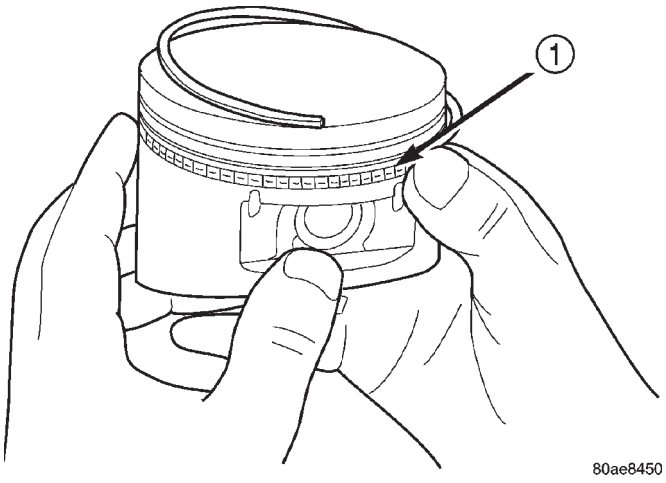


Fig. 16 Side Rail—Installation

1 – SIDE RAIL END

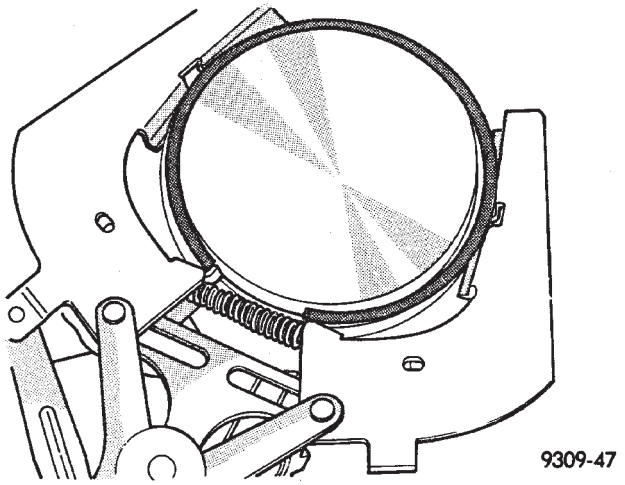


Fig. 17 Upper and Intermediate Rings—Installation

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

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

(3) Use piston ring compressor and Guide Pins Special Tool 8507 (Fig. 22) to install the rod and piston assemblies. The oil slinger slots in the rods must face front of the engine. The “F”’s near the piston wrist pin bore should point to the front of the engine.

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

(5) Install bearing cap and connecting rod on the journal and tighten bolts to 27 N·m (20 ft. lbs.) plus a 90° turn. DO NOT rotate crankshaft. Plastigage will smear, resulting in inaccurate indication.

(6) Remove the bearing cap and determine amount of bearing-to-journal clearance by measuring the width of compressed Plastigage (Fig. 23). Refer to

SERVICE PROCEDURES (Continued)

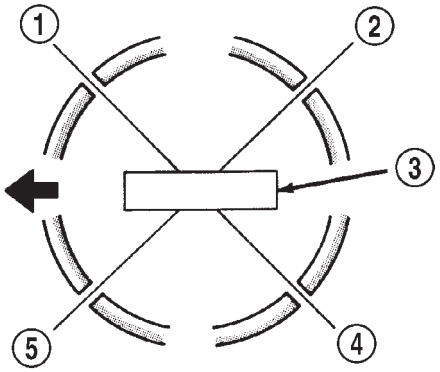


Fig. 18 Piston Ring End Gap Position

1 – SIDE RAIL UPPER
2 – NO. 1 RING GAP
3 – PISTON PIN
4 – SIDE RAIL LOWER
5 – NO. 2 RING GAP AND SPACER EXPANDER GAP

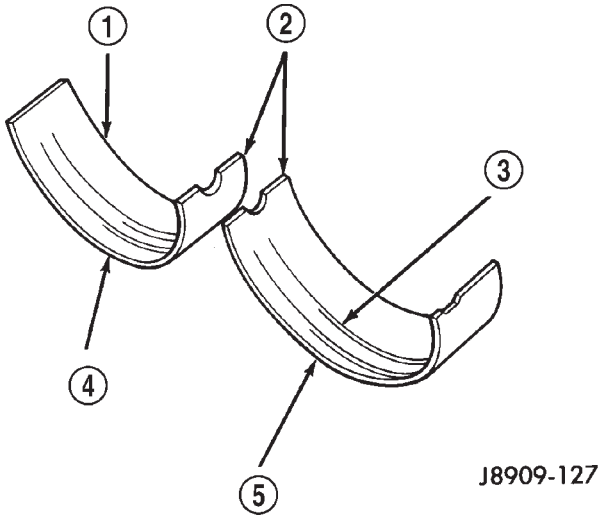


Fig. 19 Connecting Rod Bearing Inspection

1 – UPPER BEARING HALF
2 – MATING EDGES
3 – GROOVES CAUSED BY ROD BOLTS SCRATCHING JOURNAL DURING INSTALLATION
4 – WEAR PATTERN — ALWAYS GREATER ON UPPER BEARING
5 – LOWER BEARING HALF

Engine Specifications for the proper clearance. **Plastigage should indicate the same clearance across the entire width of the insert. If the clearance varies, it may be caused by either a tapered journal, bent connecting rod or foreign material trapped between the insert and cap or rod.**

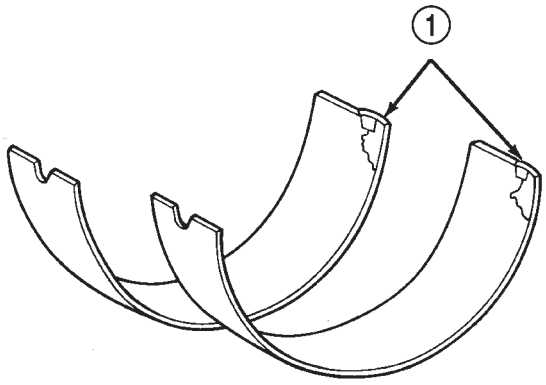


Fig. 20 Locking Tab Inspection

1 – ABNORMAL CONTACT AREA CAUSED BY LOCKING TABS NOT FULLY SEATED OR BEING BENT

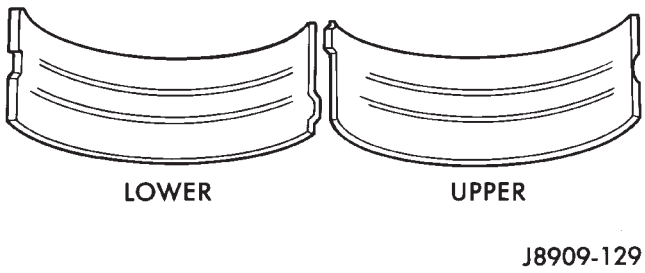


Fig. 21 Scoring Caused by Insufficient Lubrication or by Damaged Crankshaft Pin Journal

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

(8) If bearing-to-journal clearance exceeds the specification, determin which services bearing set to use the bearing sizes are as follows:

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

(10) Once you have selected the proper insert, install the insert and cap. Tighten the connecting rod bolts to 27 N·m (20 ft. lbs.) plus a 90° turn.

Slide snug-fitting feeler gauge between the connecting rod and crankshaft journal flange (Fig. 24). Refer to Engine Specifications for the proper clearance. Replace the connecting rod if the side clearance is not within specification.

CRANKSHAFT MAIN BEARINGS

INSPECTION

Wipe the inserts clean and inspect for abnormal wear patterns and for metal or other foreign material imbedded in the lining. Normal main bearing insert wear patterns are illustrated (Fig. 25).

SERVICE PROCEDURES (Continued)

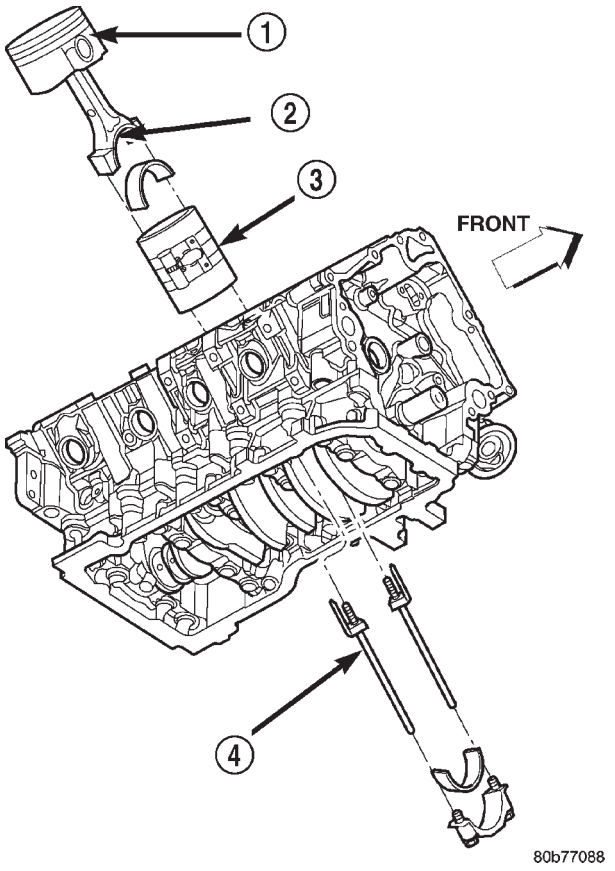


Fig. 22 Piston and Connecting Rod—Installation

1 – "F" TOWARD FRONT OF ENGINE
2 – OIL SLINGER SLOT
3 – RING COMPRESSOR
4 – SPECIAL TOOL 8507

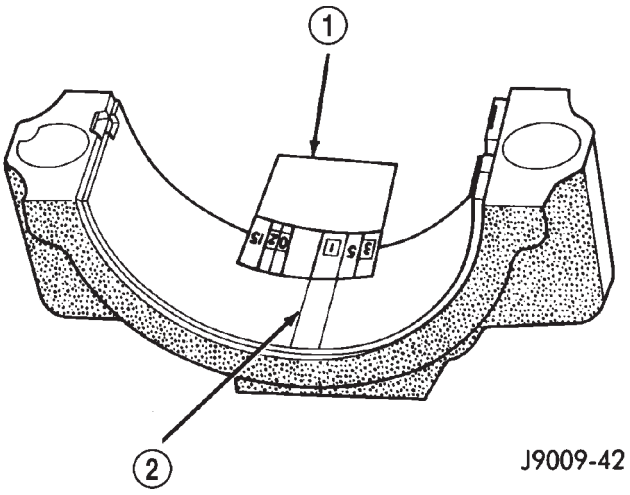


Fig. 23 Measuring Bearing Clearance with Plastigage

1 – PLASTIGAGE SCALE
2 – COMPRESSED PLASTIGAGE

Bearing Mark	SIZE	USED WITH JOURNAL SIZE
.025 US	.025 mm (.001 in.)	50.983-50.967 mm (2.0073-2.0066 in.)
Std.	STANDARD	50.992-51.008 mm (2.0076-2.0082 in.)
.250 US	.250 mm (.010 in.)	50.758-50.742 mm (1.9984-1.9978 in.)

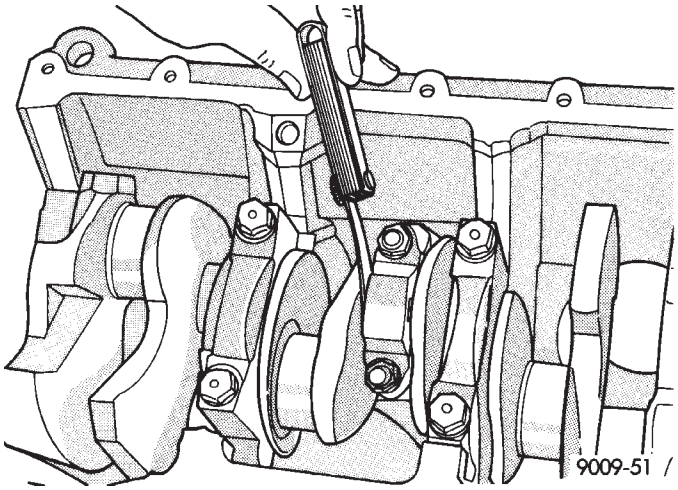


Fig. 24 Checking Connecting Rod Side Clearance—Typical

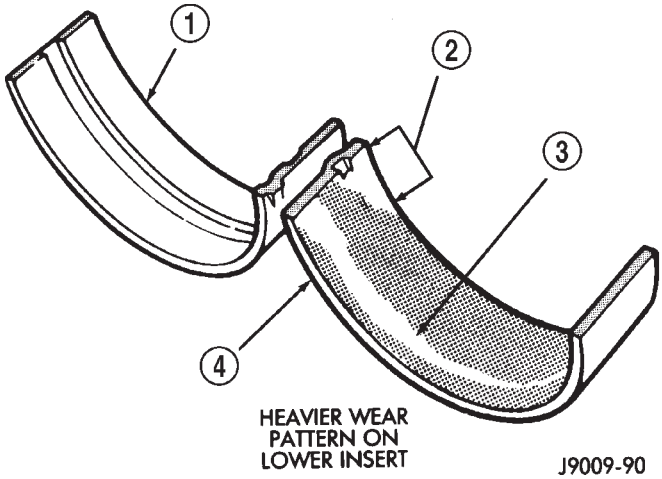


Fig. 25 Main Bearing Wear Patterns

1 – UPPER INSERT
2 – NO WEAR IN THIS AREA
3 – LOW AREA IN BEARING LINING
4 – LOWER INSERT

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

SERVICE PROCEDURES (Continued)

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

Inspect the upper insert locking tabs for damage.

Replace all damaged or worn bearing inserts.

MAIN BEARING JOURNAL DIAMETER (CRANKSHAFT REMOVED)

Remove the crankshaft from the cylinder block. Refer to Crankshaft in this section for procedure.

Clean the oil off the main bearing journal.

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

The maximum allowable taper is 0.008mm (0.0004 inch.) and maximum out of round is 0.005mm (0.002 inch). Compare the measured diameter with the journal diameter specification (Main Bearing Fitting Chart). Select inserts required to obtain the specified bearing-to-journal clearance.

Install the crankshaft into the cylinder block. Refer to Crankshaft in this section for procedure.

CRANKSHAFT MAIN BEARING SELECTION

(1) Service main bearings are available in three grades. The chart below identifies the three service grades available.

GRADE MARKING	SIZE mm (in.)	FOR USE WITH JOURNAL SIZE
A	.008 mm U/S (.0004 in.) U/S	63.488-63.496 mm (2.4996-2.4999 in.)
B	STANDARD	63.496-63.504 mm (2.4996-2.4999 in.)
C	.008 mm O/S (.0004 in.) O/S	63.504-63.512 mm (2.5002-2.5005 in.)

FORM-IN-PLACE GASKETS & SEALERS

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. **Do not use form-in-place gasket material unless specified.** Bead size, continuity, and location are of great importance. Too thin a bead can result in leakage while too much can result in spill-over which can break off and obstruct fluid feed lines. A continuous bead of the proper width is essential to obtain a leak-free gasket.

There are numerous types of form-in-place gasket materials that are used in the engine area. Mopar® Engine RTV GEN II, Mopar® ATF-RTV, and Mopar® Gasket Maker gasket materials, each have different properties and can not be used in place of the other.

MOPAR® ENGINE RTV GEN II

Mopar® Engine RTV GEN II is used to seal components exposed to engine oil. This material is a specially designed black silicone rubber RTV that retains adhesion and sealing properties when exposed to engine oil. Moisture in the air causes the material to cure. This material is available in three ounce tubes and has a shelf life of one year. After one year this material will not properly cure. Always inspect the package for the expiration date before use.

MOPAR® ATF RTV

Mopar® ATF RTV is a specifically designed black silicone rubber RTV that retains adhesion and sealing properties to seal components exposed to automatic transmission fluid, engine coolants, and moisture. This material is available in three ounce tubes and has a shelf life of one year. After one year this material will not properly cure. Always inspect the package for the expiration date before use.

MOPAR® GASKET MAKER

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

MOPAR® GASKET SEALANT

Mopar® Gasket Sealant is a slow drying, permanently soft sealer. This material is recommended for sealing threaded fittings and gaskets against leakage of oil and coolant. Can be used on threaded and machined parts under all temperatures. This material is used on engines with multi-layer steel (MLS) cylinder head gaskets. This material also will prevent corrosion. Mopar® Gasket Sealant is available in a 13 oz. aerosol can or 4oz./16 oz. can w/applicator.

FORM-IN-PLACE GASKET AND SEALER APPLICATION

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

Mopar® Gasket Maker material should be applied sparingly 1 mm (0.040 in.) diameter or less of sealant to one gasket surface. Be certain the material surrounds each mounting hole. Excess material can easily be wiped off. Components should be torqued in place within 15 minutes. The use of a locating dowel is recommended during assembly to prevent smearing material off the location.

Mopar® Engine RTV GEN II or ATF RTV gasket material should be applied in a continuous bead

SERVICE PROCEDURES (Continued)

approximately 3 mm (0.120 in.) in diameter. All mounting holes must be circled. For corner sealing, a 3.17 or 6.35 mm (1/8 or 1/4 in.) drop is placed in the center of the gasket contact area. Uncured sealant may be removed with a shop 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 material off the location.

Mopar® Gasket Sealant in an aerosol can should be applied using a thin, even coat sprayed completely over both surfaces to be joined, and both sides of a gasket. Then proceed with assembly. Material in a can w/applicator can be brushed on evenly over the sealing surfaces. Material in an aerosol can should be used on engines with multi-layer steel gaskets.

ENGINE GASKET SURFACE PREPARATION

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

Never use the following to clean gasket surfaces:

- Metal scraper
- Abrasive pad or paper to clean cylinder block and head
- High speed power tool with an abrasive pad or a wire brush (Fig. 26)

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

Only use the following for cleaning gasket surfaces:

- Solvent or a commercially available gasket remover
- Plastic or wood scraper (Fig. 26)
- Drill motor with 3M Roloc™ Bristle Disc (white or yellow) (Fig. 26)

CAUTION: Excessive pressure or high RPM (beyond the recommended speed), can damage the sealing surfaces. The mild (white, 120 grit) bristle disc is recommended. If necessary, the medium (yellow, 80 grit) bristle disc may be used on cast iron surfaces with care.

ENGINE PERFORMANCE

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

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

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

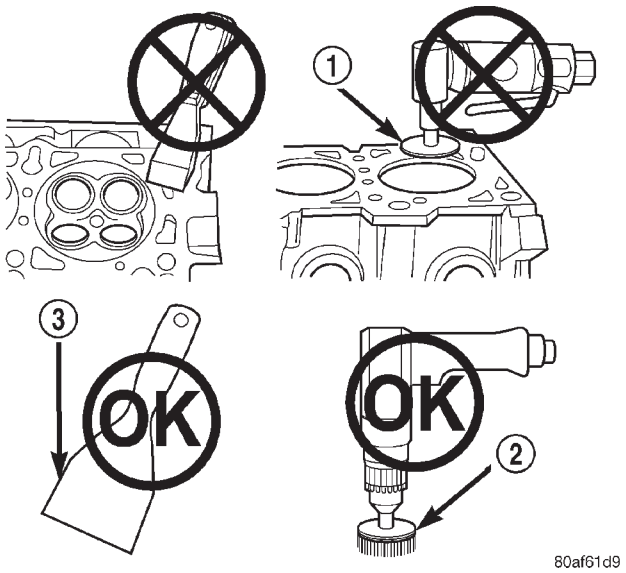


Fig. 26 Proper Tool Usage For Surface Preparation

1 – ABRASIVE PAD
2 – 3M ROLOC™ BRISTLE DISC
3 – PLASTIC/WOOD SCRAPER

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

(4) Perform cylinder compression test:

CAUTION: DO NOT overspeed the engine.

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

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

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

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

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

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

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

(h) Repeat for all remaining cylinders.

SERVICE PROCEDURES (Continued)

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

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

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

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

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

(6) Perform a combustion analysis.

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

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

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

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

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

(12) Road test vehicle as a final test.

HONING CYLINDER BORES

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

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

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

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

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

(3) Honing should be done by moving the hone up and down fast enough to get a crosshatch pattern. The hone marks should INTERSECT at 50° to 60° for proper seating of rings (Fig. 27).

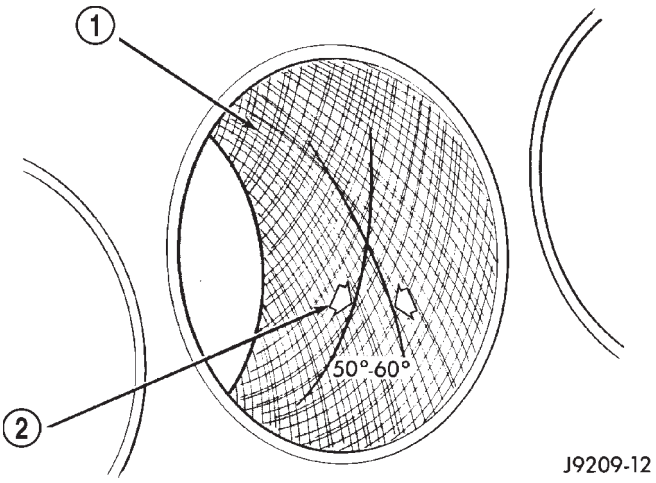


Fig. 27 Cylinder Bore Crosshatch Pattern

1 – CROSSHATCH PATTERN
2 – INTERSECT ANGLE

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

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

REPAIR DAMAGED OR WORN THREADS

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

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

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

SERVICE PROCEDURES (Continued)

HYDROSTATIC LOCK

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

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

(2) Disconnect the battery negative cable.

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

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

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

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

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

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

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

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

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

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

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

(13) Install a new oil filter.

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

(15) Connect the battery negative cable.

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

ENGINE OIL

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

ENGINE OIL SPECIFICATION

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

API SERVICE GRADE CERTIFIED

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

SAE VISCOSITY

An SAE viscosity grade is used to specify the viscosity of engine oil. Use only engine oils with multiple viscosities such as 5W-30 or 10W-30 in the 4.7L engines. These are specified with a dual SAE viscosity grade which indicates the cold-to-hot temperature viscosity range. Select an engine oil that is best suited to your particular temperature range and variation (Fig. 28).

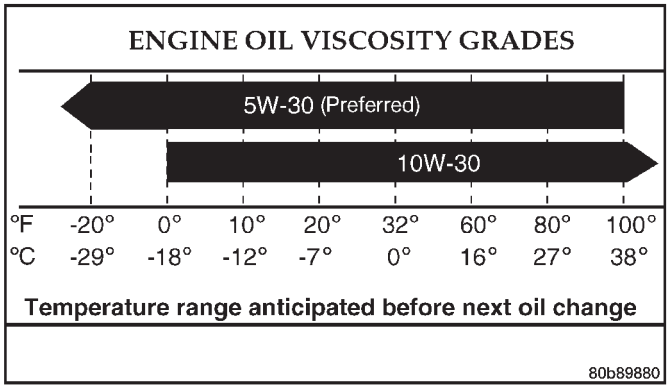


Fig. 28 Temperature/Engine Oil Viscosity—4.7L Engine

ENERGY CONSERVING OIL

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

CONTAINER IDENTIFICATION

Standard engine oil identification notations have been adopted to aid in the proper selection of engine oil. The identifying notations are located on the label of engine oil plastic bottles and the top of engine oil cans (Fig. 29).

OIL LEVEL INDICATOR (DIPSTICK)

The engine oil level indicator is located at the right rear of the engine on the 4.7L engines. (Fig. 30).

SERVICE PROCEDURES (Continued)



9400-9

Fig. 29 Engine Oil Container Standard Notations

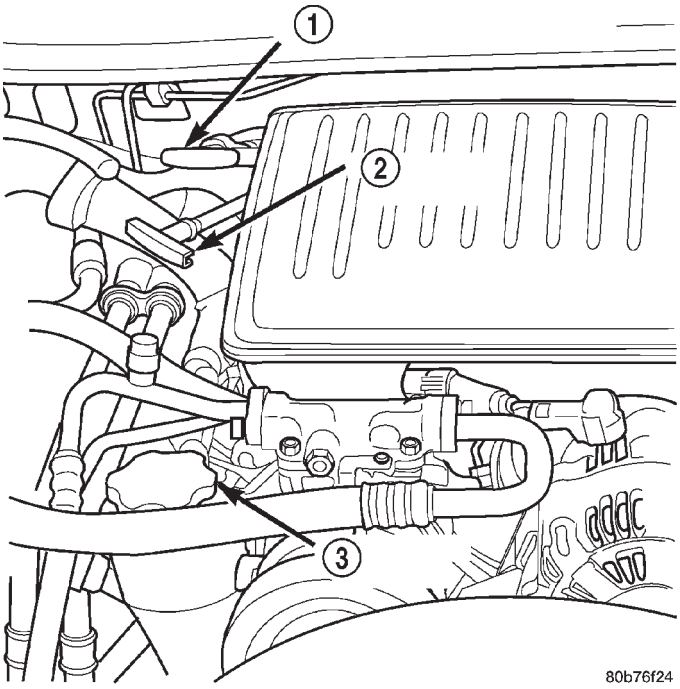


Fig. 30 Engine Oil Dipstick 4.7L Engine

1 – TRANSMISSION DIPSTICK
2 – ENGINE OIL DIPSTICK
3 – ENGINE OIL FILL CAP

CRANKCASE OIL LEVEL INSPECTION

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

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

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

(1) Position vehicle on level surface.

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

(3) Wipe dipstick clean.

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

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

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

ENGINE OIL CHANGE

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

Run engine until achieving normal operating temperature.

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

(2) Hoist and support vehicle on safety stands.

(3) Remove oil fill cap.

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

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

(6) Install drain plug in crankcase.

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

(8) Install oil fill cap.

(9) Start engine and inspect for leaks.

(10) Stop engine and inspect oil level.

ENGINE OIL FILTER CHANGE

FILTER SPECIFICATION

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

OIL FILTER REMOVAL

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

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

(3) Rotate the oil filter counterclockwise (Fig. 31) to remove it from the cylinder block oil filter boss.

(4) When filter separates from cylinder block oil filter boss, tip gasket end upward to minimize oil spill. Remove filter from vehicle.

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

OIL FILTER INSTALLATION

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

(2) Thread filter onto adapter nipple. When gasket makes contact with sealing surface, (Fig. 32) hand tighten filter one full turn, do not over tighten.

SERVICE PROCEDURES (Continued)

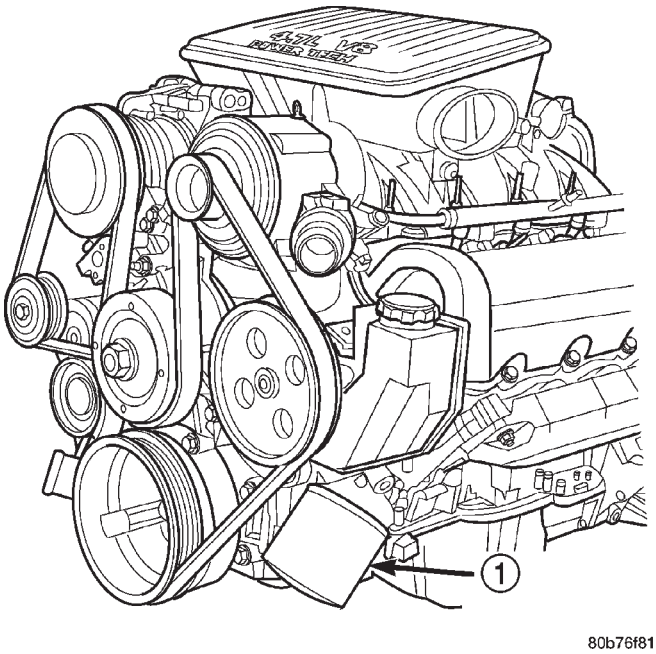


Fig. 31 Oil Filter—4.7L Engine

1 – ENGINE OIL FILTER

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

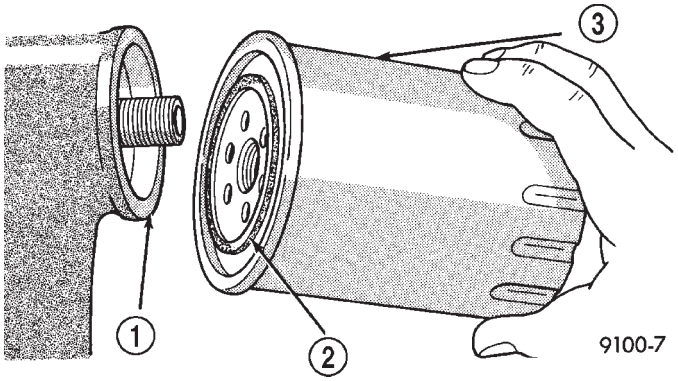


Fig. 32 Oil Filter Sealing Surface—Typical

1 – SEALING SURFACE
2 – RUBBER GASKET
3 – OIL FILTER

USED ENGINE OIL DISPOSAL

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

REMOVAL AND INSTALLATION

ENGINE MOUNTS—LEFT AND RIGHT

REMOVAL

(1) Disconnect the negative cable from the battery.

CAUTION: Remove the fan blade, fan clutch and fan shroud before raising engine. Failure to do so may cause damage to the fan blade, fan clutch and fan shroud.

(2) Remove the fan blade, fan clutch and fan shroud. Refer to Group 7. for procedure.

(3) Remove the engine oil filter.

(4) Support the engine with a suitable jack and a block of wood across the full width of the engine oil pan.

(5) Remove the four cylinder block-to-insulator mount bolts and the nut form the engine insulator mount through bolt (Fig. 33) (Fig. 34).

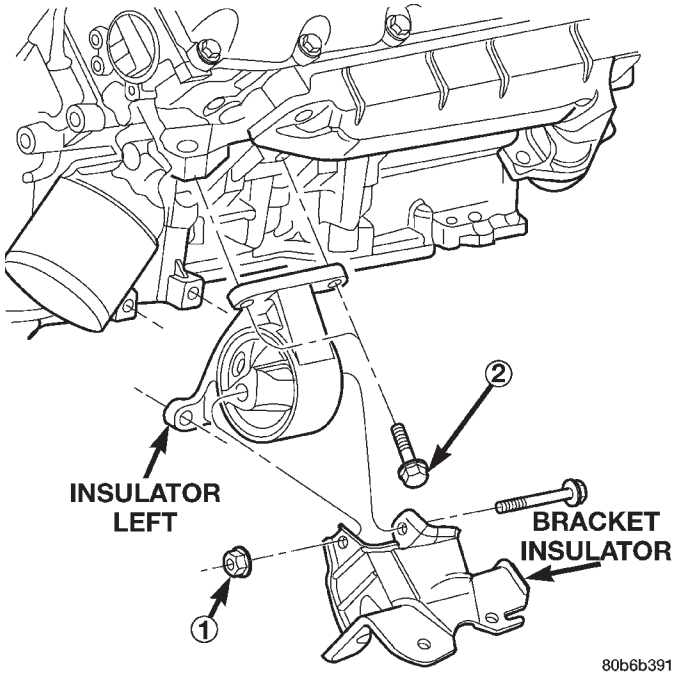


Fig. 33 Engine Insulator Mount—Left

(6) Using the jack, raise the engine high enough to remove the engine insulator mount through bolt and the insulator mount.

REMOVAL AND INSTALLATION (Continued)

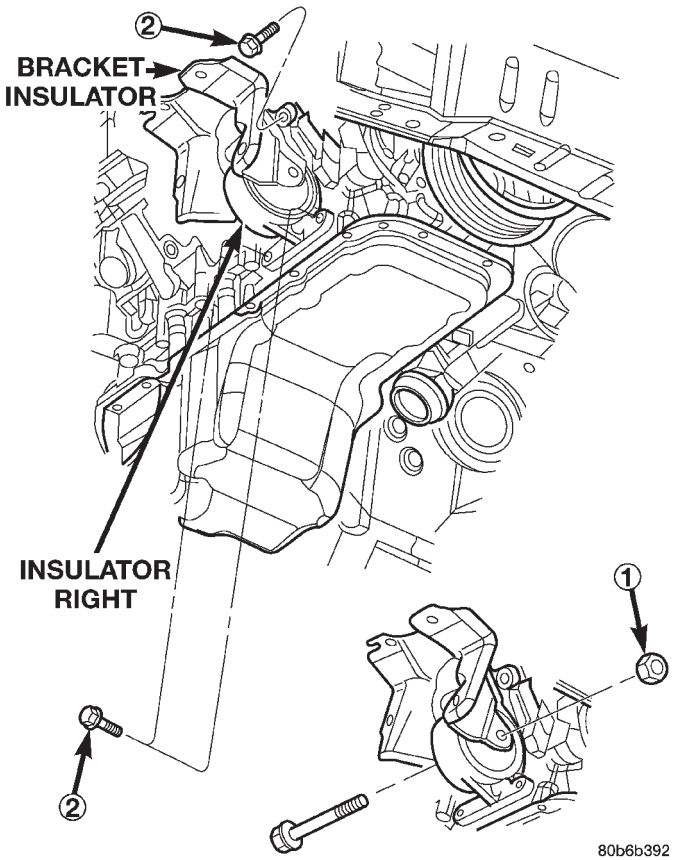


Fig. 34 Engine Insulator Mount—Right

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

INSTALLATION

(1) Position the insulator mount and install the insulator mount through bolt.

(2) Lower the engine until the four cylinder block-to-insulator mount bolts can be installed.

(3) Remove the jack and block of wood.

(4) Torque the cylinder block-to-insulator mount bolts to 61N·m (45 ft. lbs.).

(5) Install and torque the through bolt retaining nut to 61N·m (45 ft. lbs.).

(6) Install the fan blade, fan clutch and fan shroud.

ENGINE MOUNT—REAR

REMOVAL

(1) Raise vehicle on hoist.

(2) Using a suitable jack, support transmission.

(3) Remove the lock nut from the insulator mount through bolt and the four insulator-to-transmission mounting bolts.

(4) Raise the transmission enough to remove the through bolt and insulator mount (Fig. 35) (Fig. 36).

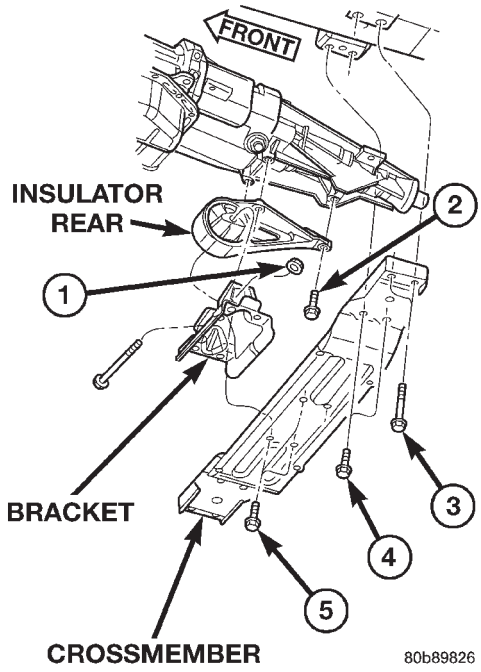


Fig. 35 Engine Rear Mount—4X2

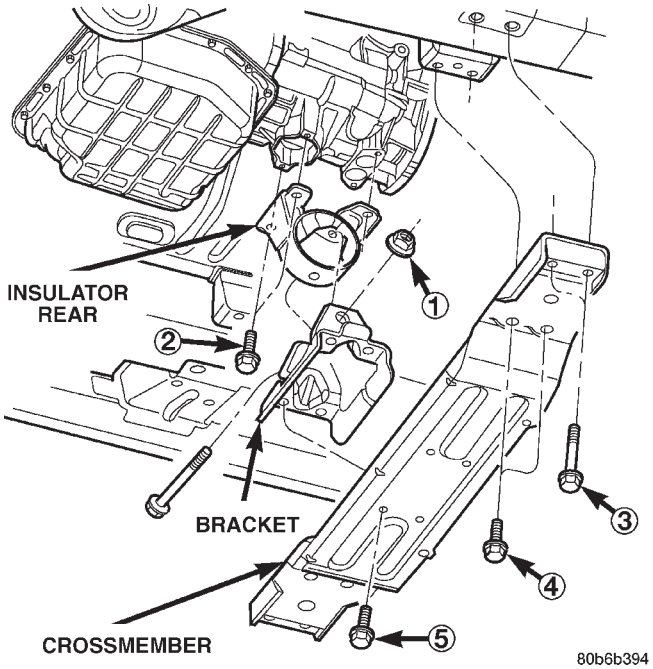


Fig. 36 Engine Rear Mount—4X4

REMOVAL AND INSTALLATION (Continued)

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

INSTALLATION

(1) Position the insulator mount and install the through bolt.

(2) Lower the transmission enough to install the four insulator-to-transmission mounting bolts. Torque the bolts to 46N·m (34 ft. lbs.).

(3) Install the through bolt lock nut. Torque nut to 68N·m (50 ft. lbs.).

(4) Remove jack, lower vehicle.

STRUCTURAL COVER

REMOVAL

(1) Raise vehicle on hoist.

(2) Remove the left hand exhaust pipe from exhaust manifold. Refer to Group 11, Exhaust System.

(3) Loosen the right hand exhaust manifold-to-exhaust pipe retaining bolts.

(4) Remove the eight bolts retaining structural cover (Fig. 37).

(5) Pivot the exhaust pipe downward and remove the structural cover.

INSTALLATION

CAUTION: The structural cover must be installed as described in the following steps. Failure to do so will cause severe damage to the cover.

(1) Position the structural cover in the vehicle.

(2) Install all four bolts retaining the cover-to-engine. DO NOT tighten the bolts at this time.

(3) Install the four cover-to-transmission bolts. Do NOT tighten at this time.

