ENGINE 3.3/3.8L

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ENGINE 3.3/3.8L

DESCRIPTION

The 3.3 Liter (201 cu. in.) and 3.8 Liter (231 cu. in.) engines are 60° V-6 engines with cast iron cylinder blocks and aluminum cylinder heads (Fig. 1). The engine uses a single, block mounted camshaft with pushrods to actuate the valves. These engines do 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).

DIAGNOSIS AND TESTING

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 Engine Mechanical and the Engine Performance diagnostic charts, for possible causes and corrections of malfunctions (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING - MECHANICAL) (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING - PERFORMANCE).

For fuel system diagnosis, (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - DIAGNOSIS AND TESTING).

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
- Hydraulic Lash Adjuster Noise Diagnosis
- Engine Oil Leak Inspection

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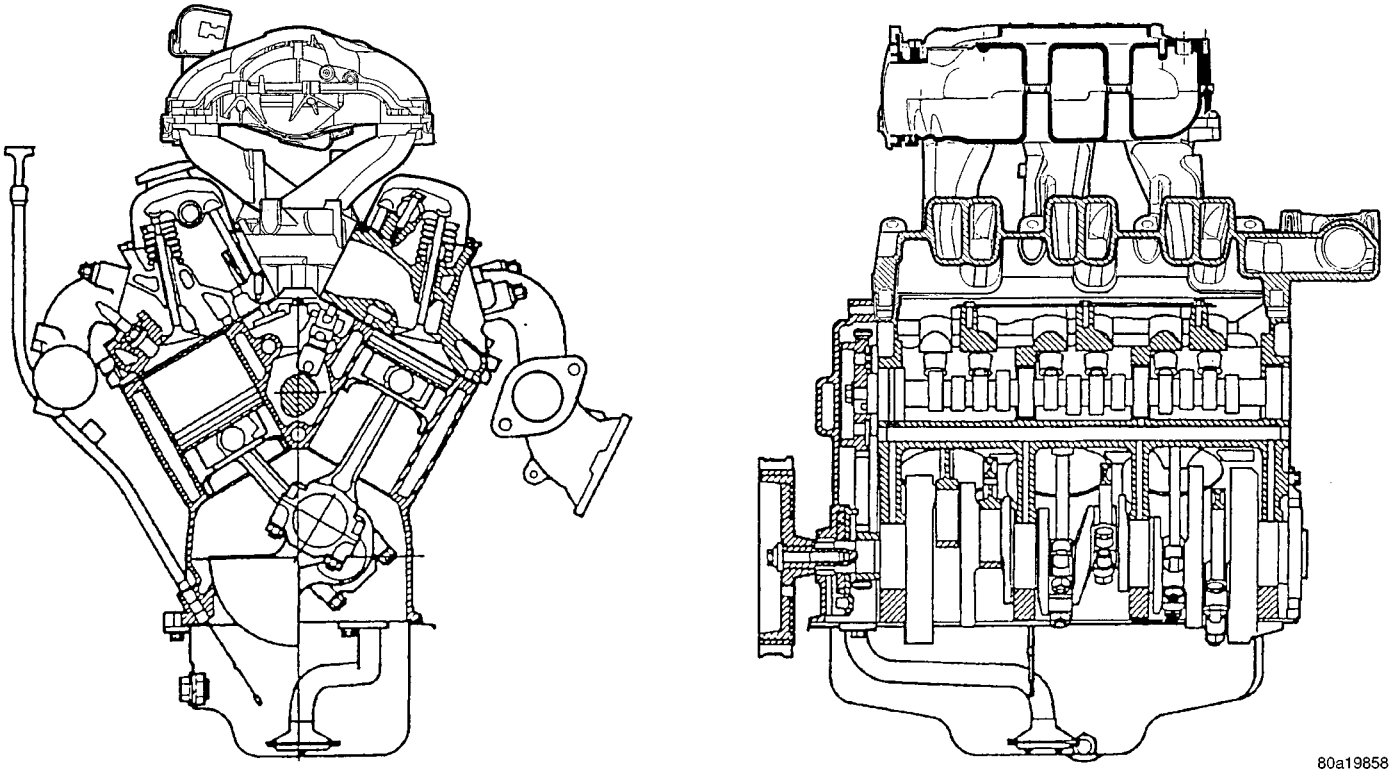
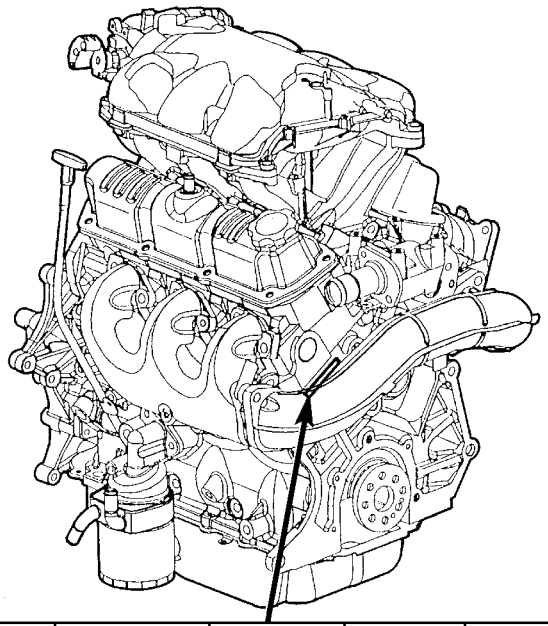


Fig. 1 3.3/3.8L V-6 Engines



X Model Year	X Manufacturing Plant	XXXXX Component Code/Usage	XXXX Month/Day	XXXXXXXX Serial Code
Last digit of model year	Saltillo S Trenton T	Engine 2.4L 3.3/3.8L Usage Pass Car PC Truck T		Last 8 Digits of VIN

80ac274f

Fig. 2 Engine Identification

ENGINE 3.3/3.8L (Continued)

DIAGNOSIS AND TESTING - ENGINE DIAGNOSIS - PERFORMANCE

CONDITION	POSSIBLE CAUSE	CORRECTION
ENGINE WILL NOT START	1. Weak battery.	1. Test battery. Charge or replace as necessary. (Refer to 8 - ELECTRICAL/BATTERY SYSTEM - DIAGNOSIS AND TESTING)
	2. Corroded or loose battery connections.	2. Clean and tighten battery connections. Apply a coat of light mineral grease to terminals.
	3. Faulty starter.	3. Test starting system. (Refer to 8 - ELECTRICAL/STARTING - DIAGNOSIS AND TESTING)
	4. Faulty coil(s) or control unit.	4. Test and replace as needed. (Refer to Appropriate Diagnostic Information)
	5. Incorrect spark plug gap.	5. Set gap. (Refer to 8 - ELECTRICAL/IGNITION CONTROL - SPECIFICATIONS)
	6. Contamination in fuel system.	6. Clean system and replace fuel filter.
	7. Faulty fuel pump.	7. Test fuel pump and replace as needed. (Refer to Appropriate Diagnostic Information)
	8. Incorrect engine timing.	8. Check for a skipped timing belt/chain.
ENGINE STALLS OR IDLES ROUGH	1. Idle speed too low.	1. Test minimum air flow. (Refer to Appropriate Diagnostic Information)
	2. Incorrect fuel mixture.	2. (Refer to Appropriate Diagnostic Information)
	3. Intake manifold leakage.	3. Inspect intake manifold, manifold gasket, and vacuum hoses.
	4. Faulty ignition coil(s).	4. Test and replace as necessary. (Refer to Appropriate Diagnostic Information)

ENGINE 3.3/3.8L (Continued)

CONDITION	POSSIBLE CAUSE	CORRECTION
ENGINE LOSS OF POWER	1. Dirty or incorrectly gapped plugs.	1. Clean plugs and set gap.
	2. Contamination in fuel system.	2. Clean system and replace fuel filter.
	3. Faulty fuel pump.	3. Test and replace as necessary. (Refer to Appropriate Diagnostic Information)
	4. Incorrect valve timing.	4. Correct valve timing.
	5. Leaking cylinder head gasket.	5. Replace cylinder head gasket.
	6. Low compression.	6. Test compression of each cylinder.
	7. Burned, warped, or pitted valves.	7. Replace valves.
	8. Plugged or restricted exhaust system.	8. Perform exhaust restriction test. (Refer to 11 - EXHAUST SYSTEM - DIAGNOSIS AND TESTING) Install new parts, as necessary.
	9. Faulty ignition coil(s).	9. Test and replace as necessary. (Refer to Appropriate Diagnostic Information)
ENGINE MISSES ON ACCELERATION	1. Dirty or incorrectly gapped spark plugs.	1. Clean spark plugs and set gap.
	2. Contamination in Fuel System.	2. Clean fuel system and replace fuel filter.
	3. Burned, warped, or pitted valves.	3. Replace valves.
	4. Faulty ignition coil(s).	4. Test and replace as necessary. (Refer to Appropriate Diagnostic Information)
ENGINE MISSES AT HIGH SPEED	1. Dirty or incorrect spark plug gap.	1. Clean spark plugs and set gap.
	2. Faulty ignition coil(s).	2. Test and replace as necessary. (Refer to Appropriate Diagnostic Information)
	3. Dirty fuel injector(s).	3. Test and replace as necessary. (Refer to Appropriate Diagnostic Information)
	4. Contamination in fuel system.	4. Clean system and replace fuel filter.

ENGINE 3.3/3.8L (Continued)

DIAGNOSIS AND TESTING - ENGINE DIAGNOSIS - MECHANICAL

CONDITION	POSSIBLE CAUSES	CORRECTION
NOISY VALVES	1. High or low oil level in crankcase.	1. Check and correct engine oil level.
	2. Thin or diluted oil.	2. Change oil to correct viscosity.
	3. Thick oil	3. (a) Change engine oil and filter. (b) Run engine to operating temperature. (c) Change engine oil and filter again.
	4. Low oil pressure.	4. Check and correct engine oil pressure problem.
	5. Dirt in hydraulic lifters/lash adjusters.	5. Replace hydraulic lifters/lash adjusters.
	6. Worn rocker arms.	6. Inspect oil supply to rocker arms.
	7. Worn hydraulic lifters/lash adjusters.	7. Replace hydraulic lifters/lash adjusters.
	8. Worn valve guides.	8. Replace cylinder head assembly.
	9. Excessive runout of valve seats on valve faces.	9. Grind valve seats and valves.
CONNECTING ROD NOISE	1. Insufficient oil supply.	1. Check engine oil level.
	2. Low oil pressure.	2. Check engine oil level. Inspect oil pump relief valve and spring.
	3. Thin or diluted oil.	3. Change oil to correct viscosity.
	4. Thick oil	4. (a) Change engine oil and filter. (b) Run engine to operating temperature. (c) Change engine oil and filter again.
	5. Excessive bearing clearance.	5. Measure bearings for correct clearance. Repair as necessary.
	6. Connecting rod journal out-of-round.	6. Replace crankshaft or grind surface.
	7. Misaligned connecting rods.	7. Replace bent connecting rods.

ENGINE 3.3/3.8L (Continued)

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

ENGINE 3.3/3.8L (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
OIL CONSUMPTION OR SPARK PLUGS FOULED	1. PCV system malfunction.	1. Check system and repair as necessary. (Refer to 25 - EMISSIONS CONTROL/ EVAPORATIVE EMISSIONS/PCV VALVE - DIAGNOSIS AND TESTING)
	2. Worn, scuffed or broken rings.	2. Hone cylinder bores. Install new rings.
	3. Carbon in oil ring slots.	3. Install new rings.
	4. Rings fitted too tightly in grooves.	4. Remove rings and check grooves. If groove is not proper width, replace piston.
	5. Worn valve guide(s).	5. Replace cylinder head assembly.
	6. Valve stem seal(s) worn or damaged.	6. Replace seal(s).

DIAGNOSIS AND TESTING - 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 as necessary.

(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 outlet on the cover.
- Remove the PCV valve hose from the cylinder head cover. Cap or plug the PCV valve outlet 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.

NOTE: If oil leakage is observed at the dipstick tube to block location; remove the tube, clean and reseal using Mopar® Stud & Bearing Mount (press fit tube applications only), and for O-ring style tubes, remove tube and replace the O-ring seal.

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.

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(3) Remove torque converter or clutch housing cover and inspect rear of block for evidence of oil. Use a black light to check for the oil leak. If a leak is present in this area, remove transmission for further inspection.

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

(b) Where leakage tends to run straight down, possible causes are a porous block, oil 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, replace component(s) as necessary.

DIAGNOSIS AND TESTING - CYLINDER COMPRESSION PRESSURE TEST

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

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

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

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

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

(4) Remove the Auto Shutdown (ASD) relay from the PDC.

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

(6) Insert compression gauge adaptor Special Tool 8116 or the equivalent, into the #1 spark plug hole in cylinder head. Connect the 0–500 psi (Blue) pressure transducer (Special Tool CH7059) with cable adaptors to the DRBIII®. For Special Tool identification, (Refer to 9 - ENGINE - SPECIAL TOOLS).

(7) Crank engine until maximum pressure is reached on gauge. 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.**

DIAGNOSIS AND TESTING - 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 PRESSURE 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 pressure 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.

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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 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.

STANDARD PROCEDURE

STANDARD PROCEDURE - MEASURING BEARING CLEARANCE USING PLASTIGAGE

Engine crankshaft bearing clearances can be determined by use of Plastigage or equivalent. The following is the recommended procedure for the use of Plastigage:

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

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

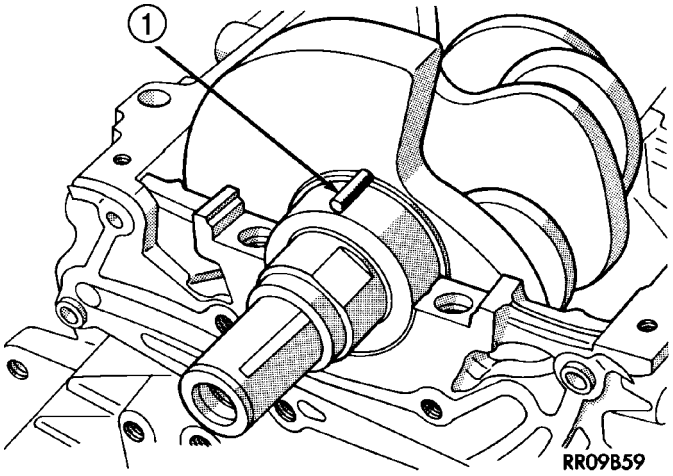

Fig. 3 Plastigage Placed in Lower Shell—Typical

1 - PLASTIGAGE

(3) Remove the bearing cap and compare the width of the flattened Plastigage with the metric scale provided on the package. Locate the band closest to the same width. This band shows the amount of clearance in thousandths of a millimeter. Differences in readings between the ends indicate the amount of taper present. Record all readings taken. Compare the clearance measurements to specsifications found in the engine specifications table(Refer to 9 - ENGINE - SPECIFICATIONS). **Plastigage generally is accompanied by two scales. One scale is in inches, the other is a metric scale.**

NOTE: Plastigage is available in a variety of clearance ranges. Use the most appropriate range for the specifications you are checking.

(4) Install the proper crankshaft bearings to achieve the specified bearing clearances.

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

MOPAR® GASKET MAKER 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.

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MOPAR® BED PLATE SEALANT is a unique (green-in-color) anaerobic type gasket material that is specially made to seal the area between the bed plate 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 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.

SEALER APPLICATION

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

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

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

STANDARD PROCEDURE - 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. 4)

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. 4)
- Drill motor with 3M Roloc™ Bristle Disc (white or yellow) (Fig. 4)

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

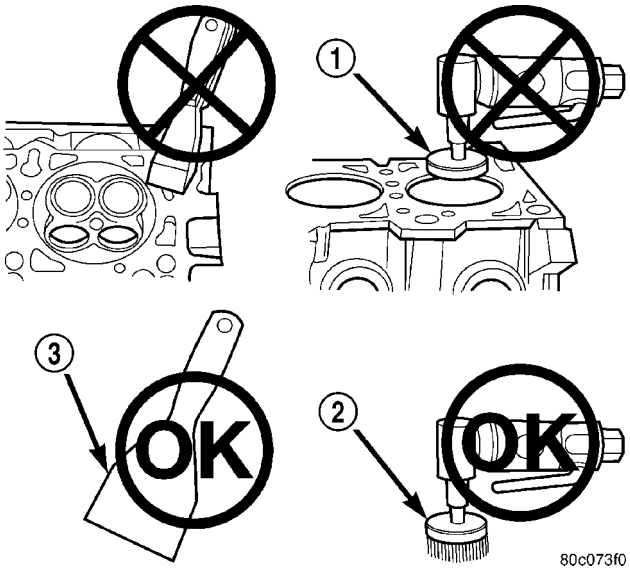

Fig. 4 Proper Tool Usage For Surface Preparation

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

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) Install a new oil filter.

(11) Fill engine with specified amount of approved oil.

(12) Connect negative battery cable.

(13) Start engine and check for any leaks.

STANDARD PROCEDURE - REPAIR OF DAMAGED OR WORN THREADS

Damaged or worn threads (excluding spark plug and camshaft bearing cap attaching 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 center line.

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

STANDARD PROCEDURE - ENGINE CORE AND OIL GALLERY PLUGS

Using a blunt tool such as a drift and a hammer, strike the bottom edge of the cup plug. With the cup plug rotated, grasp firmly with pliers or other suitable tool and remove plug (Fig. 5).

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

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

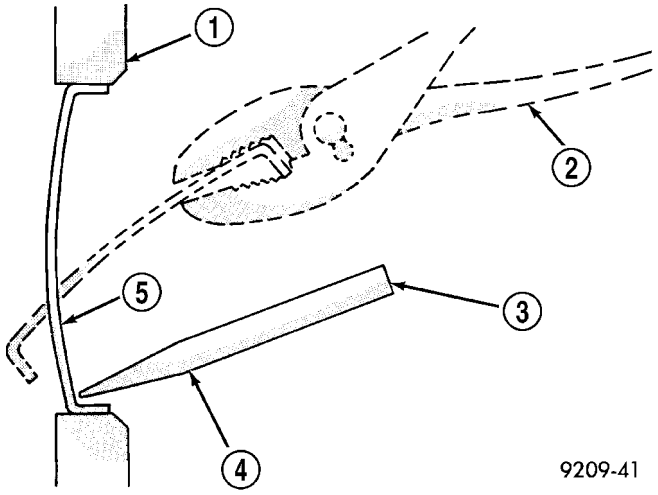

Fig. 5 Core Hole Plug Removal

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

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 - ENGINE ASSEMBLY

(1) Perform fuel pressure release procedure (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE).

(2) Disconnect negative battery cable.

(3) Remove air cleaner and hoses.

(4) Disconnect the fuel line from fuel rail (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE).

(5) Remove the wiper module (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER MODULE - REMOVAL).

(6) Block off heater hoses to the rear heater system using pinch-off pliers (if equipped).

(7) Drain the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

(8) Disconnect the heater hoses.

(9) Remove the radiator upper support crossmember (Refer to 23 - BODY/EXTERIOR/GRILLE OPENING REINFORCEMENT - REMOVAL).

(10) Remove the radiator fans (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL).

(11) Disconnect the throttle cables from the throttle body.

(12) Disconnect the MAP, IAC, and TPS electrical connectors.

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(13) Disconnect the EGR transducer electrical connector (if equipped).
(14) Disconnect the vacuum hoses from throttle body.
(15) Disconnect the brake booster and speed control vacuum hoses.
(16) Disengage wire harness clip from the right side engine mount.
(17) Remove the power steering reservoir from mounting position and set aside. **Do not** disconnect hose.
(18) Disconnect ground strap from rear of cylinder head.
(19) Disconnect engine coolant temperature (ECT) sensor and ignition coil electrical connectors.
(20) Disconnect the fuel injector electrical harness connector and disengage clip from support bracket.
(21) Disconnect camshaft and crankshaft position sensor electrical connectors.
(22) Evacuate air conditioning system. Refer to 24 - HEATING & AIR CONDITIONING.
(23) Disconnect A/C compressor electrical connector.
(24) Disconnect the A/C lines from compressor. Cover and seal all openings of hoses and compressor.
(25) Remove the radiator upper hose.
(26) Disengage electrical harness clip at transaxle dipstick tube.
(27) Remove transaxle dipstick tube. Seal opening using a suitable plug.

NOTE: When the transaxle cooler lines are removed from the rolled-groove type fittings at the transaxle, damage to the inner wall of the hose will occur. To prevent prevent potential leakage, the cooler hoses must be cut off flush at the transaxle fitting, and a service cooler hose splice kit must be installed upon reassembly.

(28) Using a blade or suitable hose cutter, cut transaxle oil cooler lines off flush with fittings. Plug cooler lines and fittings to prevent debris from entering transaxle or cooler circuit. A service splice kit will be installed upon reassembly.
(29) Disconnect transaxle shift linkage and electrical connectors.
(30) Raise vehicle on hoist and drain the engine oil.
(31) Remove the axle shafts. (Refer to 3 - DIFFERENTIAL & DRIVELINE/HALF SHAFT - REMOVAL)
(32) Remove crossmember cradle plate (Fig. 6).
(33) **AWD equipped:** Remove the power transfer unit (PTU) (Refer to 21 - TRANSMISSION/TRANSAXLE/POWER TRANSFER UNIT - REMOVAL).
(34) Disconnect exhaust pipe from the manifold (Fig. 7).

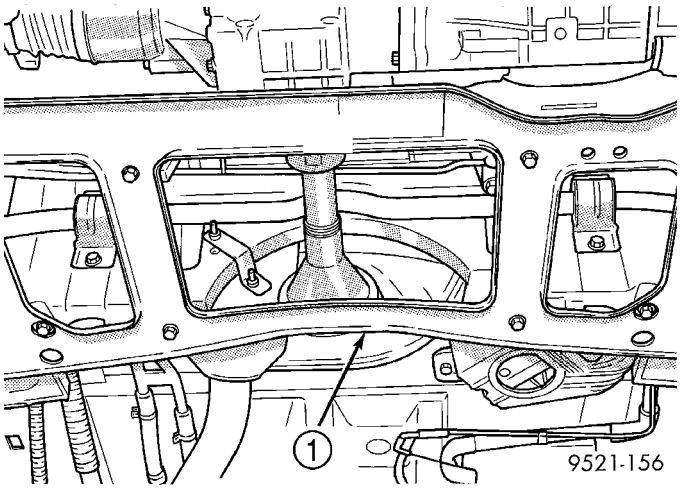


Fig. 6 Crossmember Cradle Plate

1 - CRADLE PLATE

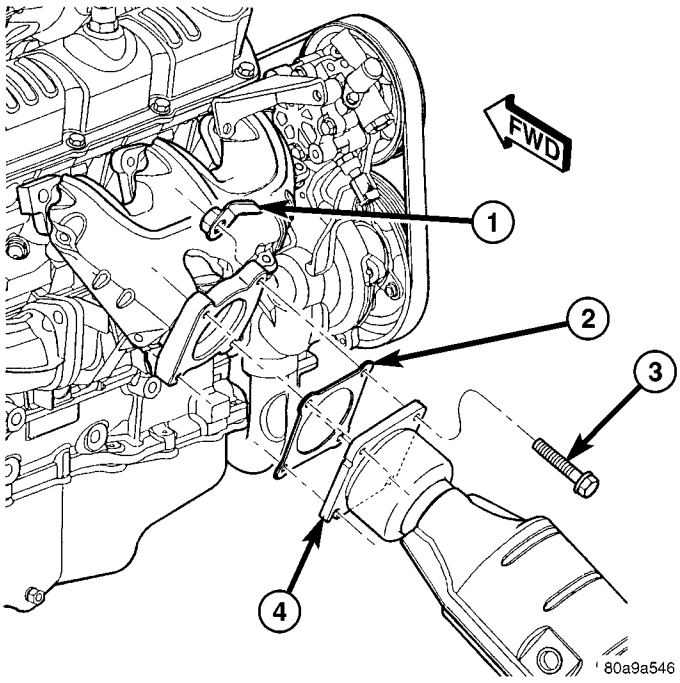


Fig. 7 Catalytic Converter to Exhaust Manifold

1 - FLAG NUT
2 - GASKET
3 - BOLT
4 - CATALYTIC CONVERTER

(35) Remove front engine mount and bracket as an assembly.
(36) Remove the engine rear mount bracket.
(37) Remove the engine to transaxle struts (Fig. 8).
(38) Remove transaxle case cover (Fig. 8).
(39) Remove flex plate to torque converter bolts. Mark torque converter to flex plate for orientation for reassembly.
(40) Remove the power steering pressure hose support clip attaching bolt.

ENGINE 3.3/3.8L (Continued)

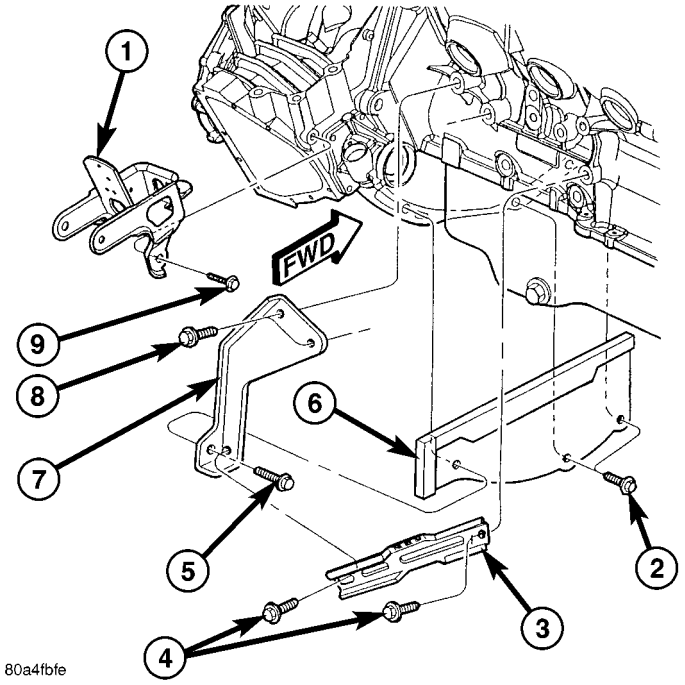


Fig. 8 POWERTRAIN SUPPORTS AND DUST COVER

1 - BRACKET - ENGINE REAR MOUNT
2 - BOLT - TRANSAXLE CASE COVER
3 - STRUT - TRANSAXLE TO ENGINE HORIZONTAL
4 - BOLT - HORIZONTAL STRUT
5 - BOLT - STRUT TO TRANSAXLE
6 - COVER - TRANSAXLE CASE LOWER
7 - STRUT - TRANSAXLE TO ENGINE
8 - BOLT - STRUT TO ENGINE
9 - BOLT - ENGINE REAR MOUNT BRACKET

(41) Disconnect the knock sensor electrical connector (3.8L only).

(42) Disconnect the engine block heater electrical connector (if equipped).

(43) Remove the accessory belt splash shield.

(44) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(45) Disconnect the radiator lower hose.

(46) Remove air conditioning compressor from engine.

(47) Remove the generator (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - REMOVAL).

(48) Remove the water pump pulley attaching bolts and position pulley between pump hub and housing.

(49) Disconnect the oil pressure switch electrical connector.

(50) Disconnect wiring harness support clip from engine oil dipstick tube.

(51) Install Special Tools 6912 and 8444 Adapters on the right side (rear) of engine block (Fig. 9).

(52) Lower the vehicle.

(53) Remove the power steering pump and set aside.

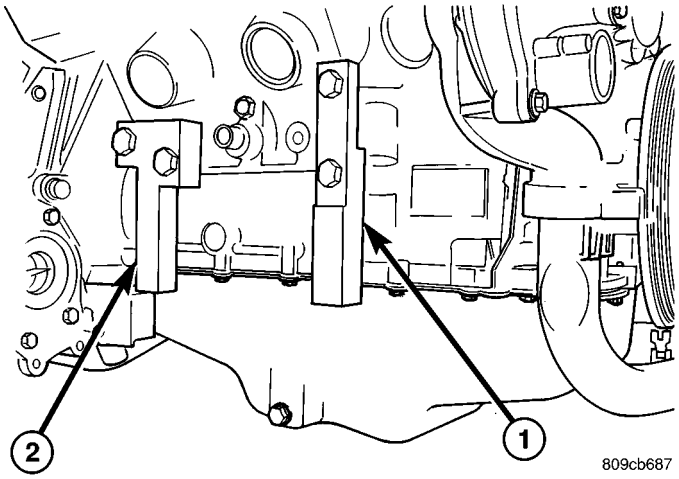


Fig. 9 ADAPTER TOOLS MOUNTED ON BLOCK

1 - SPECIAL TOOL 6912
2 - SPECIAL TOOL 8444

(54) Raise vehicle enough to allow engine dolly Special Tool 6135 and cradle Special Tool 6710 with post Special Tool 6848 and adaptor Special Tool 6909 to be installed under vehicle (Fig. 12).

(55) Loosen cradle/post mounts to allow movement for positioning posts into locating holes on the engine (Fig. 10) and (Fig. 11). Slowly lower vehicle and position cradle/post mounts until the engine is resting on posts. Tighten all cradle/post mounts to cradle frame. This will keep mounts from moving when removing or installing engine and transmission.

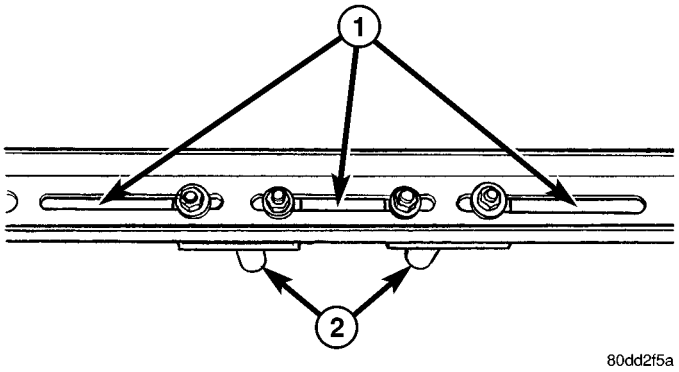


Fig. 10 Positioning Special Tool 6848 for use with Adapters 8444 & 6912

1 - SLOTS
2 - SPECIAL TOOLS 6848

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

(57) Install and secure the safety straps to the cradle fixture and around the engine (Fig. 12).

(58) Remove the engine right side mount to engine attaching bolts (Fig. 13).

(59) Remove the left mount through bolt (Fig. 14).

ENGINE 3.3/3.8L (Continued)

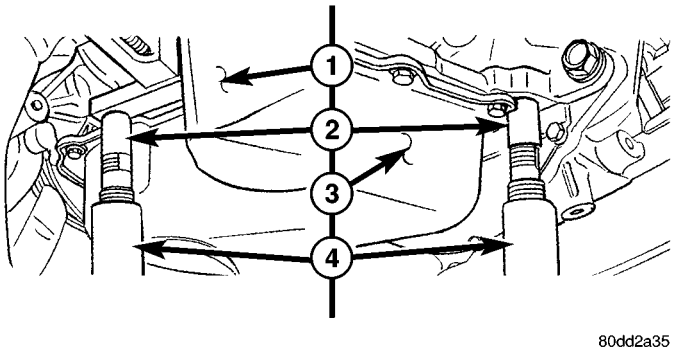


Fig. 11 Special Tools 6848 with Adapters 6909

1 - OIL FILTER
2 - SPECIAL TOOLS 6909
3 - OIL PAN
4 - SPECIAL TOOLS 6848

(60) Raise vehicle slowly. It is necessary to move the engine/transmission assembly with the dolly to allow for removal around body flanges.

INSTALLATION - ENGINE ASSEMBLY

(1) Position engine and transmission assembly under vehicle. Slowly lower the vehicle down over the engine and transmission. It is necessary to move the engine/transmission assembly with the dolly for clearance around body flanges.

(2) Align engine and transmission mounts to attaching points. Install mounting bolts at the right engine mount (Fig. 13) and left transmission mount (Fig. 14).

(3) Remove the safety straps from around engine.

(4) Slowly raise vehicle enough to remove the engine dolly and cradle Special Tools 6135, 6710, 6848 and 6909 (Fig. 12).

(5) Remove Special Tools 6912 and 8444 (Fig. 9).

(6) Lower the vehicle.

(7) Install power steering pump and pressure line support.

(8) Install the generator and wiring harness (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - INSTALLATION).

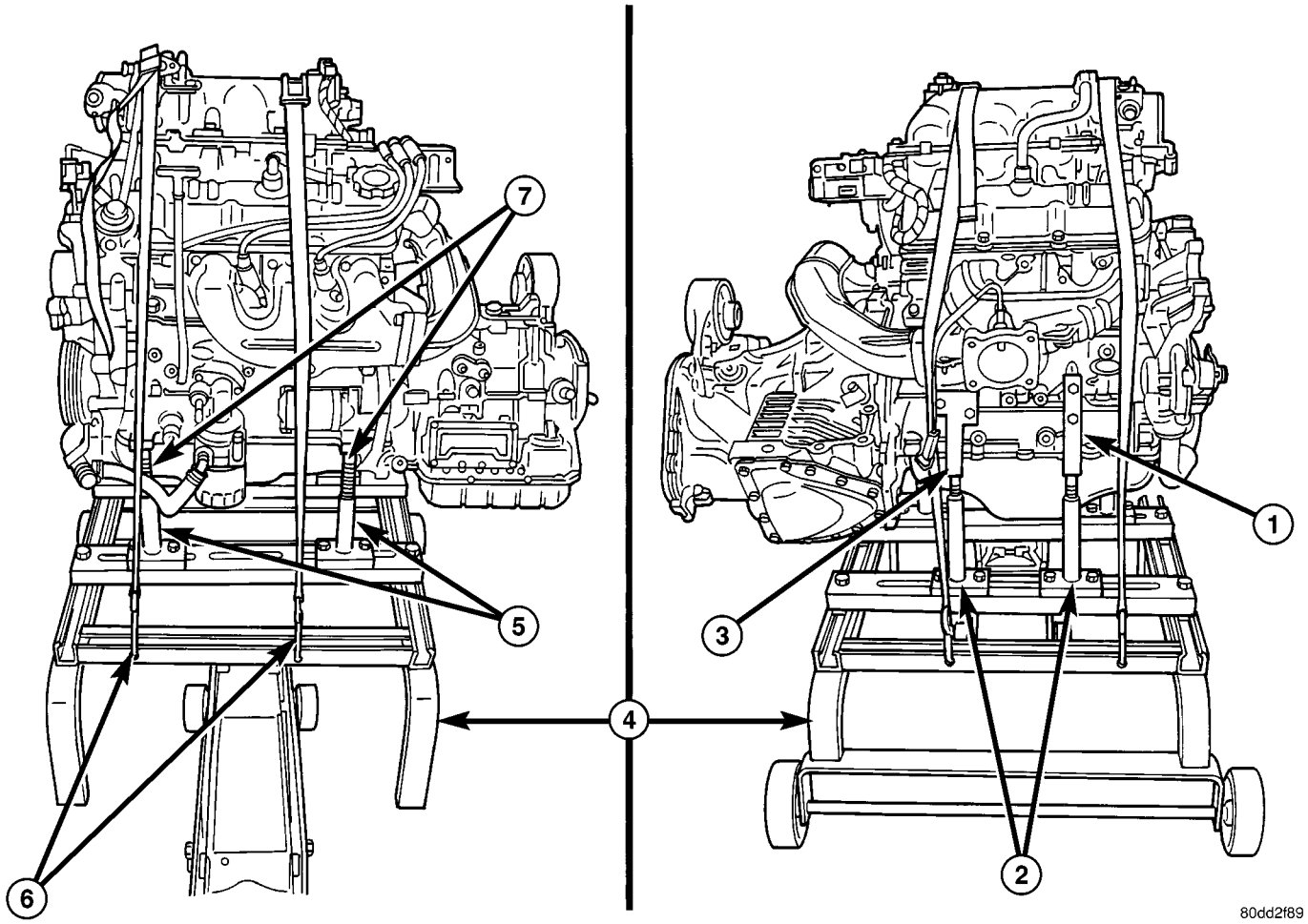


Fig. 12 Positioning Engine Cradle Support Post Mounts

1 - SPECIAL TOOL 8444
2 - SPECIAL TOOLS 6848
3 - SPECIAL TOOL 6912
4 - SPECIAL TOOLS 6135 & 6710
5 - SPECIAL TOOLS 6848
6 - SAFETY STRAPS
7 - SPECIAL TOOLS 6909

ENGINE 3.3/3.8L (Continued)

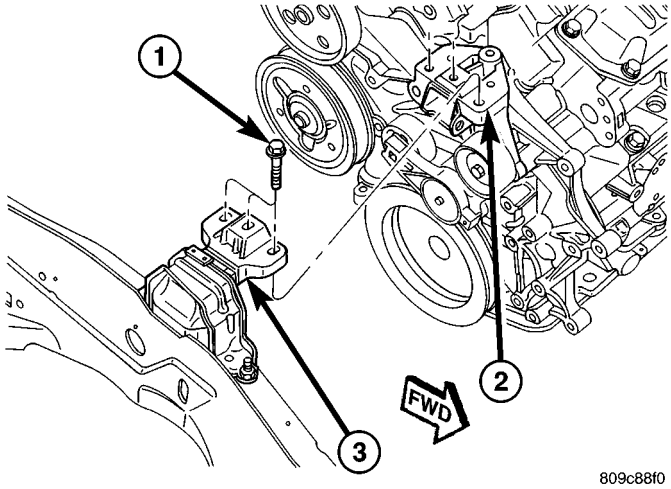


Fig. 13 Right Mount to Engine

1 - BOLT
2 - MOUNT BRACKET
3 - ENGINE RIGHT MOUNT ASSEMBLY

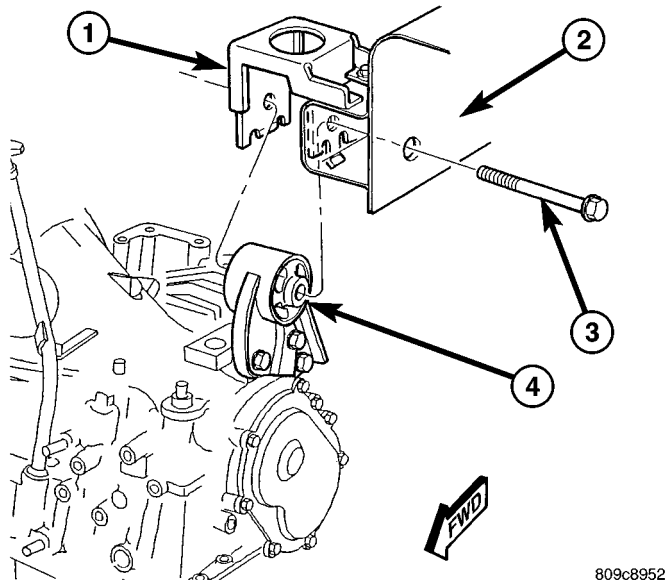


Fig. 14 LEFT MOUNT TO FRAME BRACKET

1 - FRAME BRACKET
2 - FRAME RAIL - LEFT
3 - BOLT
4 - TRANSAXLE MOUNT

(9) Raise vehicle.

(10) Attach wiring harness support clip to the engine oil dipstick tube.

(11) Connect oil pressure switch electrical connector.

(12) Install the A/C compressor.

(13) Install the water pump pulley.

(14) Connect the radiator lower hose.

(15) Install the accessory drive belt and splash shield (Refer to 7 - COOLING/ACCESSORY DRIVE/ DRIVE BELTS - INSTALLATION).

(16) Connect the engine block heater electrical connector (if equipped).

(17) Connect the knock sensor electrical connector (3.8L only).

(18) Install the torque converter to flex plate bolts.

(19) Install the transaxle case cover (Fig. 8).

(20) Install the powertrain struts (Fig. 8).

(21) Install the engine rear mount bracket.

(22) Install the engine front mount and bracket assembly.

(23) **AWD equipped;** Install the power transfer unit (PTU) (Refer to 21 - TRANSMISSION/TRANSAXLE/POWER TRANSFER UNIT - INSTALLATION).

(24) Install the axle shafts (Refer to 3 - DIFFERENTIAL & DRIVELINE/HALF SHAFT - INSTALLATION).

(25) Connect exhaust pipe to manifold (Fig. 7).

(26) Install crossmember cradle plate (Fig. 6).

(27) Lower vehicle.

(28) Connect transaxle shift linkage.

(29) Connect transaxle electrical connectors.

(30) Remove plugs from transmission cooler hoses and install transaxle oil cooler line service splice kit. Refer to instructions included with kit.

(31) Install transaxle dipstick tube and attach electrical harness clip.

(32) Connect the A/C lines to compressor.

(33) Connect the A/C compressor electrical connector.

(34) Evacuate and recharge A/C system.

(35) Connect crankshaft and camshaft position sensors.

(36) Connect the fuel injector electrical harness connector and engage clip to support bracket.

(37) Connect engine coolant temperature (ECT) sensor and ignition coil electrical connectors.

(38) Connect the ground strap to rear of cylinder head.

(39) Install power steering reservoir.

(40) Engage wire harness clip to engine right side mount.

(41) Connect the brake booster and speed control vacuum hoses.

(42) Connect the vacuum hoses to the throttle body.

(43) Connect the EGR transducer electrical connector (if equipped).

(44) Connect the TPS, IAC, and MAP sensor electrical connectors.

(45) Connect throttle cables to throttle body.

(46) Install the radiator fans (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION).

(47) Connect the radiator upper hose.

(48) Connect the heater hoses. Remove pinch-off pliers from the rear heater hoses (if equipped).

ENGINE 3.3/3.8L (Continued)

(49) Install the radiator upper support crossmember (Refer to 23 - BODY/EXTERIOR/GRILLE OPENING REINFORCEMENT - INSTALLATION).

(50) Install the wiper module (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER MODULE - INSTALLATION).

(51) Connect the fuel line to fuel rail (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/FUEL LINES - STANDARD PROCEDURE).

(52) Install the air cleaner and hoses.

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

(54) Connect negative cable to battery.

(55) Fill the cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE).

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

(57) Adjust transmission linkage, if necessary.

SPECIFICATIONS

3.3/3.8L ENGINE

GENERAL DESCRIPTION

DESCRIPTION	SPECIFICATION	
	Metric	Standard
Engine Type	60° V-6 Engine	
Number of Cylinders	6	
Displacement 3.3L	3.3Liters	201 cu.in.
Displacement 3.8L	3.8 Liters	231 cu. in.
Bore 3.3L	93.0 mm	201 cu.in.
Bore 3.8L	96.0 mm	3.779 cu.in.
Stroke 3.3L	81 mm	3.188 in.
Stroke	87 mm	3.425 in.
Compression Ratio 3.3L	-	9.35:1
Compression Ratio 3.8L	-	9.6:1
Firing Order	-	1-2-3-4-5-6
Compression Pressure-Minimum	689.5 kPa	100 psi.
Cylinder Compression (Max. Difference Between Cylinders	-	25%

CYLINDER BLOCK

DESCRIPTION	SPECIFICATION	
	Metric	Standard
Cylinder Bore Diameter (Standard) 3.3L	92.993-93.007 mm	3.661-3.6617 in.
Cylinder Bore Diameter (Standard) 3.8L	95.993-96.007 mm	3.7792-3.780 in.
Out of Round (Service Limits)	0.076 mm	0.003 in.
Taper (Service Limits)	0.051 mm	0.002 in.
Lifter Bore Diameter	22.980-23.010 mm	0.905-0.906 in.
Deck Surface Flatness (Max.)	0.1 mm	0.004 in.

CRANKSHAFT

DESCRIPTION	SPECIFICATION	
	Metric	Standard
Connecting Rod Journal Diameter	57.979-58.005 mm	2.2827-2.2837 in.
Main Bearing Journal Diameter	63.993-64.013 mm	2.5194-2.5202 in.
Journal Out-of-Round (Max.)	0.025 mm	0.001 in.
Journal Taper (Max.)	0.025 mm	0.001 in
End Play	0.09-0.24 mm	0.0036-0.0095 in.
Wear Limit	0.381 mm	0.015 in.
Main Bearing Diametrical Clearance 1-2-3-4	0.011-0.055 mm	0.0005-0.0022 in.
Wear Limit	0.076 mm	0.003 in.

