# 2007 ENGINE

## 2.0L - Service Information - Caliber

## DESCRIPTION

The 2.0 Liter (122 cu. in.) in-line four cylinder engine is a double overhead camshaft with mechanical lash buckets and four valves per cylinder design. This engine is NOT free-wheeling; meaning that the pistons will contact the valves in the event of a timing chain failure.

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

The engine serial number is located on the rear of the cylinder block. The serial number contains engine build date information.

## DIAGNOSIS AND TESTING

### ENGINE DIAGNOSIS - PERFORMANCE

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

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| | | gasket, and vacuum hoses. |
| | 4. Faulty ignition coil(s). | 4. Test and replace as necessary (Refer to Appropriate Diagnostic Information) |
| | 5. Contamination in Oil Control Valve (OCV). | 5. Remove OCV and inspect for contamination. Replace OCV if contaminated or sticking. |
| ENGINE LOSS OF POWER | 1. Dirty or incorrectly gapped plugs. | 1. Clean plugs and set gap. |
| | 2. Contamination in fuel system. | 2. Clean system and replace fuel filter. |
| | 3. Faulty fuel pump. | 3. Test and replace as necessary (Refer to Appropriate Diagnostic Information) |
| | 4. Incorrect valve timing. | 4. Correct valve timing. |
| | 5. Leaking cylinder head gasket. | 5. Replace cylinder head gasket. |
| | 6. Low compression. | 6. Test compression of each cylinder. |
| | 7. Burned, warped, or pitted valves. | 7. Replace valves. |
| | 8. Plugged or restricted exhaust system. | 8. Perform exhaust restriction test. Install new parts. Refer to **DIAGNOSIS AND TESTING** , as necessary. |
| | 9. Faulty ignition coil(s). | 9. Test and replace as necessary (Refer to Appropriate Diagnostic Information) |
| ENGINE MISSES ON ACCELERATION | 1. Dirty or incorrectly gapped spark plugs. | 1. Clean spark plugs and set gap. |
| | 2. Contamination in Fuel System. | 2. Clean fuel system and replace fuel filter. |
| | 3. Burned, warped, or pitted valves. | 3. Replace valves. |
| | 4. Faulty ignition coil(s). | 4. Test and replace as necessary (Refer to Appropriate Diagnostic Information) |
| ENGINE MISSES AT HIGH SPEED | 1. Dirty or incorrect spark plug gap. | 1. Clean spark plugs and set gap. |
| | 2. Faulty ignition coil(s). | 2. Test and replace as necessary (Refer to Appropriate Diagnostic Information) |
| | 3. Dirty fuel injector(s). | 3. Test and replace as necessary (Refer to Appropriate Diagnostic Information) |
| | 4. Contamination in fuel system. | 4. Clean system and replace fuel filter. |

## 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.**

1. Check the coolant level and fill as required. DO NOT install the pressure cap.
2. Start and operate the engine until it attains normal operating temperature, then turn the engine OFF.
3. Clean spark plug recesses with compressed air.
4. Remove the spark plugs.
5. Remove the oil filler cap.
6. Remove the air cleaner.
7. 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.
8. 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.
9. All gauge pressure indications should be equal, with no more than 25% leakage per cylinder.
10. **FOR EXAMPLE:** At 552 kPa (80 psi) input pressure, a minimum of 414 kPa (60 psi) should be maintained in the cylinder.

## ENGINE DIAGNOSIS - MECHANICAL

| CONDITION | POSSIBLE CAUSES | CORRECTION |
|---|---|---|
| VALVETRAIN NOISE | 1. High or low oil level in crankcase. | 1. Check and correct engine oil level. |
| | 2. Thin or diluted oil. | 2. Change oil to correct viscosity. |
| | 3. Thick oil | 3. (a) Change engine oil and filter. |
| | - | (b) Run engine to operating temperature. |
| | - | (c) Change engine oil and filter again. |
| | 4. Low oil pressure. | 4. Check and correct engine oil level. |
| | 5. Worn cam lobe. | 5. Install new camshaft. |
| | 6. Worn tappet bucket. | 6. Install new select fit tappet |

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| | | bucket. |
| | 7. Worn valve guides. | 7. Replace cylinder head. |
| | 8. Excessive runout of valve seats on valve faces. | 8. Grind valve seats and replace valves. |
| CONNECTING ROD NOISE | 1. Insufficient oil supply. | 1. Check engine oil level. |
| | 2. Low oil pressure. | 2. Check engine oil level. Inspect oil pump relief valve and spring. |
| | 3. Thin or diluted oil. | 3. Change oil to correct viscosity. |
| | 4. Thick oil | 4. (a) Change engine oil and filter. |
| | - | (b) Run engine to operating temperature. |
| | - | (c) Change engine oil and filter again. |
| | 5. Excessive bearing clearance. | 5. Measure bearings for correct clearance. Repair as necessary. |
| | 6. Connecting rod journal out-of-round. | 6. Replace crankshaft or grind surface. |
| | 7. Connecting rod out-of-round. | 7. Replace connecting rod. |
| | 8. Misaligned connecting rods. | 8. Replace bent connecting rods. |
| MAIN BEARING NOISE | 1. Insufficient oil supply. | 1. Check engine oil level. |
| | 2. Low oil pressure. | 2. Check engine oil level. Inspect oil pump relief valve and spring. |
| | 3. Thin or diluted oil. | 3. Change oil to correct viscosity. |
| | 4. Thick oil | 4. (a) Change engine oil and filter. |
| | - | (b) Run engine to operating temperature. |
| | - | (c) Change engine oil and filter again. |
| | 5. Excessive bearing clearance. | 5. Measure bearings for correct clearance. Repair as necessary. |
| | 6. Excessive end play. | 6. Check thrust bearing for wear on flanges. |
| | 7. Crankshaft journal out-of-round or worn. | 7. Replace crankshaft or grind journals. |
| | 8. Loose flywheel or torque converter. | 8. Tighten to correct torque. |
| OIL PRESSURE DROP | 1. Low oil level. | 1. Check engine oil level. |
| | 2. Faulty oil pressure 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 balance shaft module. |
| | 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. |

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| | 9. Excessive bearing clearance. | 9. Measure bearings for correct clearance. |
| OIL LEAKS | 1. Misaligned or deteriorated gaskets.<br>2. Loose fastener, broken or porous metal part.<br>3. Misaligned or deteriorated cup or threaded plug. | 1. Replace gasket(s).<br>2. Tighten, repair or replace the part.<br>3. Replace as necessary. |
| OIL CONSUMPTION OR SPARK PLUGS FOULED | 1. PCV system malfunction.<br>2. Worn, scuffed or broken rings.<br>3. Carbon in oil ring slots.<br>4. Rings fitted too tightly in grooves.<br>5. Worn valve guide(s).<br>6. Valve stem seal(s) worn or damaged. | 1. Check system and repair as necessary. Refer to **DIAGNOSIS AND TESTING** .<br>2. Hone cylinder bores. Install new rings.<br>3. Install new rings.<br>4. Remove rings and check grooves. If groove is not proper width, replace piston.<br>5. Replace cylinder head.<br>6. Replace seal(s). |

**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 the section, Inspection for Rear Seal Area Leak.

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

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

**INSPECTION FOR REAR SEAL AREA LEAKS**

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

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

1. Disconnect the battery.
2. Raise the vehicle.
3. Remove torque converter or clutch housing cover and inspect rear of block for evidence of oil. Use a black light to check for the oil leak. If a leak is present in this area, remove transmission for further inspection.
   - Circular spray pattern generally indicates seal leakage or crankshaft damage.
   - Where leakage tends to run straight down, possible causes are a porous block, oil gallery cup plug, bedplate to cylinder block mating surfaces and seal bore. See proper repair procedures for these items.
4. If no leaks are detected, pressurize the crankcase as 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.

## 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 engine cover.
4. Disconnect coil electrical connectors and remove coils.
5. Remove all spark plugs from engine. As spark plugs are being removed, check electrodes for abnormal firing indicators fouled, hot, oily, etc. Record cylinder number of spark plug for future reference.
6. Disconnect injector electrical connectors.
7. Be sure throttle blade is fully open during the compression check.
8. Insert compression gauge adaptor 8116 or the equivalent, into the #1 spark plug hole in cylinder head. Connect the 0-500 psi (Blue) pressure transducer CH7059 with cable adaptors to the DRBIII®. For Special Tool identification, refer to **SPECIAL TOOLS**.
9. Crank engine until maximum pressure is reached on gauge. Record this pressure as #1 cylinder pressure.
10. Repeat the previous step for all remaining cylinders.
11. Compression should not be less than 1034 kPa (150 psi) and not vary more than 25 percent from cylinder to cylinder.
12. If one or more cylinders have abnormally low compression pressures, repeat the compression test.
13. 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.**

## ENGINE DIAGNOSIS - INTRODUCTION

Engine diagnosis is helpful in determining the causes of malfunctions not detected and remedied by routine maintenance.

These malfunctions may be classified as either mechanical (e.g, a strange noise), or performance (e.g, engine idles rough and stalls).

 

Refer to the Engine Mechanical and the Engine Performance diagnostic charts, for possible causes and corrections of malfunctions. Refer to **DIAGNOSIS AND TESTING**.

For fuel system diagnosis, refer to **DIAGNOSIS AND TESTING** .

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

- Cylinder Compression Pressure Test
- Cylinder Combustion Pressure Leakage Test
- Engine Cylinder Head Gasket Failure Diagnosis
- Intake Manifold Leakage Diagnosis
- Mechanical Valve Tappet Noise Diagnosis
- Engine Oil Leak Inspection

## STANDARD PROCEDURE

### ENGINE GASKET SURFACE PREPARATION

 

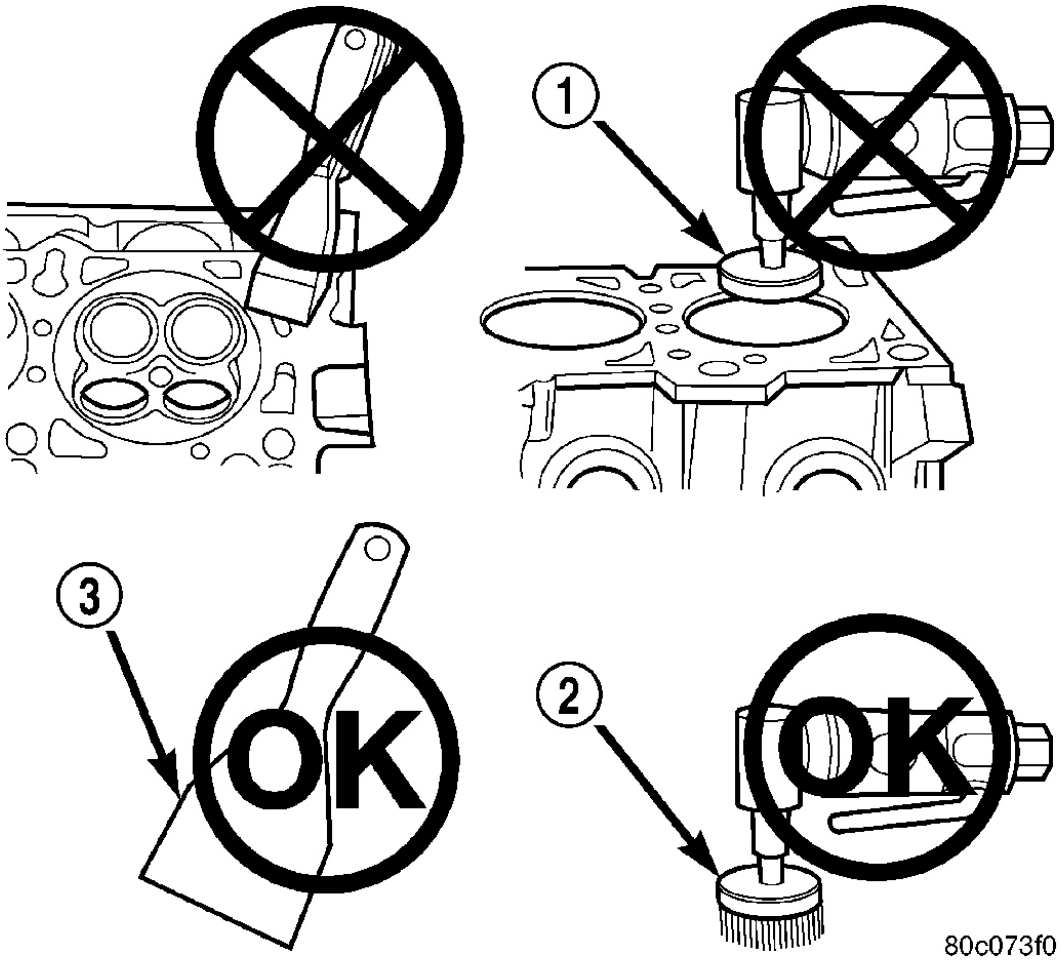


**Fig. 1: Proper Tool Usage for Surface Preparation**
**Courtesy of CHRYSLER LLC**

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

 

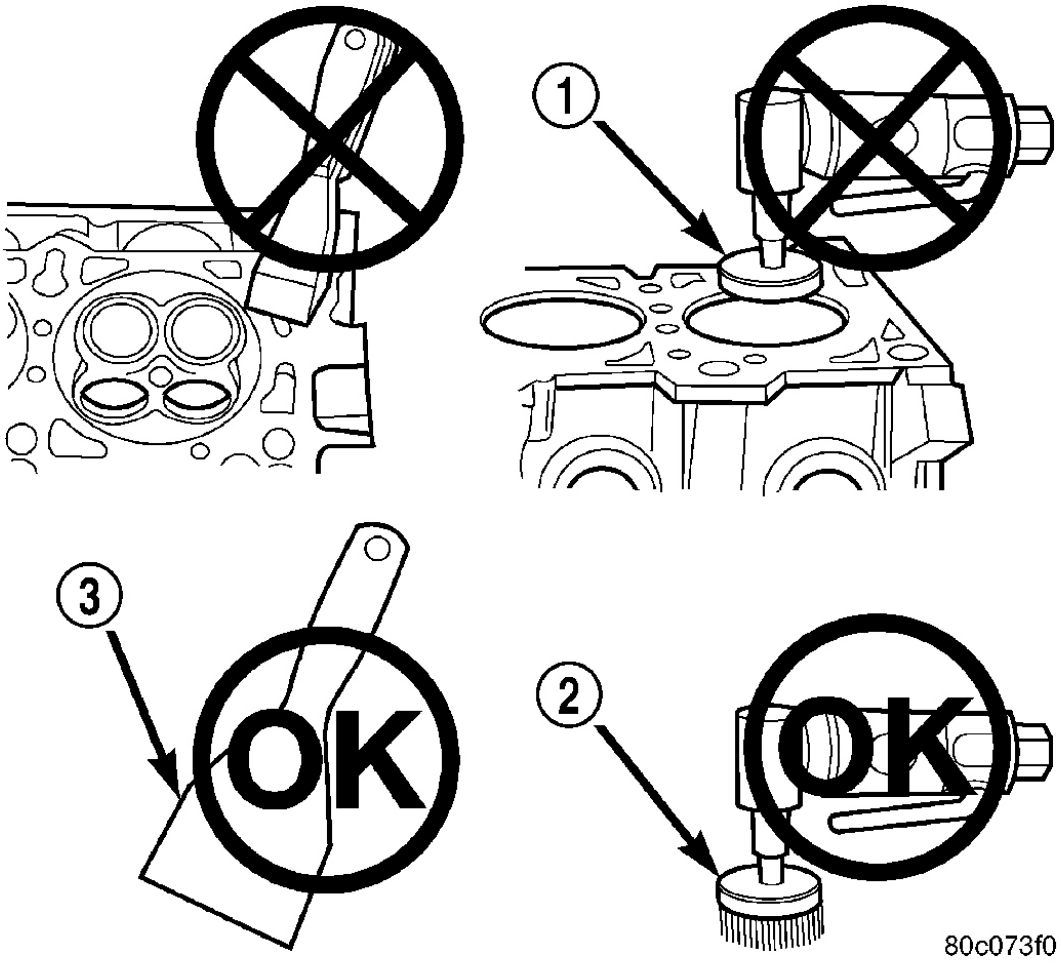


**Fig. 2: Proper Tool Usage for Surface Preparation**
**Courtesy of CHRYSLER LLC**

**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 (3).
Drill motor with 3M Roloc™ Bristle Disc (white or yellow) (2).

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

 

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.

**FORM-IN-PLACE GASKETS AND SEALERS**

**NOTE: All of the sealants mentioned below are not used on every engine, they are listed as a general reference guide. See service information for specific sealer usage.**

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. All sealing surfaces that use form-in-place gaskets and sealers **must** free of grease or oil. Surfaces should be cleaned with Mopar® brake parts cleaner prior to sealer application. After the sealer is applied, the parts should be assembled in no more than 10 minutes.

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.

**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 and "T" joint locations, 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.

**MEASURING BEARING CLEARANCE USING PLASTIGAGE**

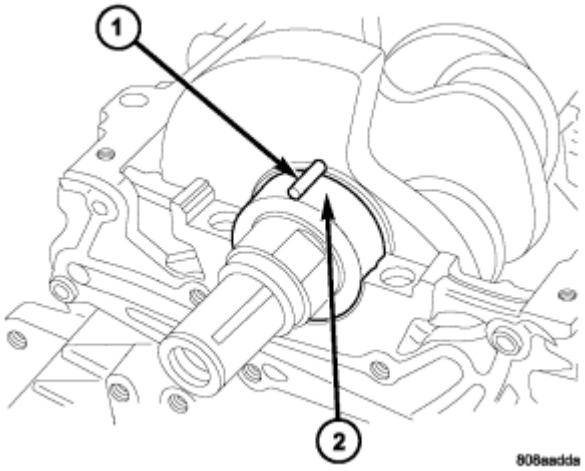


**Fig. 3: Plastigage Placed in Lower Shell-Typical**
**Courtesy of CHRYSLER LLC**

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

1. Remove oil film from surface to be checked. Plastigage is soluble in oil.
2. Place a piece of Plastigage (1) across the entire width of the journal. (In addition, suspected areas can be checked by placing the Plastigage in the suspected area). Torque the bearing cap bolts of the bearing being checked to the proper specifications.

 

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

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

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

**ENGINE GASKET SURFACE PREPARATION**

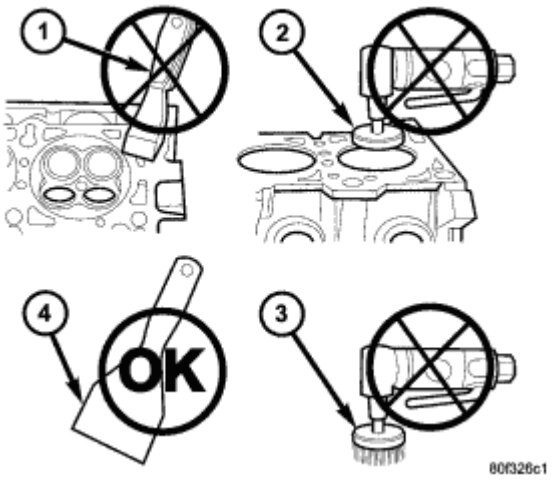


**Fig. 4: Precaution On Cleaning Gasket Surfaces**
**Courtesy of CHRYSLER LLC**

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 (2).
High speed power tool with 3M Roloc™ Bristle Disc (white or yellow) or a wire brush (3).

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

**CAUTION: The use of unapproved cleaning methods can cause severe engine damage.**

 

Only use the following for cleaning gasket surfaces:

Solvent or a commercially available gasket remover.

Plastic or wood scraper (4).

## HYDROSTATIC LOCKED ENGINE

When an engine is suspected to be hydrostatically locked, regardless of what caused the problem, the following steps should be used.

**CAUTION: DO NOT use starter motor to rotate the engine, severe damage may occur.**

1. Inspect air cleaner, induction system and intake manifold to insure system is dry and clear of foreign material.
2. Remove negative battery cable.
3. Place a shop towel around the spark plugs when removing them from the engine. This will catch any fluid that may possibly be in the cylinder under pressure.
4. With all spark plugs removed, rotate engine crankshaft using a breaker bar and socket.
5. Identify the fluid in the cylinder(s) (i.e, coolant, fuel, oil or other).
6. Make sure all fluid has been removed from the cylinders. Inspect engine for damage (i.e, connecting rods, pistons, valves, etc.)
7. Repair engine or components as necessary to prevent this problem from re-occurring.

**CAUTION: Squirt approximately one teaspoon of oil into the cylinders, rotate engine to lubricate the cylinder walls to prevent damage on restart.**

8. Install new spark plugs.
9. Drain engine oil and remove oil filter.
10. Install a new oil filter.
11. Fill engine with specified amount of approved oil.
12. Connect negative battery cable.
13. Start engine and check for any leaks.

## ENGINE CORE AND OIL GALLERY PLUGS

### CYLINDER HEAD CORE PLUGS

 

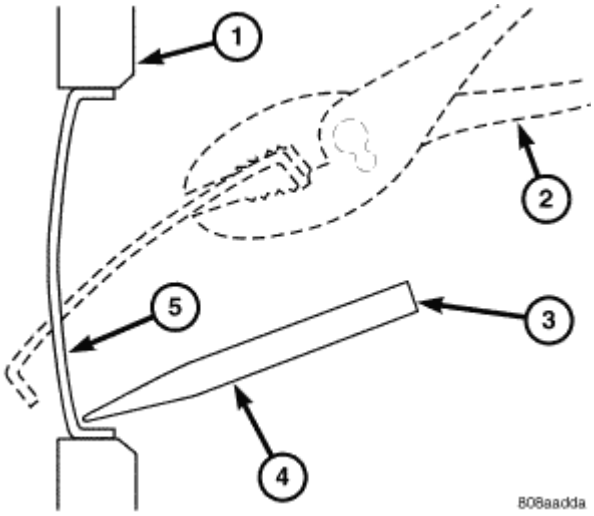


**Fig. 5: CORE HOLE PLUG REMOVAL**
**Courtesy of CHRYSLER LLC**

Using a blunt tool (3) such as a drift and a hammer, strike the bottom edge of the cup plug (5). With the cup plug rotated, grasp firmly with pliers or other suitable tool (2) and remove plug (5).

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

Thoroughly clean inside of cup plug hole in cylinder head. Be sure to remove old sealer. Lightly coat inside of cup plug hole with Mopar® Stud and Bearing Mount (or equivalent). 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.

**CYLINDER BLOCK MAIN OIL GALLERY PLUGS**

 

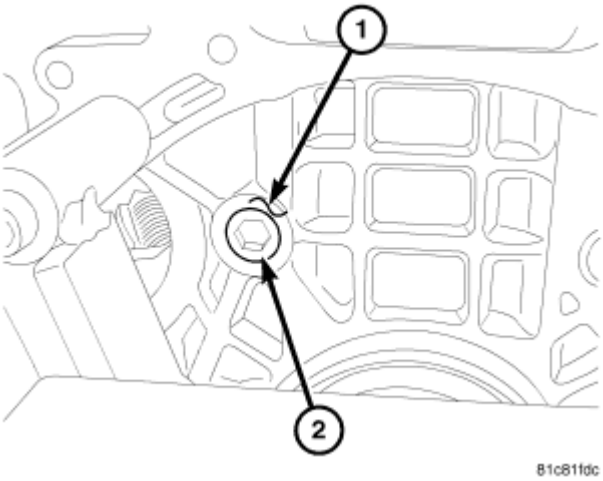


**Fig. 6: GALLERY PLUG**
**Courtesy of CHRYSLER LLC**

**CAUTION: Excessive use of brake parts cleaner to clean threads in block could cause #5 main bearing failure.**

1. Use Mopar® Brake Parts Cleaner (or equivalent) sparingly to clean plug and block.
2. Coat plug threads with Mopar® Thread Sealant (or equivalent).
3. Install plug (2). The plug (2) is correctly installed when it is protruding 1 mm to flush with the block boss face (1).

## REMOVAL

### ENGINE ASSEMBLY

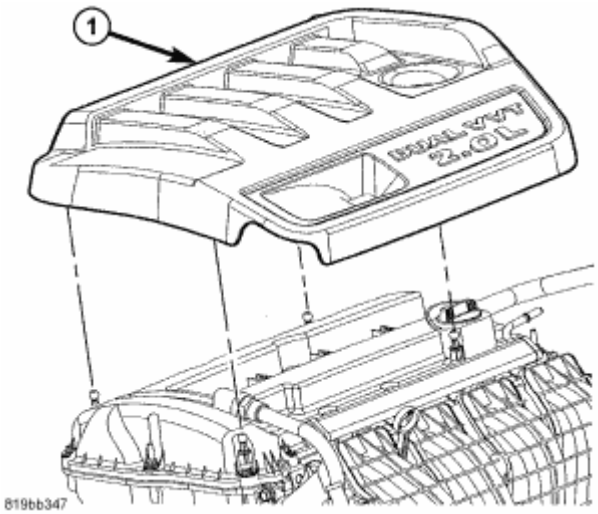


**Fig. 7: ENGINE COVER**
**Courtesy of CHRYSLER LLC**

 

1. Remove hood.
2. Remove engine cover (1).

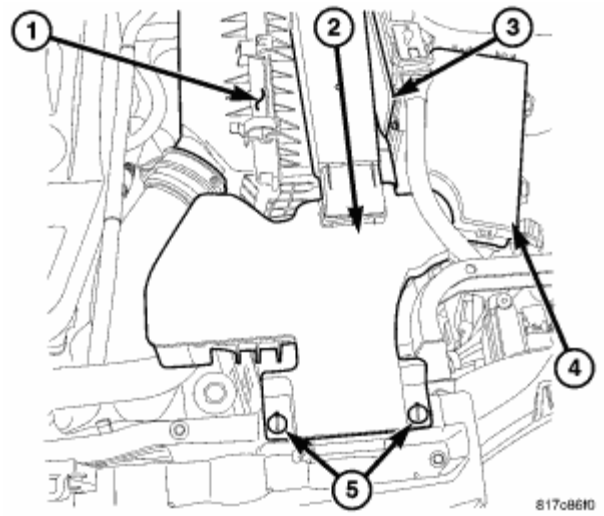


**Fig. 8: AIR CLEANER INLET**
**Courtesy of CHRYSLER LLC**

3. Perform fuel pressure release procedure. Refer to **STANDARD PROCEDURE** .
4. Remove retainers (5) and remove air inlet (2).
5. Remove air cleaner housing assembly (1) and clean air hose. Refer to **REMOVAL**.

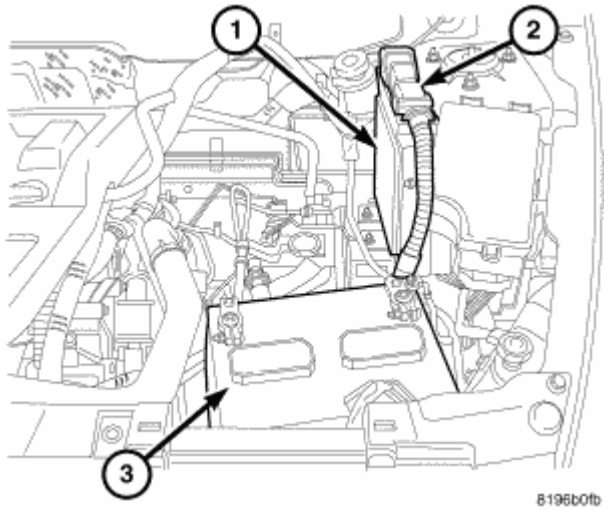


**Fig. 9: BATTERY**
**Courtesy of CHRYSLER LLC**

6. Disconnect both cables from battery (3).
7. Remove battery (3).

 

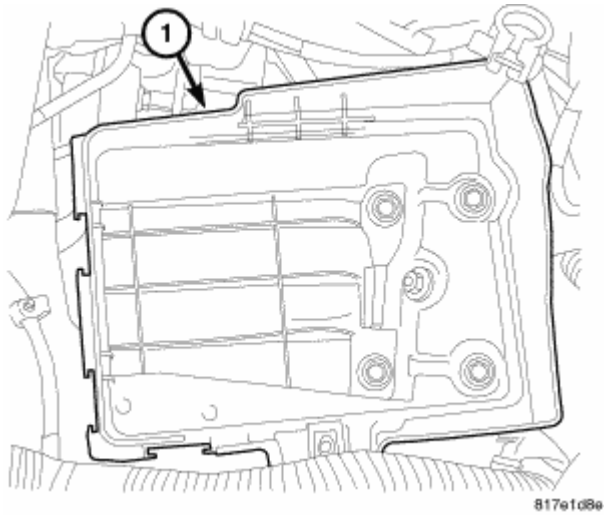


**Fig. 10: BATTERY TRAY**
**Courtesy of CHRYSLER LLC**

8. Remove battery tray (1).
9. Drain cooling system. Refer to **STANDARD PROCEDURE** .

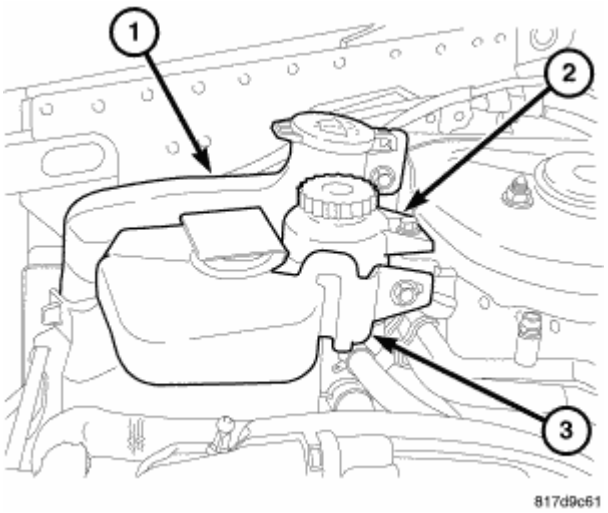


**Fig. 11: Coolant Reservoir**
**Courtesy of CHRYSLER LLC**

10. Remove coolant reservoir (3).
11. Remove power steering reservoir (2).
12. Remove windshield washer reservoir (1).

 

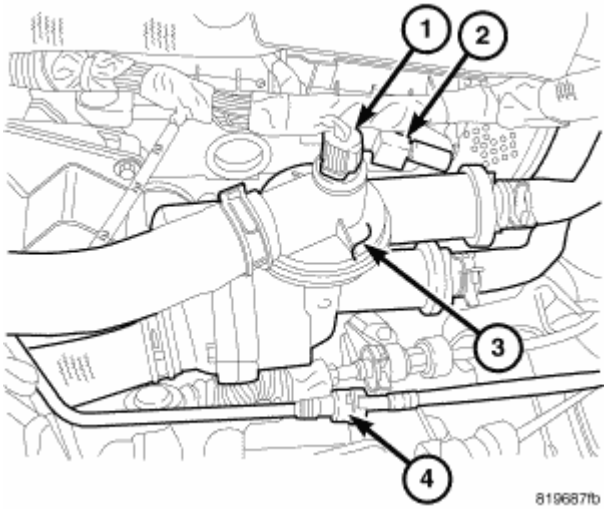


**Fig. 12: COOLANT ADAPTER**
**Courtesy of CHRYSLER LLC**

13. Remove coolant hoses from coolant adapter (3).

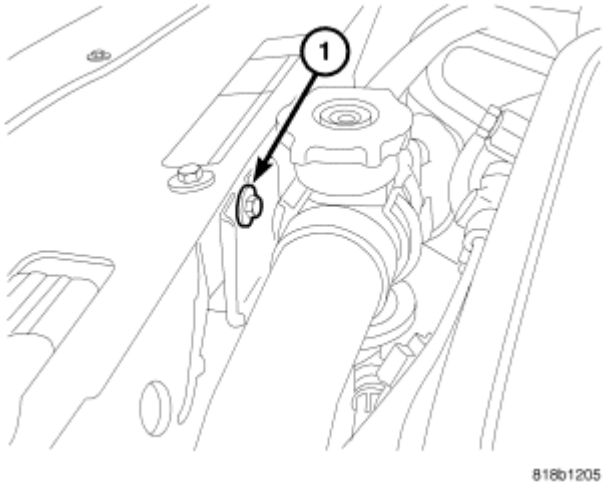


**Fig. 13: RADIATOR HOSE SUPPORT**
**Courtesy of CHRYSLER LLC**

14. Remove grill closure panel.
15. Remove upper radiator hose support (1).

 

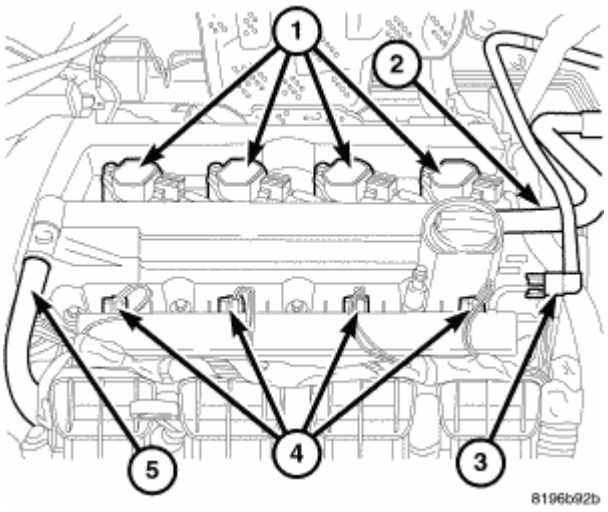


**Fig. 14: COIL CONNECTOR**
**Courtesy of CHRYSLER LLC**

16. Disconnect engine electrical connectors and reposition harness.
17. Remove air intake tube from throttle body.
18. Disconnect fuel line (3) from fuel rail.

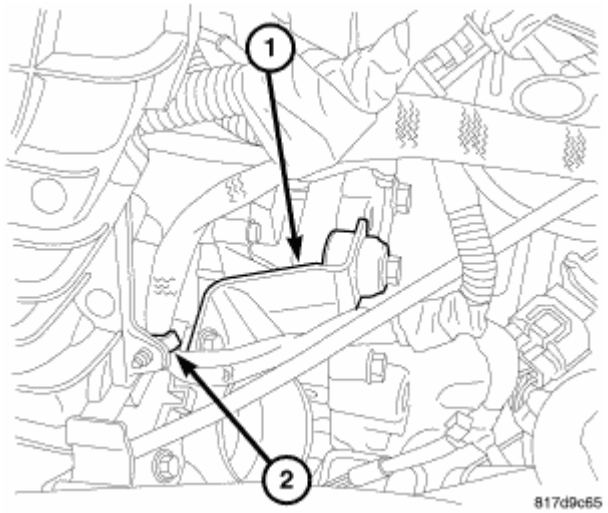


**Fig. 15: THROTTLE BODY SUPPORT**
**Courtesy of CHRYSLER LLC**

19. Remove vacuum lines from throttle body and intake manifold.
20. Remove harness from intake (2).
21. Remove throttle body support bracket (1).

 

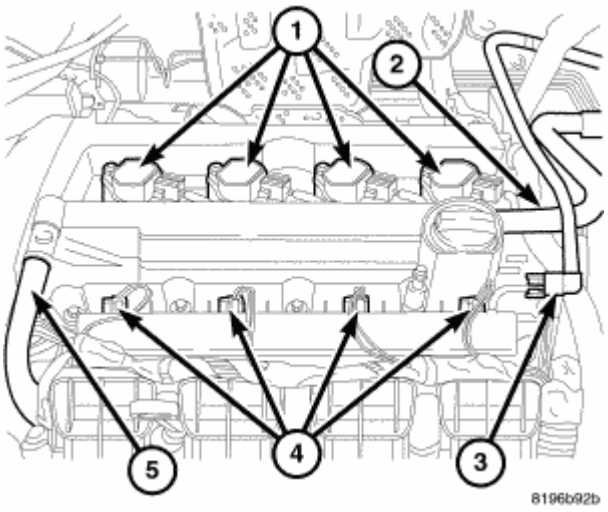


**Fig. 16: COIL CONNECTOR**
**Courtesy of CHRYSLER LLC**

22. Disconnect electronic throttle control and manifold flow control valve electrical connectors.
23. Remove PCV hose (5), and make-up air hose (2) from valve cover.
24. Remove dipstick.

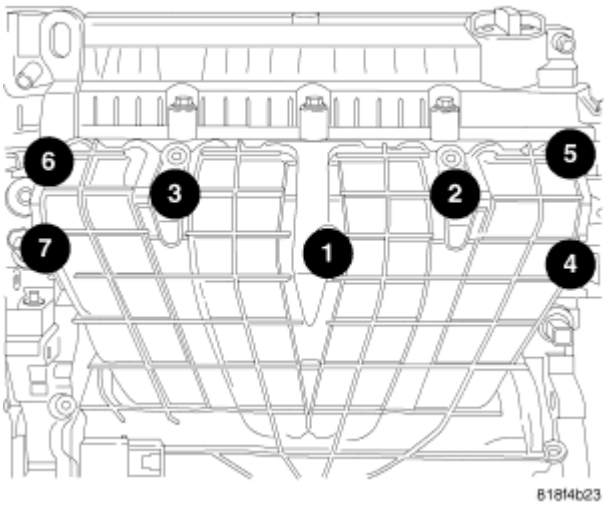


**Fig. 17: Torque Sequence**
**Courtesy of CHRYSLER LLC**

25. Remove intake bolts (1-7) and remove intake.
26. Disconnect electrical connectors and reposition harness.
27. Remove accessory drive belt.

 

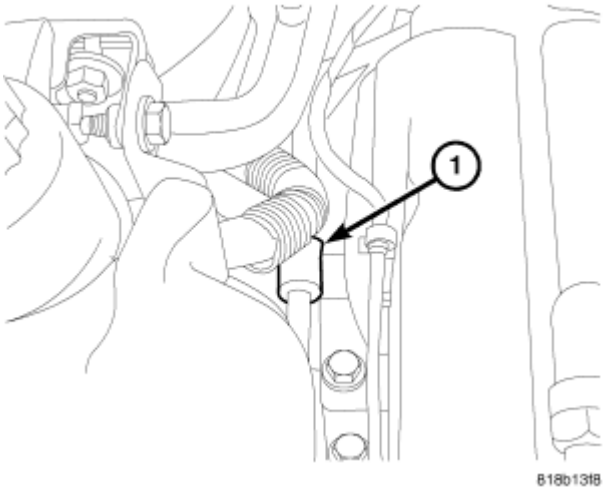


**Fig. 18: POWER STEERING LINE SUPPORT**
**Courtesy of CHRYSLER LLC**

28. Remove power steering line support at engine mount (1) and exhaust manifold.
29. Remove power steering pump and set aside.
30. Remove upper idler pulley.

