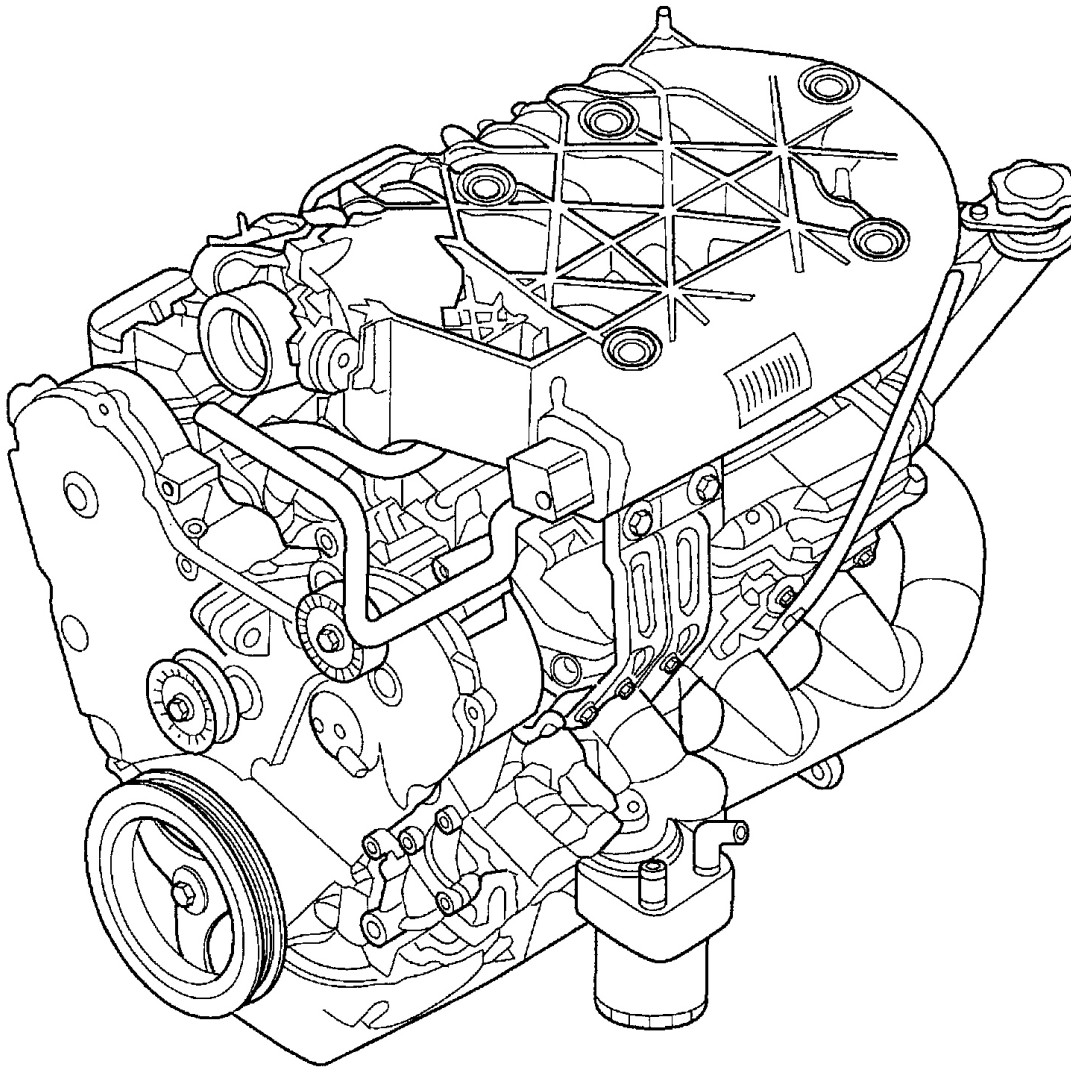


2004 ENGINE

Engine 3.5L - Pacifica

ENGINE 3.5L

DESCRIPTION



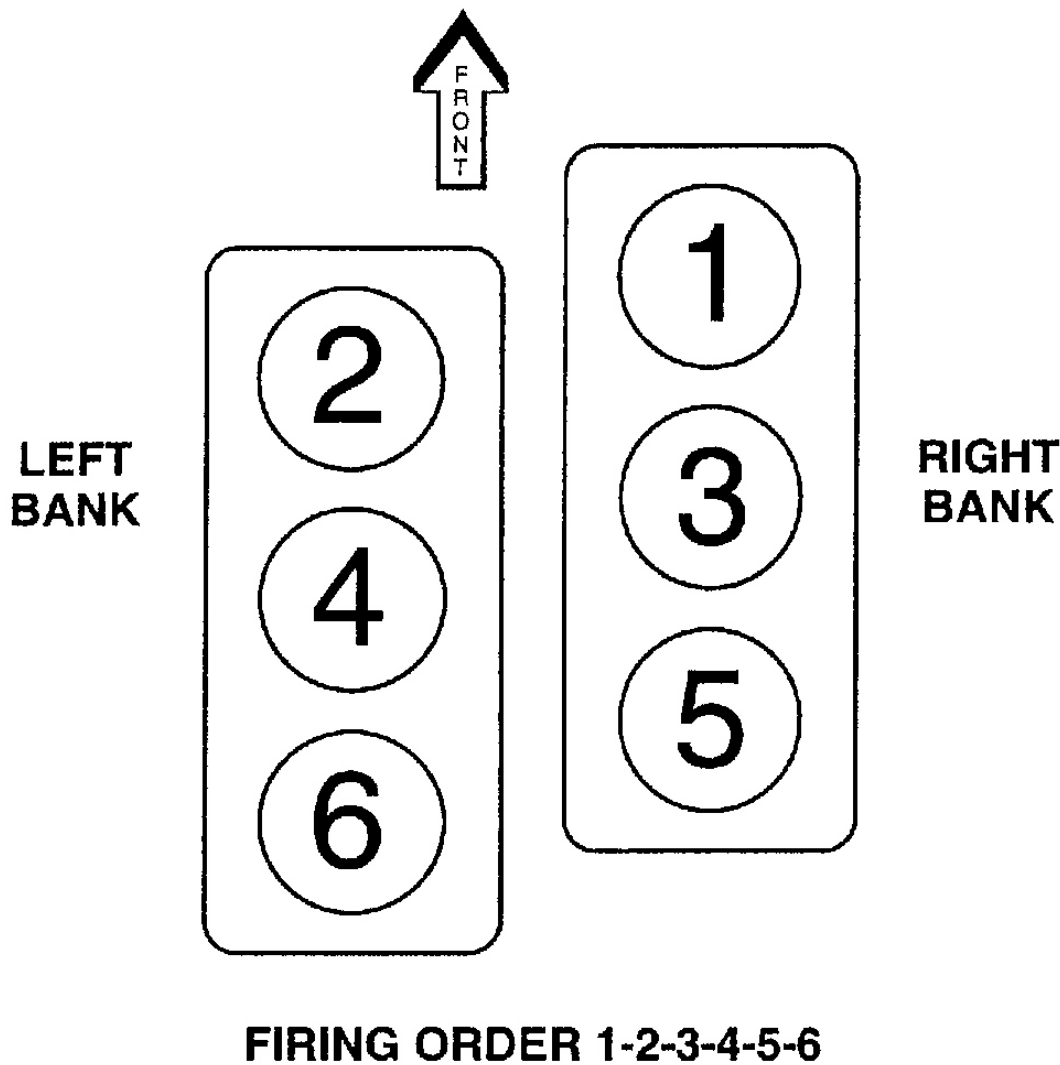
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Fig. 1: View Of 3.5L Engine
Courtesy of DAIMLERCHRYSLER CORP.

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

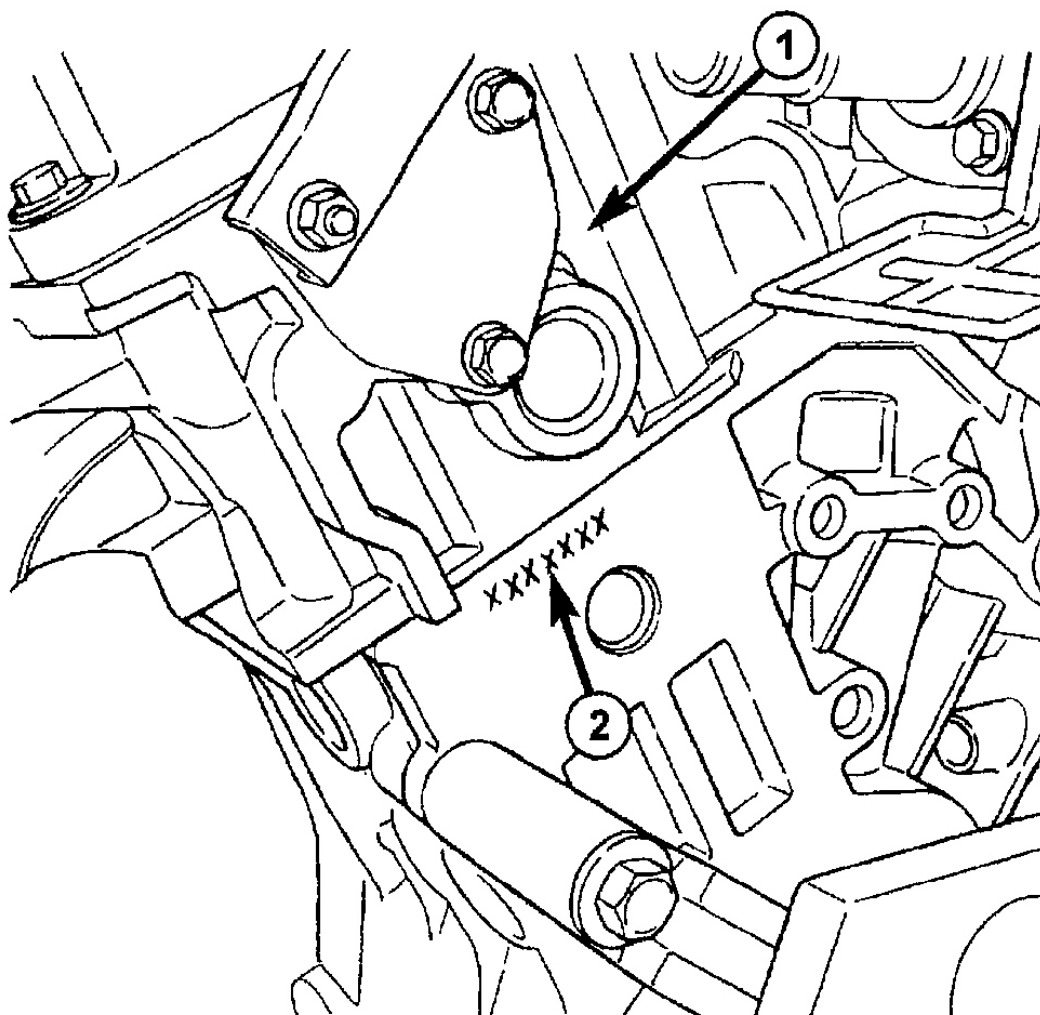
The cylinders are numbered from front to rear, with the right bank odd numbered, and the left bank even numbered (**Fig. 2**). The firing order is 1-2-3-4-5-6.

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



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Fig. 2: Identifying Cylinder Numbering and Firing Order
Courtesy of DAIMLERCHRYSLER CORP.



- 1 - REAR OF LEFT CYLINDER HEAD
- 2 - ENGINE IDENTIFICATION NUMBER

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Fig. 3: Locating Engine Identification Number
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 **DIAGNOSIS AND TESTING - ENGINE MECHANICAL** and **DIAGNOSIS AND TESTING - ENGINE PERFORMANCE** for possible causes and corrections of malfunctions. Refer to appropriate FUEL article for the fuel system diagnosis.

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

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

DIAGNOSIS AND TESTING - ENGINE PERFORMANCE

DIAGNOSIS AND TESTING - ENGINE 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. (Refer to <u>BATTERY SYSTEM</u>) 2. Clean and tighten battery connections. Apply a "coat of light mineral grease to terminals. 3. Test starting system. (Refer to <u>STARTING</u>) 4. Test and replace as needed. 5. Check and adjust gap as needed. 6. Clean system and replace fuel filter. 7. Test fuel pump and replace as needed. 8. Check for a skipped timing belt or a loose camshaft sprocket.
ENGINE STALLS OR IDLES ROUGH	1. Idle speed too low. 2. Incorrect fuel mixture. 3. Intake manifold leakage. 4. Faulty coil(s).	1. Test minimum air flow. 2. (Refer to <u>POWERTRAIN DIAGNOSTIC PROCEDURES</u>) 3. Inspect intake manifold gasket, manifold, and vacuum hoses. 4. Test and replace as necessary. (Refer to <u>IGNITION CONTROL</u>)

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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. 6. Low compression. 7. Burned, warped, or pitted valves. 8. Plugged or restricted exhaust system. 9. Faulty coil(s).	1. Set gap as needed or replace plug(s). 2. Clean system and replace fuel filter. 3. Test and replace as necessary. 4. Correct valve timing as needed. 5. Replace cylinder head gasket. 6. Test compression of each cylinder. 7. Replace valves. 8. Check exhaust system restriction. Replace parts, as necessary. 9. Test and replace as necessary. (Refer to <u>IGNITION CONTROL</u>)
ENGINE MISSES ON ACCELERATION	1. Dirty or incorrectly gapped spark plugs. 2. Contamination in Fuel System. 3. Burned, warped, or pitted valves. 4. Faulty coil(s).	1. Set gap as needed or replace plug(s). 2. Clean fuel system and replace fuel filter. 3. Replace valves. 4. Test and replace as necessary. (Refer to <u>IGNITION CONTROL</u>)
ENGINE MISSES AT HIGH SPEED	1. Dirty or incorrect spark plug gap. 2. Faulty coil(s). 3. Dirty fuel injector(s). 4. Contamination in fuel system.	1. Set gap as needed or replace plug(s). 2. Test and replace as necessary. (Refer to <u>IGNITION CONTROL</u>) 3. Test and replace as necessary.) 4. Clean system and replace fuel filter.

DIAGNOSIS AND TESTING - ENGINE MECHANICAL**DIAGNOSIS AND TESTING - ENGINE MECHANICAL**

CONDITION	POSSIBLE CAUSES	CORRECTION
	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.	1. Check and correct engine oil level. 2. Change oil to correct viscosity. 3. a. Change oil and filter. b. Run engine to operating temperature. c. Change oil and filter again. 4. Check and correct engine oil level.

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

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OIL PRESSURE DROP	4. Clogged oil filter. 5. Worn parts in oil pump. 6. Thin or diluted oil. 7. Oil pump relief valve stuck. 8. Oil pump suction tube loose. 9. Oil pump cover warped or cracked. 10. Excessive bearing clearance.	4. Install new oil filter. 5. Replace worn parts or pump. 6. Change oil to correct viscosity. 7. Remove valve and inspect, clean, or replace. 8. Remove oil pan and install new tube or clean, if necessary. 9. Install new oil pump. 10. Measure bearings for correct clearance.
OIL LEAKS	1. Misaligned or deteriorated gaskets. 2. Loose fastener, broken or porous metal part. 3. Misaligned or deteriorated cup or threaded plug.	1. Replace gasket(s). 2. Tighten, repair or replace the part. 3. Replace as necessary.
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. Clean pistons and install new rings. 4. Remove rings and check grooves. If groove is not proper width, replace piston. 5. Replace cylinder head(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(R). 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 the section, Inspection for Rear Seal Area Leak.
6. If no leaks are detected, turn off the air supply. Remove the air hose, all plugs, and caps. Install the PCV valve and fresh air hose (make-up air). Proceed to next step.
 7. Clean the oil off the suspect oil leak area using a suitable solvent. Drive the vehicle at various speeds approximately 24 km (15 miles). Inspect the engine for signs of an oil leak by using a black light.

NOTE: If oil leakage is observed at the dipstick tube to block location; remove the tube,

clean and reseal using Mopar Stud & Bearing Mount (press fit tube applications only), and for O-ring style tubes, remove tube and replace the O-ring seal.

INSPECTION FOR REAR SEAL AREA LEAKS

Since it is sometimes difficult to determine the source of an oil leak in the rear seal area of the engine, a more involved inspection is necessary. The following steps should be followed to help pinpoint the source of the leak.

If the leakage occurs at the crankshaft rear oil seal area:

1. Disconnect the battery.
2. Raise the vehicle.
3. Remove torque converter or clutch housing cover and inspect rear of block for evidence of oil. Use a black light to check for the oil leak. If a leak is present in this area, remove transmission for further inspection.
 - a. Circular spray pattern generally indicates seal leakage or crankshaft damage.
 - b. Where leakage tends to run straight down, possible causes are a porous block, oil gallery cup plug, bedplate to cylinder block mating surfaces and seal bore. See proper repair procedures for these items.
4. If no leaks are detected, pressurize the 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 - 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(R) Engine RTV GEN II, Mopar(R) ATF-RTV, and Mopar(R) Gasket Maker gasket materials, each have different properties and can not be used in place of the other.

MOPAR(R) 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(R) 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(R) 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(R) 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(R) 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(R) Gasket Sealant is available in a 13 oz. aerosol can or 4 oz./16 oz. can w/applicator.

SEALER APPLICATION

Mopar(R) 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(R) 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(R) Gasket Sealant in an aerosol can should be applied using a thin, even coat sprayed completely over both surfaces to be joined, and both sides of a gasket. Then proceed with assembly. Material in a can

w/applicator can be brushed on evenly over the sealing surfaces. Material in an aerosol can should be used on engines with multi-layer steel gaskets.

STANDARD PROCEDURE - ENGINE GASKET SURFACE PREPARATION

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

Never use the following to clean gasket surfaces:

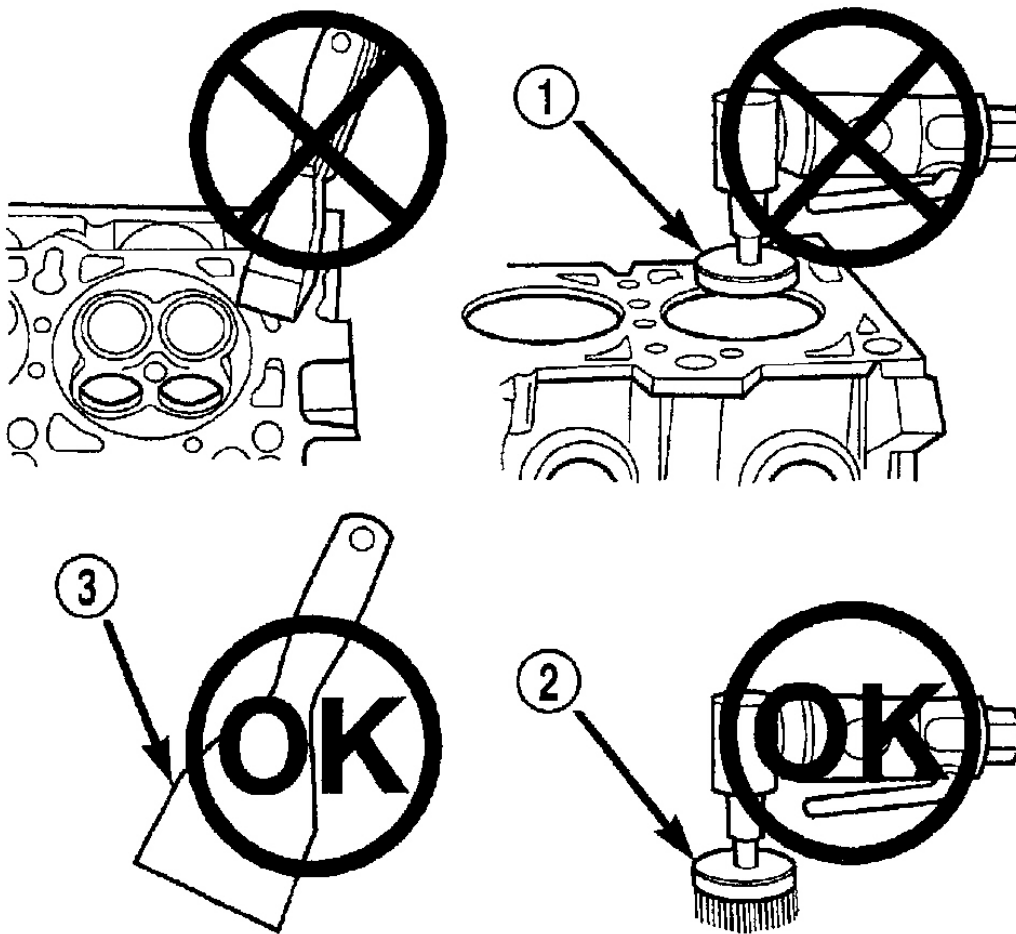
- Metal scraper
- Abrasive pad or paper to clean cylinder block and head
- High speed power tool with an abrasive pad or a wire brush (**Fig. 4**)

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

Only use the following for cleaning gasket surfaces:

- Solvent or a commercially available gasket remover
- Plastic or wood scraper (**Fig. 4**)
- Drill motor with 3M Roloc(tm) Bristle Disc (white or yellow) (**Fig. 4**)

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



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

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Fig. 4: Proper Tool Usage For Surface Preparation
Courtesy of DAIMLERCHRYSLER CORP.

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.

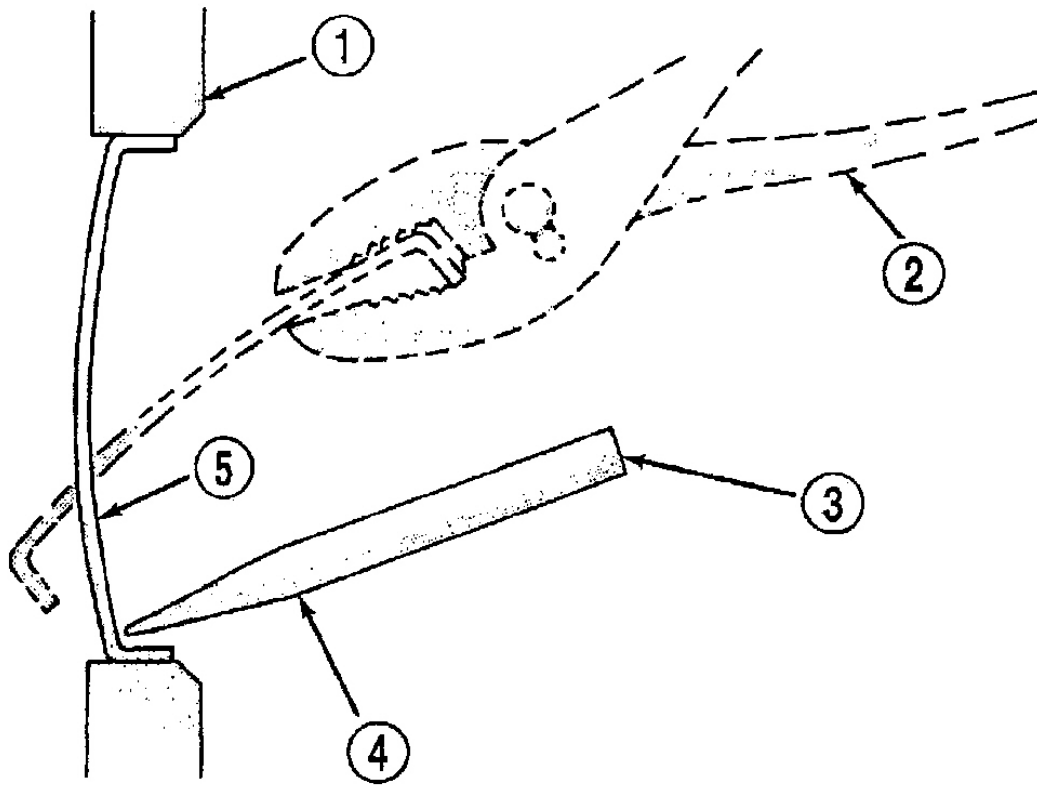
1. Inspect air cleaner, induction system and intake manifold to insure system is dry and clear of foreign material.
2. Remove negative battery cable.
3. Place a shop towel around the spark plugs when removing them from the engine. This will catch any fluid that may possibly be in the cylinder under pressure.
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 - 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(R) 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

NOTE: Capture and store any residual fluid drainage, or leakage from ancillary components, in the appropriately marked containers.

1. Perform the fuel pressure release procedure.
2. Disconnect negative battery cable.
3. Drain the cooling system (Refer to **STANDARD PROCEDURE - COOLING SYSTEM DRAINING**).
4. Remove the engine cover (**Fig. 6**).
5. Remove the cruise control servo.
6. Remove the radiator closure panel.
7. Remove the radiator core support.
8. Remove upper radiator hose.
9. Remove the radiator cooling fan assembly (Refer to **RADIATOR FAN**).
10. Remove air cleaner housing (**Fig. 6**).
11. Evacuate and recover the air conditioning (Refer to **STANDARD PROCEDURE - REFRIGERANT SYSTEM EVACUATE**).
12. Disconnect the throttle and cruise control cables from the throttle body (**Fig. 7**).
13. Disconnect the cruise control and power brake booster vacuum hoses at the engine.
14. Disconnect the transmission wiring harness from the solenoid pack, input and output sensors and the range sensor connectors (**Fig. 8**).
15. Disconnect the engine wiring harness grounds at the left inner frame rail.
16. Disconnect the transmission shift cable.
17. Disconnect the transmission cooler lines (**Fig. 9**).
18. Disconnect the engine block heater wiring connector and set aside (if equipped).
19. Disconnect the coolant reservoir hoses at the thermostat housing (**Fig. 9**).
20. Disconnect the heater hoses at the heater core (**Fig. 9**).
21. Disconnect upper radiator hose at the thermostat housing (**Fig. 9**).

NOTE: Use a brake pedal prop rod and depress the brake pedal to prevent excessive brake fluid loss when the brake system is opened.

22. Disconnect both front brake lines from the Hydraulic Control Unit (HCU) (**Fig. 10**).
23. Disconnect the air condition suction discharge hoses at the air conditioning compressor and plug the compressor openings to prevent contamination.
24. Disconnect lower radiator hose at the engine outlet and remove. (**Fig. 9**).
25. Disconnect A/C clutch electrical connector.
26. Disconnect oil pressure sending unit wiring harness connector.
27. Disconnect the electrical connectors at the generator.

28. Disconnect the fuel supply line at the fuel rail.
29. Disconnect the ignition harness connector at the intake manifold.
30. Raise and support the vehicle.
31. Remove the front wheels.
32. Remove left inner fender well.

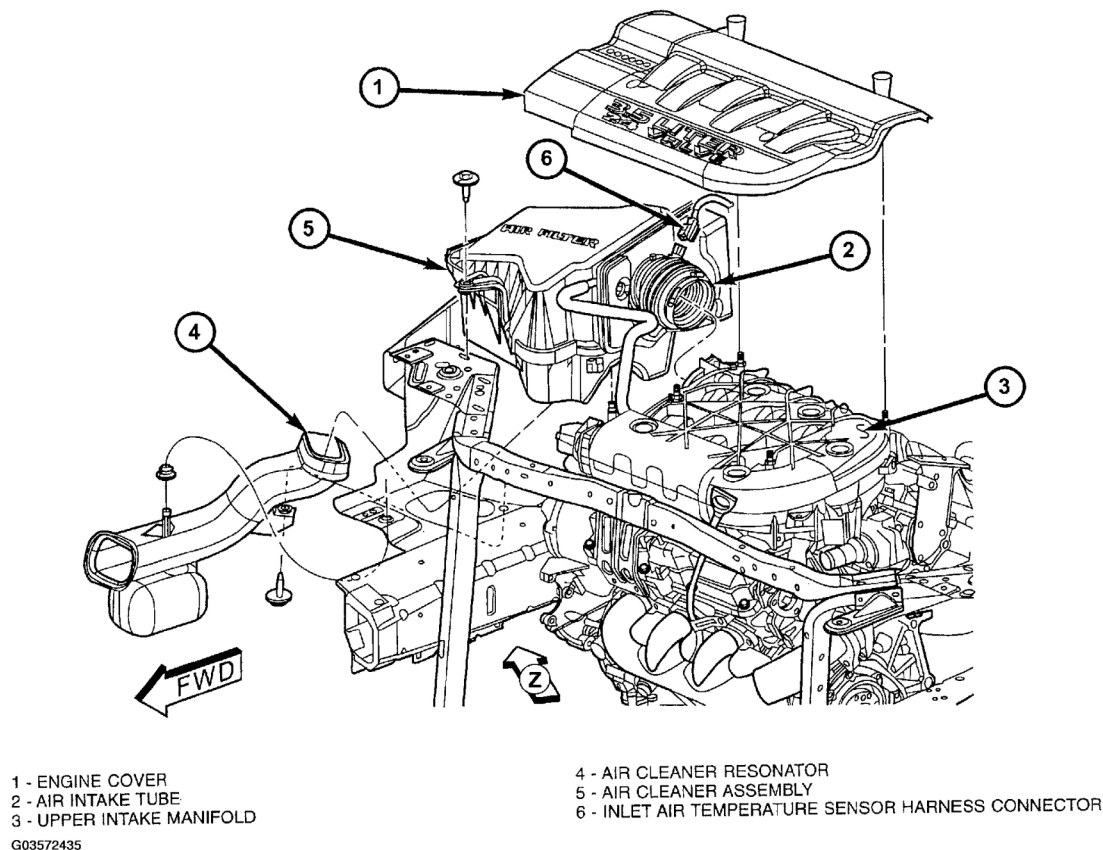
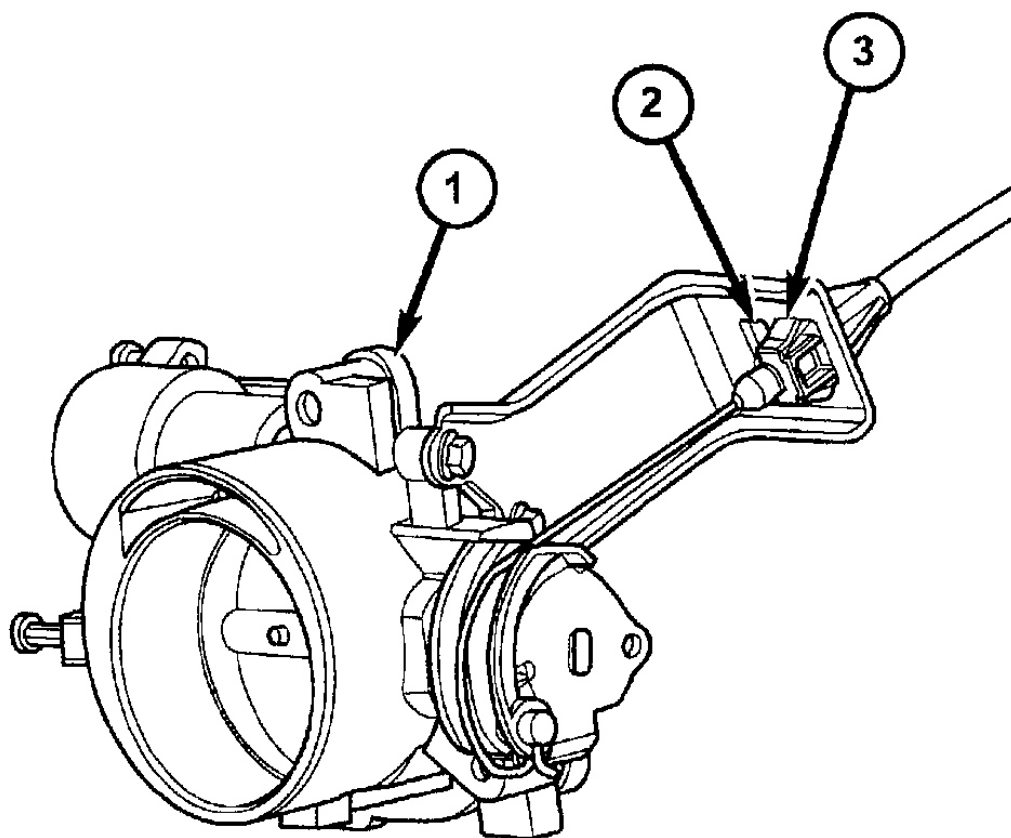


Fig. 6: Identifying Air Intake System
Courtesy of DAIMLERCHRYSLER CORP.

33. Disconnect the engine harness from the powertrain control module (PCM).
34. Disconnect the left wheel speed sensor and retainers (**Fig. 10**).
35. Remove the left sway bar link at the front strut (**Fig. 10**).
36. Remove left drive axle nut (**Fig. 10**).
37. Remove both left steering knuckle pinch bolts (**Fig. 10**).
38. Separate the left steering knuckle from the strut and suitably support steering knuckle (**Fig. 10**).
39. Disconnect the negative battery cable from the transmission.
40. Remove the left fascia screws.
41. Remove right inner fender well.

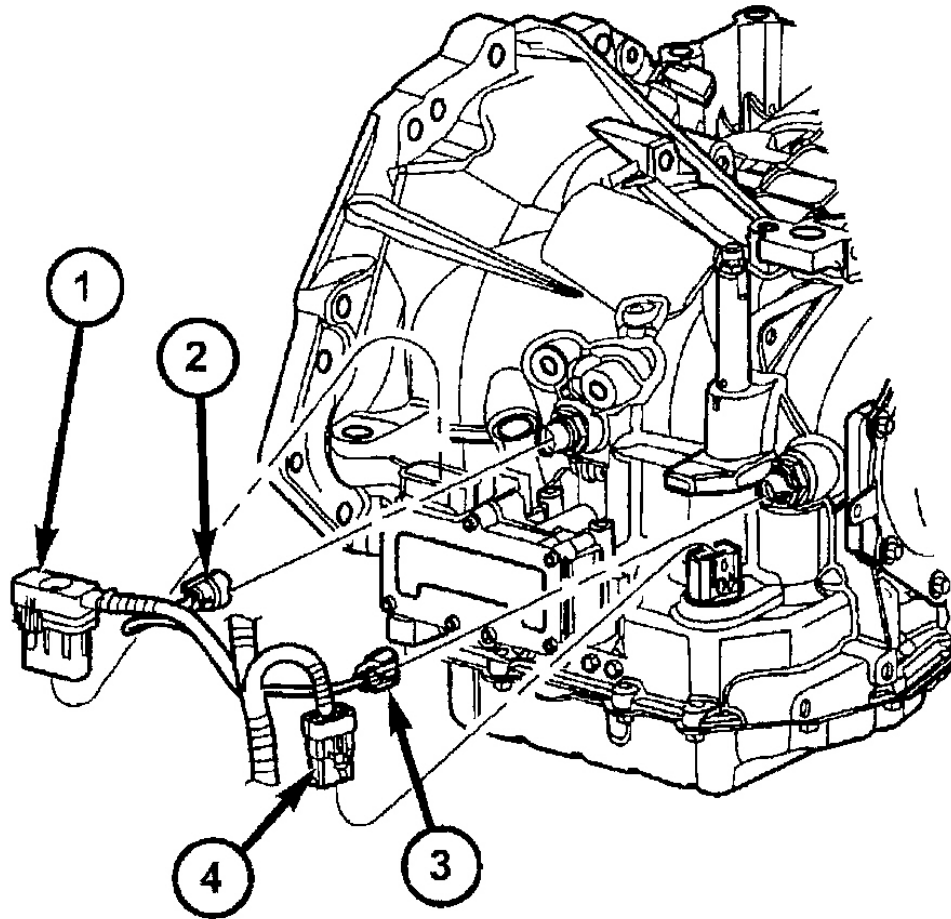
42. Remove right fascia screws.
43. Disconnect the right wheel speed sensor and retainers (**Fig. 10**).
44. Remove right sway bar link at the front strut (**Fig. 10**).
45. Remove right drive axle nut (**Fig. 10**).
46. Remove right steering knuckle pinch bolts (**Fig. 10**).
47. Separate the right steering knuckle from the strut and suitably support the steering knuckle (**Fig. 10**).
48. Unplug fascia driving lamps (if equipped).
49. Remove front fascia.
50. Raise the vehicle.
51. Disconnect the starter wiring connectors and harness retainers.
52. Disconnect the exhaust manifold Oxygen sensor electrical connector (**Fig. 11**).
53. Disconnect the catalytic converter oxygen sensor electrical connector (**Fig. 11**).
54. Remove the exhaust system from the manifold and set aside.



- 1 - THROTTLE BODY
- 2 - SPEED CONTROL CABLE ACCESS
- 3 - THROTTLE CABLE

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Fig. 7: Identifying Throttle Body Components
Courtesy of DAIMLERCHRYSLER CORP.



- 1 - SOLENOID PACK CONNECTOR
- 2 - INPUT SPEED SENSOR CONNECTOR
- 3 - OUTPUT SPEED SENSOR CONNECTOR
- 4 - TRANSMISSION RANGE SENSOR CONNECTOR

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Fig. 8: Identifying Transmission Connectors
Courtesy of DAIMLERCHRYSLER CORP.

- 55. Paint mark the rear driveshaft front and rear positions, then remove the drive shaft (Refer to **PROPELLER SHAFT**).
- 56. Remove the engine to transmission support plate.
- 57. Remove transmission inspection shield.
- 58. Remove the flex plate to torque converter bolts.

CAUTION: Secure the steering wheel to prevent rotation and possible damage to the steering column clock spring when coupling is separated.

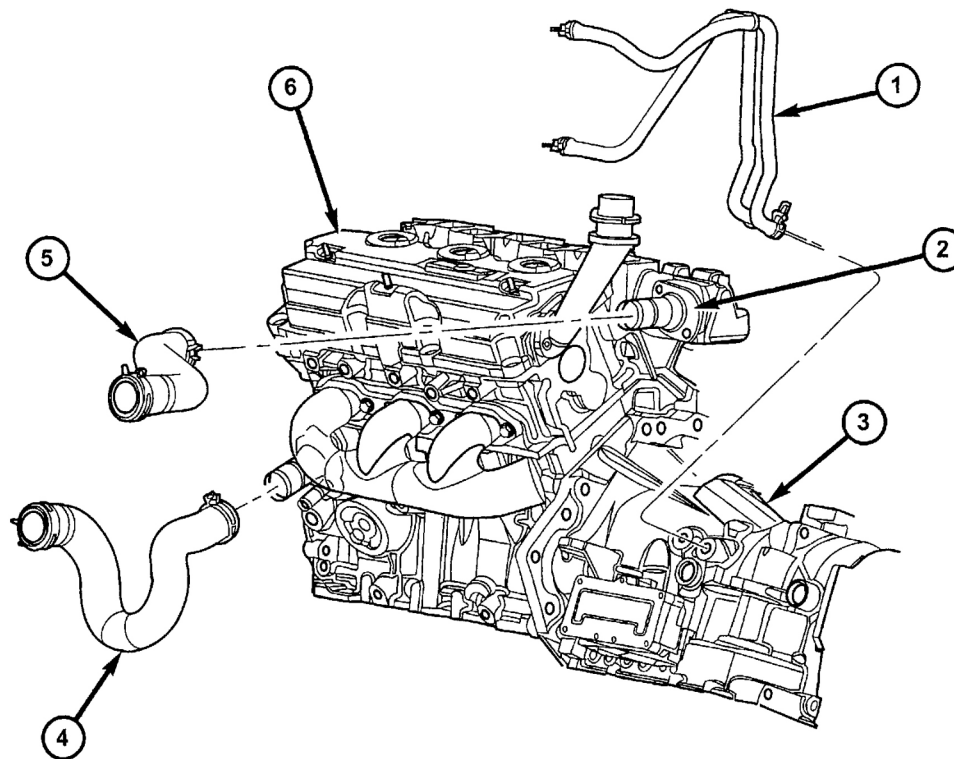
59. Remove the lower steering column coupling pin with special tool 6831-A, and separate union. (**Fig. 12**).
60. Remove both lower engine mount nuts (**Fig. 13**).
61. Paint mark the front cradle to body location and position the engine cradle support under the vehicle (**Fig. 13**).
62. Lower the vehicle until just above the cradle support fixture (**Fig. 13**).
63. Align the cradle support dowels with the cradle access holes (**Fig. 13**).
64. Adjust engine support fixture to fit flush with the oil pan and adjust cradle support fixture arms to fit flush with cradle (**Fig. 14**).
65. Carefully lower the vehicle onto the cradle support fixture.
66. Remove the upper engine mount (Refer to **REMOVAL**).

CAUTION: While slowly separating the body from the cradle assembly, constant checks must be made to assure proper positioning and that no damage to other components or wiring harnesses occur during separation.

67. Carefully remove the front and rear cradle mounting bolts and raise the vehicle to separate the engine, transmission and cradle assembly from the vehicle.
68. Connect engine lifting brackets to engine (**Fig. 15**)
69. Separate the Power Transfer Unit (PTU), (if equipped).
70. Separate the engine and transmission from the engine cradle using the lifting brackets. (**Fig. 15**).
71. Separate the transmission from the engine.

INSTALLATION - ENGINE ASSEMBLY

1. Install transmission and power transfer unit (PTU) (if equipped), onto engine assembly.
2. Mount engine assembly onto cradle assembly.



1 - TRANSMISSION OIL COOLER HOSES
2 - THERMOSTAT HOUSING
3 - TRANSMISSION
G03572438

4 - LOWER RADIATOR HOSE
5 - UPPER RADIATOR HOSE
6 - ENGINE

Fig. 9: Locating Coolant Hoses
Courtesy of DAIMLERCHRYSLER CORP.

3. Carefully position the engine cradle assembly under the vehicle.

CAUTION: While slowly lowering the body to the cradle assembly, constantly check to assure proper positioning and no damage occurs to other components or harnesses until union is made.

4. Lower the vehicle until the union is made between the cradle assembly and body, taking care to align the cradle to body marks.
5. Install the cradle supporting bolts and tighten to 163 N.m (120 lbs. ft.).
6. Install upper engine mount, tighten bolt to timing cover to 54 N.m (40 lbs., ft.). Tighten bolt to right rail 68 N.m (50 lbs.ft.).
7. Slowly raise the vehicle off of the engine cradle support.
8. Insert drive axles into steering knuckles. Tighten nut to 244 N.m (180 lbs. ft.). (Refer to **HUB & BEARING**).
9. Align front steering knuckles with struts and install bolts. Tighten bolts to 244 N.m (180 lbs. ft.). (**Fig. 10**). (Refer to **STEERING KNUCKLE**).

10. Install front wheel speed sensor wire support brackets to the struts (**Fig. 10**). Tighten bolts to 12 N.m (105 lbs. in.).
11. Connect both front wheel speed sensors to wiring harness.
12. Install brake line support bracket to cradle (**Fig. 10**). Tighten bolts to 12 N.m (105 lbs. in.).
13. Connect sway bar links to front struts (**Fig. 10**).
14. Raise vehicle.
15. Install the steering column coupler pin.
16. Connect the engine block heater (if equipped).
17. Connect negative battery cable to transmission.

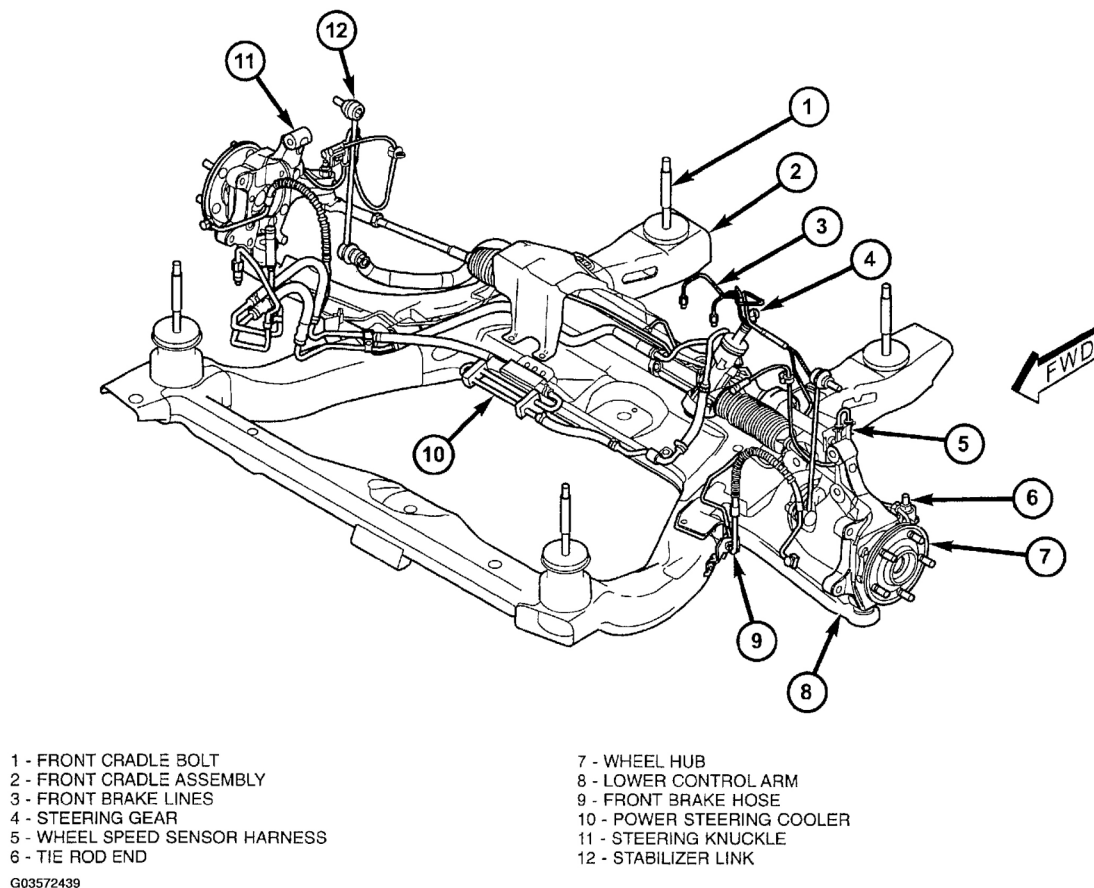
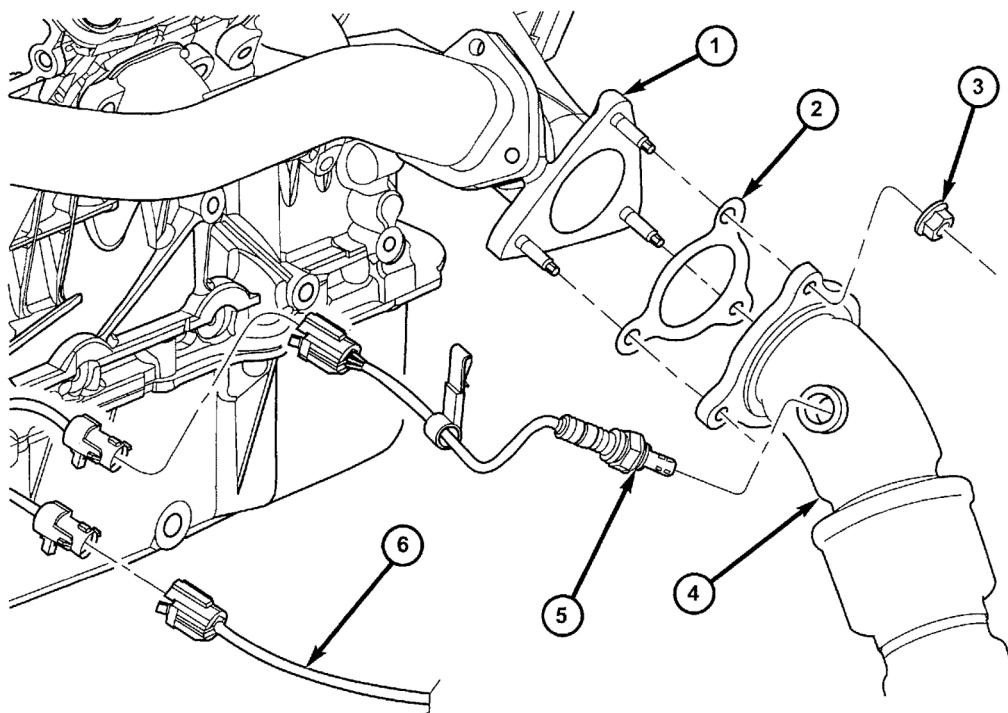


Fig. 10: Identifying Front Cradle Assembly Components
Courtesy of DAIMLERCHRYSLER CORP.

18. Route engine wiring harness connector to PCM and connect.
19. Install inner fender wells.
20. Connect both front driving lights to the front fascia.
21. Install front fascia.
22. Install engine mount nuts and tighten to 101 N.m (75 lbs.ft.).

23. Install flex plate to torque converter bolts. Tighten bolts to 75 N.m (55 lbs.ft.).
24. Install transmission inspection shield. Tighten bolts to 12 N.m (105 lbs. in.).
25. Install engine to transmission support collar-Tighten bolts to 54 N.m (40 lbs. ft.).
26. Properly align and install the drive shaft (Refer to **PROPELLER SHAFT**)
27. Install exhaust system (Refer to **EXHAUST SYSTEM**).
28. Connect exhaust manifold and catalytic converter oxygen sensor electrical connectors (**Fig. 11**).
29. Connect starter wiring and properly position harness wiring.
30. Install front wheels.
31. Lower the vehicle.
32. Connect both front brake lines to the brake system H.C.U. and tighten.
33. Connect the ignition harness connector at the intake manifold.
34. Connect the engine wiring harness and the ground wire on left frame rail
35. Connect transmission cooler lines to transmission (**Fig. 9**).
36. Connect transmission shift cable.



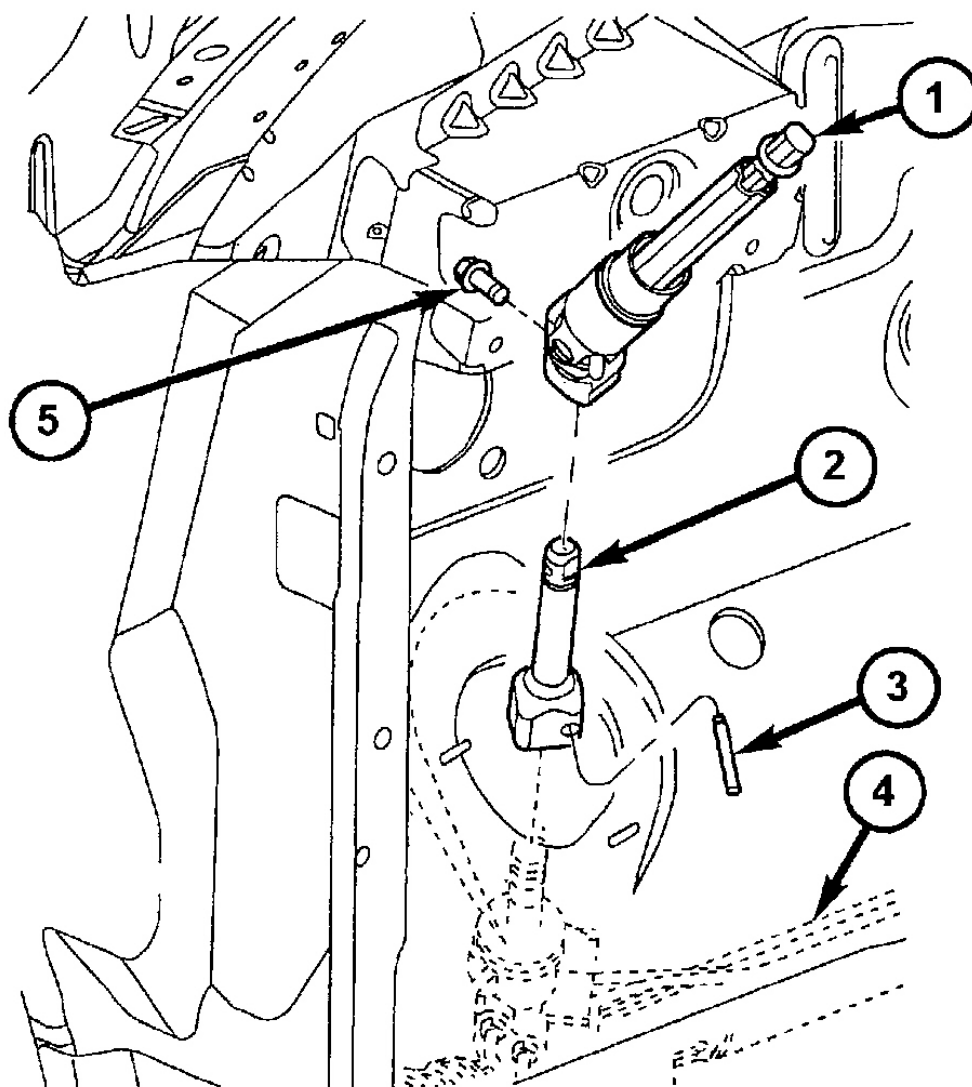
1 - EXHAUST MANIFOLD
2 - GASKET
3 - RETAINING NUT
G03572440

4 - FRONT EXHAUST PIPE
5 - OXYGEN SENSOR 1 OF 2
6 - OXYGEN SENSOR 2 OF 2

Fig. 11: Identifying Front Exhaust Pipe Components
Courtesy of DAIMLERCHRYSLER CORP.

37. Connect transmission solenoid pack, input and output sensors and transmission range sensor.

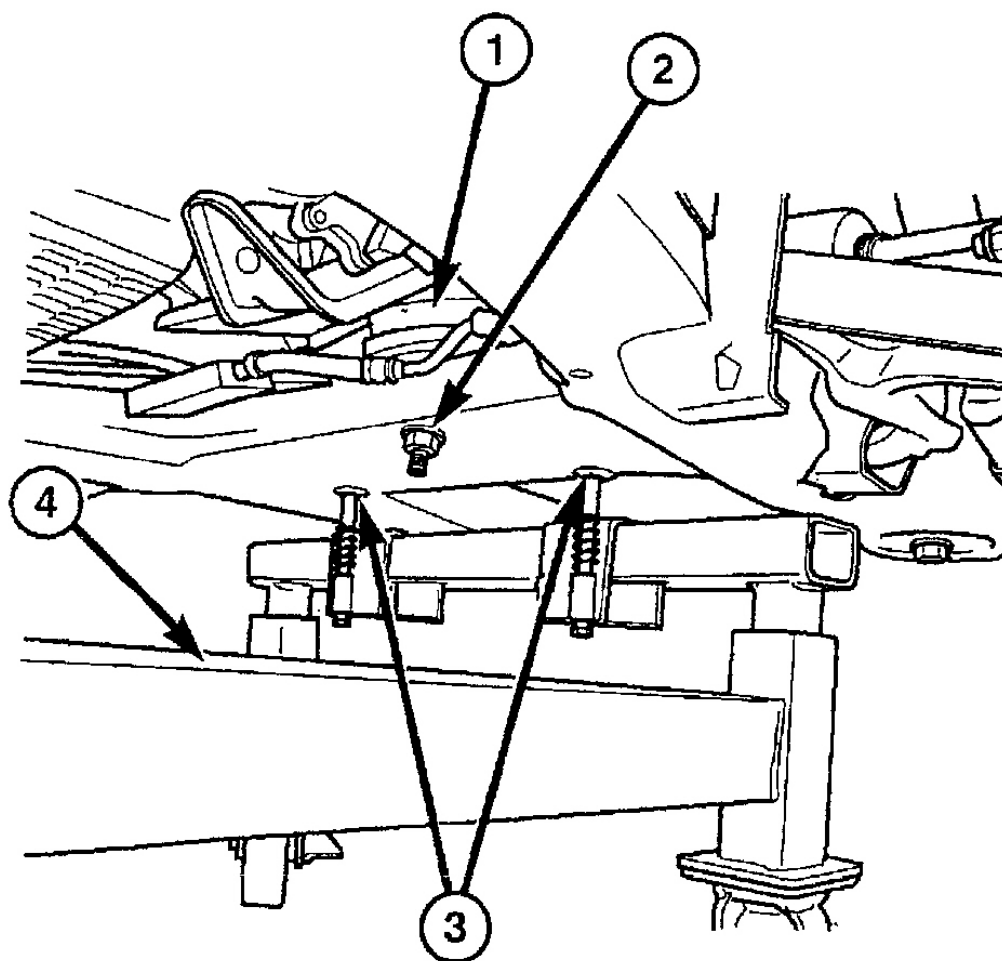
38. Install the cruise control, power brake booster and fuel vapor vacuum hoses to the engine.
39. Connect throttle cable and cruise control cable to throttle body (**Fig. 7**).
40. Connect electrical connectors to generator.
41. Connect oil pressure sending unit wiring harness connector.
42. Connect A/C electrical connector.
43. Connect suction/discharge hose at air conditioning compressor.
44. Connect lower radiator hose to engine (**Fig. 9**).
45. Connect heater hoses to heater core (**Fig. 9**).
46. Connect coolant reservoir hose to thermostat housing (**Fig. 9**).
47. Connect the fuel line to the fuel rail.
48. Install cooling fan assembly (Refer to **RADIATOR FAN**).
49. Install radiator core support.
50. Install radiator close out panel.
51. Connect upper radiator hose (**Fig. 9**).
52. Install the cruise control servo.
53. Install air cleaner housing (**Fig. 6**).
54. Install the engine cover (**Fig. 6**).
55. Install new oil filter. Fill engine crankcase with proper oil to correct level.
56. Connect negative battery cable to battery.
57. Fill the cooling system (Refer to **STANDARD PROCEDURE - COOLING SYSTEM FILLING**).
58. Bleed brakes.
59. Start engine and run until operating temperature is reached and radiator fans cycle.
60. Evacuate and recharge air conditioning.
61. Check all fluid levels and properly fill.
62. Check front end alignment.



- 1 - LOWER STEERING COLUMN COUPLING ASSEMBLY
- 2 - INTERMEDIATE SHAFT TO STEERING GEAR
- 3 - PIN
- 4 - STEERING GEAR
- 5 - EXTENSION TO SHAFT BOLT

G03572441

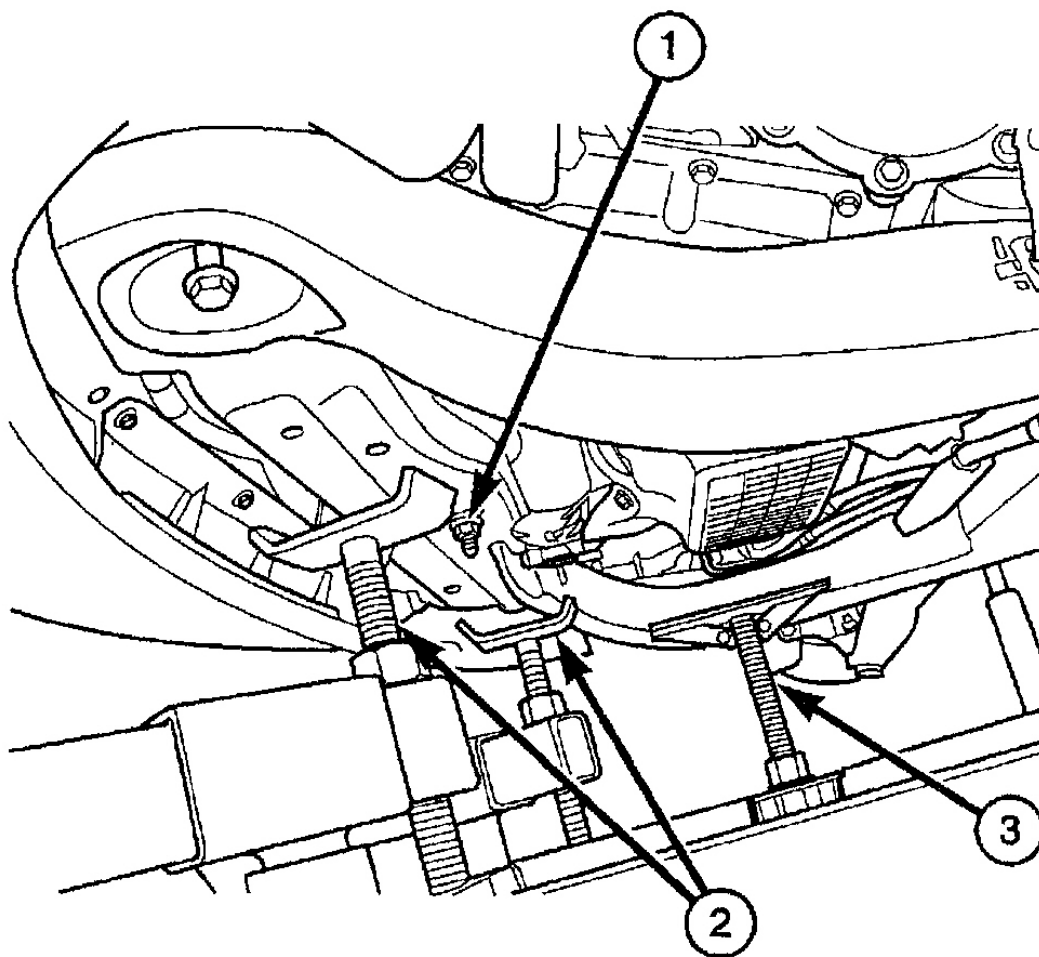
Fig. 12: Identifying Steering Column Coupling Components
Courtesy of DAIMLERCHRYSLER CORP.



- 1 - RIGHT LOWER ENGINE MOUNT
- 2 - RIGHT LOWER ENGINE MOUNT NUT
- 3 - ALIGNMENT DOWEL ACCESS HOLES
- 4 - CRADLE SUPPORT FIXTURE

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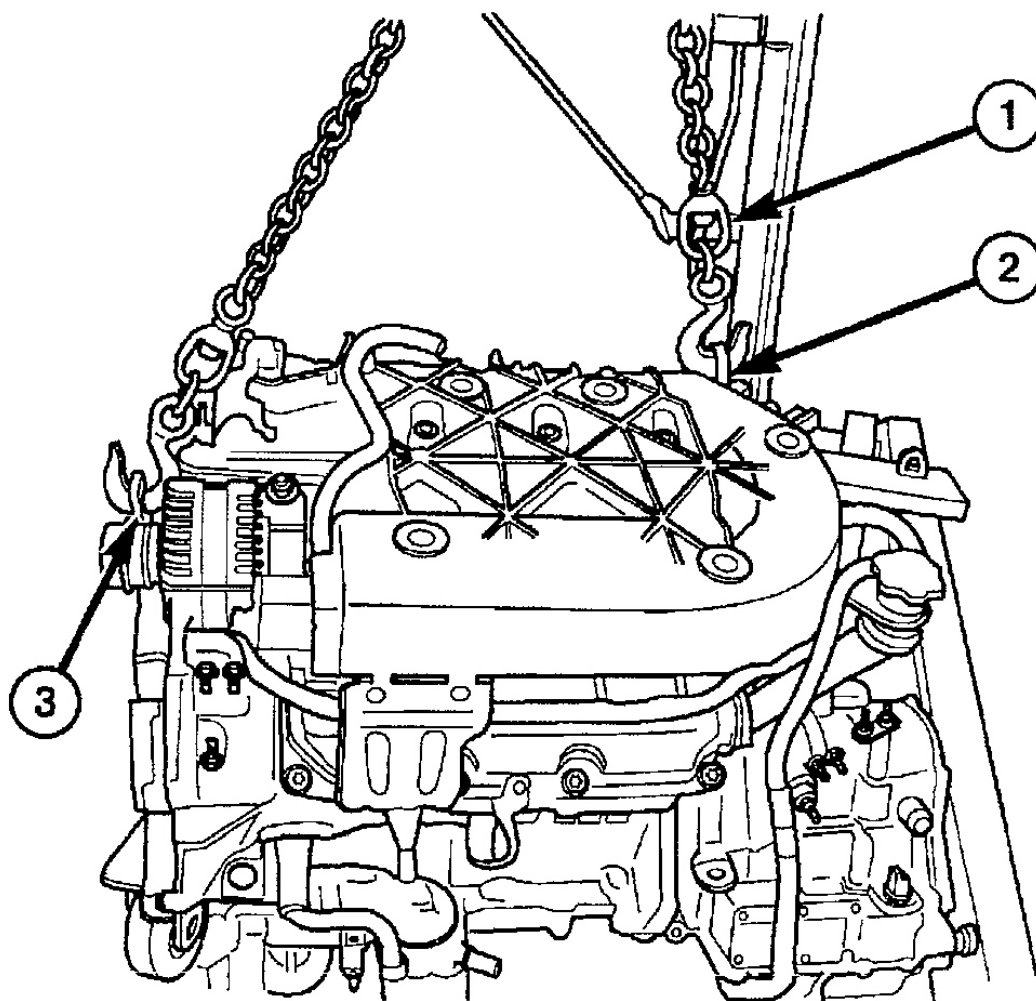
Fig. 13: Locating Cradle Support Fixture - Rear
Courtesy of DAIMLERCHRYSLER CORP.



- 1 - LEFT LOWER ENGINE MOUNT NUT
- 2 - CRADLE SUPPORT FIXTURE ARMS
- 3 - CRADLE SUPPORT FIXTURE ENGINE STABILIZER

G03572443

Fig. 14: Locating Cradle Support Fixture - Front
Courtesy of DAIMLERCHRYSLER CORP.



- 1 - SUITABLE LIFTING CHAIN
- 2 - 8537-7 PART OF KIT 8537-12
- 3 - 8537-15 PART OF KIT 8537-12

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Fig. 15: Locating Engine Lifting Bracket
Courtesy of DAIMLERCHRYSLER CORP.

SPECIFICATIONS

SPECIFICATIONS - 3.5L ENGINE

SPECIFICATIONS - 3.5L ENGINE

DESCRIPTION	SPECIFICATION
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2004 Chrysler Pacifica

2004 ENGINE Engine 3.5L - Pacifica

Type	60° SOHC V-6 24-Valve
Displacement	3.5 Liters (214 Cubic Inches)
Bore and Stroke	96.0 x 81.0 mm (3.780x3.189 in.)
Compression Ratio	10:1
Lead Cylinder	#1 Right Bank
Firing Order	1-2-3-4-5-6
Cylinder Block	
Cylinder Bore Diameter	96.0 mm +/-0.0076 (3.780 in. +/-0.0003 in.)
Out-of-Round (Max.)	0.076 mm (0.003 in.)
Taper (Max.)	0.051 mm (0.002 in.)
Pistons	
Type Material	Aluminum (Full Floating Pins)
Piston Diameter	95.98 +/- 0.019 mm (3.7788 +/- 0.0008 in.)
Clearance at Size Location	-0.007 to +0.047 mm (-0.0003 to +0.0018 in.)
Piston Weight - A Weight	438-443 grams (15.45-15.62 oz.)
-B Weight	433-438 grams (15.27-15.45 oz.)
Piston Ring Groove Diameter	87.4-87.6 mm (3.441-3.449 in.)
-No. 1	86.3-86.5 mm (3.397-3.4055 in.)
-No. 2	85.8-86.0 mm (3.378-3.385 in.)
-No. 3	
Piston Pins	
Type	Full Floating
Clearance in Piston	0.005-0.015 mm (0.0002-0.0006 in.)
Clearance in Rod	0.007-0.018 mm (0.0003-0.007 in.)
Diameter	23.997-24.000 mm (0.9448-0.9449 in.)
Piston Rings	
Ring Gap-Top Compression Ring	0.20-0.36 mm (0.008-0.014 in.)
Ring Gap-2nd Compression Ring	0.23-0.50 mm (0.0091-0.0197 in.)
Ring Gap-Oil Control (Steel Rails)	0.25-0.76 mm (0.010-0.030 in.)
Ring Side Clearance	
Top and Second Compression Ring	0.04-0.08 mm (0.0016-0.0031 in.)
Oil Ring (Steel Rails)	0.038-0.184 mm (0.0015-0.0073 in.)
Ring Width	
Top Compression Ring	1.17-1.19 mm (0.0461-0.0469 in.)
2nd Compression Ring	1.47-1.49 mm (0.058-0.059 in.)
Oil Ring (Steel Rings)	0.445-0.470 mm (0.0176-0.0186 in.)
Connecting Rods	
Bearing Clearance	0.019-0.081 mm (0.0007-0.0031 in.)
Piston Pin Bore Diameter	24.0076-24.0153 mm (0.9452-0.9455 in.)
Side Clearance (Max.)	0.39 mm (0.0153 in.)

2004 Chrysler Pacifica

2004 ENGINE Engine 3.5L - Pacifica

Total Weight (Less Bearing)	647 grams (22.8223 oz.)
Crankshaft Main Bearing Journals	
Diameter	63.987-64.013 mm (2.519-2.520 in.)
Main Bearing Diametrical Clearance -(Max. Allowable)	0.011-0.077 mm (0.0007-0.0030 in.) 0.087 mm (0.0034 in.)
Out-of-Round (Max.)	0.015 mm (0.0006 in.)
Taper (Max.)	0.015 mm (0.0006 in.)
End Play -(Max.)	0.10-0.30 mm (0.004-0.012 in.) 0.43 mm (0.017 in.)
Connecting Rod Journals	
Diameter	57.982-58.002 mm (2.282-2.283 in.)
Bearing Diametrical Clearance	0.048-0.084 mm (0.001-0.003 in.)
Out-of-Round (Max.)	0.005 mm (0.0001 in.)
Taper (Max.)	0.007 mm (0.0002 in.)
Camshaft	
Bore Diameter	43.038-43.059 mm (1.6944-1.6952 in.)
Bearing Journal Diameter	42.939-42.960 mm (1.6905-1.6913 in.)
Diametrical Clearance -(Max.)	0.078-0.12 mm (0.003-0.0047 in.) 0.15 mm (0.0059 in.)
End Play	0.03-0.35 mm (0.001-0.014 in.)
Valve Timing-Intake Valve	
Opens (ATDC)	3°
Closes (ABDC)	61°
Duration	238°
Centerline	122°
Valve Timing-Exhaust Valve	
Opens (BBDC)	56°
Closes (ATDC)	16°
Duration	252°
Centerline	110°
Valve Overlap	13°
Cylinder Head	
Gasket Thickness (Compressed)	1.78 mm (0.059 in.)
Valve Seat Angle	45-45.5°
Valve Seat Runout (Max.)	0.051 mm (0.002 in.)
Valve Seat Width-Intake	0.8-1.2 mm (0.031-0.0472 in.)
Valve Seat Width - Exhaust	1.3-1.7 mm (0.05-0.067 in.)
Guide Bore Diameter (Std.)	6.975-7.00 mm (0.2746-0.2756 in.)
Valve Guide Height ⁽¹⁾	9.5-10.5 mm (0.3740-0.4134 in.)
Valves	
Face Angle	44.5-45°

2004 Chrysler Pacifica

2004 ENGINE Engine 3.5L - Pacifica

Head Diameter-Intake	36.37-36.63 mm (1.4319-1.4421 in.)
Head Diameter-Exhaust	28.87-29.13 mm (1.1366-1.1469 in.)
Length-Intake (Overall)	114.41-114.99 mm (4.5043-4.5272 in.)
Length-Exhaust (Overall)	125.67-126.25 mm (4.9476-4.9705 in.)
Stem Diameter-Intake	6.935-6.953 mm (0.2730-0.2737 in.)
Stem Diameter-Exhaust	6.906-6.924 mm (0.2719-0.2726 in.)
Stem-to-Guide Clearance-Intake -(Max.) Rocking Method	0.022-0.065 mm (0.0009-0.0026 in.) 0.29 mm (0.0114 in.)
Stem-to-Guide Clearance-Exhaust -(Max.) Rocking Method	0.051-0.094 mm (0.002-0.0037 in.) 0.370 mm (0.0146 in.)
Valve Lift-Intake (Zero Lash)	8.55 mm (0.3367 in.)
Valve Lift-Exhaust (Zero Lash)	6.53 mm (0.2571 in.)
Valve Margin - Intake:	0.835-1.165 mm (0.0329-0.0459 in.)
Valve Margin - Exhaust:	1.44-1.77 mm (0.0567-0.0697 in.)
Valve Stem Tip Height-Intake	42.366-43.655 mm (1.6680-1.7187 in.)
Valve Stem Tip Height-Exhaust	44.705-45.986 mm (1.760-1.8105 in.)
Valve Springs	
Free Length-Intake (Approx.)	43.675 mm (1.7195 in.)
Free Length-Exhaust - Yellow (Approx.)	47.1 mm (1.8543 in.)
Free Length-Exhaust - White (Approx.)	48.3 mm (1.9015 in.)
Spring Force-Intake (Valve Closed)	309-358 N @ 38.0 mm (69.5-80.5 lbs. @ 1.4961 in.)
Spring Force-Exhaust - Yellow (Valve Closed)	314-354 N @ 29.85 mm (71-79 lbs. @ 1.175 in.)
Spring Force-Exhaust - White (Valve Closed)	355-401 N @ 38 mm (80-90 lbs. @ 1.4961 in.)
Spring Force-Intake (Valve Open)	836-907 N @ 29.45 mm (188-204 lbs. @ 1.1594 in.)
Spring Force-Exhaust (Valve Open)	621-687 N @ 31.47 mm (140-154 lbs. @ 1.239 in.)
Number of Coils-Intake	6.86
Number of Coils - Exhaust	7.66
Color of Spring (Top of Coils) -Intake (Right Hand Coil Direction) -Exhaust (Left Hand Coil Direction)	Orange Yellow or White
Wire Diameter-Intake	4.35 mm (0.1712 in.)
Wire Diameter-Exhaust	3.93-- 3.99 mm (0.1547-0.1570 in.)
Spring Installed Height (Spring Seat to Bottom of Retainer)- Intake & Exhaust	38.0 mm (1.4961 in.)
Oil Pump	
Clearance Over Rotors	0.077 mm (0.003 in.)
Cover Out-of-Flat (Max.)	0.025 mm (0.001 in.)
Inner & Outer Rotor Thickness (Min.)	14.299 mm (0.563 in.)

2004 Chrysler Pacifica

2004 ENGINE Engine 3.5L - Pacifica

Outer Rotor Thickness (Max.)	0.39 mm (0.015 in.)
Outer Rotor Diameter (Min.)	79.997 mm (3.149 in.)
Tip Clearance Between Rotors (Max.)	0.20 mm (0.008 in.)

Oil Pressure

(NOTE: At Normal Operating Temperatures)

Pressure @ Curb Idle Speed ⁽²⁾	34.47 kPa Min. (5 psi) Min.
Pressure @ 3000 RPM	300-724 kPa (45-105 psi)

(1) Measured from cylinder head surface

CAUTION:

(2) If pressure is zero at curb idle, DO NOT run engine at 3000 RPM.

SPECIFICATIONS - TORQUE**TORQUE SPECIFICATIONS**

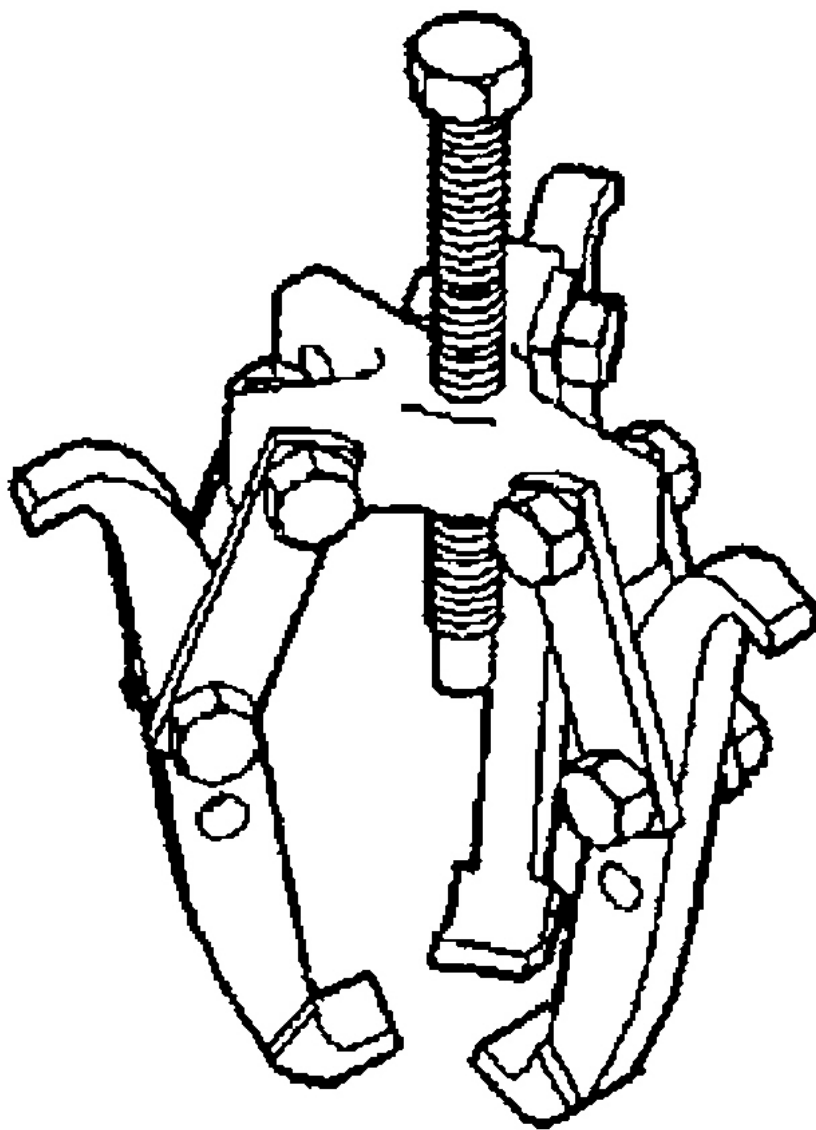
DESCRIPTION	N.m	Ft. Lbs.	In. Lbs.
Camshaft Sprocket Bolt-Right Side	102 + 1/4 Turn	75 + 1/4 Turn	-
Camshaft Sprocket Bolt-Left Side	115 + 1/4 Turn	85 + 1/4 Turn	-
Camshaft Thrust Plate-Bolts	28	-	250
Connecting Rod Cap-Bolts	27 + 1/4 Turn	20 + 1/4 Turn	-
Crankshaft Main Bearing Cap	20 + 1/4 Turn	15 + 1/4 Turn	-
-Inner Main Cap Bolts	27 + 1/4 Turn	20 + 1/4 Turn	-
-Outer Main Cap Bolts	28	-	250
-Tie Bolts (Horizontal)			
Crankshaft Damper-Bolt	95	70	-
Cylinder Head Bolts ⁽¹⁾	61	45	-
-Step 1	88	65	-
-Step 2	88	65	-
-Step 3	+1/4 Turn	+ 1/4 Turn	-
-Step 4			
Cylinder Head Cover-Bolts	12	-	105
Exhaust Manifold to Cylinder Head-Bolts	23	-	200
Exhaust Manifold Heat Shield - Bolts	12	-	105
Flex plate to Crankshaft	95	70	-
Flex plate to Torque Converter	75	55	-
Intake Manifold - Lower	28	-	250
Intake Manifold - Upper	12	-	105
Left Engine Mount to Cradle	75	55	-
Oil Pan	12	-	105
-M6 Bolts	28	-	250
-M8 Bolts			
Oil Pan Drain Plug	27	20	-

2004 Chrysler Pacifica

2004 ENGINE Engine 3.5L - Pacifica

Oil Filter	16	12	-
Oil Pump to Block-Bolts	28	-	250
Oil Pump Cover-Bolts	12	-	105
Oil Pump Pick Up Tube-Bolt	28	-	250
Crankshaft Rear Seal Retainer	12	-	105
Right Engine Mount to Cradle	75	55	-
Rocker Shaft Pedestal Retaining - Bolts	31	-	275
Spark Plugs	28	20	-
Structural Collar	(Refer to INSTALLATION)		
Timing Belt Tensioner-Bolts	28	-	250
Timing Belt Tensioner Pulley Assembly-Bolt	61	45	-
Timing Belt Cover	12	-	105
-M6 Bolts	28	-	250
-M8 Bolts	54	40	-
-M10 Bolts			
Upper Engine Mount to Frame Rail	68	50	-
Upper Engine Mount to timing Cover	54	40	-
(1) Refer to procedure for tightening sequence. (Refer to INSTALLATION)			

SPECIAL TOOLS**3.5L ENGINE**

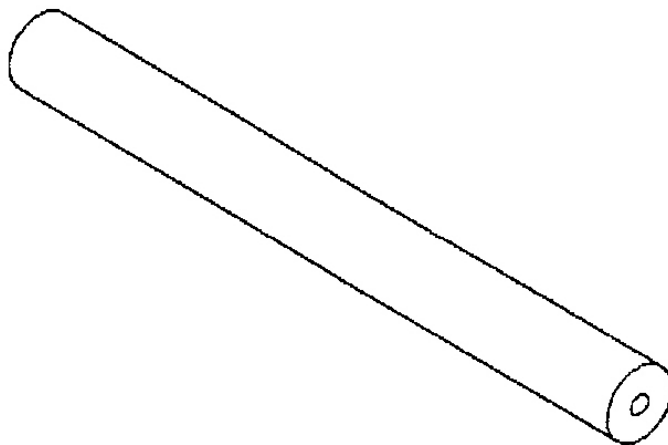


Puller 1023

G03572445

Fig. 16: Identifying Puller 1023

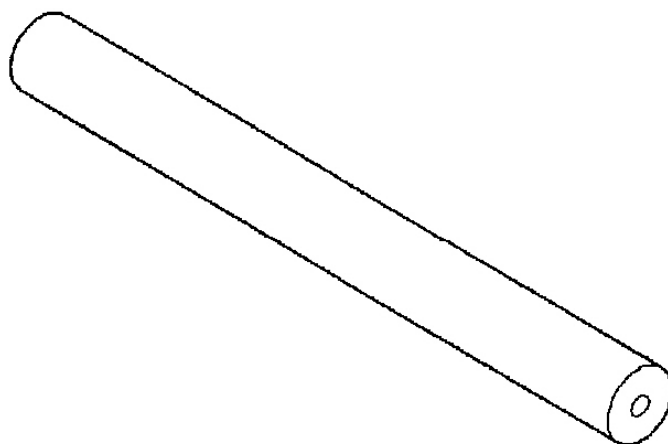
Courtesy of DAIMLERCHRYSLER CORP.



