4.0L ENGINE

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DESCRIPTION AND OPERATION

ENGINE

DESCRIPTION

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

This engine is designed for unleaded fuel. The engine cylinder head has dual quench-type combustion chambers that create turbulence and fast burning of the air/fuel mixture. This results in good 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).

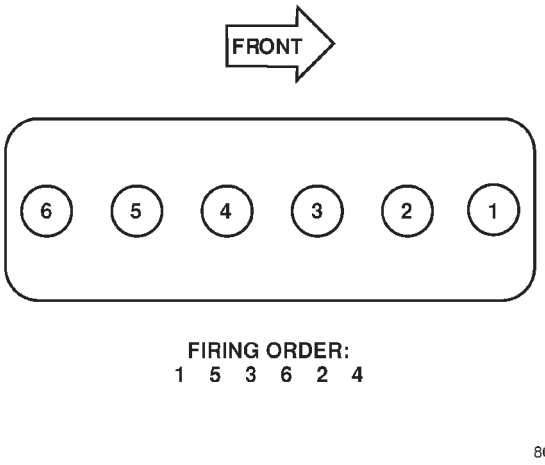


Fig. 1 Engine Firing Order

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.

BUILD DATE CODE

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

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.

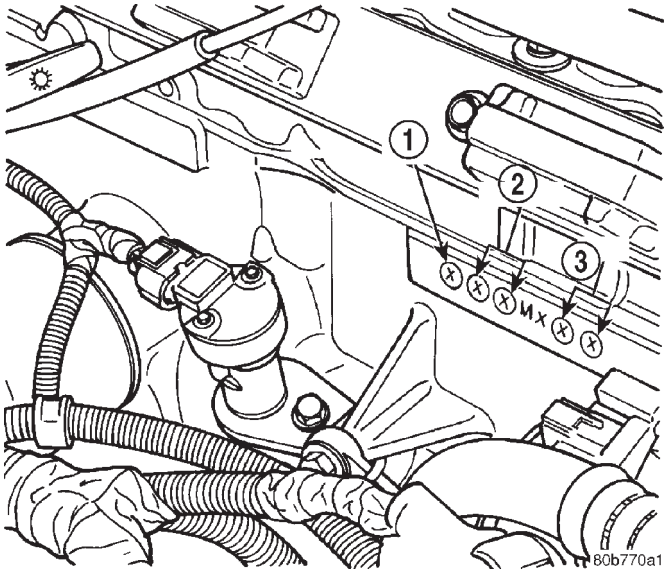


Fig. 2 Build Date Code Location

1 – YEAR
2 – MONTH
3 – DAY

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, distributor drive gear, cylinder walls, and piston pins.

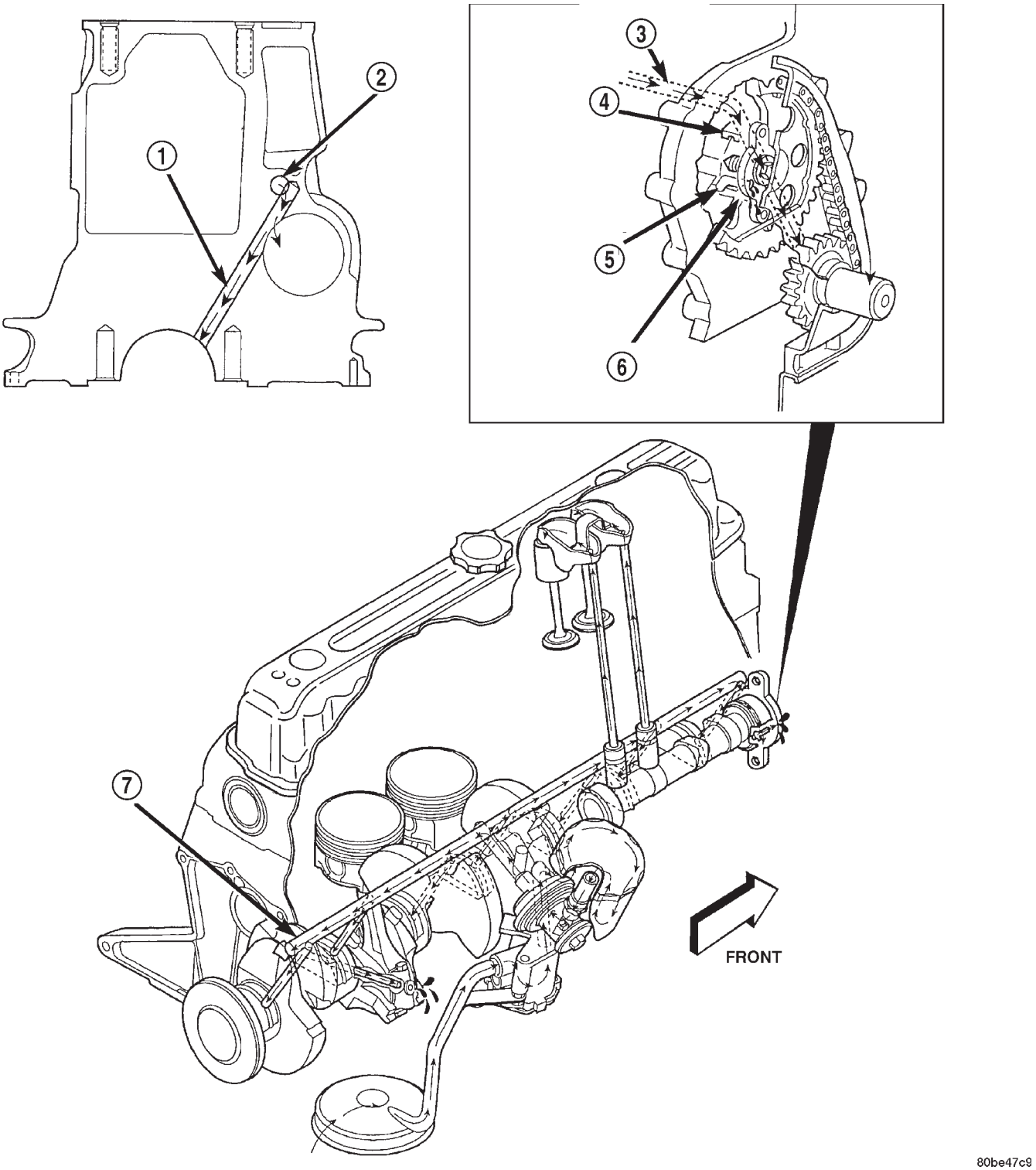
The hydraulic valve tappets receive oil directly from the main oil gallery. Oil is provided to the camshaft bearing through galleries. The front camshaft bearing journal passes oil through the camshaft

DESCRIPTION AND OPERATION (Continued)

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

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

DESCRIPTION AND OPERATION (Continued)

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).

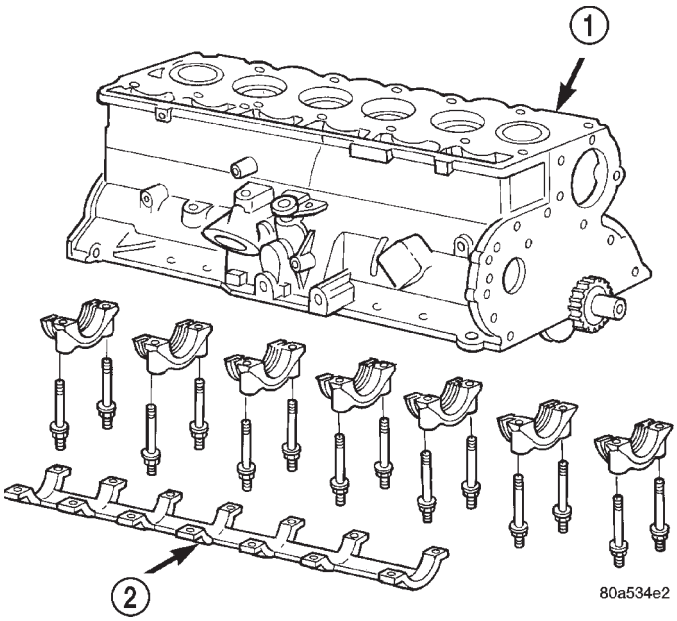


Fig. 3 4.0L Cylinder Block with Main Bearing Caps and Cap Brace

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).

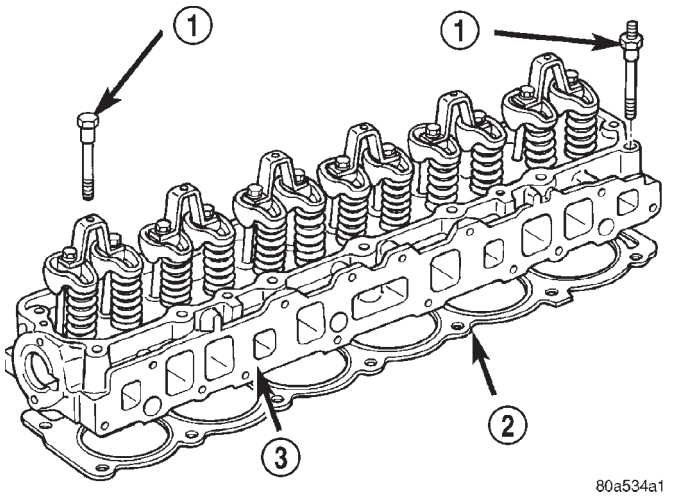


Fig. 4 Cylinder Head 4.0L Engine

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).

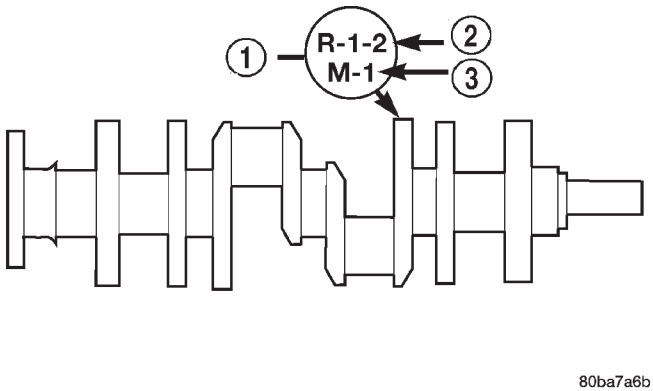


Fig. 5 Crankshaft with Select Fit Marking Location

1 – 1/4" LETTERS
2 – (ROD)
3 – (MAIN)

DESCRIPTION AND OPERATION (Continued)

PISTON AND CONNECTING ROD

DESCRIPTION

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 ductile iron. A pressed fit piston pin is used to attach the piston and connecting rod.

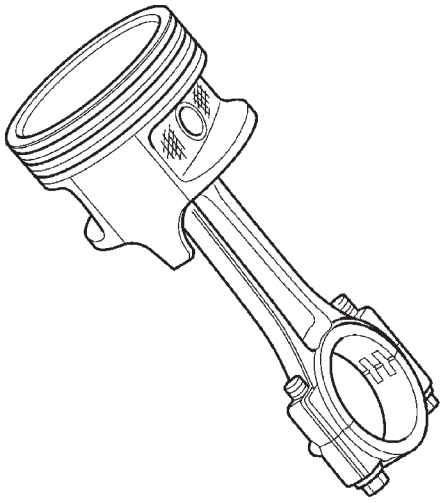


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Fig. 6 Piston and Connecting Rod Assembly

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).

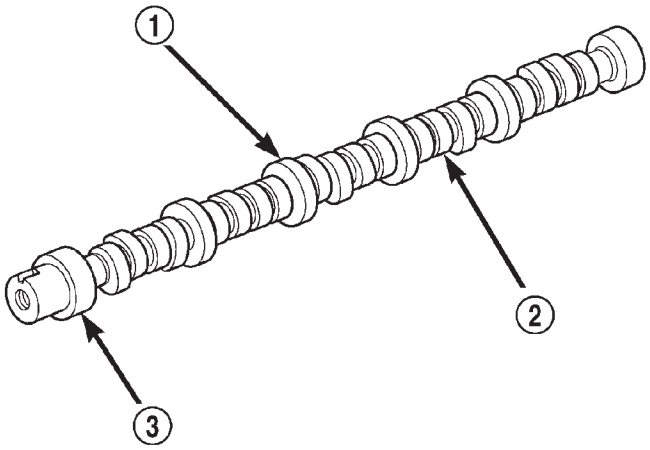

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Fig. 7 Camshaft—Typical

1 – CAMSHAFT
2 – LOBES
3 – BEARING JOURNAL

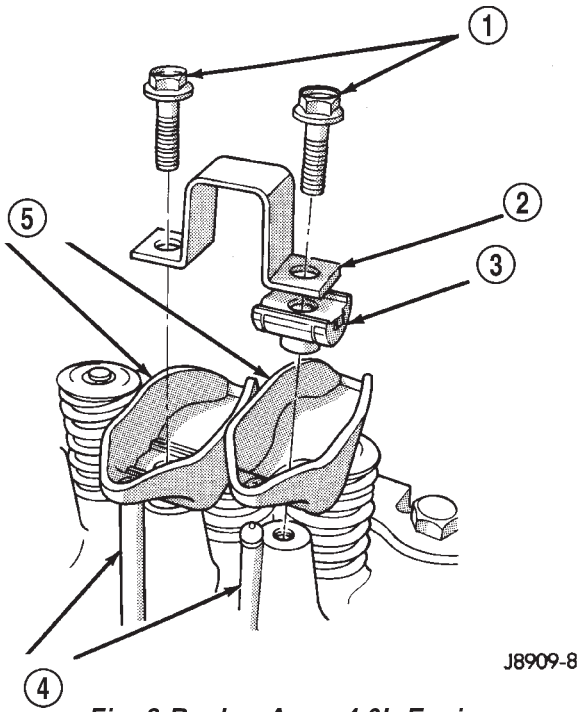


Fig. 8 Rocker Arms 4.0L Engine

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).

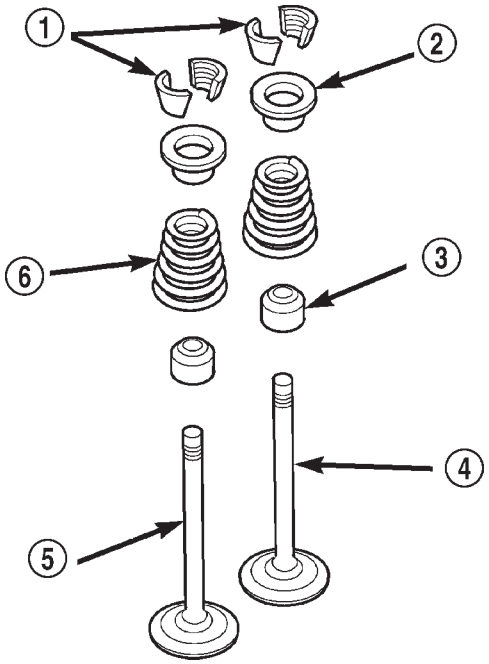


Fig. 9 Valve and Keeper Configuration 4.0L Engine

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).

CYLINDER HEAD COVER

DESCRIPTION

The cylinder head cover (Fig. 10) is made of stamped steel and incorporates the Crankcase Ventilation (CCV) Hoses and the oil fill opening.

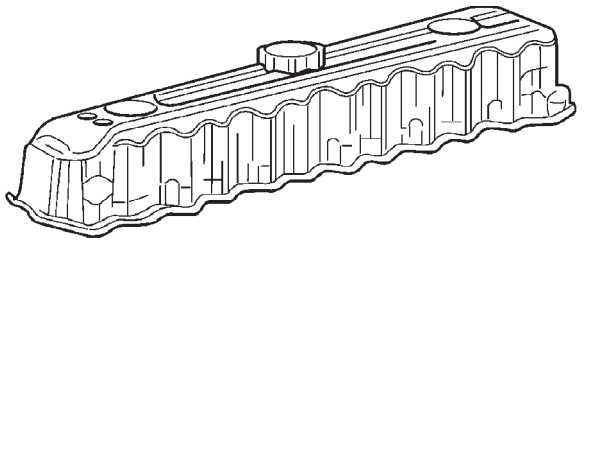


Fig. 10 Cylinder Head Cover

HYDRAULIC TAPPET

DESCRIPTION

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

VALVE GUIDE

DESCRIPTION

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

OIL PAN

DESCRIPTION

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

VALVE STEM SEAL

DESCRIPTION

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

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.