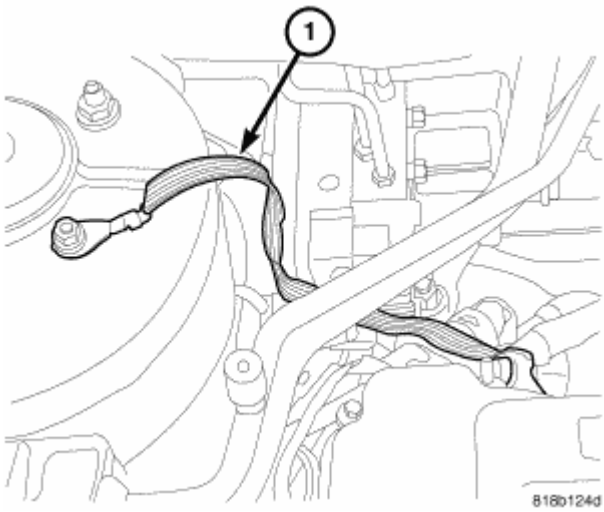


**Fig. 19: GROUND STRAP**
**Courtesy of CHRYSLER LLC**

31. Remove ground strap near right tower.
32. Raise vehicle.
33. Remove right front tire.
34. Remove splash shield.

 

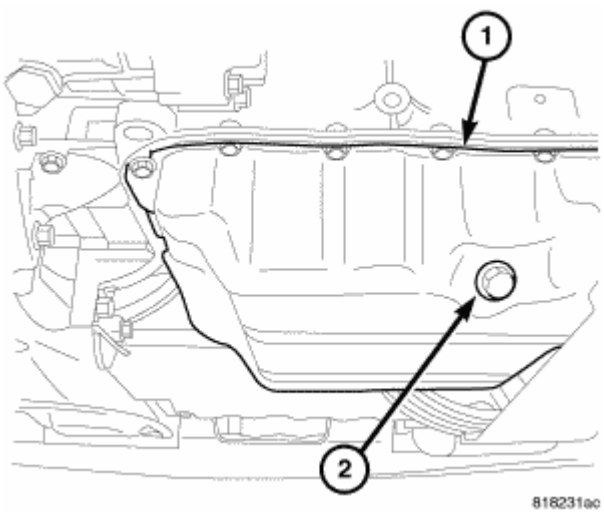


**Fig. 20: OIL DRAIN PLUG**
**Courtesy of CHRYSLER LLC**

35. Drain oil (2).

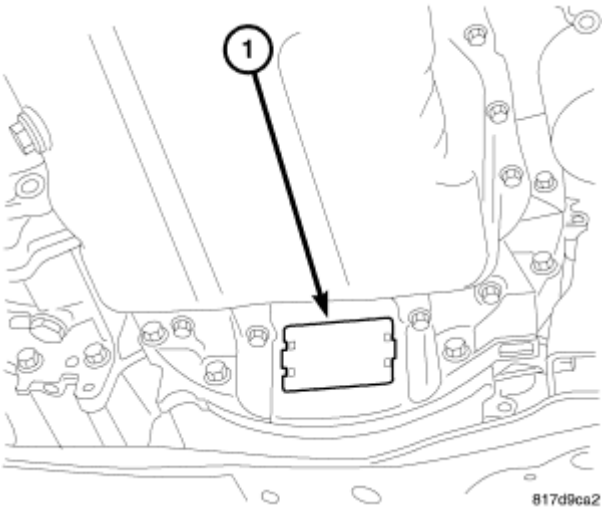


**Fig. 21: INSPECTION COVER**
**Courtesy of CHRYSLER LLC**

36. Remove inspection cover (1) and mark torque converter to flywheel.

 

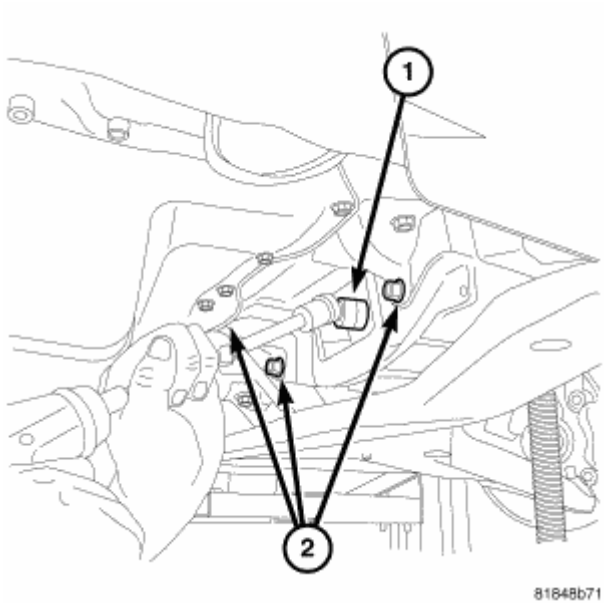


**Fig. 22: MODULAR CLUTCH TO FLEX PLATE BOLTS**
**Courtesy of CHRYSLER LLC**

37. Remove torque converter bolts (1).
38. Remove lower bellhousing bolts (2).

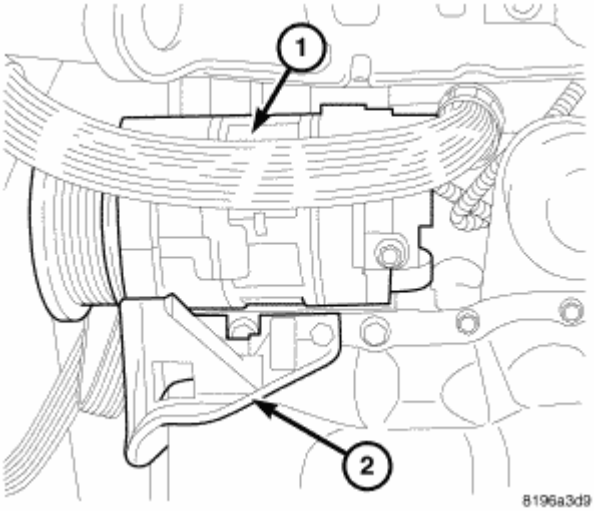


**Fig. 23: A/C COMPRESSOR**
**Courtesy of CHRYSLER LLC**

39. Remove A/C compressor (1) mounting bolts.
40. Remove generator and lower idler pulley.

 

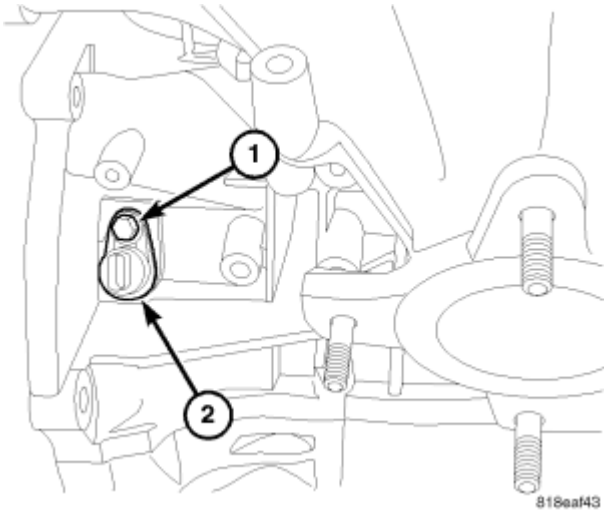


**Fig. 24: Crankshaft Position Sensor**
**Courtesy of CHRYSLER LLC**

41. Disconnect crankshaft position sensor electrical connector and remove crankshaft position sensor (2).

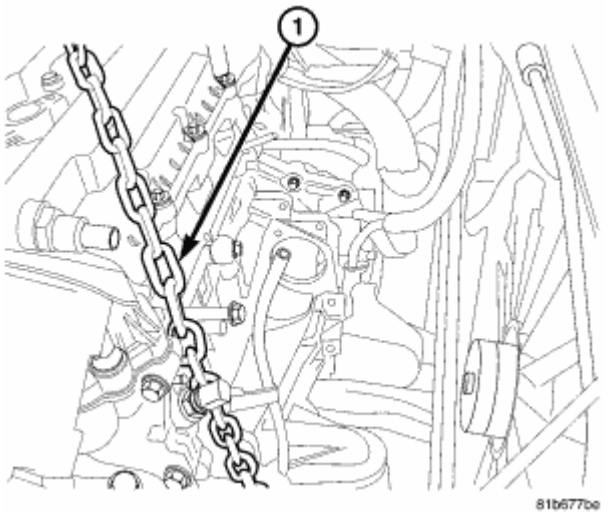


**Fig. 25: LIFT CHAIN**
**Courtesy of CHRYSLER LLC**

42. Remove exhaust variable valve timing solenoid.
43. Install engine lift chain (1) as shown to cylinder head.
44. Connect the chain to the rear engine lift hook.
45. Install engine lifting crane.

 

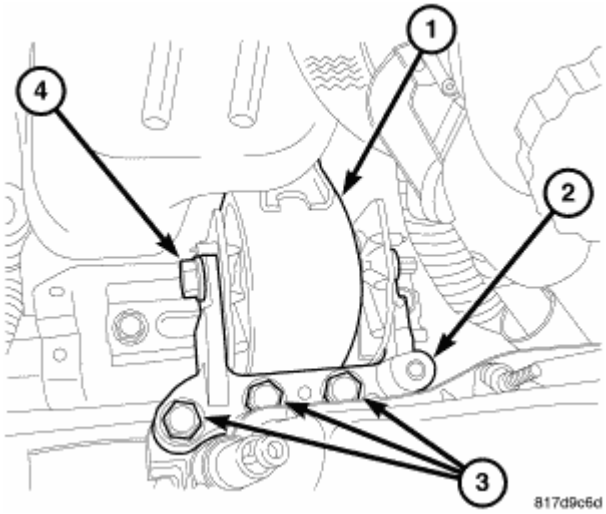


**Fig. 26: RIGHT ENGINE MOUNT**
**Courtesy of CHRYSLER LLC**

46. Remove right engine mount through bolt (4).
47. Remove engine mount adapter retaining bolts (3) and mount adapter (2).
48. Lift engine from engine compartment.

**ENGINE COVER**

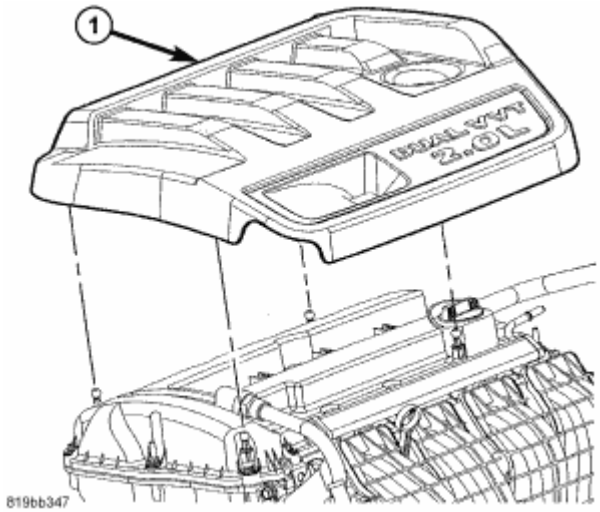


**Fig. 27: ENGINE COVER-2.0L**
**Courtesy of CHRYSLER LLC**

1. Remove engine cover (1) by pulling upwards.

# INSTALLATION

**ENGINE ASSEMBLY**

 

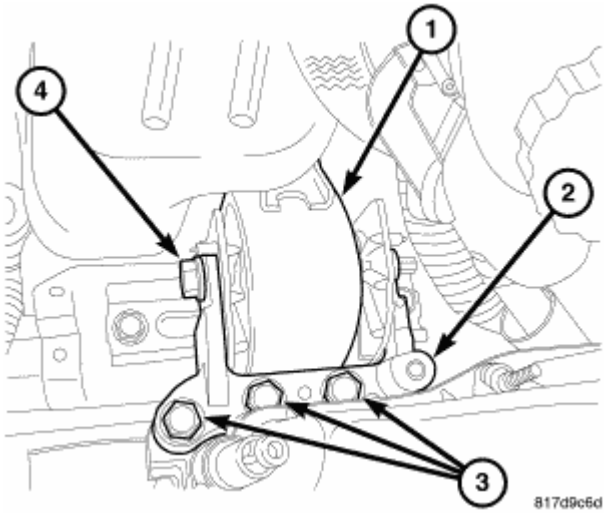


**Fig. 28: RIGHT ENGINE MOUNT**
**Courtesy of CHRYSLER LLC**

1. Position engine assembly over vehicle and slowly lower the engine into place.
2. Continue lowering engine until engine and transaxle are aligned. to mounting locations.
3. Install engine mount adapter (2) and tighten bolts (3). Install mount through bolt (4) and tighten to 118 N.m (87 ft. lbs.).

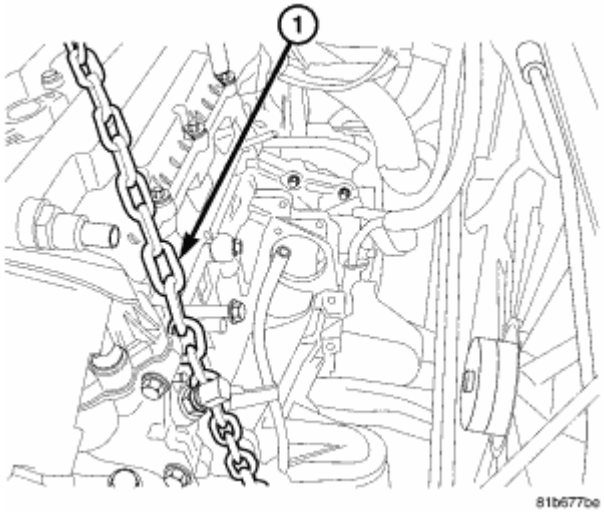


**Fig. 29: LIFT CHAIN**
**Courtesy of CHRYSLER LLC**

4. Remove engine lift chain (1).
5. Install oil control valve.

 

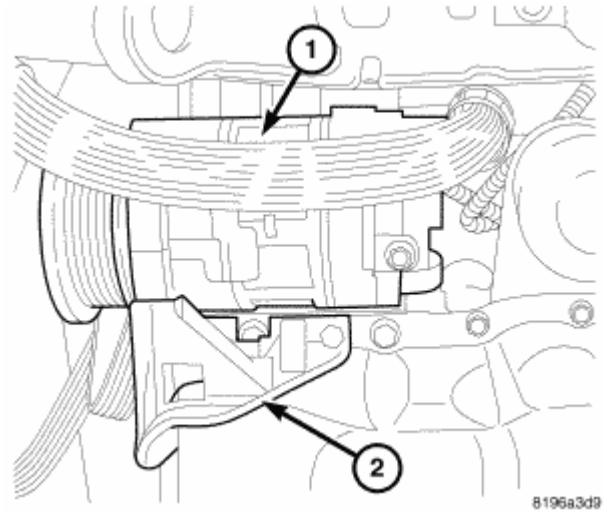


**Fig. 30: A/C COMPRESSOR**
**Courtesy of CHRYSLER LLC**

6. Raise vehicle.
7. Install A/C compressor (1).

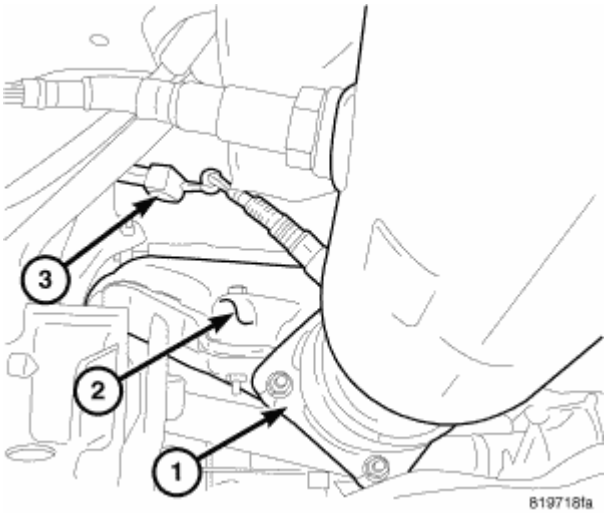


**Fig. 31: CAT AT EXHAUST MANIFOLD**
**Courtesy of CHRYSLER LLC**

8. Install exhaust manifold and heat shields (2). Refer to **INSTALLATION**.
9. Install oxygen sensor and connect electrical connector (3).

 

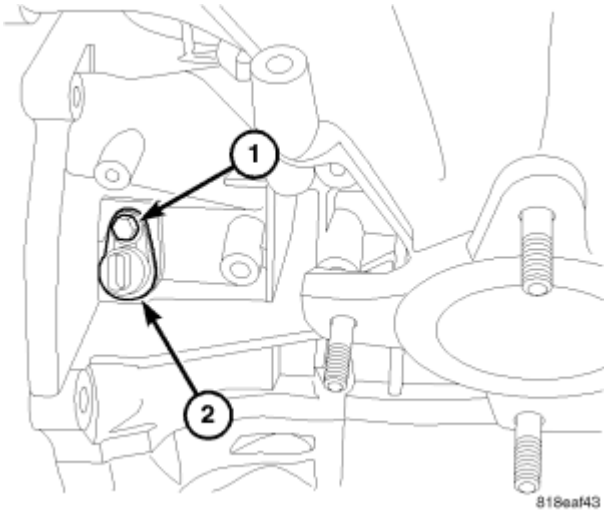


**Fig. 32: Crankshaft Position Sensor**
**Courtesy of CHRYSLER LLC**

10. Install crankshaft position sensor (2) and connect connector.

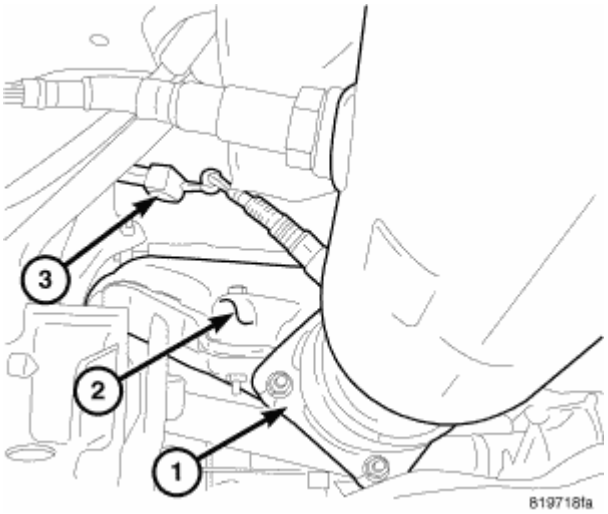


**Fig. 33: CAT AT EXHAUST MANIFOLD**
**Courtesy of CHRYSLER LLC**

11. Install manifold to exhaust pipe bolts (1) and tighten bolts.
12. Install generator.

 

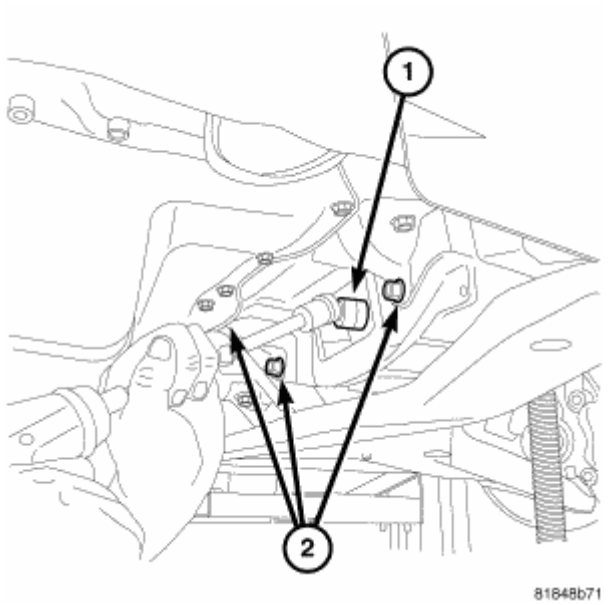


**Fig. 34: MODULAR CLUTCH TO FLEX PLATE BOLTS**
**Courtesy of CHRYSLER LLC**

13. Install lower bell housing bolts (2) and tighten bolts.
14. Align torque converter and flex plate mark. Install torque converter bolts (1) and tighten.

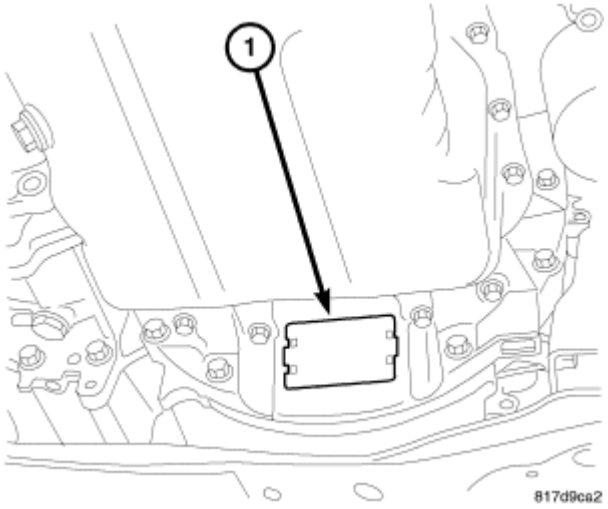


**Fig. 35: INSPECTION COVER**
**Courtesy of CHRYSLER LLC**

15. Install inspection cover (1).

 

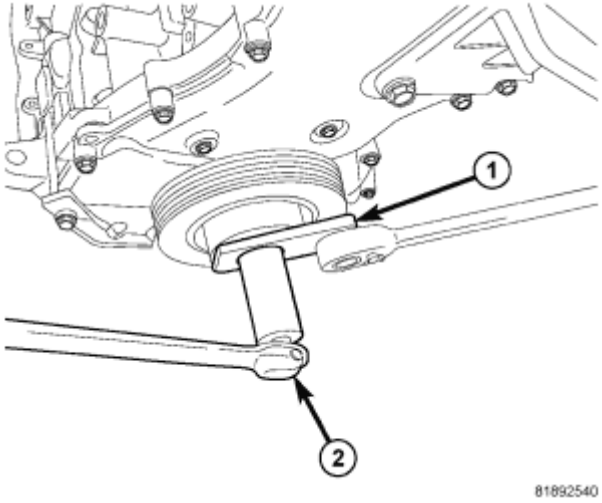


**Fig. 36: DAMPER REMOVAL**
**Courtesy of CHRYSLER LLC**

16. Install crankshaft damper
17. Install Damper holder 9707 (1).
18. Apply clean engine oil crankshaft damper bolt threads and between bolt head and washer. Tighten bolt to 210 N.m (155 ft. lbs.).
19. Install right splash shield.
20. Install tire.

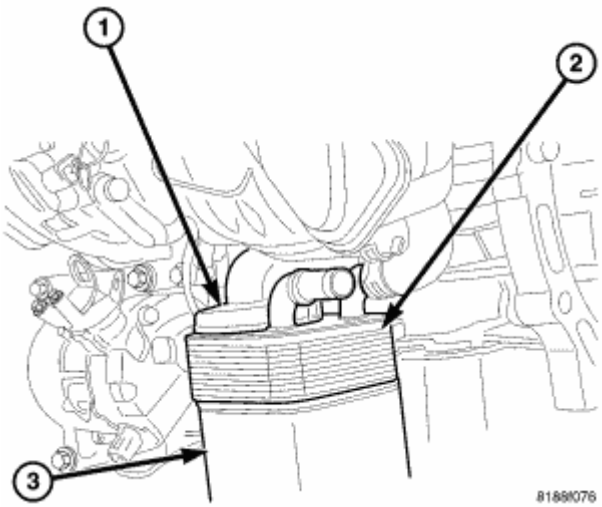


**Fig. 37: OIL COOLER**
**Courtesy of CHRYSLER LLC**

21. Install coolant hose to oil cooler (2).
22. Install new oil filter (3).
23. Lower vehicle.
24. Install upper idler pulley.

 

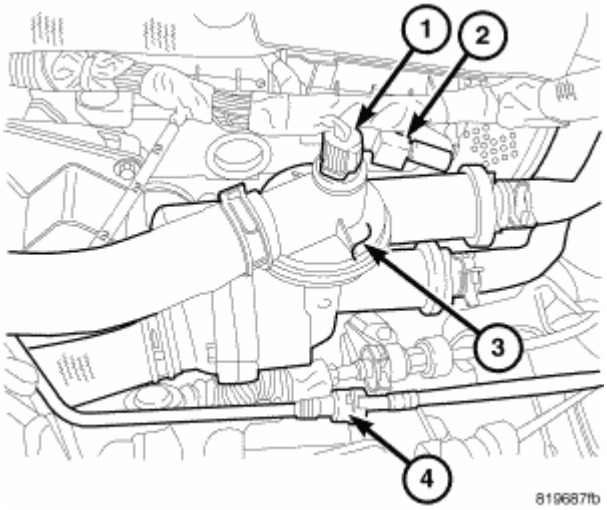


**Fig. 38: COOLANT ADAPTER**
**Courtesy of CHRYSLER LLC**

25. Install coolant adapter assembly (3).

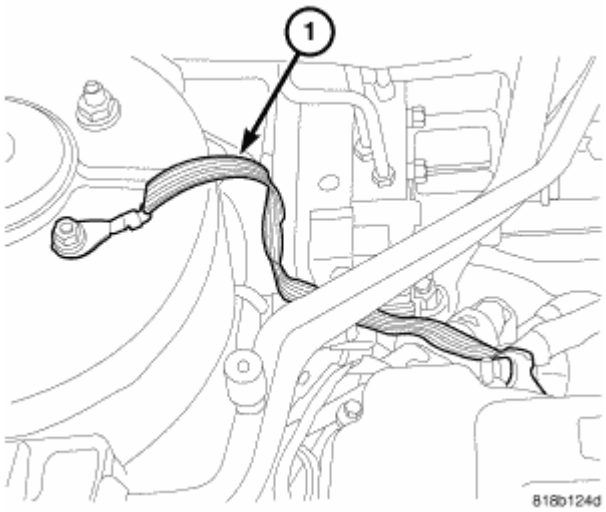


**Fig. 39: GROUND STRAP**
**Courtesy of CHRYSLER LLC**

26. Install Ground strap (1) near right strut tower.

 

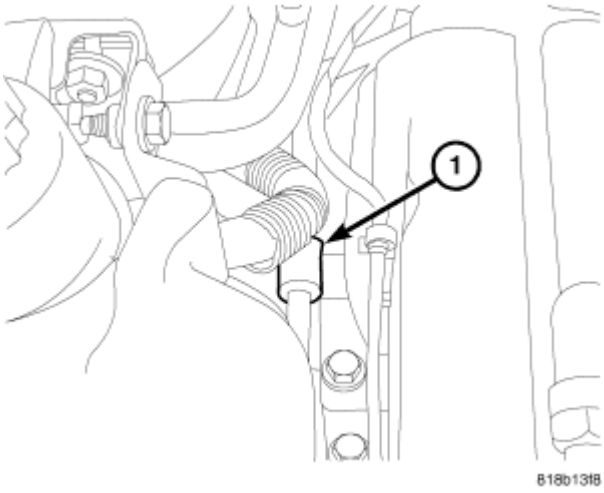


**Fig. 40: POWER STEERING LINE SUPPORT**
**Courtesy of CHRYSLER LLC**

27. Install power steering line support bracket (1).
28. Install power steering pump.
29. Install accessory drive belt.
30. Connect electrical connectors at block ground, starter, A/C compressor, knock sensor, Oil pressure sensor, generator, Coolant temperature sensor at block, and block heater (if equipped).

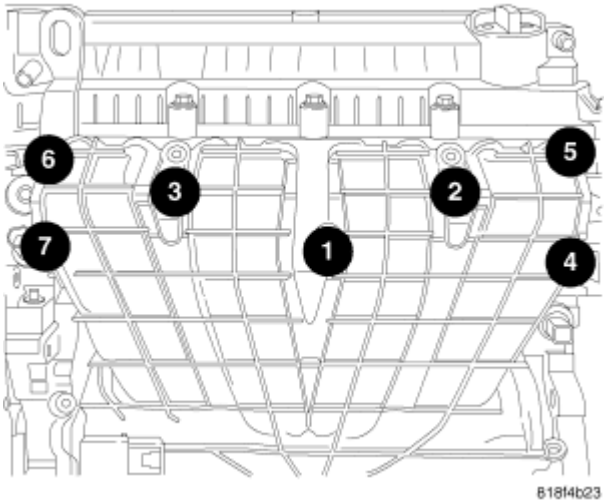


**Fig. 41: Torque Sequence**
**Courtesy of CHRYSLER LLC**

31. Install intake manifold and tighten bolts as shown.

 

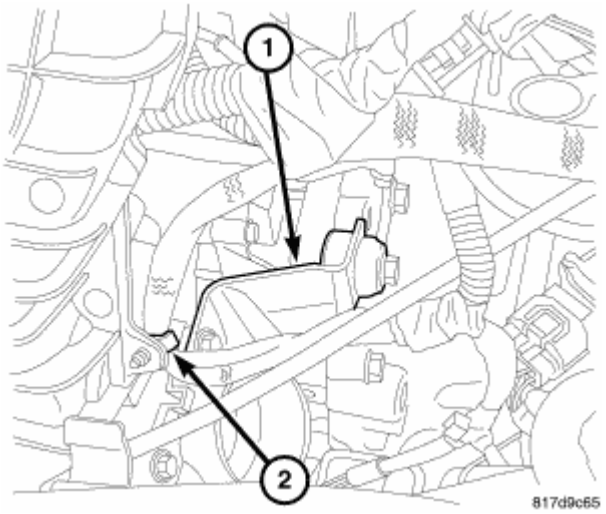


**Fig. 42: THROTTLE BODY SUPPORT**
**Courtesy of CHRYSLER LLC**

32. Install throttle body support bracket (1).
33. Install harness retainer (2).
34. Install engine oil level indicator.

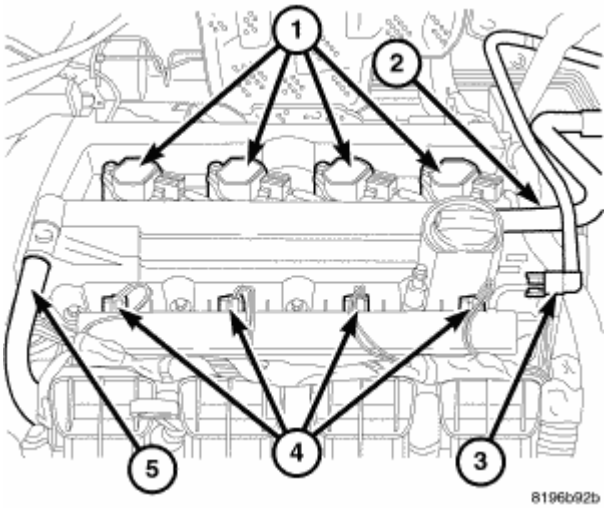


**Fig. 43: COIL CONNECTOR**
**Courtesy of CHRYSLER LLC**

35. Install PCV hose (5) to valve cover.
36. Install make-up air hose (2).
37. Connect manifold flow control valve and electronic throttle control electrical connectors.
38. Install vacuum lines at throttle body and intake manifold.
39. Install intake air tube to throttle body.

 

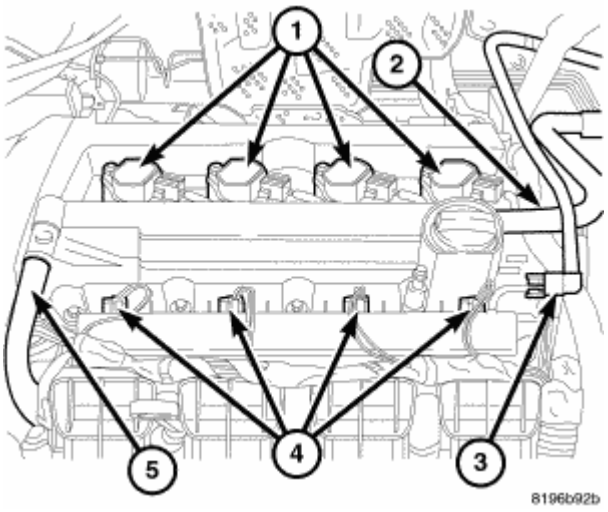


**Fig. 44: COIL CONNECTOR**
**Courtesy of CHRYSLER LLC**

40. Connect coil electrical connectors (1).
41. Connect injector electrical connectors (4).
42. Connect fuel line (3) to rail.
43. Connect intake and exhaust oil control valve electrical connectors.

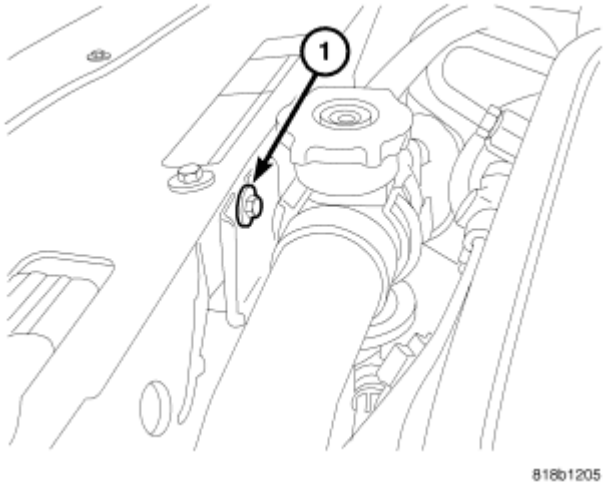


**Fig. 45: RADIATOR HOSE SUPPORT**
**Courtesy of CHRYSLER LLC**

44. Install grill trim panel.
45. Install upper radiator support bracket (1).

 

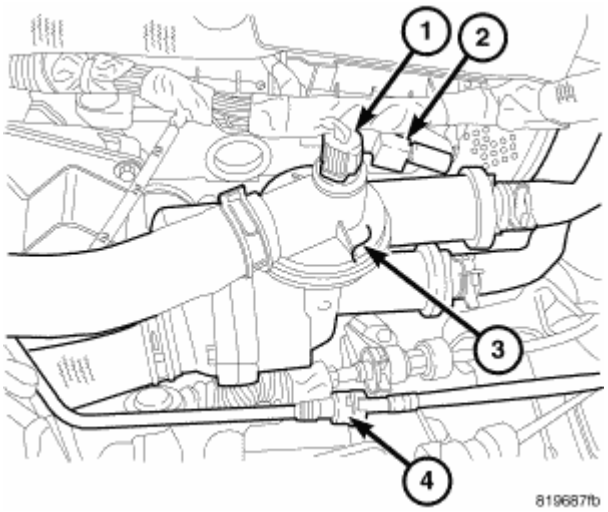


**Fig. 46: COOLANT ADAPTER**
**Courtesy of CHRYSLER LLC**

46. Connect coolant temperature sensor (1).
47. Connect capacitor electrical connector (2).
48. Install coolant hoses at coolant adapter (3).

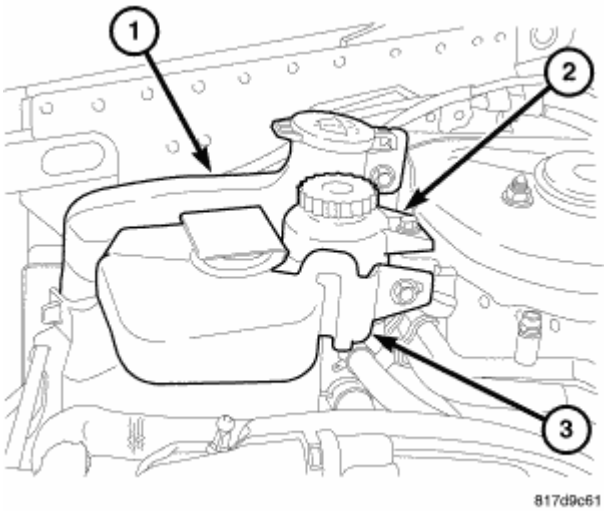


**Fig. 47: COOLANT RESERVOIR**
**Courtesy of CHRYSLER LLC**

49. Install coolant reservoir (3) and connect hose.

 

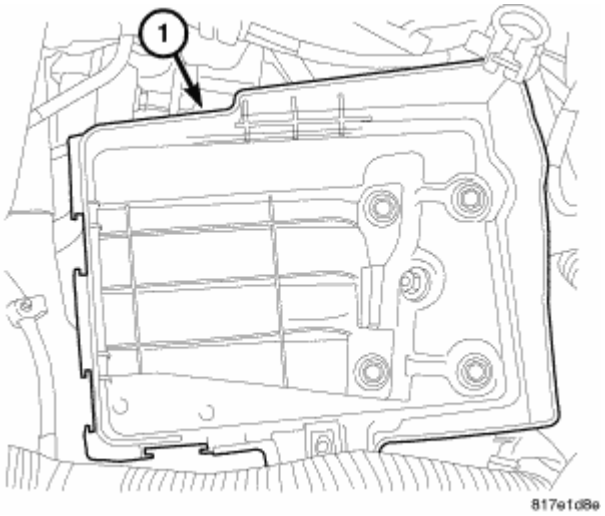


**Fig. 48: BATTERY TRAY**
**Courtesy of CHRYSLER LLC**

50. Install battery tray (1).

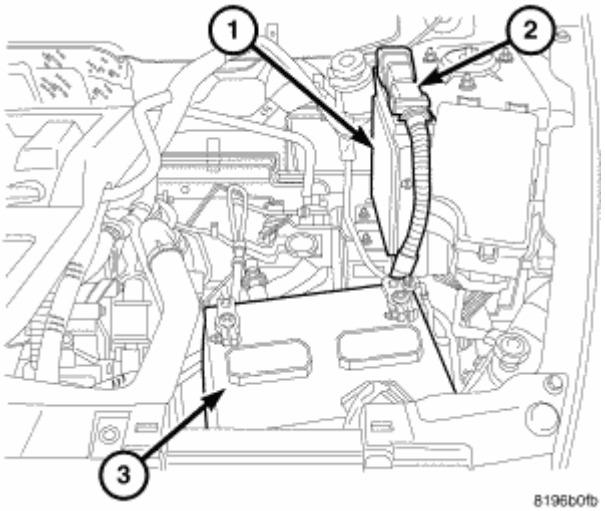


**Fig. 49: BATTERY**
**Courtesy of CHRYSLER LLC**

51. Install battery (3).
52. Connect battery cables.

 

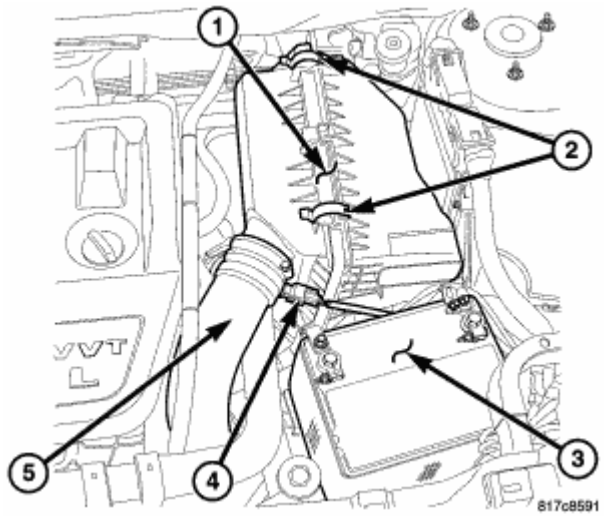


**Fig. 50: AIR CLEANER HOUSING**
**Courtesy of CHRYSLER LLC**

53. Install air cleaner housing (1) and connect inlet air hose.
54. Install clean air hose (5).
55. Fill with coolant.
56. Fill with oil.
57. Start engine and check for leaks.

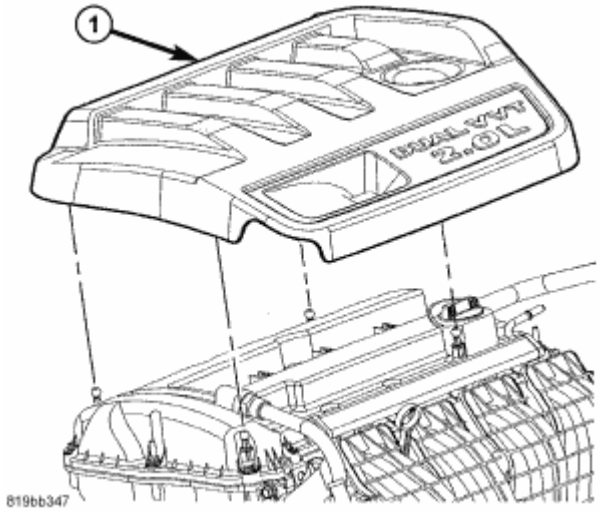


**Fig. 51: ENGINE COVER - 2.0L**
**Courtesy of CHRYSLER LLC**

58. Install engine cover (1).
59. Install hood.

**ENGINE COVER**

 

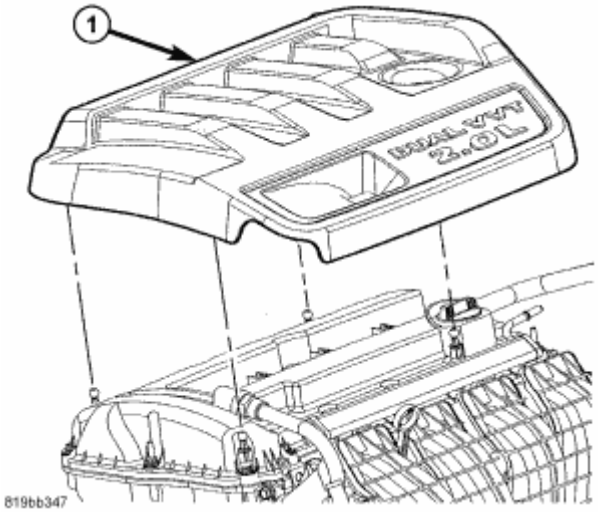


**Fig. 52: ENGINE COVER - 2.0L**
**Courtesy of CHRYSLER LLC**

1. Position engine cover (1) over mounting studs.
2. Seat the cover on the rear studs by pushing downwards.
3. Push downward on the front of the cover to seat the front studs.

