

ENGINE

TABLE OF CONTENTS

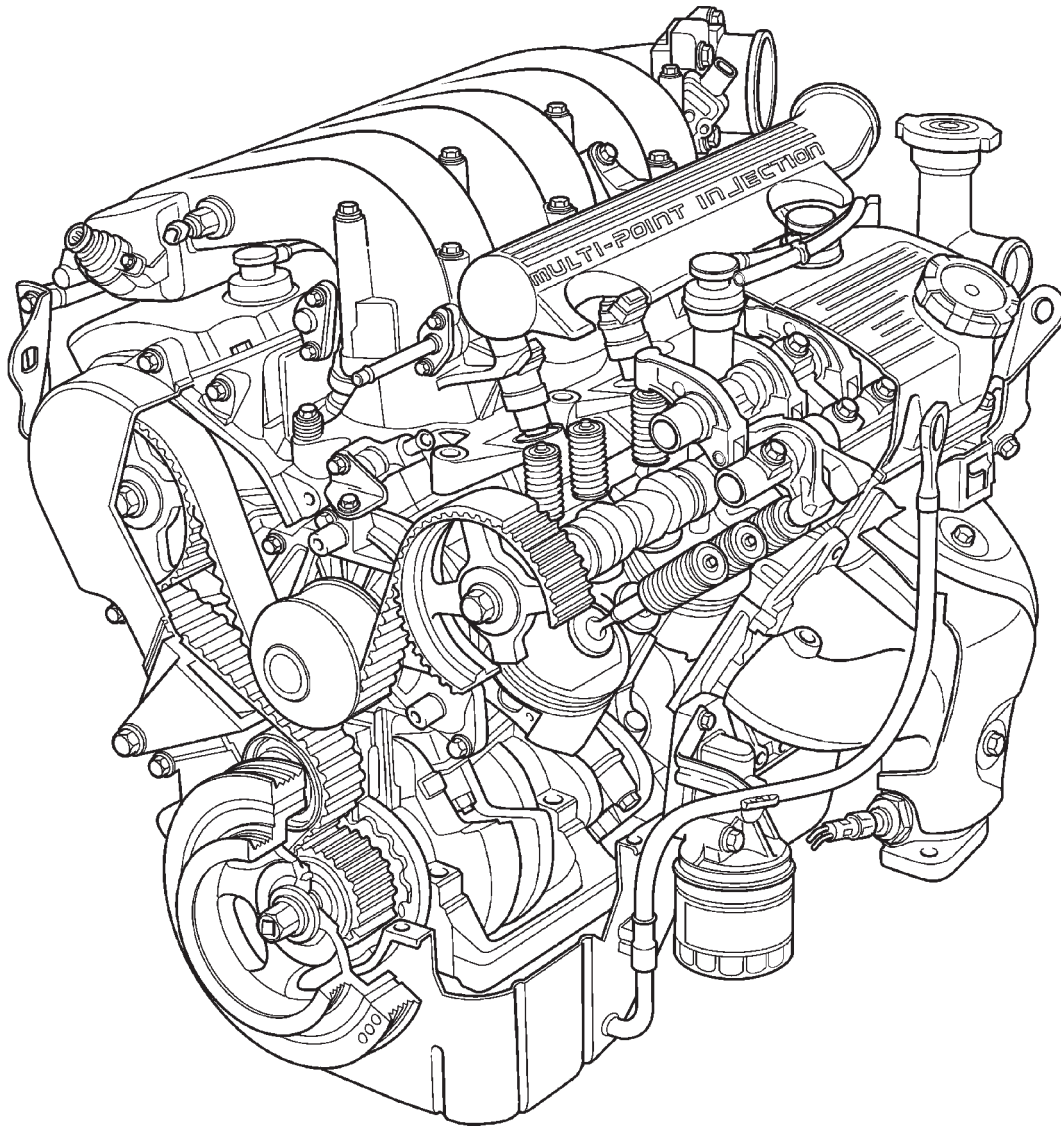
	page		page
DESCRIPTION AND OPERATION		REMOVAL AND INSTALLATION	
2.5L ENGINE.....	2	ENGINE MOUNTS—FRONT AND REAR.....	23
CYLINDER BLOCK	3	ENGINE MOUNT—RIGHT/ENGINE SUPPORT	
CRANKSHAFT.....	3	BRACKET.....	24
PISTONS AND CONNECTING RODS	3	ENGINE MOUNT—LEFT	24
CYLINDER HEAD	3	ENGINE ASSEMBLY	24
CAMSHAFT.....	4	INTAKE MANIFOLD—UPPER	26
ROCKER ARMS AND SHAFTS	5	INTAKE MANIFOLD—LOWER.....	29
VALVES.....	6	EXHAUST MANIFOLD.....	30
INTAKE MANIFOLD.....	6	CYLINDER HEAD COVER	32
EXHAUST MANIFOLD.....	6	CYLINDER HEAD	32
ENGINE LUBRICATION SYSTEM	6	ROCKER ARM AND HYDRAULIC ADJUSTER ..	34
DIAGNOSIS AND TESTING		CAMSHAFT.....	35
ENGINE DIAGNOSIS—INTRODUCTION	8	VALVE SPRINGS AND SEALS—IN VEHICLE	
ENGINE DIAGNOSIS—PERFORMANCE	9	SERVICE	37
ENGINE DIAGNOSIS—MECHANICAL.....	10	CRANKSHAFT DAMPER	38
HYDROSTATIC LOCKED ENGINE	12	TIMING BELT COVERS.....	39
INTAKE MANIFOLD LEAKAGE DIAGNOSIS	12	TIMING BELT	39
CYLINDER COMPRESSION PRESSURE TEST ..	12	CAMSHAFT SPROCKETS	42
CYLINDER COMBUSTION PRESSURE		CAMSHAFT OIL SEAL.....	43
LEAKAGE TEST	13	OIL PAN	43
ENGINE CYLINDER HEAD GASKET FAILURE		CRANKSHAFT OIL SEAL—FRONT	44
DIAGNOSIS	13	CRANKSHAFT.....	45
LASH ADJUSTER (TAPPET) NOISE		CRANKSHAFT OIL SEAL AND RETAINER—	
DIAGNOSIS	14	REAR.....	48
ENGINE OIL LEAK INSPECTION.....	14	ENGINE CORE PLUGS	48
ENGINE OIL PRESSURE CHECKING	15	OIL FILTER	49
SERVICE PROCEDURES		OIL PUMP.....	49
ENGINE OIL LEVEL CHECK	15	PISTON AND CONNECTING ROD.....	50
ENGINE OIL SERVICE.....	16	DISASSEMBLY AND ASSEMBLY	
ENGINE OIL CHANGE.....	16	CYLINDER HEAD	52
FORM-IN-PLACE GASKETS & SEALERS	17	ROCKER ARMS	53
ENGINE GASKET SURFACE PREPARATION	18	OIL PUMP.....	54
REPAIR OF DAMAGED OR WORN THREADS ..	18	CLEANING AND INSPECTION	
CYLINDER BORE—HONING.....	18	INTAKE MANIFOLD.....	54
CYLINDER—BORING	19	EXHAUST MANIFOLD.....	54
PISTON—FITTING	19	CAMSHAFT.....	55
PISTON RING—FITTING	19	CYLINDER BORE AND BLOCK.....	55
CONNECTING ROD—FITTING	20	CYLINDER HEAD	56
CRANKSHAFT MAIN BEARING—FITTING	20	CYLINDER HEAD COVER	56
CRANKSHAFT END PLAY.....	22	ROCKER ARM AND AUTO LASH ADJUSTER...	56
CAMSHAFT END PLAY.....	22	OIL FILTER BRACKET.....	56

OIL PUMP.....	57
TIMING BELT	58
VALVES, SPRINGS, SEATS AND GUIDES	59
ADJUSTMENTS	
ENGINE SUPPORT ADJUSTMENT	60

SPECIFICATIONS	
2.5L ENGINE.....	61
TORQUE	63
SPECIAL TOOLS	
2.5L ENGINE.....	64

DESCRIPTION AND OPERATION

2.5L ENGINE



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Fig. 1 2.5L V-6 Engine

DESCRIPTION

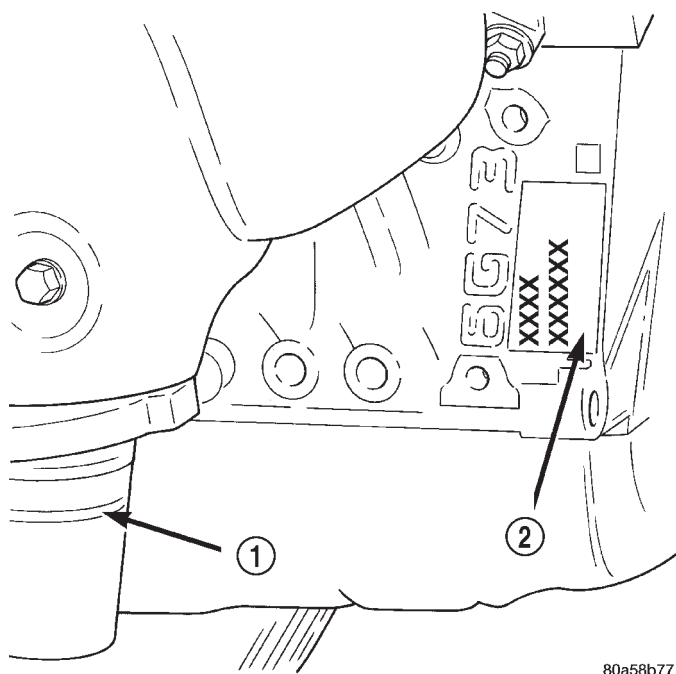
The 2.5 Liter (152 cu. in.) 60° V-6 engine is a single overhead camshaft (per bank) with four valves per cylinder design (Fig. 1). The engine does not have provisions for a free wheeling valve train.

The firing order is 1-2-3-4-5-6. The cylinders are numbered from the front of the engine to the rear.

The front cylinder bank is numbered 2, 4, and 6. The rear cylinder bank is numbered 1, 3, and 5.

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

DESCRIPTION AND OPERATION (Continued)

**Fig. 2 Engine Identification**

- 1 - OIL FILTER
2 - ENGINE SERIAL NUMBER AND VIN NUMBER

CYLINDER BLOCK**DESCRIPTION**

The cast iron cylinder block is a partial open design to improve cooling and weight reduction (Fig. 3). High rigidity is provided with ribs cast in the outer wall, and a monoblock or beam type main bearing cap system. This single unit four bearing main cap is designed to control vibration of the cylinder block partition walls.

CRANKSHAFT**DESCRIPTION**

The crankshaft is made of nodular cast iron and has six individual throws with five counter weights (Fig. 3). The crankshaft is supported by four main bearings

with number three being the thrust bearing. The six separate connecting rod throws pins reduce torque fluctuations while a dynamic damper is used to control torsional vibration of the crankshaft. Rubber lipped seals are used at front and rear. The front seal is retained in the oil pump case and the rear is retained in a die-cast aluminum block-mounted housing.

PISTONS AND CONNECTING RODS**DESCRIPTION**

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

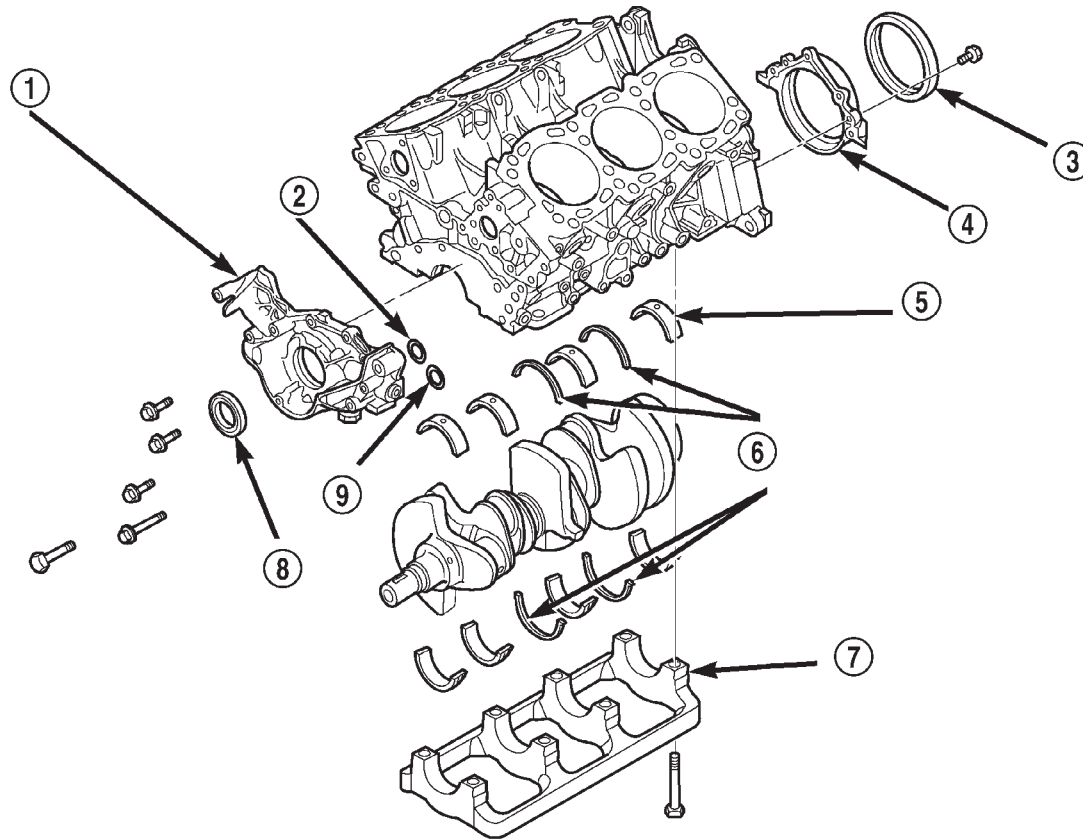
CYLINDER HEAD**DESCRIPTION**

The aluminum alloy cylinder heads feature a pent-roof design with four valves per cylinder (Fig. 4). Valve guides are made of cast iron alloy and seat inserts are made of sintered alloy iron, these are pressed into the head. To improve combustion efficiency the chambers have a compact pent-roof design with a squish area. The cylinder heads are common to either cylinder bank.

OPERATION

The cylinder head closes the combustion chamber, allowing the pistons to compress the air/fuel mixture for ignition. The valves are actuated by the lobe profiles on the camshaft to open and close at specified duration to either allow clean air in the combustion chamber or the exhaust gases out; depending on the stroke of the engine.

DESCRIPTION AND OPERATION (Continued)



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Fig. 3 Cylinder Block and Crankshaft

- 1 - OIL PUMP ASSEMBLY
- 2 - O-RING
- 3 - SEAL
- 4 - CASE
- 5 - UPPER BEARING (GROOVED)

- 6 - THRUST BEARINGS (2 PAIRS)
- 7 - MAIN BEARING MONOBLOCK CAP
- 8 - SEAL
- 9 - O-RING

CAMSHAFT**DESCRIPTION**

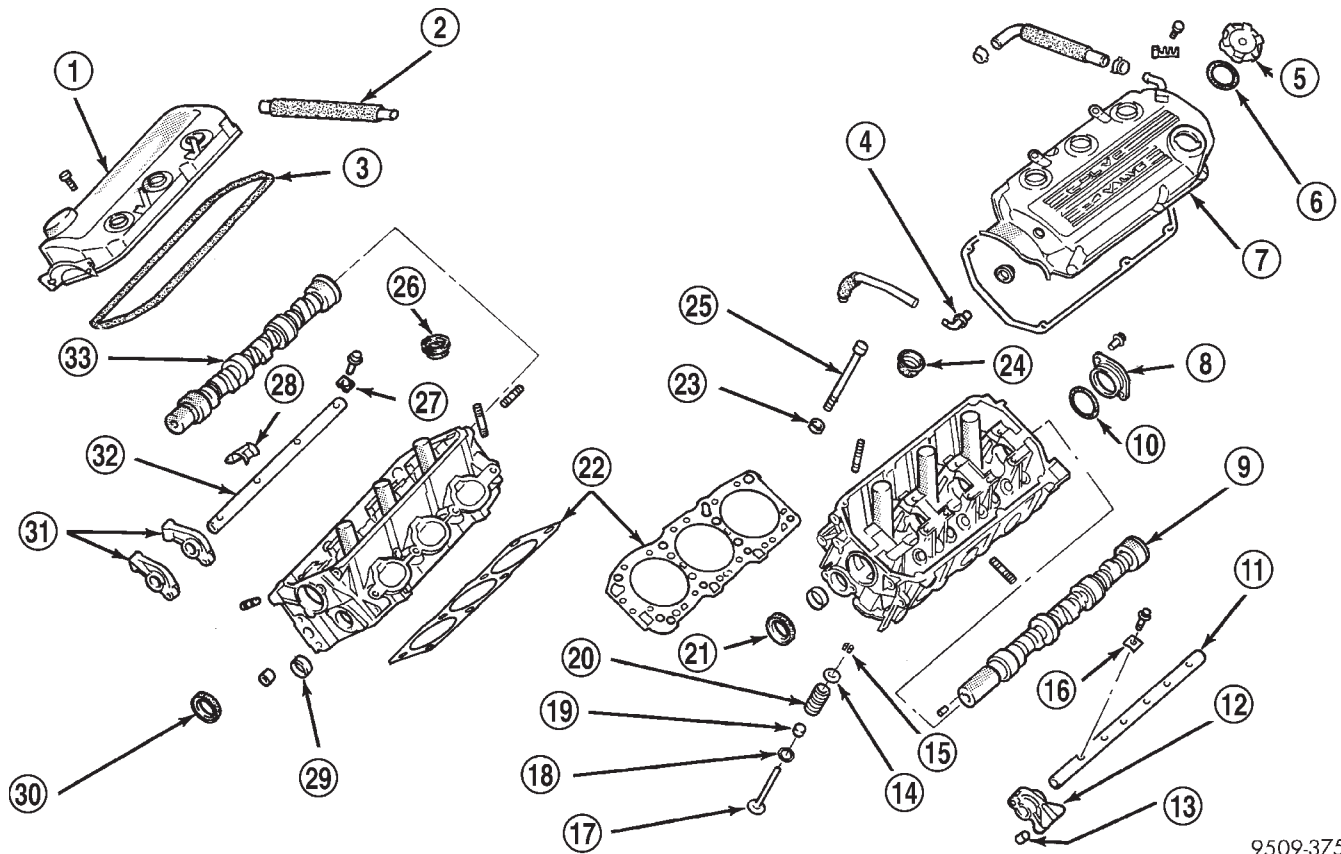
Two overhead camshafts provide valve actuation, one left (front cylinder bank) and one right (rear cylinder bank) (Fig. 4). The distributor is directly driven by the right camshaft. Both camshafts are supported by four bearing journals integral with the cylinder head. A flange at the rear of the camshaft acts as a

thrust collar. Right and left camshaft driving sprockets are interchangeable.

OPERATION

The camshafts are driven by the crankshaft via drive sprockets and a belt. The camshafts have precisely machined lobes to provide accurate valve timing and duration.

DESCRIPTION AND OPERATION (Continued)



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Fig. 4 Cylinder Head and Valvetrain

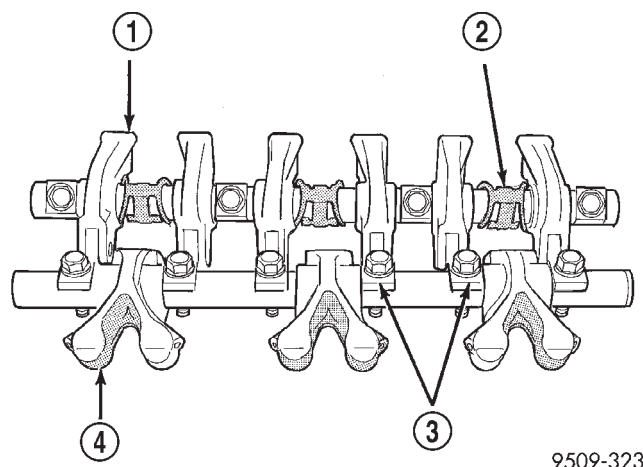
- | | |
|-------------------------------|------------------------------|
| 1 – CYLINDER HEAD COVER | 18 – SPRING SEAT |
| 2 – BREATHER HOSE | 19 – VALVE STEM SEAL |
| 3 – GASKET | 20 – SPRING |
| 4 – PCV VALVE | 21 – SEAL |
| 5 – OIL FILLER CAP | 22 – HEAD GASKETS |
| 6 – GASKET | 23 – WASHER |
| 7 – CYLINDER HEAD COVER | 24 – SEAL |
| 8 – CAMSHAFT THRUST CASE | 25 – CYLINDER HEAD BOLT |
| 9 – CAMSHAFT (LEFT SIDE) | 26 – SEAL |
| 10 – O-RING | 27 – CAP |
| 11 – EXHAUST ROCKER ARM SHAFT | 28 – SPRING |
| 12 – EXHAUST ROCKER ARM | 29 – CAP |
| 13 – HYDRAULIC LASH ADJUSTER | 30 – SEAL |
| 14 – SPRING RETAINER | 31 – INTAKE ROCKER ARMS |
| 15 – LOCKS | 32 – INTAKE ROCKER ARM SHAFT |
| 16 – CAP | 33 – CAMSHAFT (RIGHT SIDE) |
| 17 – VALVE | |

ROCKER ARMS AND SHAFTS**DESCRIPTION**

The rocker arms are made of light weight die-cast with roller type follower operating against the camshaft (Fig. 5). The valve actuating end of the rocker arms are machined for hydraulic lash adjusters, eliminating the need for periodic valve lash adjustment.

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

DESCRIPTION AND OPERATION (Continued)



9509-323

Fig. 5 Rocker Arms and Shafts

- 1 - INTAKE ROCKER ARMS
- 2 - ROCKER SHAFT SPRINGS
- 3 - ROCKER ARM SHAFT RETAINERS
- 4 - EXHAUST ROCKER ARMS

VALVES**DESCRIPTION**

Four valves per cylinder are actuated by die-cast aluminum roller rocker arms and hydraulic lash adjusters assemblies which pivot on rocker arm shafts (Fig. 4). All valves have 6 mm diameter chrome plated valve stems. The valves have a carbonitriding finish for long life. Fluorcarbon valve stem seals are used on both valves. Stamped steel valve spring seat, Valve springs, spring retainers, and locks are conventional.

INTAKE MANIFOLD**DESCRIPTION**

This intake manifold system (Fig. 6) is composed of an upper intake manifold plenum and a lower manifold. This aluminum alloy manifold has long runners to improve inertia. The upper intake plenum chamber (surge tank) absorbs air pulsations created during the suction phase of each cylinder. The lower intake manifold is machined for six injectors and fuel rail mounting.

OPERATION

The intake manifold meters and delivers air to the combustion chambers. This air allows the fuel delivered by the fuel injectors to ignite, thus producing power.

EXHAUST MANIFOLD**DESCRIPTION**

The exhaust manifolds (Fig. 6) are made of cast nodular graphite iron for heat resistance. Exhaust gasses from the left cylinder bank, leave the left manifold through a stainless steel pipe routed under the engine to the right side manifold. The collected exhaust from both manifolds are combined, and exit to the exhaust pipe through a flex-joint.

OPERATION

The exhaust manifold collects the exhaust gasses exiting the combustion chambers. Then it channels the exhaust gasses to the exhaust pipes attached to the manifold.

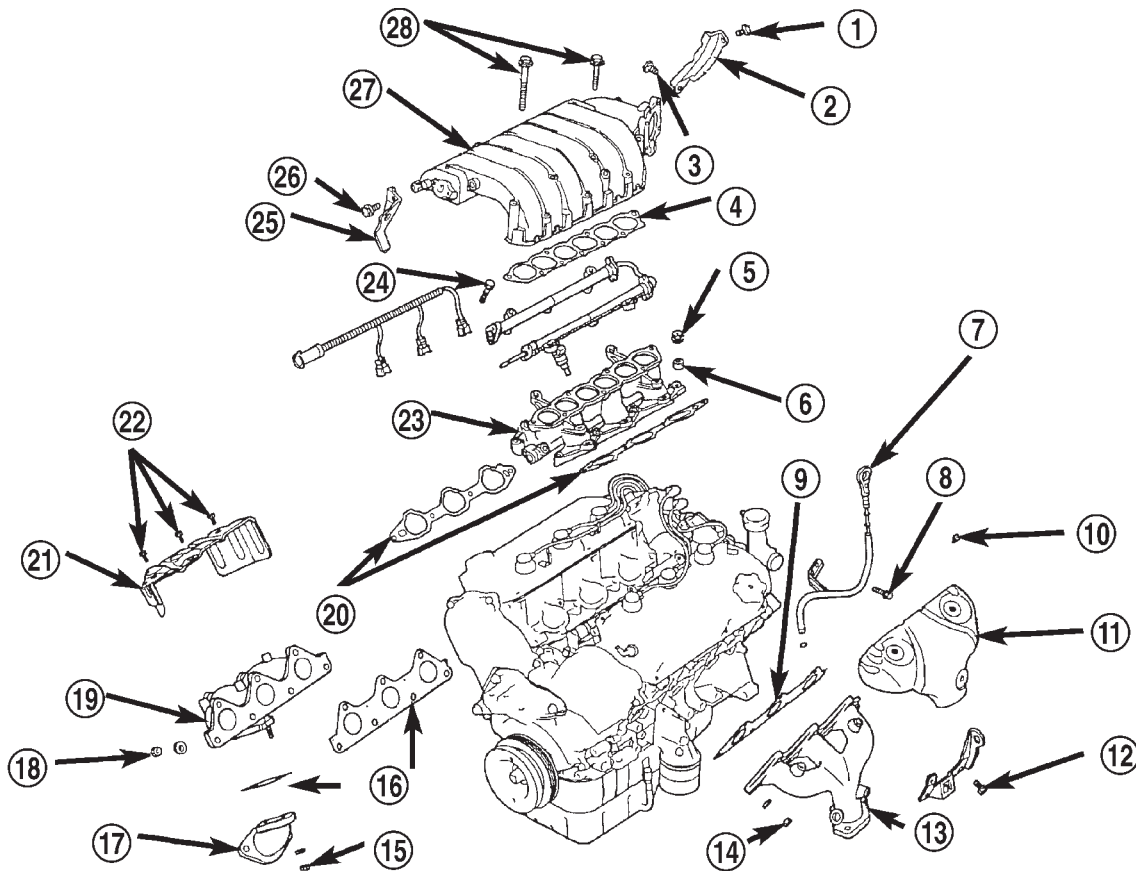
ENGINE LUBRICATION SYSTEM**DESCRIPTION**

The lubrication system is a full flow filtration pressure feed type. The trochoid type oil pump is mounted to the front of the engine block and is directly coupled to the crankshaft.

OPERATION

Engine oil, stored in the oil pan, is taken in and discharged the oil pump. Oil pressure is regulated by a relief valve located in the oil pump housing. The oil is fed through an oil filter and to the crankshaft journals from the oil gallery in the cylinder block. This gallery also feeds oil under pressure to the cylinder heads and camshaft journals. It then flows from the cylinder head passages to the rocker shafts to the rocker arm pivots and auto lash adjusters (Fig. 7).

DESCRIPTION AND OPERATION (Continued)

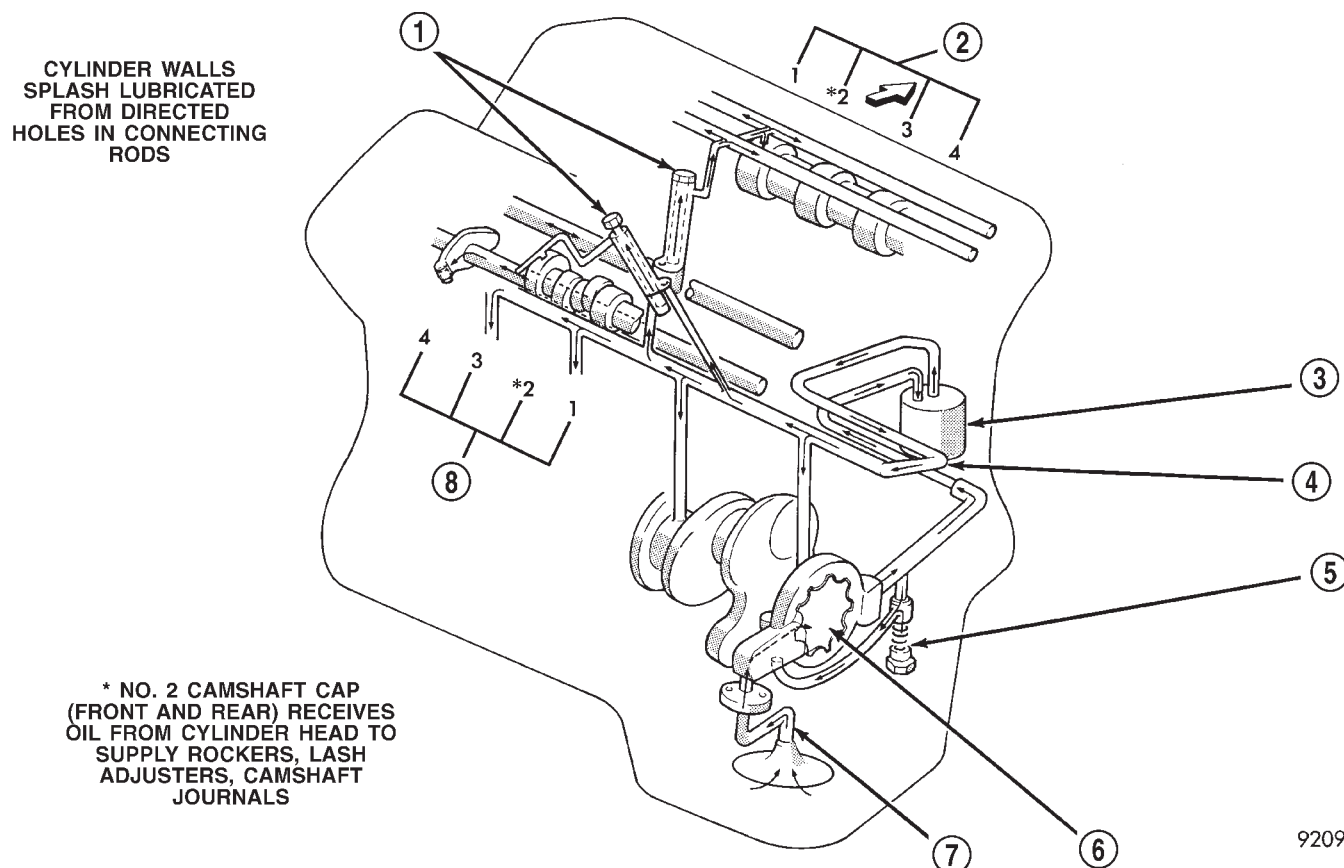


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Fig. 6 Intake and Exhaust Manifolds

- | | |
|--------------------------------|------------------------------------|
| 1 – 18 N•m (13 ft. lbs.) | 15 – NUT 59 N•m (43 ft. lbs.) |
| 2 – LEFT SIDE MANIFOLD SUPPORT | 16 – GASKETS |
| 3 – 36 N•m (26 ft. lbs.) | 17 – EXHAUST MANIFOLD |
| 4 – GASKET | 18 – 30 N•m (22 ft. lbs.) |
| 5 – NUT | 19 – REAR EXHAUST MANIFOLD |
| 6 – SPRING WASHER | 20 – LOWER INTAKE MANIFOLD GASKETS |
| 7 – OIL DIPSTICK AND TUBE | 21 – REAR HEAT SHIELD |
| 8 – 23 N•m (17 ft. lbs.) | 22 – 13 N•m (10 ft. lbs.) |
| 9 – GASKET | 23 – LOWER INTAKE MANIFOLD |
| 10 – 13 N•m (10 ft. lbs.) | 24 – 12 N•m (8 ft. lbs.) |
| 11 – FRONT HEAT SHIELD | 25 – RIGHT SIDE MANIFOLD SUPPORT |
| 12 – 36 N•m (26 ft. lbs.) | 26 – 18 N•m (13 ft. lbs.) |
| 13 – FRONT EXHAUST MANIFOLD | 27 – UPPER INTAKE MANIFOLD |
| 14 – 30 N•m (22 ft. lbs.) | 28 – 18 N•m (13 ft. lbs.) |

DESCRIPTION AND OPERATION (Continued)

**Fig. 7 Engine Lubrication System**

- 1 - CYLINDER HEAD BOLTS
- 2 - CAMSHAFT JOURNALS
- 3 - FILTER
- 4 - MAIN GALLERY

- 5 - RELIEF VALVE
- 6 - PUMP
- 7 - PICKUP
- 8 - CAMSHAFT JOURNALS

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 mechanical (e.g., a strange noise), or performance (e.g., engine idles rough and stalls).

Refer to the Service Diagnosis—Mechanical Chart and the Service Diagnosis—Performance Chart, for possible causes and corrections of malfunctions. Refer

to Group 14, Fuel System, for the fuel system diagnosis.

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

- Cylinder Compression Pressure Test
- Cylinder Combustion Pressure Leakage Test
- Engine Cylinder Head Gasket Failure Diagnosis
- Intake Manifold Leakage Diagnosis
- Lash Adjuster (Tappet) Noise Diagnosis
- Engine Oil Leak Inspection

DIAGNOSIS AND TESTING (Continued)

ENGINE DIAGNOSIS—PERFORMANCE

CONDITION	POSSIBLE CAUSE	CORRECTION
ENGINE WILL NOT START	- Weak battery. - Corroded or loose battery connections. - Faulty starter. - Faulty coil(s) or control unit. - Incorrect spark plug gap. - Contamination in fuel system. - Faulty fuel pump. - Incorrect engine timing.	- Test battery. Charge or replace as necessary. Refer to Group 8A, Battery. - Clean and tighten battery connections. Apply a coat of light mineral grease to terminals. - Test starting system. Refer to Group 8B, Starting. - Test and replace as needed. Refer to Group 8D, Ignition System. - Set gap. Refer to Group 8D, Ignition System. - Clean system and replace fuel filter. - Test fuel pump and replace as needed. Refer to Group 14, Fuel System. - Check for a skipped timing belt/chain.
ENGINE STALLS OR IDLES ROUGH	- Idle speed too low. - Incorrect fuel mixture. - Intake manifold leakage. - Faulty coil(s).	- Test minimum air flow. Refer to Group 14, Fuel System. - Refer to Group 14, Fuel System. - Inspect intake manifold, manifold gasket, and vacuum hoses. - Test and replace as necessary. Refer to Group 8D, Ignition System.
ENGINE LOSS OF POWER	- Dirty or incorrectly gapped plugs. - Contamination in fuel system. - Faulty fuel pump. - Incorrect valve timing. - Leaking cylinder head gasket. - Low compression. - Burned, warped, or pitted valves. - Plugged or restricted exhaust system. - Faulty coil(s).	- Clean plugs and set gap. Refer to Group 8D, Ignition System. - Clean system and replace fuel filter. - Test and replace as necessary. Refer to Group 14, Fuel System. - Correct valve timing. - Replace cylinder head gasket. - Test compression of each cylinder. - Replace valves. - Install new parts, as necessary. - Test and replace as necessary. Refer to Group 8D, Ignition System.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSE	CORRECTION
ENGINE MISSES ON ACCELERATION	1. Dirty or incorrectly gapped spark plugs. 2. Contamination in Fuel System. 3. Burned, warped, or pitted valves. 4. Faulty coil(s).	1. Clean spark plugs and set gap. Refer to Group 8D, Ignition System. 2. Clean fuel system and replace fuel filter. 3. Replace valves. 4. Test and replace as necessary. Refer to Group 8D, Ignition System.
ENGINE MISSES AT HIGH SPEED	1. Dirty or incorrect spark plug gap. 2. Faulty coil(s). 3. Dirty fuel injector(s). 4. Contamination in fuel system.	1. Clean spark plugs and set gap. Refer to Group 8D, Ignition System. 2. Test and replace as necessary. Refer to Group 8D, Ignition System. - Test and replace as necessary. Refer to Group 14, Fuel System. 4. Clean system and replace fuel filter.

