2003-04 ENGINE

2.4L DOHC - Sebring Convertible & Stratus Sedan

ENGINE 2.4L DOHC

DESCRIPTION

The 2.4 Liter (148 cu. in.) in-line four cylinder engine is a double over head camshaft with hydraulic lifters and four valve per cylinder design (**Fig. 1**). The engine is free-wheeling; meaning it has provisions for piston-to-valve clearance. However valve-to-valve interference can occur, if camshafts are rotated independently.

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

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

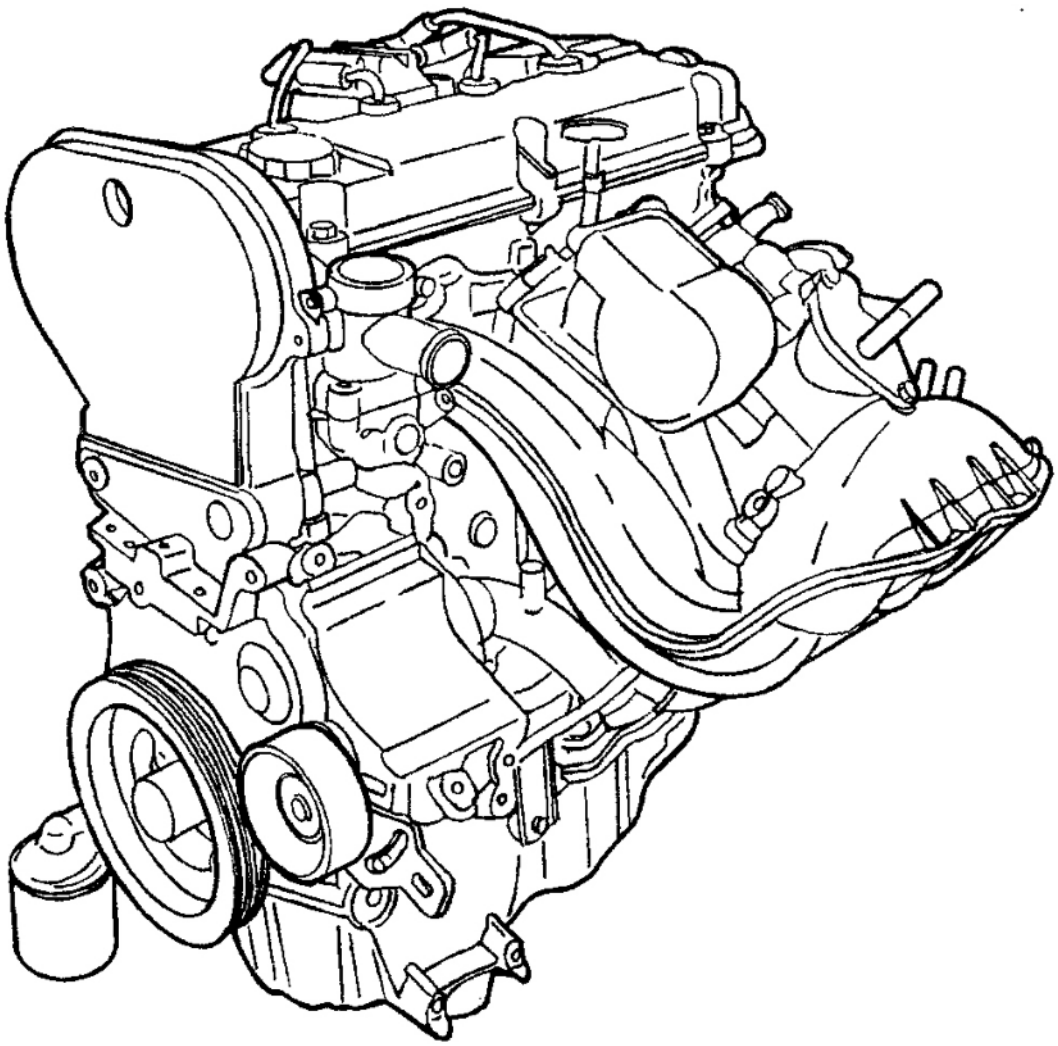
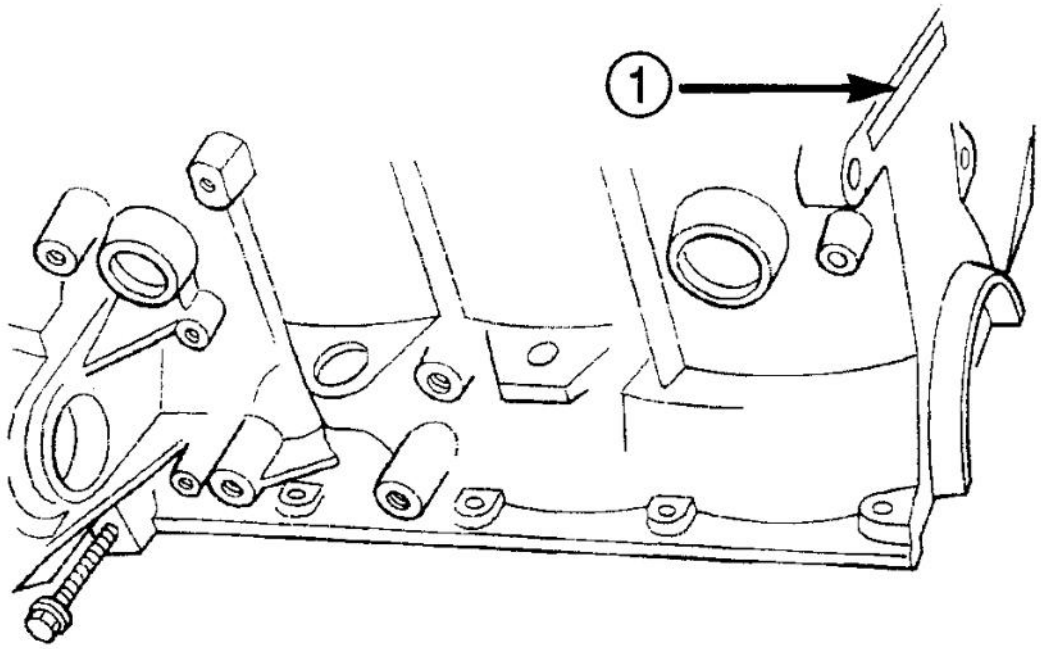


Fig. 1: Identifying 2.4 Liter Engine
Courtesy of DAIMLERCHRYSLER CORP.



1 - ENGINE IDENTIFICATION LOCATION

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Fig. 2: Locating Engine Identification
Courtesy of DAIMLERCHRYSLER CORP.

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 **DIAGNOSIS AND TESTING - ENGINE DIAGNOSIS - PERFORMANCE** and **DIAGNOSIS AND TESTING - ENGINE DIAGNOSIS - MECHANICAL** tables).

For fuel system diagnosis, (Refer to **FUEL SYSTEMS** (2003) or **FUEL DELIVERY - EXCEPT COUPE** (2004)).

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

DIAGNOSIS AND TESTING - ENGINE DIAGNOSIS - PERFORMANCE

DIAGNOSIS AND TESTING - ENGINE DIAGNOSIS - PERFORMANCE

CONDITION	POSSIBLE CAUSE	CORRECTION
ENGINE WILL NOT START	1. Weak battery. 2. Corroded or loose battery connections. 3. Faulty starter. 4. Faulty coil(s) or control unit. 5. Incorrect spark plug gap. 6. Contamination in fuel system. 7. Faulty fuel pump. 8. Incorrect engine timing.	1. Test battery. Charge or replace as necessary. 2. Clean and tighten battery connections. Apply a coat of light mineral grease to terminals. 3. Test starting system. 4. Test and replace as needed. 5. Set gap. 6. Clean system and replace fuel filter. 7. Test fuel pump and replace as needed. 8. Check for a skipped timing belt/chain.
ENGINE STALLS OR IDLES ROUGH	1. Idle speed too low. 2. Incorrect fuel mixture. 3. Intake manifold leakage. 4. Faulty ignition coil(s).	1. Test minimum air flow.) 2. (Refer to Appropriate Diagnostics) 3. Inspect intake manifold, manifold gasket, and vacuum hoses. 4. Test and replace as necessary.
ENGINE LOSS OF POWER	1. Dirty or incorrectly gapped plugs. 2. Contamination in fuel system. 3. Faulty fuel pump. 4. Incorrect valve timing. 5. Leaking cylinder head gasket.	1. Clean plugs and set gap. 2. Clean system and replace fuel filter. 3. Test and replace as necessary. 4. Correct valve timing. 5. Replace cylinder head gasket. 6. Test compression of each cylinder.

	6. Low compression. 7. Burned, warped, or pitted valves. 8. Plugged or restricted exhaust system. 9. Faulty ignition coil(s).	7. Replace valves. 8. Perform exhaust restriction test. (Refer to DIAGNOSIS AND TESTING) Install new parts, as necessary. 9. Test and replace as necessary.
ENGINE MISSES ON ACCELERATION	1. Dirty or incorrectly gapped spark plugs. 2. Contamination in Fuel System. 3. Burned, warped, or pitted valves. 4. Faulty ignition coil(s).	1. Clean spark plugs and set gap. 2. Clean fuel system and replace fuel filter. 3. Replace valves. 4. Test and replace as necessary.
ENGINE MISSES AT HIGH SPEED	1. Dirty or incorrect spark plug gap. 2. Faulty ignition coil(s). 3. Dirty fuel injector(s). 4. Contamination in Fuel System.	1. Clean spark plugs and set gap. 2. Test and replace as necessary. 3. Test and replace as necessary. 4. Clean system and replace fuel filter.

DIAGNOSIS AND TESTING - ENGINE DIAGNOSIS - MECHANICAL

DIAGNOSIS AND TESTING - ENGINE DIAGNOSIS - MECHANICAL

CONDITION	POSSIBLE CAUSE	CORRECTION
NOISY VALVES	1. High or low oil level in crankcase. 2. Thin or diluted oil. 3. Thick oil 4. Low oil pressure. 5. Dirt in tappets/lash adjusters. 6. Worn rocker arms. 7. Worn tappets/lash adjusters. 8. Worn valve guides. 9. Excessive runout of valve seats on valve faces.	1. Check and correct engine oil level. 2. Change oil to correct viscosity. 3. a. Change engine oil and filter. b. Run engine to operating temperature. c. Change engine oil and filter again. 4. Check and correct engine oil level. 5. Replace rocker arm/hydraulic lash adjuster assembly. 6. Inspect oil supply to rocker arms. 7. Install new rocker arm/hydraulic lash adjuster assembly. 8. Ream guides and install new valves with oversize stems.

	10. Missing adjuster pivot.	9. Grind valve seats and valves. 10. Replace rocker arm/hydraulic lash adjuster assembly.
CONNECTING ROD NOISE	1. Insufficient oil supply. 2. Low oil pressure. 3. Thin or diluted oil. 4. Thick oil 5. Excessive bearing clearance. 6. Connecting rod journal out-of-round. 7. Misaligned connecting rods.	1. Check engine oil level. 2. Check engine oil level. Inspect oil pump relief valve and spring. 3. Change oil to correct viscosity. 4. a. Change engine oil and filter. b. Run engine to operating temperature. c. Change engine oil and filter again. 5. Measure bearings for correct clearance. Repair as necessary. 6. Replace crankshaft or grind surface. 7. Replace bent connecting rods.
MAIN BEARING NOISE	1. Insufficient oil supply 2. Low oil pressure. 3. Thin or diluted oil. 4. Thick oil 5. Excessive bearing clearance. 6. Excessive end play. 7. Crankshaft journal out-of-round or worn. 8. Loose flywheel or torque converter	1. Check engine oil level. 2. Check engine oil level. Inspect oil pump relief valve and spring. 3. Change oil to correct viscosity. 4. a. Change engine oil and filter. b. Run engine to operating temperature. c. Change engine oil and filter again. 5. Measure bearings for correct clearance. Repair as necessary. 6. Check thrust bearing for wear on flanges. 7. Replace crankshaft or grind journals. 8. Tighten to correct torque.
	1. Low oil level. 2. Faulty oil pressure sending unit. 3. Low oil pressure. 4. Clogged oil filter. 5. Worn parts in oil pump.	1. Check engine oil level. 2. Install new sending unit. 3. Check sending unit and main bearing oil clearance. 4. Install new oil filter. 5. Replace worn parts or pump.

OIL PRESSURE DROP	6. Thin or diluted oil. 7. Oil pump relief valve stuck. 8. Oil pump suction tube loose. 9. Oil pump cover warped or cracked. 10. Excessive bearing clearance.	6. Change oil to correct viscosity. 7. Remove valve and inspect, clean, or replace. 8. Remove oil pan and install new tube or clean, if necessary. 9. Install new oil pump. 10. Measure bearings for correct clearance.
OIL LEAKS	1. Misaligned or deteriorated gaskets. 2. Loose fastener, broken or porous metal part. 3. Misaligned or deteriorated cup or threaded plug.	1. Replace gasket(s). 2. Tighten, repair or replace the part. 3. Replace as necessary.
OIL CONSUMPTION OR SPARK PLUGS FOULED	1. PCV system malfunction. 2. Worn, scuffed or broken rings. 3. Carbon in oil ring slots. 4. Rings fitted too tightly in grooves. 5. Worn valve guide(s). 6. Valve stem seal(s) worn or damaged.	1. Check system and repair as necessary. 2. Hone cylinder bores. Install new rings. 3. Install new rings. 4. Remove rings and check grooves. If groove is not proper width, replace piston. 5. Ream guide(s) and replace valve(s) with oversize valve(s) and seal(s). 6. Replace seal(s).

DIAGNOSIS AND TESTING - CYLINDER COMPRESSION PRESSURE TEST

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

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

1. Check engine oil level and add oil if necessary.
2. Drive the vehicle until engine reaches normal operating temperature. Select a route free from traffic and other forms of congestion, observe all traffic laws, and accelerate through the gears several times briskly.
3. Remove all spark plugs from engine. As spark plugs are being removed, check electrodes for abnormal firing indicators fouled, hot, oily, etc. Record cylinder number of spark plug for future reference.
4. Remove the Auto Shutdown (ASD) relay from the PDC.
5. Be sure throttle blade is fully open during the compression check.
6. Insert compression gauge adaptor Special Tool 8116 or the equivalent, into the #1 spark plug hole in

cylinder head. Connect the 0-500 psi (Blue) pressure transducer (Special Tool CH7059) with cable adaptors to the DRBIII®. For Special Tool identification, (Refer to **SPECIAL TOOLS**).

7. Crank engine until maximum pressure is reached on gauge. Record this pressure as #1 cylinder pressure.
8. Repeat the previous step for all remaining cylinders.
9. Compression should not be less than 689 kPa (100 psi) and not vary more than 25 percent from cylinder to cylinder.
10. If one or more cylinders have abnormally low compression pressures, repeat the compression test.
11. If the same cylinder or cylinders repeat an abnormally low reading on the second compression test, it could indicate the existence of a problem in the cylinder in question. **The recommended compression pressures are to be used only as a guide to diagnosing engine problems. An engine should not be disassembled to determine the cause of low compression unless some malfunction is present.**

DIAGNOSIS AND TESTING - CYLINDER COMBUSTION PRESSURE LEAKAGE TEST

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

Combustion pressure leakage testing will detect:

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

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

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

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

Clean spark plug recesses with compressed air.

Remove the spark plugs.

Remove the oil filler cap.

Remove the air cleaner.

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.

DIAGNOSIS AND TESTING - ENGINE OIL LEAK INSPECTION

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

1. Do not clean or degrease the engine at this time because some solvents may cause rubber to swell, temporarily stopping the leak.
2. Add an oil soluble dye (use as recommended by manufacturer). Start the engine and let idle for approximately 15 minutes. Check the oil dipstick to make sure the dye is thoroughly mixed as indicated with a bright yellow color under a black light.
3. Using a black light, inspect the entire engine for fluorescent dye, particularly at the suspected area of oil leak. If the oil leak is found and identified, repair as necessary.
4. If dye is not observed, drive the vehicle at various speeds for approximately 24 km (15 miles), and repeat inspection.
5. **If the oil leak source is not positively identified at this time,** proceed with the air leak detection test method as follows:
   - Disconnect the fresh air hose (make-up air) at the cylinder head cover and plug or cap the 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 **INSPECTION FOR REAR SEAL AREA LEAKS**.
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 crank-case 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.

STANDARD PROCEDURE

STANDARD PROCEDURE - REPAIR OF DAMAGED OR WORN THREADS

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

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

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

STANDARD PROCEDURE - 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 - 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 multilayer 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. 3**)

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

Only use the following for cleaning gasket surfaces:

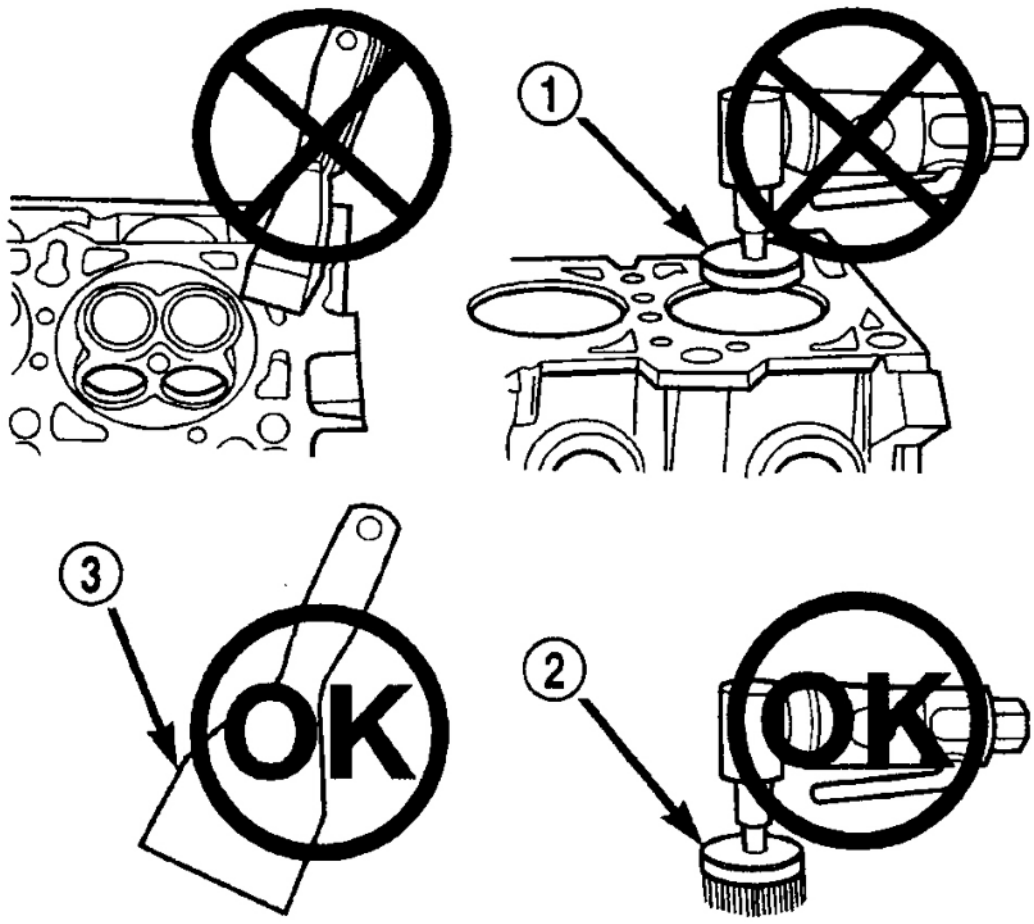
- Solvent or a commercially available gasket remover
- Plastic or wood scraper (**Fig. 3**)
- Drill motor with 3M Roloc™ Bristle Disc (white or yellow) (**Fig. 3**)

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 - 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. 4**). (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.
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 **SPECIFICATIONS**). **Plastigage generally is accompanied by two scales. One scale is in inches, the other is a metric scale.**



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

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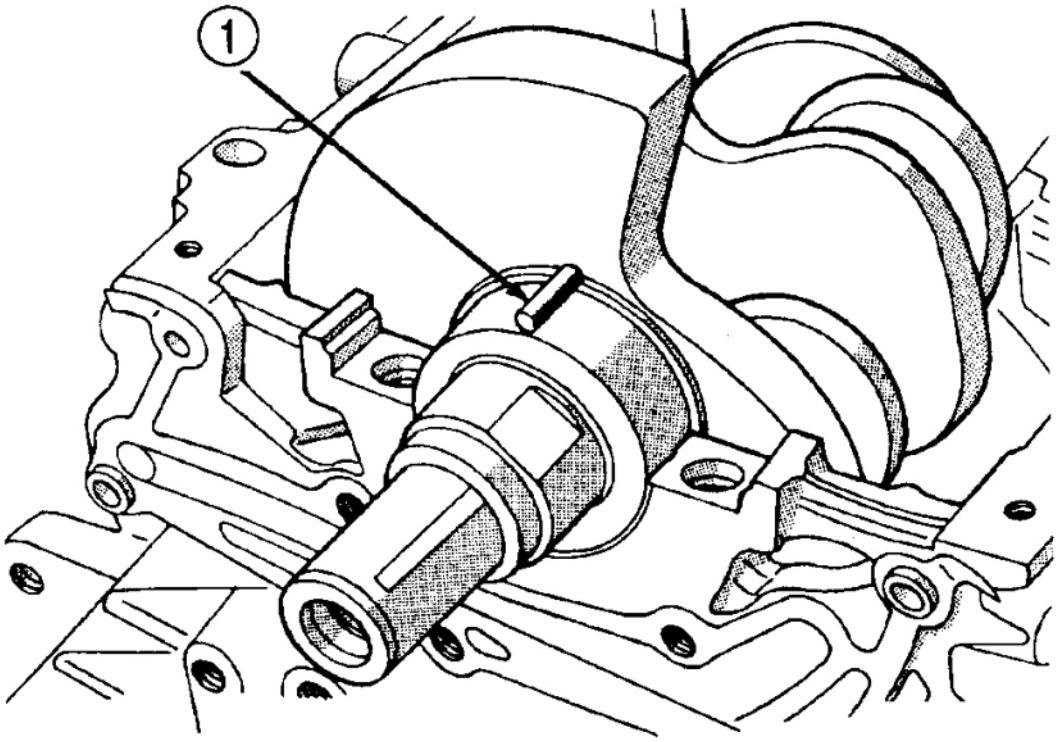
Fig. 3: Identifying Proper Tool Usage For Surface Preparation
Courtesy of DAIMLERCHRYSLER CORP.



1 - PLASTIGAGE
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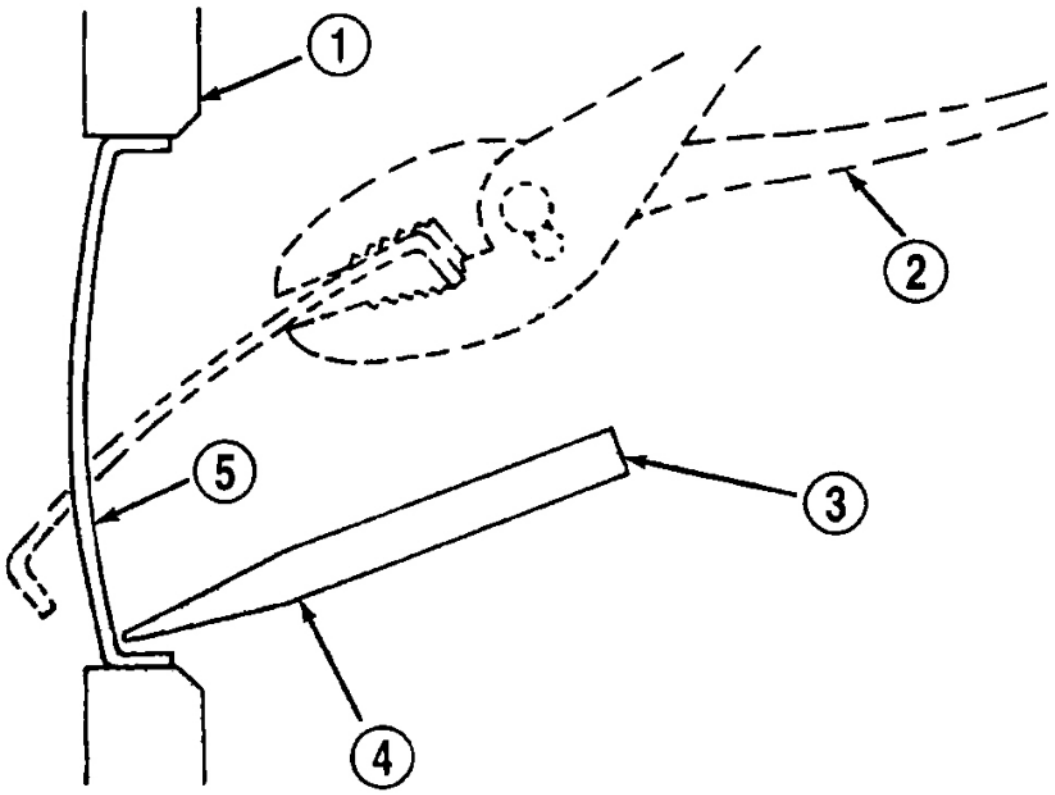
Fig. 4: Placing Plastigage In Lower Shell
Courtesy of DAIMLERCHRYSLER CORP.

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.

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**).



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

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Fig. 5: Removing Core Hole Plug
Courtesy of DAIMLERCHRYSLER CORP.

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.

REMOVAL - ENGINE ASSEMBLY

1. Perform fuel pressure release procedure (Refer to **FUEL SYSTEM PRESSURE RELEASE** (2003) or **STANDARD PROCEDURE - FUEL SYSTEM PRESSURE RELEASE PROCEDURE** (2004)).
2. Disconnect negative battery cable.
3. Drain cooling system (Refer to COOLING article).
4. Discharge A/C system using a suitable refrigerant recovery machine.
5. Remove throttle body air inlet hose and air cleaner housing assembly.
6. Remove upper radiator crossmember.
7. Disconnect upper and lower radiator hoses at radiator.
8. Using a blade or suitable hose cutter, cut transaxle oil cooler lines off flush with fittings. Plug lines and fittings to prevent debris from entering transaxle or cooler circuit. A service splice kit will be installed upon reassembly.
9. Disconnect A/C lines at condenser. Remove cooling module assembly (radiator, fan module, and condenser).
10. Disconnect transmission electrical harness connectors (C104 & C105).
11. Disconnect transmission shift cable.
12. Disconnect engine electrical harness from PCM and bulkhead connectors.
13. Raise vehicle on hoist.
14. Remove both front wheels.
15. Remove left and right splash shields.
16. Remove both axle shafts (Refer to DRIVELINE/HALF SHAFT article).
17. Drain engine oil.
18. Remove accessory drive belts (Refer to SPECIFICATIONS & DRIVE BELT ROUTING article.
19. Remove power steering pump from bracket. **Do not** disconnect power steering lines from pump. Reposition pump and support with suitable retaining strap.
20. Disconnect heater return hose from pipe connection at right front frame rail area.
21. Disconnect A/C compressor electrical connectors.
22. Disconnect exhaust pipe from manifold.
23. Remove through bolts from front and rear engine mounts.
24. Remove rear mount bracket from transmission.
25. Remove structural collar and torque reaction bracket (Refer to **STRUCTURAL COLLAR**).
26. Mark flex plate to torque converter position. Remove torque converter bolts.
27. Lower vehicle.
28. Disconnect positive cable from battery and PDC.
29. Disconnect ground cable from left side transaxle mount bracket.
30. Disconnect throttle and speed control cables.
31. Disconnect coolant recovery container overflow hose.
32. Disconnect heater hose at thermostat housing.

33. Disconnect all ground straps attaching to engine.
34. Disconnect brake booster and vapor purge vacuum hoses.
35. Disconnect fuel line from fuel rail.
36. Disconnect generator connectors.
37. Remove intake manifold (Refer to **REMOVAL**).
38. Remove generator.
39. Remove A/C suction line at compressor. Cap suction port and line.
40. Remove A/C compressor.
41. Raise vehicle enough to allow engine dolly 6135 and cradle 6710 with posts 6848 to be installed under vehicle (**Fig. 6**).
42. Loosen cradle engine mounts to allow movement for positioning onto engine locating holes on the engine bedplate, compressor and support bracket. Install adapters 6909 to the two post at rear of engine. Lower vehicle and position cradle mounts until the engine is resting on posts. Tighten post mounts to cradle frame. This will keep mounts from moving when removing or installing engine/transmission assembly. Secure engine/transmission to dolly/ cradle with safety straps.
43. Lower vehicle so weight of the engine and transmission ONLY is on the cradle.
44. Remove right and left side vertical engine mount bolts.
45. Slowly raise vehicle in short length spans. Inspect at each interval for potential engine or transaxle contact to vehicle components. Move the cradle/dolly fixture as necessary to allow for removal clearance.

INSTALLATION - ENGINE ASSEMBLY

1. Position engine/transaxle assembly under vehicle and slowly lower vehicle in short length spans. Inspect at each interval for potential engine or transaxle contact to vehicle components. Move the cradle/dolly fixture as necessary to allow for installation clearance.
2. Continue lowering vehicle until right side engine mount and left side transaxle mount align to their mounting locations. Install mounting bolts and torque to 61 N.m (45 ft. lbs.).
3. Remove safety straps from engine/transaxle assembly. Slowly raise vehicle enough to remove the engine dolly and cradle.
4. Install A/C compressor.
5. Connect A/C suction line to compressor.
6. Install generator.
7. Install intake manifold. Torque fasteners to 12 N.m (105 in. lbs.) (Refer to **INSTALLATION**).
8. Connect generator connectors.
9. Connect fuel line to fuel rail.
10. Connect brake booster and vapor purge hoses.
11. Connect all ground straps to engine.
12. Connect heater hose to thermostat housing.
13. Connect coolant recovery container overflow hose.
14. Connect throttle and speed control cables.
15. Connect ground cable to left side transaxle mount bracket.

16. Connect positive cable to battery and PDC.
17. Raise vehicle on hoist.
18. Install torque converter bolts.
19. Install structural collar and torque reaction bracket (Refer to **STRUCTURAL COLLAR**).
20. Install rear mount bracket to transmission.
21. Install front and rear engine mount through bolts. Torque fasteners to 61 N.m (45 ft. lbs.).
22. Connect exhaust pipe to exhaust manifold. Torque fasteners to 28 N.m (250 in. lbs.).
23. Connect A/C compressor electrical connectors.
24. Connect heater return hose to pipe connection at right front frame rail area.
25. Install power steering pump to bracket.
26. Install accessory drive belts (refer to SPECIFICATIONS & DRIVE BELT ROUTING article.
27. Install both axle shafts (Refer to DRIVELINE/HALF SHAFT article).
28. Install new oil filter.
29. Install left and right splash shields.
30. Install both front wheels.
31. Lower vehicle.
32. Connect engine electrical harness to PCM and bulkhead connectors.
33. Connect transmission shift cable.
34. Connect transmission electrical connectors (C104 & C105).
35. Install cooling module assembly (radiator, fan module, and condenser). Connect A/C lines to condenser.
36. Connect transmission oil cooler lines using service splice kit. Refer to instructions provided with kit.
37. Connect upper and lower radiator hoses.
38. Install upper radiator crossmember.
39. Install throttle body air inlet hose and air cleaner housing assembly.
40. Fill engine crankcase with proper oil to correct level.
41. Evacuate and recharge A/C system (Refer to **MANUAL A/C-HEATER SYSTEMS - EXCEPT COUPE** (2003) or **STANDARD PROCEDURE** (2004)).
42. Fill cooling system (Refer to COOLING article).
43. Connect negative battery cable.
44. Start engine and run until normal operating temperature is reached.

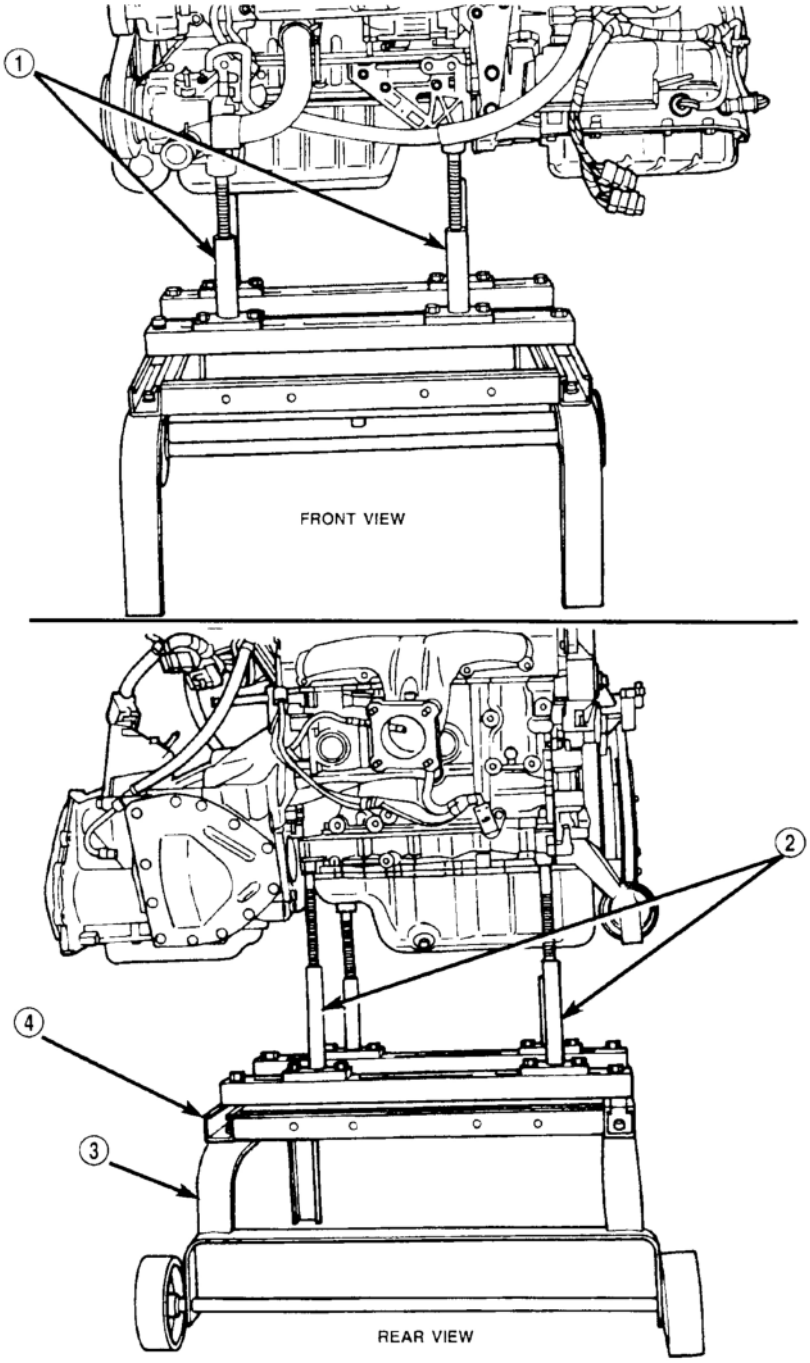


Fig. 6: Positioning Engine Cradle Support Post Mounts
Courtesy of DAIMLERCHRYSLER CORP.

SPECIFICATIONS

2.4L ENGINE

2.4L ENGINE SPECIFICATIONS

DESCRIPTION	SPECIFICATION
General Specification	
Type	In-Line OHV, DOHC
Number of Cylinders	4
Displacement	2.4 Liters (148 cu. in.)
Bore	87.5 mm (3.445 in.)
Stroke	101.0 mm (3.976 in.)
Compression Ratio	9.5:1
Firing Order	1-3--4-2
Compression Pressure	1172-1551 kPa (170-225 psi)
Max. Variation Between Cylinders	25%
Cylinder Block	
Cylinder Bore Diameter	87.4924-87.5076 mm (3.4446-3.4452 in.)
Out-of-Round (Max.)	0.051 mm (0.002 in.)
Taper (Max.)	0.051 mm (0.002 in.)
Pistons	
Piston Diameter	87.463-87.481 mm (3.4434-3.4441 in.)
Clearance @ 14 mm (9/16 in.) from bottom of skirt	0.024-0.057 mm (0.0009-0.0022 in.)
Weight	332-346 grams (11.85-12.20 oz.)
Land Clearance (Diametrical)	0.614-0.664 mm (0.024-0.026 in.)
Piston Length	60.3 mm (2.374 in.)
Piston Ring Groove Depth No. 1	4.640-4.784 mm (0.182-0.188 in.)
Piston Ring Groove Depth No. 2	4.575-4.719 mm (0.180-0.185 in.)
Piston Ring Groove Depth No. 3	4.097-4.236 mm (0.161-0.166 in.)
Piston Pins	
Clearance in Piston	0.005-0.018 mm (0.0002-0.0008 in.)
Clearance in Connecting Rod	interference
Diameter	21.998-22.003 mm (0.8660-0.8662 in.)
End Play	None
Length	72.75-73.25 mm (2.864-2.883 in.)
Piston Rings	
Ring Gap-Top Compression Ring	0.25-0.51 mm (0.0098-0.020 in.)
Wear Limit	0.8 mm (0.031 in.)
Ring Gap-2nd Compression Ring	0.23-0.48 mm (0.009-0.018 in.)
Wear Limit	0.8 mm (0.031 in.)
Ring Gap-Oil Control Steel Rails	0.25-0.64 mm (0.0098-0.025 in.)
Wear Limit	1.0 mm (0.039 in.)
Ring Side Clearance-Compression Rings	0.030-0.080 mm (0.0011-0.0031 in.)
Wear Limit	0.10 mm (0.004 in.)

Ring Side Clearance-Oil Ring Pack	0.012-0.178 mm (0.0004-0.0070 in.)
Ring Width-Compression Rings	1.47-1.50 mm (0.057-0.059 in.)
Ring Width-Oil Ring Pack	2.72-2.88 mm (0.107-0.1133 in.)
Connecting Rod	
Bearing Clearance	0.025-0.071 mm (0.0009-0.0027 in.)
Wear Limit	0.075 mm (0.003 in.)
Bore Diameter-Piston Pin	20.96-20.98 mm (0.8252-0.8260 in.)
Bore Diameter-Crankshaft End	53.007-52.993 mm (2.0868-2.0863 in.)
Side Clearance	0.13-0.38 mm (0.005-0.015 in.)
Wear Limit	0.40 mm (0.016 in.)
Weight-Total (Less Bearing)	565.8 grams (19.96 oz.)
Crankshaft	
Connecting Rod Journal Diameter	49.984-50.000 mm (1.967-1.9685 in.)
Main Bearing Journal Diameter	59.992-60.008 mm (2.361-2.3625 in.)
Journal Out-of-Round (Max.)	0.0035 mm (0.0001 in.)
Journal Taper (Max.)	0.0038 mm (0.0001 in.)
End Play	0.09-0.24 mm (0.0035-0.0094 in.)
Wear Limit	0.37 mm (0.015 in.)
Main Bearing Diametrical Clearance	0.018-0.058 mm (0.0007-0.0023 in.)
Hydraulic Lash Adjuster	
Body Diameter	15.901-15.913 mm (0.626-0.6264 in.)
Plunger Travel Minimum (Dry)	3.0 mm (0.118 in.)
Cylinder Head Camshaft Bearing Bore Diameter	
Journals No.1-6	26.020-26.041 mm (1.024-1.025 in.)
Camshaft	
Journal Diameter No. 1-6	25.951-25.970 mm (1.021-1.022 in.)
Bearing Clearance-Diametrical	0.069-0.071 mm (0.0027-0.003 in.)
End Play	0.05-0.17 mm (0.0019-0.0066 in.)
Lift (Zero Lash) Intake	8.25 mm (0.324 in.)
Exhaust	6.52 mm (0.256 in.)
Intake Valve Timing(1)	
Closes (ABDC	51°
Opens (BTDC)	1°
Duration	232°
Exhaust Valve Timing(1)	
Closes (ATDC)	8°
Opens (BBDC)	52°
Duration	240°
Valve Overlap	9°
(1)All readings in crankshaft degrees, at 0.5 mm (0.019 in.) of valve lift.	
Cylinder Head	

Material	Cast Aluminum
Gasket Thickness (Compressed)	0.71 mm (0.028 in.)
Valve Seat	
Angle	45°
Seat Diameter-Intake	33 mm (1.299 in.)
Seat Diameter-Exhaust	28 mm (1.102 in.)
Runout (Max.)	0.05 mm (0.002 in.)
Valve Seat Width-Intake and Exhaust	0.9-1.3 mm (0.035-0.051 in.)
Service Limit-Intake	2.0 mm (0.079 in.)
Service Limit-Exhaust	2.5 mm (0.098 in.)
Valve Guide	
Diameter I.D.	5.975-6.000 mm (0.235-0.236 in.)
Guide Bore Diameter	11.0-11.02 mm (0.4330-0.4338 in.)
Guide Height (spring seat to guide tip)	13.25-13.75 mm (0.521-0.541 in.)
Valves	
Face Angle-Intake and Exhaust	44.5-45°
Head Diameter-Intake	34.67-34.93 mm 1.364-1.375 in.)
Head Diameter-Exhaust	30.37-30.63 mm (1.195-1.205 in.)
Valve Length (Overall)	
-Intake	112.76-113.32 mm (4.439-4.461 in.)
-Exhaust	109.59-110.09 mm (4.314-4.334 in.)
Valve Stem Diameter	
-Intake	5.934-5.952 mm (0.2337-0.2344 in.)
-Exhaust	5.906-5.924 mm (0.2326-0.2333 in.)
Valve Margin	
Intake	1.285-1.615 mm (0.050-0.063
Service Limit	0.95 mm (1/32 in.)
Exhaust	0.985-1.315 mm (0.038-0.051 in.)
Service Limit	1.05 mm (3/64 in.)
Valve Stem Tip Height	
Intake	48.04 mm (1.891 in.)
Exhaust	47.99 mm (1.889 in.)
Valve Stem to Guide Clearance	
Intake	0.048-0.066 mm (0.0018-0.0025 in.)
Max. Allowable	0.076 mm (0.003 in.)
Service Limit	0.25 mm (0.010 in.)
Exhaust	0.0736-0.094 mm (0.0029-0.0037 in.)
Max. Allowable	0.101 mm (0.004 in.)
Service Limit	0.25 mm (0.010 in.)
Valve Springs	
Free Length (Approx.)	48.4 mm (1.905 in.)
Nominal Force (Valve Closed)	

	338 N @ 38.0 mm (75.98 lbs. @ 1.496 in.)
Nominal Force (Valve Open)	607 N @ 29.75 mm (136 lbs. @ 1.172 in.)
Installed Height	38.00 mm (1.496 in.)
Number of Coils	7.82
Wire Diameter	3.86 mm (1.496 in.)
Oil Pump	
Clearance Over Rotors (Max.)	0.10 mm (0.004 in.)
Cover Out-of-Flat (Max.)	0.025 mm (0.001 in.)
Inner Rotor Thickness (Min.)	9.40 mm (0.370 in.)
Outer Rotor Thickness (Min.)	9.40 mm (0.370 in.)
Outer Rotor Clearance (Max.)	0.039 mm (0.015 in.)
Outer Rotor Diameter (Min.)	79.95 mm (3.148 in.)
Tip Clearance Between Rotors (Max.)	0.20 mm (0.008 in.)
Oil Pressure	
At Curb Idle Speed(1)	25 kPa (4 psi)
At 3000 rpm	170-550 kPa (25-80 psi)
CAUTION: **(1) If pressure is ZERO at curb idle, DO NOT run engine at 3000 rpm.**	

TORQUE

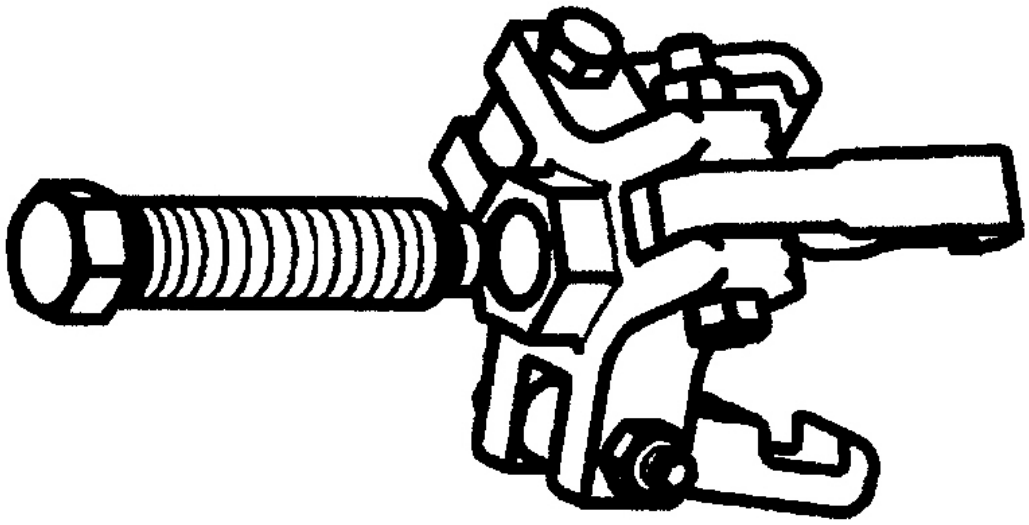
TORQUE DESCRIPTION

DESCRIPTION	N.m	Ft. Lbs.	In. Lbs.
Balance Shaft Carrier to Block-Bolts	54	40	-
Balance Shaft Gear Cover-Double Ended Fastener	12	-	105
Balance Shaft Sprocket-Bolt	28	-	250
Balance Shaft Chain Tensioner-Bolts	12	-	105
Balance Shaft Carrier Cover-Bolts	12	-	105
Camshaft Sprocket-Bolt	115	85	-
Connecting Rod Cap-Bolts	27 +1/4 turn	20 +1/4 turn	-
Crankshaft Main Bearing Cap/Bedplate			
-M8 Bolts	28		250
-M11 Bolts	75	55	-
Crankshaft Damper	136	100	-
Cylinder Head-Bolts	(Refer to **INSTALLATION - CYLINDER HEAD**)		

Cylinder Head Cover-Bolts	12	-	105
Flex Plate to Crankshaft	95	70	-
Engine Mount Bracket Right-Bolts	61	45	-
Engine Mounting-Bolts	(Refer to **ENGINE MOUNTING**)		
Exhaust Manifold to Cylinder Head-Bolts	23	-	200
Exhaust Manifold Heat Shield-Bolts	12	-	105
Intake Manifold -Bolts	28	-	250
Oil Filter	11	8	-
Oil Pan-Bolts	12	-	105
Oil Pan Drain-Plug	28	20	-
Oil Pump to Block-Bolts	28	-	250
Oil Pump Cover Plate-Bolts	12	-	105
Oil Pump Pick-up Tube-Bolt	23	-	200
Oil Pump Relief Valve-Cap	41	30	-
Spark Plugs	18	13	-
Structural Collar	(Refer to **STRUCTURAL COLLAR**)		
Timing Belt Covers			
Front Covers to Rear Cover-Screws	6	-	50
Rear Cover-M6 Bolts	12	-	105
-M8 Bolts	28	-	250
Timing Belt Idler Pulley	61	45	-
Timing Belt Tensioner Lock Bolt	25	-	220
Timing Belt Tensioner Assembly-Bolts	61	45	-

SPECIAL TOOLS

2.4L ENGINE



Puller 8454

G03633116

Fig. 7: Identifying Puller 8454
Courtesy of DAIMLERCHRYSLER CORP.

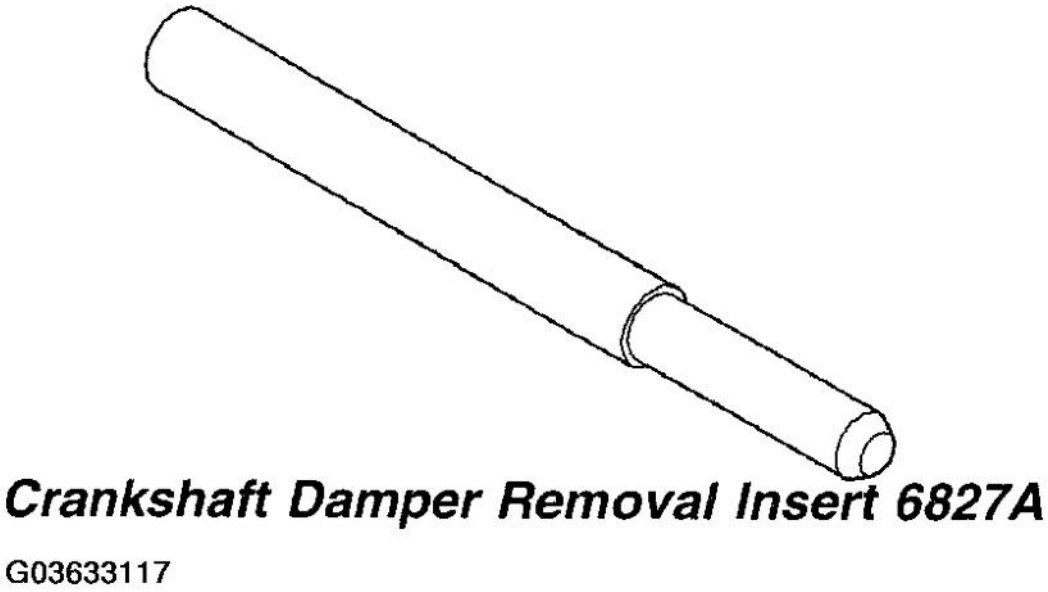


Fig. 8: Identifying Crankshaft Damper Removal Insert 6827A
Courtesy of DAIMLERCHRYSLER CORP.

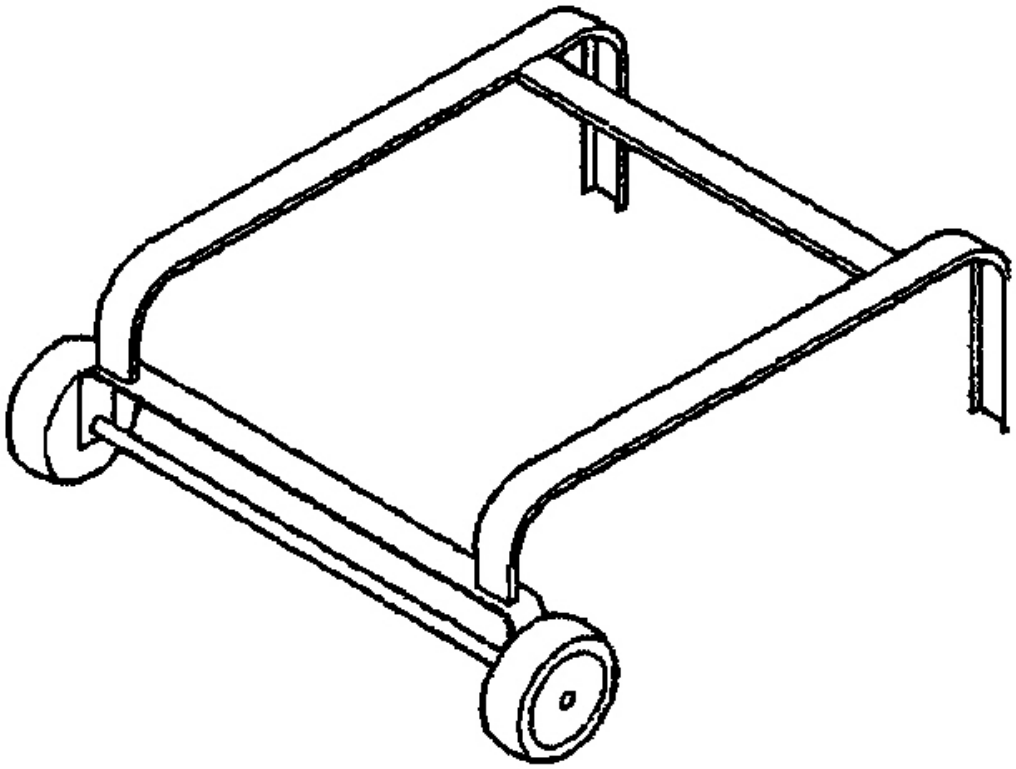


Fig. 9: Identifying Dolly 6135
Courtesy of DAIMLERCHRYSLER CORP.

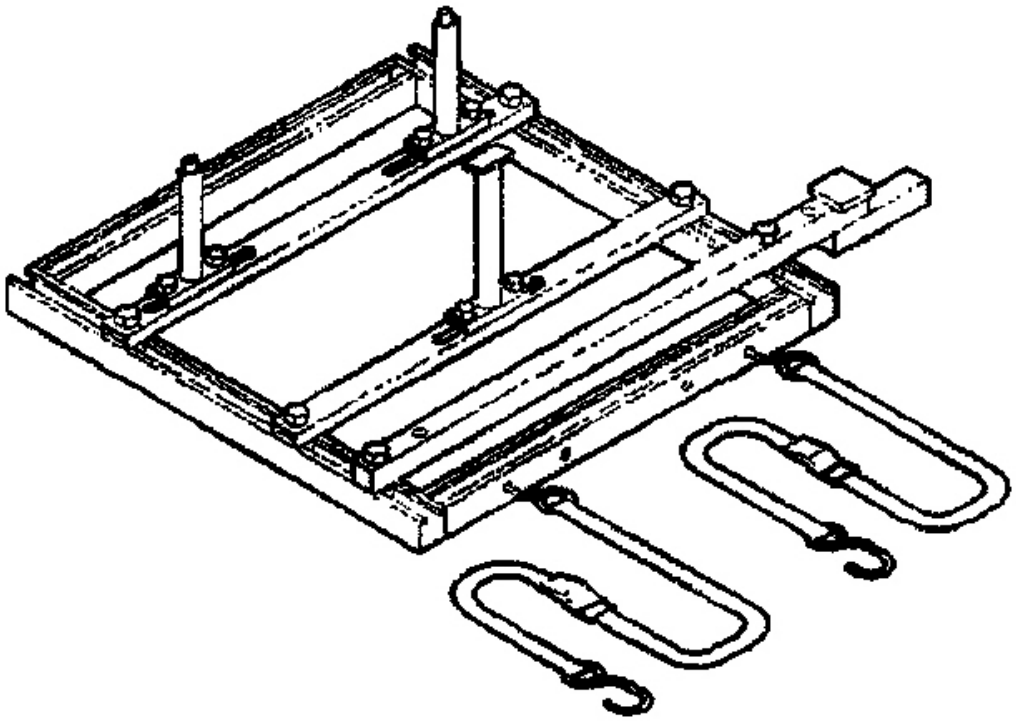


Fig. 10: Identifying Cradle 6710A
Courtesy of DAIMLERCHRYSLER CORP.

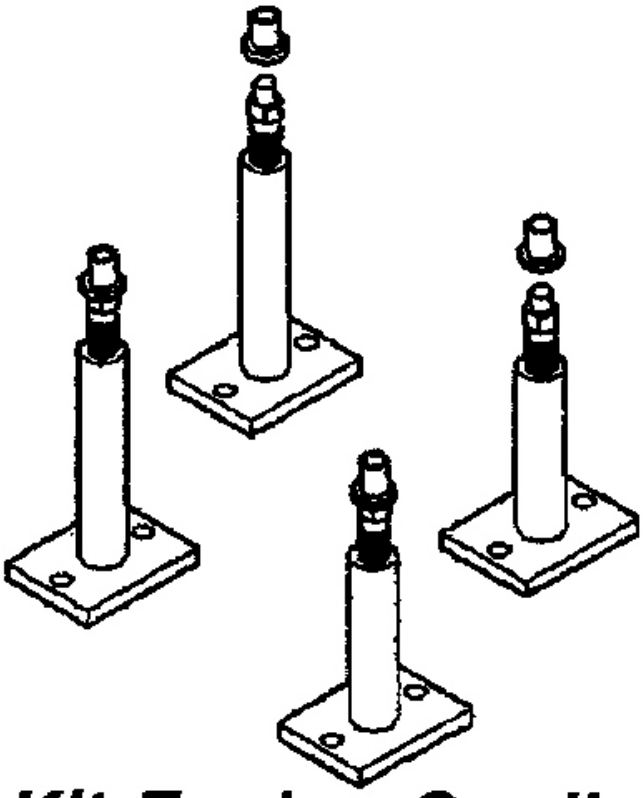
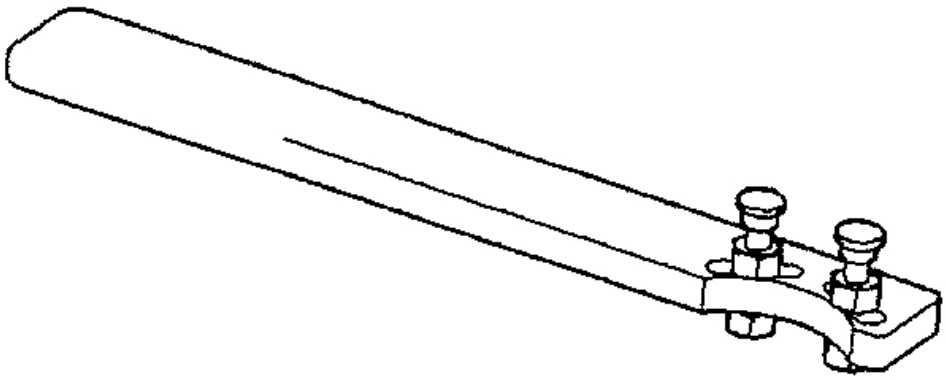


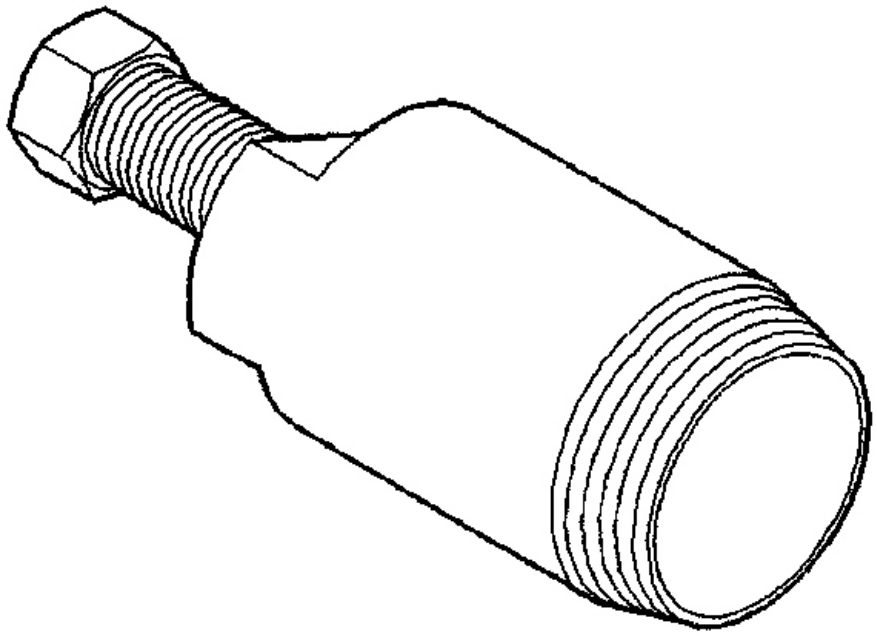
Fig. 11: Identifying Post Kit Engine Cradle 6848
Courtesy of DAIMLERCHRYSLER CORP.



Camshaft Sprocket Holder 6847

G03633121

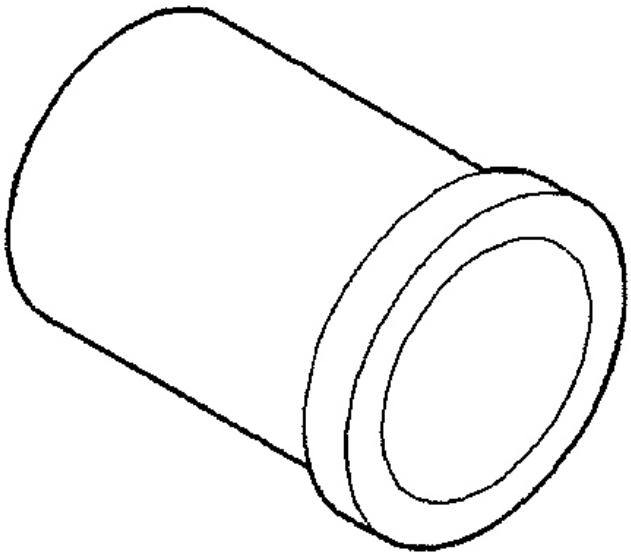
Fig. 12: Identifying Camshaft Sprocket Holder 6847
Courtesy of DAIMLERCHRYSLER CORP.



Camshaft Seal Remover C-4679A

G03633122

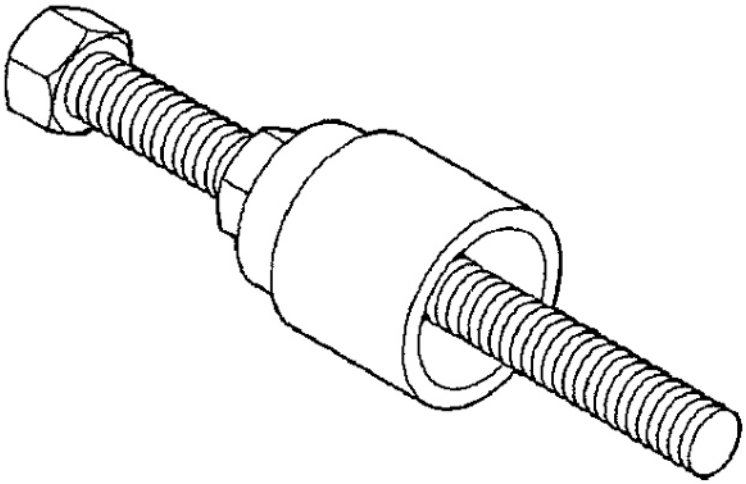
Fig. 13: Identifying Camshaft Seal Remover C-4679A
Courtesy of DAIMLERCHRYSLER CORP.



Camshaft Seal Installer MD-998306

G03633123

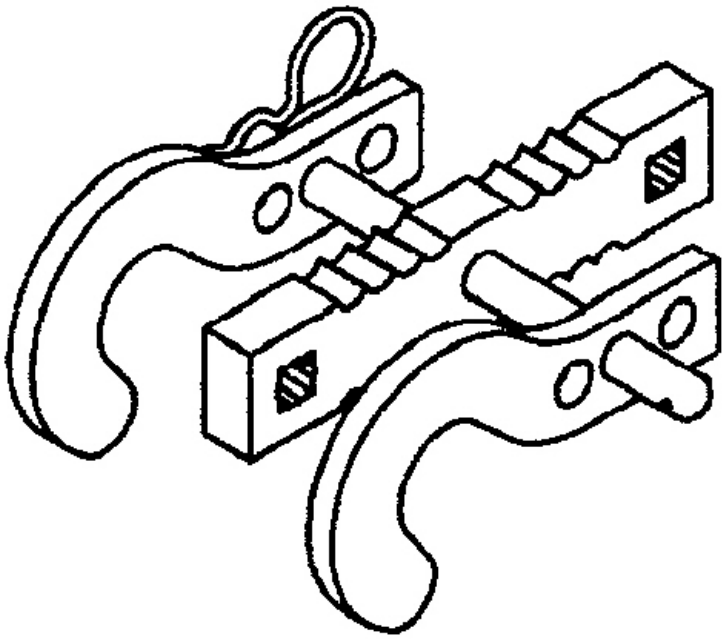
Fig. 14: Identifying Camshaft Seal Installer Md-998306
Courtesy of DAIMLERCHRYSLER CORP.



Crankshaft Damper/Sprocket Installer 6792

G03633124

Fig. 15: Identifying Crankshaft Damper/Sprocket Installer 6792
Courtesy of DAIMLERCHRYSLER CORP.



Valve Spring Compressor 8215-A

G03633125

Fig. 16: Identifying Valve Spring Compressor 8215-A
Courtesy of DAIMLERCHRYSLER CORP.

