2009 ENGINE

2.7L DOHC - Service Information - Journey

DESCRIPTION

DESCRIPTION

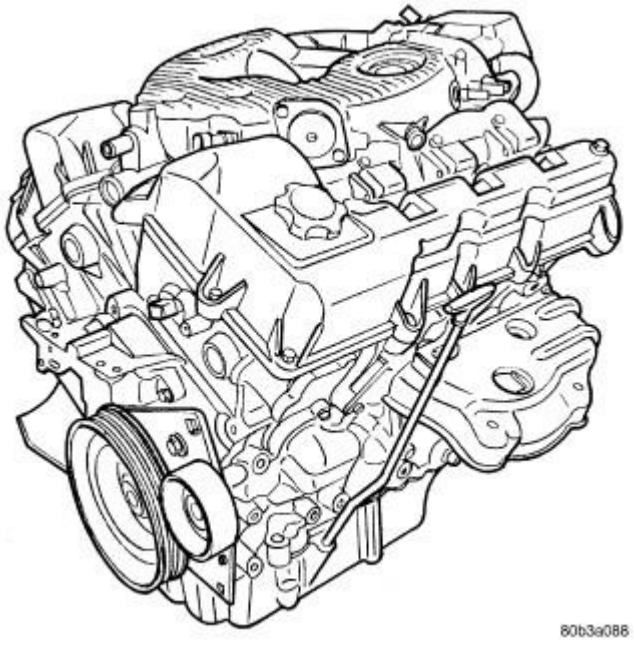

Fig. 1: 2.7 Liter Engine
Courtesy of CHRYSLER LLC

The 2.7 Liter (167 Cubic Inches) 60 degree V6 engine is a double overhead camshaft design with hydraulic lifters and four valves per cylinder. The engine does not have provisions for a free wheeling valve train.

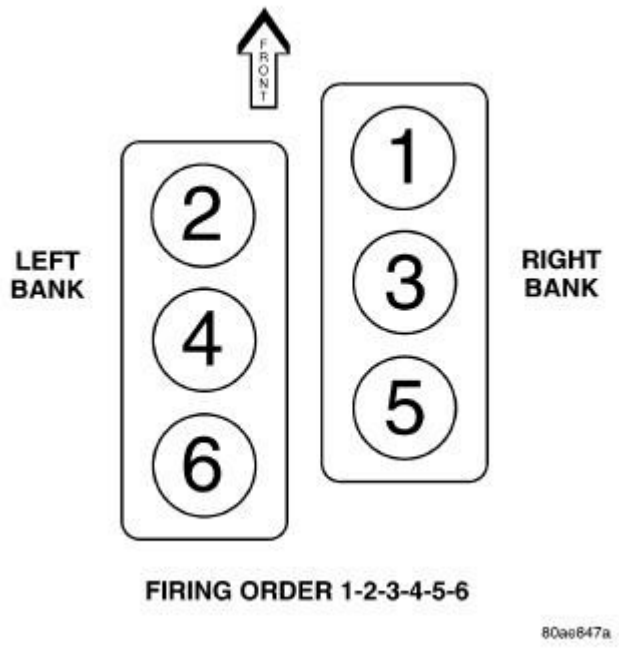

Fig. 2: Cylinder Numbering & Firing Order
Courtesy of CHRYSLER LLC

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

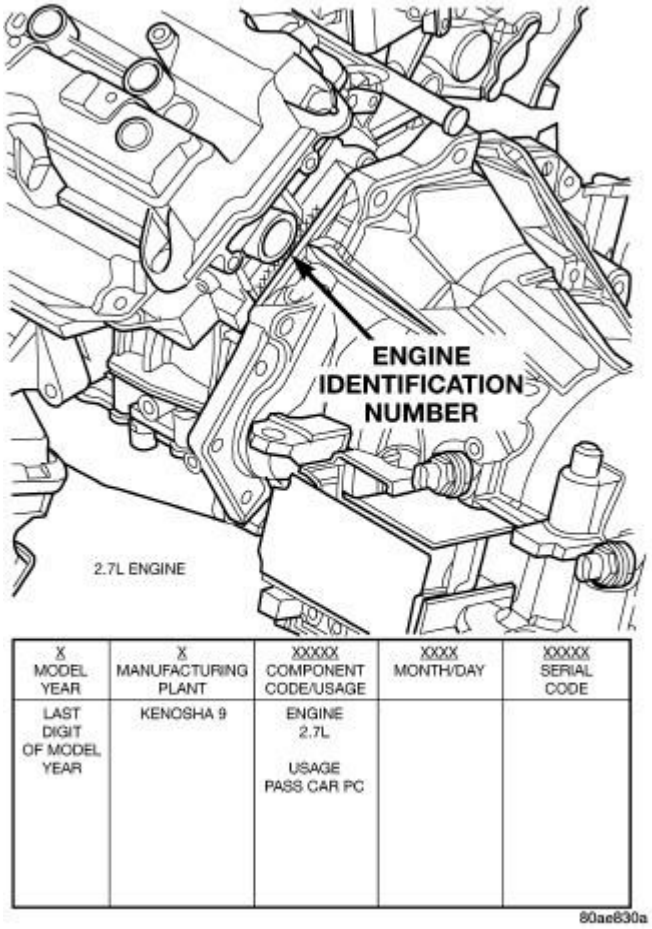

Fig. 3: Engine Identification
Courtesy of CHRYSLER LLC

The engine identification number is located on the rear of the cylinder block just below the left cylinder head.

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).

See **ENGINE DIAGNOSIS - PERFORMANCE** and **ENGINE DIAGNOSIS - MECHANICAL** for possible causes and corrections of malfunctions.

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: Refer to **CYLINDER COMPRESSION PRESSURE TEST**.
- Cylinder Combustion Pressure Leakage Test: Refer to **CYLINDER COMBUSTION PRESSURE LEAKAGE TEST**.
- Cylinder Head Gasket Failure Diagnosis: Refer to **CYLINDER HEAD GASKET**.
- Intake Manifold Leakage Diagnosis: Refer to .**INTAKE MANIFOLD LEAKS**
- Lash Adjuster (Tappet) Noise Diagnosis: Refer to **DIAGNOSIS AND TESTING - HYDRAULIC LASH ADJUSTER NOISE DIAGNOSIS**.
- Engine Oil Leak Inspection: Refer to **ENGINE OIL LEAK INSPECTION**.

ENGINE DIAGNOSIS - PERFORMANCE

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

	4. Faulty coil(s).	4. Test and replace as necessary. (Refer to Appropriate Diagnostic Information)
ENGINE LOSS OF POWER	1. Dirty or incorrectly gapped plugs. 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. (Refer to Appropriate Diagnostic Information) 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 Appropriate Diagnostic Information)
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 Appropriate Diagnostic Information)
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 Appropriate Diagnostic Information) Test and replace as necessary. (Refer to Appropriate Diagnostic Information) 4. Clean system and replace fuel filter.

ENGINE DIAGNOSIS - MECHANICAL

CONDITION	POSSIBLE CAUSES	CORRECTION

VALVETRAIN NOISE	1. High or low oil level in crankcase. 2. Thin or diluted oil. 3. Thick oil 4. Low oil pressure. 5. Dirt in tappets/lash adjusters. 6. Worn rocker arms. 7. Worn tappets/lash adjusters. 8. Worn valve guides. 9. Excessive runout of valve seats on valve faces. 10. Missing adjuster pivot.	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. 5. Replace rocker arm/hydraulic lash adjuster assembly. 6. Inspect oil supply to rocker arms. 7. Install new rocker arm/hydraulic lash adjuster assembly. 8. Ream guides and install new valves with oversize stems. 9. Grind valve seats and valves. 10. Replace rocker arm/hydraulic lash adjuster assembly.
CONNECTING ROD NOISE	1. Insufficient oil supply. 2. Low oil pressure. 3. Thin or diluted oil. 4. Thick oil (b.) Run engine to operating temperature. (c.) Change oil and filter again. 5. Excessive bearing clearance. 6. Connecting rod journal out-of-round. 7. Misaligned connecting rods.	1. Check engine oil level. 2. Check engine oil level. Inspect oil pump relief valve and spring. 3. Change oil to correct viscosity. 3. (a.) Change oil and filter. 5. Measure bearings for correct clearance. Repair as necessary. 6. Replace crankshaft or grind surface. 7. Replace bent connecting rods.
MAIN BEARING NOISE	1. Insufficient oil supply. 2. Low oil pressure. 3. Thin or diluted oil. 4. Thick oil (b.) Run engine to operating temperature. (c.) Change oil and filter again. 4. Excessive bearing clearance.	1. Check engine oil level. 2. Check engine oil level. Inspect oil pump relief valve and spring. 3. Change oil to correct viscosity. 3. (a.) Change oil and filter. 4. Measure bearings for correct

		clearance. Repair as necessary.
	5. Excessive end play.	5. Check thrust bearing for wear on flanges.
	6. Crankshaft journal out-of-round or worn.	6. Replace crankshaft or grind journals.
	7. Loose flywheel or torque converter.	7. Tighten to correct torque.
OIL PRESSURE DROP	1. Low oil level.	1. Check engine oil level.
	2. Faulty oil pressure sending unit.	2. Install new sending unit.
	3. Low oil pressure.	3. Check sending unit and main bearing oil clearance.
	4. Clogged oil filter.	4. Install new oil filter.
	5. Worn parts in oil pump.	5. Replace worn parts or pump.
	6. Thin or diluted oil.	6. Change oil to correct viscosity.
	7. Oil pump relief valve stuck.	7. Remove valve and inspect, clean, or replace.
	8. Oil pump suction tube loose.	8. Remove oil pan and install new tube or clean, if necessary.
	9. Oil pump cover warped or cracked.	9. Install new oil pump.
	10. Excessive bearing clearance.	10. Measure bearings for correct clearance.
OIL LEAKS	1. Misaligned or deteriorated gaskets.	1. Replace gasket(s).
	2. Loose fastener, broken or porous metal part.	2. Tighten, repair or replace the part.
	3. Misaligned or deteriorated cup or threaded plug.	3. Replace as necessary.
OIL CONSUMPTION OR SPARK PLUGS FOULED	1. PCV system malfunction.	1. Check system and repair as necessary. (Refer to Appropriate Diagnostic Information)
	2. Worn, scuffed or broken rings.	2. Hone cylinder bores. Install new rings.
	3. Carbon in oil ring slots.	3. Clean pistons and install new rings.
	4. Rings fitted too tightly in grooves.	4. Remove rings and check grooves. If groove is not proper width, replace piston.
	5. Worn valve guide(s).	5. Replace cylinder head(s).
	6. Valve stem seal(s) worn or damaged.	6. Replace seal(s).

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 such as fouled, hot, oily, etc. Record cylinder number of spark plug for future reference.
4. Remove the Auto Shutdown (ASD) relay from the Totally Integrated Power Module (TIPM).
5. Install a suitable compression test gauge into the #1 spark plug hole in cylinder head.
6. Crank engine until maximum pressure is reached on gauge. Record this pressure as #1 cylinder pressure.
7. Repeat the previous step for all remaining cylinders.
8. Compression should not be less than 689 kPa (100 psi) and not vary more than 25 percent from cylinder to cylinder.
9. If one or more cylinders have abnormally low compression pressures, repeat the compression test.
10. If the same cylinder or cylinders repeat an abnormally low reading on the second compression test, it could indicate the existence of a problem in the cylinder in question. **The recommended compression pressures are to be used only as a guide to diagnosing engine problems. An engine should not be disassembled to determine the cause of low compression unless some malfunction is present.**

CYLINDER COMBUSTION PRESSURE LEAKAGE TEST

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

Combustion pressure leakage testing will detect:

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

WARNING: DO NOT REMOVE THE 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.

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 Information procedures.
    - If the leakage occurs at the crankshaft rear oil seal area, refer to **INSPECTION FOR REAR**

SEAL AREA LEAKS.

6. If no leaks are detected, turn off the air supply. Remove the air hose, all plugs, and caps. Install the PCV valve and fresh air hose (make-up air). Proceed to next step.
7. Clean the oil off the suspect oil leak area using a suitable solvent. Drive the vehicle at various speeds approximately 24 km (15 miles). Inspect the engine for signs of an oil leak by using a black light.

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

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

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.

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, bed plate to cylinder block mating surfaces and seal bore. See proper repair procedures for these items.
4. If no leaks are detected, pressurize the crankcase as previously described in step 5 under ENGINE OIL LEAK INSPECTION.

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

ENGINE GASKET SURFACE PREPARATION

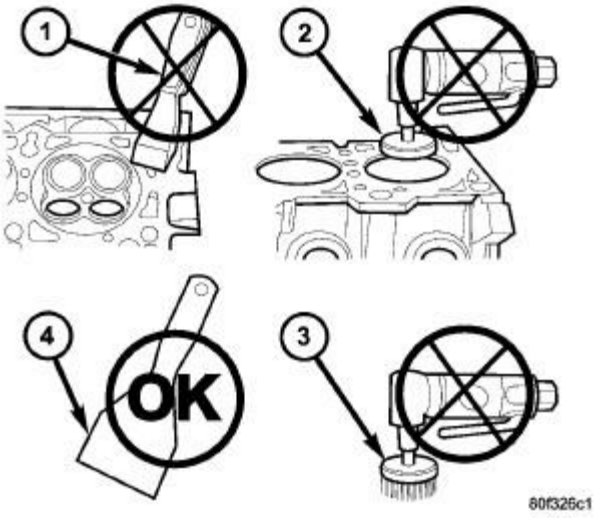

Fig. 4: PROPER TOOL USAGE FOR SURFACE PREPARATION
Courtesy of CHRYSLER LLC

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 (1).
- Abrasive pad or paper to clean cylinder block and head.
- High speed power tool with an abrasive pad or a wire brush (2,3).

Fig. 5: PROPER TOOL USAGE FOR SURFACE PREPARATION
Courtesy of CHRYSLER LLC

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 (4).

Sealing surfaces must be free of grease or oil residue. Clean surfaces with Mopar® brake parts cleaner (or equivalent).

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.

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 reoccurring.

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.

FORM-IN-PLACE GASKETS AND SEALERS

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

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

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

MOPAR® ATF RTV is a specifically designed black silicone rubber RTV that retains adhesion and sealing

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

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

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

MOPAR® GASKET SEALANT is a slow drying, permanently soft sealer. This material is recommended for sealing threaded fittings and gaskets against leakage of oil and coolant. Can be used on threaded and machined parts under all temperatures. This material also will prevent corrosion. Mopar® Gasket Sealant is available in a 13 oz. aerosol can or 4oz./16 oz. can w/applicator.

SEALER APPLICATION

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

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

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

ENGINE CORE AND OIL GALLERY PLUGS

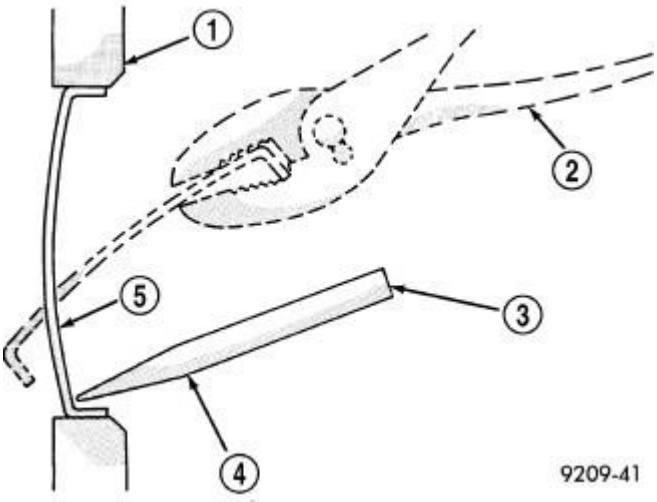

Fig. 6: Core Hole Plug Removal
Courtesy of CHRYSLER LLC

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

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.

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

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

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

REMOVAL

REMOVAL

1. Remove the engine cover.
2. Release fuel pressure. Refer to **Fuel System/Fuel Delivery - Standard Procedure** .
3. Disconnect negative battery cable.

4. Drain cooling system. Refer to **Cooling - Standard Procedure** .
5. Evacuate the A/C system using a suitable refrigerant recovery machine. Refer to **Heating and Air Conditioning/Plumbing - Standard Procedure** .
6. Remove throttle body air inlet hose and air cleaner housing assembly. See **Engine/Air Intake System/BODY, Air Cleaner - Removal**.
7. Raise vehicle on hoist.
8. Remove both front wheels.

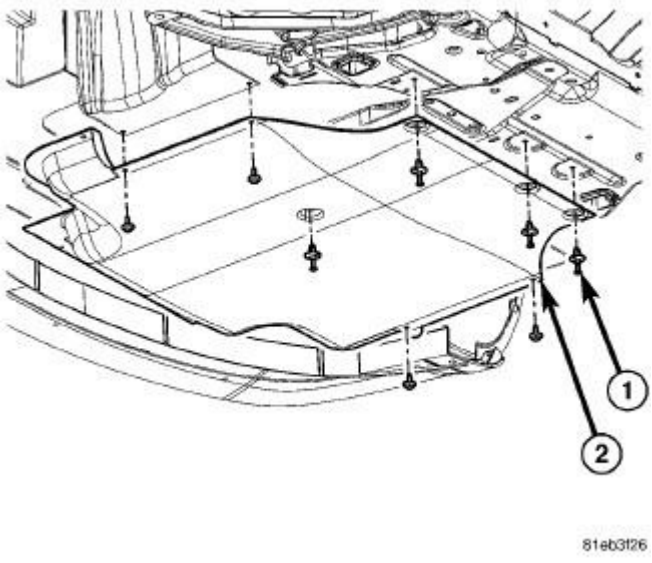

Fig. 7: Belly Pan
Courtesy of CHRYSLER LLC

1 - Belly Pan Fasteners
2 - Belly Pan

9. Remove fasteners (1), and remove the belly pan (2).

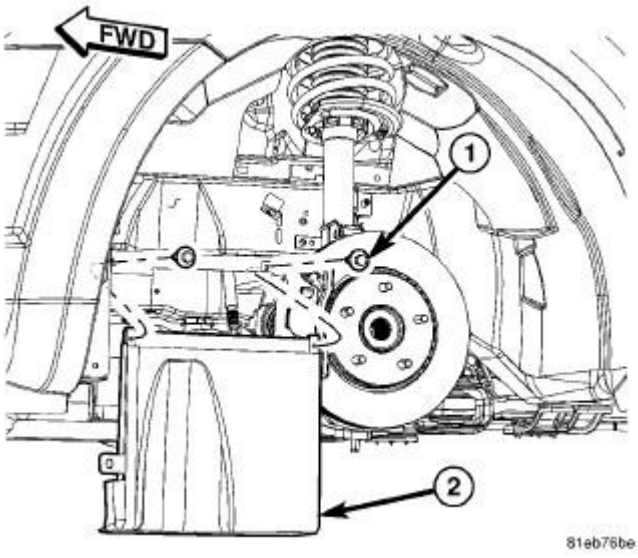

Fig. 8: Left Lower Splash Shield
Courtesy of CHRYSLER LLC

10. Remove the left lower splash shield (2).

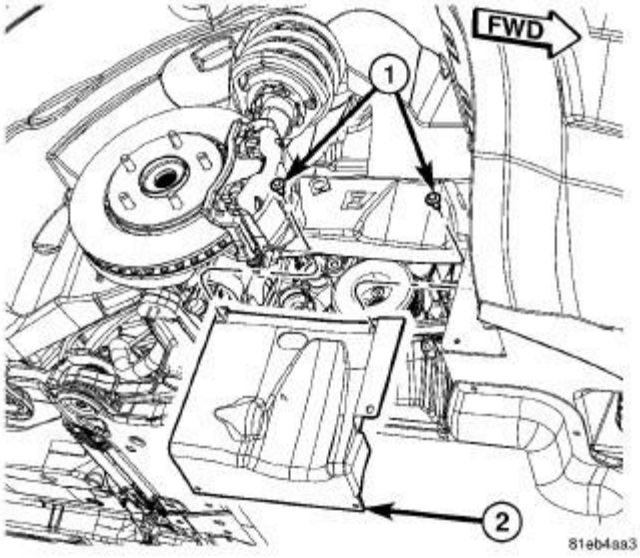

Fig. 9: Right Lower Splash Shield
Courtesy of CHRYSLER LLC

11. Remove the right lower splash shield (2).

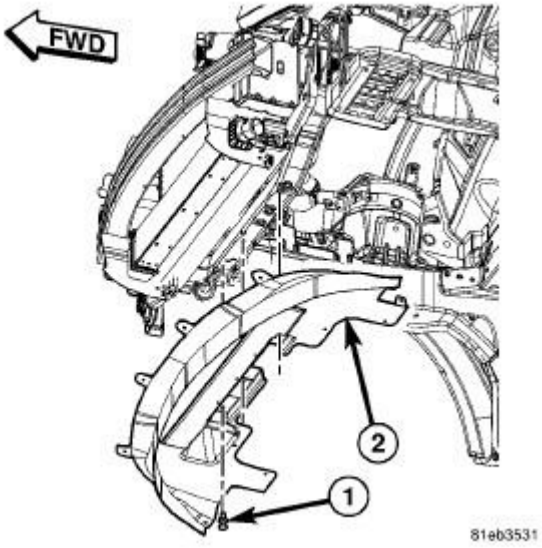

Fig. 10: Lower Fascia Closeout Panel
Courtesy of CHRYSLER LLC

12. Remove the lower fascia closeout panel (2).
13. Lower vehicle.

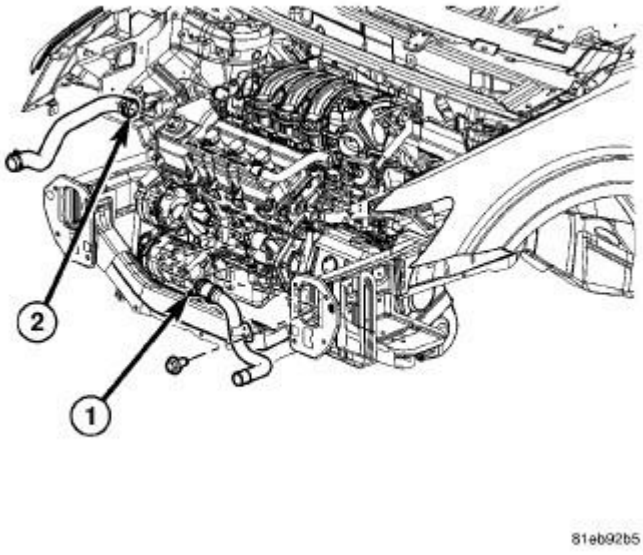

Fig. 11: Upper/Lower Radiator Hoses
Courtesy of CHRYSLER LLC

14. Disconnect upper (2) and lower (1) radiator hoses at the thermostat housing and at the water pump fitting.

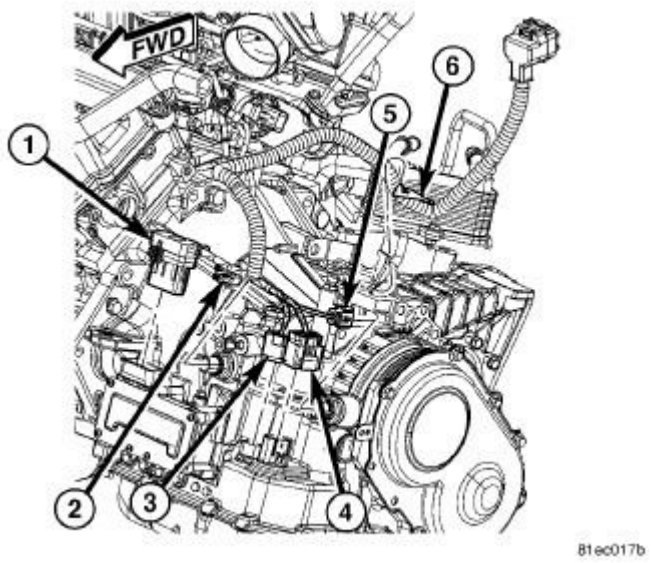

Fig. 12: Transmission Control Module Harness Connector
Courtesy of CHRYSLER LLC

15. Disconnect transmission control module harness connector (1).
16. Disconnect transmission solenoid harness connectors (3) and (4).
17. Disconnect transmission input shaft speed sensor (2) and the output shaft speed sensor (5).
18. Disconnect transmission shift cable.
19. Disconnect the transaxle oil cooler lines at the transaxle.

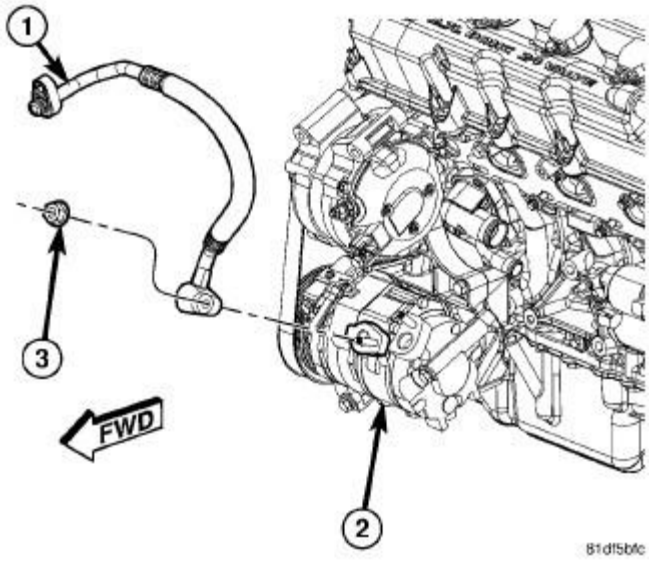

Fig. 13: A/C Discharge Line At Compressor
Courtesy of CHRYSLER LLC

20. Disconnect A/C discharge line (1) at compressor (2).

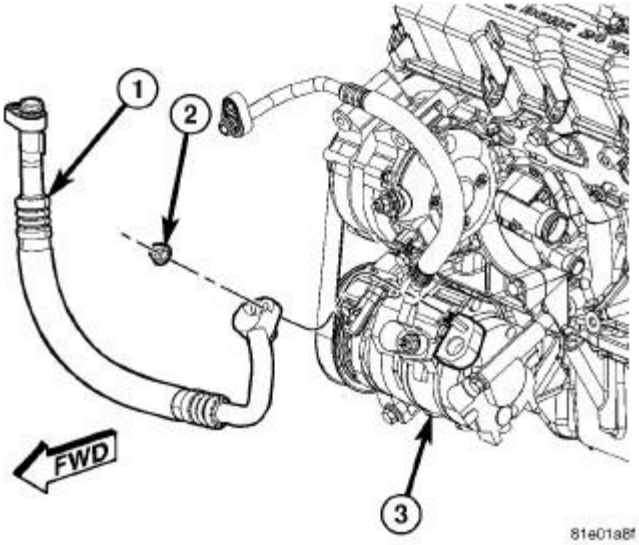

Fig. 14: A/C Compressor To Bracket
Courtesy of CHRYSLER LLC

21. Disconnect A/C suction line (1) at compressor (2).
22. Remove the A/C compressor (3). Refer to **Heating and Air Conditioning/Plumbing/COMPRESSOR, A/C - Removal** .
23. Remove cooling fan assembly. Refer to **Cooling/Engine/FAN, Cooling - Removal** .

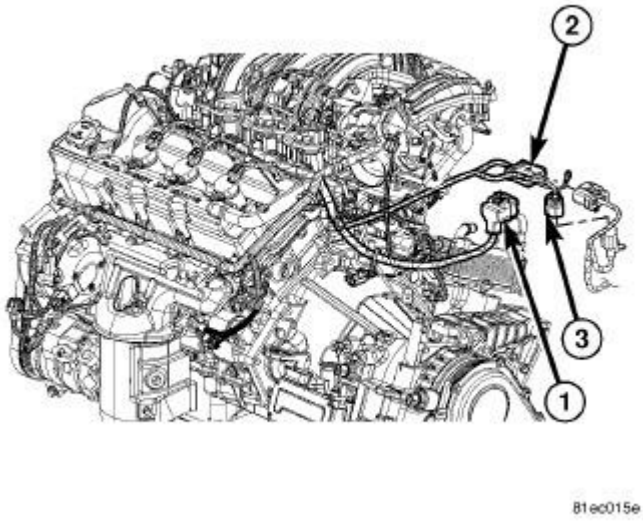

Fig. 15: Engine Electrical Harnesses Connectors
Courtesy of CHRYSLER LLC

24. Disconnect engine electrical harnesses connectors (1), (2) and (3).
25. Raise vehicle.

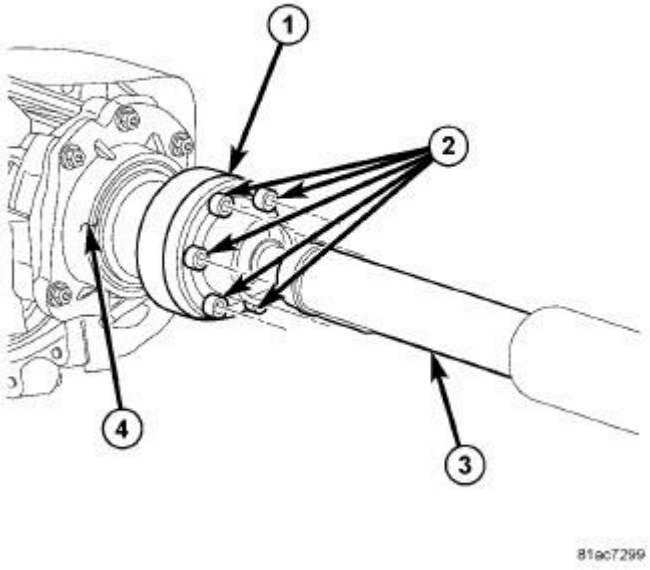

Fig. 16: Propeller Shaft To PTU Fasteners
Courtesy of CHRYSLER LLC

26. If equipped with AWD, remove the propeller shaft to PTU fasteners (2). Refer to **Differential and Driveline/Propeller Shaft - Removal** .

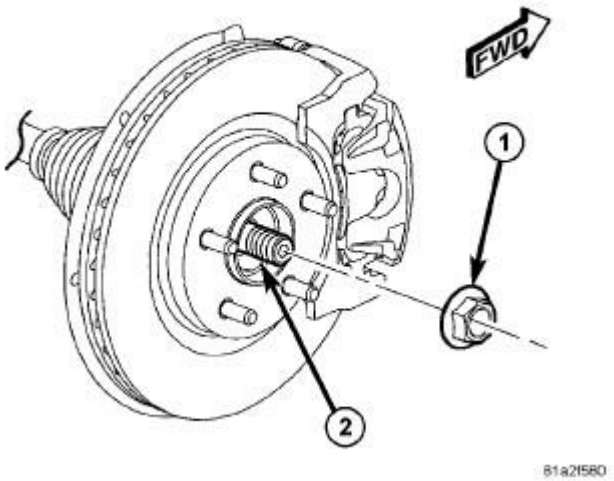

Fig. 17: Axle Shafts Hub Nut

Courtesy of CHRYSLER LLC

27. Remove both axle shafts (2). Refer to **Differential and Driveline/Half Shaft - Removal** .

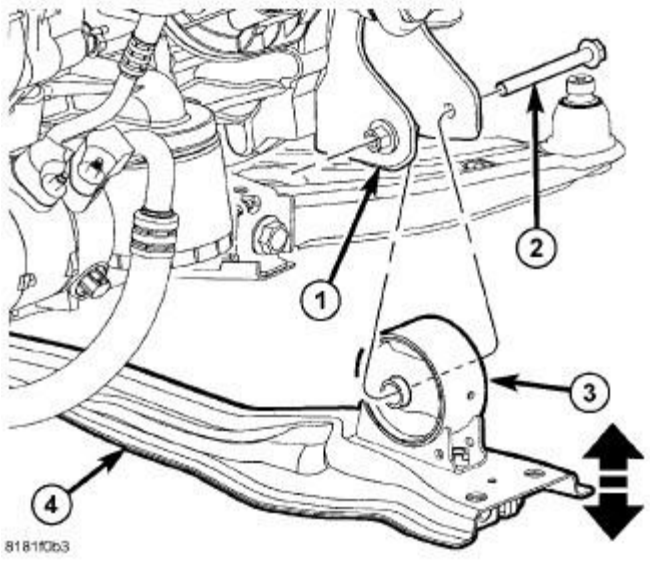

Fig. 18: Front Engine Mount Through Bolt
Courtesy of CHRYSLER LLC

28. Remove front engine mount through bolt (2).

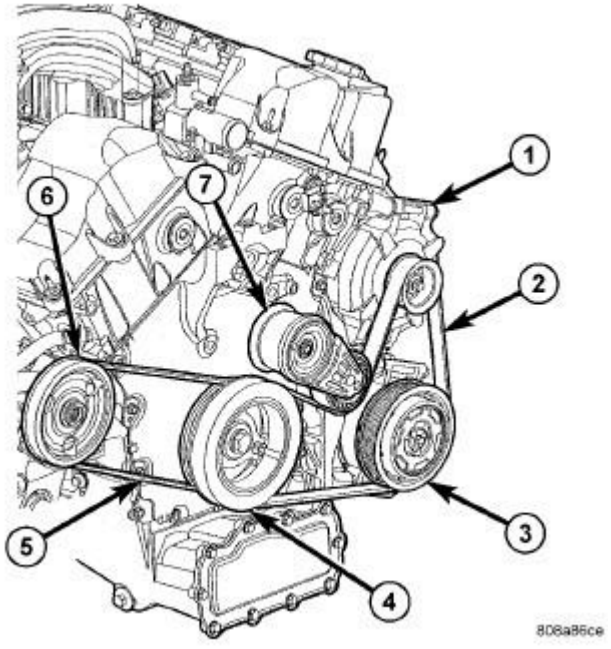

Fig. 19: Accessory Drive Belt System - 2.7L
Courtesy of CHRYSLER LLC

1 - GENERATOR 2 - IDLER/TENSIONER

29. Remove accessory drive belts (2) and (5). Refer to **Cooling/Accessory Drive/BELT, Serpentine - Removal** .
30. Remove power steering pump and bracket as an assembly. **Do not** disconnect power steering lines from pump. Reposition pump and support with suitable retaining strap.

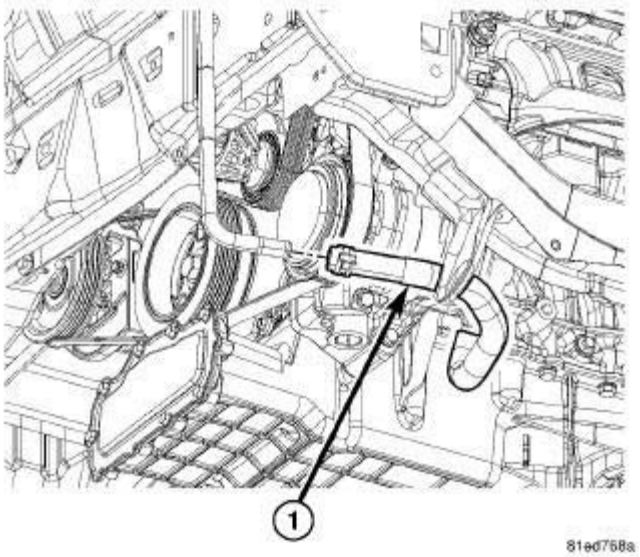

Fig. 20: Heater Return Hose
Courtesy of CHRYSLER LLC

31. Disconnect heater return hose (1) from pipe connection at right front frame rail area.

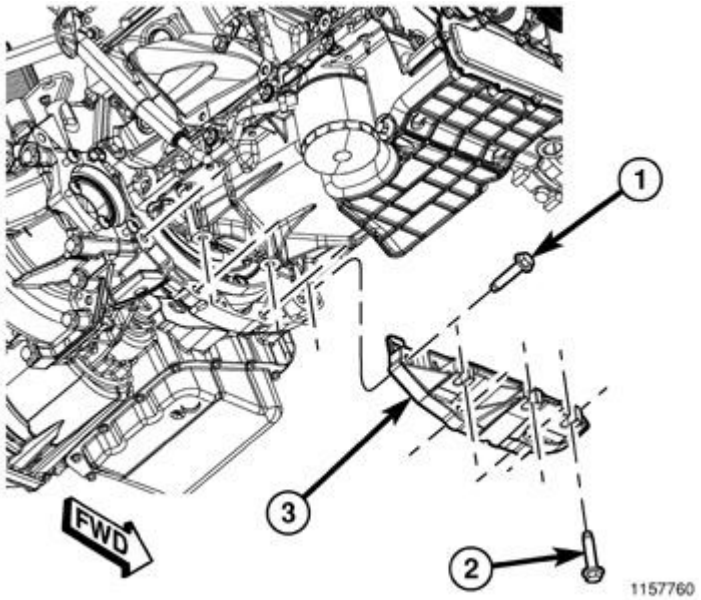

Fig. 21: Structural Collar
Courtesy of CHRYSLER LLC

32. Remove structural collar (3). See **Engine/Engine Block/COVER, Structural Dust - Removal**.

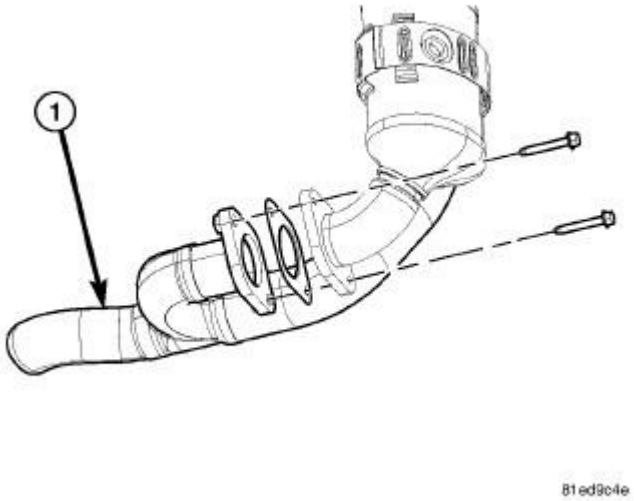

Fig. 22: Exhaust Cross-Under Pipe
Courtesy of CHRYSLER LLC

33. Remove the exhaust cross-under pipe (1). See **Engine/Manifolds/MANIFOLD, Exhaust - Removal**.

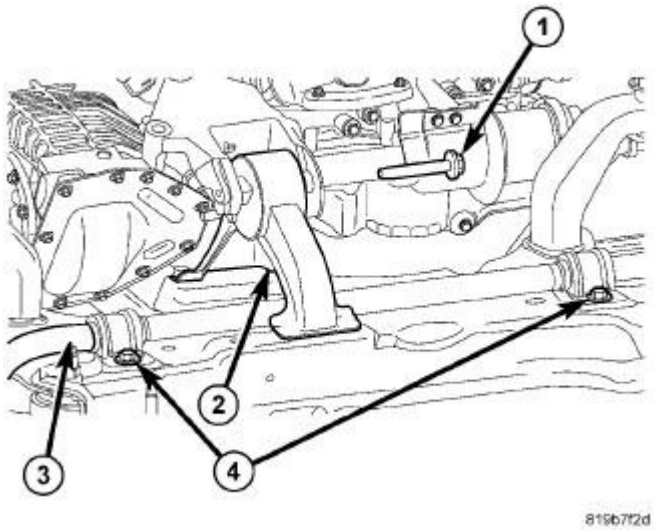

Fig. 23: Rear Engine Mount & Transaxle Bracket
Courtesy of CHRYSLER LLC

34. Remove rear engine mount and transaxle bracket (2).
35. Drain engine oil.
36. Remove transaxle torque converter housing cover.
37. Mark flex plate to torque converter position. Remove torque converter bolts.
38. Lower vehicle.
39. Disconnect positive cable from battery and TIPM.
40. Disconnect ground cable from left side transaxle mount bracket.

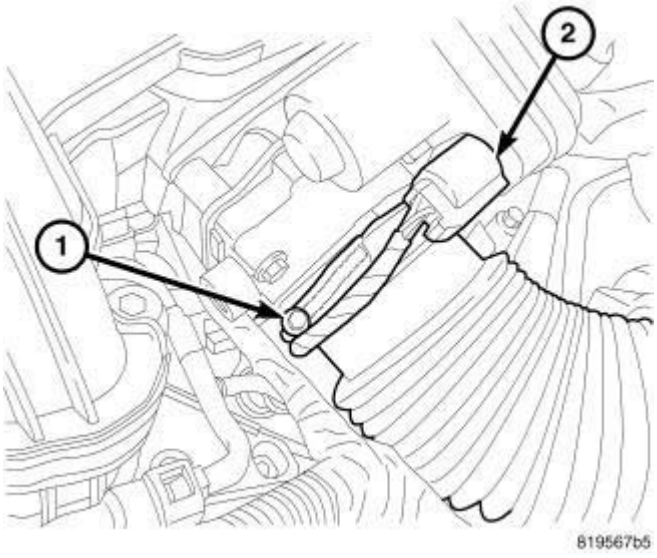

Fig. 24: Electronic Throttle Control Harness Connector
Courtesy of CHRYSLER LLC

41. Disconnect ETC harness connector (1) from throttle body.

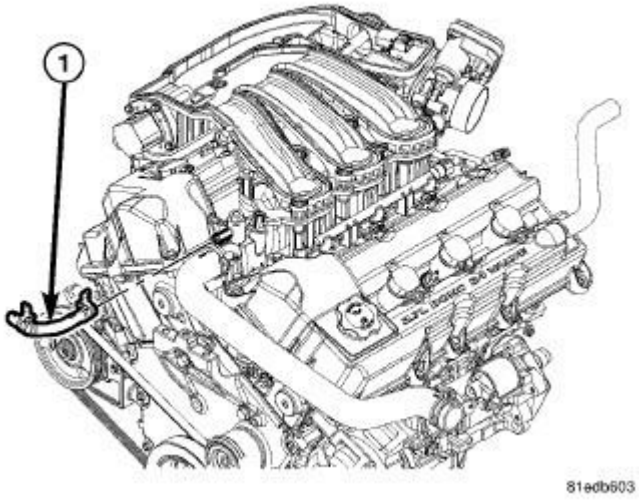

Fig. 25: Coolant Pressure Bottle Coolant Hose
Courtesy of CHRYSLER LLC

42. Disconnect coolant pressure bottle coolant hose (1) from engine coolant outlet connector.

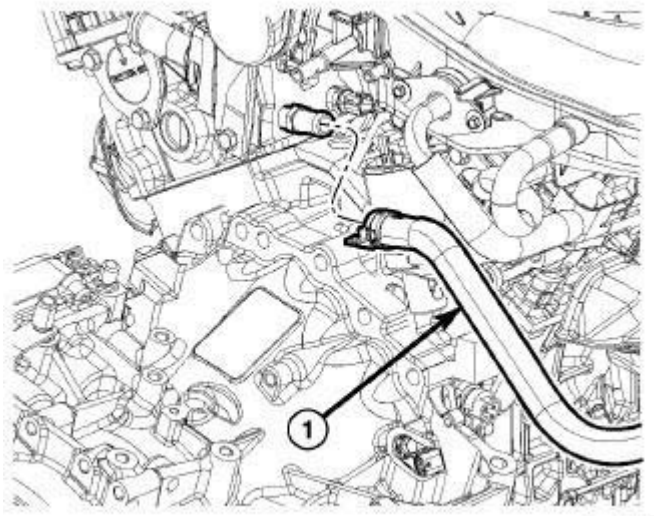

Fig. 26: Heater Hose From Engine Coolant Outlet
Courtesy of CHRYSLER LLC

43. Disconnect heater hose (1) from engine coolant outlet below the ETC.

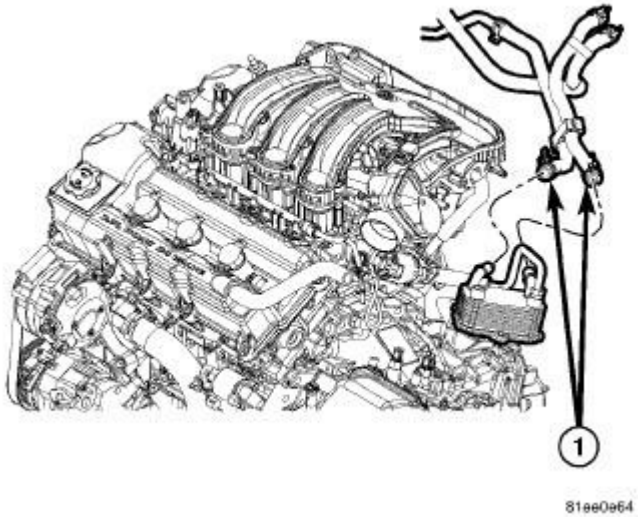

Fig. 27: Oil Cooler Lines
Courtesy of CHRYSLER LLC

44. If equipped, disconnect the oil cooler lines (1) from the engine oil cooler.
45. Disconnect ground strap at right shock tower.

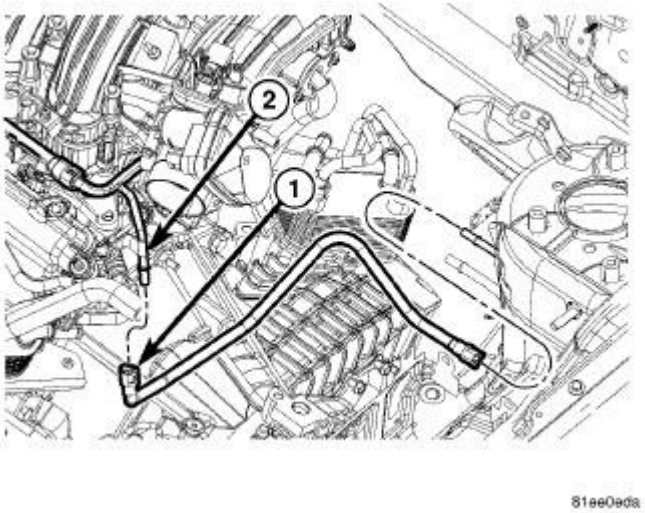

Fig. 28: Fuel Line From Fuel Rail Inlet
Courtesy of CHRYSLER LLC

46. Disconnect fuel line (1) from fuel rail inlet (2).

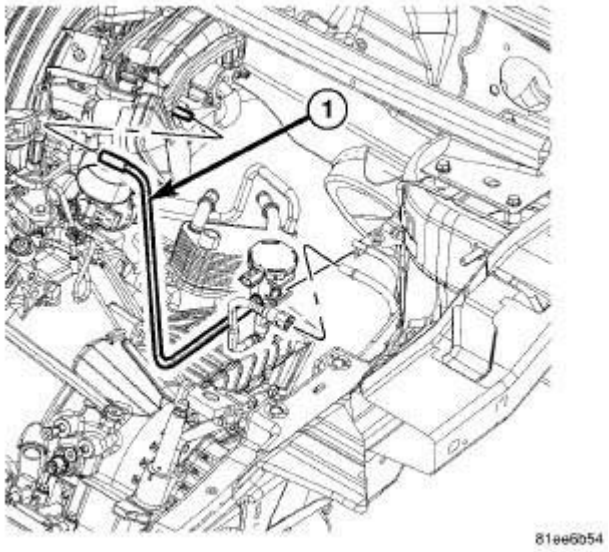

Fig. 29: Vapor Purge Vacuum Hose
Courtesy of CHRYSLER LLC

47. Disconnect vapor purge vacuum hose (1).

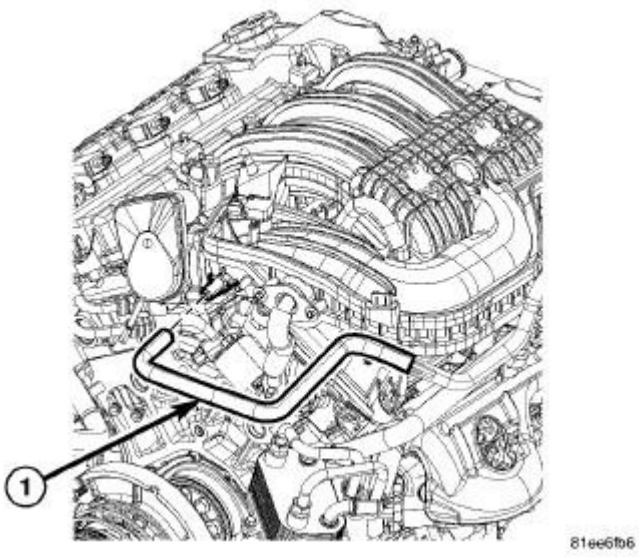

Fig. 30: Brake Booster Vacuum Hose
Courtesy of CHRYSLER LLC

48. Disconnect brake booster vacuum hose (1).
49. Disconnect all ground straps attaching to engine.
50. Position vehicle height to allow engine dolly 6135 and cradle 6710A with posts 6848 to be installed under vehicle.
51. Loosen cradle engine mounts to allow movement for positioning onto engine locating holes on the engine block, compressor mount bracket and oil pan rail. Lower vehicle and position cradle until the engine is resting on posts. Tighten post mounts to cradle frame to prevent movement when removing or installing engine/transaxle assembly. Secure engine/transaxle assembly to dolly/cradle with safety straps.
52. Lower vehicle so weight of the engine and transmission ONLY is on the cradle.
53. Remove right and left side engine mount bolts.
54. Slowly raise vehicle in short length spans. Inspect at each interval for potential engine or transaxle contact to vehicle components. Move the cradle/dolly fixture as necessary to allow for removal clearance.

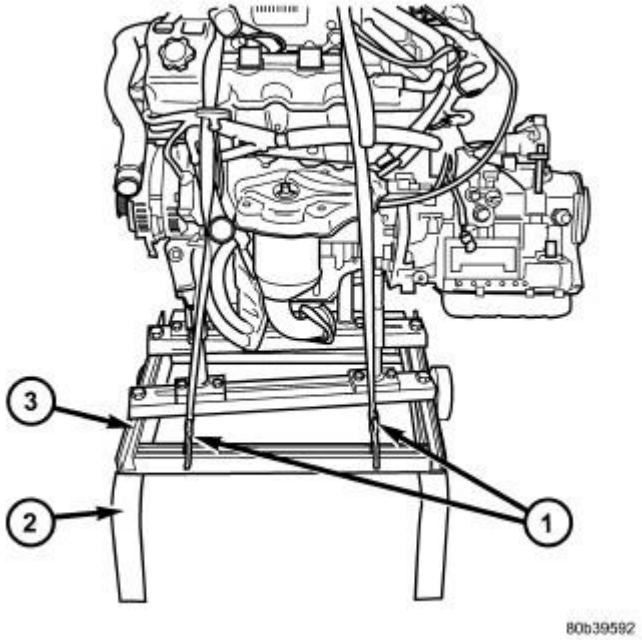

Fig. 31: ENGINE REMOVAL CRADLE
Courtesy of CHRYSLER LLC

1 - SAFETY STRAPS
2 - SPECIAL TOOL 6135
3 - SPECIAL TOOL 6710

INSTALLATION

INSTALLATION

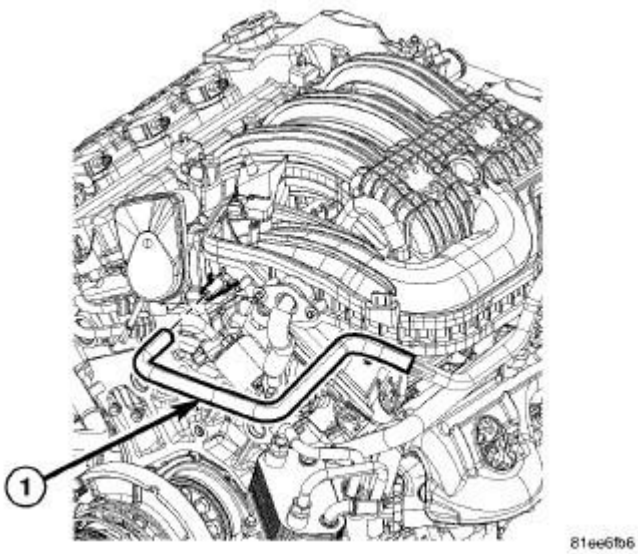

Fig. 32: Brake Booster Vacuum Hose
Courtesy of CHRYSLER LLC

1. Position engine/transaxle assembly under vehicle and slowly lower vehicle in short length spans. Inspect at each interval for potential engine or transaxle contact to vehicle components. Move the cradle/dolly fixture as necessary to allow for installation clearance.
2. Continue lowering vehicle until right side engine mount and left side transaxle mount align to their mounting locations. Install mounting bolts and torque to 61 N.m (45 ft. lbs.).
3. Remove safety straps from engine/transaxle assembly. Slowly raise vehicle enough to remove the engine dolly and cradle.
4. Reattach all ground straps to engine.
5. Connect brake booster vacuum hose (1).

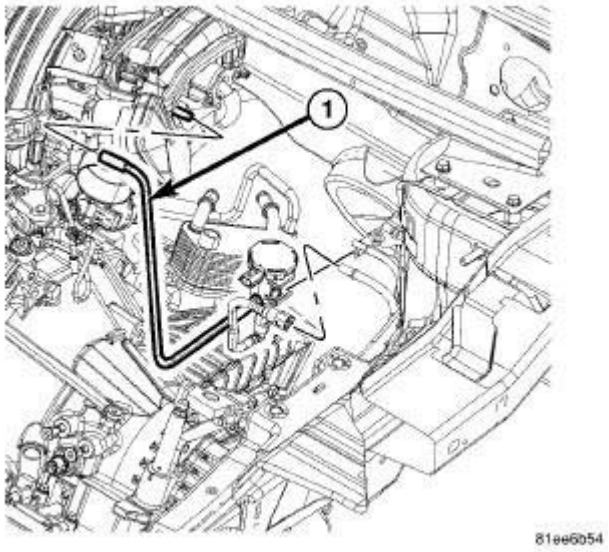

Fig. 33: Vapor Purge Vacuum Hose
Courtesy of CHRYSLER LLC

6. Connect vapor purge vacuum hose (1).

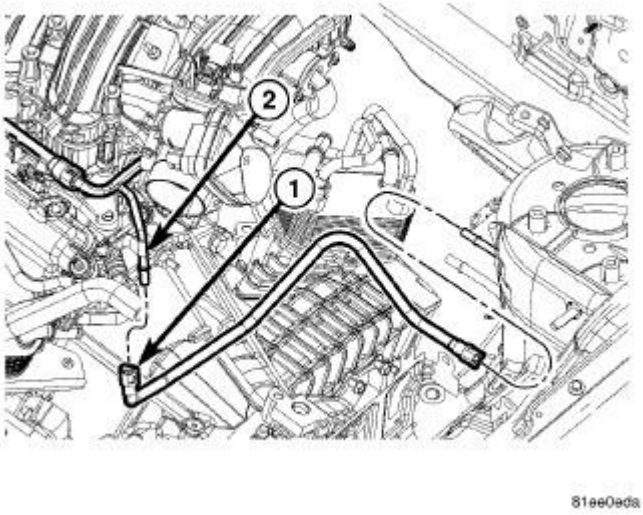

Fig. 34: Fuel Line From Fuel Rail Inlet
Courtesy of CHRYSLER LLC

7. Connect fuel line (1).
8. Connect ground strap to right shock tower.

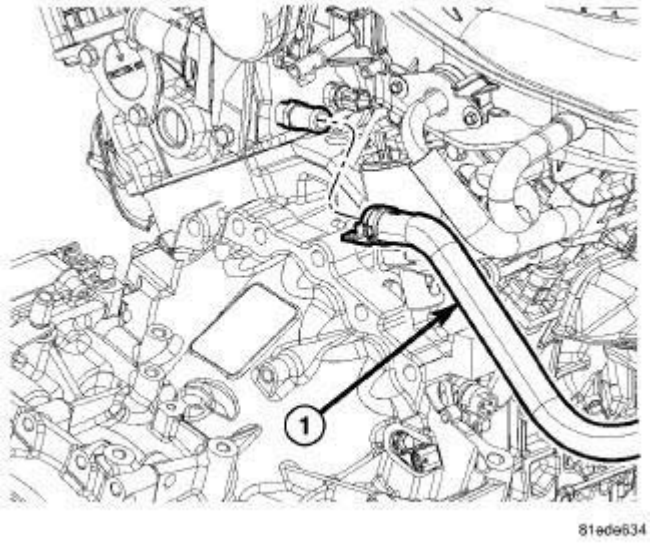

Fig. 35: Heater Hose From Engine Coolant Outlet
Courtesy of CHRYSLER LLC

9. Connect the heater hose (1) to the engine coolant outlet below the ETC.

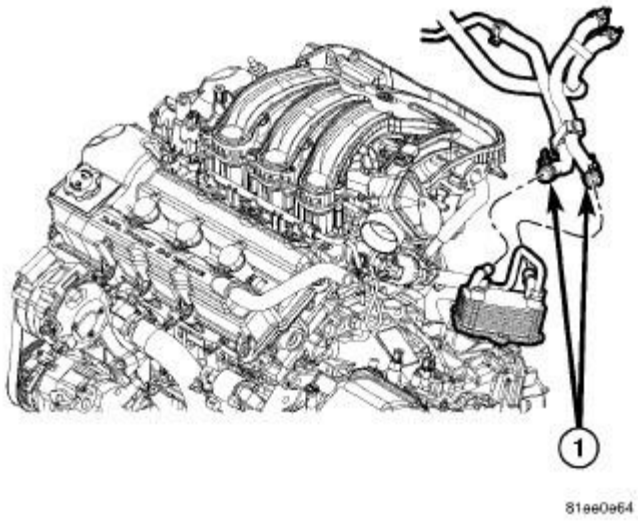

Fig. 36: Oil Cooler Lines
Courtesy of CHRYSLER LLC

10. If equipped, reconnect the oil cooler lines (1) from the engine oil cooler.

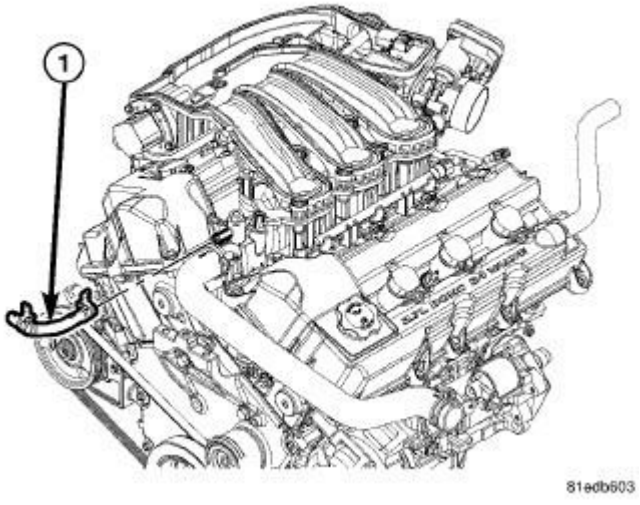

Fig. 37: Coolant Pressure Bottle Coolant Hose
Courtesy of CHRYSLER LLC

11. Connect coolant pressure bottle coolant hose (1) to coolant outlet connector.

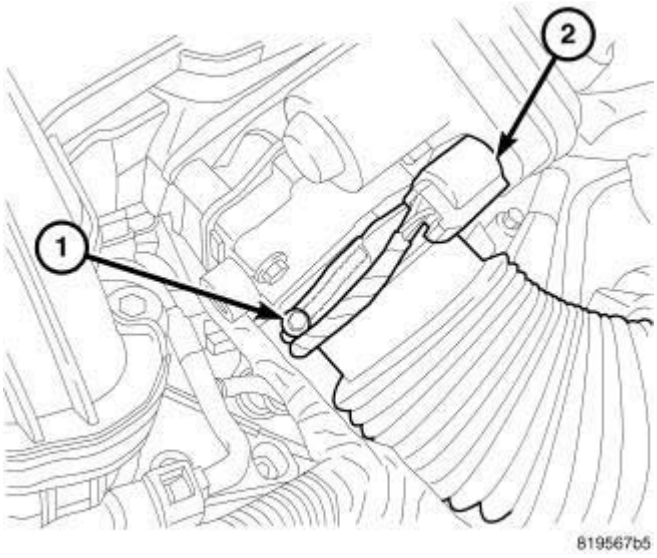

Fig. 38: Electronic Throttle Control Harness Connector
Courtesy of CHRYSLER LLC

12. Connect ETC harness connector (2).
13. Connect ground cable to right engine mount bracket.
14. Connect positive cable to battery and TIPM.
15. Raise vehicle.
16. **Automatic Transmission Equipped Vehicles:**
    - Install torque converter bolts.
    - Install torque converter housing cover.
17. **Manual Transmission Equipped Vehicles:**

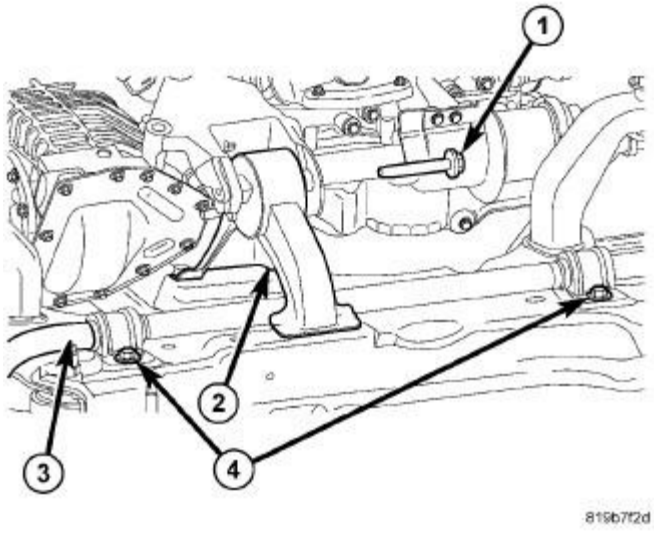

Fig. 39: Rear Engine Mount & Transaxle Bracket

Courtesy of CHRYSLER LLC

- Install modular clutch assembly-to-drive plate bolts.
- Install clutch/drive plate inspection cover.
- Connect clutch hydraulic circuit quick connect fitting.

18. Install rear engine mount (2) and transaxle bracket.

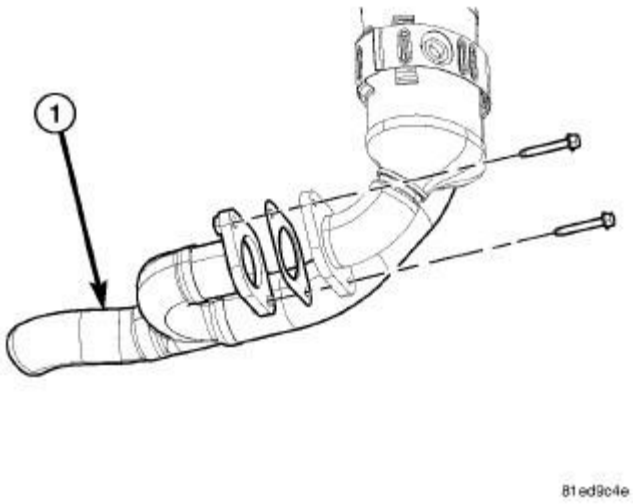

Fig. 40: Exhaust Cross-Under Pipe
Courtesy of CHRYSLER LLC

19. Install exhaust cross-under pipe (1). See **Engine/Manifolds/MANIFOLD, Exhaust - Removal**.

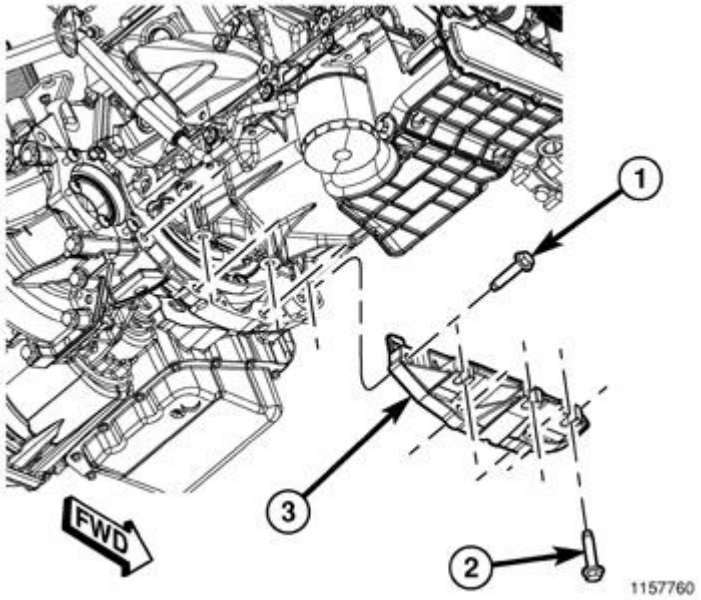

Fig. 41: Structural Collar
Courtesy of CHRYSLER LLC

20. Install structural collar (3). See **Engine/Engine Block/COVER, Structural Dust - Installation**.

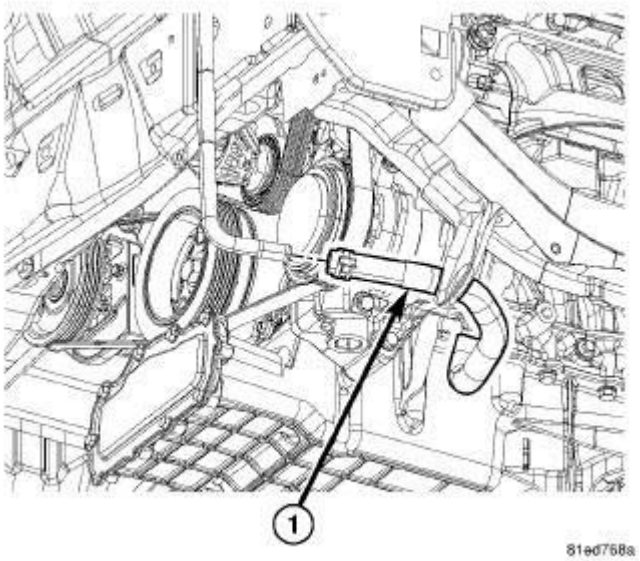

Fig. 42: Heater Return Hose
Courtesy of CHRYSLER LLC

21. Reconnect the heater return hose (1) from the pipe connection at the right front frame rail area.

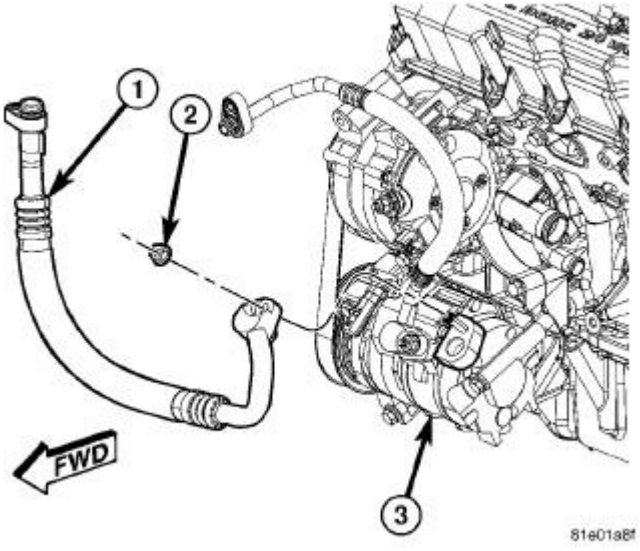

Fig. 43: A/C Compressor To Bracket
Courtesy of CHRYSLER LLC

22. Install A/C compressor (3) to bracket.
23. Connect A/C compressor clutch electrical connector.
24. Install power steering pump and bracket assembly. Refer to **Steering/Pump - Installation** .

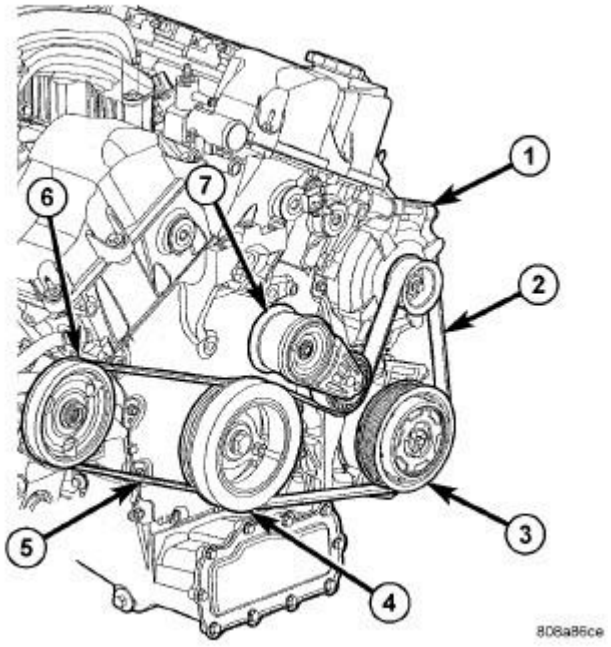

Fig. 44: Accessory Drive Belt System - 2.7L
Courtesy of CHRYSLER LLC

1 - GENERATOR
2 - IDLER/TENSIONER

25. Install accessory drive belts (2) and (5). Refer to **Cooling/Accessory Drive/BELT, Serpentine - Installation** .

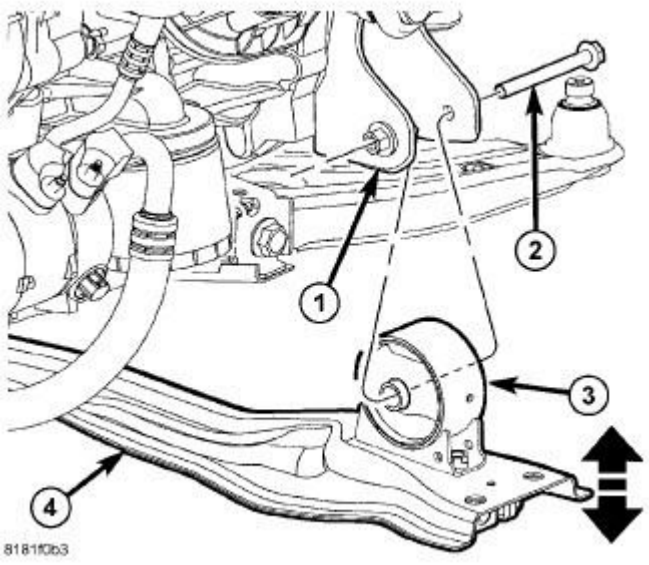

Fig. 45: Front Engine Mount Through Bolt
Courtesy of CHRYSLER LLC

26. Install the fore-aft crossmember. Refer to **Frame and Bumpers/Frame/CROSSMEMBER - Installation** .
27. Install front engine mount through bolt (2).

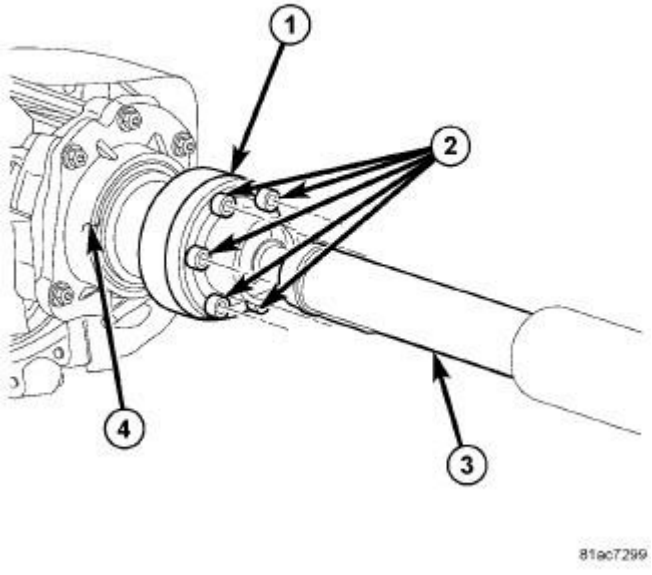

Fig. 46: Propeller Shaft To PTU
Courtesy of CHRYSLER LLC

28. Connect the propeller shaft (3) to the PTU. Refer to **Differential and Driveline/Propeller Shaft - Installation** .

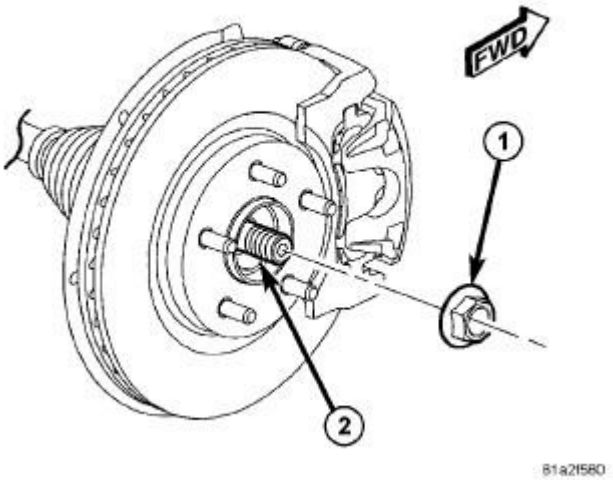

Fig. 47: Axle Shafts Hub Nut
Courtesy of CHRYSLER LLC

29. Install both axle shafts (2). Refer to **Differential and Driveline/Half Shaft - Installation** .
30. Lower vehicle.
31. Install the cooling fan assembly. Refer to **Cooling/Engine/FAN, Cooling - Installation** .