ENGINE DIAGNOSIS—MECHANICAL

CONDITION	POSSIBLE CAUSES	CORRECTION
NOISY VALVES	1. High or low oil level in crankcase. 2. Thin or diluted oil. 3. Low oil pressure. 4. Dirt in tappets/lash adjusters. 5. Worn rocker arms. 6. Worn tappets/lash adjusters. 7. Worn valve guides. 8. Excessive runout of valve seats on valve faces. 9. Missing adjuster pivot.	1. Check and correct engine oil level. 2. Change oil to correct viscosity. 3. Check and correct engine oil level. 4. Replace rocker arm/hydraulic lash adjuster assembly. 5. Inspect oil supply to rocker arms. 6. Install new rocker arm/hydraulic lash adjuster assembly. 7. Ream guides and install new valves with oversize stems. 8. Grind valve seats and valves. 9. Replace rocker arm/hydraulic lash adjuster assembly.
CONNECTING ROD NOISE	1. Insufficient oil supply. 2. Low oil pressure. 3. Thin or diluted oil. 4. Excessive bearing clearance. 5. Connecting rod journal out-of-round. 6. Misaligned connecting rods.	1. Check engine oil level. 2. Check engine oil level. Inspect oil pump relief valve and spring. 3. Change oil to correct viscosity. 4. Measure bearings for correct clearance. Repair as necessary. 5. Replace crankshaft or grind surface. 6. Replace bent connecting rods.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
MAIN BEARING NOISE	1. Insufficient oil supply. 2. Low oil pressure. 3. Thin or diluted oil. 4. Excessive bearing clearance. 5. Excessive end play. 6. Crankshaft journal out-of-round or worn. 7. Loose flywheel or torque converter.	1. Check engine oil level. 2. Check engine oil level. Inspect oil pump relief valve and spring. 3. Change oil to correct viscosity. 4. Measure bearings for correct clearance. Repair as necessary. 5. Check thrust bearing for wear on flanges. 6. Replace crankshaft or grind journals. 7. Tighten to correct torque.
OIL PRESSURE DROP	1. Low oil level. 2. Faulty oil pressure sending unit. 3. Low oil pressure. 4. Clogged oil filter. 5. Worn parts in oil pump. 6. Thin or diluted oil. 7. Oil pump relief valve stuck. 8. Oil pump suction tube loose. 9. Oil pump cover warped or cracked. 10. Excessive bearing clearance.	1. Check engine oil level. 2. Install new sending unit. 3. Check sending unit and main bearing oil clearance. 4. Install new oil filter. 5. Replace worn parts or pump. 6. Change oil to correct viscosity. 7. Remove valve and inspect, clean, or replace. 8. Remove oil pan and install new tube or clean, if necessary. 9. Install new oil pump. 10. Measure bearings for correct clearance.
OIL LEAKS	1. Misaligned or deteriorated gaskets. 2. Loose fastener, broken or porous metal part. 3. Misaligned or deteriorated cup or threaded plug.	1. Replace gasket(s). 2. Tighten, repair or replace the part. 3. Replace as necessary.

DIAGNOSIS AND TESTING (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
OIL CONSUMPTION OR SPARK PLUGS FOULED	1. PCV system malfunction. 2. Worn, scuffed or broken rings. 3. Carbon in oil ring slots. 4. Rings fitted too tightly in grooves. 5. Worn valve guide(s). 6. Valve stem seal(s) worn or damaged.	1. Check system and repair as necessary. Refer to Group 25, Emission Control Systems. 2. Hone cylinder bores. Install new rings. 3. Install new rings. 4. Remove rings and check grooves. If groove is not proper width, replace piston. 5. Ream guide(s) and replace valve(s) with oversize valve(s) and seal(s). 6. Replace seal(s).

HYDROSTATIC LOCKED ENGINE

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

CAUTION: DO NOT use starter motor to rotate the engine, severe damage may occur.

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

(2) Remove negative battery cable.

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

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

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

(6) Make sure all fluid has been removed from the cylinders. Inspect engine for damage (i.e., connecting rods, pistons, valves, etc.)

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

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

(8) Install new spark plugs.

(9) Drain engine oil and remove oil filter.

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

(11) Connect negative battery cable.

(12) Start engine and check for any leaks.

INTAKE MANIFOLD LEAKAGE DIAGNOSIS

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

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

(1) Start the engine.

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

(3) If engine RPM'S change, the area of the suspected leak has been found.

(4) Repair as required.

CYLINDER COMPRESSION PRESSURE TEST

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

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

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

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

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

DIAGNOSIS AND TESTING (Continued)

(4) Disconnect coil wire from distributor and secure to good ground to prevent a spark from starting a fire (Conventional Ignition System). For Direct Ignition System DIS disconnect the coil connector.

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

(6) Insert compression gage adaptor Special Tool 8116 or the equivalent, into the #1 spark plug hole in cylinder head. Connect the 0–500 psi (Blue) pressure transducer with cable adaptors to the DRBIII®.

(7) Crank engine until maximum pressure is reached on gage. Record this pressure as #1 cylinder pressure.

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

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

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

(11) If the same cylinder or cylinders repeat an abnormally low reading on the second compression test, it could indicate the existence of a problem in the cylinder in question. **The recommended compression pressures are to be used only as a guide to diagnosing engine problems. An engine should not be disassembled to determine the cause of low compression unless some malfunction is present.**

CYLINDER COMBUSTION PRESSURE LEAKAGE TEST

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

Combustion pressure leakage testing will detect:

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

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

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

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

- Clean spark plug recesses with compressed air.
- Remove the spark plugs.
- Remove the oil filler cap.
- Remove the air cleaner.

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

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

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

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

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, perform either of the following procedures:

DIAGNOSIS AND TESTING (Continued)

PRESSURE TEST

- Install cooling system tester Special Tool 7700 or equivalent, 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.

CHEMICAL TEST

- This procedure involves using Bloc-Chek Test Kit, Special Tool C-3685-A or the equivalent. Perform test procedure following the instructions included with the test kit.

LASH ADJUSTER (TAPPET) NOISE DIAGNOSIS

A tappet-like noise may be produced from several items. Check the following items.

- (1) Engine oil level too high or too low. This may cause aerated oil to enter the adjusters and cause them to be spongy.
- (2) Insufficient running time after rebuilding cylinder head. Low speed running up to 1 hour may be required.
- (3) During this time, turn engine off and let set for a few minutes before restarting. Repeat this several times after engine has reached normal operating temperature.
- (4) Low oil pressure.
- (5) The oil restrictor pressed into the vertical oil passage to the cylinder head is plugged with debris.
- (6) Air ingested into oil due to broken or cracked oil pump pick up.
- (7) Worn valve guides.
- (8) Rocker arm ears contacting valve spring retainer.
- (9) Rocker arm loose, adjuster stuck or at maximum extension and still leaves lash in the system.
- (10) Faulty lash adjuster.
 - a. Check lash adjusters for sponginess while installed in cylinder head. Depress part of rocker arm over adjuster. Normal adjusters should feel very firm. Spongy adjusters can be bottomed out easily.
 - b. Remove suspected lash adjusters, and replace 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 24 km (15 miles), and repeat inspection.

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

- Disconnect the fresh air hose (make-up air) at the cylinder head cover and plug or cap the nipple on the cover.
- Remove the PCV valve hose from the cylinder head cover. Cap or plug the PCV valve nipple on the cover.
- 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.

- 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 provides the best bubbles which will pinpoint the leak source. If the oil leak is detected and identified, repair per service manual procedures.

- If the leakage occurs at the crankshaft 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. Remove the air hose, all plugs, and caps. Install the PCV valve and fresh air hose (make-up air). Proceed to next step.

(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. If a leak is

DIAGNOSIS AND TESTING (Continued)

present in this area, remove transmission for further inspection.

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

(b) Where leakage tends to run straight down, possible causes are a porous block, oil gallery cup plug, bedplate to cylinder block mating surfaces and seal bore. See proper repair procedures for these items.

(4) If no leaks are detected, pressurize the crankcase as previously described.

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

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

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

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

(7) After the oil leak root cause and appropriate corrective action have been identified, refer to Crank-

shaft Oil Seal—Rear for proper replacement procedures.

ENGINE OIL PRESSURE CHECKING

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

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

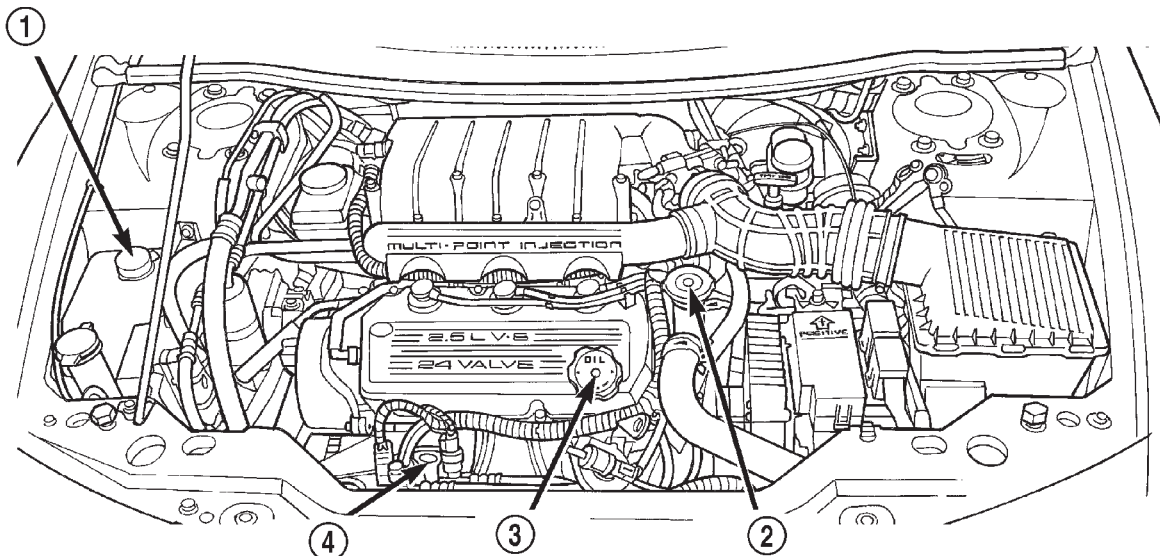
CAUTION: If oil pressure is 0 at idle, Do Not Run engine at 3000 RPM.

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

SERVICE PROCEDURES**ENGINE OIL LEVEL CHECK**

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

Checking the oil while the vehicle is on level ground will improve the accuracy of the oil level reading. Remove dipstick (Fig. 8), and observe oil level. Add oil only when the level is at or below the ADD mark (Fig. 9).



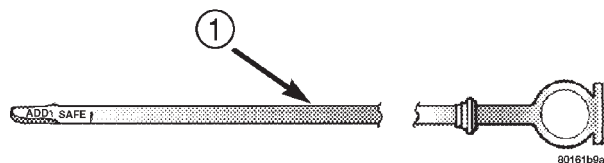
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Fig. 8 Dipstick and Engine Oil Fill Locations—2.5L

1 - COOLANT RECOVERY CONTAINER
2 - COOLANT PRESSURE CAP

3 - ENGINE OIL FILL
4 - ENGINE OIL DIPSTICK

SERVICE PROCEDURES (Continued)

**Fig. 9 Oil Level**

1 – ENGINE OIL LEVEL DIPSTICK

ENGINE OIL SERVICE

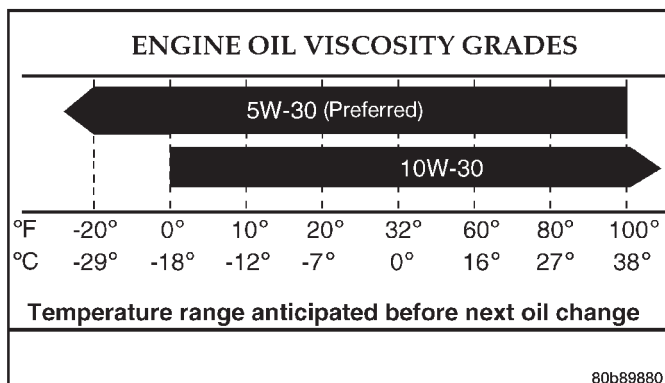
WARNING: NEW OR USED ENGINE OIL CAN BE IRRITATING TO THE SKIN. AVOID PROLONGED OR REPEATED SKIN CONTACT WITH ENGINE OIL. CONTAMINANTS IN USED ENGINE OIL, CAUSED BY INTERNAL COMBUSTION, CAN BE HAZARDOUS TO YOUR HEALTH. THOROUGHLY WASH EXPOSED SKIN WITH SOAP AND WATER. DO NOT WASH SKIN WITH GASOLINE, DIESEL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

API SERVICE GRADE CERTIFIED

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

SAE VISCOSITY

An SAE viscosity grade is used to specify the viscosity of engine oil. Use only engine oils with multiple viscosities such as 5W-30 or 10W-30. 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. 10).

**Fig. 10 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.

CONTAINER IDENTIFICATION

Standard engine oil identification notations have been adopted to aid in the proper selection of engine oil. The identifying notations are located on the label of engine oil plastic bottles and the top of engine oil cans (Fig. 11).



9400-9

Fig. 11 Engine Oil Container Standard Notations**ENGINE OIL CHANGE****CHANGING ENGINE OIL**

Change engine oil at mileage and time intervals described in the Maintenance Schedule. Refer to Group 0, Lubrication and Maintenance.

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

Run engine until achieving normal operating temperature.

- (1) Position the vehicle on a level surface and turn engine off.
- (2) Hoist and support vehicle on safety stands. Refer to Hoisting and Jacking Recommendations.
- (3) Remove oil fill cap. Refer to (Fig. 8).
- (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

SERVICE PROCEDURES (Continued)

stretching or other damage. Replace drain plug and gasket if damaged.

- (6) Install drain plug in crankcase.
- (7) Lower vehicle and fill crankcase with specified type and amount of engine oil described in this section.
- (8) Install oil fill cap.
- (9) Start engine and inspect for leaks.
- (10) Stop engine and inspect oil level.

ENGINE OIL FILTER CHANGE

FILTER SPECIFICATION

All engines are equipped with a high quality full-flow, disposable type oil filter. Replace oil filter with a Mopar® or the equivalent.

OIL FILTER REMOVAL

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

USED ENGINE OIL DISPOSAL

Care should be exercised when disposing used engine oil after it has been drained from a vehicle engine. Refer to the WARNING listed above.

FORM-IN-PLACE GASKETS & SEALERS

There are numerous places where form-in-place gaskets are used on the engine. Care must be taken when applying form-in-place gaskets to assure obtaining the desired results. **Do not use form-in-place gasket material unless specified.** Bead size, continuity, and location are of great importance. Too thin a bead can result in leakage while too much can result in spill-over which can break off and obstruct fluid feed lines. A continuous bead of the proper width is essential to obtain a leak-free gasket.

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

MOPAR® ENGINE RTV GEN II

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

MOPAR® ATF RTV

Mopar® ATF RTV is a specifically designed black silicone rubber RTV that retains adhesion and seal-

ing properties to seal components exposed to automatic transmission fluid, engine coolants, and moisture. This material is available in three ounce tubes and has a shelf life of one year. After one year this material will not properly cure. Always inspect the package for the expiration date before use.

MOPAR® GASKET MAKER

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

MOPAR® BED PLATE SEALANT

Mopar® Bed Plate Sealant is a unique (green-in-color) anaerobic type gasket material that is specially made to seal the area between the bedplate and cylinder block without disturbing the bearing clearance or alignment of these components. The material cures slowly in the absence of air when torqued between two metallic surfaces, and will rapidly cure when heat is applied.

MOPAR® GASKET SEALANT

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

FORM-IN-PLACE GASKET AND SEALER APPLICATION

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

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

Mopar® Engine RTV GEN II or ATF RTV gasket material should be applied in a continuous bead approximately 3 mm (0.120 in.) in diameter. All mounting holes must be circled. For corner sealing, a 3.17 or 6.35 mm (1/8 or 1/4 in.) drop is placed in the center of the gasket contact area. Uncured sealant may be removed with a shop towel. Components should be torqued in place while the sealant is still wet to the touch (within 10 minutes). The usage of a

SERVICE PROCEDURES (Continued)

locating dowel is recommended during assembly to prevent smearing material off the location.

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

ENGINE GASKET SURFACE PREPARATION

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

Never use the following to clean gasket surfaces:

- Metal scraper
- Abrasive pad or paper to clean cylinder block and head
- High speed power tool with an abrasive pad or a wire brush (Fig. 12)

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

Only use the following for cleaning gasket surfaces:

- Solvent or a commercially available gasket remover
- Plastic or wood scraper (Fig. 12)
- Drill motor with 3M Roloc™ Bristle Disc (white or yellow) (Fig. 12)

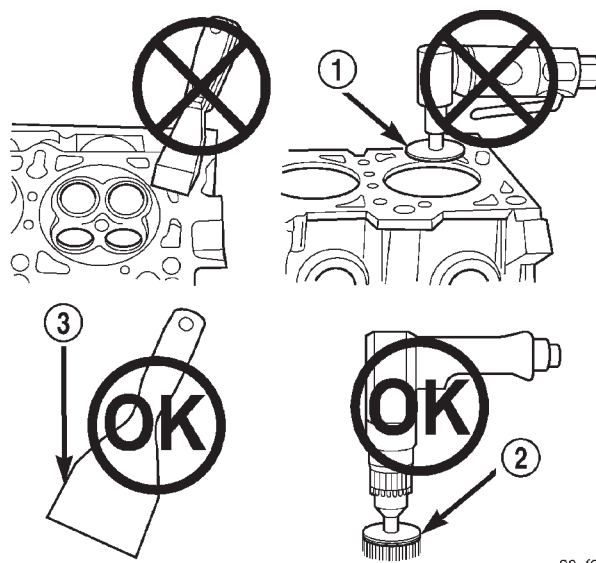
CAUTION: Excessive pressure or high RPM (beyond the recommended speed), can damage the sealing surfaces. The mild (white, 120 grit) bristle disc is recommended. If necessary, the medium (yellow, 80 grit) bristle disc may be used on cast iron surfaces with care.

REPAIR OF DAMAGED OR WORN THREADS

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

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

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



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Fig. 12 Proper Tool Usage For Surface Preparation

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

CYLINDER BORE—HONING

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

(2) Deglazing of the cylinder walls may be done using a cylinder surfacing hone, recommended tool C-3501 or equivalent, equipped with 280 grit stones, if the cylinder bore is straight and round. 20–60 strokes depending on the bore condition, will be sufficient to provide a satisfactory surface. Inspect cylinder walls after each 20 strokes, using a light honing oil. **Do not use engine or transmission oil, mineral spirits or kerosene.**

(3) Honing should be done by moving the hone up and down fast enough to get a cross-hatch pattern. When hone marks **intersect** at 50–60 degrees, the cross hatch angle is most satisfactory for proper seating of rings (Fig. 13).

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

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

SERVICE PROCEDURES (Continued)

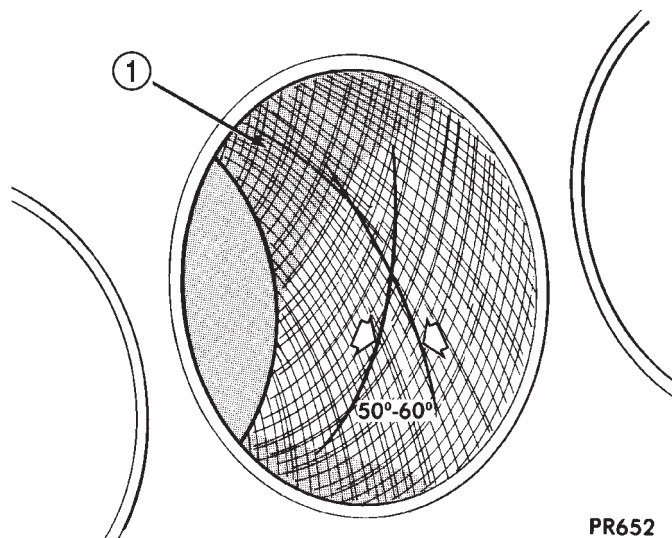


Fig. 13 Cylinder Bore Cross-Hatch Pattern

1 - CROSS-HATCH PATTERN

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

CYLINDER—BORING

Examine cylinder walls for scuffs, scoring and measure cylinder bore for out-of-round or taper. If defective, bore cylinder to oversize. Measure at points shown in (Fig. 14).

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

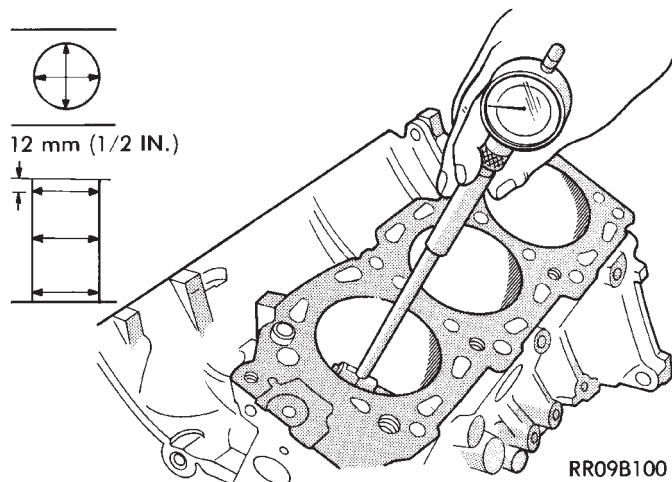


Fig. 14 Measure Cylinder Bore

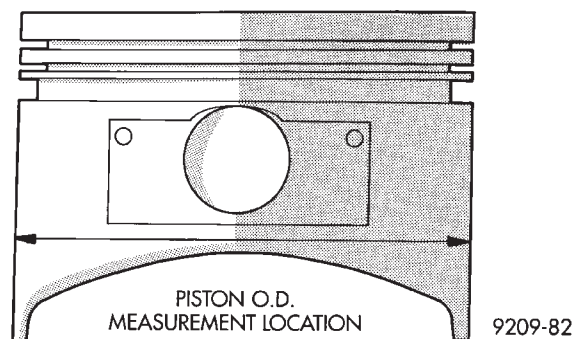


Fig. 15 Measure Piston

(1) Bore to specified clearance between the piston O. D. and cylinder. The measuring point of the piston O. D. is shown in (Fig. 15).

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

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

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

PISTON—FITTING

Measure approximately 2 mm (0.080 in.) above the bottom of the piston skirt and across the thrust face (Fig. 16). Refer to Cylinder Boring.

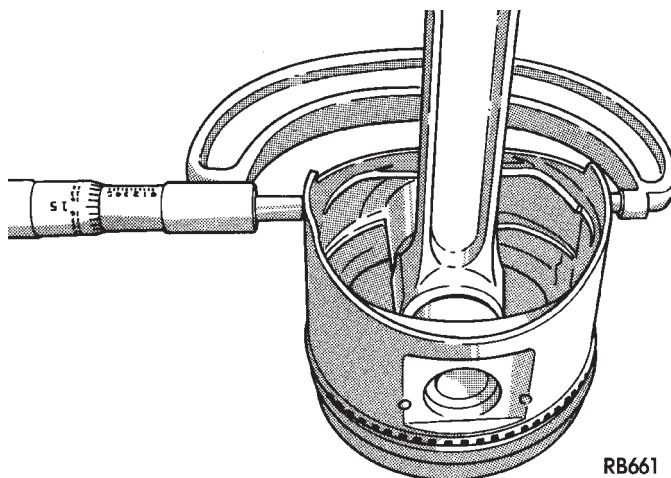


Fig. 16 Measuring Piston for Clearance and Wear

PISTON RING—FITTING

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

SERVICE PROCEDURES (Continued)

cylinder bore. Check gap with feeler gauge (Fig. 17). Refer to Engine Specifications.

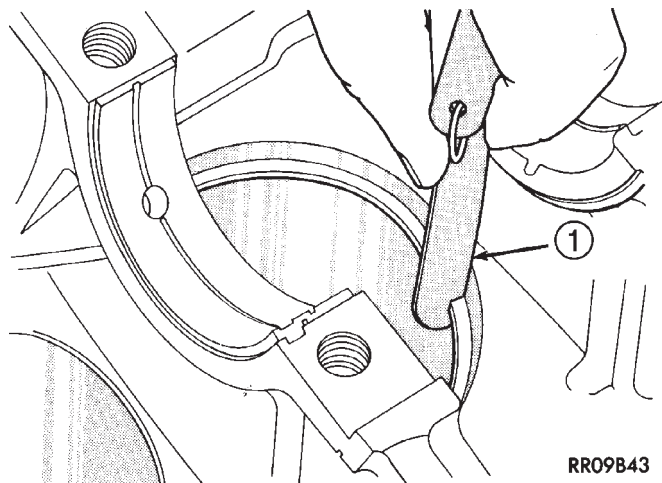


Fig. 17 Check Gap on Piston Rings

1 – FEELER GAUGE

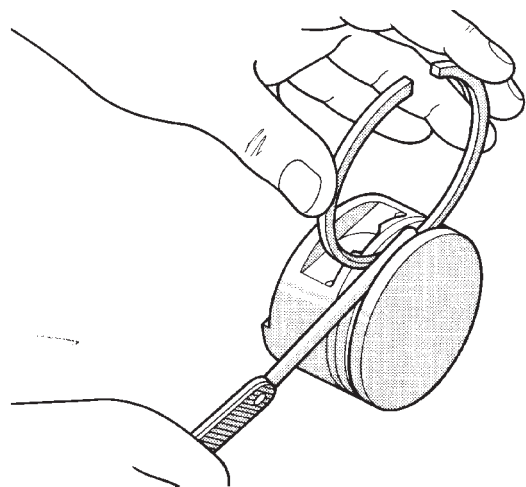


Fig. 18 Piston Ring Groove Clearance

(2) Check piston ring to groove clearance (Fig. 18). Refer to Engine Specifications.

CONNECTING ROD—FITTING

(1) Follow the procedures in the Standard Service Procedures Section for Measuring Main Bearing and Connecting Rod Bearing Clearances. (Fig. 19). Refer to Engine Specifications.

(2) Tighten connecting rod nuts to 51 N·m (37 ft. lbs.).

(3) Remove connecting rod cap and measure Plastigage (Fig. 19). Refer to Engine Specifications

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

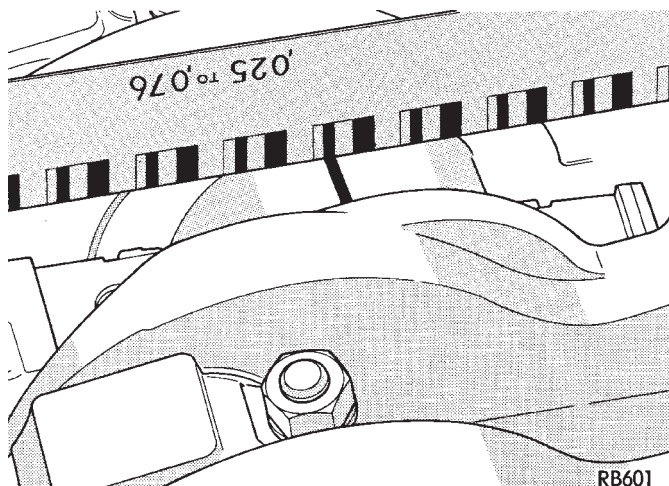


Fig. 19 Checking Connecting Rod Bearing Clearance

CONNECTING ROD SIDE CLEARANCE

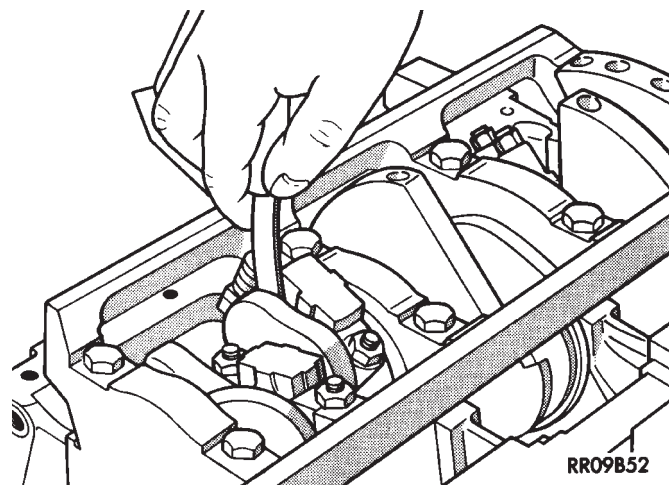


Fig. 20 Checking Connecting Rod Side Clearance

Using a feeler gauge, check connecting rod side clearance (Fig. 20). Refer to Engine Specifications.

CRANKSHAFT MAIN BEARING—FITTING

MAIN BEARING JOURNAL MEASUREMENT

Measure the journal outside diameter (Fig. 21). If the clearance exceeds the specifications limit, replace the main bearing(s), and if necessary, replace the crankshaft. Refer to Engine Specifications.

PLASTIGAGE MEASUREMENT

(1) Remove oil from journal and bearing shell.

(2) Install crankshaft.

(3) Cut plastigage to same length as width of the bearing and place it in parallel with the journal axis (Fig. 22).

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

SERVICE PROCEDURES (Continued)

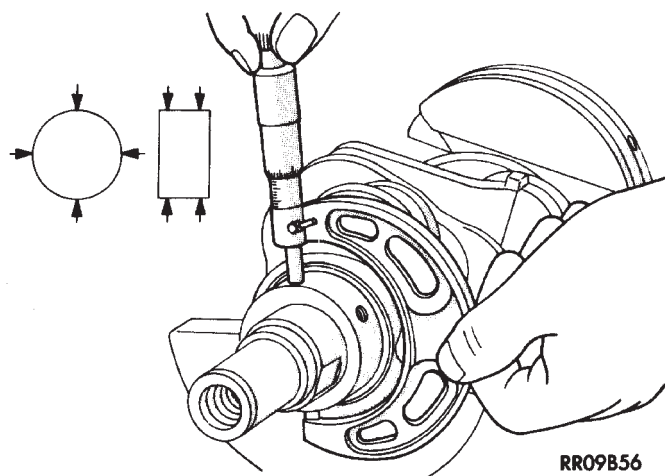


Fig. 21 Measure Crankshaft Journal O. D.

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

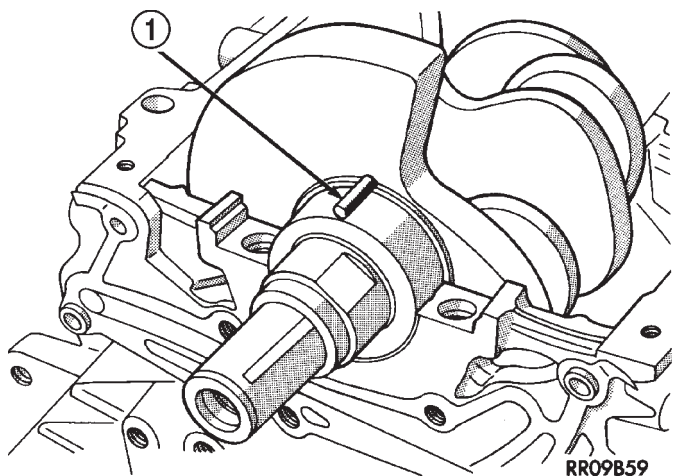


Fig. 22 Measure Oil Clearance with Plastigage

1 - PLASTIC GAUGE

(5) Carefully remove the bearing cap and measure the width of the plastigage at the widest part using the scale on the plastigage package (Fig. 23). Refer to Engine Specifications for proper clearance. Also see Measuring Main and Connecting Rod Bearing Clearances in Standard Service Procedures.

CRANKSHAFT BEARING INSTALLATION

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

(1) Measure the crankshaft journal diameter and confirm its classification from the Main Journal Size Identification Chart. In the case of a bearing supplied as a service part, the identification is embossed at the position show in (Fig. 25).

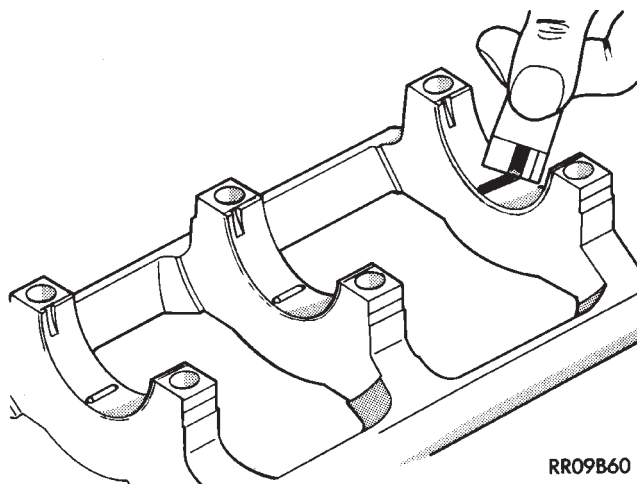
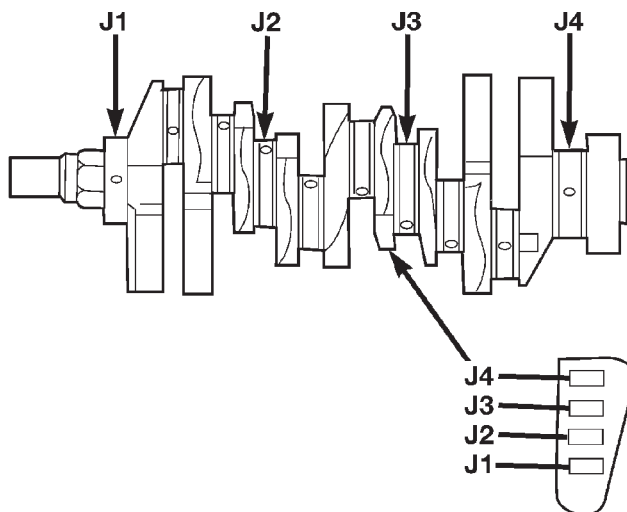


Fig. 23 Measuring Clearance

NOTE: Service Replacement parts have identification marks, but factory-assembled parts have no identification marks. Service crankshaft identification will have marks at counterweights (Fig. 24).

