ENGINE

TABLE OF CONTENTS

ENGINE 3.5L

DESCRIPTION

The 3.5 Liter (214 Cubic Inches) 60 degree V-6 engines is a single overhead camshaft design with hydraulic lifters and four valves per cylinder (Fig. 1). The engine does not have provisions for a free wheeling valve train.

The cylinders are numbered from front to rear, with the right bank odd numbered, and the left bank even numbered (Fig. 2). The firing order is 1–2–3–4–5–6.

The engine identification number is located on the rear of engine block just below the cylinder head (Fig. 3).

ENGINE 3.5L (Continued)

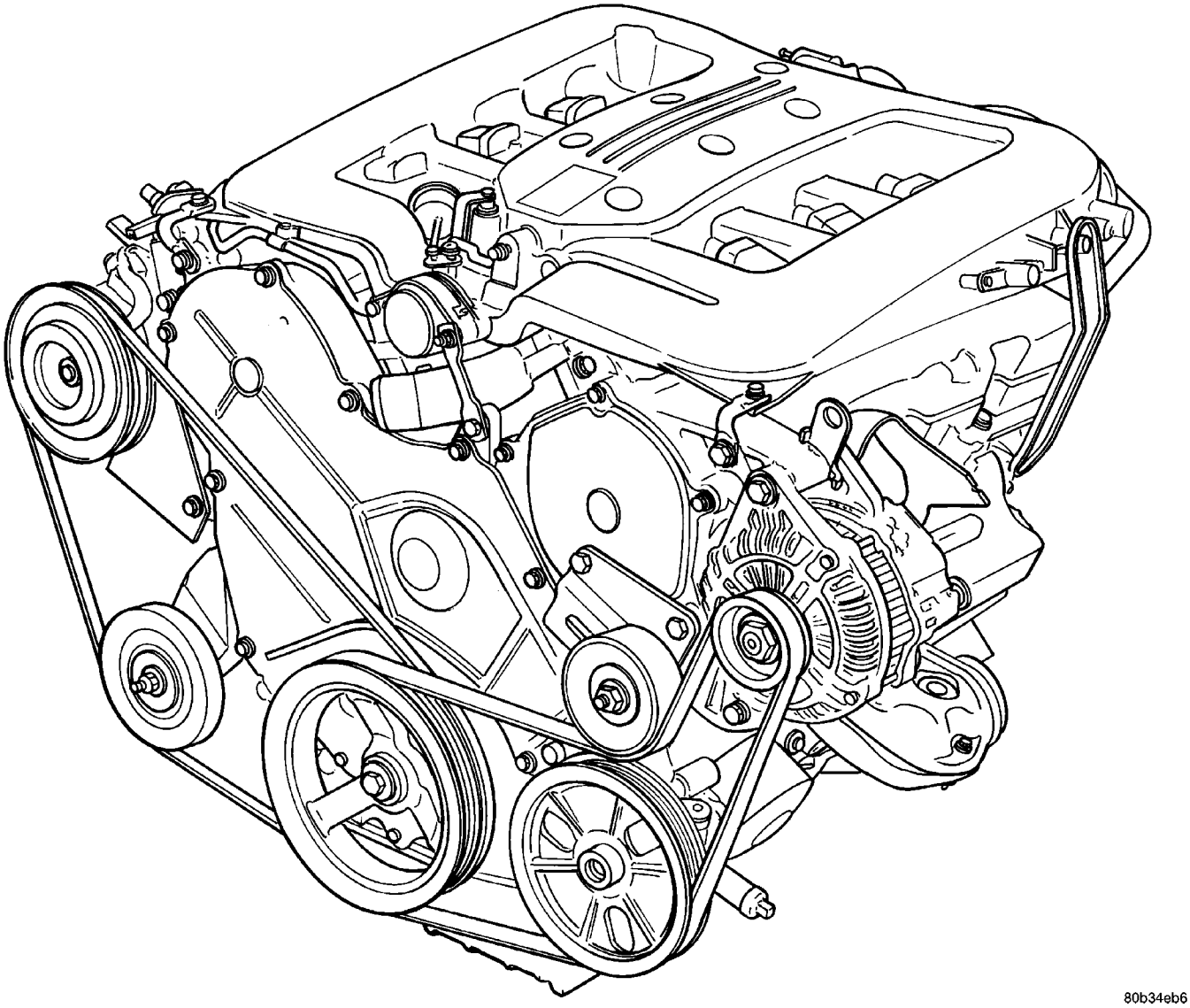


Fig. 1 3.5L Engine

ENGINE 3.5L (Continued)

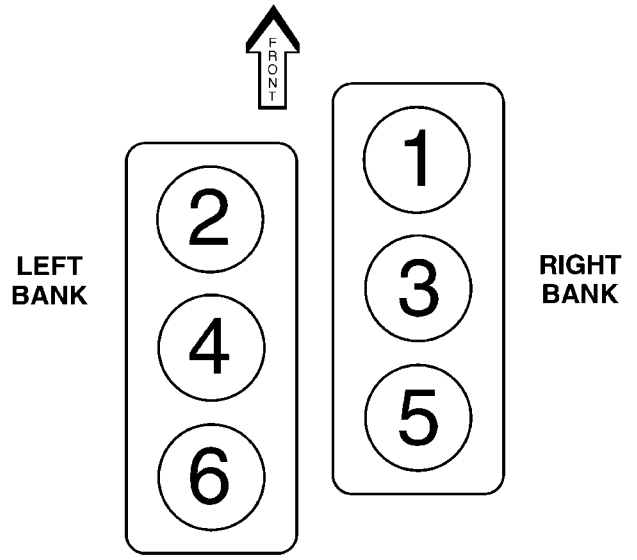
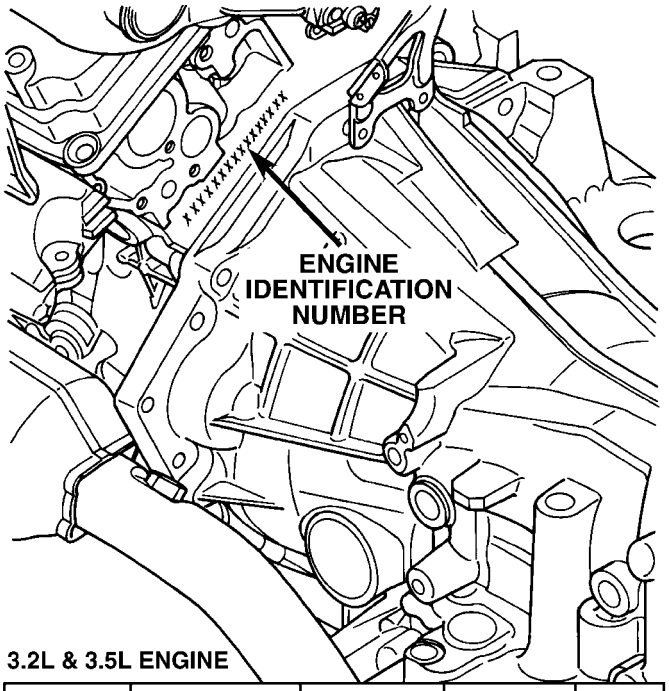


Fig. 2 Cylinder Numbering & Firing Order - 3.5L



X Model Year	X Manufacturing Plant	XXXXX Component Code/Usage	XXXX Month/Day	XXXXX Serial Code
Last digit of model year	Trenton T	Engine 3.2L 3.5L Usage Pass Car PC		

80ae845a

Fig. 3 ENGINE IDENTIFICATION

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

ENGINE 3.5L (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 oil and filter. (b.) Run engine to operating temperature. (c.) Change oil and filter again.
	4. Low oil pressure.	4. Check and correct engine oil level.
	5. Dirt in tappets/lash adjusters.	5. Replace rocker arm/hydraulic lash adjuster assembly.
	6. Worn rocker arms.	6. Inspect oil supply to rocker arms.
	7. Worn tappets/lash adjusters.	7. Install new rocker arm/hydraulic lash adjuster assembly.
	8. Worn valve guides.	8. Ream guides and install new valves with oversize stems.
	9. Excessive runout of valve seats on valve faces.	9. Grind valve seats and valves.
	10. Missing adjuster pivot.	10. Replace rocker arm/hydraulic lash adjuster assembly.
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. Thick / Thin or diluted oil.	3. Change oil to correct viscosity. 3. (a.) Change oil and filter. (b.) Run engine to operating temperature. (c.) Change oil and filter again.
	4. Excessive bearing clearance.	4. Measure bearings for correct clearance. Repair as necessary.
	5. Connecting rod journal out-of-round.	5. Replace crankshaft or grind surface.
	6. Misaligned connecting rods.	6. Replace bent connecting rods.

ENGINE 3.5L (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. Thick / Thin or diluted oil.	3. Change oil to correct viscosity. 3. (a.) Change oil and filter. (b.) Run engine to operating temperature. (c.) Change oil and filter again.
	4. Excessive bearing clearance.	4. Measure bearings for correct clearance. Repair as necessary.
	5. Excessive end play.	5. Check thrust bearing for wear on flanges.
	6. Crankshaft journal out-of-round or worn.	6. Replace crankshaft or grind journals.
	7. Loose flywheel or torque converter.	7. Tighten to correct torque.
OIL PRESSURE DROP	1. Low oil level.	1. Check engine oil level.
	2. Faulty oil pressure sending unit.	2. Install new sending unit.
	3. Low oil pressure.	3. Check sending unit 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 3.5L (Continued)

CONDITION	POSSIBLE CAUSES	CORRECTION
OIL CONSUMPTION OR SPARK PLUGS FOULED	1. PCV system malfunction.	1. Check system and repair as necessary. (Refer to Appropriate Diagnostic Manual)
	2. Worn, scuffed or broken rings.	2. Hone cylinder bores. Install new rings.
	3. Carbon in oil ring slots.	3. Clean pistons and 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(s).
	6. Valve stem seal(s) worn or damaged.	6. Replace seal(s).

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/ BATTERY - DESCRIPTION)
	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. Check and adjust gap as needed.
	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 or a loose camshaft sprocket (3.2/3.5L).

ENGINE 3.5L (Continued)

CONDITION	POSSIBLE CAUSE	CORRECTION
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 gasket, manifold, and vacuum hoses.
	4. Faulty coil(s).	4. Test and replace as necessary. (Refer to Appropriate Diagnostic Information)
ENGINE LOSS OF POWER	1. Dirty or incorrectly gapped plugs.	1. Set gap as needed or replace plug(s).
	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 as needed.
	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. Check exhaust system restriction. Replace parts, as necessary.
	9. Faulty 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. Set gap as needed or replace plug(s).
	2. Contamination in Fuel System.	2. Clean fuel system and replace fuel filter.
	3. Burned, warped, or pitted valves.	3. Replace valves.
	4. Faulty coil(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. Set gap as needed or replace plug(s).
	2. Faulty coil(s).	2. Test and replace as necessary. (Refer to Appropriate Diagnostic Information)
	3. Dirty fuel injector(s).	Test and replace as necessary. (Refer to Appropriate Diagnostic Information)
	4. Contamination in fuel system.	4. Clean system and replace fuel filter.

ENGINE 3.5L (Continued)

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) Disconnect and remove all ignition coils from spark plugs.

(4) 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.

(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 gage. Record this pressure as #1 cylinder pressure.

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

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

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

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

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.

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 - 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.

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

MOPAR® GASKET SEALANT 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.

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.

ENGINE 3.5L (Continued)

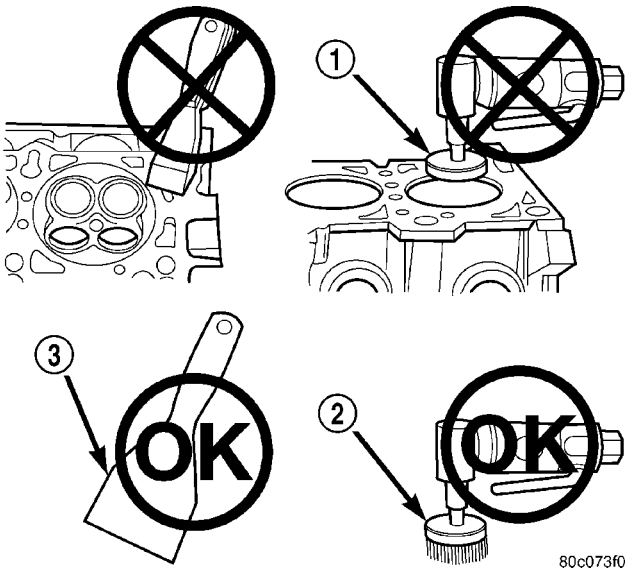


Fig. 4 Proper Tool Usage For Surface Preparation

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

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

STANDARD PROCEDURE - 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 - 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).

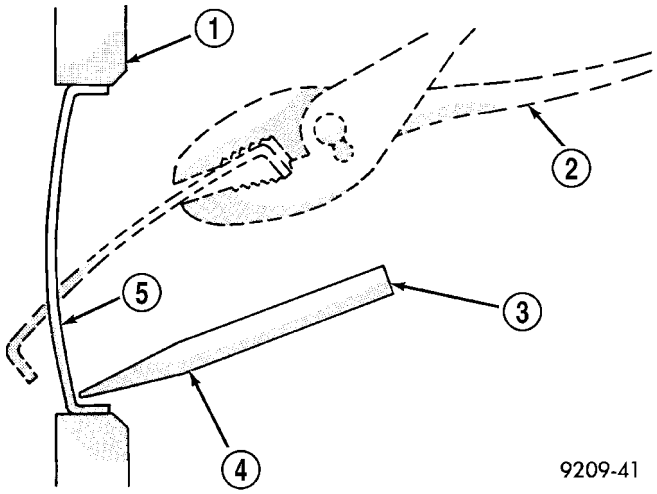


Fig. 5 Core Hole Plug Removal

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

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.

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

ENGINE 3.5L (Continued)

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. 6). (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.

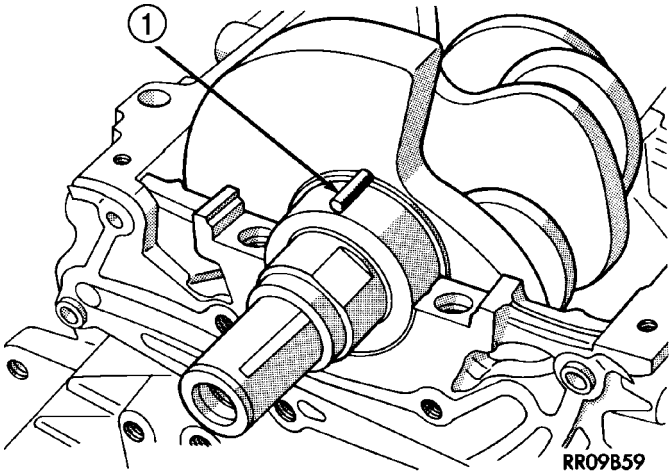


Fig. 6 Plastigage Placed in Lower Shell—Typical

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 clearance measurements to specs found in 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.**

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.

REMOVAL - ENGINE ASSEMBLY

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

(2) Disconnect negative cable at right strut tower (Fig. 7).

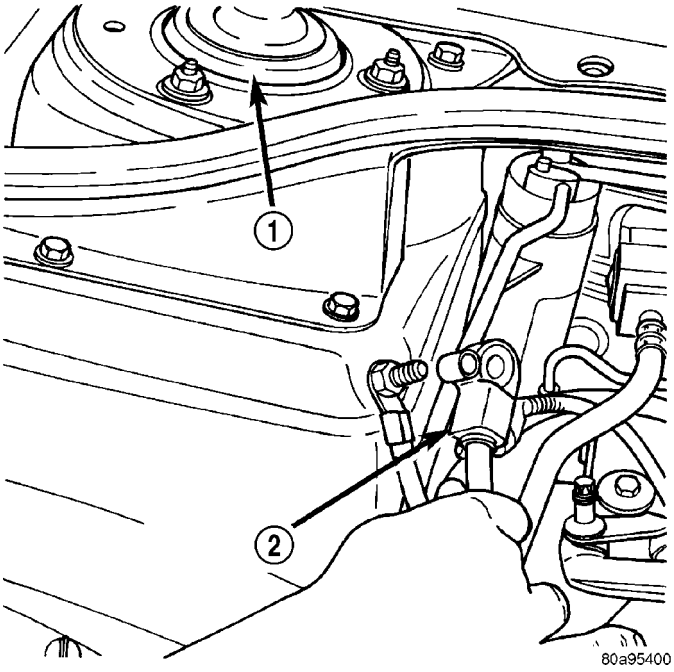


Fig. 7 NEGATIVE CABLE REMOTE TERMINAL

1 - RIGHT STRUT TOWER
2 - BATTERY NEGATIVE CABLE

(3) Mark hood position at hinges and remove hood. (Refer to 23 - BODY/HOOD/HOOD - REMOVAL)

(4) Remove both wiper arms. (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER ARMS - REMOVAL)

(5) Remove both right and left cowl screens. (Refer to 23 - BODY/EXTERIOR/COWL GRILLE AND SCREEN - REMOVAL)

(6) Remove strut tower brace.(Refer to 23 - BODY/EXTERIOR/FRONT STRUT TOWER TO TOWER BRACE - REMOVAL)

(7) Remove air cleaner assembly with air inlet hose (Fig. 8).

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

(9) Disconnect hood release cable from hood latch.

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

(11) Remove radiator fan. (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL)

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

ENGINE 3.5L (Continued)

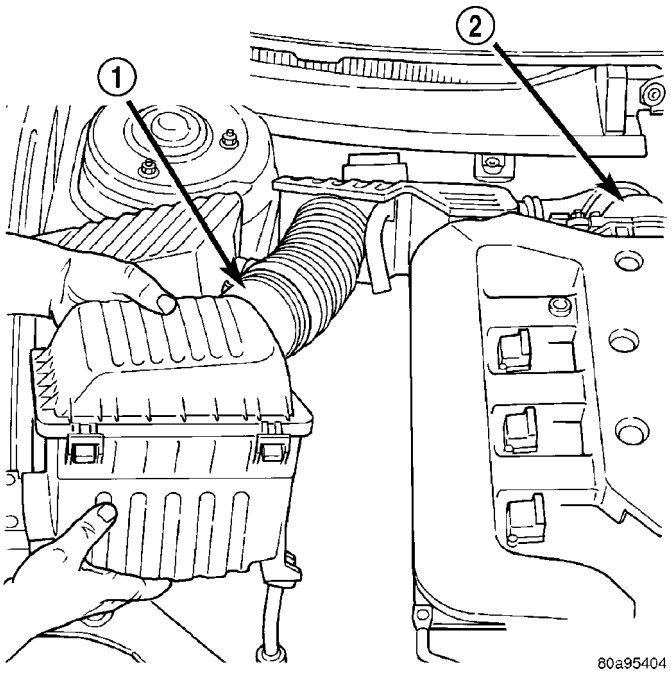


Fig. 8 AIR CLEANER WITH INLET HOSE

1 - AIR CLEANER ASSEMBLY WITH AIR INLET HOSE
2 - THROTTLE BODY

(13) Disconnect upper radiator hose at engine.
(14) Disconnect lower radiator hose at radiator.
(15) Disconnect engine oil and transmission cooler lines at radiator.
(16) Remove power steering line bracket at left side of radiator.
(17) Remove fasteners attaching air conditioning condenser to radiator.
(18) Remove radiator. (Refer to 7 - COOLING/ENGINE/RADIATOR - REMOVAL)
(19) Remove generator. (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - REMOVAL)
(20) Remove power steering pump mounting bolts and set pump aside (Do not disconnect lines). (Refer to 19 - STEERING/PUMP - REMOVAL)
(21) Remove air conditioning compressor mounting bolts and set aside (Do not disconnect lines).
(22) Loosen and remove V-Band clamp at right exhaust manifold.
(23) Remove front and rear support bracket fasteners attaching right side catalytic converter down pipe.
(24) Disconnect fuel line. (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/FUEL LINES - STANDARD PROCEDURE)
(25) Disconnect throttle and speed control cables from bracket. (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/THROTTLE CONTROL CABLE - REMOVAL)
(26) Disconnect coolant hoses at coolant recovery/pressure container.
(27) Disconnect all vacuum hoses.
(28) Disconnect ground straps at both cylinder heads.

CAUTION: Upper Intake manifold is a composite design. Therefore, manifold should be removed before lifting engine or damage to the manifold could occur.

(29) Remove upper intake manifold and cover intake manifold openings with tape. (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - REMOVAL)
(30) Disconnect heater hoses.
(31) Remove rear throttle body support bracket.
(32) Remove fastener for water pipe at transmission to block bolt.
(33) Remove four upper transmission to block bolts.
(34) Disconnect all electrical connections.
(35) Hoist vehicle.
(36) Drain engine oil.
(37) Remove structural collar and mark flex plate to torque converter position.
(38) Remove bolts holding torque converter to flex plate.
(39) Disconnect both transmission oil cooler line brackets from engine.
(40) Loosen and remove left exhaust manifold V-Band clamp.
(41) For starter removal, loosen the left converter exhaust pipe band clamp and exhaust pipe support bracket at transaxle.
(42) Remove starter. (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - REMOVAL)
(43) Remove left engine mount bolts.
(44) Remove right engine mount bolts.
(45) Remove crankshaft position sensor. (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/CRANKSHAFT POSITION SENSOR - REMOVAL)
(46) Remove two lower transmission to block bolts.
(47) Lower vehicle.
(48) Attach lifting device to engine.
(49) Insert floor jack with small block of wood under transmission pan to support transmission.
(50) Hoist engine from engine compartment.

INSTALLATION - ENGINE ASSEMBLY

(1) Attach lifting device and lower engine into engine compartment.
(2) Align engine mounts and install fasteners but **do not tighten** until all mounting bolts have been installed.
(3) Install transmission case to engine block tighten bolts to 102 N·m (75 ft. lbs.).
(4) Remove engine lifting device.
(5) Raise vehicle.

ENGINE 3.5L (Continued)

(6) Tighten engine mount fastener to 61 N·m (45 ft. lbs.).
(7) Align flex plate to torque converter and install mounting bolts. Tighten bolts to 75 N·m (55 ft. lbs.).
(8) Install crankshaft position sensor. (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/CRANKSHAFT POSITION SENSOR - INSTALLATION)
(9) Install starter. (Refer to 8 - ELECTRICAL/ STARTING/STARTER MOTOR - INSTALLATION)
(10) Install new V-Band clamp at left side exhaust manifold to catalytic converter. Tighten V-Band clamp to 11 N·m (100 in. lbs.).
(11) Install left side catalytic converter down pipe support fastener at transaxle. Tighten fastener to 47 N·m (35 ft. lbs.).
(12) Tighten the left converter down pipe band clamp.
(13) Install the transmission oil cooler lines bracket to engine.
(14) Install structural collar/cover. (Refer to 9 - ENGINE/ENGINE BLOCK/STRUCTURAL COVER - INSTALLATION)
(15) Lower vehicle.
(16) Connect all electrical connections.
(17) Install four upper transmission to block bolts tighten to 102 N·m (75 ft. lbs.).
(18) Install water pipe and retaining fasteners to the transaxle/cylinder block double-ended bolts.
(19) Install rear throttle body support bracket.
(20) Connect heater hoses.
(21) Install upper intake manifold. (Refer to 9 - ENGINE/MANIFOLDS/INTAKE MANIFOLD - INSTALLATION)
(22) Connect ground straps at both cylinder heads.
(23) Connect all vacuum hoses.
(24) Connect coolant hoses at coolant recovery/ pressure container.
(25) Connect throttle and speed control cables to bracket and throttle arm. (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/THROTTLE CONTROL CABLE - INSTALLATION)
(26) Connect fuel line. (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/FUEL LINES - STANDARD PROCEDURE)
(27) Install new V-Band clamp at right exhaust manifold. Tighten V-Band clamp to 11 N·m (100 in. lbs.).
(28) Install and tighten right side catalytic converter down pipe support bracket fastener at transaxle mount.
(29) Install air conditioning compressor and tighten fasteners to 28 N·m (250 in. lbs.).
(30) Install power steering pump and tighten fasteners to 28 N·m (250 in. lbs.).
(31) Install generator. (Refer to 8 - ELECTRICAL/ CHARGING/GENERATOR - INSTALLATION)
(32) Install radiator. (Refer to 7 - COOLING/ENGINE/RADIATOR - INSTALLATION)
(33) Attach air conditioning condenser to radiator.
(34) Install power steering line bracket to radiator.
(35) Connect engine oil and transmission cooler lines to radiator.
(36) Install lower radiator hose.
(37) Install upper radiator hose.
(38) Install accessory drive belts. (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION) .
(39) Install radiator fan. (Refer to 7 - COOLING/ ENGINE/RADIATOR FAN - INSTALLATION)
(40) Fill cooling system. (Refer to 7 - COOLING - STANDARD PROCEDURE)
(41) Fill engine with proper amount of oil.
(42) Connect hood release cable to hood latch and install upper radiator crossmember. (Refer to 23 - BODY/EXTERIOR/GRILLE OPENING REINFORCEMENT - INSTALLATION)
(43) Install air cleaner and air inlet hose.
(44) Install strut tower brace. (Refer to 23 - BODY/ EXTERIOR/FRONT STRUT TOWER TO TOWER BRACE - INSTALLATION)
(45) Install both cowl covers. (Refer to 23 - BODY/ EXTERIOR/COWL GRILLE AND SCREEN - INSTALLATION)
(46) Install both wiper arms. (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER ARMS - INSTALLATION)
(47) Install hood. (Refer to 23 - BODY/HOOD/ HOOD - INSTALLATION)
(48) Connect negative cable.

SPECIFICATIONS

3.5L ENGINE

DESCRIPTION	SPECIFICATION
Type	60° SOHC V-6 24-Valve
Displacement	3.5 Liters (214 Cubic Inches)
Bore and Stroke	96.0 x 81.0 mm (3.780 x 3.189 in.)
Compression Ratio	9.9:1
Lead Cylinder	#1 Right Bank
Firing Order	1-2-3-4-5-6
Cylinder Block	
Cylinder Bore Diameter	96.0 mm ±0.0076 (3.780 in. ±0.0003 in.)
Out-of-Round (Max.)	0.076 mm (0.003 in.)
Taper (Max.)	0.051 mm (0.002 in.)

ENGINE 3.5L (Continued)

DESCRIPTION	SPECIFICATION
Pistons	
Type Material	Aluminum (Full Floating Pins)
Piston Diameter	95.98 ± 0.019 mm (3.7788 ± 0.0008 in.)
Clearance at Size Location	–0.007 to +0.047 mm (–0.0003 to +0.0018 in.)
Piston Weight	
—A Size	438–443 grams (15.45–15.62 oz.)
—B Size	433–438 grams (15.27–15.45 oz.)
Piston Ring Groove Diameter	
—No. 1	87.4–87.6 mm (3.441–3.449 in.)
—No. 2	86.3–86.5 mm (3.397–3.4055 in.)
—No. 3	85.8–86.0 mm (3.378–3.385 in.)
Piston Pins	
Type	Full Floating
Clearance in Piston	0.005–0.015 mm (0.0002–0.0006 in.)
Clearance in Rod	0.007–0.018 mm (0.0003–0.007 in.)
Diameter	23.997–24.000 mm (0.9448–0.9449 in.)
Piston Rings	
Ring Gap—Top Compression Ring	0.20–0.36 mm (0.008–0.014 in.)
Ring Gap—2nd Compression Ring	0.23–0.50 mm (0.0091–0.0197 in.)
Ring Gap—Oil Control (Steel Rails)	0.25–0.76 mm (0.010–0.030 in.)
Ring Side Clearance	
Top and Second Compression Ring	0.04–0.08 mm (0.0016–0.0031 in.)
Oil Ring (Steel Rails)	0.038–0.184 mm (0.0015–0.0073 in.)

DESCRIPTION	SPECIFICATION
Ring Width	
Top Compression Ring	1.17–1.19 mm (0.0461–0.0469 in.)
2nd Compression Ring	1.47–1.49 mm (0.058–0.059 in.)
Oil Ring (Steel Rings)	0.445–0.470 mm (0.0176–0.0186 in.)
Connecting Rods	
Bearing Clearance	0.019–0.081 mm (0.0007–0.0031 in.)
Piston Pin Bore Diameter	24.0076–24.0153 mm (0.9452–0.9455 in.)
Side Clearance (Max.)	0.39 mm (0.0153 in.)
Total Weight (Less Bearing)	647 grams (22.8223 oz.)
Crankshaft Main Bearing Journals	
Diameter	63.987–64.013 mm (2.519–2.520 in.)
Main Bearing Diametrical Clearance	0.011–0.077 mm (0.0007–0.0030 in.)
—(Max. Allowable)	0.087 mm (0.0034 in.)
Out-of-Round (Max.)	0.015 mm (0.0006 in.)
Taper (Max.)	0.015 mm (0.0006 in)
End Play	0.10–0.30 mm (0.004–0.012 in.)
—(Max.)	0.43 mm (0.017 in.)
Connecting Rod Journals	
Diameter	57.979–58.005 mm (2.283–2.284 in.)
Bearing Diametrical Clearance	0.019–0.087 mm (0.00075–0.0034 in.)
Out-of-Round (Max.)	0.015 mm (0.0006 in.)
Taper (Max.)	0.015 mm (0.0006 in.)

ENGINE 3.5L (Continued)

DESCRIPTION	SPECIFICATION
Camshaft	
Bore Diameter	43.038–43.059 mm (1.6944–1.6952 in.)
Bearing Journal Diameter	42.939–42.960 mm (1.6905–1.6913 in.)
Diametrical Clearance	0.078–0.12 mm (0.003–0.0047 in.)
—(Max.)	0.15 mm (0.0059 in.)
End Play	0.11–0.35 mm (0.004–0.014 in.)
Valve Timing—Intake Valve	
Opens (ATDC)	3°
Closes (ABDC)	61°
Duration	238°
Centerline	122°
Valve Timing—Exhaust Valve	
Opens (BBDC)	56°
Closes (ATDC)	16°
Duration	252°
Centerline	112°
Valve Overlap	13°
Cylinder Head	
Gasket Thickness (Compressed)	1.78 mm (0.070 in.)
Valve Seat Angle	45–45.5°
Valve Seat Runout (Max.)	0.051 mm (0.002 in.)
Valve Seat Width—Intake	0.75–1.25 mm (0.0295–0.0492 in.)
Valve Seat Width—Exhaust	1.25–1.75 mm (0.0492–0.0689 in.)
Guide Bore Diameter (Std.)	6.975–7.00 mm (0.2746–0.2756 in.)
Valve Guide Height*	9.5–10.5 mm (0.3740–0.4134 in.)
*Measured from cylinder head surface	
Valves	
Face Angle	44.5–45°
Head Diameter—Intake	36.37–36.63 mm (1.4319–1.4421 in.)
Head Diameter—Exhaust	28.87–29.13 mm (1.1366–1.1469 in.)
Length—Intake (Overall)	114.41–114.99 mm (4.5043–4.5272 in.)
Length—Exhaust (Overall)	125.67–126.25 mm (4.9476–4.9705 in.)
Stem Diameter—Intake	6.935–6.953 mm (0.2730–0.2737 in.)
Stem Diameter—Exhaust	6.906–6.924 mm (0.2719–0.2726 in.)
Stem-to-Guide Clearance—Intake	0.022–0.065 mm (0.0009–0.0026 in.)
—(Max.) Rocking Method	0.29 mm (0.0114 in.)
Stem-to-Guide Clearance—Exhaust	0.051–0.094 mm (0.002–0.0037 in.)
—(Max.) Rocking Method	0.370 mm (0.0146 in.)
Valve Lift—Intake (Zero Lash)	8.55 mm (0.3367 in.)
Valve Lift—Exhaust (Zero Lash)	6.53 mm (0.2571 in.)
Valve Margin - Intake:	0.835–1.165 mm (0.0329–0.0459 in.)
Valve Margin - Exhaust:	1.44–1.77 mm (0.0567–0.0697 in.)
Valve Stem Tip Height—Intake	42.366–43.655 mm (1.6680–1.7187 in.)
Valve Stem Tip Height—Exhaust	44.705–45.986 mm (1.760–1.8105 in.)
Valve Springs	
Free Length—Intake (Approx.)	43.675 mm (1.7195 in.)
Free Length—Exhaust (Approx.)	44.319 mm (1.7448 in.)
Spring Force—Intake (Valve Closed)	309–358 N @ 38.0 mm (69.5–80.5 lbs. @ 1.4961 in.)
Spring Force—Exhaust (Valve Closed)	314–354 N @ 38.0 mm (71–79 lbs. @ 1.4961 in.)

ENGINE 3.5L (Continued)

DESCRIPTION	SPECIFICATION
Spring Force—Intake (Valve Open)	836–907 N @ 29.85 mm (188–204 lbs. @ 1.1594 in.)
Spring Force—Exhaust (Valve Open)	579–640 N @ 31.47 mm (130–144 lbs. @ 1.239 in.)
Number of Coils—Intake	6.86
Number of Coils—Exhaust	7.66
Color of Spring (Top of Coils)	
—Intake (Right Hand Coil Direction)	Orange
—Exhaust (Left Hand Coil Direction)	Yellow
Wire Diameter—Intake	4.29–4.34 mm (0.1689–0.1709 in.)
Wire Diameter—Exhaust	4.16–4.22 mm (0.1638–0.1661 in.)
Spring Installed Height (Spring Seat to Bottom of Retainer)—Intake & Exhaust	38.0 mm (1.4961 in.)
Oil Pump	
Clearance Over Rotors	0.077 mm (0.003 in.)
Cover Out-of-Flat (Max.)	0.025 mm (0.001 in.)
Inner & Outer Rotor Thickness (MIn.)	14.299 mm (0.563 in.)
Outer Rotor Thickness (Max.)	0.39 mm (0.015 in.)
Outer Rotor Diameter (Min.)	79.997 mm (3.149 in.)
Tip Clearance Between Rotors (Max.)	0.20 mm (0.008 in.)
Oil Pressure	
(NOTE: At Normal Operating Temperatures)	
Pressure @ Curb Idle Speed*	34.47 kPa Min. (5 psi) Min.
Pressure @ 3000 RPM	300–724 kPa (45–105 psi)
*CAUTION: If pressure is zero at curb idle, DO NOT run engine at 3000 RPM.	

TORQUE

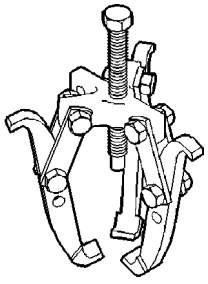
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
A/C Compressor Bracket to Engine—Bolts	54	40	—
A/C Compressor to Bracket	28	—	250
Camshaft Sprocket Bolt—Right Side	102 +¼ Turn	75 +¼ Turn	—
Camshaft Sprocket Bolt—Left Side	115 +¼ Turn	85 +¼ Turn	—
Camshaft Thrust Plate—Bolts	28	—	250
Connecting Rod Cap—Nuts	54 +¼ Turn	40 +¼ Turn	—
Crankshaft Main Bearing Cap			
—Inner Main Cap Bolts	20 +¼ Turn	15 +¼ Turn	—
—Outer Main Cap Bolts	27 +¼ Turn	20 +¼ Turn	—
—Tie Bolts (Horizontal)	28	—	250
Crankshaft Damper—Bolt	95	70	—
Cylinder Head Bolts*			
—Step 1	61	45	—
—Step 2	88	65	—
—Step 3	88	65	—
—Step 4	+¼ Turn	+¼ Turn	—
*Refer to procedure for tightening sequence. (Refer to 9 - ENGINE/CYLINDER HEAD - INSTALLATION)			
Cylinder Head Cover—Bolts	12	—	105
Exhaust Manifold to Cylinder Head—Bolts	23	—	200
Exhaust Manifold Heat Shield—Bolts	12	—	105
Engine Mount Bracket to Block—Bolts	61	45	—
Engine Mount Isolator—Nuts	61	45	—
Generator Bracket—Bolts	54	40	—
Intake Manifold			
—M6 Bolts	12	—	105
—M8 Bolts	28	—	250

ENGINE 3.5L (Continued)

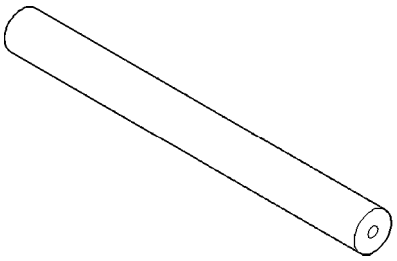
DESCRIPTION	N·m	Ft. Lbs.	In. Lbs.
Oil Pan			
—M6 Bolts	12	—	105
—M8 Bolts	28	—	250
Oil Pan Drain Plug	27	20	—
Oil Filter	16	12	—
Oil Pump to Block—Bolts	28	—	250
Oil Pump Cover—Bolts	12	—	105
Oil Pump Pick Up Tube—Bolt	28	—	250
PCV Valve	7	—	60
Crankshaft Rear Seal Retainer	12	—	105
Rocker Shaft Pedestal Retaining—Bolts	31	—	275
Spark Plugs	28	20	—
Structural Collar	(Refer to 9 - ENGINE/ ENGINE BLOCK/ STRUCTURAL COVER - INSTALLATION)		
Thermostat Housing/Water Inlet Connector—Bolts	12	—	105
Throttle Body—Bolts	12	—	105
Timing Belt Tensioner—Bolts	28	—	250
Timing Belt Tensioner Pulley Assembly—Bolt	61	45	—
Timing Belt Cover			
—M6 Bolts	12	—	105
—M8 Bolts	28	—	250
—M10 Bolts	54	40	—

SPECIAL TOOLS

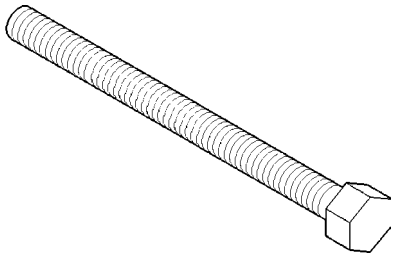
3.5L ENGINE



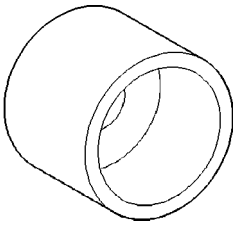
Puller Damper 1023



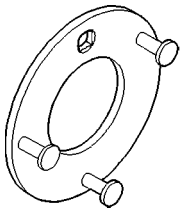
Crankshaft Damper Remover Insert C-4685-C2



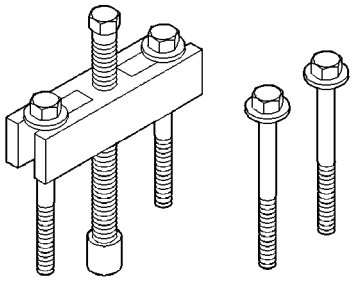
Crankshaft Damper/Sprocket Installer Bolt C-4685-C1



Crankshaft Sprocket Installer 6641

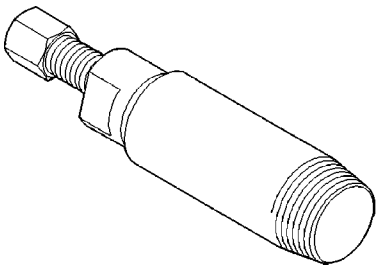


Crankshaft Damper Holder 8191

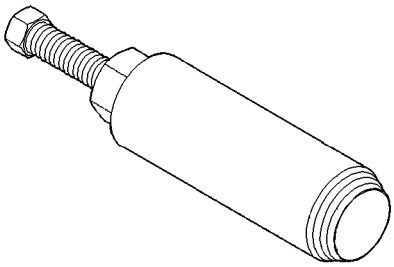


Crankshaft Sprocket Puller L-4407A

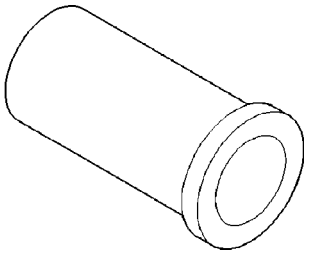
ENGINE 3.5L (Continued)



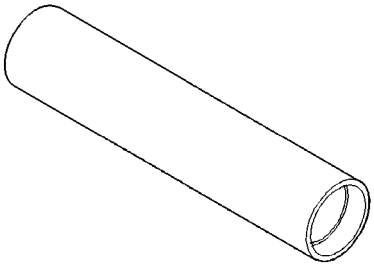
Crankshaft Seal Remover



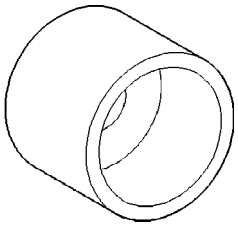
Camshaft Seal Remover C-3981B



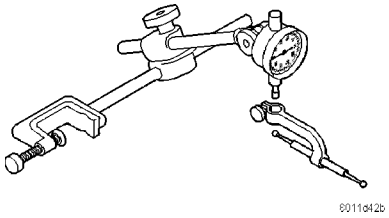
Crankshaft Seal Installer 6342



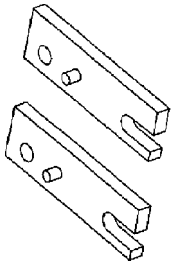
Camshaft Seal Installer 6052



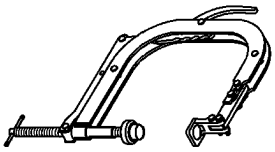
Crankshaft Sprocket Installer 6641



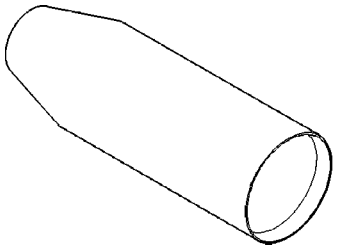
Dial Indicator C-3339



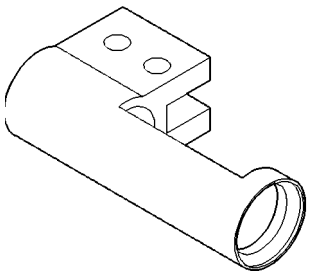
Camshaft Alignment 6642



Valve Spring Compressor C-3422-D

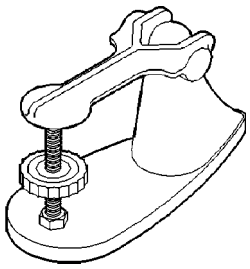


Camshaft Seal Protector 6788

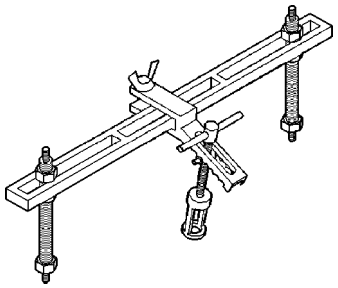


Valve Spring Adapter 6526

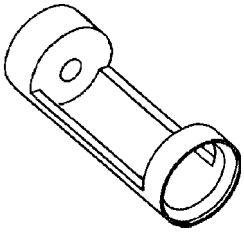
ENGINE 3.5L (Continued)



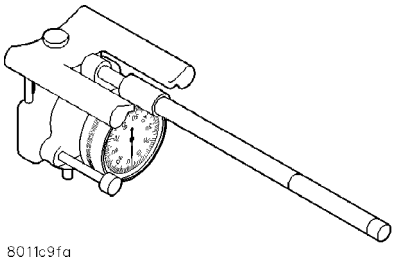
Valve Spring Tester C-647



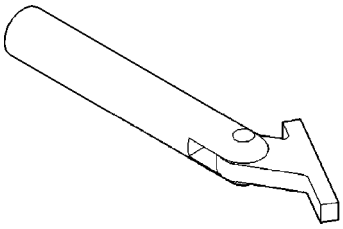
Valve Spring Compressor MD-998772-A



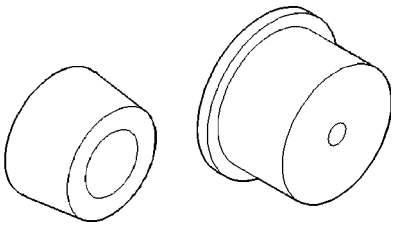
Valve Spring Adapter 6527



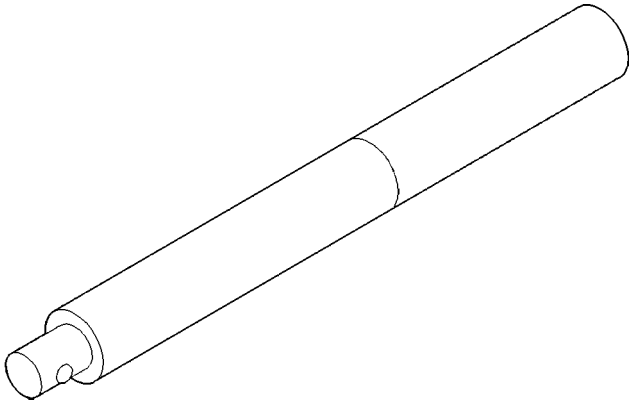
Indicator Bore Size C-119



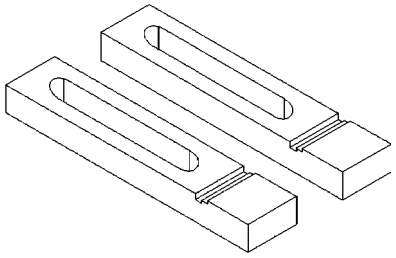
Main Bearing Remover/Installer C-3059



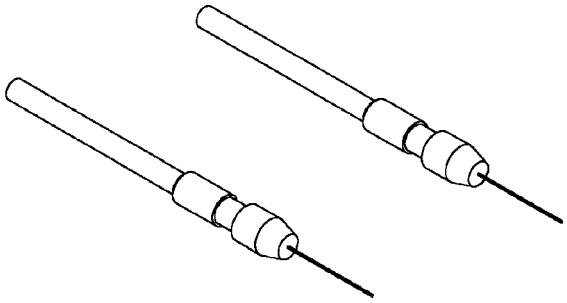
Crankshaft Rear Seal Guide 6926-1 & Installer 6926-2



Driver Handle C-4171

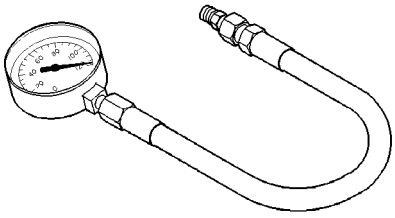


Crankshaft Rear Seal Retainer Alignment Fixture 8225

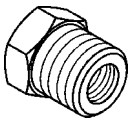


Release Probe 8351

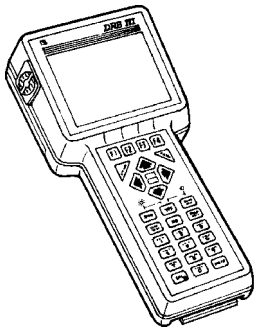
ENGINE 3.5L (Continued)



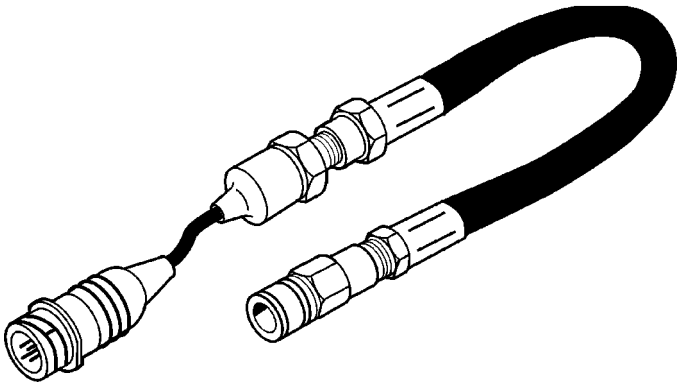
Pressure Gauge C-3292



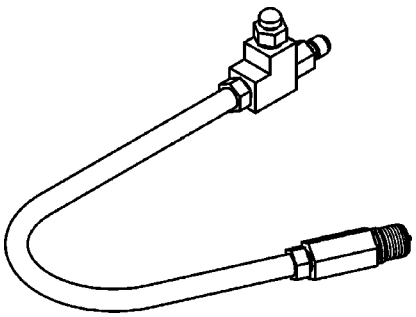
Adapter 8406



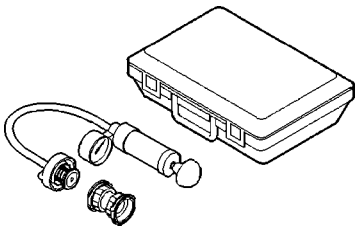
DRB III® with PEP Module – OT-CH6010A



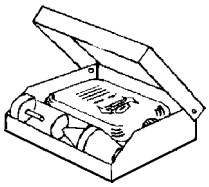
Pressure Transducer CH7059



Adaptor 8116



Cooling System Tester 7700



Combustion Leak Tester C-3685-A

AIR CLEANER ELEMENT

REMOVAL

(1) Remove air cleaner lid. Lift lid off of air cleaner housing.