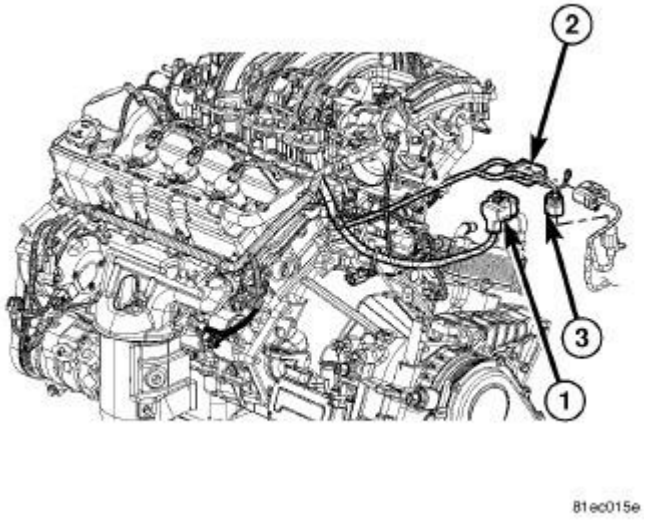

Fig. 48: Engine Electrical Harnesses Connectors
Courtesy of CHRYSLER LLC

32. Connect engine electrical harness connectors (1), (2), and (3) to PCM and bulkhead connectors.

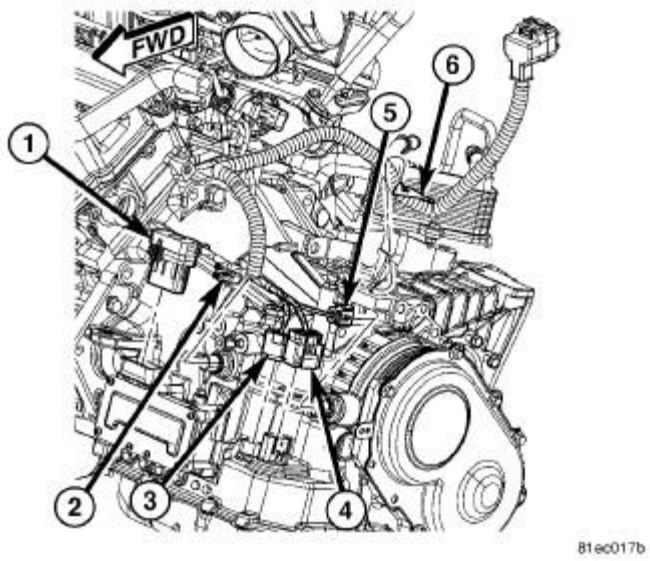

Fig. 49: Transmission Control Module Harness Connector
Courtesy of CHRYSLER LLC

33. **Automatic Transmission Equipped Vehicles:**
    - Connect transmission shift cable.
    - Connect transmission electrical harness connectors (1), (2), (3), (4) and (5).
    - Connect transmission oil cooler lines.
34. **Manual Transmission Equipped Vehicles:**

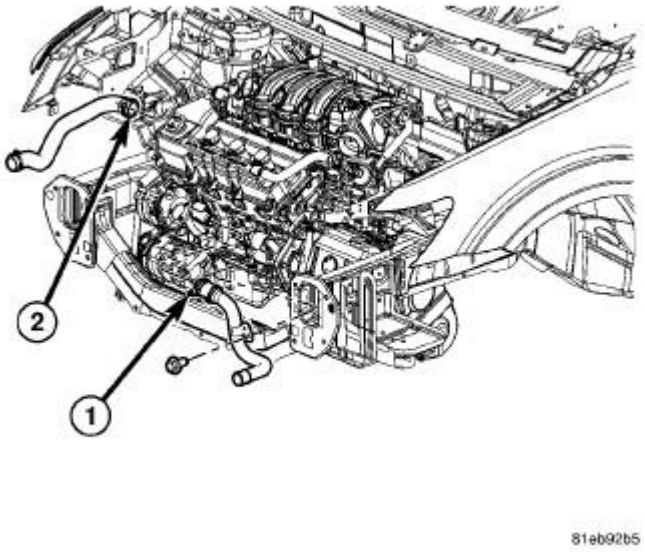

Fig. 50: Upper/Lower Radiator Hoses

Courtesy of CHRYSLER LLC

- Connect transmission shift cables. Refer to **Transmission and Transfer Case/Manual/CABLE, Gearshift Control - Installation** .
- Connect back up lamp switch connector.

35. Connect upper (2) and lower (1) radiator hoses.
36. Raise vehicle.
37. Ensure oil pan drain plug is installed. Install new oil filter.

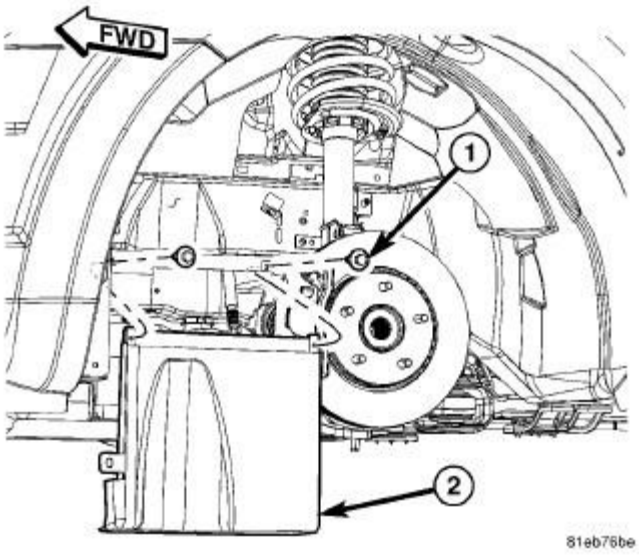

Fig. 51: Left Lower Splash Shield
Courtesy of CHRYSLER LLC

38. Install left lower splash shield (2).

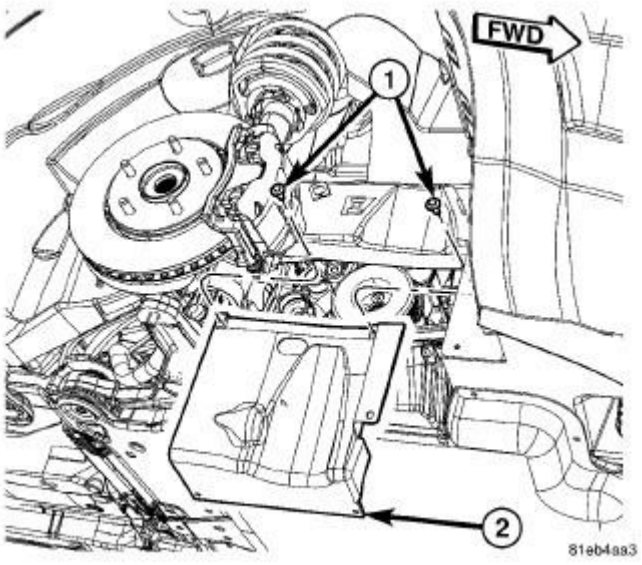

Fig. 52: Right Lower Splash Shield
Courtesy of CHRYSLER LLC

39. Install the right splash shield (2).
40. Install both front wheels (1).
41. Lower vehicle.
42. Install throttle body air inlet hose and air cleaner housing assembly. See **Engine/Air Intake System/BODY, Air Cleaner - Installation**.
43. Fill engine crankcase with proper oil to correct level.
44. Evacuate and recharge Air Conditioning system. Refer to **Heating and Air Conditioning/Plumbing - Standard Procedure** .
45. Fill cooling system. Refer to **Cooling - Standard Procedure** .
46. Connect negative battery cable.
47. Start engine and run until operating temperature is reached. Inspect for leaks, and verify normal operation.

NOTE: The Cam/Crank Variation Relearn procedure must be performed anytime there has been a repair/replacement made to a powertrain system, for example: flywheel, valvetrain, camshaft and/or crankshaft sensors or components. Refer to DTC-Based Diagnostics/MODULE, Powertrain Control (PCM) - Standard Procedure .

SPECIFICATIONS

2.7L ENGINE

GENERAL SPECIFICATIONS

DESCRIPTION	SPECIFICATION	
Type	60° DOHC V6 24-Valve	
Compression Ratio	9.67:1	
Lead Cylinder	#1 Right Bank	
Firing Order	1-2-3-4-5-6	
-	**Metric**	**Standard**
Displacement	2.7 Liters	167 Cubic Inches
Bore AND Stroke	86.0 x 78.5 mm	3.386 in. x 3.091 in.

CYLINDER BLOCK

Description	Specification	
	Metric	**Standard**
Cylinder Bore Diameter	86.0 mm ±0.0076	3.3859 in. ±0.0003
Out of Round (Max.)	0.076 mm	0.003 in.
Taper (Max.)	0.051 mm	0.002 in.

PISTONS

Description	Specification	
	Metric	**Standard**
Material	Aluminum Alloy	
Piston Diameter	85.983 mm ±0.019	3.3851 in. ±0.0017
Clearance at Size Location	- 0.0096 to +0.0436 mm	- 0.0003 to +0.0016 in.
Piston Weight	316-326 grams	11.1466-11.4994 oz.
Piston Ring Groove Diameter-No. 1	77.8-78 mm	3.063-3.070 in.
Piston Ring Groove Diameter-No. 2	75.9-76.1 mm	2.988-2.996 in.
Piston Ring Groove Diameter-No. 3	76.5-76.7 mm	3.011-3.019 in.

PISTON PINS

Description	Specification	
	Metric	**Standard**
Type	Full Floating	
Pin Diameter	21.997-22.000 mm	0.8661-0.8662 in.
Clearance in Piston	0.005-0.013 mm	0.0002-0.0005 in.
Clearance in Rod	0.007-0.018 mm	0.0003-0.0008 in.

PISTON RINGS

Description	Specification	
	Metric	**Standard**

Ring Gap-Top Compression Ring	0.20-0.36 mm	0.008-0.014 in.
Ring Gap-2nd Compression Ring	0.37-0.63 mm	0.0146-0.0249 in.
Ring Gap-Oil Control (Steel Rails)	0.25-0.76 mm	0.010-0.030 in.

PISTON RING SIDE CLEARANCE

Description	Specification	
	Metric	Standard
Compression Ring-Top	0.035-0.083 mm	0.0013-0.0032 in.
Compression Ring-Second	0.040-0.080 mm	0.0016-0.0031 in.
Oil Ring (Steel Rails)	0.058-0.204 mm	0.0022-0.0080 in.

PISTON RING WIDTH

Description	Specification	
	Metric	Standard
Compression Rings-Top and Second	1.47-1.49 mm	0.0579-0.0587 in.
Oil Ring (Steel Rails	0.445-0.470 mm	0.0176-0.0186 in.

CONNECTING RODS

Description	Specification	
	Metric	Standard
Bearing Clearance	0.024-0.064 mm	0.001-0.0026 in.
Side Clearance	0.13-0.38 mm	0.0052-0.015 in.
Side Clearance (Max.)	0.4318 mm	0.017 in.
Piston Pin Bore Diameter	22.007-22.015 mm	0.8665-0.8668 in.
Bearing Bore Out of Round (Max.)	0.004 mm	0.0002 in.
Total Weight (Less Bearing)	529.9 ±7 grams	18.6917 ±0.247 oz.

CRANKSHAFT MAIN BEARING JOURNALS

Description	Specification	
	Metric	Standard
Diameter	63.49-63.51 mm	2.4997-2.5004 in.
Bearing Clearance	0.035-0.053 mm	0.0014-0.0021 in.
Bearing Clearance (Max.)	0.087 mm	0.0034 in.
Out of Round (Max.)	0.015 mm	0.0006 in.
Taper (Max.)	0.015 mm	0.0006 in.
End Play	0.0475-0.2725 mm	0.0019-0.0108 in.
End Play (Max.)	0.43 mm	0.017 in.

CONNECTING ROD JOURNALS

Description	Specification	
	Metric	Standard
Diameter	53.51-53.49 mm	2.1067-2.106 in.
Bearing Clearance	0.024-0.064 mm	0.001-0.0026 in.
Out of Round (Max.)	0.015 mm	0.0006 in.
Taper (Max.)	0.015 mm	0.0006 in.

CAMSHAFT

Description	Specification	
	Metric	Standard
Bore Diameter	24.050-24.071 mm	0.9469-0.09476 in.
Bearing Journal Diameter	24.000-23.981	0.9449-0.9441 in.
Bearing Clearance	0.05-0.09 mm	0.0020-0.0035 in.
Bearing Clearance (Max.)	0.13 mm	0.0051 in.
End Play	0.13 mm	0.0051-0.0110 in.

VALVE TIMING-INTAKE VALVES

Description	Specification
Opens (ATDC)	2°
Closes (ABDC)	44°
Duration	222°

VALVE TIMING-EXHAUST VALVES

Description	Specification
Opens (BBDC)	36°
Closes (ATDC)	4°
Duration	220°
Valve Overlap	2°

CYLINDER HEAD

Description	Specification	
	metric	Standard
Gasket Thickness (Compressed)	1.50 mm ±0.05	0.0591 in. ±0.002 in.
Valve Seat Angle	45°-45.5°	
Valve Seat Runout (Max.)	0.05 mm	0.002 in.
Intake Valve Seat Width	1.00-1.5 mm	0.0394-0.0591 in.
Exhaust Valve Seat Width	1.25-1.75 mm	0.0492-0.0689 in.
Guide Bore Diameter (Std.)	5.975-6.00 mm	0.2353-0.2363 in.
Valve Guide Height*-Intake AND Exhaust	13.25-13.75 mm	0.5217-0.5414 in.
*Measured from cylinder head surface to top of guide		

VALVES

Description	Specification	
	Metric	Standard
Face Angle	44.5°-45.5°	
Head Diameter-Intake	33.67-33.93	1.3256-1.3358 in.
Head Diameter-Exhaust	27.67-27.93 mm	1.0894-1.1000 in.
Length-Intake (Overall)	107.89-108.39 mm	4.2476-4.2673 in.
Length-Exhaust (Overall)	105.88-106.38 mm	4.1685-4.1882 in.
Stem Diameter-Intake	5.934-5.952 mm	0.2337-0.2344 in.
Stem Diameter-Exhaust	5.906-5.924 mm	0.2326-0.2333 in.
Stem-to-Guide Clearance-Intake (New)	0.023-0.066 mm	0.0009-0.0026 in.
Stem-to-Guide Clearance-Exhaust (New)	0.051-0.094 mm	0.002-0.0037 in.
Stem-to-Guide Clearance-Intake (Max., Rocking Method)	0.29 mm	0.0114 in.
Stem-to-Guide Clearance-Exhaust (Max., Rocking Method)	0.370 mm	0.0146 in.
Valve Lift-Intake (Zero Lash)	9.0 mm	0.3543 in.
Valve Lift-Exhaust (Zero Lash)	8.0 mm	0.3150 in.
Valve Stem Tip Height-Intake	47.120 ±0.467 mm	1.8551 ±0.00184 in.
Valve Stem Tip Height-Exhaust	48.672 ±0.467 mm	1.9162 ±0.00184 in.

VALVE SPRING

Description	Specification	
	Metric	Standard
Free Length-Intake AND Exhaust (Approx.)	45.63 mm	1.7965 in.
Spring Force-Intake AND Exhaust (Valve Closed)	249-284 N @ 38.0 mm	56.0-64.0 lbs. @ 1.4961 in.
Spring Force-Intake (Valve Open)	658-721 N @ 29.0 mm	147.9-162.1 lbs. @ 1.1417 in.
Spring Force-Exhaust (Valve Open)	614-671 N @ 30.0 mm	138.0-150.8 lbs. @ 1.1811 in.
Number of Coils-Intake AND Exhaust	7.35	
Wire Diameter-Intake AND Exhaust	3.861 mm	0.1520 in.
Installed Height-Intake AND Exhaust (Spring seat to bottom of retainer)	38.0 mm	1.4961 in.

OIL PUMP

	Specification

Description	Metric	Standard
Clearance Over Rotors (Max.)	0.077 mm	0.003 in.
Cover-Out-of-Flat (Max.)	0.025 mm	0.001 in.
Inner AND Outer Rotor Thickness	9.475-9.500 mm	0.3731-0.3741 in.
Outer Rotor Clearance (Max.)	0.39 mm	0.015 in.
Outer Rotor Diameter (Min.)	89.175 mm	3.5109 in.
Tip Clearance Between Rotors (Max.)	0.20 mm	0.008 in.

OIL PRESSURE

Description	Specification	
	Metric	Standard
(NOTE: At Normal Operating Temperatures)		
Pressure @ Curb Idle Speed*	34.7 kPa Min.	5 psi Min.
Pressure @ 3000 RPM	300-724 kPa	45-105 psi
*CAUTION: If oil pressure is zero at idle, DO NOT run engine at 3000 RPM.		

TORQUE

DESCRIPTION	N.m	Ft. Lbs.	In. Lbs.
A/C Compressor to Engine - Bolts	28	21	-
Camshaft Sprocket - Bolts	28	-	250
Camshaft Chain Tensioner (Secondary) - Bolts	12	-	105
Camshaft Bearing Cap - Bolts	12	-	105
Connecting Rod Cap - Bolts	27 +1/4 Turn	20 +1/4 Turn	-
Crankshaft Main Bearing Cap - Tie Bolts	28	-	250
Crankshaft Main Bearing Cap - Outer Cap Bolts	27 +1/4 Turn	20 +1/4 Turn	-
Crankshaft Main Bearing Cap - Inner Cap Bolts	20 +1/4 Turn	15 +1/4 Turn	-
Crankshaft Damper - Bolt	170	125	-
Cylinder Head - Bolts	See **Engine/Cylinder Head - Installation**.		
Cylinder Head Cover - Bolts	12	-	105
Exhaust Manifold - Bolts	23	-	200
Exhaust Manifold Heat Shield - Bolts	12	-	105
Exhaust Manifold to Catalytic Converter V-Band Clamp	11	-	100
Engine Mount Bracket to Block	61	45	-

- Bolts			
Engine Mount Isolator - Nuts	61	45	-
Flex Plate Bolts	95	70	-
Intake Manifold (Upper and Lower) - Bolts	12	-	105
Generator Bracket-Bolts	41	30	-
Oil Pan - Bolts	28	-	250
Oil Pan - Nuts	12	-	105
Oil Pan Drain - Plug	27	20	-
Oil Filter	16	12	-
Oil Pump to Block - Bolts	28	-	250
Oil Pump Cover - Bolts	12	-	105
Oil Pump Pick Up Tube - Bolt	28	-	250
PCV Valve	7	-	60
Crankshaft Rear Seal Retainer - Bolts	12	-	105
Spark Plugs	20	15	-
Starter Mounting - Bolts	41	30	-
Structural Collar	See **Engine/Engine Block/COVER, Structural Dust - Installation**.		
Thermostat Housing/Water Inlet Connector - Bolts	12	-	105
Throttle Body - Bolts	12	-	105
Timing Chain Cover - M6 Bolts	12	-	105
Timing Chain Cover - M10 Bolts	54	40	-
Timing Chain Tensioner (Primary)	12	-	105
Timing Chain Guide Access Plug	20	15	-
Water Pump - Bolts	12	-	105
Cooling System Bleed Screw	12	-	110
Water Outlet Housing - Bolts	12	-	105

SPECIAL TOOLS

2.7L ENGINE

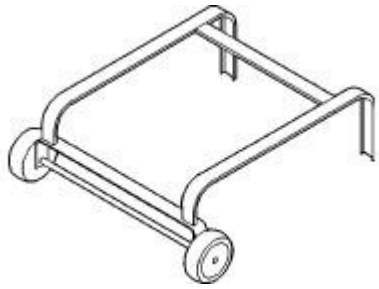

Fig. 53: Dolly 6135
Courtesy of CHRYSLER LLC

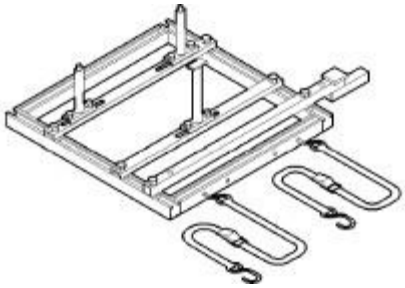

Fig. 54: Cradle 6710
Courtesy of CHRYSLER LLC

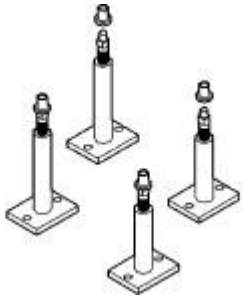

Fig. 55: Post Kit Engine Cradle 6848
Courtesy of CHRYSLER LLC

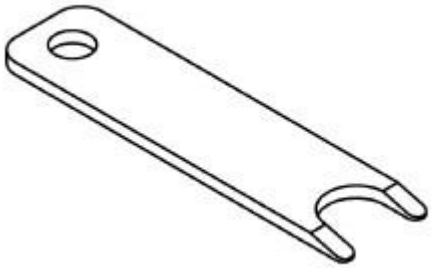

Fig. 56: Disconnect Tool, 6638A
Courtesy of CHRYSLER LLC

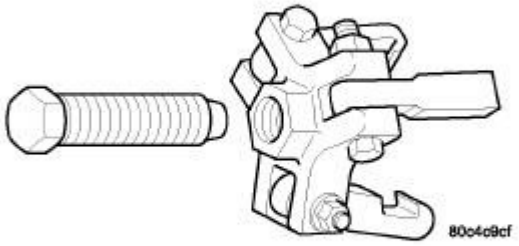

Fig. 57: Puller 8454
Courtesy of CHRYSLER LLC

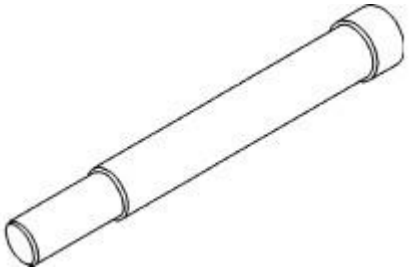

Fig. 58: Crankshaft Damper Remover Insert 8194
Courtesy of CHRYSLER LLC

Fig. 59: Crankshaft Damper Installer Screw 8179
Courtesy of CHRYSLER LLC

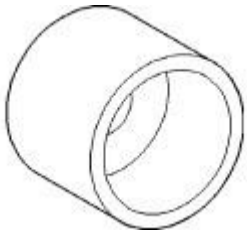

Fig. 60: Crankshaft Damper Installer 6792-1
Courtesy of CHRYSLER LLC

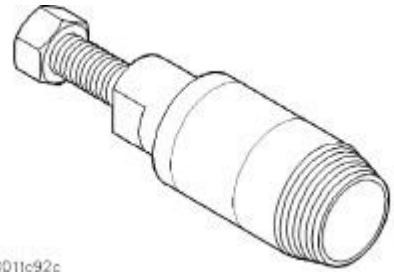

Fig. 61: Crankshaft Seal Remover 6771
Courtesy of CHRYSLER LLC

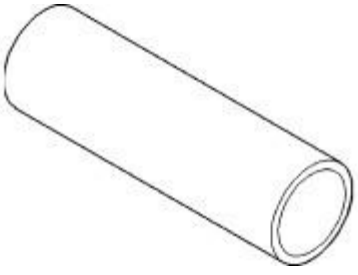

Fig. 62: Crankshaft Seal & Sprocket Installer 6780-1
Courtesy of CHRYSLER LLC

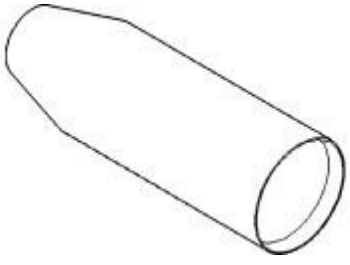

Fig. 63: Crankshaft Seal Protector 6780-2
Courtesy of CHRYSLER LLC

Fig. 64: Puller 5048
Courtesy of CHRYSLER LLC

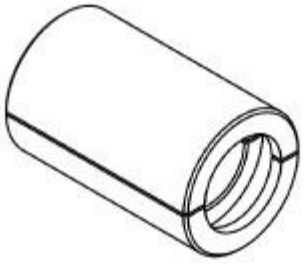

Fig. 65: Puller Adaptor 8539
Courtesy of CHRYSLER LLC

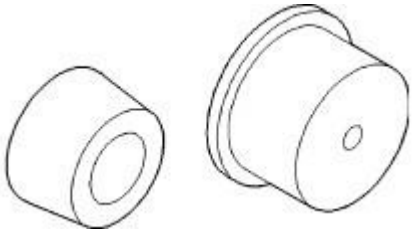

Fig. 66: Crankshaft Rear Seal Guide 6926-1 & Installer 6926-2
Courtesy of CHRYSLER LLC

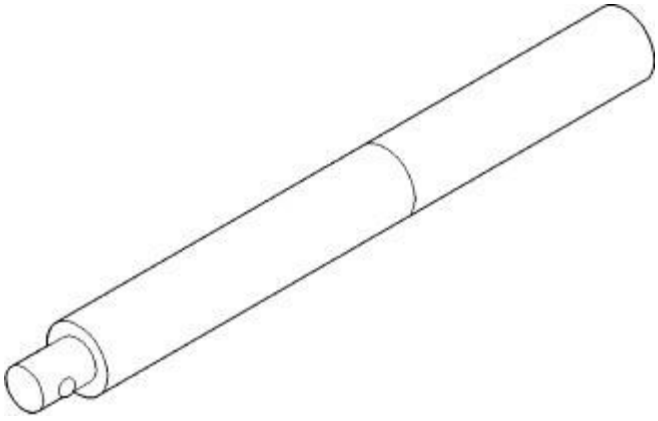

Fig. 67: Driver Handle C-4171
Courtesy of CHRYSLER LLC

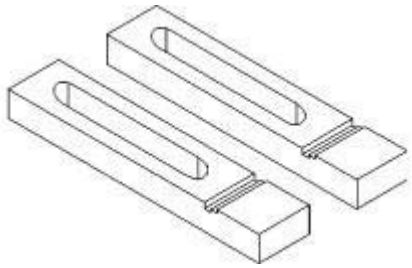

Fig. 68: Crankshaft Real Seal Retainer Alignment Fixture 8225
Courtesy of CHRYSLER LLC

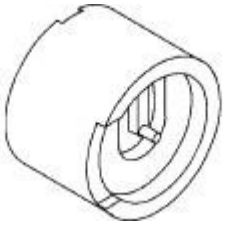

Fig. 69: Timing Chain Tensioner Resetting Gauge 8186
Courtesy of CHRYSLER LLC

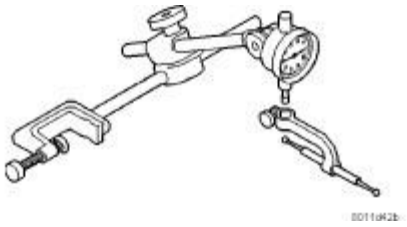

Fig. 70: Dial Indicator C-3339
Courtesy of CHRYSLER LLC

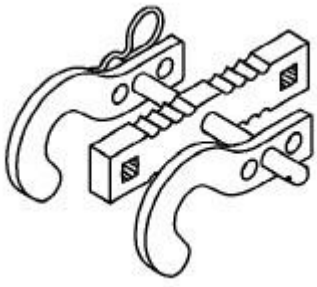

Fig. 71: Valve Spring Compressor 8215-A
Courtesy of CHRYSLER LLC

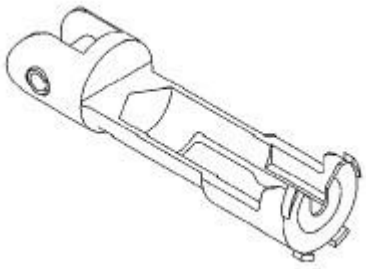

Fig. 72: Adaptor 8216-A
Courtesy of CHRYSLER LLC

Fig. 73: Valve Spring Compressor C-3422-D
Courtesy of CHRYSLER LLC

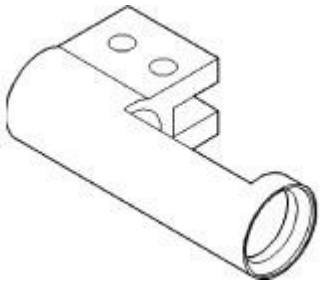

Fig. 74: Valve Spring Adapter 6526
Courtesy of CHRYSLER LLC

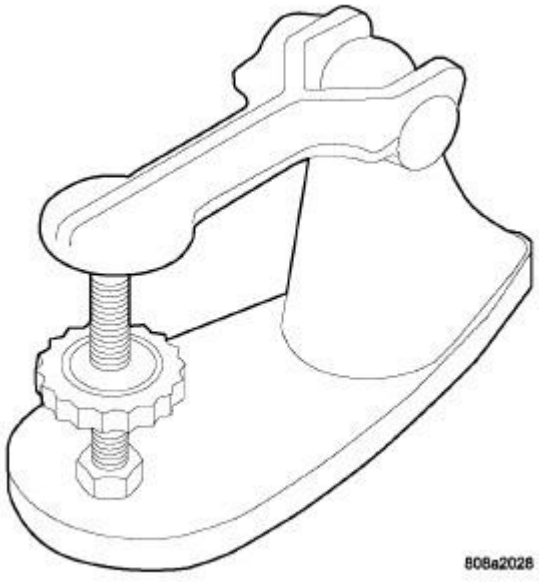

Fig. 75: Valve Spring Tester C-647
Courtesy of CHRYSLER LLC

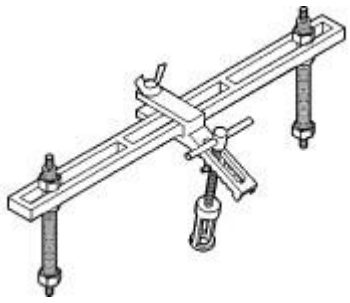

Fig. 76: Valve Spring Compressor MD-998772-A
Courtesy of CHRYSLER LLC

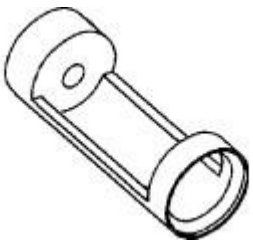

Fig. 77: Valve Spring Adapter 6527
Courtesy of CHRYSLER LLC

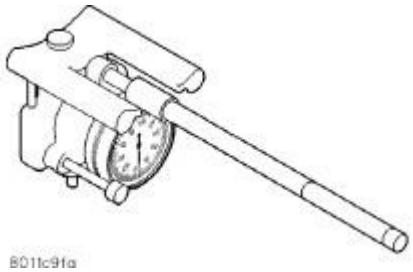

Fig. 78: Indicator Bore Size C-119
Courtesy of CHRYSLER LLC

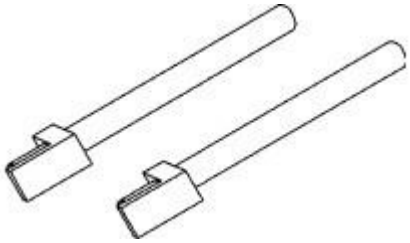

Fig. 79: Connecting Rod Installation Guides 8189
Courtesy of CHRYSLER LLC

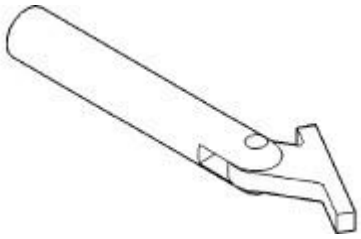

Fig. 80: Main Bearing Remover/Installer C-3059
Courtesy of CHRYSLER LLC

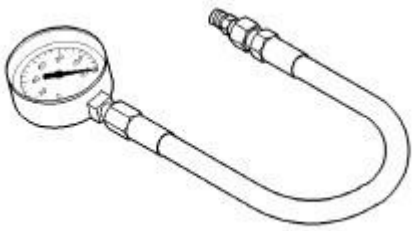

Fig. 81: Pressure Gauge C-3292
Courtesy of CHRYSLER LLC

Fig. 82: Adapter 8406
Courtesy of CHRYSLER LLC

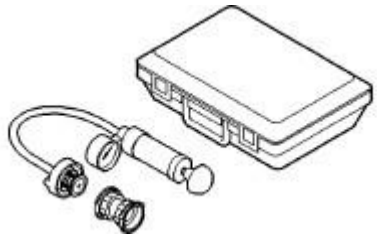

Fig. 83: Cooling System Tester 7700
Courtesy of CHRYSLER LLC

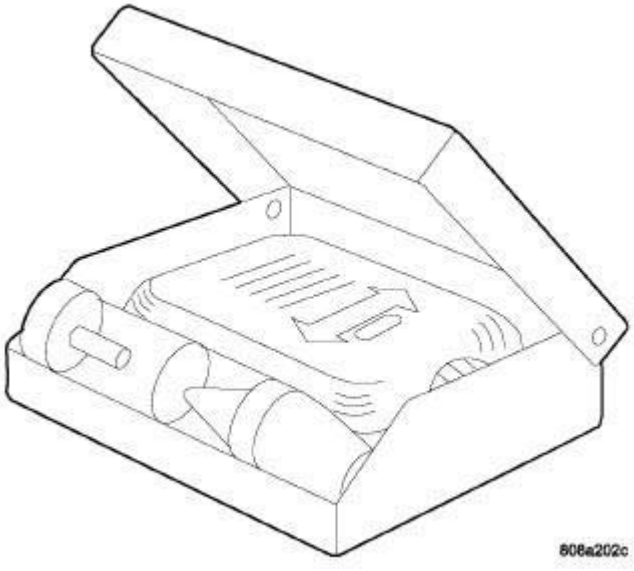

Fig. 84: Combustion Leak Tester C-3685-A
Courtesy of CHRYSLER LLC

AIR INTAKE SYSTEM

AIR CLEANER

Removal

REMOVAL

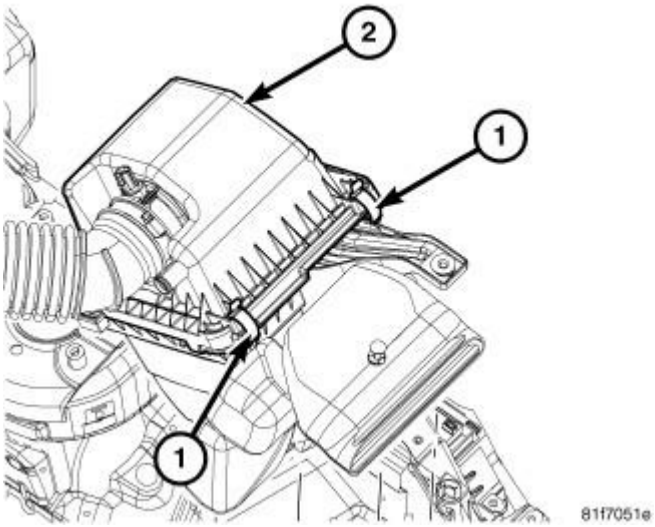

Fig. 85: Air Filter Housing Clips
Courtesy of CHRYSLER LLC

1. Disengage the air filter housing clips (1).
2. Slide the air filter housing cover (2) forward slightly to disengage tabs from the bottom of the air filter housing.
3. Remove air cleaner element from air cleaner housing.

Installation

INSTALLATION

1. Install air filter element into the bottom half of the air filter housing.

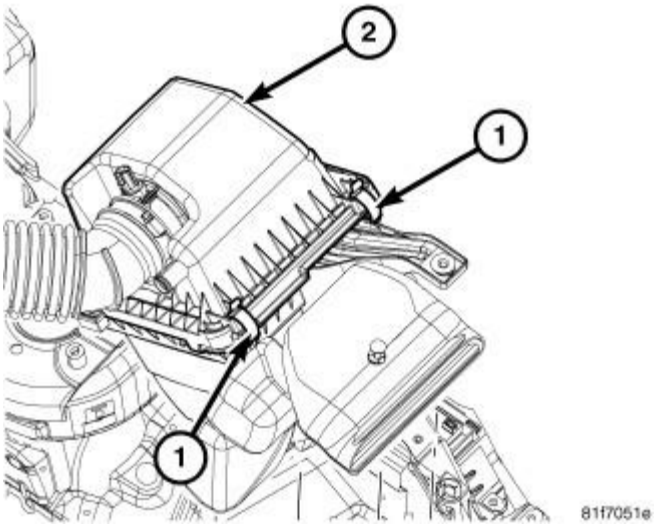

Fig. 86: Air Filter Housing Clips
Courtesy of CHRYSLER LLC

2. Slide the air filter housing cover (2) rearward to engage the tabs into the bottom half of the air filter housing.
3. Reengage the air filter housing clips (1).

BODY, AIR CLEANER

Removal

REMOVAL

1. Disconnect negative battery cable.

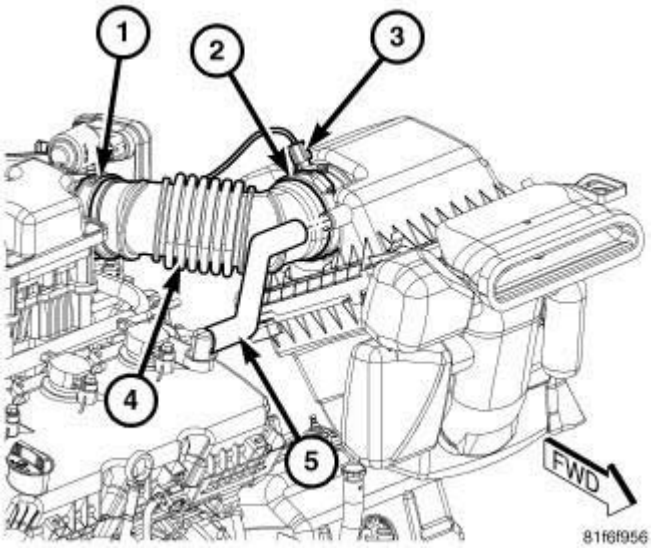

Fig. 87: Inlet Air Temperature Sensor Electrical Connector
Courtesy of CHRYSLER LLC

2. Disconnect inlet air temperature sensor electrical connector (3).
3. Disconnect fresh air makeup hose (5) from the air filter box.
4. Loosen the clamp (1) from at the throttle body.
5. Remove the air inlet tube (4) from the throttle body.

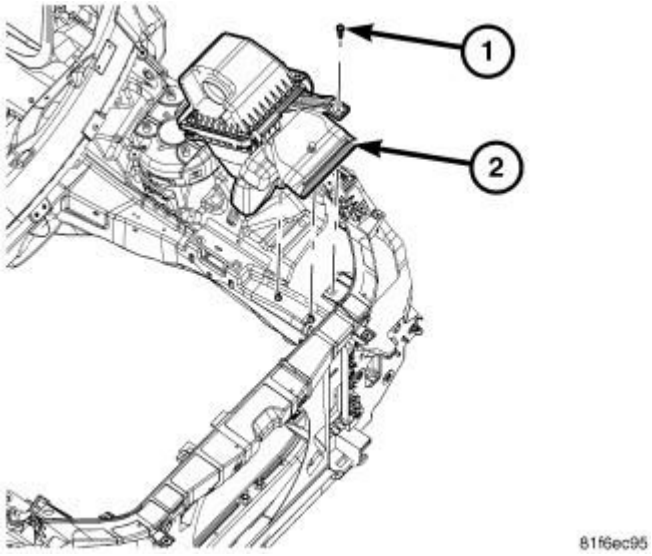

Fig. 88: Retainer From Bracket
Courtesy of CHRYSLER LLC

6. Remove retainer (1) from bracket.
7. Remove the retainer that secures the air scoop to the top of the radiator core support.
8. Pull air cleaner housing (2) straight up off of locating pins.

Installation

INSTALLATION

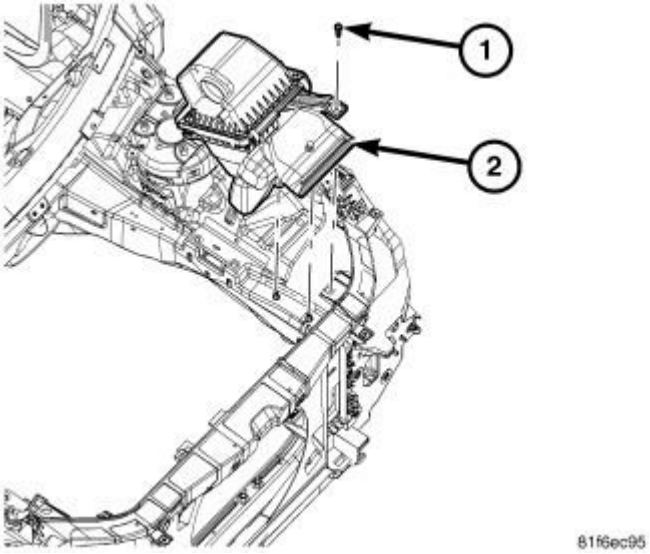

Fig. 89: Retainer From Bracket
Courtesy of CHRYSLER LLC

1. Install air filter housing (2) straight down on locating pins.

2. Reposition the bracket and install the retainer (1). Tighten the retainer to 5 N.m (44 in. lbs.).
3. Install the push pin that secures the air scoop to the top of the radiator core support.

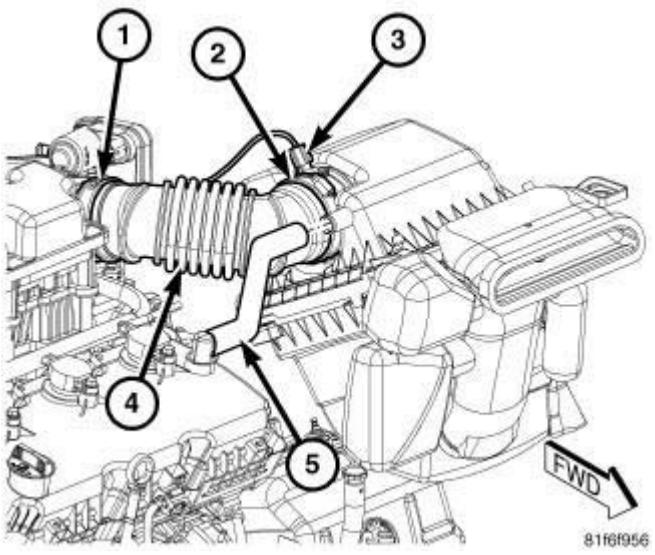

Fig. 90: Inlet Air Temperature Sensor Electrical Connector
Courtesy of CHRYSLER LLC

4. Install throttle body air inlet tube (4) to the throttle body. Tighten the clamp (1).
5. Connect fresh air makeup hose (5) to the air filter housing
6. Connect inlet air temperature sensor harness connector (3).
7. Connect negative battery cable.

CYLINDER HEAD

DESCRIPTION

DESCRIPTION

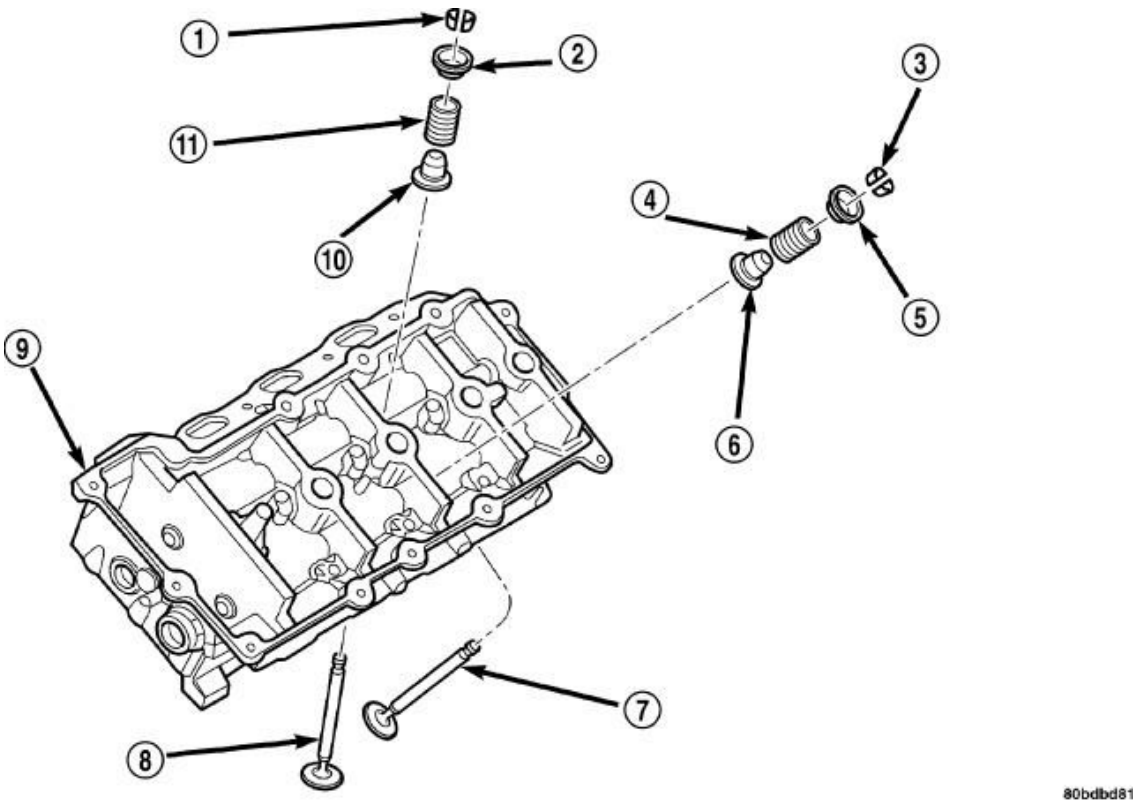

Fig. 91: Cylinder Head, Valves & Springs
Courtesy of CHRYSLER LLC

1 - VALVE KEEPER	7 - VALVE-EXHAUST
2 - SPRING RETAINER	8 - VALVE-INTAKE
3 - VALVE KEEPER	9 - CYLINDER HEAD
4 - VALVE SPRING-EXHAUST	10 - VALVE STEM SEAL
5 - SPRING RETAINER	11 - VALVE SPRING-INTAKE
6 - VALVE STEM SEAL	-

The cylinder heads are made of an aluminum alloy. The cylinder head features four valves (8) per cylinder with pressed in powdered metal valve guides. The cylinder heads provide enclosures for the timing chain drive, necessitating a unique right and left cylinder head.

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. See **CYLINDER COMPRESSION PRESSURE TEST**. An engine cylinder head gasket leaking between adjacent cylinders will result in approximately a 50-70% reduction in compression pressure.

CYLINDER-TO-WATER JACKET LEAKAGE TEST

WARNING: USE EXTREME CAUTION WHEN THE ENGINE IS OPERATING 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.

STANDARD PROCEDURE

CYLINDER HEAD OIL GALLERY CUP PLUG SERVICE

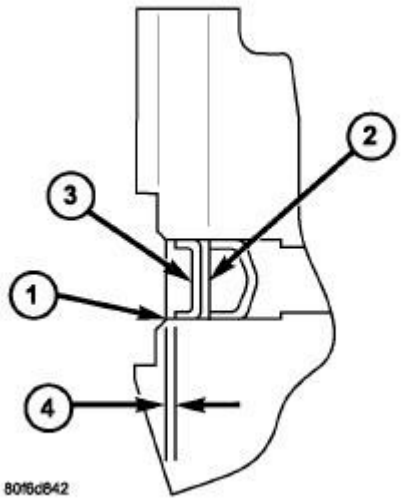

Fig. 92: Oil Gallery Cup Plug
Courtesy of CHRYSLER LLC

1 - CUP PLUG BORE CHAMFER
2 - ORIGINAL CUP PLUG
3 - NEW CUP PLUG
4 - 1-2 mm

NOTE: DETERMINE WHICH CUP PLUG IS LEAKING BEFORE PERFORMING THIS PROCEDURE. IF NECESSARY, PERFORM AN ENGINE OIL LEAK INSPECTION.

Each cylinder head on a 2.7L engine has 6 external oil gallery cup plugs. It is not necessary to remove the original cup plug to install a new cup plug (3). The cup plug bore is deep enough to allow for two plugs. If it becomes necessary to service an oil gallery cup plug, perform the Repair Procedure.

NOTE: INSPECT THE CUP PLUG BORE IN QUESTION FOR THE PRESENCE OF TWO CUP PLUGS. IF THE CUP PLUG FLANGE IS JUST INSIDE (1-2 MM) THE CHAMFERED EDGE OF THE BORE TWO CUP PLUGS ARE ALREADY IN PLACE AND THE CYLINDER HEAD CANNOT BE REPAIRED.

Repair Procedure

1. Remove component(s) necessary to gain access to the oil gallery cup plug requiring service.

NOTE: SOME OF THE OIL GALLERY CUP PLUGS ARE SERVICEABLE WITH THE HEAD INSTALLED ON THE ENGINE AND THE ENGINE IN THE VEHICLE, WHILE OTHERS REQUIRE REMOVING THE AFFECTED CYLINDER HEAD

FROM THE ENGINE. IN EITHER CASE ONLY REPLACE THE CUP PLUG REQUIRING SERVICE.

2. Clean the cup plug bore with brake cleaner and compressed air. It is not necessary to remove the existing cup plug.
3. Lightly coat the new cup plug with sealer; p/n 04318083.
4. Using an appropriate installation tool drive the new cup plug into the bore until the flanged edge of the plug is just inside (1-2 mm) the chamfered edge of the bore.
5. Allow the sealant to cure for at least 20 minutes.
6. Assemble any components removed in step # 1 as necessary.

REMOVAL

REMOVAL

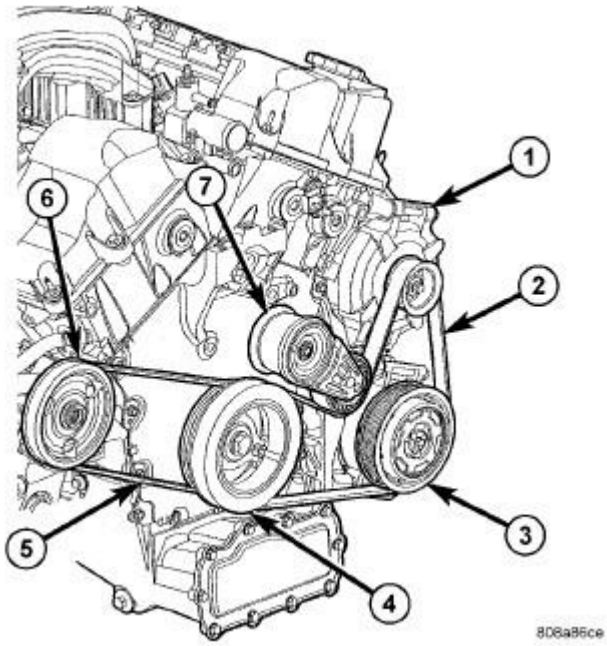

Fig. 93: Accessory Drive Belt System - 2.7L
Courtesy of CHRYSLER LLC

1 - GENERATOR
2 - IDLER/TENSIONER

1. Perform fuel pressure release procedure **before attempting any repairs.** . Refer to **Fuel System/Fuel Delivery - Standard Procedure** .
2. Disconnect negative cable from remote jumper terminal.
3. Drain cooling system.

4. Remove accessory drive belts. Refer to **Cooling/Accessory Drive/BELT, Serpentine - Removal** .
5. Remove the vibration damper. See **Engine/Engine Block/DAMPER, Vibration - Removal**.
6. Remove exhaust cross-under pipe. See **Engine/Manifolds/MANIFOLD, Exhaust - Removal**.
7. Remove the maniverter. See **Engine/Manifolds/MANIFOLD, Exhaust - Removal**.

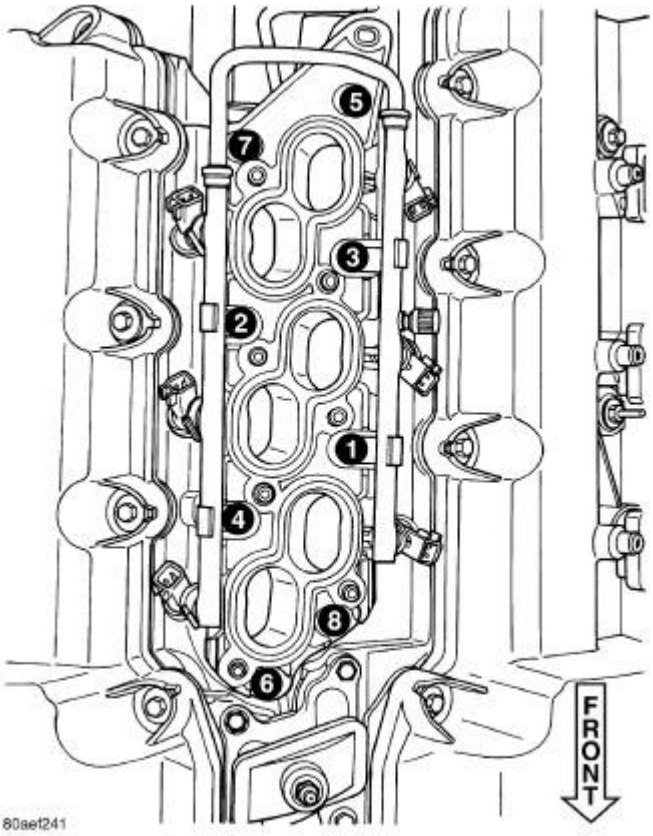

Fig. 94: Lower Intake Manifold Tightening Sequence
Courtesy of CHRYSLER LLC

8. Remove oil pressure sensor heat shield. Disconnect oil pressure sensor connector.
9. Remove upper and lower intake manifolds. See **Engine/Manifolds/MANIFOLD, Intake - Removal**.

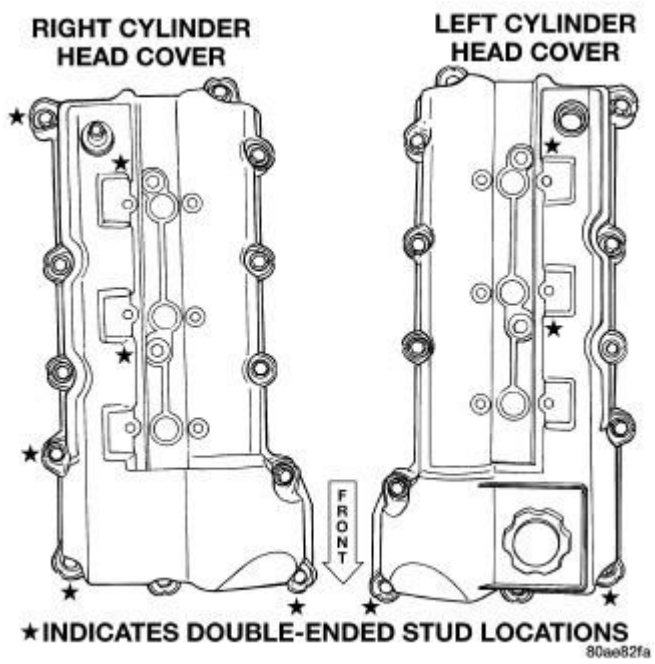

Fig. 95: Cylinder Head Covers
Courtesy of CHRYSLER LLC

10. Remove cylinder head covers. See **Engine/Cylinder Head/COVER(S), Cylinder Head - Removal**.
11. Disconnect camshaft position sensor and crankshaft position sensor connectors.
12. Reposition engine wiring harness to left side of vehicle.

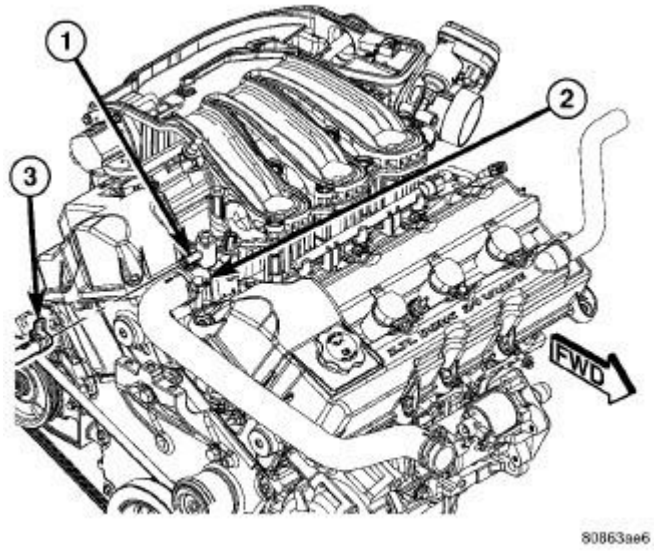

Fig. 96: Coolant Outlet Connector - 2.7L
Courtesy of CHRYSLER LLC

1 - BOLT (2)
2 - BOLT (2)
3 - COOLANT OUTLET CONNECTOR

13. Remove coolant outlet connector (3). Refer to **Cooling/Engine/HOUSING, Coolant Outlet - Removal** .

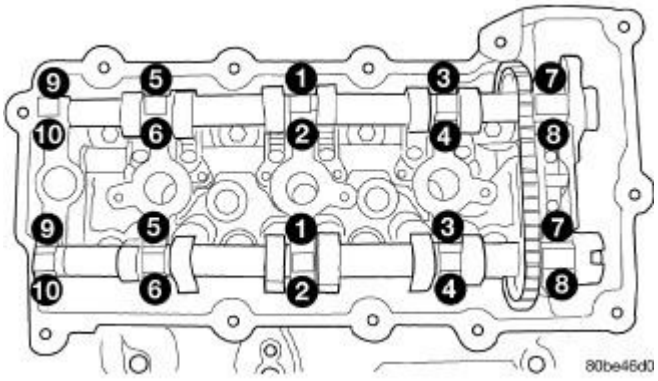

Fig. 97: Camshaft Bearing Cap Tightening Sequence
Courtesy of CHRYSLER LLC

14. Remove timing chain cover. See **Engine/Valve Timing/COVER(S), Engine Timing - Removal**.
15. Rotate crankshaft until crankshaft sprocket timing mark aligns with timing mark on oil pump housing.
16. Remove primary timing chain. See **Engine/Valve Timing/CHAIN and SPROCKETS, Timing - Removal**.
17. Remove upper primary timing chain guides.
18. Remove camshaft bearing caps **gradually** in REVERSE sequence of installation (10-1).

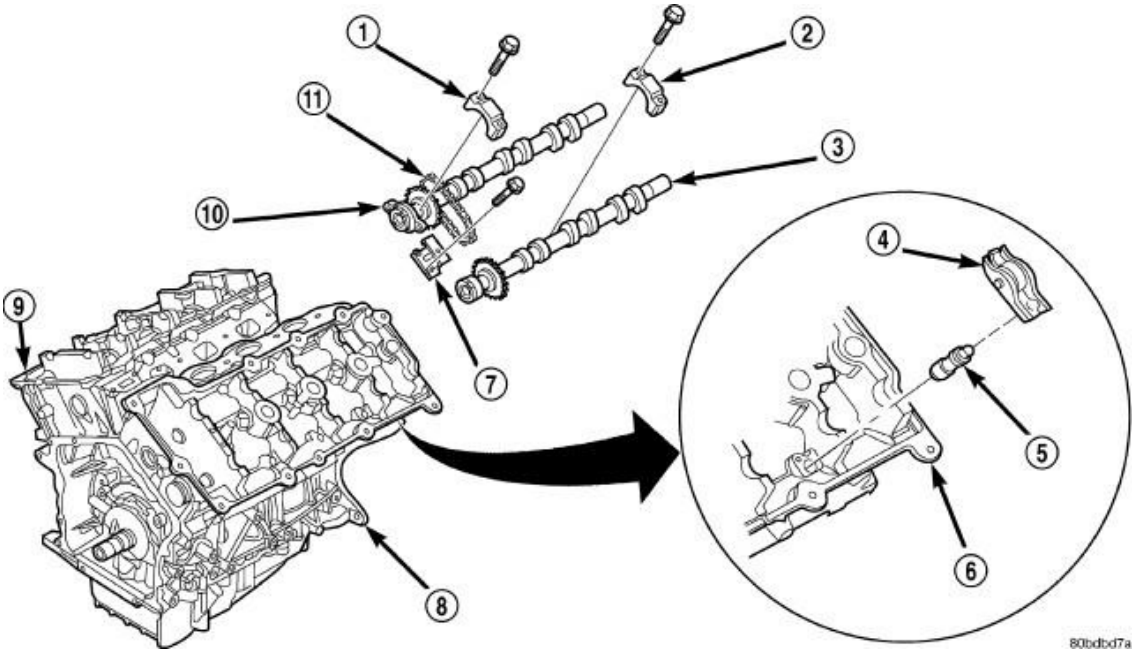

Fig. 98: Camshaft & Valvetrain Components
Courtesy of CHRYSLER LLC

1 - CAMSHAFT BEARING CAP - INTAKE	7 - CAMSHAFT (SECONDARY) CHAIN TENSIONER
2 - CAMSHAFT BEARING CAP - EXHAUST	8 - CYLINDER BLOCK
3 - CAMSHAFT - EXHAUST	9 - CYLINDER HEAD
4 - ROCKER ARM	10 - CAMSHAFT - INTAKE
5 - HYDRAULIC LIFTER	11 - CAMSHAFT (SECONDARY) TIMING CHAIN
6 - CYLINDER HEAD	

19. Remove camshafts (10) and valvetrain components from cylinder head. Note component locations for reinstallation in original locations.
20. For left cylinder head removal:
    - Remove fastener securing engine oil dipstick tube to cylinder head. Remove engine oil dipstick tube.
    - Remove generator.
21. For right cylinder head removal:
    - Remove cylinder head ground strap.
    - Disconnect EGR valve electrical connector (if equipped).

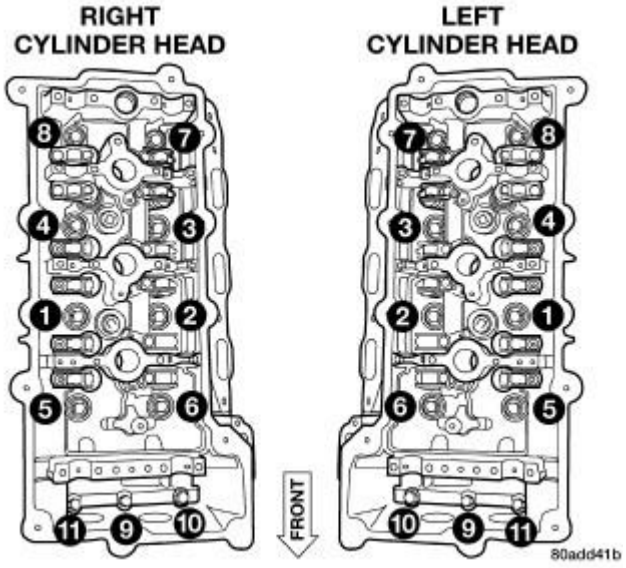

Fig. 99: Cylinder Head Tightening Sequence
Courtesy of CHRYSLER LLC

CAUTION: Ensure cylinder head bolts 11-9 are removed before attempting the removal of cylinder head, as damage to cylinder head and/or block may occur.

22. Remove cylinder head bolts in reverse sequence of installation starting with bolts 11-9, then bolts 8-1.
23. Remove cylinder head(s).
24. Remove and discard cylinder head gasket.
25. Clean cylinder head and block sealing surfaces. See **Engine/Cylinder Head - Cleaning**.

CLEANING

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. See **Engine - Standard Procedure**. Be careful not to gouge or scratch the aluminum head sealing surface.

Clean all engine oil passages.

INSPECTION

INSPECTION

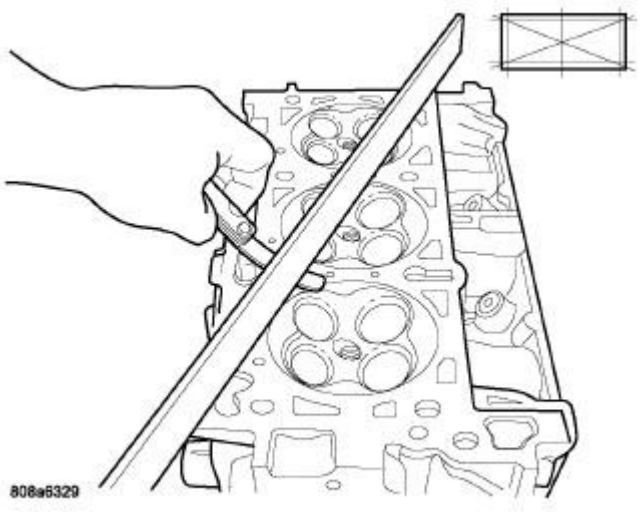

Fig. 100: Checking Cylinder Head Flatness-Typical
Courtesy of CHRYSLER LLC

1. Before cleaning, check for leaks, damage and cracks.
2. Clean cylinder head and oil passages. See **Engine/Cylinder Head - Cleaning**.
3. Check cylinder head for flatness.
4. Cylinder head must be flat within:

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.

- 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.

INSTALLATION

INSTALLATION

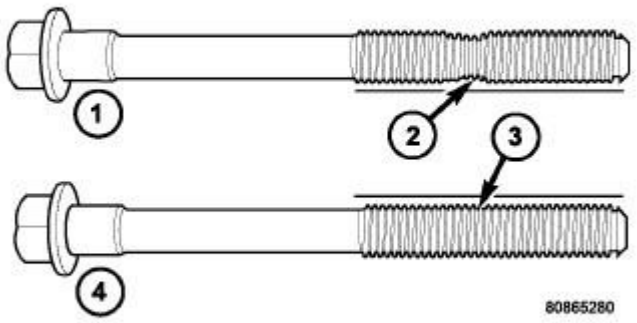

Fig. 101: Check For Stretched Bolts
Courtesy of CHRYSLER LLC

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

NOTE: The cylinder head bolts (4) 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

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

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

1. Clean sealing surfaces of cylinder head and block. See **Engine - Standard Procedure**.
2. Lubricate bolt threads with clean engine oil and install bolts.
3. Install new head gasket over locating dowels.

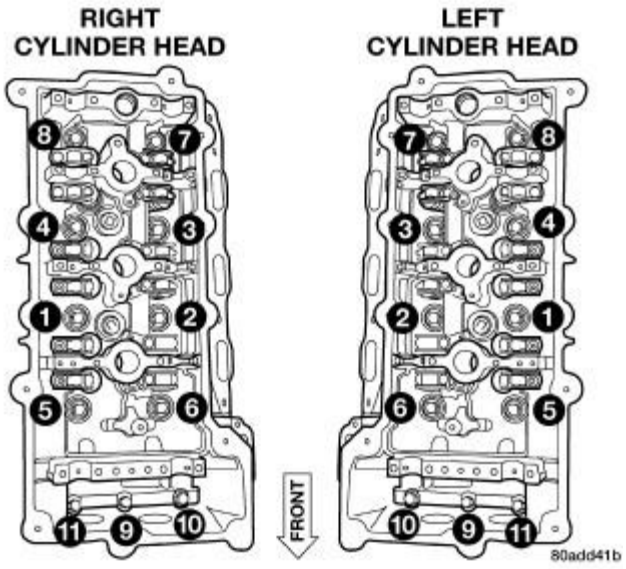

Fig. 102: Cylinder Head Tightening Sequence
Courtesy of CHRYSLER LLC

4. Install cylinder head to block, assuring head is properly positioned over locating dowels.
5. Tighten bolts in sequence shown in illustration, using the following steps and torque values:
   - Step 1: Bolts 1-8 to 48 N.m (35 ft. lbs.)
   - Step 2: Bolts 1-8 to 75 N.m (55 ft. lbs.)
   - Step 3: Bolts 1-8 to 75 N.m (55 ft. lbs.)
   - Step 4: Bolts 1-8 to +90° Turn **Do not use a torque wrench for this step.**
   - Step 5: Bolts 9-11 to 28 N.m (250 in. lbs.)
6. For left cylinder head installation:
   - Install engine oil dipstick tube.
   - Install generator.

7. For right cylinder head installation:
   - Install cylinder head ground strap.
   - Connect EGR valve electrical connector (if equipped).

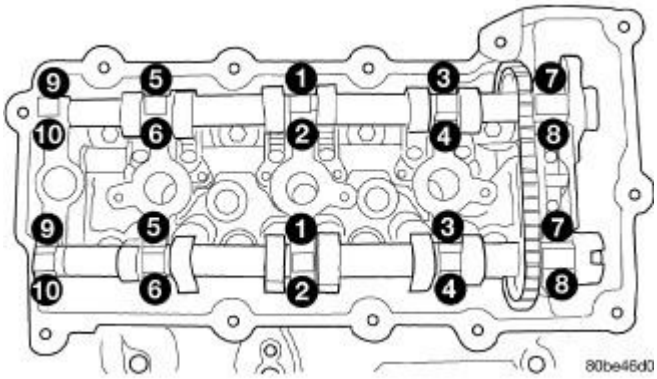

Fig. 103: Camshaft Bearing Cap Tightening Sequence
Courtesy of CHRYSLER LLC

8. Install all valvetrain components and camshafts. See **Engine/Cylinder Head/CAMSHAFT, Engine - Installation**. Tighten camshaft bearing caps in sequence shown in illustration to 12 N.m (105 in. lbs.).
9. Install primary timing chain, guides and sprockets. See **Engine/Valve Timing/CHAIN and SPROCKETS, Timing - Installation**.

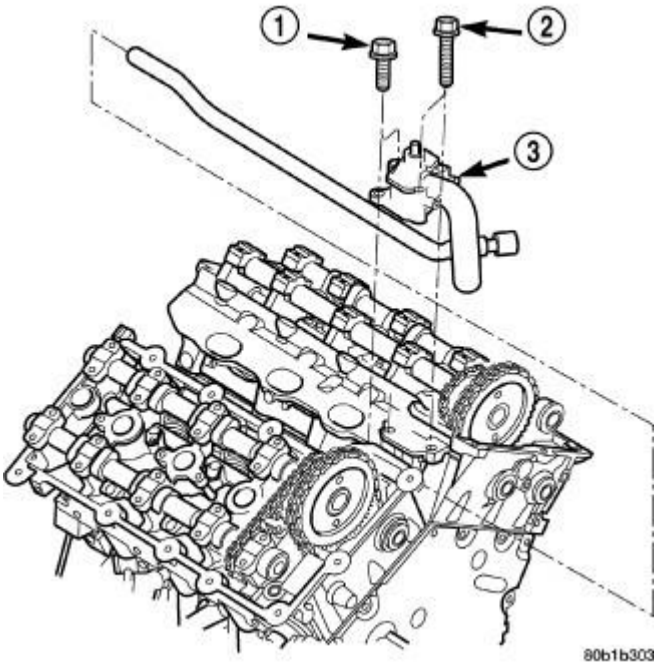

Fig. 104: WATER OUTLET CONNECTOR
Courtesy of CHRYSLER LLC

1 - BOLT (2) 2 - BOLT (2) 3 - WATER OUTLET CONNECTOR

10. Install coolant outlet connector (3). Refer to **Cooling/Engine/HOUSING, Coolant Outlet - Installation** .

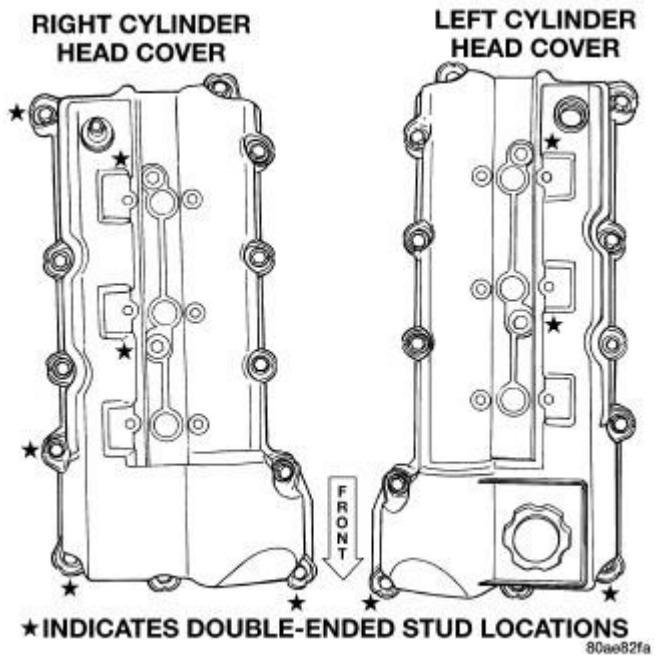

Fig. 105: Cylinder Head Covers
Courtesy of CHRYSLER LLC

11. Install cylinder head covers. See **Engine/Cylinder Head/COVER(S), Cylinder Head - Installation**.
12. Connect camshaft position sensor and crankshaft position sensor connectors.
13. Install timing chain cover. See **Engine/Valve Timing/COVER(S), Engine Timing - Installation**.
14. Install crankshaft vibration damper. See **Engine/Engine Block/DAMPER, Vibration - Installation**.