Crankshaft Sprocket Remover Insert C-4685-C2

G03572446

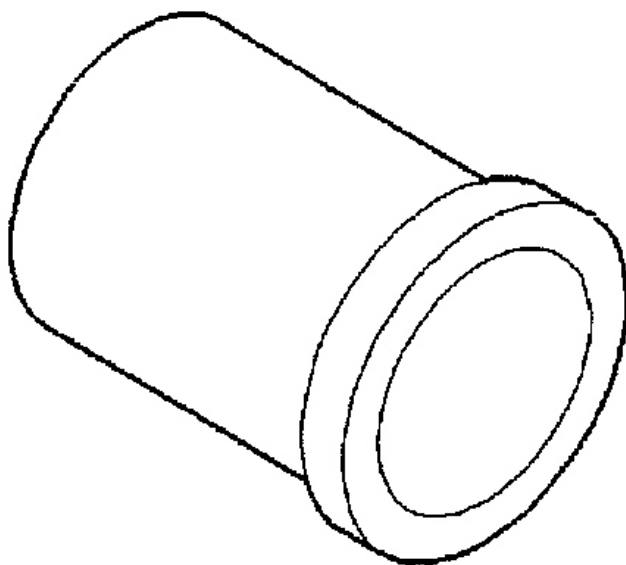
Fig. 17: Identifying Crankshaft Sprocket Remover Insert C-4685-C2
Courtesy of DAIMLERCHRYSLER CORP.



Crankshaft Sprocket Remover Insert C-4685-C2

G03572447

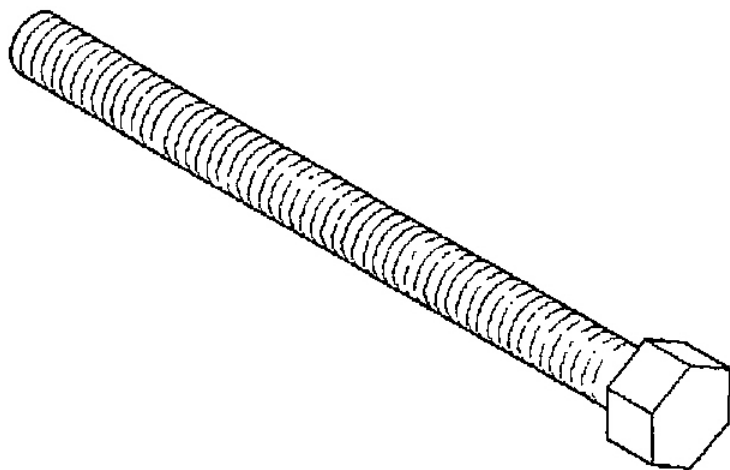
Fig. 18: Identifying Crankshaft Sprocket Remover Insert C-4685-C2
Courtesy of DAIMLERCHRYSLER CORP.



Camshaft Seal Installer MD-998306

G03572448

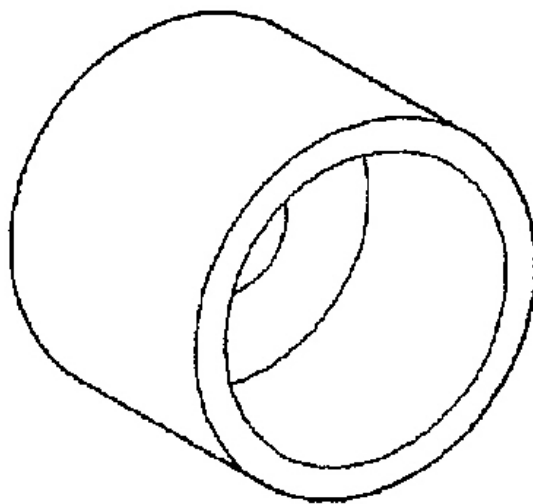
Fig. 19: Identifying Crankshaft Seal Installer MD-998306
Courtesy of DAIMLERCHRYSLER CORP.



Crankshaft Damper Installer Bolt C-4685-C1

G03572449

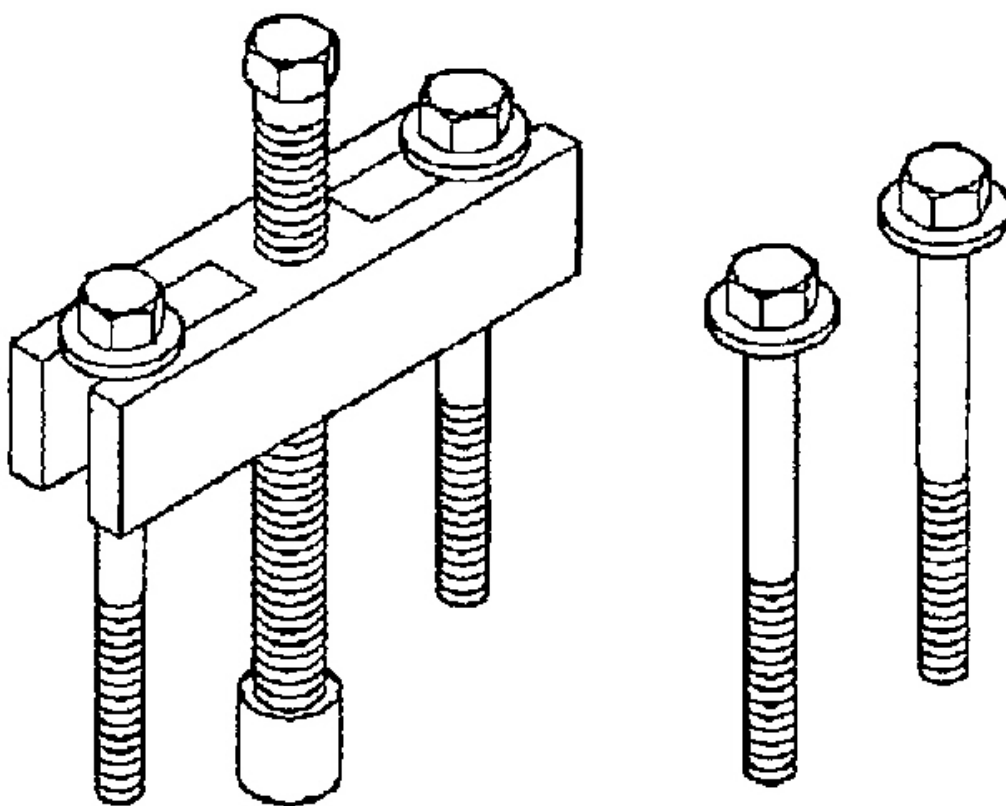
Fig. 20: Identifying Crankshaft Damper Installer Bolt C-4685-C1
Courtesy of DAIMLERCHRYSLER CORP.



Crankshaft Damper Installer 6792-1

G03572450

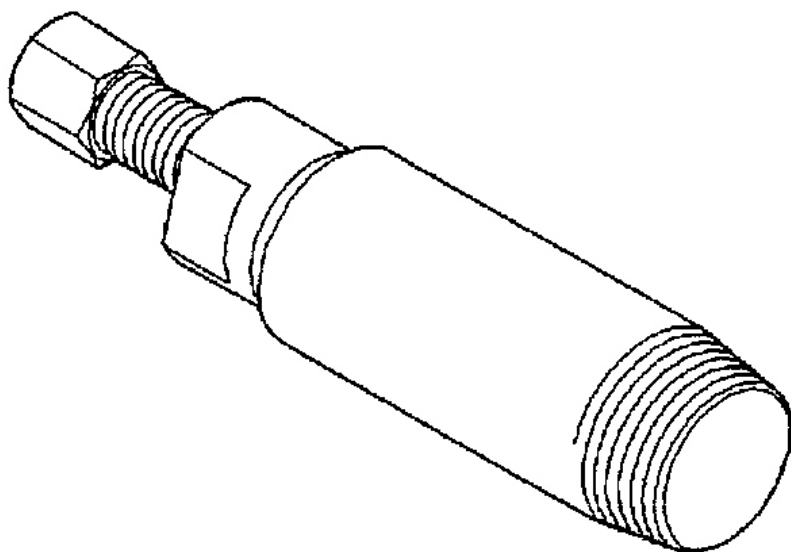
Fig. 21: Identifying Crankshaft Damper Installer 6792-1
Courtesy of DAIMLERCHRYSLER CORP.



Gear Puller L-4407A

G03572451

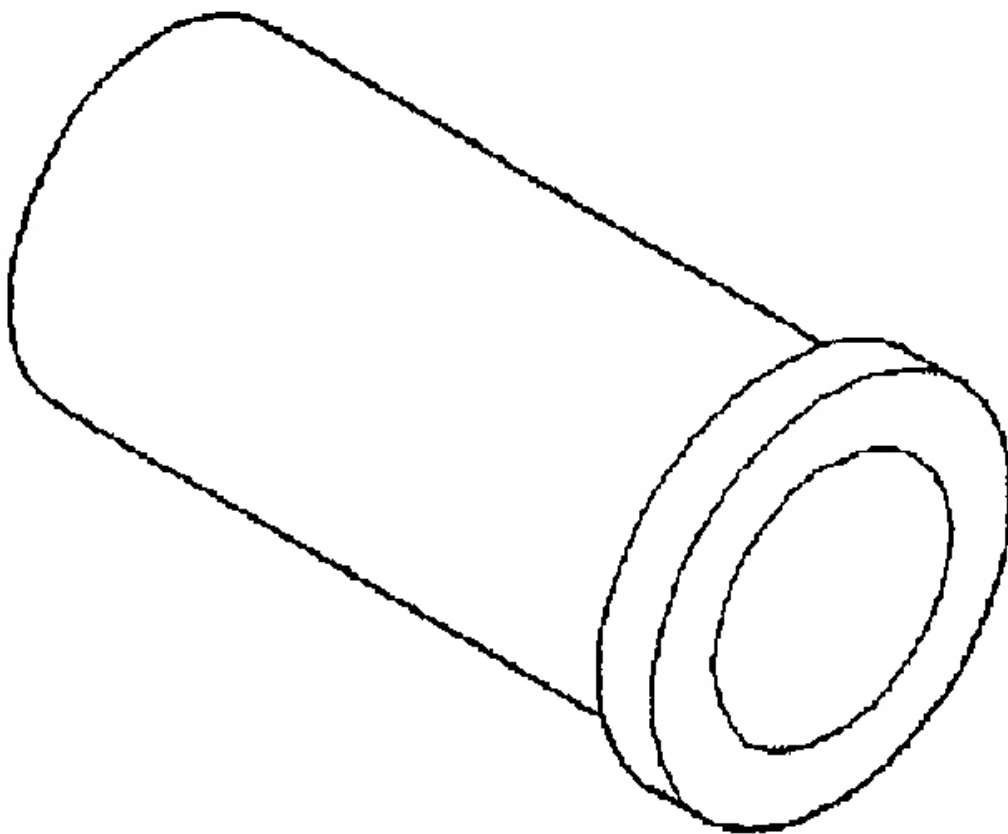
Fig. 22: Identifying Gear Puller L4407A
Courtesy of DAIMLERCHRYSLER CORP.



Front Crankshaft Seal Remover 6341A

G03572452

Fig. 23: Identifying Front Crankshaft Seal Remover 6341A
Courtesy of DAIMLERCHRYSLER CORP.

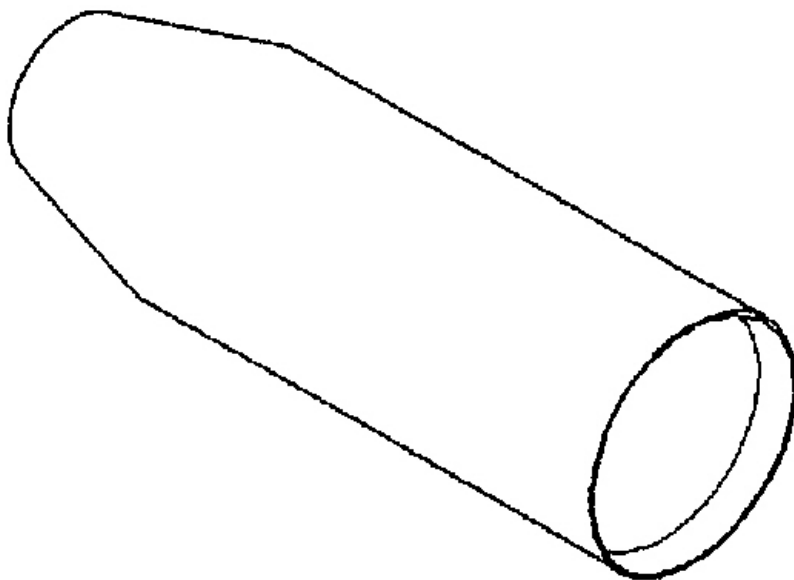


Driver 6342

G03572453

Fig. 24: Identifying Driver 6342

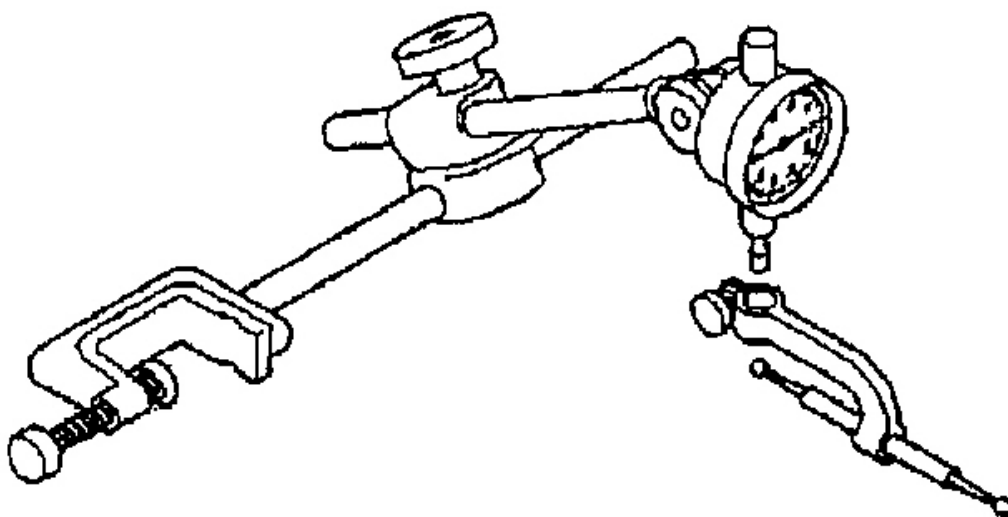
Courtesy of DAIMLERCHRYSLER CORP.



Crankshaft Seal Protector 6780-2

G03572454

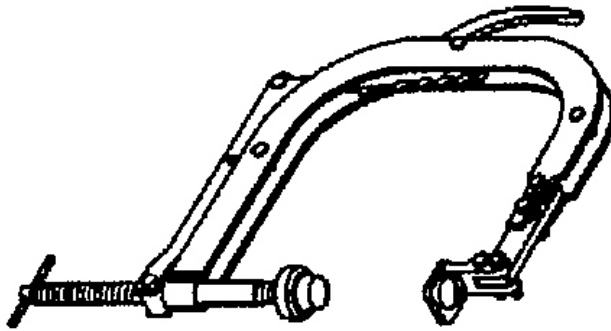
Fig. 25: Identifying Crankshaft Seal Protector 6780-2
Courtesy of DAIMLERCHRYSLER CORP.



DIAL INDICATOR C-3339

G03572455

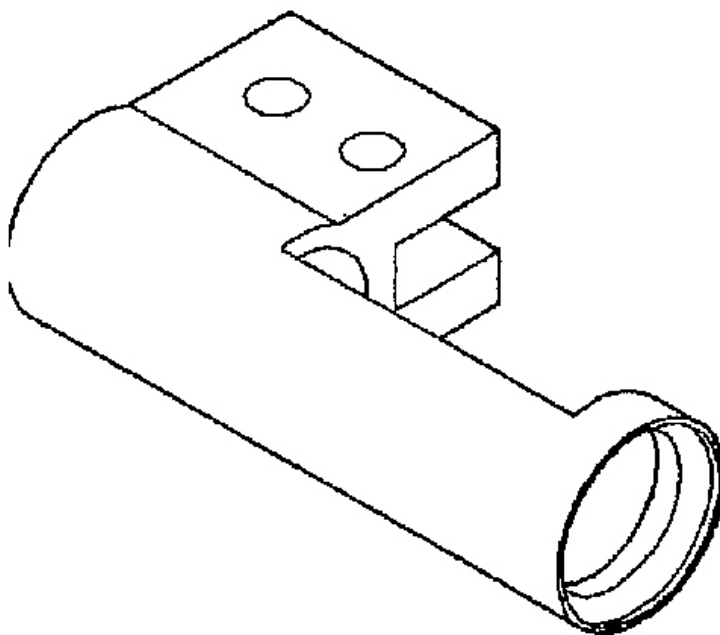
Fig. 26: Identifying Dial Indicator C-3339
Courtesy of DAIMLERCHRYSLER CORP.



Valve Spring Compressor C-3422-D

G03572456

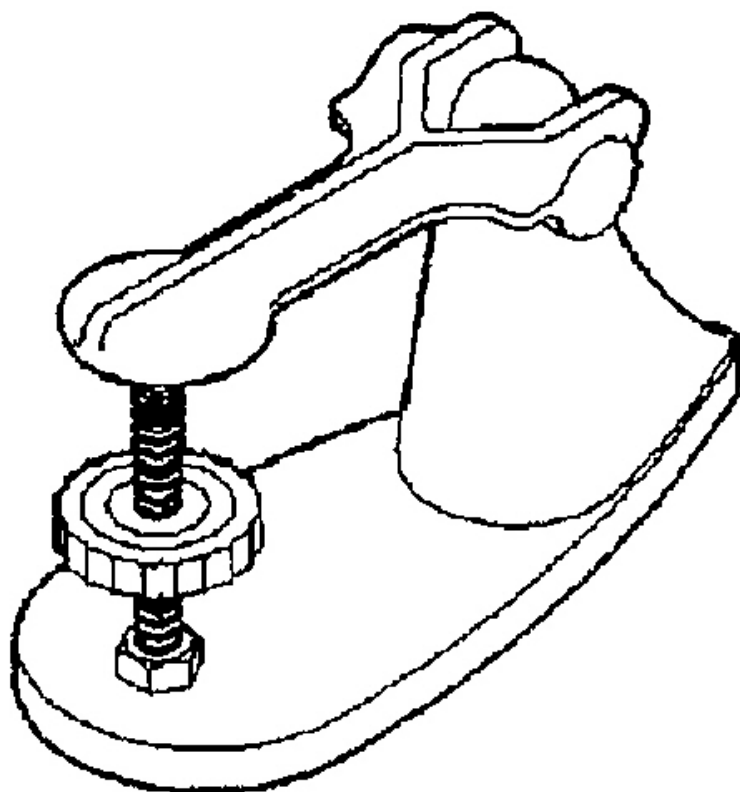
Fig. 27: Identifying Valve Spring Compressor C-3422-D
Courtesy of DAIMLERCHRYSLER CORP.



Spring Compressor Adapter 6526

G03572457

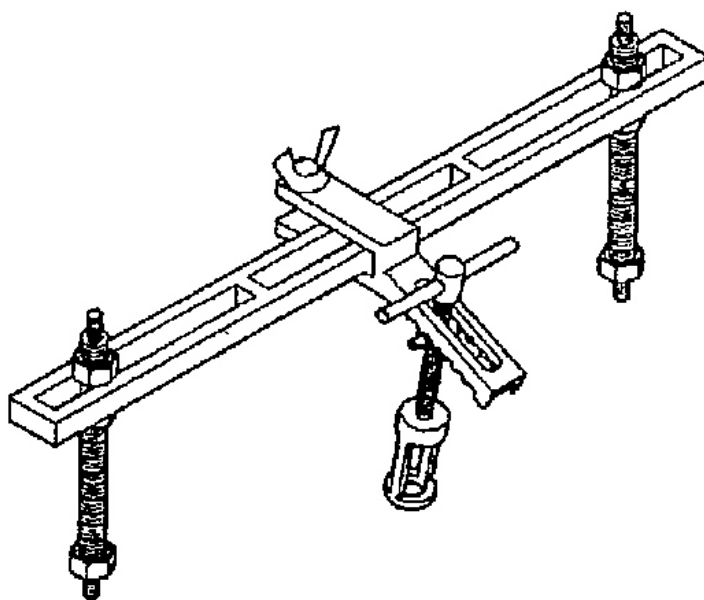
Fig. 28: Identifying Spring Compressor Adapter 6526
Courtesy of DAIMLERCHRYSLER CORP.



Valve Spring Tester C-647

G03572458

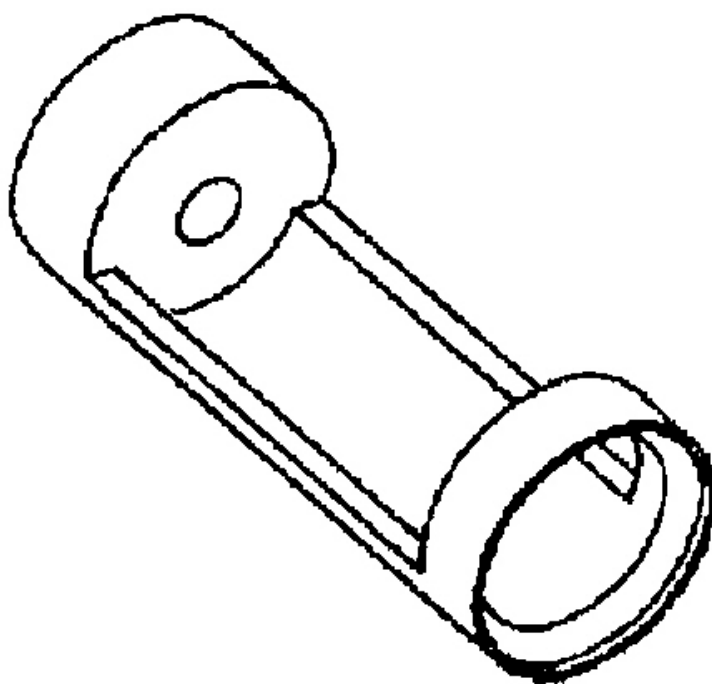
Fig. 29: Identifying Valve Spring Testing C-647
Courtesy of DAIMLERCHRYSLER CORP.



Valve Spring Compressor MD998772A

G03572459

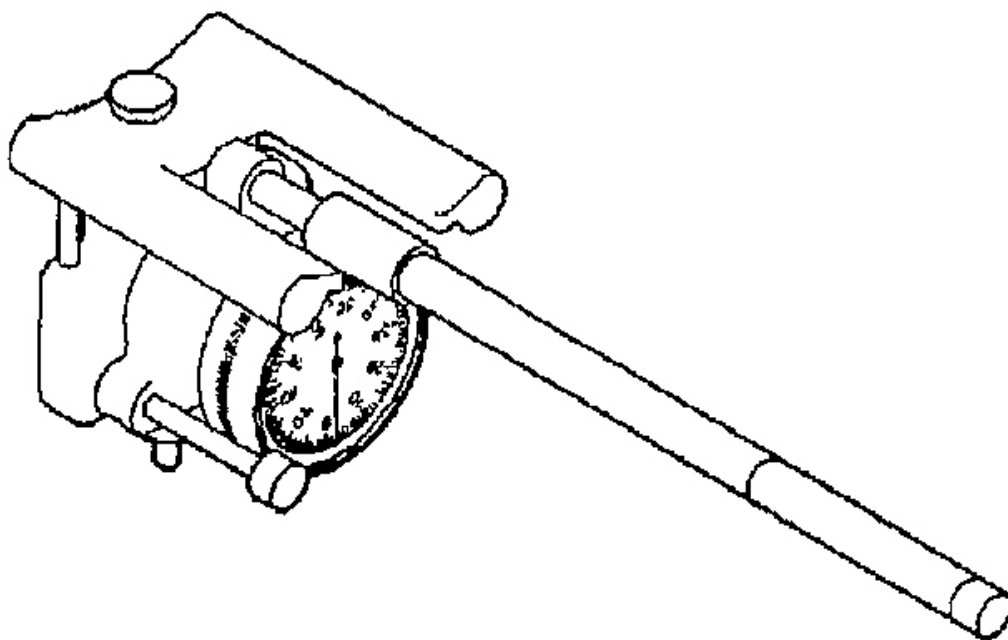
Fig. 30: Identifying Valve Spring Compressor MD998772A
Courtesy of DAIMLERCHRYSLER CORP.



Valve Spring Adapter 6527

G03572460

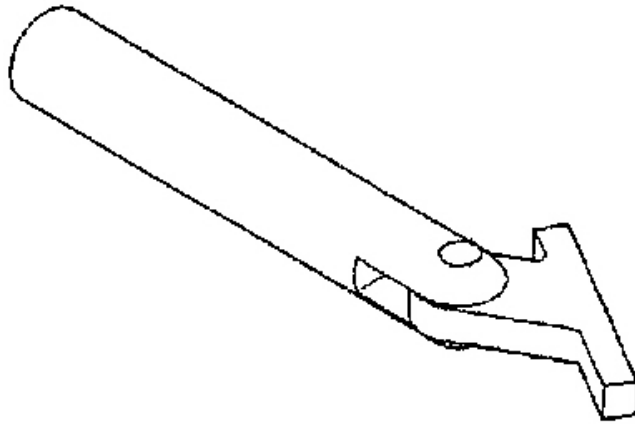
Fig. 31: Identifying Valve Spring Adapter 6527
Courtesy of DAIMLERCHRYSLER CORP.



Indicator, Cylinder Bore C-119

G03572461

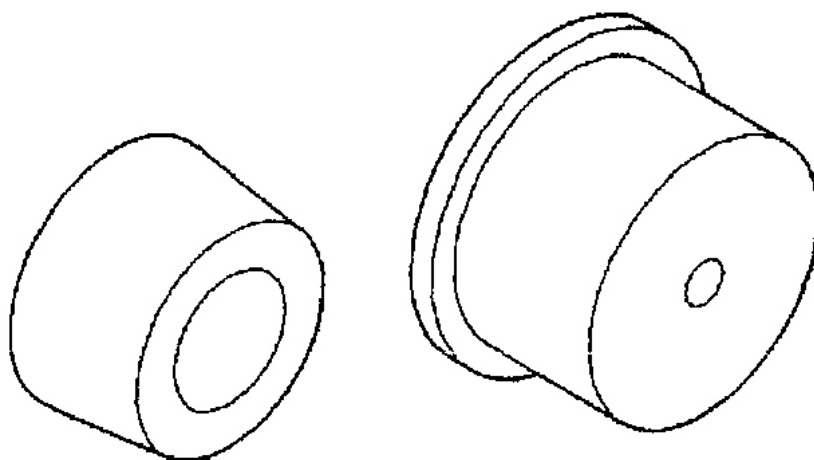
Fig. 32: Identifying Indicator, Cylinder Bore C-119
Courtesy of DAIMLERCHRYSLER CORP.



Crankshaft Main Bearing Remover C-3059

G03572462

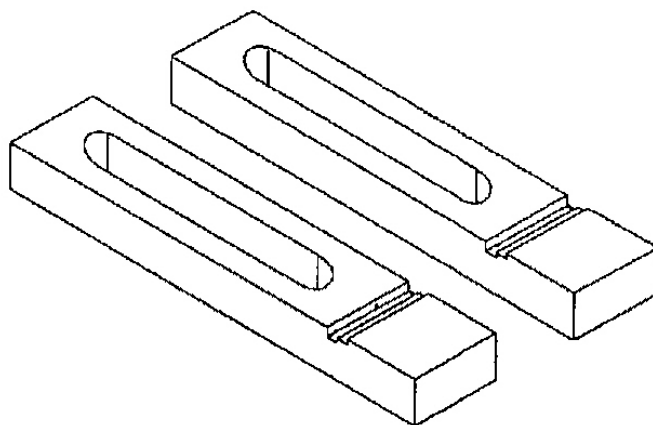
Fig. 33: Identifying Crankshaft Main Bearing Remover C-3059
Courtesy of DAIMLERCHRYSLER CORP.



Rear Crankshaft Oil Seal Installer 6926

G03572463

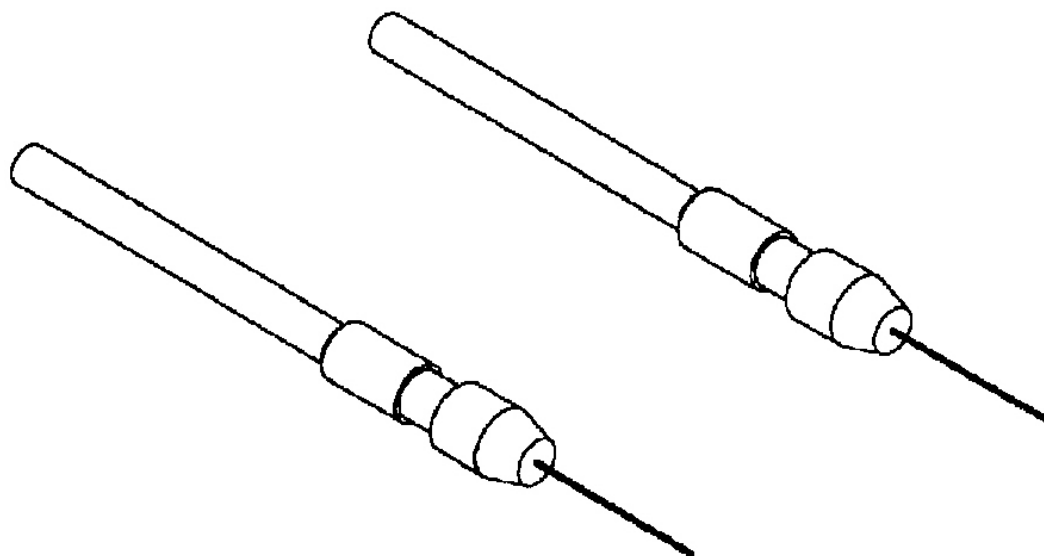
Fig. 34: Identifying Rear Crankshaft Oil Seal Installer 6926
Courtesy of DAIMLERCHRYSLER CORP.



Crankshaft Real Seal Retainer Alignment Fixture 8225

G03572464

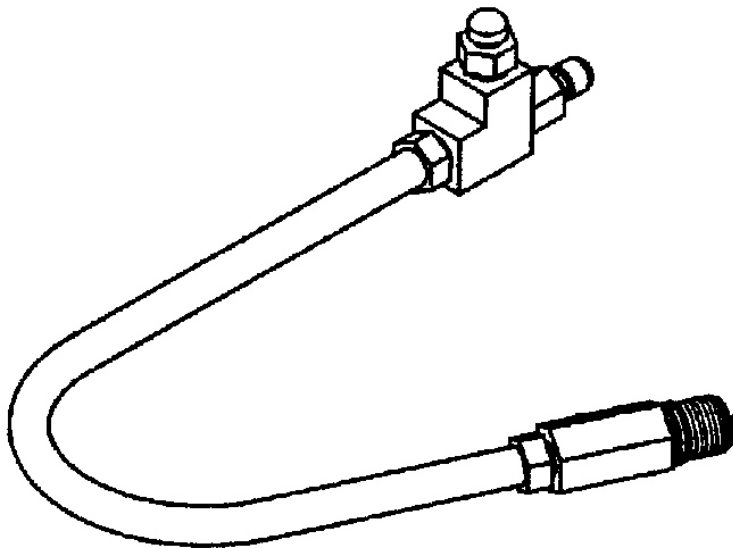
Fig. 35: Identifying Crankshaft Real Seal Retainer Alignment Fixture 8225
Courtesy of DAIMLERCHRYSLER CORP.



Release Probe 8351

G03572465

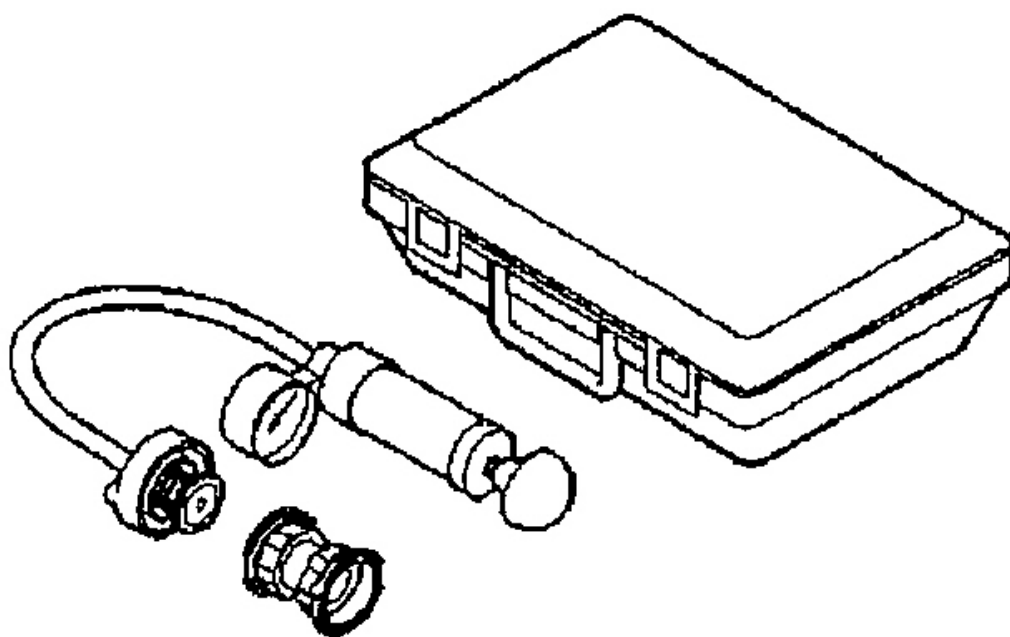
Fig. 36: Identifying Release Probe 8351
Courtesy of DAIMLERCHRYSLER CORP.



Cylinder Compression Pressure Adaptor 8116

G03572466

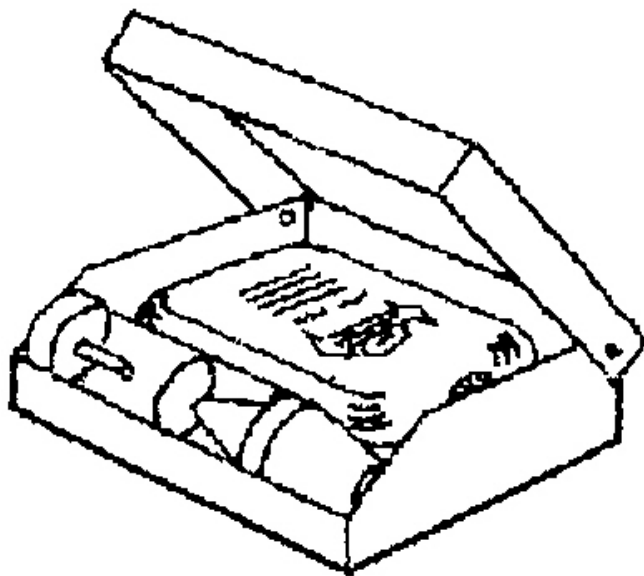
Fig. 37: Identifying Cylinder Compression Pressure Adaptor 8116
Courtesy of DAIMLERCHRYSLER CORP.



Pressure Tester Kit 7700

G03572467

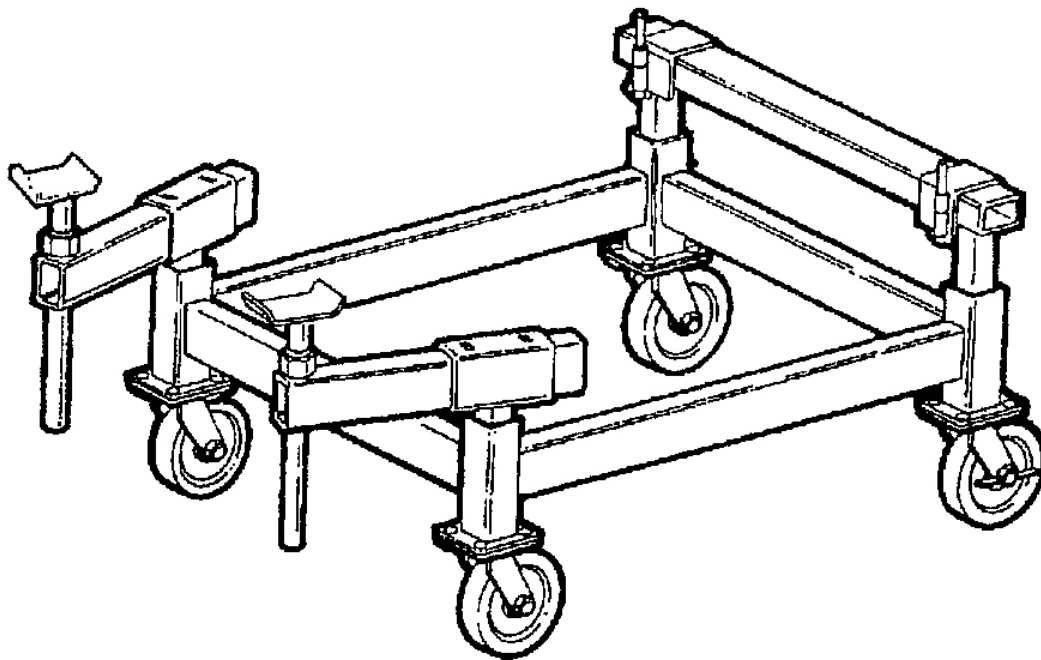
Fig. 38: Identifying Pressure Tester Kit 7700
Courtesy of DAIMLERCHRYSLER CORP.



Bloc-Chek-Kit C-3685-A

G03572468

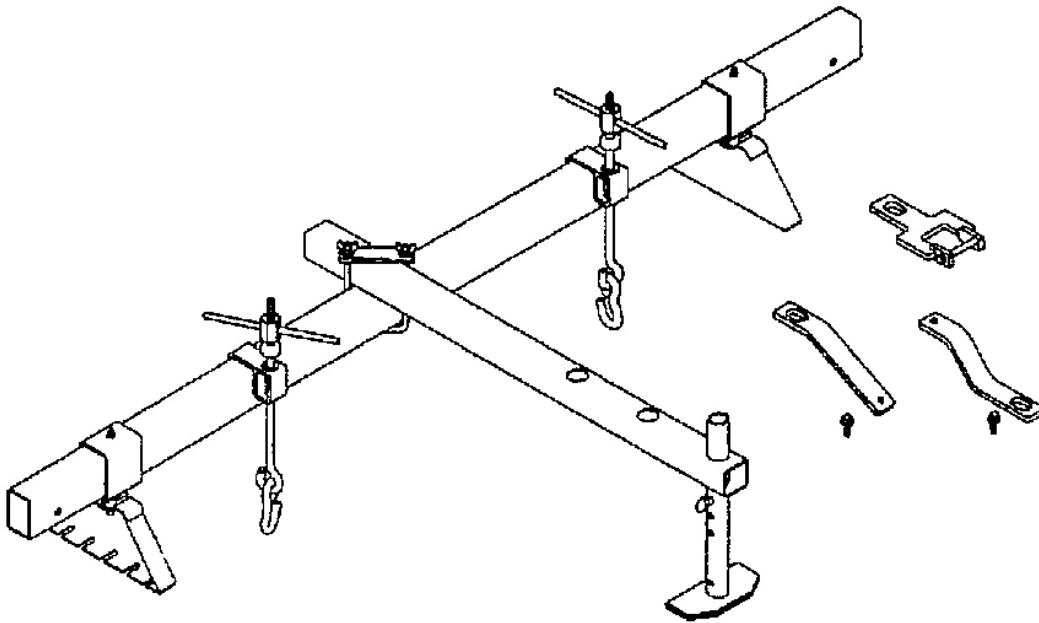
Fig. 39: Identifying Bloc-Chek-Kit C-3685-A
Courtesy of DAIMLERCHRYSLER CORP.



Driveline Support Table 8874

G03572469

Fig. 40: Identifying Driveline Support Table 8874
Courtesy of DAIMLERCHRYSLER CORP.



Driveline Support Fixture 8534B

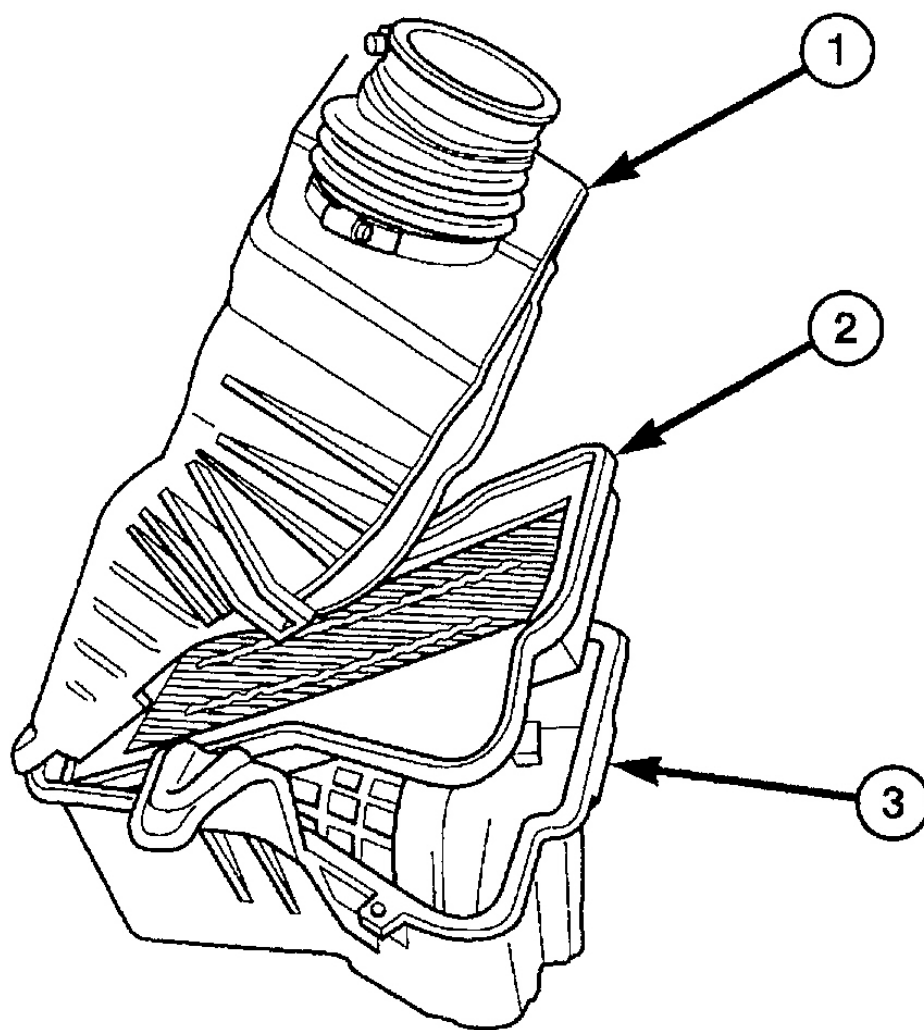
G03572470

Fig. 41: Identifying Driveline Support Fixture 8534B
Courtesy of DAIMLERCHRYSLER CORP.

AIR CLEANER ELEMENT

REMOVAL

1. Disconnect the intake air temperature sensor (IAT) wiring harness connector.
2. Disconnect the air inlet tube at the throttle body.
3. Remove the cover screws.
4. Lift cover and pull toward the engine and remove cover tabs from air box.
5. Lift cover and remove the element (**Fig. 42**).



- 1 - HOUSING COVER
- 2 - SCREWS
- 3 - ELEMENT HOUSING

G03572471

Fig. 42: Removing Air Cleaner Element
Courtesy of DAIMLERCHRYSLER CORP.

INSTALLATION

1. Install the air filter element into air box (**Fig. 42**).
2. Move cover so that the tabs insert into the air box.

3. Seat cover onto element housing and tighten the screws.
4. Reconnect the air inlet tube and tighten clamp.
5. Connect the intake air temperature sensor wire harness connector.

AIR CLEANER HOUSING

REMOVAL

1. Disconnect the intake air temperature sensor (IAT) wiring harness connector.
2. Remove the air inlet hose at the throttle body.
3. Disconnect the air circulation hose at the element housing.
4. Remove the housing retaining bolt.
5. Pull housing up and off of the locating pin.
6. Remove element housing from vehicle.

INSTALLATION

1. Install housing into vehicle and the locating pin.
2. Install housing retaining bolt.
3. Connect the air inlet hose to the throttle body and tighten clamp.
4. Connect the air circulation hose to housing.
5. Connect the intake air temperature (IAT) sensor wiring harness connector.

CYLINDER HEAD(S)

DESCRIPTION

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

DIAGNOSIS AND TESTING-CYLINDER HEAD GASKET

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

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

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

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

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

CYLINDER-TO-CYLINDER LEAKAGE TEST

To determine if an engine cylinder head gasket is leaking between adjacent cylinders, follow the procedures in Cylinder Compression Pressure Test (Refer to **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.

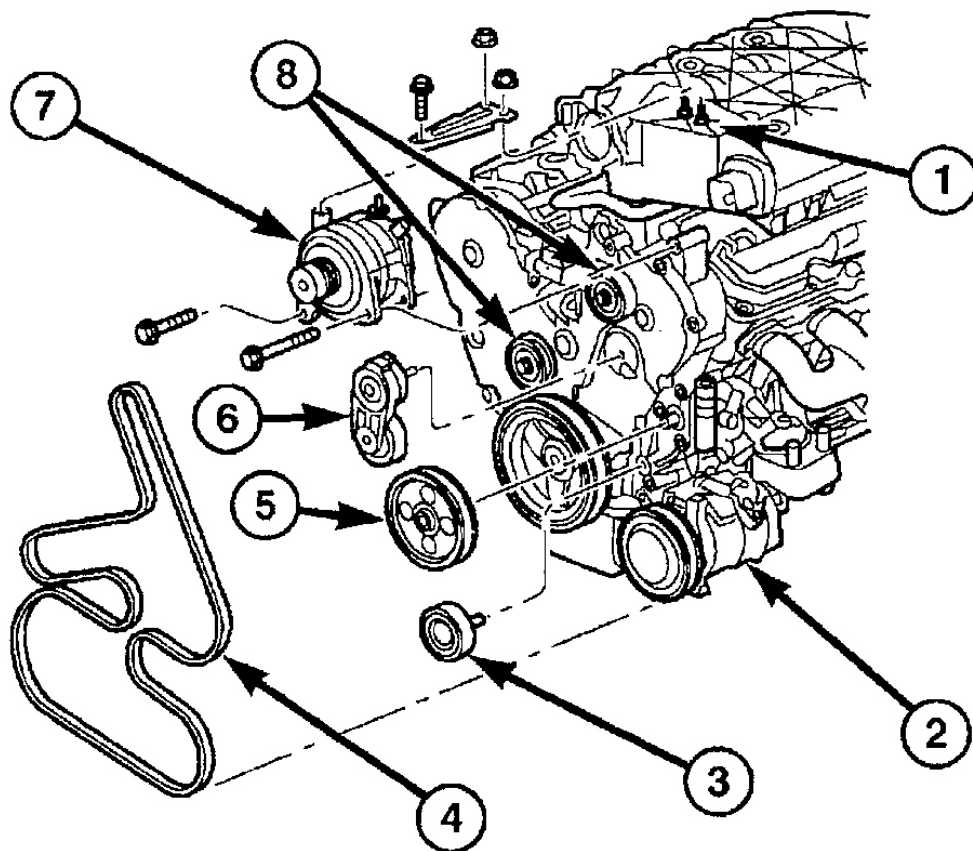
CHEMICAL TEST METHOD

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(S)

RIGHT CYLINDER HEAD

1. Perform the fuel relief procedure.
2. Disconnect the negative battery cable.
3. Drain cooling system (Refer to **STANDARD PROCEDURE - COOLING SYSTEM DRAINING**).
4. Remove the engine cover.
5. Remove air cleaner element housing (Refer to **REMOVAL**).
6. Disconnect the fuel line at the fuel rail.
7. Remove the upper intake manifold (Refer to **REMOVAL**).
8. Remove the lower intake manifold (Refer to **REMOVAL**).
9. Raise the vehicle.
10. Remove right front tire.
11. Remove right inner splash shield.
12. Remove accessory drive belt (**Fig. 43**).

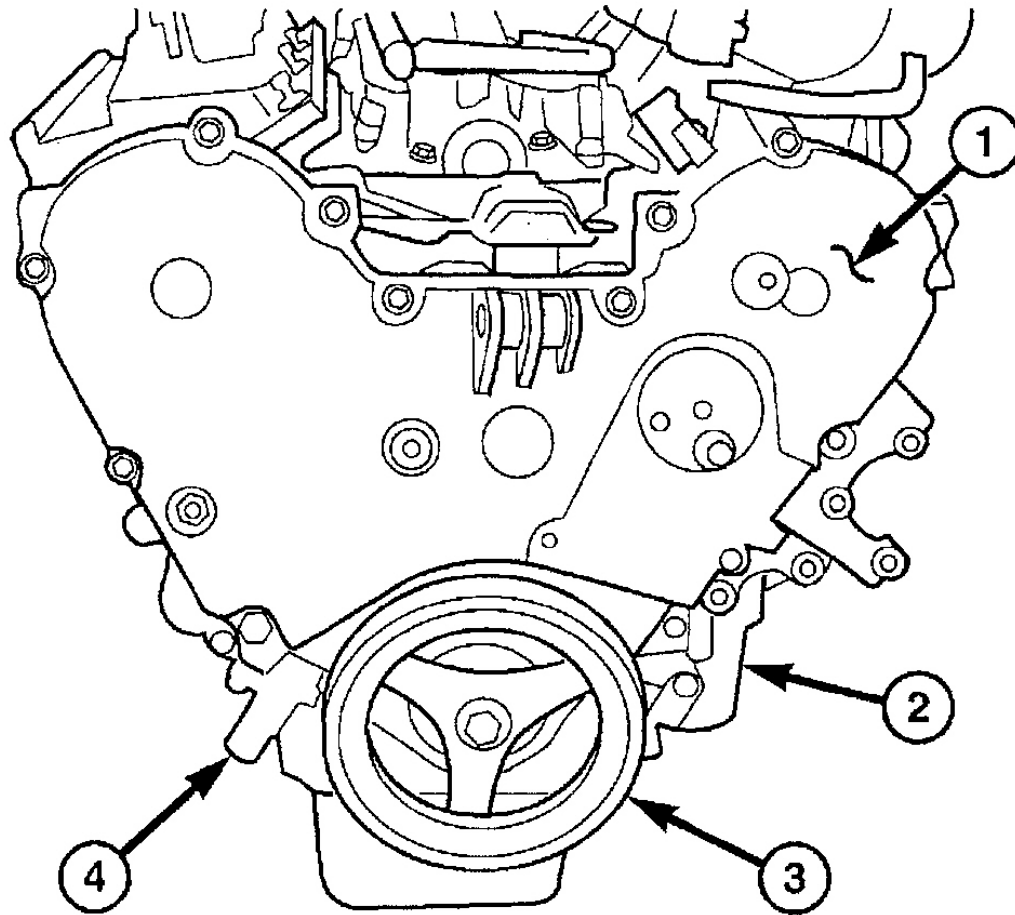


- 1 - UPPER INTAKE MANIFOLD
- 2 - AIR CONDITIONING COMPRESSOR
- 3 - IDLER PULLEY
- 4 - ACCESSORY DRIVE BELT
- 5 - POWER STEERING PULLEY
- 6 - ACCESSORY DRIVE BELT TENSIONER
- 7 - GENERATOR
- 8 - IDLER PULLEYS

G03572473

Fig. 43: Exploded View Of Accessory Drive Belt And Pulleys
 Courtesy of DAIMLERCHRYSLER CORP.

13. Remove vibration damper (Refer to **REMOVAL**) (**Fig. 44**).



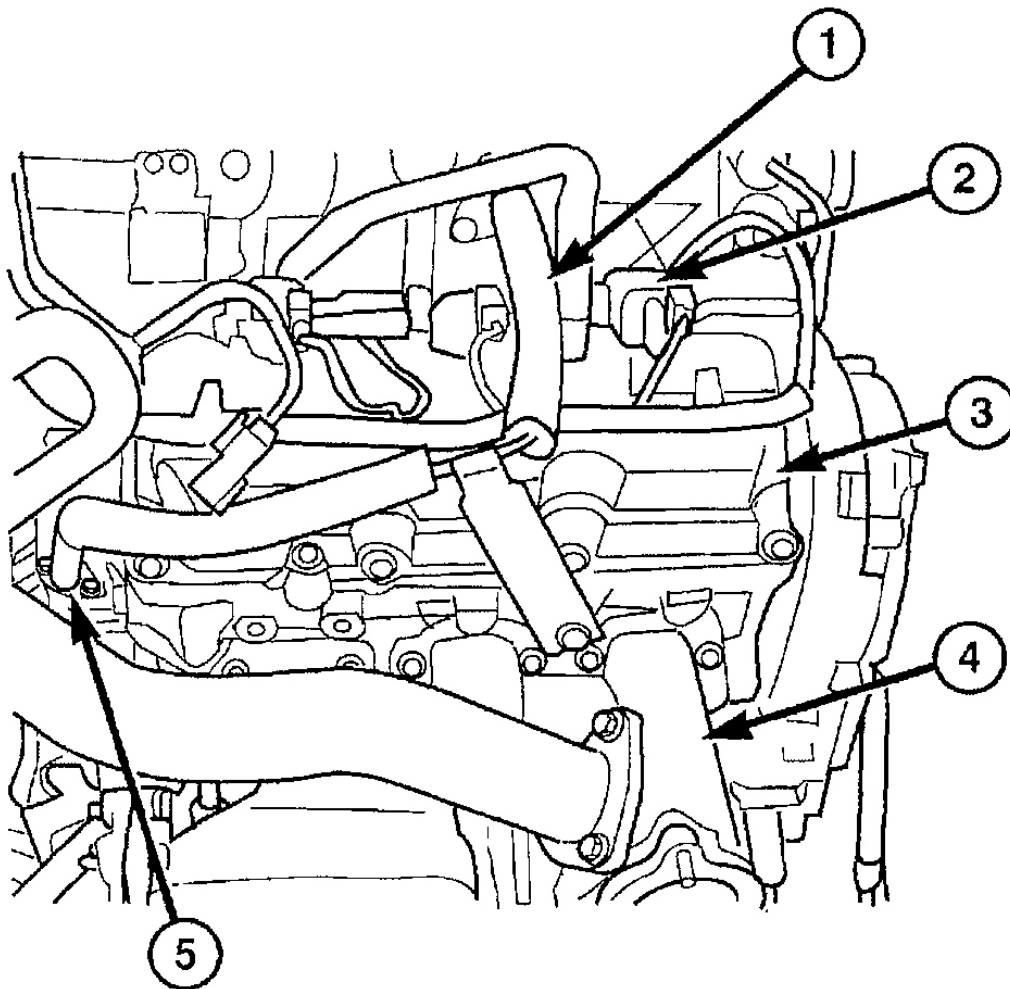
- 1 - FRONT TIMING BELT COVER
- 2 - ENGINE OIL FILTER
- 3 - VIBRATION DAMPER
- 4 - TIMING BELT TENSIONER

G03572472

Fig. 44: Identifying Front Timing Belt Cover
Courtesy of DAIMLERCHRYSLER CORP.

- 14. Remove lower accessory drive belt idler pulley (**Fig. 43**).
- 15. Remove the power steering mounting bolts and set the pump aside (Refer to **PUMP**).
- 16. Remove lower outer timing belt cover bolts (**Fig. 44**).
- 17. Raise the vehicle.
- 18. Remove catalytic converter mounting nuts (Refer to **CATALYTIC CONVERTER**).

19. Disconnect both oxygen sensor harness connectors.
20. Separate the muffler to tail pipe union (Refer to **MUFFLER**).
21. Remove catalytic converter (Refer to **CATALYTIC CONVERTER**).
22. Remove the exhaust cross over pipe lower bolts (Refer to **CROSS-OVER PIPE**).
23. Remove right exhaust manifold (Refer to **REMOVAL - LEFT EXHAUST MANIFOLD**).
24. Lower vehicle.
25. Remove the upper accessory drive belt idler pulley (**Fig. 43**).
26. Remove the belt tensioner (**Fig. 43**).
27. Support the engine with a block of wood and the floor jack.
28. Remove the upper engine mount (Refer to **REMOVAL**).
29. Remove the power steering reservoir bolts and set reservoir aside.
30. Remove the remaining outer timing belt cover bolts and cover.
31. Rotate the engine to TDC and align timing belt marks.
32. Remove the timing belt tensioner and reset the tensioner (Refer to **REMOVAL**). (**Fig. 44**).
33. Remove the timing belt (Refer to **REMOVAL**).
34. Remove the right valve cover to cylinder head ground strap (**Fig. 45**).

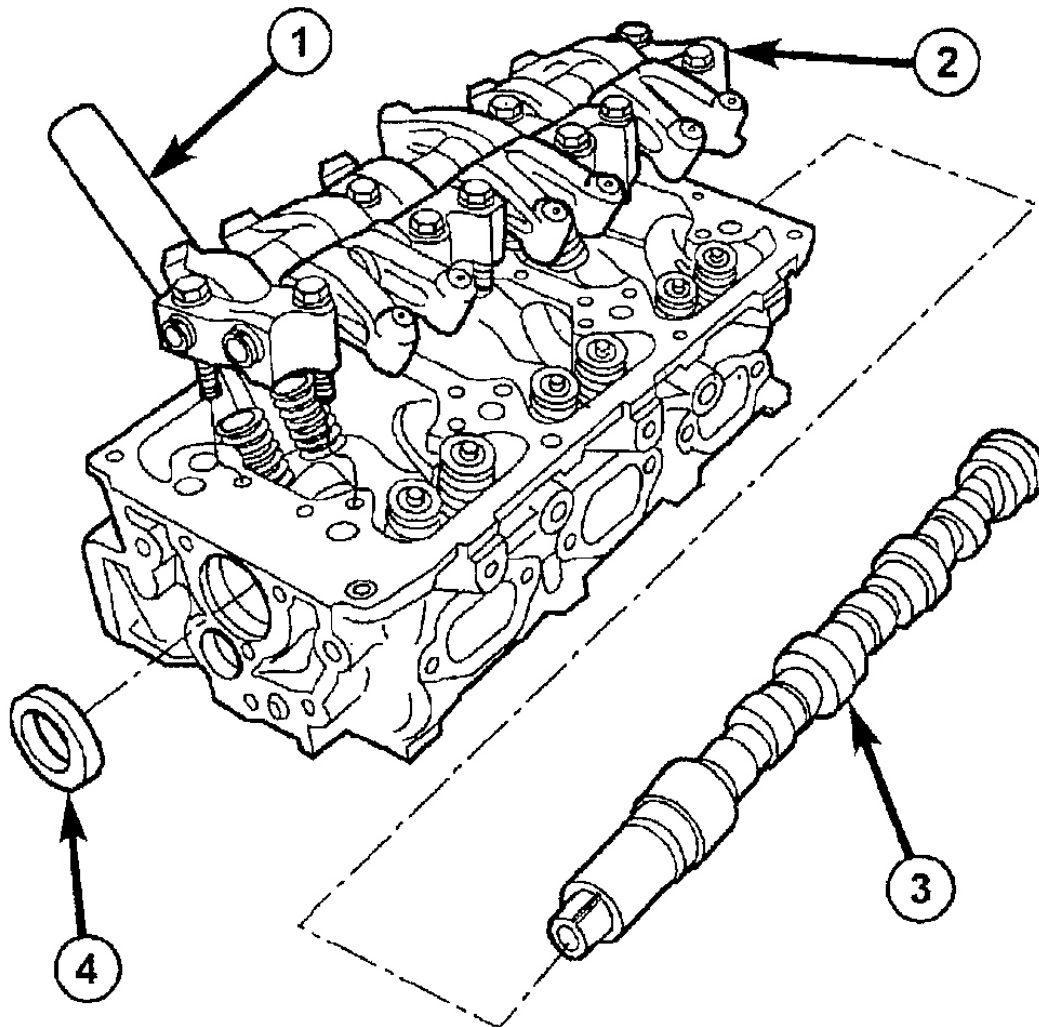


- 1 - EGR TUBE
- 2 - IGNITION COIL
- 3 - CYLINDER HEAD COVER
- 4 - RIGHT EXHAUST MANIFOLD
- 5 - EGR VALVE

G03572475

Fig. 45: Identifying EGR Valve And Tube
 Courtesy of DAIMLERCHRYSLER CORP.

- 35. Remove the EGR valve and tube assembly (**Fig. 45**).
- 36. Remove the right cylinder head cover (**Fig. 45**).
- 37. Remove the right rocker arm assembly (**Fig. 46**).

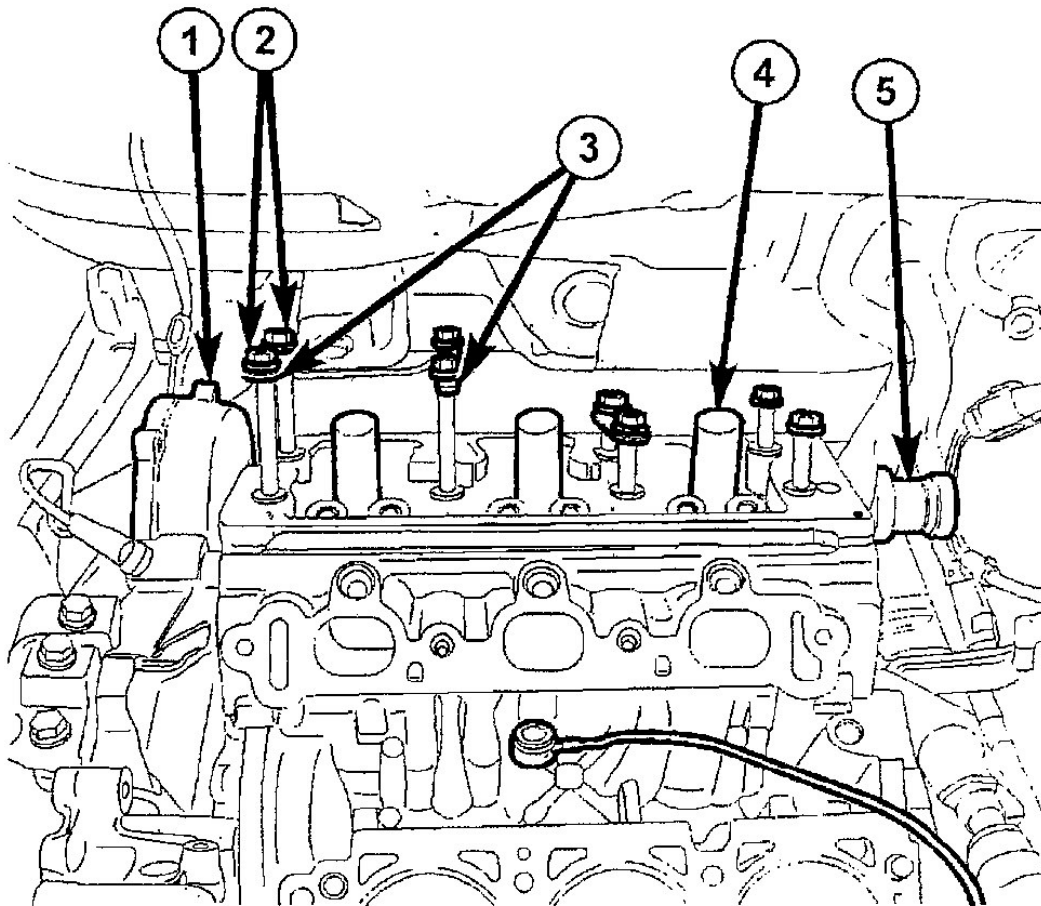


- 1 - SPARK PLUG TUBE
- 2 - ROCKER ARM ASSEMBLY
- 3 - CAMSHAFT
- 4 - CAMSHAFT SEAL

G03572476

Fig. 46: Exploded View Of camshaft, Rocker Arm Assembly And Cylinder Head
 Courtesy of DAIMLERCHRYSLER CORP.

38. Remove the right rear camshaft thrust plate.
39. Counterhold the cam gear and remove the right cam gear retaining bolt.
40. Push the camshaft out of the back of the cylinder head approximately 3.5 inches and remove the cam gear (**Fig. 47**).



- 1 - INNER TIMING BELT COVER
- 2 - CYLINDER HEAD BOLTS
- 3 - RUBBER BANDS
- 4 - SPARK PLUG TUBE
- 5 - CAMSHAFT

G03572477

Fig. 47: Removing Right Cylinder Head
 Courtesy of DAIMLERCHRYSLER CORP.

- 41. Remove the inner timing cover to cylinder head retaining bolts.
- 42. Remove the cylinder head bolts in REVERSE of tightening sequence (**Fig. 47**).

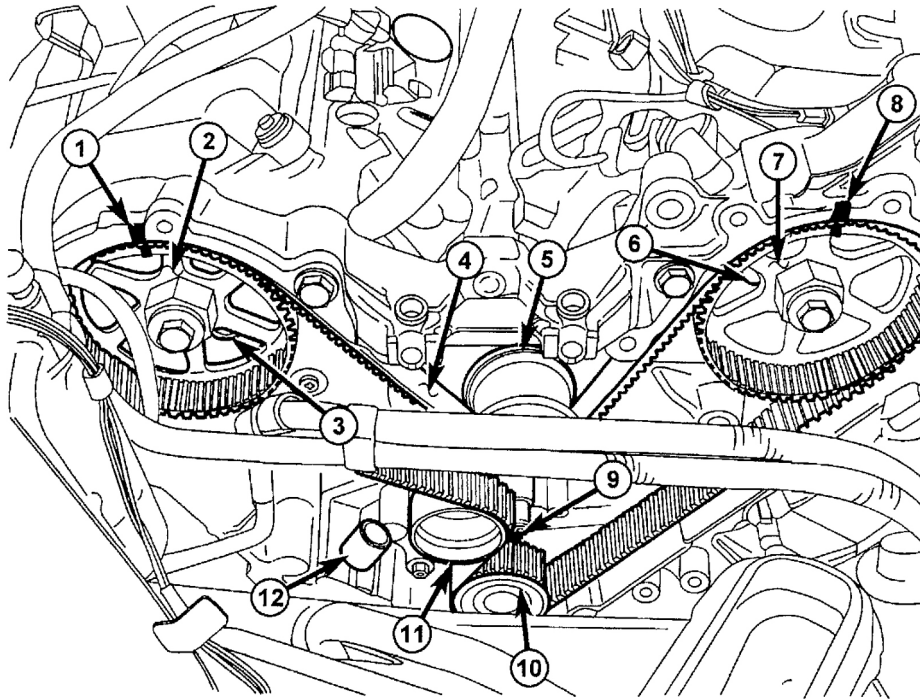
NOTE: Because of clearance restrictions when removing the right cylinder head, the front four cylinder head bolts must be loosened, raised and supported

with a rubber band before the cylinder head can be removed.

43. Remove the cylinder head (**Fig. 47**).
44. Clean and inspect all mating surfaces.

LEFT CYLINDER HEAD

1. Perform the fuel relief procedure.
2. Disconnect the negative battery cable.
3. Drain cooling system (Refer to **STANDARD PROCEDURE - COOLING SYSTEM DRAINING**).
4. Remove engine cover.
5. Remove air cleaner element housing (Refer to **REMOVAL**).
6. Remove radiator close out panel.
7. Remove radiator core support.
8. Remove radiator fan assembly (Refer to **RADIATOR FAN**).
9. Disconnect the fuel line at the fuel rail.
10. Remove the lower intake manifold (Refer to **REMOVAL**).
11. Remove the left exhaust manifold (Refer to **REMOVAL**).
12. Remove the outer timing belt cover (Refer to **TIMING BELT/CHAIN COVER(S) - REMOVAL**).
13. Rotate the engine to TDC and align the timing marks (**Fig. 48**).



- 1 - RIGHT CAMSHAFT GEAR ALIGNMENT MARK
- 2 - RIGHT CAMSHAFT GEAR
- 3 - CYLINDER HEAD TO INNER TIMING BELT COVER BOLTS - RIGHT
- 4 - TIMING BELT
- 5 - WATER PUMP PULLEY
- 6 - CYLINDER HEAD TO INNER TIMING BELT COVER BOLTS - LEFT

- 7 - LEFT CAMSHAFT GEAR
- 8 - LEFT CAMSHAFT GEAR ALIGNMENT MARK
- 9 - CRANKSHAFT GEAR ALIGNMENT MARK
- 10 - CRANKSHAFT GEAR
- 11 - TIMING BELT TENSIONER PULLEY
- 12 - TIMING BELT TENSIONER

G03572474

Fig. 48: Identifying Timing Gear Marks
 Courtesy of DAIMLERCHRYSLER CORP.

14. Remove the timing belt tensioner, timing belt, then reset tensioner (**Fig. 48**).
15. Remove the left cylinder head cover to cylinder head ground strap.
16. Remove the left cylinder head cover.
17. Remove the left rocker arm assembly.
18. Remove the left camshaft thrust plate.
19. Counterhold the left cam gear and remove the cam gear retaining bolt (**Fig. 48**).
20. Push the camshaft out of the back of the cylinder head approximately 3.5 inches and remove the cam gear.
21. Remove the front timing belt housing to cylinder head bolts (**Fig. 48**).
22. Remove the cylinder head bolts in REVERSE of tightening sequence.
23. Remove the cylinder head.
24. Clean and inspect all mating surfaces.

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.

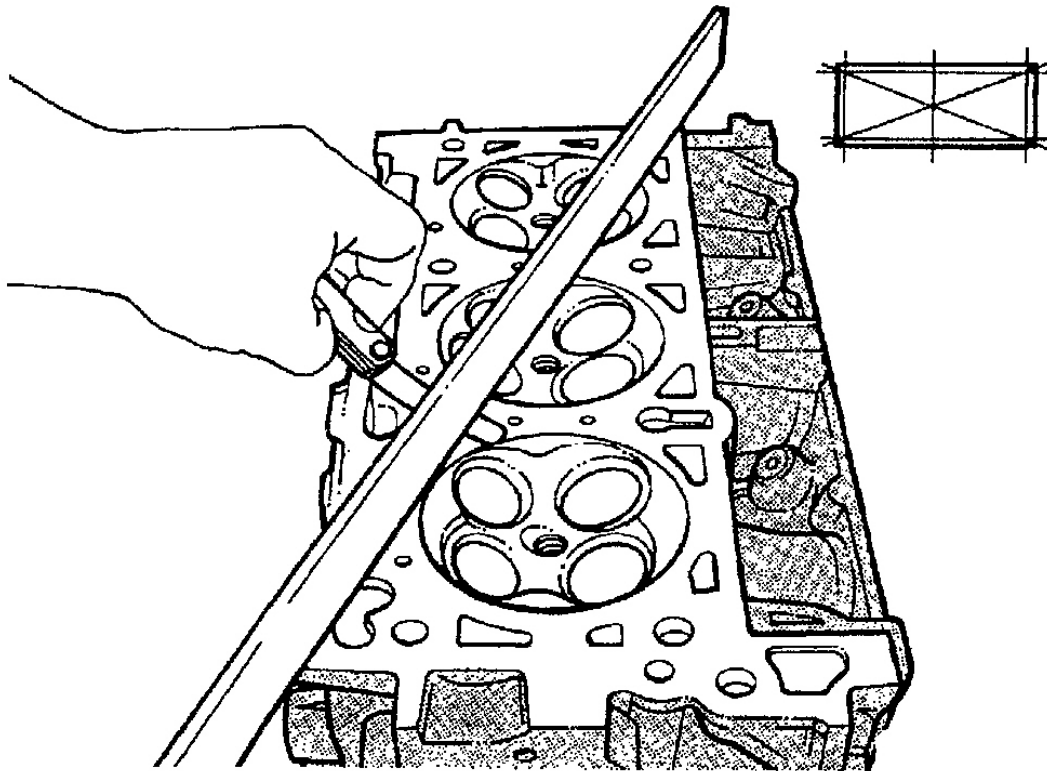
NOTE: **Multi-Layer Steel (MLS) head gaskets require a scratch free sealing surface.**

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. Before cleaning, check for leaks, damage and cracks.
2. Clean cylinder head and oil passages.
3. Check cylinder head for flatness (**Fig. 49**).



G03572478

Fig. 49: Checking Cylinder Head Flatness
Courtesy of DAIMLERCHRYSLER CORP.

4. Cylinder head must be flat within:

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

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

INSTALLATION - CYLINDER HEAD(S)

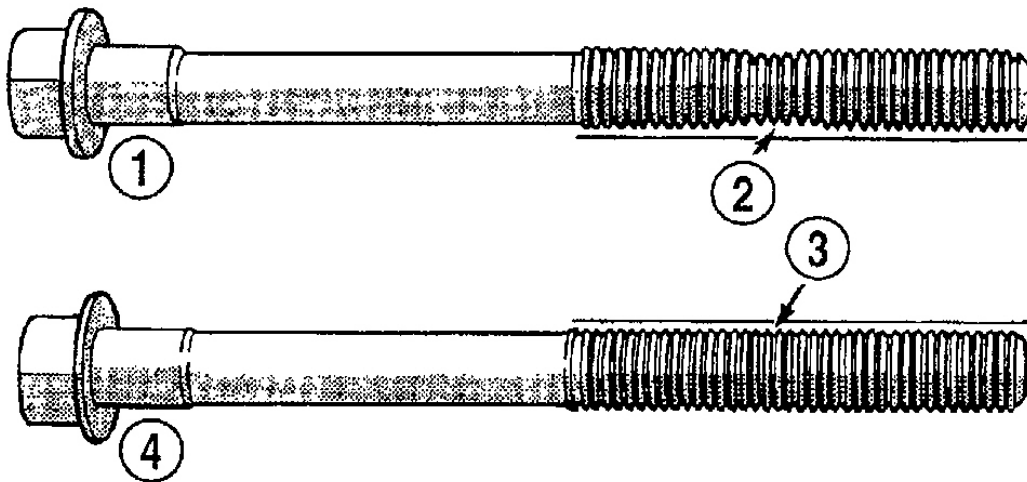
RIGHT CYLINDER HEAD

CAUTION: THE CYLINDER HEAD GASKETS ARE NOT INTERCHANGEABLE BETWEEN CYLINDER HEADS AND ARE CLEARLY MARKED RIGHT OR LEFT.

The cylinder head bolts are tightened using a torque plus angle procedure. The bolts must be examined **BEFORE** reuse. If the threads are necked down the bolts must be replaced (**Fig. 50**).

Necking can be checked by holding a scale or straight edge against the threads. If all the threads do not contact the scale the bolt must be replaced (**Fig. 50**).

CAUTION: When cleaning cylinder head and cylinder block surfaces, DO NOT use a metal scraper because the surfaces could be cut or ground. Use ONLY a wooden or plastic scraper (Refer to STANDARD PROCEDURE - ENGINE GASKET SURFACE PREPARATION).



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

G03572479

Fig. 50: Check for Stretched Bolts

Courtesy of DAIMLERCHRYSLER CORP.