CAUTION: The structural cover must be held tightly against both the engine and the transmission bell housing during tightening sequence. Failure to do so may cause damage to the cover.

(4) Starting with the two rear cover-to-engine bolts, tighten bolts (1) (Fig. 37) to 54 N·m (40 ft. lbs.), then tighten bolts (2) (Fig. 37) and (3) to 54 N·m (40 ft. lbs.) in the sequence shown.

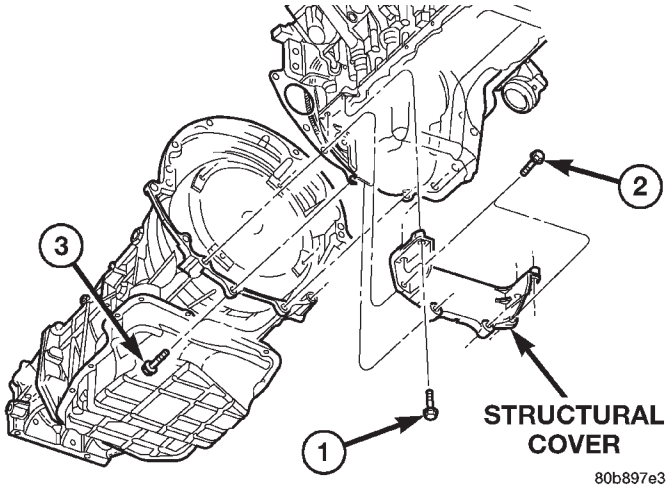


Fig. 37 Structural Cover

SEQUENCE	ITEM	TORQUE
1	BOLT (Qty 4)	54 N·m (40 ft. lbs.)
2	BOLT (Qty 2)	54 N·m (40 ft. lbs.)
3	BOLT (Qty 2)	54 N·m (40 ft. lbs.)

(5) Install the exhaust pipe on left hand exhaust manifold.

(6) Tighten exhaust manifold-to-exhaust pipe retaining bolts to 20–26 N·m (15–20 ft. lbs.).

ENGINE

REMOVAL

(1) Disconnect the battery negative cable.

(2) Remove the front fascia. Refer to BODY for correct procedure.

(3) Raise vehicle on hoist.

(4) Remove exhaust crossover pipe from exhaust manifolds. Refer to Group 11, Exhaust System.

(5) Disconnect two ground straps from the lower left hand side and one ground strap from the lower right hand side of the engine.

(6) Disconnect crankshaft position sensor. (Fig. 38)

(7) Remove structural cover. Refer to Structural Cover in this section for procedure.

(8) Remove starter. Refer to STARTING SYSTEM.

REMOVAL AND INSTALLATION (Continued)

(9) Remove rubber splash shield.

(10) Drain cooling system. Refer to COOLING SYSTEM.

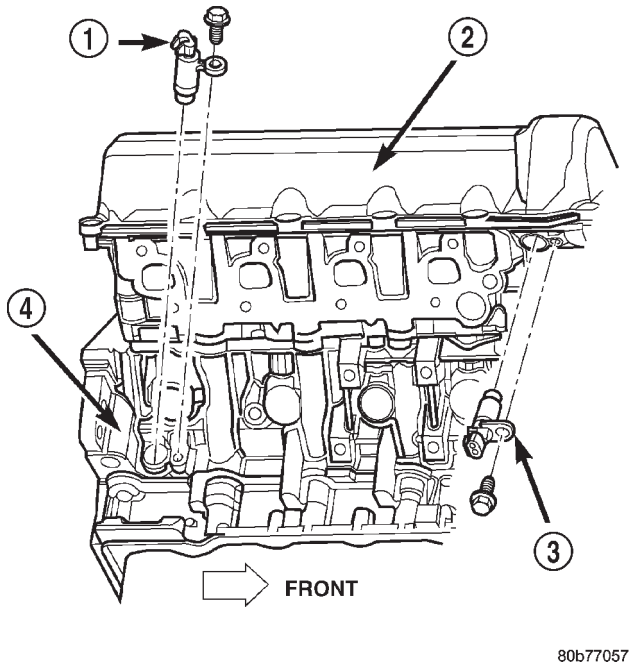


Fig. 38 Crankshaft Position Sensor

1 – CRANKSHAFT POSITION SENSOR
2 – CYLINDER HEAD COVER
3 – CAMSHAFT POSITION SENSOR
4 – RIGHT SIDE CYLINDER BLOCK

(11) Remove torque converter bolts (Automatic Transmission Only). Refer to TRANSMISSION.

(12) Remove transmission to engine mounting bolts.

(13) Disconnect the engine block heater power cable from the block heater.

(14) Lower vehicle.

(15) Remove throttle body resonator assembly and inlet hose.

(16) Disconnect throttle and speed control cables.

(17) Disconnect tube from both the left and right side crankcase breathers, then remove the breathers (Fig. 39).

(18) Discharge A/C system. Refer to HEATING and AIR CONDITIONING.

(19) Remove shroud, fan assemblies and accessory drive belt. Refer to COOLING SYSTEM for procedure.

(20) Remove A/C compressor.

(21) Disconnect transmission oil cooler lines at the radiator.

(22) Disconnect radiator lower hose at the thermostat housing. Refer to Group 7.

(23) Remove A/C condenser. Refer to HEATING and AIR CONDITIONING.

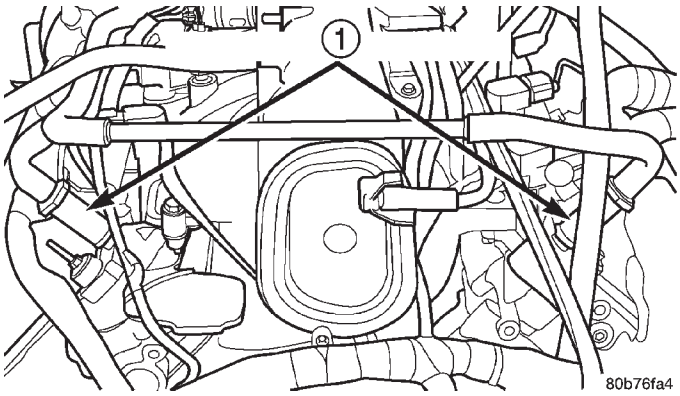


Fig. 39 Crankcase Breather Connection Points

1 – CRANKCASE BREATHERS

(24) Remove radiator. Refer to COOLING SYSTEM.

(25) Remove generator.

(26) Disconnect the two heater hoses from the timing chain cover.

(27) Disconnect engine harness at the following points :

- Intake air temperature (IAT) sensor (Fig. 40)
- Fuel Injectors
- Throttle Position (TPS) Switch
- Idle Air Control (IAC) Motor
- Engine Oil Pressure Switch
- Engine Coolant Temperature (ECT) Sensor
- Manifold absolute pressure (MAP) Sensor
- Camshaft Position (CMP) Sensor
- Coil Over Plugs

(28) Release fuel rail pressure then disconnect the fuel supply quick connect fitting at the fuel rail. Refer to FUEL SYSTEM for procedure.

(29) Remove power steering pump and position out of the way.

(30) Disconnect ground straps from the left side of the engine.

(31) Install Engine Lifting Fixture Special Tool 8347 (Fig. 41) following these steps.

- Holding the lifting fixture at a slight angle, slide the large bore in the front plate over the hex portion of the lifting stud.
- Position the two remaining fixture arms onto the two lifting studs in the cylinder heads.
- Pull foward and upward on the lifting fixture so that the lifting stud rest in the slotted area below the large bore.
- Secure the lifting fixture to the three studs using three 7/16 – 14 N/C locknuts.
- Make sure the lifting loop in the lifting fixture is in the last hole (closest to the throttle body) to minimize the angle of engine during removal.

(32) Disconnect body ground strap at the right side cowl.

REMOVAL AND INSTALLATION (Continued)

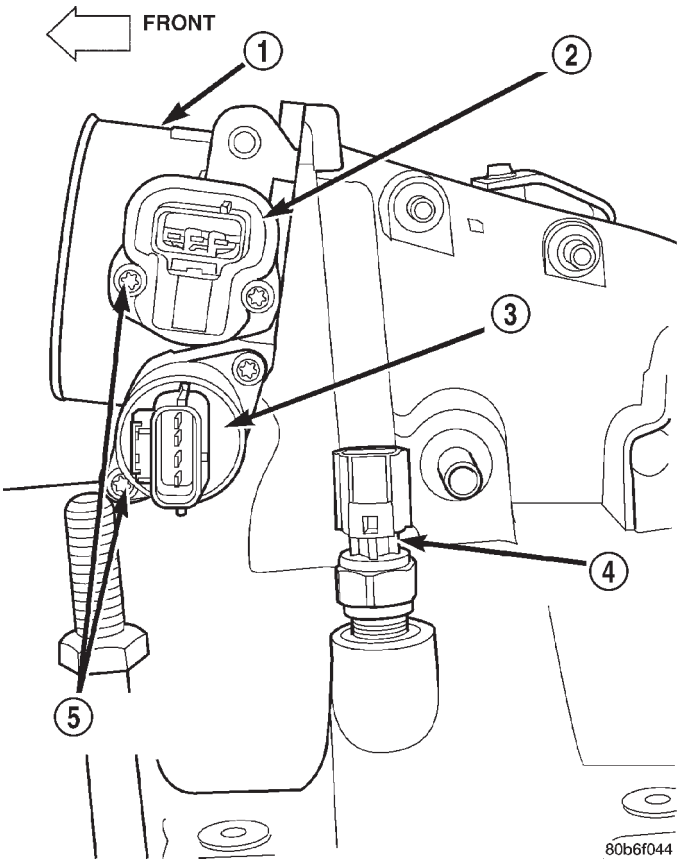


Fig. 40 Throttle Body Connection Points

1 – THROTTLE BODY
2 – TPS
3 – IAC MOTOR
4 – IAT SENSOR
5 – MOUNTING SCREWS

NOTE: It will be necessary to support the transmission in order to remove the engine.

(33) Position a suitable jack under the transmission.

(34) Remove the engine mount through bolts.

(35) Raise engine slightly, then remove both left and right side engine mounts from engine. Refer to Engine Mounts—Front in this section.

(36) Remove engine from the vehicle.

INSTALLATION

(1) Position engine in the vehicle.

(2) Install both left and right side engine mounts onto engine.

Position both the left and right side engine mount brackets and install the through bolts and nuts.

(3) Install transmission to engine mounting bolts. Tighten the bolts to 41 N·m (30 ft. lbs.).

(4) Remove jack from under the transmission.

(5) Remove engine lifting fixture special tool 8347 (Fig. 41).

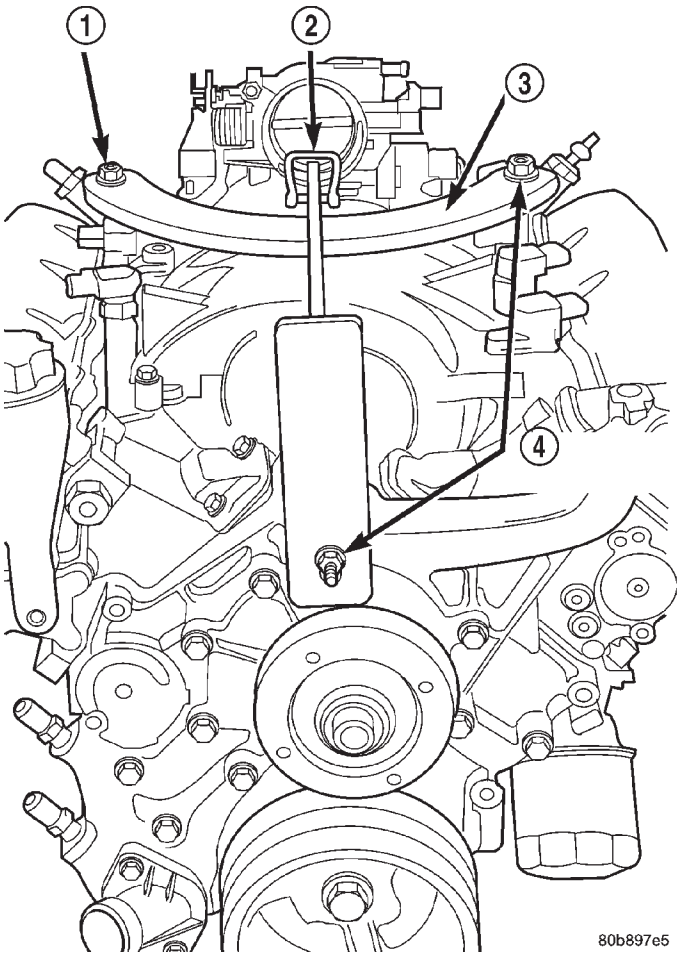


Fig. 41 Engine Lifting Fixture Attachment Locations

1 – ATTACHING LOCATION
2 – ADJUSTABLE HOOK
3 – SPECIAL TOOL 8347 ENGINE LIFT FIXTURE
4 – ATTACHING LOCATIONS

(6) Connect ground straps on the left side of the engine.

(7) Install power steering pump.

(8) Connect fuel supply line quick connect fitting.

(9) Connect engine harness at the following points (Fig. 40) :

- Intake Air Temperature (IAT) Sensor
- Idle Air Control (IAC) Motor
- Fuel Injectors
- Throttle Position (TPS) Switch
- Engine Oil Pressure Switch
- Engine Coolant Temperature (ECT) Sensor
- Manifold Absolute Pressure (MAP) Sensor
- Camshaft Position (CMP) Sensor
- Coil Over Plugs

(10) Install generator.

(11) Install radiator.

(12) Install A/C condenser.

(13) Connect radiator lower hose at the thermostat housing.

REMOVAL AND INSTALLATION (Continued)

(14) Connect the transmission oil cooler lines to the radiator.

(15) Install A/C compressor. Tighten the A/C compressor and generator M10 mounting bolts 40–68N·M (30–50 ft. lbs.) and the M8 bolts 22–34 N·m (200–300 in. lbs.).

(16) Install accessory drive belt, fan assembly and shroud.

(17) Install breathers, then connect tube to both crankcase breathers (Fig. 39).

(18) Connect throttle and speed control cables.

(19) Install throttle body resonator assembly and inlet hose.

(20) Raise vehicle.

(21) Connect two ground straps on the lower left hand side of the engine and one ground strap on the lower right side.

(22) Install torque converter bolts.

(23) Connect crankshaft position sensor (Fig. 38).

(24) Install starter.

(25) Install rubber splash shield.

CAUTION: The structural cover requires a specific torque sequence. Failure to follow this sequence may cause severe damage to the cover.

(26) Install structural cover. Refer to Structural Cover in this section.

(27) Install exhaust crossover pipe.

(28) Install engine block heater power cable, If equipped.

(29) Lower vehicle.

(30) Check and fill engine oil.

(31) Recharge the A/C system.

(32) Refill the engine cooling system.

(33) Connect the battery negative cable.

(34) Start engine and check for leaks.

INTAKE MANIFOLD

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove air cleaner housing and throttle body resonator (Fig. 42).

(3) Disconnect throttle and speed control cables.

(4) Disconnect electrical connectors for the following components: Refer to FUEL SYSTEM for location.

- Manifold Absolute Pressure (MAP) Sensor
- Intake Air Temperature (IAT) Sensor
- Throttle Position (TPS) Sensor
- Coolant Temperature (CTS) Sensor
- Idle Air Control (IAC) Motor

(5) Disconnect vapor purge hose, brake booster hose, speed control servo hose, positive crankcase ventilation (PCV) hose.

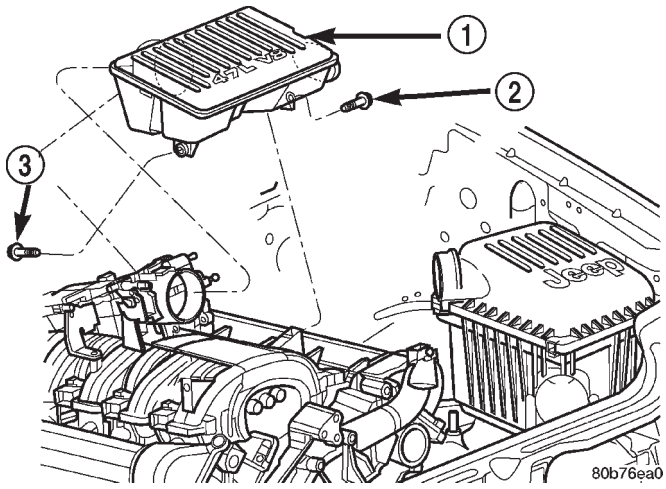


Fig. 42 Throttle Body Resonator

1 – THROTTLE BODY RESONATOR
2 – BOLT
3 – BOLT

(6) Remove accessory drive belt. Refer to COOLING SYSTEM.

(7) Disconnect generator electrical connections.

(8) Unbolt the generator and move it away from the intake manifold for clearance.

(9) Disconnect air conditioning compressor electrical connections.

(10) Unbolt the air conditioning compressor and move it away from the intake manifold for clearance.

(11) Disconnect left and right radio suppressor straps.

(12) Disconnect and remove ignition coil towers.

(13) Remove top oil dipstick tube retaining bolt and ground strap.

(14) Bleed fuel system. Refer to FUEL SYSTEM.

(15) Remove fuel rail.

(16) Remove throttle body assembly and mounting bracket.

(17) Drain cooling system below coolant temperature level. Refer to COOLING SYSTEM.

(18) Remove coolant temperature sensor. Refer to FUEl SYSTEM.

(19) Remove cowl to hood seal. Refer to BODY.

(20) Remove right side engine lifting stud.

(21) Remove intake manifold retaining fasteners, in

(21) reverse order of tightening sequence (Fig. 43).

NOTE: Intake must be lifted upward and level in the front and rear to clear the cowl. Interference with the cowl will occur during removal.

(22) Remove intake manifold.

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Install intake manifold gaskets.
(2) Install intake manifold.
(3) Install intake manifold retaining bolts and tighten in sequence shown in (Fig. 43) to 12 N·m (105 in. lbs.).

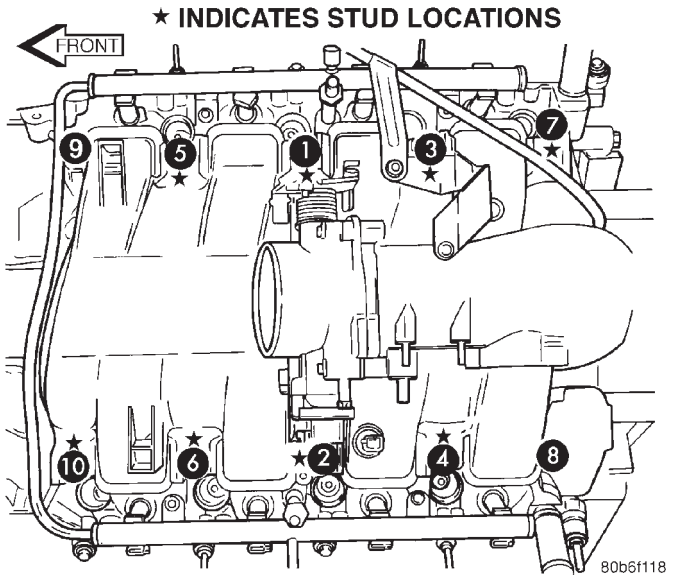


Fig. 43 Intake Manifold Tightening Sequence

(4) Install left and right radio suppressor straps.
(5) Install throttle body assembly.
(6) Install throttle cable bracket.
(7) Connect throttle cable and speed control cable to throttle body.
(8) Install fuel rail.
(9) Install ignition coil towers.
(10) Install coolant temperature sensor.
(11) Connect electrical connectors for the following components:

- Manifold Absolute Pressure (MAP) Sensor
- Intake Air Temperature (IAT) Sensor
- Throttle Position (TPS) Sensor
- Coolant Temperature (CTS) Sensor
- Idle Air Control (IAC) Motor
- Ignition coil towers
- Fuel injectors

(12) Install top oil dipstick tube retaining bolt and ground strap.
(13) Install right side engine lifting stud.
(14) Install generator including electrical connections.
(15) Connect Vapor purge hose, Brake booster hose, Speed control servo hose, Positive crankcase ventilation (PCV) hose.
(16) Install air conditioning compressor including electrical connections.
(17) Fill cooling system. Refer to Group 7, Cooling System for procedure.
(18) Install accessory drive belt.
(19) Install cowl to hood seal. Refer to BODY.
(20) Install air cleaner housing and throttle body resonator. Tighten resonator bolts 4.5 N·m (40 in. lbs.).
(21) Connect negative cable to battery.

EXHAUST MANIFOLDS

RIGHT EXHAUST MANIFOLD

REMOVAL

(1) Disconnect negative cable for battery.
(2) Remove battery from vehicle.
(3) Remove Power Distribution Center (PDC) fasteners and set aside.
(4) Remove battery tray assembly.
(5) Remove washer bottle assembly
(6) Remove accessory drive belt. Refer to Group 7, Cooling System for procedures.
(7) Remove A/C compressor from mounting and set aside.
(8) Remove A/C accumulator support bracket fastener.
(9) Drain coolant below heater hose level. Refer to Group 7, Cooling System for procedures.
(10) Remove heater hoses at engine.
(11) Remove fasteners attaching exhaust manifold heat shield.
(12) Remove heat shield.
(13) Remove upper exhaust manifold attaching fasteners.
(14) Raise vehicle on hoist.
(15) Disconnect exhaust pipe from manifold.
(16) Remove fasteners attaching starter. Move starter aside.
(17) Remove lower exhaust manifold attaching fasteners.
(18) Remove exhaust manifold and gasket. Manifold is removed from below the engine compartment.

INSTALLATION

(1) Install exhaust manifold and gasket from below engine compartment.
(2) Install lower exhaust manifold fasteners. DO NOT tighten until all fasteners are in place.
(3) Lower vehicle and install upper exhaust manifold fasteners. Tighten all manifold bolts starting at center and working outward to 25 N·m (18 ft. lbs.).

CAUTION: Over tightening heat shield fasteners, may cause shield to distort and/or crack.

(4) Install exhaust manifold heat shield. Tighten fasteners to 8 N·m (72 in. lbs.), then loosen 45 degrees.
(5) Install starter and fasteners.

REMOVAL AND INSTALLATION (Continued)

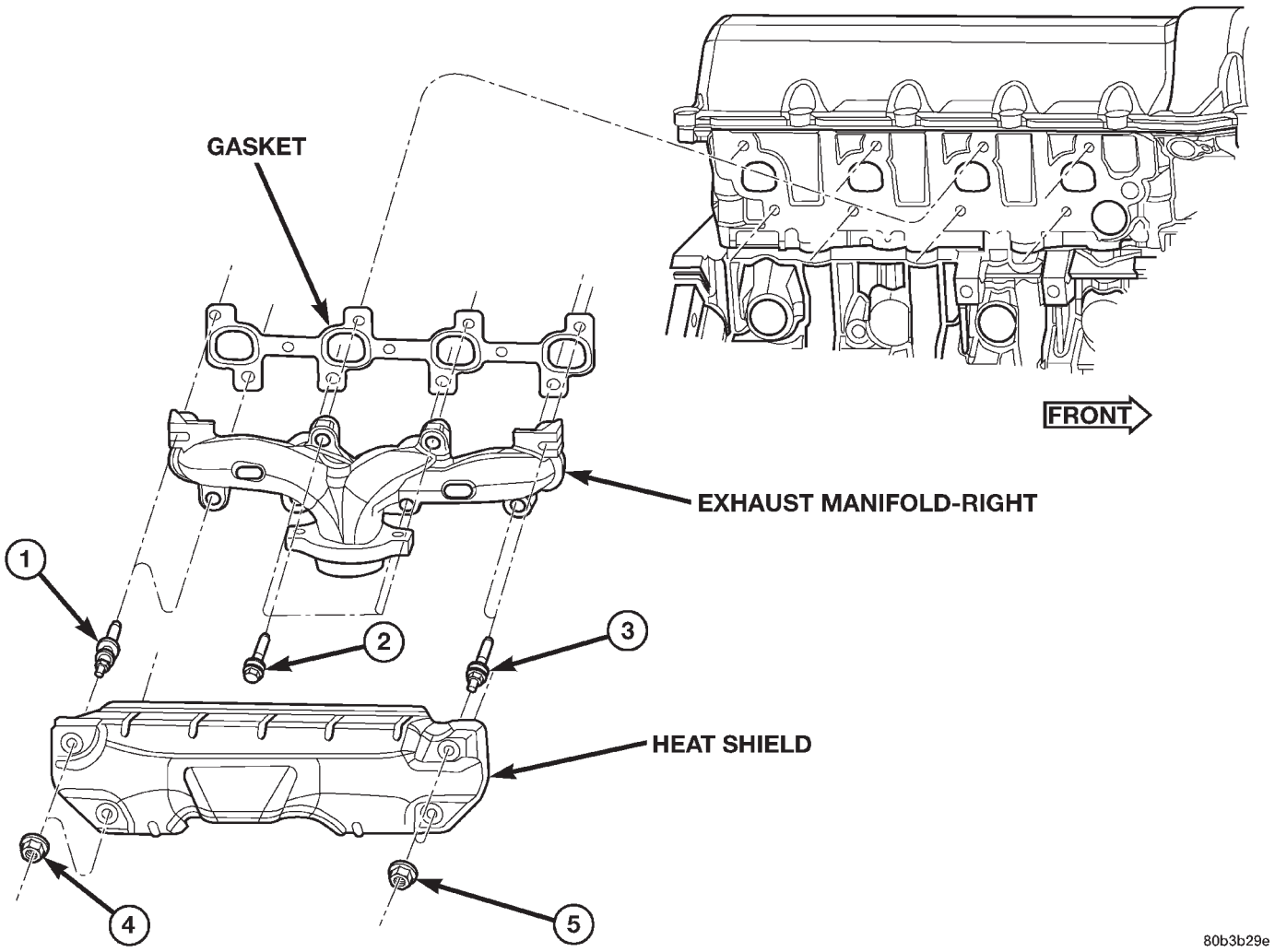


Fig. 44 Exhaust Manifold—Right

ITEM	DESCRIPTION	TORQUE	ITEM	DESCRIPTION	TORQUE
1	Stud (Qty 2)	25 N·m (18 ft. lbs.)	4	Nut (Qty 2)	8 N·m (72 in. lbs.), then loosen 45 degrees
2	Bolt (Qty 4)		5	Nut (Qty 2)	
3	Stud (Qty 2)				

(6) Connect exhaust pipe to manifold.
(7) Connect heater hoses at engine.
(8) Install fastener attaching A/C accumulator.
(9) Install A/C compressor and fasteners.
(10) Install accessory drive belt.
(11) Install washer bottle and battery tray assembly.
(12) Install PDC.
(13) Install battery and connect cables.
(14) Fill cooling system. Refer to Group 7, Cooling System for procedure.

LEFT EXHAUST MANIFOLD

REMOVAL

(1) Disconnect negative cable for battery.
(2) Hoist vehicle.
(3) Disconnect exhaust pipe at manifold.
(4) Lower vehicle.
(5) Remove air cleaner housing and tube.
(6) Remove the front two exhaust heat shield retaining fasteners. Raise vehicle and remove the fasteners at rear of heat shield.
(7) Remove heat shield (Fig. 45).

REMOVAL AND INSTALLATION (Continued)

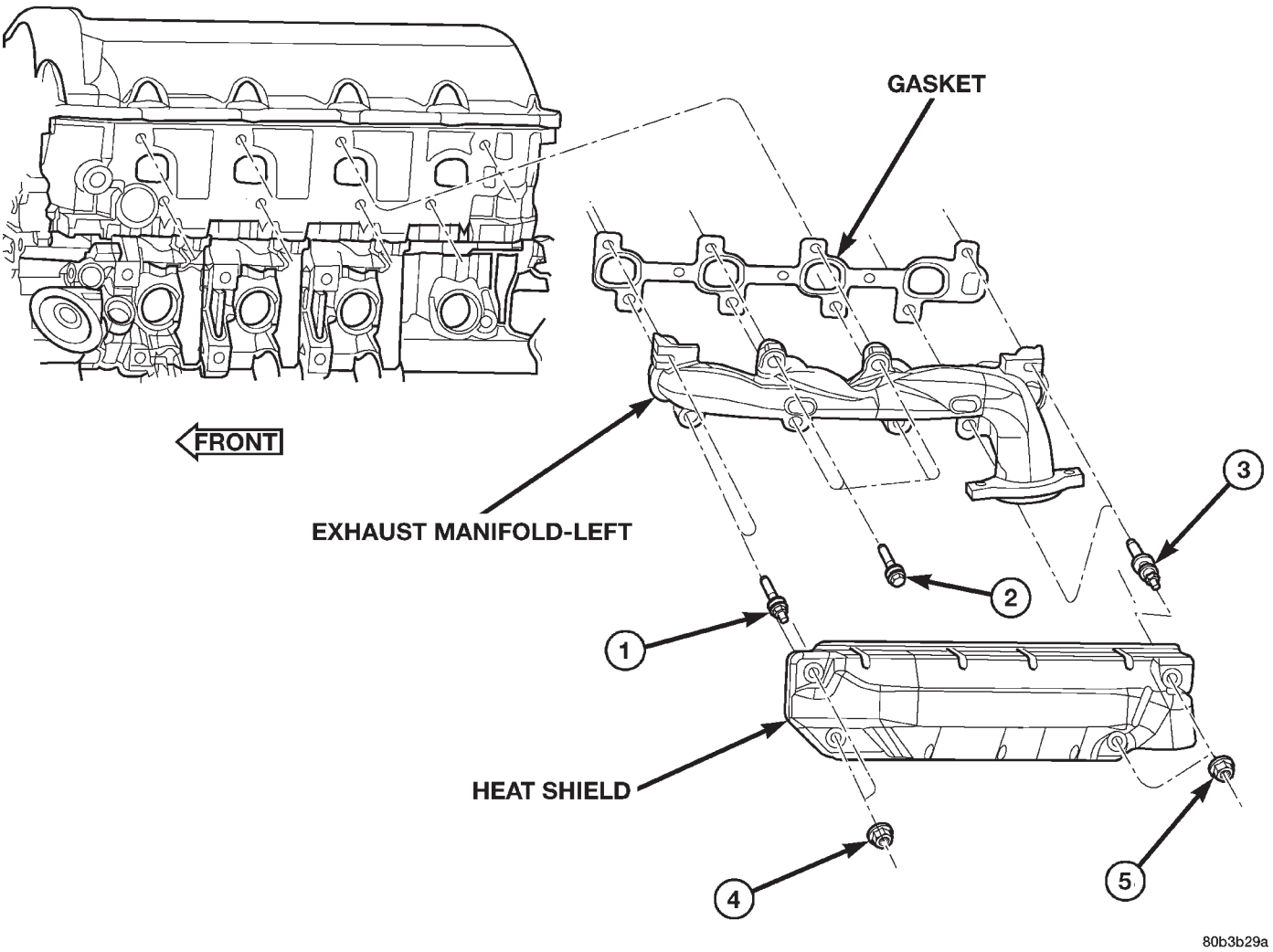


Fig. 45 Exhaust Manifold—Left

ITEM	DESCRIPTION	TORQUE	ITEM	DESCRIPTION	TORQUE
1	Stud (Qty 2)	25 N·m (18 ft. lbs.)	4	Nut (Qty 2)	8 N·m (72 in. lbs.), then loosen 45 degrees
2	Bolt (Qty 4)		5	Nut (Qty 2)	
3	Stud (Qty 2)				

(8) Lower vehicle and remove the upper exhaust manifold retaining bolts (Fig. 45).

(9) Raise vehicle and remove the lower exhaust manifold retaining bolts (Fig. 45).

(10) Remove exhaust manifold and gasket (Fig. 45). Manifold is removed from below the engine compartment.

INSTALLATION

(1) Install exhaust manifold and gasket from below engine compartment.

(2) Install lower exhaust manifold fasteners (Fig. 45). DO NOT tighten until all fasteners are in place.

(3) Lower vehicle and install upper exhaust manifold fasteners (Fig. 45). Tighten all manifold bolts starting at center and working outward to 25 N·m (18 ft. lbs.).

CAUTION: Over tightening heat shield fasteners, may cause shield to distort and/or crack.

REMOVAL AND INSTALLATION (Continued)

(4) Install exhaust manifold heat shield (Fig. 45). Tighten fasteners to 8 N·m (72 in. lbs.), then loosen 45 degrees.
(5) Install air cleaner housing and tube.
(6) Connect exhaust pipe to manifold.
(7) Connect negative cable to battery.

CYLINDER HEAD COVERS

CYLINDER HEAD COVER LEFT

REMOVAL

(1) Disconnect negative cable from battery.
(2) Remove air cleaner housing and throttle body resonator (Fig. 46).

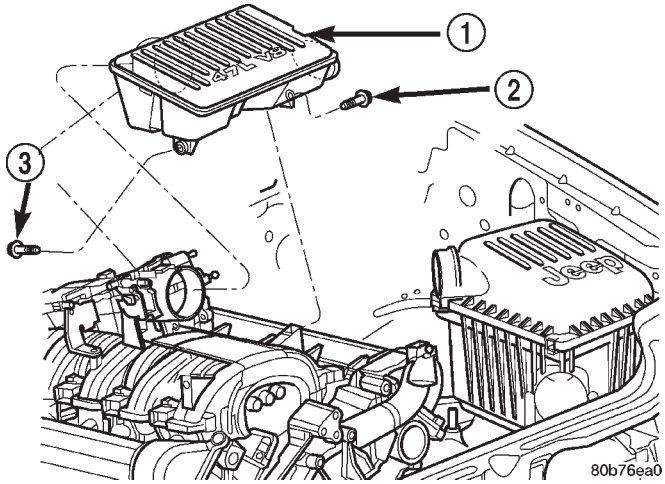


Fig. 46 Throttle Body Resonator

1 – THROTTLE BODY RESONATOR
2 – BOLT
3 – BOLT

(3) Disconnect injector connectors and un-clip the injector harness.
(4) Route injector harness in front of cylinder head cover.
(5) Remove the cylinder head cover mounting bolts.
(6) Remove cylinder head cover and gasket.

NOTE: The gasket may be used again, provided no cuts, tears, or deformation has occurred.

INSTALLATION

CAUTION: Do not use harsh cleaners to clean the cylinder head covers. Severe damage to covers may occur.

(1) Clean cylinder head cover and both sealing surfaces. Inspect and replace gasket as necessary.
(2) Install cylinder head cover and hand start all fasteners. Verify that all studs are in the correct location shown in (Fig. 47).

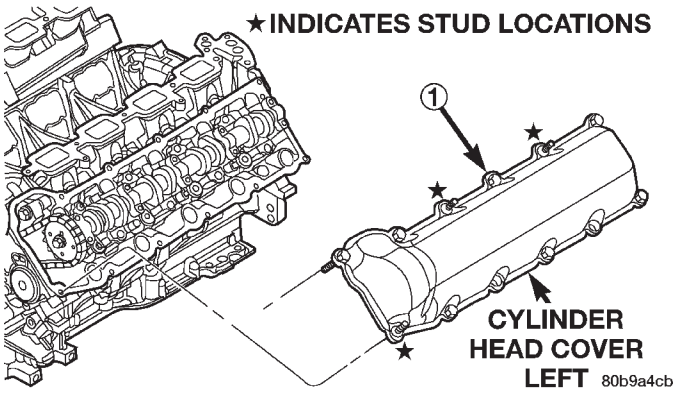


Fig. 47 Cylinder Head Cover—Left

ITEM	DESCRIPTION	TORQUE
1	Cover Fasteners	12 N·m (105 in. lbs.)

(3) Tighten cylinder head cover bolts and double ended studs to 12 N·m (105 in. lbs.).
(4) Connect injector electrical connectors and injector harness retaining clips.
(5) Install air cleaner assembly and throttle body resonator. Tighten resonator bolts 4.5 N·m (40 in. lbs.).
(6) Connect negative cable to battery.

CAUTION: DO NOT allow other components including the wire harness to rest on or against the cylinder head cover. Prolonged contact with other objects may wear a hole in the engine cylinder head cover.

CYLINDER HEAD COVER RIGHT

REMOVAL

(1) Disconnect and remove battery from engine compartment.
(2) Remove air cleaner housing and throttle body resonator (Fig. 46).
(3) Disconnect battery lugs from Power Distribution Center (PDC).
(4) Un-clip PDC and move to the left side of the fender well.
(5) Drain cooling system, below the level of the heater hoses. Refer to COOLING SYSTEM.
(6) Remove accessory drive belt. Refer to COOLING SYSTEM.
(7) Remove air conditioning compressor retaining bolts and move compressor to the left.

REMOVAL AND INSTALLATION (Continued)

(8) Remove battery tray and disconnect battery temperature sensor.
(9) Remove heater hoses from front of engine.
(10) Loosen air conditioning accumulator bracket.
(11) Disconnect injector and ignition coil connectors.
(12) Disconnect and remove positive crankcase ventilation (PCV) hose.
(13) Remove oil fill tube.
(14) Un-clip injector and ignition coil harness and move away from cylinder head cover.
(15) Remove right rear breather tube and filter assembly.
(16) Remove cylinder head cover retaining bolts.
(17) Remove cylinder head cover.

NOTE: The gasket may be used again, provided no cuts, tears, or deformation has occurred.

INSTALLATION

CAUTION: Do not use harsh cleaners to clean the cylinder head covers. Severe damage to covers may occur.

(1) Clean cylinder head cover and both sealing surfaces. Inspect and replace gasket as necessary.
(2) Install cylinder head cover and hand start all fasteners. Verify that all double ended studs are in the correct location shown in (Fig. 48).