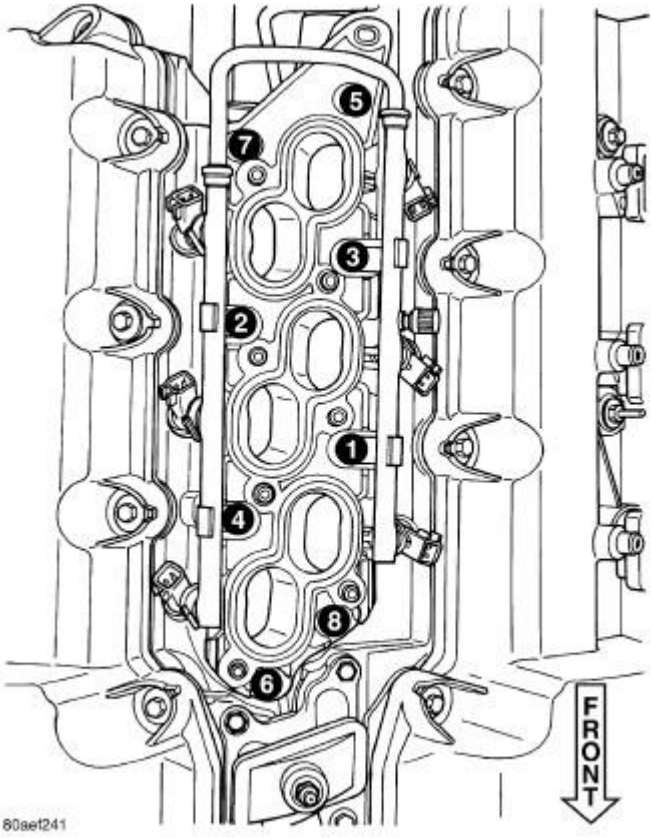

Fig. 106: Lower Intake Manifold Tightening Sequence
Courtesy of CHRYSLER LLC

15. Install lower and upper intake manifolds. See **Engine/Manifolds/MANIFOLD, Intake - Installation**.
16. Connect oil pressure sensor connector. Install oil pressure sensor heat shield.
17. Install the maniverter. See **Engine/Manifolds/MANIFOLD, Exhaust - Installation**.
18. Install exhaust cross-under pipe. See **Engine/Manifolds/MANIFOLD, Exhaust - Installation**.

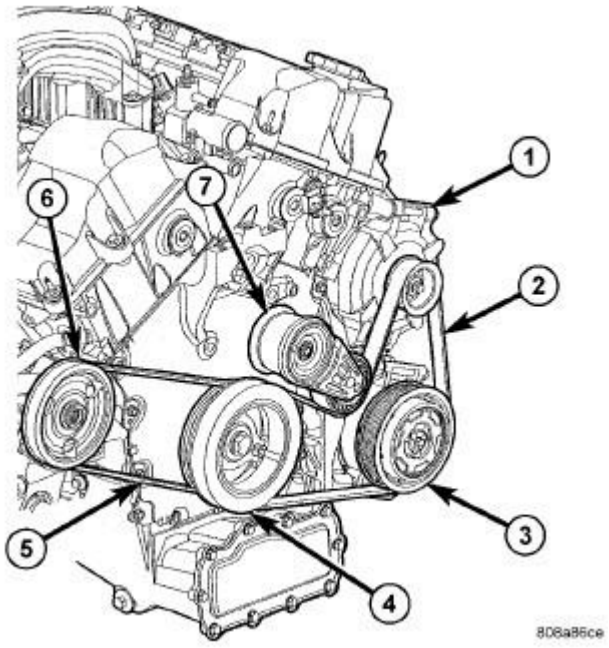

Fig. 107: Accessory Drive Belt System - 2.7L
Courtesy of CHRYSLER LLC

1 - GENERATOR
2 - IDLER/TENSIONER

19. Install accessory drive belts. Refer to **Cooling/Accessory Drive/BELT, Serpentine - Installation** .
20. Fill cooling system.
21. Connect negative cable to remote jumper terminal.

CAMSHAFT, ENGINE

Description

DESCRIPTION

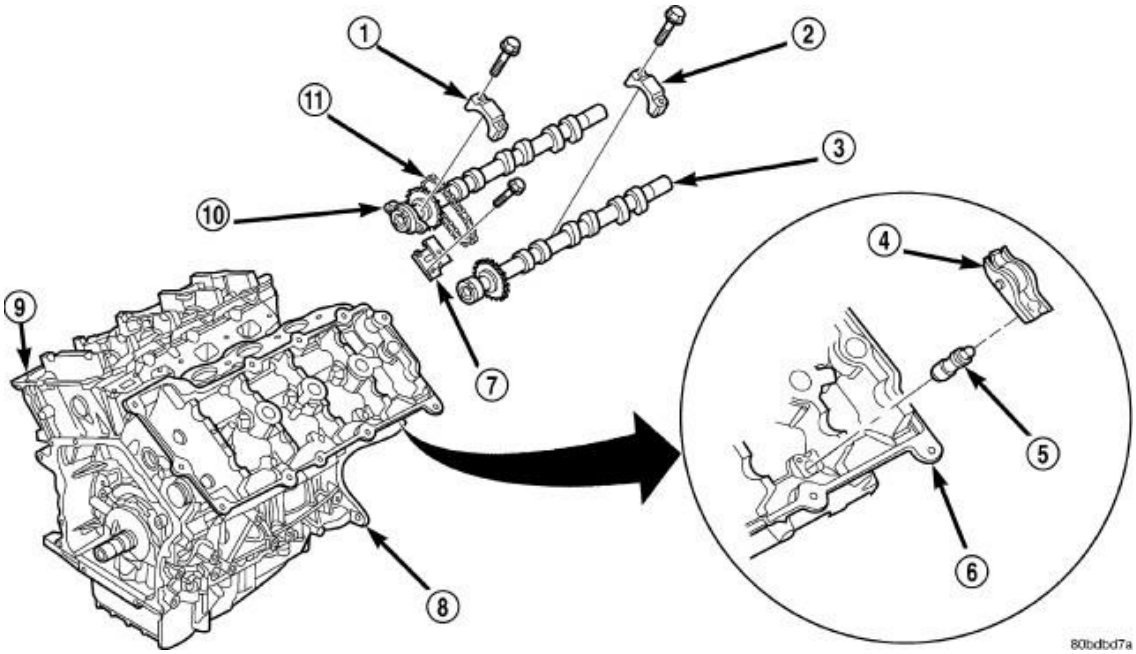

Fig. 108: Camshaft & Valvetrain Components
Courtesy of CHRYSLER LLC

1 - CAMSHAFT BEARING CAP - INTAKE	7 - CAMSHAFT (SECONDARY) CHAIN TENSIONER
2 - CAMSHAFT BEARING CAP - EXHAUST	8 - CYLINDER BLOCK
3 - CAMSHAFT - EXHAUST	9 - CYLINDER HEAD
4 - ROCKER ARM	10 - CAMSHAFT - INTAKE
5 - HYDRAULIC LIFTER	11 - CAMSHAFT (SECONDARY) TIMING CHAIN
6 - CYLINDER HEAD	

The assembled fabricated camshafts (3,10) are composed of five bearing journals machined into a hollow steel tube. Six steel lobes, a secondary timing drive sprocket, and a primary sprocket/thrust flange are pressed onto the camshaft tube using a unique assembly process. Camshaft end play is controlled by the primary camshaft sprocket attachment flange on the intake camshafts (10) and by a thrust flange on the exhaust camshafts.

Operation

OPERATION

The camshaft has precisely machined (egg shaped) lobes to provide accurate valve timing and duration. The camshaft is driven by the crankshaft via drive sprockets and chains.

Removal

REMOVAL

NOTE: The engine can be equipped with either conventional roller-type (early production) or silent type (late production) secondary timing chains.

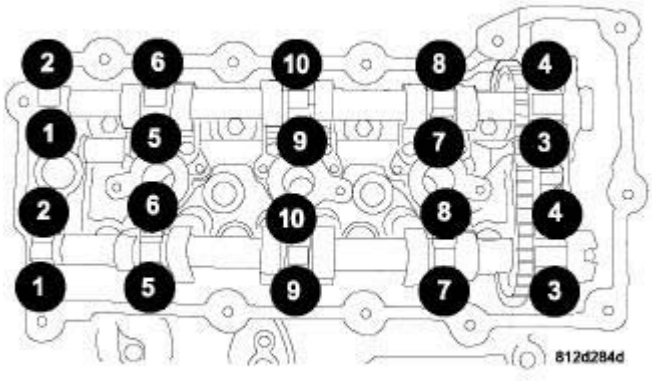

Fig. 109: Camshaft Bearing Cap Removal
Courtesy of CHRYSLER LLC

1. Remove the primary timing chain. See **Engine/Valve Timing/CHAIN and SPROCKETS, Timing - Removal**.
2. Remove secondary chain tensioner mounting bolts.

NOTE: Camshaft bearing caps should have been marked during engine manufacturing. For example, number one exhaust camshaft bearing is marked "1E & gt;"

3. Slowly loosen camshaft bearing cap bolts in the sequence shown in illustration.

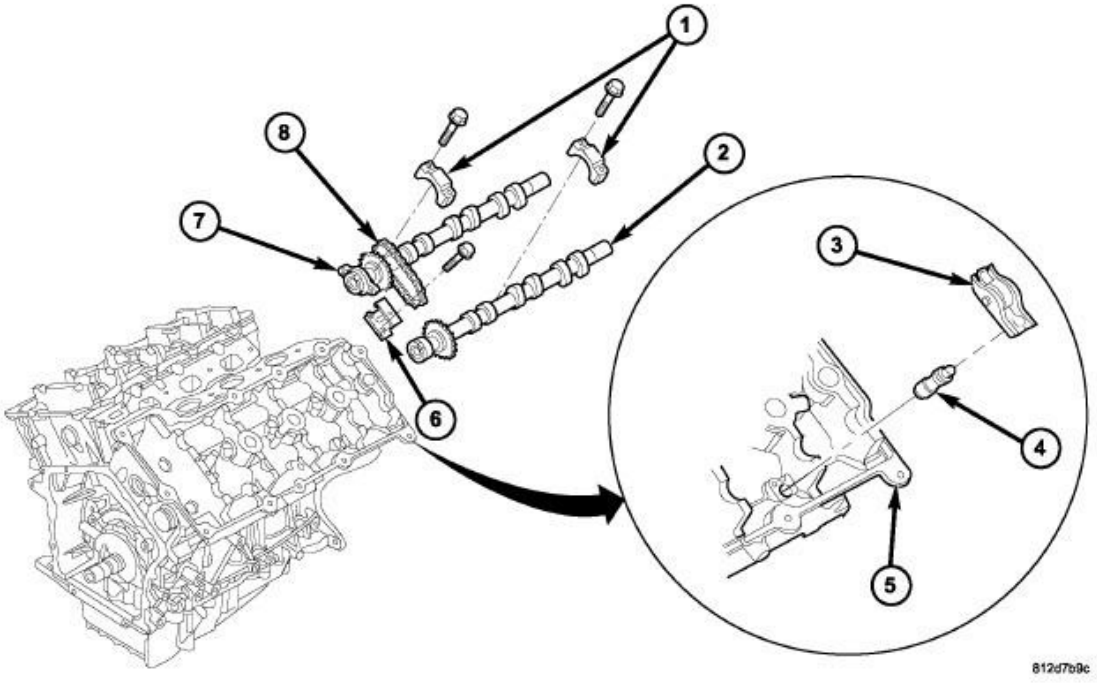

Fig. 110: Camshaft & Valvetrain Components
Courtesy of CHRYSLER LLC

4. Remove camshaft bearing caps (1).
5. Remove intake camshaft (7), exhaust camshaft (2), secondary timing chain (8), and secondary timing chain tensioner (6) together as an assembly.
6. Remove secondary timing chain tensioner (6) and secondary timing chain (8) from camshafts (2) and (7).
7. Inspect camshafts. See **Engine/Cylinder Head/CAMSHAFT, Engine - Inspection**.

Inspection

INSPECTION

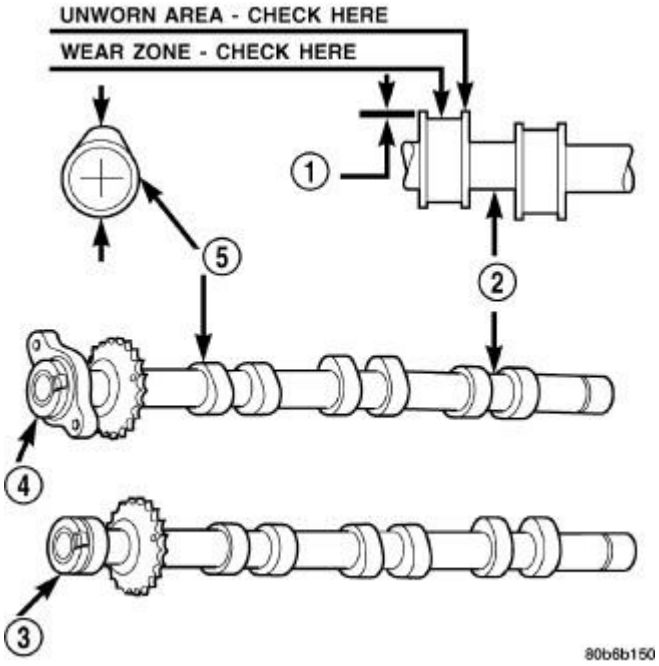

Fig. 111: Camshaft Inspection
Courtesy of CHRYSLER LLC

1 - ACTUAL WEAR
2 - BEARING JOURNAL
3 - EXHAUST CAMSHAFT
4 - INTAKE CAMSHAFT
5 - LOBE

1. Inspect camshaft bearing journals (2) for damage and binding. If journals are binding, check the cylinder head for damage. Also check cylinder head oil holes for clogging.
2. Inspect camshaft sprockets for excessive wear. Replace camshafts if necessary.
3. Check the cam lobe surfaces for abnormal wear and damage. Replace camshaft if defective. Measure the actual wear and replace, if out of limits-standard value is 0.0254 mm (0.001 in.); wear **limit** is 0.254 mm (0.010 in.).

Installation

INSTALLATION

CAUTION: When the timing chain is removed and the cylinder heads are installed, DO NOT rotate the camshafts or crankshaft without first locating the proper crankshaft position. Failure to do so will result in valve and/or piston damage.

NOTE: The engine can be equipped with either conventional roller-type (early

production) or silent type (late production) secondary timing chains.

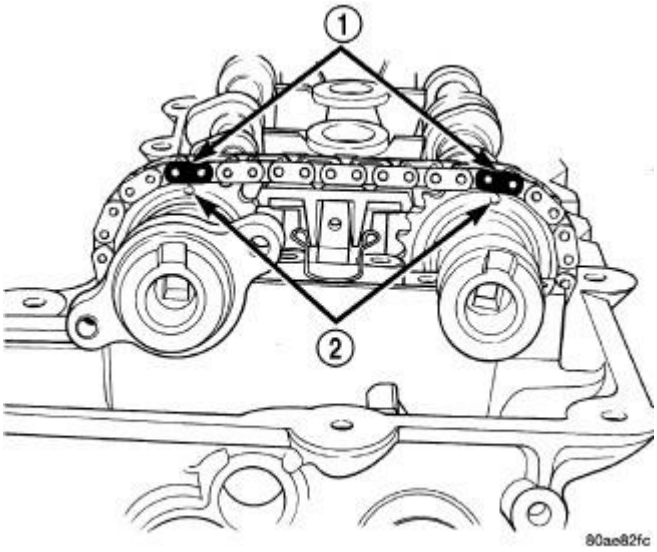

Fig. 112: Camshaft Chain Timing
Courtesy of CHRYSLER LLC

1 - PLATED CHAIN LINKS 2 - CAMSHAFT TIMING MARKS (DOTS)

1. For engines equipped with roller chains (early production), assemble camshaft chain on the cams ensuring that the plated links (1) are aligned with the timing dot (2) on the camshaft sprockets.

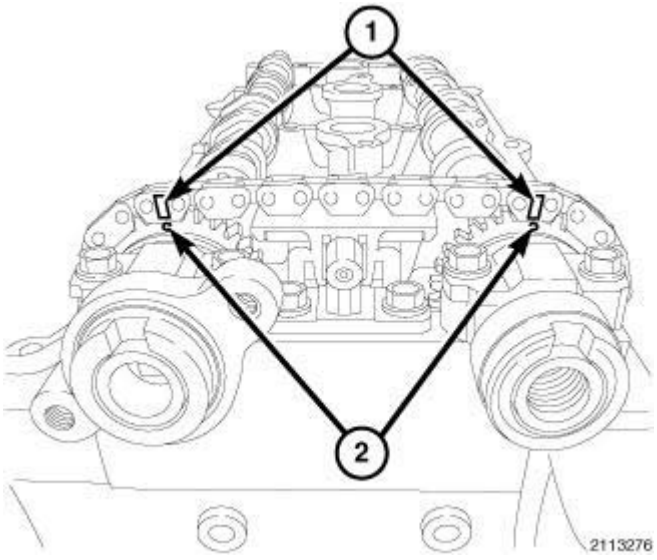

Fig. 113: Identifying Marked Links & Timing Dot On Camshaft Sprockets
Courtesy of CHRYSLER LLC

2. For engines equipped with silent chains (late production) assemble camshaft chain on the cams ensuring that the marked links (1) are aligned with the timing dot (2) on the camshaft sprockets.

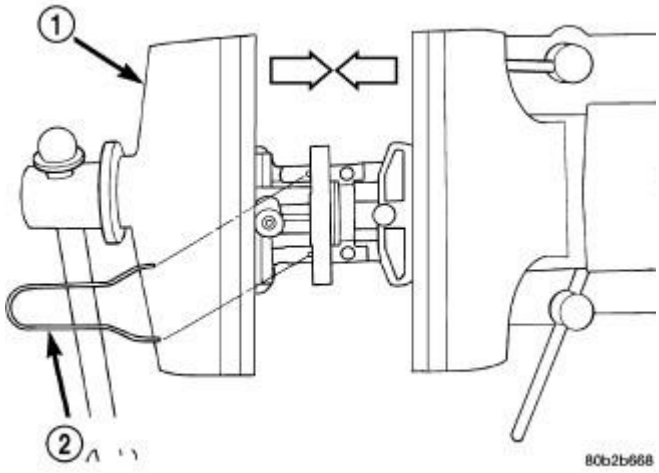

Fig. 114: Locking Camshaft (Secondary) Chain Tensioner
Courtesy of CHRYSLER LLC

1 - VISE
2 - LOCK PIN

3. If camshaft chain tensioner is already in the compressed and locked position, proceed to step four.
4. When the camshaft chain tensioner is removed, it is necessary to compress and lock the tensioner using the following procedures:
   a. Place tensioner (1) into a soft jaw vise.
   b. SLOWLY compress tensioner until fabricated lock pin (2) or the equivalent can be inserted into the locking holes.
   c. Remove compressed and locked tensioner from the vise.
5. Insert the compressed and locked camshaft chain tensioner in-between the camshafts and chain.

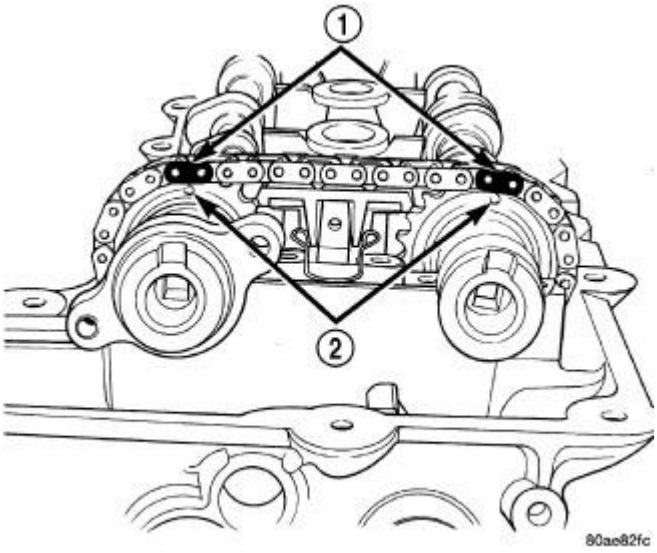

Fig. 115: Camshaft Chain Timing
Courtesy of CHRYSLER LLC

1 - PLATED CHAIN LINKS 2 - CAMSHAFT TIMING MARKS (DOTS)

6. For engines equipped with roller chains (early production), rotate the cams so that the plated links (1) and dots (2) are facing the 12:00 O'clock position.

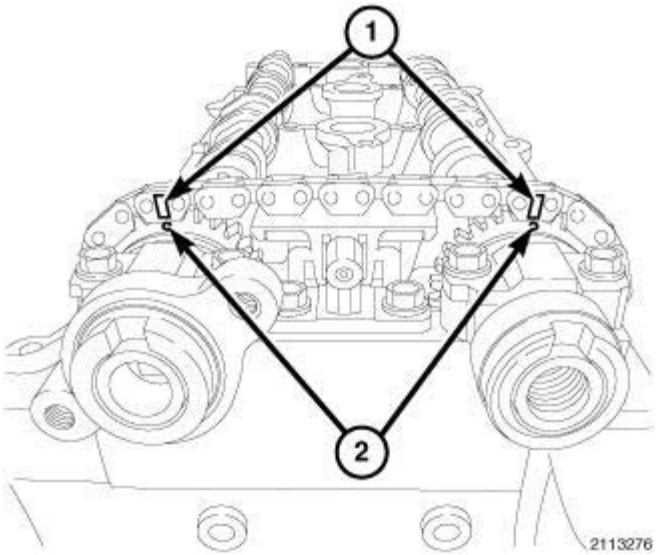

Fig. 116: Identifying Marked Links & Timing Dot On Camshaft Sprockets
Courtesy of CHRYSLER LLC

7. For engines equipped with silent chains (late production), rotate the cams so that the marked links (1) and dots (2) are facing the 12:00 O'clock position.

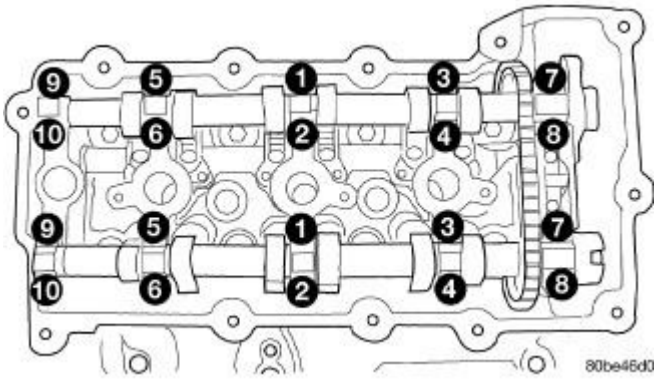

Fig. 117: Camshaft Bearing Cap Tightening Sequence
Courtesy of CHRYSLER LLC

8. Install cams to cylinder head. Verify that rocker arms are correctly seated and in proper positions.
9. Install camshaft bearing caps. Verify that bearing caps are installed in same position as removed.
10. Tighten cam bearing cap bolts gradually in sequence shown in illustration to 12 N.m (105 in. lbs.).
11. Install secondary chain tensioner bolts and tighten to 12 N.m (105 in. lbs.).
12. Remove locking pin from secondary tensioners.
13. Verify end play of camshafts are within specification. See **Engine - Specifications**.
14. Install the primary timing chain. See **Engine/Valve Timing/CHAIN and SPROCKETS, Timing - Installation**.

COVER(S), CYLINDER HEAD, LEFT

Removal

REMOVAL

1. Disconnect negative battery cable.
2. Disconnect electrical connectors from ignition coils and capacitor. Reposition electrical harness.
3. Remove ground strap from cylinder head cover stud.

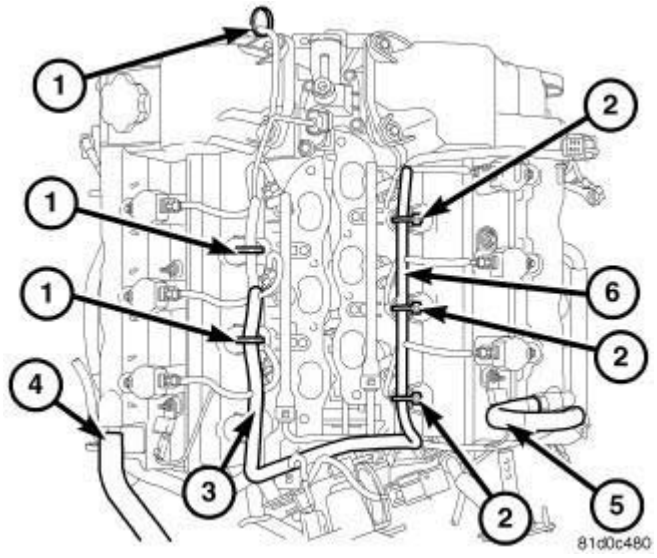

Fig. 118: Engine Harness Retaining Clips
Courtesy of CHRYSLER LLC

1 - Left cylinder head cover engine harness retainers 2 - Right cylinder head cover engine harness retainers
3 - Left engine harness
4 - Makeup air hose
5 - PCV Hose
6 - Right engine harness

4. Disconnect engine harness retaining clips (1) from cylinder head cover studs. Position the engine harness (3) aside.
5. Remove fastener attaching ignition coil capacitor.
6. Remove ignition coils. Refer to **Electrical - Ignition Control/Ignition Control/COIL, Ignition - Removal** .

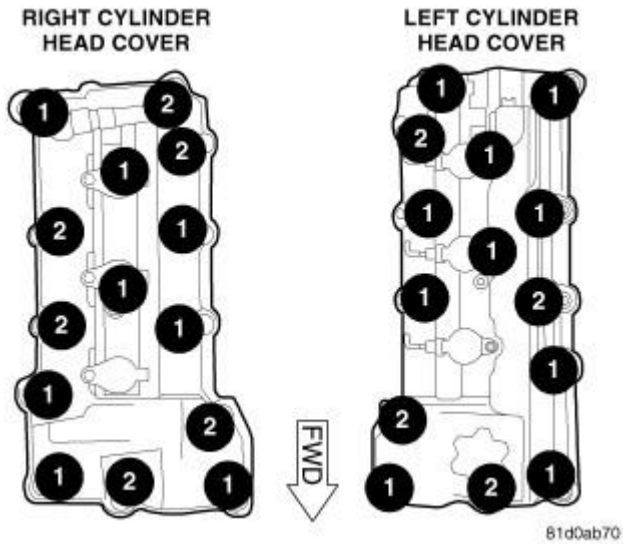

Fig. 119: Cylinder Head Cover Fasteners
Courtesy of CHRYSLER LLC

1 - DOUBLE ENDED STUDS
2 - BOLTS

7. Loosen all left cylinder head cover fasteners.

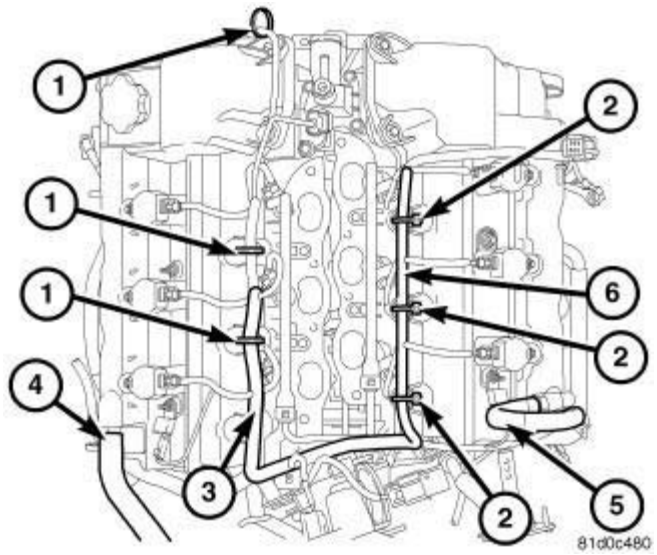

Fig. 120: Engine Harness Retaining Clips
Courtesy of CHRYSLER LLC

1 - Left cylinder head cover engine harness retainers
2 - Right cylinder head cover engine harness retainers
3 - Left engine harness
4 - Makeup air hose

5 - PCV Hose
6 - Right engine harness

8. Disconnect the makeup air hose (4).

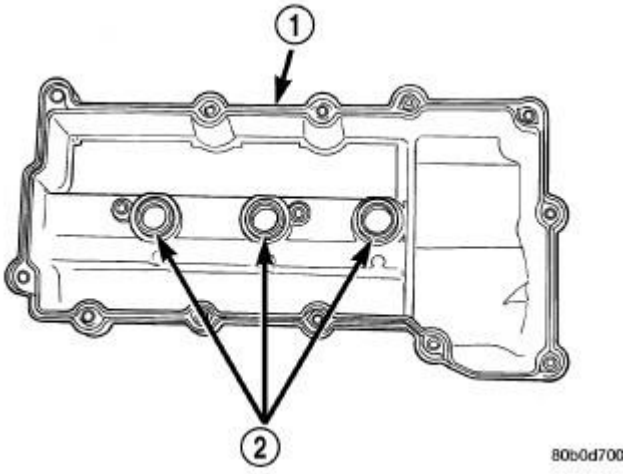

Fig. 121: Cylinder Head Cover Gasket & Spark Plug Seals
Courtesy of CHRYSLER LLC

1 - ONE PIECE GASKET
2 - SPARK PLUG WELL SEALS

NOTE: Cylinder head cover attaching bolts are captured to the cover.

CAUTION: Make certain the double ended studs in the center of the cylinder head cover are loose before attempting to remove cover.

9. Remove the left cylinder head cover (1).

Installation

INSTALLATION

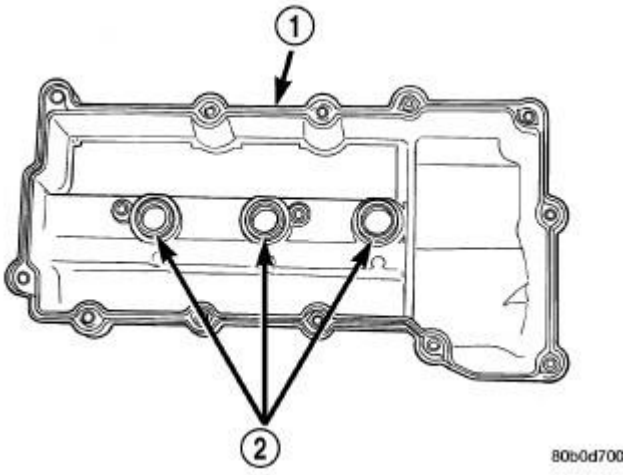

Fig. 122: Cylinder Head Cover Gasket & Spark Plug Seals
Courtesy of CHRYSLER LLC

1 - ONE PIECE GASKET 2 - SPARK PLUG WELL SEALS

1. Clean cylinder head cover and both sealing surfaces. Inspect and replace gaskets (1) as necessary.

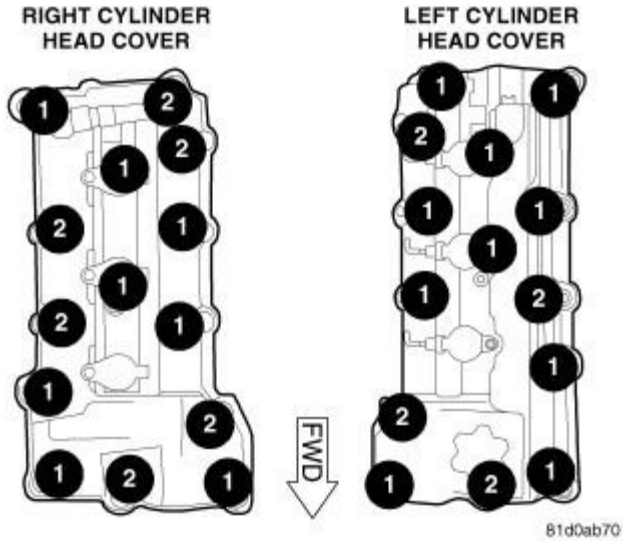

Fig. 123: Cylinder Head Cover Fasteners
Courtesy of CHRYSLER LLC

1 - DOUBLE ENDED STUDS 2 - BOLTS

2. Install cylinder head cover and hand start all fasteners. Verify that all double-ended studs are in the correct locations (1).
3. Tighten cylinder head cover attaching bolts and double-ended studs to 12 N.m (105 in. lbs.).

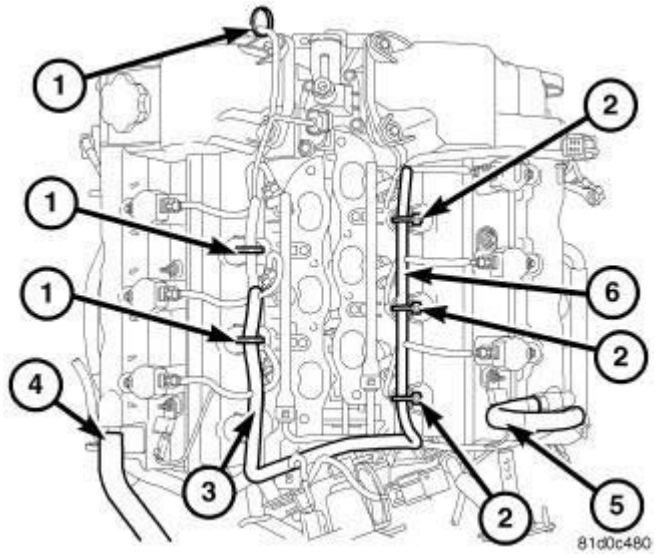

Fig. 124: Engine Harness Retaining Clips
Courtesy of CHRYSLER LLC

1 - Left cylinder head cover engine harness retainers 2 - Right cylinder head cover engine harness retainers
3 - Left engine harness
4 - Makeup air hose
5 - PCV Hose
6 - Right engine harness

4. Reposition the left engine harness (3), and install the left engine harness retainers (1) to the double-ended studs.
5. Install the ignition coils. Refer to **Electrical - Ignition Control/Ignition Control/COIL, Ignition - Installation** .
6. Install ignition coil capacitor and fastener.
7. Reconnect all electrical connectors.
8. Install ground strap to cylinder head cover stud.

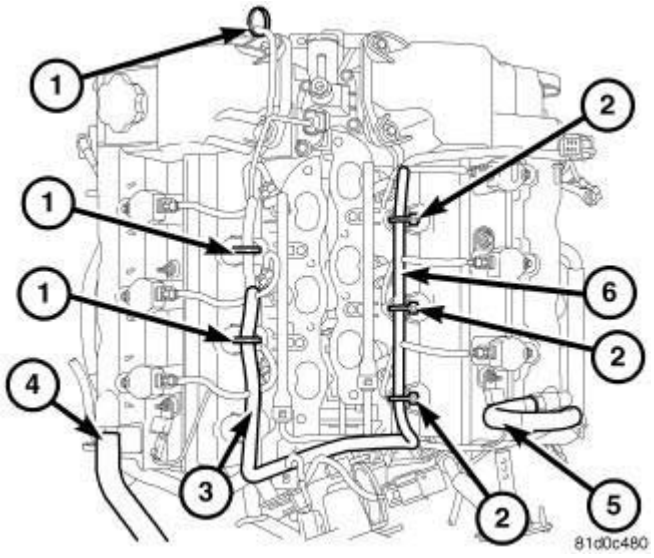

Fig. 125: Engine Harness Retaining Clips
Courtesy of CHRYSLER LLC

1 - Left cylinder head cover engine harness retainers 2 - Right cylinder head cover engine harness retainers
3 - Left engine harness
4 - Makeup air hose
5 - PCV Hose
6 - Right engine harness

9. Install the makeup air hose.
10. Connect negative battery cable.

COVER(S), CYLINDER HEAD, RIGHT

Removal

REMOVAL

1. Disconnect negative battery cable.

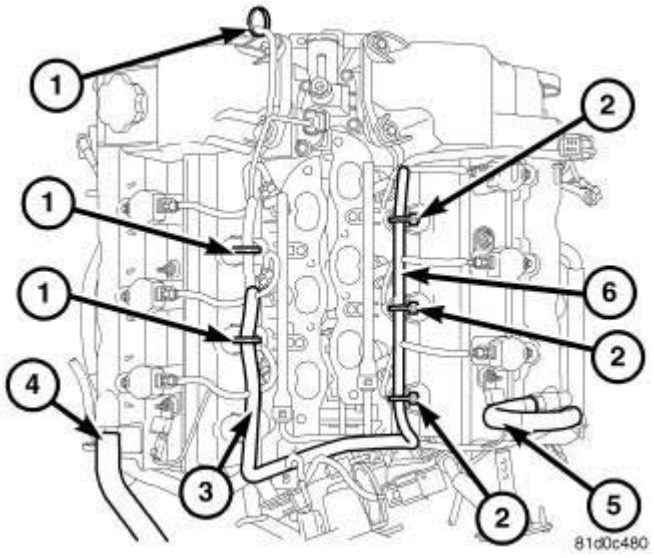

Fig. 126: Engine Harness Retaining Clips
Courtesy of CHRYSLER LLC

1 - Left cylinder head cover engine harness retainers 2 - Right cylinder head cover engine harness retainers
3 - Left engine harness
4 - Makeup air hose
5 - PCV Hose
6 - Right engine harness

2. Disconnect electrical connectors from ignition coils and capacitor.
3. Disconnect right engine harness retaining clips (2) from cylinder head cover studs. Position the engine harness (6) aside.
4. Disconnect the PCV hose (5) from the upper intake manifold.
5. Remove upper intake manifold. See **Engine/Manifolds/MANIFOLD, Intake - Removal**.

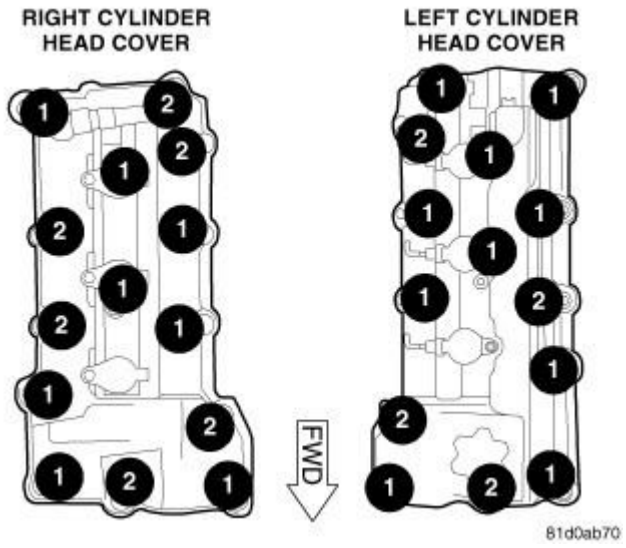

Fig. 127: Cylinder Head Cover Fasteners
Courtesy of CHRYSLER LLC

1 - DOUBLE ENDED STUDS 2 - BOLTS

6. Remove ground strap from cylinder head cover stud.
7. Disconnect electrical harness retaining clips from cylinder head cover studs. Reposition electrical harness.
8. Remove fastener attaching ignition coil capacitor.
9. Remove ignition coils. Refer to **Electrical - Ignition Control/Ignition Control/COIL, Ignition - Removal** .
10. Loosen all cylinder head cover fasteners.

NOTE: Cylinder head cover attaching bolts are captured to the cover.

CAUTION: Make certain the double ended studs in the center of the cylinder head cover are loose before attempting to remove cover.

11. Remove cylinder head cover.

Installation

INSTALLATION

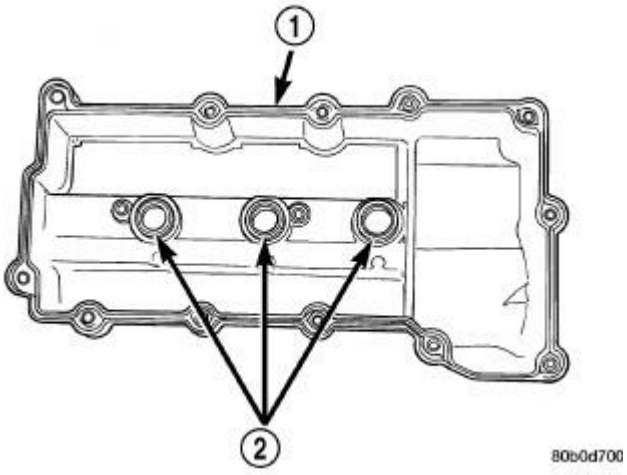

Fig. 128: Cylinder Head Cover Gasket & Spark Plug Seals
Courtesy of CHRYSLER LLC

1 - ONE PIECE GASKET 2 - SPARK PLUG WELL SEALS

1. Clean cylinder head cover and both sealing surfaces. Inspect and replace gaskets (1) as necessary.

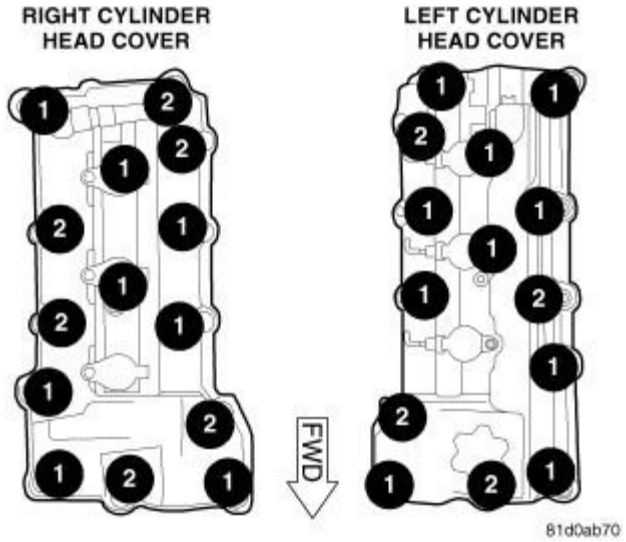

Fig. 129: Cylinder Head Cover Fasteners
Courtesy of CHRYSLER LLC

1 - DOUBLE ENDED STUDS 2 - BOLTS

2. Install cylinder head cover and hand start all fasteners. Verify that all double-ended studs are in the correct locations.
3. Tighten cylinder head cover attaching bolts and double-ended studs (1) to 12 N.m (105 in. lbs.).

4. Install ignition coils. Refer to **Electrical - Ignition Control/Ignition Control/COIL, Ignition - Installation** .
5. Install ignition coil capacitor and fastener.
6. Connect ground strap to cylinder head cover stud.

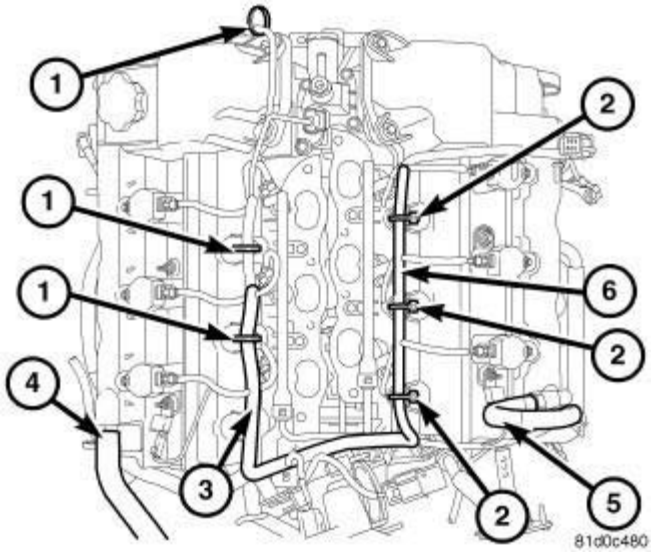

Fig. 130: Engine Harness Retaining Clips
Courtesy of CHRYSLER LLC

1 - Left cylinder head cover engine harness retainers 2 - Right cylinder head cover engine harness retainers
3 - Left engine harness
4 - Makeup air hose
5 - PCV Hose
6 - Right engine harness

7. Reposition the right engine harness (6), and install the right engine harness retainers (2) to the double-ended studs.
8. Install upper intake manifold. See **Engine/Manifolds/MANIFOLD, Intake - Installation**.
9. Reconnect the PCV to the upper intake manifold.

LIFTER(S), HYDRAULIC

Diagnosis and Testing

DIAGNOSIS AND TESTING - HYDRAULIC LASH ADJUSTER 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 **LASH ADJUSTER (TAPPET) NOISE 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.

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) If lash adjuster(s) are still spongy, replace with new adjuster/rocker arm assembly.
4. Low oil pressure	4. See below: (a) Check and correct engine oil level. (b) Check engine oil pressure. (c) Check for excessive bearing clearance and correct. (d) Check for worn oil pump.
5. Oil passage to cylinder head(s) plugged with debris.	5. Check cylinder head oil passages and cylinder head gasket restrictor for blockage. Clean or replace as necessary.
6. Worn valve guide(s).	6. Ream guide(s) and replace valve(s) with oversize valves and seal(s).
7. Air injested into oil due to broken or cracked oil pump pickup tube.	7. Inspect pickup tube and replace as necessary.
8. Collapsed lash adjuster due to debris injestion.	8. Clean debris from engine and replace lash adjuster(s).

Removal

REMOVAL

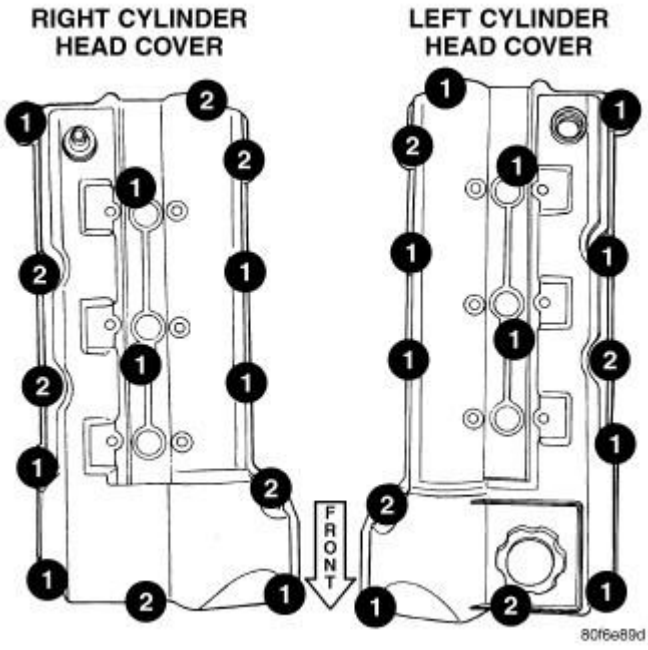

Fig. 131: Cylinder Head Cover Fasteners
Courtesy of CHRYSLER LLC

1 - DOUBLE ENDED STUDS 2 - BOLTS

1. Remove cylinder head cover(s). See **Engine/Cylinder Head/COVER(S), Cylinder Head - Removal**.

CAUTION: If lash adjusters and rocker arms are to be reused, always mark position for reassembly in their original positions.

2. Remove rocker arm(s). See **Engine/Cylinder Head/ROCKER ARM, Valve - Removal**.
3. Remove lash adjuster(s).

Installation

INSTALLATION

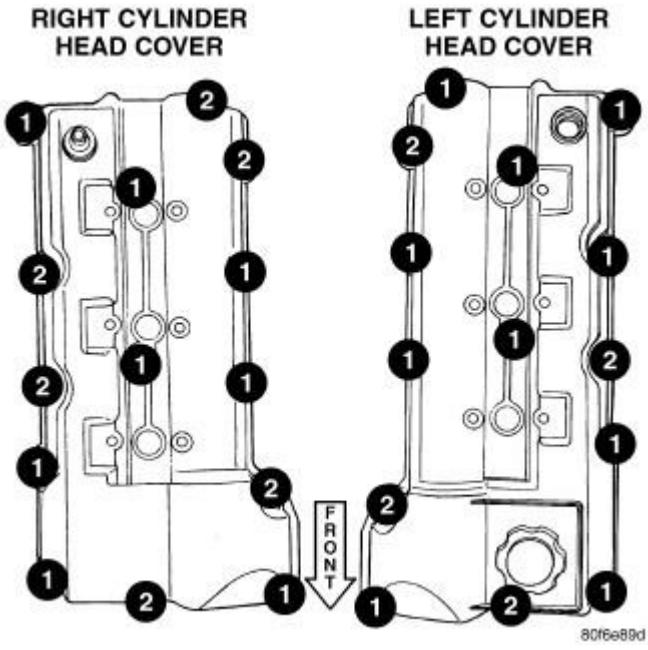

Fig. 132: Cylinder Head Cover Fasteners
Courtesy of CHRYSLER LLC

1 - DOUBLE ENDED STUDS 2 - BOLTS

1. Install hydraulic lash adjuster making sure adjusters are at least partially full of oil. This can be verified by little or no plunger travel when lash adjuster is depressed.
2. Install the rocker arm(s). See **Engine/Cylinder Head/ROCKER ARM, Valve - Installation**.
3. Install the cylinder head covers. See **Engine/Cylinder Head/COVER(S), Cylinder Head - Installation**.

ROCKER ARM, VALVE

Description

DESCRIPTION

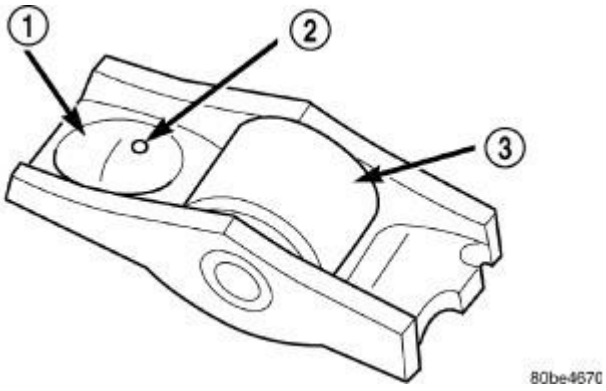

Fig. 133: Rocker Arm
Courtesy of CHRYSLER LLC

1 - LASH ADJUSTER POCKET 2 - OIL SQUIRT HOLE 3 - ROLLER

The rocker arms are composed of steel stamping with an integral roller bearing. The rocker arms incorporate a 0.5 mm (0.0197 in.) oil hole in the lash adjuster socket for roller/camshaft lobe lubrication.

Removal

REMOVAL

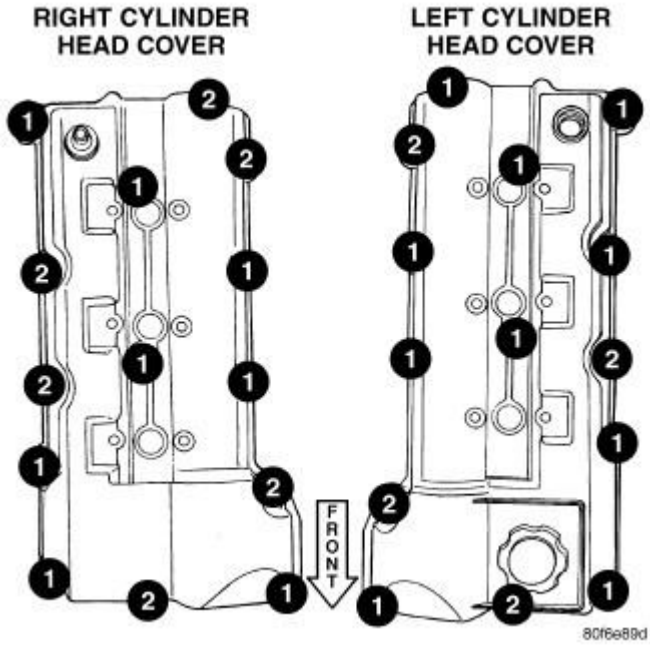

Fig. 134: Cylinder Head Cover Fasteners
Courtesy of CHRYSLER LLC

1 - DOUBLE ENDED STUDS 2 - BOLTS

1. Remove cylinder head cover(s). See **Engine/Cylinder Head/COVER(S), Cylinder Head - Removal**.

CAUTION: Always rotate engine by turning the crankshaft. Failure to do so will result in valve and/or piston damage.

2. Rotate engine until the cam lobe is on its base circle (heel), on the rocker arm being removed.

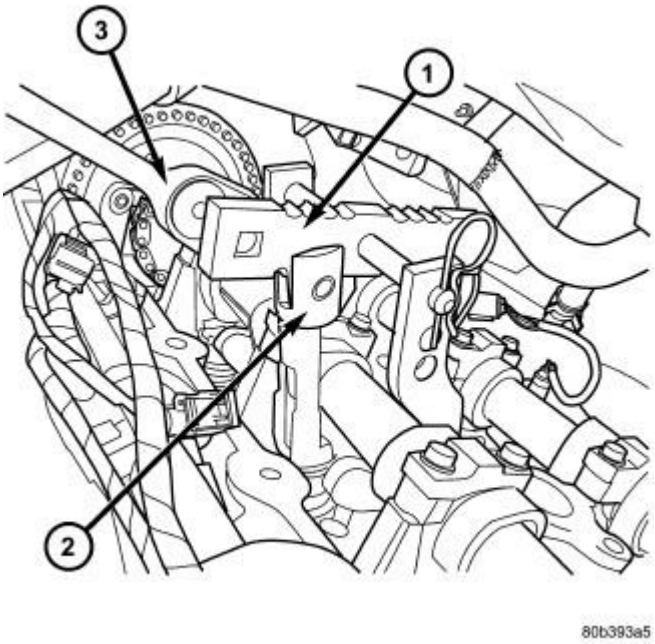

Fig. 135: Rocker Arm - Removal/Installation
Courtesy of CHRYSLER LLC

1 - SPECIAL TOOL 8215A 2 - SPECIAL TOOL 8216A 3 - 3/8" DRIVE RATCHET

CAUTION: Depress valve spring only enough to remove rocker arm.

3. Using Special Tools 8215A (1) and 8216A (2) Adaptor, depress valve spring only enough to release tension on rocker arm.
4. Remove rocker arm from cylinder head.

CAUTION: If rocker arms are to be reused, identify position of rocker arms for reassembly in their original positions.

5. Repeat procedure for each rocker arm removed.
6. Inspect the rocker arm for wear or damage. See **Engine/Cylinder Head/ROCKER ARM, Valve - Inspection**.

Inspection

INSPECTION

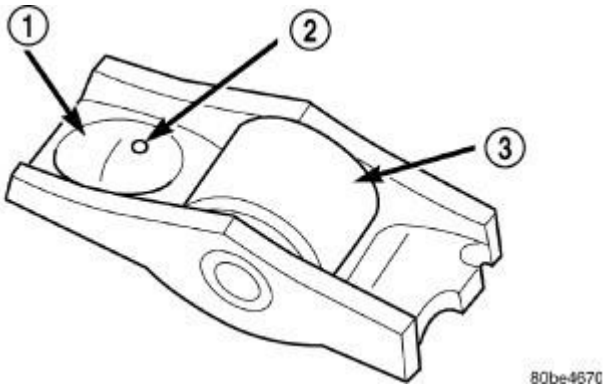

Fig. 136: Rocker Arm
Courtesy of CHRYSLER LLC

1 - LASH ADJUSTER POCKET
2 - OIL SQUIRT HOLE
3 - ROLLER

Inspect the cam follower assembly for wear or damage. Replace as necessary.

Installation

INSTALLATION

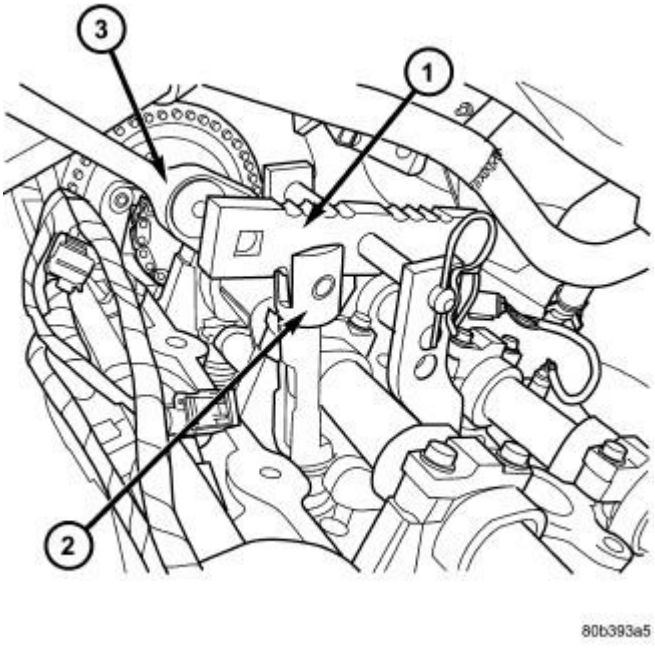

Fig. 137: Rocker Arm - Removal/Installation
Courtesy of CHRYSLER LLC

1 - SPECIAL TOOL 8215A
2 - SPECIAL TOOL 8216A
3 - 3/8" DRIVE RATCHET

1. Lubricate rocker arms with clean engine oil before installation.
2. Rotate engine until cam lobe is on its base circle (heel) of rocker arm being installed.
3. Using Special Tools 8215A (1) and 8216A Adaptor, depress valve spring only enough to install rocker arm.
4. Install rocker arm in original position (if reused) over valve and lash adjuster. Release tension on valve spring.

NOTE: Inspect rocker arm for proper engagement into lash adjuster and valve tip.

5. Repeat procedure for each rocker arm being installed.

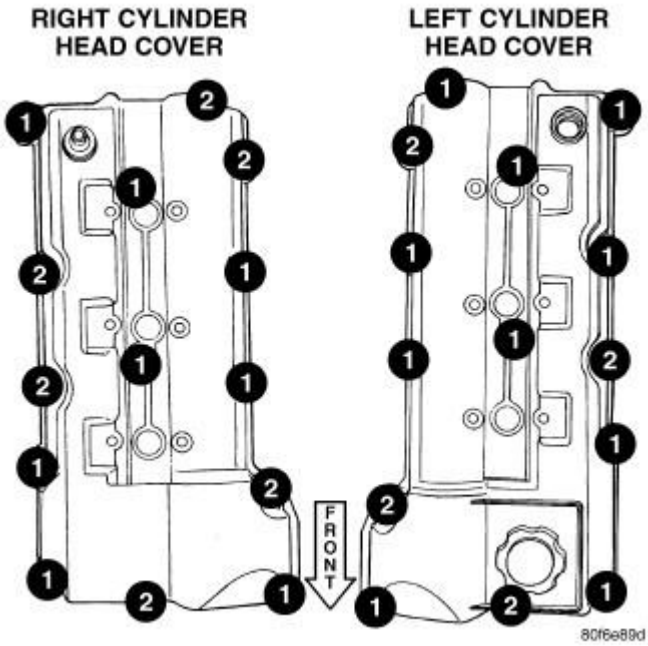

Fig. 138: Cylinder Head Cover Fasteners
Courtesy of CHRYSLER LLC

1 - DOUBLE ENDED STUDS 2 - BOLTS

6. Install cylinder head cover(s).

SEAL(S), VALVE GUIDE

Removal

REMOVAL

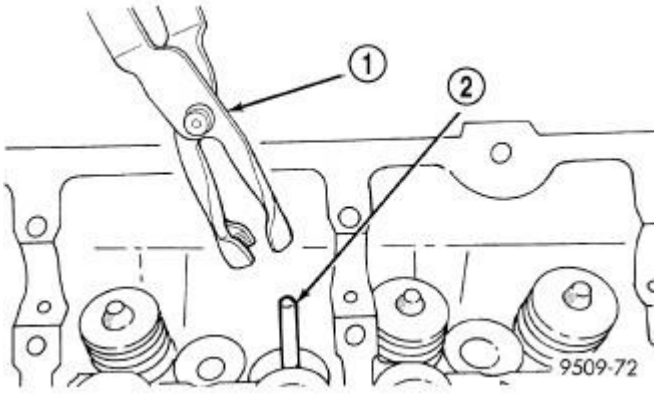

Fig. 139: Valve Stem Seal-Removal/Installation

Courtesy of CHRYSLER LLC

1 - VALVE SEAL TOOL 2 - VALVE STEM

1. Remove valve spring. See **Engine/Cylinder Head/SPRING(S), Valve - Removal**.
2. Remove valve stem seal by using a valve seal tool.

Installation

INSTALLATION

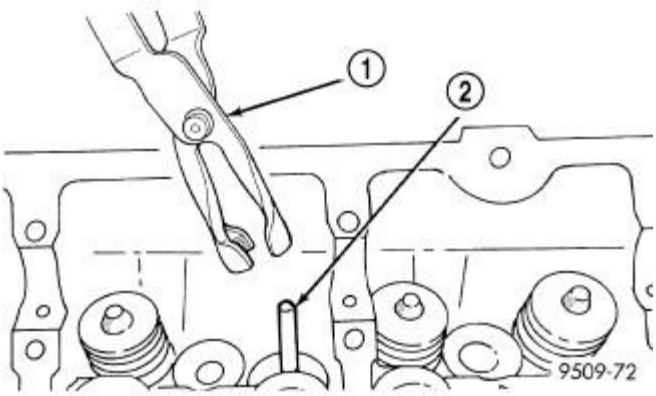

Fig. 140: Valve Stem Seal-Removal/Installation
Courtesy of CHRYSLER LLC

1 - VALVE SEAL TOOL 2 - VALVE STEM

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.
2. Install valve spring. See **Engine/Cylinder Head/SPRING(S), Valve - Installation**.

SPRING(S), VALVE

Description

DESCRIPTION

The valve springs are made from high strength, chrome-silicon steel. The springs are common for intake and exhaust applications. The valve spring seat is integral with the valve stem seal, which incorporates a garter spring to maintain consistent lubrication control to the valve stem.

Removal

IN VEHICLE

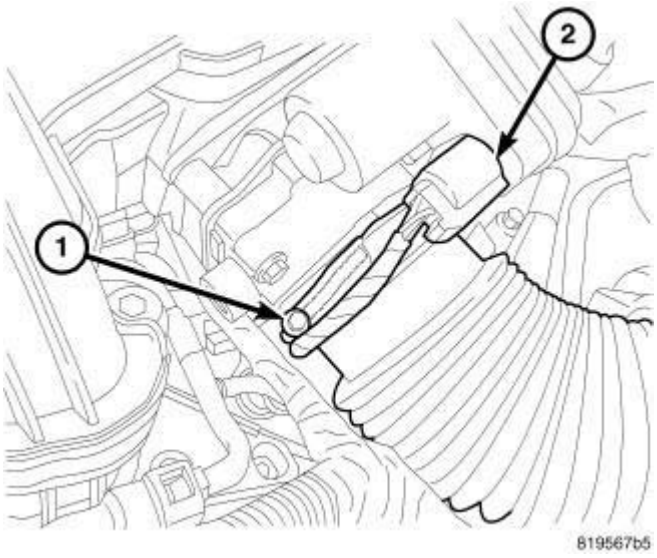

Fig. 141: Air Cleaner Housing & Inlet Hose
Courtesy of CHRYSLER LLC

1. Perform fuel system pressure release procedure before attempting any repairs. Refer to **Fuel System/Fuel Delivery - Standard Procedure** .
2. Disconnect negative cable from remote jumper terminal.
3. Remove air cleaner housing and inlet hose (1).

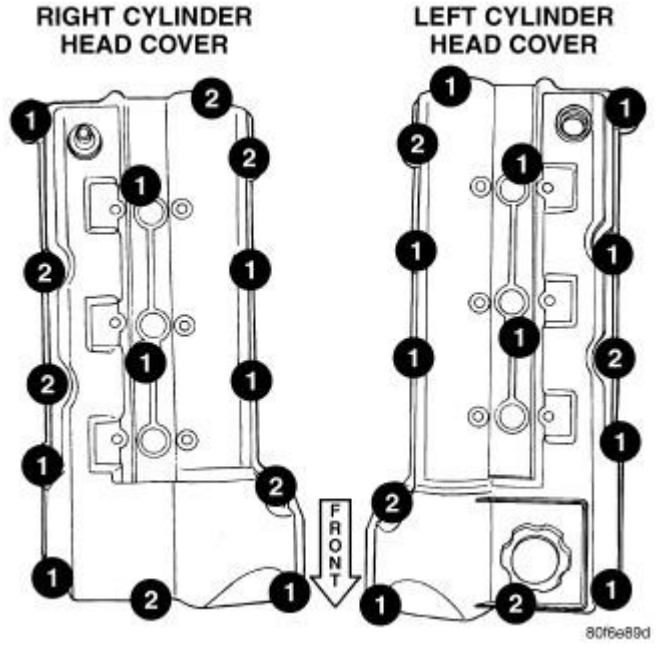

Fig. 142: Cylinder Head Cover Fasteners
Courtesy of CHRYSLER LLC

1 - DOUBLE ENDED STUDS 2 - BOLTS

4. Remove upper intake manifold. See **Engine/Manifolds/MANIFOLD, Intake - Removal**.
5. Remove cylinder head covers. See **Engine/Cylinder Head/COVER(S), Cylinder Head - Removal**.
6. Remove crankshaft vibration damper. See **Engine/Engine Block/DAMPER, Vibration - Removal**.

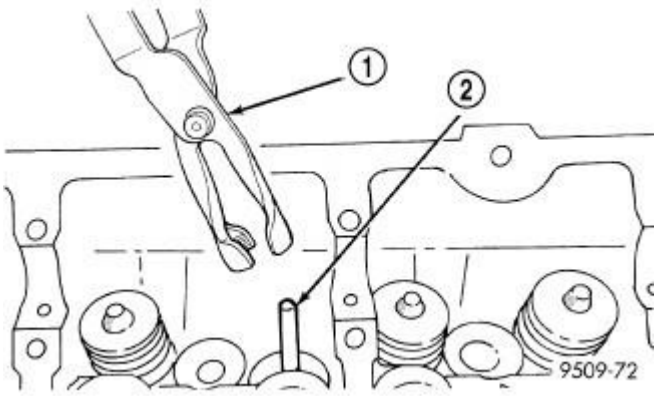

Fig. 143: Valve Stem Seal-Removal/Installation
Courtesy of CHRYSLER LLC

1 - VALVE SEAL TOOL 2 - VALVE STEM

7. Remove camshafts and rocker arms. See **Engine/Cylinder Head/CAMSHAFT, Engine - Removal**.
8. With air hose attached to spark plug adapter installed in the cylinder being serviced, apply 620.5-689 kPa (90-100 psi) air pressure. This is to hold valves in place while servicing components.
9. Using Special Tool MD 998772A with adapter 6779, compress valve spring and remove valve locks, retainer, and valve spring.
10. Remove valve stem seal. See **Engine/Cylinder Head/SEAL(S), Valve Guide - Removal**.

OFF VEHICLE

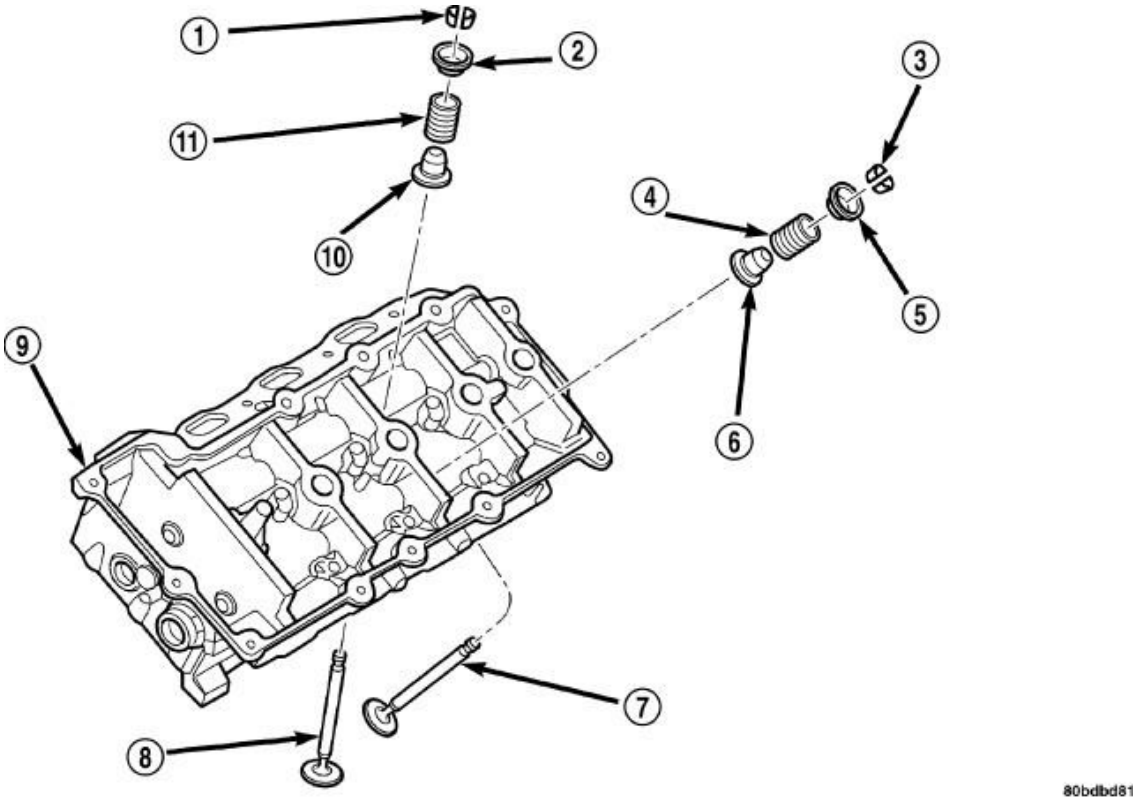

Fig. 144: Cylinder Head, Valves & Springs
Courtesy of CHRYSLER LLC

1 - VALVE KEEPER	7 - VALVE-EXHAUST
2 - SPRING RETAINER	8 - VALVE-INTAKE
3 - VALVE KEEPER	9 - CYLINDER HEAD
4 - VALVE SPRING-EXHAUST	10 - VALVE STEM SEAL
5 - SPRING RETAINER	11 - VALVE SPRING-INTAKE
6 - VALVE STEM SEAL	-

1. With cylinder head removed, compress valve springs using a Special Tool C-3422-D, Valve Spring Compressor.
2. Remove valve retaining locks, valve spring retainers, valve springs and valve spring seat/stem seal assembly.