(2) Remove filter element (Fig. 9).

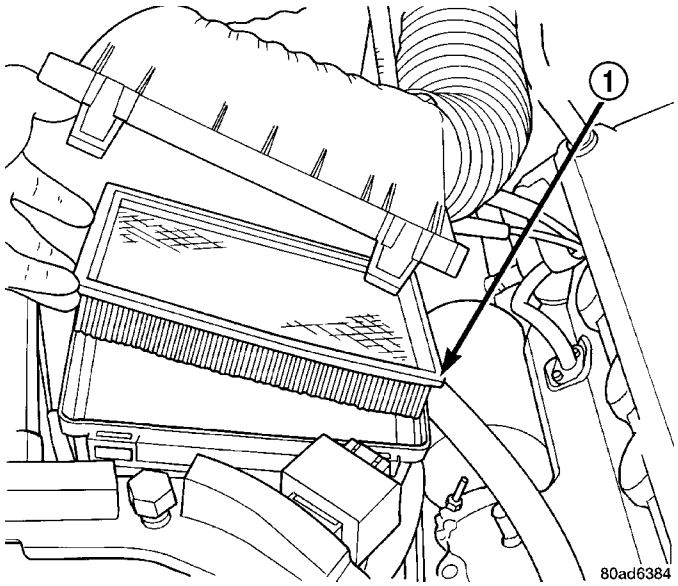


Fig. 9 Air Cleaner Housing and Element

1 - AIR FILTER ELEMENT

INSTALLATION

(1) If necessary, clean the inside of the air cleaner housing.

(2) Install new filter element (Fig. 9).

(3) Place lid over air cleaner housing.

CYLINDER HEAD

DESCRIPTION

The aluminum alloy cylinder heads feature cross-flow type intake and exhaust ports. Valve guides and seat inserts are powdered metal. Valves are arranged in a "V", with each camshaft on center. To improve combustion speed the chambers are a compact spherical design with a squish area of approximately 30 percent of the piston top area. The cylinder heads are common to either cylinder bank by reversing the direction of installation.

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.

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

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

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

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

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

(5) Remove front timing belt covers. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL)

(6) Remove camshaft sprockets. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL)

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

(8) Remove V-Band clamp(s) at exhaust manifold to catalytic converter pipe connection.

NOTE: Do not reuse V-Band Clamp.

(9) Remove rear timing belt cover to cylinder head fasteners (Fig. 10). Remove the rear covers.

(10) The right side rear timing belt cover has O-rings to seal the water pump passages to cylinder block (Fig. 11). Do not reuse O-rings.

(11) Remove cylinder head bolts in REVERSE of tightening sequence (Fig. 15).

(12) Remove cylinder head(s).

CYLINDER HEAD (Continued)

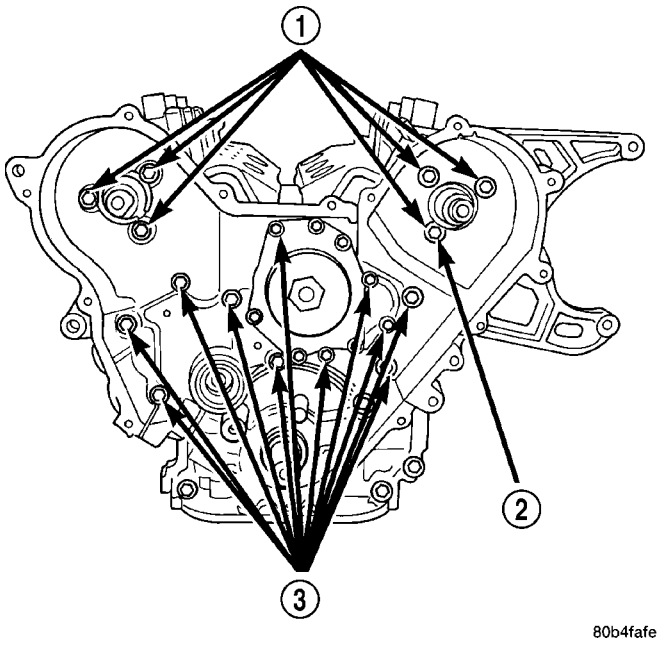


Fig. 10 Rear Timing Belt Cover Bolts

1 - REAR COVER TO CYLINDER HEAD BOLTS
2 - APPLY SEALANT TO BOLT THREADS
3 - REAR COVER TO CYLINDER BLOCK BOLTS

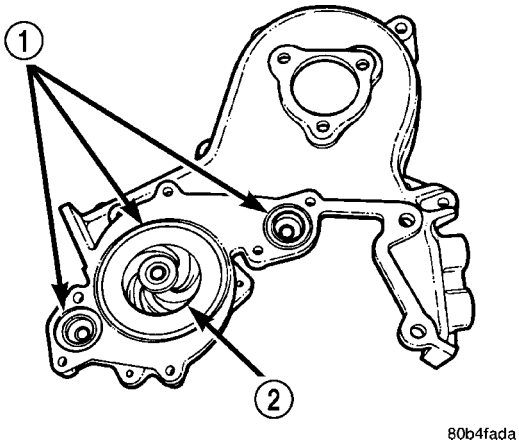


Fig. 11 Right Side Timing Belt Cover Water Pump O-Rings

1 - O-RINGS
2 - WATER PUMP IMPELLER

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.

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. 12).

(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.

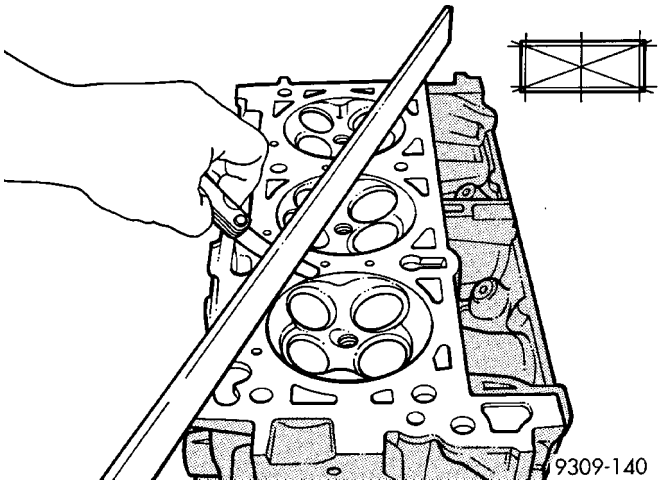


Fig. 12 Checking Cylinder Head Flatness

INSTALLATION

The cylinder head bolts are tightened using a torque plus angle procedure. The bolts must be examined BEFORE reuse. If the threads are necked down the bolts must be replaced (Fig. 13).

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 must be replaced.

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

(1) Clean sealing surfaces of cylinder head and block.

CYLINDER HEAD (Continued)

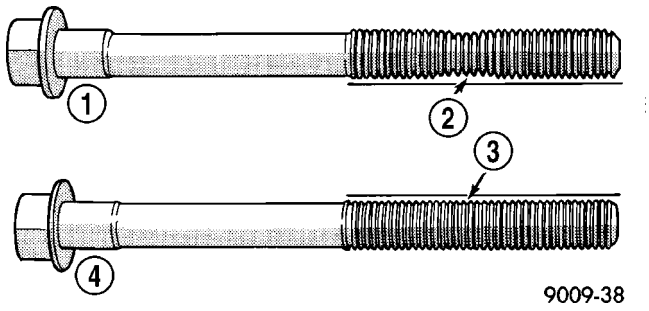


Fig. 13 Checking Bolts for Stretching (Necking)

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

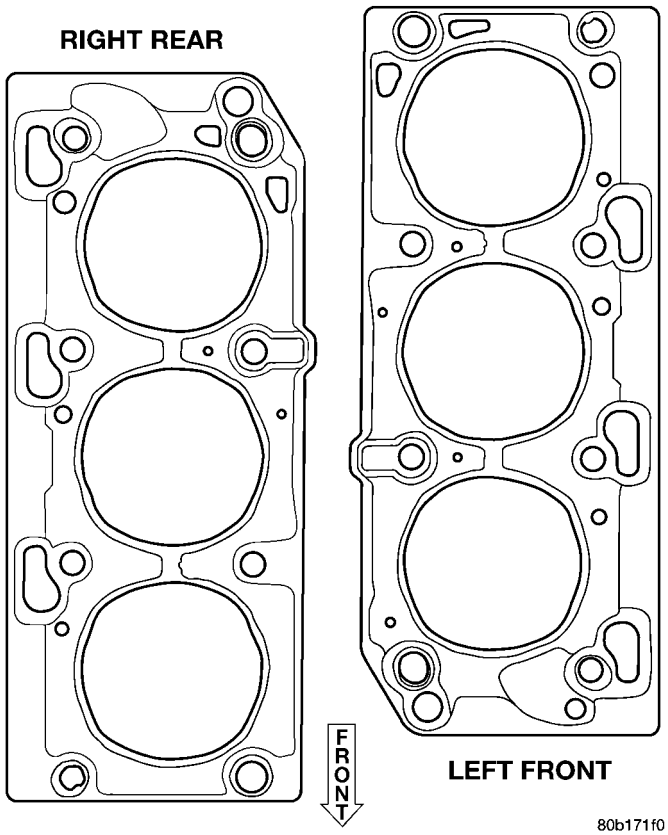


Fig. 14 Cylinder Head Gasket Identification

CAUTION: Ensure that the correct head gaskets are used and are oriented correctly on cylinder block. The 3.5L engine head gaskets have perfectly round combustion sealing rings. The 3.2L engine does NOT have perfectly round combustion sealing rings.

(2) Install head gasket over locating dowels. Ensure the gasket is installed on the correct side of engine (Fig. 14).

(3) Install cylinder head over locating dowels.

(4) Before installing the bolts, lubricate the threads with engine oil.

(5) Tighten the cylinder head bolts in the sequence shown in (Fig. 15). Using the 4 step torque-turn method, tighten according to the following torque values:

- Step 1: All to 61 N·m (45 ft. lbs.)
- Step 2: All to 88 N·m (65 ft. lbs.)
- Step 3: All (again) to 88 N·m (65 ft. lbs.)
- Step 4: + 90° Turn **Do not use a torque wrench for this step.**

(6) Bolt torque after 90° turn should be over 122 N·m (90 ft. lbs.) in the tightening direction. If not, replace the bolt.

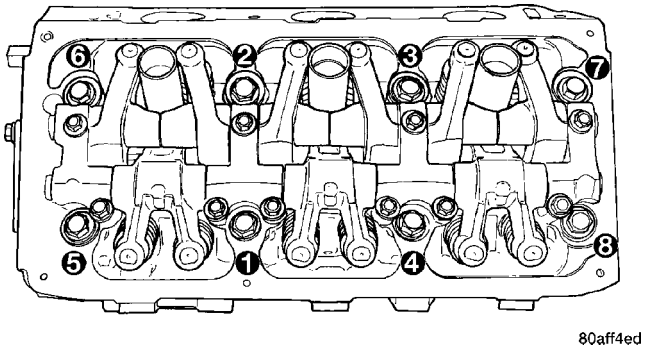


Fig. 15 Cylinder Head Bolt Tightening Sequence

(7) Clean right rear timing belt cover O-ring sealing surfaces and grooves (Fig. 11). Lubricate new O-rings with Mopar® Dielectric Grease or equivalent to facilitate assembly.

(8) Install rear timing belt covers (Fig. 10) and (Fig. 11). Tighten bolts to specified torque:

- M10—54 N·m (40 ft. lbs.)
- M8—28 N·m (20 ft. lbs.)
- M6—12 N·m (105 in. lbs.)

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

(10) Install front timing belt covers. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION)

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

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

(13) Connect catalytic converter to exhaust manifold using a new V-band clamp(s). Tighten clamp to 10 N·m (100 in. lbs.).

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

(15) Connect negative cable to remote jumper terminal

CAMSHAFT OIL SEAL(S)

REMOVAL

(1) Remove camshaft sprocket(s). (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL)

(2) Use Special Tool C-3981B to remove camshaft oil seal (Fig. 16).

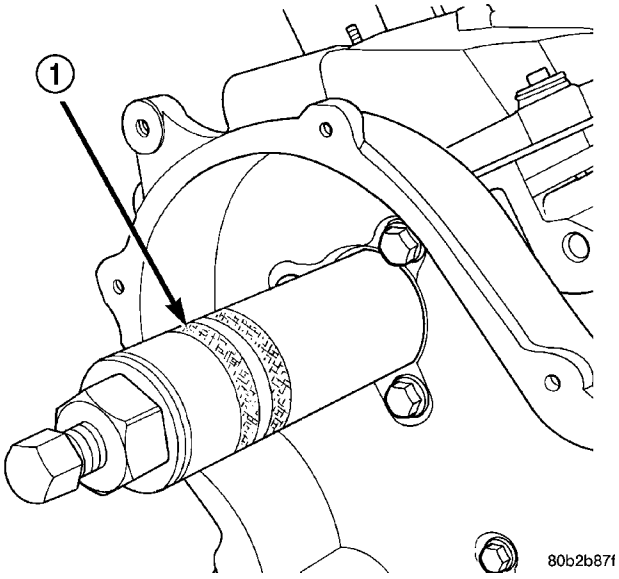


Fig. 16 Camshaft Oil Seal - Removal

1 - SPECIAL TOOL C-3981B

INSTALLATION

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

(2) Install the oil seal using Special Tool 6788 Seal Protector Sleeve (Fig. 17) and Seal Installer 6052 (Fig. 18).

(3) Install camshaft sprocket(s). (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION)

CAMSHAFT(S)

DESCRIPTION

A single overhead camshaft per cylinder head provides valve actuation. The left camshaft accommodates a cam sensor pick-up wheel and is therefore longer. Each camshaft is supported by four bearing journals. Thrust for each camshaft is taken at a thrust plate attached to the rear of each cylinder head. Right and left camshaft driving sprockets are not interchangeable because of the cam sensor pick-up wheel on the left sprocket. Camshaft bearing lubrication is provided via oil feed passage through each rocker shaft pedestal dowel.

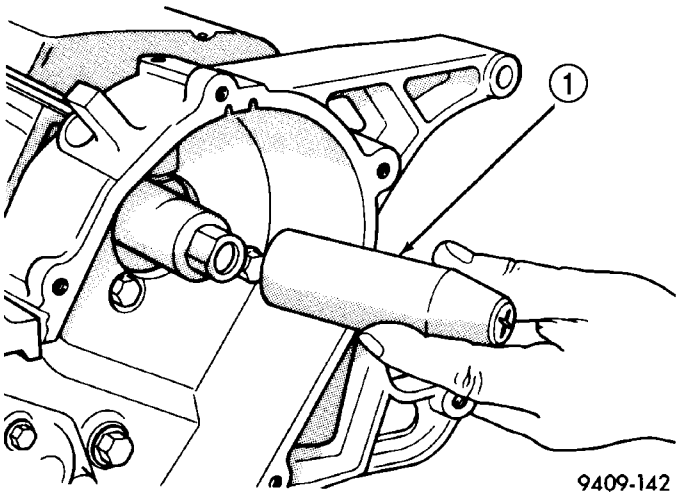


Fig. 17 Camshaft Oil Seal Protector Sleeve

1 - SPECIAL TOOL 6788

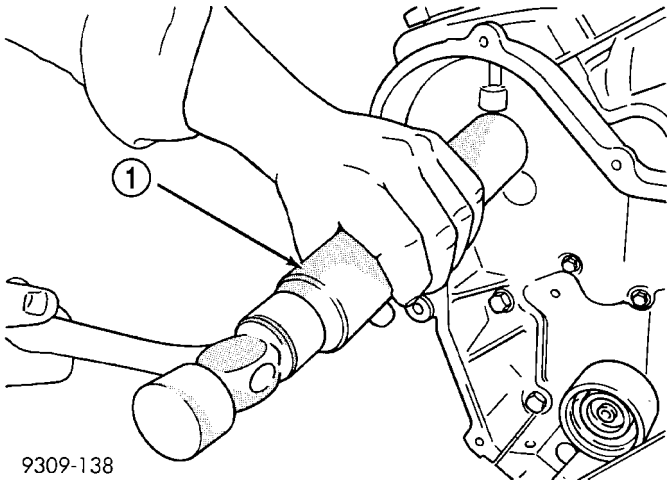


Fig. 18 Camshaft Oil Seal - Installation

1 - SPECIAL TOOL 6052

OPERATION

The camshaft is driven by the crankshaft via drive sprockets and belt. The camshaft has precisely machined lobes to provide accurate valve timing and duration.

STANDARD PROCEDURE - MEASURING CAMSHAFT END PLAY

(1) Oil camshaft journals and install camshaft **WITHOUT** rocker arms. Install rear cam caps and tighten screws to specified torque.

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

(3) Zero dial indicator (Fig. 19).

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

(5) Record reading on dial indicator. For end play specification, (Refer to 9 - ENGINE - SPECIFICATIONS).

CAMSHAFT(S) (Continued)

(6) If end play is excessive, check cylinder head and camshaft for wear; replace as necessary.

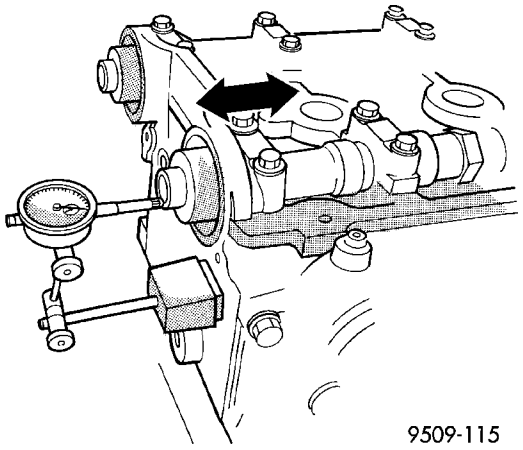


Fig. 19 Camshaft End Play - Typical

REMOVAL

Camshafts are removed from the rear of each cylinder head. The cylinder head must be removed.

(1) Remove camshaft sprocket(s). (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL)

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

(3) Mark the rocker arm and shaft assembly before removal. Remove the rocker arm and shaft assembly from the head. (Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - REMOVAL)

(4) Remove the rear camshaft cover and O-ring from head.

CAUTION: Be careful not to nick or scratch the journals when removing the camshaft.

(5) Carefully remove the camshaft from the rear of the cylinder head (Fig. 20).

CLEANING

Clean camshaft with a suitable solvent.

INSPECTION

(1) Inspect camshaft bearing journals for damage and binding (Fig. 21). If journals are binding, check the cylinder head for damage. Also check cylinder head oil holes for clogging.

(2) Check the cam lobe and bearing surfaces for abnormal wear and damage. Replace camshaft if defective.

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

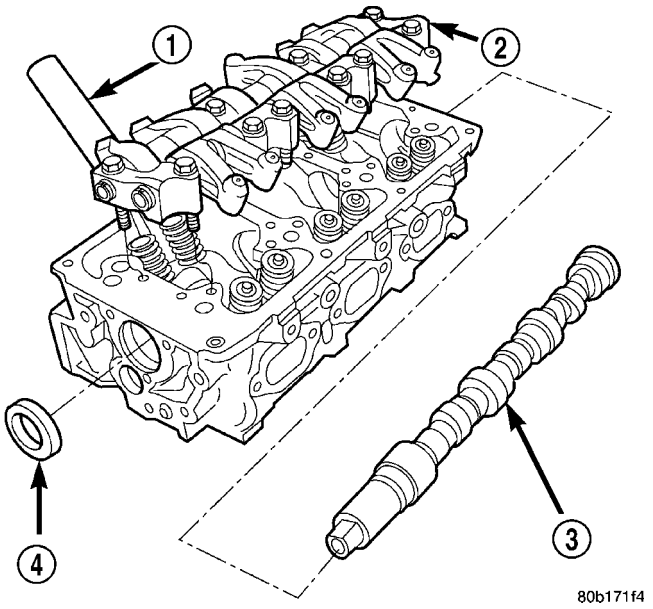


Fig. 20 Cylinder Head, Camshaft, and Rocker Arms

1 - SPARK PLUG TUBE
2 - ROCKER ARM ASSEMBLY
3 - CAMSHAFT
4 - SEAL

(3) Measure the lobe actual wear (Fig. 21) 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.).

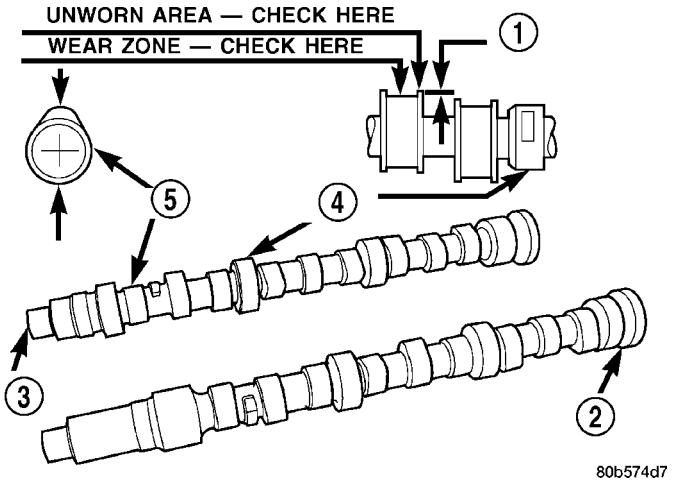


Fig. 21 Camshaft Inspection

1 - ACTUAL WEAR
2 - LEFT CAMSHAFT
3 - RIGHT CAMSHAFT
4 - BEARING JOURNAL
5 - LOBE

INSTALLATION

(1) Lubricate camshaft bearing journals and camshaft lobes with clean engine oil and install camshaft into cylinder head (Fig. 20).

CAMSHAFT(S) (Continued)

(2) Install cylinder head(s). (Refer to 9 - ENGINE/CYLINDER HEAD - INSTALLATION)

(3) Install the rocker arm assembly. (Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - INSTALLATION)

(4) Install camshaft sprockets and timing belt. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION)

CYLINDER HEAD COVER(S)

REMOVAL

WARNING: DO NOT START OR RUN ENGINE WITH CYLINDER HEAD COVER REMOVED FROM THE ENGINE. DAMAGE OR PERSONAL INJURY MAY OCCUR.

(1) Remove air cleaner assembly.

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

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

(4) Disconnect electrical connectors and remove ignition coils (Fig. 23).

(5) Remove nuts attaching wire harness to cylinder head cover (Fig. 22). Move harness for cover removal clearance.

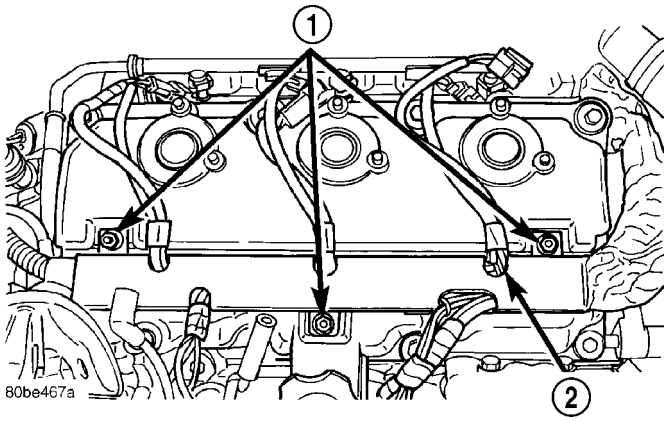


Fig. 22 WIRE HARNESS RETAINING NUTS

1 - NUTS
2 - WIRE HARNESS

(6) For right cylinder head cover removal perform the following:

(a) Remove A/C compressor belt. (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL)

(b) Remove A/C compressor mounting bolts.

(c) Move compressor aside for cylinder head cover clearance.

(7) Remove cylinder head cover bolts and remove cover (Fig. 24).

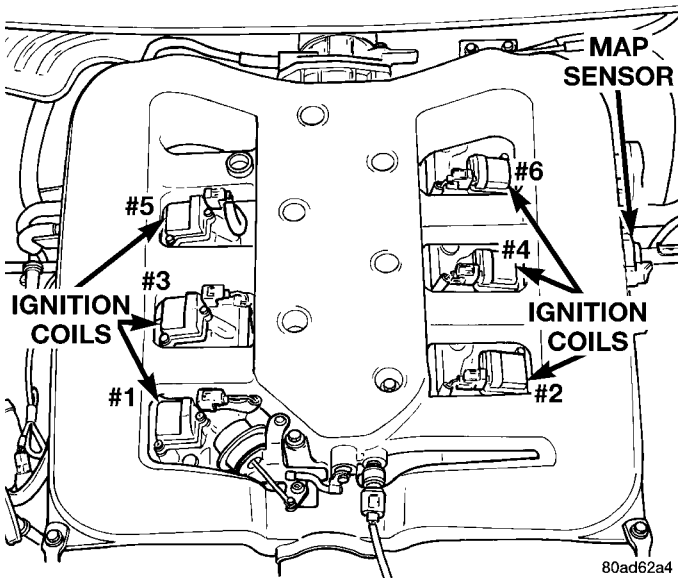


Fig. 23 Ignition Coils

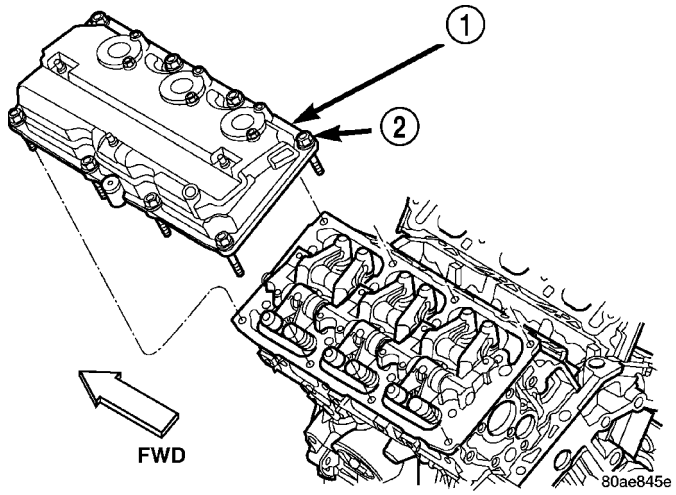


Fig. 24 CYLINDER HEAD COVERS

1 - CYLINDER HEAD COVER-LEFT SIDE
2 - BOLTS (8)

INSTALLATION

(1) Clean cylinder head and cover mating surfaces. Inspect and replace gasket and seals as necessary (Fig. 25).

(2) To replace spark plug tube seals:

(a) Using a suitable pry tool, carefully remove tube seals.

(b) Position new seal with the part number on seal facing cylinder head cover.

(c) Install seals using Special Tool MD-998306 (Fig. 26).

(3) Install cylinder head cover bolts and tighten to 12 N·m (105 in. lbs.) (Fig. 24).

CYLINDER HEAD COVER(S) (Continued)

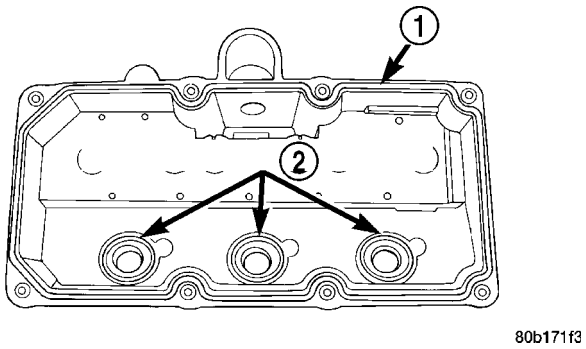


Fig. 25 Cylinder Head Cover Gasket and Spark Plug Tube Seals

1 - CYLINDER HEAD COVER GASKET
2 - SPARK PLUG TUBE SEALS

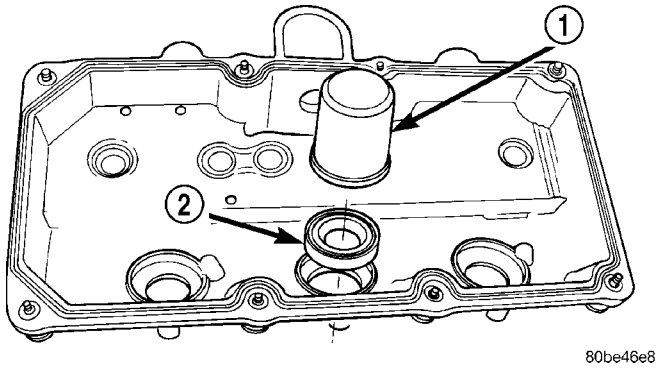


Fig. 26 Spark Plug Tube Seal Installation

1 - SPECIAL TOOL MD-998306
2 - SPARK PLUG TUBE SEAL

(4) For right cylinder head cover installation perform the following:

(a) Position A/C compressor on bracket and install mounting bolts.

(b) Install A/C compressor belt. (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION)

(5) Position wire harness on cylinder head cover and install retaining nuts (Fig. 22).

(6) Install ignition coils and connect all electrical connectors (Fig. 23).

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

(8) Install air cleaner assembly.

INTAKE/EXHAUST VALVES & SEATS

DESCRIPTION

Valves are made of highly heat-resistant steel and are chrome plated to prevent stem scuffing. The intake valve is a one-piece forging, while the exhaust valve has a forged head with a welded stem for lock groove hardenability. The four valves (two intake and two exhaust) employ a three-groove lock design to help facilitate valve rotation.

STANDARD PROCEDURE - VALVE AND VALVE SEAT REFACING

The valve face and valve seat angles are shown in (Fig. 28).

VALVES

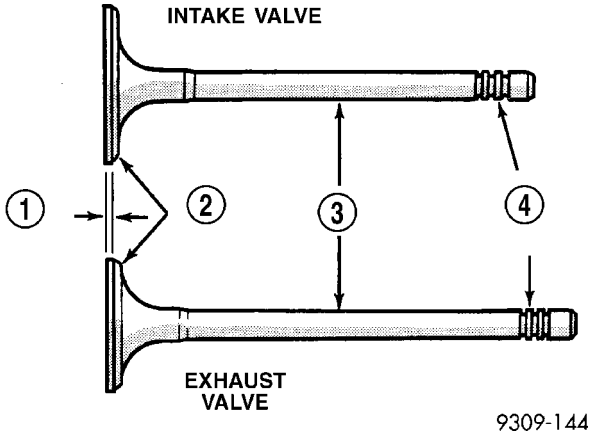


Fig. 27 Intake and Exhaust Valves

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

(1) Inspect the remaining margin after the valves are refaced (Fig. 27). (Refer to 9 - ENGINE - SPECIFICATIONS)

VALVE SEATS

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

(2) Measure the concentricity of valve seat using dial indicator. Total runout should not exceed 0.051 mm (0.002 inch.) total indicator reading.

INTAKE/EXHAUST VALVES & SEATS (Continued)

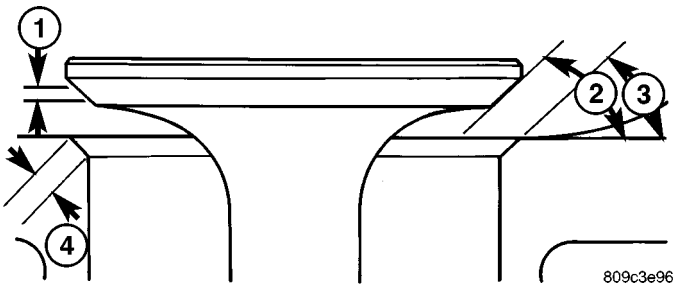


Fig. 28 Valve Face and Seat

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

(3) Inspect the valve seat with Prussian blue to determine where the valve contacts the seat. To do this, coat valve seat **LIGHTLY**with Prussian blue 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, then lower valve seat with a 15 degree stone. If the blue is transferred to the bottom edge of valve face, then raise valve seat with a 65 degree stone.

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 the intake seats should be 0.75 to 1.25 mm (0.0296 to 0.0493 in.) and exhaust seats should be 1.25 to 1.75 mm (0.049 to 0.069 in.) (Fig. 28).

VALVE AND SPRING INSTALLED HEIGHT

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

(2) If valves or seats have been refaced, check valve tip height (A) (Fig. 29). If valve tip height is greater than 43.65 mm (1.7185 in.) intake or 45.98 mm (1.8102 in.) exhaust, grind valve tip until within specifications. Make sure measurement is taken from cylinder head surface to the top of valve stem.

(3) Install valve seal/spring seat assembly over valve guides on all valve stems (Fig. 31). Ensure that the garter spring is intact around the top of the rubber seal.

(4) Place valve spring (color-coded end facing up (Fig. 30)) and valve retainer into position on spring seat (Fig. 31).

(5) Compress valve springs with valve spring compressor C-3422-D and adapter 6526 (Refer to 9 - ENGINE - SPECIAL TOOLS), install locks and release tool.

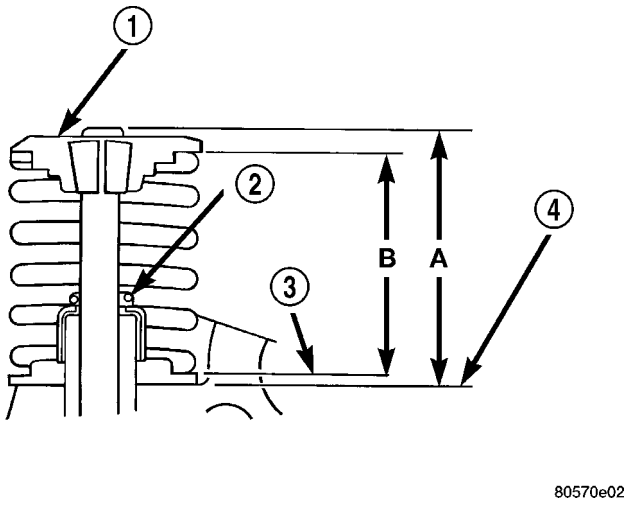


Fig. 29 Checking Valve Tip Height and Valve Spring Installed Height

1 - SPRING RETAINER
2 - GARTER SPRING
3 - VALVE SPRING SEAT TOP
4 - CYLINDER HEAD SURFACE

(6) If valves and/or seats are refaced, measure the installed height of springs (B) (Fig. 29). Measurements are taken from top of spring seat to the bottom surface of spring retainer. If height is greater than 38.75 mm (1.5256 in.), install a 0.762 mm (0.030 in.) spacer in head counterbore under the valve spring seat to bring spring height back within specification.

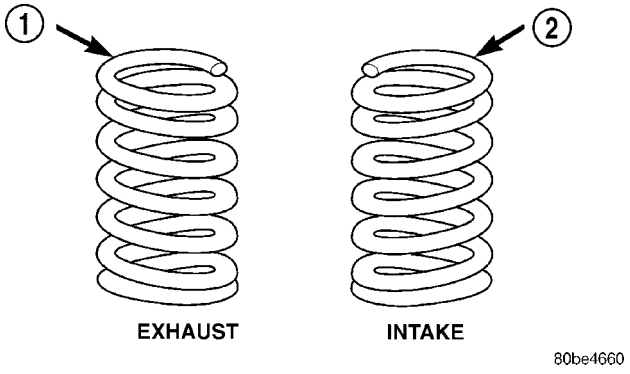


Fig. 30 Valve Spring Identification

1 - YELLOW DYE
2 - ORANGE DYE

REMOVAL

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

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

(3) Remove valve(s) from cylinder head.

INTAKE/EXHAUST VALVES & SEATS (Continued)

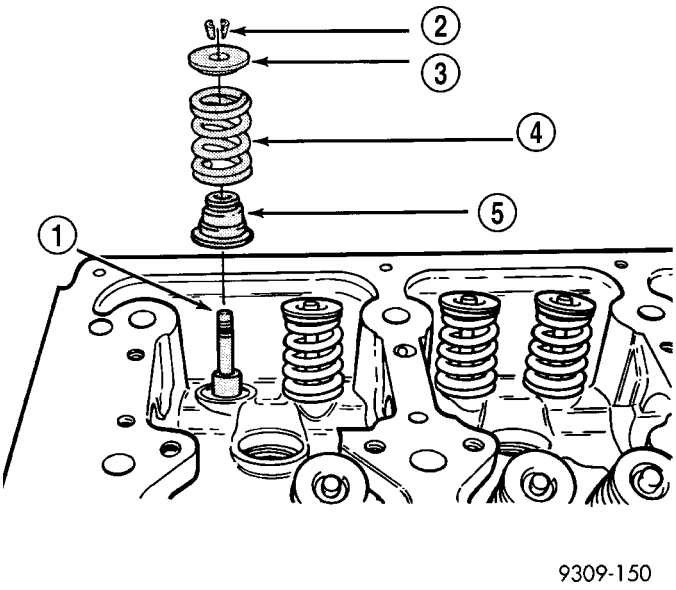


Fig. 31 Valve Seal and Spring - Installation

1 - VALVE
2 - VALVE RETAINING LOCKS
3 - VALVE SPRING RETAINER
4 - VALVE SPRING
5 - VALVE SEAL AND VALVE SPRING SEAT ASSEMBLY

CLEANING

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

INSPECTION

INSPECTION - VALVES

(1) Measure valve stems for wear (Fig. 32) approximately 60 mm (2.36 in.) below the valve lock grooves.

(2) Compare measurement to specifications, (Refer to 9 - ENGINE - SPECIFICATIONS).

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

INSPECTION - VALVE GUIDES

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

(2) 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.

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

(4) Move valve to and from the indicator.

(5) Note dial indicator reading and compare to engine specifications. (Refer to 9 - ENGINE - SPECIFICATIONS)

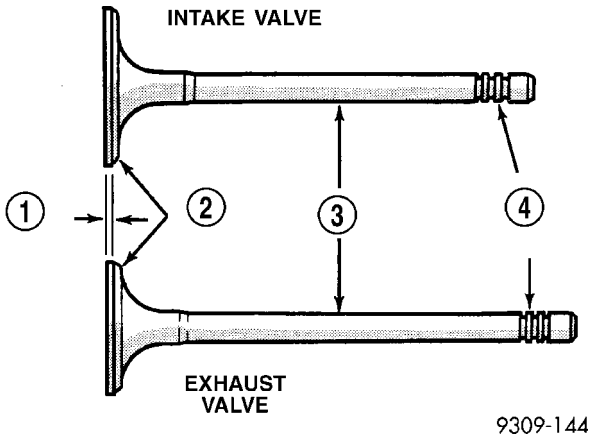


Fig. 32 Intake and Exhaust Valves

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

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

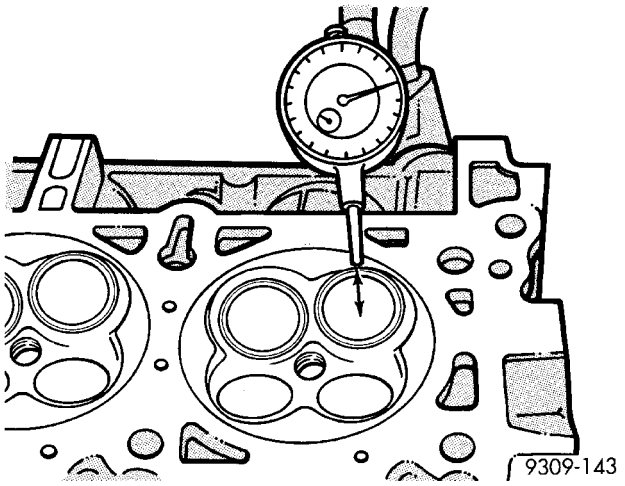


Fig. 33 Measuring Valve Guide Wear

INSTALLATION

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

(2) If valves or seats have been reground, check valve tip height (A) (Fig. 34). If valve tip height is greater than 43.65 mm (1.7185 in.) intake or 45.98 mm (1.8102 in.) exhaust, grind valve tip until within specifications. Make sure measurement is taken from cylinder head surface to the top of valve stem.