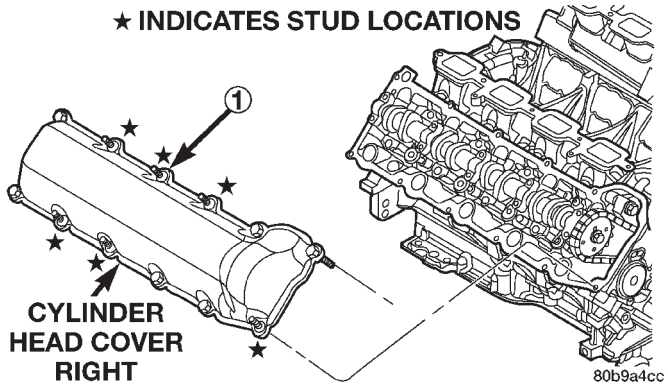


Fig. 48 Cylinder Head Cover—Right

ITEM	DESCRIPTION	TORQUE
1	Cover Fasteners	12 N·m (105 in. lbs.)

(3) Tighten cylinder head cover bolts and double ended studs to 12 N·m (105 in. lbs).
(4) Install right rear breather tube and filter assembly.
(5) Connect injector, ignition coil electrical connectors and harness retaining clips.
(6) Install the oil fill tube.
(7) Install PCV hose.
(8) Tighten air conditioning accumulator bracket.
(9) Install heater hoses.
(10) Connect battery temperature sensor and install battery tray.
(11) Install air conditioning compressor retaining bolts.
(12) Install accessory drive belt.
(13) Fill Cooling system.
(14) Connect PDC and install battery lugs.
(15) Install throttle body resonator and air cleaner housing. Tighten resonator bolts 4.5 N·m (40 in. lbs.).
(16) Install battery and connect battery cables.

CAUTION: DO NOT allow other components including the wire harness to rest on or against the engine cylinder head cover. Prolonged contact with other objects may wear a hole in the cylinder head cover.

ROCKER ARMS

REMOVAL

NOTE: Disconnect the battery negative cable to prevent accidental starter engagement.

(1) Remove the cylinder head cover. Refer to Cylinder Head Cover in this section.
(2) For rocker arm removal on cylinders 3 and 5 Rotate the crankshaft until cylinder #1 is at TDC exhaust stroke.
(3) For rocker arm removal on cylinders 2 and 8 Rotate the crankshaft until cylinder #1 is at TDC compression stroke.
(4) For rocker arm removal on cylinders 4 and 6 Rotate the crankshaft until cylinder #3 is at TDC compression stroke.
(5) For rocker arm removal on cylinders 1 and 7 Rotate the crankshaft until cylinder #2 is at TDC compression stroke.
(6) Using special tool 8516 press downward on the valve spring, remove rocker arm (Fig. 49).

INSTALLATION

CAUTION: Make sure the rocker arms are installed with the concave pocket over the lash adjusters. Failure to do so may cause severe damage to the rocker arms and/or lash adjusters.

NOTE: Coat the rocker arms with clean engine oil prior to installation.

REMOVAL AND INSTALLATION (Continued)

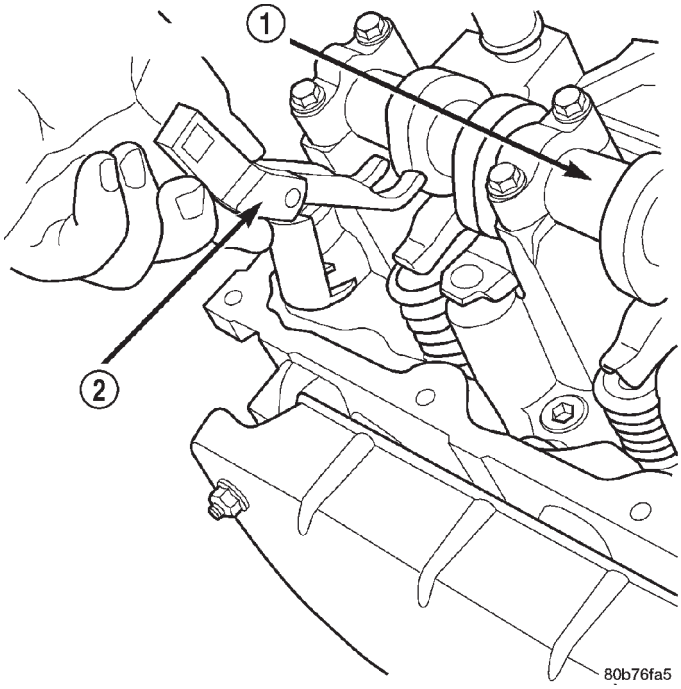


Fig. 49 Rocker Arm—Removal

1 – CAMSHAFT
2 – SPECIAL TOOL 8516

(1) For rocker arm installation on cylinders 3 and 5 Rotate the crankshaft until cylinder #1 is at TDC exhaust stroke.

(2) For rocker arm installation on cylinders 2 and 8 Rotate the crankshaft until cylinder #1 is at TDC compression stroke.

(3) For rocker arm installation on cylinders 4 and 6 Rotate the crankshaft until cylinder #3 is at TDC compression stroke.

(4) For rocker arm installation on cylinders 1 and 7 Rotate the crankshaft until cylinder #2 is at TDC compression stroke.

(5) Using special tool 8516 press downward on the valve spring, install rocker arm (Fig. 49).

(6) Install the cylinder head cover.

VALVE STEM SEALS AND SPRINGS

To service valve stem seals or springs refer to cylinder head removal procedures outlined in this section.

CYLINDER HEADS

CYLINDER HEAD—LEFT

REMOVAL

(1) Disconnect the negative cable from the battery.

(2) Raise the vehicle on a hoist.

(3) Disconnect the exhaust pipe at the left side exhaust manifold.

(4) Drain the engine coolant. Refer to COOLING SYSTEM.

(5) Lower the vehicle.

(6) Remove the intake manifold. Refer to procedure in this section.

(7) Remove the cylinder head cover. Refer to procedure in this section.

(8) Remove the fan shroud and fan blade assembly. Refer to COOLING SYSTEM.

(9) Remove accessory drive belt. Refer to COOLING SYSTEM.

(10) Remove the power steering pump and set aside.

(11) Rotate the crankshaft until the damper timing mark is aligned with TDC indicator mark (Fig. 50).

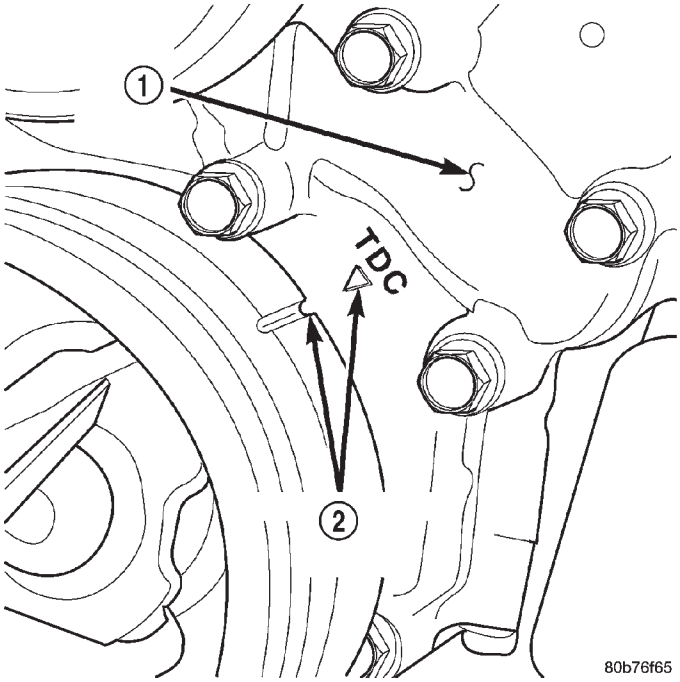


Fig. 50 Engine Top Dead Center (TDC) Indicator Mark

1 – TIMING CHAIN COVER
2 – CRANKSHAFT TIMING MARKS

(12) Verify the V8 mark on the camshaft sprocket is at the 12 o'clock position (Fig. 52). Rotate the crankshaft one turn if necessary.

(13) Remove the crankshaft damper. Refer to Crankshaft Damper in this section.

(14) Remove the timing chain cover. Refer to procedure in this section.

(15) Lock the secondary timing chains to the idler sprocket using Special Tool 8515 (Fig. 51).

NOTE: Mark the secondary timing chain prior to removal to aid in installation.

REMOVAL AND INSTALLATION (Continued)

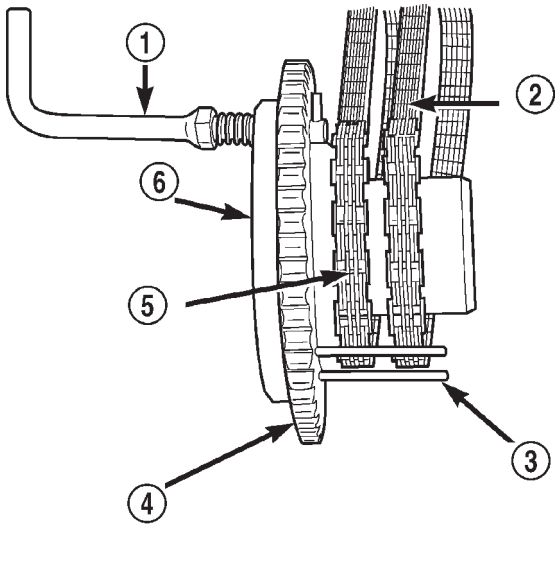


Fig. 51 Using Special Tool 8515 to Hold Chains to Idler Sprocket.

1 – LOCK ARM
2 – RIGHT CAMSHAFT CHAIN
3 – SECONDARY CHAINS RETAINING PINS (4)
4 – IDLER SPROCKET
5 – LEFT CAMSHAFT CHAIN
6 – SPECIAL TOOL 8515

(16) Mark the secondary timing chain, one link on each side of the V8 mark on the camshaft drive gear (Fig. 52).

(17) Remove the left side secondary chain tensioner. Refer to Timing Chain and Sprockets in this section.

(18) Remove the cylinder head access plug (Fig. 53).

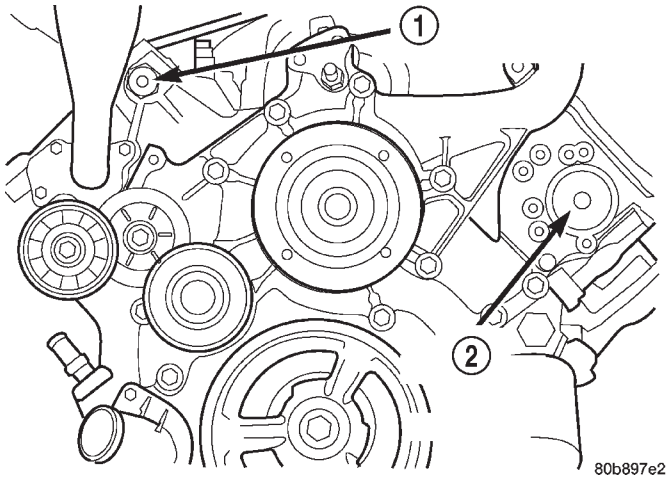


Fig. 53 Cylinder Head Access Plugs

1 – RIGHT CYLINDER HEAD ACCESS PLUG
2 – LEFT CYLINDER HEAD ACCESS PLUG

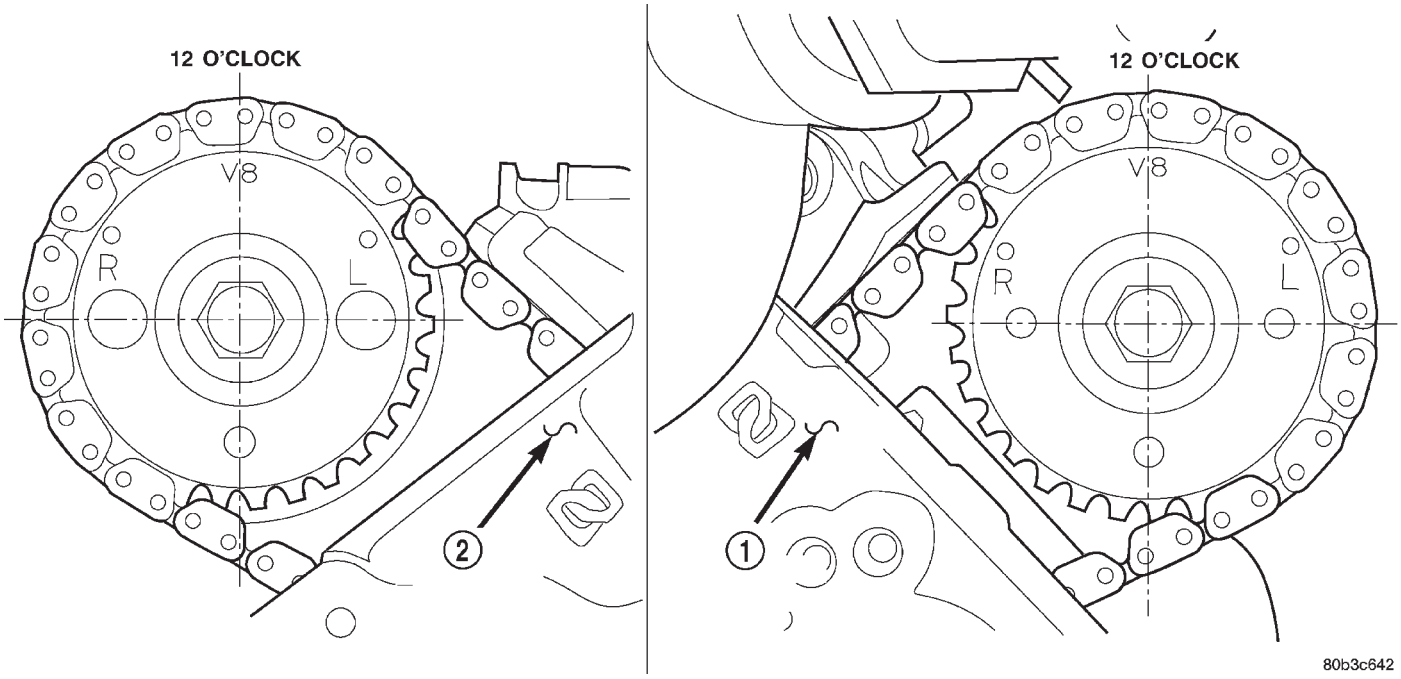


Fig. 52 Camshaft Sprocket V8 Marks

1 – LEFT CYLINDER HEAD
2 – RIGHT CYLINDER HEAD

REMOVAL AND INSTALLATION (Continued)

(19) Remove the left side secondary chain guide. Refer to Timing Chain and Sprockets in this section.
(20) Remove the retaining bolt and the camshaft drive gear.

CAUTION: Do not allow the engine to rotate. Severe damage to the valve train can occur.

CAUTION: Do not overlook the four smaller bolts at the front of the cylinder head. Do not attempt to remove the cylinder head without removing these four bolts.

NOTE: The cylinder head is attached to the cylinder block with fourteen bolts.

(21) Remove the cylinder head retaining bolts.
(22) Remove the cylinder head and gasket. Discard the gasket.

CAUTION: Do not lay the cylinder head on its gasket sealing surface, due to the design of the cylinder head gasket any distortion to the cylinder head sealing surface may prevent the gasket from properly sealing resulting in leaks.

INSTALLATION

NOTE: The cylinder head bolts are tightened using a torque plus angle procedure. The bolts must be examined BEFORE reuse. If the threads are necked down the bolts should be replaced.

Necking can be checked by holding a straight edge against the threads. If all the threads do not contact the scale, the bolt should be replaced (Fig. 54).

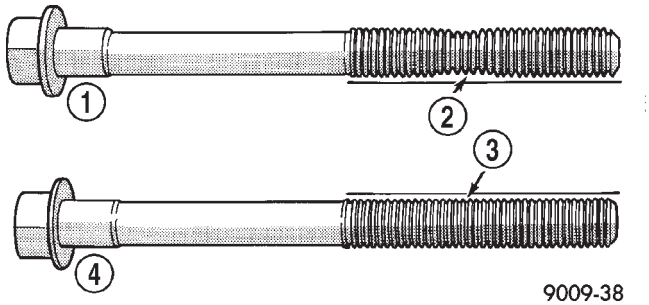


Fig. 54 Checking Cylinder Head Bolts for Stretching (Necking)

1 – STRETCHED BOLT
2 – THREADS ARE NOT STRAIGHT ON LINE
3 – THREADS ARE STRAIGHT ON LINE
4 – UNSTRETCHED BOLT

CAUTION: When cleaning cylinder head and cylinder block surfaces, DO NOT use a metal scraper because the surfaces could be cut or ground. Use only a wooden or plastic scraper.

(1) Clean the cylinder head and cylinder block mating surfaces (Fig. 55).

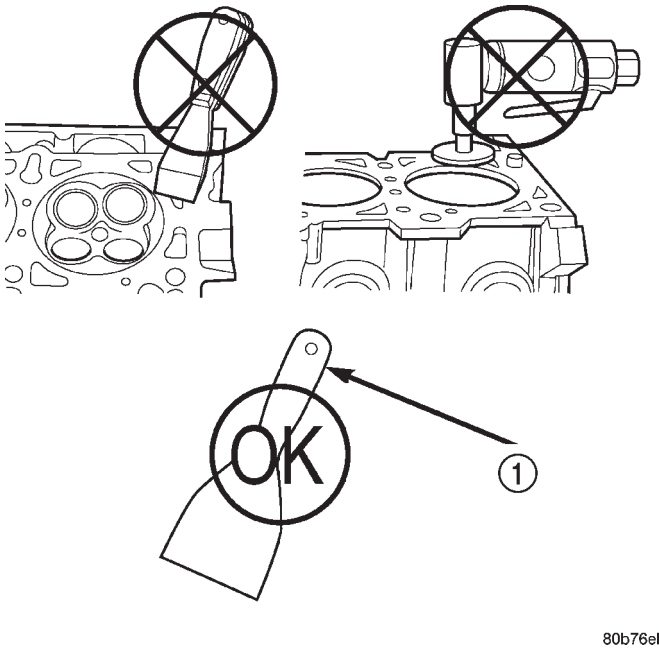


Fig. 55 Proper Tool Usage for Surface Preparation

1 – PLASTIC/WOOD SCRAPER

(2) Position the new cylinder head gasket on the locating dowels.

CAUTION: When installing cylinder head, use care not damage the tensioner arm or the guide arm.

(3) Position the cylinder head onto the cylinder block. Make sure the cylinder head seats fully over the locating dowels.

NOTE: The four smaller cylinder head mounting bolts require sealant to be added to them before installing. Failure to do so may cause leaks.

(4) Lubricate the cylinder head bolt threads with clean engine oil and install the ten M11 bolts.
(5) Coat the four M8 cylinder head bolts with **Mopar® Lock and Seal Adhesive** then install the bolts.

NOTE: The cylinder head bolts are tightened using an angle torque procedure, however, the bolts are not a torque-to-yield design.

(6) Tighten the bolts in sequence (Fig. 56) using the following steps and torque values:

REMOVAL AND INSTALLATION (Continued)

- Step 1: Tighten bolts 1–10, 20 N·m (15 ft. lbs.).
- Step 2: Tighten bolts 1–10, 47 N·m (35 ft. lbs.). Tighten bolts 11–14, 25 N·m (18 ft. lbs.).
- Step 3: Tighten bolts 1–10, 90 degrees. Tighten bolts 11–14, 30 N·m (22 ft. lbs.).

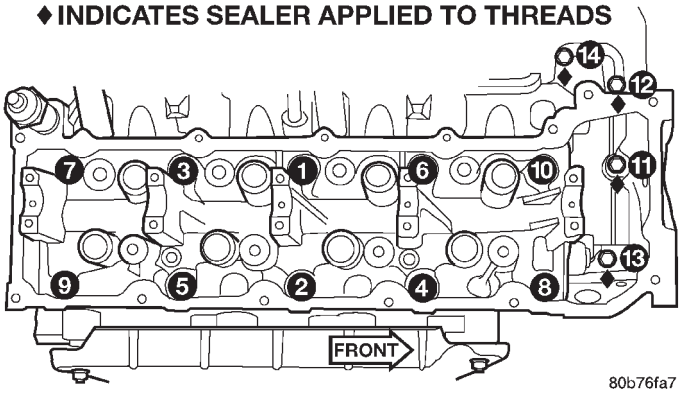


Fig. 56 Cylinder Head Tightening Sequence

(7) Position the secondary chain onto the camshaft drive gear, making sure one marked chain link is on either side of the V8 mark on the gear and position the gear onto the camshaft.
(8) Install the camshaft drive gear retaining bolt.
(9) Install the left side secondary chain guide.
(10) Install the cylinder head access plug.
(11) Re-set and Install the left side secondary chain tensioner.
(12) Remove Special Tool 8515.
(13) Install the timing chain cover.
(14) Install the crankshaft damper. Tighten damper bolt 175 N·m (130 Ft. Lbs.).
(15) Install the power steering pump.
(16) Install the fan blade assembly and fan shroud.
(17) Install the cylinder head cover.
(18) Install the intake manifold.
(19) Refill the cooling system
(20) Raise the vehicle.
(21) Install the exhaust pipe onto the left exhaust manifold.
(22) Lower the vehicle.
(23) Connect the negative cable to the battery.
(24) Start the engine and check for leaks.

CYLINDER HEAD—RIGHT

REMOVAL

(1) Disconnect battery negitive cable.
(2) Raise the vehicle on a hoist.
(3) Disconnect the exhaust pipe at the right side exhaust manifold.
(4) Drain the engine coolant. Refer to COOLING SYSTEM.
(5) Lower the vehicle.
(6) Remove the intake manifold. Refer to procedure in this section.
(7) Remove the cylinder head cover. Refer to procedure in this section.
(8) Remove the fan shroud. Refer to COOLING SYSTEM.
(9) Remove oil fill housing from cylinder head.
(10) Remove accessory drive belt. Refer to COOLING SYSTEM.
(11) Rotate the crankshaft until the damper timing mark is aligned with TDC indicator mark (Fig. 50).
(12) Verify the V8 mark on the camshaft sprocket is at the 12 o'clock position (Fig. 52). Rotate the crankshaft one turn if necessary.
(13) Remove the crankshaft damper. Refer to Crankshaft Damper in this section.
(14) Remove the timing chain cover. Refer to Timing Chain Cover in this section.
(15) Lock the secondary timing chains to the idler sprocket using Special Tool 8515 (Fig. 51).

NOTE: Mark the secondary timing chain prior to removal to aid in installation.

(16) Mark the secondary timing chain, one link on each side of the V8 mark on the camshaft drive gear (Fig. 52).
(17) Remove the right side secondary chain tensioner. Refer to Timing Chain and Sprockets in this section.
(18) Remove the cylinder head access plug (Fig. 57).

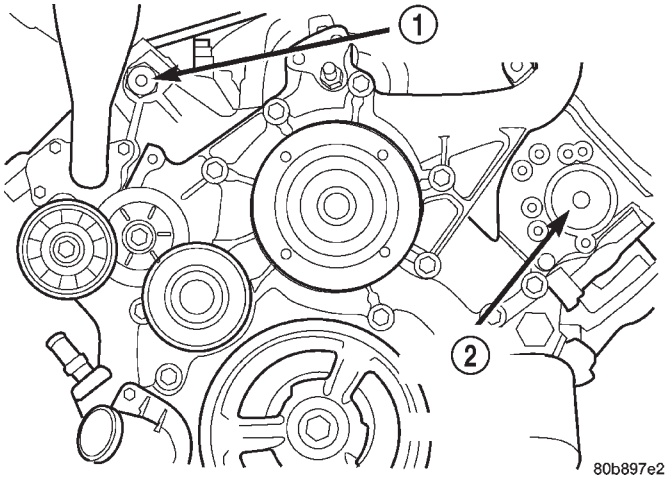


Fig. 57 Cylinder Head Access Plugs

1 – RIGHT CYLINDER HEAD ACCESS PLUG
2 – LEFT CYLINDER HEAD ACCESS PLUG

(19) Remove the right side secondary chain guide. Refer to Timing Chain and Sprockets in this section.
(20) Remove the retaining bolt and the camshaft drive gear.

REMOVAL AND INSTALLATION (Continued)

CAUTION: Do not allow the engine to rotate. severe damage to the valve train can occur.

CAUTION: Do not overlook the four smaller bolts at the front of the cylinder head. Do not attempt to remove the cylinder head without removing these four bolts.

CAUTION: Do not hold or pry on the camshaft target wheel for any reason. A damaged target wheel can result in a vehicle no start condition.

NOTE: The cylinder head is attached to the cylinder block with fourteen bolts.

(21) Remove the cylinder head retaining bolts.
(22) Remove the cylinder head and gasket. Discard the gasket.

CAUTION: Do not lay the cylinder head on its gasket sealing surface, do to the design of the cylinder head gasket any distortion to the cylinder head sealing surface may prevent the gasket from properly sealing resulting in leaks.

INSTALLATION

NOTE: The cylinder head bolts are tightened using a torque plus angle procedure. The bolts must be examined BEFORE reuse. If the threads are necked down the bolts should be replaced.

Necking can be checked by holding a straight edge against the threads. If all the threads do not contact the scale, the bolt should be replaced (Fig. 54).

CAUTION: When cleaning cylinder head and cylinder block surfaces, DO NOT use a metal scraper because the surfaces could be cut or ground. Use only a wooden or plastic scraper.

(1) Clean the cylinder head and cylinder block mating surfaces (Fig. 58).
(2) Position the new cylinder head gasket on the locating dowels.

CAUTION: When installing cylinder head, use care not damage the tensioner arm or the guide arm.

(3) Position the cylinder head onto the cylinder block. Make sure the cylinder head seats fully over the locating dowels.

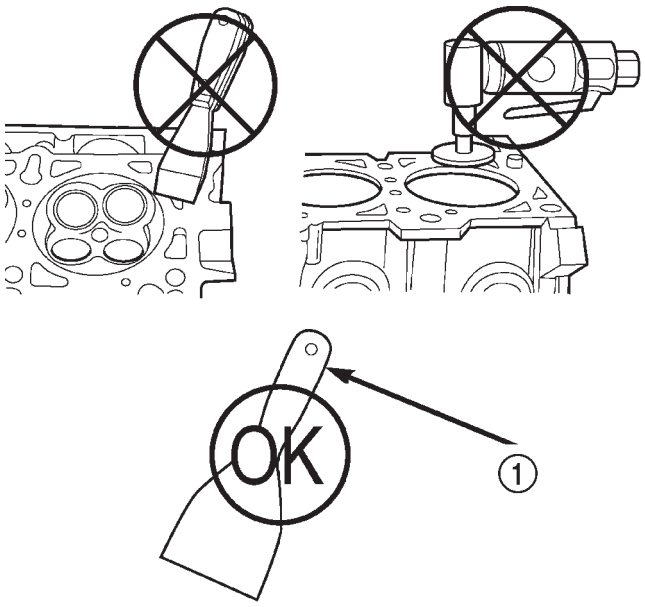


Fig. 58 Proper Tool Usage For Surface Preparation
1 – PLASTIC/WOOD SCRAPER

NOTE: The four smaller cylinder head mounting bolts require sealant to be added to them before installing. Failure to do so may cause leaks.

(4) Lubricate the cylinder head bolt threads with clean engine oil and install the ten M10 bolts.
(5) Coat the four M8 cylinder head bolts with **Mopar Lock and Seal Adhesive** then install the bolts.

NOTE: The cylinder head bolts are tightened using an angle torque procedure, however, the bolts are not a torque-to-yield design.

(6) Tighten the bolts in sequence (Fig. 59) using the following steps and torque values:
- Step 1: Tighten bolts 1–10, 20 N·m (15 ft. lbs.).
- Step 2: Tighten bolts 1–10, 47 N·m (35 ft. lbs.). Tighten bolts 11–14, 25 N·m (18 ft. lbs.).
- Step 3: Tighten bolts 1–10, 90 degrees. Tighten bolts 11–14, 30 N·m (22 ft. lbs.).

(7) Position the secondary chain onto the camshaft drive gear, making sure one marked chain link is on either side of the V8 mark on the gear and position the gear onto the camshaft.
(8) Install the camshaft drive gear retaining bolt.
(9) Install the right side secondary chain guide.
(10) Install the cylinder head access plug.
(11) Re-set and install the right side secondary chain tensioner.
(12) Remove Special Tool 8515.
(13) Install the timing chain cover.

REMOVAL AND INSTALLATION (Continued)

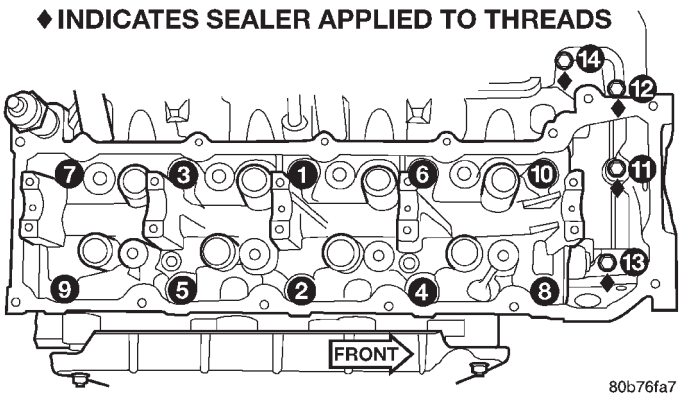


Fig. 59 Cylinder Head Tightening Sequence

(14) Install the crankshaft damper. Tighten damper bolt 175 N·m (130 Ft. Lbs.).
(15) Install accessory drive belt.
(16) Install the fan shroud.
(17) Install the cylinder head cover.
(18) Install the intake manifold.
(19) Install oil fill housing onto cylinder head.
(20) Refill the cooling system.
(21) Raise the vehicle.
(22) Install the exhaust pipe onto the right exhaust manifold.
(23) Lower the vehicle.
(24) Reconnect battery negitive cable.
(25) Start the engine and check for leaks.

VALVES AND VALVE SPRINGS

REMOVAL

NOTE: The cylinder heads must be removed in order to preform this procedure.

(1) Using Special Tool 8516 Valve Spring Compressor, remove the rocker arms and the hydraulic lash adjusters (Fig. 60).
(2) Remove the camshaft bearing caps and the camshaft.

NOTE: All eight valve springs and valve are removed in the same manner; this procedure only covers one valve and valve spring.

(3) Using Special Tool C-3422–B or C-3422–C Valve Spring Compressor and Special tool 8519 Adapter, compress the valve spring.

NOTE: It may be necessary to tap the top of the valve spring to loosen the spring retainers locks enough to be removed.

(4) Remove the two spring retainer lock halves.

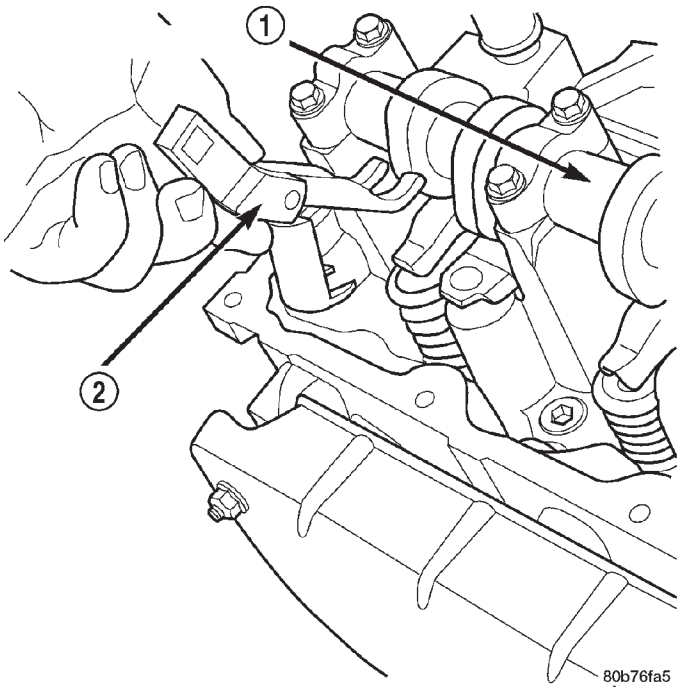


Fig. 60 Rocker Arm—Removal

1 – CAMSHAFT
2 – SPECIAL TOOL 8516

NOTE: the valve spring is under tension use care when releasing the valve spring compressor.

(5) Remove the valve spring compressor.
(6) Remove the spring retainer, and the spring.

NOTE: Check for sharp edges on the keeper grooves. Remove any burrs from the valve stem before removing the valve from the cylinder head.

(7) Remove the valve from the cylinder head.

NOTE: The valve stem seals are common between intake and exhaust.

(8) Remove the valve stem seal. Mark the valve for proper installation.

TESTING VALVE SPRINGS

NOTE: Whenever the valves are removed from the cylinder head it is recommended that the valve springs be inspected and tested for reuse.

Inspect the valve springs for physical signs of wear or damage. Turn table of tool C-647 until surface is in line with the 40.69 mm (1.602 in.) mark on the threaded stud and the zero mark on the front. Place spring over the stud on the table and lift compressing lever to set tone device. Pull on torque wrench until Ping is heard. Take reading on torque wrench

REMOVAL AND INSTALLATION (Continued)

at this instant. Multiply this reading by two. This will give the spring load at test length. Fractional measurements are indicated on the table for finer adjustments. Refer to Specifications Section to obtain specified height and allowable tensions. Replace any springs that do not meet specifications. (Fig. 61)

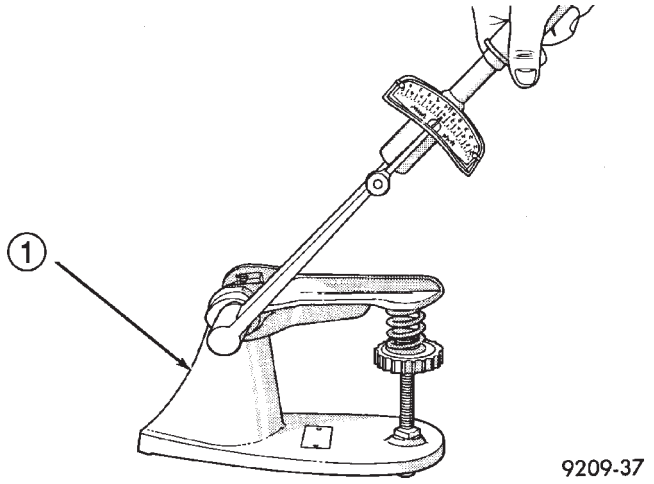


Fig. 61 Testing Valve Springs

1 – SPECIAL TOOL C-647

INSTALLATION

(1) coat the valve stem with clean engine oil and insert it into the cylinder head.

(2) Install the valve stem seal. make sure the seal is fully seated and that the garter spring at the top of the seal is intact.

(3) Install the spring and the spring retainer.

(4) Using the valve spring compressor, compress the spring and install the two valve spring retainer halves.

(5) Release the valve spring compressor and make sure the two spring retainer halves and the spring retainer are fully seated.

(6) lubricate the camshaft journal with clean engine oil then Position the camshaft (with the sprocket dowel on the left camshaft at 11 o'clock and the right camshaft at 12 o'clock), then position the camshaft bearing caps.

(7) Install the camshaft bearing cap retaining bolts. Tighten the bolts 9–13 N·m (100 in. lbs.) in ½ turn increments in the sequence shown (Fig. 63).

(8) Position the hydraulic lash adjusters and rocker arms (Fig. 60).

HYDRAULIC LASH ADJUSTER

REMOVAL

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

(2) Remove rocker arm(s). Refer to procedure in this section.

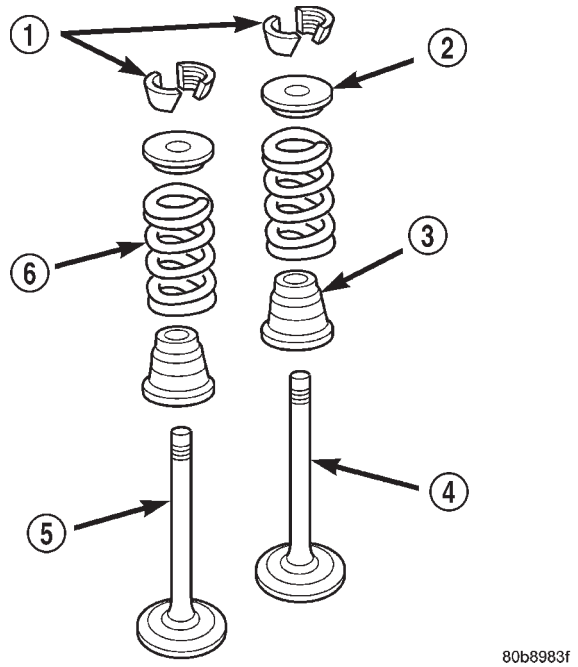


Fig. 62 Valve Assembly Configuration

1 – VALVE LOCKS (3–BEAD)
2 – RETAINER
3 – VALVE STEM OIL SEAL
4 – INTAKE VALVE
5 – EXHAUST VALVE
6 – VALVE SPRING

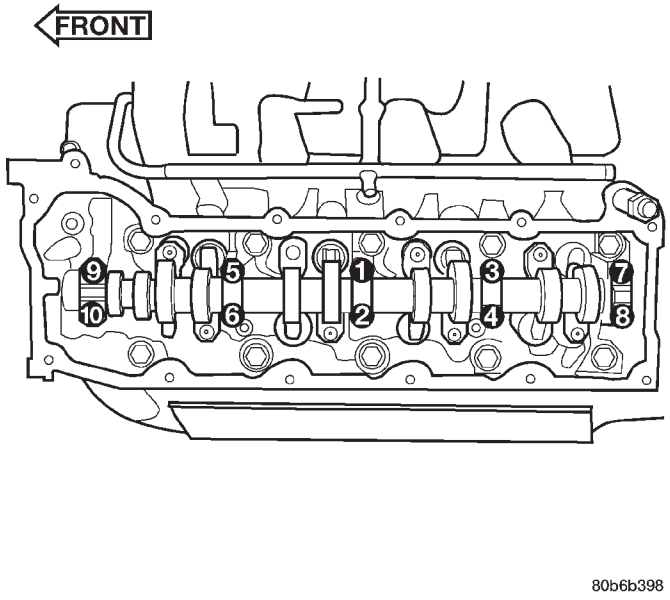


Fig. 63 Camshaft Bearing Caps Tightening Sequence

REMOVAL AND INSTALLATION (Continued)

CAUTION: If lash adjusters and rocker arms are to be reused, always mark position for reassembly in their original positions.