Inspection

INSPECTION

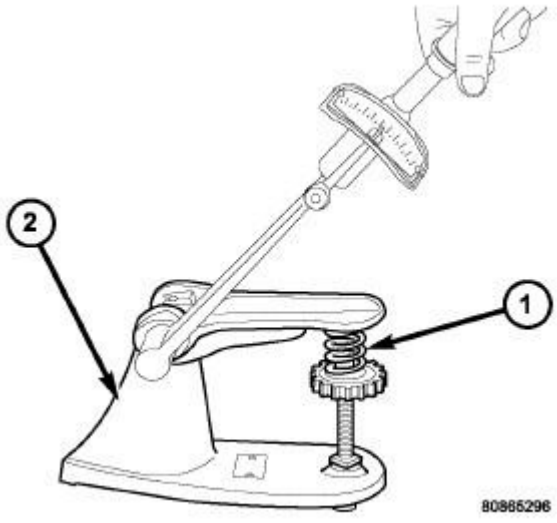

Fig. 145: TESTING VALVE SPRING
Courtesy of CHRYSLER LLC

1 - SPECIAL TOOL C-647

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

Installation

IN VEHICLE

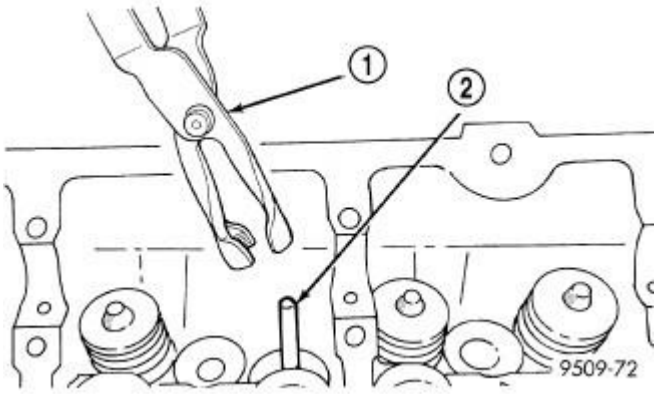

Fig. 146: Valve Stem Seal-Removal/Installation

Courtesy of CHRYSLER LLC

1 - VALVE SEAL TOOL 2 - VALVE STEM

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 locks
2. Follow the same procedure on the remaining cylinders using the firing sequence 1-2-3-4-5-6. **Make sure piston is at TDC on the cylinder that the valve spring is to be removed.**
3. Remove spark plug adapter tool and Special Tool MD 998772A.
4. Install rocker arm(s).

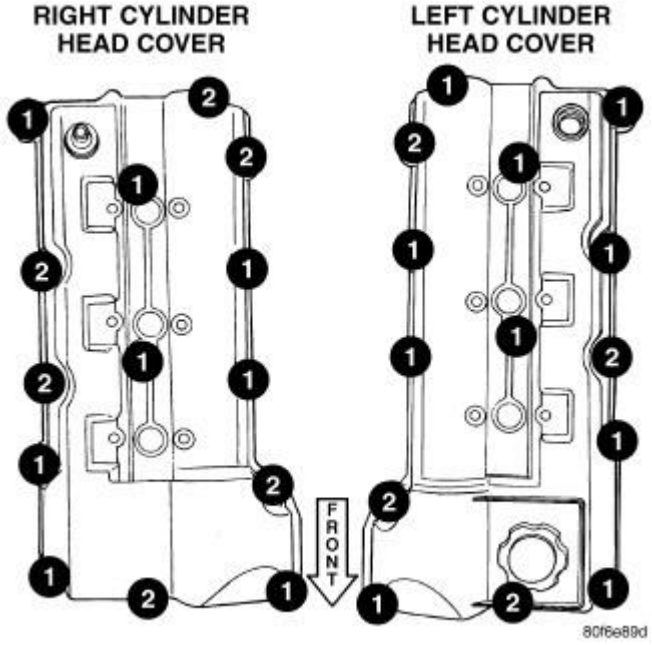

Fig. 147: Cylinder Head Cover Fasteners
Courtesy of CHRYSLER LLC

1 - DOUBLE ENDED STUDS 2 - BOLTS

5. Install camshafts. See **Engine/Cylinder Head/CAMSHAFT, Engine - Installation**, **Engine/Valve Timing/CHAIN and SPROCKETS, Timing - Installation** and **Engine/Valve Timing/COVER(S), Engine Timing - Installation**.
6. Install cylinder head covers. See **Engine/Cylinder Head/COVER(S), Cylinder Head - Installation**.
7. Install upper intake manifold. See **Engine/Manifolds/MANIFOLD, Intake - Installation**.

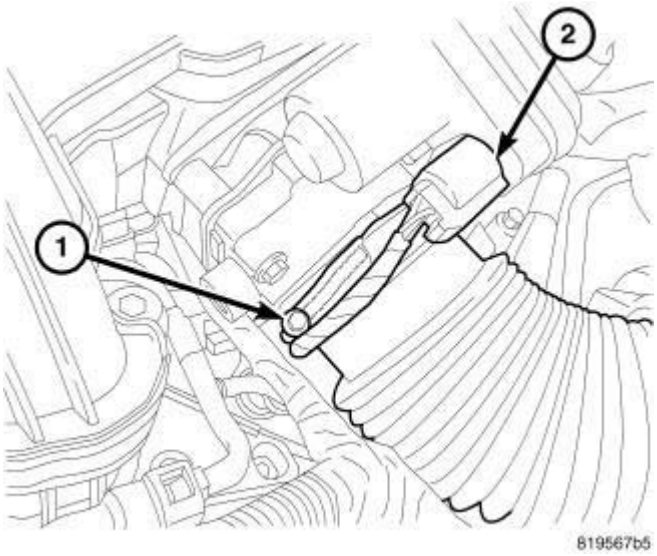

Fig. 148: Air Cleaner Housing & Inlet Hose
Courtesy of CHRYSLER LLC

8. Install air cleaner housing and inlet hose (1).
9. Connect negative cable.

OFF VEHICLE

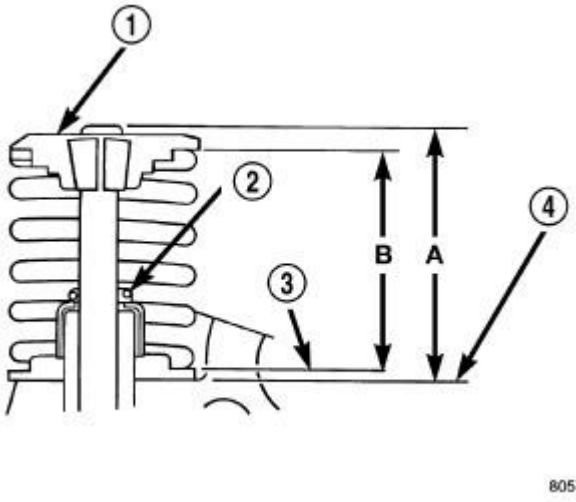

Fig. 149: Valve Tip Height & Valve Spring Installed Height
Courtesy of CHRYSLER LLC

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

1. If removed, install the valve(s). See **Engine/Cylinder Head/VALVES, Intake and Exhaust - Installation**.
2. If valves or seats have been re-ground, check valve tip height (A). If valve tip height for intake valve is greater than 47.59 mm (1.8737 in.) or 49.14 mm (1.9347 in.) for exhaust valve, grind valve tip until within specifications. Make sure measurement is taken from cylinder head surface to the top of valve stem.

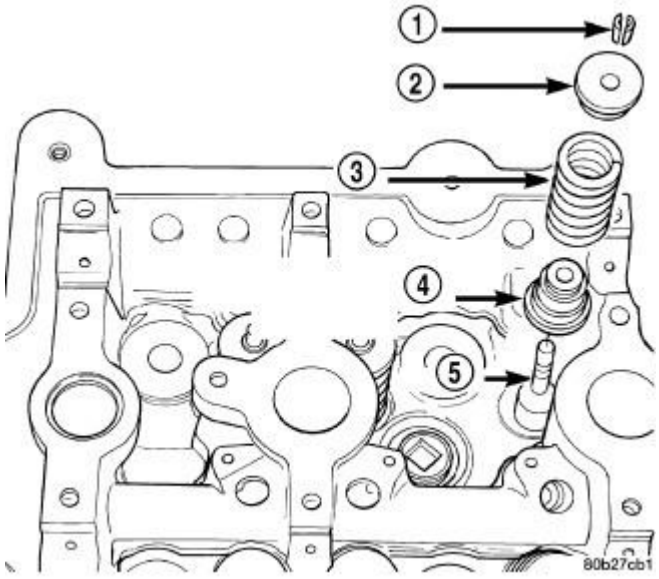

Fig. 150: Valve Seal & Spring
Courtesy of CHRYSLER LLC

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

3. Install valve seal/spring seat assembly over valve guides on all valve stems. Ensure that the garter spring is intact around the top of the rubber seal. Install valve springs, valve retainers.

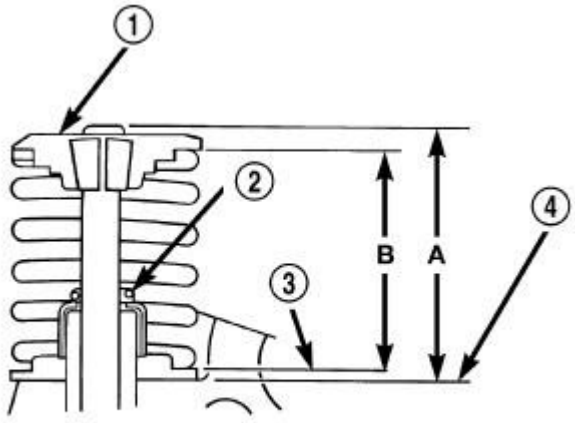

Fig. 151: Valve Tip Height & Valve Spring Installed Height
Courtesy of CHRYSLER LLC

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

4. Compress valve springs with a valve spring compressor install locks and release tool. **If valves and/or seats are re-ground, 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.

VALVES, INTAKE AND EXHAUST

Description

DESCRIPTION

The valves are made of heat resistant steel, and have chrome plated stems to prevent scuffing. The four valves per cylinder (two intake and two exhaust) are actuated by roller rocker arms, which pivot on stationary lash adjusters. All valves use three bead lock keepers to retain springs and to promote valve rotation.

Standard Procedure

VALVE AND VALVE SEAT REFACING

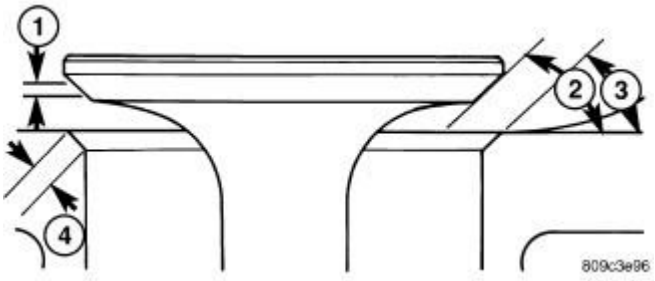

Fig. 152: Valve Face & Seat
Courtesy of CHRYSLER LLC

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

The intake and exhaust valves have a 44.5 to 45 degree face angle (2). The valve seats have a 45 to 45.5 degree face angle (3).

VALVES

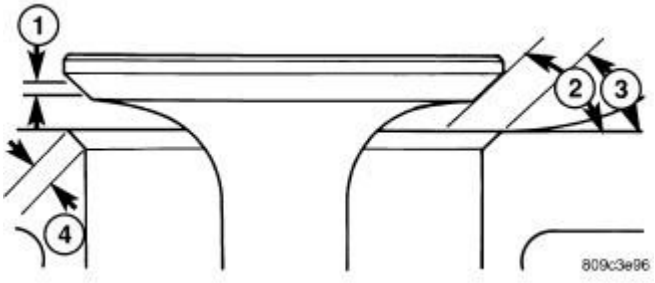

Fig. 153: Valve Face & Seat
Courtesy of CHRYSLER LLC

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

Inspect the remaining margin after the valves are refaced. See **Engine - Specifications**.

VALVE SEATS

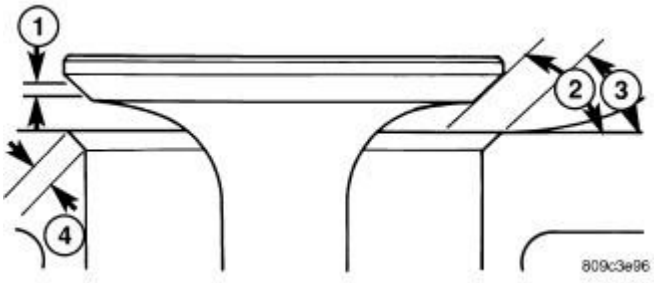

Fig. 154: Valve Face & Seat
Courtesy of CHRYSLER LLC

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

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 1.00 to 1.50 mm (0.0394 to 0.0591 in.) and exhaust seats should be 1.25 to 1.75 mm (0.049 to 0.069 in.).

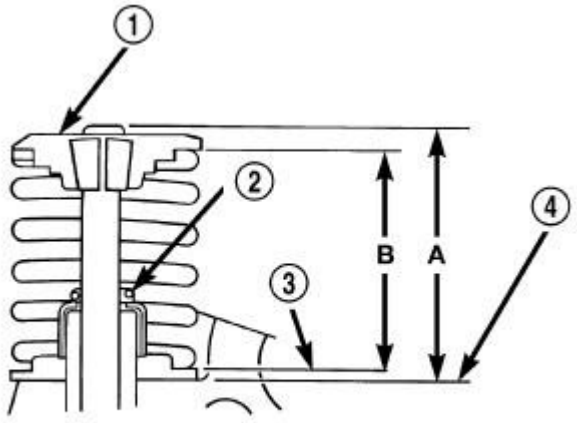

Fig. 155: Valve Tip Height & Valve Spring Installed Height
Courtesy of CHRYSLER LLC

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

5. Check the valve spring installed height after refacing the valve and seat.

VALVE AND SPRING INSTALLED HEIGHT

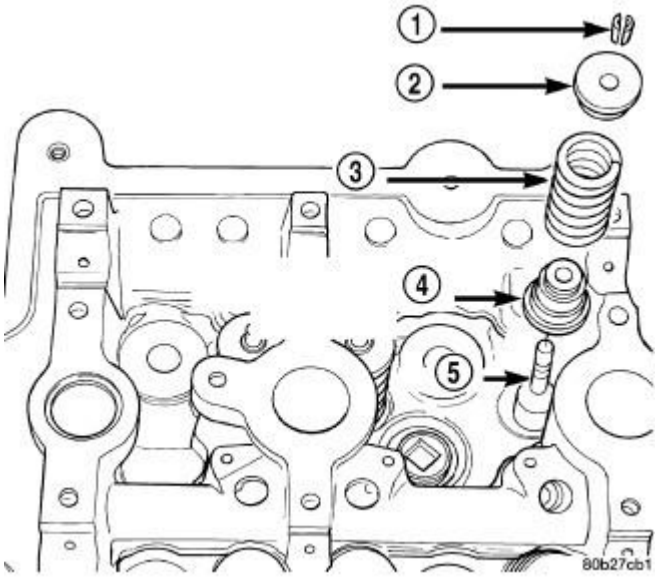

Fig. 156: Valve Seal & Spring
Courtesy of CHRYSLER LLC

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

1. Coat valve stems with clean engine oil and insert them in cylinder head.
2. If valves (5) or seats have been refaced, check valve tip height (A). If valve tip height for intake valve is greater than 47.59 (1.8737 in.) or 49.14 (1.9347 in.) for exhaust valve, grind valve tip until within specifications. Make sure measurement is taken from cylinder head surface to the top of valve stem.
3. Install valve seal/spring seat assembly over valve guides on all valve stems. Ensure that the garter spring is intact around the top of the rubber seal.

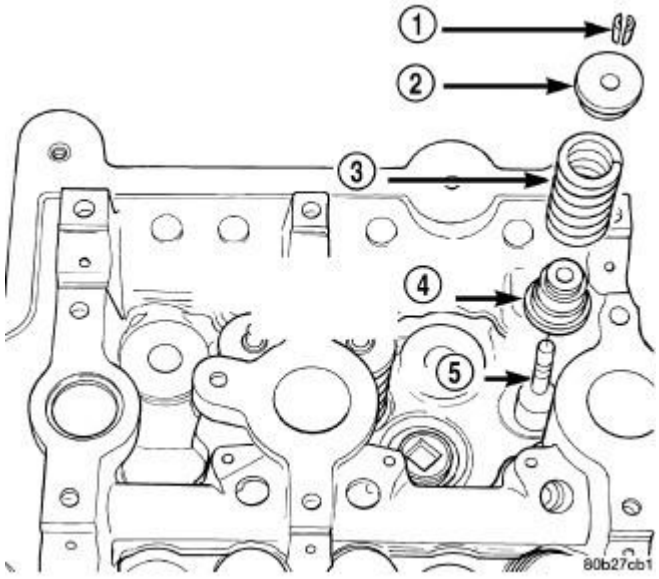

Fig. 157: Valve Seal & Spring
Courtesy of CHRYSLER LLC

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

4. Position valve springs (3) and retainer on spring seat.
5. Compress valve spring with a valve spring compressor.
6. Install retainer locks and release tool.
7. If valves and/or seats are refaced, measure the installed height of springs (B). Measurement is 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

REMOVAL

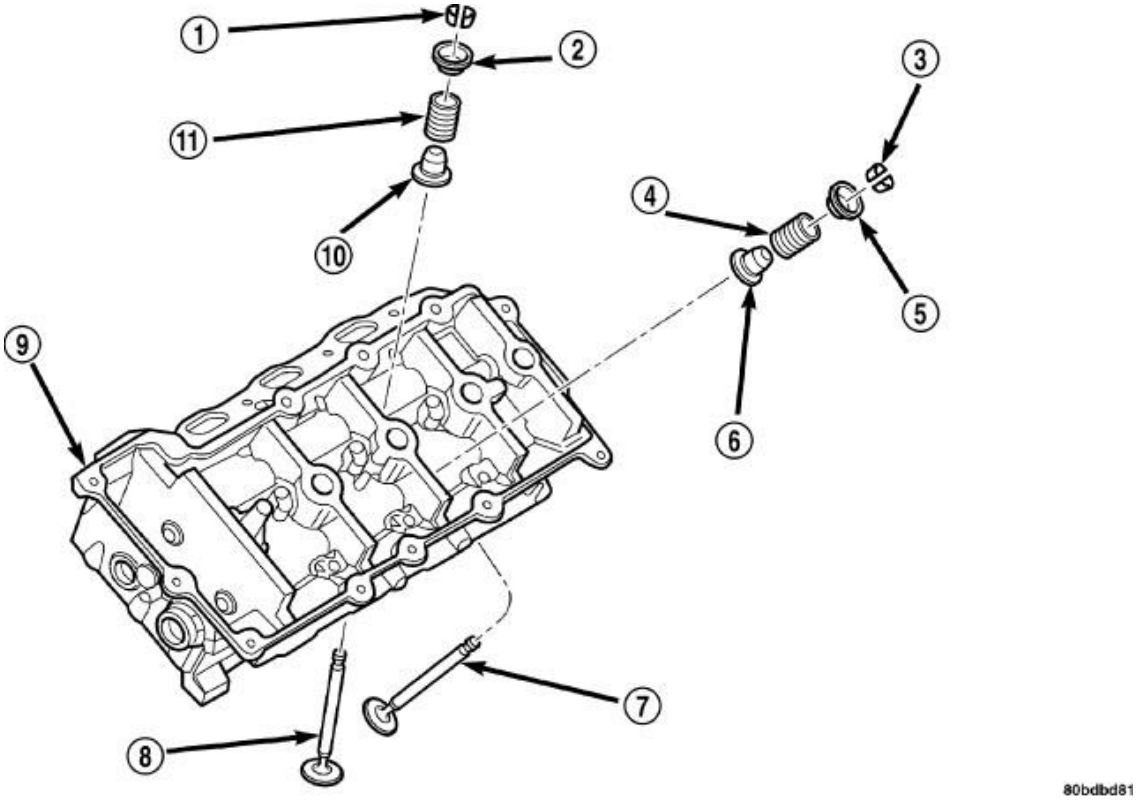

Fig. 158: Cylinder Head, Valves & Springs
Courtesy of CHRYSLER LLC

1 - VALVE KEEPER	7 - VALVE-EXHAUST
2 - SPRING RETAINER	8 - VALVE-INTAKE
3 - VALVE KEEPER	9 - CYLINDER HEAD
4 - VALVE SPRING-EXHAUST	10 - VALVE STEM SEAL
5 - SPRING RETAINER	11 - VALVE SPRING-INTAKE
6 - VALVE STEM SEAL	-

1. Remove cylinder head(s). See **Engine/Cylinder Head - Removal**.
2. Remove valve spring. See **Engine/Cylinder Head/SPRING(S), Valve - Removal**.
3. Before removing valves, **remove any burrs from valve stem lock grooves to prevent damage to the valve guides.**
4. Remove valve (7). Identify each valve to ensure installation in original location.

Inspection

INSPECTION

VALVES

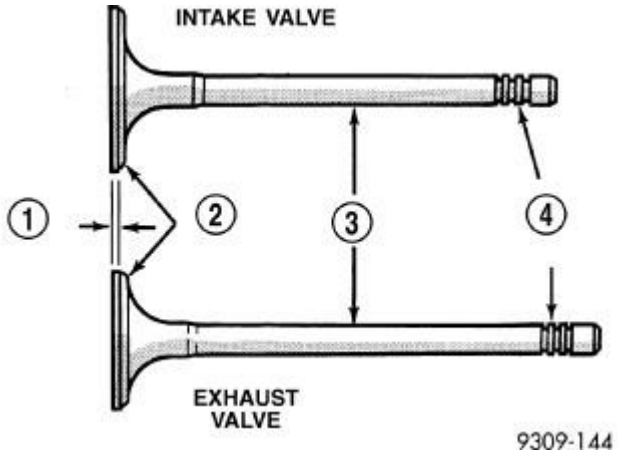

Fig. 159: Intake & Exhaust Valves
Courtesy of CHRYSLER LLC

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

1. Clean and inspect valves thoroughly. Replace burned, warped and cracked valves.
2. Measure valve stems for wear (3). For valve specifications, see **Engine - Specifications**.

NOTE: Valve stems are chrome plated and should not be polished.

VALVE GUIDES

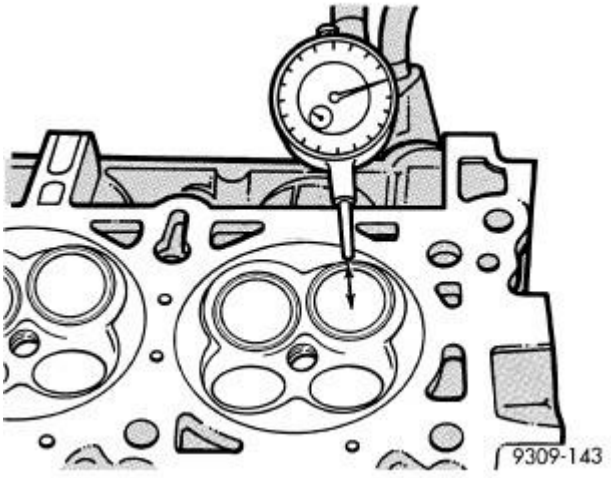

Fig. 160: Measuring Valve Guide Wear - Typical
Courtesy of CHRYSLER LLC

1. Remove carbon and varnish deposits from inside of valve guides with a reliable guide cleaner.
2. Measure valve stem-to-guide clearance as follows:
3. Install valve into cylinder head so it is 15 mm (0.590 inch.) off the valve seat. A small piece of hose may be used to hold valve in place.
4. Attach dial indicator Tool C-3339A to cylinder head and set it at right angle of valve stem being measured.
5. Move valve to and from the indicator. For clearance specifications, see **Engine - Specifications**.

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

Installation

INSTALLATION

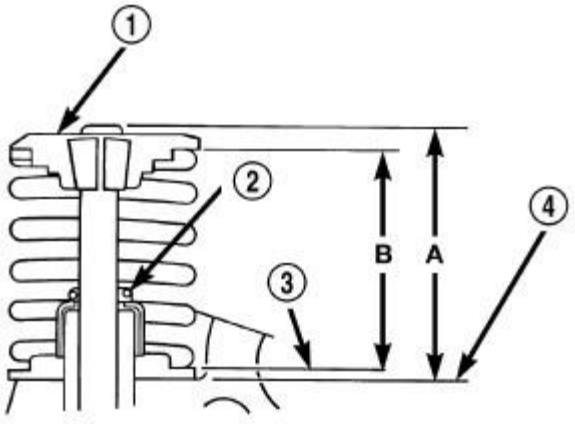

Fig. 161: Valve Tip Height & Valve Spring Installed Height
Courtesy of CHRYSLER LLC

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

1. Coat valve stems with clean engine oil and insert them in cylinder head.
2. If valves or seats have been re-ground, check valve tip height (A). If valve tip height for intake valve is greater than 47.59 mm (1.8737 in.) or 49.14 mm (1.9347 in.) for exhaust valve, grind valve tip until within specifications. Make sure measurement is taken from cylinder head surface to the top of valve stem.

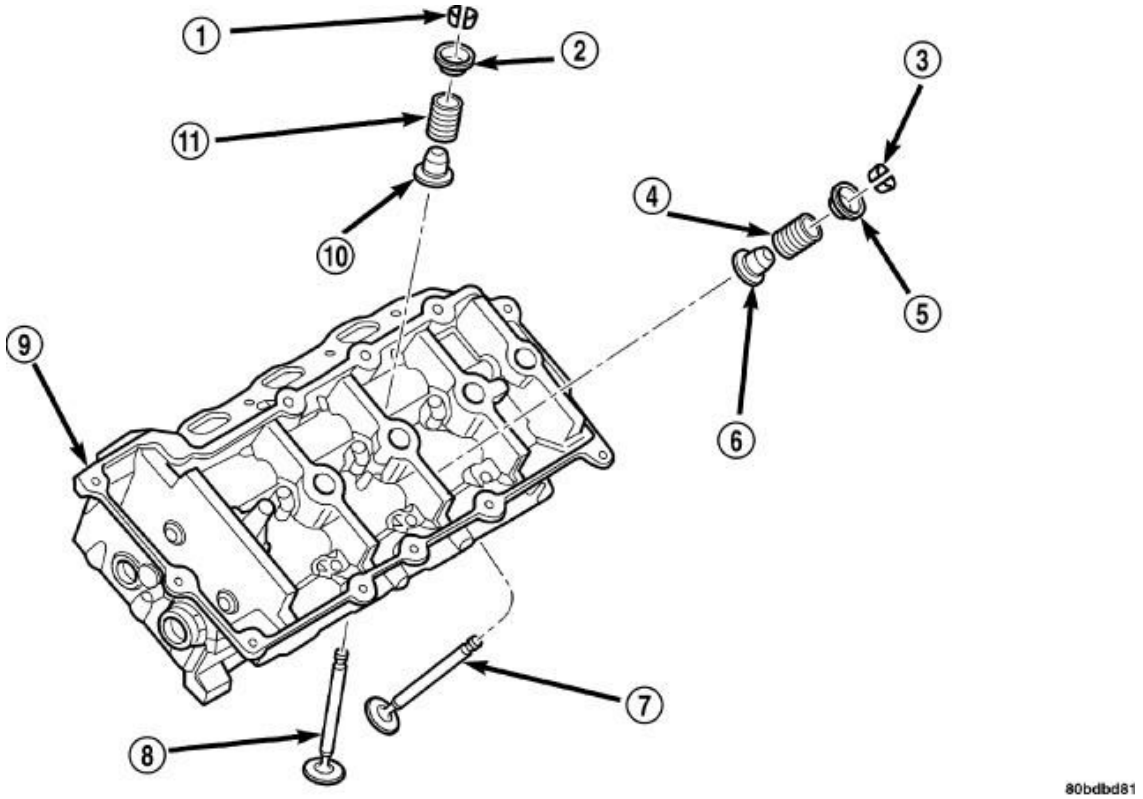

Fig. 162: Cylinder Head, Valves & Springs
Courtesy of CHRYSLER LLC

1 - VALVE KEEPER	7 - VALVE-EXHAUST
2 - SPRING RETAINER	8 - VALVE-INTAKE
3 - VALVE KEEPER	9 - CYLINDER HEAD
4 - VALVE SPRING-EXHAUST	10 - VALVE STEM SEAL
5 - SPRING RETAINER	11 - VALVE SPRING-

	INTAKE
6 - VALVE STEM SEAL	-

3. Install valve spring (4). See **Engine/Cylinder Head/SPRING(S), Valve - Installation**.

ENGINE BLOCK

DESCRIPTION

DESCRIPTION

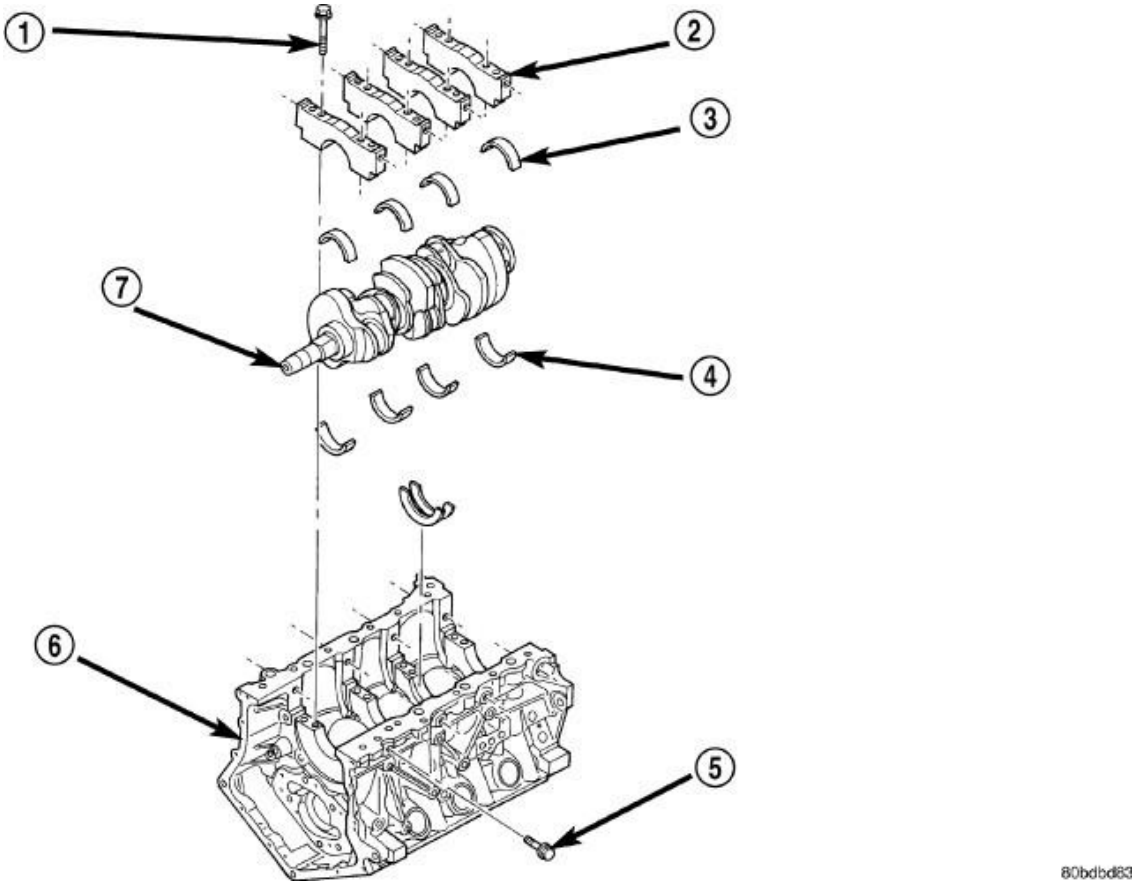

Fig. 163: Engine Block & Crankshaft
Courtesy of CHRYSLER LLC

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

The cylinder block (6) is made of heat treated aluminum with cast-in-place iron liners. The block is a closed deck design with the right bank forward. To provide high rigidity and improved NVH, the block has cast-in contours and ribs, along with powdered metal main caps (2) each with 6 bolts, 4 vertical (1) and 2 horizontal (5). The engine is equipped with a windage tray mounted to the main caps.

The block design allows coolant flow between the cylinder bores and an internal coolant by-pass to the thermostat.

STANDARD PROCEDURE

CYLINDER BORE HONING

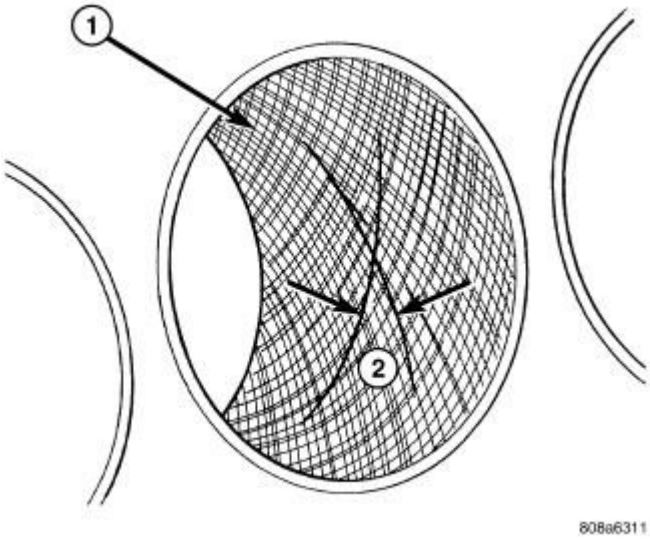

Fig. 164: Cylinder Bore Cross-Hatch Pattern
Courtesy of CHRYSLER LLC

1 - CROSS-HATCH PATTERN 2 - 40°-60°

1. Used carefully, a quality commercially available cylinder bore resizing hone 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 quality commercially available 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.

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

CLEANING

Clean cylinder block thoroughly using a suitable cleaning solvent.

INSPECTION

INSPECTION

ENGINE BLOCK

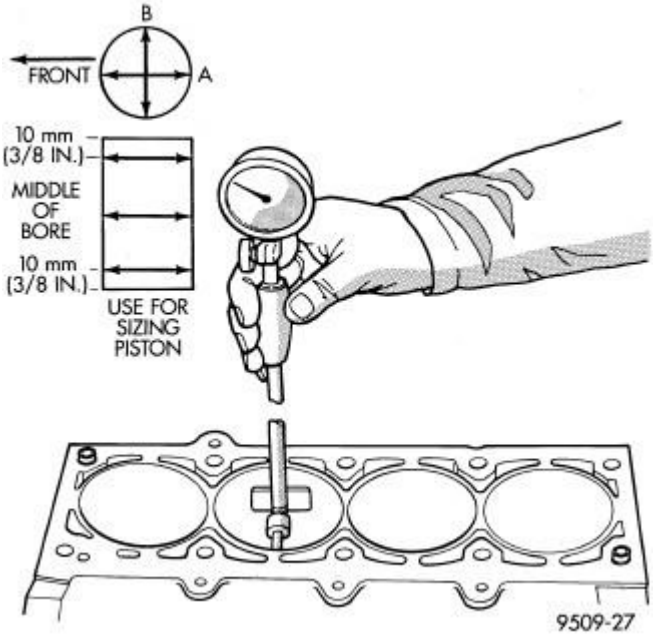

Fig. 165: Checking Cylinder Bore Size
Courtesy of CHRYSLER LLC

1. Clean cylinder block thoroughly and check all core hole plugs for evidence of leaking.
2. If new core plugs are to be installed, see **Engine - Standard Procedure**.
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. See **Engine - Specifications**. If the cylinder walls are badly scuffed or scored, the cylinder block should be replaced, and new pistons and rings fitted.

Measure the cylinder bore at three levels in directions A and B. 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. See **Engine - Specifications**.

BEARING(S), CONNECTING ROD

Standard Procedure

CONNECTING ROD AND BEARING FITTING

CONNECTING ROD BEARING

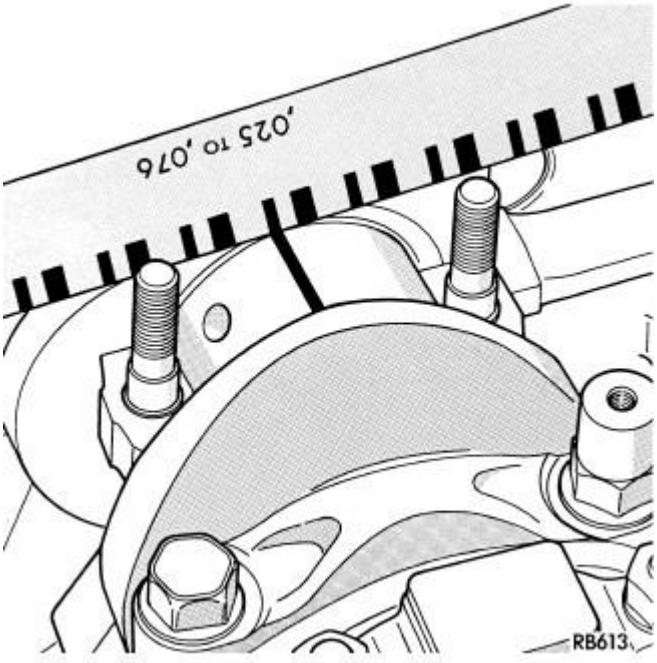

Fig. 166: Checking Connecting Rod Bearing Clearance-Typical

Courtesy of CHRYSLER LLC

Fit all connecting rods on one bank until complete.

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

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

The bearing shells must be installed with the tangs inserted into the machined grooves in the rods and caps. Also, assure that the hole in upper bearing half aligns with oil squirt hole in rod. Install cap with the tangs on the same side as the rod.

CAUTION: Assure that hole in upper bearing half aligns with hole in connecting rod as engine damage may occur.

Limits of taper or out-of-round on any crankshaft journals should be held to 0.015 mm (0.0006 in.). Bearings are available 0.025 mm (0.001 in.) and 0.250 mm (0.010 in.) undersize. **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. For more information on using plastigage, see **Engine - Standard Procedure**. Refer to **Engine - Specifications** for bearing clearance specifications.

CONNECTING ROD BOLTS

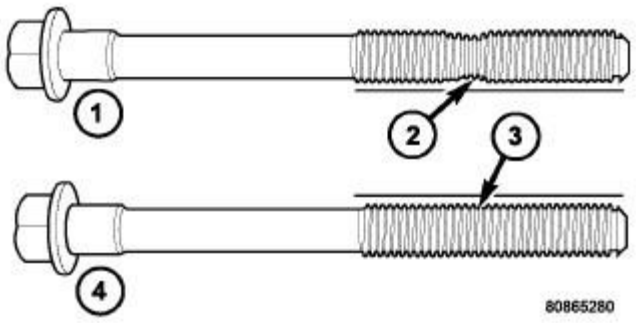

Fig. 167: Check For Stretched Bolts
Courtesy of CHRYSLER LLC

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

NOTE: The connecting rod bearing cap bolts must be examined before reuse. If the threads are necked down (2) due to stretching, the bolt(s) must be replaced.

NOTE: Connecting rod bolts are retained in the rod cap with a light press fit. If bolts are to be removed, use a hammer and punch to drive bolts from connecting rod cap using care not to damage fractured cap surface.

1. Examine connecting rod bolt 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 should be replaced.
2. Before installing the bolts, lubricate the threads with engine oil.
3. Install bolts finger tight. Then alternately torque each nut to assemble the cap properly.
4. Tighten the nuts to specification. See **Engine - Specifications**.

CONNECTING ROD SIDE CLEARANCE

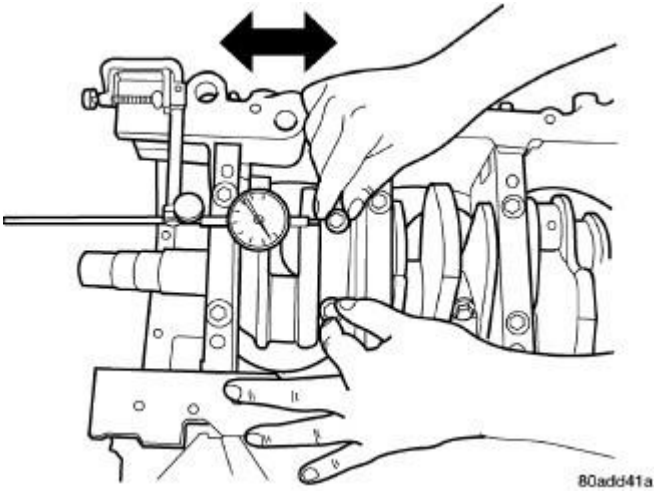

Fig. 168: Connecting Rod Side Clearance Measuring
Courtesy of CHRYSLER LLC

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. Compare measurement to specification listed in engine specifications. See **Engine - Specifications**. Repeat procedure for each connecting rod. Turn crankshaft for connecting rod accessibility.

BEARING(S), CRANKSHAFT, MAIN

Standard Procedure

CRANKSHAFT MAIN BEARING FITTING

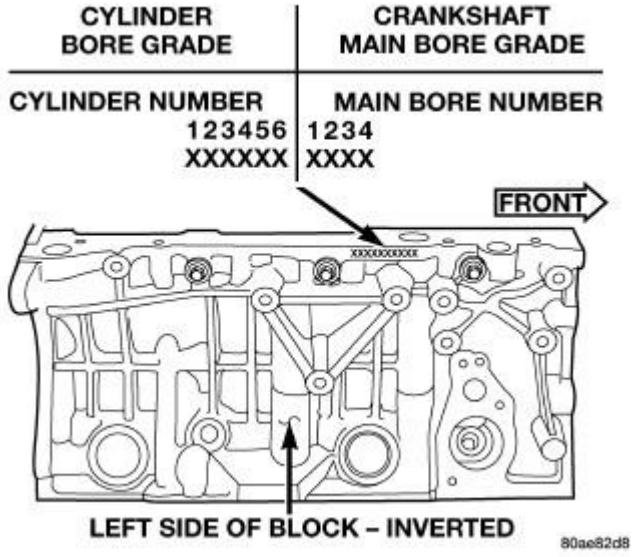

Fig. 169: Cylinder Block Main Bore Grade Marking
Courtesy of CHRYSLER LLC

The grade marks for the cylinder block main bearing bore grade is located on the pan rail just below the left side engine mount bracket. These marks are read left to right, corresponding to main bore 1, 2, 3, 4.

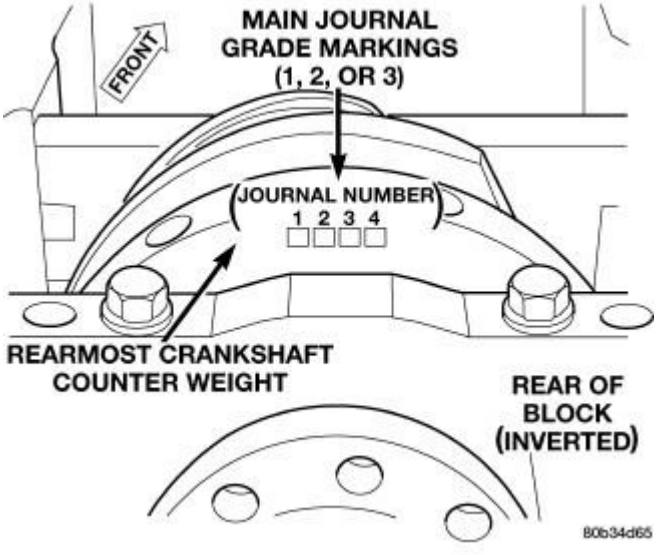

Fig. 170: Crankshaft Main Journal Grade Marking Location
Courtesy of CHRYSLER LLC

The main bearings are "select fit" to achieve proper oil clearances. For main bearing selection, the block and

crankshaft have grade identification marks.

The grade marks for the crankshaft are located on the rearmost crankshaft counter weight as shown in illustration. The crankshaft journal grade marks are read left to right, corresponding with journal number 1, 2, 3, 4.

MAIN BEARING SELECTION CHART-2.7L

Main Bearing Bore Grade Mark				
-	-	1	2	3
Crankshaft Main Journal Grade Mark	1	(3) standard	(2) +0.003 mm (+0.0002 in.)	(1) +0.006 mm (+0.0003 in.)
	2	(4) -0.003 mm (-0.0002)	(3) standard	(2) +0.003 mm (+0.0002 in.)
	3	(5) -0.006 mm (-0.0003 in.)	(4) -0.003 mm (-0.0002 in.)	(3) standard

Refer to the selection chart to properly select the main bearings. For an example, if the main bore grade is 3 and the journal grade is 2, the proper select fit bearing would be (2) +0.003 mm (+0.0002 in.).

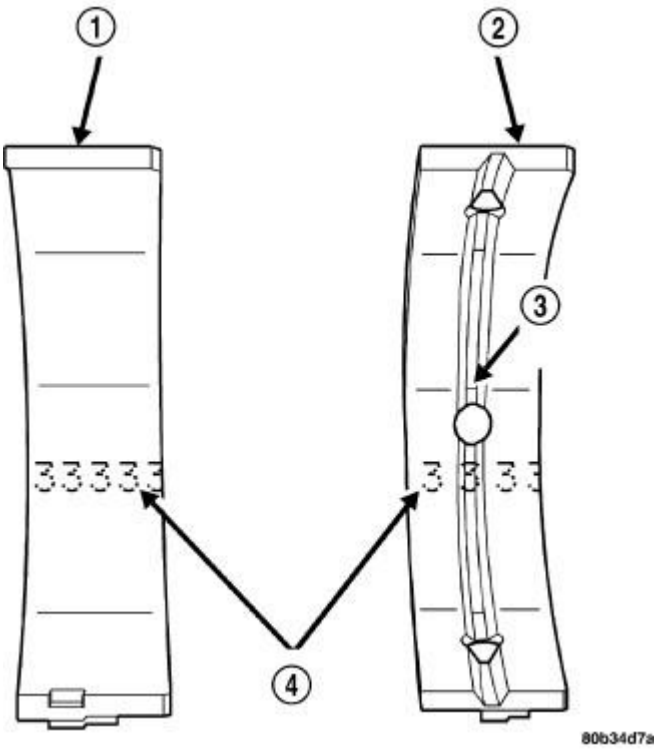

Fig. 171: Main Bearing Grade Marks
Courtesy of CHRYSLER LLC

1 - LOWER MAIN BEARING
2 - UPPER MAIN BEARING

3 - OIL FEED HOLE AND GROOVE
4 - GRADE SELECTION INK MARKS

NOTE: Service main bearings have a number from 1-5 marked in ink on the bearing surface. For verification, use the MAIN BEARING SELECTION CHART-2.7L for number to size identification.

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

NOTE: Although cylinder bores are graded for size, there is only one piston size.

COVER, STRUCTURAL DUST

Removal

REMOVAL

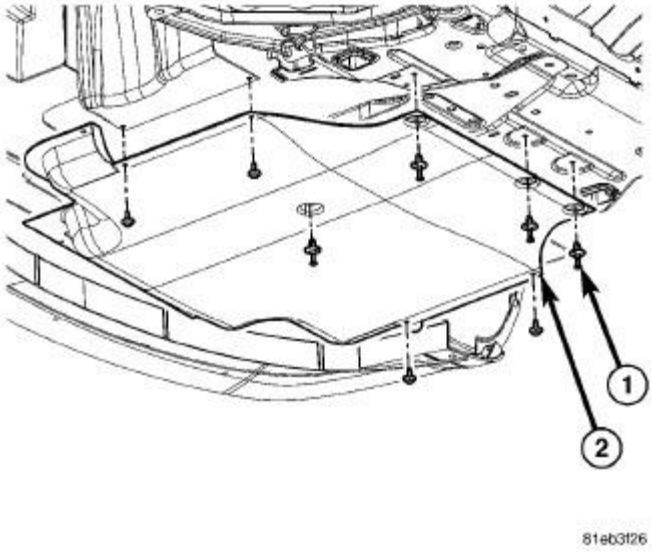

Fig. 172: Belly Pan
Courtesy of CHRYSLER LLC

1. Raise and secure the vehicle on a hoist. Refer to **Vehicle Quick Reference/Hoisting - Standard Procedure** .
2. Remove the belly pan (2), if equipped.

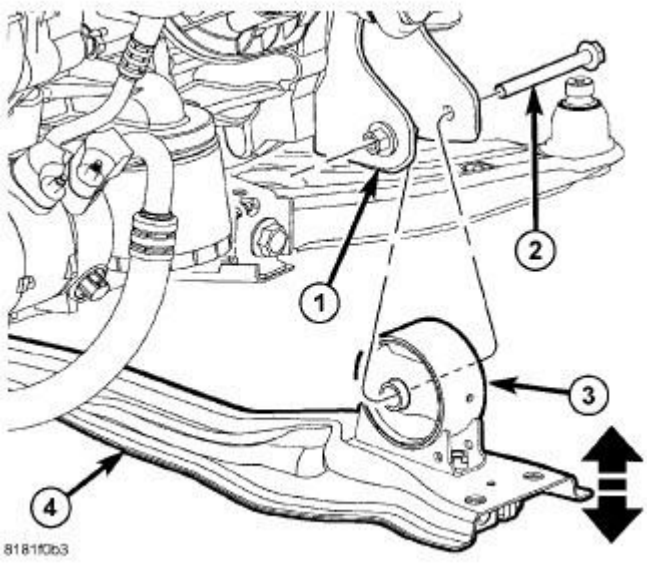

Fig. 173: Front Engine Mount Through Bolt
Courtesy of CHRYSLER LLC

3. Remove the fore/aft crossmember (4). Refer to **Frame and Bumpers/Frame/CROSSMEMBER - Removal** .

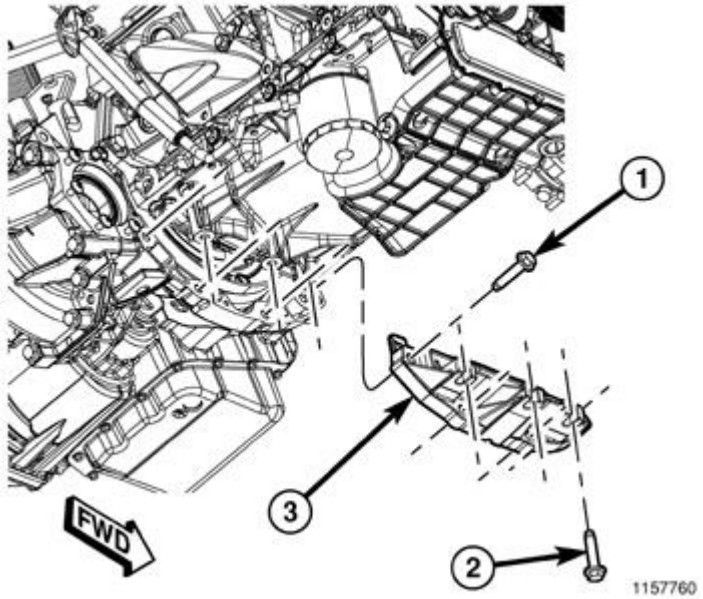

Fig. 174: Structural Collar
Courtesy of CHRYSLER LLC

4. Remove three bolts (2) attaching the structural collar (3) to the oil pan.
5. Remove four bolts (1) and the structural collar (3) from the transmission.

Installation

INSTALLATION

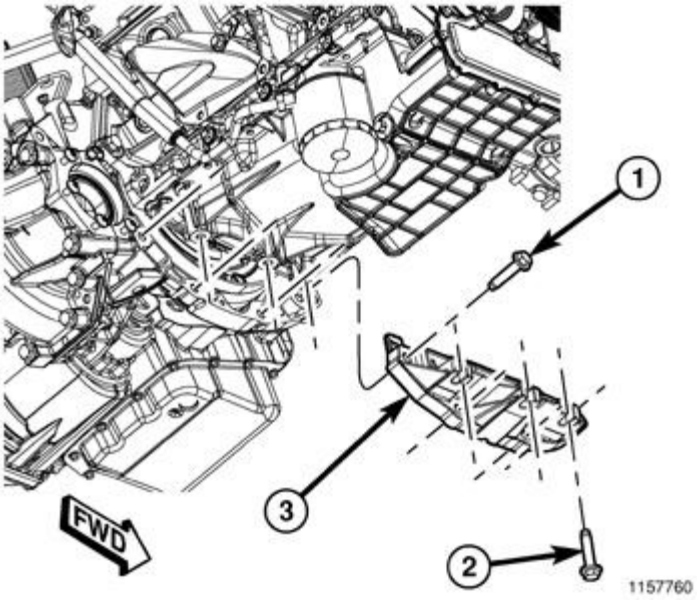

Fig. 175: Structural Collar
Courtesy of CHRYSLER LLC

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

1. Position the structural collar (3) on the engine and transaxle.
2. Finger tighten all bolts (1) and (2).

NOTE: Make sure that structural collar (3) is flush with the oil pan and the transmission bell housing.

3. Install the vertical collar bolts (2) to the oil pan, pre-torque bolts to 1.1 N.m (10 in. lbs.).
4. Install the horizontal collar bolts (1) to the transmission and tighten to 55 N.m (40 ft. lbs.).
5. Starting with the center vertical bolts and working outward, final torque all bolts to 55 N.m (40 ft. lbs.).

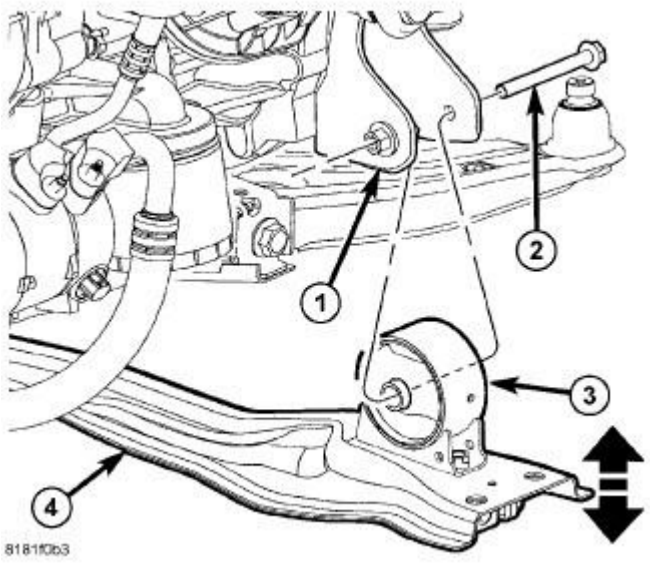

Fig. 176: Front Engine Mount Through Bolt
Courtesy of CHRYSLER LLC

6. Install the fore/aft crossmember (4). Refer to **Frame and Bumpers/Frame/CROSSMEMBER - Installation** .

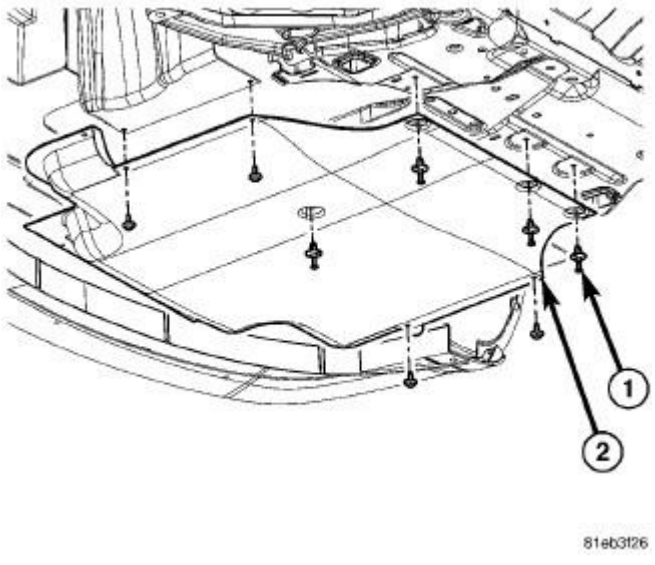

Fig. 177: Belly Pan
Courtesy of CHRYSLER LLC

7. Install the belly pan (2), if equipped.
8. Lower the vehicle.

CRANKSHAFT

Description

DESCRIPTION

The crankshaft is constructed of a forged micro alloy steel. The six throw, nine counterweight crankshaft is supported by four select fit main bearings with the number three serving as the thrust washer location. The select fit identification markings will be on the rear side of the number nine (rearmost) counterweight. The six separate connecting rod throws are an even-firing design which reduces torque fluctuations while a vibration damper is used to control torsional vibration.

The crankshaft oil seals are a one piece design. The front seal is retained by the timing chain cover, and the rear seal in a housing that attaches to the cylinder block.

Standard Procedure

CRANKSHAFT END PLAY

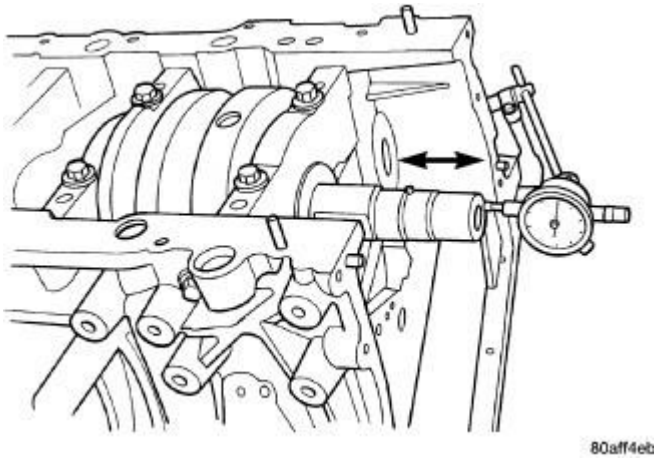

Fig. 178: CHECKING CRANKSHAFT END PLAY
Courtesy of CHRYSLER LLC

1. Mount a dial indicator to a stationary point at front of engine. Locate the probe perpendicular against nose of crankshaft.
2. Move crankshaft all the way to the rear of its travel.
3. Zero the dial indicator.
4. Move crankshaft all the way to the front and read the dial indicator. For crankshaft end play clearances, see **Engine - Specifications**.

Removal

REMOVAL

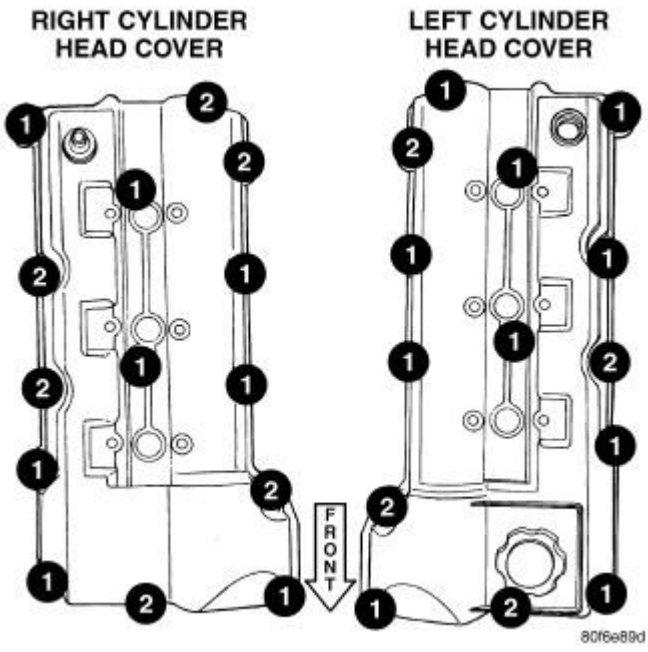

Fig. 179: Cylinder Head Cover Fasteners
Courtesy of CHRYSLER LLC

1. Drain engine oil and remove oil filter. See **Engine/Lubrication/OIL - Standard Procedure**
2. Remove engine from vehicle. See **Engine - Removal**.
3. Mount engine on an engine stand.
4. Remove oil pan and oil pick-up tube. See **Engine/Lubrication/PAN, Oil - Removal**.
5. Remove idler pulley bracket for accessory drive belt.
6. Remove upper intake manifold. See **Engine/Manifolds/MANIFOLD, Intake - Removal**.
7. Remove cylinder head covers. See **Engine/Cylinder Head/COVER(S), Cylinder Head - Removal**.

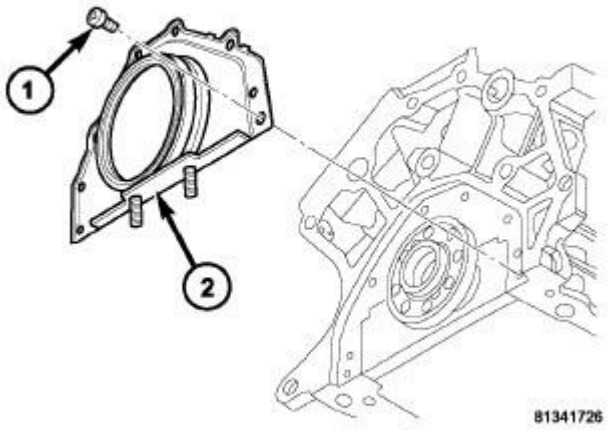

Fig. 180: Oil Seal Retainer
Courtesy of CHRYSLER LLC

8. Remove timing chain cover. See **Engine/Valve Timing/COVER(S), Engine Timing - Removal**.
9. Remove primary timing chain. See **Engine/Valve Timing/CHAIN and SPROCKETS, Timing - Removal**.
10. Remove crankshaft sprocket. See **Engine/Valve Timing/CHAIN and SPROCKETS, Timing - Removal**.
11. Remove oil pump. See **Engine/Lubrication/PUMP, Engine Oil - Removal**.
12. Remove crankshaft rear oil seal retainer (2). See **Engine/Engine Block/SEAL, Crankshaft Oil - Removal**.

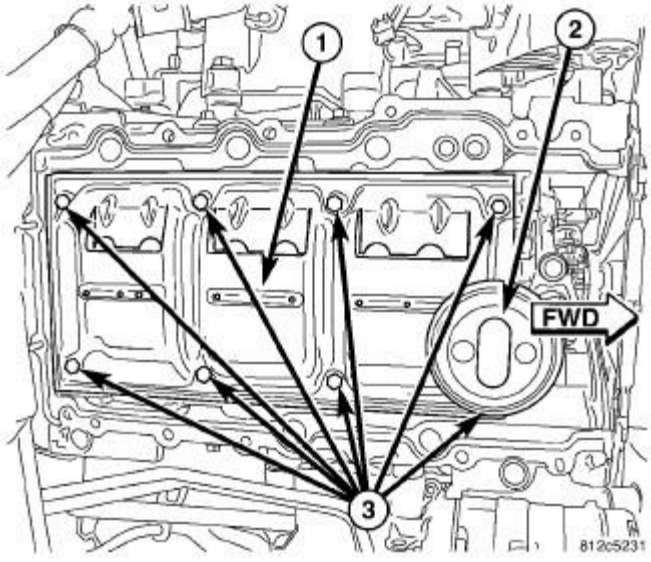

Fig. 181: Windage Tray
Courtesy of CHRYSLER LLC

13. Remove windage tray (1).

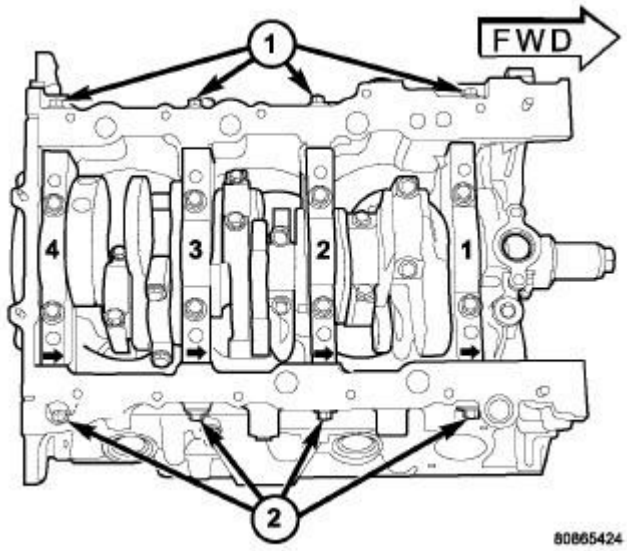

Fig. 182: Main Bearing Cap Identification
Courtesy of CHRYSLER LLC

14. Turn crankshaft until connecting rod cap to be removed is accessible.

NOTE: Connecting rod bearing caps are not interchangeable and should be marked before removing to ensure correct reassembly.

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

15. Mark connecting rod bearing cap positions using a permanent ink marker or scribe tool. Also scribe a location reference mark from the #3 main bearing cap to the engine block to use as a guide during reassembly.
16. Remove connecting rod bearing caps. Use care to prevent damage to the crankshaft bearing surfaces.

CAUTION: Care should be taken not to damage the fractured rod and cap joint face surfaces or damage to the engine may occur.

17. Remove main bearing tie bolts (1) and (2).

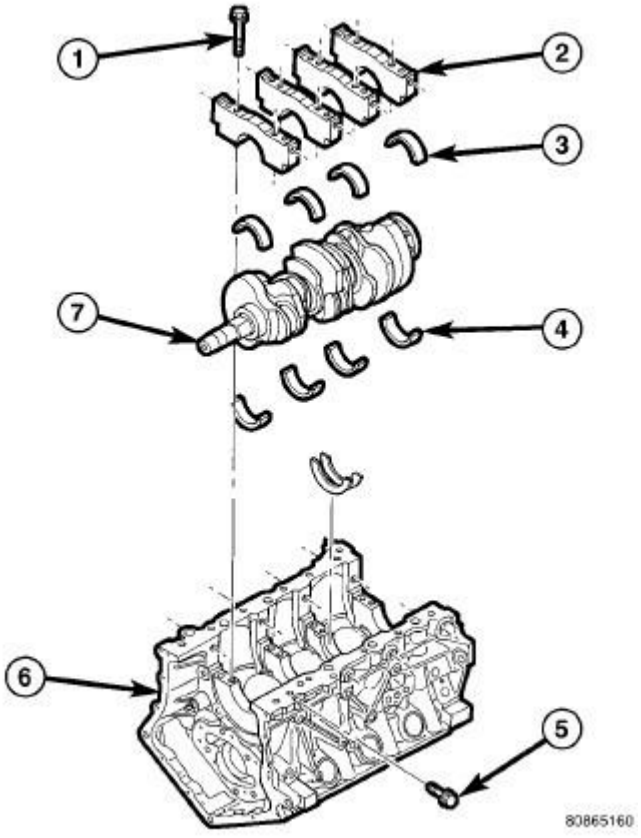

Fig. 183: Cylinder Block & Crankshaft
Courtesy of CHRYSLER LLC

18. Remove main bearing cap bolts (1) and main bearing caps (2).

CAUTION: When removing crankshaft, use care not to damage bearing surfaces on the crankshaft.

19. Remove crankshaft (7) from cylinder block (6).

Installation

INSTALLATION

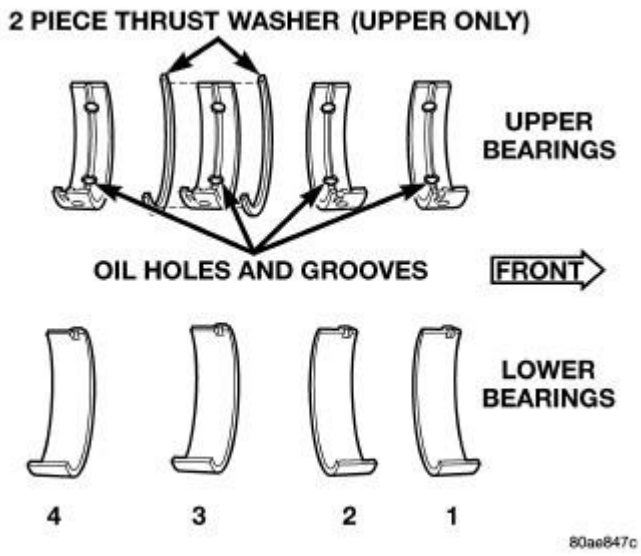

Fig. 184: Main Bearing Identification
Courtesy of CHRYSLER LLC

NOTE: Upper and lower bearing halves are NOT interchangeable.

CAUTION: Main bearings are select fit. See Engine/Engine Block/BEARING(S), Crankshaft - Standard Procedure.

1. Install crankshaft upper main bearings in cylinder block. Ensure the tangs engage the slots in the block and oil holes in bearings line up with oil holes in cylinder block. See **Engine/Engine Block/BEARING (S), Crankshaft - Standard Procedure**.
2. Lubricate upper main bearing halves with engine oil.

CAUTION: When installing crankshaft, use care not to damage bearing surfaces on the crankshaft.

3. Install crankshaft.

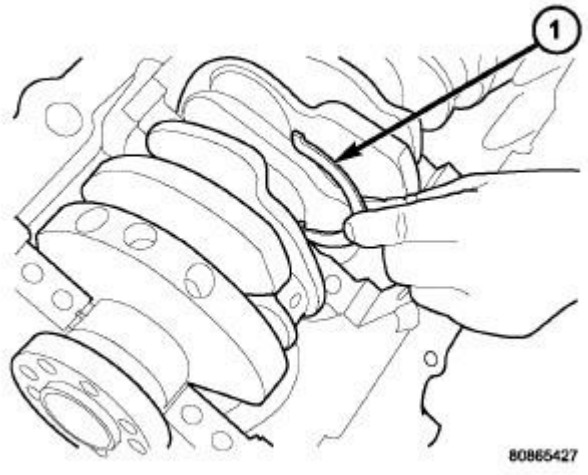

Fig. 185: Thrust Washer - Installation
Courtesy of CHRYSLER LLC

NOTE: Make sure that the coated and oil groove side of crankshaft thrust washer faces the crankshaft thrust surface.

4. Push crankshaft forward. Lubricate and install the front thrust washer (1) by rolling the thrust washer onto the machined shelf between the No. 3 upper main bulk head and crankshaft thrust surface.
5. Move crankshaft rearward. Lubricate and install the rear thrust washer by rolling the thrust washer onto the machined shelf between the No. 3 upper main bulk head and crankshaft thrust surface.

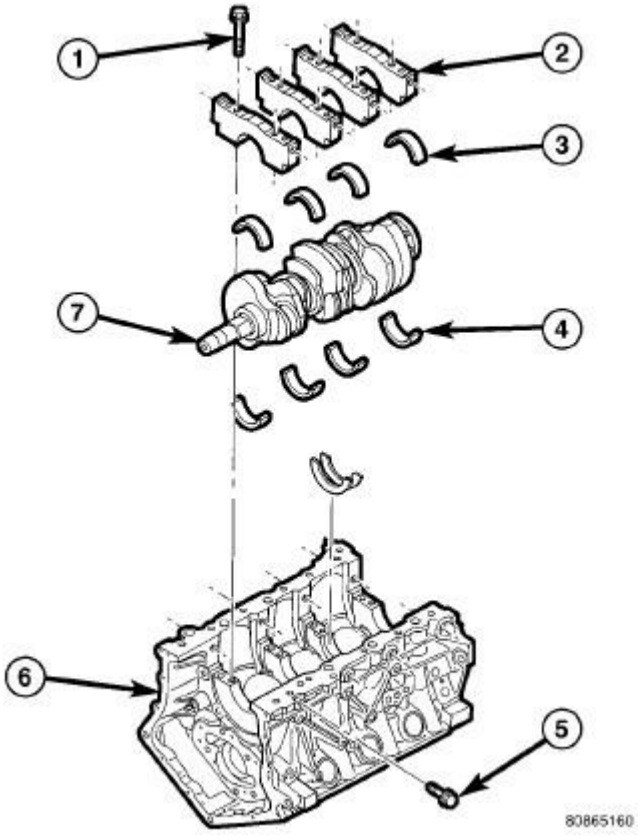

Fig. 186: Cylinder Block & Crankshaft
Courtesy of CHRYSLER LLC

6. Install lower main bearings (3) into main bearing caps (2).
7. Lubricate lower main bearings (3) with clean engine oil.

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

8. Install each main cap (2) and tighten inner bolts (1) finger tight. Align the location reference mark scribed on the #3 main bearing cap during disassembly.

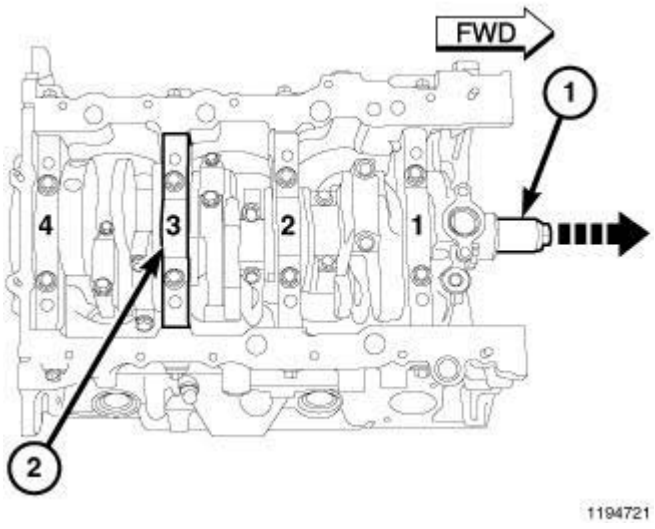

Fig. 187: Moving Crankshaft Forward So Crankshaft Face Is Tight Against Thrust Bearing
Courtesy of CHRYSLER LLC

CAUTION: The #3 main bearing cap must be centered over the inner bolt holes located on the block. Failure to center the bearing cap can result in contact with the crankshaft counterweights and thrust bearing failure.