(3) Install valve stem seals and valve springs. (Refer to 9 - ENGINE/CYLINDER HEAD/VALVE STEM SEALS - INSTALLATION) (Refer to 9 - ENGINE/CYLINDER HEAD/VALVE SPRINGS - INSTALLATION)

INTAKE/EXHAUST VALVES & SEATS (Continued)

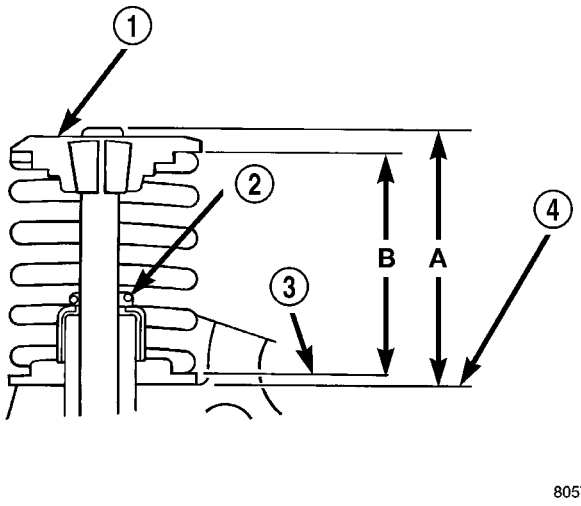


Fig. 34 Checking Valve Tip Height and Valve Spring Installed Height

1 - SPRING RETAINER
2 - GARTER SPRING
3 - VALVE SPRING SEAT TOP
4 - CYLINDER HEAD SURFACE

ROCKER ARM / ADJUSTER ASSEMBLY

DESCRIPTION

DESCRIPTION - ROCKER ARM

Rocker arms are made of light weight permanent mold aluminum alloy with a roller type follower operating against the camshaft (Fig. 35). The valve actuating end of the rocker arms are machined to retain hydraulic lash adjusters, eliminating the need for manual valve lash adjustment.

DESCRIPTION - ROCKER ARM SHAFTS

The rocker arm shafts (Fig. 36) are tubular steel and are supported by several forged aluminum alloy pedestals, which are fastened to the cylinder head. Four shafts are used, one for each intake and exhaust rocker arm bank on each cylinder head. The shafts are hollow to provide a duct for lubricating oil flow from the cylinder head to the valve mechanisms. One hollow dowel per pedestal is used to locate the pedestal to the cylinder head, orient the exhaust rocker shaft, and serve as a cam bearing oil feed passage.

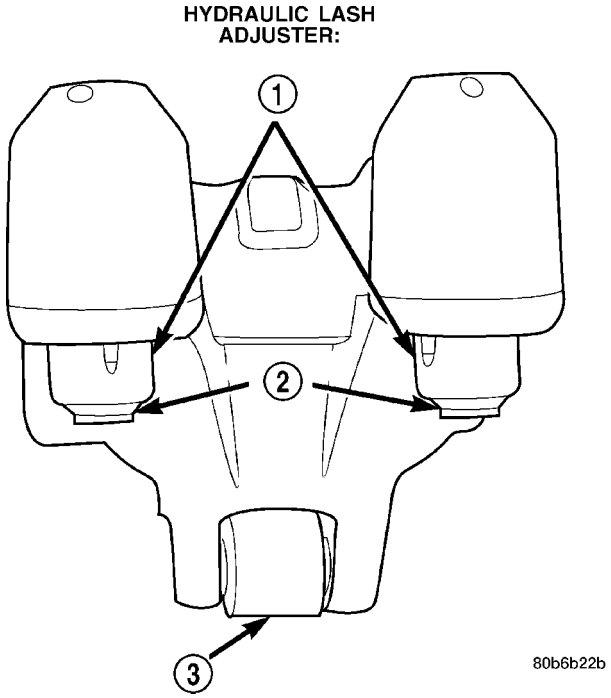


Fig. 35 Rocker Arm Assembly

1 - RETAINER
2 - SWIVEL PAD
3 - ROLLER

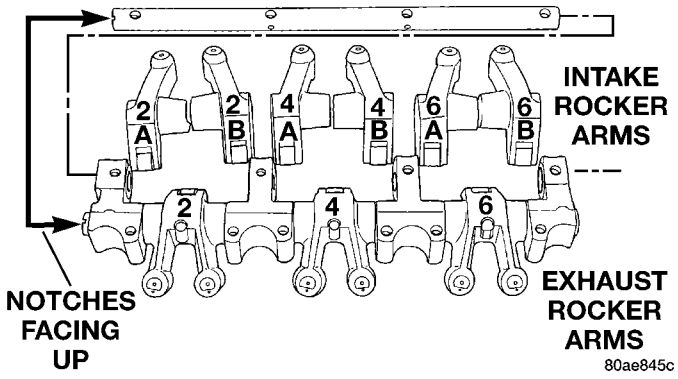


Fig. 36 Rocker Arms and Shafts

DIAGNOSIS AND TESTING

LASH ADJUSTER (TAPPET) NOISE DIAGNOSIS

Proper noise diagnosis is essential in locating the source of a NVH complaint. Locating a lash adjuster (tappet) type noise can sometimes be difficult. As a result, an initial misdiagnosis may occur.

Refer to the following chart indicating possible lash adjuster (tappet) noise sources and possible sources that could lead to a misdiagnosis.

Refer to Lash Adjuster (Tappet) Noise Chart for Possible Causes and Correction of a lash adjuster (tappet) type noise.

ROCKER ARM / ADJUSTER ASSEMBLY (Continued)

POSSIBLE NOISE SOURCES	POSSIBLE NOISE MISDIAGNOSIS SOURCES
Spongy/soft/aerated lash adjusters.	SRV valve axle chatter.
Missing lash adjuster swivel contact pads.	Exhaust rocker arm-to-cylinder head cover contact.
Intake rocker-to-camshaft bearing journal contact.	Piston pin bore fit.
Rocker arm bind-up.	Timing drive hydraulic tensioner tick.
Intake rocker arm-to-spark plug tube contact.	Accessory drive belt deterioration.
Excessive cam end play.	Piston-to-bore clearance knock.
Broken valve spring.	Crankshaft bearing noise.
Broken/loose camshaft sprocket bolt.	
Incomplete cam lobe machining.	
Cracked lash adjuster cartridge body.	

LASH ADJUSTER (TAPPET) NOISE CHART

POSSIBLE CAUSES	CORRECTION
1. Engine oil level—too high or too low. This may cause aerated oil to enter the adjusters and cause them to be spongy.	1. Check and correct engine oil level.
2. Insufficient running time after rebuilding cylinder head.	2. Low speed running of up to 1 hour may be required to fully evacuate trapped air from the valve train system. During this time, turn engine off and let set for a few minutes before restarting. Repeat this several times after engine has reached normal operating temperature.
3. Air trapped in lash adjuster (after 1 hour run time).	3. See below: (a) Check lash adjusters for sponginess while installed in cylinder head. Depress part of rocker arm over adjuster. Normal adjusters should feel very firm. Very spongy adjusters can be bottomed out easily. (b) Before proceeding, perform Lash Adjuster Bleeding procedure. (c) If lash adjuster(s) are still spongy, replace with new adjuster/rocker arm assembly*.
4. Low oil pressure	4. See below: (a) Check and correct engine oil level. (b) Check engine oil pressure. (c) Check for excessive bearing clearance and correct. (d) Check for worn oil pump.
5. Oil passage to cylinder head(s) plugged with debris.	5. Check cylinder head oil passages and cylinder head gasket restrictor for blockage. Clean or replace as necessary.
6. Worn valve guide(s).	6. Ream guide(s) and replace valve(s) with oversize valves and seal(s).
7. Air injested into oil due to broken or cracked oil pump pickup tube.	7. Inspect pickup tube and replace as necessary.
8. Collapsed lash adjuster due to debris injestion.	8. Clean debris from engine and replace lash adjuster/rocker assembly*.
9. Intake rocker arm roller clevis ear(s) contacting camshaft bearing journal(s) on side.	9. Inspect camshaft end play and all valve train components for wear. Replace as necessary.
***Lash adjusters are serviced with the rocker arms—do not disassemble.**	

STANDARD PROCEDURE - HYDRAULIC LASH ADJUSTER BLEEDING

Use this procedure to manually bleed aerated oil from the lash adjuster and remove sponginess.

(1) Run the engine, bringing it to operating temperature in order to freshly pressurize and warm the valvetrain system oil supply.

(2) Remove cylinder head cover(s).

(3) Ensure the rocker arm is positioned on the base circle of the cam (Fig. 37). Rotate engine as necessary.

(4) For intake rocker arm positions:

(a) Adjust Special Tool 8351 Release Probe's gauge pin to extend approximately 20 mm (0.787 in.). Then, carefully insert the release probe gauge pin into the lash adjuster service access hole (Fig. 38).

CAUTION: If probe tip breaks off within the lash adjuster, replace the affected rocker arm.

(b) Gently unseat lash adjuster's internal check ball.

(c) While the internal check ball is held unseated, press the rocker arm into the valve tip, allowing the lash adjuster to fully collapse. Hold this fully collapsed position for about one second, or longer.

(d) Slowly release the rocker arm, thereby allowing the lash adjuster to extend, which in turn refills the high pressure chamber with non-aerated oil.

(e) Remove probe to allow check ball to seat.

(f) Recheck for sponginess. If the lash adjuster sponginess is not completely or nearly eliminated, then repeat procedure.

(g) If the spongy condition cannot be removed, replace effected rocker arm(s).

(5) For exhaust rocker arm positions:

(a) Adjust Special Tool 8351 Release Probe gauge pin to extend approximately 20 mm (0.787 in.). Then, using two release probes, carefully insert gauge pins into the lash adjuster service access holes (Fig. 38).

CAUTION: If probe tip breaks off within the lash adjuster, replace the affected rocker arm.

(b) Gently unseat BOTH lash adjuster's internal check ball at the same time.

(c) While the internal check ball is held unseated, press the rocker arm into the valve tip, allowing the lash adjuster to fully collapse. Hold this fully collapsed position for about one second, or longer.

(d) Slowly release the rocker arm, thereby allowing the lash adjuster to extend, which in turn refills the high pressure chamber with non-aerated oil.

(e) Remove probes to allow check balls to seat.

(f) Recheck for sponginess. If the lash adjuster sponginess is not completely or nearly eliminated, then repeat procedure.

(g) If the spongy condition cannot be removed, replace effected rocker arm(s).

(6) Install cylinder head cover(s).

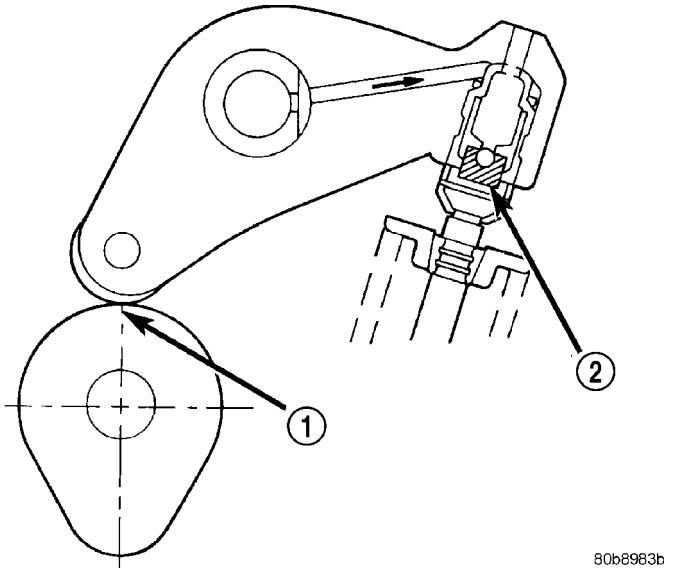


Fig. 37 Rocker Arm Positioned On Base Circle Of Camshaft

1 - CAMSHAFT BASE CIRCLE
2 - HIGH-PRESSURE CHAMBER

REMOVAL

CAUTION: The rocker arm shafts are hollow and are used as lubrication oil passages. The rocker arm and shaft assembly on the RIGHT side of the engine has an oil passage hole from the cylinder head to the third rocker shaft support. The rocker arm shaft assembly on the LEFT side of the engine has an oil passage hole from the cylinder head to the second rocker shaft support.

ROCKER ARM / ADJUSTER ASSEMBLY (Continued)

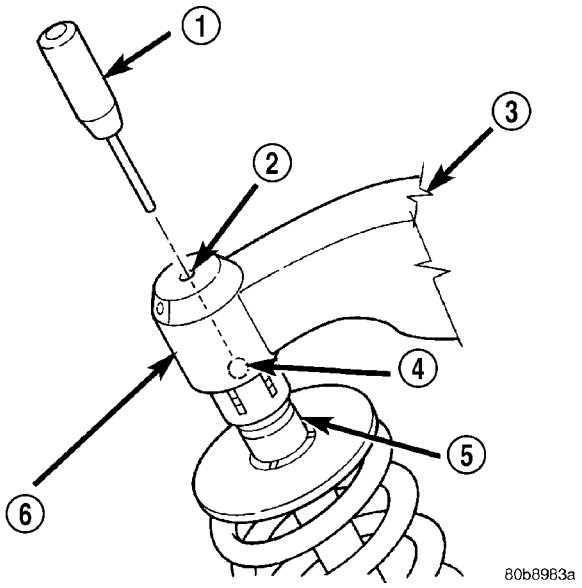


Fig. 38 Purging Air From Lash Adjuster

1 - SPECIAL TOOL 8351
2 - OIL AIR RELIEF SERVICE ACCESS HOLE
3 - ROCKER ARM ASSY
4 - INTERNAL CHECK BALL
5 - VALVE TIP
6 - HYDRAULIC LASH ADJUSTER WITHIN ROCKER ARM

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

(2) Identify the rocker arm assembly and rocker arms before disassembly (Fig. 39).

(3) Remove rocker arm assembly bolts.

(4) Remove rocker arm assembly.

NOTE: To prevent air ingestion into lash adjusters, avoid turning rocker arm assembly upside down.

CAUTION: Do not allow rocker arm assembly to rest on lash adjusters, as damage may occur to lash adjusters and/or plastic retainers.

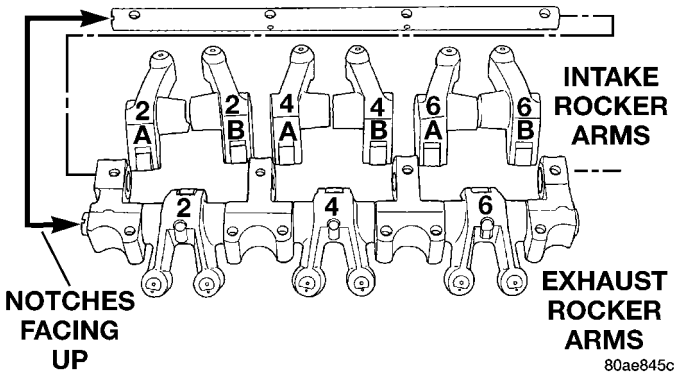


Fig. 39 Rocker Arms and Shafts

DISASSEMBLY

(1) Remove rocker arm and shafts. (Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - REMOVAL)

(2) Remove dowel pin using a 4 mm screw, nut, spacer, and washer installed into the pin (Fig. 40). Thread the screw into the pin, then loosen the nut on the screw. This will pull the dowel out of the shaft support. Do not reuse dowel pins. Remove the rocker arms and pedestals in order.

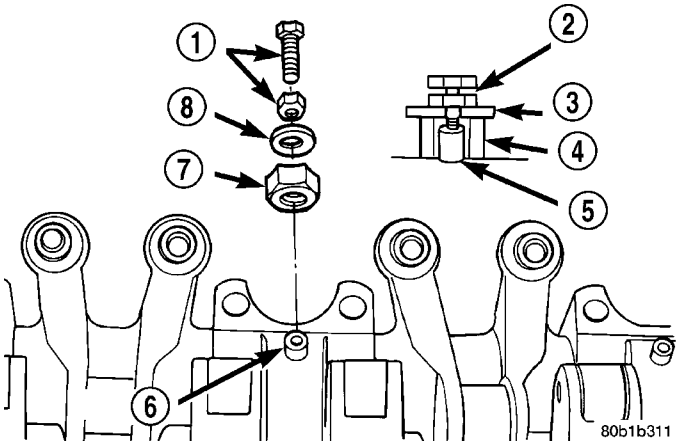


Fig. 40 Rocker Arms and Shaft - Disassembly

1 - 4mm SCREW AND NUT
2 - 4mm SCREW AND NUT
3 - WASHER
4 - SPACER
5 - DOWEL
6 - DOWEL
7 - SPACER
8 - WASHER

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

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

INSPECTION

The rocker arm shafts are hollow and are used as lubrication oil ducts. The rocker arm and shaft assembly on the **right** side of the engine has an oil passage hole from the cylinder head located at the third rocker shaft support pedestal. The rocker arm and shaft assembly on the **left** side of the engine has an oil passage hole from the cylinder head located at the second rocker shaft support pedestal.

NOTE: To prevent air ingestion into lash adjusters, avoid turning rocker arm assembly upside down.

CAUTION: Do not allow rocker arm assembly to rest on lash adjusters, as damage may occur to lash adjuster and plastic retainer.

ROCKER ARM / ADJUSTER ASSEMBLY (Continued)

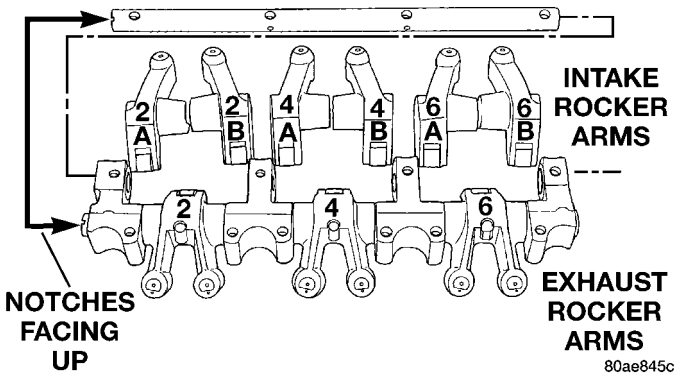


Fig. 41 Rocker Arms and Shafts

The intake and exhaust rocker arms are different. They should be identified before disassembling the assembly (Fig. 41).

Check rocker arms for wear or damage (Fig. 42):

- Roller scuffing or wear
- Shaft bore scuffing or wear
- Swivel pad on lash adjuster missing or broken
- Rocker arm showing signs of fatigue or cracking
- Roller axle protruding from arm

Replace assembly as necessary if any rocker arms shows signs of wear.

CAUTION: Do Not remove lash adjuster from rocker arm assembly. Damage to the adjuster and rocker arm will result.

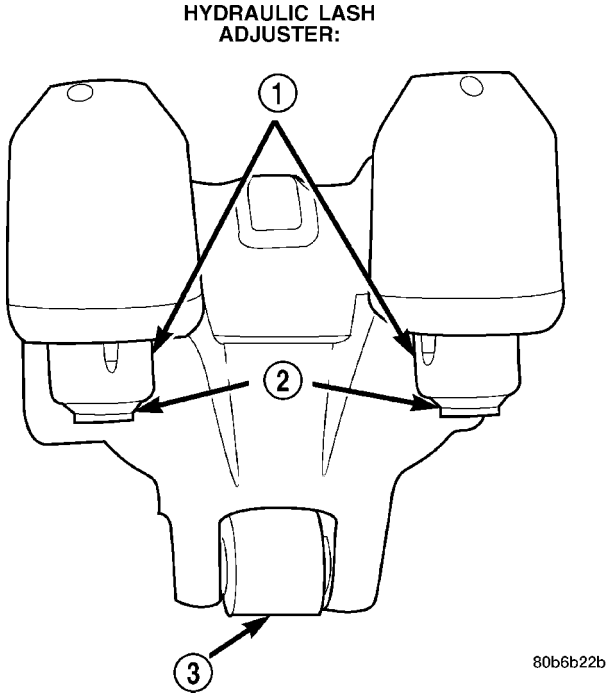


Fig. 42 Rocker Arm Assembly

1 - RETAINER
2 - SWIVEL PAD
3 - ROLLER

ASSEMBLY

CAUTION: New dowel pins must be installed when reassembling.

(1) Install the rocker arms, and pedestals onto the shaft.

(2) Install dowel pins (Fig. 43). Dowel pins pass through the pedestal into the exhaust rocker shafts. Dowel pins should be pressed in until they bottom-out against the rocker shaft in the pedestal.

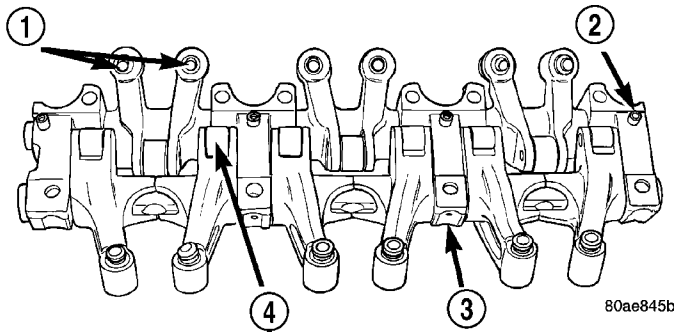


Fig. 43 Assemble Rocker Arms and Shaft

1 - HYDRAULIC LASH ADJUSTERS
2 - DOWEL PIN
3 - PEDESTAL
4 - ROLLER

(3) Install rocker arm and shafts. (Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - INSTALLATION)

INSTALLATION

NOTE: Rocker arm and shaft assembly can be installed either prior to or after (preferred) cylinder head installation.

(1) Rotate camshafts to the position shown in (Fig. 44). With the camshafts in these positions the lobes are in a neutral position (no load to the valve). This will allow the rocker arm shaft assembly to be tightened into position with little or no valve spring load on it.

(2) Install the rocker arm and shaft assembly making sure that the identification marks face toward the front of engine for left head and toward the rear of the engine for right head.

(3) Tighten rocker arm/shaft assembly bolts in sequence to 31 N·m (275 in. lbs.) (Fig. 45).

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

ROCKER ARM / ADJUSTER ASSEMBLY (Continued)

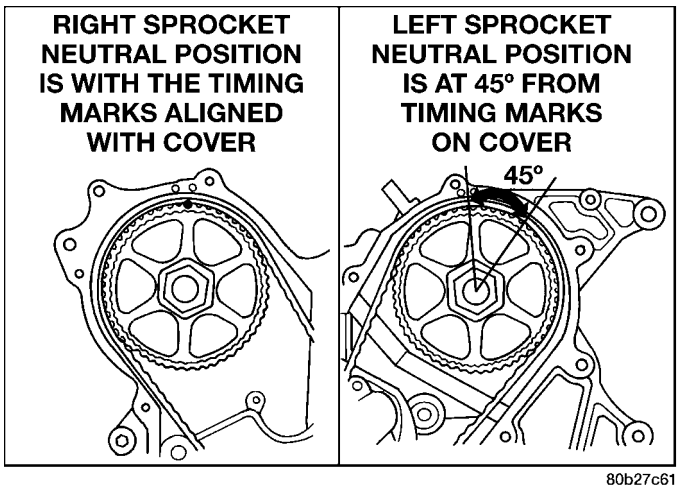


Fig. 44 Camshaft Sprockets Neutral Position

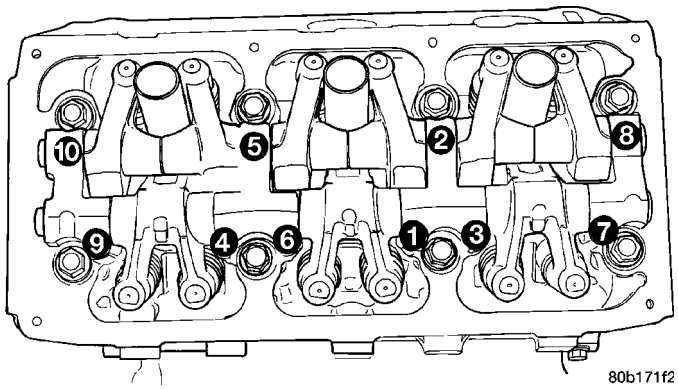


Fig. 45 Rocker Arm and Shaft Assembly Tightening Sequence

SPARK PLUG TUBE

REMOVAL

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

(2) Using suitable locking pliers, remove the tube from the cylinder head (Fig. 46) and discard tube.

(3) Clean area around spark plug with Mopar® Parts Cleaner or equivalent.

INSTALLATION

(1) Apply Mopar® Stud and Bearing Mount to a new tube approximately 1 mm (0.039 in.) from the end of tube, in a 3 mm (0.118 in.) wide area.

(2) Install sealer end of tube into the cylinder head. Then carefully install the tube using a hard-wood block and mallet. Install the tube until it is seated into the bottom of the bore.

(3) For spark plug tube seal replacement, (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

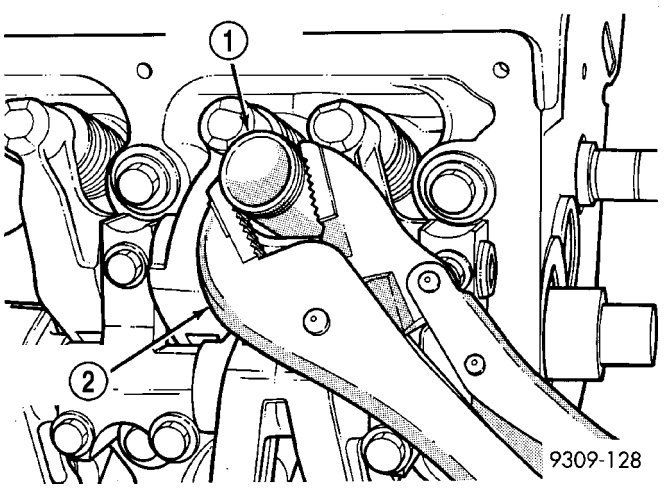


Fig. 46 Servicing Spark Plug Tubes

1 - SPARK PLUG TUBE
2 - LOCKING PLIERS

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

VALVE STEM SEALS

REMOVAL

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

(2) Remove valve stem seals by using a valve stem seal tool (Fig. 47).

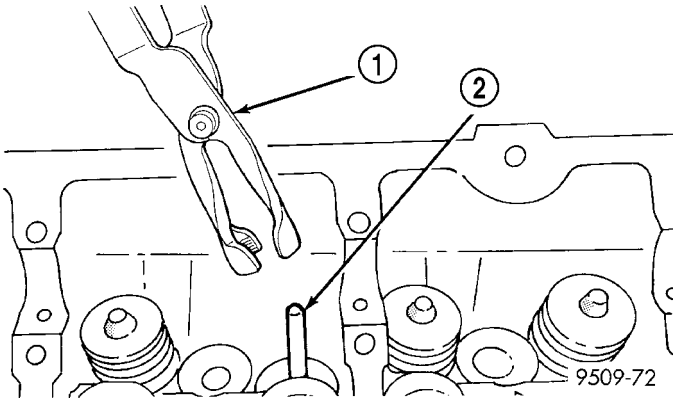


Fig. 47 Valve Stem Seal - Removal

1 - VALVE SEAL TOOL
2 - VALVE STEM

INSTALLATION

(1) The valve stem seal/valve spring seat should be pushed firmly and squarely over the valve guide using the 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.

VALVE STEM SEALS (Continued)

CAUTION: Do not remove garter spring around the seal at the top of the valve stem seal (Fig. 48).

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

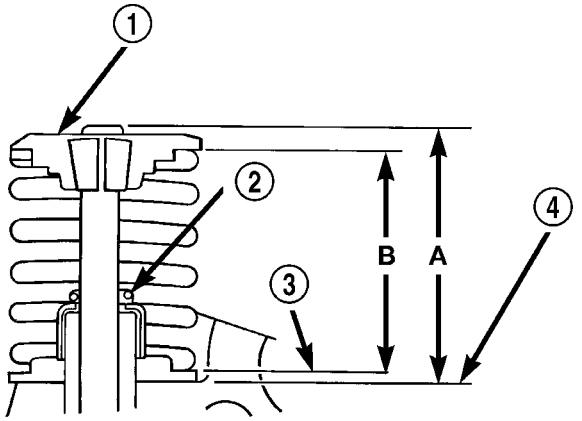


Fig. 48 Checking Valve Tip Height and Valve Spring Installed Height

1 - SPRING RETAINER
2 - GARTER SPRING
3 - VALVE SPRING SEAT TOP
4 - CYLINDER HEAD SURFACE

VALVE SPRINGS

DESCRIPTION

The valve springs are made from chrome silicon alloy wire and incorporate a “bee-hive” design. Valve spring retainers and locks are common from valve-to-valve. The valve spring seat is integral with the valve stem oil seal, which incorporates a garter spring to maintain consistent lubrication control to the valve stem.

The valve springs are unique for intake compared to exhaust. Both have different lengths and are wound in opposite directions. The valve springs are color coded, intake spring is right hand coil direction with orange dye on the top coils, and the exhaust spring is left hand coil direction with a yellow dye on the top coils (Fig. 49).

REMOVAL

REMOVAL - CYLINDER HEAD OFF

(1) Using Special Tool C-3422–D (valve spring compressor) with Adapter 6526 compress valve spring and remove valve retaining locks. For Special Tool identification, (Refer to 9 - ENGINE - SPECIAL TOOLS).

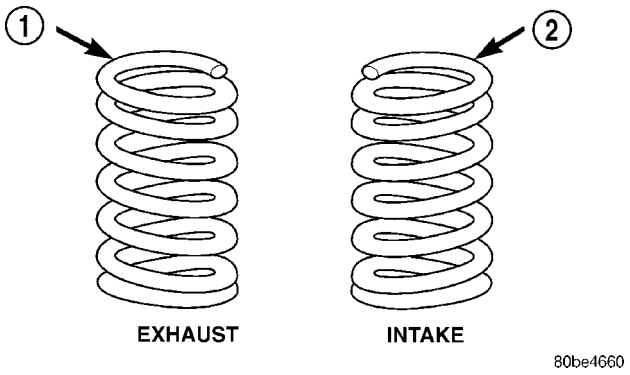


Fig. 49 Valve Spring Identification

1 - YELLOW DYE
2 - ORANGE DYE

(2) Slowly release valve spring compressor.Remove valve spring retainer and valve spring.

(3) Remove valve stem seal assembly (Refer to 9 - ENGINE/CYLINDER HEAD/VALVE STEM SEALS - REMOVAL).

REMOVAL - CYLINDER HEAD ON

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

(2) Disconnect negative cable from battery.

(3) Remove air cleaner housing and hose assembly.

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

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

(6) Remove rocker arm and shaft assembly. (Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - REMOVAL)

(7) Remove spark plugs. (Refer to 8 - ELECTRICAL/IGNITION CONTROL/SPARK PLUG - REMOVAL)

(8) Rotate the crankshaft clockwise, until the number 1 piston is at TDC (Top Dead Center) on the compression stroke.

(9) With air hose attached to spark plug adapter installed in number 1 spark plug hole, apply 620.5 to 689 kPa (90 to 100 psi) air pressure. This is to hold valves into place while servicing components.

(10) Using Tool MD 998772A with adapter 6527 or equivalent, compress valve spring and remove valve locks, retainer, and valve spring.

(11) Remove valve stem seal, if required. (Refer to 9 - ENGINE/CYLINDER HEAD/VALVE STEM SEALS - REMOVAL)

(12) Follow the same procedure on the remaining 5 cylinders using the firing sequence 1-2-3-4-5-6. **Make**

VALVE SPRINGS (Continued)

sure piston is at TDC in each cylinder of the valve spring that is being removed.

(13) Remove spark plug adapter tool.

INSPECTION

When valves have been removed for inspection, reconditioning or replacement, valve springs should be tested (Fig. 50). **As an example;** the compression length of the spring to be tested is 38.00 mm (1.496 in.). Turn table of Tool C-647 until surface is in line with the 38.00 mm (1.496 inches.) 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 springs that do not meet specifications.

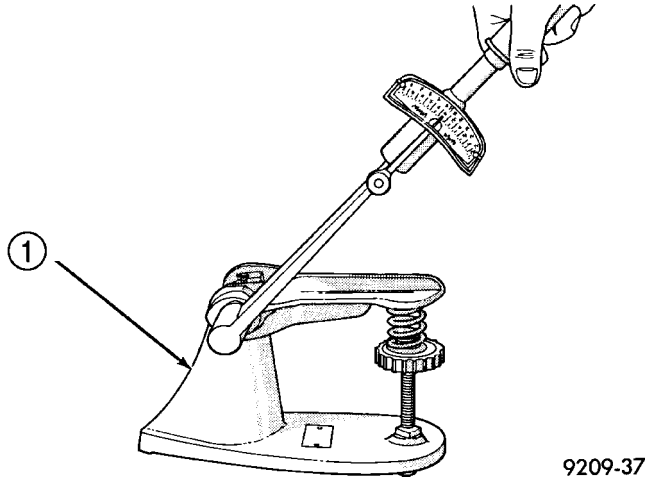


Fig. 50 Testing Valve Spring

1 - SPECIAL TOOL C-647

INSTALLATION

INSTALLATION - CYLINDER HEAD OFF

(1) Install valves if removed.

(2) Install valve stem seal/spring seat assembly over valve guides on all valve stems (Fig. 52). Ensure that the garter spring is intact around the top of the rubber seal.

(3) Place valve spring (color-coded end facing up) and valve retainer into position.

(4) Compress valve spring with valve spring compressor. Install locks and release tool. **If valves and/or seats are reground, measure the installed height of springs (B) (Fig. 51), make sure measurements are taken from top of spring seat to the bottom surface of spring retainer**. If height is greater than 38.75 mm (1.5256 in.), install a 0.762 mm (0.030 in.) spacer in head counterbore under the valve spring seat to bring spring height back within specification.

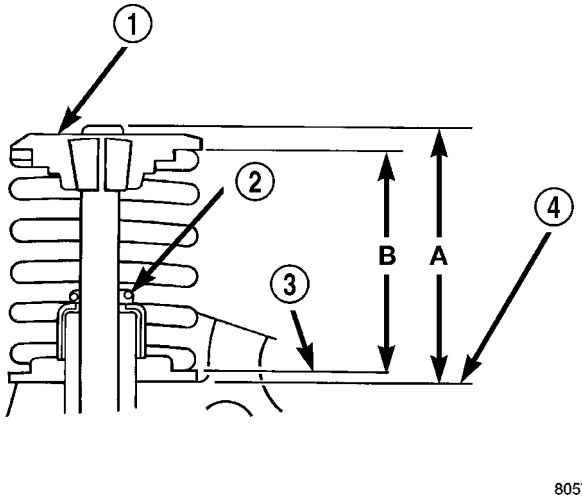


Fig. 51 Checking Valve Tip Height and Valve Spring Installed Height

1 - SPRING RETAINER
2 - GARTER SPRING
3 - VALVE SPRING SEAT TOP
4 - CYLINDER HEAD SURFACE

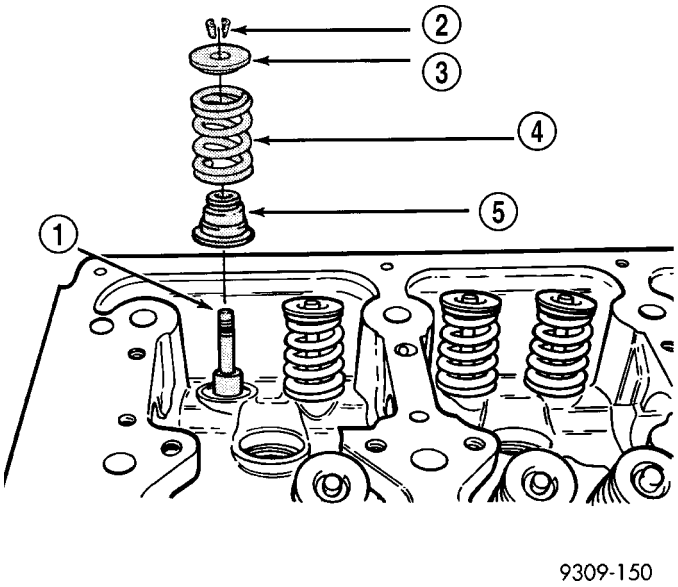


Fig. 52 Valve, Spring, and Valve Seal

1 - VALVE
2 - VALVE RETAINING LOCKS
3 - VALVE SPRING RETAINER
4 - VALVE SPRING
5 - VALVE SEAL AND VALVE SPRING SEAT ASSEMBLY

VALVE SPRINGS (Continued)

INSTALLATION - CYLINDER HEAD ON

(1) Compress valve spring using Special Tool MD 998772A with Adaptor 6527 only enough to install retainer and locks.

(2) After installing locks, release tension on valve spring and verify proper installation.

(3) Remove Special Tool MD 998772A.

(4) Install rocker arm and shaft assembly. (Refer to 9 - ENGINE/CYLINDER HEAD/ROCKER ARM / ADJUSTER ASSY - INSTALLATION)

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

(6) Install spark plugs. (Refer to 8 - ELECTRICAL/ IGNITION CONTROL/SPARK PLUG - INSTALLATION)

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

(8) Connect negative cable.

ENGINE BLOCK

DESCRIPTION

The cylinder block (Fig. 53) is made of heat treated aluminum with cast-in-place iron liners. The block is a closed deck design with the right bank forward. To provide high rigidity and improved NVH, the block has cast-in contours and ribs, along with powdered metal 6 bolt main caps (4 vertical, 2 horizontal), with a die cast aluminum structural beam windage tray mounted to the main caps.

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.

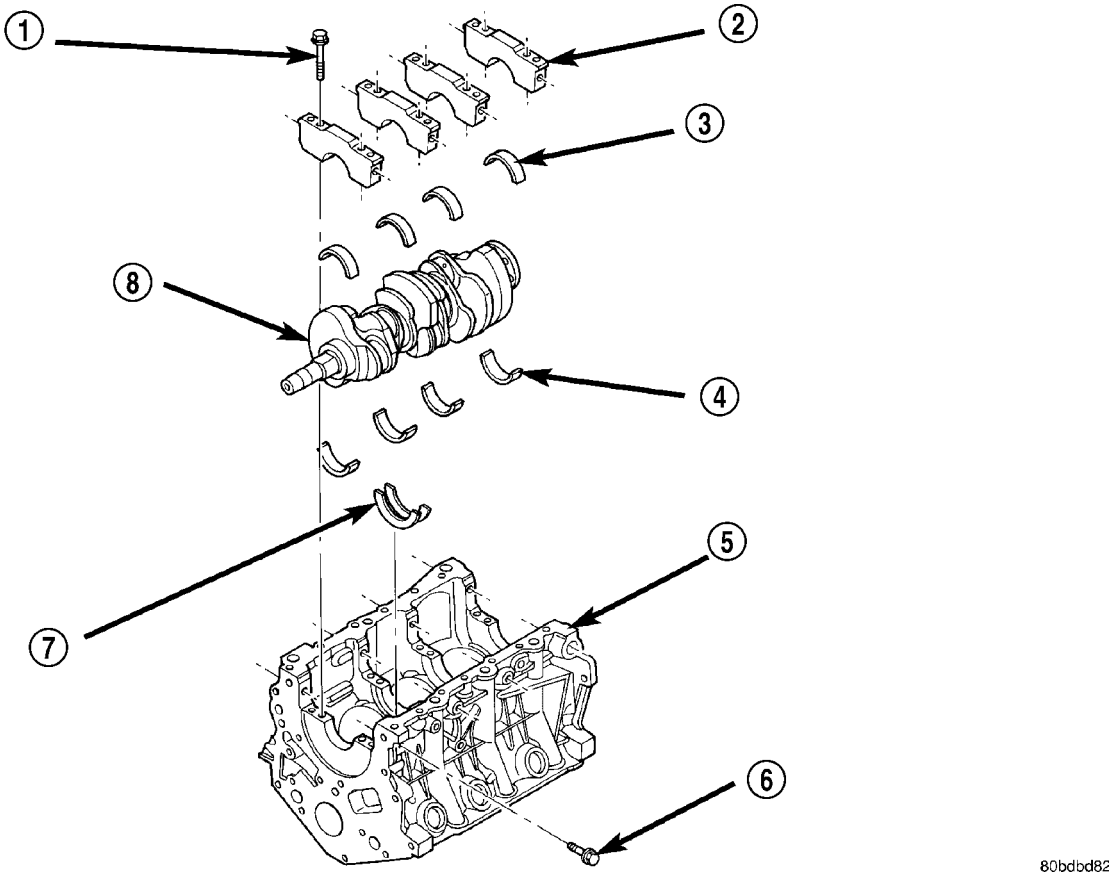


Fig. 53 ENGINE BLOCK AND CRANKSHAFT

1 - MAIN CAP BOLT - VERTICAL
2 - MAIN CAP
3 - MAIN BEARING - LOWER
4 - MAIN BEARING - UPPER
5 - CYLINDER BLOCK
6 - MAIN CAP BOLT - HORIZONTAL
7 - CRANKSHAFT THRUST WASHER
8 - CRANKSHAFT

ENGINE BLOCK (Continued)

(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. 54).

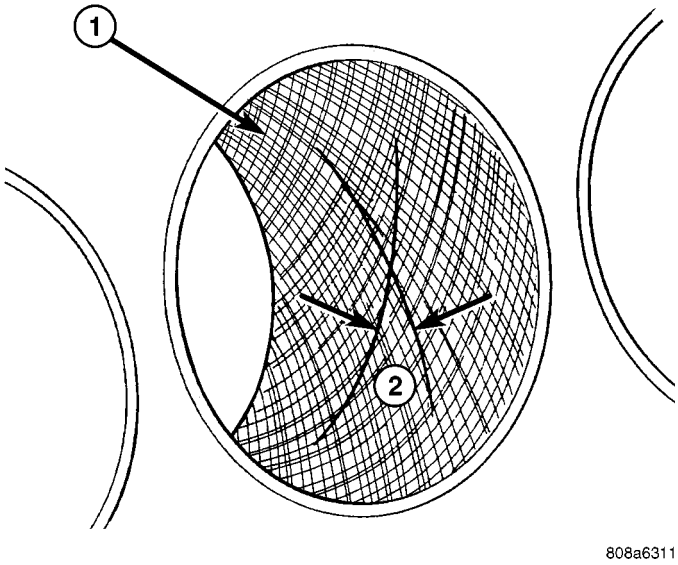


Fig. 54 Cylinder Bore Cross-Hatch Pattern

1 - CROSS-HATCH PATTERN
2 - 40°–60°

(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.

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. 55) (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.