(3) Remove lash adjuster(s).

INSTALLATION

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

(2) Install rocker arm(s). Refer to procedure in this section.

(3) Install cylinder head cover(s). Refer to procedure in this section.

CRANKSHAFT DAMPER

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove accessory drive belt. Refer to COOLING SYSTEM.

(3) Drain cooling system. Refer to COOLING SYSTEM.

(4) Remove radiator upper hose.

(5) Remove upper fan shroud. Refer to COOLING SYSTEM.

(6) Using Special Tools 6958 Spanner with Adapter Pins 8346, loosen fan and viscous assembly from water pump (Fig. 64).

(7) Remove fan and viscous assembly.

(8) Disconnect electrical connector for fan mounted inside radiator shroud.

NOTE: Transmission cooler line snaps into shroud lower right hand corner.

(9) Remove crankshaft damper bolt.

(10) Remove damper using Special Tools 8513 Insert and 1026 Three Jaw Puller (Fig. 65).

INSTALLATION

CAUTION: To prevent severe damage to the Crankshaft, Damper or Special Tool 8512, thoroughly clean the damper bore and the crankshaft nose before installing Damper.

(1) Align crankshaft damper slot with key in crankshaft. Slide damper onto crankshaft slightly.

CAUTION: Special Tool 8512, is assembled in a specific sequence. Failure to assemble this tool in this sequence can result in tool failure and severe damage to either the tool or the crankshaft.

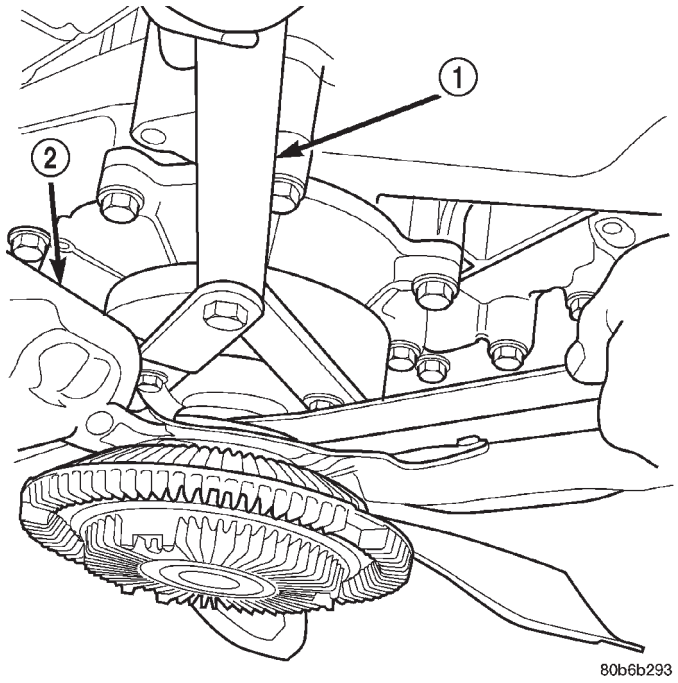


Fig. 64 Fan Assembly—Removal/Installation

1 – SPECIAL TOOL 6958 SPANNER WRENCH WITH ADAPTER PINS 8346
2 – FAN

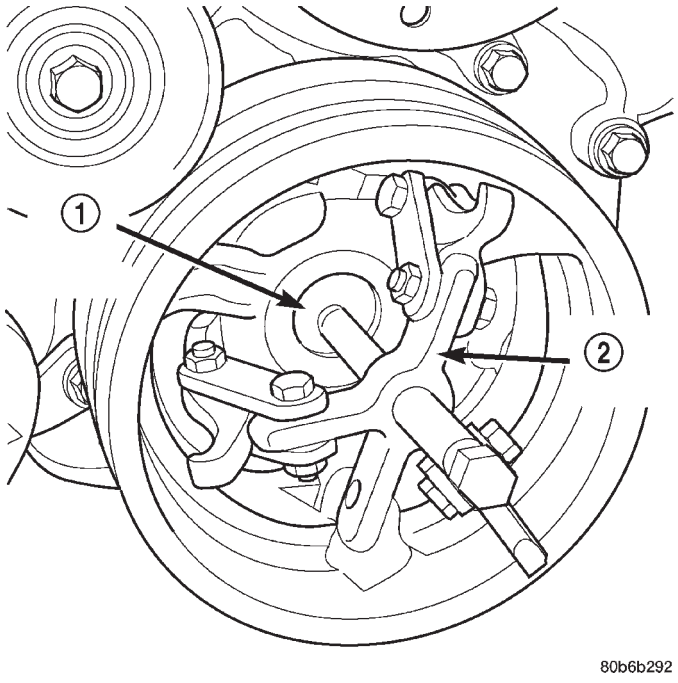


Fig. 65 Crankshaft Damper—Removal

1 – SPECIAL TOOL 8513 INSERT
2 – SPECIAL TOOL 1026

(2) Assemble Special Tool 8512 as follows, The nut is threaded onto the shaft first. Then the roller bearing is placed onto the threaded rod (The hardened

REMOVAL AND INSTALLATION (Continued)

bearing surface of the bearing **MUST** face the nut). Then the hardened washer slides onto the threaded rod (Fig. 66). Once assembled coat the threaded rod's threads with Mopar® Nickel Anti-Seize or (Loctite No. 771).

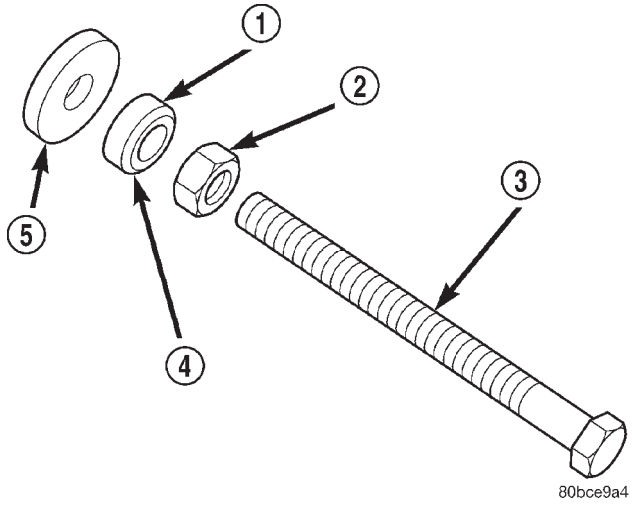


Fig. 66 Proper Assembly Method for Special Tool 8512

1 – BEARING
2 – NUT
3 – THREADED ROD
4 – BEARING HARDENED SURFACE (FACING NUT)
5 – HARDENED WASHER

(3) Using Special Tool 8512, press damper onto crankshaft (Fig. 67).

(4) Install then tighten crankshaft damper bolt to 175 N·m (130 ft. lbs.).

(5) Install fan blade assembly.

(6) Install radiator upper shroud and tighten fasteners to 11 N·m (95 in. lbs.).

(7) Connect electrical connector for shroud fan.

(8) Install radiator upper hose.

(9) Install accessory drive belt.

(10) Refill cooling system.

(11) Connect negative cable to battery.

TIMING CHAIN COVER

REMOVAL

(1) Disconnect the battery negative cable.

(2) Drain cooling system and remove viscous fan drive assembly. Refer to Group 7, Cooling System for procedures.

(3) Remove radiator shroud. Refer to Group 7, Cooling System for procedure.

(4) Disconnect both heater hoses at timing cover.

(5) Disconnect lower radiator hose at engine.

(6) Remove crankshaft damper. Refer to procedure in this section.

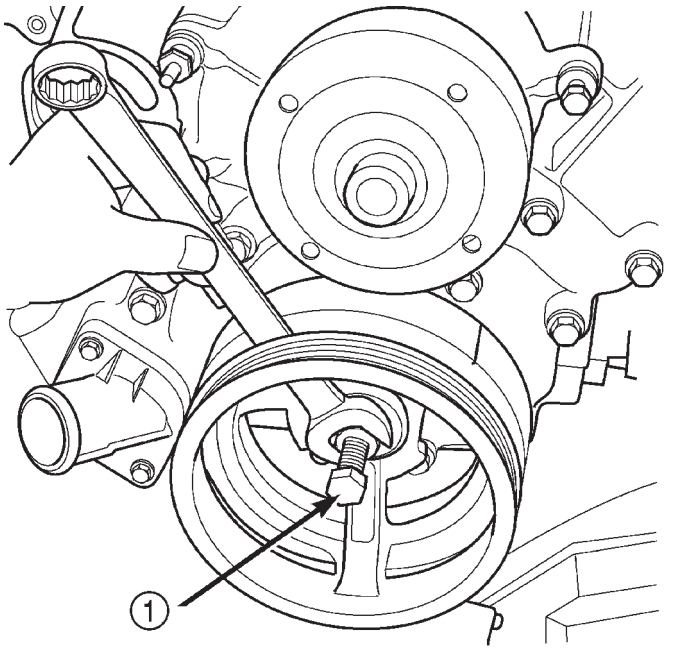


Fig. 67 Crankshaft Damper—Installation

1 – SPECIAL TOOL 8512

(7) Remove accessory drive belt tensioner assembly (Fig. 68).

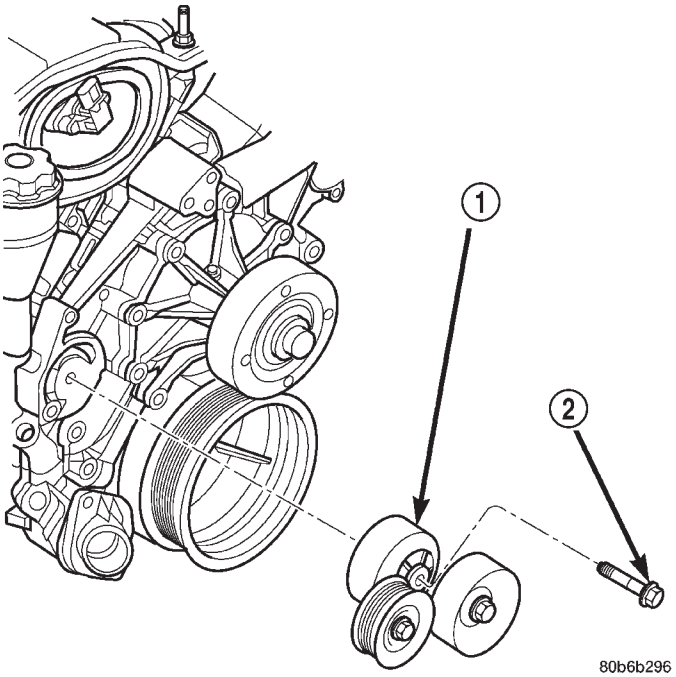


Fig. 68 Accessory Drive Belt Tensioner

1 – TENSIONER ASSEMBLY
2 – FASTENER TENSIONER TO FRONT COVER

(8) Remove the generator and A/C compressor.

(9) Remove cover and gasket (Fig. 69).

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

(1) Clean timing chain cover and block surface. Inspect cover gasket and replace as necessary.

(2) Install cover and gasket. Tighten fasteners in sequence as shown in (Fig. 69) to 54 N·m (40 ft. lbs.).

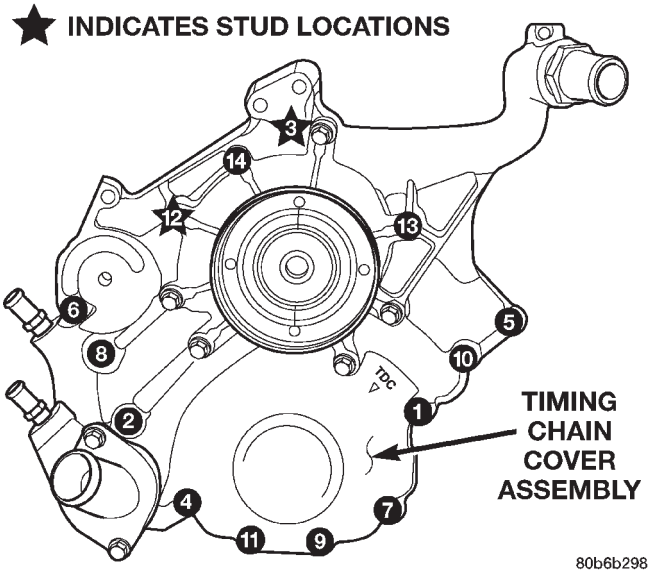


Fig. 69 Timing Chain Cover Fasteners

(3) Install the A/C compressor and generator.

(4) Install crankshaft damper. Refer to procedure in this section.

(5) Install accessory drive belt tensioner assembly. Tighten fastener to 54 N·m (40 ft. lbs.).

(6) Install lower radiator hose.

(7) Install both heater hoses.

(8) Install radiator shroud and viscous fan drive assembly. Refer to Group 7, Cooling System for procedure.

(9) Fill cooling system. Refer to Group 7, Cooling System for procedures.

(10) Connect the battery negative cable.

TIMING CHAIN AND SPROCKETS

REMOVAL

(1) Disconnect negative cable from battery.

(2) Drain cooling system. Refer to Group 7, Cooling System for procedures.

(3) Remove right and left cylinder head covers. Refer to procedure in this section.

(4) Remove radiator fan shroud. Refer to Group 7, Cooling System for procedure.

(5) Rotate engine until timing mark on crankshaft damper aligns with TDC mark on timing chain cover (Fig. 70) (#1 cylinder exhaust stroke) and the camshaft sprocket “V8” marks are at the 12 o’clock position (Fig. 71).

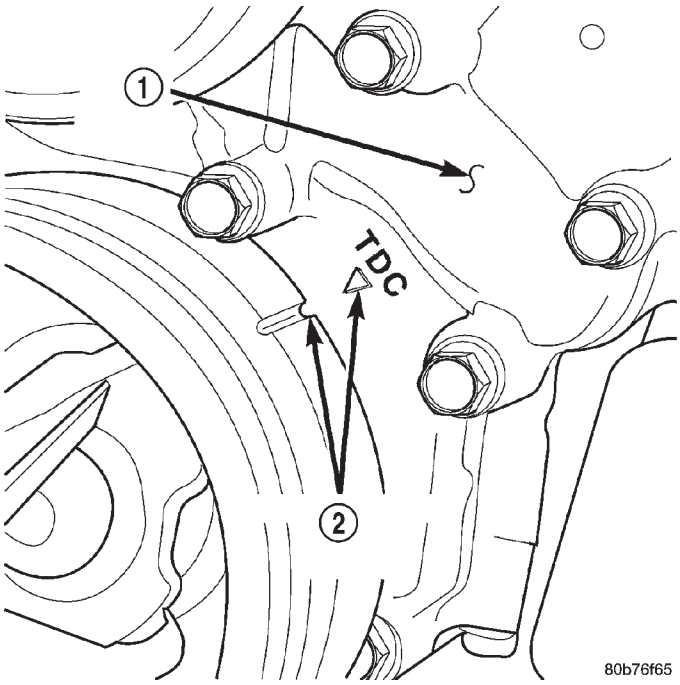


Fig. 70 Engine Top Dead Center (TDC) Indicator Mark

1 – TIMING CHAIN COVER
2 – CRANKSHAFT TIMING MARKS

(6) Remove power steering pump. Refer to Group 19, Steering for procedures.

(7) Remove access plugs (2) from left and right cylinder heads for access to chain guide fasteners (Fig. 72).

(8) Remove the oil fill housing to gain access to the right side tensioner arm fastener.

(9) Remove crankshaft damper and timing chain cover. Refer to procedures in this section.

(10) Collapse and pin primary chain tensioner (Fig. 73).

CAUTION: Plate behind left secondary chain tensioner could fall into oil pan. Therefore, cover pan opening.

(11) Remove secondary chain tensioners.

(12) Remove camshaft position sensor from right cylinder head (Fig. 74).

CAUTION: Care should be taken not to damage camshaft target wheel. Do not hold target wheel while loosening or tightening camshaft sprocket. Do not place the target wheel near a magnetic source of any kind. A damaged or magnetized target wheel could cause a vehicle no start condition.

REMOVAL AND INSTALLATION (Continued)

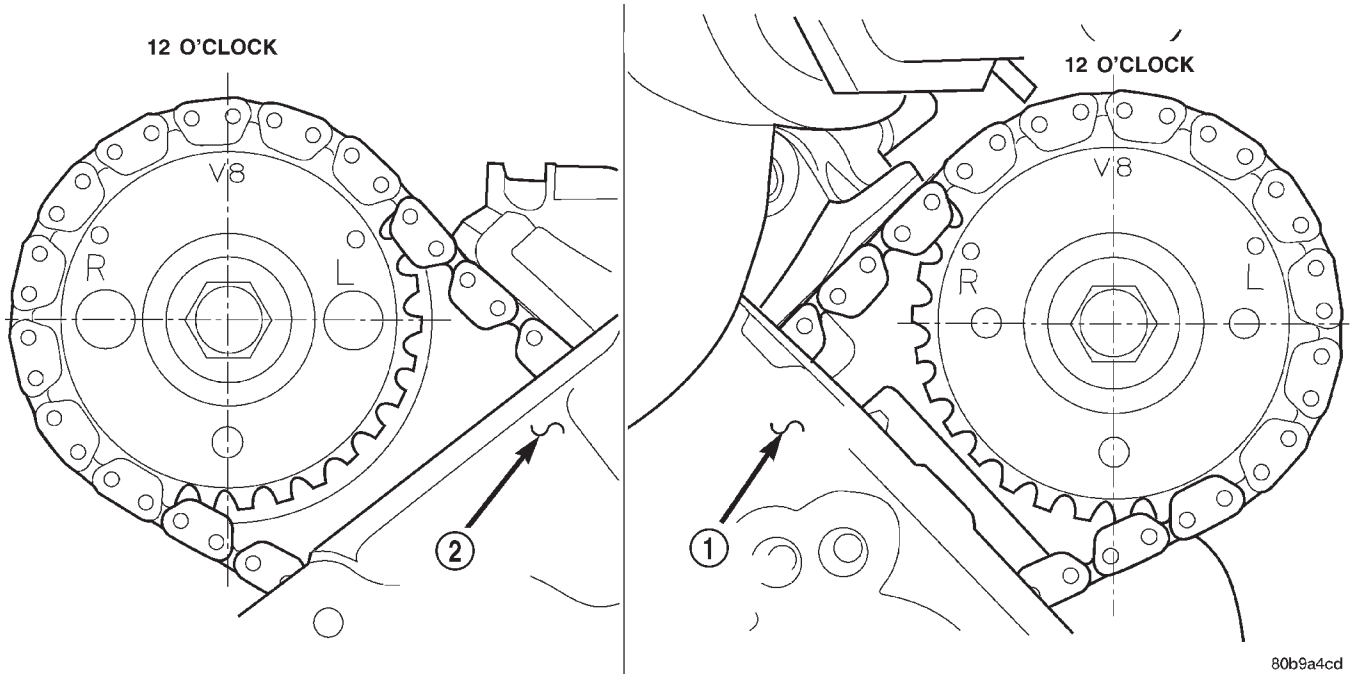


Fig. 71 Camshaft Sprocket V8 Marks

1 – LEFT CYLINDER HEAD
2 – RIGHT CYLINDER HEAD

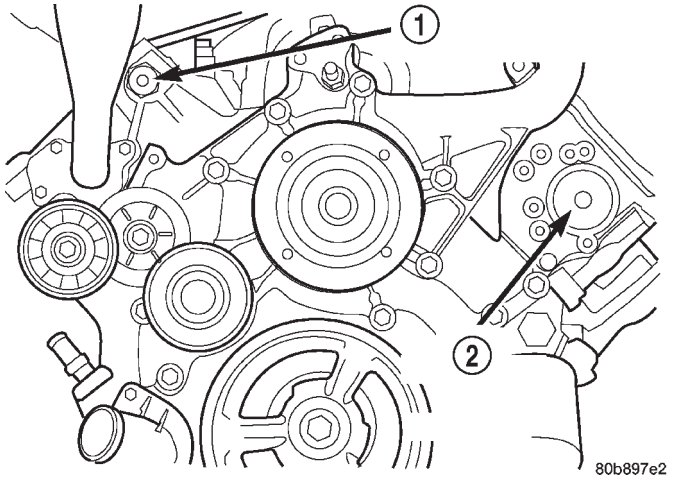


Fig. 72 Cylinder Head Access Plug Location

1 – RIGHT CYLINDER HEAD ACCESS PLUG
2 – LEFT CYLINDER HEAD ACCESS PLUG

CAUTION: Do not forcefully rotate the camshafts or crankshaft independently of each other. Damaging intake valve to piston contact will occur. Ensure negative battery cable is disconnected to guard against accidental starter engagement.

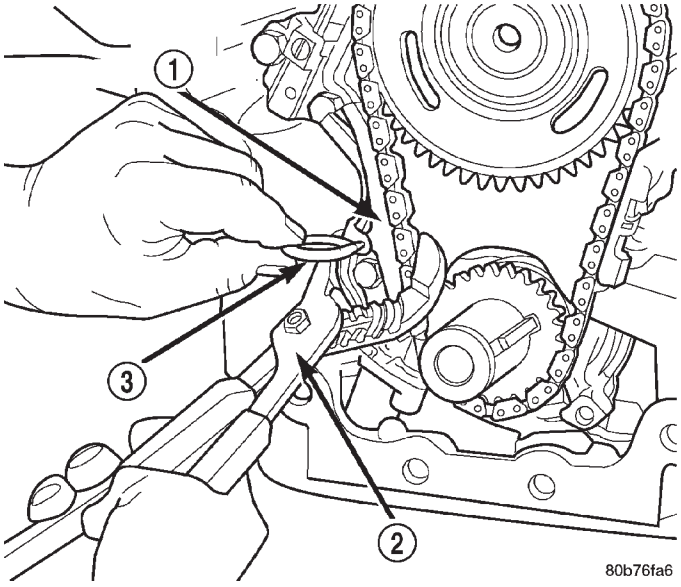


Fig. 73 Collapsing And Pinning Primary Chain Tensioner

1 – PRIMARY CHAIN TENSIONER
2 – ADJUSTABLE PLIERS
3 – SPECIAL TOOL 8514

REMOVAL AND INSTALLATION (Continued)

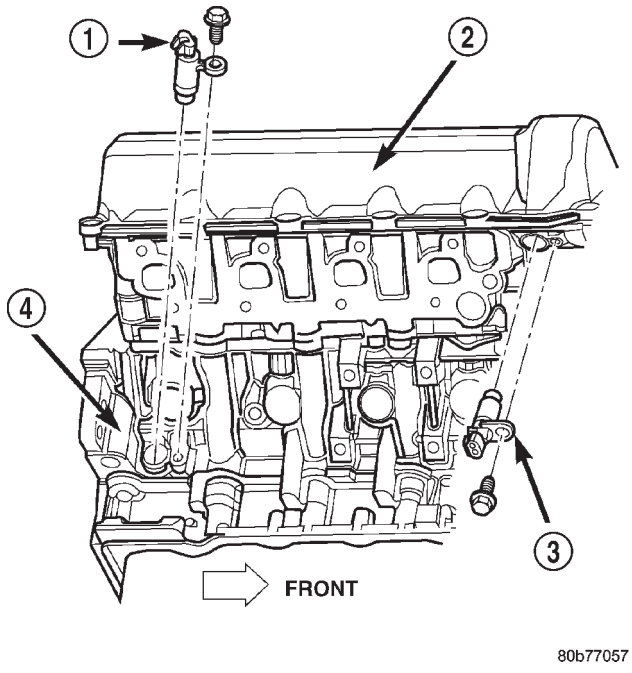


Fig. 74 Camshaft Position Sensor—Removal

1 – CRANKSHAFT POSITION SENSOR
2 – CYLINDER HEAD COVER
3 – CAMSHAFT POSITION SENSOR
4 – RIGHT SIDE CYLINDER BLOCK

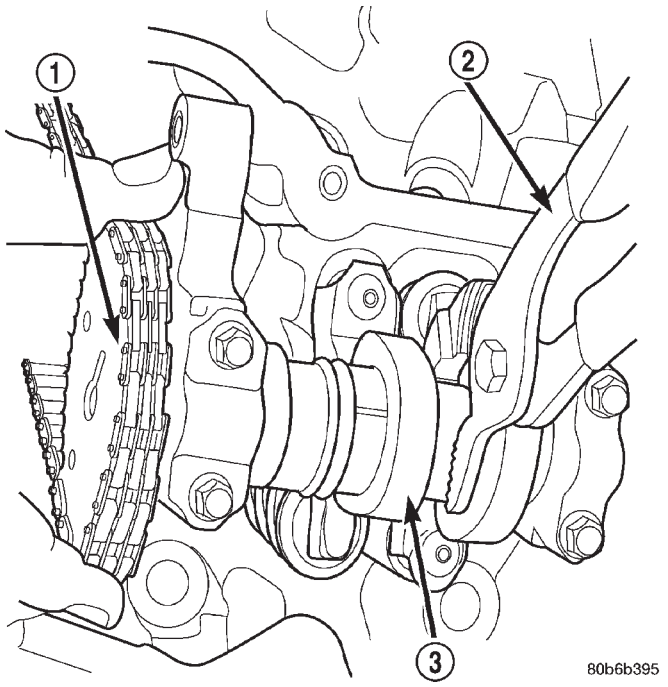


Fig. 75 Camshaft Rotation—Left Side

1 – CAMSHAFT SPROCKET AND CHAIN
2 – ADJUSTABLE PLIERS
3 – CAMSHAFT

(13) Remove left and right camshaft sprocket bolts.

(14) While holding the left camshaft steel tube with adjustable pliers, (Fig. 75) remove the left camshaft sprocket. Slowly rotate the camshaft approximately 15 degrees clockwise to a neutral position.

(15) While holding the right camshaft steel tube with adjustable pliers, (Fig. 76) remove the right camshaft sprocket. Slowly rotate the camshaft approximately 45 degrees counterclockwise to a neutral position.

(16) Remove idler sprocket assembly bolt.

(17) Slide the idler sprocket assembly and crank sprocket forward simultaneously to remove the primary and secondary chains.

(18) Remove both pivoting tensioner arms and chain guides.

(19) Remove chain tensioner.

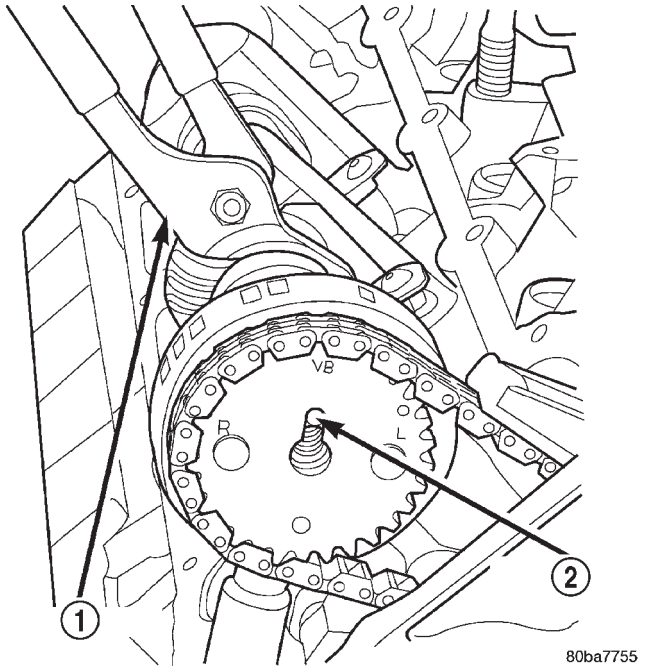


Fig. 76 Camshaft Rotation—Right Side

1 – ADJUSTABLE PLIERS
2 – CAMSHAFT DOWEL

INSPECTION OF COMPONENTS

Inspect the following components:

- Sprockets for excessive tooth wear. Some tooth markings are normal and not a cause for sprocket replacement.
- Idler sprocket assembly bushing and shaft for excessive wear.
- Idler sprocket assembly spline joint. The joint should be tight with no backlash or axial movement.
- Chain guides and tensioner arms. Replace these parts if grooving in plastic face is more than 1 mm (0.039 in.) deep. If plastic face is severely grooved or melted, the tensioner lube jet may be clogged. The tensioner should be replaced.

REMOVAL AND INSTALLATION (Continued)

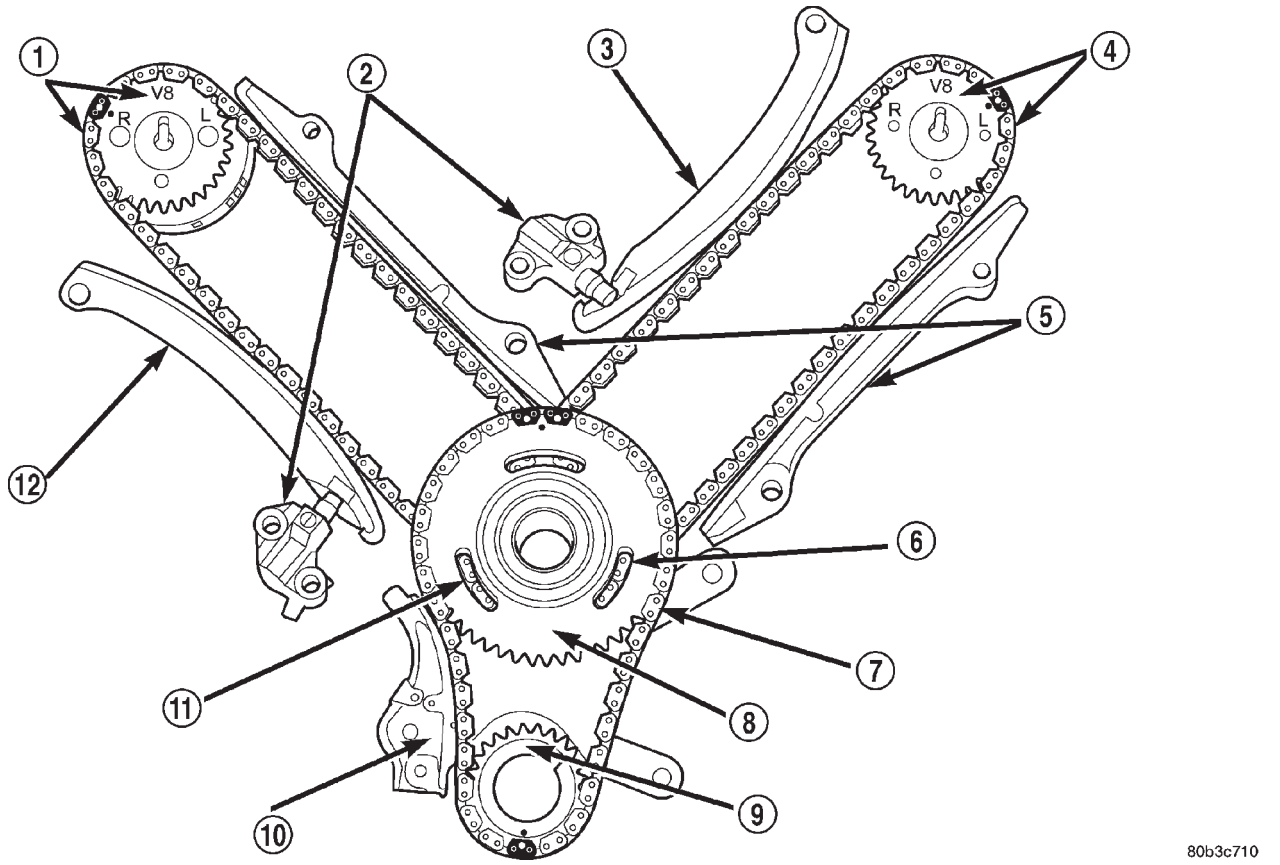


Fig. 77 Timing Chain System

1 – RIGHT CAMSHAFT SPROCKET AND SECONDARY CHAIN
2 – SECONDARY TIMING CHAIN TENSIONER
3 – SECONDARY TENSIONER ARM
4 – LEFT CAMSHAFT SPROCKET AND SECONDARY CHAIN
5 – CHAIN GUIDE
6 – TWO PLATED LINKS ON RIGHT CAMSHAFT CHAIN
7 – PRIMARY CHAIN
8 – IDLER SPROCKET
9 – CRANKSHAFT SPROCKET
10 – PRIMARY CHAIN TENSIONER
11 – TWO PLATED LINKS ON LEFT CAMSHAFT CHAIN
12 – SECONDARY TENSIONER ARM

- secondary chain tensioner piston and ratcheting device. Inspect for evidence of heavy contact between tensioner piston and tensioner arm. If this condition exist the tensioner tensioner arm and chain should be replaced.
- Primary chain tensioner plastic faces. Replace as required.

INSTALLATION

(1) Using a vise, lightly compress the secondary chain tensioner piston until the piston step is flush with the tensioner body. Using a pin or suitable tool, release ratchet pawl by pulling pawl back against spring force through access hole on side of tensioner. While continuing to hold pawl back, Push ratchet device to approximately 2 mm from the tensioner body. Install Special Tool 8514 lock pin into hole on front of tensioner. Slowly open vise to transfer piston spring force to lock pin (Fig. 78).

(2) Position primary chain tensioner over oil pump and insert bolts into lower two holes on tensioner bracket. Tighten bolts to 28 N·m (250 in. lbs.).

CAUTION: Overtightening the tensioner arm torx® bolt can cause severe damage to the cylinder head. Tighten torx® bolt to specified torque only.

(3) Install right side chain tensioner arm. Apply Mopar® Lock N, Seal to torx® bolt, tighten bolt to 17 N·m (150 in. lbs.).

NOTE: The silver bolts retain the guides to the cylinder heads and the black bolts retain the guides to the engine block.

(4) Install the left side chain guide. Tighten the bolts to 28 N·m (250 in. lbs.).

REMOVAL AND INSTALLATION (Continued)

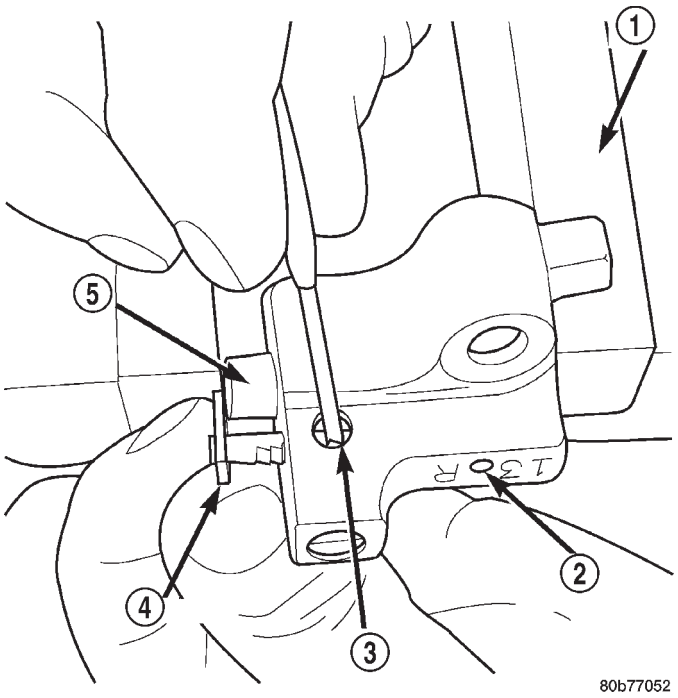


Fig. 78 Resetting Secondary Chain Tensioners

1 – VISE
2 – INSERT LOCK PIN
3 – RATCHET PAWL
4 – RATCHET
5 – PISTON

CAUTION: Overtightening the tensioner arm torx® bolt can cause severe damage to the cylinder head. Tighten torx® bolt to specified torque only.

(5) Install left side chain tensioner arm. Apply Mopar® Lock N, Seal to torx® bolt, tighten bolt to 17 N·m (150 in. lbs.).

(6) Install the right side chain guide. Tighten the bolts to 28 N·m (250 in. lbs.).

(7) Install both secondary chains onto the idler sprocket. Align two plated links on the secondary chains to be visible through the two lower openings on the idler sprocket (4 o'clock and 8 o'clock). Once the secondary timing chains are installed, position special tool 8515 to hold chains in place for installation (Fig. 79).

(8) Align primary chain double plated links with the timing mark at 12 o'clock on the idler sprocket. Align the primary chain single plated link with the timing mark at 6 o'clock on the crankshaft sprocket (Fig. 77).

(9) Lubricate idler shaft and bushings with clean engine oil.

(10) Install all chains, crankshaft sprocket, and idler sprocket as an assembly (Fig. 80). After guiding both secondary chains through the block and cylinder head openings, affix chains with a elastic strap or the equivalent, This will maintain tension on chains to aid in installation.