## SPECIFICATIONS

### TORQUE

### TORQUE SPECIFICATIONS

| DESCRIPTION | N.m | Ft. Lbs. | In. Lbs. |
|---|---|---|---|
| Balance Shaft Module | 29 + 90° | 22 + 90° | - |
| Bell Housing | 48 | 35 | - |
| Camshaft Sprocket-Bolt | 60 | 44 | - |
| Camshaft Bearing Cap-Bolts | | - | |
| M6 Bolts | 12 | - | 105 |
| M8 Bolts | 34 | 25 | - |
| Connecting Rod Cap-Bolts | 20 +90° | 15 +90° | - |
| coolant temperature Sender | 8 | - | 71 |
| Crankshaft Main Bearing Cap-Bolts | 27 + 45° | 20 + 45° | - |
| Crankshaft Damper-Bolt | 210 | 155 | - |
| Cylinder Head-Bolts | | Refer to Procedure | |
| Cylinder Head Cover-Bolts | 10 | - | 90 |
| Engine Support Bracket-Bolts | 40 | 30 | - |
| Exhaust Manifold-Bolts | 34 | 25 | - |
| Exhaust Manifold Heat Shield-Bolts | 9 | - | 80 |
| Flex Plate to Crankshaft-Bolts | 95 | 70 | - |
| | | | |

 

| | | | |
|---|---|---|---|
| Intake Manifold | 24 | 18 | - |
| Ladder Frame | 22 | 16 | - |
| Oil Cooler Connector Bolt | 49 | 36 | - |
| Oil Filter | 14 | 10 | - |
| Oil Filter Nipple | 49 | 36 | - |
| Oil Jet Fastener | 12 | - | 105 |
| Oil Pan-Bolts | - | - | - |
| M6 Bolts | 9.5 | - | 85 |
| M8 Bolts | 25 | 18 | 220 |
| Oil Pan Drain-Plug | 40 | 30 | - |
| Oil Pressure Switch | 8 | - | 71 |
| PCV Valve | 5 | - | 40 |
| Spark Plugs | 27 | 20 | 239 |
| Timing Chain Cover | - | - | - |
| M6 Bolts | 9 | - | 80 |
| M8 Bolts | 26 | - | 230 |
| Timing Chain Tensioner Assembly-Bolts | 12 N.m | - | 105 |
| Timing Chain Guides | 12 N.m | - | 105 |

**2.0L ENGINE**

**GENERAL SPECIFICATIONS**

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| Type | In-Line OHV, DOHC | |
| Number of Cylinders | 4 | |
| Firing Order | 1-3-4-2 | |
| Compression Ratio | 10.5:1 | |
| Max. Variation Between Cylinders | 25% | |
| Displacement | 2.0 Liters | 122 cu. in. |
| Bore | 86 mm | 3.386 in. |
| Stroke | 86 mm | 3.386 in. |
| Compression Pressure | 1172-1551 kPa | 170-225 psi |

**CYLINDER BLOCK**

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| Material | Cast Aluminum | |
| Cylinder Bore Diameter | - | |
| A | 86.0 < 86.010 | 3.3858 < 3.3862 in. |
| B | 86.010 < 86.020 | 3.3862 < 3.3866 in. |
| C | 86.020 < 86.030 | 3.3866 < 3.3869 in. |

| | | |
|---|---|---|
| Cylinder Bore Out-of-Round (Max.) | 0.020 mm | 0.0008 in. |
| Cylinder Bore Taper (Max.) | 0.028 mm | 0.001 in. |
| Main Bearing Bore Diameter | - | |
| 1 | 56.000 < 56.006 mm | 2.2047 < 2.2049 in. |
| 2 | 56.006 < 56.012 mm | 2.2049 < 2.2051 in. |
| 3 | 56.012 < 56.018 mm | 2.2051 < 2.2054 in. |
| Main Bearing Bore Diameter Taper (Max.) | 0.0082 mm | 0.0003 in. |

**PISTONS**

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | **Metric** | **Standard** |
| Piston Diameter | - | |
| A | 87.995 - 88.015 mm | 3.4644 - 3.4652 in. |
| B | 88.005 - 88.025 mm | 3.4648 - 3.4656 in. |
| C | 88.015 - 88.035 mm | 3.4652 - 3.4659 in. |
| Clearance to Bore | (-0.015) - 0.015 mm | (0.0006) - 0.0006 in. |
| Weight | 345 - 355 grams | 12.17 - 12.52 oz. |
| Land Clearance (Diametrical) | 0.60 - 0.73 mm | 0.0236 - 0.0287 in. |
| Piston Length | 49.0 mm | 2.929 in. |
| Piston Ring Groove Depth No. 1 | 3.51 - 3.68 mm | 0.1382-0.0256 in. |
| Piston Ring Groove Depth No. 2 | 4.05 - 4.25 mm | 0.1594 - 0.1673 in. |
| Piston Ring Groove Depth No. 3 | 2.70 - 2.90 mm | 0.1063 - 0.1142 in. |

**PISTON RINGS**

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | **Metric** | **Standard** |
| Ring Gap-Top Compression Ring | 0.15 - 0.30 mm | 0.0059 - 0.0118 in. |
| Wear Limit | 0.8 mm | 0.031 in. |
| Ring Gap-2nd Compression Ring | 0.30 - 0.45 mm | 0.0118 - 0.0177 in. |
| Wear Limit | 0.8 mm | 0.031 in. |
| Ring Gap-Oil Control Steel Rails | 0.20 - 0.70 mm | 0.0079 - 0.0276 in. |
| Wear Limit | 1.0 mm | 0.039 in. |
| Ring Side Clearance-Compression Rings | 0.03 - 0.07 mm | 0.1182 - 0.0028 in. |
| Wear Limit | 0.10 mm | 0.004 in. |
| Ring Side Clearance-Oil Ring Pack | 0.06 - 0.15 mm | 0.0024 - 0.0059 in. |
| Ring Width-Top Compression Ring | 2.95 - 3.25 mm | 0.1161 - 0.1280 in. |
| Ring Width-2nd Compression | 3.45 - 3.75 mm | 0.1358 - 0.1476 in. |

| | | |
|---|---|---|
| Ring | | |
| Ring Width-Oil Ring Pack | 2.30 - 2.60 mm | 0.0906 - 0.1024 in. |
| Ring Thickness-Top Compression Ring | 1.17 - 1.19 mm | 0.0461 - 0.0469 in. |
| Ring Thickness-2nd Compression Ring | 1.17 - 1.19 mm | 0.0461 - 0.0469 in. |
| Ring Thickness-Oil Ring Pack | 1.88 - 1.95 mm | 0.0740 - 0.0768 in. |

**CONNECTING ROD**

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| Bearing Clearance | 0.032 - 0.060 mm | 0.001 - 0.002 in. |
| Wear Limit | 0.070 mm | 0.0027 in. |
| Bore Diameter-Piston Pin | 20.974 - 20.985 mm | 0.8257 - 0.8261 in. |
| Bore Diameter-Crankshaft End | 51 - 51.015 mm | 2.0078 - 2.0084 in. |
| Side Clearance | 0.1 - 0.25 mm | 0.0039 - 0.0098 in. |
| Wear Limit | 0.27 mm | 0.0106 in. |
| Weight-Total (Less Bearing) | 490 grams | 17.28 oz. |

**CRANKSHAFT**

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| Connecting Rod Journal Diameter | - | |
| Journal Grade | - | |
| 1 | 47.966 - 47.972 mm | 1.8884 - 1.8886 in. |
| 2 | 47.960 - 47.966 mm | 1.8884 - 1.8881 in. |
| 3 | 47.954 - 47.960 mm | 1.8879 - 1.8881 in. |
| Rod Journal- Taper (Max) | 0.005 mm | 0.0001 in. |
| Main Bearing Journal Diameter | - | |
| Journal Grade | - | |
| 0 | 51.985 - 51.988 mm | 2.0466 - 2.0467 in. |
| 1 | 51.982 - 51.985 mm | 2.0465 - 2.0466 in. |
| 2 | 51.979 - 51.982 mm | 2.0464 - 2.0465 in. |
| 3 | 51.976 - 51.979 mm | 2.0462 - 2.0464 in. |
| 4 | 51.973 - 51.976 mm | 2.0461 - 2.0462 in. |
| Journal Out-of-Round (Max.) | 0.005 mm | 0.0001 in. |
| Journal Taper (Max.) | 0.006 mm | 0.0002 in. |
| End Play | 0.05 - 0.25 mm | 0.0019 - 0.0098 in. |
| Wear Limit | 0.30 mm | 0.0118 in. |
| Main Bearing Diametrical Clearance | 0.028 - 0.048 mm | 0.0011 - 0.0018 in. |
| Main Bearing Diametrical | | |

| | | |
|---|---|---|
| Clearance (Max) | 0.058 mm | 0.0022 in. |

**CYLINDER HEAD CAMSHAFT BEARING BORE DIAMETER**

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| Front Cam Bearing Bore | - | |
| Intake | 30.000 - 30.021 mm | 1.1810 - 1.1819 in. |
| Exhaust | 40.000 - 40.024 mm | 1.5747 - 1.5757 in. |
| Cam Bearing Bore No. 1-4 | 24.000 - 24.021 mm | 0.9448 - 0.9457 in. |

**CAMSHAFT**

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| Front Cam Journal Diameter | - | - |
| Intake Cam | 31.984 - 32.000 mm | 1.2592 - 1.2598 in. |
| Exhaust Cam | 35.984 - 36.000 mm | 1.4166 - 1.4173 in. |
| Cam Journal Diameter No. 1-4 | 23.954 - 23.970 mm | 0.943 - 0.944 in. |
| Bearing Clearance - Diametrical | - | - |
| Front Exhaust Journal | 0.019-0.051 mm | 0.0007-0.0020 in. |
| All Others | 0.030 - 0.067 mm | 0.0011 - 0.0026 in. |
| End Play | 0.11 - 0.25 mm | 0.004 - 0.009 in. |
| Max Lift @ 0.2mm (0.007 in.) lash | - | |
| Intake | 9.2 mm | (0.362 in.) |
| Max Lift @ 0.28mm (0.011 in.) lash | - | - |
| Exhaust | 8.42 mm | (0.331 mm) |
| Intake Valve Timing w/ VVT in lock-pin position* | - | |
| Closes (ABDC) | 49.3° | |
| Opens (ATDC) | 10.3° | |
| Duration | 219° | |
| Exhaust Valve Timing w/ VVT in lock-pin position* | - | |
| Closes (BTDC) | 8.45° | |
| Opens (BBDC) | 45° | |
| Duration | 216.55° | |
| Valve Overlap @ 0.5 mm (0.019 in.) w/ VVT in lock-pin position | 18.75° | |

*
All reading in crankshaft degrees at 0.5 mm (0.019 in.) valve lift.

**CYLINDER HEAD**

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| Material | Cast Aluminum - Heat treated | |
| Gasket Thickness (Compressed) | 0.54 mm | 0.021 in. |

**VALVE SEAT**

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| Angle | 44.75° - 45.10° | |
| Seat Outer Diameter - Intake | 34.45 - 34.61 mm | 1.3562 - 1.3625 in. |
| Seat Outer Diameter - Exhaust | 28.04 - 28.20 mm | 1.1039 - 1.1102 in. |
| Runout (Max.) | 0.05 mm | 0.002 in. |
| Valve Seat Width | - | - |
| Intake | 1.16 - 1.46 mm | 0.0456 - 0.0574 in. |
| Exhaust | 1.35 - 1.65 mm | 0.0531 - 0.0649 in. |
| Service Limit - Intake | 2.0 mm | 0.079 in. |
| Service Limit - Exhaust | 2.5 mm | 0.098 in. |

**VALVE GUIDE**

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| Diameter I.D. | 5.500 - 5.512 mm | 0.2165 - 0.2170 in. |
| Guide Bore Diameter | 10.983 - 11.001 mm | 0.432 - 0.4331 in. |
| Guide Height (spring seat to guide tip) | 14.6 - 15.2 mm | 0.5748 - 0.5984 in. |

**VALVES**

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| Face Angle - Intake and Exhaust | 45.25° - 45.75° | |
| Head Diameter - Intake | 34.9 - 35.1 mm | 1.374 -1.3818 in. |
| Head Diameter - Exhaust | 28.9 - 29.1 mm | 1.1377 - 1.1456 in. |
| Valve Lash | - | - |
| Intake | 0.17 - 0.23 mm | 0.006 - 0.009 in. |
| Exhaust | 0.27 - 0.33 mm | 0.010 - 0.12 in. |
| Valve Length (Overall) | - | - |
| Intake | 113.18 mm | 4.455 in. |
| Exhaust | 105.887 mm | 4.168 in. |
| Valve Stem Diameter | - | - |
| Intake | 5.465 - 5.480 mm | 0.2151 - 0.2157 in. |
| Exhaust | 5.458 - 5.470 mm | 0.2148 - 0.2153 in. |

**VALVE MARGIN**

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| Intake | 0.672 mm | 0.0264 in. |
| Exhaust | 0.744 mm | 0.02929 in. |

**VALVE STEM TIP**

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| Intake | 48.04 mm | 1.891 in. |
| Exhaust | 47.99 mm | 1.889 in. |

**VALVE STEM TO GUIDE CLEARANCE**

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| Intake | 0.048 - 0.066 mm | 0.0018 - 0.0025 in. |
| Max. Allowable | 0.076 mm | 0.003 in. |
| Service Limit | 0.25 mm | 0.010 in. |
| Exhaust | 0.0736 - 0.094 mm | 0.0029 - 0.0037 in. |
| Max. Allowable | 0.101 mm | 0.004 in. |
| Service Limit | 0.25 mm | 0.010 in. |

**VALVE SPRINGS**

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| Free Length (Approx.) | 47.0 mm | 1.850 in. |
| Nominal Force (Valve Closed) | 179.5 N ± 9 @ 35.0 mm | 40.35 lbs. @ 2.023 in. |
| Nominal Force (Valve Open) | 364.8 N ± 17 N @ 29.25 mm | 82.01 lbs. ± 3.82 lbs. @ 1.152 in. |
| Installed Height | 35.00 mm | 1.378 in. |
| Number of Coils | 8.5 ± 0.1 | |
| Wire Diameter | 2.90 mm ± 0.03 | 0.114 in ± 0.001 in. |

**OIL PRESSURE**

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| At Curb Idle Speed* | 25 kPa | 4 psi. min. |
| At 3000 RPM | 170 - 550 kPa | 25 - 80 psi. |

**CAUTION:**
***If pressure is ZERO at curb idle, DO NOT run engine at 3000 RPM.**

## SPECIAL TOOLS

**WORLD ENGINE**

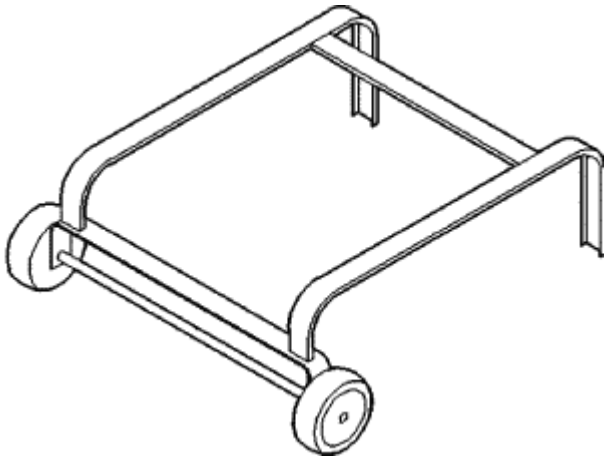

**Fig. 53: DOLLY 6135**
**Courtesy of CHRYSLER LLC**

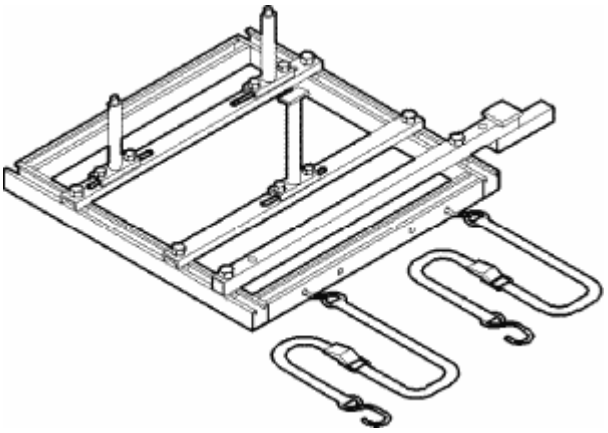

**Fig. 54: CRADLE 6710**
**Courtesy of CHRYSLER LLC**

 

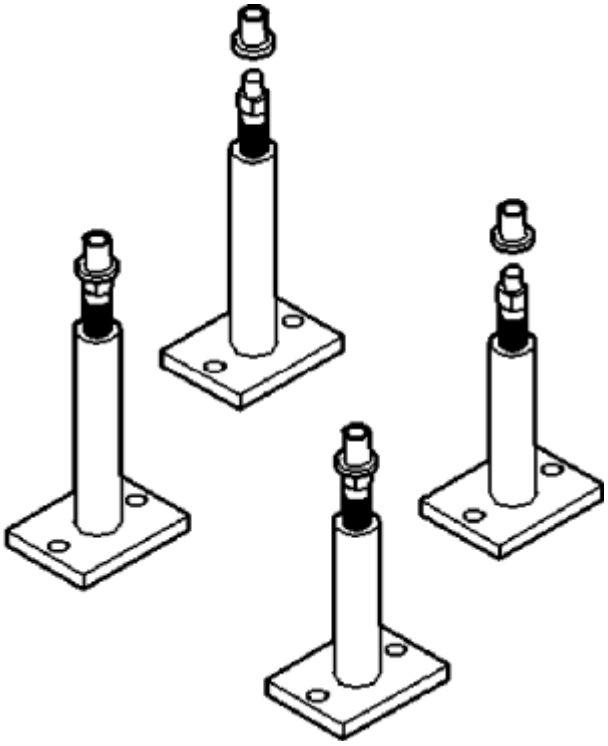

**Fig. 55: POST KIT ENGINE CRADLE 6848**
**Courtesy of CHRYSLER LLC**

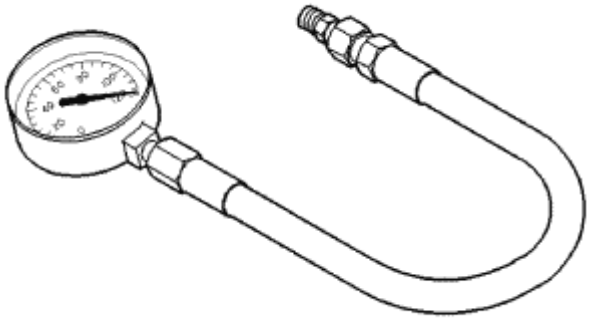

**Fig. 56: OIL PRESSURE GAGE C-3292**
**Courtesy of CHRYSLER LLC**

 

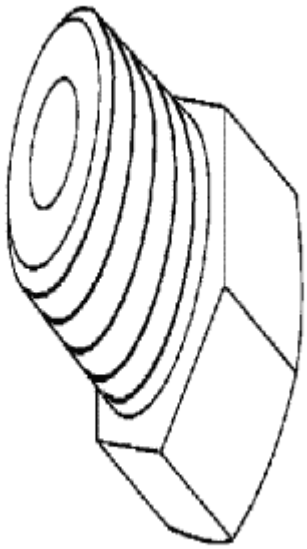

**Fig. 57: OIL PRESSURE ADAPTER-9879**
**Courtesy of CHRYSLER LLC**

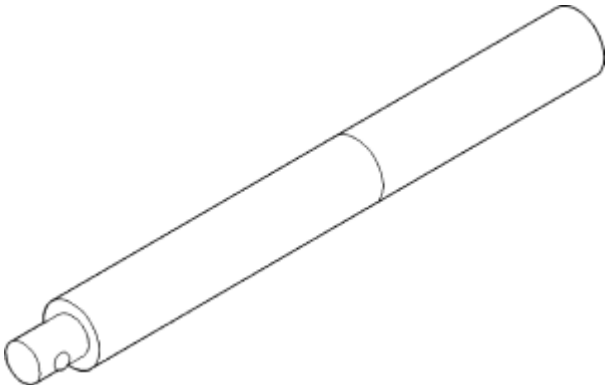

**Fig. 58: DRIVER HANDLE C-4171**
**Courtesy of CHRYSLER LLC**

 

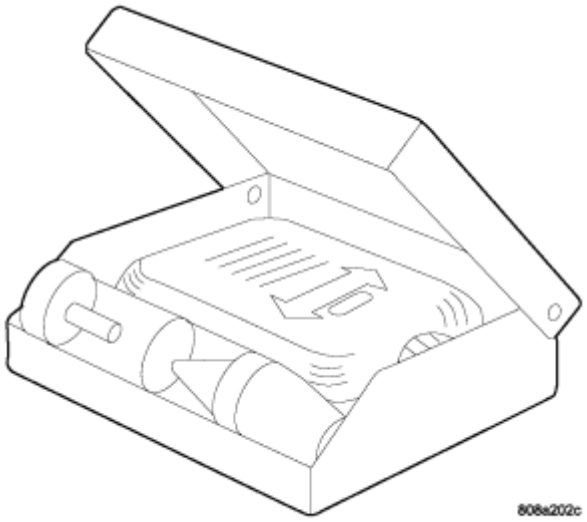


**Fig. 59: COMBUSTION LEAK TESTER C-3685-A**
**Courtesy of CHRYSLER LLC**

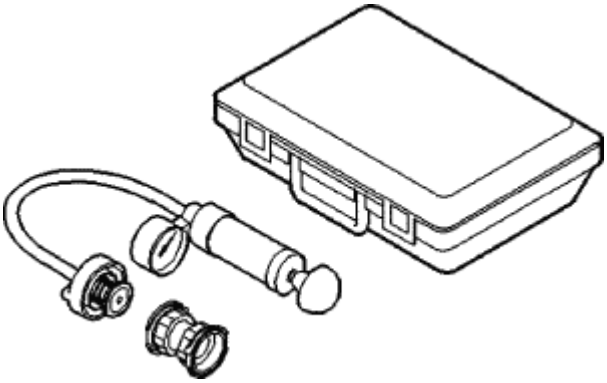

**Fig. 60: COOLING SYSTEM TESTER 7700**
**Courtesy of CHRYSLER LLC**

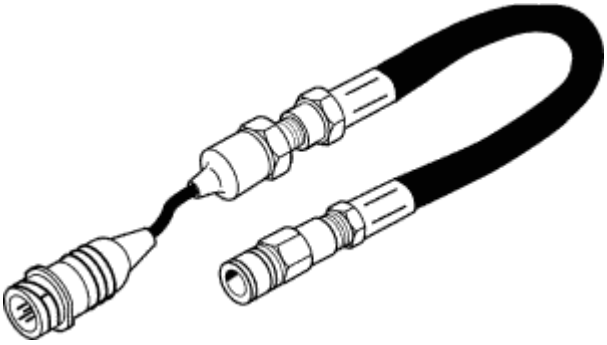

**Fig. 61: PRESSURE TRANSDUCER CH7059**
**Courtesy of CHRYSLER LLC**

 

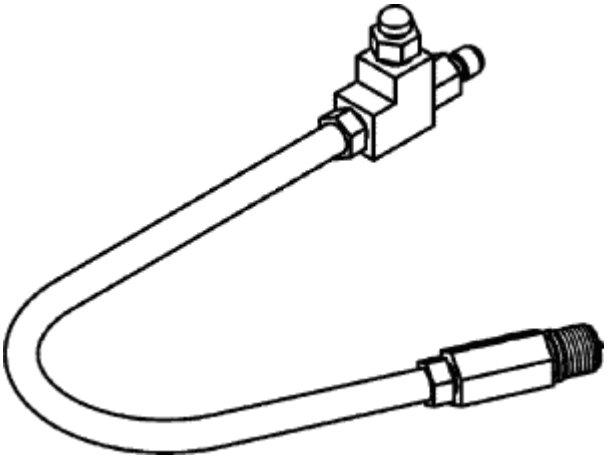

**Fig. 62: CYLINDER COMPRESSION PRESSURE ADAPTOR 8116**
**Courtesy of CHRYSLER LLC**


**Fig. 63: DRB III® WITH PEP MODULE OT-CH6010A**
**Courtesy of CHRYSLER LLC**

 

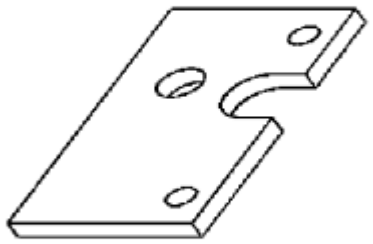

**Fig. 64: ADAPTER PLATE 9704**
**Courtesy of CHRYSLER LLC**

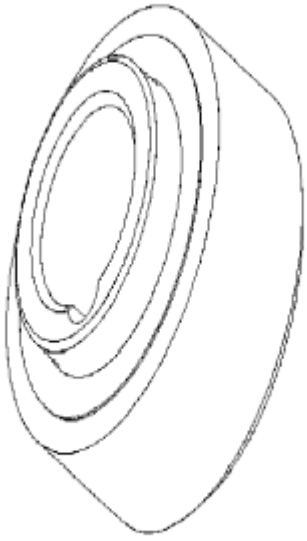

**Fig. 65: FRONT SEAL INSTALLER 9506**
**Courtesy of CHRYSLER LLC**

 

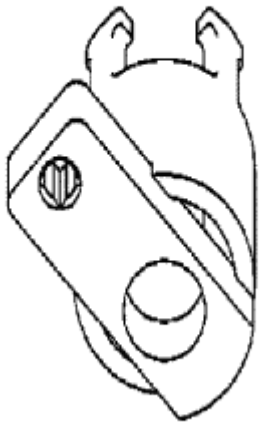

**Fig. 66: HOLDING FIXTURE 9707**
**Courtesy of CHRYSLER LLC**

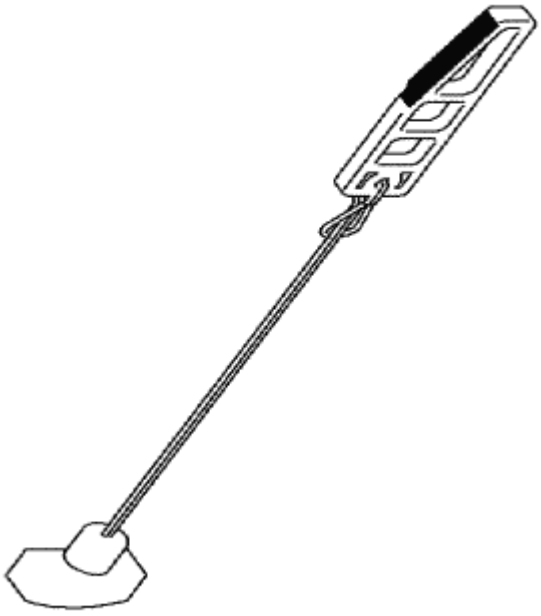

**Fig. 67: LOCKING WEDGE 9701**
**Courtesy of CHRYSLER LLC**

 

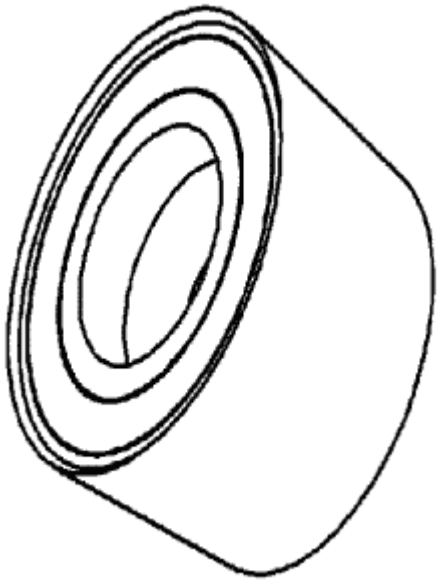

**Fig. 68: REAR CRANKSHAFT SEAL GUIDE 9509**
**Courtesy of CHRYSLER LLC**

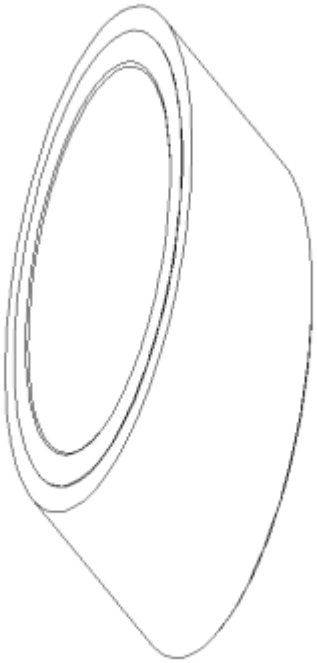

**Fig. 69: REAR MAIN SEAL DRIVER 9706**
**Courtesy of CHRYSLER LLC**

 

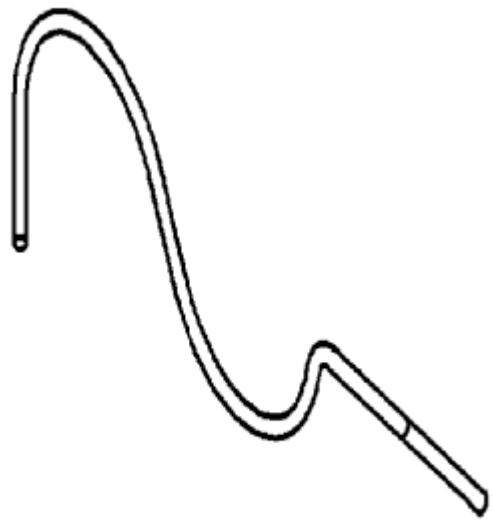

**Fig. 70: TENSIONER PIN 9703**
**Courtesy of CHRYSLER LLC**

# ENGINE DATA PLATE

## DESCRIPTION

### 2.4L ENGINE

The 2.4 Liter (148 cu. in.) in-line four cylinder engine is a double overhead camshaft design with mechanical lash tappets and four valves per cylinder design. This engine is NOT free-wheeling; meaning that the pistons will contact the valves in the event of a timing chain failure.

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

 

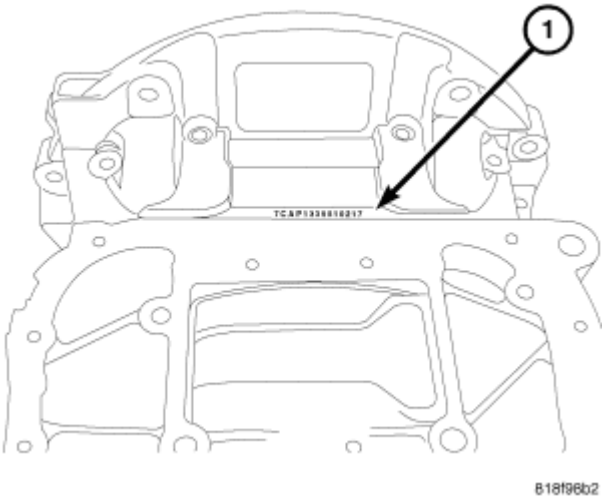


**Fig. 71: Locating Engine Serial Number**
**Courtesy of CHRYSLER LLC**

The engine serial number (1) is located on the rear of the cylinder block behind the oil pan. The serial number is visible with the oil pan in place. The serial number contains engine build date information.

# AIR INTAKE SYSTEM

### ELEMENT-AIR CLEANER

#### REMOVAL

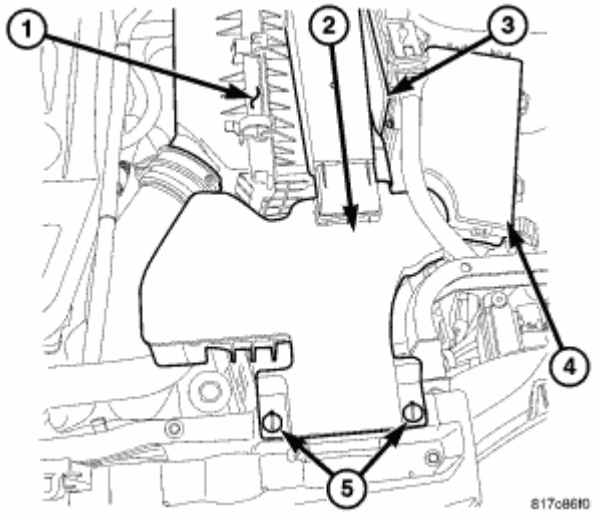


**Fig. 72: AIR CLEANER INLET**
**Courtesy of CHRYSLER LLC**

1. Turn lock retainers (5) and remove fresh air inlet (2) from air cleaner housing (1).

 

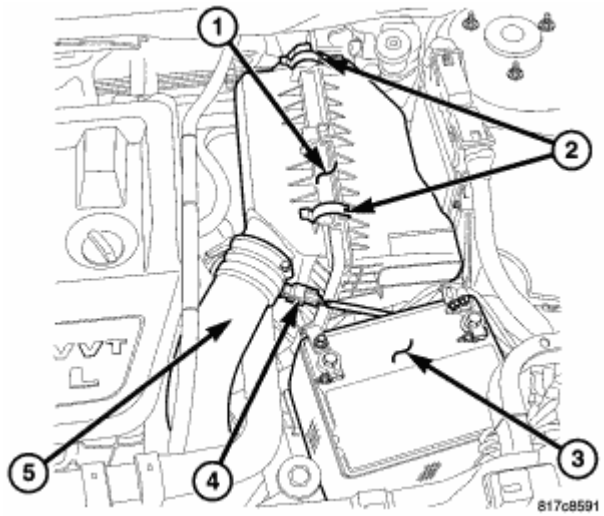


**Fig. 73: AIR CLEANER HOUSING**
**Courtesy of CHRYSLER LLC**

2. Disconnect intake air temperature sensor connector (4).
3. Remove air inlet tube (5) from air cleaner housing (1).
4. Unfasten clasps (2) on sides of air cleaner housing cover.

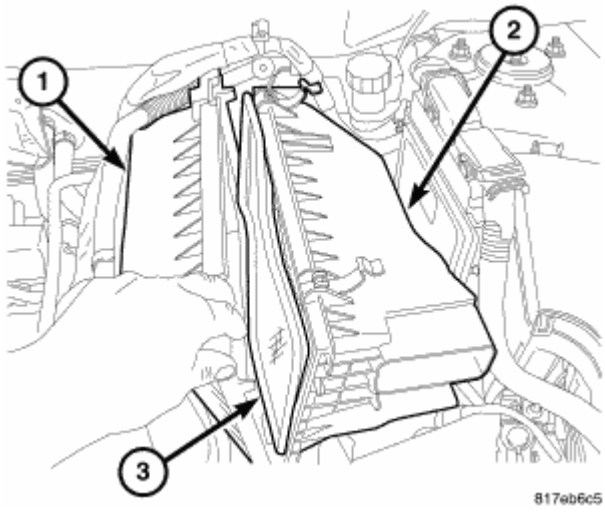


**Fig. 74: AIR FILTER**
**Courtesy of CHRYSLER LLC**

5. Pull air cleaner cover (1) aside.
6. Remove filter element (3).
7. If necessary, clean the inside of the air cleaner housing (2).

**INSTALLATION**

 

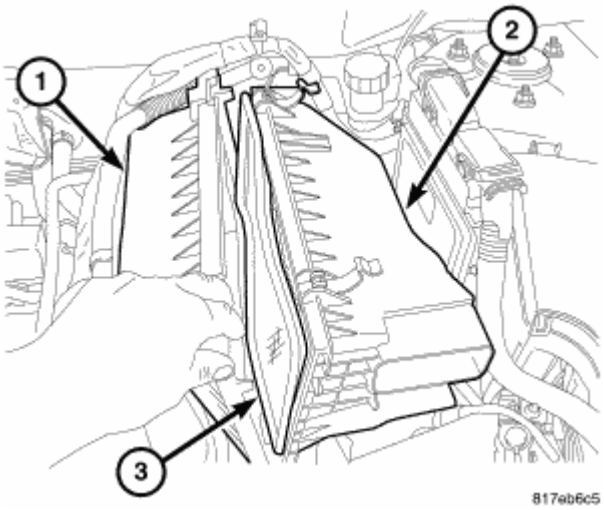


**Fig. 75: AIR FILTER**
**Courtesy of CHRYSLER LLC**

1. Install new filter element.

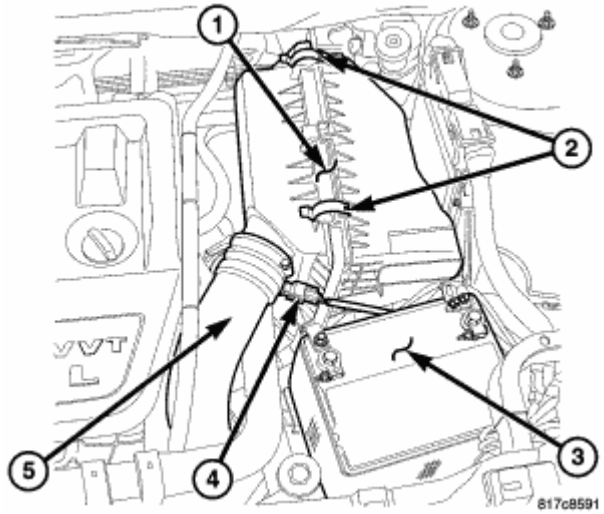


**Fig. 76: AIR CLEANER HOUSING**
**Courtesy of CHRYSLER LLC**

2. Place cover over air cleaner housing. Snap clasps (2) in place.
3. Install air inlet tube (5).
4. Connect intake air temperature sensor connector (4).

 

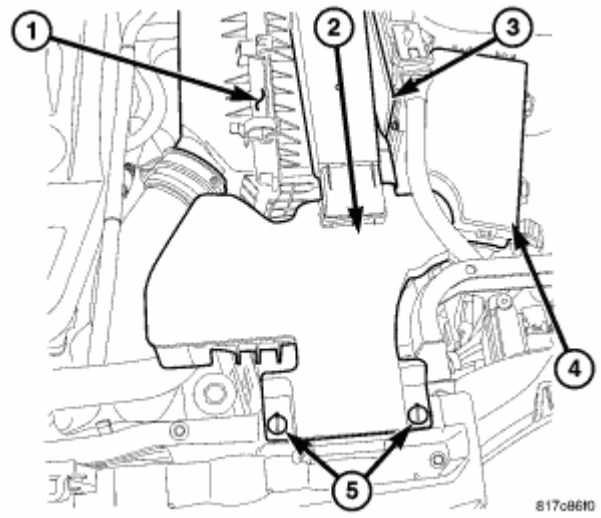


**Fig. 77: AIR CLEANER INLET**
**Courtesy of CHRYSLER LLC**

5. Install fresh air inlet (2) on air cleaner housing (1) and lock retainers (5).

## HOUSING-AIR CLEANER

### REMOVAL

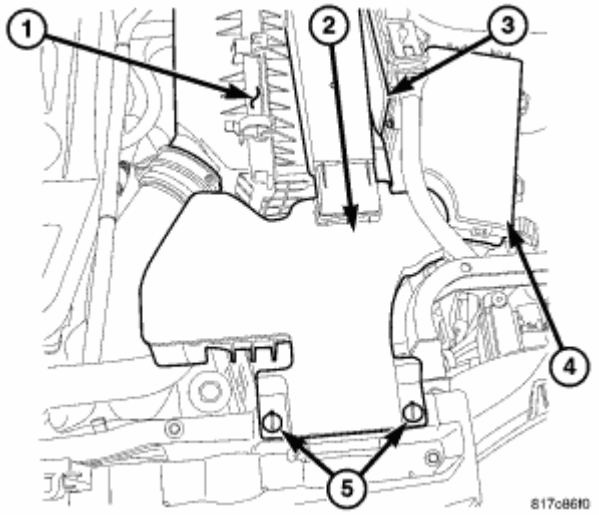


**Fig. 78: AIR CLEANER INLET**
**Courtesy of CHRYSLER LLC**

1. Remove fresh air inlet (2) from air cleaner housing (1).

 

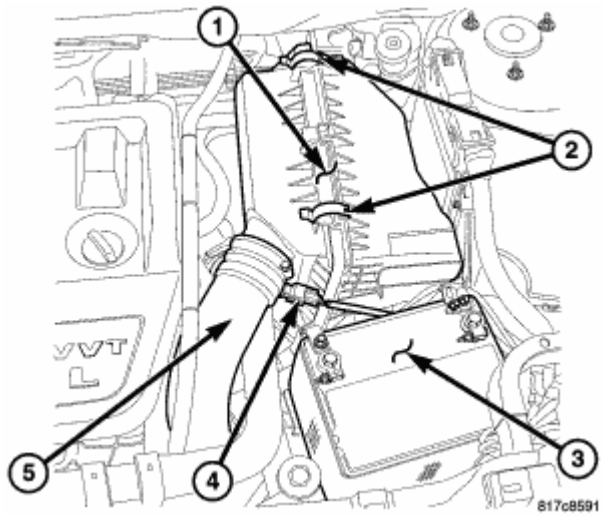


**Fig. 79: AIR CLEANER HOUSING**
**Courtesy of CHRYSLER LLC**

2. Remove intake air temperature sensor electrical connector (4).
3. Remove air inlet tube (5) from housing (1).
4. Pull housing (1) upward to remove.

**INSTALLATION**

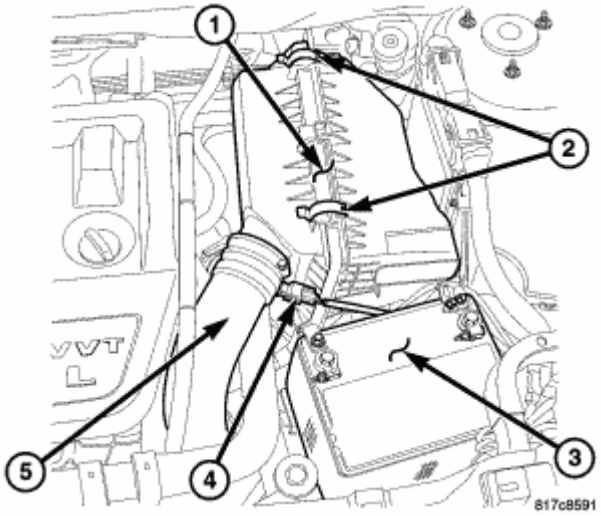


**Fig. 80: AIR CLEANER HOUSING**
**Courtesy of CHRYSLER LLC**

1. Make sure the rubber grommets, for the air cleaner housing lower pins, are in place when reinstalling the air cleaner housing. The rubber grommets mount to the PDC bracket.
2. Push air cleaner housing (1) down while aligning pins into the grommets.
3. Connect the throttle body air inlet hose (5) to the air cleaner housing (1).
4. Connect intake air temperature sensor connector (4).

 

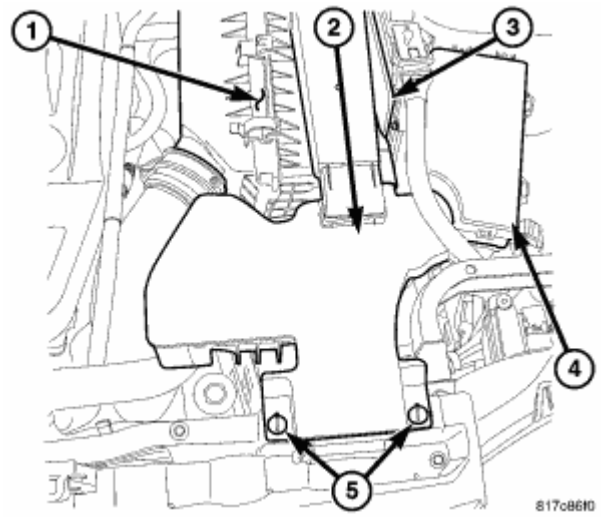


**Fig. 81: AIR CLEANER INLET**
**Courtesy of CHRYSLER LLC**

5. Install fresh air inlet (2) and lock retainers (5).

# CYLINDER HEAD

### DESCRIPTION

The cross flow designed, aluminum cylinder head contains dual overhead camshafts with four valves per cylinder. The valves are arranged in two in-line banks. The intake valves face toward the front of the vehicle. The exhaust valves face the dash panel. The cylinder head incorporates powdered metal valve guides and seats. The cylinder head is sealed to the block using a multi-layer steel head gasket and retaining bolts.