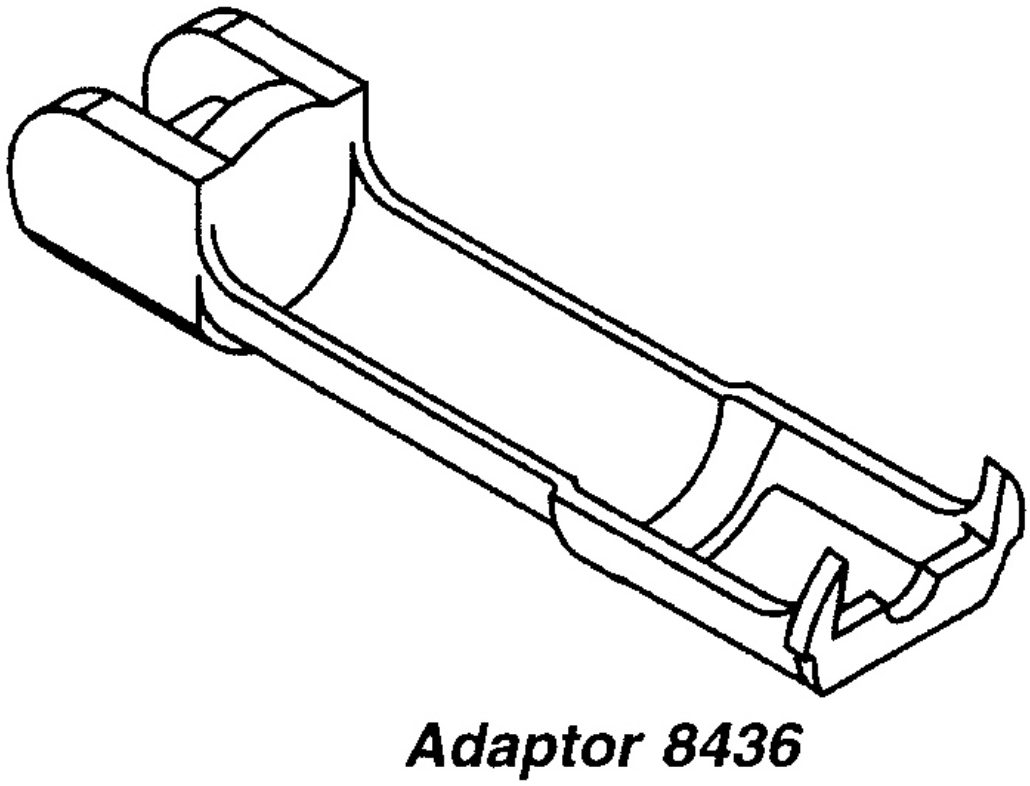
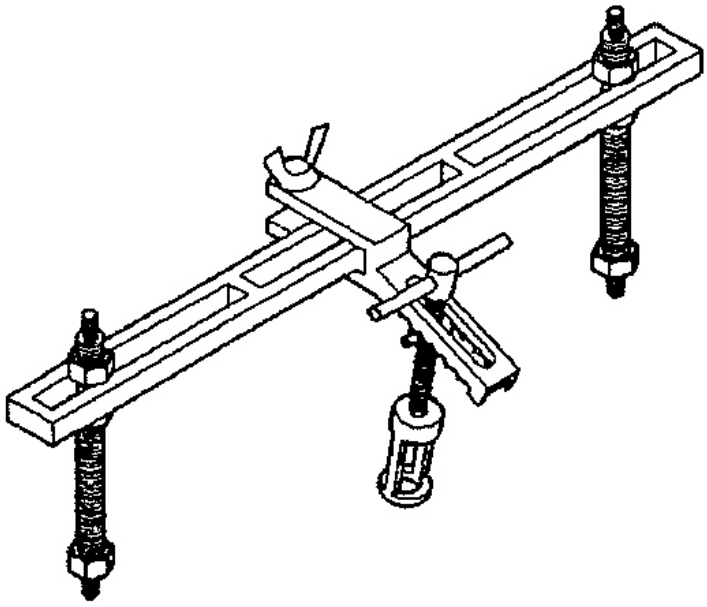


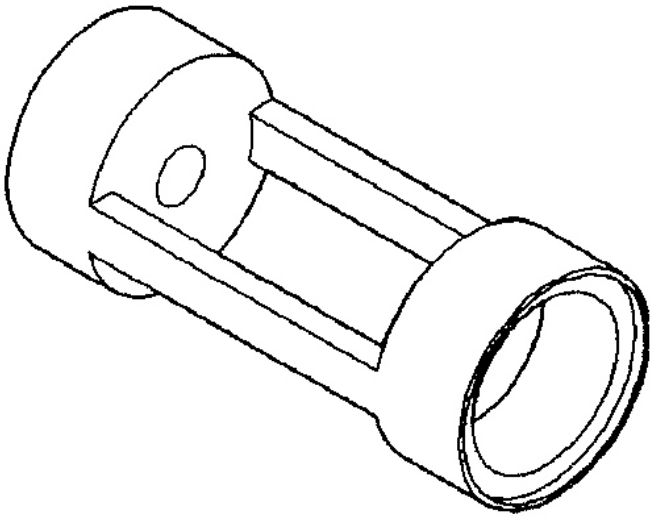
Fig. 17: Identifying Adaptor 8436
Courtesy of DAIMLERCHRYSLER CORP.



Valve Spring Compressor MD998772A

G03633127

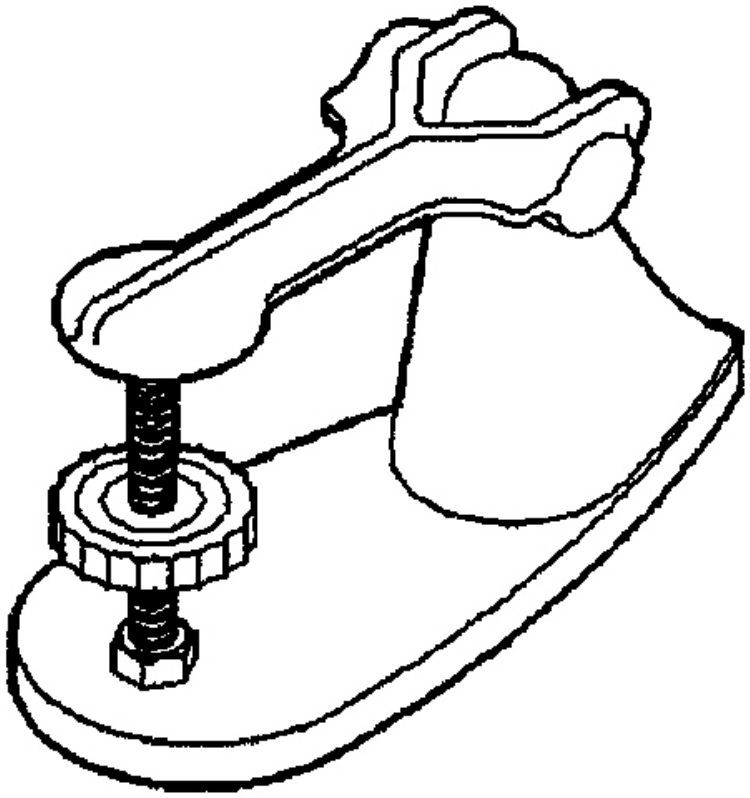
Fig. 18: Identifying Valve Spring Compressor Md998772A
Courtesy of DAIMLERCHRYSLER CORP.



Valve Spring Compressor Adapter 6779

G03633128

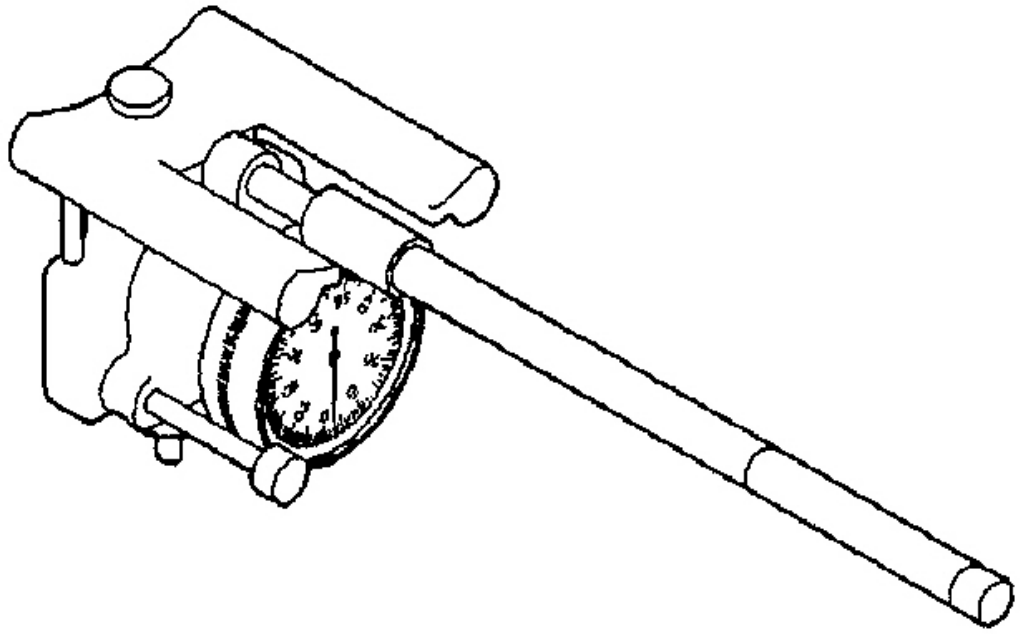
Fig. 19: Identifying Valve Spring Compressor Adapter 6779
Courtesy of DAIMLERCHRYSLER CORP.



Valve Spring Tester C-647

G03633129

Fig. 20: Identifying Valve Spring Tester C-647
Courtesy of DAIMLERCHRYSLER CORP.



Indicator, Cylinder Bore C-119

G03633130

Fig. 21: Identifying Indicator, Cylinder Bore C-119
Courtesy of DAIMLERCHRYSLER CORP.

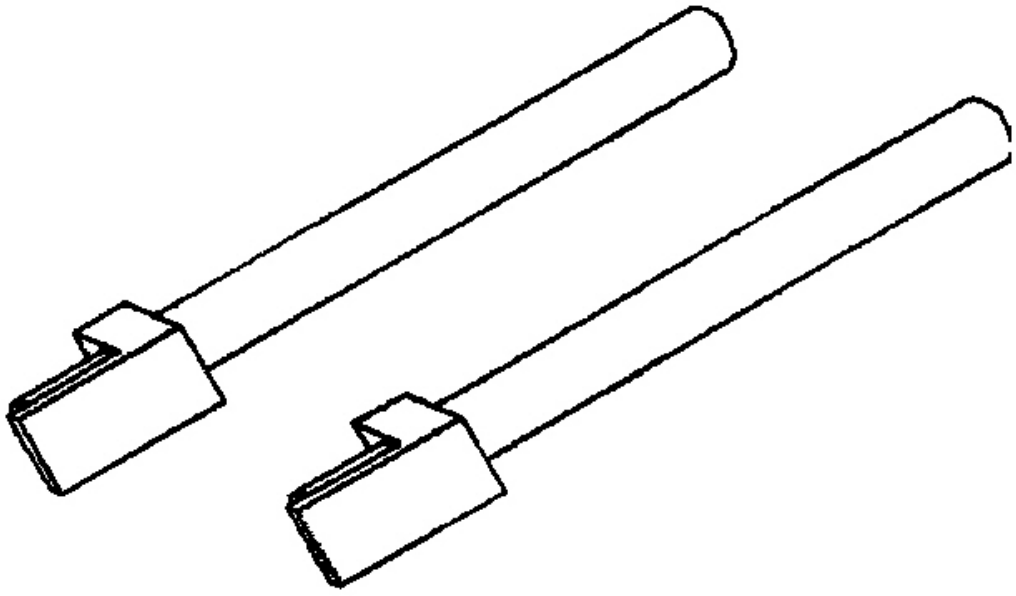
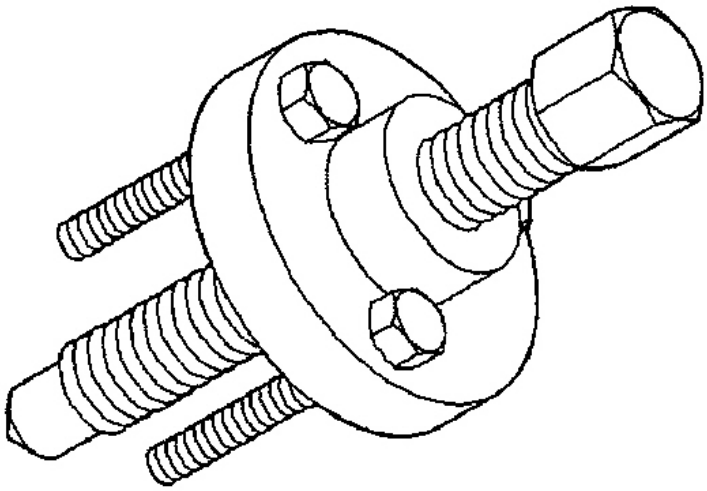


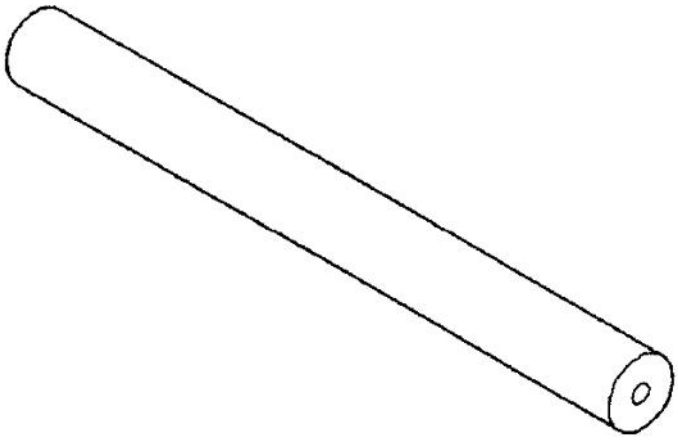
Fig. 22: Identifying Connecting Rod Guides 8189
Courtesy of DAIMLERCHRYSLER CORP.



Crankshaft Sprocket Remover 6793

G03633132

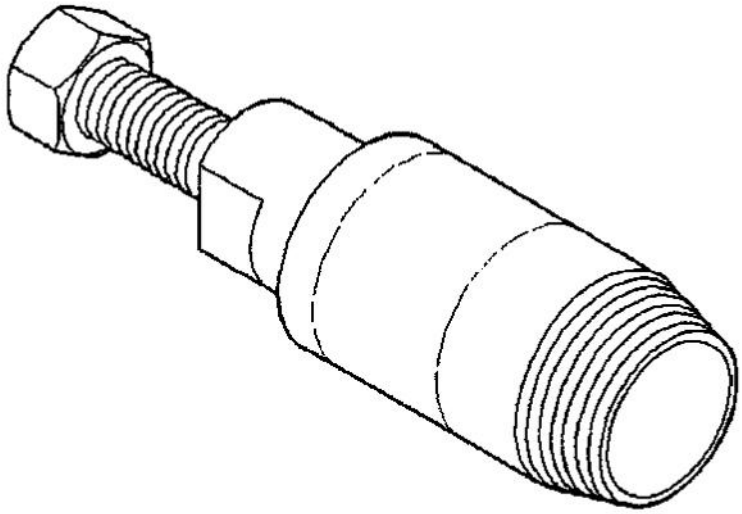
Fig. 23: Identifying Crankshaft Sprocket Remover 6793
Courtesy of DAIMLERCHRYSLER CORP.



Crankshaft Sprocket Remover Insert C-4685-C2

G03633133

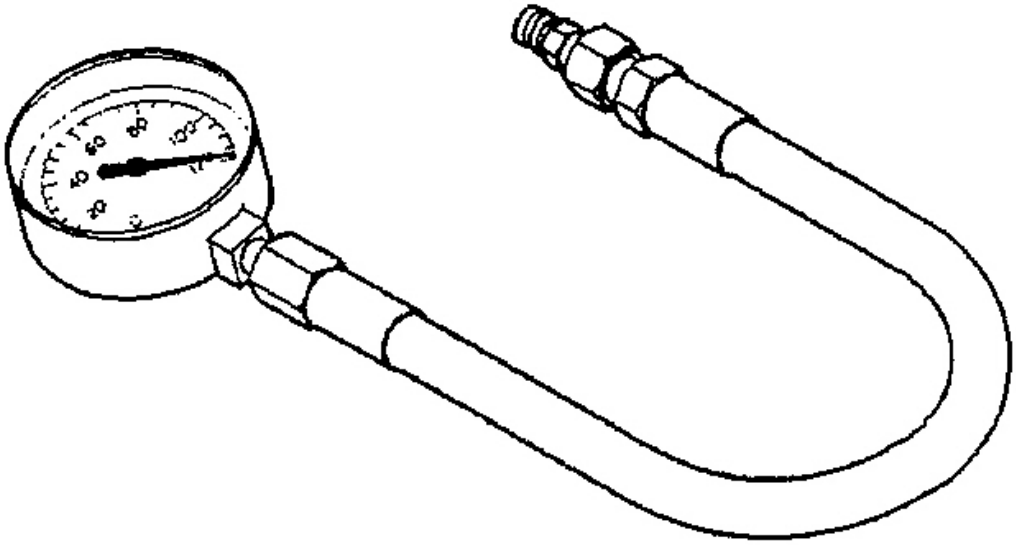
Fig. 24: Identifying Crankshaft Sprocket Remover Insert C-4685-C2
Courtesy of DAIMLERCHRYSLER CORP.



Front Crankshaft Oil Seal Remover 6771

G03633134

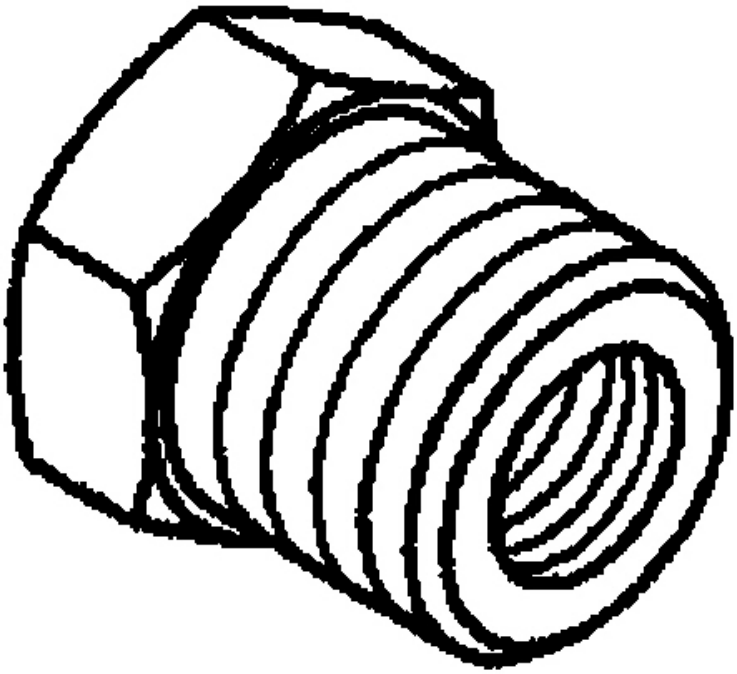
Fig. 25: Identifying Front Crankshaft Oil Seal Remover 6771
Courtesy of DAIMLERCHRYSLER CORP.



Oil Pressure Gauge C-3292

G03633135

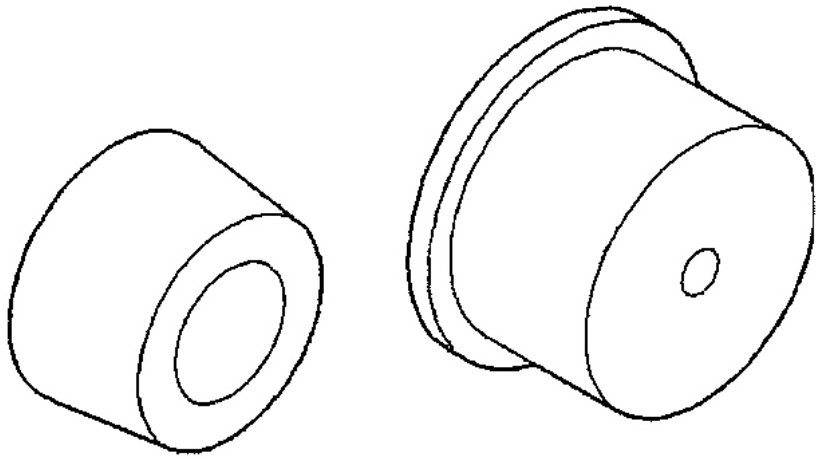
Fig. 26: Identifying Oil Pressure Gauge C-3292
Courtesy of DAIMLERCHRYSLER CORP.



Adapter 8406

G03633136

Fig. 27: Identifying Adapter 8406
Courtesy of DAIMLERCHRYSLER CORP.



Rear Crankshaft Oil Seal Installer 6926

G03633137

Fig. 28: Identifying Rear Crankshaft Oil Seal Installer 6926
Courtesy of DAIMLERCHRYSLER CORP.

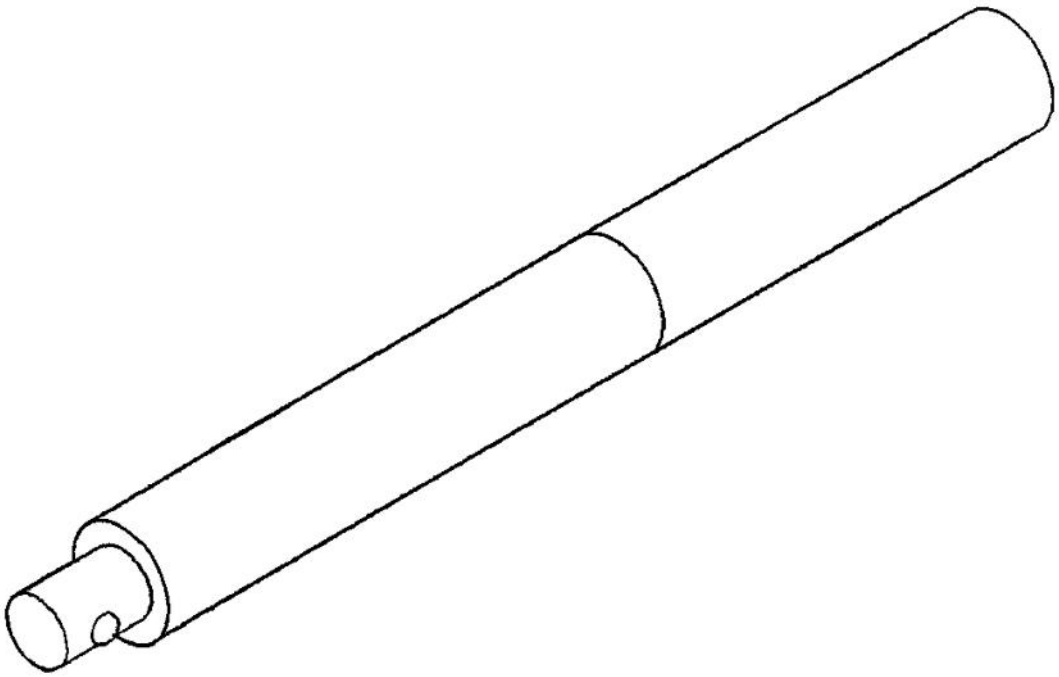
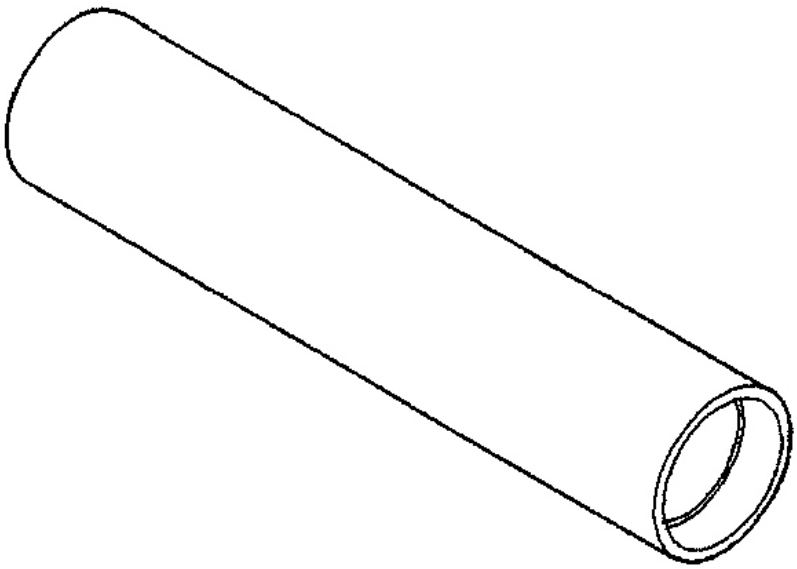


Fig. 29: Identifying Driver Handle C-4171
Courtesy of DAIMLERCHRYSLER CORP.



Balance Shaft Sprocket Installer 6052

G03633139

Fig. 30: Identifying Balance Shaft Sprocket Installer 6052
Courtesy of DAIMLERCHRYSLER CORP.

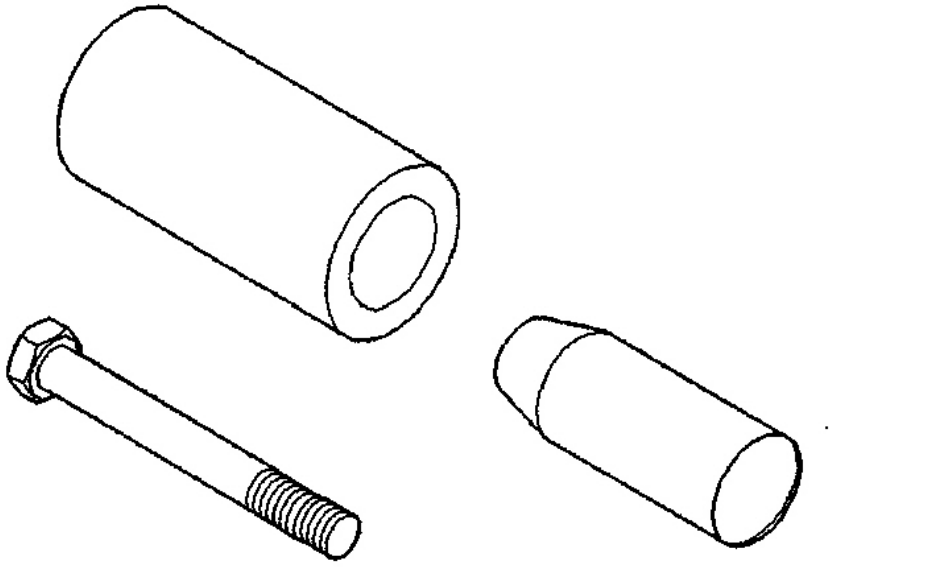


Fig. 31: Identifying Front Crankshaft Oil Seal Installer 6780
Courtesy of DAIMLERCHRYSLER CORP.

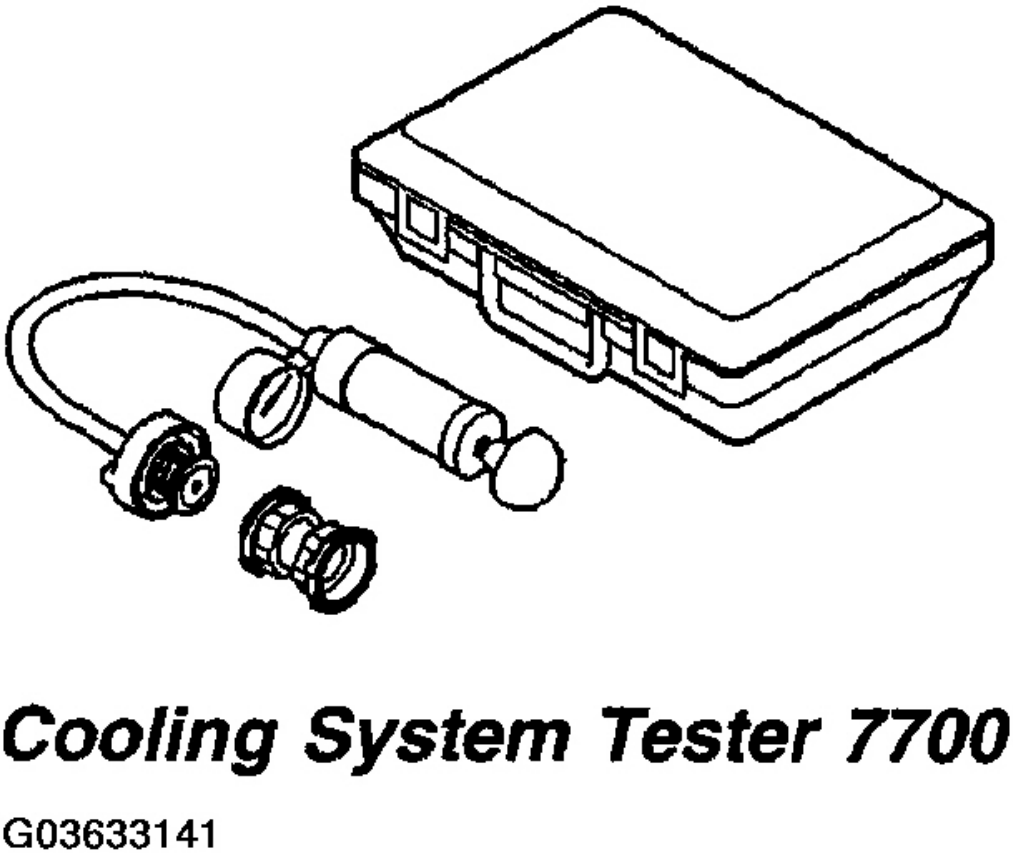
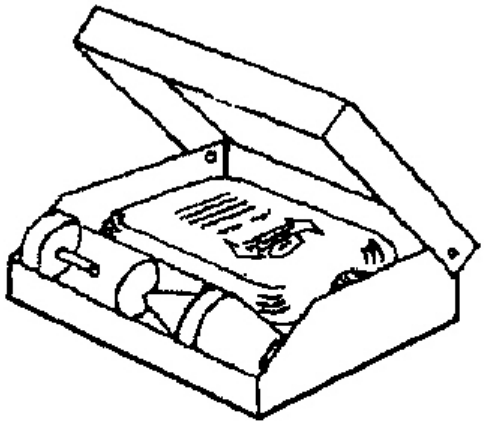


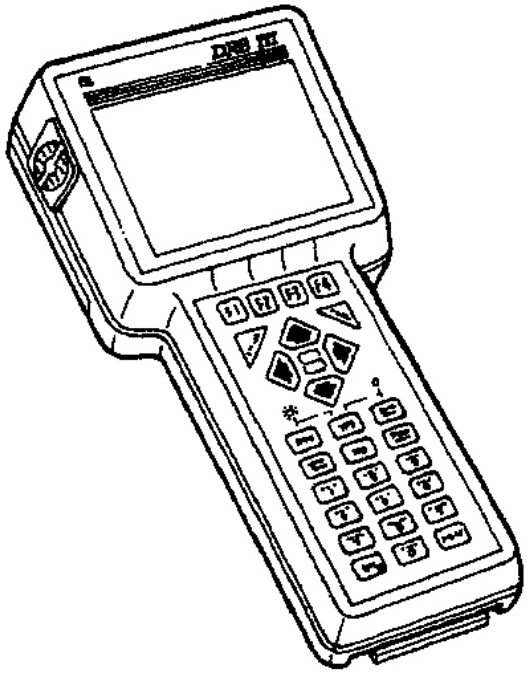
Fig. 32: Identifying Cooling System Tester 7700
Courtesy of DAIMLERCHRYSLER CORP.



Combustion Leak Tester C-3685-A

G03633142

Fig. 33: Identifying Combustion Leak Tester C-3685-A
Courtesy of DAIMLERCHRYSLER CORP.



DRB III® with PEP Module OT-CH6010A

G03633143

Fig. 34: Identifying DRB III® with PEP Module OT-CH6010A
Courtesy of DAIMLERCHRYSLER CORP.

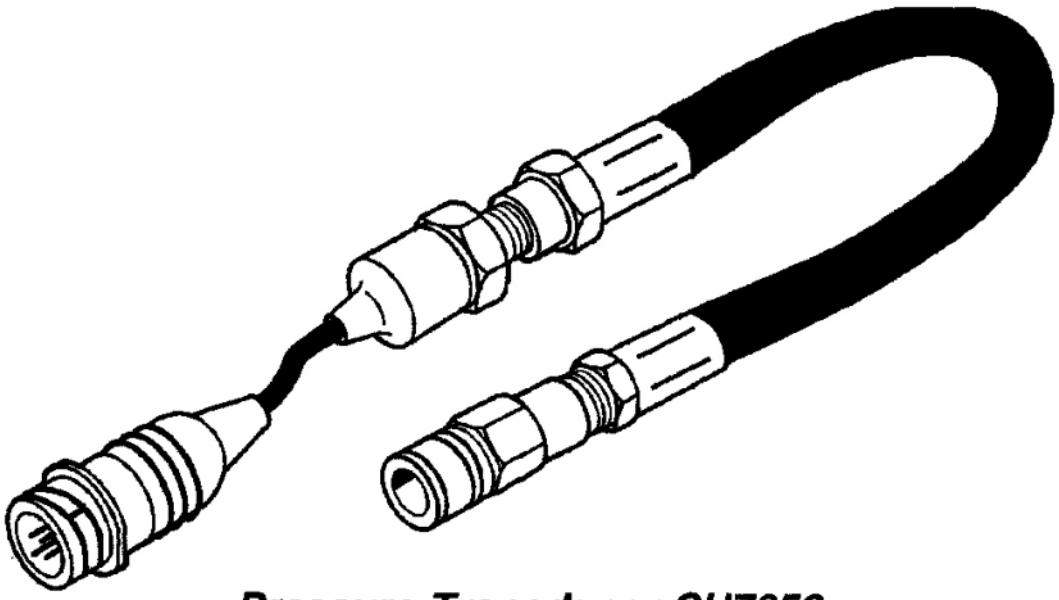
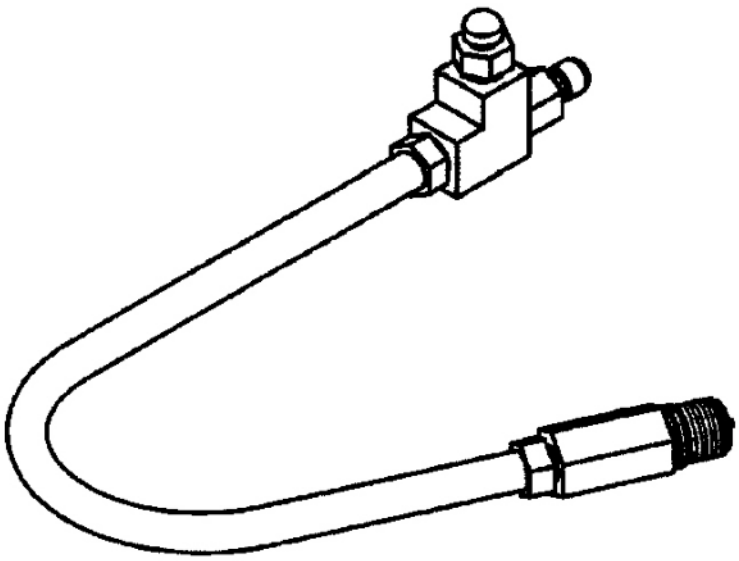


Fig. 35: Identifying Pressure Transducer CH7059
Courtesy of DAIMLERCHRYSLER CORP.



Cylinder Compression Pressure Adaptor 8116

G03633145

Fig. 36: Identifying Cylinder Compression Pressure Adaptor 8116
Courtesy of DAIMLERCHRYSLER CORP.

AIR CLEANER ELEMENT

REMOVAL

1. Disconnect negative battery cable.
2. Disconnect inlet air temperature sensor electrical connector.
3. Disconnect fresh air makeup hose from throttle body air inlet hose.
4. Disconnect PCV hose from intake manifold.
5. Loosen hose clamp at throttle body air inlet hose. Remove hose from throttle body.
6. Push in on locking tabs to disengage air inlet hose from air cleaner housing. Remove throttle body air inlet hose and air cleaner element together.
7. Separate air cleaner element from throttle body air inlet hose.

INSTALLATION

1. Clean any debris from inside air cleaner housing.
2. Install air cleaner element onto throttle body air inlet hose.
3. Install throttle body air inlet hose into air cleaner housing. Push in on hose until an audible "click" is

heard from locking tabs.

4. Install hose on throttle body. Tighten hose clamp.
5. Connect PCV hose to intake manifold.
6. Connect fresh air makeup hose.
7. Connect inlet air temperature sensor electrical connector.
8. Connect negative battery cable.

AIR CLEANER HOUSING

REMOVAL

1. Disconnect negative battery cable.
2. Disconnect inlet air temperature sensor electrical connector.
3. Disconnect fresh air makeup hose from throttle body air inlet hose.
4. Loosen hose clamp at throttle body air inlet hose. Remove hose from throttle body (**Fig. 37**).
5. Remove push pin securing air duct to upper radiator support.
6. Remove nut on bracket that holds air cleaner housing.
7. Pull air cleaner housing straight up off locating pins (**Fig. 37**).

INSTALLATION

1. Install air cleaner housing straight down on locating pins (**Fig. 37**).
2. Install nut on bracket that holds air cleaner housing and tighten.

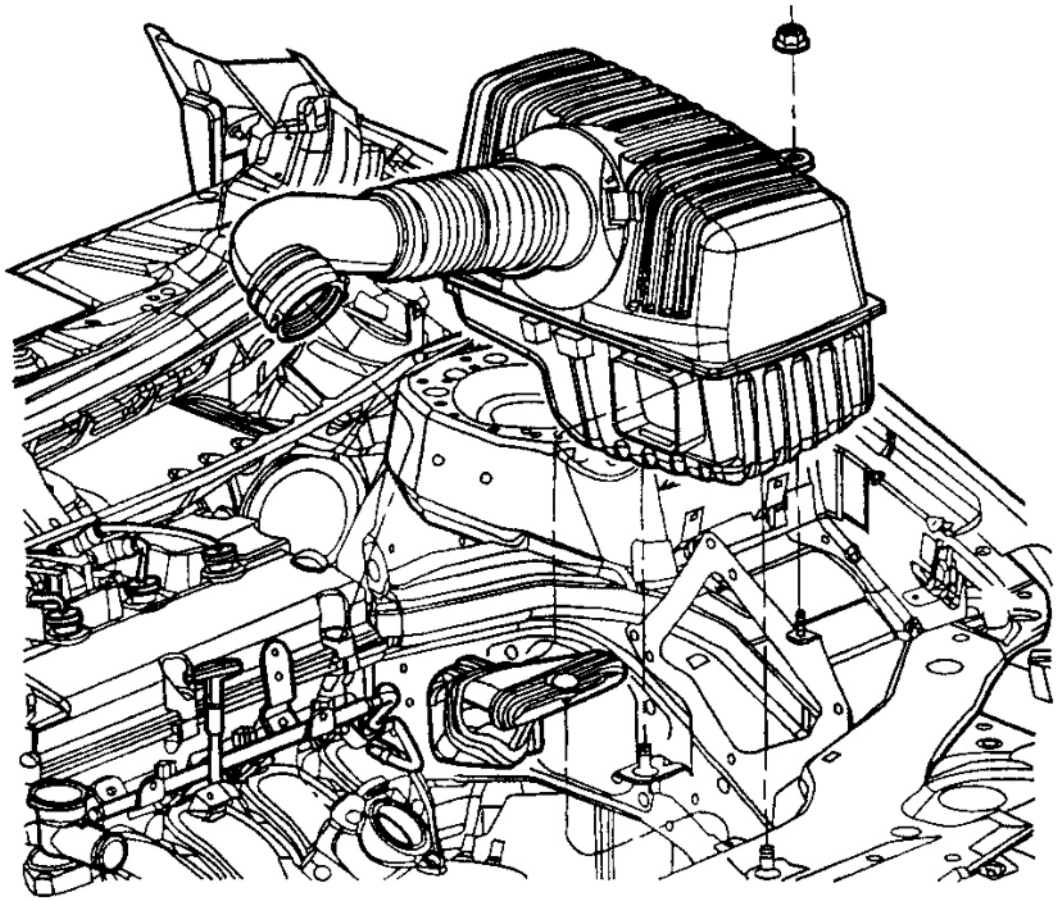


Fig. 37: Identifying Air Cleaner Housing
Courtesy of DAIMLERCHRYSLER CORP.

3. Install push pin that secures air duct to upper radiator support.
4. Install throttle body air inlet hose to throttle body. Tighten hose clamp.
5. Connect fresh air makeup hose.
6. Connect inlet air temperature sensor electrical connector.
7. Connect negative battery cable.

CYLINDER HEAD

DESCRIPTION

The cross flow designed, aluminum cylinder head contains dual over-head camshafts with four valves per cylinder (**Fig. 38**). The valves are arranged in two in-line banks. The intake valves face toward the front of the

vehicle. The exhaust valves face the dash panel. The cylinder head incorporates powdered metal valve guides and seats. The cylinder head is sealed to the block using a multi-layer steel head gasket and retaining bolts.

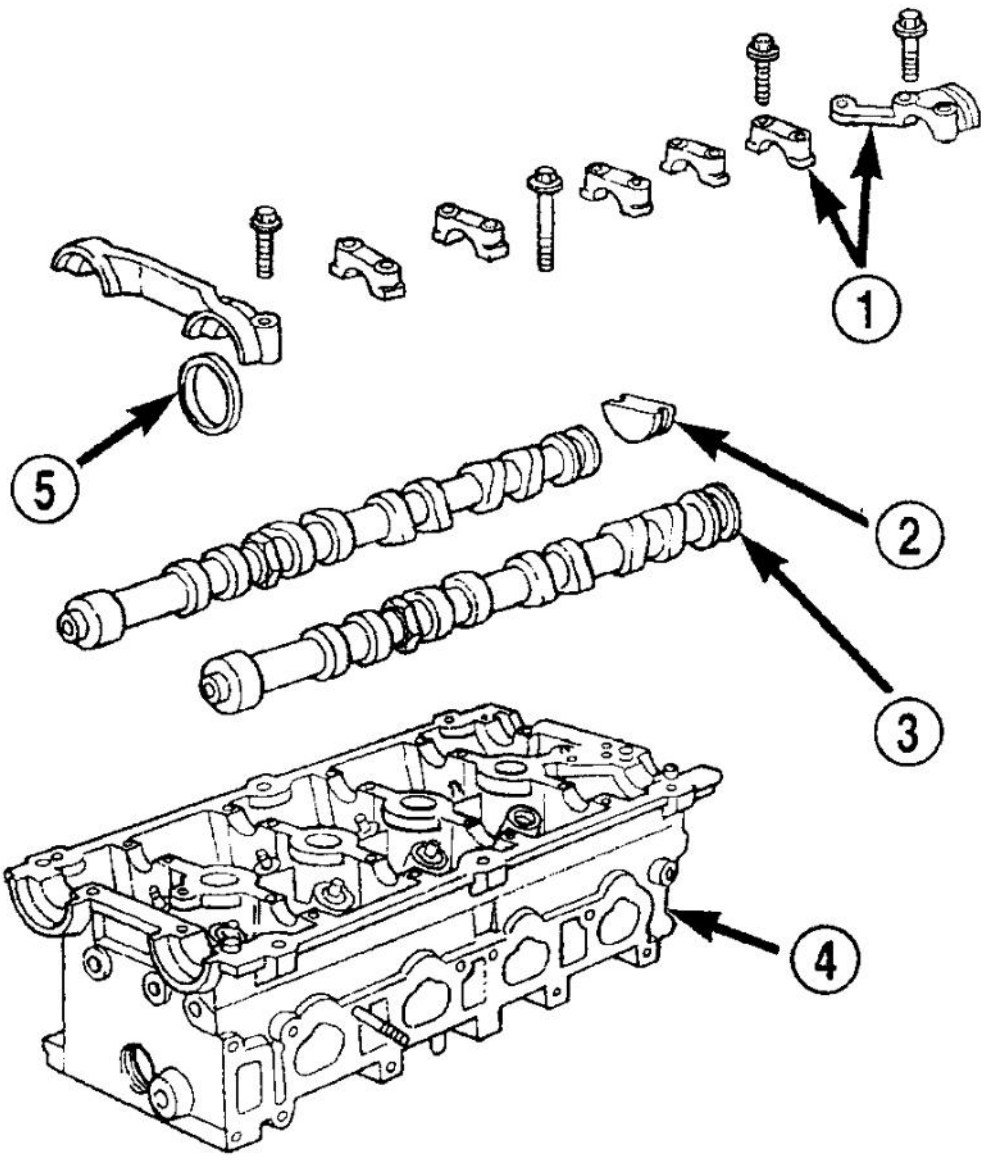
Integral oil galleries provide lubrication passages to the hydraulic lash adjusters, camshafts, and valve mechanisms.

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



1 - CAMSHAFT BEARING CAPS
2 - PLUG
3 - CAMSHAFT
4 - CYLINDER HEAD
5 - CAMSHAFT OIL SEAL

G03633147

Fig. 38: Identifying Cylinder Head And Camshafts

Courtesy of DAIMLERCHRYSLER CORP.

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 **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 - CYLINDER HEAD

1. Perform fuel system pressure release procedure **before attempting any repairs.** (refer to **FUEL SYSTEM PRESSURE RELEASE** (2003) or **STANDARD PROCEDURE - FUEL SYSTEM**

PRESSURE RELEASE PROCEDURE (2004)).

2. Disconnect negative battery cable.
3. Drain cooling system (Refer to COOLING article).
4. Remove throttle body air inlet hose and air cleaner housing assembly.
5. Remove intake manifold (Refer to **REMOVAL**).
6. Disconnect heater hose from thermostat housing.
7. Remove heater tube support bracket from cylinder head.
8. Disconnect camshaft position sensor electrical connector.
9. Disconnect EGR solenoid electrical connector.
10. Raise vehicle on hoist.
11. Disconnect exhaust pipe from exhaust manifold.
12. Remove accessory drive belts (Refer to SPECIFICATIONS & DRIVE BELT ROUTING article.
13. Remove crankshaft damper (Refer to **VIBRATION DAMPER**).
14. Remove upper and lower timing belt covers (Refer to **TIMING BELT COVER(S)**).
15. Remove timing belt (Refer to **TIMING BELT AND SPROCKET(S)**).
16. Remove camshaft sprockets (refer to **TIMING BELT AND SPROCKET(S)**).
17. Remove timing belt idler pulley and rear timing belt cover.
18. Remove cylinder head cover (refer to **CYLINDER HEAD COVER**).
19. Remove camshafts and rocker arms (Refer to **REMOVAL**).
20. Remove cylinder head bolts and remove cylinder head from engine block.
21. Inspect and clean cylinder head (Refer to **STANDARD PROCEDURE**).

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.

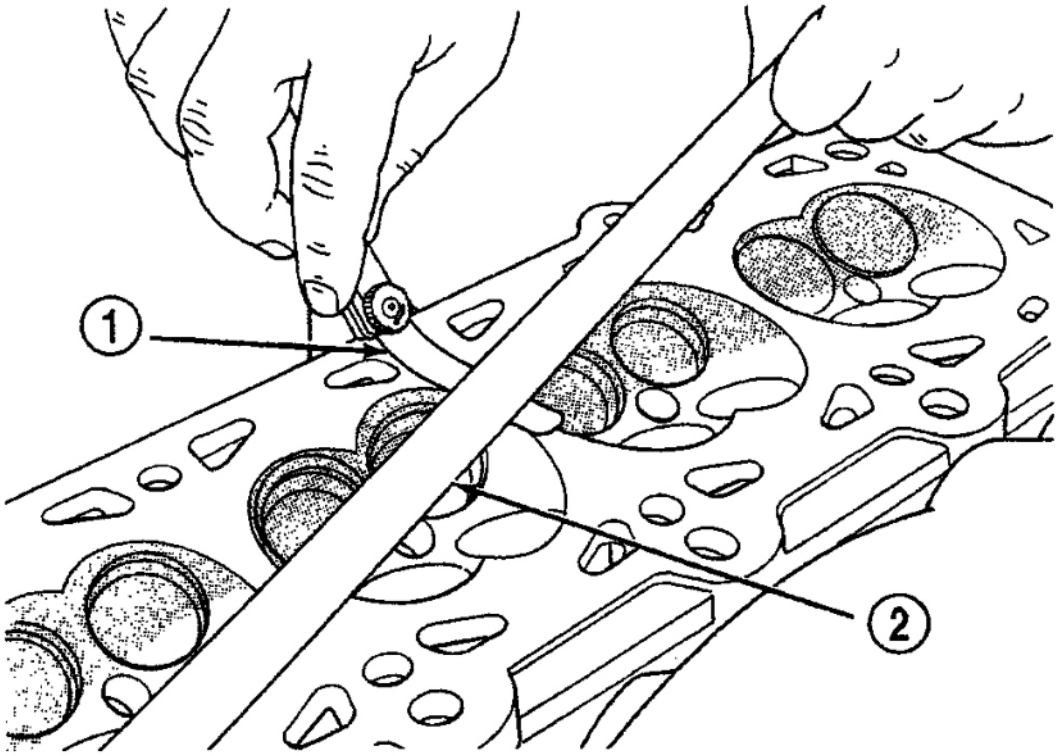
Remove all gasket material from cylinder head and block (Refer to **STANDARD PROCEDURE**). Be careful not to gouge or scratch the aluminum head sealing surface.

Clean all engine oil passages.

INSPECTION

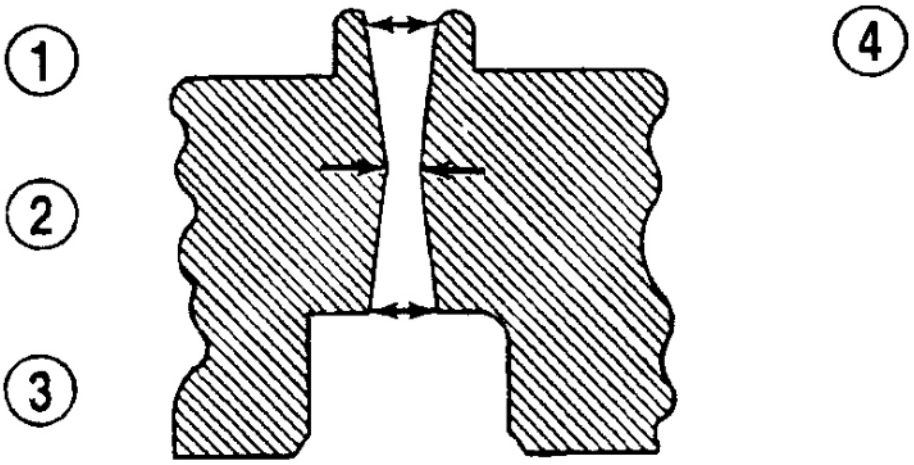
1. Cylinder head must be flat within 0.1 mm (0.004 in.) (**Fig. 39**).
2. Inspect camshaft bearing journals for scoring.
3. Remove carbon and varnish deposits from inside of valve guides with a reliable guide cleaner.
4. Using a small hole gauge and a micrometer, measure valve guides in 3 places top, middle and bottom (**Fig. 40**). (Refer to **SPECIFICATIONS**) Replace guides if they are not within specification.

5. Check valve guide height (**Fig. 41**).



1 - FEELER GAUGE
2 - STRAIGHT EDGE
G03633148

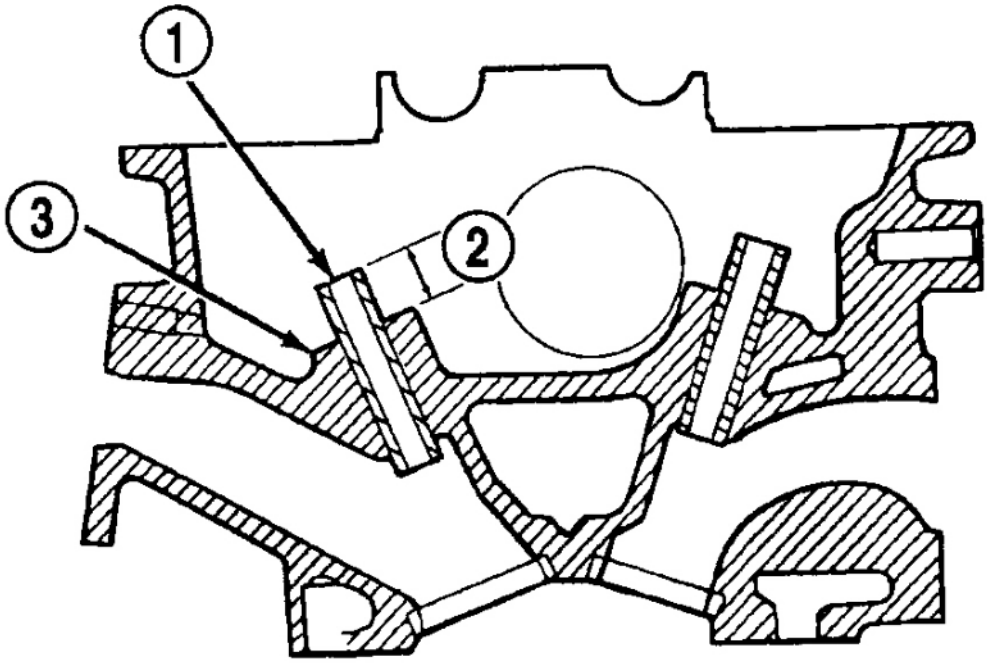
Fig. 39: Checking Cylinder Head Flatness
Courtesy of DAIMLERCHRYSLER CORP.



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

G03633149

Fig. 40: Checking Wear On Valve Guide-Typical
Courtesy of DAIMLERCHRYSLER CORP.



1 - VALVE GUIDE
2 - 13.25 - 13.75 MM (0.521 - 0.541 IN.)
3 - SPRING SEAT

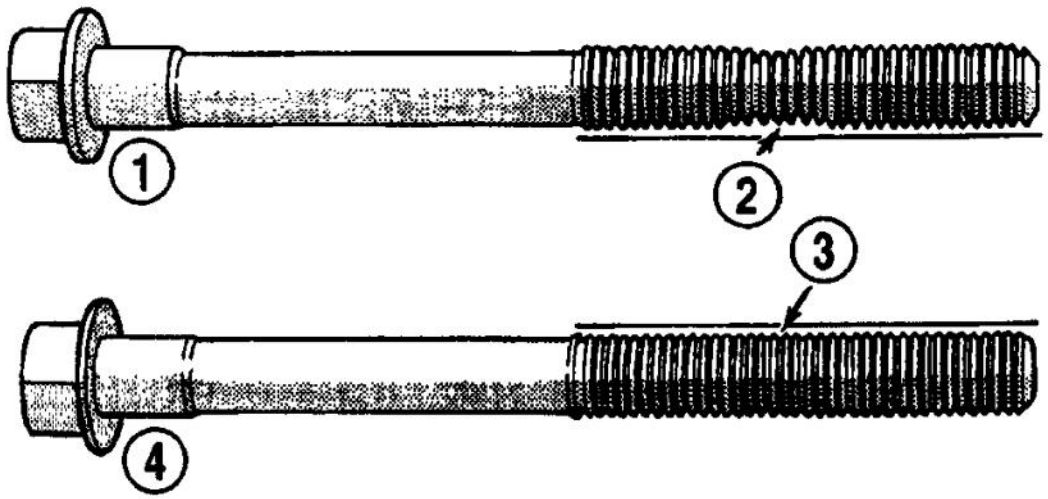
G03633150

Fig. 41: Identifying Valve Guide Height
Courtesy of DAIMLERCHRYSLER CORP.

INSTALLATION - CYLINDER HEAD

NOTE: The Cylinder head bolts should be examined BEFORE reuse. If the threads are necked down, the bolts must be replaced (Fig. 42).

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



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

G03633151

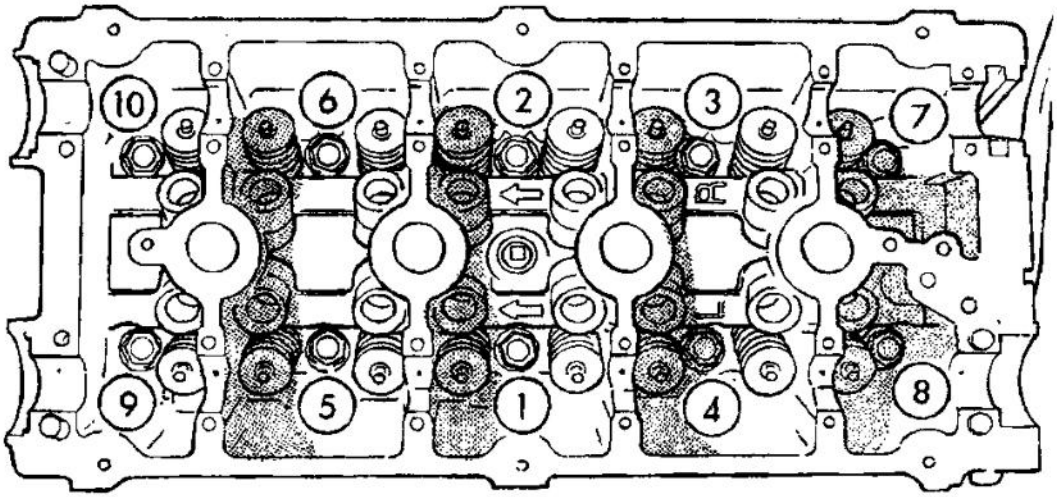
Fig. 42: Checking Bolts For Stretching (Necking)
Courtesy of DAIMLERCHRYSLER CORP.

1. Before installing the bolts, the threads should be coated with engine oil.
2. Position cylinder head gasket on block.
3. Install cylinder head on block.
4. Tighten the cylinder head bolts in the sequence shown in (**Fig. 43**). Using the 4 step torque turn method, tighten according to the following values:
   - First: All to 34 N.m (25 ft. lbs.)
   - Second: All to 68 N.m (50 ft. lbs.)
   - Third: All to 68 N.m (50 ft. lbs.)

CAUTION: Do not use a torque wrench for the Fourth step.

   - **Fourth: Turn all bolts an additional 1/4 Turn**
5. Install rocker arms and camshafts (Refer to **INSTALLATION**).
6. Install cylinder head cover (Refer to **CYLINDER HEAD COVER**).

7. Install rear timing belt cover and timing belt idler pulley (Refer to **TIMING BELT COVER(S)**).
8. Install camshaft sprockets (Refer to **TIMING BELT AND SPROCKET(S)**).



G03633152

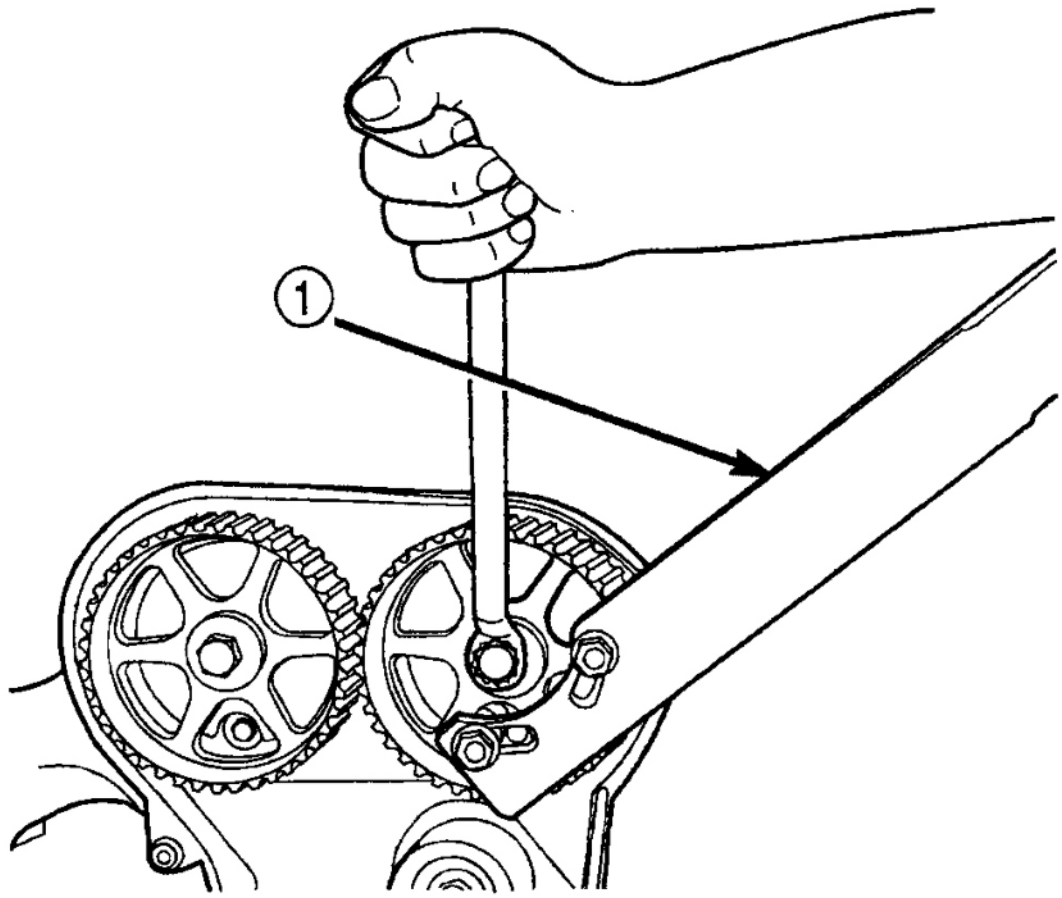
Fig. 43: Identifying Cylinder Head Tightening Sequence
Courtesy of DAIMLERCHRYSLER CORP.

9. Install timing belt (Refer to **TIMING BELT AND SPROCKET(S)**).
10. Install upper and lower timing belt covers (Refer to **TIMING BELT COVER(S)**).
11. Install crankshaft damper (Refer to **VIBRATION DAMPER**).
12. Install accessory drive belts (Refer to SPECIFICATIONS & DRIVE BELT ROUTING article.
13. Connect exhaust pipe to exhaust manifold. Torque fasteners to 28 N.m (250 in. lbs.).
14. Connect camshaft position sensor electrical connector.
15. Connect EGR solenoid electrical connector.
16. Install heater tube support bracket to cylinder head.
17. Connect heater hose to thermostat housing.
18. Install intake manifold (Refer to **INSTALLATION**).
19. Install throttle body air inlet hose and air cleaner housing assembly.
20. Fill cooling system (Refer to COOLING article).
21. Connect negative battery cable.

CAMSHAFT OIL SEAL(S)

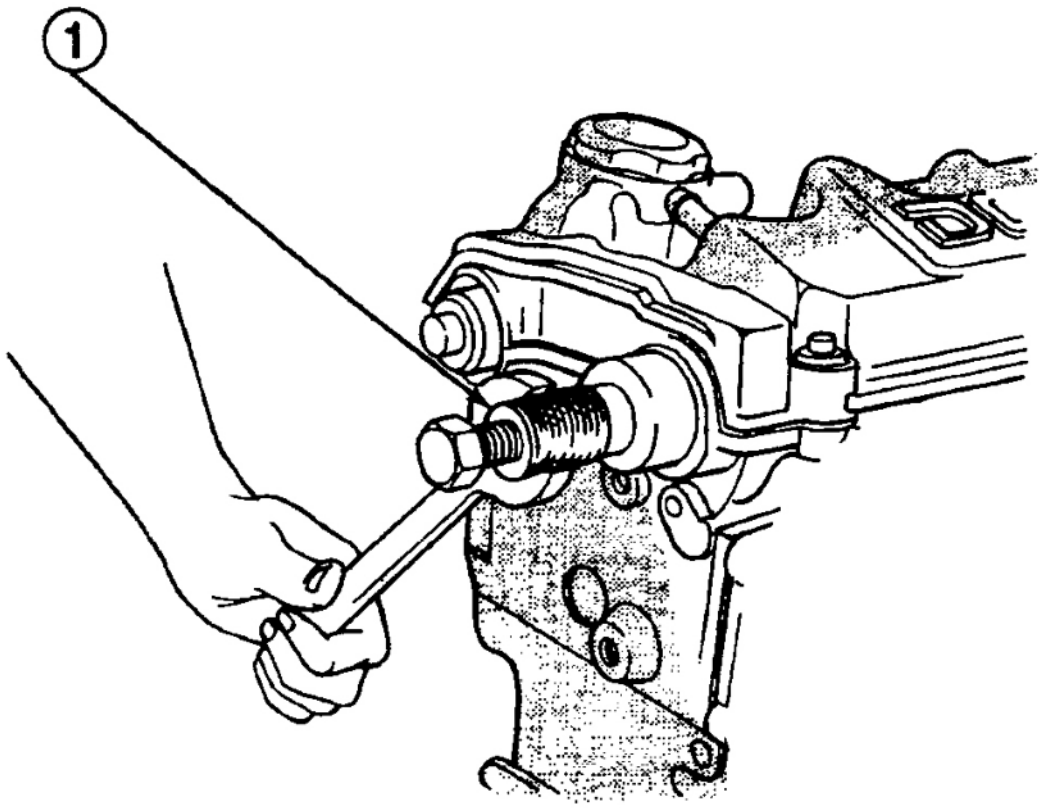
REMOVAL

1. Remove timing belt (refer to **TIMING BELT AND SPROCKET(S)**).
2. Hold each camshaft sprocket with Special Tool 6847 while removing center bolt (**Fig. 44**).
3. Remove camshaft sprockets.
4. Remove rear timing belt cover (refer to **TIMING BELT COVER(S)**).
5. Remove camshaft seal using Special Tool C-4679A (**Fig. 45**).



1 - SPECIAL TOOL 6847
G03633153

Fig. 44: Removing Camshaft Sprocket
Courtesy of DAIMLERCHRYSLER CORP.



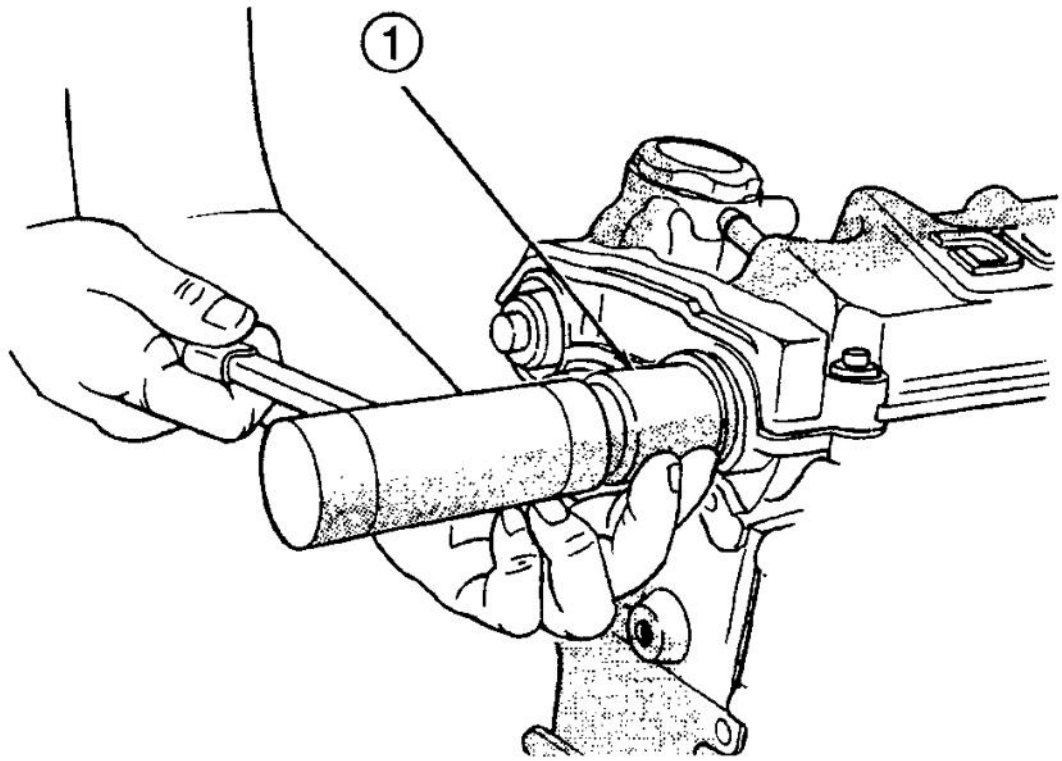
1 - SPECIAL TOOL C-4679
G03633154

Fig. 45: Removing Camshaft Oil Seal
Courtesy of DAIMLERCHRYSLER CORP.