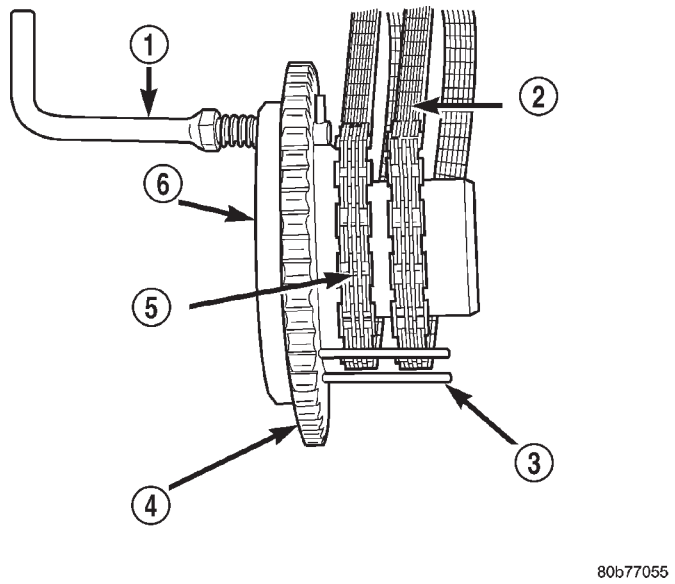


Fig. 79 Installing Secondary Timing Chains on Idler Sprocket

1 – LOCK ARM
2 – RIGHT CAMSHAFT CHAIN
3 – SECONDARY CHAINS RETAINING PINS (4)
4 – IDLER SPROCKET
5 – LEFT CAMSHAFT CHAIN
6 – SPECIAL TOOL 8515

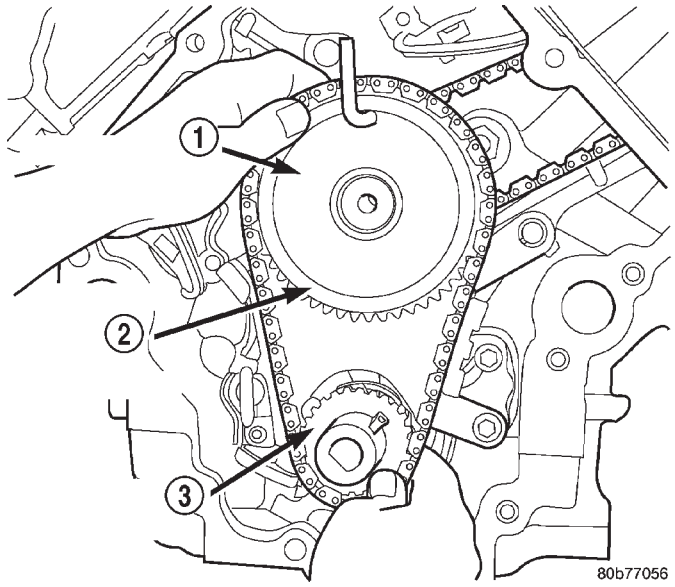


Fig. 80 Installing Idler Gear, Primary and Secondary Timing Chains

1 – SPECIAL TOOL 8515
2 – PRIMARY CHAIN IDLER SPROCKET
3 – CRANKSHAFT SPROCKET

REMOVAL AND INSTALLATION (Continued)

NOTE: It will be necessary to slightly rotate camshafts for sprocket installation.

(11) Align left camshaft sprocket “L” dot to plated link on chain.

(12) Align right camshaft sprocket “R” dot to plated link on chain.

CAUTION: Remove excess oil from the camshaft sprocket bolt. Failure to do so can result in overtorque of bolt resulting in bolt failure.

(13) Remove Special Tool 8515, then attach both sprockets to camshafts. Remove excess oil from bolts, then Install sprocket bolts, but do not tighten at this time.

(14) Verify that all plated links are aligned with the marks on all sprockets and the “V8” marks on camshaft sprockets are at the 12 o'clock position (Fig. 77).

CAUTION: Ensure the plate between the left secondary chain tensioner and block is correctly installed.

(15) Install both secondary chain tensioners. Tighten bolts to 28 N·m (250 in. lbs.).

NOTE: Left and right secondary chain tensioners are not common.

(16) Before installing idler sprocket bolt, lubricate washer with oil, and tighten idler sprocket assembly retaining bolt to 34 N·m (25 ft. lbs.).

(17) Remove all locking pins (3) from tensioners.

CAUTION: After pulling locking pins out of each tensioner, DO NOT manually extend the tensioner(s) ratchet. Doing so will over tension the chains, resulting in noise and/or high timing chain loads.

(18) Using Special Tool 6958, Spanner with Adaptor Pins 8346, tighten left (Fig. 81) and right (Fig. 82). camshaft sprocket bolts to 122 N·m (90 ft. lbs.).

(19) Rotate engine two full revolutions. Verify timing marks are at the follow locations:

- primary chain idler sprocket dot is at 12 o'clock (Fig. 77)
- primary chain crankshaft sprocket dot is at 6 o'clock (Fig. 77)
- secondary chain camshaft sprockets “V8” marks are at 12 o'clock (Fig. 77)

(20) Lubricate all three chains with engine oil.

(21) After installing all chains, it is recommended that the idler gear end play be checked (Fig. 83). The end play must be within 0.10–0.25 mm (0.004–0.010 in.). If not within specification, the idler gear must be replaced.

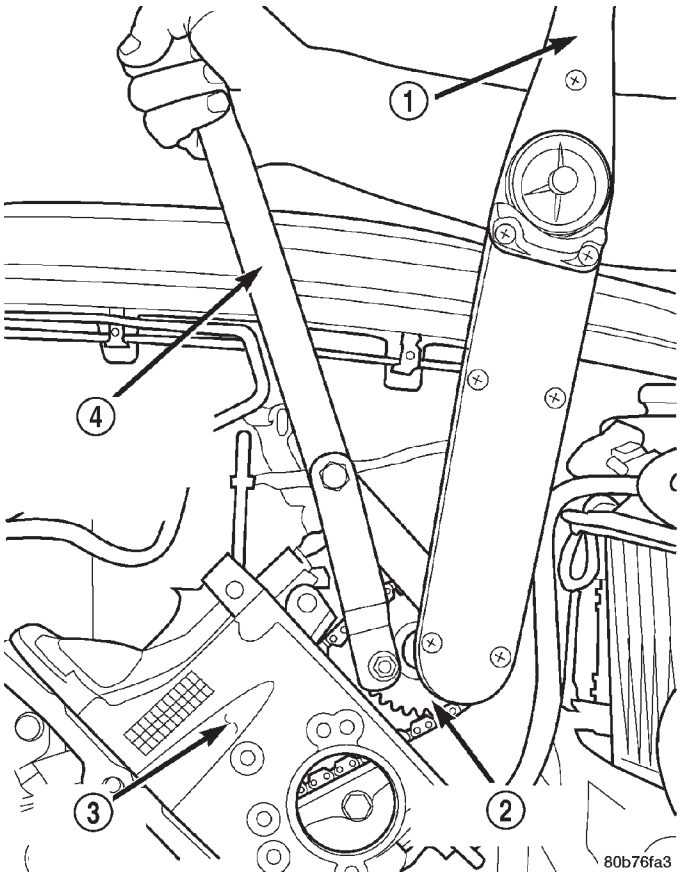


Fig. 81 Tightening Left Side Camshaft Sprocket Bolt

1 – TORQUE WRENCH
2 – CAMSHAFT SPROCKET
3 – LEFT CYLINDER HEAD
4 – SPECIAL TOOL 6958 SPANNER WITH ADAPTER PINS 8346

(22) Install timing chain cover and crankshaft damper. Refer to procedures in this section.

(23) Install cylinder head covers. Refer to procedures in this section.

NOTE: Before installing threaded plug in right cylinder head, the plug must be coated with sealant to prevent leaks.

(24) Coat the large threaded access plug with **Mopar® Thread Sealant with Teflon**, then install into the right cylinder head and tighten to 81 N·m (60 ft. lbs.) (Fig. 72).

(25) Install the oil fill housing.

(26) Install access plug in left cylinder head (Fig. 72).

(27) Install power steering pump. Refer to Group 19, Steering for procedure.

(28) Install radiator fan shroud. Refer to Group 7, Cooling System for procedure.

(29) Fill cooling system. Refer to Group 7, Cooling System for coolant fill procedure.

REMOVAL AND INSTALLATION (Continued)

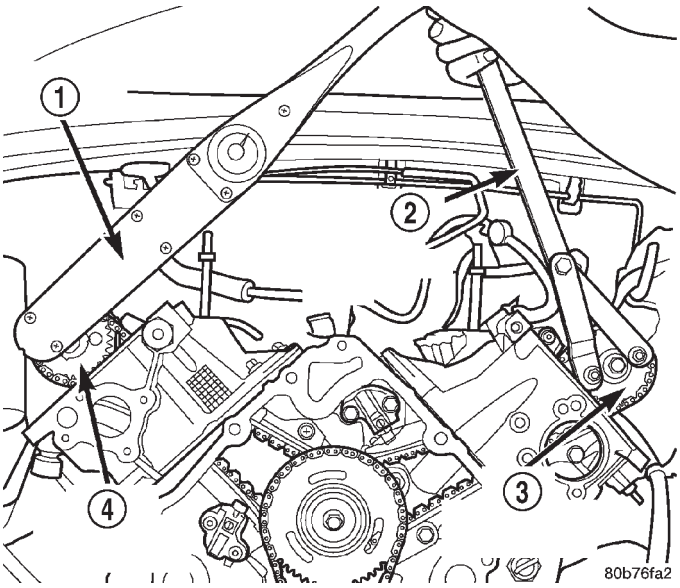


Fig. 82 Tightening Right Side Camshaft Sprocket Bolt

1 – TORQUE WRENCH
2 – SPECIAL TOOL 6958 WITH ADAPTER PINS 8346
3 – LEFT CAMSHAFT SPROCKET
4 – RIGHT CAMSHAFT SPROCKET

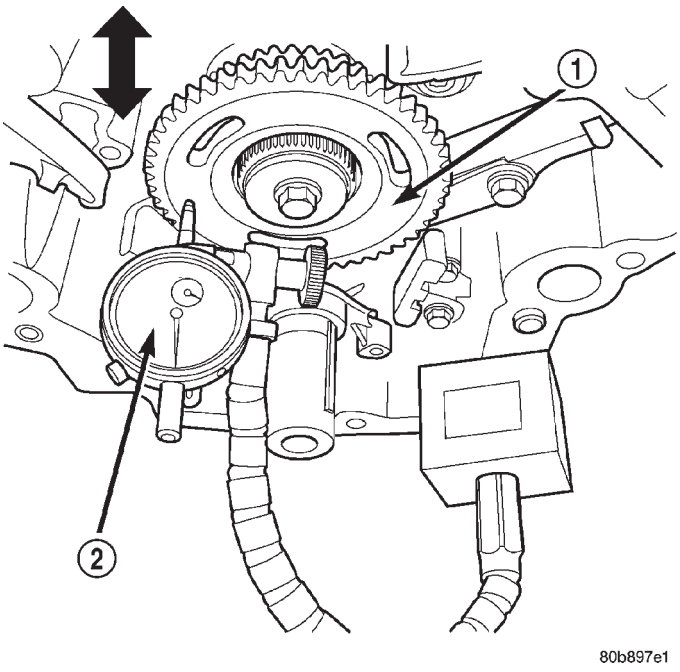


Fig. 83 Measuring Idler Gear End Play

1 – IDLER SPROCKET ASSEMBLY
2 – DIAL INDICATOR

(30) Connect negative cable to battery.

IDLER SHAFT—TIMING DRIVE

REMOVAL

(1) Remove the timing chain and sprockets. Refer to procedure in this section.

NOTE: To remove the idler shaft, it is necessary to tap threads into the shaft to install the removal tool.

(2) Using a 12 mm X 1.75 tap, cut threads in the idler shaft center bore (Fig. 84).

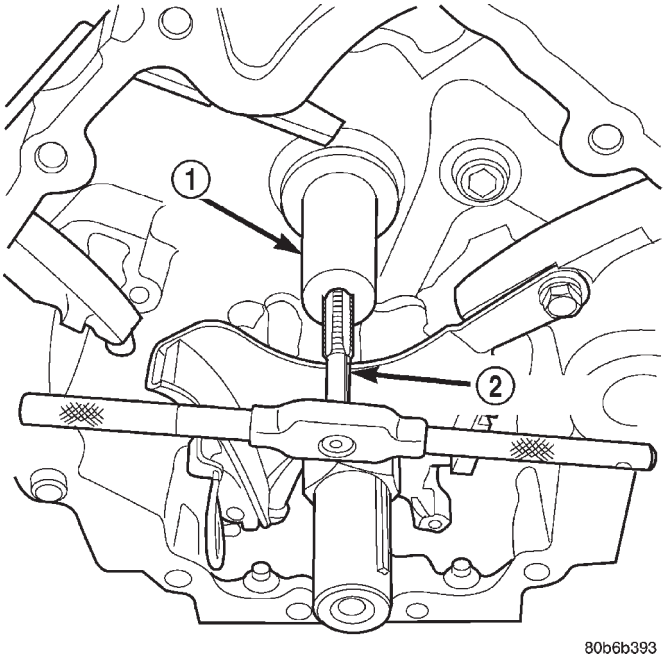


Fig. 84 Tapping Idler Shaft For Special Tool 8517

1 – IDLER SHAFT
2 – TAP 12mm X 1.75

(3) Cover the radiator core with a suitable cover.

CAUTION: Use care when removing idler shaft, DO NOT strike the radiator cooling fins with the slide hammer.

(4) Using Special Tool 8517 Slide Hammer, remove the idler shaft (Fig. 85).

INSTALLATION

(1) Thoroughly clean the idler shaft bore.
(2) Position the idler shaft in the bore.

NOTE: The two lubrication holes in the idler shaft do not require any special alignment.

NOTE: Before using the retaining bolt to install the idler shaft, coat the threads and the pilot on the idler shaft with clean engine oil.

REMOVAL AND INSTALLATION (Continued)

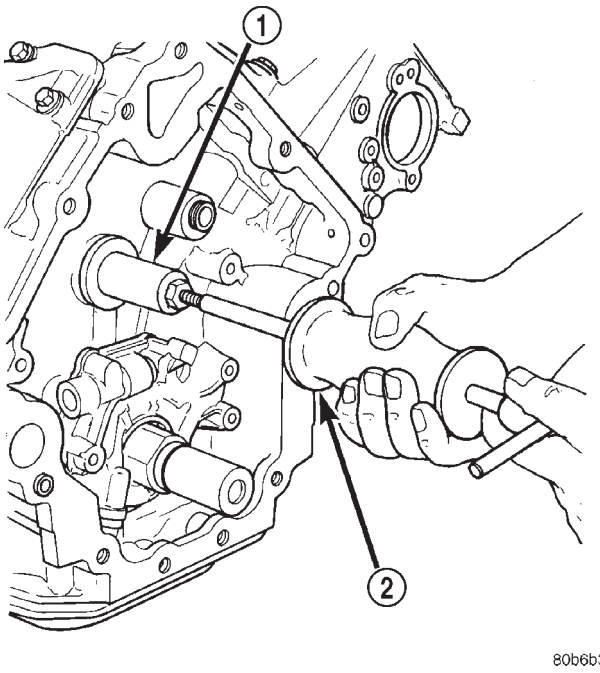


Fig. 85 Removing Idler Shaft

1 – IDLER SHAFT
2 – SPECIAL TOOL 8517

(3) Using the primary idler sprocket retaining bolt and washer, carefully draw the idler shaft into the bore until fully seated.

(4) Coat the idler shaft with clean engine oil and install the timing chains and sprockets. Refer to procedure in this section.

CAMSHAFTS—IN VEHICLE

LEFT CAMSHAFT

REMOVAL

CAUTION: When the timing chain is removed and the cylinder heads are still installed, DO NOT forcefully rotate the camshafts or crankshaft independently of each other. Severe valve and/or piston damage can occur.

CAUTION: When removing the cam sprocket, timing chains or camshaft, Failure to use Special Tool 8350 will result in hydraulic tensioner ratchet over extension, requiring timing chain cover removal to reset the tensioner ratchet.

(1) Remove cylinder head cover. Refer to Cylinder Head Cover in this section.

(2) Set engine to TDC cylinder #1, camshaft sprocket V8 marks at the 12 o'clock position.

(3) Mark one link on the secondary timing chain on both sides of the V8 mark on the camshaft sprocket to aid in installation.

CAUTION: Do not hold or pry on the camshaft target wheel (Located on the right side camshaft sprocket) for any reason, Severe damage will occur to the target wheel resulting in a vehicle no start condition.

(4) Loosen but **DO NOT** remove the camshaft sprocket retaining bolt. Leave the bolt snug against the sprocket.

NOTE: The timing chain tensioners must be secured prior to removing the camshaft sprockets. Failure to secure tensioners will allow the tensioners to extend, requiring timing chain cover removal in order to reset tensioners.

CAUTION: Do not force wedge past the narrowest point between the chain strands. Damage to the tensioners may occur.

(5) Position Special Tool 8350 timing chain wedge between the timing chain strands, tap the tool to securely wedge the timing chain against the tensioner arm and guide (Fig. 86).

(6) Hold the camshaft with adjustable pliers while removing the camshaft sprocket bolt and sprocket (Fig. 87).

(7) Using the pliers, gently allow the camshaft to rotate 15° clockwise until the camshaft is in the neutral position (no valve load).

(8) Starting at the outside working inward, loosen the camshaft bearing cap retaining bolts 1/2 turn at a time. Repeat until all load is off the bearing caps.

CAUTION: DO NOT STAMP OR STRIKE THE CAMSHAFT BEARING CAPS. SEVERE DAMAGE WILL OCCUR TO THE BEARING CAPS.

NOTE: When the camshaft is removed the rocker arms may slide downward, mark the rocker arms before removing camshaft.

(9) Remove the camshaft bearing caps and the camshaft.

INSTALLATION

(1) Lubricate camshaft journals with clean engine oil.

REMOVAL AND INSTALLATION (Continued)

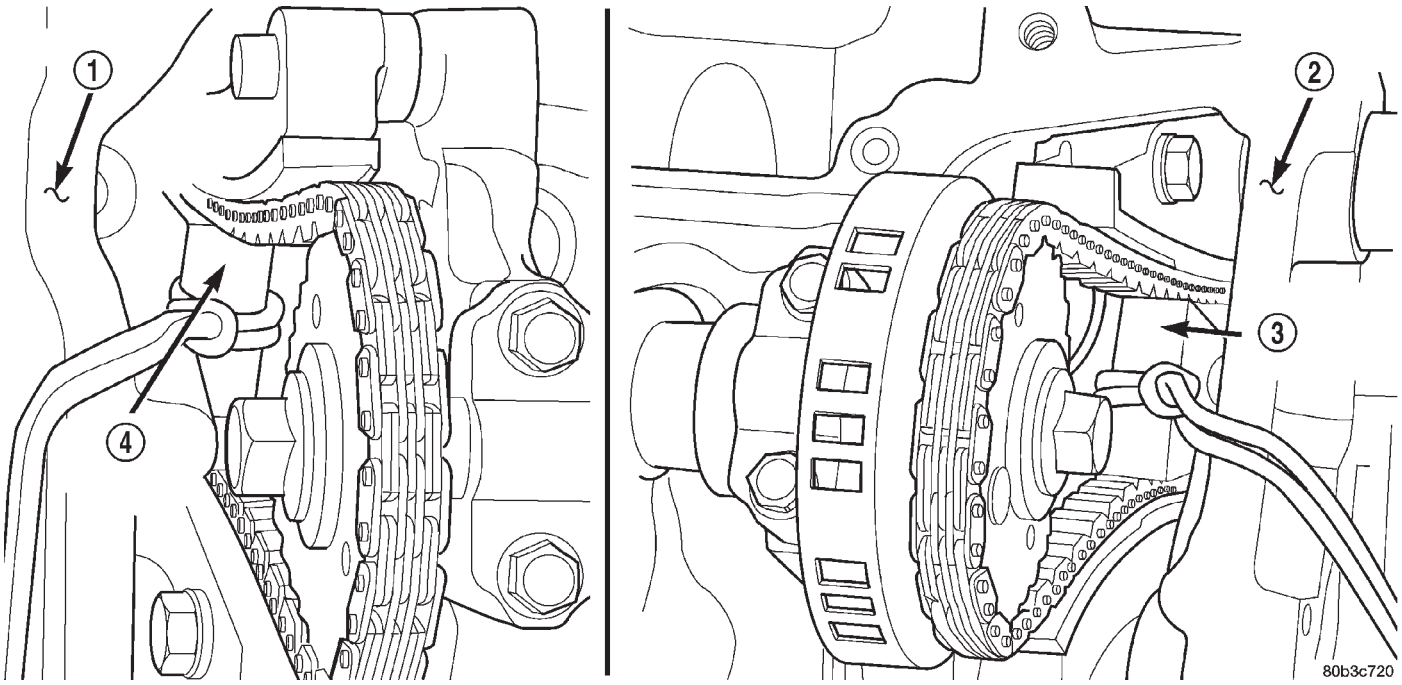


Fig. 86 Securing Timing Chain Tensioners Using Timing Chain Wedge

1 – LEFT CYLINDER HEAD
2 – RIGHT CYLINDER HEAD
3 – SPECIAL TOOL 8350 WEDGE
4 – SPECIAL TOOL 8350 WEDGE

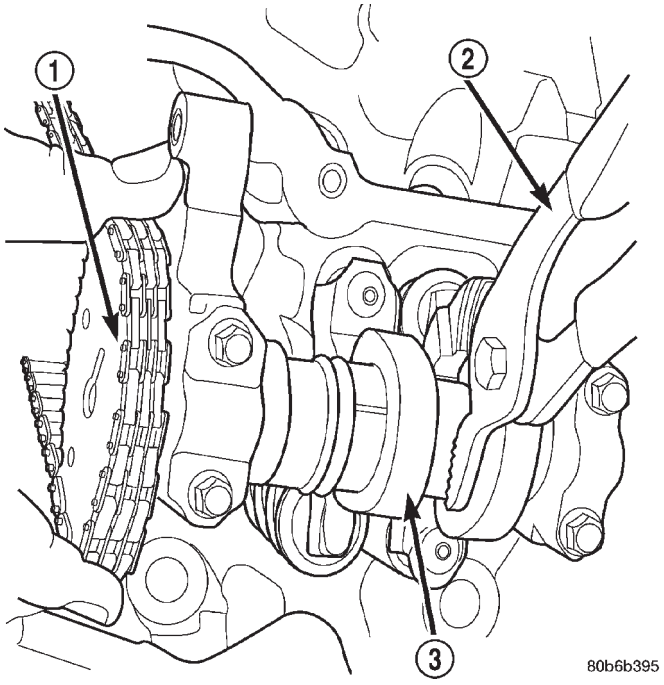


Fig. 87 Camshaft Sprocket and Chain

1 – CAMSHAFT SPROCKET AND CHAIN
2 – ADJUSTABLE PLIERS
3 – CAMSHAFT

NOTE: Position the left side camshaft so that the camshaft sprocket dowel is near the 1 o'clock position, This will place the camshaft at the neutral position easing the installation of the camshaft bearing caps.

(2) Position the camshaft into the cylinder head.

(3) Install the camshaft bearing caps, hand tighten the retaining bolts.

(4) Working in ½ turn increments, tighten the bearing cap retaining bolts starting with the middle cap working outward (Fig. 88).

(5) Torque the camshaft bearing cap retaining bolts to 11 N·m (100 in. lbs.).

(6) Position the camshaft drive gear into the timing chain aligning the V8 mark between the two marked chain links (Two links marked during removal) (Fig. 89).

(7) Using the adjustable pliers, rotate the camshaft until the camshaft sprocket dowel is aligned with the slot in the camshaft sprocket. Install the sprocket onto the camshaft (Fig. 90).

CAUTION: Remove excess oil from camshaft sprocket bolt. Failure to do so can cause bolt overtorque resulting in bolt failure.

(8) Remove excess oil from bolt, then install the camshaft sprocket retaining bolt and hand tighten.

(9) Remove Special Tool 8350 timing chain wedge (Fig. 86).

REMOVAL AND INSTALLATION (Continued)

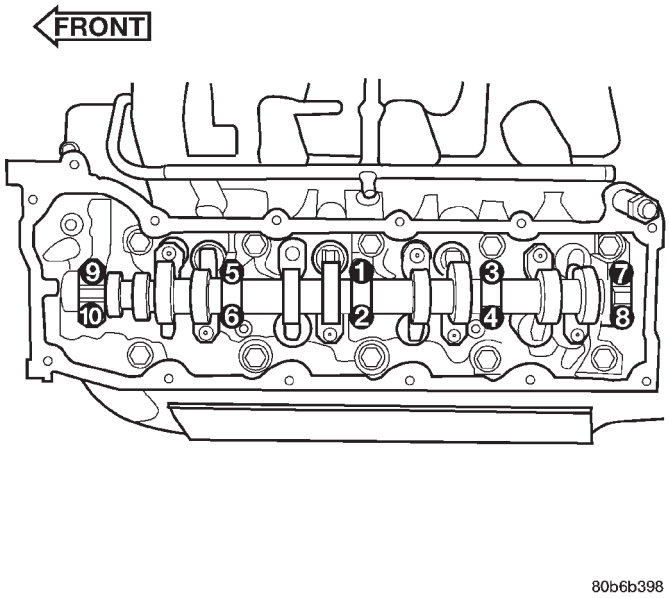


Fig. 88 Camshaft Bearing Caps Tightening Sequence

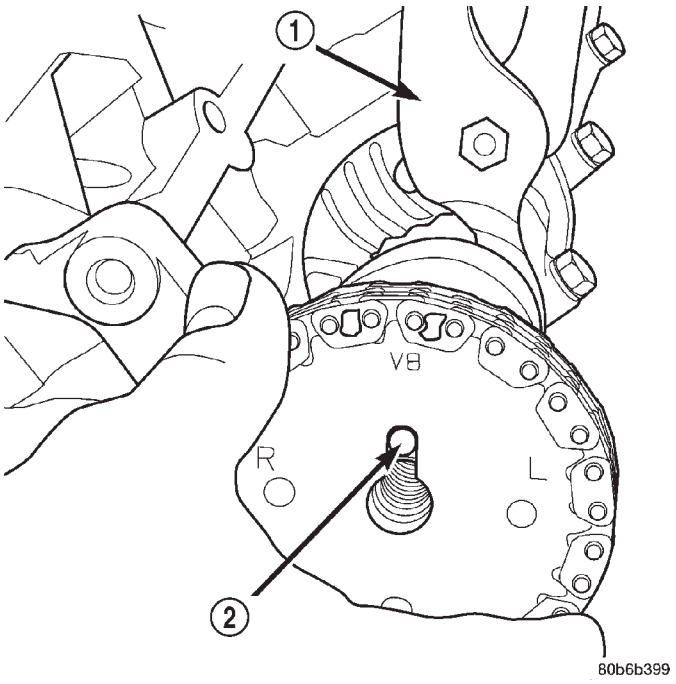


Fig. 90 Camshaft Sprocket Installation

1 – ADJUSTABLE PLIERS
2 – CAMSHAFT DOWEL

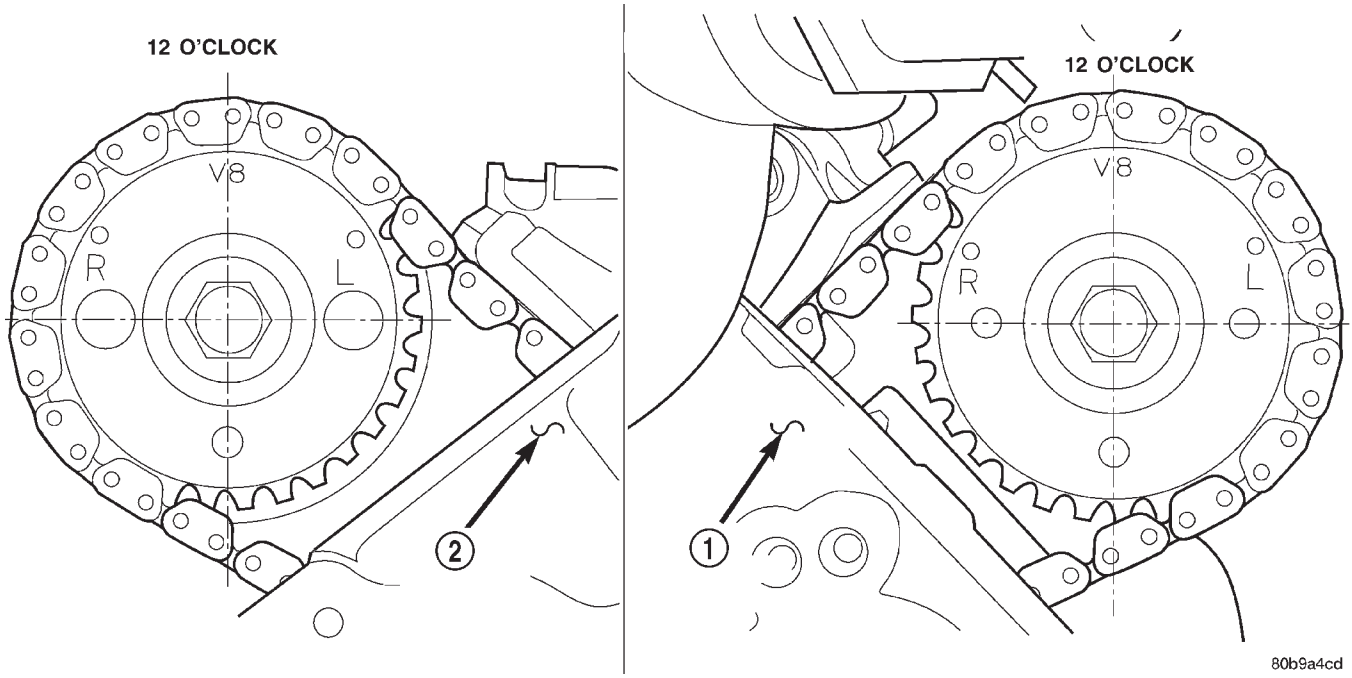


Fig. 89 Timing Chain to Sprocket Alignment

1 – LEFT CYLINDER HEAD
2 – RIGHT CYLINDER HEAD

REMOVAL AND INSTALLATION (Continued)

(10) Using Special Tool 6958 spanner wrench with adapter pins 8346 (Fig. 91), torque the camshaft sprocket retaining bolt to 122 N·m (90 ft. lbs.).

(11) Install the cylinder head cover.

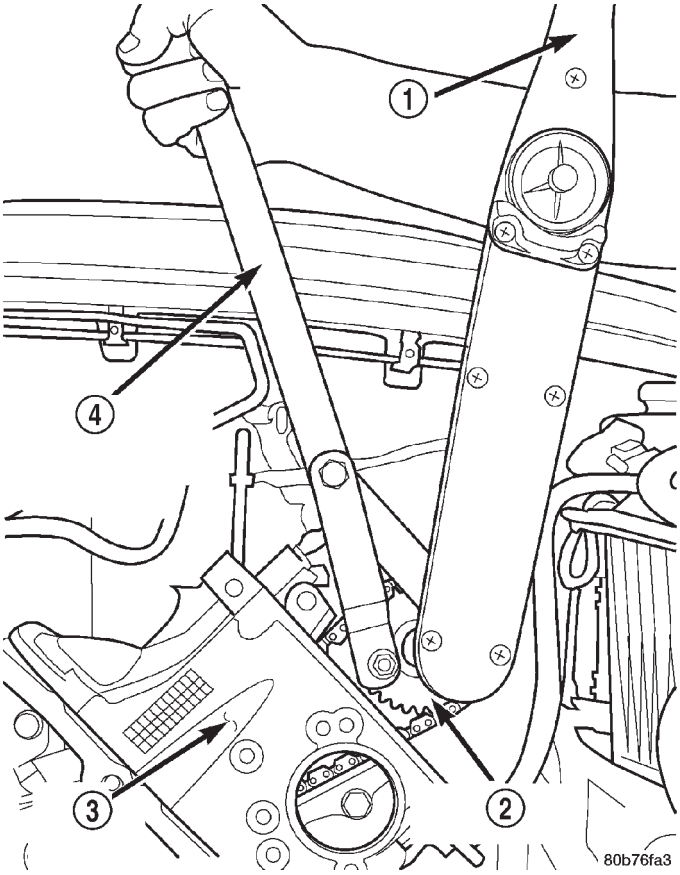


Fig. 91 Tightening Left Side Cam Sprocket Retaining Bolt

1 – TORQUE WRENCH
2 – CAMSHAFT SPROCKET
3 – LEFT CYLINDER HEAD
4 – SPECIAL TOOL 6958 SPANNER WITH ADAPTER PINS 8346

RIGHT CAMSHAFT

REMOVAL

CAUTION: When the timing chain is removed and the cylinder heads are still installed, DO NOT forcefully rotate the camshafts or crankshaft independently of each other. Severe valve and/or piston damage can occur.

CAUTION: When removing the cam sprocket, timing chains or camshaft, Failure to use special tool 8350 will result in hydraulic tensioner ratchet over extension, Requiring timing chain cover removal to re-set the tensioner ratchet.

(1) Remove the cylinder head covers. Refer to Cylinder Head Cover in this section.

(2) Set engine to TDC cylinder #1, camshaft sprocket V8 marks at the 12 o'clock position.

(3) Mark one link on the secondary timing chain on both sides of the V8 mark on the camshaft sprocket to aid in installation.

CAUTION: Do not hold or pry on the camshaft target wheel for any reason, Severe damage will occur to the target wheel. A damaged target wheel could cause a vehicle no start condition.

(4) Loosen but **DO NOT** remove the camshaft sprocket retaining bolt. Leave bolt snug against sprocket.

NOTE: The timing chain tensioners must be secured prior to removing the camshaft sprockets. Failure to secure tensioners will allow the tensioners to extend, requiring timing chain cover removal in order to reset tensioners.

CAUTION: Do not force wedge past the narrowest point between the chain strands. Damage to the tensioners may occur.

(5) Position Special Tool 8350 timing chain wedge between the timing chain strands. Tap the tool to securely wedge the timing chain against the tensioner arm and guide (Fig. 92).

(6) Remove the camshaft position sensor (Fig. 93).

(7) Hold the camshaft with adjustable pliers while removing the camshaft sprocket bolt and sprocket (Fig. 94).

(8) Using the pliers, gently allow the camshaft to rotate 45° counter-clockwise until the camshaft is in the neutral position (no valve load).

(9) Starting at the outside working inward, loosen the camshaft bearing cap retaining bolts 1/2 turn at a time. Repeat until all load is off the bearing caps.

CAUTION: DO NOT STAMP OR STRIKE THE CAMSHAFT BEARING CAPS. SEVERE DAMAGE WILL OCCUR TO THE BEARING CAPS.

NOTE: When the camshaft is removed the rocker arms may slide downward, mark the rocker arms before removing camshaft.

(10) Remove the camshaft bearing caps and the camshaft.

INSTALLATION

(1) Lubricate camshaft journals with clean engine oil.