ENGINE 3.3/3.8L (Continued)

CONNECTING RODS

DESCRIPTION	SPECIFICATION	
	Metric	Standard
Bearing Clearance	0.019-0.065 mm.	0.017-0.020 in.
Wear Limit	0.074 mm	0.003 in.
Side Clearance	0.13-0.32 mm	0.005-0.013 in.
Wear Limit	0.38 mm	0.015 in.

PISTONS

DESCRIPTION	SPECIFICATION	
	Metric	Standard
Piston Diameter 3.3L-Measured 39.8 mm (1.567 in) From Piston Top	92.968-92.998 mm.	3.660-3.661 in.
Piston Diameter 3.8L-Measured 33.01 mm (1.30 in) From Piston Top	95.968-95.998 mm.	3.778-3.779 in.
Clearance in Bore @ Size Location (New)	-0.005-0.039 mm	-0.0002–0.0015 in.
Weight 3.3L	362 ± 5 grams	12.77 ± 0.1764 oz.
Weight 3.8L	426 ± 5 grams	15.03 ± 0.1764 oz.

PISTON PINS

DESCRIPTION	SPECIFICATION	
	Metric	Standard
Type	Press Fit in Rod (Serviced as a Assembly)	
Clearance in Piston @ 21C (70°F)	0.006-0.019 mm	0.0002-0.0007 in.
Clearance in Connecting Rod	Interference Fit	
Diameter	22.87-22.88 mm	0.9007-0.9009 in.
Length 3.3L	67.25-67.75 mm	2.648-2.667 in.
Length 3.8L	71.25-71.75 mm	2.805-2.824 in.

PISTON RINGS

DESCRIPTION	SPECIFICATION	
	Metric	Standard
Ring End Gap		
Top Compression Ring	0.18-0.38 mm	0.007-0.015 in.
Second Compression Ring	0.28-0.57 mm	0.011-0.022 in.
Oil Control (Steel Rails)	0.23-0.78 mm	0.009-0.030 in.
Wear Limit-Compression Rings	1.0 mm	0.039 in.
Wear Limit-Oil Control Steel Rails	1.88 mm	0.074 in.
Ring Side Clearance		
Top Compression Ring 3.3L	0.030-0.080 mm	0.0012-0.0031 in.
Top Compression Ring 3.8L	0.030-0.069 mm	0.0012-0.0027 in.
Second Compression Ring 3.3L	0.030-0.095 mm	0.0012-0.0037 in.
Second Compression Ring 3.8L	0.041-0.085 mm	0.0016-0.0033 in.
Oil Ring (Steel Ring)	0.039-0.200 mm	0.0015-0.0078 in.
Wear Limit- Top Ring	0.10 mm	0.004 in.
Wear Limit-2nd Ring	0.13 mm	0.005
Wear Limit Oil Ring Pack	0.266 mm	0.009
Ring Width-Top Compression Ring 3.3L	1.46-1.49 mm	0.0575-0.058 in.
Ring Width-Top Compression Ring 3.8L	1.175-1.190 mm	0.0462-0.0468

ENGINE 3.3/3.8L (Continued)

DESCRIPTION	SPECIFICATION	
	Metric	Standard
Ring Width-2nd Compression Ring 3.3L and 3.8L	1.46-1.49 mm	0.0575-0.058 in.
Ring Width-Oil Ring (Steel Rails) 3.3L	0.435-0.490 mm	-.017-0.019 in.
Ring Width-Oil Ring (Steel Rails) 3.8L	0.435-0.510 mm	0.017-0.020

CAMSHAFT

DESCRIPTION	SPECIFICATION	
	Metric	Standard
Journal Diameter		
#1	50.724-50.775 mm	1.997-1.999 in.
#2	50.317-50.368 mm	1.9809-1.9829 in.
#3	49.936-49.987 mm	1.9659-1.9679 in.
#4	49.530-49.581 mm	1.9499-1.9520 in.
Bearing Clearance-Diametrical	0.025-0.101 mm	0.001-0.004 in.
Bearing Clearance (Max.Allowable)	0.127 mm	0.005 in.
End Play	0.254-0.508 mm	0.010-0.020 in.
Camshaft Bearing Diameter		
#1	50.800-50.825	1.9999-2.0009 in.
#2	50.393-50.419 mm	1.9839-1.9849 in.
#3	50.013-50.038 mm	1.9690-1.9699 in.
#4	49.606-49.632 mm	1.9529-1.954 in.
Exhaust Valve Timing		
Closes-3.3L (ATDC)	-	13°
Closes-3.8L (ATDC)	-	18°
Opens-3.3L (BBDC)	-	43°
Opens-3.8L (BBDC)	-	46°
Duration-3.3L	-	236°
Duration-3.8L	-	244°
Intake Valve Timing		
Closes-3.3L (ABDC)	-	52°
Closes-3.8L (ABDC)	-	63°
Opens-3.3L (ATDC)	-	6°
Opens-3.8L (ATDC)	-	1°
Duration-3.3L	-	226°
Duration-3.8L	-	242°
Valve Overlap-3.3L	-	7°
Valve Overlap-3.8L	-	17°

HYDRAULIC LIFTER

DESCRIPTION	SPECIFICATION	
	Metric	Standard
Type	Hydraulic Roller	
Outside Diameter	22.949-22.962 mm	0.903-0.904 in.
Clearance in Block	0.020-0.061 mm	0.0007-0.0024 in.

CYLINDER HEAD

DESCRIPTION	SPECIFICATION	
	Metric	Standard
Gasket Thickness (Compressed)	0.65-0.75 mm	0.0007-0.0024 in.

ENGINE 3.3/3.8L (Continued)

VALVES

DESCRIPTION	SPECIFICATION	
	Metric	Standard
Face Angle-Intake	-	45-45.5°
Face Angle-Exhaust	-	45-45.5°
Head Diameter-Intake	47.87-48.13 mm	1.88-1.89 in.
Head Diameter-Exhaust	35.37-35.63 mm	1.39-1.40 in.
Valve Lift (Zero Lash)-Intake and Exhaust-3.3L	9.80 mm	0.385 in.
Valve Lift (Zero Lash)-Intake and Exhaust-3.8L	11.0 mm	0.433 in.
Valve Length-Intake	125.84-126.6 mm	4.95-4.98 in.
Valve Length-Exhaust	127.20-127.96	5.00-5.04 in.
Valve Stem to Tip Height (valve tip to spring seat washer)-Intake	48.1-49.7 mm	1.89-1.95 in.
Valve Stem to Tip Height (valve tip to spring seat washer)-Exhaust	48.53-50.09 mm	1.91-1.97 in.

VALVE SEAT

DESCRIPTION	SPECIFICATION	
	Metric	Standard
Angle	-	44.5-45°
Run Out (Service Limits)	0.0762 mm	0.003 in.
Width-Intake and Exhaust	1.50-2.00 mm	0.057-0.078 in.

VALVE GUIDE

DESCRIPTION	SPECIFICATION	
	Metric	Standard
Guide Bore Diameter (Std.)	6.975-7.00 mm	0.274-0.275 in.

VALVE MARGIN

DESCRIPTION	SPECIFICATION	
	Metric	Standard
Intake	0.825-0.973 mm	0.032-0.038 in.
Exhaust	1.565-1.713 mm	0.061-0.067 in.

VALVE STEM DIAMETER

DESCRIPTION	SPECIFICATION	
	Metric	Standard
Intake (Standard)	6.935-6.953 mm	0.2718-0.2725 in.
Exhaust (Standard)	6.906-6.924 mm	0.2718-0.2725 in.

VALVE STEM TO GUIDE CLEARANCE

DESCRIPTION	SPECIFICATION	
	Metric	Standard
Intake	0.025-0.065 mm	0.001-0.0025 in.
Exhaust	0.059-0.094 mm	0.002-0.0037 in.
Max Allowable-Intake (Rocking Method)	0.247 mm	0.010 in.
Max Allowable-Exhaust (Rocking Method)	0.414 mm	0.016 in.

PUSH RODS

DESCRIPTION	SPECIFICATION	
	Metric	Standard
Length	135.438 mm	5.33 in.

ENGINE 3.3/3.8L (Continued)

VALVE SPRING

DESCRIPTION	SPECIFICATION	
	Metric	Standard
Free Length-Type A	51.4 mm	2.02 in.
Free Length-Type B	53.4 mm	2.10 in.
Wire Diameter Type A	3.95-4.77 mm	0.15-0.19 in.
Wire Diameter Type B	4.19-4.29 mm	0.16-0.17 in.
Number of Coils Type A	7.52	
Number of Coils Type B	7.25	
Spring Tension (Valve Closed) Type A	376.4-424.4 N @ 41.9 mm	84.6-95.6 lbs. @ 1.65 in.
Spring Tension (Valve Open) Type A	863.9-959.9 N @ 41.9 mm	194.2-215.8 lbs. @ 1.65 in.
Spring Tension (Valve Closed) Type B	377-423 N @ 41.9 mm	84.8-95.2 lbs. @ 1.65 in.
Spring Tension (Valve Open) Type B	880-962 N @ 30.91 mm	197.9-216.3 lbs. @ 122 in.
Installed Height	41.1-42.7 mm	1.61-1.68 in

LUBRICATION

DESCRIPTION	SPECIFICATION	
	Metric	Standard
At Curb Idle Speed* (Minimum with engine at operating temperature)	34.47 kPa	5 psi
At 3000 RPM	205-551 kPa	30-80 psi
Oil Filter By-Pass Valve Setting	62-103 kPa	9-15 psi
Oil Pressure Switch Actuating Pressure	14-28 Kpa	2-4 psi
caution: *If pressure is ZERO at curb idle, DO NOT run engine at 3000 rpm.		

OIL PUMP

DESCRIPTION	SPECIFICATION	
	Metric	Standard
Clearance Over rotors-Inner and Outer	0.10 mm	0.004 in.
Cover Out-Of-Flat (Max.)	0.025 mm	0.001 in.
Inner Rotor Thickness	7.64 mm	0.301 in.
Outer Rotor Thickness (Min)	7.64 mm	0.301 in.
Outer Rotor Clearance (Max)	0.039 mm	0.015 in.
Outer Rotor Diameter (Min)	79.95 mm	3.148 in.
Tip Clearance Between Rotors (Max)	0.20 mm	0.008 in.

SPECIFICATIONS - TORQUE

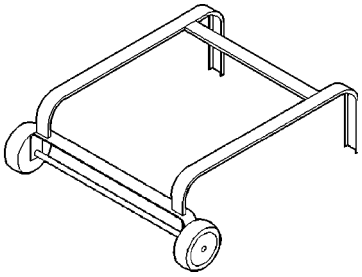
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Camshaft Sprocket—Bolt	54	40	—
Camshaft Thrust Plate—Bolts	12	—	105
Connecting Rod Cap—Bolts	54 +¼ turn	40 +¼ turn	—
Crankshaft Main Bearing Cap—Bolts	41 +¼ turn	30 +¼ turn	—
Crankshaft Main Bearing Cap Cross Bolts (3.8L)	61	45	—
Crankshaft Oil Seal Retainer Rear—Bolts	12	—	105
Crankshaft Damper—Bolt	54	40	—
Cylinder Block Drain Plugs	20	15	—
Cylinder Head—Bolts	(Refer to 9 - ENGINE/ CYLINDER HEAD - INSTALLATION)		
Cylinder Head Cover—Bolts	12	—	105
Flex Plate to Crankshaft	95	70	—

ENGINE 3.3/3.8L (Continued)

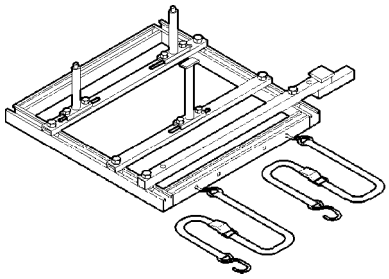
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Engine Mounting	(Refer to 9 - ENGINE/ ENGINE MOUNTING)		
Exhaust Manifold—Bolts	23	—	200
Exhaust Crossover Pipe—Bolts	54	40	—
Intake Manifold - Lower—Bolts	23	—	200
Intake Manifold - Lower Gasket Retainer—Bolts	12	—	105
Intake Manifold Upper—Bolts	12	—	105
Lifter Yoke Retainer—Bolts	12	—	105
Oil Filter Attaching Fitting	54	40	—
Oil Cooler Attaching Fitting	27	20	—
Oil Filter	20	15	—
Oil Filter Adapter—Bolts	28	—	250
Oil Gallery Plug	27	20	—
Oil Pan—Bolts	12	—	105
Oil Pan Drain—Plug	27	20	—
Oil Pressure Switch	23	—	200
Oil Pump Cover Plate—Screws	12	—	105
Oil Pump Pick-up Tube—Bolt	28	—	250
Oil Dipstick Housing—Bolts	48	35	—
Rocker Arm Shaft—Bolts	23	—	200
Spark Plug	16	12	—
Timing Chain Case Cover			
—M8 Bolt	27	20	—
—M10 Bolt	54	40	—
Water Pump—Bolts	12	—	105
Water Pump Pulley—Bolts	28	—	250

SPECIAL TOOLS

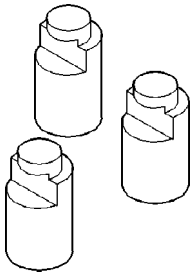
3.3/3.8L ENGINE



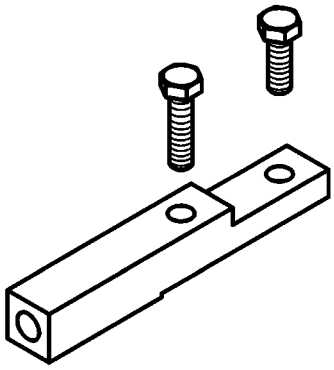
Dolly 6135



Cradle 6710A

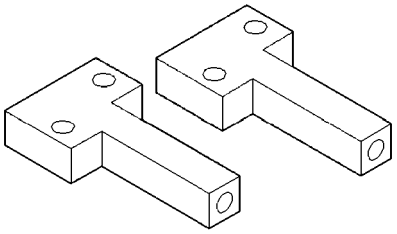


Adapter 6909A

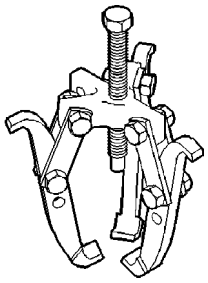


Adapter 8444

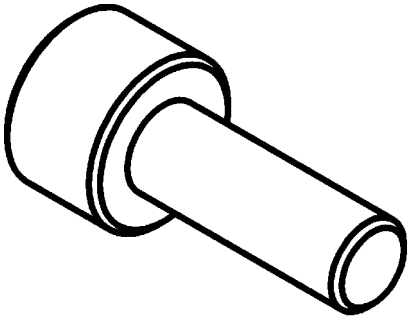
ENGINE 3.3/3.8L (Continued)



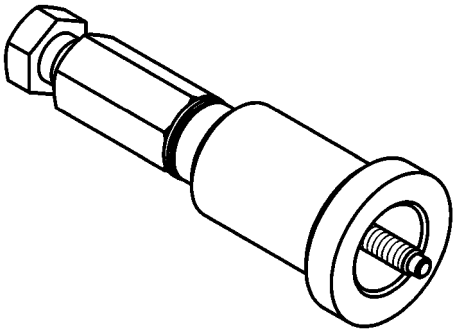
Adapter 6912



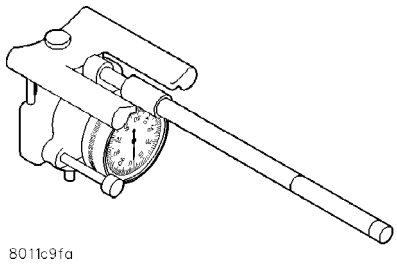
Puller 1026



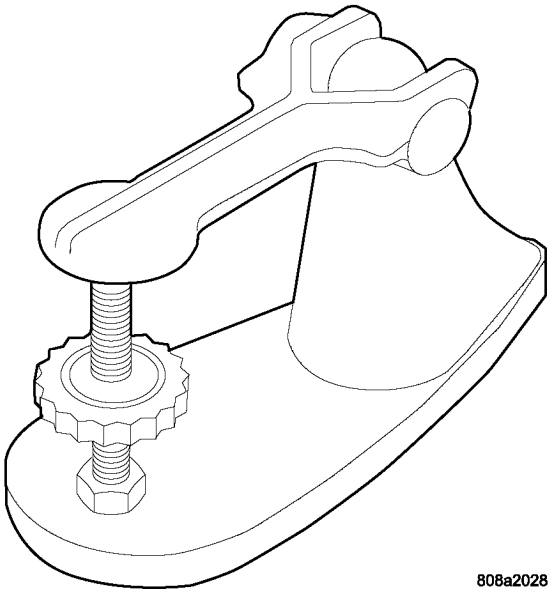
Insert, Crankshaft 8450



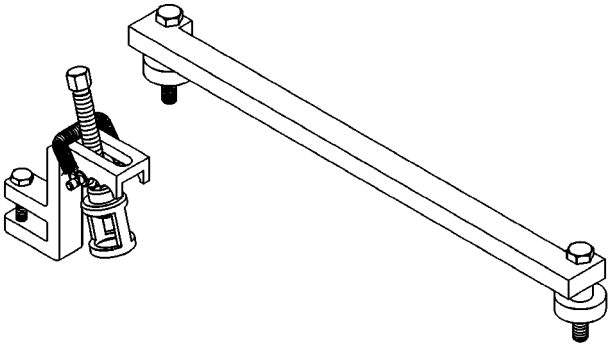
Crankshaft Damper/Sprocket Installer 8452



Indicator, Cylinder Bore C-119

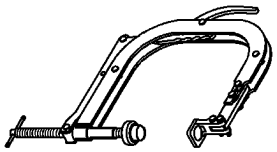


Tester - Valve Spring C-647

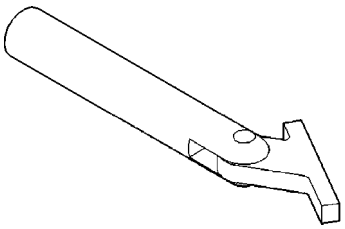


Compressor, Valve Spring In-vehicle 8453

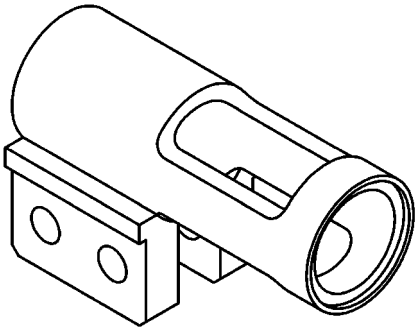
ENGINE 3.3/3.8L (Continued)



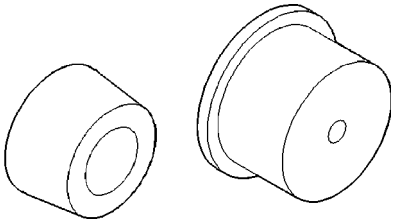
Valve Spring Compressor Off-vehicle C-3422-D



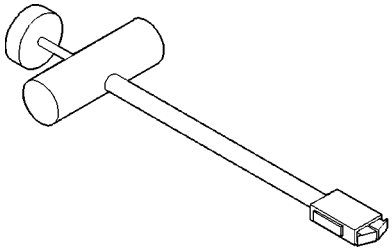
Remover and Installer, Crankshaft Main Bearing C-3059



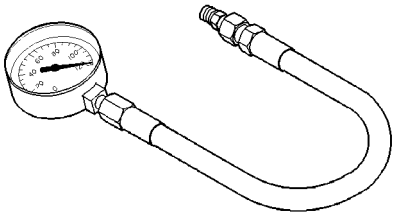
Adapter, Valve Spring Compressor Off-vehicle 8464



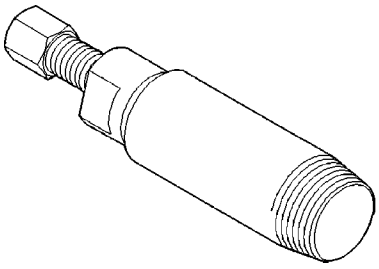
Rear Crankshaft Oil Seal Installer 6926



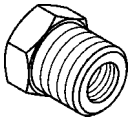
Remover, Valve Tappet C-4129-A



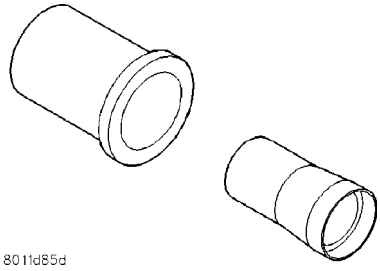
Oil Pressure Gauge C-3292



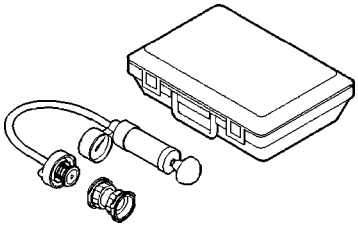
Remover, Crankshaft Front Seal 6341A



Adapter 8406

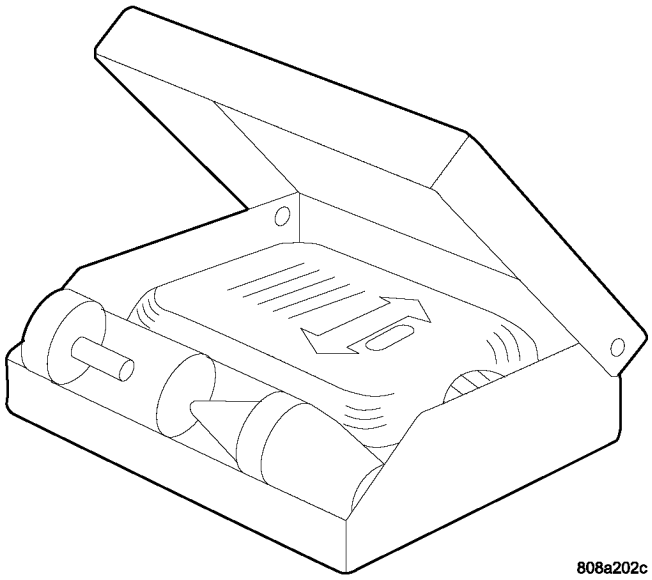


Installer, Crankshaft Front Seal C-4992

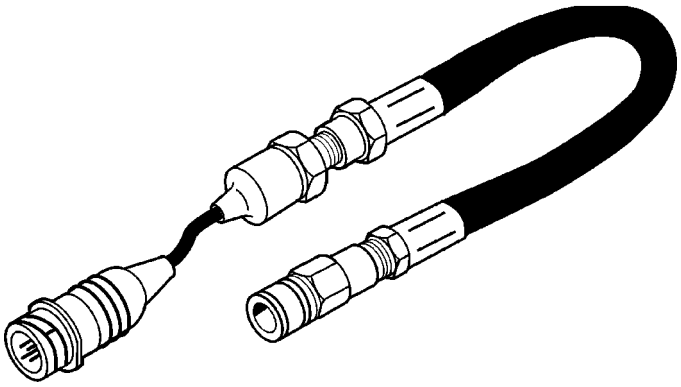


Cooling System Tester 7700

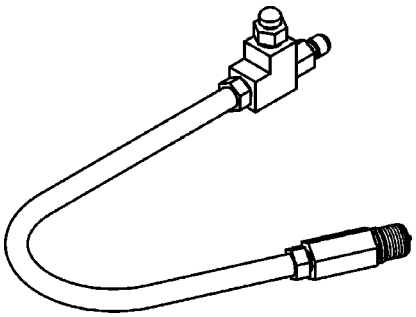
ENGINE 3.3/3.8L (Continued)



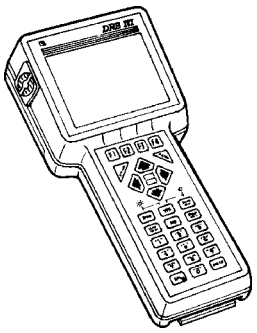
Combustion Leak Tester C-3685-A



Pressure Transducer CH7059



Compression Test Adapter 8116



DRB III® with PEP Module OT-CH6010A

AIR CLEANER ELEMENT

REMOVAL

(1) Unsnap 2 clips.

(2) Lift cover and pull toward the engine and remove cover tabs from air box.

(3) Lift cover and remove the element (Fig. 15).

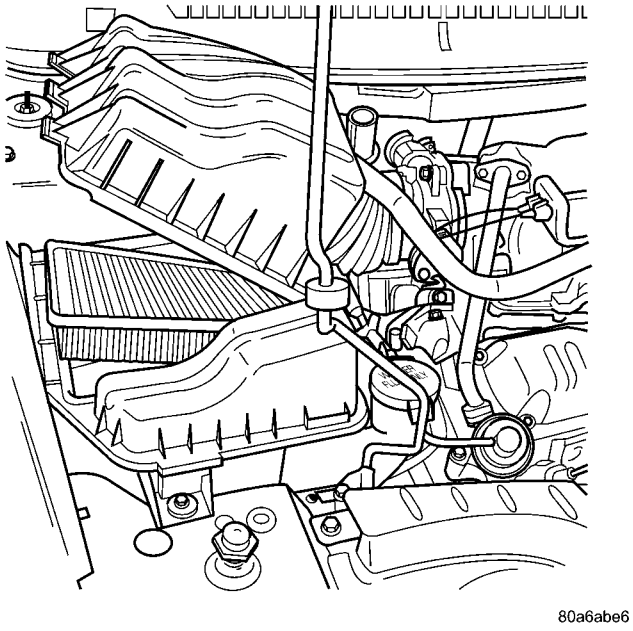


Fig. 15 AIR BOX COVER

INSTALLATION

(1) Install the air filter element into air box (Fig. 15).

(2) Move cover so that the tabs insert into the air box.

(3) Push cover down and snap the 2 clips.

AIR CLEANER HOUSING

REMOVAL

(1) Disconnect the negative battery cable.

AIR CLEANER HOUSING (Continued)

(2) Disconnect the inlet air temperature sensor (Fig. 16).

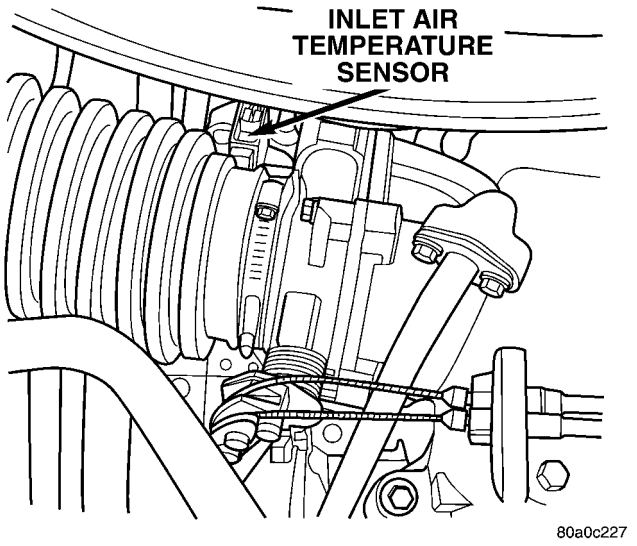


Fig. 16 Inlet Air Temperature Sensor

(3) Remove the inlet hose to throttle body.

(4) Remove the bolt for air box at upper radiator cross member.

(5) Pull air box up and off over the single locating pin.

(6) Remove air box from vehicle

INSTALLATION

(1) Install air box into vehicle and onto the locating pin.

(2) Install bolt to hold air box to the upper radiator cross member.

(3) Install the inlet hose to the throttle body.

(4) Connect the inlet air temperature sensor (Fig. 16).

(5) Connect the negative battery cable.

CYLINDER HEAD

DESCRIPTION

The aluminum cylinder heads (Fig. 17) are designed to create high flow combustion chambers to improve performance, while minimizing the change to the burn rate in the chamber. The cylinder head incorporates the combustion chamber. Two valves per-cylinder are used with inserted valve seats and guides. A multi-layer steel (MLS) type gasket is used between the cylinder head and engine block.

DIAGNOSIS AND TESTING—CYLINDER HEAD GASKET

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

Possible indications of the cylinder head gasket leaking between adjacent cylinders are:

- Loss of engine power
- Engine misfiring
- Poor fuel economy

Possible indications of the cylinder head gasket leaking between a cylinder and an adjacent water jacket are:

- Engine overheating
- Loss of coolant
- Excessive steam (white smoke) emitting from exhaust
- Coolant foaming

CYLINDER-TO-CYLINDER LEAKAGE TEST

To determine if an engine cylinder head gasket is leaking between adjacent cylinders, follow the procedures in Cylinder Compression Pressure Test (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING). An engine cylinder head gasket leaking between adjacent cylinders will result in approximately a 50–70% reduction in compression pressure.

CYLINDER-TO-WATER JACKET LEAKAGE TEST

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

VISUAL TEST METHOD

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

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

COOLING SYSTEM TESTER METHOD

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

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

CYLINDER HEAD (Continued)

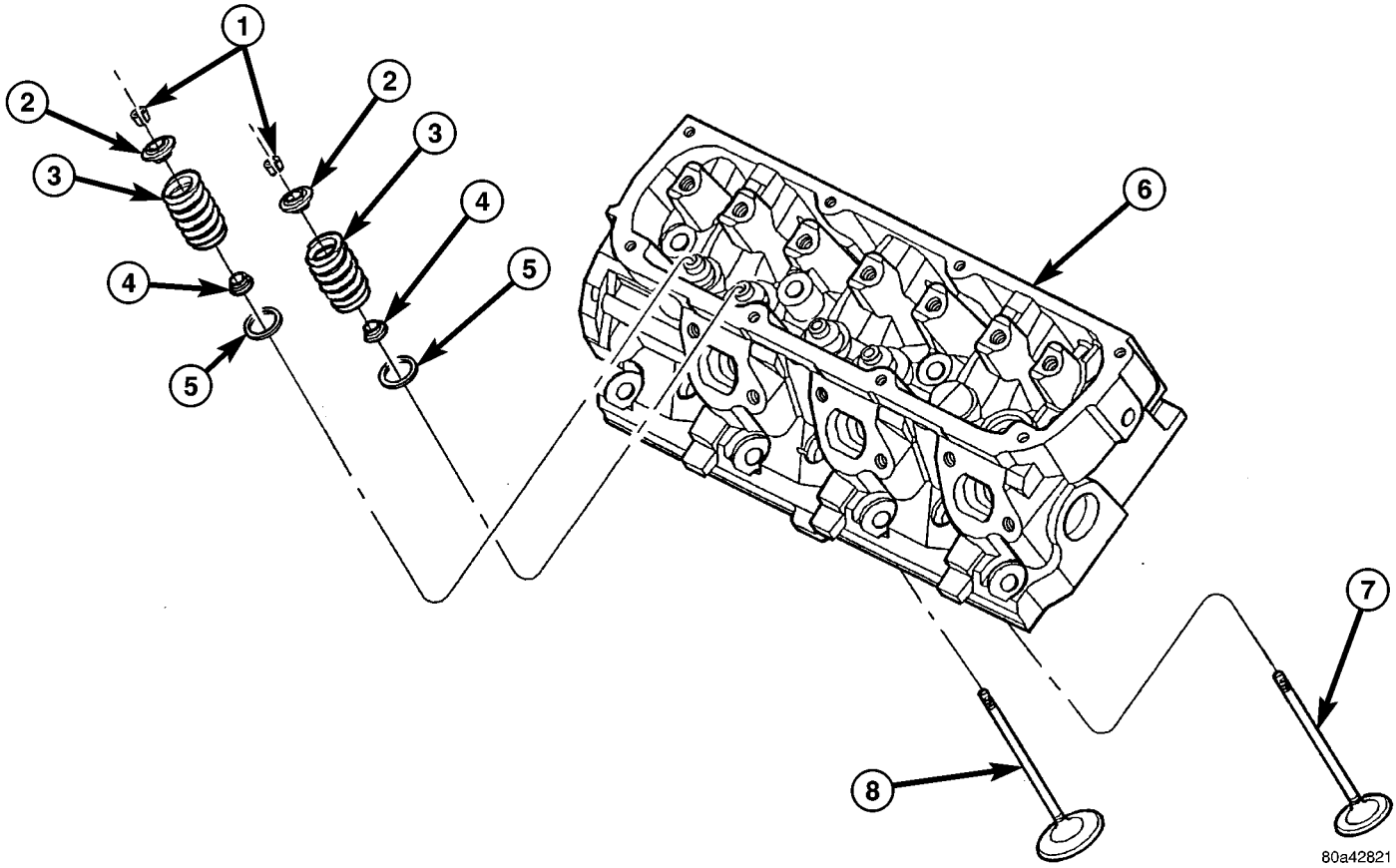


Fig. 17 Cylinder Head and Components

1 - VALVE LOCKS
2 - RETAINERS
3 - VALVE SPRINGS
4 - VALVE STEM SEALS
5 - SPRING SEATS
6 - CYLINDER HEAD
7 - VALVE - EXHAUST
8 - VALVE - INTAKE

CHEMICAL TEST METHOD

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

REMOVAL - CYLINDER HEAD

(1) Drain the cooling system. (Refer to 7 - COOLING - STANDARD PROCEDURE)

(2) Disconnect negative cable from battery.

(3) Remove upper and lower intake manifolds. (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL)

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

(4) Remove the cylinder head covers. (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL)

(5) Remove the spark plugs from cylinder head.

(6) Remove the dipstick and tube (Fig. 18).

(7) Remove exhaust manifold(s). (Refer to 9 - ENGINE/MANIFOLDS/EXHAUST MANIFOLD - REMOVAL)

(8) Remove rocker arm and shaft assemblies.(Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARMS - REMOVAL) Remove push rods and **mark positions to ensure installation in original locations.**

(9) Remove the eight head bolts from each cylinder head and remove cylinder heads (Fig. 22).

CLEANING

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.

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

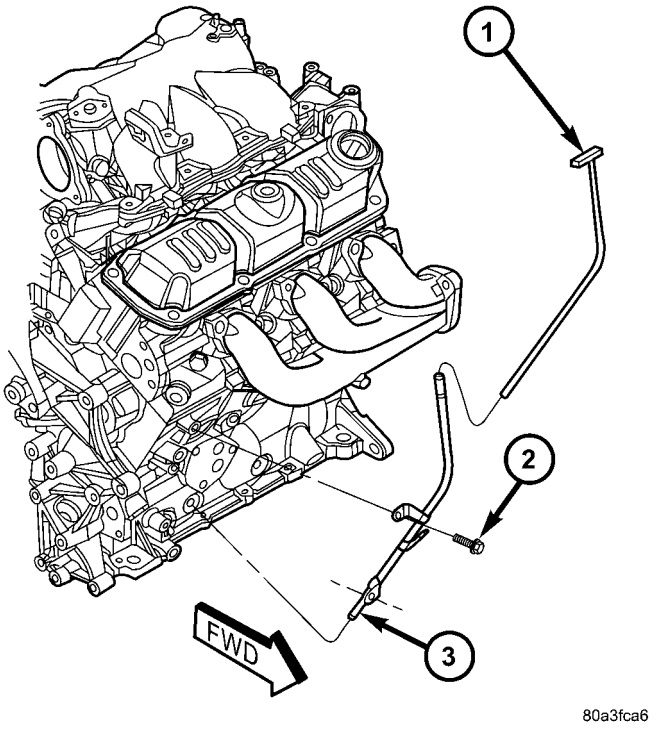


Fig. 18 DIPSTICK & TUBE

1 - DIPSTICK
2 - BOLT
3 - TUBE

Remove all gasket material from cylinder head and block (Refer to 9 - ENGINE - STANDARD PROCEDURE). Be careful not to gouge or scratch the aluminum head sealing surface.

Clean all engine oil passages.

INSPECTION

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

(2) Clean cylinder head and oil passages.

(3) Check cylinder head for flatness (Fig. 19).

(4) Cylinder head must be flat within:

- Standard dimension = less than 0.05 mm (0.002 inch.)
- Service Limit = 0.2 mm (0.008 inch.)
- Grinding Limit = Maximum of 0.2 mm (0.008 inch.) is permitted.

CAUTION: 0.20 mm (0.008 in.) MAX is a combined total dimension of the stock removal limit from cylinder head and block top surface (Deck) together.

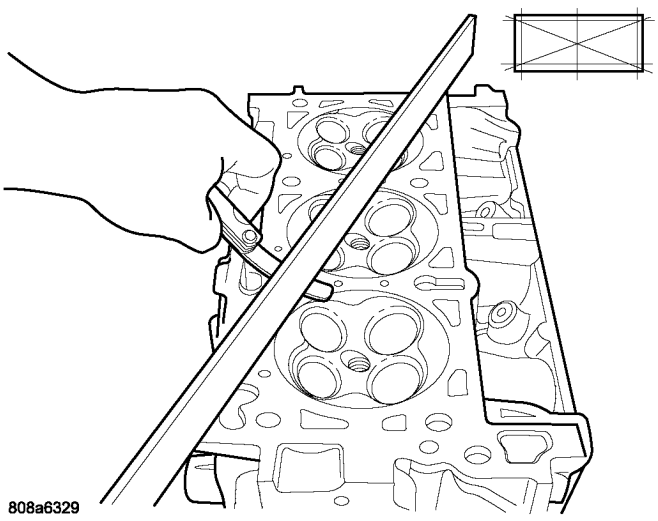


Fig. 19 Checking Cylinder Head Flatness—Typical

INSTALLATION - CYLINDER HEAD

(1) Clean all sealing surfaces of engine block and cylinder heads. (Refer to 9 - ENGINE - STANDARD PROCEDURE)

(2) Position new gasket(s) on engine block (Fig. 20). The left bank gasket is identified with the “L” stamped in the exposed area of the gasket located at front of engine (shown in (Fig. 20)). The right bank gasket is identified with a “R” stamped in the exposed area of the gasket also, but is located at the rear of the engine.

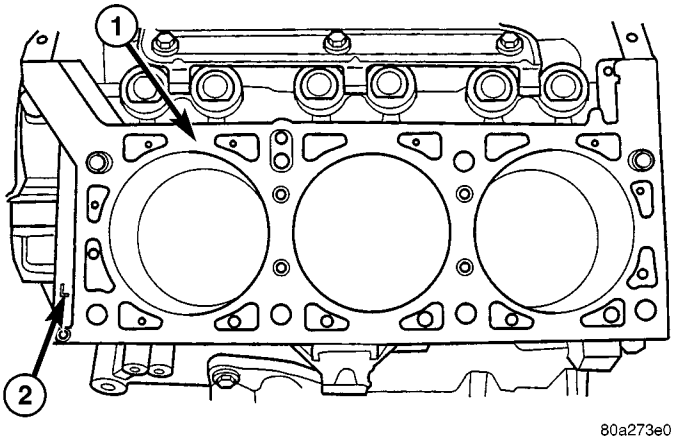


Fig. 20 Head Gasket Installation

1 - CYLINDER HEAD GASKET
2 - LOCATION IDENTIFICATION (L = LEFT BANK, R = RIGHT BANK)

(3) **The cylinder head bolts are torqued using the torque yield method, they should be examined BEFORE reuse. If the threads are necked down, the bolts must be replaced** (Fig. 21).

CYLINDER HEAD (Continued)

(4) Necking can be checked by holding a scale or straight edge against the threads. If all the threads do not contact the scale the bolt should be replaced.

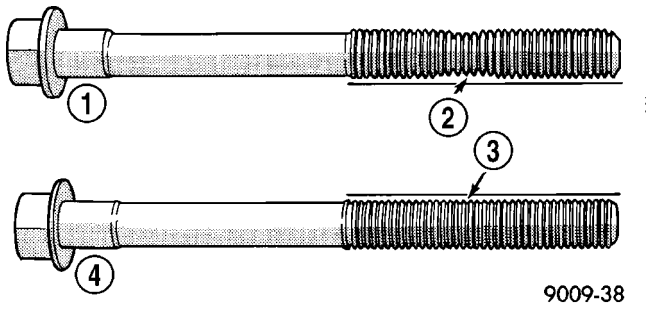


Fig. 21 Checking Bolts for Stretching (Necking)

1 - STRETCHED BOLT
2 - THREADS ARE NOT STRAIGHT ON LINE
3 - THREADS ARE STRAIGHT ON LINE
4 - UNSTRETCHED BOLT

(5) Tighten the cylinder head bolts 1–8 in the sequence shown in (Fig. 22). Using the 4 step torque turn method, tighten according to the following values:

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

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

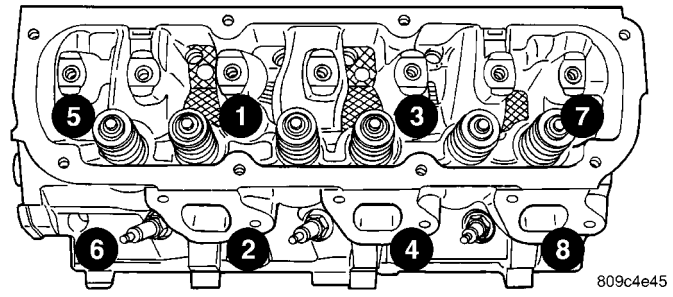


Fig. 22 CYLINDER HEAD TIGHTENING SEQUENCE

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

(7) Install the push rods.

(8) Install the rocker arm and shaft assemblies. (Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARMS - INSTALLATION)

(9) Install the cylinder head covers. (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION)

(10) Install the exhaust manifolds. (Refer to 9 - ENGINE/MANIFOLDS/EXHAUST MANIFOLD - INSTALLATION)

(11) Install new O-ring on dipstick tube. Install dipstick tube assembly (Fig. 18).

(12) Install the spark plugs.

(13) Install upper and lower intake manifolds. (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION)

(14) Fill the cooling system. (Refer to 7 - COOLING - STANDARD PROCEDURE)

(15) Connect negative cable to battery.

CYLINDER HEAD COVER(S)

DESCRIPTION

The cylinder head covers are made of stamped steel. The covers are sealed with steel reinforced silicon rubber gaskets. The cylinder head cover uses rubber isolators at each fastener location (Fig. 23).

NOTE: Due to the tight packaging near the cylinder head covers, which makes spill clean-up difficult, a spill during an engine oil change may be misinterpreted as an oil leak. When investigating an oil leak in the location of the cylinder head covers and intake manifold, follow the procedure found in Oil Leak Diagnosis (Refer to 9 - ENGINE - DIAGNOSIS AND TESTING) for determining the source of a leak.

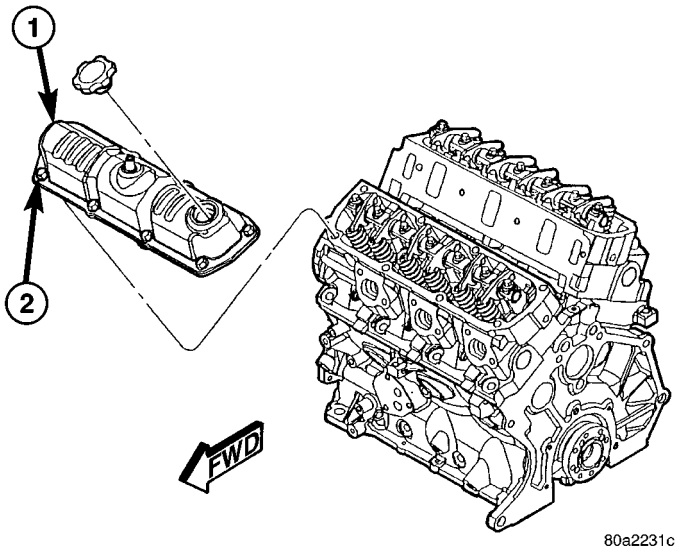


Fig. 23 Cylinder Head Cover

1 - CYLINDER HEAD COVER
2 - BOLT

CYLINDER HEAD COVER - RIGHT

REMOVAL

(1) Disconnect negative cable from battery.
(2) Remove the wiper module. (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER MODULE - REMOVAL)
(3) Disconnect spark plug wires from plugs.
(4) Disconnect PCV hose from cylinder head cover (Fig. 24).
(5) Remove cylinder head cover bolts.
(6) Remove cylinder head cover and gasket (Fig. 23).