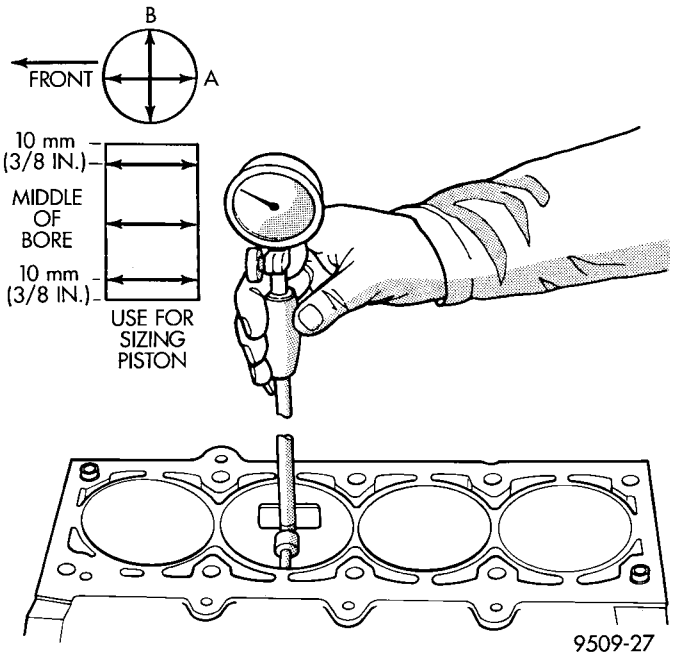


Fig. 55 Checking Cylinder Bore Size

Measure the cylinder bore at three levels in directions A and B (Fig. 55). 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).

CONNECTING ROD BEARINGS

STANDARD PROCEDURE - CONNECTING RODS AND BEARINGS

CONNECTING ROD BEARINGS

The bearing caps are not interchangeable and should be marked at removal to insure correct assembly.

The bearing shells must be installed with the tangs inserted into the machined grooves in the rods and caps. Install cap with the tangs on the same side as the rod.

Fit all rods on one bank until complete.

Limits of taper or out-of-round on any crankshaft journals should be held to 0.015 mm (0.0006 in.). Bearings are available in standard, 0.025 mm (0.001 in.), and 0.254 mm (0.010 in.) undersizes. **Install the bearings in pairs. Do not use a new bearing half with an old bearing half. Do not file the rods or bearing caps.**

(1) For measuring main bearing clearance and connecting rod bearing clearance use plastigage (Fig. 56). For more information on using plastigage (Refer to 9 - ENGINE - STANDARD PROCEDURE). Refer to Engine Specifications for bearing clearance specifications (Refer to 9 - ENGINE - SPECIFICATIONS).

NOTE: The rod bearing bolts should be examined before reuse. If the threads are necked down the bolts must be replaced (Fig. 57).

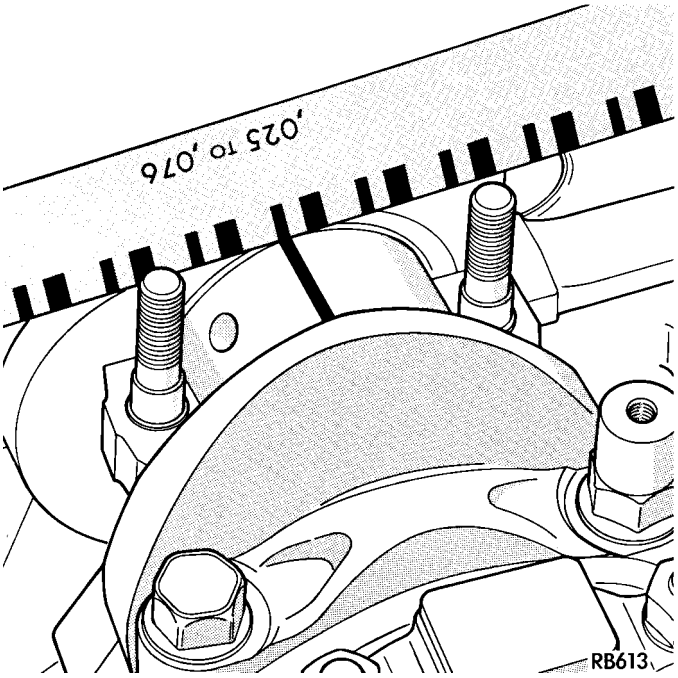


Fig. 56 CHECKING CONNECTING ROD BEARING

CONNECTING ROD BOLTS

(1) Examine connecting rod bolts for stretching. Stretching 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.

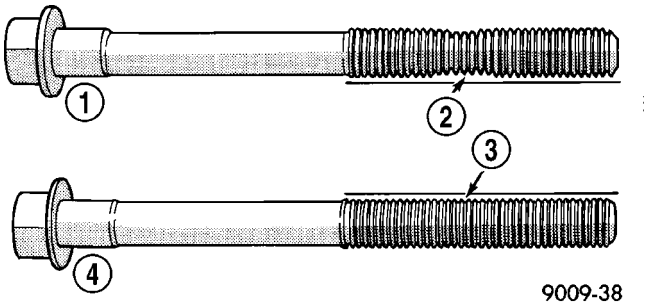


Fig. 57 CHECK FOR STRETCHED BOLTS

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

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

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

(4) Tighten the connecting rod cap nuts to specifications. (Refer to 9 - ENGINE - SPECIFICATIONS)

CONNECTING ROD SIDE CLEARANCE

(1) Mount a dial indicator to a stationary point on engine. Locate probe perpendicular to and resting against the connecting rod cap being checked. Move connecting rod all the way to rear of its travel. Zero the dial indicator. Move connecting rod forward to limit of travel and read the dial indicator (Fig. 58). Compare measurement to specification listed in engine specifications (Refer to 9 - ENGINE - SPECIFICATIONS). Repeat procedure for each connecting rod. Turn crankshaft for connecting rod accessibility.

CRANKSHAFT

DESCRIPTION

The crankshaft (Fig. 53) is constructed of a forged micro alloy steel. A six throw, nine counterweight crankshaft is supported by four select fit main bearings with number two serving as the thrust washer location. The six separate connecting rod throws are an even-firing design which reduces torque fluctuations while a torsional vibration damper is used to control torsion caused vibration of the crankshaft. Rubber lipped seals are used at front and rear. The front seal is retained in the oil pump case and the rear seal is retained in a block-mounted housing.

CRANKSHAFT (Continued)

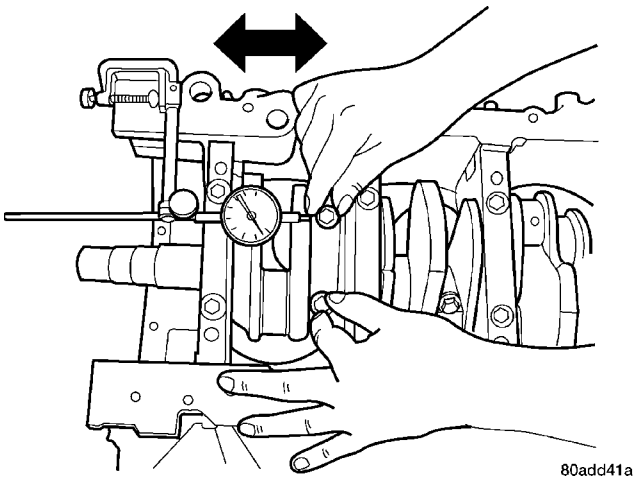


Fig. 58 CONNECTING ROD SIDE CLEARANCE

STANDARD PROCEDURE - CRANKSHAFT END PLAY

(1) Using Dial Indicator C-3339 and Mounting Post L-4438, attach to front of engine, locating probe perpendicular on nose of crankshaft (Fig. 59).

(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 Engine Specifications.

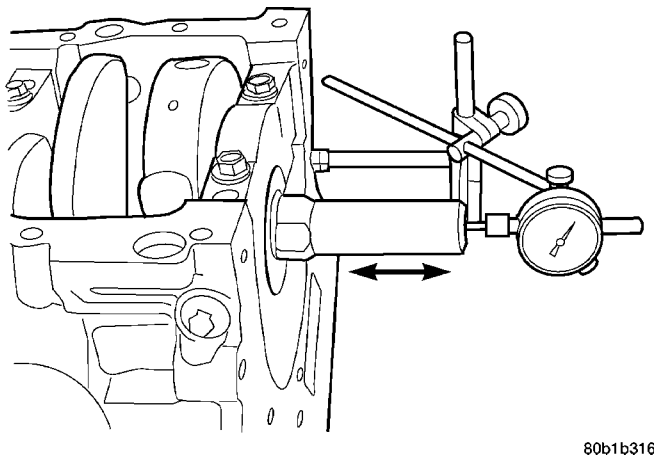


Fig. 59 Checking Crankshaft End Play

REMOVAL

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

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

(3) Remove oil pickup tube.

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

(5) Remove idler pulley for accessory drive belt.

(6) Remove front lower timing belt cover.

(7) Remove front main timing belt cover.

(8) Remove front left side timing belt cover.

(9) Remove timing belt tensioner and timing belt.

(10) Remove crankshaft sprocket. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL)

(11) Tap dowel pin out of crankshaft.

(12) Remove oil pump assembly.

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

(14) Remove connecting rod bearing caps. Connecting rod bearing caps are not interchangeable and should be marked before removal to insure correct assembly (Fig. 60).

(15) Remove main bearing caps. Main bearing caps are not interchangeable and are marked to insure correct assembly (Fig. 61).

(16) Remove crankshaft from cylinder block (Fig. 62).

NOTE: Before installing crankshaft, refer to Fitting Main Bearings and Installation of Connecting Rod Bearings. (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT MAIN BEARINGS - STANDARD PROCEDURE) (Refer to 9 - ENGINE/ENGINE BLOCK/CONNECTING ROD BEARINGS - STANDARD PROCEDURE)

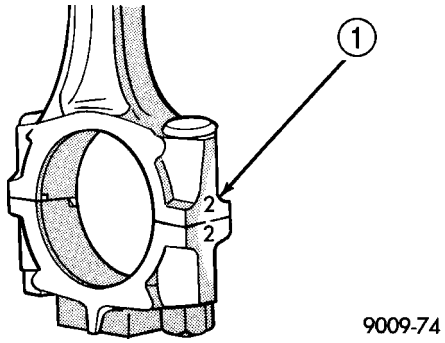


Fig. 60 CONNECTING ROD TO CYLINDER IDENTIFICATION

1 - CYLINDER NUMBER

INSPECTION

The crankshaft journals should be checked for excessive wear, taper and scoring. Limits of taper or out-of-round on any crankshaft journals should be held to 0.015 mm (0.0006 in.). Journal grinding should not exceed 0.305 mm (0.012 in.) under the standard journal diameter. DO NOT grind thrust faces of Number 2 main bearing. DO NOT nick crank pin or bearing fillets. After grinding, remove rough edges from crankshaft oil holes and clean out all passages.

CRANKSHAFT (Continued)

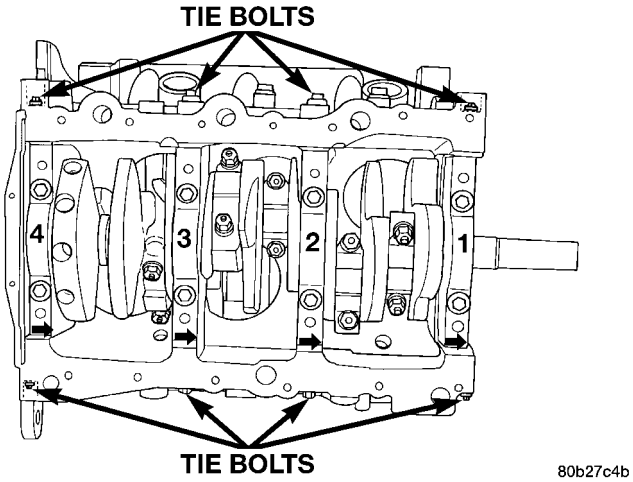


Fig. 61 MAIN BEARING CAP IDENTIFICATION

CAUTION: With a forged steel crankshaft it is important that the final paper or cloth polish after any journal regrind be in the same direction as normal rotation in the engine.

INSTALLATION

CAUTION: Main bearings are select fit. (Refer to 9 - ENGINE/ENGINE BLOCK/CONNECTING ROD BEARINGS - STANDARD PROCEDURE)

(1) Install crankshaft main bearings (Fig. 63). (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT MAIN BEARINGS - STANDARD PROCEDURE)

(2) Install the crankshaft to cylinder block. (Fig. 62)

(3) Move crankshaft forward to limit of travel. Lubricate and install the front thrust washer by rolling the washer onto the machined shelf between the No. 2 upper main bulk head and crankshaft thrust surface (Fig. 64).

(4) Move crankshaft rearward to limit of travel. Lubricate and install the rear thrust washer by rolling the washer onto the machined shelf between the No. 2 upper main bulk head and crankshaft thrust surface.

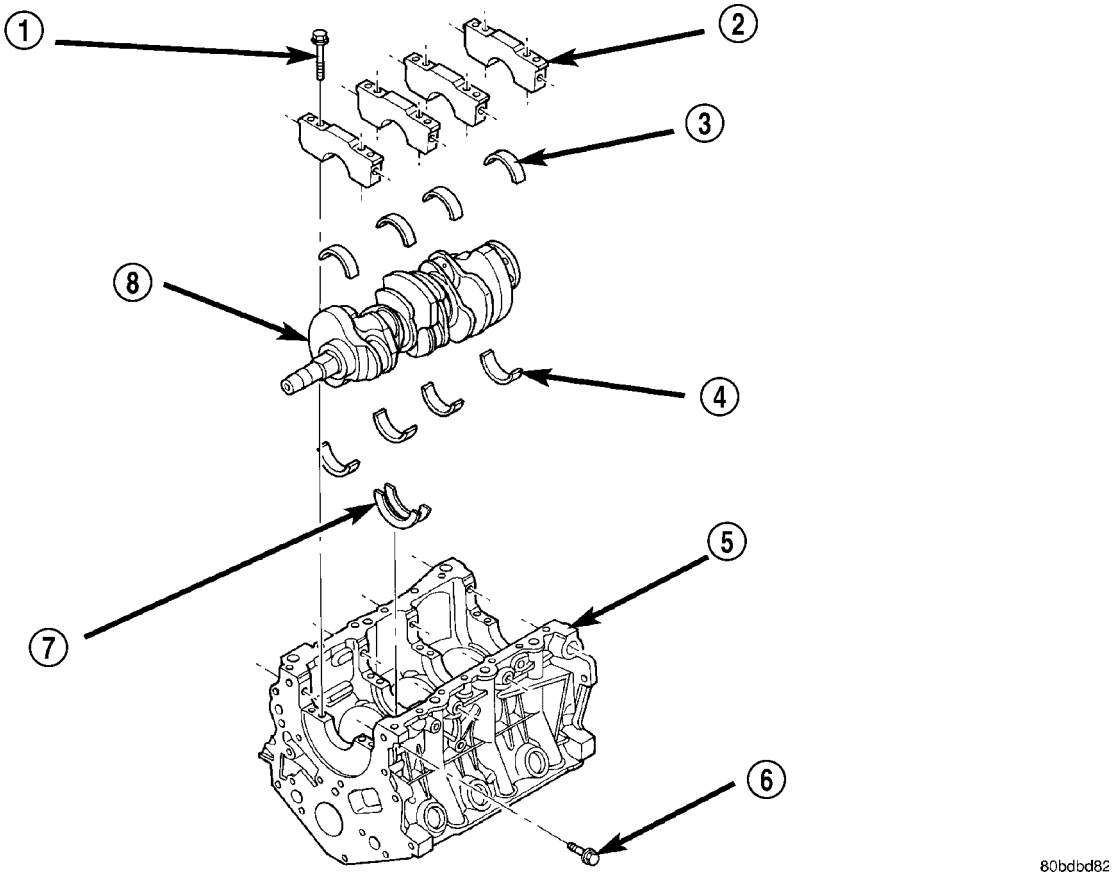


Fig. 62 ENGINE BLOCK AND CRANKSHAFT

1 - MAIN CAP BOLT - VERTICAL
2 - MAIN CAP
3 - MAIN BEARING - LOWER
4 - MAIN BEARING - UPPER
5 - CYLINDER BLOCK
6 - MAIN CAP BOLT - HORIZONTAL
7 - CRANKSHAFT THRUST WASHER
8 - CRANKSHAFT

CRANKSHAFT (Continued)

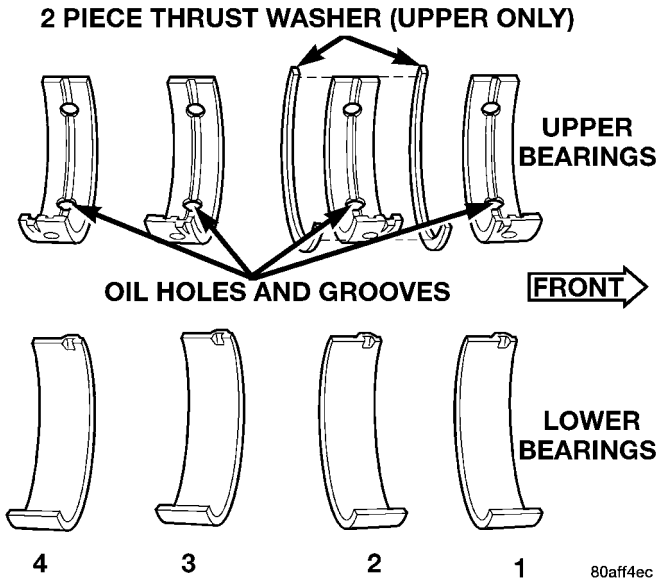


Fig. 63 Main Bearing Identification

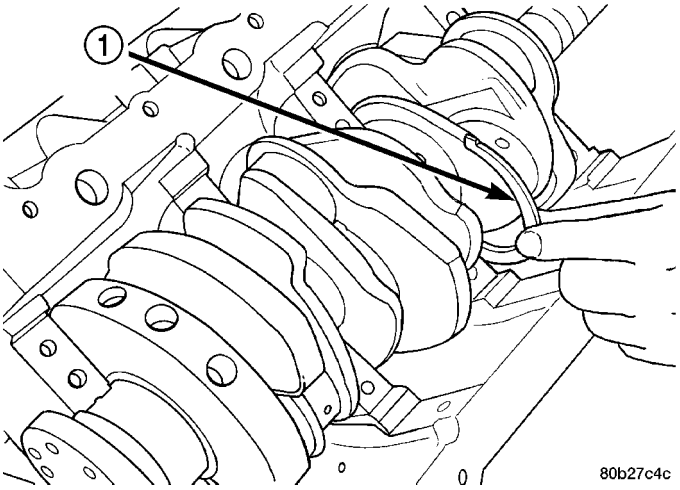


Fig. 64 Thrust Washer Installation

1 - FRONT THRUST WASHER

(5) Lubricate lower main bearings with clean engine oil.

NOTE: Lubricate main bearing cap bolts with engine oil before installation.

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

The main bearing cap bolts must be tightened in the proper sequence. First the inner main cap bolts, secondly the windage tray bolts, lastly the main cap tie (horizontal) bolts.

(7) Install the inside main bearing cap bolts and tighten to 20 N·m + 1/4 turn (15 ft. lbs. + 1/4 turn).

(8) Measure crankshaft end play. (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT - STANDARD PROCEDURE)

(9) Install connecting rods and measure side clearance. (Refer to 9 - ENGINE/ENGINE BLOCK/CONNECTING ROD BEARINGS - STANDARD PROCEDURE)

(10) Install windage tray. Lubricate bolts with engine oil and tighten to 27 N·m + 1/4 turn (20 ft. lbs. + 1/4 turn).

(11) Install the main cap tie (horizontal) bolts and tighten to 28 N·m (250 in. lbs.).

(12) Install rear crankshaft oil seal retainer and oil seal. (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT REAR OIL SEAL RETAINE - INSTALLATION) (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT OIL SEAL - REAR - INSTALLATION)

(13) Install oil pump assembly. (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - INSTALLATION)

(14) Install dowel pin in crankshaft. (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT OIL SEAL - FRONT - INSTALLATION)

(15) Install crankshaft sprocket. Refer to Front Crankshaft Oil Seal Removal and Installation for procedure.

(16) Install camshaft sprockets and timing belt. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION)

(17) Install timing belt covers. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION)

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

(19) Install idler pulley for accessory drive belt.

(20) Install oil pickup tube and tighten bolt to 28 N·m (250 in. lbs.).

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

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

(23) Fill engine crankcase with proper amount of oil.

CRANKSHAFT MAIN BEARINGS

STANDARD PROCEDURE - CRANKSHAFT MAIN BEARING FITTING

The main bearings are a “select fit” to achieve proper oil clearances. For main bearing selection, the block and crankshaft have grade identification marks.

CRANKSHAFT MAIN BEARINGS (Continued)

The marks for the cylinder block main bore grade are located on the left side pan rail, just rear of the left engine mount bracket (Fig. 65). These grade marks (1, 2, or 3) are read left to right, corresponding to main bore 1, 2, 3, 4.

The grade marks for the crankshaft are located on the rearmost crankshaft counter weight as shown in (Fig. 66). The crankshaft journal grade marks (A, B, or C) are read left to right, corresponding with journal number 1, 2, 3, 4.

Refer to the MAIN BEARING SELECTION CHART—3.2/3.5L to properly select the main bearings. For an example, if the main bore grade is 3 and the journal grade is B, the proper select fit bearing would be a (2) +0.003 mm (+0.0002 in.).

NOTE: Service main bearings have a number from (1–5) marked in ink on the bearing surface (Fig. 67). For verification, refer to the MAIN BEARING SELECTION CHART—3.2/3.5L for number to size identification.

The upper main bearing has a oil feed hole and a center groove to allow lubrication of the main journal and must be properly positioned in the block.

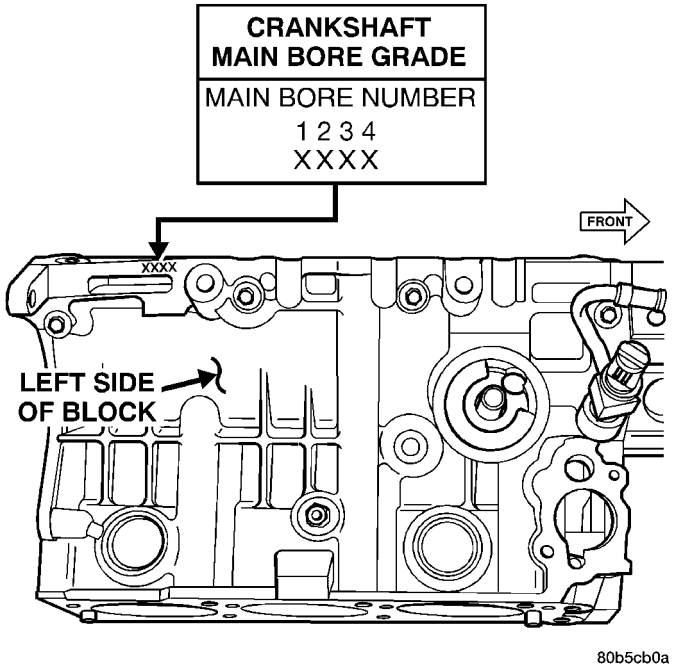


Fig. 65 Cylinder Block Main Bore Grade Marking Location

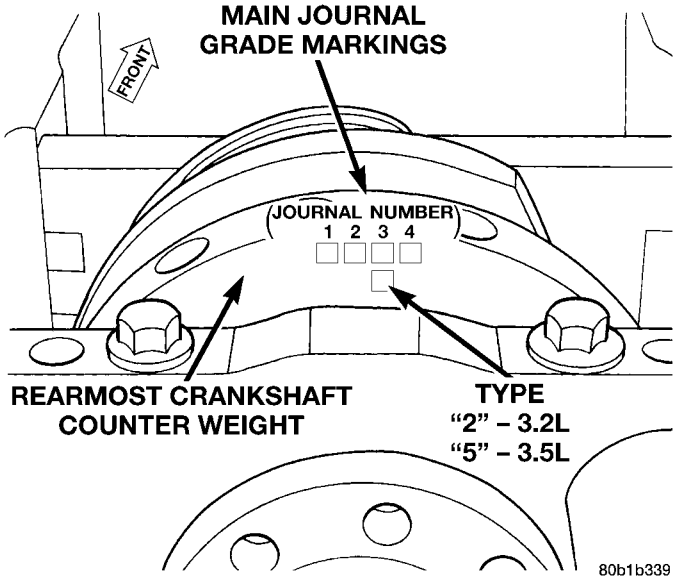


Fig. 66 Crankshaft Main Journal Grade Marking Location - Rear Of Block (Inverted) View

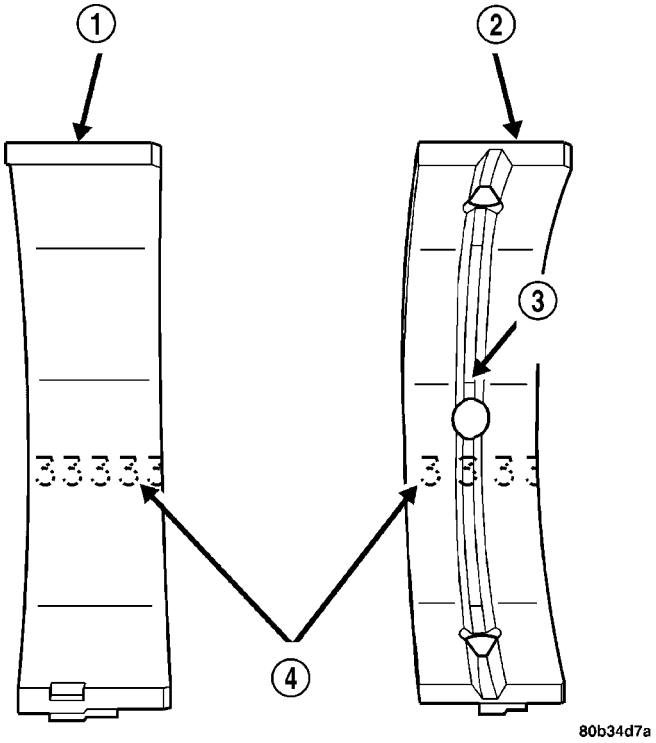


Fig. 67 Main Bearing Grade Marks

1 - LOWER MAIN BEARING
2 - UPPER MAIN BEARING
3 - OIL FEED HOLE AND GROOVE
4 - GRADE SELECTION INK MARKS

CRANKSHAFT MAIN BEARINGS (Continued)

MAIN BEARING SELECTION CHART—3.2/3.5L

		Main Bearing Bore Grade Marks		
		1	2	3
Crankshaft Main Journal Grade Marks	A	(3) standard	(2) +003 mm (+0.0002 in.)	(1) +0.006 mm (+0.0003 in.)
	B	(4) -0.003 mm (-0.0002 in.)	(3) standard	(2) +003 mm (+0.0002 in.)
	C	(5) -0.006 mm (-0.0003 in.)	(4) -0.003 mm (-0.0002 in.)	(3) standard

REMOVAL

Bearing caps are not interchangeable and are marked to insure correct assembly (Fig. 68). Upper and lower bearing halves are NOT interchangeable.

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

(2) Remove oil pick-up tube and windage tray.

(3) Identify bearing caps before removal (Fig. 68).

(4) Remove bearing caps one at a time. Remove upper half of bearing by inserting Special Main Bearing Tool C-3059 (Fig. 69) into the oil hole of crankshaft.

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

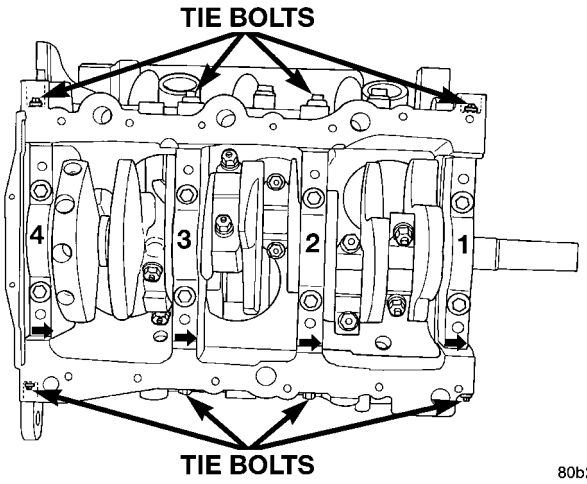


Fig. 68 Main Bearing Cap Identification

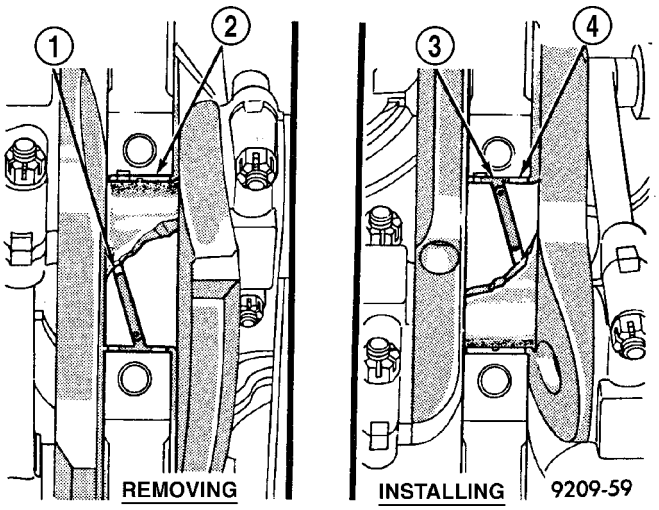


Fig. 69 Removing and Installing Upper Main Bearing With Special Tool C- 3059

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

INSTALLATION

Bearing caps are not interchangeable and are marked to insure correct assembly. Upper and lower bearing halves are NOT interchangeable (Fig. 70).

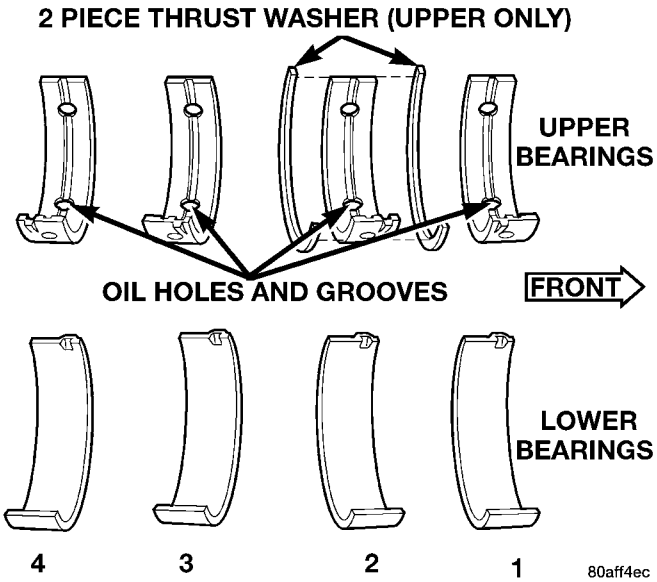


Fig. 70 Main Bearing Cap Identification

CAUTION: Main bearings are select fit. (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT MAIN BEARINGS - STANDARD PROCEDURE)

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

CRANKSHAFT MAIN BEARINGS (Continued)

When installing a new upper bearing shell, slightly chamfer the sharp edges from the plain side.

(1) Lubricate main bearing with clean engine oil.

(2) Start bearing in place, and insert Main Bearing Tool C-3059 into oil hole of crankshaft (Fig. 69).

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

NOTE: Lubricate main bearing cap bolts with engine oil before installation.

(4) Lubricate and install lower bearing half and main cap Tighten bolts finger tight.

(5) For installing thrust washers at the No. 2 main bearing location, use the following procedure:

(a) Move crankshaft forward to limit of travel. Lubricate and install the front thrust washer by rolling the washer onto the machined shelf between the No. 2 upper main bulk head and crankshaft thrust surface (Fig. 71).

(b) Move crankshaft rearward to limit of travel. Lubricate and install the rear thrust washer by rolling the washer onto the machined shelf between the No. 2 upper main bulk head and crankshaft thrust surface.

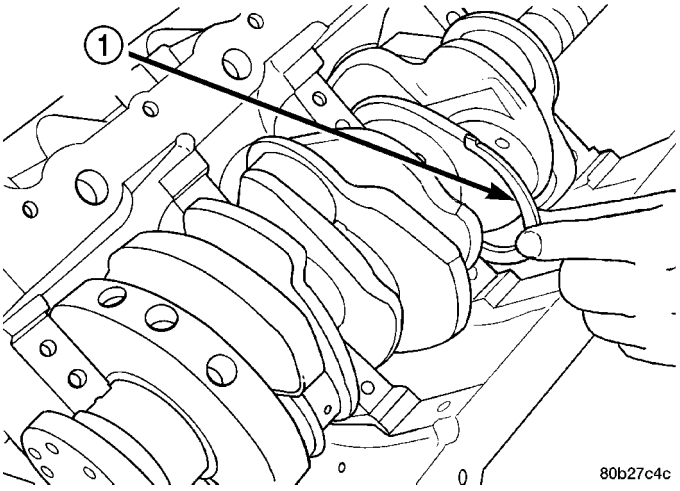


Fig. 71 Thrust Washer Installation

1 - FRONT THRUST WASHER

The main bearing cap bolts must be tightened in the proper sequence. First the inner main cap bolts, secondly the windage tray bolts, lastly the main cap tie (horizontal) bolts.

(6) Install each main bearing cap and tighten inner bolts finger tight.

(7) Tighten inner main bearing cap bolts to 20 N·m + 1/4 turn (15 ft. lbs. + 1/4 turn).

(8) Measure crankshaft end play. (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT - STANDARD PROCEDURE)

(9) Install windage tray. Lubricate bolts with engine oil and tighten to 27 N·m + 1/4 turn (20 ft. lbs. + 1/4 turn).

(10) Install the main cap tie (horizontal) bolts and tighten to 28 N·m (250 in. lbs.).

(11) Install oil pick-up tube.

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

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

CRANKSHAFT OIL SEAL - FRONT

REMOVAL

(1) Remove the crankshaft sprocket. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL)

(2) Tap the dowel pin out of the crankshaft (Fig. 72).

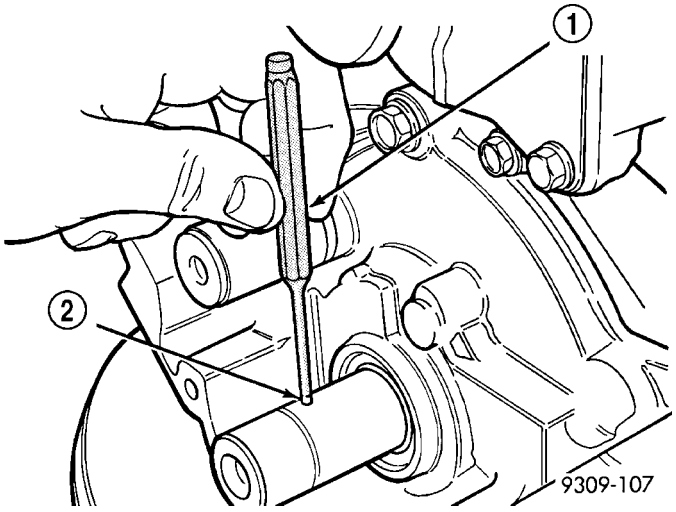


Fig. 72 Crankshaft Dowel Pin - Removal/Installation

1 - PIN PUNCH
2 - DOWEL

(3) Remove crankshaft seal using Special Tool 6341A (Fig. 73).

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

CRANKSHAFT OIL SEAL - FRONT (Continued)

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

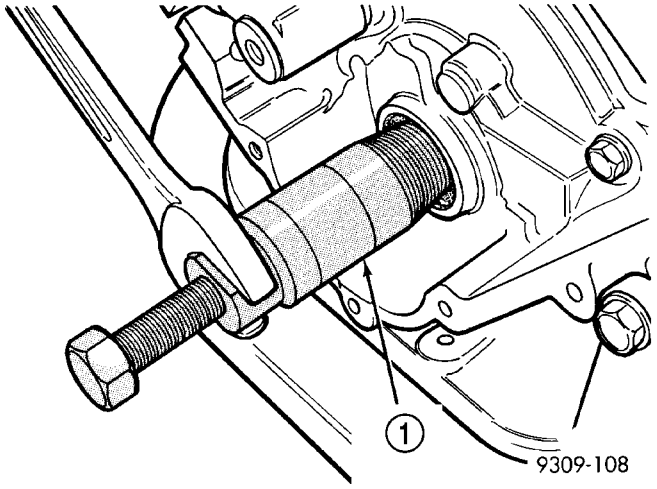


Fig. 73 REMOVING CRANKSHAFT OIL SEAL WITH SPECIAL TOOL

1 - SPECIAL TOOL 6341A

INSTALLATION

(1) Install crankshaft seal using Special Tool 6342 (Fig. 74).

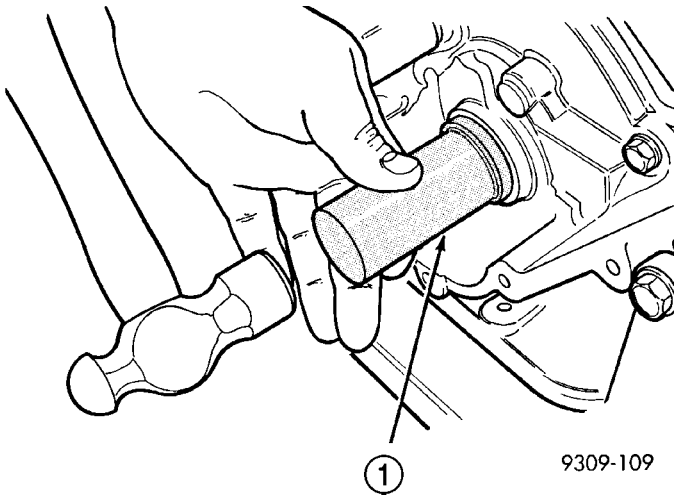


Fig. 74 INSTALLING CRANKSHAFT OIL SEAL WITH SPECIAL TOOL

1 - SPECIAL TOOL 6342

(2) Install the dowel pin into the crankshaft to 1.2 mm (0.047 in.) protrusion (Fig. 72).

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

CRANKSHAFT OIL SEAL - REAR

REMOVAL

(1) Remove transaxle from vehicle. (Refer to 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC - 42LE - REMOVAL)

(2) Remove drive plate.

(3) Insert a 3/16” wide flat bladed screwdriver between the dust lip and the metal case of the crankshaft seal. Angle the screwdriver (Fig. 75) through the dust lip against the metal case of the seal. Pry out seal.

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

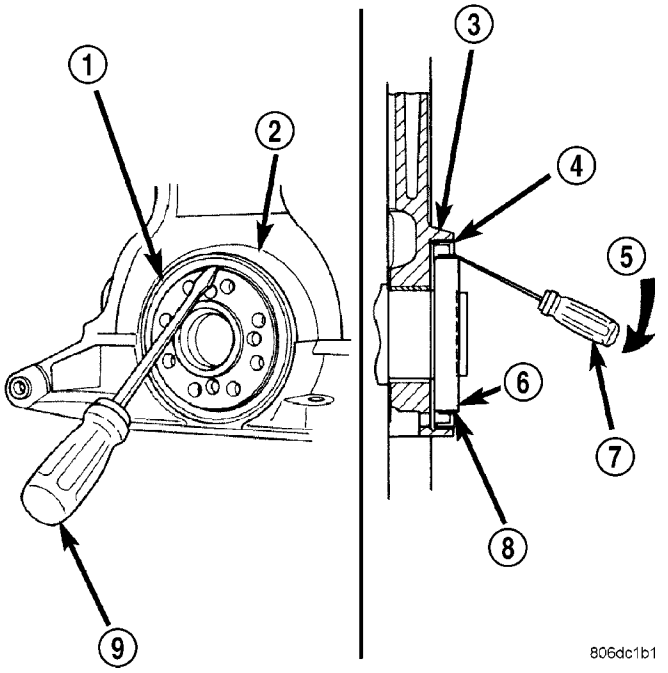


Fig. 75 Rear Crankshaft Oil Seal Removal - Typical

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 a burr or scratch is present on the crankshaft edge (chamfer), clean surface using 400 grit sand paper to prevent seal damage during installation.

CRANKSHAFT OIL SEAL - REAR (Continued)

(1) Place Special Tool 6926-1 Guide on crankshaft (Fig. 76). This is a pilot tool with a magnetic base.

(2) Position seal over pilot tool. Assure that lip of seal is facing towards the crankshaft during installation. The pilot tool remains on crankshaft during seal installation.

(3) Using Special Tool 6926-2 Installer, and C-4171 Handle (Fig. 76), drive seal into the retainer housing until seal is flush with housing surface.

(4) Install drive plate and transaxle. (Refer to 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC - 42LE - INSTALLATION)

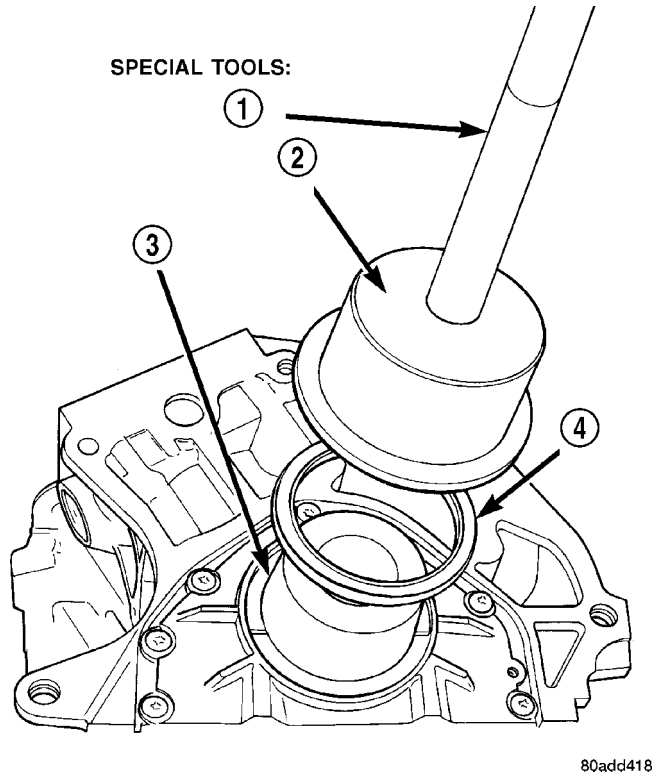


Fig. 76 Crankshaft Rear Seal - Installation

1 - C-4171 HANDLE
2 - 6926–2 INSTALLER
3 - 6926–1 GUIDE
4 - 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 seal retainer attaching screws.

(4) Remove seal retainer (Fig. 77).

NOTE: Seal retainer gasket is bonded to the retainer and must be replaced as an assembly.

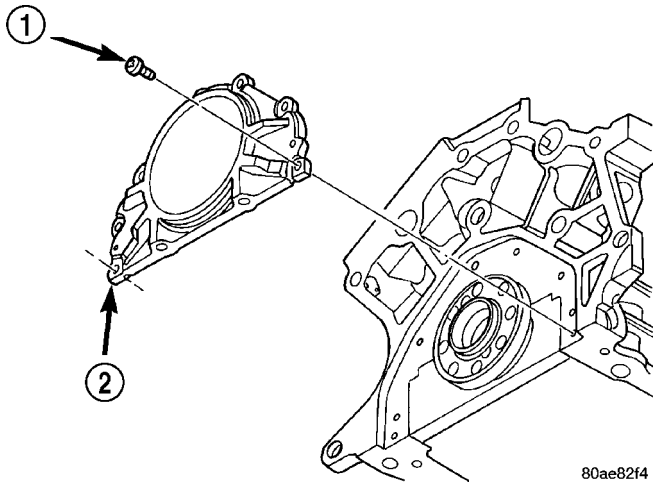


Fig. 77 Oil Seal Retainer

1 - SCREWS (7)
2 - SEAL RETAINER

INSTALLATION

(1) Clean all sealing surfaces. Replace retainer assembly if gasket is torn or damaged.

(2) Install seal retainer to block, but do not tighten attaching screws at this time.

NOTE: The following steps must be performed to prevent oil leaks at sealing joints.

(3) Attach Special Tools 8225 to pan rail using the oil pan fasteners (Fig. 78).