REMOVAL AND INSTALLATION (Continued)

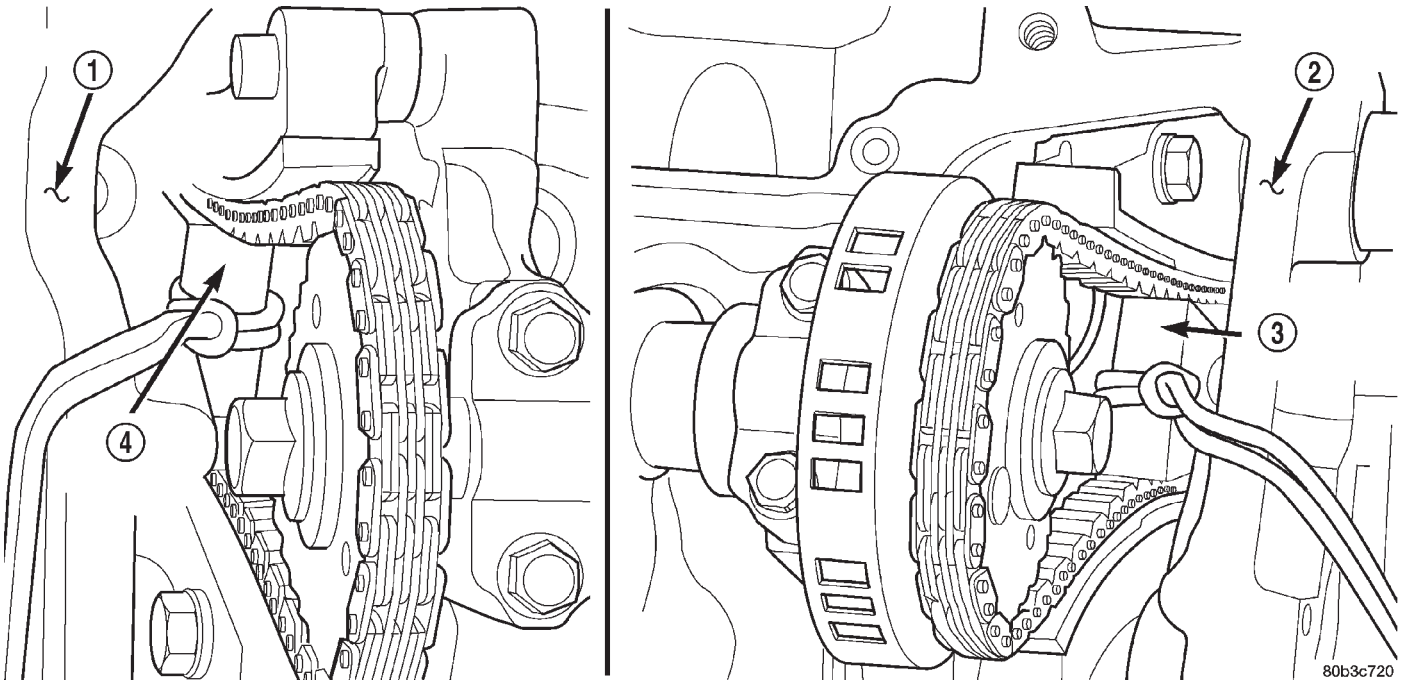


Fig. 92 Securing Timing Chain Tensioners Using Timing Chain Wedge

1 – LEFT CYLINDER HEAD
2 – RIGHT CYLINDER HEAD
3 – SPECIAL TOOL 8350 WEDGE
4 – SPECIAL TOOL 8350 WEDGE

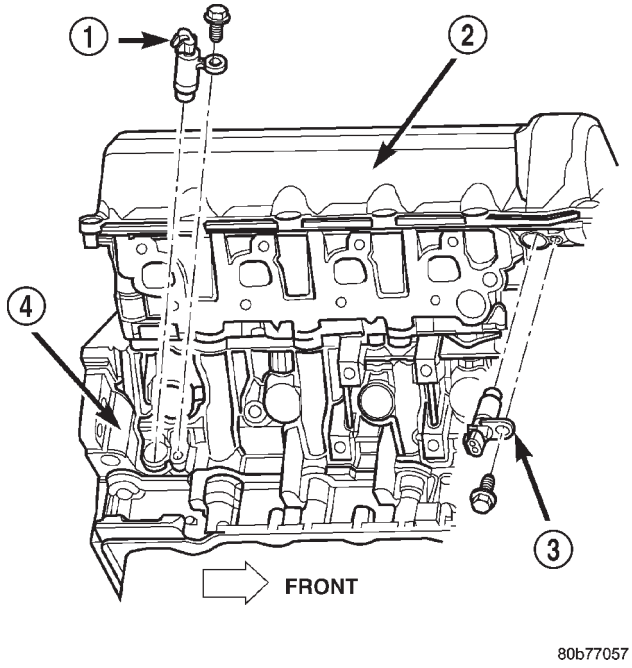


Fig. 93 Camshaft Position Sensor

1 – CRANKSHAFT POSITION SENSOR
2 – CYLINDER HEAD COVER
3 – CAMSHAFT POSITION SENSOR
4 – RIGHT SIDE CYLINDER BLOCK

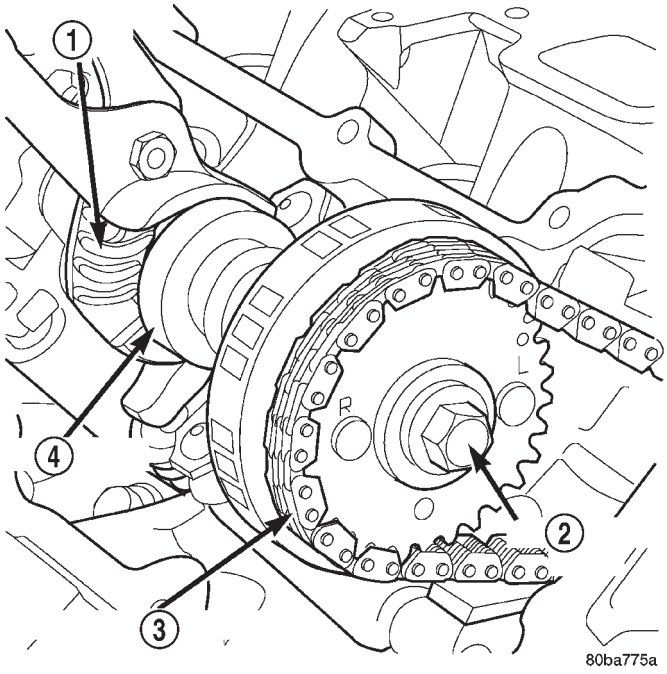


Fig. 94 Camshaft Sprocket and Chain

1 – ADJUSTABLE PLIERS
2 – SPROCKET BOLT
3 – CAMSHAFT SPROCKET AND CHAIN
4 – CAMSHAFT

REMOVAL AND INSTALLATION (Continued)

NOTE: Position the right side camshaft so that the camshaft sprocket dowel is near the 10 o'clock position, This will place the camshaft at the neutral position easing the installation of the camshaft bearing caps.

(2) Position the camshaft into the cylinder head.
(3) Install the camshaft bearing caps, hand tighten the retaining bolts.
(4) Working in 1/2 turn increments, tighten the bearing cap retaining bolts starting with the middle cap working outward (Fig. 95).

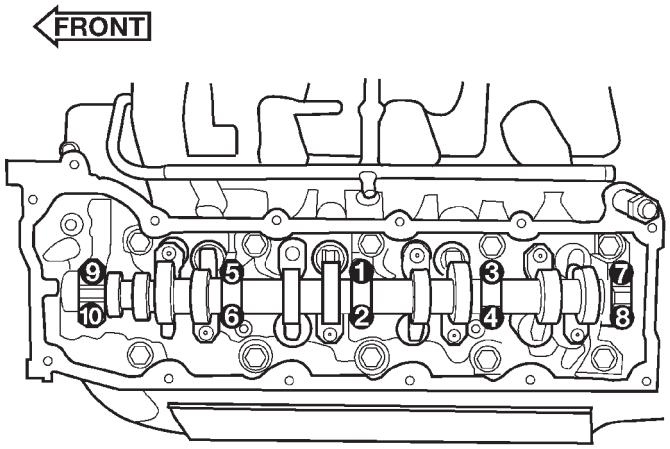


Fig. 95 Camshaft Bearing Caps Tightening Sequence

(5) Torque the camshaft bearing cap retaining bolts to 11 N·m (100 in. lbs.).
(6) Position the camshaft drive gear into the timing chain aligning the V8 mark between the two marked chain links (Two links marked during removal) (Fig. 96).
(7) Using the adjustable pliers, rotate the camshaft until the camshaft sprocket dowel is aligned with the slot in the camshaft sprocket. Install the sprocket onto the camshaft (Fig. 97).

CAUTION: Remove excess oil from camshaft sprocket bolt. Failure to do so can cause bolt overtorque resulting in bolt failure.

(8) Remove excess oil from camshaft sprocket bolt, then install the camshaft sprocket retaining bolt and hand tighten.
(9) Remove timing chain wedge special tool 8350 (Fig. 92).
(10) Using Special Tool 6958 spanner wrench with adapter pins 8346 (Fig. 98), torque the camshaft sprocket retaining bolt to 122 N·m (90 ft. lbs.).
(11) Install the camshaft position sensor (Fig. 93).
(12) Install the cylinder head cover.

CRANKSHAFT MAIN BEARINGS

CRANKSHAFT MAIN BEARING SELECTION

The main bearings are "select fit" to achieve proper oil clearances. For main bearing selection, the crankshaft position sensor target wheel has grade identification marks stamped into it (Fig. 99). These marks are read from left to right, corresponding with journal number 1, 2, 3, 4 and 5. The crankshaft position sensor target wheel is mounted to the number 8 counter weight on the crankshaft.

NOTE: Service main bearings color coded. These color codes identify what size (grade) the bearing is.

REMOVAL AND INSTALLATION (Continued)

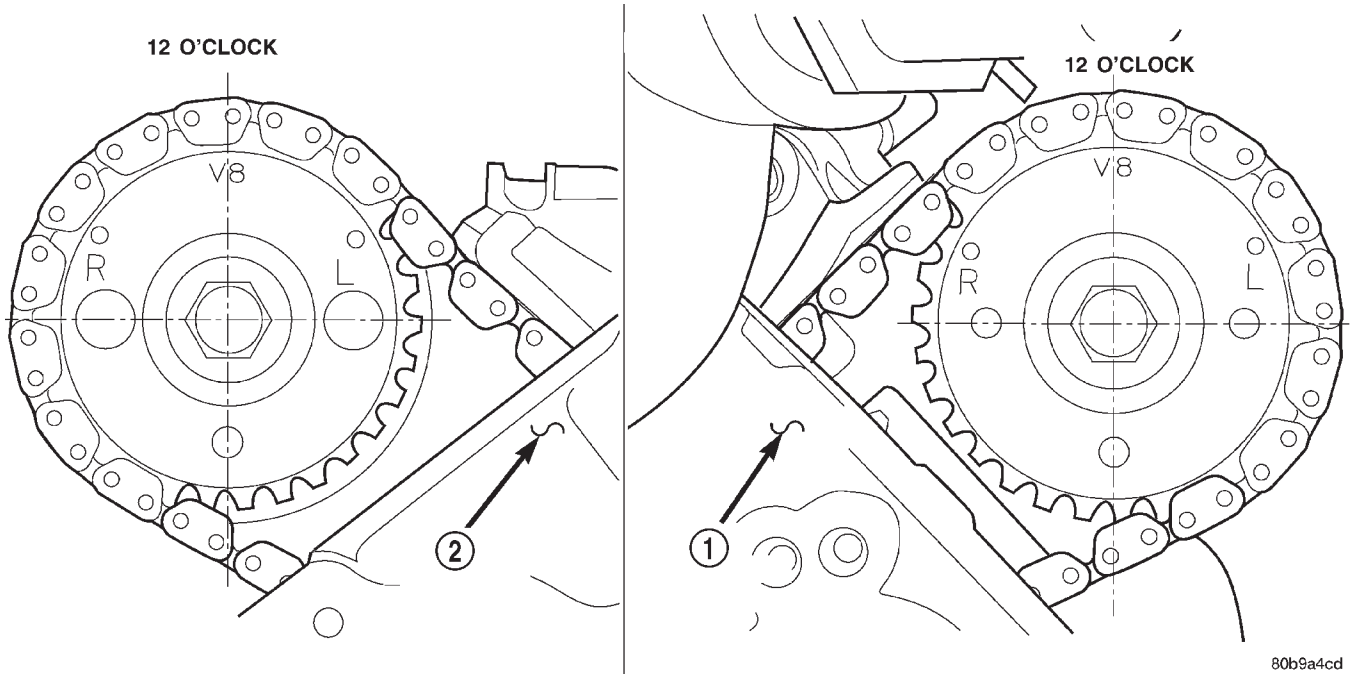


Fig. 96 Timing Chain to Sprocket Alignment

1 – LEFT CYLINDER HEAD
2 – RIGHT CYLINDER HEAD

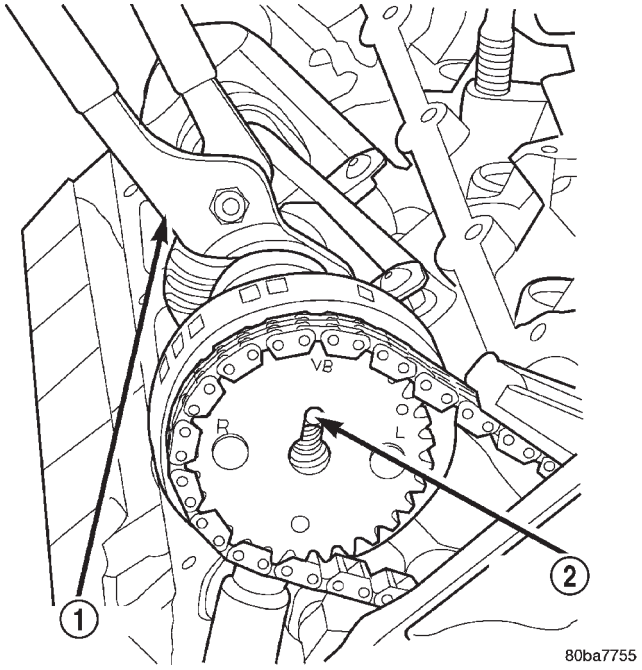


Fig. 97 Camshaft Sprocket Installation

1 – ADJUSTABLE PLIERS
2 – CAMSHAFT DOWEL

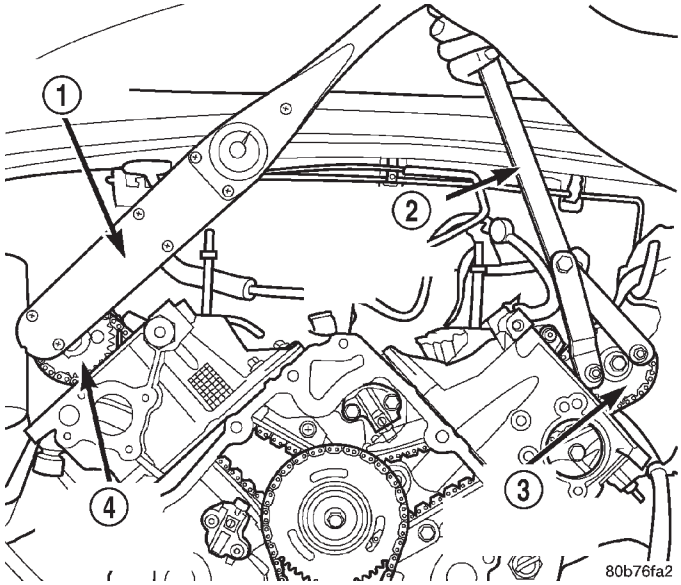


Fig. 98 Tightening Right Side Cam Sprocket Retaining Bolt

1 – TORQUE WRENCH
2 – SPECIAL TOOL 6958 WITH ADAPTER PINS 8346
3 – LEFT CAMSHAFT SPROCKET
4 – RIGHT CAMSHAFT SPROCKET

REMOVAL AND INSTALLATION (Continued)

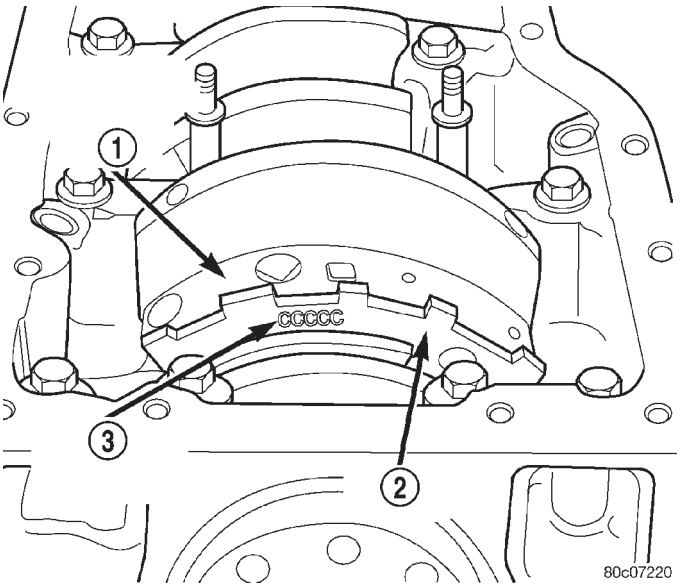


Fig. 99 Main Bearing Markings on Target Wheel

1 – REARMOST CRANKSHAFT COUNTER WEIGHT
2 – TARGET WHEEL
3 – MAIN BEARING SELECT FIT MARKINGS

MAIN BEARING SELECTION CHART—4.7L

GRADE MARKING	SIZE mm (in.)	FOR USE WITH JOURNAL SIZE
A	0.008 mm U/S (0.0004 in.) U/S	63.488–63.496 mm (2.4996–2.4999 in.)
B	NOMINAL	63.496–63.504 mm (2.4999–2.5002 in.)
C	0.008 mm O/S (0.0004 in.) O/S	63.504–63.512 mm (2.5002–2.5005 in.)

CHECKING CRANKSHAFT END PLAY

(1) Mount a dial indicator to a stationary point at front of engine. Locate the probe perpendicular against nose of crankshaft (Fig. 100).

(2) Move the crankshaft all the way to the rear of it's travel.

(3) Zero the dial indicator.

(4) Move the crankshaft all the way to the front of it's travel and read the dial indicator. Refer to Crankshaft End Play Specification Chart.

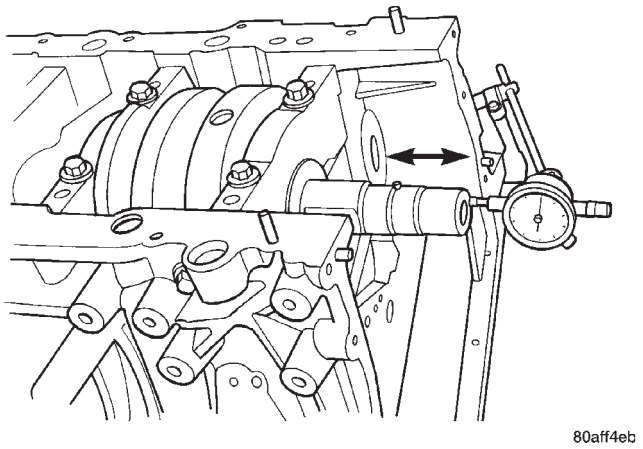


Fig. 100 Checking Crankshaft End Play—Typical

CRANKSHAFT END PLAY SPECIFICATION CHART

New Part: Specification	0.052 - 0.282mm (0.002 - 0.011 in.)
Wear Limit:	0.43mm (0.017 in.)

OIL PAN

REMOVAL

(1) Disconnect negative cable from battery.

(2) Raise vehicle on hoist.

(3) Remove structural cover. Refer to Structural Cover in this section for procedure.

(4) Remove exhaust system Y-pipe.

(5) Remove starter. Refer to Group 8B, Starting.

(6) Drain engine oil.

(7) Un-clip transmission lines from support on oil pan stud. Move lines for oil pan clearance.

CAUTION: DO NOT pry on the oil pan gasket when removing the oil pan, The oil pan gasket is mounted to the cylinder block in three locations and will remain attached to block when lowering oil pan. Gasket can not be removed with oil pan.

(8) Remove oil pan bolts and oil pan.

(9) Remove oil pump pickup tube.

(10) Remove oil pan gasket.

INSTALLATION

(1) Clean oil pan and all sealing surfaces. Inspect oil pan gasket and replace as necessary.

(2) Install oil pan gasket.

REMOVAL AND INSTALLATION (Continued)

NOTE: When installing oil pan gasket/windage tray, start four pan bolts at each corner before tightening oil pickup tube. This will keep pan gasket in alignment.

(3) Install oil pump pick-up tube using a new O-ring. First tighten bolt at O-ring end of tube to 28 N·m (20 ft. lbs.). Tighten remain tube support fasteners to 28 N·m (20 ft. lbs.).

(4) Install oil pan and tighten fasteners to 15 N·m (11 ft. lbs.) (Fig. 101).

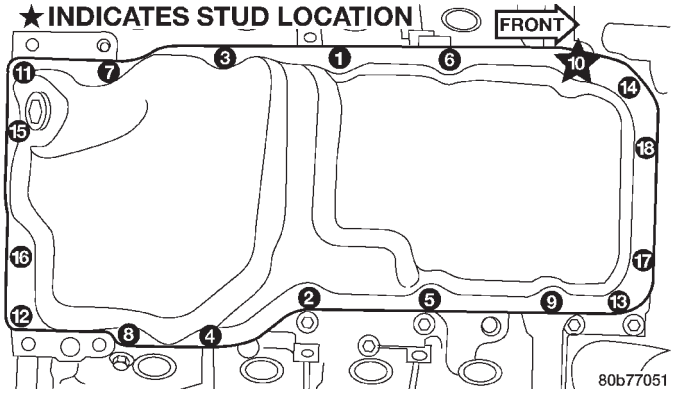


Fig. 101 Oil Pan Tightening Sequence

(5) Reconnect transmission oil cooler lines to oil pan stud bolt.

(6) Install starter.

(7) Install exhaust system Y-pipe.

(8) Install structural cover. Refer to Structural Cover in this section for procedure.

(9) Lower vehicle.

(10) Fill engine with proper amount of oil.

(11) Connect negative cable to battery.

PISTON AND CONNECTING ROD

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove the following components: (Refer to procedures in this section)

- Oil pan and gasket/windage tray.
- Cylinder head covers.
- Timing chain cover.
- Cylinder head(s).

(3) If necessary, remove top ridge of cylinder bores with a reliable ridge reamer before removing pistons from cylinder block. **Be sure to keep tops of pistons covered during this operation.** Pistons and connecting rods must be removed from top of cylinder block. When removing piston and connecting rod assemblies from the engine, rotate crankshaft so the each connecting rod is centered in cylinder bore.

CAUTION: DO NOT use a number stamp or a punch to mark connecting rods or caps, as damage to connecting rods could occur

NOTE: Connecting rods and bearing caps are not interchangeable and should be marked before removing to ensure correct reassembly.

(4) Mark connecting rod and bearing cap positions using a permanent ink marker or scribe tool (Fig. 102).

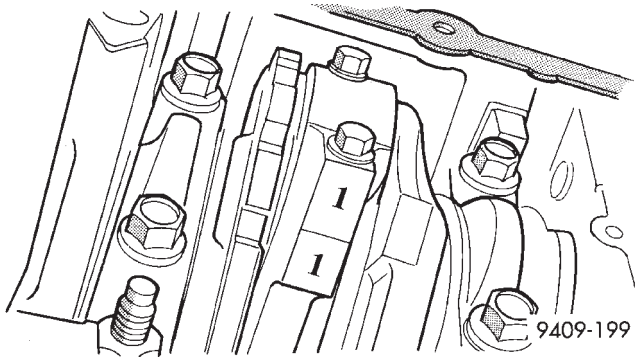


Fig. 102 Identify Connecting Rod to Cylinder Position—Typical

CAUTION: Care must be taken not to damage the fractured rod and cap joint face surfaces, as engine damage may occur.

(5) Remove connecting rod cap. Install Special Tool 8507 Connecting Rod Guides into the connecting rod being removed. Remove piston from cylinder bore. Repeat this procedure for each piston being removed.

CAUTION: Care must be taken not to nick crankshaft journals, as engine damage may occur

(6) Immediately after piston and connecting rod removal, install bearing cap on the mating connecting rod to prevent damage to the fractured cap and rod surfaces.

(7) Carefully remove piston rings from piston(s), starting from the top ring down.

PISTON RINGS—INSTALLATION

(1) The No. 1 and No. 2 piston rings have a different cross section. Ensure No. 2 ring is installed with manufacturers I. D. mark (Dot) facing up, towards top of the piston.

REMOVAL AND INSTALLATION (Continued)

NOTE: Piston rings are installed in the following order:

- **Oil ring expander.**
- **Upper oil ring side rail.**
- **Lower oil ring side rail.**
- **No. 2 Intermediate piston ring.**
- **No. 1 Upper piston ring.**

(2) Install the oil ring expander.

(3) Install upper side rail (Fig. 103) by placing one end between the piston ring groove and the expander ring. Hold end firmly and press down the portion to be installed until side rail is in position. Repeat this step for the lower side rail.

(4) Install No. 2 intermediate piston ring using a piston ring installer (Fig. 104).

(5) Install No. 1 upper piston ring using a piston ring installer (Fig. 104).

(6) Position piston ring end gaps as shown in (Fig. 105). It is important that expander ring gap is at least 45° from the side rail gaps, but not on the piston pin center or on the thrust direction.

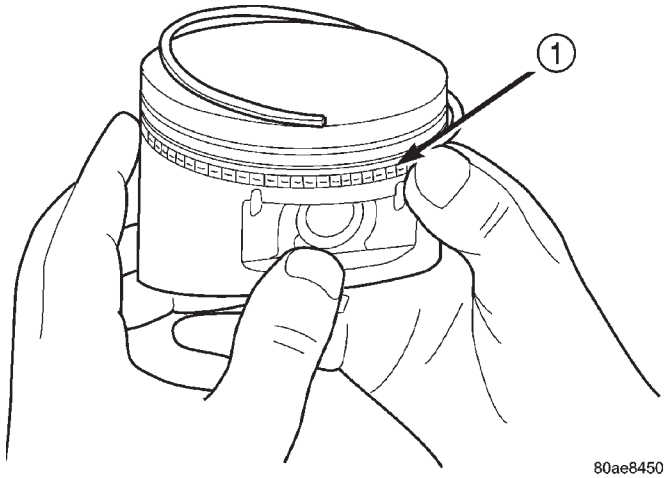


Fig. 103 Side Rail—Installation

1 – SIDE RAIL END

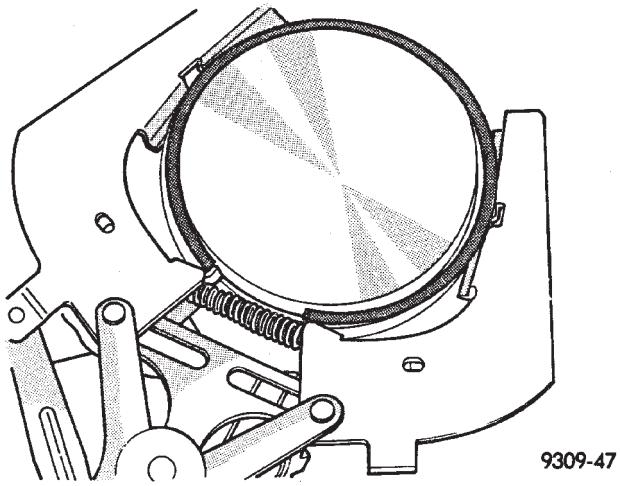


Fig. 104 Upper and Intermediate Rings—Installation

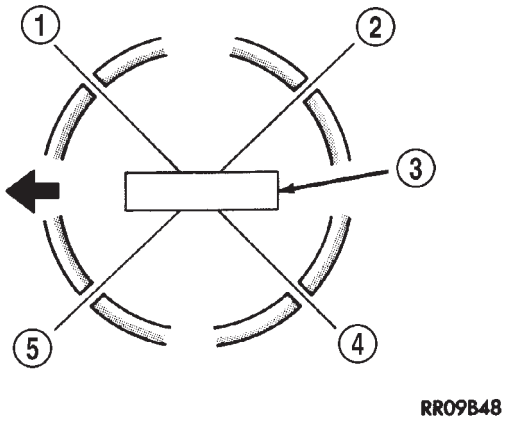


Fig. 105 Piston Ring End Gap Position

1 – SIDE RAIL UPPER
2 – NO. 1 RING GAP
3 – PISTON PIN
4 – SIDE RAIL LOWER
5 – NO. 2 RING GAP AND SPACER EXPANDER GAP

INSTALLATION

(1) Before installing piston and connecting rod assemblies in to the bore, ensure all rings are in position shown in (Fig. 105).

(2) Immerse the piston head and rings in clean engine oil. Position a ring compressor over the piston and rings. Tighten ring compressor. **Ensure position of rings do not change during this operation.**

(3) Position bearing onto connecting rod. Ensure that hole in bearing shell aligns with hole in connecting rod. Lubricate bearing surface with clean engine oil.

(4) Install Special Tool 8507 Connecting Rod Guides into connecting rod bolt threads (Fig. 106).

(5) The pistons are marked on the piston pin bore surface with an raised “F” indicating installation position. This mark must be pointing toward the front of engine on both cylinder banks. The connecting rod oil slinger slot faces the front of the engine (Fig. 107).

(6) Wipe cylinder bore clean and lubricate with engine oil.

(7) Rotate crankshaft until connecting rod journal is on the center of cylinder bore. Insert rod and piston into cylinder bore and carefully position connecting rod guides over crankshaft journal.

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

REMOVAL AND INSTALLATION (Continued)

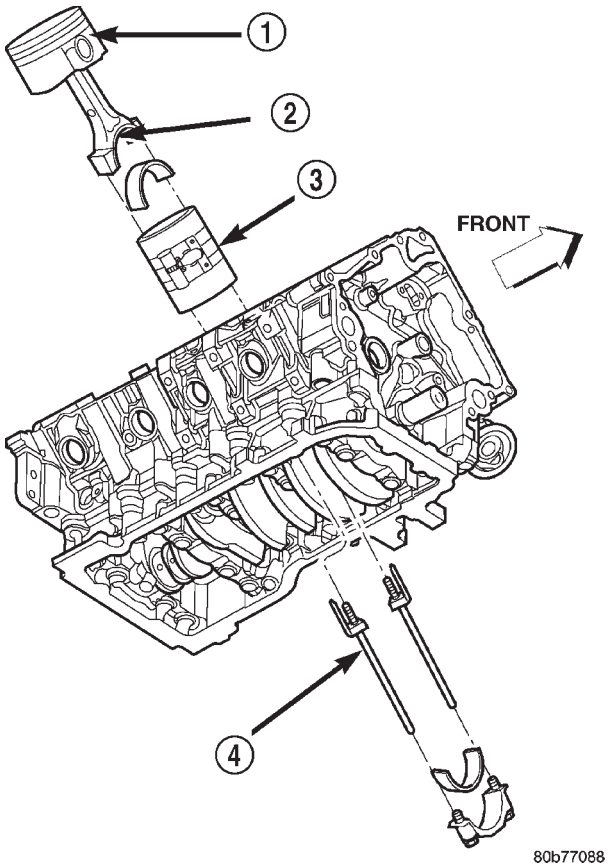


Fig. 106 Piston and Connecting Rod—Installation

1 – "F" TOWARD FRONT OF ENGINE
2 – OIL SLINGER SLOT
3 – RING COMPRESSOR
4 – SPECIAL TOOL 8507

CAUTION: Connecting Rod Bolts are Torque to Yield Bolts and Must Not Be Reused. Always replace the Rod Bolts whenever they are loosened or removed.

(9) Lubricate rod bolts and bearing surfaces with engine oil. Install connecting rod cap and bearing. Tighten bolts to 27 N·m (20 ft. lbs.) plus 90°.

(10) Install the following components: (Refer to procedures in this section)

- Cylinder head(s).
- Timing chain and cover.
- Cylinder head covers.
- Oil pan and gasket/windage tray.

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

(12) Connect negative cable to battery.

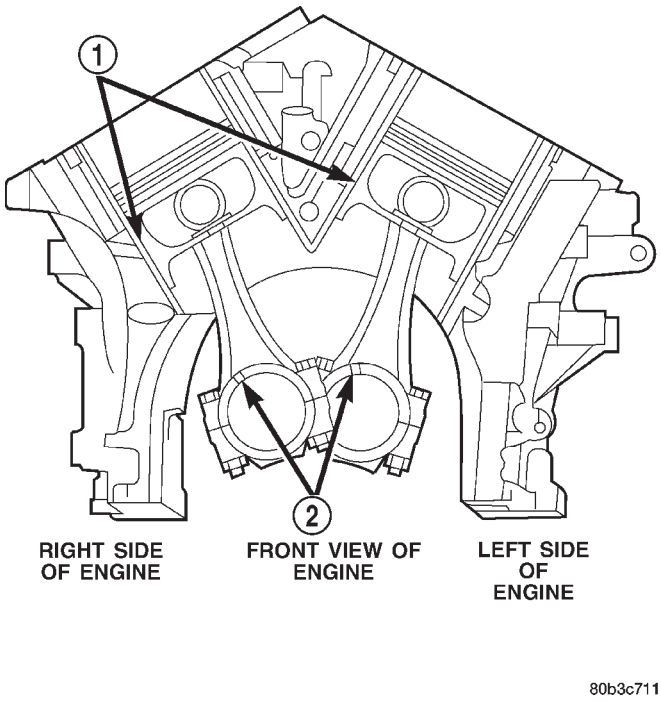


Fig. 107 Piston and Connecting Rod Positioning

1 – MAJOR THRUST SIDE OF PISTON
2 – OIL SLINGER SLOT

CRANKSHAFT

REMOVAL

NOTE: To remove the crankshaft from the engine, the engine must be removed from the vehicle.

(1) Remove the engine. Refer to Engine Assembly in this section for procedure.

(2) Remove the engine oil pump. Refer to Oil Pump in this section for procedure.

CAUTION: DO NOT pry on the oil pan gasket when removing the oil pan, The oil pan gasket is mounted to the cylinder block in three locations and will remain attached to block when removing oil pan. Gasket can not be removed with oil pan.

(3) Remove oil pan bolts and oil pan.

(4) Remove the oil pump pickup tube and oil pan gasket /windage tray.

(5) Remove the bedplate mounting bolts. Note the location of the three stud bolts for installation.

(6) Remove the connecting rods from the crankshaft.

CAUTION: The bedplate to cylinder block mating surface is a critical sealing surface. Do not pry on or damage this surface in anyway.

REMOVAL AND INSTALLATION (Continued)

NOTE: The bedplate contains the lower main bearing halves. Use care when handling bedplate as not to drop or damage bearing halves. Installing main bearing halves in the wrong position will cause sever damage to the crankshaft.

NOTE: The bedplate has pry points cast into it. Use these points only. The pry points are on both the left and right sides, only the left side is shown.

(7) Carefully pry on the pry points (Fig. 108) to loosen the bedplate then remove the bedplate.

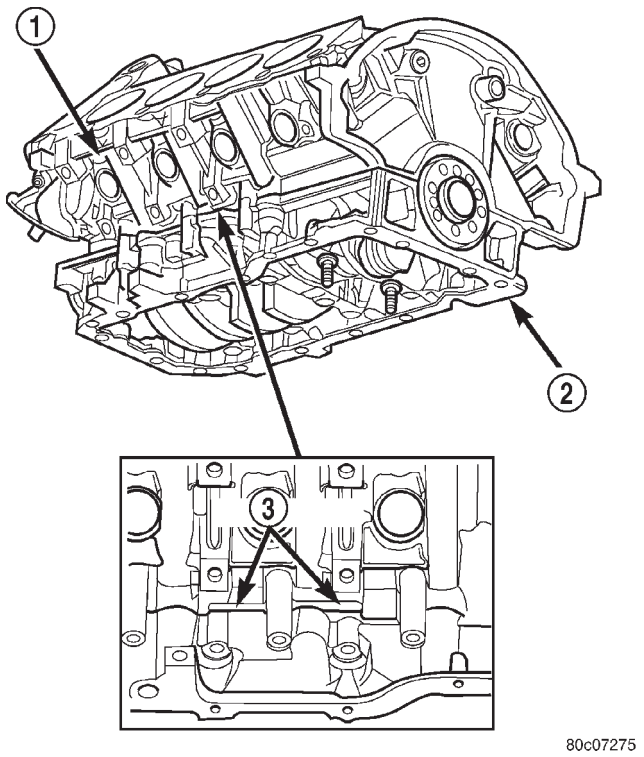


Fig. 108 Bedplate Pry Point Location

1 – CYLINDER BLOCK
2 – BEDPLATE
3 – PRY POINT

CAUTION: When removing the crankshaft, use care not to damage bearing surfaces on the crankshaft.

(8) Remove the crankshaft.
(9) Remove the crankshaft tone wheel.

INSPECTION

NOTE: Thoroughly inspect the connecting rod bearing bores and main bearing bores for scoring, blueing or severe scratches. Further disassembly may be required.

If connecting rod bearing bores show damage, the cylinder heads must be removed to service the piston and rod assemblies. If the bedplate or the cylinder block main bearing bores show damage the engine must be replaced.

(1) If required, remove the main bearing halves from the cylinder block and bedplate.
(2) Thoroughly clean the bedplate to cylinder block sealing surfaces and main bearing bores. Remove all oil and sealant residue.
(3) Inspect the bedplate main bearing bores for cracks, scoring or severe blueing. If either condition exists the engine must be replaced.
(4) Inspect the crankshaft thrust washer for scoring, scratches or blueing. If either condition exist replace the thrust washer.
(5) Inspect the oil pan gasket/windage tray for splits, tears or cracks in the gasket sealing surfaces. Replace gasket as necessary.

INSTALLATION

CAUTION: Main bearings are select fit. Refer to Crankshaft Main Bearings in this section for proper bearing selections.

(1) Lubricate upper main bearing halves with clean engine oil.

CAUTION: When installing crankshaft, use care not to damage bearing surfaces on the crankshaft.

NOTE: Apply sealant to the tone wheel retaining screws prior to installation.

(2) Install the crankshaft tone wheel. torque the mounting screws to 22 N·m (21 ft. lbs.).
(3) Install the thrust washer (Fig. 109).
(4) Position crankshaft in cylinder block.

CAUTION: The bedplate to cylinder block mateing surface must be coated with sealant prior to installation. Failure to do so will cause severe oil leaks.

NOTE: The installation time to install the bedplate after the sealant has been applied is critical.

NOTE: Make sure that the bedplate and cylinder block sealing surfaces are clean and free of oil or other contaminants. Contaminants on the sealing surfaces may cause main bearing distortion and/or oil leaks.

(5) Apply a 2.5mm (0.100 inch) (Fig. 110) bead of Mopar® Gen II Silicone Rubber Adhesive sealant to the cylinder block-to-bedplate mating surface as shown (Fig. 111).

REMOVAL AND INSTALLATION (Continued)

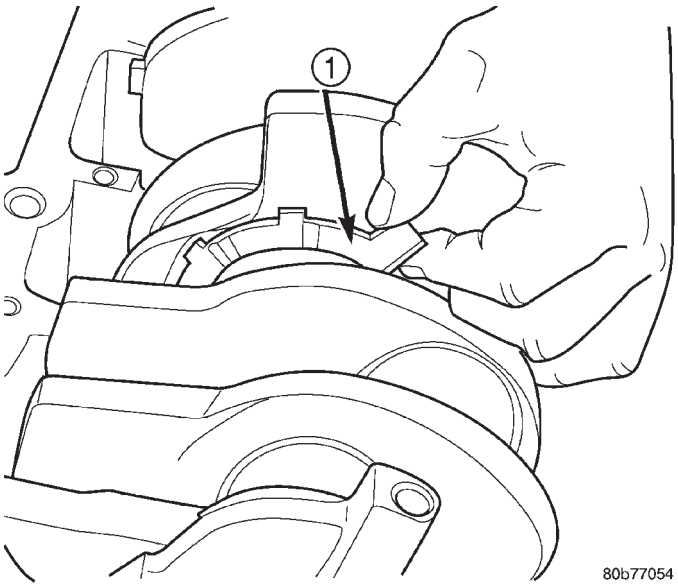


Fig. 109 Crankshaft Thrust Washer Installation

1 – CRANKSHAFT THRUST WASHER

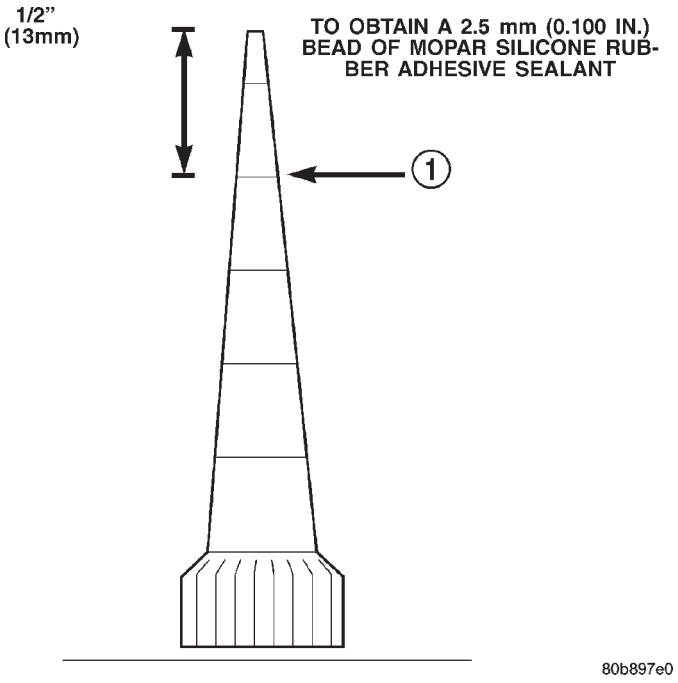


Fig. 110 Cutting Aplicator to Achieve 2.5mm (0.100 in.) Bead

1 – CUT HERE

(6) Coat the crankshaft main bearing journals with clean engine oil and position the bedplate onto the cylinder block.