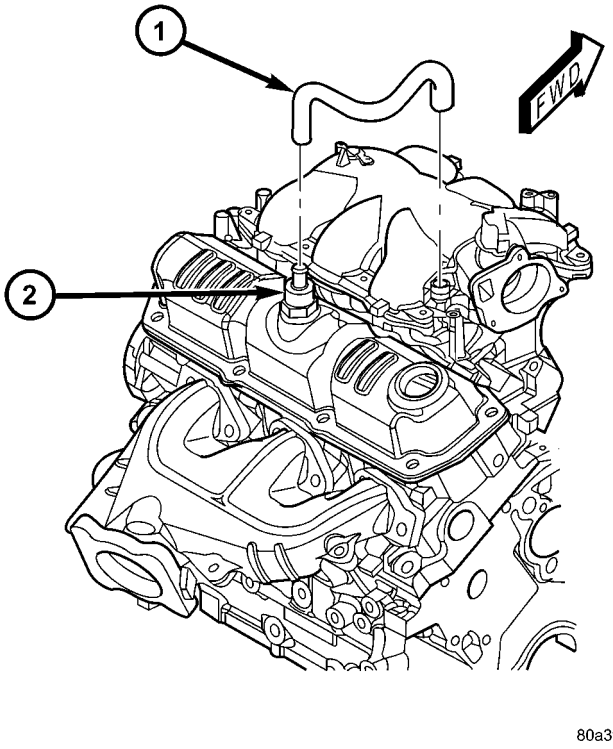


Fig. 24 PCV Hose

1 - HOSE - PCV
2 - PCV VALVE

INSTALLATION

(1) Clean cylinder head and cover mating surfaces. Inspect cylinder head cover surface for flatness. Replace gasket as necessary.
(2) Inspect seal on the cover bolt for wear or damage (Fig. 25). Replace bolt assembly as necessary.

NOTE: The cylinder head cover bolts contain a torque limiter sleeve and a seal (Fig. 25). The seal and torque sleeve is replaced with the bolt.

(3) Assemble gasket to cylinder cover by inserting the bolt assemblies through each bolt hole on the cover and gasket (Fig. 25).

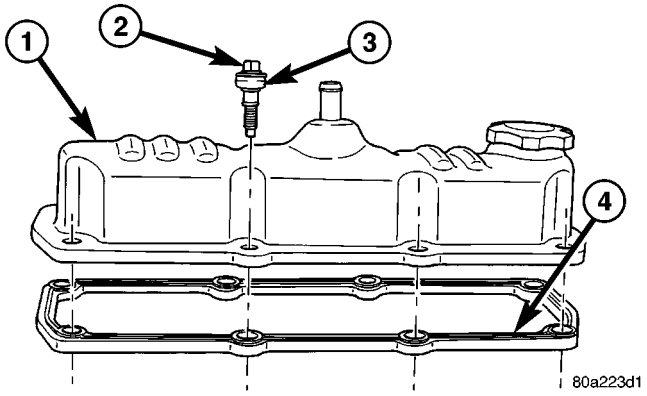


Fig. 25 CYLINDER HEAD COVER GASKET

1 - CYLINDER HEAD COVER
2 - BOLT
3 - SEAL (SERVICED WITH BOLT)
4 - GASKET

(4) Install cylinder head cover and bolts (Fig. 26).
(5) Tighten cylinder head cover bolts to 12 N·m (105 in. lbs.) (Fig. 26).

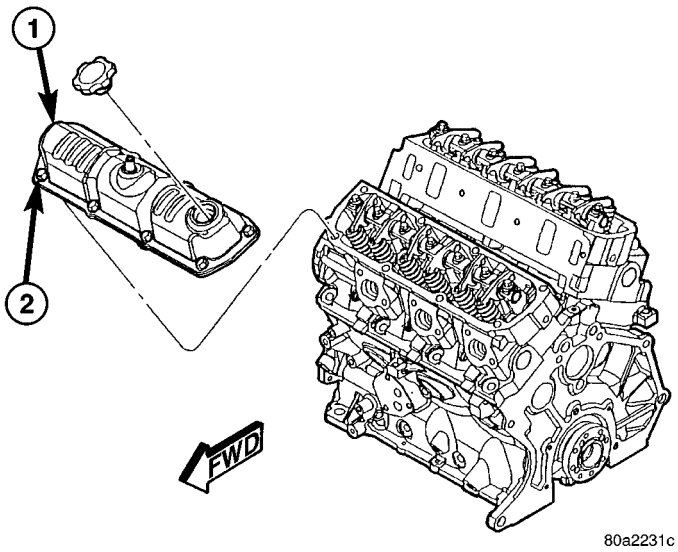


Fig. 26 Cylinder Head Cover

1 - CYLINDER HEAD COVER
2 - BOLT

(6) Connect PCV hose to cylinder head cover.
(7) Connect spark plug wires to spark plugs.
(8) Install wiper module. (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER MODULE - INSTALLATION)
(9) Connect negative cable to battery.

CYLINDER HEAD COVER - LEFT

REMOVAL

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

INSTALLATION

(1) Clean cylinder head and cover mating surfaces. Inspect cylinder head cover surface for flatness. Replace gasket as necessary.
(2) Assemble gasket to cylinder cover by inserting the fasteners through each bolt hole on cover and gasket (Fig. 25).
(3) Install the cylinder head cover and bolts (Fig. 26).
(4) Tighten cylinder head cover bolts to 12 N·m (105 in. lbs.) (Fig. 26).
(5) Connect crankcase vent hose.
(6) Connect spark plug wires to spark plugs.

INTAKE/EXHAUST VALVES & SEATS

DESCRIPTION

The valves have chrome plated valve stems with four-bead lock grooves. The valve stem seals are made of Viton rubber.

OPERATION

The two valves per cylinder are opened using hydraulic lifters, push rods, and rocker arms.

STANDARD PROCEDURE - REFACING VALVES AND VALVE SEATS

The intake and exhaust valves and seats are machined to specific angles (Fig. 27).

VALVES

(1) Inspect the remaining margin after the valves are refaced (Fig. 28). (Refer to 9 - ENGINE - SPECIFICATIONS)

VALVE SEATS

CAUTION: Remove metal from valve seat only. Do not remove material from cylinder head (Fig. 29).

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

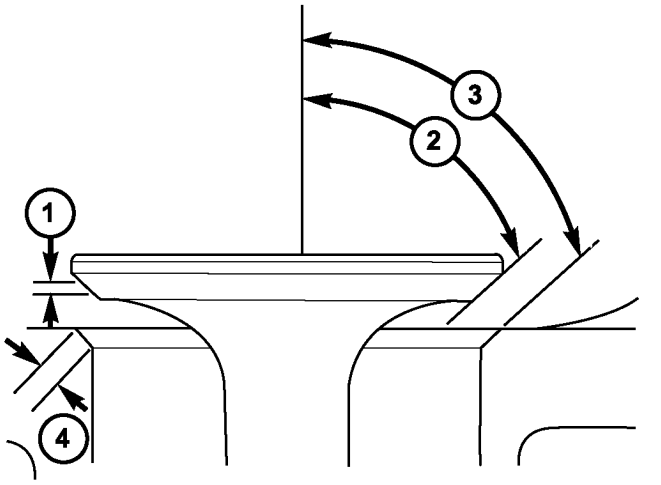


Fig. 27 VALVE FACE AND SEAT

1 - VALVE FACE WIDTH
2 - VALVE FACE ANGLE
3 - SEAT ANGLE
4 - SEAT CONTACT AREA

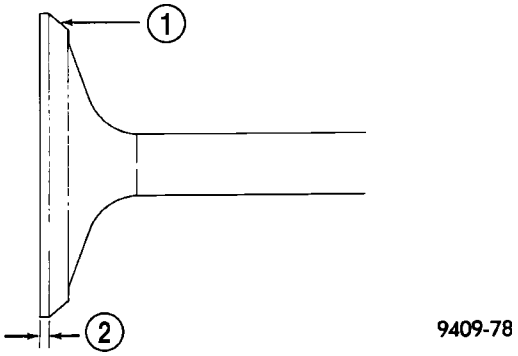


Fig. 28 Valve Margin

1 - VALVE FACE
2 - VALVE MARGIN

(2) Measure the concentricity of valve seat using dial indicator (Fig. 30). Total runout should not exceed 0.051 mm (0.002 in.) total indicator reading.
(3) Inspect the valve seat using Prussian blue to determine where the valve contacts the seat. To do this, coat valve seat **LIGHTLY**with Prussian blue then set valve in place. Rotate the valve with light pressure. If the blue is transferred to the center of valve face, contact is satisfactory. If the blue is transferred to top edge of valve face, lower valve seat with a 15 degree stone. If the blue is transferred to the bottom edge of valve face raise valve seat with a 65 degrees stone.

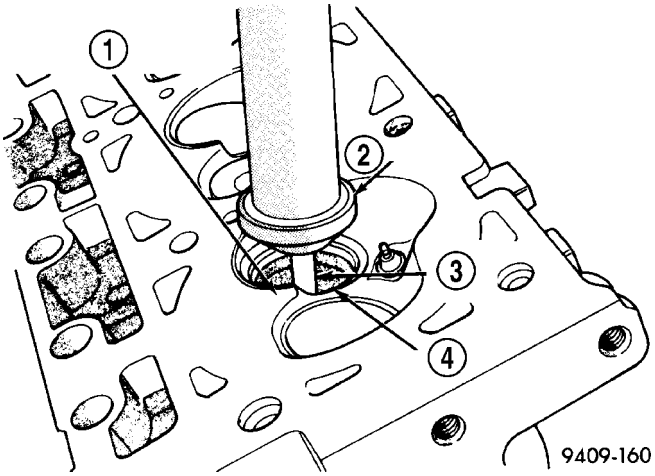


Fig. 29 Refacing Valve Seats

1 - REFACING STONE MUST NOT CUT INTO CYLINDER HEAD
2 - STONE
3 - PILOT
4 - SEAT

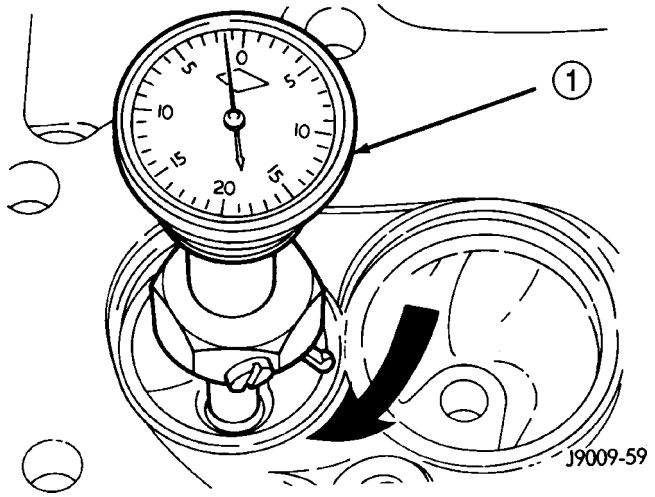


Fig. 30 Measurement of Valve Seat Runout

1 - DIAL INDICATOR

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

(4) When seat is properly positioned the width of intake and exhaust seats should be 1.50–2.00 mm (0.059–0.078 in.) (Fig. 27).

(5) After grinding the valve seats or faces, install the valve in cylinder head and check valve installed height by measuring from valve tip to spring seat (Fig. 31). Remove valve from cylinder head and grind valve tip until within specifications. Check valve tip for scoring. The tip chamfer should be reground (if necessary) to prevent seal damage when the valve is installed.

(6) Check the valve spring installed height after refacing the valve and seat (Fig. 31).

If valves and/or seats are reground, measure the installed height of springs (Fig. 31), make sure measurements are taken from top of spring seat to the bottom surface of spring retainer. If height is greater than specifications, install a 0.794 mm (0.0312 in.) spacer in head counterbore to bring spring height back within specifications.

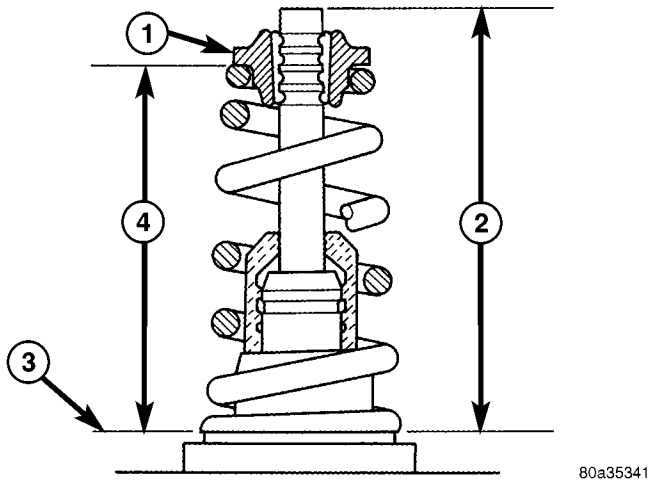


Fig. 31 Checking Valve and Spring Installed Height

1 - SPRING RETAINER
2 - VALVE INSTALLED HEIGHT* - 48.1–49.7 mm (1.89–1.95 in.)
3 - CYINDER HEAD SURFACE
4 - SPRING INSTALLED HEIGHT* - 41.1–42.7 mm (1.61–1.68 in.)
*(MEASURED FROM TOP OF SPRING SEAT)

REMOVAL

(1) With cylinder head removed, compress valve springs using Valve Spring Compressor Tool C-3422-D with adapter 8464 (Refer to 9 - ENGINE - SPECIAL TOOLS).

(2) Remove valve retaining locks.

(3) Slowly release valve spring compressor. Remove valve spring retainer, valve spring, and valve stem seal.

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

CLEANING

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

INSPECTION

VALVES

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

INTAKE/EXHAUST VALVES & SEATS (Continued)

(2) Measure valve stems for wear (Fig. 32). For valve specifications, (Refer to 9 - ENGINE - SPECIFICATIONS).

NOTE: Valve stems are chrome plated and should not be polished (Fig. 32).

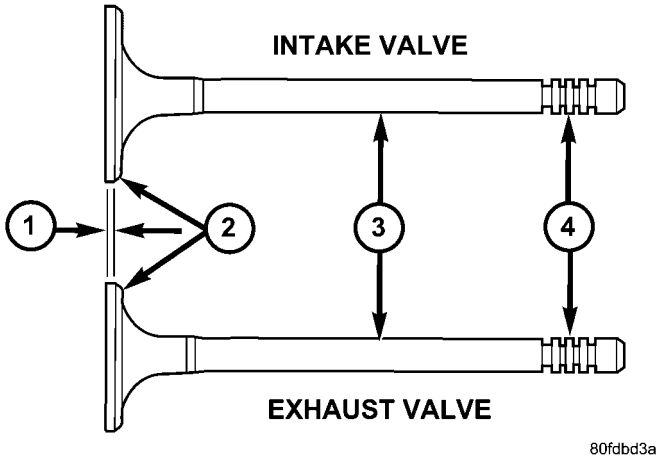


Fig. 32 Intake and Exhaust Valves

1 - MARGIN
2 - FACE
3 - STEM
4 - VALVE SPRING RETAINER LOCK GROOVES

VALVE GUIDES

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

(2) Measure valve stem-to-guide clearance as follows:

(3) Install valve into cylinder head so it is 15 mm (0.590 inch.) off the valve seat. A small piece of hose may be used to hold valve in place.

(4) Attach dial indicator Tool C-3339 to cylinder head and set it at right angle of valve stem being measured (Fig. 33).

(5) Move valve to and from the indicator. For clearance specifications, (Refer to 9 - ENGINE - SPECIFICATIONS).

NOTE: Replace cylinder head if stem-to-guide clearance exceeds specifications, or if guide is loose in cylinder head.

INSTALLATION

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

(2) Install valve spring seat on head (Fig. 35).

(3) Install new seals on all valve stems and over valve guides (Fig. 35). Install valve springs and valve retainers (Fig. 35).

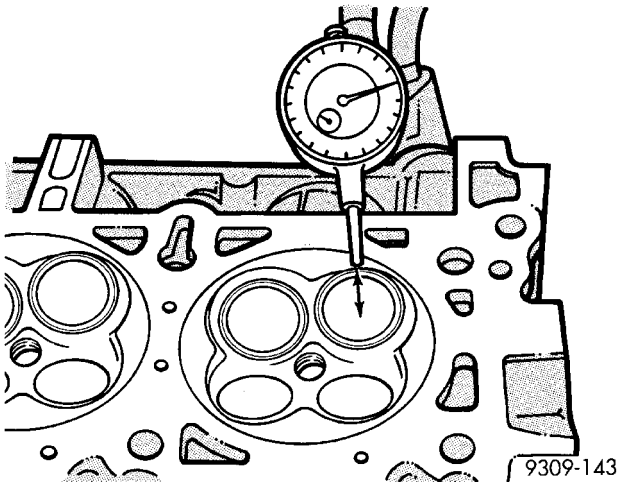


Fig. 33 Measuring Valve Guide Wear - Typical

(4) Install the valve springs. (Refer to 9 - ENGINE/CYLINDER HEAD/VALVE SPRINGS - INSTALLATION)

VALVE SPRINGS

DESCRIPTION

There are two interchangeable, floating (spring rotates during operation), valve spring designs. Type A may be identified by the counterclockwise (spring spirals down and to the left) appearance, And Type B may be identified by the clockwise (spring spirals down and to the right) appearance. Both of the valve springs are a bee-hive shaped design but have different specifications (Fig. 34). The springs are seated on a steel washer on the cylinder head with retainers and locks retaining the springs (Fig. 35). The springs are installed with the smaller diameter against spring retainer (Fig. 34).

OPERATION

The valve spring returns the valve against its seat for a positive seal of the combustion chamber.

REMOVAL

REMOVAL - CYLINDER HEAD OFF

(1) With the cylinder head on a bench, position Special Tool C-3422-D with 8464 Adapter on the valve and spring retainer (Fig. 36).

(2) Compress the spring only enough to remove the valve retainer locks.

(3) Slowly release the spring tension and remove the valve spring and retainer.

(4) For removal of the valve stem seal (Refer to 9 - ENGINE/CYLINDER HEAD/VALVE STEM SEALS - REMOVAL).

VALVE SPRINGS (Continued)

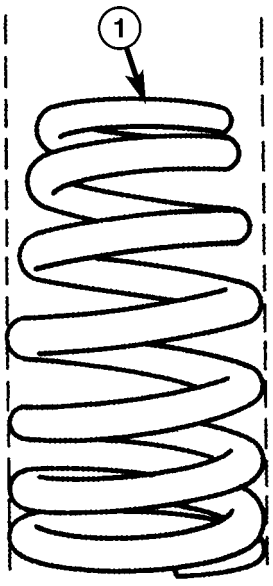


Fig. 34 Valve Spring - Type A

1 - VALVE SPRING (TOP - SMALLER DIAMETER)

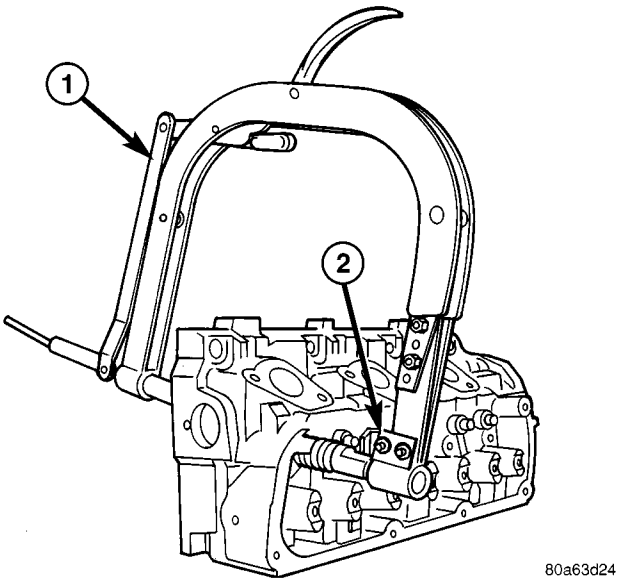


Fig. 36 VALVE SPRING - REMOVE/INSTALL

1 - SPECIAL TOOL C-3422-D SPRING COMPRESSOR
2 - SPECIAL TOOL 8464 ADAPTER

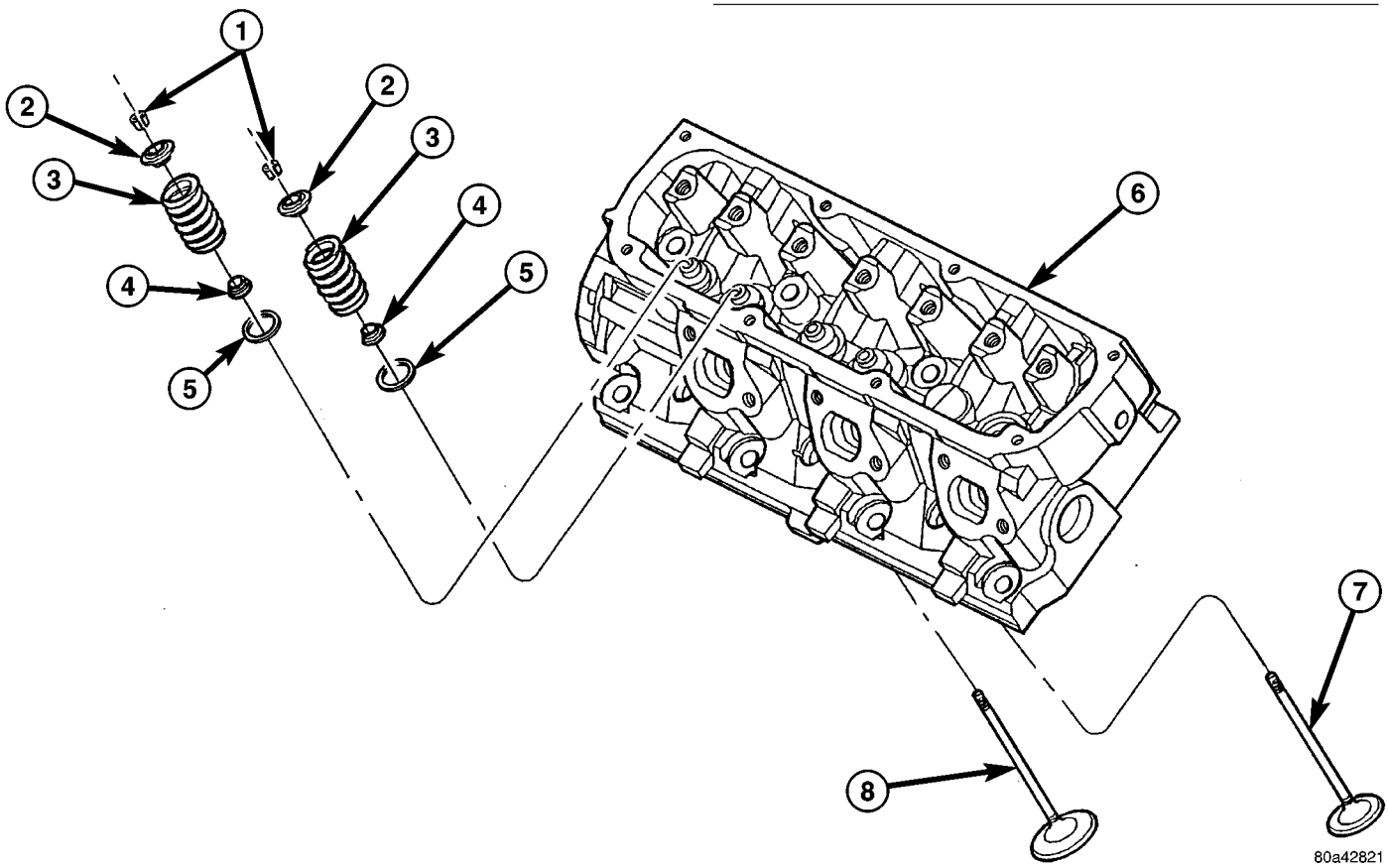


Fig. 35 VALVE COMPONENTS

1 - VALVE LOCKS
2 - RETAINERS
3 - VALVE SPRINGS
4 - VALVE STEM SEALS
5 - SPRING SEATS
6 - CYLINDER HEAD
7 - VALVE - EXHAUST
8 - VALVE - INTAKE

VALVE SPRINGS (Continued)

REMOVAL - CYLINDER HEAD ON

(1) Disconnect negative cable from battery.
(2) Remove spark plug wires and all spark plugs.
(3) Remove cylinder head cover(s). (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL)
(4) Remove rocker arms and shaft. (Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARMS - REMOVAL)
(5) Rotate engine until the piston in the cylinder bore requiring spring removal is at TDC.
(6) Install Special Tool 8453 to the cylinder head (Fig. 37). Tighten the attaching bolts to 23 N·m (200 in. lbs.).
(7) Install a spark plug adapter in the spark plug hole. Connect air hose that can supply 620.5–689 kPa (90–100 psi) of air pressure to adapter. This is to hold valves in place while servicing components.
(8) Locate the forcing screw and spring retainer adapter assembly over the spring requiring removal (Fig. 37).
(9) Slowly turn the forcing screw clockwise (compressing the valve spring) until the valve keepers can be removed.
(10) Turn forcing screw counterclockwise to relieve spring tension. Remove retainer and valve spring.
(11) Repeat procedure for each cylinder requiring valve spring removal.

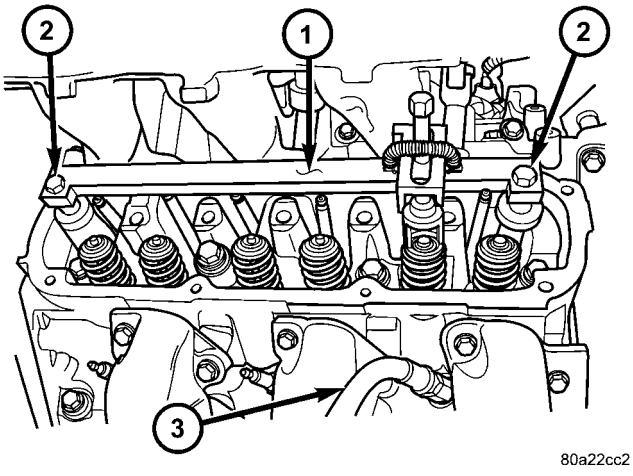


Fig. 37 VALVE SPRING - REMOVE/INSTALL (HEAD ON)

1 - SPECIAL TOOL 8453
2 - BOLTS - SPECIAL TOOL ATTACHING
3 - AIR SUPPLY HOSE ADAPTER

INSPECTION

NOTE: The are two different types of valve springs used that are interchangable, but have different specifications(Refer to 9 - ENGINE/CYLINDER HEAD/VALVE SPRINGS - DESCRIPTION).

Whenever valves have been removed for inspection, reconditioning or replacement, valve springs should be tested (Fig. 38). **As an example;** the compression length of a spring to be tested is 38.00 mm (1.496 in.). Turn the table of Tool C-647 until surface is in line with the 38.00 mm (1.496 in.) mark on the threaded stud and the zero mark on the front. Place spring over stud on the table and lift compressing lever to set tone device. Pull on torque wrench until ping is heard. Take reading on torque wrench at this instant. Multiply this reading by two. This will give the spring load at test length. Fractional measurements are indicated on the table for finer adjustments. Refer to Engine Specifications to obtain specified height and allowable tensions (Refer to 9 - ENGINE - SPECIFICATIONS). Replace any springs that do not meet specifications.

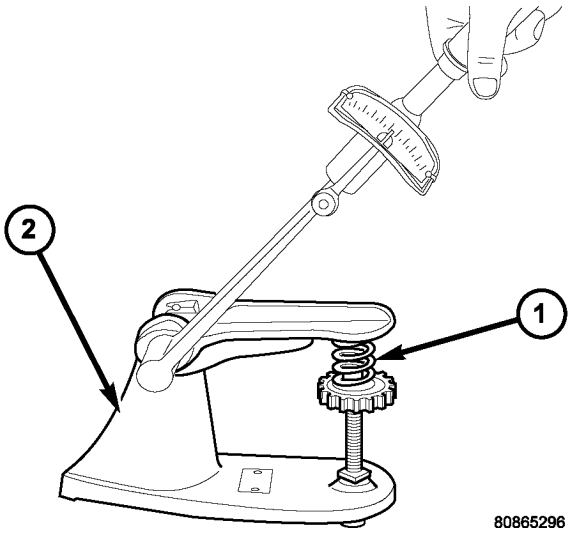


Fig. 38 TESTING VALVE SPRING

1 - SPECIAL TOOL C-647

INSTALLATION

INSTALLATION - CYLINDER HEAD OFF

(1) If removed, install a new valve stem seal (Refer to 9 - ENGINE/CYLINDER HEAD/VALVE STEM SEALS - INSTALLATION).
(2) Position valve spring and retainer on spring seat.
(3) Using Special Tool C-3422-D with 8464 Adapter (Fig. 36), compress the spring only enough to install the valve retainer locks. Install valve retainer locks.
(4) Slowly release the spring tension. Ensure the retainer locks are seated properly (Fig. 39).

INSTALLATION - CYLINDER HEAD ON

(1) The intake valve stem seals should be pushed firmly and squarely over the valve guide using the

VALVE SPRINGS (Continued)

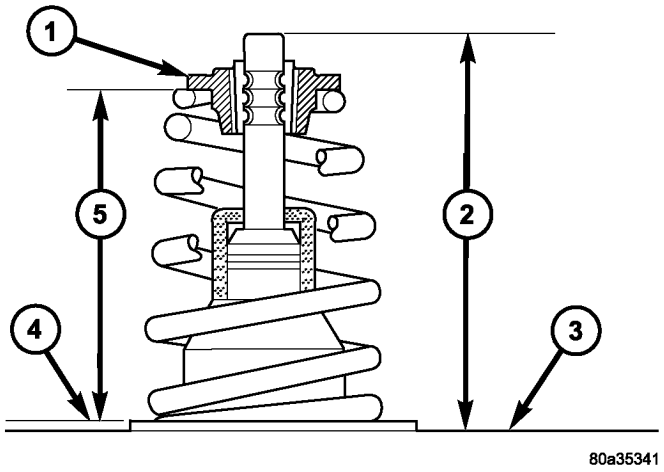


Fig. 39 VALVE SPRING INSTALLED

1 - VALVE SPRING RETAINER
2 - VALVE INSTALLED HEIGHT
3 - CYLINDER HEAD SURFACE
4 - VALVE SPRING SEAT SURFACE
5 - VALVE SPRING INSTALLED HEIGHT

valve stem as guide. **Do Not Force** seal against top of guide. When installing the valve retainer locks, compress the spring **only enough** to install the locks (Fig. 39).

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

(2) Follow the same procedure on the remaining 5 cylinders using the firing sequence 1-2-3-4-5-6. **Make sure piston in cylinder is at TDC on the valve spring that is being covered.**

(3) Remove spark plug adapter tool.

(4) Install rocker arms and shaft assembly. (Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARMS - INSTALLATION)

(5) Install cylinder head covers. (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION)

(6) Install spark plugs and connect wires.

(7) Connect negative cable to battery.

ROCKER ARMS

DESCRIPTION

DESCRIPTION - ROCKER ARMS

The rocker arms are installed on the rocker arm shaft. The rocker arms and shaft assembly is attached to the cylinder head with seven billeted bolts and retainers. The rocker arms are made of stamped steel.

DESCRIPTION - PUSHRODS

The pushrods are made of steel and are a hollow design. The pushrods are positioned between the hydraulic lifter and the rocker arm.

OPERATION

OPERATION - ROCKER ARMS

The rocker arm pivots on the rocker shaft. Rocker arms are used to translate up and down motions provided by the camshaft, hydraulic lifter, and pushrod on one end, into a down and up motions on the valve stem on the opposing end.

OPERATION - PUSHRODS

The pushrod is a solid link between the hydraulic lifter and the rocker arm. Also, the pushrod supplies engine oil from the hydraulic lifter to the rocker arm.

REMOVAL - ROCKER ARMS AND SHAFT

(1) Remove the cylinder head cover(s). (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL)

NOTE: Rocker arm shaft bolts are captured to the shaft.

(2) Loosen the rocker shaft bolts (Fig. 40), rotating one turn each, until all valve spring pressure is relieved.

(3) Remove the rocker arms and shaft assembly (Fig. 40).

(4) For rocker arm disassembly procedures, (Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARMS - DISASSEMBLY).

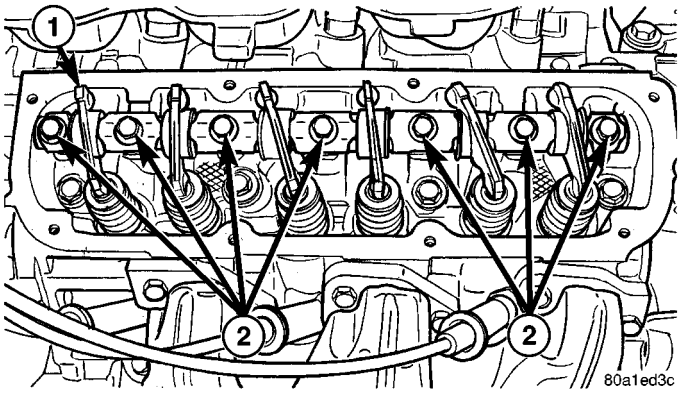


Fig. 40 ROCKER ARMS AND SHAFT

1 - ROCKER ARMS AND SHAFT ASSEMBLY
2 - ROCKER SHAFT BOLTS

ROCKER ARMS (Continued)

DISASSEMBLY - ROCKER ARMS AND SHAFT

CAUTION: Do not attempt to drive the billeted bolt from the rocker shaft. This can damage the rocker arm retainer and bolt assembly.

(1) Remove the rocker arm retainer and bolt by performing the following procedure:

(a) Using adjustable pliers, grip the edges of the retainer (Fig. 41).

(b) Apply an upward force with a slight rocking motion until the retainer disengages from shaft (Fig. 41).

(2) Remove rocker arms (Fig. 42). Identify the component locations for reassembly in original locations.

ASSEMBLY - ROCKER ARMS AND SHAFT

(1) Install rocker arms on the shaft (Fig. 42). Install in the orginal positions if re-used. **Ensure** the rocker shaft, all the retainers and washers are properly positioned and installed in the correct locations (Fig. 42).

(2) Install rocker arms and shaft to the cylinder head. (Refer to 9 - ENGINE/CYLINDER HEAD/ ROCKER ARMS - INSTALLATION)

INSTALLATION - ROCKER ARMS AND SHAFT

CAUTION: Ensure the longer shaft retaining bolt is installed in the proper location on the rocker shaft. (Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARMS - ASSEMBLY)

(1) Position the rocker arm and shaft assemblies on the pedestal mounts.

CAUTION: Ensure all pushrods are properly located on the lifter and the rocker arm socket.

(2) Align each rocker arm socket with each pushrod end.

CAUTION: The rocker arm shaft should be tightened down slowly, starting with the center bolts. Allow 20 minutes lifter bleed down time after installation of the rocker shafts before engine operation.

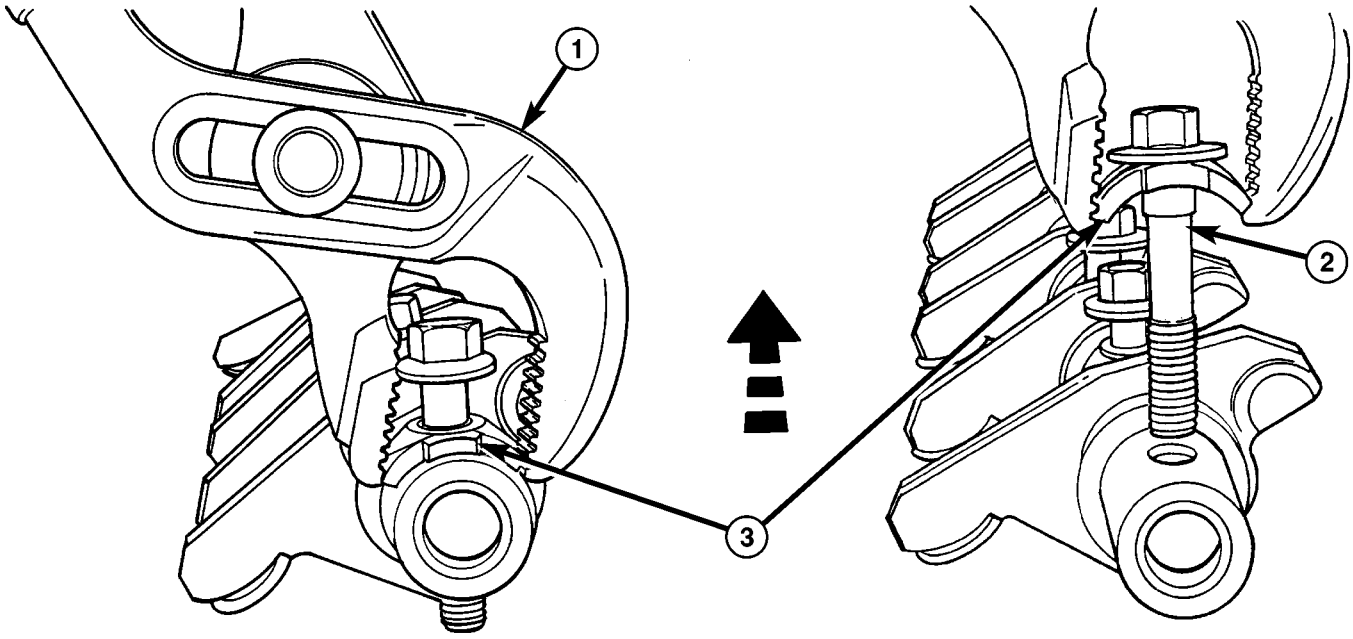


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Fig. 41 ROCKER ARM RETAINER - REMOVAL

1 - ADJUSTABLE PLIERS
2 - BILLETED ROCKER SHAFT BOLT
3 - ROCKER ARM RETAINER

ROCKER ARMS (Continued)

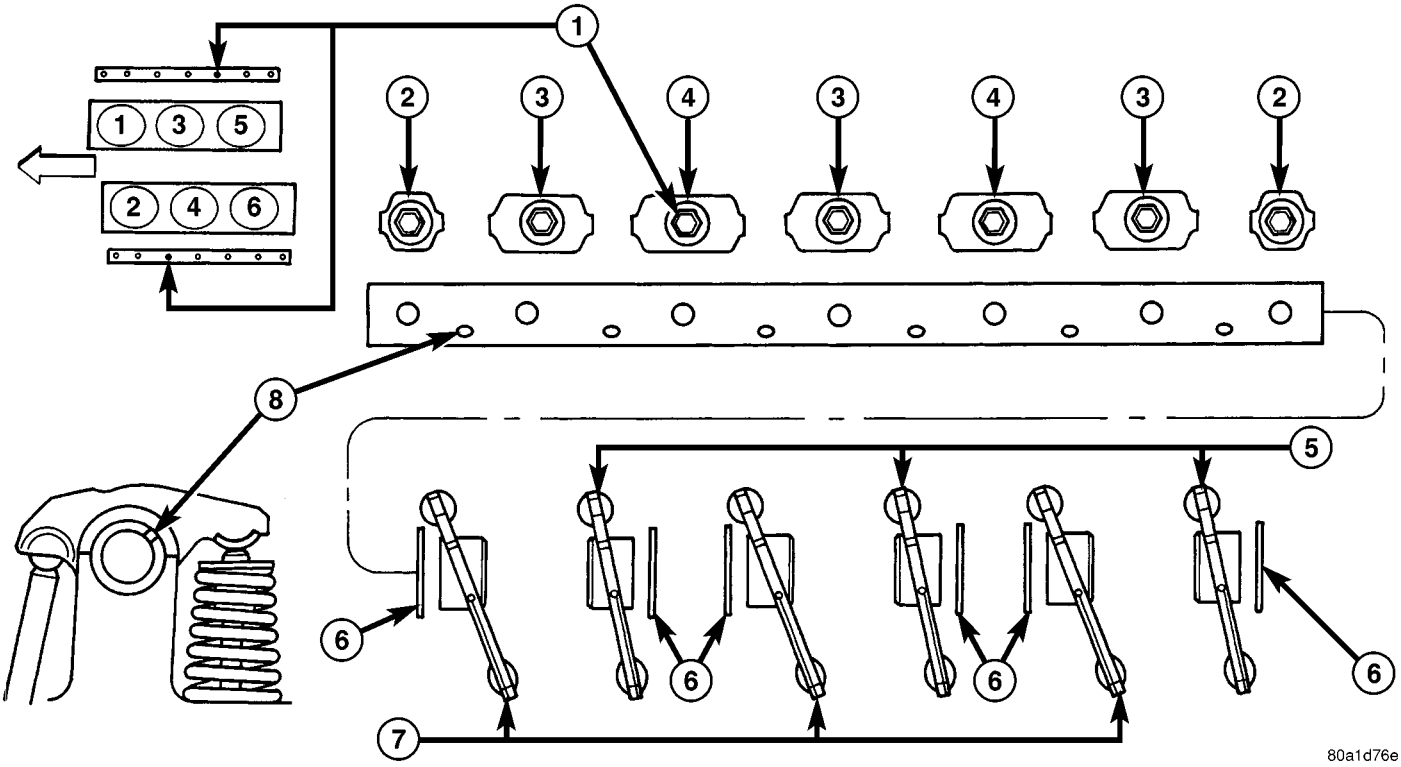

Fig. 42 ROCKER ARMS AND SHAFT

1 - BOLT (ROCKER SHAFT OIL FEED - LONGER LENGTH)
2 - SHAFT RETAINER/SPACER - 21.5 mm (0.84 in.)
3 -SHAFT RETAINER/SPACER - 37.5 mm (1.47 in.)
4 - SHAFT RETAINER/SPACER - 40.9 mm (1.61 in.)
5 - ROCKER ARM - EXHAUST
6 - WASHER
7 - ROCKER ARM - INTAKE (LARGER OFFSET)
8 - ROCKER ARMS LUBRICATION FEED HOLE (POSITION UPWARD & TOWARD VALVE SPRING)

(3) Slowly tighten rocker shaft bolts evenly until shaft is seated. Tighten bolts to 23 N·m (200 in. lbs.) (Fig. 43).

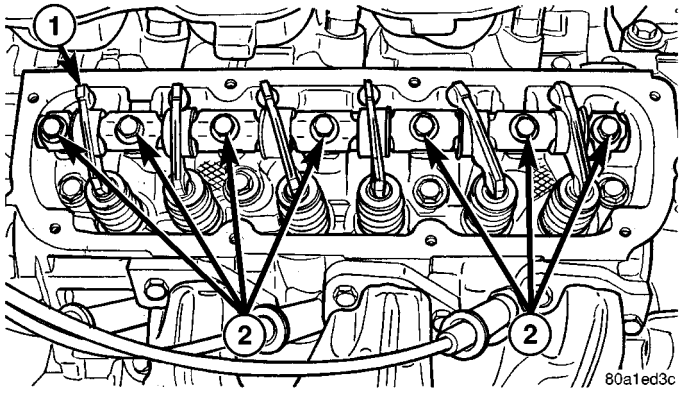

Fig. 43 ROCKER ARMS AND SHAFT

1 - ROCKER ARMS AND SHAFT ASSEMBLY
2 - ROCKER SHAFT BOLTS

(4) Install the cylinder head cover(s). (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION)

VALVE STEM SEALS

DESCRIPTION

The valve stem seals are made of Viton rubber. The seals are positioned over the valve stem and seated on the valve guide (Fig. 44).