NOTE: Make sure the marking “3.2/3.5L” on Special Tools 8225, is facing towards the cylinder block pan rail surface (notch on tool is towards the seal retainer).

(4) While applying firm pressure to the seal retainer against Special Tools 8225 (Fig. 78), tighten seal retainer screws to 12 N·m (105 in. lbs.).

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

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

CRANKSHAFT REAR OIL SEAL RETAINER (Continued)

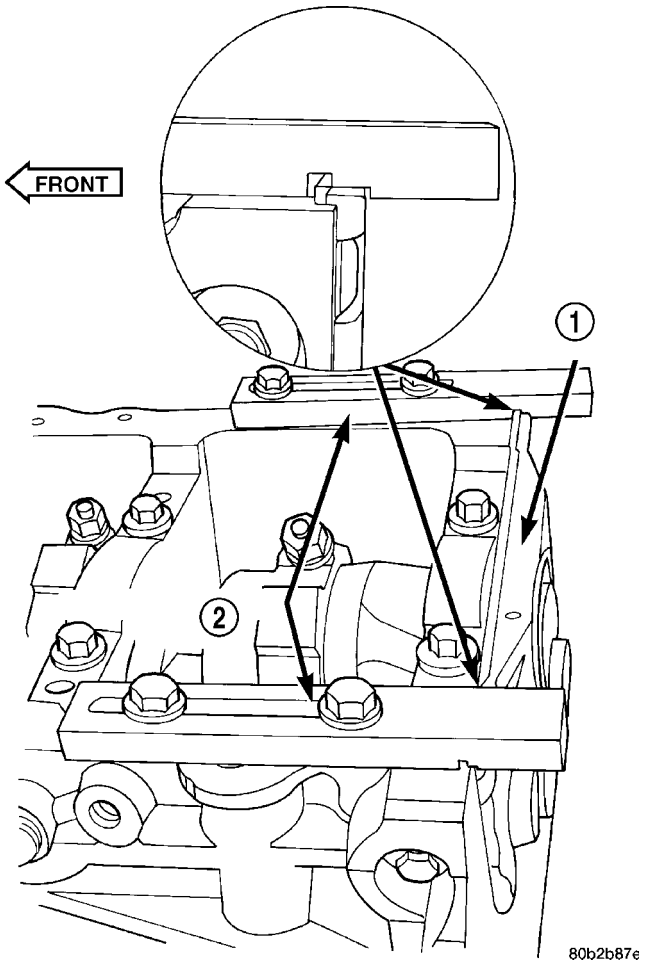


Fig. 78 Rear Crankshaft Seal Retainer Alignment

1 - SEAL RETAINER
2 - SPECIAL TOOLS 8225

FLEX PLATE

REMOVAL

(1) Remove the transaxle. (Refer to 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC - 42LE - REMOVAL)

(2) Remove flex plate attaching bolts.

(3) Remove the flex plate (Fig. 79).

INSTALLATION

(1) Position flex plate with backing plate on the crankshaft (Fig. 79).

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

(3) Install flex plate bolts (Fig. 79). Tighten bolts to 95 N·m (70 ft. lbs.).

(4) Install the transaxle. (Refer to 21 - TRANSMISSION/TRANSAXLE/AUTOMATIC - 42LE - INSTALLATION)

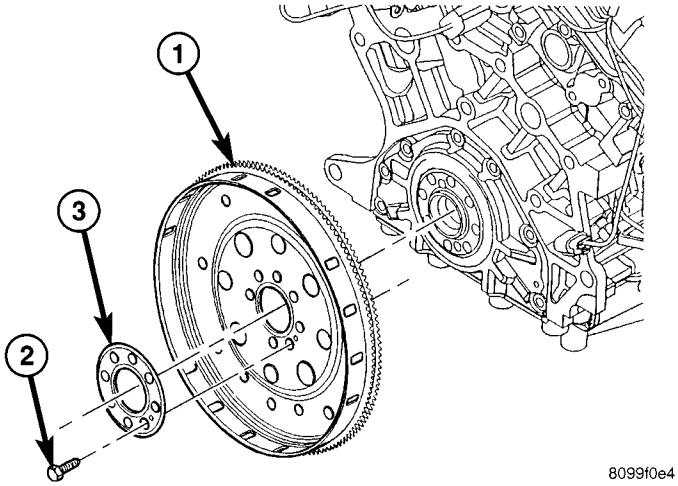


Fig. 79 FLEX PLATE

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

PISTON & CONNECTING ROD

DESCRIPTION

NOTE: Valve reliefs were removed from the pistons for the 2003MY. It is possible when ordering a service piston/rod assembly that valve reliefs are present. These may be used in the engine, and will not affect engine operation.

The pistons are made of a high strength aluminum alloy. Top land height has been decreased to reduce emissions. Piston skirts are coated with a solid lubricant for scuff resistance. Connecting rod is forged steel with a squirt hole and attaches to the piston with a full floating pin retained by lock rings.

STANDARD PROCEDURE - FITTING PISTONS

The pistons are machined to two different weight specifications and matched to rods based on weight. All piston and rod assemblies weigh the same to maintain engine balance.

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. 80). Cylinder bores should be measured halfway down the cylinder bore and transverse to the engine crankshaft center line (Refer to 9 - ENGINE - SPECIFICATIONS). **Pistons and cylinder bores should be measured at normal room temperature, 70°F (21°C).**

REMOVAL

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

PISTON & CONNECTING ROD (Continued)

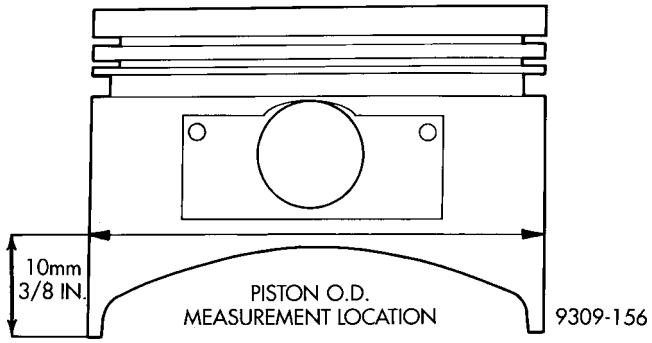


Fig. 80 Piston Measurements

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

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

(4) Inspect connecting rods and connecting rod caps for cylinder identification. Identify them if necessary (Fig. 81).

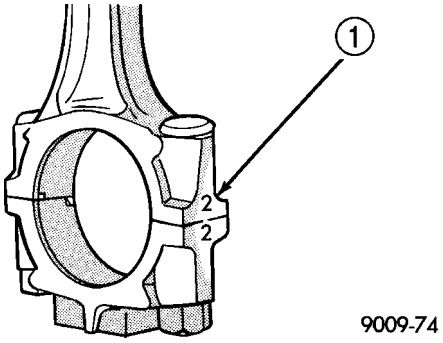


Fig. 81 Connecting Rod to Cylinder Identification

1 - CYLINDER NUMBER

(5) Remove connecting rod cap. Install protectors on connecting rod bolts (Fig. 82). Push each piston and rod assembly out of cylinder bore.

NOTE: Be careful not to nick crankshaft journals.

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

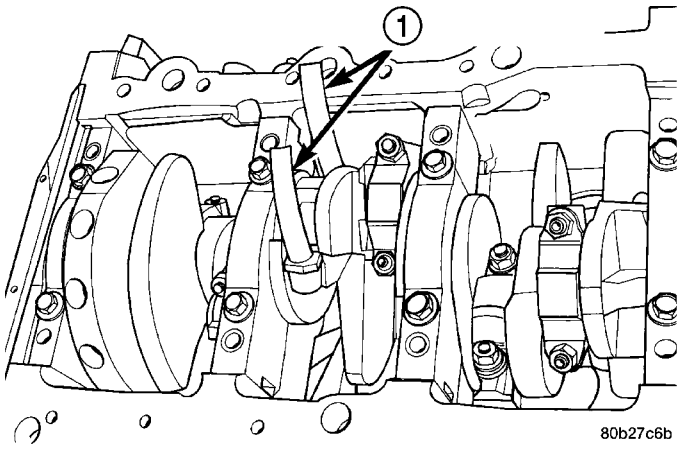


Fig. 82 Connecting Rod Guides and Crankshaft Protectors

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

INSTALLATION

(1) Install the piston rings. (Refer to 9 - ENGINE/ENGINE BLOCK/PISTON RINGS - INSTALLATION)

NOTE: The connecting rod bearing cap bolts must be examined before reuse. If the threads are necked down, the bolts must be replaced.

(2) Check connecting rod bolts for necking by holding a scale or straight edge against the threads. If all threads do not contact the scale, the bolt must be replaced (Fig. 83).

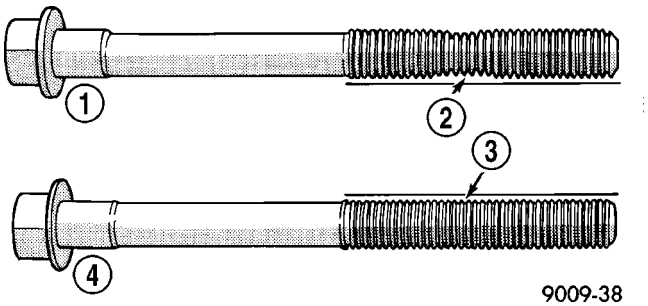


Fig. 83 Check for Stretched Bolts

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

PISTON & CONNECTING ROD (Continued)

(3) 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. 84).

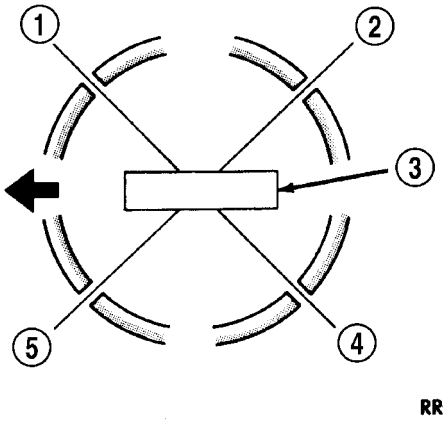


Fig. 84 Piston Ring End Gap Position

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

(4) Immerse the piston head and rings in clean engine oil, slide the ring compressor over the piston and tighten with the special wrench (Fig. 85). **Ensure position of rings does not change during this operation.**

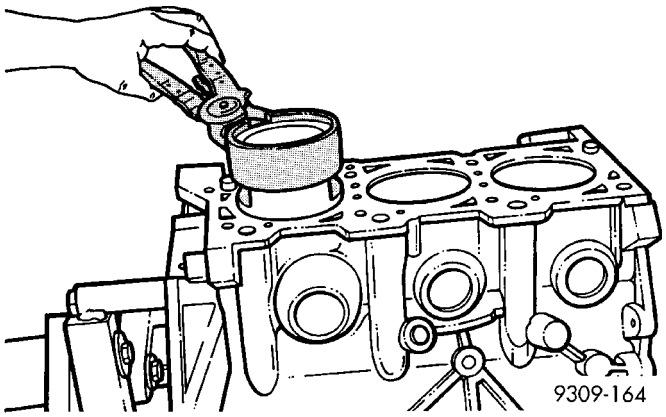


Fig. 85 Piston - Installation

(5) Install connecting rod bolt protectors on rod bolts (Fig. 82).

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

CAUTION: Do Not interchange piston assemblies cylinder-to-cylinder or bank-to-bank.

NOTE: Valve reliefs were removed from the pistons for the 2003MY. It is possible when ordering a service piston/rod assembly that valve reliefs are present. These may be used in the engine, and will not affect engine operation.

(7) The arrow on top of piston must be pointing toward front of engine (Fig. 86) and oil squirt hole on connecting rod faces the major thrust (right) side of the cylinder bore (Fig. 87).

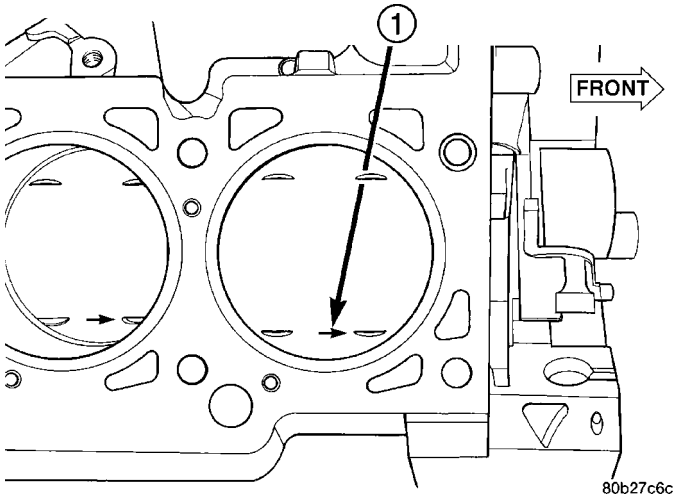


Fig. 86 Piston Orientation

1 - ARROW FACES FRONT OF ENGINE

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

(10) Install the cylinder head(s) (Refer to 9 - ENGINE/CYLINDER HEAD - INSTALLATION)

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

PISTON & CONNECTING ROD (Continued)

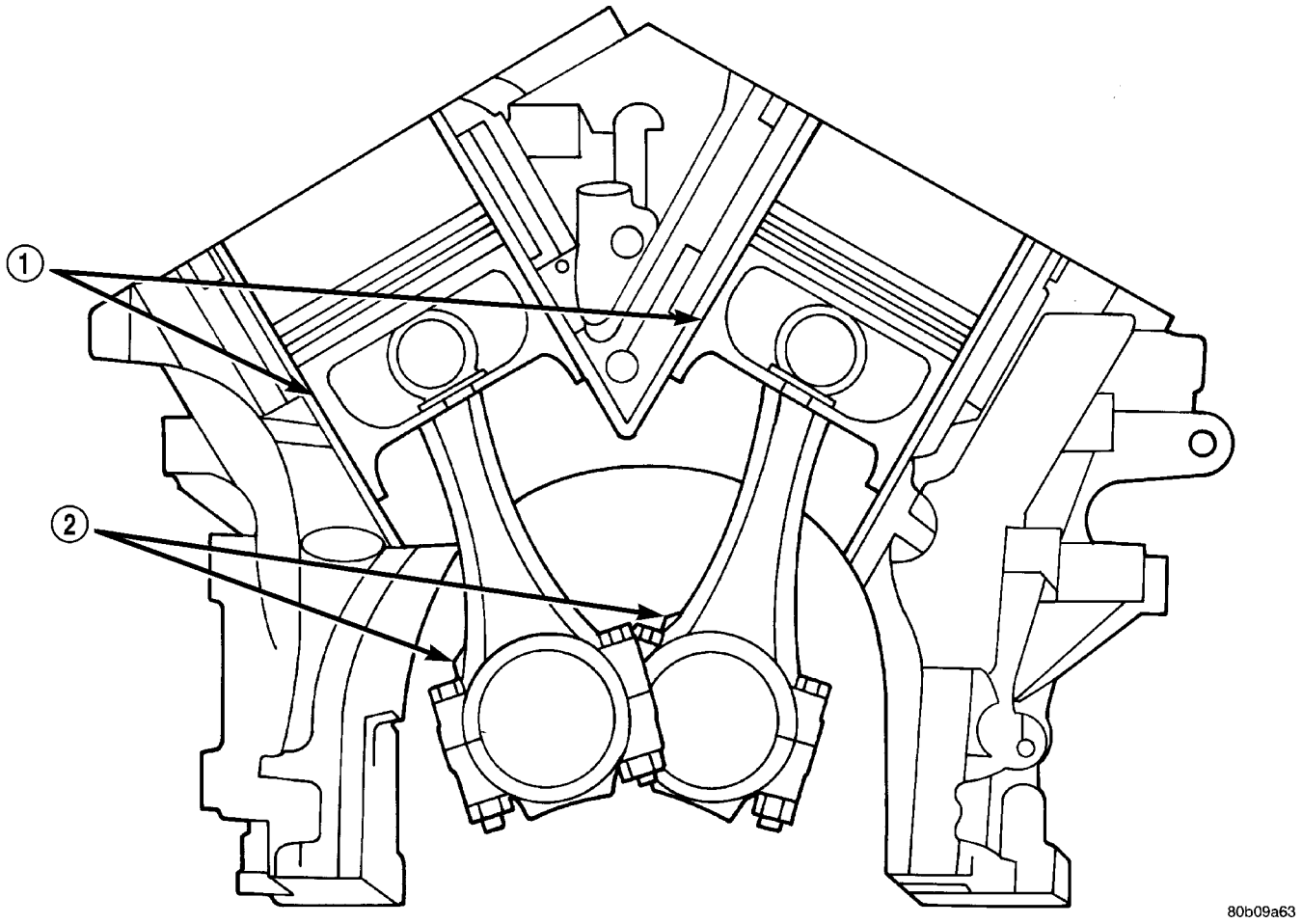


Fig. 87 Piston and Connecting Rod Positioning (Front View of Engine)

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

PISTON RINGS

STANDARD PROCEDURE - PISTON RING FITTING

(1) Wipe cylinder bore clean. Insert ring and push down with piston to ensure it is square in bore. The ring gap measurement must be made with the ring positioning at least 12 mm (0.50 in.) from bottom of cylinder bore. Check gap with feeler gauge (Fig. 88). For clearance specifications, (Refer to 9 - ENGINE - SPECIFICATIONS).

(2) Check piston ring to groove clearance: (Fig. 89). For clearance specifications, (Refer to 9 - ENGINE - SPECIFICATIONS).

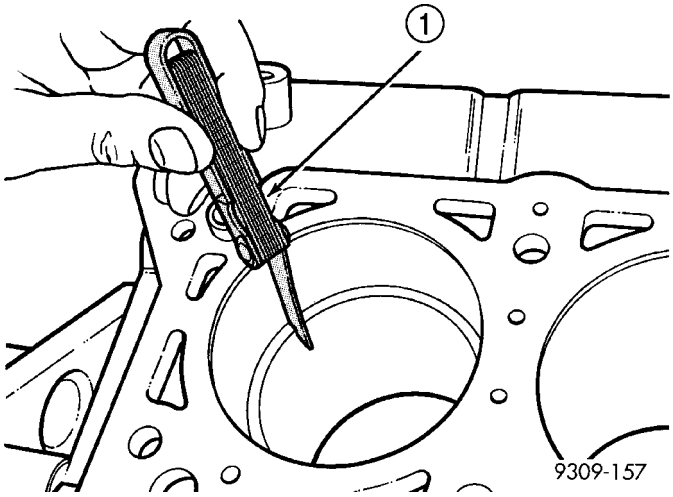


Fig. 88 Check Gap on Piston Rings

1 - FEELER GAUGE

PISTON RINGS (Continued)

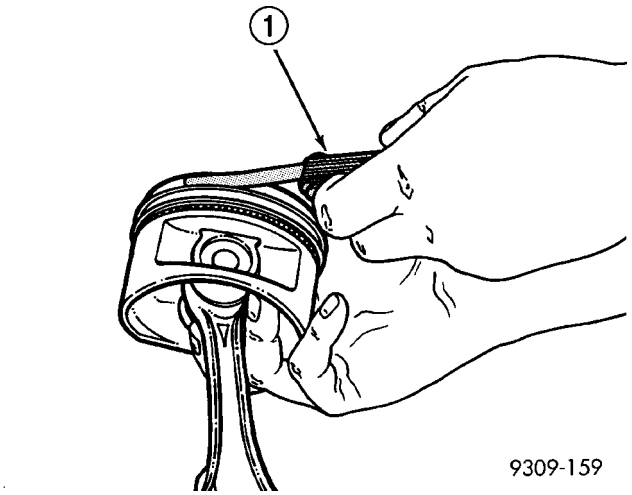


Fig. 89 Measuring Piston Ring Side Clearance

1 - FEELER GAUGE

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. 92).

(3) Remove upper oil ring side rail (Fig. 90).

(4) Remove lower oil ring side rail (Fig. 90).

(5) Remove oil ring expander (Fig. 90).

INSTALLATION

(1) Measure clearance of piston rings to the cylinder bore and piston. (Refer to 9 - ENGINE/ENGINE BLOCK/PISTON RINGS - STANDARD PROCEDURE)

The No. 1 and No. 2 piston rings have a different cross section. Insure that the No. 2 ring is installed with manufacturers I.D. mark (dot) facing up, towards top of the piston (Fig. 90).

CAUTION: Install piston rings in the following order:

- Oil ring expander.
- Upper oil ring side rail.
- Lower oil ring side rail.
- No. 2 Intermediate piston ring.
- No. 1 Upper piston ring.

(2) Install oil ring expander.

(3) 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 during this step (Fig. 91).**

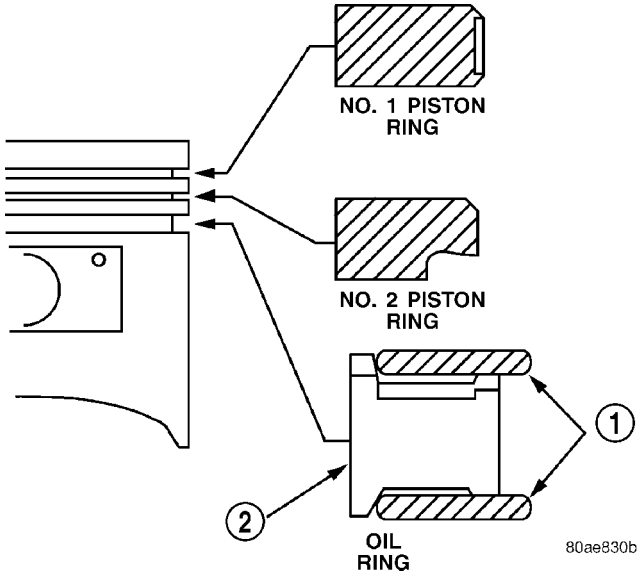


Fig. 90 PISTON RING - INSTALLATION

1 - SIDE RAIL
2 - SPACER EXPANDER

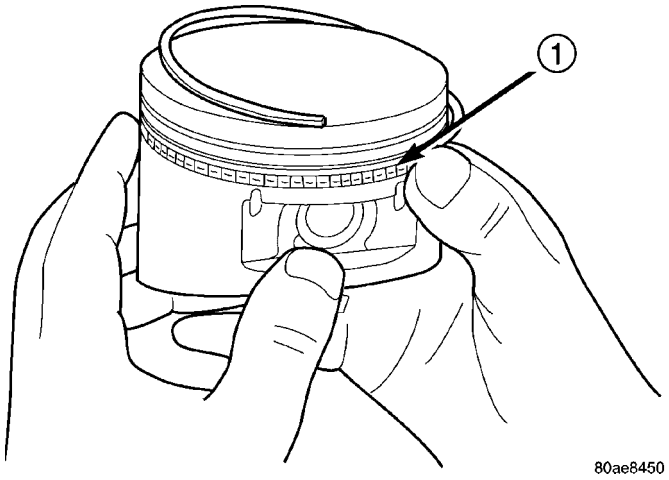


Fig. 91 SIDE RAIL - INSTALLATION

1 - SIDE RAIL END

PISTON RINGS (Continued)

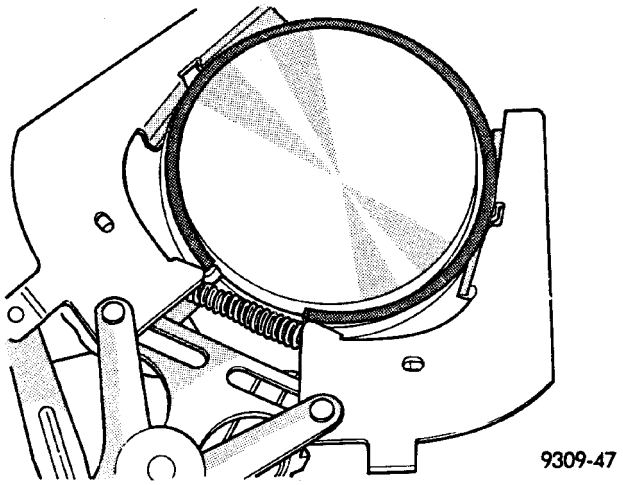


Fig. 92 UPPER AND INTERMEDIATE RINGS

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

The No. 1 and No. 2 piston rings have a different cross section. Insure that the No. 2 ring is installed with manufacturers I.D. mark (dot) facing up, towards top of the piston (Fig. 90).

(5) Install No. 2 piston ring and then No. 1 piston ring (Fig. 92).

(6) Position piston ring end gaps as shown in (Fig. 93).

(7) 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.

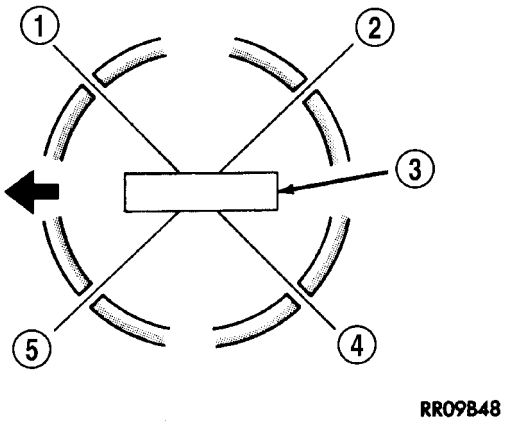


Fig. 93 PISTON RING END GAP POSITION

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

STRUCTURAL COLLAR / COVER

REMOVAL

(1) Raise vehicle on hoist.

(2) Remove bolts attaching structural collar to oil pan and transmission housing (Fig. 94).

(3) Remove collar (Fig. 94).

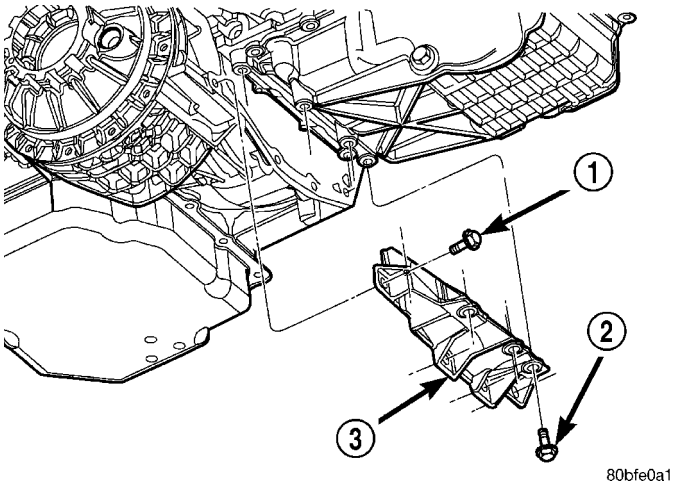


Fig. 94 Structural Collar

1 - BOLT-HORIZONTAL
2 - BOLT-VERTICAL
3 - STRUCTURAL COLLAR

INSTALLATION

CAUTION: The collar must be tighten using this service procedure, as damage to collar and/or oil pan may occur.

(1) Install structural collar (Fig. 94) using the following tightening sequence:

a. Install the **vertical** collar to oil pan bolts. Torque bolts initially to 1.1 N·m (10 in. lbs.).

b. Install the **horizontal** collar to transmission bolts and torque to 55 N·m (40 ft. lbs.).

c. Starting with the center vertical bolts and working outward, final torque bolts to 55 N·m (40 ft. lbs.).

(2) Lower vehicle.

VIBRATION DAMPER

REMOVAL

(1) Disconnect negative cable at right strut tower.

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

(3) Remove radiator fan. (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL)

VIBRATION DAMPER (Continued)

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

(5) Use Special Tool 8191 to hold crankshaft damper while removing center bolt (Fig. 95).

(6) Use Special Tool 1023 puller, and insert C-4685-C2, remove crankshaft damper (Fig. 96).

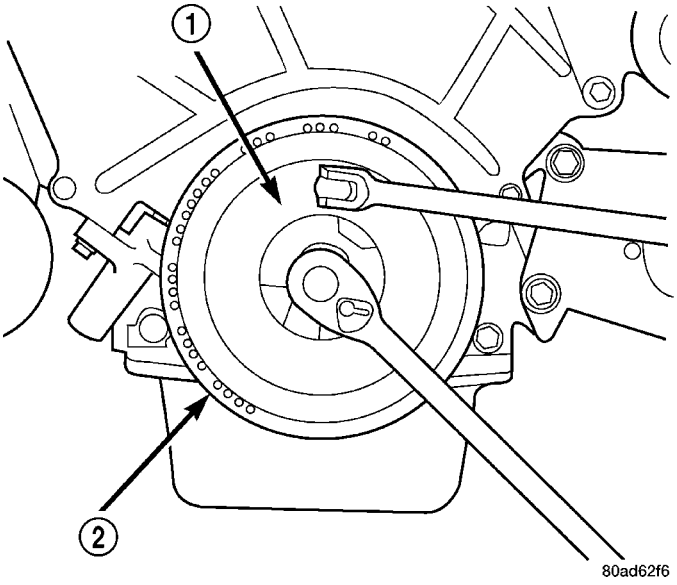


Fig. 95 Crankshaft Damper Center Bolt - Removal and Installation

1 - SPECIAL TOOL 8191
2 - CRANKSHAFT DAMPER

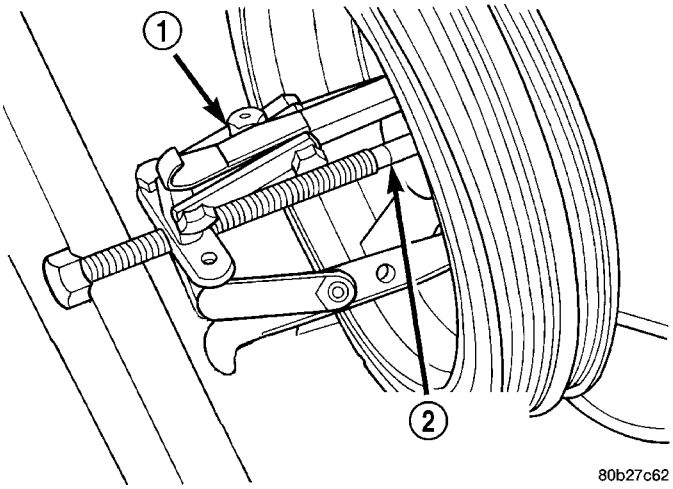


Fig. 96 CRANKSHAFT DAMPER - REMOVAL

1 - SPECIAL TOOL 1023
2 - SPECIAL TOOL C-4685–C2 INSERT

INSTALLATION

(1) Install crankshaft damper using Special Tools C-4685-C1 (5.9 in.) Bolt, with Nut and Thrust Bearing from 6792, and 6792-1 Installer (Fig. 97). Install center bolt and tighten to 115 N·m (85 ft. lbs.) (Fig. 95).

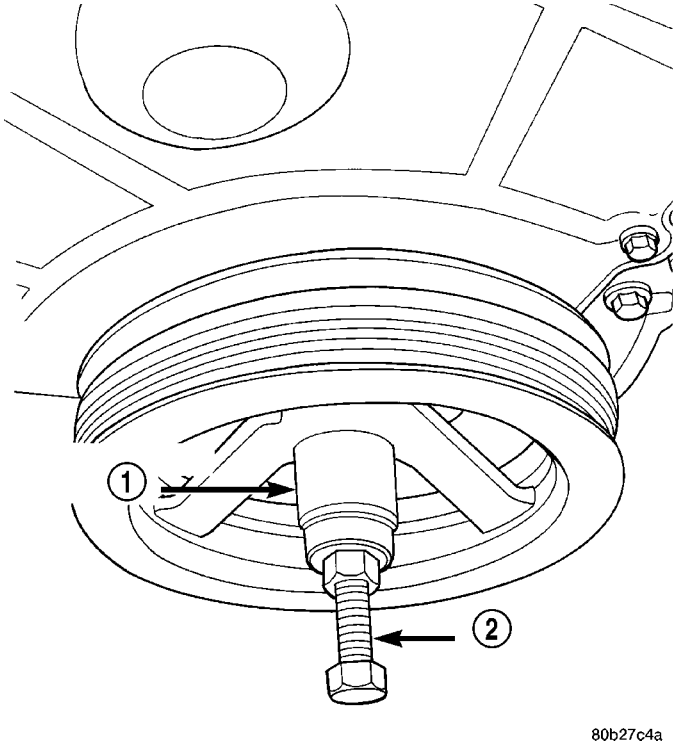


Fig. 97 CRANKSHAFT DAMPER - INSTALLATION

1 - SPECIAL TOOL 6792–1
2 - SPECIAL TOOL C-4685–C1

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

(3) Install radiator fan. (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - INSTALLATION)

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

(5) Connect negative cable.

ENGINE MOUNTING

DESCRIPTION

The engine mounting system consist of three mounts; two hydro-type mounts are attached to the right and left side of the engine block, and one molded rubber type rear mount is attached to the transaxle (Fig. 99). All three mounts attach to the suspension crossmember/engine cradle.

The engine hydro-type mounts contain a liquid that is encased in a solid rubber housing.

ENGINE MOUNTING (Continued)

INSPECTION

Engine hydro-mounts may show surface cracks. This will not effect performance and mount should not be replaced. Only replace the engine hydro-mounts when leaking fluid.

LEFT MOUNT

REMOVAL

(1) Raise vehicle on hoist.
(2) Remove the isolator attaching nuts from top of the mounting bracket (Fig. 98).
(3) Support the engine with a jack and a block of wood across the full width of the oil pan.
(4) Remove the lower attaching nuts from the bottom of the isolator to the frame (Fig. 98).
(5) Raise engine carefully with jack enough to remove the isolator with heat shield from its mount.

INSTALLATION

(1) Install isolator mount with heat shield onto the frame.
(2) Lower the engine onto the isolator mount.
(3) Remove jack from vehicle.
(4) Tighten the isolator to frame nuts to 61 N·m (45 ft. lbs.) (Fig. 98).
(5) Install the upper attaching nuts to mount and tighten to 61 N·m (45 ft. lbs.) (Fig. 98).
(6) Lower vehicle.

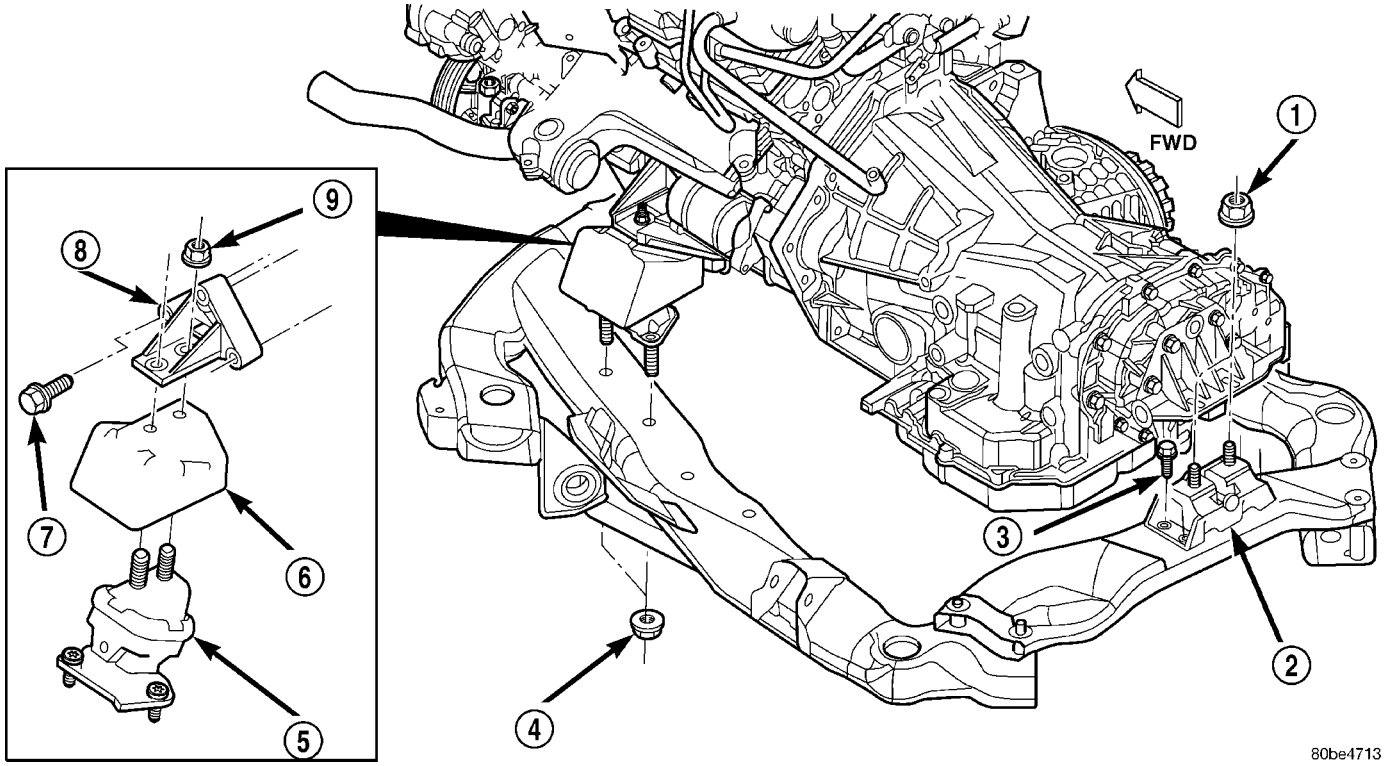


Fig. 98 ENGINE MOUNTING

1 - NUT
2 - REAR ISOLATOR
3 - BOLT
4 - NUT
5 - ISOLATOR
6 - HEAT SHIELD
7 - BOLT
8 - ENGINE MOUNT BRACKET
9 - NUT

REAR MOUNT

REMOVAL

(1) Raise vehicle on hoist.
(2) Support transaxle with a jack.
(3) Remove isolator nuts from the mount to transaxle mount bracket (Fig. 99).
(4) Remove rear mount isolator bolts to crossmember and remove mount (Fig. 99).

INSTALLATION

(1) Position isolator onto crossmember.
(2) Install bolts attaching isolator to crossmember and tighten to 33 N·m (250 in. lbs.) (Fig. 99).
(3) Lower transaxle onto isolator.
(4) Install isolator nuts and tighten to 61 N·m (45 ft. lbs.) (Fig. 99).
(5) Lower vehicle.

RIGHT MOUNT

REMOVAL

(1) Raise vehicle on hoist.
(2) Remove the isolator attaching nuts from top of the mounting bracket (Fig. 99).
(3) Support the engine with a jack and a block of wood across the full width of the oil pan.
(4) Remove the lower attaching nuts from the bottom of the isolator to the frame (Fig. 99).
(5) Raise engine carefully with jack enough to remove the isolator with heat shield from its mount.

INSTALLATION

(1) Install isolator mount with heat shield onto the frame.
(2) Lower the engine onto the isolator mount.
(3) Remove jack from vehicle.
(4) Tighten the isolator to frame nuts to 61 N·m (45 ft. lbs.) (Fig. 99).
(5) Install the upper attaching nuts to mount and tighten to 61 N·m (45 ft. lbs.) (Fig. 99).
(6) Lower vehicle.

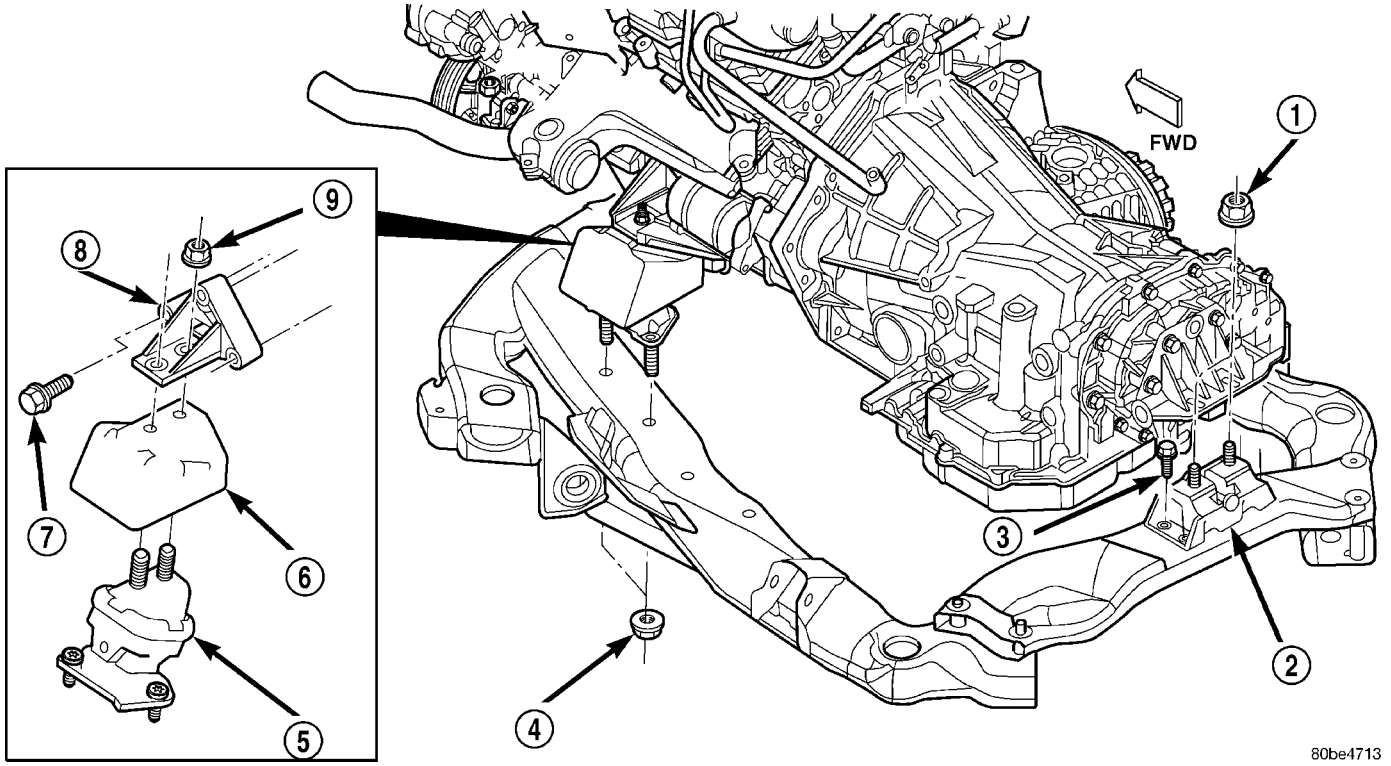


Fig. 99 ENGINE MOUNTING

1 - NUT
2 - REAR ISOLATOR
3 - BOLT
4 - NUT
5 - ISOLATOR
6 - HEAT SHIELD
7 - BOLT
8 - ENGINE MOUNT BRACKET
9 - NUT

LUBRICATION

DESCRIPTION

System is a full-flow filtration, pressure feed type. The oil pump body is mounted to the engine block. The pump inner rotor is driven by the crankshaft. A windage tray, increases power by minimizing oil windage at high engine RPM. For increased oil cooling, an oil-to-coolant oil cooler is used. This cooler is mounted inside the radiator tank.

OPERATION

Engine oil stored in the oil pan is drawn in and discharged by a gerotor type oil pump. The oil pump is directly coupled to the crankshaft. Oil pressure is regulated by a relief valve. The oil is fed through an oil filter and to the crankshaft journals from the oil gallery in the cylinder block. This gallery also feeds oil under pressure to the cylinder heads. Oil flows through each cylinder heads oil passage to the rocker shafts. Oil then feeds the camshaft journals, rocker arms, and hydraulic lash adjusters (Fig. 100).

DIAGNOSIS AND TESTING

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.