DESCRIPTION AND OPERATION (Continued)

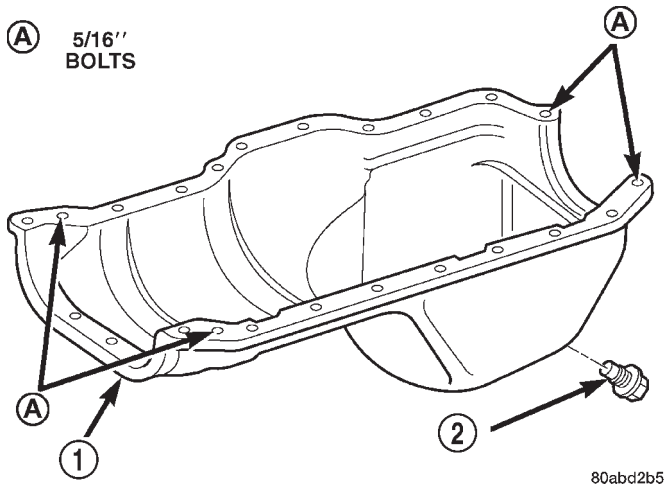


Fig. 11 Oil Pan

1 – OIL PAN
2 – OIL PAN DRAIN PLUG

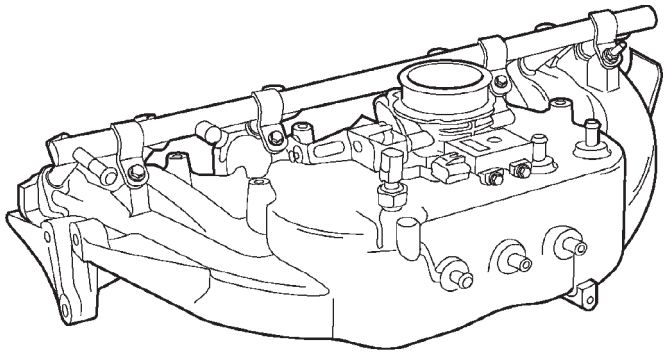


Fig. 12 Intake Manifold 4.0L Engine

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.

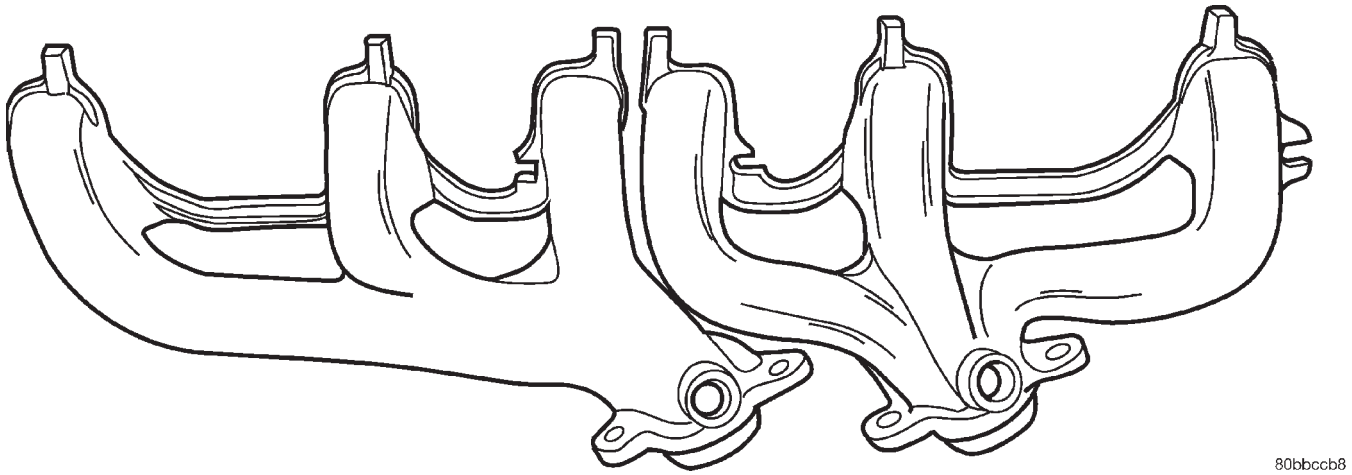


Fig. 13 Exhaust Manifolds 4.0L Engine

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

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	12. Faulty ignition coil	12. Test and replace, as necessary (Refer to Group 8D, ignition system)
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

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
	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
	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

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
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
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

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.

DIAGNOSIS AND TESTING (Continued)

(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) 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.

ENGINE CYLINDER HEAD GASKET FAILURE DIAGNOSIS

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

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

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

CYLINDER-TO-CYLINDER LEAKAGE TEST

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

CYLINDER-TO-WATER JACKET LEAKAGE TEST

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

Remove the radiator cap.

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

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

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

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

CYLINDER COMBUSTION PRESSURE LEAKAGE TEST

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

Combustion pressure leakage testing will detect:

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

(1) Check the coolant level and fill as required. DO NOT install the radiator cap.
(2) Start and operate the engine until it attains normal operating temperature, then turn the engine OFF.
(3) 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.

DIAGNOSIS AND TESTING (Continued)

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.

(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

DIAGNOSIS AND TESTING (Continued)

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

VALVE TIMING

Disconnect the spark plug wires and remove the 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.

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. 14). If the margin is less than 0.787 mm (0.031 inch), the valve must be replaced.

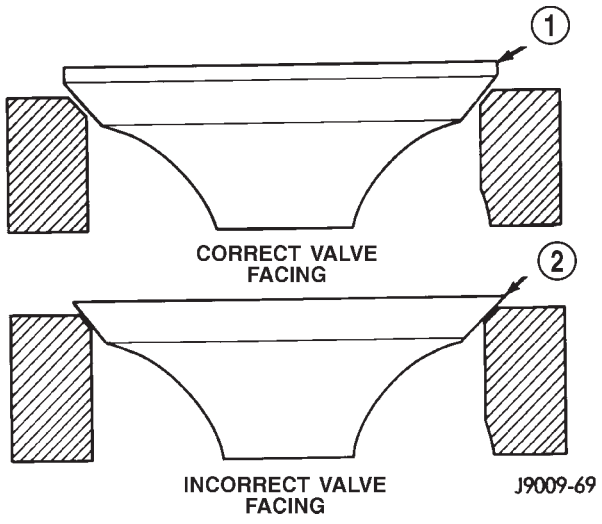


Fig. 14 Valve Facing Margin

1 – VALVE MARGIN
2 – NO MARGIN

SERVICE PROCEDURES (Continued)

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. 15).

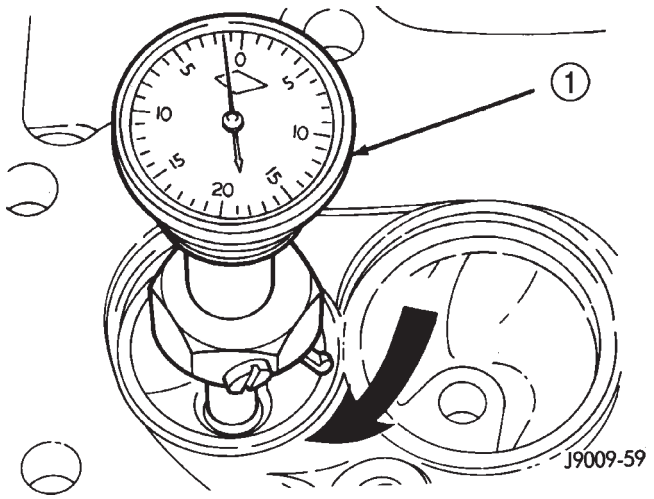


Fig. 15 Measurement of Valve Seat Runout

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. 16).

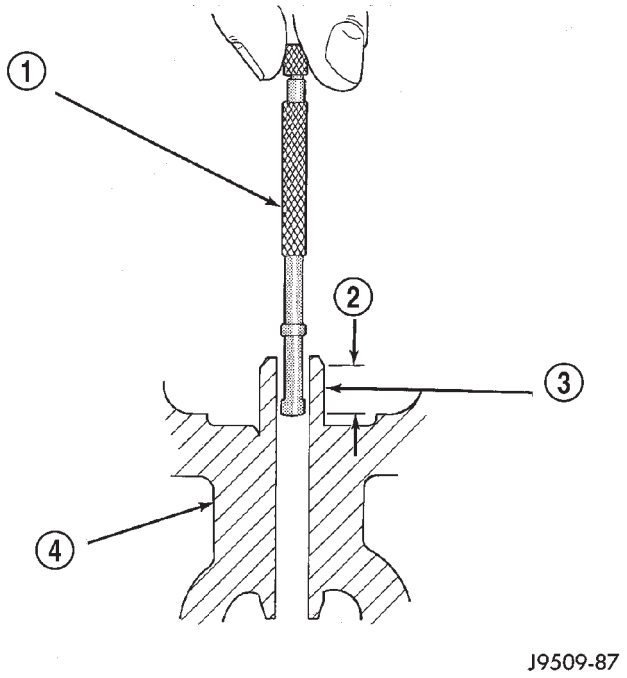


Fig. 16 Measurement of Valve Guide Bore Diameter

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.

(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.

SERVICE PROCEDURES (Continued)

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. 17).

(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.

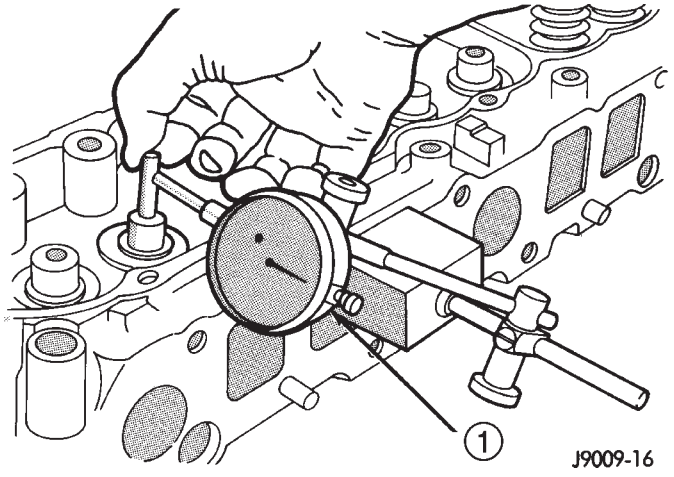


Fig. 17 Measurement of Lateral Movement of Valve Stem

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. 18).

Replace valve springs that are not within specifications.

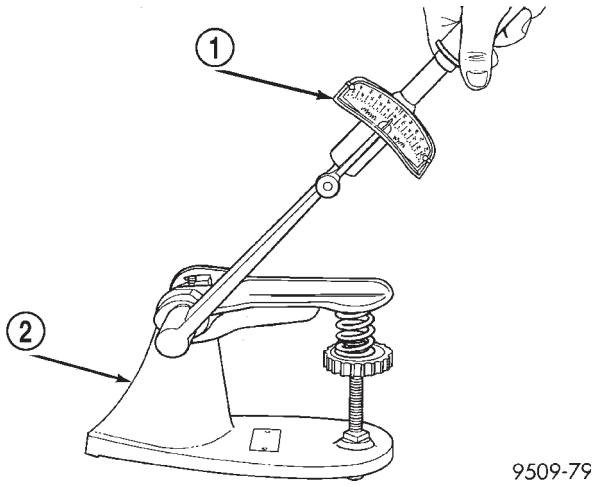


Fig. 18 Valve Spring Tester

1 – TORQUE WRENCH
2 – VALVE SPRING TESTER

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. 20).

(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. 19). Therefore measuring the inside diameter of the cylinder bore with a dial Bore Gauge is **MANDATORY**. To correctly select the proper size piston, a cylinder bore gauge capable of reading in 0.003 mm (.0001 in.) increments is required.

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

PISTON 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. 21) (Fig. 22). Rotate the ring in the groove. It must move freely around circumference of the groove.

(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. 23).

SERVICE PROCEDURES (Continued)

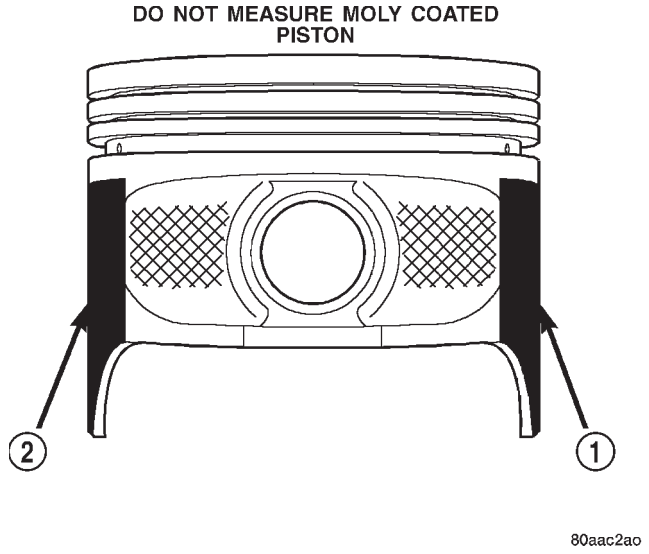


Fig. 19 Moly Coated Piston

1 – MOLY COATED
2 – MOLY COATED

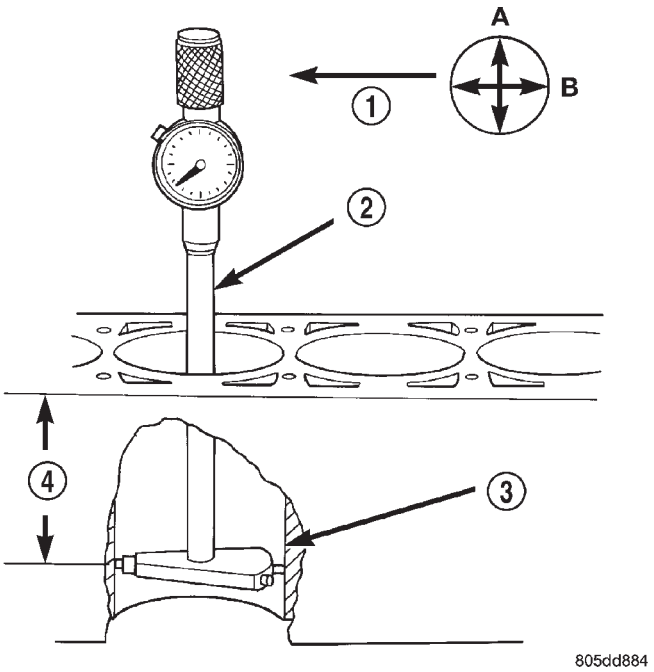


Fig. 20 Bore Gauge

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

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)

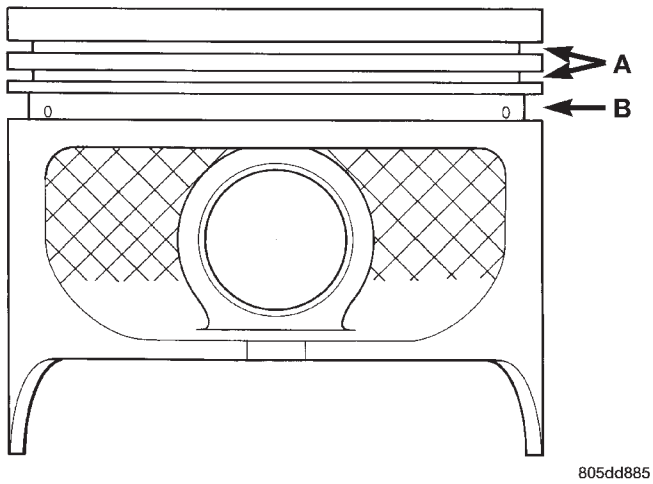


Fig. 21 Piston Dimensions

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

(6) The two compression rings are different and cannot be interchanged. The top compression ring can be identified by the shiny coating on the outer sealing surface and can be installed with either side up. (Fig. 24).

SERVICE PROCEDURES (Continued)

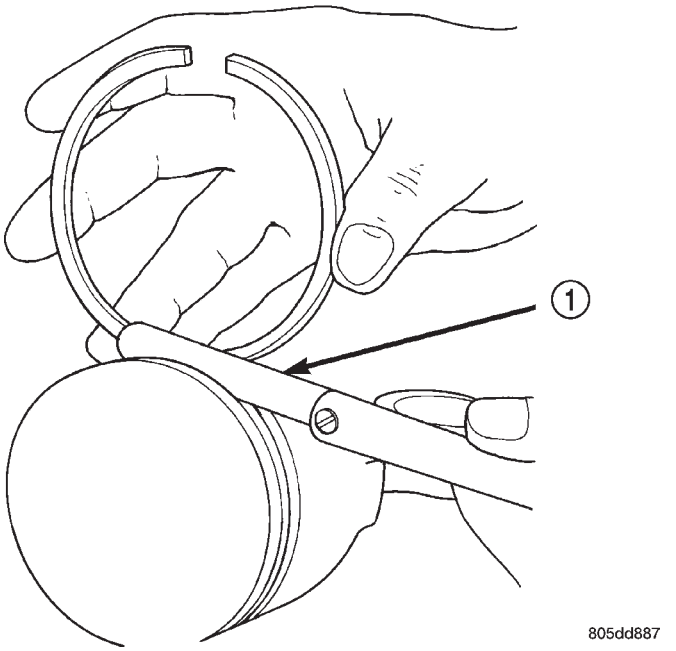


Fig. 22 Ring Side Clearance Measurement
1 – FEELER GAUGE

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.)

(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. 25).

(8) Using a ring installer, install the second compression ring with the dot facing up (Fig. 25) (Fig. 27).

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

Ring Gap Orientation

- Position the gaps on the piston as shown (Fig. 28).
- Oil spacer - Gap on center line of piston skirt.
- Oil rails - gap 180° apart on centerline of piston pin bore.