NOTE: Lubricate the bedplate retaining bolts with clean engine oil prior to installation.

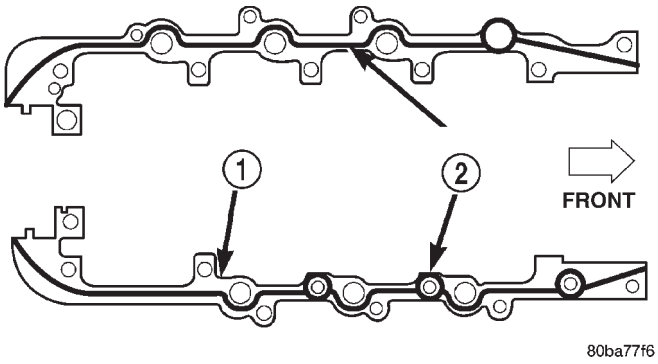


Fig. 111 Cylinder Block-to-Bedplate Sealent Bead Location

1 – CYLINDER BLOCK
2 – SEALANT BEAD LOCATION

(7) Install the bedplate retaining bolts, making sure to place the stud bolts in the correct location, Torque the bolts in the sequence shown (Fig. 112).

- Tighten bolts **A – L** to 54 N·m (40 ft. lbs.)
- Tighten bolts **1–10** to 2.8 N·m (25 in. lbs.)
- Turn bolts **1–10** an additional 90°.
- Tighten bolts **A1– A6** to 27 N·m (20 ft. lbs.)

(8) Measure crankshaft end play. Refer to Crankshaft Main Bearings in this section for procedure.

(9) Install the connecting rods and measure side clearance. Refer to Connecting Rod Bearings in this section for procedure.

(10) Position the oil pan gasket/windage tray, using a new o-ring, install the oil pickup tube. Torque the bolt to 28N·n (20 ft. lbs.) torque the nuts to 28N·m (20 ft. lbs.).

(11) Install the oil pan. Torque the retaining bolts to 15 N·m (11 ft. lbs.) in the sequence shown (Fig. 113).

(12) Install the engine.

FLEXPLATE

REMOVAL

(1) Remove the transmission. Refer to Group 21, Transmission and Transfer Case for procedure.

(2) Remove the bolts and flexplate.

INSTALLATION

(1) Position the flexplate onto the crankshaft and install the bolts hand tight.

(2) Tighten the flexplate retaining bolts to 60 N·m (45 ft. lbs.) in the sequence shown (Fig. 114).

(3) Install the transmission.

REMOVAL AND INSTALLATION (Continued)

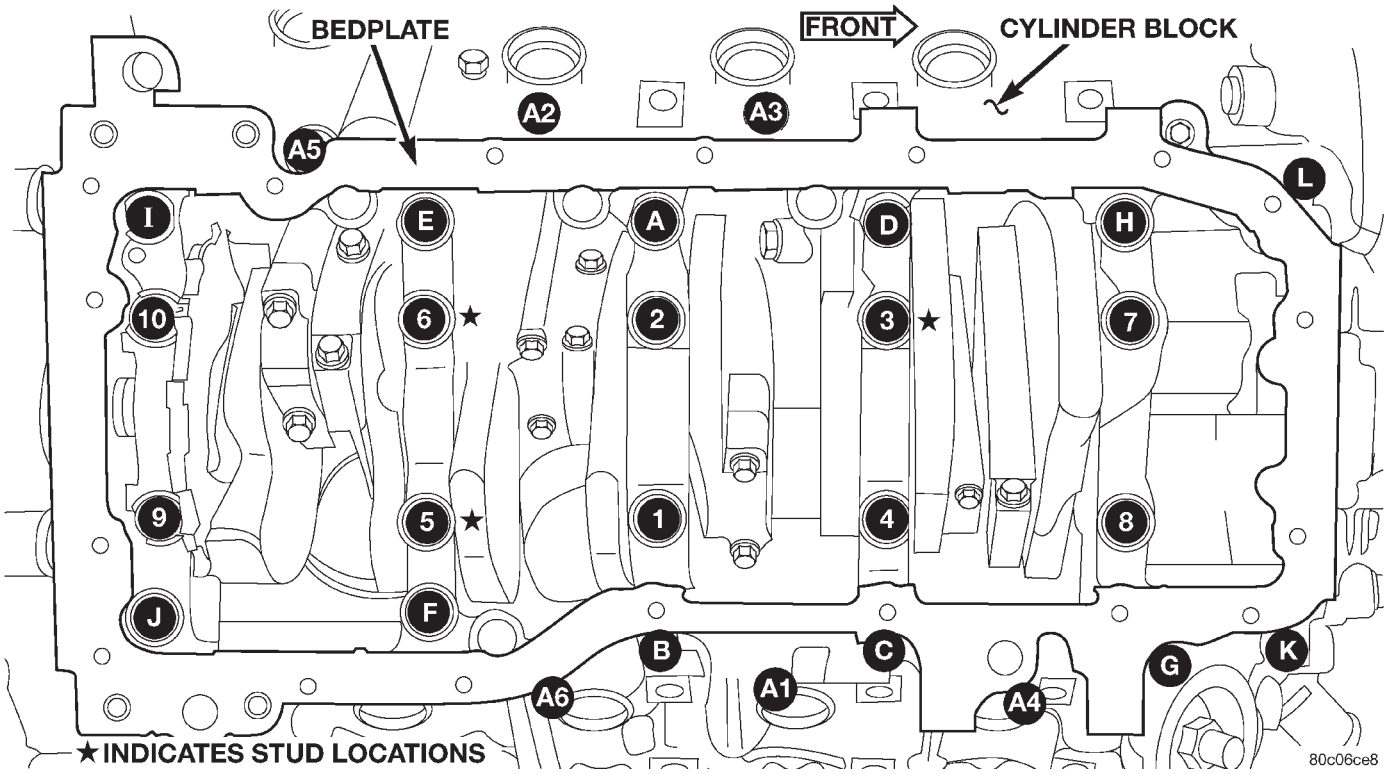


Fig. 112 Bedplate Tightening Sequence

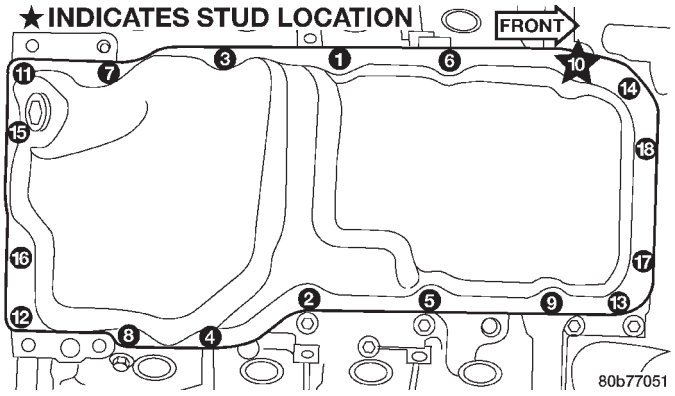


Fig. 113 Oil Pan Tightening Sequence

OIL PUMP

REMOVAL

(1) Remove the oil pan and pick-up tube. Refer to the procedure in this section.

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

(3) Remove the timing chains and tensioners. Refer to Timing Chain and Sprockets in this section.

(4) Remove the four bolts, primary timing chain tensioner and the oil pump.

INSTALLATION

(1) Position the oil pump onto the crankshaft and install two oil pump retaining bolts.

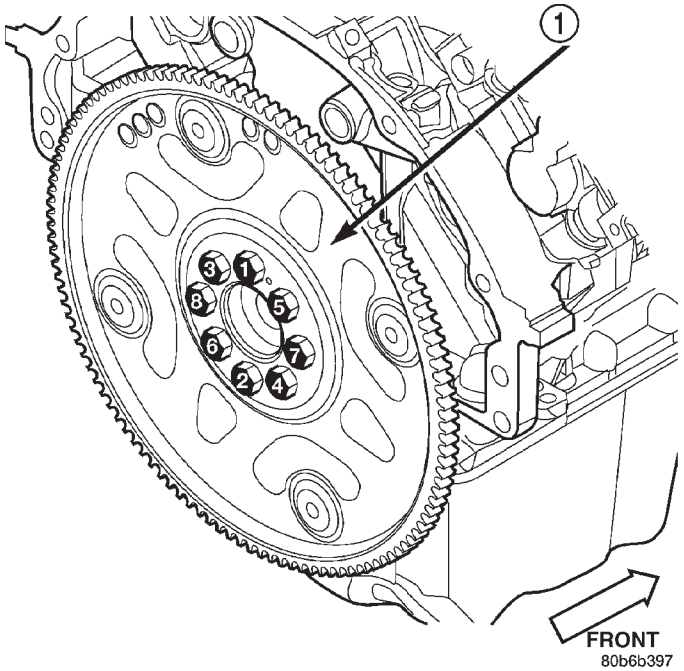


Fig. 114 Flexplate Tightening Sequence

1 – FLEXPLATE

(2) Position the primary timing chain tensioner and install the two retaining bolts.

(3) Tighten the oil pump and primary timing chain tensioner retaining bolts to 28 N·m (250 in. lbs.) in the sequence shown (Fig. 115).

REMOVAL AND INSTALLATION (Continued)

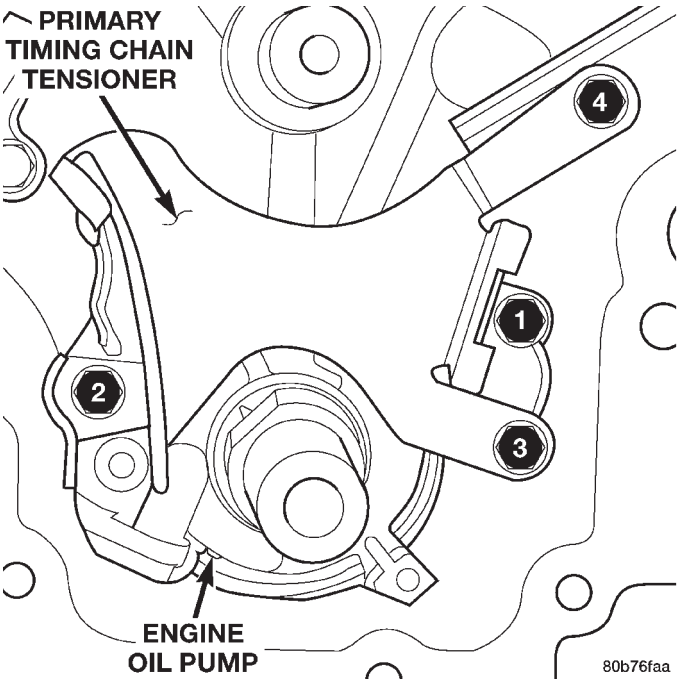


Fig. 115 Oil Pump and Primary Timing Chain Tightening Sequence

(4) Install the secondary timing chain tensioners and timing chains.
(5) Install the timing chain cover.
(6) Install the pick-up tube and oil pan.

ENGINE OIL PRESSURE SENDING UNIT

REMOVAL

(1) Disconnect the negative cable from the battery.
(2) Raise vehicle on hoist.
(3) Remove front splash shield.
(4) Disconnect oil pressure sender wire (Fig. 116).
(5) Remove the pressure sender (Fig. 116).

INSTALLATION

(1) Install oil pressure sender.
(2) Connect oil pressure sender wire.
(3) Install front splash shield.
(4) Lower vehicle.
(5) Connect the negative battery cable.

CRANKSHAFT OIL SEAL—FRONT

REMOVAL

(1) Disconnect negative cable from battery.
(2) Remove accessory drive belt refer to Group 7, Cooling System for procedure.
(3) Remove A/C compressor mouning fasteners and set aside.
(4) Drain cooling system. Refer to Group 7, Cooling System for procedure.
(5) Remove upper radiator hose.

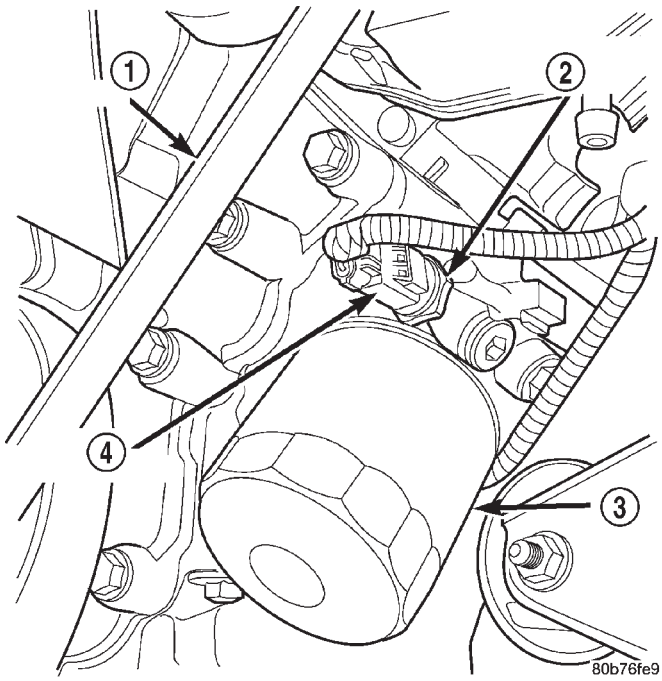


Fig. 116 Oil Pressure Sending Unit

1 – BELT
2 – OIL PRESSURE SENSOR
3 – OIL FILTER
4 – ELEC. CONNECTOR

(6) Using Special Tools 6958 Spanner with Adapter Pins 8346 loosen fan and viscous assembly from water pump (Fig. 117).
(7) Remove fan and viscous assembly
(8) Disconnect electrical connector for fan mounted inside radiator shroud.
(9) Remove radiator shroud attaching fasteners.

NOTE: Transmission cooler line snaps into shroud lower right hand corner.

(10) Remove radiator shroud.
(11) Remove crankshaft damper bolt.
(12) Remove damper using Special Tools 8513 Insert and 1026 Three Jaw Puller (Fig. 118).
(13) Using Special Tool 8511, remove crankshaft front seal (Fig. 119).

INSTALLATION

CAUTION: To prevent severe damage to the Crankshaft, Damper or Special Tool 8512, thoroughly clean the damper bore and the crankshaft nose before installing Damper.

(1) Using Special Tool 8348 and 8512, install crankshaft front seal (Fig. 120).

REMOVAL AND INSTALLATION (Continued)

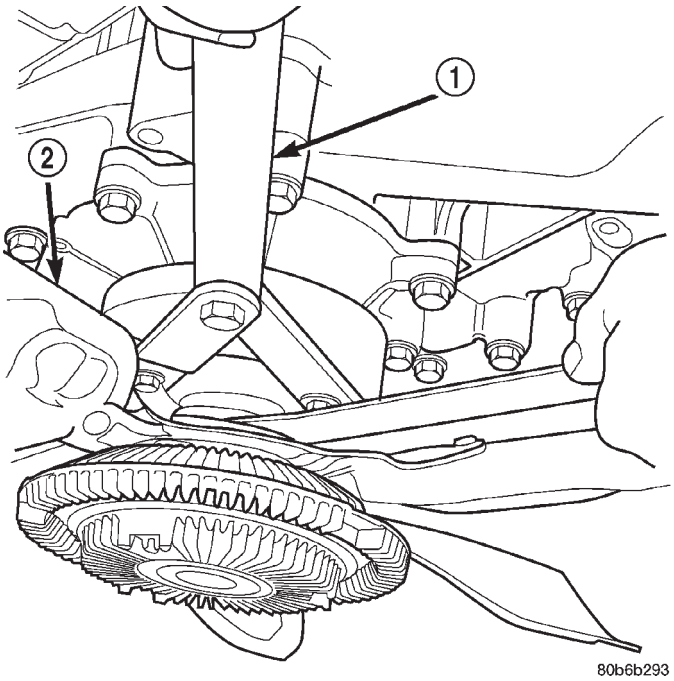


Fig. 117 Fan Assembly—Removal/Installation

1 – SPECIAL TOOL 6958 SPANNER WRENCH WITH ADAPTER PINS 8346
2 – FAN

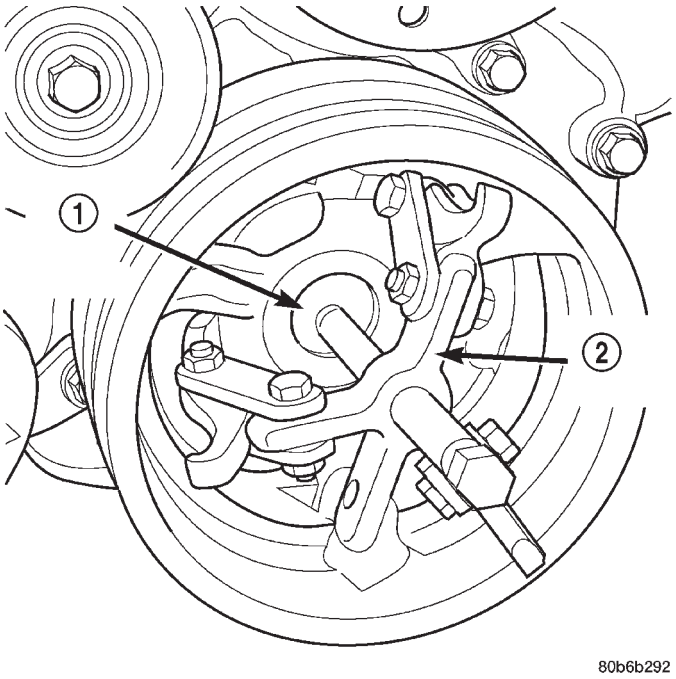


Fig. 118 Crankshaft Damper—Removal

1 – SPECIAL TOOL 8513 INSERT
2 – SPECIAL TOOL 1026

CAUTION: Special Tool 8512, is assembled in a specific sequence. Failure to assemble this tool in this sequence can result in tool failure and severe damage to either the tool or the crankshaft.

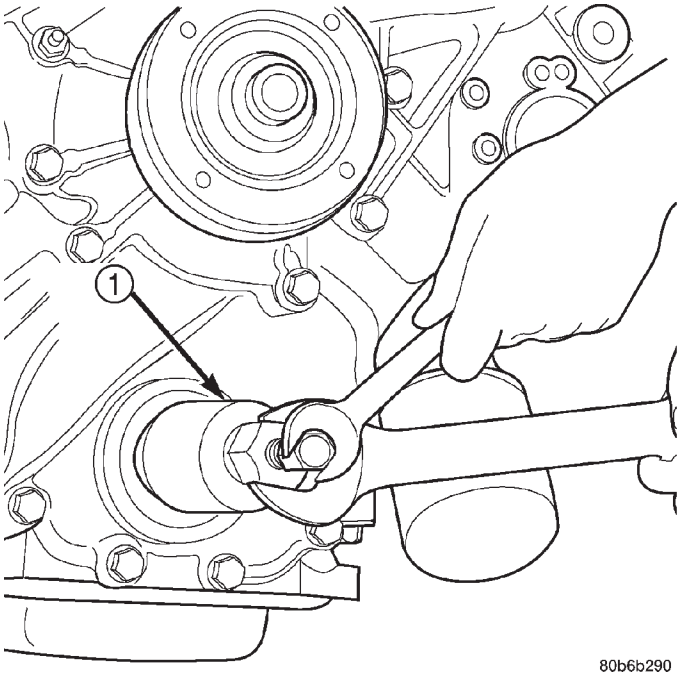


Fig. 119 Crankshaft Front Seal—Removal

1 – SPECIAL TOOL 8511

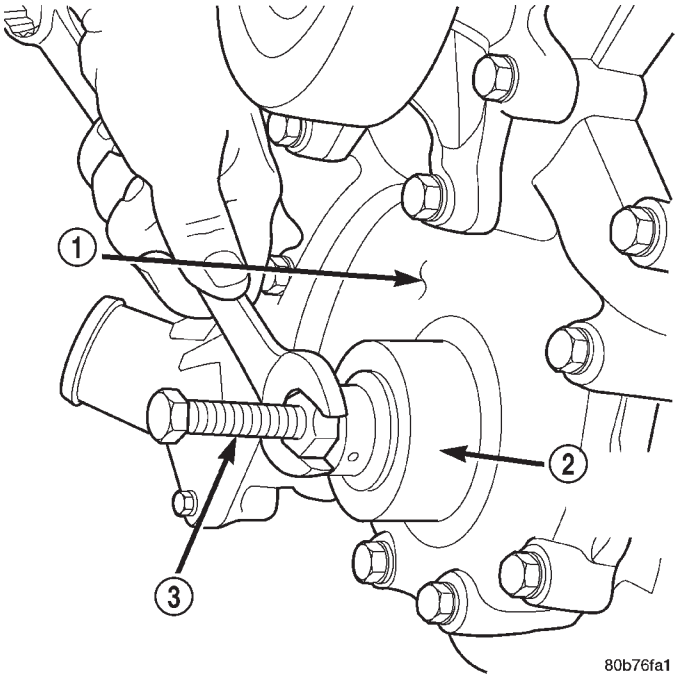


Fig. 120 Crankshaft Front Seal—Installation

1 – TIMING CHAIN COVER
2 – SPECIAL TOOL 8348
3 – SPECIAL TOOL 8512

REMOVAL AND INSTALLATION (Continued)

(2) Assemble Special Tool 8512 as follows, The nut is threaded onto the shaft first. Then the roller bearing is placed onto the threaded rod (The hardened bearing surface of the bearing **MUST** face the nut). Then the hardened washer slides onto the threaded rod (Fig. 121). Once assembled coat the threaded rod's threads with Mopar® Nickel Anti-Seize or (Loctite No. 771).

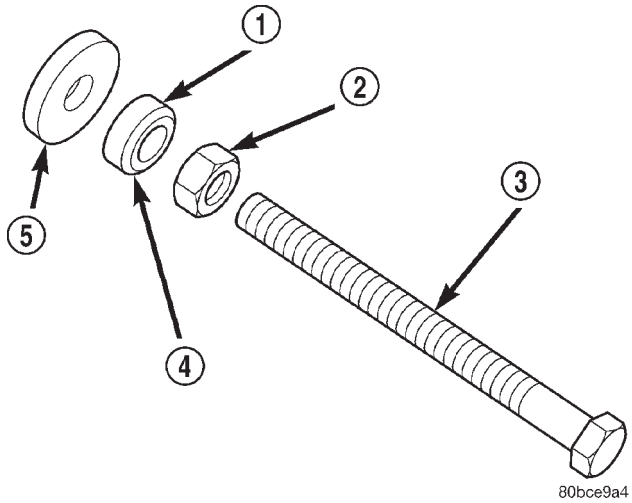


Fig. 121 Proper Assembly Method for Special Tool 8512

1 – BEARING
2 – NUT
3 – THREADED ROD
4 – BEARING HARDENED SURFACE (FACING NUT)
5 – HARDENED WASHER

(3) Align crankshaft damper slot with key in crankshaft. Slide damper onto crankshaft slightly.

(4) Using Special Tool 8512 press damper onto crankshaft (Fig. 122).

(5) Install then tighten crankshaft damper bolt to 175 N·m (130 ft. lbs.).

(6) Install radiator shroud and tighten fasteners to 11 N·m (95 in. lbs.).

(7) Connect electrical connector for shroud fan.

(8) Install fan and viscous assembly.

(9) Using Special Tools 6958 Spanner with Adapter Pins 8346 tighten fan and viscous assembly to water pump (Fig. 117).

(10) Install upper radiator hose.

(11) Install A/C compressor and tighten fasteners to 54 N·m (40 ft. lbs.).

(12) Install accessory drive belt refer to Group 7, Cooling System for procedure.

(13) Refill cooling system. Refer to Group 7, Cooling System for procedure.

(14) Connect negative cable to battery.

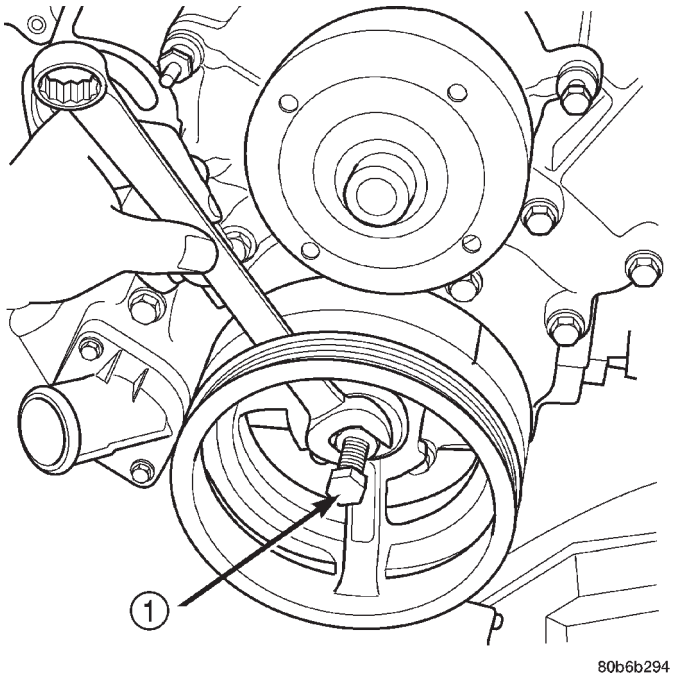


Fig. 122 Crankshaft Damper—Installation

1 – SPECIAL TOOL 8512

CRANKSHAFT OIL SEAL—REAR

REMOVAL

NOTE: This procedure can be preformed in vehicle.

(1) If being preformed in vehicle, remove the transmission. Refer to Group 21, Transmission and Transfer Case.

(2) Remove the flexplate. Refer to procedure in this section.

NOTE: The crankshaft oil seal CAN NOT be reused after removal.

NOTE: The crankshaft rear oil seal remover Special Tool 8506 must be installed deeply into the seal. Continue to tighten the removal tool into the seal until the tool can not be turned farther. Failure to install tool correctly the first time will cause tool to pull free of seal without removing seal from engine.

(3) Using Special Tool 8506 (Fig. 123), remove the crankshaft rear oil seal.

INSTALLATION

(1) Position the magnetic seal guide Special Tool 8349–2 (Fig. 124) onto the crankshaft rear face. Then position the crankshaft rear oil seal onto the guide.

(2) Using Special Tools 8349 Crankshaft Rear Oil Seal Installer and C-4171 Driver Handle (Fig. 125), with a hammer, tap the seal into place. Continue to

REMOVAL AND INSTALLATION (Continued)

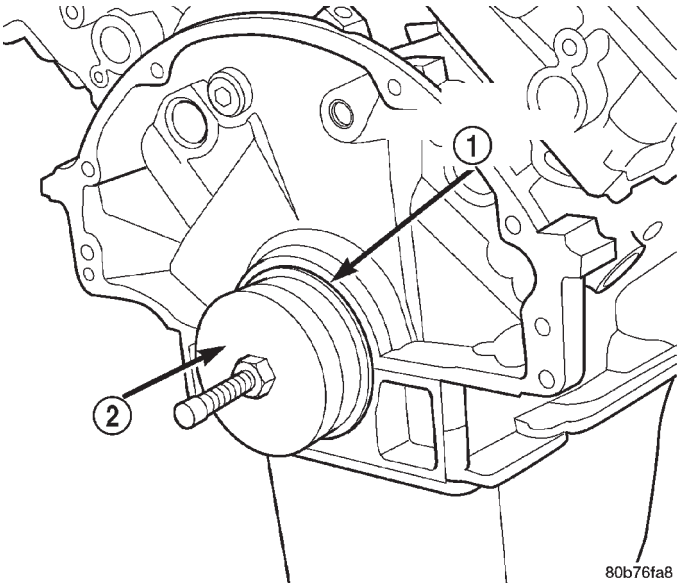


Fig. 123 Crankshaft Rear Oil Seal Removal

1 – REAR CRANKSHAFT SEAL
2 – SPECIAL TOOL 8506

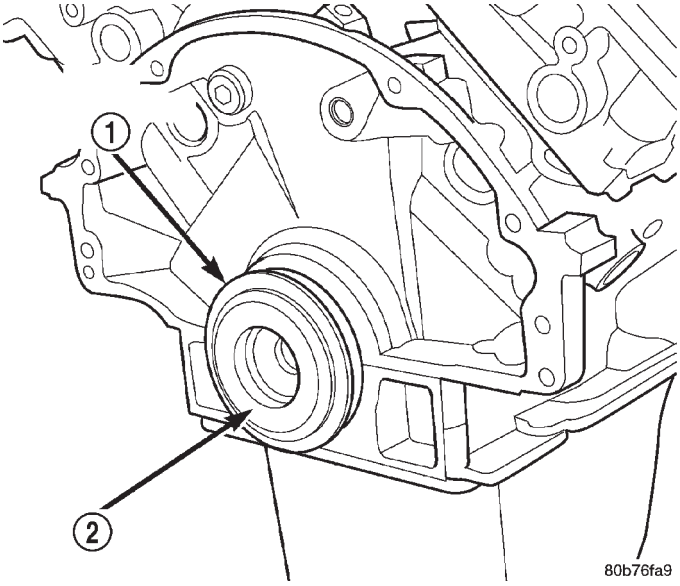


Fig. 124 Crankshaft Rear Oil Seal Guide Special Tool 8349–2 and Oil Seal

1 – REAR CRANKSHAFT SEAL
2 – SPECIAL TOOL 8349–2 GUIDE

tap on the driver handle until the seal installer seats against the cylinder block crankshaft bore.

(3) Install the flexplate.

(4) If removed, install the transmission.

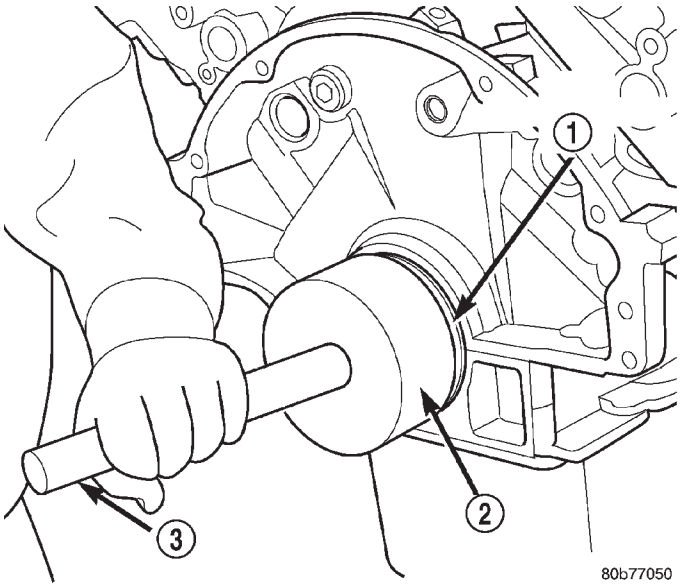


Fig. 125 Crankshaft Rear Oil Seal Installation

1 – REAR CRANKSHAFT SEAL
2 – SPECIAL TOOL 8349–1 INSTALLER
3 – SPECIAL TOOL C-4171 HANDLE

ENGINE CORE PLUGS

REMOVAL

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

(2) Using a blunt tool such as a drift or a screw driver and a hammer, strike the bottom edge of the cup plug (Fig. 126).

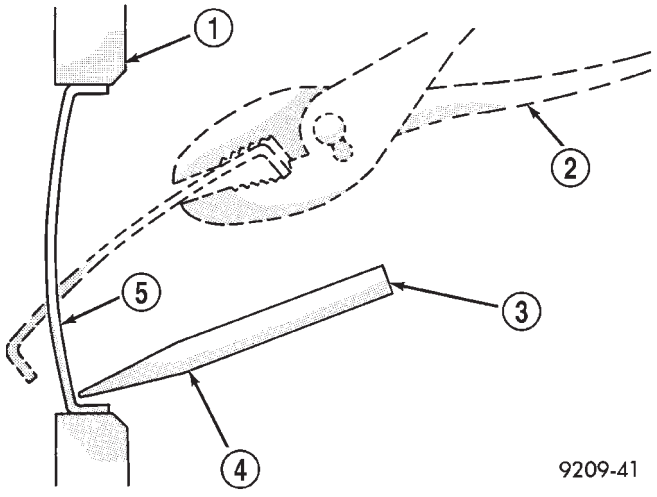


Fig. 126 Engine Core Plug Removal

1 – CYLINDER BLOCK
2 – REMOVE PLUG WITH PLIERS
3 – STRIKE HERE WITH HAMMER
4 – DRIFT PUNCH
5 – CUP PLUG

REMOVAL AND INSTALLATION (Continued)

(3) Using a suitable pair of pliers, grasp the core plug and remove.

INSTALLATION

NOTE: Thoroughly clean core plug bore, remove all of the old sealer.

(1) Coat the edges of the engine core plug and the core plug bore with Mopar Gasket Maker, or equivalent.

NOTE: It is not necessary to wait for the sealant to cure on the core plugs. The cooling system can be filled and the vehicle returned to service immediately.

(2) Using proper plug driver, drive core plug into the core plug bore. The sharp edge of the core plug should be at least 0.50 mm (0.020 in.) inside the lead in chamfer.

(3) Refill the cooling system.

DISASSEMBLY AND ASSEMBLY

VALVE SERVICE

REFACING

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

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

(1) Using a suitable dial indicator measure the center of the valve seat Total run out must not exceed 0.051 mm (0.002 in).

(2) Apply a small amount of Prussian blue to the valve seat, insert the valve into the cylinder head, while applying light pressure on the valve rotate the valve. Remove the valve and examine the valve face. If the blue is transferred below the top edge of the valve face, lower the valve seat using a 15 degree stone. If the blue is transferred to the bottom edge of the valve face, raise the valve seat using a 65 degree stone.

(3) When the seat is properly positioned the width of the intake seat must be 1.75 – 2.36 mm (0.0689 – 0.0928 in.) and the exhaust seat must be 1.71 – 2.32 mm (0.0673 – 0.0911 in.).

(4) Check the valve spring installed height after refacing the valve and seat. The installed height for both intake and exhaust valve springs must not exceed 41.44 mm (1.6315 in.).

(5) The valve seat and valve face must maintain a face angle of 44.5 – 45 degrees angle.

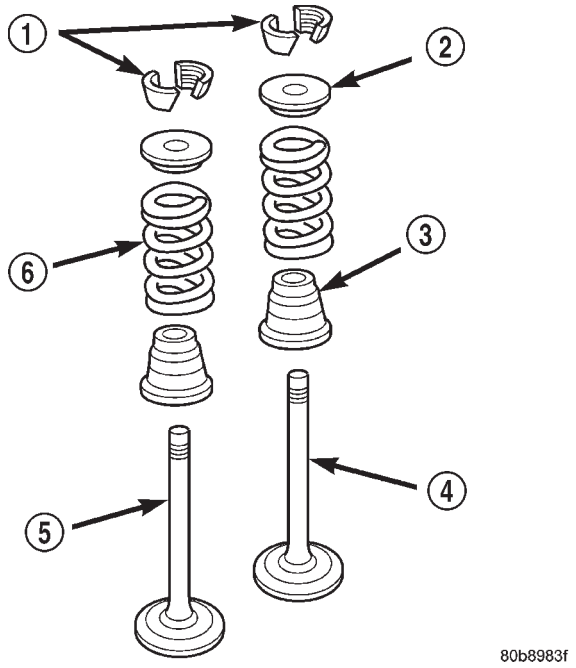


Fig. 127 Valve Assembly Configuration

1 – VALVE LOCKS (3–BEAD)
2 – RETAINER
3 – VALVE STEM OIL SEAL
4 – INTAKE VALVE
5 – EXHAUST VALVE
6 – VALVE SPRING

OIL PUMP

DISASSEMBLE

(1) Remove oil pump cover screws and lift off cover plate.

(2) Remove pump inner and outer rotors.

NOTE: Once the oil pressure relief valve, cup plug, and pin are removed, the pump assembly must be replaced.

(3) If it is necessary to remove the pressure relief valve, drive the roll pin from pump housing and remove cup plug, spring and valve.

ASSEMBLE

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

(2) Install inner and outer rotors.

(3) Install oil pump cover plate and install cover bolts and tighten them to 12 N·m (105 in. lbs.).

DISASSEMBLY AND ASSEMBLY (Continued)

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

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

CLEANING AND INSPECTION

INTAKE MANIFOLD

CLEANING

NOTE: There is NO approved repair procedure for the intake manifold. If severe damage is found during inspection, the intake manifold must be replaced.

Before installing the intake manifold thoroughly clean the mating surfaces. Use a suitable cleaning solvent, then air dry.

INSPECTION

(1) Inspect the intake sealing surface for cracks, nicks and distortion.

(2) Inspect the intake manifold vacuum hose fittings for looseness or blockage.