Integral oil galleries provide lubrication passages to the variable camshaft timing phasers, camshafts, and valve mechanisms.

**NOTE: Replacement cylinder heads will come complete with valves, seals, springs, retainers, keepers, lash buckets, and camshafts.**

### DIAGNOSIS AND TESTING

A cylinder head gasket leak can be located between adjacent cylinders, between a cylinder and the adjacent water jacket or from an oil passage to the exterior of the engine.

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

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

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

 

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

#### CYLINDER-TO-CYLINDER LEAKAGE TEST

To determine if an engine cylinder head gasket is leaking between adjacent cylinders, follow the procedures in Cylinder Compression Pressure Test. Refer to **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 combustion leak tester C-3685-A or equivalent. Perform test following the procedures supplied with the tool kit.

## REMOVAL

 

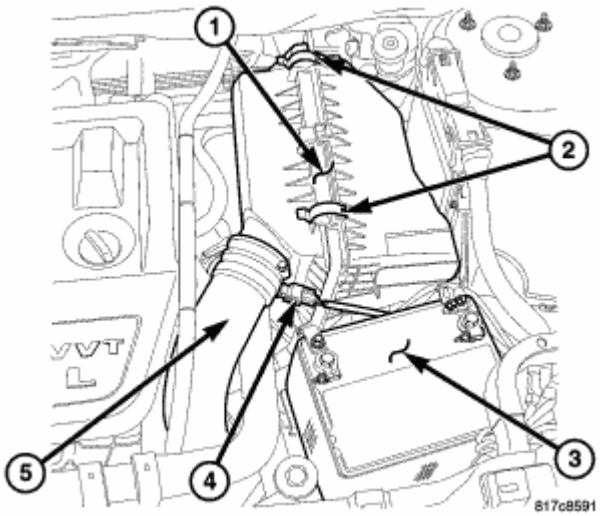


**Fig. 82: AIR CLEANER HOUSING**
**Courtesy of CHRYSLER LLC**

1. Perform fuel system pressure release procedure **before attempting any repairs** . Refer to **STANDARD PROCEDURE** .
2. Remove clean air hose and air cleaner housing (1). Refer to **REMOVAL**.
3. Disconnect negative cable from battery (3).
4. Drain cooling system. Refer to **STANDARD PROCEDURE** .

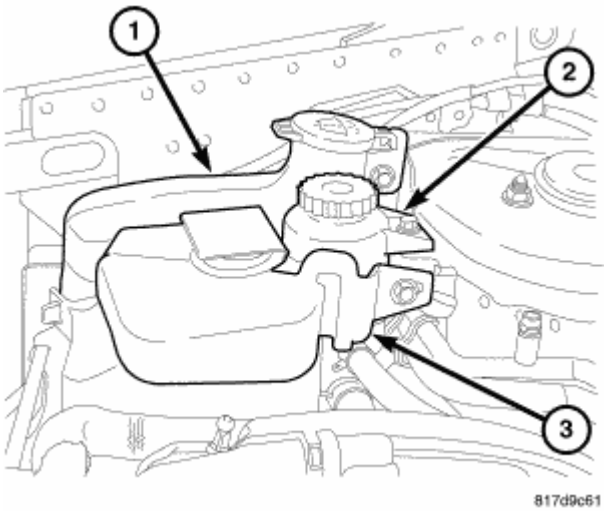


**Fig. 83: COOLANT RESERVOIR**
**Courtesy of CHRYSLER LLC**

5. Remove engine cover.
6. Remove coolant recovery bottle (3).
7. Remove and reposition power steering reservoir (2).
8. Remove power steering pump and reposition.
9. Remove windshield washer bottle (1).

 

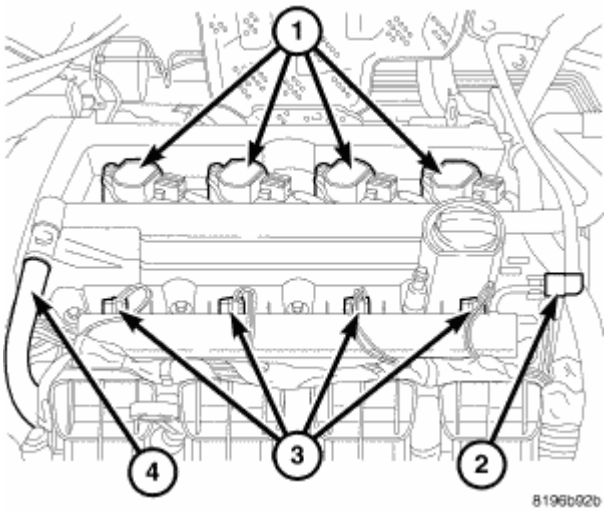


**Fig. 84: COIL CONNECTOR**
**Courtesy of CHRYSLER LLC**

10. Disconnect breather hose.
11. Disconnect PCV hose (4).
12. Disconnect ignition coil electrical connectors (1).
13. Remove cylinder head cover.

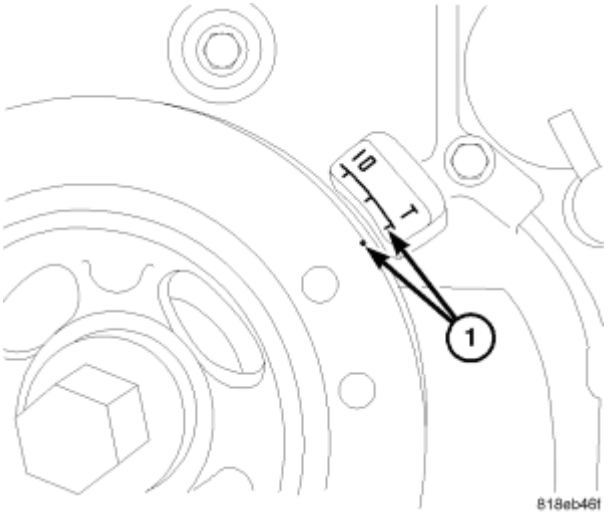


**Fig. 85: TDC**
**Courtesy of CHRYSLER LLC**

14. Raise vehicle.
15. Remove right splash shield.
16. Set engine to TDC (1).
17. Remove accessory drive belts. Refer to **REMOVAL** .

 

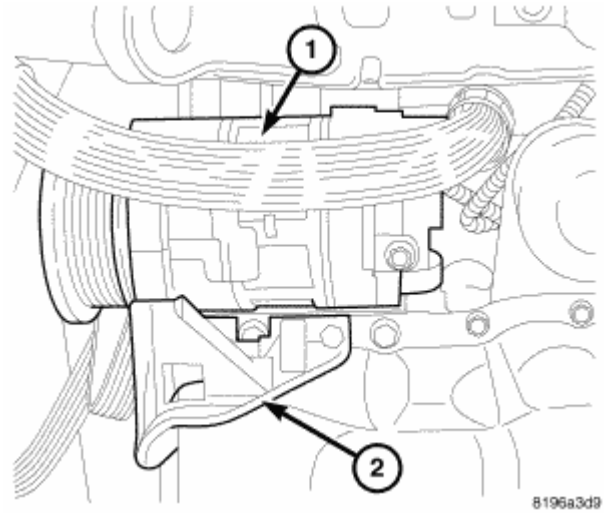


**Fig. 86: A/C COMPRESSOR**
**Courtesy of CHRYSLER LLC**

18. Remove lower A/C compressor bolts if equipped.
19. Remove lower A/C compressor mount (2) if equipped.

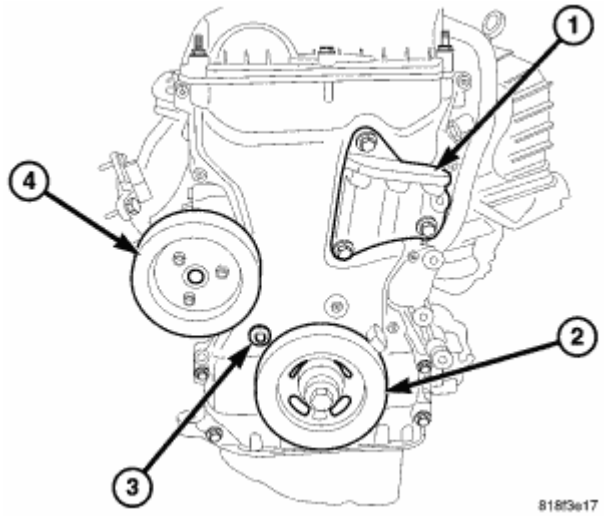


**Fig. 87: ENGINE FRONT**
**Courtesy of CHRYSLER LLC**

20. Remove accessory drive belt lower idler pulley.
21. Remove crankshaft damper (2).
22. Remove water pump pulley (4).
23. Remove right side engine mount bracket (1) lower bolt.

 

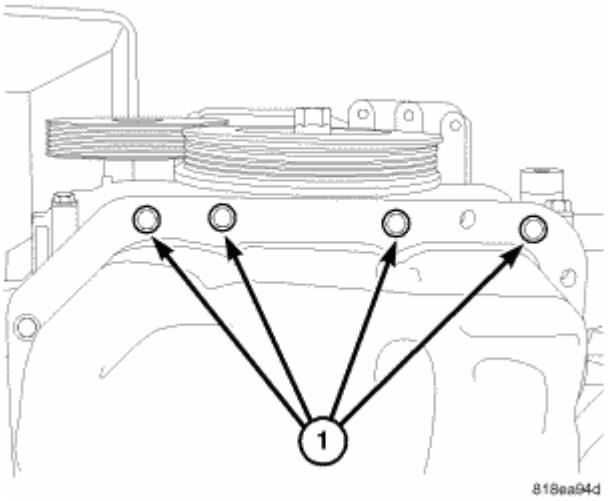


**Fig. 88: TIMING CHAIN COVER LOWER BOLTS**
**Courtesy of CHRYSLER LLC**

24. Remove timing chain cover lower bolts (1).

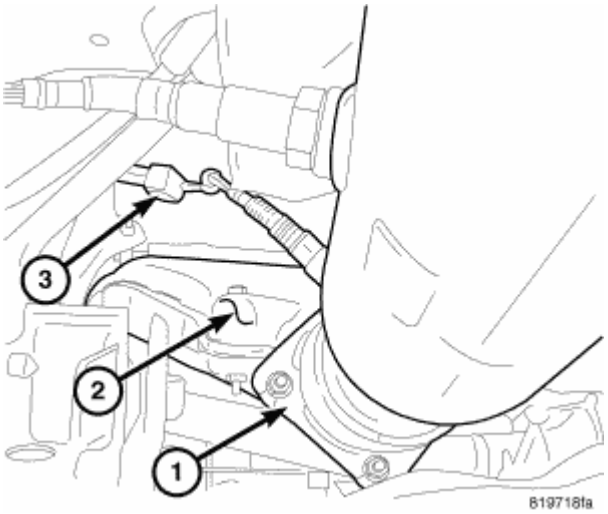


**Fig. 89: CAT AT EXHAUST MANIFOLD**
**Courtesy of CHRYSLER LLC**

25. Disconnect oxygen sensor electrical connector (3).
26. Remove exhaust pipe at manifold nuts (1) and remove pipe.
27. Lower vehicle.
28. Support engine with suitable jack.

 

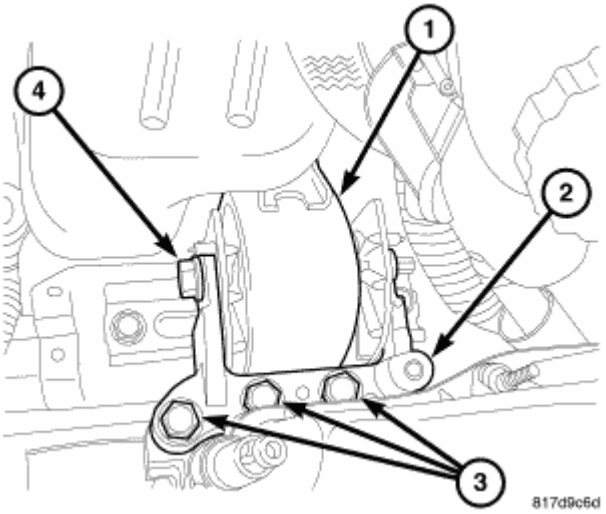


**Fig. 90: RIGHT ENGINE MOUNT**
**Courtesy of CHRYSLER LLC**

29. Remove right engine mount through bolt (4).
30. Remove right engine mount to mount bracket bolts (3).
31. Remove right engine mount adapter (2).

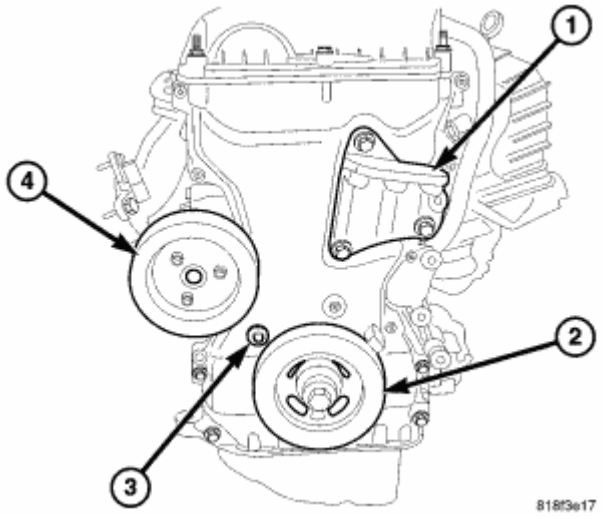


**Fig. 91: ENGINE FRONT**
**Courtesy of CHRYSLER LLC**

32. Remove accessory drive upper idler pulley.
33. Remove right upper engine mount bracket (1).
34. Remove accessory drive belt tensioner.
35. Remove upper timing chain cover retaining bolts.
36. Remove timing chain cover.

 

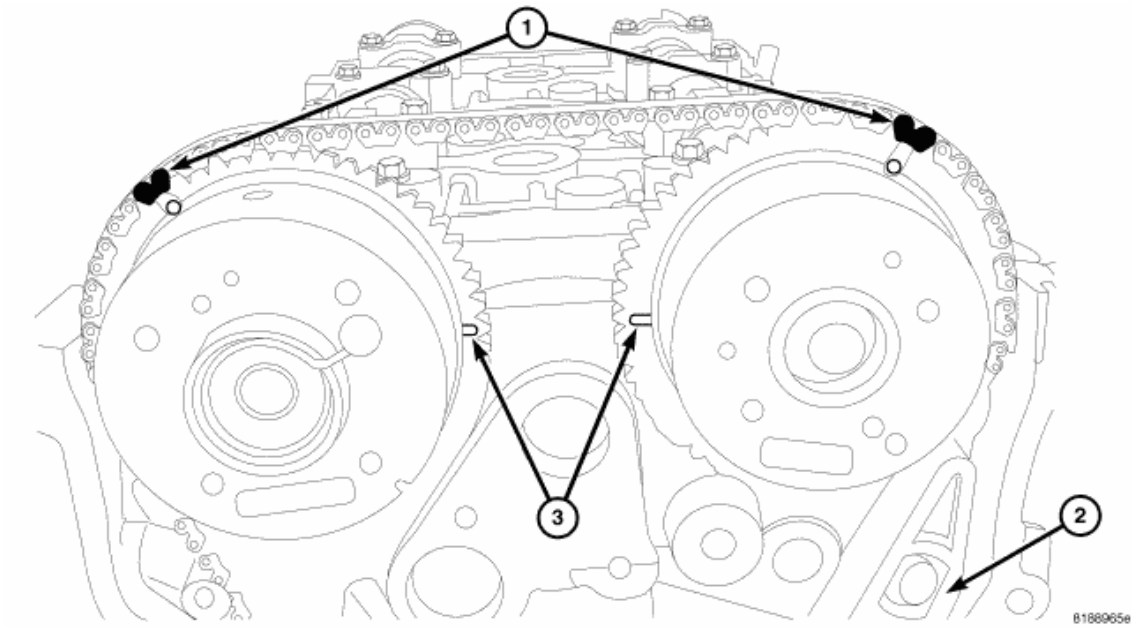


**Fig. 92: TIMING CHAIN TIMING MARKS**
**Courtesy of CHRYSLER LLC**

**NOTE: If the timing chain plated links can no longer be seen, the timing chain links corresponding to the timing marks must be marked prior to removal if the chain is to be reused.**

37. Mark chain link (1) corresponding to camshaft timing mark.

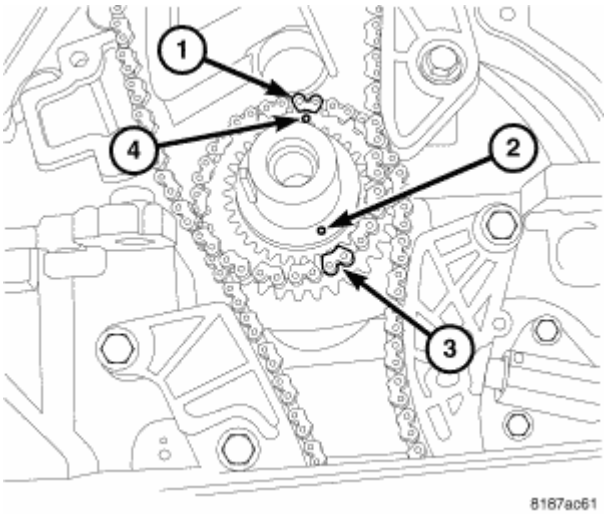


**Fig. 93: CRANKSHAFT TIMING MARKS**
**Courtesy of CHRYSLER LLC**

38. Mark chain link (3) corresponding to crankshaft timing mark (2).

 

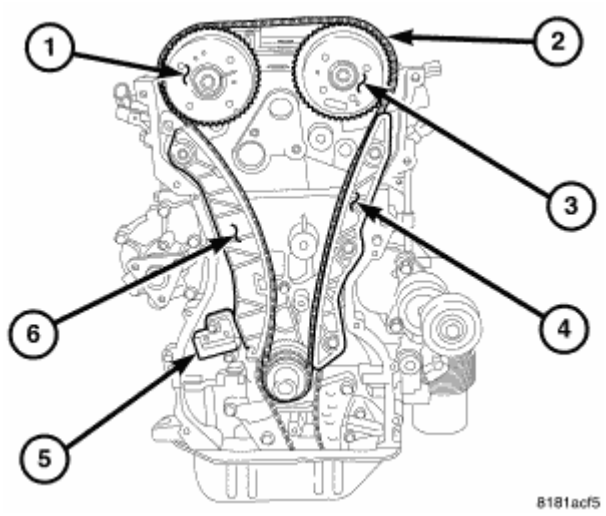


**Fig. 94: TIMING DRIVE**
**Courtesy of CHRYSLER LLC**

39. Remove timing chain tensioner (5).
40. Remove timing chain (2).
41. Remove timing chain guides (4,6).

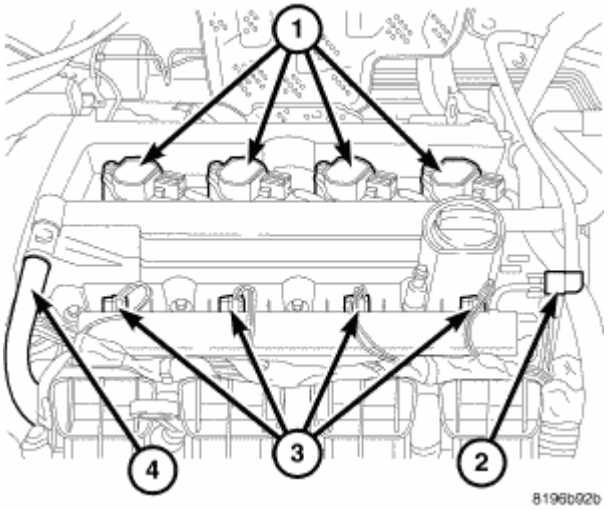


**Fig. 95: COIL CONNECTOR**
**Courtesy of CHRYSLER LLC**

42. Disconnect fuel line at the fuel rail (2).
43. Disconnect fuel injector electrical connectors (3).
44. Disconnect top engine electrical connectors and reposition harness.
45. Remove fuel rail.

 

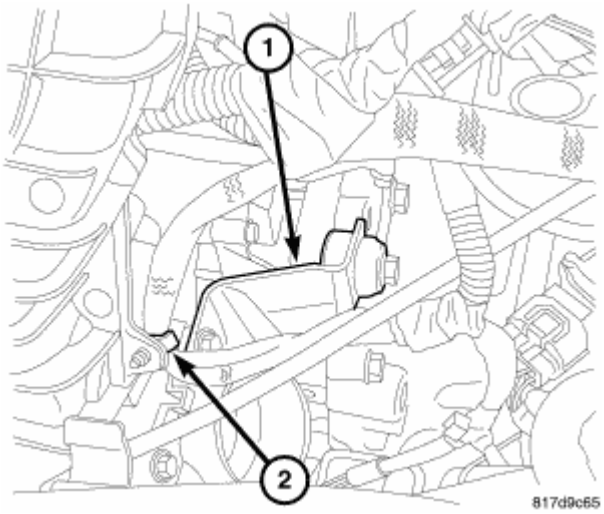


**Fig. 96: THROTTLE BODY SUPPORT**
**Courtesy of CHRYSLER LLC**

46. Remove throttle body support bracket retaining bolt (2).
47. Disconnect electronic throttle control electrical connector.
48. Disconnect map sensor electrical connector.

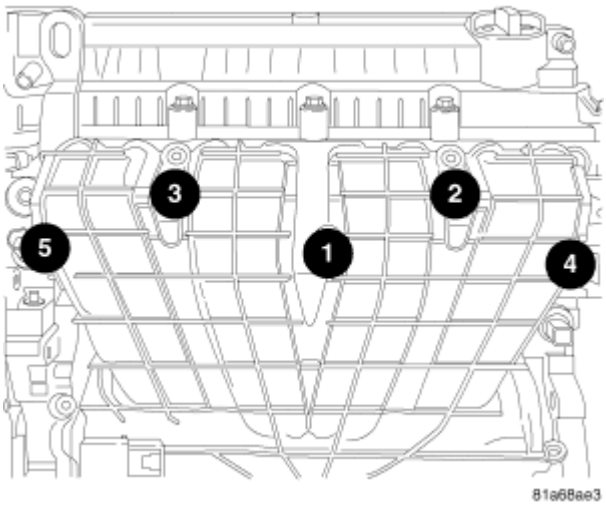


**Fig. 97: INTAKE TORQUE SEQUENCE**
**Courtesy of CHRYSLER LLC**

49. Disconnect vacuum lines at intake.
50. Remove intake manifold retaining bolts.

 

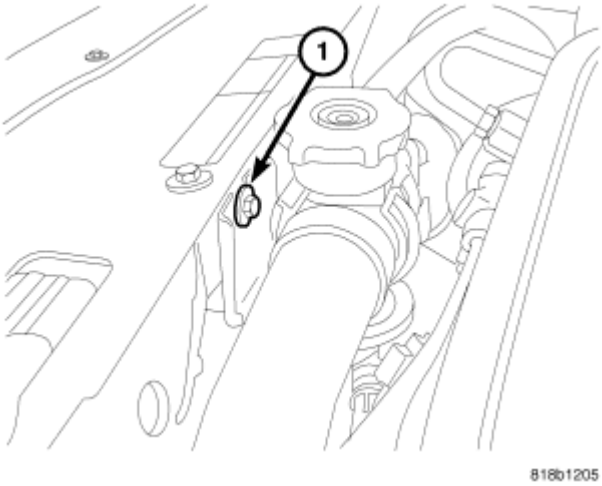


**Fig. 98: RADIATOR HOSE SUPPORT**
**Courtesy of CHRYSLER LLC**

51. Remove upper radiator hose retaining bolt (1).
52. Remove intake manifold.
53. Remove coolant outlet manifold and set aside.

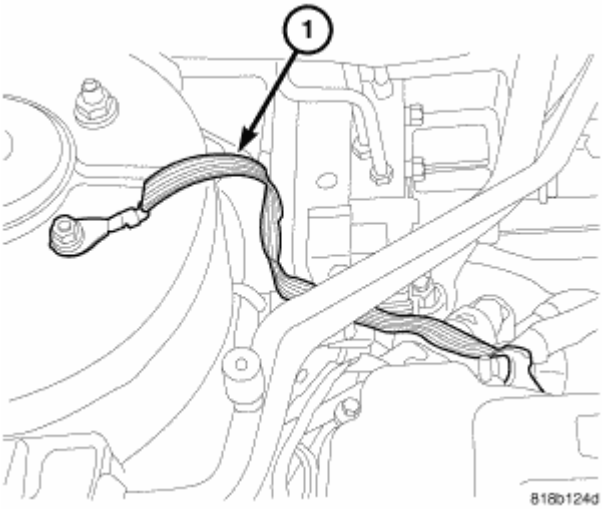


**Fig. 99: GROUND STRAP**
**Courtesy of CHRYSLER LLC**

54. Remove ground strap (1) at right rear of cylinder head.
55. Remove exhaust manifold. Refer to **REMOVAL**.
56. Remove camshafts. Refer to **REMOVAL**.

 

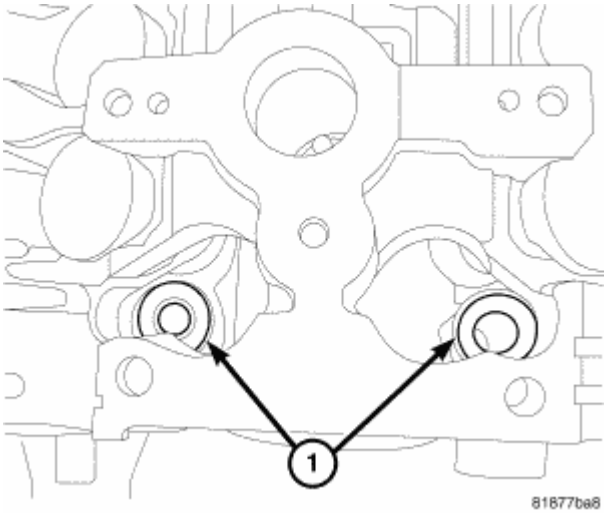


**Fig. 100: FRONT HEAD BOLT WASHERS**
**Courtesy of CHRYSLER LLC**

**NOTE: All of the cylinder head bolts have captured washers EXCEPT the front two (1).**

57. Remove cylinder head bolts.
58. Remove cylinder head from engine block.
59. Remove front cylinder head bolt washers (1).
60. Inspect and clean cylinder head and block sealing surfaces. Refer to Cleaning and Inspection in this section for procedures.

**NOTE: Ensure cylinder head bolt holes in the block are clean, dry (free of residual oil or coolant), and threads are not damaged.**

**CLEANING**

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

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

Remove all gasket material from cylinder head and block. Refer to **ENGINE GASKET SURFACE PREPARATION**. Be careful not to gouge or scratch the aluminum head sealing surface.

Clean all engine oil passages.

**INSPECTION**

**NOTE: Replacement cylinder heads will come complete with valves, seals, springs, retainers, keepers, lash buckets, and camshafts.**

 

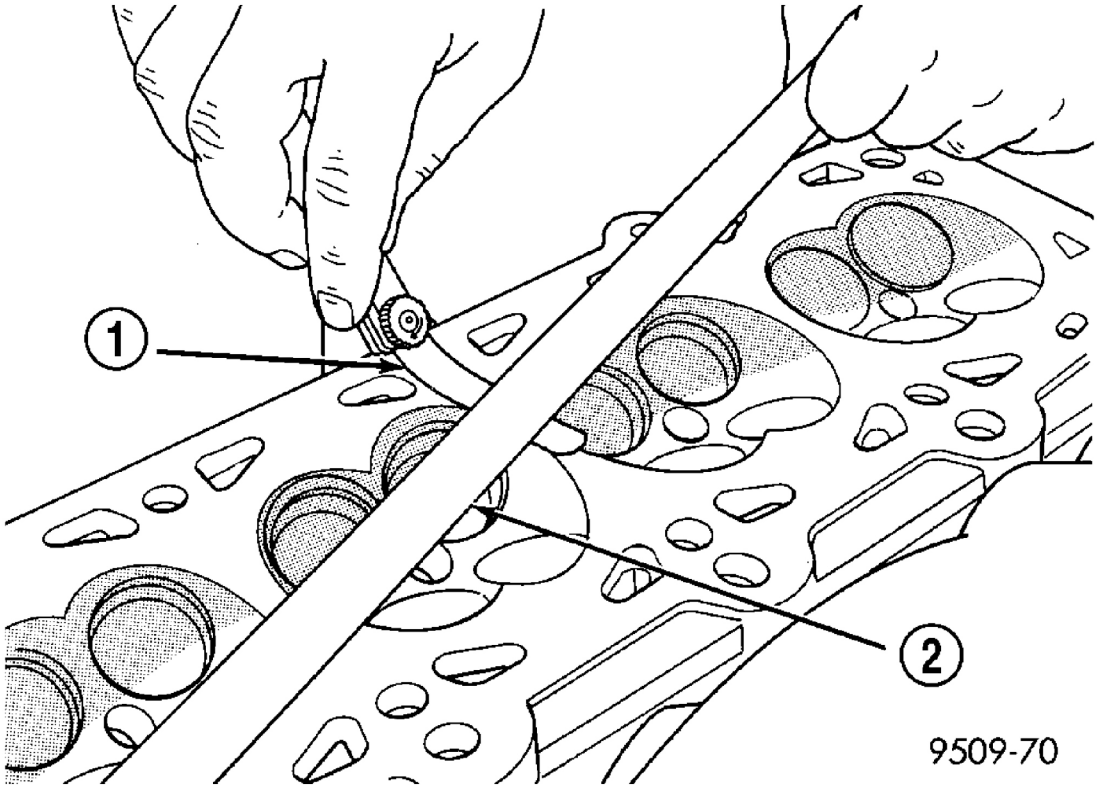


**Fig. 101: Checking Cylinder Head Flatness**
**Courtesy of CHRYSLER LLC**

1. Check cylinder head warpage with a straight edge (2) and feeler gauge (1).
2. Cylinder head must be flat within 0.1 mm (0.004 in.).

 

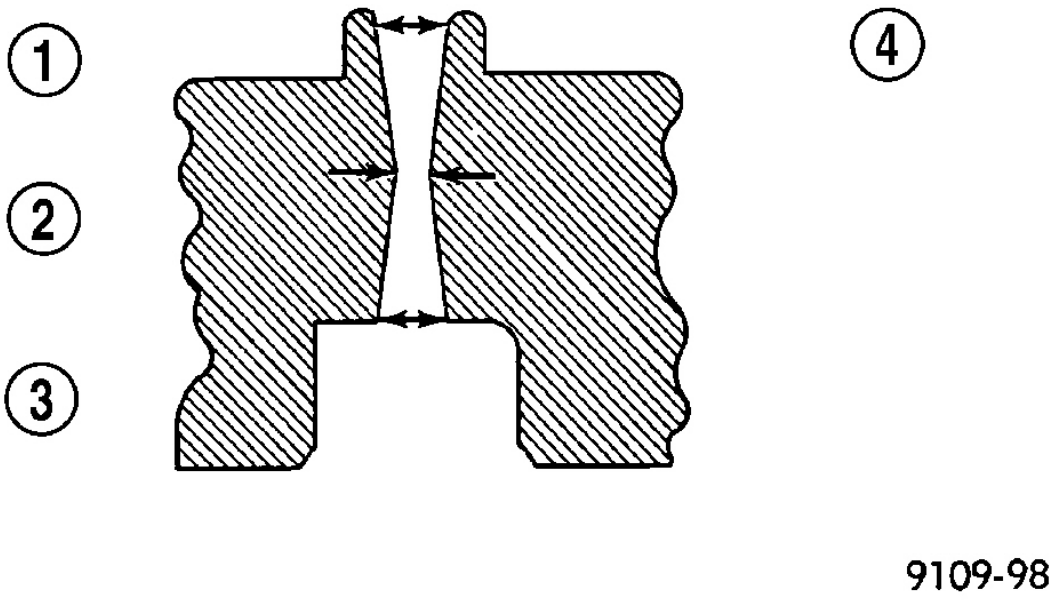


**Fig. 102: Checking Wear on Valve Guide-Typical**
**Courtesy of CHRYSLER LLC**

3. Inspect camshaft bearing journals for scoring.
4. Remove carbon and varnish deposits from inside of valve guides with a reliable guide cleaner.
5. Using a small hole gauge and a micrometer, measure valve guides in 3 places top (1), middle (2), and bottom (3). Refer to **SPECIFICATIONS**. Replace guides if they are not within specification.
6. Check valve guide height.
7. Prior to installing cylinder head, the cylinder block should be checked for flatness. Refer to **INSPECTION**.

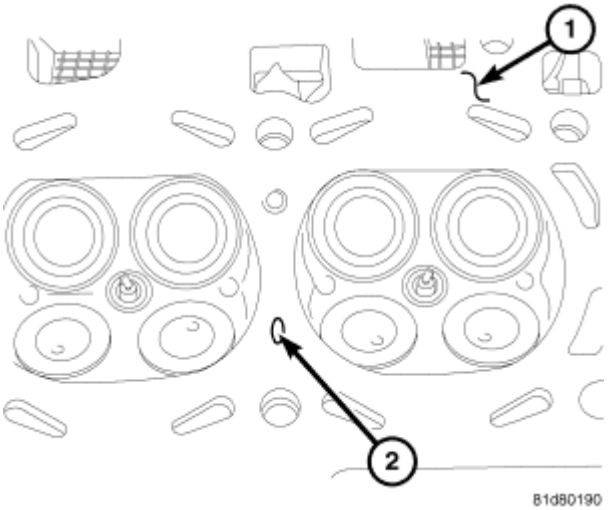


 

**Fig. 103: COOLANT PASSAGES**
**Courtesy of CHRYSLER LLC**

8. Inspect all coolant passages (2) for blockage and clean as required.

**INSTALLATION**

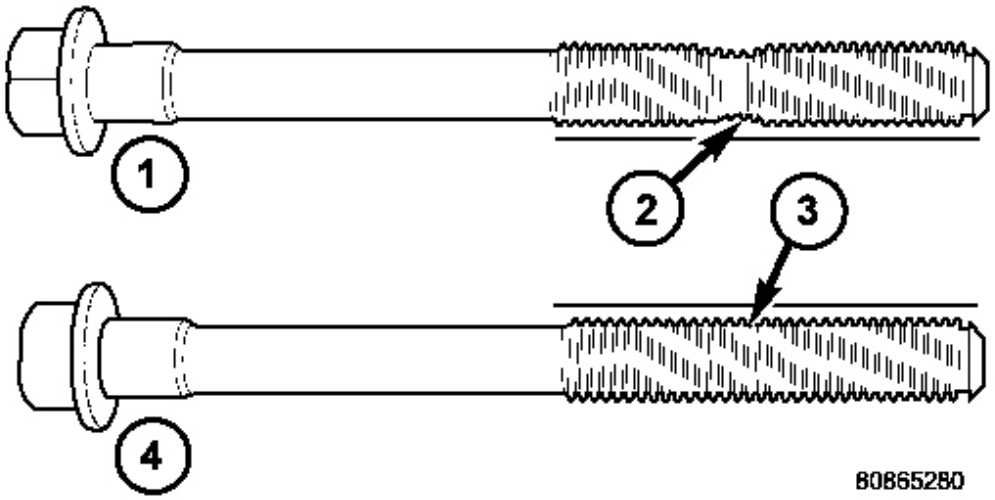


**Fig. 104: Checking Cylinder Head Bolts for Stretching (Necking)**
**Courtesy of CHRYSLER LLC**

**NOTE: Ensure cylinder head bolt holes in the block are clean, dry (free of residual oil or coolant), and threads are not damaged.**

**NOTE: The Cylinder head bolts should be examined BEFORE reuse. If the threads are necked down, the bolts should be replaced.**

Necking can be checked by holding a scale or straight edge against the threads. If all the threads do not contact the scale (2), the bolt should be replaced.

 

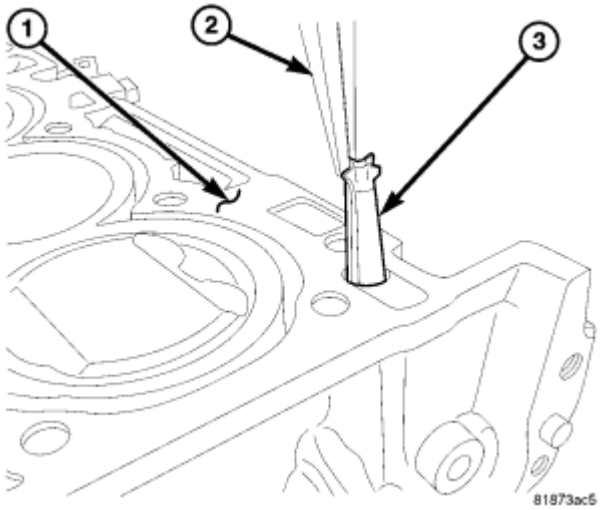


**Fig. 105: VVT Filter**
**Courtesy of CHRYSLER LLC**

**CAUTION: Always replace the variable valve timing filter screen (3) when servicing the head gasket or engine damage could result.**

1. Replace the variable valve timing filter screen (3).

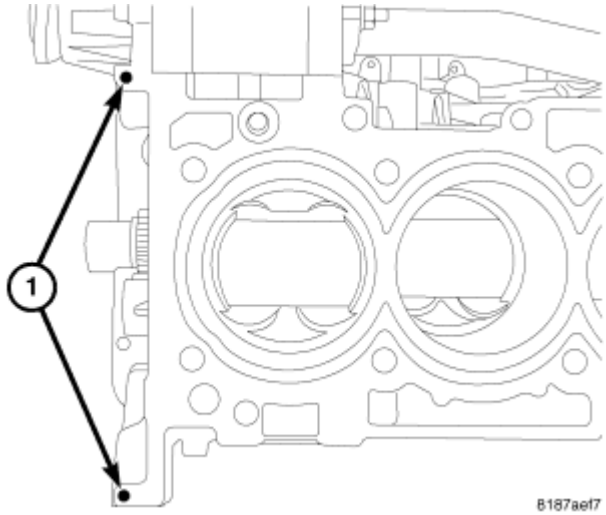


**Fig. 106: Cylinder Head RTV**
**Courtesy of CHRYSLER LLC**

**NOTE: When using RTV, the sealing surfaces must be clean and free from grease and oil.**

**NOTE: When using RTV, parts should be assembled in 10 minutes and tighten to final torque within 45 minutes.**

 

2. Place two pea size dots of Mopar® engine sealant RTV or equivalent (1) on cylinder block as shown.

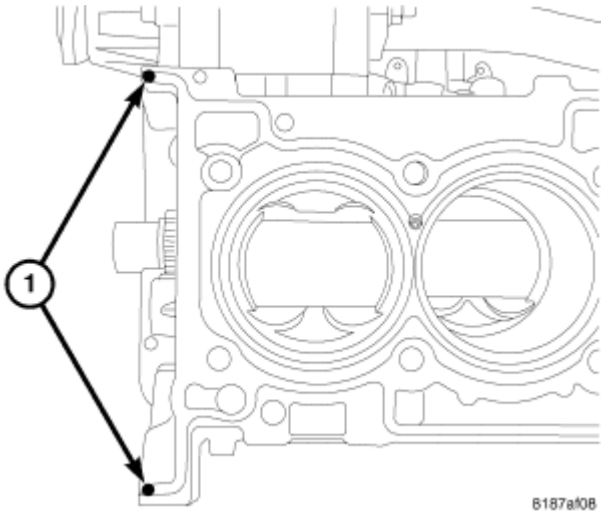


**Fig. 107: Cylinder Head Gasket RTV**
**Courtesy of CHRYSLER LLC**

3. Position the new cylinder head gasket on engine block with the part number facing up. Ensure gasket is seated over the locating dowels in block.
4. Place two pea size dots of Mopar® engine sealant RTV or equivalent (1) on cylinder head gasket as shown.

**NOTE: The head must be installed within 15 minutes before the RTV skins.**

5. Position cylinder head onto engine block.

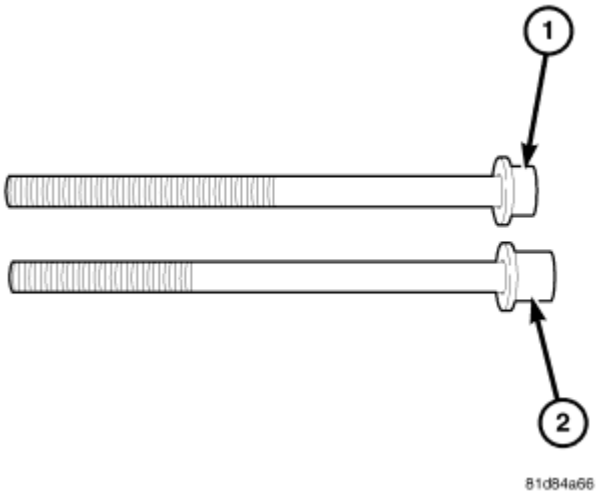


**Fig. 108: CYLINDER HEAD BOLT IDENTIFICATION**
**Courtesy of CHRYSLER LLC**

**CAUTION: This engine was built with 2 different style cylinder head bolts. Each**

 

**style bolt requires a different torque value. The bolts can be identified by the short bolt head (1) and the long bolt head (2).**

6. Measure the bolt head from the washer to the top of the bolt head. The short bolt head (1) measures 8 mm (5/16") and the long bolt head (2) measures 13 mm (1/2").
7. Identify whether your engine has the short head design (1) or the long head design (2).