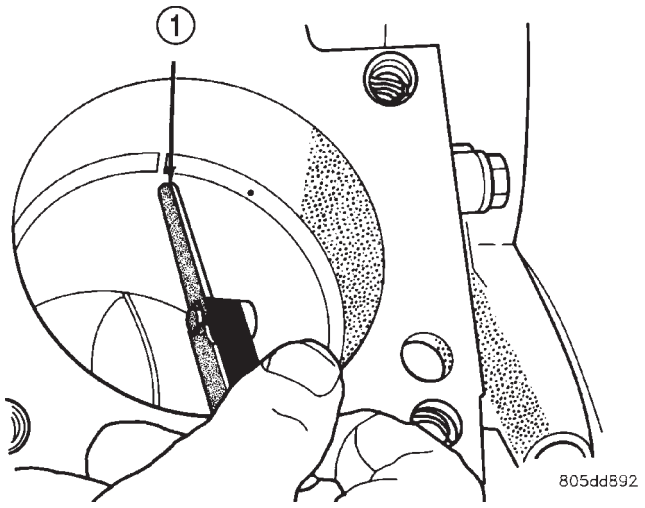


Fig. 23 Gap Measurement
1 – FEELER GAUGE

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.)

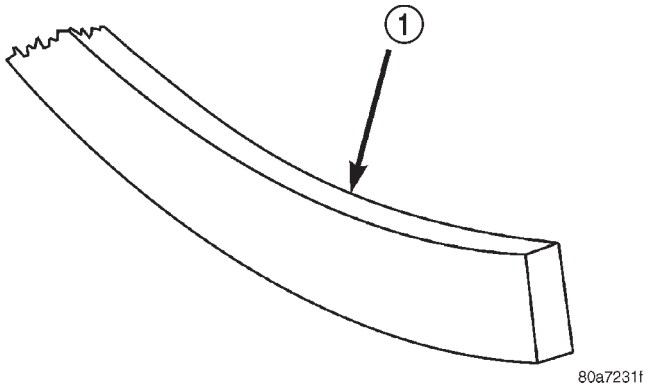


Fig. 24 Top Compression ring identification
1 – TOP COMPRESSION RING

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

SERVICE PROCEDURES (Continued)

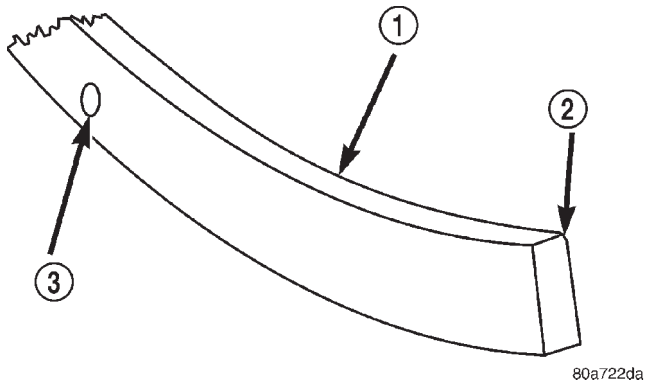


Fig. 25 Second Compression Ring Identification

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

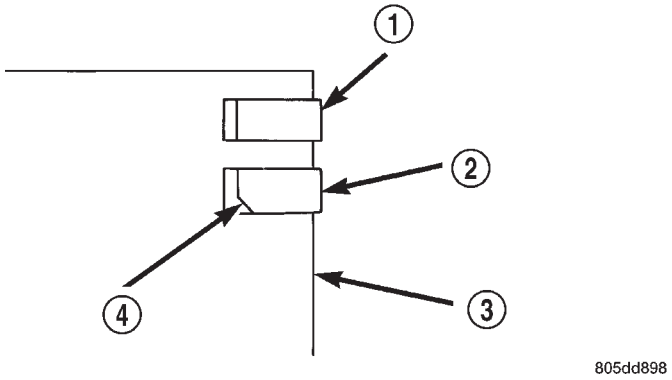


Fig. 26 Compression Ring Chamfer Location

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

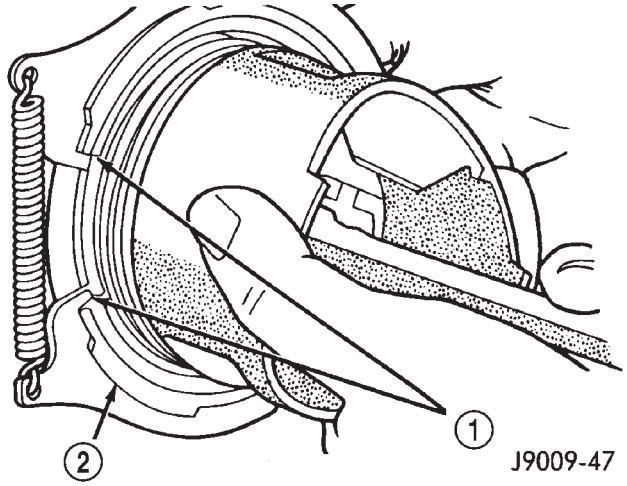


Fig. 27 Compression Ring Installation

1 – COMPRESSION RING
2 – RING EXPANDER RECOMMENDED

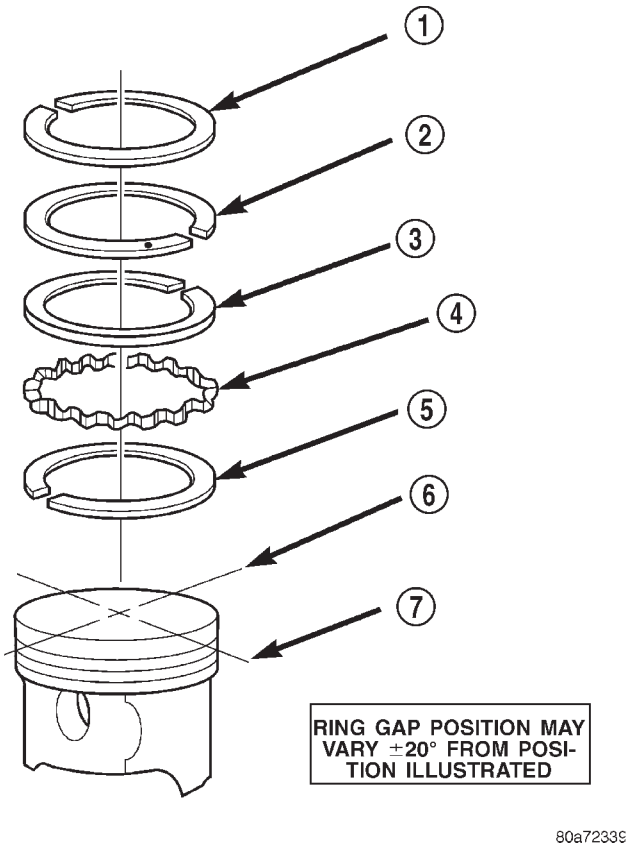


Fig. 28 Ring Gap Orientation

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. 29) (Fig. 30). Check the bearings for normal wear patterns, scoring, grooving, fatigue and pitting (Fig. 31). 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 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

SERVICE PROCEDURES (Continued)

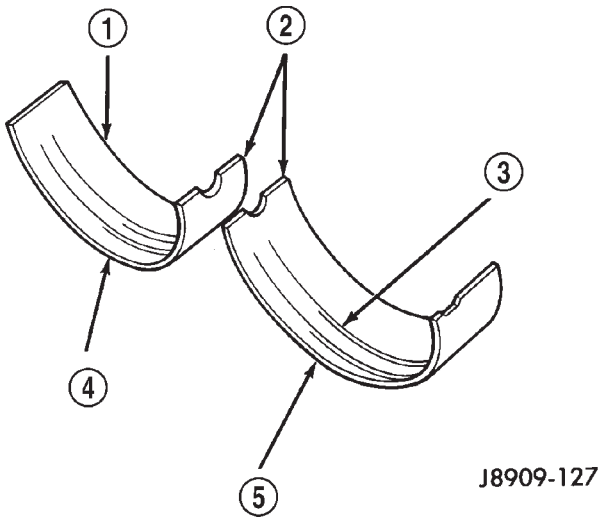


Fig. 29 Connecting Rod Bearing Inspection

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

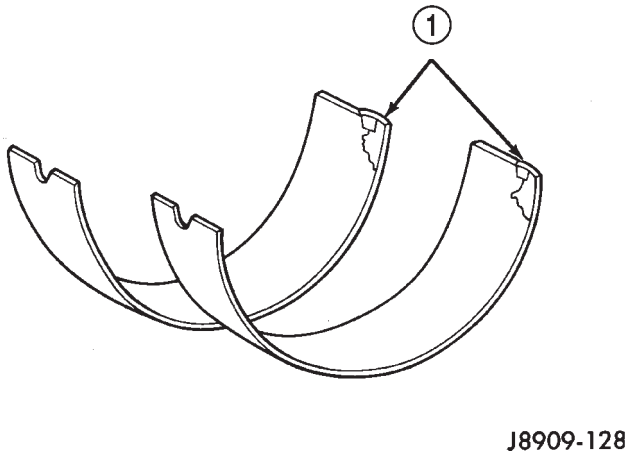


Fig. 30 Locking Tab Inspection

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

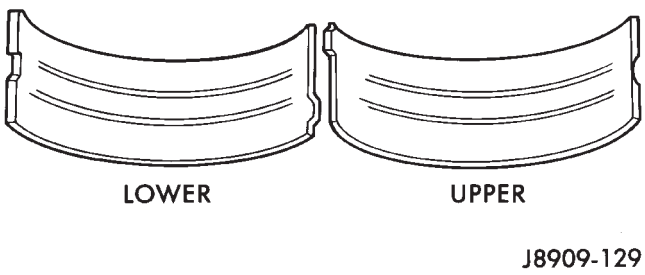


Fig. 31 Scoring Caused by Insufficient Lubrication or by Damaged Crankshaft Pin Journal

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. 32). 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.

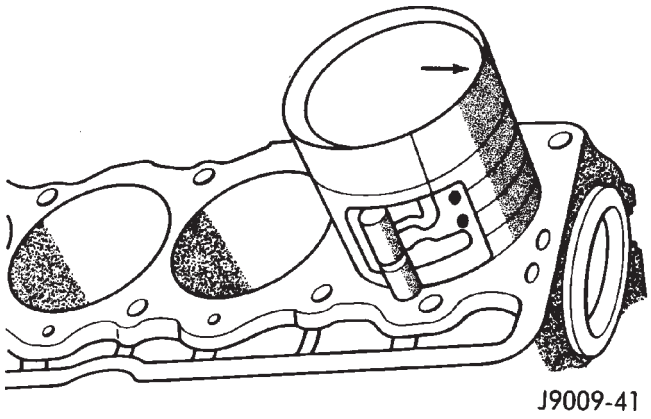


Fig. 32 Rod and Piston Assembly Installation

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

SERVICE PROCEDURES (Continued)

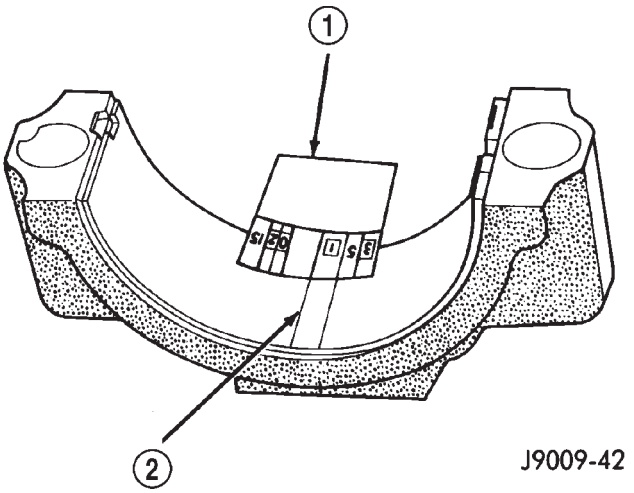


Fig. 33 Measuring Bearing Clearance with Plastigage

1 – PLASTIGAGE SCALE
2 – COMPRESSED PLASTIGAGE

(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.

SIDE CLEARANCE MEASUREMENT

Slide snug-fitting feeler gauge between the connecting rod and crankshaft journal flange (Fig. 34). Refer to Engine Specifications for the proper clearance. Replace the connecting rod if the side clearance is not within specification.

SERVICE PROCEDURES (Continued)

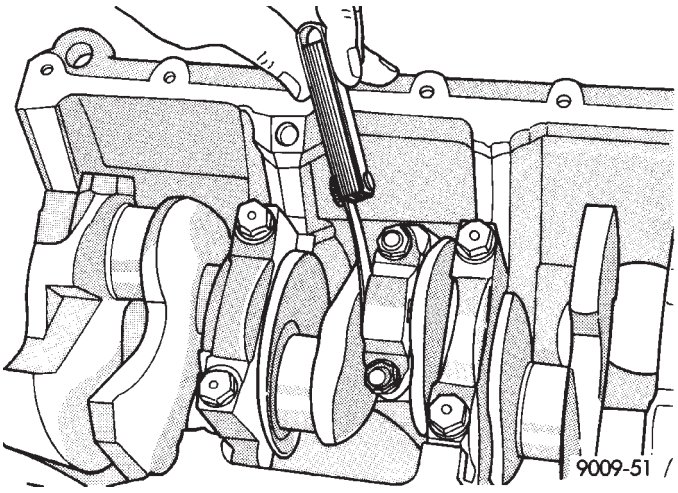


Fig. 34 Checking Connecting Rod Side Clearance—Typical

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. 35). In general the lower bearing half will have a heaver wear pattern.

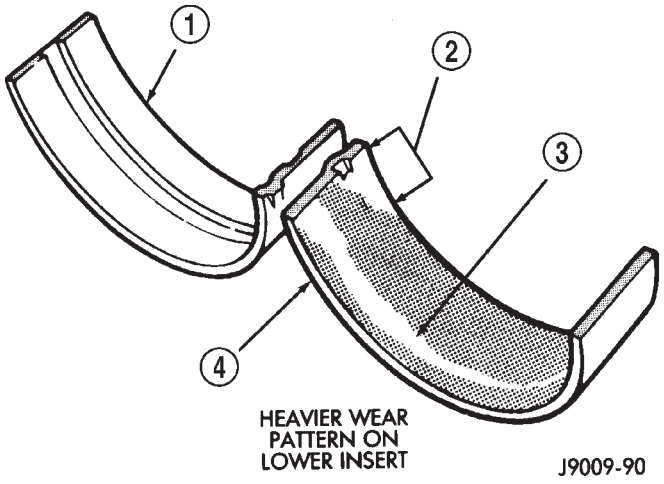


Fig. 35 Main Bearing Wear Patterns

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. 36) 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.

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

SERVICE PROCEDURES (Continued)

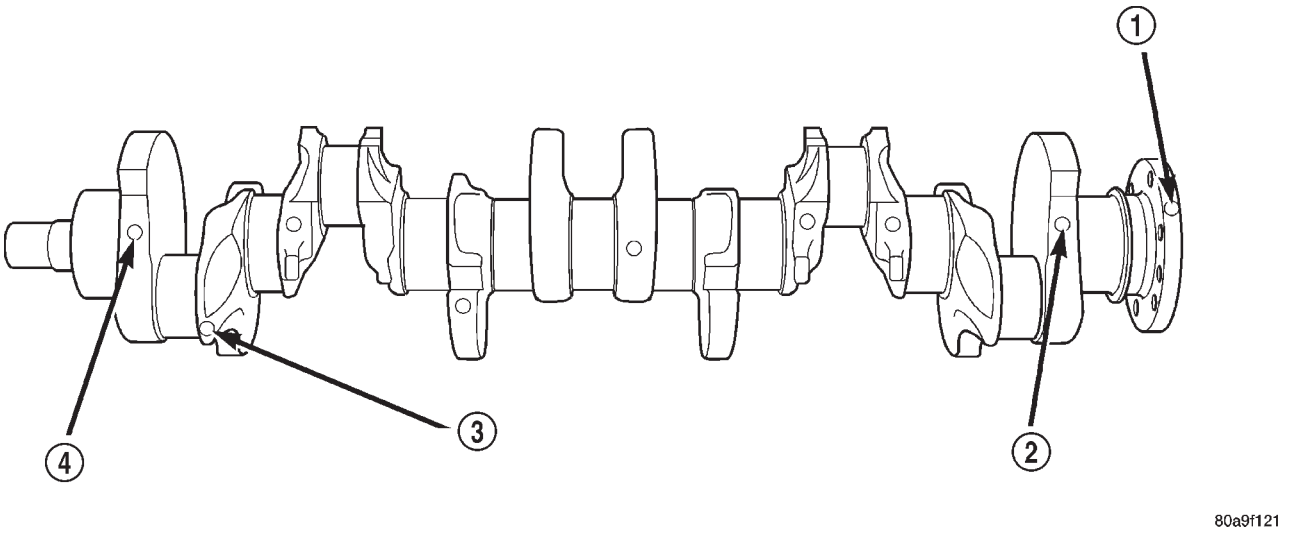


Fig. 36 Crankshaft Journal Size Paint I. D. Location

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

(Fig. 37). Refer to Engine Specifications for the proper clearance.