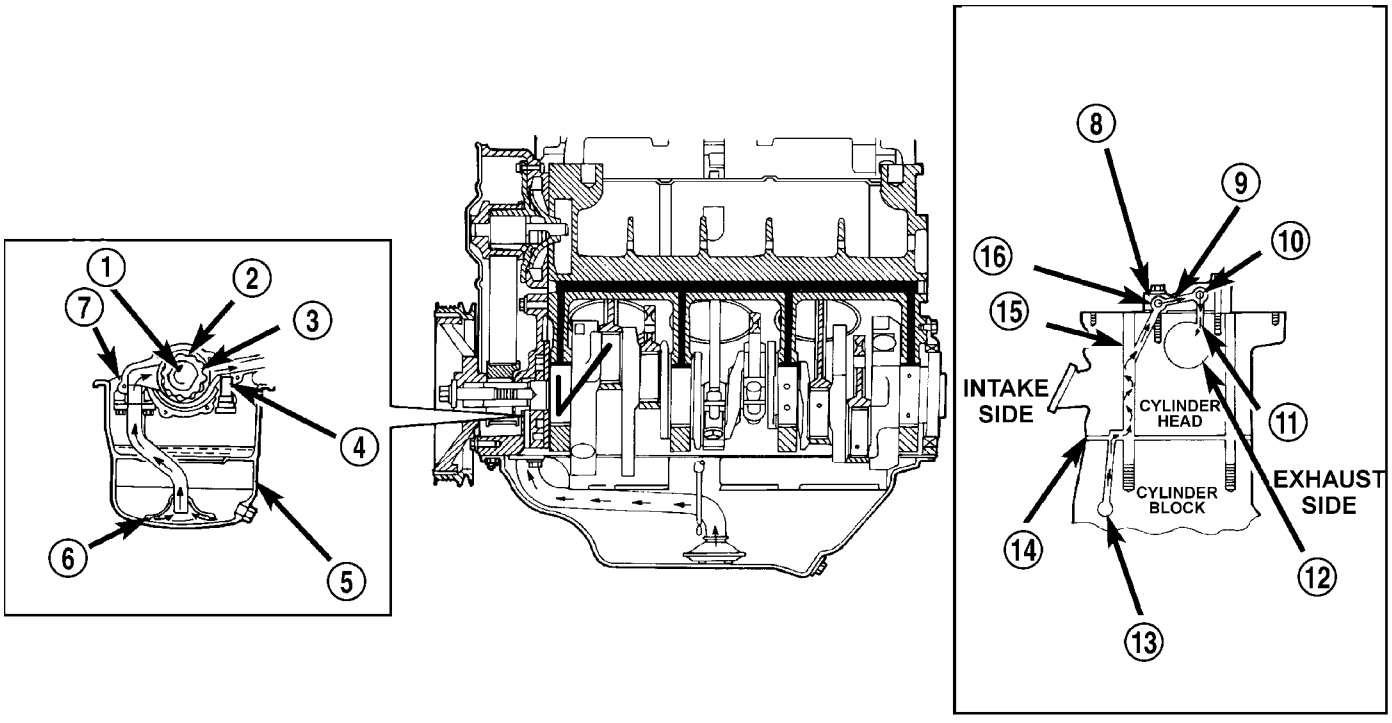


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Fig. 100 OIL LUBRICATION SYSTEM

1 - CRANKSHAFT
2 - OUTER ROTOR
3 - INNER ROTOR
4 - RELIEF VALVE
5 - OIL PAN
6 - OIL SCREEN
7 - OIL PUMP CASE
8 - OIL FLOWS TO ONLY ONE PEDESTAL ON EACH HEAD - SECOND FROM REAR ON RIGHT HEAD - SECOND FROM FRONT ON LEFT HEAD
9 - PEDESTAL DRILLED PASSAGE
10 - EXHAUST ROCKER SHAFT
11 - SHAFT/PEDESTAL DOWEL PASSAGE
12 - CAMSHAFT BEARING BORE
13 - CYLINDER BLOCK OIL GALLERY
14 - CYLINDER HEAD GASKET
15 - HEAD BOLT HOLE
16 - INTAKE ROCKER SHAFT

LUBRICATION (Continued)

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

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

- Disconnect the fresh air hose (make-up air) at the cylinder head cover and plug or cap the nipple on the cover.
- Remove the PCV valve hose from the cylinder head cover. Cap or plug the PCV valve nipple on the cover.
- Attach an air hose with pressure gauge and regulator to the dipstick tube.

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

- Gradually apply air pressure from 1 psi to 2.5 psi maximum while applying soapy water at the suspected source. Adjust the regulator to the suitable test pressure that provides the best bubbles which will pinpoint the leak source. If the oil leak is detected and identified, repair per service manual procedures.
- If the leakage occurs at the crankshaft rear oil seal area, refer to the section, Inspection for Rear Seal Area Leak.

(6) If no leaks are detected, turn off the air supply. Remove the air hose, all plugs, and caps. Install the PCV valve and fresh air hose (make-up air). Proceed to next step.

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

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.

(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 - CHECKING ENGINE OIL PRESSURE

(1) Remove the oil pressure switch. (Refer to 9 - ENGINE/LUBRICATION/OIL PRESSURE SENSOR/SWITCH - REMOVAL)

(2) Install oil pressure test gauge assembly, Special Tools C-3292 with 8406 adaptor.

(3) Start engine and monitor gauge readings.

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

(4) Oil Pressure (engine at operating temperature): **Curb Idle** 34.5 kPa (5 psi) minimum **3000 RPM** 300–724 kPa (45–105 psi).

(5) If oil pressure is 0 at idle. Shut off engine, check for pressure relief valve stuck open or a clogged oil pickup screen.

(6) Install oil pressure switch after testing is completed. (Refer to 9 - ENGINE/LUBRICATION/OIL PRESSURE SENSOR/SWITCH - INSTALLATION)

OIL

DESCRIPTION

For engine oil type and capacity (Refer to LUBRICATION & MAINTENANCE/FLUID TYPES - DESCRIPTION - ENGINE OIL)

STANDARD PROCEDURE

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. 101). Add only when the level is at or below the ADD mark.

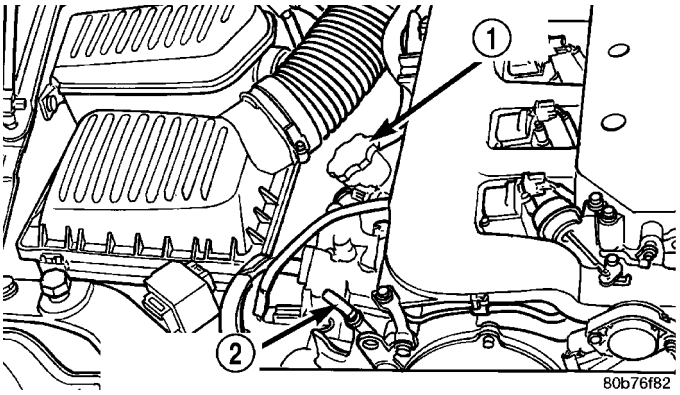

Fig. 101 ENGINE OIL FILL AND DIPSTICK LOCATIONS

1 - ENGINE OIL FILL
2 - ENGINE OIL DIPSTICK

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.

TO CHANGE ENGINE OIL

(1) Run engine until achieving normal operating temperature.

(2) Position the vehicle on a level surface and turn engine off.

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

(4) Remove oil fill cap.

(5) Place a suitable drain pan under crankcase drain.

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

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

(8) Install drain plug in crankcase.

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

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

(11) Install oil fill cap.

(12) Start engine and inspect for leaks.

(13) Stop engine and inspect oil level.

OIL FILTER SPECIFICATION

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

USED ENGINE OIL DISPOSAL

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

OIL COOLER & LINES

DESCRIPTION

Depending on vehicle options, some models use an engine oil cooler that is mounted inside the right radiator tank. An oil cooler pressure control valve is used to control flow to the cooler (Fig. 102).

OPERATION

Engine oil travels from the control valve through the supply line and into the cooler. The control valve allows engine oil flow when pressure is above

OIL COOLER & LINES (Continued)

138–207 kPa (20–30 psi) and an internal orifice limits oil flow to a maximum of 11.3 LPM (3 GPM). The engine oil exits the cooler through the oil return line and is returned to the engine oil pan (Fig. 102).

REMOVAL

ENGINE OIL COOLER

(1) The engine oil cooler is serviced with the radiator (Refer to 7 - COOLING/ENGINE/RADIATOR - REMOVAL).

COOLER LINES

(1) Disconnect cooler lines at radiator (Fig. 102).
(2) Disconnect lines at the pressure control valve and oil pan fitting (Fig. 102).
(3) Disconnect lines for support retainer and isolator.
(4) Remove lines.

PRESSURE CONTROL VALVE

(1) Disconnect oil pressure switch connector (Fig. 102).
(2) Disconnect cooler supply line for valve.
(3) Remove valve from engine block by unscrewing fitting.

INSTALLATION

ENGINE OIL COOLER

(1) Install radiator assembly (Refer to 7 - COOLING/ENGINE/RADIATOR - INSTALLATION). Tighten lines to radiator fittings to 18 N·m (160 in. lbs.) (Fig. 102).

COOLER LINES

(1) Position cooler lines and connect lines to radiator fittings. Tighten lines to radiator fittings to 18 N·m (160 in. lbs.) (Fig. 102).
(2) Connect lines to pressure control valve and oil pan fitting. Tighten lines to 30 N·m (260 in. lbs.) (Fig. 102).
(3) Connect lines to support retainer and isolator.

PRESSURE CONTROL VALVE

(1) For installation of a NEW control valve:
(a) Install fitting into block. Tighten fitting to 30 N·m (260 in. lbs.).

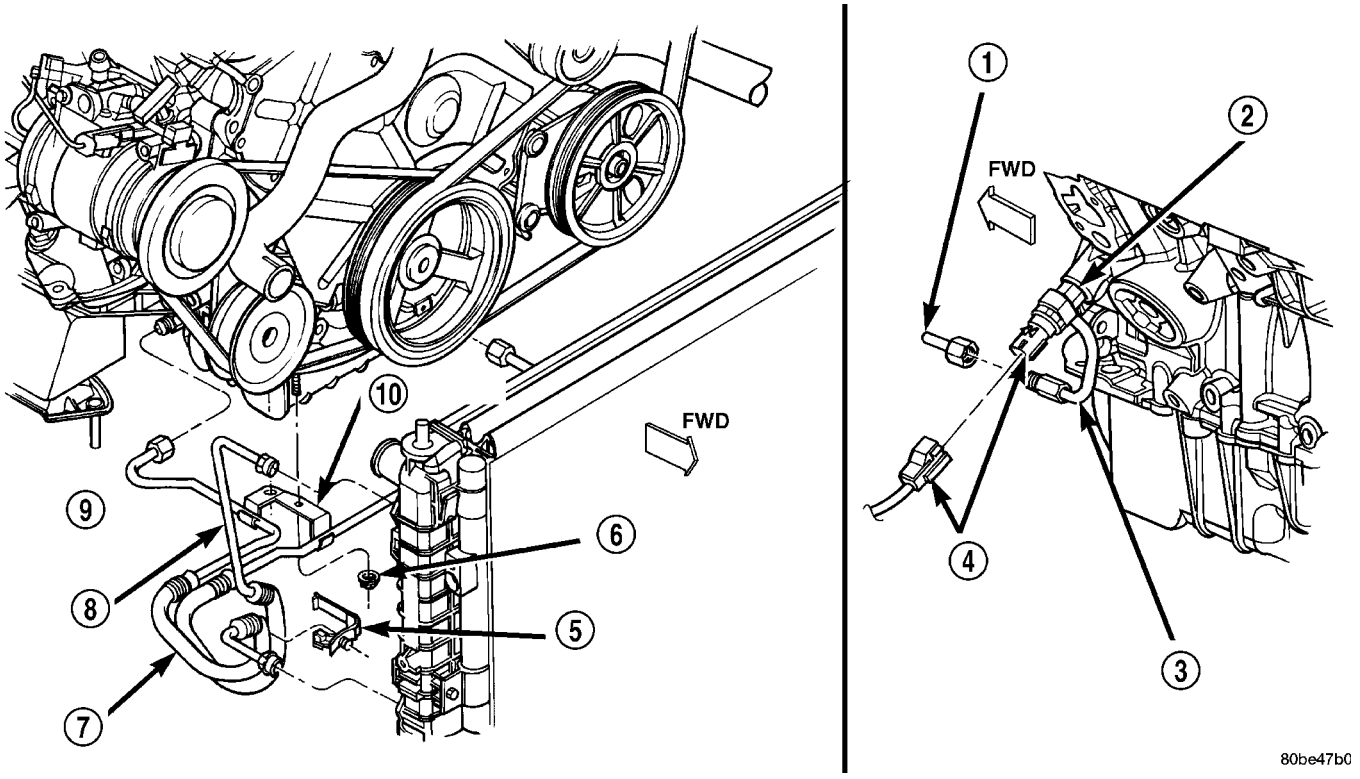

Fig. 102 Engine Oil Cooler - 3.5L

1 - SUPPLY LINE TO OIL COOLER
2 - FITTING
3 - OIL COOLER PRESSURE CONTROL VALVE
4 - OIL PRESSURE SWITCH AND CONNECTOR
5 - RETAINER
6 - NUT
7 - RETURN LINE
8 - SUPPLY LINE
9 - ENGINE OIL COOLER:
10 - ISOLATOR

OIL COOLER & LINES (Continued)

(b) Position control valve to fitting. Push line into fitting until it locks in place. Ensure proper connection is made by pulling in-and-out on valve.

(2) For installation of original control valve:

(a) Install pressure control valve to engine block. Tighten fitting to 30 N·m (260 in. lbs.).

(3) Connect oil cooler supply line. Tighten to 30 N·m (260 in. lbs.) (Fig. 102).

(4) Connect oil pressure switch connector.

OIL FILTER

REMOVAL

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

(1) Using a suitable oil filter wrench, unscrew filter from base and discard (Fig. 103).

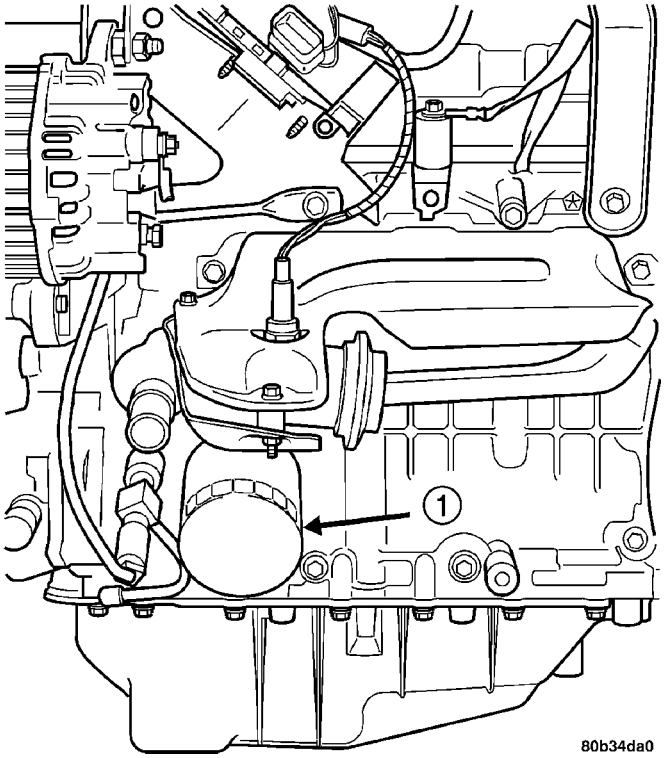

Fig. 103 OIL FILTER

1 - OIL FILTER

INSTALLATION

(1) Wipe base clean, then inspect gasket contact surface.

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

(3) Install and tighten filter to 16 N·m (12 ft. lbs.) of torque after gasket contacts base (Fig. 103). Use filter wrench if necessary.

(4) Start engine and check for leaks.

OIL PAN

REMOVAL

(1) Disconnect negative cable from remote jumper terminal.

(2) Remove dipstick and tube.

(3) Raise vehicle on hoist and drain engine oil.

(4) Remove structural collar from rear of oil pan and transmission housing (Fig. 104).

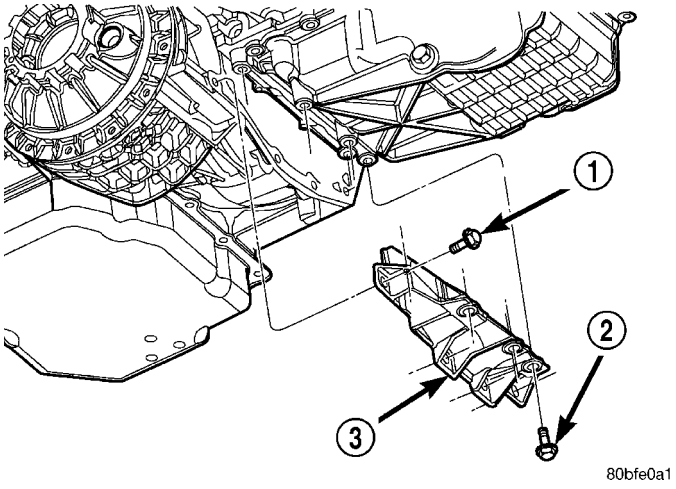

Fig. 104 STRUCTURAL COLLAR

1 - BOLT-HORIZONTAL
2 - BOLT-VERTICAL
3 - STRUCTURAL COLLAR

(5) Disconnect engine oil cooler line from pan.

(6) Disconnect transmission oil cooler line clips.

(7) Remove oil pan (Fig. 105).

(8) Remove oil pan gasket.

(9) Clean oil pan and all gasket surfaces.

OIL PAN (Continued)

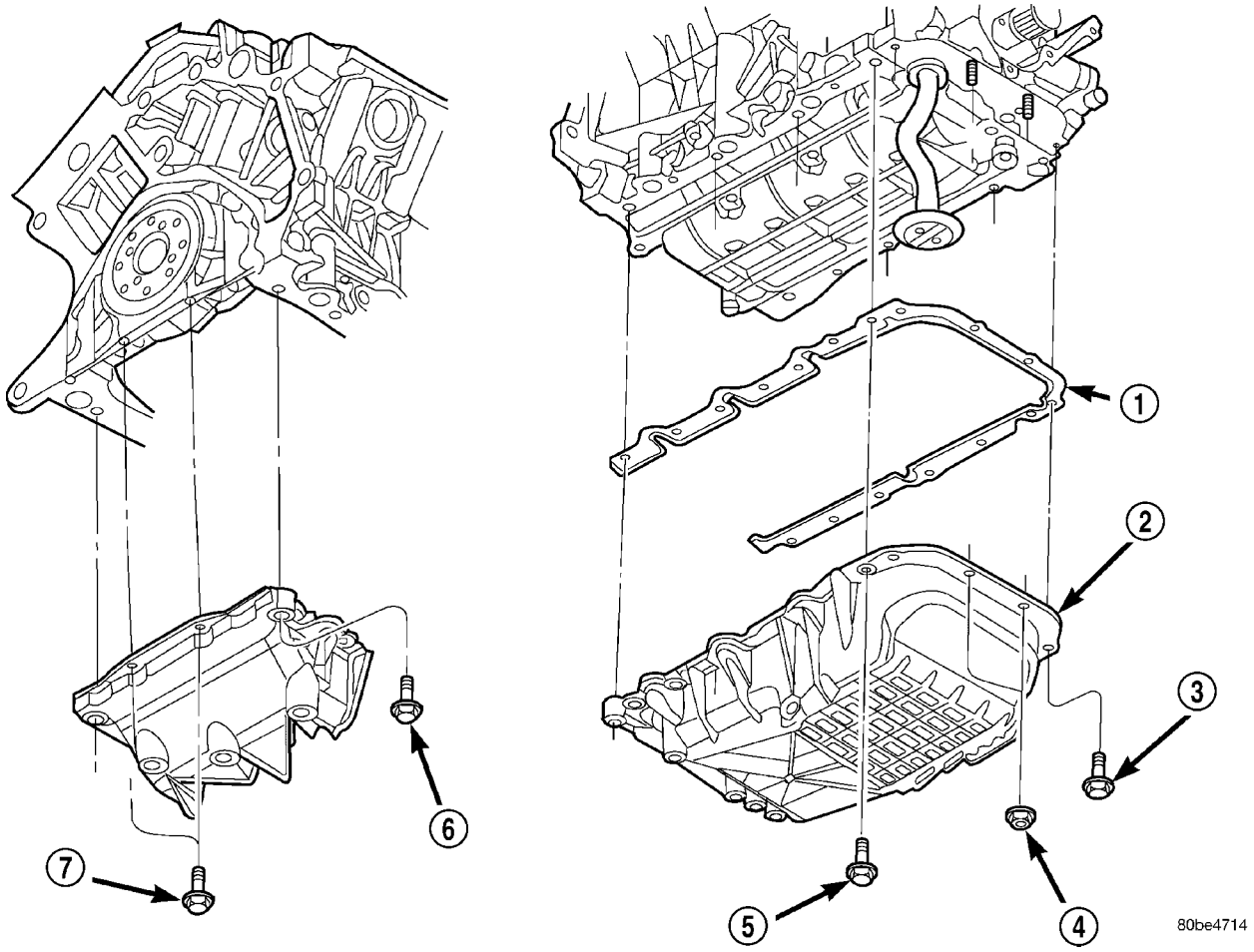

Fig. 105 OIL PAN

1 - GASKET
2 - OIL PAN
3 - BOLT-M6
4 - NUT-M6
5 - BOLT-M8
6 - BOLT-M8
7 - BOLT-M6

INSTALLATION

(1) Apply a 1/8 inch bead of Mopar® Engine RTV GEN II at the parting line of the oil pump housing and the rear seal retainer (Fig. 106).

(2) Install oil pan gasket to the engine block.

(3) Install pan and attaching fasteners (Fig. 105).

(4) Install the structural collar (Fig. 104), using the follow procedure:

(a) Install the **vertical** collar to oil pan bolts. Pre-torque bolts to 1.1 N·m (10 in. lbs.).

(b) Install the **horizontal** collar to transmission bolts and tighten to 55 N·m (40 ft. lbs.).

(c) Starting with center vertical bolts and working outward, final torque all bolts to 55 N·m (40 ft. lbs.).

(5) Lower vehicle and install dipstick and tube.

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

(7) Connect negative cable.

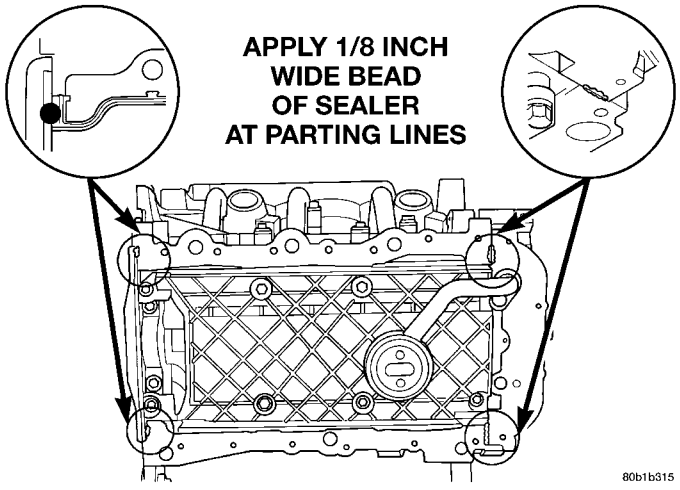

Fig. 106 OIL PAN SEALING

OIL PRESSURE RELIEF VALVE

REMOVAL

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

(2) To remove the relief valve, proceed as follows:

(a) Remove the cotter pin that retains the retainer cap.

(b) Drill a 3.175 mm (1/8 inch.) hole into the relief valve retainer cap

(c) Insert a self-threading sheet metal screw into cap.

(d) Using a suitable slide hammer tool, remove retainer cap. Discard retainer cap

(e) Remove spring and relief valve (Fig. 107).

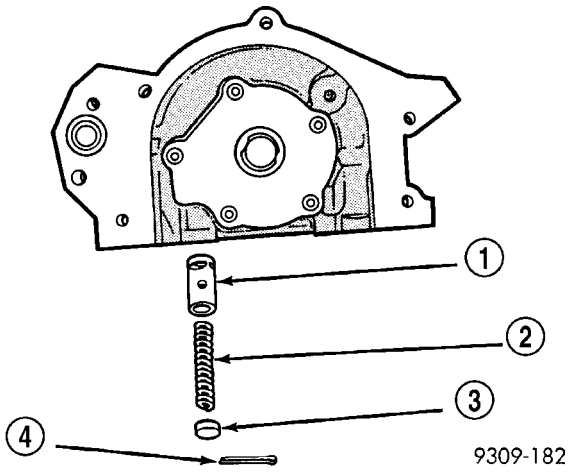

Fig. 107 Oil Pressure Relief Valve

1 - RELIEF VALVE
2 - SPRING
3 - RETAINER CAP
4 - COTTER PIN

INSPECTION

(1) Inspect oil pressure relief valve plunger for scoring and free operation in its bore. Small marks may be removed with 400-grit wet or dry sandpaper.

(2) The relief valve spring has a free length of approximately 49.5 mm (1.95 in.) it should test between 101–110 N (23–25 lbs.) when compressed to 34 mm (1.34 in.). Replace spring that fails to meet specifications.

INSTALLATION

(1) Lubricate relief valve with oil.

CAUTION: The pressure relief valve must be installed as shown in (Fig. 107), or engine damage may occur.

(2) Install valve, spring and retainer cap (Fig. 107).

(3) Install new cotter pin.

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

OIL PRESSURE SWITCH

DESCRIPTION

The engine oil pressure switch is located on the lower left front side of the engine (Fig. 108). It screws into the engine oil cooler adapter fitting that is installed into the engine main oil gallery. 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) Position an oil collecting container under switch location.

(3) Disconnect electrical connector (Fig. 108).

(4) Hold oil cooler fitting with a wrench.

(5) Unscrew oil pressure switch from fitting (Fig. 108).

INSTALLATION

(1) Apply Mopar® Thread Sealant to the switch threads.

(2) Install oil pressure switch to fitting (Fig. 108).

(3) Hold oil cooler fitting with a wrench and tighten oil pressure switch.

(4) Connect electrical connector (Fig. 108).

(5) Lower vehicle.

(6) Start engine and check for leaks.

(7) Check engine oil level and adjust as neccessary.

OIL PRESSURE SWITCH (Continued)

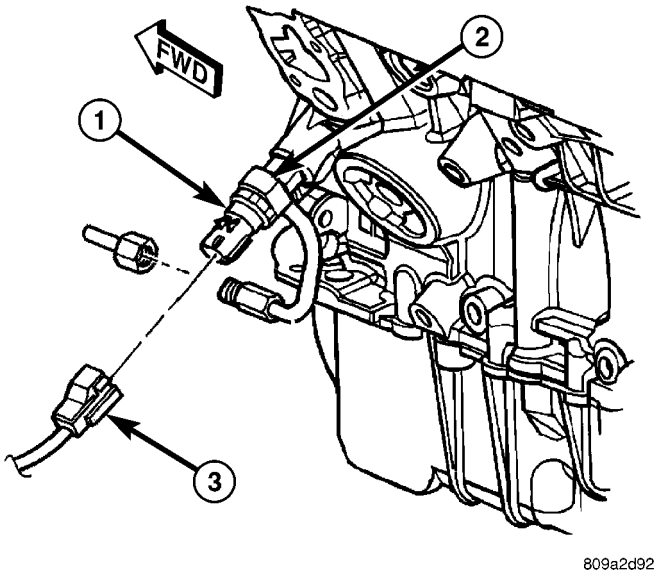

Fig. 108 OIL PRESSURE SWITCH

1 - OIL PRESSURE SWITCH
2 - OIL COOLER FITTING
3 - ELECTRICAL CONNECTOR

OIL PUMP

REMOVAL

It is necessary to remove the oil pump body to service the oil pump rotors.

The oil pump pressure relief valve can be serviced by removing the oil pan. (Refer to 9 - ENGINE/LUBRICATION/OIL PRESSURE RELIEF VALVE - REMOVAL)

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

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

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

(4) Remove the timing belt. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL)

(5) Remove the crankshaft sprocket. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL)

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

(7) Remove the oil pickup tube.

(8) Remove the oil pump fasteners. Remove pump and gasket from engine (Fig. 109).

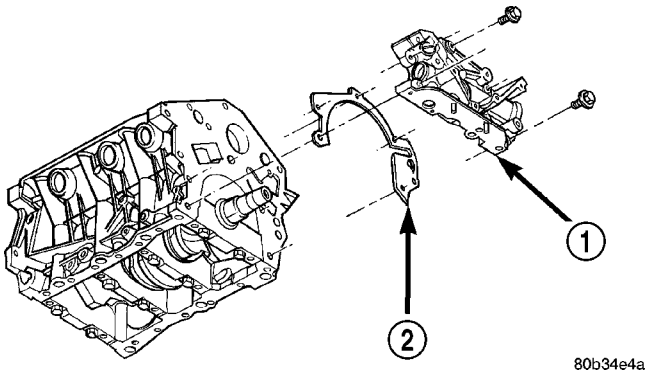

Fig. 109 OIL PUMP - REMOVAL/INSTALLATION

1 - OIL PUMP
2 - GASKET

DISASSEMBLY

(1) To remove the relief valve, proceed as follows:

(2) Remove cotter pin. Drill a 3.175 mm (1/8 inch.) hole into the relief valve retainer cap and insert a self-threading sheet metal screw into cap.

(3) Clamp screw into a vise and while supporting oil pump body, remove cap by tapping oil pump body using a soft hammer. Discard retainer cap and remove spring and relief valve (Fig. 110).

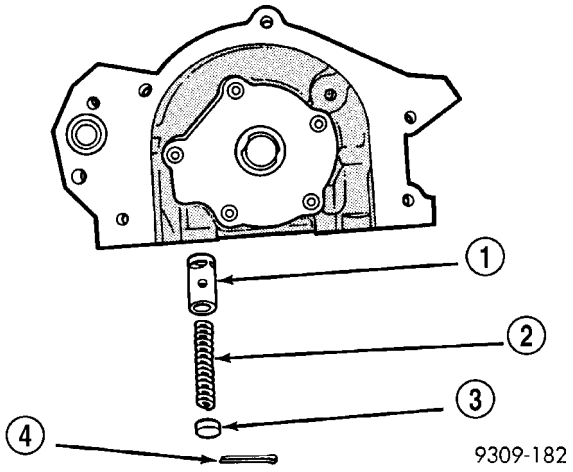

Fig. 110 Oil Pressure Relief Valve

1 - RELIEF VALVE
2 - SPRING
3 - RETAINER CAP
4 - COTTER PIN

(4) Remove oil pump cover screws, and lift off cover.

(5) Remove pump rotors.

(6) Wash all parts in a suitable solvent and inspect carefully for damage or wear (Fig. 111).

OIL PUMP (Continued)

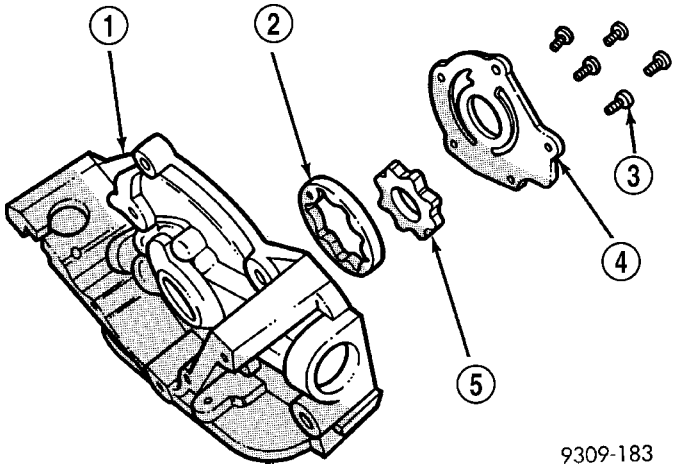

Fig. 111 Oil Pump

1 - OIL PUMP BODY
2 - OIL PUMP OUTER ROTOR
3 - SCREWS
4 - OIL PUMP COVER
5 - OIL PUMP INNER ROTOR

CLEANING

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

INSPECTION

(1) Disassemble oil pump. (Refer to 9 - ENGINE/ LUBRICATION/OIL PUMP - DISASSEMBLY)

(2) Clean all parts thoroughly. Mating surface of the oil pump housing should be smooth. Replace pump cover if scratched or grooved.

(3) Lay a straightedge across the pump cover surface (Fig. 112). If a 0.025 mm (0.001 in.) feeler gauge can be inserted between cover and straight edge, cover should be replaced.

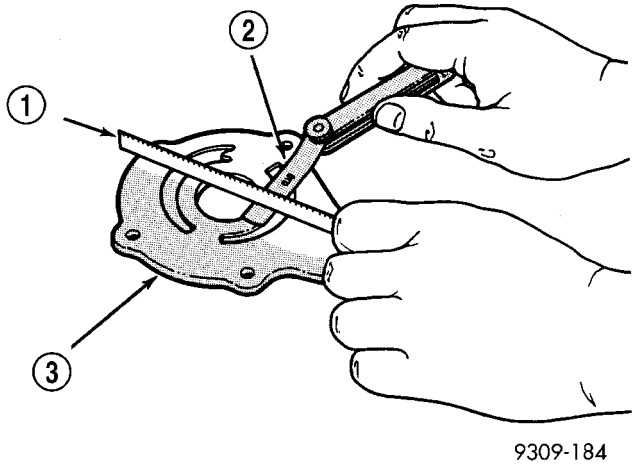

Fig. 112 Checking Oil Pump Cover Flatness

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

(4) Measure thickness and diameter of outer rotor. If outer rotor thickness measures 14.299 mm (0.563 in.) or less (Fig. 113), or if the diameter is 79.78 mm (3.141 inches.) or less, replace outer rotor.

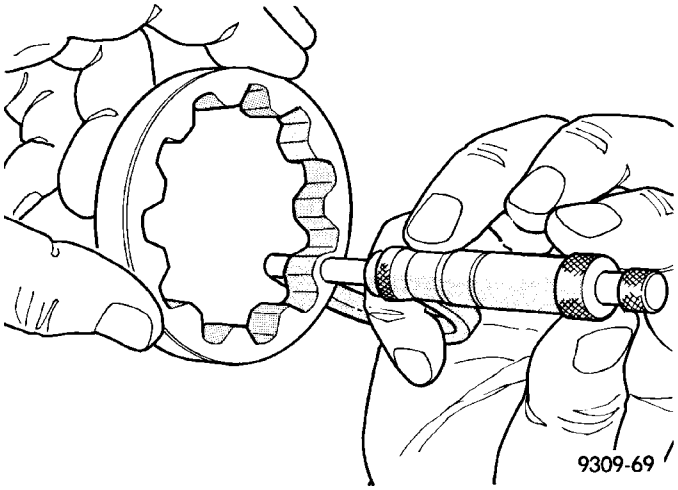

Fig. 113 Measuring Outer Rotor Thickness

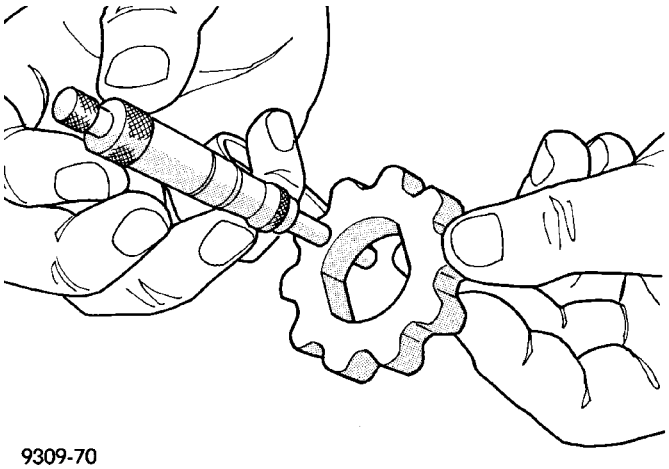

Fig. 114 Measuring Inner Rotor Thickness

(5) If inner rotor measures 14.299 mm (0.563 in.) or less replace inner rotor (Fig. 114).

(6) Slide outer rotor into body, press to one side with fingers and measure clearance between rotor and body (Fig. 115). If measurement is 0.39 mm (0.015 inch.) or more, replace body only if outer rotor is in specifications.

(7) Install inner rotor into body. If clearance between inner and outer rotors (Fig. 116) is 0.20 mm (0.008 inch.) or more, replace both rotors.

(8) Place a straightedge across the face of the body, between bolt holes. If a feeler gauge of 0.077 mm (0.003 in.) or more can be inserted between rotors and the straightedge, replace pump assembly (Fig. 117) **ONLY** if rotors are in specs.

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

OIL PUMP (Continued)

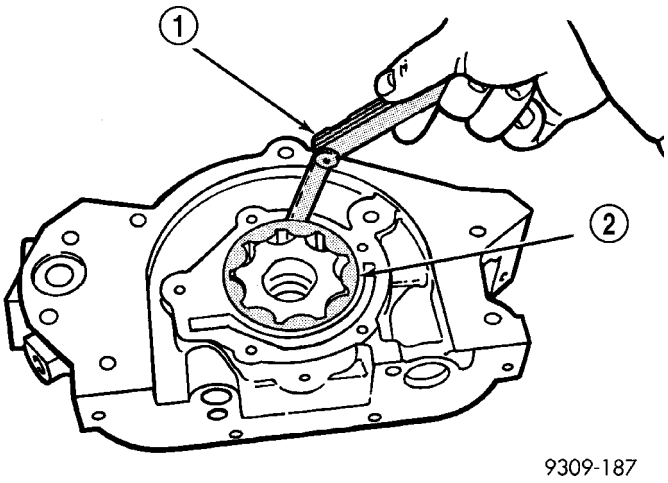

Fig. 115 Measuring Outer Rotor Clearance in Housing

1 - FEELER GAUGE
2 - OUTER ROTOR

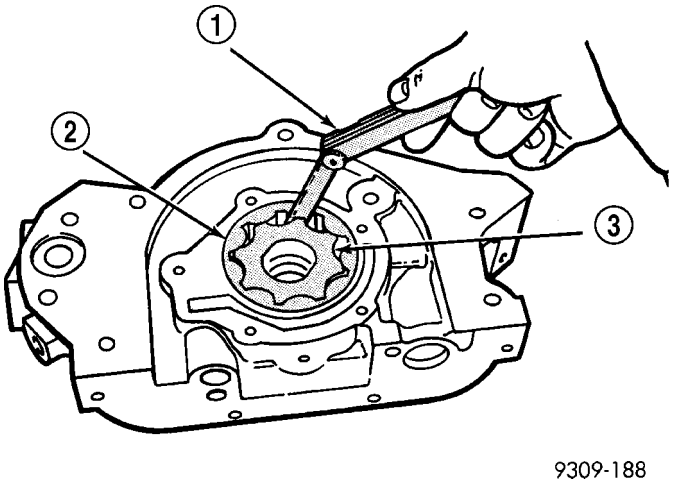

Fig. 116 Measuring Clearance Between Rotors

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

(10) The relief valve spring (Fig. 118) has a free length of approximately 49.5 mm (1.95 in.) it should test between 101–110 N (23–25 lbs.) when compressed to 34 mm (1–11/32 in.). Replace spring that fails to meet specifications.

(11) Assemble oil pump. (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - ASSEMBLY)

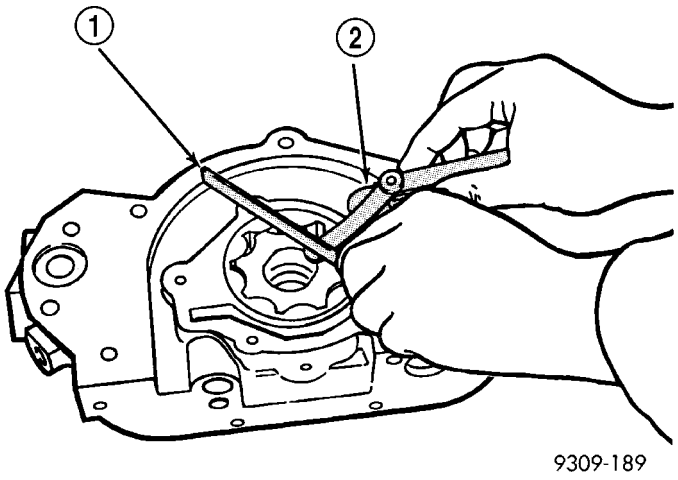

Fig. 117 Measuring Clearance Over Rotors

1 - STRAIGHT EDGE
2 - FEELER GAUGES

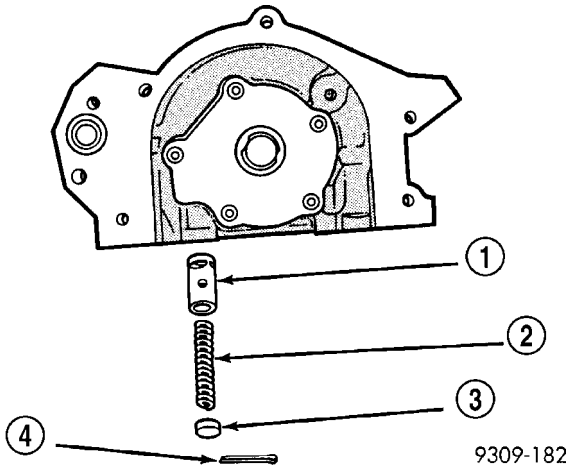

Fig. 118 Oil Pressure Relief Valve

1 - RELIEF VALVE
2 - SPRING
3 - RETAINER CAP
4 - COTTER PIN

ASSEMBLY

(1) Assemble oil pump using new parts as required.

(2) Tighten cover screws to 12 N·m (105 in. lbs.) (Fig. 111).

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

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

OIL PUMP (Continued)

INSTALLATION

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

(2) Install oil pump and gasket carefully over the crankshaft. Position pump onto block and tighten bolts to 28 N·m (250 in. lbs.)

(3) Install new O-ring on oil pickup tube.

(4) Install oil pickup tube.

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

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

(7) Install timing belt. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION)

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

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

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

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

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

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

INTAKE MANIFOLD

DESCRIPTION

The composite upper intake manifold is a cross-flow type with long runners to improve air charge inertia (Fig. 119). An active Short Runner Valve (SRV) opens during certain operating conditions to improve top end performance. A Manifold Tuning Valve (MTV) connects the plenums at specific engine speeds to maximize low RPM torque without reducing high RPM power.

The aluminum lower intake manifold attaches to each cylinder head and uses a gasket for sealing (Fig. 120). The manifold coolant passage allows coolant to flow between cylinder heads. An attached steel tube, allows coolant flow to the heater.