1. Clean sealing surfaces of cylinder head and block.

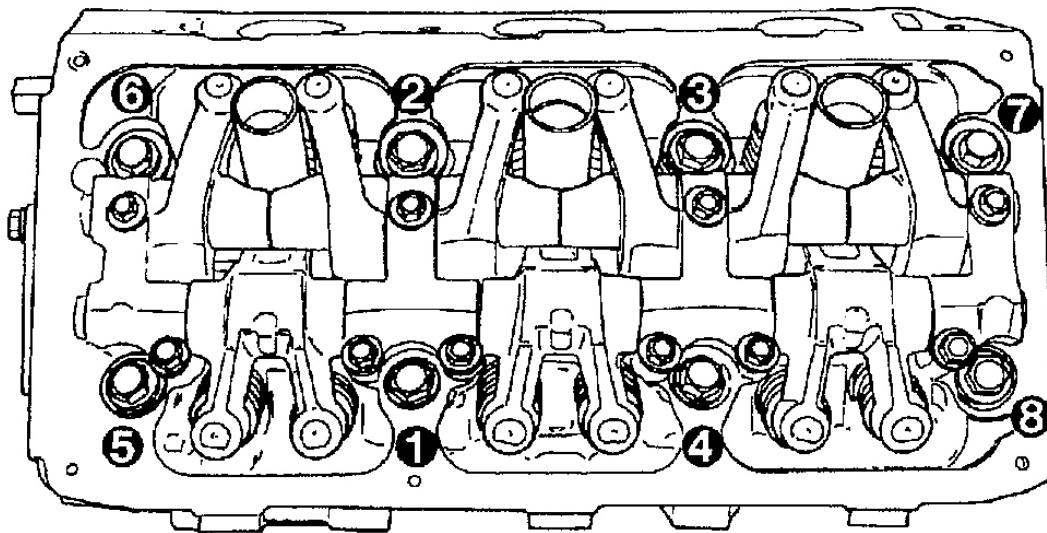
CAUTION: Ensure that the correct head gaskets are used and are oriented correctly on cylinder block.

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

NOTE: Before installing the cylinder head bolts, lubricate the threads with engine oil.

3. Insert the front four cylinder head bolts into the cylinder head. Pull the bolts up to the top of their travel and retain with rubber bands.
4. Install the cylinder head over locating dowels and finger tighten the head bolts.
5. Tighten the cylinder head bolts in the sequence shown in (Fig. 51). Using the 4 step torque-turn method, tighten according to the following torque values:
 - Step 1: All to 61 N.m (45 ft. lbs.)
 - Step 2: All to 88 N.m (65 ft. lbs.)

- Step 3: All (again) to 88 N.m (65 ft. lbs.)
 - Step 4: + 90° Turn Do not use a torque wrench for this step.
6. Bolt torque after 90° turn should be over 122 N.m (90 ft. lbs.) in the tightening direction. If not, replace the bolt.
 7. Install the inner timing cover to cylinder head bolts. Tighten bolts to 54 N.m (40 lbs.ft.).
 8. Install camshaft sprocket. Counterhold the camshaft sprocket gear and tighten the camshaft sprocket bolt to 102 N.m plus a 1/4 turn (75 lbs. ft. plus a 1/4 turn). (Refer to **INSTALLATION**).
 9. Install the rear camshaft thrust plate.



G03572480

Fig. 51: Cylinder Head Bolt Tightening Sequence

Courtesy of DAIMLERCHRYSLER CORP.

10. Rotate the camshaft gear to it's alignment mark and check the left camshaft gear and crankshaft gear timing alignment marks.
11. Install the timing belt and tensioner (Refer to **INSTALLATION**).
12. Install the timing belt outer cover (Refer to **TIMING BELT/CHAIN COVER(S) - INSTALLATION**).
13. Install the power steering reservoir.
14. Install the vibration damper (Refer to **INSTALLATION**).
15. Install the upper engine mount (Refer to **INSTALLATION**).
16. Install the accessory drive belt tensioner.
17. Install the accessory drive belt idler pulley.
18. Install the right exhaust manifold (Refer to **INSTALLATION - LEFT EXHAUST MANIFOLD**).
19. Install the exhaust cross over pipe (Refer to **INSTALLATION - LEFT EXHAUST MANIFOLD**).

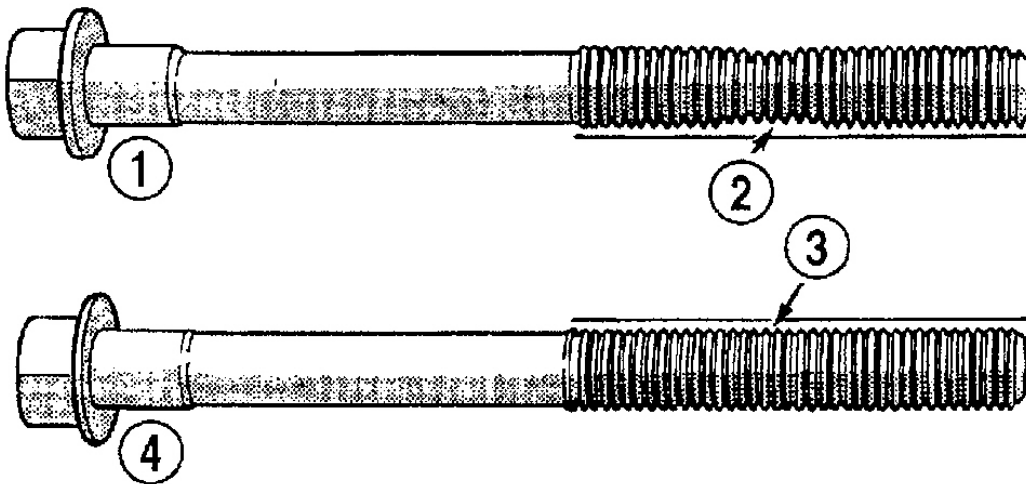
20. Install the catalytic converter and exhaust system.
21. Connect both oxygen sensors.
22. Lower the vehicle.
23. Install the right rocker arm assembly.
24. Install the right cylinder head cover and ground strap.
25. Install lower intake manifold (Refer to **INSTALLATION**).
26. Install the fuel rail.
27. Install the upper intake manifold (Refer to **INSTALLATION**).
28. Install the air cleaner element housing (Refer to **INSTALLATION**).
29. Install the engine cover.
30. Fill the coolant system.
31. Connect the negative battery cable.

LEFT CYLINDER HEAD

CAUTION: THE CYLINDER HEAD GASKETS ARE NOT INTERCHANGEABLE BETWEEN CYLINDER HEADS AND ARE CLEARLY MARKED RIGHT OR LEFT.

The cylinder head bolts are tightened using a torque plus angle procedure. The bolts must be examined BEFORE reuse. If the threads are necked down the bolts must be replaced (Fig. 52**).**

Necking can be checked by holding a scale or straight edge against the threads. If all the threads do not contact the scale the bolt must be replaced (**Fig. 52**).



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

G03572481

Fig. 52: Checking For Stretched Bolts
Courtesy of DAIMLERCHRYSLER CORP.

CAUTION: When cleaning cylinder head and cylinder block surfaces, DO NOT use a metal scraper because the surfaces could be cut or ground. Use ONLY a wooden or plastic scraper (Refer to STANDARD PROCEDURE - ENGINE GASKET SURFACE PREPARATION).

1. Clean sealing surfaces of cylinder head and block.

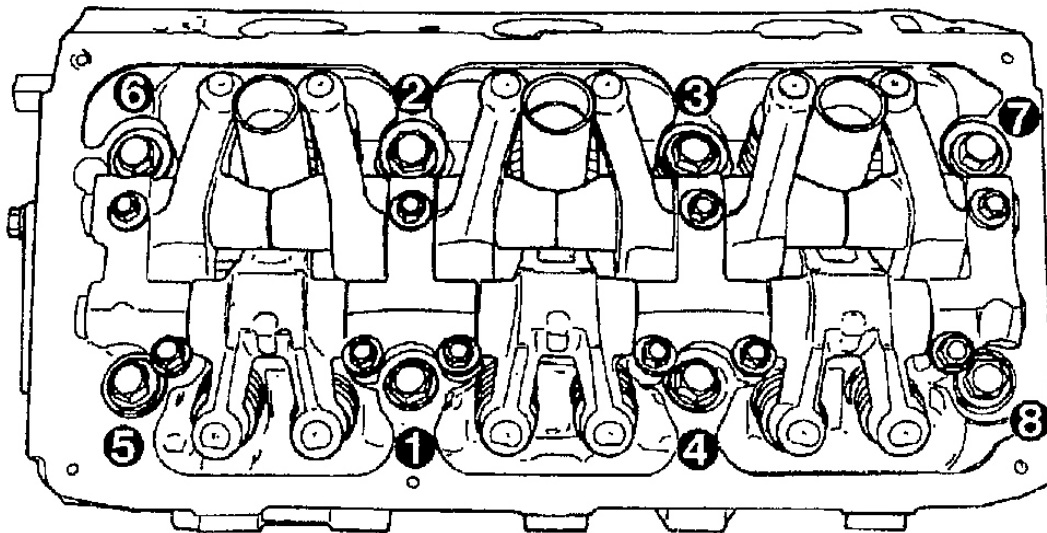
CAUTION: Ensure that the correct head gaskets are used and are oriented correctly on cylinder block.

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

NOTE: Before installing the cylinder head bolts, lubricate the threads with engine oil.

3. Install the cylinder head over locating dowels, insert and finger tighten the head bolts.
4. Tighten the cylinder head bolts in the sequence shown in (**Fig. 53**). Using the 4 step torque-turn method tighten according to the following torque values:

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



G03572482

Fig. 53: Cylinder Head Bolt Tightening Sequence
 Courtesy of DAIMLERCHRYSLER CORP.

5. Bolt torque after 90° turn should be over 122 N.m (90 ft. lbs.) in the tightening direction. If not replace the bolt.
6. Install the inner timing cover to cylinder head bolts. Tighten bolts to 54 N.m (40 lbs.ft.).
7. Install camshaft sprocket. Counterhold the camshaft sprocket gear and tighten the camshaft sprocket bolt to 115 N.m plus a 1/4 turn (85 lbs. ft. plus a 1/4 turn). (Refer to **INSTALLATION**).
8. Install the rear camshaft thrust plate.
9. Rotate the camshaft gear to it's alignment mark and check the right camshaft gear and crankshaft gear timing alignment marks.
10. Install the timing belt and tensioner (Refer to **INSTALLATION**).
11. Install the timing belt front cover (Refer to **TIMING BELT/CHAIN COVER(S) - INSTALLATION**).
12. Install the vibration damper (Refer to **INSTALLATION**).
13. Install the upper engine mount (Refer to **INSTALLATION**).
14. Install the accessory drive belt tensioner.
15. Install the accessory drive belt idler pulley.
16. Install the left exhaust manifold (Refer to **INSTALLATION - LEFT EXHAUST MANIFOLD**).

17. Install the exhaust cross over pipe (Refer to **INSTALLATION - LEFT EXHAUST MANIFOLD**).
18. Install the left rocker arm assembly.
19. Install the left cylinder head cover and ground strap.
20. Install lower intake manifold (Refer to **INSTALLATION**).
21. Install the fuel rail.
22. Install the upper intake manifold (Refer to **INSTALLATION**).
23. Install the radiator cooling fan assembly (Refer to **RADIATOR FAN**).
24. Install the radiator core support.
25. Install the radiator close out panel.
26. Install the air cleaner element housing (Refer to **INSTALLATION**).
27. Install the engine cover.
28. Fill the coolant system.
29. Connect the negative battery cable.

CAMSHAFT OIL SEAL(S)

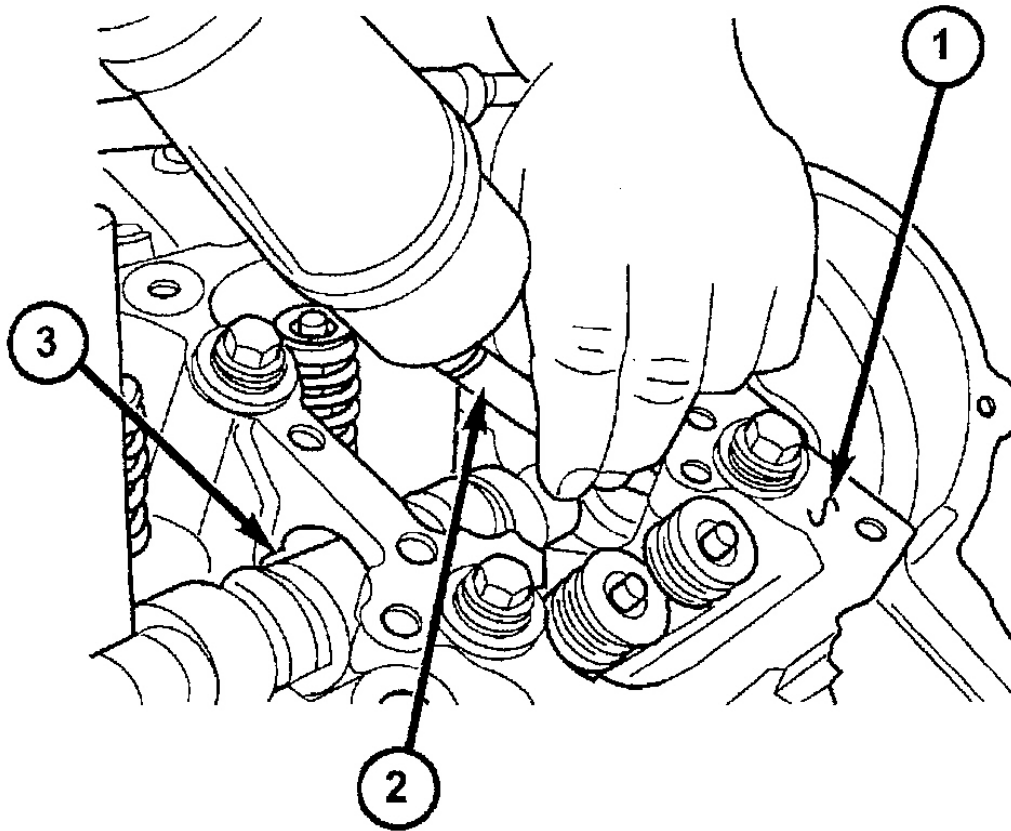
REMOVAL

RIGHT CYLINDER HEAD

1. Disconnect the negative battery cable.
2. Remove front timing cover and align the camshaft gear and crankshaft gear timing marks to TDC (Refer to **TIMING BELT/CHAIN COVER(S) - REMOVAL**).
3. Remove timing belt and right camshaft sprocket (Refer to **REMOVAL**).
4. Remove the camshaft thrust plate from the rear of the cylinder head.
5. Remove the cylinder head cover (Refer to **CYLINDER HEAD COVER(S) - REMOVAL**).
6. Remove the rocker arm assembly (Refer to **REMOVAL**).
7. Maneuver the camshaft rearward and out of the cylinder head approximately 3.5 inches (**Fig. 54**).

NOTE: Care must be taken not to damage the cylinder head to seal or camshaft journal surfaces when removing the camshaft seal.

8. Using an appropriate driver carefully remove camshaft oil seal (**Fig. 54**).



- 1 - CYLINDER HEAD
- 2 - DRIFT
- 3 - CAMSHAFT

G03572483

Fig. 54: Removing Camshaft Seal - Right Cylinder Head
 Courtesy of DAIMLERCHRYSLER CORP.

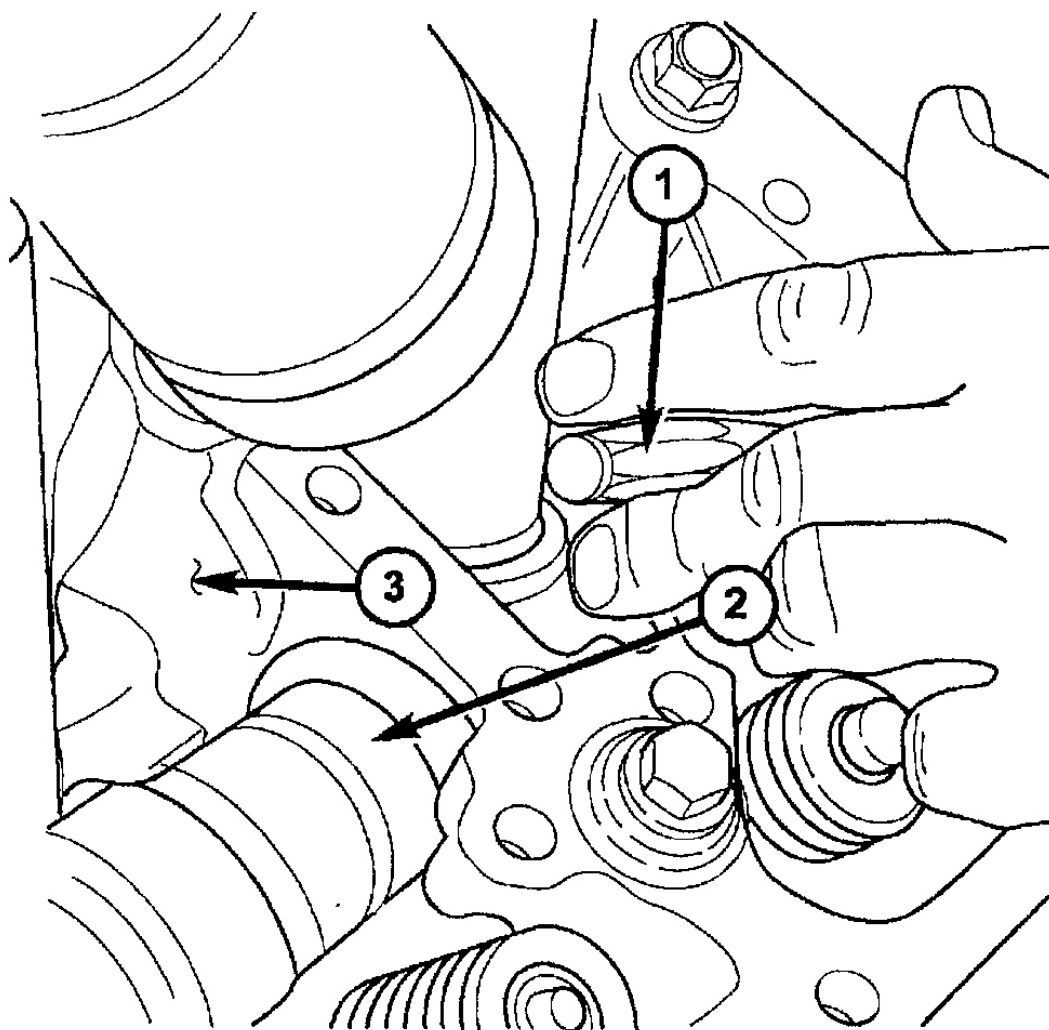
LEFT CYLINDER HEAD

1. Disconnect the negative battery cable.
2. Drain cooling system.
3. Remove front timing cover and align the camshaft gear and crankshaft gear timing marks to TDC (Refer to **TIMING BELT/CHAIN COVER(S) - REMOVAL**).
4. Remove the rear timing cover (Refer to **TIMING BELT/CHAIN COVER(S) - REMOVAL**).
5. Remove the cylinder head cover (Refer to **CYLINDER HEAD COVER(S) - REMOVAL**).
6. Remove the rocker arm assembly (Refer to **REMOVAL**).

7. Remove the camshaft thrust plate from the rear of the cylinder head.
8. Maneuver the camshaft rearward and out of the cylinder head approximately 3.5 inches (**Fig. 55**)

NOTE: Care must be taken not to damage the cylinder head to seal or camshaft journal surfaces when removing the camshaft seal.

9. Using an appropriate driver carefully remove camshaft oil seal (**Fig. 55**).



- 1 - DRIFT
- 2 - CAMSHAFT
- 3 - CYLINDER HEAD

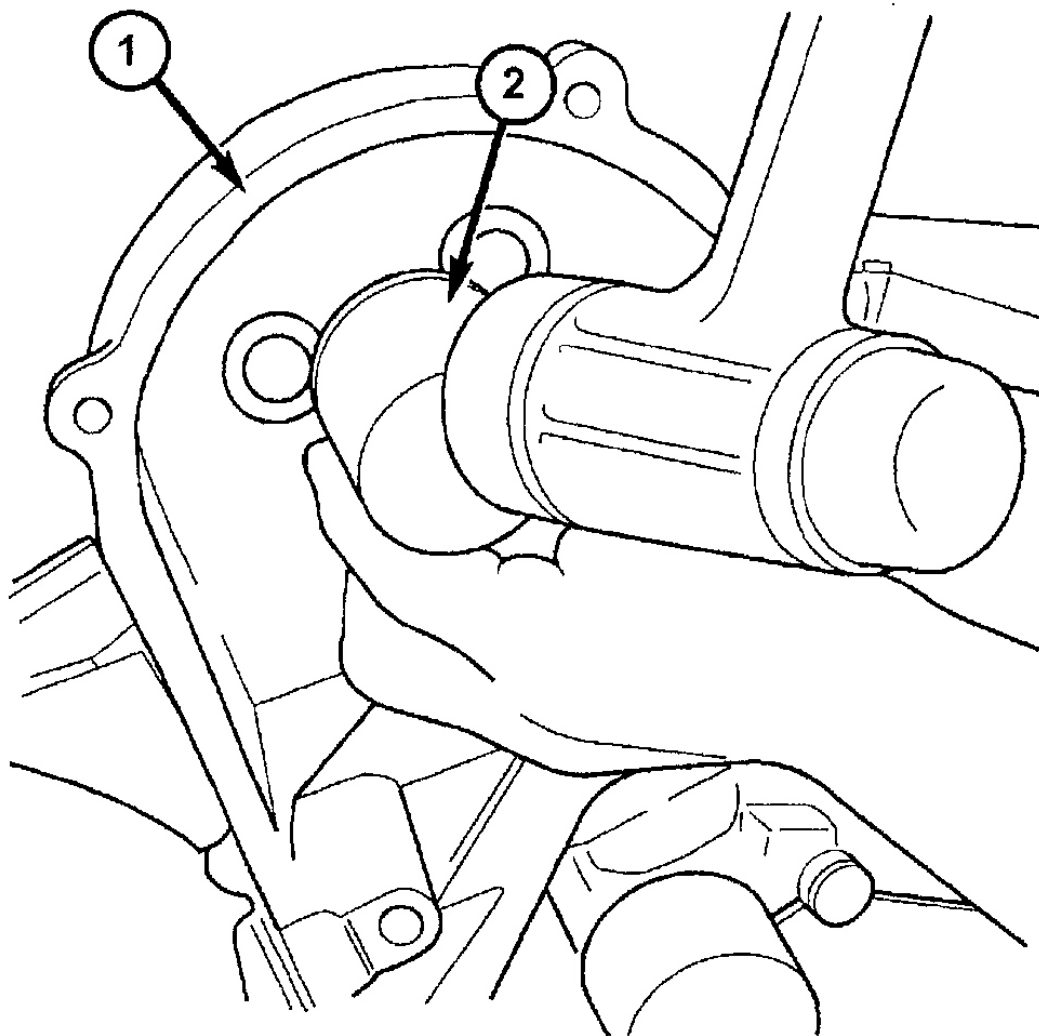
G03572484

Fig. 55: Removing Camshaft Seal - Left Cylinder Head
Courtesy of DAIMLERCHRYSLER CORP.

INSTALLATION

RIGHT CYLINDER HEAD

1. Position the camshaft seal into the cylinder head (**Fig. 56**).



1 - REAR TIMING COVER

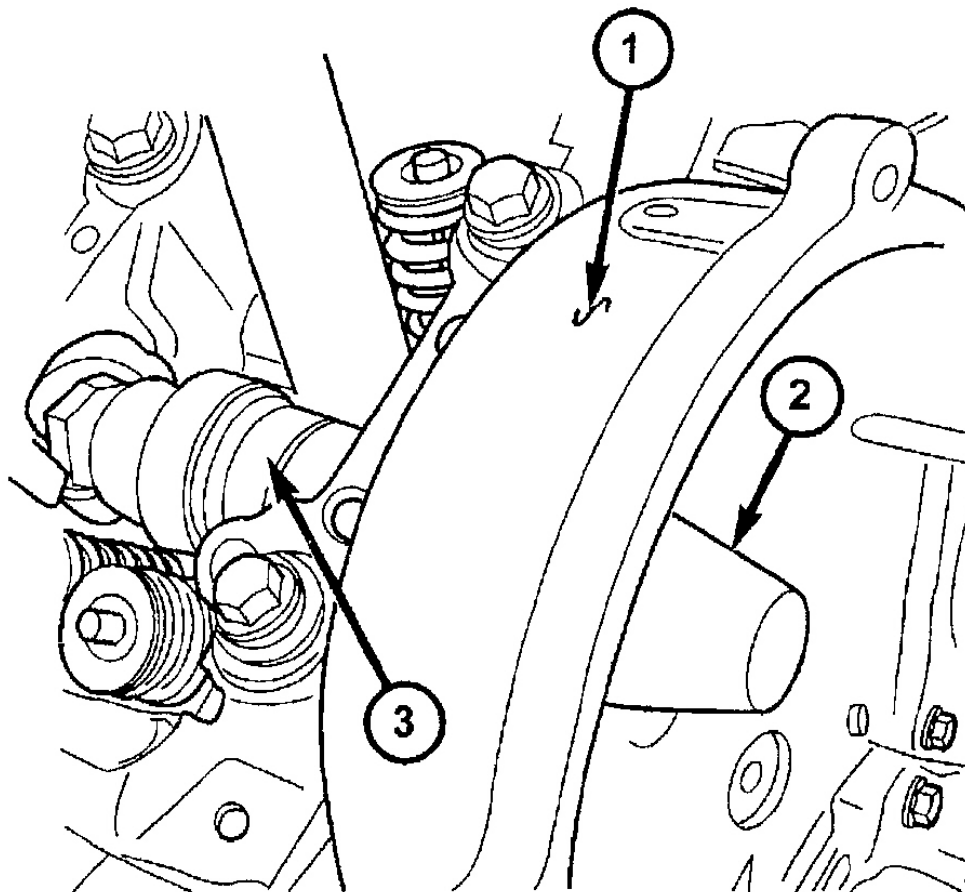
2 - SPECIAL TOOL 6788

G03572485

Fig. 56: Installing Camshaft Seal

Courtesy of DAIMLERCHRYSLER CORP.

2. Using special tool MD-998306 tap the seal into place (**Fig. 56**).
3. Apply light coat of clean engine oil to the camshaft oil seal lip and Special Tool 6788 Seal Protector Sleeve.
4. Install oil seal Special Tool 6788 Seal Protector Sleeve onto the camshaft (**Fig. 57**).



- 1 - REAR TIMING COVER
- 2 - SPECIAL TOOL 6788
- 3 - CAMSHAFT

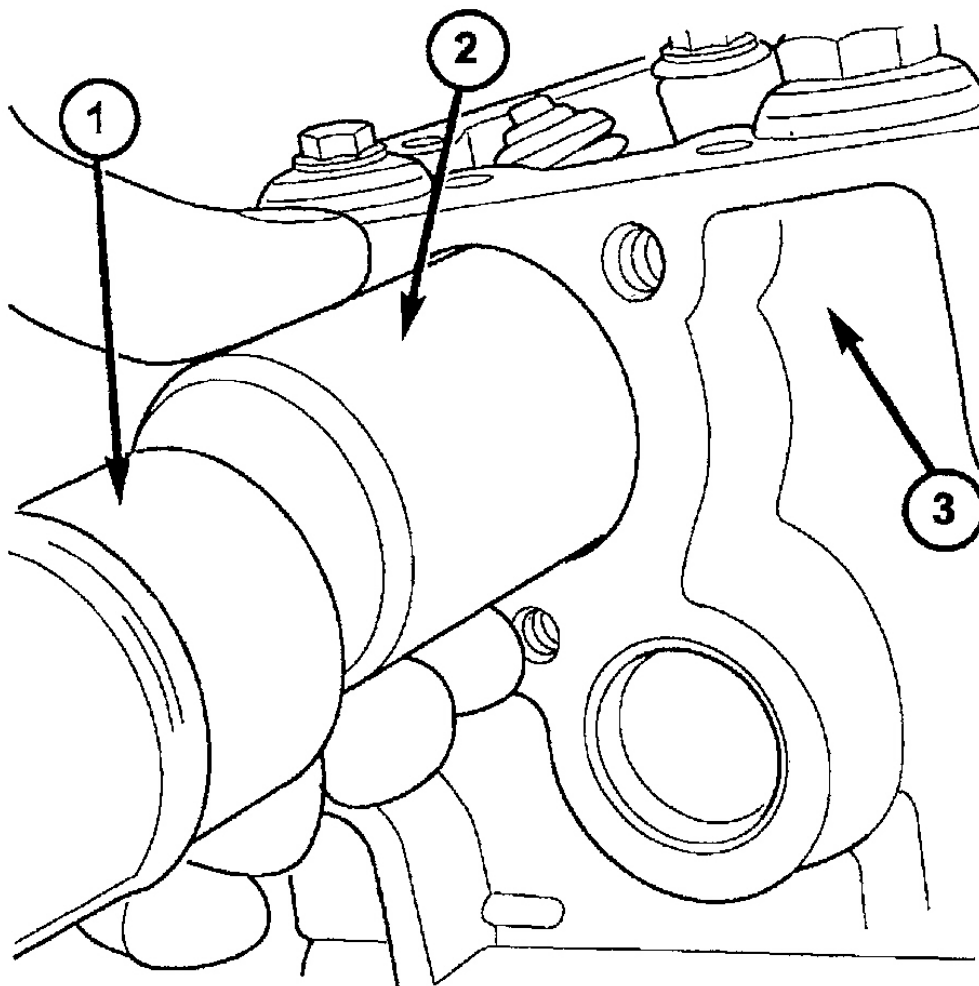
G03572486

Fig. 57: Installing Special Tool Onto The Camshaft
Courtesy of DAIMLERCHRYSLER CORP.

5. Slide the camshaft forward, inserting the seal protector through the camshaft seal until the camshaft seats (**Fig. 57**).
6. Remove Special Tool 6788 from the camshaft.
7. Install the camshaft thrust plate to the rear of the cylinder head.
8. Install camshaft sprocket and timing belt (Refer to **INSTALLATION**).

LEFT CYLINDER HEAD

1. Position the camshaft seal into the cylinder head
2. Using special tool MD-998306 tap the seal into place (**Fig. 58**).



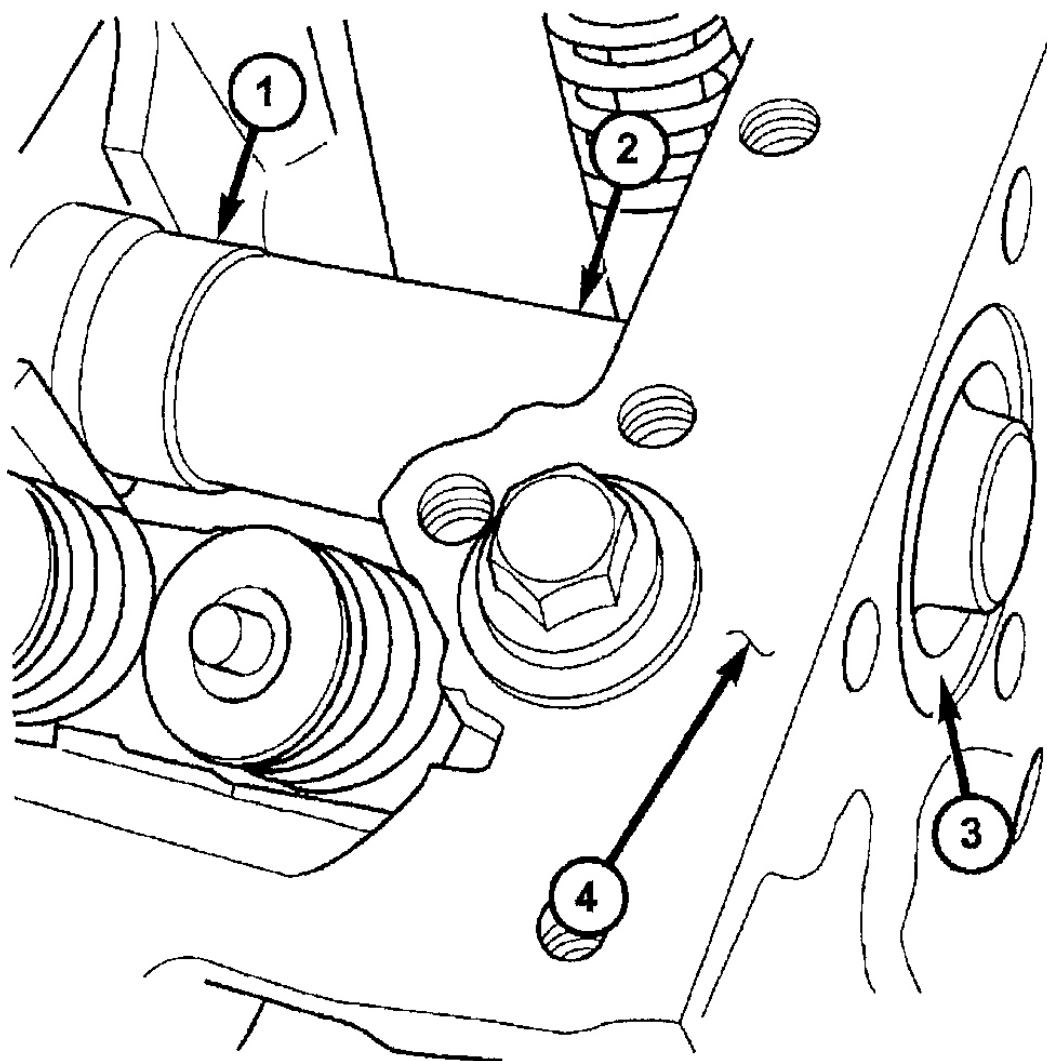
- 1 - MALLET
2 - SPECIAL TOOL MD-998306
3 - CYLINDER HEAD

G03572487

Fig. 58: Installing Camshaft Seal
Courtesy of DAIMLERCHRYSLER CORP.

3. Apply light coat of engine oil to the camshaft oil seal lip and Special Tool 6788 Seal Protector Sleeve.

4. Install oil seal Special Tool 6788 Seal Protector Sleeve onto the camshaft (**Fig. 59**)



- 1 - CAMSHAFT
2 - SPECIAL TOOL 6788
3 - CAMSHAFT SEAL
4 - CYLINDER HEAD

G03572488

Fig. 59: Installing Special Tool Onto The Camshaft
Courtesy of DAIMLERCHRYSLER CORP.

5. Slide the camshaft forward, inserting the seal protector through the camshaft seal until the camshaft seats

(**Fig. 59**).

6. Remove Special Tool 6788 from the camshaft.
7. Install the camshaft thrust plate to the rear of the cylinder head.
8. Install rear timing belt cover (Refer to **TIMING BELT/CHAIN COVER(S) - INSTALLATION**).
9. Install the camshaft gear and align the timing marks.
10. Install the timing belt (Refer to **INSTALLATION**).
11. Install the rocker arm assembly.
12. Install the cylinder head cover.
13. Install the front timing belt cover (Refer to **TIMING BELT/CHAIN COVER(S) - INSTALLATION**).
14. Install the vibration damper (Refer to **INSTALLATION**).
15. Fill cooling system (Refer to **STANDARD PROCEDURE - COOLING SYSTEM FILLING**).
16. Connect the negative battery cable.

CAMSHAFT(S)

DESCRIPTION

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

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.

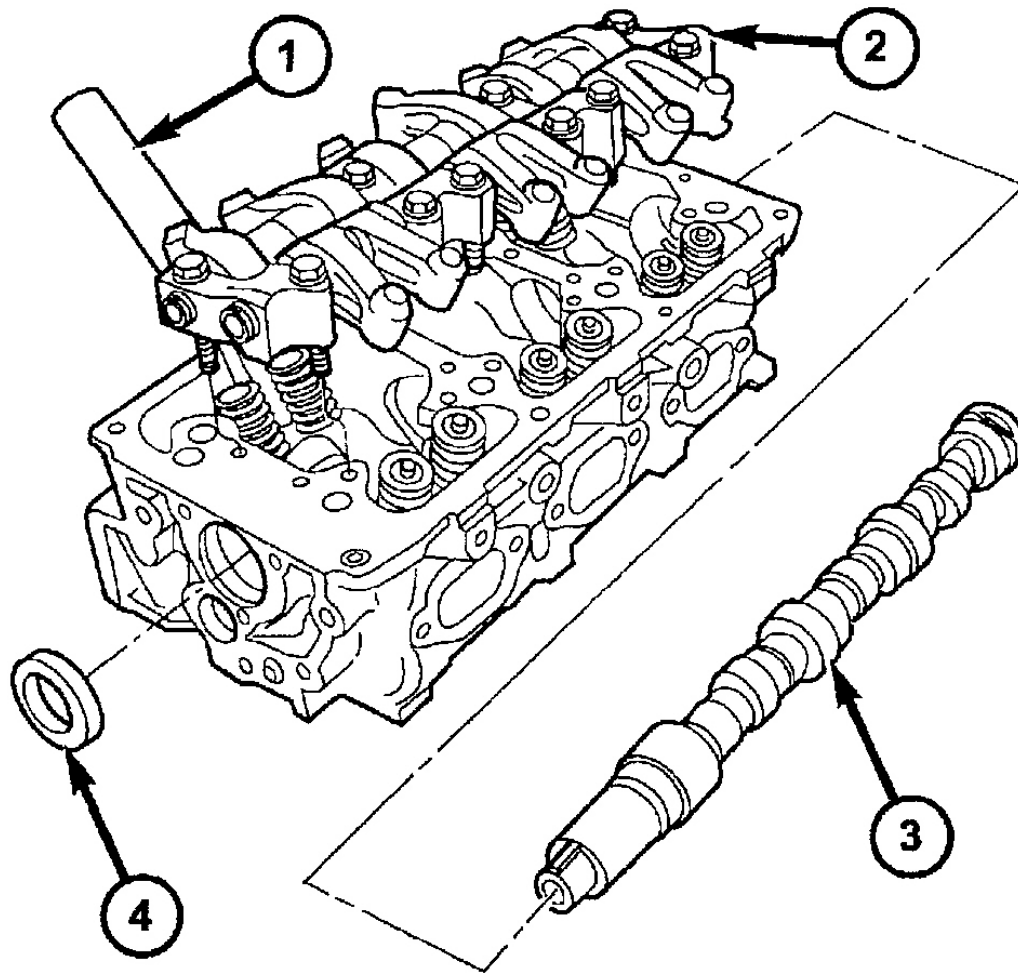
REMOVAL

NOTE: **Camshafts are removed from the rear of each cylinder head.**

1. Remove the cylinder head (Refer to **REMOVAL - CYLINDER HEAD(S)**).

CAUTION: Care must be taken not to nick or scratch the journals when removing the camshaft.

2. Carefully remove the camshaft from the rear of the cylinder head (**Fig. 60**).



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

G03572489

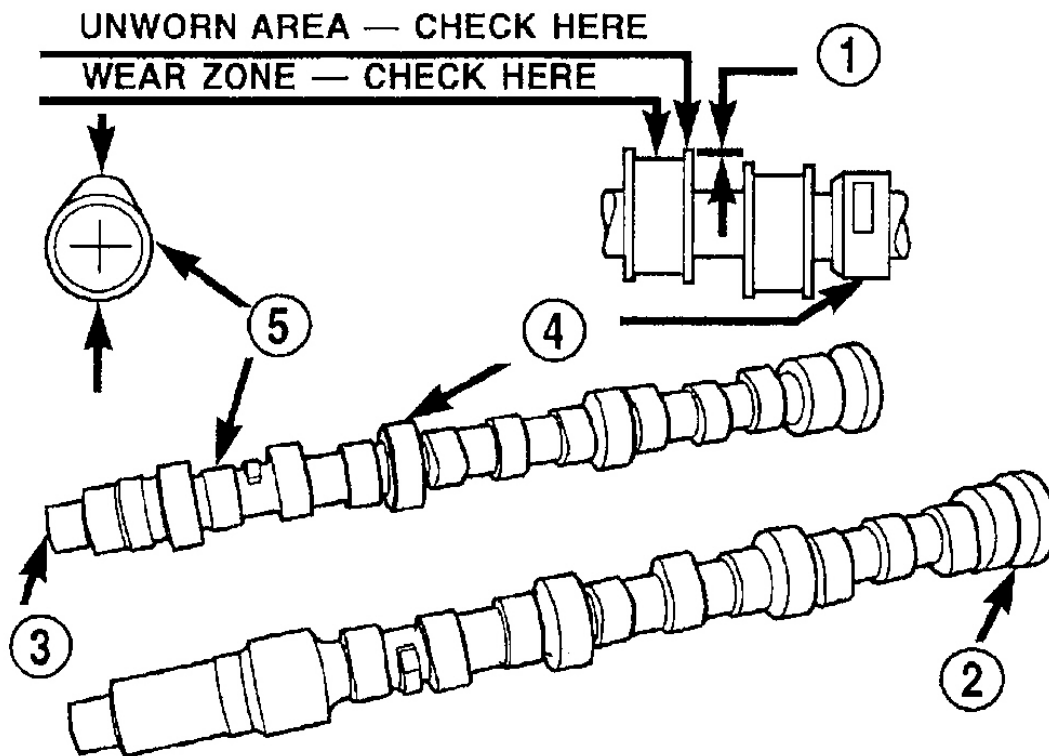
Fig. 60: Exploded View Of Cylinder Head, Camshaft And Rocker Arm
Courtesy of DAIMLERCHRYSLER CORP.

INSPECTION

1. Inspect camshaft bearing journals for damage and binding. 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.

3. Measure the lobe actual wear (**Fig. 61**) 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 - ACTUAL WEAR
- 2 - LEFT CAMSHAFT
- 3 - RIGHT CAMSHAFT
- 4 - BEARING JOURNAL
- 5 - LOBE

G03572490

Fig. 61: Inspecting Camshaft
Courtesy of DAIMLERCHRYSLER CORP.

INSTALLATION

NOTE: Care must be taken not to scrape or nick the camshaft journals when installing

the camshaft into position.

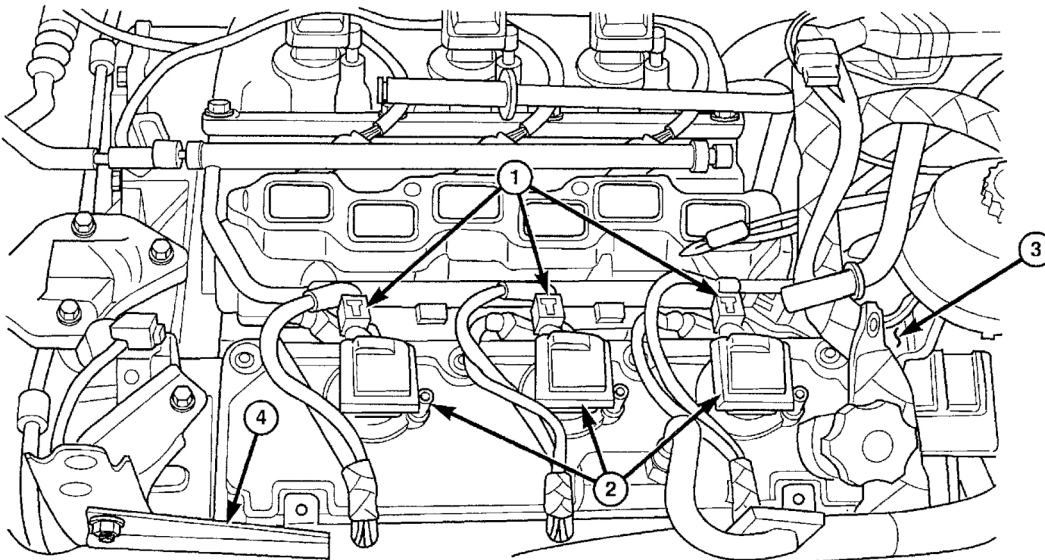
1. Lubricate camshaft bearing journals, camshaft lobes and camshaft seal with clean engine oil and install camshaft into cylinder head (**Fig. 60**).
2. Install the cylinder head (Refer to **INSTALLATION**).

CYLINDER HEAD COVER - LEFT

REMOVAL

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

1. Disconnect and isolate the negative battery cable.
2. Remove the upper intake manifold from the engine (Refer to **REMOVAL**).
3. Cover lower intake manifold with a suitable cover during service.
4. Disconnect and remove the three ignition coils (**Fig. 62**).

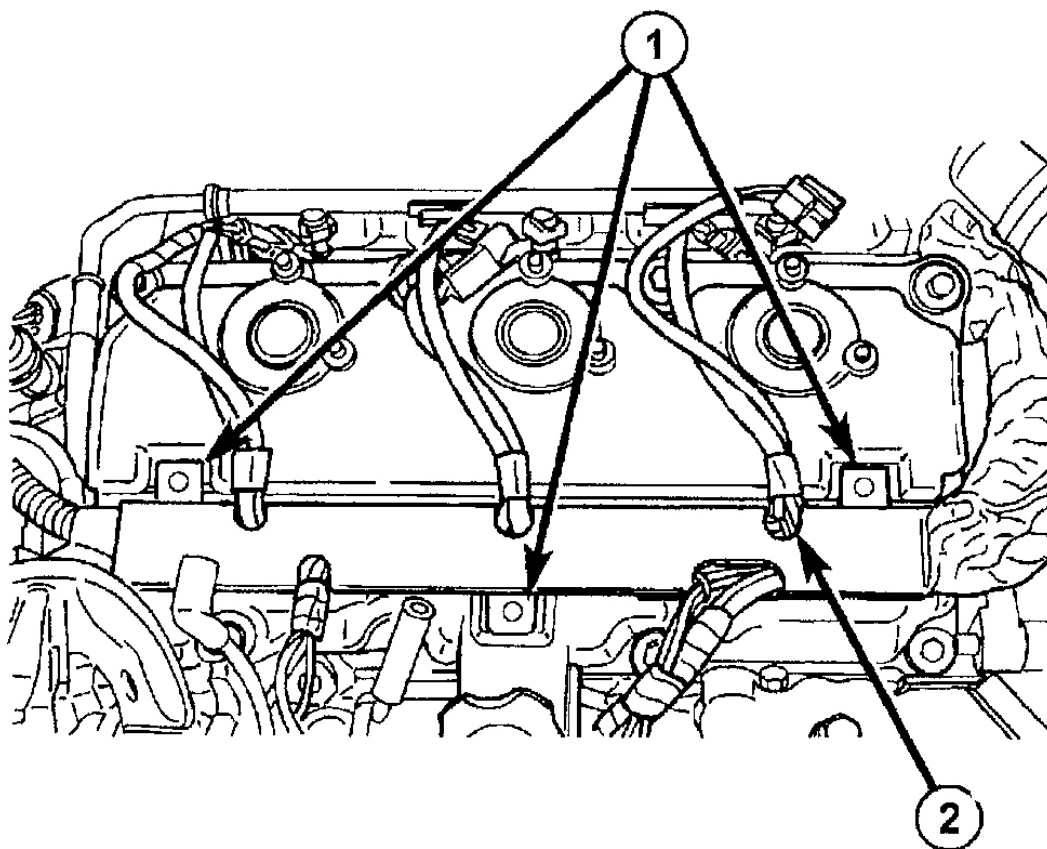


1 - ELECTRICAL CONNECTORS
2 - IGNITION COILS
G03572491

3 - CYLINDER HEAD COVER
4 - BRACKET

Fig. 62: Locating Ignition Coils
Courtesy of DAIMLERCHRYSLER CORP.

5. Remove the upper intake manifold support brackets from the front and rear of the engine.
6. Lift up on the wire harness track retaining tabs (**Fig. 63**).

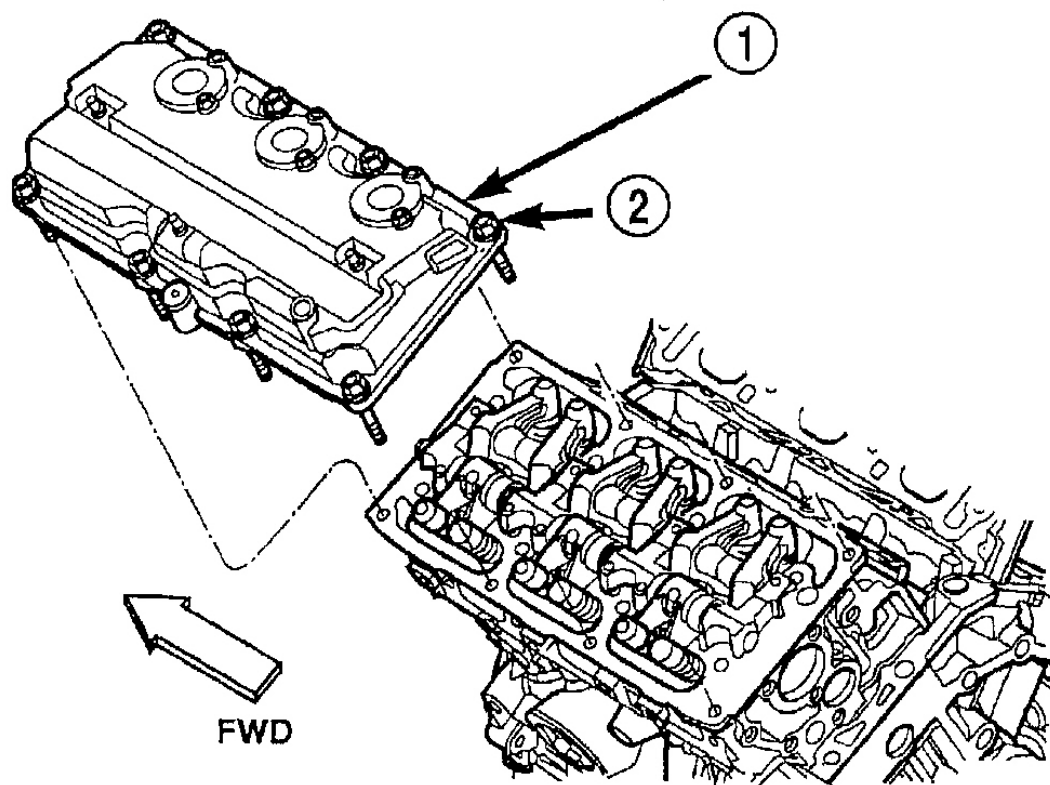


1 - PUSH TABS
2 - WIRING HARNESS

G03572492

Fig. 63: Locating Wiring Harness Retaining Tabs
Courtesy of DAIMLERCHRYSLER CORP.

7. Remove the ground strap/resistor retaining bolt from the cylinder head cover.
8. Completely loosen the cylinder head cover retaining bolts and remove the cylinder head cover (**Fig. 64**).



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

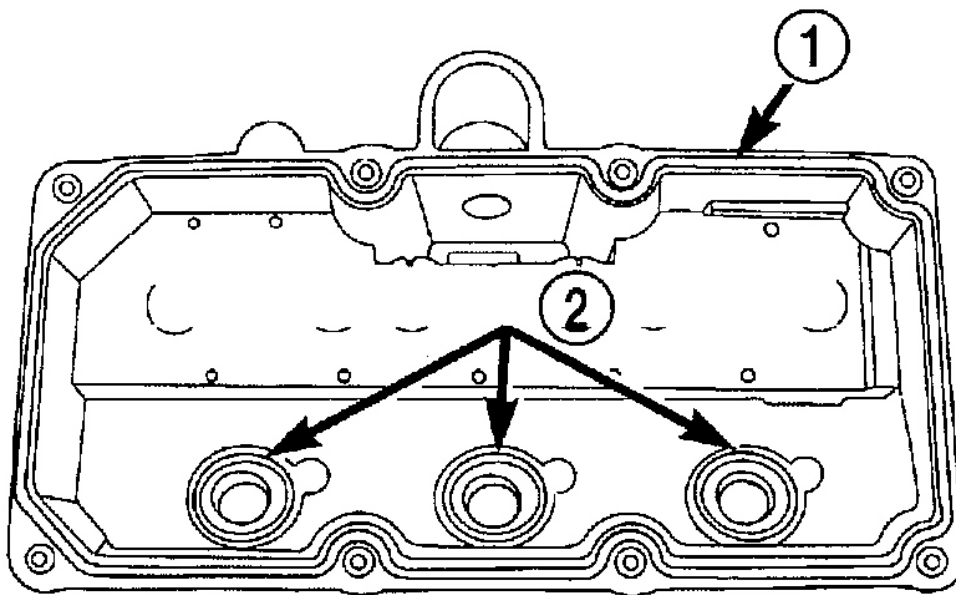
G03572493

Fig. 64: Removing Cylinder Head Cover - Left
Courtesy of DAIMLERCHRYSLER CORP.

9. Remove the PCV valve from the valve cover assembly (if required).

INSTALLATION

1. Clean cylinder head and cover mating surfaces. Inspect and replace gasket and seals as necessary (**Fig. 65**).

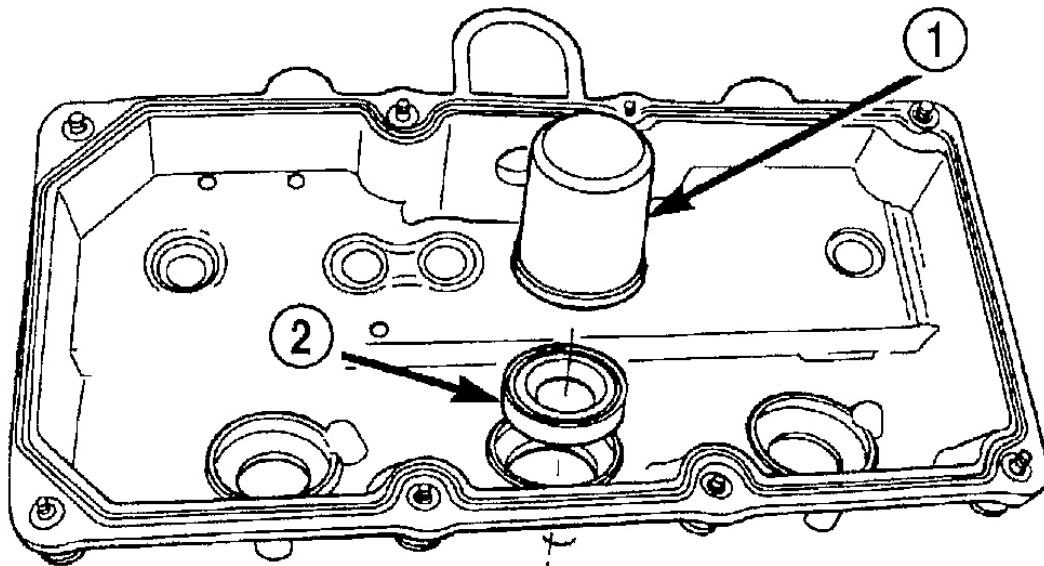


1 - CYLINDER HEAD COVER GASKET
2 - SPARK PLUG TUBE SEALS

G03572494

Fig. 65: Locating Spark Plug Tube Seals
Courtesy of DAIMLERCHRYSLER CORP.

2. To replace spark plug tube seals:
 - a. Using a suitable pry tool, carefully remove tube seals.
 - b. Position new seal with the part number on seal facing cylinder head cover.
 - c. Install seals using Special Tool MD-998306 (**Fig. 66**).



1 - SPECIAL TOOL MD-998306

2 - SPARK PLUG TUBE SEAL

G03572495

Fig. 66: Installing Spark Plug Tube Seals
Courtesy of DAIMLERCHRYSLER CORP.

3. Install PCV valve (if required)
4. Install cylinder head cover and bolts. Tighten to 12 N.m (105 in. lbs.).
5. Position the wiring harness on the cylinder head cover.
6. Reclip the wire harness track retaining tabs into the cover (**Fig. 63**).
7. Install the ground strap/resistor retaining bolt onto the cylinder head cover.
8. Install the upper intake manifold support brackets onto the front and rear of the engine.
9. Install the ignition coils. Tighten mounting screws to 6.7 N.m (60 in. lbs.) (**Fig. 62**).
10. Connect the ignition coil electrical connectors.
11. Install upper intake manifold (Refer to **INSTALLATION**).
12. Connect negative battery cable.

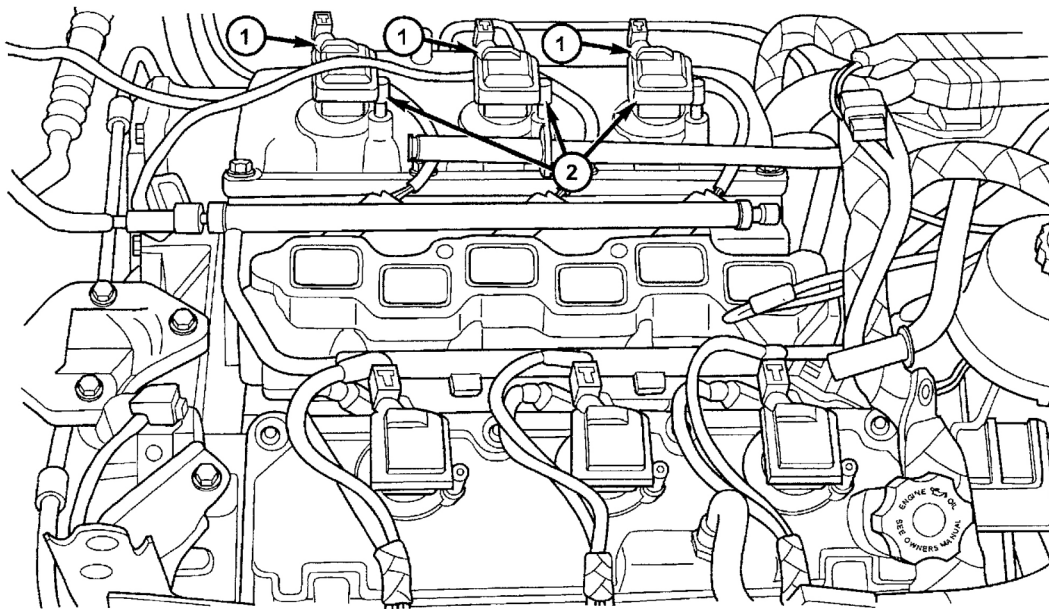
CYLINDER HEAD COVER - RIGHT

REMOVAL

WARNING: DO NOT START OR RUN ENGINE WITH CYLINDER HEAD COVER

REMOVED FROM THE ENGINE. DAMAGE OR PERSONAL INJURY MAY OCCUR.

1. Disconnect the negative battery cable.
2. Remove the upper intake manifold from the engine (Refer to **REMOVAL**).
3. Cover lower intake manifold with a suitable cover during service.
4. Disconnect and remove the three ignition coils (**Fig. 67**).



1 - ELECTRICAL CONNECTORS
G03572496

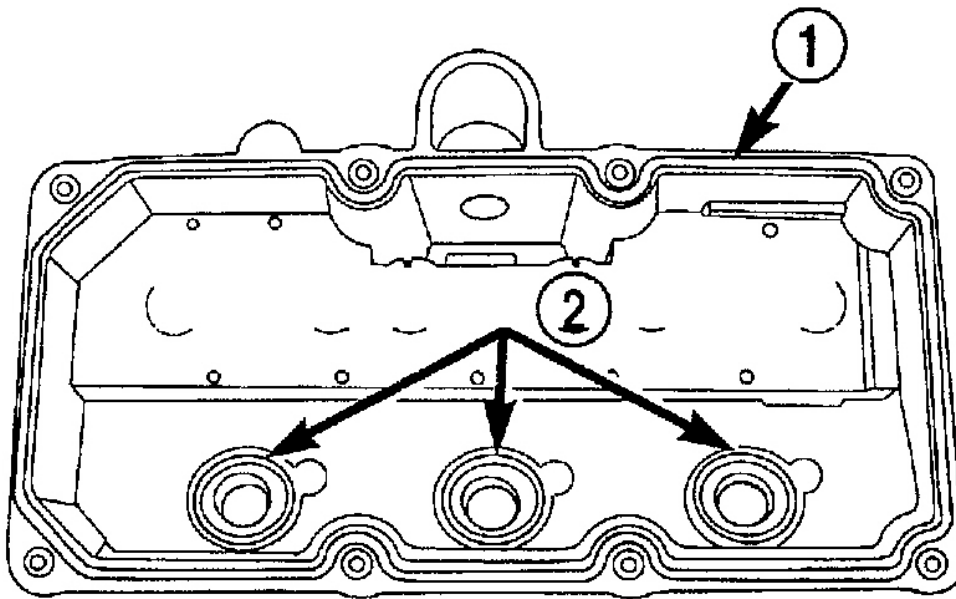
2 - IGNITION COILS

Fig. 67: Locating Ignition Coils - Right
Courtesy of DAIMLERCHRYSLER CORP.

5. Lift up on the wire harness track retaining tabs.
6. Remove the ground strap retaining bolt from the cylinder head cover.
7. Completely loosen the cylinder head cover retaining bolts and remove the cylinder head cover.

INSTALLATION

1. Clean cylinder head and cover mating surfaces. Inspect and replace gasket and seals as necessary (**Fig. 68**).



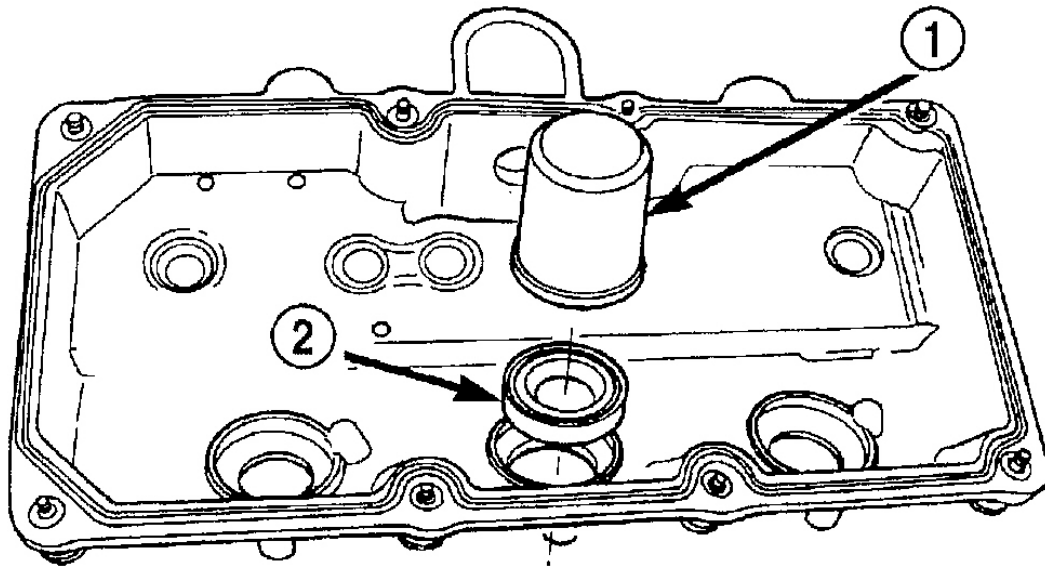
1 - CYLINDER HEAD COVER GASKET

2 - SPARK PLUG TUBE SEALS

G03572497

Fig. 68: Identifying Spark Plug Tube Seals
Courtesy of DAIMLERCHRYSLER CORP.

2. To replace spark plug tube seals:
 - a. Using a suitable pry tool, carefully remove tube seals.
 - b. Position new seal with the part number on seal facing cylinder head cover.
 - c. Install seals using Special Tool MD-998306 (**Fig. 69**).



1 - SPECIAL TOOL MD-998306

2 - SPARK PLUG TUBE SEAL

G03572498

Fig. 69: Installing Spark Plug Tube Seals
Courtesy of DAIMLERCHRYSLER CORP.

3. Install cylinder head cover bolts and tighten to 12 N.m (105 in. lbs.).
4. Install the ground strap retaining bolt to the cylinder head cover.
5. Install the wire harness track retaining nuts (**Fig. 67**).
6. Install the ignition coils. Tighten mounting screws to 6.7 N.m (60 in. lbs.) (**Fig. 67**).
7. Connect the ignition coil electrical connectors (**Fig. 67**).
8. Install upper intake manifold (Refer to **INSTALLATION**).
9. Connect negative battery cable.

INTAKE/EXHAUST VALVES & SEATS

DESCRIPTION

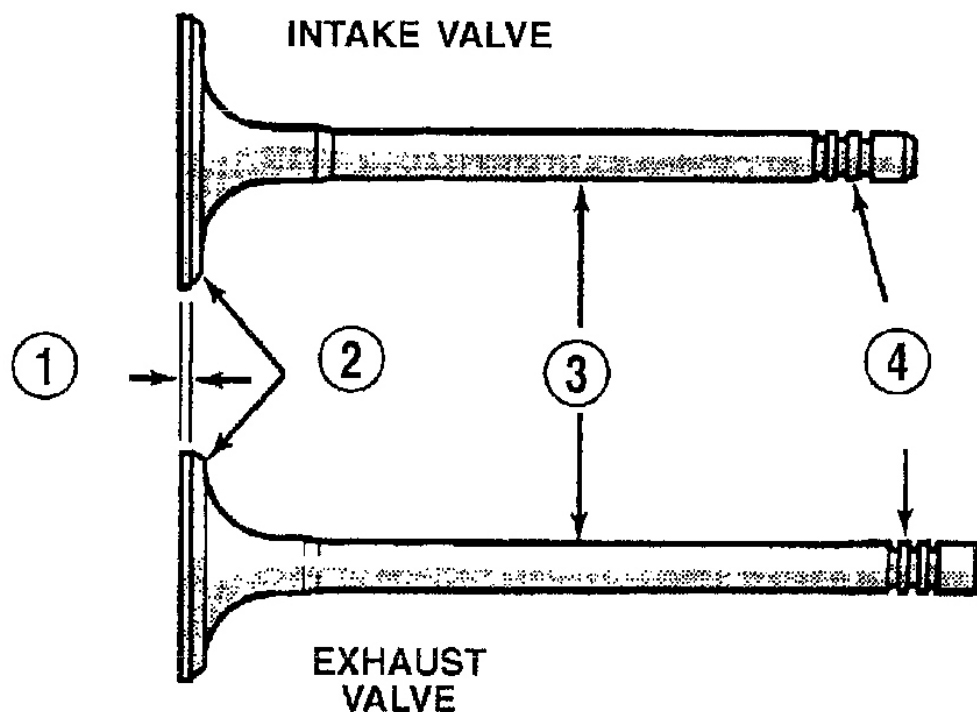
Valves are made of highly heat-resistant steel and are chrome plated to prevent stem scuffing. The intake valve is a one-piece forging, while the exhaust valve has a forged head with a welded stem for lock groove hardenability. The four valves (two intake and two exhaust) employ a three-groove lock design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

OPERATION

The intake valve allows the air/fuel mixture to enter the combustion chamber. The exhaust valve allows the burned air/fuel mixture to exit the combustion chamber. Also, the intake and exhaust valves seal the combustion chamber during the compression and power strokes.

STANDARD PROCEDURE - VALVE AND VALVE SEAT REFACING

The valve face and valve seat angles are shown in (**Fig. 70**).



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

G03572499

Fig. 70: Identifying Intake and Exhaust Valve Face And Seat Angles
Courtesy of DAIMLERCHRYSLER CORP.

VALVES

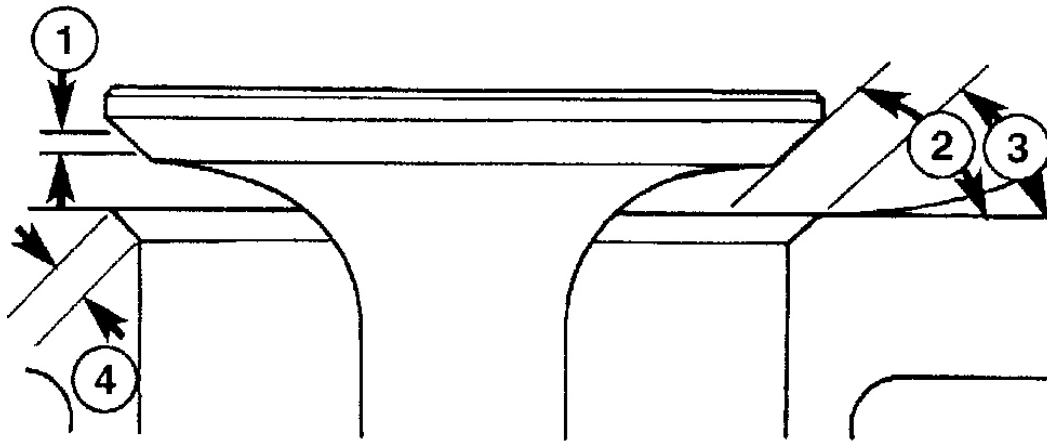
1. Inspect the remaining margin after the valves are refaced (Refer to **SPECIFICATIONS**).

VALVE SEATS

1. When refacing valve seats, it is important that the correct size valve guide pilot be used for reseating stones. A true and complete surface must be obtained.
2. Measure the concentricity of valve seat using dial indicator. Total runout should not exceed 0.051 mm (0.002 inch.) total indicator reading.
3. Inspect the valve seat with Prussian blue to determine where the valve contacts the seat. To do this, coat valve seat **LIGHTLY** with Prussian blue then set valve in place. Rotate the valve with light pressure. If the blue is transferred to the center of valve face, contact is satisfactory. If the blue is transferred to top edge of valve face, then lower valve seat with a 15 degree stone. If the blue is transferred to the bottom edge of valve face, then raise valve seat with a 65 degree stone.

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

4. When seat is properly positioned the width of the intake seats should be 0.75 to 1.25 mm (0.0296 to 0.0493 in.) and exhaust seats should be 1.25 to 1.75 mm (0.049 to 0.069 in.) (**Fig. 71**).



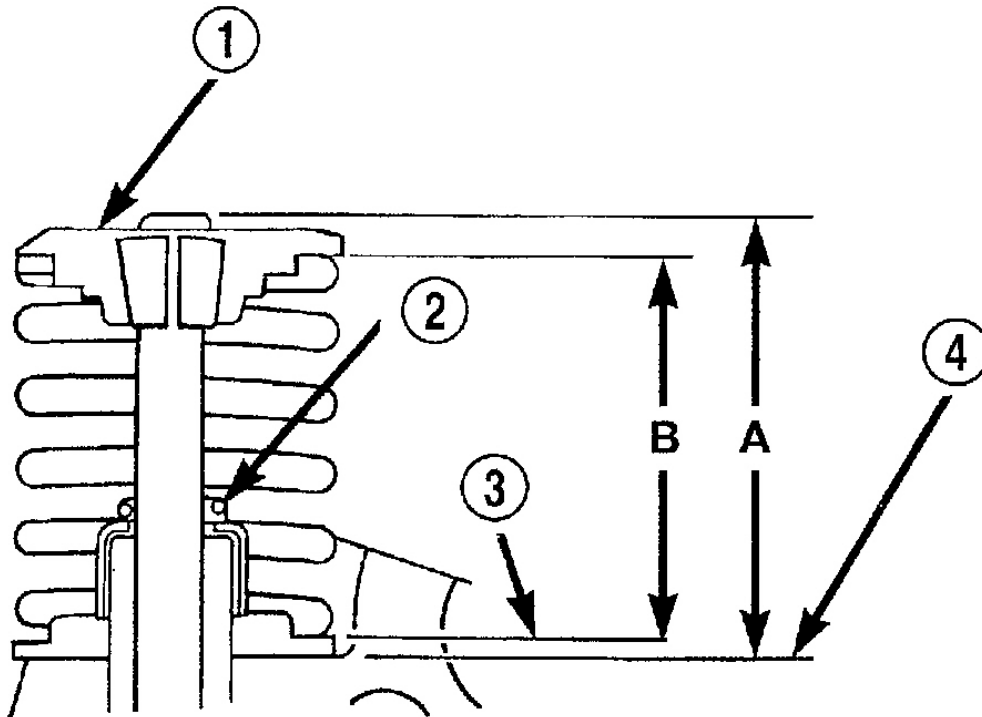
- 1 - SEAT WIDTH
- 2 - FACE ANGLE
- 3 - SEAT ANGLE
- 4 - SEAT CONTACT AREA

G03572500

Fig. 71: Identifying Valve Face & Seat
Courtesy of DAIMLERCHRYSLER CORP.

VALVE AND SPRING INSTALLED HEIGHT

1. Coat valve stems with clean engine oil and insert them in cylinder head.
2. If valves or seats have been refaced, check valve tip height (A) (**Fig. 72**). If valve tip height is greater than 43.65 mm (1.7185 in.) intake or 45.98 mm (1.8102 in.) exhaust, grind valve tip until within specifications. Make sure measurement is taken from cylinder head surface to the top of valve stem.

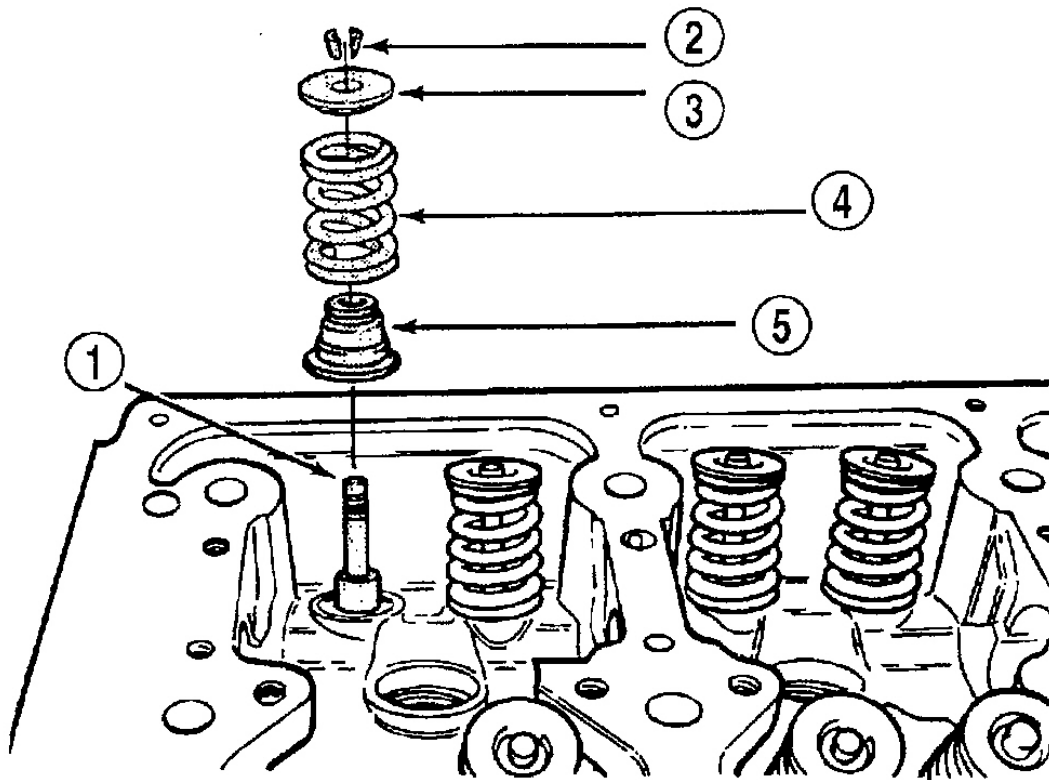


- 1 - SPRING RETAINER
- 2 - GARTER SPRING
- 3 - VALVE SPRING SEAT TOP
- 4 - CYLINDER HEAD SURFACE

G03572501

Fig. 72: Checking Valve Tip Height and Valve Spring Installed Height
Courtesy of DAIMLERCHRYSLER CORP.

3. Install valve seal/spring seat assembly over valve guides on all valve stems (**Fig. 73**). Ensure that the garter spring is intact around the top of the rubber seal.

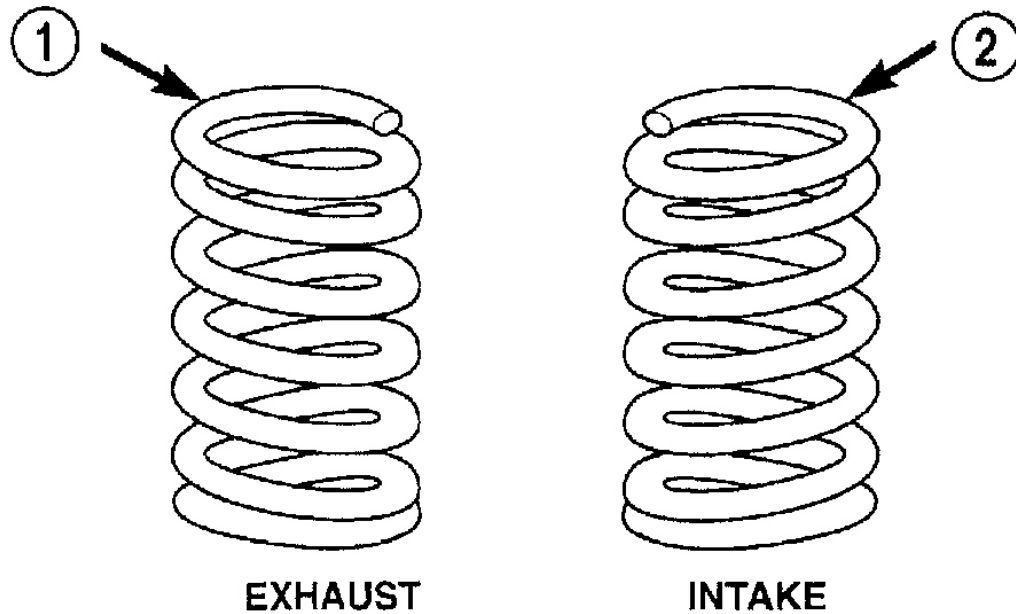


- 1 - VALVE
- 2 - VALVE RETAINING LOCKS
- 3 - VALVE SPRING RETAINER
- 4 - VALVE SPRING
- 5 - VALVE SEAL AND VALVE SPRING SEAT ASSEMBLY

G03572503

Fig. 73: Installing Valve Seal and Spring
 Courtesy of DAIMLERCHRYSLER CORP.

4. Place valve spring (color-coded end facing up) (**Fig. 74**) and valve retainer into position on spring seat (**Fig. 72**).



1 - YELLOW OR WHITE DYE

2 - ORANGE DYE

G03572502

Fig. 74: Identifying Valve Springs
Courtesy of DAIMLERCHRYSLER CORP.

5. Compress valve springs with valve spring compressor C-3422-D and adapter 6526 (Refer to **SPECIAL TOOLS**), install locks and release tool.
6. If valves and/or seats are refaced, measure the installed height of springs (**Fig. 72**). Measurements are taken from top of spring seat to the bottom surface of spring retainer. If height is greater than 38.75 mm (1.5256 in.), install a 0.762 mm (0.030 in.) spacer in head counterbore under the valve spring seat to bring spring height back within specification.