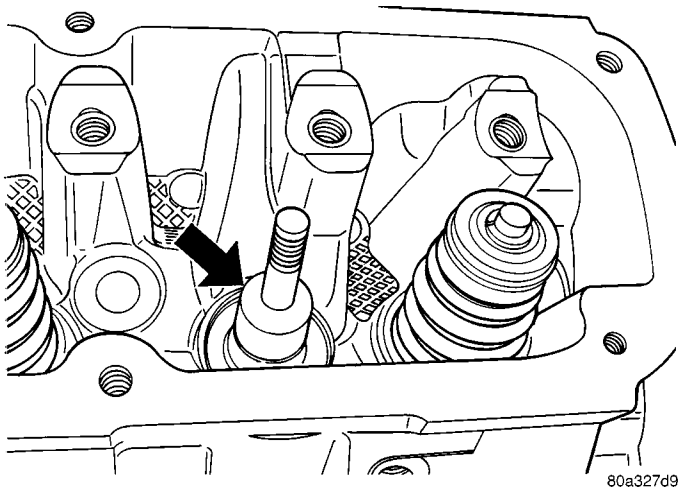

Fig. 44 Valve Stem Seal

VALVE STEM SEALS (Continued)

REMOVAL

(1) Remove the valve springs. (Refer to 9 - ENGINE/CYLINDER HEAD/VALVE SPRINGS - REMOVAL)

(2) Remove the valve stem seal (Fig. 44).

INSTALLATION

(1) Install the valve stem seal squarely over the valve guide, using the valve stem as a guide (Fig. 44). Do not force the seal against top of the valve guide.

(2) Install the valve spring. (Refer to 9 - ENGINE/CYLINDER HEAD/VALVE SPRINGS - INSTALLATION)

ENGINE BLOCK

DESCRIPTION

The cylinder block is made of cast iron and is a deep skirt design.

STANDARD PROCEDURE - 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. Use a light honing oil. **Do not use engine or transmission oil, mineral spirits or kerosene.** Inspect cylinder walls after each 20 strokes.

(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 40-60 degrees, the cross hatch angle is most satisfactory for proper seating of rings (Fig. 45).

(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 40–60 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.

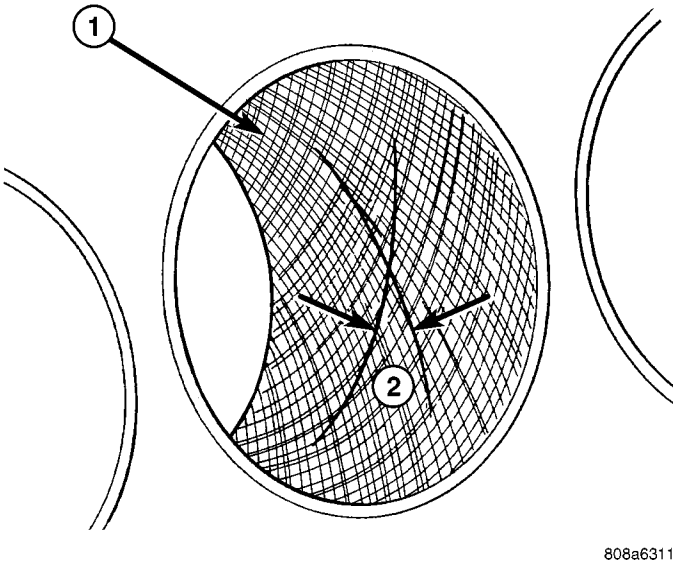

Fig. 45 Cylinder Bore Cross-Hatch Pattern

1 - CROSS-HATCH PATTERN
2 - 40°–60°

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.

CLEANING

Clean cylinder block thoroughly using a suitable cleaning solvent.

INSPECTION

ENGINE BLOCK

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

(2) If new core plugs are to be installed, (Refer to 9 - ENGINE - STANDARD PROCEDURE - ENGINE CORE AND OIL GALLERY PLUGS).

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

(4) Check block deck surfaces for flatness. Deck surface must be within service limit of 0.1 mm (0.004 in.).

CYLINDER BORE

NOTE: The cylinder bores should be measured at normal room temperature, 21°C (70°F).

The cylinder walls should be checked for out-of-round and taper with Tool C119 or equivalent (Fig.

ENGINE BLOCK (Continued)

46) (Refer to 9 - ENGINE - SPECIFICATIONS). If the cylinder walls are badly scuffed or scored, the cylinder block should be replaced, and new pistons and rings fitted.

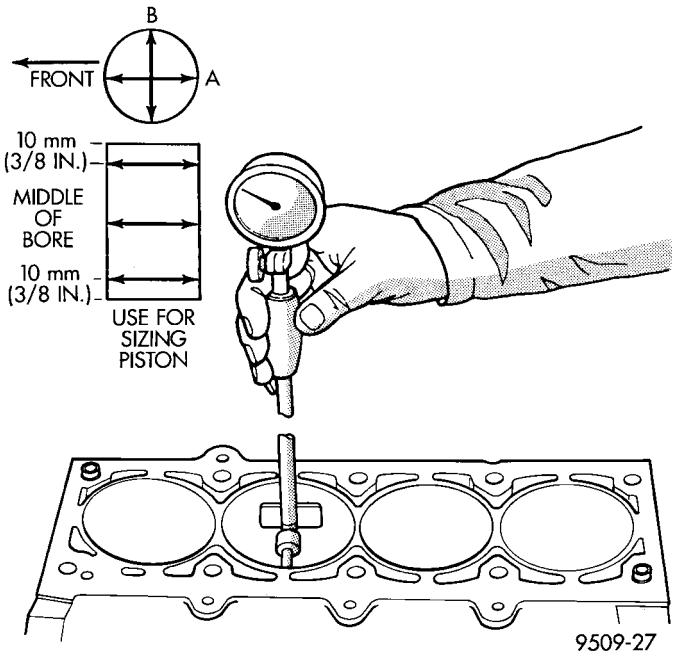

Fig. 46 Checking Cylinder Bore Size

Measure the cylinder bore at three levels in directions A and B (Fig. 46). Top measurement should be 10 mm (3/8 in.) down and bottom measurement should be 10 mm (3/8 in.) up from bottom of bore. (Refer to 9 - ENGINE - SPECIFICATIONS).

HYDRAULIC LIFTERS (CAM IN BLOCK)

DESCRIPTION

The hydraulic lifters are a roller type design and are positioned in the cylinder block. The lifters are aligned and retained by a yoke and a retainer (Fig. 48).

Lifter alignment is maintained by machined flats on lifter body. Lifters are fitted in pairs into six aligning yokes. The aligning yokes are secured by a yoke retainer (Fig. 48).

DIAGNOSIS AND TESTING - HYDRAULIC LIFTERS

HYDRAULIC LIFTERS DIAGNOSIS - PRELIMINARY STEP

Before disassembling any part of the engine to correct lifter noise, check the engine oil pressure. (Refer to 9 - ENGINE/LUBRICATION - DIAGNOSIS AND TESTING)

Check engine oil level. The oil level in the pan should never be above the MAX mark on dipstick, or below the MIN mark. Either of these two conditions could cause noisy lifters.

OIL LEVEL TOO HIGH

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

OIL LEVEL TOO LOW

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

VALVE TRAIN NOISE

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

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

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

HYDRAULIC LIFTERS (CAM IN BLOCK) (Continued)

REMOVAL

(1) Remove the cylinder head(s). (Refer to 9 - ENGINE/CYLINDER HEAD - REMOVAL)

(2) Remove the yoke retainer and aligning yokes (Fig. 48).

(3) Remove the hydraulic lifters. If necessary use Special Tool C-4129, or equivalent to remove lifters from bores. If lifters are to be reused, identify each lifter to ensure installation in original location.

INSTALLATION

(1) Lubricate the lifters with engine oil.

NOTE: Position the lifter in bore with the lubrication hole facing upward (Fig. 47).

(2) Install the hydraulic lifters with the lubrication hole facing upward towards middle of block (Fig. 47). Install lifters in original positions, if reused.

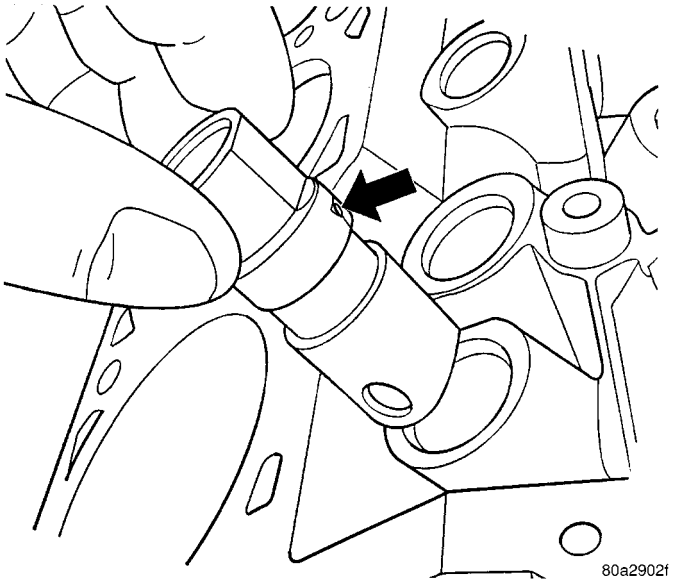

Fig. 47 LIFTER LUBRICATION HOLE

(3) Install lifter aligning yokes (Fig. 48).

(4) Install yoke retainer and torque screws to 12 N·m (105 in. lbs.) (Fig. 48).

(5) Install the cylinder heads. (Refer to 9 - ENGINE/CYLINDER HEAD - INSTALLATION)

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

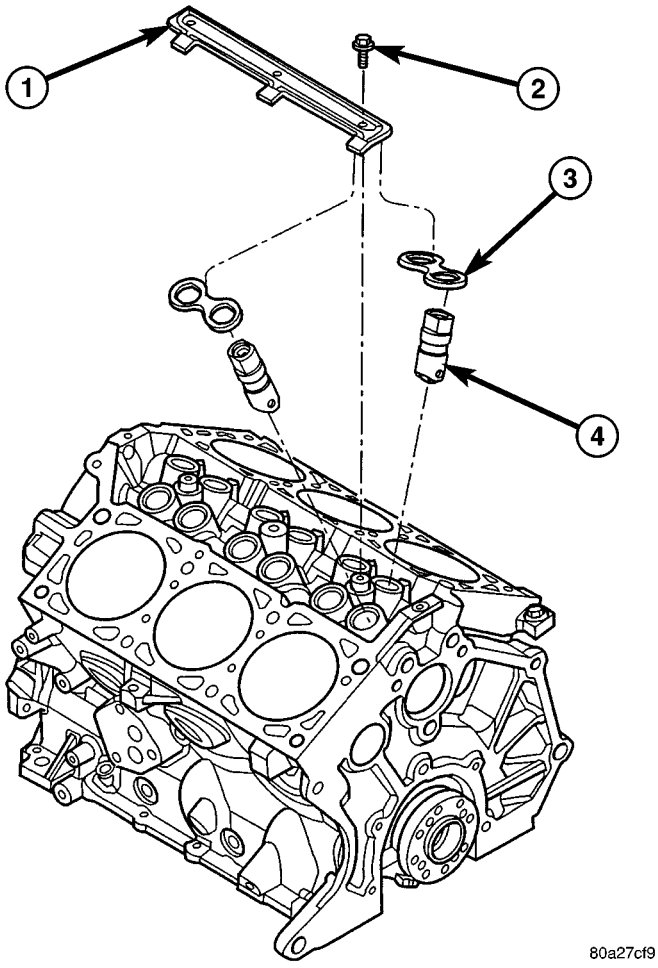

Fig. 48 Lifter Aligning Yoke and Retainer

1 - YOKE RETAINER
2 - BOLT - YOKE RETAINER
3 - ALIGNING YOKE
4 - HYDRAULIC LIFTER

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

CAMSHAFT & BEARINGS (IN BLOCK)

DESCRIPTION

The nodular iron camshaft is mounted in the engine block and supported with four steel backed aluminum bearings (Fig. 49). A thrust plate, located in front of the first bearing, is bolted to the block and controls the camshaft end play (Fig. 49). To distinguish camshafts between the 3.3L and 3.8L engines, a cast-in ring is located between the rear bearing journal and rear lobe (Fig. 50). The 3.3L engine application is as-cast only. The 3.8L engine application the cast ring is machined off.

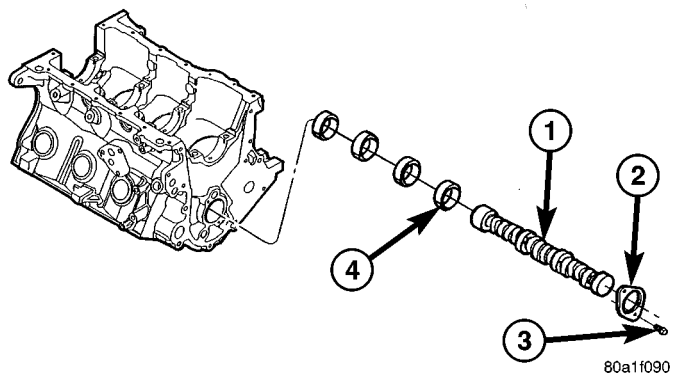

Fig. 49 CAMSHAFT AND BEARINGS

1 - CAMSHAFT
2 - THRUST PLATE
3 - BOLT
4 - CAMSHAFT BEARINGS (SERVICED WITH BLOCK)

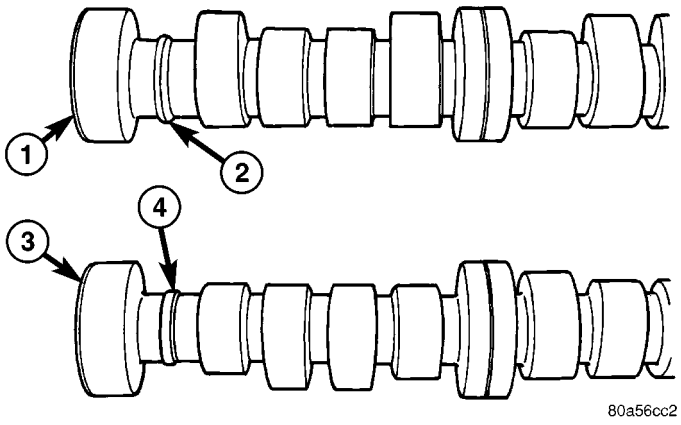

Fig. 50 CAMSHAFT IDENTIFICATION

1 - CAMSHAFT - 3.3L ENGINE
2 - CAST-IN RING
3 - CAMSHAFT - 3.8L ENGINE
4 - MACHINED CAST-IN RING

OPERATION

The camshaft is driven by the crankshaft through a timing chain and sprockets. The camshaft has precisely machined (egg-shaped) lobes to provide accurate valve timing and duration.

REMOVAL

(1) Remove the engine assembly from vehicle (Refer to 9 - ENGINE - REMOVAL).

(2) Remove the cylinder heads (Refer to 9 - ENGINE/CYLINDER HEAD - REMOVAL).

(3) Remove the timing chain and camshaft sprocket (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).

(4) Remove the hydraulic lifters (Refer to 9 - ENGINE/ENGINE BLOCK/HYDRAULIC LIFTERS (CAM IN BLOCK) - REMOVAL). Identify each tappet for reinstallation in original location.

(5) Remove camshaft thrust plate (Fig. 49).

(6) Install a long bolt into front of camshaft to facilitate removal of the camshaft.

(7) Remove the camshaft (Fig. 49), being careful not to damage cam bearings with the cam lobes.

NOTE: The camshaft bearings are serviced with the engine block.

INSPECTION

(1) Check the cam lobes and bearing surfaces for abnormal wear and damage (Fig. 51). Replace camshaft as required.

NOTE: If camshaft is replaced due to lobe wear or damage, always replace the lifters.

(2) Measure the lobe actual wear (unworn area - wear zone = actual wear) (Fig. 51) and replace camshaft if out of limit. Standard value is 0.0254 mm (0.001 in.), wear **limit** is 0.254 mm (0.010 in.).

INSTALLATION

(1) Lubricate camshaft lobes and camshaft bearing journals with engine oil.

(2) Install a long bolt into the camshaft to assist in the installation of the camshaft.

(3) Carefully install the camshaft in engine block.

(4) Install camshaft thrust plate and bolts (Fig. 49). Tighten to 12 N·m (105 in. lbs.) torque.

(5) Measure camshaft end play. (Refer to 9 - ENGINE - SPECIFICATIONS) If not within specifications, replace thrust plate.

(6) Install the timing chain and sprockets. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION)

CAMSHAFT & BEARINGS (IN BLOCK) (Continued)

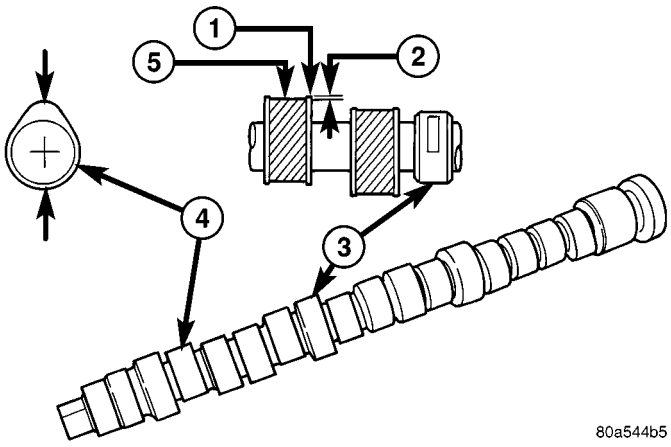

Fig. 51 Checking Camshaft for Wear (Typical)

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

NOTE: When camshaft is replaced, all of the hydraulic lifters must be replaced also.

(7) Install the hydraulic lifters (Refer to 9 - ENGINE/ENGINE BLOCK/HYDRAULIC LIFTERS (CAM IN BLOCK) - INSTALLATION). Each lifter reused must be installed in the same position from which it was removed.

(8) Install the timing chain cover. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION)

(9) Install the cylinder heads. (Refer to 9 - ENGINE/CYLINDER HEAD - INSTALLATION)

(10) Install the cylinder head covers. (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION)

(11) Install the lower and upper intake manifolds. (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION)

(12) Install the engine assembly. (Refer to 9 - ENGINE - INSTALLATION)

PISTON & CONNECTING ROD

DESCRIPTION

The pistons are made of cast aluminum alloy and are a strutless, short skirt design. The piston rings consist of two compression rings and a three piece oil ring. Piston pins connect the piston to the forged steel connecting rods. The piston pins are a press fit into the connecting rod.

STANDARD PROCEDURE

STANDARD PROCEDURE - FITTING CONNECTING RODS

The bearing caps are not interchangeable or reversible, and should be marked at removal to ensure correct reassembly. The bearing shells must be installed with the tangs inserted into the machined grooves in the rods and caps. Install cap with the tangs on the same side as the rod. For connecting rod bearing fitting (Refer to 9 - ENGINE/ENGINE BLOCK/CONNECTING ROD BEARINGS - STANDARD PROCEDURE). Fit all connecting rods on one bank until complete.

NOTE: The connecting rod cap bolts should be examined before reuse. Bolt stretch can be checked by holding a scale or straight edge against the threads. If all the threads do not contact the scale the bolt must be replaced (Fig. 52).

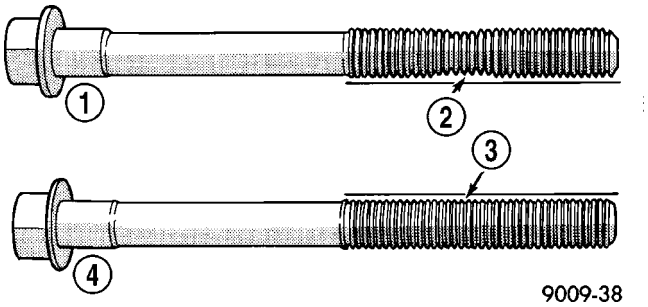

Fig. 52 Check for Stretched (Necked) Bolts

1 - STRETCHED BOLT
2 - THREADS ARE NOT STRAIGHT ON LINE
3 - THREADS ARE STRAIGHT ON LINE
4 - UNSTRETCHED BOLT

PISTON & CONNECTING ROD (Continued)

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

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

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

(4) Using a feeler gauge, check connecting rod side clearance (Fig. 53). Refer to Engine Specifications (Refer to 9 - ENGINE - SPECIFICATIONS).

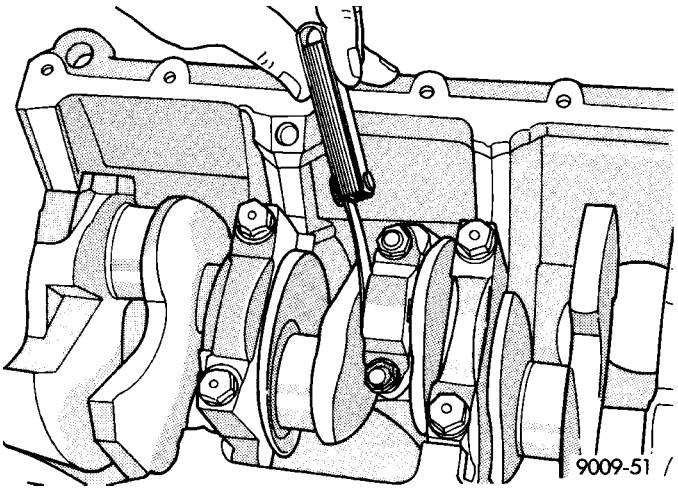

Fig. 53 Checking Connecting Rod Side Clearance

STANDARD PROCEDURE - FITTING PISTONS

The piston and cylinder wall must be clean and dry. Piston diameter should be measured 90 degrees to piston pin at size location shown in (Fig. 54). Cylinder bores should be measured halfway down the cylinder bore and transverse to the engine crankshaft center line shown in (Fig. 55). Refer to Engine Specifications (Refer to 9 - ENGINE - SPECIFICATIONS). **Pistons and cylinder bores should be measured at normal room temperature, 21°C (70°F).**

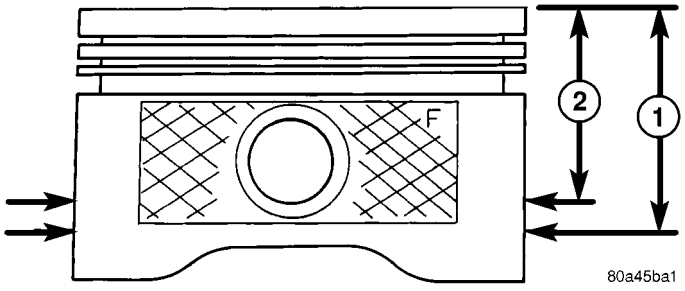

Fig. 54 Piston Measurement Locations - Typical

1 - 39.8 mm (1.56 in.) 3.3L ENGINE
2 - 33.0 mm (1.29 in.) 3.8L ENGINE

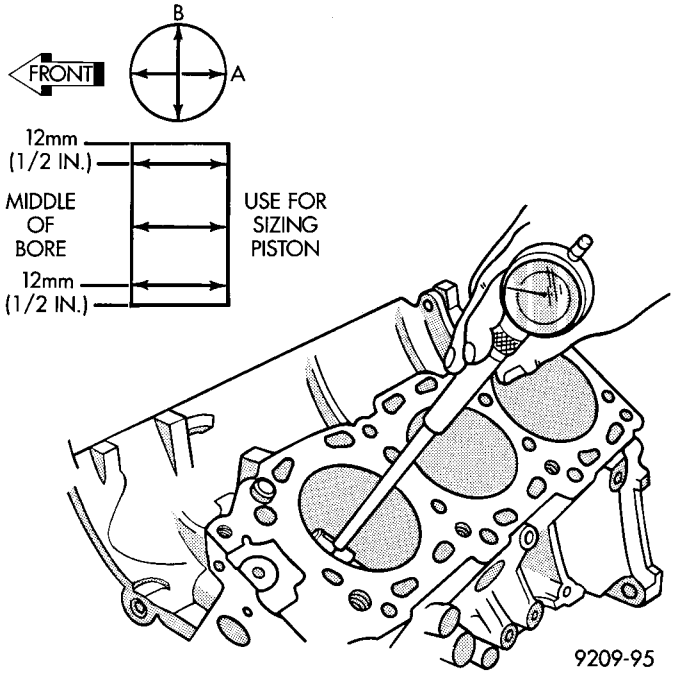

Fig. 55 Checking Cylinder Bore Size

REMOVAL

(1) Disconnect negative cable from battery.

(2) Remove the cylinder heads. (Refer to 9 - ENGINE/CYLINDER HEAD - REMOVAL)

(3) Remove the oil pan. (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL)

(4) Remove the top ridge of cylinder bores with a reliable ridge reamer, if necessary, before removing pistons from cylinder block. **Be sure to keep tops of pistons covered during this operation. Pistons and connecting rods must be removed from top of cylinder block. When removing piston and connecting rod assemblies from the engine, rotate crankshaft so that each connecting rod is centered in cylinder bore.**

(5) Inspect connecting rods and connecting rod caps for cylinder identification. Identify them, if necessary (Fig. 56).

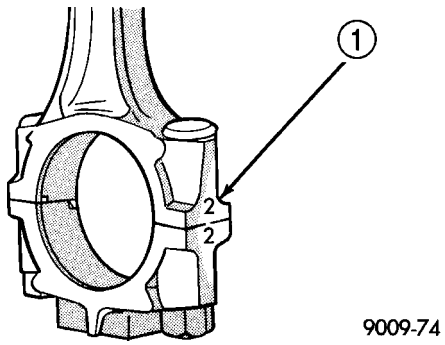

Fig. 56 Identify Connecting Rod to Cylinder

1 - CYLINDER NUMBER

PISTON & CONNECTING ROD (Continued)

(6) Remove connecting rod cap. Install connecting rod bolt protectors on connecting rod bolts (Fig. 57).

(7) Remove each piston and connecting rod assembly out of the cylinder bore.

NOTE: Be careful not to nick crankshaft journals.

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

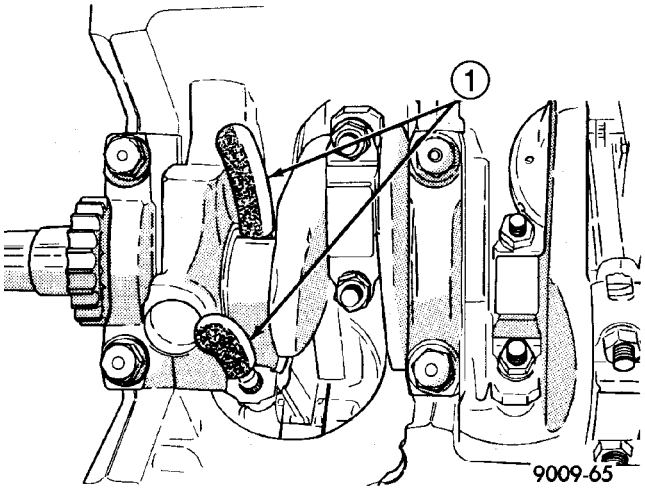

Fig. 57 Connecting Rod Protectors

1 - COVER ROD BOLTS WITH A SUITABLE COVERING WHEN REMOVING OR INSTALLING PISTON ASSEMBLY

INSTALLATION

(1) Before installing pistons and connecting rod assemblies into the bore, ensure that compression ring gaps are staggered so that neither is in line with oil ring rail gap (Fig. 58).

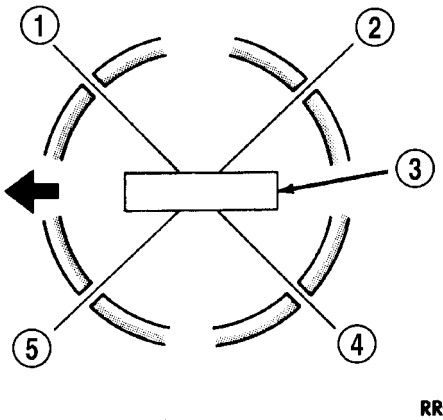

Fig. 58 Piston Ring End Gap Position

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

(2) Before installing the ring compressor, ensure the oil ring expander ends are butted and the rail gaps located as shown in (Fig. 58).

(3) Lubricate the piston and rings with clean engine oil. Position a ring compressor over the piston and rings, and tighten the compressor (Fig. 59). **Be sure position of rings does not change during this operation.**

(4) Position upper bearing onto connecting rod. Lubricate bearing with oil.

(5) Install connecting rod bolt protectors (rubber hose or equivalent) on the connecting rod bolts (Fig. 59).

(6) The pistons are marked with a “F” located near the piston pin. Install piston with this mark positioned to front of engine on both cylinder banks. The connecting rod oil squirt hole faces the major thrust (right) side of the engine block (Fig. 60).

(7) Rotate crankshaft until the connecting rod journal is located in the center of the cylinder bore. Insert connecting rod and piston into cylinder bore. Carefully guide connecting rod over the crankshaft journal (Fig. 59).

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

(9) Install lower bearing shell and connecting rod cap (Fig. 59). Install nuts on cleaned and oiled rod bolts and tighten to 54 N·m (40 ft. lbs.) PLUS ¼ turn.

(10) Repeat procedure for each piston and connecting rod installation.

(11) Install the cylinder heads. (Refer to 9 - ENGINE/CYLINDER HEAD - INSTALLATION)

(12) Install the oil pan. (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION)

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

(14) Connect negative cable to battery.

PISTON & CONNECTING ROD (Continued)

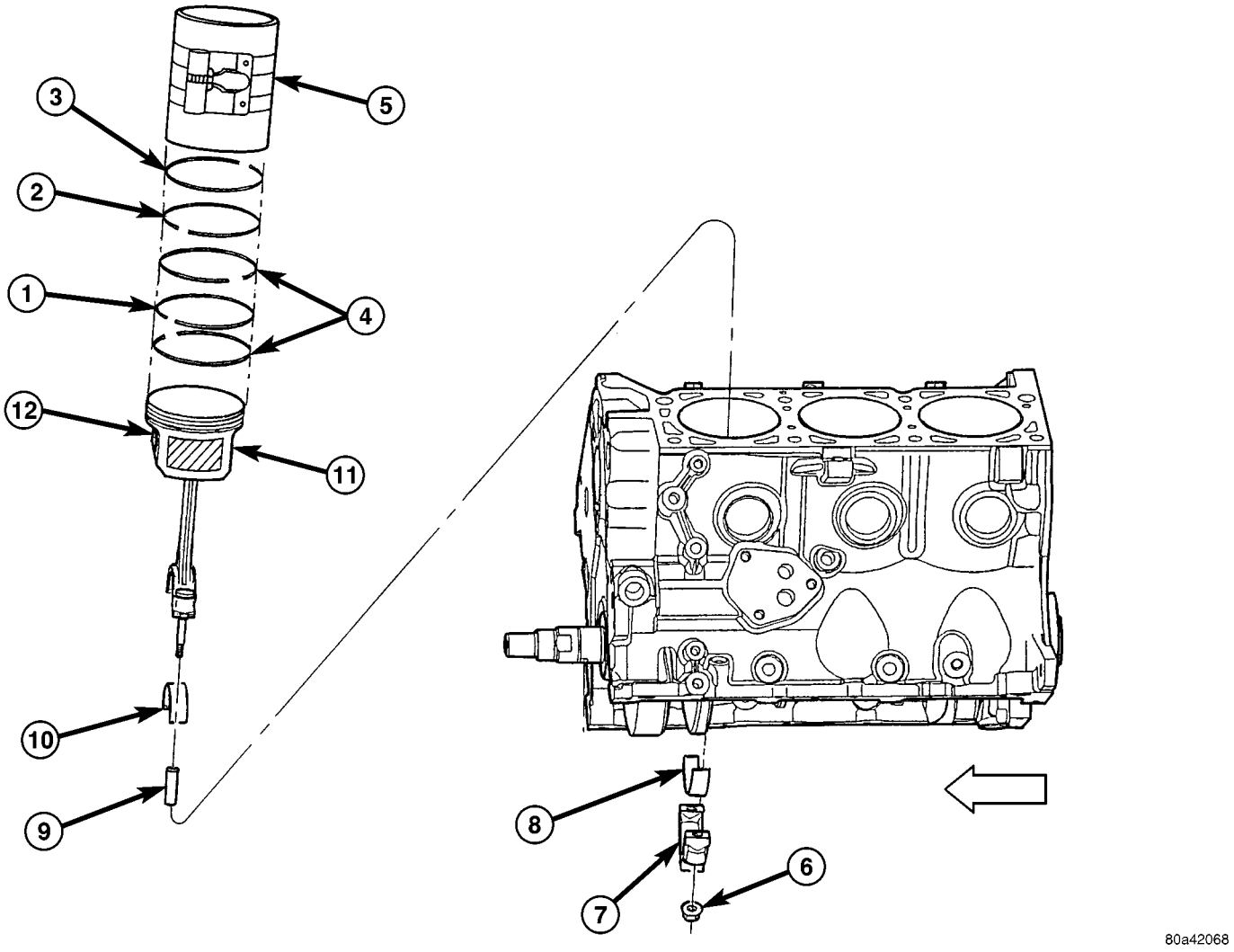

Fig. 59 PISTON AND CONNECTING ROD INSTALLATION

1 - RING - OIL CONTROL
2 - RING - NO. 2 COMPRESSION
3 - RING - NO. 1 COMPRESSION
4 - RING - SIDE RAIL UPPER & LOWER
5 - PISTON RING COMPRESSOR
6 - NUT - CONNECTING ROD
7 - CAP - CONNECTING ROD
8 - BEARING - CONNECTING ROD LOWER
9 - CRANKSHAFT JOURNAL PROTECTOR (RUBBER HOSE)
10 - BEARING - CONNECTING ROD UPPER
11 - PISTON AND CONNECTING ROD ASSEMBLY
12 - PISTON LOCATION MARK (F = FRONT)

PISTON & CONNECTING ROD (Continued)

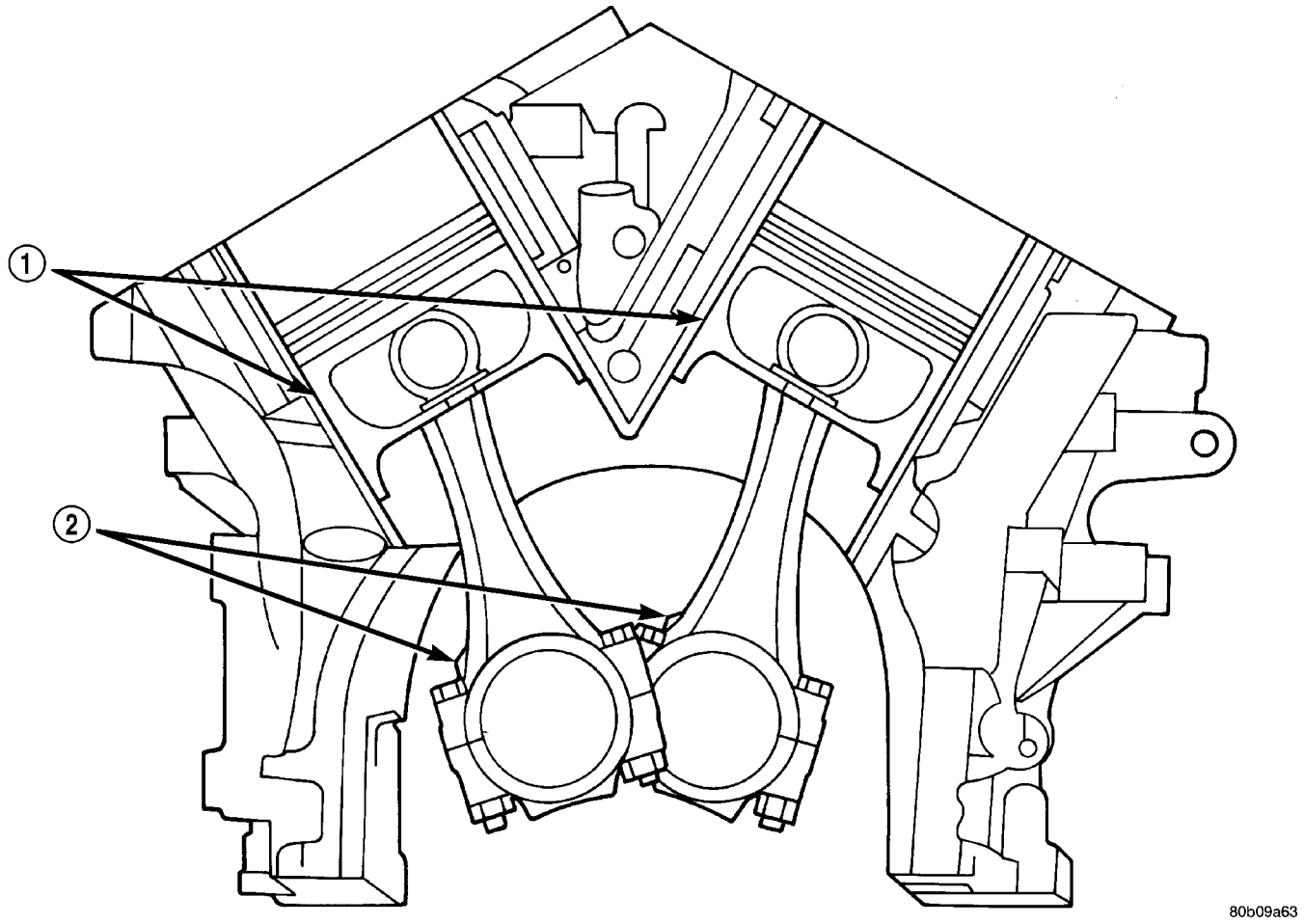

Fig. 60 Piston and Connecting Rod Positioning (Front View of Engine)

1 - MAJOR THRUST SIDE OF PISTON
2 - OIL SQUIRT HOLE

CONNECTING ROD BEARINGS

STANDARD PROCEDURE - MEASURING CONNECTING ROD BEARING CLEARANCE

The bearing caps are not interchangeable and should be marked at removal to ensure correct assembly. The bearing shells must be installed with the tangs inserted into the machined grooves in the rods and caps. Install cap with the tangs on the same side as the rod. Fit all rods on one bank until complete. Connecting rod bearings are available in the standard size and the following undersizes: 0.025 mm (0.001 in.) and 0.250 mm (0.010 in.).

CAUTION: Install the bearings in pairs. Do not use a new bearing half with an old bearing half. Do not file the rods or bearing caps.

Measure connecting rod journal for taper and out-of-round. (Refer to 9 - ENGINE/ENGINE BLOCK/ CRANKSHAFT - INSPECTION)

The connecting rod bearing clearances can be determined by use of Plastigage or the equivalent. The following is the recommended procedure for the use of Plastigage:

(1) Rotate the crankshaft until the connecting rod to be checked is at the bottom of its stroke.

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

(3) Place a piece of Plastigage across the entire width of the bearing shell in the bearing cap approximately 6.35 mm (1/4 in.) off center and away from the oil hole. In addition, suspect areas can be checked by placing Plastigage in that area.

(4) Assemble the rod cap with Plastigage in place. Tighten the rod cap to the specified torque. **Do not rotate the crankshaft while assembling the cap or the Plastigage may be smeared, giving inaccurate results.**

(5) Remove the bearing cap and compare the width of the flattened Plastigage with the scale provided on the package (Fig. 61). Locate the band closest to the same width. This band indicates the

CONNECTING ROD BEARINGS (Continued)

amount of oil clearance. Differences in readings between the ends indicate the amount of taper present. Record all readings taken. Refer to Engine Specifications (Refer to 9 - ENGINE - SPECIFICATIONS). **Plastigage generally is accompanied by two scales. One scale is in inches, the other is a metric scale. If the bearing clearance exceeds wear limit specification, replace the bearing.**

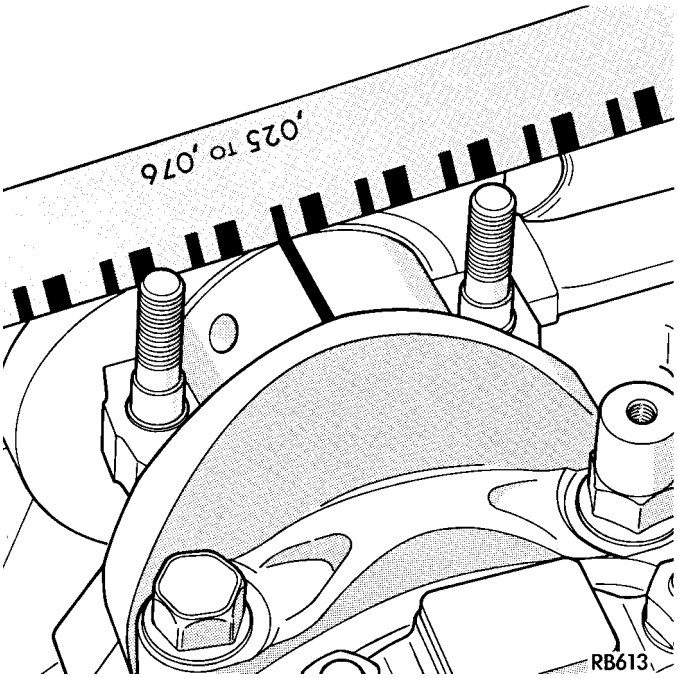

Fig. 61 Measuring Connecting Rod Bearing Clearance

PISTON RINGS

STANDARD PROCEDURE - PISTON RING FITTING

(1) Wipe cylinder bore clean. Insert the ring and push down with piston to ensure squareness in bore to approximately 12 mm (0.50 in.) from top of cylinder bore. Check ring gap with a feeler gauge (Fig. 62). For clearance specification (Refer to 9 - ENGINE - SPECIFICATIONS).

(2) Check piston ring to groove side clearance (Fig. 63). For clearance specification (Refer to 9 - ENGINE - SPECIFICATIONS)

REMOVAL

(1) Remove piston and connecting rod. (Refer to 9 - ENGINE/ENGINE BLOCK/PISTON & CONNECTING ROD - REMOVAL)

(2) Remove No. 1 and No.2 piston rings from piston using a ring expander tool (Fig. 66).

(3) Remove upper oil ring side rail (Fig. 65).

(4) Remove lower oil ring side rail (Fig. 65).

(5) Remove oil ring expander (Fig. 65).

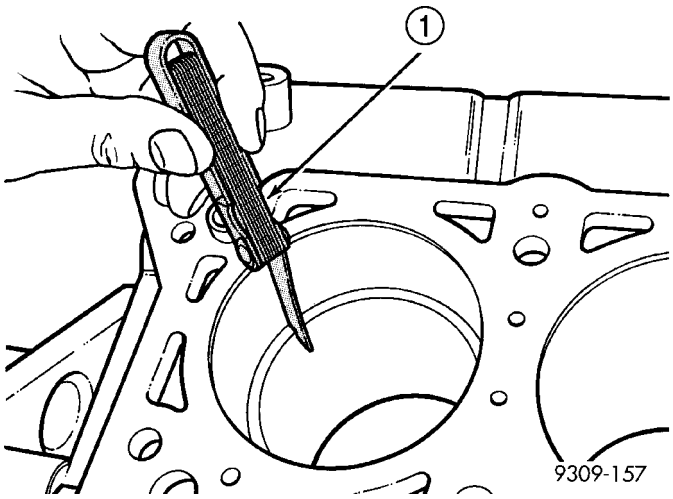

Fig. 62 Piston Ring Gap

1 - FEELER GAUGE

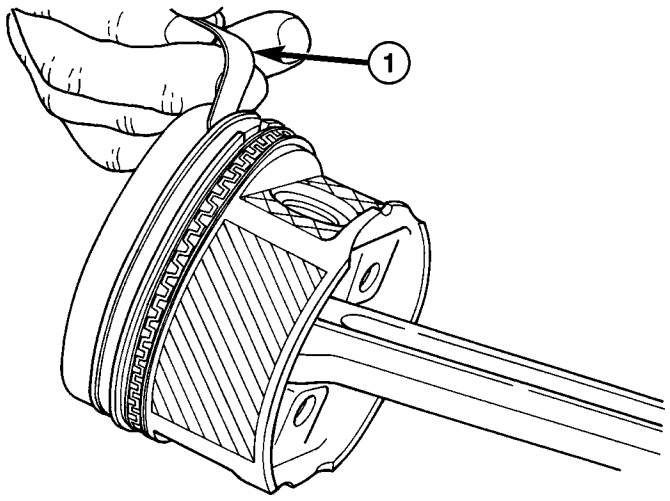

Fig. 63 Piston Ring Side Clearance

1 - FEELER GAUGE

INSTALLATION

(1) Install rings with manufacturers I.D. mark (if present) facing up, to the top of the piston (Fig. 64).