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

INSTALLATION

1. Shaft seal surface must be free of varnish, dirt or nicks. Polish with 400 grit paper if necessary.
2. Install camshaft seals into cylinder head using Special Tool MD-998306 until flush with head (**Fig. 46**).



1 - SPECIAL TOOL MD-998306
G03633155

Fig. 46: Installing Camshaft Seal
Courtesy of DAIMLERCHRYSLER CORP.

3. Install timing belt rear cover (refer to **TIMING BELT COVER(S)**).
4. Install camshaft sprockets. Hold each sprocket with Special Tool 6847 and tighten center bolt to 115 N.m (85 ft. lbs.) (**Fig. 44**).
5. Install timing belt and front covers (Refer to **TIMING BELT AND SPROCKET(S)**) (Refer to **TIMING BELT COVER(S)**).

CAMSHAFT(S)

DESCRIPTION

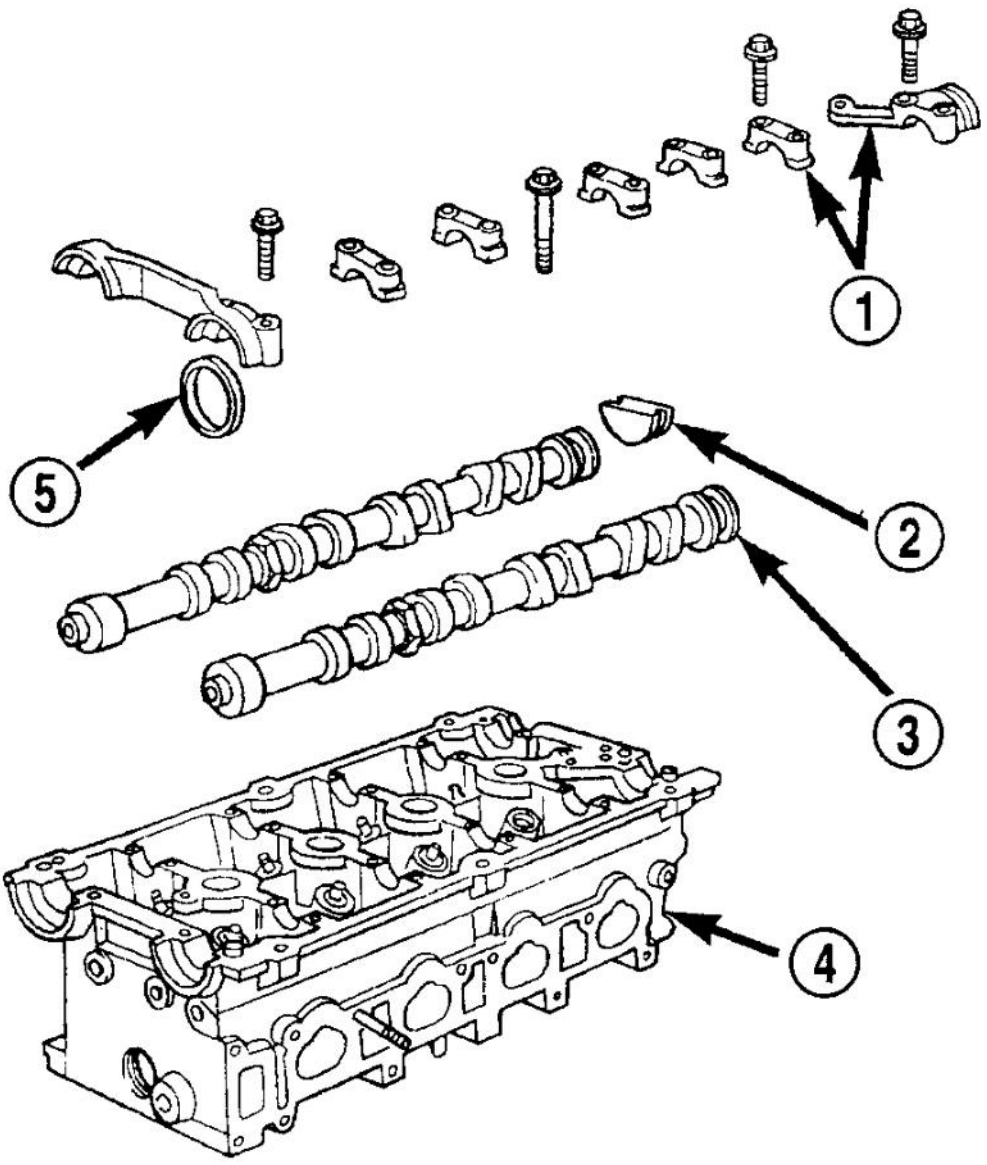
Both camshafts have six bearing journal surfaces and two cam lobes per cylinder (**Fig. 47**). Flanges at the rear journals control camshaft end play. Provision for a cam position sensor is located on the intake camshaft on the rear of the cylinder head. A hydrodynamic oil seal is used for oil control at the front of the camshaft.

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.



1 - CAMSHAFT BEARING CAPS
2 - PLUG
3 - CAMSHAFT
4 - CYLINDER HEAD
5 - CAMSHAFT OIL SEAL

G03633156

Fig. 47: Identifying Camshafts Components

Courtesy of DAIMLERCHRYSLER CORP.

3. Zero dial indicator (**Fig. 48**).
4. Move camshaft as far forward as it will go.
5. Record reading on dial indicator. For end play specification, (Refer to **SPECIFICATIONS**).
6. If end play is excessive, check cylinder head and camshaft for wear; replace as necessary.

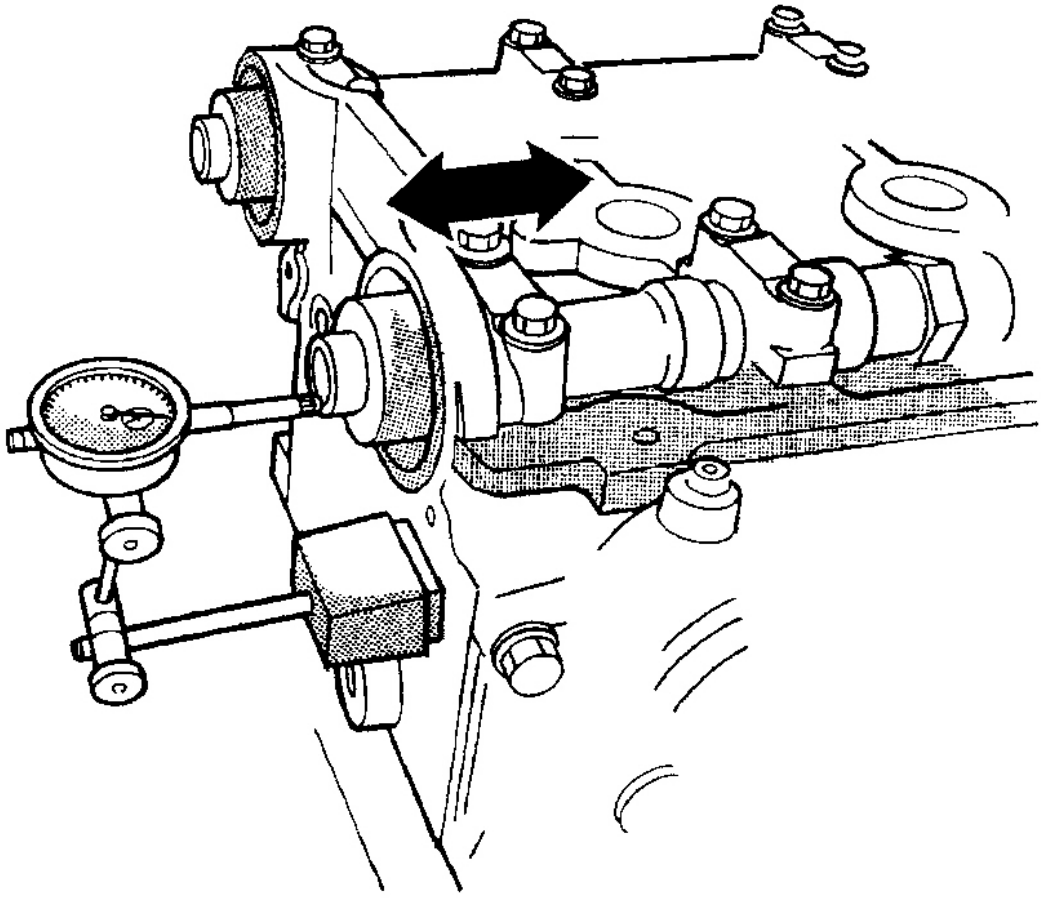


Fig. 48: Measuring Camshaft End Play
Courtesy of DAIMLERCHRYSLER CORP.

REMOVAL

1. Remove cylinder head cover (Refer to **CYLINDER HEAD COVER**).
2. Remove camshaft position sensor and camshaft target magnet (Refer to).

3. Remove timing belt (Refer to **TIMING BELT AND SPROCKET(S)**.
4. Remove camshaft sprockets and timing belt rear cover (Refer to **TIMING BELT AND SPROCKET(S)** and **TIMING BELT COVER(S)**).
5. Bearing caps are identified for location. Remove the outside bearing caps first (**Fig. 49**).
6. Loosen the camshaft bearing cap attaching fasteners in sequence shown (**Fig. 50**) one camshaft at a time.

CAUTION: Camshafts are not interchangeable. The intake cam number 6 thrust bearing face spacing is wider.

7. Identify the camshafts before removing from the head. The camshafts are not interchangeable.
8. Remove camshafts from cylinder head.

NOTE: If removing rocker arms, identify for reinstallation in the original position.

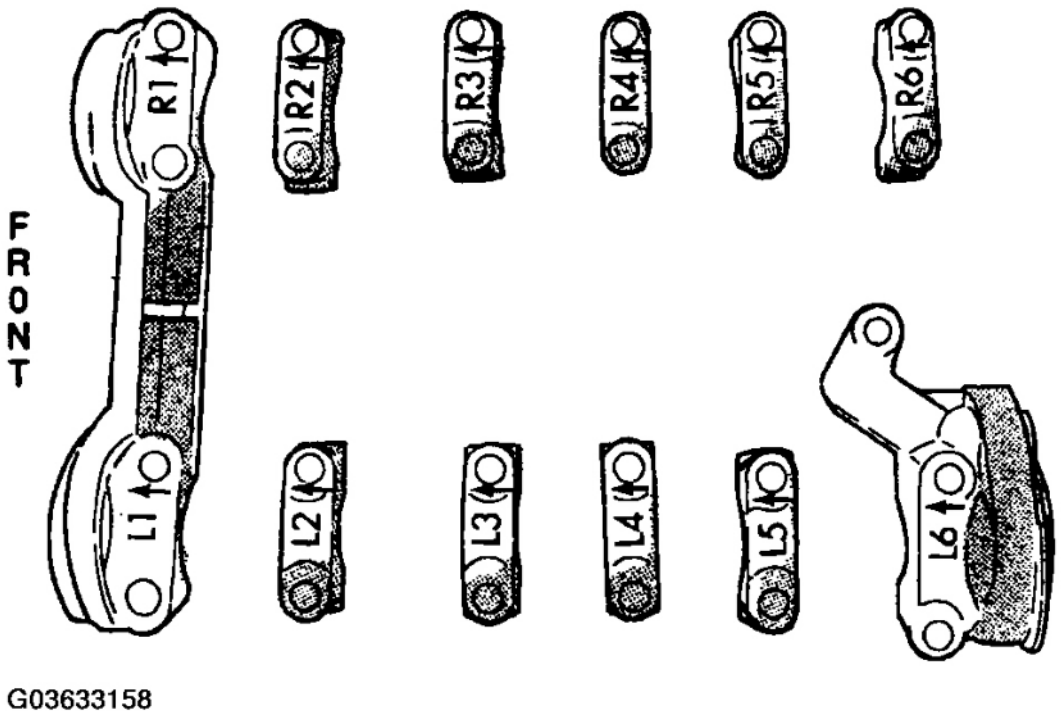


Fig. 49: Identifying Camshaft Bearing Cap Identification
Courtesy of DAIMLERCHRYSLER CORP.

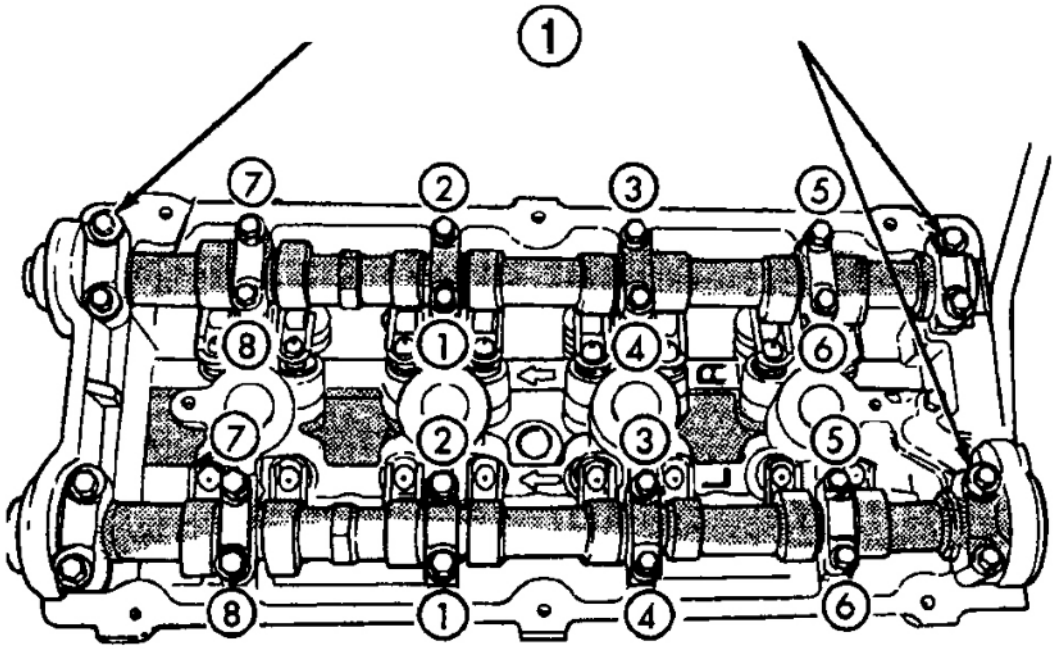
CLEANING

Clean camshaft with a suitable solvent.

INSPECTION

1. Inspect camshaft bearing journals for damage and binding (**Fig. 51**). 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.

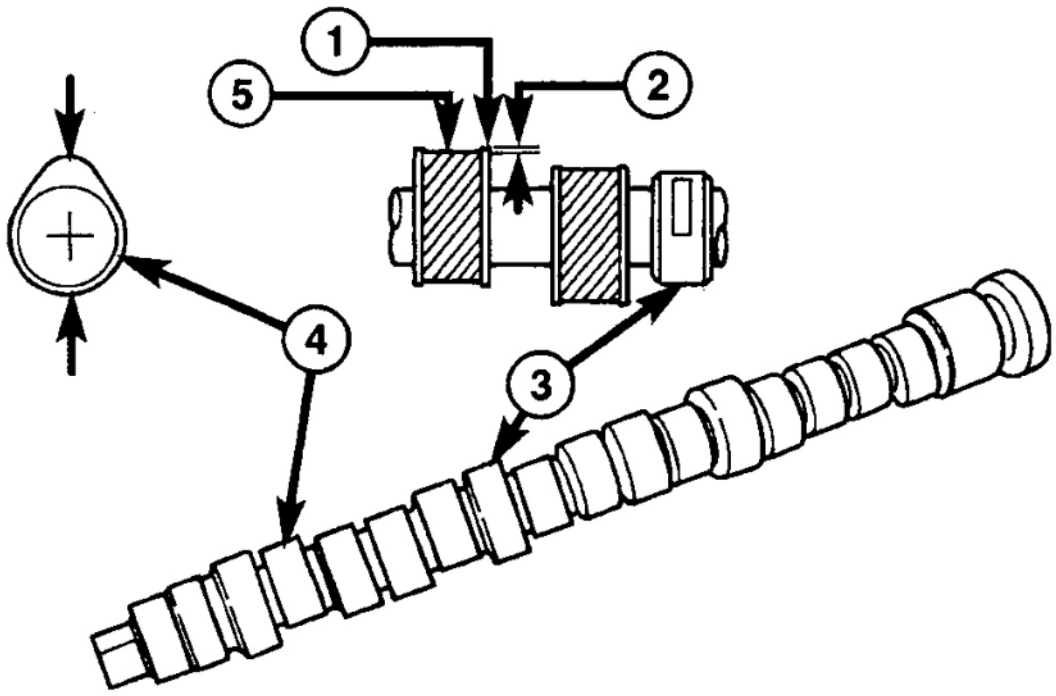
NOTE: If camshaft is replaced due to lobe wear or damage, always replace the rocker arms.



1 - REMOVE OUTSIDE BEARING CAPS FIRST
G03633159

Fig. 50: Removing Camshaft Bearing Cap
Courtesy of DAIMLERCHRYSLER CORP.

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



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

G03633160

Fig. 51: Checking Camshaft(s) For Wear
Courtesy of DAIMLERCHRYSLER CORP.

INSTALLATION

CAUTION: Ensure that NONE of the pistons are at top dead center when installing the camshafts.

1. Lubricate all camshaft bearing journals, rocker arms and camshaft lobes.
2. Install all rocker arms in original positions, if reused.
3. Position camshafts on cylinder head bearing journals. Install right and left camshaft bearing caps No. 2 - 5 and right No. 6. Tighten M6 fasteners to 12 N.m (105 in. lbs.) in sequence shown in (**Fig. 52**).
4. Apply Mopar® Gasket Maker to No. 1 and No. 6 bearing caps (**Fig. 53**). Install bearing caps and tighten M8 fasteners to 28 N.m (250 in. lbs.).

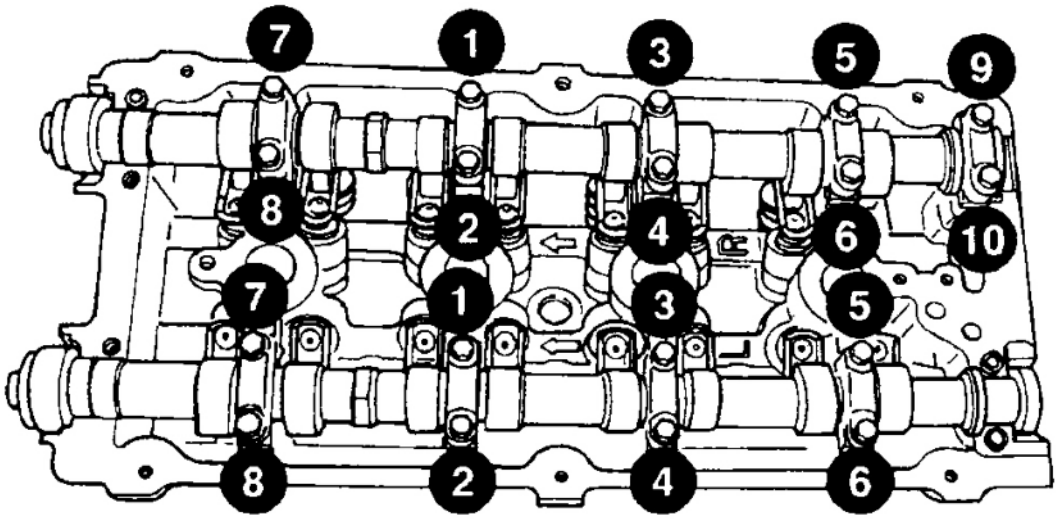
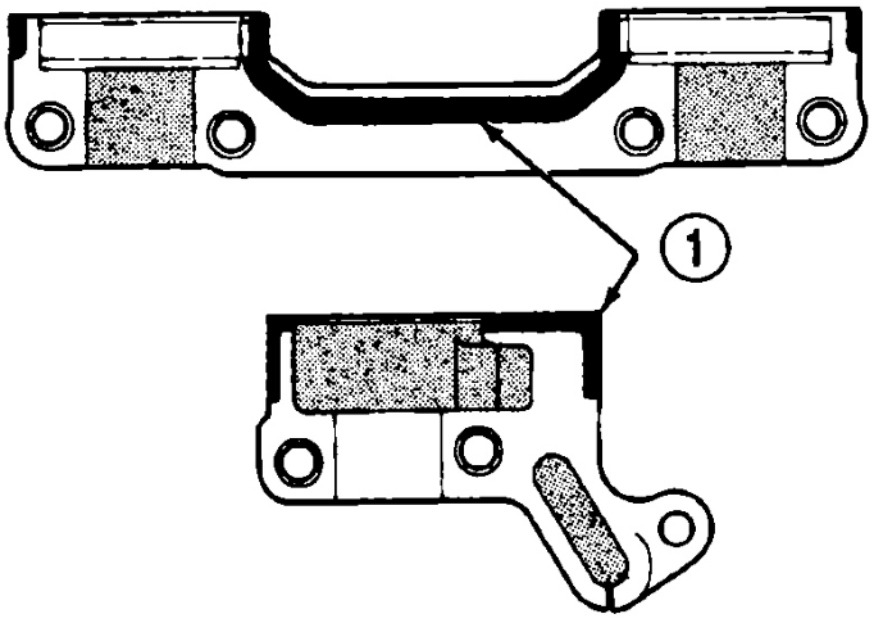


Fig. 52: Identifying Camshaft Bearing Cap Tightening Sequence
Courtesy of DAIMLERCHRYSLER CORP.



1 - 1.5 mm (.060 in.) DIAMETER BEAD OF MOPAR GASKET MAKER

G03633162

Fig. 53: Identifying Camshaft Bearing Cap Sealing
Courtesy of DAIMLERCHRYSLER CORP.

NOTE: Bearing end caps must be installed before seals can be installed.

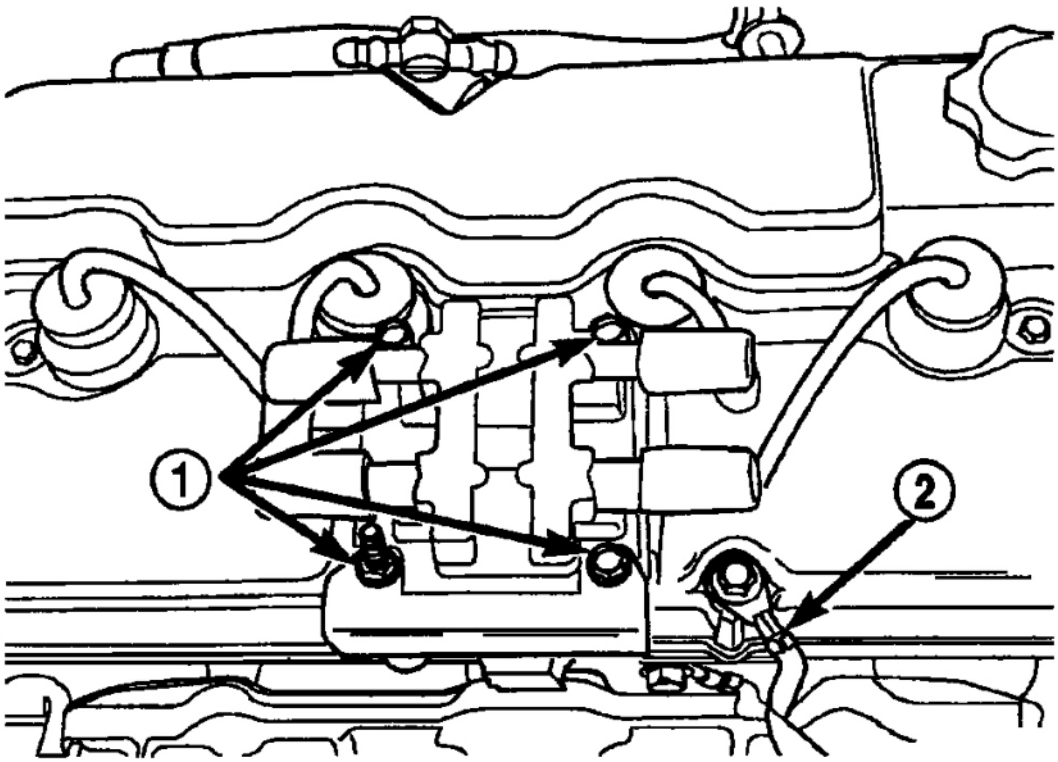
5. Install camshaft oil seals (Refer to **INSTALLATION**).
6. Install camshaft target magnet and camshaft position sensor.
7. Install cylinder head cover (Refer to **CYLINDER HEAD COVER**).
8. Install timing belt rear cover and camshaft sprockets (Refer to **TIMING BELT COVER(S)** and **TIMING BELT AND SPROCKET(S)**).
9. Install timing belt (Refer to **TIMING BELT AND SPROCKET(S)**.

CYLINDER HEAD COVER

REMOVAL

1. Remove ignition coil and plug wires (**Fig. 54**). Remove ground strap.
2. Remove the cylinder head cover fasteners.

3. Remove cylinder head cover from cylinder head.



1 - IGNITION COIL FASTENERS
2 - GROUND STRAP

G03633163

Fig. 54: Locating Ignition Coil And Ground Strap
Courtesy of DAIMLERCHRYSLER CORP.

CLEANING

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

INSPECTION

Inspect cover rails for flatness.

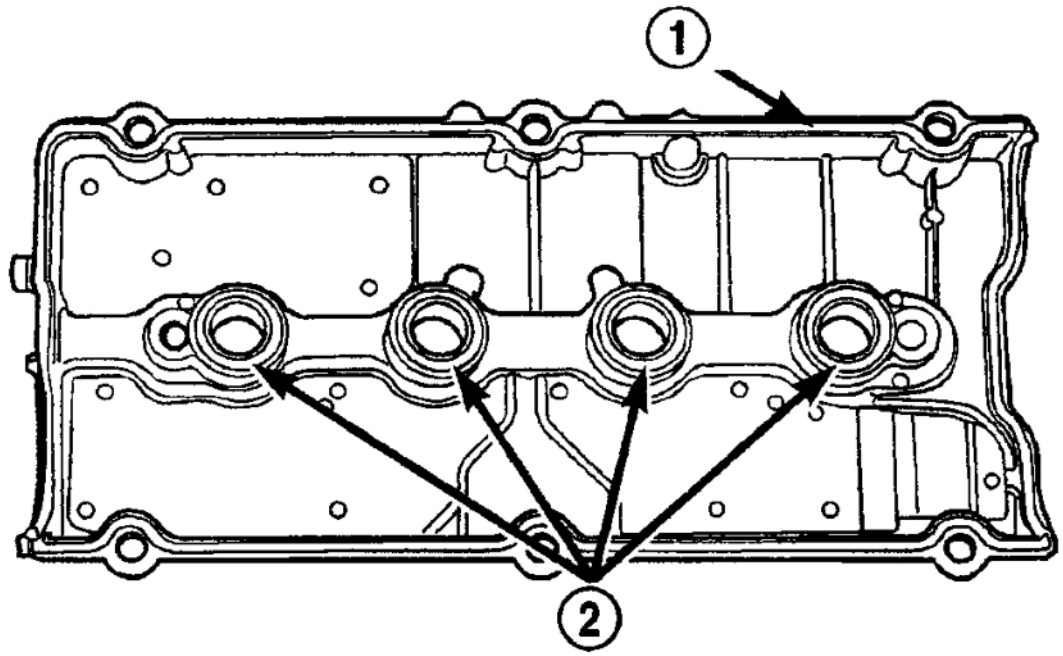
INSTALLATION

NOTE: Replace spark plug well seals when installing a new cylinder head cover gasket.

1. Install new cylinder head cover gaskets and spark plug seals (**Fig. 55**).

CAUTION: Do not allow oil or solvents to contact the timing belt as they can deteriorate the rubber and cause tooth skipping.

2. Apply Mopar® Engine RTV GEN II at the camshaft cap corners and at the top edge of the 1/2 round seal.
3. Install cylinder head cover assembly to head and tighten fasteners in sequence shown in (**Fig. 56**). Using the 3 step torque method:
   a. Tighten all fasteners to 4.5 N.m (40 in. lbs.)
   b. Tighten all fasteners to 9.0 N.m (80 in. lbs.)
   c. Tighten all fasteners to 12 N.m (105 in. lbs.)



1 - ONE PIECE RUBBER GASKET
2 - SPARK PLUG WELL SEALS
G03633164

Fig. 55: Identifying Cylinder Head Cover Gasket And Spark Plug Seals
Courtesy of DAIMLERCHRYSLER CORP.

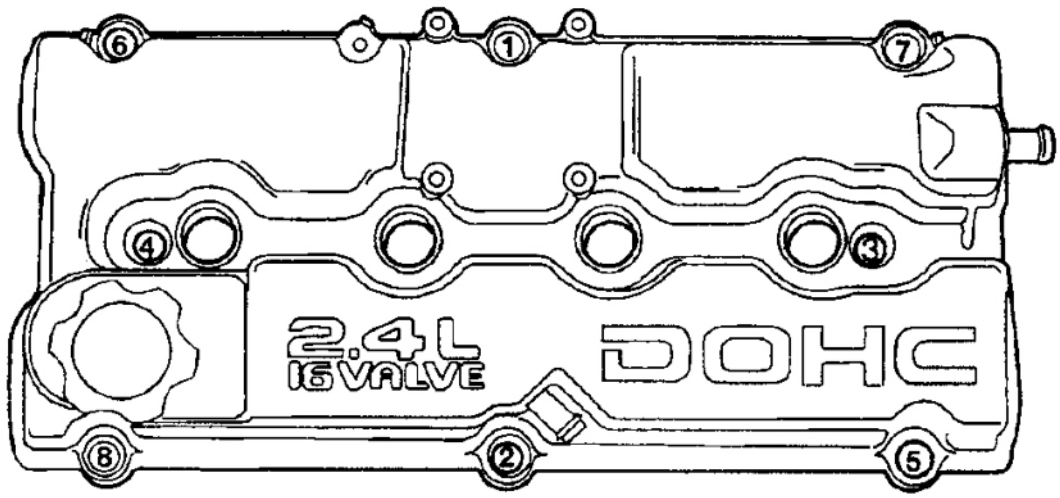


Fig. 56: Identifying Cylinder Head Cover Tightening Sequence
Courtesy of DAIMLERCHRYSLER CORP.

4. Install ignition coil and plug wires. Tighten fasteners to 12 N.m (105 in. lbs.).
5. Install ground strap.

HYDRAULIC LASH ADJUSTERS

DIAGNOSIS AND TESTING

HYDRAULIC LASH ADJUSTER NOISE DIAGNOSIS

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

1. Engine oil level too high or too low. This may cause aerated oil to enter the adjusters and cause them to be spongy.
2. Insufficient running time after rebuilding cylinder head. Low speed running up to 1 hour may be required.
3. During this time, turn engine off and let set for a few minutes before restarting. Repeat this several times after engine has reached normal operating temperature.
4. Low oil pressure.
5. The oil restrictor (integral to the cylinder head gasket) in the vertical oil passage to the cylinder head is plugged with debris.
6. Air ingested into oil due to broken or cracked oil pump pick up.
7. Worn valve guides.
8. Rocker arm ears contacting valve spring retainer.

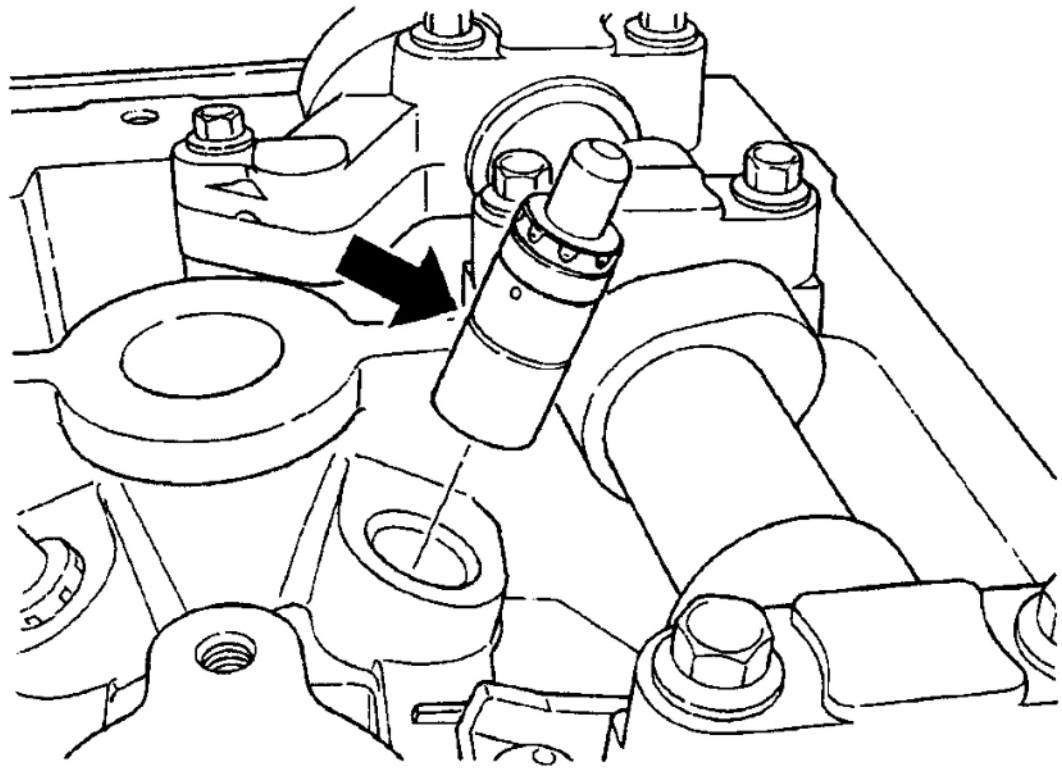
9. Rocker arm loose, adjuster stuck or at maximum extension and still leaves lash in the system.
10. Faulty lash adjuster.

- Check lash adjusters for sponginess while installed in cylinder head. Depress part of rocker arm over adjuster. Normal adjusters should feel very firm. Spongy adjusters can be bottomed out easily.
- Remove suspected lash adjusters, and replace as necessary.

REMOVAL

NOTE: This procedure is for in-vehicle service with camshafts installed.

1. Remove cylinder head cover. (Refer to **CYLINDER HEAD COVER**)
2. Remove rocker arm. (Refer to **REMOVAL**)
3. Remove hydraulic lash adjuster (**Fig. 57**).
4. Repeat removal procedure for each hydraulic lash adjuster.
5. If reusing, mark each hydraulic lash adjuster for reassembly in original position. Lash adjusters are serviced as an assembly.



G03633166

Fig. 57: Identifying Hydraulic Lash Adjuster
Courtesy of DAIMLERCHRYSLER CORP.

INSTALLATION

1. Install hydraulic lash adjuster (**Fig. 57**). Ensure the lash adjusters are at least partially full of engine oil. This is indicated by little or no plunger travel when the lifter is depressed.
2. Install rocker arm. (Refer to **INSTALLATION**)
3. Repeat installation procedure for each hydraulic lash adjuster.
4. Install cylinder head cover. (Refer to **CYLINDER HEAD COVER**)

INTAKE/EXHAUST VALVES & SEATS

DESCRIPTION

The valves are made of heat resistant steel. They have chrome plated stems to prevent scuffing. Viton rubber valve stem seals are integral with the spring seats. The valves have three-bead lock keepers to retain springs and to promote valve rotation.

OPERATION

The four valves per cylinder (two intake and two exhaust) are opened by using roller rocker arms which pivot on hydraulic lash adjusters.

CLEANING

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

ROCKER ARMS

REMOVAL

NOTE: This procedure is for in-vehicle service with camshafts installed.

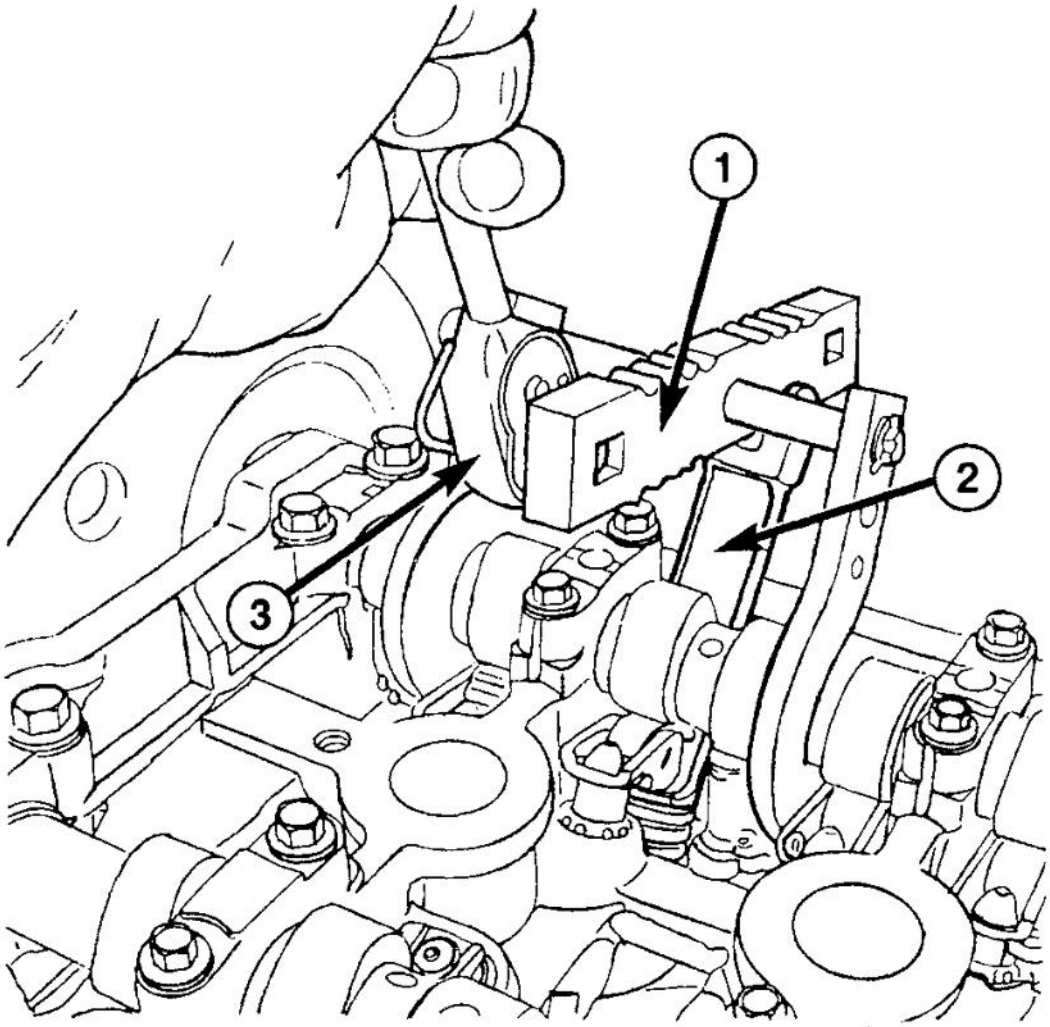
1. Disconnect negative battery cable.
2. Remove cylinder head cover. (Refer to **CYLINDER HEAD COVER**)
3. Remove spark plugs.
4. Rotate engine until the camshaft lobe, on the follower being removed, is positioned on its base circle (heel). Also, the piston should be a minimum of 6.3 mm (0.25 in) below TDC position.

CAUTION: If cam follower assemblies are to be reused, always mark position for reassembly in their original positions.

5. Using Special Tools 8215-A and 8436 slowly depress valve assembly until rocker arm can be removed

(**Fig. 58**).

6. Repeat removal procedure for each rocker arm.



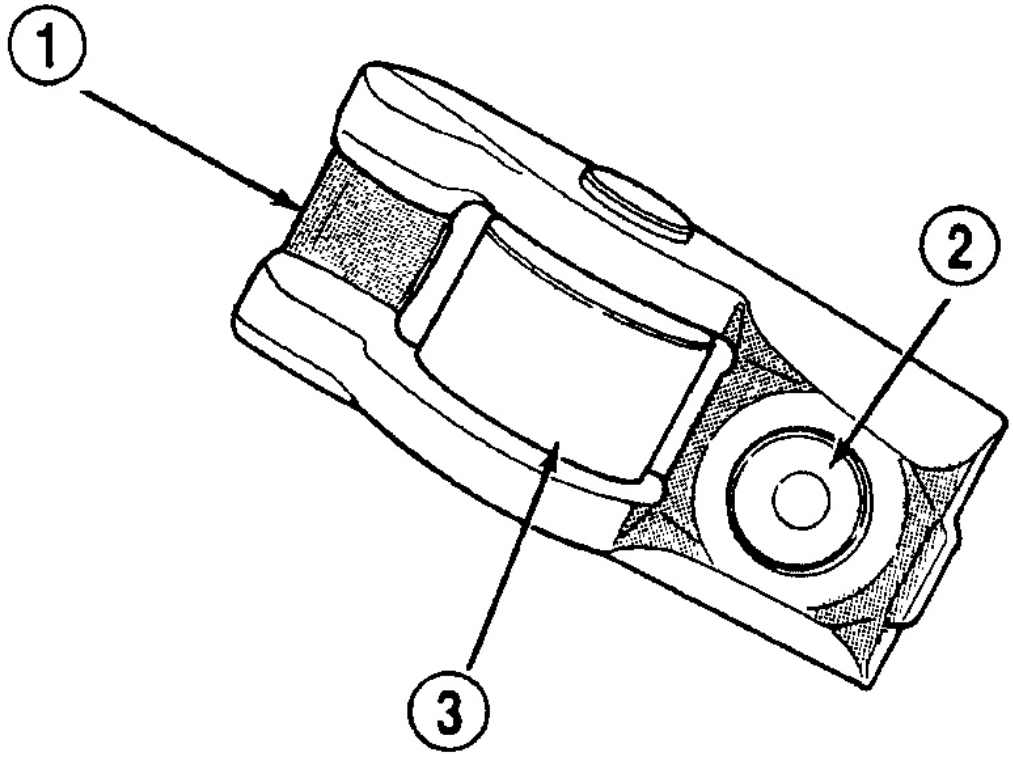
1 - SPECIAL TOOL 8215-A
2 - SPECIAL TOOL 8436
3 - 3/8" DRIVE RACHET

G03633167

Fig. 58: Removing Rocker Arm
Courtesy of DAIMLERCHRYSLER CORP.

INSPECTION

Inspect the rocker arm for wear or damage (**Fig. 59**). Replace as necessary.



1 - TIP
2 - LASH ADJUSTER POCKET
3 - ROLLER

G03633168

Fig. 59: Inspecting Rocker Arm
Courtesy of DAIMLERCHRYSLER CORP.

INSTALLATION

1. Lubricate rocker arm with clean engine oil.
2. Using Special Tools 8215-A and 8436 slowly depress valve assembly until rocker arm can be installed on the hydraulic lifter and valve stem (**Fig. 58**).
3. Repeat installation procedure for each rocker arm.
4. Install spark plugs.

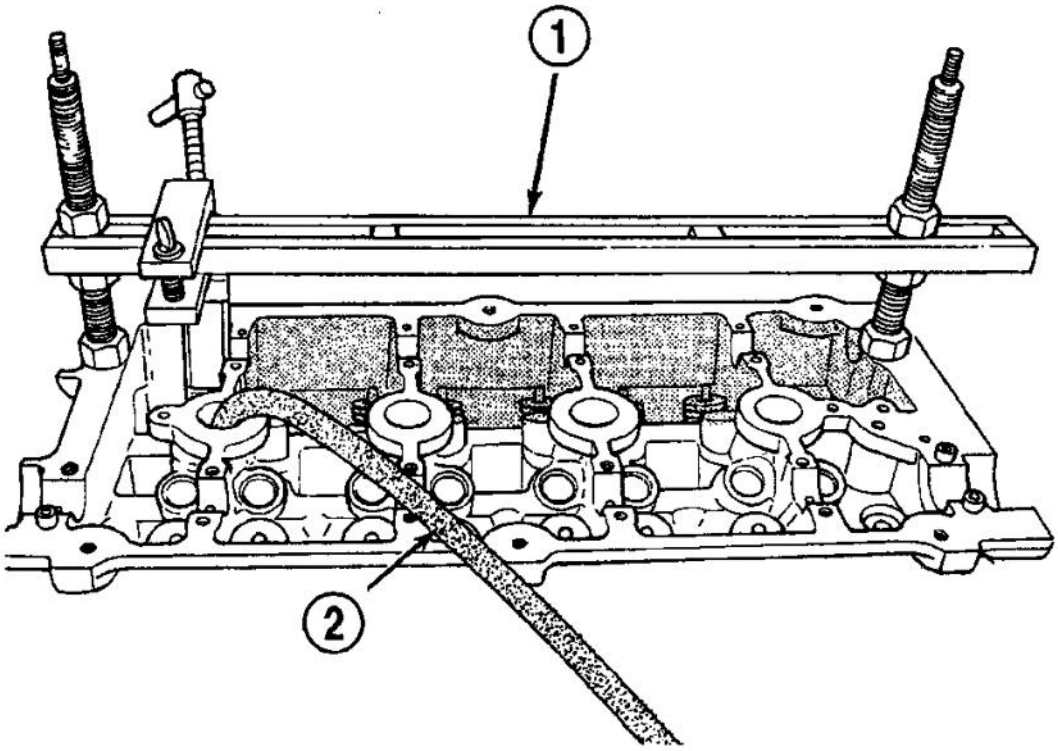
5. Install cylinder head cover. (Refer to **CYLINDER HEAD COVER**)
6. Connect negative battery cable.

VALVE SPRINGS & SEALS

REMOVAL

REMOVAL - CYLINDER HEAD ON

1. Disconnect negative battery cable.
2. Remove timing belt (Refer to **TIMING BELT AND SPROCKET(S)**).
3. Remove cylinder head cover (Refer to **CYLINDER HEAD COVER**).
4. Remove camshafts (Refer to **REMOVAL**).
5. Rotate crankshaft until piston is at TDC.
6. With air hose attached to adapter tool installed in spark plug hole, apply 90-120 psi air pressure.
7. Using Special Tool MD-998772-A with adapter 6779 (**Fig. 60**), compress valve springs and remove valve locks.
8. Remove valve spring(s).
9. Remove valve stem seal(s) by a using valve stem seal tool (**Fig. 62**).



1 - VALVE SPRING COMPRESSOR MD 998772A
2 - AIR HOSE
G03633169

Fig. 60: Removing Valve Spring
Courtesy of DAIMLERCHRYSLER CORP.

REMOVAL - CYLINDER HEAD OFF

1. With cylinder head removed from cylinder block, compress valve springs using a universal valve spring compressor.
2. Remove valve retaining locks, valve spring retainers, valve stem seals and valve springs.
3. Before removing valves, **remove any burrs from valve stem lock grooves to prevent damage to the valve guides.** Identify valves, locks and retainers to insure installation in original location.
4. Inspect the valves. (Refer to **INSPECTION**)

INSPECTION

1. Whenever valves have been removed for inspection, reconditioning or replacement, valve springs should be tested for correct tension. Discard the springs that do not meet specifications. The following specifications apply to both intake and exhaust valves springs:

- Valve Closed Nominal Tension-76 lbs. @ 38.0 mm (1.50 in.)
- Valve Open Nominal Tension-136 lbs. @ 29.75 mm (1.17 in.)

2. Inspect each valve spring for squareness with a steel square and surface plate, test springs from both ends. If the spring is more than 1.5 mm (1/16 inch) out of square, install a new spring.

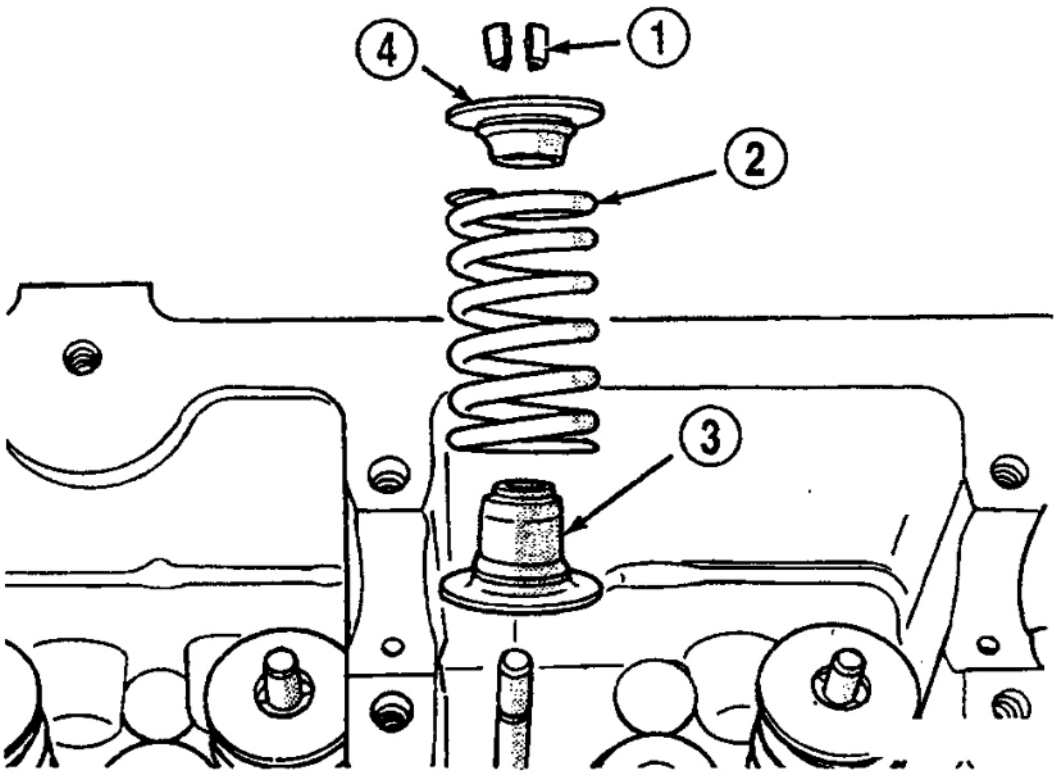
INSTALLATION

INSTALLATION - CYLINDER HEAD ON

1. Install valve seal/valve spring seat assembly (**Fig. 61**). Push the assembly down to seat it onto the valve guide.
2. Install valve spring and retainer, use Special Tool MD-998772-A with adapter 6779 to compress valve springs only enough to install locks (**Fig. 60**). Correct alignment of tool is necessary to avoid nicking valve stems.
3. Remove air hose and install spark plugs.
4. Install camshafts (Refer to **INSTALLATION**).
5. Install cylinder head cover (Refer to **CYLINDER HEAD COVER**).
6. Install timing belt (Refer to **TIMING BELT AND SPROCKET(S)**).
7. Connect negative battery cable.

INSTALLATION - CYLINDER HEAD OFF

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



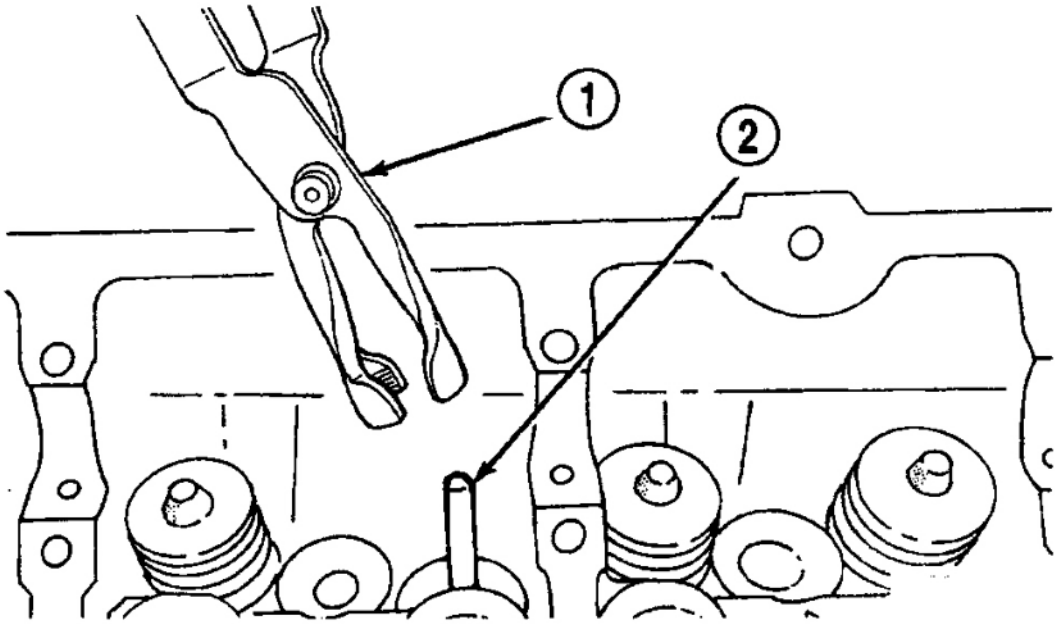
1 - VALVE RETAINING LOCKS
2 - VALVE SPRING
3 - VALVE SEAL AND VALVE SPRING SEAT ASSEMBLY
4 - VALVE SPRING RETAINER

G03633170

Fig. 61: Identifying Valve Stem Seal/Valve Spring Seat
Courtesy of DAIMLERCHRYSLER CORP.

2. Install new valve stem seals on all valves using a valve stem seal tool (**Fig. 62**). The valve stem seals should be pushed firmly and squarely over valve guide.

CAUTION: When oversize valves are used, the corresponding oversize valve seal must also be used. Excessive guide wear may result if oversize seals are not used with oversize valves.



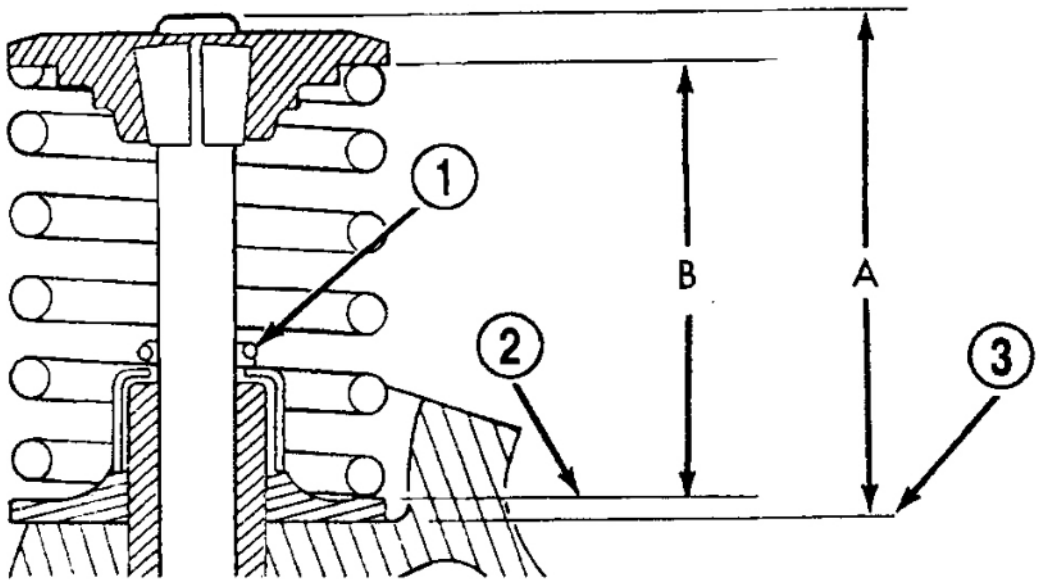
1 - VALVE SEAL TOOL
2 - VALVE STEM
G03633171

Fig. 62: Identifying Valve Stem Oil Seal Tool
Courtesy of DAIMLERCHRYSLER CORP.

3. Install valve springs and retainers. Compress valve springs only enough to install locks, taking care not to misalign the direction of compression. Nicked valve stems may result from misalignment of the valve spring compressor.

CAUTION: When depressing the valve spring retainers with valve spring compressor the locks can become dislocated. Ensure both locks are in the correct location after removing tool.

4. Check the valve spring installed height B after refacing the valve and seat (**Fig. 63**). 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 (1.525 in.), install a 0.762 mm (0.030 in.) spacer under the valve spring seat to bring spring height back within specification.



1 - GARTER SPRING
2 - VALVE SPRING SEAT
3 - CYLINDER HEAD SURFACE

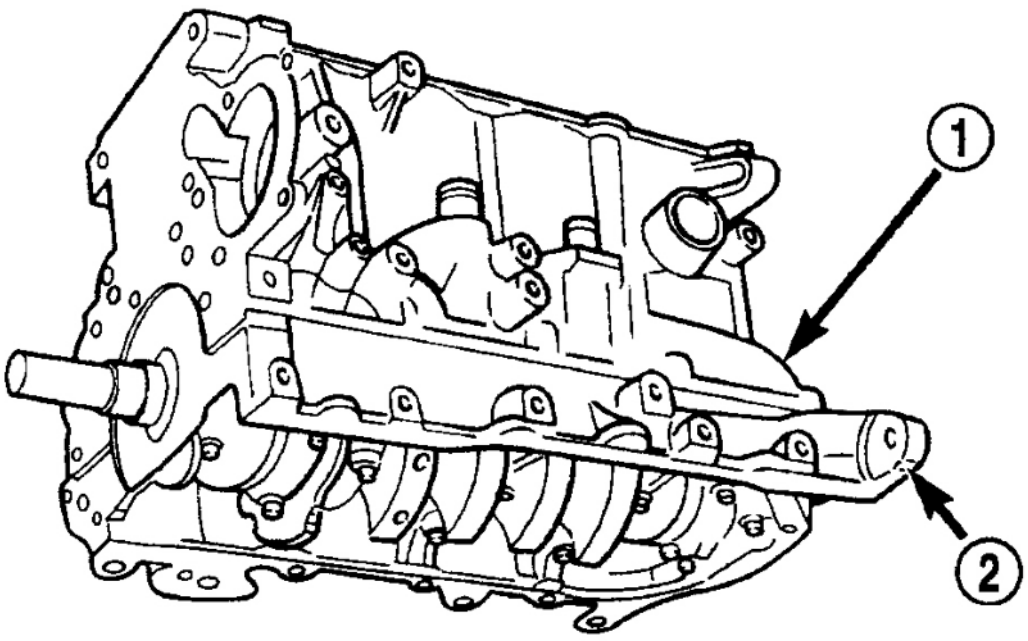
G03633172

Fig. 63: Checking Spring Installed Height And Valve Tip Height Dimensions
Courtesy of DAIMLERCHRYSLER CORP.

ENGINE BLOCK

DESCRIPTION

The cast iron cylinder block is a two-piece assembly, consisting of the cylinder block and bedplate (**Fig. 64**). The bedplate incorporates the main bearing caps and bolts to the cylinder block. This design offers a much stronger lower end and increased cylinder block rigidity. The rear oil seal retainer is integral with the block. The bedplate and block are serviced as an assembly.

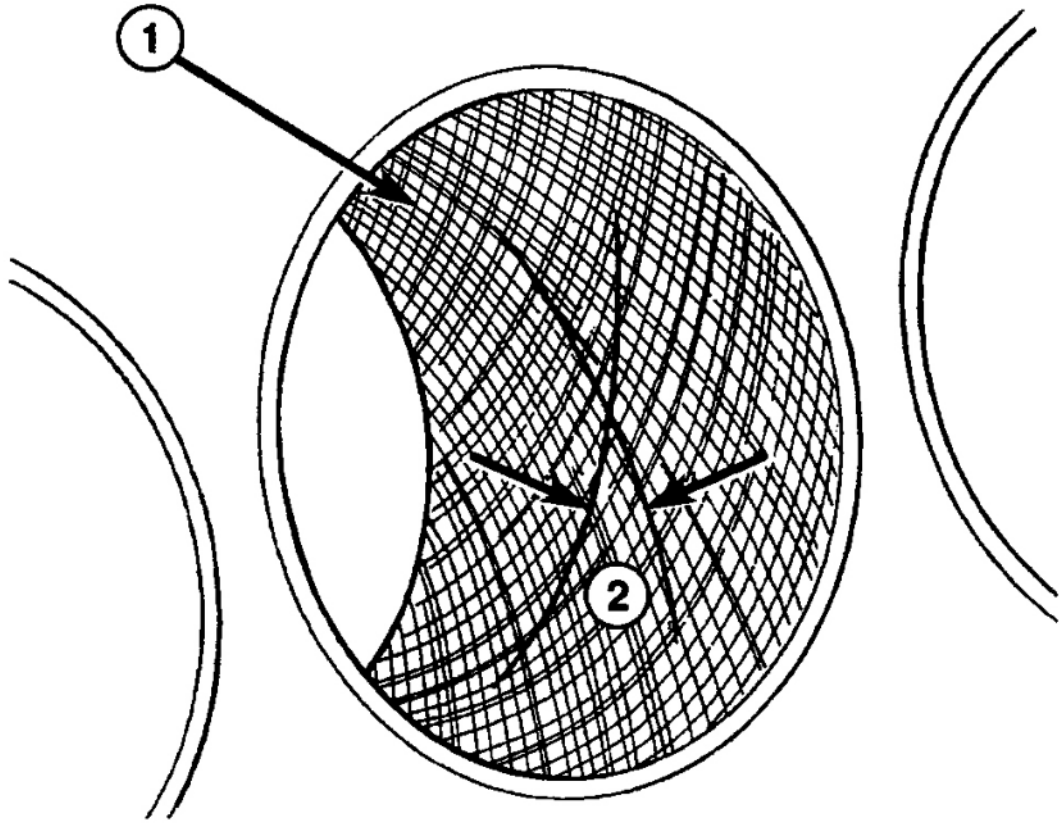


1 - CYLINDER BLOCK
2 - BEDPLATE
G03633173

Fig. 64: Identifying Cylinder Block And Bedplate
Courtesy of DAIMLERCHRYSLER CORP.

STANDARD PROCEDURE - CYLINDER BORE HONING

1. Used carefully, the cylinder bore resizing hone, recommended tool C-823 or equivalent, equipped with 220 grit stones, is the best tool for this honing procedure. In addition to deglazing, it will reduce taper and out-of-round as well as removing light scuffing, scoring or scratches. Usually a few strokes will clean up a bore and maintain the required limits.
2. Deglazing of the cylinder walls may be done using a cylinder surfacing hone, recommended tool C-3501 or equivalent, equipped with 280 grit stones, if the cylinder bore is straight and round. 20-60 strokes depending on the bore condition, will be sufficient to provide a satisfactory surface. Use a light honing oil. **Do not use engine or transmission oil, mineral spirits or kerosene.** Inspect cylinder walls after each 20 strokes.
3. Honing should be done by moving the hone up and down fast enough to get a cross-hatch pattern. When hone marks **intersect** at 40-60 degrees, the cross hatch angle is most satisfactory for proper seating of rings (**Fig. 65**).



1 - CROSS-HATCH PATTERN
2 - 40°–60°
G03633174

Fig. 65: Identifying Cylinder Bore Cross-Hatch Pattern
Courtesy of DAIMLERCHRYSLER CORP.

4. A controlled hone motor speed between 200-300 RPM is necessary to obtain the proper crosshatch angle. The number of up and down strokes per minute can be regulated to get the desired 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 **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. 66**) (Refer to **SPECIFICATIONS**). If the cylinder walls are badly scuffed or scored, the cylinder block should be replaced, and new pistons and rings fitted.

Measure the cylinder bore at three levels in directions A and B (**Fig. 66**). 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 **SPECIFICATIONS**).

CRANKSHAFT

STANDARD PROCEDURE - MEASURING CRANKSHAFT END PLAY

1. Mount a dial indicator to front of engine with the locating probe on nose of crankshaft (**Fig. 67**).
2. Move crankshaft all the way to the rear of its travel.
3. Zero the dial indicator.

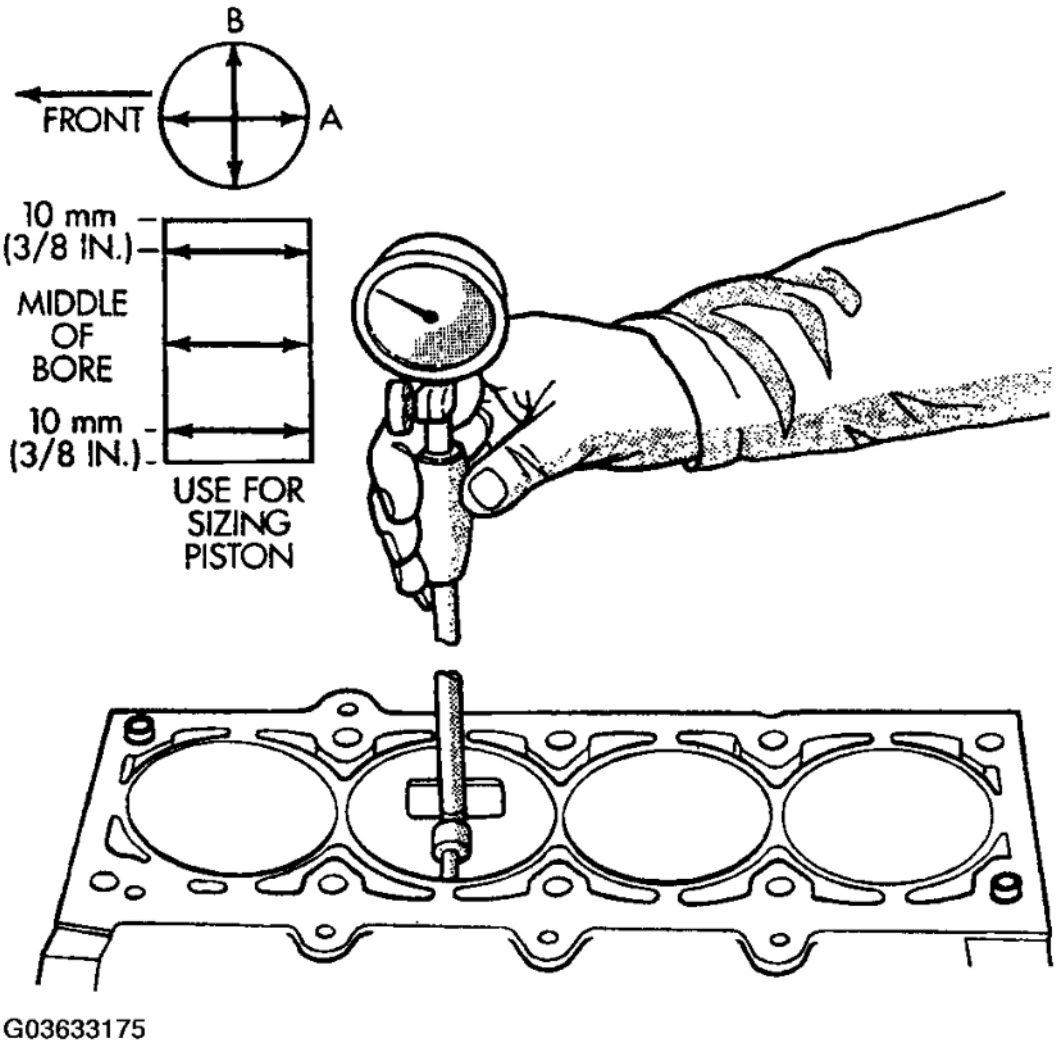


Fig. 66: Checking Cylinder Bore Size
Courtesy of DAIMLERCHRYSLER CORP.