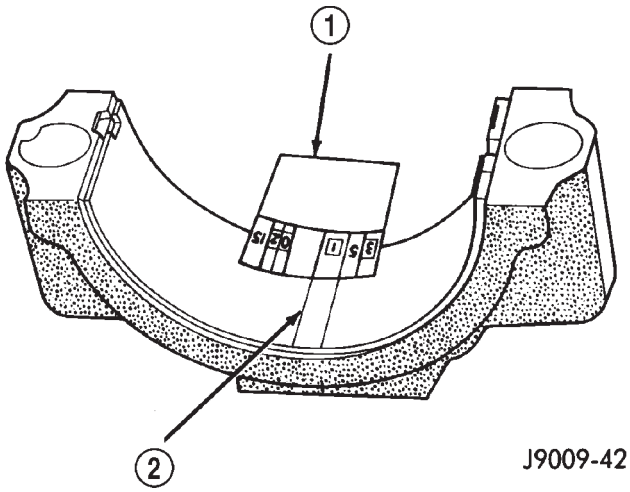


Fig. 37 Measuring Bearing Clearance with Plastigage

1 – PLASTIGAGE SCALE
2 – COMPRESSED PLASTIGAGE

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).

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.

SERVICE PROCEDURES (Continued)

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 (2.4996 - 2.4991 in.) 0.0127 mm (0.0005 in.) Undersize	Yellow - Standard	Blue - Undersize 0.025 mm (0.001 in.)
Blue	63.4619 - 63.4492 mm (2.4985 - 2.4980 in.) 0.0254 mm (0.001 in.) Undersize	Blue - Undersize 0.025 mm (0.001 in.)	Blue - Undersize 0.025 mm (0.001 in.)
Green	63.4492 - 63.4365 mm (2.4980 - 2.4975 in.) 0.0381 mm (0.0015 in.) Undersize	Blue - Undersize 0.025 mm (0.001 in.)	Green - Undersize 0.051 mm (0.002 in.)
Red	63.2333 - 63.2206 mm (2.4895 - 2.4890 in.) 0.254 mm (0.010 in.) Undersize	Red - Undersize 0.254 mm (0.010 in.)	Red - Undersize 0.254 mm (0.010 in.)

FORM-IN-PLACE GASKETS

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

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

MOPAR SILICONE RUBBER ADHESIVE SEALANT

Mopar Silicone Rubber Adhesive Sealant, normally black in color, is available in 3 ounce tubes. Moisture in the air causes the sealant material to cure. This material is normally used on flexible metal flanges. It has a shelf life of a year and will not properly cure if over aged. Always inspect the package for the expiration date before use.

MOPAR GASKET MAKER

Mopar Gasket Maker, normally red in color, is available in 6 cc tubes. This anaerobic type gasket material cures in the absence of air when squeezed between smooth machined metallic surfaces. It will not cure if left in the uncovered tube. DO NOT use on flexible metal flanges.

SURFACE PREPARATION

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

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

GASKET APPLICATION

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

Mopar Silicone Rubber Adhesive Sealant should be applied in a continuous bead approximately 3 mm (0.12 inch) in diameter. All mounting holes must be circled. For corner sealing, a 3 or 6 mm (1/8 or 1/4 inch) drop is placed in the center of the gasket con-

SERVICE PROCEDURES (Continued)

tact 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 use of a locating dowel is recommended during assembly to prevent smearing the material off location.

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

ENGINE PERFORMANCE

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

(1) Test cranking amperage draw. Refer to Electrical Group 8B, Cold Cranking Test.

(2) Check intake manifold bolt torque; Refer to Group 11, Exhaust System and Intake Manifold.

(3) Perform cylinder compression test. Refer to Cylinder Compression Pressure Test in the Engine Diagnosis area of this section.

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

(5) Test resistance of spark plug cables. Refer to Electrical Group 8D, Spark Plug Cables.

(6) Inspect the primary wires. Test coil output voltage and primary resistance. Replace parts as necessary. Refer to Electrical Group 8D, for specifications.

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

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

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

(10) 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. 38).

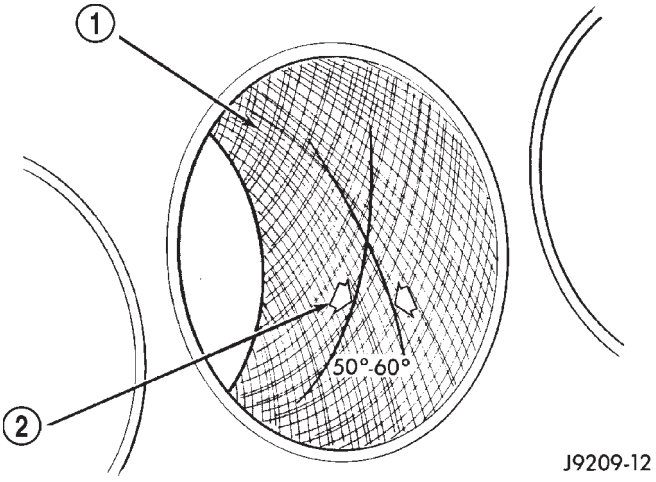


Fig. 38 Cylinder Bore Crosshatch Pattern

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.

SERVICE PROCEDURES (Continued)

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 ENGINE ASSEMBLY (SHORT BLOCK)

A service replacement engine assembly (short block) may be installed whenever the original cylinder block is defective or damaged beyond repair. It consists of the cylinder block, crankshaft, piston and rod assemblies. If needed, the camshaft must be procured separately and installed before the engine is installed in the vehicle.

A short block is identified with the letter "S" stamped on the same machined surface where the build date code is stamped for complete engine assemblies.

Installation includes the transfer of components from the defective or damaged original engine. Follow the appropriate procedures for cleaning, inspection and torque tightening.

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 negative cable from the battery.

(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 spark plugs to 37 N·m (27 ft. lbs.) torque.

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

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

(13) Install a new oil filter.

(14) Fill engine crankcase with the specified amount and grade of oil (refer to Group 0, Lubrication and Maintenance).

(15) Connect the negative cable to the battery.

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

ENGINE OIL SERVICE

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

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 the latest recommended service grades.

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. 39).

9400-9

Fig. 39 Engine Oil Container Standard Notations

SERVICE PROCEDURES (Continued)

SAE VISCOSITY

An SAE viscosity grade is used to specify the viscosity of engine oil. SAE 10W–30 specifies a multiple viscosity engine oil. Engine oils also have multiple viscosities. These are specified with a dual SAE viscosity grade which indicates the cold-to-hot temperature viscosity range. Select an engine oil that is best suited to your particular temperature range and variation (Fig. 40).

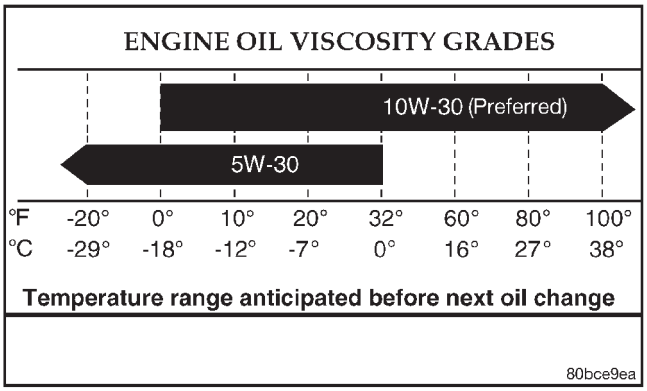


Fig. 40 Temperature/Engine Oil Viscosity

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.

CRANKCASE OIL LEVEL INSPECTION

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

The engine oil level indicator (Dipstick) is located at the right rear of the 4.0L engine. Inspect engine oil level approximately every 800 kilometers (500 miles). Unless the engine has exhibited loss of oil pressure, run the engine for about five minutes before checking oil level. Checking engine oil level on a cold engine is not accurate.

To ensure proper lubrication of an engine, the engine oil must be maintained at an acceptable level. The acceptable levels are indicated between the ADD and SAFE marks on the engine oil dipstick (Fig. 41).

(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 (Fig. 41).

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

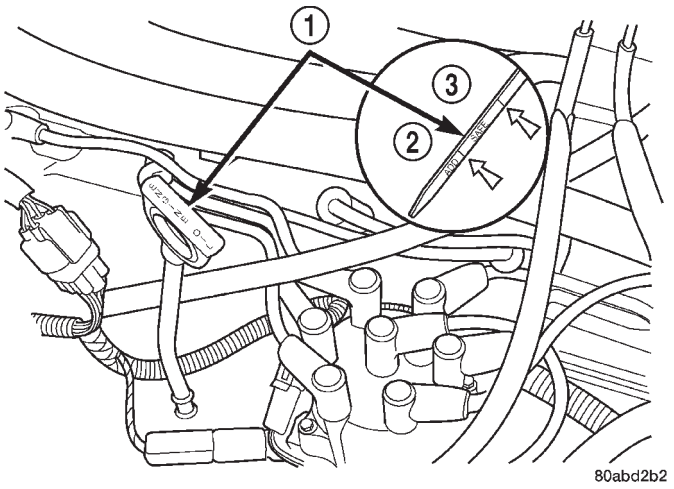


Fig. 41 Engine Oil Dipstick—4.0L Engine

1 – DIPSTICK
2 – ADD
3 – SAFE

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

CAUTION: Do not use oil filter with metric threads. The proper oil filter has SAE type 3/4 X 16 threads. An oil filter with metric threads can result in oil leaks and engine failure.

All Jeep engines are equipped with a high quality full-flow, throw-away type oil filter. DaimlerChrysler

SERVICE PROCEDURES (Continued)

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 to remove it from the cylinder block oil filter boss or filter adapter housing (Fig. 42).

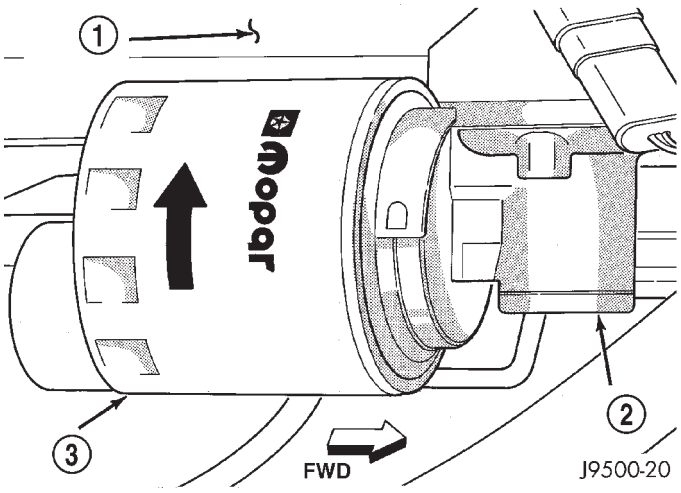


Fig. 42 Oil Filter—4.0L Engine

1 – CYLINDER BLOCK
2 – ADAPTER
3 – OIL FILTER

(4) When filter separates from adapter nipple, tip gasket end upward to minimize oil spill. Remove filter from vehicle.
(5) Make sure old gasket comes off with oil filter. With a wiping cloth, clean the gasket sealing surface (Fig. 43) of oil and grime.

OIL FILTER INSTALLATION

(1) Lightly lubricate oil filter gasket with engine oil or chassis grease.
(2) Thread filter onto adapter nipple. When gasket makes contact with sealing surface, (Fig. 43) hand tighten filter one full turn, do not over tighten.
(3) Add oil, verify crankcase oil level and start engine. Inspect for oil leaks.

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.

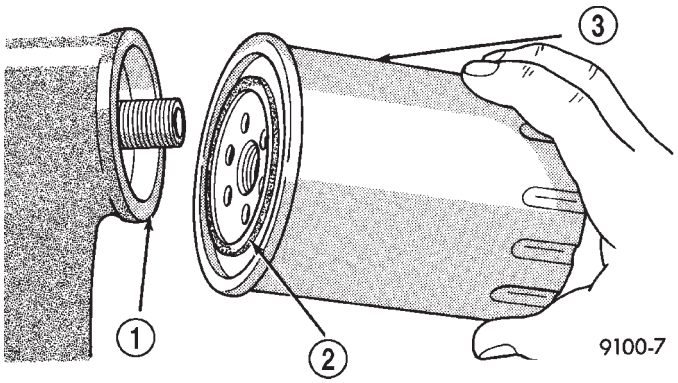


Fig. 43 Oil Filter Sealing Surface—Typical

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

REMOVAL AND INSTALLATION

ENGINE MOUNTS—FRONT

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

REMOVAL

(1) Disconnect negative cable from battery.
(2) Raise the vehicle.
(3) Support the engine.
(4) Remove the nut from the through bolt (Fig. 44). DO NOT remove the through bolt.
(5) Remove the retaining bolts and nuts from the support cushions (Fig. 44).
(6) Remove the through bolt.
(7) Remove the support cushions.

INSTALLATION

(1) If the engine support bracket was removed, position the bracket onto the block and install the attaching bolts (Fig. 44). Tighten the engine support bracket bolts to 61 N·m (45 ft. lbs.) torque.
(2) If the support cushion bracket was removed, position the bracket onto the lower front sill (Fig. 45). Install support cushion bracket bolts and nuts. Tighten the bolts to 54 N·m (40 ft. lbs.) torque. Tighten the nuts to 41 N·m (30 ft. lbs.) torque.
(3) Place the support cushion into position on the support cushion bracket (Fig. 44). Install and tighten the bolts and nuts to 41 N·m (30 ft. lbs.) torque.
(4) Install the through bolt and the retaining nut (Fig. 44). Tighten the through bolt nut to 65 N·m (48 ft. lbs.) torque.

REMOVAL AND INSTALLATION (Continued)

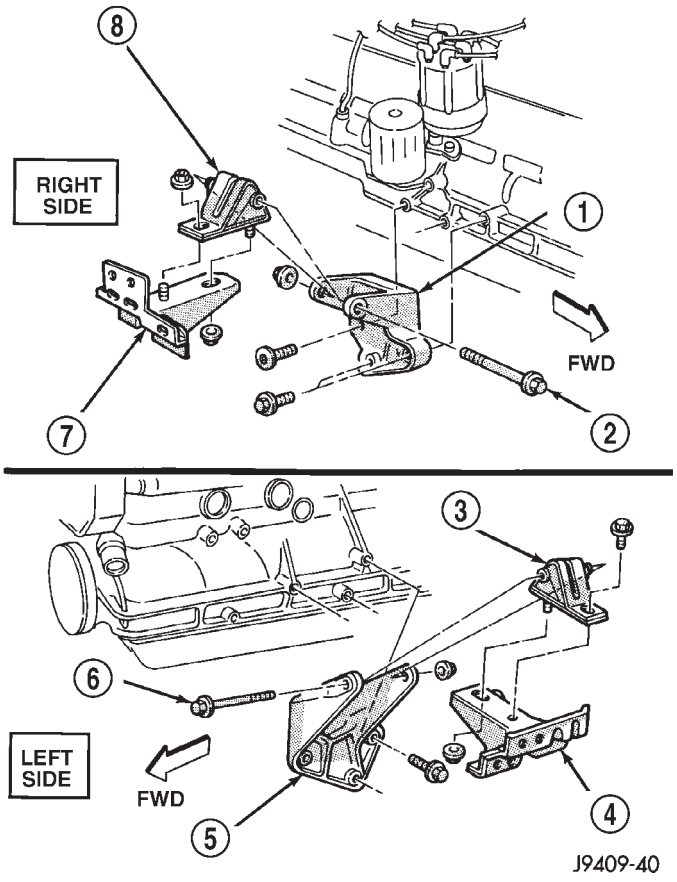


Fig. 44 Front Mounts

1 – ENGINE SUPPORT BRACKET
2 – THROUGH BOLT
3 – SUPPORT CUSHION
4 – SUPPORT CUSHION BRACKET
5 – ENGINE SUPPORT BRACKET
6 – THROUGH BOLT
7 – SUPPORT CUSHION BRACKET
8 – SUPPORT CUSHION

(5) Remove the engine support.
(6) Lower the vehicle.
(7) Connect negative cable to battery.

ENGINE MOUNT—REAR

A resilient rubber cushion supports the transmission at the rear between the transmission extension housing and the rear support crossmember or skid plate.

REMOVAL

(1) Disconnect negative cable from battery.
(2) Raise the vehicle and support the transmission.
(3) Remove the nuts holding the support cushion to the crossmember (Fig. 46) (Fig. 47). Remove the crossmember.