CAUTION: Install piston rings in the following order:

1. Oil ring expander.
2. Upper oil ring side rail.
3. Lower oil ring side rail.
4. No. 2 Intermediate piston ring.
5. No. 1 Upper piston ring.

(2) Install the side rail by placing one end between the piston ring groove and the expander. Hold end firmly and press down the portion to be installed until side rail is in position. **Do not use a piston ring expander** (Fig. 65).

PISTON RINGS (Continued)

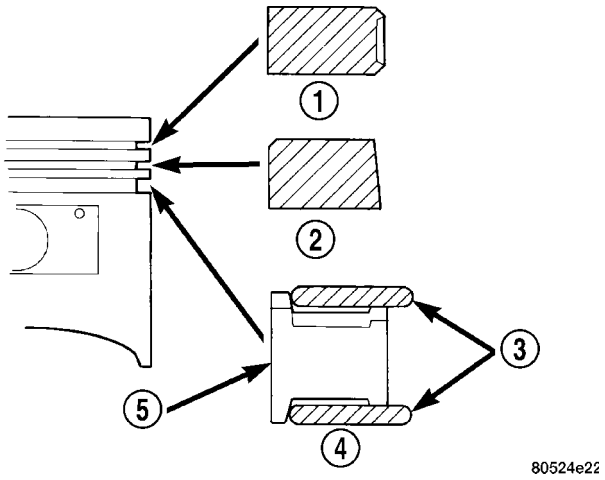

Fig. 64 Piston Ring Installation

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

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

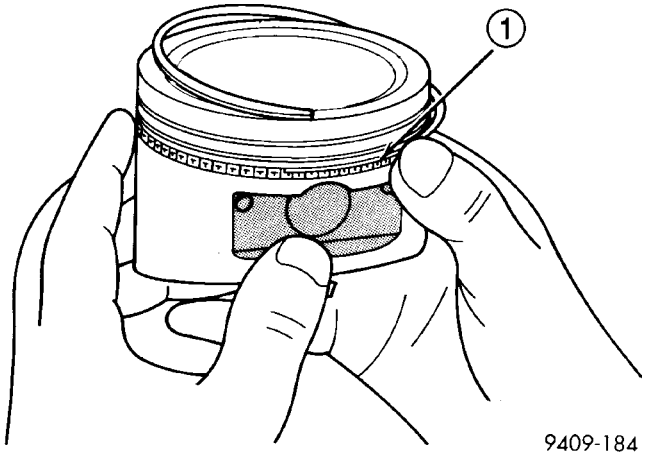

Fig. 65 Oil Ring Side Rail - Typical

1 - SIDE RAIL END

(4) Install No. 2 piston ring and then No. 1 piston ring (Fig. 66).

(5) Position piston ring end gaps as shown in (Fig. 67).

(6) Position oil ring expander gap at least 45° from the side rail gaps but **not** on the piston pin center or on the thrust direction. Staggering ring gap is important for oil control.

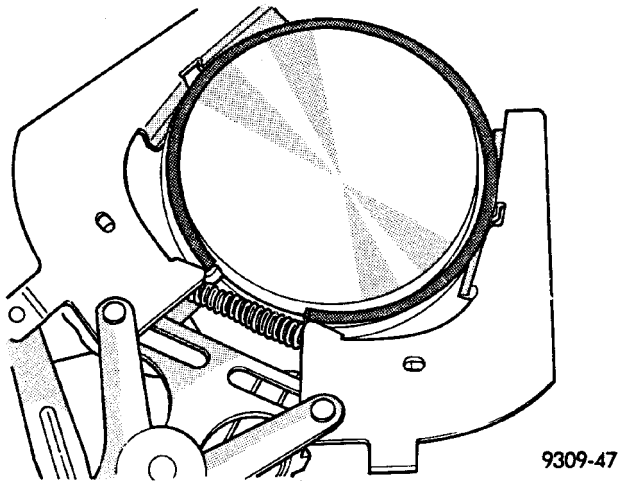

Fig. 66 Piston Ring Installation

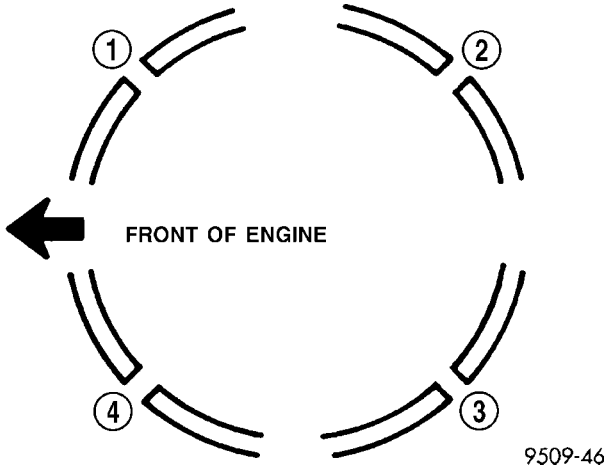

Fig. 67 Piston Ring End Gap Position

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

CRANKSHAFT MAIN BEARINGS

STANDARD PROCEDURE - MAIN BEARING FITTING

Bearing caps are not interchangeable and should be marked at removal to insure correct assembly (Fig. 68). Upper and lower bearing halves are NOT interchangeable. Lower main bearing halves of 1, 3 and 4 are interchangeable. Upper main bearing halves of 1, 3 and 4 are interchangeable.

CRANKSHAFT MAIN BEARINGS (Continued)

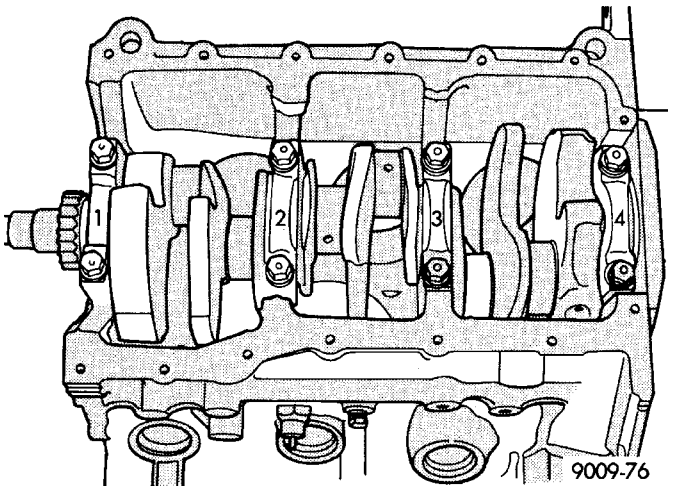

Fig. 68 Main Bearing Cap Identification

Upper and lower number 2 bearing halves are flanged to carry the crankshaft thrust loads and are NOT interchangeable with any other bearing halves in the engine (Fig. 69). All bearing cap bolts removed during service procedures are to be cleaned and lubricated with engine oil before installation. Bearing shells are available in standard and the following undersizes: 0.025 mm (0.001 in.) and 0.254 mm (0.010 in). Never install an undersize bearing that will reduce clearance below specifications.

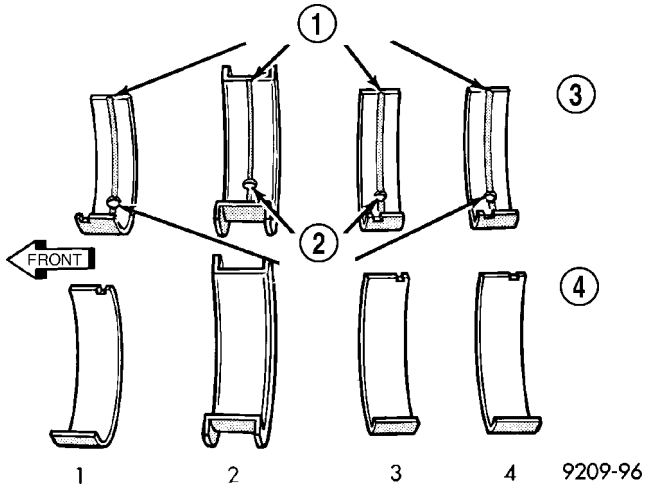

Fig. 69 Main Bearing Identification

1 - OIL GROOVES
2 - OIL HOLES
3 - UPPER BEARINGS
4 - LOWER BEARINGS

CRANKSHAFT BEARING OIL CLEARANCE

Inspect the crankshaft bearing journals. (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT - INSPECTION)

Engine crankshaft bearing clearances can be determined by use of Plastigage or the equivalent. The following is the recommended procedures for the use of Plastigage with the engine in the vehicle or engine on a repair stand.

PLASTIGAGE METHOD—ENGINE IN-VEHICLE

NOTE: The total clearance of the main bearings can only be determined with the engine in the vehicle by removing the weight of the crankshaft. This can be accomplished by either of two following methods:

(1) Preferred method:

a. Shim the bearings adjacent to the bearing to be checked in order to remove the clearance between upper bearing shell and the crankshaft. This can be accomplished by placing a minimum of 0.254 mm (0.010 in.) shim (e. g. cardboard, matchbook cover, etc.) between the bearing shell and the bearing cap on the adjacent bearings and tightening bolts to 14–20 N·m (10–15 ft. lbs.).

- When checking #1 main bearing shim #2 main bearing.
- When checking #2 main bearing shim #1 & #3 main bearing.
- When checking #3 main bearing shim #2 & #4 main bearing.
- When checking #4 main bearing shim #3 main bearing.

NOTE: Remove all shims before reassembling engine.

(2) Alternative Method:

a. Support the weight of the crankshaft with a jack under the counterweight adjacent to the bearing being checked.

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

(4) Place a piece of Plastigage across the entire width of the bearing shell in the cap approximately 6.35 mm (1/4 in.) off center and away from the oil holes (Fig. 70). (In addition, suspected areas can be checked by placing the Plastigage in the suspected area). Torque the bearing cap bolts of the bearing being checked to the proper specifications.

(5) Remove the bearing cap and compare the width of the flattened Plastigage (Fig. 71) with the scale provided on the package. Locate the band closest to the same width. This band shows the amount of clearance in thousandths. Differences in readings between the ends indicate the amount of taper present. Record all readings taken. (Refer to 9 - ENGINE - SPECIFICATIONS) **Plastigage generally is accompanied by two scales. One scale is in inches, the other is a metric scale.**

CRANKSHAFT MAIN BEARINGS (Continued)

NOTE: Plastigage is available in a variety of clearance ranges. Use the most appropriate range for the specifications you are checking.

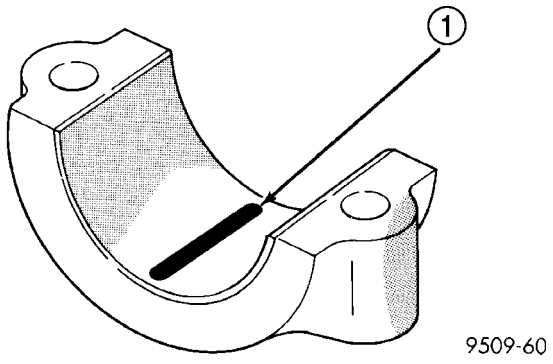

Fig. 70 Plastigage Placed in Lower

1 - PLASTIGAGE

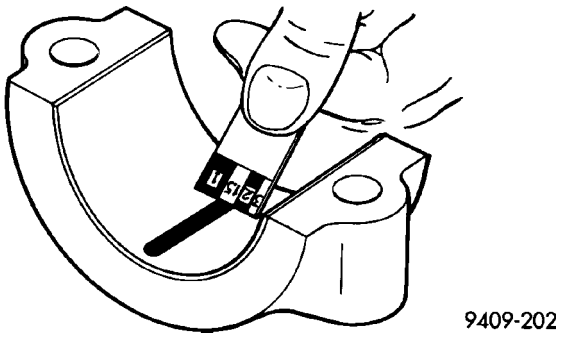

Fig. 71 Clearance Measurement

PLASTIGAGE METHOD—ENGINE OUT-OF-VEHICLE

(1) With engine in the inverted position (crankshaft up) and mounted on a repair stand, remove main journal cap.

(2) Remove oil from journal and bearing shell.

(3) Cut Plastigage to same length as width of the bearing and place it in parallel with the journal axis (Fig. 70).

(4) Carefully install the main bearing cap and tighten the bolts to specified torque.

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

(5) Carefully remove the bearing cap and measure the width of the Plastigage at the widest part using the scale on the Plastigage package (Fig. 71). Refer to Engine Specifications for proper clearances (Refer to 9 - ENGINE - SPECIFICATIONS). If the clearance exceeds the specified limits, replace the main bearing(s) with the appropriate size, and if necessary, have the crankshaft machined to next undersize.

REMOVAL - CRANKSHAFT MAIN BEARINGS

(1) Remove the oil pan. (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL)

(2) Identify main bearing caps before removal.

(3) Remove bearing caps one at a time. Remove upper half of bearing by inserting Special Main Bearing Tool C-3059 (Fig. 72) into the oil hole of crankshaft.

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

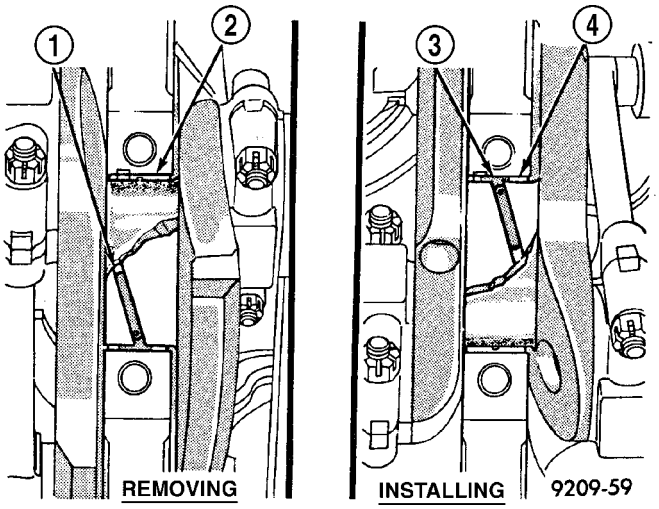

Fig. 72 Upper Main Bearing Removing/Installing With Special Tool C-3059

1 - SPECIAL TOOL C-3059
2 - BEARING
3 - SPECIAL TOOL C-3059
4 - BEARING

INSTALLATION - CRANKSHAFT MAIN BEARINGS

NOTE: One main bearing should be selectively fitted while all other main bearing caps are properly tightened.

(1) For main bearing fitting procedure, (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT MAIN BEARINGS - STANDARD PROCEDURE)

(2) Start bearing in place, and insert Main Bearing Tool C-3059 into oil hole of crankshaft (Fig. 72).

(3) Slowly rotate crankshaft counterclockwise sliding the bearing into position. Remove Special Main Bearing Tool C-3059.

(4) Inspect main cap bolts for stretching (Fig. 73). Replace bolts that are stretched.

NOTE: The main cap bolts should be examined before reuse. Bolt stretch can be checked by holding a scale or straight edge against the threads. If all the threads do not contact the scale the bolt must be replaced (Fig. 73).

(5) Install each main cap and tighten bolts finger tight.

CRANKSHAFT MAIN BEARINGS (Continued)

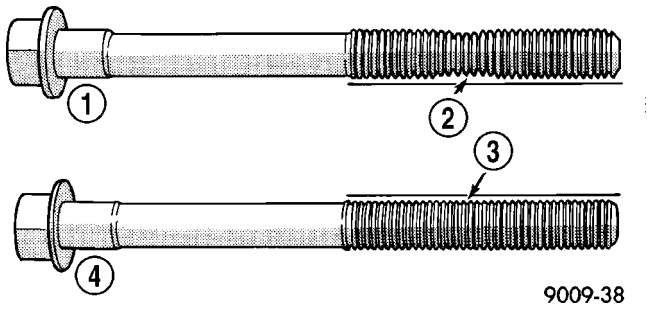

Fig. 73 Check for Stretched (Necked) Bolts

1 - STRETCHED BOLT
2 - THREADS ARE NOT STRAIGHT ON LINE
3 - THREADS ARE STRAIGHT ON LINE
4 - UNSTRETCHED BOLT

(6) Tighten number 1, 3 and 4 main cap bolts to 41 N·m + 1/4 Turn (30 ft. lbs.+ 1/4 Turn).

(7) Rotate the crankshaft until the number 6 piston is at TDC.

(8) To ensure correct thrust bearing alignment the following procedure must be done:

a. Move crankshaft all the way to the rear of its travel.

b. Then, move crankshaft all the way to the front of its travel.

c. Wedge an appropriate tool between the rear of the cylinder block and rear crankshaft counterweight. This will hold the crankshaft in it's most forward position.

d. Tighten the #2 Thrust Bearing cap bolts to 41 N·m + 1/4 Turn (30 ft. lbs.+ 1/4 Turn). Remove the holding tool.

(9) Install oil pan. (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION)

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

CRANKSHAFT

DESCRIPTION

DESCRIPTION - 3.3L

The nodular iron crankshaft is supported by four main bearings, with number two position the thrust bearing (Fig. 76). Crankshaft end sealing is provided by front and rear rubber seals.

DESCRIPTION - 3.8L

The nodular iron crankshaft is supported by four main bearings, with number two position providing thrust bearing location (Fig. 77). Each main bearing cap has two vertical retaining bolts. The two center main caps have horizontal bolts to add increased rigidity to the lower engine block (Fig. 77). Crankshaft end sealing is provided by front and rear rubber seals.

STANDARD PROCEDURE - MEASURING CRANKSHAFT END PLAY

(1) Mount a dial indicator to front of engine with the locating probe on nose of crankshaft (Fig. 74).

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

(3) Zero the dial indicator.

(4) Move crankshaft all the way to the front and read the dial indicator. (Refer to 9 - ENGINE - SPECIFICATIONS) for end play specification.

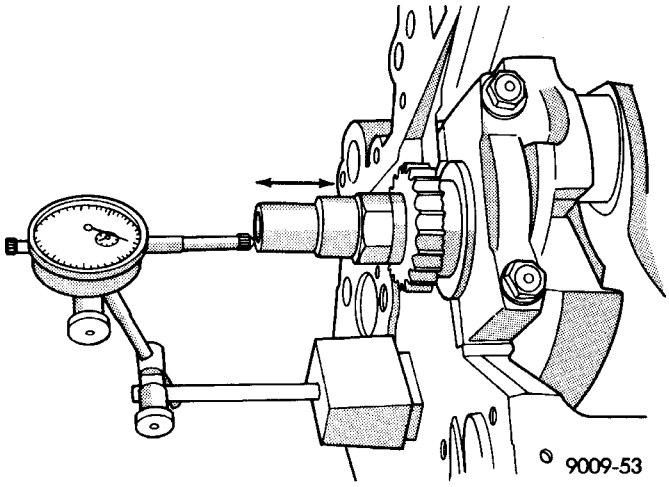

Fig. 74 Checking Crankshaft End Play - Typical

REMOVAL

(1) Remove the engine assembly (Refer to 9 - ENGINE - REMOVAL).

(2) Separate transaxle from engine.

(3) Mount engine on an engine stand.

(4) Remove the oil filter.

(5) Remove the oil pan and oil pick-up tube (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

(6) Remove the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING CHAIN COVER - REMOVAL).

(7) Remove timing chain and sprockets (Refer to 9 - ENGINE/VALVE TIMING/TIMING CHAIN AND SPROCKETS - REMOVAL).

(8) Remove crankshaft rear oil seal and retainer (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT OIL SEAL - REAR - REMOVAL).

(9) Rotate the crankshaft until connecting rod cap is accessible.

(10) Mark connecting rod cap position using a suitable marker/scribe tool.

CRANKSHAFT (Continued)

(11) Remove connecting rod bearing cap. Use care to prevent damage to the crankshaft bearing surfaces.

(12) Repeat removal procedure for each connecting rod cap.

(13) Remove and discard the main bearing cross bolts and washers (3.8L engine only) (Fig. 77).

NOTE: Install new cross bolt and washer assembly (3.8L engine only) upon reassembly.

(14) Remove the main bearing cap bolts

(15) Remove the main bearing caps.

(16) Remove the crankshaft from engine block (Fig. 76) or (Fig. 77).

INSTALLATION

(1) For main bearing identification, refer to (Fig. 69). Lubricate with engine oil and install the crankshaft main bearing halves in the engine block.

(2) Position the crankshaft in engine block (Fig. 76) or (Fig. 77).

(3) Perform main bearing fitting procedure (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT MAIN BEARINGS - STANDARD PROCEDURE).

(4) Inspect main cap bolts for stretching (Fig. 75). Replace bolts that are stretched.

NOTE: The main cap bolts should be examined before reuse. Bolt stretch can be checked by holding a scale or straight edge against the threads. If all the threads do not contact the scale the bolt must be replaced (Fig. 75).

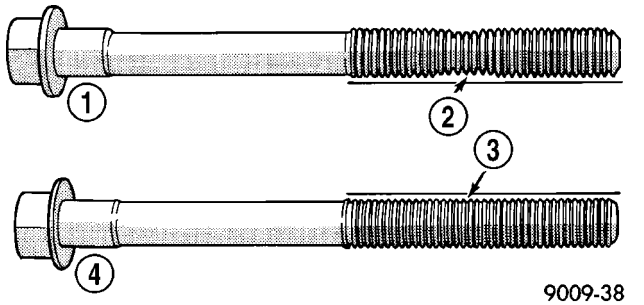

Fig. 75 Check for Stretched (Necked) Bolts

1 - STRETCHED BOLT
2 - THREADS ARE NOT STRAIGHT ON LINE
3 - THREADS ARE STRAIGHT ON LINE
4 - UNSTRETCHED BOLT

(5) Install the main bearing caps and bolts. Tighten bolts to 41 N·m (30 ft. lbs.) plus ¼ turn.

NOTE: Install new cross bolt and washer assembly (3.8L engine only) upon reassembly.

(6) Install and tighten the NEW cross bolts and washer assemblies (3.8L engine only) to 61 N·m (45 ft. lbs.) (Fig. 77).

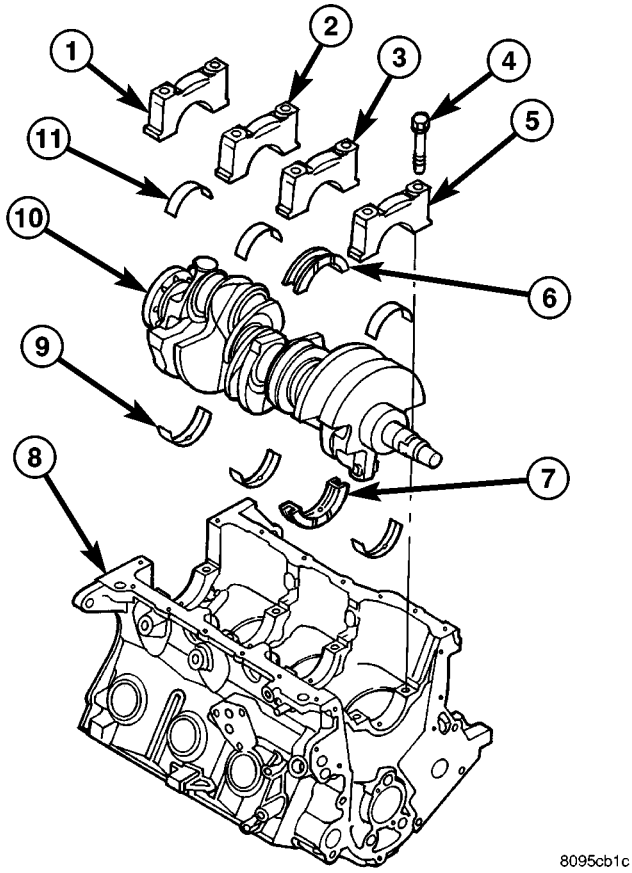

Fig. 76 CRANKSHAFT AND BLOCK - 3.3L

1 - MAIN BEARING CAP No. 4
2 - MAIN BEARING CAP No. 3
3 - MAIN BEARING CAP No. 2
4 - MAIN BEARING CAP BOLT (QTY. 2 PER CAP)
5 - MAIN BEARING CAP No. 1
6 - LOWER MAIN BEARING - THRUST
7 - UPPER MAIN BEARING - THRUST
8 - ENGINE BLOCK
9 - UPPER MAIN BEARINGS
10 - CRANKSHAFT
11 - LOWER MAIN BEARINGS

(7) Position and install the connecting rod and bearing caps on the crankshaft (Refer to 9 - ENGINE/ENGINE BLOCK/CONNECTING ROD BEARINGS - STANDARD PROCEDURE).

(8) Install the crankshaft rear oil seal (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT OIL SEAL - REAR - INSTALLATION).

(9) Install the crankshaft sprocket (Refer to 9 - ENGINE/VALVE TIMING/TIMING CHAIN AND SPROCKETS - INSTALLATION).

(10) Install the timing chain and camshaft sprocket (Refer to 9 - ENGINE/VALVE TIMING/TIMING CHAIN AND SPROCKETS - INSTALLATION).

CRANKSHAFT (Continued)

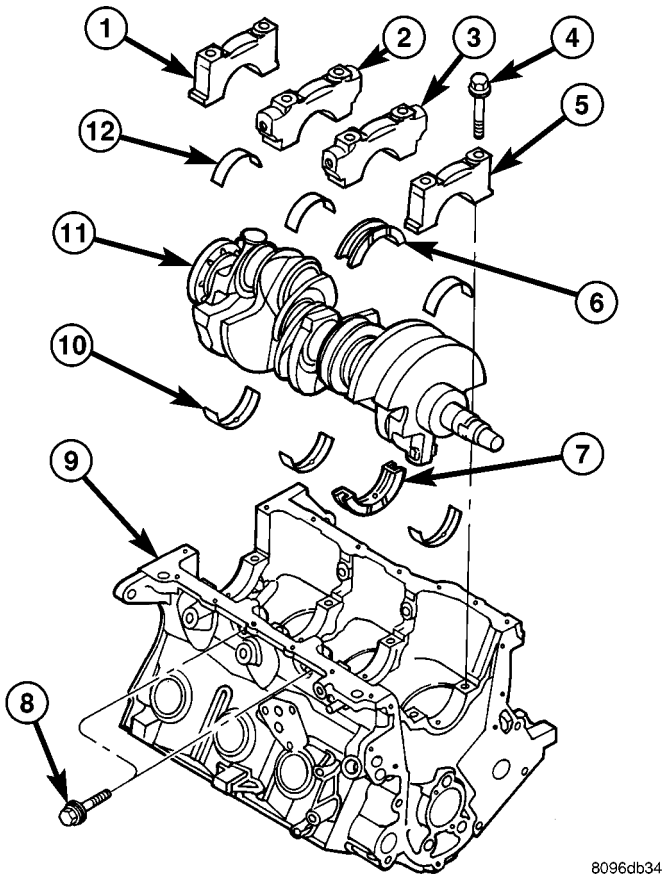

Fig. 77 CRANKSHAFT AND BLOCK - 3.8L

1 - MAIN BEARING CAP No. 4
2 - MAIN BEARING CAP No. 3
3 - MAIN BEARING CAP No. 2
4 - MAIN BEARING CAP BOLT
5 - MAIN BEARING CAP No. 1
6 - THRUST MAIN BEARING - LOWER
7 - THRUST MAIN BEARING - UPPER
8 - MAIN BEARING CAP CROSS BOLT
9 - ENGINE BLOCK
10 - MAIN BEARING - UPPER
11 - CRANKSHAFT
12 - MAIN BEARING - LOWER

(11) Install the timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING CHAIN COVER - INSTALLATION).

(12) Install the oil pick-up tube and oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

(13) Install the transaxle to the engine.

(14) Install the engine assembly (Refer to 9 - ENGINE - INSTALLATION).

CRANKSHAFT OIL SEAL - FRONT

REMOVAL

(1) Disconnect negative cable from battery.

(2) Raise vehicle on hoist. Remove right wheel and inner splash shield.

(3) Remove accessory drive belt. (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL)

(4) Remove crankshaft damper. (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL)

(5) Position Special Tool 6341A on crankshaft nose. Carefully screw the tool into the seal until it engages firmly (Fig. 78). Be careful not to damage that crankshaft seal surface of cover

(6) Remove oil seal by turning the forcing screw until the seal disengages from the cover (Fig. 79).

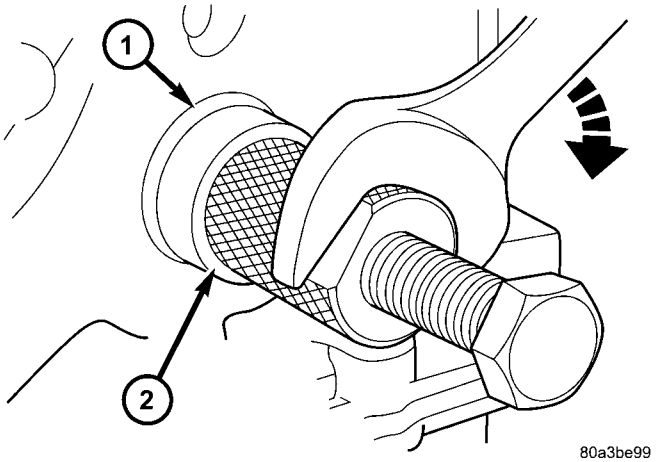

Fig. 78 Engaging Tool into Seal

1 - SEAL
2 - SPECIAL TOOL 6341A

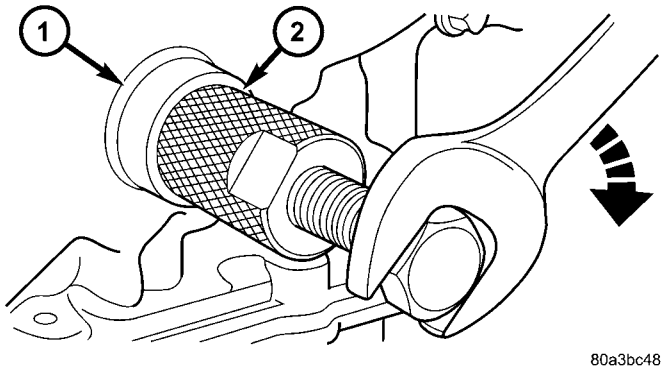

Fig. 79 Crankshaft Front Seal Removal

1 - SEAL
2 - SPECIAL TOOL 6341A

INSTALLATION

(1) Position Special Tool C-4992-2 Guide, on the crankshaft nose (Fig. 80).

CRANKSHAFT OIL SEAL - FRONT (Continued)

(2) Position new seal over the guide with the seal spring in the direction of the engine front cover (Fig. 80).

(3) Install seal using Special Tool C-4992-1 until seal is flush with cover. (Fig. 80).

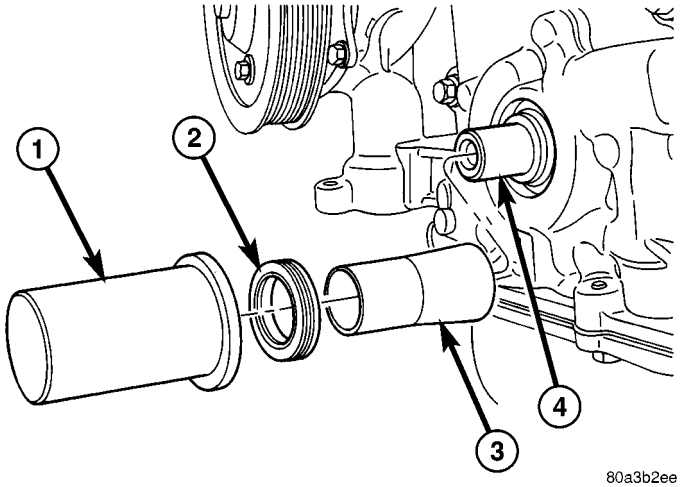

Fig. 80 CRANKSHAFT FRONT SEAL INSTALLATION

1 - SPECIAL TOOL C-4992-1
2 - SEAL
3 - SPECIAL TOOL C-4992-2
4 - CRANKSHAFT

(4) Install crankshaft damper. (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION)

(5) Install accessory drive belt. (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION)

(6) Install inner splash shield and right front wheel.

(7) Lower vehicle and connect negative cable to battery.

CRANKSHAFT OIL SEAL - REAR

REMOVAL

(1) Remove the transaxle. Refer to TRANSAXLE AND POWER TRANSFER UNIT for procedure.

(2) Remove the flex plate. (Refer to 9 - ENGINE/ENGINE BLOCK/FLEX PLATE - REMOVAL)

(3) Insert a 3/16 flat bladed pry tool between the dust lip and the metal case of the crankshaft seal. Angle the pry tool (Fig. 81) through the dust lip against metal case of the seal. Pry out seal.

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

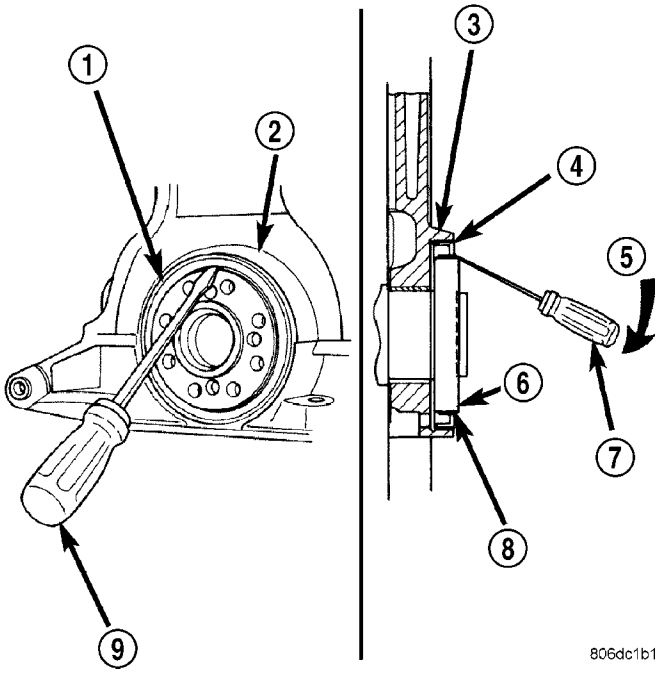

Fig. 81 Crankshaft Rear Oil Seal - Removal

1 - REAR CRANKSHAFT SEAL
2 - ENGINE BLOCK
3 - ENGINE BLOCK
4 - REAR CRANKSHAFT SEAL METAL CASE
5 - PRY IN THIS DIRECTION
6 - CRANKSHAFT
7 - SCREWDRIVER
8 - REAR CRANKSHAFT SEAL DUST LIP
9 - SCREWDRIVER

INSTALLATION

CAUTION: If burr or scratch is present on the crankshaft edge (chamfer), cleanup with 400 grit sand paper to prevent seal damage during installation of new seal.

(1) Place Special Tool 6926-1 magnetic pilot tool on crankshaft (Fig. 82).

(2) Place seal over Special Tool 6926-1 Pilot. Using Special Tool 6926-2 Installer with C-4171 Handle, drive seal into the retainer housing (Fig. 82).

(3) Install the flex plate. (Refer to 9 - ENGINE/ENGINE BLOCK/FLEX PLATE - INSTALLATION)

(4) Install transaxle. Refer to TRANSAXLE AND POWER TRANSFER UNIT for procedure.

CRANKSHAFT OIL SEAL - REAR (Continued)

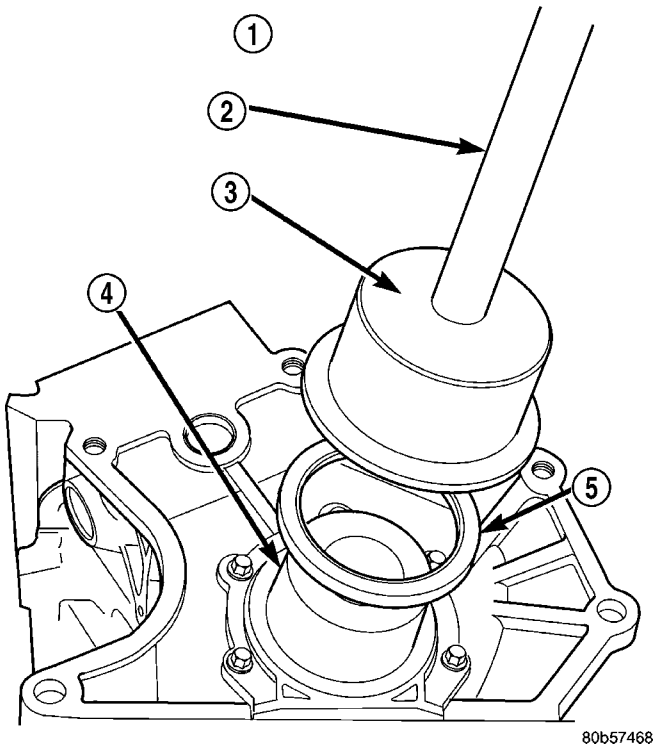

Fig. 82 Rear Crankshaft Oil Seal—Installation

1 - SPECIAL TOOLS:
2 - C-4171 HANDLE
3 - 6926–2 INSTALLER
4 - 6926–1 GUIDE
5 - SEAL

CRANKSHAFT REAR OIL SEAL RETAINER

REMOVAL

(1) Remove crankshaft rear oil seal (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT OIL SEAL - REAR - REMOVAL).

(2) Remove oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

(3) Remove oil seal retainer screws (Fig. 83).

(4) Remove oil seal retainer (Fig. 83).

(5) Clean engine block and retainer of oil and gasket material. Make sure surfaces are clean and free of oil.

INSTALLATION

(1) Position new gasket and install retainer on block (Fig. 83). Tighten attaching screws to 12 N·m (105 in. lbs.).

(2) Install oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

(3) Install oil seal (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT OIL SEAL - REAR - INSTALLATION).

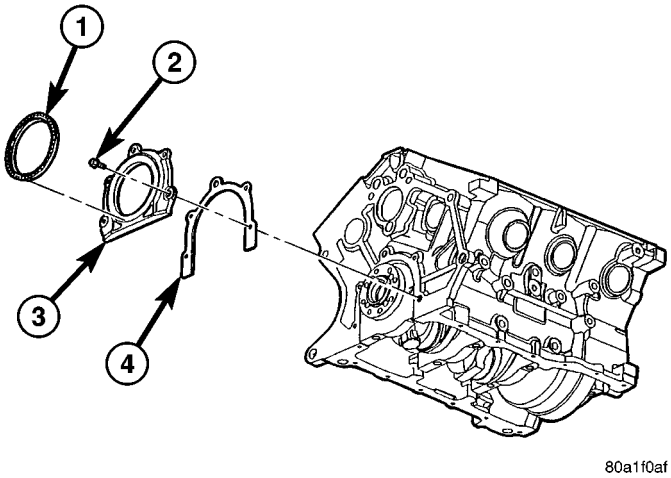

Fig. 83 CRANKSHAFT REAR OIL SEAL

1 - OIL SEAL
2 - BOLT
3 - RETAINER - OIL SEAL
4 - GASKET

VIBRATION DAMPER

REMOVAL

(1) Disconnect negative cable from battery.

(2) Raise vehicle on hoist.

(3) Remove the right front wheel and inner splash shield.

(4) Remove the accessory drive belt. (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL)

(5) Remove vibration damper bolt.

(6) Insert Special Tool 8450 into crankshaft nose (Fig. 84).

(7) Position 3-jaw puller Special Tool 1026 on damper as shown in (Fig. 84). Turn puller forcing screw until damper releases from crankshaft.

(8) Remove the crankshaft vibration damper.

INSTALLATION

(1) Install crankshaft vibration damper using the forcing screw, nut, and thrust bearing/washer from Special Tool 8452 (Fig. 85).

NOTE: To minimize friction and prolong tool life, lubricate the threads on the forcing screw of Special Tool 8452.

(2) Position vibration damper on crankshaft.

(3) Screw Special Tool 8452 into crankshaft until the bolt seats. Turn the nut to install damper until it seats fully.

(4) Remove Special Tool 8452.

(5) Install vibration damper bolt. Torque bolt to 54 N·m (40 ft. lbs.).

VIBRATION DAMPER (Continued)

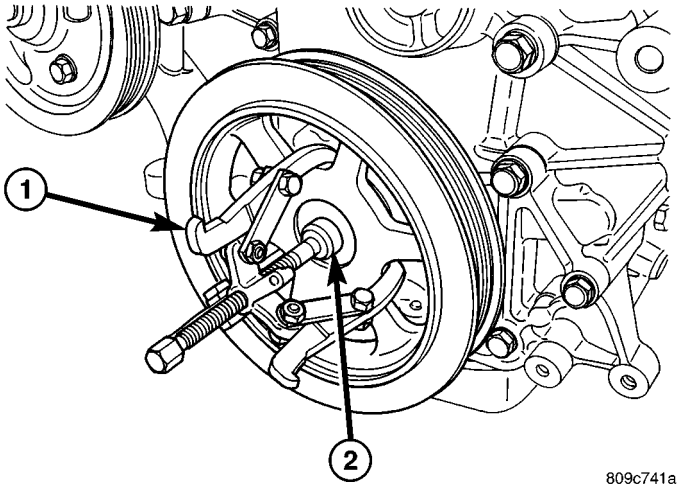

Fig. 84 Vibration Damper - Removal

1 - SPECIAL TOOL 8450 - INSERT
2 - SPECIAL TOOL 1026 - 3 JAW PULLER

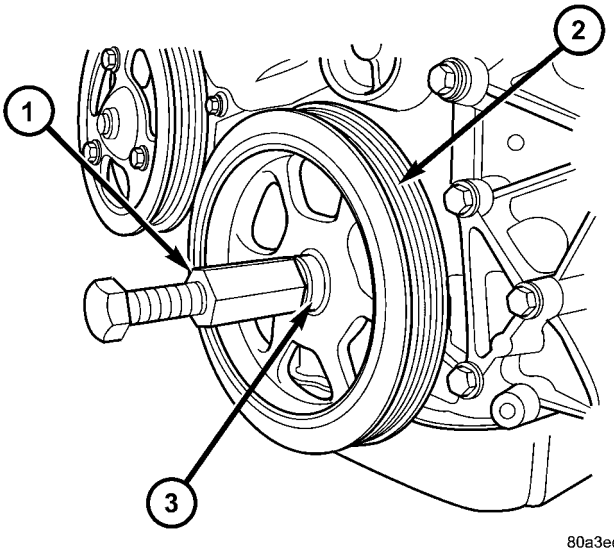

Fig. 85 Vibration Damper - Installation

1 - FORCING SCREW / NUT FROM SPECIAL TOOL 8452
2 - VIBRATION DAMPER
3 - THRUST BEARING / WASHER

(6) Install the accessory drive belt. (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION)

(7) Install inner splash shield and right front wheel.

(8) Connect negative cable to battery.

FLEX PLATE

REMOVAL

(1) Remove the transaxle (Refer to 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC - 41TE - REMOVAL).

(2) Remove flex plate attaching bolts.

(3) Remove the flex plate (Fig. 86).

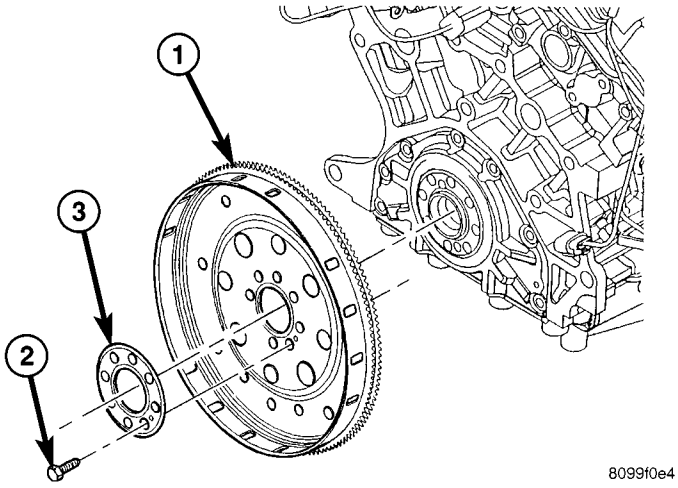

Fig. 86 FLEX PLATE

1 - FLEX PLATE
2 - BOLT (QTY. 8)
3 - BACKING PLATE

INSTALLATION

(1) Position flex plate with backing plate on the crankshaft (Fig. 86).