REMOVAL

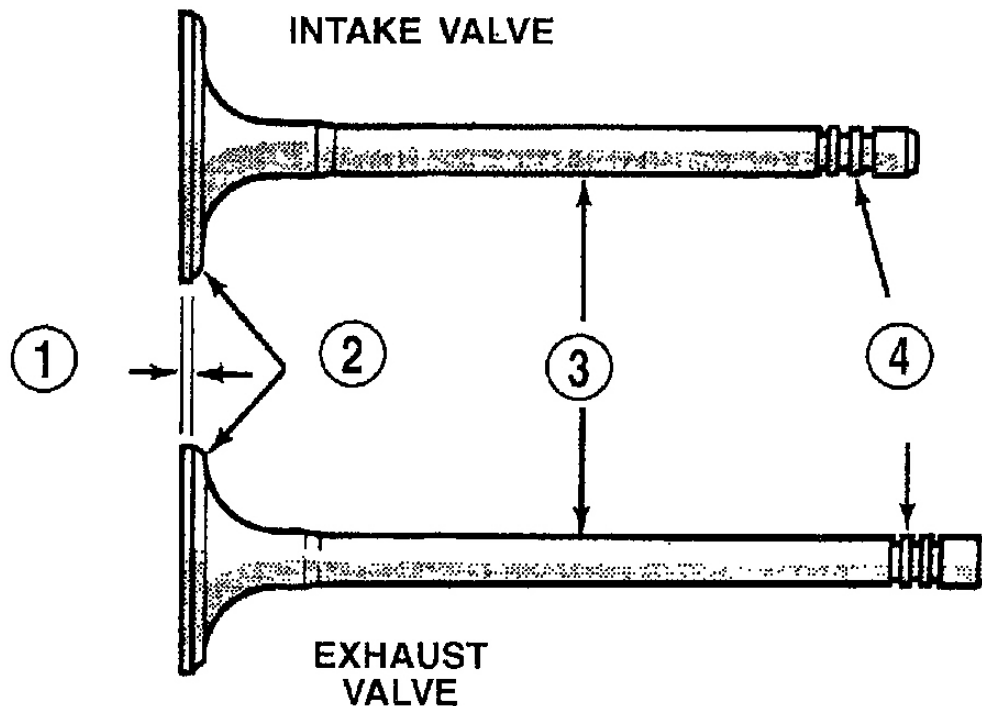
1. Remove cylinder head(s) (Refer to **REMOVAL - CYLINDER HEAD(S)**).
2. Remove rocker arm assembly (Refer to **REMOVAL**).
3. Remove valve spring(s) (Refer to **REMOVAL**).
4. Before removing valve, remove any burrs from valve stem lock grooves to prevent damage to the valve guides. Identify valves to insure installation in original location.
5. Remove valve(s) from cylinder head.

CLEANING

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

INSPECTION**INSPECTION - VALVES**

1. Measure valve stems for wear (**Fig. 75**) approximately 60 mm (2.36 in.) below the valve lock grooves.



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

G03572504

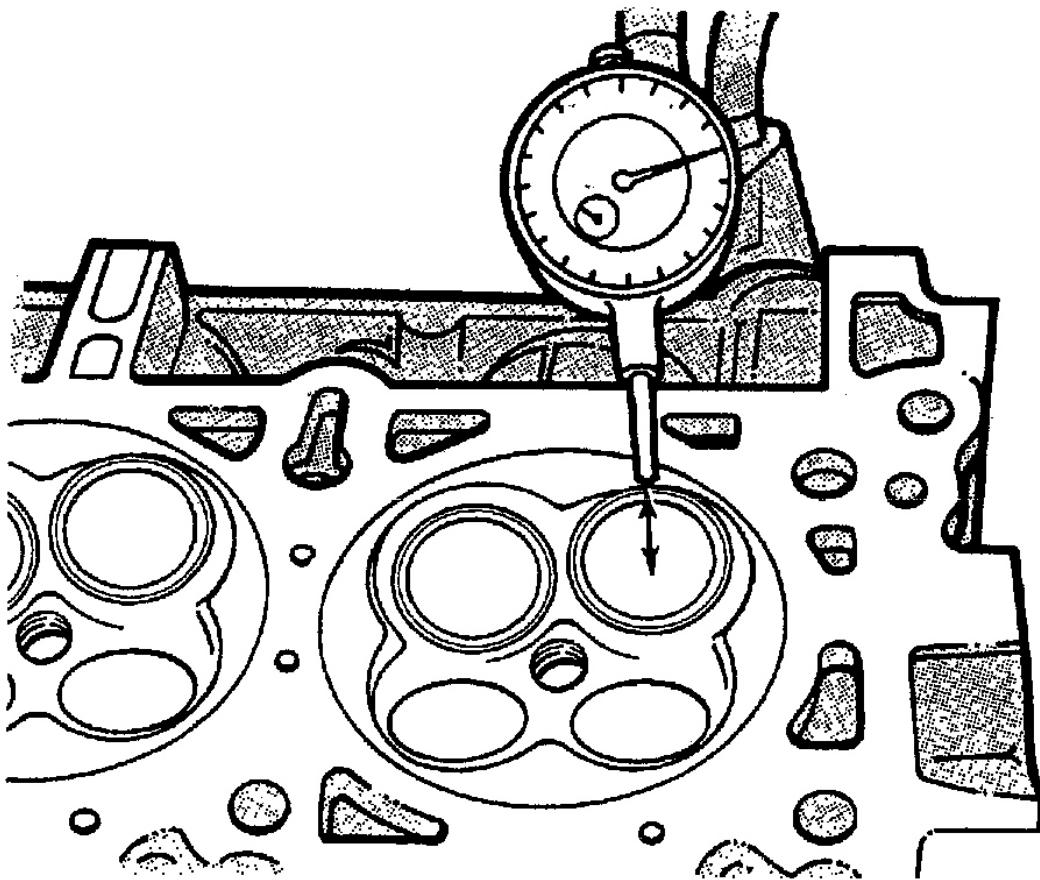
Fig. 75: Inspecting Intake and Exhaust Valves
Courtesy of DAIMLERCHRYSLER CORP.

2. Compare measurement to specifications, (Refer to **SPECIFICATIONS**).

NOTE: Valve stems are chrome plated and should not be polished (Fig. 75).

INSPECTION - VALVE GUIDES

1. Measure valve stem-to-guide clearance as follows:
2. Install valve into cylinder head so it is 15 mm (0.590 inch.) off the valve seat. A small piece of hose may be used to hold valve in place.
3. Attach dial indicator Tool C-3339 to cylinder head and set it at right angle of valve stem being measured (Fig. 76).



G03572505

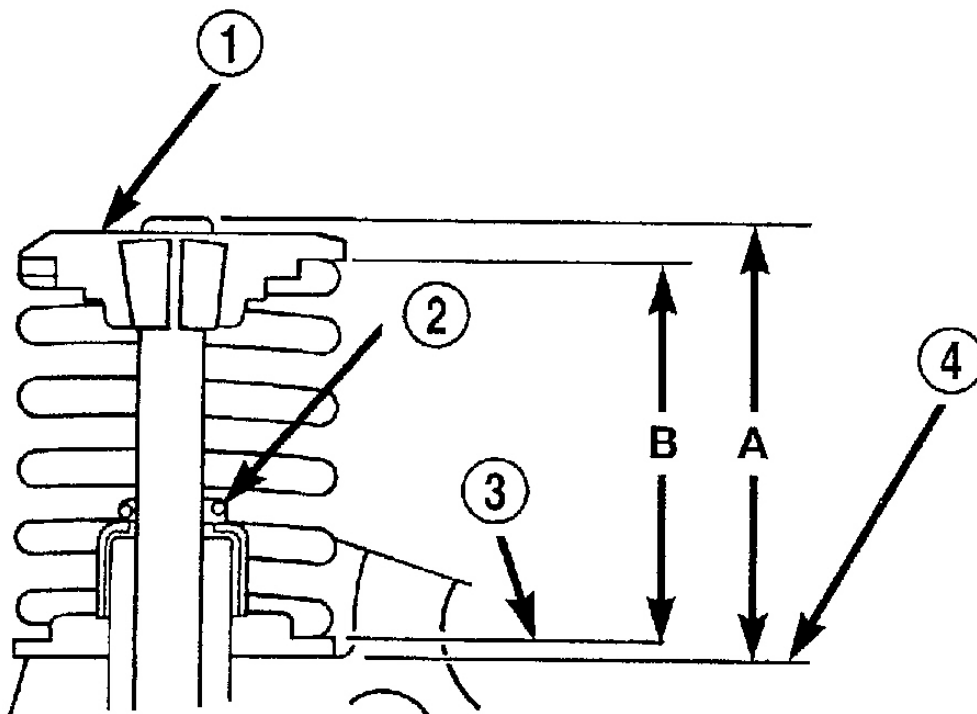
Fig. 76: Measuring Valve Guide Wear
Courtesy of DAIMLERCHRYSLER CORP.

4. Move valve to and from the indicator.
5. Note dial indicator reading and compare to engine SPECIFICATIONS . (Refer to SPECIFICATIONS).

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

INSTALLATION

1. Coat valve stems with clean engine oil and insert them in cylinder head.
2. If valves or seats have been reground, check valve tip height (A) (**Fig. 77**). If valve tip height is greater than 43.65 mm (1.7185 in.) intake or 45.98 mm (1.8102 in.) exhaust, grind valve tip until within specifications. Make sure measurement is taken from cylinder head surface to the top of valve stem.



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

G03572506

Fig. 77: Checking Valve Tip Height and Valve Spring Installed Height
Courtesy of DAIMLERCHRYSLER CORP.

3. Install new valve stem seals.

4. Install valve springs (Refer to **INSTALLATION**).
5. Install cylinder head(s) (Refer to **INSTALLATION**).

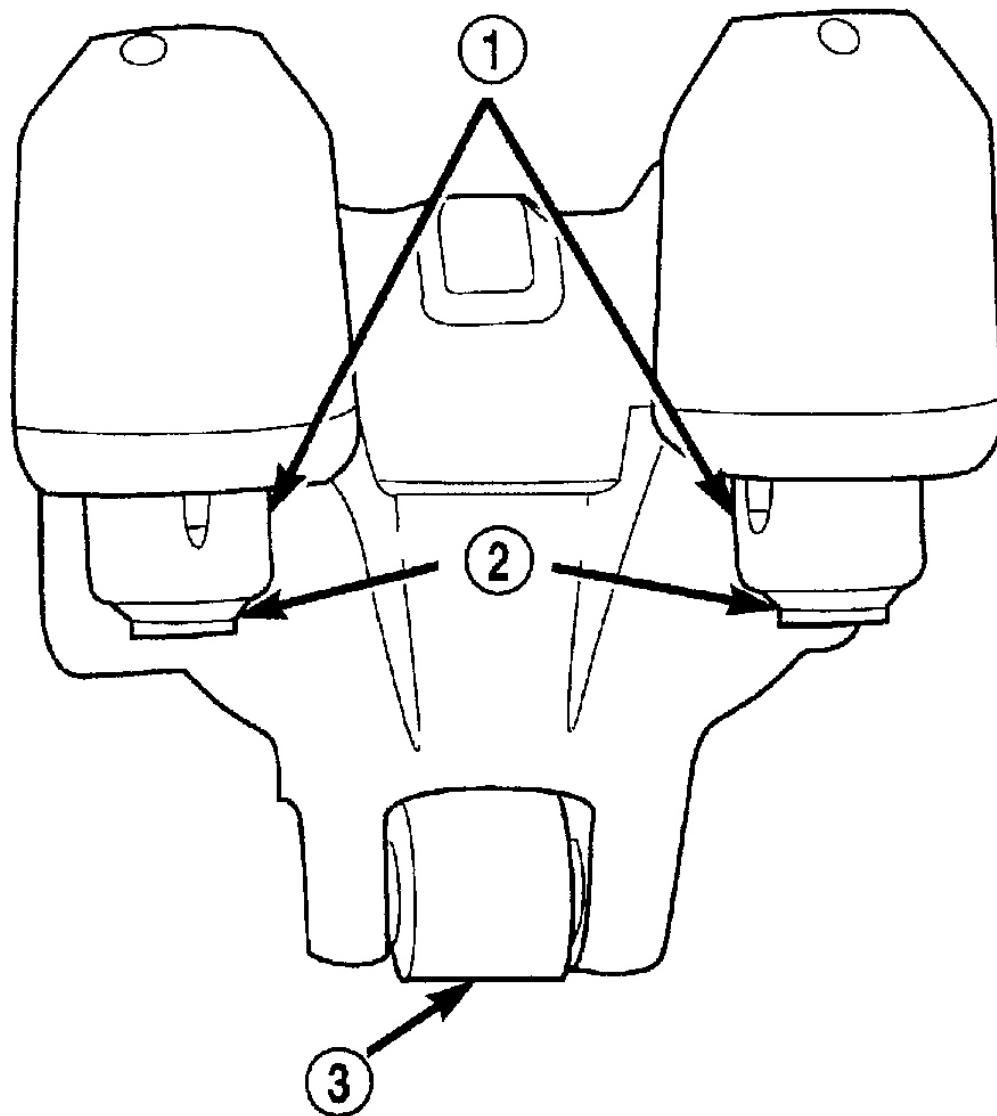
ROCKER ARM SHAFT/ROCKER ARM/LASH ADJUSTER

DESCRIPTION

DESCRIPTION - ROCKER ARM

Rocker arms are made of light weight permanent mold aluminum alloy with a roller type follower operating against the camshaft (**Fig. 78**). The valve actuating end of the rocker arms are machined to retain hydraulic lash adjusters, eliminating the need for manual valve lash adjustment.

**HYDRAULIC LASH
ADJUSTER:**



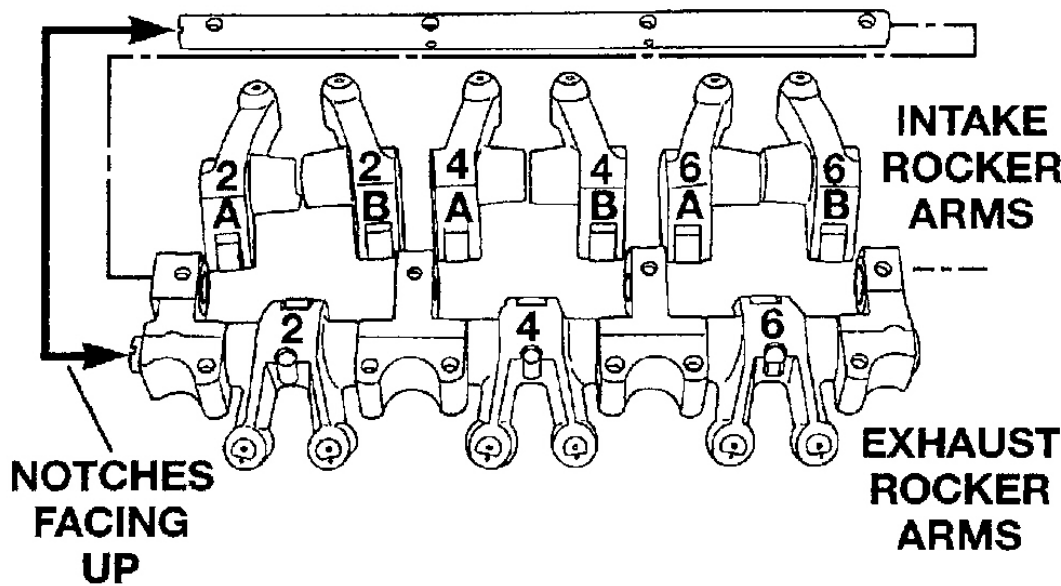
- 1 - RETAINER
- 2 - SWIVEL PAD
- 3 - ROLLER

G03572507

Fig. 78: Identifying Roller Type Followers In Rocker Arms
Courtesy of DAIMLERCHRYSLER CORP.

DESCRIPTION - ROCKER ARM SHAFTS

The rocker arm shafts (**Fig. 79**) are tubular steel and are supported by several forged aluminum alloy pedestals, which are fastened to the cylinder head. Four shafts are used, one for each intake and exhaust rocker arm bank on each cylinder head. The shafts are hollow to provide a duct for lubricating oil flow from the cylinder head to the valve mechanisms. One hollow dowel per pedestal is used to locate the pedestal to the cylinder head, orient the exhaust rocker shaft, and serve as a cam bearing oil feed passage.



G03572508

Fig. 79: Identifying Rocker Arms and Shafts
Courtesy of DAIMLERCHRYSLER CORP.

OPERATION

The rocker arm is the pivot point between the camshaft lobe and the valve.

DIAGNOSIS AND TESTING**LASH ADJUSTER (TAPPET) NOISE DIAGNOSIS**

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

Refer to **DIAGNOSIS AND TESTING** chart indicating possible lash adjuster (tappet) noise sources and possible sources that could lead to a misdiagnosis.

Refer to **LASH ADJUSTER (TAPPET) NOISE CHART** for Possible Causes and Correction of a lash

adjuster (tappet) type noise.

DIAGNOSIS AND TESTING

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

LASH ADJUSTER (TAPPET) NOISE CHART

LASH ADJUSTER (TAPPET) NOISE CHART

POSSIBLE CAUSES	CORRECTION
1. Engine oil level-too high or too low. This may cause aerated oil to enter the adjusters and cause them to be spongy.	1. Check and correct engine oil level.
2. Insufficient running time after rebuilding cylinder head.	2. Low speed running of up to 1 hour may be required to fully evacuate trapped air from the valve train system. During this time, turn engine off and let set for a few minutes before restarting. Repeat this several times after engine has reached normal operating temperature.
3. Air trapped in lash adjuster (after 1 hour run time).	3. See below: a. Check lash adjusters for sponginess while installed in cylinder head. Depress part of rocker arm over adjuster. Normal adjusters should feel very firm. Very spongy adjusters can be bottomed out easily. b. Before proceeding, perform Lash Adjuster Bleeding procedure. c. If lash adjuster(s) are still spongy, replace with new adjuster/rocker arm assembly ⁽¹⁾ .
4. Low oil pressure	4. See below: a. Check and correct engine oil level. b. Check engine oil pressure. c. Check for excessive bearing clearance and correct, d. Check for worn oil pump.
5. Oil passage to cylinder head(s) plugged with debris.	5. Check cylinder head oil passages and cylinder head gasket restrictor for blockage. Clean or replace as necessary.
6. Worn valve guide(s).	6. Ream guide(s) and replace valve(s) with oversize valves and seal(s).

2004 Chrysler Pacifica

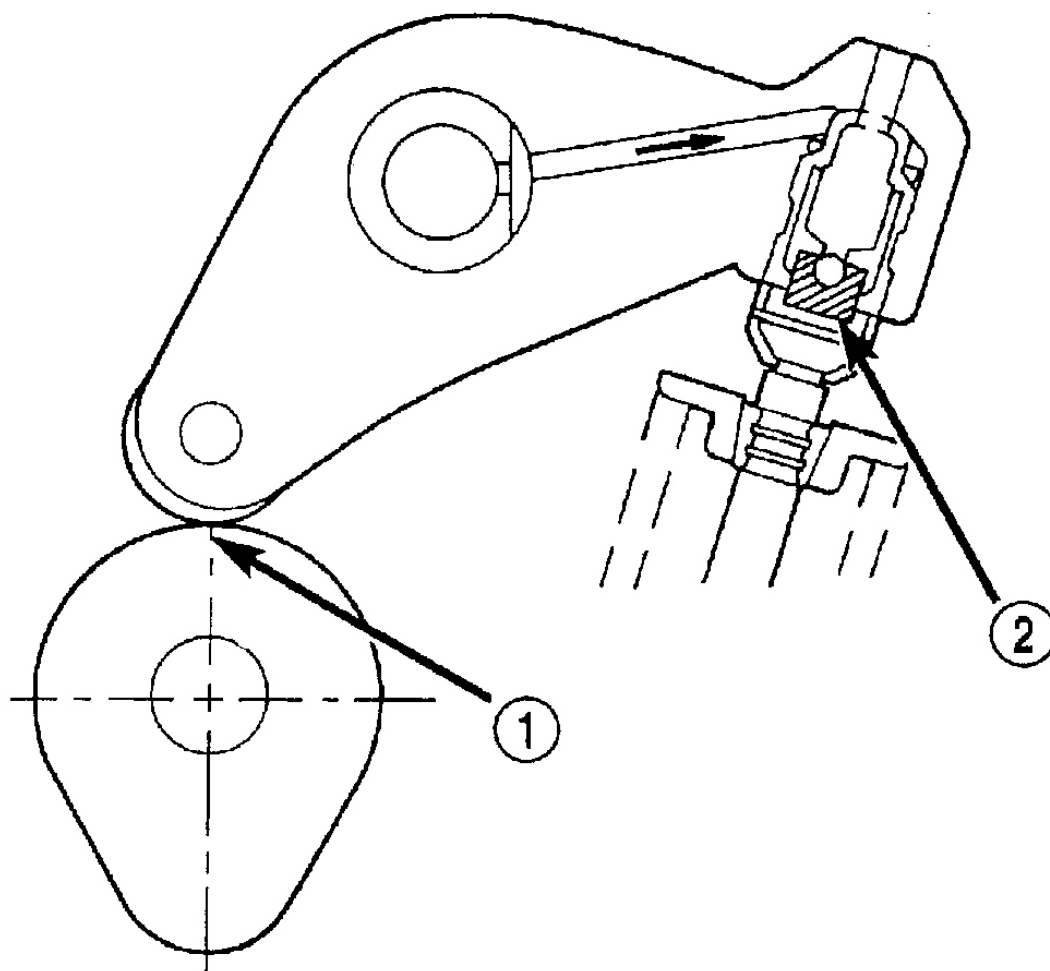
2004 ENGINE Engine 3.5L - Pacifica

7. Air injected into oil due to broken or cracked oil pump pickup tube.	7. Inspect pickup tube and replace as necessary.
8. Collapsed lash adjuster due to debris injection.	8. Clean debris from engine and replace lash adjuster/rocker assembly (1).
9. Intake rocker arm roller clevis ear(s) contacting camshaft bearing journal(s) on side.	9. Inspect camshaft end play and all valve train components for wear. Replace as necessary.
(1) Lash adjusters are serviced with the rocker arms-do not disassemble.	

STANDARD PROCEDURE - HYDRAULIC LASH ADJUSTER BLEEDING

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

1. Run the engine, bringing it to operating temperature in order to freshly pressurize and warm the valvetrain system oil supply.
2. Remove cylinder head cover(s).
3. Ensure the rocker arm is positioned on the base circle of the cam (**Fig. 80**). Rotate engine as necessary.

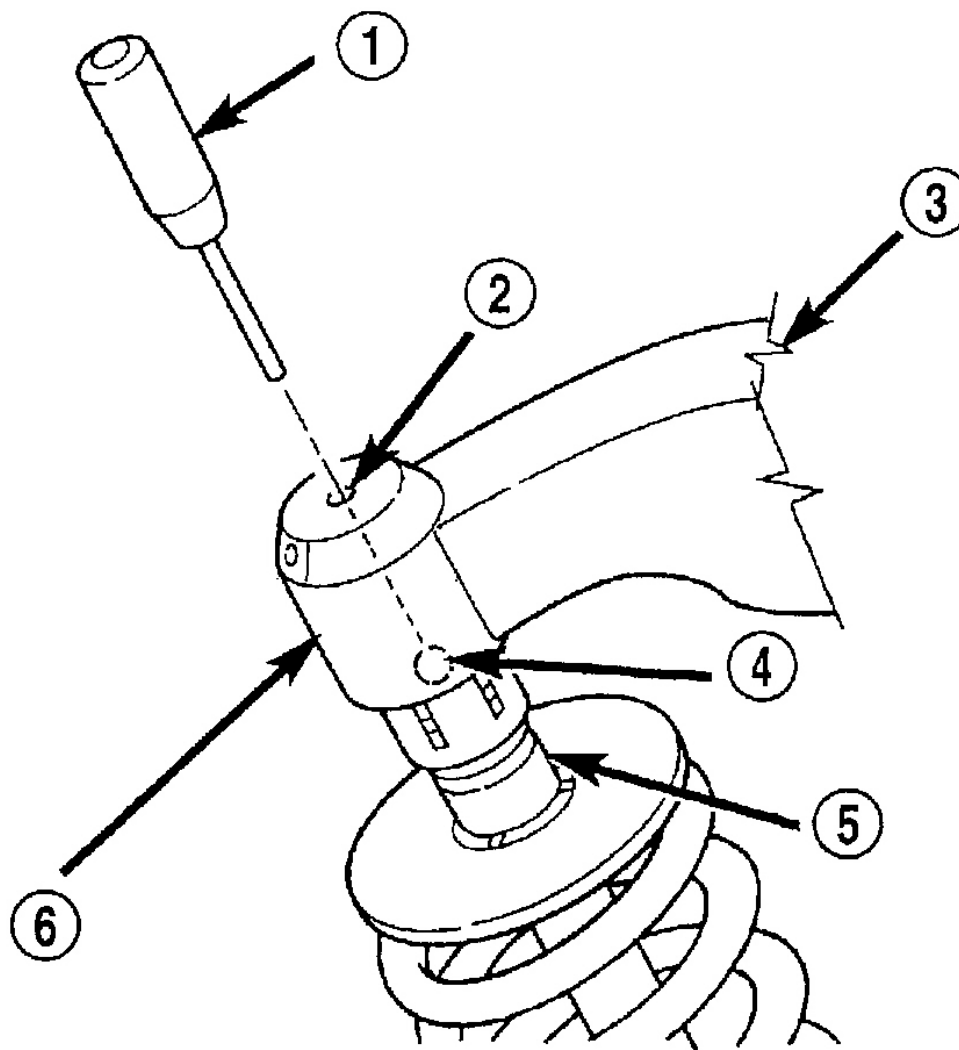


1 - CAMSHAFT BASE CIRCLE
2 - HIGH-PRESSURE CHAMBER

G03572509

Fig. 80: Rocker Arm Positioned On Base Circle Of Camshaft
Courtesy of DAIMLERCHRYSLER CORP.

4. For intake rocker arm positions:
 - a. Adjust Special Tool 8351 Release Probe's gauge pin to extend approximately 20 mm (0.787 in.). Then, carefully insert the release probe gauge pin into the lash adjuster service, access hole (**Fig. 81**).



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

G03572510

Fig. 81: Purging Air From Lash Adjuster
 Courtesy of DAIMLERCHRYSLER CORP.

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

- b. Gently unseat lash adjuster's internal check ball.
 - c. While the internal check ball is held unseated, press the rocker arm into the valve tip, allowing the lash adjuster to fully collapse. Hold this fully collapsed position for about one second, or longer.
 - d. Slowly release the rocker arm, thereby allowing the lash adjuster to extend, which in turn refills the high pressure chamber with non-aerated oil.
 - e. Remove probe to allow check ball to seat.
 - f. Recheck for sponginess. If the lash adjuster sponginess is not completely or nearly eliminated, then repeat procedure.
 - g. If the spongy condition cannot be removed, replace effected rocker arm(s).
5. For exhaust rocker arm positions:
- a. Adjust Special Tool 8.351 Release Probe gauge pin to extend approximately 20 mm (0.787 in.). Then, using two release probes, carefully insert gauge pins into the lash adjuster service access holes (**Fig. 81**).

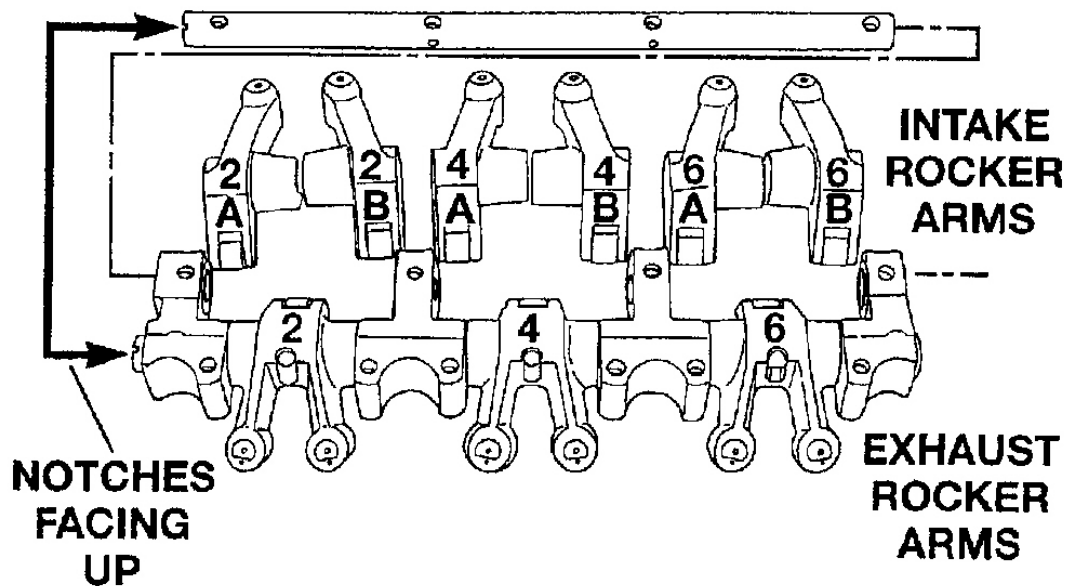
CAUTION: If probe tip breaks off within the lash adjuster, replace the affected rocker arm.

- b. Gently unseat BOTH lash adjuster's internal check ball at the same time.
 - c. While the internal check ball is held unseated, press the rocker arm into the valve tip, allowing the lash adjuster to fully collapse. Hold this fully collapsed position for about one second, or longer.
 - d. Slowly release the rocker arm, thereby allowing the lash adjuster to extend, which in turn refills the high pressure chamber with non-aerated oil.
 - e. Remove probes to allow check balls to seat.
 - f. Recheck for sponginess. If the lash adjuster sponginess is not completely or nearly eliminated, then repeat procedure.
 - g. If the spongy condition cannot be removed, replace effected rocker arm(s).
6. Install cylinder head cover(s).

REMOVAL

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

- 1. Remove cylinder head covers. (Refer to **CYLINDER HEAD COVER(S) - REMOVAL**)
- 2. Identify the rocker arm assembly and rocker arms before disassembly (**Fig. 82**).



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Fig. 82: Identifying Rocker Arms and Shafts
Courtesy of DAIMLERCHRYSLER CORP.

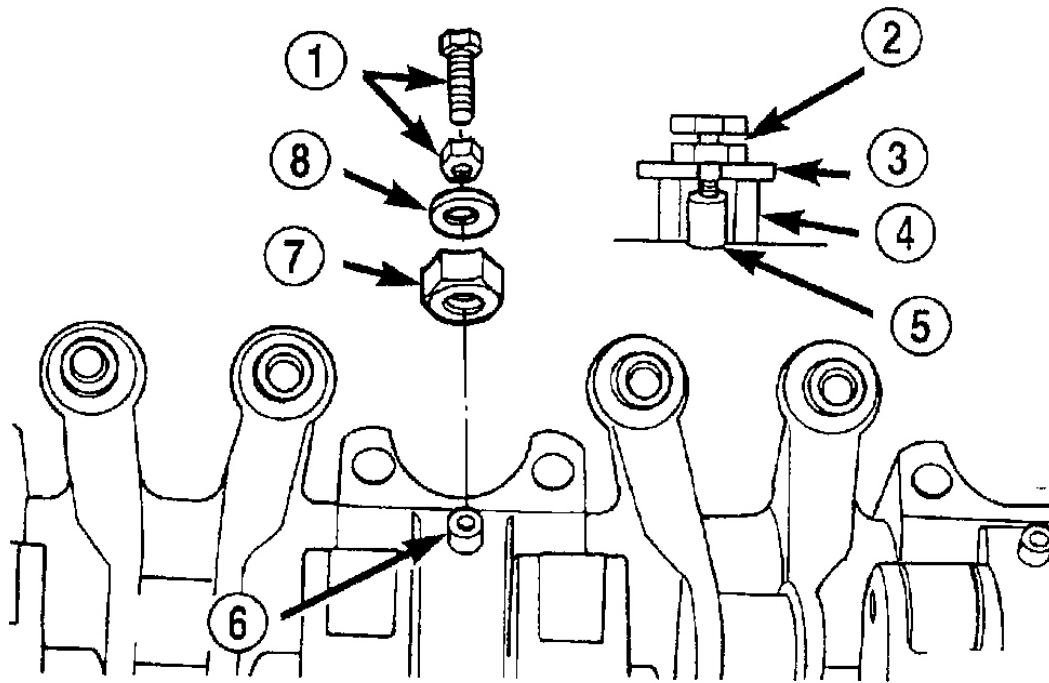
3. Remove rocker arm assembly bolts.
4. Remove rocker arm assembly.

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

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

DISASSEMBLY

1. Remove rocker arm and shafts. (Refer to **REMOVAL**)
2. Remove dowel pin using a 4 mm screw, nut, spacer, and washer installed into the pin (**Fig. 83**). Thread the screw into the pin, then loosen the nut on the screw. This will pull the dowel out of the shaft support. Do not reuse dowel pins. Remove the rocker arms and pedestals in order.



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

G03572512

Fig. 83: Disassembling Rocker Arms
 Courtesy of DAIMLERCHRYSLER CORP.

3. Check the rocker arm mounting portion of the shafts for wear or damage. Replace if damaged or heavily worn.
4. Check shaft oil holes for clogging with small wire, clean as required.

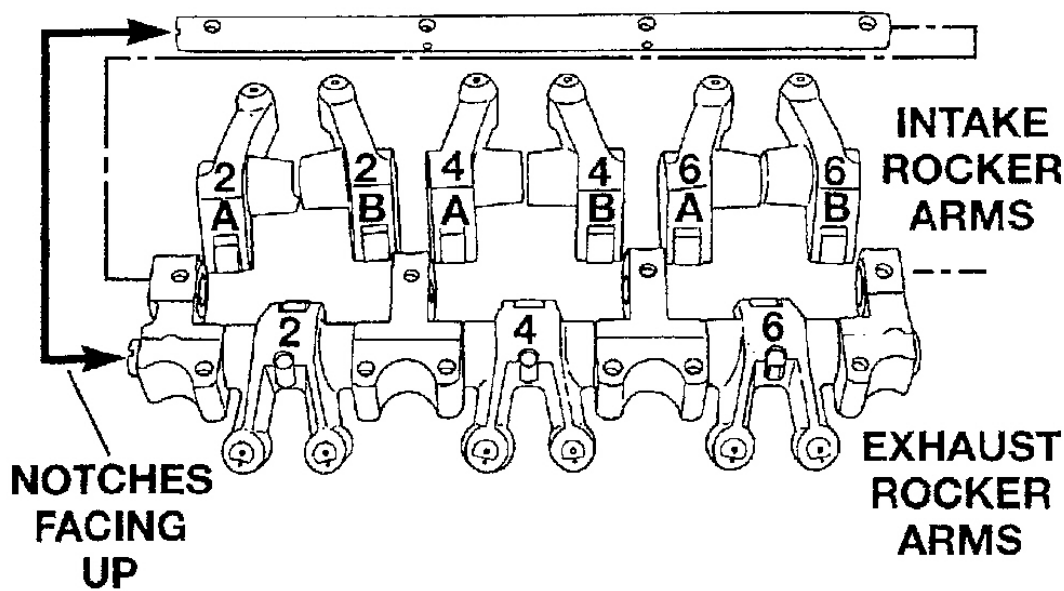
INSPECTION

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

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

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

The intake and exhaust rocker arms are different. They should be identified before disassembling the assembly (**Fig. 84**).

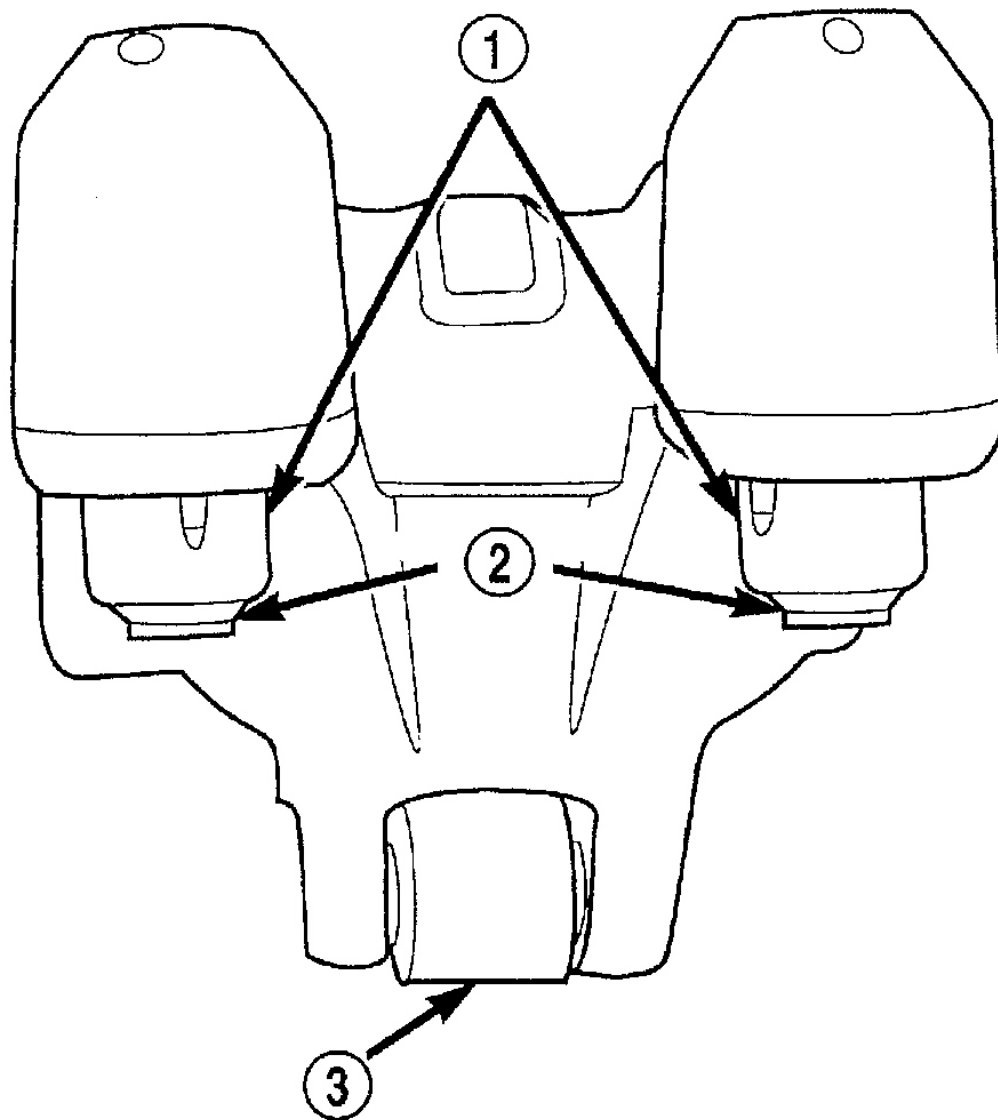


G03572513

Fig. 84: Identifying Rocker Arms and Shafts
Courtesy of DAIMLERCHRYSLER CORP.

Check rocker arms for wear or damage (**Fig. 85**):

**HYDRAULIC LASH
ADJUSTER:**



- 1 - RETAINER
- 2 - SWIVEL PAD
- 3 - ROLLER

G03572514

Fig. 85: Identifying Roller Type Followers In Rocker Arms
Courtesy of DAIMLERCHRYSLER CORP.

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

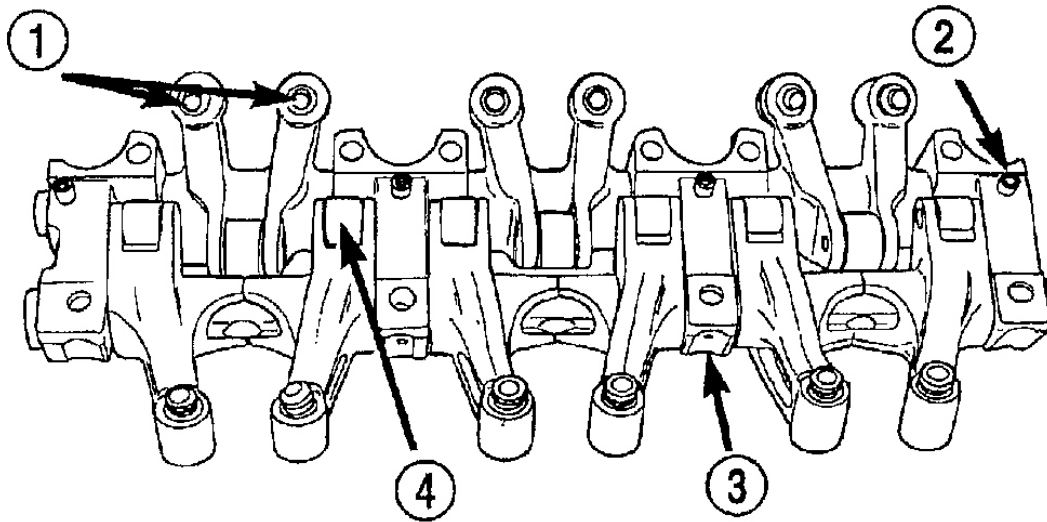
Replace assembly as necessary if any rocker arms shows signs of wear.

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

ASSEMBLY

CAUTION: New dowel pins must be installed when reassembling.

1. Install the rocker arms, and pedestals onto the shaft.
2. Install dowel pins (**Fig. 86**). Dowel pins pass through the pedestal into the exhaust rocker shafts. Dowel pins should be pressed in until they bottom-out against the rocker shaft in the pedestal.



1 - HYDRAULIC LASH ADJUSTERS

2 - DOWEL PIN

3 - PEDESTAL

4 - ROLLER

G03572515

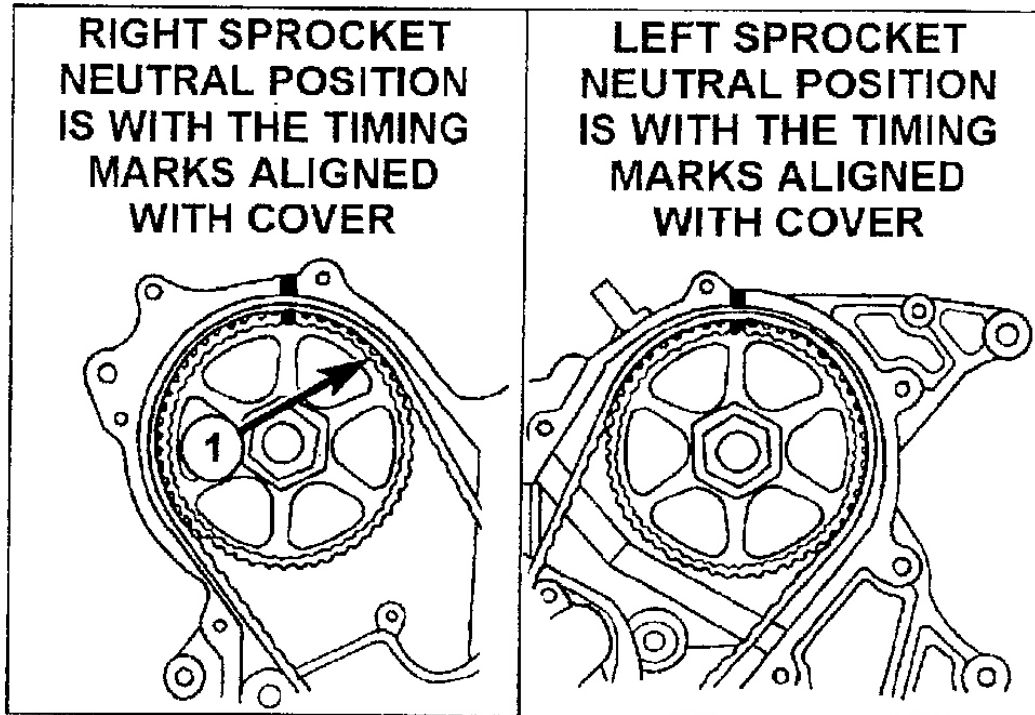
Fig. 86: Assembling Rocker Arms and Shaft
Courtesy of DAIMLERCHRYSLER CORP.

3. Install rocker arm and shafts. (Refer to **INSTALLATION**)

INSTALLATION

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

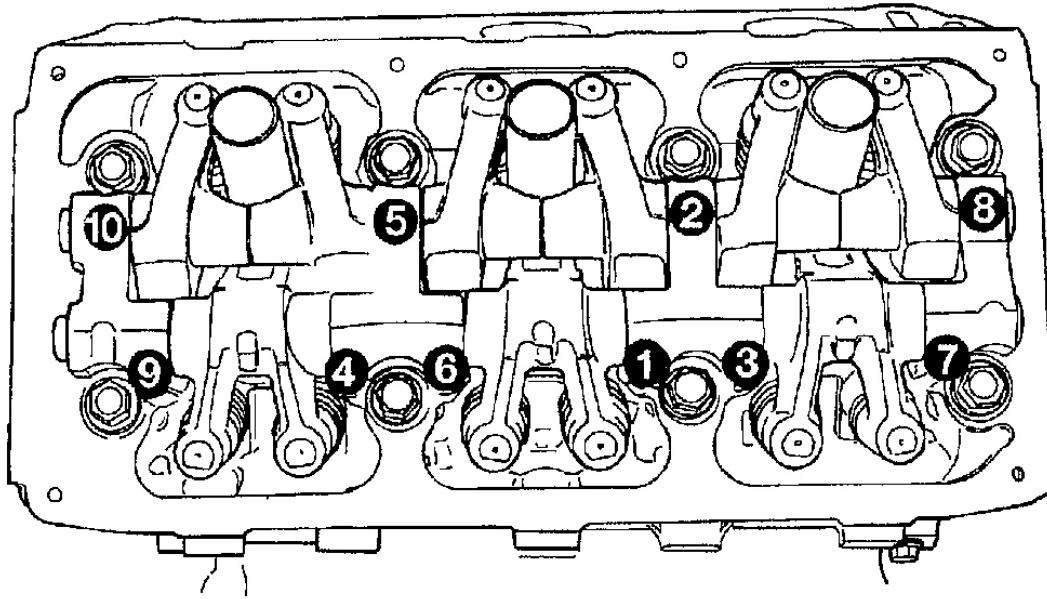
1. .Rotate camshafts to the position shown in (**Fig. 87**). With the camshafts in these positions the lobes are in a neutral position (no load to the valve). This will allow the rocker arm shaft assembly to be tightened into position with little or no valve spring load on it.



G03572516

Fig. 87: Identifying Camshaft Gear Timing Marks
Courtesy of DAIMLERCHRYSLER CORP.

2. Install the rocker arm and shaft assembly making sure that the identification marks face toward the front of engine for left head and toward the rear of the engine for right head.
3. Tighten rocker arm/shaft assembly bolts in sequence to 31 N.m (275 in. lbs.) (**Fig. 88**).



G03572517

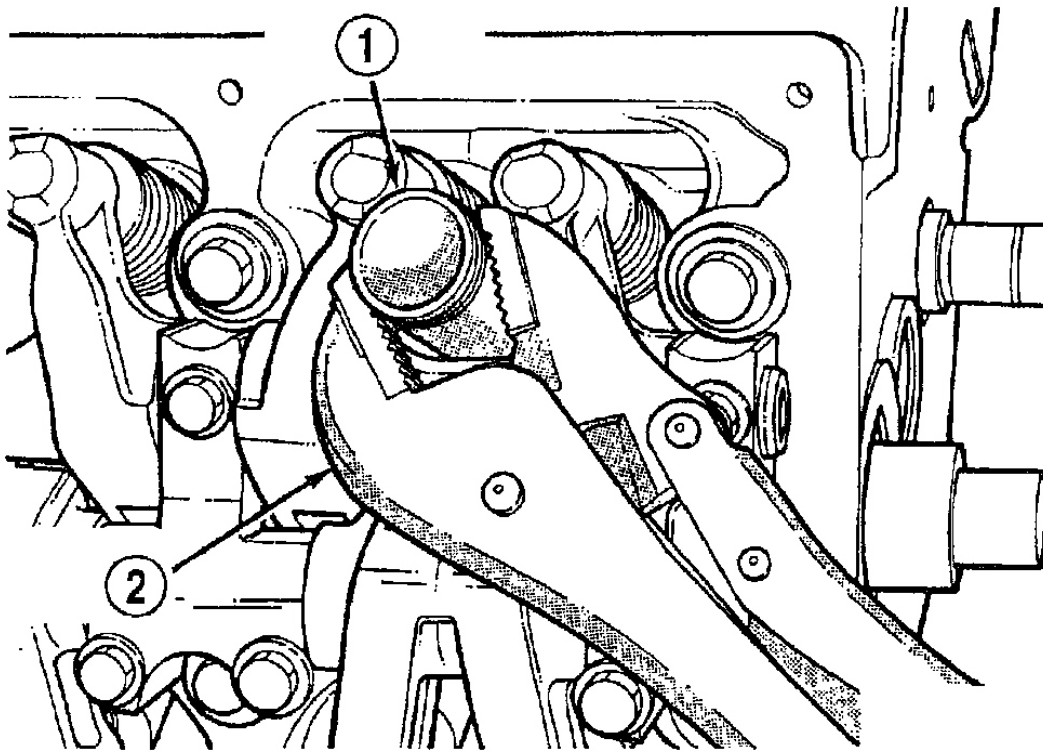
Fig. 88: Rocker Arm/Shaft Assembly Bolt Torque Sequence
Courtesy of DAIMLERCHRYSLER CORP.

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

SPARK PLUG TUBE

REMOVAL

1. Remove cylinder head cover(s). (Refer to **CYLINDER HEAD COVER(S) - REMOVAL**)
2. Using suitable locking pliers, remove the tube from the cylinder head (**Fig. 89**) and discard tube.



- 1 - SPARK PLUG TUBE
2 - LOCKING PLIERS

G03572518

Fig. 89: Servicing Spark Plug Tubes
Courtesy of DAIMLERCHRYSLER CORP.

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

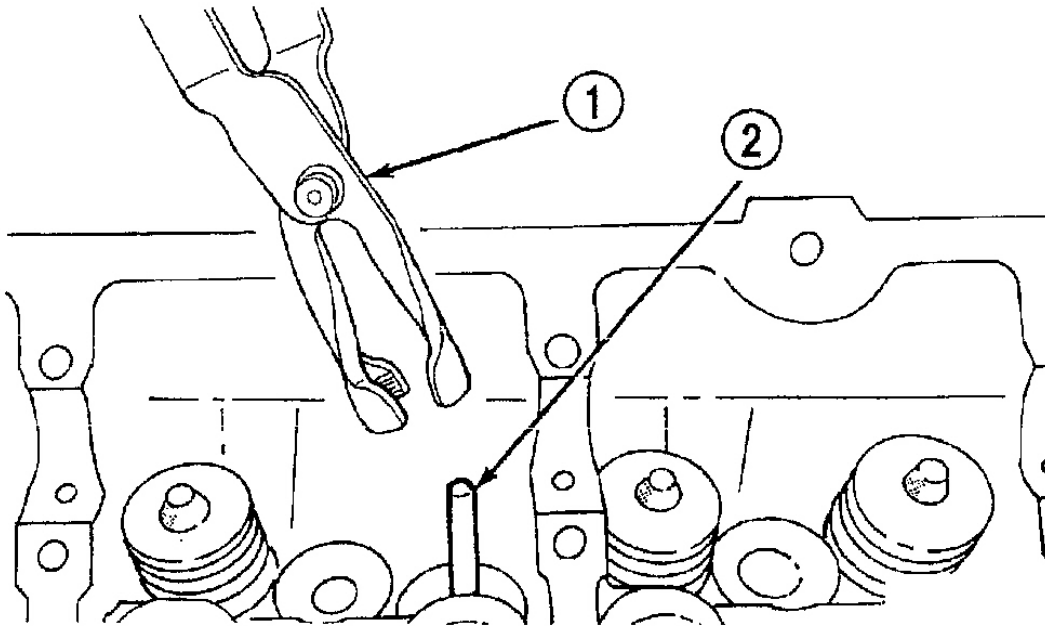
INSTALLATION

1. Apply Mopar(R) Stud and Bearing Mount to a new tube approximately 1 mm (0.039 in.) from the end of tube, in a 3 mm (0.118 in.) wide area.
2. Install sealer end of tube into the cylinder head. Then carefully install the tube using a hardwood block and mallet. Install the tube until it is seated into the bottom of the bore.
3. For spark plug tube seal replacement, (Refer to **CYLINDER HEAD COVER(S) - REMOVAL**).
4. Install cylinder head cover(s). (Refer to **INSTALLATION**)

VALVE STEM SEALS

REMOVAL

1. Remove valve spring. (Refer to **REMOVAL**)
2. Remove valve stem seals by using a valve stem seal tool (**Fig. 90**).



1 - VALVE SEAL TOOL

2 - VALVE STEM

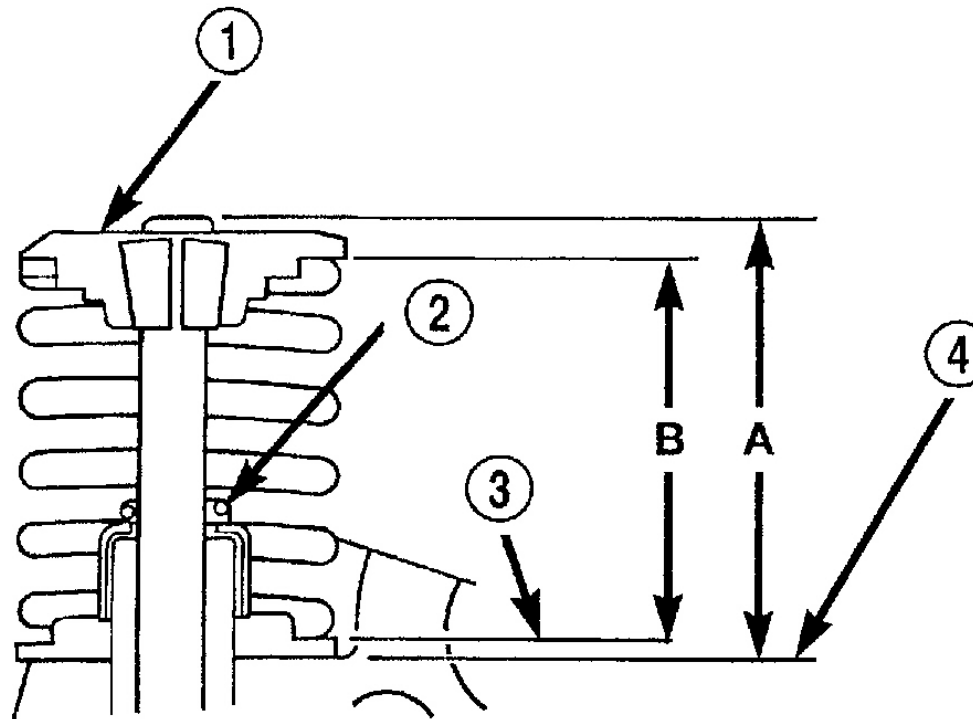
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Fig. 90: Removing Valve Stem Seal
Courtesy of DAIMLERCHRYSLER CORP.

INSTALLATION

1. The valve stem seal/valve spring seat should be pushed firmly and squarely over the valve guide using the valve stem as guide. **Do Not Force** seal against top of guide. When installing the valve retainer locks, compress the spring only enough to install the locks.

CAUTION: Do not remove garter spring around the seal at the top of the valve stem seal (Fig. 91**).**



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

G03572520

Fig. 91: Checking Valve Tip Height and Valve Spring Installed Height
Courtesy of DAIMLERCHRYSLER CORP.

2. Install valve spring. (Refer to INSTALLATION)

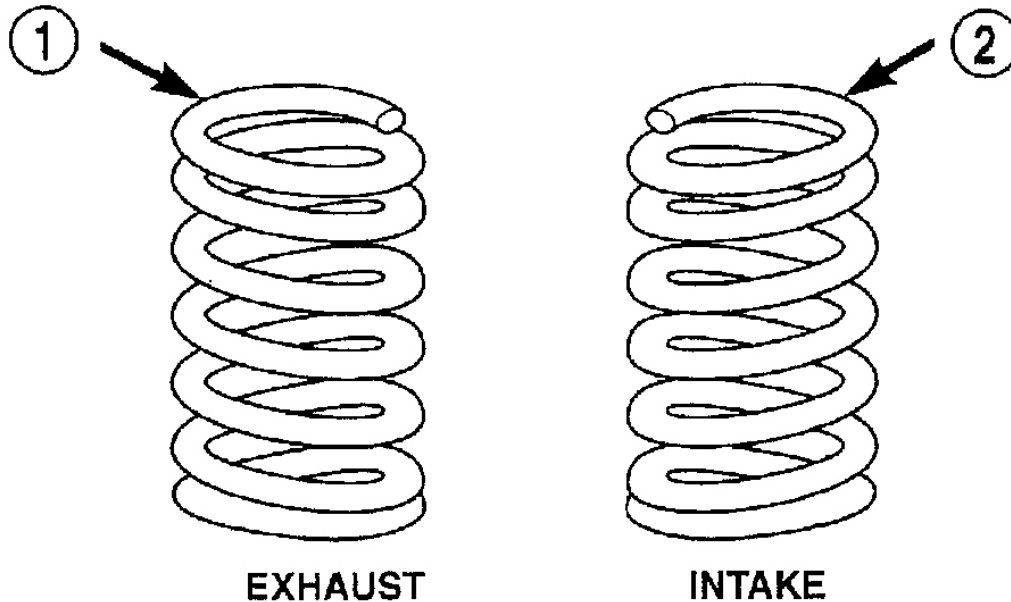
VALVE SPRINGS

DESCRIPTION

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

The valve springs are unique for intake compared to exhaust. Both have different lengths and are wound in

opposite directions. The valve springs are color coded, intake spring is right hand coil direction with orange dye on the top coils, and the exhaust spring is left hand coil direction with a yellow or white dye on the top coils (**Fig. 92**).



1 - YELLOW OR WHITE DYE

2 - ORANGE DYE

G03572521

Fig. 92: Identifying Valve Springs

Courtesy of DAIMLERCHRYSLER CORP.

The exhaust spring with the white dye on the top of the coils has an increased open and closed load when compared to the exhaust spring with the yellow dye. A yellow and a white exhaust valve spring should never be used on a single forked rocker arm. Color coated exhaust springs should always be used in pairs for a forked exhaust rocker springs.

OPERATION

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

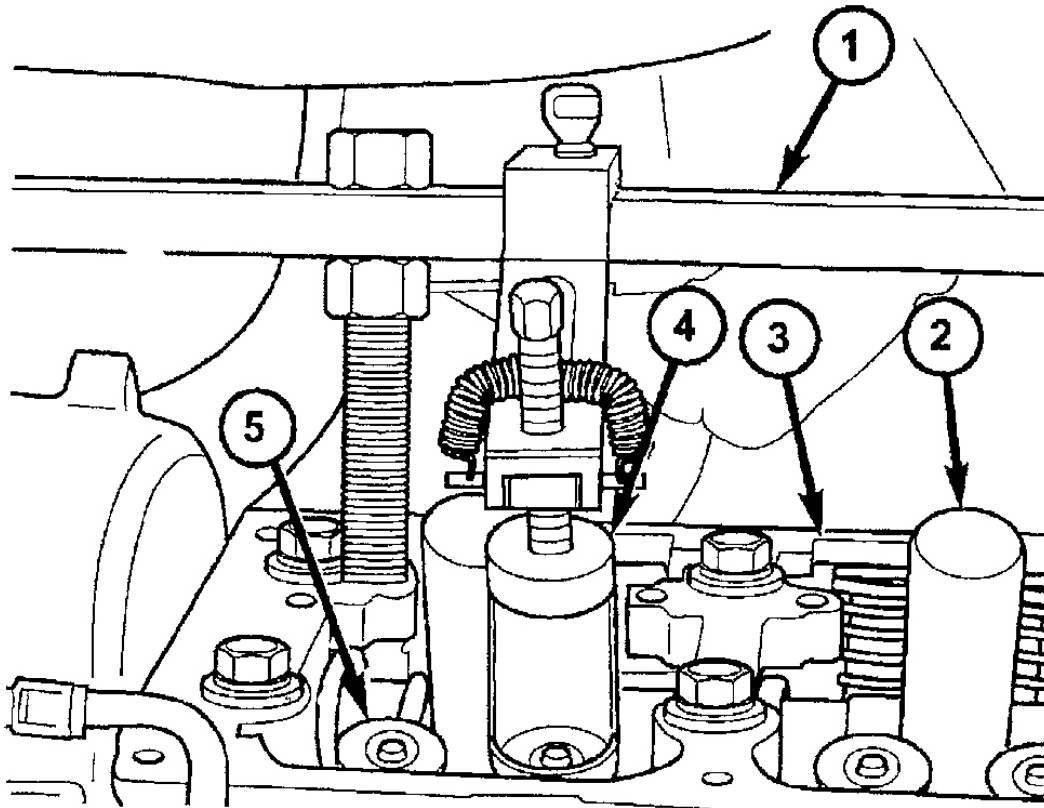
REMOVAL

REMOVAL - CYLINDER HEAD OFF

1. Compress valve spring with valve spring compressor C-3422-D and adapter 6526 (Refer to **SPECIAL TOOLS**).
2. Remove valve retaining locks. Release valve spring compressor. Remove valve spring retainer and valve spring.
3. Remove valve stem seal assembly. (Refer to **REMOVAL**)

REMOVAL - CYLINDER HEAD ON

1. Disconnect negative battery cable.
2. Remove upper intake manifold (Refer to **REMOVAL**).
3. Remove cylinder head cover(s) (Refer to **CYLINDER HEAD COVER(S) - REMOVAL**).
4. Remove rocker arm and shaft assembly (Refer to **REMOVAL**).
5. Remove spark plugs.
6. Rotate the crankshaft clockwise, until the number 1 piston is at TDC (Top Dead Center) on the compression stroke.
7. With air hose attached to spark plug adapter installed in number 1 spark plug hole, apply 620.5 to 689 kPa (90 to 100 psi) air pressure. This is to hold valves into place while servicing components.
8. Using Tool MD 998772A with adapter 6527 or equivalent, compress valve spring and remove valve locks. Release tension on valve spring, remove retainer and valve spring (Refer to **SPECIAL TOOLS**) (**Fig. 93**).



- 1 - MD 998772A
- 2 - SPARK PLUG TUBES
- 3 - CYLINDER HEAD
- 4 - 6527 - ADAPTOR
- 5 - VALVE SPRING RETAINER

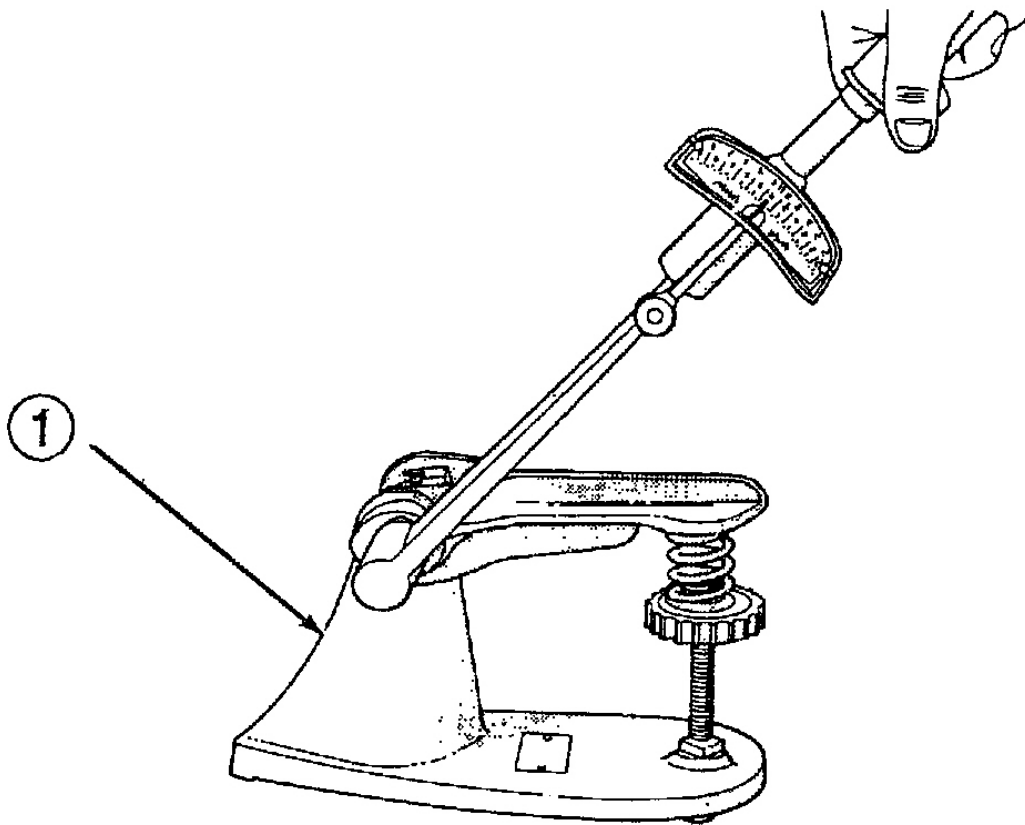
G03572522

Fig. 93: Removing Valve Spring
 Courtesy of DAIMLERCHRYSLER CORP.

9. Remove valve stem seal, if required. (Refer to **REMOVAL**)
10. Follow the same procedure on the remaining 5 cylinders using the firing sequence 1-2-3-4-5-6. **Make sure piston is at TDC in each cylinder of the valve spring that is being removed.**
11. Remove spark plug adapter tool.

INSPECTION

When valves have been removed for inspection, reconditioning or replacement, valve springs should be tested (**Fig. 94**). **As an example;** the compression length of the spring to be tested is 38.00 mm (1.496 in.). Turn table of Tool. C-647 until surface is in line with the 38.00 mm (1.496 inches.) mark on the threaded stud and the zero mark on the front. Place spring over stud on the table and lift compressing lever to set tone device. Pull on torque wrench until ping is heard. Take reading on torque wrench at this instant. Multiply this reading by two. This will give the spring load at test length. Fractional measurements are indicated on the table for finer adjustments. Refer to Engine Specifications to obtain specified height and allowable tensions (Refer to **SPECIFICATIONS**). Replace springs that do not meet specifications.



1 - SPECIAL TOOL C-647

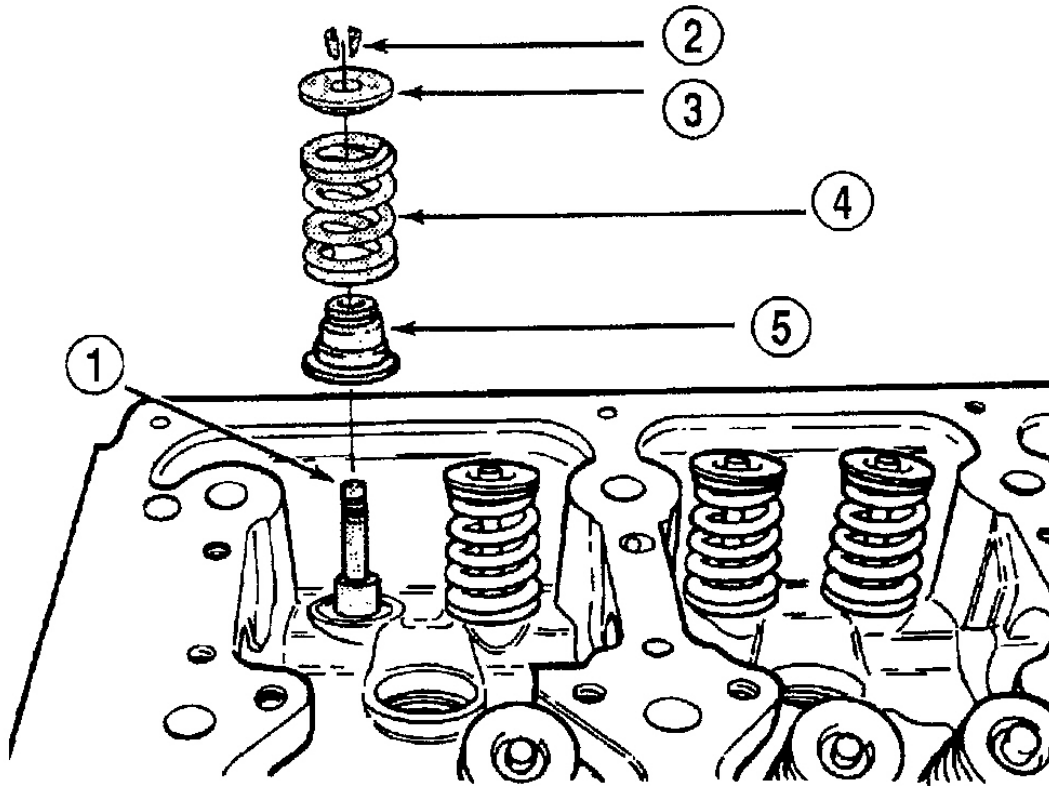
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Fig. 94: Testing Valve Spring
Courtesy of DAIMLERCHRYSLER CORP.

INSTALLATION

INSTALLATION - CYLINDER HEAD OFF

1. Install valves if removed.
2. Install valve stem seal/spring seat assembly over valve guides on all valve stems (**Fig. 95**). Ensure that the garter spring is intact around the top of the rubber seal.



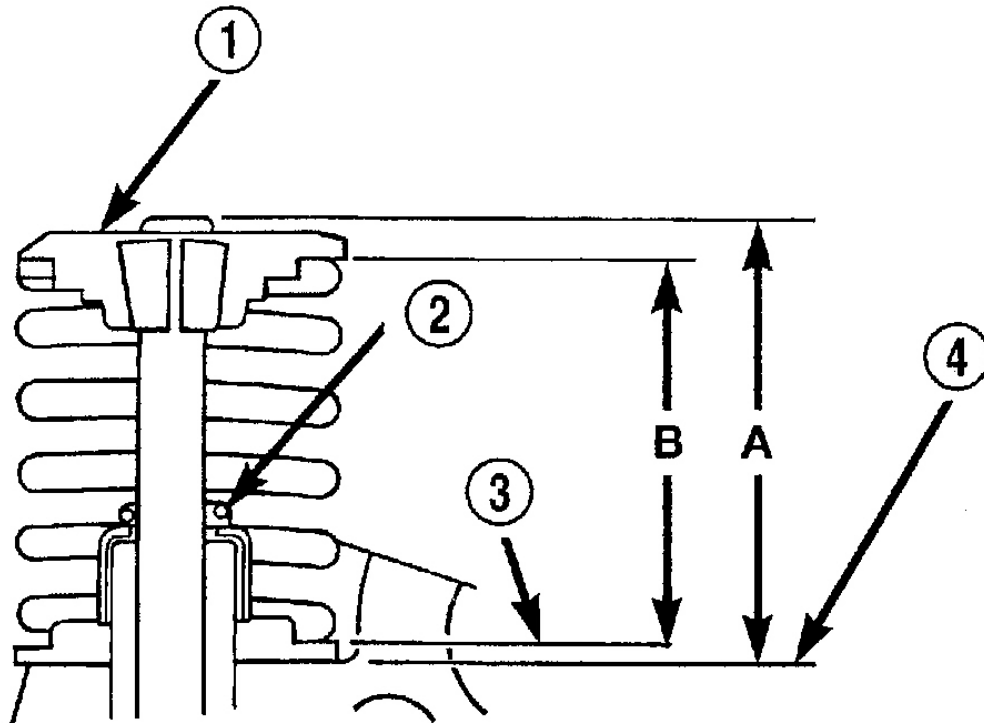
- 1 - VALVE
- 2 - VALVE RETAINING LOCKS
- 3 - VALVE SPRING RETAINER
- 4 - VALVE SPRING
- 5 - VALVE SEAL AND VALVE SPRING SEAT ASSEMBLY

G03572524

Fig. 95: Installing Valve Seal and Spring
Courtesy of DAIMLERCHRYSLER CORP.

3. Place valve spring (color-coded end facing up) and valve retainer into position.
4. Compress valve spring with valve spring compressor. Install locks and release tool. **If valves and/or seats are reground, measure the installed height of springs (B), make sure measurements are taken from top of spring seat to the bottom surface of spring retainer . If height is greater than 38.75 mm**

(1.5256 in.), install a 0.762 mm (0.030 in.) spacer in head counterbore under the valve spring seat to bring spring height back within specification (**Fig. 96**).



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

G03572525

Fig. 96: Checking Valve Tip Height and Valve Spring Installed Height
Courtesy of DAIMLERCHRYSLER CORP.

INSTALLATION - CYLINDER HEAD ON

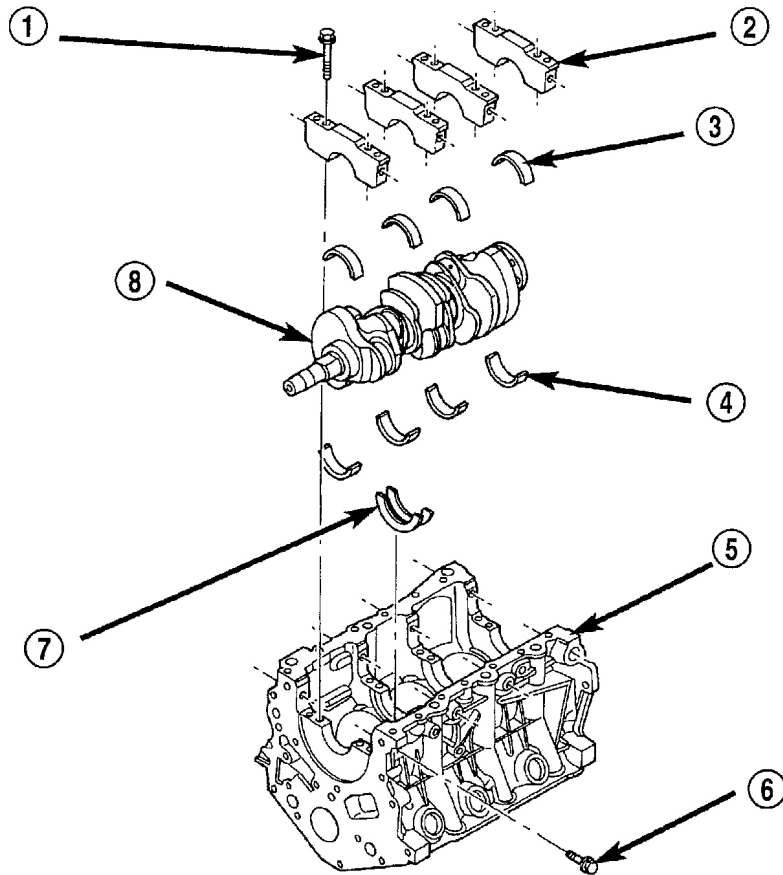
1. Install new valve seal(s) if required (Refer to **INSTALLATION**).
2. Place valve spring (color-coded end facing up) and valve retainer into position.
3. Compress valve spring using Special Tool MD 998772A with Adaptor 6527 only enough to install locks (**Fig. 93**).
4. After installing locks, release tension on valve spring and verify proper installation.

5. Remove Special Tool MD 998772A and spark plug adapter tool.
6. Install rocker arm and shaft assembly. (Refer to **INSTALLATION**)
7. Install cylinder head cover(s) (Refer to **INSTALLATION**).
8. Install spark plugs.
9. Install upper intake manifold (Refer to **INSTALLATION**).
10. Connect negative battery cable.

ENGINE BLOCK

DESCRIPTION

The cylinder block (**Fig. 97**) is made of heat treated aluminum with cast-in-place iron liners. The block is a closed deck design with the right bank forward. To provide high rigidity and improved noise, vibration and harshness (NVH), the block has cast-in contours and ribs, along with powdered metal 6 bolt main caps (4 vertical, 2 horizontal), with a die cast aluminum structural beam windage tray mounted to the main caps.



- 1 - MAIN CAP BOLT - VERTICAL
- 2 - MAIN CAP
- 3 - MAIN BEARING - LOWER
- 4 - MAIN BEARING - UPPER

- 5 - CYLINDER BLOCK
- 6 - MAIN CAP BOLT - HORIZONTAL
- 7 - CRANKSHAFT THRUST WASHER
- 8 - CRANKSHAFT

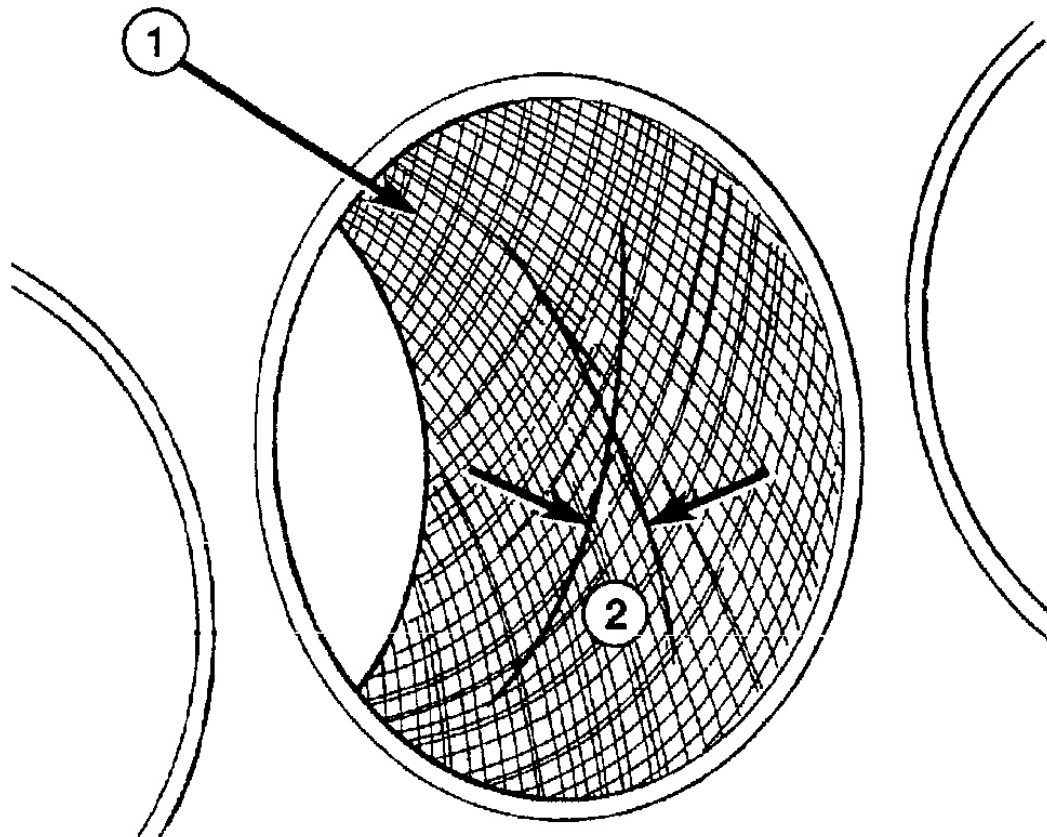
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Fig. 97: Exploded View Of Cylinder Block and Crankshaft Components
 Courtesy of DAIMLERCHRYSLER CORP.

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. 98**).



1 - CROSS-HATCH PATTERN

2 - 40°-60°

G03572527

Fig. 98: 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 cross-hatch angle. The number of up and down strokes per minute can be regulated to get the desired 40-60 degree angle. Faster up and down strokes increase the cross-hatch angle.
5. After honing, it is necessary that the block be cleaned again to remove all traces of abrasive.

CAUTION: Ensure all abrasives are removed from engine parts after honing. It is recommended that a solution of soap and hot water be used with a brush

and the parts then thoroughly dried. The bore can be considered clean when it can be wiped clean with a white cloth and cloth remains clean. Oil the bores after cleaning to prevent rusting.

CLEANING

Clean cylinder block thoroughly using a suitable cleaning solvent.