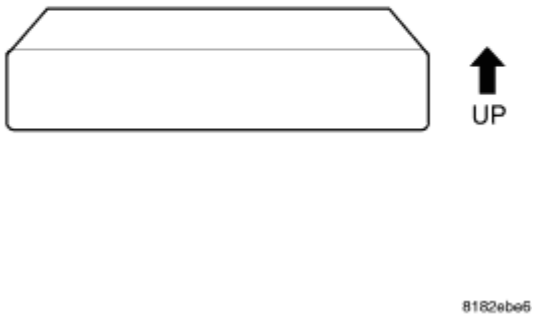


**Fig. 109: Washer**
**Courtesy of CHRYSLER LLC**

**NOTE: The front two cylinder head bolts do not have captured washers. The washers must be installed with the bevel up towards the bolt head.**

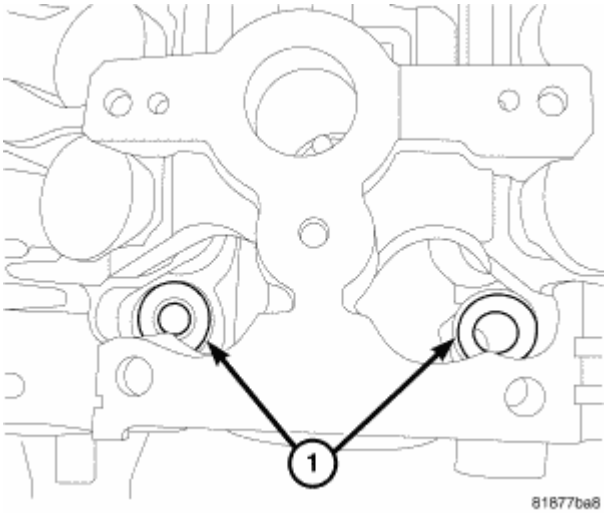


**Fig. 110: Front Head Bolt Washers**
**Courtesy of CHRYSLER LLC**

8. Install washers (1) for the front two cylinder head bolts.

 

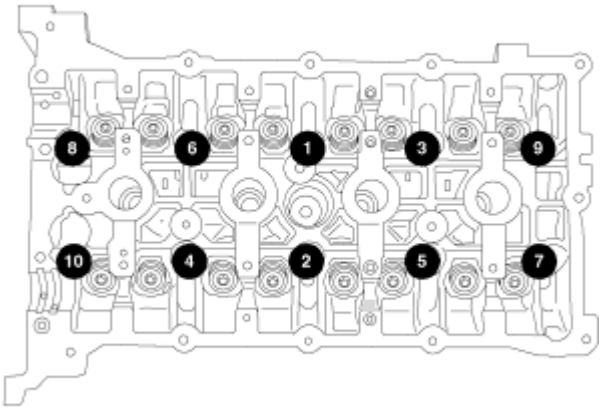


**Fig. 111: Cylinder Head Torque Sequence**
**Courtesy of CHRYSLER LLC**

9. Before installing the bolts, the threads should be lightly coated with engine oil.
10. Install the cylinder head bolts and tighten in the sequence shown.

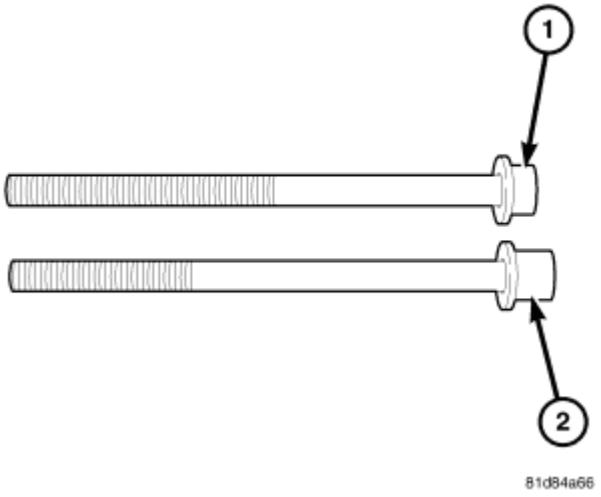


**Fig. 112: CYLINDER HEAD BOLT IDENTIFICATION**
**Courtesy of CHRYSLER LLC**

11. If your bolt has the short head (1), use the following torque specifications:
    First: All to 30 N.m (25 ft. lbs.)
    Second: All to 61 N.m (45 ft. lbs.)
    Third: All to 61 N.m (45 ft. lbs.)
    Fourth: All an additional 90°

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

 

12. If your bolt has the long head (2), use the following torque specifications:
    First: All to 30 N.m (25 ft. lbs.)
    Second: All to 73 N.m (54 ft. lbs.)
    Third: All to 73 N.m (54 ft. lbs.)
    Fourth: All an additional 90°

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

13. Clean excess RTV from timing chain cover sealing surface.
14. Install camshafts. Refer to **INSTALLATION**.

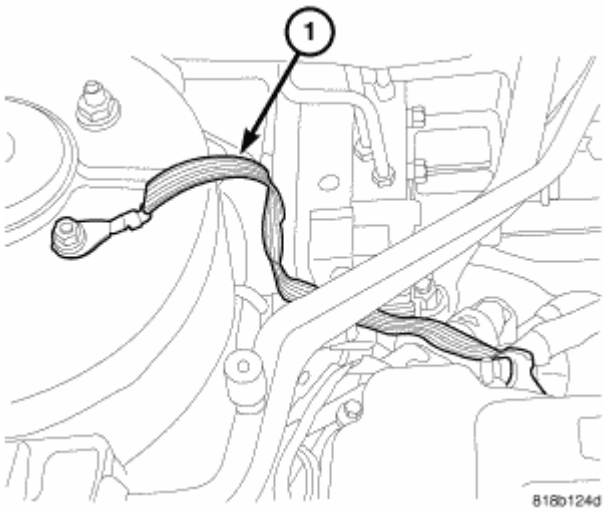


**Fig. 113: Ground Strap**
**Courtesy of CHRYSLER LLC**

15. Install cylinder head cover. Refer to **INSTALLATION**.
16. On AWD vehicles install maniverter. Refer to **INSTALLATION**.
17. On FWD vehicles install exhaust manifold. Refer to **INSTALLATION**.
18. Install ground strap (1) at right rear of cylinder head.

 

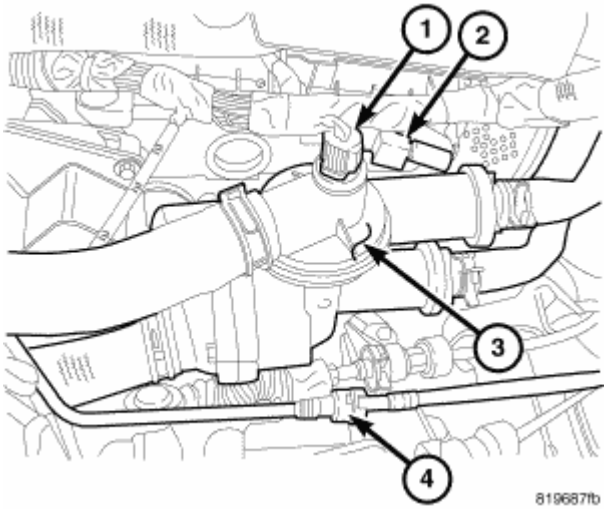


**Fig. 114: COOLANT ADAPTER**
**Courtesy of CHRYSLER LLC**

19. Install coolant adapter (3) with new seals.
20. Connect coolant hoses.
21. Connect purge hose (4).

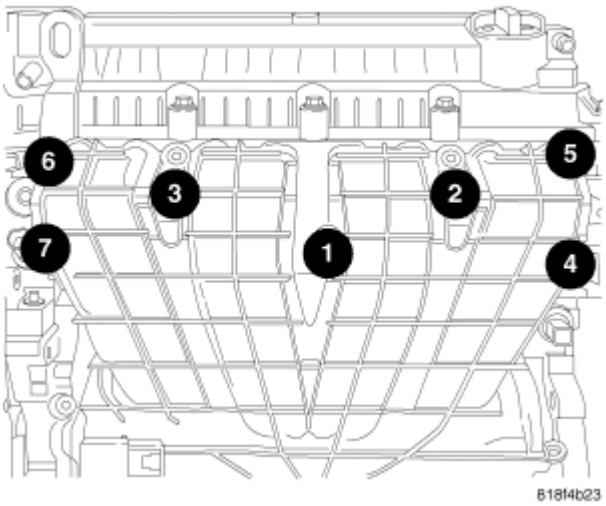


**Fig. 115: INTAKE BOLTS**
**Courtesy of CHRYSLER LLC**

22. Install intake manifold.
23. Install intake manifold bolts and tighten to 24 N.m (18 ft. lbs.).

 

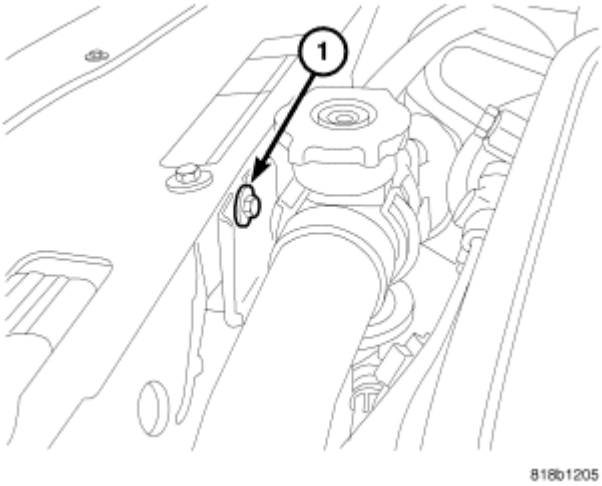


**Fig. 116: Radiator Hose Support**
**Courtesy of CHRYSLER LLC**

24. Install upper radiator hose retaining bracket bolt (1).

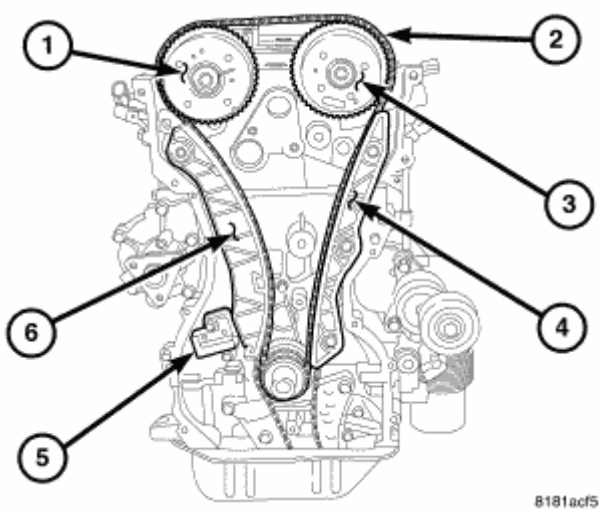


**Fig. 117: TIMING DRIVE**
**Courtesy of CHRYSLER LLC**

25. Install timing chain (2). Refer to **TIMING CHAIN**.
26. Install timing chain cover. Refer to **INSTALLATION**.

 

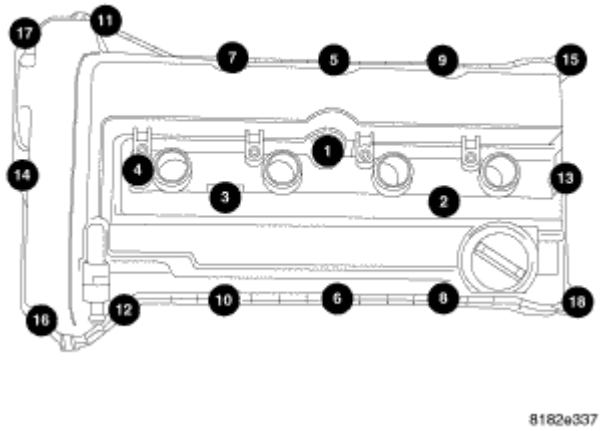


**Fig. 118: Torque Sequence**
**Courtesy of CHRYSLER LLC**

27. Remove coils from cylinder head cover.
28. Install cylinder head cover. Refer to **INSTALLATION**.

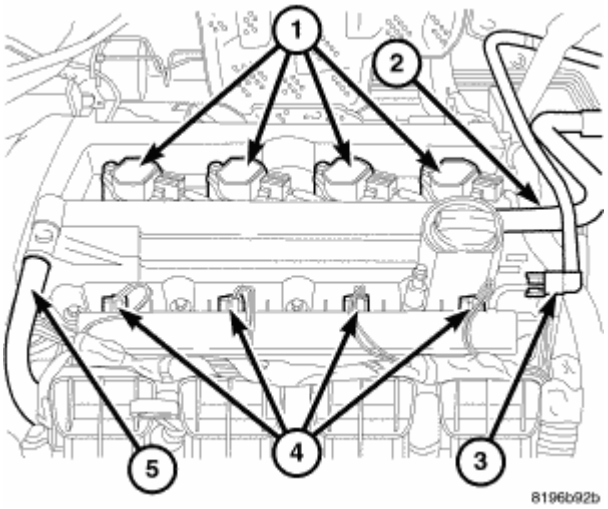


**Fig. 119: COIL CONNECTOR**
**Courtesy of CHRYSLER LLC**

29. Connect cam sensor wiring connector.
30. Install spark plugs and tighten to 27 N.m (20 ft.lbs.).
31. Install ignition coils (1) and tighten to 8 N.m (70 in.lbs.).

 

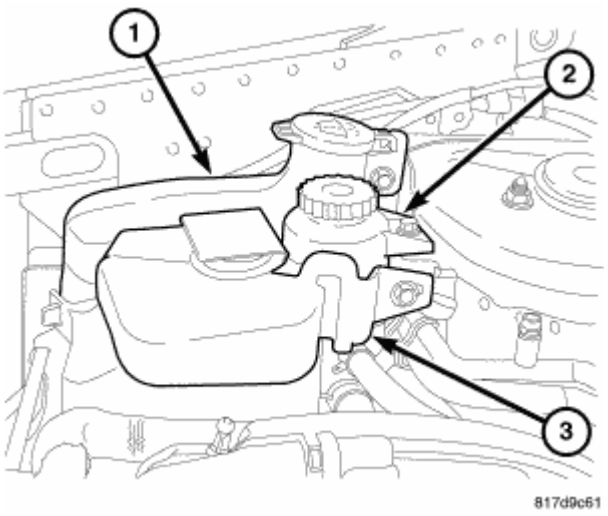


**Fig. 120: Coolant Reservoir**
**Courtesy of CHRYSLER LLC**

32. Install power steering pump reservoir (2).
33. Install windshield washer reservoir (1).
34. Install coolant recovery reservoir (3)
35. Install accessory drive belts. Refer to **INSTALLATION** .
36. Connect engine coolant temperature sensor connector.

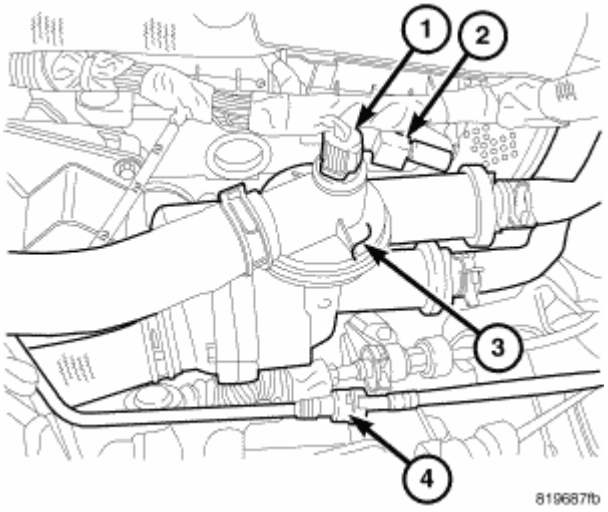


**Fig. 121: COOLANT ADAPTER**
**Courtesy of CHRYSLER LLC**

37. Connect coolant hoses to coolant adapter (3). Connect heater hoses to coolant adapter (1).
38. Connect coolant temperature sensor (1) and capacitor (2) electrical connectors.
39. Install heater tube support bracket to cylinder head.

 

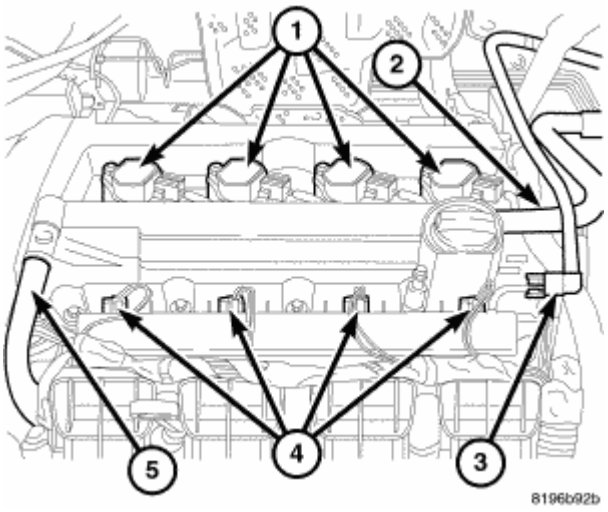


**Fig. 122: COIL CONNECTOR**
**Courtesy of CHRYSLER LLC**

40. Install fastener attaching dipstick tube to lower intake manifold.
41. Connect coil (1) and injector (4) electrical connectors.
42. Install fuel rail.
43. Connect fuel supply line quick-connect (3) at the fuel rail assembly. Refer to **STANDARD PROCEDURE** .
44. Fill cooling system. Refer to **STANDARD PROCEDURE** .

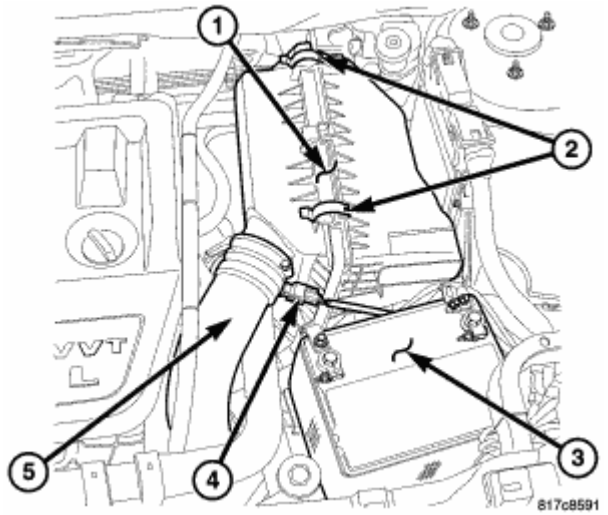


**Fig. 123: Air Cleaner Housing**
**Courtesy of CHRYSLER LLC**

45. Connect negative cable to battery (3).
46. Install clean air hose (5) and air cleaner housing (1). Refer to **INSTALLATION**.
47. Install new oil filter and fill engine with oil.
48. Start engine and check for leaks.

 

49. Install engine cover.

## CAMSHAFT(S)

### DESCRIPTION

Both camshafts have five bearing journal surfaces and two cam lobes per cylinder. The two front journals are larger to allow for feeding oil to the variable valve timing (VVT) camshaft phasers. Flanges on the third smaller journal control camshaft end play. At the rear of each camshaft is an integral cam sensor target.

#### CAMSHAFT BEARING CAPS

The front cam bearing cap spans both camshafts, and includes dowels for precise alignment. The front exhaust journal has a select fit bearing insert. This bearing is required to seal the oil passage to the camshaft phaser, because a portion of the lower bearing saddle is machined away for head bolt access. The select fit is required to minimize bearing clearance and oil leakage. An exhaust bearing grade (1,2,or 3) is stamped into the front bearing cap adjacent to the exhaust cam journal. The bearings are also marked with the corresponding grade markings. If the bearing is replaced, the same grade must be used. Due to unique purpose of this bearing, it may appear to have uneven wear patterns. Unless the wear is excessive, greater than 1 mm (0.0394 in.), it is no cause for concern.

The front intake journal has a full lower bearing saddle, and therefore, no bearing insert is required.

All small bearing caps have a formed in arrow to assist in assembly. All small bearing cap arrows must point towards the center of the cylinder head. The small bearing caps are marked for position during the manufacturing process, and must be reinstalled in their original position.

The #1 cap includes a passage to direct oil from the cylinder head oil gallery to the #1 small bearing journal. Through the #2 journal oil is fed into the camshaft as well. The hollow camshaft then distributes oil to the remainder of the small journals.

The #3 small cap is machined at the front and rear face to control camshaft end-play. This cap has dowels for precise alignment.

### OPERATION

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

### STANDARD PROCEDURE

 

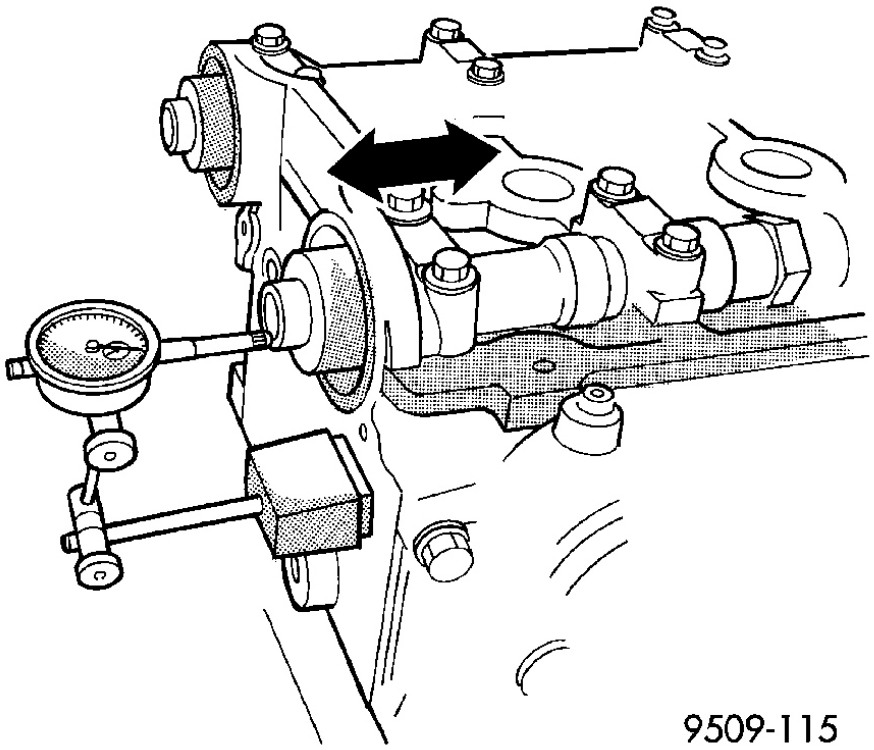


**Fig. 124: Camshaft End Play - Typical**
**Courtesy of CHRYSLER LLC**

1. Using a suitable tool, move camshaft as far rearward as it will go.
2. Zero dial indicator.
3. Move camshaft as far forward as it will go.
4. Record reading on dial indicator. For end play specification, refer to **SPECIFICATIONS**.
5. If end play is excessive, check cylinder head and camshaft for wear; replace as necessary.

**REMOVAL**

 

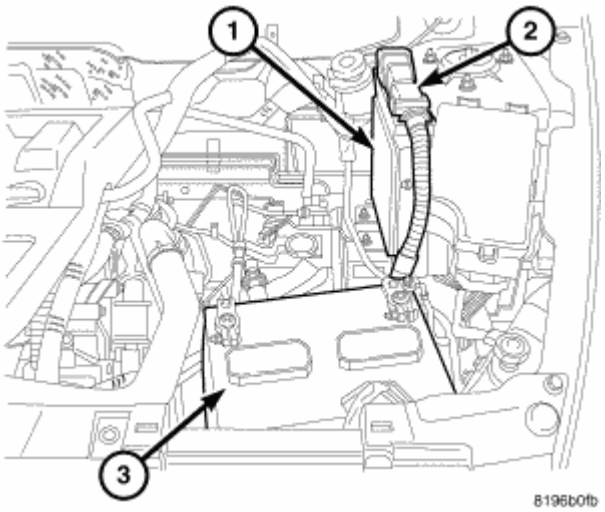


**Fig. 125: BATTERY**
**Courtesy of CHRYSLER LLC**

1. Remove engine cover by pulling upward.
2. Disconnect negative cable from battery (3).

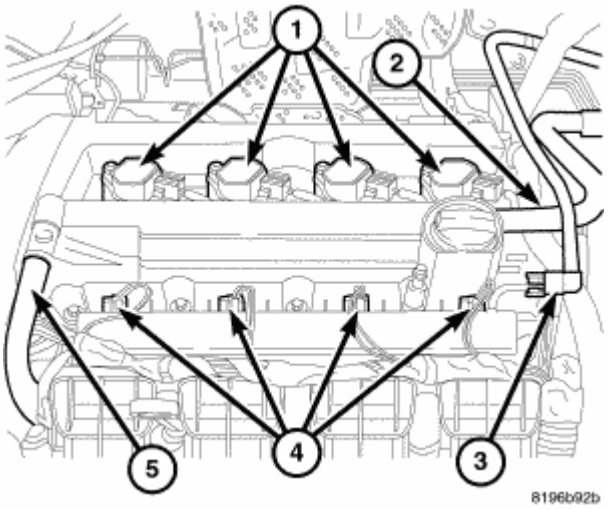


**Fig. 126: COIL CONNECTOR**
**Courtesy of CHRYSLER LLC**

3. Disconnect coil electrical connectors (1).
4. Remove cylinder head cover. Refer to **REMOVAL**.

 

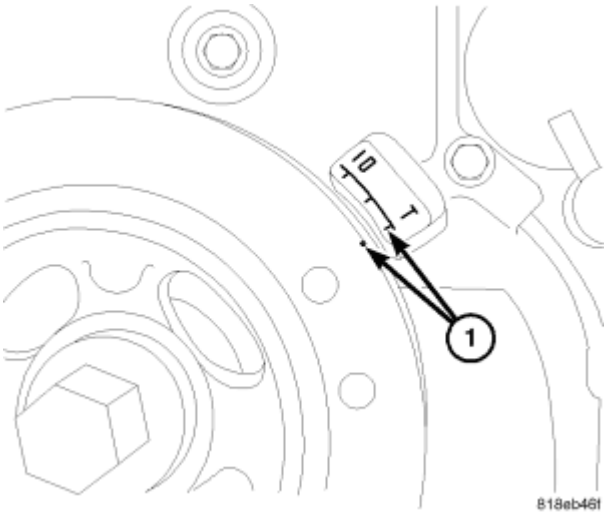


**Fig. 127: TDC**
**Courtesy of CHRYSLER LLC**

5. Raise vehicle.
6. Remove right splash shield.
7. Rotate engine to TDC (1).

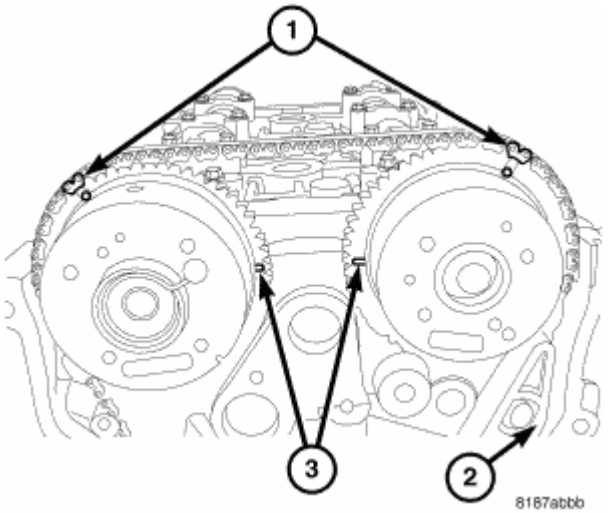


**Fig. 128: TIMING CHAIN TIMING MARKS**
**Courtesy of CHRYSLER LLC**

8. Make sure camshaft timing marks (3) are aligned.
9. Mark the chain link corresponding to timing marks (1) with a paint marker.

 

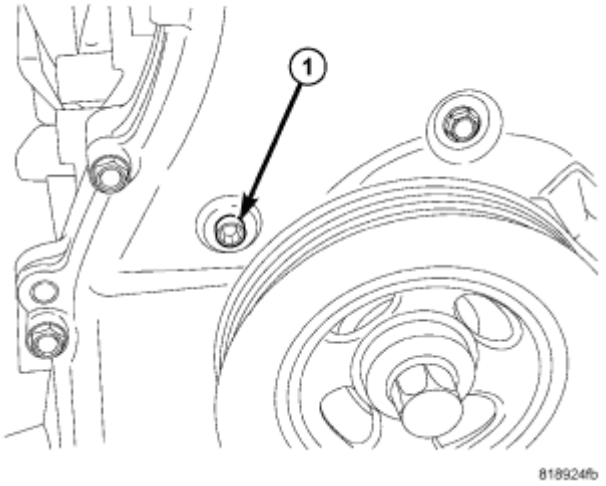


**Fig. 129: TENSIONER ACCESS PLUG**
**Courtesy of CHRYSLER LLC**

10. Remove timing tensioner plug (1) from front cover.

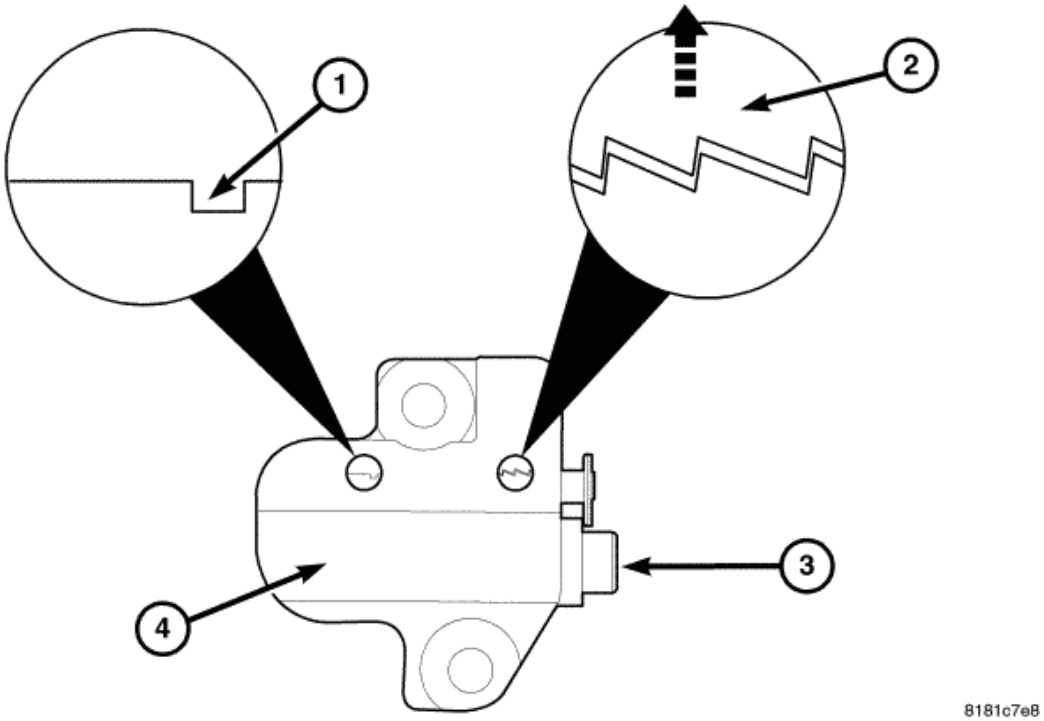


**Fig. 130: TENSIONER RESET**
**Courtesy of CHRYSLER LLC**

11. Insert small Allen wrench through timing tensioner plug hole and lift ratchet (2) upward to release the tensioner and push Allen wrench inward. Leave the Allen wrench installed during the remainder of this procedure.

 

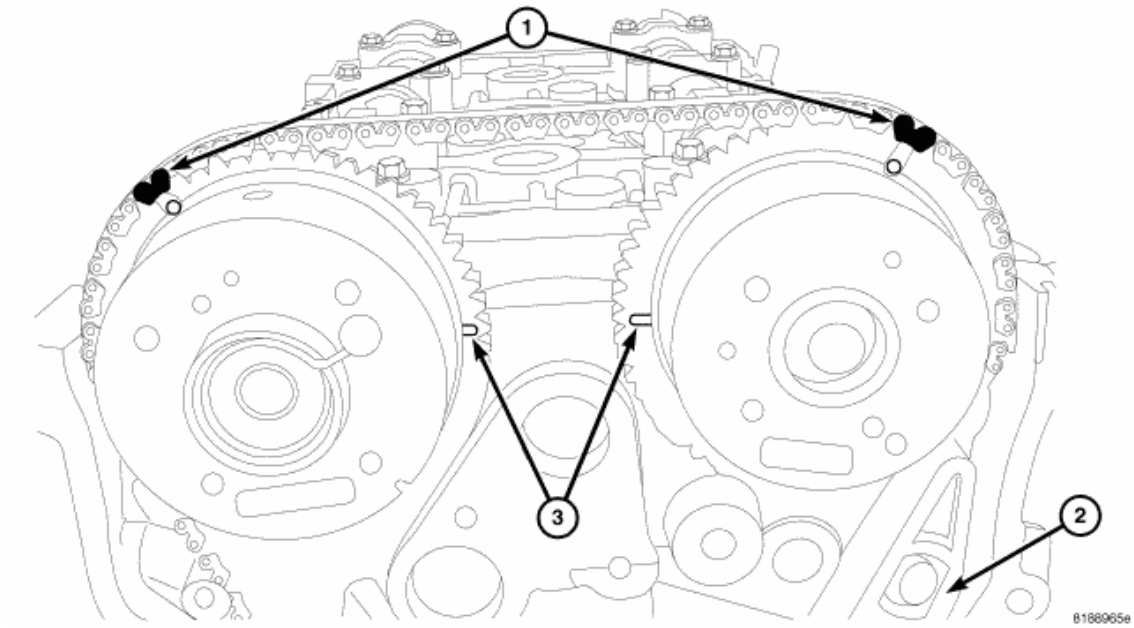


**Fig. 131: TIMING CHAIN TIMING MARKS**
**Courtesy of CHRYSLER LLC**

12. Verify that camshaft timing marks (3) are facing each other as shown.
13. Mark the camshaft sprocket timing marks and the corresponding chain links (1) with a paint marker.

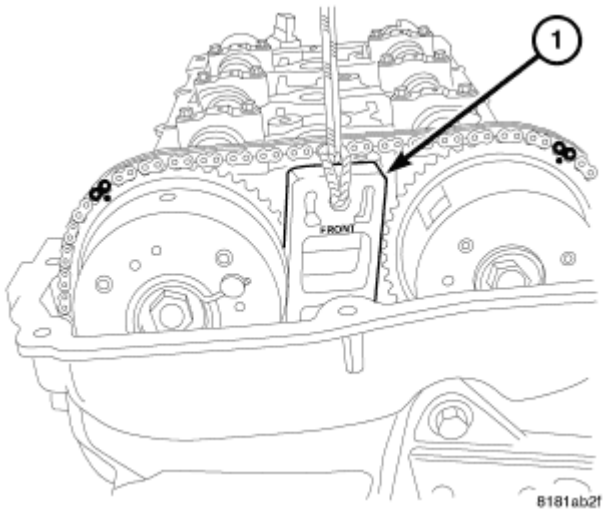


**Fig. 132: WEDGE TOOL 9701**
**Courtesy of CHRYSLER LLC**

14. Insert wedge 9701 (1) between camshaft phasers.

 

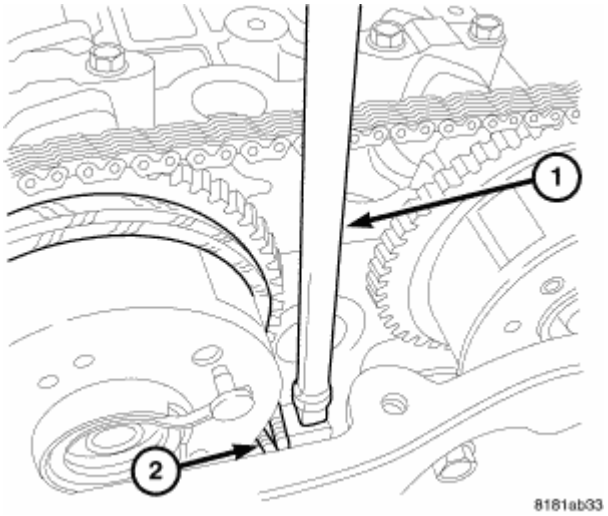


**Fig. 133: SEATING WEDGE TOOL 9701**
**Courtesy of CHRYSLER LLC**

15. Lightly tap Wedge 9701(2) into place until it will no longer sink down.

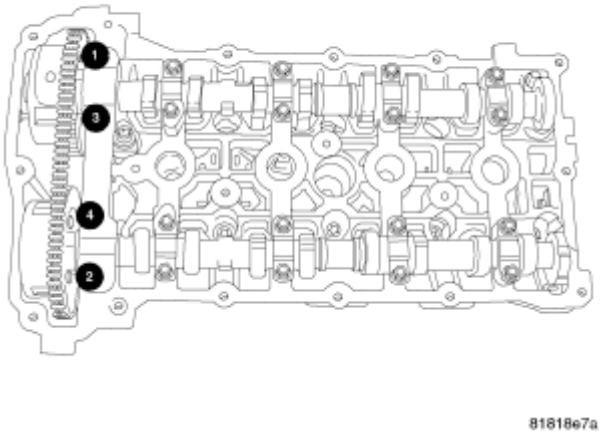


**Fig. 134: FRONT CAM CAP REMOVAL SEQUENCE**
**Courtesy of CHRYSLER LLC**

16. Remove the front camshaft bearing cap.
17. Slowly remove the remaining intake and exhaust camshaft bearing cap bolts one turn at a time.

 

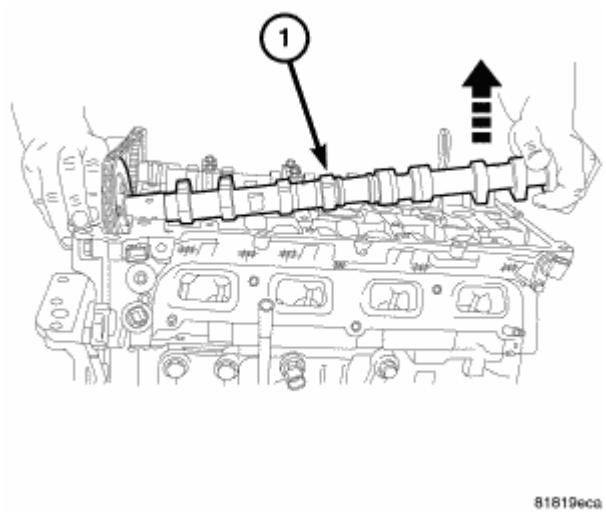


**Fig. 135: RAISE INTAKE CAM**
**Courtesy of CHRYSLER LLC**

18. Remove intake camshaft (1) by lifting the rear of the camshaft upward.

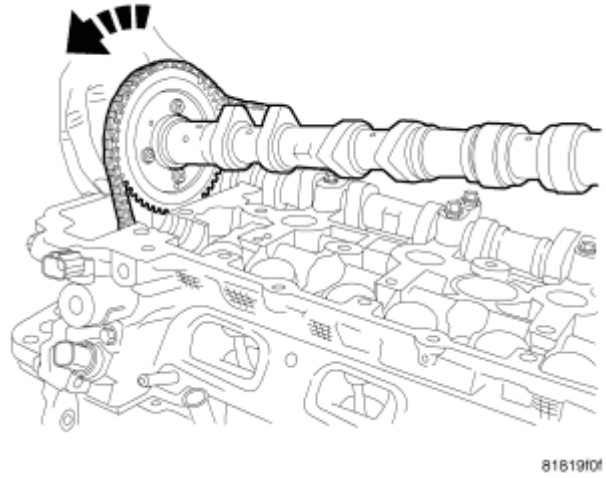


**Fig. 136: ROLL CAMSHAFT**
**Courtesy of CHRYSLER LLC**

19. Rotate the camshaft while lifting out of the front bearing cradle.

 

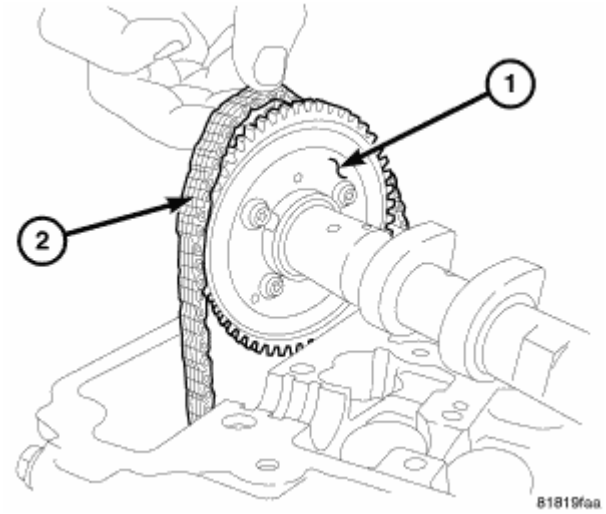


**Fig. 137: CHAIN REMOVAL**
**Courtesy of CHRYSLER LLC**

20. Lift the timing chain (2) off the sprocket (1).
21. Remove exhaust camshaft.
22. Secure timing chain with wire so that it does fall into the timing chain cover.