(2) Apply Mopar® Lock & Seal Adhesive to the flex plate bolts.

(3) Install flex plate bolts (Fig. 86). Tighten bolts to 95 N·m (70 ft. lbs.).

(4) Install the transaxle (Refer to 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC - 41TE - INSTALLATION).

ENGINE MOUNTING

DESCRIPTION

The engine mounting system consist of four mounts; right and a left side support the powertrain, and a front and a rear mount control powertrain torque. The right side mount is a hydro-type (Fig. 87), all others are of molded rubber material.

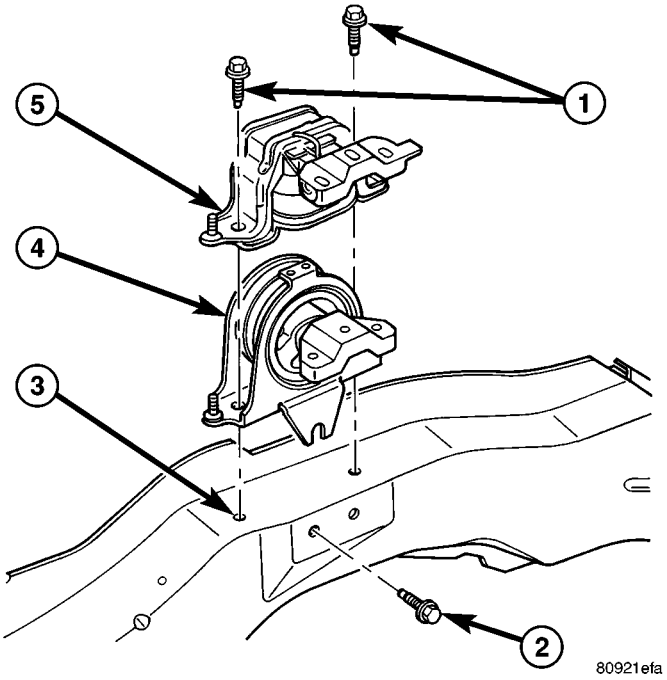

Fig. 87 Engine Hydro-type Mount - Right Side

1 - BOLT
2 - BOLT
3 - FRAME RAIL
4 - RIGHT MOUNT - 2.4L ENGINE
5 - RIGHT MOUNT - 3.3/3.8L ENGINE

FRONT MOUNT

REMOVAL

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

(2) Remove the front engine mount through bolt from the insulator and front crossmember mounting bracket (Fig. 88).

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

(4) Remove the front engine mount screws and remove the insulator assembly (Fig. 88).

(5) Remove the front mounting bracket, if necessary (Fig. 88).

INSTALLATION

(1) Install the front mounting bracket, if removed (Fig. 88).

(2) Install the front engine mount through bolt from the insulator and front crossmember mounting bracket (Fig. 88).

(3) Install the insulator assembly and mounting screws (Fig. 88).

FRONT MOUNT (Continued)

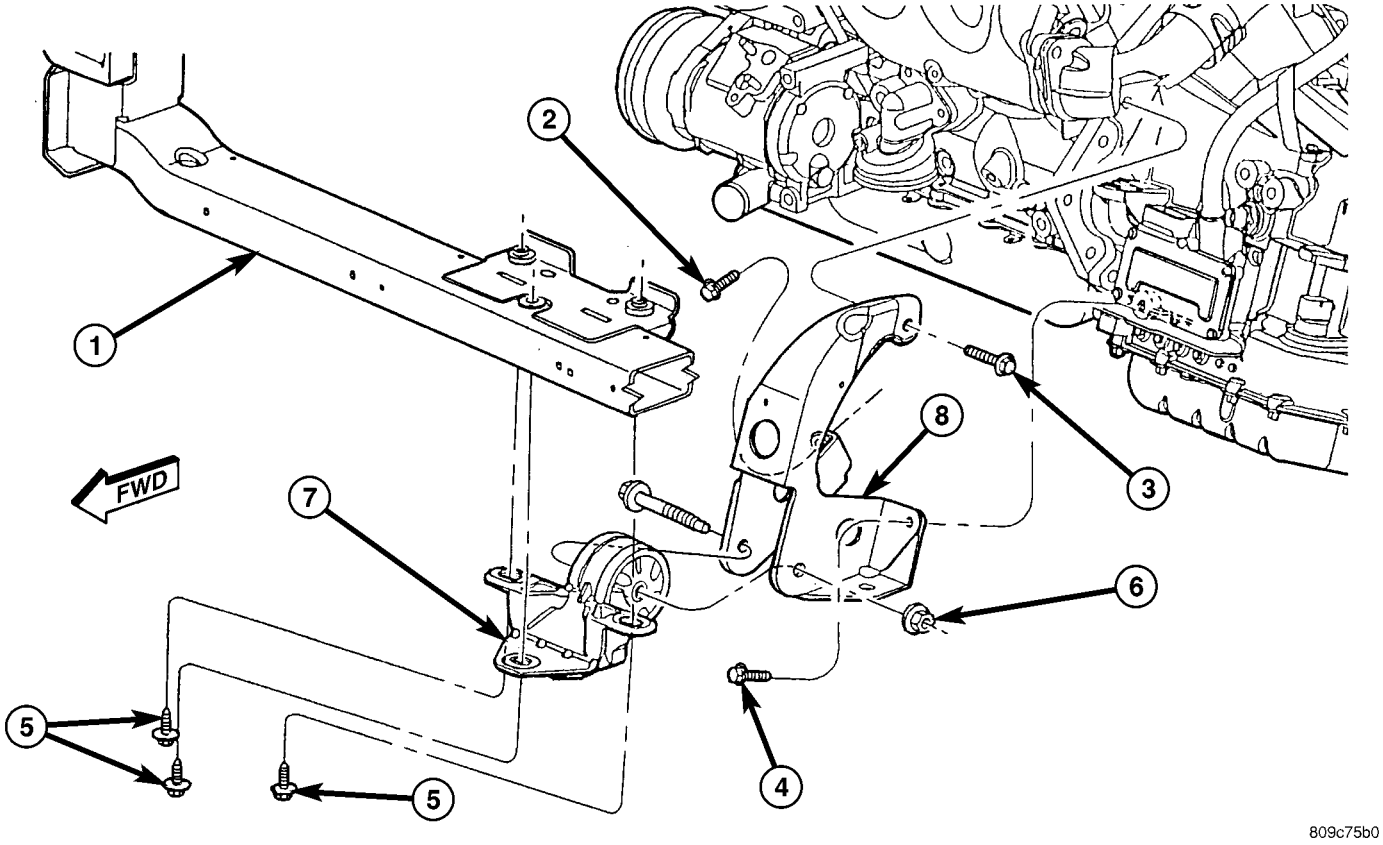

Fig. 88 Engine Mounting - Front

1 - CROSSMEMBER
2 - BOLT - 68 N·m (50 ft. lbs.)
3 - BOLT - 102 N·m (75 ft. lbs.)
4 - BOLT - 68 N·m (50 ft. lbs.)
5 - BOLT 54 N·m (40 ft. lbs.)
6 - NUT - 68 N·m (50 ft. lbs.)
7 - MOUNT - ENGINE FRONT
8 - BRACKET - ENGINE FRONT MOUNT

LEFT MOUNT

REMOVAL

(1) Raise the vehicle on hoist.
(2) Remove the left front wheel.
(3) Remove the left mount through bolt access cover.
(4) Support the transaxle with a suitable jack.
(5) Remove the engine front mount through bolt to allow left mount removal clearance (Fig. 88).
(6) Remove the left mount through frame rail bolt (Fig. 89).

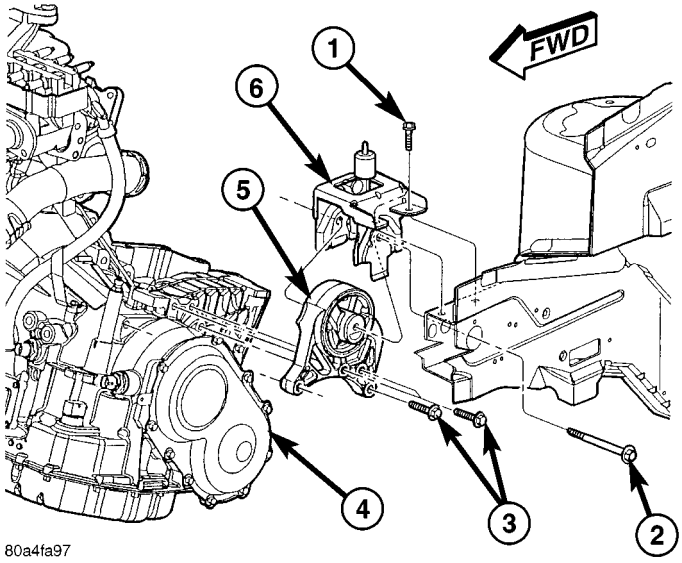

Fig. 89 LEFT MOUNT TO BRACKET

1 - BOLT - BRACKET TO FRAME RAIL 68 N·m (50 ft. lbs.)
2 - BOLT - MOUNT TO RAIL THRU 75 N·m (55 ft. lbs.)
3 - BOLT - LEFT MOUNT TO TRANSAXLE 54 N·m (40 ft. lbs.)
4 - TRANSAXLE
5 - MOUNT - LEFT
6 - BRACKET - LEFT MOUNT

(7) Lower transaxle for access to horizontal bolts.
(8) Remove the horizontal bolts from the mount to the transaxle (Fig. 90).

NOTE: To remove mount, additional lowering of transaxle may be required.

(9) Remove left mount.

INSTALLATION

(1) Install left mount on transaxle (Fig. 90).
(2) Raise transaxle with jack until left mount is in position.
(3) Install left mount through bolt (Fig. 89).
(4) Install left mount through bolt access cover.
(5) Install front mount through bolt (Fig. 88).
(6) Install left front wheel.
(7) Lower vehicle.

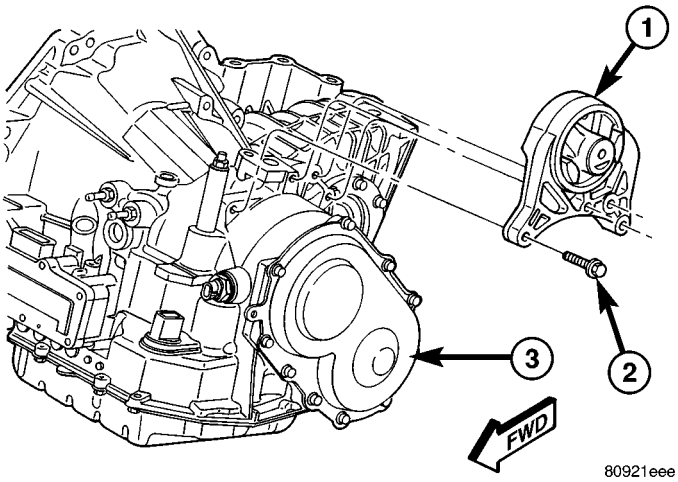

Fig. 90 LEFT MOUNT - 41TE TRANSAXLE

1 - LEFT MOUNT ASSEMBLY
2 - BOLT - 54 N·m (40 ft. lbs.)
3 - TRANSAXLE - 41TE

REAR MOUNT

REMOVAL

(1) Raise vehicle on hoist.
(2) Remove the rear mount heat shield (Fig. 91).

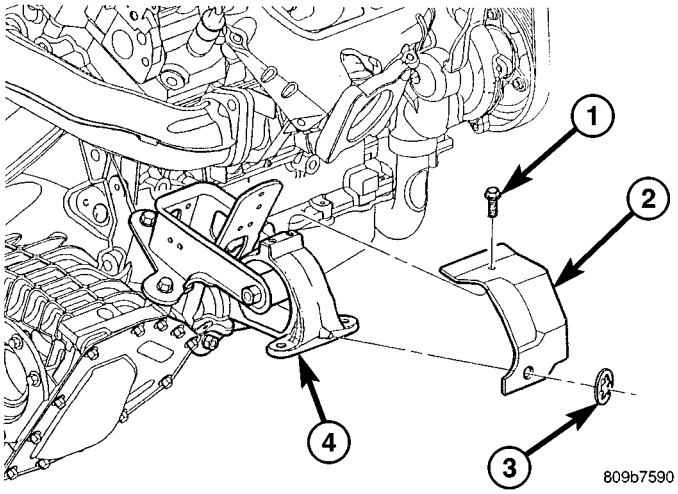

Fig. 91 Rear Mount Heat Shield

1 - BOLT - HEAT SHIELD 11 N·m (100 in. lbs.)
2 - HEAT SHIELD
3 - CLIP
4 - REAR MOUNT

(3) Remove the through bolt from the mount and rear mount bracket (Fig. 92).
(4) Remove the mount bolts (Fig. 92).
(5) Remove the rear mount (Fig. 92).
(6) For rear mount bracket removal, remove the bolts attaching bracket to transaxle (Fig. 93).
(7) Remove rear mount bracket.

REAR MOUNT (Continued)

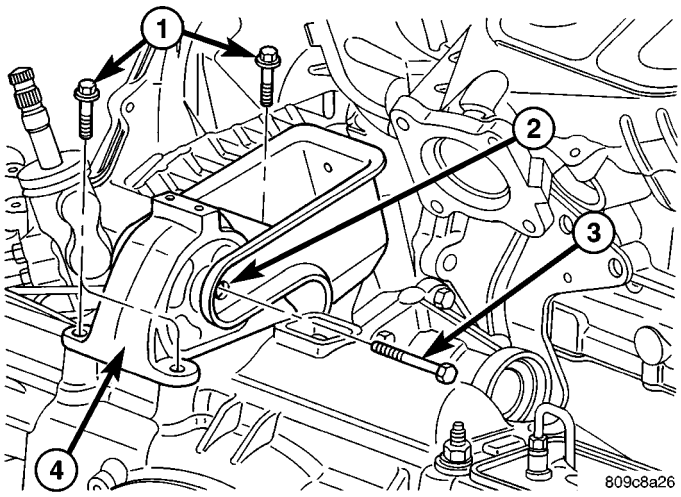

Fig. 92 Rear Mount

1 - BOLT 54 N·m (40 ft. lbs.)
2 - REAR MOUNT BRACKET
3 - THRU-BOLT 54 N·m (40 ft. lbs.)
4 - REAR MOUNT

INSTALLATION

(1) Install rear mount bracket, if removed (Fig. 93).

(2) Install the rear mount and bolts (Fig. 92). Tighten bolts to 54 N·m (40 ft. lbs.).

(3) Install the mount through bolt to the mount and bracket (Fig. 92). Tighten through bolt to 54 N·m (40 ft. lbs.).

(4) Install the rear mount heat shield (Fig. 91).

(5) Lower vehicle on hoist.

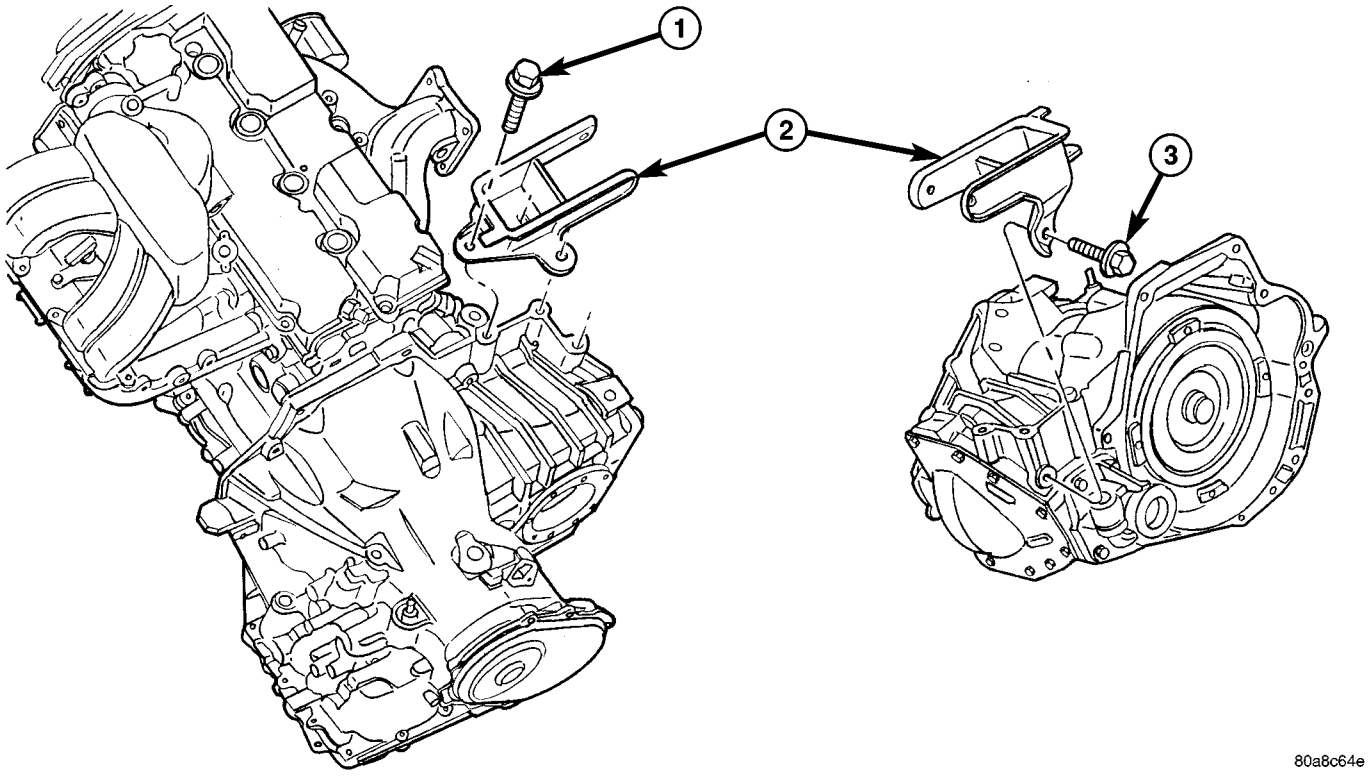

Fig. 93 Rear Mount Bracket - (all engines)

1 - BOLT - VERTICAL 102 N·m (75 ft. lbs.)
2 - BRACKET - REAR MOUNT
3 - BOLT - HORIZONTAL 102 N·m (75 ft. lbs.)

RIGHT MOUNT

REMOVAL

(1) Remove air cleaner housing lid and clean air hose from throttle body.
(2) Remove air cleaner element and housing.
(3) Disconnect make-up air hose from cylinder head cover.
(4) Remove the load on the right engine mount by carefully supporting the engine assembly with a floor jack.
(5) Disconnect electrical harness support clips from engine mount bracket.
(6) Remove the bolts attaching the engine mount to the frame rail (Fig. 94).
(7) Remove the three bolts attaching the engine mount to the engine bracket (Fig. 94).
(8) Remove the right engine mount (Fig. 94).

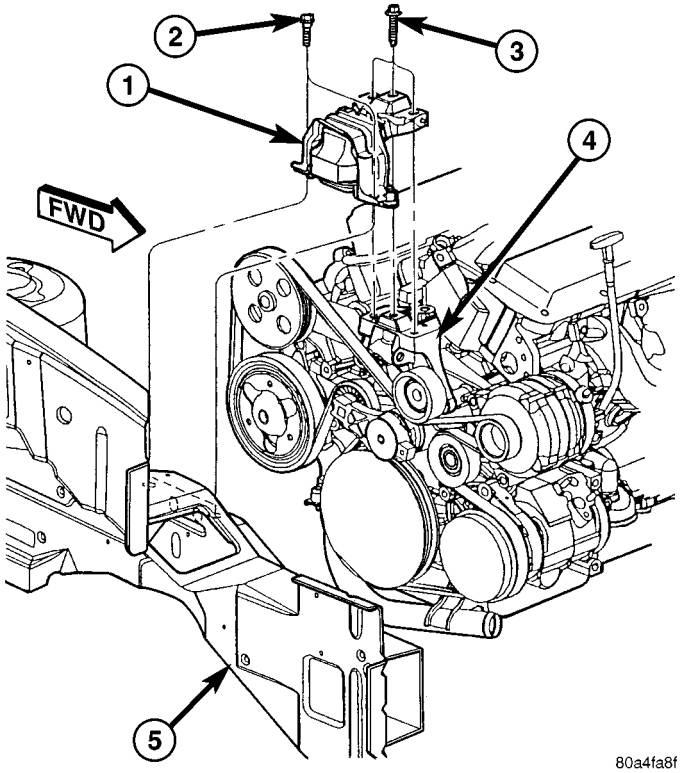

Fig. 94 Right Engine Mount

1 - RIGHT ENGINE MOUNT
2 - BOLT - MOUNT TO FRAME RAIL
3 - BOLT - MOUNT TO ENGINE
4 - ENGINE MOUNT BRACKET
5 - RIGHT FRAME RAIL

INSTALLATION

(1) Install engine bracket (if removed). Tighten bolts to 33 N·m (24 ft. lbs.).
(2) Position right engine mount and install frame rail to mount bolts (Fig. 94). Tighten bolts to 68 N·m (50 ft. lbs.).
(3) Install the mount to engine bracket bolts and tighten to 54 N·m (40 ft. lbs.). (Fig. 94)
(4) Connect electrical harness support clips to engine mount bracket.
(5) Remove jack from under engine.
(6) Connect make-up air hose to cylinder head cover.
(7) Install air cleaner housing and element.
(8) Install air cleaner housing lid and clean air tube to throttle body.

LUBRICATION

DESCRIPTION

The lubrication system is a full flow filtration pressure feed type. The oil pump is mounted in the timing chain cover and is driven by the crankshaft

OPERATION

Oil from the oil pan is pumped by a internal gear type oil pump directly coupled to the crankshaft. The pressure is regulated by a relief valve located in the timing chain cover. The oil is pumped through an oil filter and feeds a main oil gallery. This oil gallery feeds oil under pressure to the main and rod bearings, camshaft bearings. Passages in the cylinder block feed oil to the hydraulic lifters and rocker shaft brackets which feeds the rocker arm pivots (Fig. 95).

DIAGNOSIS AND TESTING - ENGINE OIL PRESSURE

(1) Disconnect and remove oil pressure switch (Refer to 9 - ENGINE/LUBRICATION/OIL PRESSURE SENSOR/SWITCH - REMOVAL).
(2) Install Special Tools C-3292 Gauge with 8406 Adaptor. For Special Tool identification, (Refer to 9 - ENGINE - SPECIAL TOOLS).
(3) Start engine and record oil pressure. Refer to Oil Pressure in Engine Specifications for the correct pressure (Refer to 9 - ENGINE - SPECIFICATIONS).

LUBRICATION (Continued)

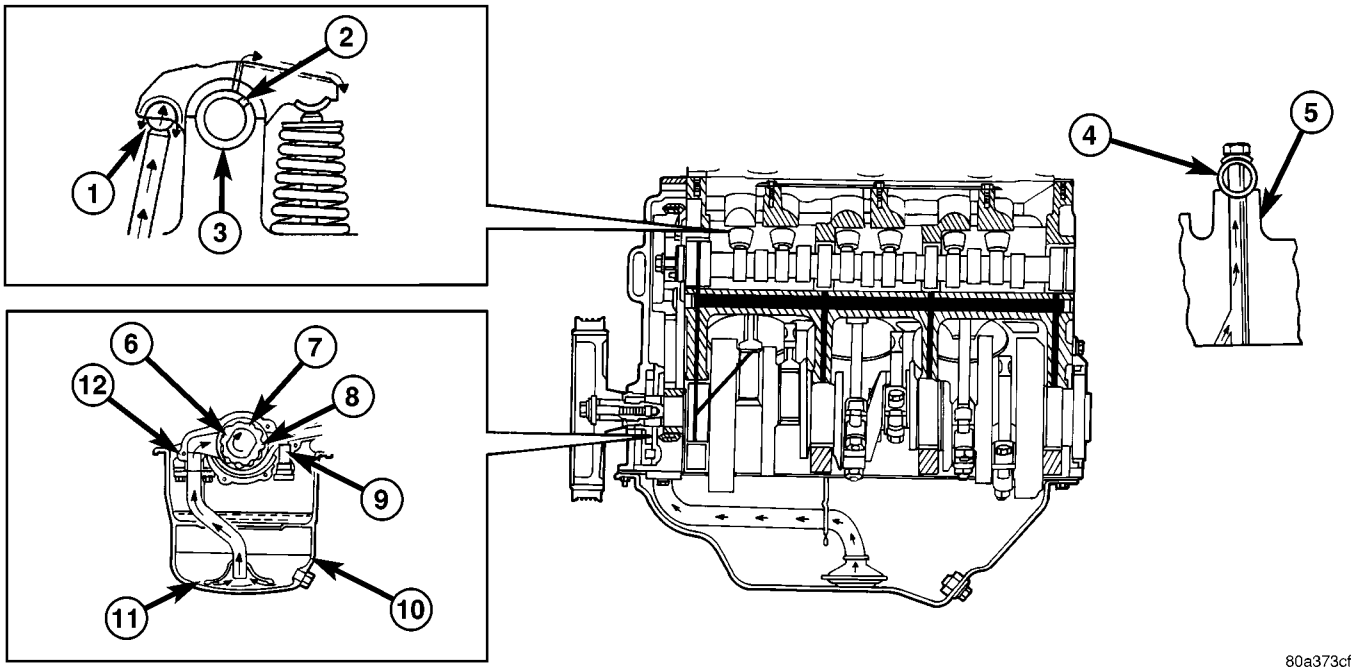

Fig. 95 Engine Oiling System

1 - OIL SUPPLY FOR BALL SOCKET THROUGH PUSH ROD
2 - OIL SUPPLY PASSAGE FROM SHAFT TO ROCKER ARM
3 - ROCKER SHAFT
4 - OIL FLOWS TO ONLY ONE PEDASTAL ON EACH HEAD; THIRD FROM REAR ON RIGHT HEAD, THIRD FROM FRONT ON LEFT HEAD
5 - ROCKER SHAFT TOWER
6 - CRANKSHAFT
7 - OUTER ROTOR
8 - INNER ROTOR
9 - RELIEF VALVE
10 - OIL PAN
11 - OIL SCREEN
12 - OIL PUMP CASE

OIL

STANDARD PROCEDURE

STANDARD PROCEDURE - ENGINE OIL AND FILTER CHANGE

Change engine oil at mileage and time intervals described in the Maintenance Schedule. (Refer to LUBRICATION & MAINTENANCE/MAINTENANCE SCHEDULES - DESCRIPTION)

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) Open hood, remove oil fill cap (Fig. 97).

(3) Hoist and support vehicle on safety stands. Refer to Hoisting and Jacking Recommendations. (Refer to LUBRICATION & MAINTENANCE/HOISTING - STANDARD PROCEDURE)

(4) Place a suitable drain pan under crankcase drain (Fig. 96).

(5) Remove drain plug from crankcase (Fig. 96) and allow oil to drain into pan. Inspect drain plug threads for stretching or other damage. Replace drain plug and gasket if damaged.

(6) Remove oil filter. (Refer to 9 - ENGINE/LUBRICATION/OIL FILTER - REMOVAL)

(7) Install and tighten drain plug in crankcase.

(8) Install new oil filter. (Refer to 9 - ENGINE/LUBRICATION/OIL FILTER - INSTALLATION)

(9) Lower vehicle and fill crankcase with specified type and amount of engine oil. (Refer to LUBRICATION & MAINTENANCE/FLUID TYPES - DESCRIPTION)

(10) Install oil fill cap.

OIL (Continued)

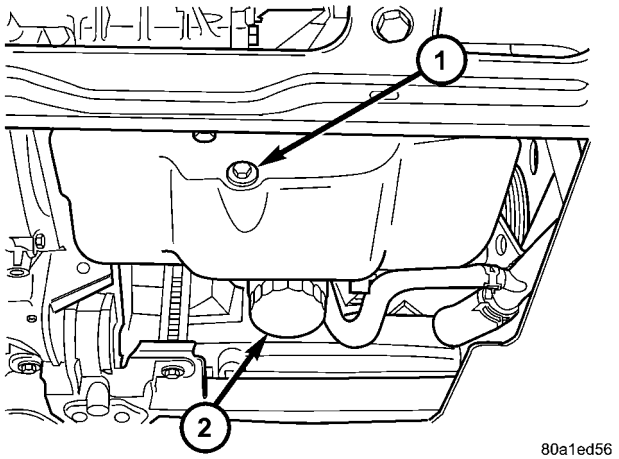

Fig. 96 Engine Oil Drain Plug and Oil Filter

1 - DRAIN PLUG
2 - OIL FILTER

(11) Start engine and inspect for leaks.
(12) Stop engine and inspect oil level.

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

STANDARD PROCEDURE - 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 (Fig. 97). Add only when the level is at or below the ADD mark.

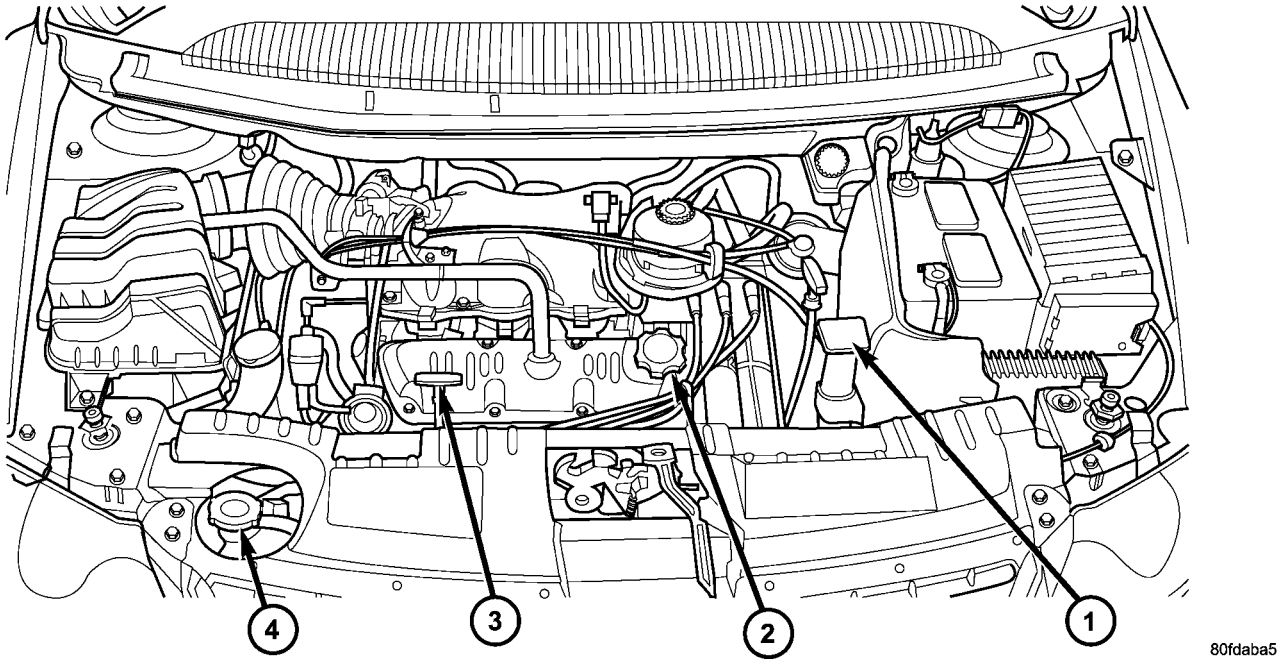

Fig. 97 Engine Oil Level Dipstick and Fill Locations

1 - COOLANT RECOVERY CONTAINER
2 - ENGINE OIL FILL CAP
3 - ENGINE OIL LEVEL DIPSTICK
4 - RADIATOR PRESSURE CAP

OIL COOLER & LINES

DESCRIPTION

An engine oil cooler is used on 3.3/3.8L engines (Heavy Duty Cooling Only) (Fig. 99). The cooler is a coolant-to-oil type and mounted between the oil filter and engine block.

OPERATION

Engine oil travels from the oil filter and into the oil cooler. Engine oil then exits the cooler into the main gallery. Engine coolant flows into the cooler from the heater return tube and exits into the water pump inlet.

REMOVAL

(1) Drain cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE - COOLING SYSTEM DRAINING).

(2) Disconnect oil cooler inlet and outlet hoses (Fig. 98).

(3) Remove oil filter.

(4) Remove oil cooler attachment fitting (Fig. 99).

(5) Remove oil cooler.

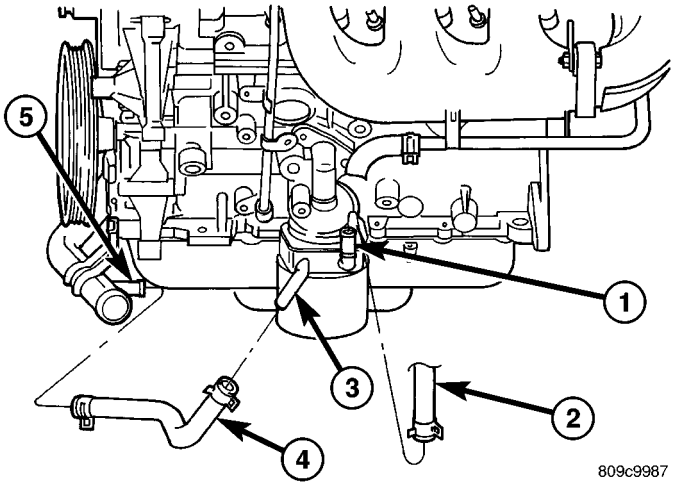

Fig. 98 Engine Oil Cooler Hoses

1 - OIL COOLER INLET TUBE
2 - INLET HOSE
3 - OIL COOLER OUTLET TUBE
4 - OUTLET HOSE
5 - WATER PUMP INLET TUBE

INSTALLATION

(1) Lubricate seal and position oil cooler to connector fitting on oil filter adapter (Fig. 99).

NOTE: Position the flat side of oil cooler parallel to oil pan rail.

(2) Install oil cooler attachment fitting and tighten to 27 N·m (20 ft. lbs.) (Fig. 99).

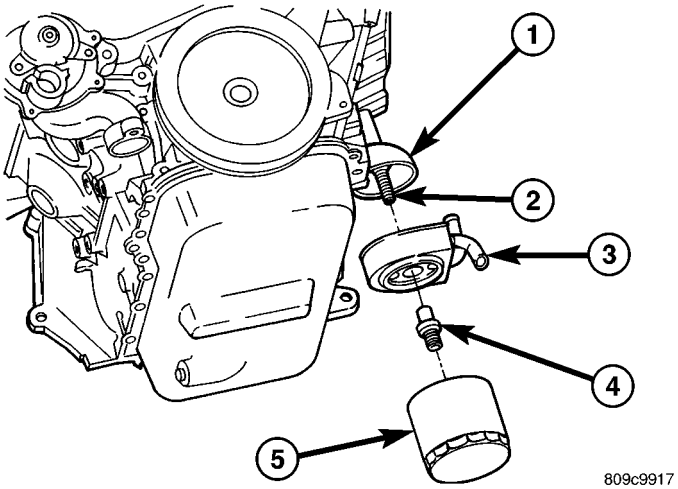

Fig. 99 Engine Oil Cooler - 3.3/3.8L (Heavy Duty Cooling)

1 - OIL FILTER ADAPTER
2 - CONNECTOR
3 - ENGINE OIL COOLER
4 - OIL COOLER ATTACHMENT FITTING
5 - OIL FILTER

(3) Install oil filter.

(4) Connect oil cooler inlet and outlet hoses (Fig. 98).

(5) Fill cooling system (Refer to 7 - COOLING - STANDARD PROCEDURE - COOLING SYSTEM FILLING).

OIL FILTER

REMOVAL

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

(1) Using suitable oil filter wrench, turn filter counterclockwise to remove from oil filter adapter (Fig. 100). Properly discard used oil filter.

INSTALLATION

(1) Wipe oil filter adapter base clean and inspect gasket contact surface.

(2) Lubricate gasket of new filter with clean engine oil.

(3) Install new filter until gasket contacts base (Fig. 100). Tighten filter 1 turn or 20 N·m (15 ft. lbs.). Use filter wrench if necessary.

(4) Start engine and check for leaks.

OIL FILTER ADAPTER

REMOVAL

(1) Raise vehicle on hoist.
(2) Remove the oil filter.
(3) Disconnect oil pressure switch electrical connector.
(4) Remove oil filter adapter attaching bolts (Fig. 100).
(5) Remove oil filter adapter and seal (Fig. 100).

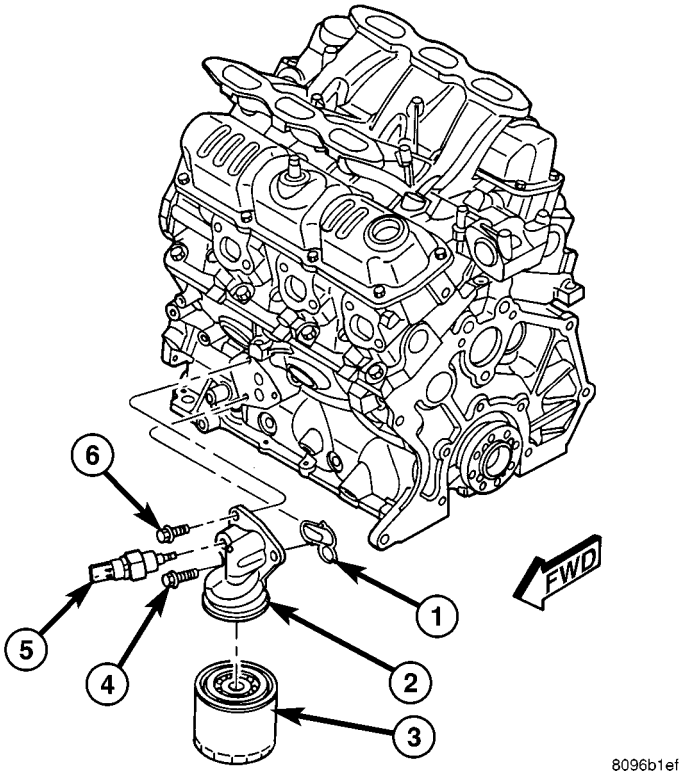

Fig. 100 OIL FILTER ADAPTER

1 - SEAL
2 - OIL FILTER ADAPTER
3 - OIL FILTER
4 - BOLT
5 - OIL PRESSURE SWITCH
6 - BOLT

INSTALLATION

(1) Clean oil filter adapter and install new seal.
(2) Position adapter on engine block and install bolts (Fig. 100).
(3) Tighten adapter bolts to 28 N·m (250 in. lbs.).
(4) Connect oil pressure switch electrical connector (Fig. 100).
(5) Install the oil filter.
(6) Lower vehicle on hoist.
(7) Start engine and allow to run approximately 2 minutes.
(8) Turn off engine and check oil level. Adjust oil level as necessary.

OIL PAN

REMOVAL

(1) Disconnect negative cable from battery and remove engine oil dipstick.
(2) Raise vehicle on hoist and drain engine oil.
(3) Remove drive belt splash shield.
(4) Remove strut to transaxle attaching bolt (Fig. 101). Loosen strut to engine block attaching bolts.
(5) Remove transaxle case cover (Fig. 101).

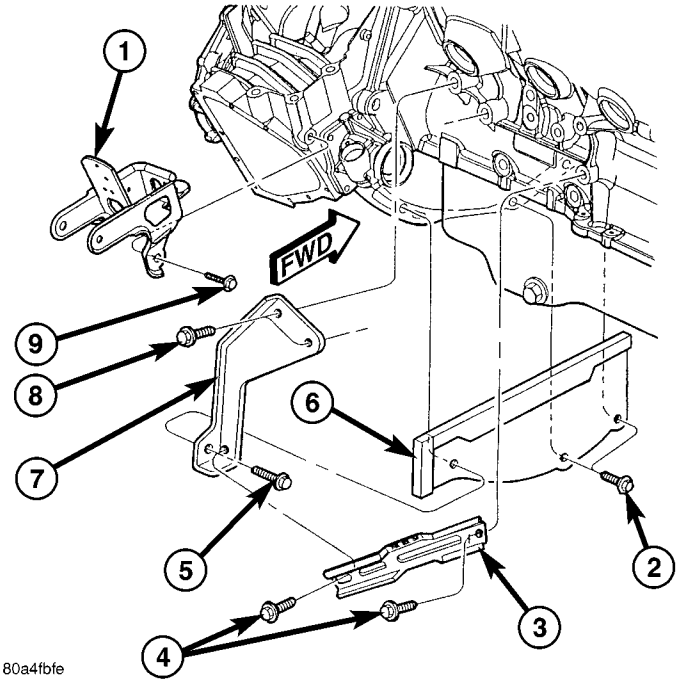

Fig. 101 Powertrain Struts and Transaxle Case Cover

1 - BRACKET - ENGINE REAR MOUNT
2 - BOLT - TRANSAXLE CASE COVER
3 - STRUT - TRANSAXLE TO ENGINE HORIZONTAL
4 - BOLT - HORIZONTAL STRUT
5 - BOLT - STRUT TO TRANSAXLE
6 - COVER - TRANSAXLE CASE LOWER
7 - STRUT - TRANSAXLE TO ENGINE
8 - BOLT - STRUT TO ENGINE
9 - BOLT - ENGINE REAR MOUNT BRACKET

(6) Remove oil pan fasteners (Fig. 102).
(7) Remove the oil pan and gasket (Fig. 102).

CLEANING

(1) Clean oil pan with solvent and wipe dry with a clean cloth.
(2) Clean all gasket material from mounting surfaces of pan and block.
(3) Clean oil screen and pick-up tube in clean solvent.

OIL PAN (Continued)

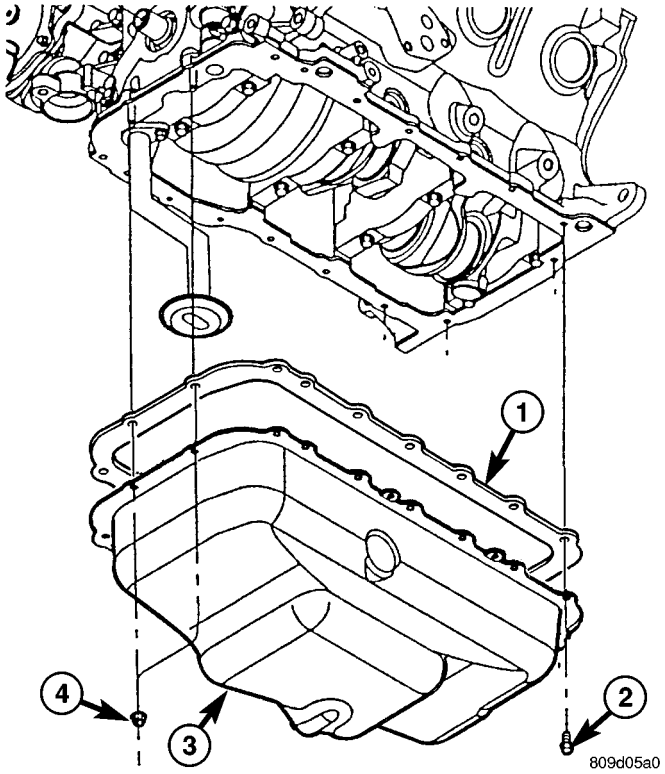

Fig. 102 OIL PAN

1 - GASKET
2 - BOLT
3 - OIL PAN
4 - NUT

INSPECTION

(1) Inspect oil drain plug and plug hole for stripped or damaged threads and repair as necessary. Install a new drain plug gasket. Tighten to 27 N·m (20 ft. lbs.).