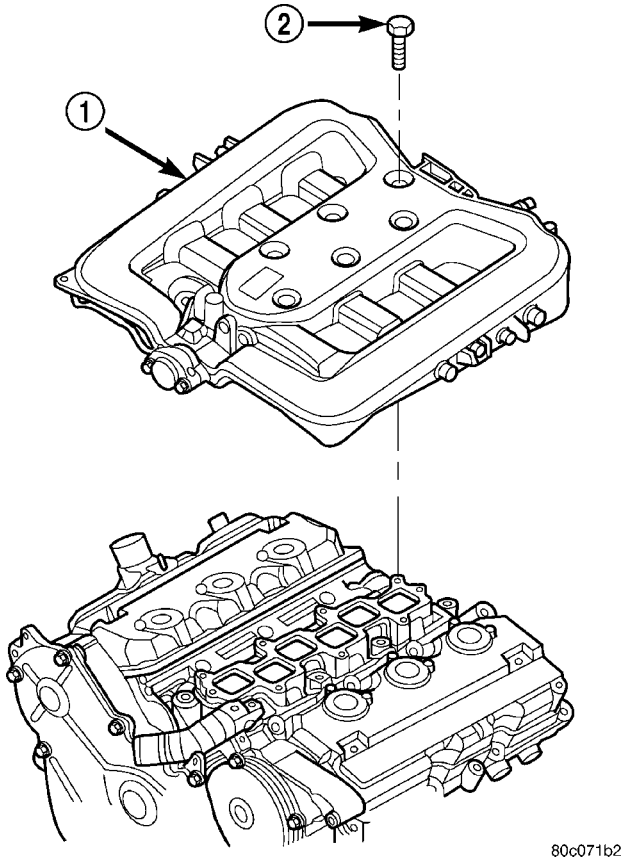

Fig. 119 UPPER INTAKE MANIFOLD

1 - INTAKE MANIFOLD-UPPER
2 - BOLT

INTAKE MANIFOLD (Continued)

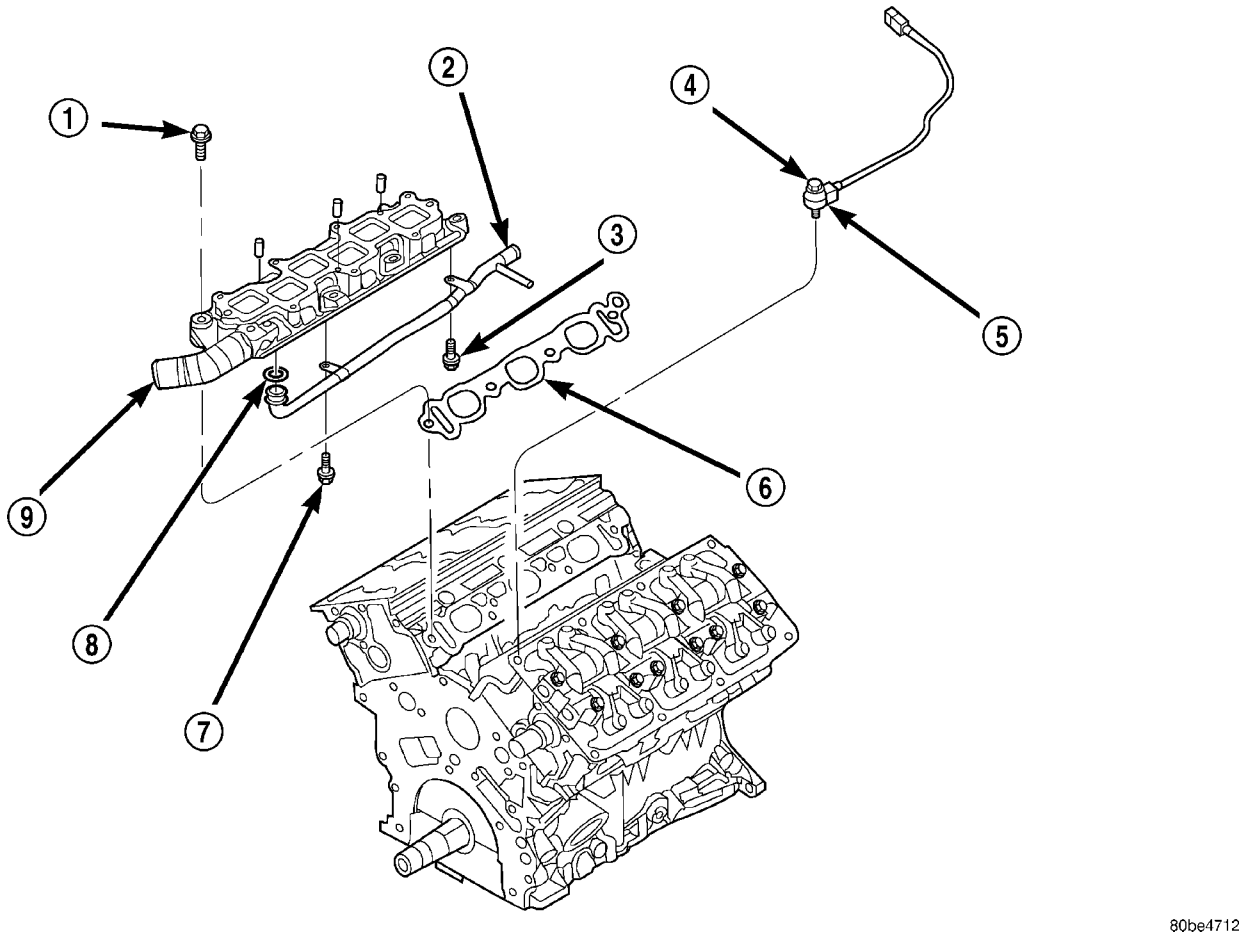

Fig. 120 LOWER INTAKE MANIFOLD

1 - BOLT
2 - HEATER SUPPLY TUBE
3 - BOLT
4 - BOLT
5 - KNOCK SENSOR
6 - GASKET
7 - BOLT
8 - O-RING
9 - INTAKE MANIFOLD-LOWER

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

REMOVAL

(1) Disconnect negative cable from remote jumper terminal.
(2) Disconnect the Inlet Air Temperature (IAT) Sensor connector. Remove air cleaner housing and inlet hose (Fig. 121).
(3) Remove throttle and speed control cables from throttle arm and bracket (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/THROTTLE CONTROL CABLE - REMOVAL).
(4) Disconnect electrical connectors from the following sensors and actuators:

- Short Runner Valve (SRV)(If Equipped)
- Manifold Tuning Valve (MTV)(If Equipped)
- Throttle Position Sensor (TPS)
- Idle Air Control (IAC)
- Manifold Absolute Pressure (MAP)

INTAKE MANIFOLD - UPPER (Continued)

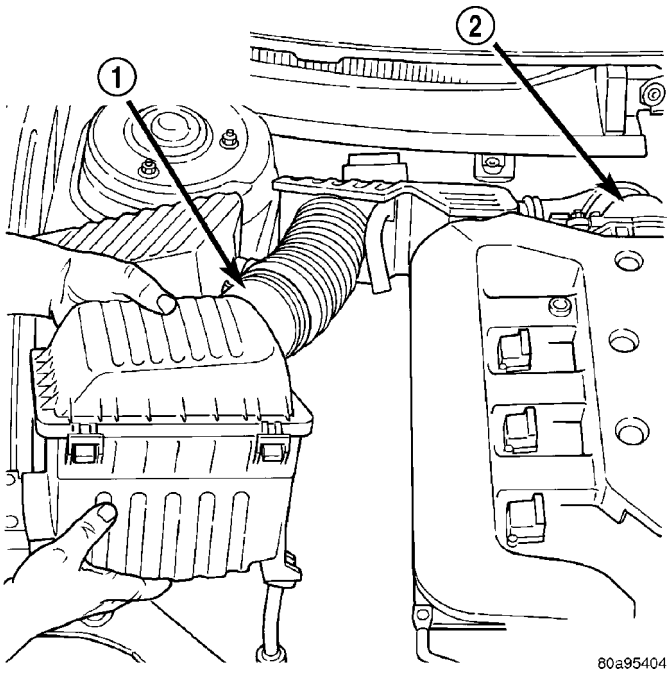

Fig. 121 AIR CLEANER WITH INLET HOSE

1 - AIR CLEANER ASSEMBLY WITH AIR INLET HOSE
2 - THROTTLE BODY

(5) Disconnect vacuum hoses from the following:
- Speed Control Reservoir
- Positive Crankcase Ventilation (PCV) Valve
- Proportional Purge Solenoid
- Power Brake Booster

(6) Remove right side (Fig. 122) and left side (Fig. 123) intake manifold supports.

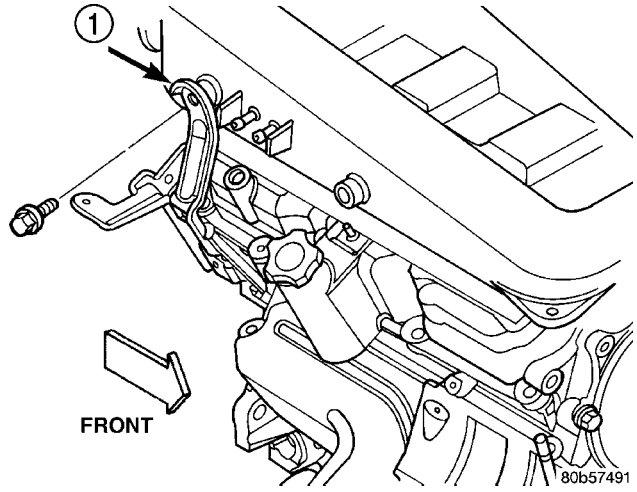

Fig. 122 INTAKE MANIFOLD SUPPORT - RIGHT

1 - SUPPORT BRACKET

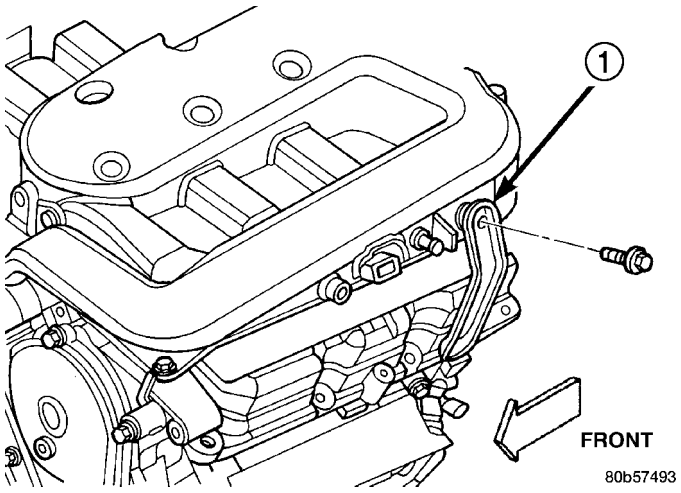

Fig. 123 INTAKE MANIFOLD SUPPORT - LEFT

1 - SUPPORT BRACKET

(7) Remove support brackets at intake manifold front corners and at MTV (Fig. 124).

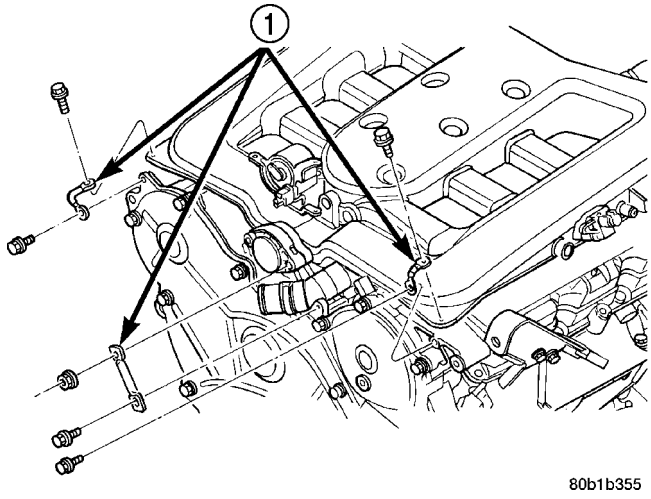

Fig. 124 INTAKE MANIFOLD SUPPORTS - FRONT

1 - SUPPORT BRACKETS

(8) Loosen upper fastener attaching throttle body to support bracket.

(9) Remove bolts attaching intake manifold and remove manifold (Fig. 125).

INTAKE MANIFOLD - UPPER (Continued)

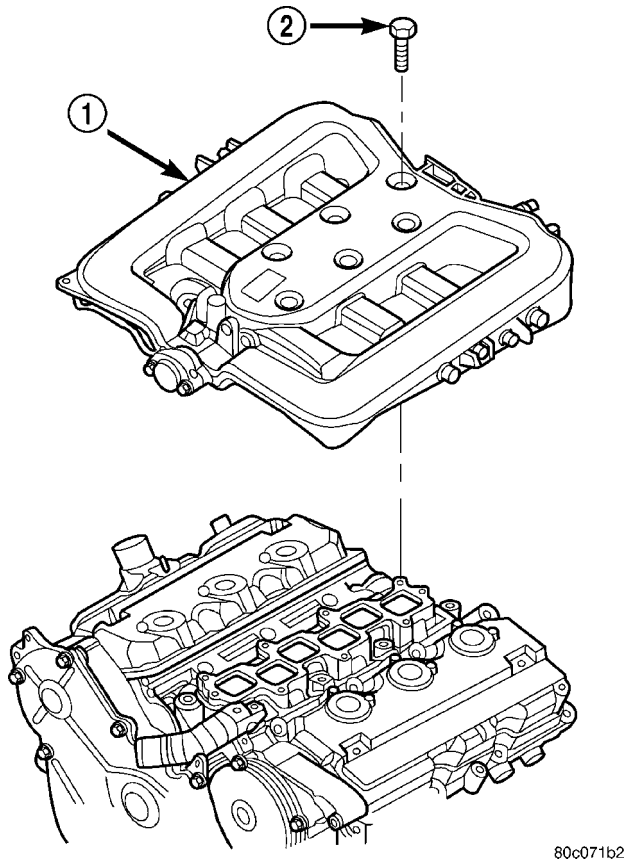

Fig. 125 UPPER INTAKE MANIFOLD

1 - INTAKE MANIFOLD-UPPER
2 - BOLT

INSPECTION

Check manifold for:

- Damage and cracks
- Gasket surface damage or warpage
- Damaged or clogged EGR ports

If the manifold exihibits any damaged or warped conditions, replace the manifold. Clean EGR ports as neccessary.

INSTALLATION

(1) Clean and inspect gasket sealing surfaces.

NOTE: Intake gaskets can be reused, provided they are free of cuts or tears.

(2) Inspect gasket for cuts or tears. Replace gaskets as necessary.

(3) Install intake manifold (Fig. 125) and hand start all attaching bolts.

(4) Tighten bolts gradually in sequence shown in (Fig. 126)until a torque of 12 N·m (105 in. lbs.) is obtained.

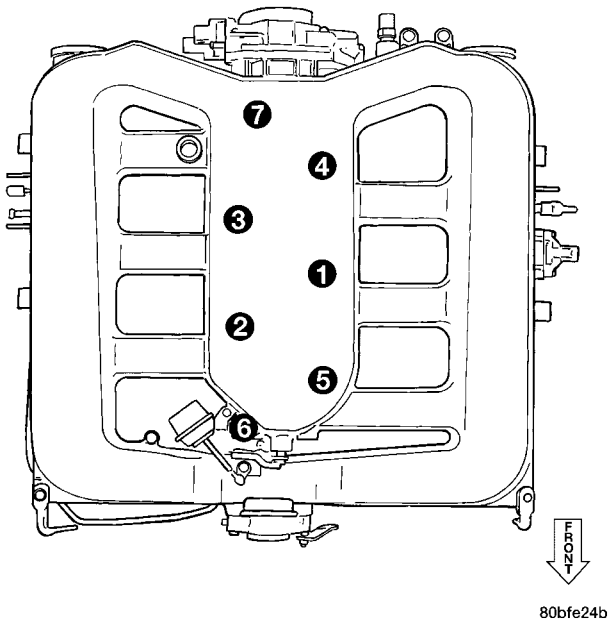

Fig. 126 UPPER INTAKE MANIFOLD TIGHTENING

(5) Install right side (Fig. 122) and left side (Fig. 123) intake manifold supports.

(6) Install manifold support brackets at front corners and at MTV (Fig. 124).

(7) Tighten fastener attaching throttle body to support bracket.

(8) Connect vacuum lines to the following:

- Speed Control Reservoir
- Positive Crankcase Ventilation (PCV) Valve
- Proportional Purge Solenoid
- Power Brake Booster

(9) Connect electrical connectors to the following:

- Short Runner Valve (SRV)(If Equipped)
- Manifold Tuning Valve (MTV)(If Equipped)
- Throttle Position Sensor (TPS)
- Idle Air Control (IAC)
- Manifold Absolute Pressure (MAP)

(10) Install throttle and speed control cables to bracket and throttle arm (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/THROTTLE CONTROL CABLE - INSTALLATION).

(11) Install air cleaner housing and inlet hose (Fig. 121). Connect Inlet Air Temperature (IAT) Sensor connector.

(12) Connect negative cable to remote jumper terminal.

INTAKE MANIFOLD - LOWER

REMOVAL

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

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

(3) Disconnect the radiator upper hose from the coolant outlet at front of manifold.

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

(5) Disconnect the electrical connectors to fuel injectors and coolant temperature sensor.

(6) Disconnect heater and coolant bottle supply hoses from coolant tube at rear of intake manifold (Fig. 127).

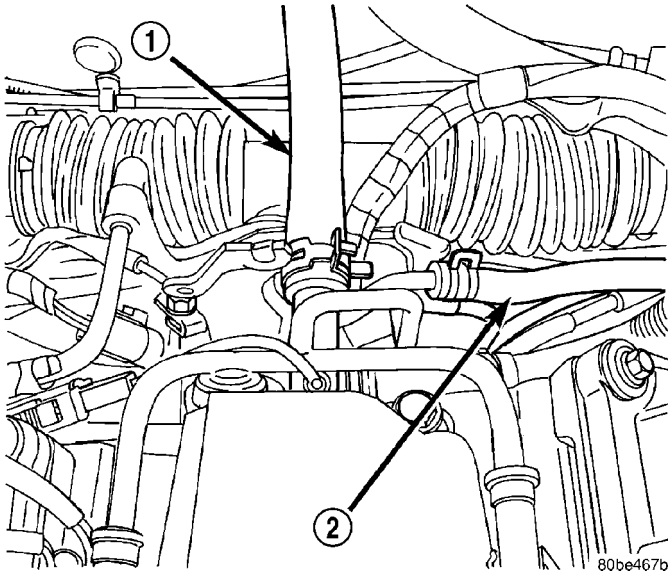

Fig. 127 HEATER SUPPLY HOSE CONNECTIONS

1 - HEATER SUPPLY HOSE
2 - COOLANT BOTTLE SUPPLY HOSE

(7) Disconnect the fuel supply hose from fuel rail. (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/ FUEL LINES - STANDARD PROCEDURE)

(8) Remove the screw attaching the fuel rail support bracket to the throttle body support bracket.

(9) Remove the bolts attaching fuel rail.

(10) Remove fuel rail and injectors as an assembly.

(11) Remove bolts attaching lower intake and remove intake manifold (Fig. 128).

INSPECTION

Check manifold for:

- Damage and cracks
- Gasket surface damage or warpage
- Damaged fuel injector ports

If the manifold exihibits any of these conditions, replace the manifold.

INSTALLATION

(1) Clean all sealing surfaces.

NOTE: Gaskets can be reused provided they are free of tears or cuts.

(2) Inspect gaskets for tears or cuts. Replace as necessary.

(3) Position gaskets and intake manifold on cylinder head surfaces.

(4) Install fuel rail with injectors.

(5) Install intake manifold bolts and gradually tighten in sequence shown in (Fig. 129) until a torque of 28 N·m (250 in. lbs.) is obtained.

(6) Install screw attaching fuel rail support bracket to the throttle body support bracket.

(7) Connect fuel supply hose to fuel rail. (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/FUEL LINES - STANDARD PROCEDURE)

(8) Connect heater and coolant bottle supply hoses to coolant tube at rear of intake manifold (Fig. 127).

(9) Connect electrical connectors to fuel injectors and coolant temperature sensor.

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

(11) Connect the radiator upper hose to the coolant outlet at front of lower manifold.

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

INTAKE MANIFOLD - LOWER (Continued)

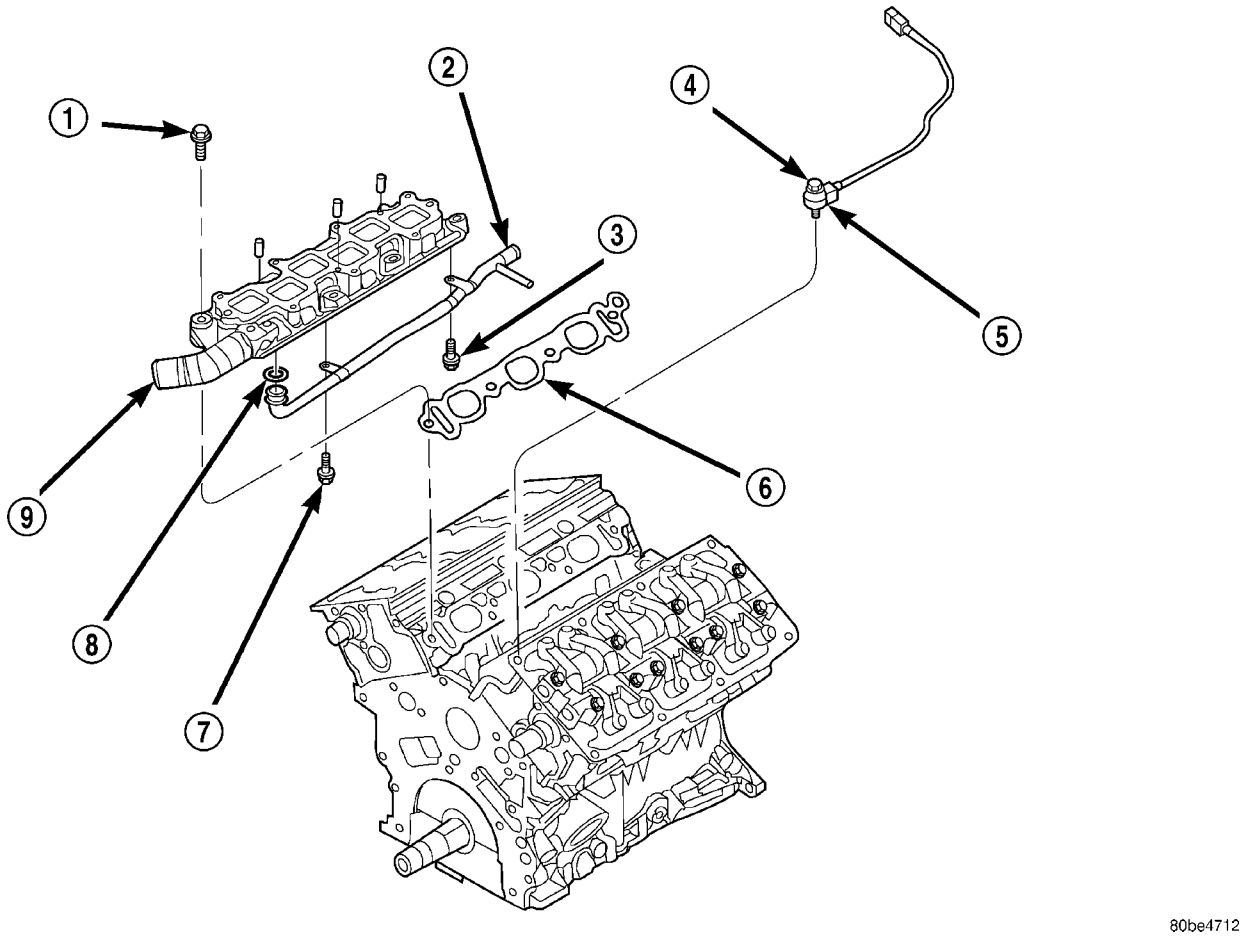

Fig. 128 LOWER INTAKE MANIFOLD

1 - BOLT
2 - HEATER SUPPLY TUBE
3 - BOLT
4 - BOLT
5 - KNOCK SENSOR
6 - GASKET
7 - BOLT
8 - O-RING
9 - INTAKE MANIFOLD-LOWER

INTAKE MANIFOLD - LOWER (Continued)

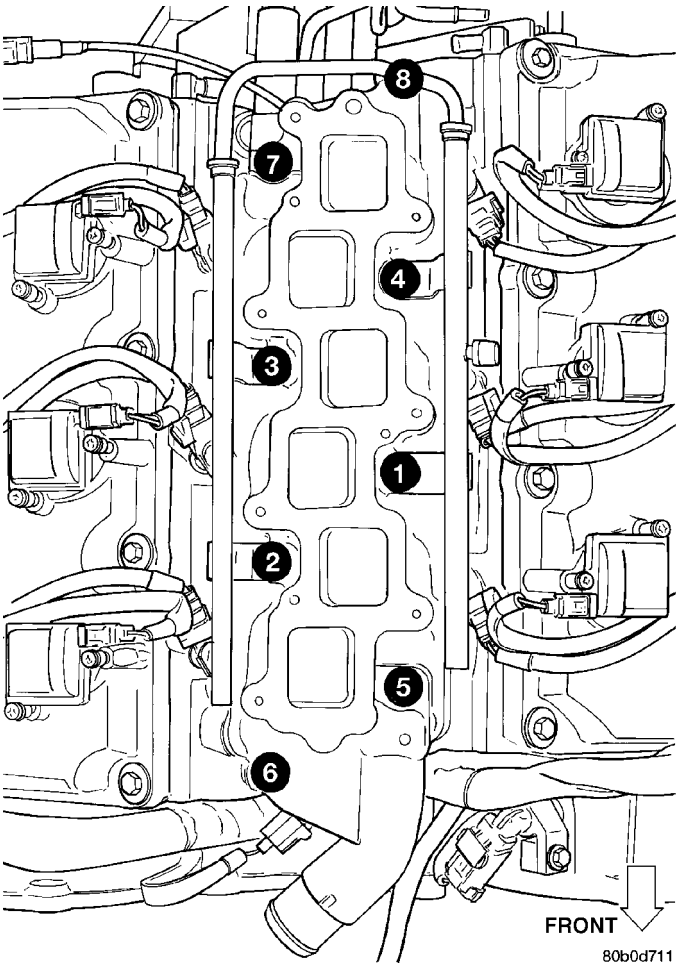

Fig. 129 LOWER INTAKE MANIFOLD TIGHTENING

EXHAUST MANIFOLD

DESCRIPTION

Both manifolds are a log style made of ductile cast iron (Fig. 130). The outlets are designed for V-Band clamp attachment of close coupled catalytic converters.

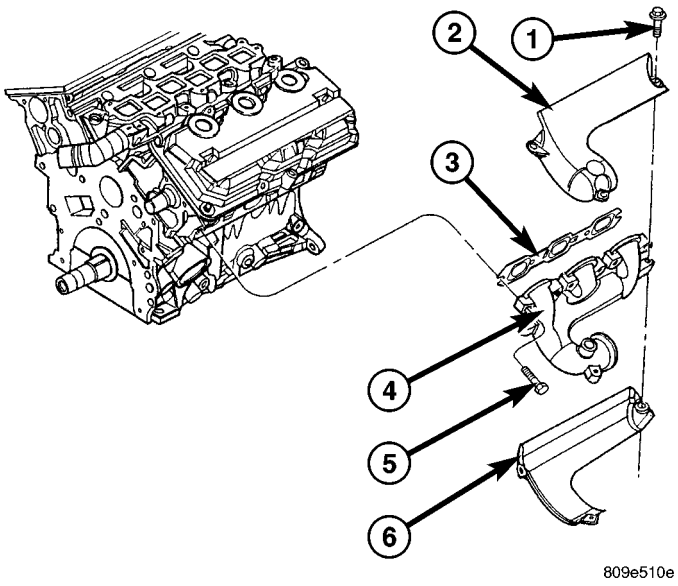

Fig. 130 EXHAUST MANIFOLD

1 - BOLT - HEAT SHIELD
2 - HEAT SHIELD
3 - GASKET
4 - EXHAUST MANIFOLD
5 - BOLT - EXHAUST MANIFOLD
6 - HEAT SHIELD

EXHAUST MANIFOLD - RIGHT

REMOVAL

(1) Disconnect negative cable from remote jumper terminal.

(2) Raise vehicle on hoist.

(3) Remove the exhaust system. (Refer to 11 - EXHAUST SYSTEM - REMOVAL)

(4) Loosen converter pipe support attaching bolt at transaxle mount.

(5) Loosen the A/C belt. (Refer to 7 - COOLING/ ACCESSORY DRIVE/DRIVE BELTS - REMOVAL)

(6) Lower vehicle.

(7) Remove air cleaner housing and air inlet tube.

(8) Loosen and remove V-Band clamp at exhaust manifold connector.

EXHAUST MANIFOLD - RIGHT (Continued)

NOTE: Do not reuse V-Band clamp.

(9) Remove the A/C compressor attaching bolts and set compressor aside.
(10) Remove engine oil dipstick tube.
(11) Remove the A/C compressor bracket.
(12) Disconnect oxygen sensor electrical connector and remove sensor.
(13) Remove heat shield attaching bolts and remove heat shields (Fig. 130).
(14) Remove the exhaust manifold attaching bolts (Fig. 131).
(15) Remove the exhaust manifold and gasket (Fig. 131).

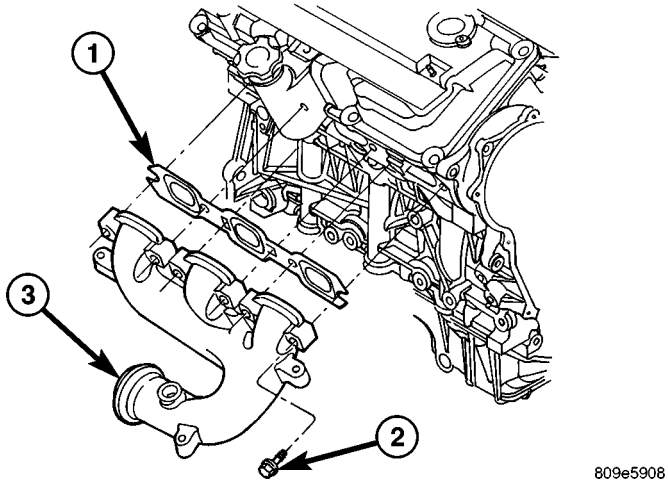

Fig. 131 EXHAUST MANIFOLD - RIGHT SIDE

1 - GASKET
2 - BOLT - EXHAUST MANIFOLD
3 - EXHAUST MANIFOLD

INSPECTION

(1) Inspect exhaust manifolds for damage or cracks.
(2) Check manifold flatness.
(3) Inspect the exhaust manifold gasket for obvious discoloration or distortion.
(4) Check distortion of the cylinder head mounting surface with a straightedge and thickness gauge.

INSTALLATION

(1) Install exhaust manifold and gasket. Tighten bolts starting at the center working outward to 23 N·m (200 in. lbs.) (Fig. 131).
(2) Install heat shields and tighten attaching bolts to 12 N·m (105 in. lbs.) (Fig. 130).
(3) Install oxygen sensor to manifold and connect electrical connector.
(4) Install the A/C compressor mounting bracket.
(5) Install engine oil dipstick tube.
(6) Install the A/C compressor and drive belt. For belt installation procedure, (Refer to 7 - COOLING/ ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).
(7) Install a new V-Band clamp and tighten to 11 N·m (100 in. lbs.).
(8) Raise vehicle on hoist.
(9) Install the exhaust system. (Refer to 11 - EXHAUST SYSTEM - INSTALLATION)
(10) Install and/or tighten nut attaching converter pipe support to transaxle mount to 47 N·m (35 ft. lbs.).
(11) Lower the vehicle.
(12) Install air cleaner housing and air inlet tube.
(13) Connect negative cable.

EXHAUST MANIFOLD - LEFT

REMOVAL

(1) Disconnect negative cable from remote jumper terminal.
(2) Raise the vehicle on hoist.
(3) Remove the exhaust system. (Refer to 11 - EXHAUST SYSTEM - REMOVAL)
(4) Loosen converter pipe support attaching bolt at transaxle mount.
(5) Lower the vehicle.
(6) Loosen and remove the V-Band clamp at exhaust manifold connector.

NOTE: Do not reuse V-Band clamp.

(7) Remove electrical connector harness bracket.
(8) Disconnect oxygen sensor electrical connector and remove sensor from manifold.
(9) Remove heat shield attaching bolts and remove heat shield (Fig. 132).
(10) Remove exhaust manifold attaching bolts (Fig. 132).
(11) Remove exhaust manifold and gasket (Fig. 132).

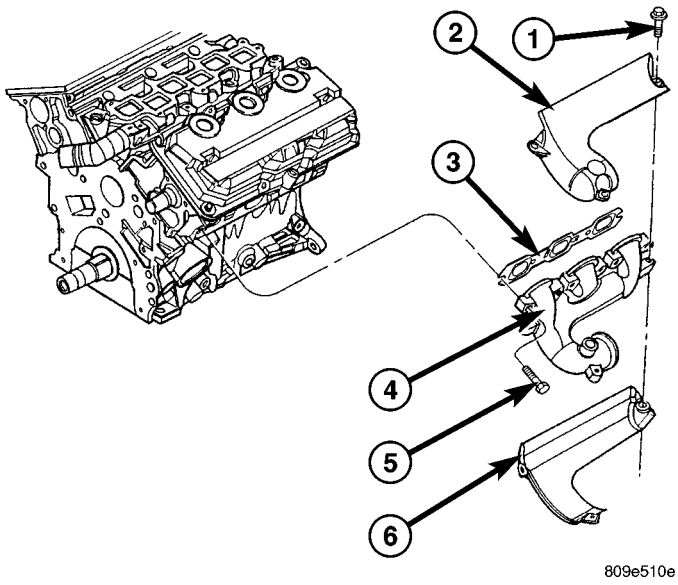

Fig. 132 EXHAUST MANIFOLD

1 - BOLT - HEAT SHIELD
2 - HEAT SHIELD
3 - GASKET
4 - EXHAUST MANIFOLD
5 - BOLT - EXHAUST MANIFOLD
6 - HEAT SHIELD

INSPECTION

(1) Inspect exhaust manifolds for damage or cracks.
(2) Check manifold flatness.
(3) Inspect the exhaust manifold gasket for obvious discoloration or distortion.
(4) Check distortion of the cylinder head mounting surface with a straightedge and thickness gauge.

INSTALLATION

(1) Install the exhaust manifold and gasket. Tighten bolts starting at the center working outward to 23 N·m (200 in. lbs.) (Fig. 132).
(2) Install heat shields and tighten bolts to 12 N·m (105 in. lbs.) (Fig. 132).
(3) Install oxygen sensor to manifold and connect electrical connector.
(4) Attach electrical connector bracket to brace.
(5) Install a new V-Band clamp and tighten to 11 N·m (100 In. lbs.).
(6) Raise vehicle on hoist.
(7) Install and/or tighten nut attaching converter pipe support to transaxle mount to 47 N·m (35 ft. lbs.).
(8) Install the exhaust system. (Refer to 11 - EXHAUST SYSTEM - INSTALLATION)
(9) Lower vehicle and connect negative cable.

VALVE TIMING

DESCRIPTION

The timing drive system (Fig. 133) has been designed to provide quiet performance and reliability to support a **NON** free-wheeling engine.

The timing drive components include a crankshaft sprocket, camshaft sprockets, tensioner pulley, hydraulic tensioner and a timing belt. The water pump is driven by the back side of the timing belt. The right and left camshaft sprockets are not interchangeable because of the cam sensor pick-up wheel on the left sprocket.

VALVE TIMING (Continued)

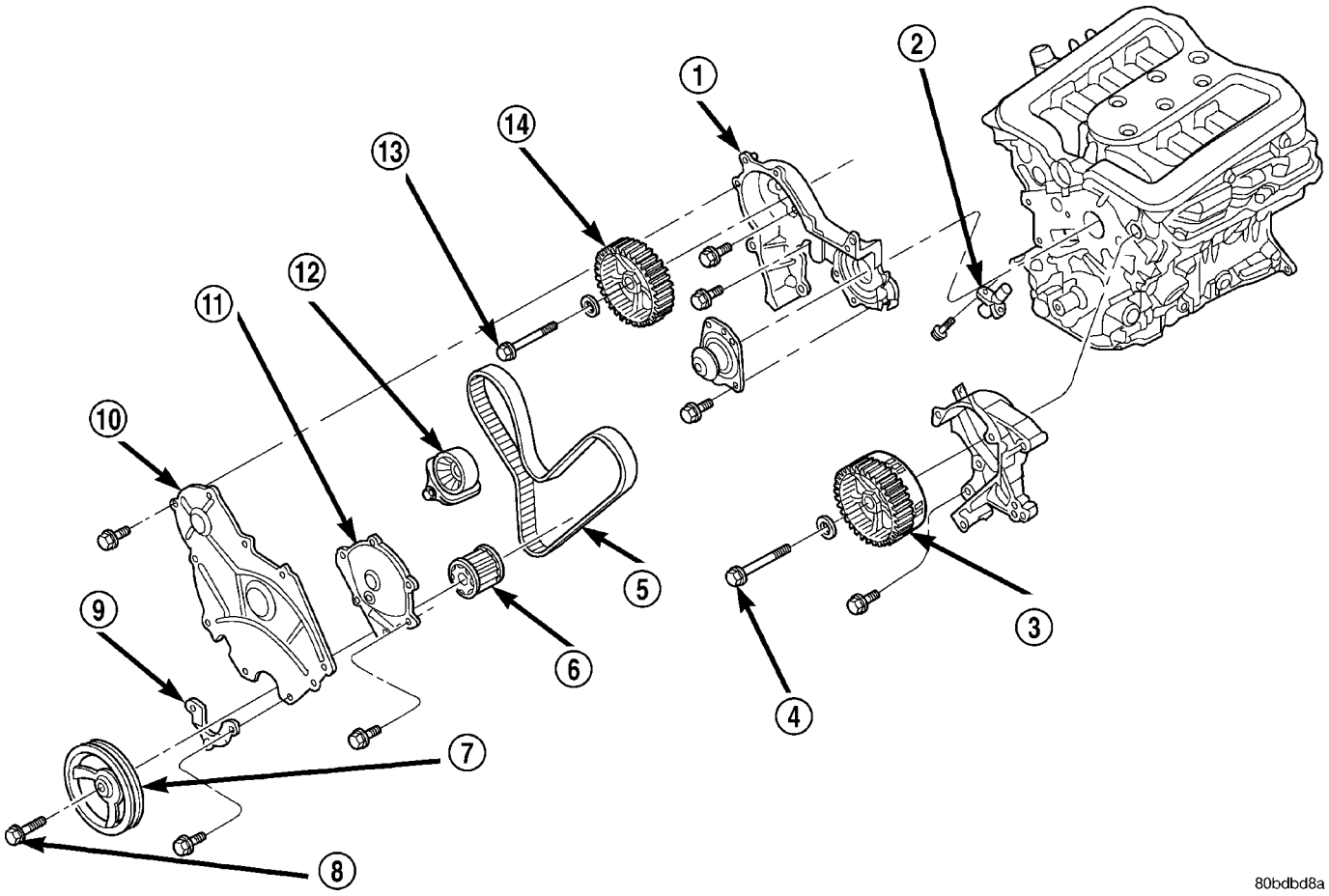

Fig. 133 TIMING DRIVE SYSTEM

1 - TIMING BELT COVER - RIGHT REAR
2 - TENSIONER-TIMING BELT
3 - CAMSHAFT SPROCKET
4 - BOLT-CAMSHAFT SPROCKET
5 - TIMING BELT
6 - CRANKSHAFT SPROCKET
7 - CRANKSHAFT DAMPER
8 - BOLT-CRANKSHAFT DAMPER
9 - TIMING BELT COVER-LOWER
10 - TIMING BELT COVER-RIGHT
11 - TIMING BELT COVER-LEFT
12 - TENSIONER PULLEY
13 - BOLT-CAMSHAFT SPROCKET
14 - CAMSHAFT SPROCKET

STANDARD PROCEDURE - VALVE TIMING VERIFICATION

(1) Refer to Camshaft Sprocket Removal procedure for verification of valve timing (Refer to 9 - ENGINE/ VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL)

TIMING BELT COVER(S) - FRONT

REMOVAL

(1) Disconnect negative cable from remote jumper terminal.

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

(3) Remove the radiator fan (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL)

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

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

TIMING BELT COVER(S) - FRONT (Continued)

(6) Remove the lower belt cover located behind the crankshaft vibration damper (Fig. 135).

(7) Remove the A/C belt guide/lift bracket (Fig. 134).

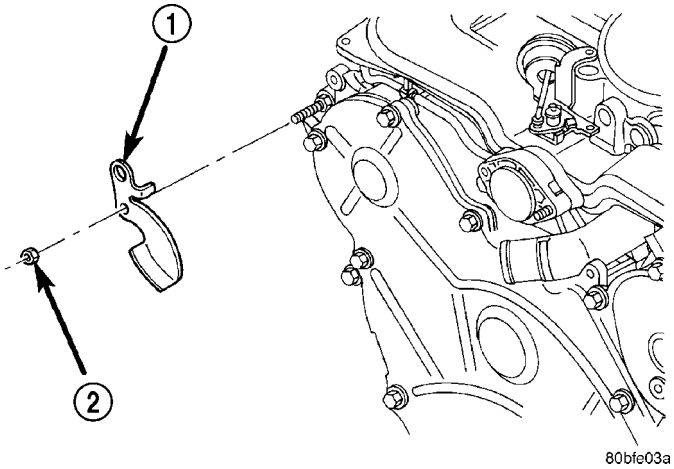

Fig. 134 A/C BELT GUIDE/LIFT BRACKET

1 - A/C BELT GUIDE/LIFT BRACKET
2 - NUT

(8) Remove the stamped steel cover (Fig. 135). **Do not remove the sealer on the cover, it is reusable (Fig. 136).** If some sealer is missing use Mopar® Engine RTV GEN II to replace the missing sealer.

(9) Remove the left cast cover (Fig. 135).

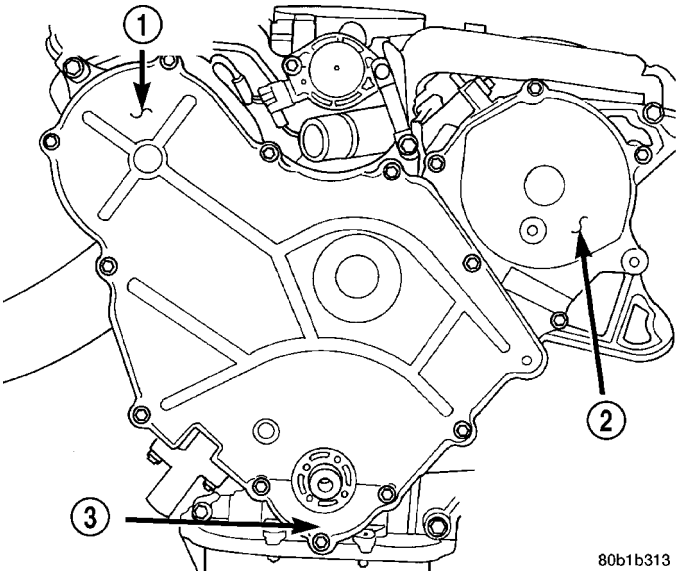

Fig. 135 TIMING BELT COVERS

1 - RIGHT SIDE COVER (STAMPED)
2 - LEFT SIDE COVER (CAST)
3 - LOWER COVER

INSTALLATION

(1) Install the left cast cover (Fig. 135) and generator/power steering belt tensioner pulley and bracket.

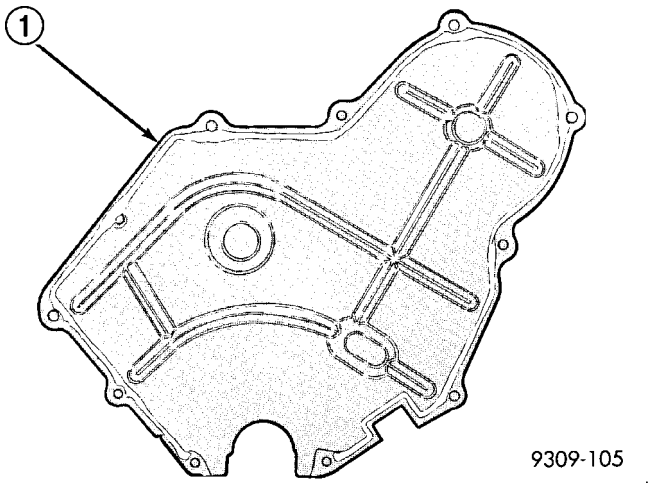

Fig. 136 TIMING BELT COVER SEALER

1 - SEALER

(2) Install the right stamped steel cover (Fig. 135).

(3) Install A/C belt guide/lift bracket (Fig. 134).

(4) Install the lower cover (Fig. 135).

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

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

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

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

(9) Connect negative cable to remote jumper terminal.

TIMING BELT COVER(S) - REAR

REMOVAL

(1) Remove camshaft sprocket(s). (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL)

(2) Remove rear timing belt cover bolts (Fig. 137).