**CLEANING**

Clean camshafts with a suitable solvent.

**INSPECTION**

1. Inspect camshaft bearing journals for damage. If journals are damaged, check the cylinder head for damage. Also check cylinder head oil holes for clogging.
2. Check the cam lobe and bearing surfaces for abnormal wear and damage. Replace camshaft if defective.

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

**INSTALLATION**

 

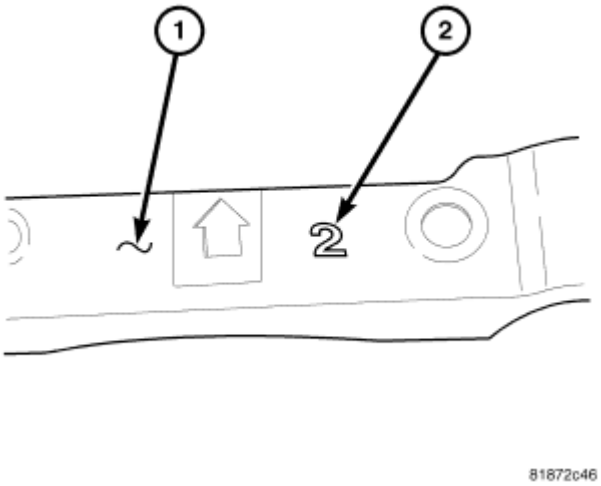


**Fig. 138: Cam Cap Bearing Identification**
**Courtesy of CHRYSLER LLC**

1. The cam cap (1) is numbered (2) either one, two, or three, this corresponds to the select fit bearing to use.

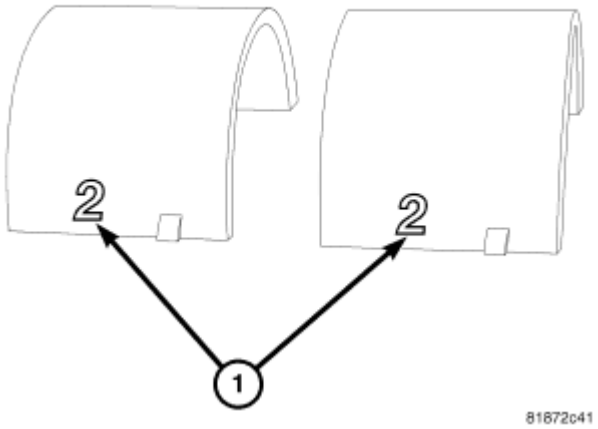


**Fig. 139: Cam Bearing Identification**
**Courtesy of CHRYSLER LLC**

2. Install the corresponding select fit bearing (1).
3. Oil all of the camshaft journals with clean engine oil.
4. Install camshaft phasers on camshafts if removed.
    - Install camshaft phaser making sure that the dowel is in the correct hole.
    - Install camshaft phaser bolt and hand tighten.

 

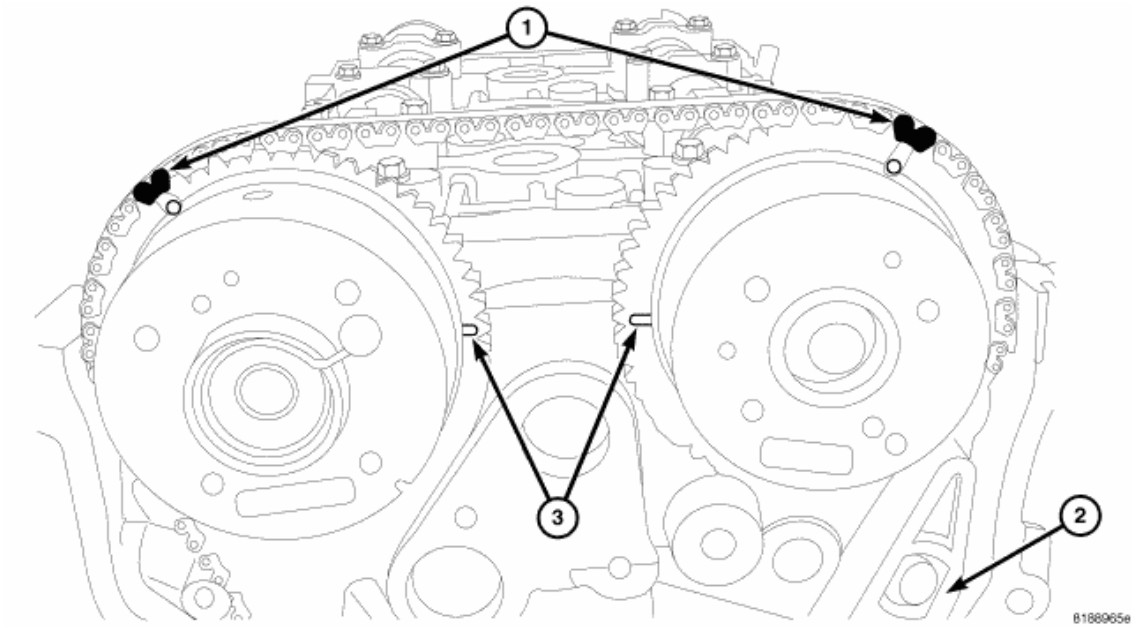


**Fig. 140: Timing Chain Timing Marks**
**Courtesy of CHRYSLER LLC**

5. Install timing chain onto exhaust cam sprocket making sure that the timing marks (1) on the sprocket and the painted chain link are aligned.

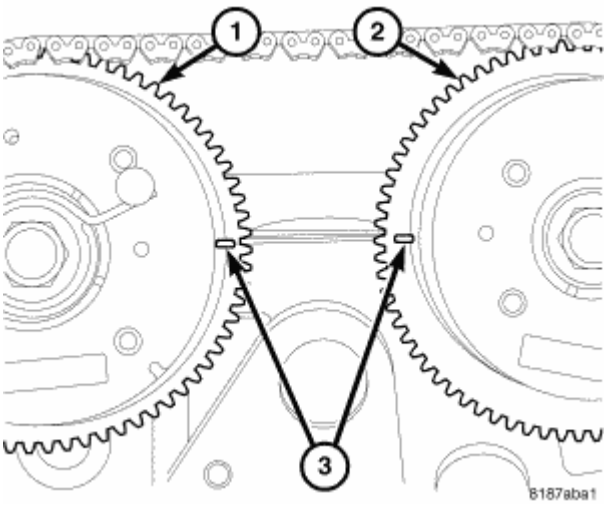


**Fig. 141: Camshaft Timing**
**Courtesy of CHRYSLER LLC**

6. Position exhaust camshaft and on bearing journals in the cylinder head.
7. Align exhaust cam timing mark (3) so it is parallel to the cylinder head as shown.

 

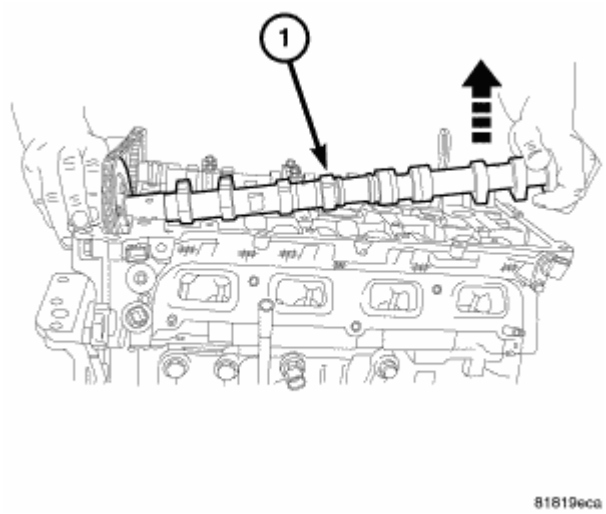


**Fig. 142: Raise Intake Cam**
**Courtesy of CHRYSLER LLC**

8. Install intake camshaft by raising the rear of the camshaft upward and roll the sprocket into the chain.

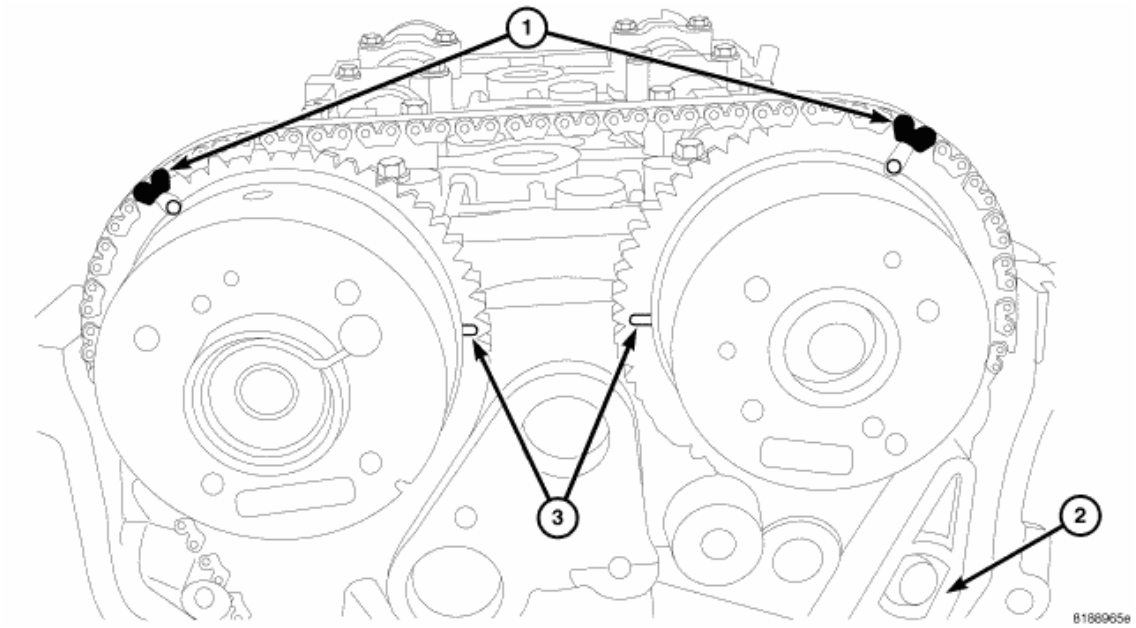


**Fig. 143: Timing Chain Timing Marks**
**Courtesy of CHRYSLER LLC**

9. Align the timing marks (1) on the intake cam sprocket with the painted chain link.
10. Position the intake camshaft into the bearing journals in the cylinder head.
11. Verify that the timing marks (1) are aligned on both camshafts and that the timing marks (3) are parallel with the cylinder head.

**CAUTION: Install the front intake and exhaust camshaft bearing cap last. Ensure that the dowels are seated and follow torque sequence or damage to**

 

**engine could result.**

**NOTE: If the front camshaft bearing cap is broken, the cylinder head MUST be replaced.**

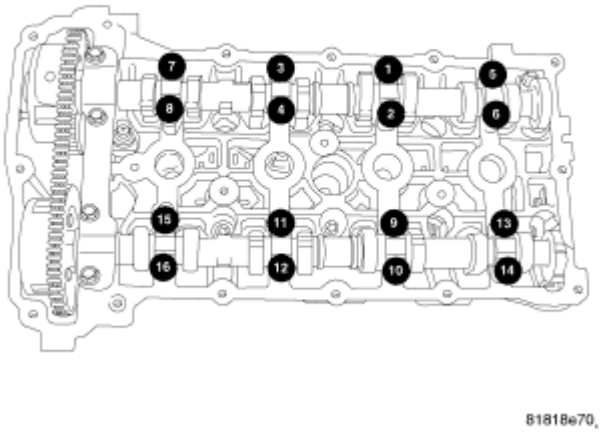


**Fig. 144: CAM CAP TORQUE SEQUENCE**
**Courtesy of CHRYSLER LLC**

12. Install intake and exhaust camshaft bearing caps and slowly tighten bolts to 9.5 N.m (85 in. lbs.) in the sequence shown.

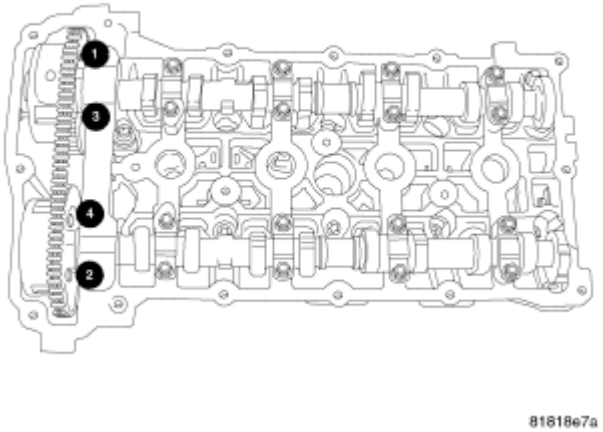


**Fig. 145: Front Cam Cap Torque Sequence**
**Courtesy of CHRYSLER LLC**

**NOTE: Verify that the exhaust bearing shells are correctly installed, and the dowels are seated in the head, prior to torquing bolts.**

13. Install the front intake and exhaust bearing cap and tighten bolts to 25 N.m (18 ft. lbs.) in the sequence

 

shown.

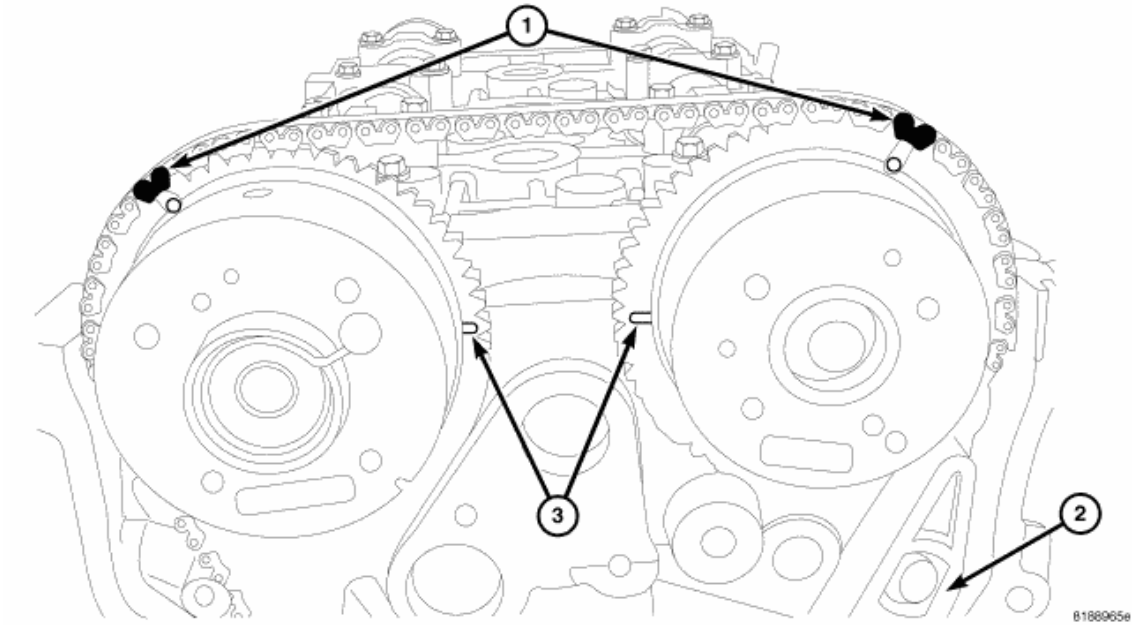


**Fig. 146: Timing Chain Timing Marks**
**Courtesy of CHRYSLER LLC**

14. Verify that all timing marks (1,3) are aligned.
15. Remove Allen wrench from timing chain tensioner.

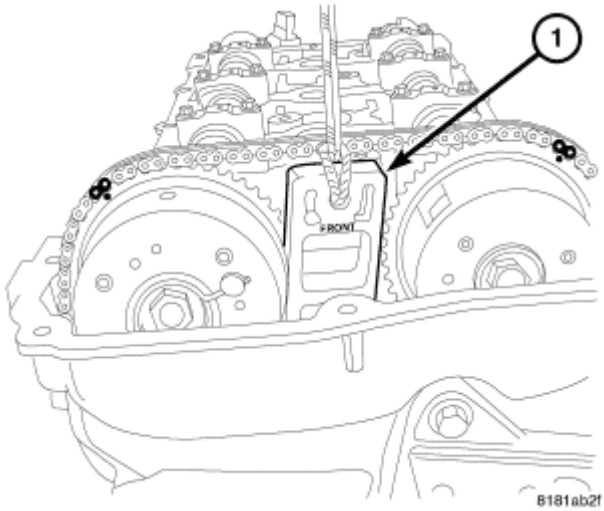


**Fig. 147: Wedge Tool 9701**
**Courtesy of CHRYSLER LLC**

16. Remove locking wedge 9701 by pulling straight upward on pull rope.

 

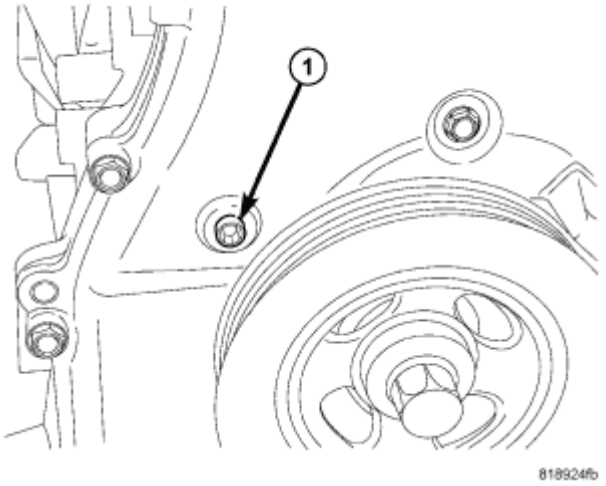


**Fig. 148: Tensioner Access Plug**
**Courtesy of CHRYSLER LLC**

17. Apply MOPAR® thread sealant (or equivalent) to timing tensioner plug (1) and Install.
18. Install right splash shield.

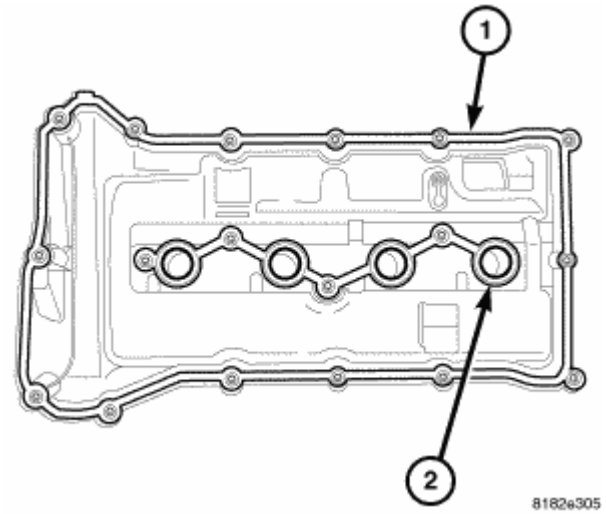


**Fig. 149: GASKET LOCATION**
**Courtesy of CHRYSLER LLC**

19. Install new cylinder head cover gaskets (1,2).
20. Install cylinder head cover. Refer to **INSTALLATION**.
21. Install engine cover.
22. Connect negative battery cable.
23. Fill cooling system.
24. Fill with oil.
25. Start engine and check for leaks.

 

## COVER-CYLINDER HEAD

### REMOVAL

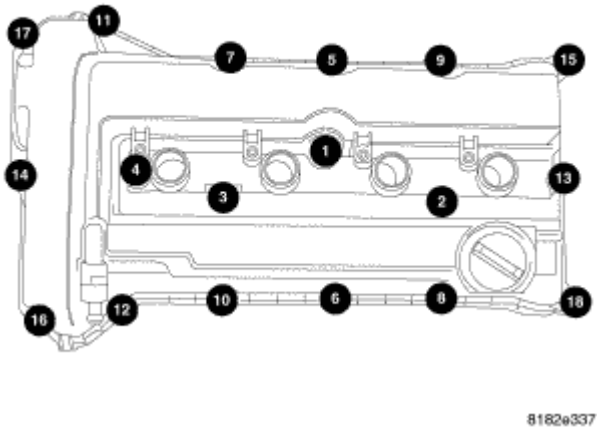


**Fig. 150: TORQUE SEQUENCE**
**Courtesy of CHRYSLER LLC**

1. Remove engine cover.
2. Disconnect ignition coil electrical connectors.
3. Disconnect PCV and make-up air hoses from cylinder head cover.
4. Use compressed air to blow dirt and debris off the cylinder head cover prior to removal.
5. Remove cylinder head cover bolts.
6. Remove cylinder head cover from cylinder head.

### INSTALLATION

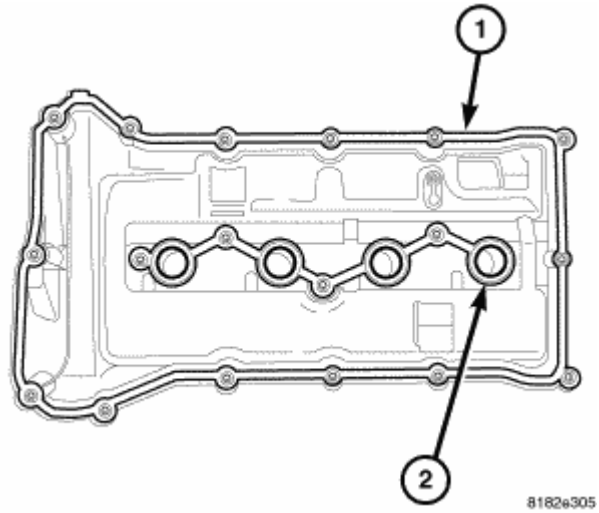


**Fig. 151: Gasket Location**
**Courtesy of CHRYSLER LLC**

 

1. Install new cylinder head cover gaskets (1,2).

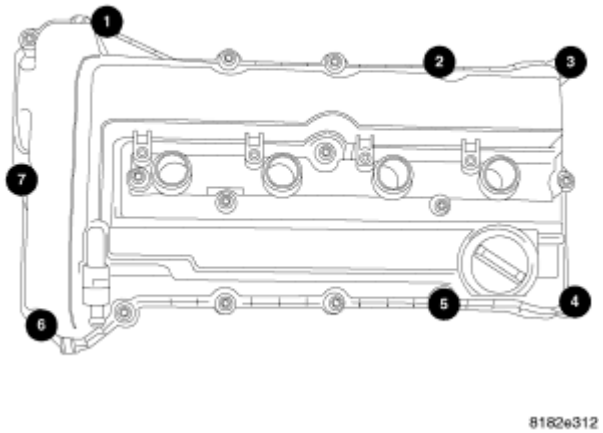


**Fig. 152: Stud Location**
**Courtesy of CHRYSLER LLC**

2. Install studs in cover as shown.

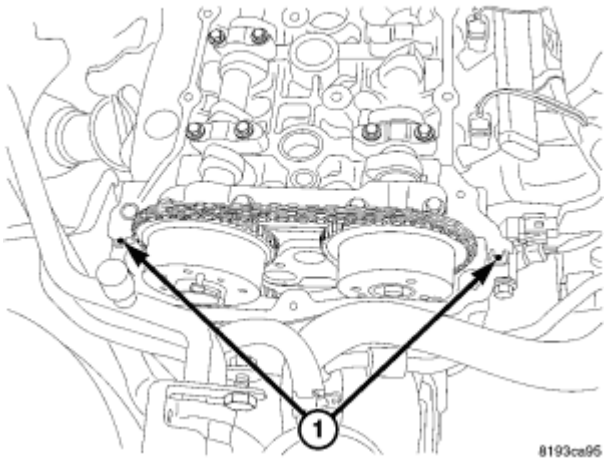


**Fig. 153: HEAD COVER T-JOINT**
**Courtesy of CHRYSLER LLC**

3. Clean all RTV from cylinder head.

**NOTE: When using RTV, the sealing surfaces must be clean and free from grease and oil.**

**NOTE: When using RTV, parts should be assembled in 10 minutes and tighten to final torque within 45 minutes.**

 

4. Apply a dot of Mopar® engine sealant RTV or equivalent to cylinder head/front cover T-joint (1).

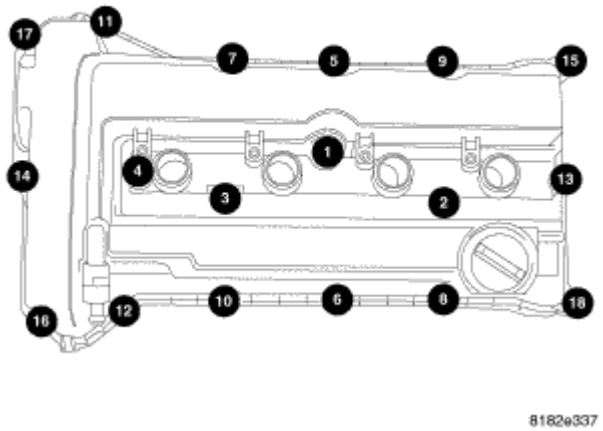


**Fig. 154: Torque Sequence**
**Courtesy of CHRYSLER LLC**

5. Install cylinder head cover assembly to cylinder head and install all bolts, ensuring the studs are located as shown.
6. Tighten bolts in sequence shown using a 2 step torque method as follows:
   - Tighten all bolts to 5 N.m (44 in. lbs.)
   - Tighten all bolts to 10 N.m (90 in. lbs.).
7. Install ignition coils. Tighten fasteners to 8 N.m (70 in. lbs.).
8. If the PCV valve was removed, tighten PCV valve to 5 N.m (44 in. lbs.).
9. Connect PCV and make-up air hoses to cylinder head cover.
10. Install engine cover.

## TAPPETS-VALVE

### DIAGNOSIS AND TESTING

#### HYDRAULIC LASH ADJUSTER NOISE DIAGNOSIS

A tappet-like noise may be produced from incorrect valve lash. Refer to **STANDARD PROCEDURE**.

### STANDARD PROCEDURE

#### MEASURING VALVE LASH

 

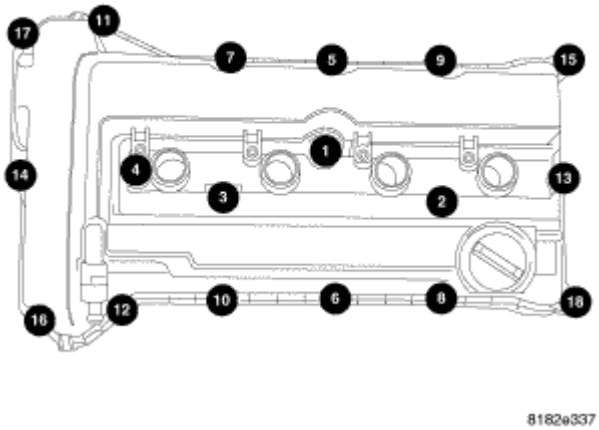


**Fig. 155: TORQUE SEQUENCE**
**Courtesy of CHRYSLER LLC**

1. Remove engine cover.
2. Remove cylinder head cover. Refer to **REMOVAL**.

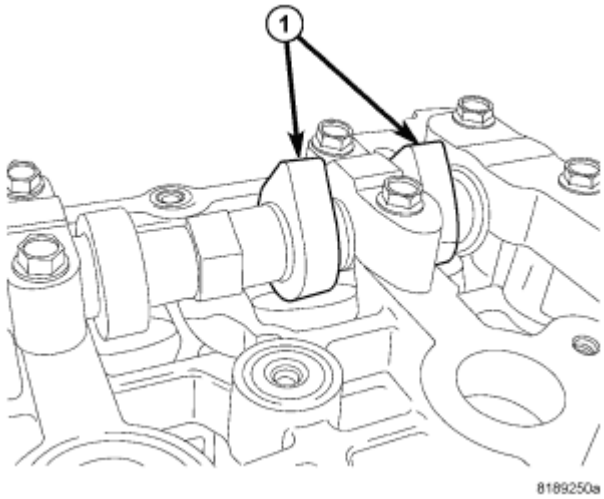


**Fig. 156: LOBES VERTICAL**
**Courtesy of CHRYSLER LLC**

3. Rotate camshaft so lobes are vertical (1).
4. Check clearance using feeler gauges.
5. Repeat for all tappets and record readings.
6. If clearance was too small, go to the clearance to small procedure. step **Clearance to Small**.
7. If clearance was too large, go to the clearance to large procedure. step **Clearance to Large**.

**Clearance to Small**

 

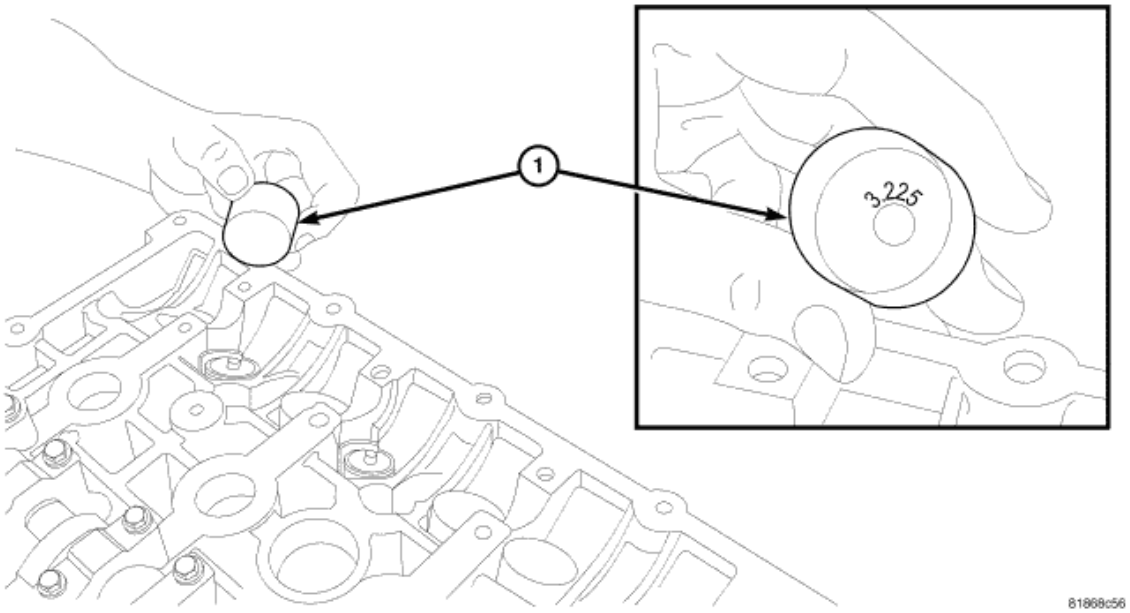


**Fig. 157: TAPPET IDENTIFICATION**
**Courtesy of CHRYSLER LLC**

1. Remove camshafts. Refer to **REMOVAL**.
2. Specification - clearance = change
3. Decrease bucket thickness by change figure.
4. Install camshafts. Refer to **INSTALLATION**.
5. Verify that valve lash is correct.

**Clearance to Large**

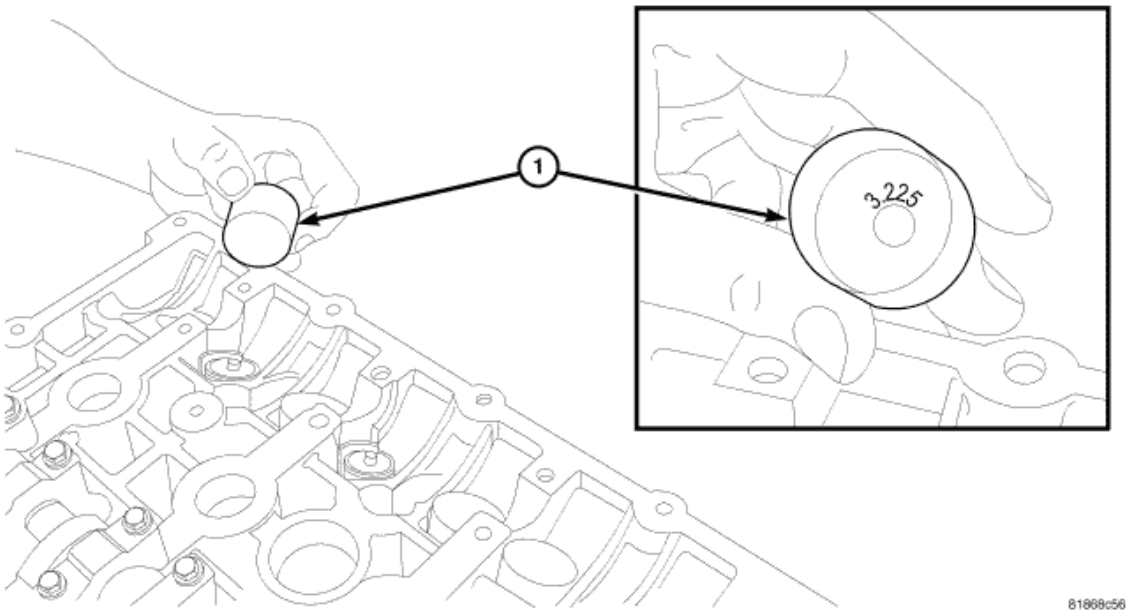


**Fig. 158: TAPPET IDENTIFICATION**

 

**Courtesy of CHRYSLER LLC**

1. Remove camshafts. Refer to **REMOVAL**.
2. Clearance - specification = change.
3. Increase bucket thickness by change figure.
4. Install camshafts. Refer to **INSTALLATION**.
5. Verify that valve lash is correct.

**REMOVAL**

**VALVE TAPPETS**

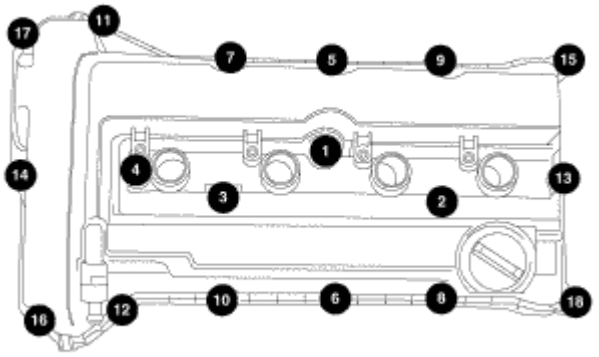


**Fig. 159: TORQUE SEQUENCE**
**Courtesy of CHRYSLER LLC**

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

**NOTE: Camshaft tappets must be replaced if cylinder head or camshafts are replaced.**

1. Remove cylinder head cover. Refer to **REMOVAL**.
2. Remove camshafts. Refer to **REMOVAL**.

 

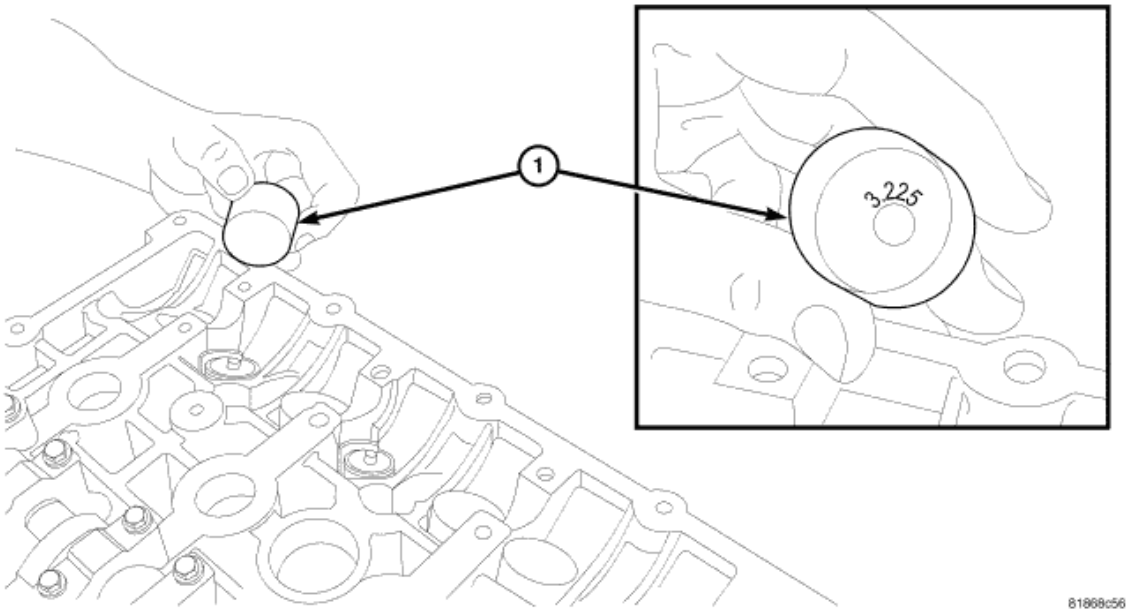


**Fig. 160: TAPPET IDENTIFICATION**
**Courtesy of CHRYSLER LLC**

3. Remove camshaft tappets (1).
4. Repeat removal procedure for each camshaft tappet (1).
5. If reusing, mark each camshaft bucket for reassembly in original position.

**INSTALLATION**

**HYDRAULIC LASH ADJUSTERS**

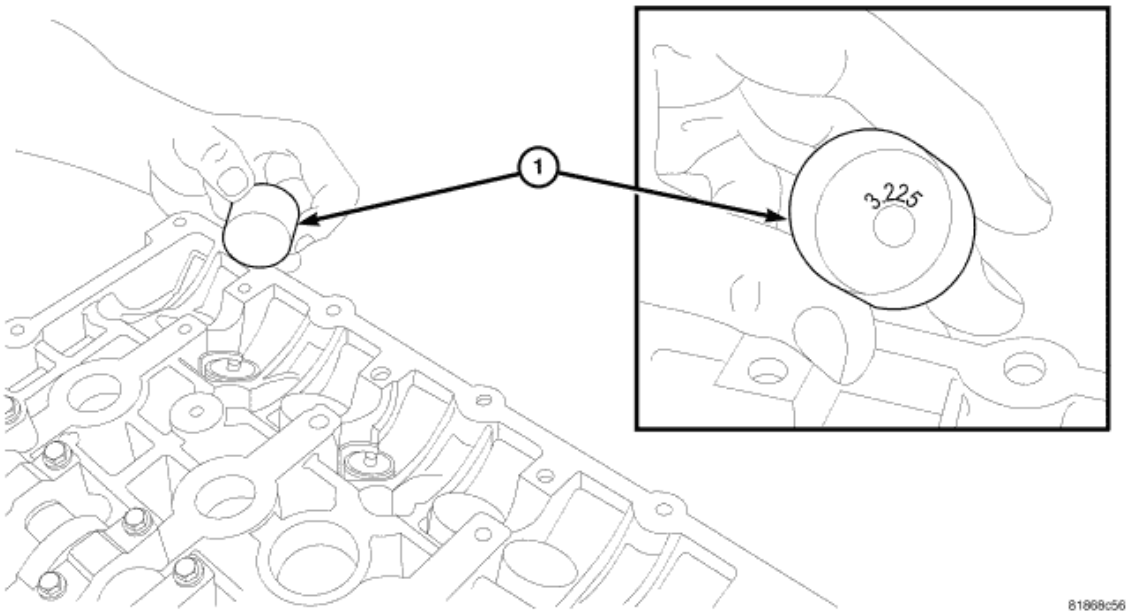


**Fig. 161: TAPPET IDENTIFICATION**

 

**Courtesy of CHRYSLER LLC**

**NOTE: If reinstalling original tappets they must go back in their original location or engine damage could result.**

1. Apply a light coat of clean engine oil to camshafts tappets (1) prior to assembly.
2. Install camshaft tappets (1) into cylinder head.
3. Repeat installation procedure for each camshaft tappet.
4. Install camshafts. Refer to **INSTALLATION**.

**NOTE: If installing new tappets, the valve lash procedure must be performed.**

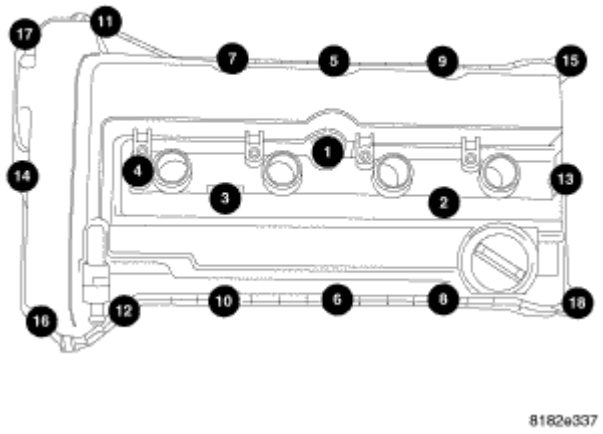


**Fig. 162: TORQUE SEQUENCE**
**Courtesy of CHRYSLER LLC**

5. Install cylinder head cover. Refer to **INSTALLATION**.

## VALVES & SEATS-INTAKE/EXHAUST

### DESCRIPTION

#### VALVE AND VALVE SPRING

The valves are made of heat resistant steel. They have nitrided stems to prevent scuffing. Viton rubber valve stem seals are integral with the spring seats. The valves have a single bead lock keepers to retain the springs.

### OPERATION

#### VALVE AND VALVE SPRING

The four valves per cylinder (two intake and two exhaust) are opened by using direct acting tappets which are actuated by the camshaft.