(2) Inspect oil pan mounting flange for bends or distortion. Straighten flange if necessary.

(3) Inspect condition of oil screen and pick-up tube.

INSTALLATION

(1) Clean sealing surfaces and apply a 1/8 inch bead of Mopar® Engine RTV GEN II at the parting line of the chain case cover and the rear seal retainer (Fig. 103).

(2) Position a new pan gasket on oil pan (Fig. 102).

(3) Install oil pan and tighten fasteners to 12 N·m (105 in. lbs.) (Fig. 102).

(4) Install cover to transaxle case (Fig. 101).

(5) Install the strut bolt to transaxle housing (Fig. 101). Tighten all bending brace bolts.

(6) Install the drive belt splash shield.

(7) Lower vehicle and install oil dipstick.

(8) Connect negative cable to battery.

(9) Fill crankcase with oil to proper level.

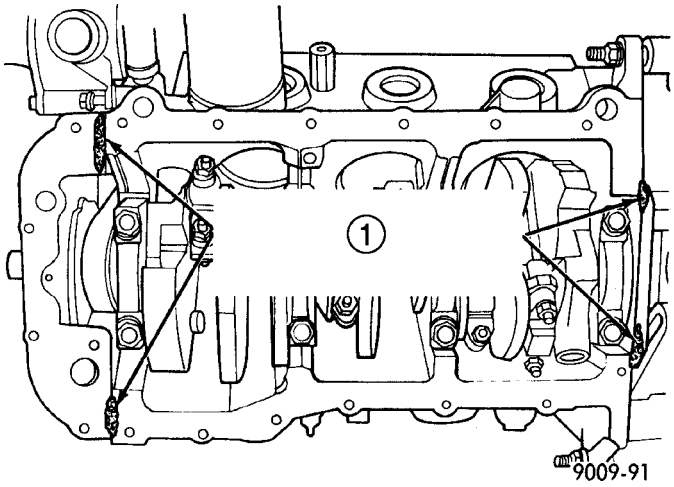

Fig. 103 Oil Pan Sealing

1 - SEALER LOCATIONS

OIL PRESSURE RELIEF VALVE

REMOVAL

(1) Remove oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

(2) Drill a 3.175 mm (1/8 in.) hole in the center of the retainer cap (Fig. 104). Insert a self-threading sheet metal screw into the cap.

(3) Using suitable pliers, remove cap and discard.

(4) Remove spring and relief valve (Fig. 104).

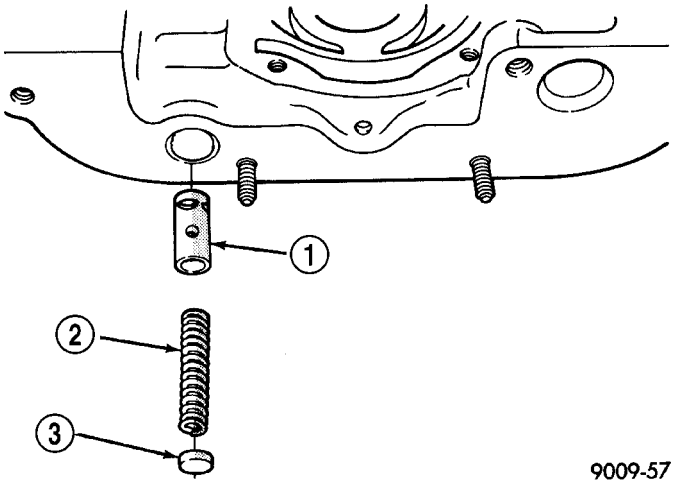

Fig. 104 Oil Pressure Relief Valve

1 - RELIEF VALVE
2 - SPRING
3 - RETAINER CAP

OIL PRESSURE RELIEF VALVE (Continued)

INSTALLATION

(1) Clean relief valve, spring and bore.

NOTE: Lubricate relief valve with clean engine oil before installing.

(2) Install relief valve and spring into housing.
(3) Install new retainer cap until flush with sealing surface.
(4) Install oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).
(5) Fill crankcase with proper oil to correct level.

OIL PRESSURE SWITCH

DESCRIPTION

The engine oil pressure switch is located on the lower left front side of the engine. It screws into the oil filter adapter. The normally closed switch provides an input through a single wire to the low pressure indicator light on the instrument cluster.

OPERATION

The oil pressure switch provides a ground for the instrument cluster low oil pressure indicator light. The switch receives oil pressure input from the engine main oil gallery. When engine oil pressure is greater than 27.5 Kpa (4 psi), the switch contacts open, providing a open circuit to the low pressure indicator light. For wiring circuits and diagnostic information, (Refer to Appropriate Wiring/Diagnostic Information).

REMOVAL

(1) Raise vehicle on hoist.
(2) Disconnect electrical connector from switch.
(3) Remove oil pressure switch (Fig. 105).

INSTALLATION

(1) Install oil pressure switch. Torque oil pressure switch to 23 N·m (200 in. lbs.) (Fig. 105).
(2) Connect electrical connector to switch.
(3) Lower the vehicle.
(4) Start engine and check for leaks.
(5) Check engine oil level. Adjust as necessary.

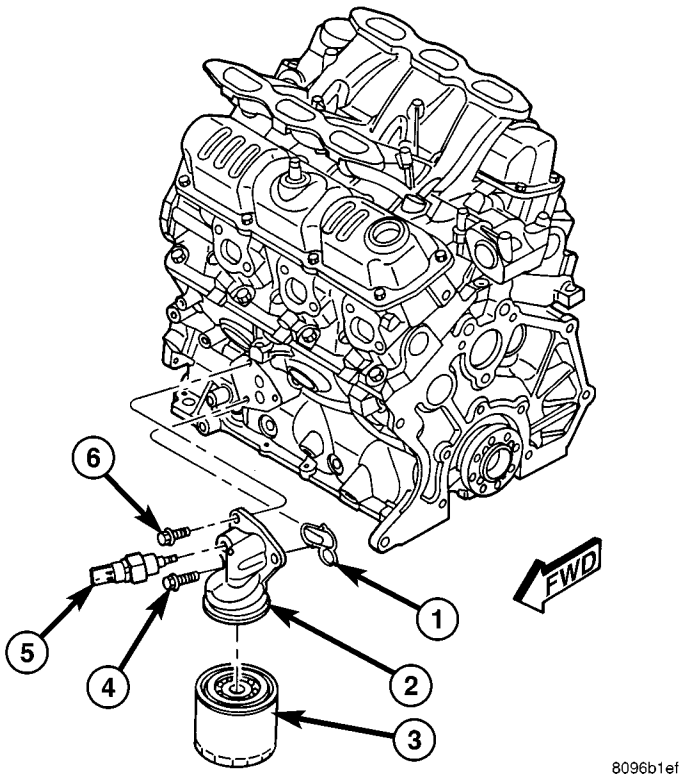

Fig. 105 OIL FILTER ADAPTER

1 - SEAL
2 - OIL FILTER ADAPTER
3 - OIL FILTER
4 - BOLT
5 - OIL PRESSURE SWITCH
6 - BOLT

OIL PUMP

DESCRIPTION

The oil pump is located in the timing chain cover. It is driven by the crankshaft.

REMOVAL

The oil pump is contained within the timing chain cover housing (Fig. 106).

(1) Remove oil pan. (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL)

(2) Remove the timing chain cover. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL)

(3) Disassemble oil pump from timing chain cover. (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - DISASSEMBLY)

(4) Clean and Inspect oil pump components. (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - CLEANING) (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - INSPECTION)

OIL PUMP (Continued)

DISASSEMBLY

(1) Remove oil pump cover screws, and lift off cover (Fig. 106).

(2) Remove oil pump rotors (Fig. 106).

(3) Clean and inspect oil pump components. (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - CLEANING) (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - INSPECTION)

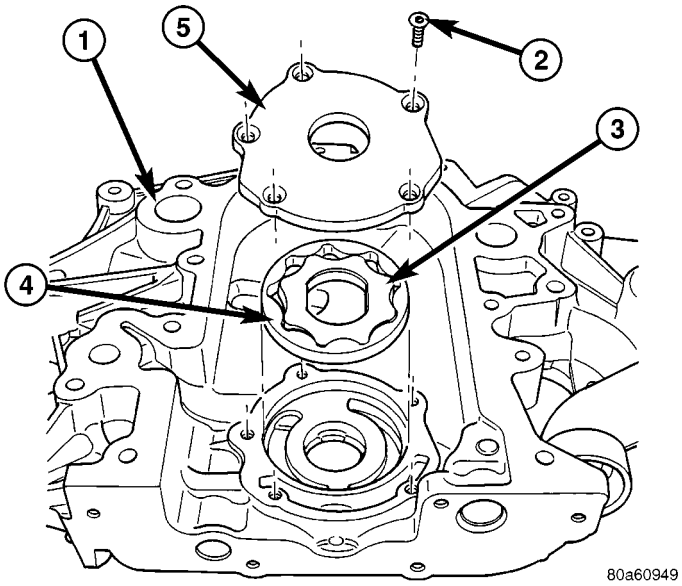

Fig. 106 OIL PUMP

1 - TIMING CHAIN COVER
2 - SCREWS
3 - INNER ROTOR
4 - OUTER ROTOR
5 - COVER

CLEANING

(1) Clean all parts thoroughly in a suitable solvent.

INSPECTION

(1) Inspect mating surface of the chain case cover. Surface should be smooth. Replace cover if scratched or grooved.

(2) Lay a straightedge across the pump cover surface (Fig. 107). If a 0.025 mm (0.001 in.) feeler gauge can be inserted between cover and straight edge, cover should be replaced.

(3) Measure thickness and diameter of outer rotor. If outer rotor thickness measures 7.64 mm (0.301 in.) or less (Fig. 108), or if the diameter is 79.95 mm (3.148 in.) or less, replace outer rotor.

(4) If inner rotor thickness measures 7.64 mm (0.301 in.) or less, replace inner rotor (Fig. 109).

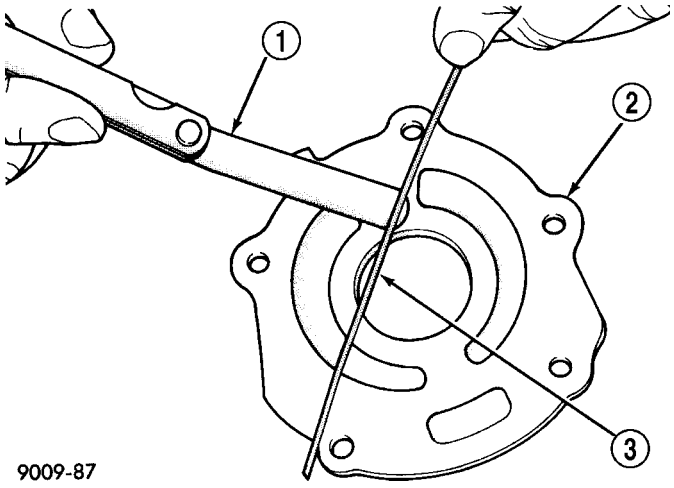

Fig. 107 Checking Oil Pump Cover Flatness

1 - FEELER GAUGE
2 - OIL PUMP COVER
3 - STRAIGHT EDGE

(5) Install outer rotor into chain case cover. Press rotor to one side with fingers and measure clearance between rotor and chain case cover (Fig. 110). If measurement is 0.39 mm (0.015 in.) or more, replace chain case cover, only if outer rotor is in specification.

(6) Install inner rotor into chain case cover. If clearance between inner and outer rotors (Fig. 111) is 0.203 mm (0.008 in.) or more, replace both rotors.

(7) Place a straightedge across the face of the chain case cover, between bolt holes. If a feeler gauge of 0.10 mm (0.004 in.) or more can be inserted between rotors and the straightedge, replace pump assembly (Fig. 112). **ONLY** if rotors are in specs.

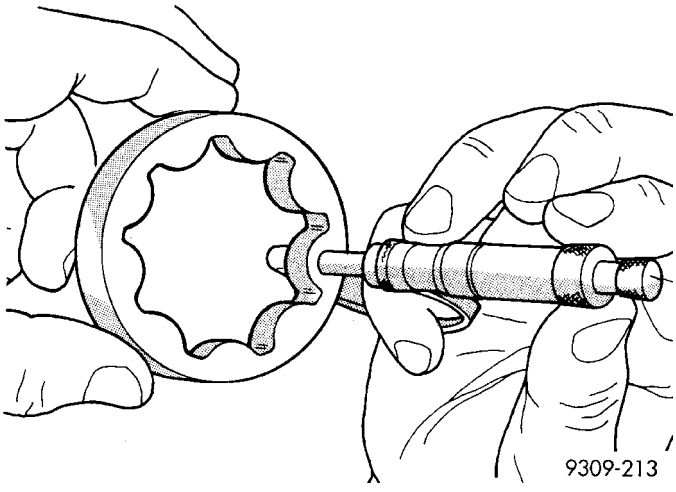

Fig. 108 Measuring Outer Rotor Thickness

OIL PUMP (Continued)

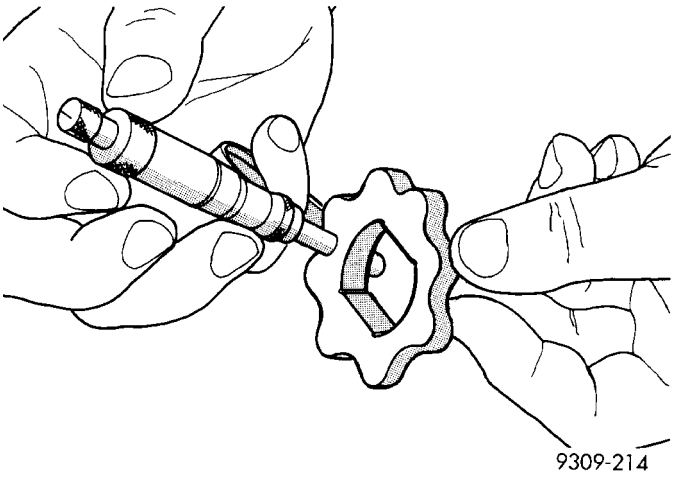

Fig. 109 Measuring Inner Rotor Thickness

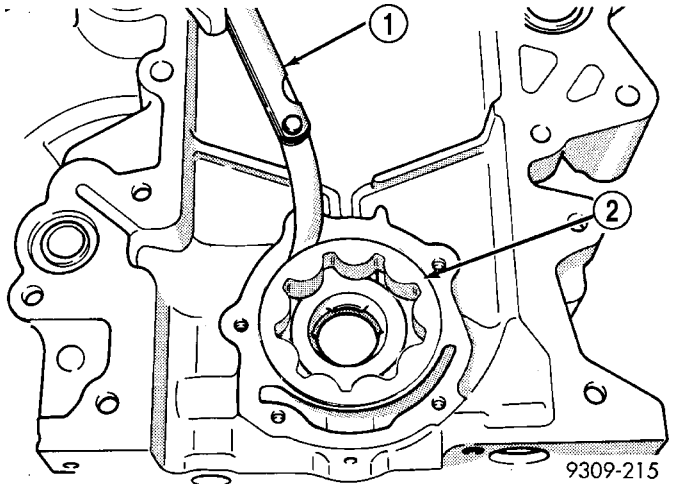

Fig. 110 Measuring Outer Rotor Clearance in Housing

1 - FEELER GAUGE
2 - OUTER ROTOR

(8) Remove oil pressure relief valve. (Refer to 9 - ENGINE/LUBRICATION/OIL PRESSURE RELIEF VALVE - REMOVAL)

(9) Inspect oil pressure relief valve and bore. Inspect for scoring, pitting and free valve operation in bore (Fig. 113). Small marks may be removed with 400-grit wet or dry sandpaper.

(10) The relief valve spring has a free length of approximately 49.5 mm (1.95 inches) it should test between 19.5 and 20.5 pounds when compressed to 34 mm (1-11/32 inches). Replace spring that fails to meet specifications.

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

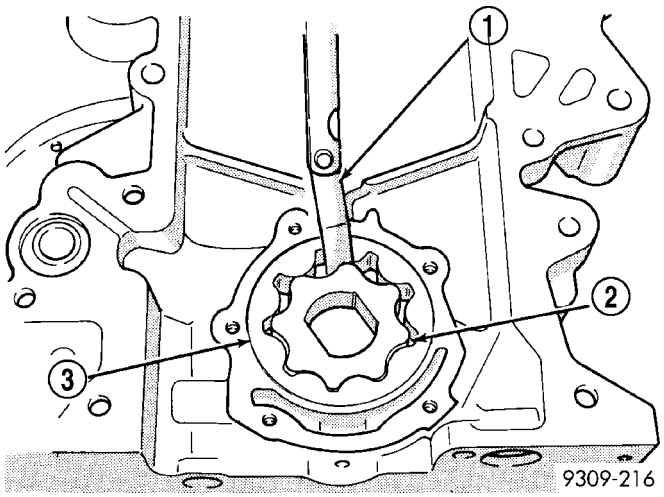

Fig. 111 Measuring Clearance Between Rotors

1 - FEELER GAUGE
2 - INNER ROTOR
3 - OUTER ROTOR

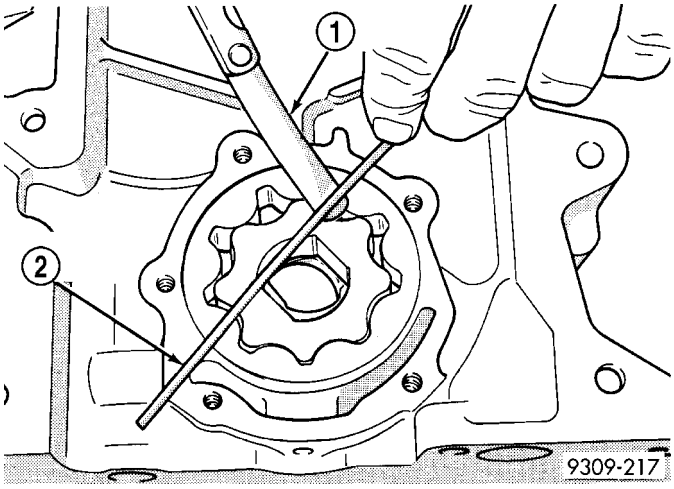

Fig. 112 Measuring Clearance Over Rotors

1 - FEELER GAUGE
2 - STRAIGHT EDGE

ASSEMBLY

(1) Assemble pump, using new parts as required. **Install the inner rotor with chamfer facing the cast iron oil pump cover.**

(2) Prime oil pump before installation by filling rotor cavity with engine oil.

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

(4) If removed, install the oil pressure relief valve. (Refer to 9 - ENGINE/LUBRICATION/OIL PRESSURE RELIEF VALVE - INSTALLATION)

INSTALLATION

(1) Install oil pump. (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - ASSEMBLY)

OIL PUMP (Continued)

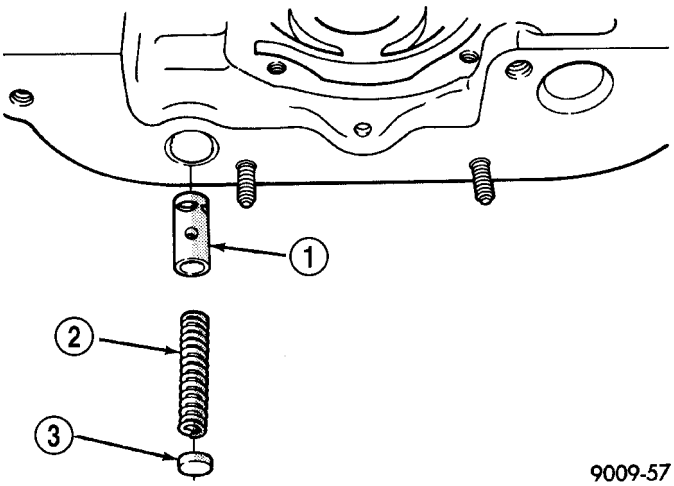

Fig. 113 Oil Pressure Relief Valve

1 - RELIEF VALVE
2 - SPRING
3 - RETAINER CAP

(2) Install timing chain cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION) and oil pan (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

INTAKE MANIFOLD

DESCRIPTION

The intake system is made up of an upper and lower intake manifold. The upper intake manifold is made of a composite for both the 3.3L engine and for the 3.8L engine (Fig. 118). The lower intake manifold is common between the two engines (Fig. 122). It also provides coolant crossover between cylinder heads and houses the coolant thermostat (Fig. 122).

The intake manifold utilizes a compact design with very low restriction and outstanding flow balance. This design allows the engine to perform with a wide torque curve while increasing higher rpm horsepower.

If, for some reason, the molded-in vacuum ports break, the composite manifold can be salvaged. The vacuum ports are designed to break at the shoulder, if overloaded. Additional material in the shoulder area provides sufficient stock to repair. For more information and procedure, (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - STANDARD PROCEDURE). Also, if the special screws that attach the MAP sensor, power steering reservoir, throttle cable bracket, and the EGR tube become stripped, an oversized screw is available to repair the stripped-out condition. For more information and procedure, (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - STANDARD PROCEDURE)

DIAGNOSIS AND TESTING - INTAKE MANIFOLD LEAKS

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.

INTAKE MANIFOLD - UPPER

STANDARD PROCEDURE

STANDARD PROCEDURE - MANIFOLD STRIPPED THREAD REPAIR

The composite upper intake manifold thread bosses, if stripped out, can be repaired by utilizing a repair screw available through Mopar® parts. Repair screws are available for the following manifold attached components:

- MAP sensor
- Power steering reservoir
- EGR tube
- Throttle cable bracket

The repair screws require a unique tightening torque specification from the original screw. Refer to the following chart for specification.

DESCRIPTION	TORQUE*
STRIP-OUT REPAIR SCREWS ONLY	
MAP Sensor Repair Screw	4 N·m (35 in. lbs.)
Power Steering Reservoir Repair Screw	9 N·m (80 in. lbs.)
EGR Tube Attaching Repair Screw	9 N·m (80 in. lbs.)
Throttle Cable Bracket Repair Screw	9 N·m (80 in. lbs.)
*Install Slowly Using Hand Tools Only	

INTAKE MANIFOLD - UPPER (Continued)

STANDARD PROCEDURE - INTAKE MANIFOLD VACUUM PORT REPAIR

The composite intake manifold vacuum ports can be repaired. Although, if the manifold plenum chamber is damaged or cracked, the manifold must be replaced.

To repair a broken or damaged vacuum nipple (port) on the composite intake manifold, perform the following procedure:

PARTS REQUIRED	TOOLS REQUIRED
· Brass Nipple – 1/4″ O.D. x 1/8″ pipe thread (LDP/Speed Control Port)	· Pipe Tap – 1/8″ - 18 NPT · Drill Bit – 11/32″ · File/Sandpaper
· Brass Nipple – 1/2″ O.D. x 1/4″ pipe thread (Brake Booster Port)	· Pipe Tap – 1/4″ - 18 NPT · Drill Bit – 7/16″ · File/Sandpaper

NOTE: While performing this procedure, avoid getting the manifold material residue into the plenum chamber.

(1) File or sand the remaining port back until a flat surface is obtained (plane normal to nipple (port) axis).

(2) Drill out the nipple (port) base using a 7/16” (brake booster port) or 11/32” (LDP/speed control port) drill bit (Fig. 114).

(3) Using a 1/4”–18 NPT (brake booster port) or 1/8”–18 NPT (LDP/speed control port) pipe tap, cut internal threads (Fig. 114). Use caution to start tap in a axis same as original nipple.

(4) Apply Mopar® Thread Sealant to threads of repair nipple(s).

(5) Install repair nipple(s). Do not over torque repair nipple(s).

REMOVAL - UPPER INTAKE MANIFOLD

(1) Disconnect battery negative cable.

(2) Disconnect inlet air temperature (IAT) sensor electrical connector.

(3) Remove air inlet resonator to throttle body hose assembly.

(4) Disconnect throttle and speed control cables from throttle body (Refer to 14 - FUEL SYSTEM/ FUEL INJECTION/THROTTLE CONTROL CABLE - REMOVAL).

(5) Disconnect make-up air hose support clip from throttle cable bracket.

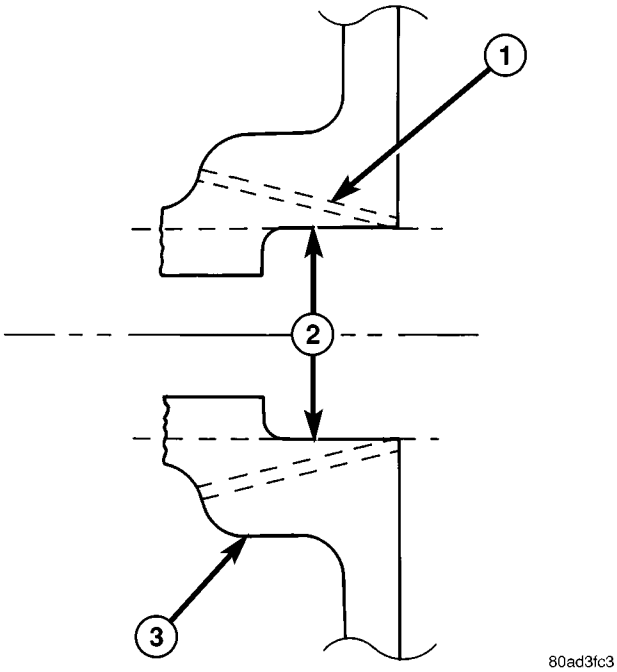

Fig. 114 Intake Manifold Port Repair

1 - BRAKE BOOSTER PORT = 1/4″–18 NPT PIPE TAP
1 - LDP/SPEED CONTROL PORT = 1/8″–18 NPT PIPE TAP
2 - DRILL BIT = 7/16″ BRAKE BOOSTER PORT
2 - DRILL BIT = 11/32″ LDP/SPEED CONTROL PORT
3 - INTAKE MANIFOLD

(6) Disconnect the automatic idle speed (AIS) motor and throttle position sensor (TPS) wiring connectors from throttle body.

(7) Disconnect the manifold absolute pressure (MAP) sensor electrical connector.

(8) Disconnect the vapor purge vacuum hose from throttle body.

(9) Disconnect the PCV hose (Fig. 115).

(10) Remove the power steering reservoir attaching bolts and only loosen the nut (Fig. 116). Lift reservoir up to disengage lower mount from stud. Set reservoir aside. **Do not** disconnect hose.

(11) Disconnect the brake booster and leak detection pump (LDP) hoses from intake manifold (Fig. 117).

(12) Remove intake manifold bolts and remove the manifold (Fig. 118).

(13) Cover the lower intake manifold with a suitable cover while the upper manifold is removed.

(14) Clean and inspect the upper intake manifold (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - CLEANING) and (Refer to 9 - ENGINE/ MANIFOLDS/INTAKE MANIFOLD - INSPECTION).

CLEANING

(1) Discard gasket(s).

(2) Clean all sealing surfaces.

INTAKE MANIFOLD - UPPER (Continued)

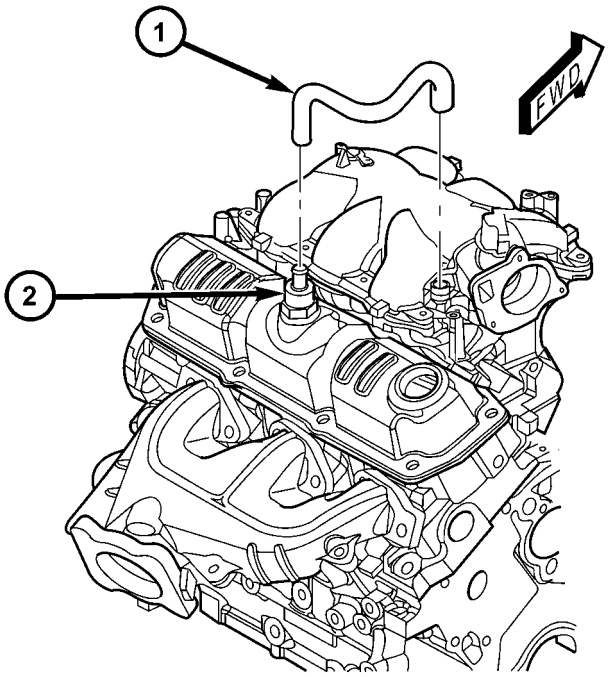

Fig. 115 PCV & HOSE

1 - HOSE - PCV
2 - PCV VALVE

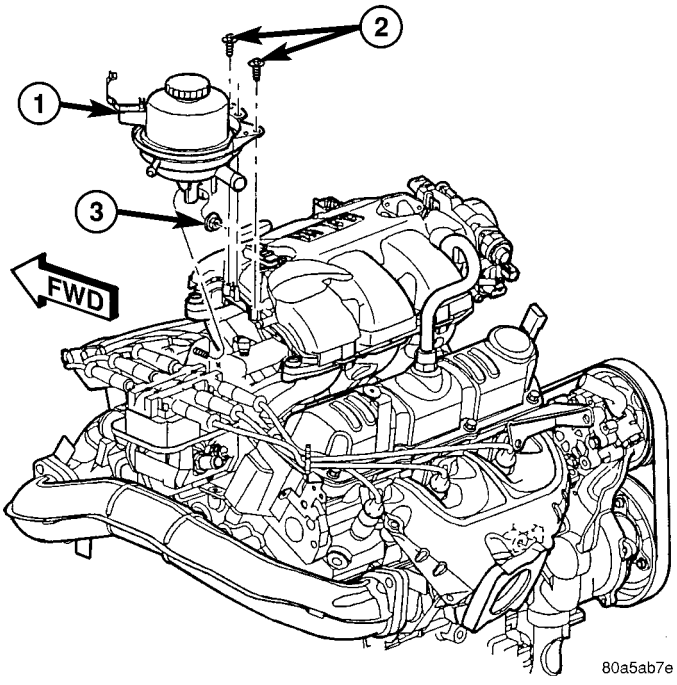

Fig. 116 POWER STEERING FLUID RESERVOIR

1 - POWER STEERING RESERVOIR
2 - BOLT - RESERVOIR TO MANIFOLD
3 - NUT - RESERVOIR TO COIL BRACKET

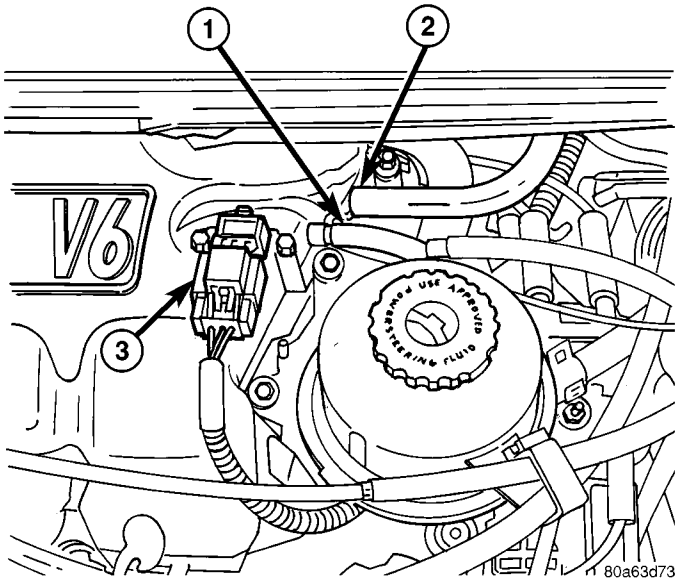

Fig. 117 BRAKE BOOSTER & LDP VACUUM HOSES

1 - LDP & SPEED CONTROL VACUUM HOSE
2 - BRAKE BOOSTER VACUUM HOSE
3 - MAP SENSOR

INSPECTION

Check manifold for:

- Damage and cracks.
- Mounting surface distortion by using a straight-edge and thickness gauge.

INSTALLATION - UPPER INTAKE MANIFOLD

(1) If the following components were removed from manifold, install and tighten to specifications:

CAUTION: The special screws used for the composite manifold attached components must be installed slowly using hand tools only. This requirement is to prevent the melting of material that causes stripped threads. If threads become stripped, an oversize repair screw is available. For more information and procedure (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - STANDARD PROCEDURE - MANIFOLD STRIPPED THREAD REPAIR).

- MAP sensor - 1.7 N·m (15 in. lbs.)
- Throttle cable bracket - 5.6 N·m (50 in. lbs.)

(2) Remove covering on lower intake manifold and clean surfaces.

(3) Inspect manifold gasket condition. Gaskets can be re-used, if not damaged. To replace, remove gasket from upper manifold (Fig. 118). Position new gasket in seal channel and press lightly in-place. Repeat procedure for each gasket position.

(4) Position upper manifold on lower manifold (Fig. 118). Apply Mopar® Lock & Seal Adhesive (Medium Strength Threadlocker) to each upper intake manifold bolt. Install and tighten bolts to 12 N·m (105 in. lbs.) following torque sequence in (Fig. 119).

INTAKE MANIFOLD - UPPER (Continued)

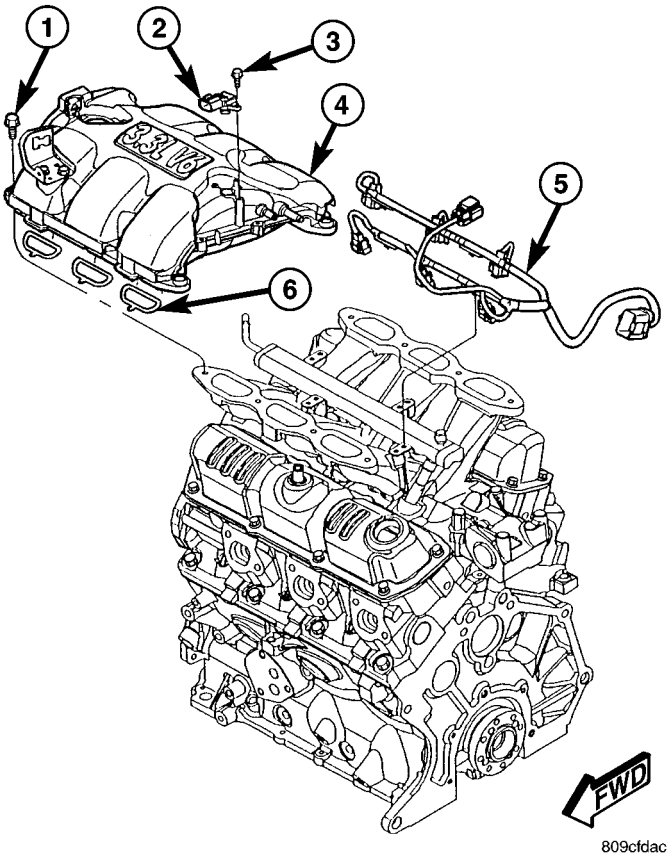

Fig. 118 INTAKE MANIFOLD - UPPER

1 - BOLT
2 - MAP SENSOR
3 - SCREW
4 - MANIFOLD - UPPER
5 - WIRE HARNESS
6 - GASKET (3 PER CYL. BANK)

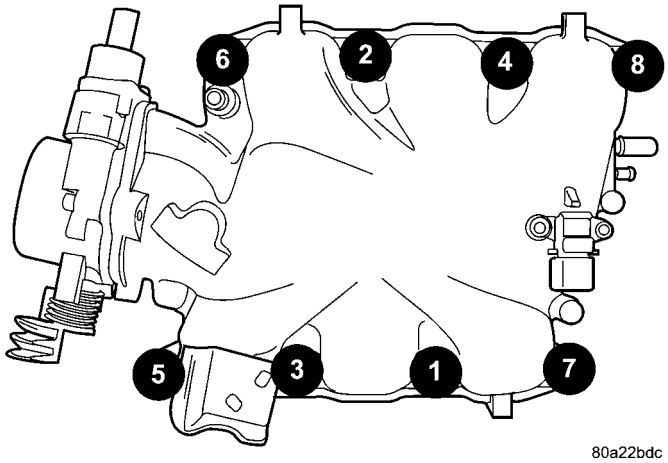

Fig. 119 UPPER MANIFOLD TIGHTENING SEQUENCE

(5) Connect the MAP sensor electrical connector.

(6) Connect the brake booster and LDP vacuum hose to intake manifold (Fig. 117).

CAUTION: The special screws used for attaching the EGR tube and power steering reservoir to the manifold must be installed slowly using hand tools only. This requirement is to prevent the melting of material that causes stripped threads. If threads become stripped, an oversize repair screw is available. For more information and procedure (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - STANDARD PROCEDURE - MANIFOLD STRIPPED THREAD REPAIR).

(7) Install the power steering reservoir (Fig. 116). Tighten screws to manifold to 5.6 N·m (50 in. lbs.).

(8) Connect throttle and speed control cables to throttle body (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/THROTTLE CONTROL CABLE - INSTALLATION)

(9) Attach make up air hose clip into the hole in the throttle cable bracket.

(10) Connect the wiring connectors to the throttle position sensor (TPS) and Automatic Idle Speed (AIS) motor.

(11) Install air cleaner and air inlet hose assembly.

(12) Connect the inlet air temperature (IAT) sensor electrical connector.

(13) Connect battery negative cable.

INTAKE MANIFOLD - LOWER

REMOVAL - LOWER INTAKE MANIFOLD

(1) Perform fuel system pressure release procedure **(before attempting any repairs).** (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY - STANDARD PROCEDURE)

(2) Drain the cooling system. (Refer to 7 - COOLING - STANDARD PROCEDURE)

(3) Remove the upper intake manifold. (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL)

(4) Remove the fuel line. (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/FUEL LINES - STANDARD PROCEDURE) (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE)

(5) Remove ignition coil and bracket (Fig. 120).

(6) Disconnect heater supply hose and engine coolant temperature sensor (Fig. 121).

(7) Disconnect the fuel injector wire harness.

(8) Remove the fuel injectors and rail assembly (Fig. 120).

(9) Remove radiator upper hose.

(10) Remove the intake manifold bolts.

(11) Remove lower intake manifold (Fig. 122).

INTAKE MANIFOLD - LOWER (Continued)

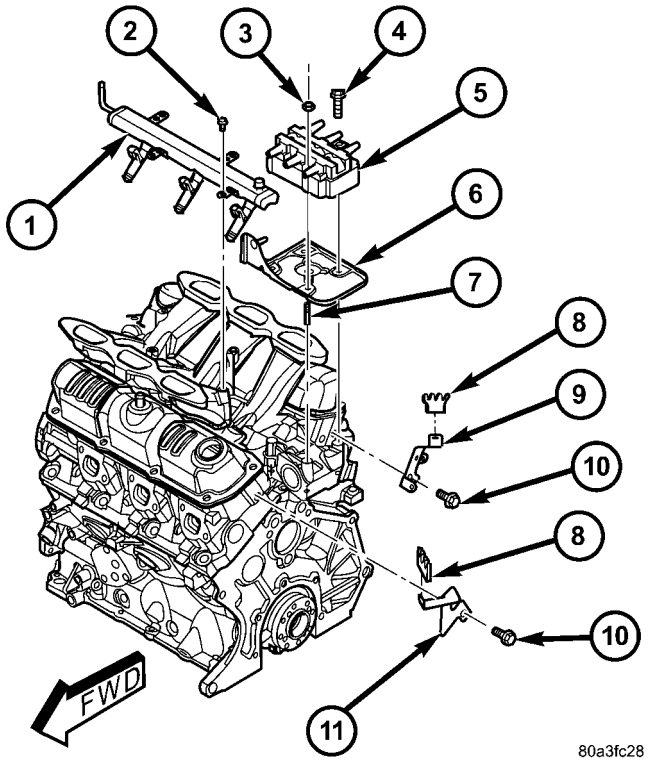

Fig. 120 FUEL RAIL AND IGNITION COIL & BRACKET

1 - FUEL RAIL
2 - BOLT - FUEL RAIL
3 - NUT - IGNITION COIL
4 - BOLT - IGNITION COIL
5 - IGNITION COIL
6 - BRACKET - IGNITION COIL
7 - STUD - IGNITION COIL
8 - SEPARATOR - SPARK PLUG CABLE
9 - BRACKET - SPARK PLUG CABLE SEPARATOR
10 - BOLT - SEPARATOR BRACKET
11 - BRACKET - SPARK PLUG CABLE SEPARATOR

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

(12) Remove intake manifold seal retainers screws (Fig. 122). Remove intake manifold gasket.

(13) Inspect and clean manifold. (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSPECTION) (Refer to 9 - ENGINE/MANIFOLDS/ INTAKE MANIFOLD - CLEANING)

CLEANING

(1) Discard gasket(s).
(2) Clean all sealing surfaces.

INSPECTION

Check for:

- Damage and cracks of each section.
- Clogged water passages in end cross-overs (if equipped).

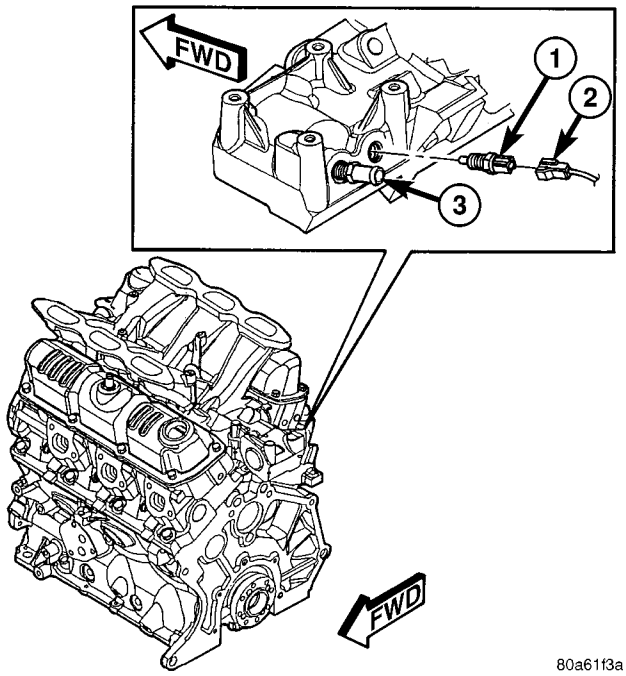

Fig. 121 ECT SENSOR & HEATER SUPPLY

1 - ENGINE COOLANT TEMPERATURE SENSOR
2 - CONNECTOR - ENGINE COOLANT SENSOR
3 - FITTING - HEATER SUPPLY

- Check for cylinder head mounting surface distortion using a straightedge and thickness gauge. (Refer to 9 - ENGINE/CYLINDER HEAD - INSPECTION)

INSTALLATION - LOWER INTAKE MANIFOLD

(1) Place a bead (approximately 1/4 in. diameter) of Mopar® Engine RTV GEN II onto each of the **four** manifold to cylinder head gasket corners (Fig. 123).

(2) Carefully install the new intake manifold gasket (Fig. 122). Tighten end seal retainer screws to 12 N·m (105 in. lbs.).

(3) Install lower intake manifold (Fig. 122). Install the bolts and torque to 1 N·m (10 in. lbs.). Then torque bolts to 22 N·m (200 in. lbs.) in sequence shown in (Fig. 124). Then torque again to 22 N·m (200 in. lbs.). After intake manifold is in place, **inspect to make sure seals are in place.**

(4) Install the fuel injectors and rail assembly. (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/ FUEL RAIL - INSTALLATION)

(5) Connect fuel injector electrical harness.

(6) Connect the engine coolant temperature sensor (Fig. 121).

(7) Connect the heater supply (Fig. 121) and radiator upper hoses to manifold.