INSPECTION

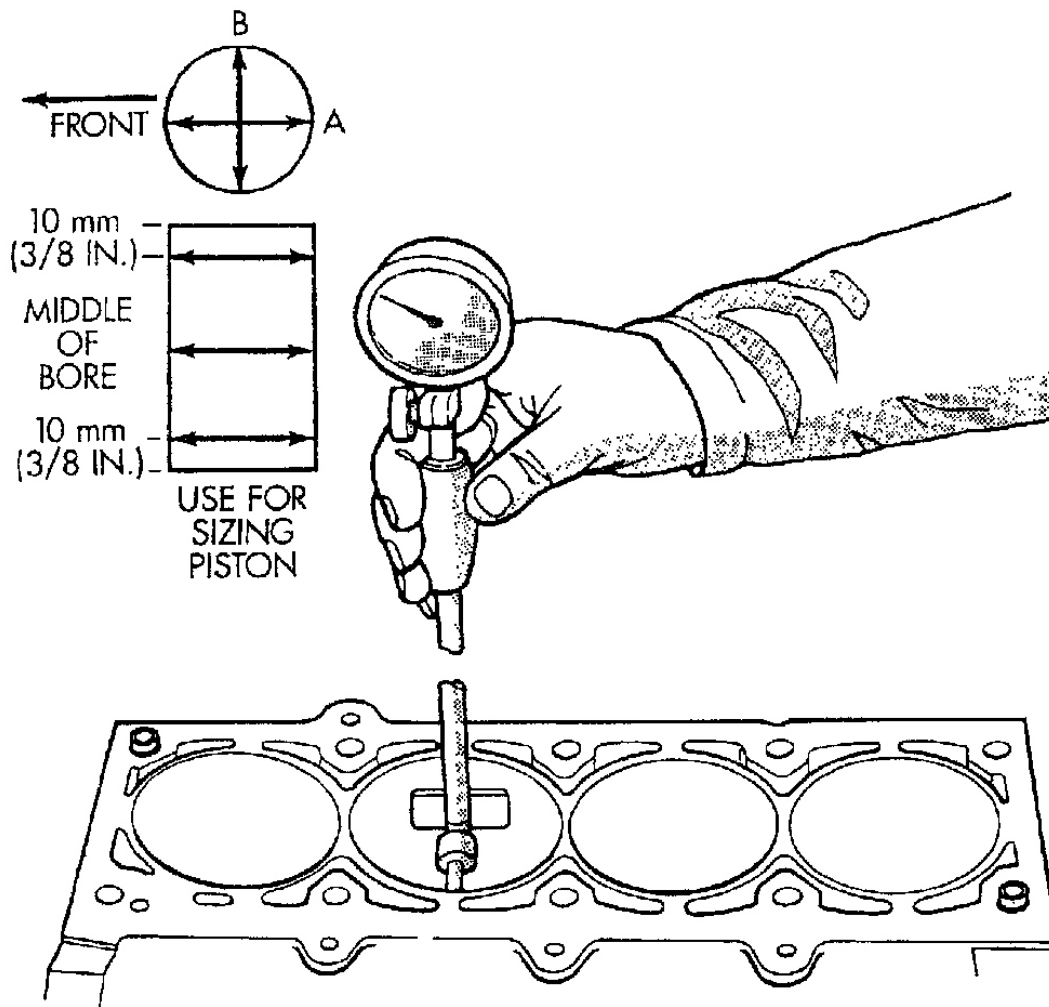
ENGINE BLOCK

1. Clean cylinder block thoroughly and check all core hole plugs for evidence of leaking.
2. If new core plugs are to be installed, (Refer to **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. 99**) (Refer to **SPECIFICATIONS**). If the cylinder walls are badly scuffed or scored, the cylinder block should be replaced, and new pistons and rings fitted.



G03572528

Fig. 99: Measuring Cylinder Bore

Courtesy of DAIMLERCHRYSLER CORP.

Measure the cylinder bore at three levels in directions A and B (**Fig. 99**). 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**).

CONNECTING ROD BEARINGS

STANDARD PROCEDURE - CONNECTING RODS AND BEARINGS

CONNECTING ROD BEARINGS

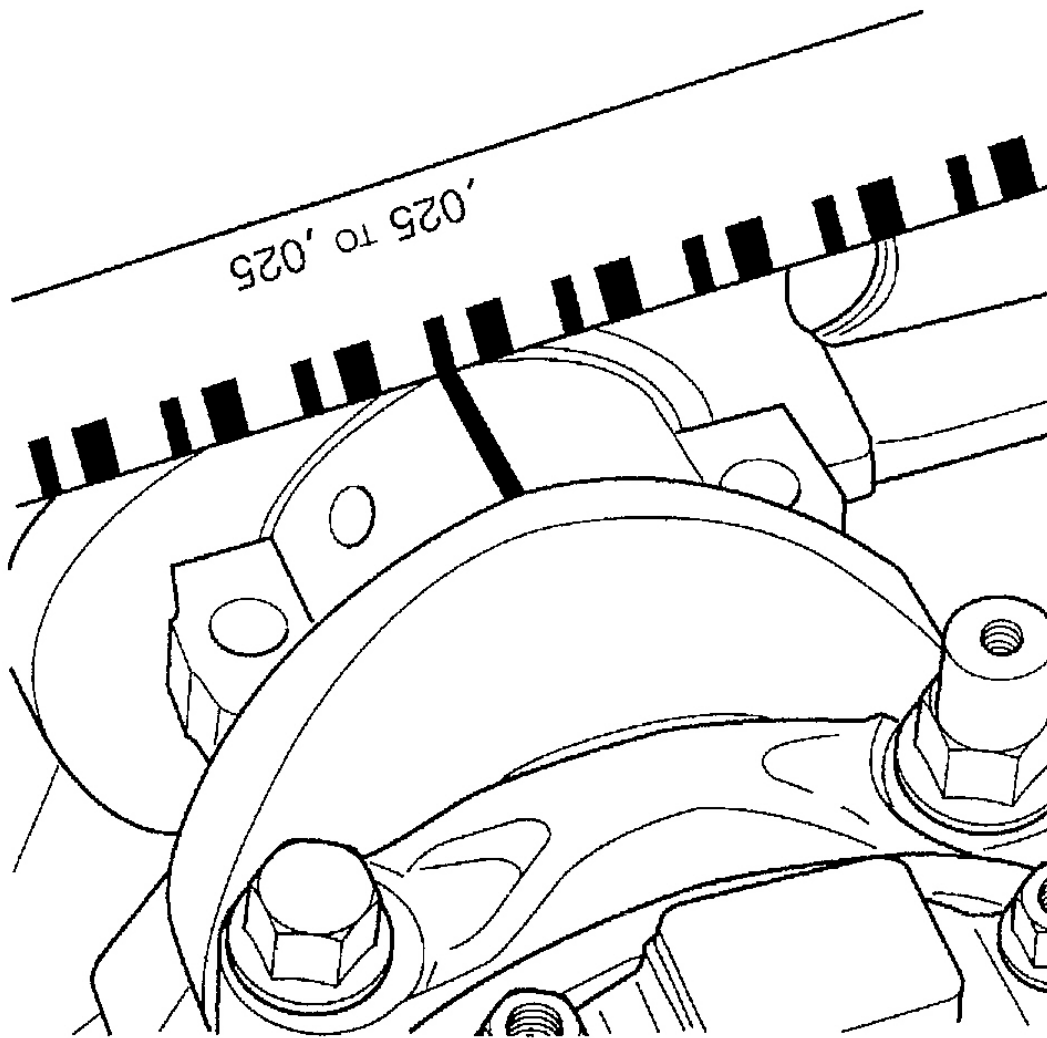
The bearing caps are not interchangeable and should be marked at removal to insure correct assembly.

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

Fit all rods on one bank until complete.

Limits of taper or out-of-round on any crankshaft journals should be held to 0.005 mm (0.0001 in.). Bearings are available in standard, 0.025 mm (0.001 in.), and 0.254 mm (0.010 in.) undersizes. **Install the bearings in pairs. Do not use a new bearing half with an old bearing half. Do not file the rods or bearing caps.**

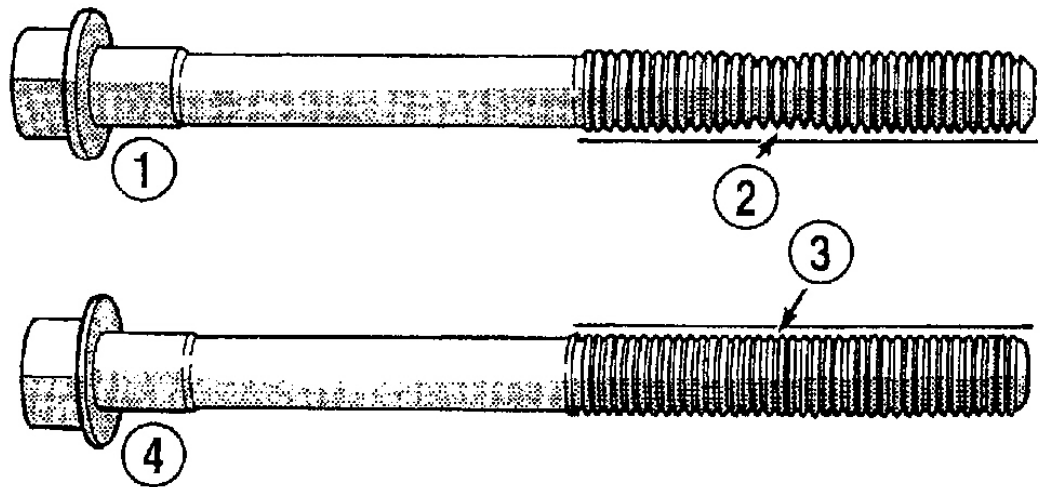
1. For measuring main bearing clearance and connecting rod bearing clearance use plastigage (**Fig. 100**). For more information on using plastigage (Refer to **STANDARD PROCEDURE**). Refer to Specifications for bearing clearance specifications (Refer to **SPECIFICATIONS**).



G03572529

Fig. 100: Measuring Connecting Rod Bearing Clearance
Courtesy of DAIMLERCHRYSLER CORP.

NOTE: The rod bearing bolts should be examined before reuse. If the threads are necked down the bolts must be replaced (Fig. 101).



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

G03572530

Fig. 101: Checking For Stretched Bolts
Courtesy of DAIMLERCHRYSLER CORP.

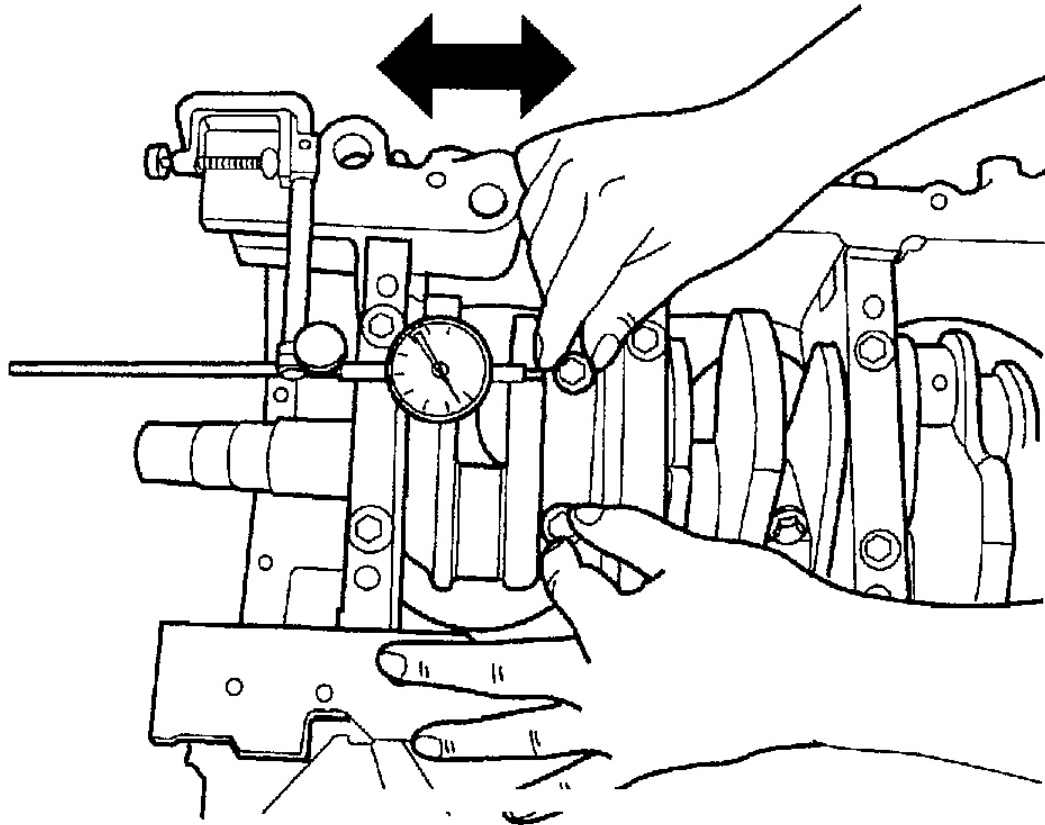
CONNECTING ROD BOLTS

1. Examine connecting rod bolts for stretching. Stretching can be checked by holding a scale or straight edge against the threads. If all the threads do not contact the scale the bolt must be replaced.
2. Before installing the nuts the threads should be oiled with engine oil.
3. Install nuts on each bolt finger tight. Then alternately torque each nut to assemble the cap properly.
4. Tighten the connecting rod cap nuts to specifications. (Refer to SPECIFICATIONS)

CONNECTING ROD SIDE CLEARANCE

1. Mount a dial indicator to a stationary point on engine. Locate probe perpendicular to and resting against the connecting rod cap being checked. Move connecting rod all the way to rear of its travel. Zero the dial

indicator. Move connecting rod forward to limit of travel and read the dial indicator (**Fig. 102**). Compare measurement to specification listed in engine specifications (Refer to **SPECIFICATIONS**). Repeat procedure for each connecting rod. Turn crankshaft for connecting rod accessibility.



G03572531

Fig. 102: Measuring Connecting Rod Side Clearance
Courtesy of DAIMLERCHRYSLER CORP.

CRANKSHAFT

DESCRIPTION

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

OPERATION

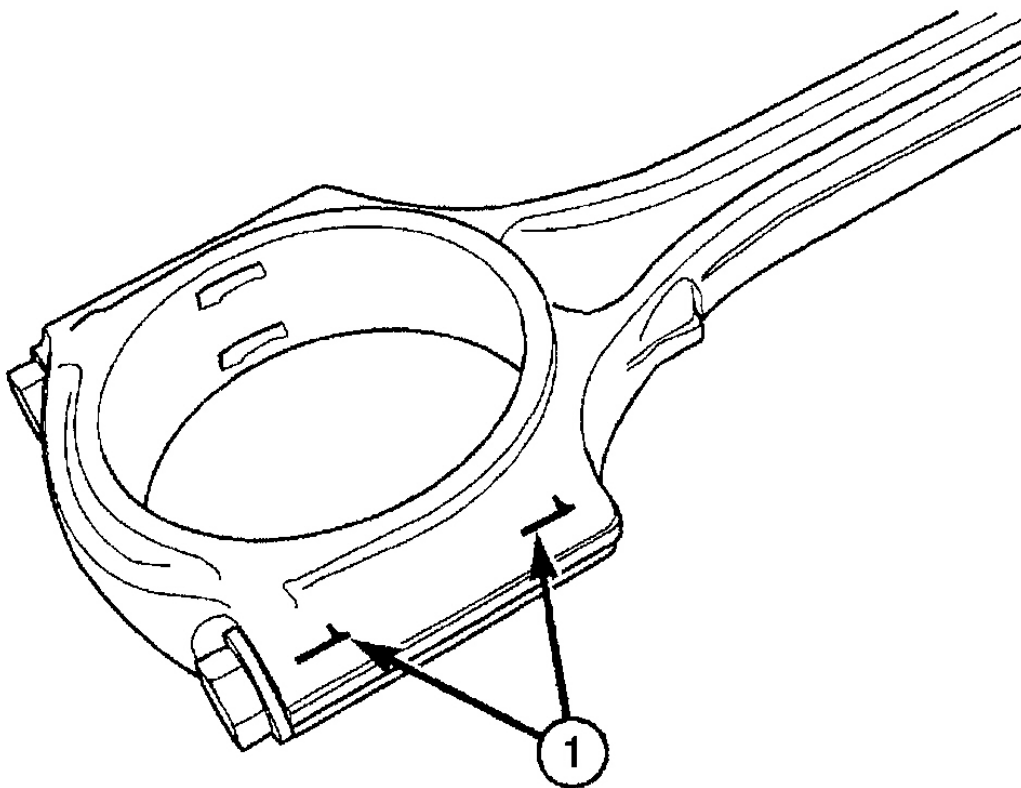
The crankshaft transfers force generated by combustion within the cylinder to the flywheel or flex-plate.

REMOVAL

1. Remove engine from vehicle (Refer to **REMOVAL**).
2. Remove oil pan (Refer to **REMOVAL**).
3. Remove oil pickup tube.
4. Remove front timing belt cover (Refer to **TIMING BELT/CHAIN COVER(S) - REMOVAL**).
5. Remove timing belt and tensioner (Refer to **REMOVAL**).
6. Remove crankshaft sprocket (Refer to **REMOVAL**).
7. Tap dowel pin out of crankshaft.
8. Remove oil pump assembly (Refer to **REMOVAL**).
9. Remove crankshaft rear oil seal retainer (Refer to **REMOVAL**).

WARNING: DO NOT use a metal stamp to mark the bearing caps. Do Use a scribe or paint mark

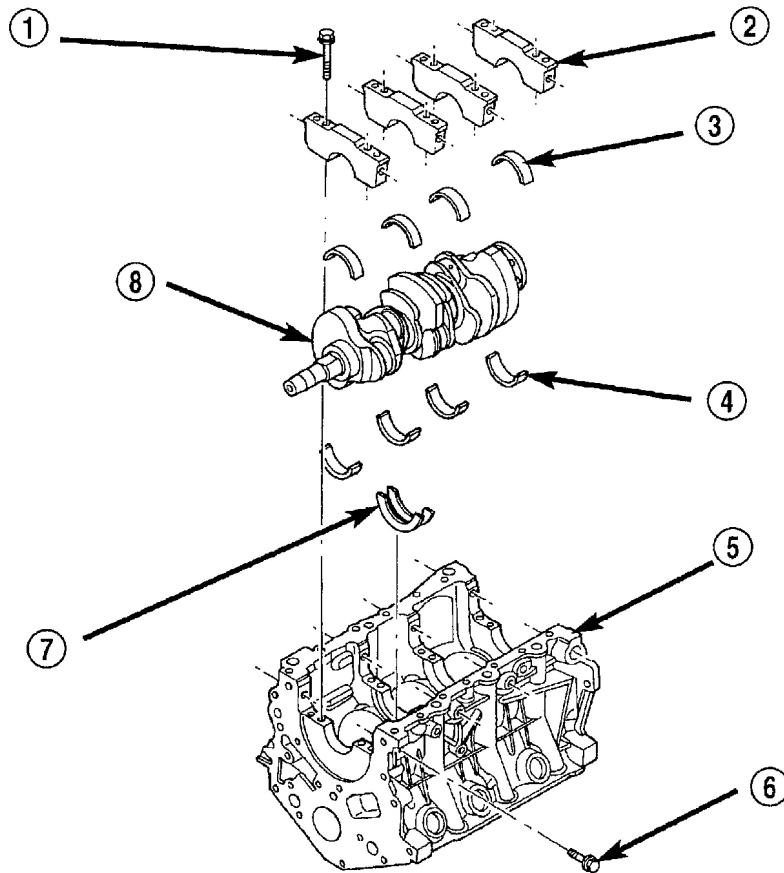
10. Remove connecting rod bearing caps. Connecting rod bearing caps are not interchangeable and should be paint marked or scribed before removal to insure correct assembly (**Fig. 103**) (**Fig. 104**).



1 - PAINT MARK OR SCRIBE

G03572532

Fig. 103: Marking Connecting Rod & Cap
Courtesy of DAIMLERCHRYSLER CORP.



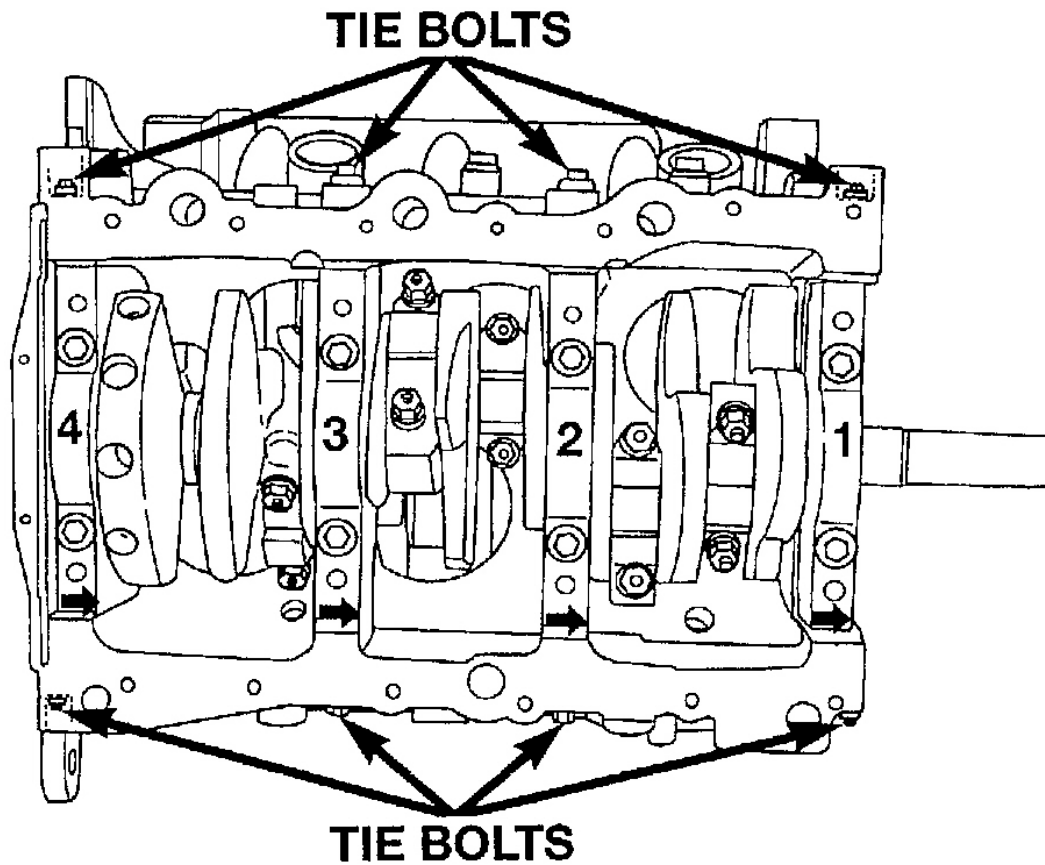
- 1 - MAIN CAP BOLT - VERTICAL
- 2 - MAIN CAP
- 3 - MAIN BEARING - LOWER
- 4 - MAIN BEARING - UPPER

- 5 - CYLINDER BLOCK
- 6 - MAIN CAP BOLT - HORIZONTAL
- 7 - CRANKSHAFT THRUST WASHER
- 8 - CRANKSHAFT

G03572534

Fig. 104: Exploded View Of Cylinder Block and Crankshaft Components
Courtesy of DAIMLERCHRYSLER CORP.

11. Remove main bearing caps. Main bearing caps are not interchangeable and are marked to insure correct assembly (**Fig. 105**). (**Fig. 104**)



G03572533

Fig. 105: Identifying Main Bearing Caps
Courtesy of DAIMLERCHRYSLER CORP.

12. Remove crankshaft from cylinder block (**Fig. 104**).

NOTE: Before installing crankshaft refer to Fitting Main Bearings and Installation of Connecting Rod Bearings. (Refer to **STANDARD PROCEDURE - CRANKSHAFT MAIN BEARING FITTING**) (Refer to **STANDARD PROCEDURE - CONNECTING RODS AND BEARINGS**)

INSPECTION

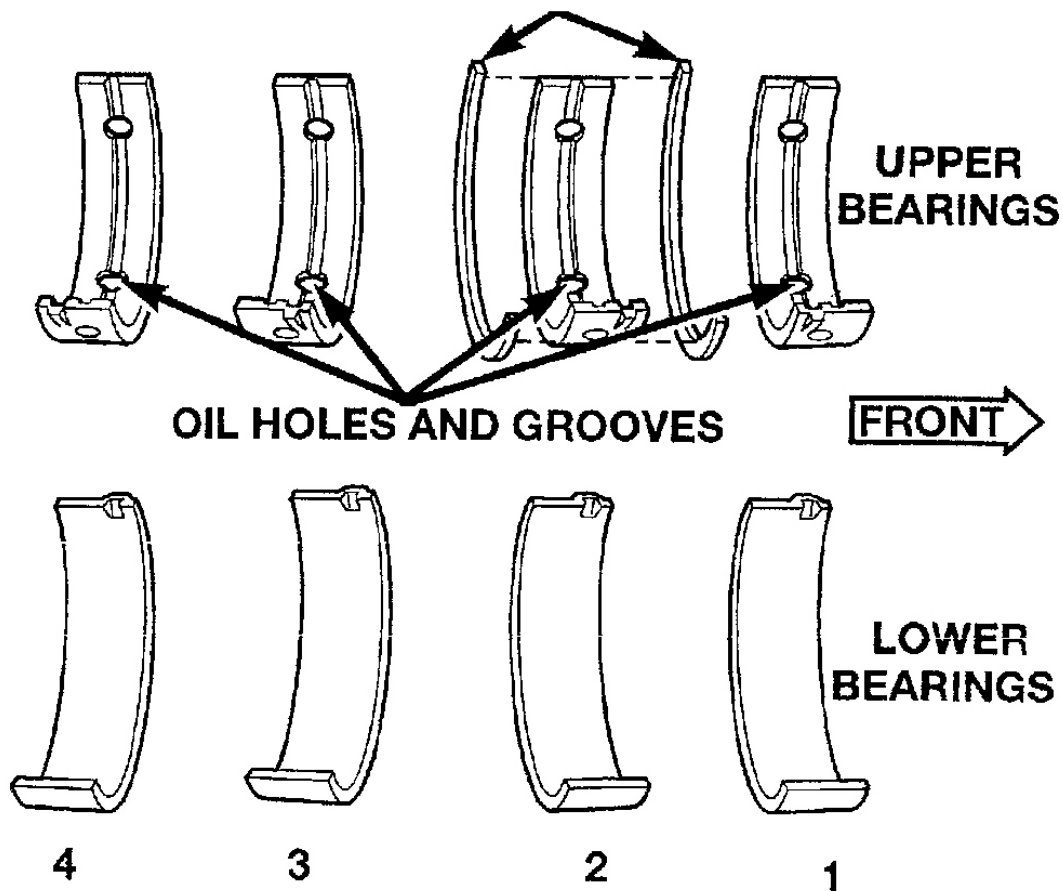
The crankshaft journals should be checked for excessive wear, taper and scoring. Limits of taper or out-of-round on any crankshaft journals should be held to 0.015 mm (0.0006 in.). Journal grinding should not exceed 0.305 mm (0.012 in.) under the standard journal diameter. DO NOT grind thrust faces of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

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

INSTALLATION

CAUTION: Main bearings are select fit (Refer to STANDARD PROCEDURE - CRANKSHAFT MAIN BEARING FITTING) for proper bearing size selection.

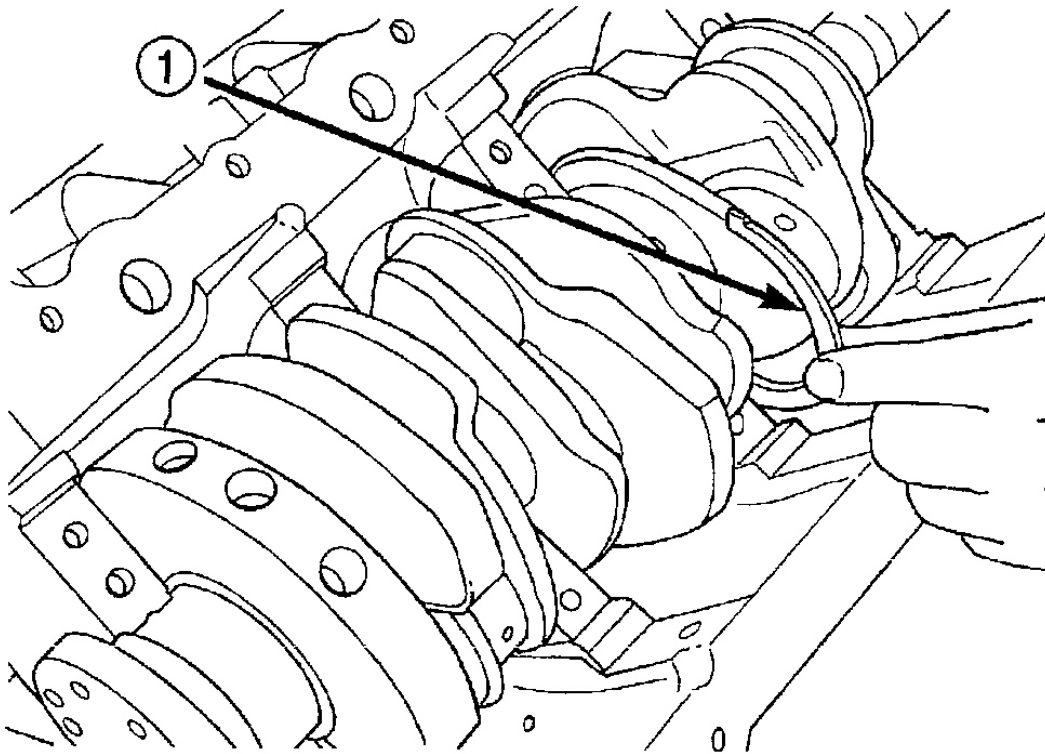
1. Install crankshaft upper main bearings in cylinder block. Ensure oil holes in bearings line up with oil holes in cylinder block (**Fig. 106**). (Refer to STANDARD PROCEDURE - CRANKSHAFT MAIN BEARING FITTING)



G03572535

Fig. 106: Identifying Main Bearings
Courtesy of DAIMLERCHRYSLER CORP.

2. Install the crankshaft to cylinder block. (**Fig. 104**)
3. Move crankshaft forward to limit of travel. Lubricate and install the front thrust washer by rolling the washer onto the machined shelf between the No. 2 upper main bulk head and crankshaft thrust surface (**Fig. 107**).



1 - FRONT THRUST WASHER

G03572536

Fig. 107: Installing Thrust Washer
Courtesy of DAIMLERCHRYSLER CORP.

4. Move crankshaft rearward to limit of travel. Lubricate and install the rear thrust washer by rolling the washer onto the machined shelf between the No. 2 upper main bulk head and crankshaft thrust surface (**Fig. 107**).
5. Install lower main bearings into main bearing caps.
6. Lubricate lower main bearings with clean engine oil.

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

7. Install each main cap and tighten bolts finger tight.

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

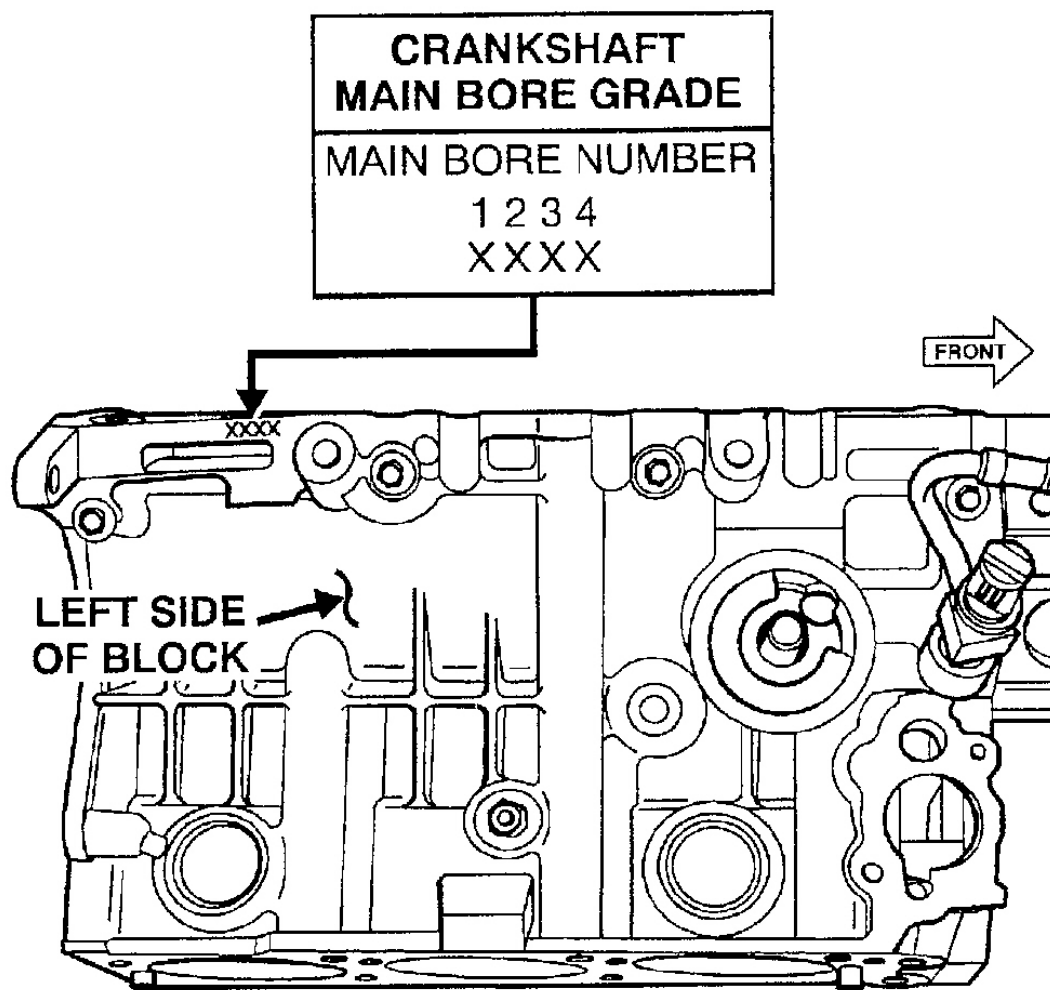
8. Install the inside main bearing cap bolts and tighten to 20 N.m + 1/4 turn (15 ft. lbs. + 1/4 turn).
9. Measure crankshaft end play. (Refer to **STANDARD PROCEDURE - CRANKSHAFT MAIN BEARING FITTING**)
10. Install connecting rods and measure side clearance. (Refer to **STANDARD PROCEDURE - CONNECTING RODS AND BEARINGS**)
11. Install windage tray. Lubricate bolts with engine oil and tighten to 27 N.m + 1/4 turn (20 ft. lbs. + 1/4 turn).
12. Install the main cap tie (horizontal) bolts and tighten to 28 N.m (250 in. lbs.).
13. Install rear crankshaft oil seal retainer and oil seal (Refer to **INSTALLATION**) and (Refer to **INSTALLATION**)
14. Install oil pump assembly (Refer to **INSTALLATION**).
15. Install dowel pin in crankshaft (Refer to **INSTALLATION**).
16. Install crankshaft sprocket (Refer to **INSTALLATION**).
17. Install timing belt and tensioner (Refer to **INSTALLATION**).
18. Install front timing belt cover (Refer to **TIMING BELT/CHAIN COVER(S) - INSTALLATION**).
19. Install oil pickup tube and tighten bolt to 28 N.m (250 in. lbs.).
20. Install oil pan (Refer to **INSTALLATION**).
21. Install engine assembly (Refer to **INSTALLATION - ENGINE ASSEMBLY**).
22. Fill engine crankcase with proper amount of oil.

CRANKSHAFT MAIN BEARINGS

STANDARD PROCEDURE - CRANKSHAFT MAIN BEARING FITTING

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

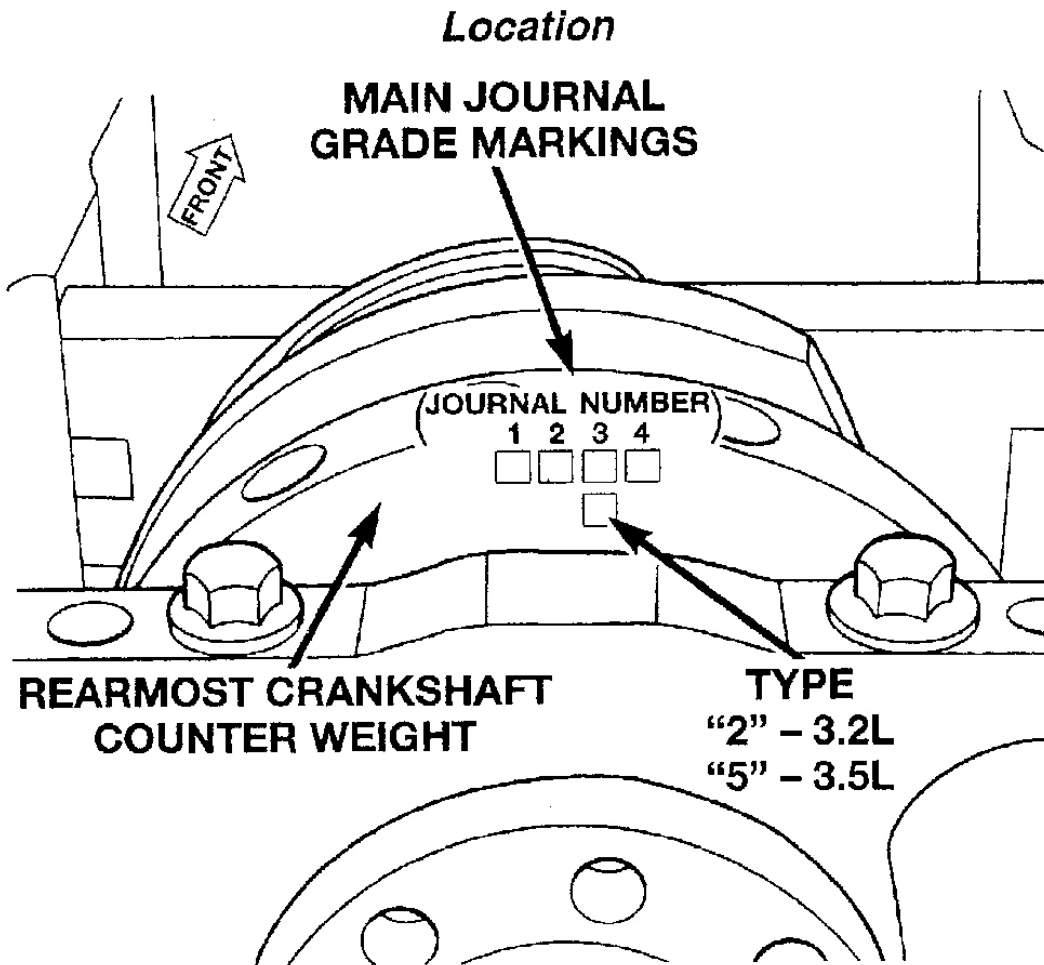
The marks for the cylinder block main bore grade are located on the left side pan rail (**Fig. 108**). These grade marks (1, 2, or 3) are read left to right, corresponding to main bore 1, 2, 3, 4.



G03572537

Fig. 108: Locating Cylinder Block Main Bore Grade Markings
Courtesy of DAIMLERCHRYSLER CORP.

The grade marks for the crankshaft are located on the rearmost crankshaft counter weight as shown in (Fig. 109). The crankshaft journal grade marks (A, B, or C) are read left to right, corresponding with journal number 1, 2, 3, 4.

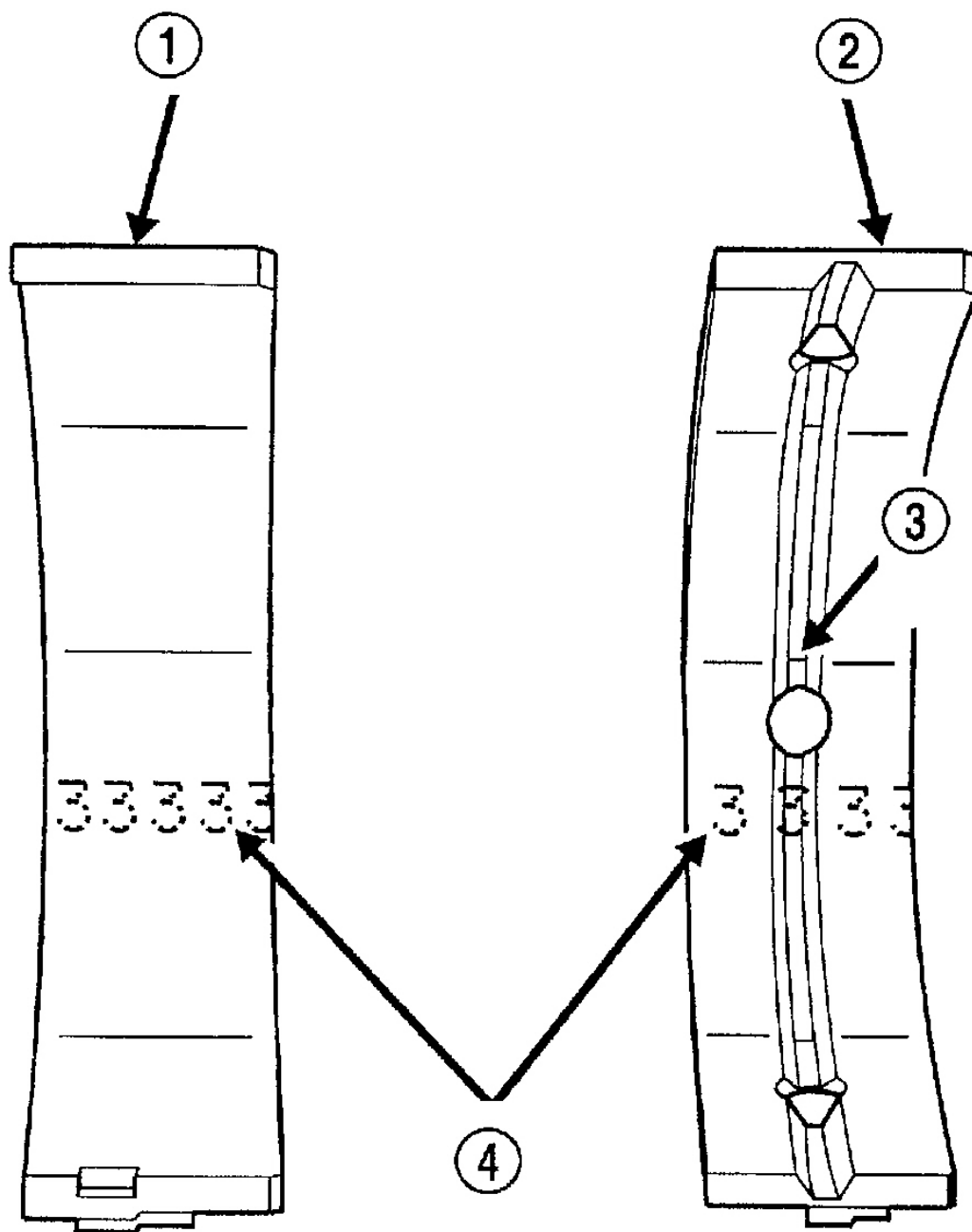


G03572538

Fig. 109: Locating Crankshaft Main Journal Grade Markings
Courtesy of DAIMLERCHRYSLER CORP.

Refer to the MAIN BEARING SELECTION CHART to properly select the main bearings. See **Fig. 111** . For an example, if the main bore grade is 3 and the journal grade is B, the proper select fit bearing would be a (2) +0.003 mm (+0.0002 in.).

NOTE: Service main bearings have a number from (1-5) marked in ink on the bearing surface (**Fig. 110**). For verification, refer to the MAIN BEARING SELECTION CHART for number to size identification. See **Fig. 111** .



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

G03572539

Fig. 110: Locating Main Bearing Grade Markings

Courtesy of DAIMLERCHRYSLER CORP.

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

Main Bearing Bore Grade Marks				
	1	2	3	
Crankshaft Main Journal Grade Marks	A	(3) Standard	(2) +005 mm (+0.0001 in.)	(1) +0.006 mm (+0.0002 in.)
	B	(4) -0.005 mm (-0.0001 in.)	(3) Standard	(2) +005 mm (+0.0001 in.)
	C	(5) -0.006 mm (-0.0002 in.)	(4) -0.005 mm (-0.0001 in.)	(3) Standard

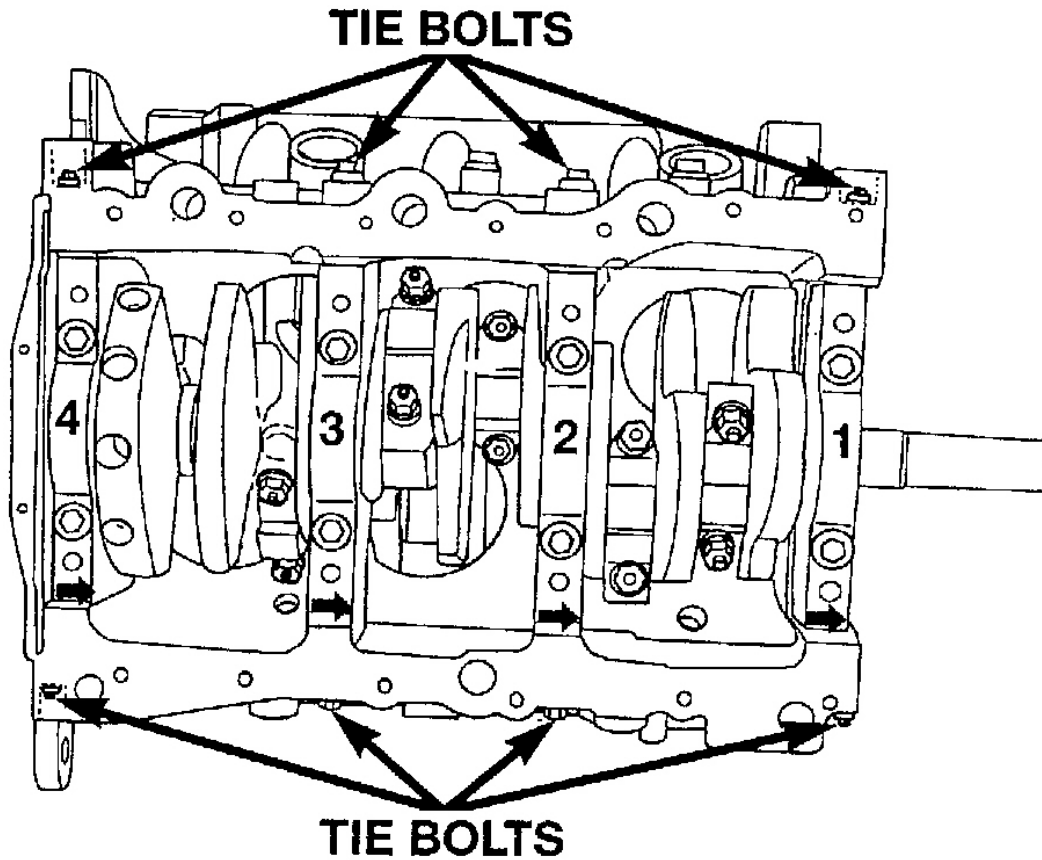
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Fig. 111: MAIN BEARING SELECTION CHART

Courtesy of DAIMLERCHRYSLER CORP.

REMOVAL

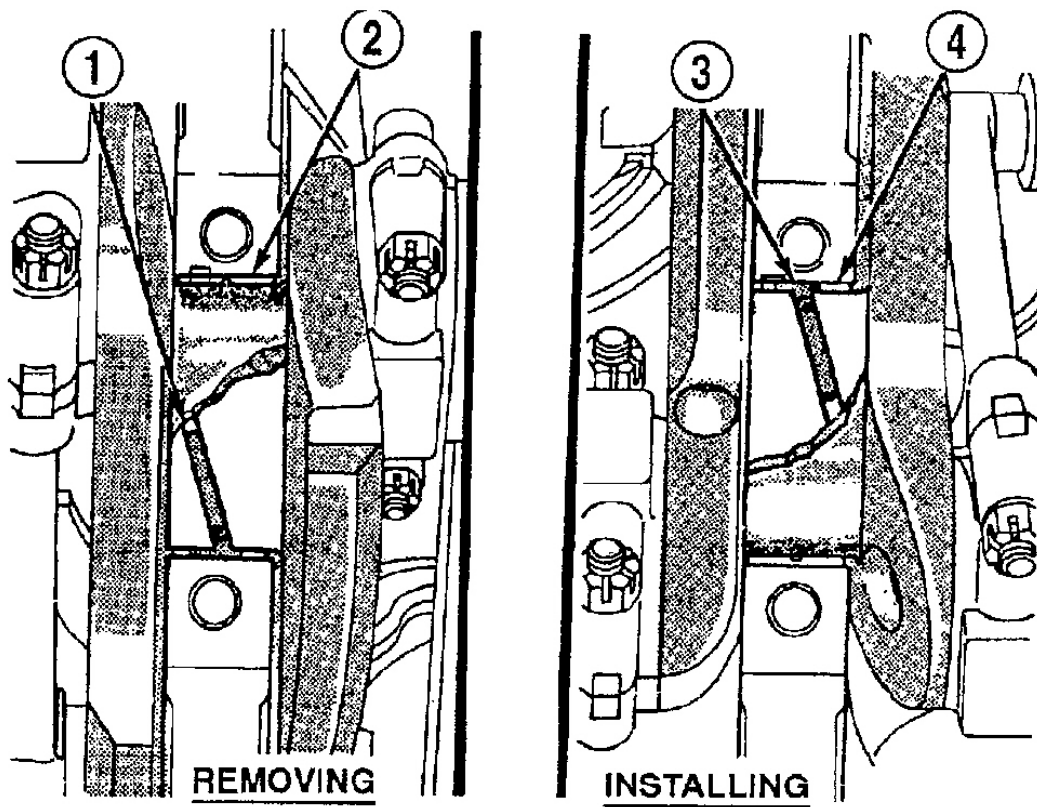
Bearing caps are not interchangeable and are marked to insure correct assembly (**Fig. 112**). Upper and lower bearing halves are NOT interchangeable.



G03572541

Fig. 112: Locating Main Bearing Caps
Courtesy of DAIMLERCHRYSLER CORP.

1. Remove oil pan. (Refer to **REMOVAL**)
2. Remove oil pick-up tube and windage tray.
3. Identify bearing caps before removal (**Fig. 112**).
4. Remove bearing caps one at a time. Remove upper half of bearing by inserting Special Main Bearing Tool C-3059 (**Fig. 113**) into the oil hole of crankshaft.



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

G03572542

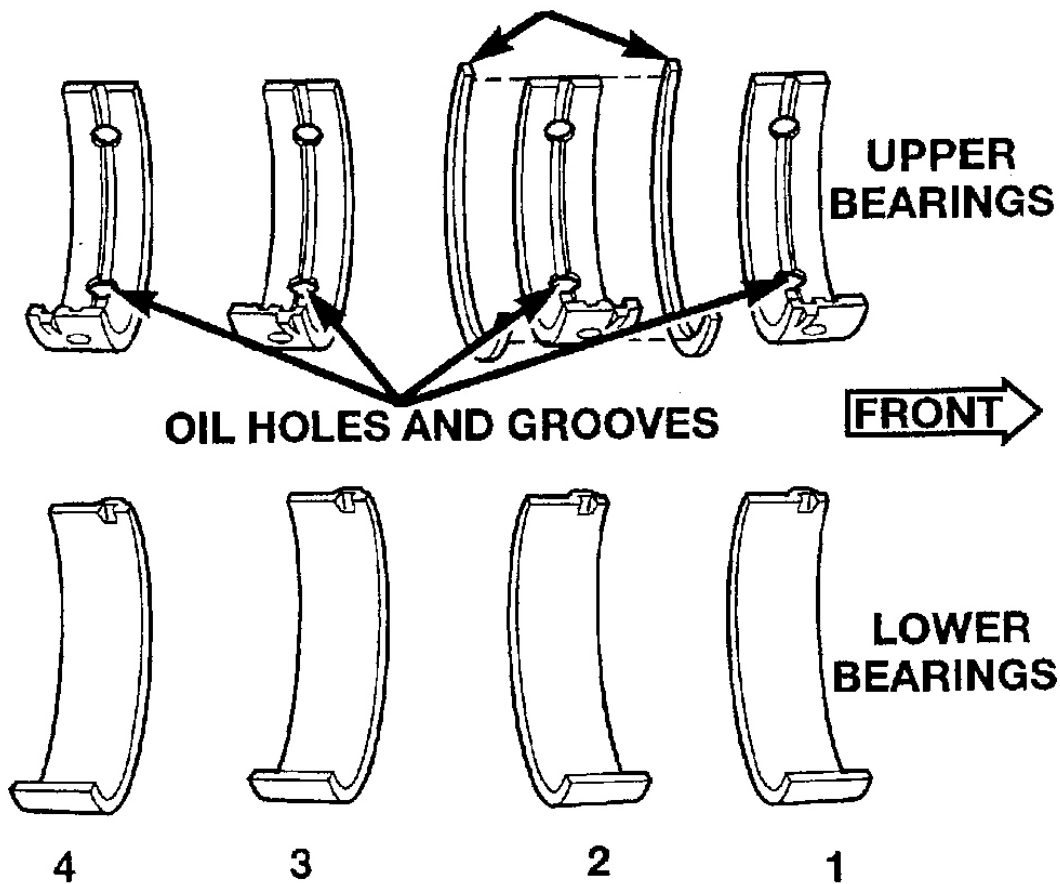
Fig. 113: Removing and Installing Upper Main Bearing With Special Tool C- 3059
Courtesy of DAIMLERCHRYSLER CORP.

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

INSTALLATION

Bearing caps are not interchangeable and are marked to insure correct assembly. Upper and lower bearing halves are NOT interchangeable (**Fig. 114**).

2 PIECE THRUST WASHER (UPPER ONLY)



G03572543

Fig. 114: Identifying Main Bearings

Courtesy of DAIMLERCHRYSLER CORP.

CAUTION: Main bearings are select fit. (Refer to STANDARD PROCEDURE - CRANKSHAFT MAIN BEARING FITTING)

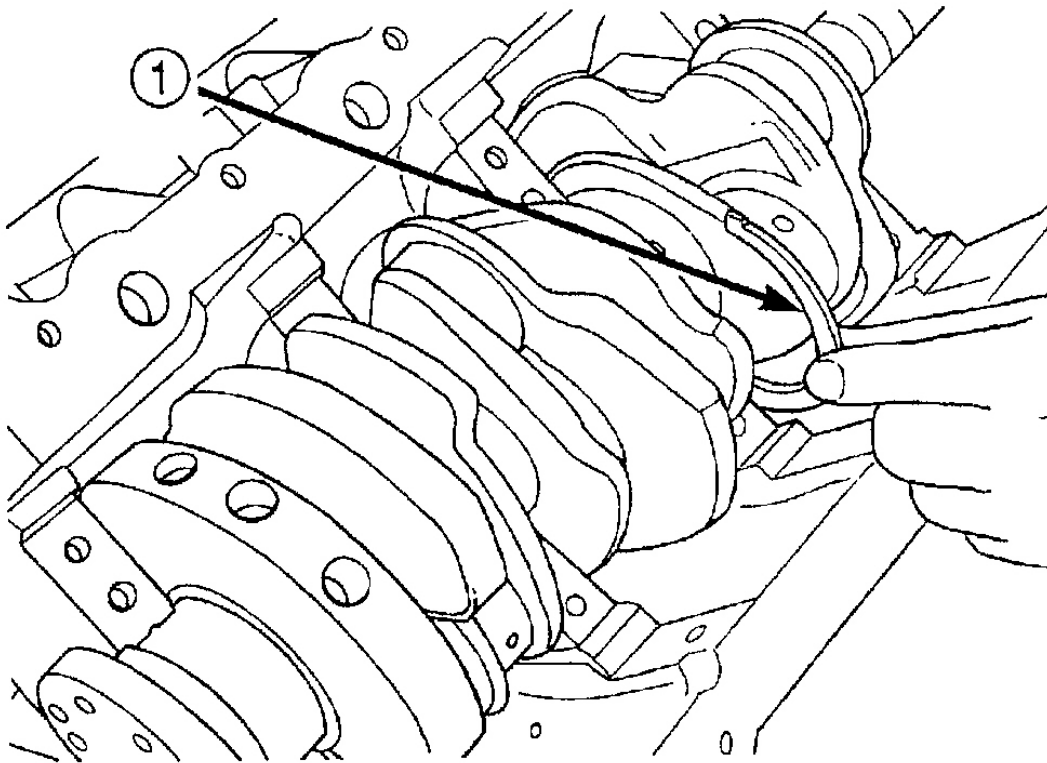
NOTE: Only one main bearing should be selectively fitted while all other main bearing caps are properly tightened.

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

1. Lubricate main bearing with clean engine oil.
2. Start bearing in place, and insert Main Bearing Tool C-3059 into oil hole of crankshaft (**Fig. 113**).
3. Slowly rotate crankshaft counterclockwise sliding the bearing into position. Remove Special Main Bearing Tool C-3059.

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

4. Lubricate and install lower bearing half and main cap Tighten bolts finger tight.
5. For installing thrust washers at the No. 2 main bearing location, use the following procedure:
 - a. Move crankshaft forward to limit of travel. Lubricate and install the front thrust washer by rolling the washer onto the machined shelf between the No. 2 upper main bulk head and crankshaft thrust surface (**Fig. 115**).



1 - FRONT THRUST WASHER

G03572544

Fig. 115: Installing Thrust Washer
Courtesy of DAIMLERCHRYSLER CORP.

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

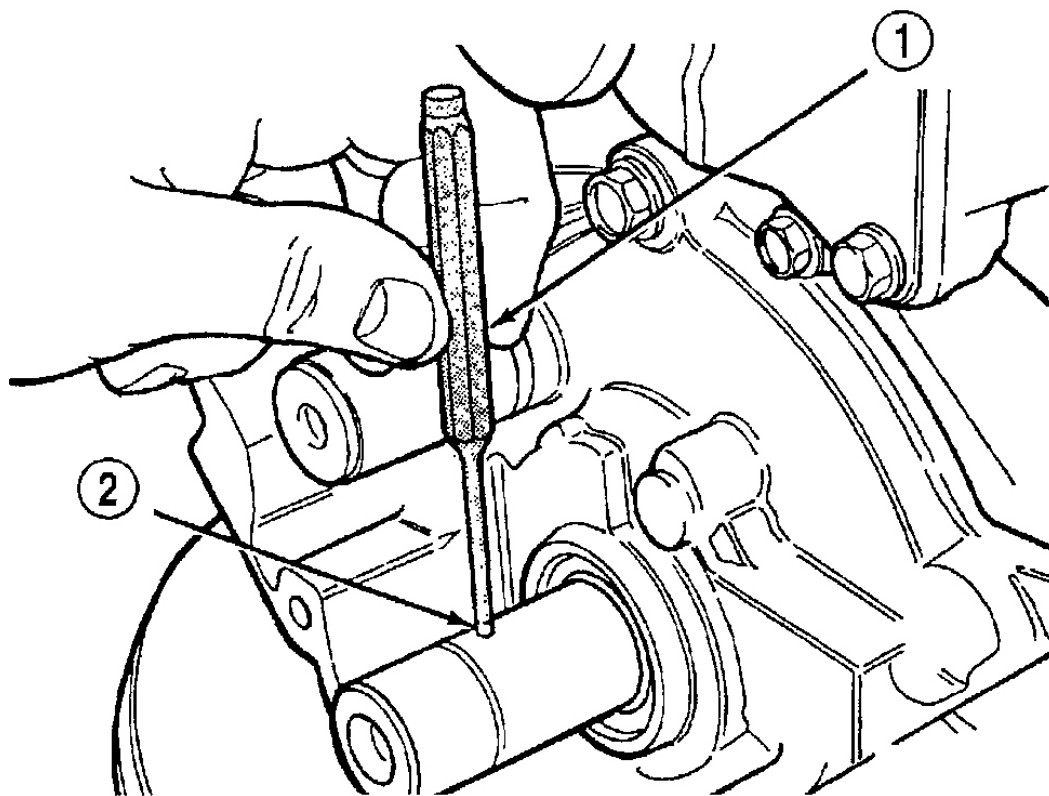
The main bearing cap bolts must be tightened in the proper sequence. First the inner main cap bolts, secondly the windage tray bolts, lastly the main cap tie (horizontal) bolts.

6. Install each main bearing cap and tighten inner bolts finger tight.
7. Tighten inner main bearing cap bolts to 20 N.m + 1/4 turn (15 ft. lbs. + 1/4 turn).
8. Measure crankshaft end play. (Refer to **STANDARD PROCEDURE - CRANKSHAFT MAIN BEARING FITTING**)
9. Install windage tray. Lubricate bolts with engine oil and tighten to 27 N.m + 1/4 turn (20 ft. lbs. + 1/4 turn).
10. Install the main cap tie (horizontal) bolts and tighten to 28 N.m (250 in. lbs.).
11. Install oil pick-up tube.
12. Install oil pan. (Refer to **INSTALLATION**)
13. Fill engine crankcase with proper oil to correct level.

CRANKSHAFT OIL SEAL - FRONT

REMOVAL

1. Remove the crankshaft sprocket. (Refer to **REMOVAL**)
2. Tap the dowel pin out of the crankshaft (**Fig. 116**).



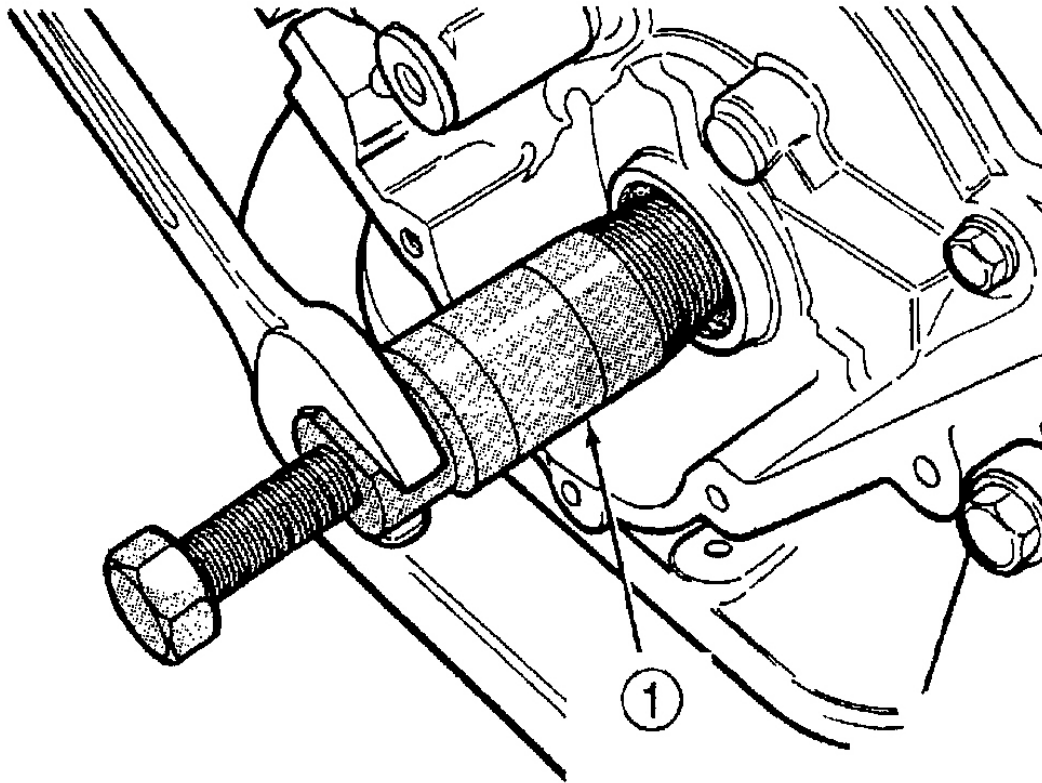
1 - PIN PUNCH

2 - DOWEL

G03572545

Fig. 116: Removing Crankshaft Sprocket Dowel Pin
Courtesy of DAIMLERCHRYSLER CORP.

3. Remove crankshaft seal using Special Tool 6341A (**Fig. 117**).



1 - SPECIAL TOOL 6341A

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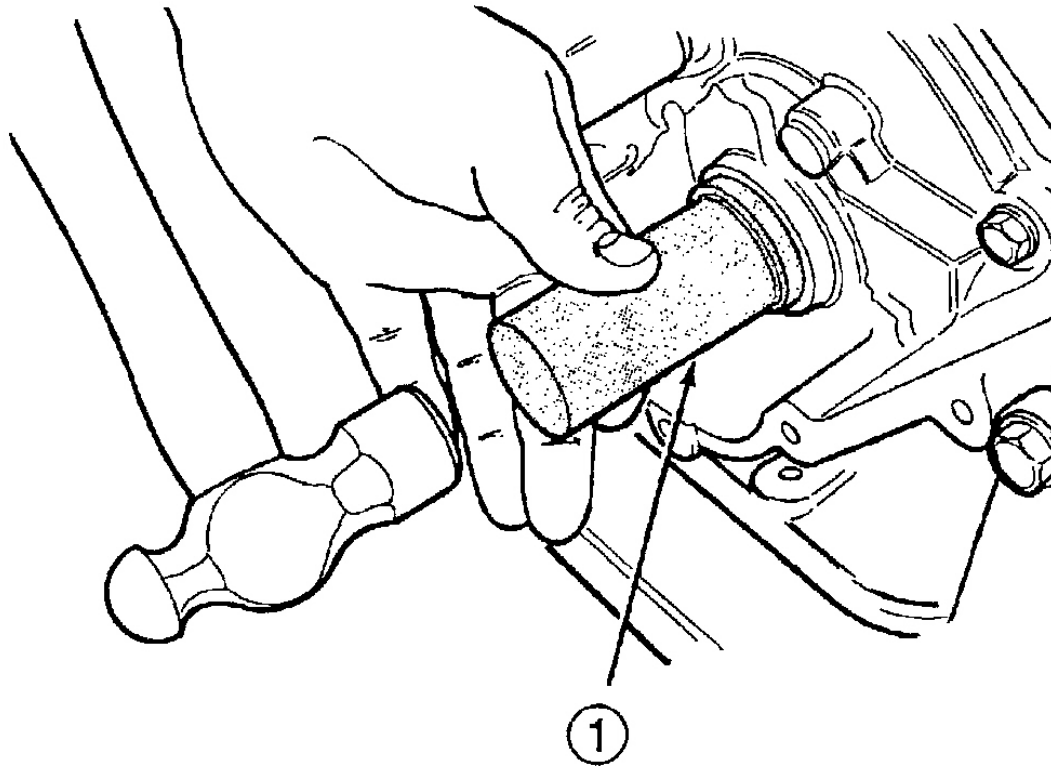
Fig. 117: Removing Crankshaft Oil Seal
Courtesy of DAIMLERCHRYSLER CORP.

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

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

INSTALLATION

1. Install crankshaft seal using Special Tool 6342 (**Fig. 118**).



1 - SPECIAL TOOL 6342

G03572547

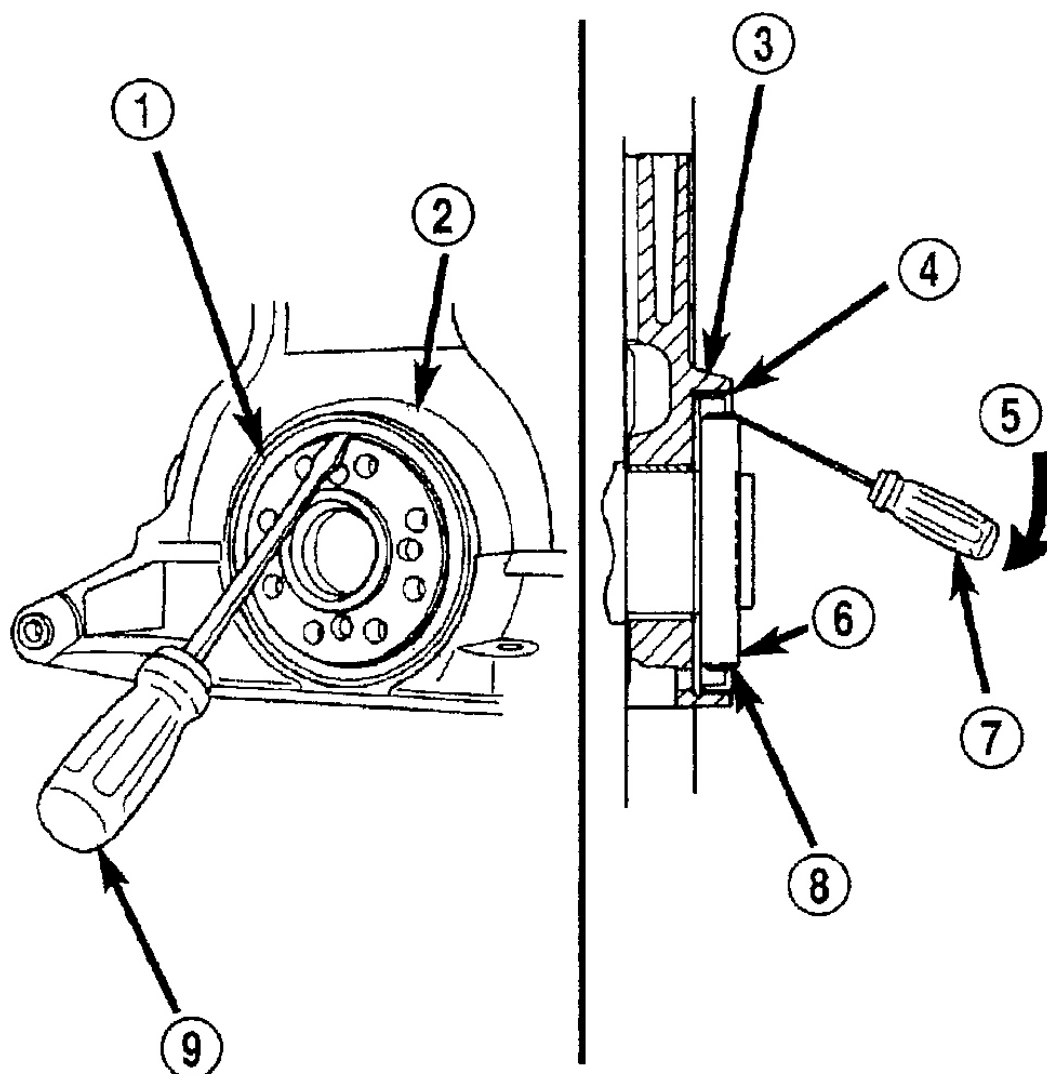
Fig. 118: Instlling Crankshaft Oil Seal
Courtesy of DAIMLERCHRYSLER CORP.

2. Install the dowel pin into the crankshaft to 1.2 mm (0.047 in.) protrusion (**Fig. 116**).
3. Install the crankshaft sprocket. (Refer to **INSTALLATION**)

CRANKSHAFT OIL SEAL - REAR

REMOVAL

1. Remove transaxle from vehicle. (Refer to **41AE/TE AUTOMATIC TRANSAXLE**)
2. Remove drive plate.
3. Insert a 3/16" wide flat bladed screwdriver between the dust lip and the metal case of the crankshaft seal. Angle the screwdriver (**Fig. 119**) through the dust lip against the metal case of the seal. Pry out seal.



- 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

G03572548

Fig. 119: Removing Rear Crankshaft Oil Seal

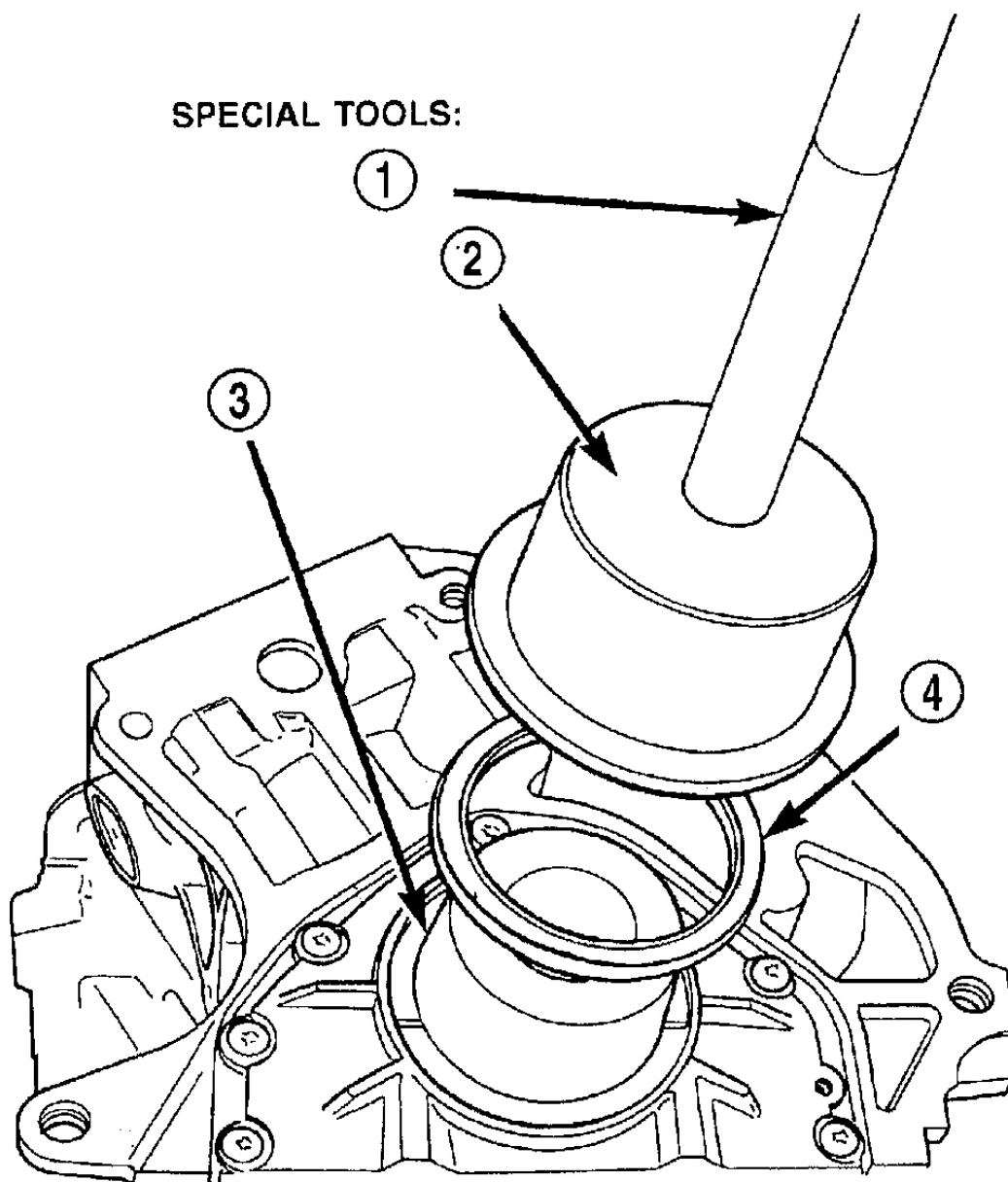
Courtesy of DAIMLERCHRYSLER CORP.

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

INSTALLATION

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

1. Place Special Tool 6926-1 Guide on crankshaft (**Fig. 120**). This is a pilot tool with a magnetic base.



- 1 - C-4171 HANDLE
- 2 - 6926-2 INSTALLER
- 3 - 6926-1 GUIDE
- 4 - SEAL

G03572549

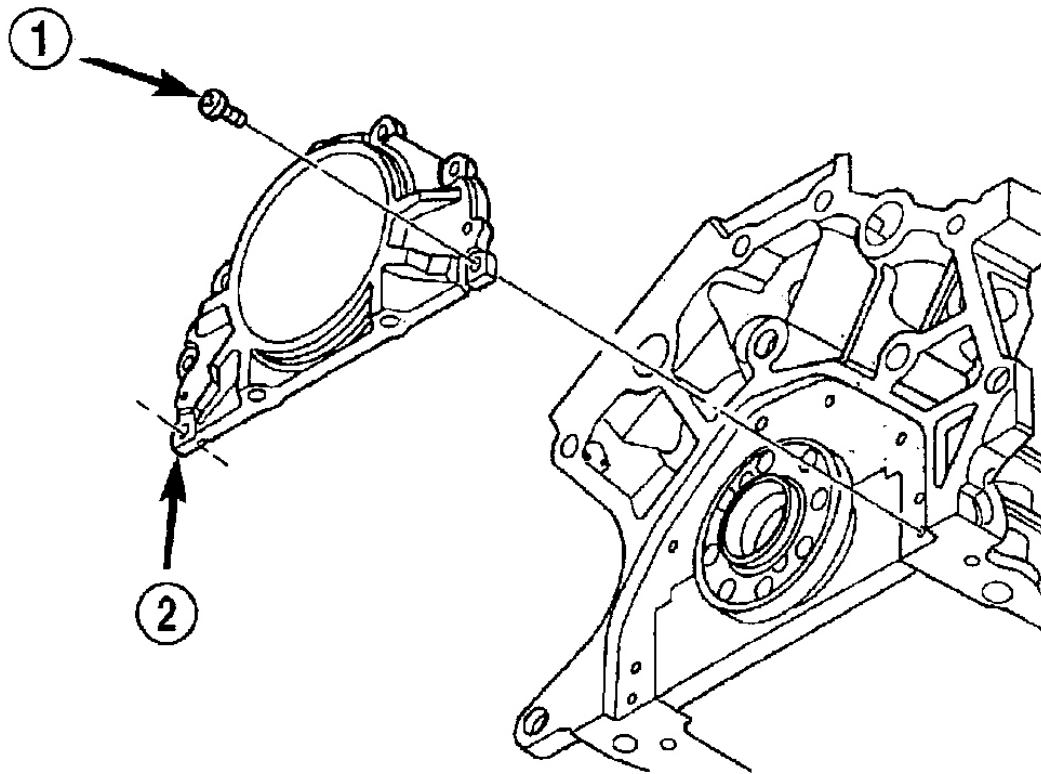
Fig. 120: Installing Crankshaft Rear Seal

Courtesy of DAIMLERCHRYSLER CORP.

2. Position seal over pilot tool. Assure that lip of seal is facing towards the crankshaft during installation. The pilot tool remains on crankshaft during seal installation.
3. Using Special Tool 6926-2 Installer, and C-4171 Handle (**Fig. 120**), drive seal into the retainer housing until seal is flush with housing surface.
4. Install drive plate and transaxle. (Refer to **41AE/TE AUTOMATIC TRANSAXLE**)

CRANKSHAFT REAR OIL SEAL RETAINER**REMOVAL**

1. Remove crankshaft rear oil seal. (Refer to **REMOVAL**)
2. Remove oil pan. (Refer to **REMOVAL**).
3. Remove seal retainer attaching screws.
4. Remove seal retainer (**Fig. 121**).