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

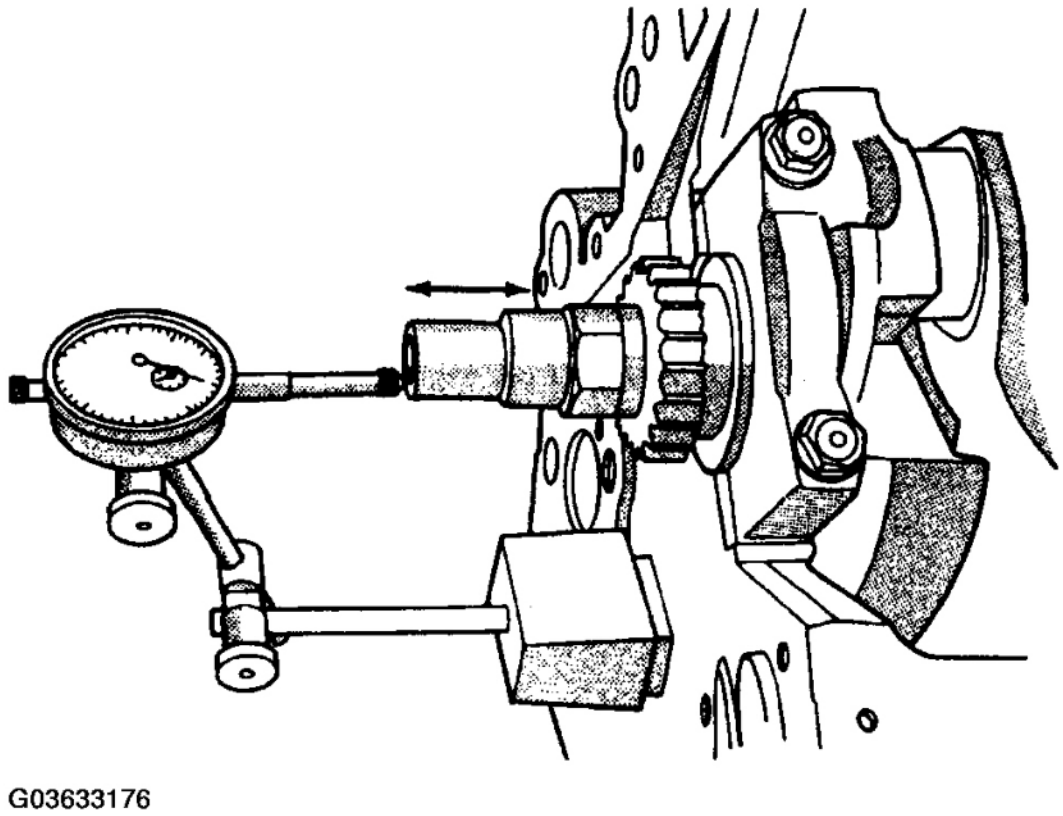


Fig. 67: Checking Crankshaft End Play-Typical
Courtesy of DAIMLERCHRYSLER CORP.

REMOVAL - CRANKSHAFT

NOTE: Crankshaft can not be removed when engine is in vehicle.

1. Remove engine assembly from vehicle (Refer to **REMOVAL - ENGINE ASSEMBLY**).
2. Separate transaxle from engine.
3. Remove drive plate/flex plate.
4. Remove crankshaft rear oil seal (Refer to **REMOVAL**).
5. Mount engine on a suitable repair stand.
6. Drain engine oil and remove oil filter.
7. Remove crankshaft vibration damper (Refer to **VIBRATION DAMPER**).
8. Remove engine mount support bracket.
9. Remove front timing belt covers (Refer to **TIMING BELT COVER(S)**).
10. Remove the timing belt (Refer to **TIMING BELT AND SPROCKET(S)**.
11. Remove the rear timing belt cover (Refer to **TIMING BELT COVER(S)**).

12. Remove the oil pan (Refer to **REMOVAL**).
13. Remove oil pump pick-up tube.
14. Remove the crankshaft sprocket and oil pump (Refer to **REMOVAL**).
15. Remove balance shafts and housing assembly (Refer to **BALANCE SHAFTS AND CARRIER ASSEMBLY**).
16. Remove crankshaft position sensor.

NOTE: If piston/connecting rod replacement is necessary, remove cylinder head (Refer to REMOVAL - CYLINDER HEAD).

17. Using a permanent ink or paint marker, identify cylinder number on each connecting rod cap (**Fig. 68**).

CAUTION: DO NOT use a number stamp or a punch to mark connecting rods. Damage to connecting rod could occur.

18. Remove all connecting rod bolts and caps. Care should be taken not to damage the fracture rod and cap surfaces.

NOTE: Do not reuse connecting rod bolts.

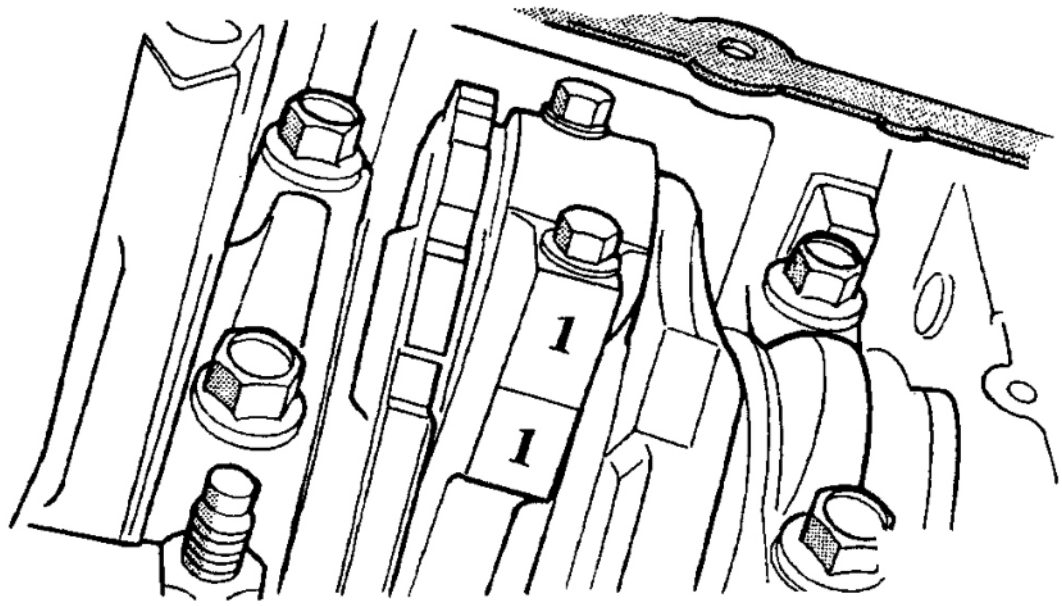


Fig. 68: Identify Connecting Rod To Cylinder
Courtesy of DAIMLERCHRYSLER CORP.

19. Remove all bedplate bolts from the engine block (**Fig. 69**).
20. Using a mallet gently tap the bedplate loose from the engine block dowel pins.

CAUTION: Do not pry up on one side of the bedplate. Damage may occur to cylinder block to bedplate alignment and thrust bearing.

21. Bedplate should be removed evenly from the cylinder block dowel pins to prevent damage to the dowel pins and thrust bearing.

CAUTION: Use extreme care when handling crankshaft. Tone wheel damage can occur if crankshaft is mis-handled.

22. Lift out crankshaft from cylinder block. Do not damage the main bearings or journals when removing the crankshaft.

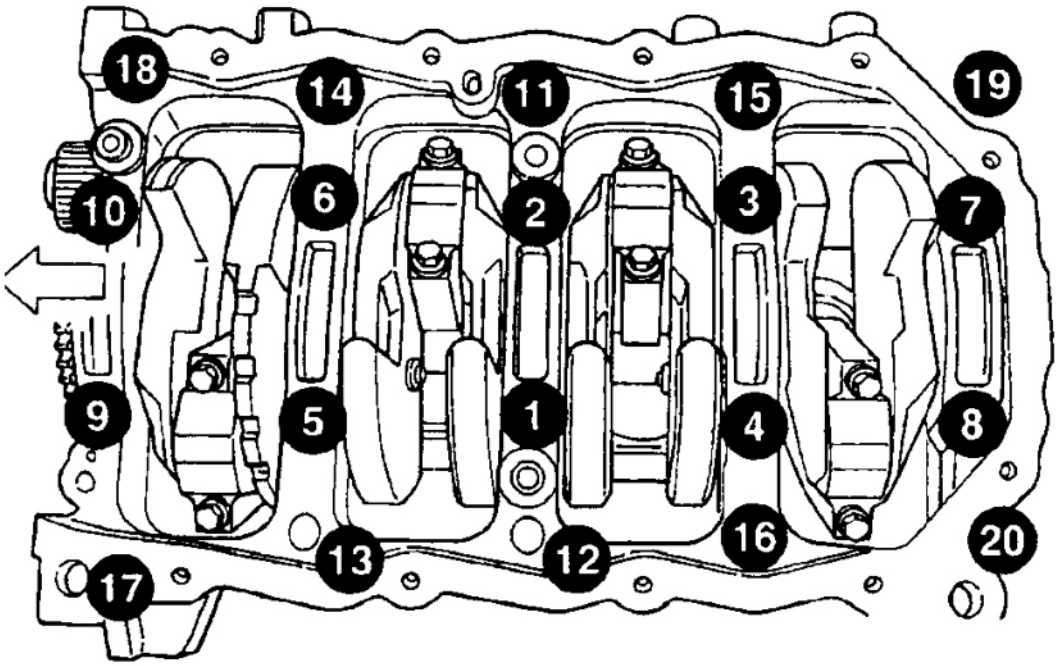


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Fig. 69: Identifying Bedplate Bolt Tightening Sequence
Courtesy of DAIMLERCHRYSLER CORP.

INSPECTION

The crankshaft journals should be checked for excessive wear, taper and scoring (**Fig. 70**). Limits of taper or

out of round on any crankshaft journals should be held to 0.025 mm (0.001 in.). Journal grinding should not exceed 0.305 mm (0.012 in.) under the standard journal diameter. DO NOT grind thrust faces of No. 3 main bearing. DO NOT nick crank pin or bearing fillets. After grinding, remove rough edges from crankshaft oil holes and clean out all passages.

CAUTION: With the nodular cast iron crankshafts, it is important that the final paper or cloth polish be in the same direction as normal rotation in the engine.

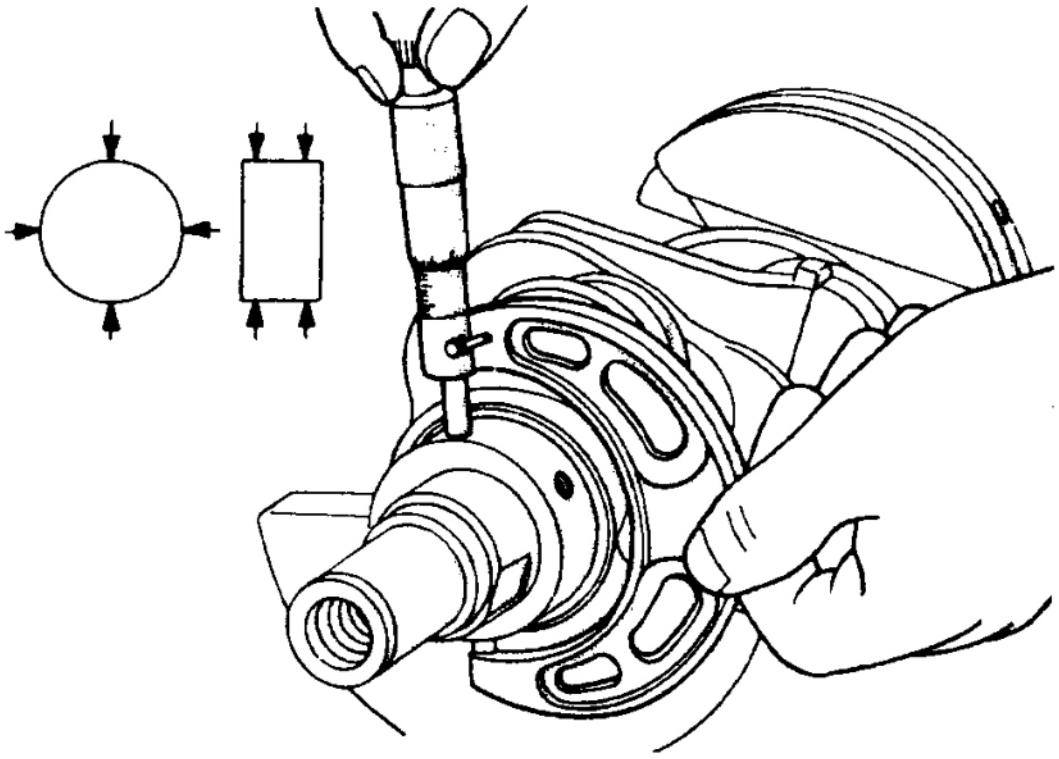

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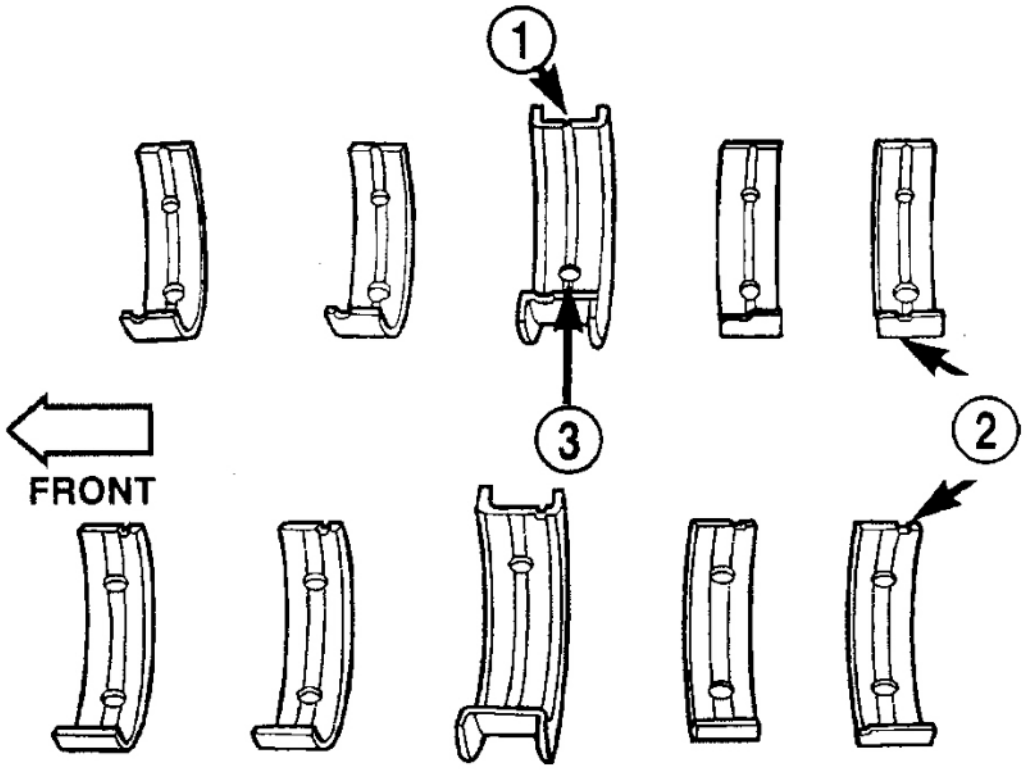
Fig. 70: Measuring Crankshaft Journal
Courtesy of DAIMLERCHRYSLER CORP.

INSTALLATION - CRANKSHAFT

CRANKSHAFT MAIN BEARING LOCATION

The crankshaft is supported in five main bearings. All upper and lower bearing shells in the crankcase have oil grooves and holes (**Fig. 71**). Crankshaft end play is controlled by a flanged bearing on the number three main bearing journal.



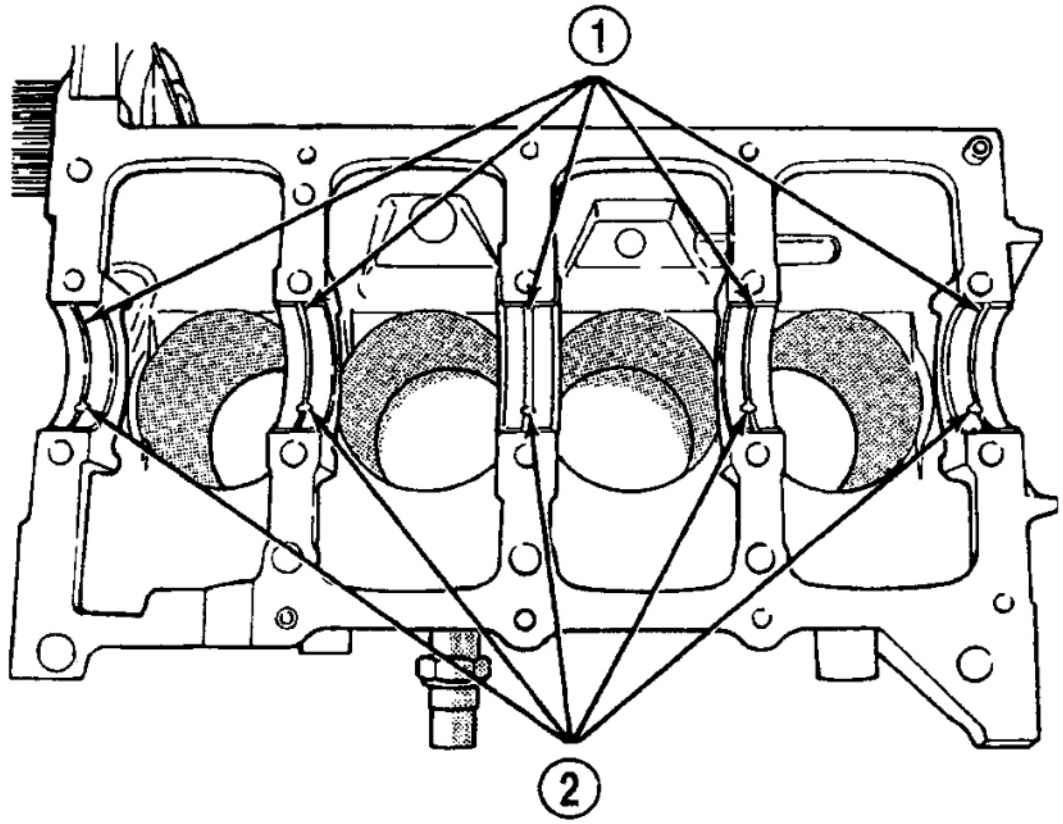
1 - OIL GROOVE
2 - MAIN BEARINGS
3 - OIL HOLE

G03633180

Fig. 71: Identifying Main Bearing Identification
Courtesy of DAIMLERCHRYSLER CORP.

1. Install the main bearing upper shells with the lubrication groove and oil hole in the engine block (**Fig. 72**).
2. Make certain oil holes in block line up with oil hole in bearings and bearing tabs seat in the block tab slots.

CAUTION: Use extreme care when handling crankshaft. Tone wheel damage can occur if crankshaft is mis-handled.



1 - LUBRICATION GROOVES
2 - OIL HOLES

G03633181

Fig. 72: Installing Main Bearing Upper Shell
Courtesy of DAIMLERCHRYSLER CORP.

CAUTION: Do not get oil on the bedplate mating surface. It will affect the sealer ability to seal the bedplate to cylinder block.

3. Oil the bearings and journals. Install crankshaft in engine block.

CAUTION: Use only the specified anaerobic sealer on the bedplate or damage may occur to the engine.

4. Apply 1.5 to 2.0 mm (0.059 to 0.078 in.) bead of Mopar® Bed Plate Sealant to the bed plate as shown in (**Fig. 73**).

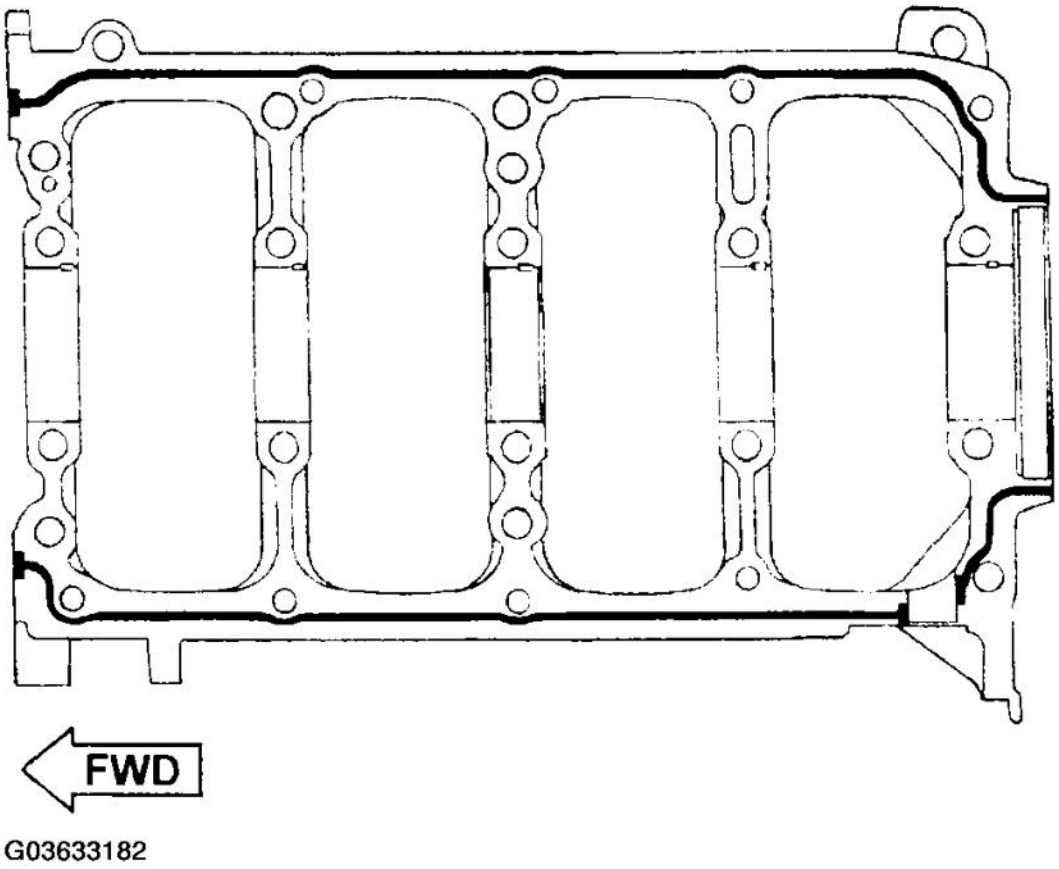


Fig. 73: Identifying Bedplate Sealing
Courtesy of DAIMLERCHRYSLER CORP.

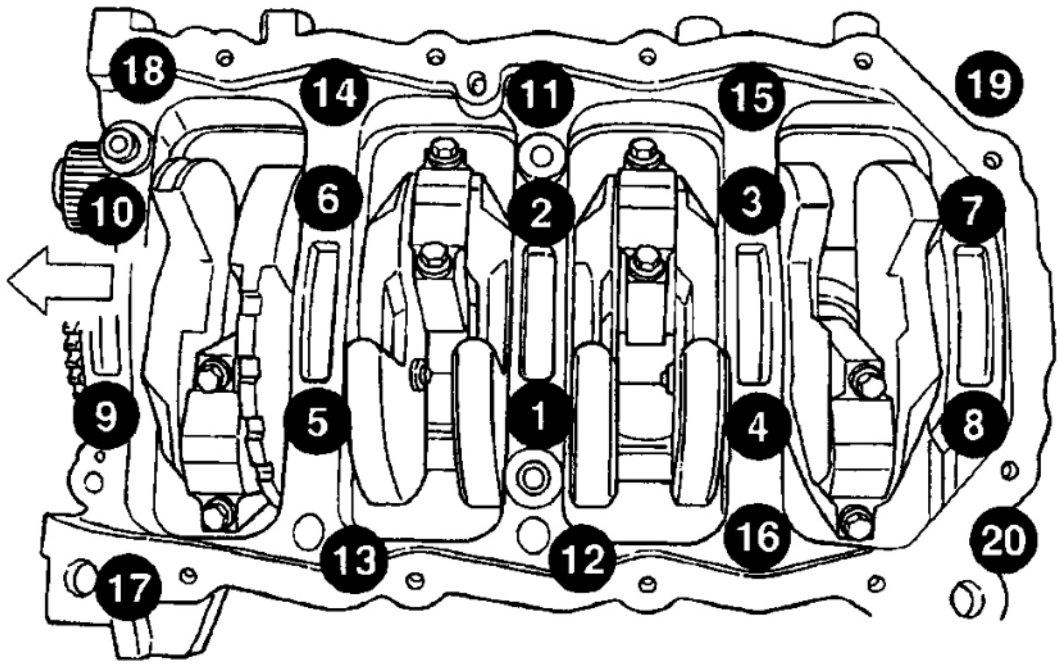


Fig. 74: Identifying Bedplate Bolt Torque Sequence
Courtesy of DAIMLERCHRYSLER CORP.

5. Install lower main bearings into main bearing cap/bedplate. Make certain the bearing tabs are seated into the bedplate slots. Install the main bearing/bedplate into engine block.
6. Before installing the bolts the threads should be oiled with clean engine oil, wipe off any excess oil.
7. Install main bearing bedplate to engine block bolts 11, 17, and 20 finger tight. Tighten these bolts down together until the bedplate contacts the cylinder block (**Fig. 74**).
8. To ensure correct thrust bearing alignment, perform the following steps:
   - Step 1: Rotate crankshaft until number 4 piston is at TDC.
   - Step 2: Move crankshaft rearward to limits of travel.
   - Step 3: Then, move crankshaft forward to limits of travel.
   - Step 4: Wedge an appropriate tool between the rear of the cylinder block **(NOT BED PLATE)** and the rear crankshaft counterweight. This will hold the crankshaft in it's furthest forward position.
   - Step 5: Install and tighten bolts (1-10) in sequence shown in (**Fig. 74**) to 41 N.m (30 ft. lbs.).
   - Step 6: Remove wedge tool used to hold crankshaft.
9. Tighten bolts (1-10) again to 41 N.m (30 ft. lbs.) in sequence shown in (**Fig. 74**).
10. Install main bearing bedplate to engine block bolts (11-20), and torque each bolt to 28 N.m (250 in. lbs.) in sequence shown in (**Fig. 74**).
11. Tighten bolts (1-10) to 75 N.m (55 ft. lbs.) in sequence shown in (**Fig. 74**).

12. Tighten bolts (11-20) again to 28 N.m (250 in. lbs.) in sequence shown in (**Fig. 74**).
13. After the main bearing bedplate is installed, check the crankshaft turning torque. The turning torque should not exceed 5.6 N.m (50 in. lbs.).
14. Check crankshaft end play (Refer to **STANDARD PROCEDURE**).
15. Install connecting rod bearings and caps. **Do Not Reuse Connecting Rod Bolts.** Torque connecting rod bolts to 27 N.m (20 ft. lbs.) plus 1/4 turn.
16. Install balance shafts and housing assembly (Refer to **BALANCE SHAFTS AND CARRIER ASSEMBLY**).
17. Install the oil pump (Refer to **INSTALLATION**).
18. Install oil pump pick-up tube. Torque fastener to 23 N.m (200 in. lbs.).
19. Install the oil pan (Refer to **INSTALLATION**).
20. Install crankshaft position sensor.
21. Install cylinder head if it was removed (Refer to **INSTALLATION - CYLINDER HEAD**).
22. Install the timing belt rear cover (Refer to **TIMING BELT COVER(S)**).
23. Install crankshaft sprocket (Refer to **TIMING BELT AND SPROCKET(S)**).
24. Install the timing belt (Refer to **TIMING BELT AND SPROCKET(S)**.
25. Install the timing belt front covers (Refer to **TIMING BELT COVER(S)**).
26. Install engine mount support bracket.
27. Install crankshaft vibration damper (Refer to **VIBRATION DAMPER**).
28. Install **NEW** oil filter.
29. Install crankshaft rear oil seal (Refer to **INSTALLATION**).
30. Install flex plate. Apply Mopar® Lock & Seal Adhesive to bolt threads and tighten to 95 N.m (70 ft. lbs.).
31. Attach transaxle to engine. Tighten attaching bolts to 101 N.m (75 ft. lbs.).
32. Install the engine assembly (Refer to **INSTALLATION - ENGINE ASSEMBLY**).

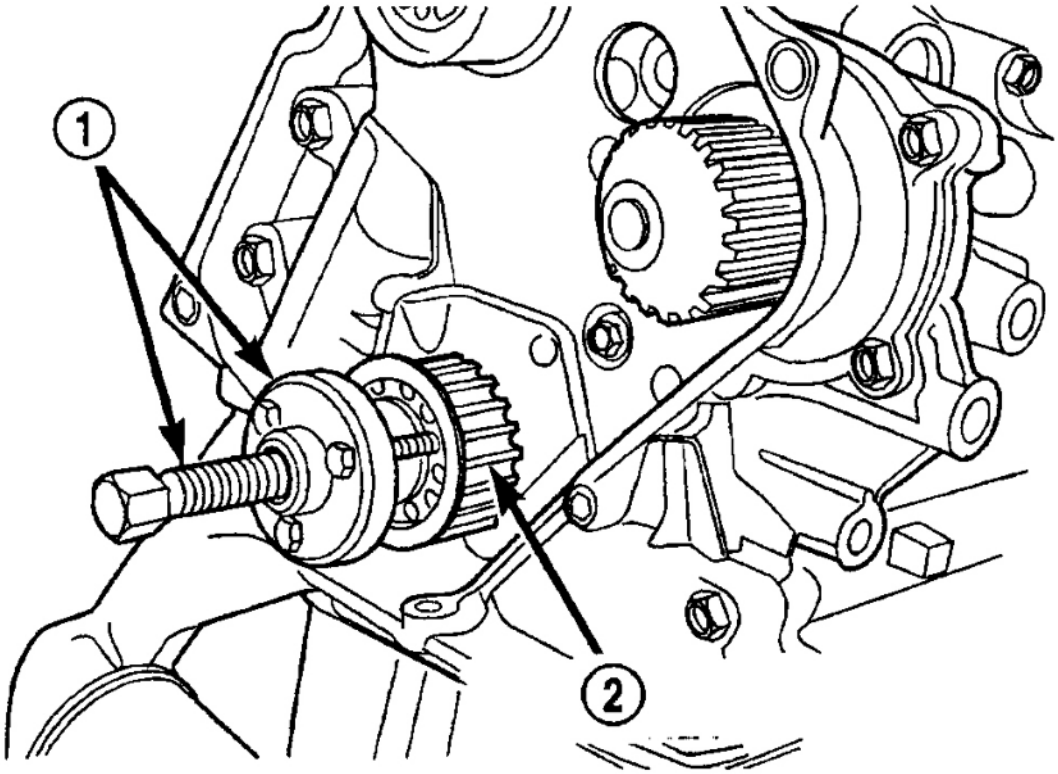
CRANKSHAFT OIL SEAL - FRONT

REMOVAL

1. Disconnect negative battery cable.
2. Remove accessory drive belts (Refer to SPECIFICATIONS & DRIVE BELT ROUTING article.
3. Remove crankshaft damper (Refer to **VIBRATION DAMPER**).
4. Remove timing belt (Refer to **TIMING BELT AND SPROCKET(S)**).
5. Remove crankshaft sprocket using Special Tool 6793 and insert C-4685-C2 (**Fig. 75**).

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

6. Use Tool 6771 to remove front crankshaft oil seal (**Fig. 76**). Be careful not to damage the seal surface of cover.

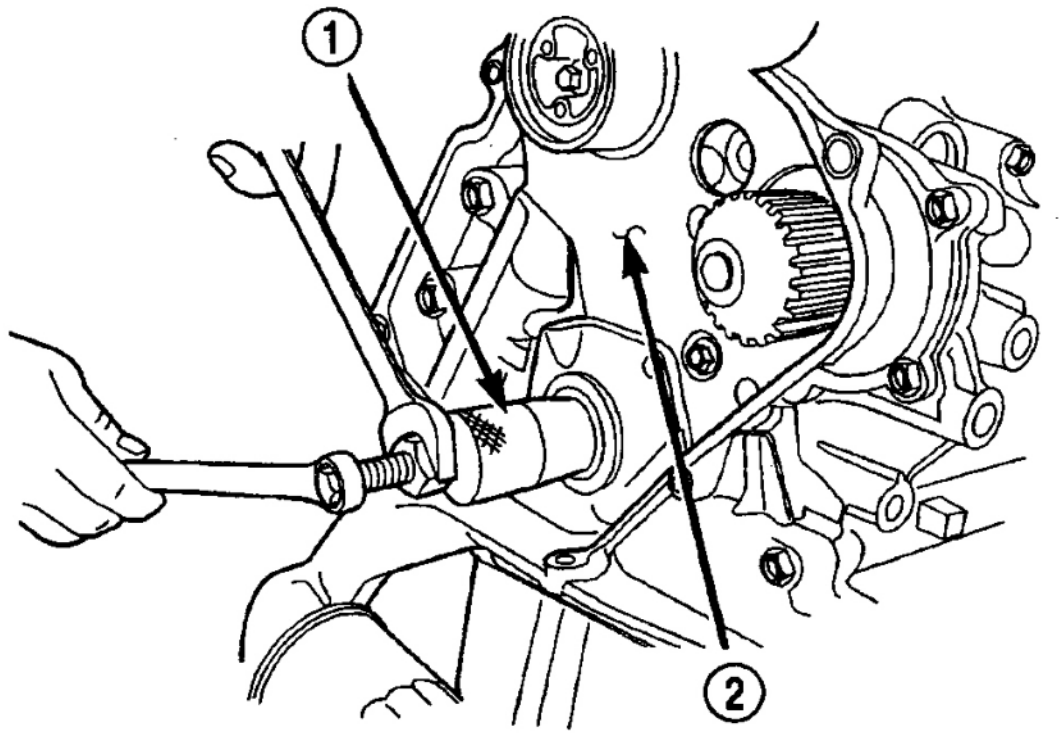


1 - SPECIAL TOOL 6793
2 - CRANKSHAFT SPROCKET
G03633184

Fig. 75: Removing Crankshaft Sprocket
Courtesy of DAIMLERCHRYSLER CORP.

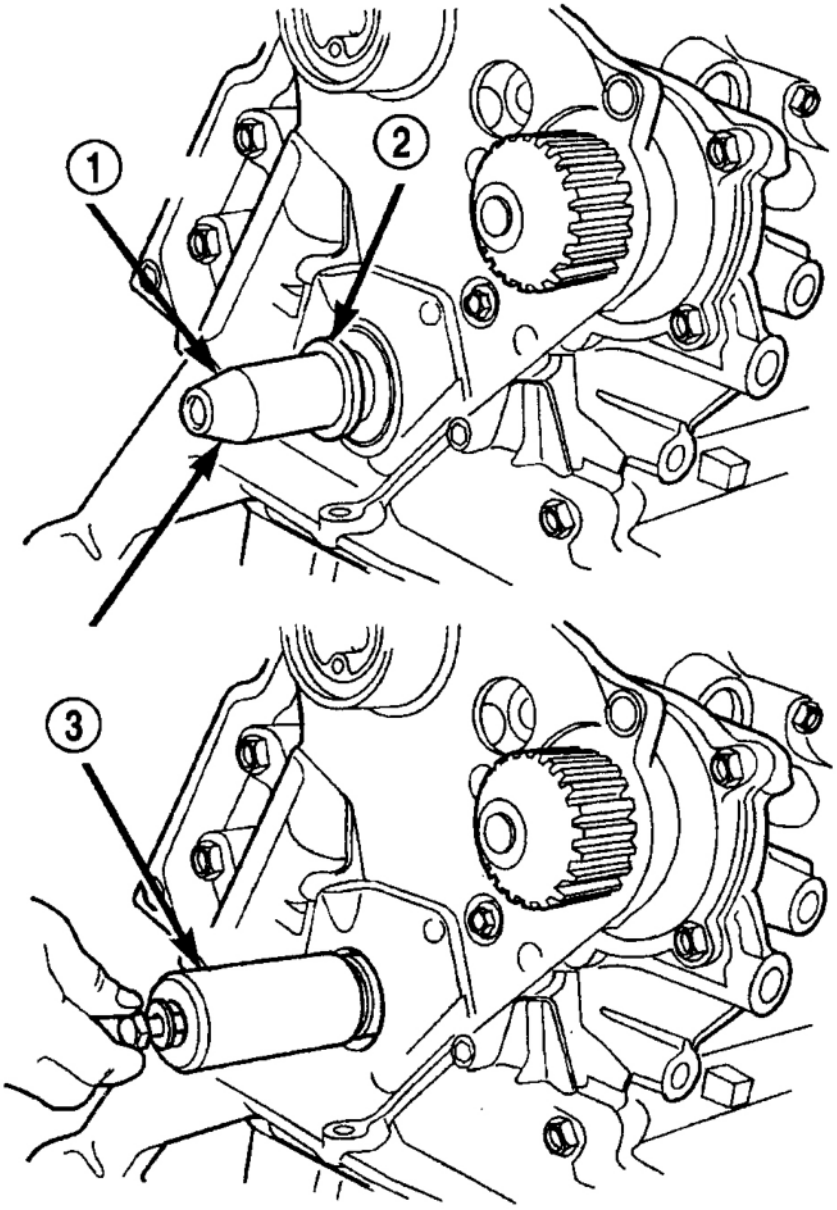
INSTALLATION

1. Install new seal by using Special Tool 6780 (**Fig. 77**).



1 - SPECIAL TOOL 6771
2 - REAR TIMING BELT COVER
G03633185

Fig. 76: Removing Front Crankshaft Oil Seal
Courtesy of DAIMLERCHRYSLER CORP.

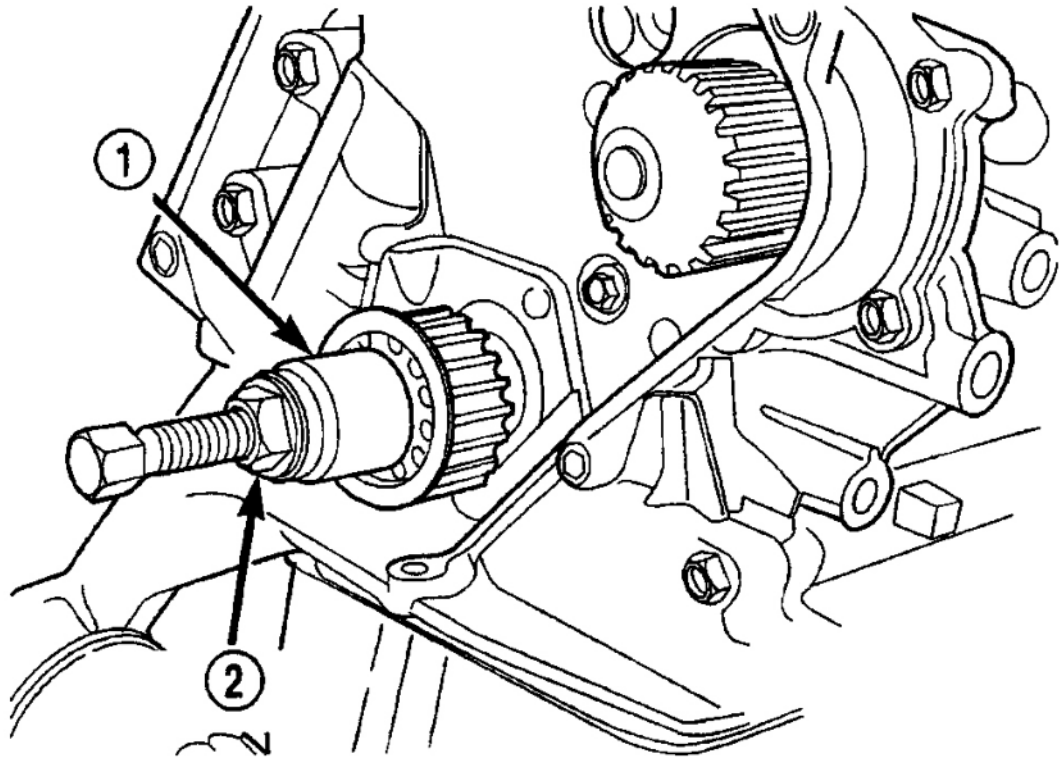


1 - PROTECTOR
2 - SEAL
3 - SPECIAL TOOL 6780
G03633186

Fig. 77: Installing Front Crankshaft Oil Seal
Courtesy of DAIMLERCHRYSLER CORP.

2. Place seal into opening with seal spring towards the inside of engine. Install seal until flush with cover.
3. Install crankshaft sprocket using Special Tool 6792 (**Fig. 78**).

4. Install timing belt and timing belt covers (Refer to **TIMING BELT COVER(S)**).
5. Install crankshaft damper (Refer to **VIBRATION DAMPER**).
6. Install accessory drive belts (Refer to SPECIFICATIONS & DRIVE BELT ROUTING article.
7. Connect negative battery cable.



1 - SPECIAL TOOL 6792
2 - TIGHTEN NUT TO INSTALL
G03633187

Fig. 78: Installing Crankshaft Sprocket
Courtesy of DAIMLERCHRYSLER CORP.

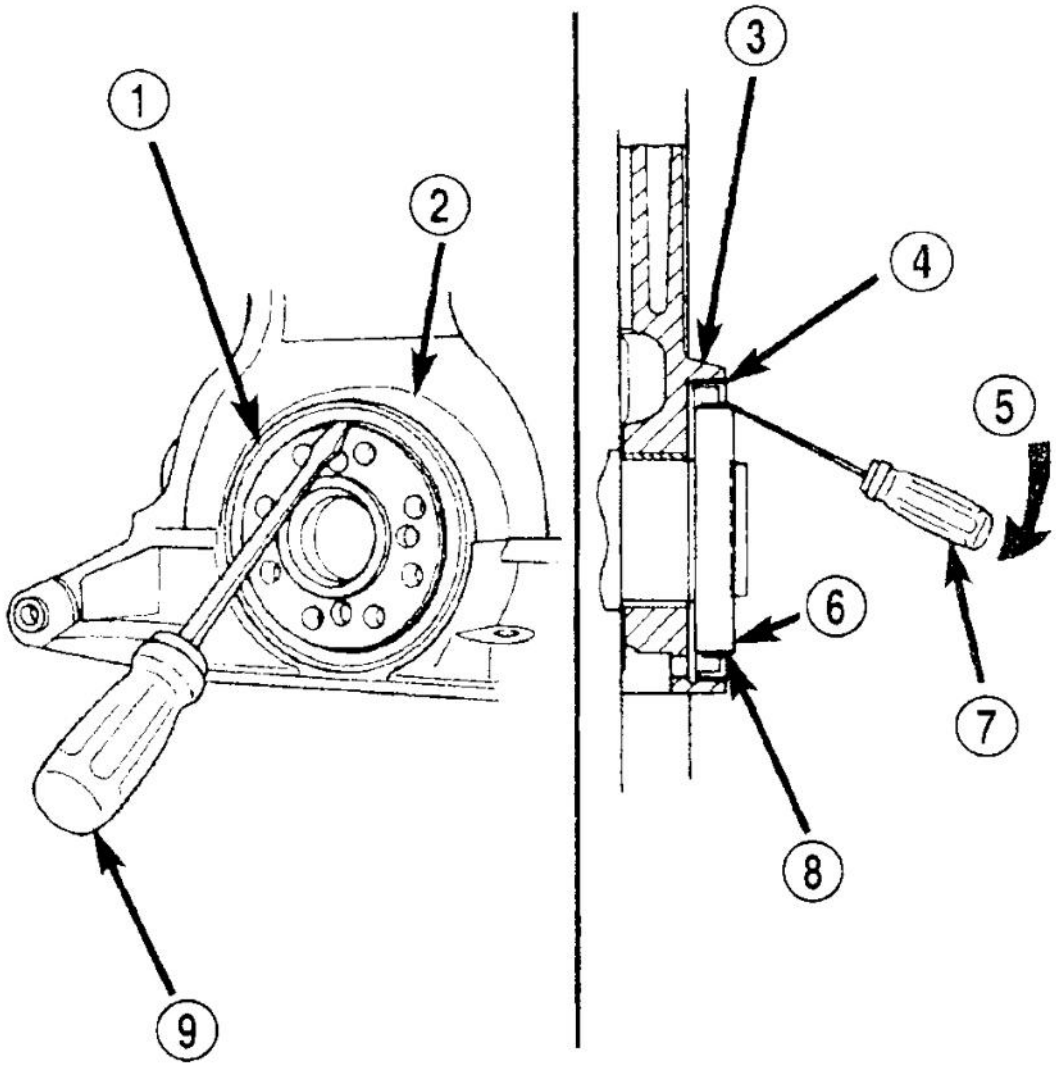
CRANKSHAFT OIL SEAL - REAR

REMOVAL

1. Remove transaxle (Refer to 40TE - REMOVAL).
2. Remove flex plate (Refer to **REMOVAL**).
3. Insert a 3/16 flat bladed screwdriver between the dust lip and the metal case of the crankshaft seal. Angle

the screwdriver (**Fig. 79**) through the dust lip against metal case of the seal. Pry out seal.

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



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

G03633188

Fig. 79: Removing Rear Crankshaft Oil Seal

Courtesy of DAIMLERCHRYSLER CORP.

INSTALLATION

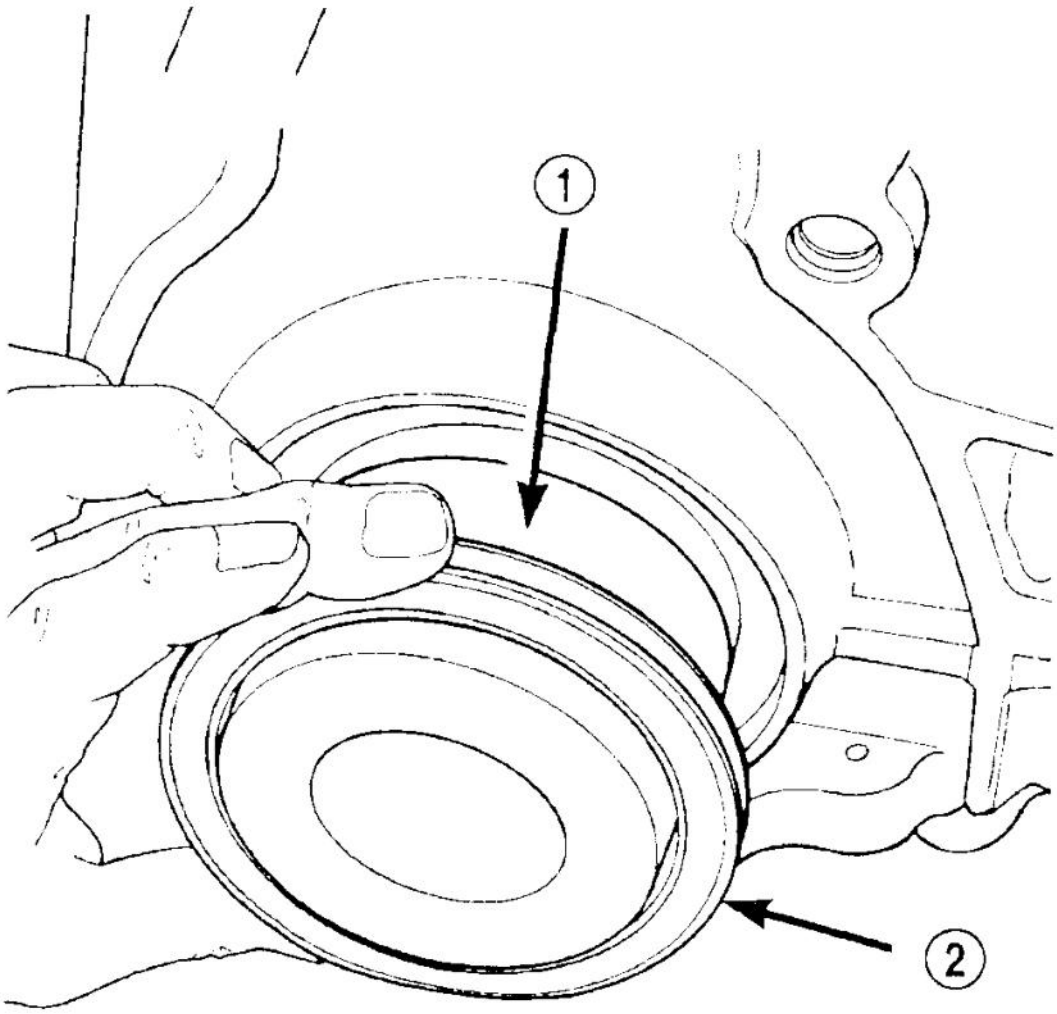
CAUTION: If burr or scratch is present on the crankshaft edge (chamfer), cleanup with 400 grit sand paper to prevent seal damage during installation of new seal.

NOTE: When installing seal, no lube on seal is needed.

1. Place Special Tool 6926-1 Seal Guide on crankshaft (**Fig. 80**).
2. Position seal over guide tool (**Fig. 80**). Guide tool should remain on crankshaft during installation of seal. Ensure that the lip of the seal is facing towards the crankcase during installation.

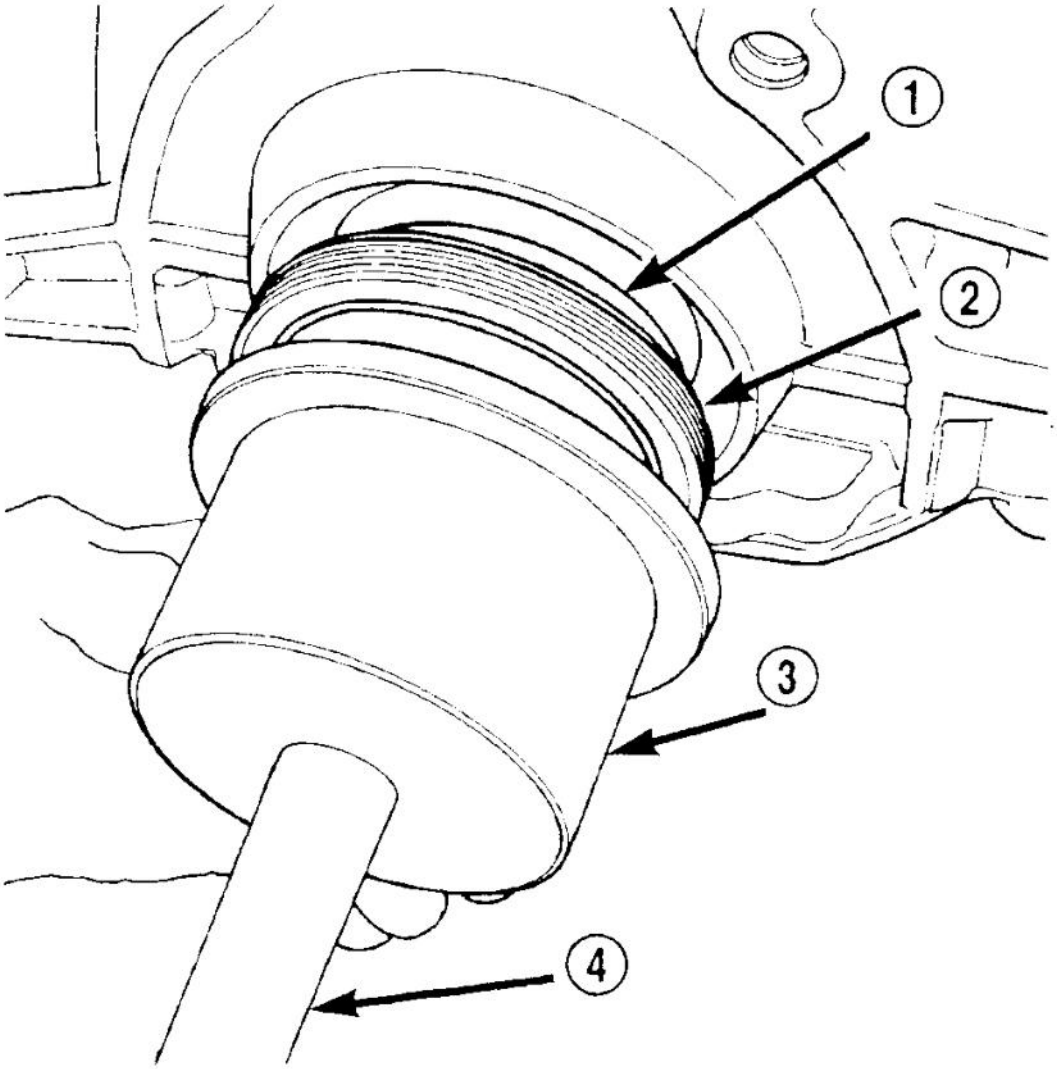
CAUTION: If the seal is driven into the block past flush, this may cause an oil leak.

3. Drive the seal into the block using Special Tool 6926-2 and handle C-4171 (**Fig. 81**) until the tool bottoms out against the block (**Fig. 82**).



1 - SPECIAL TOOL 6926-1 PILOT
2 - SEAL
G03633189

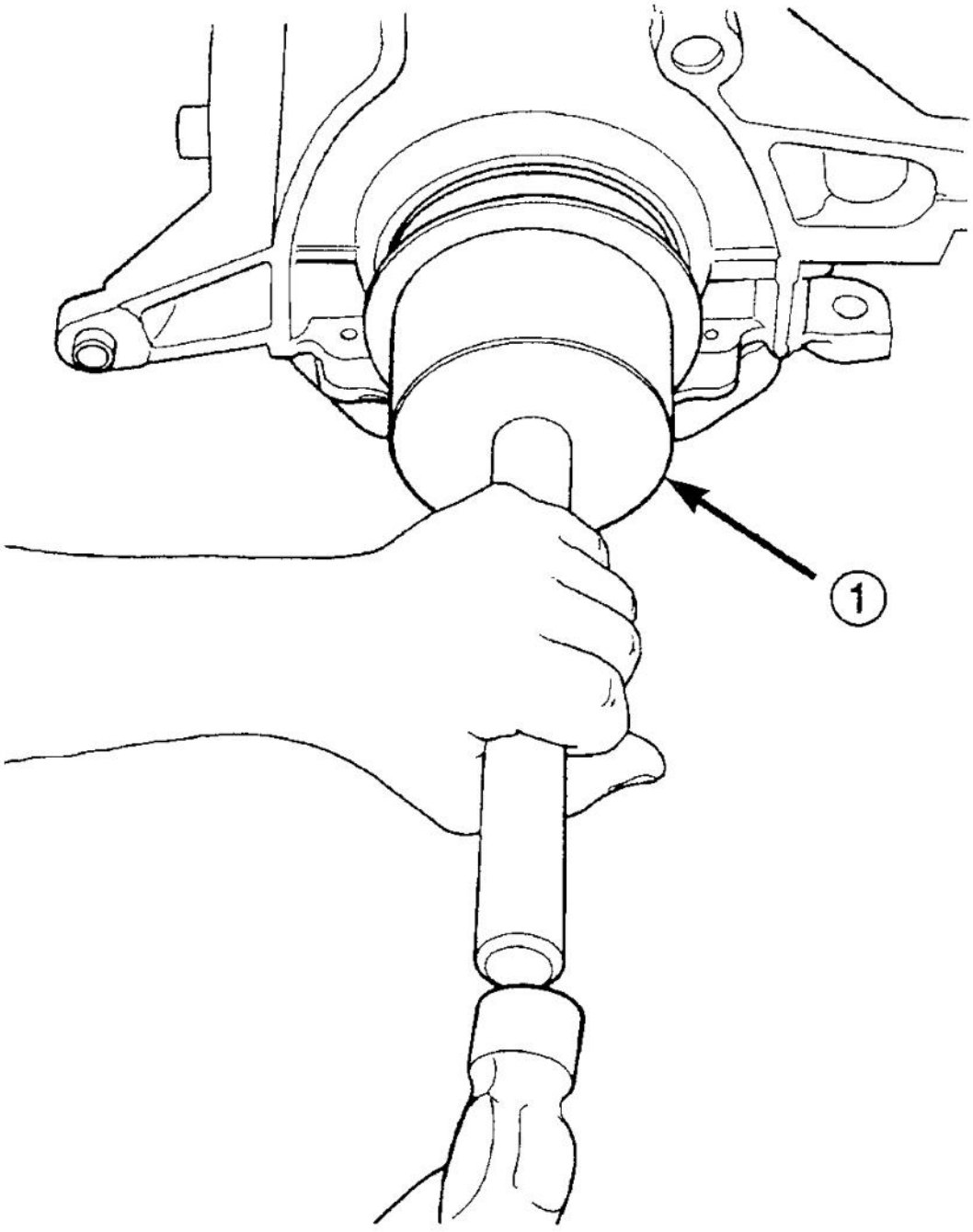
Fig. 80: Identifying Rear Crankshaft Seal And Special Tool 6926-1
Courtesy of DAIMLERCHRYSLER CORP.



1 - SPECIAL TOOL 6926–1 PILOT
2 - SEAL
3 - SPECIAL TOOL 6926–2 INSTALLER
4 - SPECIAL TOOL C-4171

G03633190

Fig. 81: Identifying Crankshaft Seal And Special Tools 6926-2 & C-4171
Courtesy of DAIMLERCHRYSLER CORP.



1 - SPECIAL TOOL 6926–2 INSTALLER

G03633191

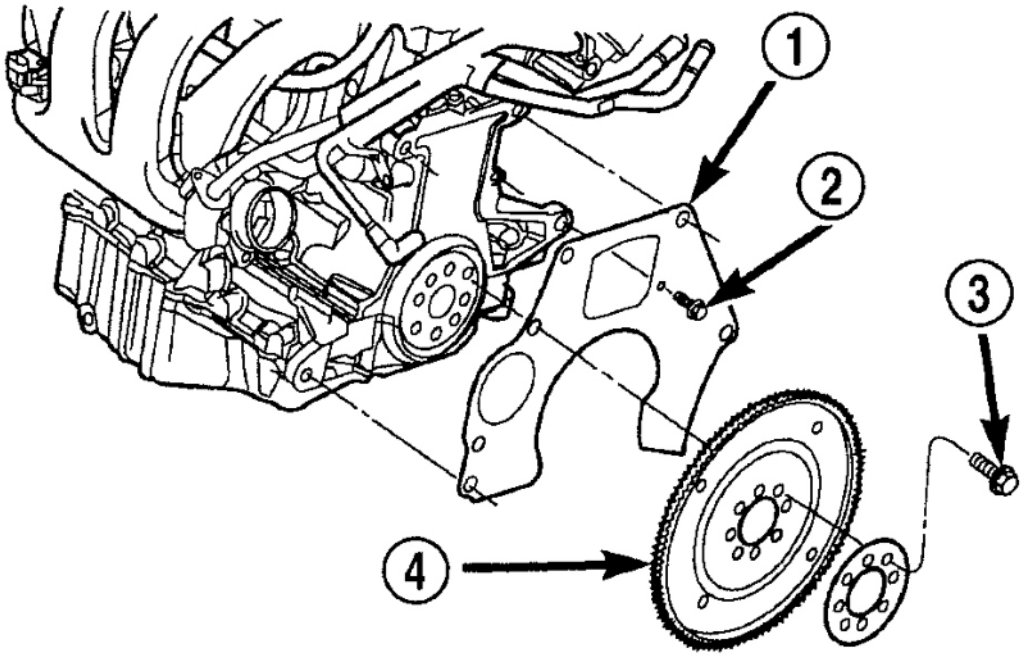
Fig. 82: Installing Rear Crankshaft Seal
Courtesy of DAIMLERCHRYSLER CORP.

4. Install flex plate. Apply Mopar® Lock & Seal Adhesive to bolt threads and tighten bolts to 95 N.m (70 ft. lbs.).
5. Install transaxle (Refer to 40TE - INSTALLATION).

FLEX PLATE

REMOVAL

1. Remove the transaxle (Refer to 40TE -REMOVAL).
2. Remove the flex plate attaching bolts (**Fig. 83**).
3. Remove the flex plate (**Fig. 83**).



1 - ADAPTOR PLATE
2 - BOLT
3 - BOLT (QTY. 8)
4 - FLEX PLATE
G03633192

Fig. 83: Removing Flex Plate
Courtesy of DAIMLERCHRYSLER CORP.

INSTALLATION

1. Position the drive plate on crankshaft (**Fig. 83**).
2. Apply Mopar® Lock & Seal Adhesive to flex plate bolt threads.
3. Install the flex plate bolts and tighten to 95 N.m (70 ft. lbs.) (**Fig. 83**).
4. Install the transaxle (Refer to 40TE - INSTALLATION).

PISTON & CONNECTING ROD

DESCRIPTION

The pistons are made of a cast aluminum alloy. The pistons have pressed-in pins attached to forged powdered metal connecting rods. The pistons pin is offset 1 mm (0.0394 in.) towards the thrust side of the piston. The connecting rods are a cracked cap design and are not repairable. Hex head cap screws are used to provide alignment and durability in the assembly. The pistons and connecting rods are serviced as an assembly.

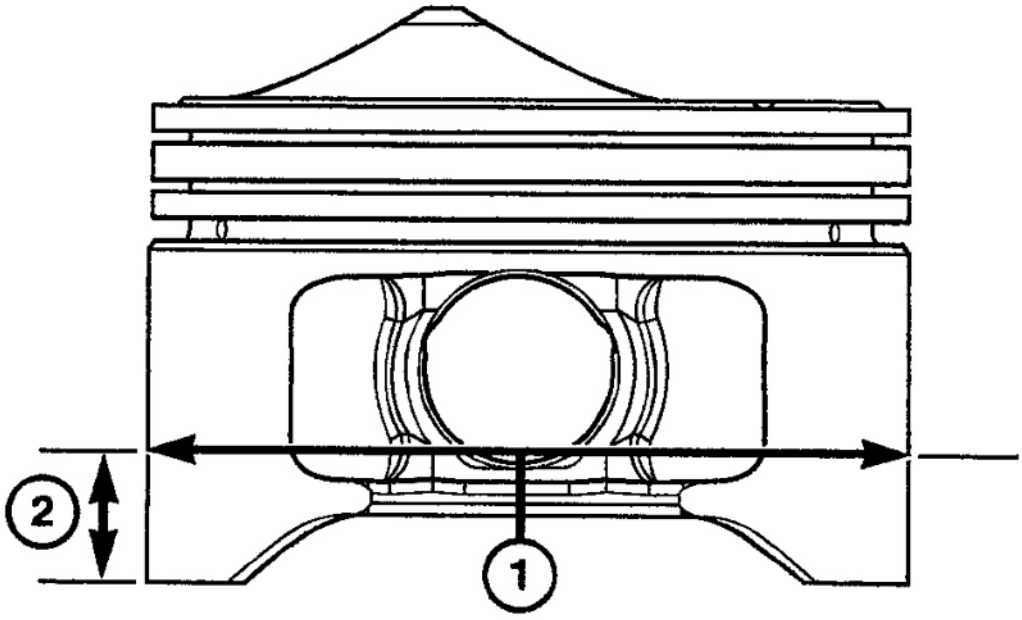
STANDARD PROCEDURE - PISTON TO CYLINDER BORE FITTING

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

Piston and cylinder wall must be clean and dry. Piston diameter should be measured 90 degrees to piston pin.

Piston measurement should be taken approximately 14 mm (0.551 in.) from the bottom of the skirt as shown in (**Fig. 84**)

Cylinder bores should be measured halfway down the cylinder bore and transverse (measurement location B) to the engine crankshaft center line shown in (**Fig. 85**). Refer to for Engine Specifications (Refer to **SPECIFICATIONS**). Correct piston to bore clearance must be established in order to assure quiet and economical operation.



1 - PISTON DIAMETER
2 - 14 mm (0.551 in.)

G03633193

Fig. 84: Identifying Piston Measurement
Courtesy of DAIMLERCHRYSLER CORP.