(8) Connect the fuel line. (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/QUICK CONNECT FITTING - STANDARD PROCEDURE)

INTAKE MANIFOLD - LOWER (Continued)

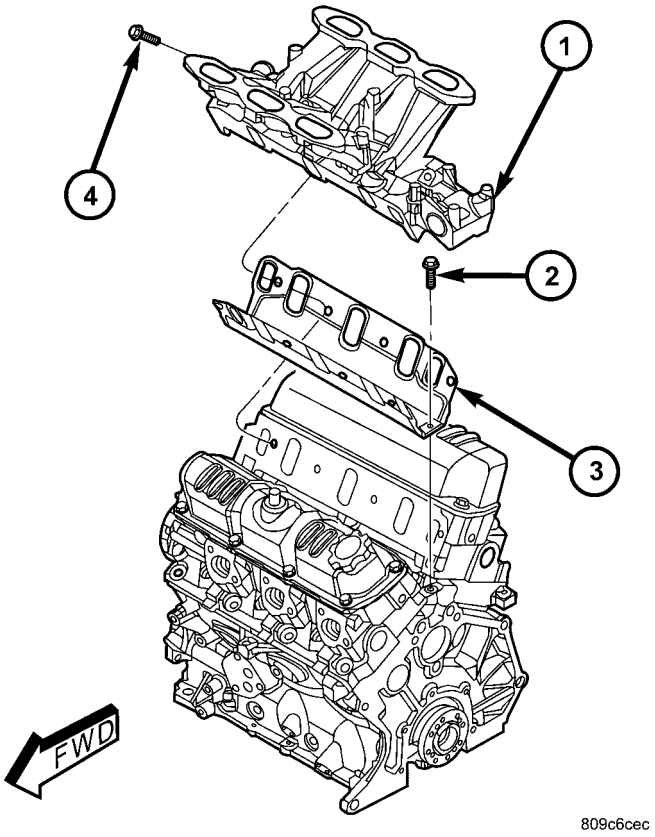

Fig. 122 INTAKE MANIFOLD - LOWER

1 - INTAKE MANIFOLD - LOWER
2 - BOLT - GASKET END SEAL RETAINER
3 - GASKET
4 - BOLT - LOWER INTAKE MANIFOLD

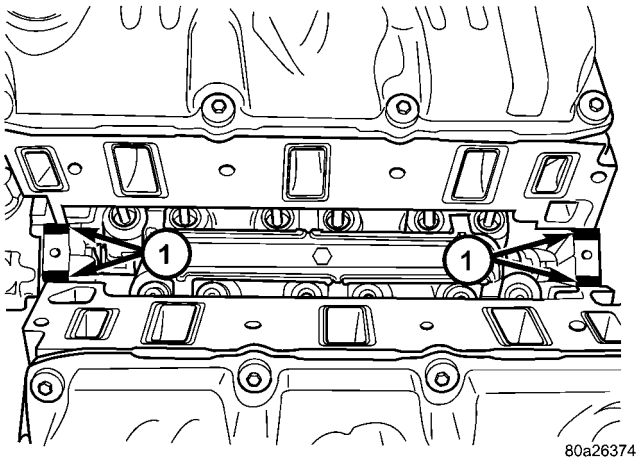

Fig. 123 Intake Manifold Gasket Sealing

1 - SEALER LOCATIONS

(9) Install the upper intake manifold. (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION)

(10) Connect negative battery cable.

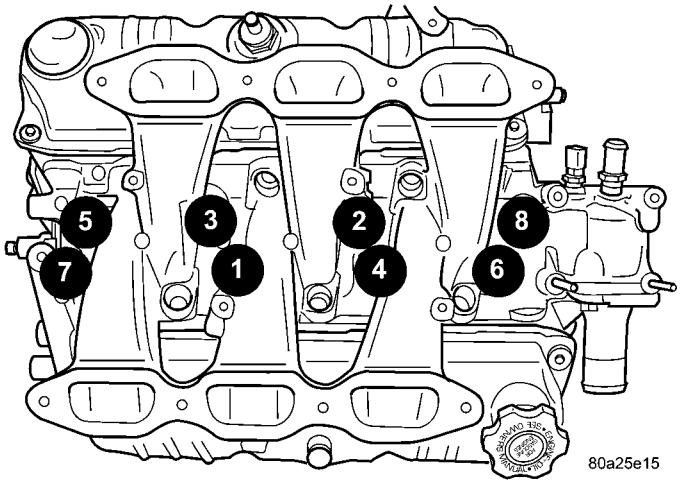

Fig. 124 LOWER MANIFOLD TIGHTENING SEQUENCE

(11) Fill the cooling system. (Refer to 7 - COOLING - STANDARD PROCEDURE)

EXHAUST MANIFOLD - RIGHT

REMOVAL

(1) Disconnect battery negative cable.

(2) Remove the wiper module. (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER MODULE - REMOVAL)

(3) Disconnect spark plug wires.

(4) Remove bolts fastening crossover pipe to exhaust manifold (Fig. 125).

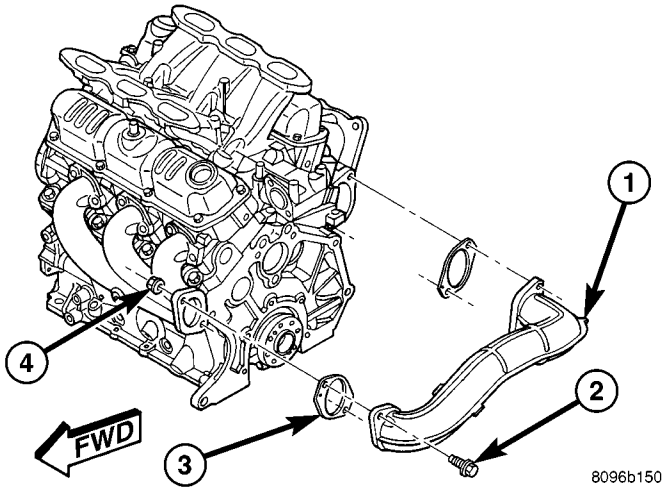

Fig. 125 CROSS-OVER PIPE

1 - CROSS-OVER PIPE
2 - BOLT
3 - GASKET
4 - FLAG NUT

(5) Disconnect and remove the upstream oxygen sensor (Fig. 128).

EXHAUST MANIFOLD - RIGHT (Continued)

(6) Remove the heat shield attaching screws (Fig. 128).

(7) Remove the upper heat shield (Fig. 128).

(8) Raise vehicle on hoist and remove drive belt shield.

(9) Loosen the power steering pump support strut lower bolt (Fig. 126).

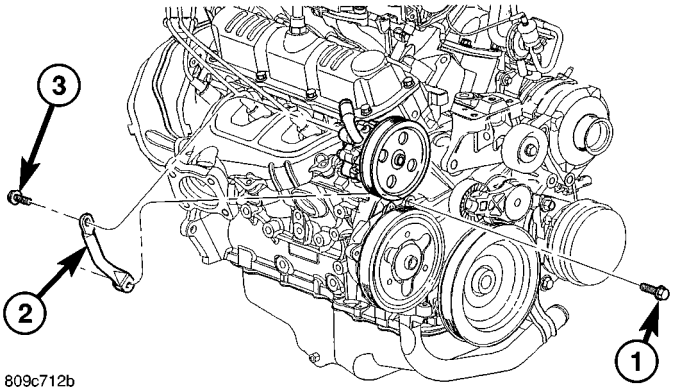

Fig. 126 P/S PUMP STRUT

1 - BOLT - LOWER
2 - STRUT - P/S PUMP
3 - BOLT - UPPER

(10) Disconnect downstream oxygen sensor connector.

(11) Disconnect catalytic converter pipe from exhaust manifold (Fig. 127).

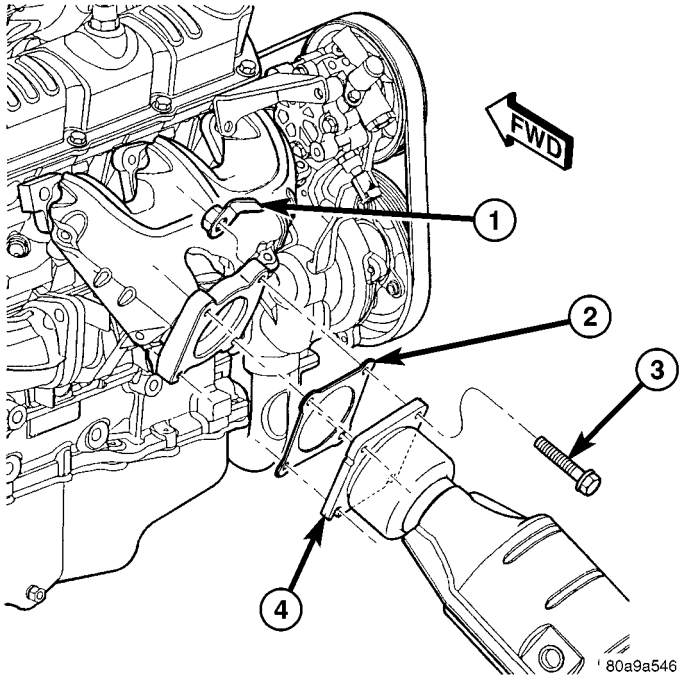

Fig. 127 Catalytic Converter to Exhaust Manifold

1 - FLAG NUT
2 - GASKET
3 - BOLT
4 - CATALYTIC CONVERTER

(12) Lower vehicle and remove the power steering pump support strut upper bolt (Fig. 126).

(13) Remove bolts attaching exhaust manifold to cylinder head and remove manifold (Fig. 128).

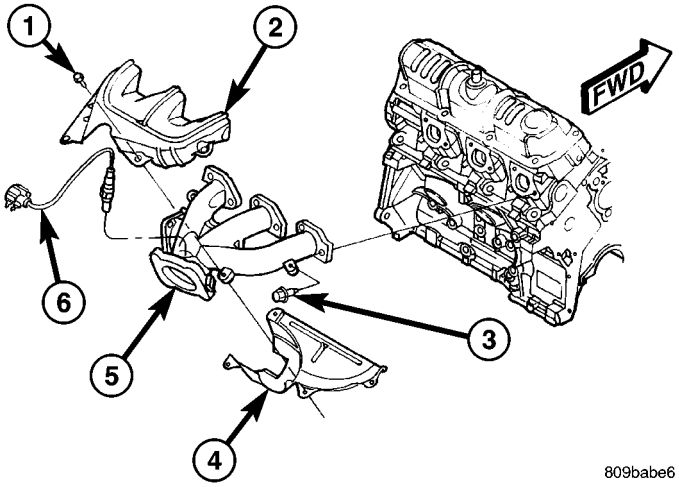

Fig. 128 EXHAUST MANIFOLD - RIGHT

1 - SCREW - HEAT SHIELD
2 - HEAT SHIELD - UPPER
3 - BOLT - EXHAUST MANIFOLD
4 - HEAT SHIELD - LOWER
5 - EXHAUST MANIFOLD - RIGHT
6 - OXYGEN SENSOR - UPSTREAM

(14) Inspect and clean manifold. (Refer to 9 - ENGINE/MANIFOLDS/EXHAUST MANIFOLD - CLEANING) (Refer to 9 - ENGINE/MANIFOLDS/ EXHAUST MANIFOLD - INSPECTION)

CLEANING

(1) Discard gasket (if equipped) and clean all surfaces of manifold and cylinder head.

INSPECTION

Inspect exhaust manifolds for damage or cracks and check distortion of the cylinder head mounting surface and exhaust crossover mounting surface with a straightedge and thickness gauge (Fig. 129).

Manifold surface flatness limits should not exceed 1.0 mm (0.039 in.).

INSTALLATION

(1) Position exhaust manifold on cylinder head and install bolts to center runner (cylinder #3) and initial tighten to 2.8 N·m (25 in. lbs.) (Fig. 128)

(2) Using a new gasket, attach crossover pipe to exhaust manifold and tighten bolts to 41 N·m (30 ft. lbs.) (Fig. 125).

EXHAUST MANIFOLD - RIGHT (Continued)

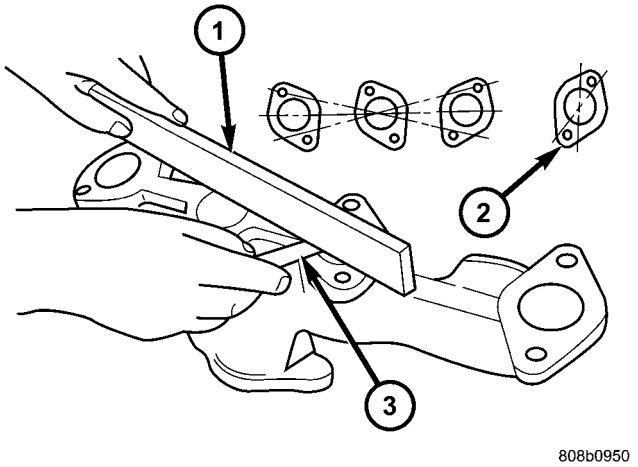

Fig. 129 Check Exhaust Manifold Mounting

1 - STRAIGHT EDGE
2 - CROSSOVER PIPE MOUNTING SURFACE
3 - FEELER GAUGE

NOTE: Inspect crossover pipe fasteners for damage from heat and corrosion. The cross-over bolts are made of a special stainless steel alloy. If replacement is required, OEM bolts are highly recommended.

(3) Install the remaining manifold attaching bolts. Tighten all bolts to 23 N·m (200 in. lbs.).

(4) Position the power steering pump support strut and install upper bolt (Fig. 126).

(5) Install heat shield and attaching screws (Fig. 128).

(6) Install and connect upstream oxygen sensor (Fig. 128).

(7) Raise the vehicle.

(8) Attach catalytic converter pipe to exhaust manifold using new gasket and tighten bolts to 37 N·m (27 ft. lbs.) (Fig. 127).

(9) Connect downstream oxygen sensor connector.

(10) Tighten the power steering pump support strut lower bolt (Fig. 126).

(11) Install the belt splash shield and lower the vehicle.

(12) Install the wiper module. (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER MODULE - INSTALLATION)

(13) Connect battery negative cable.

EXHAUST MANIFOLD - LEFT

REMOVAL

(1) Disconnect battery negative cable.

(2) Remove bolts attaching crossover pipe to exhaust manifold (Fig. 130).

(3) Disconnect left cylinder bank spark plug wires.

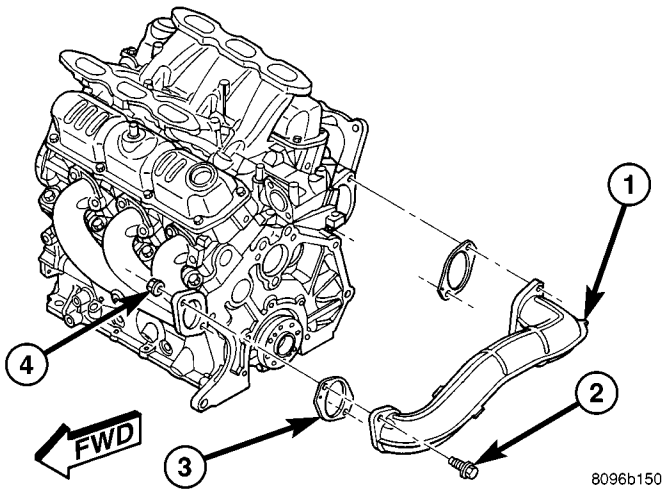

Fig. 130 CROSS-OVER PIPE

1 - CROSS-OVER PIPE
2 - BOLT
3 - GASKET
4 - FLAG NUT

(4) Remove heat shield attaching bolts (Fig. 131).

(5) Remove bolts attaching exhaust manifold to cylinder head (Fig. 131).

(6) Remove the exhaust manifold (Fig. 131).

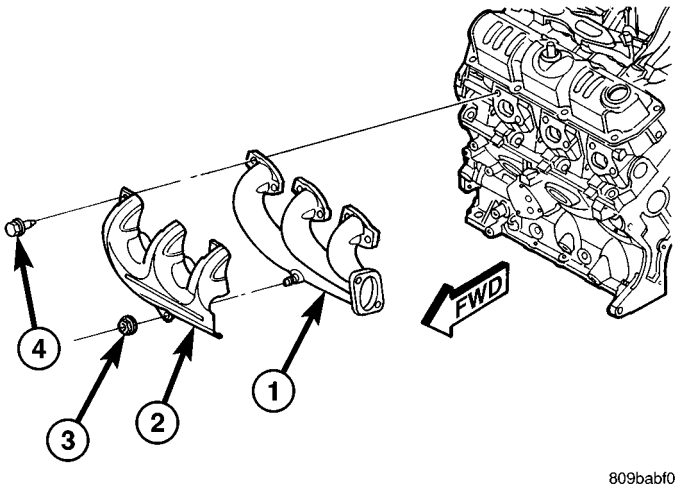

Fig. 131 EXHAUST MANIFOLD - LEFT

1 - EXHAUST MANIFOLD - LEFT BANK
2 - HEAT SHIELD
3 - NUT - HEAT SHIELD
4 - BOLT - EXHAUST MANIFOLD

(7) Inspect and clean manifold. (Refer to 9 - ENGINE/MANIFOLDS/EXHAUST MANIFOLD - INSPECTION) (Refer to 9 - ENGINE/MANIFOLDS/EXHAUST MANIFOLD - CLEANING)

CLEANING

(1) Discard gasket (if equipped) and clean all surfaces of manifold and cylinder head.

EXHAUST MANIFOLD - LEFT (Continued)

INSPECTION

Inspect exhaust manifolds for damage or cracks and check distortion of the cylinder head mounting surface and exhaust crossover mounting surface with a straightedge and thickness gauge (Fig. 132).

Manifold surface flatness limits should not exceed 1.0 mm (0.039 in.).

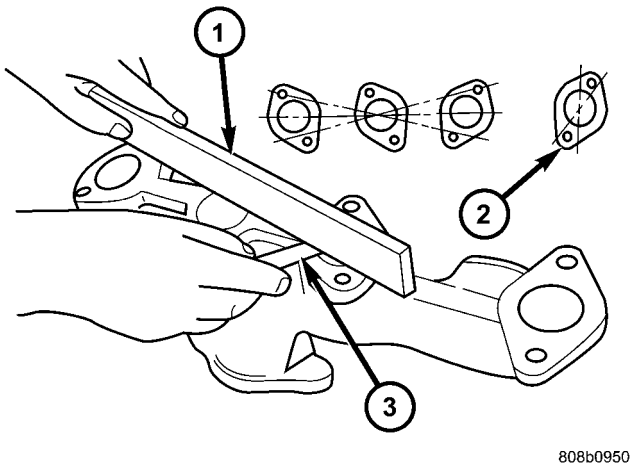

Fig. 132 Check Exhaust Manifold Mounting

1 - STRAIGHT EDGE
2 - CROSSOVER PIPE MOUNTING SURFACE
3 - FEELER GAUGE

INSTALLATION

(1) Position exhaust manifold on cylinder head (Fig. 131). Install bolts to center runner (cylinder #4) and initial tighten to 2.8 N·m (25 in. lbs.).

(2) Using a new gasket, attach crossover pipe to exhaust manifold and tighten bolts to 41 N·m (30 ft. lbs.) (Fig. 130).

NOTE: Inspect crossover pipe fasteners for damage from heat and corrosion. The cross-over bolts are made of a special stainless steel alloy. If replacement is required, OEM bolts are highly recommended.

(3) Position heat shield on manifold (Fig. 131).

(4) Install the remaining manifold attaching bolts. Tighten all bolts to 23 N·m (200 in. lbs.).

(5) Install and tighten heat shield attaching nut to 12 N·m (105 in. lbs.) (Fig. 131).

(6) Connect battery negative cable.

VALVE TIMING

STANDARD PROCEDURE

STANDARD PROCEDURE - VALVE TIMING VERIFICATION

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

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

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

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

(5) Position the degree wheel to zero.

(6) Remove dial indicator from spark plug hole.

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

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

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

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

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

STANDARD PROCEDURE - MEASURING TIMING CHAIN WEAR

NOTE: This procedure must be performed with the timing chain cover removed (Refer to 9 - ENGINE/ VALVE TIMING/TIMING CHAIN COVER - REMOVAL).

(1) Position a scale next to timing chain so that any movement of chain may be measured (Fig. 133).

(2) Position a torque wrench and socket on the camshaft sprocket attaching bolt. Apply force in the direction of crankshaft rotation to take up slack to the following torque:

- 41 N·m (30 ft. lb.) with cylinder heads installed
- 20 N·m (15 ft. lb.) with cylinder heads removed

NOTE: With torque applied to the camshaft sprocket bolt, crankshaft should not be permitted to move. It may be necessary to block crankshaft to prevent rotation.

(3) Holding a measuring scale along edge of chain links (Fig. 133).

VALVE TIMING (Continued)

(4) Apply force in the reverse direction to the following torque:

- 41 N·m (30 ft. lb.) with cylinder heads installed
- 20 N·m (15 ft. lb.) with cylinder heads removed

(5) Measure amount of sprocket/chain movement.

(6) Install a new timing chain and sprockets if movement exceeds 3.175 mm (1/8 in.).

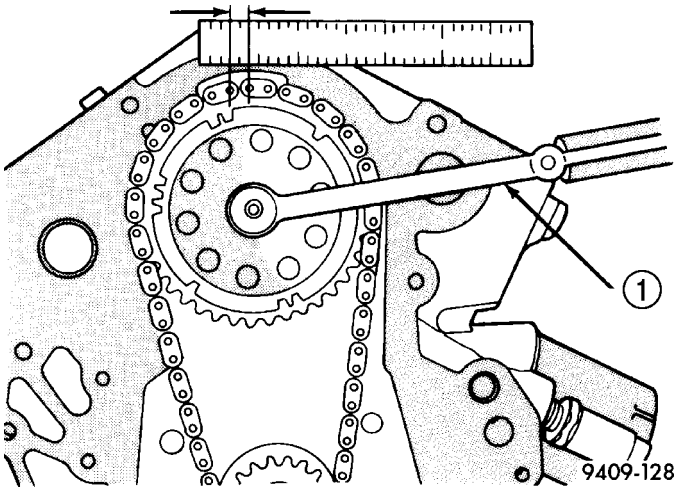

Fig. 133 Measuring Timing Chain Wear

1 - TORQUE WRENCH

TIMING CHAIN COVER

REMOVAL

(1) Disconnect negative cable from battery.

(2) Drain cooling system. (Refer to 7 - COOLING - STANDARD PROCEDURE)

(3) Raise vehicle on hoist.

(4) Drain engine oil.

(5) Remove right wheel and inner splash shield.

(6) Remove oil pan. (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL)

(7) Remove oil pick-up tube (Fig. 134).

(8) Remove accessory drive belt. (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL)

(9) Remove A/C compressor and set aside.

(10) Remove crankshaft vibration damper. (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL)

(11) Remove radiator lower hose.

(12) Remove heater hose from timing chain cover housing (Fig. 135) or water pump inlet tube (if engine oil cooler equipped) (Fig. 136).

(13) Remove the right side engine mount. (Refer to 9 - ENGINE/ENGINE MOUNTING/RIGHT MOUNT - REMOVAL)

(14) Remove idler pulley from engine bracket (Fig. 137).

(15) Remove the engine mount bracket (Fig. 137).

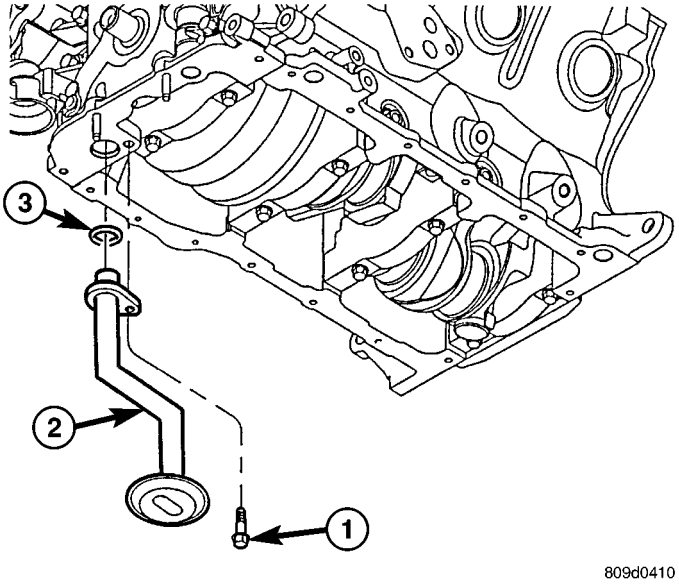

Fig. 134 OIL PICKUP TUBE

1 - BOLT
2 - OIL PICK-UP TUBE
3 - O-RING

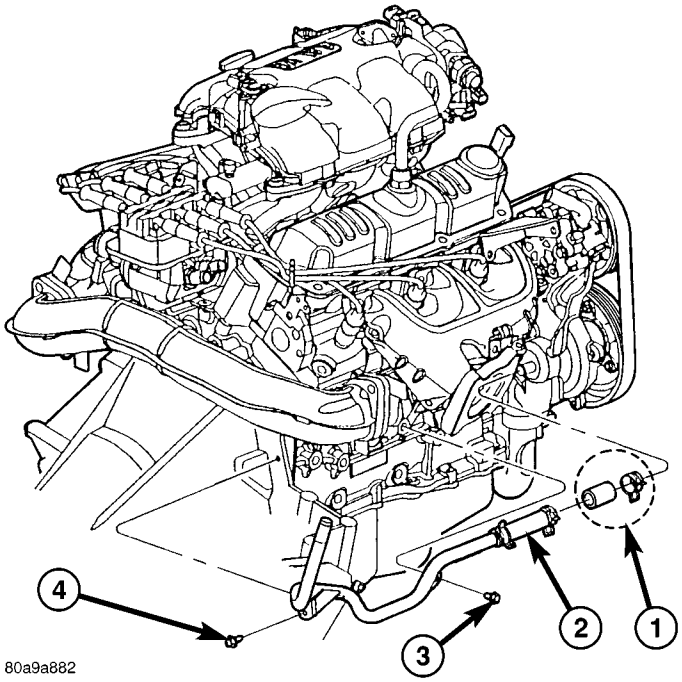

Fig. 135 HEATER RETURN HOSE (Without Engine Oil Cooler)

1 - CAP AND CLAMP (OIL COOLER EQUIPPED ONLY)
2 - HOSE ASSEMBLY - HEATER RETURN
3 - BOLT - HEATER TUBE ATTACHING
4 - BOLT - HEATER TUBE ATTACHING

(16) Remove camshaft position sensor from timing chain cover (Fig. 137).

TIMING CHAIN COVER (Continued)

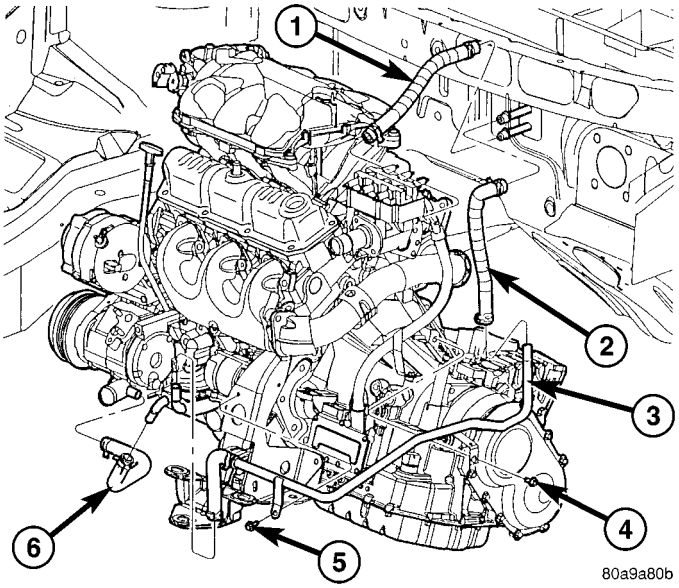

Fig. 136 HEATER HOSES 3.3/3.8L (With Engine Oil Cooler)

1 - HOSE - HEATER SUPPLY
2 - HOSE - HEATER RETURN
3 - TUBE ASSEMBLY - HEATER RETURN
4 - BOLT - TUBE ASSEMBLY
5 - BOLT - TUBE ASSEMBLY
6 - HOSE - HEATER RETURN/OIL COOLER OUTLET

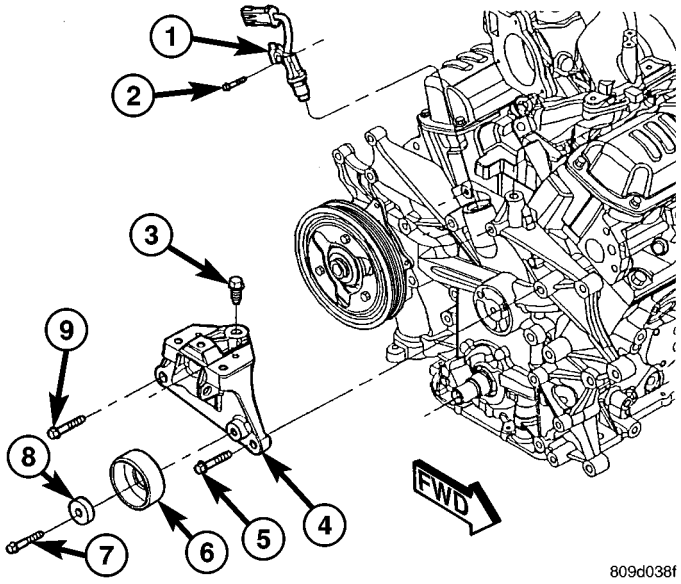

Fig. 137 Engine Mount Bracket

1 - CAMSHAFT SENSOR
2 - BOLT - CAMSHAFT SENSOR
3 - BOLT - MOUNT BRACKET (VERTICAL)
4 - BRACKET - ENGINE MOUNT
5 - BOLT - MOUNT BRACKET (HORIZONTAL)
6 - PULLEY - IDLER
7 - BOLT - IDLER PULLEY
8 - SPACER - IDLER PULLEY BOLT
9 - BOLT - MOUNT BRACKET (HORIZONTAL)

(17) Remove the water pump for cover removal clearance. (Refer to 7 - COOLING/ENGINE/WATER PUMP - REMOVAL)

(18) Remove the bolt attaching the power steering pump support strut to the front cover (Fig. 138).

(19) Remove the timing chain cover fasteners. Remove timing chain cover (Fig. 139).

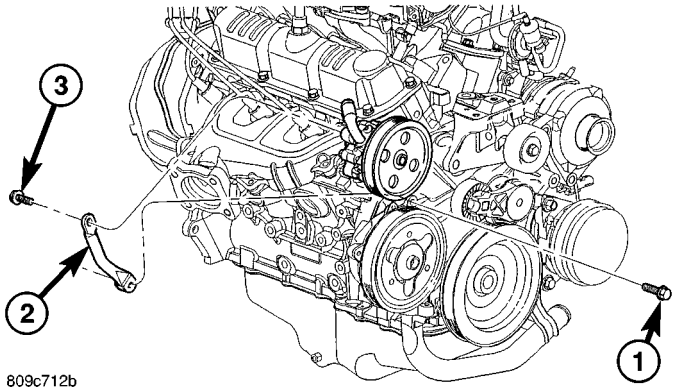

Fig. 138 Power Steering Pump Strut

1 - BOLT - LOWER
2 - STRUT - P/S PUMP
3 - BOLT - UPPER

INSTALLATION

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

NOTE: DO NOT USE SEALER ON COVER GASKET

(2) Position new gasket on timing cover (Fig. 139). Adhere new gasket to chain case cover, making sure that the lower edge of the gasket is flush to 0.5 mm (0.020 in.) passed the lower edge of the cover.

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

(4) Position oil pump inner rotor so the mating flats are in the same position as the crankshaft drive flats (Fig. 139).

CAUTION: Make sure the oil pump is engaged on the crankshaft correctly or severe damage may result.

(5) Install timing cover (Fig. 139).

(6) Install timing chain cover bolts. Tighten M8 bolts to 27 N·m (20 ft. lbs.) and M10 bolts to 54 N·m (40 ft. lbs.) (Fig. 140).

(7) Install crankshaft front oil seal. (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT OIL SEAL - FRONT - INSTALLATION)

(8) Install water pump and pulley. (Refer to 7 - COOLING/ENGINE/WATER PUMP - INSTALLATION)

TIMING CHAIN COVER (Continued)

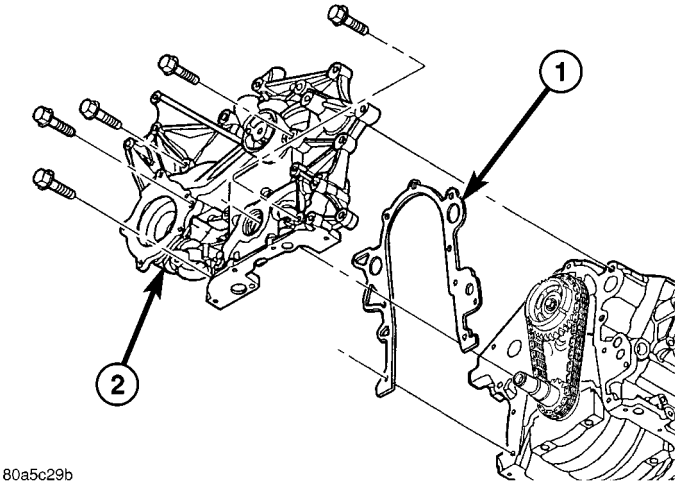

Fig. 139 Timing Chain Cover and Gasket

1 - GASKET
2 - TIMING CHAIN COVER

(9) Install crankshaft vibration damper. (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION)

(10) Install engine mount bracket (Fig. 137) and tighten M10 to 54 N·m (40 ft. lbs.), M8 bolt to 28 N·m (21 ft. lb. lbs.).

(11) Install idler pulley on engine mount bracket (Fig. 137).

(12) Install right side engine mount. (Refer to 9 - ENGINE/ENGINE MOUNTING/RIGHT MOUNT - INSTALLATION)

(13) Install camshaft position sensor (Refer to 8 - ELECTRICAL/IGNITION CONTROL/CAMSHAFT POSITION SENSOR - INSTALLATION).

(14) Connect the heater return hose at rear of timing chain cover (Fig. 135) or at water pump inlet tube (if engine oil cooler equipped) (Fig. 136).

(15) Connect the radiator lower hose.

(16) Install A/C compressor.

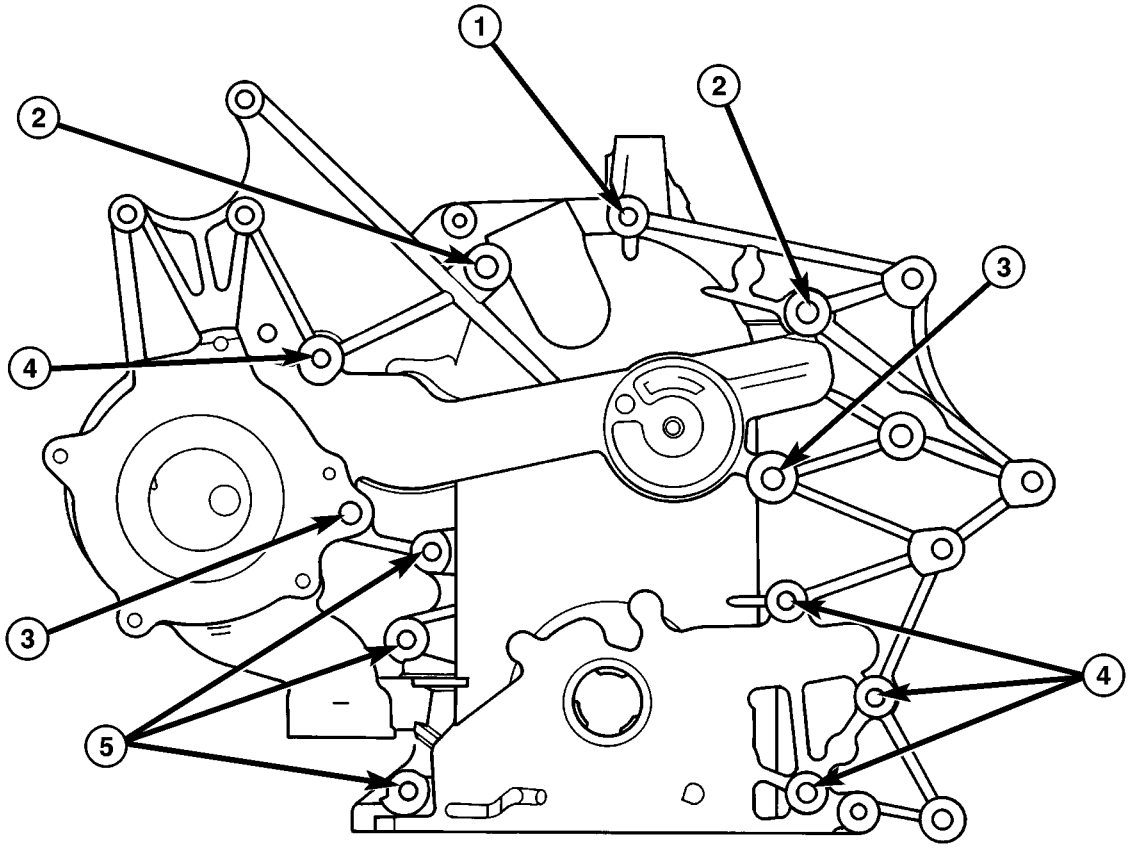

Fig. 140 TIMING CHAIN COVER BOLT LOCATIONS

1 - BOLT - M8 x 1.25 x 95
2 - BOLT - M10 x 1.5 x 100
3 - BOLT - M10 x 1.5 x 85
4 - BOLT - M8 x 1.25 x 80
5 - BOLT - M8 x 1.25 x 45

TIMING CHAIN COVER (Continued)

(17) Install accessory drive belt. (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION)

(18) Install oil pump pick-up tube with new O-ring. Tighten attaching bolt to 28 N·m (250 in. lbs.).

(19) Install oil pan. (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION)

(20) Install inner splash shield and right front wheel.

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

(22) Fill cooling system. (Refer to 7 - COOLING - STANDARD PROCEDURE)

(23) Connect negative cable to battery.

TIMING CHAIN AND SPROCKETS

REMOVAL

REMOVAL - TIMING CHAIN AND CAMSHAFT SPROCKET

(1) Disconnect negative cable from battery.

(2) Remove the timing chain cover. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL)

(3) Rotate engine by turning crankshaft until the timing marks are aligned as shown in (Fig. 141).

(4) Remove camshaft sprocket attaching bolt.

(5) Remove the timing chain with camshaft sprocket.

(6) Remove the crankshaft sprocket. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL)

REMOVAL - CRANKSHAFT SPROCKET

(1) Remove the timing chain. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL)

(2) Using Special Tools 8539, 5048-6, and 5048-1, remove the crankshaft sprocket while holding the crankshaft from turning (Fig. 142). Be careful not to damage the crankshaft surfaces.

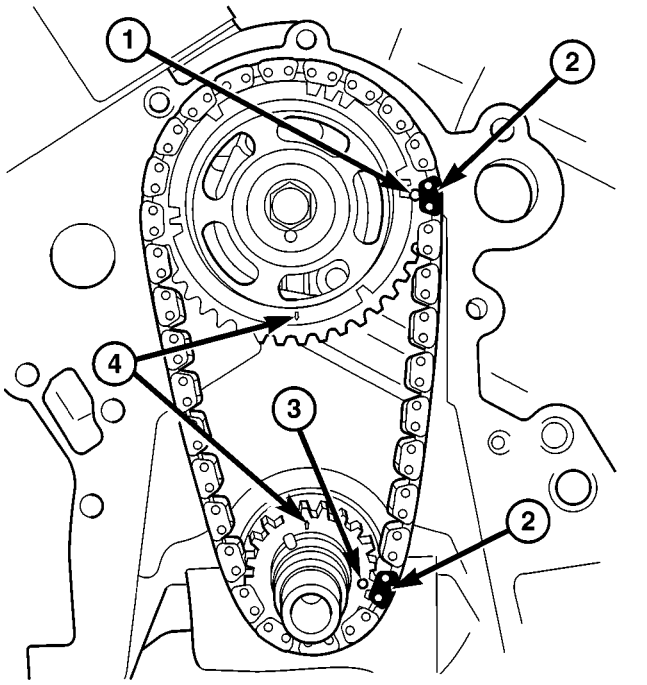

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Fig. 141 Timing Mark Alignment

1 - CAMSHAFT SPROCKET TIMING MARK (DOT)
2 - PLATED LINK
3 - CRANKSHAFT SPROCKET TIMING MARK (DOT)
4 - ARROWS

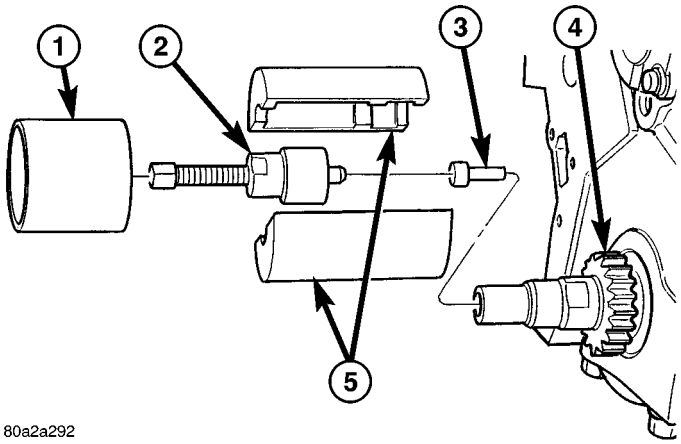

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Fig. 142 CRANKSHAFT SPROCKET - REMOVAL

1 - SPECIAL TOOL 5048-6
2 - SPECIAL TOOL 5048-1
3 - SPECIAL TOOL 8450
4 - CRANKSHAFT SPROCKET
5 - SPECIAL TOOL 8539

INSTALLATION

INSTALLATION - CRANKSHAFT SPROCKET

(1) Position the sprocket on the crankshaft (timing mark out) with the timing slot aligned with the timing pin.

(2) Install sprocket using Special Tool 8452 (Fig. 143). Install sprocket until it is fully seats on the crankshaft.

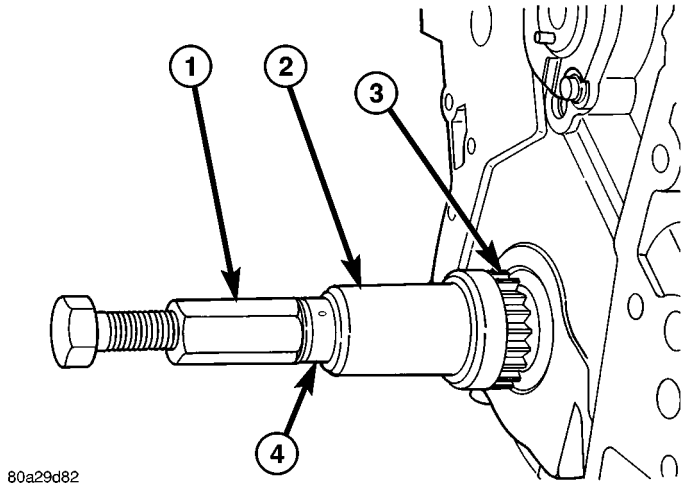

Fig. 143 CRANKSHAFT SPROCKET - INSTALLATION

1 - SPECIAL TOOL 8452-3
2 - SPECIAL TOOL 8452-1
3 - CRANKSHAFT SPROCKET
4 - THRUST BEARING / WASHER

(3) Install the timing chain and camshaft sprocket. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION)

INSTALLATION - TIMING CHAIN AND CAMSHAFT SPROCKET

(1) Rotate crankshaft so the timing arrow is to the 12 o'clock position (Fig. 141).

NOTE: Lubricate timing chain and sprockets with clean engine oil before installation.

(2) While holding camshaft sprocket and chain in hand, place timing chain around the sprocket, aligning the plated link with the dot on the sprocket. Position the timing arrow to the 6 o'clock position (Fig. 141).

(3) Place timing chain around crankshaft sprocket with the plated link lined up with the dot on the sprocket. Install camshaft sprocket into position.

(4) Use a straight edge to check alignment of timing marks.

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

(6) Rotate crankshaft 2 revolutions and check timing mark alignment (Fig. 141). If timing marks do not line up, remove camshaft sprocket and realign.

(7) Install the timing chain cover. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION)

(8) Connect negative cable to battery.