1 - SCREWS (7)
 2 - SEAL RETAINER
 G03572550

Fig. 121: Locating Oil Seal Retainer
 Courtesy of DAIMLERCHRYSLER CORP.

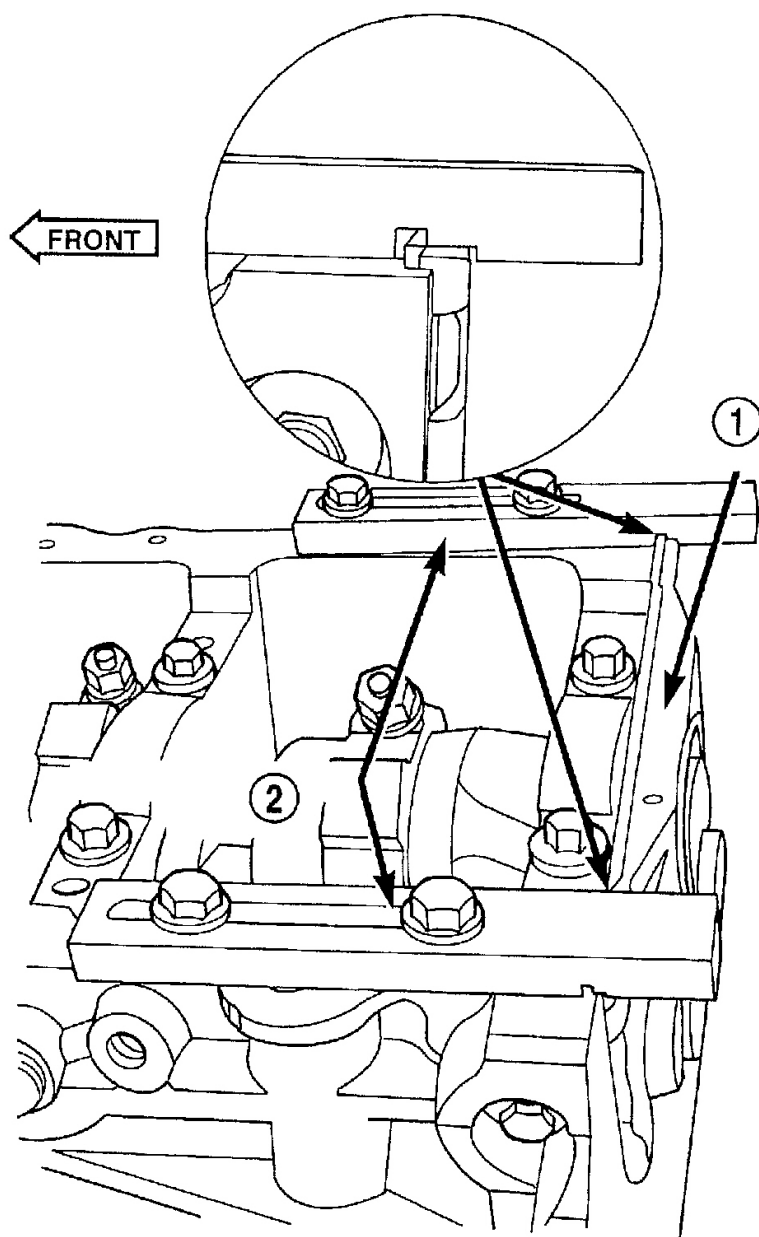
NOTE: Seal retainer gasket is bonded to the retainer and must be replaced as an assembly.

INSTALLATION

1. Clean all sealing surfaces. Replace retainer assembly if gasket is torn or damaged.
2. Install seal retainer to block, but do not tighten attaching screws at this time.

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

3. Attach Special Tools 8225 to pan rail using the oil pan fasteners (**Fig. 122**).



- 1 - SEAL RETAINER
 - 2 - SPECIAL TOOLS 8225
- G03572551

Fig. 122: Aligning Rear Crankshaft Seal Retainer
Courtesy of DAIMLERCHRYSLER CORP.

NOTE: Make sure the marking "3.5L" on Special Tools 8225, is facing towards the

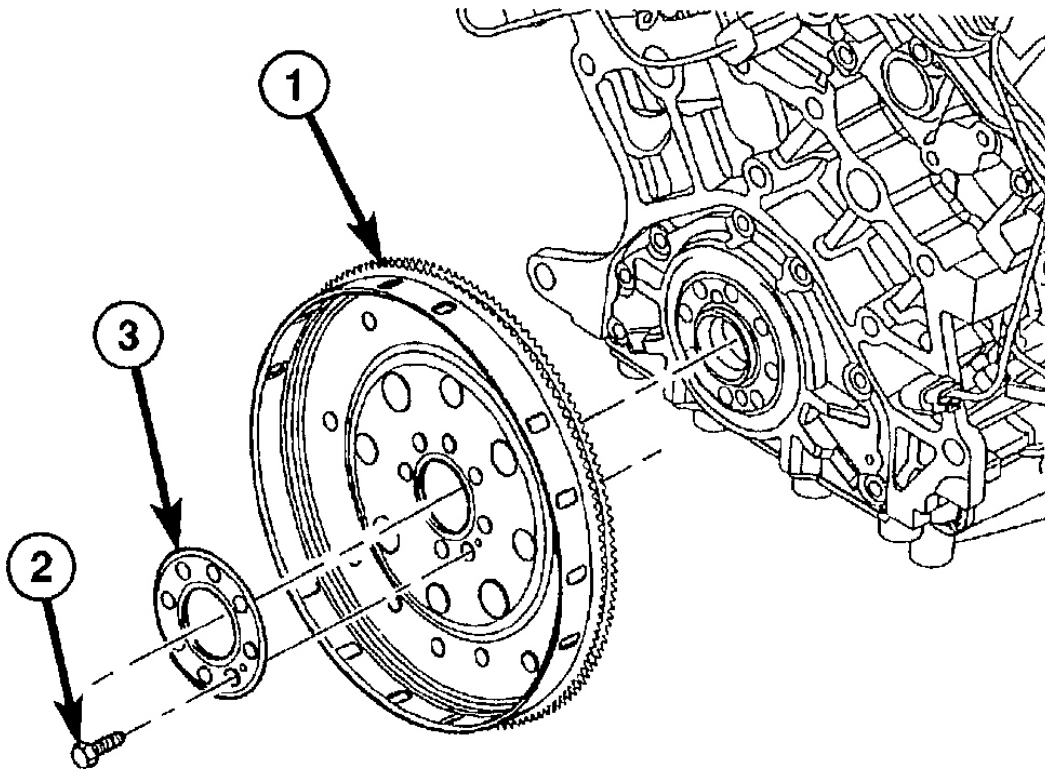
cylinder block pan rail surface (notch on tool is towards the seal retainer).

4. While applying firm pressure to the seal retainer against Special Tools 8225 (**Fig. 122**), tighten seal retainer screws to 12 N.m (105 in. lbs.).
5. Install crankshaft rear oil seal. (Refer to **INSTALLATION**)
6. Install oil pan. (Refer to **INSTALLATION**)

FLEX PLATE

REMOVAL

1. Remove the transaxle (Refer to **41AE/TE AUTOMATIC TRANSAXLE**).
2. Remove flex plate attaching bolts.
3. Remove the flex plate (**Fig. 123**).



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

G03572552

Fig. 123: Removing Flex Plate**Courtesy of DAIMLERCHRYSLER CORP.****INSTALLATION**

1. Position flex plate with backing plate on the crankshaft (**Fig. 123**).
2. Apply Mopar(R) Lock & Seal Adhesive to the flex plate bolts.
3. Install flex plate bolts (**Fig. 123**). Tighten bolts to 95 N.m (70 ft. lbs.).
4. Install the transaxle (Refer to **41AE/TE AUTOMATIC TRANSAXLE**).

PISTON & CONNECTING ROD**DESCRIPTION**

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

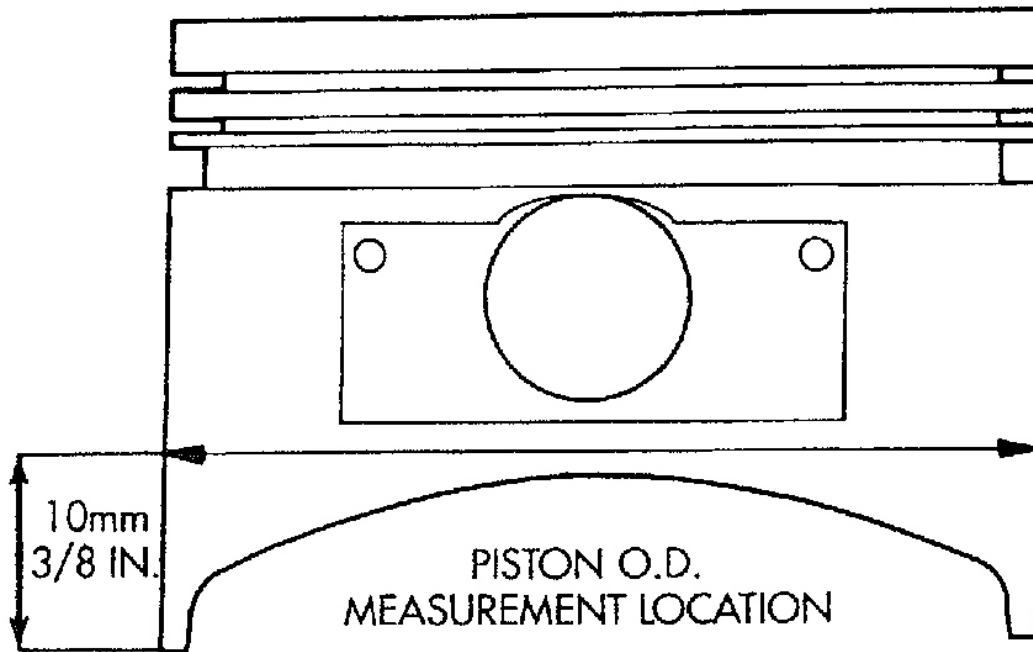
OPERATION

The piston and connecting rod is the link between the combustion force to the crankshaft.

STANDARD PROCEDURE - FITTING PISTONS

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

Piston and cylinder wall must be clean and dry. Piston diameter should be measured 90 degrees to piston pin at size location shown in (**Fig. 124**). Cylinder bores should be measured halfway down the cylinder bore and transverse to the engine crankshaft center line (Refer to **SPECIFICATIONS**). **Pistons and cylinder bores should be measured at normal room temperature, 70°F**

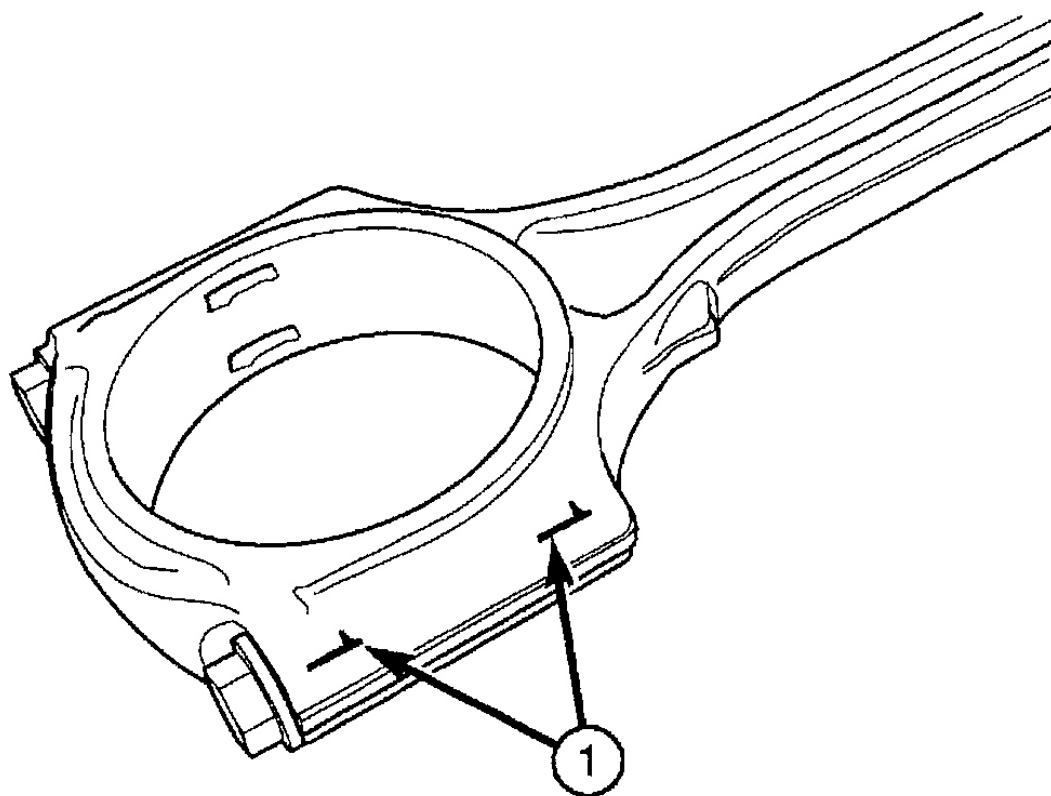


G03572553

Fig. 124: Locating Piston Measurement Location
Courtesy of DAIMLERCHRYSLER CORP.

REMOVAL

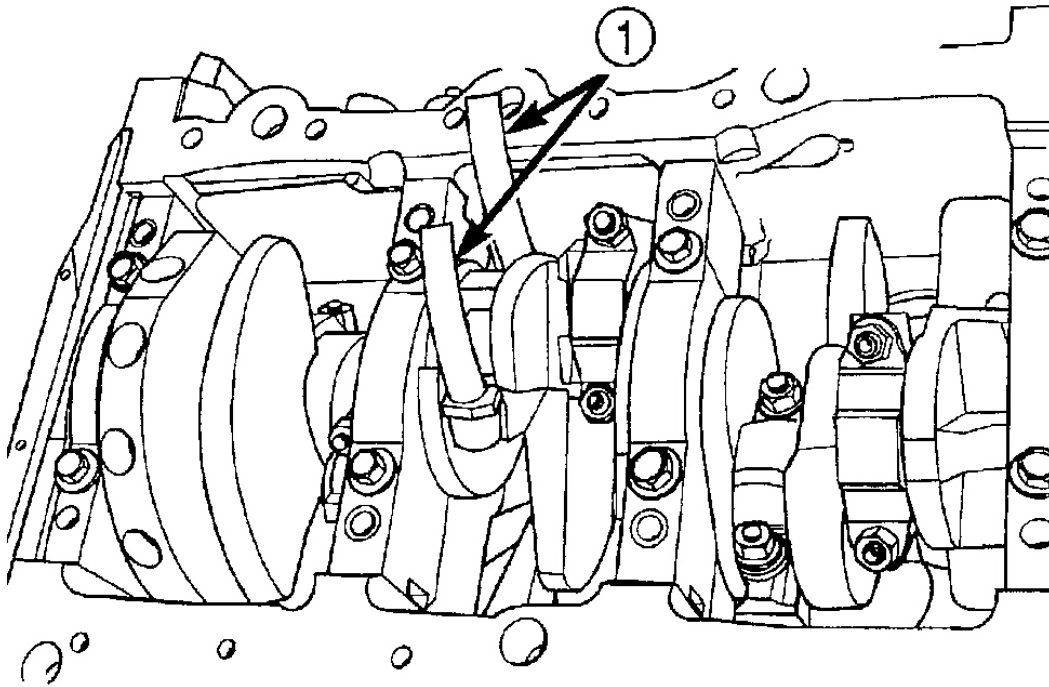
1. Remove the cylinder heads (Refer to **REMOVAL - CYLINDER HEAD(S)**)
2. Remove the oil pan. (Refer to **REMOVAL**)
3. Remove top ridge of cylinder bores with a reliable ridge reamer before removing pistons from cylinder block. Be sure to keep tops of pistons covered during this operation. Pistons and connecting rods must be removed from top of cylinder block. When removing piston and connecting rod assemblies from the engine, rotate crankshaft so that each connecting rod is centered in cylinder bore.
4. Inspect connecting rods and connecting rod caps for cylinder identification. Identify them if necessary (**Fig. 125**).



G03572554

Fig. 125: Marking Connecting Rod & Cap
Courtesy of DAIMLERCHRYSLER CORP.

5. Remove connecting rod cap. Install protectors on connecting rod bolts (**Fig. 126**). Push each piston and rod assembly out of cylinder bore.



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

G03572555

Fig. 126: Installing Rod Guides and Crankshaft Protectors
Courtesy of DAIMLERCHRYSLER CORP.

NOTE: Be careful not to nick crankshaft journals.

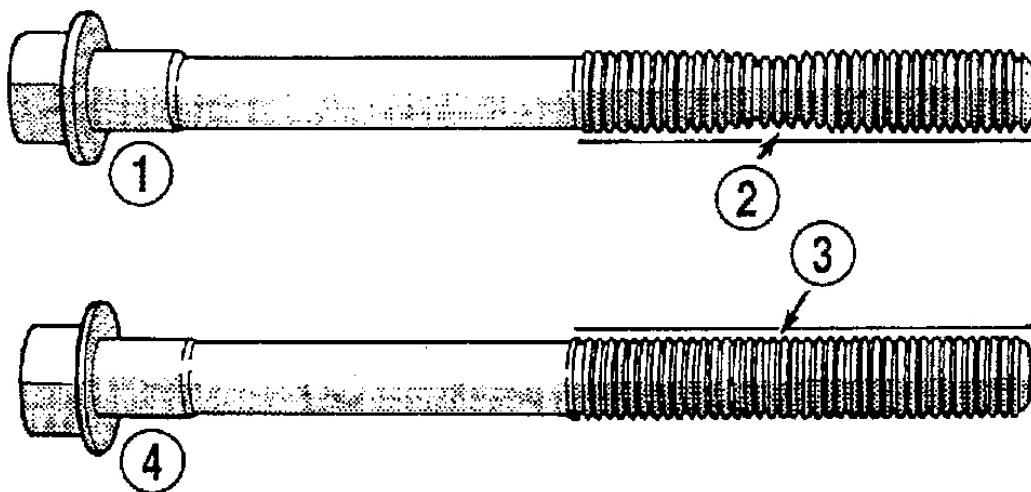
6. After removal, install bearing cap on the mating rod.

INSTALLATION

1. Install the piston rings. (Refer to **INSTALLATION**)

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

2. Check connecting rod bolts for necking by holding a scale or straight edge against the threads. If all threads do not contact the scale, the bolt must be replaced (**Fig. 127**).

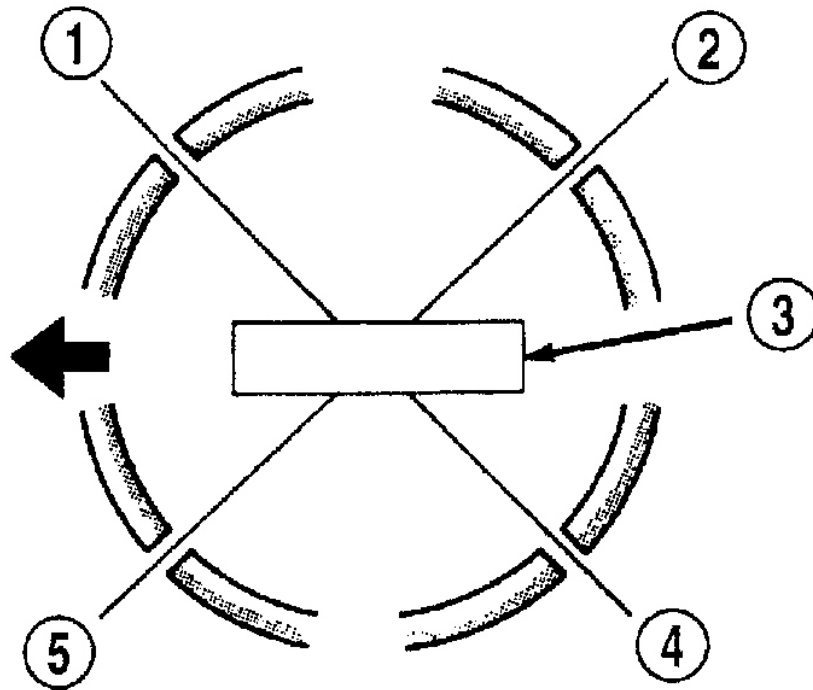


- 1 - STRETCHED BOLT
- 2 - THREADS ARE NOT STRAIGHT ON LINE
- 3 - THREADS ARE STRAIGHT ON LINE
- 4 - UNSTRETCHED BOLT

G03572556

Fig. 127: Checking for Stretched Bolts
 Courtesy of DAIMLERCHRYSLER CORP.

3. Before installing pistons and connecting rod assemblies into the bore, ensure that compression ring gaps are staggered so that neither is in line with oil ring rail gap (**Fig. 128**).

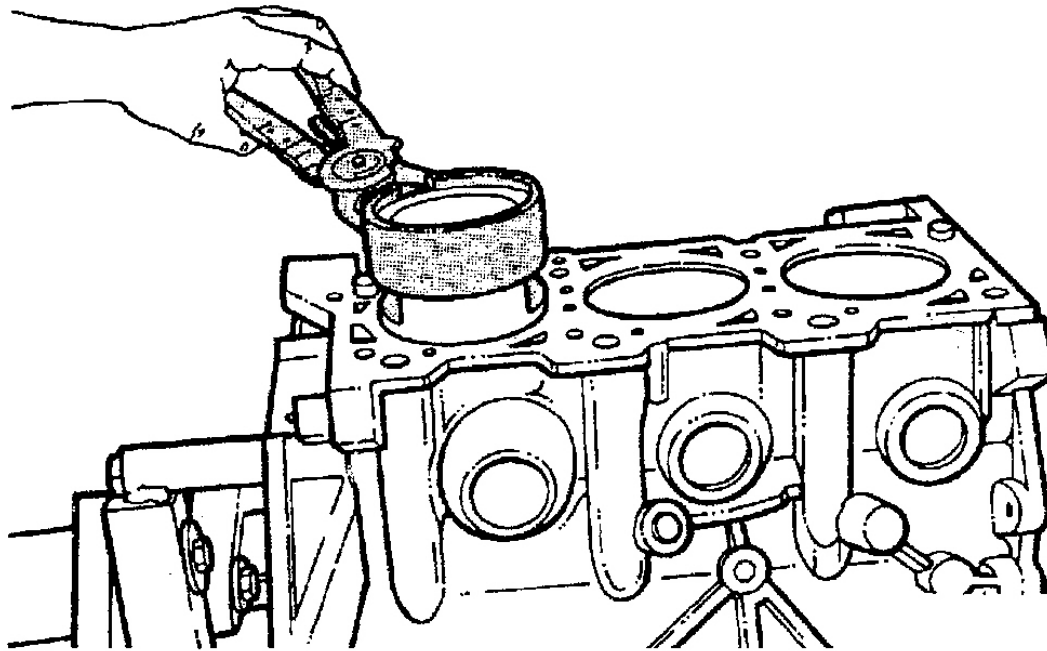


- 1 - SIDE RAIL UPPER
- 2 - NO. 1 RING GAP
- 3 - PISTON PIN
- 4 - SIDE RAIL LOWER
- 5 - NO. 2 RING GAP AND SPACER EXPANDER GAP

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Fig. 128: Identifying Piston Ring End Gap Positions
Courtesy of DAIMLERCHRYSLER CORP.

4. Immerse the piston head and rings in clean engine oil, slide the ring compressor over the piston and tighten with the special wrench (**Fig. 129**). **Ensure position of rings does not change during this operation.**



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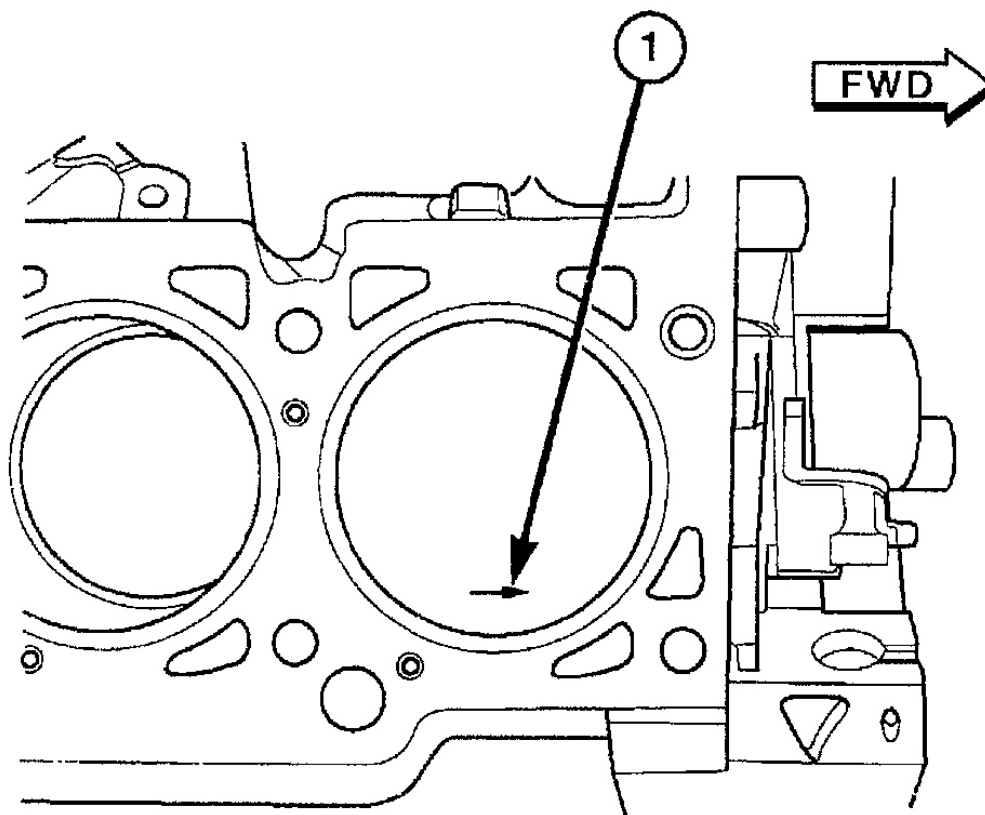
Fig. 129: Installing Piston

Courtesy of DAIMLERCHRYSLER CORP.

5. Install connecting rod bolt protectors on rod bolts (**Fig. 126**).
6. Rotate crankshaft so that the connecting rod journal is on the center of the cylinder bore. Insert rod and piston into cylinder bore and guide rod over the crankshaft journal.

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

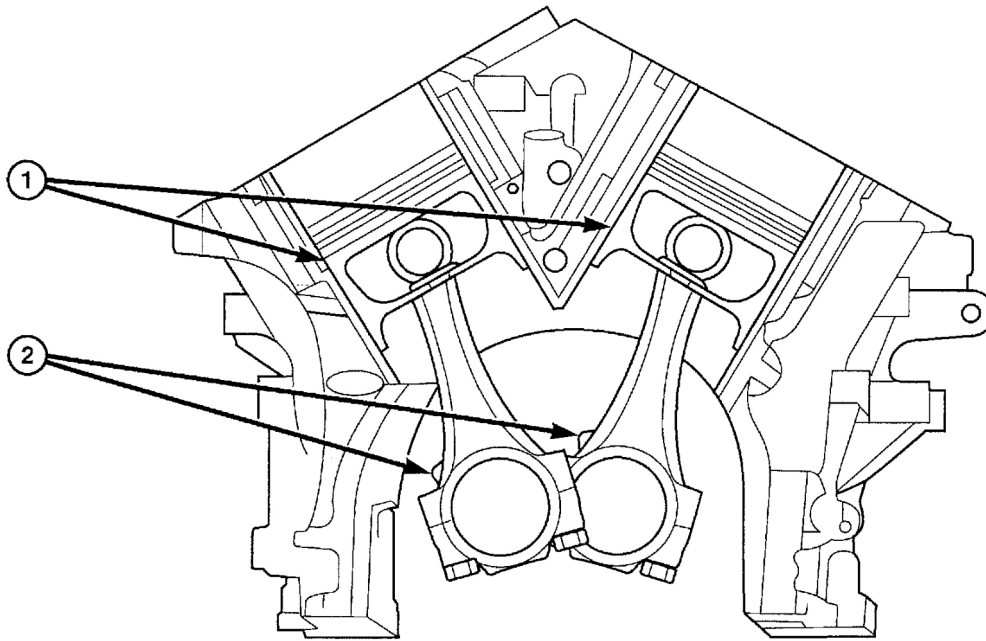
7. The arrow on top of piston must be pointing toward front of engine (**Fig. 130**) and oil squirt hole on connecting rod faces the major thrust (right) side of the cylinder bore (**Fig. 131**).



1 - ARROW FACES FRONT OF ENGINE

G03572559

Fig. 130: Identifying Piston Orientation
Courtesy of DAIMLERCHRYSLER CORP.



1 - MAJOR THRUST SIDE OF PISTON
G03572560

2 - OIL SQUIRT HOLE

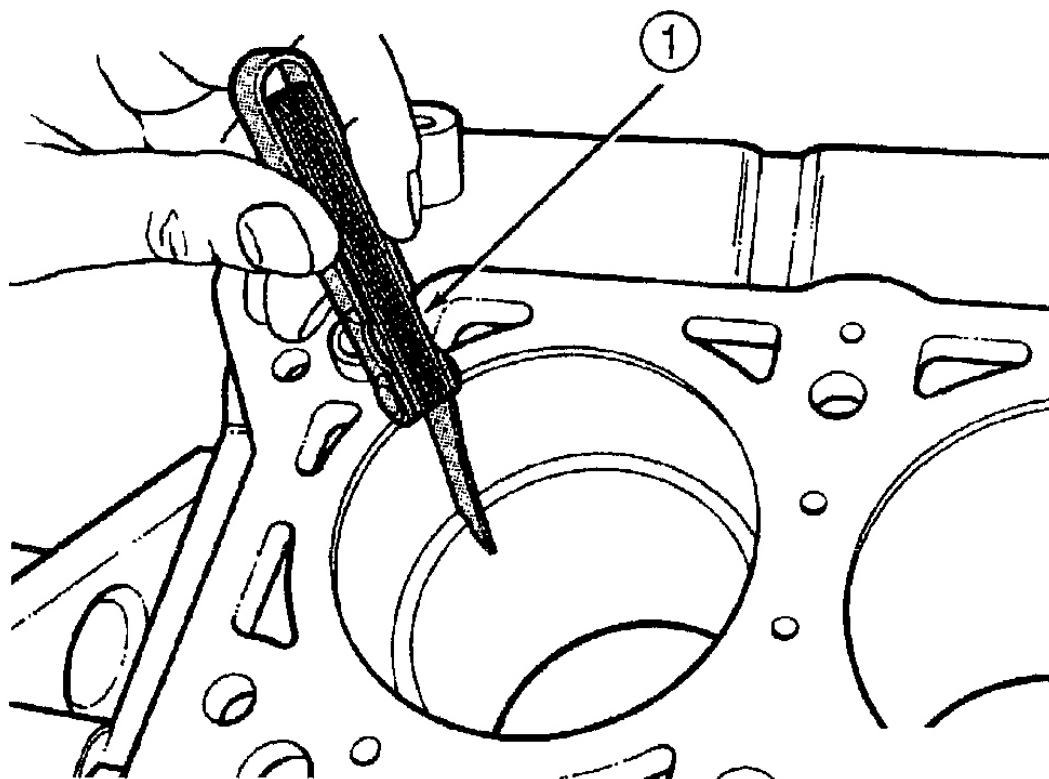
Fig. 131: Identifying Piston And Connecting Rod Positioning
Courtesy of DAIMLERCHRYSLER CORP.

8. Tap the piston down in cylinder bore, using a hammer handle. At the same time, guide connecting rod into position on connecting rod journal.
9. Install rod caps. Install nuts on cleaned and oiled rod bolts and tighten nuts to 54 N.m (40 ft. lbs.) Plus 1/4 turn.
10. Install the cylinder head(s) (Refer to **INSTALLATION**)
11. Install the oil pan. (Refer to **INSTALLATION**)

PISTON RINGS

STANDARD PROCEDURE - PISTON RING FITTING

1. Wipe cylinder bore clean. Insert ring and push down with piston to ensure it is square in bore. The ring gap measurement must be made with the ring positioning at least 12 mm (0.50 in.) from bottom of cylinder bore. Check gap with feeler gauge (**Fig. 132**). For clearance specifications, (Refer to **SPECIFICATIONS**).

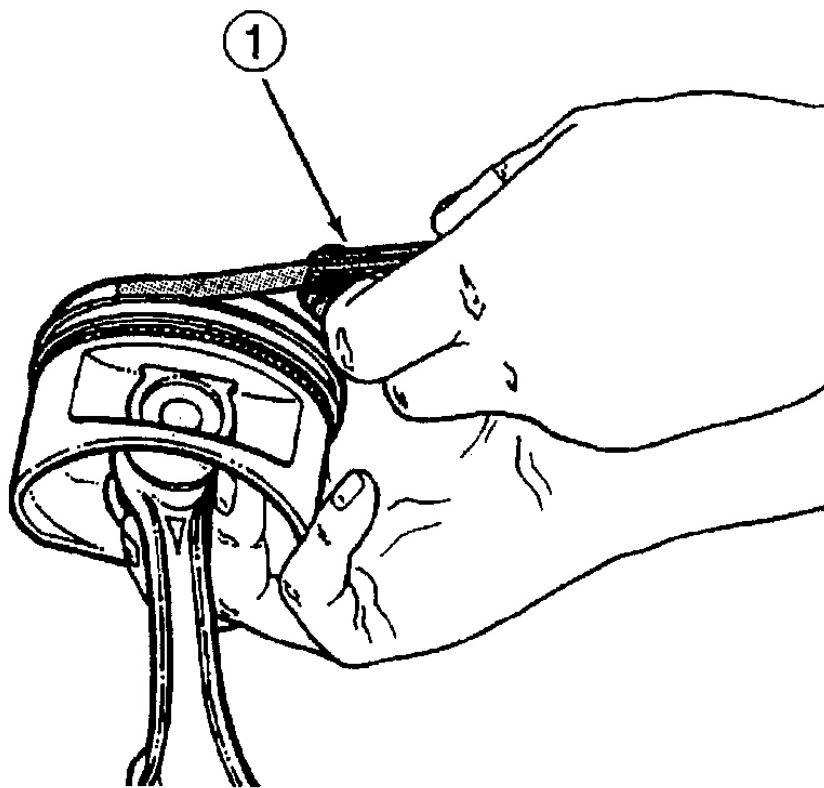


1 - FEELER GAUGE

G03572561

Fig. 132: Checking Gap On Piston Rings
Courtesy of DAIMLERCHRYSLER CORP.

2. Check piston ring to groove clearance: (**Fig. 133**). For clearance specifications, (Refer to **SPECIFICATIONS**).



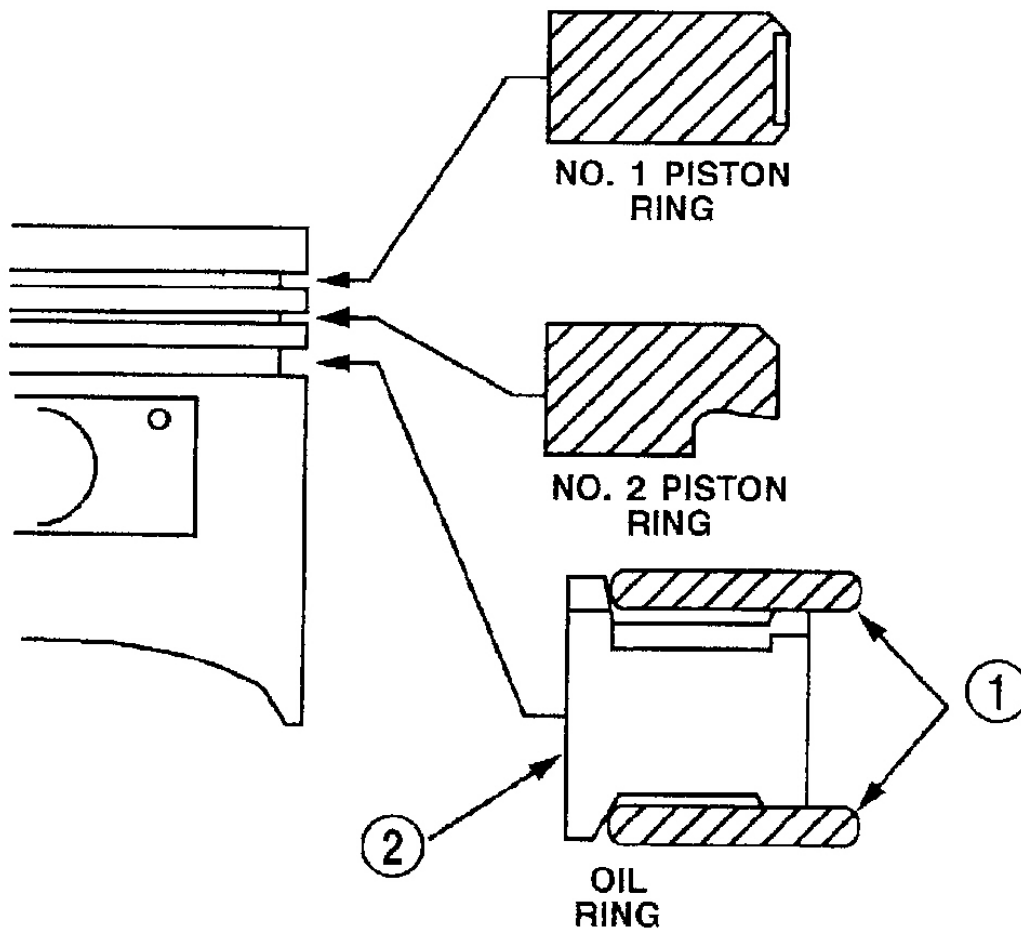
1 - FEELER GAUGE

G03572562

Fig. 133: Measuring Piston Ring Side Clearance
Courtesy of DAIMLERCHRYSLER CORP.

REMOVAL

1. Remove piston and connecting rod. (Refer to **REMOVAL**)
2. Remove No. 1 and No. 2 piston rings from piston using a ring expander tool (**Fig. 136**).
3. Remove upper oil ring side rail (**Fig. 134**).



1 - SIDE RAIL
2 - SPACER EXPANDER

G03572563

Fig. 134: Identifying Piston Ring Locations
Courtesy of DAIMLERCHRYSLER CORP.

4. Remove lower oil ring side rail (**Fig. 134**).
5. Remove oil ring expander (**Fig. 134**).

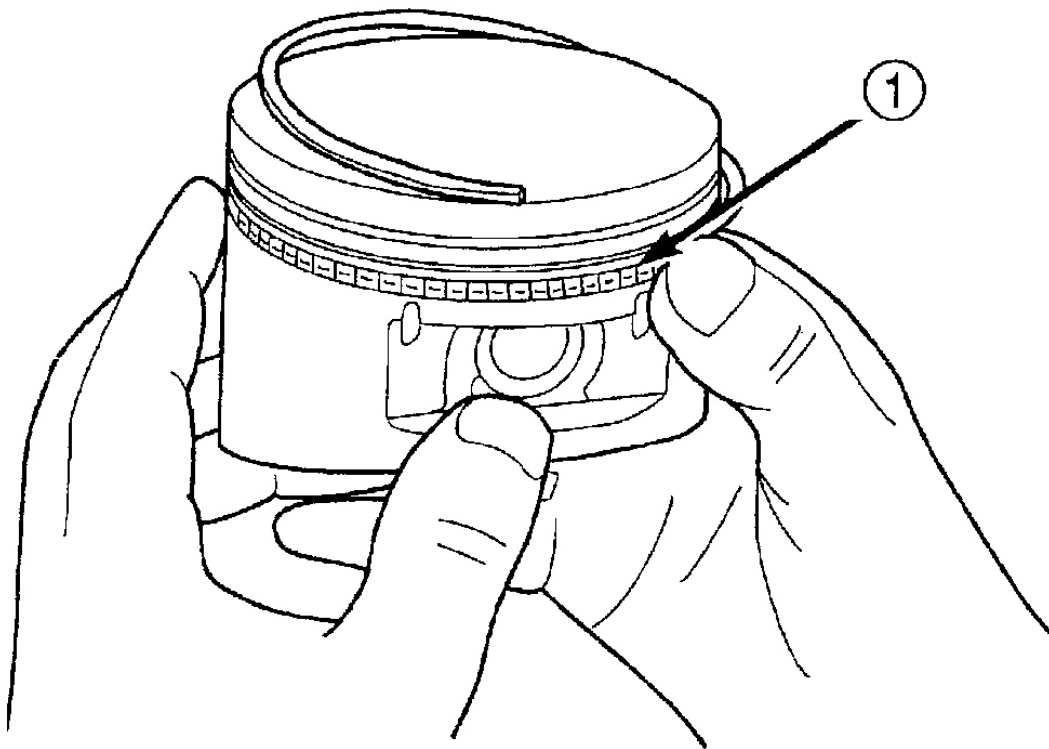
INSTALLATION

1. Measure clearance of piston rings to the cylinder bore and piston. (Refer to **STANDARD PROCEDURE - PISTON RING FITTING**)

The No. 1 and No. 2 piston rings have a different cross section. Insure that the No. 2 ring is installed with manufacturers I.D. mark (dot) facing up, towards top of the piston (**Fig. 134**).

CAUTION: Install piston rings in the following order:

- Oil ring expander.
 - Upper oil ring side rail.
 - Lower oil ring side rail.
 - No. 2 Intermediate piston ring.
 - No. 1 Upper piston ring.
2. Install oil ring expander.
 3. Install the side rail by placing one end between the piston ring groove and the expander. Hold end firmly and press down the portion to be installed until side rail is in position. **Do not use a piston ring expander during this step (Fig. 135).**



1 - SIDE RAIL END

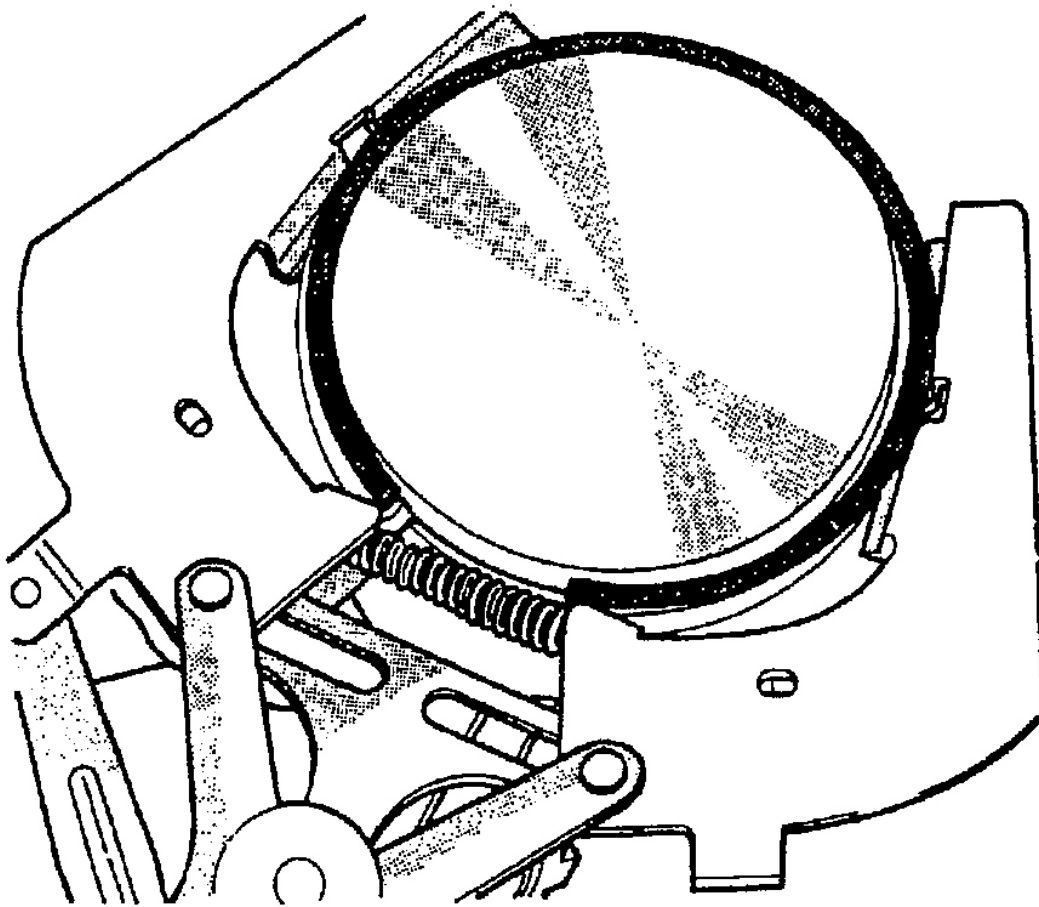
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Fig. 135: Installing Side Rail
Courtesy of DAIMLERCHRYSLER CORP.

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

The No. 1 and No. 2 piston rings have a different cross section. Insure that the No. 2 ring is installed with manufacturers I.D. mark (dot) facing up, towards top of the piston (**Fig. 134**).

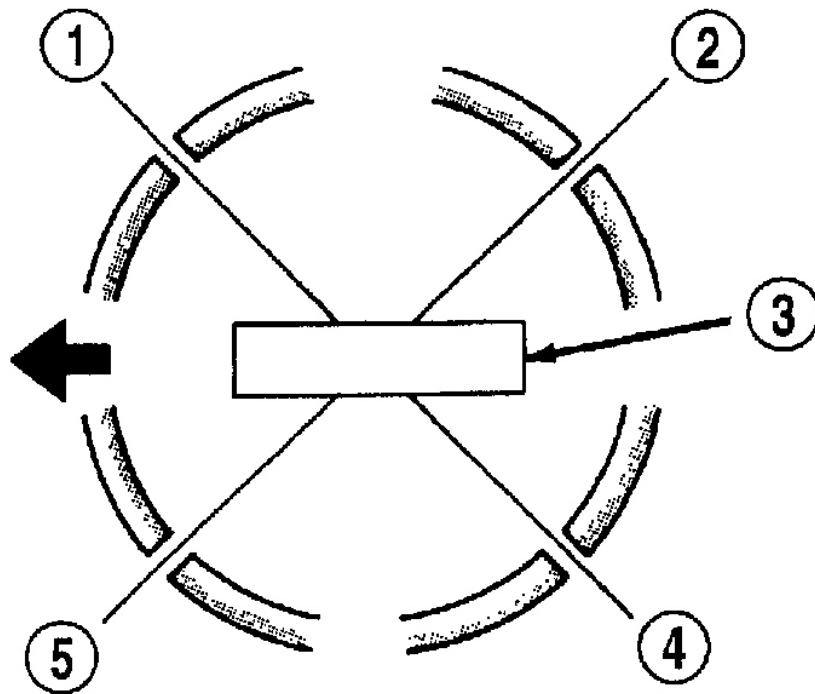
5. Install No. 2 piston ring and then No. 1 piston ring (**Fig. 136**).



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Fig. 136: Installing Upper And Intermediate Rings
Courtesy of DAIMLERCHRYSLER CORP.

6. Position piston ring end gaps as shown in (**Fig. 137**).



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

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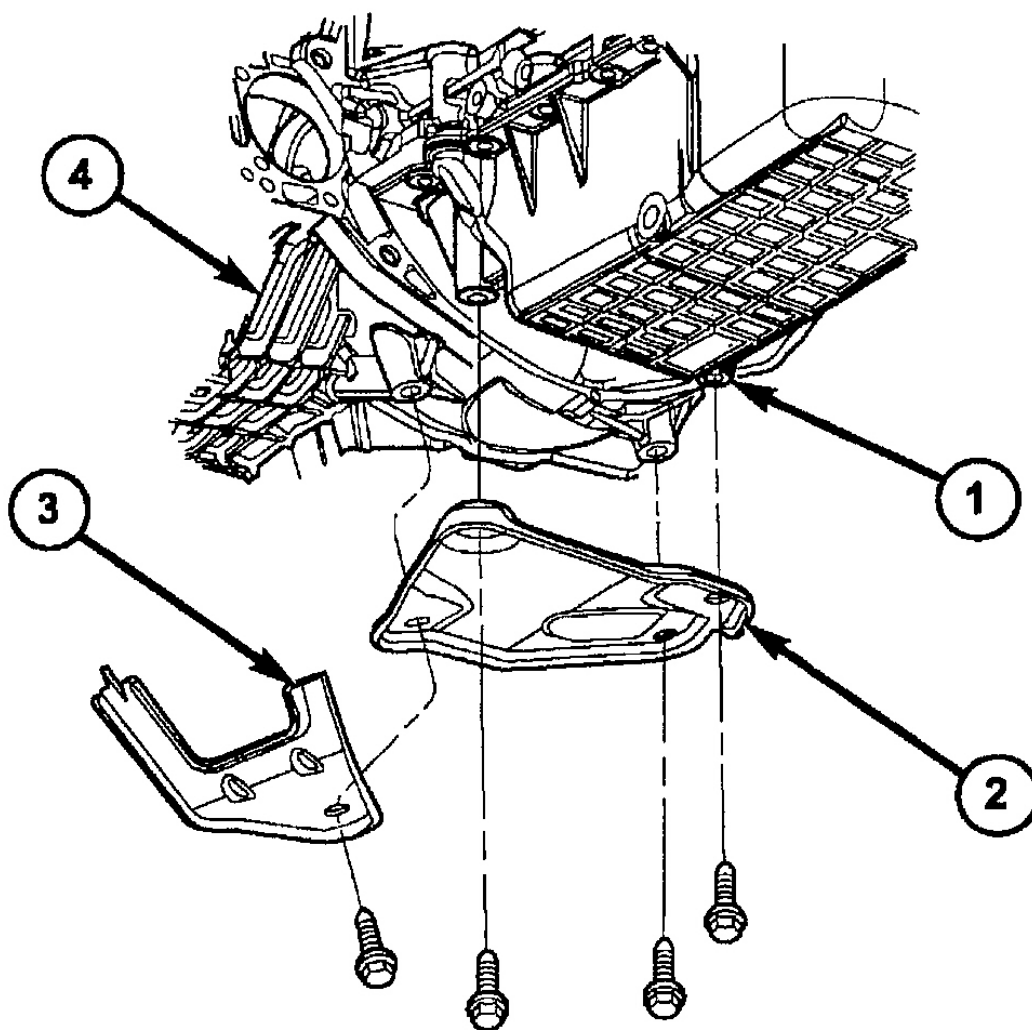
Fig. 137: Identifying Piston Ring End Gap Positions
Courtesy of DAIMLERCHRYSLER CORP.

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

STRUCTURAL COVER

REMOVAL

1. Raise and support the vehicle.
2. Remove the bolts attaching the structural collar to the oil pan and transmission housing (**Fig. 138**).



- 1 - ENGINE OIL PAN
- 2 - STRUCTURAL SUPPROT
- 3 - ENGINE MOUNT BRACKET
- 4 - TRANSMISSION

G03572567

Fig. 138: Identifying Structural Cover
Courtesy of DAIMLERCHRYSLER CORP.

- 3. Remove the structural collar.

INSTALLATION

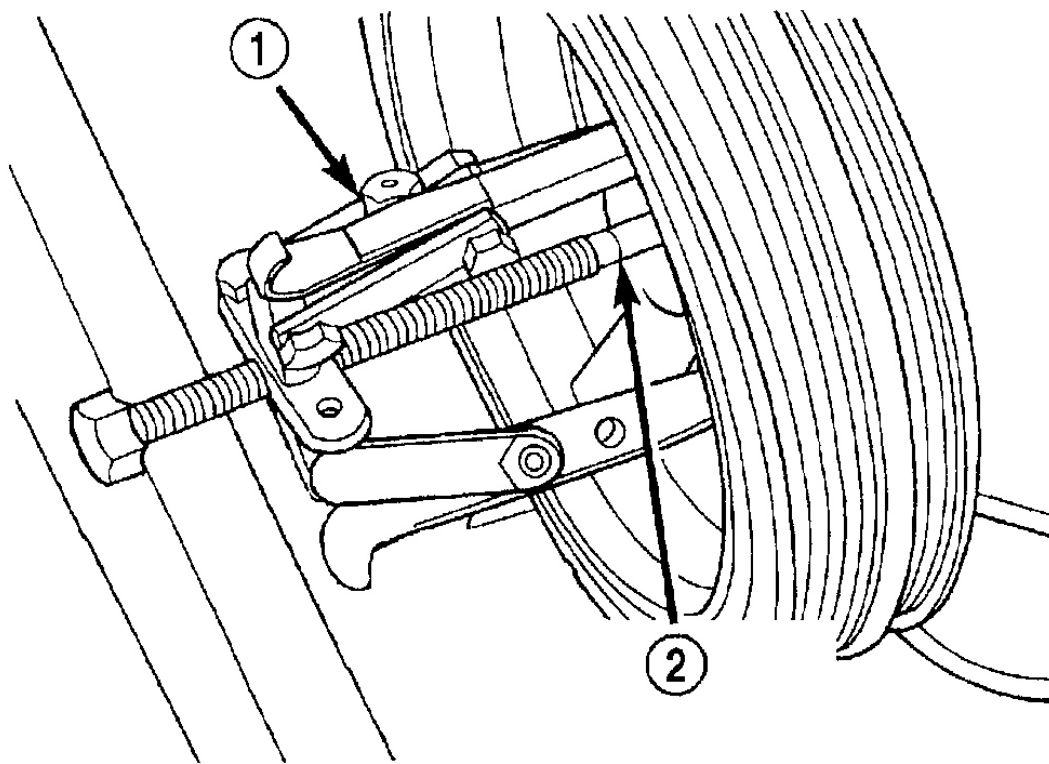
CAUTION: The collar must be tightened using this service procedure, as damage to collar and/or oil pan may occur.

1. Install structural collar (**Fig. 138**) using the following tightening sequence:
 - Loosely install the collar to oil pan bolts.
 - Loosely install the collar to transmission bolts.
 - Initial torque bolts to 27 N.m (20 ft. lbs.).
 - Final torque bolts to 55 N.m (40 ft. lbs.).
2. Lower vehicle.

VIBRATION DAMPER

REMOVAL

1. Disconnect negative battery cable.
2. Raise vehicle on hoist.
3. Remove the right front wheel and accessory drive belt splash shield.
4. Remove accessory drive belt (Refer to **DRIVE BELTS**).
5. Remove vibration damper bolt.
6. Use Special Tool 1023 puller, and insert 9020-R, remove crankshaft damper (**Fig. 139**)



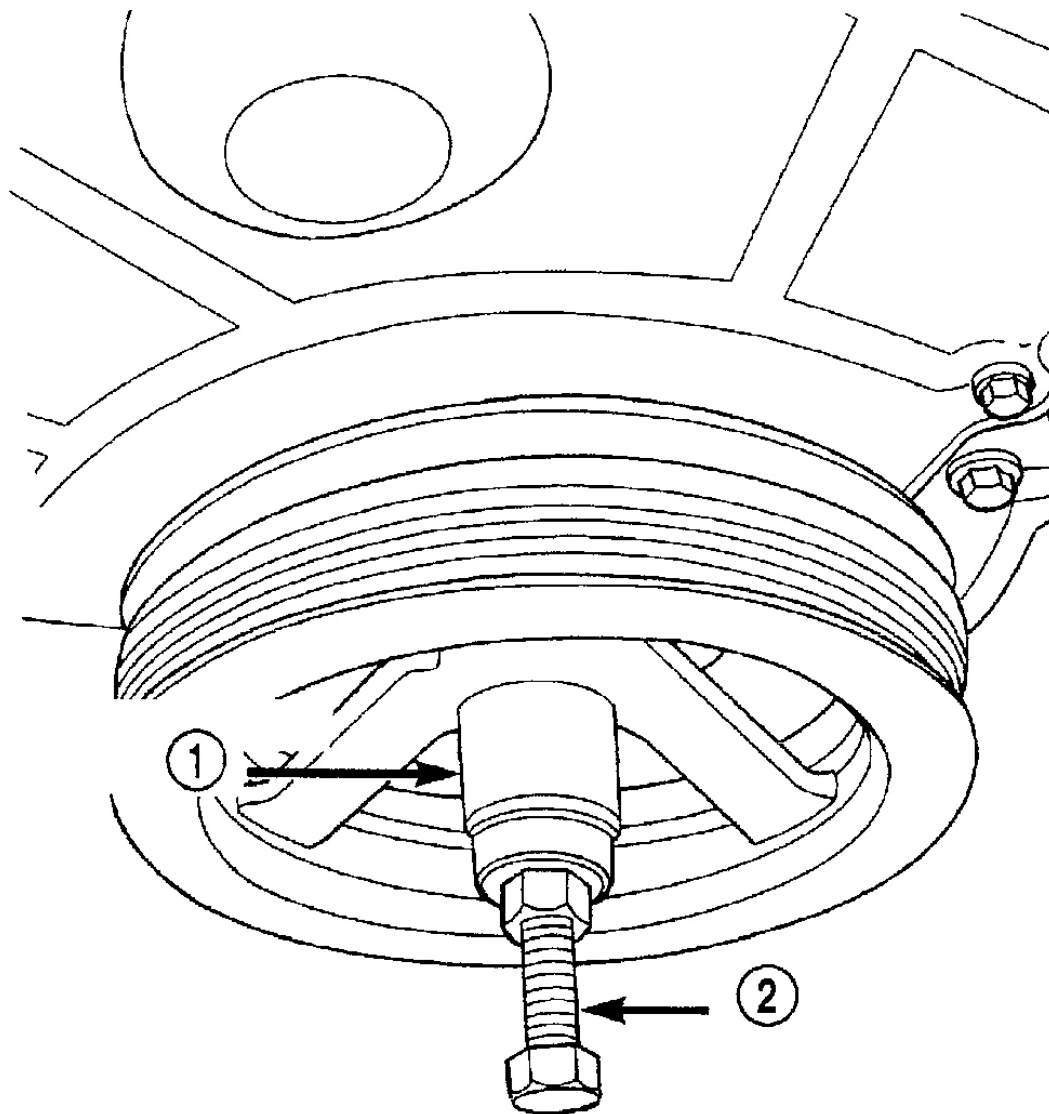
- 1 - SPECIAL TOOL 1023 PULLER
- 2 - SPECIAL TOOL 9020-R INSERT

G03572568

Fig. 139: Removing Crankshaft Damper
Courtesy of DAIMLERCHRYSLER CORP.

INSTALLATION

1. Install crankshaft damper using Special Tools C-4685-C1 (5.9 in.) Bolt, with Nut and Thrust Bearing from 6792, and 6792-1 Installer (**Fig. 140**).



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

G03572569

Fig. 140: Installing Crankshaft Damper
 Courtesy of DAIMLERCHRYSLER CORP.

2. Install vibration damper bolt. Torque bolt to 115 N.m (85 ft. lbs.).
3. Install accessory drive belt (Refer to **DRIVE BELTS**).
4. Install the accessory drive belt splash shield and right front wheel.
5. Lower vehicle.

6. Connect negative battery cable.

ENGINE MOUNTING

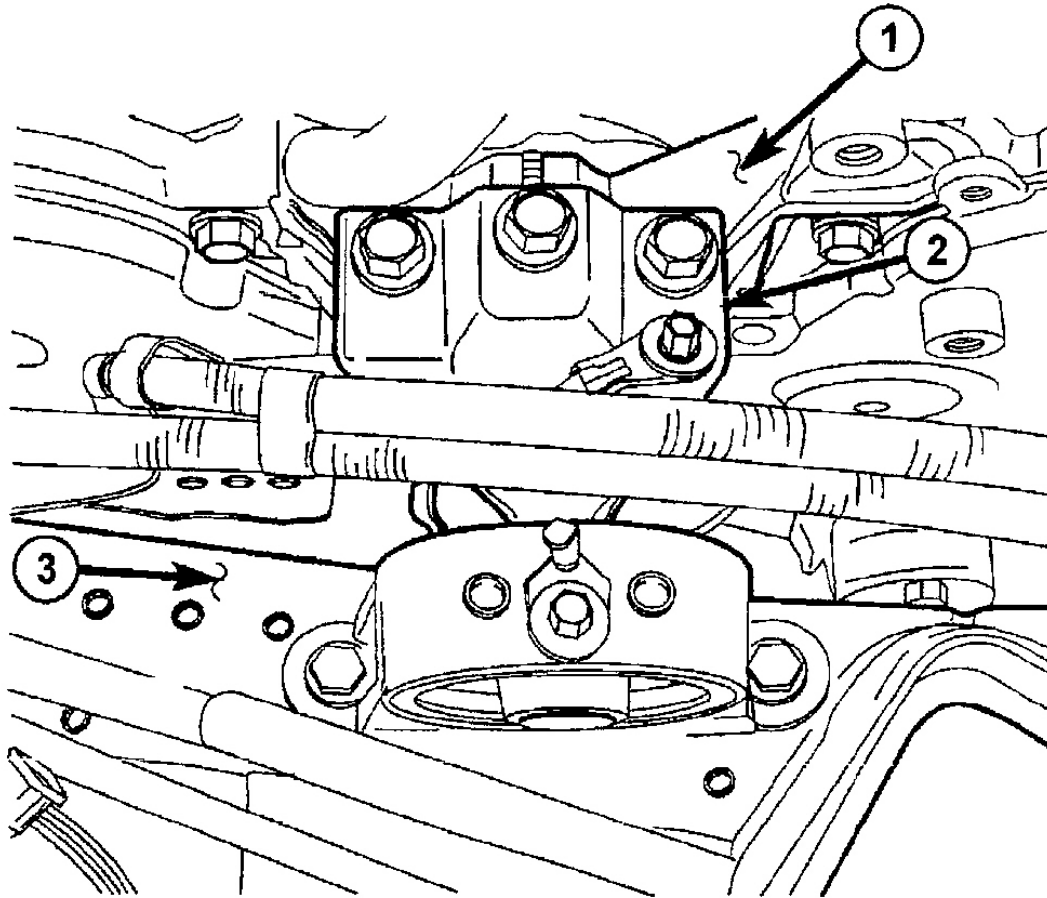
DESCRIPTION

The engine mounting system are of molded rubber material and consist of three mounts; right and a left side support the powertrain, and a front mount control powertrain torque.

UPPER MOUNT

REMOVAL

1. Support engine assembly with a floor jack so it will not rotate.
2. Remove the air cleaner element housing (Refer to **REMOVAL**).
3. Remove the upper engine mount bolts from the inner frame rail
4. Remove the upper engine mount bolts from the engine.



- 1 - INTAKE MANIFOLD
- 2 - UPPER ENGINE MOUNT
- 3 - FRAME RAIL

G03572570

Fig. 141: Identifying Upper Engine Mount
Courtesy of DAIMLERCHRYSLER CORP.

INSTALLATION

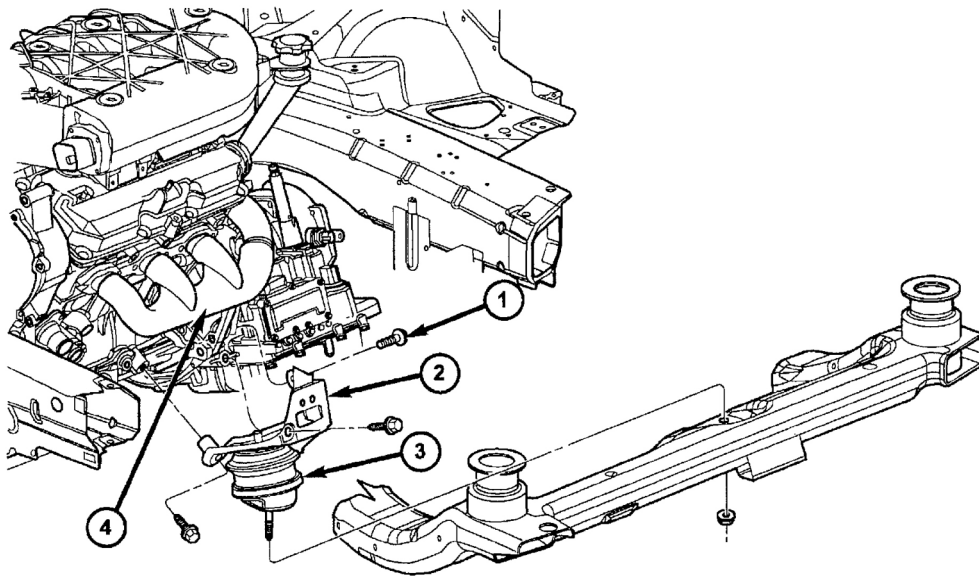
1. Support the engine assembly with a floor jack.
2. Properly position the upper engine mount and install the retaining bolts (**Fig. 141**).
3. Tighten the bolts attached to the intake manifold to 54 N.m (40 lbs. ft. (**Fig. 141**).
4. Tighten the bolts attached to the inner frame rail to 68 N.m (50 lbs. ft.) (**Fig. 141**).
5. Remove the jack used to support engine assembly.

6. Install the air cleaner element housing (Refer to **INSTALLATION**).

LEFT MOUNT

REMOVAL

1. Disconnect the negative battery cable.
2. Remove engine cover.
3. Remove radiator cooling fan assembly (Refer to **RADIATOR FAN**).
4. Raise and support the vehicle.
5. Remove both of the engine mount to cradle nuts (**Fig. 142**).
6. Lower the vehicle.
7. Connect the engine support fixture and support engine weight.
8. Remove the engine mount bolts and remove mount (**Fig. 142**).



1 - BOLT
2 - BRACKET
G03572571

3 - ENGINE MOUNT
4 - LEFT EXHAUST MANIFOLD

Fig. 142: Identifying Left Engine Mount
Courtesy of DAIMLERCHRYSLER CORP.

INSTALLATION

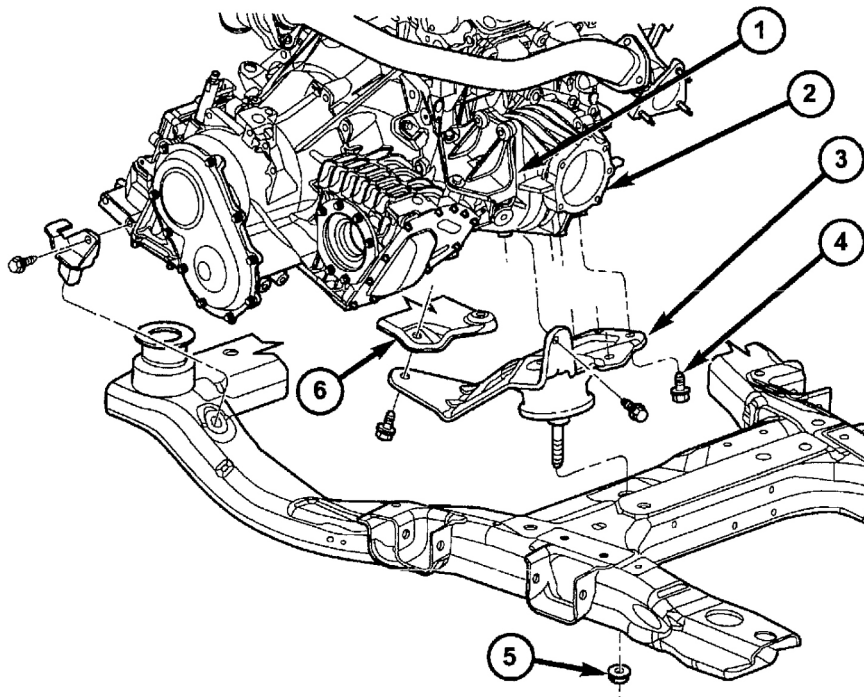
1. Install engine mount to bracket. Tighten nut to 101 N.m (75 lbs. ft.) (**Fig. 142**).
2. Install left mount to the engine block. Tighten bolts to 54 N.m (4Q lbs.ft.) (**Fig. 142**).
3. Lower vehicle.
4. Remove the engine support fixture.

5. Raise and support the vehicle.
6. Install both of the engine mount to cradle nut. Tighten nut to 101 N.m (75 lbs. ft.) (**Fig. 142**).
7. Lower vehicle.
8. Install radiator fan assembly (Refer to **RADIATOR FAN**).
9. Install the engine cover.
10. Connect the negative battery cable.

RIGHT MOUNT

REMOVAL

1. Disconnect the negative battery cable.
2. Raise and support the vehicle.
3. Remove both of the engine mount to cradle nuts.
4. Lower the vehicle.
5. Connect the engine support fixture and support the engine weight.
6. Raise and support the vehicle.
7. Remove the right mount bracket bolts (**Fig. 143**)



1 - POWER TRANSFER UNIT UPPER BRACKET
 2 - POWER TRANSFER UNIT
 3 - ENGINE MOUNT BRACKET

4 - BOLT
 5 - NUT
 6 - STRUCTURAL COVER

G03572572

Fig. 143: Identifying Right Engine Mount
Courtesy of DAIMLERCHRYSLER CORP.

8. Remove the engine mount top nut (**Fig. 143**).
9. Remove the engine mount plate and engine mount (**Fig. 143**).

INSTALLATION

1. Install the engine mount and plate. Tighten bolts to 54 N.m (40 lbs. ft.) (**Fig. 143**).
2. Install the engine mount upper nut. Tighten nut to 101 N.m (75 lbs. ft.) (**Fig. 143**).
3. Install right engine mount bracket bolts. Tighten bolts to 54 N.m (40 lbs. ft.) (**Fig. 143**).
4. Lower the vehicle.
5. Remove the engine support fixture.
6. Raise and support the vehicle.
7. Install both lower engine mount to cradle nuts. Tighten nuts to 101 N.m (75 lbs. ft.) (**Fig. 143**).
8. Lower vehicle and connect the negative battery cable.

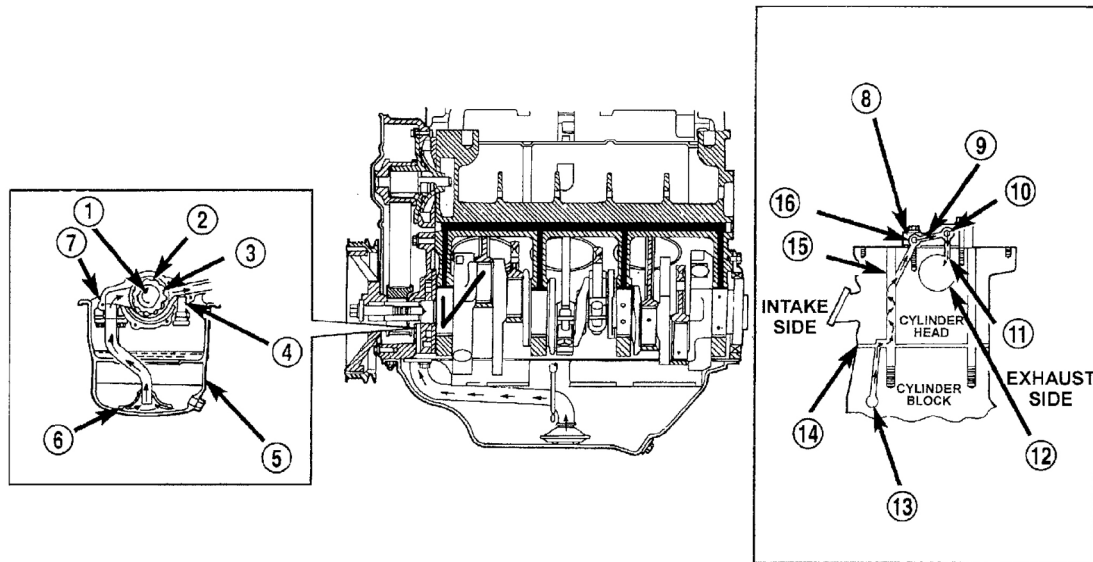
LUBRICATION

DESCRIPTION

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

OPERATION

Engine oil stored in the oil pan is drawn in and discharged by a gerotor type oil pump. The oil pump is directly coupled to the crankshaft. Oil pressure is regulated by a relief valve. The oil is fed through an oil filter and to the crankshaft journals from the oil gallery in the cylinder block. This gallery also feeds oil under pressure to the cylinder heads. Oil flows through each cylinder heads oil passage to the rocker shafts. Oil then feeds the camshaft journals, rocker arms, and hydraulic lash adjusters (**Fig. 144**).



- 1 - CRANKSHAFT
- 2 - OUTER ROTOR
- 3 - INNER ROTOR
- 4 - RELIEF VALVE
- 5 - OIL PAN
- 6 - OIL SCREEN
- 7 - OIL PUMP CASE
- 8 - OIL FLOWS TO ONLY ONE PEDESTAL ON EACH HEAD - SECOND FROM REAR ON RIGHT HEAD - SECOND FROM FRONT ON LEFT HEAD

G03572573

- 9 - PEDESTAL DRILLED PASSAGE
- 10 - EXHAUST ROCKER SHAFT
- 11 - SHAFT/PEDESTAL DOWEL PASSAGE
- 12 - CAMSHAFT BEARING BORE
- 13 - CYLINDER BLOCK OIL GALLERY
- 14 - CYLINDER HEAD GASKET
- 15 - HEAD BOLT HOLE
- 16 - INTAKE ROCKER SHAFT

Fig. 144: Cutaway View Of Oil Lubrication System
Courtesy of DAIMLERCHRYSLER CORP.

DIAGNOSIS AND TESTING - CHECKING ENGINE OIL PRESSURE

Check oil pressure using a gauge at oil pressure switch location.

1. Remove the oil pressure switch (Refer to **REMOVAL**).
2. Install oil pressure test gauge, Special Tool C-3292 with Adapter 8406. For Special Tool identification, (Refer to **SPECIAL TOOLS**).

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

3. Warm engine to normal operating temperature.
4. Monitor gauge readings at idle and 3000 rpm. For specifications (Refer to **SPECIFICATIONS**).

OIL

DESCRIPTION

For engine oil type and capacity (Refer to owner's manual)

STANDARD PROCEDURE

STANDARD PROCEDURE - ENGINE OIL LEVEL CHECK

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

Checking the oil while the vehicle is on level ground will improve the accuracy of the oil level reading. Add only when the level is at or below the ADD mark.

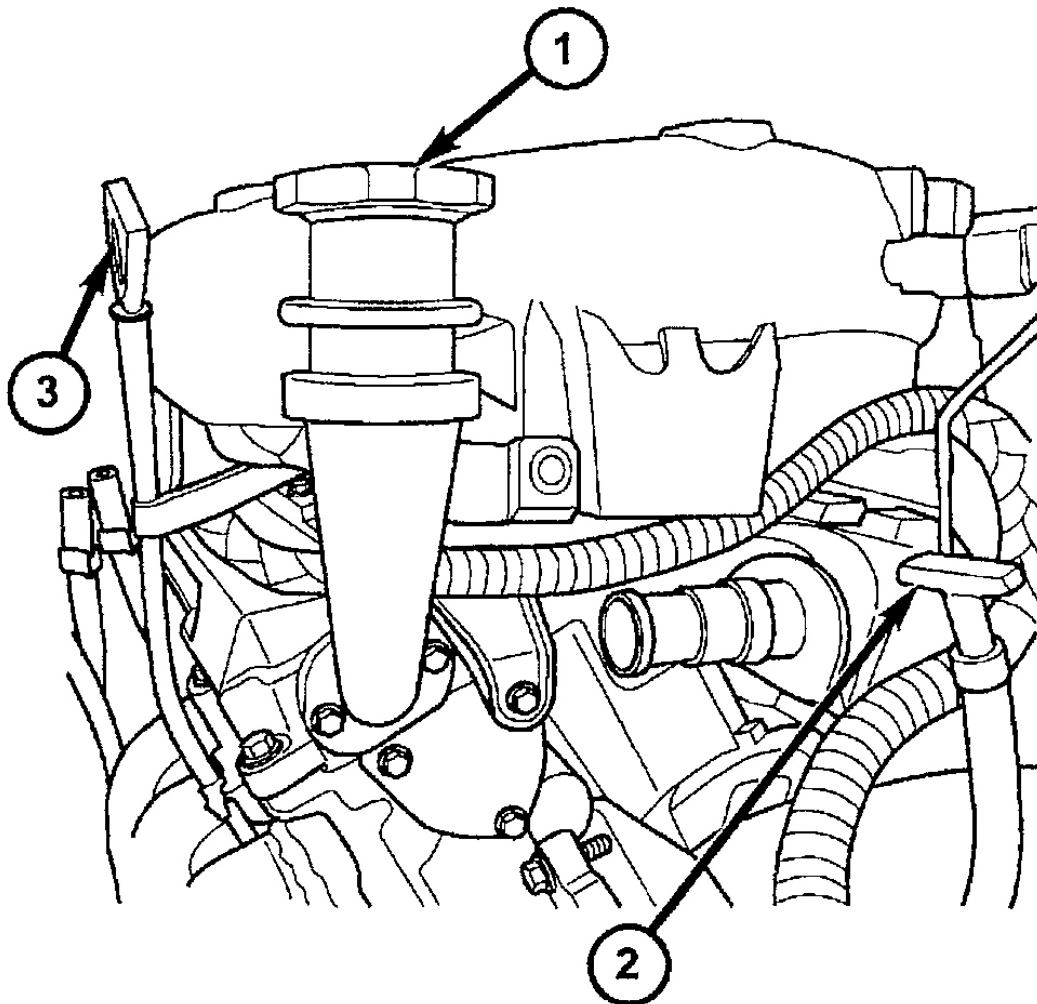
STANDARD PROCEDURE - ENGINE OIL AND FILTER CHANGE

Change engine oil at mileage and time intervals described in the Maintenance Schedule. (Refer to owner's manual)

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

TO CHANGE ENGINE OIL

1. Run engine until achieving normal operating temperature.
2. Position the vehicle on a level surface and turn engine off.
3. Open hood, remove engine oil fill cap (**Fig. 145**).