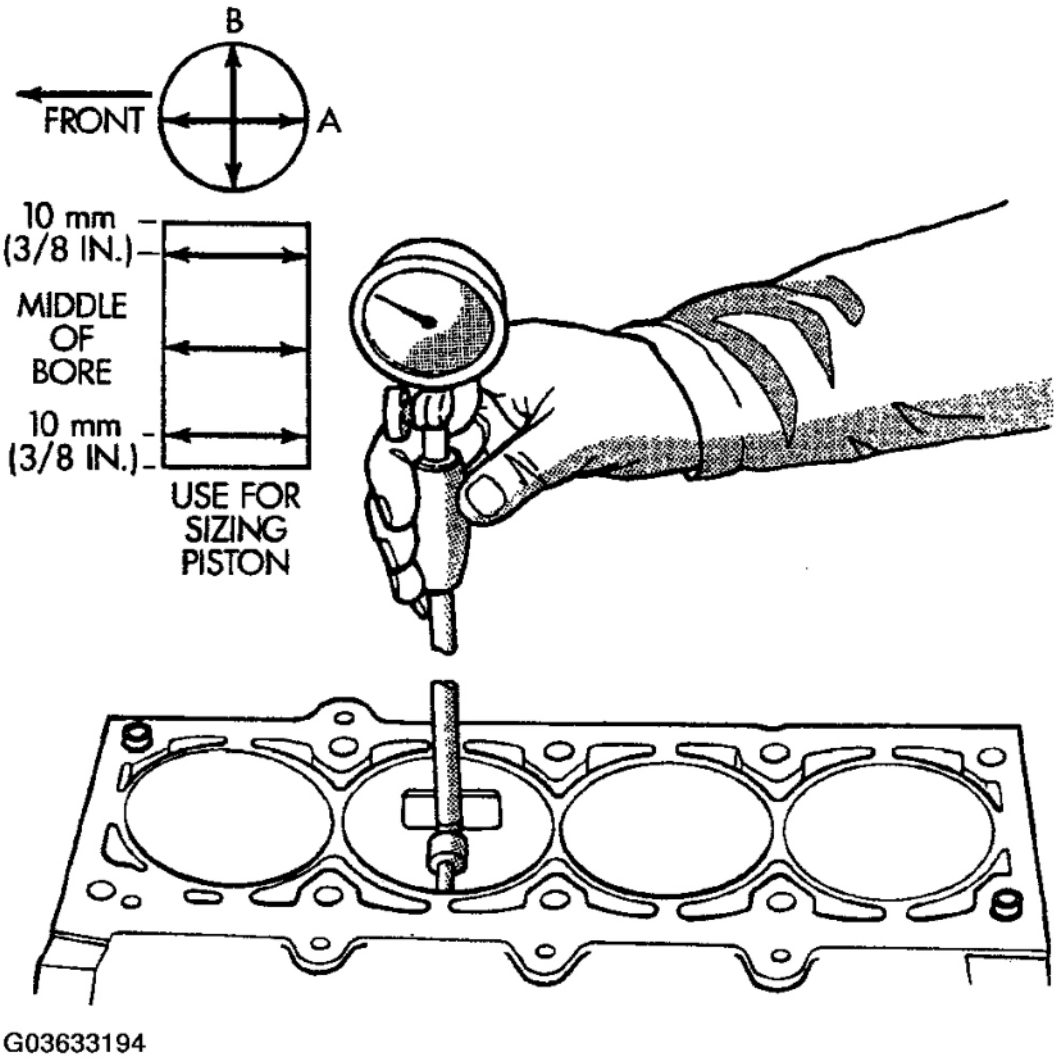
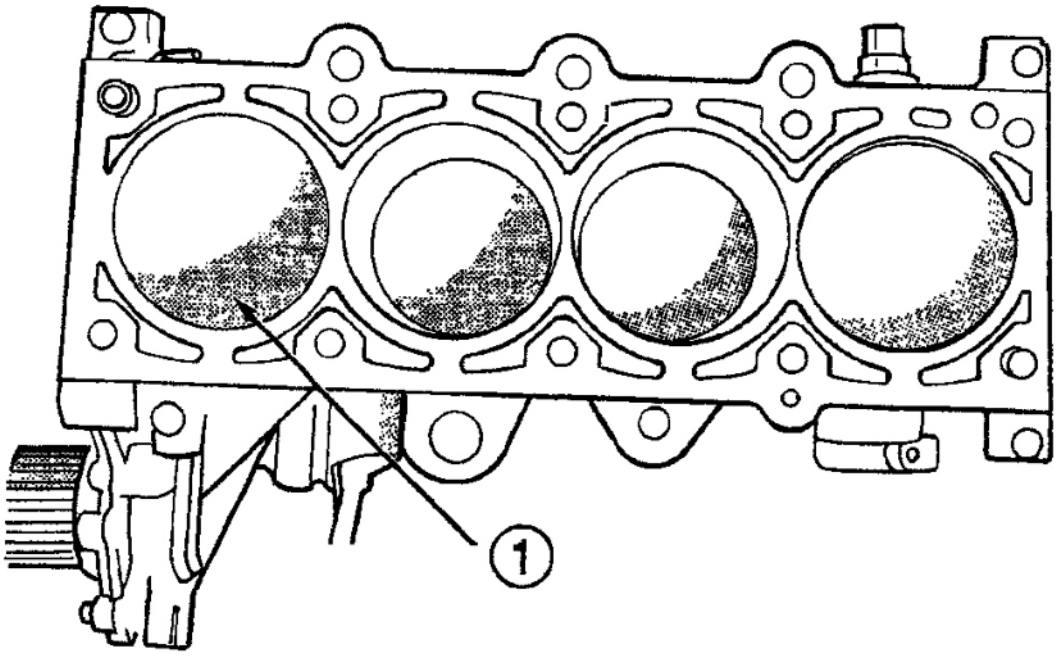


Fig. 85: Checking Cylinder Bore
Courtesy of DAIMLERCHRYSLER CORP.

REMOVAL

1. Remove cylinder head (Refer to **REMOVAL - CYLINDER HEAD**).
2. Remove oil pan (Refer to **REMOVAL**).
3. Remove Balance Shaft Carrier Assembly (Refer to **BALANCE SHAFTS AND CARRIER ASSEMBLY**).
4. 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.**



1 - DIRECTIONAL ARROW WILL BE IMPRINTED IN THIS AREA

G03633195

Fig. 86: Identifying Piston Markings
Courtesy of DAIMLERCHRYSLER CORP.

5. Pistons have a directional stamping in the front half of the piston facing towards the **front** of engine (**Fig. 86**).
6. Pistons and connecting rods must be removed from top of cylinder block. Rotate crankshaft so that each connecting rod is centered in cylinder bore.
7. Using a permanent ink or paint marker, identify cylinder number on each connecting rod cap (**Fig. 87**).

CAUTION: DO NOT use a number stamp or a punch to mark connecting rods. Damage to connecting rod could occur.

8. Remove connecting rod bolts and cap. Care should be taken not to damage the fracture rod and cap surfaces.

NOTE: Do not reuse connecting rod bolts.

CAUTION: Care must be taken not to damage the fractured rod and cap joint surfaces, as engine damage many occur.

9. To protect crankshaft journal and fractured rod surfaces, install Special Tool 8189, connecting rod guides onto connecting rod (**Fig. 88**). Carefully push each piston and rod assembly out of cylinder bore.
10. Remove Special Tool 8189, connecting rod guides and re-install bearing cap on the mating rod.

NOTE: Piston and rods are serviced as an assembly.

11. Repeat procedure for each piston and connecting rod assembly.
12. Remove piston rings (Refer to **REMOVAL**).

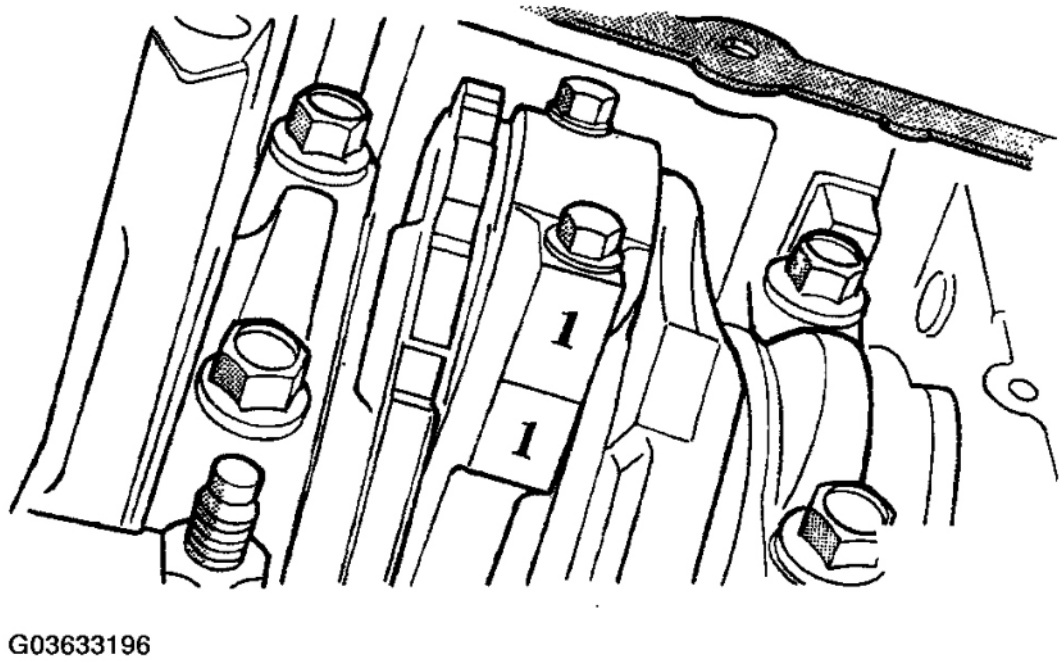
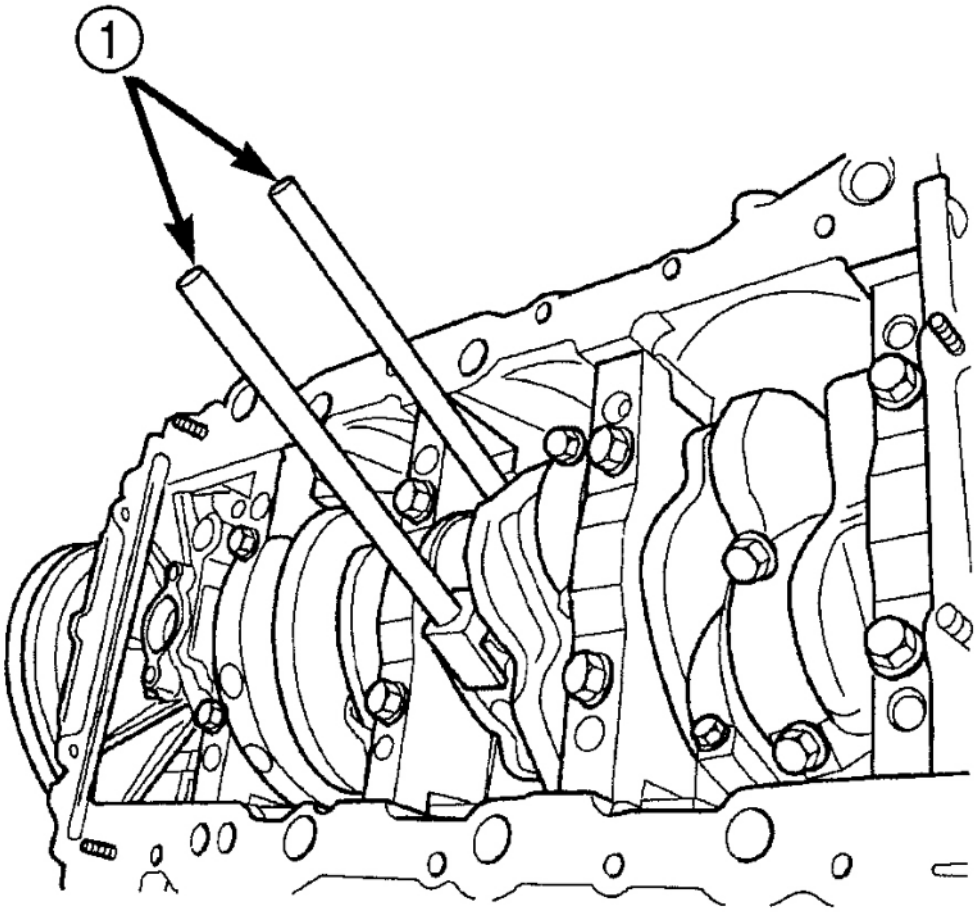


Fig. 87: Identify Connecting Rod To Cylinder
Courtesy of DAIMLERCHRYSLER CORP.



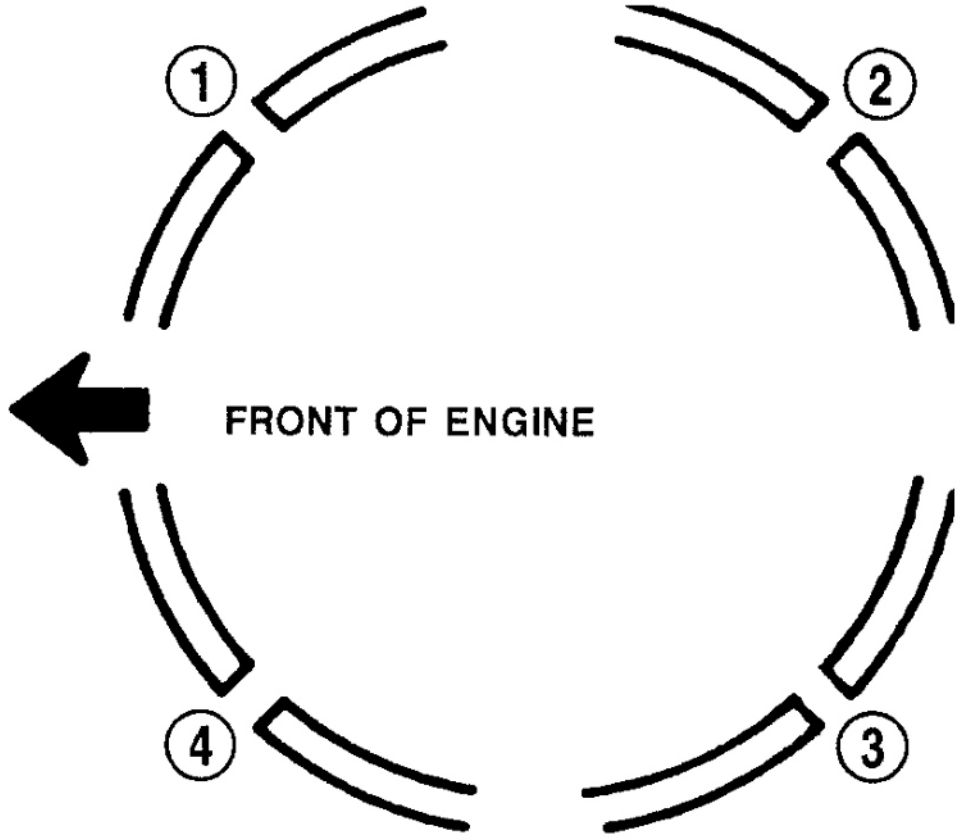
1 - SPECIAL TOOL 8189 CONNECTING ROD GUIDES

G03633197

Fig. 88: Connecting Rod Guides-Typical
Courtesy of DAIMLERCHRYSLER CORP.

INSTALLATION

1. Install piston rings on piston (Refer to **INSTALLATION**)
2. Before installing pistons and connecting rod assemblies into the bore, be sure that compression ring gaps are staggered so that neither is in line with oil ring rail gap (**Fig. 89**).
3. Before installing the ring compressor, make sure the oil ring expander ends are butted and the rail gaps located as shown in (**Fig. 89**). As viewed from top.
4. Immerse the piston head and rings in clean engine oil, slide the ring compressor, over the piston (**Fig. 90**). **Be sure position of rings does not change during this operation.**



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

G03633198

Fig. 89: Identifying Piston Ring End Gap Position
Courtesy of DAIMLERCHRYSLER CORP.

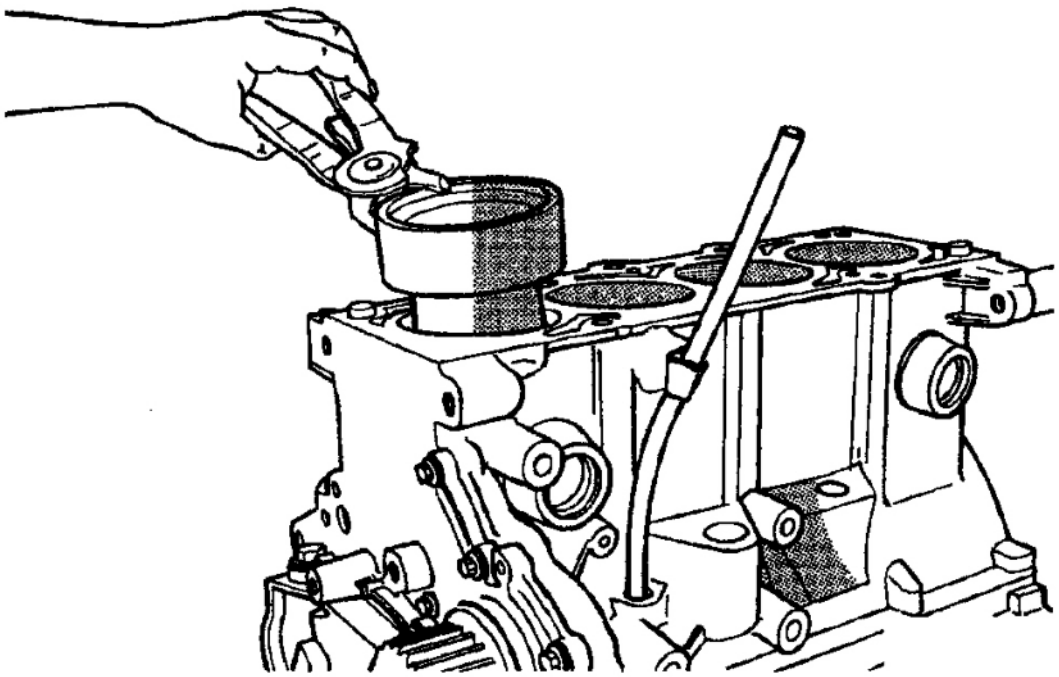


Fig. 90: Installing Piston
Courtesy of DAIMLERCHRYSLER CORP.

5. The directional stamp on the piston should face toward the front of the engine (**Fig. 86**).
6. Rotate crankshaft so that the connecting rod journal is on the center of the cylinder bore. Lubricate connecting rod journal with clean engine oil.
7. Install connecting rod upper bearing half into connecting rod. Install Special Tool 8189, connecting rod guides onto connecting rod (**Fig. 88**).
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. Remove Special Tool 8189, connecting rod guides.

NOTE: The connecting rod cap bolts should not be reused.

10. Before installing the **NEW** bolts, the threads should be coated with clean engine oil.
11. Install connecting rod lower bearing half into connecting rod cap. Install connecting rod cap.
12. Install each bolt finger tight then alternately torque each bolt to assemble the cap properly.
13. Tighten the connecting rod bolts using the 2 step torque-turn method. Tighten according to the following values:

CAUTION: Do not use a torque wrench for the second step.

1. Tighten the bolts to 27 N.m (20 ft. lbs.).
2. Tighten the connecting rod bolts an additional **1/4 TURN.**

14. Using a feeler gauge, check connecting rod side clearance (**Fig. 91**). (Refer to **SPECIFICATIONS**) for connecting rod side clearance.
15. Install Balance Shaft Carrier Assembly (Refer to **BALANCE SHAFTS AND CARRIER ASSEMBLY**).
16. Install oil pan (Refer to **INSTALLATION**).
17. Install cylinder head (Refer to **INSTALLATION - CYLINDER HEAD**).

CONNECTING ROD BEARINGS

STANDARD PROCEDURE

CONNECTING ROD - FITTING

1. For measuring connecting rod bearing clearance procedure and use of Plastigage (Refer to **STANDARD PROCEDURE**). For bearing clearance refer to **SPECIFICATIONS**.

NOTE: The rod bearing bolts should not be reused.

2. Before installing the **NEW** bolts the threads should be oiled with clean engine oil.
3. Install each bolt finger tight then alternately torque each bolt to assemble the cap properly.
4. Tighten the connecting rod bolts using the 2 step torque-turn method. Tighten according to the following values:

CAUTION: Do not use a torque wrench for the second step.

1. Tighten the bolts to 27 N.m (20 ft. lbs.).
2. Tighten the connecting rod bolts an additional **1/4 TURN.**

5. Using a feeler gauge, check connecting rod side clearance (**Fig. 91**). Refer to clearance specifications (Refer to **SPECIFICATIONS**).

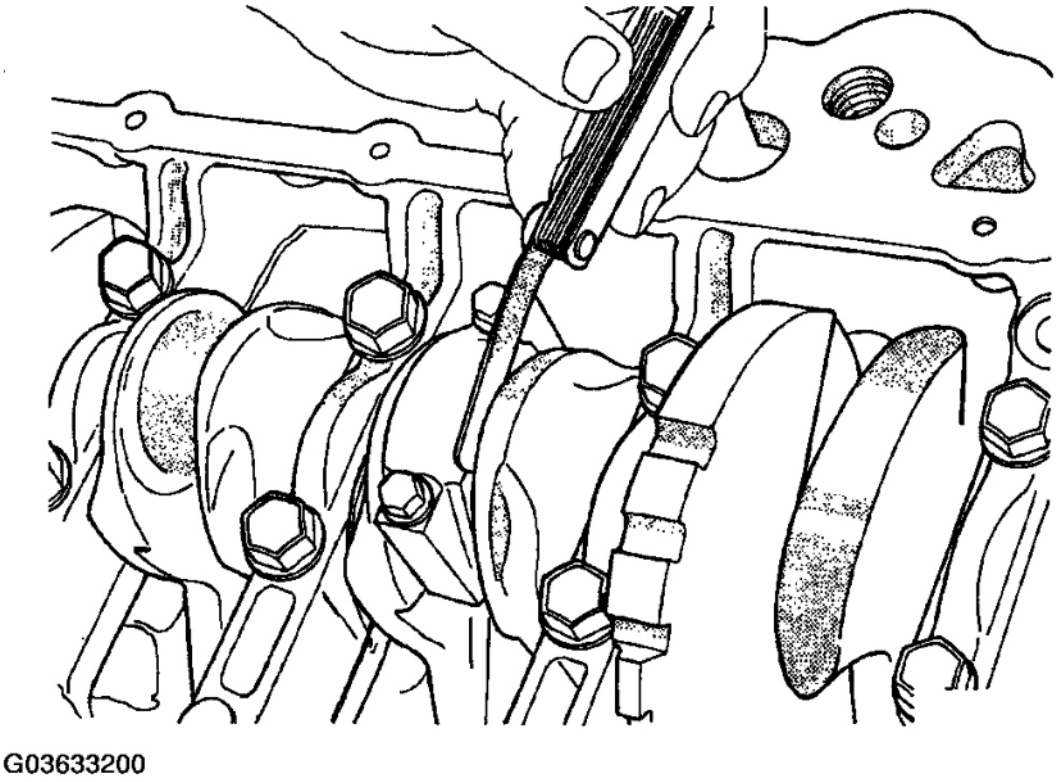


Fig. 91: Identifying Connecting Rod Side Clearance
Courtesy of DAIMLERCHRYSLER CORP.

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 inch) from bottom of cylinder bore. Check gap with feeler gauge (**Fig. 92**). Refer to Engine Specifications.
2. Check piston ring to groove side clearance (**Fig. 93**). Refer to Engine Specifications.

REMOVAL

1. Using a suitable ring expander, remove upper and intermediate piston rings (**Fig. 94**).
2. Remove the upper oil ring side rail, lower oil ring side rail and then oil ring expander from piston.

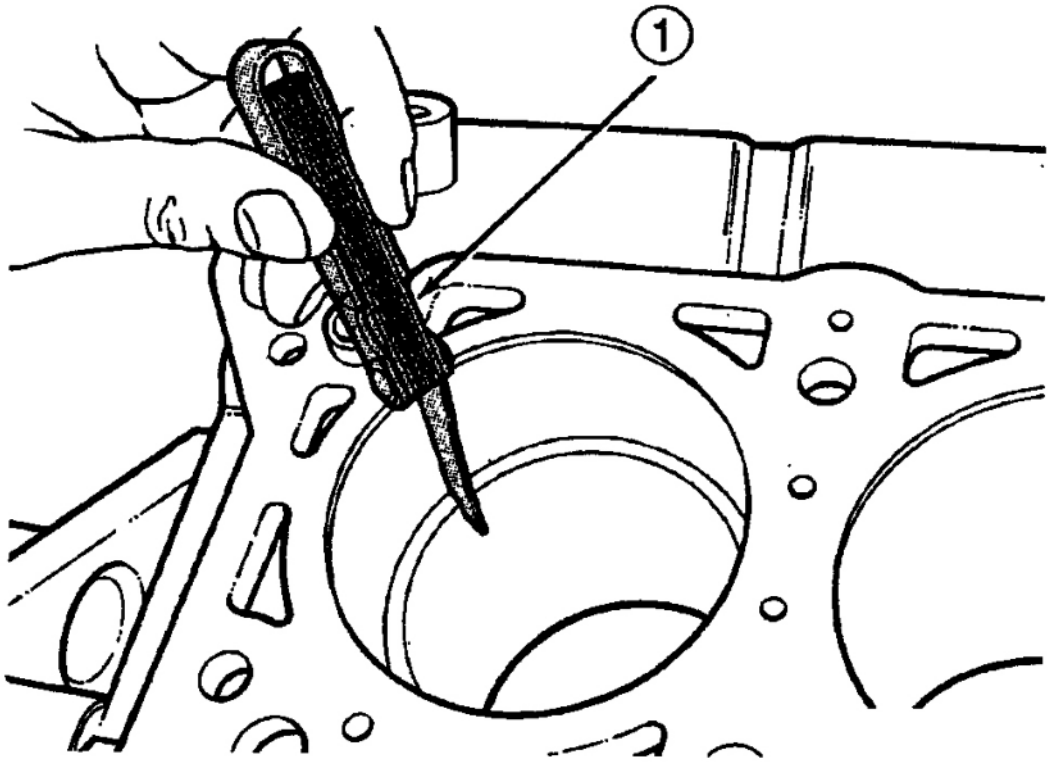
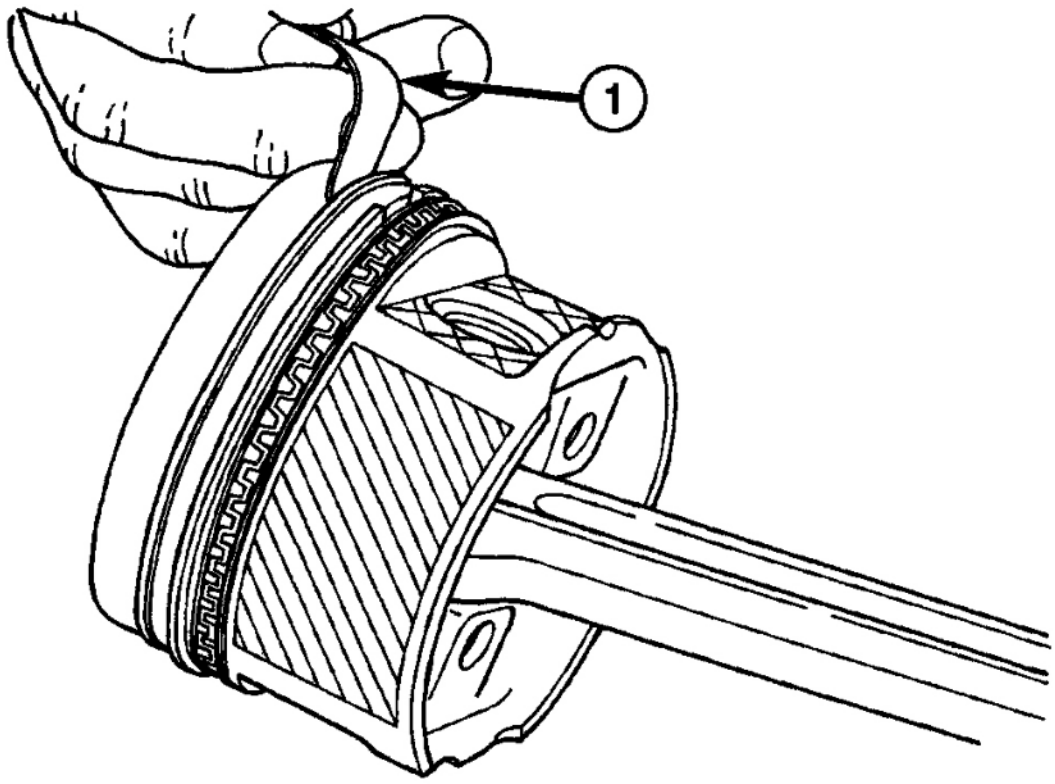


Fig. 92: Identifying Piston Ring Gap
Courtesy of DAIMLERCHRYSLER CORP.



1 - FEELER GAUGE
G03633202

Fig. 93: Identifying Piston Ring Side Clearance
Courtesy of DAIMLERCHRYSLER CORP.

3. Clean ring grooves of any carbon deposits.

INSTALLATION

NOTE: The identification mark on face of upper and intermediate piston rings must point toward top of piston.

Install rings with manufacturers identification mark facing up, to the top of the piston (**Fig. 95**).

CAUTION: Install piston rings in the following order:

1. Oil ring expander.
2. Upper oil ring side rail.

3. Lower oil ring side rail.

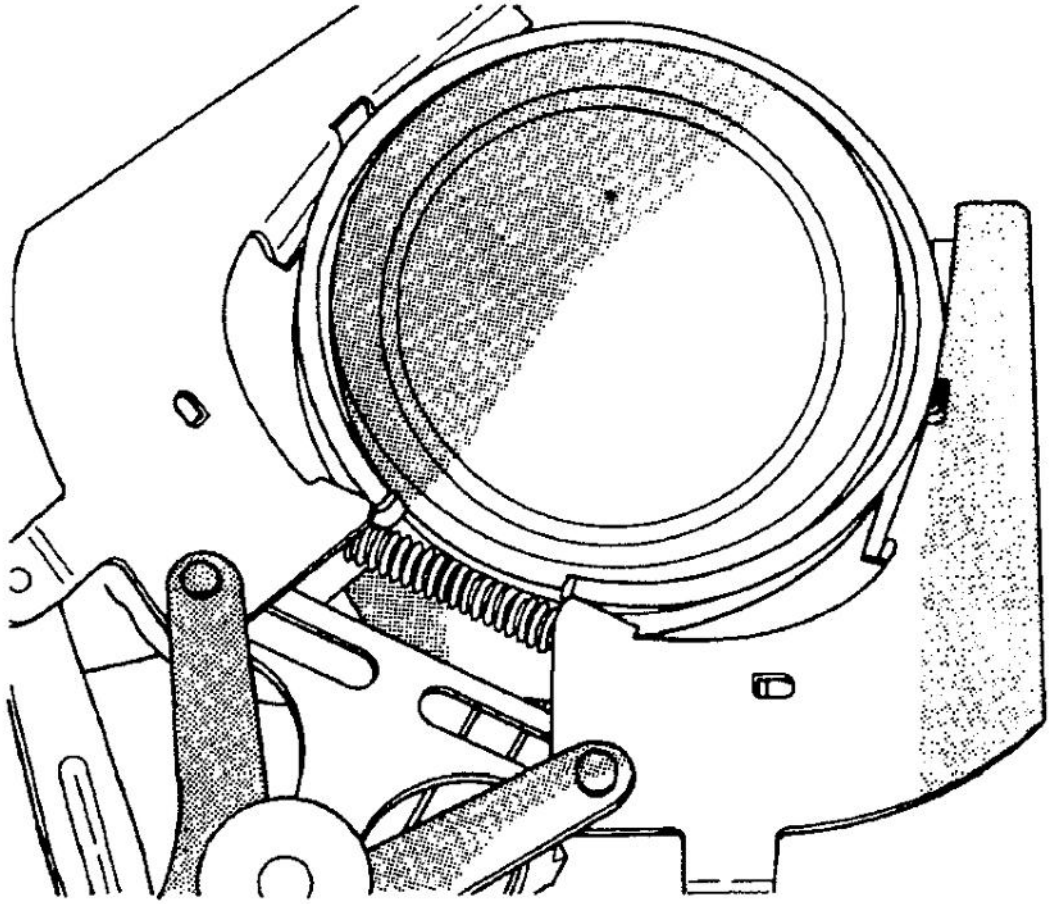
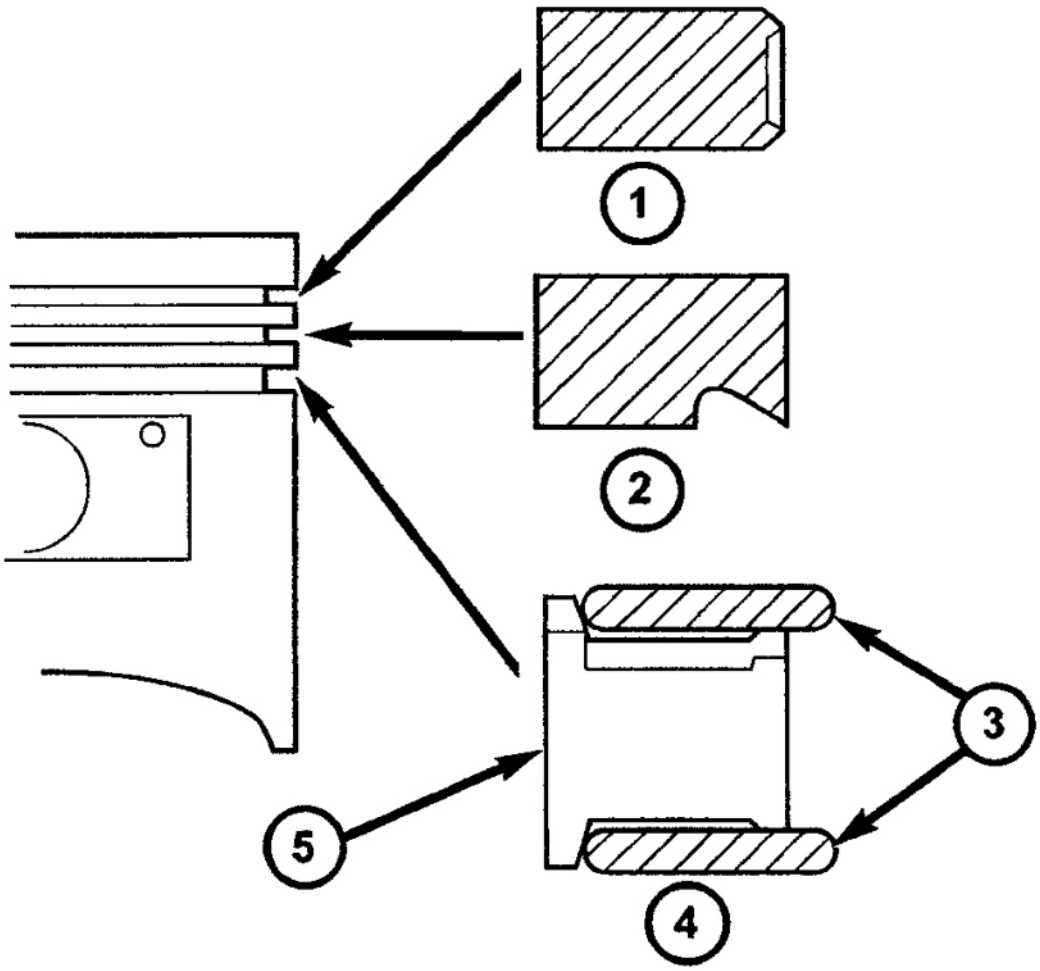


Fig. 94: Removing Piston Rings
Courtesy of DAIMLERCHRYSLER CORP.



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

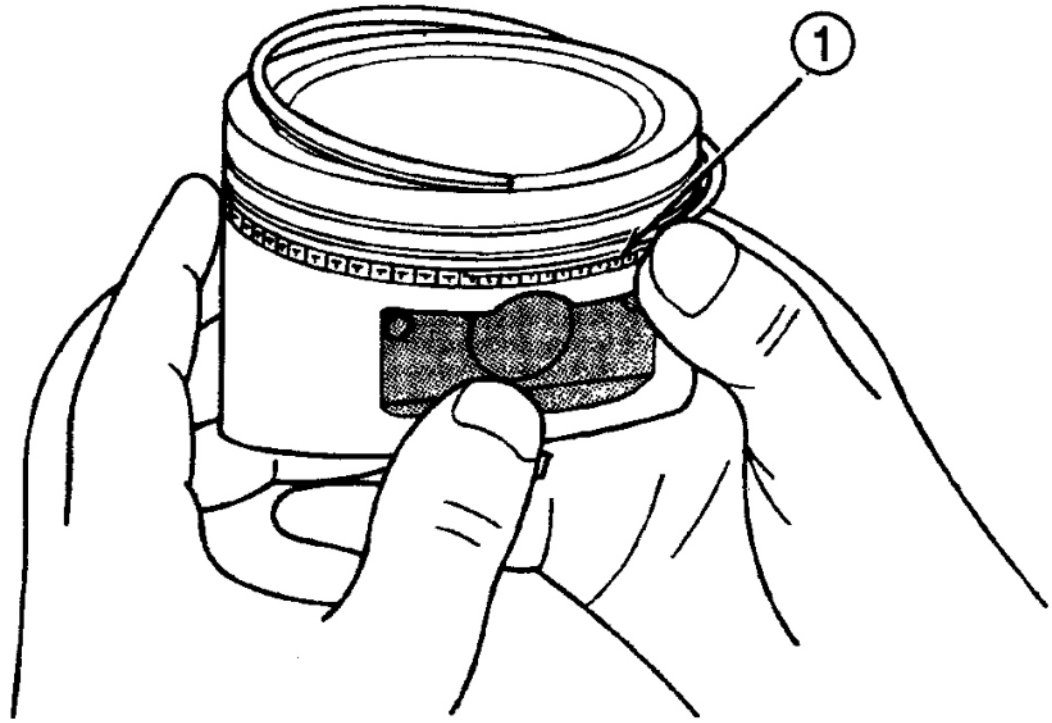
G03633204

Fig. 95: Identifying Piston Ring
Courtesy of DAIMLERCHRYSLER CORP.

4. No. 2 Intermediate piston ring.
5. No. 1 Upper piston ring.
    1. Install oil ring expander (**Fig. 95**).
    2. Install upper side rail first and then the lower side rail. Install the side rails by placing one end between the piston ring groove and the oil ring expander. Hold end firmly and press down the

portion to be installed until side rail is in position. **Do not use a piston ring expander (Fig. 96).**

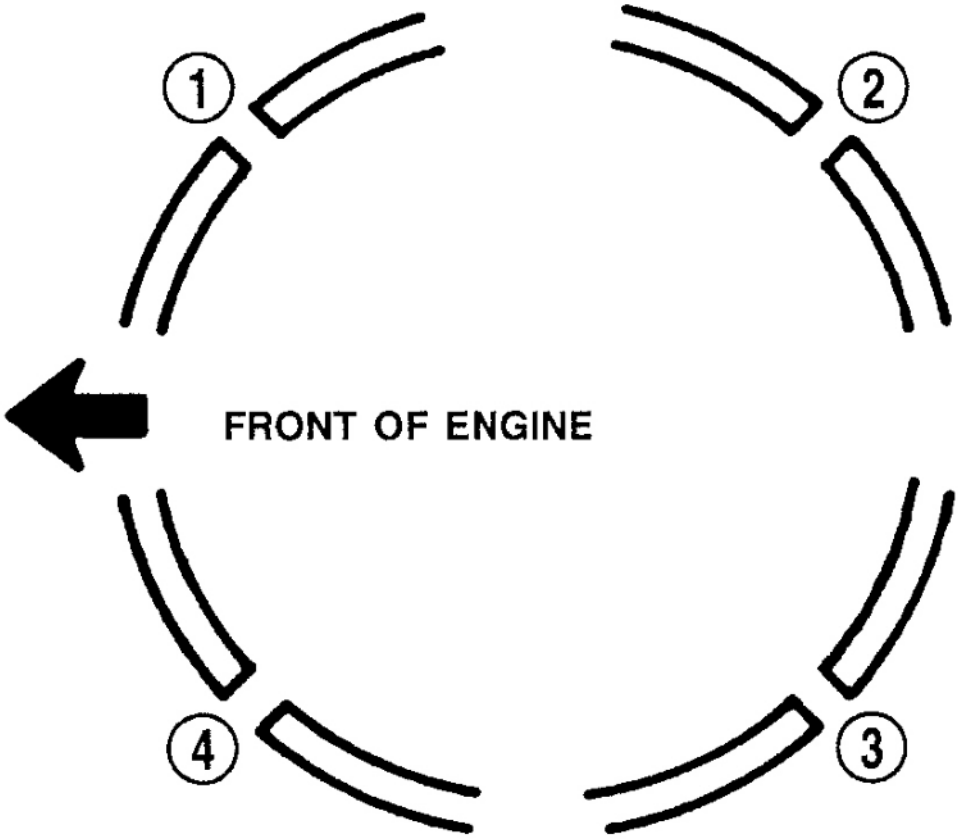
3. Install No. 2 piston ring and then No. 1 piston ring (**Fig. 95**).



1 - SIDE RAIL END
G03633205

Fig. 96: Installing Side Rail
Courtesy of DAIMLERCHRYSLER CORP.

4. Position piston ring end gaps as shown in (**Fig. 97**).
5. Position oil ring expander gap at least 45° from the side rail gaps but **not** on the piston pin center or on the thrust direction. Staggering ring gap is important for oil control.



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

G03633206

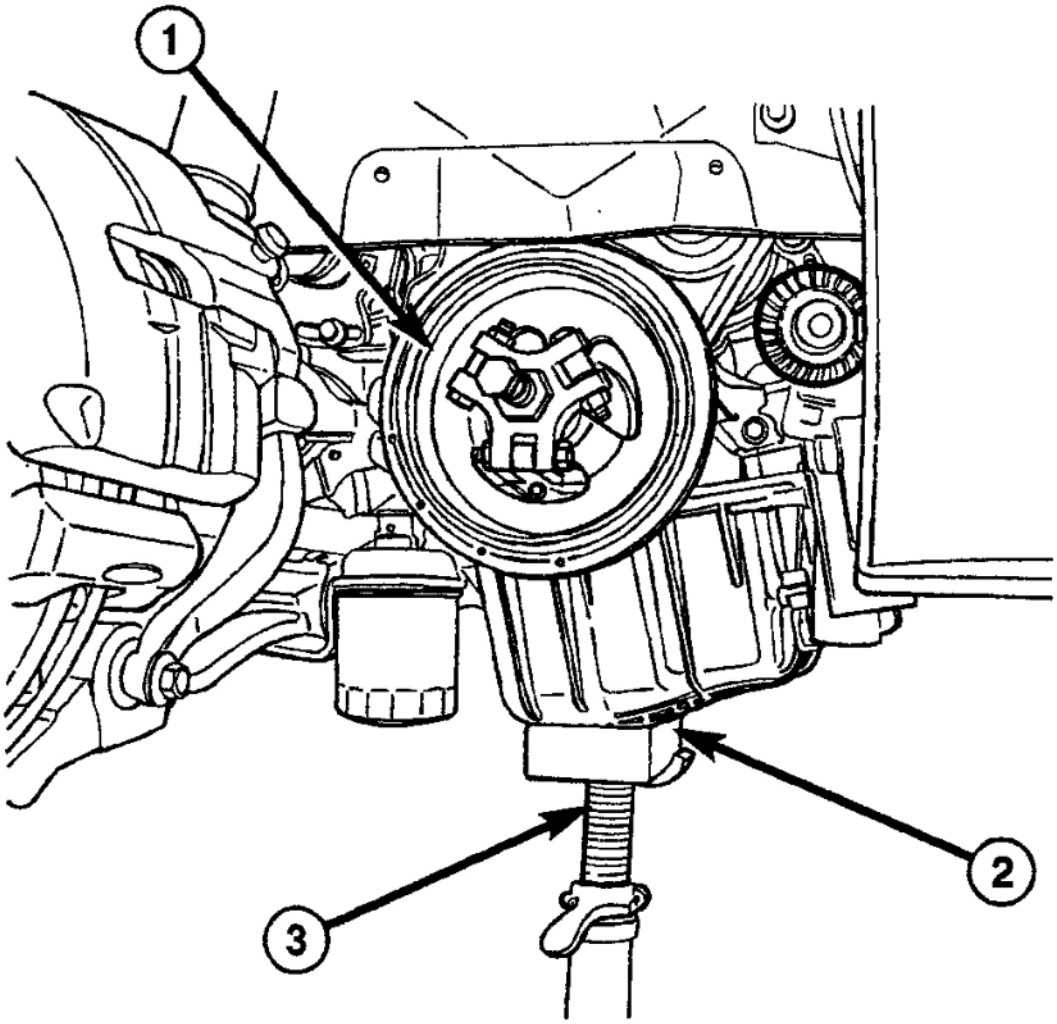
Fig. 97: Identifying Piston Ring End Gap Position
Courtesy of DAIMLERCHRYSLER CORP.

VIBRATION DAMPER

REMOVAL

1. Disconnect negative battery cable.
2. Support engine under oil pan with wooden block and floor jack.
3. Remove three right side engine mount vertical bolts to front engine bracket.
4. Raise vehicle on hoist.

5. Remove right front wheel and belt splash shield.
6. Support engine under oil pan with a wooden block and screw jack (**Fig. 98**).
7. Remove front and rear engine mount through bolts.
8. Slowly lower engine down with screw jack.
9. Remove accessory drive belts (Refer to SPECIFICATIONS & DRIVE BELT ROUTING article.
10. Remove crankshaft damper bolt.
11. Remove damper using Special Tool 8454 Puller and Insert 6827-A (**Fig. 99**).



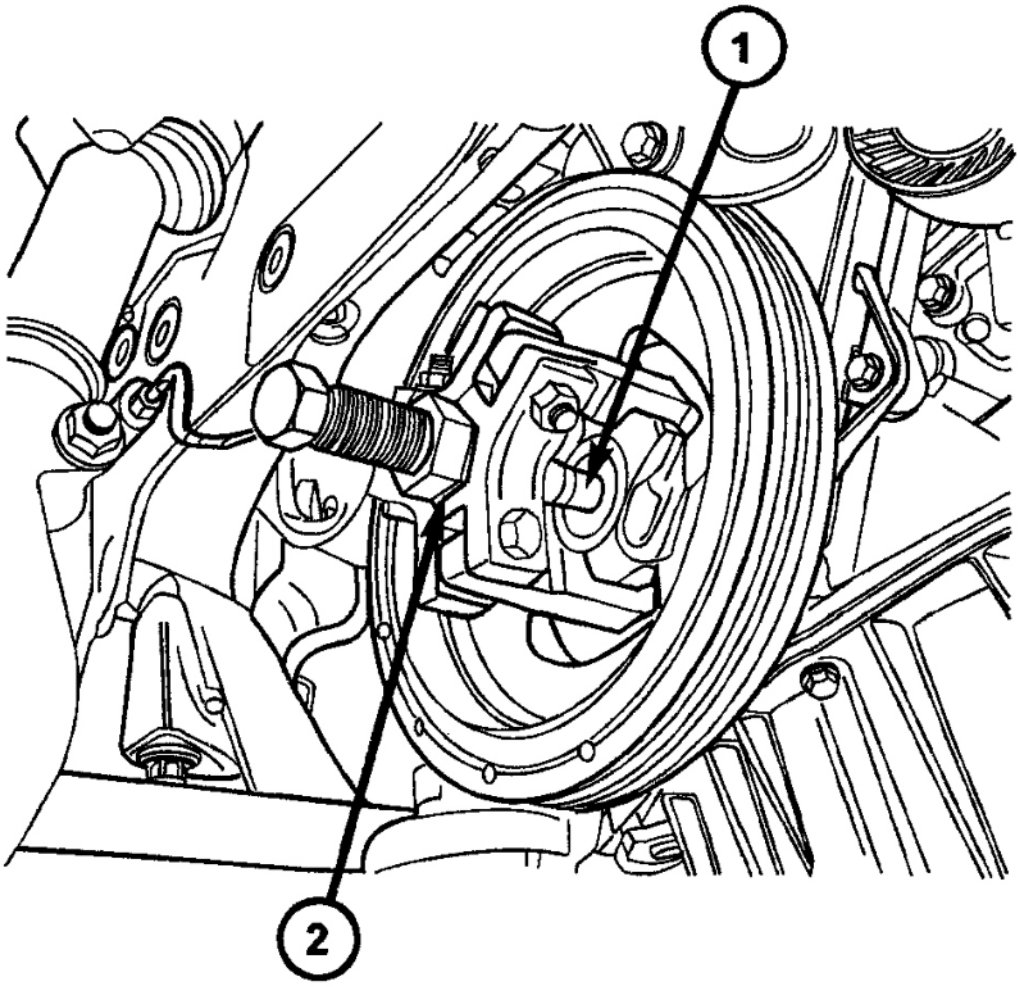
1 - VIBRATION DAMPER
2 - WOODEN BLOCK
3 - SCREW JACK

G03633207

Fig. 98: Removing Vibration Damper
Courtesy of DAIMLERCHRYSLER CORP.

INSTALLATION

1. Install crankshaft vibration damper using M12 1.75 x 150 mm bolt, washer, thrust bearing and nut from Special Tool 6792 (**Fig. 100**).
2. Install crankshaft vibration damper bolt and tighten to 136 N.m (100 ft. lbs.).
3. Install accessory drive belts (Refer to SPECIFICATIONS & DRIVE BELT ROUTING article.
4. Raise engine with screw jack enough to install front and rear engine mount through bolts. Torque fasteners to 61 N.m (45 ft. lbs.).
5. Install belt splash shield and right front wheel.
6. Lower vehicle.
7. Support engine under oil pan with wooden block and floor jack.
8. Slowly raise engine with floor jack until engine mount bracket aligns with right side engine mount.



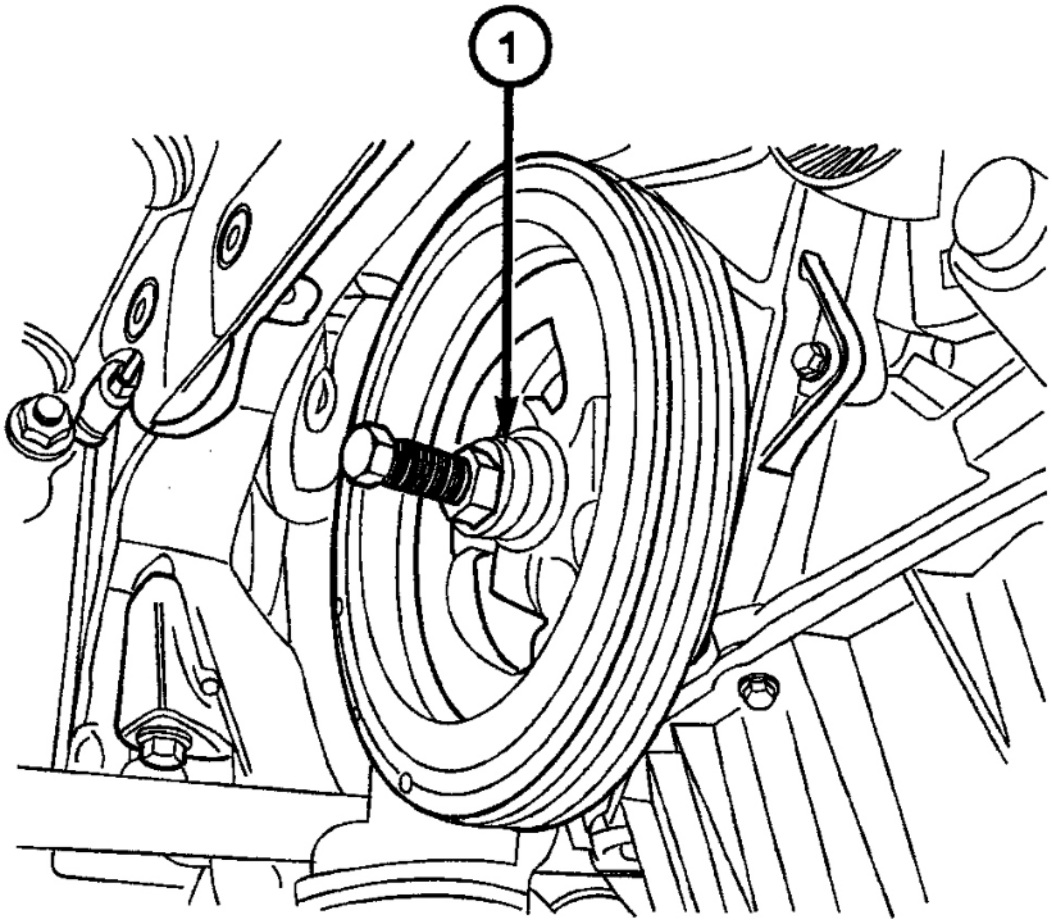
1 - SPECIAL TOOL 6827-A INSERT
2 - SPECIAL TOOL 8454 PULLER

G03633208

Fig. 99: Removing Vibration Damper
Courtesy of DAIMLERCHRYSLER CORP.

Install three vertical bolts to front engine bracket. Torque fasteners to 61 N.m (45 ft. lbs.)

9. Remove floor jack.
10. Connect negative battery cable.



1 - M12–1.75 x 150 MM BOLT, WASHER AND THRUST BEARING FROM SPECIAL TOOL 6792

G03633209

Fig. 100: Installing Vibration Damper
Courtesy of DAIMLERCHRYSLER CORP.

STRUCTURAL COLLAR

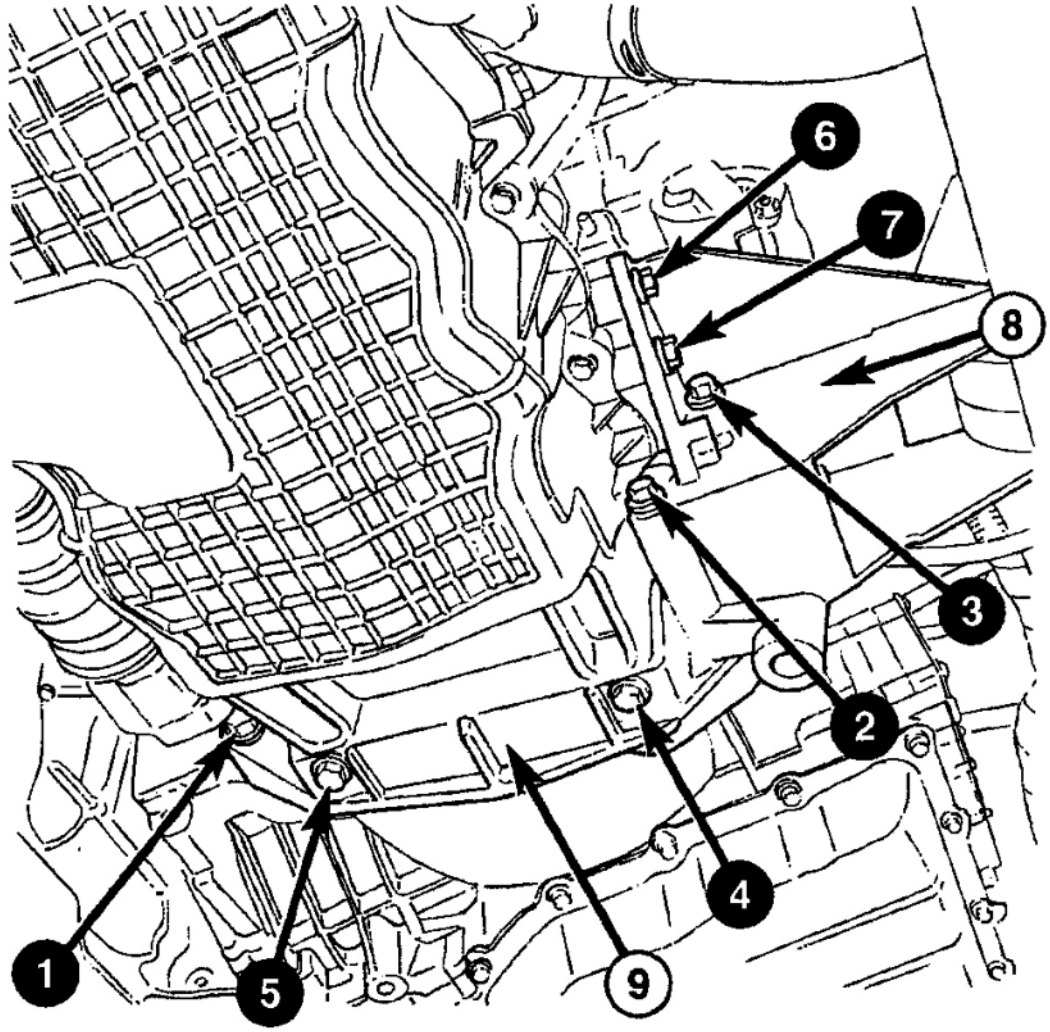
REMOVAL

1. Raise vehicle on hoist.
2. Remove front engine mount through bolt.
3. Remove bolts attaching torque reaction bracket to engine and transaxle (**Fig. 101**). Remove torque reaction bracket.
4. Remove bolts attaching structural collar to oil pan and transaxle (**Fig. 101**). Remove structural collar.

INSTALLATION

CAUTION: Torque procedure for structural collar and torque reaction bracket must be followed or damage could occur to oil pan, collar, and/or bracket.

1. Perform the following steps for installing structural collar and torque reaction bracket. Refer to (**Fig. 101**):



1-7 - BOLT TIGHTENING SEQUENCE
8 - TORQUE REACTION BRACKET
9 - STRUCTURAL COLLAR

G03633210

Fig. 101: Identifying Structural Collar And Torque Reaction Bracket
Courtesy of DAIMLERCHRYSLER CORP.

- Step 1: Place collar into position between transaxle and oil pan. Install collar to transaxle bolt (1), **hand tight only** .
- Step 2: Install collar to oil pan bolts (4) and (5), **hand tight only** .
- Step 3: Position torque reaction bracket in place. Install attaching bolts (2) and (3), **hand tight only** .
- Step 4: Final torque bolts (1-3) to 101 N.m (75 ft. lbs.).
- Step 5: Install bolts (6) and (7) through torque reduction bracket into engine block, **hand tight only** .
- Step 6: Final torque bolts (4) and (5) to 45 N.m (35 ft. lbs.).
- Step 7: Final torque bolts (6) and (7) to 61 N.m (45 ft. lbs.).

2. Install front engine mount through bolt and torque to 61 N.m (45 ft. lbs.).
3. Lower vehicle.

ENGINE MOUNTING

ADJUSTMENTS

ENGINE SUPPORT ADJUSTMENT

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

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

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

ENGINE SUPPORT ADJUSTMENT

1. Remove the load on the engine motor mounts by carefully supporting the engine and transmission assembly with a floor jack.
2. Loosen the right engine support assembly vertical fasteners.
3. Loosen the left engine support assembly vertical bolts.
4. Pry the engine right or left as required to achieve the proper drive shaft assembly length. Refer to DRIVELINE/HALF SHAFT article for driveshaft identification and related assembly length measuring.
5. Tighten right engine support assembly vertical bolts to 61 N.m (45 ft. lbs.). and tighten left engine support assembly bolts to 61 N.m (45 ft. lbs.).
6. Recheck drive shaft length.

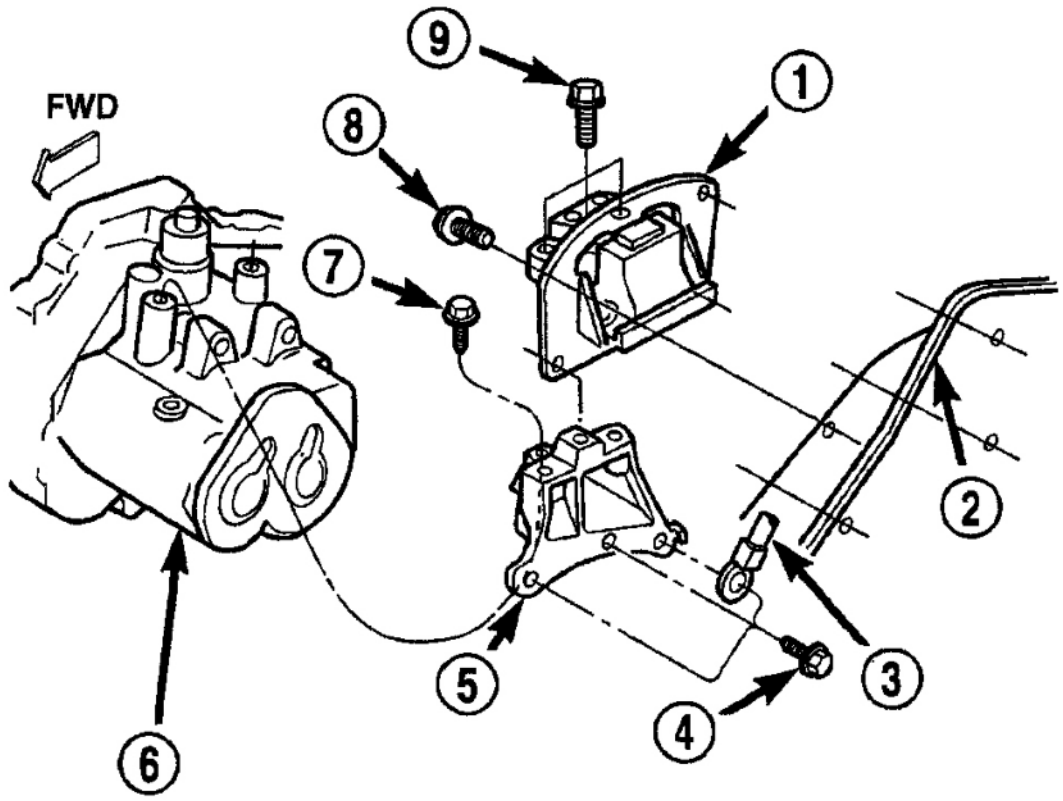
LEFT MOUNT

REMOVAL

1. Disconnect negative battery cable.
2. Remove throttle body air inlet hose and air cleaner housing assembly.
3. Remove two nuts securing speed control servo bracket to left shock tower. Reposition servo.
4. Support transmission with floor jack and wooden block.
5. Remove the three vertical bolts from mount to transmission bracket (A) (**Fig. 102**).
6. Slightly lower transmission with floor jack.
7. Remove mount to frame rail fasteners (B) and remove mount (**Fig. 102**).

INSTALLATION

1. Position mount to frame rail. Install mount to frame rail fasteners (B) (**Fig. 102**). Torque fasteners to 33 N.m (24 ft. lbs.).
2. Raise transmission into position with floor jack.
3. Install three vertical bolts from mount to transmission bracket (A) (**Fig. 102**). Torque fasteners to 61 N.m (45 ft. lbs.).
4. Remove floor jack and wooden block.
5. Install speed control servo to left shock tower. Torque fasteners to 6.7 N.m (60 in. lbs.)
6. Install throttle body air inlet hose and air cleaner housing assembly.
7. Connect negative battery cable.



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

G03633211

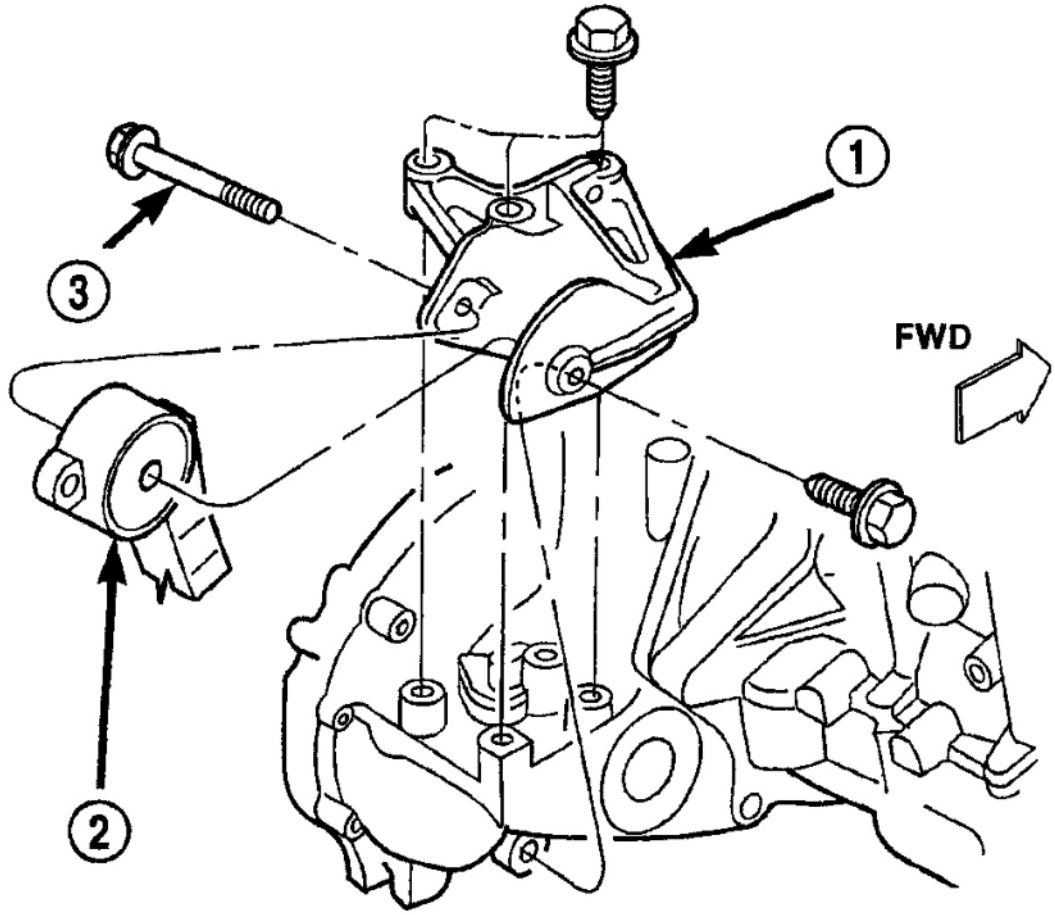
Fig. 102: Identifying Left Side Mount
Courtesy of DAIMLERCHRYSLER CORP.

REAR MOUNT

REMOVAL

1. Remove throttle body air inlet hose and air cleaner housing assembly.
2. Remove three vertical bolts attaching rear mount bracket to transaxle case (**Fig. 103**).

3. Raise vehicle on hoist.
4. Remove rear mount bracket through bolt (**Fig. 103**).
5. Remove horizontal bolt attaching rear mount bracket to transaxle case (**Fig. 103**).
6. Remove mount bracket.
7. Remove rear mount to suspension crossmember attaching bolts.
8. Remove rear mount.



1 - REAR TORQUE BRACKET
2 - REAR MOUNT
3 - THROUGH BOLT

G03633212

Fig. 103: Identifying Engine Mounting-Rear
Courtesy of DAIMLERCHRYSLER CORP.