 

**CLEANING**

**VALVE AND VALVE SPRING**

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

**CAUTION: Due to the small margin on the valves, grinding is not recommended.**

## SPRINGS & SEALS-VALVE

**REMOVAL**

**VALVE SPRINGS AND VALVE SEALS IN VEHICLE**

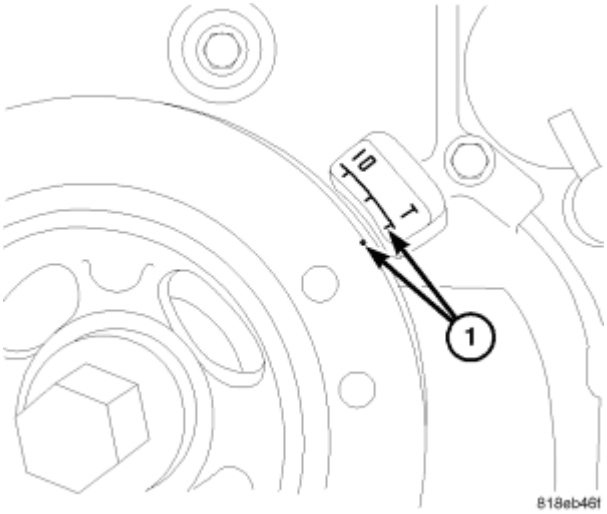


**Fig. 163: TDC Mark**
**Courtesy of CHRYSLER LLC**

1. Rotate crankshaft until piston is at TDC on compression.

 

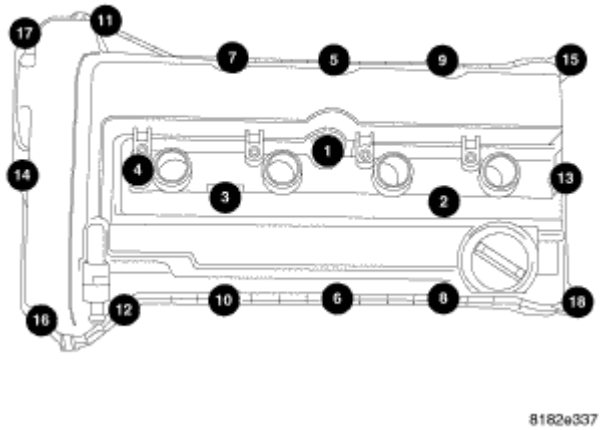


**Fig. 164: Cylinder Head Cover Bolt Removal Sequence**
**Courtesy of CHRYSLER LLC**

2. Remove cylinder head cover. Refer to **REMOVAL**.
3. Remove camshafts. Refer to **REMOVAL**.
4. Mark valve tappet location for assembly.
5. Remove valve tappets.
6. With air hose attached to adapter tool installed in spark plug hole, apply 90-120 psi air pressure.

**CAUTION: Care must be taken not to damage the tappet bore or engine damage may result.**

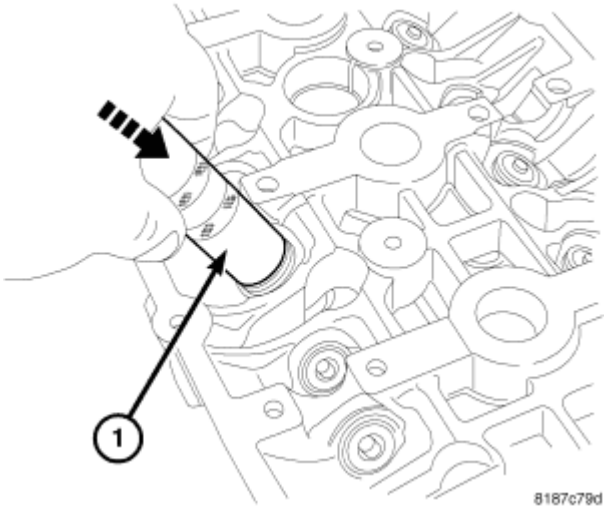


**Fig. 165: Valve Keeper Tool**
**Courtesy of CHRYSLER LLC**

7. Using metric valve keeper tool (1) such as Snap-on® GA317 (or equivalent), and remove valve spring keepers and retainer.

 

8. Remove valve spring(s).
9. Remove valve stem seal(s) by a using valve stem seal tool.

**VALVE AND VALVE SPRING**

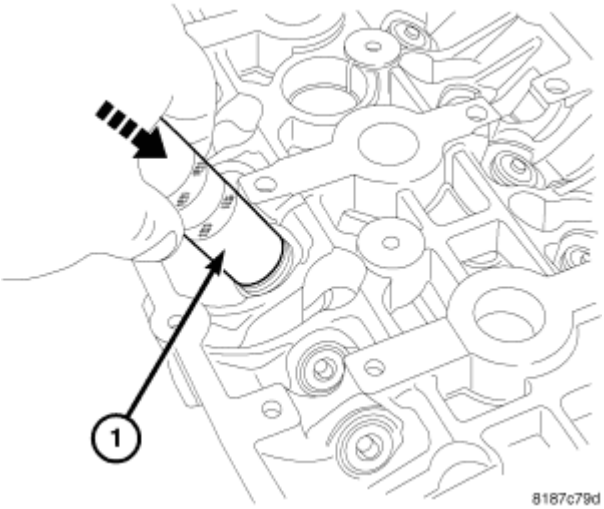


**Fig. 166: Valve Keeper Tool**
**Courtesy of CHRYSLER LLC**

1. With cylinder head removed from cylinder block, place a ball of rags in the combustion chamber.

**CAUTION: Care must be taken not to damage the tappet bore or engine damage may result.**

2. Mark valve tappet location for assembly.
3. Remove valve tappets.
4. Using metric valve keeper tool such as Snap-on® GA317 (or equivalent) remover (1) , remove valve keepers with a downward push.
5. Remove retainer and springs.
6. Before removing valves, **remove any burrs from valve stem lock grooves to prevent damage to the valve guides.** Identify valves, locks and retainers to insure installation in original location.
7. Inspect the valves. Refer to **INSPECTION**.

**INSPECTION**

**VALVE AND VALVE SPRING**

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

Valve closed nominal load - 179.5 N ± 9 N @ 35.0 mm (40.35 lbs. ± 2 lbs. @ 1.38 in.).

 

Valve open nominal load - 364.8 N ± 17 N @ 29.25 mm (82 lbs. ± 3.8 lbs. @ 1.152 in.).

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

**INSTALLATION**

**VALVE AND VALVE SPRING**

**CAUTION: Care must be taken not to damage the tappet bore or engine damage may result.**

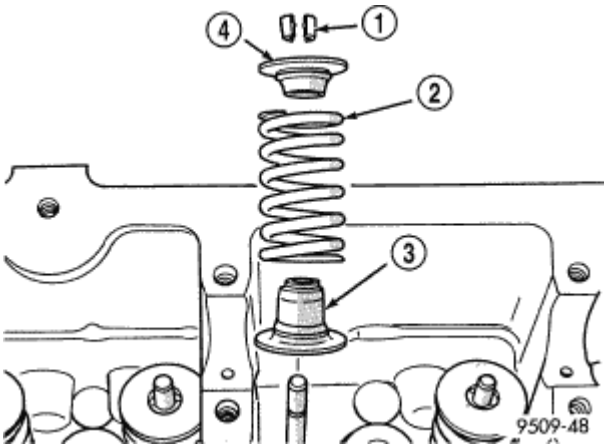


**Fig. 167: Valve Stem Seal & Spring**
**Courtesy of CHRYSLER LLC**

1. Coat valve stems with clean engine oil and insert in cylinder head.
2. Install new valve stem seals (3) on all valves using an appropriate sized socket to seat the seal/spring seat. The valve stem seals should be pushed firmly and squarely over valve guide.
3. Install valve springs (2).
4. Install keepers in retainer and place on valve spring.

 

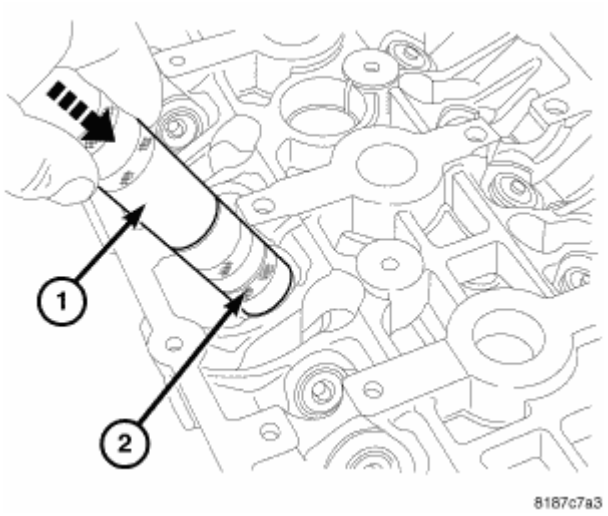


**Fig. 168: Valve Keeper Tool**
**Courtesy of CHRYSLER LLC**

5. Using metric valve keeper tool such as Snap-on® GA317 (or equivalent) installer (2) and remover (1) as a handle, push downward to install keepers.

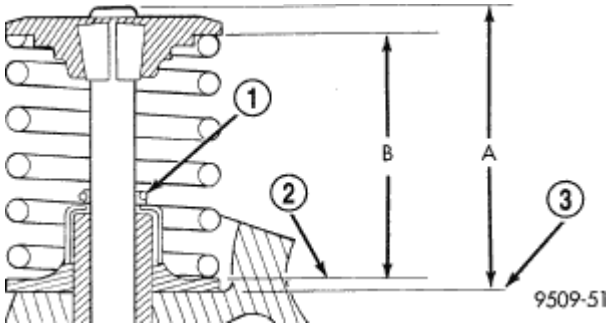


**Fig. 169: Check Valve Spring Installed Height B**
**Courtesy of CHRYSLER LLC**

6. Check the valve spring installed height B after refacing the valve and seat. Make sure measurements are taken from top of spring seat to the bottom surface of spring retainer. If height is greater than 38.75 mm (1.525 in.), install a 0.762 mm (0.030 in.) spacer under the valve spring seat to bring spring height back within specification.
7. Install valve tappets.

**VALVE SPRINGS AND VALVE SEALS IN VEHICLE**

**CAUTION: Care must be taken not to damage the tappet bore or engine damage may result.**

 

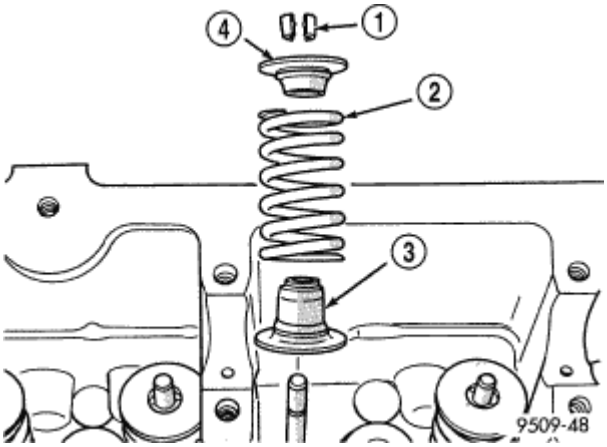


**Fig. 170: Valve Stem Seal & Spring**
**Courtesy of CHRYSLER LLC**

1. Install valve seal/valve spring seat (3) assembly. Push the assembly down with appropriate size socket to seat it onto the valve guide.
2. Install valve spring (2) and retainer (4) with keepers (1).

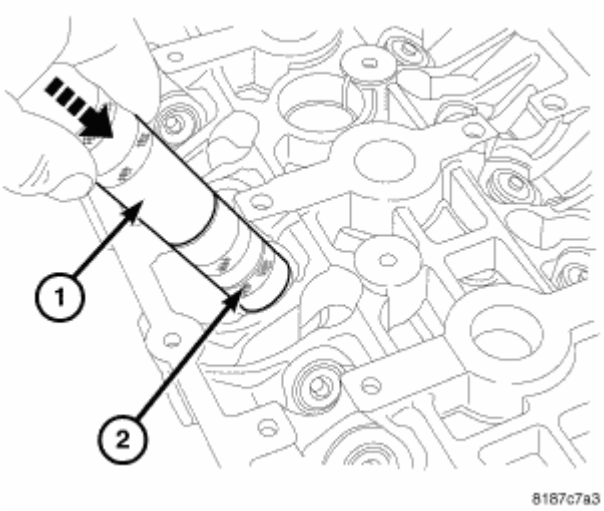


**Fig. 171: Valve Keeper Tool**
**Courtesy of CHRYSLER LLC**

3. Place the valve keepers in the retainer. Using metric valve keeper tool such as Snap-on® GA317 (or equivalent) installer (2) and remover (1) as a handle, install valve keepers with a downward push.
4. Remove air hose and install spark plugs.
5. Install valve tappets.
6. Install camshafts. Refer to **INSTALLATION**.
7. Install cylinder head cover. Refer to **INSTALLATION**.

## ASSEMBLY-VARIABLE VALVE TIMING

### DESCRIPTION

 

The world engine is equipped with Variable Valve Timing (VVT). This system advances and/or retards intake and/or exhaust camshaft timing to improve engine performance, mid-range torque, idle quality, fuel economy, and reduce emissions. The camshaft sprockets are integrated with the VVT assemblies and are serviced as an assembly. VVT assemblies are sometimes referred to as camshaft phasers.

**OPERATION**

The Variable Valve Timing (VVT) assemblies are actuated with engine oil pressure. The oil flow to the VVT assemblies are controlled by two Oil Control Valves (OCV). There is an OCV and Camshaft Position Sensor (CMP) for each camshaft. The OCV's consist of a Pulse Width Modulated (PWM) solenoid and a spool valve. The PCM actuates the OCV to control oil flow through the spool valve into the VVT assemblies. The VVT assembly consists of a rotor, stator, and sprocket. The stator is connected to the timing chain through the sprocket. The rotor is connected to the camshaft. Oil flow in to the VVT assembly rotates the rotor with respect to the stator, thus rotating the camshaft with respect to the timing chain. Thus, the VVT assemblies change valve timing by changing the relationship between the camshaft and the timing chain. An infinitely variable valve timing position can be achieved within the limits of the hardware. The CMP monitors the position of the camshaft with respect to the crankshaft and provides feedback to the PCM.

**REMOVAL**

**CAMSHAFT PHASERS**

**NOTE: Camshaft phaser and camshaft sprocket are supplied as an assembly, do not attempt to disassemble.**

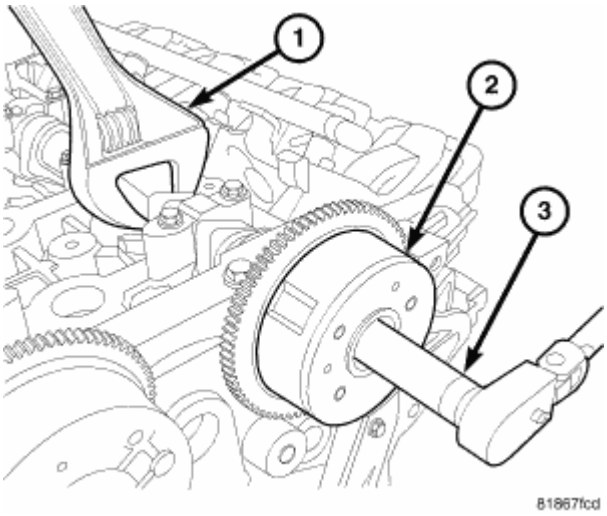


**Fig. 172: Cam Phaser Installation**
**Courtesy of CHRYSLER LLC**

1. Remove camshafts. Refer to **REMOVAL**.
2. Remove camshaft phaser (2) retaining bolt while holding the camshaft in place with a wrench (1) on the camshaft flats.
3. Remove phaser (2) assembly from camshaft.

 

**INSTALLATION**

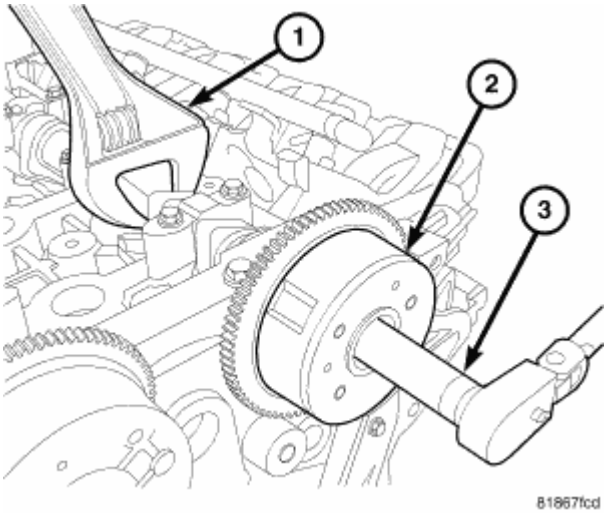


**Fig. 173: CAM PHASER INSTALLATION**
**Courtesy of CHRYSLER LLC**

**CAUTION: Do not use an impact wrench to tighten camshaft sprocket bolts. Damage to the camshaft-to-sprocket locating dowel pin and camshaft phaser may occur.**

1. Install phaser (2) assembly on camshaft.

**NOTE: Make sure the dowel is seated in the dowel hole and not in a oil feed hole. The dowel hole is larger than the 4 oil feed holes.**

2. Install phaser retaining bolt and torque while holding camshaft in place with a wrench (1).
3. Install camshafts. Refer to **INSTALLATION**.

# ENGINE BLOCK

## DESCRIPTION

### CYLINDER BLOCK AND LADDER FRAME

The die cast aluminum cylinder block is a two-piece assembly, consisting of the cylinder block and ladder frame. The block is an open deck design with cast in place cast iron cylinder liners. The cast iron cylinder liners are recessed below the aluminum deck surface. The ladder frame bolts to the cylinder block and does not incorporate the main bearing caps. This design offers a much stronger lower end and increased cylinder block and transaxle rigidity. The rear oil seal retainer is integral with the block and ladder frame. The ladder frame and block are serviced as an assembly.

 

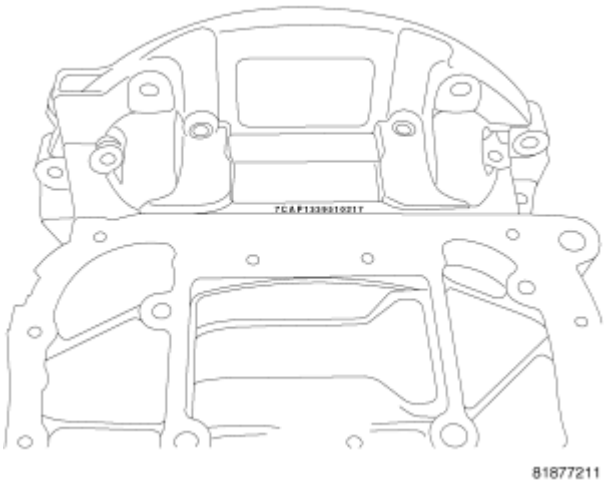


**Fig. 174: Serial Number**
**Courtesy of CHRYSLER LLC**

The engine serial number is located on the bottom of the ladder frame just behind the oil pan. The date can be seen with the oil pan in place.

## STANDARD PROCEDURE

### CYLINDER BORE HONING

 

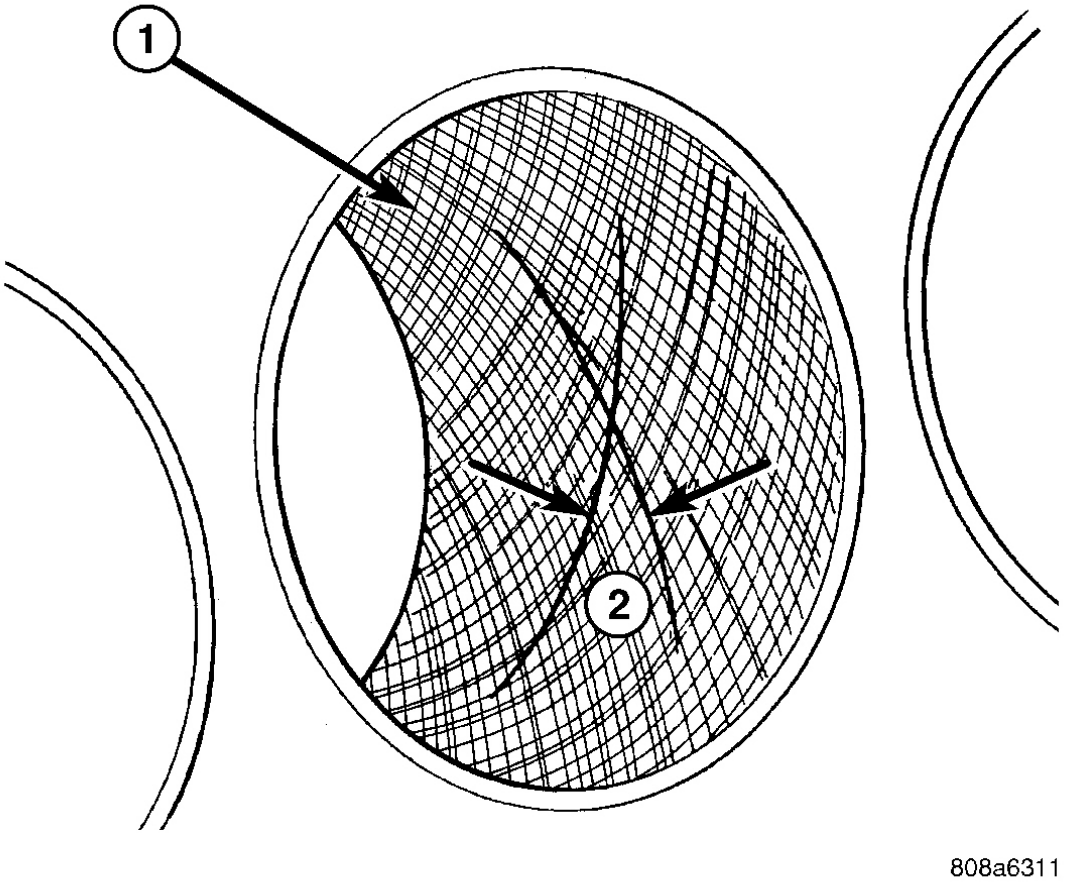


**Fig. 175: Cylinder Bore Cross-Hatch Pattern**
**Courtesy of CHRYSLER LLC**

| |
|---|
| 1 - CROSS-HATCH PATTERN<br>2 - 40°-60° |

1. Deglazing of the cylinder walls may be done using a quality commercially available flex hone, 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.
2. Honing should be done by moving the hone up and down fast enough to get a cross-hatch pattern. When hone marks **intersect** at 30-50 degrees, the cross hatch angle is most satisfactory for proper seating of rings. See **Fig. 175**.
3. 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 30-50 degree angle. Faster up and down strokes increase the cross-hatch angle.
4. After honing, it is necessary that the block be cleaned again to remove all traces of abrasive.

 

**CAUTION: Ensure all abrasives are removed from engine parts after honing. It is recommended that a solution of soap and hot water be used with a brush and the parts then thoroughly dried. The bore can be considered clean when it can be wiped clean with a white cloth and cloth remains clean. Oil the bores after cleaning to prevent rusting.**

## CLEANING

Clean cylinder block thoroughly using a suitable cleaning solvent.

## INSPECTION

### ENGINE BLOCK

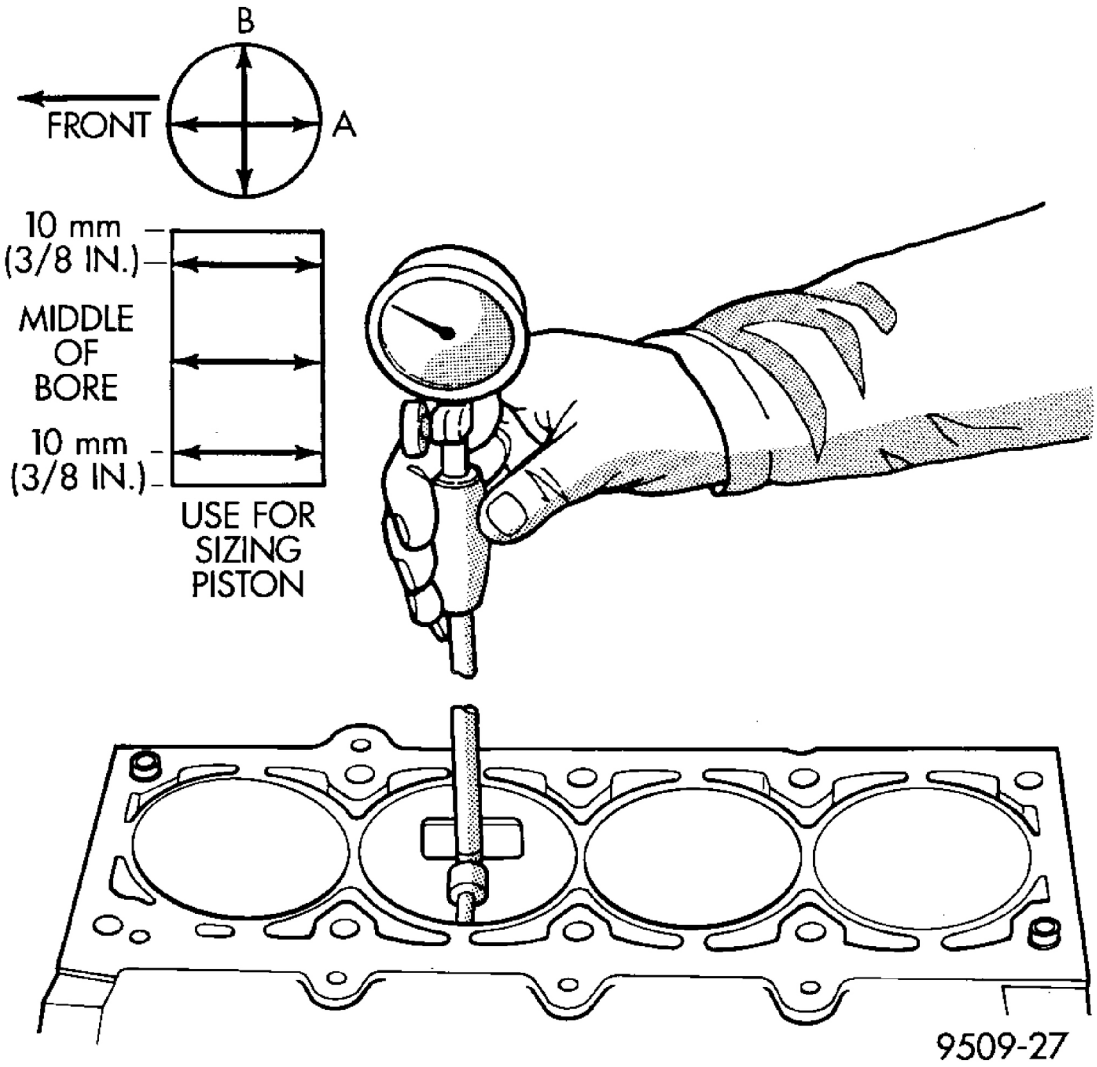


**Fig. 176: Checking Cylinder Bore Diameter**
**Courtesy of CHRYSLER LLC**

 

1. Clean cylinder block thoroughly and check all core hole plugs for evidence of leaking.
2. Examine block and cylinder bores for cracks or fractures.
3. Check block deck surfaces for flatness. Deck surface must be within service limit of 0.050 mm (0.002 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 **Fig. 176**. Refer to **SPECIFICATIONS**. If the cylinder walls are badly scuffed or scored, the cylinder block should be replaced, and new pistons and rings fitted.

Measure the cylinder bore at three levels in directions A and B. See **Fig. 176**. Top measurement should be 10 mm (3/8 in.) down and bottom measurement should be 10 mm (3/8 in.) up from bottom of bore. Refer to **SPECIFICATIONS**.

## CRANKSHAFT

**STANDARD PROCEDURE**

**MEASURING CRANKSHAFT END PLAY**

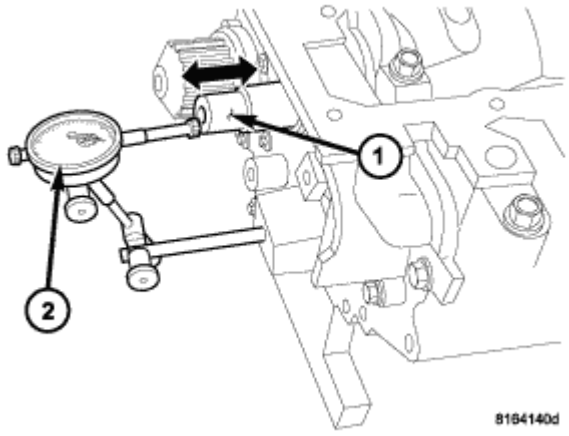


**Fig. 177: Checking Crankshaft End Play - Typical**
**Courtesy of CHRYSLER LLC**

| |
|---|
| 1 - Crankshaft |
| 2 - DIAL INDICATOR |

1. Mount a dial indicator (2) to front of engine with the locating probe on nose of crankshaft (1). See **Fig. 177**.

 

2. Move crankshaft all the way to the rear of its travel.
3. Zero the dial indicator.
4. Move crankshaft all the way to the front and read the dial indicator. Refer to **SPECIFICATIONS** for end play specification.

**REMOVAL**

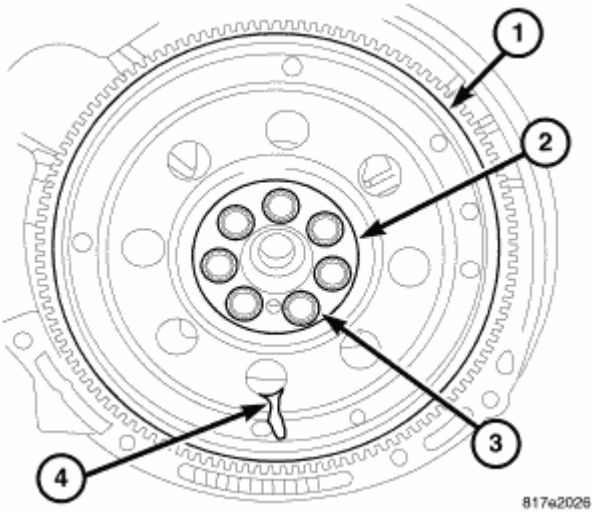


**Fig. 178: FLEX PLATE**
**Courtesy of CHRYSLER LLC**

**NOTE: Crankshaft cannot be removed when engine is in vehicle.**

1. Remove engine assembly from vehicle. Refer to **REMOVAL**.
2. Separate transaxle from engine.
3. Remove flex plate/flywheel (1).
4. Remove crankshaft rear oil seal. Refer to **REMOVAL**.

 

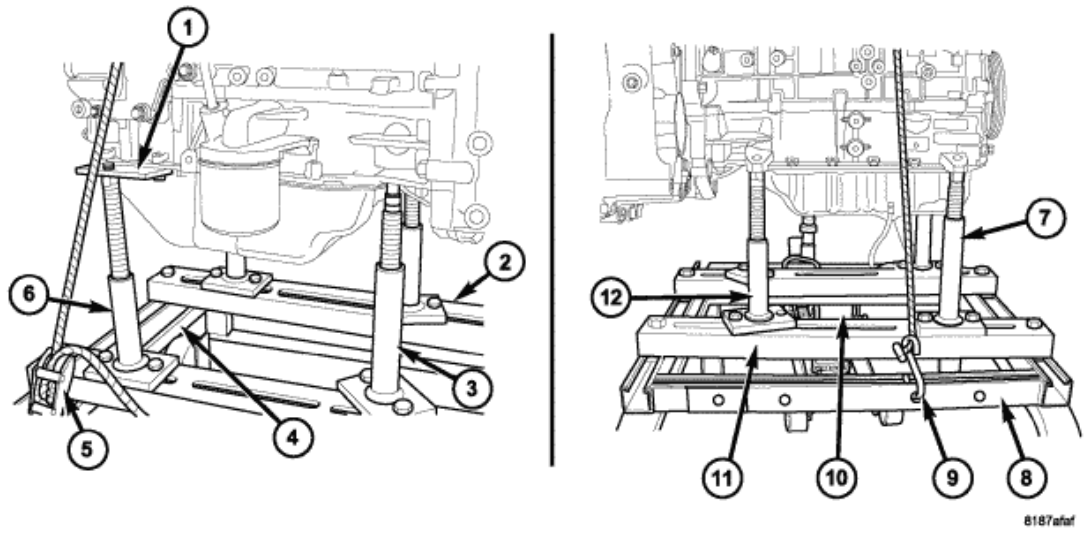


**Fig. 179: ENGINE DOLLY**
**Courtesy of CHRYSLER LLC**

5. Remove engine from cradle 6710 (11) and mount engine on a suitable repair stand.

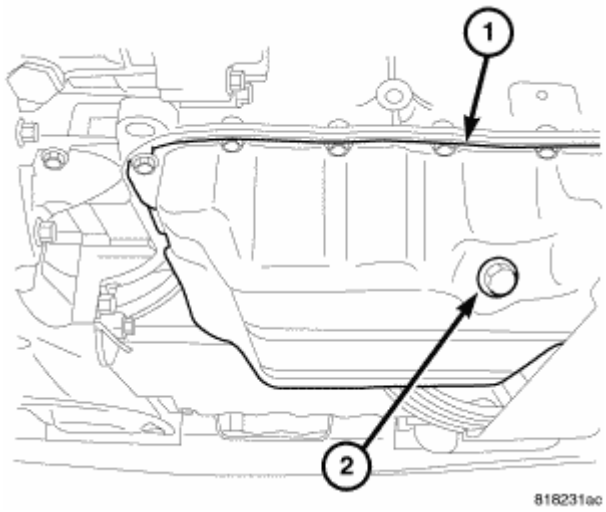


**Fig. 180: OIL DRAIN PLUG**
**Courtesy of CHRYSLER LLC**

6. Drain engine oil (2).

 

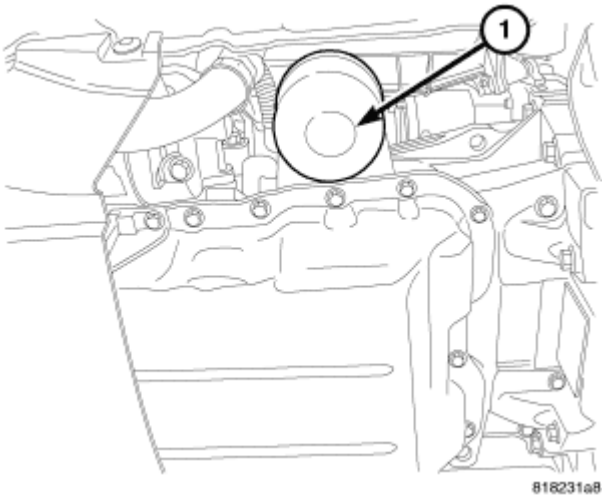


**Fig. 181: OIL FILTER**
**Courtesy of CHRYSLER LLC**

7. Remove oil filter (1).

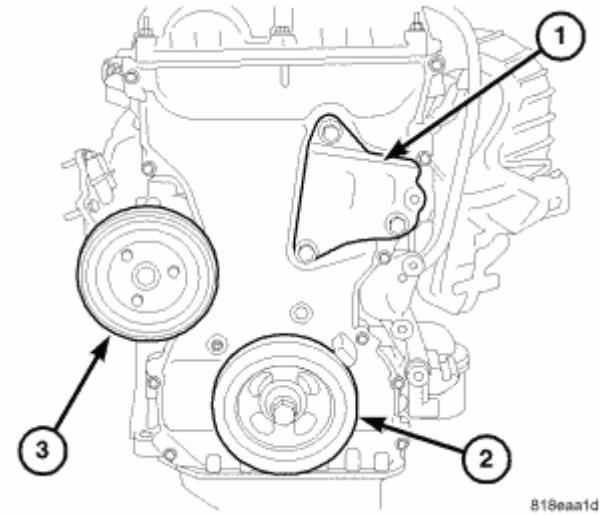


**Fig. 182: RIGHT ENGINE MOUNT BRACKET**
**Courtesy of CHRYSLER LLC**

8. Remove crankshaft vibration damper (2). Refer to **REMOVAL**.
9. Remove water pump pulley (3).
10. Remove engine mount support bracket (1).

 

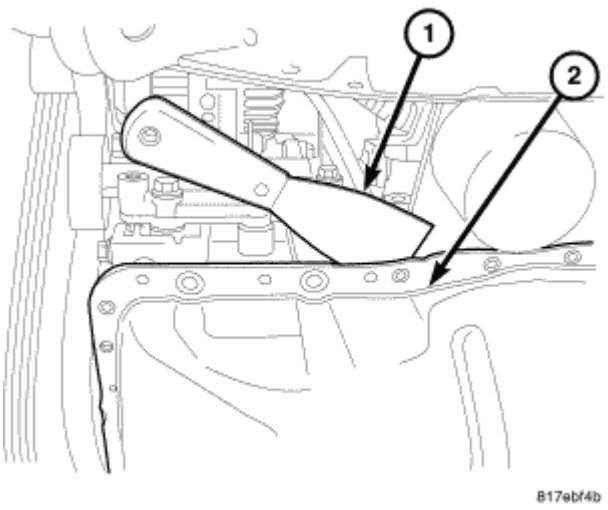


**Fig. 183: OIL PAN REMOVAL**
**Courtesy of CHRYSLER LLC**

11. Remove the oil pan (2). Refer to **PAN-OIL**.
12. Remove timing chain cover. Refer to **REMOVAL**.
13. Remove the timing chain. Refer to **REMOVAL - TIMING CHAIN**.
14. Remove balance shaft module.

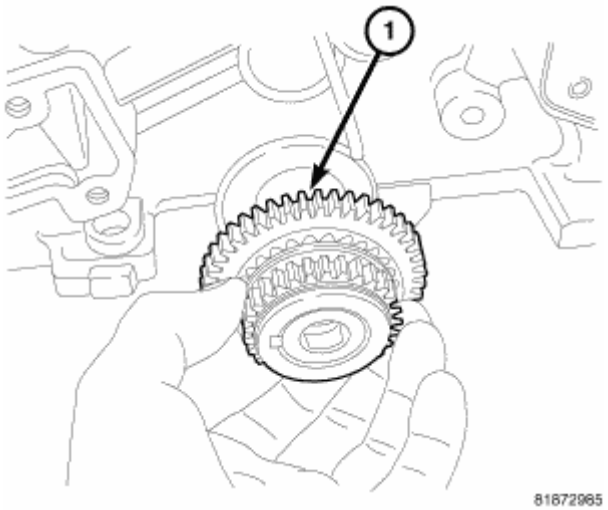


**Fig. 184: CRANKSHAFT SPROCKET**
**Courtesy of CHRYSLER LLC**

15. Remove the crankshaft sprocket (1).

 

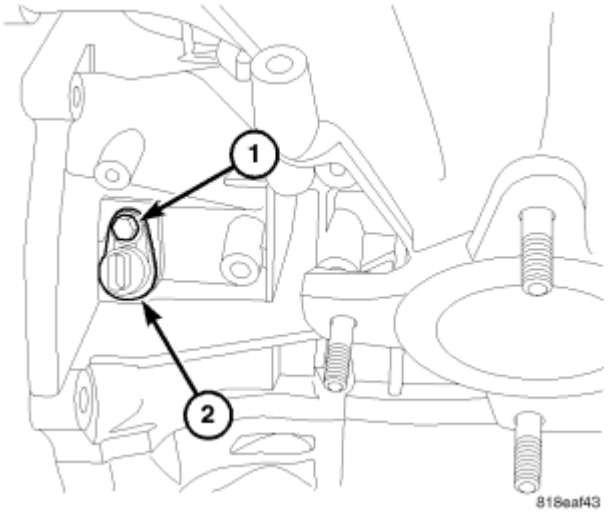


**Fig. 185: CRANKSHAFT POSITION SENSOR**
**Courtesy of CHRYSLER LLC**

16. Remove crankshaft position sensor retaining bolt (1) and remove sensor (2).
17. Remove ladder frame. Refer to **REMOVAL**.

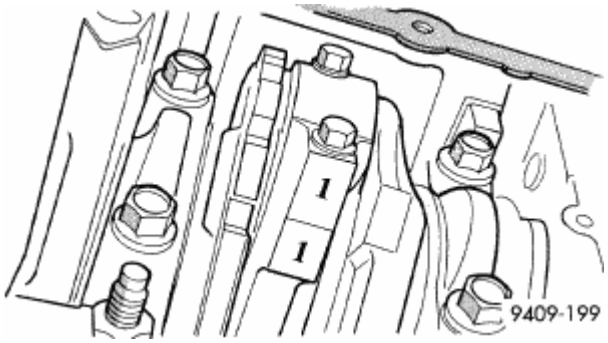


**Fig. 186: IDENTIFY CONNECTING ROD TO CYLINDER - TYPICAL**
**Courtesy of CHRYSLER LLC**

**NOTE: If piston/connecting rod replacement is necessary, remove cylinder head. Refer to REMOVAL.**

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

18. Using a permanent ink or paint marker, identify cylinder number on each connecting rod and cap.
19. Remove all connecting rod bolts and caps. Care should be taken not to damage the fracture rod and cap surfaces.