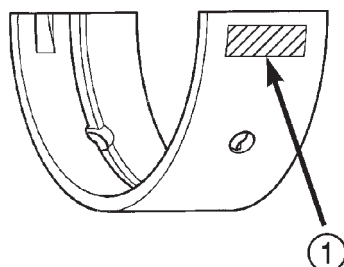


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Fig. 24 Crankshaft Size Identification

MAIN JOURNAL SIZE IDENTIFICATION	
SERVICE PART MARKING (Fig. 25)	JOURNAL OUTER DIAMETER
0	59.994–60.000 mm (2.3620–2.3622 in.)
1	59.988–59.994 mm (2.3617–2.3620 in.)
2	59.982–59.988 mm (2.3615–2.3617 in.)

SERVICE PROCEDURES (Continued)

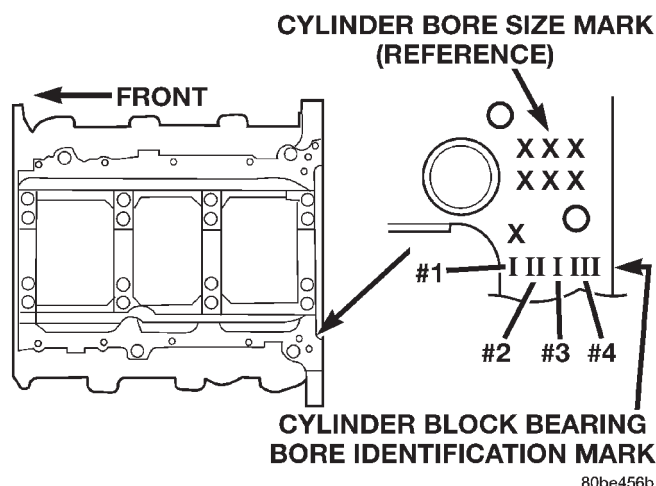


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Fig. 25 Bearing Identification

1 - IDENTIFICATION MARK

(2) The identification mark for the diameter of the cylinder block bearing bore is embossed as shown in (Fig. 26), starting from the # 1 mark at the front of the engine.



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Fig. 26 Cylinder Block Bearing Bore Markings

(3) Select and install the bearings according to these marks. Using the chart below, select the proper bearing by using the markings on the crankshaft and block. For a example:

(a) If the crankshaft journal outer diameter is 60.000 mm (2.3622 in.), the service part classification will be "0" and the identification mark will be "0".

(b) If the identification mark for the cylinder block main bore is "II", select the bearing "2" according the chart below.

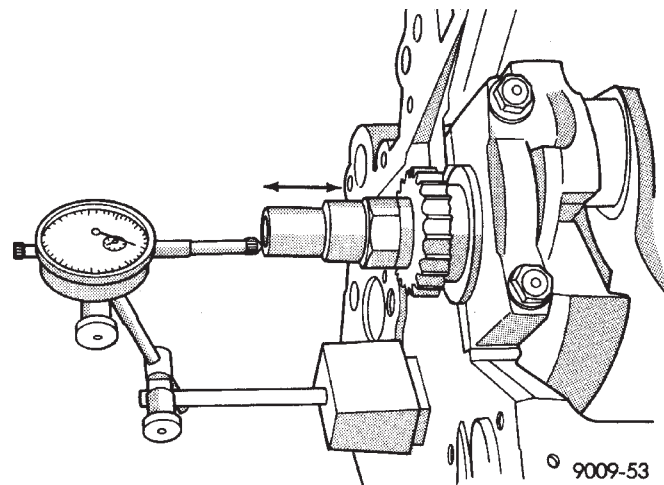
		Block Identification Mark		
		I	II	III
Main Journal Identification Mark	0	1	2	3
	1	2	3	4
	2	3	4	5

CRANKSHAFT END PLAY

(1) Mount a dial indicator to front of engine, locating probe on nose of crankshaft (Fig. 27).

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

(3) Zero the dial indicator.



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Fig. 27 Crankshaft End Play—Typical

(4) Move crankshaft all the way to the front and read the dial indicator. Refer to Engine Specifications.

CAMSHAFT END PLAY

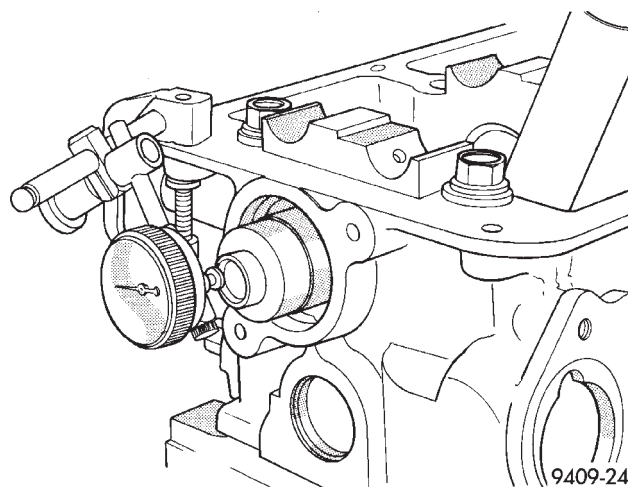
(1) Oil camshaft journals and install camshaft without rocker arm assemblies.

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

(3) Zero dial indicator (Fig. 28).

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

(5) End play travel: 0.1 - 0.2 mm (0.004 - 0.008 in.). Max. Travel: 0.4 mm (0.016 in.)



9409-24

Fig. 28 Camshaft End Play

REMOVAL AND INSTALLATION

ENGINE MOUNTS—FRONT AND REAR

REMOVAL

FRONT MOUNT

- (1) Raise vehicle on hoist.
- (2) Remove through bolt (A) at front mount (Fig. 30).
- (3) Remove attaching bolts from mount to lower radiator support crossmember.

NOTE: It may be necessary to tilt engine for front mount removal clearance.

- (4) Remove front mount.

REAR MOUNT

- (1) Raise vehicle on hoist.
- (2) Remove through bolt (A) from rear engine mount and bracket (Fig. 31).
- (3) Remove rear strut bracket (Fig. 29).
- (4) Remove bolts attaching rear mount to crossmember.

NOTE: It may be necessary to tilt engine for rear mount removal clearance.

- (5) Remove rear mount.

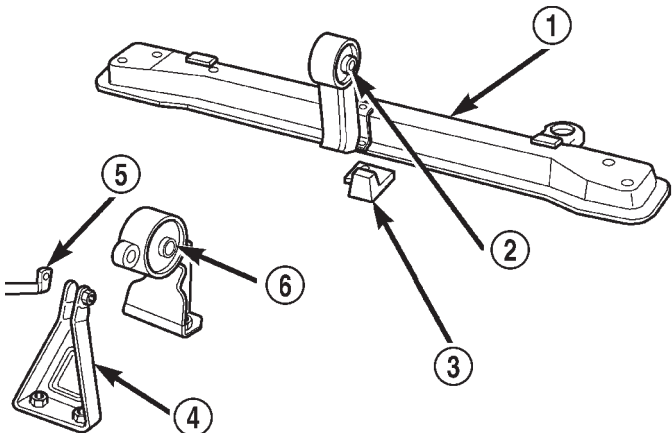


Fig. 29 Engine Mounting—Front and Rear

- 1 - LOWER RADIATOR SUPPORT
- 2 - FRONT ENGINE MOUNT
- 3 - DAMPER WEIGHT (SOME MODELS)
- 4 - REAR STRUT BRACKET
- 5 - SUPPORT BRACKET (SOME MODELS)
- 6 - REAR ENGINE MOUNT

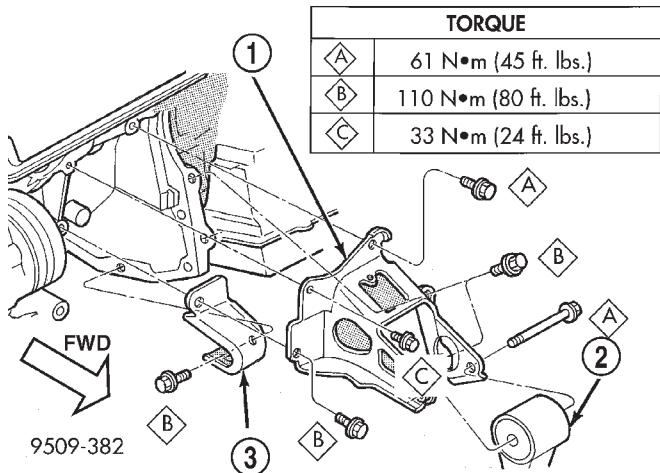


Fig. 30 Engine Mounting—Front 2.5L

- 1 - FRONT TORQUE BRACKET
- 2 - SUPPORT
- 3 - STRUT

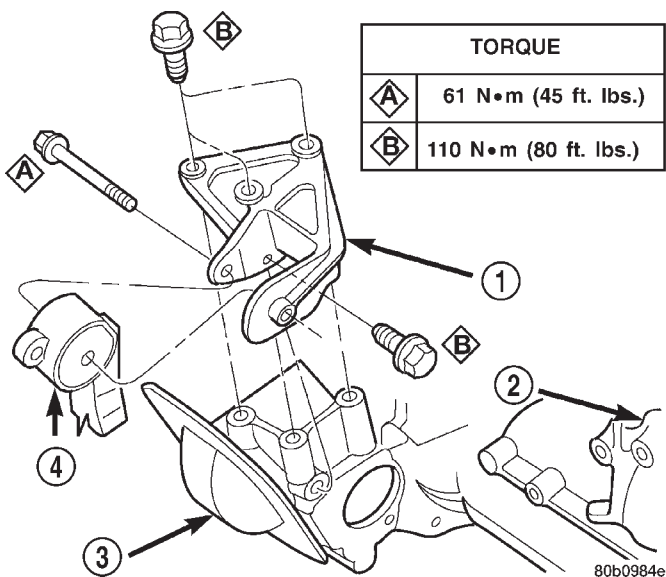


Fig. 31 Engine Mounting—Rear 2.5L

- 1 - REAR TORQUE BRACKET
- 2 - ENGINE
- 3 - TRANSMISSION
- 4 - REAR MOUNT

INSTALLATION

FRONT MOUNT

- (1) Position front mount. Install front mount to lower radiator support crossmember attaching bolts. Tighten bolts to 61 N•m (45 ft. lbs.)
- (2) Install through bolt (A) (Fig. 30).
- (3) Tighten front through bolt (A) to 61 N•m (45 ft. lbs.) (Fig. 30).
- (4) Lower vehicle.

REMOVAL AND INSTALLATION (Continued)

REAR MOUNT

- (1) Position rear mount.
- (2) Install bolts attaching rear mount to suspension crossmember. Tighten bolts to 61 N·m (45 ft. lbs.).
- (3) Install rear strut bracket (Fig. 29). Tighten bolts to 61 N·m (45 ft. lbs.).
- (4) Install through bolt (A) and tighten 61 N·m (45 ft. lbs.) (Fig. 31).
- (5) Lower vehicle

ENGINE MOUNT—RIGHT/ENGINE SUPPORT BRACKET

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

- (1) Raise vehicle on a hoist and remove inner splash. Remove the right engine support assembly vertical fasteners from frame rail (Fig. 32).
- (2) Lower vehicle. Remove the load on the engine motor mounts by carefully supporting the engine assembly with a floor jack.
- (3) Remove the three bolts attaching the engine support assembly to the engine bracket.
- (4) Move the air conditioning dryer aside.
- (5) Remove coolant recovery system tank. Refer to Group 7, Cooling System for procedure.
- (6) Remove right engine support.
- (7) Remove the three bolts attaching the engine support bracket to the cylinder block.

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

- (8) Reverse removal procedure for installation. Refer to (Fig. 32) for bolt tightening specifications.

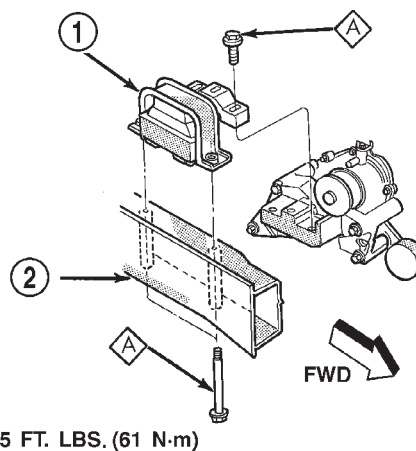
ENGINE MOUNT—LEFT

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

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

REMOVAL

- (1) Support the transmission with a transmission jack.



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Fig. 32 Engine Mounting—Right Side 2.5L

- 1 - RIGHT ENGINE SUPPORT ASSEMBLY
2 - FRAME RAIL

- (2) Remove the three vertical bolts (A) from the mount to the transmission bracket (Fig. 33).
- (3) Remove the mount to frame rail fasteners (B) and remove mount (Fig. 33).

INSTALLATION

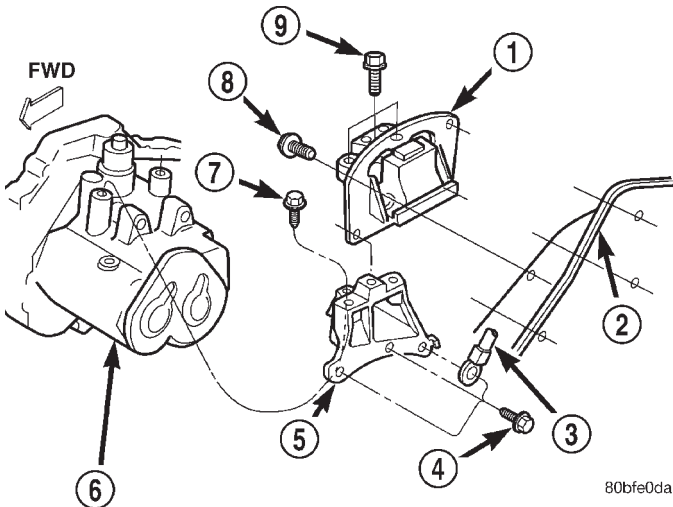
- (1) Install mount. Tighten mount to frame rail fasteners (B) to 33 N·m (24 ft. lbs.) (Fig. 33).
- (2) If removed, install transmission bracket and tighten bolts (C) and (D) to 61 N·m (45 ft. lbs.) (Fig. 33).
- (3) Install mount to transmission bracket vertical bolts (A). Tighten to 61 N·m (45 ft. lbs.) (Fig. 33).

ENGINE ASSEMBLY

REMOVAL

- (1) Perform fuel pressure release procedure. Refer to Group 14, Fuel System for procedure. Remove fuel line to fuel rail.
- (2) Disconnect negative cable from battery remote jumper terminal.
- (3) Remove Powertrain Control Module (PCM) attaching screws and set aside.
- (4) Drain cooling system. Refer to Group 7, Cooling System for procedure.
- (5) Remove upper radiator hose, radiator and fan module. Refer to Group 7, Cooling System for procedure.
- (6) Remove lower radiator hose.
- (7) Disconnect automatic transaxle cooler lines and plug.
- (8) Disconnect transaxle shift linkage.
- (9) Disconnect throttle body linkage.
- (10) Disconnect engine wiring harness.
- (11) Disconnect heater hoses.

REMOVAL AND INSTALLATION (Continued)

**Fig. 33 Left Side Mount—Typical**

- 1 - TRANSMISSION SUPPORT ASSEMBLY
- 2 - LEFT FRAME RAIL
- 3 - GROUND CABLE
- 4 - BOLT (D)
- 5 - TRANSMISSION BRACKET
- 6 - TRANSMISSION
- 7 - BOLT (C)
- 8 - BOLT (B)
- 9 - BOLT (A)

(12) Remove refrigerant from air conditioning system using a refrigerant recovery machine. Refer to Group 24, Air Conditioning for procedure.

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

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

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

(16) Disconnect exhaust pipe from manifold.

(17) Remove front and rear engine mount through bolts.

(18) Lower vehicle. Remove air cleaner assembly.

(19) Remove power steering pump and reservoir and set them aside.

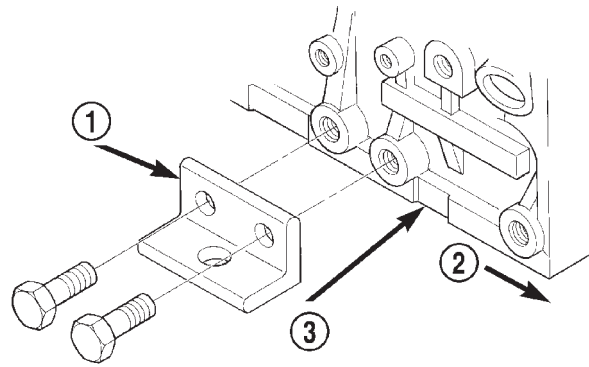
(20) Remove A/C compressor.

(21) Remove ground straps to body.

(22) Mount Special Tool 6973 bracket, to the right side of the cylinder block (Fig. 34). Align the front adjustable post with the hole in the bracket.

(23) Raise vehicle enough to allow engine dolly and cradle Special Tools 6135 and 6710 to be installed under vehicle (Fig. 35).

(24) Loosen cradle engine mounts to allow movement for positioning onto engine locating holes on the engine bedplate. Lower vehicle and position cradle mounts until the engine is resting on mounts. Tighten mounts to cradle frame. This will keep mounts from



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Fig. 34 Bracket for Cradle Post Support

- 1 - SPECIAL TOOL 6973
- 2 - FRONT OF ENGINE
- 3 - OIL PAN MATTING SURFACE

moving when removing or installing engine and transaxle.

(25) Lower vehicle so weight of the engine and transaxle ONLY is on the cradle.

(26) Remove engine and transaxle mount bolts.

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

INSTALLATION

(1) Position engine/transaxle assembly under vehicle and slowly lower the vehicle.

(2) Align engine and transaxle mounts to attaching points. Install mounting bolts at the right engine and left transaxle mounts. Refer to procedures in this section.

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

(4) Remove Special Tool 6973 bracket from engine.

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

(6) Install transaxle and engine braces.

(7) Connect exhaust system to manifold.

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

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

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

(11) Install front and rear engine mounts. Refer to procedure in this section.

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

REMOVAL AND INSTALLATION (Continued)

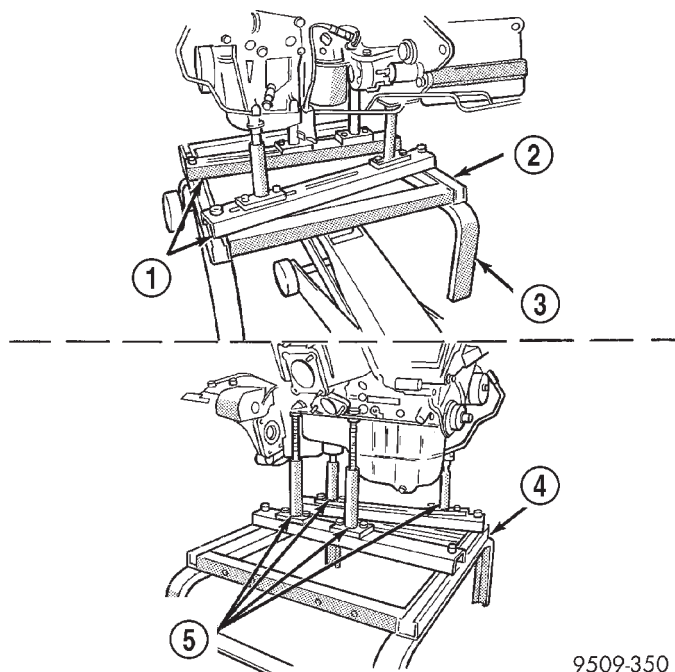


Fig. 35 Positioning Engine Cradle Support Post Mounts

- 1 - SPECIAL TOOL SUPPORT BARS NO. 6810-3A
- 2 - SPECIAL TOOL ENGINE CRADLE NO. 6810
- 3 - SPECIAL TOOL ENGINE DOLLY NO. 6135
- 4 - SPECIAL TOOL ENGINE CRADLE NO. 6810
- 5 - SPECIAL TOOL ADJUSTABLE POSTS NO. 6848

(13) Connect automatic transaxle cooler lines and shifter linkage. Refer to Group 21, Transaxle for procedures.

(14) Connect fuel line and heater hoses.

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

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

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

(18) Connect battery.

(19) Install Powertrain Control Module (PCM).

(20) Install air cleaner and hoses.

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

(22) Evacuate and charge air conditioning system. Refer to Group 24, Heating and Air Conditioning for procedures.

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

(24) Adjust transaxle linkage, if necessary.

INTAKE MANIFOLD—UPPER

REMOVAL

(1) Disconnect negative cable from auxiliary jumper terminal (Fig. 36).

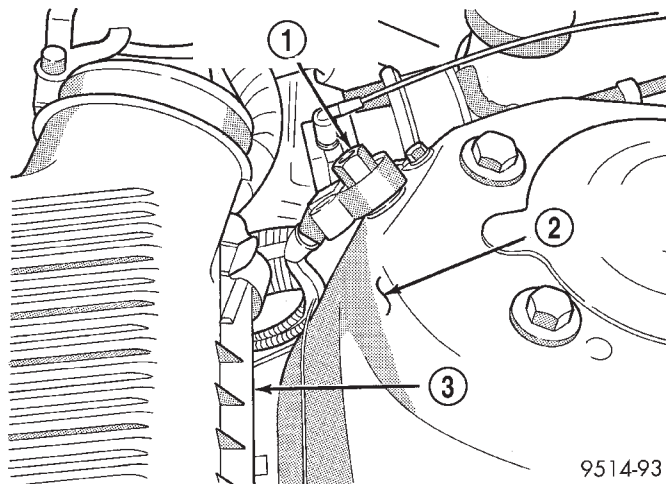


Fig. 36 Auxiliary Jumper Terminal

- 1 - AUXILIARY JUMPER TERMINAL
- 2 - LEFT STRUT TOWER
- 3 - AIR CLEANER HOUSING

(2) Remove bolt holding air inlet resonator to intake manifold (Fig. 37).

(3) Loosen throttle body air inlet hose clamp.

(4) Release snaps holding air cleaner housing cover to housing.

(5) Remove air cleaner cover and inlet hoses from engine.

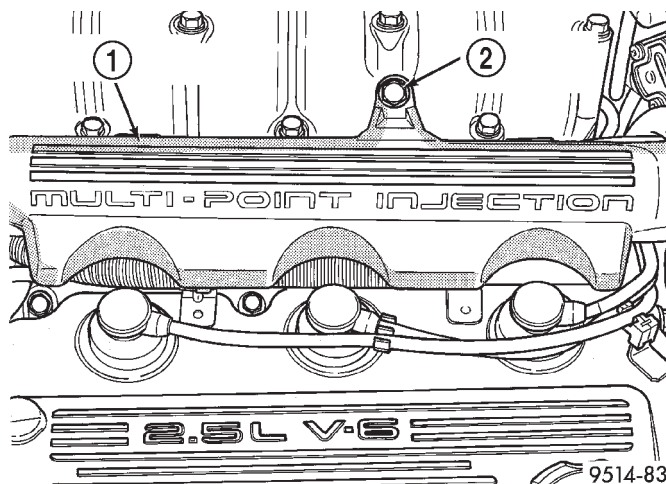


Fig. 37 Air Inlet Resonator

- 1 - AIR INLET RESONATOR
- 2 - RESONATOR BOLT

(6) Disconnect connectors from MAP and intake air temperature sensors (Fig. 38).

REMOVAL AND INSTALLATION (Continued)

(7) Remove manifold support bracket bolt located rearward of MAP sensor (Fig. 38).

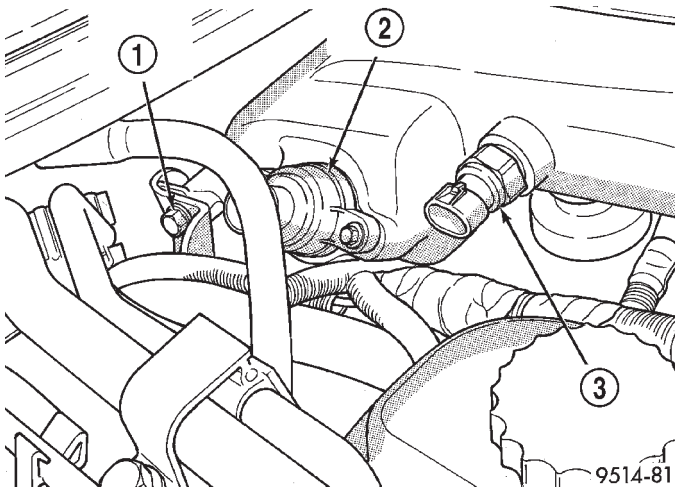


Fig. 38 Intake Manifold Sensors and Left Manifold Support Bolt

- 1 - SUPPORT BRACKET BOLT
- 2 - MAP SENSOR
- 3 - INTAKE AIR TEMPERATURE SENSOR

(8) Disconnect TPS and idle air control motor connectors (Fig. 39) and (Fig. 40).

(9) Disconnect brake booster hose.

(10) Disconnect purge hose from throttle body.

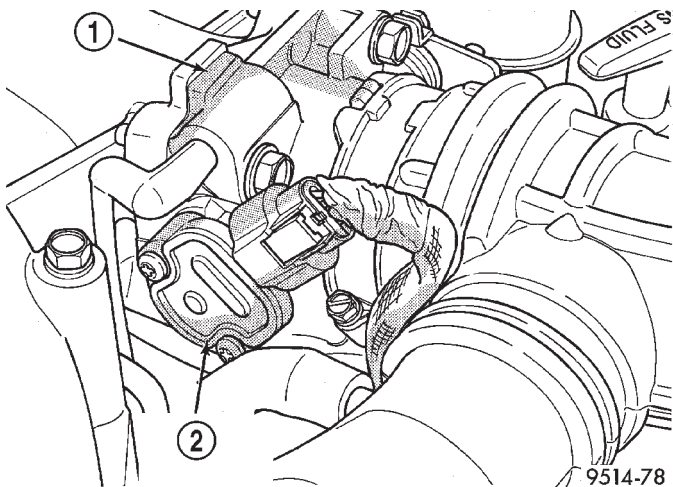


Fig. 39 Throttle Position Sensor

- 1 - THROTTLE BODY
- 2 - THROTTLE POSITION SENSOR

(11) Squeeze retainer tab on throttle cable and slide cable out of bracket (Fig. 41).

(12) Slide speed control cable out of bracket, if equipped (Fig. 41).

(13) Remove EGR tube from intake manifold and discard gasket (Fig. 42).

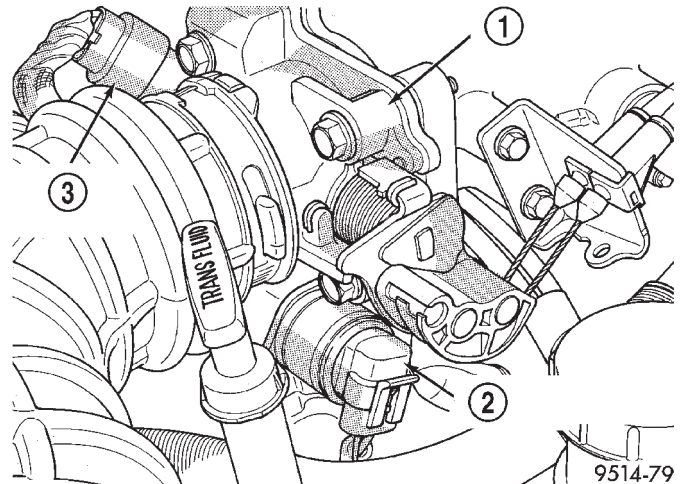


Fig. 40 Idle Air Control Motor

- 1 - THROTTLE BODY
- 2 - IDLE AIR CONTROL MOTOR
- 3 - THROTTLE POSITION SENSOR

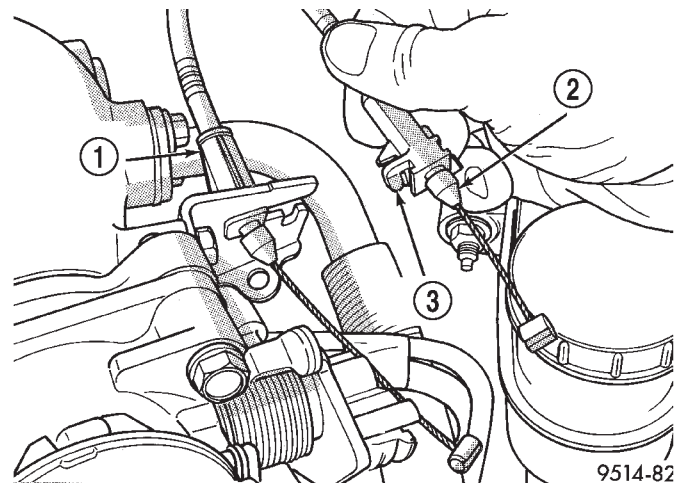


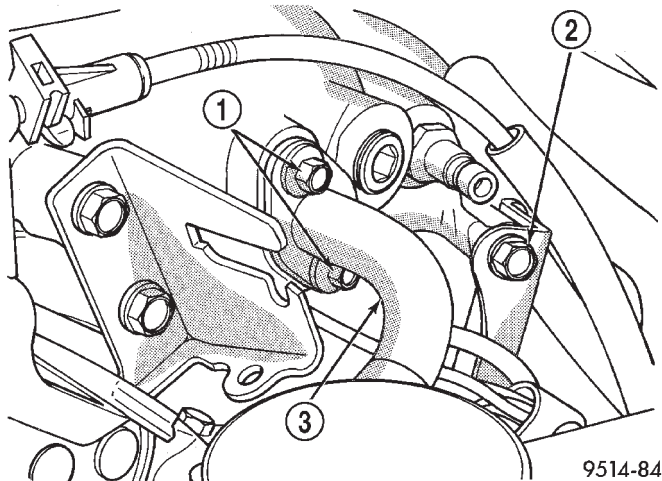
Fig. 41 Throttle Cable Attachment

- 1 - SPEED CONTROL CABLE
- 2 - THROTTLE CABLE
- 3 - RELEASE TANG

(14) Remove manifold support bracket bolt located rearward of EGR tube (Fig. 42).

(15) Remove bolts holding upper intake manifold and remove manifold (Fig. 43).

REMOVAL AND INSTALLATION (Continued)

**Fig. 42 EGR Tube and Right Manifold Support Bolt**

- 1 - EGR TUBE BOLTS
- 2 - SUPPORT BRACKET BOLT
- 3 - EGR TUBE

INSTALLATION

(1) Install new gasket and position upper intake manifold to lower manifold. Install manifold bolts and tighten to 18 N·m (13 ft. lbs.) (Fig. 43).

(2) Install bolts at manifold support brackets. Tighten bolts to 18 N·m (13 ft. lbs.).

(3) Install EGR tube with new gasket to plenum. Tighten EGR tube to intake manifold plenum screws to 11 N·m (95 in. lbs.).

(4) Install throttle and speed control cables.

(5) Connect brake booster hose.

(6) Connect purge hose to throttle body.

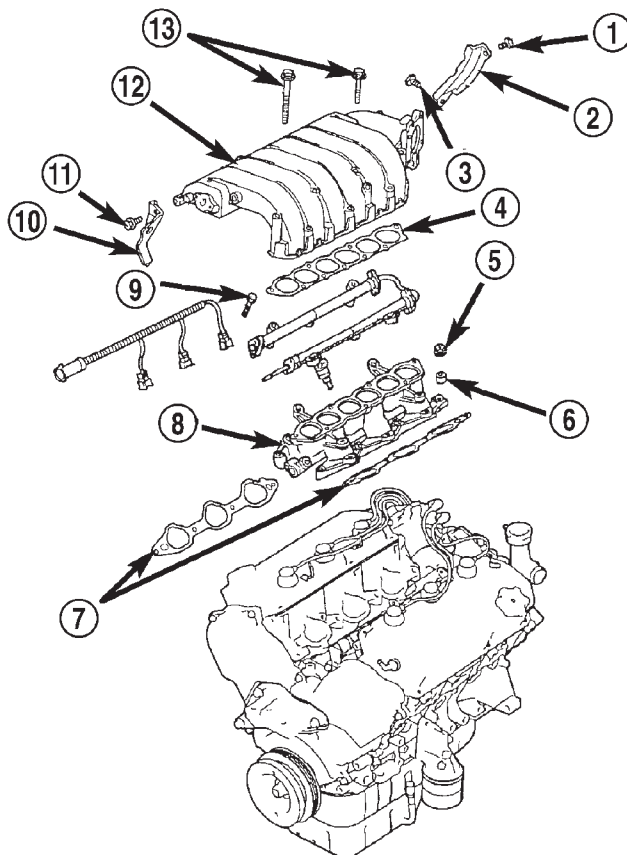
(7) Attach electrical connectors to sensors.

(8) Install air cleaner cover and inlet hoses.

(9) Tighten air inlet tube clamps to 3 N·m $\pm$ 1 (25 in. lbs. $\pm$ 5).

(10) Install bolt holding air inlet resonator to intake manifold (Fig. 37).

(11) Connect negative cable to auxiliary jumper terminal (Fig. 36).

**Fig. 43 Intake Manifolds**

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- 1 - 18 N·m (13 ft. lbs.)
- 2 - LEFT SIDE MANIFOLD SUPPORT
- 3 - 36 N·m (26 ft. lbs.)
- 4 - GASKET
- 5 - NUT
- 6 - SPRING WASHER
- 7 - LOWER INTAKE MANIFOLD GASKETS

- 8 - LOWER INTAKE MANIFOLD
- 9 - 12 N·m (8 ft. lbs.)
- 10 - RIGHT SIDE MANIFOLD SUPPORT
- 11 - 18 N·m (13 ft. lbs.)
- 12 - UPPER INTAKE MANIFOLD
- 13 - 18 N·m (13 ft. lbs.)

REMOVAL AND INSTALLATION (Continued)

INTAKE MANIFOLD—LOWER

REMOVAL

(1) Disconnect negative cable from auxiliary jumper terminal (Fig. 44).

WARNING: RELEASE FUEL SYSTEM PRESSURE BEFORE SERVICING FUEL SYSTEM COMPONENTS. SERVICE VEHICLES IN WELL VENTILATED AREAS AND AVOID IGNITION SOURCES. NEVER SMOKE WHILE SERVICING THE VEHICLE.

(2) Release fuel system pressure. Refer to Group 14, Fuel System for procedure.

WARNING: WRAP SHOP TOWELS AROUND HOSE TO CATCH ANY GASOLINE SPILLAGE.

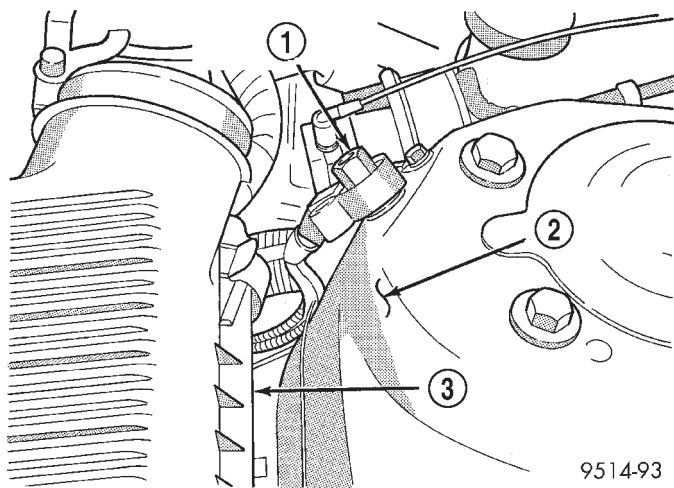


Fig. 44 Auxiliary Jumper Terminal

- 1 - AUXILIARY JUMPER TERMINAL
2 - LEFT STRUT TOWER
3 - AIR CLEANER HOUSING

(3) Disconnect fuel supply tube from rail. Refer to Group 14, Fuel System for procedure.