(3) Inspect the manifold to throttle body mating surface for cracks, nicks and distortion.

EXHAUST MANIFOLD

CLEANING

(1) Clean the exhaust manifold using a suitable cleaning solvent, then allow to air dry.

(2) Clean all gasket residue from the manifold mating surface.

INSPECTION

(1) Inspect the exhaust manifold for cracks in the mating surface and at every mounting bolt hole.

(2) Using a straight edge and a feeler gauge, check the mating surface for warp and twist.

(3) Inspect the manifold to exhaust pipe mating surface for cracks, gouges, or other damage that would prevent sealing.

CYLINDER HEADS

CLEANING

CYLINDER HEAD GASKET SURFACE PREPARATION

To ensure engine gasket sealing, proper surface preparation must be performed, especially with the use of aluminum engine components.

Never use the following to clean gasket surfaces:

- **never use a metal scraper.**
- **never use an abrasive pad or paper to clean the cylinder block.**
- **never use a high speed power tool or wire brush on any gasket sealing surface** (Fig. 128).

Only use the following for cleaning gasket surfaces:

- use Mopar® Brake and Parts Cleaner
- use only a plastic or wood scraper (Fig. 128)

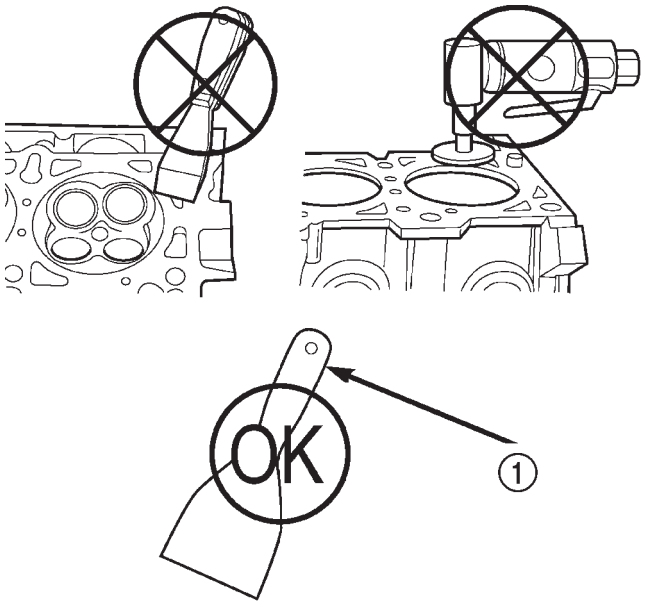


Fig. 128 Proper Tool Usage For Surface Preparation
1 – PLASTIC/WOOD SCRAPER

INSPECTION

(1) Inspect the cylinder head for out-of-flatness, using a straightedge and a feeler gauge. If tolerances exceed 0.0508 mm (0.002 in.) replace the cylinder head.

(2) Inspect the valve seats for damage. Service the valve seats as necessary.

(3) Inspect the valve guides for wear, cracks or looseness. If either condition exist, replace the cylinder head.

PISTON AND CONNECTING ROD

CLEANING

CAUTION: DO NOT use a wire wheel or other abrasive cleaning devise to clean the pistons or connecting rods. The pistons have a Moly coating, this coating must not be damaged.

(1) Using a suitable cleaning solvent clean the pistons in warm water and towel dry.

(2) Use a wood or plastic scraper to clean the ring land grooves.

CLEANING AND INSPECTION (Continued)

CAUTION: DO NOT remove the piston pin from the piston and connecting rod assembly.

INSPECTION

Check the crankshaft connecting rod journal for excessive wear, taper and scoring.

Check the pistons for taper and elliptical shape before they are fitted into the cylinder bore.

Replace any piston and connecting rod not meeting the specifications.

CRANKSHAFT JOURNALS

CLEANING

Use only suitable cleaning solvents. Never use an abrasive cleanser.

INSPECTION

CAUTION: After any journal grind, it is important that the final paper or cloth polish be in the same direction as the engine rotates.

The crankshaft connecting rod and main journals should be checked for excessive wear, taper and scoring. The maximum taper or out-of-round on any crankshaft journal is 0.025 mm (0.001 inch).

Journal grinding should not exceed 0.305 mm (0.012 inch) under the standard journal diameter. DO NOT grind thrust faces of No.3 main bearing. DO NOT nick crank pin or bearing fillets. After grinding, remove rough edges from crankshaft oil holes and clean out all oil passages.

OIL PAN

CLEANING

(1) Clean oil pan in solvent and wipe dry with a clean cloth.

(2) Clean the oil pan gasket surface. **DO NOT** use a grinder wheel or other abrasive tool to clean sealing surface.

(3) Clean oil screen and tube thoroughly in clean solvent.

INSPECTION

(1) Inspect oil drain plug and plug hole for stripped or damaged threads. Repair as necessary.

(2) Inspect the oil pan mounting flange for bends or distortion. Straighten flange, if necessary.

OIL PUMP

CLEANING

(1) Wash all parts in a suitable solvent.

INSPECTION

CAUTION: Oil pump pressure relief valve and spring should not be removed from the oil pump. If the these components are disassembled andør removed from the pump the entire oil pump assembly must be replaced.

(1) Clean all parts thoroughly. Mating surface of the oil pump housing should be smooth. If the pump cover is scratched or grooved the oil pump assembly should be replaced.

(2) Lay a straight edge across the pump cover surface (Fig. 129). If a 0.025 mm (0.001 in.) feeler gauge can be inserted between the cover and the straight edge the oil pump assembly should be replaced.

(3) Measure the thickness of the outer rotor (Fig. 130). If the outer rotor thickness measures at 12.005 mm (0.400 in.) or less the oil pump assembly must be replaced.

(4) Measure the diameter of the outer rotor. If the outer rotor diameter measures at 85.925 mm (0.400 in.) or less the oil pump assembly must be replaced.

(5) Measure the thickness of the inner rotor (Fig. 131). If the inner rotor thickness measures at 12.005 mm (0.400 in.) or less then the oil pump assembly must be replaced.

(6) Slide outer rotor into the body of the oil pump. Press the outer rotor to one side of the oil pump body and measure clearance between the outer rotor and the body (Fig. 132). If the measurement is 0.47mm (0.0186 in.) or more the oil pump assembly must be replaced.

(7) Install the inner rotor in the into the oil pump body. Measure the clearance between the inner and outer rotors (Fig. 133). If the clearance between the rotors is.150 mm (0.006 in.) or more the oil pump assembly must be replaced.

(8) Place a straight edge across the body of the oil pump (between the bolt holes), if a feeler gauge of .095 mm (0.0038 in.) or greater can be inserted between the straightedge and the rotors, the pump must be replaced (Fig. 134).

NOTE: 4.7 Oil pump is released as an assembly. There are no Chrysler part numbers for Sub-Assembly components. In the event the oil pump is not functioning or out of specification it must be replaced as an assembly.

CLEANING AND INSPECTION (Continued)

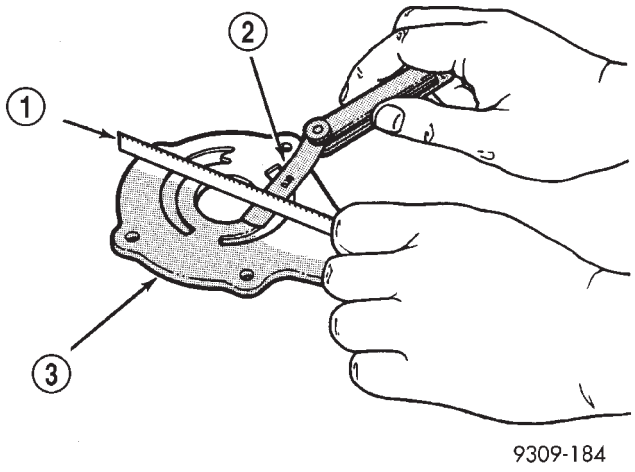


Fig. 129 Checking Oil Pump Cover Flatness

1 – STRAIGHT EDGE
2 – FEELER GAUGE
3 – OIL PUMP COVER

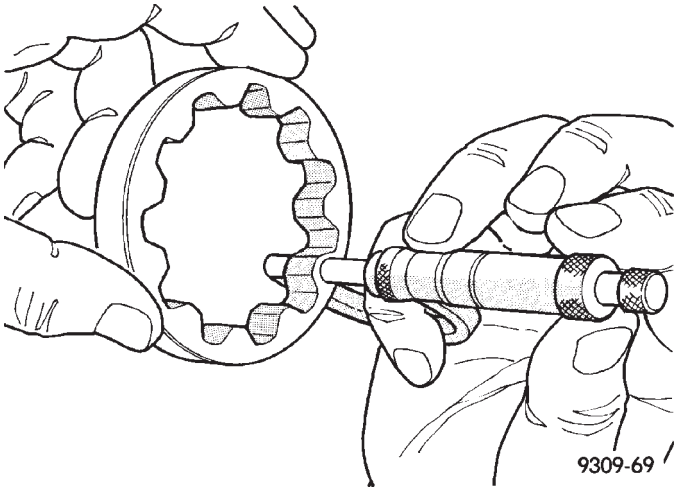


Fig. 130 Measuring Outer Rotor Thickness

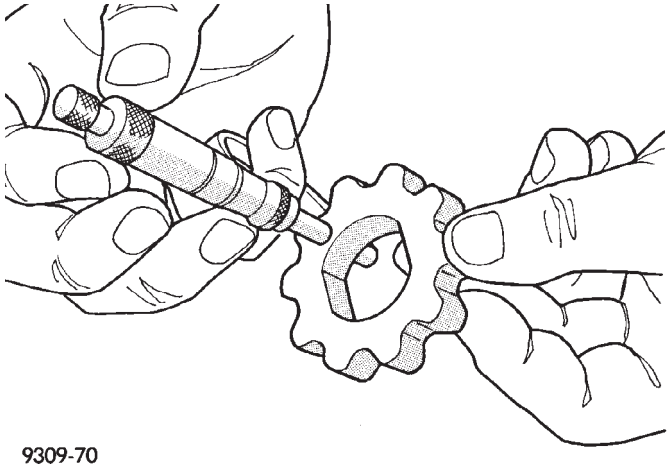


Fig. 131 Measuring Inner Rotor Thickness

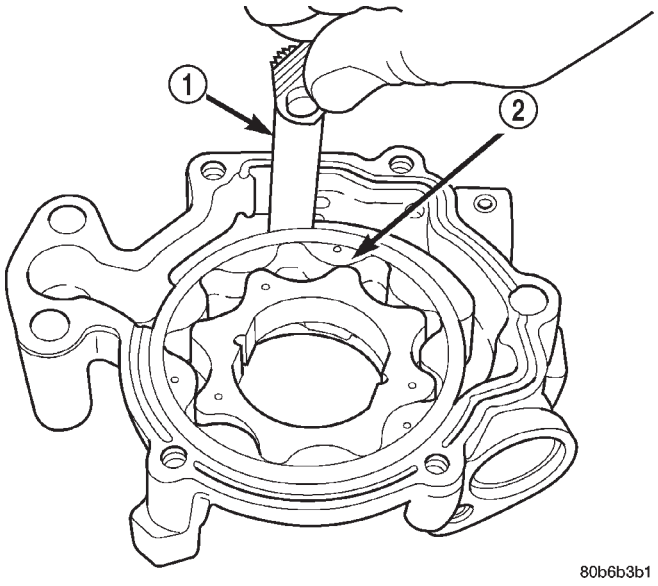


Fig. 132 Measuring Outer Rotor Clearance in Housing

1 – FEELER GAUGE
2 – OUTER ROTOR

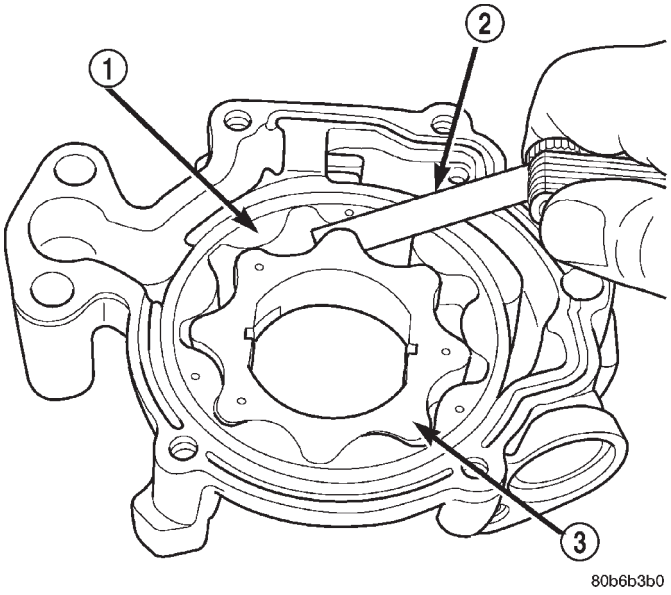


Fig. 133 Measuring Clearance Between Rotors

1 – OUTER ROTOR
2 – FEELER GAUGE
3 – INNER ROTOR

CLEANING AND INSPECTION (Continued)

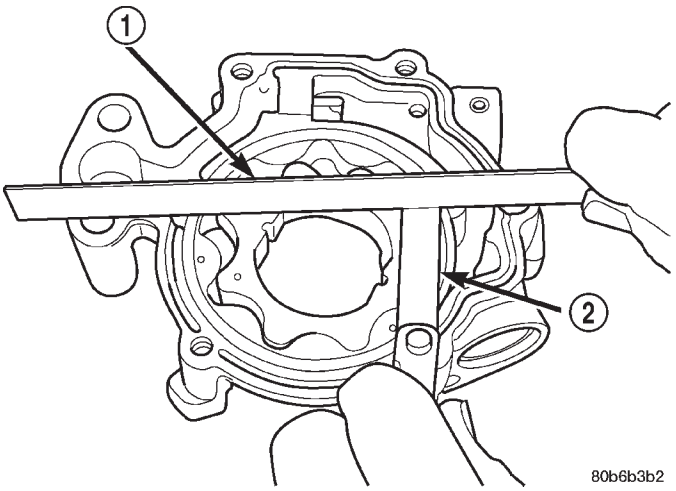


Fig. 134 Measuring Clearance Over Rotors

1 – STRAIGHT EDGE
2 – FEELER GAUGE

CYLINDER BLOCK

CLEANING

Thoroughly clean the oil pan and engine block gasket surfaces.

Use compressed air to clean out:

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

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

INSPECTION

(1) It is mandatory to use a dial bore gauge to measure each cylinder bore diameter. To correctly select the proper size piston, a cylinder bore gauge, capable of reading in 0.003 mm (.0001 in.) INCREMENTS is required. If a bore gauge is not available, do not use an inside micrometer (Fig. 135).

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

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

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

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

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

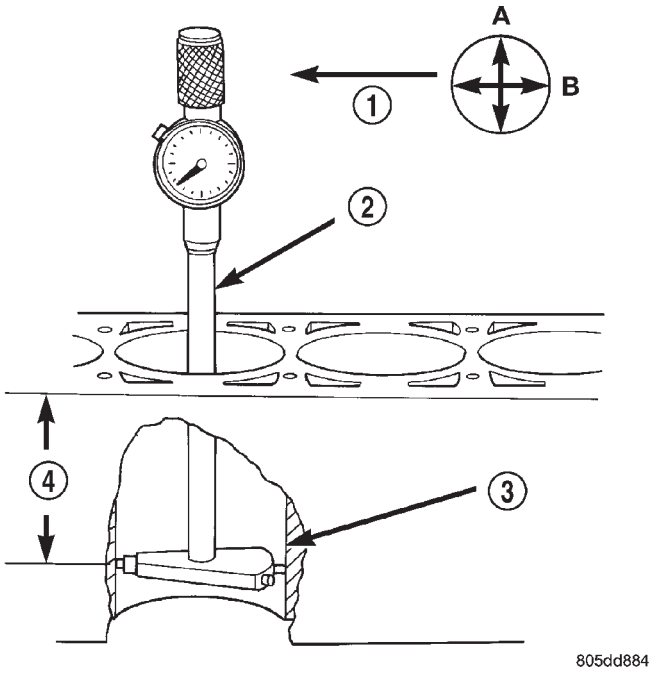


Fig. 135 Bore Gauge—Typical

1 – FRONT
2 – BORE GAUGE
3 – CYLINDER BORE
4 – 49.5 MM (1–15/16 in)

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

SPECIFICATIONS

4.7L ENGINE

DESCRIPTION	SPECIFICATION
GENERAL SPECIFICATIONS	
Engine Type	90° SOHC V-8 16-Valve
Displacement	4.7 Liters / 4701cc (287 Cubic Inches)
Bore	93.0 mm (3.66 in.)
Stroke	86.5 mm (3.40 in.)
Compression Ratio	9.0:1
Cylinder Compression Pressure	965-1241 Kpa (140-180 PSI)
Horsepower	235 BHP @ 4800 RPM
Torque	295 LB-FT @ 3200 RPM

SPECIFICATIONS (Continued)

DESCRIPTION	SPECIFICATION
Lead Cylinder	#1 Left Bank
Firing Order	1-8-4-3-6-5-7-2
CYLINDER BLOCK	
Cylinder Block	Cast Iron
Bore Diameter	93.010 ±.0075 mm (3.6619 ± 0.0003 in.)
Out of Round (MAX)	0.076 mm (0.003 in.)
Taper (MAX)	0.051 mm (0.002 in.)
PISTONS	
Material	Aluminum Alloy
Diameter	92.975 mm (3.6605 in.)
Weight	367.5 grams (12.96 oz)
Ring Groove Diameter	
No. 1	83.73 - 83.97 mm (3.296 - 3.269 in.)
No. 2	82.833 - 83.033 mm (3.261 - 3.310 in.)
No. 3	83.88 - 84.08 mm (3.302 - 3.310 in.)
PISTON PINS	
Type	Pressed Fit
Clearance In Piston	0.010 - 0.019 mm (0.0004 - 0.0008 in.)
Diameter	24.013 - 24.016 mm (0.9454 - 0.9456 in.)
PISTON RINGS	
Ring Gap	
Top Compression Ring	0.37 - 0.63 mm (0.0146 - 0.0249 in.)
Second Compression Ring	0.37 - 0.63 mm (0.0146 - 0.0249 in.)
Oil Control (Steel Rails)	0.25 - 0.76 mm (0.0099 - 0.30 in.)
Side Clearance	
Top Compression Ring	.051 -.094 mm (0.0020 - 0.0037 in.)
Second Compression Ring	0.040 - 0.080 mm (0.0016 - 0.0031 in.)
Oil Ring (Steel Ring)	.019 -.229 mm (.0007 -.0091 in.)
Ring Width	
Top Compression Ring	1.472 - 1.490 mm (0.057 - 0.058 in.)
Second Compression Ring	1.472 - 1.490 mm (0.057 - 0.058 in.)
Oil Ring (Steel Rails)	0.445 - 0.470 mm (0.017 - 0.018 in.)
CONNECTING RODS	
Bearing Clearance	0.010 - 0.048 mm (0.0004 - 0.0019 in.)
Side Clearance	0.10 - 0.35 mm (0.004 - 0.0138 in.)
Piston Pin Bore Diameter (Interference Fit)	.022 -.045 mm (0.0009 - 0.0018 in.)
Bearing Bore Out of Round (MAX)	0.004 mm (0.0002 in.)
Total Weight (Less Bearing)	578 grams (20.388 ounces)
CRANKSHAFT	
Main BearingJournal	
Diameter	63.488 - 63.512 mm (2.4996 - 2.5005 in.)
Bearing Clearance	0.004 - 0.032 mm (0.0002 - 0.0013 in.)
Out of Round (MAX)	0.005 mm (0.0002 in.)
Taper (MAX)	0.008 mm (0.0004 in.)
End Play	0.052 - 0.282 mm (0.0021 - 0.0112 in.)
End Play (MAX)	0.282 mm (0.0112 in)
Connecting Rod Journal	
Diameter	50.992 - 51.008 mm (2.0076 - 2.0082 in.)
Bearing Clearance	0.010 - 0.048 mm (0.0004 -0.0019 in.)
Out of Round (MAX)	0.005 mm (0.0002 in.)
Taper (MAX)	0.008 mm (0.0004 in.)

SPECIFICATIONS (Continued)

DESCRIPTION	SPECIFICATION
CAMSHAFT	
Bore Diameter	26.02 - 26.04 mm
	(1.0245 - 1.0252 in.)
Bearing Journal Diameter	25.975 - 25.995 mm
	(1.0227 - 1.0235 in.)
Bearing Clearance	0.025 - 0.065 mm
	(0.001 - 0.0026 in.)
Bearing Clearance (MAX)	0.065 mm (0.0026 in.)
End Play	.075 -.200 mm
	(0.003 - 0.0079 in.)
End Play (MAX)	.200 mm (0.0079 in.)
VALVE TIMING	
Intake	
Opens (ATDC)	3.6°
Closes (ATDC)	247.1°
Duration	243.5°
Exhaust	
Opens (BTDC)	232.5°
Closes (ATDC)	21.2°
Duration	253.70°
Valve Overlap	17.6°
VALVES	
Face Angle	45° - 45.5°
Head Diameter	
Intake	48.52 - 48.78 mm
	(1.9103 - 1.9205 in.)
Exhaust	36.87 - 37.13 mm
	1.4516 - 1.4618 in.)
Length (Overall)	
Intake	113.45 - 114.21 mm
	(4.4666 - 4.4965)
Exhaust	114.92 - 115.68 mm
	(4.5244 - 4.5543 in.)
Stem Diameter	
Intake	6.931 - 6.957 mm
	(0.2729 - 0.2739 in.)
Exhaust	6.902 - 6.928 mm
	(0.2717 - 0.2728 in.)

DESCRIPTION	SPECIFICATION
Stem - to - Guide Clearance	
Intake	.018 -.069 mm
	(0.0008 - 0.0028 in.)
Exhaust	.047 -.098 mm
	(0.0019 - 0.0039 in.)
Max. Allowable Stem - to - Guide Clearance (Rocking Method)	
Intake	0.069 mm (0.0028 in.)
Exhaust	0.098 mm (0.0039 in.)
Valve Lift (Zero Lash)	
Intake	11.25 mm (0.443 in.)
Exhaust	10.90 mm (0.4292 in.)
VALVE SPRING	
Free Lenght (Approx)	
Intake and Exhaust	48.6 mm (1.9134 in.)
Spring Force (Valve Closed)	
Intake and Exhaust	315.5 - 352.5 N @ 40.89 mm
	(70.92722 - 79.24515lbs. @ 1.6099 in.)
Spring Force (Valve Open)	
Intake and Exhaust	786.0 - 860.0 N @ 29.64 mm
	176.6998 - 193.3357 lbs. @ 1.167 in.)
Number of Coils	
Intake and Exhaust	6.69
Wire Diameter	
Intake and Exhaust	4.2799 - 4.3561 mm
	(0.1685 - 0.1715 in.)

SPECIFICATIONS (Continued)

DESCRIPTION	SPECIFICATION
Installed Height (Spring Seat to Bottom of Retainer)	
Nominal	
Intake	40.97 mm (1.613 in.)
Exhaust	40.81 mm (1.606 in.)
CYLINDER HEAD	
Gasket Thickness (Compressed)	.7 mm (0.0276 in.)
Valve Seat Angle	44.5° - 45.0°
Valve Seat Runout (MAX)	0.051 mm (0.002 in.)
Valve Seat Width	
Intake	1.75 - 2.36 mm (0.0698 - 0.0928 in.)
Exhaust	1.71 - 2.32 mm (0.0673 - 0.0911 in.)
Guide Bore Diameter (Std.)	6.975 - 7.00 mm (0.2747 - 0.2756 in.)
Cylinder Head Warpage (Flatness)	0.0508 mm (0.002 in.)
OIL PUMP	
Clearance Over Rotors (MAX)	.035 -.095 mm (0.0014 - 0.0038 in.)
Cover Out - of -Flat (MAX)	.025 mm (0.001 in.)
Inner and Outer Rotor Thickness	12.08 mm (0.4756 in.)
Outer Rotor Clearance (MAX)	85.96 mm (3.3843 in.)
Outer Rotor Diameter (MIN)	85.925 mm (0.400 in.)
Tip Clearance Between Rotors (MAX)	.150 mm (0.006 in.)
OIL PRESSURE	
At Curb Idle Speed (MIN)*	25 kPa (4 psi)
@ 3000 rpm	170 - 550 kPa (25 - 80 psi)

DESCRIPTION	SPECIFICATION
*** CAUTION: If pressure is zero at curb idle, DO NOT run engine at 3000 rpm.**	

TORQUE

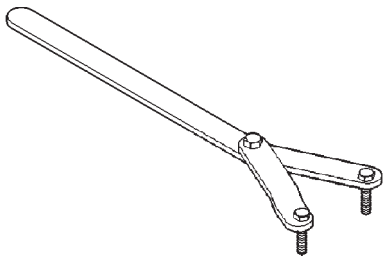
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Camshaft			
Non - Oiled Sprocket Bolt	122	90	—
Bearing Cap Bolts	11	—	100
Timing Chain Cover—Bolts	54	40	—
Connecting Rod Cap—Bolts	27	20	—
	PLUS 90° TURN		
Bed Plate—Bolts	Refer to Procedure		
Crankshaft Damper—Bolt	175	130	—
Cylinder Head—Bolts			
M11 Bolts	81	60	—
M8 Bolts	28	—	250
Cylinder Head Cover—Bolts	12	—	105
Exhaust Manifold—Bolts	25	18	—
Exhaust Manifold Heat Shield—Nuts	8	—	72
	Then loosen 45°		
Flexplate—Bolts	60	45	—
Engine Mount Bracket to Block—Bolts	61	45	—
Rear Mount to Transmission—Bolts	46	34	—
Generator Mounting—Bolts			
M10 Bolts	54	40	—
M8 Bolts	28	—	250
Intake Manifold—Bolts	12	—	105
	Refer to Procedure for Tightening Sequence		
Oil Pan—Bolts	15	—	130
Oil Pan—Drain Plug	34	25	—
Oil Pump—Bolts	28	—	250
Oil Pump Cover—Bolts	12	—	105
Oil Pickup Tube—Bolt and Nut	28	—	250

SPECIFICATIONS (Continued)

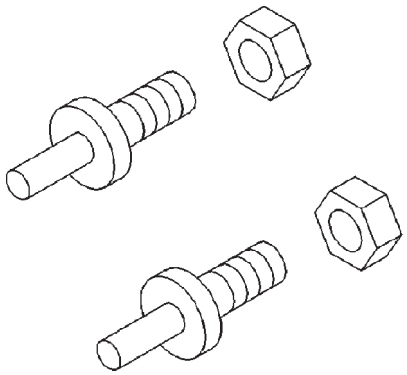
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Oil Dipstick Tube—Bolt	28	—	250
Oil Fill Tube—Bolts	12	—	105
Timing Chain Guide—Bolts	28	—	250
Timing Chain Tensioner Arm—Special Pin Bolt	17	—	150
Hydraulic Tensioner—Bolts	28	—	250
Timing Chain Primary Tensioner—Bolts	28	—	250
Timing Drive Idler Sprocket—Bolt	34	25	—
Thermostat Housing—Bolts	12	—	105
Water Pump—Bolts	54	40	—

SPECIAL TOOLS

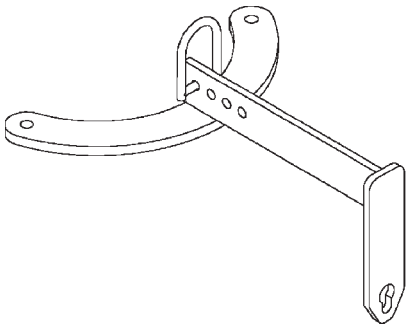
4.7L ENGINE



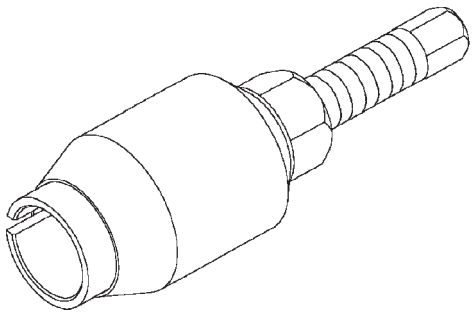
Spanner Wrench 6958



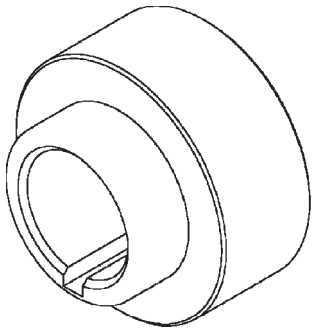
Adapter Pins 8346



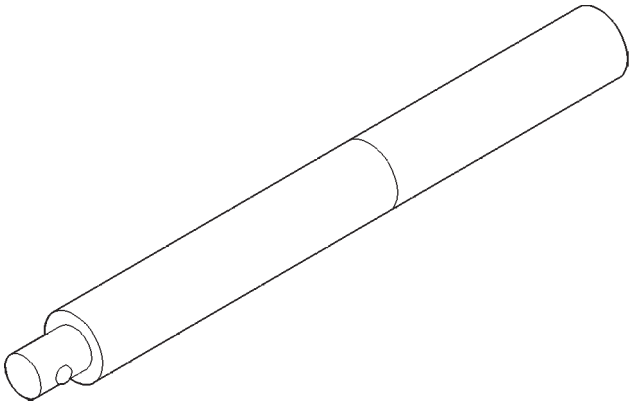
Engine Lift Fixture 8347



Front Crankshaft Seal Remover 8511

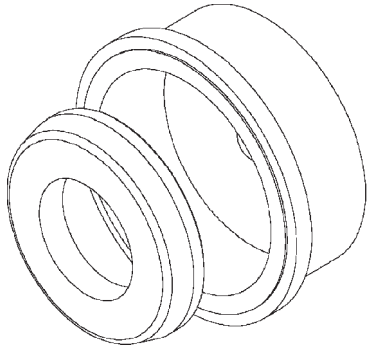


Front Crankshaft Seal Installer 8348

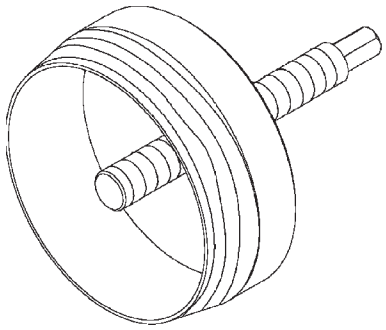


Handle C-4171

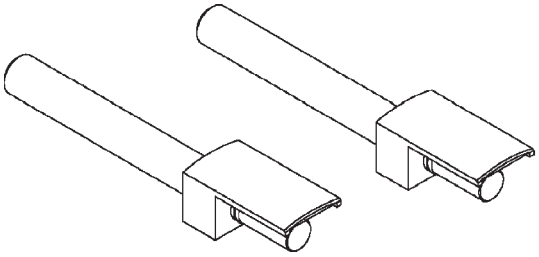
SPECIAL TOOLS (Continued)



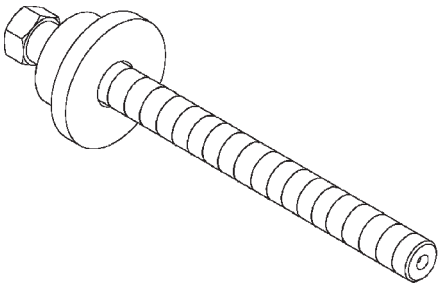
Rear Crankshaft Seal Installer 8349



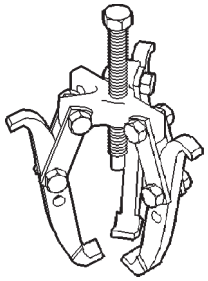
Rear Crankshaft Seal Remover 8506



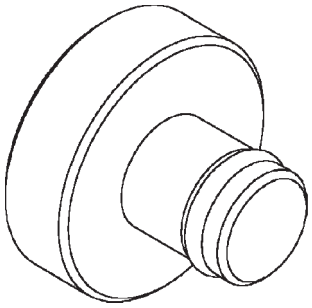
Connecting Rod Guides 8507



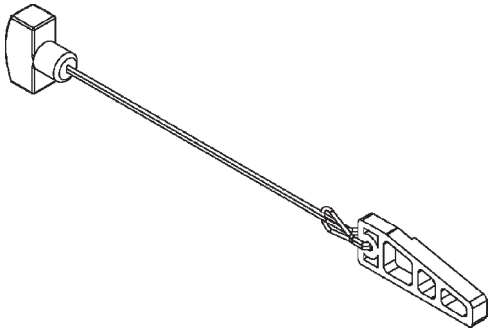
Crankshaft Damper Installer 8512



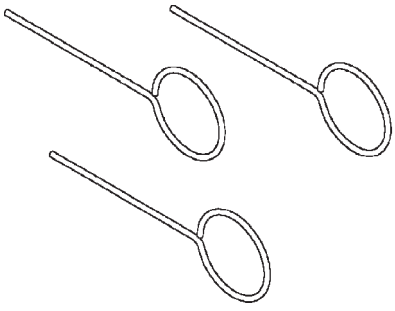
Puller 1026



Crankshaft Damper Removal Insert 8513

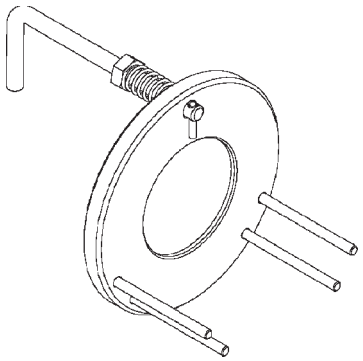


Chain Tensioner Wedge 8350

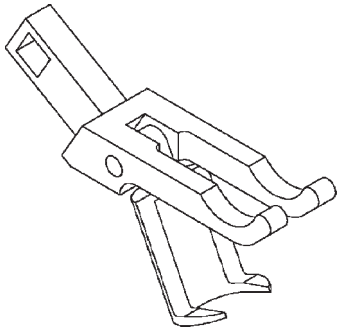


Chain Tensioner Pins 8514

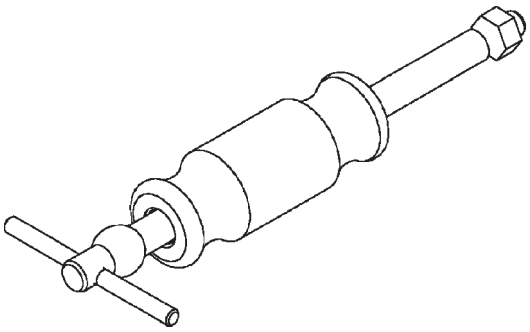
SPECIAL TOOLS (Continued)



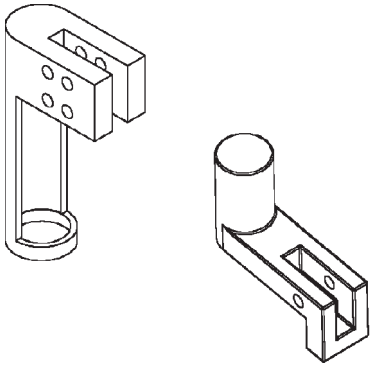
Secondary Chain Holder 8515



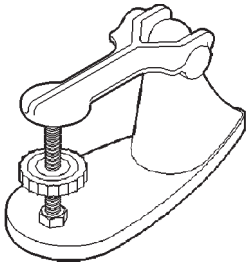
Remover, Rocker Arm 8516



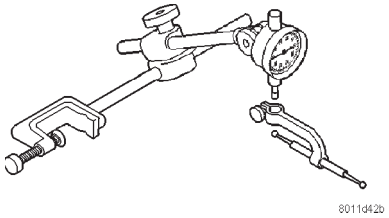
Idler Shaft Remover 8517



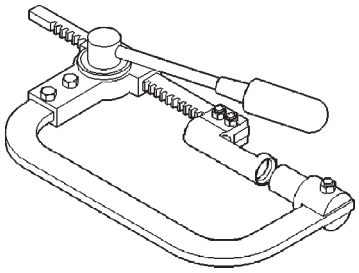
Valve Spring Compressor Adapters 8519



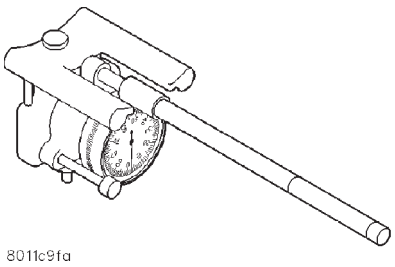
Valve Spring Tester C-647



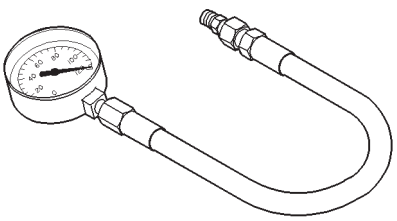
Dial Indicator C-3339



Valve Spring Compressor C-3422-B

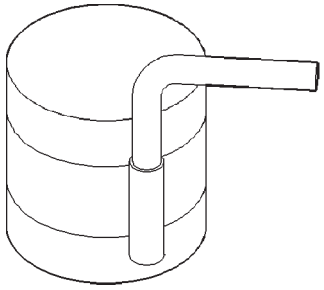


Bore Size Indicator C-119

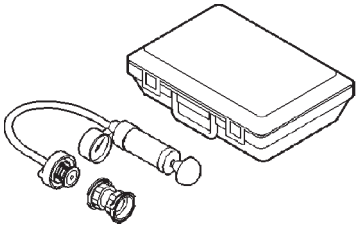


Oil Pressure Gauge C-3292

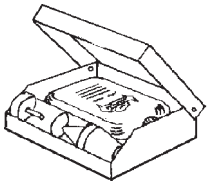
SPECIAL TOOLS (Continued)



Piston Ring Compressor C-385



Pressure Tester Kit 7700



Bloc–Chek–Kit C-3685–A