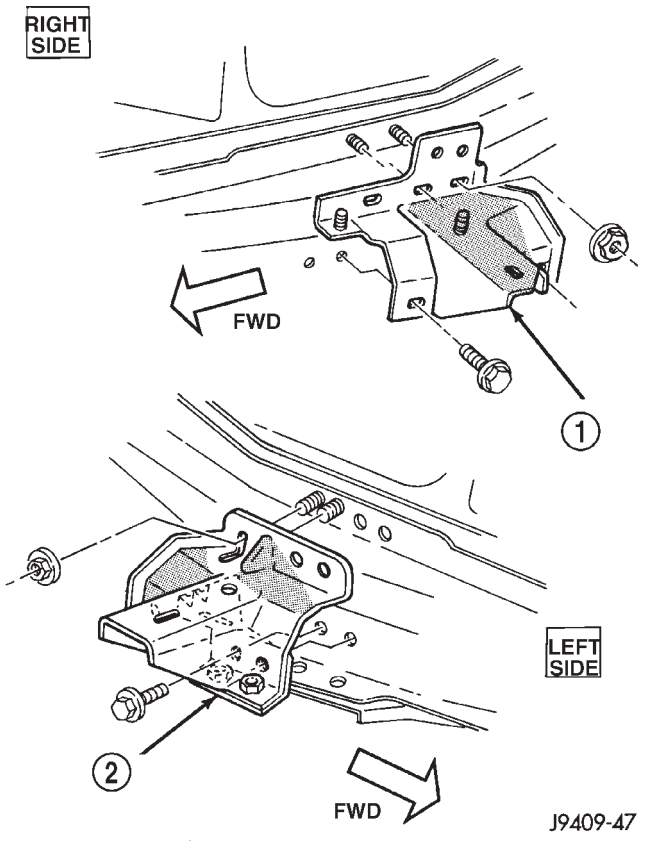


Fig. 45 Support Cushion Bracket

1 – SUPPORT CUSHION BRACKET
2 – SUPPORT CUSHION BRACKET

MANUAL TRANSMISSION

(Fig. 46)

a. Remove the support cushion nuts and remove the cushion.

b. Remove the transmission support bracket bolts and remove the bracket from the transmission.

AUTOMATIC TRANSMISSION

(Fig. 47)

a. Remove the support cushion bolts and remove the cushion and the support bracket from the transmission (4WD) or from the adaptor bracket (2WD).

b. On 2WD vehicles, remove the bolts holding the transmission support adaptor bracket to the transmission (Fig. 47). Remove the adaptor bracket.

INSTALLATION

MANUAL TRANSMISSION:

a. Install the transmission support bracket to the transmission. Install the bolts and tighten to 46 N·m (34 ft. lbs.) torque.

REMOVAL AND INSTALLATION (Continued)

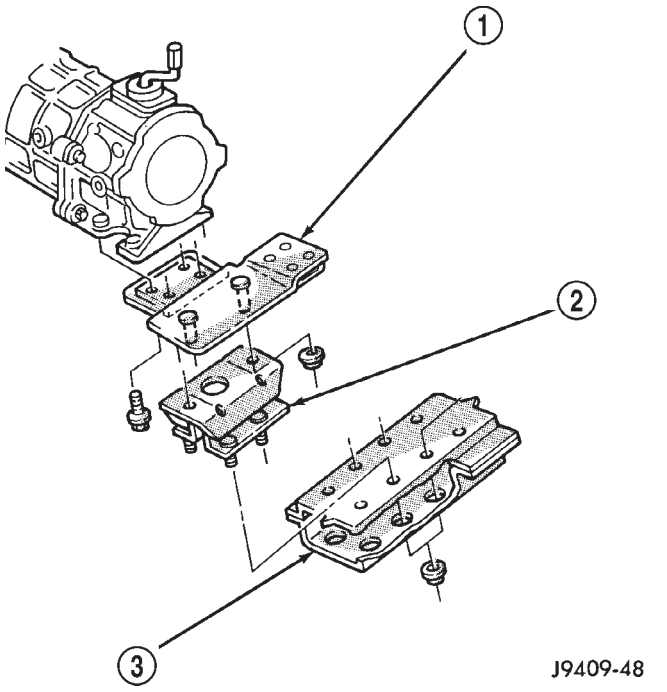


Fig. 46 Rear Mount(Manual Transmission)

1 – TRANSMISSION SUPPORT BRACKET
2 – SUPPORT CUSHION
3 – CROSSMEMBER ASSEMBLY

b. Install the support cushion to the support bracket. Install the nuts and tighten to 75 N·m (55 ft. lbs.) torque.

AUTOMATIC TRANSMISSION:

a. On 2WD vehicles, position the transmission support adaptor bracket to the transmission. Install the bolts and tighten to 75 N·m (55 ft. lbs.) torque.

b. Position the transmission support bracket and support cushion to the adaptor bracket (2WD) or the transmission (4WD). Install the bolts and tighten to 75 N·m (55 ft. lbs.) torque.

(1) Position the crossmember onto the support cushion studs. Install the stud nuts and tighten to 22 N·m (192 in. lbs) torque.

(2) Install crossmember-to-sill bolts and tighten to 41 N·m (30 ft. lbs.) torque.

(3) Remove the transmission support.

(4) Lower the vehicle.

(5) Connect negative cable to battery.

ENGINE ASSEMBLY

REMOVAL

(1) Disconnect the battery cables. Remove the battery.

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

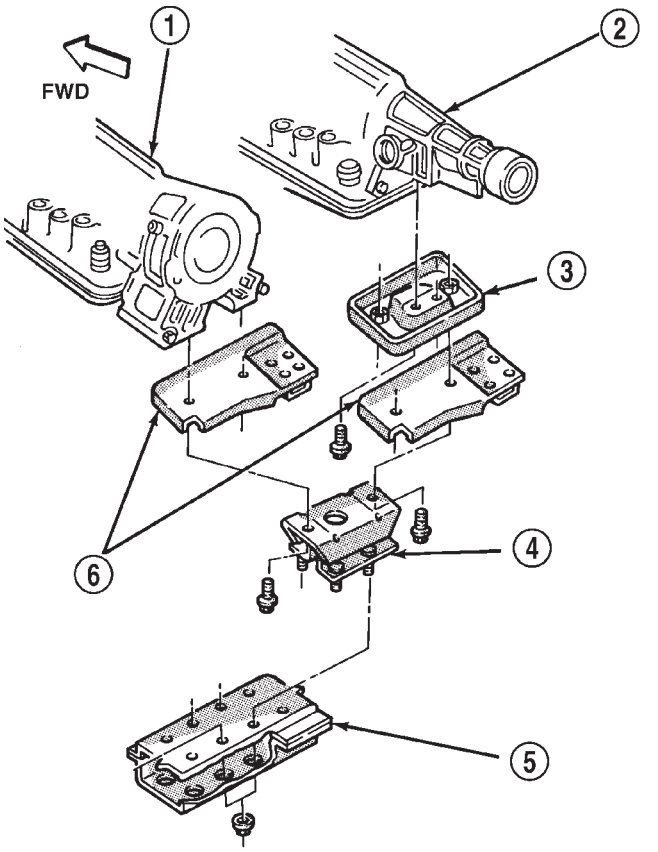


Fig. 47 Rear Mount(Automatic Transmission)

1 – 4×4
2 – 2×4
3 – TRANSMISSION SUPPORT ADAPTOR BRACKET
4 – SUPPORT CUSHION
5 – CROSSMEMBER ASSEMBLY
6 – TRANSMISSION SUPPORT BRACKET

WARNING: THE COOLANT IN A RECENTLY OPERATED ENGINE IS HOT AND PRESSURIZED. USE CARE TO PREVENT SCALDING BY HOT COOLANT. CAREFULLY RELEASE THE PRESSURE BEFORE REMOVING THE RADIATOR DRAIN COCK AND CAP.

(3) Remove the air cleaner assembly.

(4) Loosen 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.

(5) Remove the lower radiator hose.

(6) Remove the upper radiator hose and coolant recovery hose (Fig. 48).

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

(8) Remove the fan shroud (Fig. 48) and electric cooling fan.

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

REMOVAL AND INSTALLATION (Continued)

(10) Disconnect radiator fan switch wire connector.

(11) **Vehicles with Air Conditioning:**

(a) Discharge A/C system (refer to group 24, Heating and Air Conditioning for proper procedures)

(b) Disconnect the suction/discharge hose and cap off compressor ports to prevent foreign material and refrigerant oil loss.

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

(13) Remove the fan assembly from the idler pulley.

(14) Disconnect the heater hoses at the engine thermostat housing and water pump (Fig. 48) (Fig. 49).

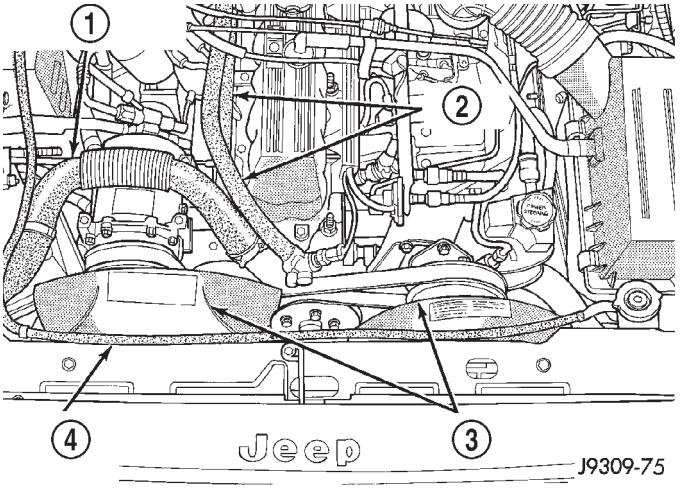


Fig. 48 Upper Radiator Hose, Coolant Recovery Hose, Fan Shroud & Heater hoses

1 – UPPER RADIATOR HOSE
2 – HEATER HOSES
3 – FAN SHROUDS
4 – COOLANT RECOVERY HOSE

(15) Disconnect the throttle cable.

(16) Disconnect the speed control cable (if equipped).

(17) Disconnect the line pressure cable (if equipped with automatic transmission).

(18) Disconnect the fuel injector harness at the injectors.

(19) Disconnect the distributor electrical connection and the oil pressure switch connector.

WARNING: THE FUEL SYSTEM IS UNDER A CONSTANT PRESSURE (EVEN WITH THE ENGINE TURNED OFF). BEFORE DISCONNECTING FUEL LINES, THE FUEL SYSTEM PRESSURE MUST BE RELEASED.

(20) Perform the Fuel System Pressure Release procedure (refer to Group 14, Fuel System).

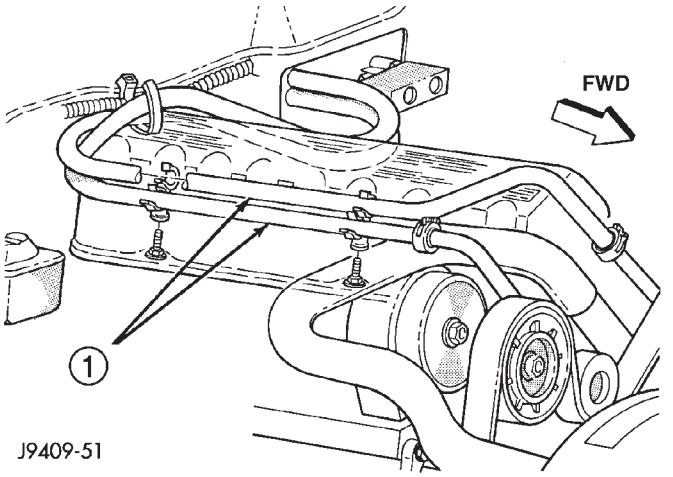


Fig. 49 Heater Hoses (RH Drive Vehicle)

1 – HEATER HOSES

(21) Remove the latch clip and disconnect fuel supply line.

(22) Remove the power brake vacuum check valve from the booster, if equipped.

(23) If equipped with power steering :

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

(b) Drain the pump reservoir.

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

(24) Identify, tag and disconnect all necessary wire connectors and vacuum hoses.

(25) Raise and support the vehicle.

(26) Disconnect the wires from the starter motor solenoid.

(27) Remove the starter motor.

(28) Disconnect the exhaust pipe from the manifold.

(29) Disconnect the engine speed sensor wire connection.

(30) Remove the exhaust pipe support.

(31) Remove the flywheel and converter housing access cover.

(32) **Vehicles with Automatic Transmission:**

(a) Mark the converter and drive plate location.

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

(33) Remove the upper flywheel and converter housing bolts and loosen the bottom bolts.

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

(35) Lower the vehicle.

(36) Attach a lifting device to the engine.

(37) Raise the engine off the front supports.

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

REMOVAL AND INSTALLATION (Continued)

(39) Remove the remaining converter (or flywheel) housing bolts.

(40) 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 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 cushions from the engine mount bracket as an aide in alignment of the engine to the transmission.

(2) **Vehicles with Manual Transmission:**

(a) Insert the transmission shaft into the clutch spline.

(b) Align the flywheel housing with the engine.

(c) Install and tighten the flywheel housing lower bolts finger tight.

(3) **Vehicles with Automatic Transmission:**

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

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

(c) Tighten all 4 bolts finger tight.

(4) Install the engine mount cushions (if removed).

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

(6) Remove the engine lifting device.

(7) Raise and support the vehicle.

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

(9) **Vehicles with Automatic Transmission:**

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

(b) Ensure the installation reference marks are aligned.

(10) Install the flywheel and converter housing access cover.

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

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

(13) Connect the engine speed sensor wire connections and tighten the screws.

(14) Connect the exhaust pipe to the manifold.

(15) Install the starter motor and connect the cable.

(16) Connect the wires to the starter motor solenoid.

(17) Lower the vehicle.

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

(19) **Vehicles with Power Steering:**

(a) Remove the protective caps

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

(c) Fill the pump reservoir with fluid.

(20) Install the power brake vacuum check valve to the booster, if equipped.

(21) Connect the fuel supply hose the fuel rail. Push until a “click” is heard. Install latch clip

(22) Connect the fuel injector harness to the injectors.

(23) Connect the distributor electrical connector and oil pressure switch connector.

(24) Connect the line pressure cable (if equipped with automatic transmission).

(25) Connect the speed control cable, if equipped.

(26) Connect the throttle cable.

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

(28) Install the fan assembly to the idler pulley.

(29) Connect the suction/discharge hose to the compressor.

(30) Connect automatic transmission fluid cooler lines, if equipped.

(31) Install the fan shroud, electric cooling fan and radiator and condenser (if equipped with A/C).

(32) Connect the electric fan connector.

(33) Install upper radiator support.

(34) Connect the upper radiator hose.

(35) Connect the lower radiator hose.

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

(37) Install the air cleaner assembly.

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

(39) Add the proper amount of engine oil and coolant.

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.

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

(41) Charge the air conditioning system (refer to Group 24, Heating and Air Conditioning for proper procedures).

REMOVAL AND INSTALLATION (Continued)

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 the resonator 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
- Manifold Absolute Pressure (MAP) Sensor.

(6) Disconnect 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 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. 50).
(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. 50).
(5) Install washer and fastener Numbers 6 and 7 (Fig. 50).
(6) Tighten the fasteners in sequence and to the specified torque (Fig. 50).
- Fastener Numbers 1 through 5—Tighten to 33 N·m (24 ft. lbs.) torque.
- Fastener Numbers 6 and 7—Tighten to 31 N·m (23 ft. lbs.) torque.
- Fastener Numbers 8 through 11—Tighten to 33 N·m (24 ft. lbs.) torque.

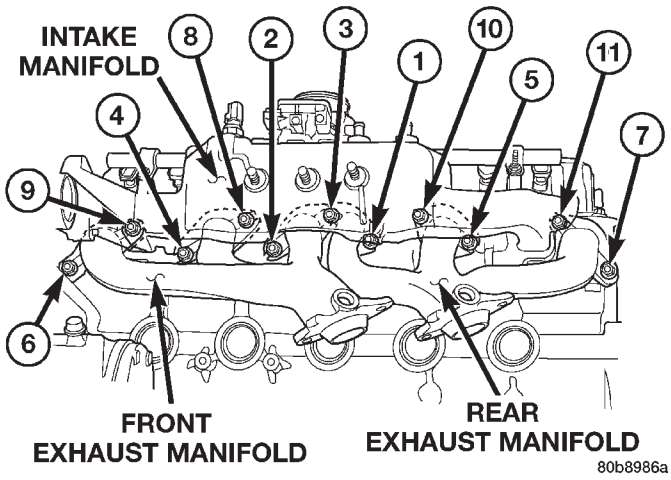


Fig. 50 Intake and Exhaust Manifolds—4.0L

(7) Install the power steering pump to the intake manifold.
(8) Install the accessory drive belt. (Refer to Group 7, Cooling System for the correct procedures)
(9) Install the fuel system supply line to the fuel rail assembly. **Before connecting the fuel supply line to the fuel rail inspect the O-rings and replace if necessary. Refer to Group 14, Fuel System for the correct procedure.**
(10) Connect all electrical connections on the intake manifold.
(11) Connect the vacuum hoses previously removed.
(12) Install throttle cable, vehicle speed control cable (if equipped).
(13) Install the transmission line pressure cable (if equipped). Refer to Group 21, Transmission for the adjustment procedures.
(14) Install air cleaner assembly.
(15) Connect air inlet hose to the resonator assembly.
(16) Raise the vehicle.
(17) Connect the exhaust pipes to the engine exhaust manifolds. Tighten the bolts to 31 N·m (23 ft. lbs.)

REMOVAL AND INSTALLATION (Continued)

(18) Lower the vehicle.
(19) Connect the battery negative cable.
(20) Start the engine and check for leaks.

EXHAUST MANIFOLD—4.0L ENGINE

The intake and engine exhaust manifolds on the 4.0L engine must be removed and installed together. The manifolds use a common gasket at the cylinder head.

Refer to Intake Manifold—4.0L Engine in this section for the proper removal and installation procedures.

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. 52)

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. 51).
(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.
(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.