(4) Remove upper intake manifold. Refer to procedure in this section.

(5) Disconnect electrical connectors from fuel injectors.

(6) Remove bolts holding fuel rail (Fig. 45).

(7) Lift fuel rail off engine. **There are spacers under each fuel rail bolt (Fig. 46).**

(8) Remove lower intake manifold attaching bolts. Remove intake manifold (Fig. 47).

INSTALLATION

(1) Install new intake manifold gaskets (Fig. 47).

(2) Install intake manifold, spring washers and nuts (Fig. 47).

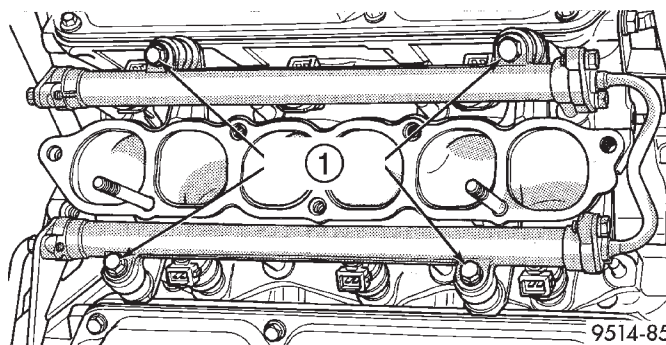


Fig. 45 Fuel Rail Attachment

- 1 - FUEL RAIL BOLTS

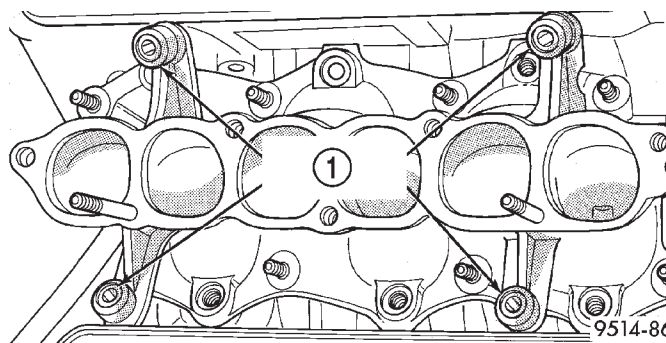


Fig. 46 Fuel Rail Spacers

- 1 - FUEL RAIL SPACERS

(3) Tighten the intake manifold mounting nuts (Fig. 48) one bank after the other by using the following procedures:

- Tighten nuts "R" to 6.4 N·m (56 in. lbs.)
- Tighten nuts "L" to 21 N·m (185 in. lbs.)
- Tighten nuts "R" to 21 N·m (185 in. lbs.)
- Tighten nuts "L" again to 21 N·m (185 in. lbs.)
- Tighten nuts "R" again to 21 N·m (185 in. lbs.)

(4) Apply a light coating of clean engine oil to the O-ring on the nozzle end of each injector.

(5) Insert fuel injector nozzles into openings in intake manifold. Seat the injectors in place. Tighten fuel rail bolts to 12 N·m (8 ft. lbs.).

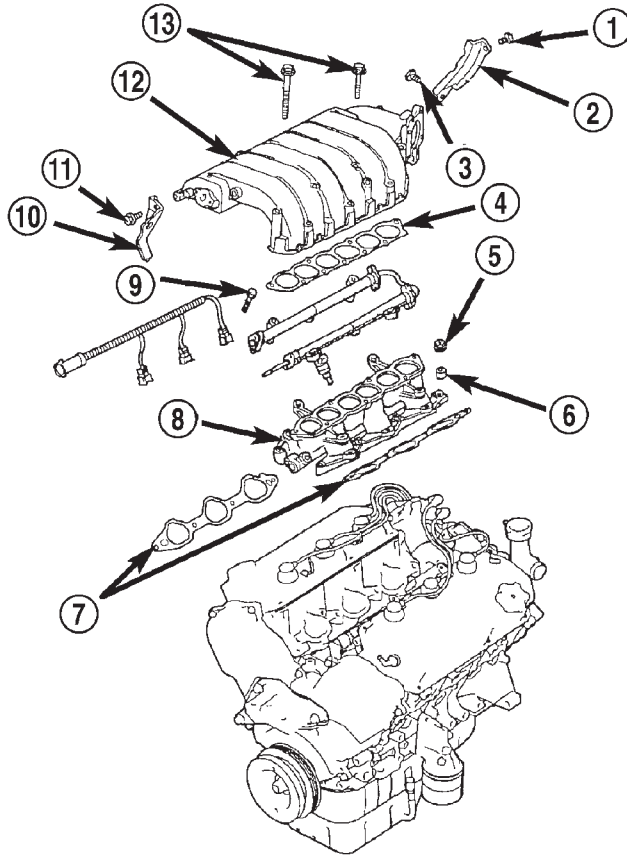
(6) Attach electrical connectors to fuel injectors.

(7) Connect fuel supply tube to fuel rail. Refer to Group 14, Fuel System for procedure.

(8) Install upper intake manifold. Refer to procedure in this section.

(9) Connect negative cable to auxiliary jumper terminal.

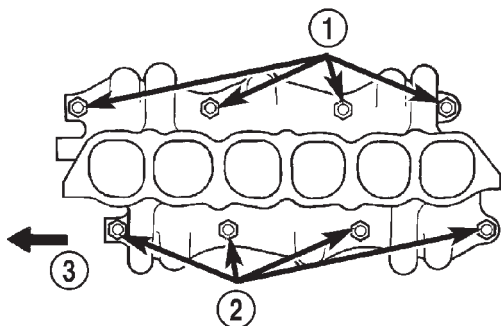
REMOVAL AND INSTALLATION (Continued)



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Fig. 47 Intake Manifolds

- | | |
|-----------------------------------|----------------------------------|
| 1 – 18 N•m (13 ft. lbs.) | 8 – LOWER INTAKE MANIFOLD |
| 2 – LEFT SIDE MANIFOLD SUPPORT | 9 – 12 N•m (8 ft. lbs.) |
| 3 – 36 N•m (26 ft. lbs.) | 10 – RIGHT SIDE MANIFOLD SUPPORT |
| 4 – GASKET | 11 – 18 N•m (13 ft. lbs.) |
| 5 – NUT | 12 – UPPER INTAKE MANIFOLD |
| 6 – SPRING WASHER | 13 – 18 N•m (13 ft. lbs.) |
| 7 – LOWER INTAKE MANIFOLD GASKETS | |



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Fig. 48 Intake Manifold Tightening

- | |
|----------------------|
| 1 – NUT "R" |
| 2 – NUT "L" |
| 3 – TIMING BELT SIDE |

EXHAUST MANIFOLD**REMOVAL****REAR EXHAUST MANIFOLD**

(1) Raise vehicle and remove the entire exhaust system. Refer to Group 11, Exhaust System for procedure.

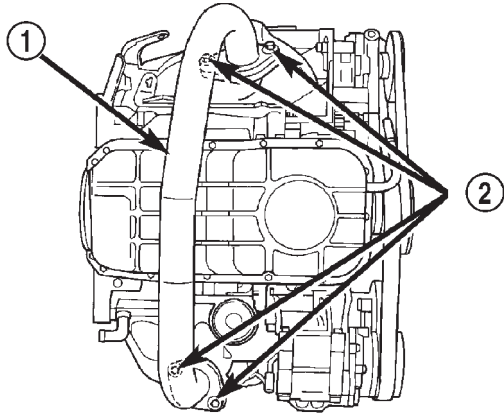
(2) Remove bolts attaching cross-under pipe to manifolds (Fig. 49). Remove assembly.

(3) Remove heat shield from rear exhaust manifold (Fig. 50).

(4) Remove power steering pump bracket. Refer to Group 19, Steering for procedure.

(5) Remove nuts attaching rear manifold to cylinder head and remove manifold (Fig. 51).

REMOVAL AND INSTALLATION (Continued)



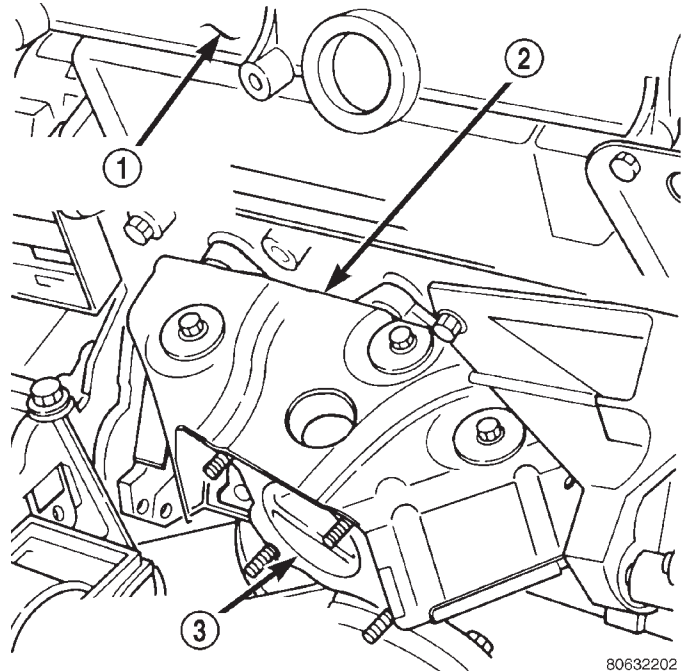
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Fig. 49 Cross-Under Pipe Attaching Bolts

- 1 - EXHAUST CROSS-UNDER PIPE
2 - ATTACHING BOLTS

FRONT EXHAUST MANIFOLD

- (1) Remove cooling fan module. Refer to Group 7, Cooling System for procedure.
- (2) Raise vehicle and remove bolts attaching cross-under pipe to manifold (Fig. 49).
- (3) Remove oil dipstick tube.
- (4) Lower vehicle.
- (5) Remove generator support bracket.
- (6) Remove screws attaching front heat shield to manifold.

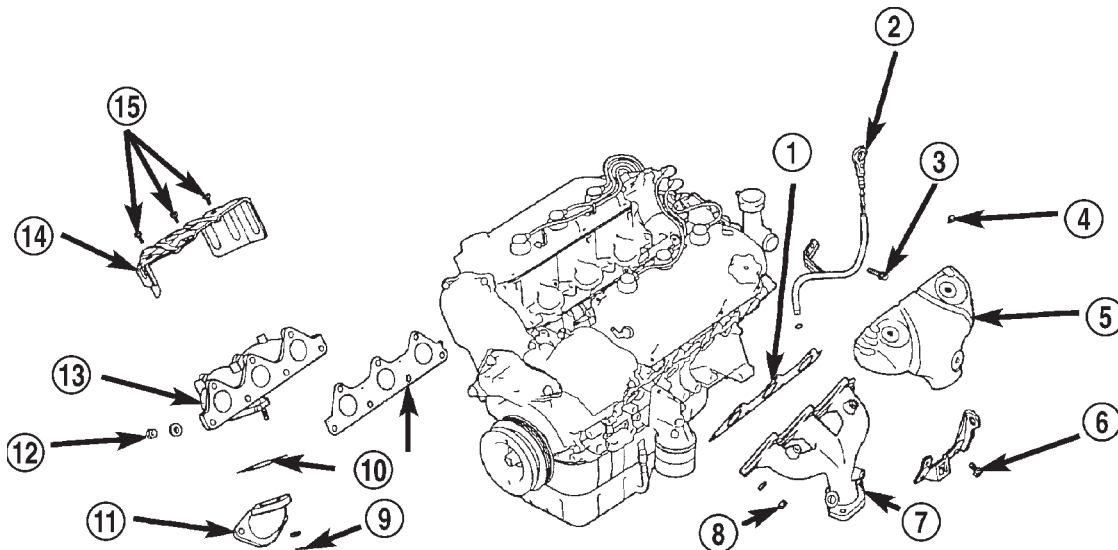


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Fig. 50 Rear Exhaust Manifold Heat Shield

- 1 - REAR OF INTAKE MANIFOLD
2 - HEAT SHIELD
3 - REAR EXHAUST MANIFOLD FLANGE

- (7) Remove front exhaust manifold attaching fasteners.
- (8) Remove front exhaust manifold (Fig. 51).



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Fig. 51 Exhaust Manifolds

- | | |
|----------------------------|------------------------------|
| 1 - GASKET | 9 - NUT 59 N•m (43 ft. lbs.) |
| 2 - OIL DIPSTICK AND TUBE | 10 - GASKETS |
| 3 - 23 N•m (17 ft. lbs.) | 11 - EXHAUST MANIFOLD |
| 4 - 13 N•m (10 ft. lbs.) | 12 - 30 N•m (22 ft. lbs.) |
| 5 - FRONT HEAT SHIELD | 13 - REAR EXHAUST MANIFOLD |
| 6 - 36 N•m (26 ft. lbs.) | 14 - REAR HEAT SHIELD |
| 7 - FRONT EXHAUST MANIFOLD | 15 - 13 N•m (10 ft. lbs.) |
| 8 - 30 N•m (22 ft. lbs.) | |

REMOVAL AND INSTALLATION (Continued)

INSTALLATION

REAR EXHAUST MANIFOLD

(1) Position new exhaust manifold gasket onto rear cylinder head.

(2) Install the rear exhaust manifold (Fig. 51) and tighten attaching nuts to 30 N·m (22 ft. lbs.).

(3) Install rear exhaust manifold heat shield and tighten fastener to 13 N·m (115 in. lbs.).

(4) Install power steering pump bracket to engine. Refer to Group 19, Steering for procedure.

(5) Install exhaust system. Refer to Group 11, Exhaust System for procedure.

(6) Attach cross-under pipe to exhaust manifold and tighten fasteners to 31 N·m (275 in. lbs.) (Fig. 49).

FRONT EXHAUST MANIFOLD

(1) Position new exhaust manifold gasket onto front cylinder head.

(2) Install front exhaust manifold (Fig. 51) and tighten attaching nuts to 30 N·m (22 ft. lbs.).

(3) Install front manifold heat shield and tighten attaching screws to 13 N·m (115 in. lbs.).

(4) Install generator support bracket.

(5) Install cooling fan module. Refer to Group 7, Cooling System for procedure.

(6) Raise vehicle.

(7) Install oil dipstick tube.

(8) Attach cross-under pipe to exhaust manifold and tighten fasteners to 31 N·m (275 in. lbs.) (Fig. 49).

CYLINDER HEAD COVER

FRONT CYLINDER HEAD COVER

REMOVAL

(1) Disconnect and relocate spark plug cables and wiring harness.

(2) Disconnect PCV and breather hoses.

(3) Remove cylinder head cover fasteners and remove cover (Fig. 52).

INSTALLATION

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

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

(2) Install cover and tighten cover bolt washer and gasket assembly to 10 N·m (88 in. lbs.).

(3) Connect PCV and breather hoses.

(4) Connect spark plug cables and wiring harness.

REAR CYLINDER HEAD COVER

REMOVAL

(1) Remove upper intake manifold. Refer to procedure in this section.

(2) Cover lower intake manifold with a suitable cover during service.

(3) Disconnect and relocate spark plug cables.

(4) Disconnect breather hose.

(5) Remove cylinder head cover fasteners and remove cover (Fig. 52).

INSTALLATION

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

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

(2) Install cover and tighten cover bolt washer and gasket assembly to 10 N·m (88 in. lbs.).

(3) Connect spark plug cables.

(4) Connect breather hose.

(5) Install upper intake manifold. Refer to procedure in this section.

SPARK PLUG TUBE SEALS

The spark plug tube seals are located on the end of each tube (Fig. 53). These seals slide onto each tube to seal the cylinder head cover to spark plug tube. If these seals show signs of hardness and/or cracks, they should be replaced.

CYLINDER HEAD

REMOVAL

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

(2) Raise vehicle and disconnect exhaust system from exhaust manifold.

(3) Remove timing belt and camshaft sprockets. Refer to procedures in this section.

(4) Remove upper and lower intake manifolds. Refer to procedures in this section.

(5) Remove distributor. Refer to Group 8D, Ignition System for procedure.

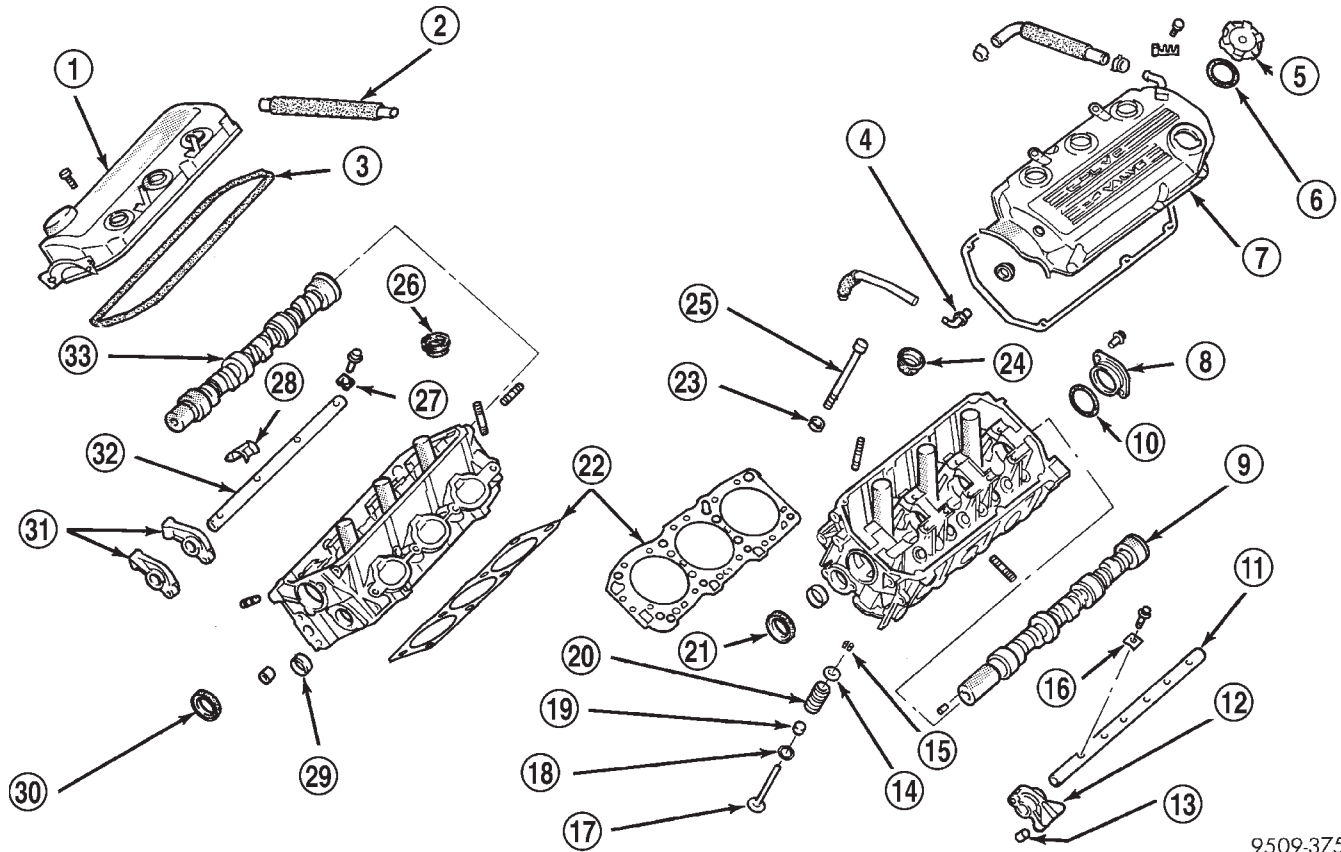
(6) Remove bolts attaching thermostat housing assembly to cylinder head.

(7) Remove cylinder head covers and rocker arm assemblies. Refer to procedures in this section.

(8) Remove cylinder head bolts and remove cylinder head(s).

(9) Remove exhaust manifold from cylinder head(s).

REMOVAL AND INSTALLATION (Continued)



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Fig. 52 Cylinder Head Components

- | | |
|-------------------------------|------------------------------|
| 1 – CYLINDER HEAD COVER | 18 – SPRING SEAT |
| 2 – BREATHER HOSE | 19 – VALVE STEM SEAL |
| 3 – GASKET | 20 – SPRING |
| 4 – PCV VALVE | 21 – SEAL |
| 5 – OIL FILLER CAP | 22 – HEAD GASKETS |
| 6 – GASKET | 23 – WASHER |
| 7 – CYLINDER HEAD COVER | 24 – SEAL |
| 8 – CAMSHAFT THRUST CASE | 25 – CYLINDER HEAD BOLT |
| 9 – CAMSHAFT (LEFT SIDE) | 26 – SEAL |
| 10 – O-RING | 27 – CAP |
| 11 – EXHAUST ROCKER ARM SHAFT | 28 – SPRING |
| 12 – EXHAUST ROCKER ARM | 29 – CAP |
| 13 – HYDRAULIC LASH ADJUSTER | 30 – SEAL |
| 14 – SPRING RETAINER | 31 – INTAKE ROCKER ARMS |
| 15 – LOCKS | 32 – INTAKE ROCKER ARM SHAFT |
| 16 – CAP | 33 – CAMSHAFT (RIGHT SIDE) |
| 17 – VALVE | |

INSTALLATION

CAUTION: When cleaning cylinder head surfaces, **DO NOT** use a metal scraper because the surfaces could be cut or ground, Use **ONLY** a wooden or plastic scraper.

- (1) Clean surfaces of cylinder head and block. Install new head gasket over locating dowels.
- (2) Install cylinder head on locating dowels.

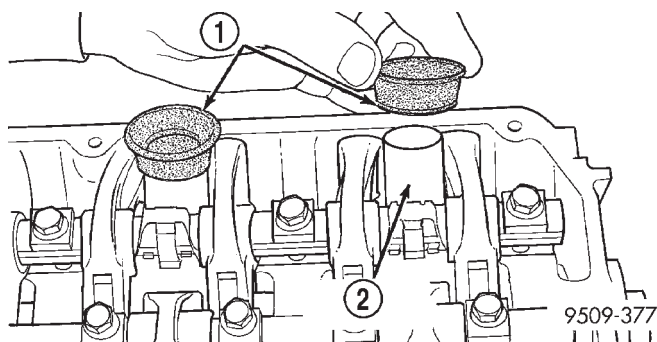
- (3) Install 10 mm Allen hex head bolts with washers.

CAUTION: Attach the head bolt washer in the direction shown in (Fig. 54).

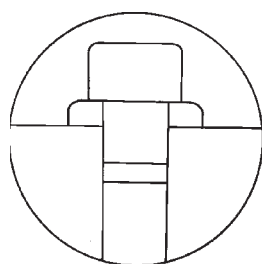
- (4) Tighten cylinder head bolts using the following procedure:

- (a) Tighten cylinder head bolts in sequence (Fig. 55) to 108 N·m (80 ft. lbs.).

REMOVAL AND INSTALLATION (Continued)

**Fig. 53 Spark Plug Tube Seal**

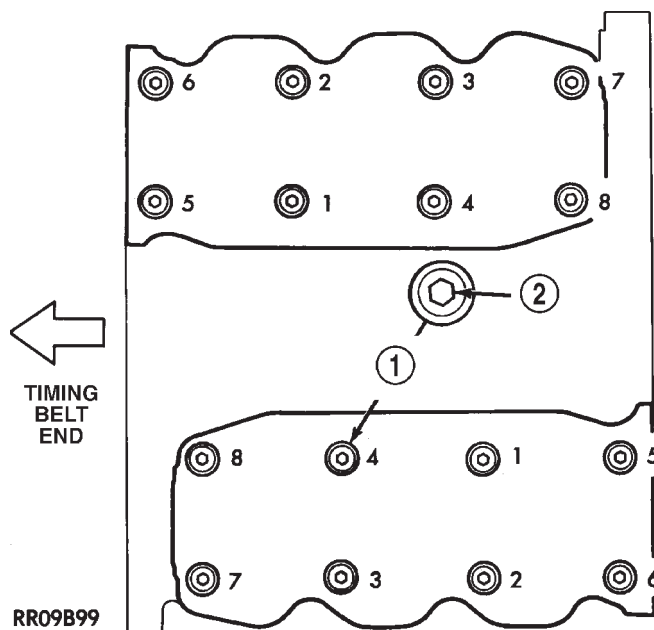
- 1 - SEALS
2 - SPARK PLUG TUBE

**CYLINDER HEAD
BOLT WASHER**

80b01c1b

Fig. 54 Cylinder Head Bolt Washer

- (b) Loosen all bolts fully.
(c) Retighten cylinder head bolts in sequence (Fig. 55) to 108 N·m (80 ft. lbs.).

**Fig. 55 Cylinder Head Bolt Tightening Sequence**

- 1 - CYLINDER HEAD BOLT AND WASHER
2 - 10 mm ALLEN HEX

(5) Install bolts attaching thermostat housing assembly to cylinder head.

(6) Install distributor. Refer to Group 8D, Ignition System for procedure.

(7) Install rocker arm assemblies and cylinder head covers. Refer to procedure in this section.

(8) Install camshaft sprockets and timing belt. Refer to procedures in this section.

(9) Install lower and upper intake manifold. Refer to procedure in this section.

(10) Install exhaust cross-under pipe and connect exhaust system to manifold flange.

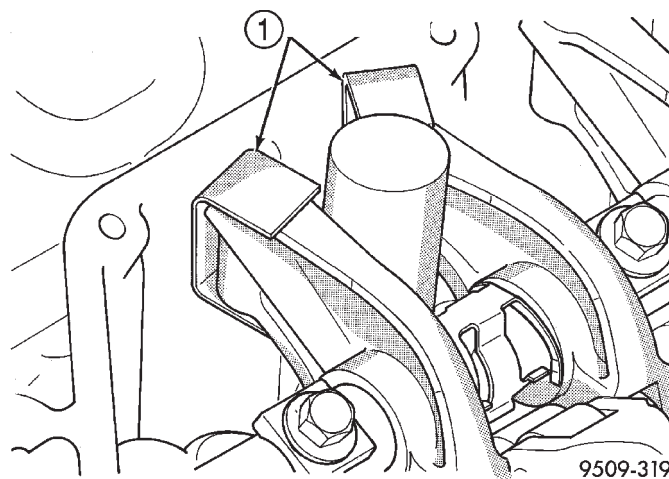
(11) Fill cooling system. Refer to Group 7, Cooling System for procedure.

ROCKER ARM AND HYDRAULIC ADJUSTER**REMOVAL**

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

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

(3) Install auto lash adjuster retainers, Special Tool MD-998443 onto rocker arms (Fig. 56). These retainers hold the lash adjusters into position when the rocker arms are serviced.

**Fig. 56 Auto Lash Adjuster Retainers**

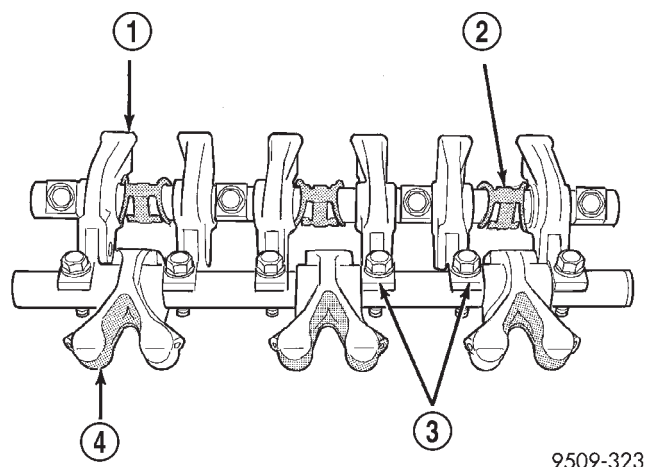
- 1 - SPECIAL TOOL MD998443

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

(5) Mark rocker arm/hydraulic lash adjuster assemblies for reassembly in their original position. Remove rocker arm/hydraulic lash adjuster assembly. Lash adjusters are serviced as an assembly with the rocker arm (Fig. 57).

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

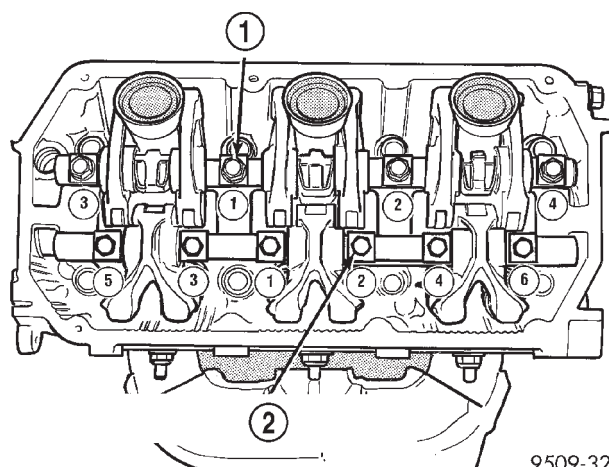
REMOVAL AND INSTALLATION (Continued)



9509-323

Fig. 57 Rocker Arm Shafts

- 1 - INTAKE ROCKER ARMS
- 2 - ROCKER SHAFT SPRINGS
- 3 - ROCKER ARM SHAFT RETAINERS
- 4 - EXHAUST ROCKER ARMS



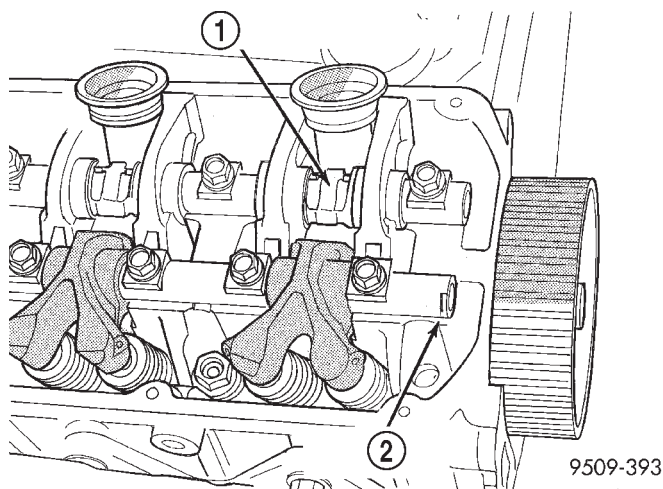
9509-324

Fig. 59 Rocker Arm Shaft Tightening Sequence

- 1 - INTAKE ROCKER ARM SHAFT TIGHTEN SEQUENCE
- 2 - EXHAUST ROCKER ARM SHAFT TIGHTEN SEQUENCE

INSTALLATION

(1) Install rocker arm and shafts with the FLAT on the shafts facing the timing belt side of the right cylinder head (Fig. 58). For the left cylinder head, install rocker arm and shafts with the FLAT on the shafts facing the transmission side of the engine. Install the retainers and spring clips in their original positions on the exhaust and intake shafts (Fig. 57).



9509-393

Fig. 58 Rocker Arm Shaft Flat

- 1 - ROCKER ARM SHAFT SPRING ORIENTATION
- 2 - DIRECTIONAL FLAT

(2) Tighten bolts to 31 N·m (276 in. lbs.) in sequence shown in (Fig. 59).

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

(4) Install cylinder head cover(s). Refer to procedure in this section.

CAMSHAFT

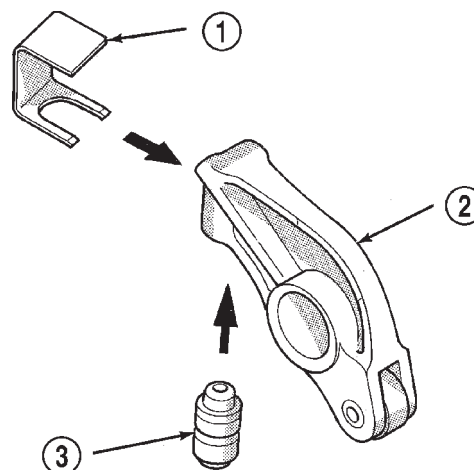
REMOVAL

NOTE: Cylinder head must be removed for camshaft replacement.

(1) Remove upper and lower intake manifolds. Refer to procedures in this section.

(2) Remove cylinder head covers. Refer to procedure in this section.

(3) Install auto lash adjuster retainers, Special Tool MD-998443 (Fig. 60). These retainers hold the lash adjuster into position when the rocker arms are serviced.



9509-321

Fig. 60 Retainer Auto Lash Adjuster

- 1 - SPECIAL TOOL MD998443
- 2 - ROLLER ROCKER ARM
- 3 - HYDRAULIC LASH ADJUSTER

REMOVAL AND INSTALLATION (Continued)

(4) Mark rocker arm shaft assemblies for installation.

(5) Remove rocker arm shaft bolts. Refer to procedure in this section.

(6) Remove the timing belt and camshaft sprocket. Refer to procedures in this section.

(7) Remove cylinder head retaining bolts.

(8) Remove cylinder head(s) from vehicle.

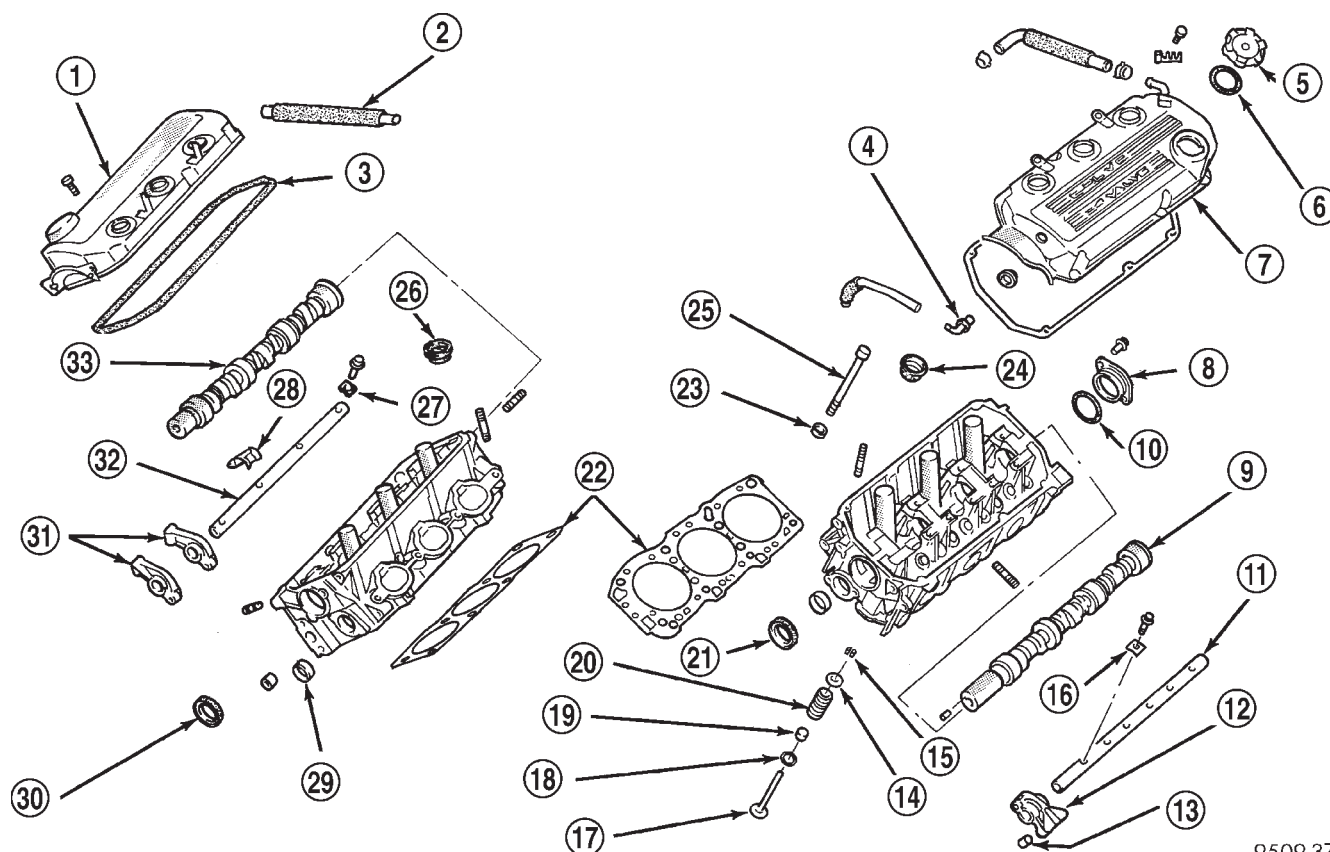
(9) Remove thrust case from front (left side) cylinder head assembly. Remove camshaft from the rear of the head (Fig. 61).