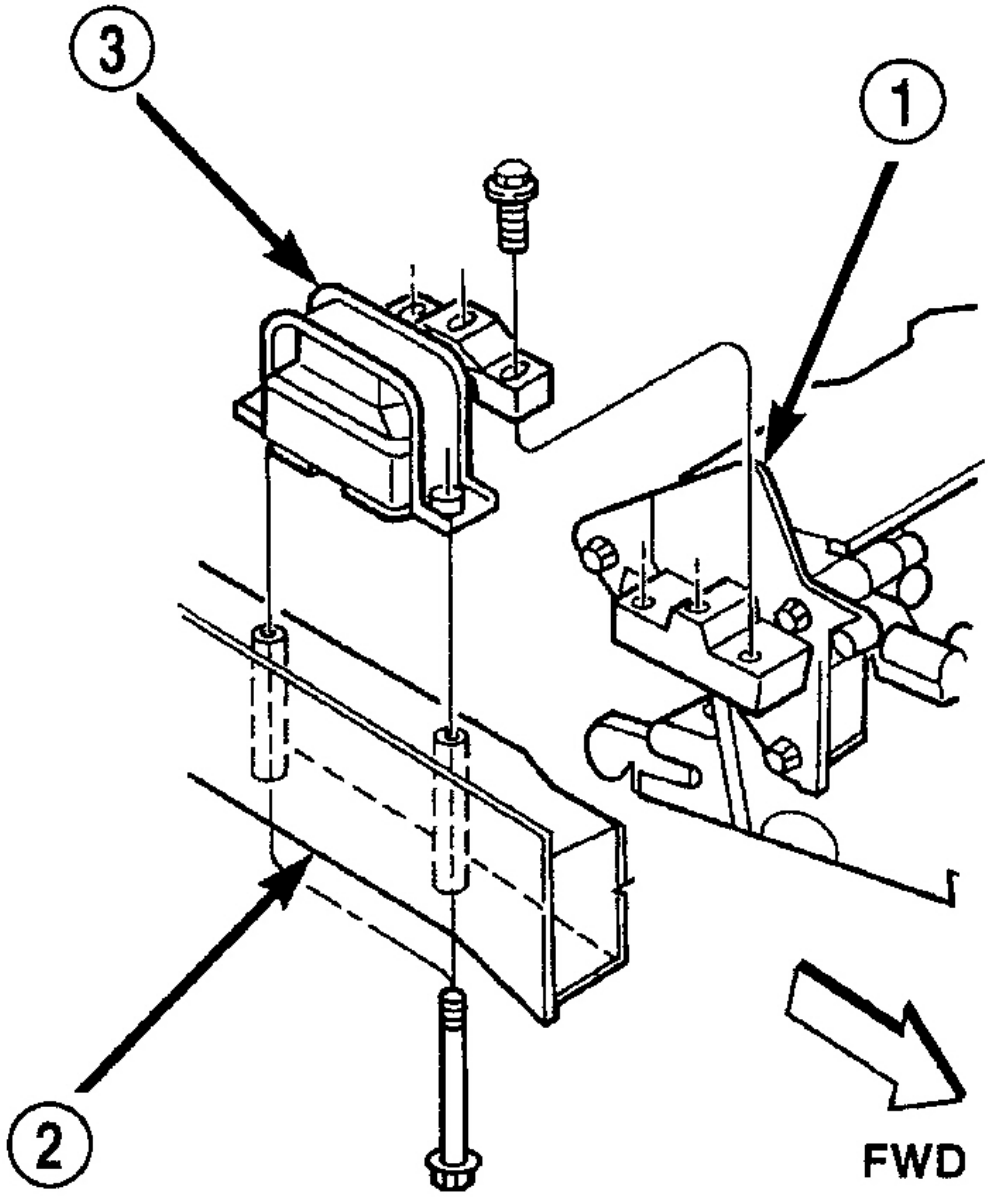
INSTALLATION

1. Position rear mount on suspension crossmember and loosely install bolts.
2. Position mount bracket on transaxle and install bolts. Tighten to 110 N.m (80 ft. lbs.) (**Fig. 103**).
3. Install rear mount to bracket through bolt and tighten to 61 N.m (45 ft. lbs.) (**Fig. 103**).
4. Tighten rear mount to crossmember bolts to 61 N.m (45 ft. lbs.) (**Fig. 103**).
5. Lower vehicle. Install throttle body air inlet hose and air cleaner housing assembly.

RIGHT MOUNT

REMOVAL

1. Remove coolant recovery container (Refer to COOLING article).
2. Remove heater tube front attaching screw.
3. Raise vehicle on a hoist and remove inner splash shield.
4. Remove heater tube rear attaching screw.
5. Remove the right engine support assembly vertical fasteners from frame rail (**Fig. 104**).
6. Lower vehicle. Remove the load on the engine motor mounts by carefully supporting the engine assembly with floor jack and wooden block on oil pan.
7. Remove the bolts attaching the engine support assembly to the engine bracket (**Fig. 104**).
8. Remove right engine mount.



1 - ENGINE SUPPORT BRACKET
2 - FRAME RAIL
3 - RIGHT ENGINE MOUNT

G03633213

Fig. 104: Identifying Engine Mounting-Right Side
Courtesy of DAIMLERCHRYSLER CORP.

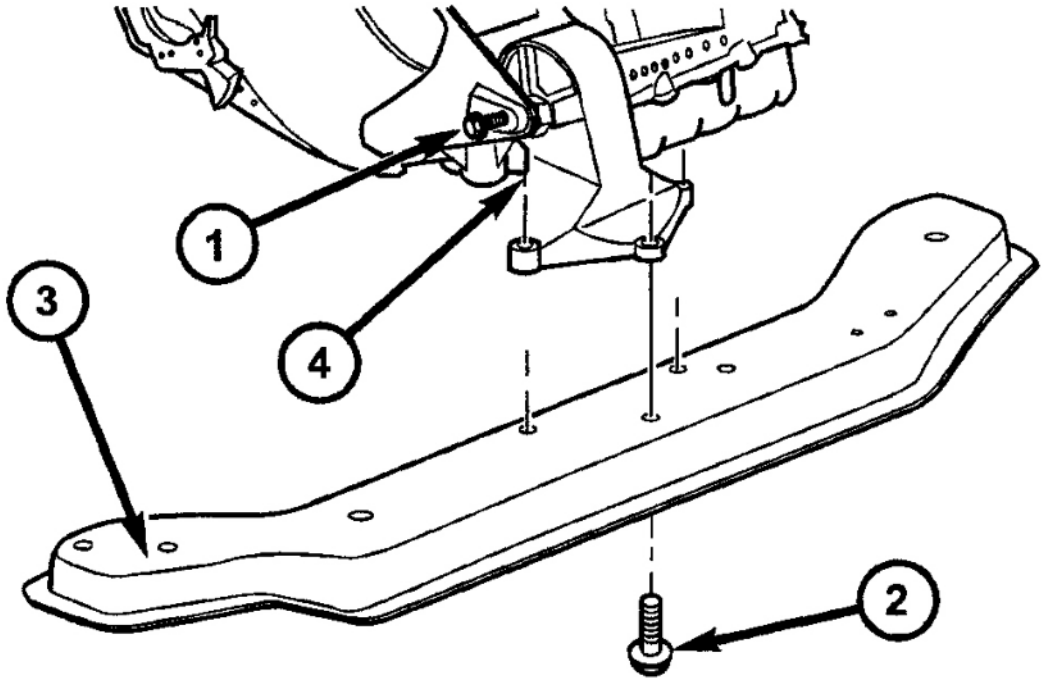
INSTALLATION

1. Position right engine mount and install frame rail to mount bolts. Tighten bolts to 61 N.m (45 ft. lbs.) (**Fig. 104**).
2. Install the mount to engine support bracket bolts and tighten to 61 N.m (45 ft. lbs.) (**Fig. 104**).
3. Raise vehicle on a hoist.
4. Install heater tube rear attaching screw.
5. Install inner splash shield and lower vehicle.
6. Install heater tube front attaching screw.
7. Install coolant recovery container (Refer to COOLING article).

FRONT MOUNT

REMOVAL

1. Raise vehicle.
2. Remove front mount to bracket horizontal through bolt (**Fig. 105**).
3. Remove front mount vertical bolts (**Fig. 105**).
4. Remove front mount.



1 - HORIZONTAL THROUGH BOLT
2 - VERTICAL BOLT(S)
3 - LOWER RADIATOR CROSSMEMBER
4 - FRONT ENGINE MOUNT

G03633214

Fig. 105: Removing Front Mount
Courtesy of DAIMLERCHRYSLER CORP.

INSTALLATION

1. Position front mount on lower radiator cross-member.
2. Loose install front mount to bracket through bolt.
3. Install front mount vertical bolts. Tighten bolts to 61 N.m (45 ft. lbs.) (**Fig. 105**).
4. Tighten horizontal through bolt to 61 N.m (45 ft. lbs.) (**Fig. 105**).
5. Lower vehicle.

LUBRICATION

DESCRIPTION

NOTE: Some 2.4L engines are not equipped with an oil pan gasket. Use the appropriate

RTV sealant.

The lubrication system is a full-flow filtration, pressure feed type. The oil pump (**Fig. 106**) is mounted in the front engine cover and driven by the crankshaft.

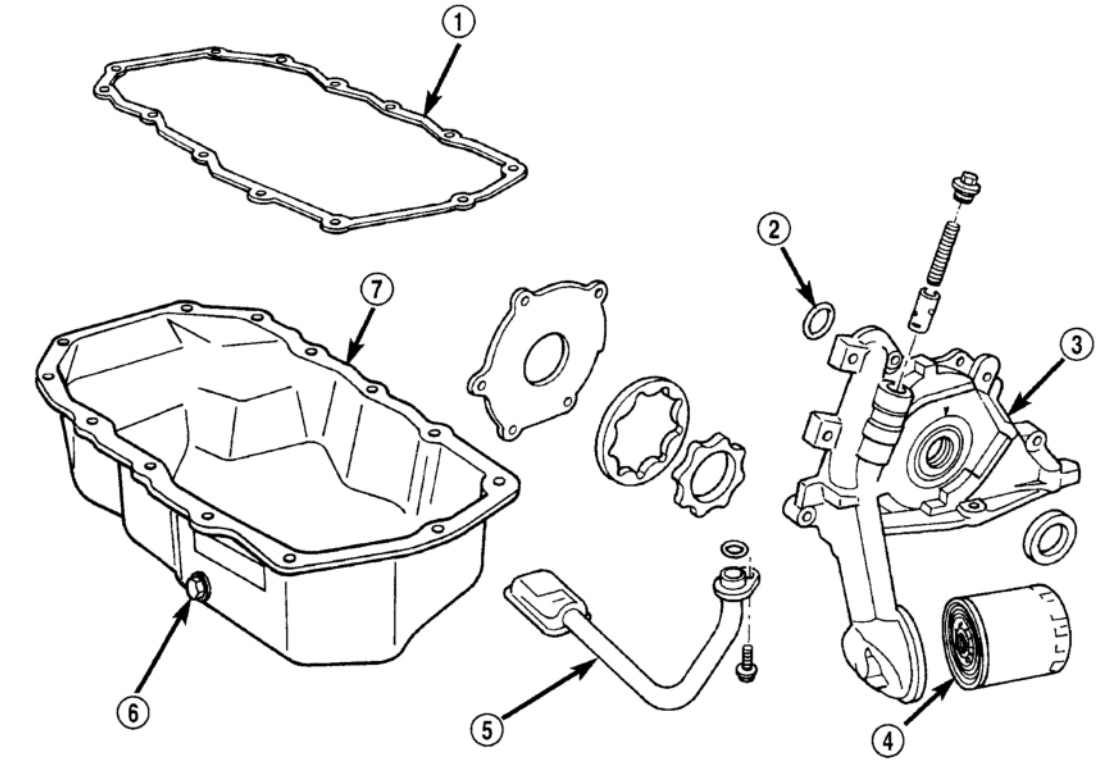


Fig. 106: Identifying Lubrication Components
Courtesy of DAIMLERCHRYSLER CORP.

OPERATION

Engine oil drawn up through the pickup tube and is pressurized by the oil pump and routed through the full-flow filter to the main oil gallery running the length of the cylinder block. A diagonal hole in each bulkhead feeds oil to each main bearing. Drilled passages within the crankshaft route oil from main bearing journals to connecting rod journals. Balance shaft lubrication is provided through an oil passage from the number one main bearing cap through the balance shaft carrier support leg. This passage directly supplies oil to the front bearings and internal machined passages in the shafts that routes oil from front to the rear shaft bearing journals. A vertical hole at the number five bulkhead routes pressurized oil through a restrictor (integral to the cylinder head gasket) up past a cylinder head bolt to an oil gallery running the length of the cylinder head. The camshaft journals are partially slotted to allow a predetermined amount of pressurized oil to pass into the bearing cap cavities. Lubrication of the camshaft lobes are provided by small holes in the camshaft bearing caps that are directed towards each lobe. Oil returning to the pan from pressurized components supplies lubrication to the

valve stems. Cylinder bores and wrist pins are splash lubricated from directed slots on the connecting rod thrust collars (**Fig. 107**).

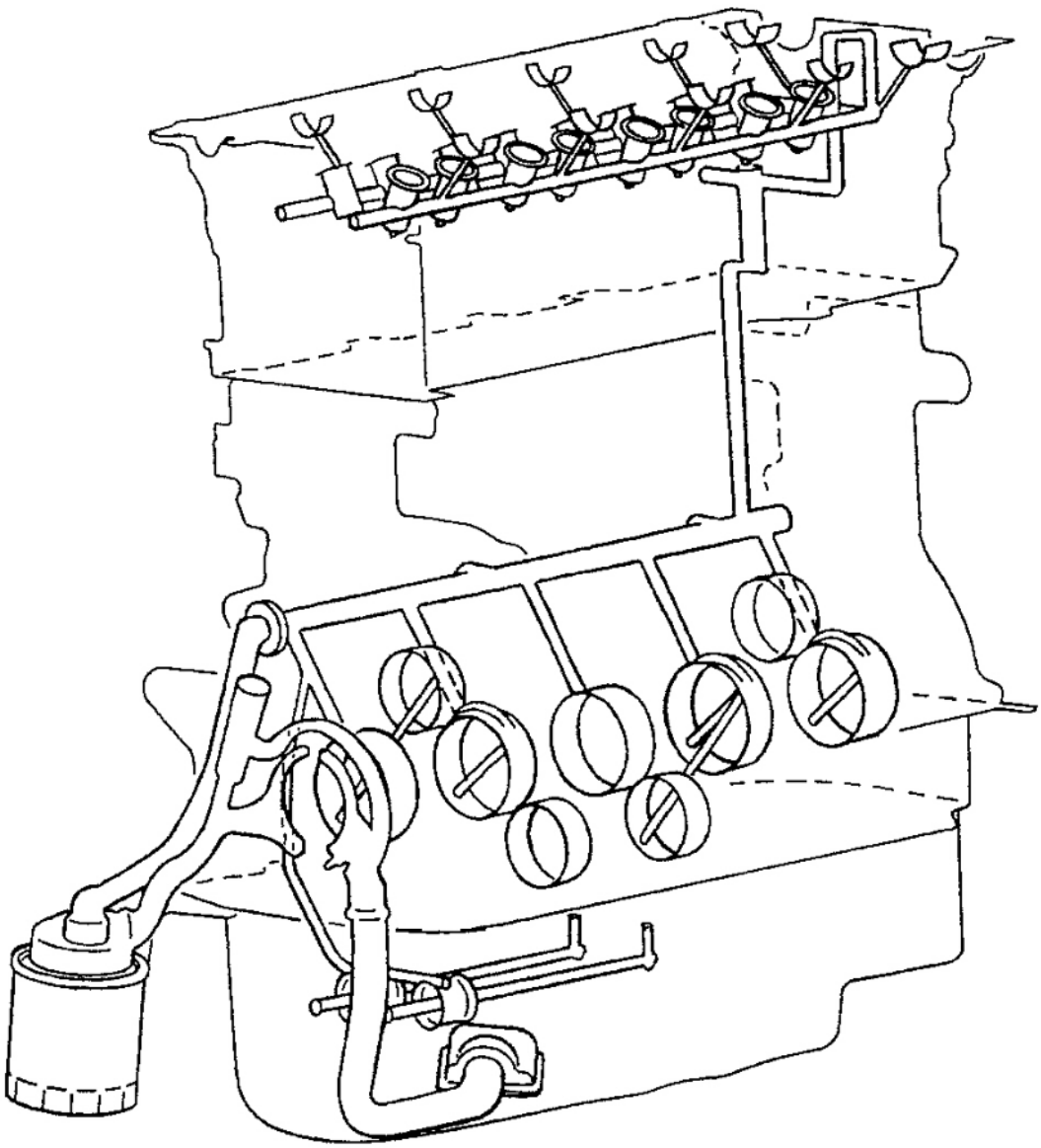


Fig. 107: Identifying Engine Lubrication System
Courtesy of DAIMLERCHRYSLER CORP.

DIAGNOSIS AND TESTING - CHECKING ENGINE OIL PRESSURE

1. Disconnect and remove oil pressure switch.

2. Install Special Tools C-3292 Gauge with 8406 Adaptor fitting.
3. Start engine and record oil pressure. Refer to Specifications for correct oil pressure requirements. (Refer to **SPECIFICATIONS**)

CAUTION: If oil pressure is 0 at idle, do not perform the 3000 RPM test

4. If oil pressure is 0 at idle. Shut off engine, check for pressure relief valve stuck open, a clogged oil pick-up screen or a damaged oil pick-up tube O-ring.
5. After test is complete, remove test gauge and fitting.
6. Install oil pressure switch and connector.

OIL

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. Remove dipstick and observe oil level (**Fig. 108**). Add oil only when the level is at or below the ADD mark (**Fig. 109**).

STANDARD PROCEDURE - ENGINE OIL AND FILTER CHANGE

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

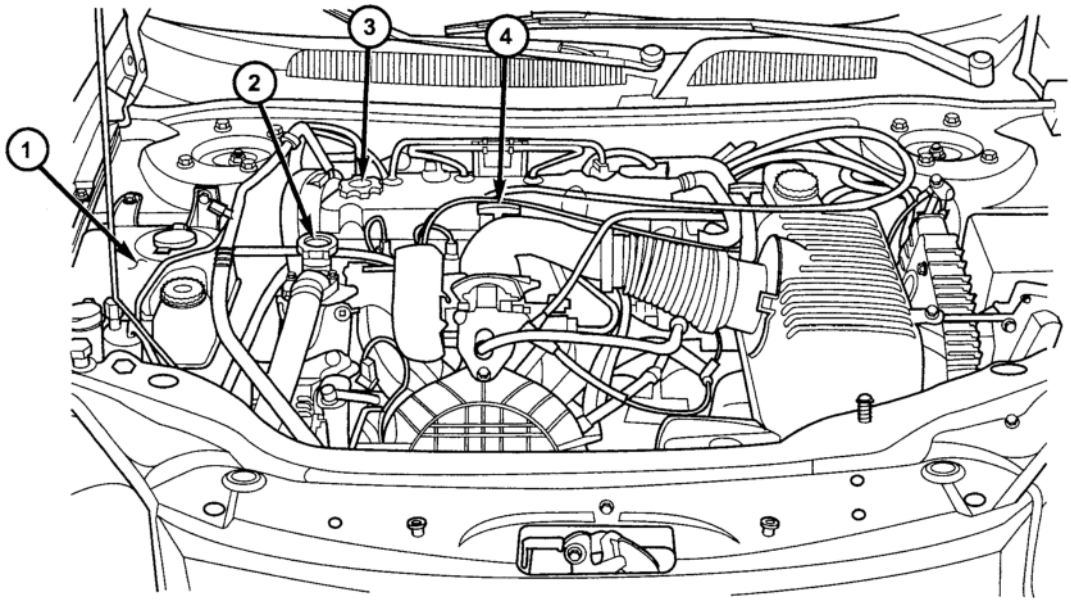


Fig. 108: Checking Fluid Level 2.0/2.4L
Courtesy of DAIMLERCHRYSLER CORP.

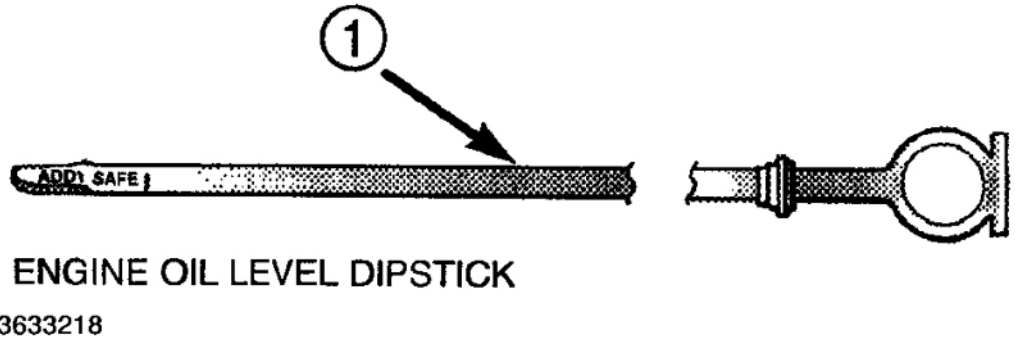


Fig. 109: Identifying Engine Oil Level Dipstick
Courtesy of DAIMLERCHRYSLER CORP.

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

PROBLEMS CAN RESULT. DO NOT POLLUTE, DISPOSE OF USED ENGINE OIL PROPERLY. CONTACT YOUR DEALER OR GOVERNMENT AGENCY FOR LOCATION OF COLLECTION CENTER IN YOUR AREA.

Run engine until achieving normal operating temperature.

1. Position the vehicle on a level surface and turn engine off.
2. Remove oil fill cap.
3. Raise vehicle on hoist.
4. Place a suitable drain pan under crankcase drain.
5. Remove drain plug from crankcase and allow oil to drain into pan. Inspect drain plug threads for stretching or other damage. Replace drain plug and gasket if damaged.
6. Remove oil filter. (Refer to **REMOVAL**)
7. Install and tighten drain plug in crankcase.
8. Install new oil filter. (Refer to **INSTALLATION**)
9. Lower vehicle and fill crankcase with specified type and amount of engine oil.
10. Install oil fill cap.
11. Start engine and inspect for leaks.
12. Stop engine and inspect oil level.

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

OIL FILTER

DESCRIPTION

The engine oil filter (**Fig. 110**) is a high quality full-flow, disposable type. Replace the oil filter with a Mopar® or the equivalent.

REMOVAL

1. Raise vehicle on hoist.
2. Position an oil collecting container under oil filter location.

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

3. Using a suitable filter wrench, turn oil filter (**Fig. 110**) counterclockwise to remove.

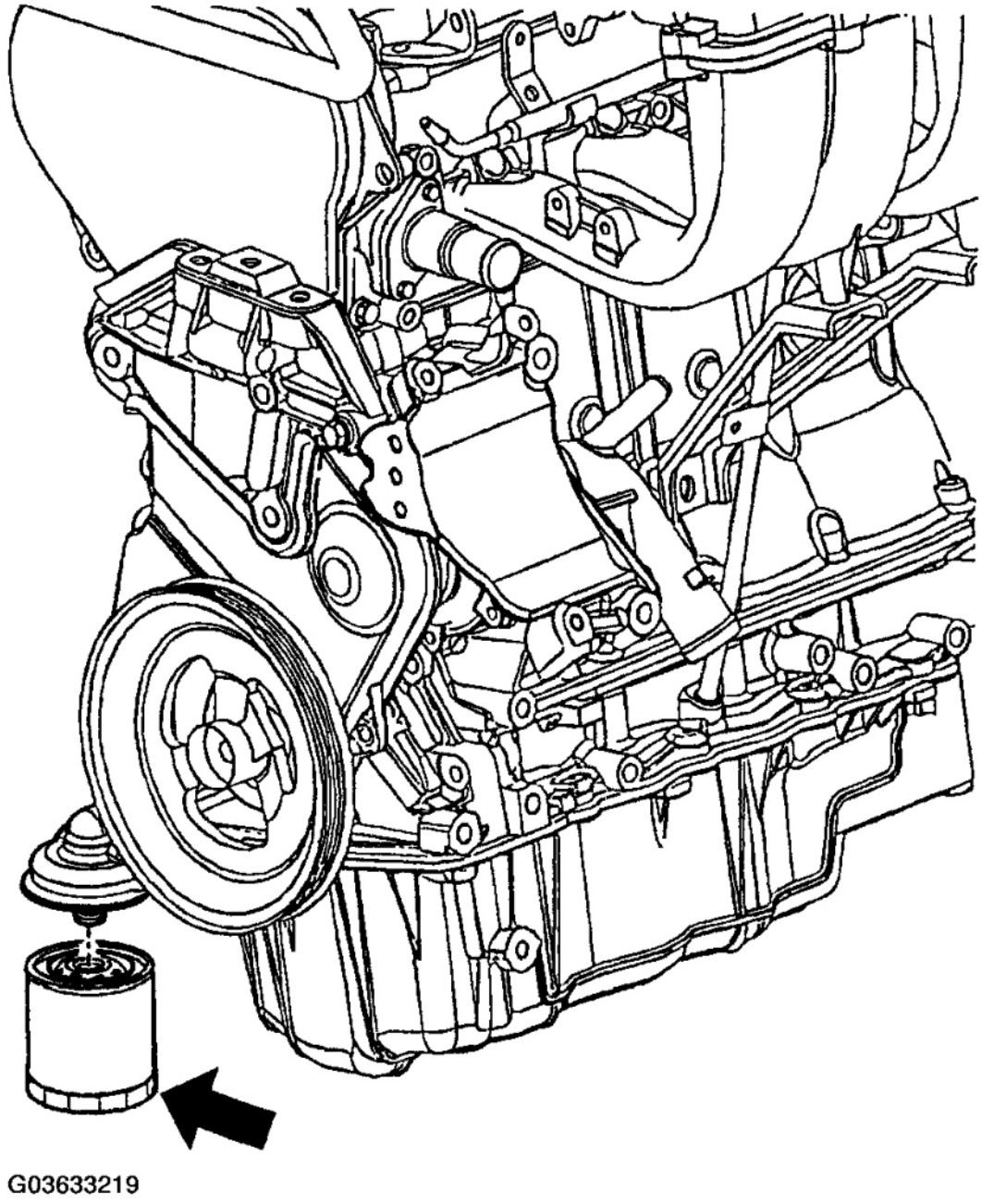


Fig. 110: Identifying Oil Filter
Courtesy of DAIMLERCHRYSLER CORP.

INSTALLATION

1. Clean and check filter mounting surface. The surface must be smooth, flat and free of debris or pieces of gasket.

2. Lubricate new oil filter gasket with clean engine oil.
3. Screw oil filter (**Fig. 110**) on until the gasket contacts base. Tighten to 11 N.m (8 ft. lbs.).

OIL PAN

REMOVAL

1. Disconnect negative battery cable.
2. Raise vehicle on hoist and drain engine oil.
3. Remove structural collar and torque reaction bracket (Refer to **STRUCTURAL COLLAR**).
4. Remove bolts attaching oil pan.
5. Remove oil pan.
6. Clean oil pan and all gasket surfaces.

INSTALLATION

1. Apply Mopar® Engine RTV GEN II at the oil pump to engine block parting line (**Fig. 111**).
2. Install the oil pan gasket to the block (**Fig. 112**).
3. Install pan and tighten the screws to 12 N.m (105 in. lbs.).
4. Install structural collar and torque reaction bracket (Refer to **STRUCTURAL COLLAR**).
5. Lower vehicle and fill engine crankcase with proper oil to correct level.
6. Connect negative battery cable.

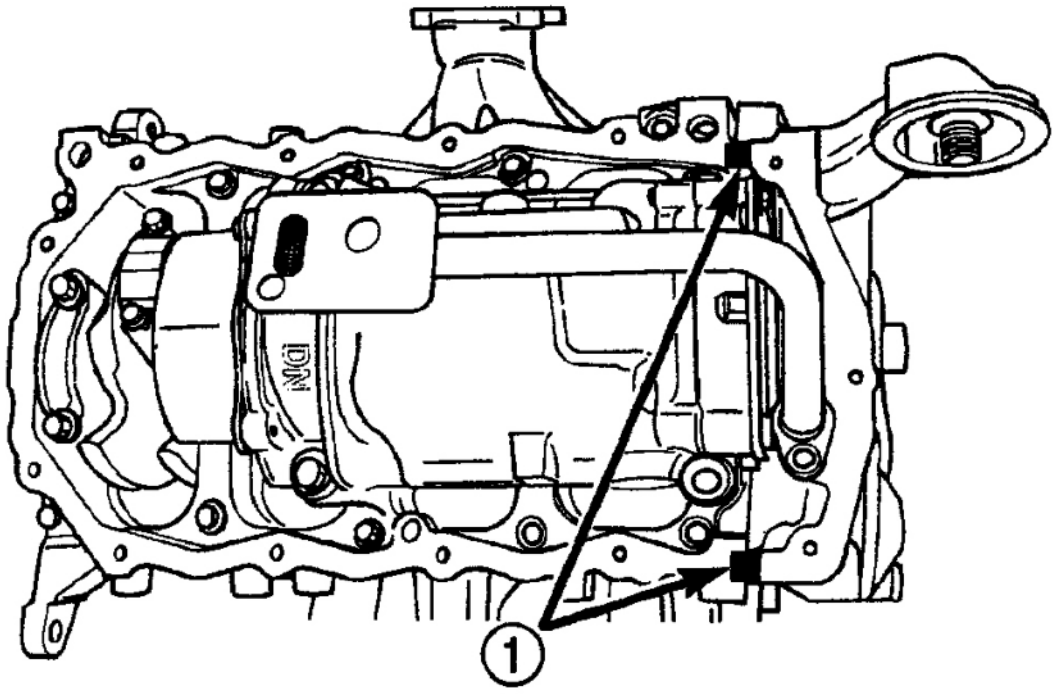
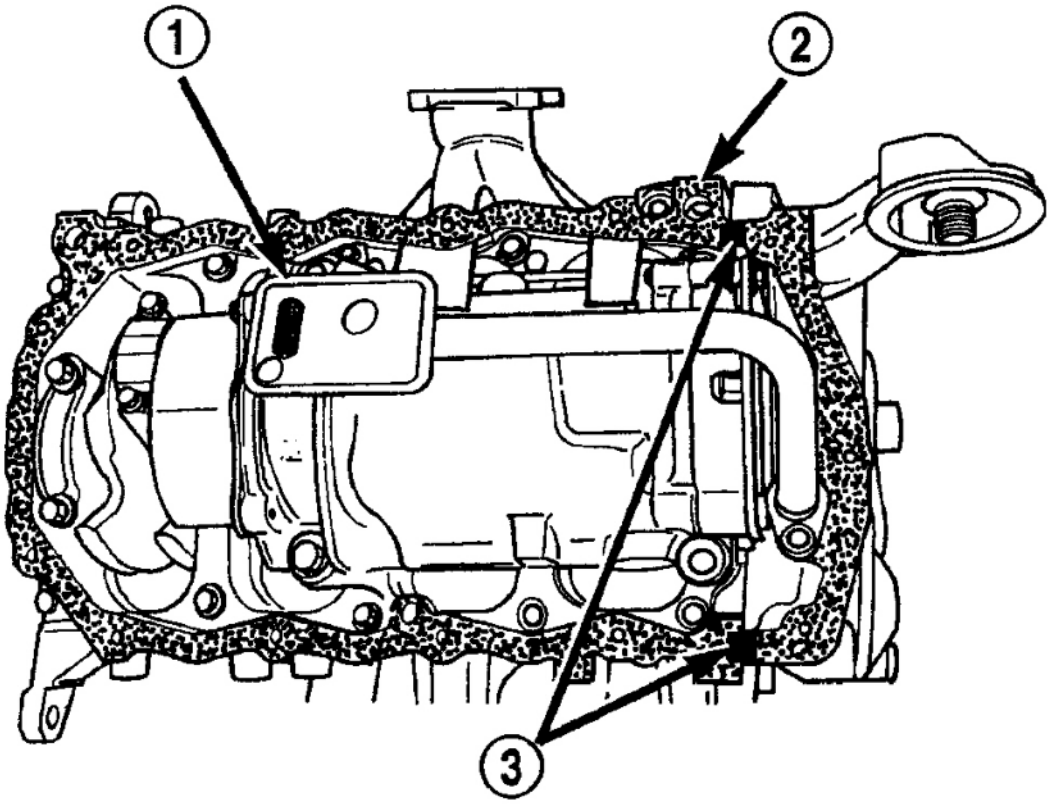


Fig. 111: Locating Oil Pan Sealing
Courtesy of DAIMLERCHRYSLER CORP.



1 - OIL PICK-UP TUBE
2 - OIL PAN GASKET
3 - SEALER

G03633221

Fig. 112: Installing Oil Pan Gasket
Courtesy of DAIMLERCHRYSLER CORP.

OIL PRESSURE SENSOR/SWITCH

REMOVAL

1. Raise vehicle.
2. Position oil collecting container under pressure switch location.
3. Disconnect oil pressure switch electrical connector and remove switch (**Fig. 113**).

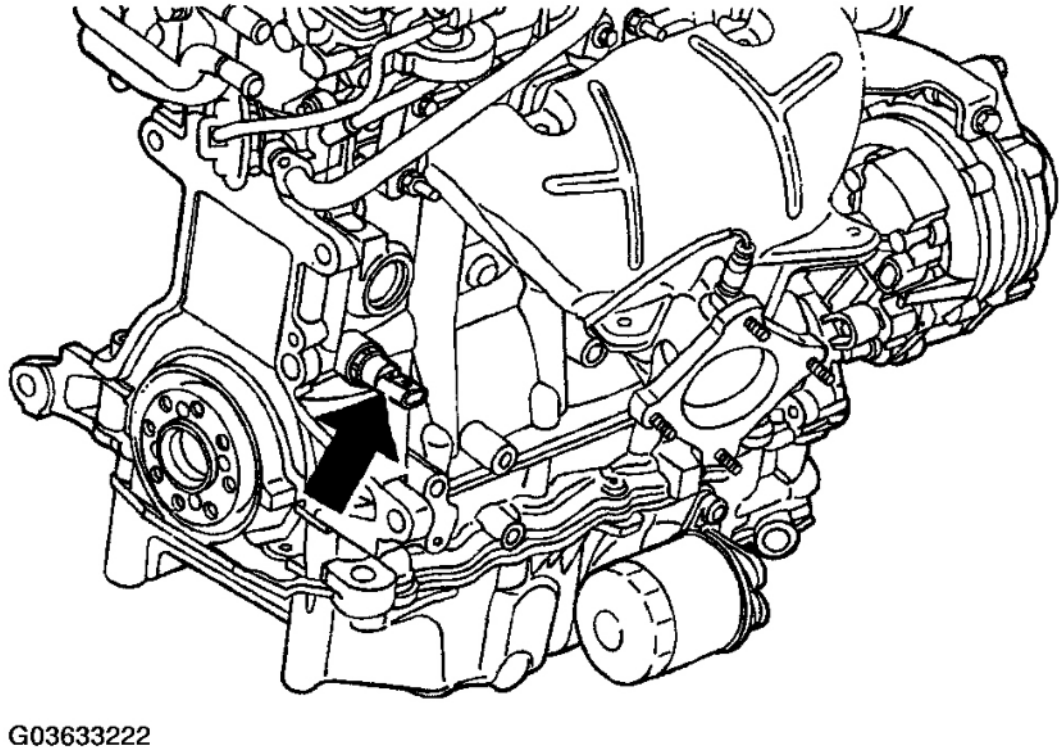


Fig. 113: Locating Engine Oil Pressure Switch
Courtesy of DAIMLERCHRYSLER CORP.

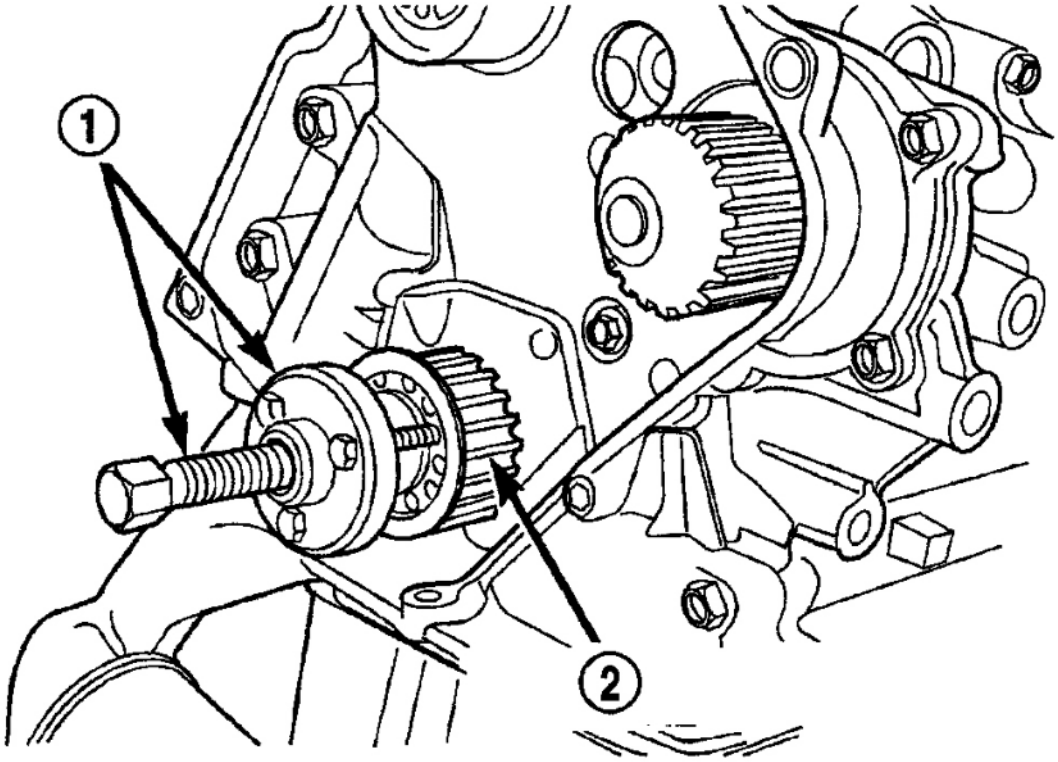
INSTALLATION

1. Install oil pressure switch and connect electrical connector (**Fig. 113**).
2. Lower vehicle.
3. Start engine and allow to run a minimum of 2 minutes.
4. Shut engine off and check engine oil level. Adjust level as necessary.

OIL PUMP

REMOVAL

1. Disconnect negative battery cable.
2. Remove crankshaft damper (Refer to **VIBRATION DAMPER**).
3. Remove Timing Belt (Refer to **TIMING BELT AND SPROCKET(S)**).
4. Remove Oil Pan (Refer to **REMOVAL**).
5. Remove Crankshaft Sprocket using Special Tool 6793 and insert C-4685-C2 (**Fig. 114**).



1 - SPECIAL TOOL 6793
2 - CRANKSHAFT SPROCKET
G03633223

Fig. 114: Removing Crankshaft Sprocket-
Courtesy of DAIMLERCHRYSLER CORP.

6. Remove oil pick-up tube.
7. Remove oil pump, (**Fig. 115**) and front crankshaft seal.

DISASSEMBLY

1. To remove the relief valve, proceed as follows:
   a. Remove the threaded plug and gasket from the oil pump (**Fig. 115**).
   b. Remove spring and relief valve (**Fig. 115**).
2. Remove oil pump cover screws, and lift off cover.
3. Remove pump rotors.
4. Wash all parts in a suitable solvent and inspect carefully for damage or wear.

CLEANING

1. Clean all parts thoroughly in a suitable solvent.

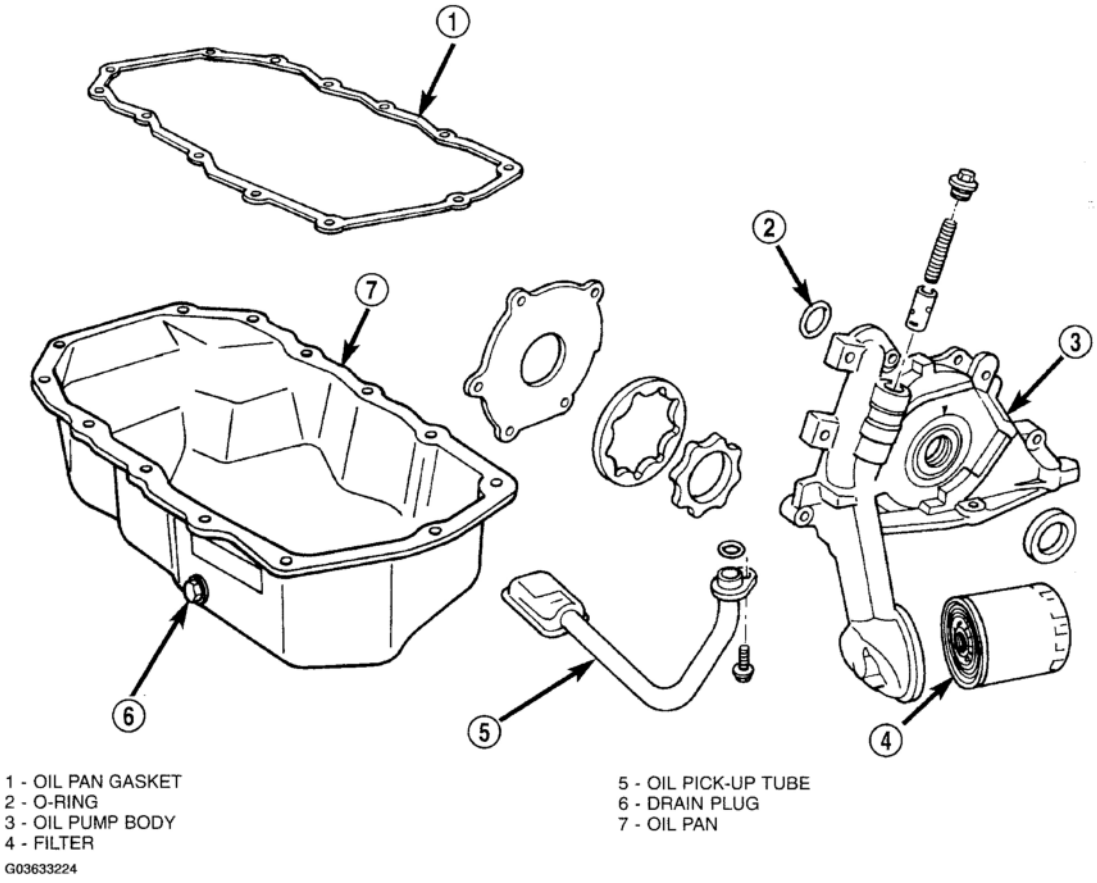
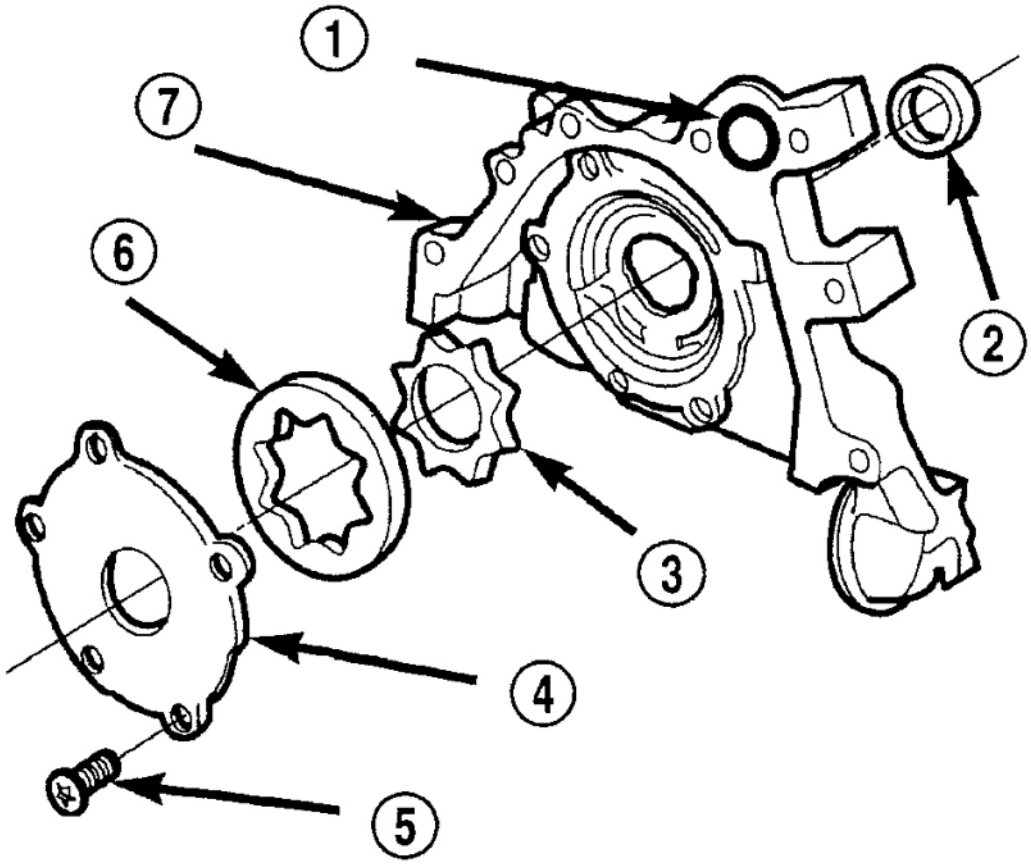


Fig. 115: Identifying Oil Pump And Pick-Up Tube
Courtesy of DAIMLERCHRYSLER CORP.

INSPECTION

1. Clean all parts thoroughly. Mating surface of the oil pump should be smooth (**Fig. 116**). Replace pump cover if scratched or grooved.



1 - O-RING
2 - SEAL
3 - INNER ROTOR
4 - OIL PUMP COVER
5 - FASTENER
6 - OUTER ROTOR
7 - OIL PUMP BODY

G03633225

Fig. 116: Identifying Oil Pump Components
Courtesy of DAIMLERCHRYSLER CORP.

2. Lay a straightedge across the pump cover surface (**Fig. 117**). If a 0.025 mm (0.001 in.) feeler gauge can be inserted between cover and straight edge, cover should be replaced.
3. Measure thickness and diameter of outer rotor. If outer rotor thickness measures 9.40 mm (0.370 in.) or less (**Fig. 118**), or if the diameter is 79.95 mm (3.148 in.) or less, replace outer rotor.
4. If inner rotor measures 9.40 mm (0.370 in.) or less replace inner rotor (**Fig. 119**).

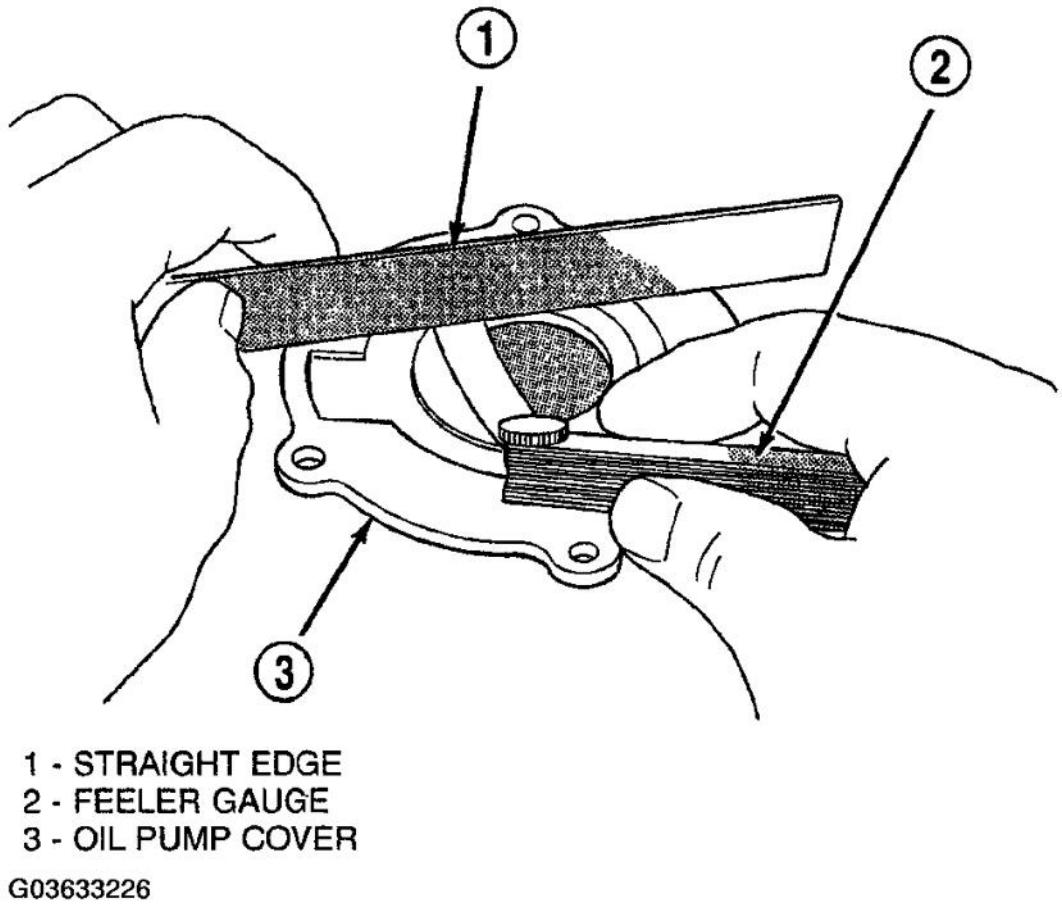


Fig. 117: Checking Oil Pump Cover Flatness
Courtesy of DAIMLERCHRYSLER CORP.

5. Slide outer rotor into pump housing, press to one side with fingers and measure clearance between rotor and housing (**Fig. 120**). If measurement is 0.39 mm (0.015 in.) or more, replace housing only if outer rotor is in specification.
6. Install inner rotor into pump housing. If clearance between inner and outer rotors (**Fig. 121**) is 0.203 mm (0.008 in.) or more, replace both rotors.

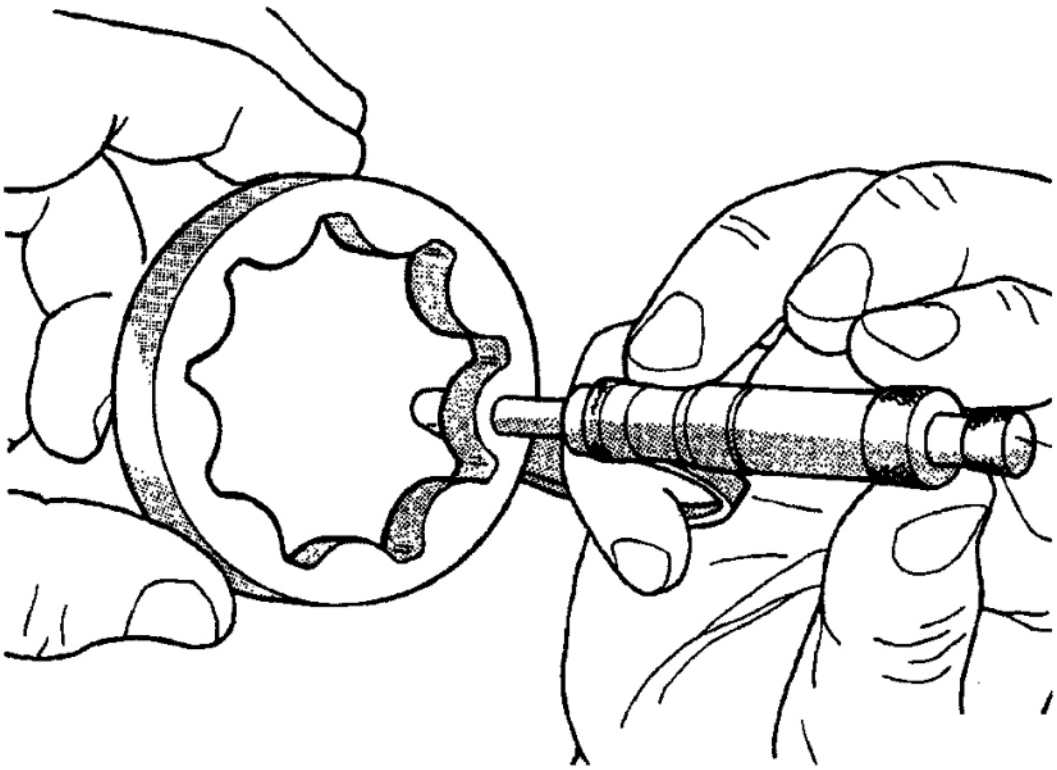


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Fig. 118: Measuring Outer Rotor Thickness
Courtesy of DAIMLERCHRYSLER CORP.

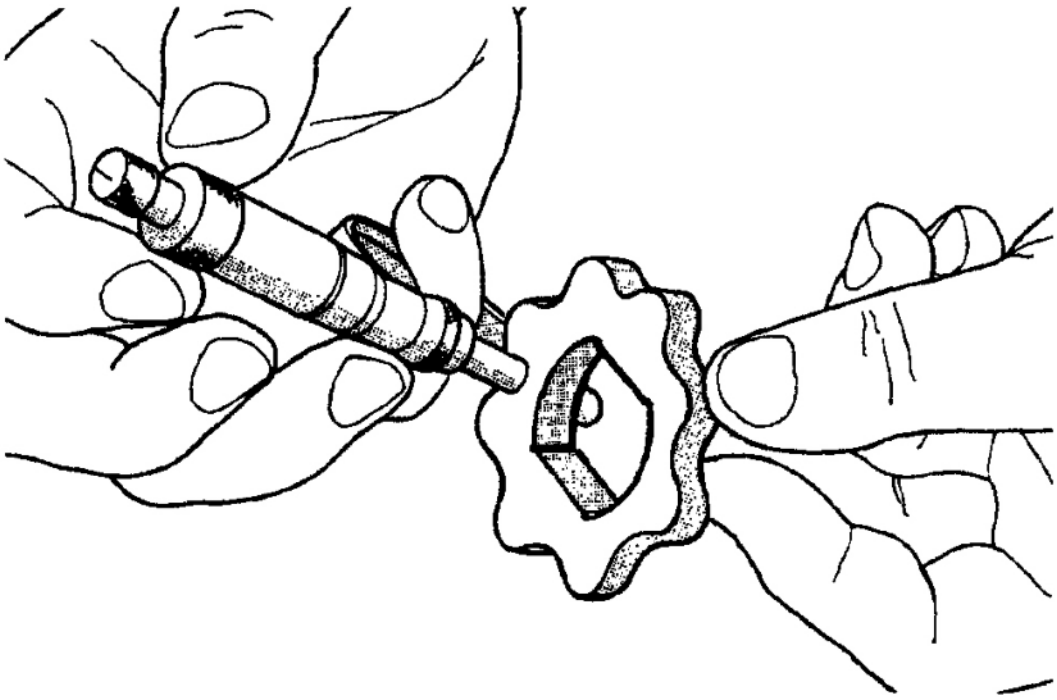


Fig. 119: Measuring Outer Rotor
Courtesy of DAIMLERCHRYSLER CORP.

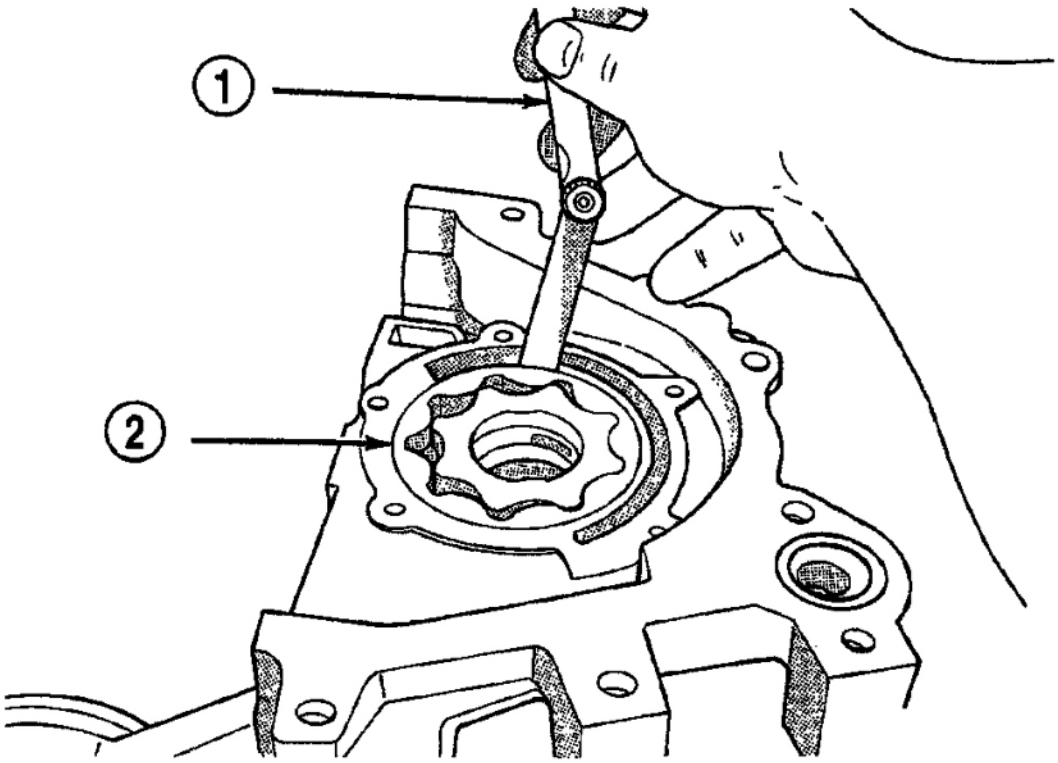


Fig. 120: Measuring Outer Rotor Clearance In Housing
Courtesy of DAIMLERCHRYSLER CORP.

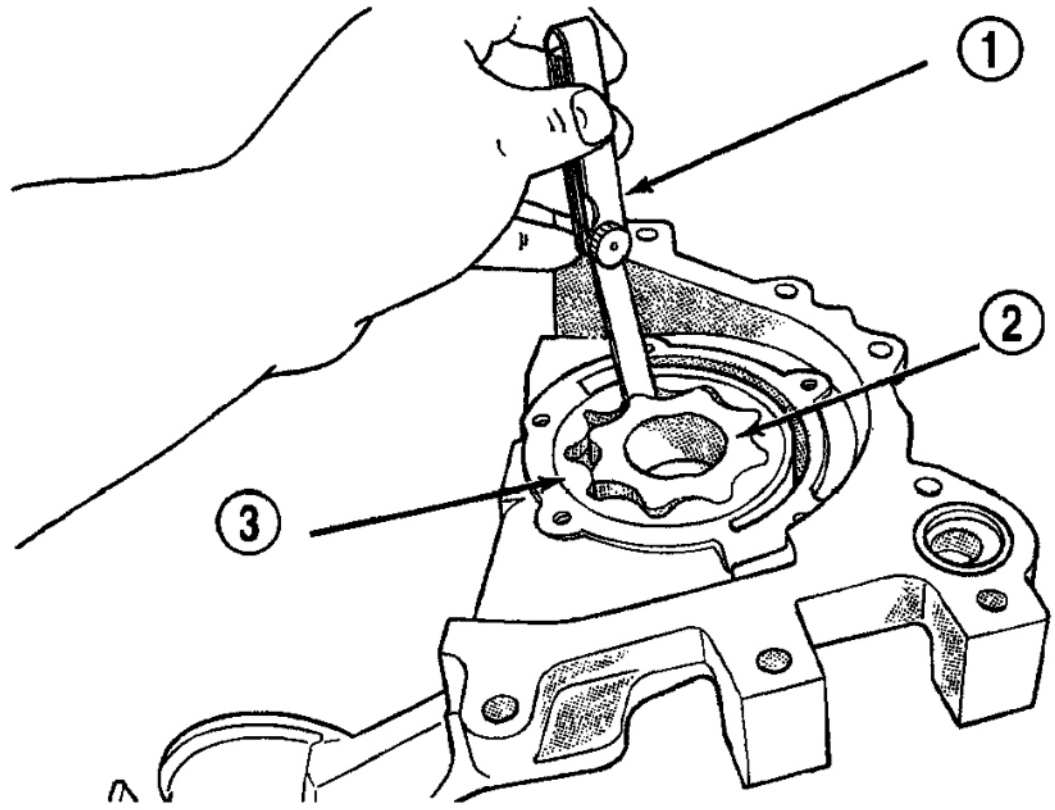
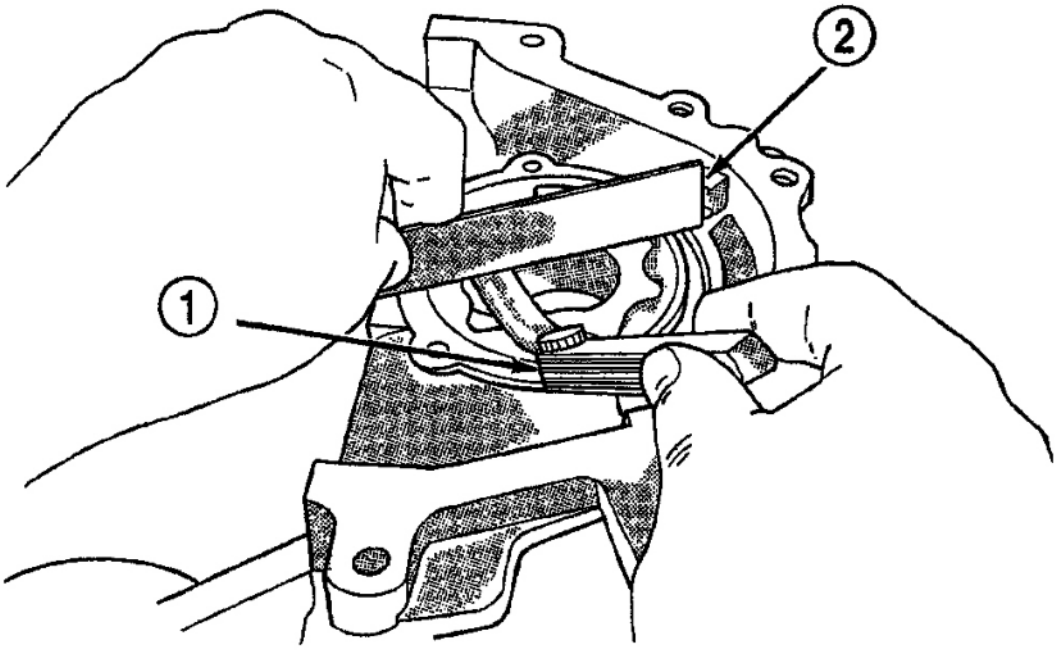


Fig. 121: Measuring Clearance Between Rotors
Courtesy of DAIMLERCHRYSLER CORP.

7. Place a straightedge across the face of the pump housing, between bolt holes. If a feeler gauge of 0.102 mm (0.004 in.), or more can be inserted between rotors and the straightedge, replace pump assembly (**Fig. 122**), **ONLY** if rotors are in specifications.
8. 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.
9. The relief valve spring has a free length of approximately 60.7 mm (2.39 inches) it should test between 18 and 19 pounds when compressed to 40.5 mm (1.60 inches). Replace spring that fails to meet specifications.
10. If oil pressure is low and pump is within specifications, inspect for worn engine bearings or other reasons for oil pressure loss.



1 - FEELER GAUGE
2 - STRAIGHT EDGE
G03633231

Fig. 122: Measuring Clearance Over Rotors
Courtesy of DAIMLERCHRYSLER CORP.

ASSEMBLY

1. Assemble pump, using new parts as required. **Install the inner rotor with chamfer facing the cast iron oil pump cover** .
2. Prime oil pump before installation by filling rotor cavity with engine oil.
3. Install cover and tighten screws to 12 N.m (105 in. lbs.).

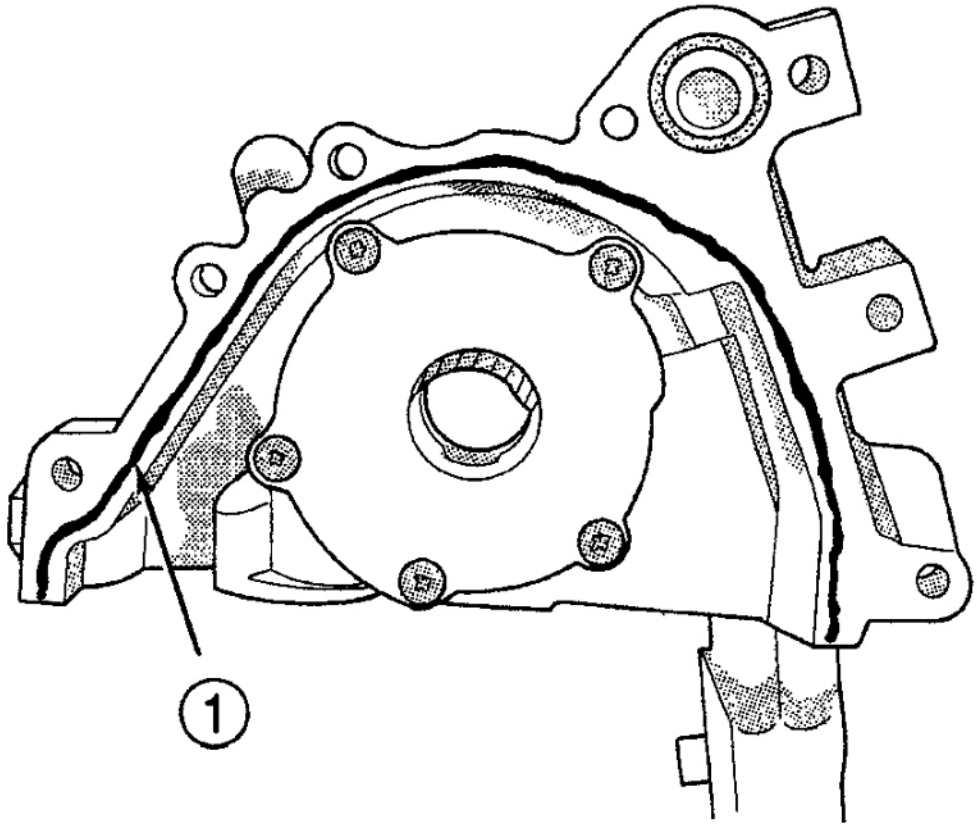
CAUTION: Oil pump pressure relief valve must be installed as shown in (Fig. 115) or serious damage may occur.