9. Verify that the #3 main bearing cap is properly centered over the inner bolt holes located in the block:
   a. Tighten main bearing cap inner bolts to 20 N.m (15 ft. lbs.).
   b. Move crankshaft (1) forward to limit of travel so that crankshaft thrust face (2) is tight against thrust bearing.

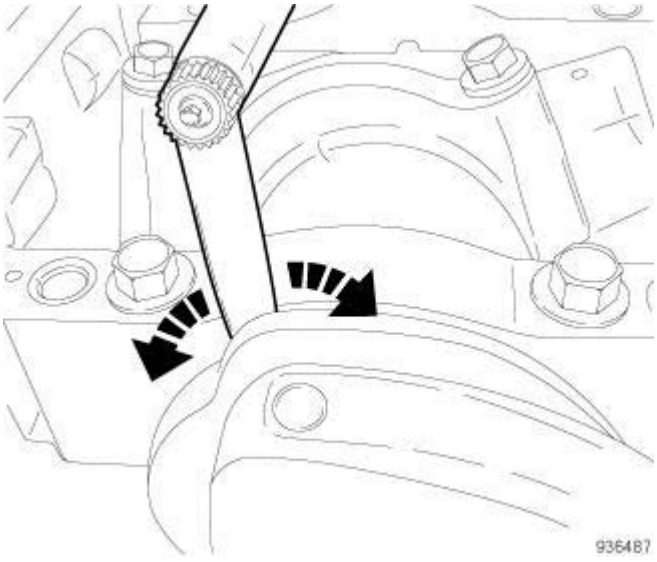

Fig. 188: Sliding Feeler Gauge Side-To-Side Across Bearing Cap
Courtesy of CHRYSLER LLC

c. Verify that a 0.25 mm (0.010 inch) shim or feeler gage will fit between the #3 main cap (rear face) and the crankshaft thrust face. Slide the gage side-to-side all of the way across the cap making sure that the clearance at all areas exceeds 0.25 mm (0.010 inch). The feeler gage should slide all the way down to the #3 main journal.

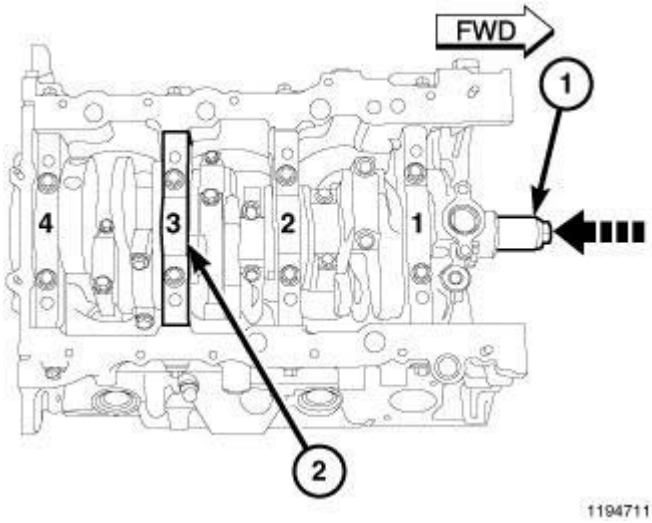

Fig. 189: Moving Crankshaft Rearward So Crankshaft Face Is Tight Against Thrust Bearing
Courtesy of CHRYSLER LLC

d. Move crankshaft (1) rearward to limit of travel so that crankshaft thrust face (2) is tight against thrust bearing.
e. Verify that a 0.25 mm (0.010 inch) shim or feeler gage will fit between the #3 main cap (front face) and the crankshaft thrust face. Slide the gage side-to-side all of the way across the cap making sure that the clearance at all areas exceeds 0.25 mm (0.010 inch). The feeler gage should slide all the way down to the #3 main journal.
f. A properly centered #3 main bearing cap has a minimum of 0.25 mm (0.010 inch) clearance in both the forward and rearward crankshaft positions. If measured clearance is less than 0.25 mm (0.010 inch), loosen and reposition #3 main bearing cap until this minimum clearance can be verified by repeating this procedure.

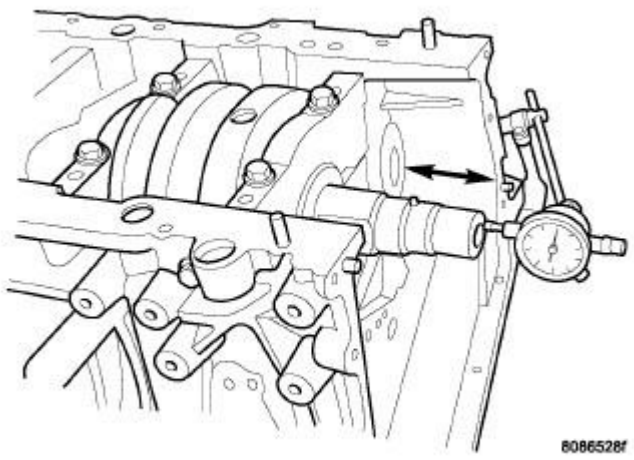

Fig. 190: CHECKING CRANKSHAFT END PLAY
Courtesy of CHRYSLER LLC

10. Following verification of proper #3 bearing cap centering, finish tightening the main bearing cap inner bolts an additional 90° turn.
11. Measure crankshaft end play. See **Engine/Engine Block/CRANKSHAFT - Standard Procedure**.

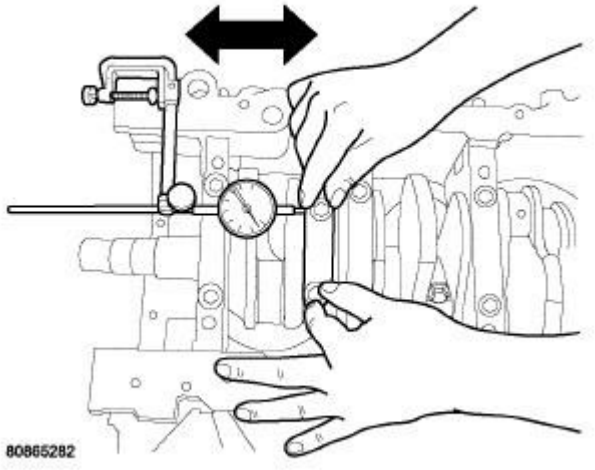

Fig. 191: Measuring Connecting Rod Side Clearance
Courtesy of CHRYSLER LLC

12. Install connecting rods and measure side clearance. See **Engine/Engine Block/BEARING(S), Connecting Rod - Standard Procedure**.

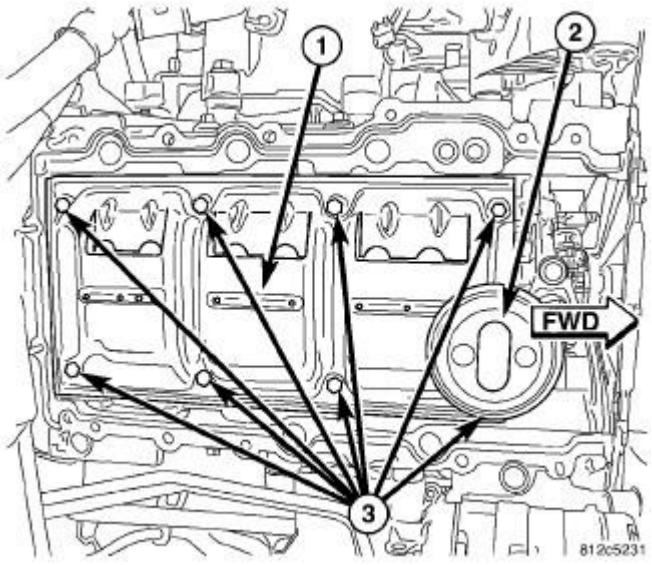

Fig. 192: Windage Tray
Courtesy of CHRYSLER LLC

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

13. Install windage tray (1) with the slots to right side of engine. Lubricate bolts (3) with engine oil and tighten to 27 N.m + 90° Turn (20 ft. lbs. + 90° turn).

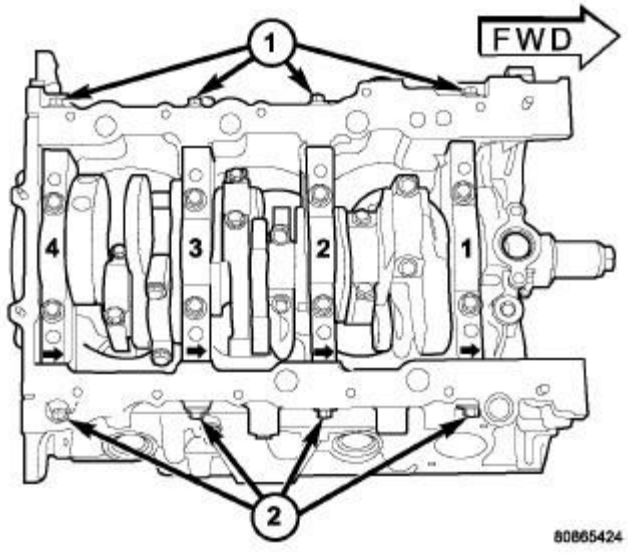

Fig. 193: Main Bearing Cap Identification
Courtesy of CHRYSLER LLC

14. Install the main cap tie (horizontal) bolts (1) and (2) and tighten to 28 N.m (250 in. lbs.).
15. Install rear crankshaft oil seal retainer and oil seal assembly. Refer to **Engine/Engine Block/RETAINER, Crankshaft Rear Oil Seal - Installation** .

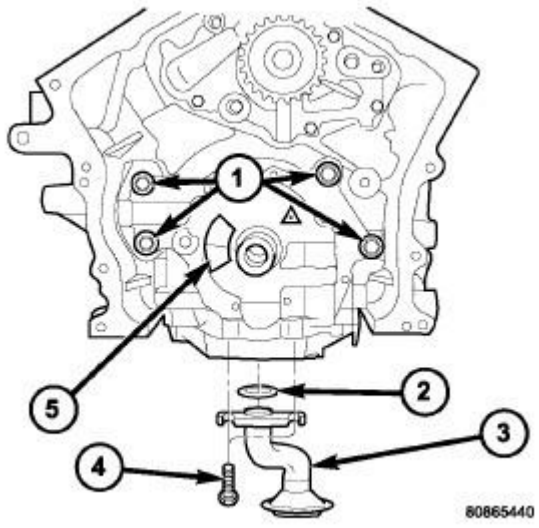

Fig. 194: Oil Pump & Pick-up Tube
Courtesy of CHRYSLER LLC

16. Install oil pump assembly (5). See **Engine/Lubrication/PUMP, Engine Oil - Installation**.
17. Install oil pick-up tube (3) and O-ring (2). Tighten bolts (4) to 28 N.m (250 in. lbs.).
18. Install oil pan gasket, oil pan, and oil filter. See **Engine/Lubrication/PAN, Oil - Installation**.
19. Install crankshaft sprocket. See **Engine/Valve Timing/CHAIN and SPROCKETS, Timing - Installation**.
20. Install timing chain. See **Engine/Valve Timing/CHAIN and SPROCKETS, Timing - Installation**.
21. Install timing chain cover. See **Engine/Valve Timing/COVER(S), Engine Timing - Installation**.

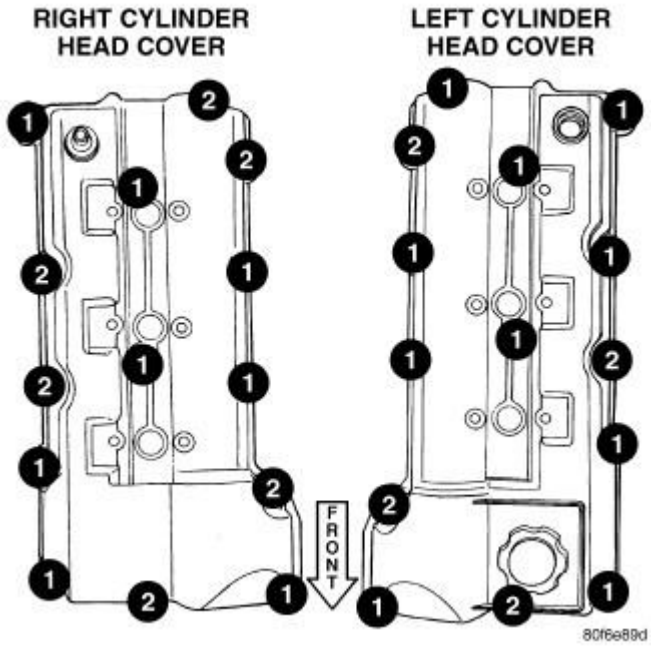

Fig. 195: Cylinder Head Cover Fasteners
Courtesy of CHRYSLER LLC

22. Install cylinder head covers. See **Engine/Cylinder Head/COVER(S), Cylinder Head - Installation**.
23. Install oil dipstick tube.
24. Install engine assembly. See **Engine - Installation**.
25. Fill engine crankcase with proper oil to correct level. See **Engine/Lubrication/OIL - Standard Procedure**.
26. Fill with coolant. Refer to **Cooling - Standard Procedure** .
27. Start engine and check for leaks.

DAMPER, VIBRATION

Removal

REMOVAL

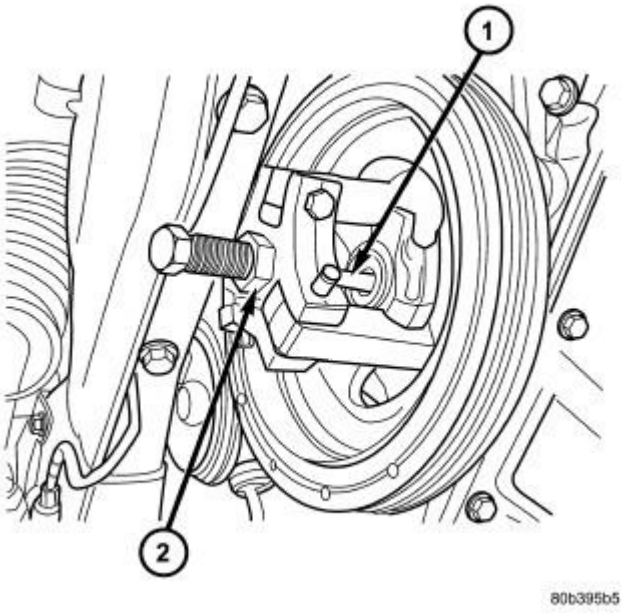

Fig. 196: Vibration Damper - Removal
Courtesy of CHRYSLER LLC

1 - SPECIAL TOOL 8454 PULLER 2 - SPECIAL TOOL 8194 INSERT

1. Disconnect negative battery cable.
2. Remove right front wheel and belt splash shield.
3. Remove accessory drive belts. Refer to **Cooling/Accessory Drive/BELT, Serpentine - Removal** .
4. Remove damper bolt.
5. Remove damper by using Special Tools 8194 Insert and 8454 Puller (1).

Installation

INSTALLATION

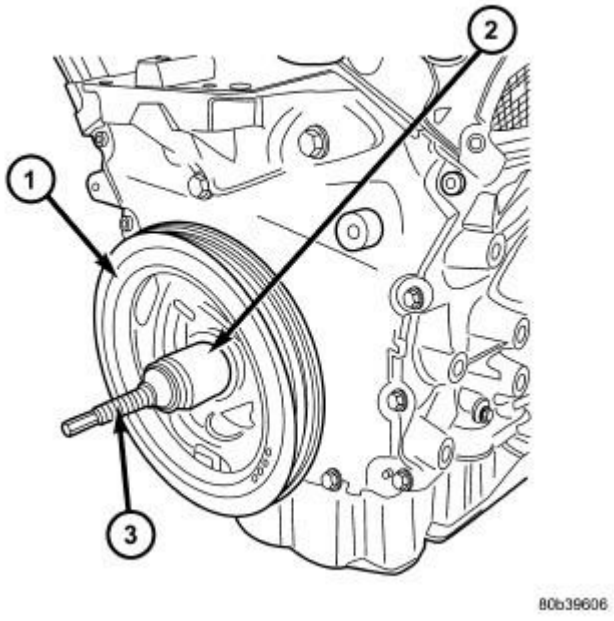

Fig. 197: Vibration Damper - Installation
Courtesy of CHRYSLER LLC

1 - VIBRATION DAMPER 2 - SPECIAL TOOL 6792-1 3 - SPECIAL TOOL 8179

1. Install damper using Special Tools 8179 (3) Screw, with Nut and Thrust Bearing from 6792, and 6792-1 Installer (2).
2. Install damper center bolt. Tighten center bolt to 170 N.m (125 ft. lbs.).
3. Install accessory drive belts. Refer to **Cooling/Accessory Drive/BELT, Serpentine - Installation** .
4. Install belt splash shield and right front wheel.
5. Lower vehicle.
6. Connect negative battery cable.

FLEXPLATE

Removal

REMOVAL

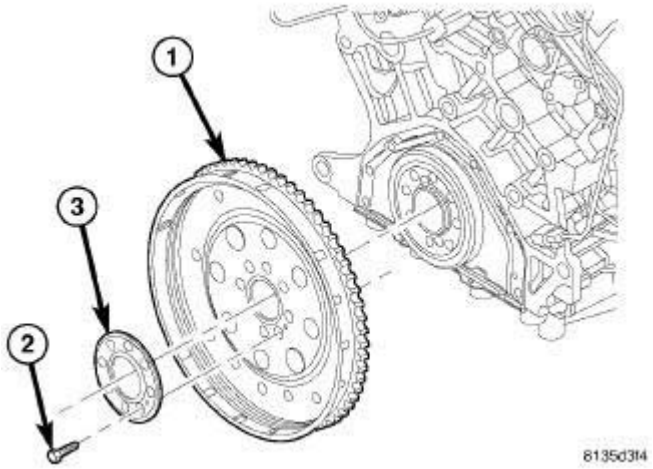

Fig. 198: Flex Plate
Courtesy of CHRYSLER LLC

1. Remove transmission.
2. Remove flex plate attaching bolts (2).
3. Remove backing plate (3) and flex plate (1).

Installation

INSTALLATION

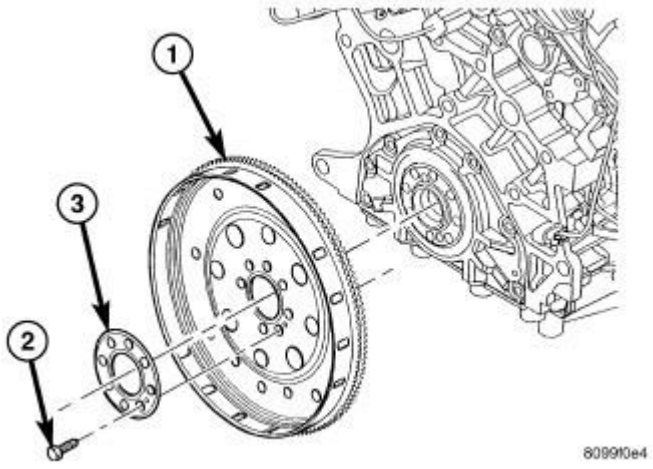

Fig. 199: FLEX PLATE
Courtesy of CHRYSLER LLC

1. Position the flex plate (1) with backing plate (3) on the crankshaft.
2. Apply Mopar® Lock AND Seal Adhesive to the eight flex plate bolts (2).
3. Install the flex plate bolts (2). Tighten the bolts to 95 N.m (70 ft. lbs.).
4. Install the transaxle. Refer to **Transmission and Transfer Case/Automatic - 62TE - Installation**

NOTE: The Cam/Crank Variation Relearn procedure must be performed anytime there has been a repair/replacement made to a powertrain system, for example: flywheel, valvetrain, camshaft and/or crankshaft sensors or components. Refer to DTC-Based Diagnostics/MODULE, Powertrain Control (PCM) - Standard Procedure .

RING(S), PISTON

Standard Procedure

PISTON RING FITTING

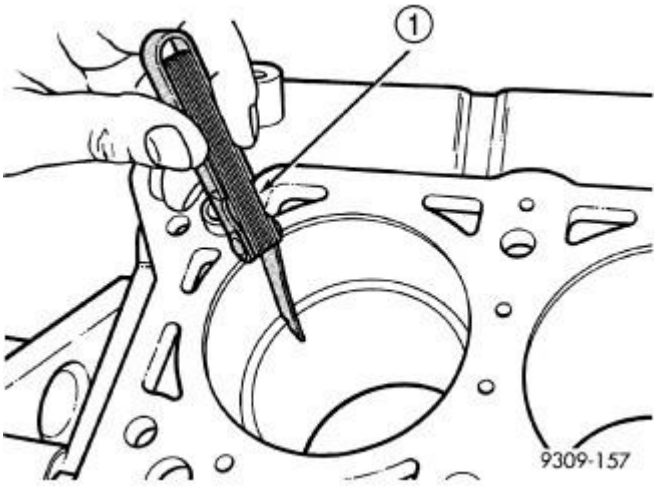

Fig. 200: CHECK GAP ON PISTON RINGS
Courtesy of CHRYSLER LLC

1 - FEELER GAUGE

1. Wipe cylinder bore clean. Insert ring and push down with piston to ensure it is square in bore. The ring gap measurement must be made with the ring positioning at least 12 mm (0.50 inch.) from bottom of cylinder bore. Check gap with feeler gauge (1). Refer to **Engine - Specifications** for clearance measurements.

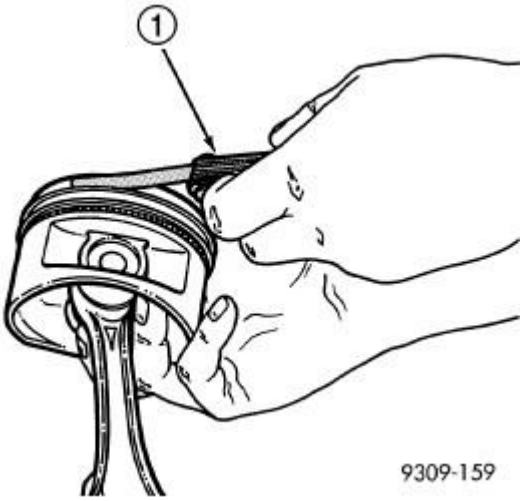

Fig. 201: Measuring Piston Ring Side Clearance
Courtesy of CHRYSLER LLC

1 - FEELER GAUGE

2. Check piston ring to groove clearance (1). For clearance specifications, see **Engine - Specifications**.

Removal

REMOVAL

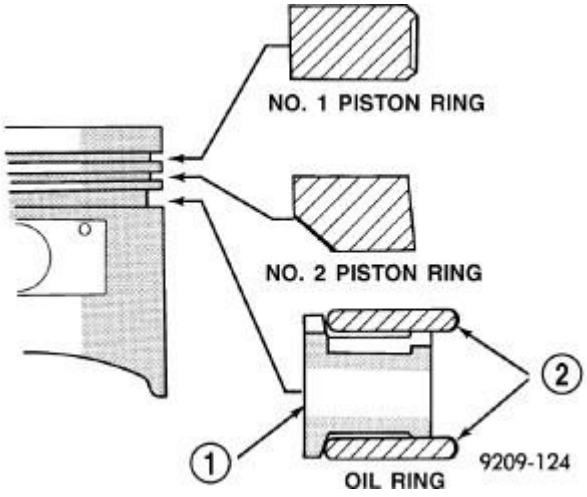

Fig. 202: PISTON RING - INSTALLATION
Courtesy of CHRYSLER LLC

1 - SPACER EXPANDER 2 - SIDE RAIL

1. Remove piston and connecting rod. See **Engine/Engine Block/ROD, Piston and Connecting - Removal**

2. Remove No. 1 and No. 2 piston rings from piston using a ring expander tool.
3. Remove upper oil ring side rail.
4. Remove lower oil ring side rail.
5. Remove oil ring expander.

Installation

INSTALLATION

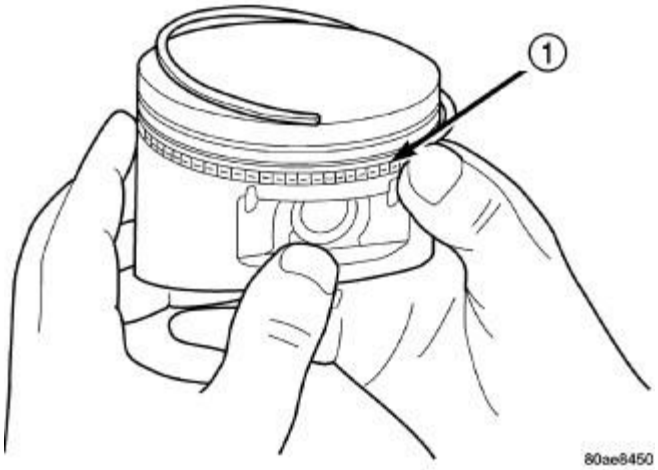

Fig. 203: SIDE RAIL - INSTALLATION
Courtesy of CHRYSLER LLC

1 - SIDE RAIL END

1. Measure clearance of piston rings to the cylinder bore and piston. See **Engine/Engine Block/RING(S), Piston - Standard Procedure**.

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.

   Install the side rail (1) by placing one end between the piston ring groove and the oil ring expander. Hold end firmly and press down the portion to be installed until side rail is in position. **Do not use a piston ring expander during this step.**

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

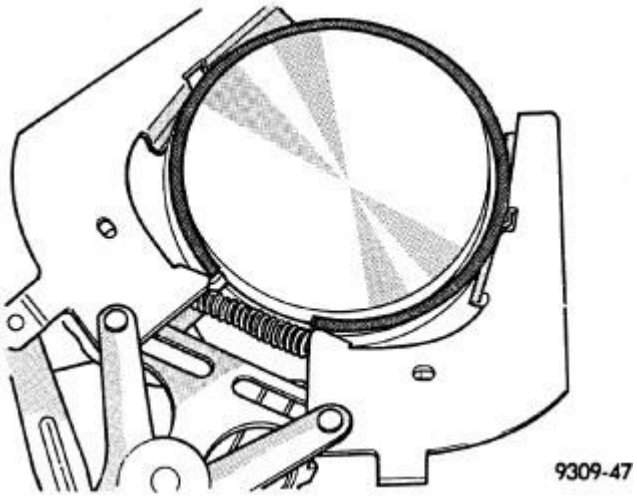

Fig. 204: Upper and Intermediate Rings - Installation
Courtesy of CHRYSLER LLC

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

4. Install No. 2 piston ring and then No. 1 piston ring.

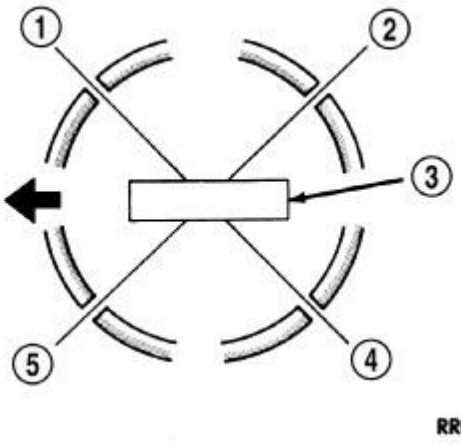

Fig. 205: PISTON RING END GAP POSITION
Courtesy of CHRYSLER LLC

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

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

ROD, PISTON AND CONNECTING

Description

DESCRIPTION

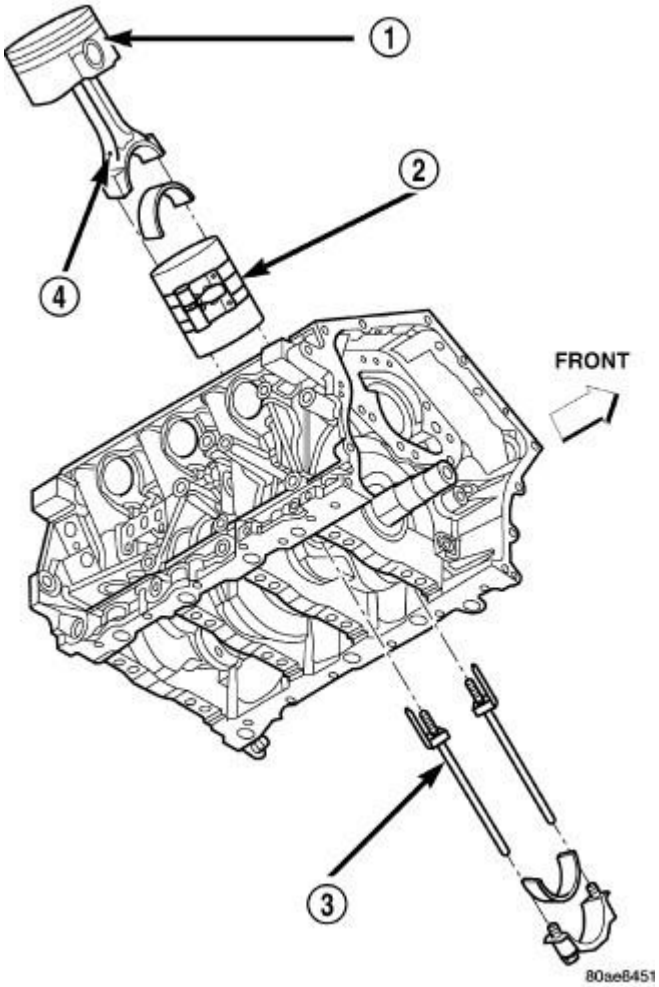

Fig. 206: Piston & Connecting Rod
Courtesy of CHRYSLER LLC

1 - "F" TOWARD FRONT OF ENGINE
2 - RING COMPRESSOR
3 - SPECIAL TOOL 8189

4 - OIL SQUIRT HOLE

The pistons (1) are made of a high strength aluminum alloy with an anodized top ring groove. Piston skirts are coated with a solid lubricant for scuff resistance. The connecting rods are made of powdered metal with a "fractured cap" design. The connecting rod attaches to the piston with a full floating pin retained by lock rings. The piston and connecting rod are serviced as an assembly.

Standard Procedure

FITTING PISTONS

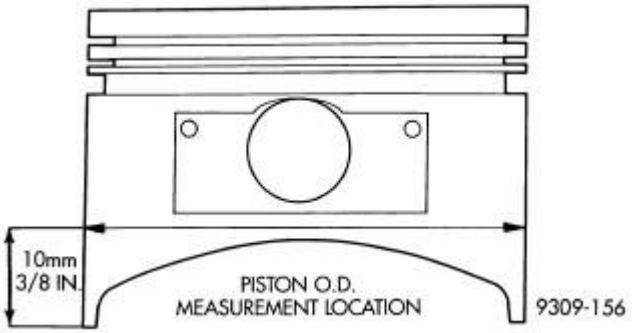

Fig. 207: Piston Measurements
Courtesy of CHRYSLER LLC

The pistons have been cast and machined to one size and weight. The piston and rod assemblies are matched to weigh the same for engine balance.

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

PISTON PINS

The pistons have been cast and machined to one size and weight. The piston and rod assemblies are matched to weigh the same for engine balance.

The piston pin is full floating and is held in place by lock rings. **Do Not switch pistons with other rods** . Pistons and connecting rods are serviced as an assembly for balance.

Removal

REMOVAL

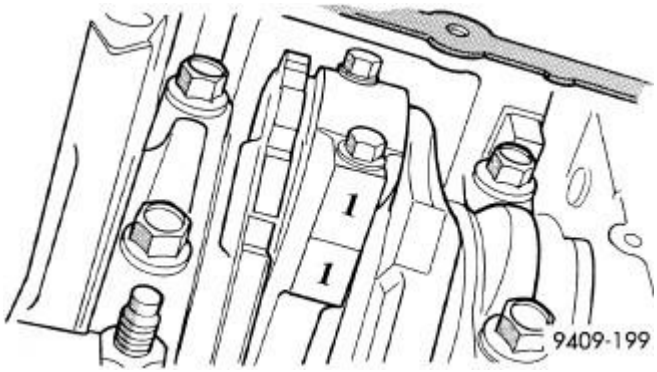

Fig. 208: Identify Connecting Rod to Cylinder
Courtesy of CHRYSLER LLC

1. 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.**

NOTE: Connecting rod bearing caps are not interchangeable and should be marked before removing to ensure correct reassembly.

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

2. Mark connecting rod and bearing cap positions using a permanent ink marker or scribe tool.

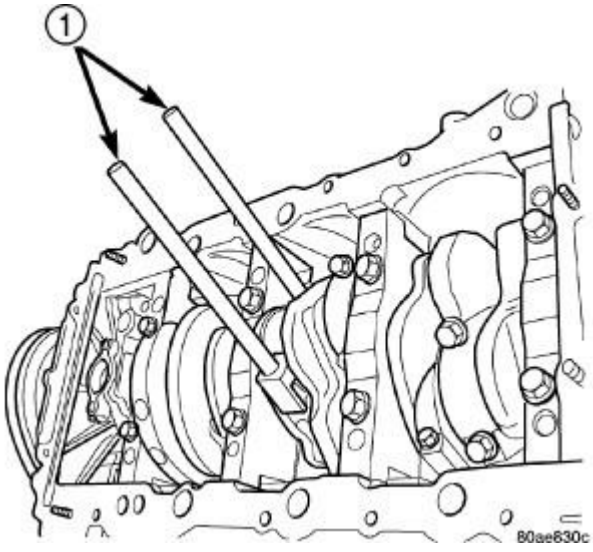

Fig. 209: Connecting Rod Guides
Courtesy of CHRYSLER LLC

1 - SPECIAL TOOL 8189 CONNECTING ROD GUIDES

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

3. Remove connecting rod cap. Install Special Tool 8189 Connecting Rod Guides into the connecting rod being removed. Remove each piston and rod assembly out of cylinder bore.

NOTE: Be careful not to nick crankshaft journals.

4. After removal, install bearing cap on the mating rod to prevent damage to the fractured cap to rod surfaces.

Installation

INSTALLATION

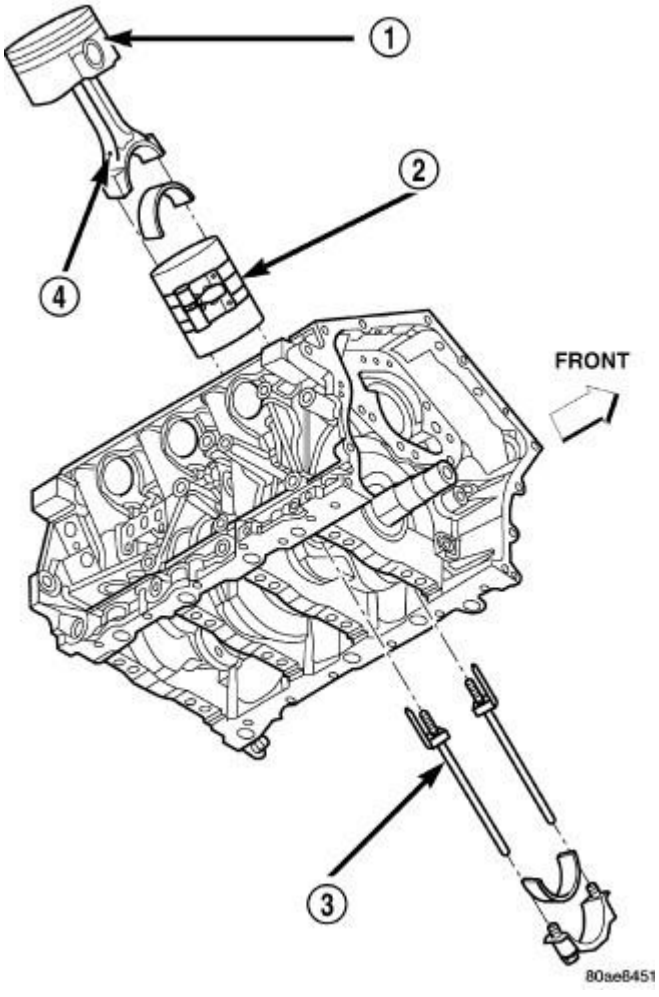

Fig. 210: Piston & Connecting Rod
Courtesy of CHRYSLER LLC

1 - "F" TOWARD FRONT OF ENGINE
2 - RING COMPRESSOR
3 - SPECIAL TOOL 8189
4 - OIL SQUIRT HOLE

1. Install the piston rings. See **Engine/Engine Block/RING(S), Piston - Installation**.
2. Before installing piston 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.
3. Before installing the ring compressor, make sure the oil ring expander ends are butted and the rail gaps are located properly.
4. Immerse the piston head and rings in clean engine oil, slide the ring compressor over the piston and tighten with the special wrench. **Ensure position of rings does not change during this operation.**

CAUTION: Ensure the hole in bearing half aligns with hole in connecting rod, as damage to engine may occur.

5. Position bearing onto connecting rod. Ensure that hole in bearing half is aligned to hole in connecting rod. Lubricate bearing surface with clean engine oil.
6. Install Special Tools 8189 Connecting Rod Guides into connecting rod.

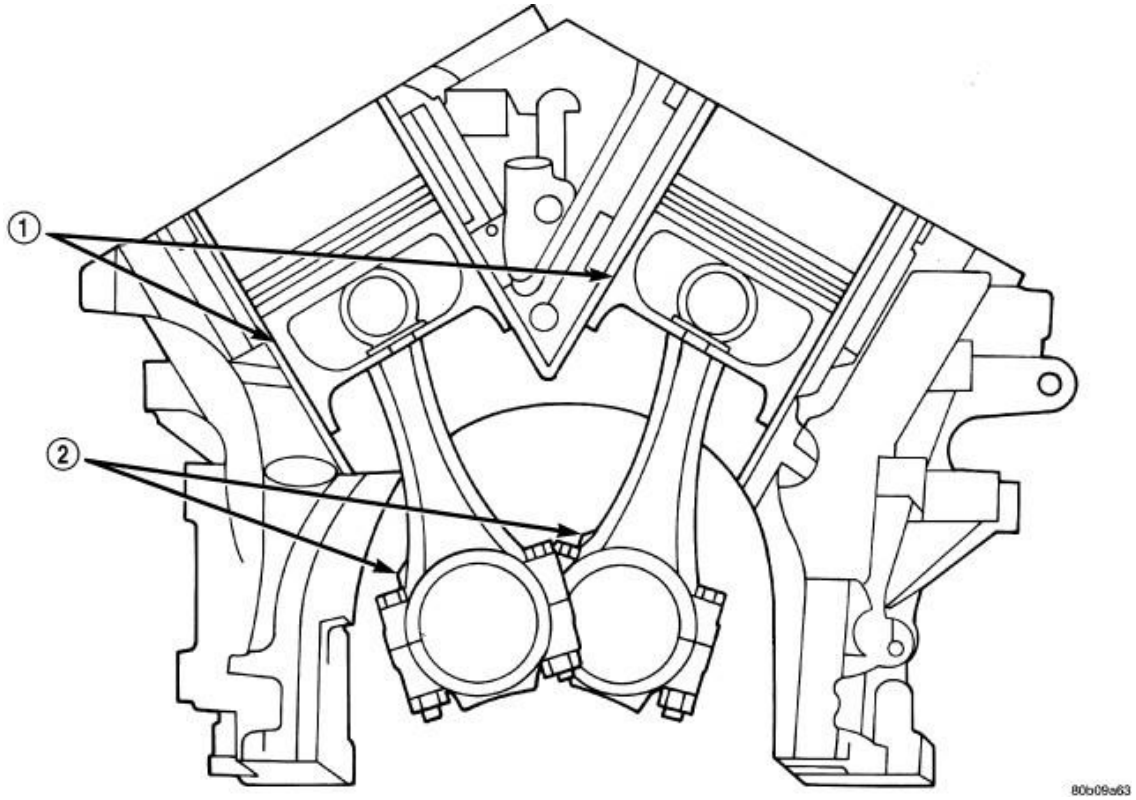

Fig. 211: Piston & Connecting Rod Positioning (Front View of Engine)
Courtesy of CHRYSLER LLC

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

7. The pistons are marked on top with an arrow and with an "F" (Front) above the pin boss. These marks must be pointing toward the front of engine on both cylinder banks. The connecting rod oil squirt hole (2) faces the major thrust (right) side of the block.
8. 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 bank to bank, as engine damage may occur.

9. Tap the piston down in cylinder bore, using a hammer handle. At the same time, guide connecting rod into position on connecting rod journal.
10. Lubricate rod bolts and bearing surface with engine oil. Install connecting rod cap and bearing. Tighten bolts to 27 N.m (20 ft. lbs.) Plus 1/4 turn.

SEAL, CRANKSHAFT OIL, FRONT

Removal

REMOVAL

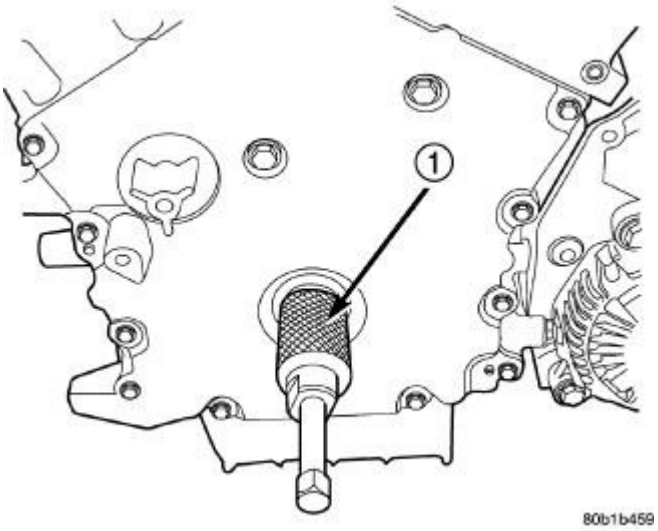

Fig. 212: Crankshaft Front Oil Seal - Removal
Courtesy of CHRYSLER LLC

1 - SPECIAL TOOL 6771

1. Remove crankshaft vibration damper. See **Engine/Engine Block/DAMPER, Vibration - Removal**.
2. Install Special Tool 8194. Insert into crankshaft nose. Remove seal using Special Tool 6771. Remover

(1).

Installation

INSTALLATION

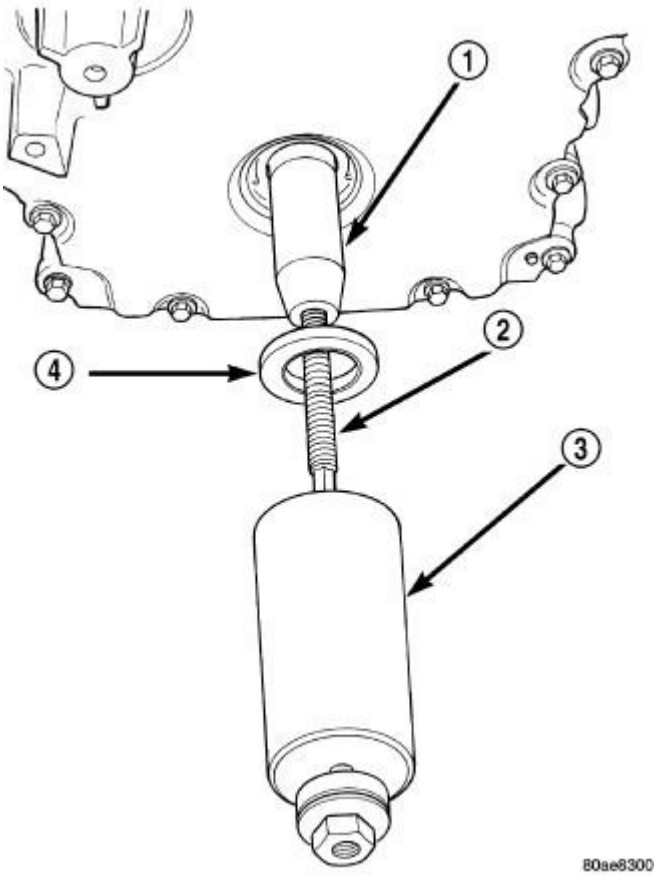

Fig. 213: Crankshaft Front Oil Seal - Installation
Courtesy of CHRYSLER LLC

1 - SPECIAL TOOL 6780-2
2 - SPECIAL TOOL 8179
3 - SPECIAL TOOL 6780-1
4 - SEAL

1. Install new seal using Special Tools 6780-2 Sleeve, 6780-1 Installer, and 8179 Stud (2).
2. Install crankshaft vibration damper. See **Engine/Engine Block/DAMPER, Vibration - Installation**.

SEAL, CRANKSHAFT OIL, REAR

Removal

REMOVAL

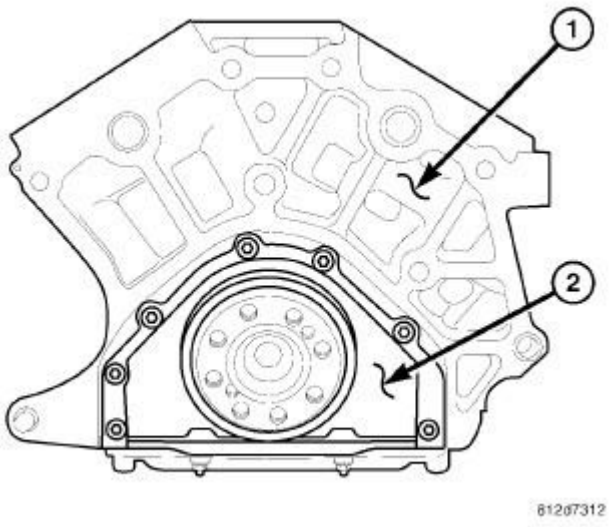

Fig. 214: REAR MAIN SEAL-INSTALLED
Courtesy of CHRYSLER LLC

The crankshaft rear oil seal is incorporated in the seal adapter (2) and can not be removed from the adapter. The crankshaft rear oil seal/seal adapter (2) are serviced as an assembly.

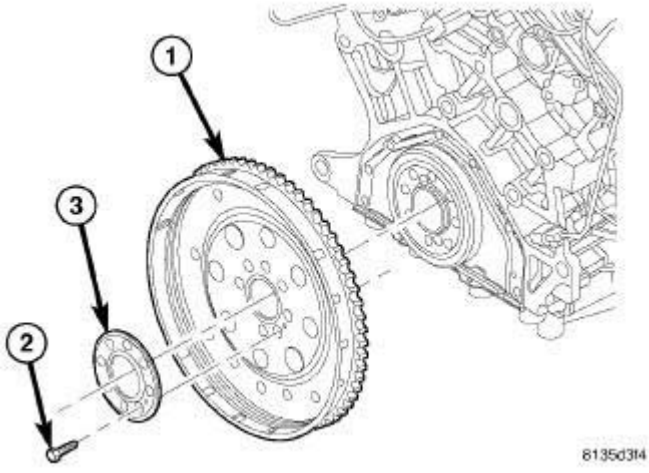

Fig. 215: Flex Plate
Courtesy of CHRYSLER LLC

1. Remove transmission. Refer to **Transmission and Transfer Case/Automatic - 41TE - Removal** .
2. Remove flex plate attaching bolts (2), backing plate (3), and flex plate (1).
3. Remove oil pan. See **Engine/Lubrication/PAN, Oil - Removal**.

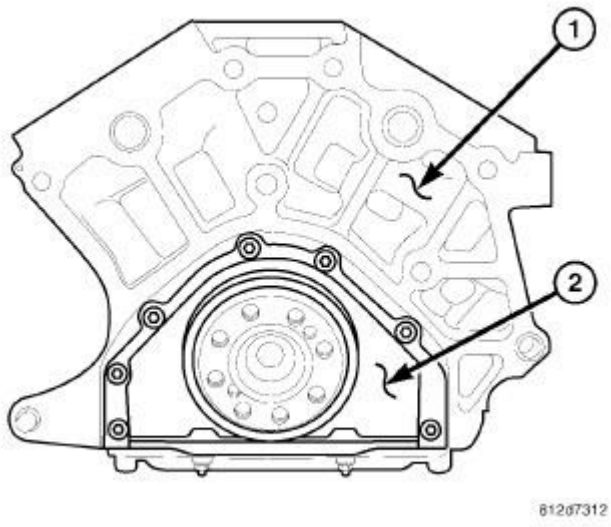

Fig. 216: REAR MAIN SEAL-INSTALLED
Courtesy of CHRYSLER LLC

4. Remove seal retainer attaching screws.
5. Remove crankshaft rear oil seal/adapter (2).

Installation

INSTALLATION

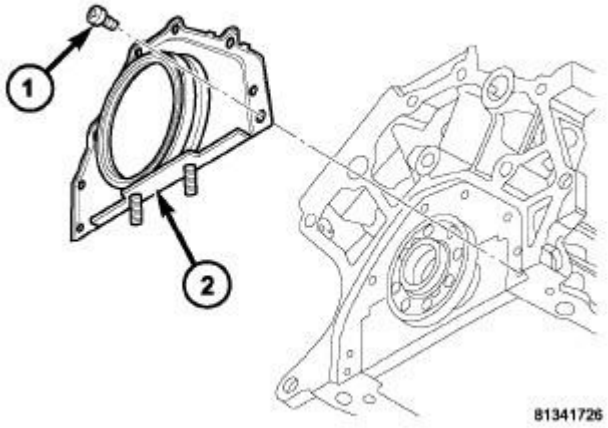

Fig. 217: Oil Seal Retainer
Courtesy of CHRYSLER LLC

NOTE: Inspect the crankshaft to make sure no nicks or burrs are on the seal surface.

1. Clean sealing surfaces thoroughly.
2. Apply engine oil to the seal lip inside diameter.

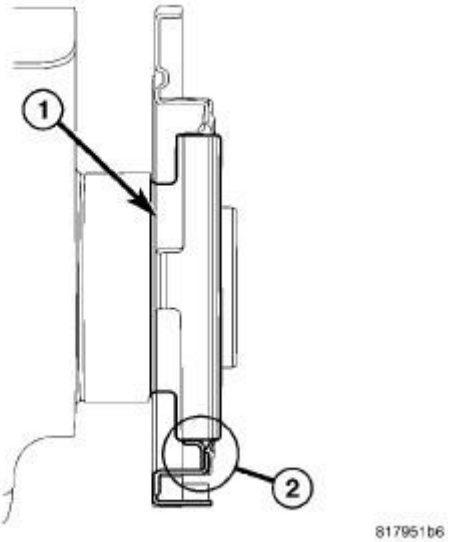

Fig. 218: REAR SEAL INSTALLED
Courtesy of CHRYSLER LLC

NOTE: The seal lip (2) on the retainer must always uniformly curl inward toward the engine on the crankshaft (1).

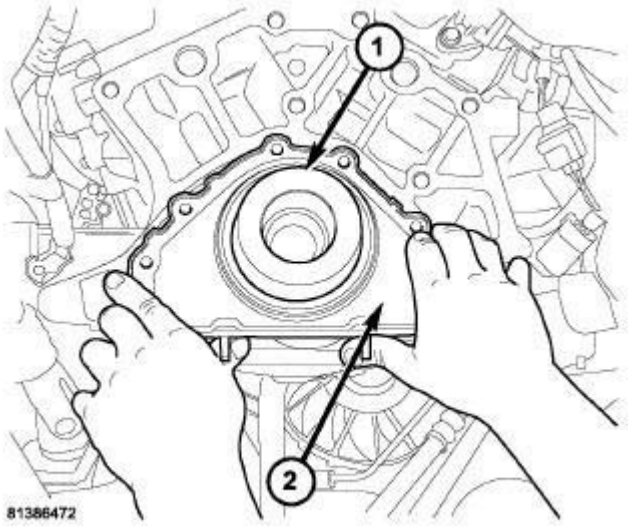

Fig. 219: REAR MAIN INSTALLATION

Courtesy of CHRYSLER LLC

3. Position the special tool 6926 (1) onto the crankshaft and gently slide the seal (2) over the crankshaft.
4. Install seal retaining bolts finger tight.

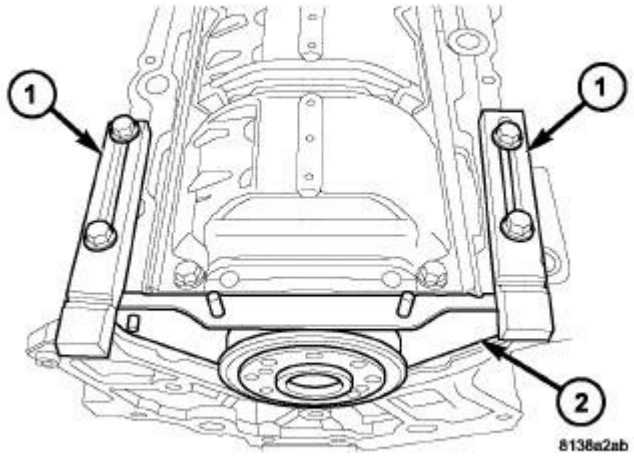

Fig. 220: REAR MAIN - SPECIAL TOOL 8225
Courtesy of CHRYSLER LLC

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

5. Attach Special Tools 8225 (1) to pan rail using the oil pan fasteners.

NOTE: Make sure that the "2.7L" stamped on the special tool is facing the cylinder block (flat side of tools against pan rail).

NOTE: Make sure that the seal flange is flush with the block oil pan sealing surface.

6. While applying firm pressure to the seal assembly (2) against Special Tools 8225 (1), tighten seal assembly screws to 12 N.m (105 in. lbs.).
7. Remove special tool 8225.
8. Install oil pan. See **Engine/Lubrication/PAN, Oil - Installation**.

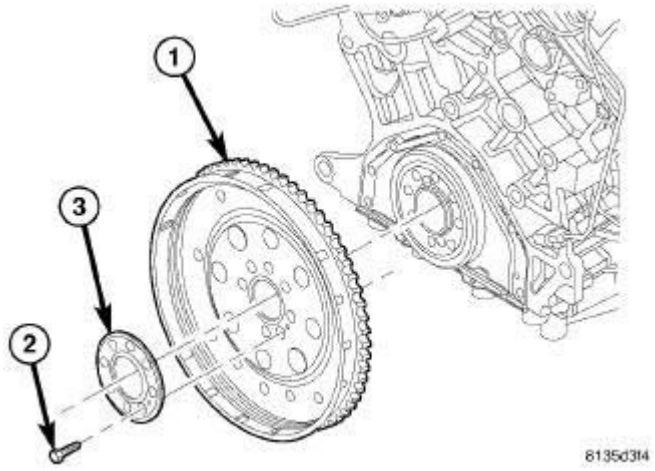

Fig. 221: Flex Plate
Courtesy of CHRYSLER LLC

9. Install flex plate (1), backing plate (3), and attaching bolts (2). See **Engine/Engine Block/FLEXPLATE - Installation**.
10. Install transmission. Refer to **Transmission and Transfer Case/Automatic - 41TE - Installation** .
11. Fill with oil (5).
12. Start engine and check for leaks.

ENGINE MOUNTING

ADJUSTMENTS

ADJUSTMENT

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

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

- Drive shaft distress: See **FRONT SUSPENSION** , **REAR SUSPENSION** and **DIFFERENTIAL AND DRIVELINE** .
- Any front end structural damage (after repair).
- Support Assembly replacement.

ENGINE SUPPORT ADJUSTMENT

1. Remove the load on the engine motor mounts by carefully supporting the engine and transmission assembly with a floor jack.
2. Loosen the right engine support assembly vertical fasteners.

3. Loosen the left engine support assembly vertical bolts.
4. Pry the engine right or left as required to achieve the proper drive shaft assembly length. Refer to **FRONT SUSPENSION** , **REAR SUSPENSION** and **DIFFERENTIAL AND DRIVELINE** for driveshaft identification and related assembly length measuring.
5. Tighten right engine support assembly vertical bolts to 61 N.m (45 ft. lbs.). and tighten left engine support assembly bolts to 61 N.m (45 ft. lbs.).
6. Recheck drive shaft length.

INSULATOR, ENGINE MOUNT, FRONT

Removal

REMOVAL

1. Raise vehicle.

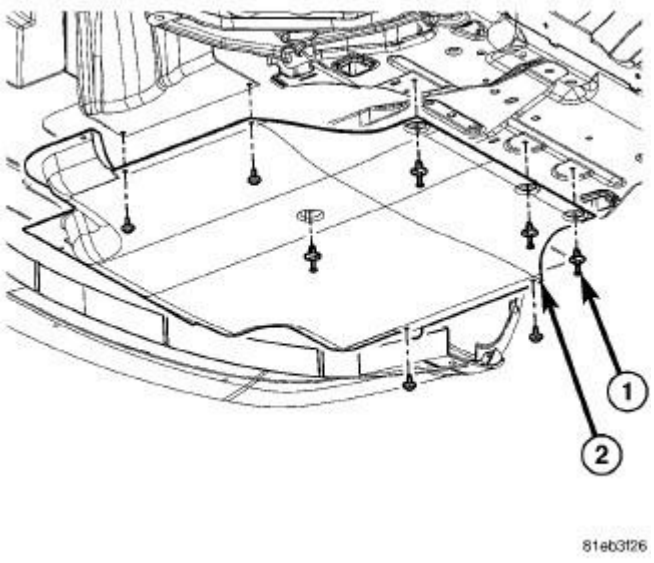

Fig. 222: Belly Pan
Courtesy of CHRYSLER LLC

1 - belly pan fasteners 2 - belly pan

2. Remove the belly pan (2).

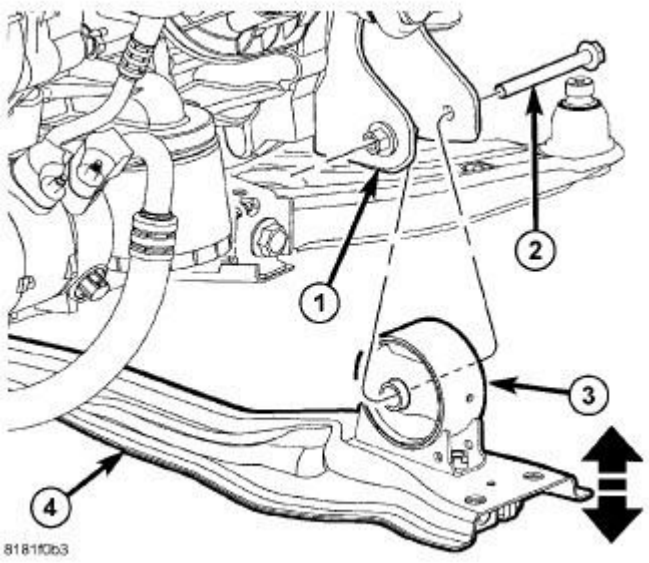

Fig. 223: Front Engine Mount Through Bolt
Courtesy of CHRYSLER LLC

3. Remove front mount to bracket horizontal through bolt (2).

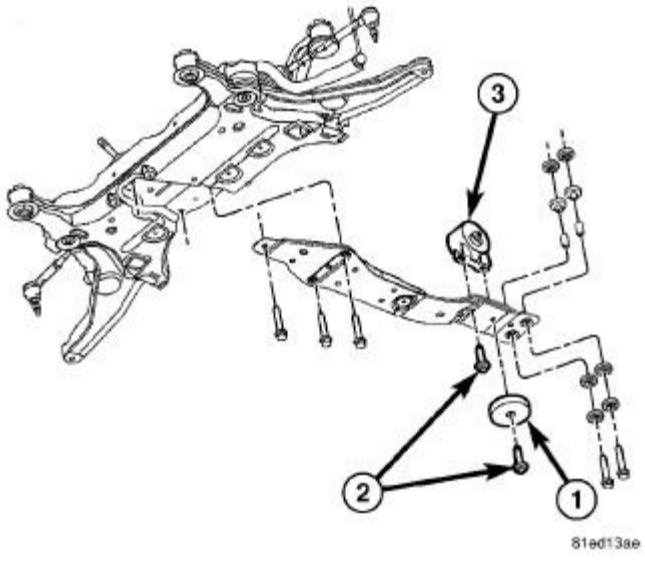

Fig. 224: Front Mount Vertical Bolts
Courtesy of CHRYSLER LLC

4. Remove front mount vertical bolts (2).
5. Remove front mount (3).

Installation

INSTALLATION

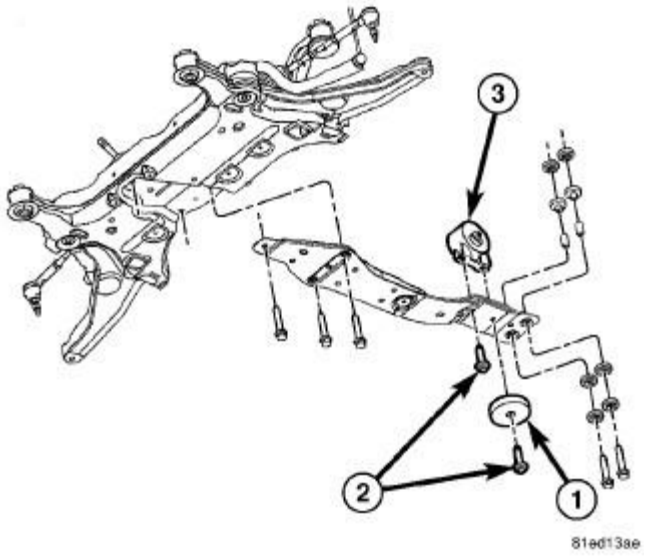

Fig. 225: Front Mount Vertical Bolts
Courtesy of CHRYSLER LLC

1. Install the front mount (3).
2. Install the front mount vertical bolts (2).

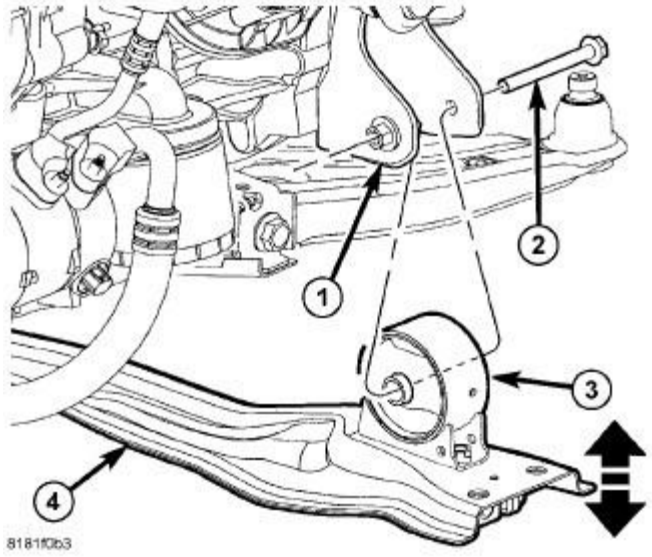

Fig. 226: Front Engine Mount Through Bolt
Courtesy of CHRYSLER LLC

3. Install the front mount to bracket horizontal through bolt (2).

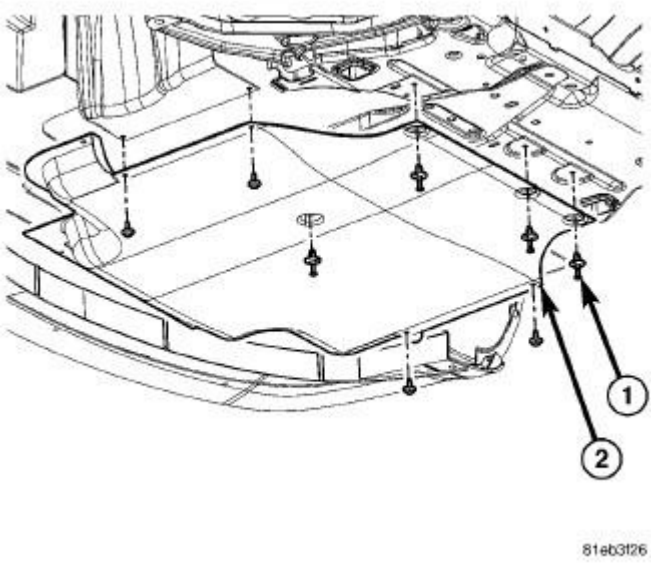

Fig. 227: Belly Pan
Courtesy of CHRYSLER LLC

1 - belly pan fasteners 2 - belly pan

4. Install the belly pan (2).

INSULATOR, ENGINE MOUNT, LEFT

Removal

REMOVAL

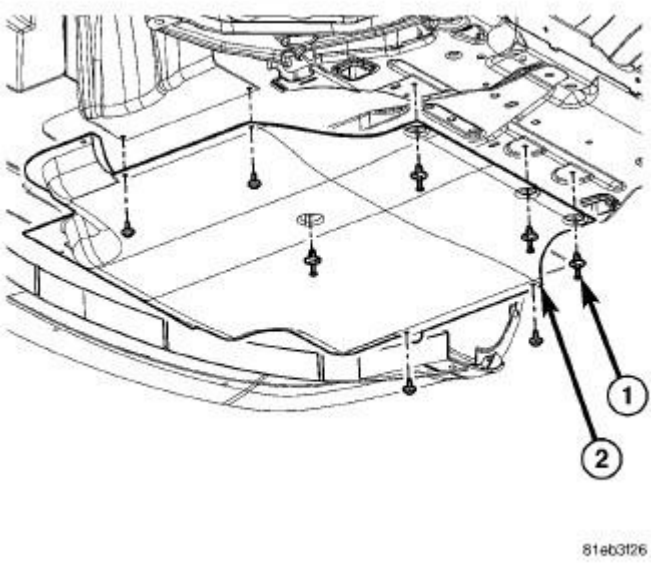

Fig. 228: Belly Pan
Courtesy of CHRYSLER LLC

1. Disconnect and isolate the negative battery cable.
2. Remove throttle body air inlet hose and air cleaner housing assembly. See **Engine/Air Intake System/BODY, Air Cleaner - Removal**.
3. Remove the belly pan (2).

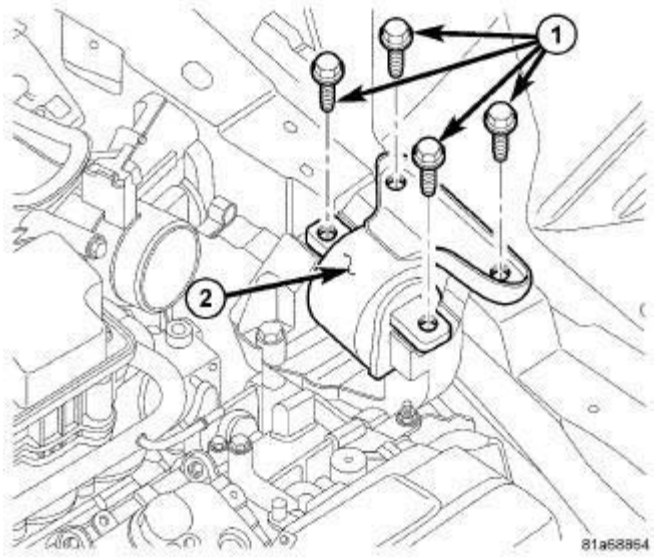

Fig. 229: Left Mount Vertical Bolts
Courtesy of CHRYSLER LLC

4. Support transmission with floor jack and wooden block.
5. Remove the vertical bolts (1) from the left mount (2) to transmission bracket.

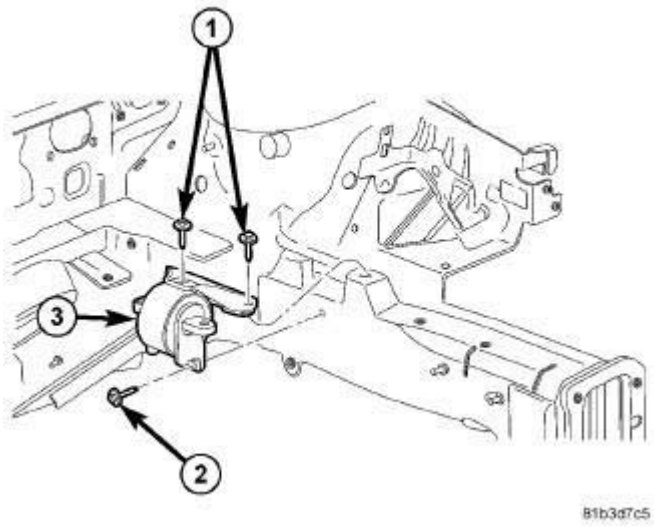

Fig. 230: Mount Isolator Bolts
Courtesy of CHRYSLER LLC

6. Slightly lower transmission with floor jack to gain access to mount to frame rail fastener (2).
7. Remove mount isolator (3).

Installation

INSTALLATION

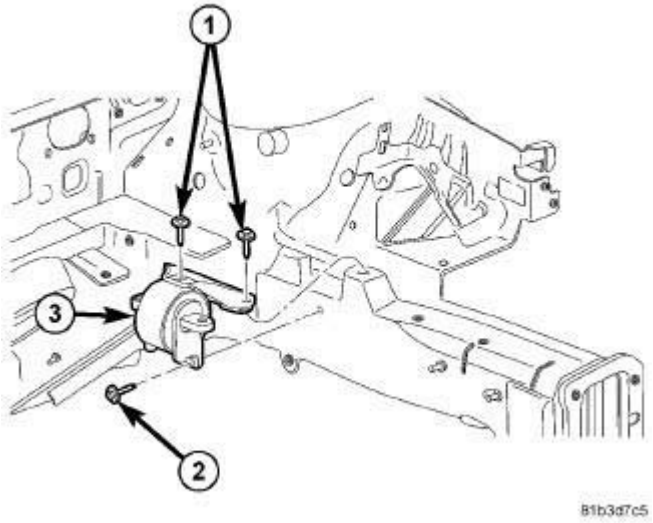

Fig. 231: Mount Isolator Bolts
Courtesy of CHRYSLER LLC

1. Position mount isolator (3) in place, install bolts (1, 2) and tighten to 50 N.m (37 ft. lbs.).

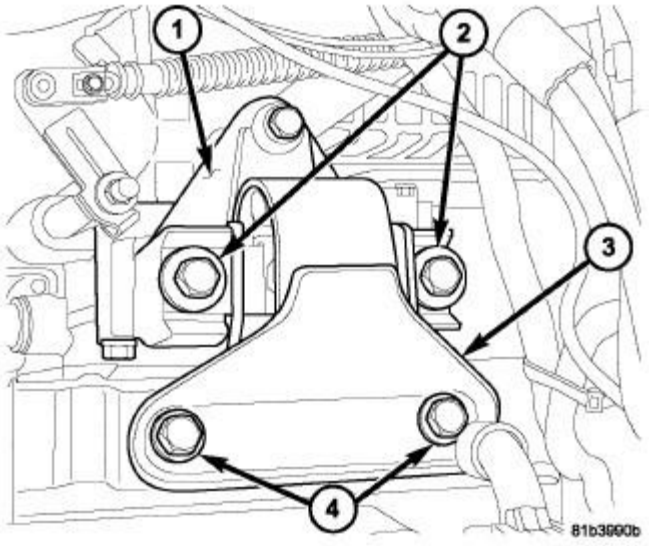

Fig. 232: Identifying Left Engine Mount
Courtesy of CHRYSLER LLC

2. Raise transaxle into position, install bolts (2) and tighten to 98 N.m (72 ft. lbs.).
3. Remove floor jack and wooden block.

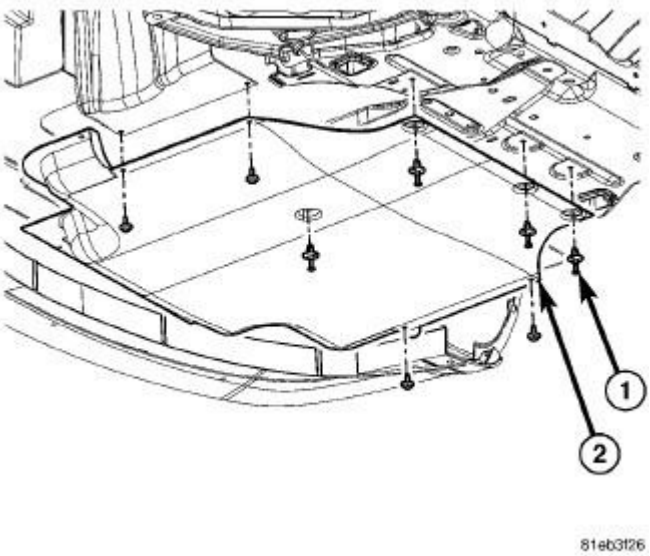

Fig. 233: Belly Pan
Courtesy of CHRYSLER LLC

4. Install belly pan (2).

5. Install throttle body air inlet hose and air cleaner housing assembly. See **Engine/Air Intake System/BODY, Air Cleaner - Installation**.
6. Connect negative battery cable.