(10) Remove distributor (if not previously removed) from rear (right side) cylinder head assembly. Remove camshaft from rear of the head (Fig. 61).

INSTALLATION

(1) Lubricate camshaft journals. Install camshaft(s) into the cylinder head(s) carefully (Fig. 61).

(2) Install thrust case on front (left side) cylinder head and tighten fasteners to 13 N·m (108 in. lbs.) (Fig. 61).



9509-375

Fig. 61 Cylinder Head Components

1 - CYLINDER HEAD COVER

2 - BREATHER HOSE

3 - GASKET

4 - PCV VALVE

5 - OIL FILLER CAP

6 - GASKET

7 - CYLINDER HEAD COVER

8 - CAMSHAFT THRUST CASE

9 - CAMSHAFT (LEFT SIDE)

10 - O-RING

11 - EXHAUST ROCKER ARM SHAFT

12 - EXHAUST ROCKER ARM

13 - HYDRAULIC LASH ADJUSTER

14 - SPRING RETAINER

15 - LOCKS

16 - CAP

17 - VALVE

18 - SPRING SEAT

19 - VALVE STEM SEAL

20 - SPRING

21 - SEAL

22 - HEAD GASKETS

23 - WASHER

24 - SEAL

25 - CYLINDER HEAD BOLT

26 - SEAL

27 - CAP

28 - SPRING

29 - CAP

30 - SEAL

31 - INTAKE ROCKER ARMS

32 - INTAKE ROCKER ARM SHAFT

33 - CAMSHAFT (RIGHT SIDE)

REMOVAL AND INSTALLATION (Continued)

(3) Install camshaft seal(s). Camshaft must be installed before the camshaft seal is installed. Refer to procedure in this section.

(4) Install camshaft sprocket(s) and tighten to 88 N·m (65 ft. lbs.).

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

(6) Install rocker arm assemblies in correct order as removed. Tighten the rocker arm assemblies in sequence shown in (Fig. 62) to 31 N·m (276 in. lbs.).

(7) Remove Special Tools MD-998443, auto lash adjuster retainers.

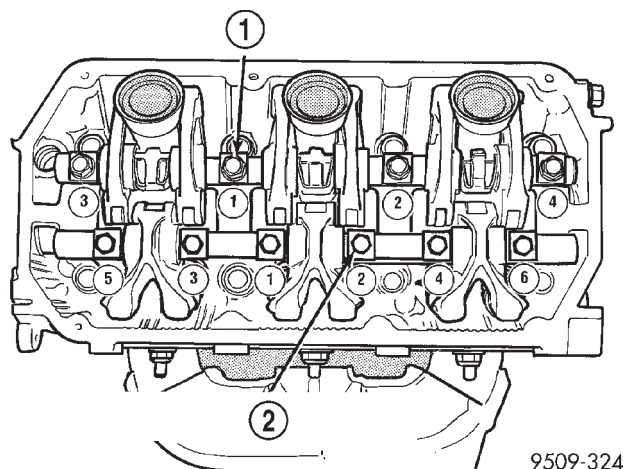


Fig. 62 Rocker Arm Shaft Tightening Sequence

- 1 – INTAKE ROCKER ARM SHAFT TIGHTEN SEQUENCE
2 – EXHAUST ROCKER ARM SHAFT TIGHTEN SEQUENCE

(8) Install cylinder head covers, lower intake manifold, and upper intake manifold. Refer to procedures in this section.

CAMSHAFT END PLAY

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

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

(3) Zero dial indicator (Fig. 63).

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

(5) End play travel: 0.1 - 0.2 mm (0.004 - 0.008 in.). Max. Travel: 0.4 mm (0.016 in.).

VALVE SPRINGS AND SEALS—IN VEHICLE SERVICE**REMOVAL**

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

(2) Remove rocker arm shaft assemblies. Refer to procedure in this section.

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

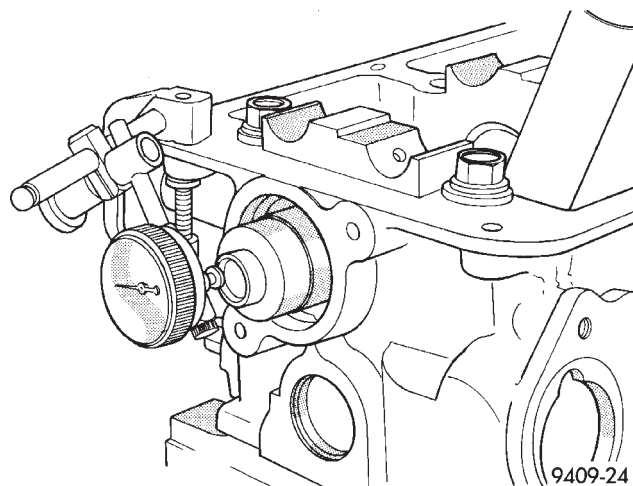


Fig. 63 Camshaft End Play

(4) Remove spark plug from applicable cylinder.

(5) Using a air hose attached to an adapter tool, install it into the spark plug hole. Apply 90-120 psi air pressure.

(6) Use Special Tool MD-998772A with Mounting Post 6886, Forcing Screw Arm 6887, Forcing Screw 6765 and Adapter 6885 (Fig. 64) to compress valve springs and remove valve locks.

(7) Remove valve spring.

(8) Remove valve stem seals with suitable tool (Fig. 65).

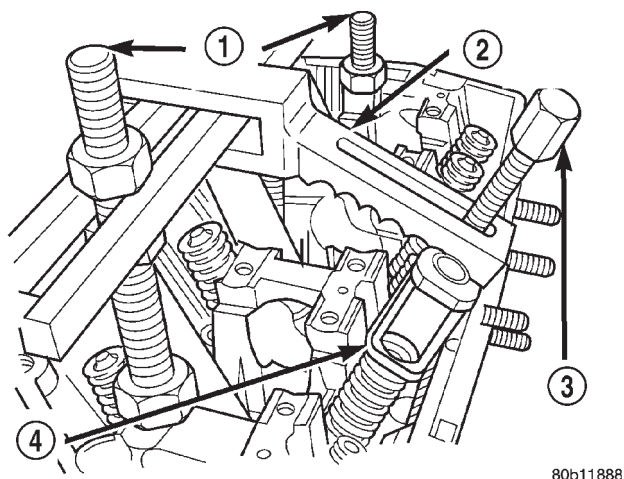


Fig. 64 Valve Springs—Removing and Installing

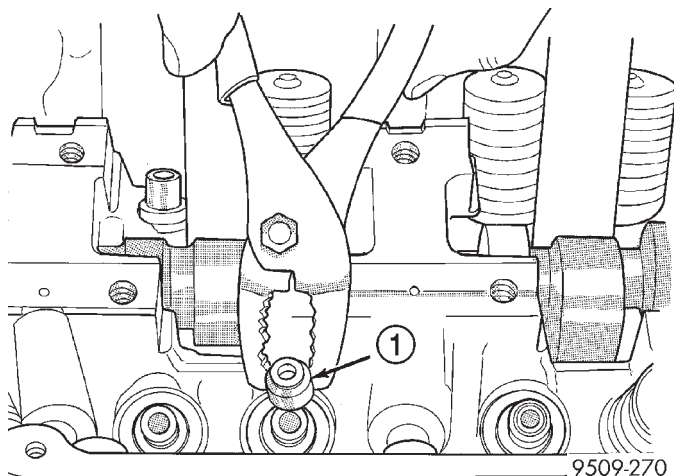
- 1 – MOUNTING POST 6886
2 – FORCING SCREW ARM 6887
3 – FORCING SCREW 6765
4 – ADAPTER 6885

INSTALLATION

(1) Install the “gray” valve seal onto the intake valve guide and the “grayish green” seal onto the exhaust valve guide (Fig. 66).

(2) Using Special Tool MD-998774, install valve seal by tapping lightly until seal is in place (Fig. 67).

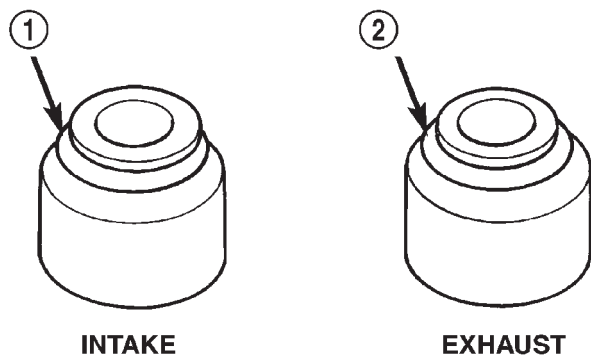
REMOVAL AND INSTALLATION (Continued)

**Fig. 65 Valve Stem Seal—Removal**

1 - VALVE STEM SEAL

(3) Use Special Tool MD-998772A with Mounting Post 6886, Forcing Screw Arm 6887, Forcing Screw 6765 and Adapter 6885 (Fig. 64) to compress valve springs only enough to install locks. Correct alignment of tool is necessary to avoid nicking valve stems.

(4) Repeat Removal Steps 3 through 7 and Installation Steps 1 through 3 until all necessary valve springs/seals are replaced.



INTAKE

EXHAUST

80be46e2

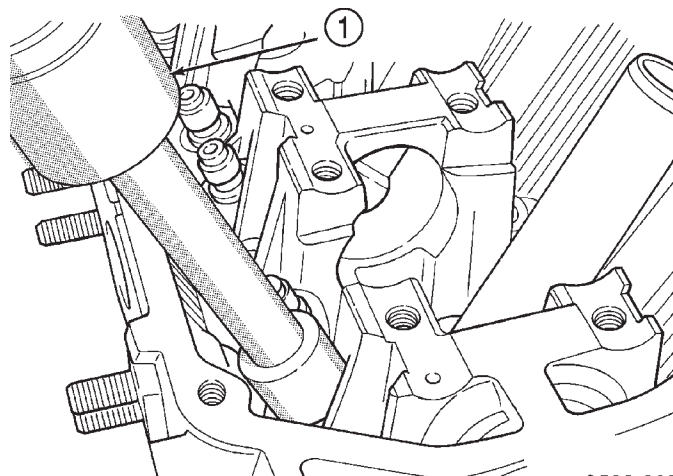
Fig. 66 Valve Stem Seal Identification

- 1 - GRAY
2 - GRAYISH GREEN

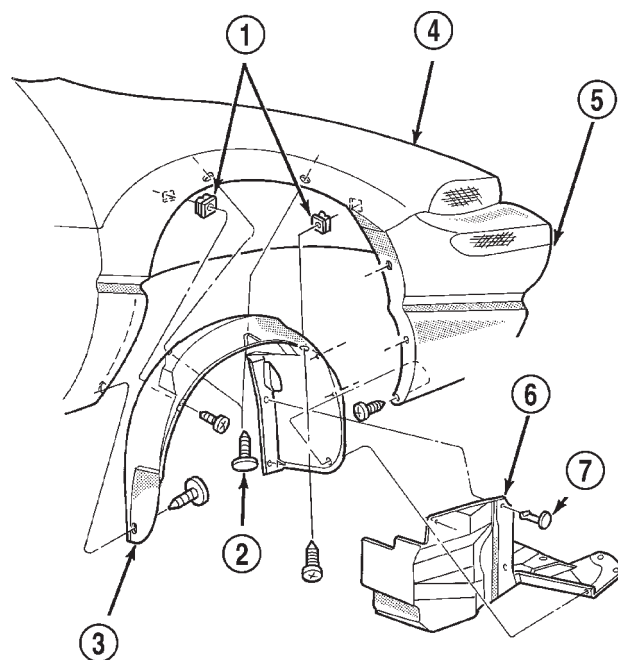
- (5) Install rocker arm shaft assemblies.
(6) Install cylinder head cover.

CRANKSHAFT DAMPER**REMOVAL**

- (1) Remove belt splash shield (Fig. 68).
(2) Remove accessory drive belts. Refer to Group 7, Cooling System for procedure.

**Fig. 67 Valve Stem Seal—Installation**

1 - SPECIAL TOOL MD998774

**Fig. 68 Belt Splash Shield**

- 1 - NUT-SNAP
2 - PUSH-IN FASTENER
3 - WHEELHOUSE SPLASH SHIELD
4 - FENDER
5 - FASCIA
6 - ACCESSORY DRIVE BELT SPLASH SHIELD
7 - PUSH-IN FASTENER

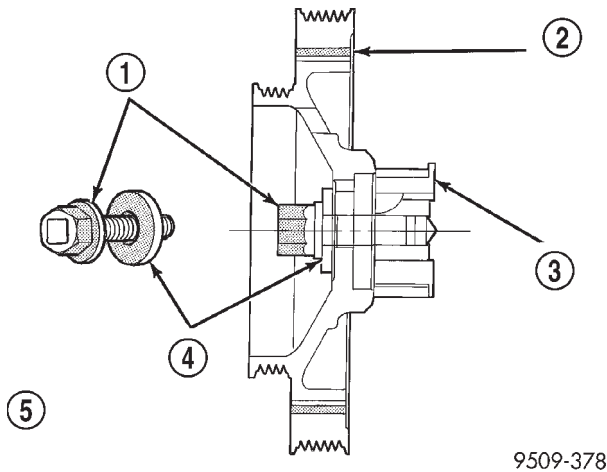
9523-150

- (3) Remove crankshaft center bolt (Fig. 69) and remove crankshaft damper.

INSTALLATION

- (1) Install crankshaft damper.

REMOVAL AND INSTALLATION (Continued)

**Fig. 69 Crankshaft Damper**

- 1 - CRANKSHAFT BOLT 22 mm OR 1/2" SQUARE
- 2 - RUBBER
- 3 - CRANKSHAFT SPROCKET
- 4 - WASHER
- 5 - BOLT TORQUE 182 N·m (134 FT. LBS.)

(2) Install crankshaft bolt and tighten to 182 N·m (134 ft. lbs.) (Fig. 69).

(3) Install accessory drive belts. Refer to Group 7, Cooling System for procedures.

(4) Install belt shield (Fig. 68).

TIMING BELT COVERS**REMOVAL**

(1) Disconnect negative cable from battery remote jumper terminal.

(2) Remove drive belt splash shield. Refer to Group 23, Body for procedure.

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

(4) Support engine and remove right engine mount. Refer to Engine Mounts in this section for procedure.

(5) Remove crankshaft damper. Refer to procedure in this section.

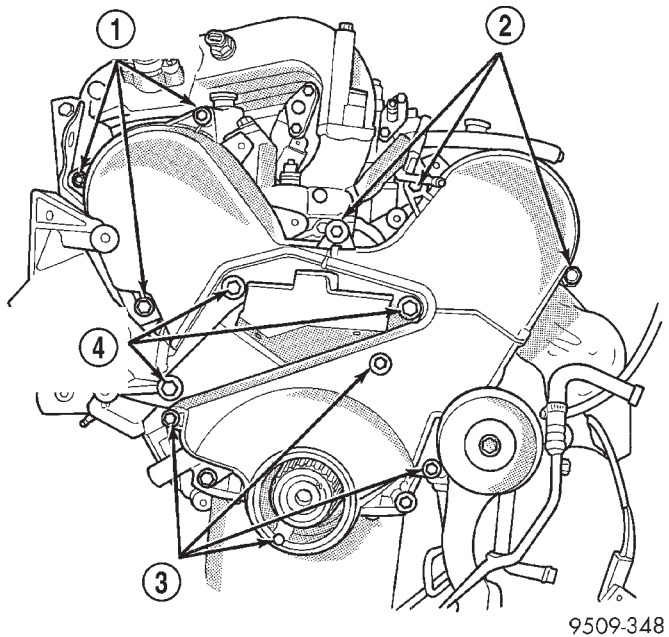
NOTE: To remove engine mount bracket the lower timing belt cover must be removed first.

(6) Remove power steering pump bracket. Refer to Group 19, Steering for procedure.

(7) Remove the timing belt covers (Fig. 70). Remove covers in this order:

- (a) Upper left cover.
- (b) Lower cover.
- (c) Upper right cover.

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

**Fig. 70 Timing Belt Covers**

- 1 - UPPER RIGHT TIMING BELT COVER FASTENERS
- 2 - UPPER LEFT TIMING BELT COVER FASTENERS
- 3 - LOWER TIMING BELT COVER FASTENERS
- 4 - ENGINE BRACKET FASTENERS

(8) Remove the engine mount bracket (Fig. 70).

INSTALLATION

(1) Install engine mount bracket (Fig. 70).

(2) Install timing belt covers (Fig. 70) in this order:

- (a) Upper right cover.
- (b) Lower cover.
- (c) Upper left cover.

(3) Install power steering pump bracket. Refer to Group 19, Steering for procedure.

(4) Install crankshaft damper. Refer to procedure in this section.

(5) Install right engine mount. Refer to Engine Mounts in this section for procedure.

(6) Install accessory drive belts. Refer to Group 7, Cooling System for service procedure.

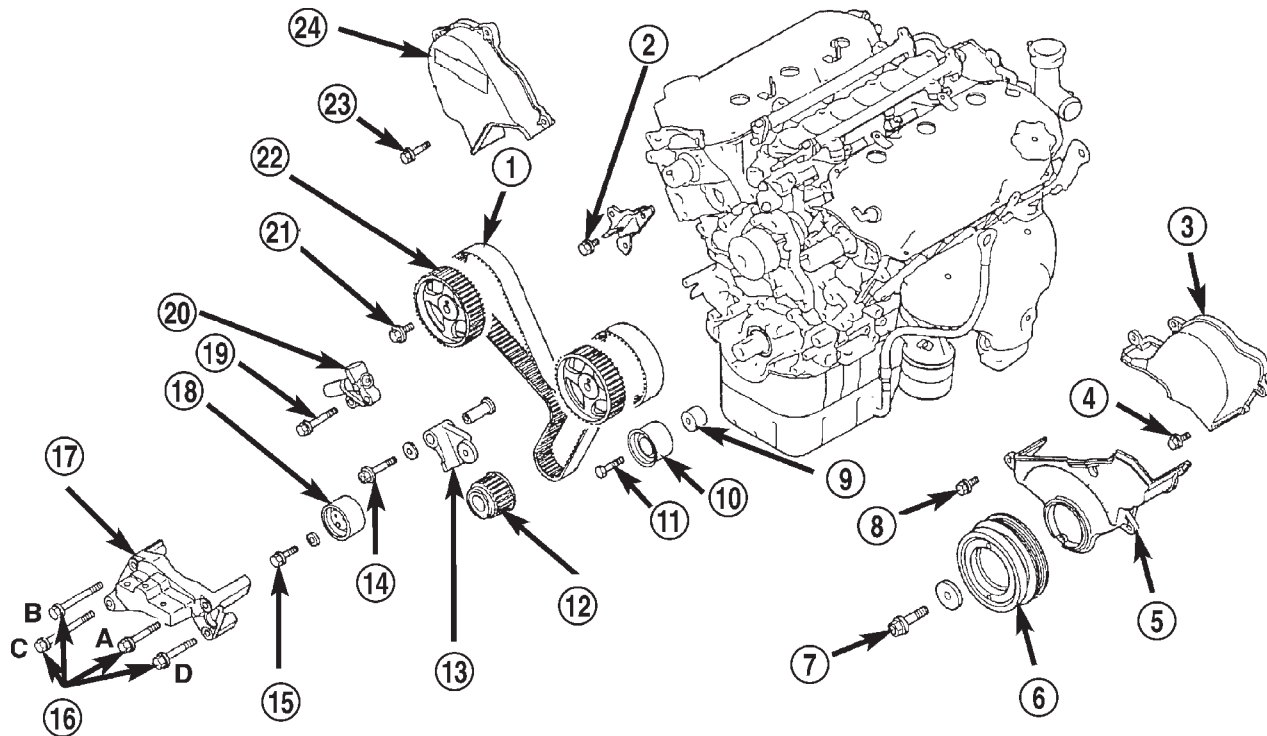
(7) Install drive belt splash shield. Refer to Group 23, Body for procedure.

(8) Connect negative cable from battery remote jumper terminal.

TIMING BELT

CAUTION: The 2.5L engine is a Non-freewheeling design. When the timing belt is removed, DO NOT rotate the camshafts or crankshaft without first locating the proper crankshaft position. Failure to do so will result in valve and/or piston damage

REMOVAL AND INSTALLATION (Continued)



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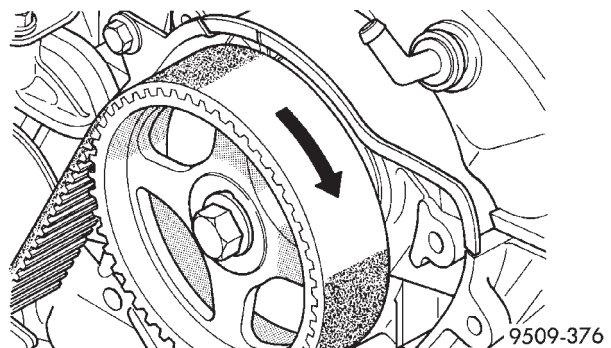
Fig. 71 Timing Belt System

- | | |
|----------------------------------|------------------------------------|
| 1 - TIMING BELT | 15 - 48 N•m (35 ft. lbs.) |
| 2 - 14 N•m (10 ft. lbs.) | 16 - 45 N•m (33 ft. lbs.) |
| 3 - UPPER LEFT TIMING BELT COVER | TIGHTENING ORDER |
| 4 - 14 N•m (10 ft. lbs.) | A-B-C-D |
| 5 - LOWER TIMING BELT COVER | |
| 6 - CRANKSHAFT DAMPER | 17 - ENGINE MOUNT BRACKET |
| 7 - 182 N•m (134 ft. lbs.) | 18 - TENSIONER PULLEY |
| 8 - 11 N•m (8 ft. lbs.) | 19 - 23 N•m (17 ft. lbs.) |
| 9 - SPACER | 20 - TENSIONER |
| 10 - IDLER PULLEY | 21 - CAMSHAFT SPROCKET BOLT |
| 11 - 44 N•m (33 ft. lbs.) | 88 N•m (65 ft. lbs.) |
| 12 - CRANKSHAFT SPROCKET | 22 - CAMSHAFT SPROCKET |
| 13 - TENSIONER ARM | 23 - 14 N•m (10 ft. lbs.) |
| 14 - 44 N•m (33 ft. lbs.) | 24 - UPPER RIGHT TIMING BELT COVER |

REMOVAL

- (1) Remove timing belt covers. Refer to procedure in this section.
- (2) Mark timing belt running direction for installation (Fig. 72).
- (3) Loosen timing belt tensioner center bolt (Fig. 73) and remove auto tensioner.
- (4) Remove timing belt.

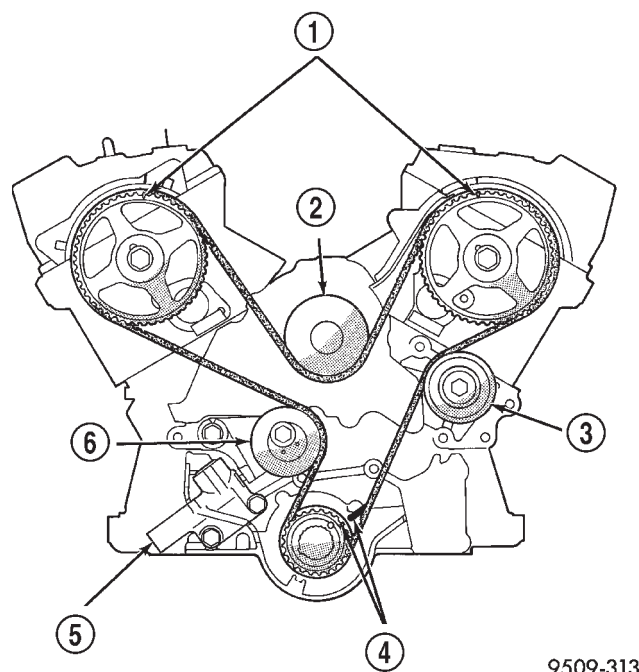
CAUTION: Coolant or oil leakage on timing belt will shorten its life drastically. If timing belt is seriously contaminated, it must be replaced. Clean all components and correct source of leak.



9509-376

Fig. 72 Mark Direction of Timing Belt

REMOVAL AND INSTALLATION (Continued)



9509-313

Fig. 73 Timing Belt Engine Sprocket Timing

- 1 - CAMSHAFT SPROCKETS ALIGN TO TIMING MARKS
- 2 - WATER PUMP PULLEY
- 3 - IDLER PULLEY
- 4 - CRANKSHAFT SPROCKET ALIGN TO TIMING MARK
- 5 - AUTO TENSIONER
- 6 - TENSIONER PULLEY

CAMSHAFT AND CRANKSHAFT TIMING PROCEDURE

TIMING BELT TENSIONER

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

(2) Place the tensioner into a vise and slowly compress the plunger (Fig. 74).

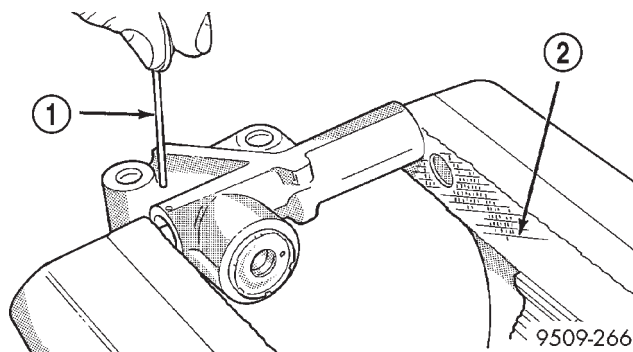
CAUTION: Index the tensioner in the vise the same way it is installed on the engine. This is to ensure proper locking pin orientation when tensioner is installed on the engine.

(3) When plunger is compressed into the tensioner body, install a locking pin through the body and plunger (Fig. 74).

INSTALLATION

(1) Set crankshaft sprocket to TDC by aligning the sprocket mark with the mark on the oil pump housing. Then rotate crankshaft 3 notches before TDC (Fig. 75).

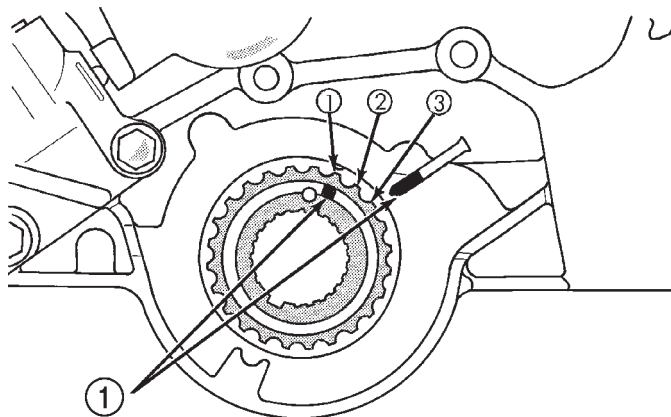
(2) Set camshaft sprockets to the aligning marks on the sprockets with the marks on the rear timing belt cover (Fig. 76).



9509-266

Fig. 74 Timing Belt Tensioner Compressing

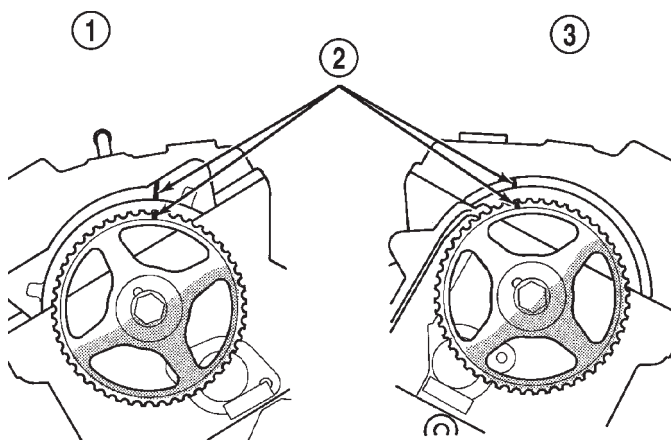
- 1 - LOCKING PIN
- 2 - SOFT JAW VISE



9509-349

Fig. 75 Crankshaft Sprocket Timing

- 1 - TIMING MARKS



9509-312

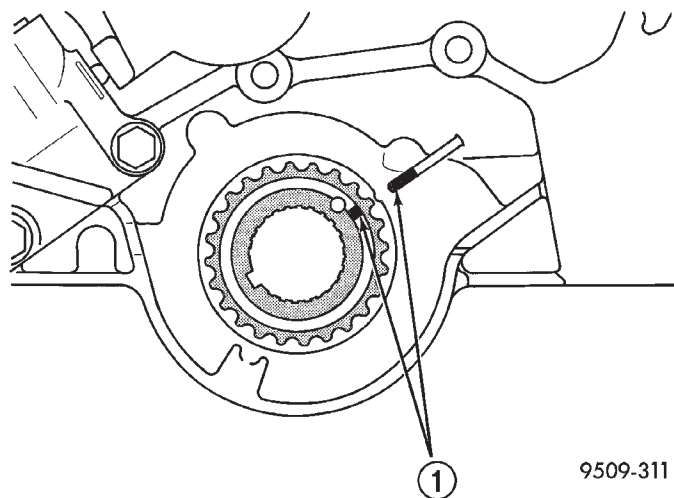
Fig. 76 Camshaft Sprocket Timing

- 1 - RIGHT CAM SPROCKET
- 2 - ALIGN TIMING MARKS
- 3 - LEFT CAM SPROCKET

REMOVAL AND INSTALLATION (Continued)

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

(4) Rotate the crankshaft to TDC (Fig. 77). Continue routing the belt around the idler pulley, crankshaft sprocket, and tensioner pulley.



9509-311

Fig. 77 Adjusting Crankshaft Sprocket for Timing Belt

1 - TIMING MARKS

(5) To tension belt perform the following:

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

(b) Loosen tensioner pulley center bolt.

(c) Using Special Tool MD 998767 and a torque wrench on the tensioner pulley. Apply 4.4 N·m (38.9 in. lbs.) of torque to tensioner (Fig. 78). Tighten tensioner pulley bolt to 48 N·m (35 ft. lbs.).

(d) With torque being applied to the tensioner pulley, install the hydraulic tensioner to the tensioner pulley bracket. Tighten tensioner fasteners to 23 N·m (205 in. lbs.).

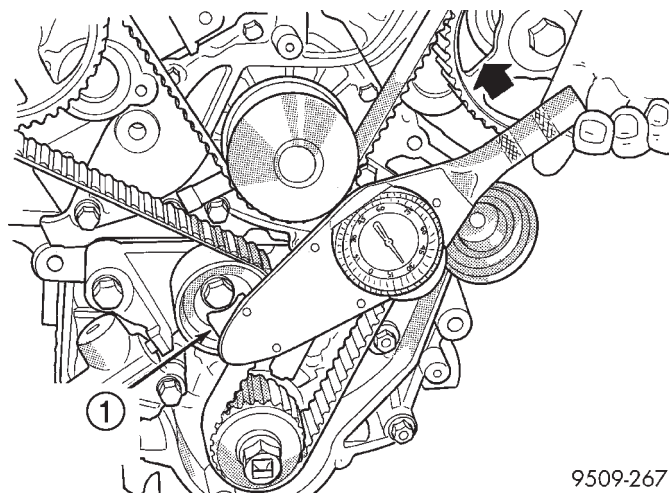
(e) Pull tensioner plunger pin.

(6) Rotate crankshaft 2 revolutions in a clockwise direction ONLY and check the alignment of the timing marks (Fig. 73). Install tensioner pin into assembly. The pin should slide in and out without any resistance. If the pin does not slide freely, perform the procedure again.

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

(8) Install right engine mount. Refer to procedure in this section.

(9) Install crankshaft damper and crankshaft damper bolt. Tighten to 182 N·m (134 ft. lbs.).



9509-267

Fig. 78 Timing Belt Tension Adjustment

1 - SPECIAL TOOL MD 998767

(10) Install accessory drive belts. Refer to Group 7, Cooling System for the procedure.

(11) Raise vehicle on hoist and install drive belt splash shield.

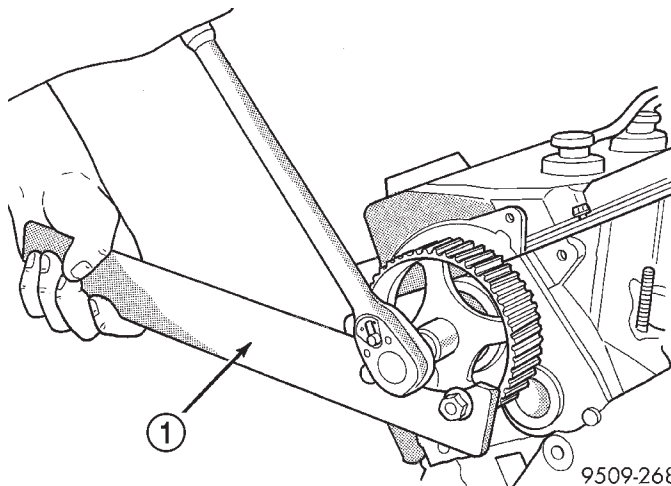
CAMSHAFT SPROCKETS

REMOVAL

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

(2) Hold camshaft sprocket with Special Tool 6847. Loosen and remove bolt and washer (Fig. 79).

(3) Remove camshaft sprocket from camshaft.



9509-268

Fig. 79 Camshaft Sprockets—Removal and Installation

1 - SPECIAL TOOL 6847

INSTALLATION

(1) Place camshaft sprocket on camshaft.

REMOVAL AND INSTALLATION (Continued)

(2) Install bolt and washer to camshaft. Using Special Tool 6847, hold camshaft sprocket and torque bolt to 88 N·m (65 ft. lbs.) (Fig. 79).

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

CAMSHAFT OIL SEAL**REMOVAL**

(1) Remove timing belt and camshaft sprocket(s). Refer to procedures in this section.