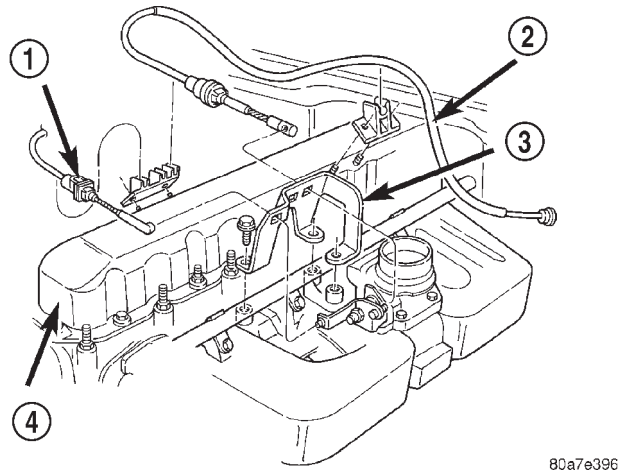


Fig. 51 Engine Cylinder Head Cover

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

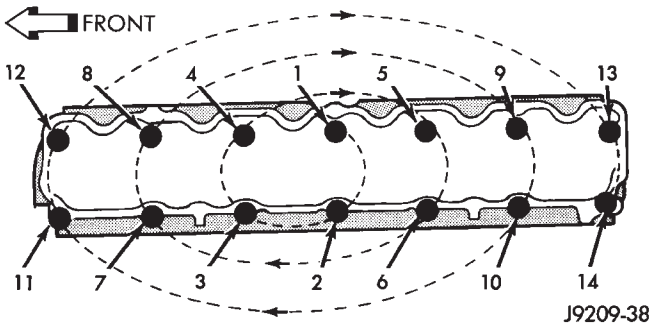


Fig. 52 Cylinder Head Cover Gasket Locator Pins at #8 & #9

ROCKER ARMS AND PUSH RODS

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

REMOVAL

(1) Remove the engine cylinder head cover.
(2) Check for rocker arm bridges which are causing misalignment of the rocker arm to valve tip area.
(3) Remove the capscrews at each bridge and pivot assembly (Fig. 53). 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. 53). 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.

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

REMOVAL AND INSTALLATION (Continued)

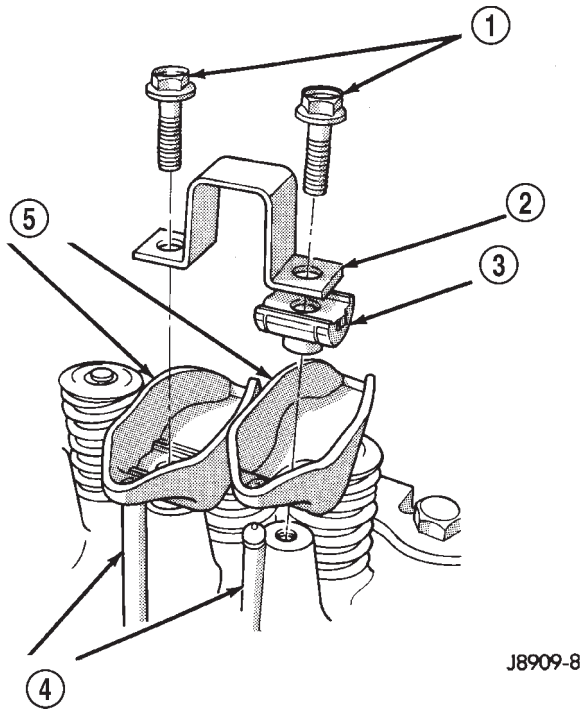


Fig. 53 Rocker Arm Assembly

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

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 SPRINGS AND OIL SEALS

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

REMOVAL

Inspect the valve stems, especially the grooves. An Arkansas smooth stone should be used to remove nicks and high spots.

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 cap screws, 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. 54).

(8) Remove valve spring and retainer (Fig. 54).

(9) Remove valve stem oil seals (Fig. 54). Note the valve seals are different for intake and exhaust valves. The top of each seal is marked either INT (intake/black in color) or EXH (exhaust/brown in color). DO NOT mix the seals.

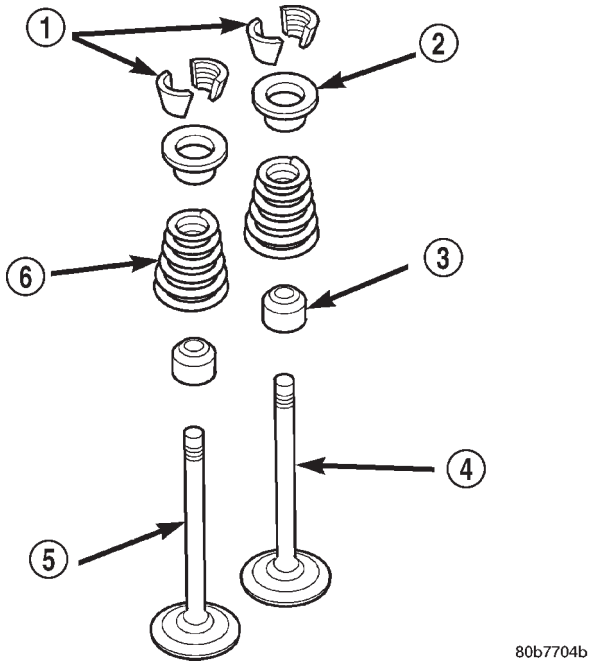


Fig. 54 Valve and Valve Components

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

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

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

(1) Lightly push the valve seal over the valve stem and valve guide boss. Be sure the seal is completely seated on the valve guide boss.
(2) Install valve spring and retainer.
(3) Compress the valve spring with Valve Spring Compressor Tool MD-998772A and insert the valve locks. Release the spring tension and remove the tool. Tap the spring from side-to-side to ensure that the spring is seated properly on the engine cylinder head.
(4) Release air pressure and disconnect the air hose. Remove the adaptor from the spark plug hole and install the spark plug.
(5) Repeat the procedures for each remaining valve spring to be removed.
(6) Install the push rods. Ensure the bottom end of each rod is centered in the plunger cap seat of the hydraulic valve tappet.
(7) Install the rocker arms, pivots and bridge at their original location.
(8) Tighten the bridge cap screws alternately, one at a time, to avoid damaging the bridge. Tighten the cap screws 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. 55). 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. 55).
(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.

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.

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.

REMOVAL AND INSTALLATION (Continued)

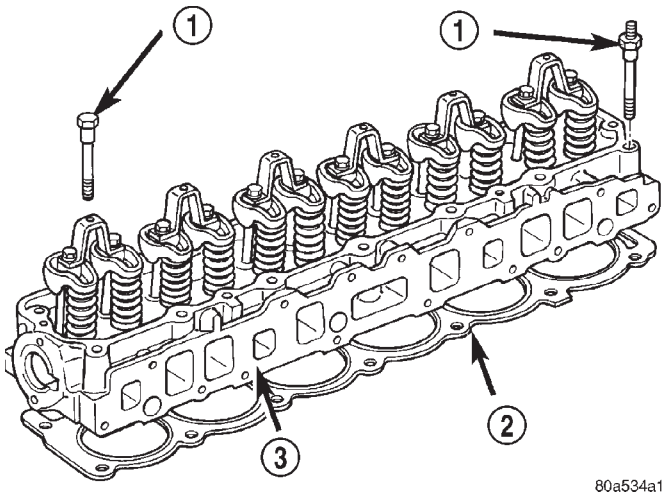


Fig. 55 Engine Cylinder Head Assembly

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

(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. 56).

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.

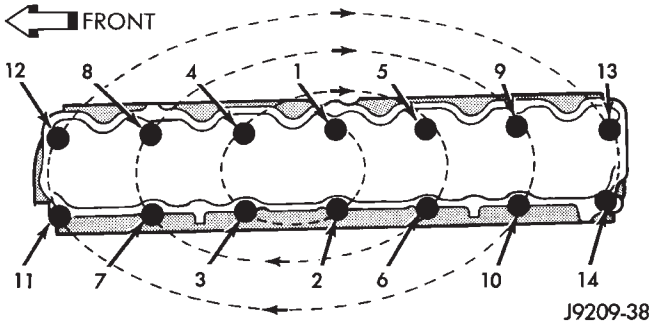


Fig. 56 Engine Cylinder Head Bolt Tightening Sequence

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

(7) Connect the temperature sending unit wire connector.

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

(9) Install the intake and engine exhaust manifolds (refer to 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.

REMOVAL AND INSTALLATION (Continued)

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. 57).

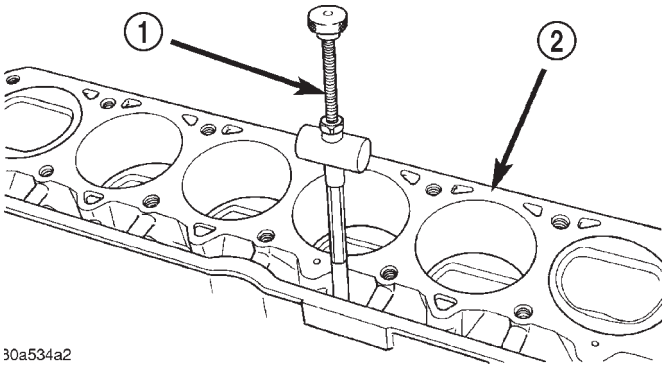


Fig. 57 Hydraulic Valve Tappet Removal—Installation Tool

1 – HYDRAULIC TAPPET REMOVAL TOOL
2 – CYLINDER BLOCK

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)

(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. 58).

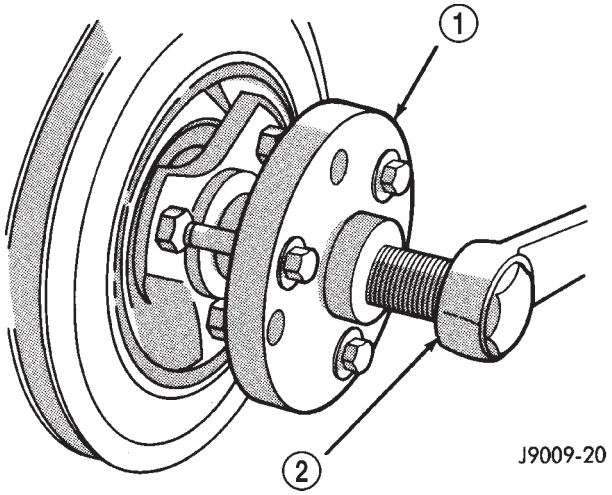


Fig. 58 Vibration Damper Removal Tool 7697

1 – VIBRATION DAMPER REMOVAL TOOL
2 – WRENCH

INSTALLATION

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

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

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

(4) Install the serpentine drive belt. (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. 59).

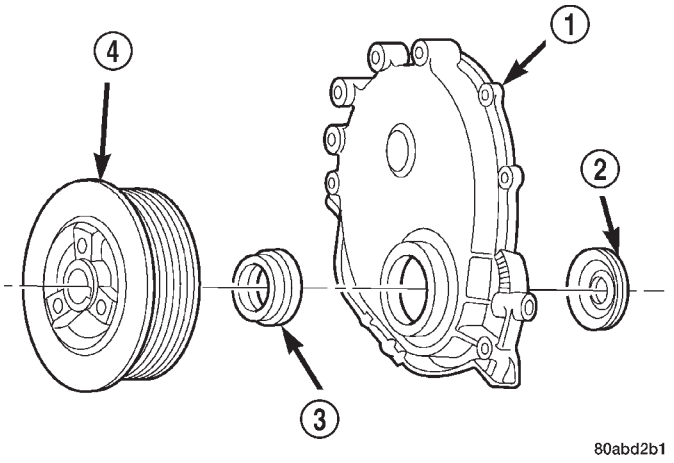


Fig. 59 Timing Case Cover Components

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

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.

REMOVAL AND INSTALLATION (Continued)

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

(4) Insert Timing Case Cover Alignment and Seal Installation Tool 6139 in the crankshaft opening in the cover (Fig. 60).

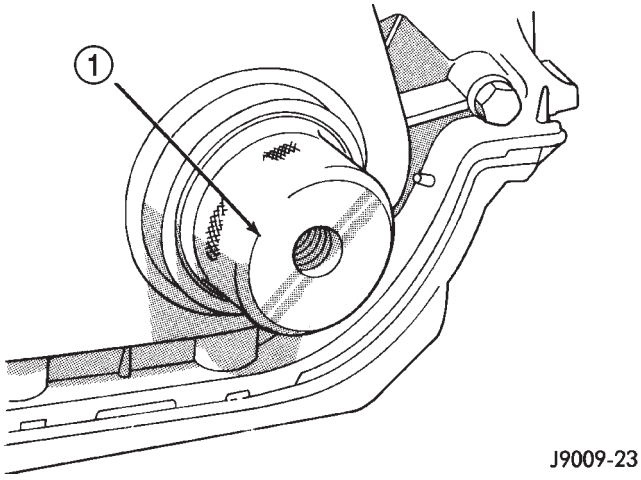


Fig. 60 Timing Case Cover Alignment and Seal Installation Tool 6139

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. 61).

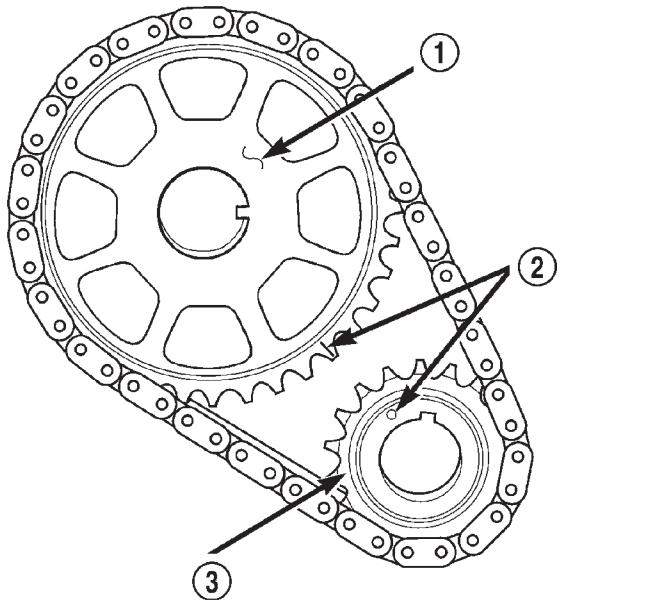


Fig. 61 Crankshaft—Camshaft Alignment

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. 62).

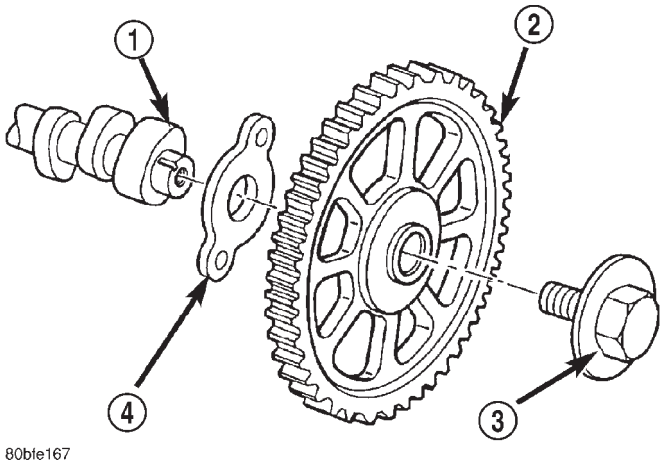


Fig. 62 Camshaft Sprocket and Thrust Plate

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

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

REMOVAL AND INSTALLATION (Continued)

(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. 61).

(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. 62). 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. 61).

(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 engine cylinder head cover.

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

(6) Remove the push rods.

(7) Remove the engine cylinder head and gasket.

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

(9) Remove the vibration damper.

(10) Remove the timing case cover.

(11) Rotate the crankshaft until the crankshaft sprocket timing mark is aligned on centerline with the camshaft sprocket timing mark (Fig. 64).

(12) Remove the timing chain and sprockets.

(13) Remove the front bumper and/or grille, as required.

(14) Remove the two thrust plate retaining screws, thrust plate and camshaft (Fig. 63).

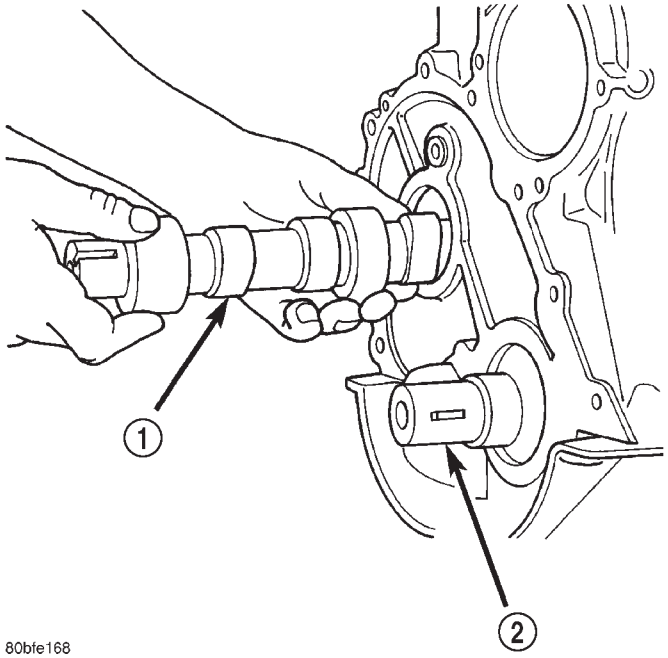


Fig. 63 Camshaft

1 – CAMSHAFT
2 – CRANKSHAFT

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 appears to have been rubbing against the thrust washer, 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. 63).