INSULATOR, ENGINE MOUNT, REAR

Removal

REMOVAL

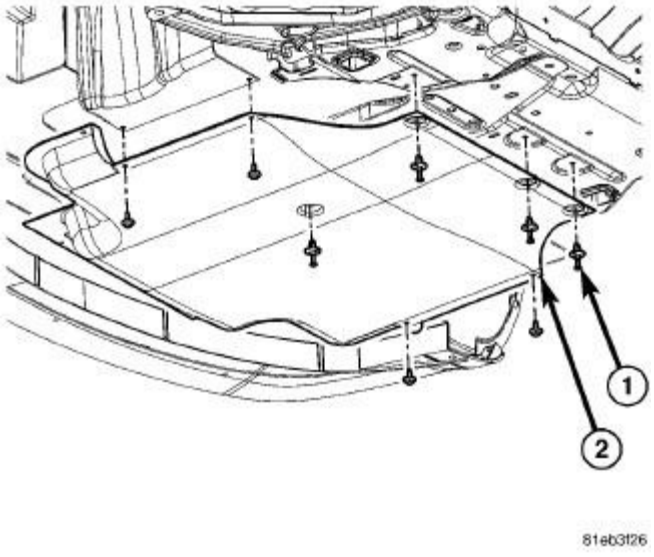

Fig. 234: Belly Pan
Courtesy of CHRYSLER LLC

1. Remove throttle body air inlet hose and air cleaner housing assembly. See **Engine/Air Intake System/BODY, Air Cleaner - Removal**.
2. Raise the vehicle.
3. Remove the belly pan (2).

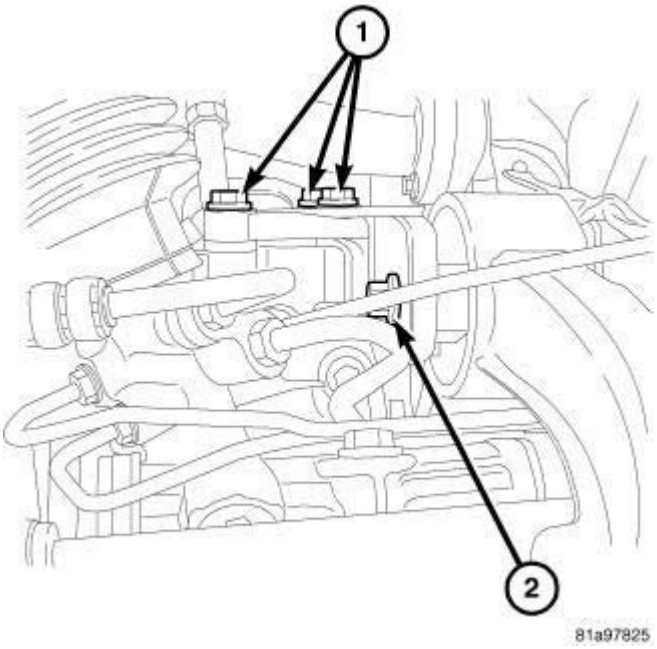

Fig. 235: Identifying Rear Mount Bracket-To-Transaxle Case Bolts
Courtesy of CHRYSLER LLC

4. Remove three vertical bolts (1) attaching rear mount bracket to transaxle case.

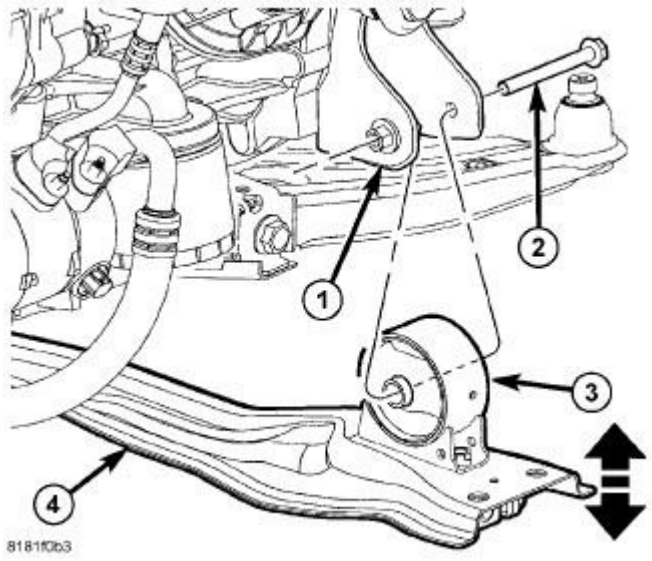

Fig. 236: Front Engine Mount Through Bolt
Courtesy of CHRYSLER LLC

5. Loosen the front mount through bolt (2).

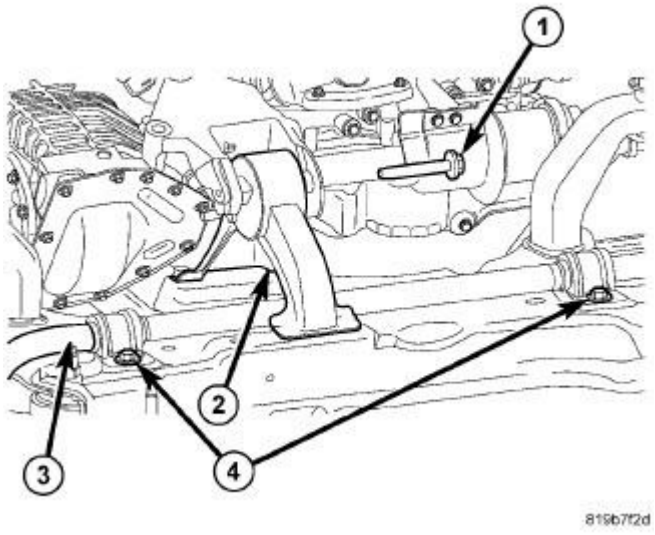

Fig. 237: Rear Engine Mount & Transaxle Bracket
Courtesy of CHRYSLER LLC

6. Remove rear mount bracket through bolt (1).
7. Remove rear mount bracket from transaxle case.
8. Remove rear isolator to suspension crossmember attaching bolts.
9. Remove rear isolator (2).

Installation

INSTALLATION

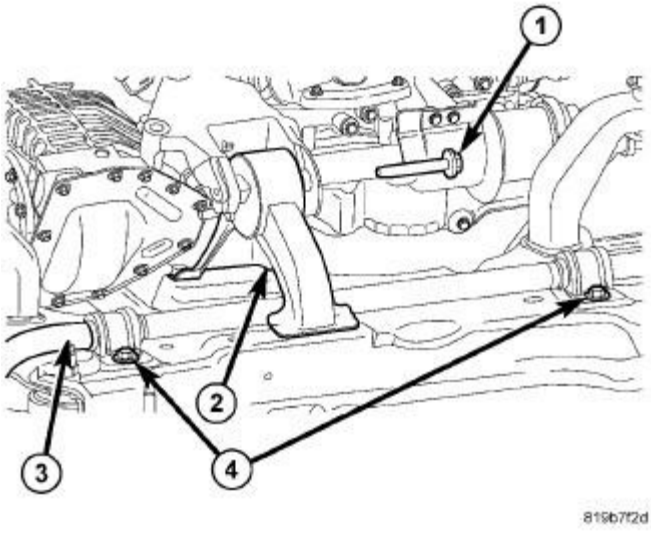

Fig. 238: Rear Isolator On Suspension Crossmember

Courtesy of CHRYSLER LLC

1. Position rear isolator (2) on suspension crossmember and loosely install bolts.

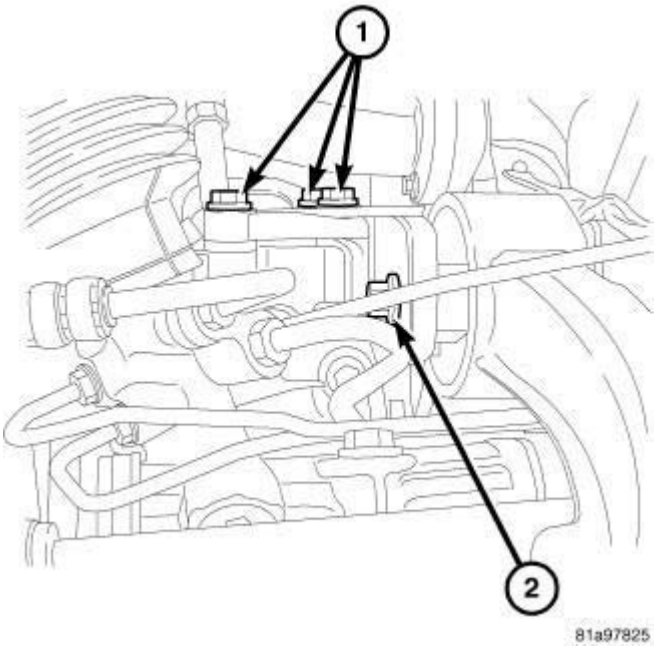

Fig. 239: Identifying Rear Mount Bracket-To-Transaxle Case Bolts
Courtesy of CHRYSLER LLC

2. Position rear mount bracket on transaxle and install bolts (1). Tighten bolts to 95 N.m (70 ft. lbs.).
3. Tighten rear isolator to suspension crossmember bolts to 61 N.m (45 ft. lbs.).

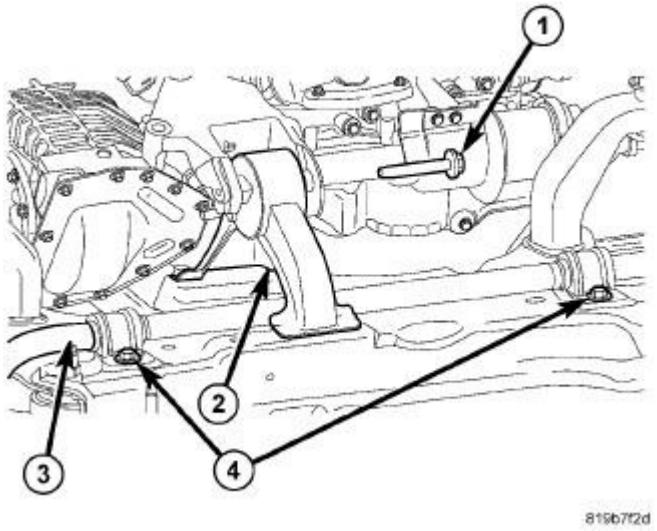

Fig. 240: Rear Isolator On Suspension Crossmember
Courtesy of CHRYSLER LLC

NOTE: Be sure the weight of the engine is static and in rest position.

4. Install rear mount bracket to rear isolator through bolt (1) and tighten to 75 N.m (55 ft. lbs.).

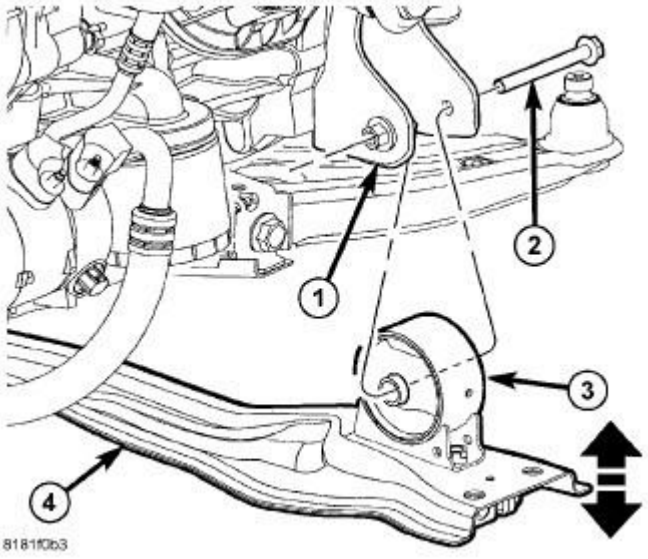

Fig. 241: Front Engine Mount Through Bolt
Courtesy of CHRYSLER LLC

5. Tighten front mount through bolt (2) to 75 N.m (55 ft. lbs.).

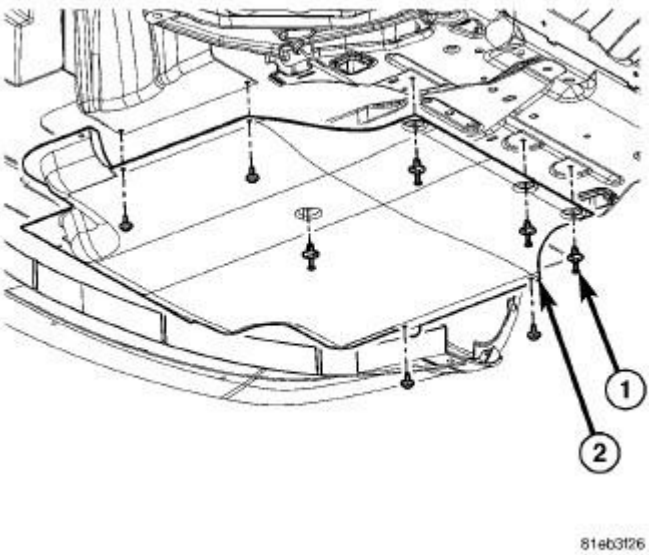

Fig. 242: Belly Pan
Courtesy of CHRYSLER LLC

6. Install the belly pan (2).

7. Install throttle body air inlet hose and air cleaner housing assembly. See **Engine/Air Intake System/BODY, Air Cleaner - Installation**.

INSULATOR, ENGINE MOUNT, RIGHT

Removal

REMOVAL

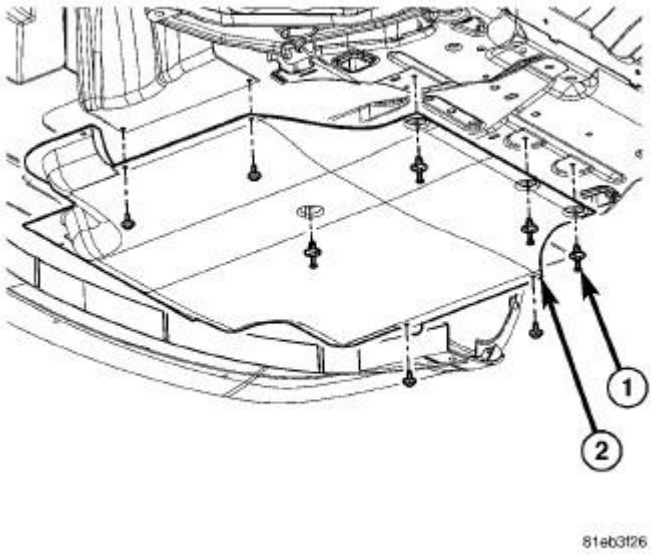

Fig. 243: Belly Pan
Courtesy of CHRYSLER LLC

1. Remove the belly pan (2).

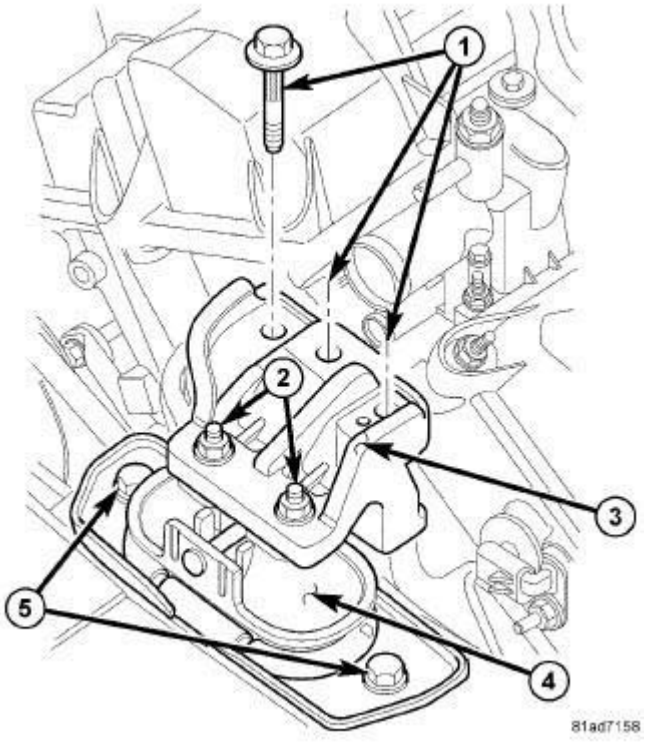

Fig. 244: Right Engine Mount
Courtesy of CHRYSLER LLC

2. Lower vehicle. Remove the load on the engine motor mounts by carefully supporting the engine assembly from below.
3. Remove coolant recovery container. Refer to **Cooling/Engine/BOTTLE, Coolant Recovery - Removal** .
4. Disconnect the ground strap.
5. Remove the right engine support bracket vertical fasteners (1) and (2) and remove support bracket (3).
6. Remove the bolts (5) attaching the right isolator (4) to the frame rail.
7. Remove right isolator (4).

Installation

INSTALLATION

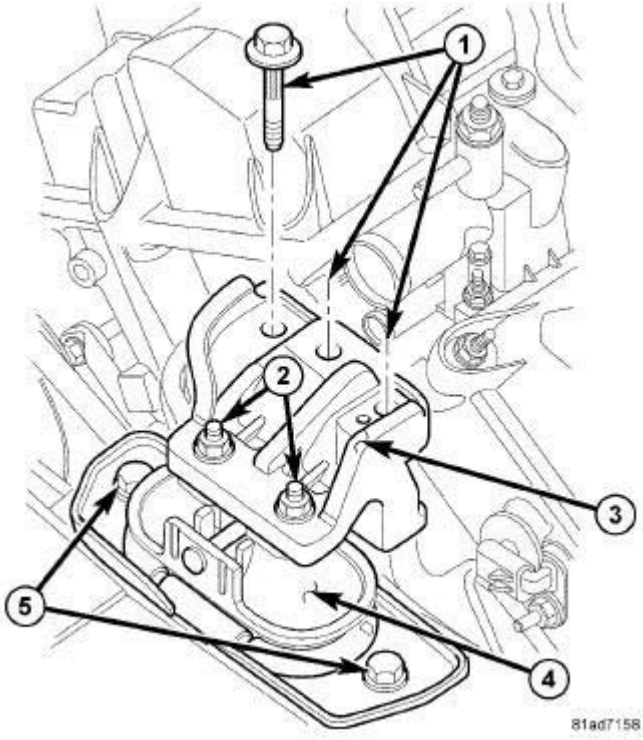

Fig. 245: Right Engine Mount
Courtesy of CHRYSLER LLC

1. Position right isolator (4) and install the isolator to frame rail bolts (5). Tighten bolts to 55 N.m (40 ft. lbs.).
2. Install the engine support bracket (3) and bolts (1). Tighten bolts to 50 N.m (37 ft. lbs).
3. Install the support bracket to isolator nuts (2) and tighten to 30 N.m (22 ft. lbs).
4. Reconnect the ground strap.

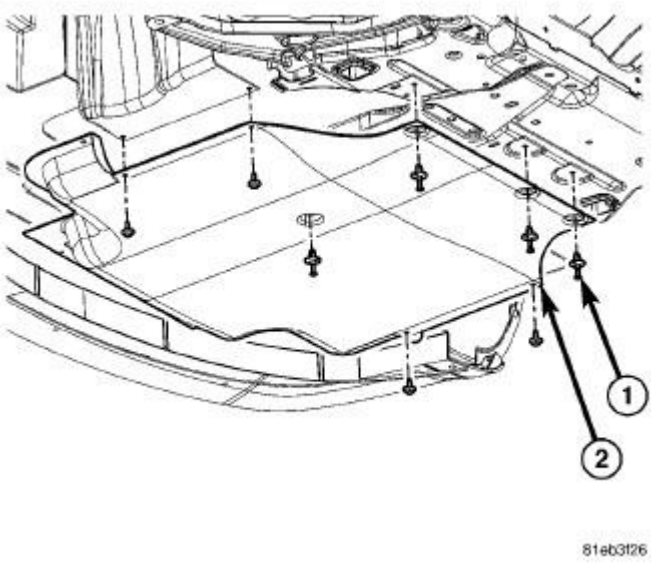

Fig. 246: Belly Pan
Courtesy of CHRYSLER LLC

5. Raise vehicle on a hoist.
6. Install the belly pan (2).
7. Install coolant recovery container. Refer to **Cooling/Engine/BOTTLE, Coolant Recovery - Installation** .

LUBRICATION

DESCRIPTION

DESCRIPTION

The lubrication 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 structural windage tray is used to increase power by minimizing oil windage at high engine RPM. An engine oil cooler is used on some models.

OPERATION

OPERATION

Oil from the oil pan is pumped by a gerotor type oil pump (3) directly coupled to the crankshaft. Oil pressure is controlled by a relief valve mounted inside the oil pump housing.

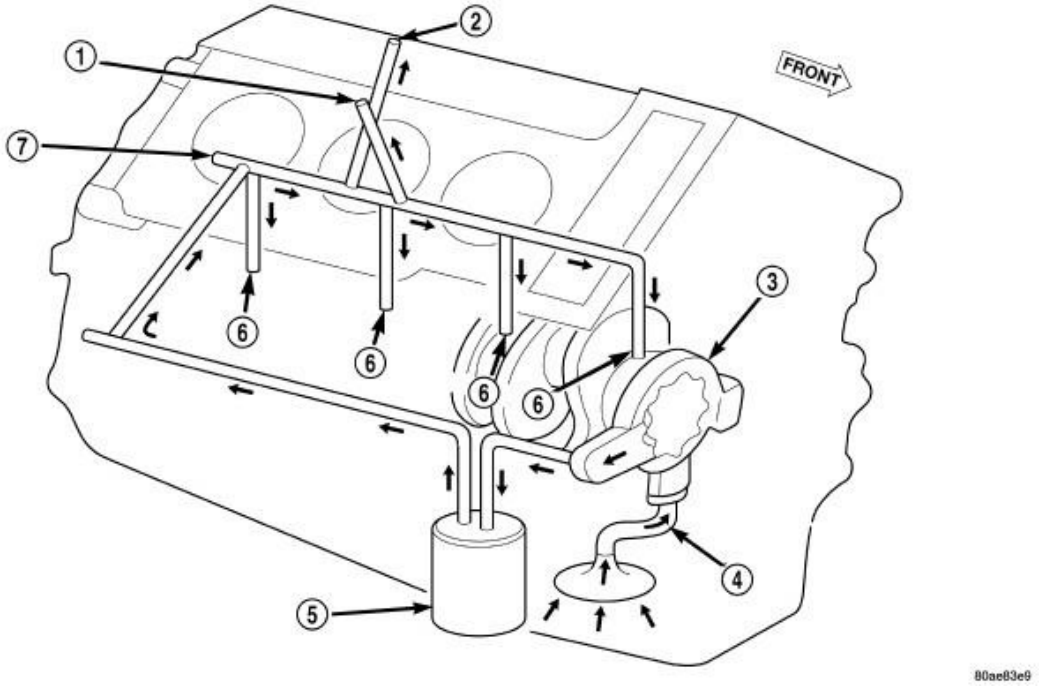

Fig. 247: Cylinder Block Oil Lubrication System
Courtesy of CHRYSLER LLC

1 - TO RIGHT CYLINDER HEAD	5 - OIL FILTER
2 - TO LEFT CYLINDER HEAD	6 - TO CRANKSHAFT MAIN JOURNALS
3 - OIL PUMP	7 - MAIN OIL GALLERY
4 - OIL PICKUP TUBE	-

FROM:	TO:	FROM:	TO:
Oil Pump	Oil Filter Mounting (inlet)	Main Oil Gallery - Center of Block	1. Crankshaft Main Bearings
Oil Filter Mounting (inlet)	Oil Filter		2. Left Cylinder Head*
Oil Filter	Oil Filter Mounting (outlet)		3. Right Cylinder Head*
Oil Filter Mounting (outlet)	Oil Gallery - Right side of Block	Crankshaft Main Bearings	Connecting Rod Bearings
Oil Gallery - Right side of Block	Oil Gallery - Rear of Block and to Oil Cooler (some models)	Left Cylinder Head	Accumulator
Oil Gallery - Rear of Block	Main Oil Gallery - Center of Block	Right Cylinder Head	Accumulator
*The cylinder head gaskets have an oil restrictor to control oil flow to the cylinder heads.			

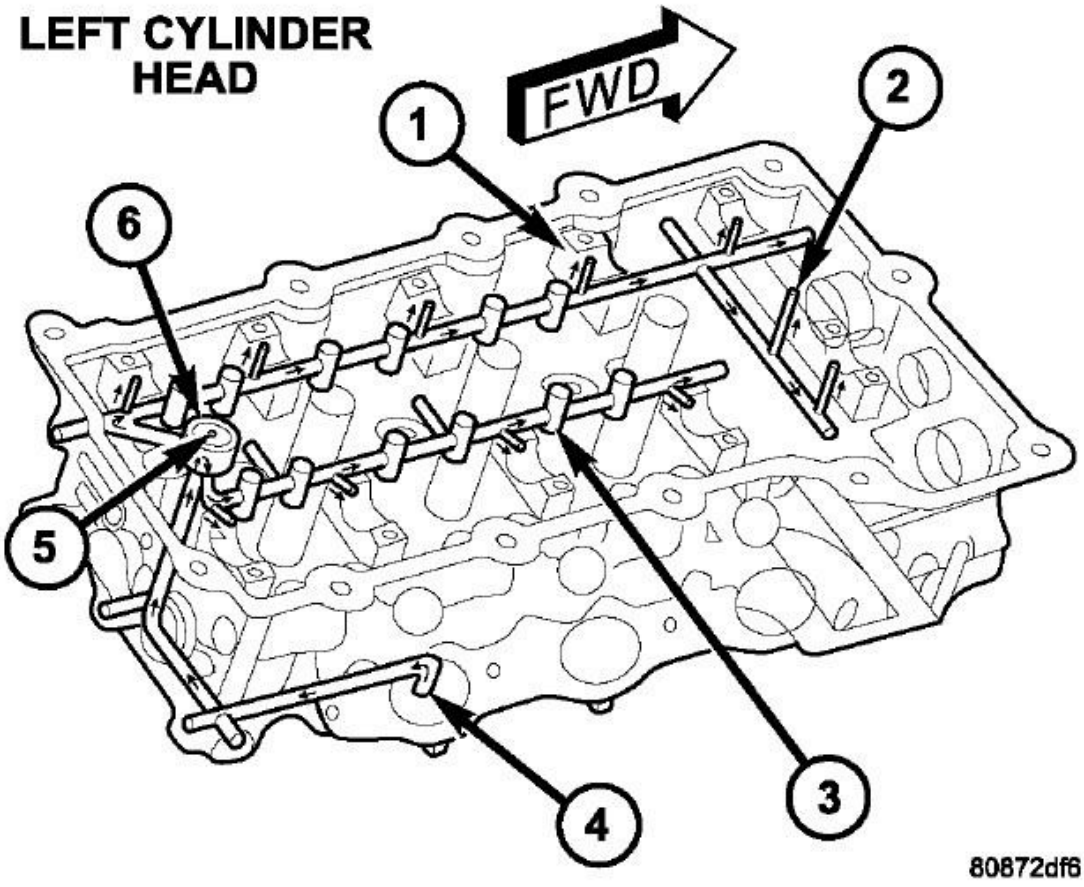

Fig. 248: Cylinder Head Oil Lubrication System - Left Side
Courtesy of CHRYSLER LLC

1 - CAM JOURNALS	4 - OIL FEED FROM BLOCK
2 - OIL FEED TO CAMSHAFT (SECONDARY) CHAIN TENSIONER	5 - VENT HOLE
3 - LASH ADJUSTER BORES	6 - ACCUMULATOR

FROM:	TO:
Left Cylinder Head Oil Inlet Gallery (intake side of head)	Oil Gallery and Accumulator - Rear of Head*
Oil Gallery and Accumulator - Rear of Head*	1. Exhaust Camshaft Oil Passage 2. Intake Camshaft Oil Passage
Left Exhaust Camshaft Oil Passage	1. Left Exhaust Camshaft Journals 2. Hydraulic Valve Lash Adjusters and Rocker Arms 3. Left Camshaft (Secondary) Chain Tensioner**
Left Intake Camshaft Oil Passage	1. Left Intake Camshaft Journals

	2. Hydraulic Valve Lash Adjusters and Rocker Arms
* When oil reaches the back of the cylinder head, the oil gallery feeds oil into an accumulator chamber that is located towards center of the head. The accumulator chamber is closed off with a pressed in core plug that has a small orifice to act as a vent. Oil then travels down at a 45 degree angle from the accumulator into two passages, one for the intake and one for the exhaust side of the cylinder head.	
** The secondary camshaft chain tensioner is the last component to receive oil on the left cylinder head.	

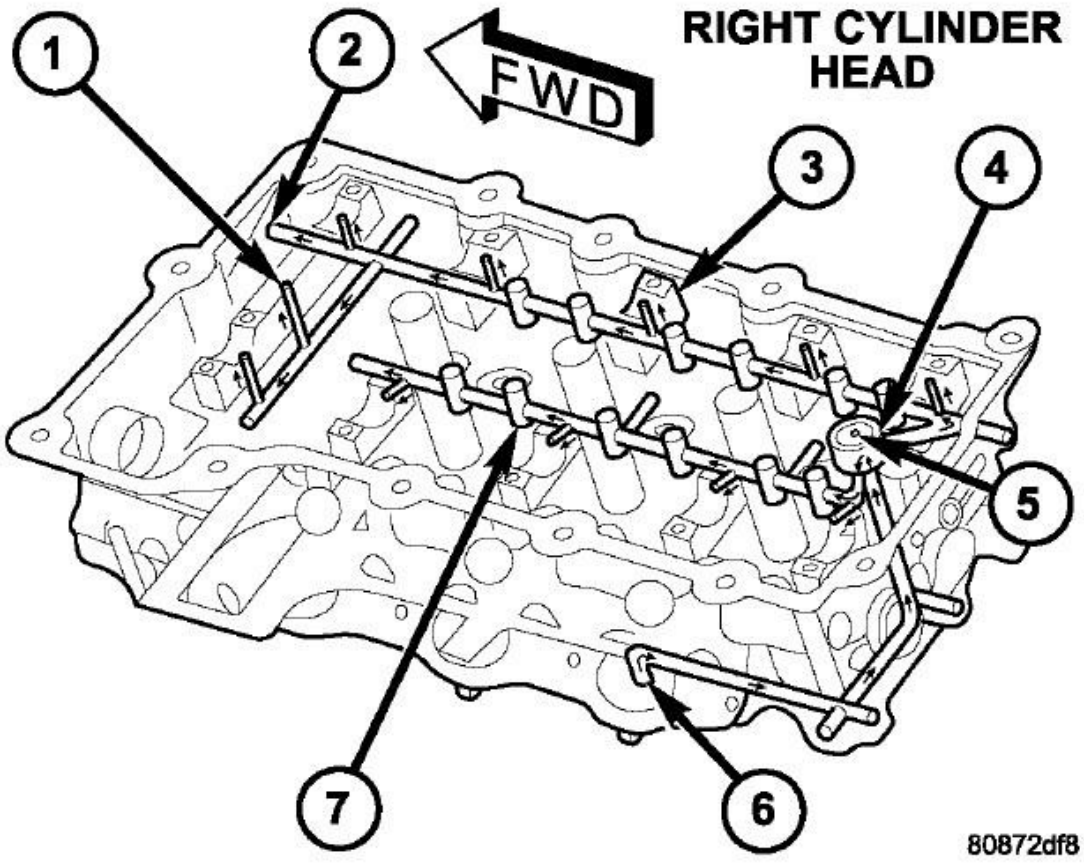

Fig. 249: Cylinder Head Oil Lubrication System - Right Side
Courtesy of CHRYSLER LLC

1 - OIL FEED TO CAMSHAFT (SECONDARY) CHAIN TENSIONER	5 - VENT HOLE
2 - OIL FEED TO TIMING CHAIN (PRIMARY) TENSIONER	6 - OIL FEED FROM BLOCK
3 - CAM JOURNALS	7 - LASH ADJUSTOR BORES
4 - ACCUMULATOR	-

FROM:	TO:
Right Cylinder Head Oil Inlet Gallery (intake side of head)	Oil Gallery and Accumulator - Rear of Head*
Oil Gallery and Accumulator - Rear of Head*	1. Exhaust Camshaft Oil Passage 2. Intake Camshaft Oil Passage
Right Exhaust Camshaft Oil Passage	1. Right Exhaust Camshaft Journals 2. Hydraulic Valve Lash Adjusters and Rocker Arms 3. Right Camshaft (Secondary) Chain Tensioner 4. Primary Timing Chain Tensioner - Right Head**
Right Intake Camshaft Oil Passage	1. Right Intake Camshaft Journals 2. Hydraulic Valve Lash Adjusters and Rocker Arms
* When oil reaches the back of the cylinder head, the oil gallery feeds oil into an accumulator chamber that is located towards center of the head. The accumulator chamber is closed off with a pressed in core plug that has a small orifice to act as a vent. Oil then travels down at a 45 degree angle from the accumulator into two passages, one for the intake and one for the exhaust side of the cylinder head.	
** The timing (primary) chain tensioner is the last component to receive oil on the right cylinder head.	

DIAGNOSIS AND TESTING

CHECKING ENGINE OIL PRESSURE

1. Remove the oil pressure switch. Refer to **Engine/Lubrication/SENSOR, Oil Pressure - Removal** .
2. Install oil pressure test gauge assembly, Special Tools C-3292A with 8406 adaptor.
3. Start engine and monitor gauge readings.

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

4. Oil Pressure (engine at operating temperature): **Curb Idle** 34.5 kPa (5 psi) minimum **3000 RPM** 300-724 kPa (45-105 psi).
5. If oil pressure is 0 at idle. Shut off engine, check for pressure relief valve stuck open or a clogged oil pickup screen.
6. Install oil pressure switch after testing is completed. Refer to **Engine/Lubrication/SENSOR, Oil Pressure - Installation** .

COOLER AND LINES, OIL

Description

DESCRIPTION

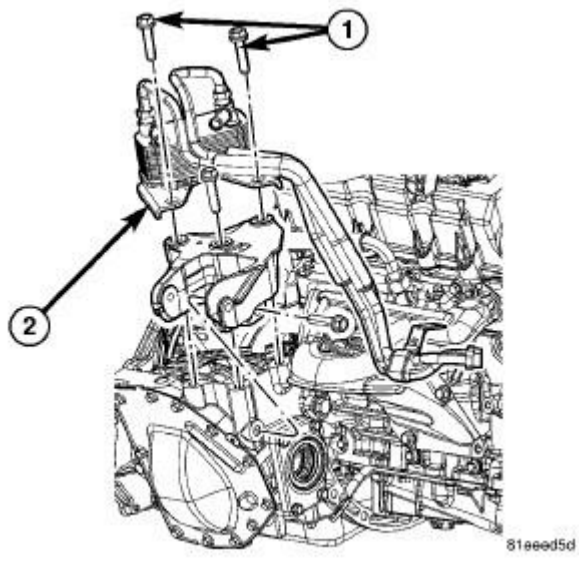

Fig. 250: Oil Cooler Fasteners
Courtesy of CHRYSLER LLC

Some 2.7L engines may be equipped with an engine oil cooler (2) that is mounted to the rear transmission mount bracket. Oil lines route oil from the engine block to the cooler, which is connected to the engine cooling system.

Removal

REMOVAL

WARNING: If the engine is at or near normal operating temperature, the coolant is hot enough to cause severe burns. Always allow the engine to cool down before removing any cooling system hoses.

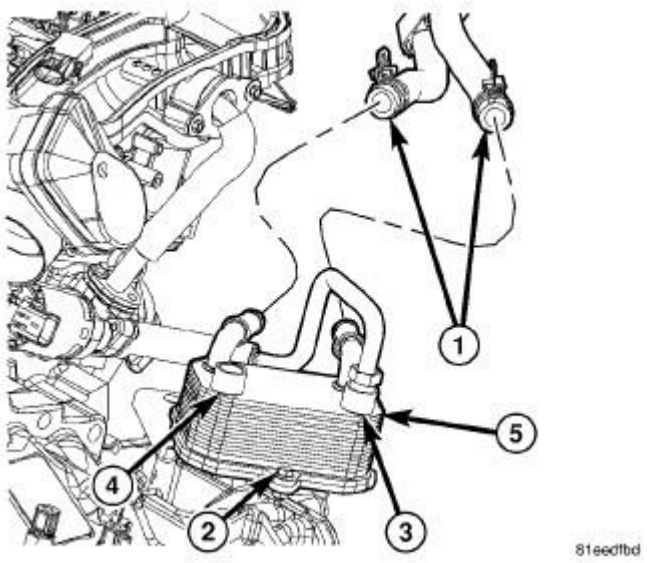

Fig. 251: Heater Hoses From Oil Cooler
Courtesy of CHRYSLER LLC

1. Disconnect the heater hoses (1) from the oil cooler (5) and clamp them off.

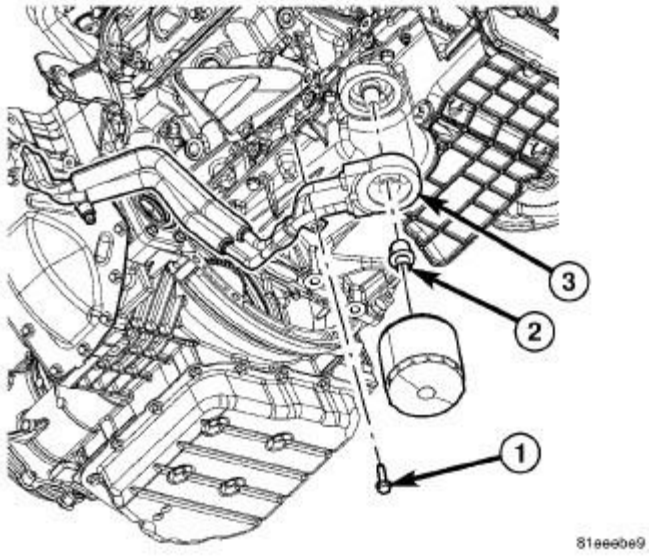

Fig. 252: Cooler Line Retaining Bracket Fastener
Courtesy of CHRYSLER LLC

2. Remove the oil filter.
3. Remove the oil filter adapter (2).
4. Remove the cooler line retaining bracket fastener (1).

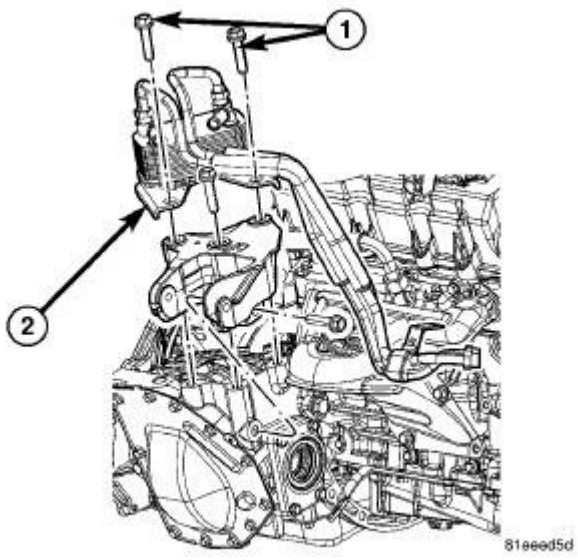

Fig. 253: Oil Cooler Fasteners
Courtesy of CHRYSLER LLC

5. Remove the oil cooler fasteners (1) and remove the oil cooler assembly (2).

Installation

INSTALLATION

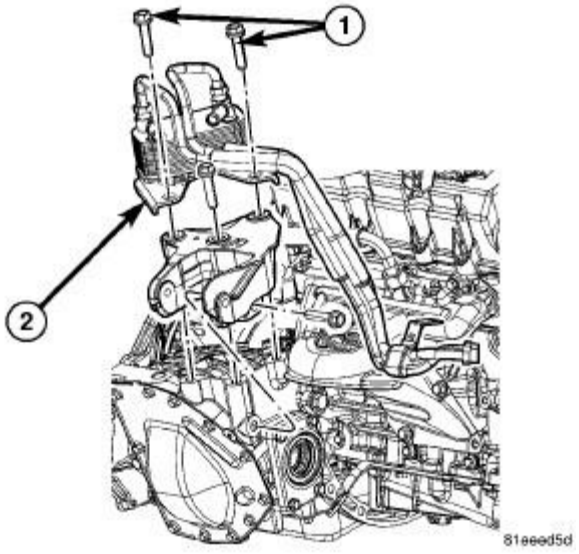

Fig. 254: Oil Cooler Fasteners
Courtesy of CHRYSLER LLC

1. Install the oil cooler (2) and install the fasteners (1). Tighten to 65 Nm (48 ft. lbs).

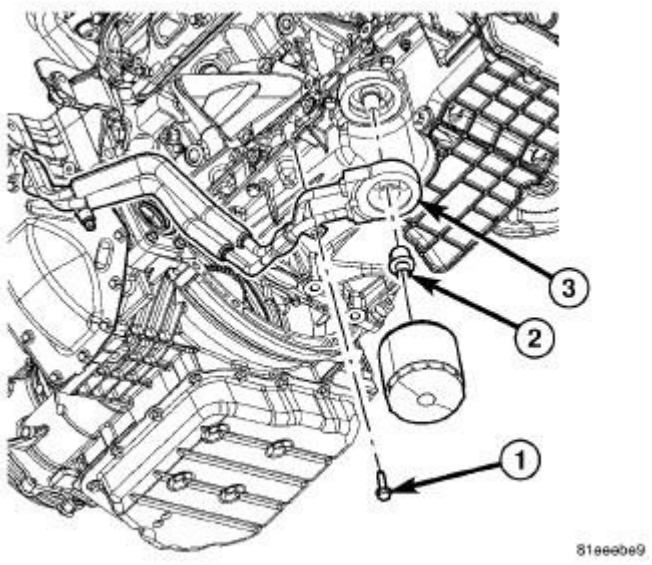

Fig. 255: Cooler Line Retaining Bracket Fastener
Courtesy of CHRYSLER LLC

2. Install the oil cooler diverter (3) and install the oil filter adapter (2).
3. Reposition the oil line retaining bracket, and install the fastener (1). Tighten to 23 Nm (17 ft. lbs.).
4. Install the oil filter.
5. Top off the cooling system as necessary. Refer to **Cooling - Standard Procedure** .

FILTER, ENGINE OIL

Removal

REMOVAL

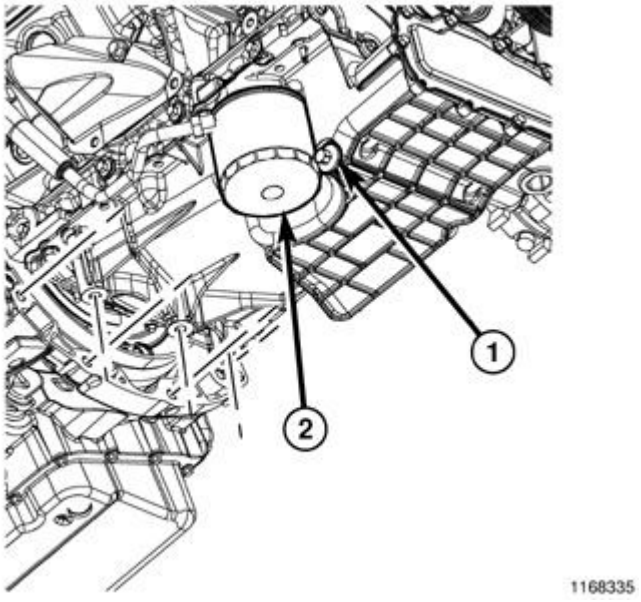

Fig. 256: Oil Filter & Drain Plug
Courtesy of CHRYSLER LLC

1. Raise vehicle on hoist.
2. Position a suitable collecting container under oil filter location.
3. Remove oil filter (2) using a suitable oil filter wrench. Dispose of oil filter following environmental guidelines.

Installation

INSTALLATION

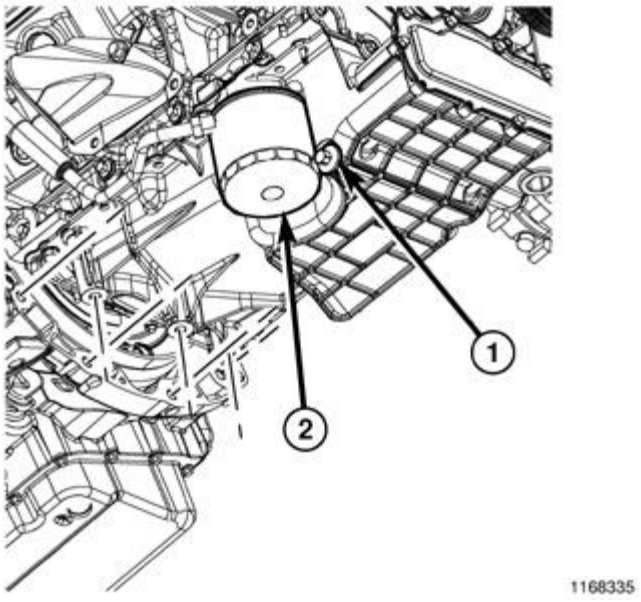

Fig. 257: Oil Filter & Drain Plug

Courtesy of CHRYSLER LLC

1. Wipe filter base clean, then inspect gasket sealing surface.
2. Lubricate gasket of new filter with clean engine oil.
3. Install oil filter (2) and tighten to 16 N.m (12 ft. lbs.) after gasket contacts base. Use filter wrench if necessary.
4. Fill crankcase with proper engine oil to correct level if drained. Start engine and check for leaks.

OIL

Description

DESCRIPTION

For engine oil type and capacity, refer to **Vehicle Quick Reference/Capacities and Recommended Fluids - Description** .

Standard Procedure

STANDARD PROCEDURE - ENGINE OIL AND FILTER CHANGE

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.

Change engine oil and filter at mileage and time intervals described in the Maintenance Schedule. Refer to **Vehicle Quick Reference/Maintenance Schedules - Description** .

TO CHANGE ENGINE OIL

1. Run engine until achieving normal operating temperature.
2. Position the vehicle on a level surface and turn engine off.
3. Hoist and support vehicle on safety stands. Refer to **Vehicle Quick Reference/Hoisting - Standard Procedure** .
4. Remove oil fill cap.
5. Place a suitable drain pan under crankcase drain.
6. Remove drain plug from crankcase and allow oil to drain into pan. Inspect drain plug threads for stretching or other damage. Replace drain plug and gasket if damaged.
7. Remove oil filter. Refer to **Engine/Lubrication/FILTER, Engine Oil - Removal**.

8. Install drain plug in crankcase.
9. Install new oil filter. Refer to **Engine/Lubrication/FILTER, Engine Oil - Installation**.
10. Lower vehicle and fill crankcase with specified type and amount of engine oil. Refer to **Vehicle Quick Reference/Capacities and Recommended Fluids - Description** .
11. Install oil fill cap.
12. Start engine and inspect for leaks.
13. Stop engine and inspect oil level.

OIL FILTER SPECIFICATION

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

USED ENGINE OIL DISPOSAL

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

ENGINE OIL LEVEL CHECK

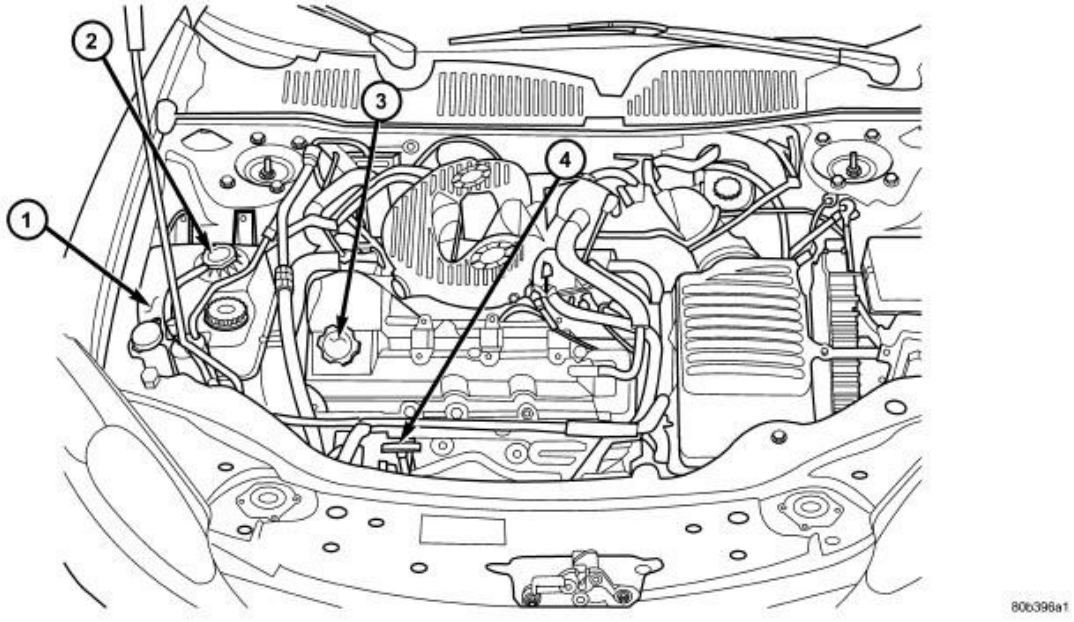

Fig. 258: Identifying Oil Dipstick, Fill Cap, Coolant Pressure Cap & Coolant Pressure Container
Courtesy of CHRYSLER LLC

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

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

PAN, OIL

Removal

REMOVAL

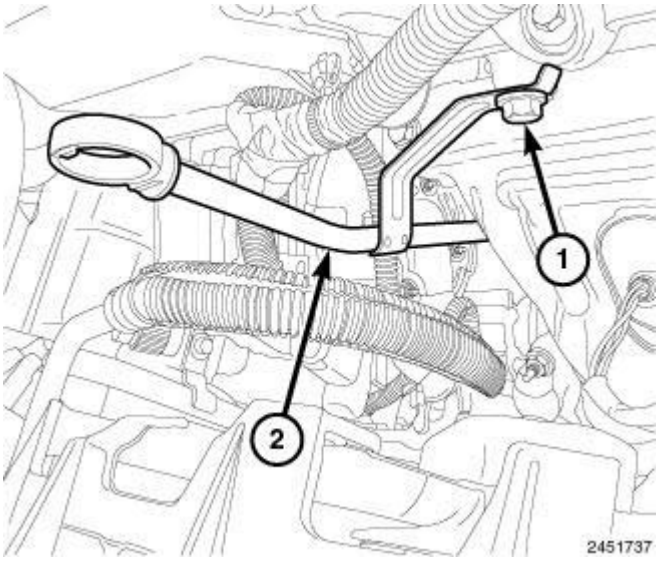

Fig. 259: Identifying Oil Dipstick Tube & Bolt
Courtesy of CHRYSLER LLC

1. Disconnect and isolate the negative battery cable.
2. Remove the bolt (1) and the engine oil dipstick tube (2).

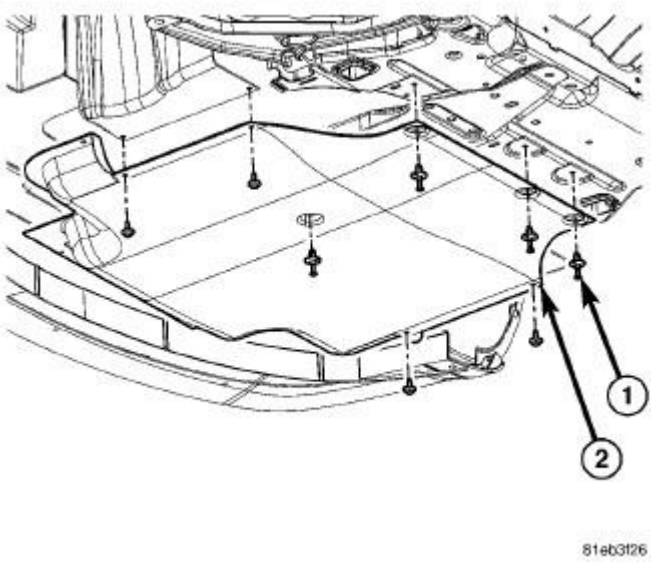

Fig. 260: Belly Pan
Courtesy of CHRYSLER LLC

3. Raise and secure the vehicle on a hoist. Refer to **Vehicle Quick Reference/Hoisting - Standard Procedure** .
4. Remove the belly pan (2), if equipped.

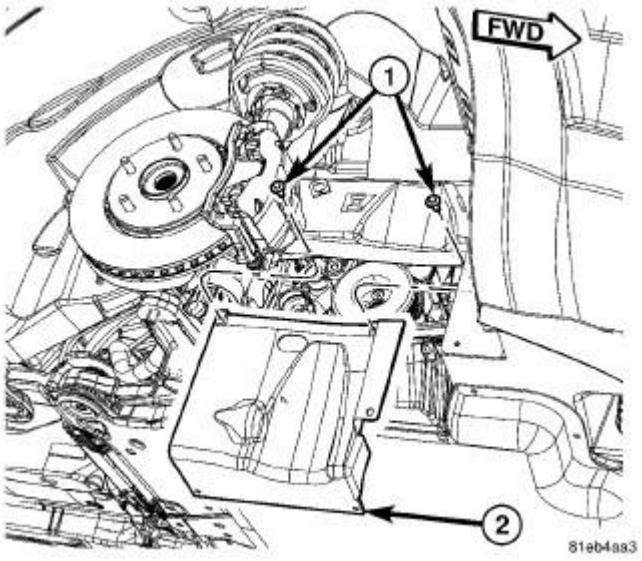

Fig. 261: Right Lower Splash Shield
Courtesy of CHRYSLER LLC

5. Remove the right lower splash shield (2).

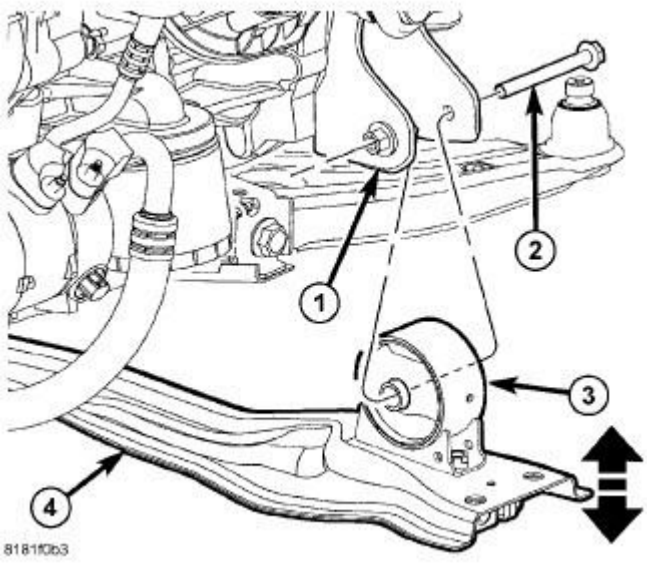

Fig. 262: Front Engine Mount Through Bolt
Courtesy of CHRYSLER LLC

6. Drain the engine oil and remove the oil filter. See **Engine/Lubrication/FILTER, Engine Oil - Removal**.
7. Remove the fore/aft crossmember (4). Refer to **Frame and Bumpers/Frame/CROSSMEMBER - Removal** .

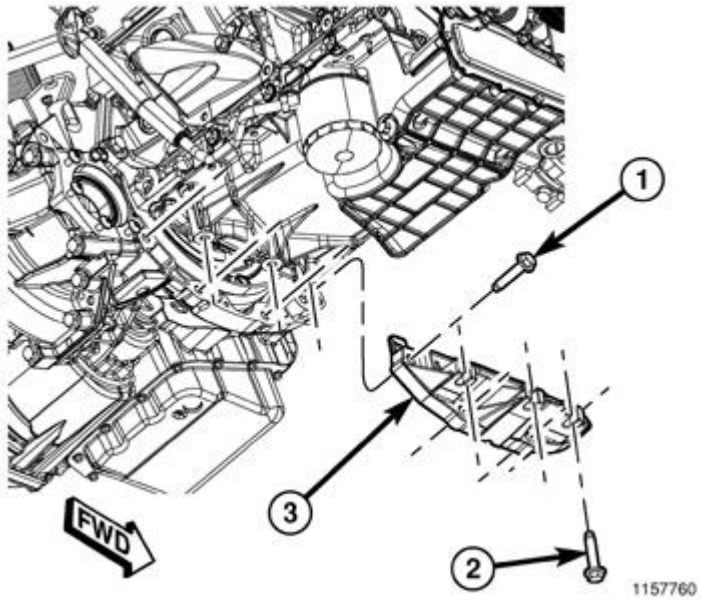

Fig. 263: Structural Collar
Courtesy of CHRYSLER LLC

8. Remove the structural collar (3). See **Engine/Engine Block/COVER, Structural Dust - Removal**.

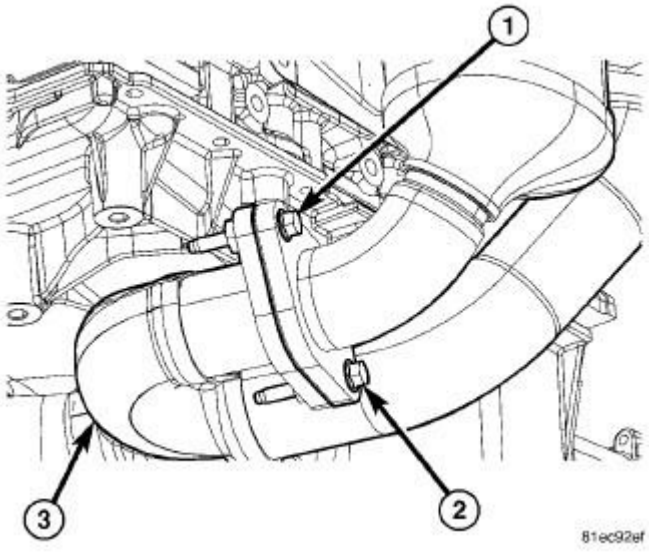

Fig. 264: Exhaust Cross-Under Pipe
Courtesy of CHRYSLER LLC

9. Remove the exhaust cross-under pipe (3). Refer to **Exhaust System/PIPE, Exhaust Crossunder - Removal** .

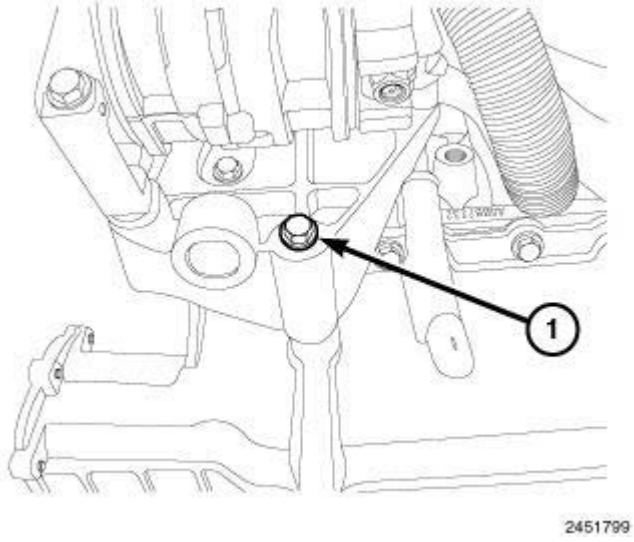

Fig. 265: A/C Compressor Mounting Bracket Lower Bolt
Courtesy of CHRYSLER LLC

10. Remove the lower bolt (1) attaching the A/C compressor mounting bracket to the oil pan.

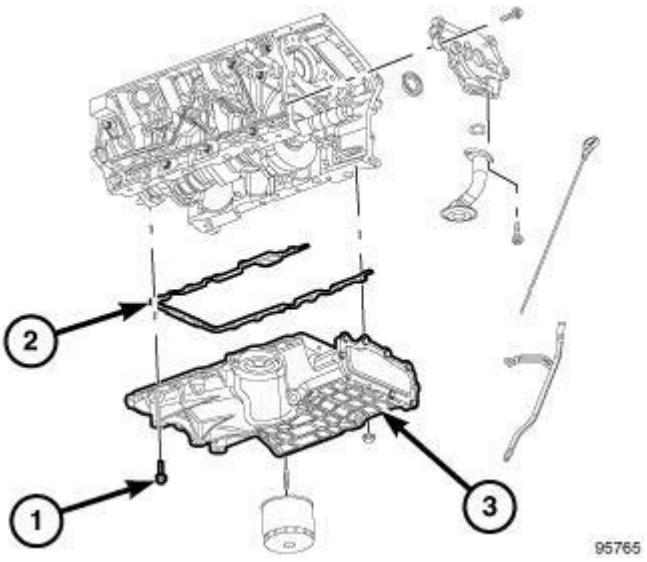

Fig. 266: Oil Pan Attaching Fasteners
Courtesy of CHRYSLER LLC

CAUTION: Assure removal of the two bolts attaching the timing cover to the oil pan, as damage to the timing cover and/or oil pan may occur.

11. Remove the oil pan attaching fasteners (1). Remove the oil pan (3) and gasket (2).

Installation

INSTALLATION

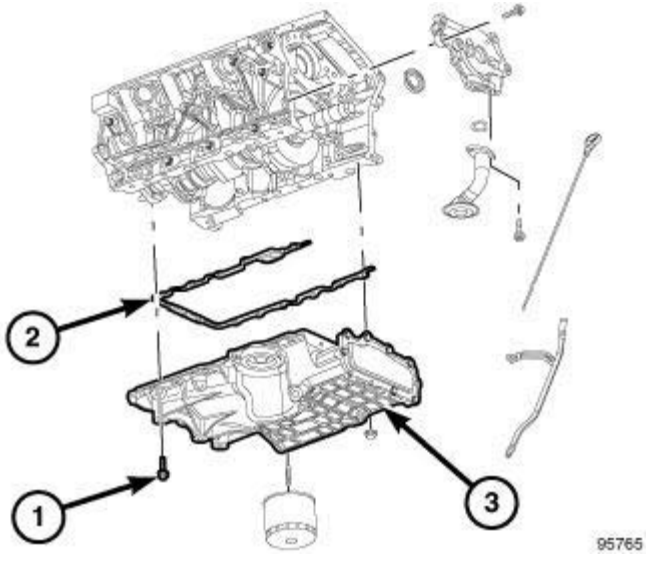

Fig. 267: Oil Pan Attaching Fasteners
Courtesy of CHRYSLER LLC

1. Clean the oil pan and oil pan sealing surfaces. Inspect the oil pan and timing chain cover gaskets. Replace as necessary.
2. Apply an 1/8 inch bead of Mopar® Engine RTV GEN II to the front T-joints (oil pan gasket to timing cover gasket interface) and the rear T-joints (oil pan gasket to crankshaft rear oil seal retainer gasket interface).
3. Install the oil pan gasket (2) to the engine block.

NOTE: To prevent oil leaks at oil pan to timing chain cover, the following tightening sequence procedure must be performed.

4. Install the oil pan (3) and fasteners (1) using the following tightening sequence:
   a. Install the oil pan bolts and nuts **finger tight only-just tight enough to compress the gasket's rubber seal** .
   b. Install the timing chain cover to oil pan bolts and tighten to 12 N.m (105 in. lbs.).
   c. Tighten the oil pan bolts to 28 N.m (250 in. lbs.).
   d. Tighten the oil pan nuts to 12 N.m (105 in. lbs.).

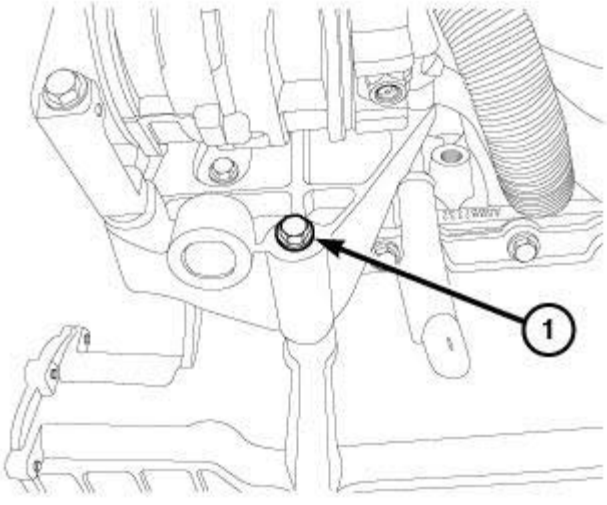

Fig. 268: A/C Compressor Mounting Bracket Lower Bolt
Courtesy of CHRYSLER LLC

5. Install the lower bolt (1) attaching the A/C compressor mounting bracket to the oil pan. Tighten bolt to 28 N.m (21 ft. lbs.).

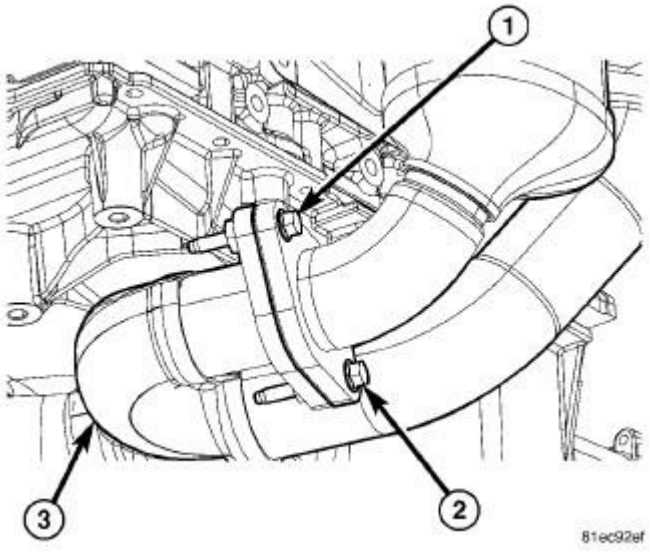

Fig. 269: Exhaust Cross-Under Pipe
Courtesy of CHRYSLER LLC

6. Install the oil filter and drain plug. See **Engine/Lubrication/FILTER, Engine Oil - Installation**.
7. Install exhaust cross-under pipe. Refer to **Exhaust System/PIPE, Exhaust Crossunder - Installation** .

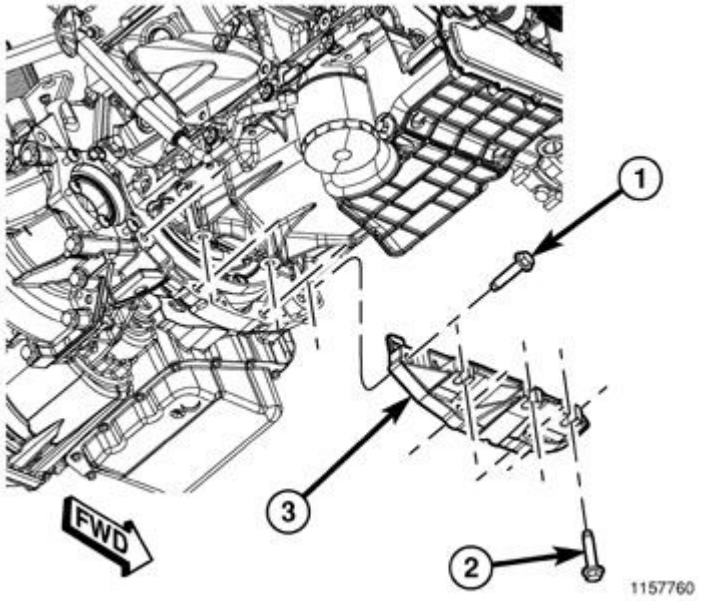

Fig. 270: Structural Collar
Courtesy of CHRYSLER LLC

8. Install structural collar (3). See **Engine/Engine Block/COVER, Structural Dust - Installation**.

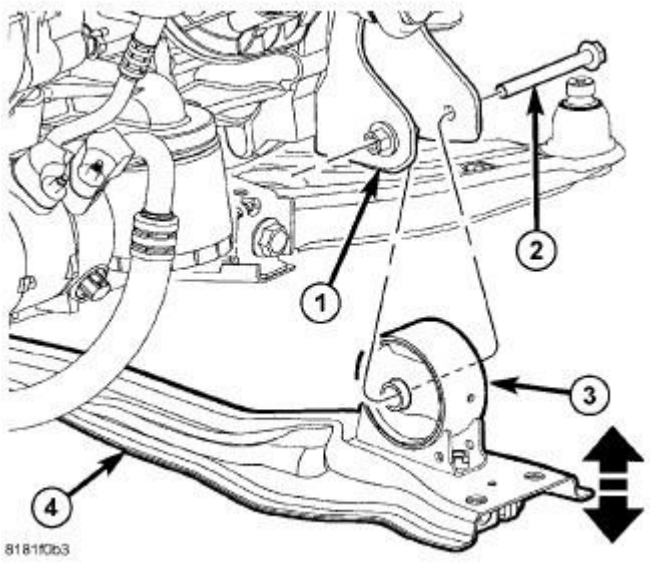

Fig. 271: Front Engine Mount Through Bolt
Courtesy of CHRYSLER LLC

9. Install the fore/aft crossmember (4). Refer to **Frame and Bumpers/Frame/CROSSMEMBER - Installation** .

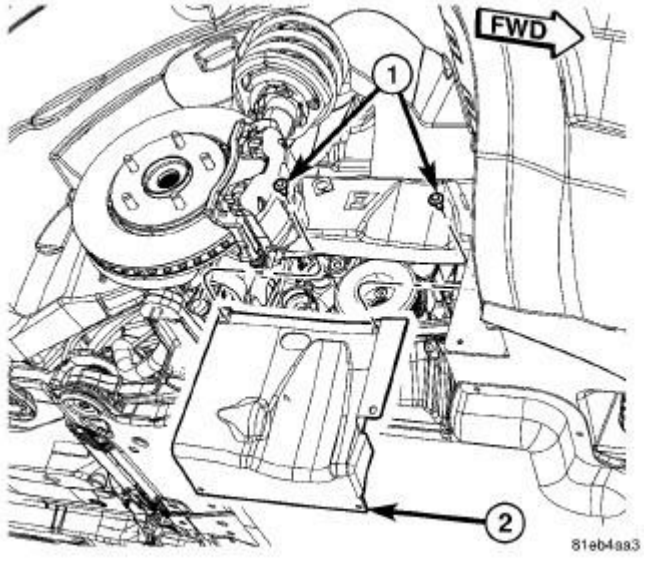

Fig. 272: Right Lower Splash Shield
Courtesy of CHRYSLER LLC

10. Install the right lower splash shield (2).

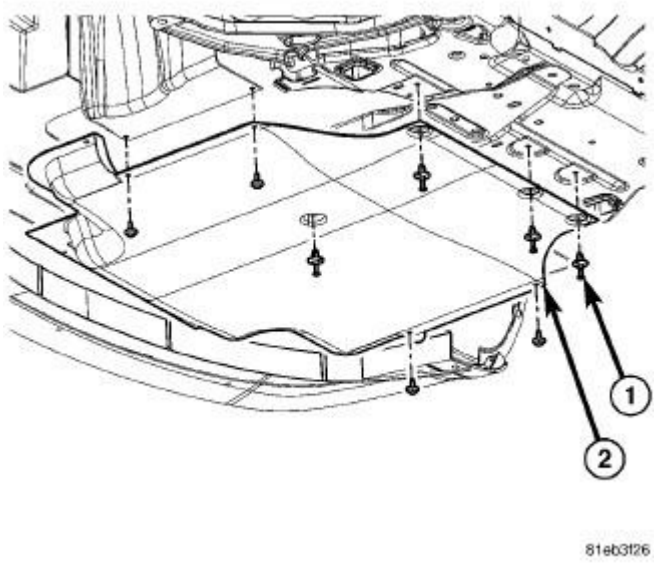

Fig. 273: Belly Pan
Courtesy of CHRYSLER LLC

11. Install the belly pan (2), if equipped.

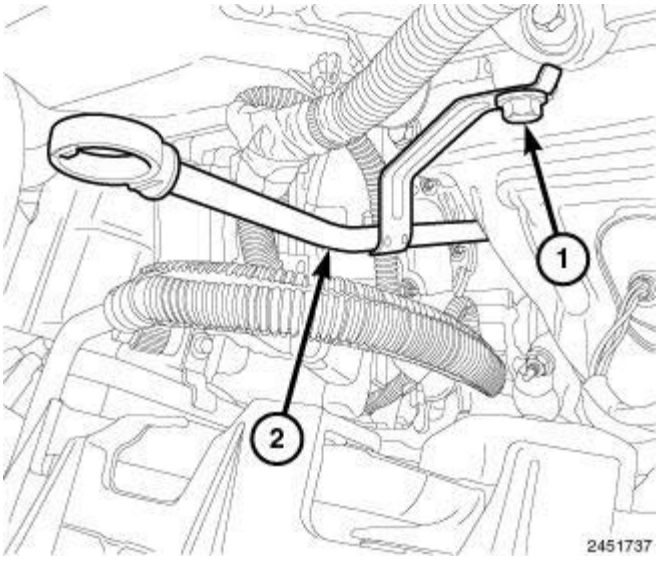

Fig. 274: Identifying Oil Dipstick Tube & Bolt
Courtesy of CHRYSLER LLC

12. Install the engine oil dipstick and tube (2). Tighten bolt to 20 N.m (15 ft. lbs.).
13. Fill the engine crankcase with the proper oil to the correct level. See **Engine/Lubrication/OIL - Standard Procedure**.
14. Connect the negative battery cable.