(2) Remove camshaft seal(s).

INSTALLATION

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

(2) Install the oil seal using Special Tool MD998713 or 6863 camshaft oil seal installers (Fig. 80) and (Fig. 81).

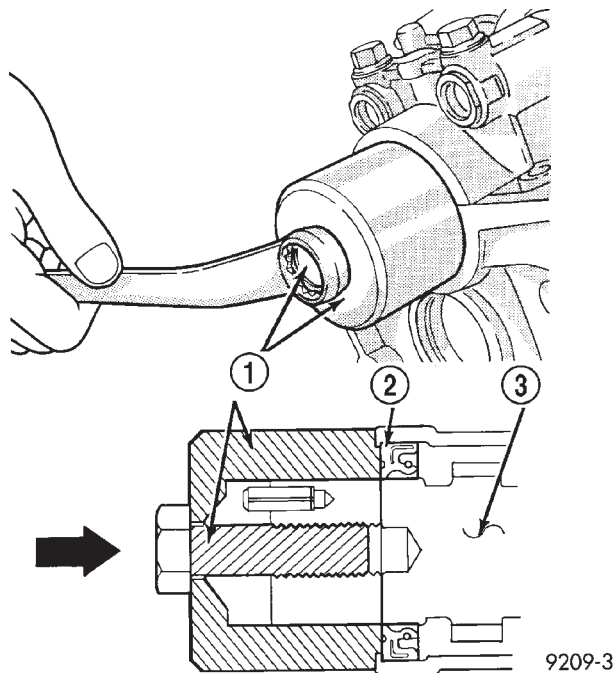


Fig. 80 Camshaft Oil Seal Installation—Right Cylinder Head

- 1 - SPECIAL TOOL MD-998713
2 - SEAL
3 - CAMSHAFT

OIL PAN**REMOVAL**

(1) Disconnect negative cable from remote battery jumper terminal (Fig. 82).

(2) Remove oil drain plug and drain oil (Fig. 83).

(3) Remove exhaust cross-under pipe. Refer to Exhaust Manifold, in this section for procedure.

(4) Remove drive belt splash shield.

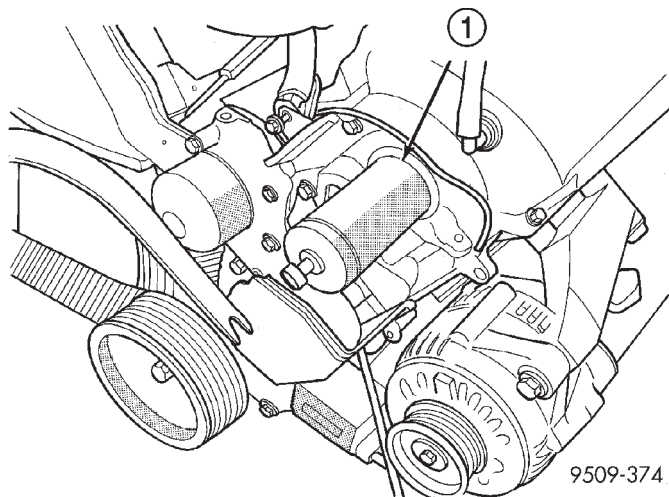


Fig. 81 Camshaft Oil Seal Installation—Left Cylinder Head

- 1 - SPECIAL TOOL 6863

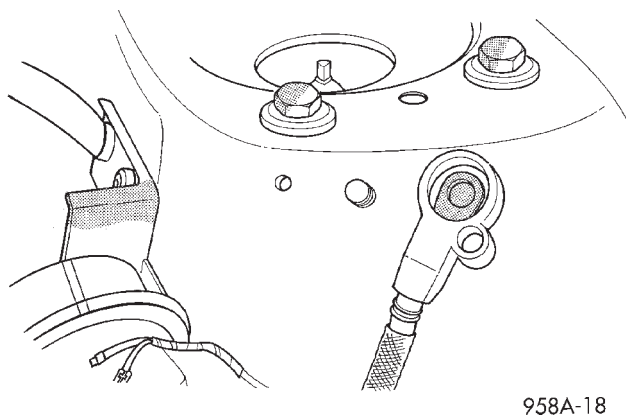


Fig. 82 Battery Negative Cable Remote Terminal Location

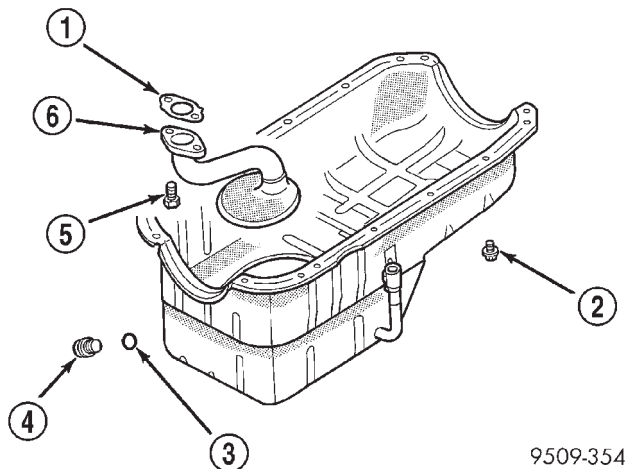
- (5) Remove dipstick tube.
(6) Remove starter motor. Refer to Group 8B, Battery/Starter/Generator Service for procedure.
(7) Remove engine to transaxle struts/bending braces.
(8) Remove transaxle inspection cover.
(9) Remove oil pan.

INSTALLATION

NOTE: Oil pan to cylinder block sealing is provided with Mopar® RTV GEN II or equivalent gasket material. See Form-In-Place Gaskets in this section.

- (1) Apply sealant as shown in (Fig. 84).
(2) Install pan and tighten screws to 6 N·m (50 in. lbs.).
(3) Install transaxle inspection cover.
(4) Install engine to transaxle struts/bending braces.

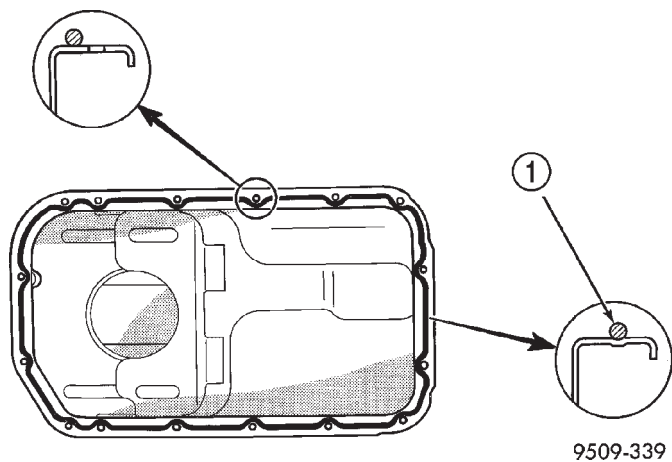
REMOVAL AND INSTALLATION (Continued)



9509-354

Fig. 83 Oil Pan

- 1 - GASKET
- 2 - SCREW
- 3 - GASKET
- 4 - OIL DRAIN PLUG
- 5 - BOLT
- 6 - OIL PICKUP



9509-339

Fig. 84 Oil Pan Sealing

1 - .157 in (4 mm) DIAMETER OF SEALANT

(5) Install exhaust cross-under pipe. Refer to Exhaust Manifold in this section for procedure.

(6) Install starter motor. Refer to Group 8B, Starting for procedure.

(7) Install drive belt splash shield.

(8) Inspect dipstick tube O-ring and replace as necessary.

(9) Install dipstick tube.

(10) Install correct amount of engine oil.

(11) Connect negative cable to battery remote jumper terminal.

CRANKSHAFT OIL SEAL—FRONT**REMOVAL**

(1) Remove crankshaft damper. Refer to procedure in this section.

(2) Remove timing belt covers and timing belt. Refer to procedures in this section.

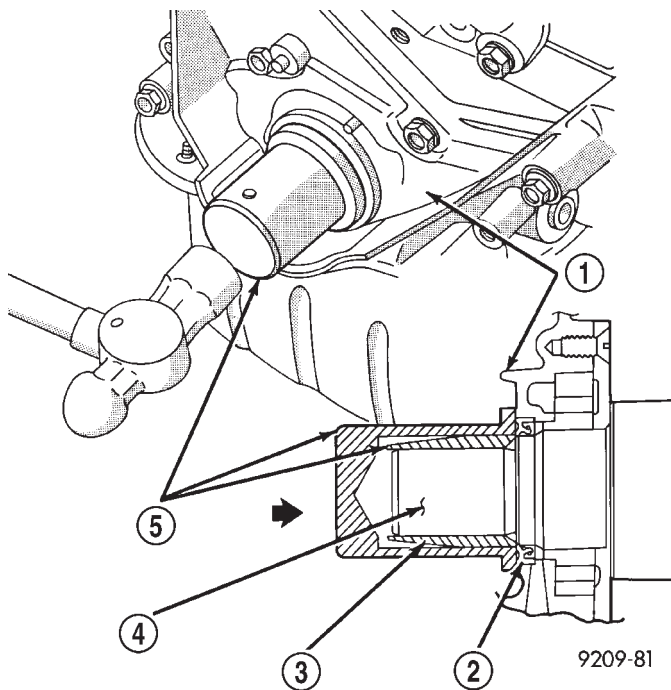
(3) Remove crankshaft sprocket and key.

(4) Pry out the front seal with a flat tip screwdriver. Cover the end of the screwdriver with a shop towel.

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

INSTALLATION

(1) Install front crankshaft seal into oil pump housing using Special Tool MD-998717 (Fig. 85).



9209-81

Fig. 85 Front Crankshaft Oil Seal

- 1 - PUMP CASE
- 2 - SEAL
- 3 - GUIDE
- 4 - CRANKSHAFT
- 5 - SPECIAL TOOL MD-998717

(2) Install crankshaft key and sprocket.

(3) Install timing belt and covers. Refer to procedures in this section.

(4) Install crankshaft damper. Refer to procedure in this section.

REMOVAL AND INSTALLATION (Continued)

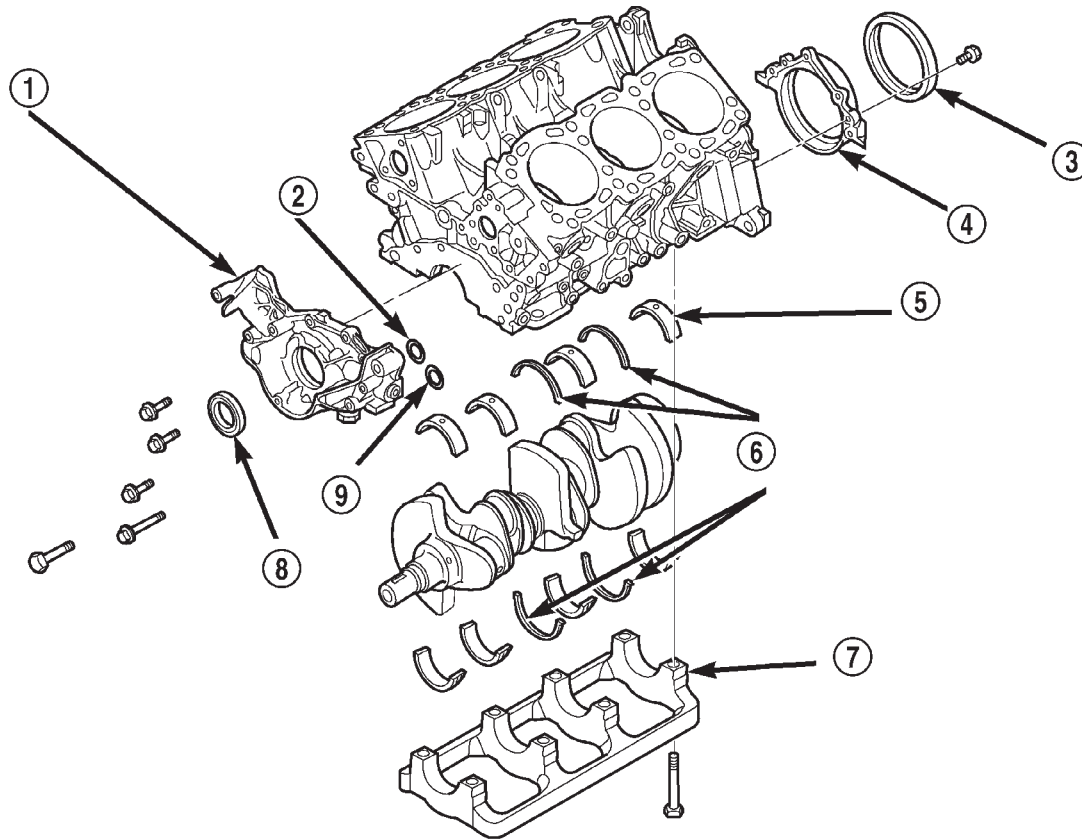


Fig. 86 Crankshaft and Cylinder Block

80ae8386

- 1 - OIL PUMP ASSEMBLY
- 2 - O-RING
- 3 - SEAL
- 4 - CASE
- 5 - UPPER BEARING (GROOVED)

- 6 - THRUST BEARINGS (2 PAIRS)
- 7 - MAIN BEARING MONOBLOCK CAP
- 8 - SEAL
- 9 - O-RING

CRANKSHAFT

REMOVAL

- (1) Remove engine assembly from vehicle. Refer to procedure in this section.
- (2) Separate engine from transaxle and remove flex plate.
- (3) Remove rear oil seal retainer and seal as an assembly (Fig. 88).
- (4) Mount engine on a suitable engine repair stand.
- (5) Remove oil pan.
- (6) Remove front mounted oil pump assembly (Fig. 86) and (Fig. 87).
- (7) Mark position of each connecting rod and cap. Remove connecting rod bearing caps.
- (8) Release monoblock main bearing cap bolts evenly. Remove lower bearing shells and identify for reassembly.

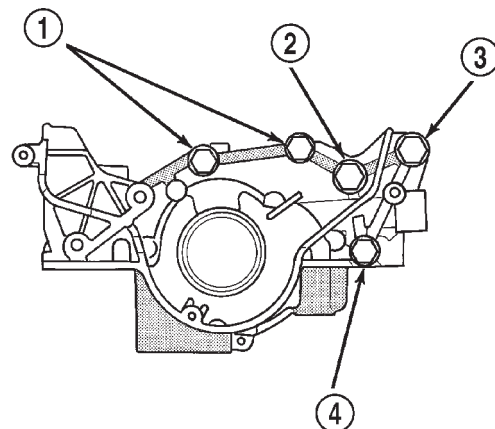


Fig. 87 Oil Pump

9509-337

- 1 - M8 × 25 MM (1 IN.)
- 2 - M8 × 30 MM (1 3/16 IN.)
- 3 - M10 × 50 MM (1 31/32 IN.)
- 4 - M8 × 60 MM (2 3/8 IN.)

REMOVAL AND INSTALLATION (Continued)

(9) Lift out crankshaft and remove upper thrust washers from each side of number three main bearing in the crankcase (Fig. 86).

INSTALLATION

(1) Select the proper size main bearings. Refer to Main Bearing Fitting in this section.

(2) Install upper main bearing shells making certain oil holes are in alignment, and bearing tabs seat in block tabs. All upper bearings have oil grooves (Fig. 89).

(3) **THRUST BEARINGS.** Crankshaft thrust bearings (washers) are installed at journal #3 separately from the radial bearings. Thrust bearings are different, one has end positioning tabs, while the other is plain. One **pair** of each thrust washers are installed into the block and one **pair** into the main bearing cap (Fig. 89).

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

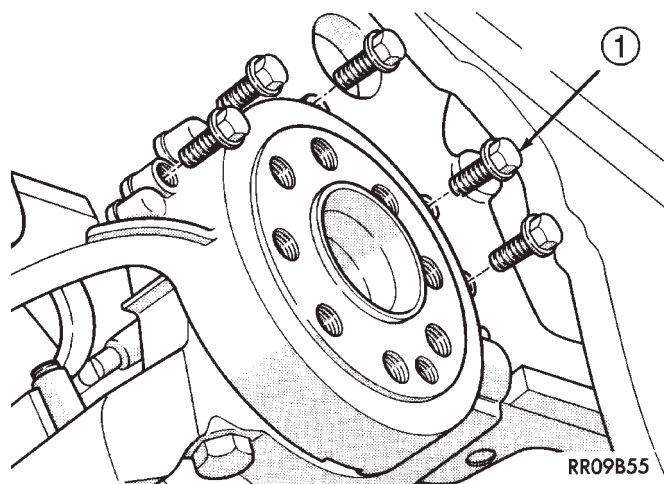


Fig. 88 Rear Seal Assembly

1 - 10mm (104 IN. LBS.)

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

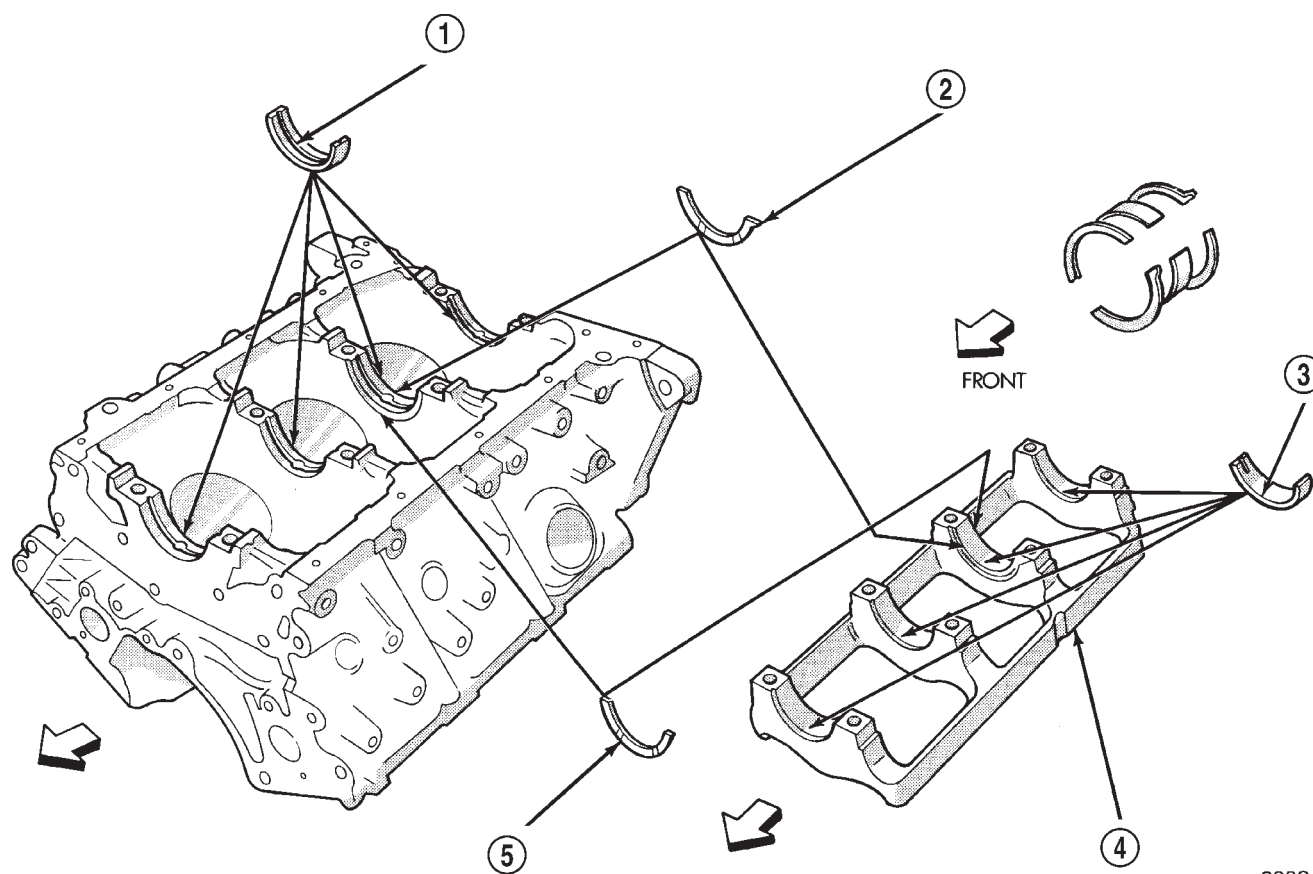


Fig. 89 Main Bearings Installation

1 - GROOVED

2 - THRUST BEARING WITH TAB

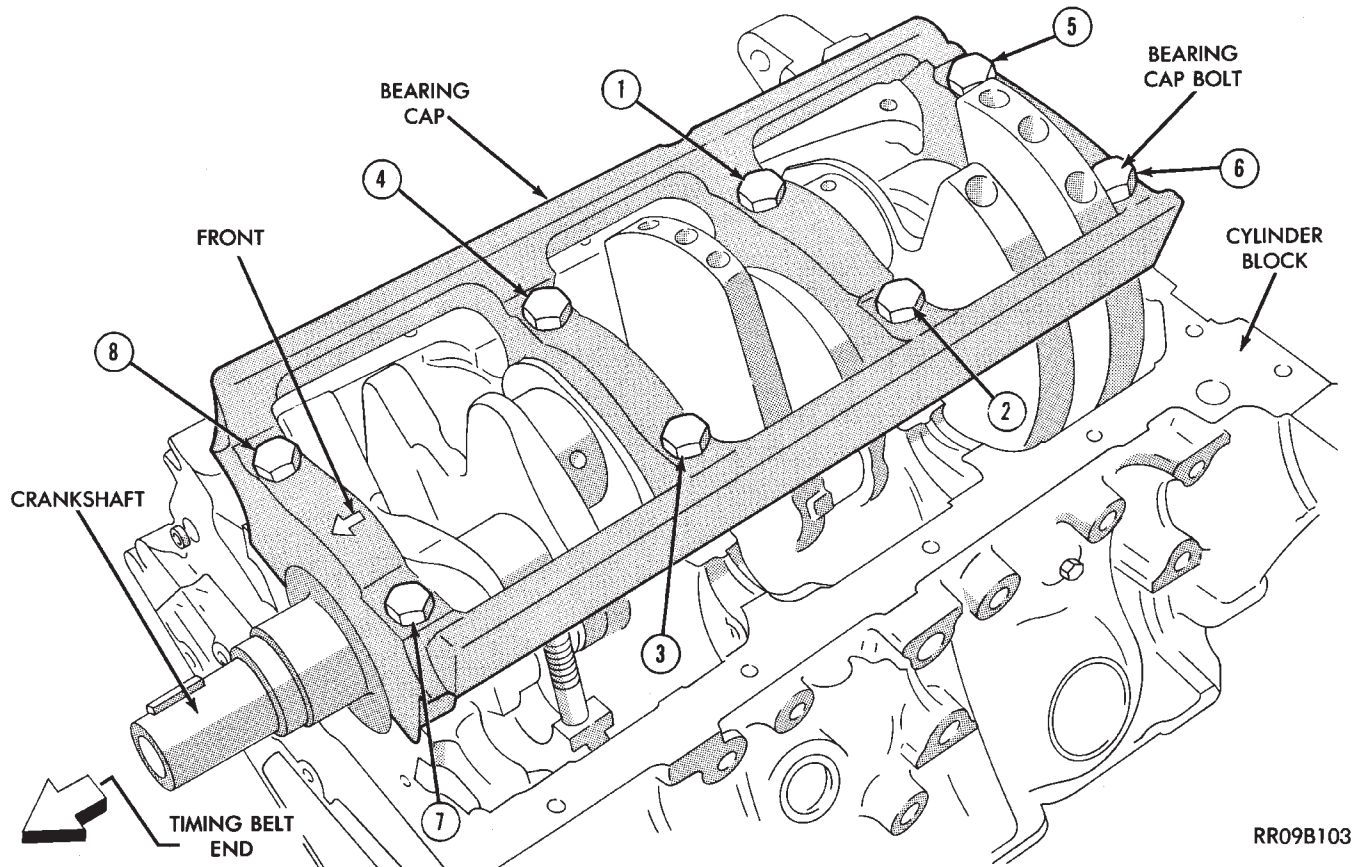
3 - PLAIN

4 - MONOBLOCK MAIN BEARING CAP

5 - THRUST BEARING WITHOUT TAB

9209-78

REMOVAL AND INSTALLATION (Continued)

**Fig. 90 Crankshaft Main Bearing Cap**

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

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

(8) Carefully install bearing cap with arrows (Fig. 90) toward timing belt end.

(9) Oil the bearing cap bolt threads, install and tighten bolts progressively in sequence shown in (Fig. 90) to 94 N·m (69 ft. lbs.).

(10) Check crankshaft end play by performing the following:

(a) Mount a dial indicator to front of engine; locating probe on nose of crankshaft (Fig. 91).

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

(c) Zero the dial indicator.

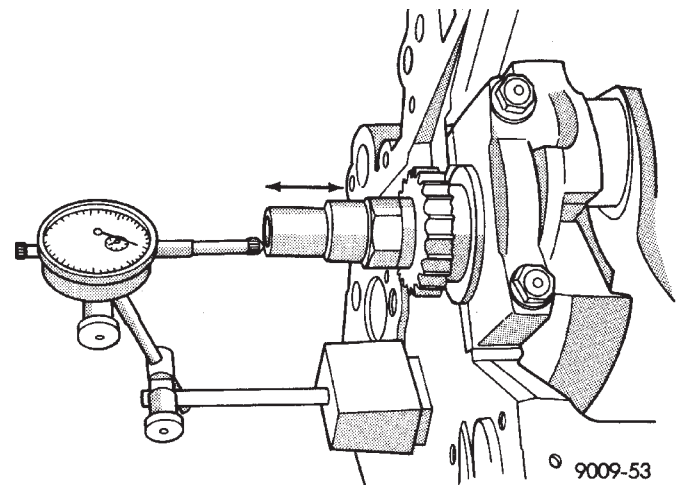
(d) Move crankshaft all the way to the front and read the dial indicator. Refer to Engine Specifications.

(11) Lubricate connecting rod bearings with engine oil. Install connecting rod caps in original position. Tighten connecting rod cap nuts to 52 N·m (38 ft. lbs.).

(12) Install oil pump assembly.

(13) Install oil pan.

(14) Install rear oil seal and retainer.

**Fig. 91 Crankshaft End Play—Typical**

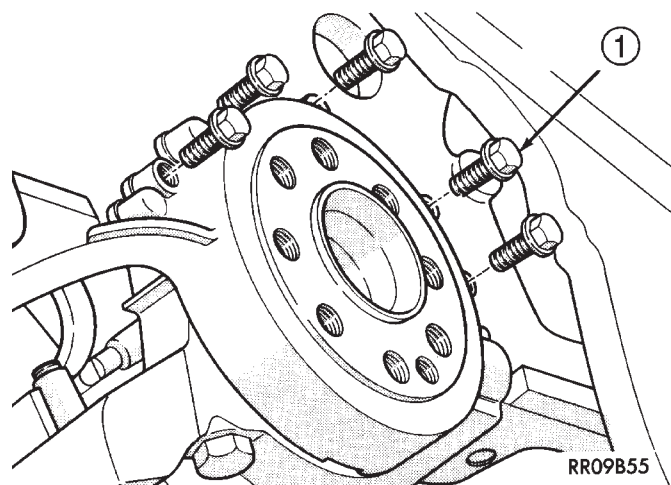
(15) Install flex plate. Apply Mopar® Lock & Seal Adhesive to bolt threads and tighten to 95 N·m (70 ft. lbs.).

(16) Install engine assembly.

REMOVAL AND INSTALLATION (Continued)

CRANKSHAFT OIL SEAL AND RETAINER—REAR**REMOVAL**

- (1) Remove transaxle from vehicle. Refer to Group 21, Transaxle for procedure.
- (2) Remove flex plate.
- (3) Remove oil pan. Refer to procedure in this section.
- (4) Remove bolts attaching oil seal retainer to cylinder block (Fig. 92).
- (5) Remove oil seal and retainer.
- (6) Remove oil seal from retainer.

**Fig. 92 Crankshaft Oil Seal Retainer—Rear**

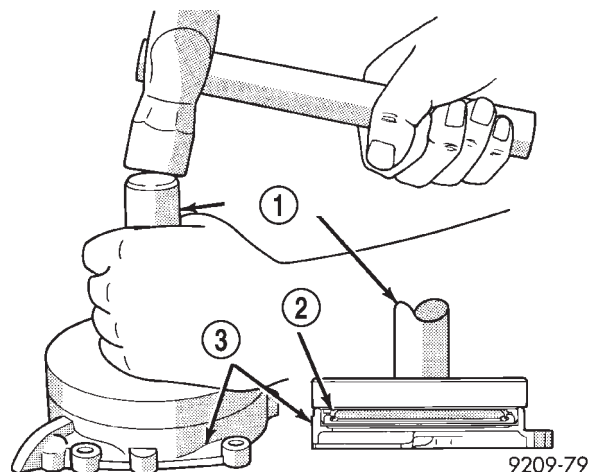
1 - 10mm (104 IN. LBS.)

INSTALLATION

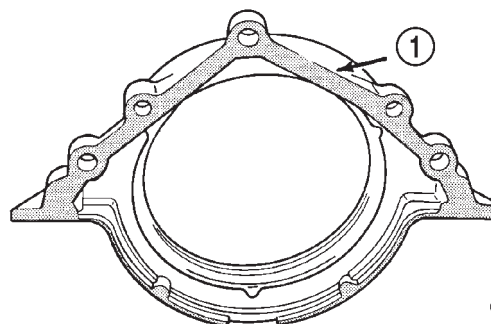
- (1) Inspect and clean all sealing surfaces.
- (2) Install rear crankshaft oil seal in housing with Special Tool MD-998718 (Fig. 93).
- (3) Apply Mopar® RTV GEN II Silicone Rubber Adhesive to the oil seal retainer housing (Fig. 94).
- (4) Apply light coating of engine oil to the entire circumference of oil seal lip.
- (5) Install seal assembly on cylinder block and tighten bolts to 11 N·m (104 in. lbs.)
- (6) Install oil pan. Refer to procedure in this section.
- (7) Install flex plate. Apply Mopar® Lock & Seal Adhesive to bolt threads and tighten to 95 N·m (70 ft. lbs.).
- (8) Install transaxle. Refer to Group 21, Transaxle for procedure.

ENGINE CORE PLUGS**REMOVAL**

Using a blunt tool such as a drift or a screwdriver and a hammer, strike the bottom edge of the cup

**Fig. 93 Install Crankshaft Rear Oil Seal**

- 1 - SPECIAL TOOL MD-998718
2 - SEAL
3 - HOUSING

**Fig. 94 Apply Sealant to Oil Seal Housing**

- 1 - MOPAR SILICONE RUBBER ADHESIVE SEALANT

plug (Fig. 95). With the cup plug rotated, grasp firmly with pliers or other suitable tool and remove plug (Fig. 95).

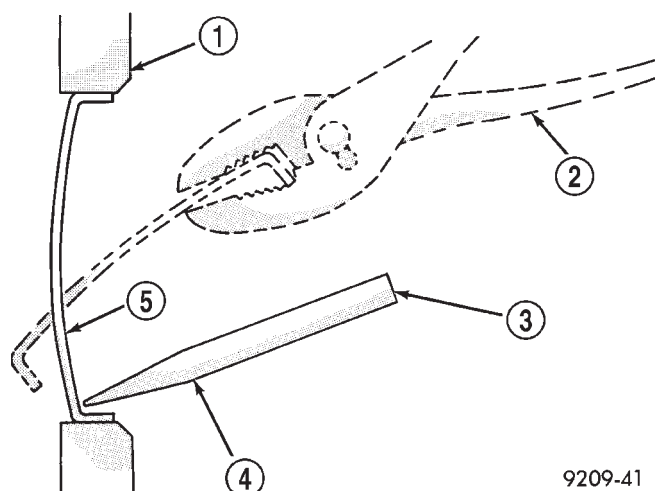
CAUTION: Do not drive cup plug into the casting as restricted cooling can result and cause serious engine problems.

INSTALLATION

Thoroughly clean all debris/rust from inside of cup plug hole in cylinder block or head. Be sure to remove old sealer. Lightly coat inside of cup plug hole with Mopar® Stud and Bearing Mount Adhesive. Make certain the new plug is cleaned of all oil or grease. Using a proper driver, drive plug into hole so that the sharp edge of the plug is at least 0.5 mm (0.020 inch.) inside the lead in chamfer (Fig. 95).

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

REMOVAL AND INSTALLATION (Continued)



9209-41

Fig. 95 Core Hole Plug Removal

- 1 - CYLINDER BLOCK
- 2 - SECOND REMOVE PLUG WITH PLIERS
- 3 - FIRST STRIKE HERE WITH HAMMER
- 4 - DRIFT
- 5 - CUP PLUG

OIL FILTER

CAUTION: When servicing the oil filter (Fig. 96), avoid deforming the filter can by installing the remove/install tool band strap against the can-to-base lock seam. The lock seam joining the can to the base is reinforced by the base plate.

REMOVAL

- (1) Turn filter counterclockwise to remove.

INSTALLATION

- (1) Lubricate new filter gasket.
- (2) Screw filter on until gasket contacts base. Tighten to 14 N·m (10 ft. lbs.).

OIL PUMP

REMOVAL

- (1) Remove accessory drive belts. Refer to Group 7, Cooling System for procedure.
- (2) Refer to procedures in this section for removing the following components:
 - Oil Pan
 - Crankshaft Damper
 - Timing Belt Covers
 - Timing Belt
- (3) Remove crankshaft sprocket and key.
- (4) Remove oil pickup tube.
- (5) Remove bolts that attach oil pump to block (Fig. 97).

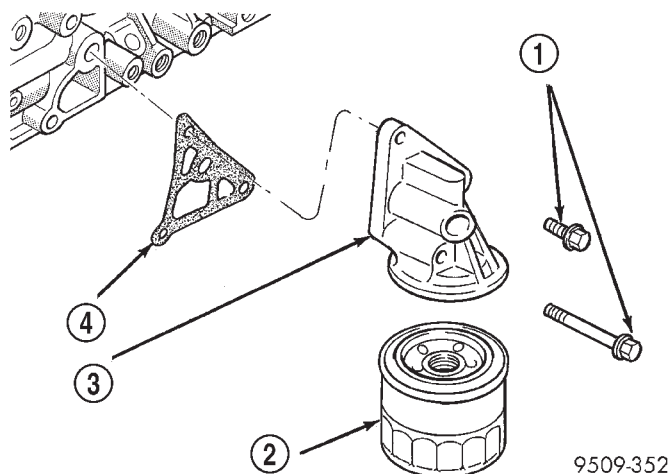
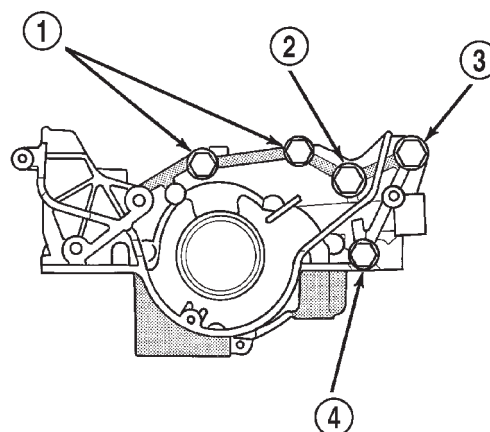


Fig. 96 Oil Filter and Bracket

- 1 - 23 N·m (17 IN. LBS.)
- 2 - FILTER
- 3 - BRACKET
- 4 - GASKET



9509-337

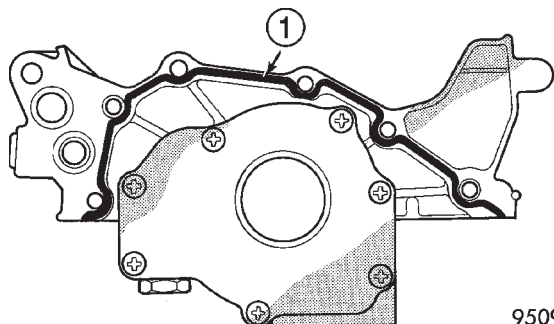
Fig. 97 Oil Pump Assembly

- 1 - M8 × 25 MM (1 IN.)
- 2 - M8 × 30 MM (1 3/16 IN.)
- 3 - M10 × 50 MM (1 31/32 IN.)
- 4 - M8 × 60 MM (2 3/8 IN.)