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

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

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

REMOVAL AND INSTALLATION (Continued)

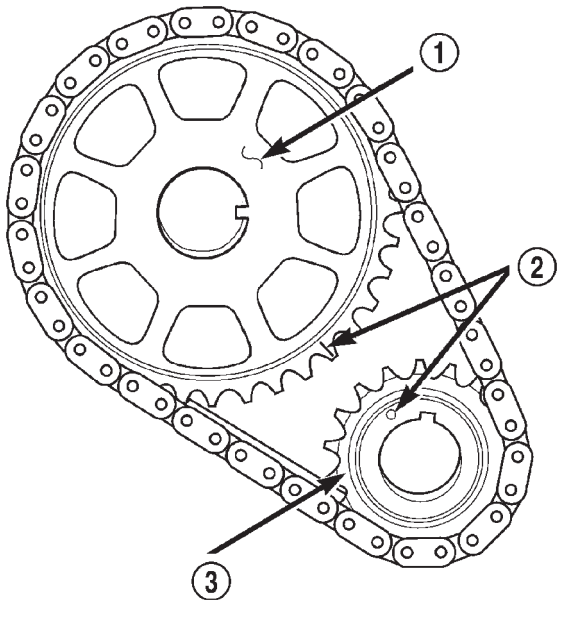


Fig. 64 Crankshaft / Camshaft Sprocket Timing Mark Alignment

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

(11) Install the timing case cover with a replacement oil seal (Fig. 65). Refer to Timing Case Cover Installation.

(12) Install the vibration damper (Fig. 65).

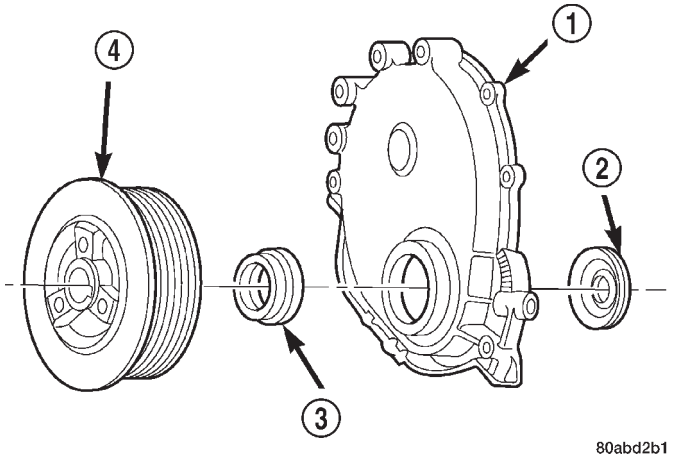


Fig. 65 Timing Case Cover Components

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) Install the serpentine drive belt. (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.

(20) 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).

(21) Check the ignition timing and adjust as necessary.

(22) Install the grille and bumper, if removed.

(23) Connect negative cable to battery.

CAMSHAFT BEARINGS

REMOVAL

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

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

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

REMOVAL AND INSTALLATION (Continued)

(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. 66).
(11) Install the timing chain cover refer to the procedure in this section.

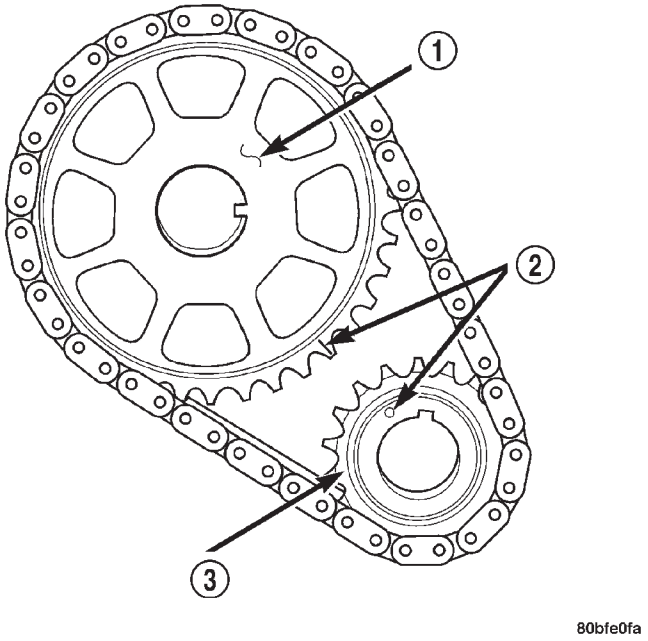


Fig. 66 Crankshaft / Camshaft Chain Drive Installation—Typical

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

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. 67).
(6) Remove only one main bearing cap and lower insert at a time (Fig. 68).
(7) Remove the lower insert from the bearing cap.
(8) Remove the upper insert by LOOSENING (DO NOT REMOVE) all of the other bearing caps. Now insert a small cotter pin tool in the crankshaft journal oil hole. Bend the cotter pin as illustrated to fabricate the tool (Fig. 69). 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. 69). After moving the insert approximately 25 mm (1 inch), it can be removed by applying pressure under the tab.

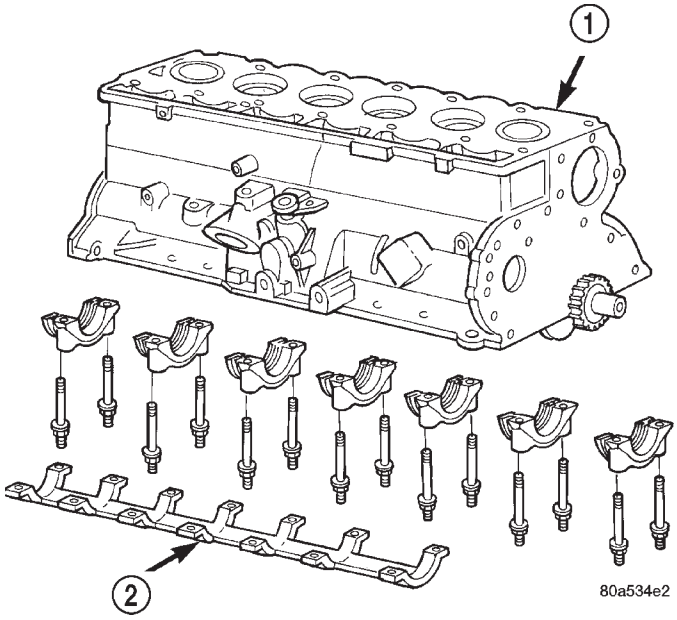


Fig. 67 Main Bearing Caps and Brace.

1 – BLOCK
2 – MAIN BEARING CAP BRACE

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

REMOVAL AND INSTALLATION (Continued)

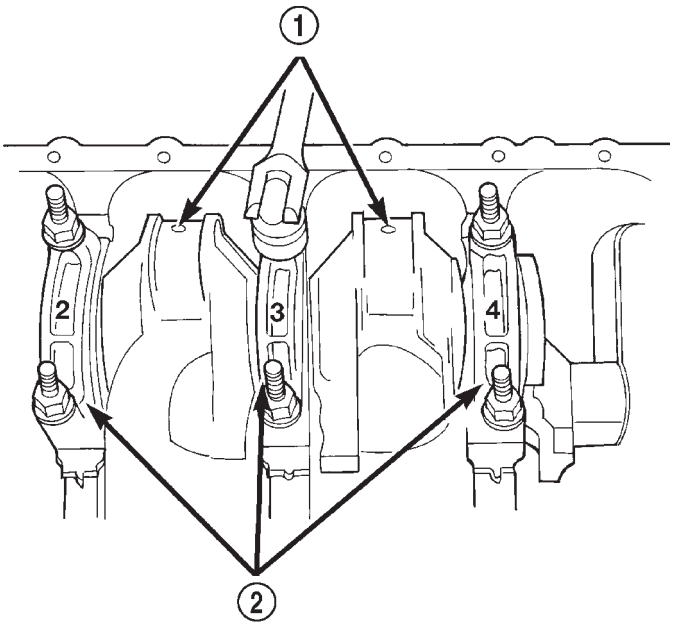


Fig. 68 Removing Main Bearing Caps and Lower Inserts

1 – CONNECTING ROD JOURNAL
2 – MAIN BEARING CAPS

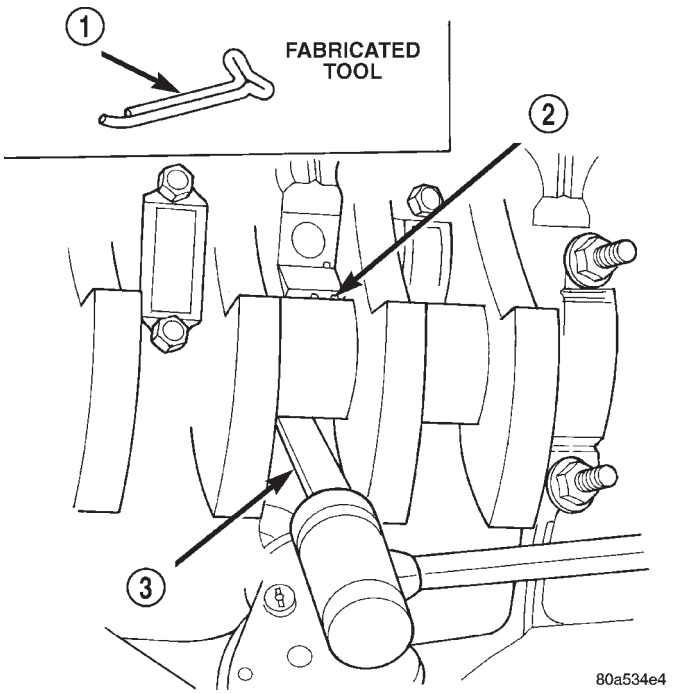


Fig. 69 Removing Upper Inserts

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

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. 70). 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.

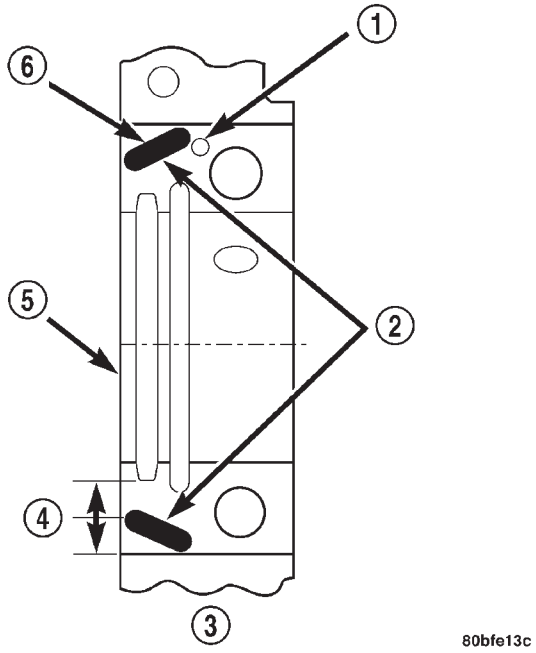


Fig. 70 Location of Sealer

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

(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.

REMOVAL AND INSTALLATION (Continued)

(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. 71). Correct end play is 0.038-0.165 mm (0.0015-0.0065 inch). The desired specifications are 0.051-0.064 mm (0.002-0.0025 inch).

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

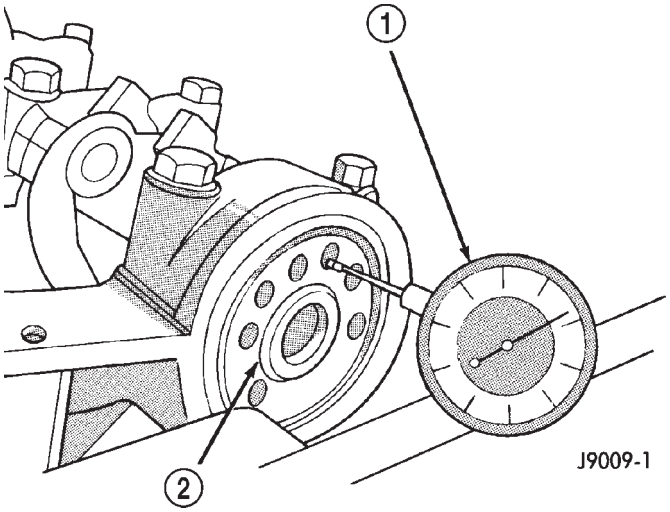


Fig. 71 Crankshaft End Play Measurement

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. 72).

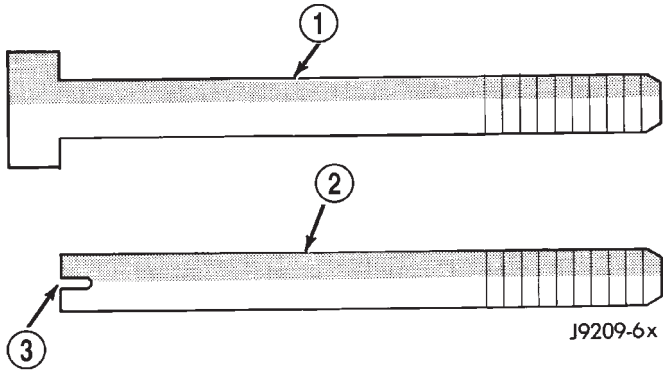


Fig. 72 Fabrication of Alignment Dowels

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

REMOVAL AND INSTALLATION (Continued)

(3) Install two dowels in the timing case cover. Install the other two dowels in the cylinder block (Fig. 73).

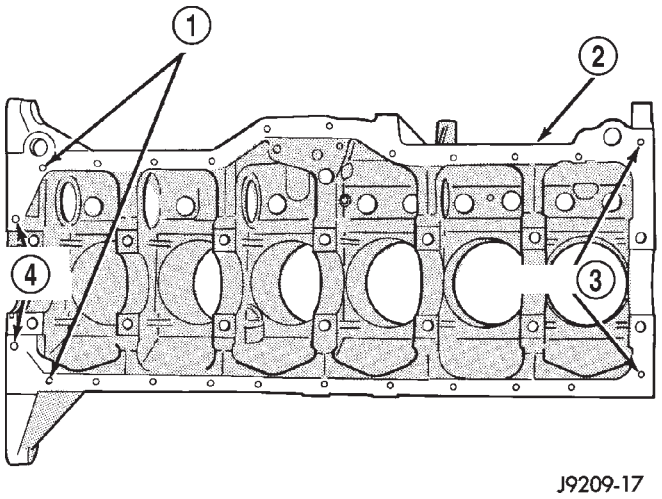


Fig. 73 Position of Dowels in Cylinder Block

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. 74).

(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. 75). Tighten these bolts to 15 N·m (132 in. lbs.) torque.

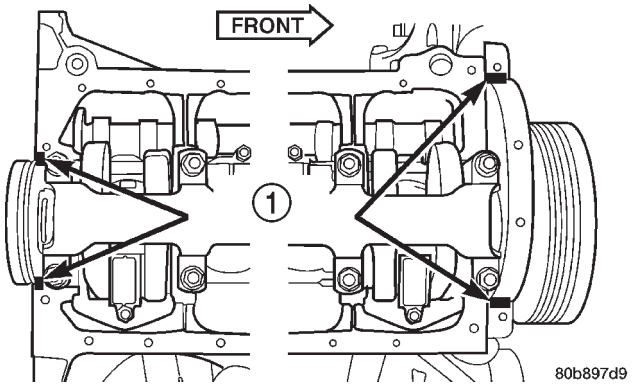


Fig. 74 Oil Pan Sealer Location

1 – SEALER LOCATIONS

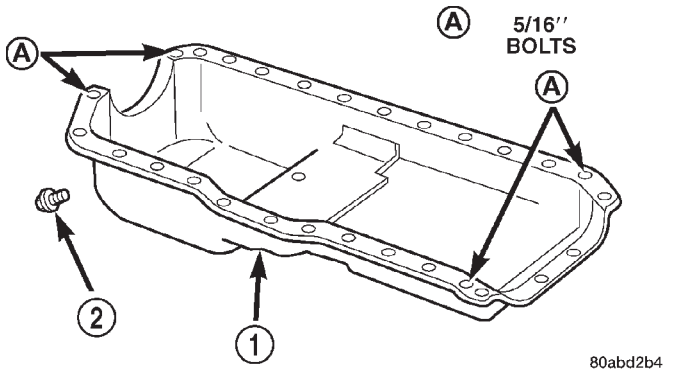


Fig. 75 Position of 5/16 inch Oil Pan Bolts

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. 75). Tighten the plug to 34 N·m (25 ft. lbs.) torque.

(17) Lower the vehicle.

(18) Connect negative cable to battery.

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

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

(20) Start the engine and inspect for leaks.

PISTONS AND CONNECTING RODS

REMOVAL

(1) Remove the engine cylinder head cover.

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

(3) Remove the push rods.

(4) Remove the engine cylinder head.

(5) Position the pistons one at a time near the bottom of the stroke. Use a ridge reamer to remove the

REMOVAL AND INSTALLATION (Continued)

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. 76).