PUMP, ENGINE OIL

Removal

REMOVAL

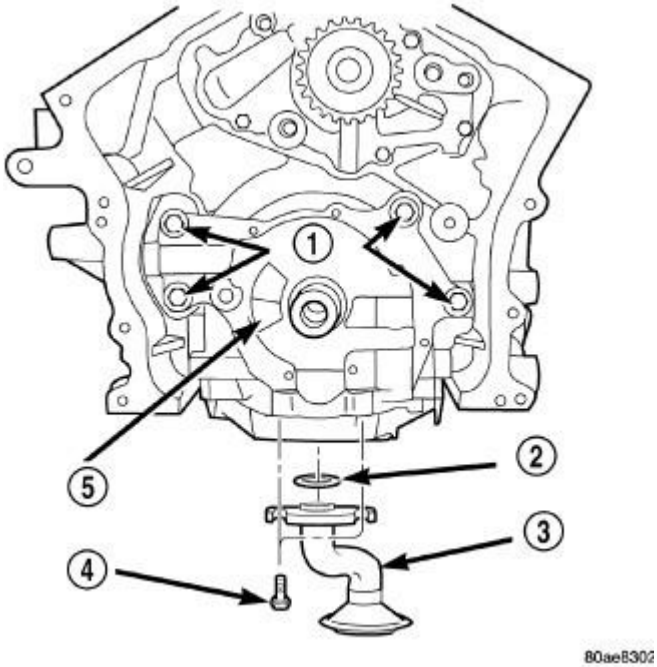

Fig. 275: Oil Pump & Pick-up Tube
Courtesy of CHRYSLER LLC

1 - BOLTS
2 - O-RING
3 - PICK-UP TUBE
4 - BOLT
5 - OIL PUMP

NOTE: The oil pump pressure relief valve can be serviced by removing the oil pan.

1. Remove crankshaft vibration damper. See **Engine/Engine Block/DAMPER, Vibration - Removal**.
2. Remove timing chain cover. See **Engine/Valve Timing/COVER(S), Engine Timing - Removal**.
3. Remove timing chain and sprockets. See **Engine/Valve Timing/CHAIN and SPROCKETS, Timing - Removal**.
4. Remove oil pan. See **Engine/Lubrication/PAN, Oil - Removal**.
5. Remove oil pick-up tube (3) and O-ring (2).
6. Ensure that crankshaft is positioned so that the oil pump drive flats are parallel to the oil pan mounting surface This position will properly locate oil pump upon installation.
7. Remove oil pump attaching bolts (1).
8. Remove oil pump (5).

Disassembly

DISASSEMBLY

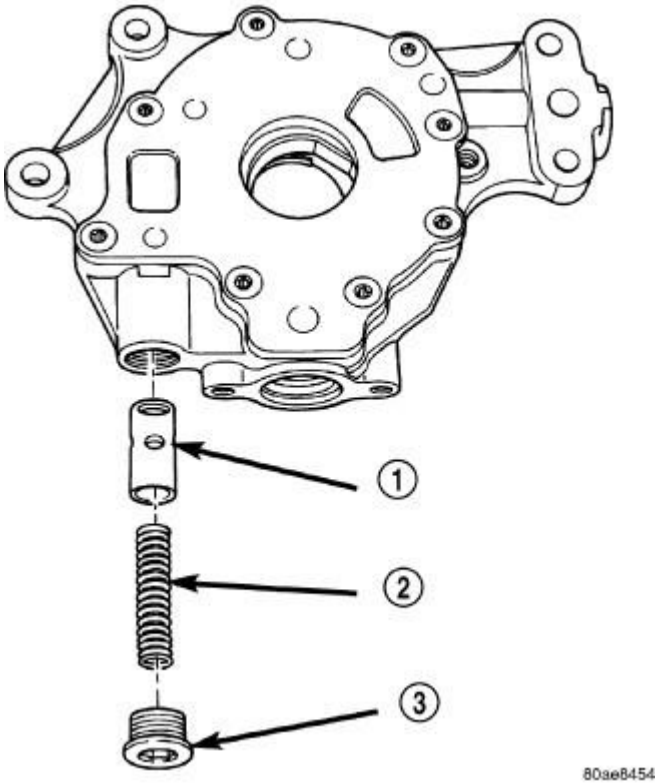

Fig. 276: Oil Pressure Relief Valve
Courtesy of CHRYSLER LLC

1 - RELIEF VALVE 2 - SPRING 3 - RETAINER CAP

1. Remove the pressure relief valve (1) by remove the threaded retaining cap from the oil pump housing.

CAUTION: Oil pump pressure relief valve must be installed as shown in illustration or engine damage may occur.

2. Remove spring and relief valve.

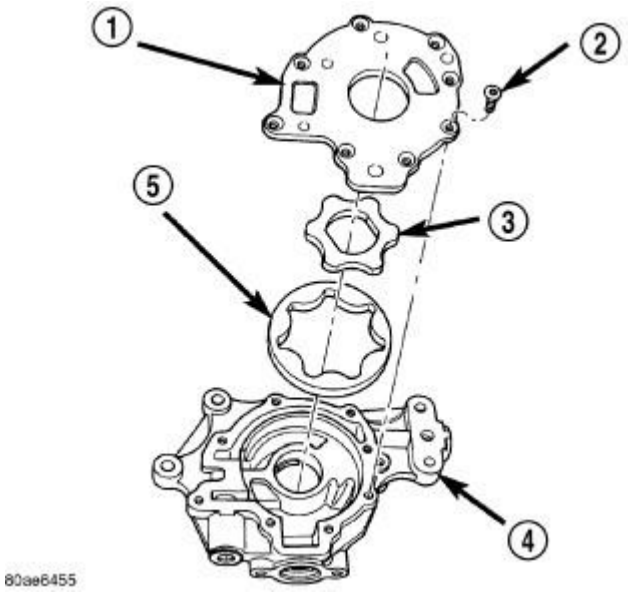

Fig. 277: Oil Pump
Courtesy of CHRYSLER LLC

1 - OIL PUMP COVER
2 - SCREWS (8)
3 - OIL PUMP INNER ROTOR
4 - OIL PUMP HOUSING
5 - OIL PUMP OUTER ROTOR

3. Remove oil pump cover screws (2) and lift off cover plate.
4. Remove pump rotors.
5. Wash all parts in a suitable solvent.
6. Inspect components carefully for damage or wear. See **Engine/Lubrication/PUMP, Engine Oil - Inspection**.

Cleaning

CLEANING

1. Clean all parts thoroughly in a suitable solvent.

Inspection

INSPECTION

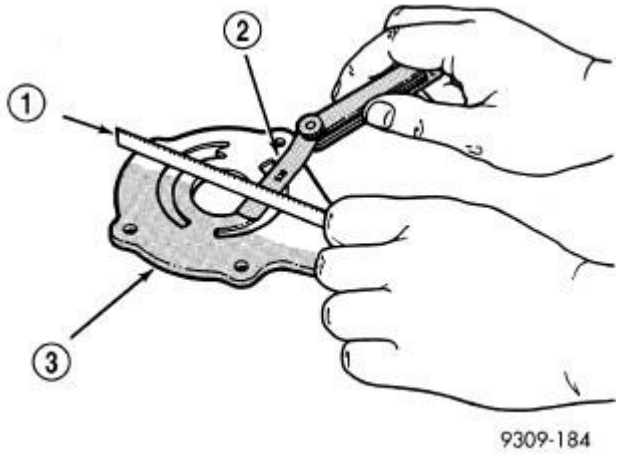

Fig. 278: CHECKING OIL PUMP COVER FLATNESS - TYPICAL
Courtesy of CHRYSLER LLC

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

1. Disassemble the oil pump. See **Engine/Lubrication/PUMP, Engine Oil - Disassembly**.
2. Clean all oil pump components. See **Engine/Lubrication/PUMP, Engine Oil - Cleaning**.
3. Inspect mating surface of the oil pump housing and cover. Replace oil pump if deeply scratched or grooved (minor surface scratches and polishing is normal).
4. Lay a straightedge across the pump cover surface (3). If a 0.025 mm (0.001 in.) feeler gauge can be inserted between cover and straight edge, cover should be replaced.

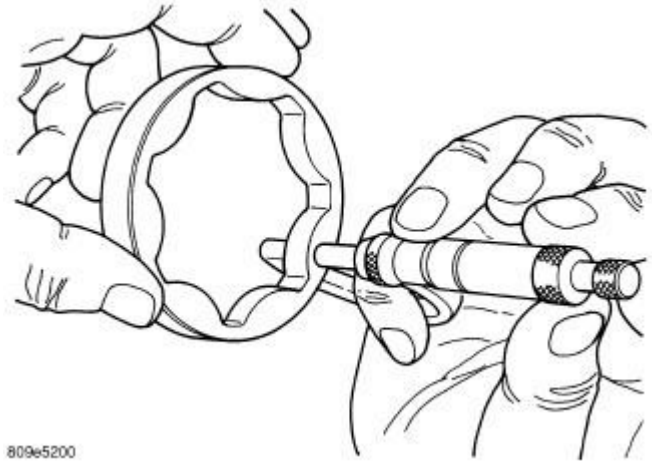

Fig. 279: MEASURING OUTER ROTOR THICKNESS
Courtesy of CHRYSLER LLC

5. Measure thickness and diameter of outer rotor. If outer rotor thickness measures 9.474 mm (0.373 in.) or

less, or if the diameter is 89.174 mm (3.5108 in.) or less, replace outer rotor.

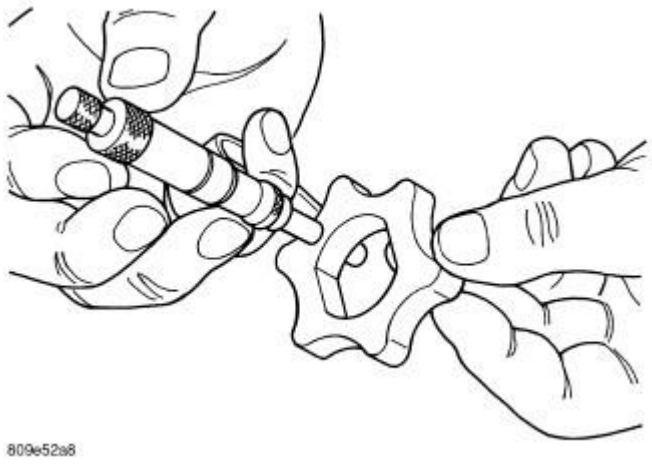

Fig. 280: MEASURING INNER ROTOR THICKNESS
Courtesy of CHRYSLER LLC

6. If inner rotor measures 9.474 mm (0.373 in.) or less replace inner rotor.

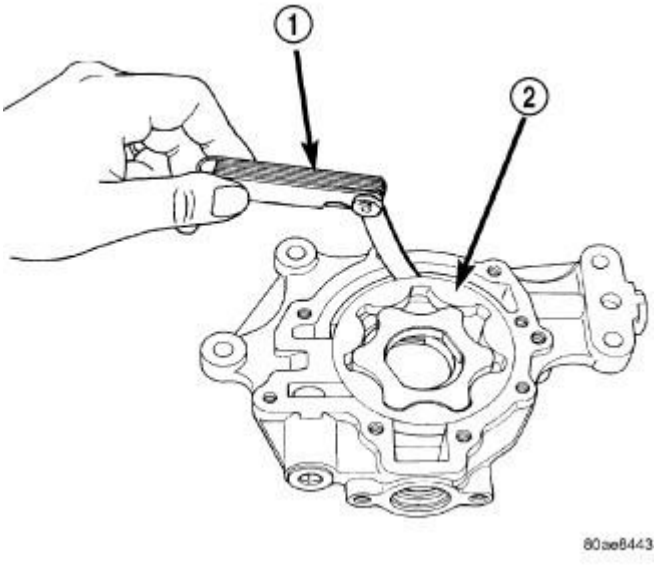

Fig. 281: MEASURING OUTER ROTOR CLEARANCE IN HOUSING
Courtesy of CHRYSLER LLC

1 - FEELER GAUGE
2 - OUTER ROTOR

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

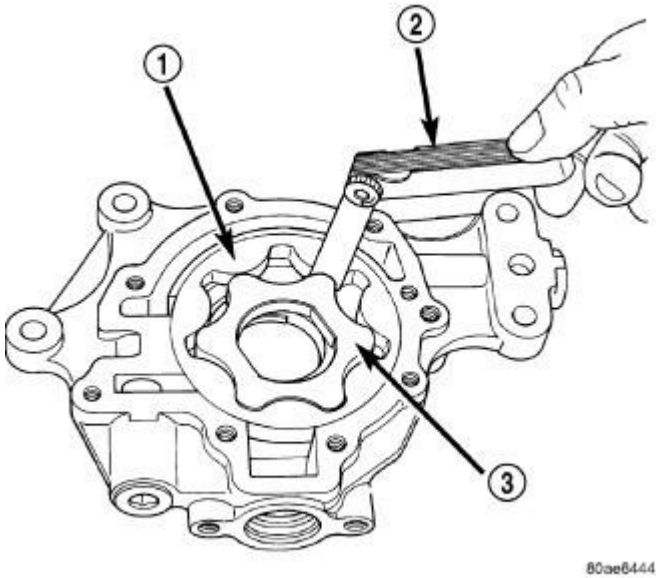

Fig. 282: MEASURING CLEARANCE BETWEEN ROTORS
Courtesy of CHRYSLER LLC

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

8. Install inner rotor into body. If clearance between inner and outer rotors is 0.20 mm (0.008 in.) or more, replace both rotors.

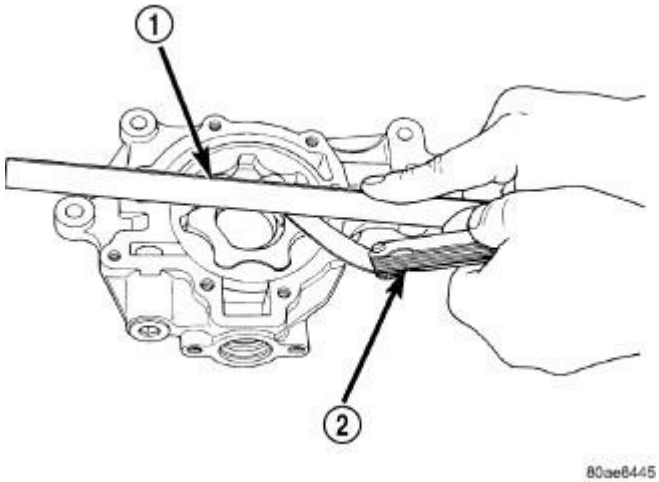

Fig. 283: MEASURING CLEARANCE OVER ROTORS
Courtesy of CHRYSLER LLC

1 - STRAIGHT EDGE
2 - FEELER GAUGE

9. 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 **ONLY** if rotors are in specification.
10. 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.
11. The relief valve spring has a free length of approximately 49.5 mm (1.95 in.) it should test between 23 - 25 pounds when compressed to 34 mm (1.34 in.). Replace spring that fails to meet specifications.
12. Assemble oil pump.

Assembly

ASSEMBLY

1. Assemble pump using new parts as required.
2. Tighten cover screws to 12 N.m (105 in. lbs.).
3. Tighten oil pressure relief valve retaining cap to 12 N.m (105 in. lbs.).
4. Prime oil pump before installation by filling rotor cavity with engine oil.

Installation

INSTALLATION

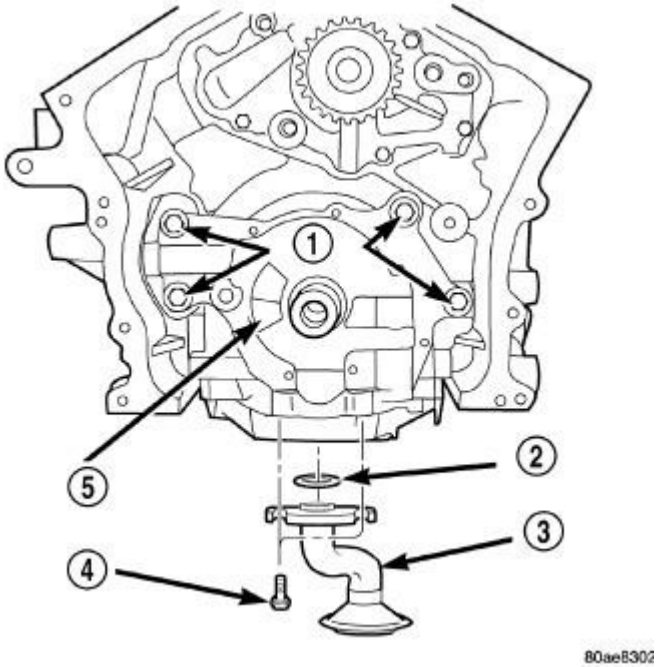

Fig. 284: Oil Pump & Pick-up Tube
Courtesy of CHRYSLER LLC

1 - BOLTS

2 - O-RING
3 - PICK-UP TUBE
4 - BOLT
5 - OIL PUMP

CAUTION: The crankshaft oil pump drive flats must be parallel to the oil pan mounting surface before installing the oil pump. This position will properly locate the oil pump. If not properly located, severe damage to the oil pump can occur.

1. Prime the oil pump before installation by filling rotor cavity with engine oil.
2. If the crankshaft has been rotated, it must be repositioned so that the oil pump drive flats are parallel to the oil pan mounting surface prior to oil pump installation.
3. Install oil pump (5) carefully over crankshaft and into position.
4. Install oil pump attaching bolts (1). Tighten bolts to 28 N.m (250 in. lbs.).
5. Install oil pick-up tube (3) with new O-ring (2). Lubricate O-ring (2) with clean engine oil before installation. Tighten attaching bolts to 28 N.m (250 in. lbs.).
6. Install oil pan. See **Engine/Lubrication/PAN, Oil - Installation**.
7. Install timing chain and sprockets. See **Engine/Valve Timing/CHAIN and SPROCKETS, Timing - Installation**.
8. Install timing chain cover. See **Engine/Valve Timing/COVER(S), Engine Timing - Installation**.
9. Install crankshaft vibration damper. See **Engine/Engine Block/DAMPER, Vibration - Installation**.
10. Fill crankcase with engine oil to correct level.

SWITCH, OIL PRESSURE

Description

DESCRIPTION

The engine oil pressure switch is located on the right side of the engine block. The switch screws into the engine main oil gallery. The normally closed switch provides an input through a single wire to the low pressure indicator light on the instrument cluster.

Removal

REMOVAL

1. Raise vehicle on hoist.
2. Remove heat shield that covers oil pressure switch.
3. Disconnect oil pressure switch electrical connector.
4. Position an oil collecting container under switch location.
5. Remove switch by unscrewing from the engine block.

Installation

INSTALLATION

1. Apply Mopar® Thread Sealant to the switch threads.
2. Install oil pressure switch.
3. Connect electrical connector.
4. Install oil pressure switch heat shield.
5. Lower vehicle.
6. Start engine and check for leaks.
7. Check engine oil level and adjust as necessary.

VALVE, OIL PRESSURE RELIEF

Removal

REMOVAL

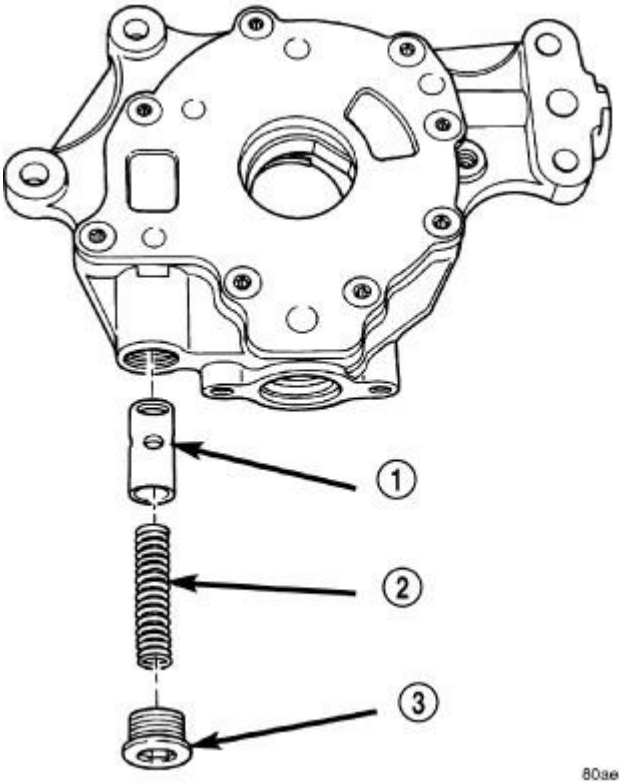

Fig. 285: Oil Pressure Relief Valve
Courtesy of CHRYSLER LLC

1 - RELIEF VALVE 2 - SPRING

3 - RETAINER CAP

1. Remove the oil pan. See **Engine/Lubrication/PAN, Oil - Removal**.
2. Remove the pressure relief valve (1) by remove the threaded retaining cap from the oil pump housing.

CAUTION: Oil pump pressure relief valve must be installed as shown in illustration or engine damage may occur.

3. Remove spring and relief valve.

Installation

INSTALLATION

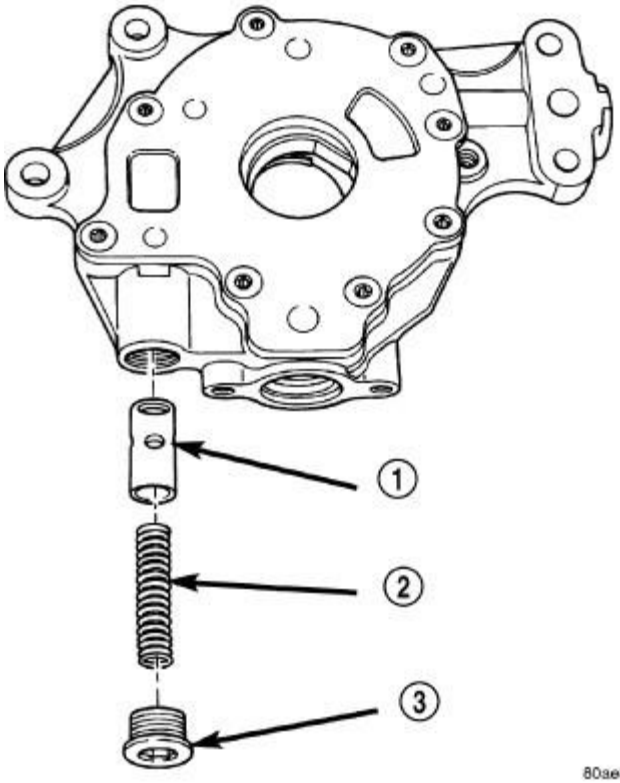

Fig. 286: Oil Pressure Relief Valve
Courtesy of CHRYSLER LLC

1 - RELIEF VALVE 2 - SPRING 3 - RETAINER CAP

1. Lubricate relief valve with oil.

CAUTION: The pressure relief valve must be installed as shown in illustration or engine damage may occur.

2. Install relief valve (1) , spring and retainer cap. Tighten cap to 12 N.m (105 in. lbs.).
3. Install the oil pan. See **Engine/Lubrication/PAN, Oil - Installation**.

MANIFOLDS

MANIFOLD, EXHAUST, CROSSOVER

Removal

REMOVAL

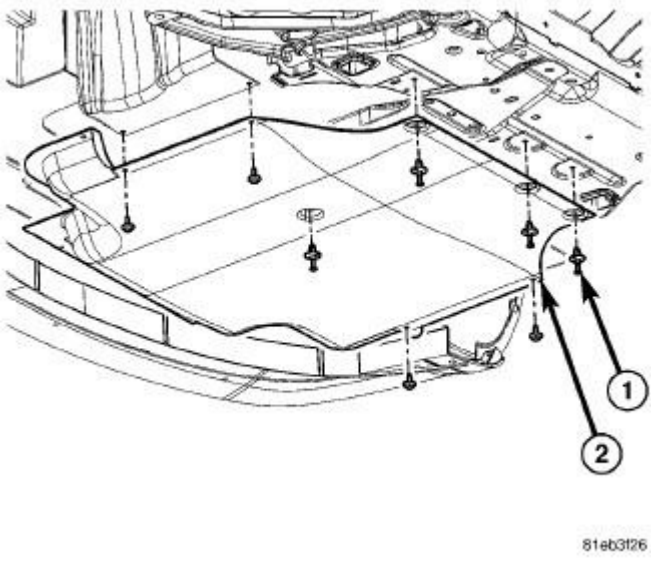

Fig. 287: Belly Pan
Courtesy of CHRYSLER LLC

1 - belly pan fasteners 2 - belly pan

1. Remove the belly pan (2).

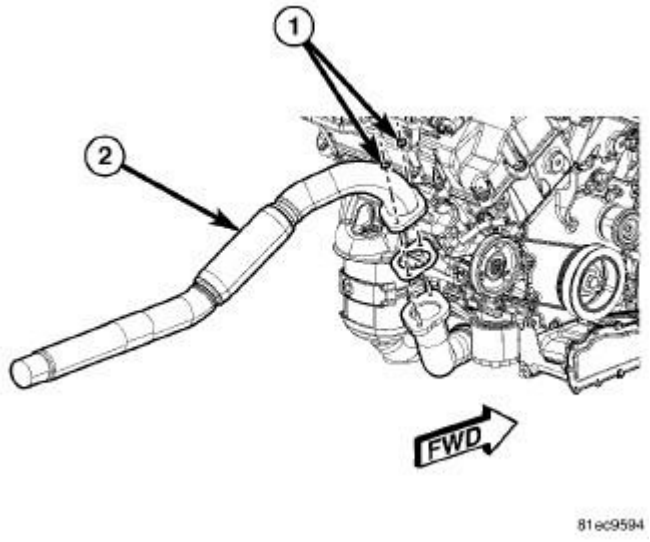

Fig. 288: Exhaust Extension Pipe
Courtesy of CHRYSLER LLC

2. Remove the fasteners (1), and remove the exhaust extension pipe (2) from the cross under pipe.

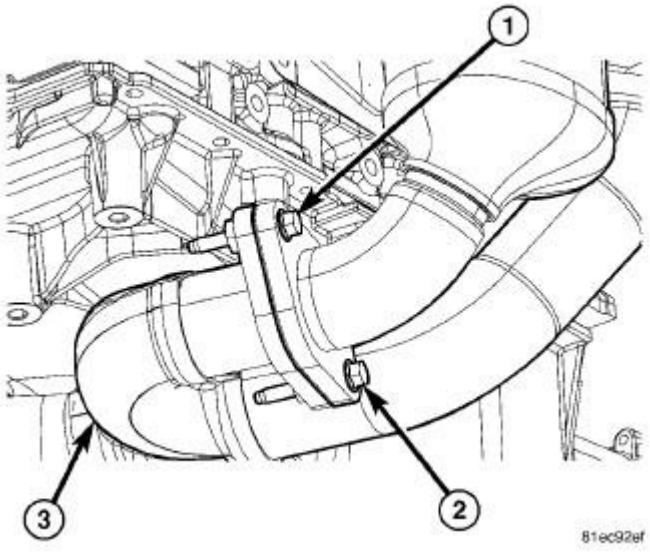

Fig. 289: Exhaust Cross-Under Pipe
Courtesy of CHRYSLER LLC

3. Remove the rear maniverter-to-cross under pipe fasteners (1) and (2).

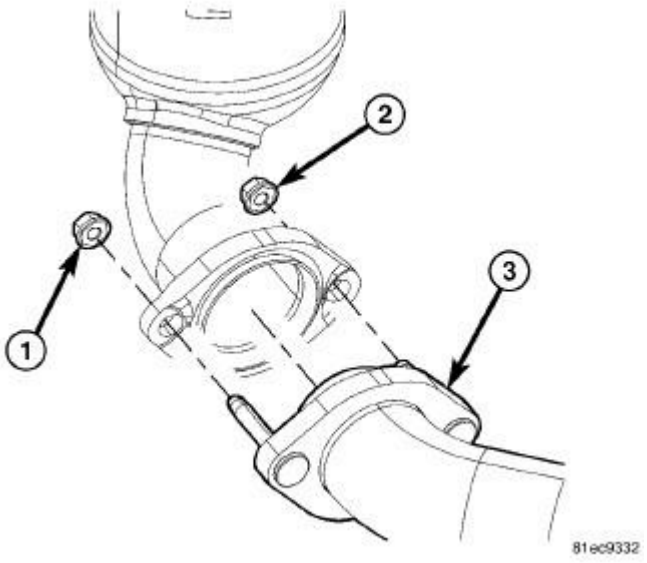

Fig. 290: Front Maniverter-To-Cross Under Fasteners
Courtesy of CHRYSLER LLC

4. Remove the front maniverter-to-cross under fasteners (1) and (2), and remove the cross under pipe (3).

Installation

INSTALLATION

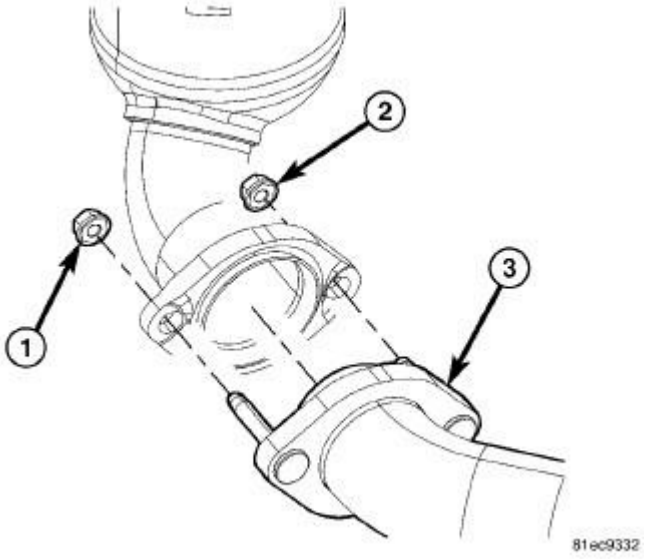

Fig. 291: Front Maniverter-To-Cross Under Fasteners
Courtesy of CHRYSLER LLC

1. Install the cross under pipe (3). and the front maniverter-to-cross under fasteners (1) and (2). Tighten to 27 Nm (20 ft. lb.).

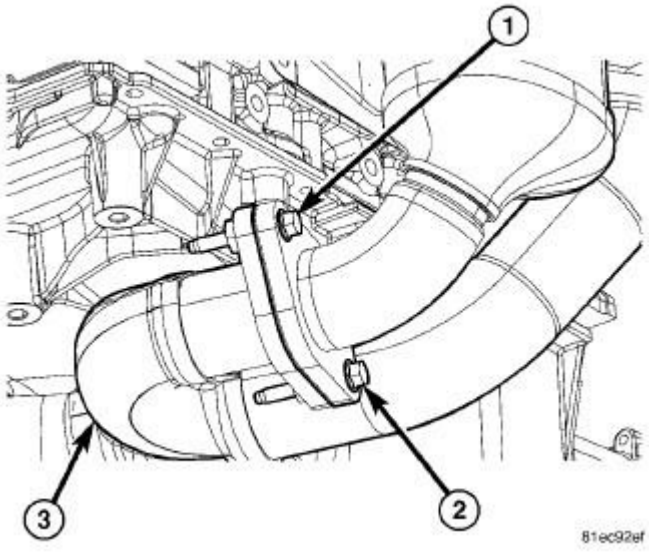

Fig. 292: Exhaust Cross-Under Pipe
Courtesy of CHRYSLER LLC

2. Install the rear maniverter-to-cross under pipe fasteners (1) and (2). Tighten to 29 Nm (21 ft. lb.).

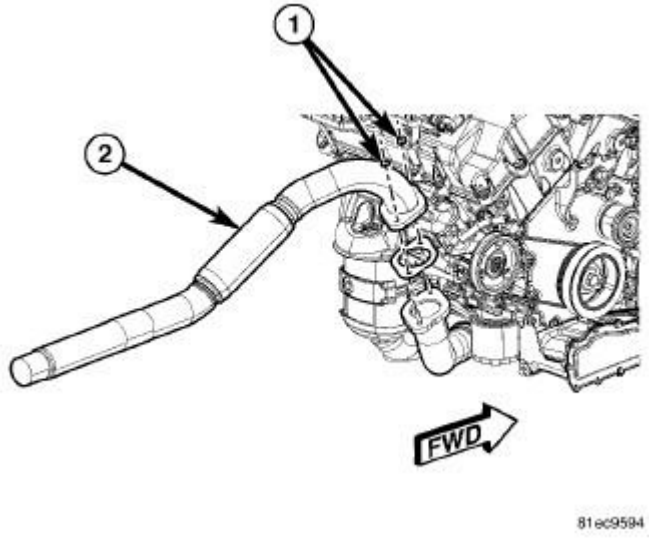

Fig. 293: Exhaust Extension Pipe
Courtesy of CHRYSLER LLC

3. Install the exhaust extension pipe (2) to the cross under pipe, and install the fasteners (1). Tighten to 27 Nm (20 ft. lb.)

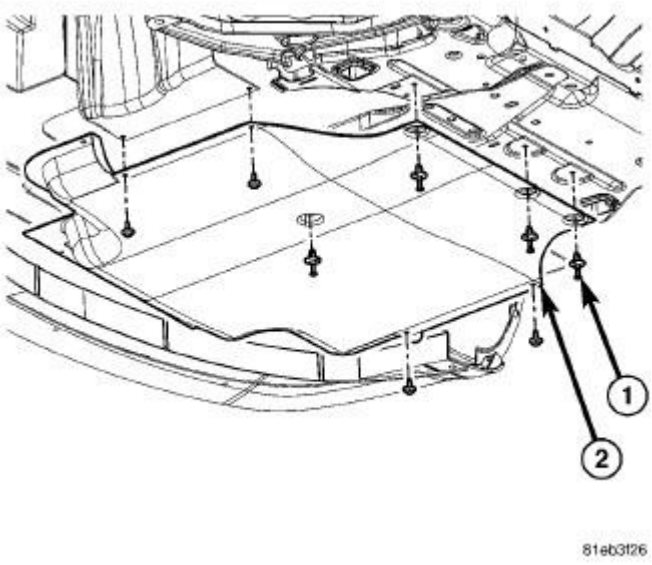

Fig. 294: Belly Pan
Courtesy of CHRYSLER LLC

1 - belly pan fasteners 2 - belly pan

4. Install the belly pan (2).

MANIFOLD, EXHAUST, FRONT

Removal

REMOVAL

1. Disconnect negative battery cable.
2. Remove the engine cover.

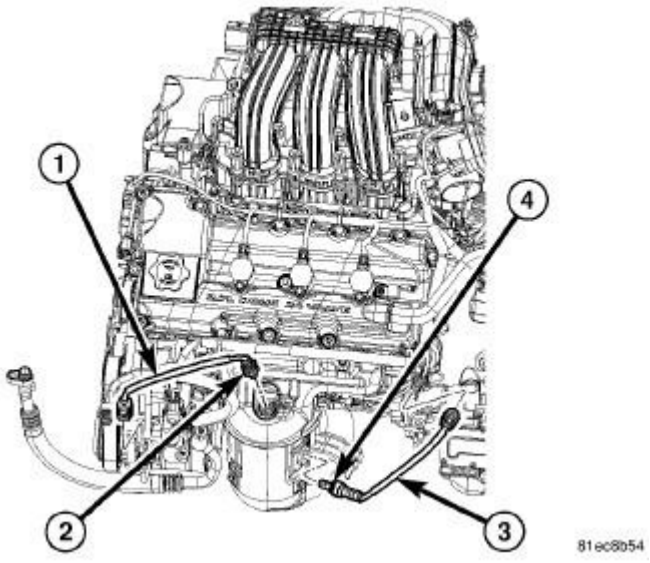

Fig. 295: Oxygen Sensors
Courtesy of CHRYSLER LLC

3. Disconnect and remove oxygen sensors (2) and (4).

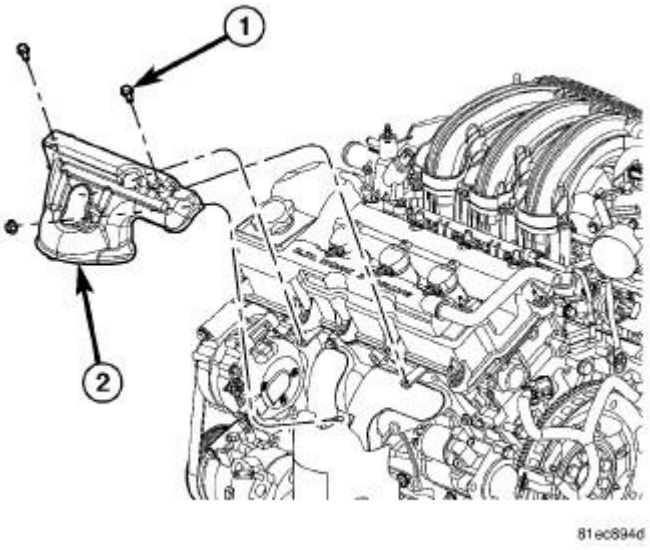

Fig. 296: Upper Maniverter Heat Shield
Courtesy of CHRYSLER LLC

4. Remove the upper maniverter heat shield (2).

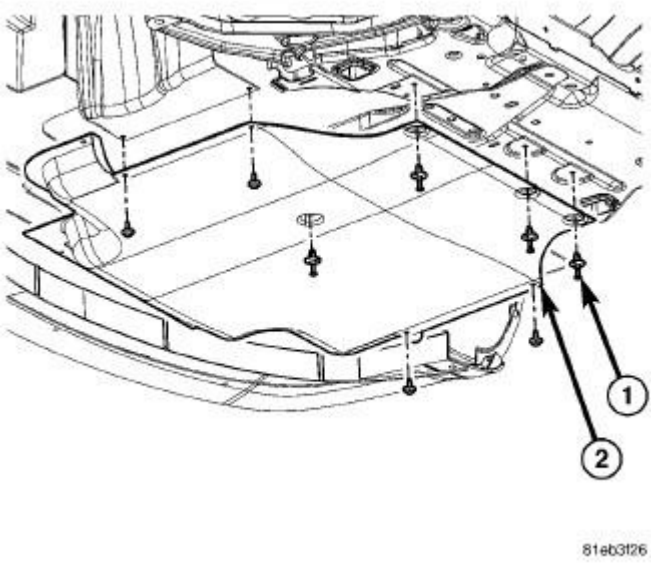

Fig. 297: Belly Pan
Courtesy of CHRYSLER LLC

1 - belly pan fasteners 2 - belly pan

5. Remove the belly pan (2).

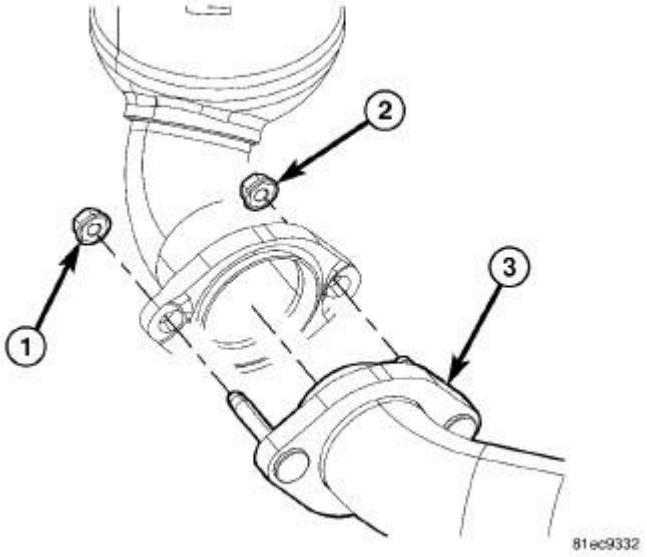

Fig. 298: Front Maniverter-To-Cross Under Fasteners
Courtesy of CHRYSLER LLC

6. Remove the front maniverter-to-crossunder fasteners (1) and (2).

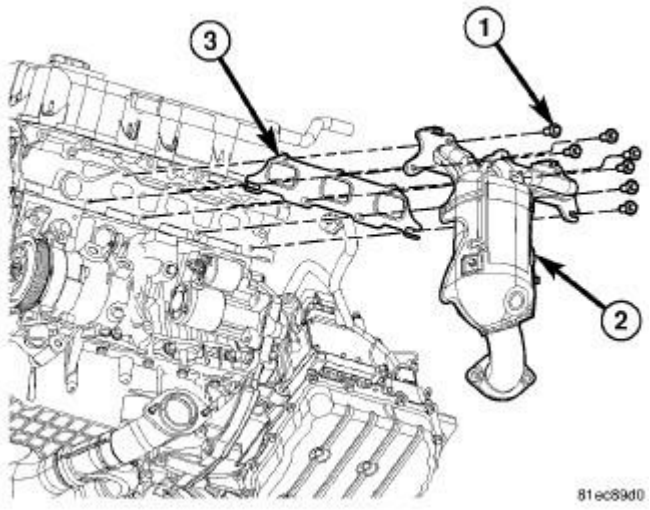

Fig. 299: Front Exhaust Maniverter Attaching Bolts
Courtesy of CHRYSLER LLC

7. Remove front exhaust maniverter attaching bolts (1) and remove the front maniverter (2).

Inspection

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

INSTALLATION

1. Clean gasket mounting surfaces. See **Engine - Standard Procedure**.

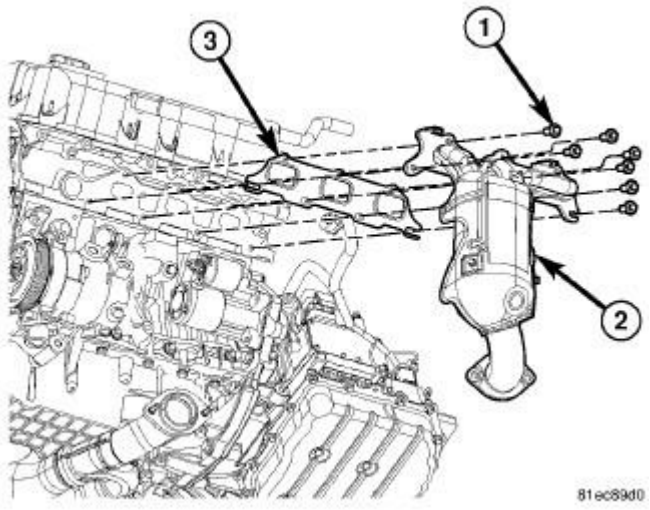

Fig. 300: Front Exhaust Maniverter Attaching Bolts
Courtesy of CHRYSLER LLC

2. Install a new gasket (3), the front maniverter (2), and the front exhaust maniverter attaching bolts (1). Tighten bolts to 23 Nm (17 ft. lb).

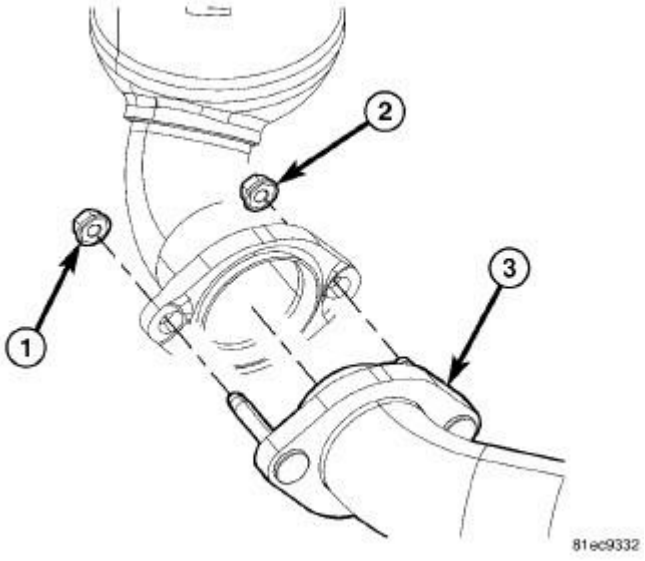

Fig. 301: Front Maniverter-To-Cross Under Fasteners
Courtesy of CHRYSLER LLC

3. Install the front maniverter-to-crossunder fasteners (1) and (2). Tighten to 27 Nm (20 ft. lb.).

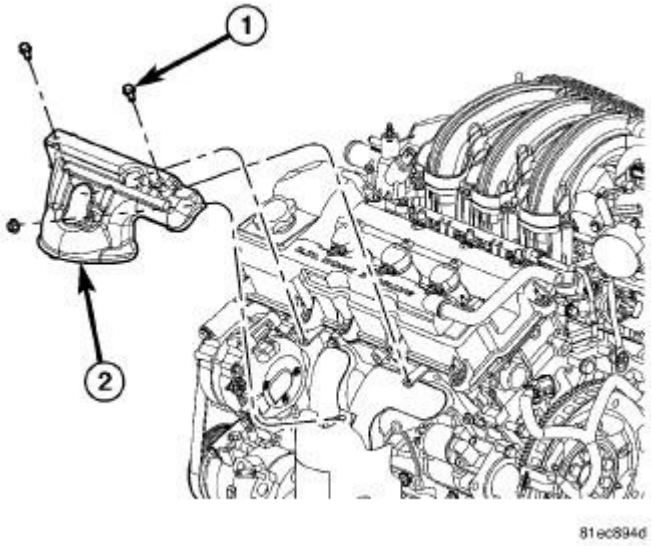

Fig. 302: Upper Maniverter Heat Shield
Courtesy of CHRYSLER LLC

4. Install the upper maniverter heat shield (3) and the heat shield fasteners (1) and (2). Tighten fasteners to 12 Nm (106 in. lb.).

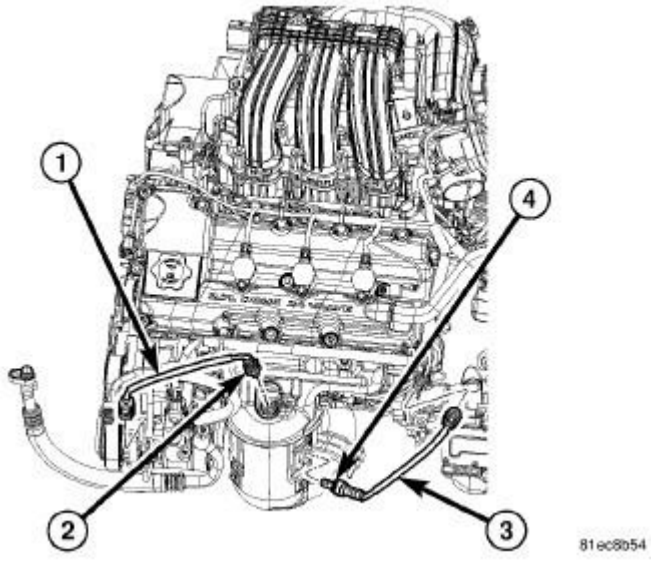

Fig. 303: Oxygen Sensors
Courtesy of CHRYSLER LLC

5. Install the oxygen sensors (2) and (4). 41 Nm (30 ft. lbs.)

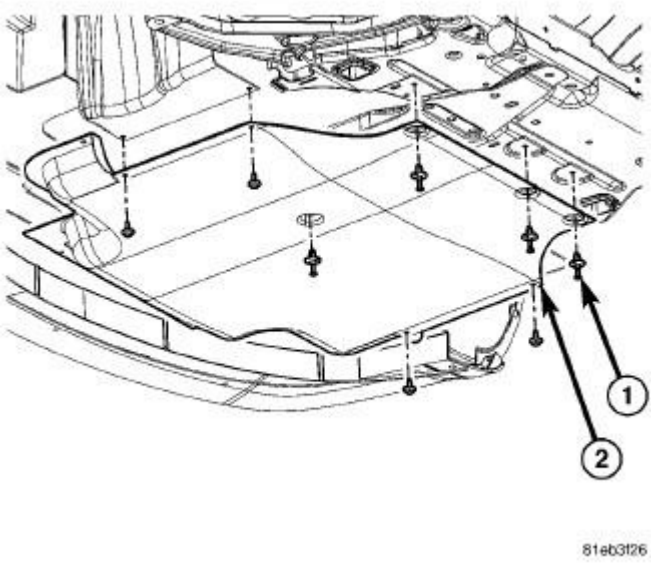

Fig. 304: Belly Pan
Courtesy of CHRYSLER LLC

1 - belly pan fasteners 2 - belly pan

6. Install the belly pan (2).
7. Install the negative battery cable.
8. Install the engine cover.

MANIFOLD, EXHAUST, REAR

Removal

REMOVAL

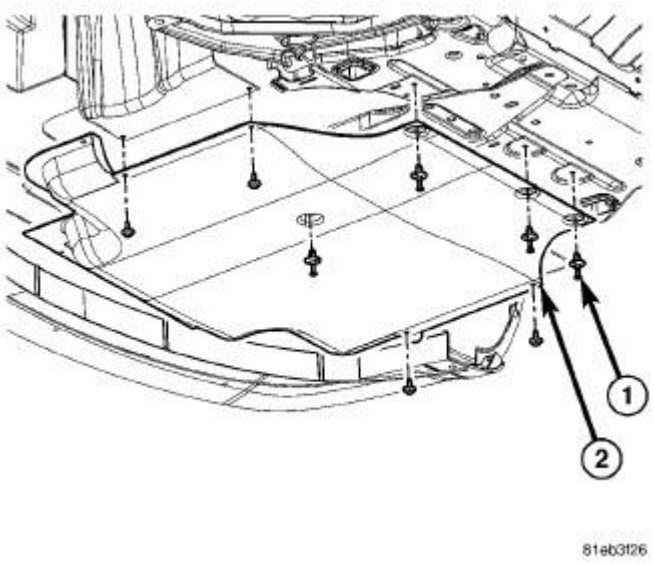

Fig. 305: Belly Pan
Courtesy of CHRYSLER LLC

1 - belly pan fasteners 2 - belly pan

1. Remove the belly pan (2).

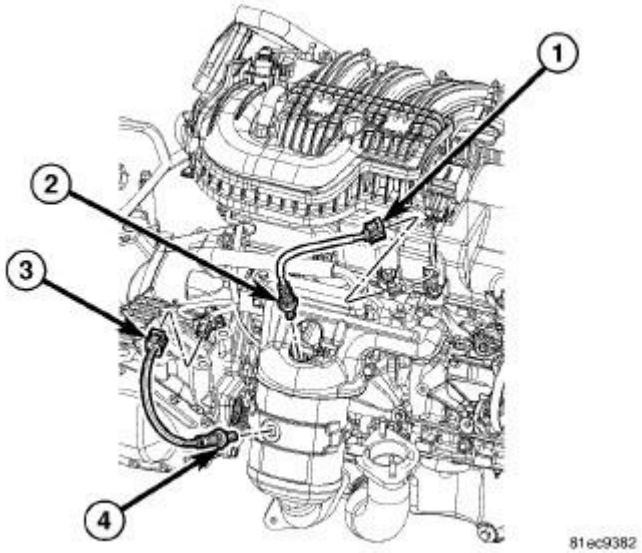

Fig. 306: Oxygen Sensors
Courtesy of CHRYSLER LLC

2. Remove the oxygen sensors (2) and (4).

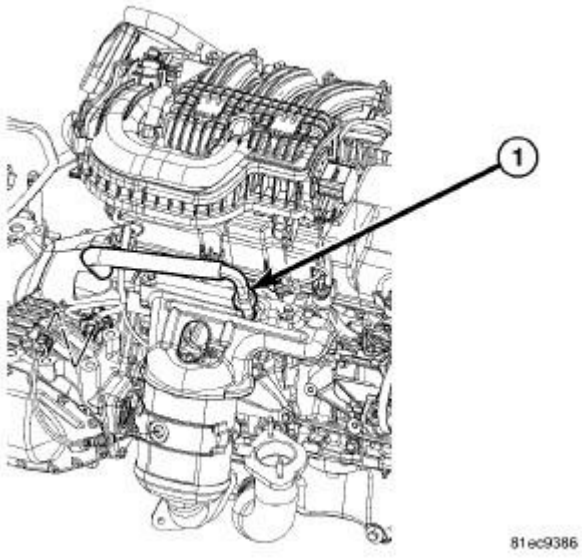

Fig. 307: Exhaust Gas Recirculation Tube
Courtesy of CHRYSLER LLC

3. Remove the EGR tube (1).

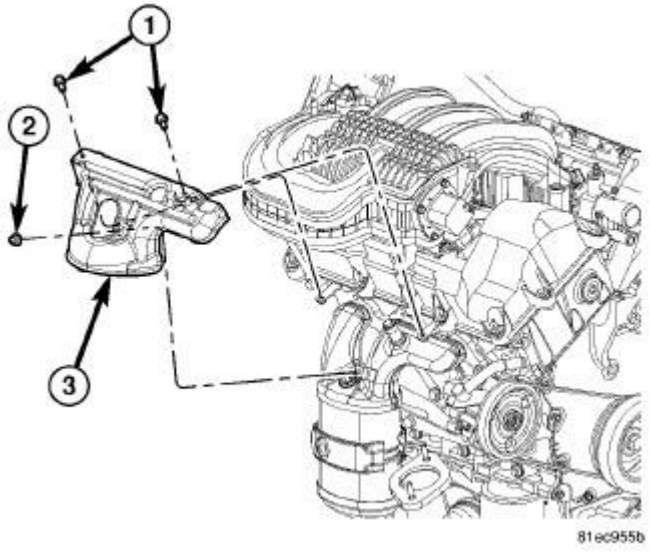

Fig. 308: Rear Maniverter Heat Shield
Courtesy of CHRYSLER LLC

4. Remove the rear maniverter heat shield (3).

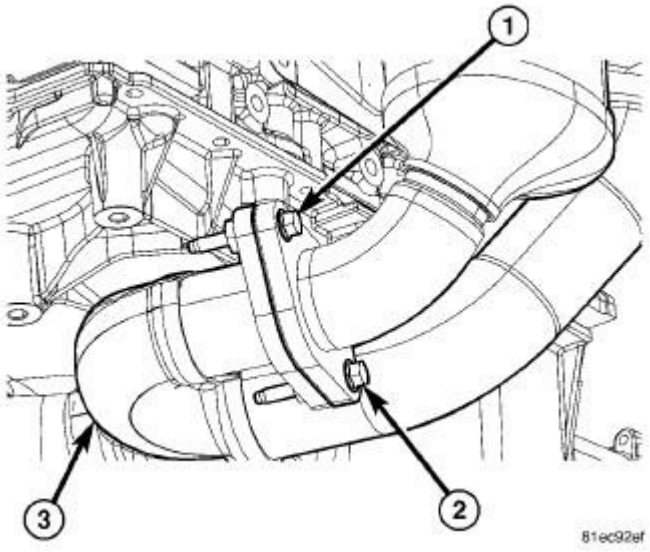

Fig. 309: Exhaust Cross-Under Pipe
Courtesy of CHRYSLER LLC

5. Remove the rear maniverter-to-crossunder fasteners (1) and (2).

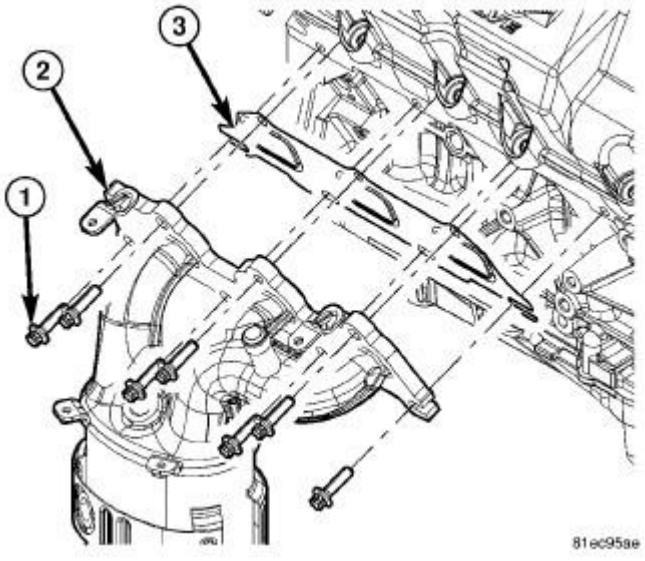

Fig. 310: Rear Maniverter Fasteners
Courtesy of CHRYSLER LLC

6. Remove the rear maniverter fasteners (1), and the rear maniverter (2).

Inspection

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

INSTALLATION

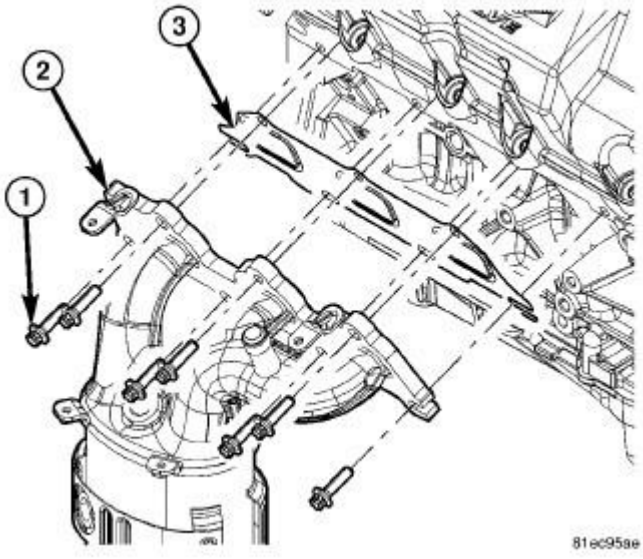

Fig. 311: Rear Maniverter Fasteners
Courtesy of CHRYSLER LLC

1. Install the rear maniverter gasket (3), the rear maniverter (2), and the rear maniverter fasteners (1). Tighten the rear maniverter fasteners to 23 Nm (17 ft. lb)

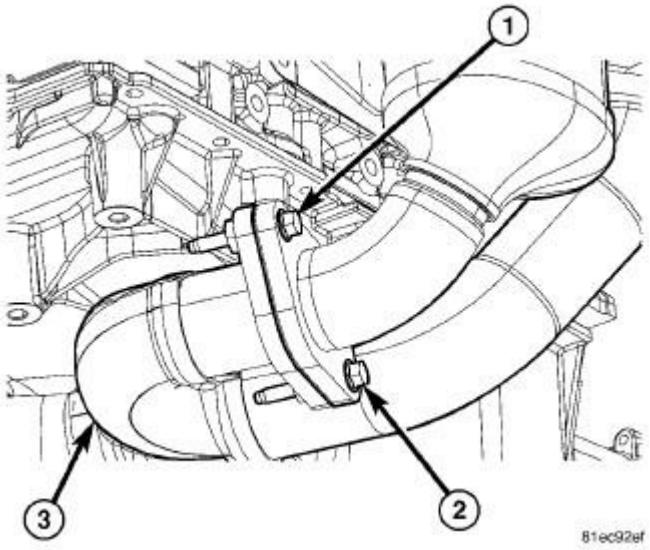

Fig. 312: Exhaust Cross-Under Pipe
Courtesy of CHRYSLER LLC

2. Install the rear maniverter-to-crossunder fasteners (1) and (2). Tighten to 29 Nm (21 ft. lb.).

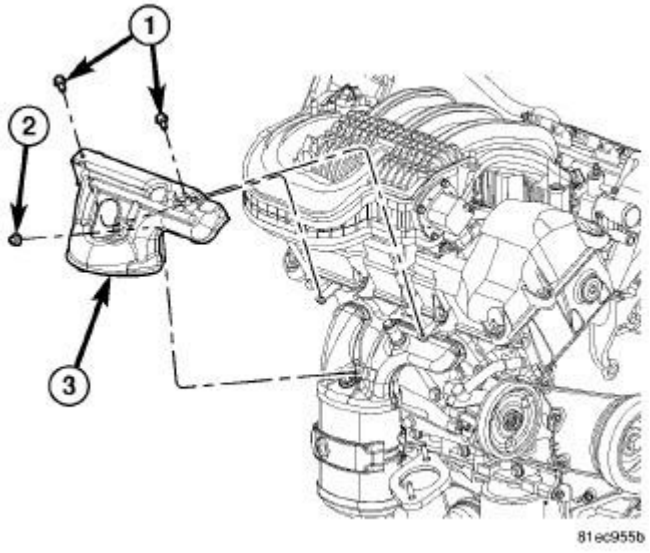

Fig. 313: Rear Maniverter Heat Shield
Courtesy of CHRYSLER LLC

3. Install the rear maniverter heat shield (3). Tighten fasteners to 12 Nm (106 in. lb.).

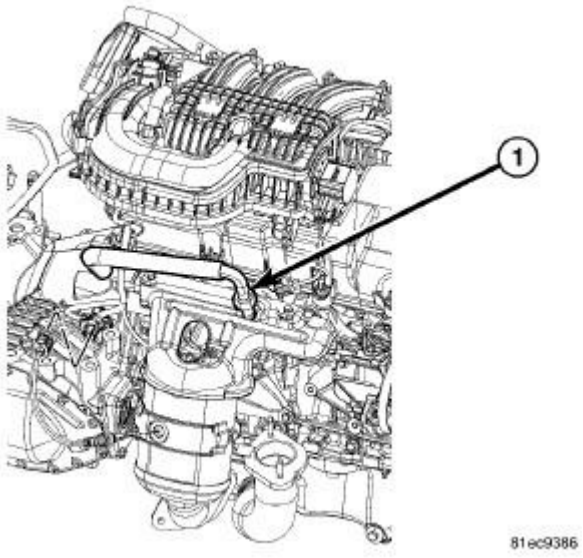

Fig. 314: Exhaust Gas Recirculation Tube
Courtesy of CHRYSLER LLC

4. Install the EGR tube (1). Refer to **Emissions Control/Exhaust Gas Recirculation/TUBE, Exhaust Gas Recirculation (EGR) - Installation** .

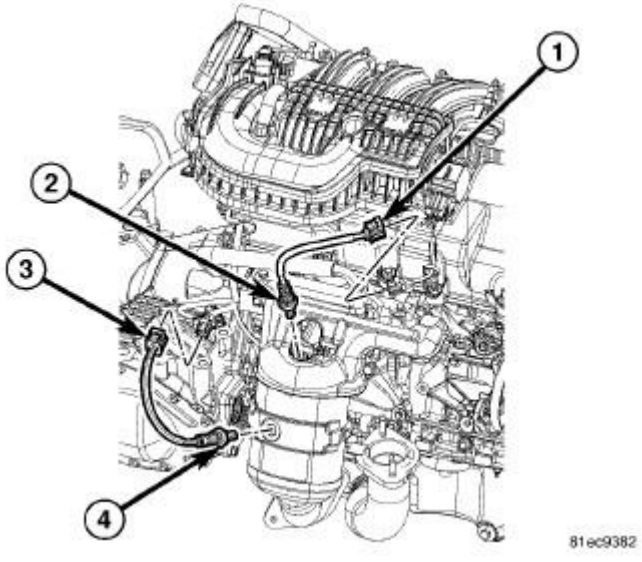

Fig. 315: Oxygen Sensors
Courtesy of CHRYSLER LLC

5. Install the oxygen sensors (2) and (4). Tighten to 41 Nm (30 ft. lbs.).

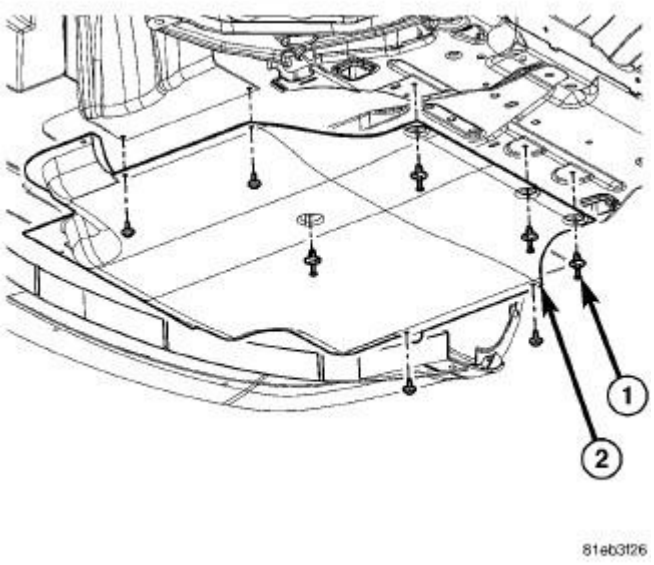

Fig. 316: Belly Pan
Courtesy of CHRYSLER LLC

1 - Belly Pan Fasteners 2 - Belly Pan

6. Install the belly pan (2).

MANIFOLD, INTAKE

Diagnosis and Testing

INTAKE MANIFOLD LEAKS

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

WARNING: Use extreme caution when the engine is operating. Do not stand in a direct line with the fan. Do not put your hands near the pulleys, belts or the fan. Do not wear loose clothing.

1. Start the engine.
2. Spray a small stream of water (Spray Bottle) at the suspected leak area.
3. If engine RPM'S change, the area of the suspected leak has been found.
4. Repair as required.

Standard Procedure

INTAKE MANIFOLD VACUUM PORT REPAIR

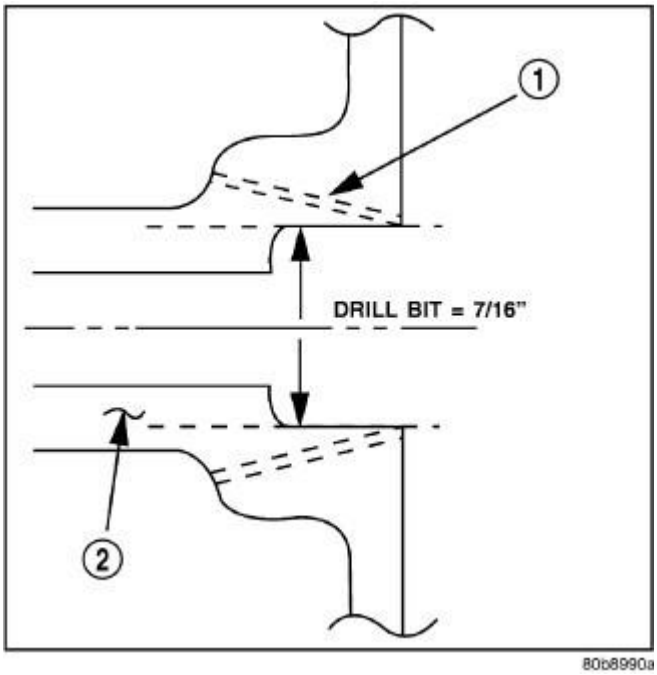

Fig. 317: MANIFOLD PORT (NIPPLE) REPAIR
Courtesy of CHRYSLER LLC

1 - 1/4" - 18 NPT PIPE TAP 2 - NIPPLE (PORT)

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

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

PARTS REQUIRED	TOOLS REQUIRED
Brass Nipple - 3/8" O.D. x 1/4" pipe thread (Speed Control Port)	Pipe Tap - 1/4" - 18 NPT
Brass Nibble - 1/2" O.D. x 1/4" pipe thread (Brake Booster Port)	Drill Bit - 7/16"
	File/Sand Paper

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

1. File or sand the remaining port back until a flat surface is obtained (plane normal to nipple (port) axis).
2. Drill out the nipple (port) base using a 7/16" drill bit.
3. Using a 1/4"-18 NPT pipe tap, cut internal threads. Use caution to start tap in a axis same as original nipple.
4. Apply Mopar® Thread Sealant to threads of repair nipple(s).

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

Removal

UPPER

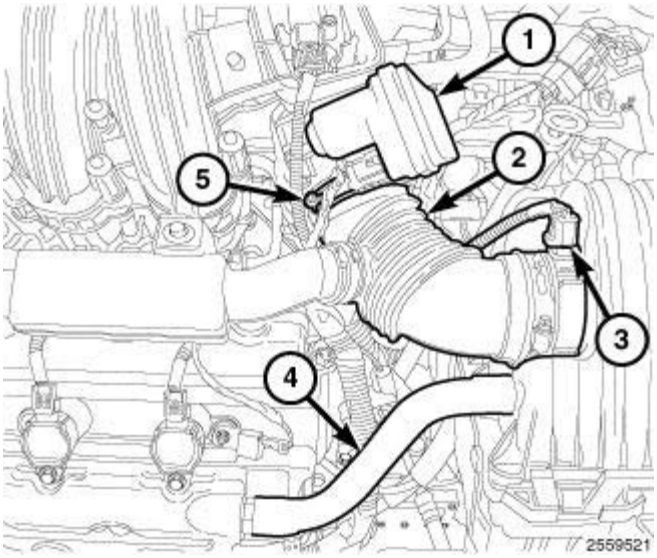

Fig. 318: Identifying Air Makeup Hose, Throttle Body & Air Inlet Hose
Courtesy of CHRYSLER LLC

1. Disconnect and isolate the negative battery cable.
2. Remove the throttle body air inlet hose (2) and air cleaner housing assembly. See **Engine/Air Intake System/BODY, Air Cleaner - Removal**.

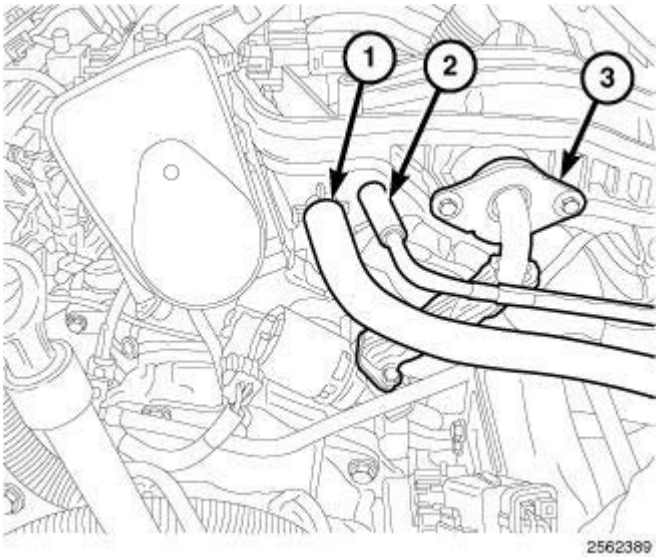

Fig. 319: Locating Upper Exhaust Gas Recirculation Tube, Brake Booster Hose & Vapor Purge Hose
Courtesy of CHRYSLER LLC

3. Remove the upper EGR tube (3). Refer to **Emissions Control/Exhaust Gas Recirculation/TUBE, Exhaust Gas Recirculation (EGR) - Removal** .
4. Disconnect the brake booster hose (1) and the vapor purge hose (2) from the upper intake manifold.