1 - ENGINE OIL FILL CAP

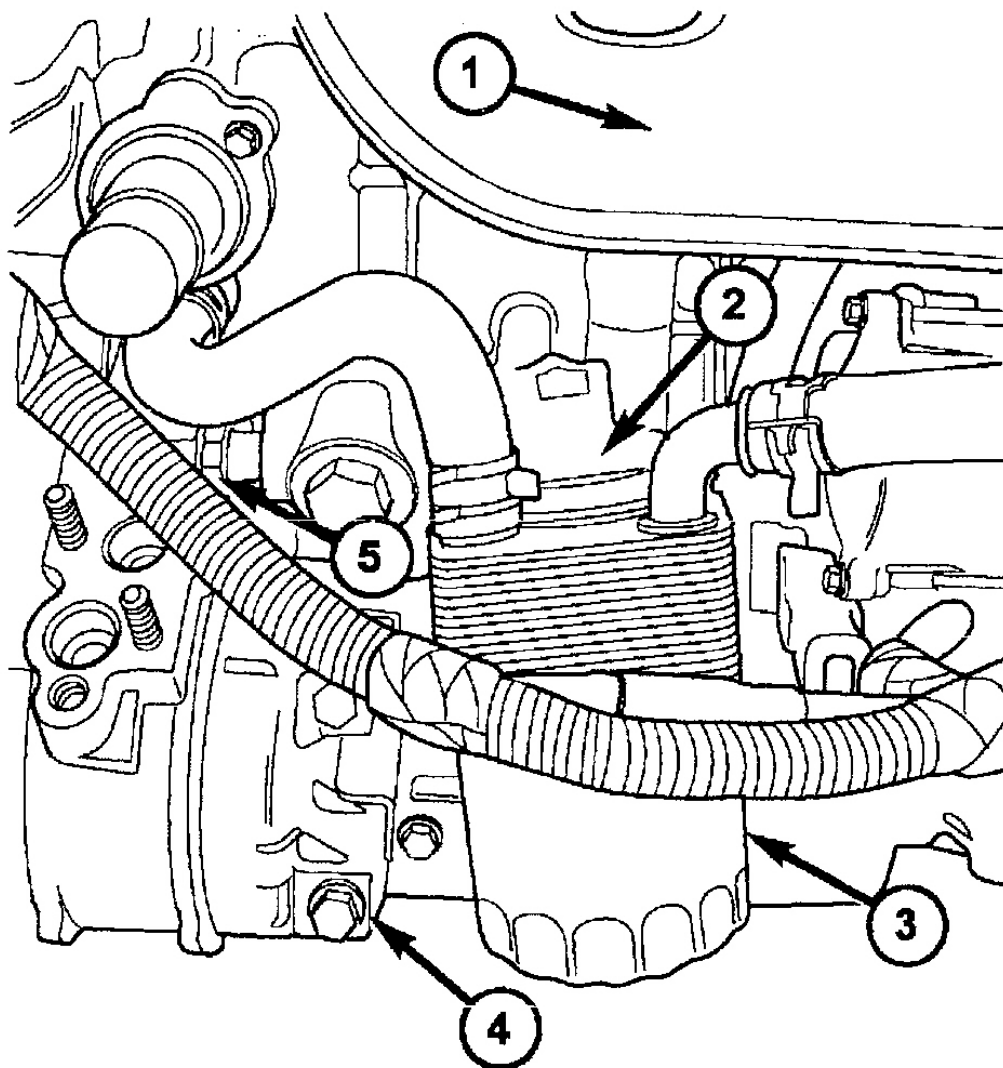
2 - TRANSMISSION FLUID LEVEL INDICATOR

3 - ENGINE OIL LEVEL INDICATOR

G03572574

Fig. 145: Locating Engine Oil Fill Cap
Courtesy of DAIMLERCHRYSLER CORP.

4. Raise vehicle on hoist.
5. Place a suitable drain pan under crankcase drain.
6. Remove oil pan drain plug from crankcase and allow oil to drain into pan. Inspect drain plug threads for stretching or other damage. Replace drain plug and gasket if damaged.
7. Remove oil filter (**Fig. 146**).



- 1 - EXHAUST MANIFOLD
- 2 - ENGINE OIL COOLER
- 3 - ENGINE OIL FILTER
- 4 - AIR CONDITIONING COMPRESSOR
- 5 - OIL PRESSURE SENDING UNIT

G03572575

Fig. 146: Locating Engine Oil Filter And Cooler
Courtesy of DAIMLERCHRYSLER CORP.

- 8. Install drain plug in crankcase. Torque oil pan drain plug to 27 N.m (20 ft. lbs.).
- 9. Install new oil filter (**Fig. 146**).

10. Lower vehicle.
11. Fill crankcase with specified type and amount of engine oil (**Fig. 145**). (Refer to owner's manual)
12. Install oil fill cap (**Fig. 145**).
13. Start engine and inspect for leaks.
14. Stop engine and inspect oil level.

OIL FILTER SPECIFICATION

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

USED ENGINE OIL DISPOSAL

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

ENGINE OIL COOLER

DESCRIPTION

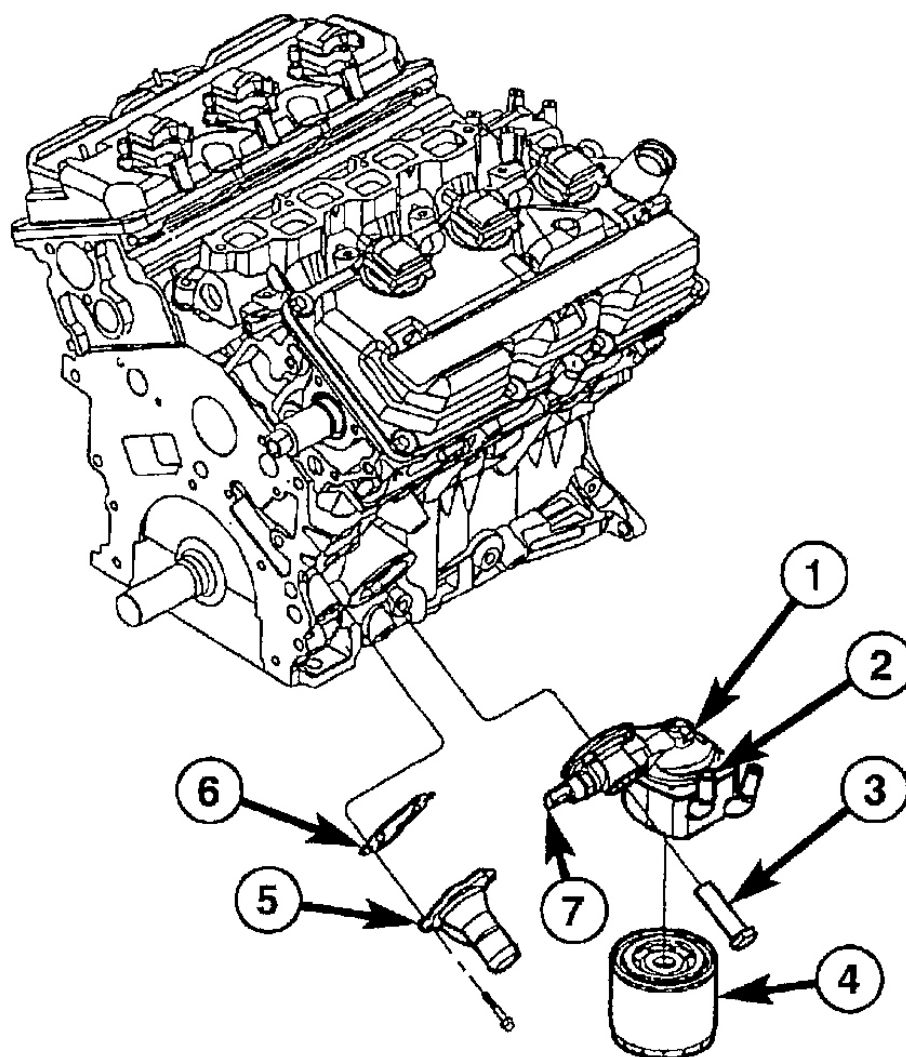
The engine oil cooler is a coolant-to-oil type and is mounted between the oil filter and the oil filter adapter (**Fig. 146**).

OPERATION

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

REMOVAL

1. Drain cooling system (Refer to **STANDARD PROCEDURE - COOLING SYSTEM DRAINING**).
2. Raise vehicle on hoist.
3. Disconnect coolant hoses from oil cooler.
4. Remove oil filter.
5. Remove oil cooler attaching fastener from center of oil cooler.
6. Remove oil cooler (**Fig. 147**).



- 1 - OIL FILTER ADAPTER
- 2 - OIL COOLER
- 3 - FASTENER - OIL FILTER ADAPTER
- 4 - OIL FILTER
- 5 - WATER INLET TUBE
- 6 - GASKET
- 7 - OIL PRESSURE SENSOR

G03572576

Fig. 147: Locating Engine Oil Cooler and Filter Adapter
Courtesy of DAIMLERCHRYSLER CORP.

INSTALLATION

1. Lubricate seal and position oil cooler to fitting on oil filter adapter (**Fig. 147**).

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

2. Install oil cooler attaching fastener and tighten to 54 N.m (40 ft. lbs.) (**Fig. 147**).
3. Install oil filter (**Fig. 147**).
4. Connect coolant hoses to oil cooler (**Fig. 147**).
5. Fill cooling system (Refer to **STANDARD PROCEDURE - COOLING SYSTEM FILLING**).

OIL FILTER

REMOVAL

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

1. Using a suitable oil filter wrench, unscrew filter from base and discard (**Fig. 146**).

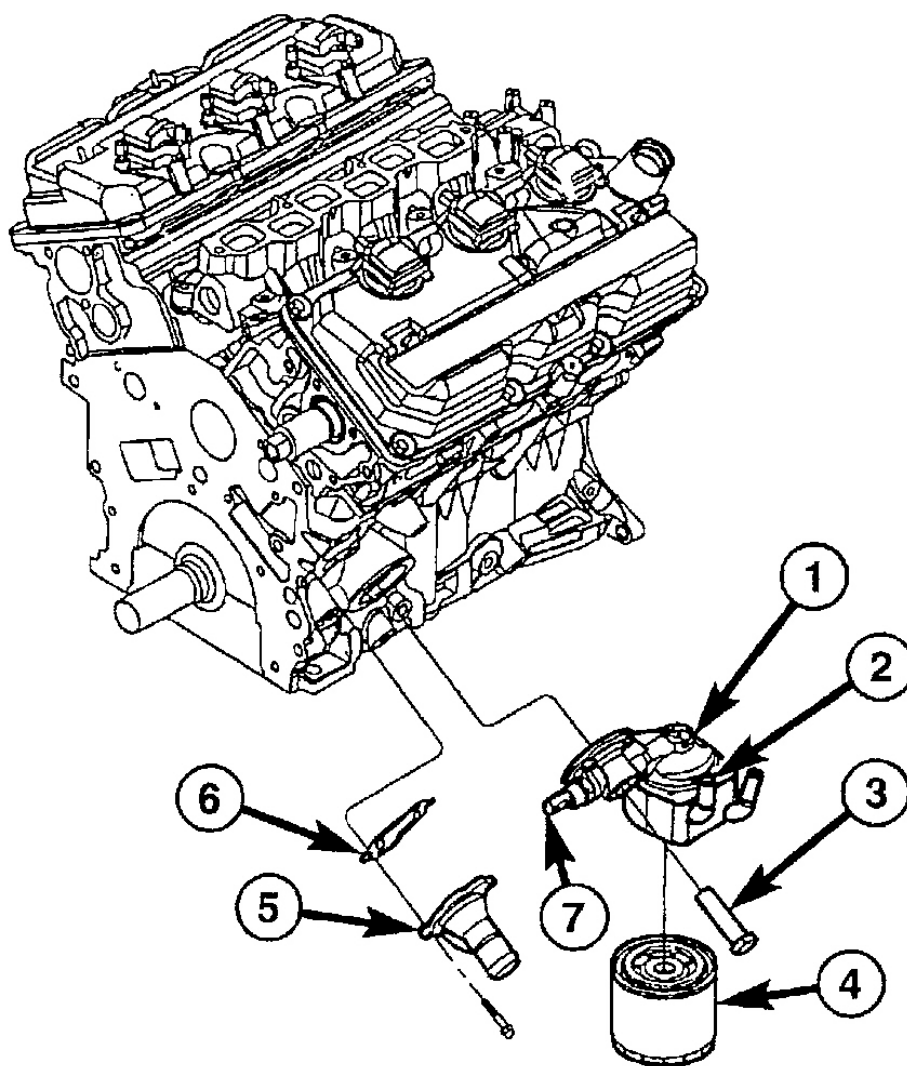
INSTALLATION

1. Wipe base clean, then inspect gasket contact surface.
2. Lubricate gasket of new filter with clean engine oil.
3. Install and tighten filter to 16 N.m (12 ft. lbs.) of torque after gasket contacts base (**Fig. 146**). Use filter wrench if necessary.
4. Start engine and check for leaks.

OIL FILTER ADAPTER

REMOVAL

1. Raise vehicle on hoist.
2. Remove the oil filter.
3. Remove oil cooler attaching fastener from center of oil cooler.
4. Reposition oil cooler.
5. Disconnect oil pressure switch electrical connector.
6. Remove oil filter adapter attaching bolt (**Fig. 148**).



- 1 - OIL FILTER ADAPTER
- 2 - OIL COOLER
- 3 - FASTENER—OIL FILTER ADAPTER
- 4 - OIL FILTER
- 5 - WATER INLET TUBE
- 6 - GASKET
- 7 - OIL PRESSURE SENSOR

G03572577

Fig. 148: Locating Engine Oil Cooler and Filter Adapter
Courtesy of DAIMLERCHRYSLER CORP.

INSTALLATION

1. Clean oil filter adapter sealing surfaces and install new seal.
2. Position adapter on engine block and install attaching bolt (**Fig. 148**). Tighten bolt to 40 N.m (30 lbs. ft.).
3. Connect oil pressure switch electrical connector.
4. Install oil cooler.
5. Install the oil filter.
6. Lower vehicle on hoist.
7. Start engine and allow to run approximately 2 minutes.
8. Turn off engine and check oil level. Adjust oil level as necessary.

OIL PAN

REMOVAL

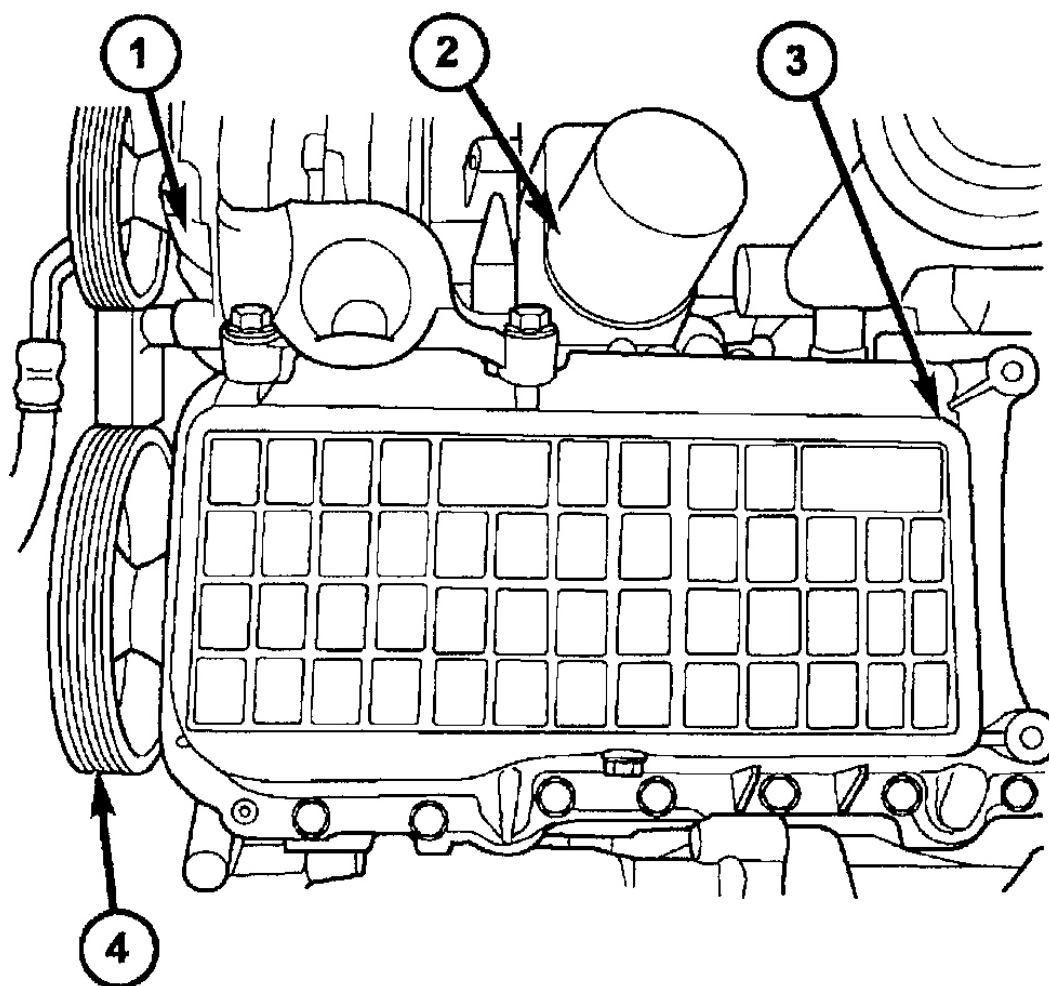
1. Disconnect negative battery cable.
2. Remove radiator close out panel.
3. Remove radiator core support.
4. Remove radiator cooling fans.

NOTE: It is not necessary to recover the refrigerant from the refrigerant system to perform this procedure.

5. Remove the top air conditioning compressor bolts.
6. Raise and support the vehicle.

NOTE: It is not necessary to recover the refrigerant from the refrigerant system to perform this procedure.

7. Remove the lower air conditioning compressor mounting bolts and reposition the compressor with a suitable retaining strap.
8. Remove the air conditioning compressor bracket
9. Remove structural collar from oil pan and transmission housing (Refer to **REMOVAL**).
10. Remove the inspection shield between the transmission and oil pan.
11. Drain engine oil.
12. Remove the engine oil indicator tube.
13. Remove oil pan fasteners. Remove oil pan (**Fig. 149**).



1 - AIR CONDITIONING COMPRESSOR

2 - OIL FILTER

3 - OIL PAN

4 - VIBRATION DAMPER

G03572578

Fig. 149: Identifying Oil Pan

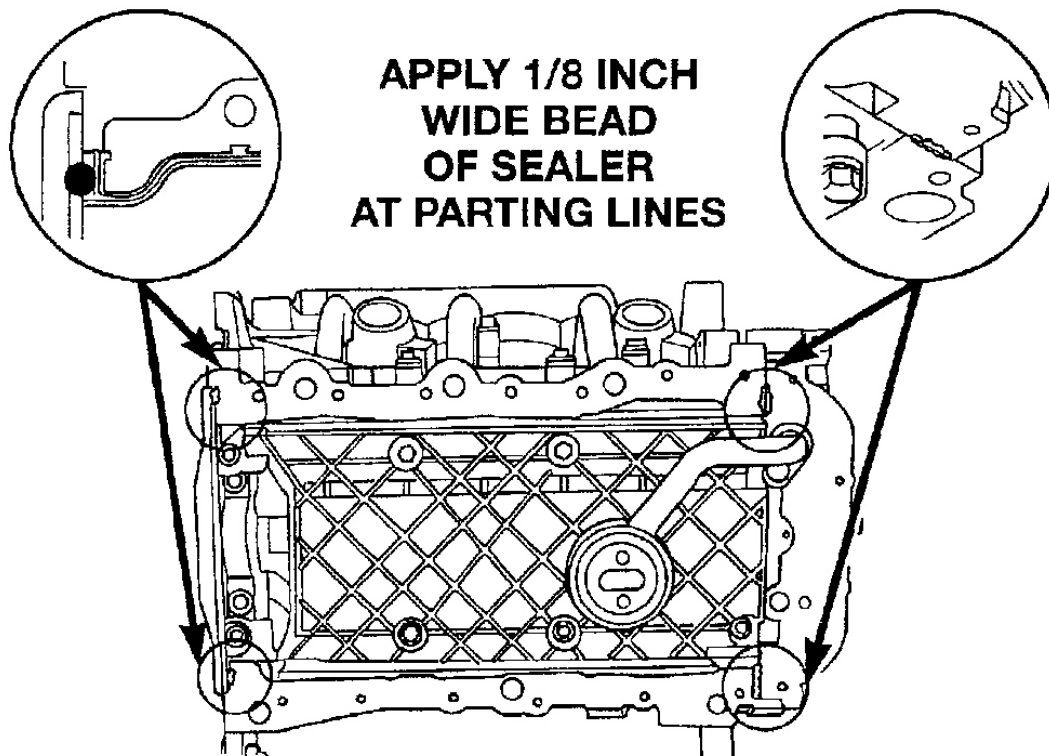
Courtesy of DAIMLERCHRYSLER CORP.

NOTE: A small amount of oil will remain in the oil pan. Use care when removing the oil pan from the engine.

14. Remove oil pan gasket.

INSTALLATION

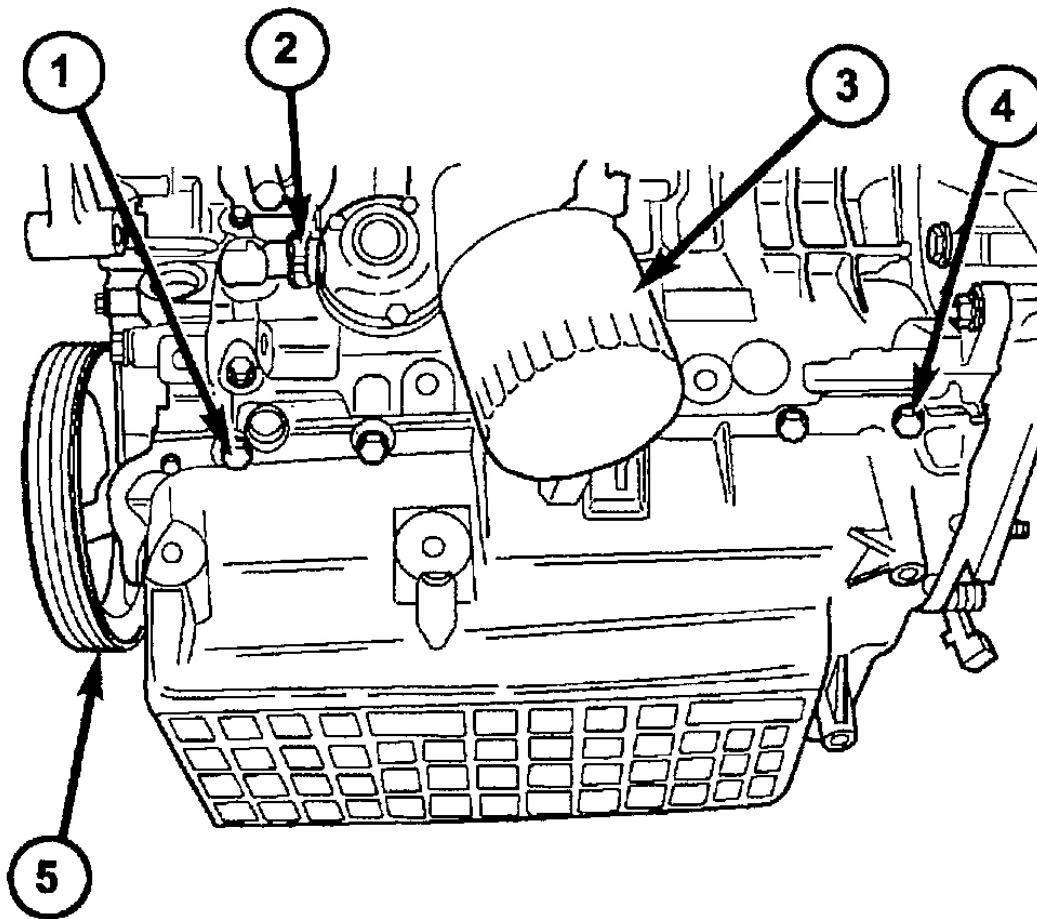
1. Clean oil pan and all gasket surfaces.
2. Apply a 1/8 inch bead of Mopar(R) Engine RTV GEN II at the parting line of the oil pump housing and the rear seal retainer (**Fig. 150**).



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Fig. 150: Applying Oil Pan Sealing - Typical
Courtesy of DAIMLERCHRYSLER CORP.

3. Install oil pan gasket to the engine block.
4. Install pan and the attaching fasteners finger tight.
5. First tighten the M8 oil pan alignment bolts to 28N.m (250 lbs. in.) (**Fig. 151**).



- 1 - 8M OIL PAN ALIGNMENT BOLT
- 2 - OIL PRESSURE SENDING UNIT
- 3 - OIL FILTER
- 4 - 8M OIL PAN ALIGNMENT BOLT
- 5 - VIBRATION DAMPER

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Fig. 151: Installing Oil Pan Alignment Bolts
 Courtesy of DAIMLERCHRYSLER CORP.

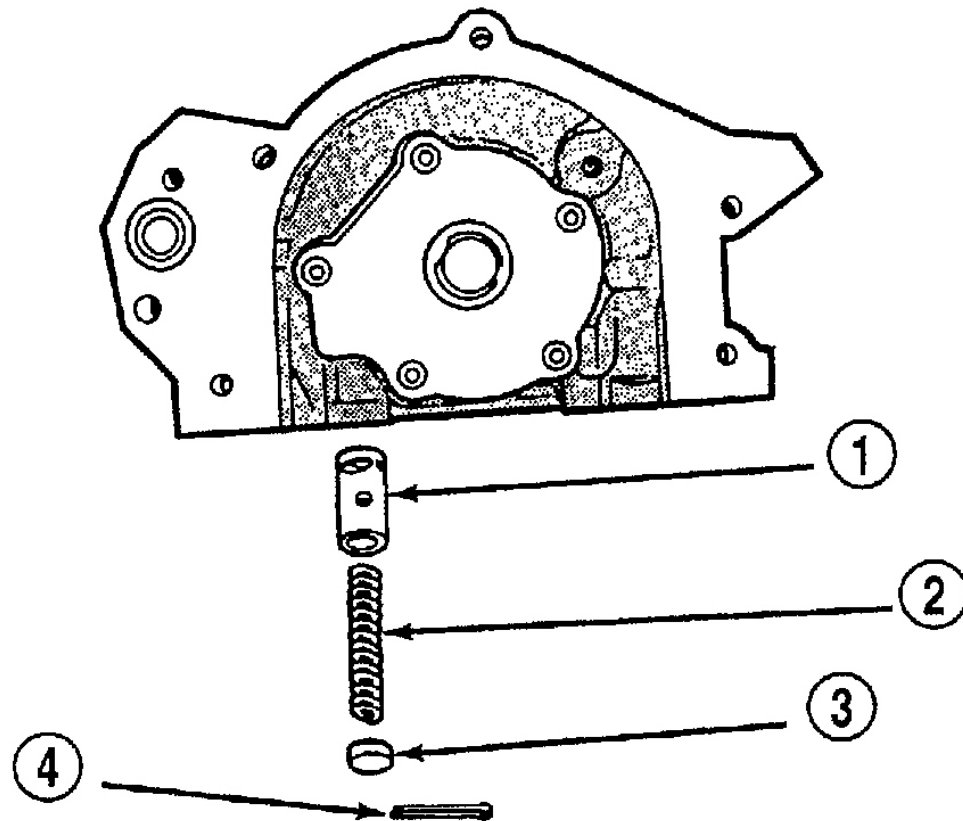
6. Tighten the remaining M6 bolts to 12 N.m (105 in. lbs.) and M8 bolts to 28 N.m (250 in. lbs.) (**Fig. 151**).
7. Install inspection shield between the engine block and transmission bell housing.
8. Install the engine oil indicator tube.
9. Install the structural collar (Refer to **INSTALLATION**).

10. Install the A/C compressor mounting bracket bolts. Tighten bolts to 54 N.m (40 ft. lbs.).
11. Install the lower A/C compressor and mounting bolts. Tighten bolts to 28 N.m (250 in. lbs.).
12. Lower vehicle.
13. Install the upper A/C compressor mounting bolts. Tighten bolts to 28 N.m (250 in. lbs.).
14. Install the oil indicator tube.
15. Install radiator fans, core support and close out panel.
16. Fill engine crankcase with proper oil to correct level.
17. Connect negative battery cable.

OIL PRESSURE RELIEF VALVE

REMOVAL

1. Remove the oil pan. (Refer to **REMOVAL**)
2. To remove the relief valve, proceed as follows:
 - a. Remove the cotter pin that retains the retainer cap.
 - b. Drill a 3.175 mm (1/8 inch.) hole into the relief valve retainer cap
 - c. Insert a self-threading sheet metal screw into cap.
 - d. Using a suitable slide hammer tool, remove retainer cap. Discard retainer cap
 - e. Remove spring and relief valve (**Fig. 152**).



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

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Fig. 152: Exploded View Of Oil Pressure Relief Valve
Courtesy of DAIMLERCHRYSLER CORP.

INSPECTION

1. Inspect oil pressure relief valve plunger for scoring and free operation in its bore. Small marks may be removed with 400-grit wet or dry sandpaper.
2. The relief valve spring has a free length of approximately 49.5 mm (1.95 in.) it should test between 101-110 N (23-25 lbs.) when compressed to 34 mm (1.34 in.). Replace spring that fails to meet specifications.

INSTALLATION

1. Lubricate relief valve with oil.

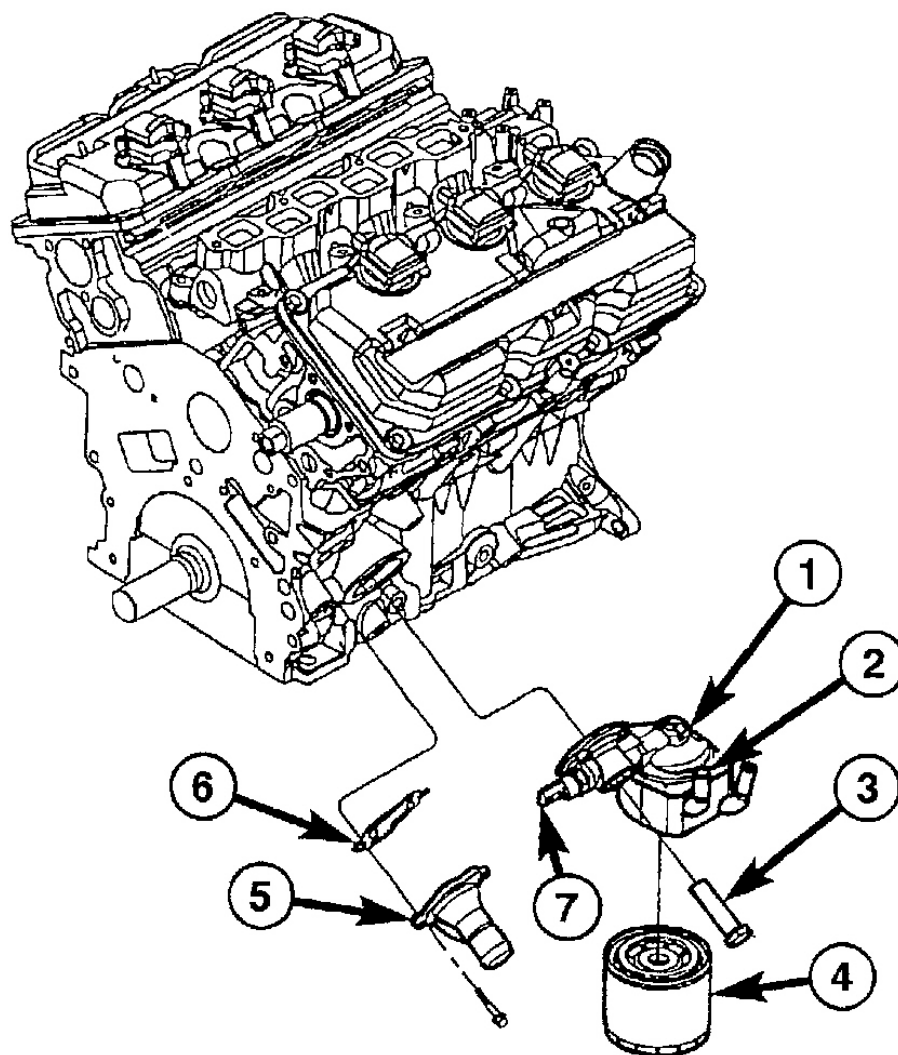
CAUTION: The pressure relief valve must be installed as shown in (Fig. 152), or engine damage may occur.

2. Install valve, spring and retainer cap (Fig. 152).
3. Install new cotter pin.
4. Install the oil pan. (Refer to INSTALLATION)

OIL PRESSURE SENSOR/SWITCH

REMOVAL

1. Raise vehicle on hoist.
2. Position an oil collecting container under switch location.
3. Disconnect electrical connector.
4. Unscrew oil pressure switch from oil filter adapter (Fig. 153).



- 1 - OIL FILTER ADAPTER
- 2 - OIL COOLER
- 3 - FASTENER - OIL FILTER ADAPTER
- 4 - OIL FILTER
- 5 - WATER INLET TUBE
- 6 - GASKET
- 7 - OIL PRESSURE SENSOR

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Fig. 153: Locating Engine Oil Cooler and Filter Adapter
Courtesy of DAIMLERCHRYSLER CORP.

INSTALLATION

1. Apply Mopar(R) Thread Sealant to the switch threads.
2. Install oil pressure switch to fitting (**Fig. 153**).
3. Connect electrical connector.
4. Lower vehicle.
5. Start engine and check for leaks.
6. Check engine oil level and adjust as necessary.

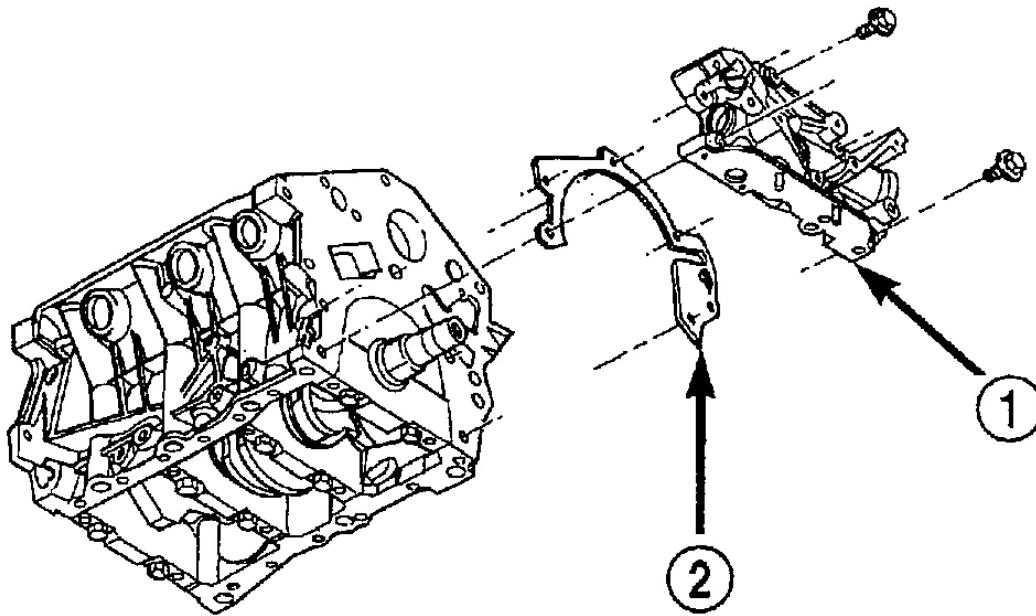
OIL PUMP

REMOVAL

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

The oil pump pressure relief valve can be serviced by removing the oil pan. (Refer to **REMOVAL**)

1. Drain the cooling system. (Refer to **STANDARD PROCEDURE - COOLING SYSTEM DRAINING**)
2. Remove the timing belt. (Refer to **REMOVAL**)
3. Remove the crankshaft sprocket. (Refer to **REMOVAL**)
4. Remove the oil pan. (Refer to **REMOVAL**)
5. Remove the oil pickup tube.
6. Remove the oil pump fasteners. Remove pump and gasket from engine (**Fig. 154**).



1 - OIL PUMP

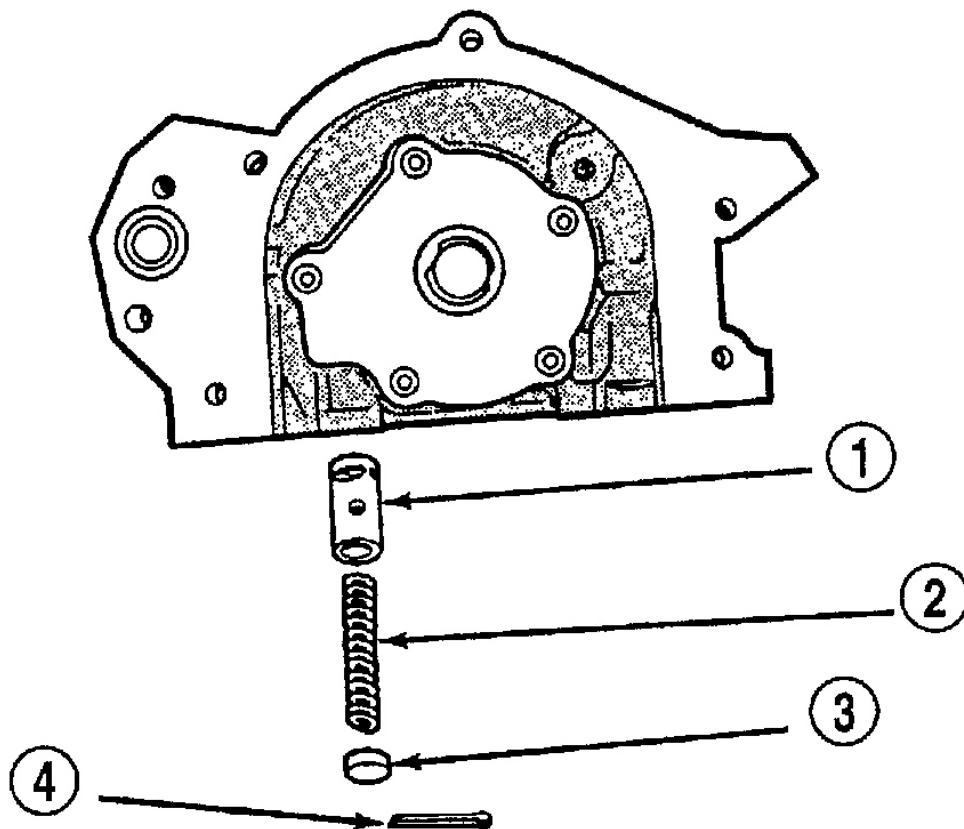
2 - GASKET

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Fig. 154: Removing Oil Pump
Courtesy of DAIMLERCHRYSLER CORP.

DISASSEMBLY

1. To remove the relief valve, proceed as follows:
2. Remove cotter pin. Drill a 3.175 mm (1/8 inch.) hole into the relief valve retainer cap and insert a self-threading sheet metal screw into cap.
3. Clamp screw into a vise and while supporting oil pump body, remove cap by tapping oil pump body using a soft hammer. Discard retainer cap and remove spring and relief valve (**Fig. 155**).

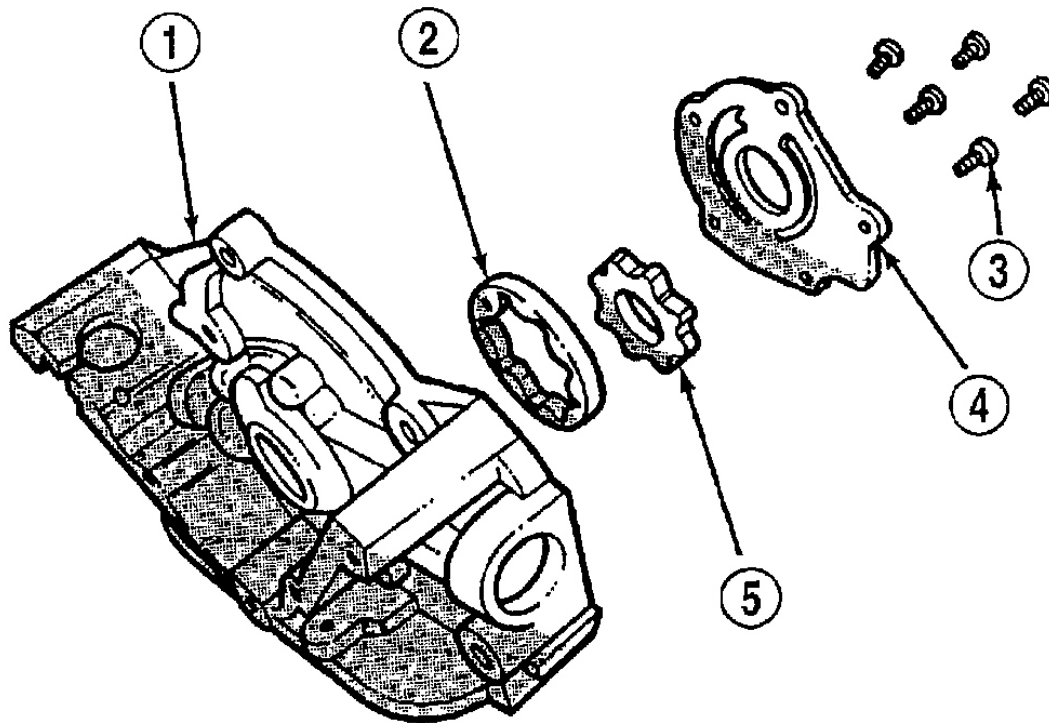


- 1 - RELIEF VALVE
- 2 - SPRING
- 3 - RETAINER CAP
- 4 - COTTER PIN

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Fig. 155: Exploded View Of Oil Pressure Relief Valve
Courtesy of DAIMLERCHRYSLER CORP.

4. Remove oil pump cover screws, and lift off cover.
5. Remove pump rotors.
6. Wash all parts in a suitable solvent and inspect carefully for damage or wear (**Fig. 156**).



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

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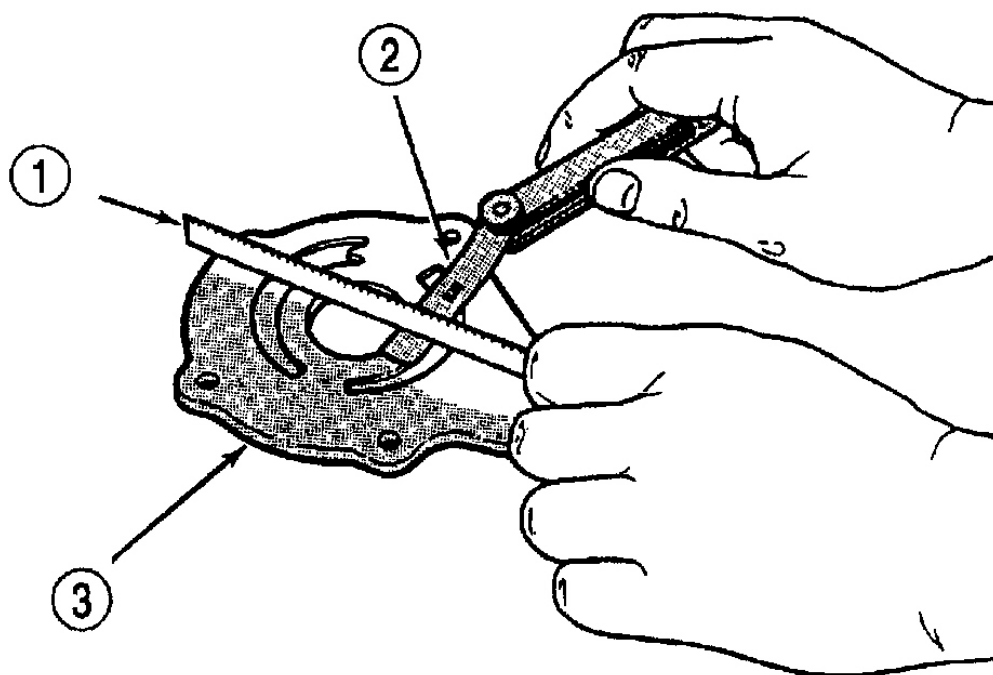
Fig. 156: Exploded View Of Oil Pump
Courtesy of DAIMLERCHRYSLER CORP.

CLEANING

1. Clean all parts thoroughly in a suitable solvent.

INSPECTION

1. Disassemble oil pump. (Refer to **DISASSEMBLY**)
2. Clean all parts thoroughly. Mating surface of the oil pump housing should be smooth. Replace pump cover if scratched or grooved.
3. Lay a straightedge across the pump cover surface (**Fig. 157**). If a 0.025 mm (0,001 in.) feeler gauge can be inserted between cover and straight edge, cover should be replaced.

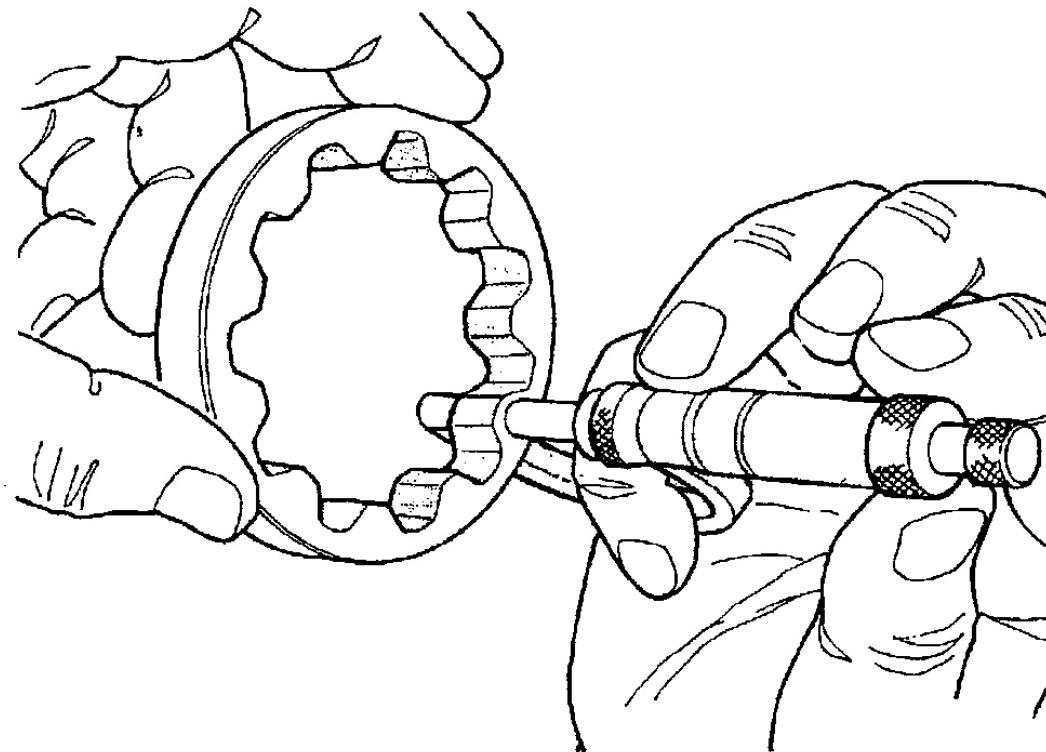


- 1 - STRAIGHT EDGE
- 2 - FEELER GAUGE
- 3 - OIL PUMP COVER

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Fig. 157: Checking Oil Pump Cover Flatness
Courtesy of DAIMLERCHRYSLER CORP.

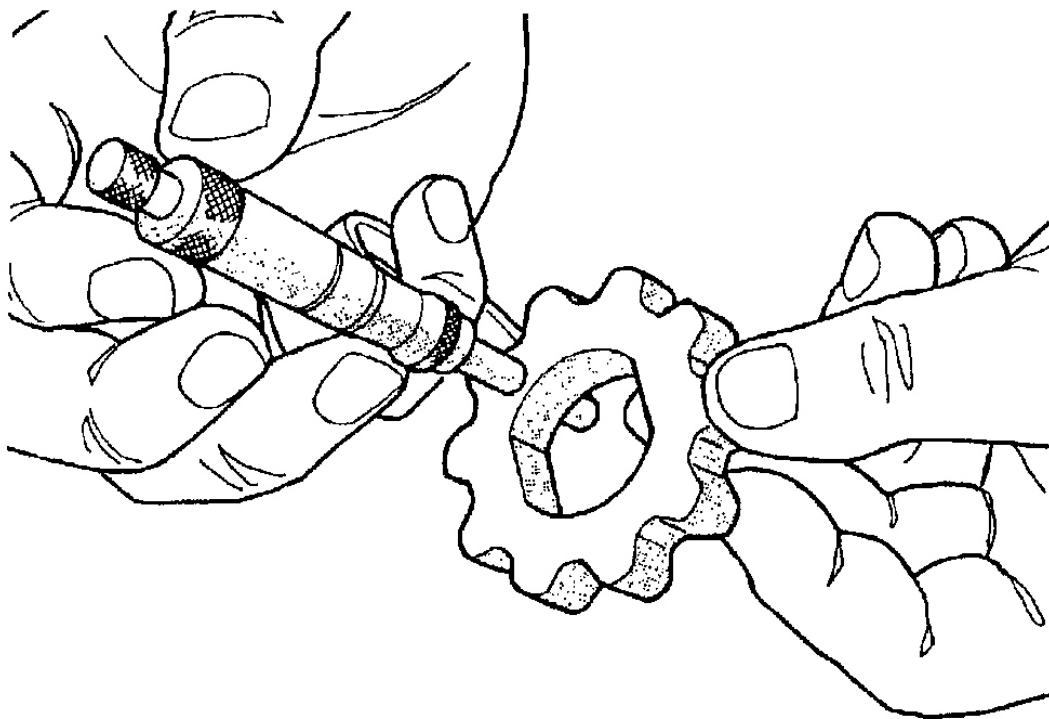
4. Measure thickness and diameter of outer rotor. If outer rotor thickness measures 14.299 mm (0.563 in.) or less (**Fig. 158**), or if the diameter is 79.78 mm (3.141 inches.) or less, replace outer rotor.



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Fig. 158: Measuring Outer Rotor
Courtesy of DAIMLERCHRYSLER CORP.

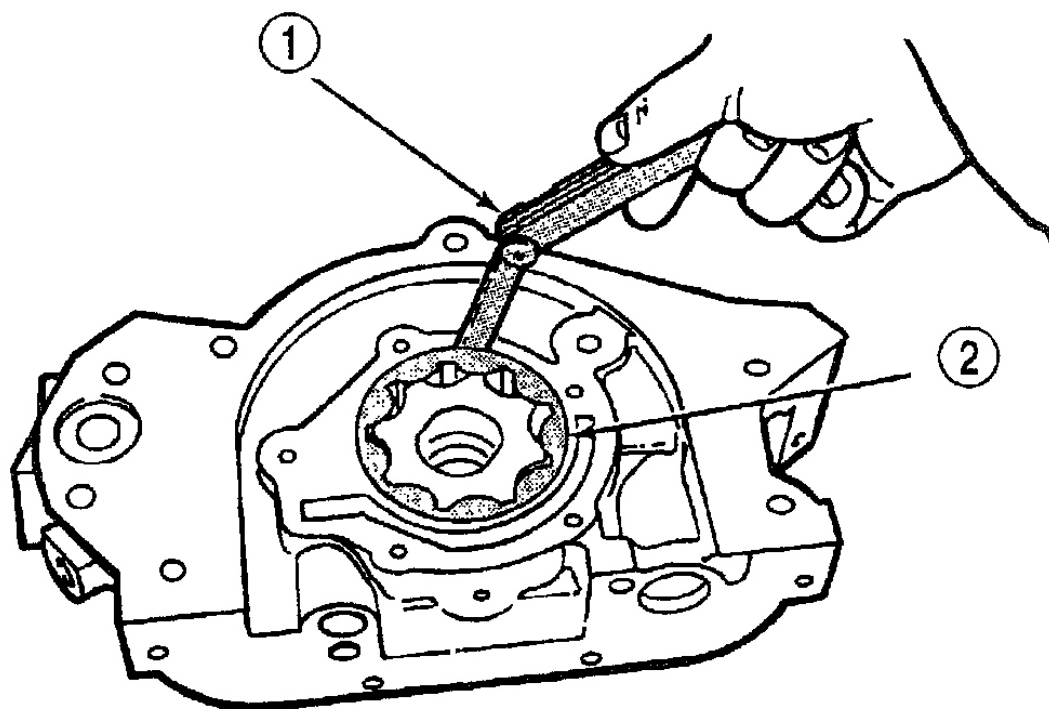
5. If inner rotor measures 14.299 mm (0.563 in.) or less replace inner rotor (**Fig. 159**).



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Fig. 159: Measuring Inner Rotor Thickness
Courtesy of DAIMLERCHRYSLER CORP.

6. Slide outer rotor into body, press to one side with fingers and measure clearance between rotor and body (**Fig. 160**). If measurement is 0.39 mm (0.015 inch.) or more, replace body only if outer rotor is in specifications.

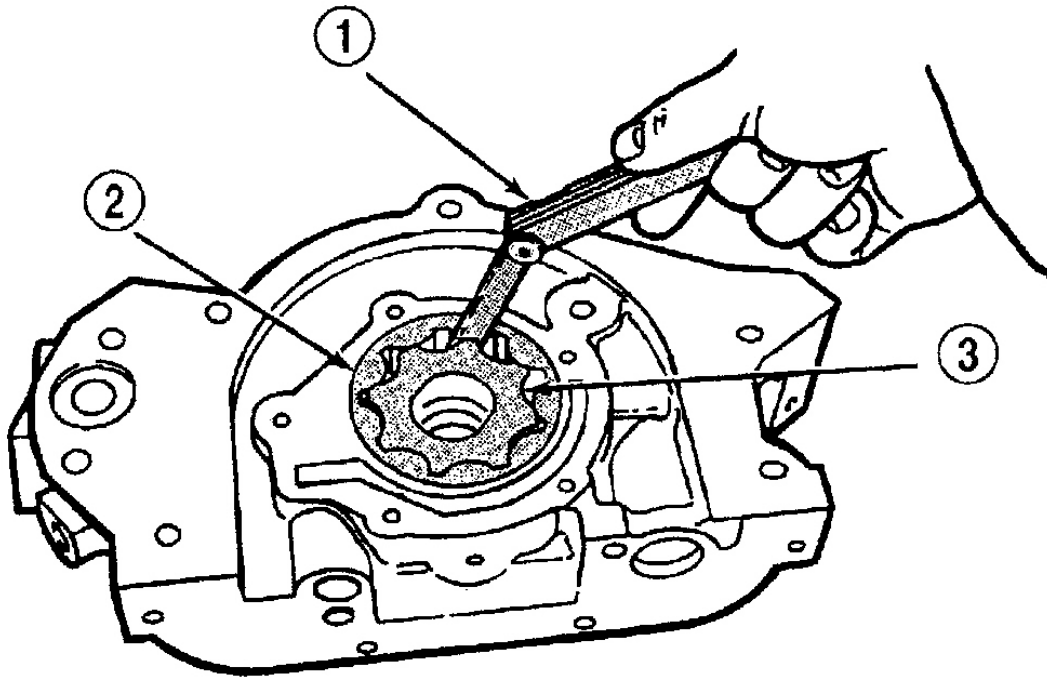


1 - FEELER GAUGE
2 - OUTER ROTOR

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Fig. 160: Measuring Outer Rotor Clearance in Housing
Courtesy of DAIMLERCHRYSLER CORP.

7. Install inner rotor into body. If clearance between inner and outer rotors (**Fig. 161**) is 0.20 mm (0.008 inch.) or more, replace both rotors.

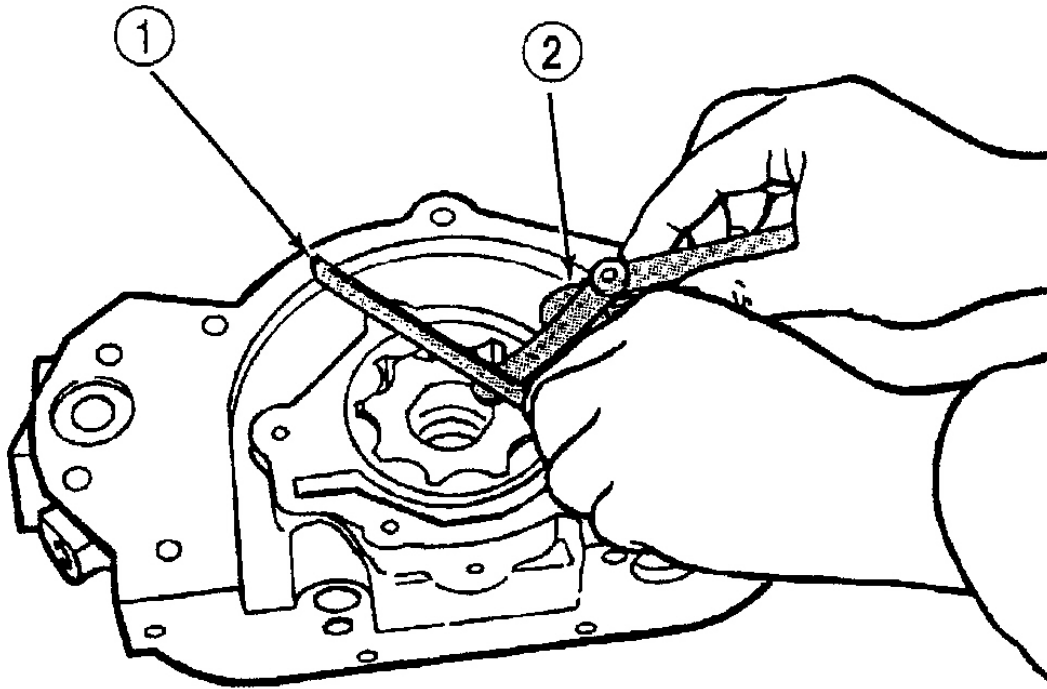


- 1 - FEELER GAUGE
- 2 - OUTER ROTOR
- 3 - INNER ROTOR

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Fig. 161: Measuring Clearance Between Rotors
 Courtesy of DAIMLERCHRYSLER CORP.

8. Place a straightedge across the face of the body, between bolt holes. If a feeler gauge of 0.077 mm (0.003 in.) or more can be inserted between rotors and the straightedge, replace pump assembly (**Fig. 162**) **ONLY** if rotors are in specs.

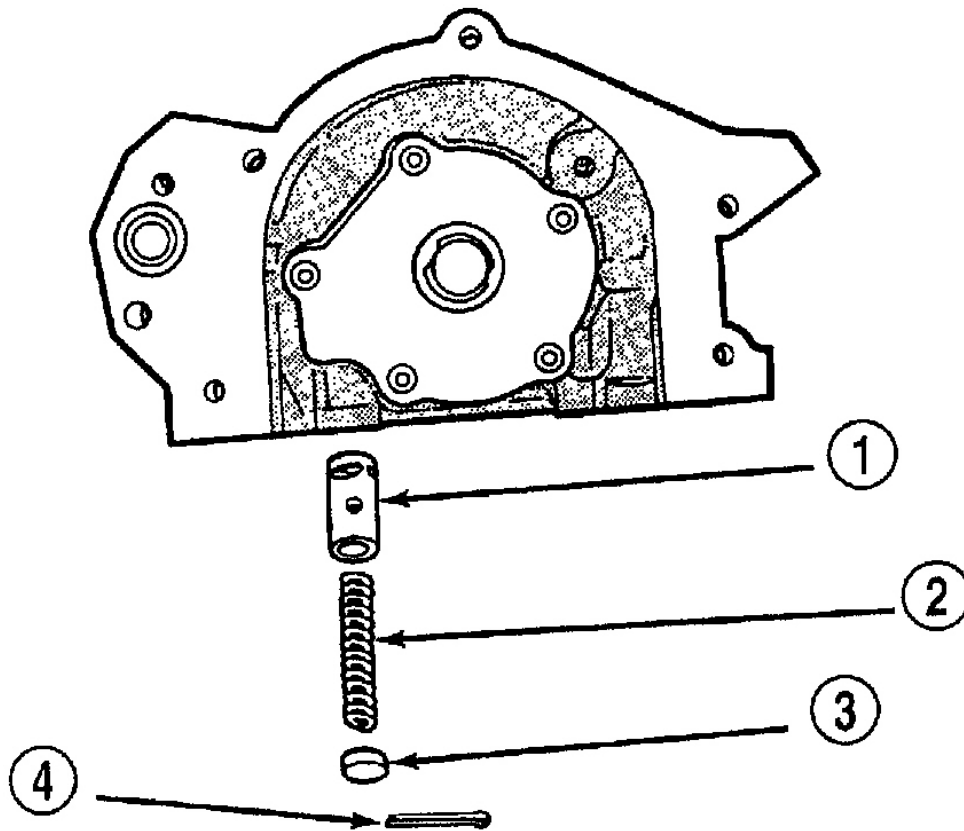


- 1 - STRAIGHT EDGE
- 2 - FEELER GAUGES

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Fig. 162: Measuring Clearance Over Rotors
 Courtesy of DAIMLERCHRYSLER CORP.

9. Inspect oil pressure relief valve plunger for scoring and free operation in its bore. Small marks may be removed with 400-grit wet or dry sandpaper.
10. The relief valve spring (**Fig. 163**) has a free length of approximately 49.5 mm (1.95 in.) it should test between 101-110 N (23-25 lbs.) when compressed to 34 mm (1-11/32 in.). Replace spring that fails to meet specifications.



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

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Fig. 163: Oil Pressure Relief Valve
Courtesy of DAIMLERCHRYSLER CORP.

11. Assemble oil pump. (Refer to ASSEMBLY)

ASSEMBLY

1. Assemble oil pump using new parts as required.
2. Tighten cover screws to 12 N.m (105 in. lbs.) (**Fig. 156**).
3. Prime oil pump before installation by filling rotor cavity with engine oil.
4. If oil pressure is low and pump is within specifications, inspect for worn engine bearings or other reasons

for oil pressure loss.

INSTALLATION

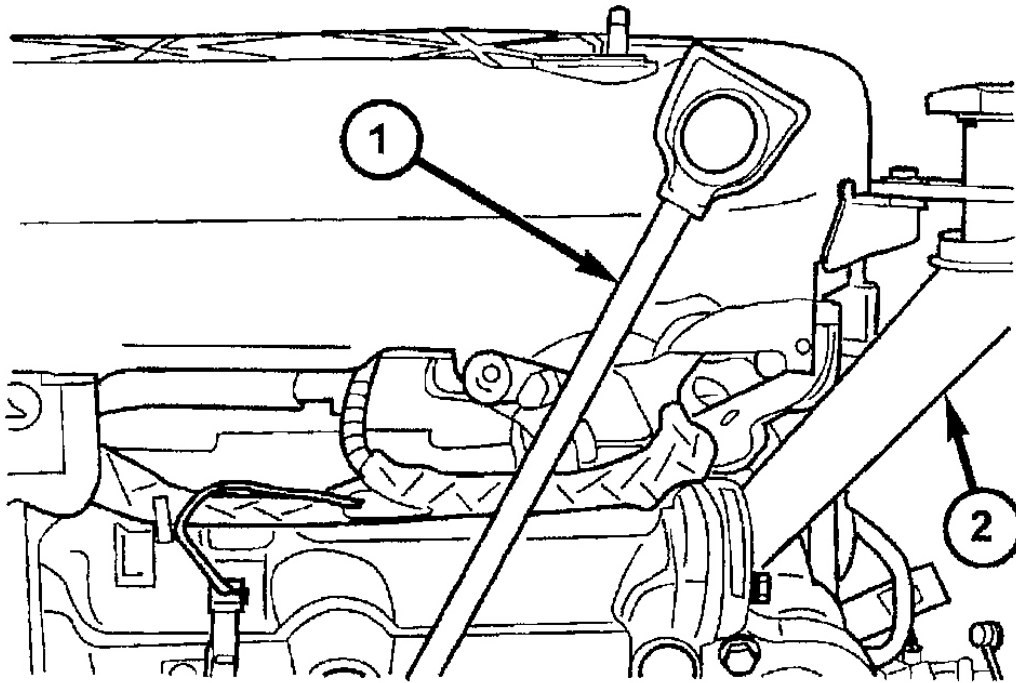
1. Prime oil pump before installation by filling rotor cavity with clean engine oil.
2. Install oil pump and gasket carefully over the crankshaft. Position pump onto block and tighten bolts to 28 N.m (250 in. lbs.) (**Fig. 154**).
3. Install new O-ring on oil pickup tube.
4. Install oil pickup tube.
5. Install oil pan. (Refer to **INSTALLATION**)
6. Install crankshaft sprocket. (Refer to **INSTALLATION**)
7. Install timing belt. (Refer to **INSTALLATION**)
8. Install the timing belt covers. (Refer to **TIMING BELT/CHAIN COVER(S) - INSTALLATION**)
9. Install the crankshaft vibration damper. (Refer to **INSTALLATION**)
10. Install the accessory drive belts. (Refer to **DRIVE BELTS**)
11. Fill the cooling system. (Refer to **STANDARD PROCEDURE - COOLING SYSTEM FILLING**)
12. Fill engine crankcase with proper oil to the correct level.

INTAKE MANIFOLD

REMOVAL

REMOVAL - UPPER INTAKE MANIFOLD

1. Disconnect negative battery cable.
2. Remove air cleaner housing and inlet hose.
3. Remove engine cover.
4. Remove throttle and speed control cables from throttle arm and bracket (Refer to **FUEL INJECTION**).
5. Remove the two cable bracket retaining bolts and position the cables and bracket assembly out of the way.
6. Remove the oil fill tube to upper intake manifold retaining bolt (**Fig. 164**).



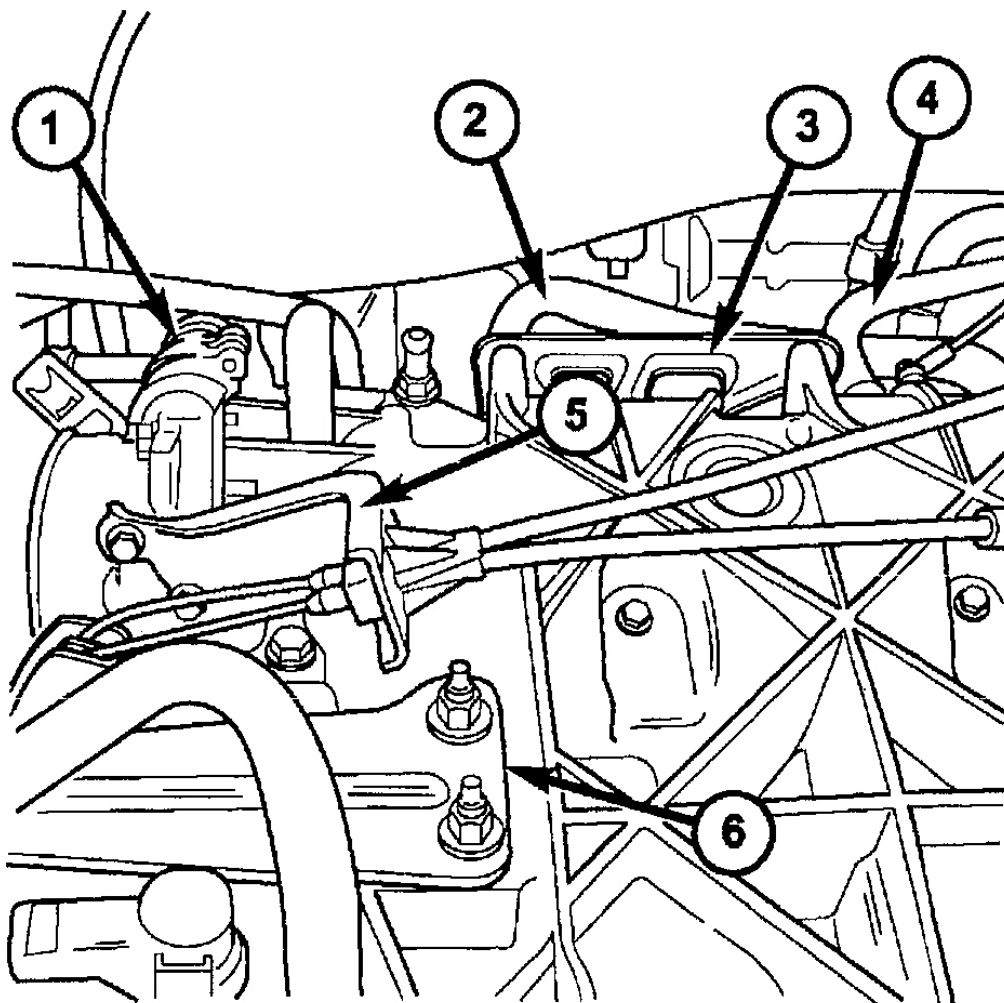
1 - OIL LEVEL INDICATOR AND TUBE

2 - OIL FILL TUBE

G03572593

Fig. 164: Locating Oil Level Indicator And Fill Tube
Courtesy of DAIMLERCHRYSLER CORP.

7. Remove the oil level tube to upper intake manifold retaining bolt (**Fig. 164**).
8. Disconnect electrical connectors from the following sensors and actuators:
 - Manifold Tuning Valve (MTV)
 - Short Runner Valve
 - Exhaust Gas Recirculation (EGR)
 - Throttle Position Sensor (TPS)
 - Idle Air Control (IAC)
 - Manifold Absolute Pressure (MAP)
9. Remove alternator support bracket (**Fig. 165**).



1 - IDLE AIR CONTROL

2 - PCV VALVE

3 - RIGHT UPPER INTAKE MANIFOLD SUPPORT BRACKET

4 - POWER BRAKE BOOSTER VACUUM SUPPLY HOSE

5 - THROTTLE CABLE ASSEMBLY

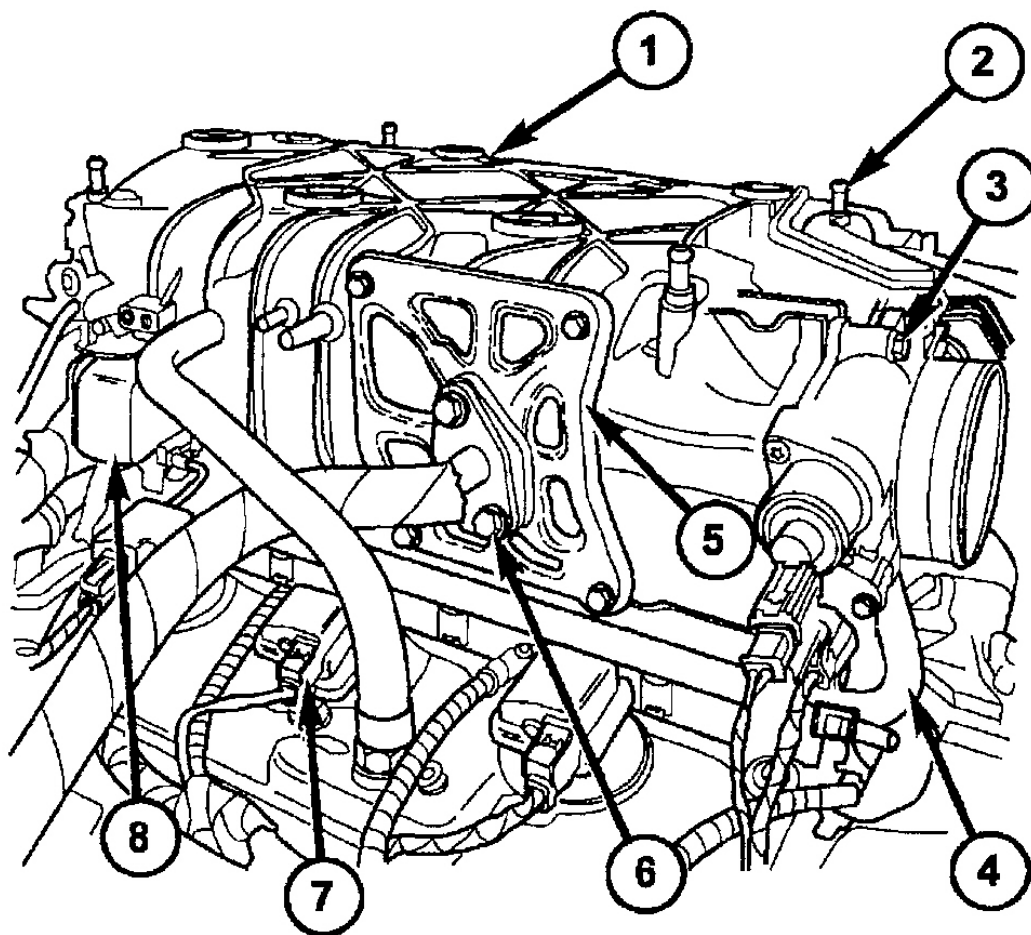
6 - BRACKET

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Fig. 165: Identifying Upper Intake Manifold Components
Courtesy of DAIMLERCHRYSLER CORP.

10. Disconnect the EGR tube (Refer to **EXHAUST GAS RECIRCULATION**).

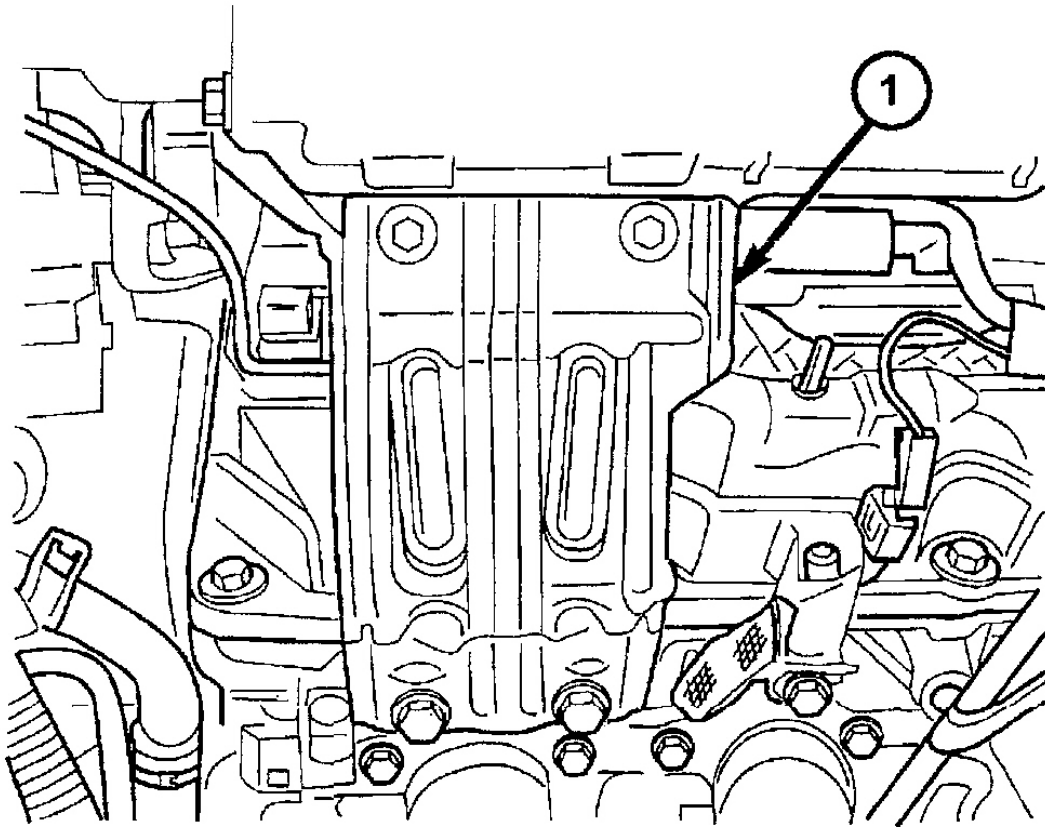
11. Disconnect vacuum hoses from the following (**Fig. 165**):
 - Positive Crankcase Ventilation (PCV) Valve
 - EVAP Purge Solenoid
 - Power Brake Booster
12. Remove the front and rear intake manifold support brackets (**Fig. 166**). (**Fig. 167**)



- 1 - UPPER INTAKE MANIFOLD
- 2 - ENGINE COVER MOUNTING STUD
- 3 - THROTTLE BODY
- 4 - FUEL RAIL
- 5 - UPPER INTAKE MANIFOLD RETAINING BRACKET
- 6 - EGR TUBE
- 7 - IGNITION COIL ASSEMBLY
- 8 - MANIFOLD TUNER VALVE ACTUATOR

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Fig. 166: Identifying Upper Intake Manifold - Right Components
Courtesy of DAIMLERCHRYSLER CORP.



1 - INTAKE MANIFOLD SUPPORT

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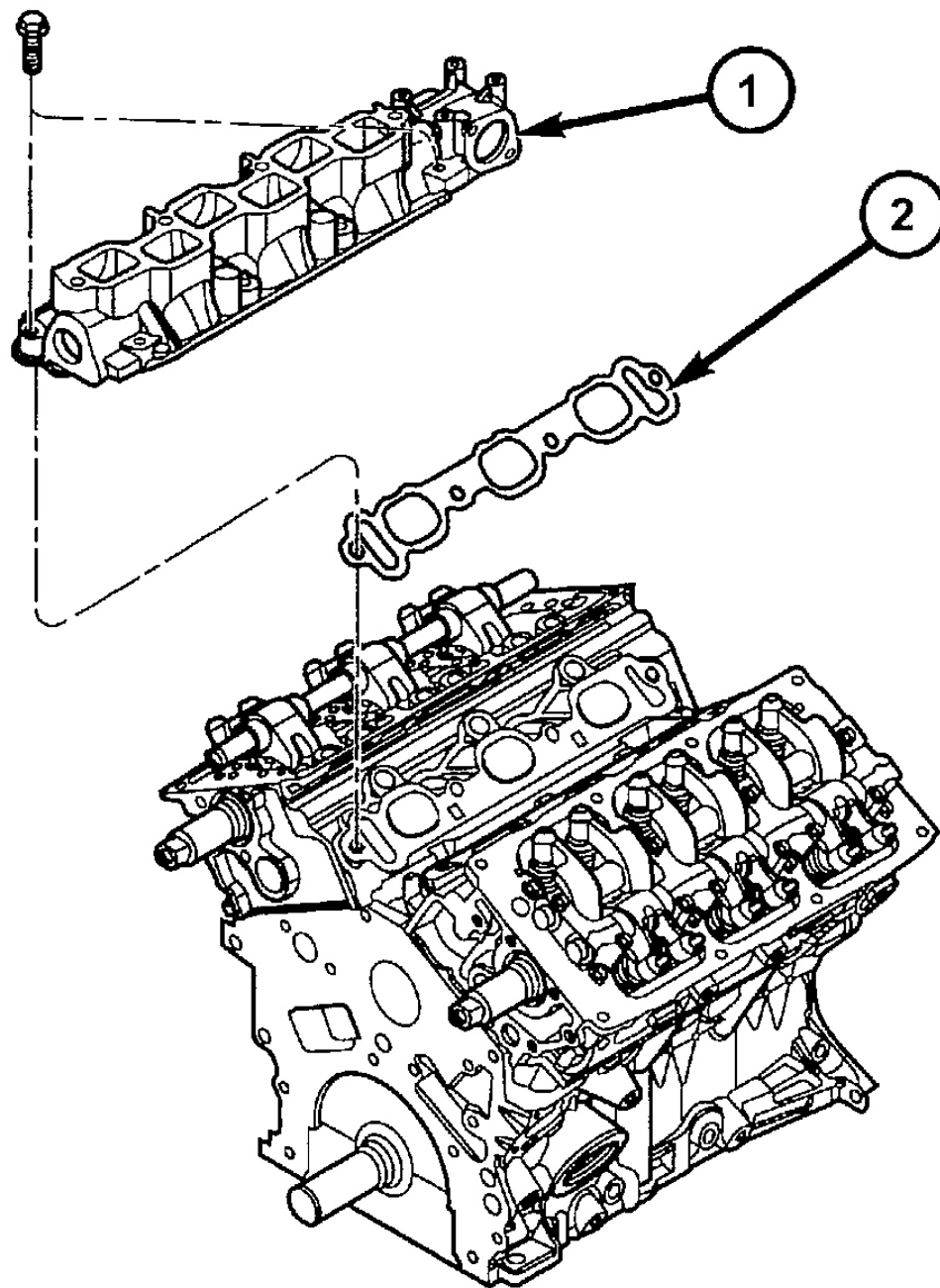
Fig. 167: Identifying Upper Intake Manifold Support - Left
Courtesy of DAIMLERCHRYSLER CORP.