INSTALLATION

- (1) Clean block and pump sealing surfaces.
- (2) Prime oil pump before installation by filling rotor cavity with clean engine oil.
- (3) Apply Mopar® Gasket Maker to oil pump as shown in (Fig. 98). Install oil-ring into the counter bore on the oil pump body discharge passage.
- (4) Install oil pump slowly onto crankshaft until seated to engine block. Tighten fasteners to M8 bolts 14 N·m (10 ft. lbs.) M10 bolts 41 N·m (30 ft. lbs.). See (Fig. 97) for bolt location and length.
- (5) Install oil pickup tube. Tighten fasteners to 19 N·m (168 in. lbs.).

REMOVAL AND INSTALLATION (Continued)



9509-338

Fig. 98 Oil Pump Sealing

1 - .118 in. (3 mm) OF SEALANT

(6) Install crankshaft sprocket and key.
 (7) Refer to procedures in this section for installing the following components:

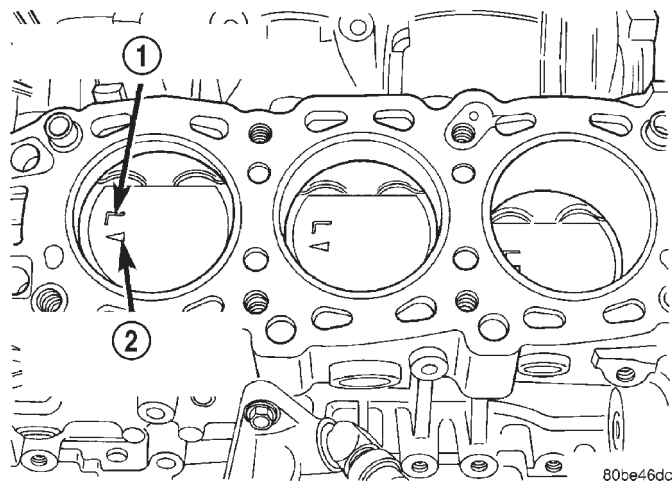
- Timing Belt
- Timing Belt Covers
- Crankshaft Damper
- Oil Pan

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

PISTON AND CONNECTING ROD**REMOVAL**

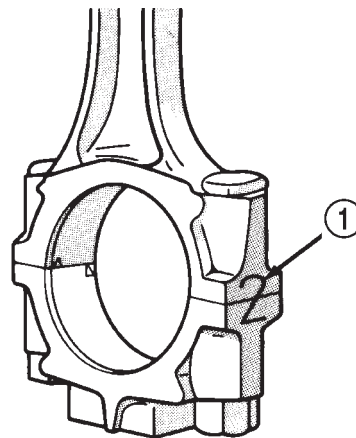
(1) Remove oil pan and cylinder head(s). Refer to procedures in this section.

(2) Identify pistons with matching cylinder. **The pistons are not interchangeable from bank to bank** (Fig. 99). Pistons with the letter R and arrow toward the front of engine are to be installed in cylinders 1-3-5. Pistons with the letter L and arrow toward the front of engine are to be installed in cylinders 2-4-6.

**Fig. 99 Piston Markings**

1 - "L" FORWARD FOR CYLINDERS 2-4-6

2 - ARROW FACE TOWARD FRONT OF ENGINE

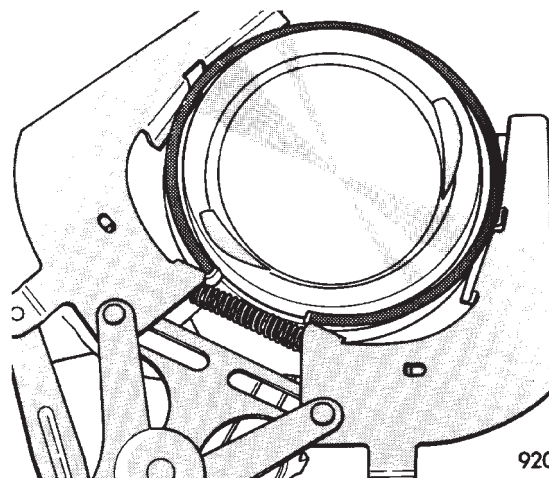


RR09B40

Fig. 100 Mark Matching Parts

1 - CYLINDER NUMBER

(3) Mark connecting rod and cap with cylinder number (Fig. 100).



9209-16

Fig. 101 Piston Ring—Removal

(4) Remove piston rings (Fig. 101).

INSTALLING PISTON RINGS

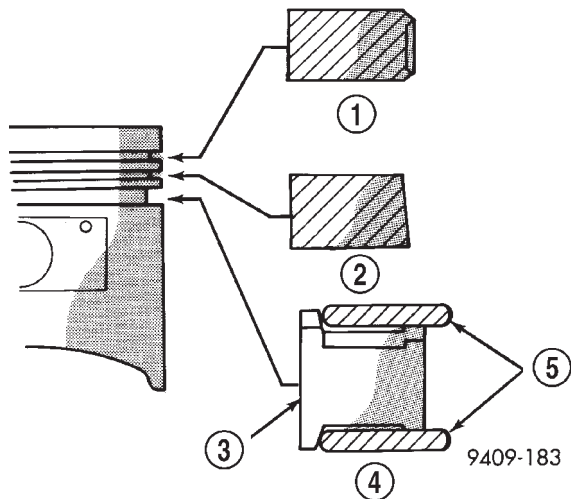
(1) The No. 1 and No. 2 piston rings have a different cross section. Install rings with manufacturers mark and size mark facing up, to the top of the piston (Fig. 102).

CAUTION: Install piston rings in the following order:

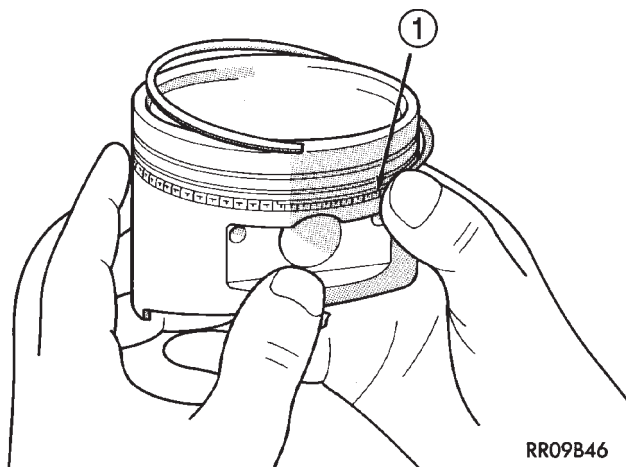
- a. Oil ring expander.
- b. Upper oil ring side rail.
- c. Lower oil ring side rail.
- d. No. 2 Intermediate piston ring.
- e. No. 1 Upper piston ring.

(2) Install the side rails (upper rail first, then lower rail) by placing one end between the piston

REMOVAL AND INSTALLATION (Continued)

**Fig. 102 Piston Ring—Installation**

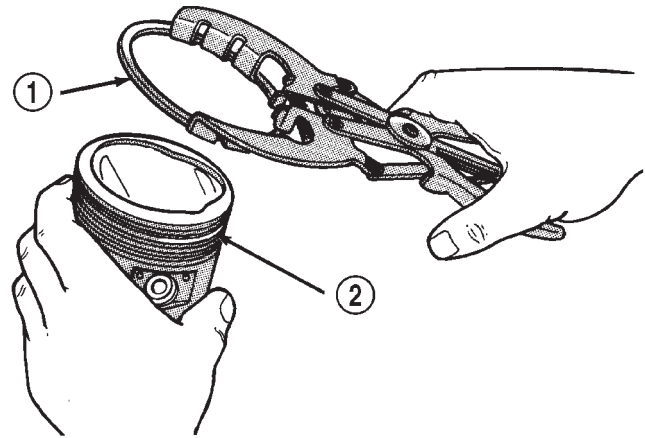
- 1 - NO. 1 PISTON RING
- 2 - NO. 2 PISTON RING
- 3 - SPACER EXTENDER
- 4 - OIL RING
- 5 - SIDE RAIL



RR09B46

Fig. 103 Side Rail—Installation

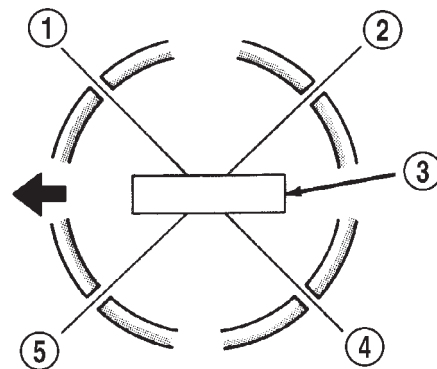
- 1 - SIDE RAIL END



9109-105

Fig. 104 Upper and Intermediate Ring—Installation

- 1 - NO. 1 RING
- 2 - NO. 2 RING - INSTALL FIRST



RR09B48

Fig. 105 Piston Ring End Gap Position

- 1 - SIDE RAIL UPPER
- 2 - NO. 1 RING GAP
- 3 - PISTON PIN
- 4 - SIDE RAIL LOWER
- 5 - NO. 2 RING GAP AND SPACER EXPANDER GAP

ring groove and the expander. Hold end firmly and press down the portion to be installed until side rail is in position. **Do Not use a piston ring expander** (Fig. 103).

(3) Using a piston ring expander, install No. 2 piston ring and then No. 1 piston ring (Fig. 104).

(4) Position piston ring end gaps as shown in (Fig. 105).

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

INSTALLATION

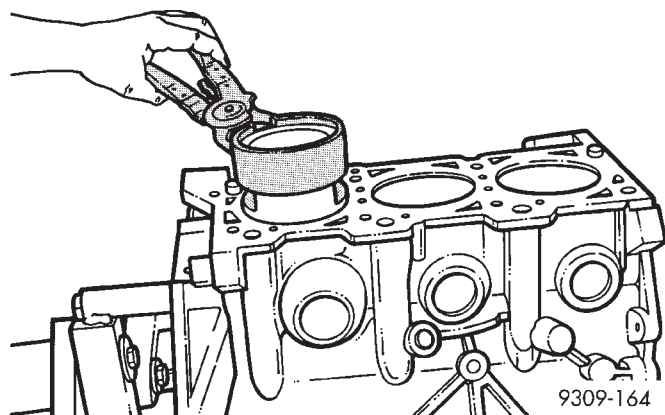
(1) Before installing pistons and connecting rod assemblies into the bore, be sure that compression ring gaps are staggered so that neither is in line with oil ring rail gap.

(2) Before installing the ring compressor, make sure the oil ring expander ends are butted and the rail gaps located as shown in (Fig. 105).

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

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

REMOVAL AND INSTALLATION (Continued)

**Fig. 106 Piston—Installation**

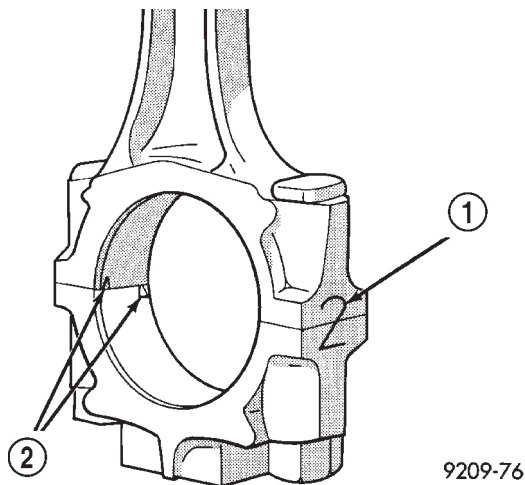
(5) Rotate crankshaft so that the connecting rod journal is on the center of the cylinder bore. Insert rod and piston into cylinder bore and guide rod over the crankshaft journal.

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

(7) Tap the piston down in cylinder bore, using a hammer handle. At the same time, guide connecting rod into position on connecting rod journal (Fig. 106).

(8) Install rod caps. Install nuts on cleaned and oiled rod bolts and tighten nuts to 52 N·m (38 ft. lbs.).

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

**Fig. 107 Connecting Rod and Cap**

- 1 - CYLINDER NUMBER
2 - NOTCHES TO HOLD BEARING

(9) Check alignment marks made during disassembly and that bearing position notches new or used are on the same side as shown in (Fig. 107).

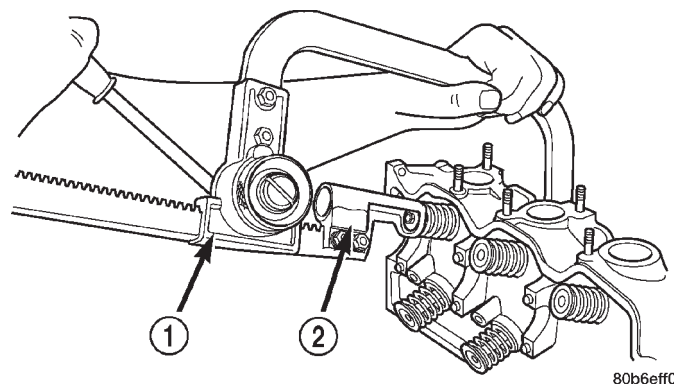
(10) Install cylinder head(s) and oil pan. Refer to procedures in this section.

DISASSEMBLY AND ASSEMBLY

CYLINDER HEAD

DISASSEMBLY

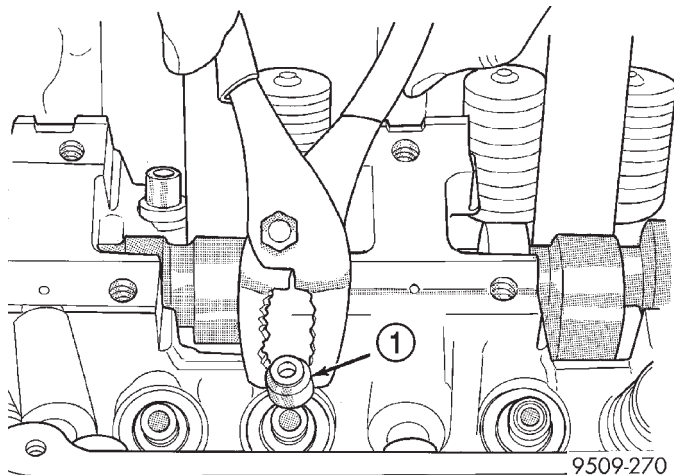
CAUTION: Before disassembly, mark each valve's position on the face of each valve being removed. The valves must be reinstalled into the same position.

**Fig. 108 Valve Removal**

- 1 - SPECIAL TOOL: C-3422-B
2 - SPECIAL TOOL: 6526

(1) With valve spring compressor Special Tool C-3422-B with adapter 6526 or equivalent, remove spring retainer locks, retainer, valve spring, and valve (Fig. 108).

(2) Remove valve stem seals with suitable tool (Fig. 109). Do not reuse valve stem seals.

**Fig. 109 Valve Stem Seals—Removal**

- 1 - VALVE STEM SEAL

ASSEMBLY

(1) Coat valve stems with clean engine oil and insert valve in cylinder head in original position, if being reused.

DISASSEMBLY AND ASSEMBLY (Continued)

(2) Install valve spring seat.

(3) Install the "gray" valve seal onto the intake valve and the "grayish green" seal onto the exhaust valve (Fig. 110). Using Special Tool MD-998774 install seal by tapping lightly until seal is in place (Fig. 111).

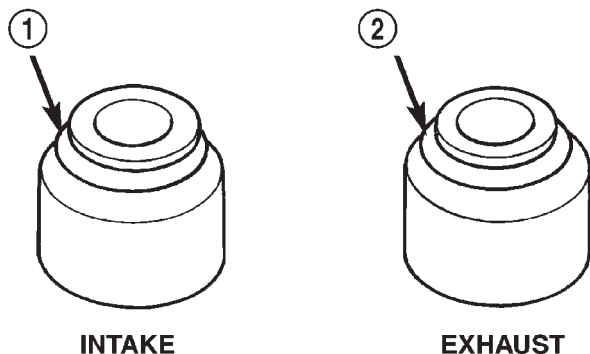


Fig. 110 Valve Stem Seals Identification

- 1 - GRAY
- 2 - GRAYISH GREEN

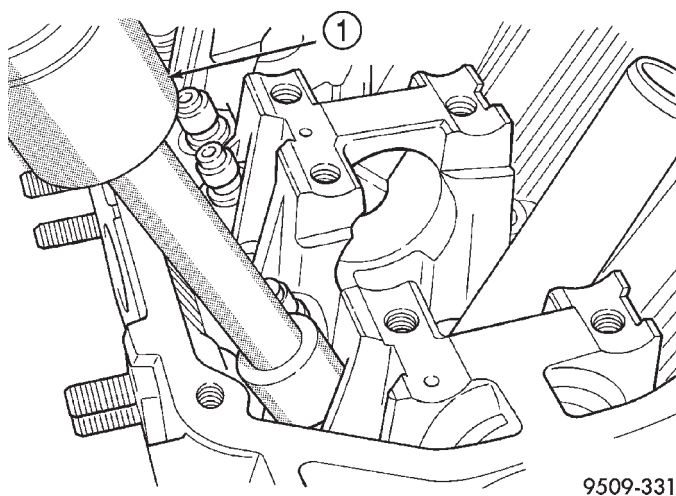


Fig. 111 Valve Stem Seals—Installed

- 1 - SPECIAL TOOL MD998774

(4) Install valve spring with the enamelled ends facing the rocker arms (Fig. 112). Install valve springs and retainers. Compress valve springs only enough to install locks, taking care not to misalign the direction of compression. Nicked valve stems may result from misalignment of the valve spring compressor.

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

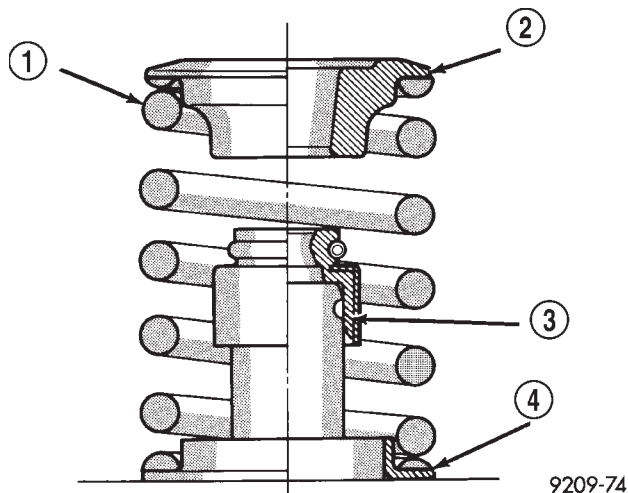


Fig. 112 Valve Spring Position—Installed

- 1 - ENAMELED END
- 2 - SPRING RETAINER
- 3 - STEM SEAL
- 4 - SPRING SEAT

ROCKER ARMS

(1) Identify the rocker arms and retainers for reassembly. Disassemble the rocker arm assemblies by removing the attaching bolts and spring clips from the shaft (Fig. 113).

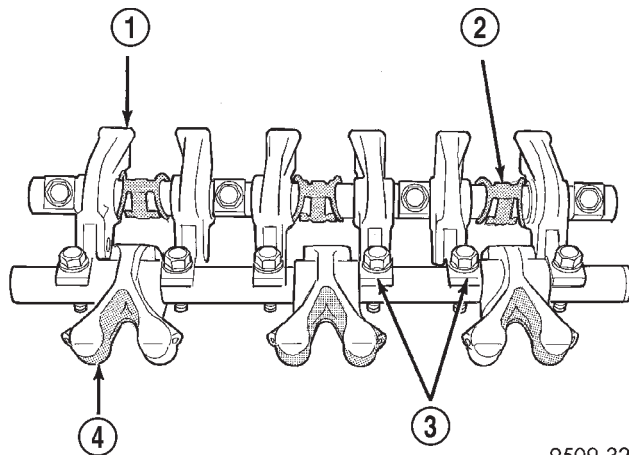


Fig. 113 Rocker Arm Shafts

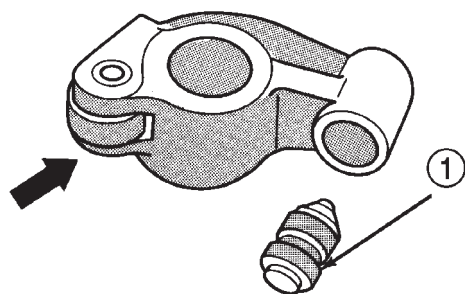
- 1 - INTAKE ROCKER ARMS
- 2 - ROCKER SHAFT SPRINGS
- 3 - ROCKER ARM SHAFT RETAINERS
- 4 - EXHAUST ROCKER ARMS

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

INSPECTION

Inspect the rocker arm for scoring, wear of the roller or damage to the rocker arm (Fig. 114). Replace as necessary.

DISASSEMBLY AND ASSEMBLY (Continued)



9009-48

Fig. 114 Rocker Arm

1 - AUTO-LASH ADJUSTER

ROCKER ARM SHAFTS

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

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

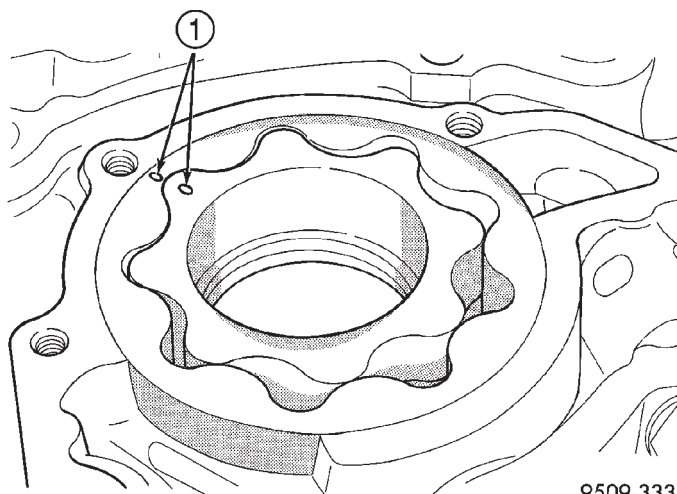
(2) Check oil holes for clogging with small wire, clean as required.

REASSEMBLY

Lubricate the rocker arms. Install onto shafts in their original position (Fig. 113).

OIL PUMP

(1) Assemble pump, using new parts as required with clean oil. Align marks on the inner and outer rotors when assembling (Fig. 115).



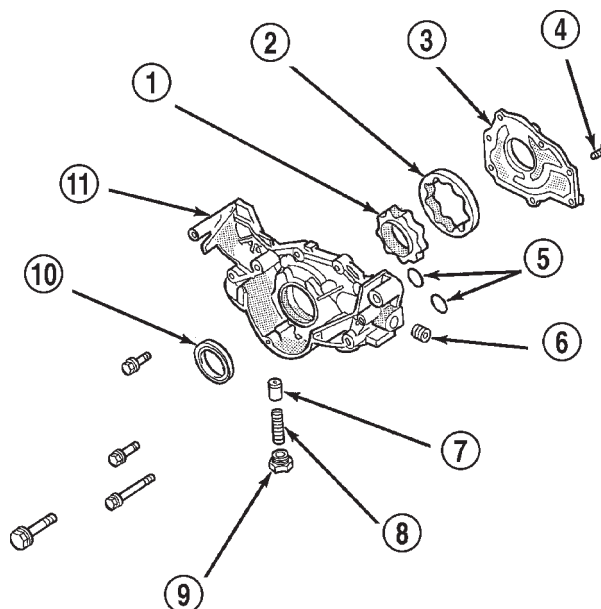
9509-333

Fig. 115 Inner and Outer Rotor Alignment Marks

1 - ALIGNMENT MARKS

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

(3) Install relief valve, spring, gasket and cap as shown in (Fig. 116). Tighten cap to 44 N·m (33 ft. lbs.)



9509-332

Fig. 116 Oil Pump

- 1 - INNER ROTOR
- 2 - OUTER ROTOR
- 3 - PUMP COVER
- 4 - SCREW
- 5 - O-RINGS
- 6 - PLUG
- 7 - OIL PRESSURE RELIEF VALVE
- 8 - RELIEF VALVE SPRING
- 9 - PLUG
- 10 - SEAL
- 11 - OIL PUMP BODY

CLEANING AND INSPECTION**INTAKE MANIFOLD****CLEANING**

Discard gasket and clean all gasket surfaces of manifold to cylinder heads.

INSPECTION

Check upper and lower manifold gasket surfaces for flatness with straight edge. Surface must be flat within 0.15 mm per 300 mm (0.006 in. per foot) of manifold length.

Inspect manifolds for cracks or distortion. Replace manifold if necessary.

EXHAUST MANIFOLD**CLEANING**

Clean sealing surfaces of manifold and cylinder head.

CLEANING AND INSPECTION (Continued)

INSPECTION

Inspect exhaust manifolds for damage or cracks. Check distortion of the cylinder head mounting surface and exhaust crossover mounting surface with a straightedge and thickness gauge.

CAMSHAFT**CLEANING**

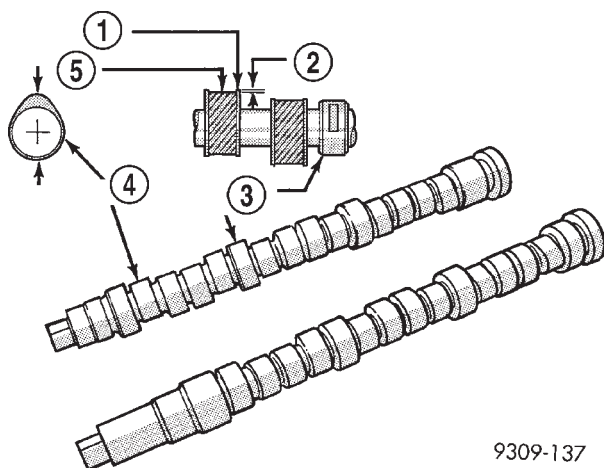
Clean camshaft with a suitable solvent.

INSPECTION

Check oil feed holes for blockage.

Inspect cylinder head journals for wear.

Check camshaft bearing journals for scratches and worn areas (Fig. 117). If light scratches are present, they may be removed with 400 grit sand paper. If deep scratches are present, replace the camshaft and check the cylinder head for damage. Replace the cylinder head if worn or damaged. Check the lobes for pitting and wear. If the lobes show signs of wear, check the corresponding rocker arm roller for wear or damage. Replace rocker arm if worn or damaged. If lobes show signs of pitting on the nose, flank or base circle; replace the camshaft.



9309-137

Fig. 117 Checking Camshafts for Wear

- 1 - UNWORN AREA - MIKE HERE
- 2 - ACTUAL WEAR
- 3 - BEARING JOURNAL
- 4 - LOBE
- 5 - WEAR ZONE - MIKE HERE

CYLINDER BORE AND BLOCK**CLEANING**

Clean cylinder block using a suitable solvent.

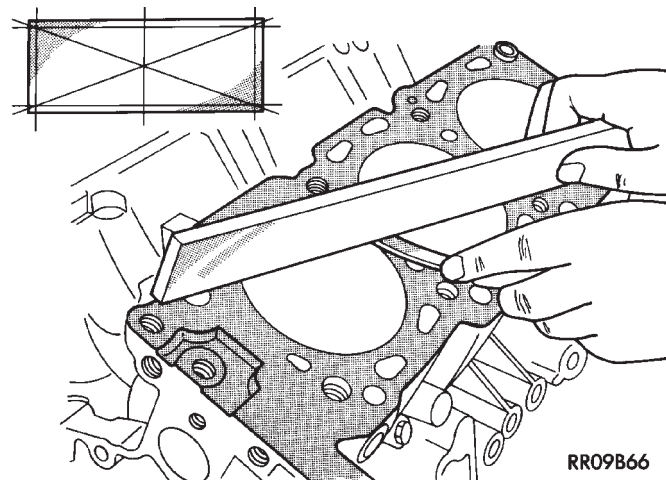
CYLINDER BLOCK INSPECTION

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

(1) Clean cylinder block and check top surface for distortion with a straight edge and thickness gauge (Fig. 118).

(2) Top surface must be flat within:

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

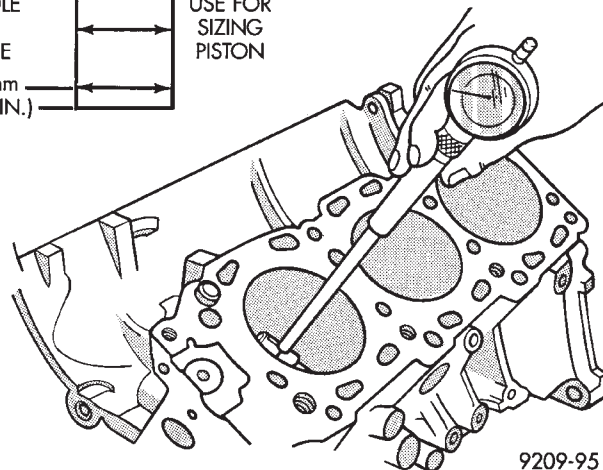
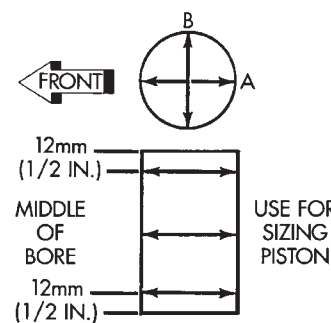


RR09B66

Fig. 118 Distortion Check

CYLINDER BORE INSPECTION

(1) Measure the cylinder bore at three levels in directions A and B (Fig. 119). Top measurement should be 12 mm (0.50 in.) down and bottom measurement should be 10 mm (0.38 in.) up.



9209-95

Fig. 119 Checking Cylinder Bore Size

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

(3) Maximum out-of-round or taper: 0.01 mm (0.0004 in.)

CLEANING AND INSPECTION (Continued)

CYLINDER HEAD

CLEANING

Clean cylinder head and oil passages using a suitable solvent.

INSPECTION

CYLINDER HEAD

Check cylinder head for flatness (Fig. 120).

Cylinder head must be flat within:

- Standard dimension: less than 0.03 mm (0.0012 inch)
- Service Limit: 0.2 mm (0.008 inch)
- Grinding Limit: Maximum of 0.2 mm (0.008 inch) is permitted.

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

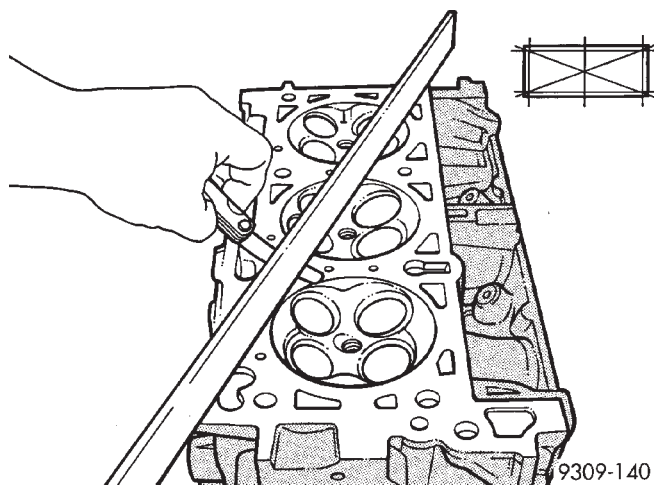


Fig. 120 Checking Cylinder Head Flatness

VALVE GUIDES

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

Using a small hole gauge and a micrometer, measure valve guides in 3 places top, middle and bottom (Fig. 121). Refer to Engine Specifications. Replace guides if they are not within specification.

Check valve guide height (Fig. 122).

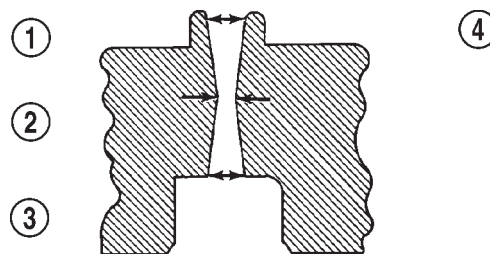
CYLINDER HEAD COVER

CLEANING

Clean cylinder head and cover mating surfaces using a suitable solvent.

INSPECTION

Inspect cover rails for flatness.



9109-98

Fig. 121 Checking Wear on Valve Guide—Typical

- 1 - TOP
- 2 - MIDDLE
- 3 - BOTTOM
- 4 - CUT AWAY VIEW OF VALVE GUIDE MEASUREMENT LOCATIONS

(A) 14.0 mm

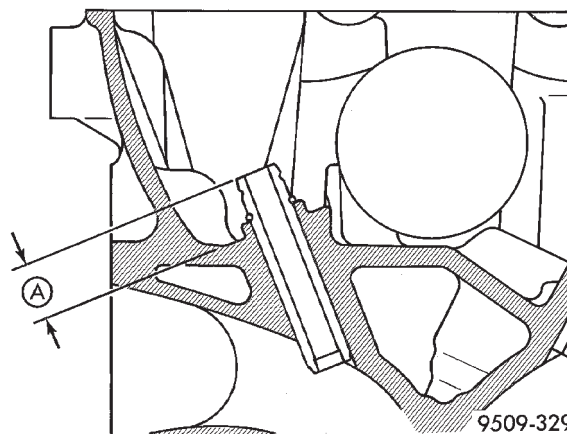


Fig. 122 Valve Guide Height

ROCKER ARM AND AUTO LASH ADJUSTER

CLEANING

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

Remove lash adjuster from rocker arm. Clean rocker arm using in a suitable solvent.

INSPECTION

Inspect the rocker arm and hydraulic lash adjuster assembly for wear or damage (Fig. 123). Replace as necessary.

OIL FILTER BRACKET

CLEANING

Remove gasket and clean bracket using a suitable solvent.