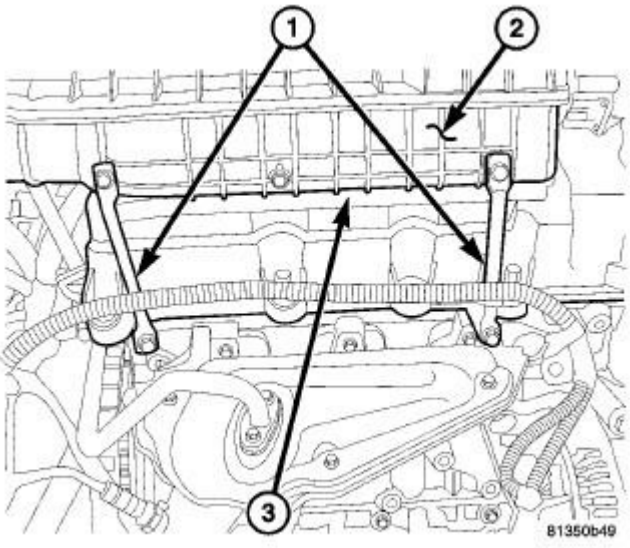

Fig. 320: Intake Brackets
Courtesy of CHRYSLER LLC

5. Remove the two intake manifold support brackets (1).

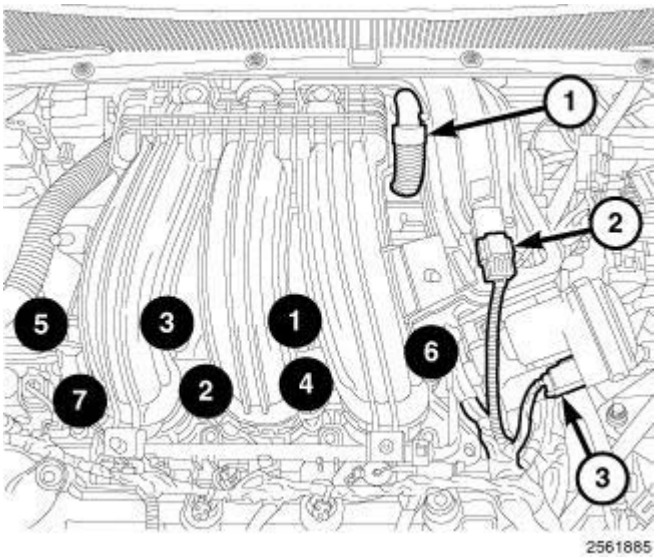

Fig. 321: Locating Manifold Bolts, Manifold Absolute Pressure Sensor & Electronic Throttle Control Electrical Connectors
Courtesy of CHRYSLER LLC

6. Disconnect the electrical connectors from the Manifold Absolute Pressure (MAP) sensor (2) and the

Electronic Throttle Control (ETC) (3).

7. Disconnect the Positive Crankcase Ventilation (PCV) hose (1).
8. Remove the seven manifold attaching bolts in reverse of the tightening sequence shown in illustration.
9. Remove the upper intake manifold.

LOWER

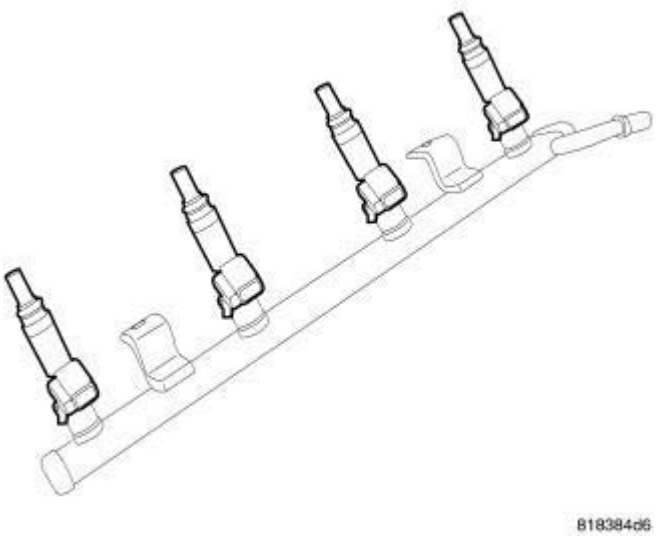

Fig. 322: Fuel Injector Location - Typical
Courtesy of CHRYSLER LLC

1. Release fuel system pressure.
2. Remove upper intake manifold. See **Engine/Manifolds/MANIFOLD, Intake - Removal**.
3. Disconnect electrical connectors from the fuel injectors.
4. Remove fuel supply hose from fuel rail
5. Remove screw attaching fuel rail support bracket to the throttle body support bracket.
6. Remove bolts attaching fuel rail.

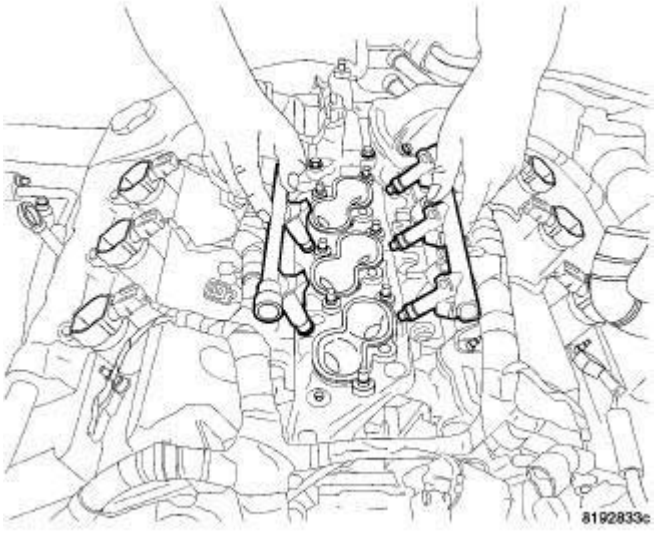

Fig. 323: FUEL RAIL REMOVE/INSTALL
Courtesy of CHRYSLER LLC

7. Remove fuel rail and injectors as an assembly.

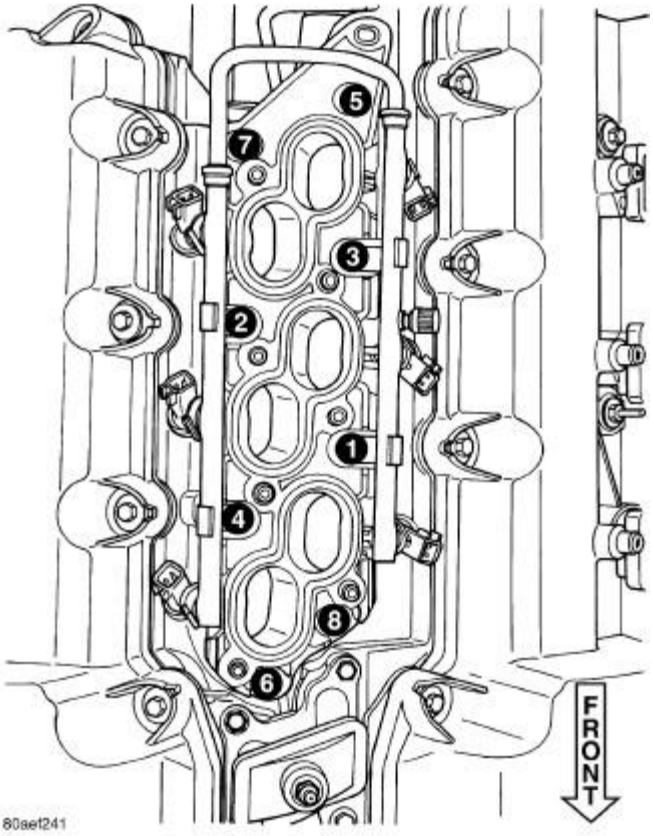

Fig. 324: Lower Intake Manifold Tightening Sequence
Courtesy of CHRYSLER LLC

8. Remove manifold attaching bolts.
9. Remove lower manifold.
10. Inspect manifold. See **Engine/Manifolds/MANIFOLD, Intake - Inspection**.

Inspection

INTAKE MANIFOLD UPPER

Check manifold for:

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

If the manifold exhibits any damaged or warped conditions, replace the manifold. Clean EGR ports as necessary.

If a vacuum port is damaged, a repair procedure can be performed. See **Engine/Manifolds/MANIFOLD, Intake - Standard Procedure**.

INTAKE MANIFOLD LOWER

Check manifold for:

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

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

Installation

UPPER

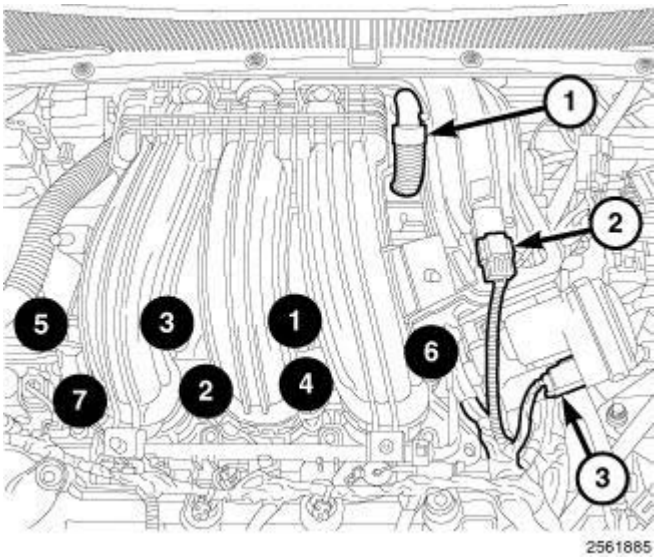

Fig. 325: Locating Manifold Bolts, Manifold Absolute Pressure Sensor & Electronic Throttle Control Electrical Connectors
Courtesy of CHRYSLER LLC

1. Clean and inspect the gasket sealing surfaces. Gaskets can be reused if free of cuts or tears.

NOTE: Make sure the fuel injectors and wiring harnesses are positioned to not interfere with upper manifold installation.

2. Position the upper intake manifold onto the lower intake manifold.
3. Install the manifold attaching bolts and tighten in the sequence shown in illustration to 12 N.m (105 in. lbs.).
4. Connect the Positive Crankcase Ventilation (PCV) hose (1).
5. Connect the electrical connectors to the Manifold Absolute Pressure (MAP) sensor (2) and the Electronic Throttle Control (ETC) (3).

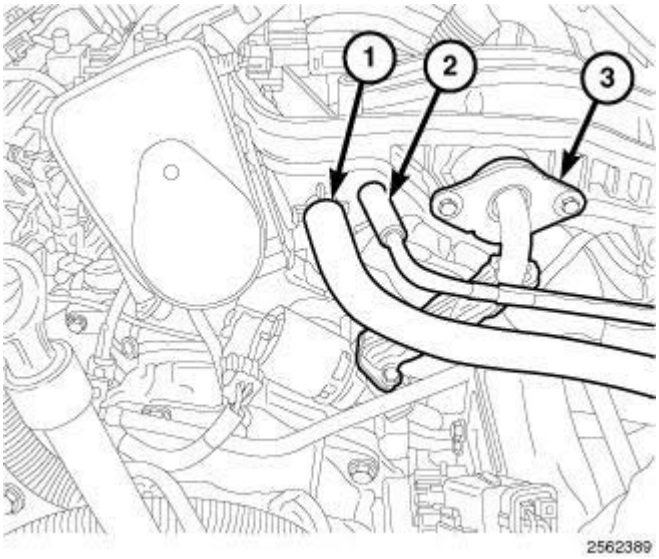

Fig. 326: Locating Upper Exhaust Gas Recirculation Tube, Brake Booster Hose & Vapor Purge Hose
Courtesy of CHRYSLER LLC

6. Connect the brake booster hose (1) and the vapor purge hose (2) to the upper intake manifold.
7. Install the upper EGR tube (3). Refer to **Emissions Control/Exhaust Gas Recirculation/TUBE, Exhaust Gas Recirculation (EGR) - Installation** .

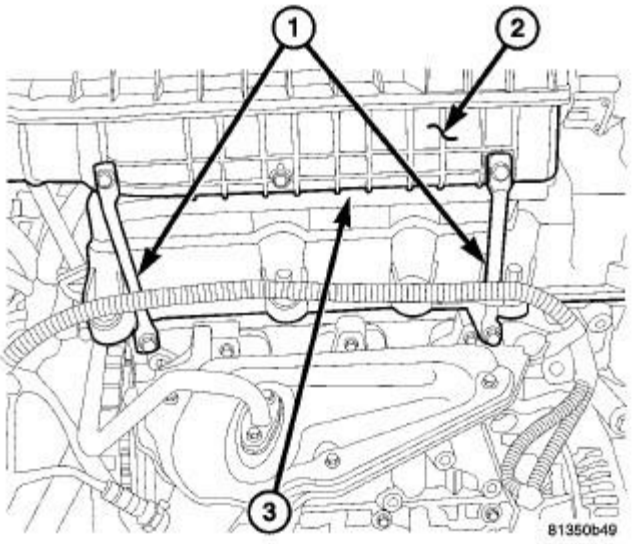

Fig. 327: Intake Brackets
Courtesy of CHRYSLER LLC

8. Install the two intake manifold support brackets (1). Tighten the fasteners to 12 N.m (105 in. lbs.).

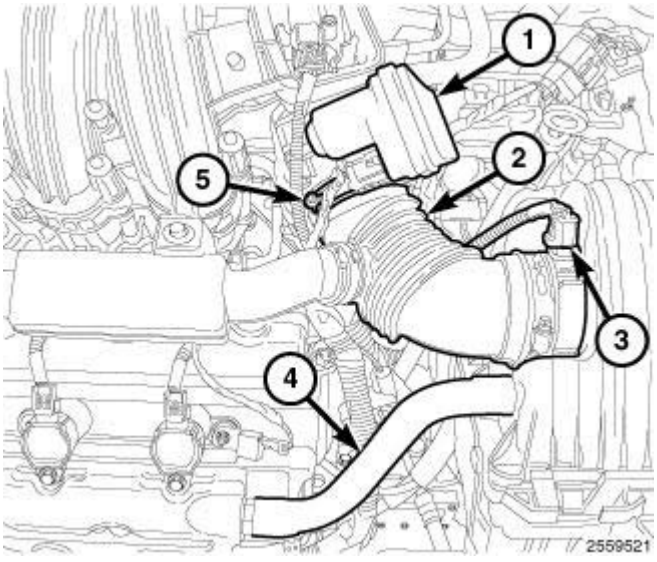

Fig. 328: Identifying Air Makeup Hose, Throttle Body & Air Inlet Hose
Courtesy of CHRYSLER LLC

9. Install the air cleaner housing assembly and connect the throttle body air inlet hose (2). See **Engine/Air Intake System/BODY, Air Cleaner - Installation**.
10. Connect the negative battery cable and tighten nut to 5 N.m (45 in. lbs.).

LOWER

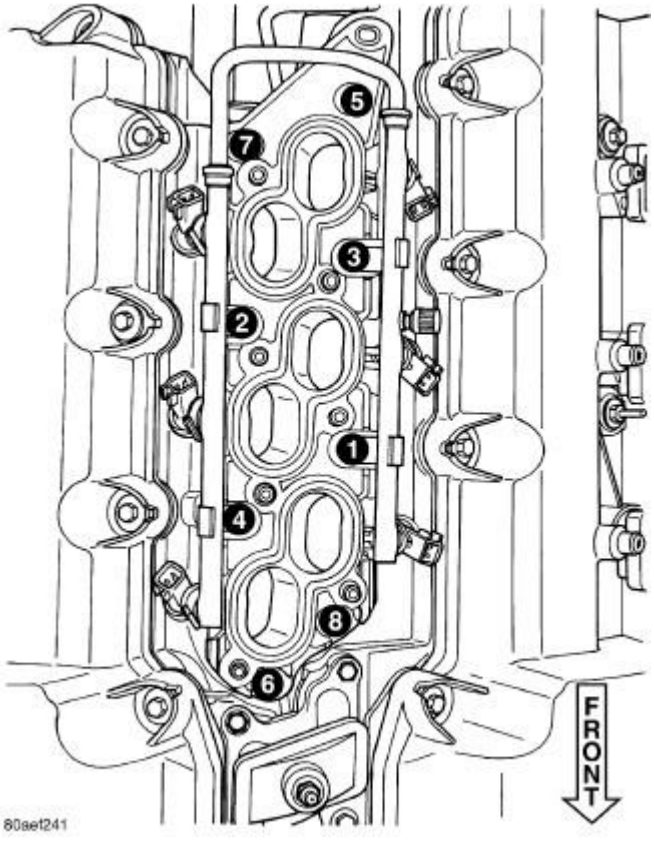

Fig. 329: Lower Intake Manifold Tightening Sequence
Courtesy of CHRYSLER LLC

1. Clean and inspect sealing surfaces of cylinder head and manifold. Gaskets can be reused provided they are free of cuts or tears.
2. Position manifold on cylinder head surfaces.

NOTE: For ease of installing upper intake manifold, install a bolt 2 - 3 turns to the rearmost attaching hole of intake. This will properly position lower manifold.

3. Install manifold attaching bolts and tighten in sequence shown in illustration, to 12 N.m (105 in. lbs.). Remove bolt used for aligning manifold.

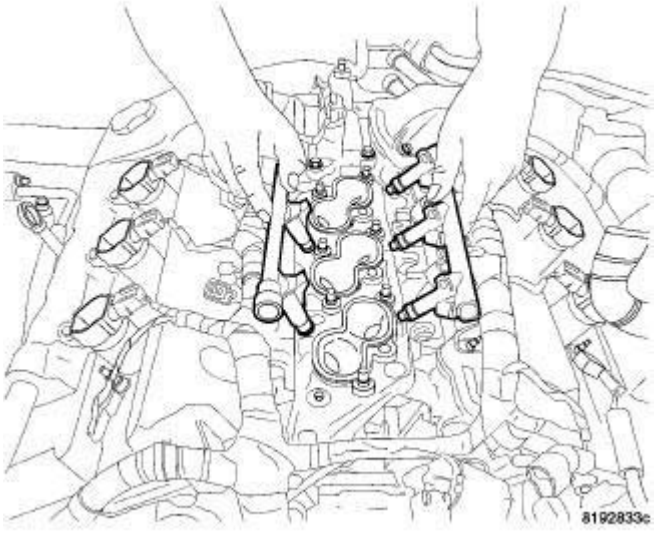

Fig. 330: FUEL RAIL REMOVE/INSTALL
Courtesy of CHRYSLER LLC

4. Install fuel rail with injectors.
5. Connect the fuel injector electrical connectors.

NOTE: Make sure fuel injectors are located in the correct location and position, as upper intake manifold interference could occur.

6. Install screw attaching fuel rail support bracket to the throttle body support bracket.
7. Connect fuel supply hose to fuel rail.
8. Install upper intake manifold. See **Engine/Manifolds/MANIFOLD, Intake - Installation**.

VALVE TIMING

DESCRIPTION

DESCRIPTION

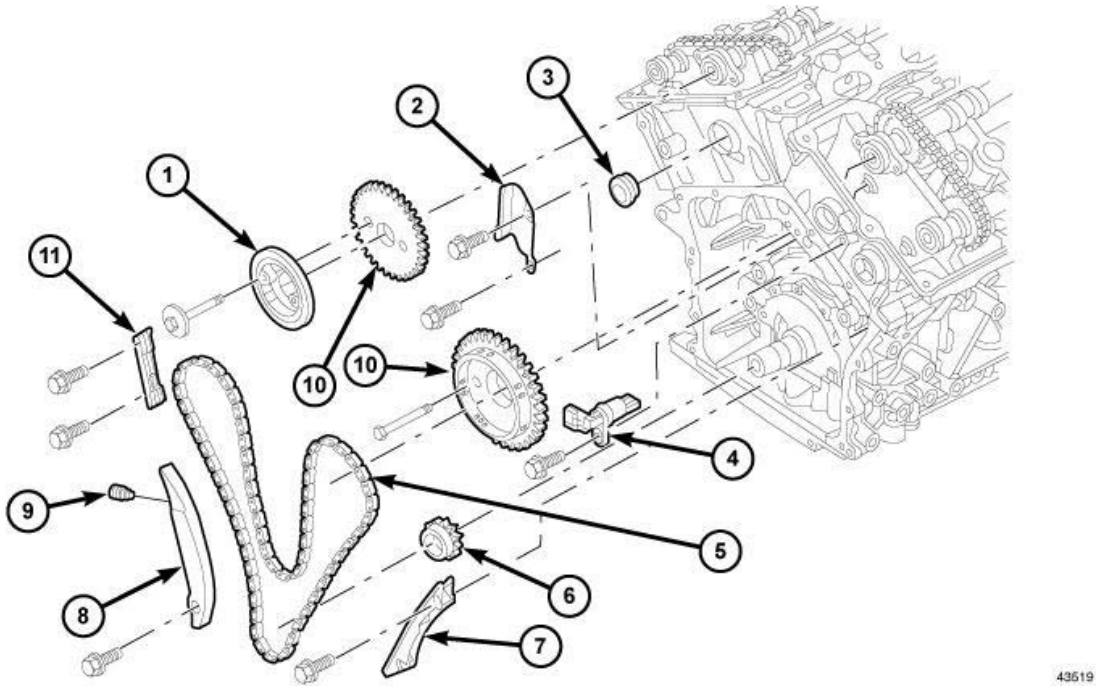

Fig. 331: Identifying Timing Drive System Components
Courtesy of CHRYSLER LLC

The timing drive system has been designed to provide quiet performance and reliability to support a **NON** free-wheeling engine. The system consists of a primary (5) drive chain and a secondary chain drive.

The **primary** timing chain (5) is a double-flexure, inverted tooth type chain. The primary chain drives both of the intake camshafts directly from a sprocket mounted on the crankshaft. In addition, the water pump is driven by the "back side" of the primary chain, necessitating the double-flexure type chain.

The chain is controlled by three fixed chain guides (2), (7), (11) and a pivoting tensioner arm (8). These guides utilize low-friction and long wearing nylon plastic wear faces. To tension the primary chain, a fully automatic spring-loaded, engine oil-fed, hydraulic tensioner (9) is used. The tensioner (9) is mounted in the right cylinder head with the plunger contacting the pivoting tensioner arm (8). A mechanical ratchet mechanism inside the tensioner prevents excessive chain slack upon engine start-up as the chain wears. The tensioner is designed with an internal oil reservoir to assure noise-free performance, even during engine start-up before oil pressure reaches the tensioner.

For lubrication the primary chain utilizes oil leakage from the front of the oil pump. This oil spills on the crankshaft sprocket, which is then carried by the chain throughout the primary drive.

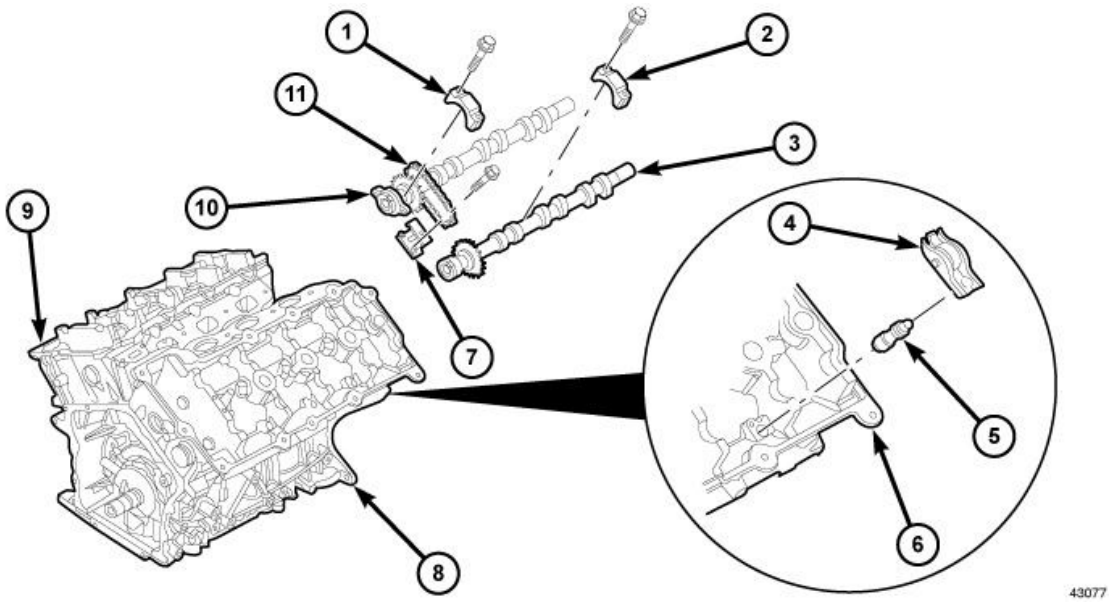

Fig. 332: Camshaft & Valvetrain Components
Courtesy of CHRYSLER LLC

The **secondary** timing chain (11) drive system uses either two conventional roller-type chains (early production) or two silent type chains (late production), one at each cylinder bank. The purpose of the secondary chain (11) is to provide a mechanical driven connection between the intake and exhaust camshafts. The intake camshafts drive the exhaust camshafts. The sprockets for both intake and exhaust camshafts are a press-fit and are only serviced as an assembly with the camshafts.

To tension the secondary chain, spring-loaded, hydraulic tensioners (7) are used at each bank and attach to each cylinder head between the intake and exhaust camshafts. The tensioner (7) incorporates upper and lower chain guide faces. The lower guide face is attached directly to the tensioner's hydraulic plunger. Also, the tensioner uses an internal oil reservoir design to prevent engine start-up noise. The secondary chains are lubricated via an oil passage through the upper guide face on each tensioner.

STANDARD PROCEDURE

ENGINE TIMING - VERIFICATION

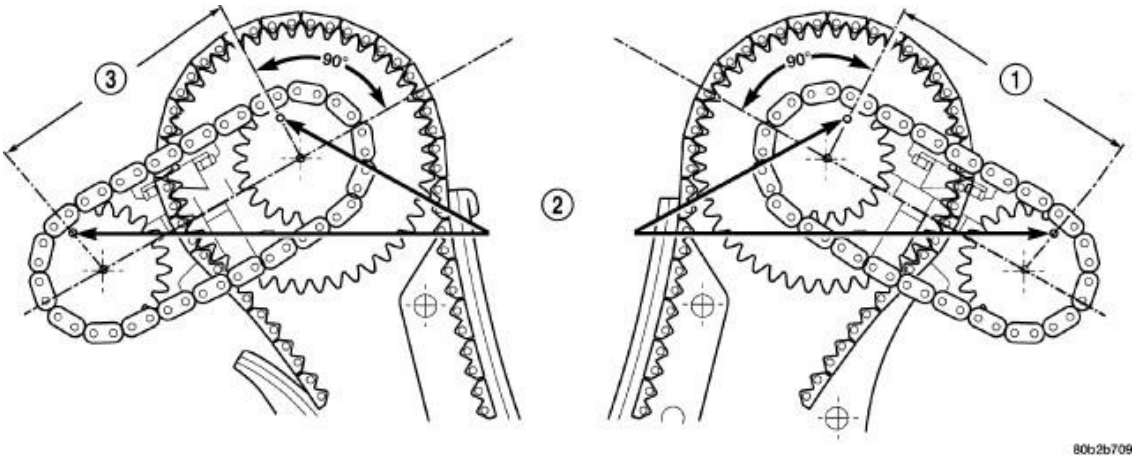

Fig. 333: ENGINE TIMING
Courtesy of CHRYSLER LLC

1 - 12 PINS	3 - 12 PINS
2 - CAMSHAFT TIMING MARKS	

NOTE: Note: The engine timing verification procedure is the same for both conventional roller-type (early production) or silent type (late production) secondary timing chains.

Correct timing is critical for the NON free-wheeling designed, 2.7L engine. Engine timing can be verified by using the following procedures:

1. Remove cylinder head covers. See **Engine/Cylinder Head/COVER(S), Cylinder Head - Removal**.
2. Rotate engine until number one cylinder is at TDC on the EXHAUST stroke.
3. View the intake camshaft sprocket timing mark. The mark should be 90° from the cylinder head cover sealing surface on both right and left cylinder banks.
4. Count the chain pins between the timing marks (2) on the intake camshaft and the exhaust camshaft. Engine is timed correctly when there are 12 chain pins between the timing marks (2) on the intake camshaft and exhaust camshaft.
5. If marks are not correctly aligned, proceed to **Engine/Valve Timing/CHAIN and SPROCKETS, Timing - Removal**.

CHAIN AND SPROCKETS, TIMING

Removal

TIMING CHAIN AND CAM SPROCKETS

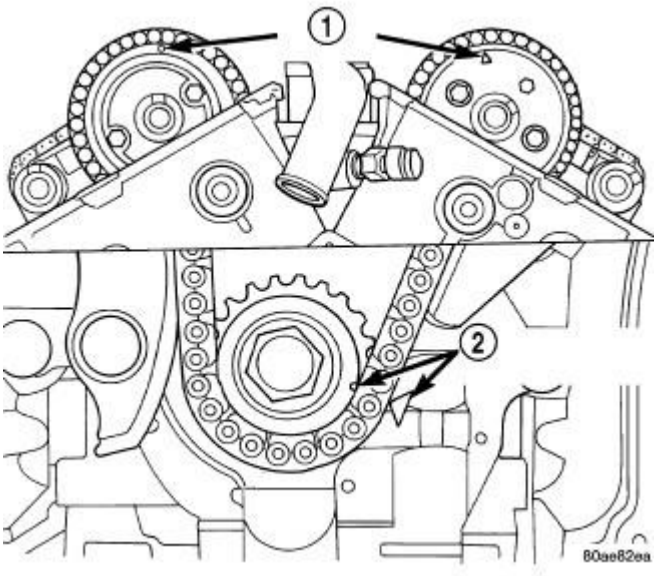

Fig. 334: TIMING MARK ALIGNMENT
Courtesy of CHRYSLER LLC

1 - CAMSHAFT TIMING MARKS 2 - CRANKSHAFT TIMING MARKS

1. Disconnect negative battery cable.
2. Drain cooling system.
3. Remove upper intake manifold. See **Engine/Manifolds/MANIFOLD, Intake - Removal**.
4. Remove cylinder head covers, crankshaft vibration damper, and timing chain cover. See **Engine/Cylinder Head/COVER(S), Cylinder Head - Removal**, **Engine/Engine Block/DAMPER, Vibration - Removal** or **Engine/Valve Timing/COVER(S), Engine Timing - Removal**.

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

5. Align crankshaft sprocket timing mark to mark on oil pump housing (2). The mark on oil pump housing is 60° ATDC of #1 cylinder.

CAUTION: When the timing chain is removed and the cylinder heads are still installed, DO NOT rotate the camshafts or crankshaft without first locating the proper crankshaft position. Failure to do so will result in valve and/or piston damage.

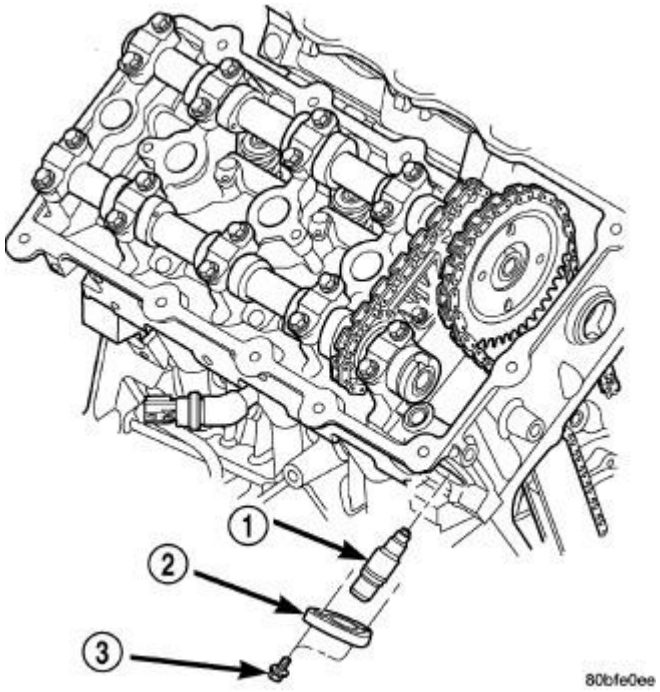

Fig. 335: PRIMARY TIMING CHAIN TENSIONER
Courtesy of CHRYSLER LLC

1 - TENSIONER
2 - RETAINER CAP
3 - BOLT

6. Remove power steering pump and bracket as an assembly. **Do not** disconnect power steering lines from pump. Reposition pump and support with suitable retaining strap.
7. Remove primary timing chain tensioner retainer cap (2) and tensioner (1) from right cylinder head.
8. Disconnect and remove camshaft position sensor from left cylinder head.
9. Remove timing chain guide access plugs from cylinder heads.

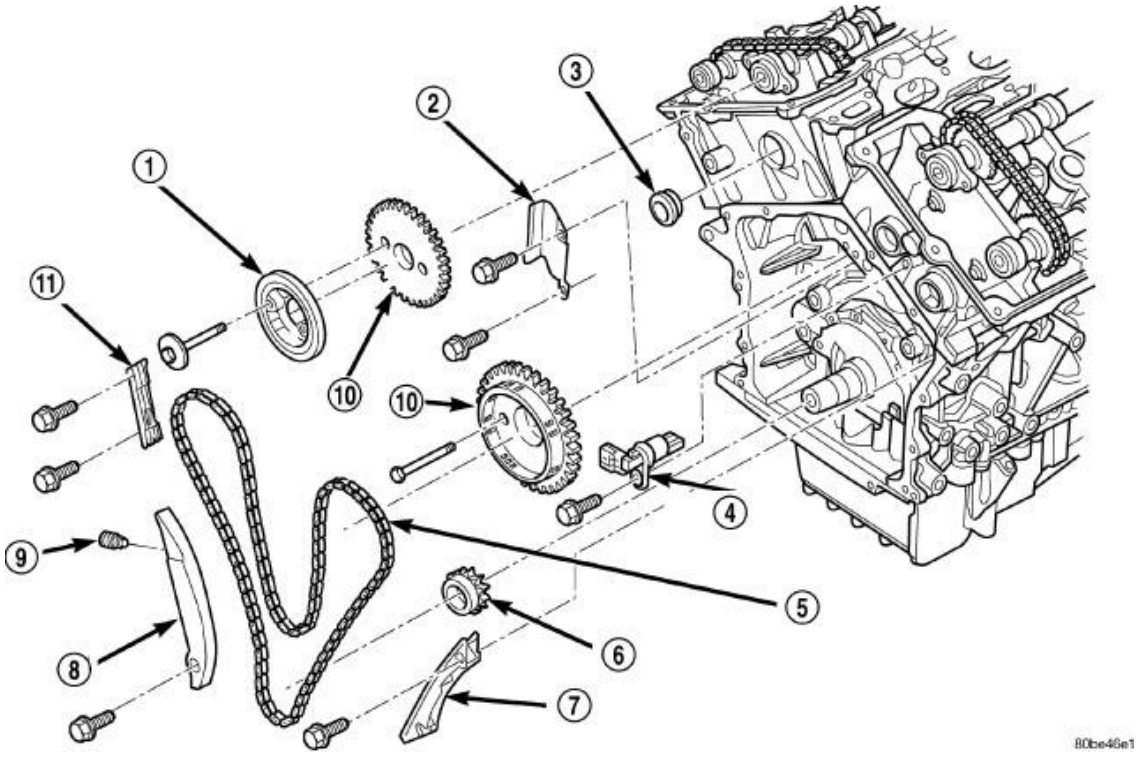

Fig. 336: TIMING DRIVE SYSTEM - PRIMARY
Courtesy of CHRYSLER LLC

1 - CAMSHAFT DAMPER (IF EQUIPPED)	7 - CHAIN GUIDE
2 - CHAIN GUIDE	8 - CHAIN TENSIONER ARM
3 - ACCESS PLUG	9 - CHAIN TENSIONER
4 - CAMSHAFT POSITION SENSOR	10 - CAMSHAFT SPROCKETS
5 - PRIMARY TIMING CHAIN	11 - CHAIN GUIDE
6 - CRANKSHAFT SPROCKET	

NOTE: When camshaft sprocket bolts are removed, the camshafts will rotate in a clockwise direction.

10. Starting with the right camshaft sprocket, remove the sprocket attaching bolts. Remove camshaft damper (if equipped) and sprocket.
11. Remove left side camshaft sprocket attaching bolts and remove sprocket.
12. Remove lower chain guide (7) and tensioner arm (8).
13. Remove the primary timing chain.
14. For removal of crankshaft sprocket, see **Engine/Engine Block/CRANKSHAFT - Removal**.

CRANKSHAFT SPROCKET

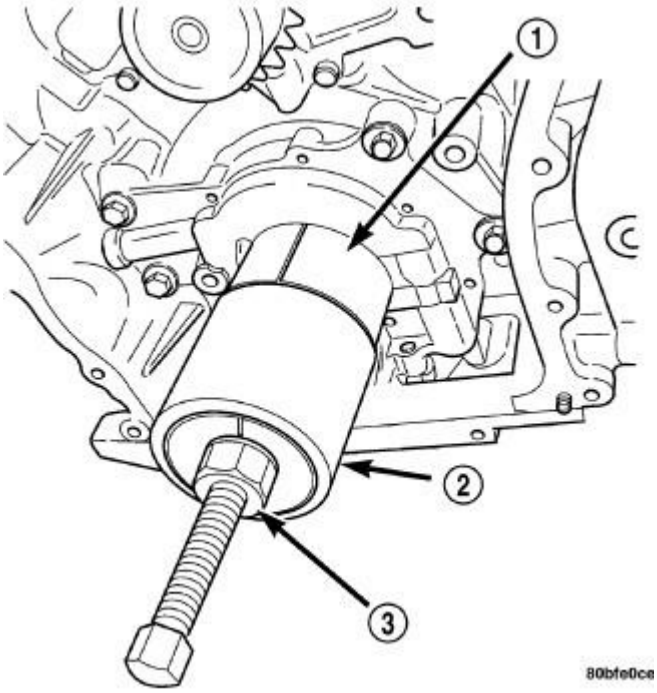

Fig. 337: Crankshaft Sprocket - Removal
Courtesy of CHRYSLER LLC

1 - SPECIAL TOOL 8539
2 - SPECIAL TOOL 5048-6
3 - SPECIAL TOOL 5048-1

1. Remove primary timing chain. See **Engine/Valve Timing/CHAIN and SPROCKETS, Timing - Removal**.

CAUTION: Use care not to turn crankshaft while removing crankshaft sprocket, as damage to valves and or pistons could occur.

2. Remove crankshaft sprocket by first installing the crankshaft damper bolt. Apply grease or equivalent to damper bolt head and position Special Tools 5048-1, 5048-6, and 8539 (1) on sprocket and crankshaft nose. Remove sprocket using care not to rotate the crankshaft.

Installation

TIMING CHAIN AND CAM SPROCKETS

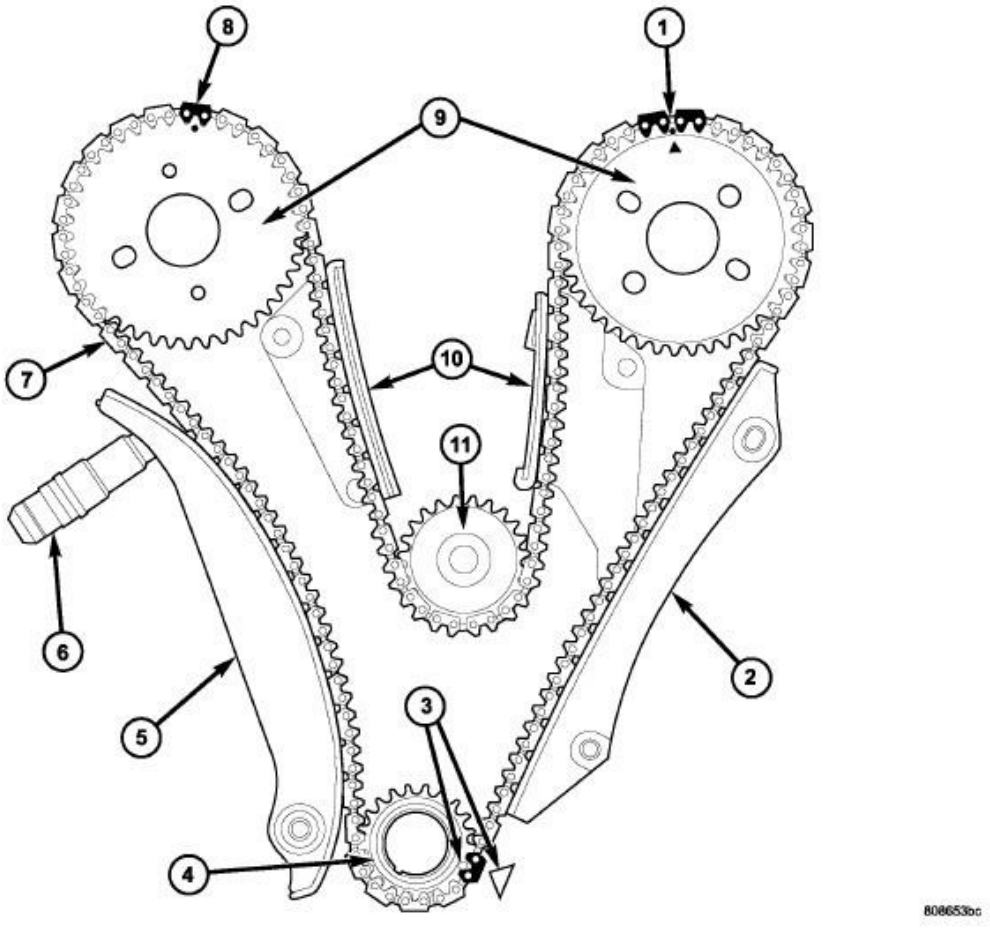

Fig. 338: TIMING CHAIN ALIGNMENT MARKS - PRIMARY
Courtesy of CHRYSLER LLC

1. Inspect all sprockets (4),(9),(11) and chain guides (2),(5),(10). Replace if worn.
2. For crankshaft sprocket installation procedures, see **Engine/Engine Block/CRANKSHAFT - Installation**.
3. If removed, install the right and left side short chain guides (10). Tighten attaching bolts to 28 N.m (250 in. lbs.).
4. Align the crankshaft sprocket timing mark to the mark on the oil pump housing (3).

NOTE: Lubricate timing chain and guides with engine oil before installation.

5. Place the left side primary chain sprocket onto the chain so that the timing mark is located in between the two (plated) timing links (1).

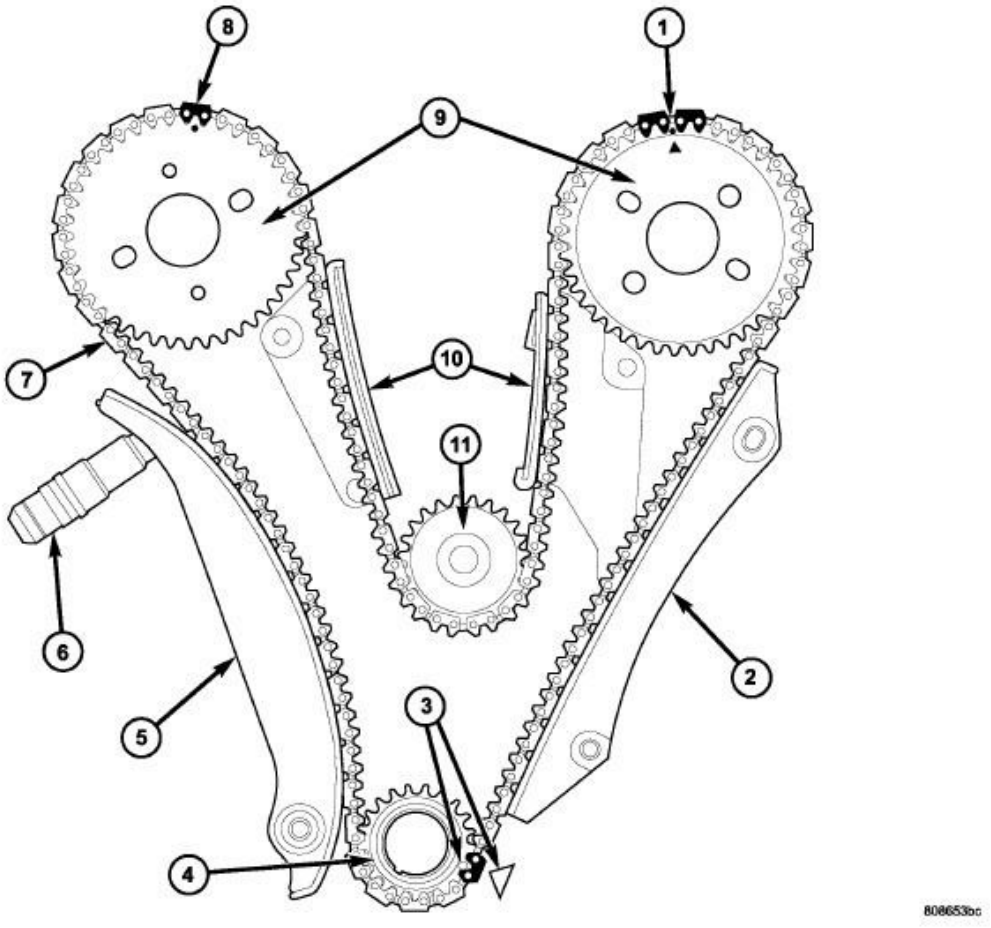

Fig. 339: TIMING CHAIN ALIGNMENT MARKS - PRIMARY
Courtesy of CHRYSLER LLC

6. Lower the primary chain with the left side sprocket through the left cylinder head opening.

NOTE: The camshaft sprockets can be allowed to float on the camshaft hub during installation.

7. Loosely position the left side camshaft sprocket over the camshaft hub.
8. Align the timing (plated) link to the crankshaft sprocket timing mark (3).
9. Position the primary chain onto the water pump drive sprocket (11).
10. Align the right camshaft sprocket timing mark to the timing (plated) link on the timing chain (8) and loosely position over the camshaft hub.
11. Verify that all chain timing (plated) links are properly aligned to the timing marks on all sprockets.
12. Install the left side lower chain guide (2) and tensioner arm (5). Tighten attaching bolts to 28 N.m (250 in. lbs.).

NOTE: Inspect the O-ring on the chain guide access plugs before installing. Replace the O-ring as necessary.

13. Install the chain guide access plugs to the cylinder heads. Tighten plugs to 20 N.m (15 ft. lbs.).

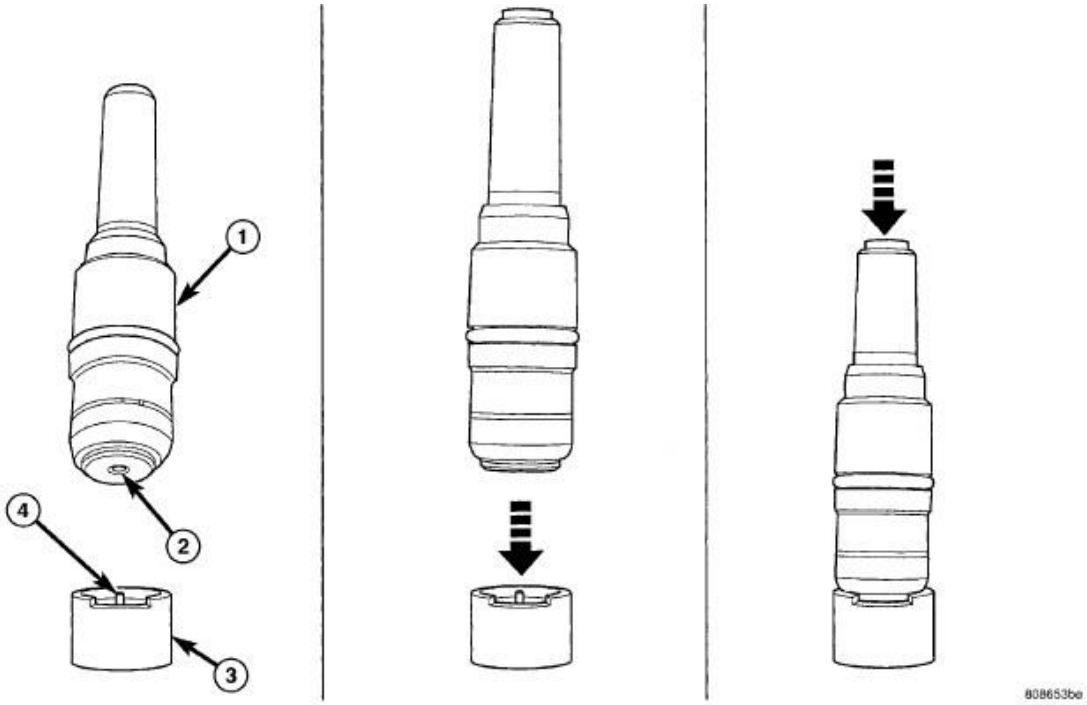

Fig. 340: TIMING CHAIN TENSIONER - OIL PURGING
Courtesy of CHRYSLER LLC

NOTE: To reset the primary timing chain tensioner, engine oil will first need to be purged from the tensioner.

14. Purge oil from the timing chain tensioner using the following procedure:
    a. Place the check ball (2) end of the tensioner into the shallow end of Chain Tensioner Gauge 8186 (3).
    b. Using hand pressure, slowly depress the tensioner until oil is purged from the tensioner.
15. Reset the timing chain tensioner using the following procedure:
    a. Position the cylinder plunger (4) into the deeper end of Chain Tensioner Gauge 8186 (3).
    b. Apply a downward force until tensioner is reset.

NOTE: If oil was not first purged from the tensioner, use slight finger pressure to assist the center arm pin of Chain Tensioner Gauge 8186 to unseat the tensioner's check ball.

CAUTION: Ensure the tensioner is properly reset. The tensioner body (4) must bottom against the top edge of Chain Tensioner Gauge 8186 (3). Failure to properly perform the resetting procedure may cause tensioner jamming.

NOTE: Inspect the tensioner O-ring (2) for nicks or cuts and make sure the snap ring (1) is correctly installed, replace as necessary.

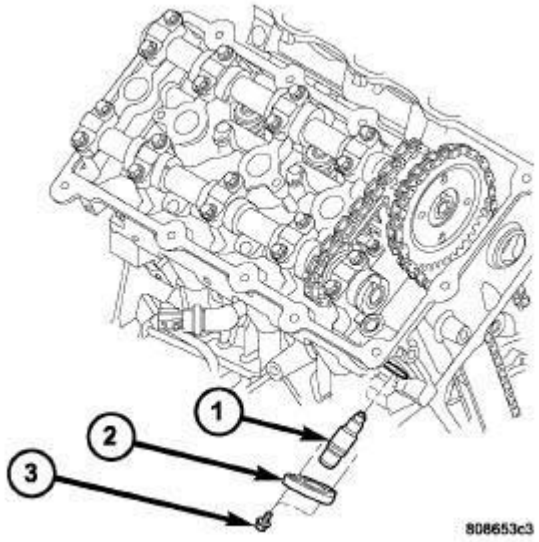

Fig. 341: PRIMARY TIMING CHAIN TENSIONER
Courtesy of CHRYSLER LLC

16. Install the reset chain tensioner (1) into the right cylinder head.
17. Position tensioner retaining plate (2) and tighten bolts (3) to 12 N.m (105 in. lbs.).

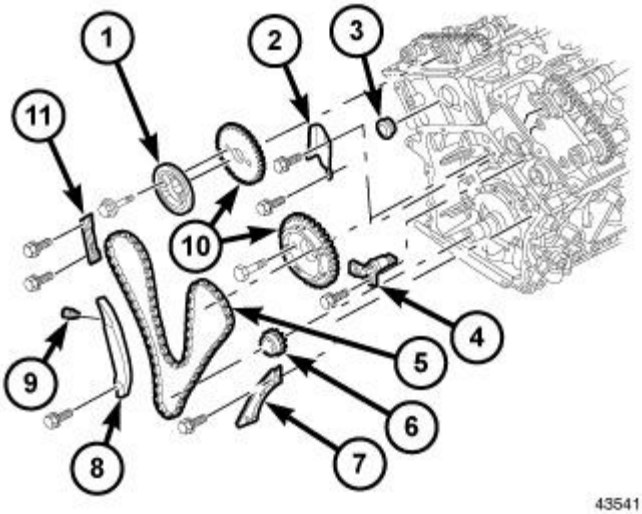

Fig. 342: TIMING DRIVE SYSTEM - PRIMARY
Courtesy of CHRYSLER LLC

18. Starting at the right cylinder bank, first position the camshaft damper (1) (if equipped) on the camshaft hub, then insert a 3/8" square drive extension with a breaker bar into the intake camshaft drive hub.

Rotate the camshaft until the camshaft hub aligns to the camshaft sprocket and damper attaching holes. Install the sprocket attaching bolts and tighten to 28 N.m (250 in. lbs.).

19. Insert a 3/8" square drive extension with a breaker bar into the intake camshaft drive hub and rotate the camshaft until the sprocket attaching bolts can be installed. Tighten the sprocket bolts to 28 N.m (250 in. lbs.).
20. Rotate the crankshaft slightly clockwise to remove timing chain slack, if necessary.

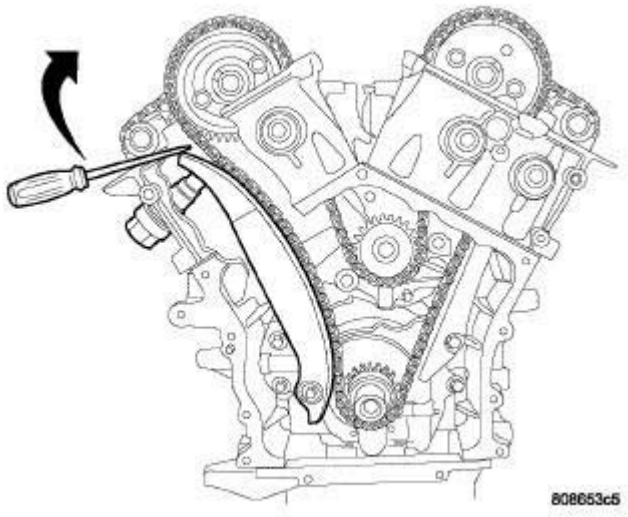

Fig. 343: TIMING CHAIN TENSIONER ACTIVATING
Courtesy of CHRYSLER LLC

21. Activate the timing chain tensioner by using a flat bladed pry tool to gently pry tensioner arm towards the tensioner slightly. Then release the tensioner arm. Verify the tensioner is activated (extends).

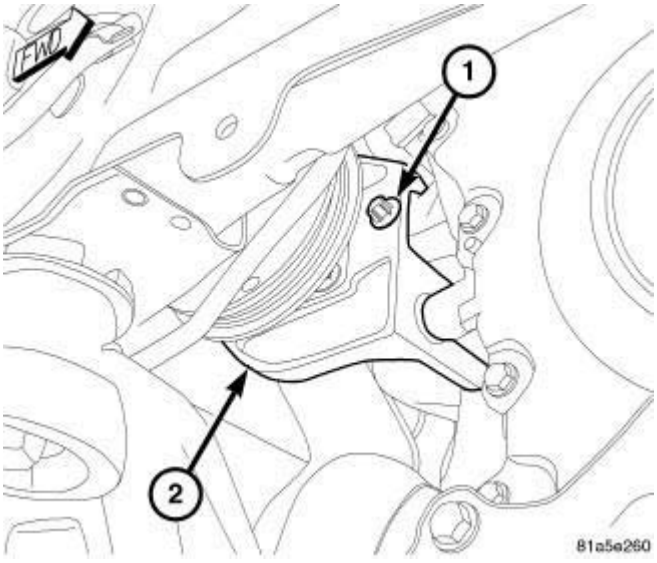

Fig. 344: FRONT PUMP MOUNTING BRACKET BOLTS - 2.7L

Courtesy of CHRYSLER LLC

22. Install the power steering pump and bracket assembly. Refer to **Steering/Pump - Installation** .

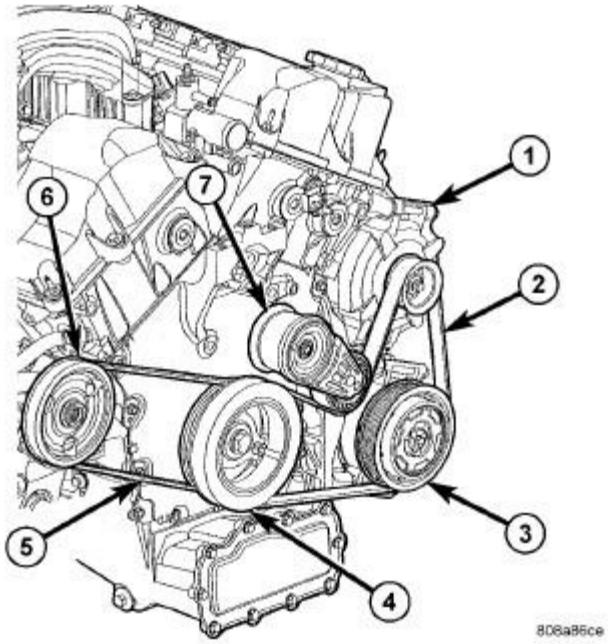

Fig. 345: Accessory Drive Belt System - 2.7L
Courtesy of CHRYSLER LLC

23. Install the camshaft position sensor and connect the electrical connector.
24. Install the timing chain cover, crankshaft vibration damper, and accessory drive belts. See **Engine/Valve Timing/COVER(S), Engine Timing - Installation**.

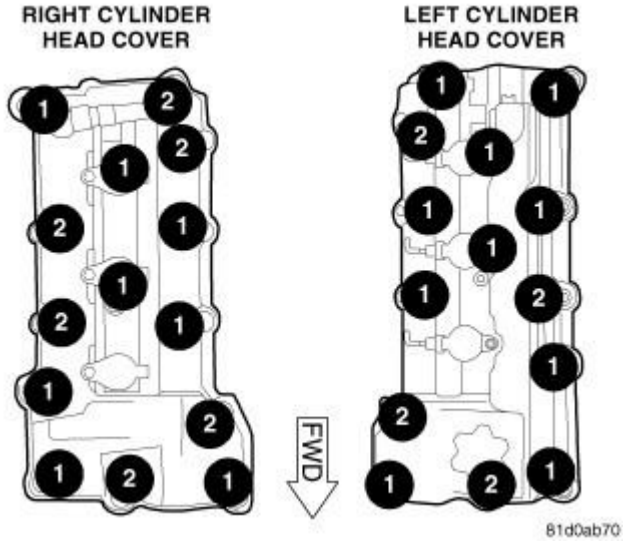

Fig. 346: Cylinder Head Cover Fasteners

Courtesy of CHRYSLER LLC

1 - DOUBLE ENDED STUDS 2 - BOLTS

25. Install the cylinder head covers. See **Engine/Cylinder Head/COVER(S), Cylinder Head - Installation**.
26. Install the upper intake manifold and air cleaner housing assembly. See **Engine/Manifolds/MANIFOLD, Intake - Installation**
27. Connect the negative battery cable and tighten nut to 5 N.m (45 in. lbs.).
28. Fill the cooling system. Refer to **Cooling - Standard Procedure** .

NOTE: After installation of a reset tensioner, engine noise will occur after initial start-up. This noise will normally disappear within 5-10 seconds.

29. Operate the engine until it reaches normal operating temperature. Check cooling system for correct fluid level. Refer to **Cooling - Standard Procedure** .

NOTE: The Cam/Crank Variation Relearn procedure must be performed anytime there has been a repair/replacement made to a powertrain system, for example: flywheel, valvetrain, camshaft and/or crankshaft sensors or components. Refer to DTC-Based Diagnostics/MODULE, Powertrain Control (PCM) - Standard Procedure .

CRANKSHAFT SPROCKET

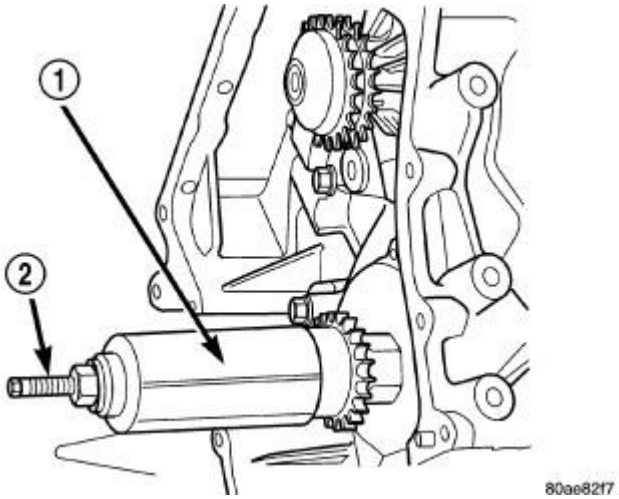

Fig. 347: Crankshaft Sprocket - Installation
Courtesy of CHRYSLER LLC

1 - SPECIAL TOOL 6780-1 2 - SPECIAL TOOL 8179

1. Install crankshaft sprocket using Special Tools 6780-1 and 8179 (2) until sprocket bottoms against crankshaft step flange. Use care not to rotate crankshaft.

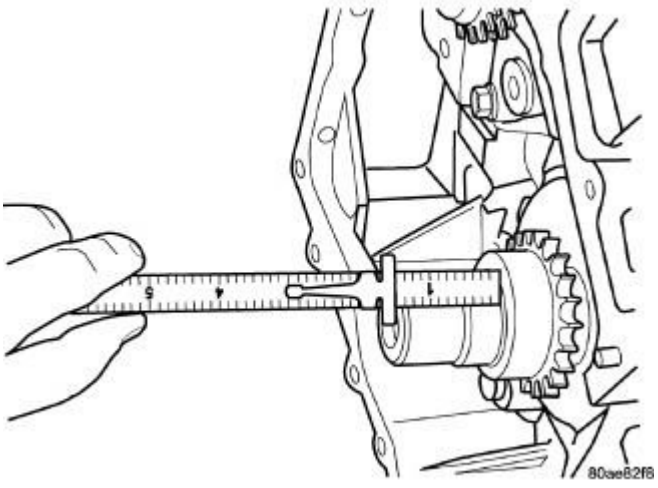

Fig. 348: Crankshaft Sprocket Depth Measurement
Courtesy of CHRYSLER LLC

2. Verify that crankshaft sprocket is installed to proper depth by measuring from sprocket outer face to end of crankshaft. Measurement should read: 39.05 ±0.50 mm (1.5374 ±0.020 in.).
3. Install primary timing chain. See **Engine/Valve Timing/CHAIN and SPROCKETS, Timing - Installation**.

COVER(S), ENGINE TIMING

Removal

REMOVAL

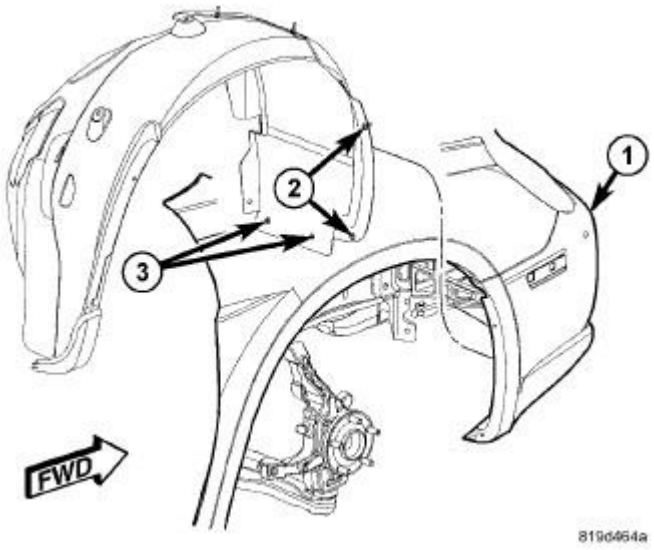

Fig. 349: FRONT SPLASH SHIELDS
Courtesy of CHRYSLER LLC

1. Disconnect and isolate negative battery cable.
2. Drain cooling system.
3. Remove coolant pressure container.
4. Remove right front wheel and belt splash shield (2).

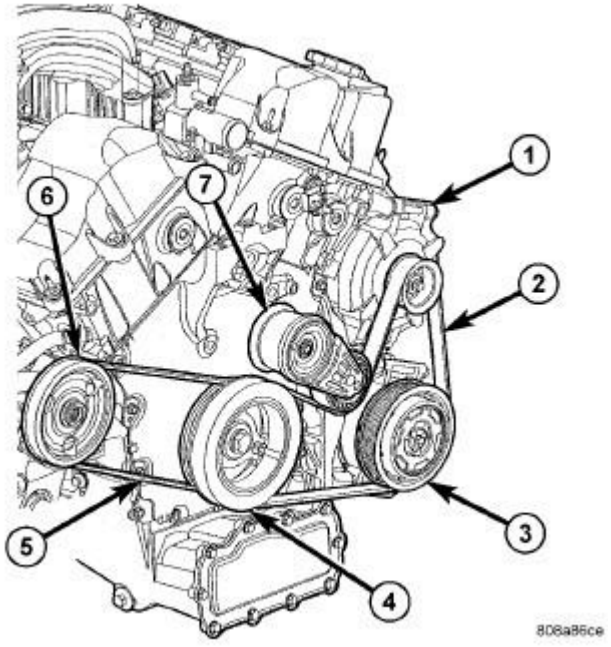

Fig. 350: Accessory Drive Belt System - 2.7L
Courtesy of CHRYSLER LLC

1 - GENERATOR 2 - IDLER/TENSIONER

5. Remove accessory drive belts (2). Refer to **Cooling/Accessory Drive/BELT, Serpentine - Removal** .
6. Remove crankshaft vibration damper. See **Engine/Engine Block/DAMPER, Vibration - Removal**.
7. Remove AC/Generator belt tensioner/bracket assembly.
8. Disconnect heater hose from tube at right front frame rail area.
9. Remove screws securing heater supply tube to right frame rail. Reposition heater supply tube.

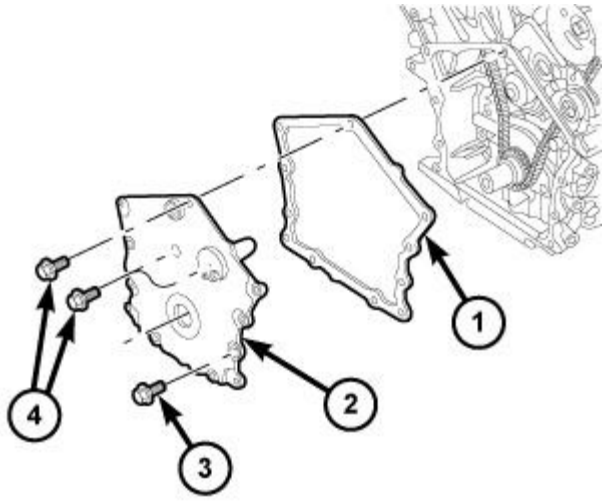

Fig. 351: TIMING CHAIN COVER
Courtesy of CHRYSLER LLC

10. Place a floor jack with wooden block under oil pan to support engine.
11. Remove right engine mount.
12. Remove upper timing chain cover bolts.
13. Remove remaining bolts securing timing chain cover to engine.
14. Remove timing chain cover (2).
15. Discard timing chain cover gasket (1). Remove front crankshaft oil seal from cover.

Installation

INSTALLATION

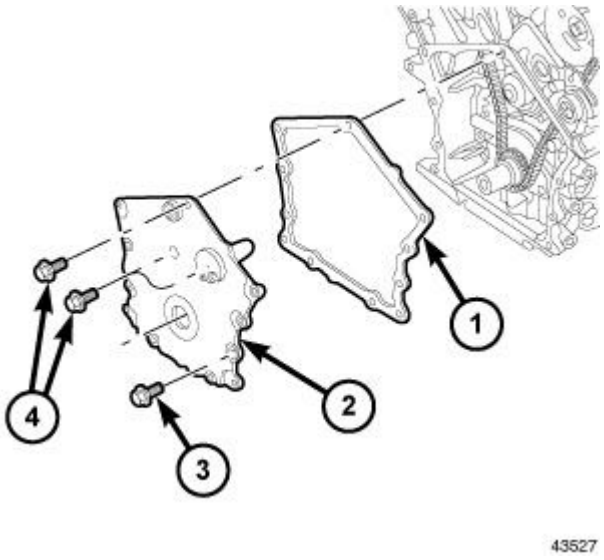

Fig. 352: TIMING CHAIN COVER
Courtesy of CHRYSLER LLC

1. Inspect and clean timing chain cover sealing surfaces.
2. Before installing timing cover gasket apply a 1/8 inch bead of Mopar® Engine RTV GEN II to the parting lines between the oil pan and cylinder block.
3. Install timing cover (2) and gasket (1). Tighten M10 cover bolts to 54 N.m (40 ft. lbs.) and M6 bolts to 12 N.m (105 in. lbs.).
4. Install front crankshaft oil seal using Special Tool 6780-2 sleeve and 6780-1 installer.
5. Lower vehicle.

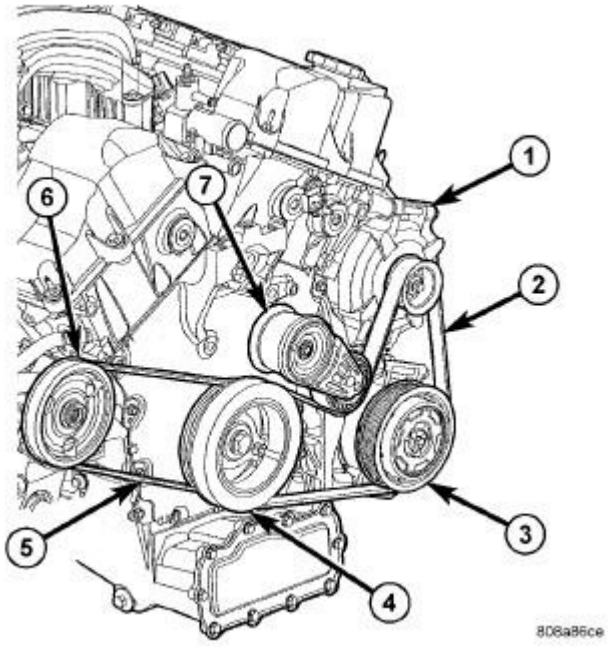

Fig. 353: Accessory Drive Belt System - 2.7L
Courtesy of CHRYSLER LLC

6. Install right engine mount. See **Engine/Engine Mounting/INSULATOR, Engine Mount - Installation**.
7. Install screws attaching heater supply tube to right front frame rail area.
8. Raise vehicle on hoist.
9. Connect heater hose to supply tube at right front frame rail area.
10. Install AC/Generator belt tensioner/bracket assembly.
11. Install crankshaft vibration damper. See **Engine/Engine Block/DAMPER, Vibration - Installation**.
12. Install accessory drive belts (2). Refer to **Cooling/Accessory Drive/BELT, Serpentine - Installation** .

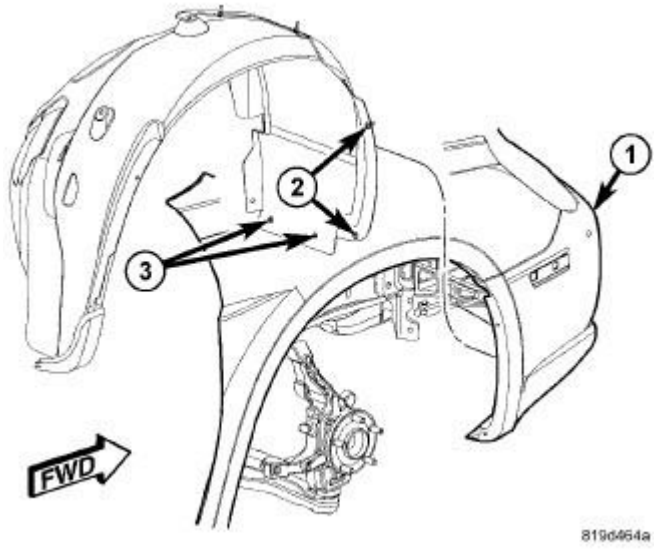

Fig. 354: Removing/Installing Front Splash Shields
Courtesy of CHRYSLER LLC

13. Install belt splash shield and right front wheel.
14. Lower vehicle.
15. Install coolant pressure container. Refer to **Cooling/Engine/BOTTLE, Coolant Recovery - Installation** .
16. Fill cooling system. Refer to **Cooling - Standard Procedure** .
17. Connect negative battery cable.