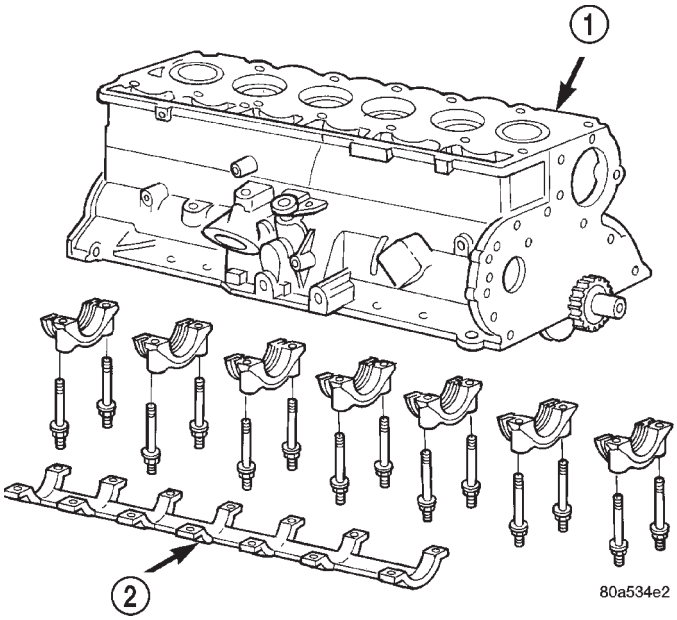


Fig. 76 Main Bearings Caps and Brace

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. 77).

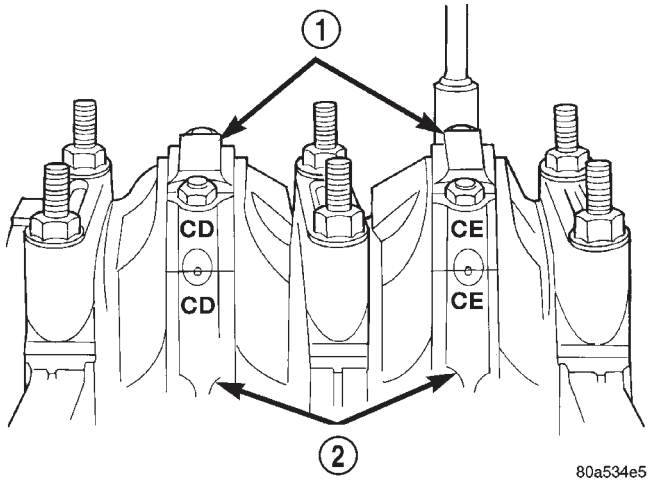


Fig. 77 Stamped Connecting Rods and Caps

1 – CONNECTING ROD CAP
2 – CONNECTING ROD

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

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

(12) Have an assistant push the piston and connecting rod assemblies up and through the top of the cylinder bores (Fig. 78).

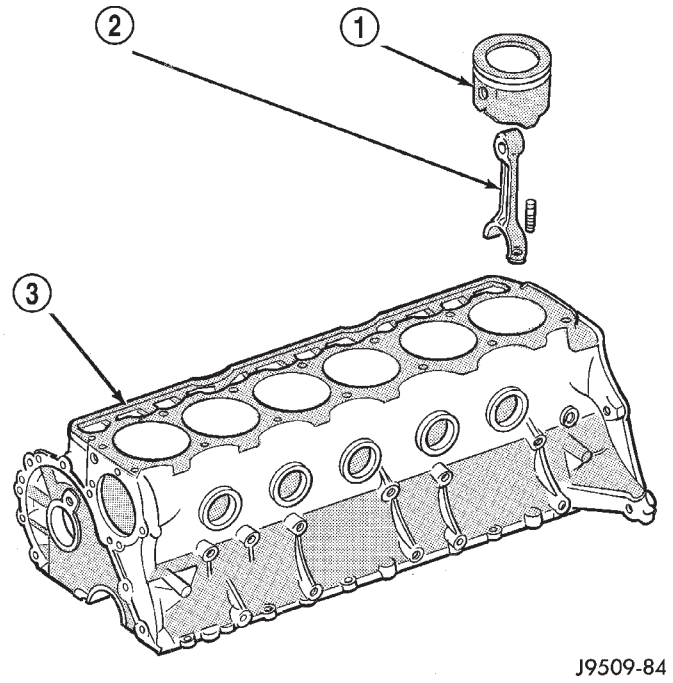


Fig. 78 Removal of Connecting Rod and Piston Assembly

1 – PISTON
2 – CONNECTING ROD
3 – BLOCK

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.

REMOVAL AND INSTALLATION (Continued)

(4) Use a piston ring compressor to install the connecting rod and piston assemblies through the top of the cylinder bores (Fig. 79).

(5) Ensure the arrow on the piston top points to the front of the engine (Fig. 79).

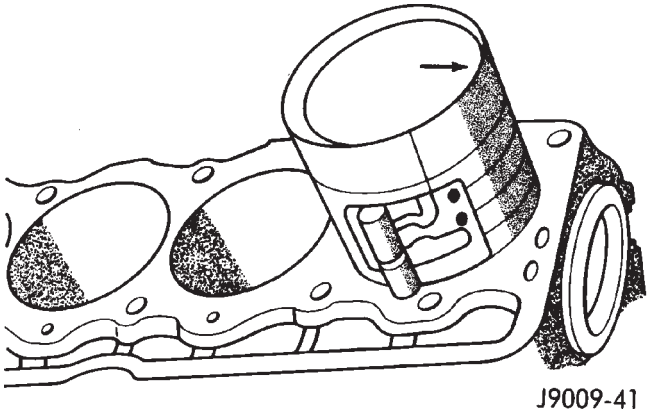


Fig. 79 Rod and Piston Assembly Installation

(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. 76). 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. 80). The dab of sealer should be 3 mm (0.125 in.) in diameter.

(6) Apply Mopar® Gasket Maker on the rear bearing cap (Fig. 80). The bead should be 2.3 mm (0.09 in.) in diameter. DO NOT apply sealer to the lip of the seal.

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

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

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

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

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

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

REMOVAL AND INSTALLATION (Continued)

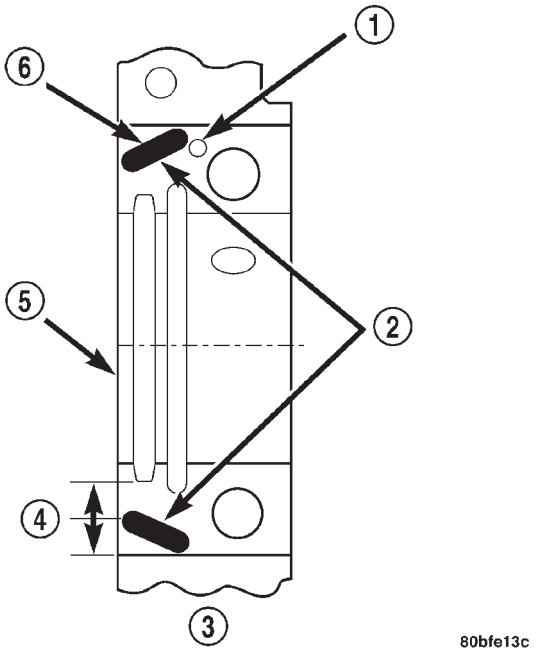


Fig. 80 Location of Sealer

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

(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. 81)

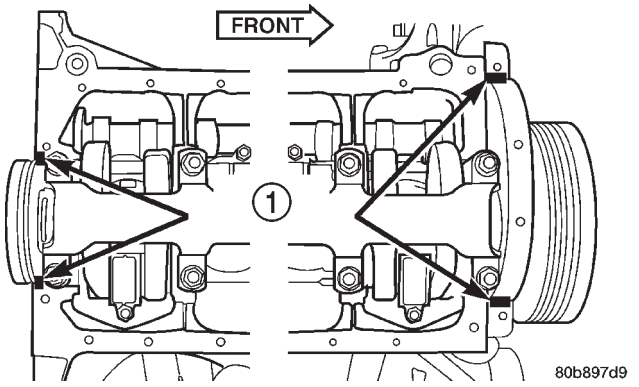


Fig. 81 Oil Pan Sealer Location

1 – SEALER LOCATIONS

(14) Install transmission inspection cover.

OIL PUMP

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

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

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

REMOVAL

(1) Drain the engine oil.
(2) Remove the oil pan.
(3) Remove the pump-to-cylinder block attaching bolts. Remove the pump assembly with gasket (Fig. 82).

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.

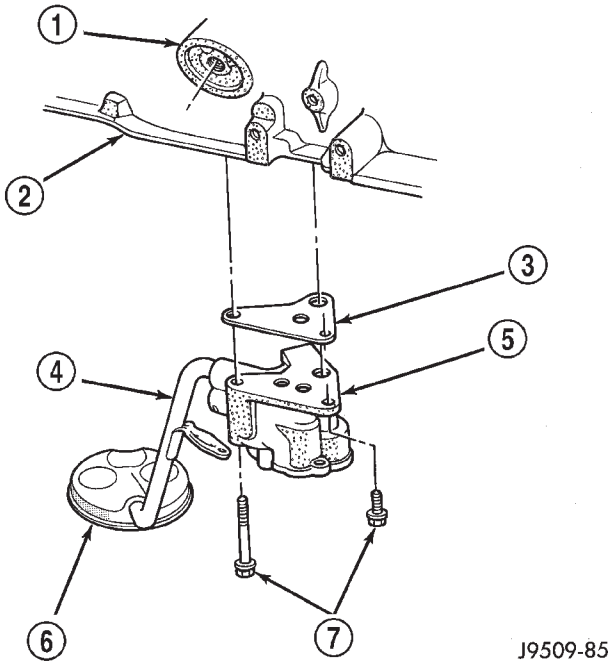


Fig. 82 Oil Pump Assembly

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

REMOVAL AND INSTALLATION (Continued)

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.

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. 83). Tighten the nut against the tool until it contacts the cover.

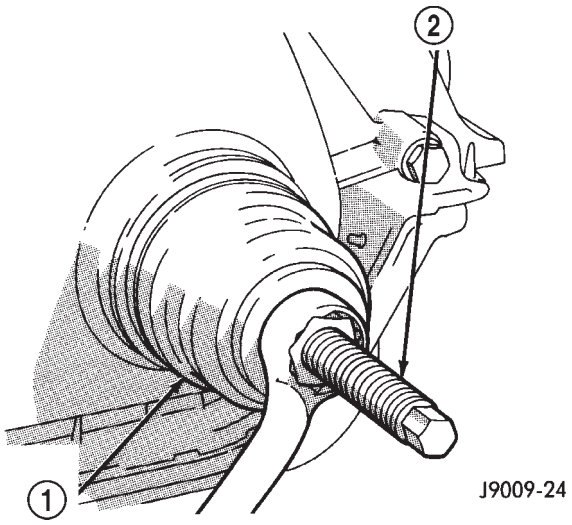


Fig. 83 Timing Case Cover Oil Seal Installation
1 – SEAL INSTALLATION TOOL
2 – DRAW SCREW TOOL

(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.

DISASSEMBLY AND ASSEMBLY

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

DISASSEMBLY AND ASSEMBLY (Continued)

(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

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. 84).

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.

CLEANING AND INSPECTION (Continued)

(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.

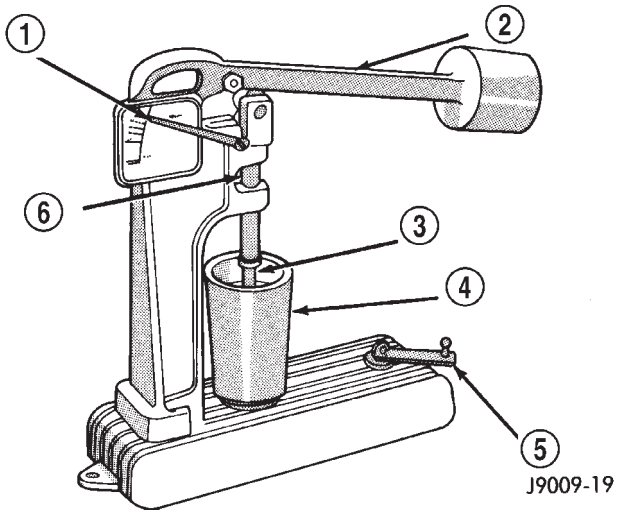


Fig. 84 Leak-Down Tester

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. 85). 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.

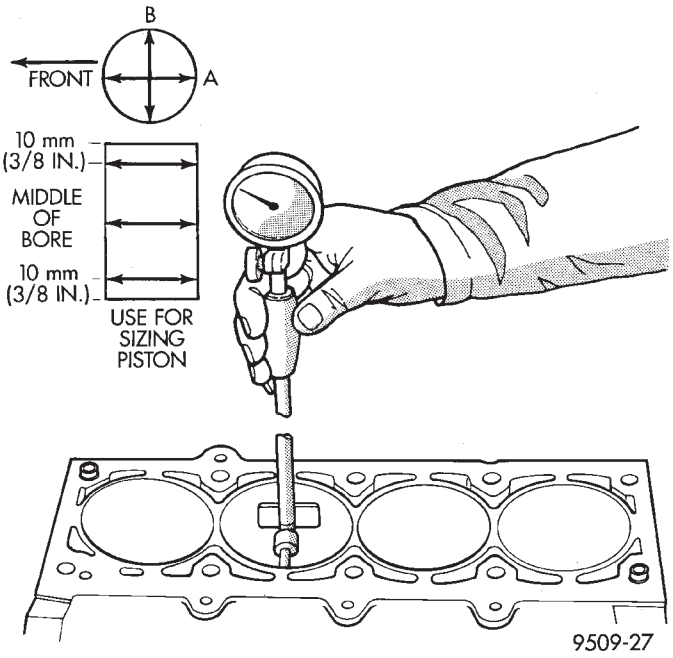


Fig. 85 Cylinder Bore Measurement

(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 Malleable 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.)
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.)

SPECIFICATIONS (Continued)

DESCRIPTION	SPECIFICATION
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.)
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.)

DESCRIPTION	SPECIFICATION
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.)	0.002 mm per mm (0.002 in. per inch)
Bend (Max.)	0.002 mm per mm (0.002 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)
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.)

SPECIFICATIONS (Continued)

DESCRIPTION	SPECIFICATION
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.)
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.)

DESCRIPTION	SPECIFICATION
VALVE SPRINGS	
Free Length (Approx.)	47.65 mm (1.876 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.)
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.)

SPECIFICATIONS (Continued)

DESCRIPTION	SPECIFICATION
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)

TORQUE SPECIFICATIONS

4.0L ENGINE

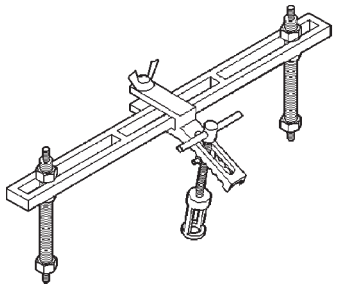
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
A/C Compressor—Bolts	28	—	250
Block Heater—Nut	2	—	16
Camshaft Sprocket—Bolt	68	50	—
Camshaft Thrust Plate to Cylinder Block—Screws	24	18	—
Clutch Cover to Flywheel—Bolts	54	40	—
Coil Bracket to Block—Bolts	22	—	192
Connecting Rod—Nuts	45	33	—
Cylinder Block—Drain Plugs	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	—

SPECIFICATIONS (Continued)

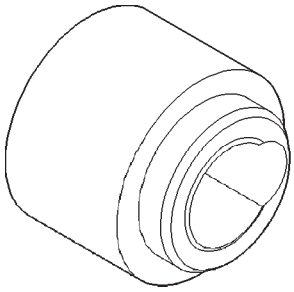
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Intake/Exhaust Manifold			
Fasteners #1-5	33	24	—
Fasteners #6 and 7	14	—	126
Fasteners #8-11	33	24	—
Flywheel to Converter Housing—Bolts	38	28	—
Flywheel to Crankshaft—Bolts	143	105	—
Front Cover to Block—Bolts			
1/4-20	7	—	60
5/16-18	22	—	192
Fuel Rail—Bolts/Stud	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

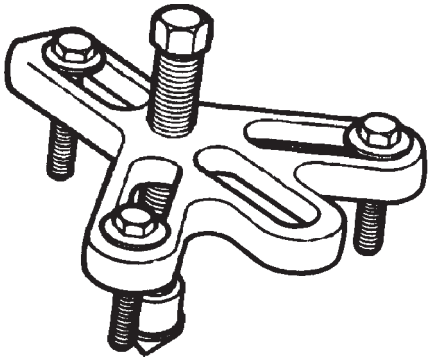
4.0L ENGINE



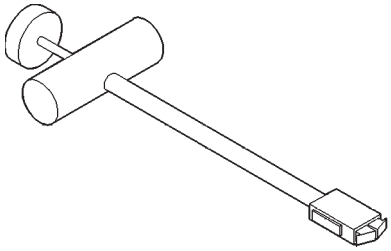
Valve Spring Compressor Tool MD-998772A



Timing Case Cover Alignment and Seal installation Tool 6139



Vibration Damper Removal Tool 7697



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