4. Install relief valve, spring, gasket and cap as shown in (**Fig. 115**). Tighten cap to 41 N.m (30 ft. lbs.).

INSTALLATION

1. Make sure all surfaces are clean and free of oil and dirt.
2. Apply Mopar® Gasket Maker to oil pump as shown in (**Fig. 123**). Install oil ring into oil pump body discharge passage.

3. Prime oil pump before installation.



1 - APPLY GASKET MAKER TO OIL PUMP BODY FLANGE

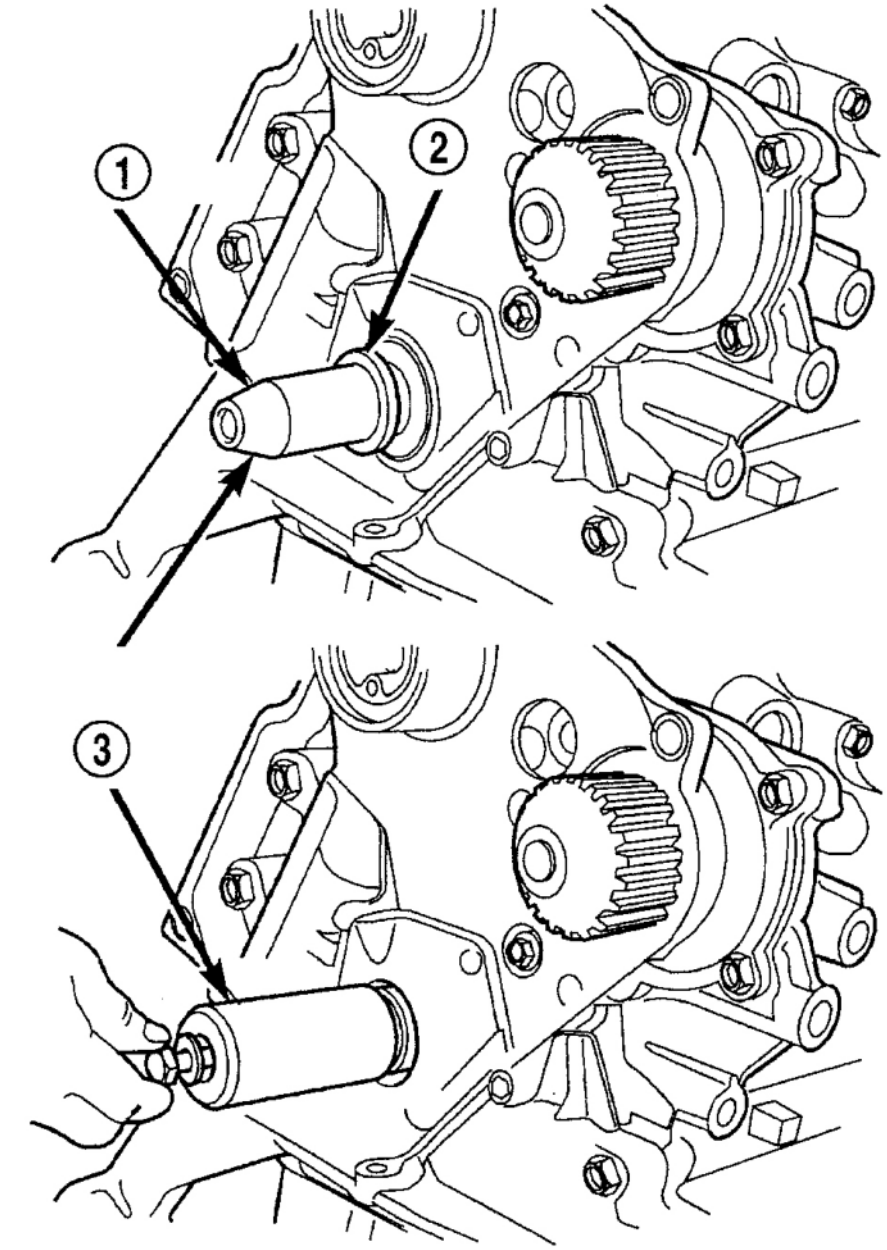
G03633232

Fig. 123: Identifying Oil Pump Sealing
Courtesy of DAIMLERCHRYSLER CORP.

4. Align oil pump rotor flats with flats on crankshaft as you install the oil pump to the block.

NOTE: Front crankshaft seal MUST be out of pump to align, or damage may result.

5. Install new front crankshaft seal using Special Tool 6780 (**Fig. 124**).



1 - PROTECTOR
2 - SEAL
3 - SPECIAL TOOL 6780

G03633233

Fig. 124: Installing Front Crankshaft Seal
Courtesy of DAIMLERCHRYSLER CORP.

6. Install crankshaft sprocket using Special Tool 6792 (**Fig. 125**).

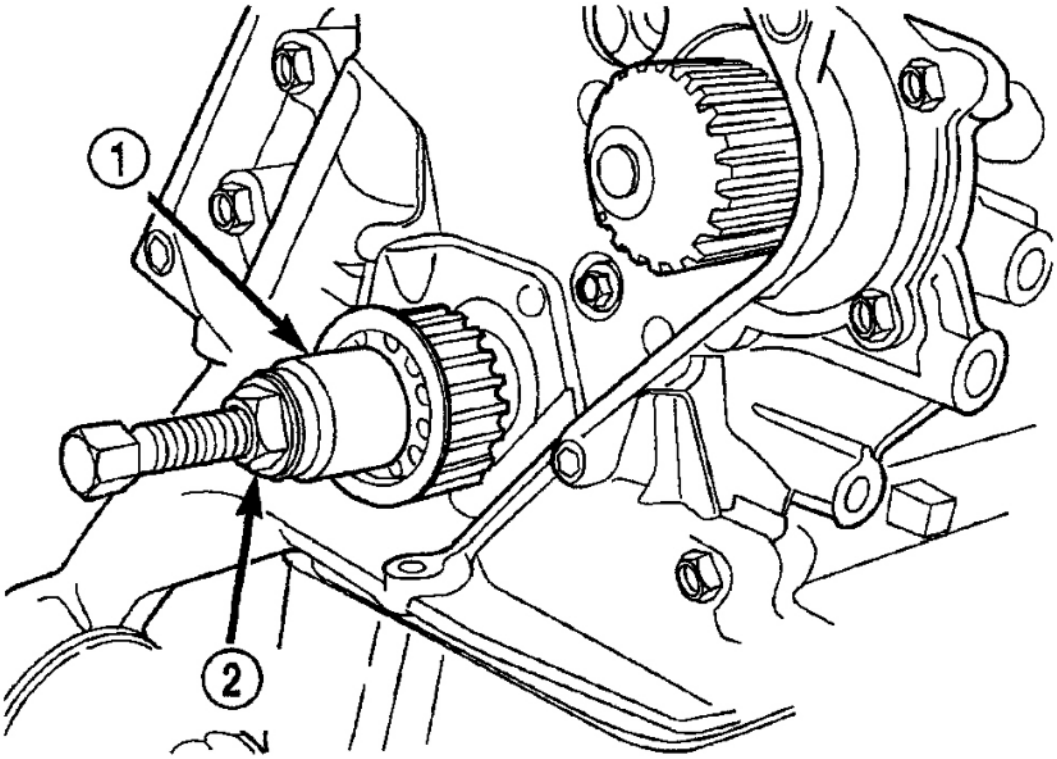


Fig. 125: Installing Crankshaft Sprocket
Courtesy of DAIMLERCHRYSLER CORP.

7. Install oil pump pick-up tube.
8. Install oil pan (Refer to **INSTALLATION**).
9. Install Timing Belt (Refer to **TIMING BELT AND SPROCKET(S)**).
10. Install crankshaft damper (Refer to **VIBRATION DAMPER**).
11. Replace oil filter.
12. Lower vehicle.
13. Fill engine crankcase with proper oil to correct level.
14. Connect negative battery cable.

INTAKE MANIFOLD

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.

REMOVAL

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

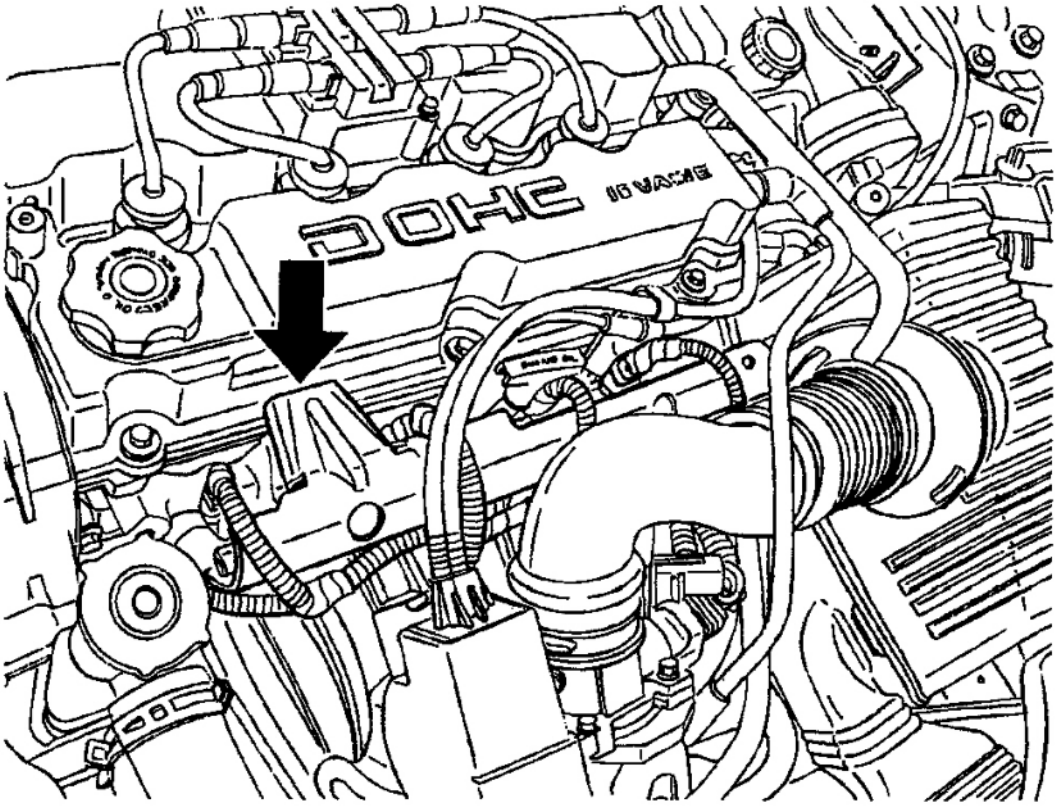
1. Perform fuel system pressure release procedure **before attempting any repairs.** (Refer to **FUEL SYSTEM PRESSURE RELEASE** (2003) or **STANDARD PROCEDURE - FUEL SYSTEM PRESSURE RELEASE PROCEDURE** (2004)).
2. Disconnect negative battery cable.
3. Drain cooling system (Refer to COOLING article).
4. Remove throttle body air inlet hose and air cleaner housing assembly.
5. Remove throttle and speed control cables from throttle lever and bracket.
6. Remove EGR tube.
7. Remove engine oil dipstick and tube from engine block. Plug hole in block to prevent debris or fluid from entering engine crankcase.
8. Disconnect necessary vacuum hoses from intake manifold.
9. Disconnect the fuel supply line quick connect at the fuel rail assembly.

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

10. Remove fastener holding fuel rail bracket to side of cylinder head.
11. Disconnect the following electrical connectors:
    - Fuel Injectors
    - Knock Sensor
    - ECT Sensor
    - IAC

- TPS
- MAP Sensor
- A/C Pressure Sensor
- A/C Compressor Clutch
- Generator

12. Reposition wiring harness.
13. Remove fuel rail support bracket (**Fig. 126**).
14. Remove fuel rail.
15. Remove coolant outlet connector (Refer to COOLING article).
16. Remove intake manifold fasteners. Remove intake manifold.



G03633235

Fig. 126: Identifying Fuel Rail Support Bracket
Courtesy of DAIMLERCHRYSLER CORP.

CLEANING

1. Discard gasket(s).

2. Clean all sealing surfaces.

INSPECTION

1. Inspect manifold for cracks or distortion. Replace manifold if necessary.
2. Inspect manifold for gasket surface damage or warpage. Replace manifold if necessary.

INSTALLATION

1. Install new intake manifold and gasket. Gradually tighten fasteners to 28 N.m (250 in. lbs.) in sequence shown in (**Fig. 127**).
2. Install coolant outlet connector (Refer to COOLING article).
3. Install fuel rail.
4. Install fuel rail support bracket (**Fig. 126**).
5. Connect previously disconnected electrical connectors.
6. Install fastener holding fuel rail bracket to side of cylinder head.
7. Inspect quick connect fittings for damage, replace if necessary. Connect fuel supply hose to fuel rail assembly. Check connection by pulling on connector to insure it locked into position.
8. Connect vacuum hoses to intake manifold.
9. Install engine oil dipstick and tube.
10. Install EGR tube .
11. Install throttle and speed control cables to bracket. Connect cables to the throttle lever.
12. Fill cooling system (Refer to COOLING article).
13. Connect negative battery cable.
14. With the DRB scan tool use ASD Fuel System Test to pressurize system to check for leaks.

CAUTION: When using the ASD Fuel System Test, the Auto Shutdown (ASD) relay will remain energized for 7 minutes or until the ignition switch is turned to the OFF position, or Stop All Test is selected.

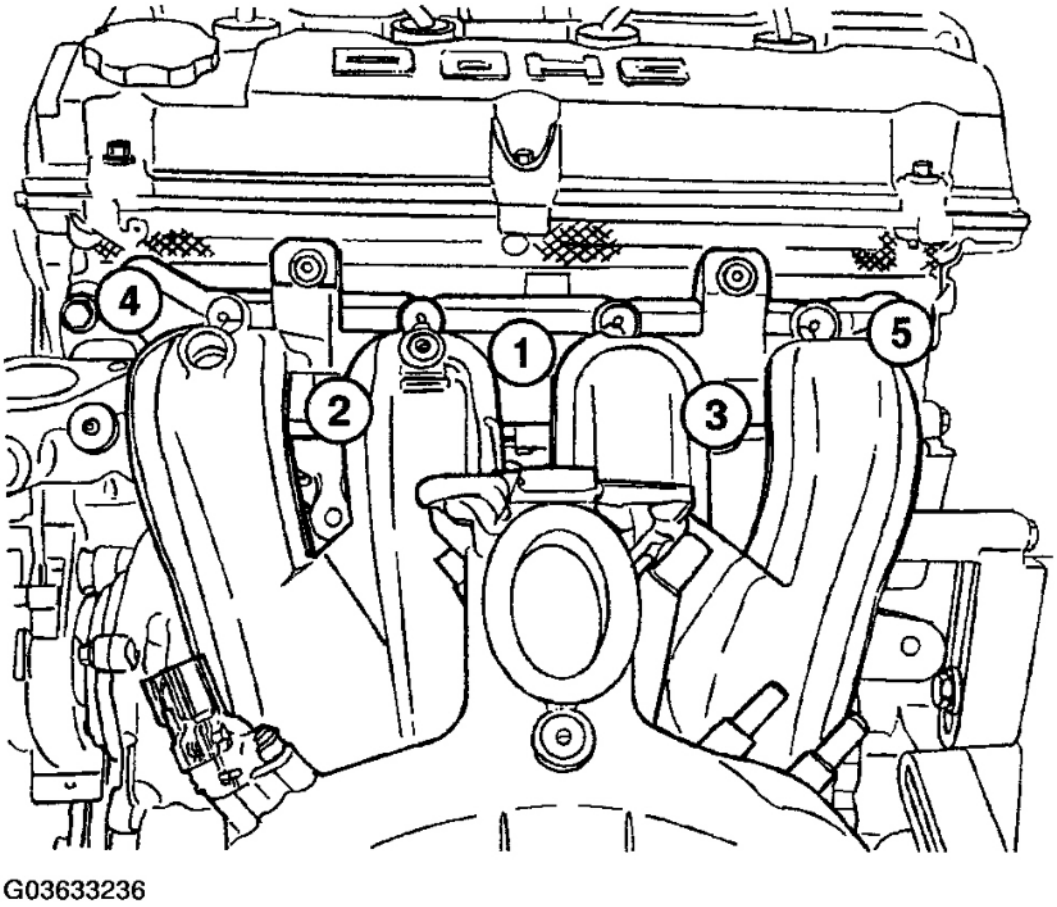
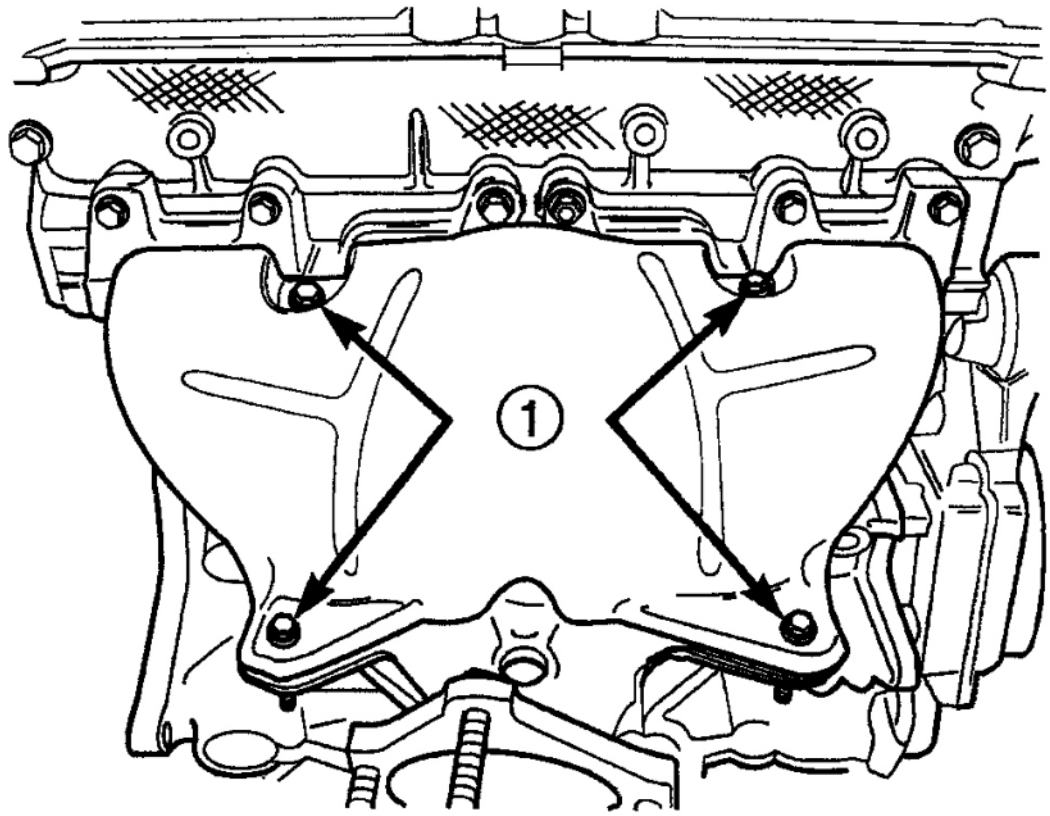


Fig. 127: Identifying Intake Manifold Tightening Sequence
Courtesy of DAIMLERCHRYSLER CORP.

EXHAUST MANIFOLD

REMOVAL

1. Disconnect negative battery cable.
2. Raise vehicle on hoist.
3. Remove complete exhaust system .
4. Remove rear engine mount and transaxle bracket.
5. Remove exhaust manifold heat shield (**Fig. 128**).
6. Disconnect oxygen sensor electrical connector.
7. Remove exhaust manifold retaining fasteners and remove exhaust manifold.
8. Remove and discard manifold gasket.



1 - BOLTS
G03633237

Fig. 128: Locating Exhaust Manifold Heat Shield Bolts
Courtesy of DAIMLERCHRYSLER CORP.

CLEANING

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

INSPECTION

1. Inspect manifold gasket surfaces for flatness with straight edge. Surface must be flat within 0.15 mm per 300 mm (0.006 in. per foot) of manifold length.
2. Inspect manifolds for cracks or distortion. Replace manifold as necessary.

INSTALLATION

1. Install new exhaust manifold gasket. **DO NOT APPLY SEALER** .
2. Position exhaust manifold in place. Tighten fasteners in sequence shown in (**Fig. 129**) to 23 N.m (200 in.

lbs.). Repeat this procedure until all fasteners are at specified torque.

3. Install exhaust manifold heat shield.
4. Connect oxygen sensor electrical connector.

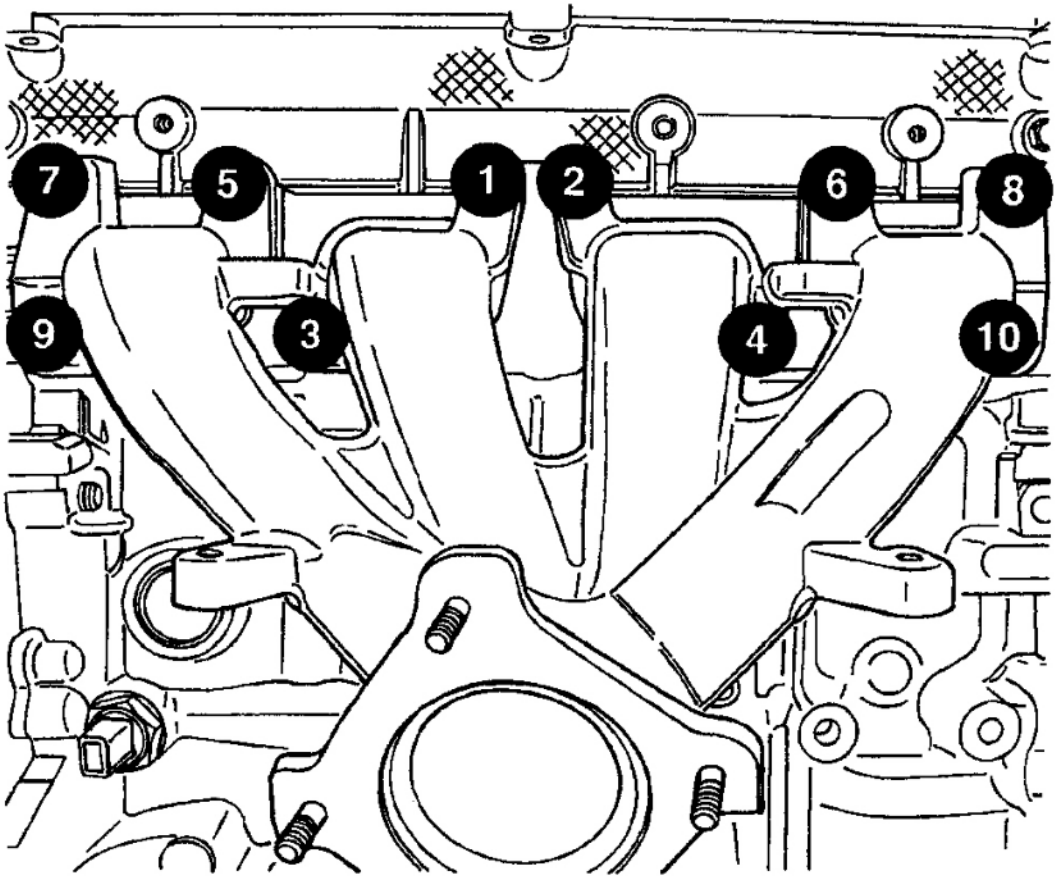


Fig. 129: Identifying Exhaust Manifold Tightening Sequence
Courtesy of DAIMLERCHRYSLER CORP.

5. Install rear engine mount and transaxle bracket.
6. Install exhaust system . Tighten fasteners to 28 N.m (250 in. lbs.).
7. Lower vehicle.
8. Connect negative battery cable.

TIMING BELT COVER(S)

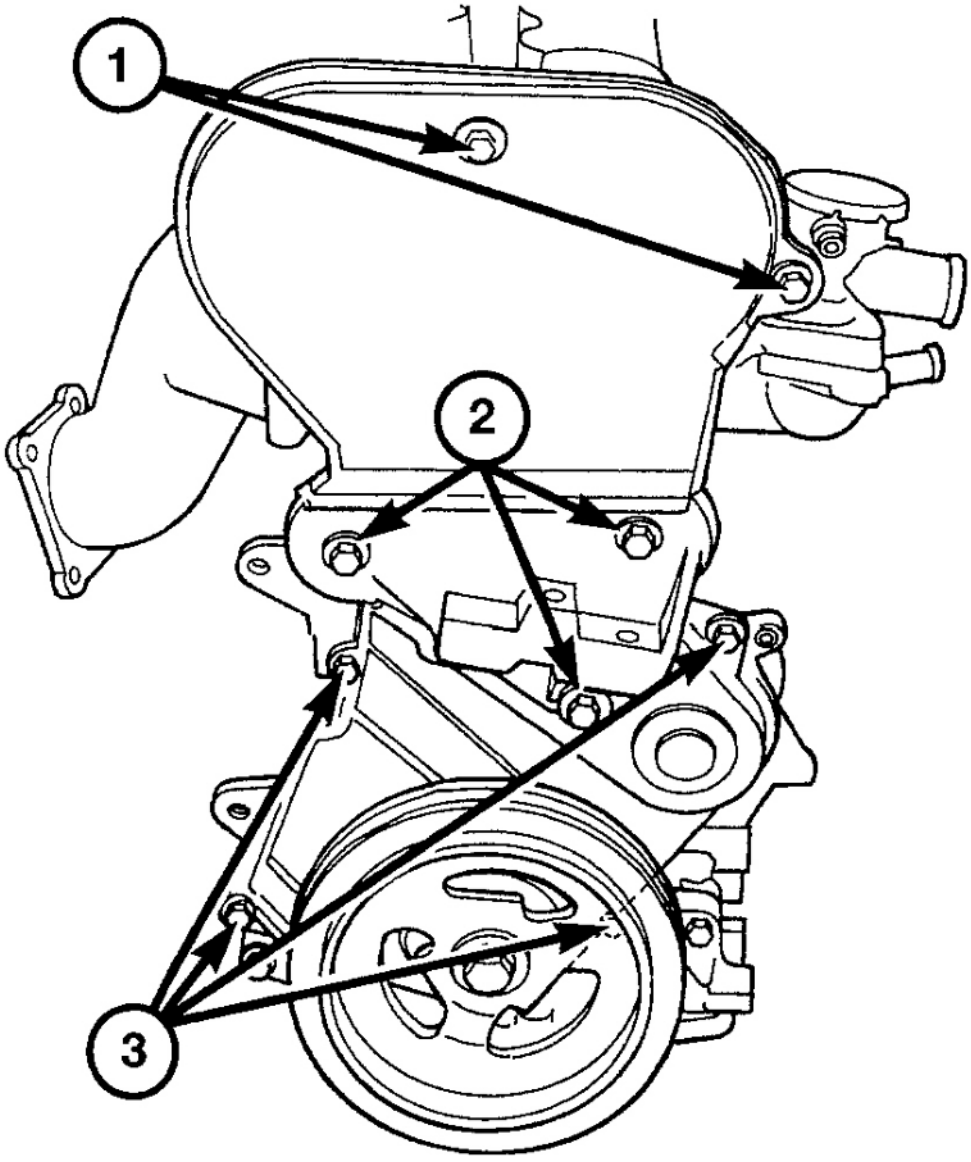
REMOVAL

FRONT COVER - UPPER

1. Remove upper timing belt cover fasteners (**Fig. 130**) and remove cover.

FRONT COVER - LOWER

1. Disconnect negative battery cable.
2. Raise vehicle on hoist.
3. Remove right front wheel and belt splash shield.
4. Remove accessory drive belts (Refer to SPECIFICATIONS & DRIVE BELT ROUTING article.
5. Remove crankshaft damper (Refer to **VIBRATION DAMPER**).
6. Remove AC/Generator belt tensioner.
7. Lower vehicle.
8. Disconnect generator connectors.
9. Remove generator and bracket.
10. Raise vehicle on hoist.
11. Remove fasteners attaching lower timing cover (**Fig. 130**).
12. Remove lower timing cover.



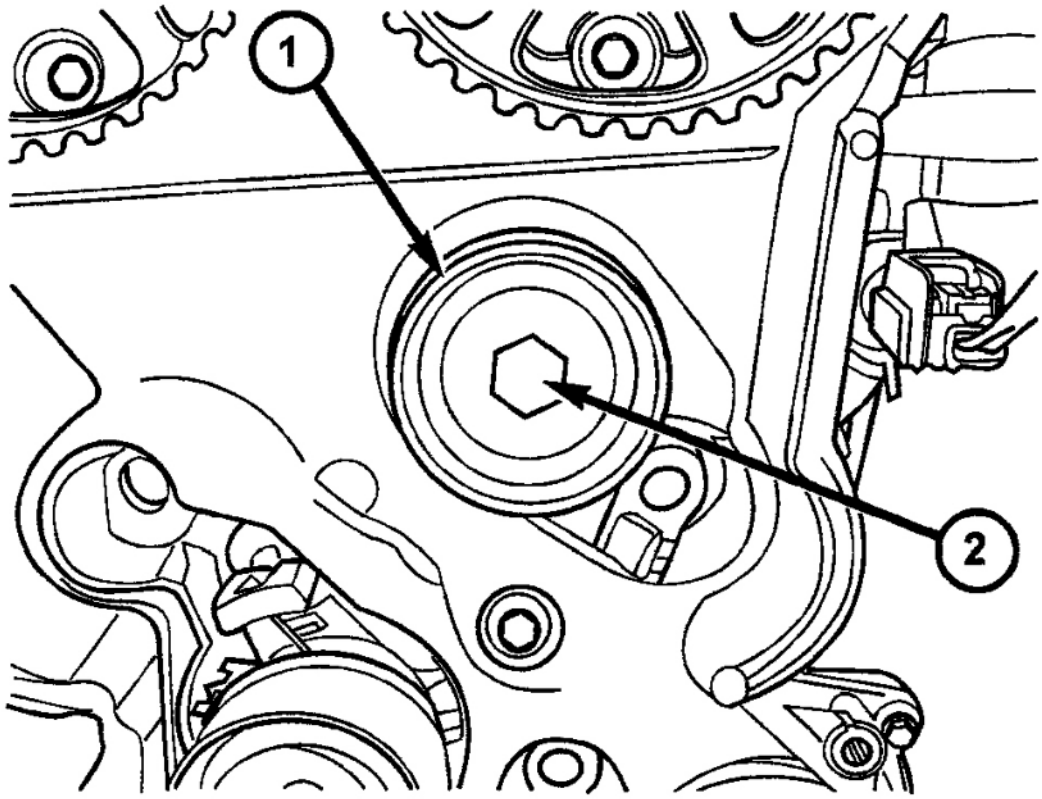
1 - UPPER TIMING BELT COVER FASTENERS
2 - ENGINE SUPPORT BRACKET FASTENERS
3 - LOWER TIMING BELT COVER FASTENERS

G03633239

Fig. 130: Removing Front Timing Belt Covers
Courtesy of DAIMLERCHRYSLER CORP.

REAR COVER

1. Remove upper and lower front timing belt covers.
2. Remove Timing Belt (Refer to **TIMING BELT AND SPROCKET(S)**).
3. Remove timing belt idler pulley (**Fig. 131**).



1 - IDLER PULLEY
2 - BOLT
G03633240

Fig. 131: Identifying Timing Belt Idler Pulley
Courtesy of DAIMLERCHRYSLER CORP.

4. Remove both camshaft sprockets. Hold camshaft sprockets with Special Tool 6847 while removing center bolts (**Fig. 132**).

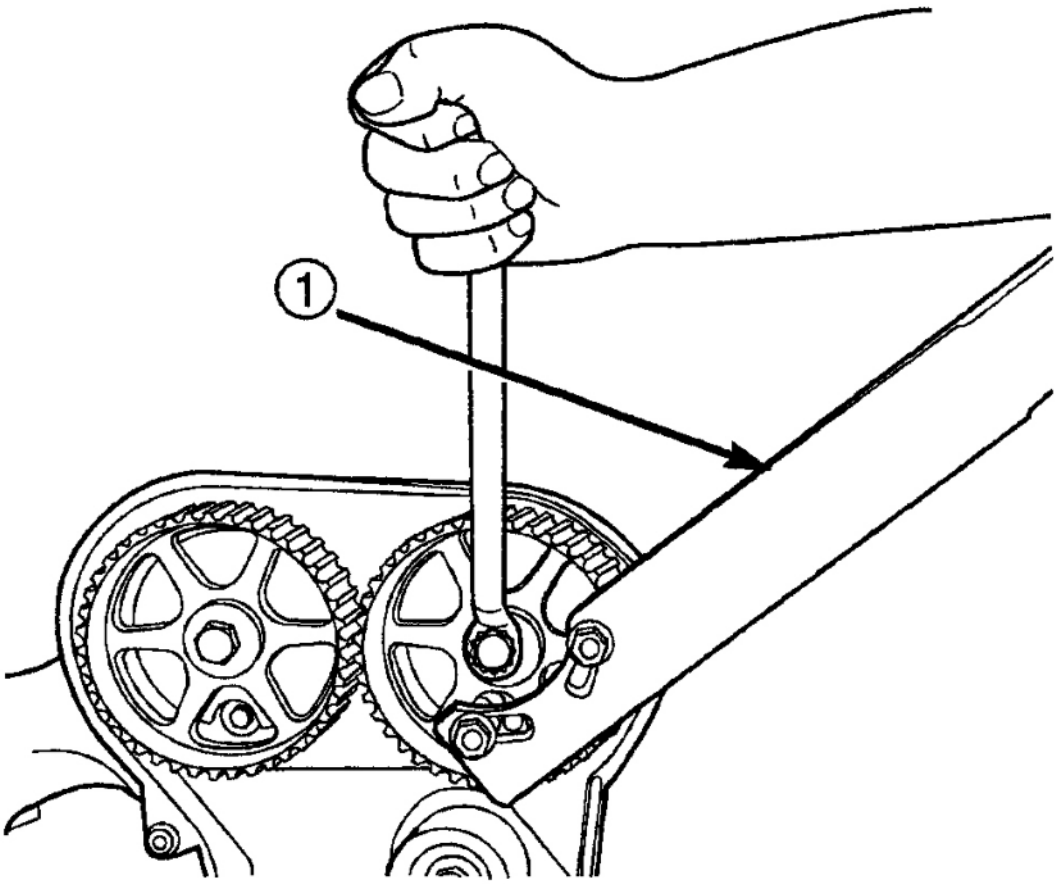
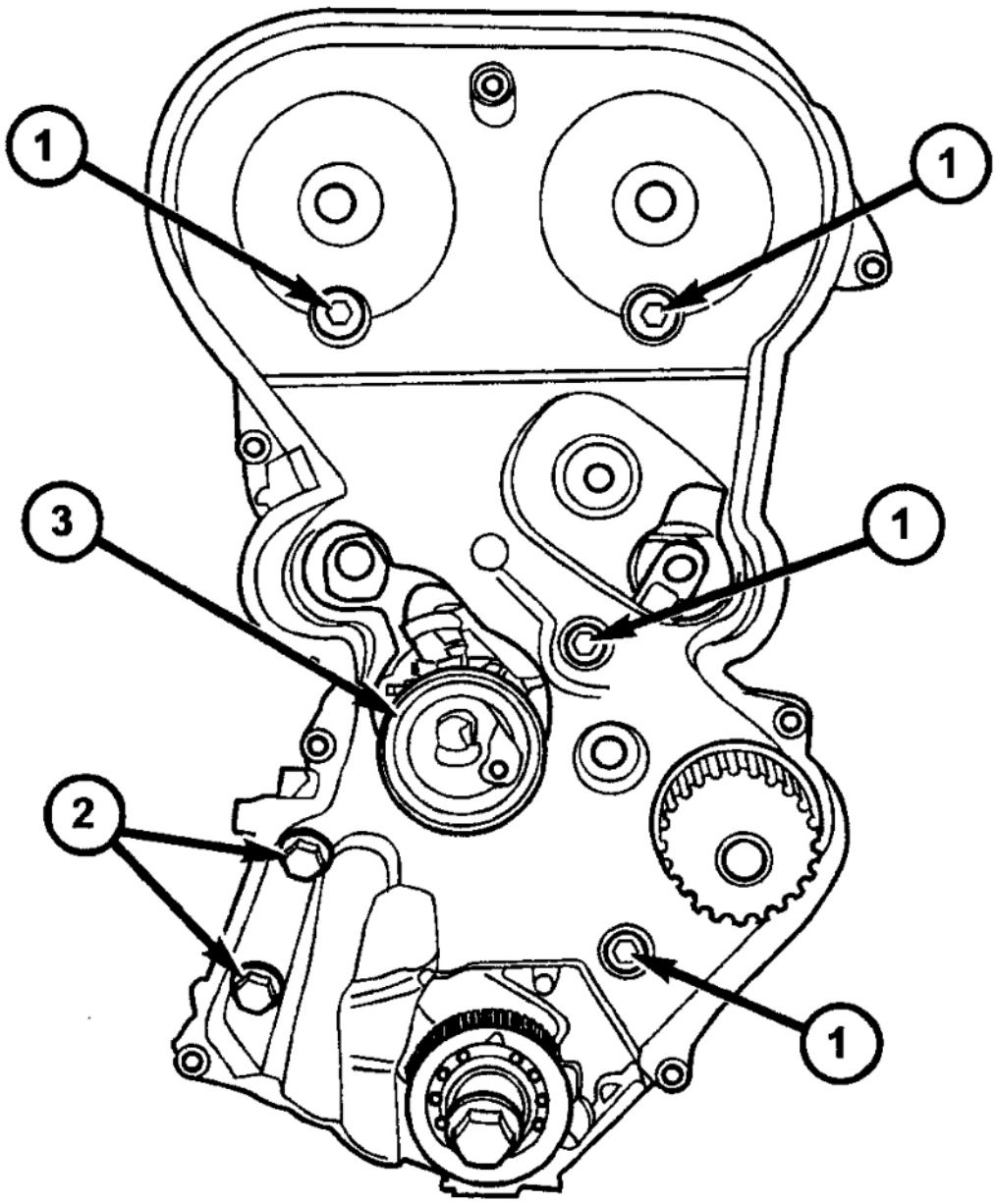


Fig. 132: Removing Camshaft Sprocket
Courtesy of DAIMLERCHRYSLER CORP.

5. Remove rear timing belt cover fasteners and remove cover from engine (**Fig. 133**).



1 - M6 BOLTS - 12 N·m (105 in. lbs.)
2 - M8 BOLTS - 28 N·m (250 in. lbs.)
3 - TIMING BELT TENSIONER

G03633242

Fig. 133: Identifying Rear Timing Belt Cover Fasteners
Courtesy of DAIMLERCHRYSLER CORP.

INSTALLATION

FRONT COVER - UPPER

1. Install timing belt cover. Torque fasteners to 6 N.m (50 in. lbs.) (**Fig. 130**).

FRONT COVER - LOWER

1. Install lower timing belt cover and torque fasteners to 6 N.m (50 in. lbs.) (**Fig. 130**).
2. Lower vehicle.
3. Install generator and bracket.
4. Connect generator connectors.
5. Raise vehicle.
6. Install AC/Generator belt tensioner.
7. Install crankshaft damper (Refer to **VIBRATION DAMPER**).
8. Install accessory drive belts (Refer to SPECIFICATIONS & DRIVE BELT ROUTING article.
9. Install belt splash shield and right front wheel.
10. Lower vehicle.
11. Connect negative battery cable.

REAR COVER

1. Install rear timing belt cover and fasteners. Torque fasteners to specified values (**Fig. 133**).
2. Install camshaft sprockets. Hold camshaft sprockets with Special Tool 6847 while tightening center bolts to 115 N.m (85 ft. lbs) (**Fig. 132**).
3. Install timing belt idler pulley (**Fig. 131**).
4. Install timing belt (Refer to **TIMING BELT AND SPROCKET(S)**).
5. Install upper and lower front timing belt covers.

TIMING BELT AND SPROCKET(S)

REMOVAL

REMOVAL - TIMING BELT

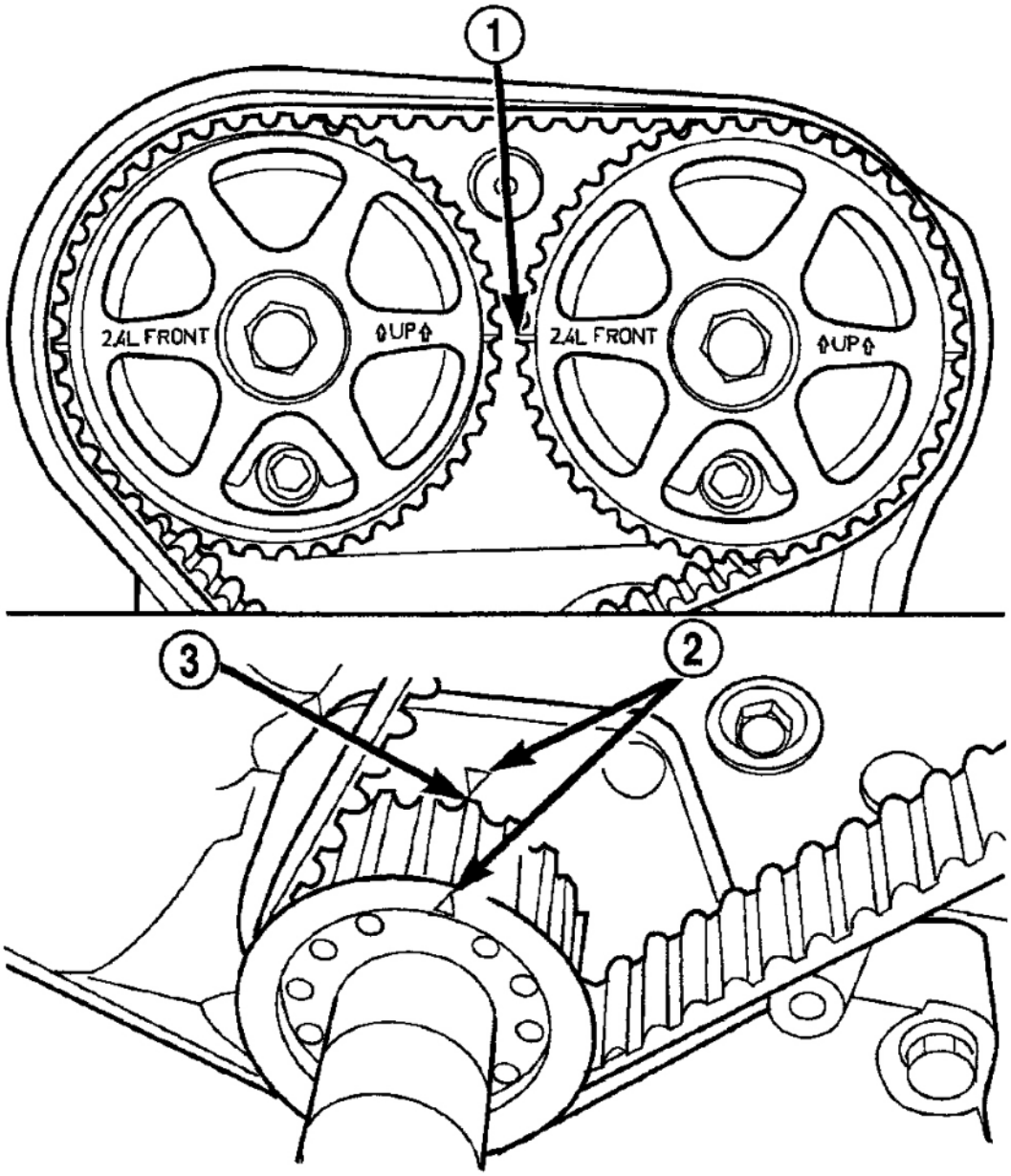
1. Disconnect negative battery cable.
2. Raise vehicle on hoist. Remove right front wheel.
3. Remove belt splash shield.
4. Remove accessory drive belts (Refer to SPECIFICATIONS & DRIVE BELT ROUTING article.
5. Remove crankshaft damper (Refer to **VIBRATION DAMPER**).
6. Remove AC/Generator belt tensioner.
7. Disconnect generator connections. Remove generator and bracket.
8. Remove upper and lower timing belt covers (Refer to **TIMING BELT COVER(S)**) (**Fig. 130**).
9. Remove coolant recovery container (Refer to COOLING article).

10. Remove right engine mount (Refer to **REMOVAL**).
11. Remove engine support bracket (**Fig. 130**).

CAUTION: When aligning crankshaft and camshaft timing marks always rotate engine from crankshaft. Camshaft should not be rotated after timing belt is removed. Damage to valve components may occur. Always align timing marks before removing timing belt.

12. Before the removal of the timing belt, rotate crankshaft until the TDC mark on oil pump housing aligns with the TDC mark on crankshaft sprocket (trailing edge of sprocket tooth) (**Fig. 134**).

NOTE: The crankshaft sprocket TDC mark is located on the trailing edge of the sprocket tooth. Failure to align trailing edge of sprocket tooth to TDC mark on oil pump housing will cause the camshaft timing marks to be misaligned.



1 - CAMSHAFT TIMING MARKS
2 - CRANKSHAFT TDC MARKS
3 - TRAILING EDGE OF SPROCKET TOOTH

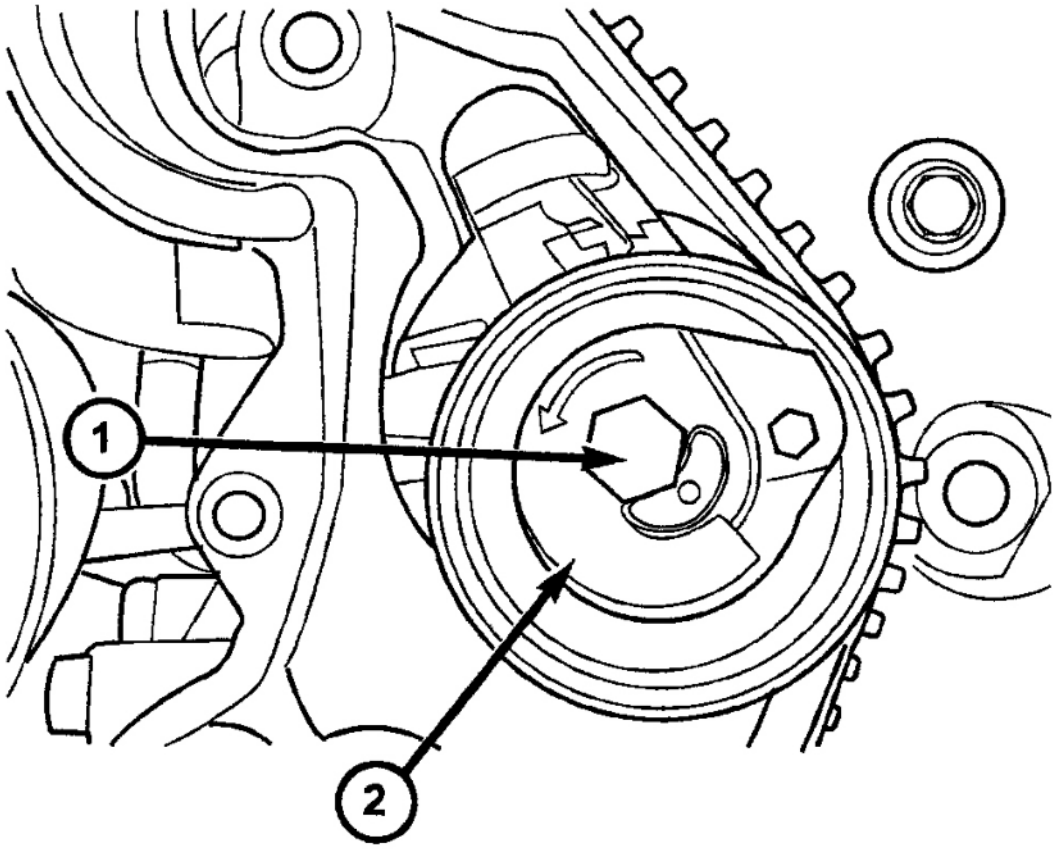
G03633243

Fig. 134: Identifying Crankshaft And Camshaft Timing
Courtesy of DAIMLERCHRYSLER CORP.

13. Loosen timing belt tensioner lock bolt (**Fig. 135**).

14. Insert a 6 mm Allen wrench into the hexagon opening located on the top plate of the belt tensioner pulley (**Fig. 135**). Rotate the top plate **CLOCKWISE** until there is enough slack in timing belt to allow for removal.
15. Remove timing belt.

CAUTION: If timing belt was damaged due to incorrect tracking (alignment), the belt tensioner pulley and bracket must be replaced as an assembly (Refer to REMOVAL).



1 - LOCK BOLT
2 - TOP PLATE
G03633244

Fig. 135: Identifying Timing Belt Tensioner
Courtesy of DAIMLERCHRYSLER CORP.

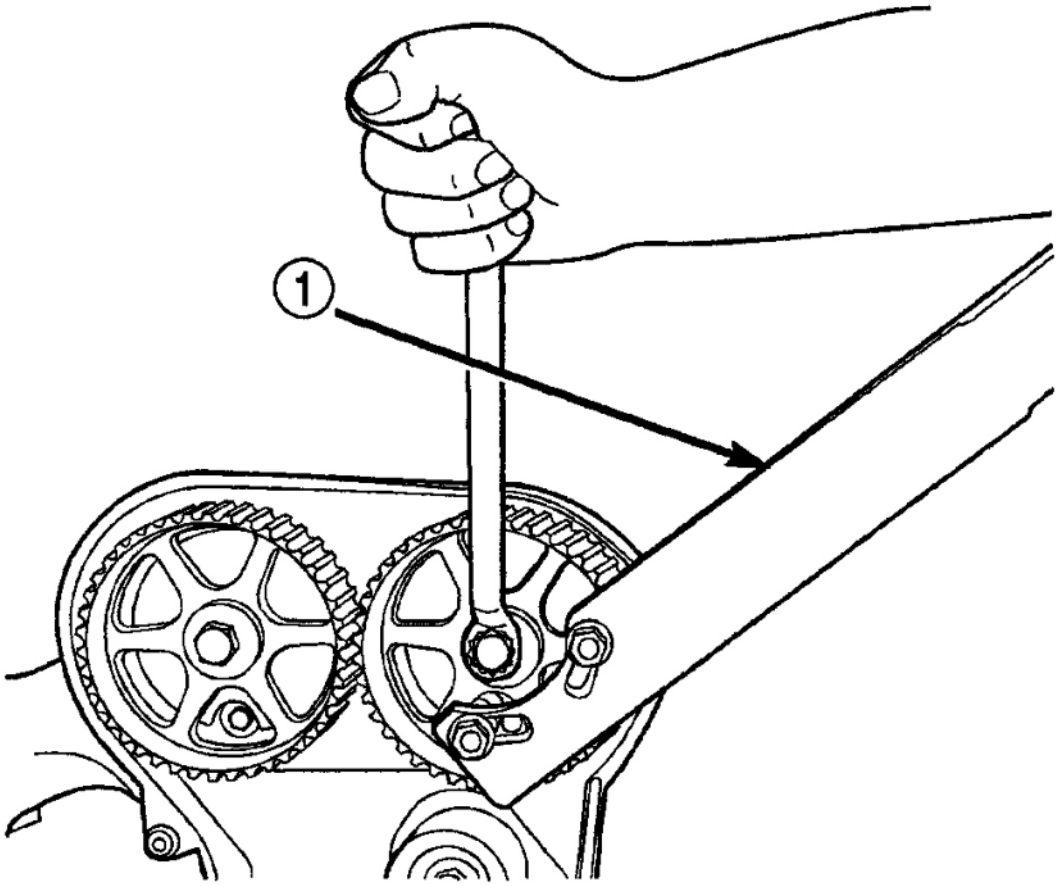
REMOVAL - CAMSHAFT SPROCKETS

1. Disconnect negative battery cable.

2. Remove timing belt (Refer to **TIMING BELT AND SPROCKET(S)**).
3. Hold camshaft sprockets with Special Tool 6847 while removing center bolts (**Fig. 136**).

REMOVAL - CRANKSHAFT SPROCKET

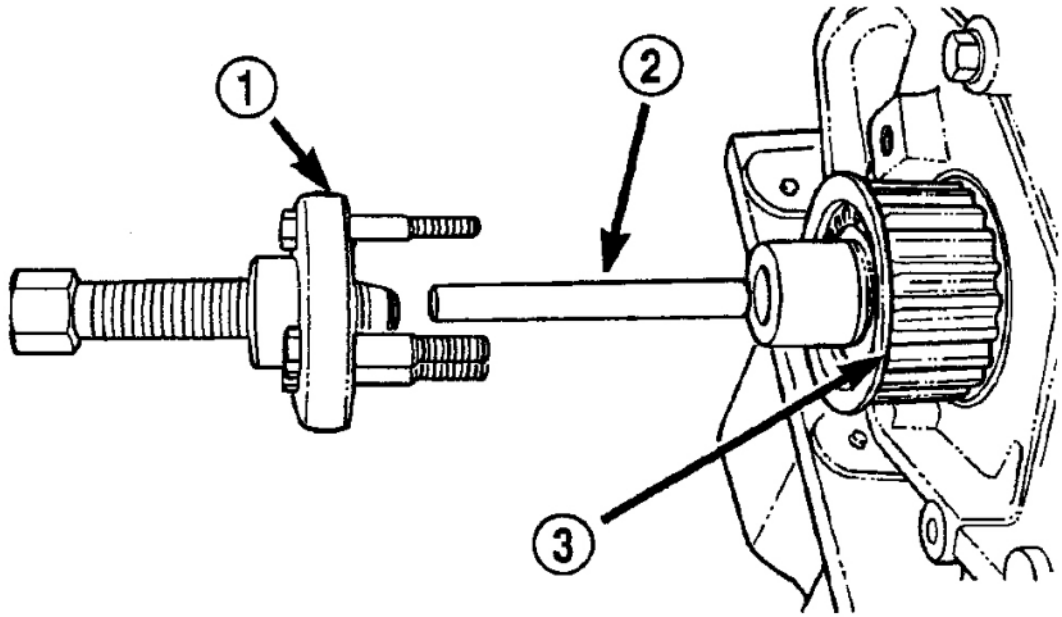
1. Disconnect negative battery cable.
2. Remove timing belt (Refer to **TIMING BELT AND SPROCKET(S)**).
3. Remove crankshaft sprocket using Special Tools 6793 and insert C-4685-C2 (**Fig. 137**).



1 - SPECIAL TOOL 6847

G03633245

Fig. 136: Identifying Camshaft Sprocket
Courtesy of DAIMLERCHRYSLER CORP.



1 - SPECIAL TOOL 6793
2 - SPECIAL TOOL C-4685–C2
3 - CRANKSHAFT SPROCKET

G03633246

Fig. 137: Removing Crankshaft Sprocket
Courtesy of DAIMLERCHRYSLER CORP.

CLEANING

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

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

INSTALLATION

INSTALLATION - CRANKSHAFT SPROCKET

CAUTION: The crankshaft sprocket is set to a predetermined depth from the factory for correct timing belt tracking. If removed, use of Special Tool 6792 is required to set the sprocket to original installation depth. An incorrectly installed sprocket will result in timing belt and engine damage.

1. Install crankshaft sprocket using Special Tool 6792 (**Fig. 138**).

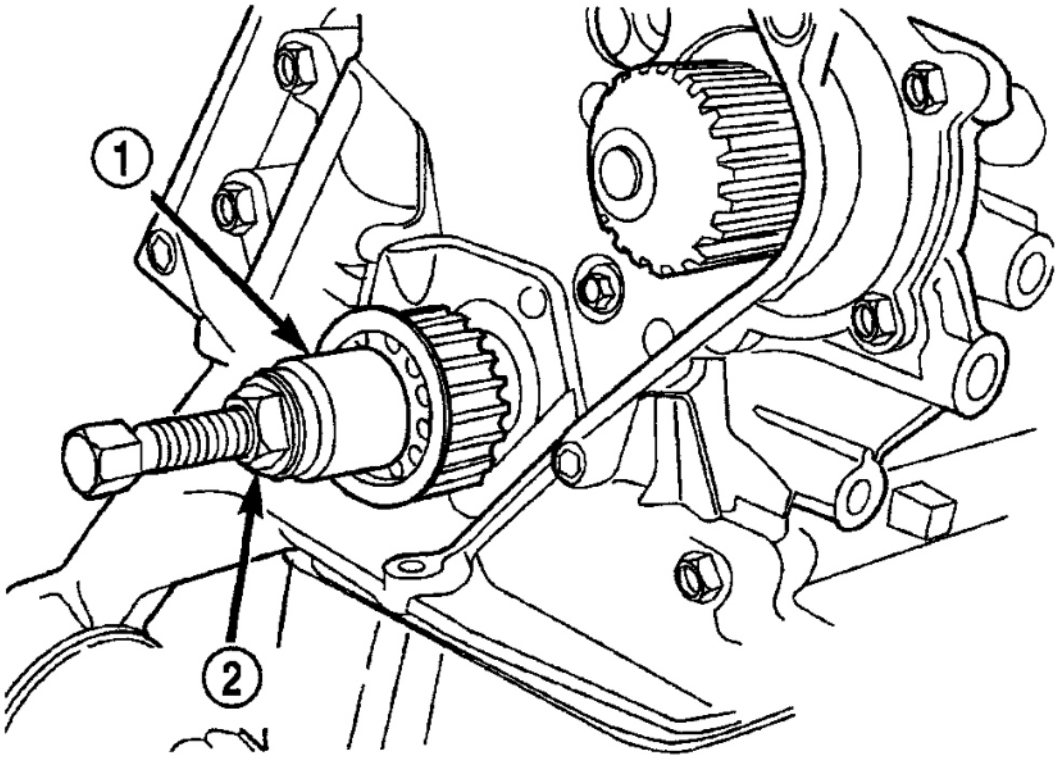


Fig. 138: Installing Crankshaft Sprocket
Courtesy of DAIMLERCHRYSLER CORP.

2. Install timing belt. (Refer to **TIMING BELT AND SPROCKET(S)**).
3. Connect negative battery cable.

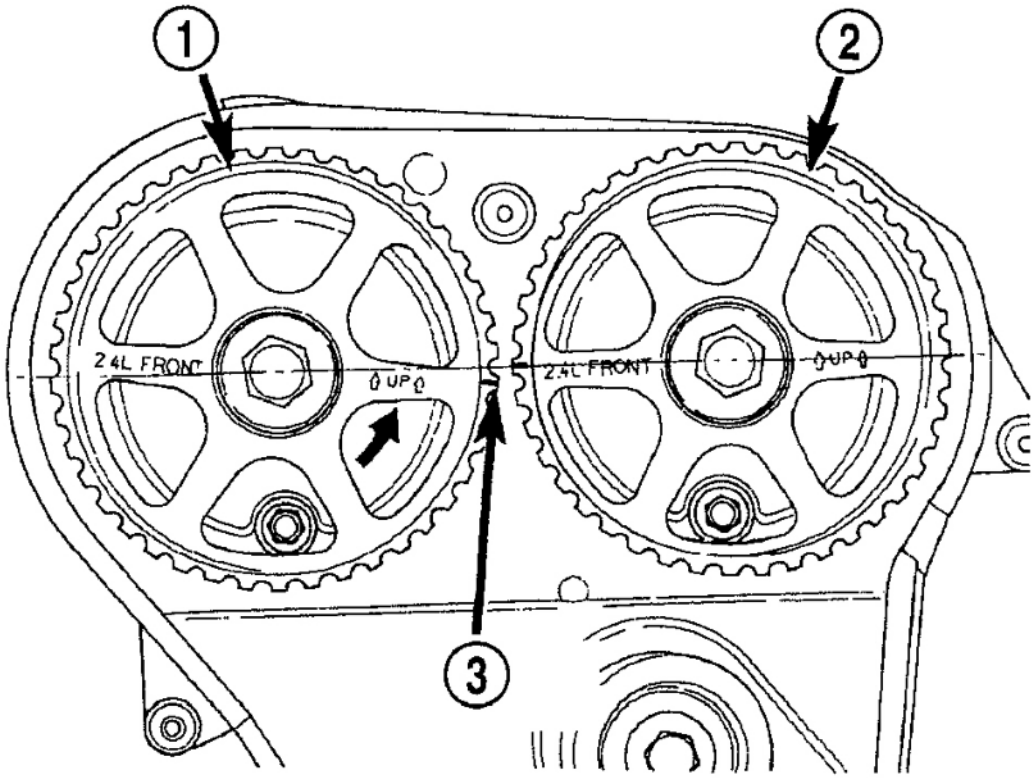
INSTALLATION - CAMSHAFT SPROCKETS

1. Install camshaft sprockets. Hold camshaft sprockets with Special Tool 6847 while tightening center bolts to 115 N.m (85 ft. lbs.) (**Fig. 136**).
2. Install timing belt (Refer to **TIMING BELT AND SPROCKET(S)**).
3. Connect negative battery cable.

INSTALLATION - TIMING BELT

1. Set crankshaft sprocket to TDC by aligning the sprocket with the arrow on the oil pump housing.
2. Set camshafts timing marks so that the exhaust camshaft sprocket is a 1/2 notch below the intake camshaft sprocket (**Fig. 139**).

CAUTION: Ensure that the arrows on both camshaft sprockets are facing up.

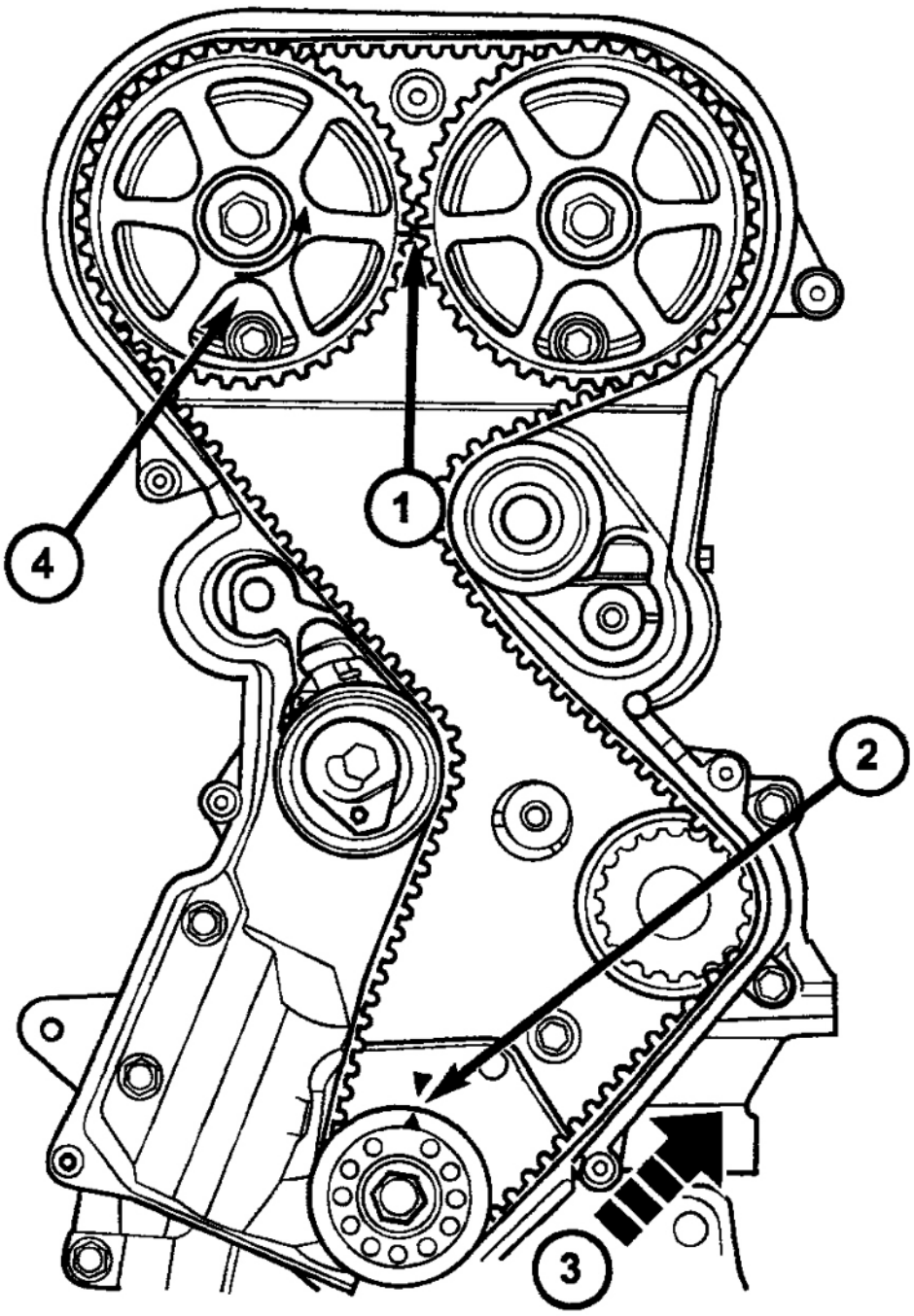


1 - CAMSHAFT SPROCKET-EXHAUST
2 - CAMSHAFT SPROCKET-INTAKE
3 - 1/2 NOTCH LOCATION

G03633248

Fig. 139: Alining Camshaft Sprockets
Courtesy of DAIMLERCHRYSLER CORP.

3. Install timing belt. Starting at the crankshaft, go around the water pump sprocket, idler pulley, camshaft sprockets and then around the tensioner (**Fig. 140**).
4. Move the exhaust camshaft sprocket counterclockwise (**Fig. 140**) to align marks and take up belt slack.