13. Remove the upper intake manifold retaining bolts and manifold. Clean all gasket sealing surfaces.

REMOVAL - LOWER INTAKE MANIFOLD

1. Perform fuel pressure release procedure. (Refer to **FUEL SYSTEM PRESSURE RELEASE PROCEDURE**)
2. Drain the cooling system (Refer to **STANDARD PROCEDURE - COOLING SYSTEM DRAINING**).
3. Disconnect the upper radiator hose from the thermostat housing.
4. Remove the upper intake manifold (Refer to **REMOVAL**).
5. Reposition power steering fluid reservoir and bracket.

6. Disconnect the electrical connectors to fuel injectors and coolant temperature sensor.
7. Disconnect the exhaust cross over retaining bolt.
8. Disconnect heater hose from intake manifold.
9. Disconnect the coolant container hose at thermostat housing.
10. Disconnect the fuel supply hose from fuel rail .
11. Remove the bolts attaching fuel rail.
12. Remove fuel rail and injectors as an assembly.
13. Remove bolts attaching lower intake and remove intake manifold (**Fig. 168**).



1 - LOWER INTAKE MANIFOLD

2 - GASKET

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Fig. 168: Removing Lower Intake Manifold

Courtesy of DAIMLERCHRYSLER CORP.

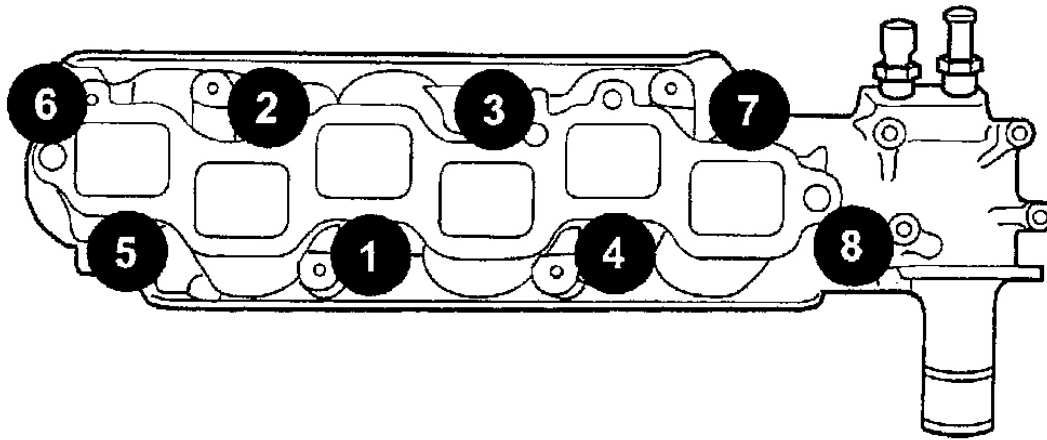
INSTALLATION

INSTALLATION - UPPER INTAKE MANIFOLD

1. Clean and inspect gasket sealing surfaces.
2. Position new gasket.
3. Install the throttle body on the upper intake (if required) (Refer to **THROTTLE BODY**).
4. Install upper intake manifold and hand start all attaching bolts.
5. Tighten bolts gradually starting in the center working outward until a torque of 12 N.m (105 in. lbs.) is obtained.
6. Install the front and rear intake manifold support brackets.
7. Install the oil level indicator and oil fill tube to intake manifold bolts (**Fig. 164**).
8. Install the EGR tube (Refer to **EXHAUST GAS RECIRCULATION**).
9. Connect vacuum lines to the following (**Fig. 165**):
 - Positive Crankcase Ventilation (PCV) Valve
 - EVAP Purge Solenoid
 - Power Brake Booster
10. Install alternator support bracket (**Fig. 165**).
11. Connect electrical connectors to the following (**Fig. 166**):
 - Manifold Tuning Valve (MTV)
 - Exhaust Gas Recirculation (EGR)
 - Throttle Position Sensor (TPS)
 - Idle Air Control (IAC)
 - Manifold Absolute Pressure (MAP)
12. Install the throttle and speed control cable bracket and retaining bolts.
13. Install throttle and speed control cables to bracket and throttle arm.
14. Install air cleaner housing and inlet hose.
15. Install the engine cover.
16. Connect negative battery cable.

INSTALLATION - LOWER INTAKE MANIFOLD

1. Clean all sealing surfaces.
2. Position new gaskets and intake manifold on cylinder head surfaces.
3. Install intake manifold bolts and gradually tighten in sequence shown in (**Fig. 169**) until a torque of 28 N.m (250 in. lbs.) is obtained.



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Fig. 169: Lower Intake Manifold Tightening Sequence
 Courtesy of DAIMLERCHRYSLER CORP.

4. Install fuel rail and injectors as an assembly.
5. Connect fuel supply hose to fuel rail.
6. Connect heater hose to intake manifold.
7. Connect coolant container to thermostat housing.
8. Install the exhaust cross over retaining bolt to the intake manifold.
9. Connect electrical connectors to fuel injectors and coolant temperature sensor.
10. Install power steering fluid reservoir and bracket.
11. Install upper intake manifold (- Refer to **INSTALLATION**).
12. Connect the upper radiator hose to the thermostat housing.
13. Fill the cooling system (Refer to **STANDARD PROCEDURE - COOLING SYSTEM FILLING**).

EXHAUST MANIFOLD - LEFT

REMOVAL - LEFT EXHAUST MANIFOLD

1. Disconnect and isolate the negative battery-cable.
2. Remove the radiator close out panel.
3. Remove the radiator core support (Refer to **EXTERIOR**).
4. Remove the radiator cooling fan assembly.
5. Loosen the oil level indicator tube retaining bolt and position the dipstick out of the way.
6. Remove the exhaust manifold crossover pipe retaining bolts (Refer to **REMOVAL - LEFT EXHAUST MANIFOLD**).

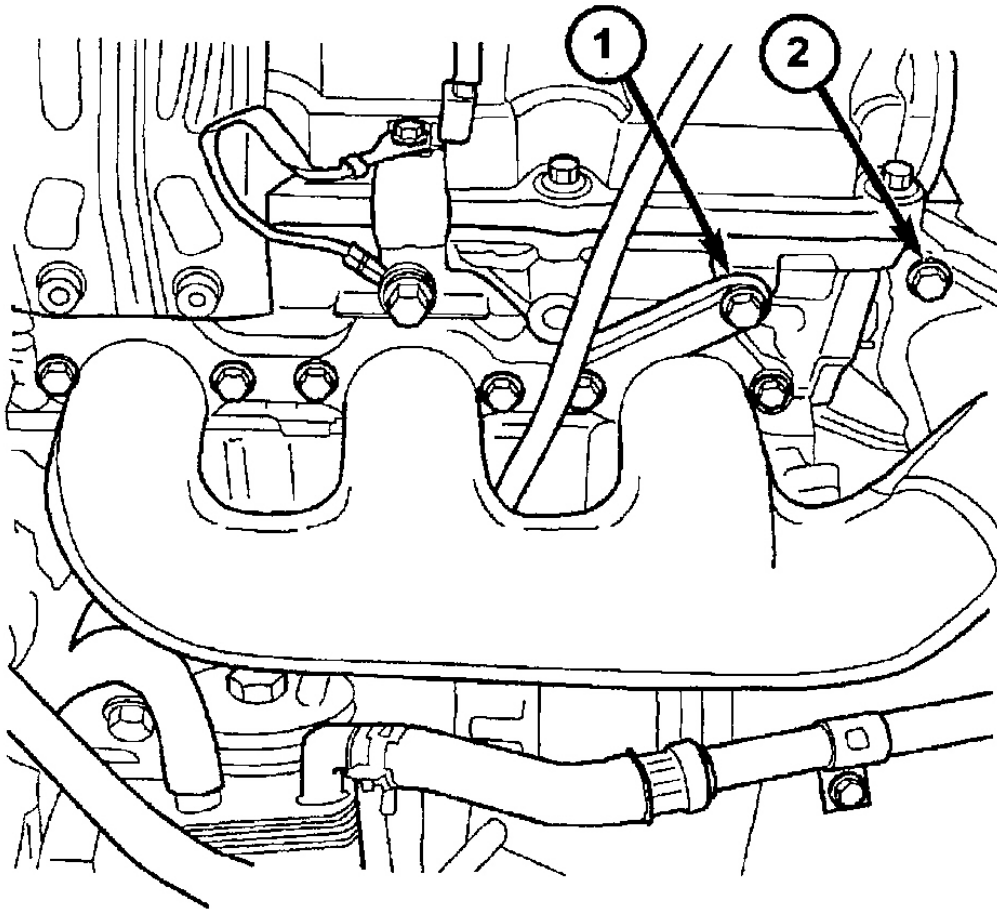
7. Remove the exhaust manifold retaining bolts, exhaust manifold, and discard gasket.

INSPECTION

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

INSTALLATION - LEFT EXHAUST MANIFOLD

1. Position the exhaust manifold and gasket. Install the retaining bolts. Tighten bolts starting at the center working outward to 23 N.m (200 in. lbs.) (**Fig. 170**).



- 1 - OIL LEVEL INDICATOR TUBE RETAINING BOLT
2 - EXHAUST CROSS OVER PIPE UNION

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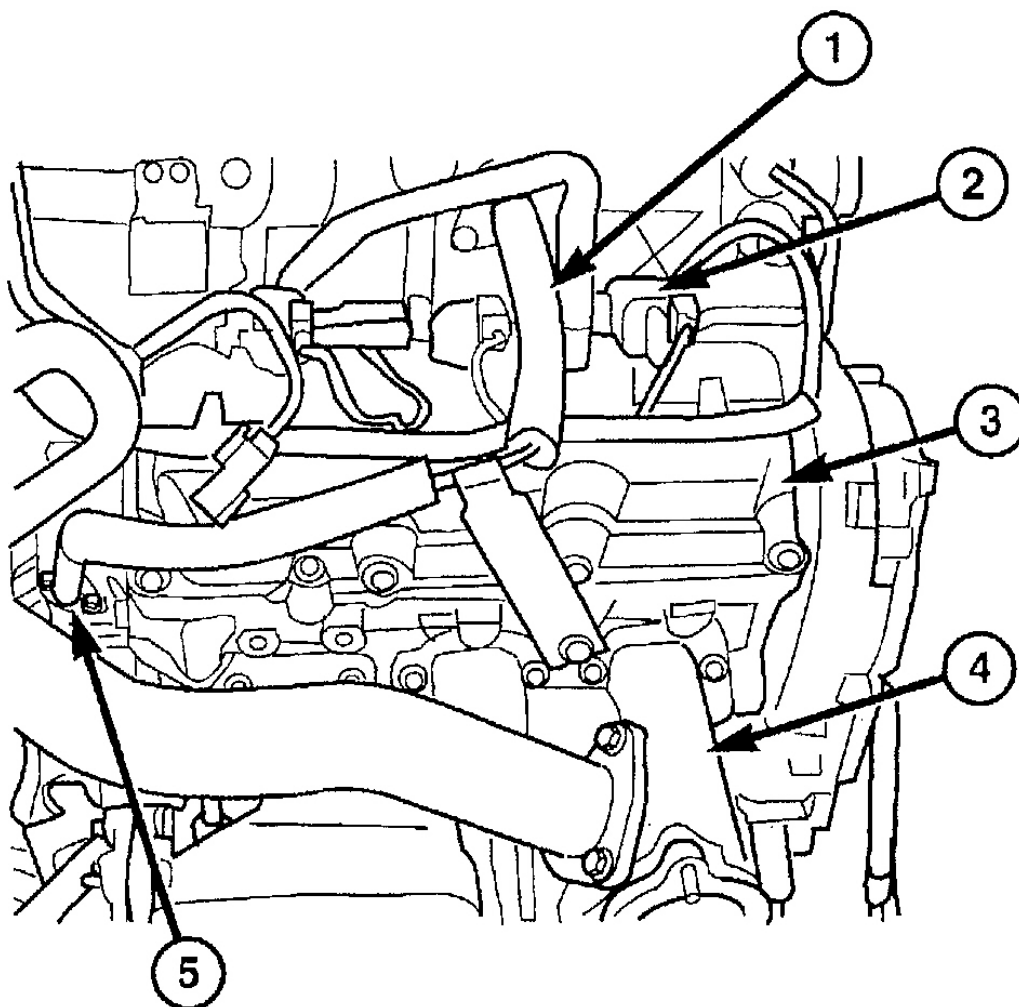
Fig. 170: Identifying Left Exhaust Manifold
Courtesy of DAIMLERCHRYSLER CORP.

2. Install the exhaust manifold crossover pipe retaining bolts. Tighten bolts to 31 N.m (275 in. lbs.).
3. Position the oil dipstick tube and install the retaining bolt.
4. Install the radiator cooling fan assembly.
5. Install the radiator closure panel crossmember (Refer to **EXTERIOR**).
6. Install the radiator close out panel.
7. Connect the negative battery cable.

EXHAUST MANIFOLD - RIGHT

REMOVAL - RIGHT EXHAUST MANIFOLD

1. Disconnect the negative battery cable.
2. Disconnect the upstream oxygen sensor electrical connector.
3. Remove the exhaust manifold crossover pipe retaining bolts (**Fig. 171**).
4. Raise and support the vehicle.
5. Disconnect the downstream oxygen sensor electrical connector.
6. Remove the exhaust manifold flange retaining bolts and disconnect the exhaust system hangers from the pipe assembly.
7. Remove the exhaust system from the vehicle.
8. Remove the EGR tube support bracket bolt (**Fig. 171**).
9. Remove the lower exhaust manifold retaining bolts (**Fig. 171**).



- 1 - EGR TUBE
- 2 - IGNITION COIL
- 3 - CYLINDER HEAD COVER
- 4 - RIGHT EXHAUST MANIFOLD
- 5 - EGR VALVE

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Fig. 171: Locating EGR Valve And Tube
Courtesy of DAIMLERCHRYSLER CORP.

10. Remove the oxygen sensor from the exhaust manifold.

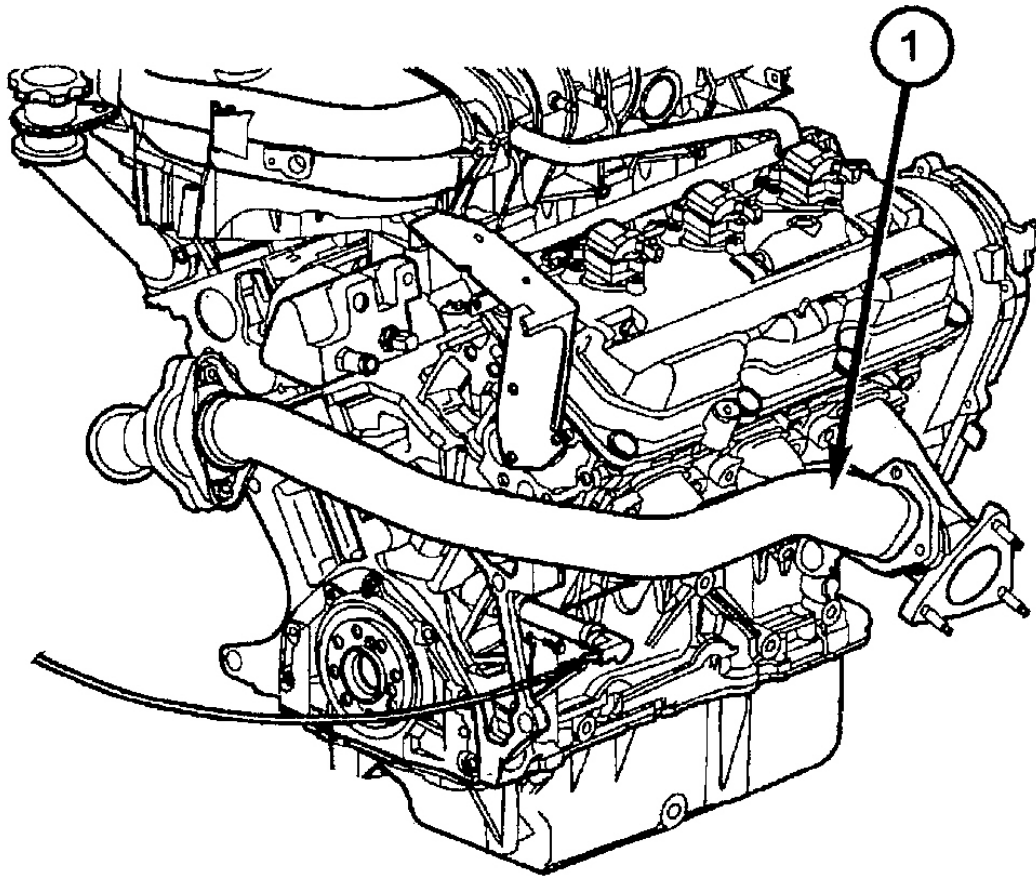
INSTALLATION - RIGHT EXHAUST MANIFOLD

1. Clean gasket surfaces.
2. Position the exhaust manifold and gasket. Install the retaining bolts. Tighten bolts starting at the center working outward to 23 N.m (200 in. lbs.) (**Fig. 171**).
3. Install exhaust system. Connect the exhaust system hangers from the pipe assembly and install the three exhaust manifold flange retaining bolts. Tighten the bolts to 30 N.m (22 ft. lbs.).
4. Connect the downstream oxygen sensor electrical connector.
5. Install the EGR tube retaining bracket (**Fig. 171**).
6. Lower vehicle.
7. Install the exhaust manifold crossover pipe retaining bolts. Tighten bolts to 31 N.m (275 in. lbs.) (**Fig. 171**).
8. Connect the upstream oxygen sensor electrical connector.
9. Connect the negative battery cable.

CROSSOVER PIPE - EXHAUST MANIFOLD

REMOVAL

1. Remove the bolts and nuts attaching the crossover pipe the manifolds (**Fig. 172**).



1 - CROSS OVER PIPE

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Fig. 172: Locating Exhaust Cross Over Pipe
 Courtesy of DAIMLERCHRYSLER CORP.

2. Remove the crossover pipe and gaskets. Discard the gaskets.

INSTALLATION

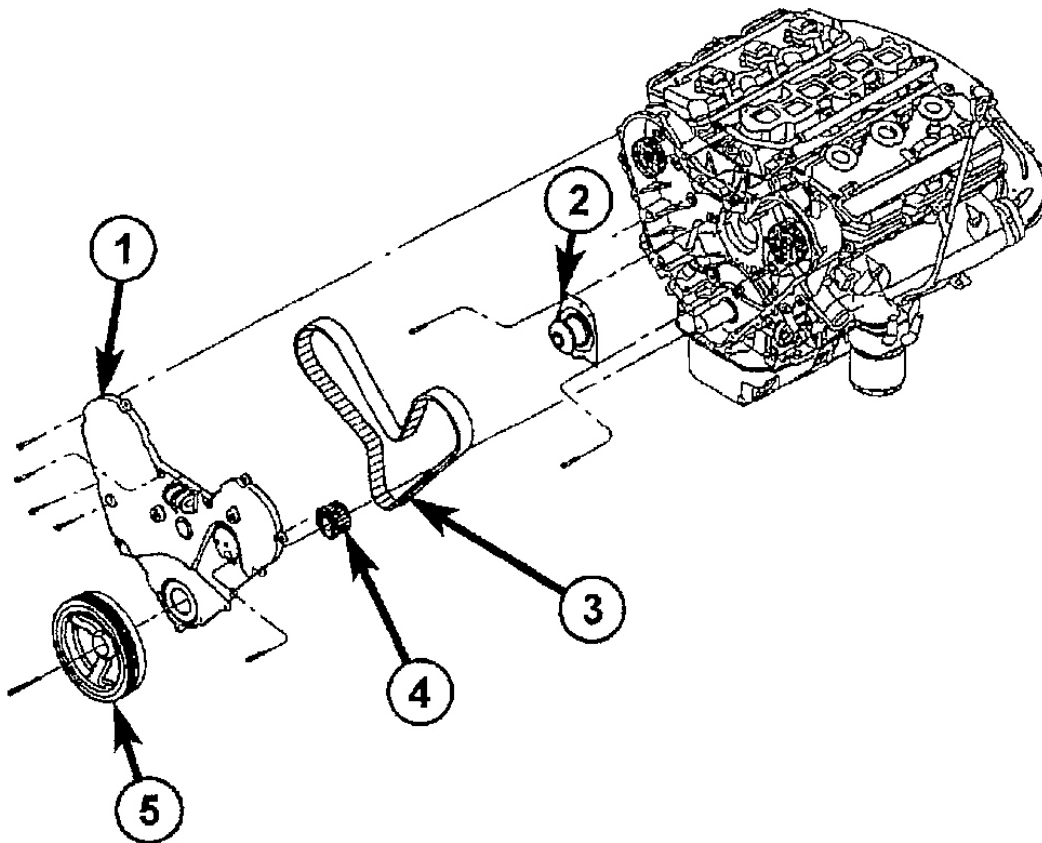
1. Position new gasket on left exhaust manifold.
2. Position cross-over pipe to the manifold connections.
3. Position new gasket on right exhaust manifold and install the bolts. Tighten bolts to 41 N.m (30 ft. lbs.)
4. Install and tighten nuts to 41 N.m (30 ft. lbs.). (**Fig. 172**)
5. Install coolant recovery container (Refer to **COOLANT RECOVERY PRESS CONTAINER**).

VALVE TIMING

DESCRIPTION

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

The timing drive components include a crankshaft sprocket, camshaft sprockets, tensioner pulley, hydraulic tensioner and a timing belt. The water pump is driven by the back side of the timing belt. The right and left camshaft sprockets are keyed and not interchangeable because of the cam sensor pick-up wheel on the left sprocket (**Fig. 173**).



- 1 - FRONT TIMING COVER
- 2 - WATER PUMP
- 3 - TIMING BELT
- 4 - CRANKSHAFT SPROCKET
- 5 - CRANKSHAFT DAMPER

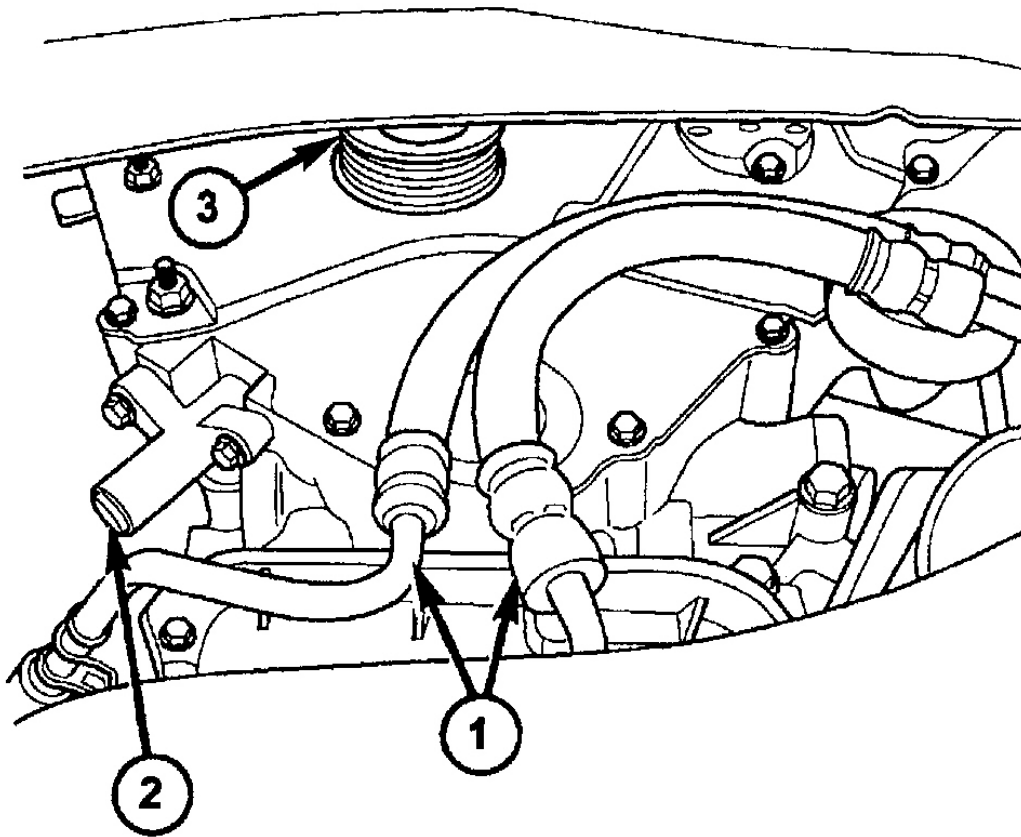
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Fig. 173: Exploded View Of Valve Timing Components

Courtesy of DAIMLERCHRYSLER CORP.

FRONT TIMING BELT COVER**REMOVAL**

1. Perform fuel pressure release procedure. (Refer to **FUEL SYSTEM PRESSURE RELEASE PROCEDURE**).
2. Disconnect negative battery cable.
3. Raise vehicle on hoist.
4. Remove accessory drive belt (Refer to **DRIVE BELTS**).
5. Remove accessory drive belt tensioner.
6. Remove bolts for power steering pump. Reposition power steering pump aside.
7. Remove crankshaft damper (Refer to **REMOVAL**).
8. Remove the lower front timing belt cover fasteners (**Fig. 174**).



- 1 - POWER STEERING HOSE
- 2 - TIMING BELT TENSIONER
- 3 - IDLER PULLEY

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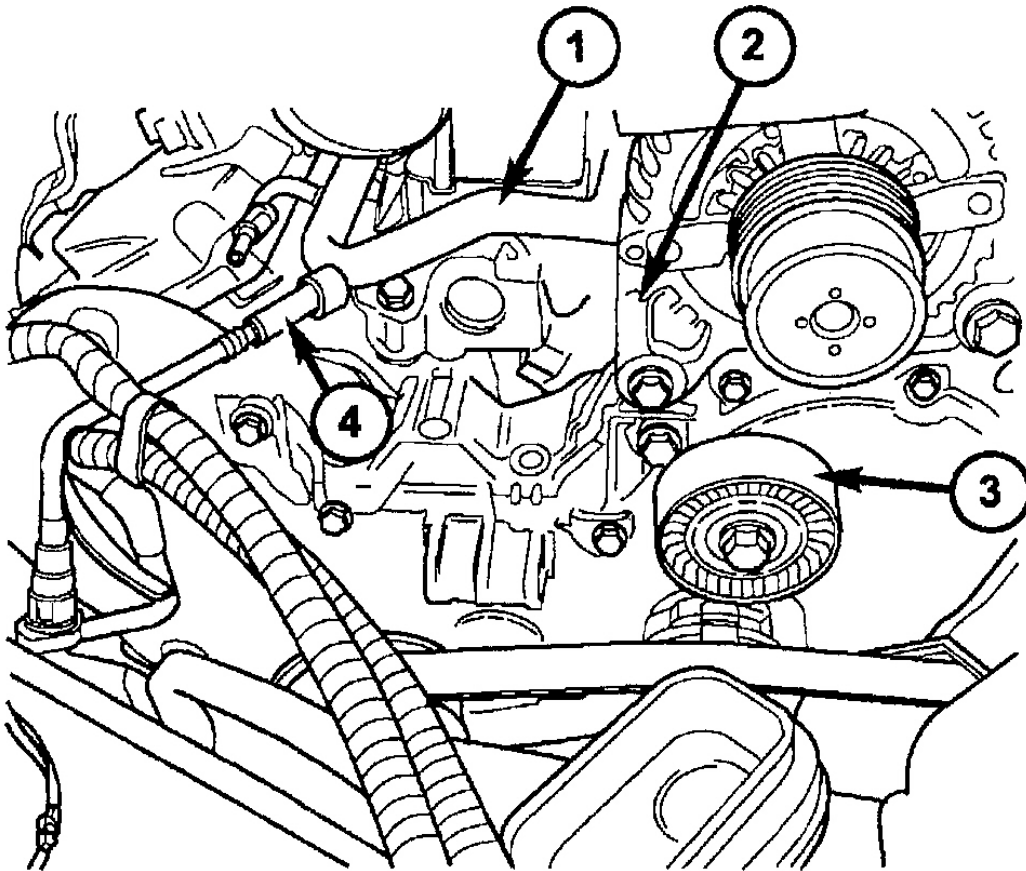
Fig. 174: Locating Lower Timing Belt Front Cover
 Courtesy of DAIMLERCHRYSLER CORP.

9. Lower the vehicle.
10. Support the engine with a floor jack.
11. Remove the air cleaner housing (Refer to **REMOVAL**).
12. Remove the front engine mount (Refer to **REMOVAL**).
13. Disconnect the fuel supply line at the fuel rail (**Fig. 175**).
14. Remove the upper timing belt cover bolts and remove front timing belt cover (Refer to **REMOVAL**).

INSTALLATION

1. Install front timing belt cover (**Fig. 173**).

2. Install the upper engine mount (Refer to **INSTALLATION**).
3. Connect fuel supply line at fuel rail (**Fig. 175**).



- 1 - FUEL RAIL
- 2 - GENERATOR
- 3 - IDLER PULLEY
- 4 - FUEL SUPPLY LINE

G03572604

Fig. 175: Connecting Fuel Supply Line At Fuel Rail
 Courtesy of DAIMLERCHRYSLER CORP.

4. Install the air cleaner housing (Refer to **INSTALLATION**).
5. Remove floor jack and raise vehicle.
6. Install power steering pump fasteners. Tighten bolts to 23 N.m (200 lbs. in.).
7. Install crankshaft damper (Refer to **INSTALLATION**).

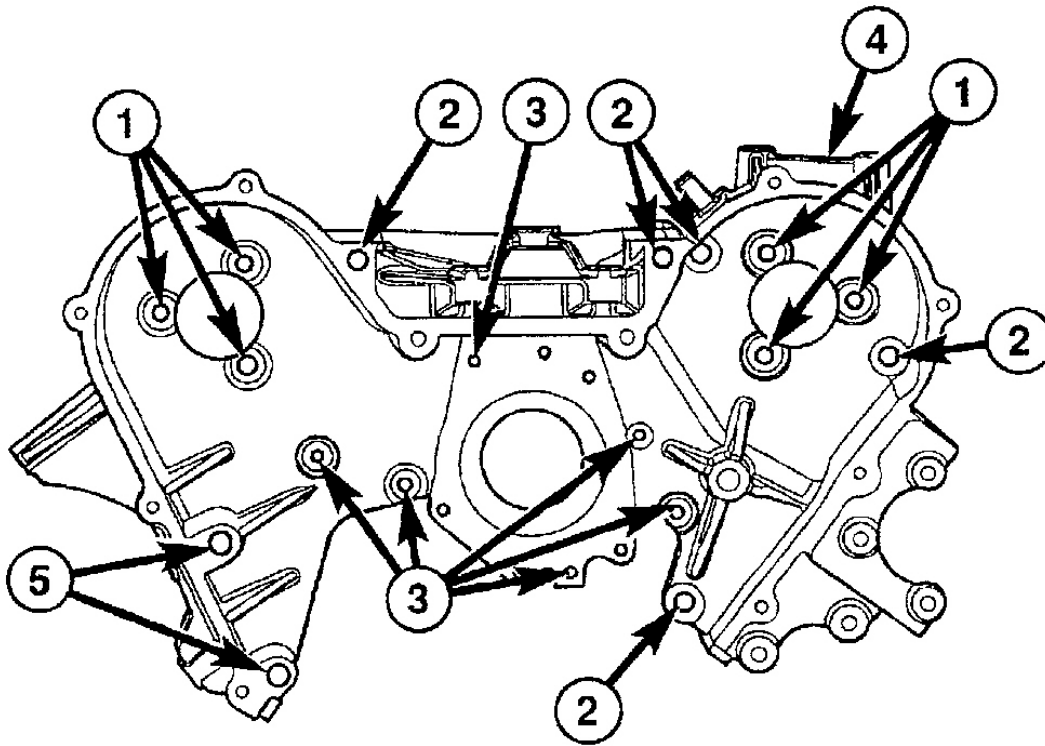
8. Install accessory drive belt tensioner. Torque fastener to 28 N.m (250 in. lbs.).
9. Install accessory drive belt (Refer to **DRIVE BELTS**).
10. Lower Vehicle.
11. Connect negative battery cable.

REAR TIMING BELT COVER

REMOVAL

1. Perform fuel pressure release procedure. (Refer to **FUEL SYSTEM PRESSURE RELEASE PROCEDURE**).
2. Disconnect the negative battery cable.
3. Remove timing belt (Refer to **REMOVAL**).
4. Remove camshaft sprockets (Refer to **REMOVAL**).
5. Remove rear timing belt cover bolts (**Fig. 176**).
6. Remove the rear cover.

NOTE: **The rear timing belt cover has O-rings to seal the water pump passages to cylinder block (Fig. 176). Do not reuse the O-rings.**



- 1 - M8 FASTENERS (APPLY THREAD SEALANT)
- 2 - M10 FASTENERS
- 3 - M6 FASTENERS
- 4 - REAR TIMING BELT COVER
- 5 - M10 FASTENERS (STUD/NUT)

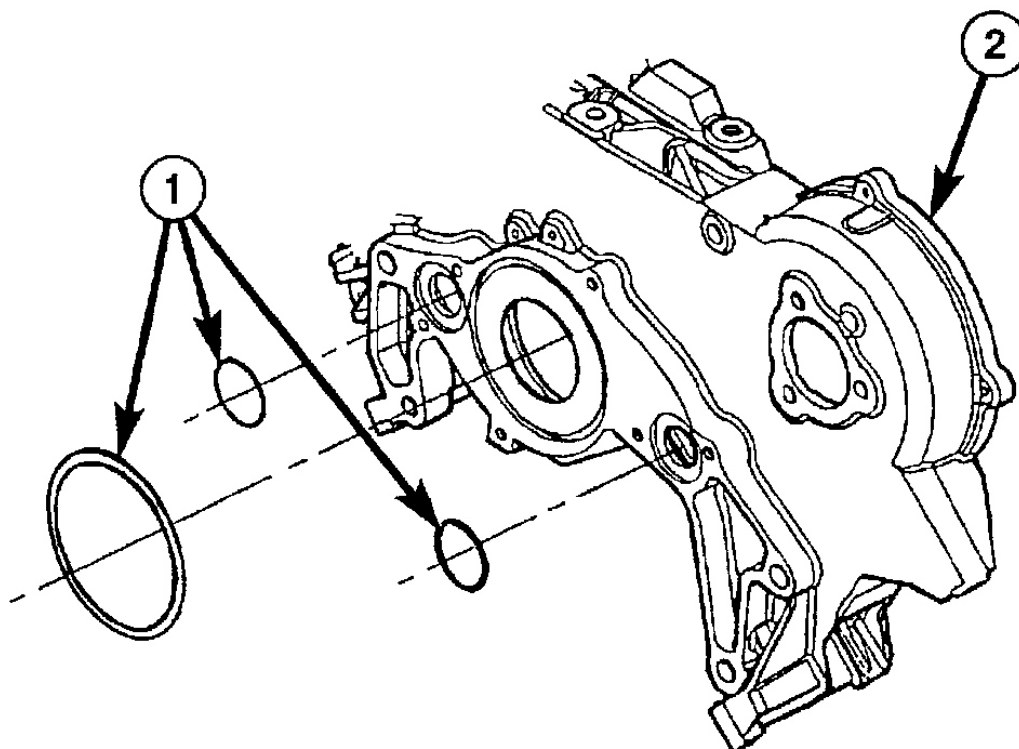
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Fig. 176: Identifying Rear Timing Belt Cover Fasteners
Courtesy of DAIMLERCHRYSLER CORP.

INSTALLATION

1. Clean rear timing belt cover O-ring sealing surfaces and grooves (**Fig. 177**). Lubricate new O-rings with Mopar(R) Dielectric Grease or equivalent to facilitate assembly.
2. Position NEW O-rings on cover (**Fig. 177**).
3. Install rear timing belt cover (**Fig. 176**). Tighten bolts to the following specified torque:
 - M10-54 N.m (40 ft. lbs.)
 - M8-28 N.m (20 ft. lbs.)
 - M6-12 N.m (105 in. lbs.)

4. Install camshaft sprockets (Refer to **INSTALLATION**).



1 - REAR TIMING BELT COVER SEALS

2 - REAR TIMING BELT COVER

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Fig. 177: Identifying Rear Timing Belt Cover Seals
Courtesy of DAIMLERCHRYSLER CORP.

5. Install timing belt (Refer to **INSTALLATION**).

TIMING BELT AND SPROCKETS

REMOVAL

REMOVAL - TIMING BELT

TIMING VERIFICATION

Remove the outer timing covers. Rotate the crankshaft until the pointer on the crankshaft sprocket aligns the TDC mark on the oil pump. Check to determine if the camshaft sprocket timing marks are aligned with the marks on the inner timing cover. It may take an additional full revolution of the crankshaft before the camshaft sprocket marks are aligned (**Fig. 178**).

CAUTION: The 3.5L is NOT a freewheeling engine. Therefore, loosen the valve train rocker assemblies before servicing the timing drive.

1. Perform fuel pressure release procedure. (Refer to **FUEL SYSTEM PRESSURE RELEASE PROCEDURE**).
2. Disconnect negative battery cable.
3. Remove both cylinder head covers and loosen the rocker arm assemblies.
4. Remove the front timing belt cover (Refer to **TIMING BELT/CHAIN COVER(S) - REMOVAL**).
5. Mark belt running direction, if timing belt is to be reused.

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

6. Rotate engine clockwise until crankshaft mark aligns with the TDC mark on oil pump housing and the camshaft sprocket timing marks are aligned with the marks on the rear cover (**Fig. 178**)
7. Remove the timing belt tensioner (**Fig. 178**) and remove timing belt.
8. Inspect the tensioner for fluid leakage.
9. Inspect the pivot and bolt for free movement, bearing grease leakage, and smooth rotation. If not rotating freely, replace the arm and pulley assembly.
10. When tensioner is removed from the engine it is necessary to compress the plunger into the tensioner body.

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

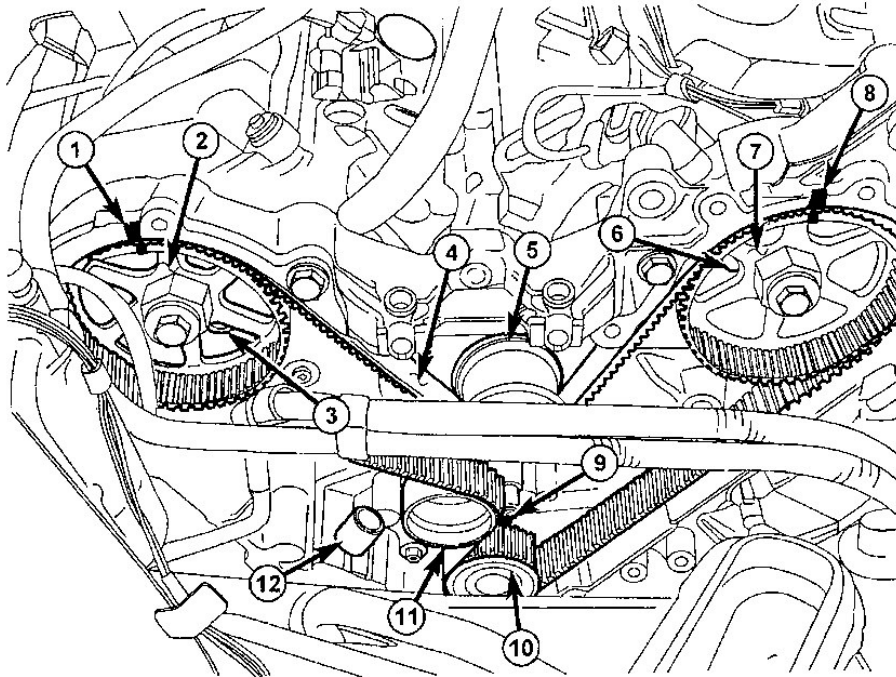
- a. Place the tensioner into a vise and SLOWLY compress the plunger (**Fig. 179**). Total bleed down of tensioner should take about 5 minutes.
- b. When plunger is compressed into the tensioner body install a pin through the body and plunger to retain plunger in place until tensioner is installed.

REMOVAL - CAMSHAFT SPROCKETS

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

NOTE: The camshaft timing gears are keyed to the camshaft.

1. Perform fuel pressure release procedure. (Refer to **FUEL SYSTEM PRESSURE RELEASE PROCEDURE**).
2. Remove front timing belt cover (Refer to **TIMING BELT/CHAIN COVER(S) - REMOVAL**).

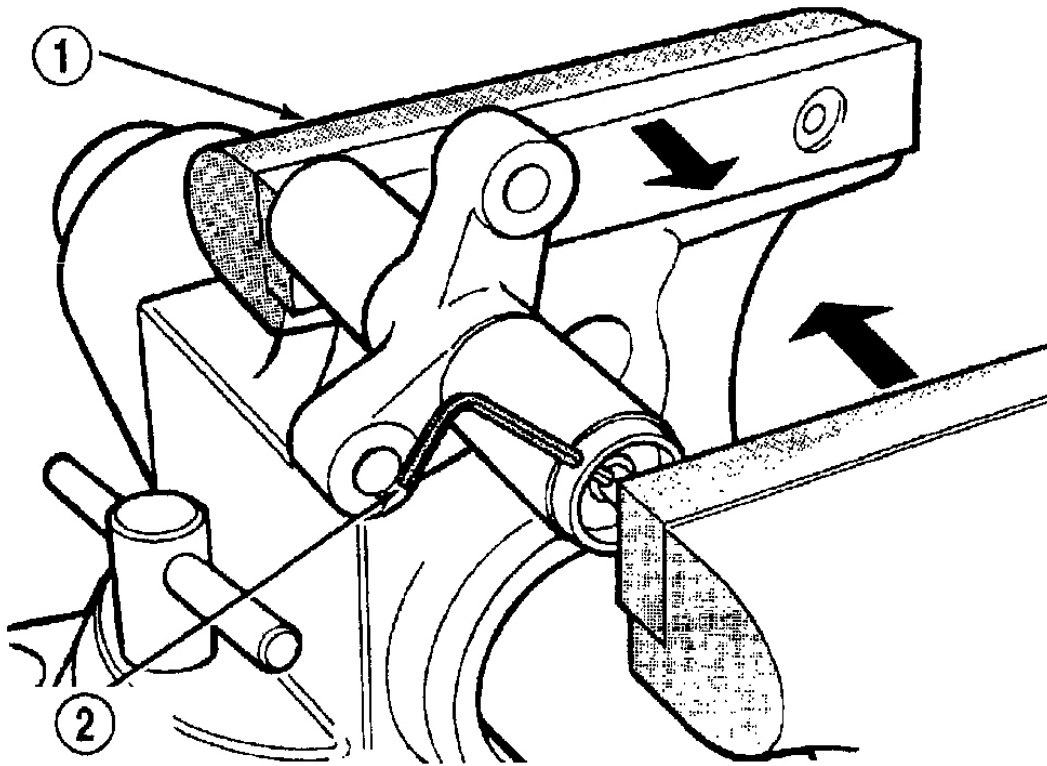


- 1 - RIGHT CAMSHAFT GEAR ALIGNMENT MARK
- 2 - RIGHT CAMSHAFT GEAR
- 3 - CYLINDER HEAD TO INNER TIMING BELT COVER BOLTS - RIGHT
- 4 - TIMING BELT
- 5 - WATER PUMP PULLEY
- 6 - CYLINDER HEAD TO INNER TIMING BELT COVER BOLTS - LEFT

- 7 - LEFT CAMSHAFT GEAR
- 8 - LEFT CAMSHAFT GEAR ALIGNMENT MARK
- 9 - CRANKSHAFT GEAR ALIGNMENT MARK
- 10 - CRANKSHAFT GEAR
- 11 - TIMING BELT TENSIONER PULLEY
- 12 - TIMING BELT TENSIONER

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Fig. 178: Identifying Timing Gear Marks
 Courtesy of DAIMLERCHRYSLER CORP.

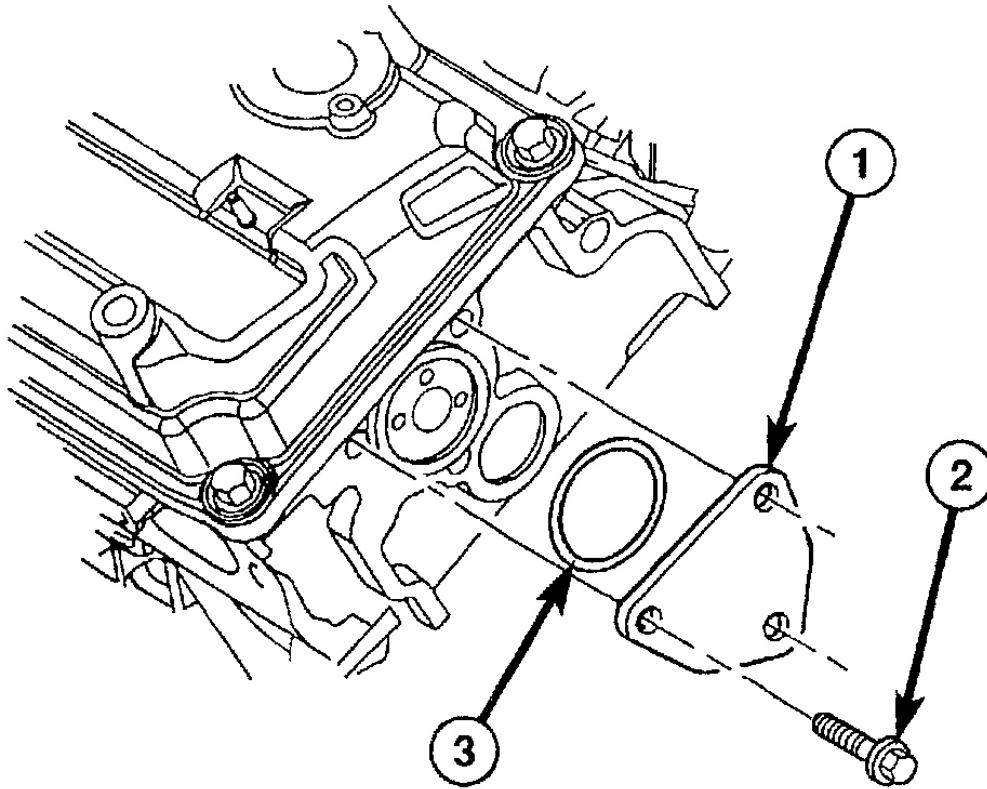


1 - VISE
2 - LOCKING PIN

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Fig. 179: Compressing Timing Belt Tensioner
Courtesy of DAIMLERCHRYSLER CORP.

3. Position crankshaft sprocket to the TDC mark on the oil pump housing by turning crankshaft in the clockwise direction
4. Install a dial indicator in number 1 cylinder to check TDC of the piston. Rotate the crankshaft until the piston is at exactly TDC.
5. Remove camshaft retainer/thrust plate from rear of right cylinder head (**Fig. 180**).



1 - CAMSHAFT THRUST PLATE

2 - BOLT

3 - O-RING

G03572609

Fig. 180: Removing Camshaft Thrust Plate
 Courtesy of DAIMLERCHRYSLER CORP.

6. Remove the right cylinder head cover.
7. Remove the right rocker arm assembly.
8. Remove the timing belt tensioner and timing belt.

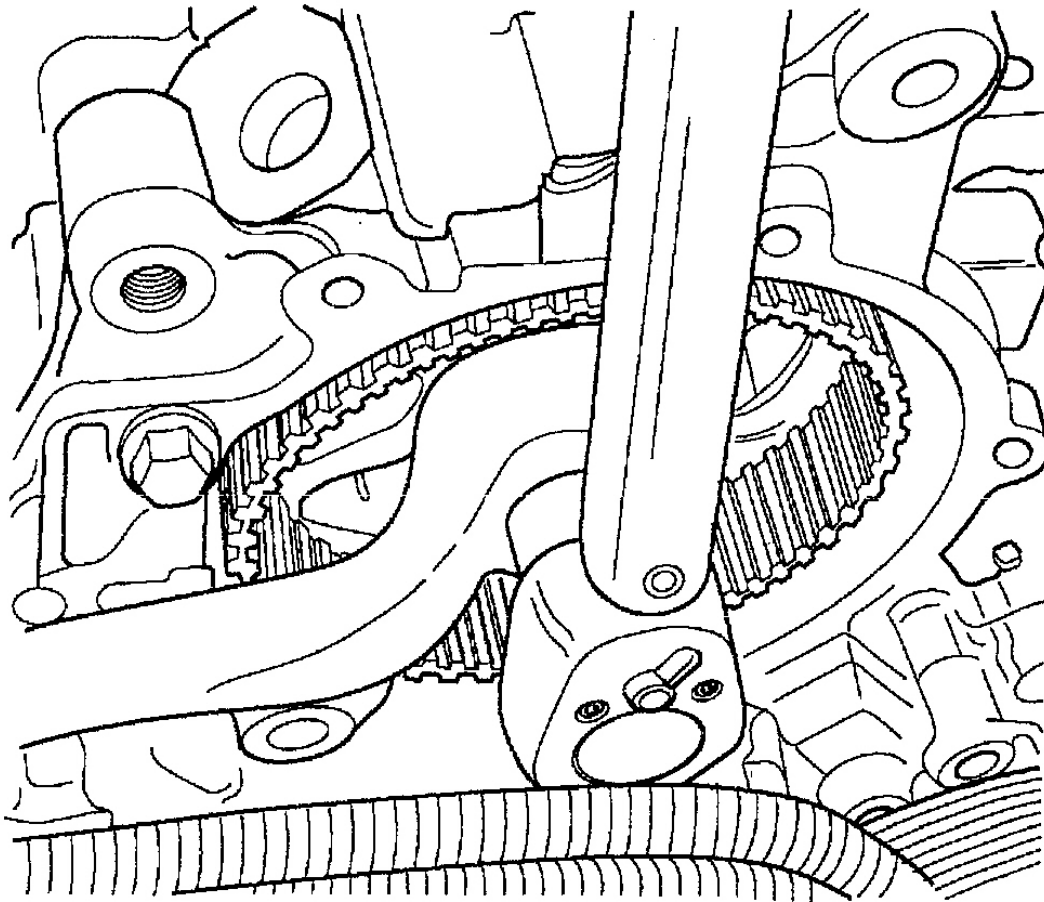
CAUTION: The right camshaft must be pushed rearward approximately 3 1/2 inches to remove the camshaft gear retaining bolt and gear. Care must be taken not to scratch or nick the camshaft or cylinder head journals when moving camshaft.

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

10. Loosen and remove the camshaft gear retaining bolt and washer. The right bolt is 213 mm (8 3/8 in.) long and the left bolt is 255 mm (10.0 in.) long.

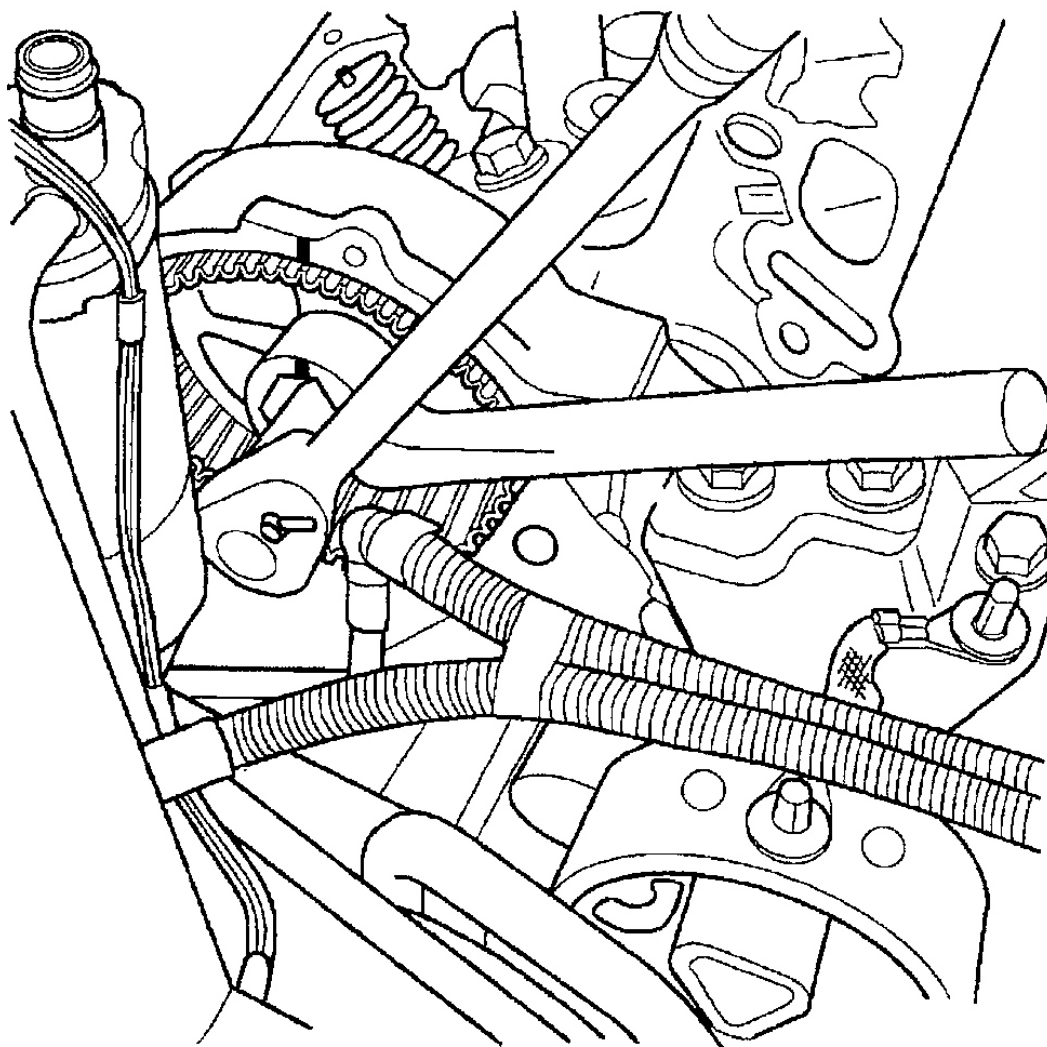
NOTE: The camshaft timing gears are keyed to the camshaft.

11. Remove the camshaft sprockets (**Fig. 181**), (**Fig. 182**).



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Fig. 181: Removing Left Camshaft Sprocket
Courtesy of DAIMLERCHRYSLER CORP.

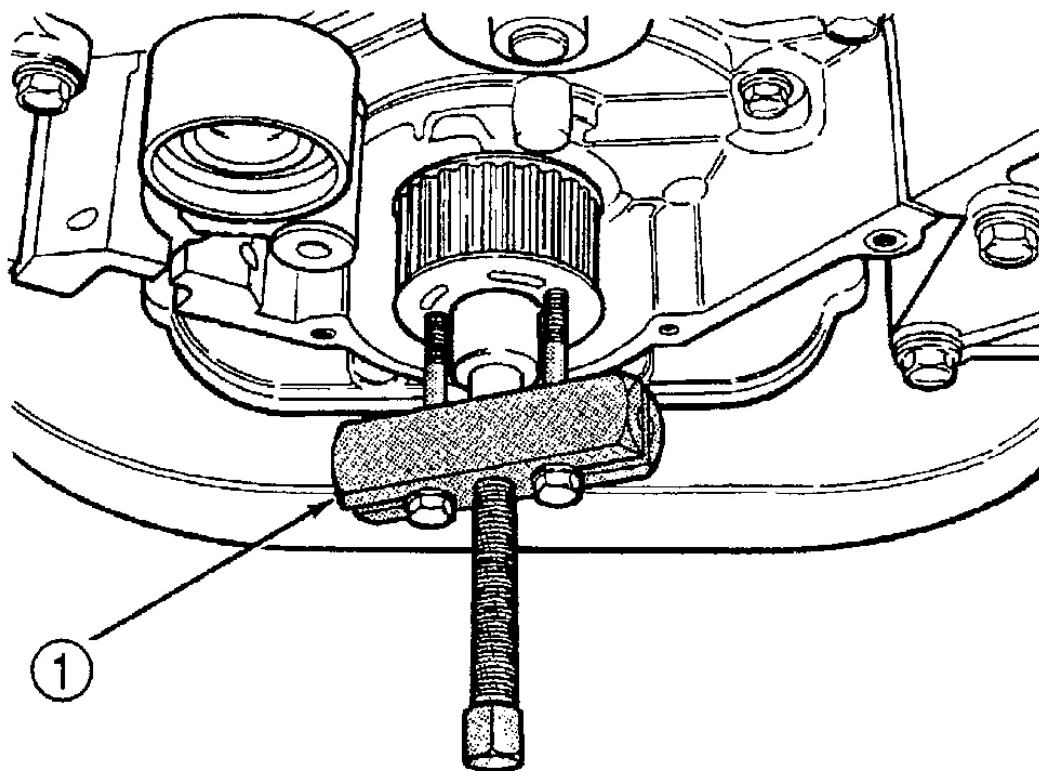


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Fig. 182: Removing Right Camshaft Sprocket
Courtesy of DAIMLERCHRYSLER CORP.

REMOVAL - CRANKSHAFT SPROCKET

1. Remove the timing belt (Refer to **REMOVAL**).
2. Remove crankshaft sprocket using Special Tool L-4407-A (**Fig. 183**).

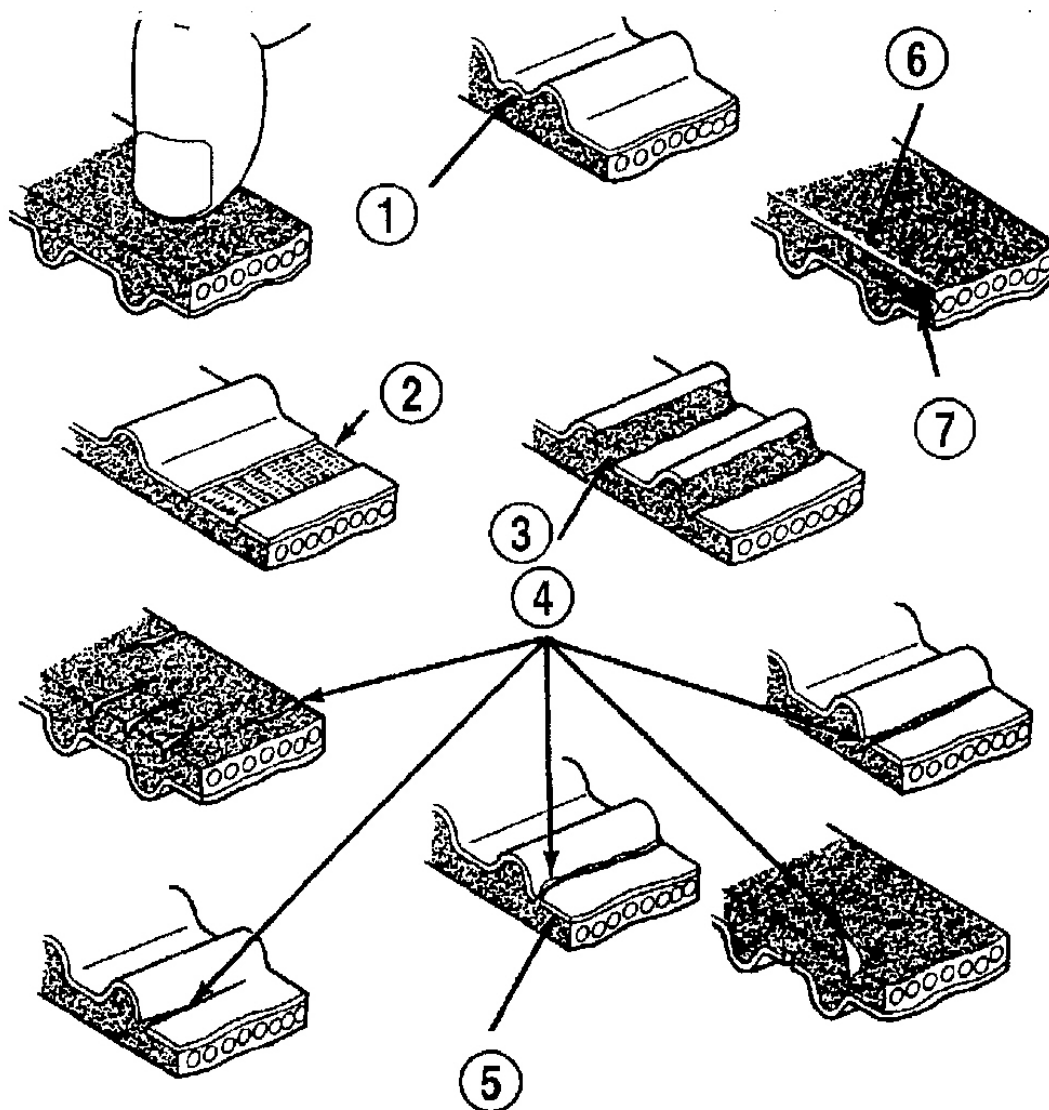


1 - SPECIAL TOOL L-4407-A
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Fig. 183: Removing Crankshaft Sprocket
Courtesy of DAIMLERCHRYSLER CORP.

INSPECTION - TIMING BELT

1. Remove front timing belt cover (Refer to **REMOVAL - TIMING BELT**).
2. Inspect both sides of the timing belt. Replace belt if any of the following conditions exist (**Fig. 184**):



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

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Fig. 184: Inspecting Timing Belt
 Courtesy of DAIMLERCHRYSLER CORP.

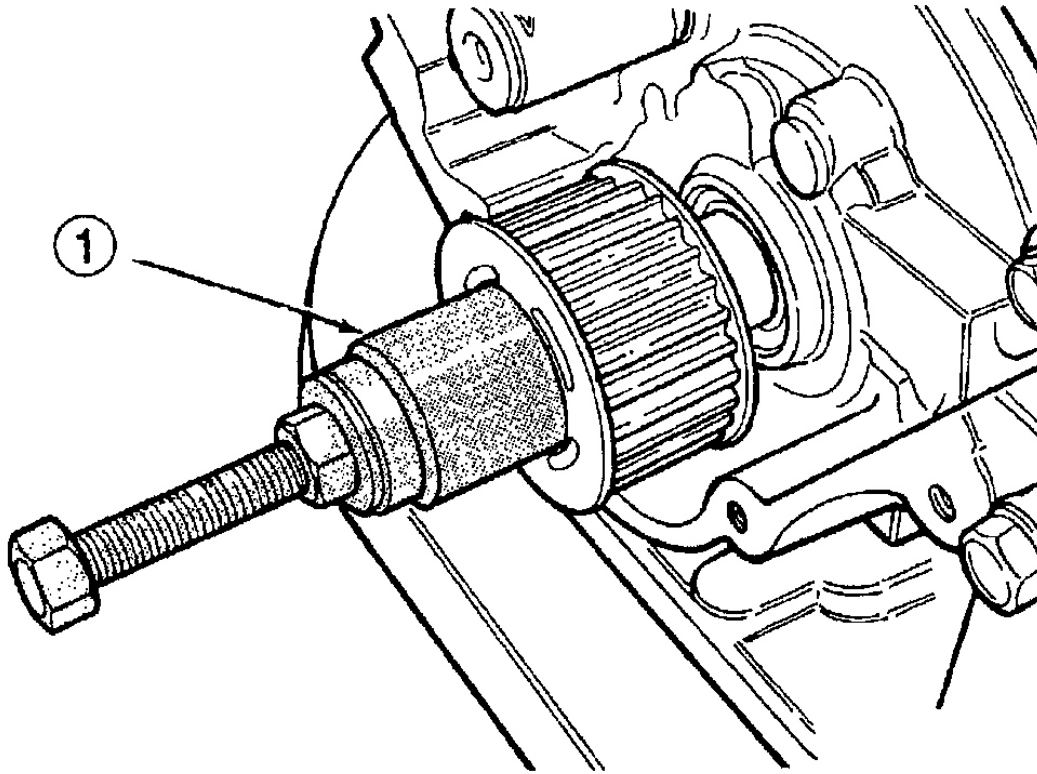
- a. Hardening of back rubber back side is glossy without resilience and leaves no indent when pressed with fingernail.
 - b. Cracks on rubber back.
 - c. Cracks or peeling of canvas.
 - d. Cracks on rib root.
 - e. Cracks on belt sides.
 - f. Missing teeth.
 - g. Abnormal wear of belt sides. The sides are normal if they are sharp as if cut by a knife.
 - h. Vehicle mileage or time at component maintenance requirement. (Refer to owner's manual)
3. If none of the above conditions are seen on the belt, the front timing belt cover can be installed (Refer to **TIMING BELT/CHAIN COVER(S) - INSTALLATION**).

INSTALLATION

INSTALLATION - CRANKSHAFT SPROCKET

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

1. Install crankshaft sprocket using Special Tools 6641 and C-4685-C1 (**Fig. 185**).



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

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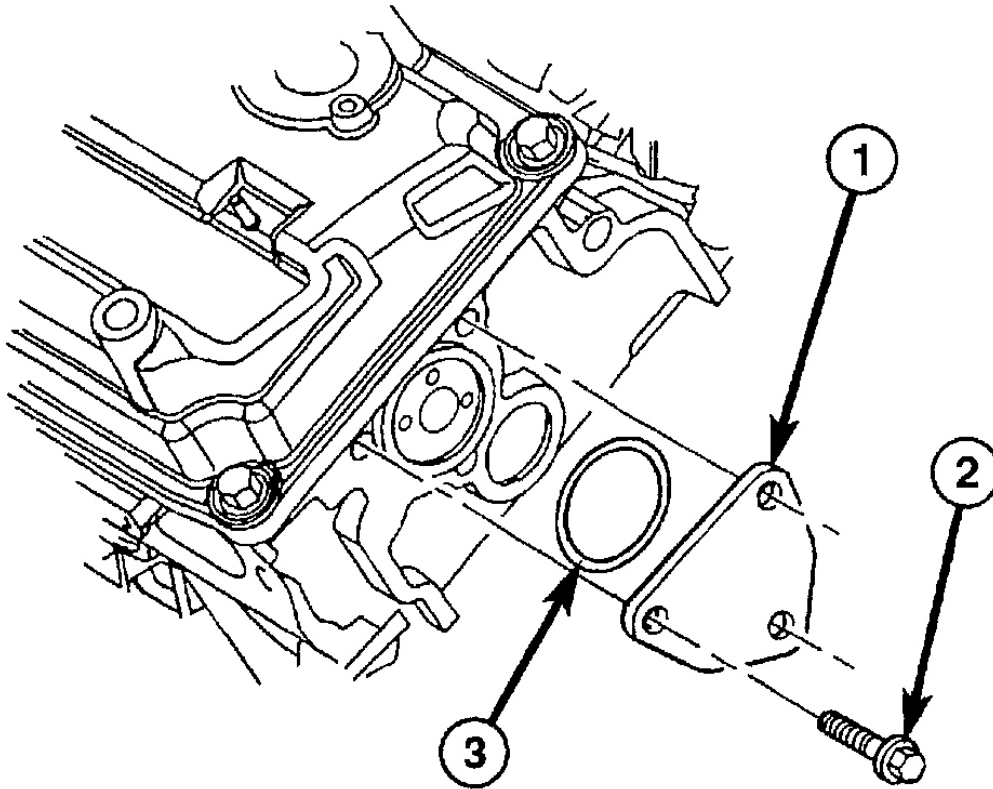
Fig. 185: Installing Crankshaft Sprocket
Courtesy of DAIMLERCHRYSLER CORP.

2. Install timing belt (Refer to **INSTALLATION**).

INSTALLATION - CAMSHAFT SPROCKETS

CAUTION: The camshaft sprockets are keyed and not interchangeable from side to side because of the camshaft position sensor pick-up.

1. Install camshaft sprockets onto the camshafts. Install **NEW** sprocket attaching bolts into place. The 255 mm (10 in.) bolt is to be installed in the left camshaft and the 213 mm (8 3/8 in.) bolt is to be installed into the right camshaft. **Do not tighten the bolts; tightened at later step.** Camshaft sprocket mark should be aligned with the marks on the cover at both sprockets (**Fig. 178**).
2. Install the right camshaft thrust plate and seal. Tighten bolts to 28 N.m (250 in. lbs.) (**Fig. 186**).



1 - CAMSHAFT THRUST PLATE

2 - BOLT

3 - O-RING

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Fig. 186: Installing Camshaft Thrust Plate
Courtesy of DAIMLERCHRYSLER CORP.

3. Install the timing belt starting first at the crankshaft sprocket, then to remaining components in a counterclockwise direction.
4. Install the belt around the last sprocket. Maintain tension on the belt as it is positioned around the tensioner pulley. Each camshaft sprockets mark should still be aligned with the rear cover marks (**Fig. 178**).

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

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

6. Remove tensioner retaining pin to allow the tensioner to extend to the pulley bracket.
7. Using a dial indicator, position the number 1 piston at TDC.
8. Hold the camshaft sprocket hex with a 36 mm (1 7/16 in.) wrench and tighten the camshaft bolts to the following:
 - Right side = 102 N.m (75 ft. lbs.) +90° turn
 - Left side = 115 N.m (85 ft. lbs.) +90° turn
9. Remove dial indicator and install spark plug.
10. Remove Special Tools 6642.
11. Install cam retainer/thrust plates and O-rings (**Fig. 186**).
12. Install front timing belt cover (Refer to **TIMING BELT/CHAIN COVER(S) - INSTALLATION**).
13. Install engine assembly (Refer to **INSTALLATION - ENGINE ASSEMBLY**).

INSTALLATION - TIMING BELT

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

1. Align the crankshaft sprocket with the TDC mark on oil pump cover (**Fig. 178**).
2. Align the camshaft sprockets timing reference mark with the mark on the rear cover (**Fig. 178**).
3. Install the timing belt starting at the crankshaft sprocket going in a counterclockwise direction. Install the belt around the last sprocket. Maintain tension on the belt as it is positioned around the tensioner pulley.

NOTE: If the camshaft gears have been removed it is only necessary to have the camshaft gear retaining bolts installed to a snug torque at this time.

4. Holding the tensioner pulley against the belt, install the tensioner into the housing and tighten to 28 N.m (250 in. lbs.). Each camshaft sprocket mark should remain aligned the cover marks.
5. When tensioner is in place pull retaining pin to allow the tensioner to extend to the pulley bracket.
6. Rotate crankshaft sprocket 2 revolutions and check the timing marks on the camshafts and crankshaft. The marks should line up within their respective locations (**Fig. 178**). If marks do not line up, repeat procedure.

NOTE: If camshaft gears have been removed and timing is correct, counterhold and tighten the camshaft gears to final torque specification (Refer to **INSTALLATION**).

7. Install the front timing belt cover (Refer to **TIMING BELT/CHAIN COVER(S) - INSTALLATION**).
8. Tighten the rocker arm assemblies and install the cylinder head covers (Refer to **INSTALLATION**).
9. Connect negative battery cable.

TIMING BELT TENSIONER & PULLEY

REMOVAL

REMOVAL - TENSIONER

1. For timing belt tensioner removal procedure (Refer to **REMOVAL - TIMING BELT**)

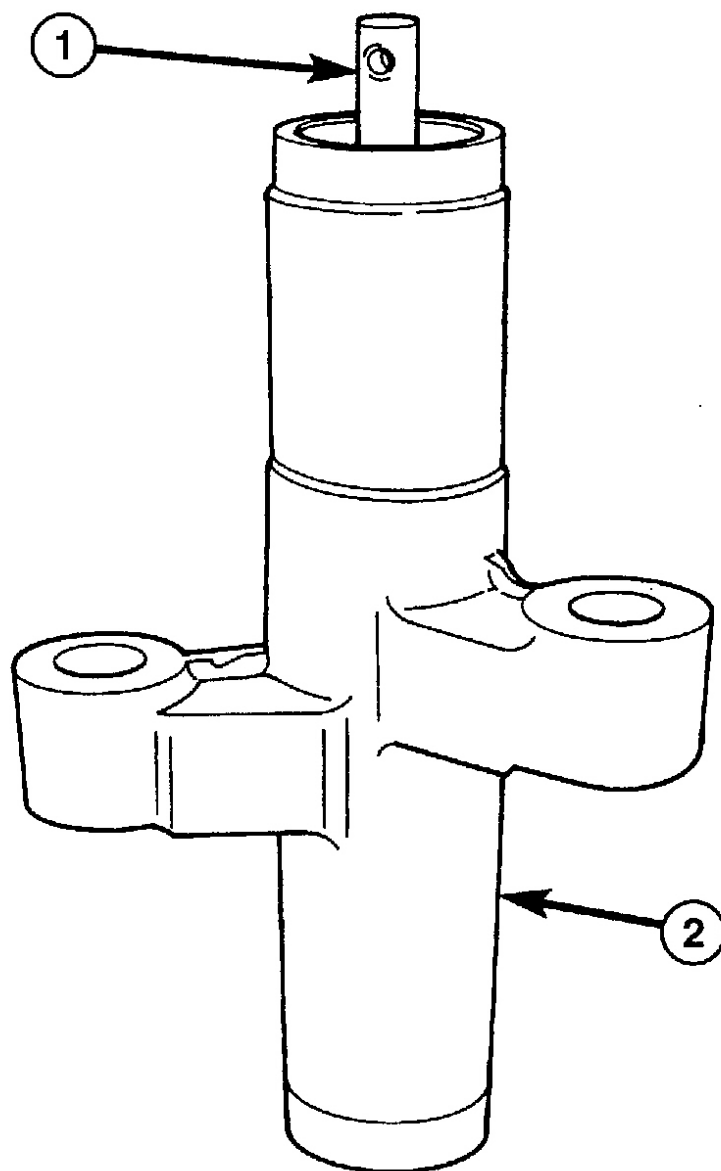
REMOVAL - TENSIONER PULLEY ASSEMBLY

1. Remove the timing belt. (Refer to **REMOVAL - TIMING BELT**)
2. Remove the timing belt tensioner pulley and bracket assembly by unscrewing the pivot bolt from the oil pump housing (**Fig. 188**).

INSPECTION

INSPECTION - TENSIONER

1. Inspect hydraulic tensioner for fluid loss around the plunger seal (**Fig. 187**). Replace tensioner if leaking.



- 1 - PLUNGER (EXTENDED POSITION)
- 2 - TENSIONER HOUSING

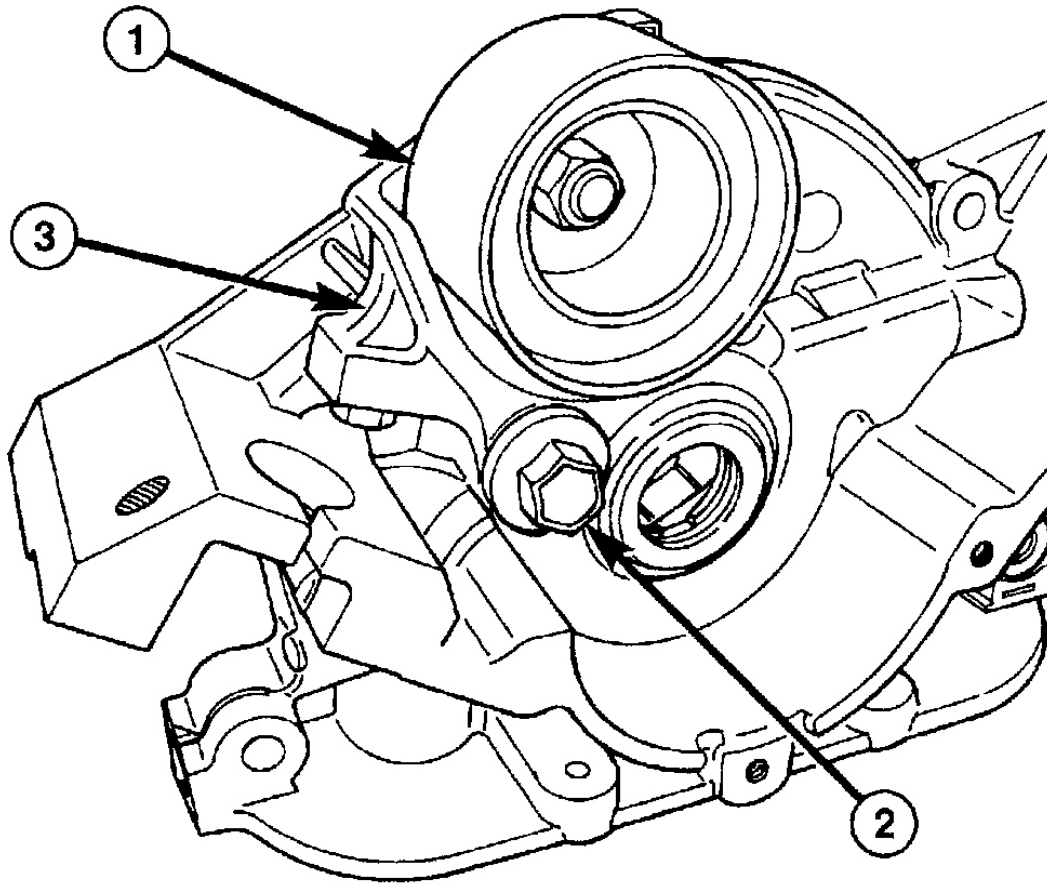
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Fig. 187: Identifying Timing Belt Tensioner
Courtesy of DAIMLERCHRYSLER CORP.

INSPECTION - TENSIONER PULLEY ASSEMBLY

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

1. Inspect pulley for free movement. Replace if pulley is loose, seized, or rough turning (**Fig. 188**).



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

G03572617

Fig. 188: Identifying Tensioner Pulley
Courtesy of DAIMLERCHRYSLER CORP.

2. Inspect pulley bearing and seal. Replace if damaged.
3. Inspect pivot bolt for free movement in assembly housing. Replace assembly if seized or excessive looseness.

INSTALLATION

INSTALLATION - TENSIONER PULLEY ASSEMBLY

1. Install the timing belt tensioner pulley assembly (**Fig. 188**). Tighten the pivot bolt to 61 N.m (45 ft. lbs.).
2. Install the timing belt. (Refer to **INSTALLATION - TIMING BELT**)

INSTALLATION - TENSIONER

1. For timing belt tensioner installation procedure (Refer to **INSTALLATION - TIMING BELT**).