(3) Remove the rear cover(s).

NOTE: The right side rear timing belt cover has O-rings to seal the water pump passages to cylinder block (Fig. 139). Do not reuse the O-rings.

INSTALLATION

(1) Inspect the rear cover foam seals for damage or wear (Fig. 138). Replace as neccessary.

TIMING BELT COVER(S) - REAR (Continued)

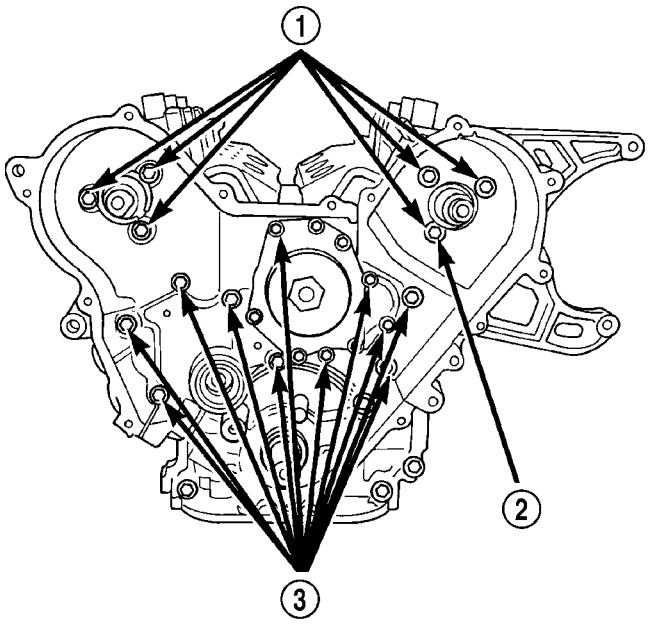

Fig. 137 Rear Timing Belt Cover Bolts

1 - REAR COVER TO CYLINDER HEAD BOLTS
2 - APPLY SEALANT TO BOLT THREADS
3 - REAR COVER TO CYLINDER BLOCK BOLTS

(2) Clean right rear timing belt cover O-ring sealing surfaces and grooves (Fig. 139). Lubricate new O-rings with Mopar® Dielectric Grease or equivalent to facilitate assembly.

(3) Position NEW O-rings on cover (Fig. 139).

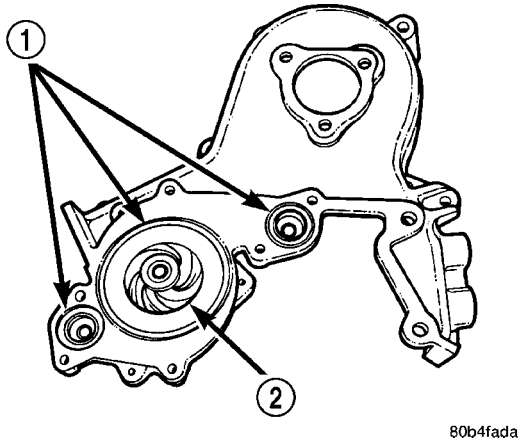

Fig. 139 Right Side Timing Belt Cover O-Rings

1 - O-RINGS
2 - WATER PUMP IMPELLER

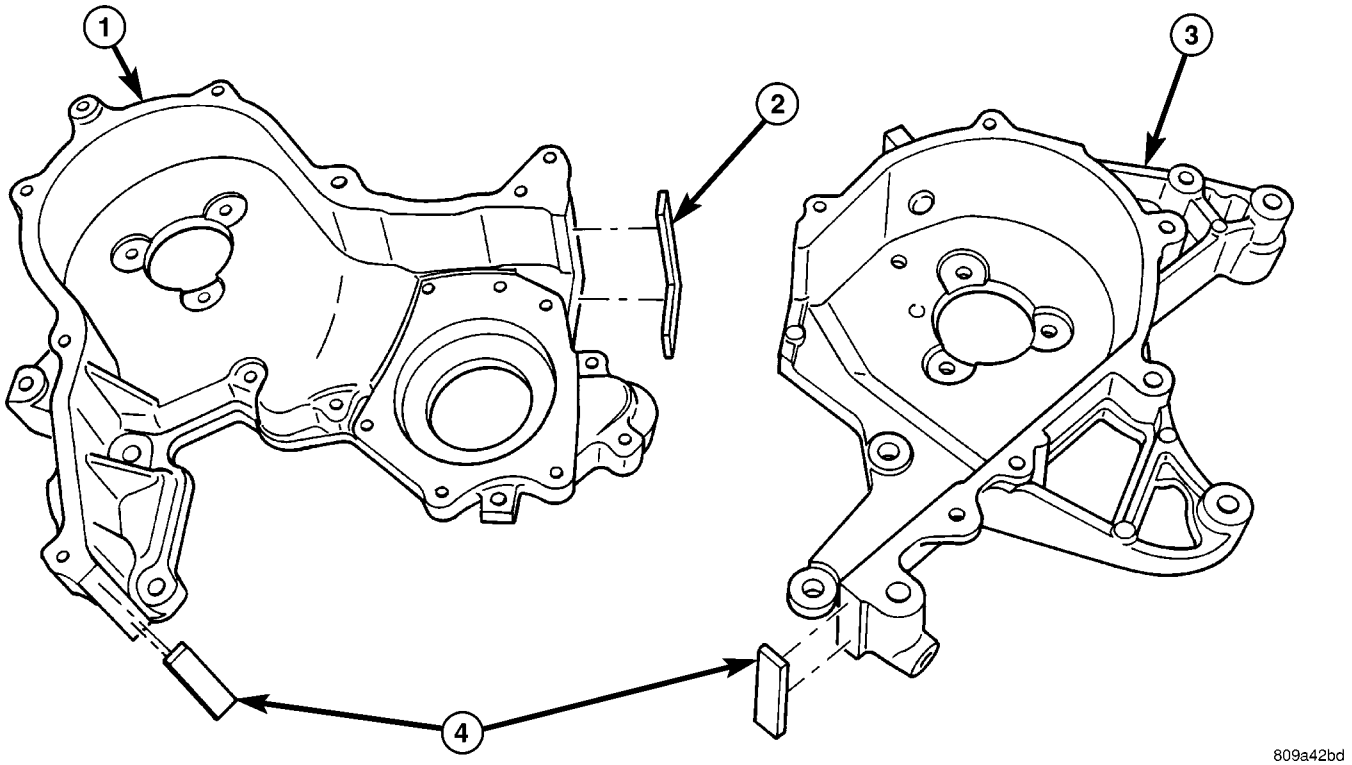

Fig. 138 TIMING COVER REAR SEALS

1 - REAR COVER - RIGHT SIDE
2 - FOAM SEAL
3 - REAR COVER - LEFT SIDE
4 - FOAM SEALS

TIMING BELT COVER(S) - REAR (Continued)

(4) Install rear timing belt covers (Fig. 140) and (Fig. 141). Tighten bolts to the following specified torque:

- M10—54 N·m (40 ft. lbs.)
- M8—28 N·m (20 ft. lbs.)
- M6—12 N·m (105 in. lbs.)

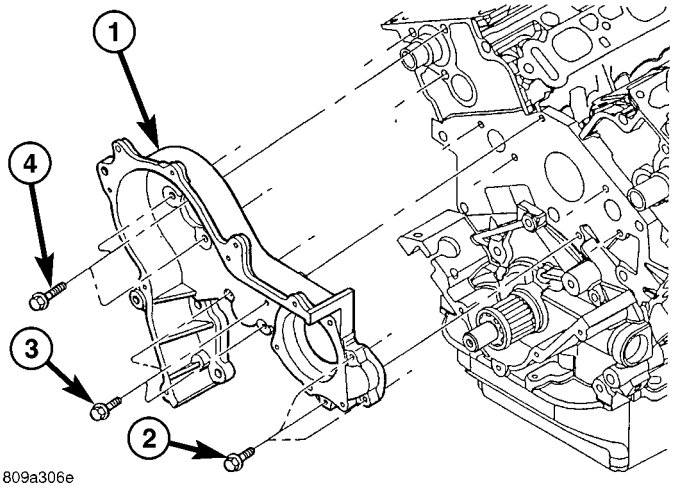

Fig. 140 REAR COVER - RIGHT

1 - REAR COVER - RIGHT SIDE
2 - BOLT
3 - BOLT
4 - BOLT

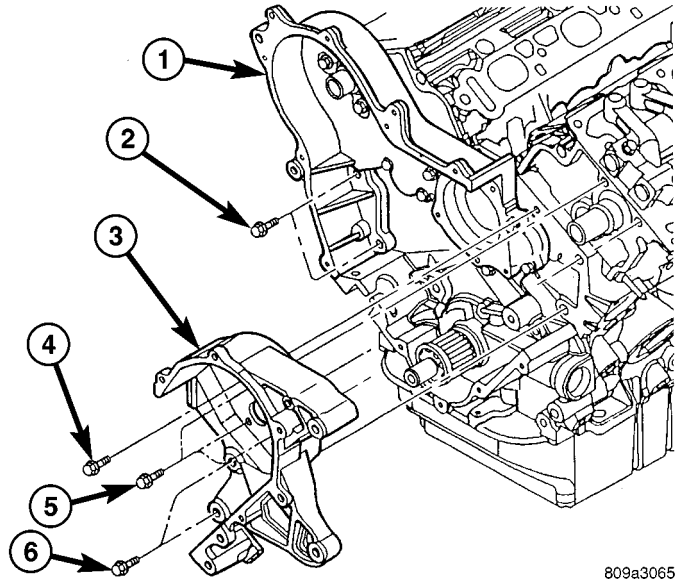

Fig. 141 REAR COVER - LEFT

1 - REAR COVER - RIGHT SIDE
2 - BOLT
3 - REAR COVER - LEFT SIDE
4 - BOLT
5 - BOLT
6 - BOLT

(5) Install camshaft sprockets and reassemble all components. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION)

TIMING BELT TENSIONER & PULLEY

REMOVAL

REMOVAL - TENSIONER PULLEY ASSEMBLY

(1) Remove the timing belt. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT AND SPROCKETS - REMOVAL - TIMING BELT)

(2) Remove the timing belt tensioner pulley and bracket assembly by unscrewing the pivot bolt from the oil pump housing (Fig. 142).

REMOVAL - TENSIONER

(1) For timing belt tensioner removal procedure (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT AND SPROCKETS - REMOVAL - TIMING BELT)

INSPECTION

INSPECTION - TENSIONER PULLEY ASSEMBLY

NOTE: The tensioner pulley, bracket, and pivot bolt is serviced as an assembly.

(1) Inspect pulley for free movement (Fig. 142). Replace if pulley is loose, seized, or rough turning

(2) Inspect pulley bearing and seal (Fig. 142). Replace if damaged.

(3) Inspect pivot bolt for free movement in tensioner bracket (Fig. 142). Replace assembly if seized or excessive looseness.

INSPECTION - TENSIONER

(1) Inspect hydraulic tensioner for fluid loss around the plunger seal (Fig. 143). Replace tensioner if leaking.

INSTALLATION

INSTALLATION - TENSIONER PULLEY ASSEMBLY

(1) Install the timing belt tensioner pulley assembly (Fig. 142). Tighten the pivot bolt to 61 N·m (45 ft. lbs.).

(2) Install the timing belt. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT AND SPROCKETS - INSTALLATION - TIMING BELT)

TIMING BELT TENSIONER & PULLEY (Continued)

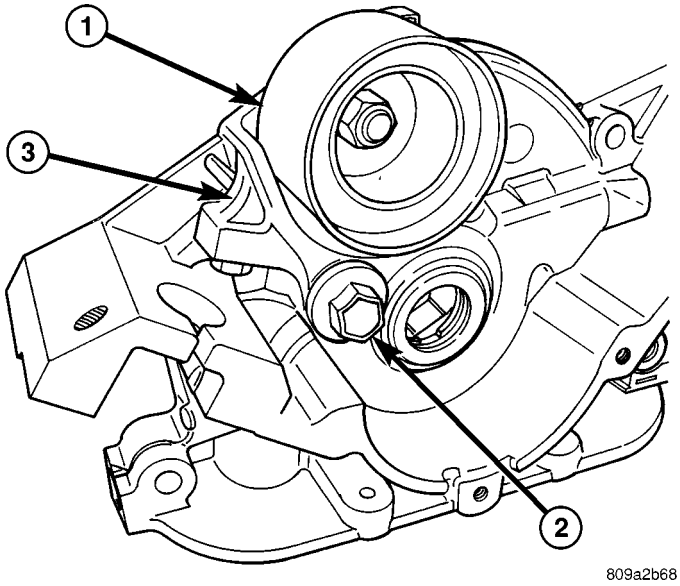

Fig. 142 TENSIONER PULLEY ASSEMBLY

1 - TENSIONER PULLEY
2 - PIVOT BOLT
3 - TENSIONER BRACKET

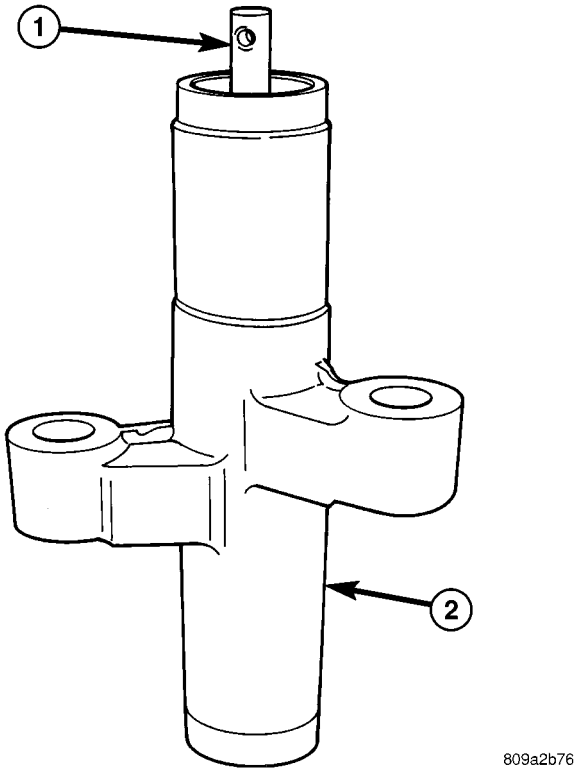

Fig. 143 TIMING BELT TENSIONER

1 - PLUNGER (EXTENDED POSITION)
2 - TENSIONER HOUSING

INSTALLATION - TENSIONER

(1) For timing belt tensioner installation procedure (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT AND SPROCKETS - INSTALLATION - TIMING BELT).

TIMING BELT AND SPROCKETS

REMOVAL

REMOVAL - TIMING BELT

CAUTION: The following procedure can only be used when the camshaft sprockets HAVE NOT BEEN LOOSENED or removed from the camshafts. Once the camshaft sprockets are loosened, an engine timing procedure is required. This procedure is detailed in the Camshaft Removal and Installation procedures (Refer to 9 - ENGINE/VALVE TIMING/ TIMING BELT AND SPROCKETS - REMOVAL).

CAUTION: The 3.2/3.5L are NOT freewheeling engines. Therefore, care should be taken not to rotate the camshafts or crankshaft with the timing belt removed.

(1) Disconnect negative cable from remote jumper terminal.
(2) Remove radiator upper crossmember. (Refer to 23 - BODY/EXTERIOR/GRILLE OPENING REINFORCEMENT - REMOVAL)
(3) Remove the radiator fan. (Refer to 7 - COOLING/ENGINE/RADIATOR FAN - REMOVAL)
(4) Remove the accessory drive belts. (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL)
(5) Remove the crankshaft vibration damper. (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL)
(6) Remove the front timing belt covers. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL)
(7) Mark belt running direction, if timing belt is to be reused.

CAUTION: When aligning timing marks, always rotate engine by turning the crankshaft. Failure to do so will result in valve and/or piston damage.

(8) Rotate engine clockwise until crankshaft mark aligns with the TDC mark on oil pump housing and the camshaft sprocket timing marks are between the marks on the rear covers (Fig. 144).

TIMING BELT AND SPROCKETS (Continued)

CAUTION: Align the camshaft sprockets between the marks on rear belt covers before timing belt removal or damage to valve and/or pistons could occur.

(9) Using a ink or paint marker; mark the exact position of the camshaft sprocket timing mark relative to the two timing marks on the rear timing cover.

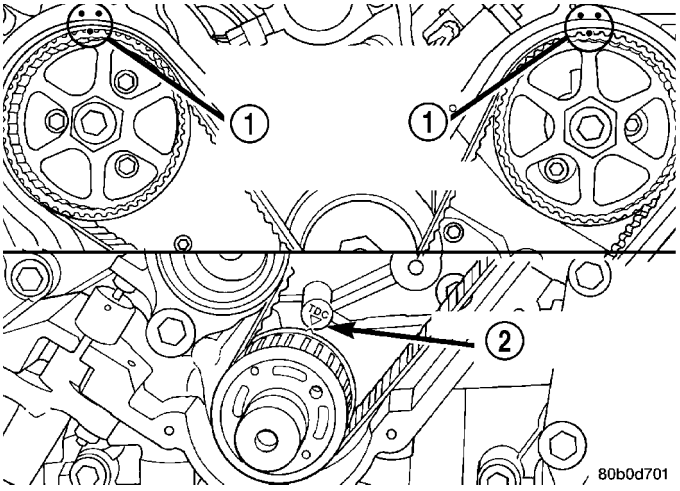

Fig. 144 Engine Timing

1 - ALIGN CAMSHAFT SPROCKET TIMING MARK BETWEEN MARKS ON REAR TIMING BELT COVER
2 - CRANKSHAFT AT TDC

(10) Remove the timing belt tensioner (Fig. 145) and remove timing belt.

TIMING BELT TENSIONER

CAUTION: Compress the tensioner slowly, as damage to tensioner could result.

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

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

(a) Place the tensioner into a vise and SLOWLY compress the plunger (Fig. 146). Total bleed down of tensioner should take about 5 minutes.

(b) When plunger is compressed into the tensioner body install a pin through the body and plunger to retain plunger in place until tensioner is installed.

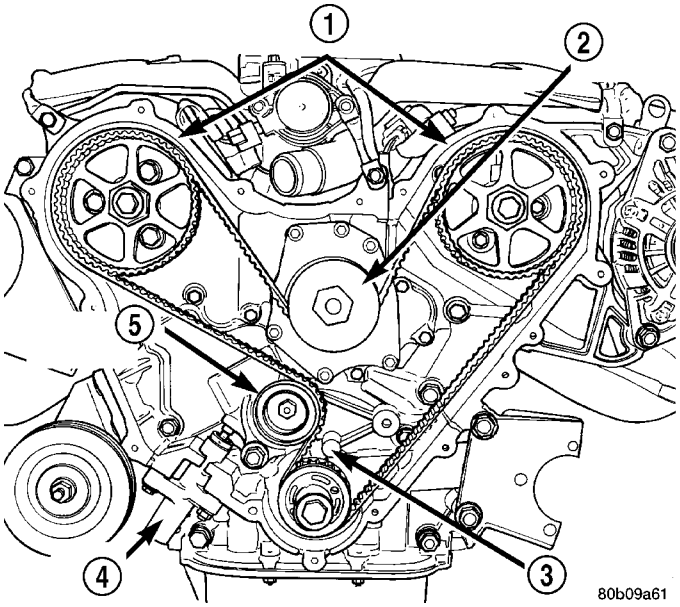

Fig. 145 TIMING BELT SYSTEM

1 - REAR TIMING BELT COVERS
2 - WATER PUMP
3 - TDC INDICATOR
4 - BELT TENSIONER
5 - TENSIONER PULLEY

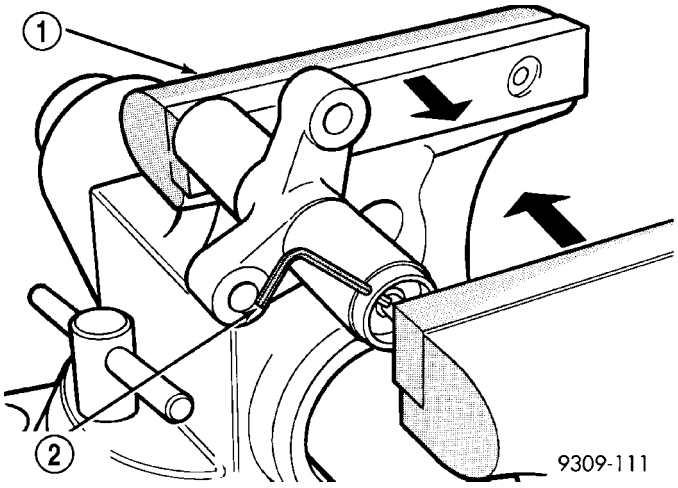

Fig. 146 Compressing Timing Belt Tensioner

1 - VISE
2 - LOCKING PIN

REMOVAL - CAMSHAFT SPROCKETS

CAUTION: The 3.2/3.5L engines are NOT a free-wheeling design. Therefore, care should be taken not to rotate the camshafts or crankshaft with the timing belt removed.

TIMING BELT AND SPROCKETS (Continued)

CAUTION: When camshaft sprocket bolts are loosened or removed, the camshafts must be re-timed to the engine. Also, the camshaft sprocket bolts must NOT be reused.

(1) Remove front timing belt covers. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL)

(2) Position crankshaft sprocket to the TDC mark on the oil pump housing by turning crankshaft in the clockwise direction (Fig. 147).

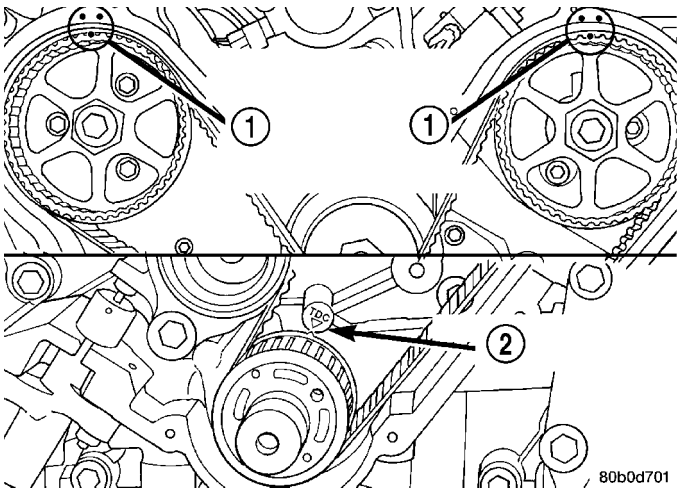

Fig. 147 Camshaft Sprocket Timing Marks

1 - ALIGN CAMSHAFT SPROCKET TIMING MARK BETWEEN MARKS ON REAR TIMING BELT COVER
2 - CRANKSHAFT AT TDC

(3) Install a dial indicator in number 1 cylinder to check TDC of the piston (Fig. 148). Rotate the crankshaft until the piston is at exactly TDC.

(4) Remove camshaft retainer/thrust plates from rear of cylinder heads. To access the right side plate, remove the EGR valve. (Refer to 25 - EMISSIONS CONTROL/EXHAUST GAS RECIRCULATION/ VALVE - REMOVAL)

NOTE: Special Tool 6642 is interchangeable between cylinder banks.

(5) Install Special Tools 6642 Camshaft Alignment tools to the rear of each cylinder head by inserting pin on the alignment tool to the pilot hole on the camshaft. Attach tools using the retainer plate bolts. (Fig. 149).

NOTE: If the alignment tools do not properly line-up to install attaching bolts, first remove the timing belt tensioner, then slowly rotate camshaft with a wrench until bolts can be installed.

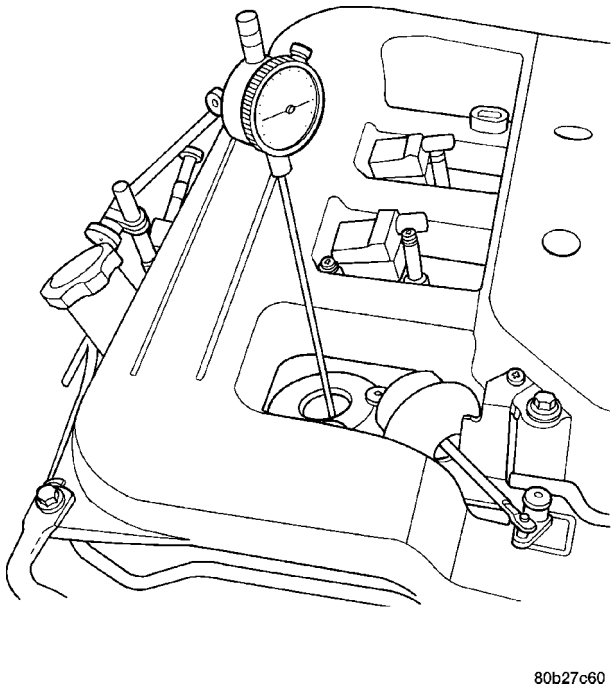

Fig. 148 Dial Indicator

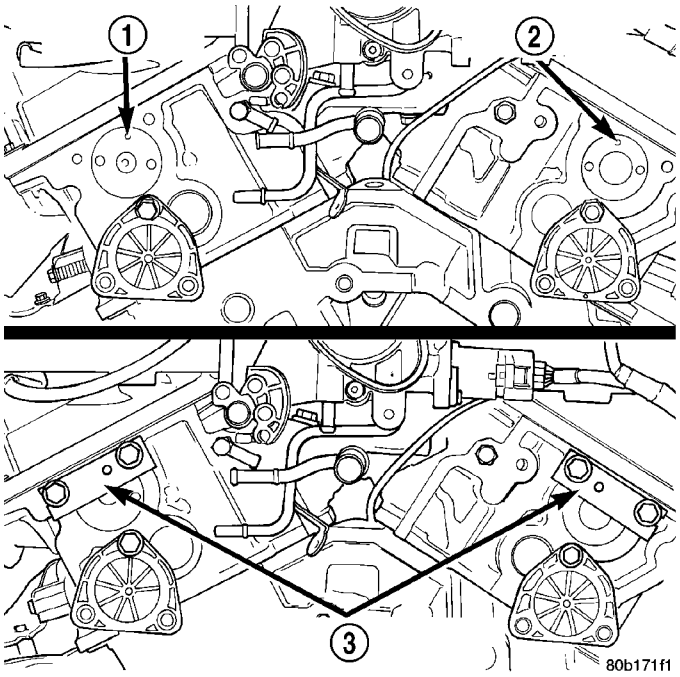

Fig. 149 Camshaft Alignment Holding Tools

1 - LEFT CAMSHAFT PILOT HOLE
2 - RIGHT CAMSHAFT PILOT HOLE
3 - CAMSHAFT ALIGNMENT SPECIAL TOOLS 6642

(6) Remove the timing belt. (Refer to 9 - ENGINE/ VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL)

(7) Hold camshaft sprocket with 36 mm (1 7/16 in.) box end wrench.

TIMING BELT AND SPROCKETS (Continued)

(8) Loosen and remove bolt and washer. To remove the camshaft sprocket bolts with engine in the vehicle, it may be necessary to lift the engine to allow bolt removal clearance. The right bolt is 213 mm (8 3/8 in.) long and the left bolt is 255 mm (10.0 in.) long.

NOTE: Each sprocket has a "D" shaped hole that allows it to rotate several degrees in each direction on its shaft. This design requires the crankshaft-to-camshaft to be properly timed to ensure proper engine performance.

(9) Remove the camshaft sprockets.

REMOVAL - CRANKSHAFT SPROCKET

(1) Remove the timing belt. (Refer to 9 - ENGINE/ VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL)

(2) Remove crankshaft sprocket using Special Tool L-4407-A (Fig. 150).

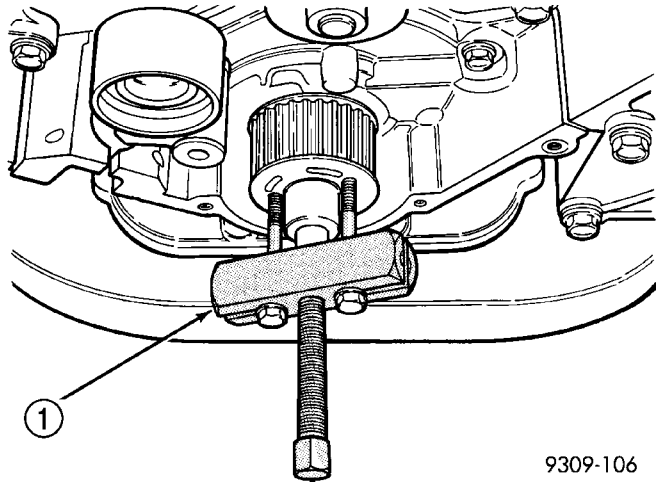

Fig. 150 Crankshaft Sprocket - Removal

1 - SPECIAL TOOL L-4407–A

INSPECTION - TIMING BELT

(1) Remove timing belt covers. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL)

(2) Inspect both sides of the timing belt. Replace belt if any of the following conditions exist (Fig. 151):

(a) Hardening of back rubber back side is glossy without resilience and leaves no indent when pressed with fingernail.

(b) Cracks on rubber back.

(c) Cracks or peeling of canvas.

(d) Cracks on rib root.

(e) Cracks on belt sides.

(f) Missing teeth.

(g) Abnormal wear of belt sides. The sides are normal if they are sharp as if cut by a knife.

(h) Vehicle mileage or time at component maintenance requirement. (Refer to LUBRICATION & MAINTENANCE/MAINTENANCE SCHEDULES - DESCRIPTION)

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

NOTE: If belt requires replacing, ensure the proper length belt is used.

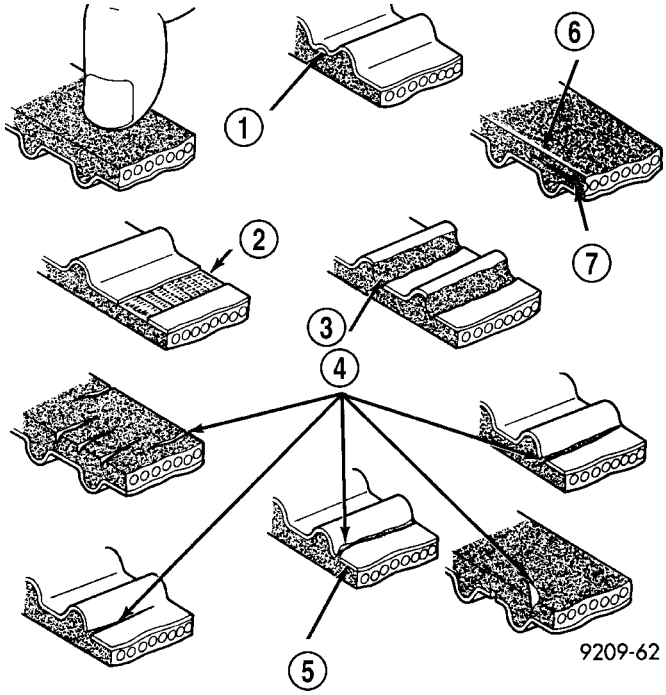

Fig. 151 Timing Belt Inspection

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

INSTALLATION

INSTALLATION - TIMING BELT

CAUTION: This procedure can only be used when the camshaft sprockets HAVE NOT BEEN LOOSENED or removed from the camshafts.

CAUTION: If camshafts have moved from the timing marks, always rotate camshaft towards the direction nearest to the timing marks (DO NOT TURN CAMSHAFTS A FULL REVOLUTION OR DAMAGE to valves and/or pistons could result).

(1) Align the crankshaft sprocket with the TDC mark on oil pump cover (Fig. 152).

TIMING BELT AND SPROCKETS (Continued)

(2) Align the camshaft sprockets (to reference mark made upon removal) between the marks on the rear covers (Fig. 144).

(3) Install the timing belt starting at the crankshaft sprocket going in a counterclockwise direction (Fig. 152). Install the belt around the last sprocket. Maintain tension on the belt as it is positioned around the tensioner pulley.

(4) Holding the tensioner pulley against the belt, Install the tensioner into the housing and tighten to 28 N·m (250 in. lbs.). Each camshaft sprocket mark should still fall between the cover marks.

(5) When tensioner is in place pull retaining pin to allow the tensioner to extend to the pulley bracket.

(6) Rotate crankshaft sprocket 2 revolutions and check the timing marks on the camshafts and crankshaft. The marks should line up within their respective locations (Fig. 152). If marks do not line up, repeat procedure.

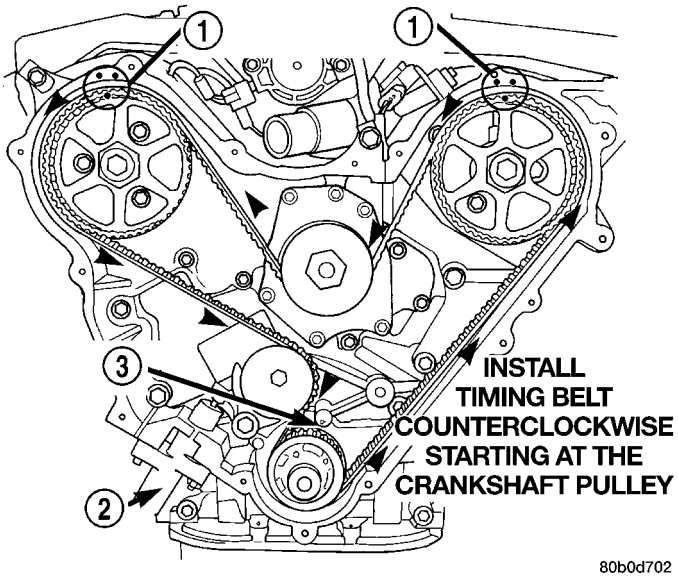

Fig. 152 TIMING BELT - INSTALLATION

1 - ALIGN CAMSHAFTS WITH TIMING MARKS
2 - INSTALL TENSIONER LOOSE
3 - CRANKSHAFT AT TDC

(7) Install the front timing belt covers. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION)

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

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

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

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

(12) Connect negative cable to remote jumper terminal.

INSTALLATION - CAMSHAFT SPROCKETS

CAUTION: The camshaft sprockets are not interchangeable from side to side (Fig. 153).

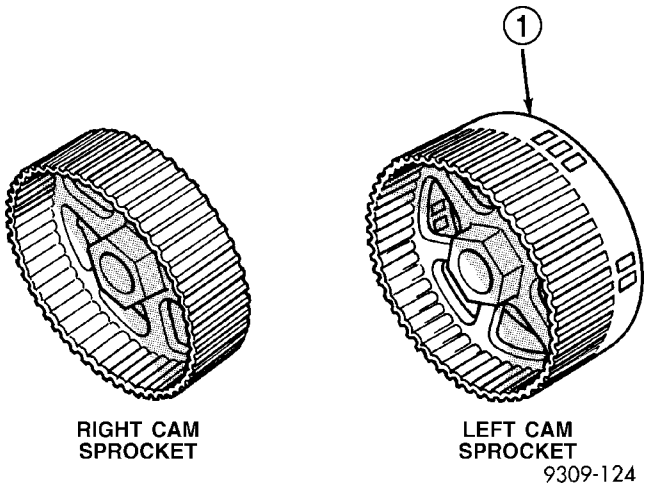

Fig. 153 CAMSHAFT SPROCKETS

1 - DIS PICKUP SLOTS

(1) Install camshaft sprockets onto the camshafts. Install **NEW** sprocket attaching bolts into place. The 255 mm (10 in.) bolt is to be installed in the left camshaft and the 213 mm (8 3/8 in.) bolt is to be installed into the right camshaft. **Do not tighten the bolts; tightened at later step.** Camshaft sprocket mark should be positioned between the marks on the cover at both sprockets (Fig. 154).

(2) Install the timing belt starting first at the crankshaft sprocket, then to remaining components in a counterclockwise direction (Fig. 155).

(3) Install the belt around the last sprocket. Maintain tension on the belt as it is positioned around the tensioner pulley. Each camshaft sprockets mark should still fall between the cover marks (Fig. 155).

NOTE: For timing belt tensioner reset procedure, (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT AND SPROCKETS - TIMING BELT - REMOVAL).

TIMING BELT AND SPROCKETS (Continued)

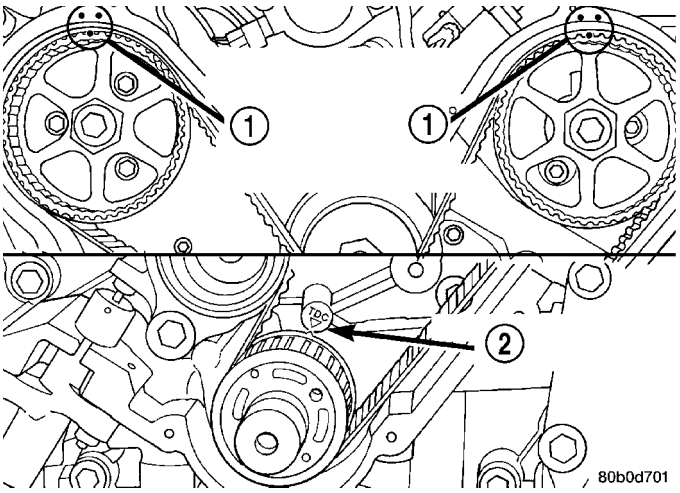

Fig. 154 Camshaft Sprocket Timing Marks

1 - ALIGN CAMSHAFT SPROCKET TIMING MARK BETWEEN MARKS ON REAR TIMING BELT COVER
2 - CRANKSHAFT AT TDC

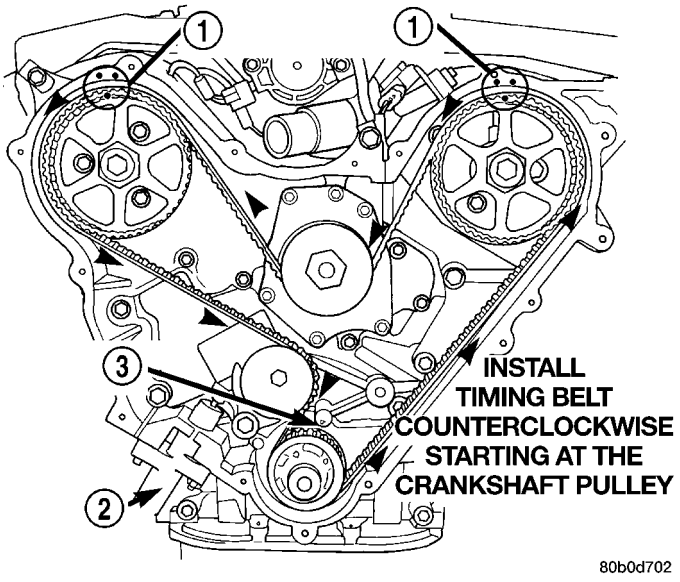

Fig. 155 TIMING BELT - INSTALLATION

1 - ALIGN CAMSHAFTS WITH TIMING MARKS
2 - INSTALL TENSIONER LOOSE
3 - CRANKSHAFT AT TDC

(4) Hold the tensioner pulley against the belt and install the reset (pinned) timing belt tensioner into the housing. Tighten attaching bolts to 28 N·m (250 in. lbs.).

(5) Remove tensioner retaining pin to allow the tensioner to extend to the pulley bracket.

(6) Using a dial indicator, position the number 1 piston at TDC (Fig. 156).

(7) Hold the camshaft sprocket hex with a 36 mm (1 7/16 in.) wrench and tighten the camshaft bolts to the following:

- Right side = 102 N·m (75 ft. lbs.) +90° turn
- Left side = 115 N·m (85 ft. lbs.) +90° turn

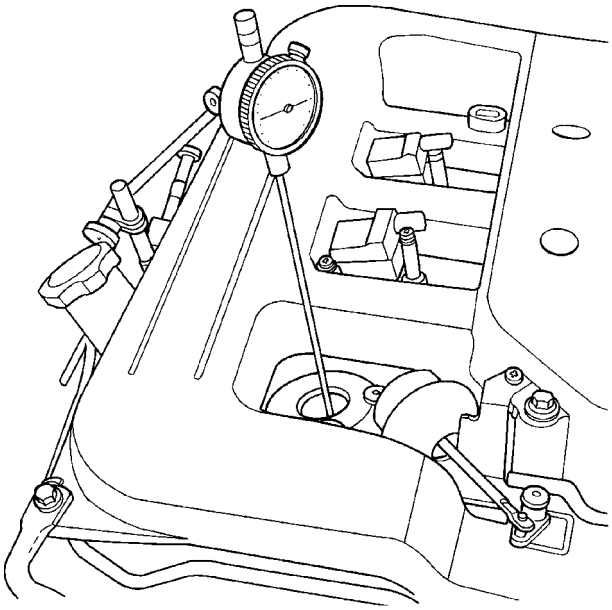

Fig. 156 Dial Indicator

(8) Remove dial indicator and install spark plug.

(9) Remove Special Tools 6642.

(10) Install cam retainer/thrust plates and O-rings (Fig. 157). Tighten bolts to 28 N·m (250 in. lbs.).

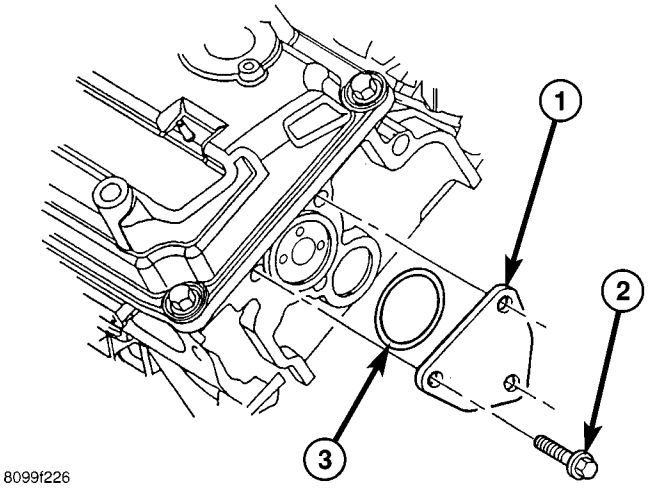

Fig. 157 CAMSHAFT THRUST PLATE

1 - CAMSHAFT THRUST PLATE
2 - BOLT
3 - O-RING

(11) Install timing belt covers. (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION)

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

TIMING BELT AND SPROCKETS (Continued)

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

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

INSTALLATION - CRANKSHAFT SPROCKET

CAUTION: To ensure proper installation depth of crankshaft sprocket, Special Tool 6641 must be used.

(1) Install crankshaft sprocket using Special Tools 6641 and C-4685-C1 (Fig. 158).

(2) Install timing belt. (Refer to 9 - ENGINE/ VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION)

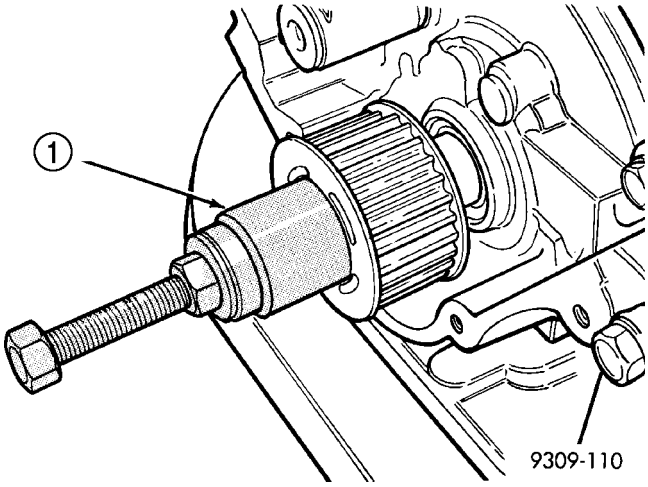

Fig. 158 CRANKSHAFT SPROCKET INSTALLATION

1 - INSTALL WITH SPECIAL TOOL 6641 WITH 12mm SCREW C-4685–C1 AND THRUST BEARING AND WASHER