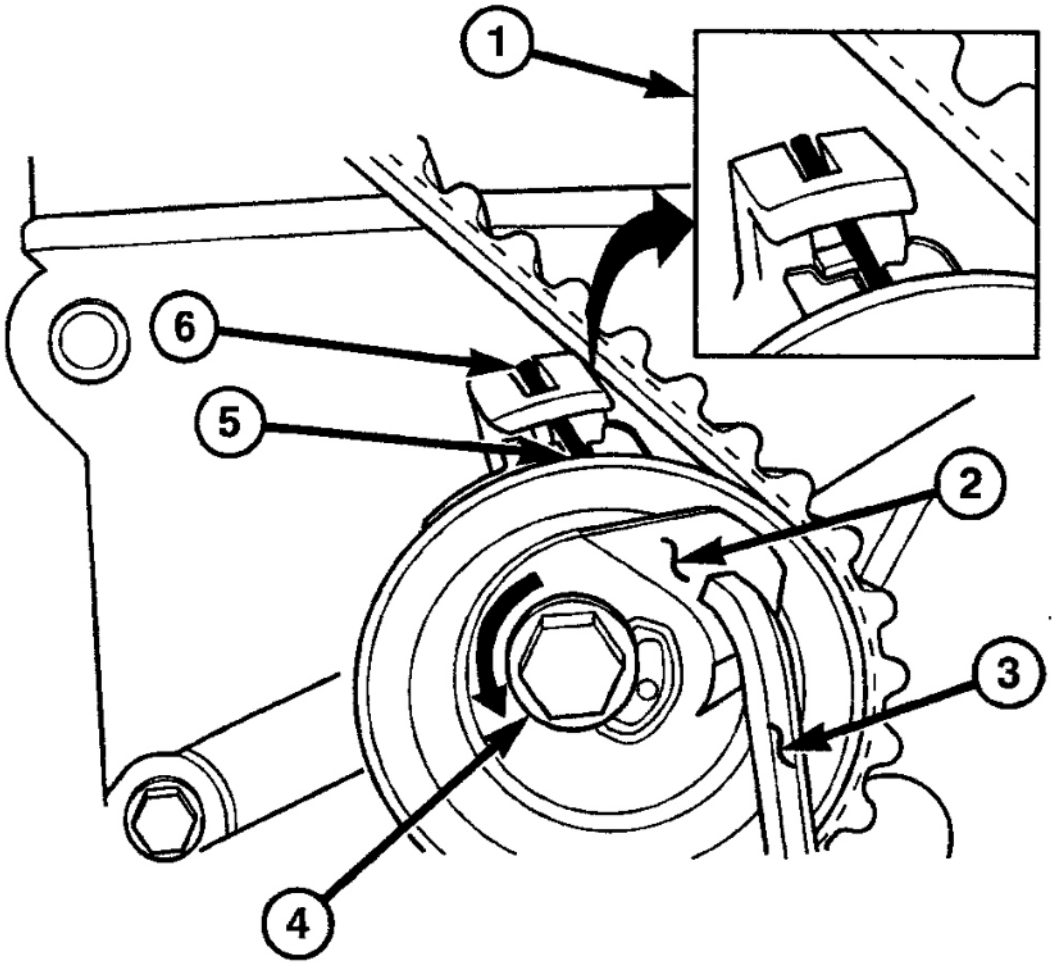


1 - CAMSHAFT TIMING MARKS 1/2 NOTCH LOCATION
2 - CRANKSHAFT AT TDC
3 - INSTALL BELT IN THIS DIRECTION
4 - ROTATE CAMSHAFT SPROCKET TO TAKE UP BELT SLACK

G03633249

Fig. 140: Installing Timing Belt
Courtesy of DAIMLERCHRYSLER CORP.

5. Insert a 6 mm Allen wrench into the hexagon opening located on the top plate of the belt tensioner pulley. Rotate the top plate **COUNTERCLOCKWISE** . The tensioner pulley will move against the belt and the tensioner setting notch will eventually start to move clockwise. Watching the movement of the setting notch, continue rotating the top plate counterclockwise until the setting notch is aligned with the spring tang (**Fig. 141**). Using the Allen wrench to prevent the top plate from moving, torque the tensioner lock bolt to 25 N.m (220 in. lbs.). Setting notch and spring tang should remain aligned after lock nut is torqued.
6. Remove Allen wrench and torque wrench.



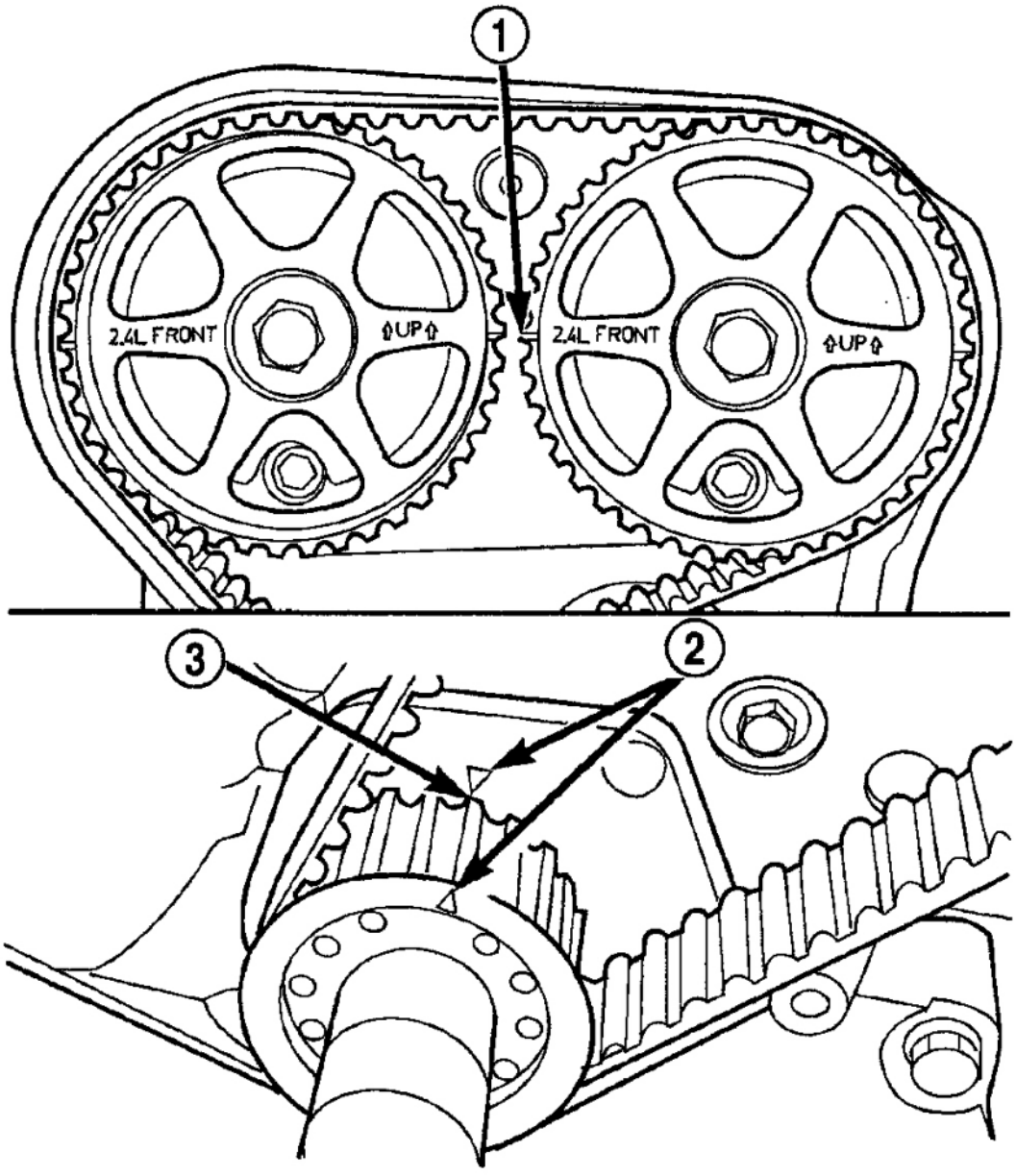
1 - ALIGN SETTING NOTCH WITH SPRING TANG
2 - TOP PLATE
3 - 6mm ALLEN WRENCH
4 - LOCK BOLT
5 - SETTING NOTCH
6 - SPRING TANG

G03633250

Fig. 141: Adjusting Timing Belt Tension
Courtesy of DAIMLERCHRYSLER CORP.

NOTE: Repositioning the crankshaft to the TDC position must be done only during the CLOCKWISE rotation movement. If TDC is missed, rotate a further two revolutions until TDC is achieved. DO NOT rotate crankshaft counterclockwise as this will make verification of proper tensioner setting impossible.

7. Rotate the crankshaft CLOCKWISE two complete revolutions manually for seating of the belt, until the crankshaft is repositioned at the TDC position. Verify that the camshaft and crankshaft timing marks are in proper position (**Fig. 142**).

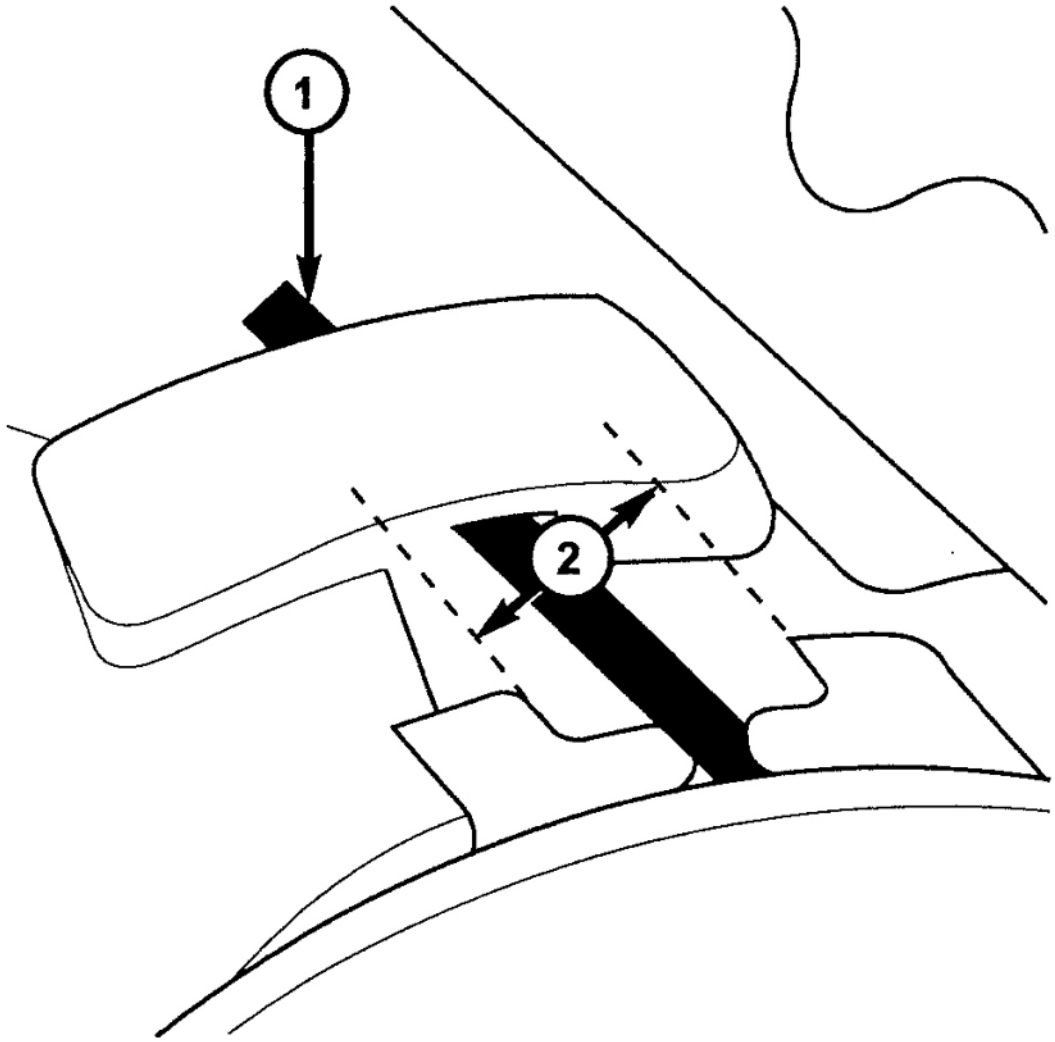


1 - CAMSHAFT TIMING MARKS
2 - CRANKSHAFT TDC MARKS
3 - TRAILING EDGE OF SPROCKET TOOTH

G03633251

Fig. 142: Identifying Crankshaft And Camshaft Timing Mark
Courtesy of DAIMLERCHRYSLER CORP.

8. Check if the spring tang is within the tolerance window (**Fig. 143**). If the spring tang is within the tolerance window, the installation process is complete and nothing further is required. If the spring tang is not within the tolerance window, repeat Steps 5 through 7.
9. Install engine mount support bracket (**Fig. 130**).
10. Install upper timing belt cover. Torque fasteners to 6 N.m (50 in. lbs.) (**Fig. 130**).
11. Install the lower timing belt cover. Torque fasteners to 6 N.m (50 in. lbs.) (**Fig. 130**).
12. Install generator and bracket. Connect generator connections.
13. Install AC/Generator belt tensioner.
14. Install crankshaft damper (Refer to **VIBRATION DAMPER**).
15. Install right engine mount (Refer to **INSTALLATION**).
16. Install coolant recovery container (Refer to COOLING article).
17. Install accessory drive belts (Refer to SPECIFICATIONS & DRIVE BELT ROUTING article.



1 - SPRING TANG
2 - TOLERANCE WINDOW
G03633252

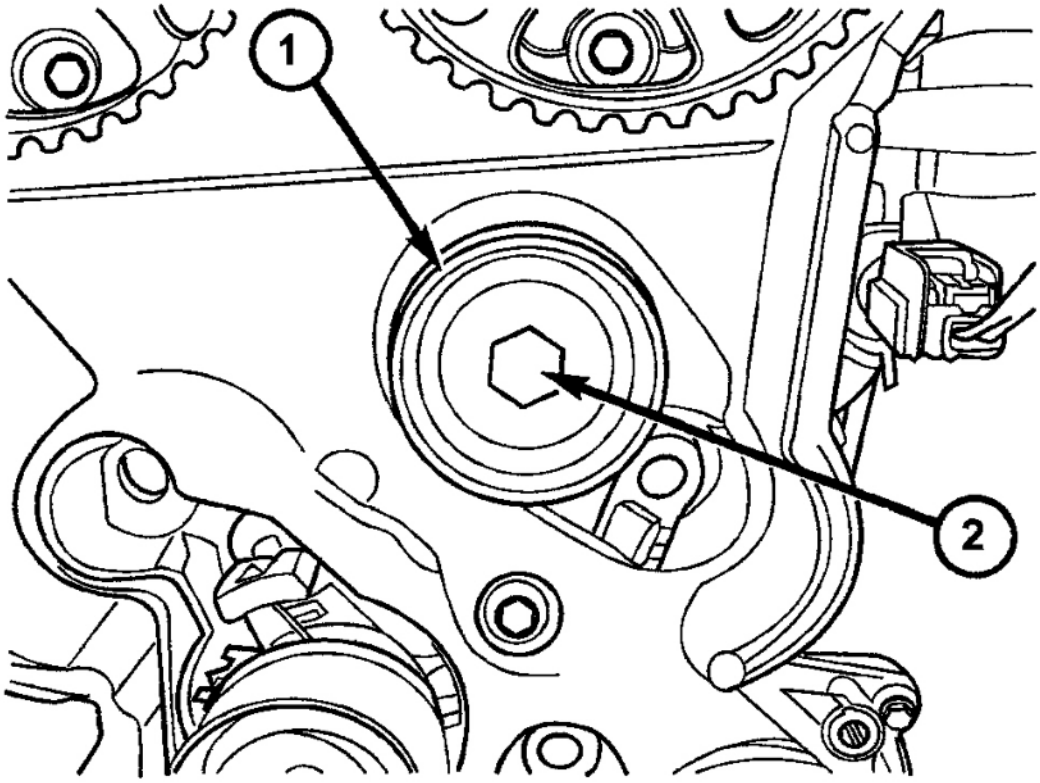
Fig. 143: Checking Timing Belt Tension
Courtesy of DAIMLERCHRYSLER CORP.

18. Install belt splash shield.
19. Install right front wheel.
20. Connect negative battery cable.

TIMING BELT TENSIONER & PULLEY

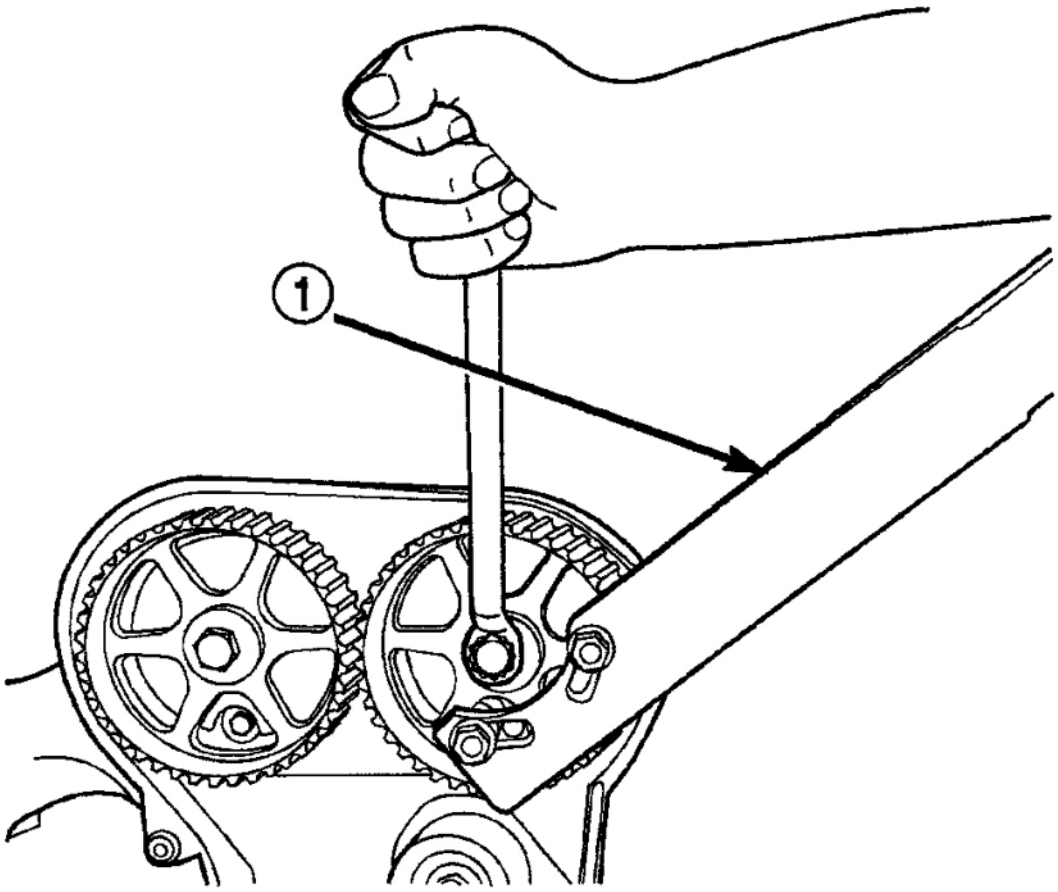
REMOVAL

1. Remove the timing belt (Refer to **TIMING BELT AND SPROCKET(S)**).
2. Remove timing belt idler pulley (**Fig. 144**).
3. Hold camshaft sprocket with Special Tool 6847 while removing bolt (**Fig. 145**). Remove both cam sprockets.



1 - IDLER PULLEY
2 - BOLT
G03633253

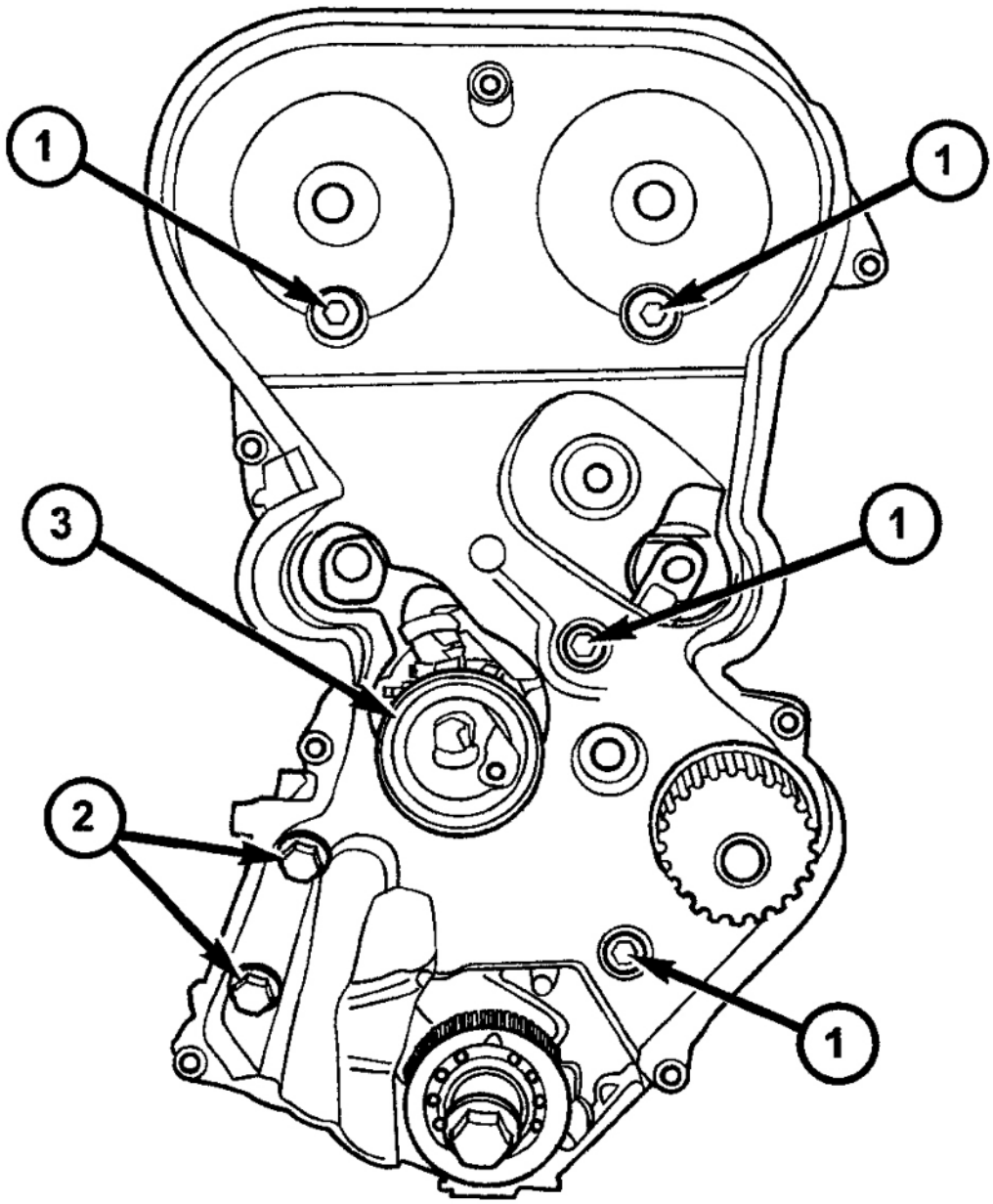
Fig. 144: Identifying Timing Belt Idler Pulley
Courtesy of DAIMLERCHRYSLER CORP.



1 - SPECIAL TOOL 6847
G03633254

Fig. 145: Removing Camshaft Sprocket
Courtesy of DAIMLERCHRYSLER CORP.

4. Remove rear timing belt cover fasteners and remove cover from engine (**Fig. 146**).



1 - M6 BOLTS - 12 N·m (105 in. lbs.)
2 - M8 BOLTS - 28 N·m (250 in. lbs.)
3 - TIMING BELT TENSIONER

G03633255

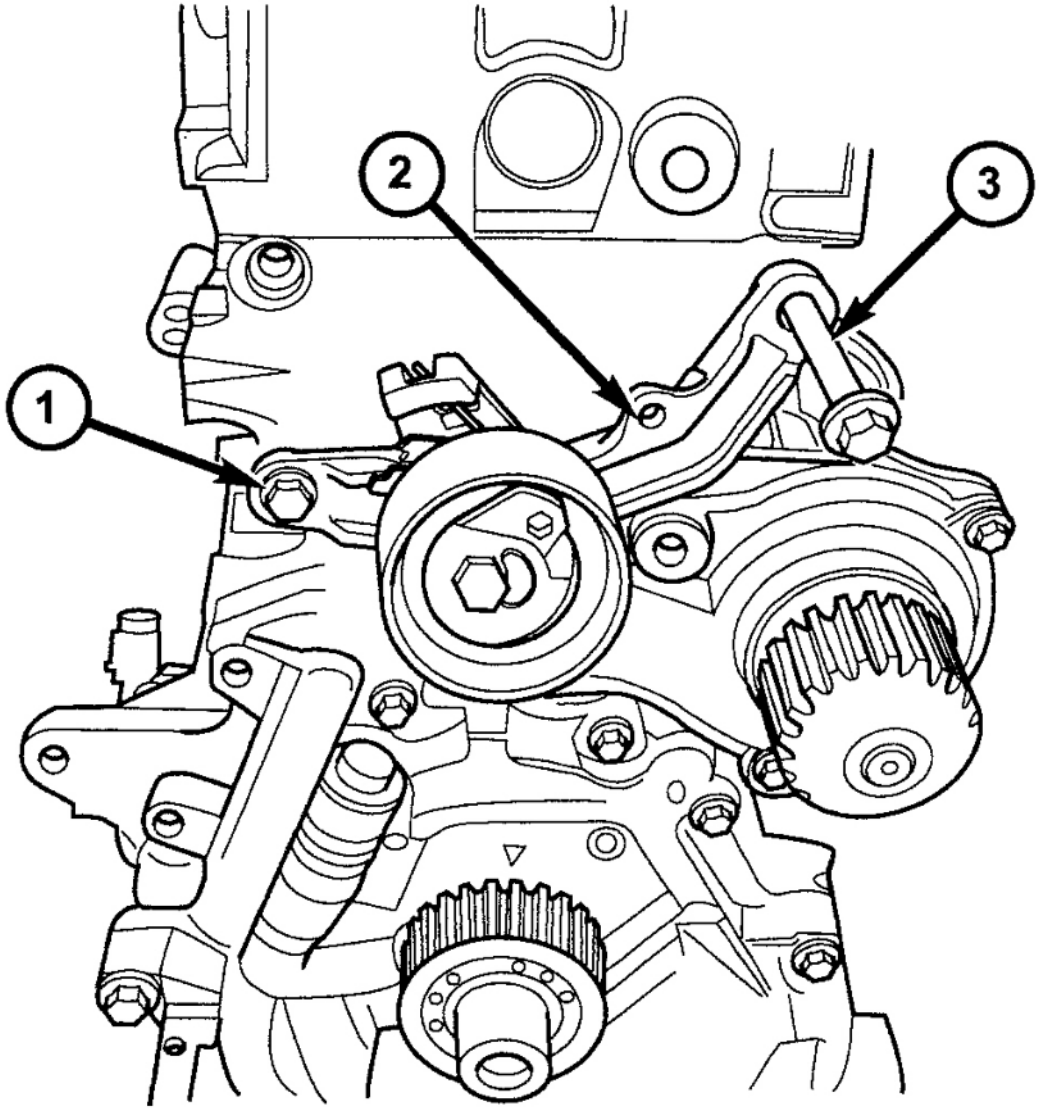
Fig. 146: Removing Rear Timing Belt Cover Fasteners
Courtesy of DAIMLERCHRYSLER CORP.

5. Remove lower bolt attaching timing belt tensioner assembly to engine and remove tensioner **as an**

assembly (**Fig. 147**).

INSTALLATION

1. Align timing belt tensioner assembly to engine and install lower mounting bolt **but do not tighten** (**Fig. 147**). To properly align tensioner assembly-install one of the engine bracket mounting bolts (M10) 5 to 7 turns into the tensioner's upper mounting location (**Fig. 147**).
2. Torque the tensioner's lower mounting bolt to 61 N.m (45 ft. lbs.). Remove the upper bolt used for tensioner alignment.
3. Install rear timing belt cover and fasteners. Torque fasteners to values specified in (**Fig. 146**).
4. Install timing belt idler pulley and torque mounting bolt to 61 N.m (45 ft. lbs.) (**Fig. 144**).
5. Install camshaft sprockets. Use Special Tool 6847 to hold sprockets (**Fig. 145**), torque bolts to 115 N.m (85 ft. lbs.).
6. Install the timing belt (Refer to **TIMING BELT AND SPROCKET(S)**).



1 - BOLT
2 - TENSIONER ASSEMBLY
3 - BOLT-INSTALL FOR PROPER ALIGNMENT

G03633256

Fig. 147: Identifying Timing Belt Tensioner/Bracket Assembly
Courtesy of DAIMLERCHRYSLER CORP.

BALANCE SHAFTS AND CARRIER ASSEMBLY

DESCRIPTION

The 2.4L engine is equipped with two nodular cast iron balance shafts installed in a cast aluminum carrier attached to the lower cylinder block (**Fig. 148**).

OPERATION

The balance shafts are driven by the crankshaft via a roller chain and sprockets. The balance shafts are connected by helical gears. The dual counter rotating shafts decrease second order vertical shaking forces caused by component movement.

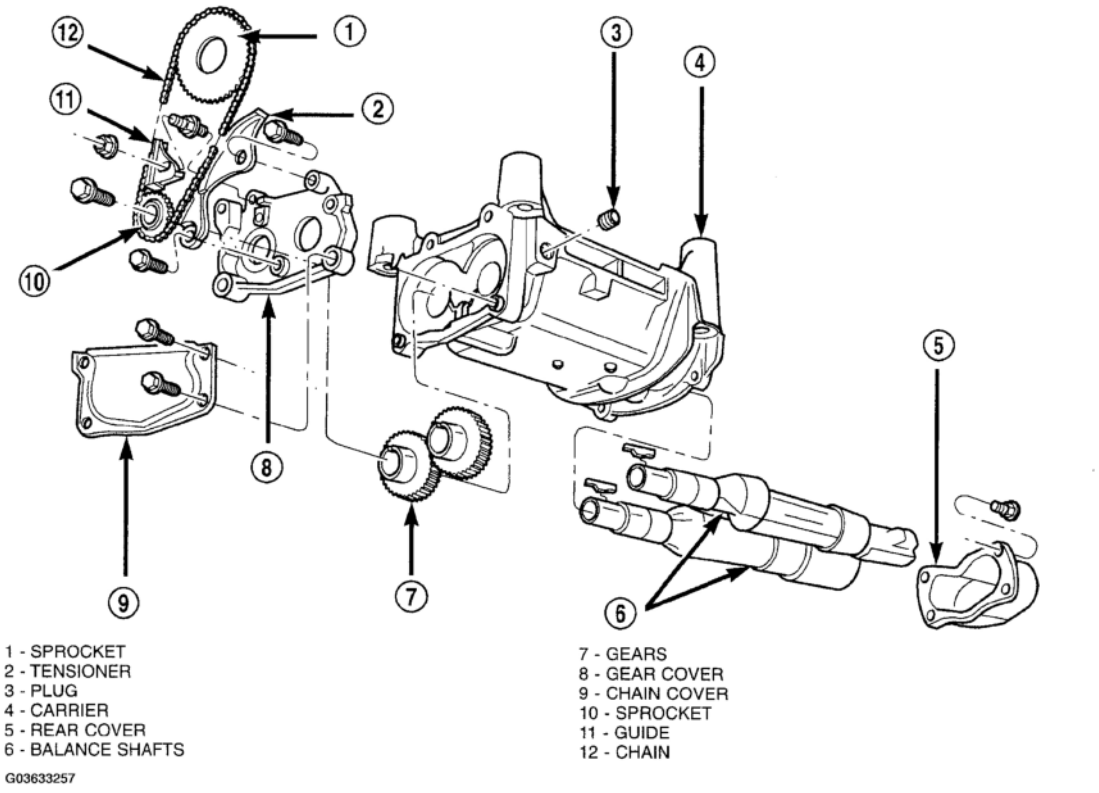


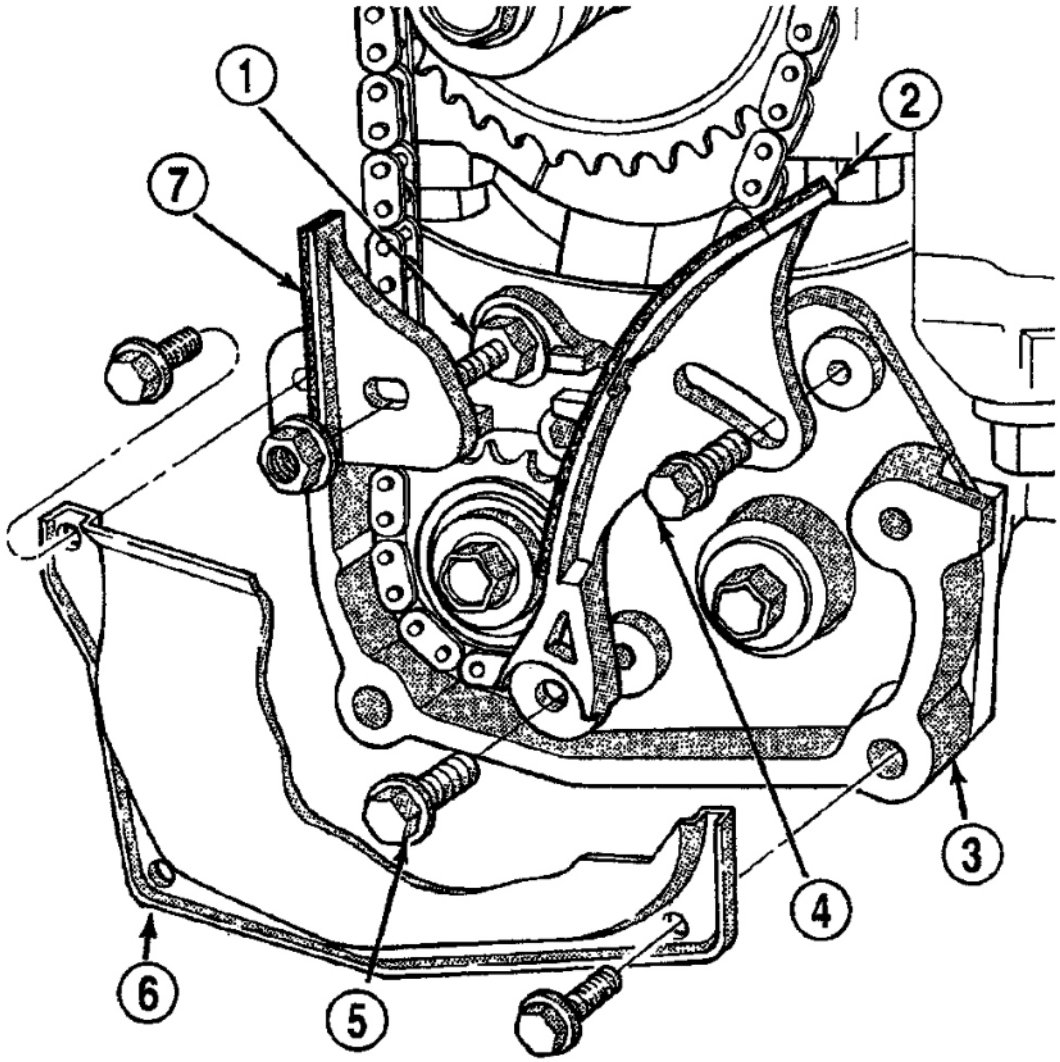
Fig. 148: Identifying Balance Shafts And Carrier Assembly
Courtesy of DAIMLERCHRYSLER CORP.

REMOVAL

BALANCE SHAFTS/CHAIN/SPROCKETS

NOTE: For service procedures requiring only temporary relocation of carrier assembly refer to BALANCE SHAFT CARRIER procedure below.

1. Drain engine oil.
2. Remove the oil pan and pick-up tube (Refer to **REMOVAL**).
3. If replacing crankshaft sprocket, remove oil pump (Refer to **REMOVAL**).



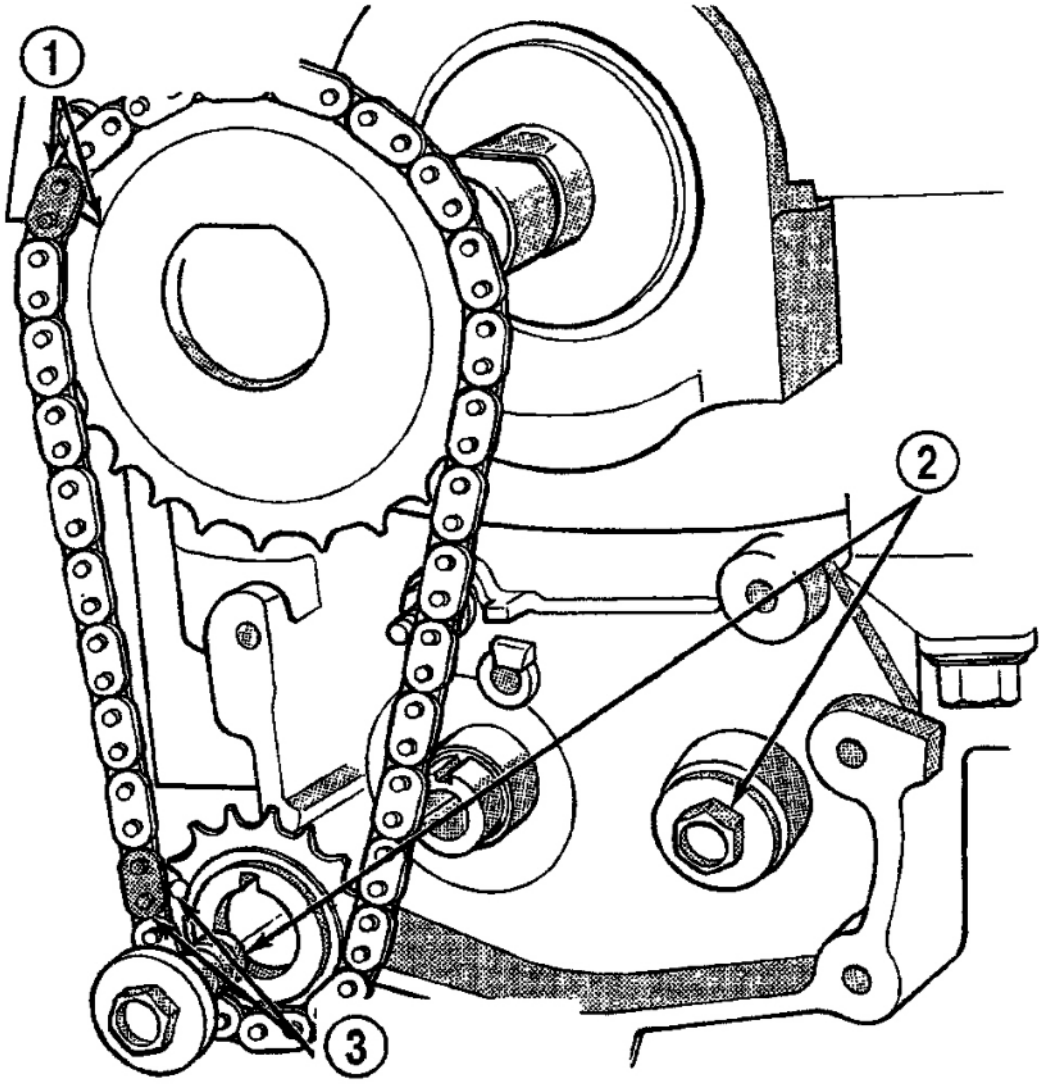
1 - STUD
2 - TENSIONER (ADJUSTER)
3 - GEAR COVER
4 - ADJUST SCREW
5 - PIVOT SHOULDER SCREW
6 - CHAIN COVER (CUTAWAY)
7 - GUIDE

G03633258

Fig. 149: Identifying Chain Cover, Guide And Tensioner
Courtesy of DAIMLERCHRYSLER CORP.

4. Remove chain cover, guide and tensioner (**Fig. 149**).

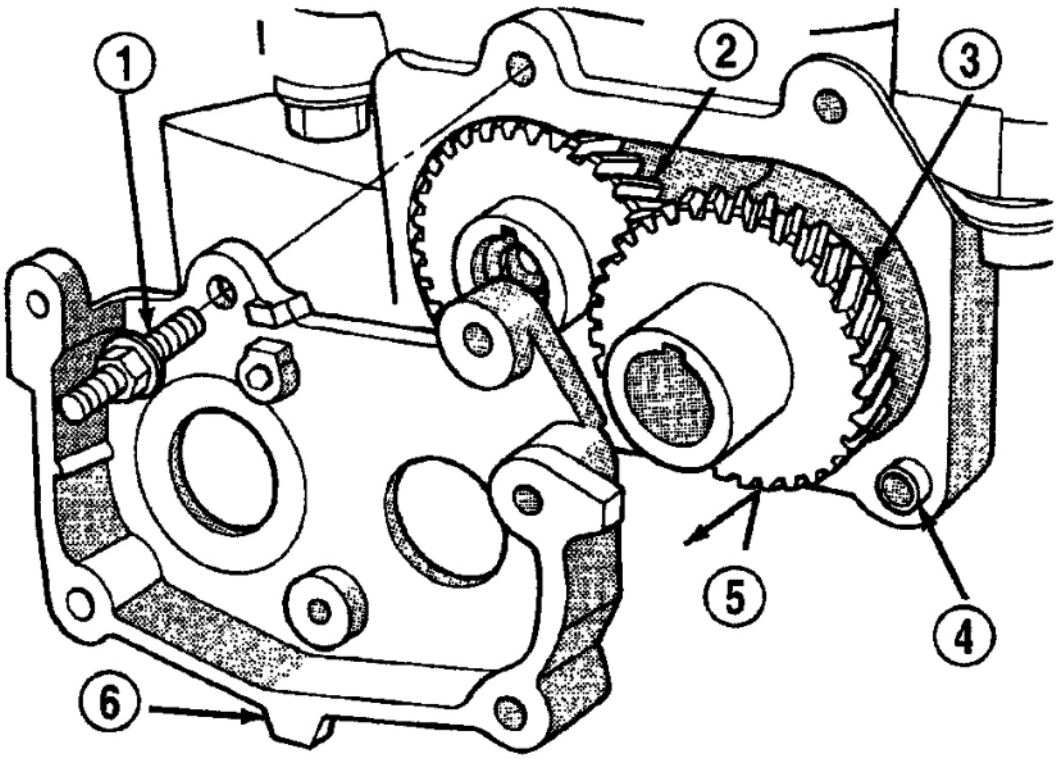
5. Remove screw retaining balance shaft drive sprocket (**Fig. 150**). Remove chain and sprocket.
6. Using two wide pry bars, work the crankshaft sprocket back and forth until it is off the crankshaft-shaft.
7. Remove gear cover retaining stud (double ended to also retain chain guide). Remove cover and balance shaft gears (**Fig. 151**).



1 - NICKEL PLATED LINK AND MARK
2 - GEAR/SPROCKET SCREWS
3 - NICKEL PLATED LINK AND DOT

G03633259

Fig. 150: Identifying Drive Chain And Sprockets
Courtesy of DAIMLERCHRYSLER CORP.



1 - STUD (DOUBLE ENDED)
2 - DRIVE GEAR
3 - DRIVEN GEAR
4 - CARRIER DOWEL
5 - GEAR(S)
6 - GEAR COVER

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Fig. 151: Identifying Gear Cover And Gears
Courtesy of DAIMLERCHRYSLER CORP.

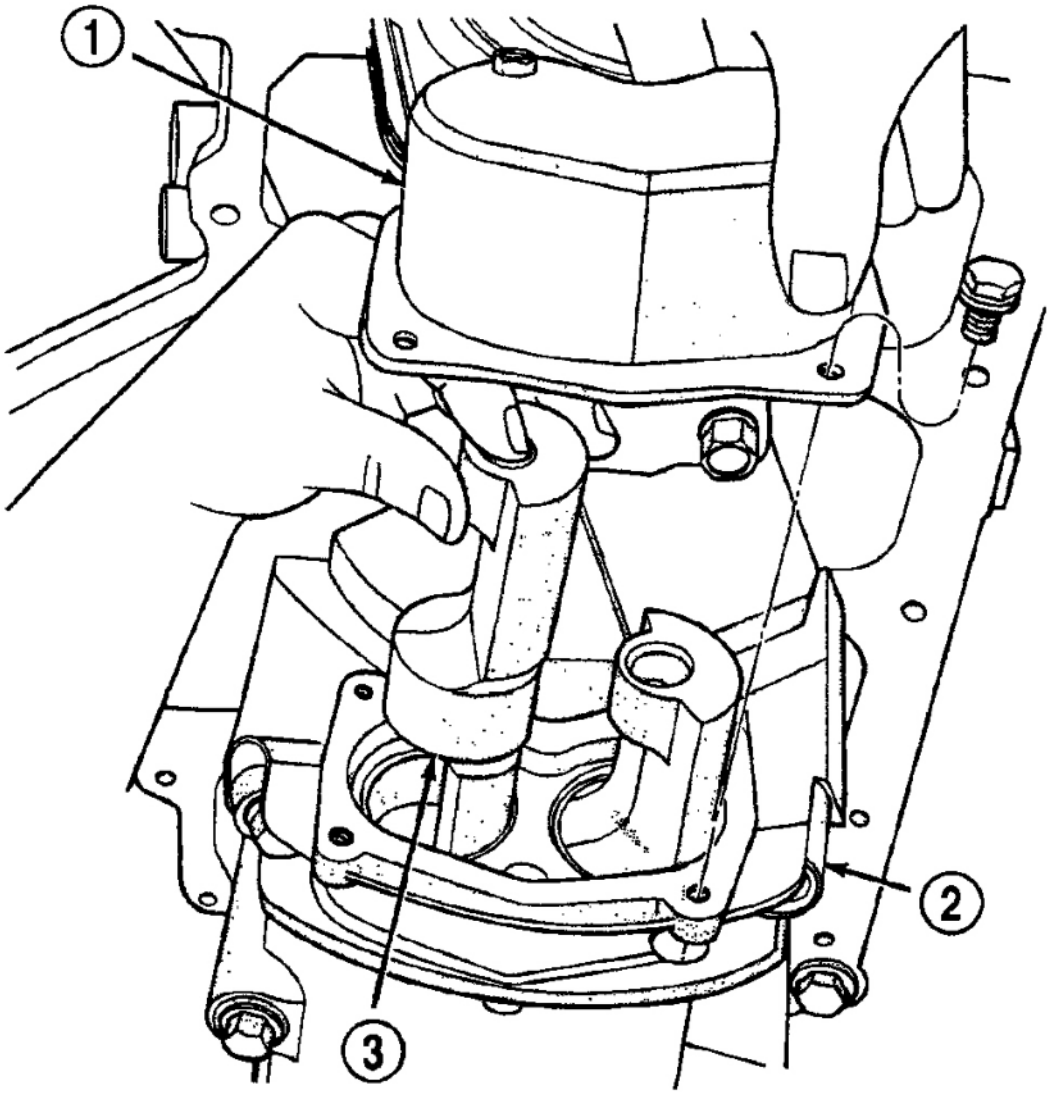


Fig. 152: Identifying Balance Shaft
Courtesy of DAIMLERCHRYSLER CORP.

8. Remove rear cover and balance shafts (**Fig. 152**).
9. Remove four carrier to crankcase attaching bolts to separate carrier from engine bedplate.

BALANCE SHAFT CARRIER

The following components will remain intact during carrier removal: Gear cover, gears, balance shafts and the rear cover (**Fig. 148**).

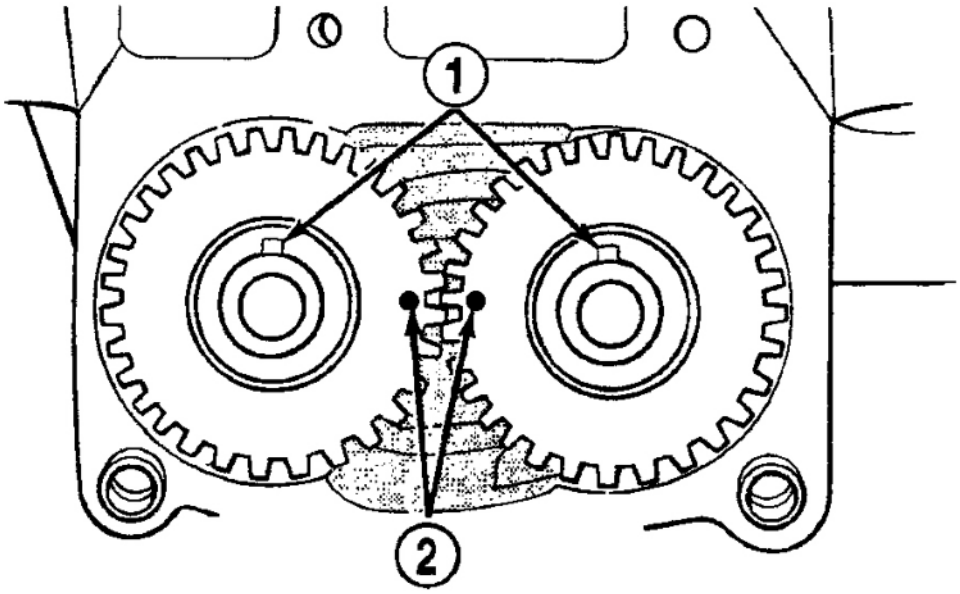
1. Drain engine oil.
2. Remove the oil pan and pick-up tube (Refer to **REMOVAL**).
3. Remove chain cover, guide and tensioner (**Fig. 149**).
4. Remove screw retaining balance shaft drive sprocket (**Fig. 150**).
5. Move balance shaft inboard through drive chain sprocket. Sprocket will hang in lower chain loop.
6. Remove carrier to crankcase attaching bolts to remove carrier.

INSTALLATION

BALANCE SHAFT INSTALLATION/TIMING

Balance shaft and carrier assembly installation is the reverse of the removal procedure. **During installation crankshaft-to-balance shaft timing must be established. Refer to remainder of this procedure** .

1. With balance shafts installed in carrier (**Fig. 148**) position carrier on crankcase and install four attaching bolts and tighten to 54 N.m (40 ft. lbs.).
2. Turn balance shafts until both shaft key ways are up, parallel to vertical centerline of engine. Install short hub drive gear on sprocket driven shaft and long hub gear on gear driven shaft. After installation gear and balance shaft keyways must be up with gear timing marks meshed as shown in (**Fig. 153**).

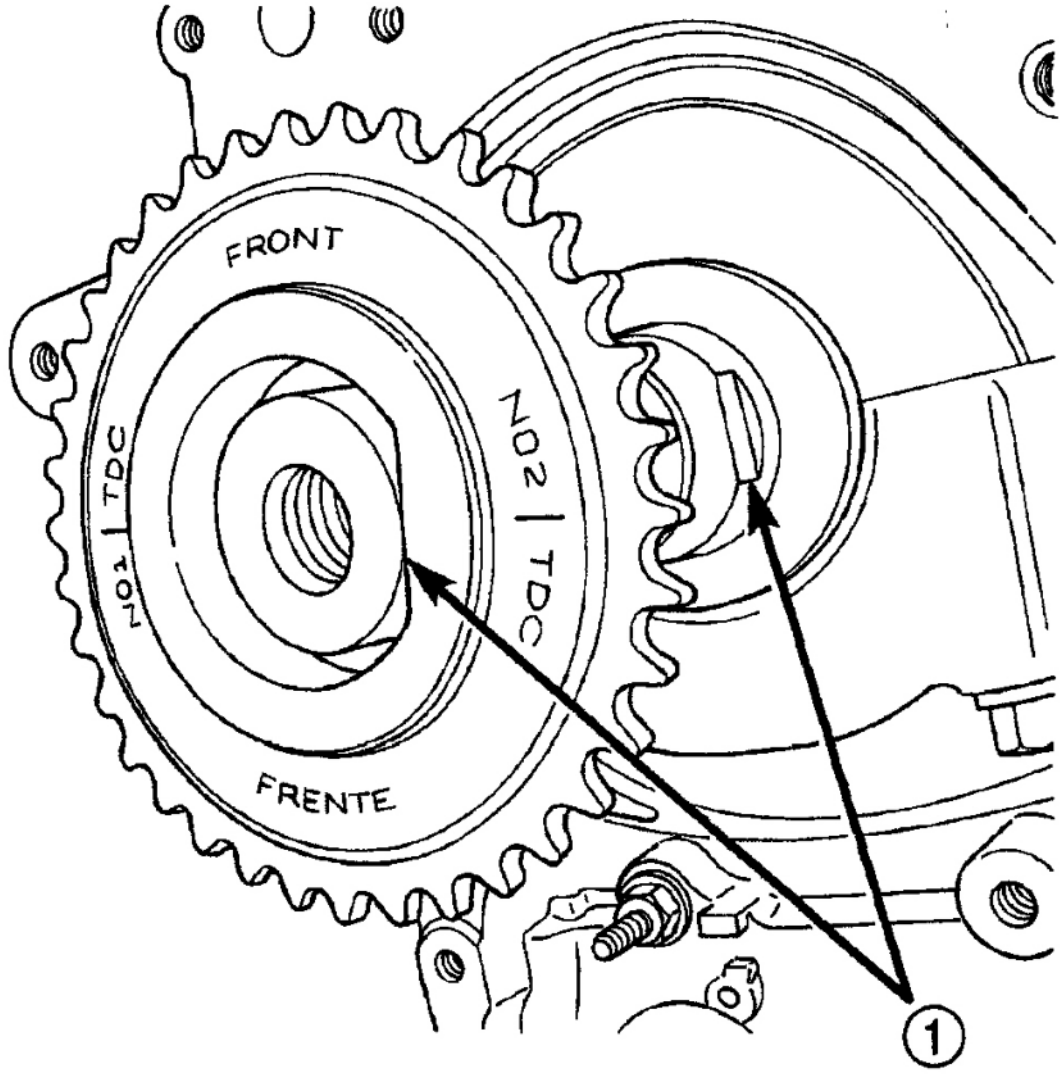


1 - KEY WAYS UP
2 - GEAR ALIGNMENT DOTS

G03633262

Fig. 153: Identifying Gear Timing
Courtesy of DAIMLERCHRYSLER CORP.

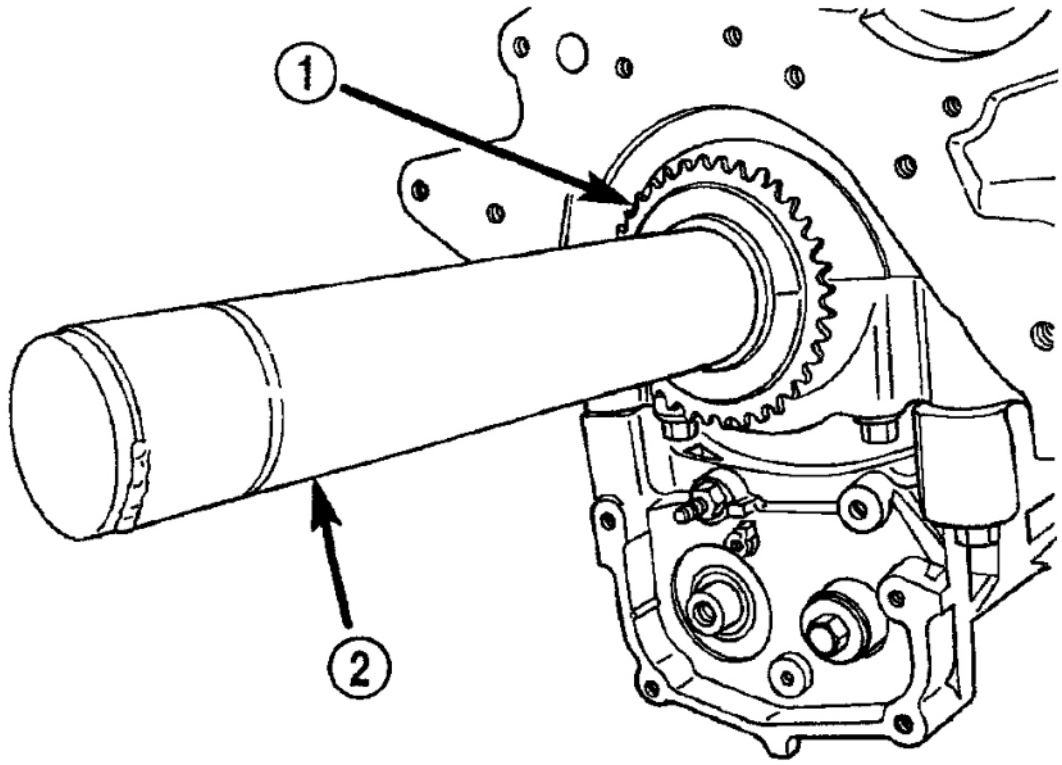
3. Install gear cover and tighten double ended stud/washer fastener to 12 N.m (105 in. lbs.).
4. Align flat on balance shaft drive sprocket to the flat on crankshaft (**Fig. 154**).



1 - ALIGN FLATS
G03633263

Fig. 154: Aligning Balance Shaft Sprocket To Crankshaft
Courtesy of DAIMLERCHRYSLER CORP.

5. Install balance shaft drive sprocket on crankshaft using Special Tool 6052 (**Fig. 155**).



1 - SPROCKET
2 - SPECIAL TOOL 6052
G03633264

Fig. 155: Installing Balance Shaft Drive Sprocket On Crankshaft
Courtesy of DAIMLERCHRYSLER CORP.

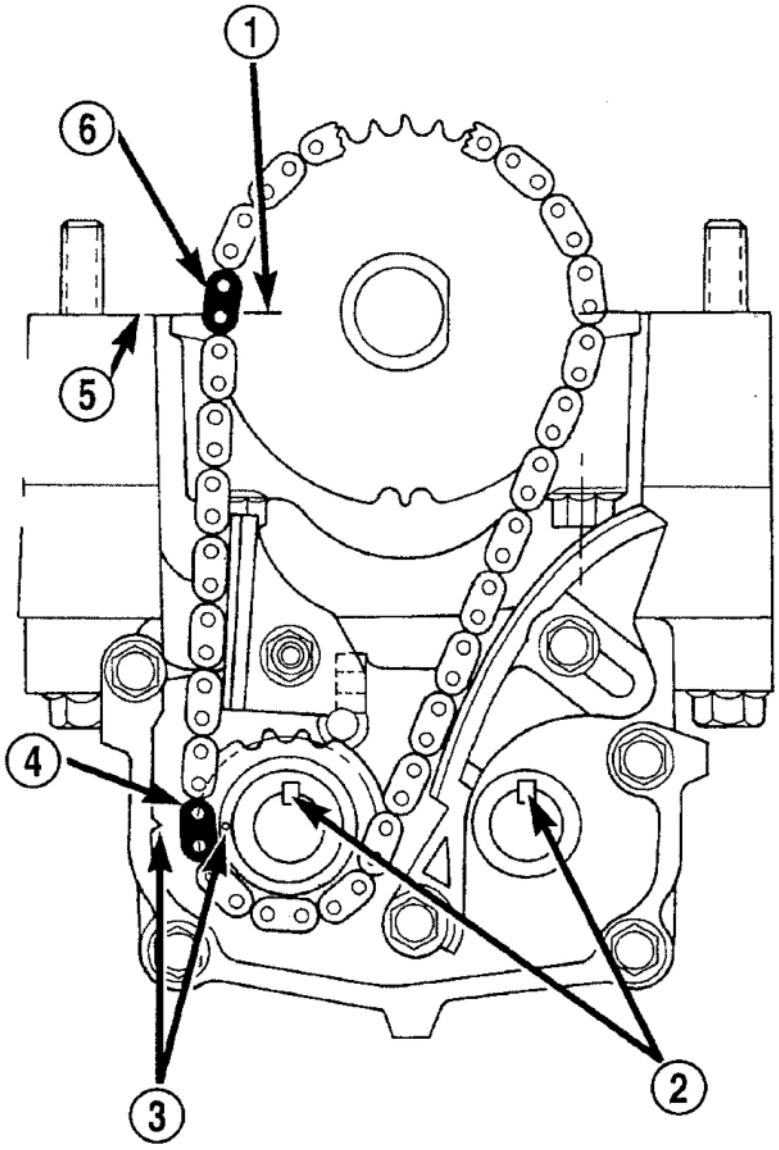
6. Turn crankshaft until number 1 cylinder is at top dead center (TDC). The timing marks on the chain sprocket should line up with the parting line on the left side of number one main bearing cap. (**Fig. 156**).
7. Place chain over crankshaft sprocket so that the plated link of the chain is over the number 1 cylinder timing mark on the balance shaft crankshaft sprocket (**Fig. 156**).
8. Place balance shaft sprocket into the timing chain (**Fig. 156**) and align the timing mark on the sprocket (dot) with the (lower) plated link on the chain.

NOTE: The lower plated link is 8 links from the upper link.

9. With balance shaft keyways pointing up (12 o'clock) slide the balance shaft sprocket onto the nose of the balance shaft. The balance shaft may have to be pushed in slightly to allow for clearance.

NOTE: THE TIMING MARK ON THE SPROCKET, THE (LOWER) NICKEL PLATED LINK, AND THE ARROW ON THE SIDE OF THE GEAR COVER SHOULD

LINE UP WHEN THE BALANCE SHAFTS ARE TIMED CORRECTLY.

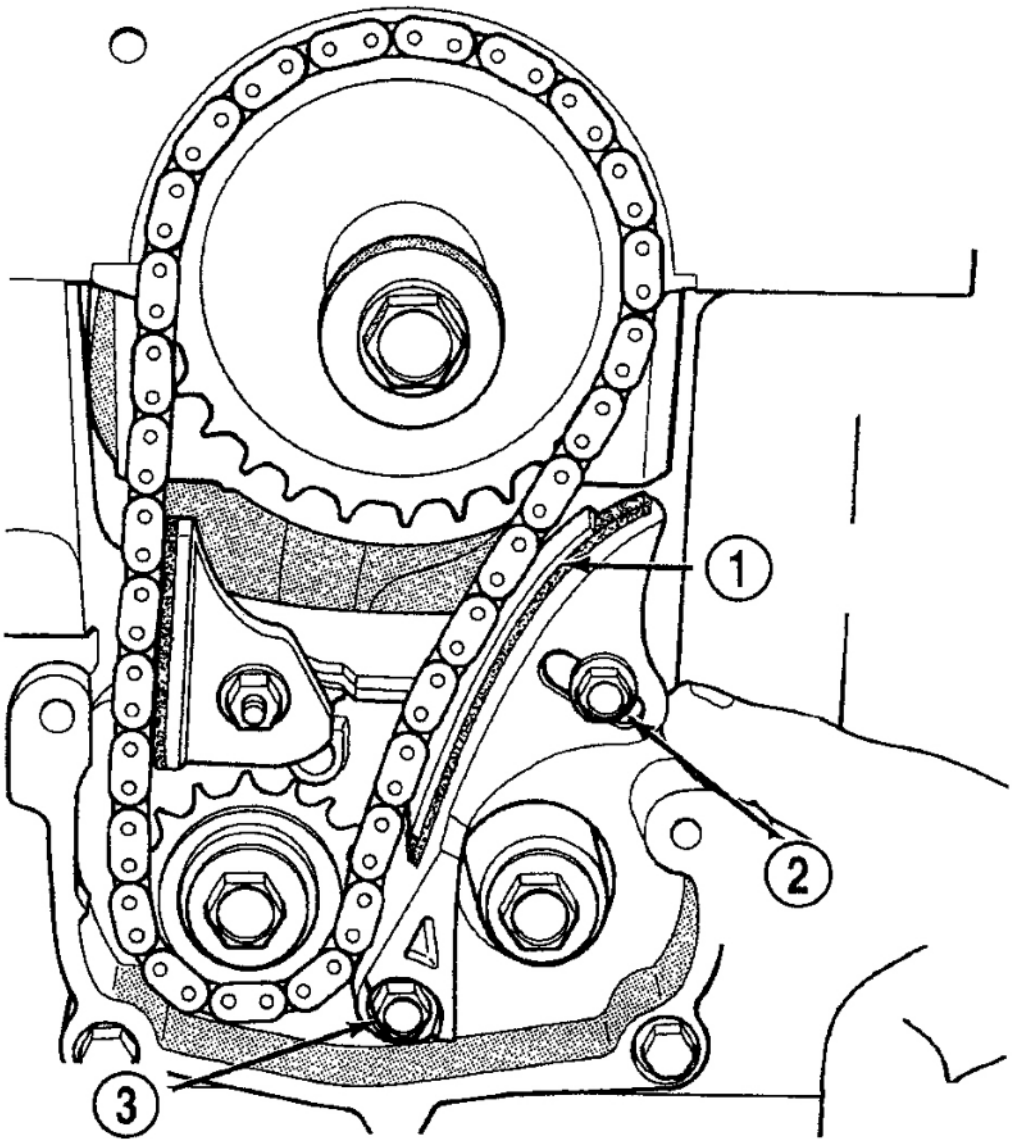


1 - MARK ON SPROCKET
2 - KEYWAYS UP
3 - ALIGN MARKS
4 - PLATED LINK
5 - PARTING LINE (BEDPLATE TO BLOCK)
6 - PLATED LINK

G03633265

Fig. 156: Identifying Balance Shaft Timing
Courtesy of DAIMLERCHRYSLER CORP.

10. If the sprockets are timed correctly, install the balance shaft bolts and tighten to 28 N.m (250 in. lbs.). A wood block placed between crankcase and crankshaft counterbalance will prevent crankshaft and gear rotation.
11. **CHAIN TENSIONING:**
    a. Install chain tensioner loosely assembled.
    b. Position guide on double ended stud making sure tab on the guide fits into slot on the gear cover. Install and tighten nut/washer assembly to 12 N.m (105 in. lbs.).
    c. Place a shim 1 mm (0.039 in.) thick x 70 mm (2.75 in.) long between tensioner and chain. Push tensioner and shim up against the chain. **Apply firm pressure 2.5-3 Kg (5.5-6.6 lbs.) directly behind the adjustment slot to take up all slack** . Chain must have shoe radius contact as shown in (**Fig. 157**).
    d. With the load applied, tighten top tensioner bolt first, then bottom pivot bolt. Tighten bolts to 12 N.m (105 in. lbs.). Remove shim.
    e. Install carrier covers and tighten screws to 12 N.m (105 in. lbs.).
12. If removed, install oil pump (Refer to **INSTALLATION**).
13. Install pick-up tube and oil pan (Refer to **INSTALLATION**).
14. Fill engine crankcase with proper oil to correct level.



1 - 1MM (0.039 IN.) SHIM
2 - TENSIONER (ADJUSTER) BOLT
3 - PIVOT BOLT

G03633266

Fig. 157: Adjusting Chain Tension
Courtesy of DAIMLERCHRYSLER CORP.