CLEANING AND INSPECTION (Continued)

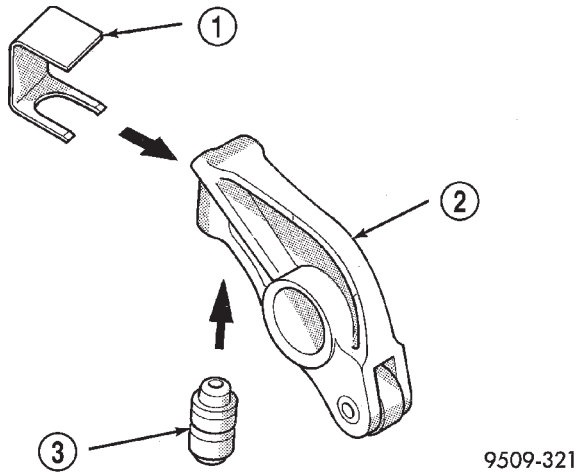


Fig. 123 Rocker Arm/Hydraulic Lash Adjuster Assemblies

- 1 - SPECIAL TOOL MD998443
- 2 - ROLLER ROCKER ARM
- 3 - HYDRAULIC LASH ADJUSTER

INSPECTION

Check the oil filter mounting surface. The surface must be smooth, flat and free of debris or old pieces of rubber (Fig. 124). Check bracket for cracks and oil leaks.

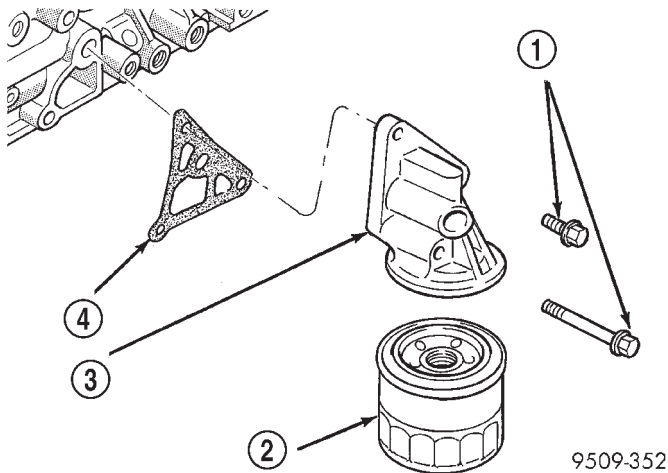


Fig. 124 Oil Filter and Bracket

- 1 - 23 N·m (17 IN. LBS.)
- 2 - FILTER
- 3 - BRACKET
- 4 - GASKET

OIL PUMP

CLEANING

Disassemble oil pump and clean all components using a suitable solvent.

INSPECTION

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

(2) Remove pump rotors and inspect case for excessive wear (Fig. 125).

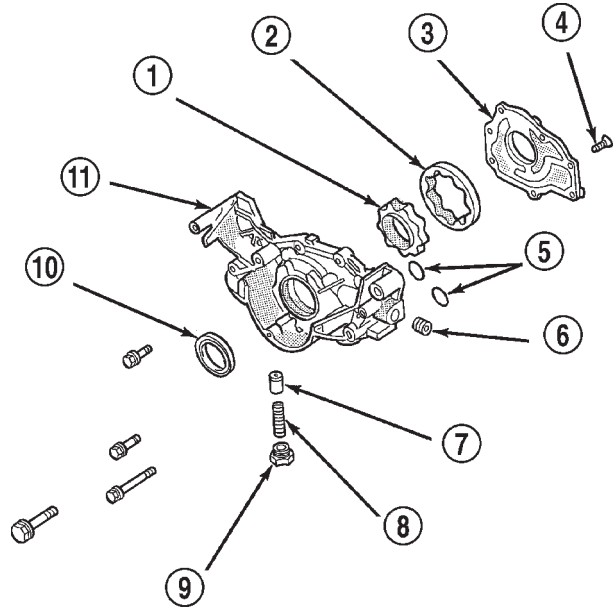


Fig. 125 Oil Pump Components

- 1 - INNER ROTOR
- 2 - OUTER ROTOR
- 3 - PUMP COVER
- 4 - SCREW
- 5 - O-RINGS
- 6 - PLUG
- 7 - OIL PRESSURE RELIEF VALVE
- 8 - RELIEF VALVE SPRING
- 9 - PLUG
- 10 - SEAL
- 11 - OIL PUMP BODY

(3) Insert the rotor into the oil pump case (Fig. 126) and measure clearance with a feeler gauge as indicated. Replace if out of limits.

(4) Using a feeler gauge, measure clearance between inner rotor tip and outer rotor (Fig. 127). Clearance specification is: 0.06 - 0.18 mm (0.0024 - 0.0071 in.). Replace if out of limits.

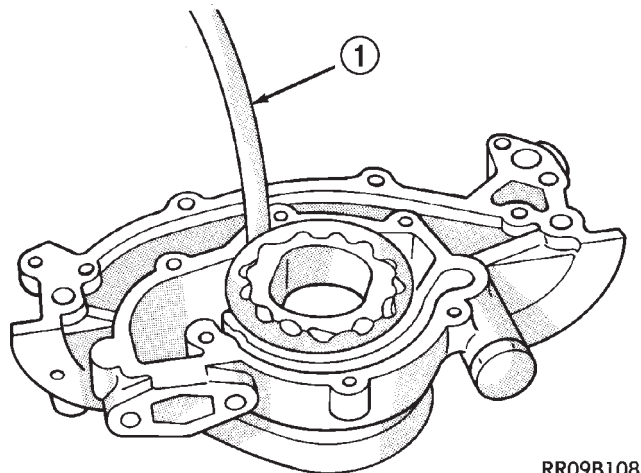
(5) Place a straightedge across face of pump housing (Fig. 128). Clearance should be between 0.04 - 0.10 mm (0.0015 - 0.0039 in.). Replace if out of limits.

OIL RELIEF PLUNGER

(1) Check that the oil relief plunger slides smoothly (Fig. 125).

(2) Check for broken relief spring.

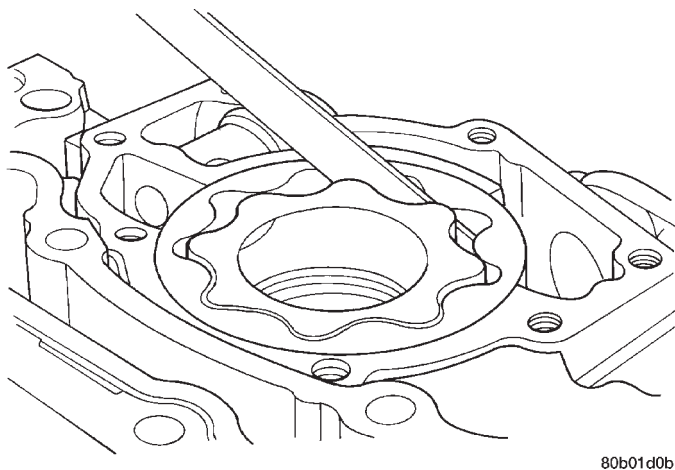
CLEANING AND INSPECTION (Continued)



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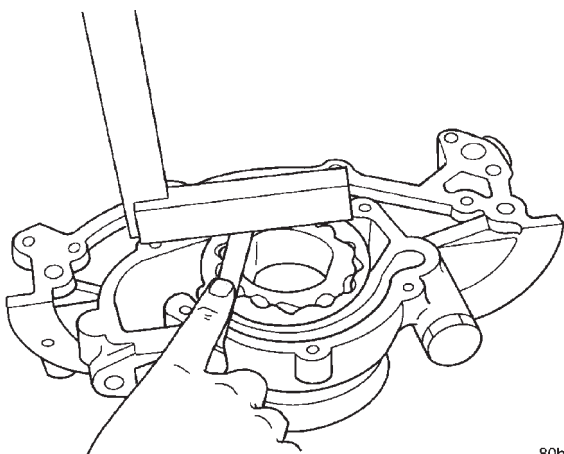
Fig. 126 Checking Clearance-Between Outer Rotor and Case

1 - 0.10 TO 0.18 mm (0.004 TO 0.007 INCH)



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Fig. 127 Measuring Clearance Between Rotors

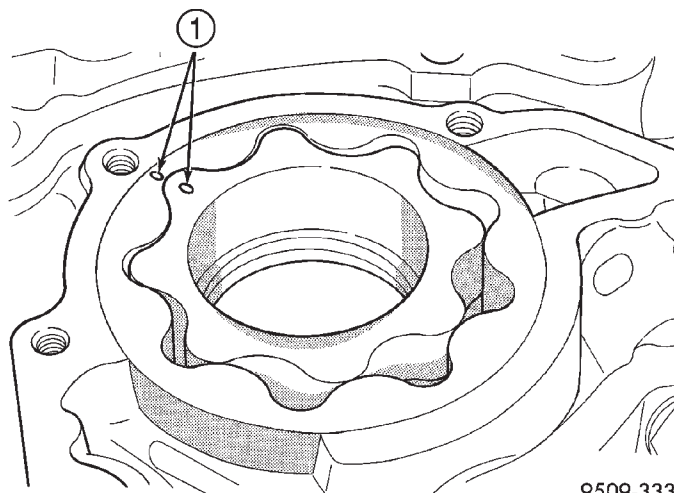


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Fig. 128 Measuring Clearance Over Rotors

OIL PUMP ASSEMBLY

(1) Assemble pump, using new parts as required with clean oil. Align marks on the inner and outer rotors when assembling (Fig. 129).



9509-333

Fig. 129 Inner and Outer Rotor Alignment Marks

1 - ALIGNMENT MARKS

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

(3) Install relief valve, spring, gasket and cap as shown in (Fig. 125). Tighten cap to 41 N·m (30 ft. lbs.)

TIMING BELT

CLEANING

Do Not attempt to clean a timing belt. If contamination from oil, grease, or coolants have occurred, the timing belt should be replaced.

Clean all sprockets using a suitable solvent. Clean all sprocket grooves of any debris.

INSPECTION

(1) Remove the upper left timing belt cover (Fig. 130).

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

- Hardening of back rubber back side is glossy without resilience and leaves no indent when pressed with fingernail.
- Cracks on rubber back.
- Cracks or peeling of canvas.
- Cracks on rib root.
- Cracks on belt sides.
- Missing teeth.
- Contamination by oil, grease, or coolants.
- Abnormal wear of belt sides. The sides are normal if they are sharp as if cut by a knife (Fig. 131).

CLEANING AND INSPECTION (Continued)

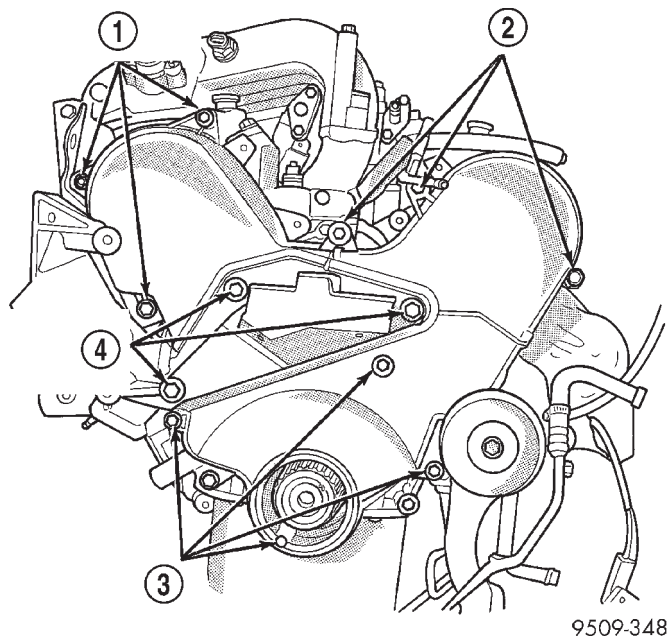


Fig. 130 Timing Belt Covers

- 1 - UPPER RIGHT TIMING BELT COVER FASTENERS
- 2 - UPPER LEFT TIMING BELT COVER FASTENERS
- 3 - LOWER TIMING BELT COVER FASTENERS
- 4 - ENGINE BRACKET FASTENERS

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

VALVES, SPRINGS, SEATS AND GUIDES

CLEANING

Clean components using a suitable solvent.

INSPECTION

- (1) Check valve stem tip for pitting or depression at point A (Fig. 132).
- (2) Check for wear and ridge wear at Point B.
- (3) Measure the clearance between the valve guide and valve stem. If the service limit is exceeded, replace the valve guides, valves or both.
- (4) Check for even contact (at face center) with valve seat, Point C.
- (5) Check margin. Refer to Engine Specifications. Replace valve if margin is out of specification.
- (6) Check valve guide height (Fig. 133).
- (7) Measure valve stem to guide clearance. Refer to Engine Specifications.
- (8) Measure valve spring free length and if the spring is square (Fig. 134). Refer to Engine Specifications.

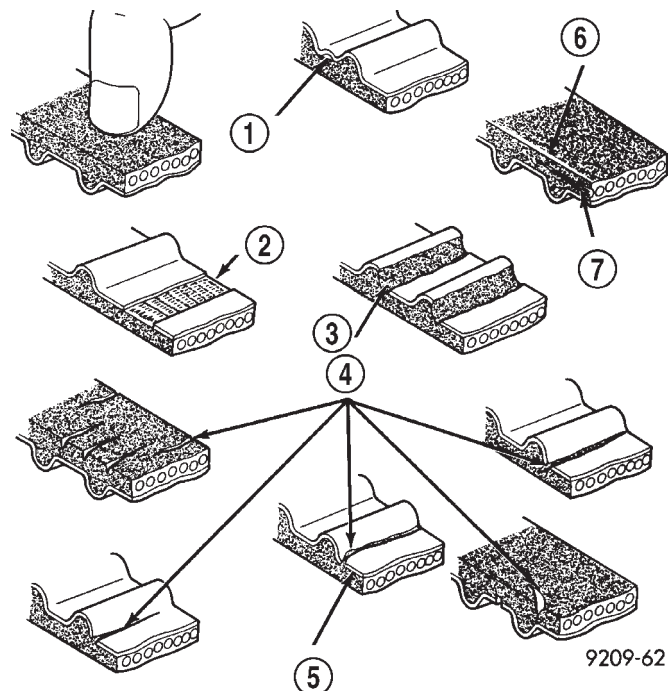


Fig. 131 Timing Belt Inspection

- 1 - PEELING
- 2 - TOOTH MISSING AND CANVAS FIBER EXPOSED
- 3 - RUBBER EXPOSED
- 4 - CRACKS
- 5 - PEELING
- 6 - ROUNDED EDGE
- 7 - ABNORMAL WEAR (FLUFFY STRAND)

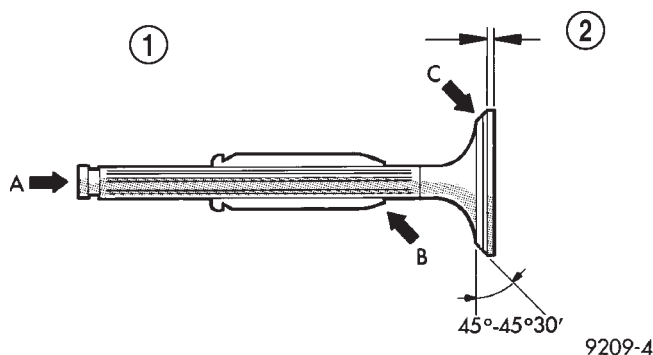
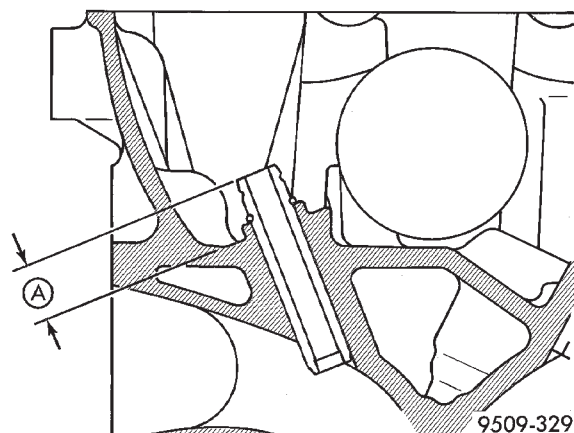
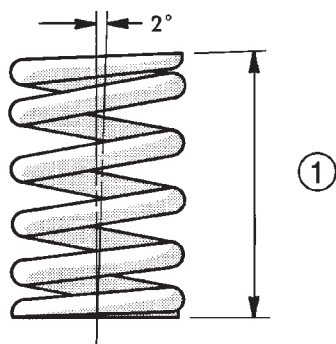


Fig. 132 Valve Inspection

- 1 - C IS A SEAT CONTACT MARK AND IS NOT FULL WIDTH OF THE FACE
- 2 - MARGIN

CLEANING AND INSPECTION (Continued)

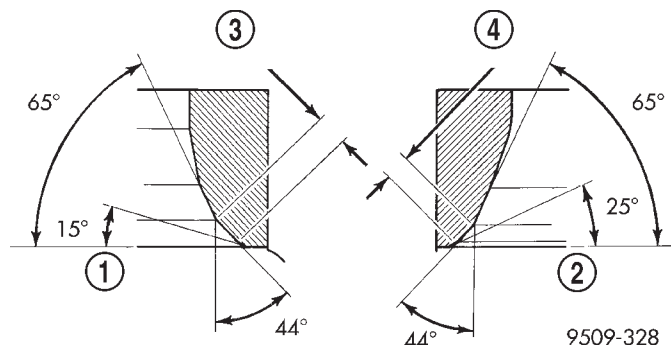
Ⓐ 14.0 mm

**Fig. 133 Valve Guide Height****Fig. 134 Valve Spring**

1 - LENGTH

VALVE SEAT INSPECTION

Inspect the valve seat with Prussian blue to determine where the valve contacts the seat. To do this, coat valve seat **LIGHTLY** with Prussian blue then set valve in place. Rotate the valve with light pressure. If the blue is transferred to the center of valve face, contact is satisfactory. If the blue is transferred to top edge of the valve face, lower valve seat with a 15 degrees stone. If the blue is transferred to the bottom edge of valve face raise valve seat with a 65 degree stone (Fig. 135).

**Fig. 135 Valve Seat Reconditioning**

- 1 - EXHAUST
- 2 - INTAKE
- 3 - 0.9-1.3mm (.035-.051 IN.)
- 4 - 0.9-1.3mm (.035-.051 IN.)

ADJUSTMENTS**ENGINE SUPPORT ADJUSTMENT**

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

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

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

ENGINE SUPPORT ADJUSTMENT

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

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

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

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

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

(6) Recheck drive shaft length.

SPECIFICATIONS

2.5L ENGINE

DESCRIPTION	SPECIFICATION
General Specification	
Type	60° V-6 SOHC (Per Bank)
Number of Cylinders	6
Displacement	2.5 Liters (152 cu. in.)
Bore	83.5 mm (3.29 in.)
Stroke	76.0 mm (2.99 in.)
Compression Ratio	9.4:1 (Federal Emissions) 9.0:1 (California Emissions)
Firing Order	1-2-3-4-5-6
Compression Pressure (at 250–400 rpm)	1451 kPa (211 psi)
—(California Emission)	1393 kPa (202 psi)
Compression Pressure (Minimum)	1109 kPa (192 psi)
—(California Emission)	1059 kPa (154 psi)
Variation Between Cylinders (Maximum)	98 kPa (14 psi)
Cylinder Block	
Cylinder Bore Diameter	83.5–83.53 mm (3.2874–3.2886 in.)
Out-of-Round (Max.)	0.01 mm (0.0004 in.)
Taper (Max.)	0.01 mm (0.0004 in.)
Flatness of Top Surface	0.05 mm (0.002 in.)
Service Limit	0.1 mm (0.004 in.)
Grinding Limit*	0.2 mm (0.008 in.)
*Includes the combined surface grinding of cylinder head and block.	

DESCRIPTION	SPECIFICATION
Pistons	
Piston Diameter	83.5 mm (3.29 in.)
Clearance in Cylinder	0.02–0.04 mm (0.0008–0.0016 in.)
Piston Pins	
Press-in Load (at room temperature)	7350–17200 N (1652–3858 lbs.)
Diameter	22.0 mm (0.87 in.)
Piston Rings	
Ring Gap—Top Compression Ring	0.25–0.40 mm (0.0098–0.0157 in.)
Wear Limit	0.8 mm (0.031 in.)
Ring Gap—2nd Compression Ring	0.40–0.55 mm (0.0157–0.0217 in.)
Wear Limit	0.8 mm (0.031 in.)
Ring Gap—Oil Control Steel Rails	0.15–0.50 mm (0.0059–0.0197 in.)
Wear Limit	1.0 mm (0.039 in.)
Ring Side Clearance—Top Compression Ring	0.03–0.07 mm (0.0012–0.0028 in.)
Wear Limit	0.10 mm (0.004 in.)
Ring Side Clearance—2nd Compression Ring	0.02–0.06 mm (0.0008–0.0024 in.)
Wear Limit	0.10 mm (0.004 in.)
Connecting Rod	
Bearing Diametrical Clearance	0.02–0.05 mm (0.0008–0.0020 in.)
Wear Limit	0.10 mm (0.004 in.)
Side Clearance (big end)	0.10–0.25 mm (0.0039–0.0098 in.)
Wear Limit	0.40 mm (0.016 in.)

SPECIFICATIONS (Continued)

DESCRIPTION	SPECIFICATION
Crankshaft	
Connecting Rod Journal Diameter	50.0 mm (1.97 in.)
Main Bearing Journal Diameter	60.0 mm (2.362 in.)
Journal Out-of-Round (Max.)	0.03 mm (0.001 in.)
Journal Taper (Max.)	0.005 mm (0.0002 in.)
End Play	0.05–0.25 mm (0.002–0.0098 in.)
Wear Limit	0.3 mm (0.012 in.)
Main Bearing Diametrical Clearance	0.02–0.04 mm (0.0008–0.0016 in.)
Wear Limit	0.1 mm (0.004 in.)
Camshaft	
Journal Diameter	44.93 mm (1.7689 in.)
End Play	0.1–0.2 mm (0.004–0.008 in.)
Wear Limit	0.4 mm (0.0158 in.)
Intake Valve Timing*	
Closes (ABDC)	45°
Opens (BTDC)	19°
Exhaust Valve Timing*	
Closes (ATDC)	15°
Opens (BBDC)	49°
Cylinder Head	
Flatness of Gasket Surface	0.03 mm (0.0012 in.)
Service Limit	0.2 mm (0.008 in.)
Grinding Limit of Gasket Surface*	0.2 mm (0.008 in.)
*Includes the combined surface grinding of cylinder head and block.	

DESCRIPTION	SPECIFICATION
Valve Seat	
Angle	44–44.5°
Valve Seat Width—Intake and Exhaust	0.9–1.3 mm (0.035–0.051 in.)
Valve Guide	
Diameter—Inner	6.0 mm (0.236 in.)
Diameter—Outer (Std.)	11.0 mm (0.433 in.)
Guide Height (spring seat to guide tip)	14.0 mm (0.551 in.)
Valves	
Face Angle Intake and Exhaust	45–45.5°
Valve Length (Overall)—Intake	112.30 mm 4.4213 in.)
Service Limit	111.80 mm (4.4016 in.)
Valve Length (Overall)—Exhaust	114.11 mm (4.4925 in.)
Service Limit	113.61 mm (4.4728 in.)
Valve Stem Diameter—Intake and Exhaust	6.0 mm (0.236 in.)
Valve Margin	
Intake	1.0 mm (0.039 in.)
Service Limit	0.5 mm (0.019 in.)
Exhaust	1.2 mm (0.047 in.)
Service Limit	0.7 mm (0.028 in.)
Valve Stem Tip Height	
Intake and Exhaust	49.30 mm (1.9409 in.)
Service Limit	49.80 mm (1.9606 in.)

SPECIFICATIONS (Continued)

DESCRIPTION	SPECIFICATION
Valve Stem to Guide Clearance	
Intake	0.02–0.05 mm (0.0008–0.0020 in.)
Service Limit	0.10 mm (0.004 in.)
Exhaust	0.04–0.07 mm (0.0016–0.0028 in.)
Service Limit	0.15 mm (0.006 in.)
Valve Springs	
Free Height	51.0 mm (2.01 in.)
Service Limit	50.0 mm (1.97 in.)
Installed Height	44.2 mm (1.740 in.)
Spring Load at Installed Height	267 N (60 lbs.)
Out-of-Squareness	2° or less
Service Limit	4° Max.
Oil Pump	
Tip Clearance Between Rotors	0.06–0.18 mm (0.0024–0.0071 in.)
Clearance Over Rotors	0.04–0.10 mm (0.0015–0.0039 in.)
Outer Rotor to Case Clearance	0.10–0.18 mm (0.004–0.007 in.)
Service Limit	0.35 mm (0.0138 in.)
Oil Pressure	
At Curb Idle Speed and Engine at Operating Temperature	41 kPa (6 psi)
At 3000 rpm*	241–517 kPa (35–75 psi)
*If pressure is ZERO at curb idle, DO NOT run engine at 3000 rpm.	

TORQUE

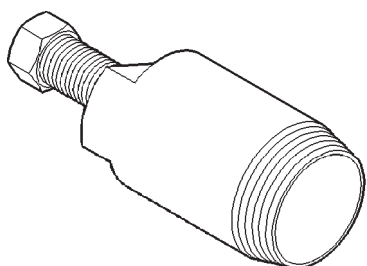
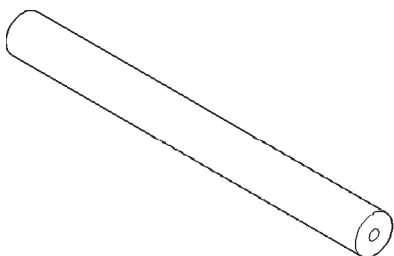
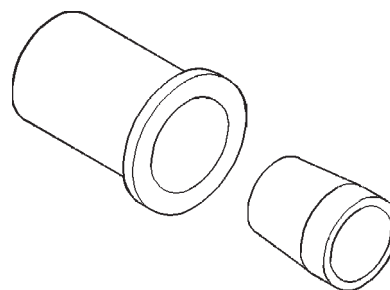
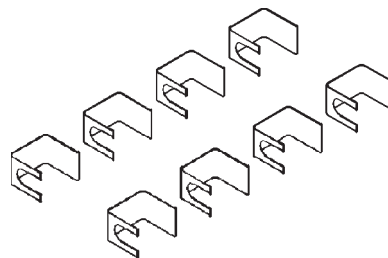
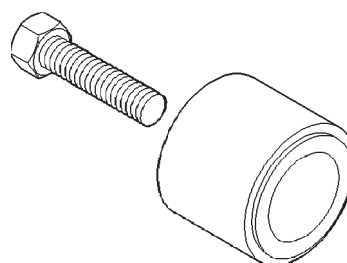
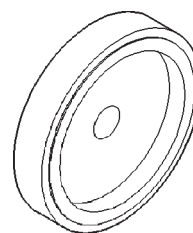
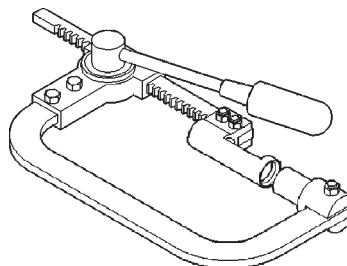
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Camshaft Sprocket—Bolt	88	65	—
Camshaft Thrust Case—Bolts	13	—	115
Connecting Rod Cap—Bolts	52	38	—
Crankshaft Main Bearing Cap—Bolts	94	69	—
Crankshaft Damper	182	134	—
Cylinder Head—Bolts	108	80	—
Cylinder Head Cover—Bolts	3.5	—	31
Distributor—Nut	13	—	115
Drive Plate to Crankshaft	95	70	—
Engine Mount Bracket Right—Bolts	61	45	—
Engine Mounting	Refer to Procedure		
Engine Support Bracket—Bolts	45	33	—
Exhaust Manifold to Cylinder Head—Bolts	44	33	—
Exhaust Manifold Heat Shield—Bolts	13	—	115
Heater Pipe Assembly	19	—	168
Intake Manifold Upper—Bolts	18	—	160
Intake Manifold Upper Supports			
—M8 Bolts	18	—	160
—M10 Bolts	36	26.5	—
Intake Manifold Lower—Nuts	21	—	186
Oil Filter Adaptor—Bolts	23	17	—
Oil Filter	14	10	—
Oil Pan—Bolts	6	—	53
Oil Pan Drain—Plug	40	29	—
Oil Pump to Block			
—M8 Bolt	14	—	124
—M10 Bolt	41	30	—
Oil Pump Cover Plate—Bolts	10	—	88.5
Oil Pump Pick-up Tube—Bolt	19	—	168

SPECIFICATIONS (Continued)

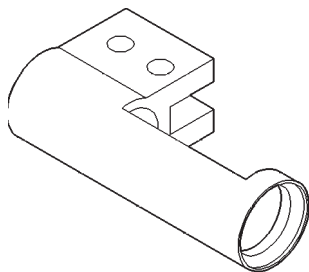
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Oil Dipstick Housing—Bolt	48	35	—
Oil Seal Retainer—Bolts	11	—	104
Rocker Arm Shaft—Bolts	31	23	—
Spark Plug	25	18	—
Timing Belt Cover—Bolts	11	—	104
Timing Belt Auto Tensioner—Bolt	23	17	—
Timing Belt Tensioner Arm Assembly—Bolt	44	33	—
Thermostat Housing— Bolts	19	—	168
Water Inlet Pipe—Bolt	14	—	124
Water Pump—Bolts	24	17	—

SPECIAL TOOLS

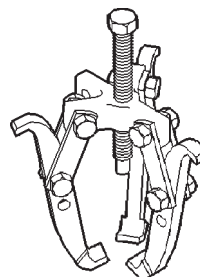
2.5L ENGINE

**Remover C-4679-A****Insert C-4685-C2****Installer MD-998717****Holders MD-998443****Installer MD-998713****Installer MD-998718****Compressor C-3422-B**

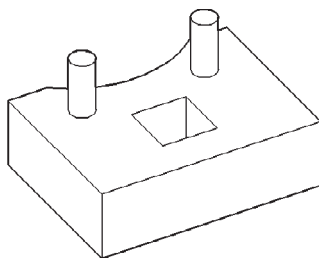
SPECIAL TOOLS (Continued)



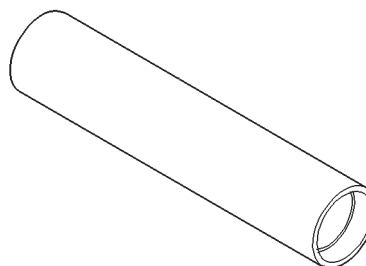
Adapter 6526



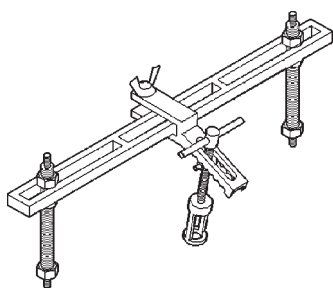
Puller 1026



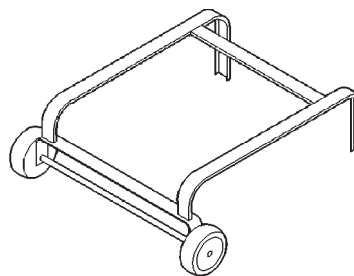
Wrench MD-998767



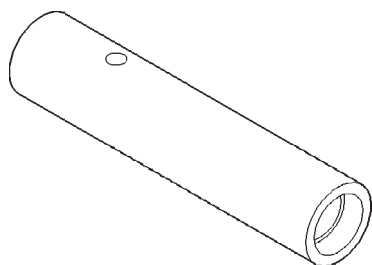
Installer 6052



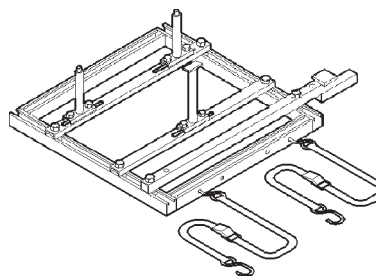
Compressor MD-998772-A



Dolly 6135

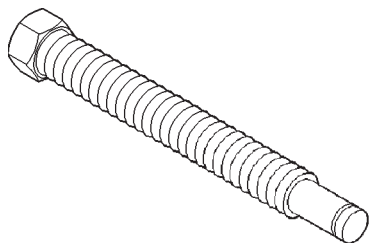


Installer MD-998774

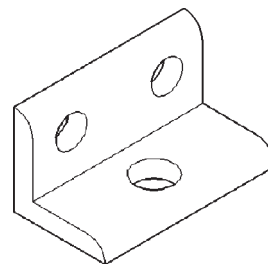


Fixture Engine 6710

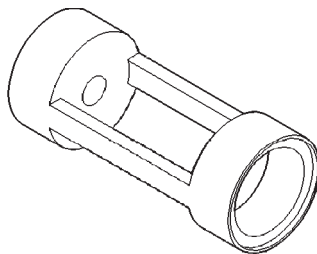
SPECIAL TOOLS (Continued)



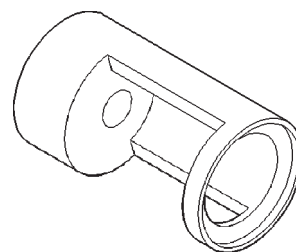
Screw 6765



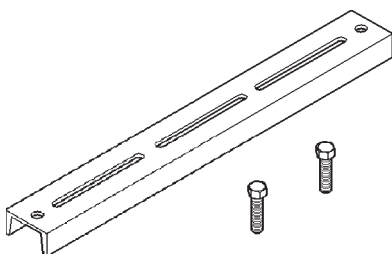
Bracket Cradle Post Support 6973



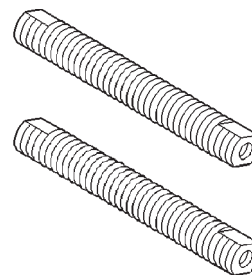
Adapter 6779



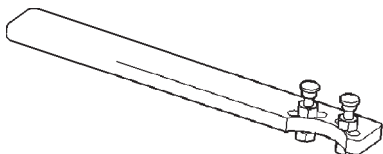
Adapter 6885



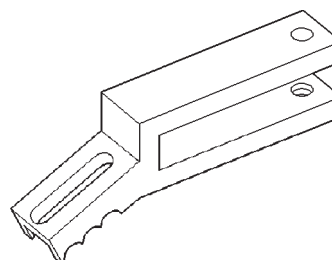
Support Bar Cradle 6710-3A



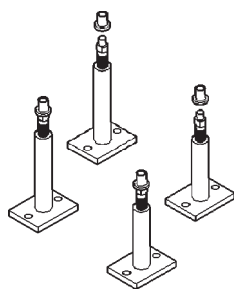
Posts 6886



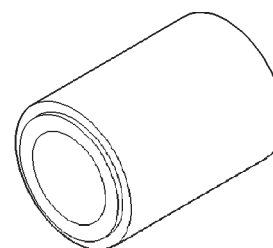
Holder 6847



Adapter 6887

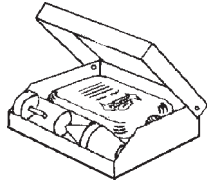


Engine Cradle Posts 6848

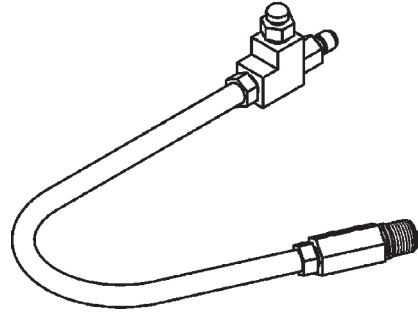


Camshaft Seal Installer 6863

SPECIAL TOOLS (Continued)



Combustion Leak Tester C-3685-A



Cylinder Compression Pressure Adaptor 8116