 

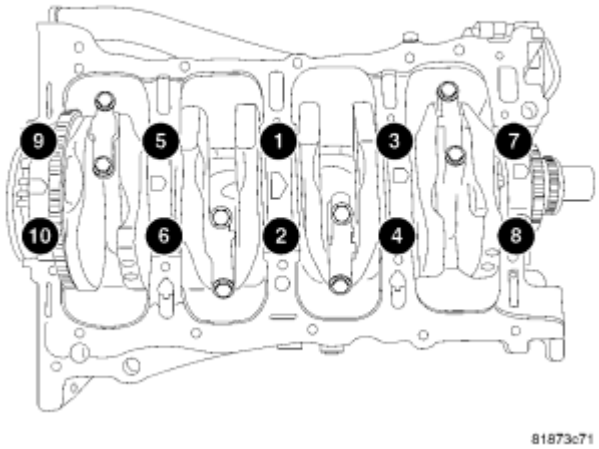


**Fig. 187: MAIN BEARING CAP REMOVAL SEQUENCE**
**Courtesy of CHRYSLER LLC**

**NOTE: Do not reuse connecting rod bolts.**

20. Remove main bearing caps.

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

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

**INSPECTION**

 

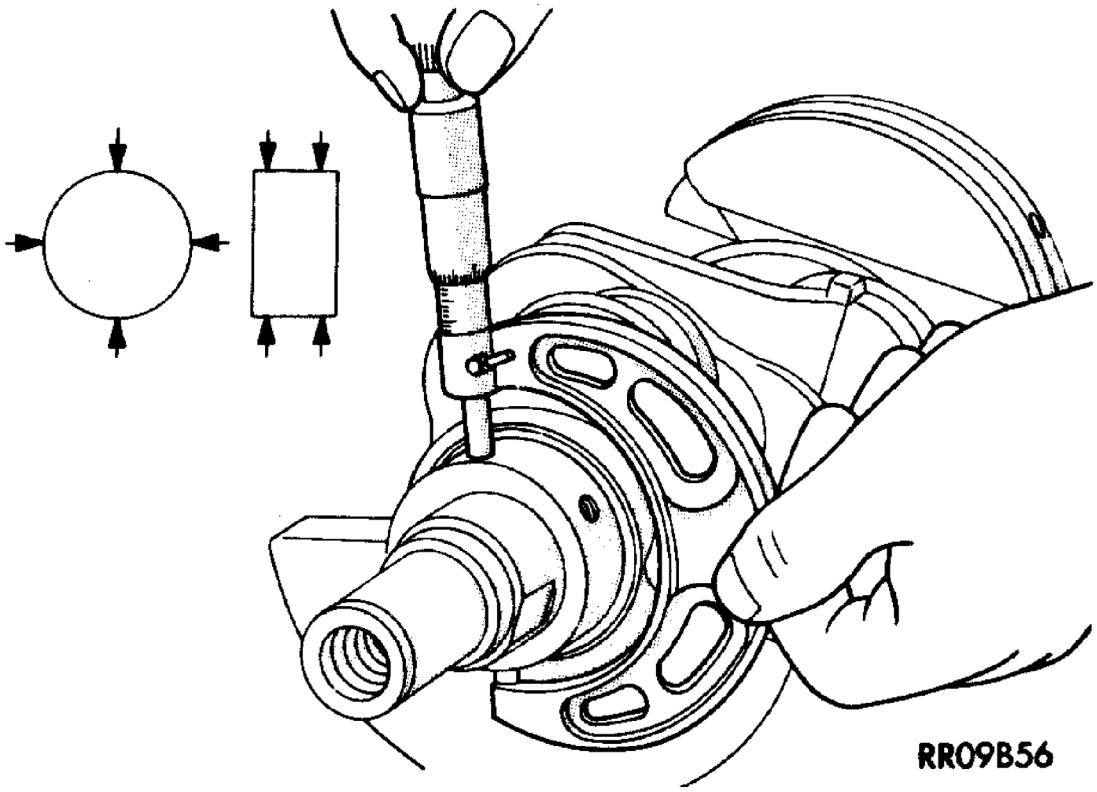


**Fig. 188: Crankshaft Journal Measurements - Typical**
**Courtesy of CHRYSLER LLC**

The crankshaft main journals should be checked for excessive wear, taper and scoring. Limits of taper on any crankshaft main journals should be held to 0.006 mm (0.00024 in.). Limits of taper on any crankshaft rod journals should be held to 0.005 mm (0.0002 in.). DO NOT nick crank pin or bearing fillets. Limits of out of round on any crankshaft journals should be held to 0.005 mm (0.0002 in). DO NOT nick crank pin or bearing fillets.

**INSTALLATION**

 

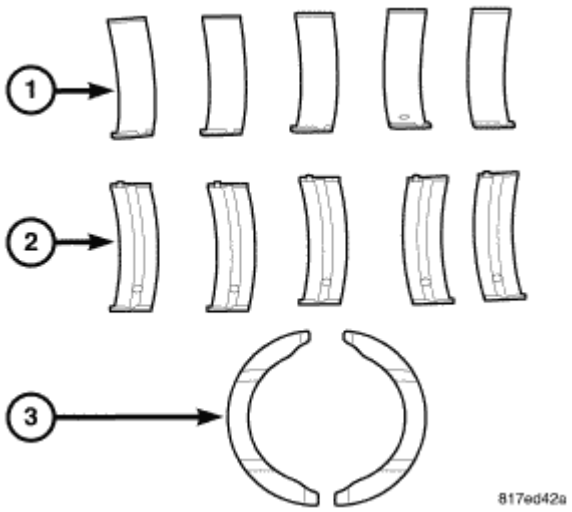


**Fig. 189: BEARING IDENTIFICATION**
**Courtesy of CHRYSLER LLC**

The crankshaft is supported in five main bearings. All upper bearing shells (2) in the crankcase have oil grooves and holes. All lower bearing shells (1) are smooth. Crankshaft end play is controlled by a two piece thrust bearing (3) on the number three main bearing journal.

1. Clean main bearing cap bolt holes with Mopar® brake parts cleaner or equivalent and blow out with compressed air.
2. Install the main bearing upper (2) shells with the lubrication groove and oil hole in the engine block.
3. Make certain oil holes in block line up with oil hole in bearings and bearing tabs seat in the block tab slots.

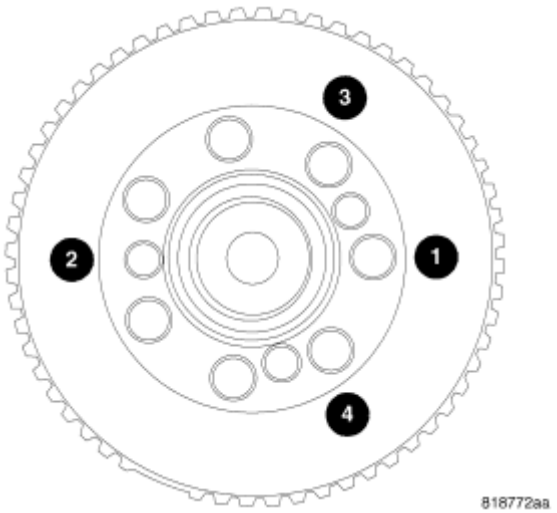


**Fig. 190: TARGET WHEEL**
**Courtesy of CHRYSLER LLC**

**NOTE: If the crankshaft is sent out for machine work, it must be balanced as an assembly with the target ring installed.**

 

4. Clean crankshaft and target ring with MOPAR® Brake Parts cleaner and dry with compressed air to ensure that the crankshaft mating surface and target ring mounting holes are free from oil and lock patch debris.

**NOTE: Always use NEW mounting screws whether installing original or new target ring.**

5. Install **NEW** mounting screws finger tight starting with the #1 location. Make sure engagement occurs with the shoulder of the screws and mounting hole before starting all other screws.
6. Tighten all mounting screws to 13 N.m (110 in-lbs) in the sequence shown.

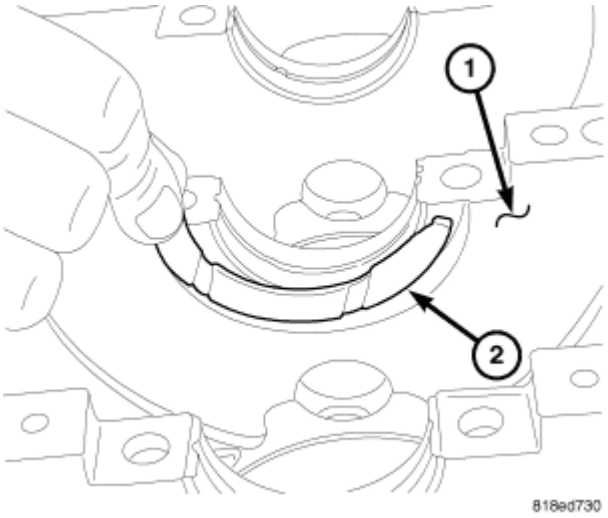


**Fig. 191: INSTALLING THRUST BEARING**
**Courtesy of CHRYSLER LLC**

**NOTE: Lightly apply trans gel to thrust bearings to hold bearings in block.**

**NOTE: The thrust bearings must be installed the notches facing the crankshaft.**

7. Install thrust bearings (2) in block (1).

**CAUTION: Do not get oil on the ladder frame mating surface. It will affect the ability of the RTV to seal the ladder frame to cylinder block.**

**NOTE: Ensure main bearing cap bolt holes in the block are clean, dry (free of residual oil or coolant), and threads are not damaged.**

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

 

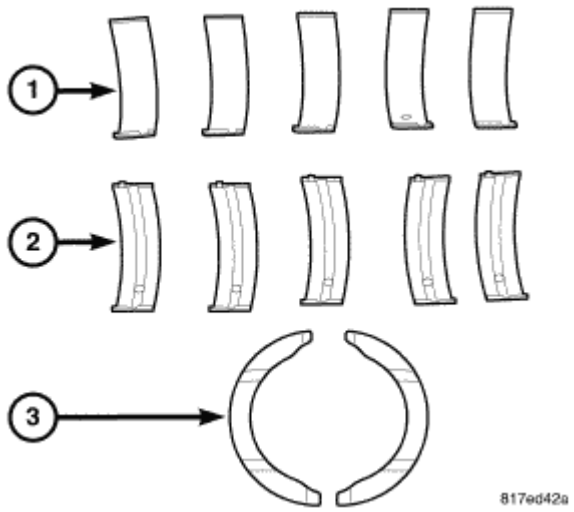


**Fig. 192: BEARING IDENTIFICATION**
**Courtesy of CHRYSLER LLC**

9. Install lower main bearings (1) into main bearing cap. Make certain the bearing tabs are seated into the bearing cap slots.

**NOTE: Main bearing caps are stamped 1 - 5 front to rear. Arrows on the caps must point towards the front of the engine.**

10. Install main bearing caps to engine block.
11. Before installing the bolts the threads should be clean and dry.
12. Loosely install main bearing cap bolts.
13. To ensure correct thrust bearing alignment, perform the following steps:

Step 1: Rotate crankshaft until number 4 piston is at TDC.

Step 2: Move crankshaft rearward to limits of travel.

Step 3: Then, move crankshaft forward to limits of travel.

Step 4: Wedge an appropriate tool between the rear of the cylinder block and the rear crankshaft counterweight. This will hold the crankshaft in its furthest forward position.

**CAUTION: There are different sets main bolts supplied with this engine. Each bolt set has a different torque value and engine damage could result if bolts are not torqued correctly. The bolts are not interchangeable.**

 

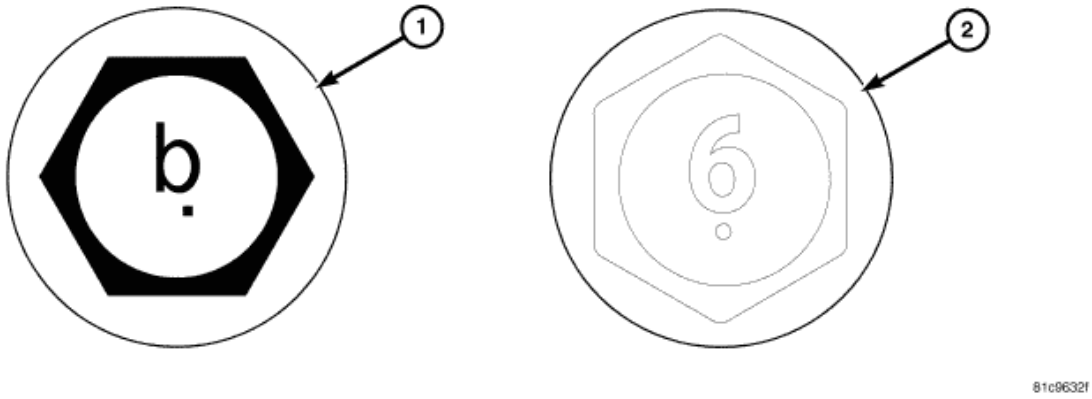


**Fig. 193: MAIN BOLT IDENTIFICATION**
**Courtesy of CHRYSLER LLC**

14. If your bolt heads look like this (1,2), go to step 15. If your bolt heads do not look like this (1,2), go to step 16.

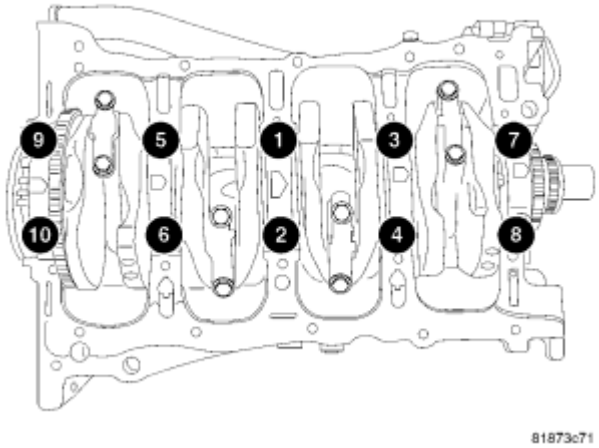


**Fig. 194: MAIN BEARING CAP TORQUE SEQUENCE**
**Courtesy of CHRYSLER LLC**

**CAUTION: Before tightening bolts, you must identify the bolt head to obtain the correct torque value. Failure to identify the bolts correctly, could result in improperly tightened bolts which could result in engine damage.**

15. Tighten bolts using a three step method, in the sequence shown.
    Tighten bolts to 15 N.m (11 ft. lbs.)
    Tighten bolts to 27 N.m (20 ft. lbs.)
    Rotate an additional 45°.
16. Tighten bolts using a three step method, in the sequence shown.

 

Tighten bolts to 15 N.m (11 ft. lbs.)

Tighten bolts to 45 N.m (33 ft. lbs.)

Rotate an additional 45°.

17. Remove wedge tool used to hold crankshaft.
18. Check the crankshaft turning torque, it should not exceed 5.6 N.m (50 in. lbs.).
19. Check crankshaft end play. Refer to **STANDARD PROCEDURE**.
20. Install connecting rod bearings and caps. **Do Not Reuse Connecting Rod Bolts.** Tighten connecting rod bolts to 20 N.m + 90° (15 ft. lbs.) + 90°. Refer to **INSTALLATION**.
21. Install the ladder frame assembly. Refer to **INSTALLATION**.
22. Install the balance shaft module. Refer to **INSTALLATION**.

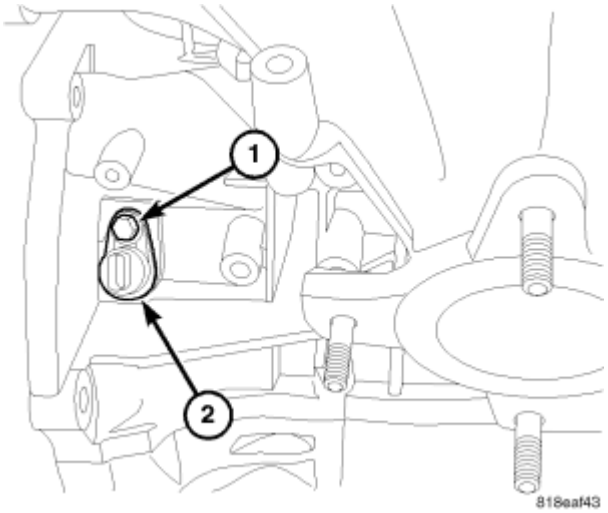


**Fig. 195: CRANKSHAFT POSITION SENSOR**
**Courtesy of CHRYSLER LLC**

23. Install crankshaft position sensor (2) and tighten bolt (1).
24. Install cylinder head if it was removed. Refer to **INSTALLATION**.

 

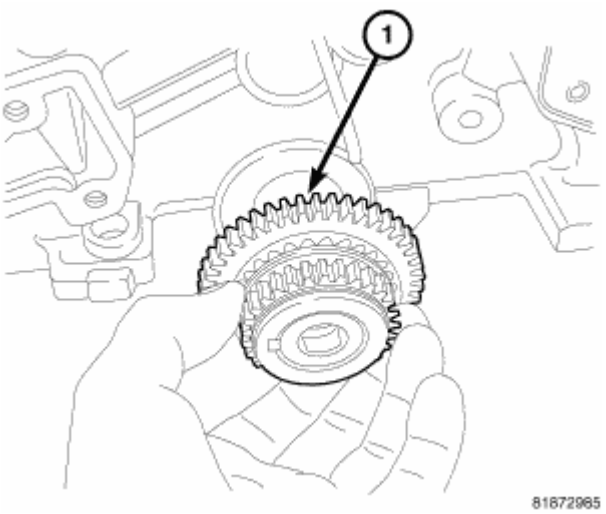


**Fig. 196: CRANKSHAFT SPROCKET**
**Courtesy of CHRYSLER LLC**

25. Install front crankshaft sprocket (1).
26. Install the timing chain. Refer to **TIMING CHAIN**.
27. Install the timing chain front cover. Refer to **INSTALLATION**.
28. Install the oil pan. Refer to **PAN-OIL**.
29. Install rear crankshaft oil seal. Refer to **INSTALLATION**.
30. Install front crankshaft oil seal. Refer to **INSTALLATION**.

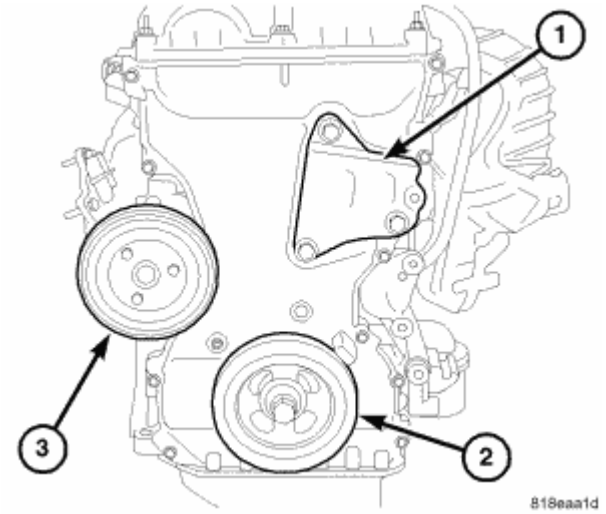


**Fig. 197: RIGHT ENGINE MOUNT BRACKET**
**Courtesy of CHRYSLER LLC**

31. Install engine mount support bracket (1).
32. Install crankshaft vibration damper (2). Refer to **INSTALLATION**.
33. Install water pump pulley (3).

 

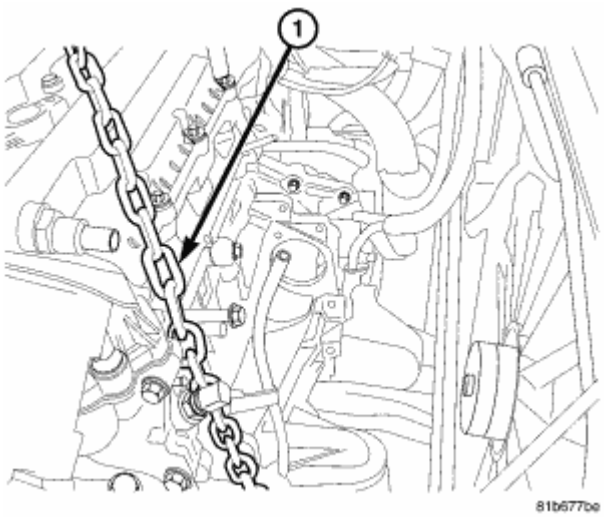


**Fig. 198: LIFT CHAIN**
**Courtesy of CHRYSLER LLC**

34. Remove engine from repair stand and install engine lift chain (1).
35. Install crankshaft rear oil seal. Refer to **INSTALLATION**.
36. Install drive plate/flex plate using **new** bolts. Tighten bolts to 95 N.m (70 ft. lbs.).
37. Attach transaxle to engine. Tighten bellhousing bolts to 101 N.m (75 ft. lbs.).
38. Install the engine assembly. Refer to **INSTALLATION**.

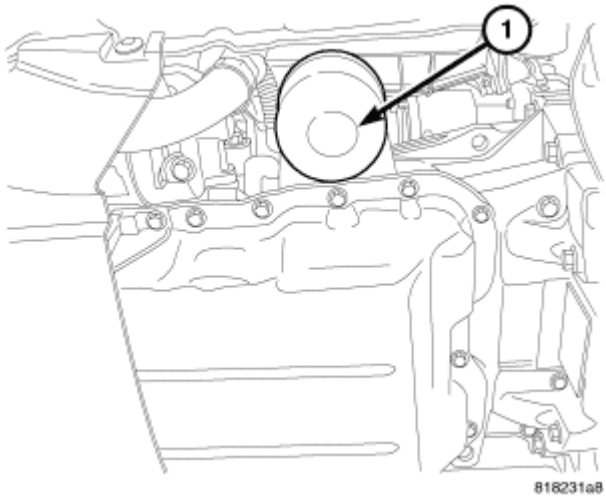


**Fig. 199: OIL FILTER**
**Courtesy of CHRYSLER LLC**

39. Install new oil filter (1) and fill with oil.
40. Fill with coolant. Refer to **STANDARD PROCEDURE** .
41. Start engine and check for leaks.
42. Install engine cover.

 

## SEAL-CRANKSHAFT OIL FRONT

### REMOVAL

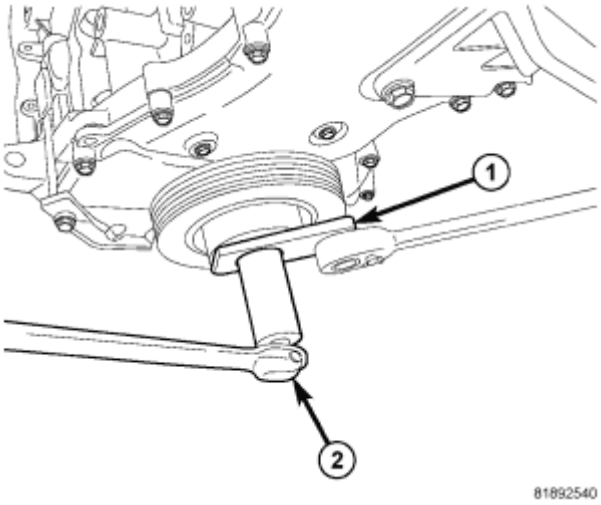


**Fig. 200: Damper Removal**
**Courtesy of CHRYSLER LLC**

1. Remove accessory drive belt.
2. Install damper holder 9707 (1) and remove damper retaining bolt.
3. Pull damper off crankshaft.

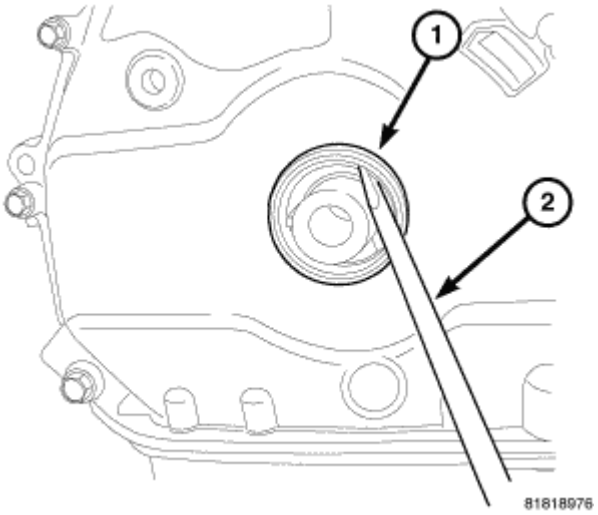


**Fig. 201: Front Crankshaft Seal Removal**
**Courtesy of CHRYSLER LLC**

4. Remove front crankshaft oil seal (1) by prying out with a screw driver (2). Be careful not to damage the cover seal surface.

### INSTALLATION

 

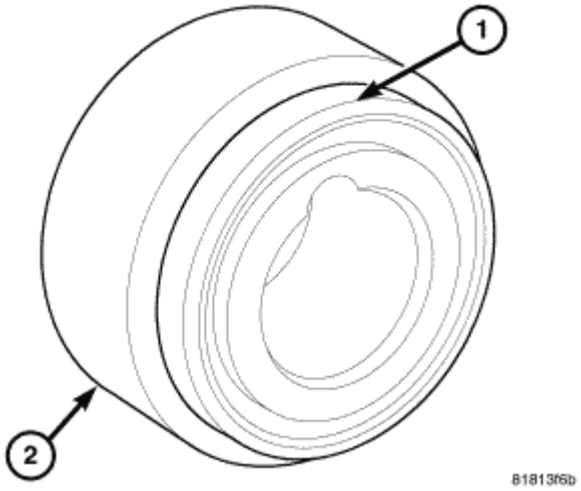


**Fig. 202: Front Crankshaft Seal Installer**
**Courtesy of CHRYSLER LLC**

1. Place seal (1) onto Seal installer 9506 (2) with seal spring towards the inside of engine.

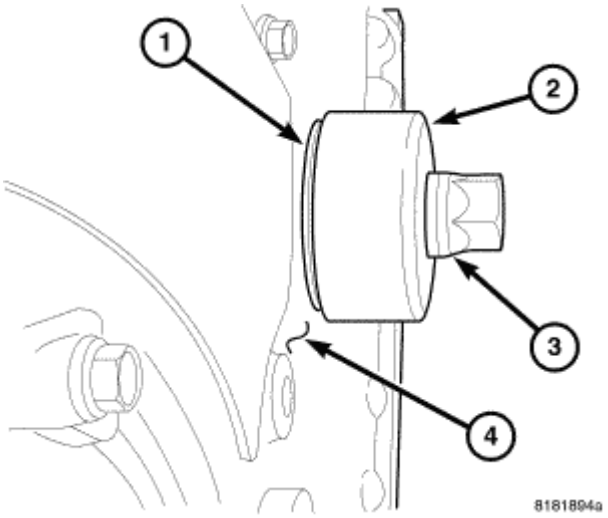


**Fig. 203: Installing Front Seal**
**Courtesy of CHRYSLER LLC**

2. Install new seal (1) by using Seal installer 9506 (2) and crankshaft damper bolt (3).

 

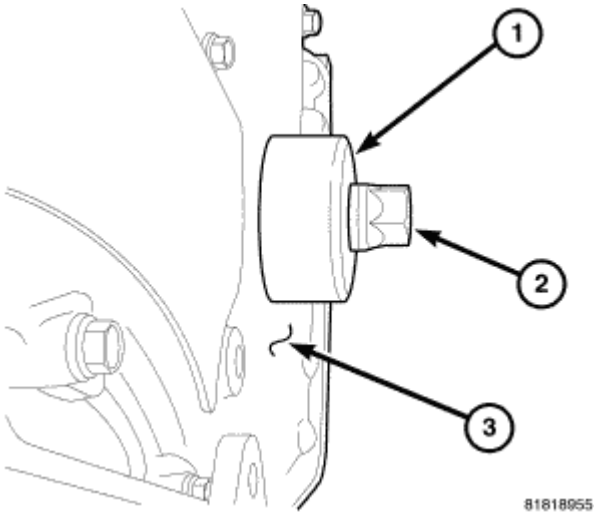


**Fig. 204: Front Seal Installed**
**Courtesy of CHRYSLER LLC**

3. Press seal into front cover until Seal Installer 9506 (1) seats against timing chain cover (3).
4. Remove seal installer 9506 (1).

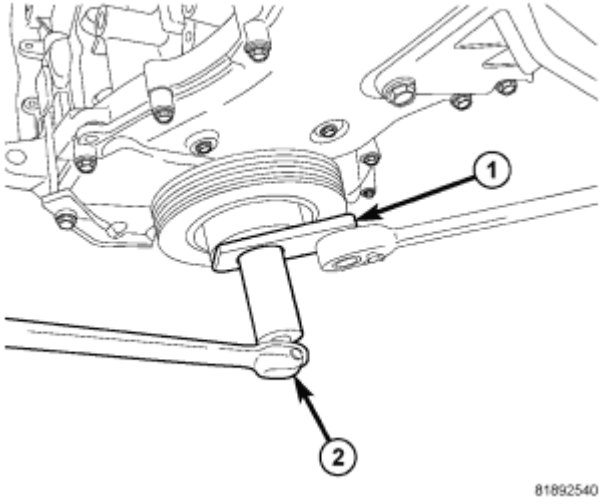


**Fig. 205: Damper Removal**
**Courtesy of CHRYSLER LLC**

5. Install crankshaft vibration damper.
6. Oil the bolt threads and between the bolt head and washer.
7. Install damper retaining bolt and damper holder 9707 (1). Tighten bolt to 50 N.m + 68° (37 ft. lbs. + 68°).

## SEAL-CRANKSHAFT OIL REAR

### REMOVAL

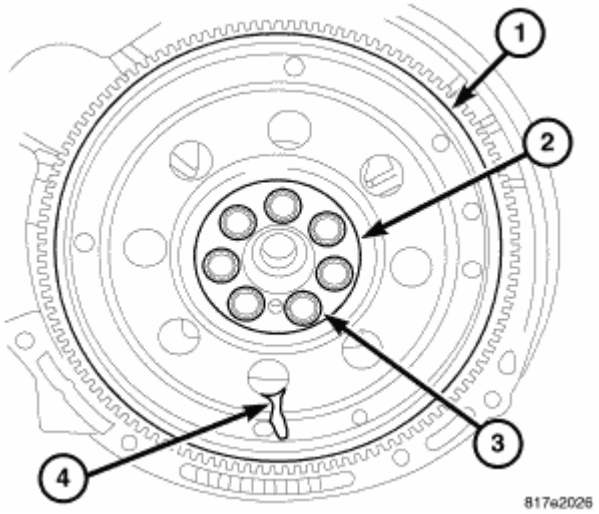


**Fig. 206: FLEX PLATE**
**Courtesy of CHRYSLER LLC**

1. Remove transaxle
2. Remove flex plate bolts and discard.
3. Remove flex plate (1).

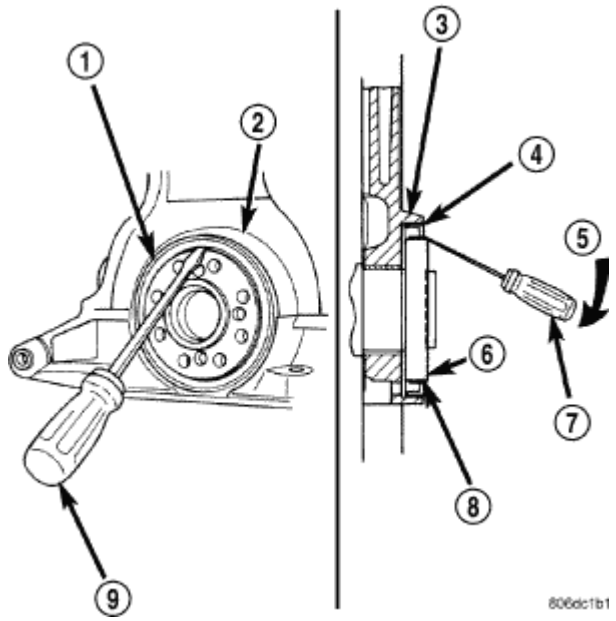


**Fig. 207: Rear Crankshaft Oil Seal - Removal**
**Courtesy of CHRYSLER LLC**

4. Insert a 3/16 flat bladed screwdriver (7) between the dust lip (8) and the metal case (4) of the crankshaft seal (1). Angle the screwdriver through the dust lip against metal case of the seal. Pry out seal.

**CAUTION: Do not permit the screwdriver blade to contact crankshaft seal surface. Contact of the screwdriver blade against crankshaft edge**

 

**(chamfer) is permitted.**

5. Check to make sure the seals garter spring is not on the crankshaft.

**INSTALLATION**

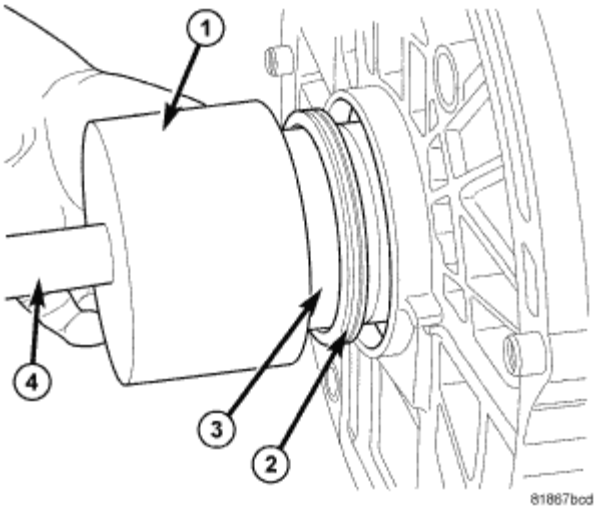


**Fig. 208: REAR MAIN INSTALLATION**
**Courtesy of CHRYSLER LLC**

**CAUTION: If a burr or scratch is present on the crankshaft edge (chamfer), cleanup with 800 emery cloth to prevent seal damage during installation of new seal. If emery cloth is used, the crankshaft must be cleaned off Mopar® brake parts cleaner.**

**NOTE: When installing seal, lubricate Seal Guide 9509 with clean engine oil.**

1. Place Seal Guide 9509 (3) on crankshaft.
2. Position seal (2) over guide tool. Guide tool should remain on crankshaft during installation of seal. Ensure that the lip of the seal is facing towards the crankcase during installation.
3. Drive the seal into the block using Seal Driver 9706 (1) and Driver Handle C-4171 (4) until Seal Driver 9706 bottoms out against the block.

 

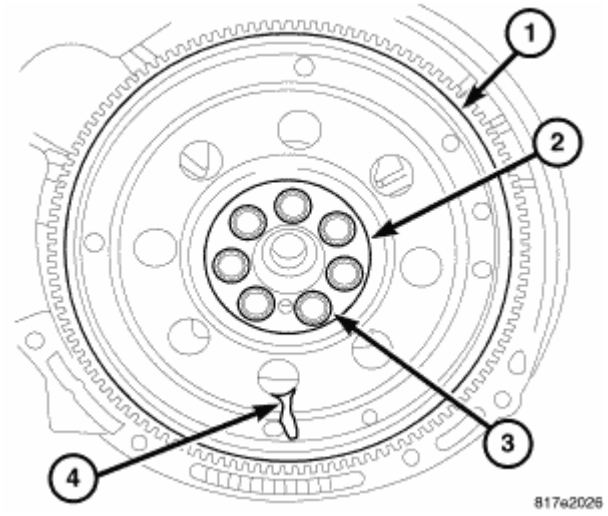


**Fig. 209: FLEX PLATE**
**Courtesy of CHRYSLER LLC**

4. Install flex plate (1).
5. Install washer (2).
6. Install **new** flex plate bolts (3) and tighten to 95 N.m (70 ft. lbs.).
7. Install transaxle. Refer to **REMOVAL** .

## PISTON & ROD-CONNECTING

### DESCRIPTION

#### PISTON AND CONNECTING ROD

The pistons are made of a cast aluminum alloy. The pistons have pressed-in pins attached to forged connecting rods. The pistons pin is offset 0.8 mm (0.0314 in.) towards the thrust side of the piston. The connecting rods are a cracked cap design and are not repairable. The piston with rings, connecting rod and piston pin are serviced as an assembly.

### STANDARD PROCEDURE

#### PISTON TO CYLINDER BORE FITTING

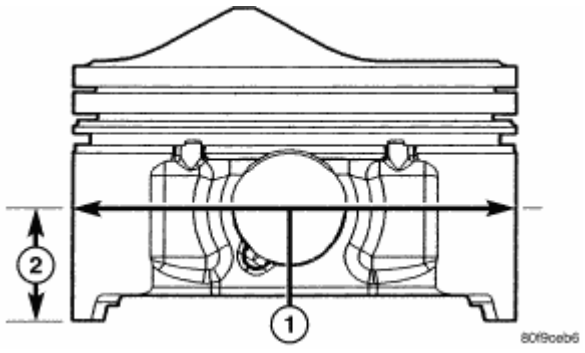


 

**Fig. 210: Piston Measurement**
**Courtesy of CHRYSLER LLC**

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

Piston and cylinder wall must be clean and dry. Piston diameter should be measured 90 degrees to piston pin (1).

1. Measurement should be taken approximately 16 mm (0.629 in.) from the bottom of the skirt (2) as shown.

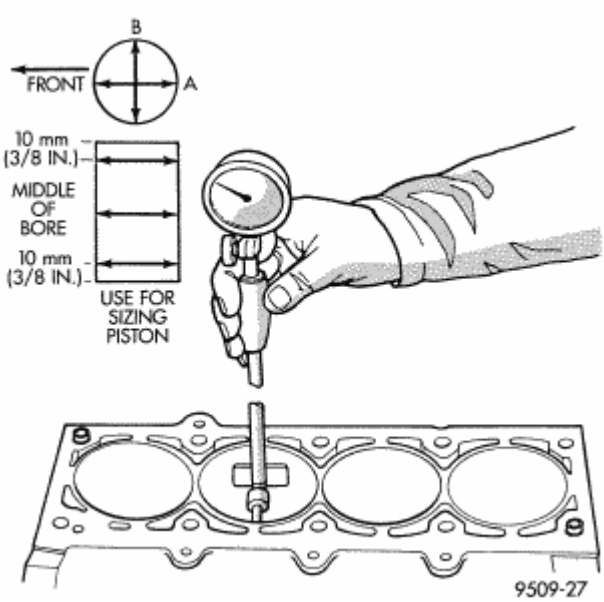


**Fig. 211: Checking Cylinder Bore Size**
**Courtesy of CHRYSLER LLC**

**NOTE: Correct piston to bore clearance must be established in order to assure quiet and economical operation.**

2. Cylinder bores should be measured halfway down the cylinder bore and transverse (measurement location B) to the engine crankshaft center line shown. Refer to **SPECIFICATIONS**.

**REMOVAL**

**PISTON AND CONNECTING ROD**

 

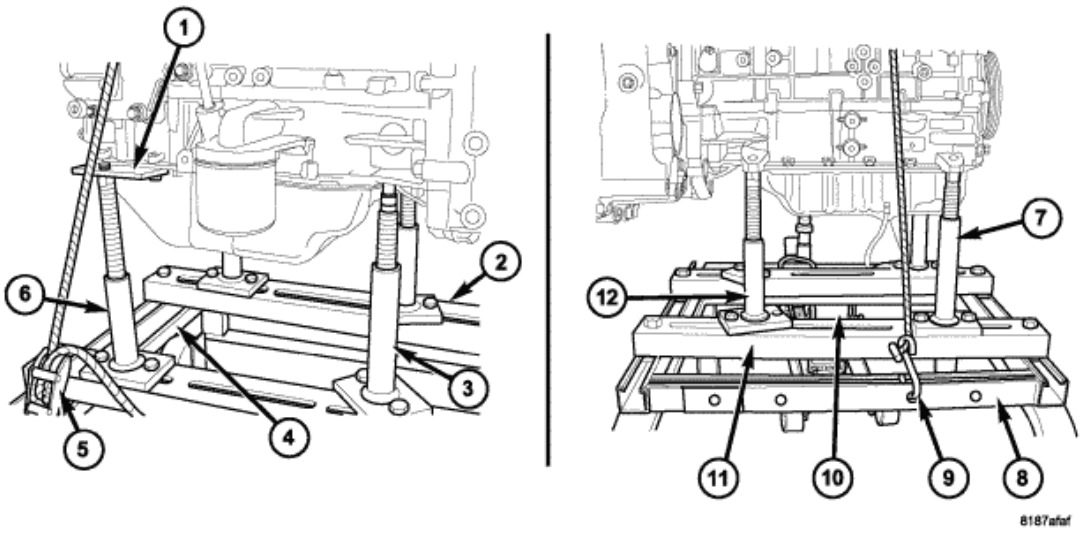


**Fig. 212: Engine Dolly**
**Courtesy of CHRYSLER LLC**

**NOTE: Pistons, rings, and rods are serviced as an assembly.**

**CAUTION: To maintain engine balance, 1, 3, or 4 pistons can be replaced. If 2 pistons are replaced, engine will be out of balance.**

1. Remove engine. Refer to **REMOVAL**.
2. Separate engine from transaxle.
3. Remove engine from dolly 6135 (8) and place on a suitable engine stand.
4. Remove cylinder head. Refer to **REMOVAL**.

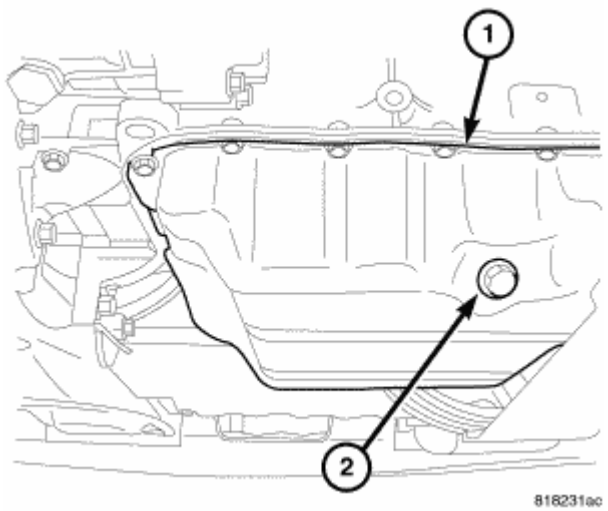


**Fig. 213: Oil Drain Plug**

 

**Courtesy of CHRYSLER LLC**

5. Drain engine oil (2).
6. Remove oil pan (1). Refer to **PAN-OIL**.

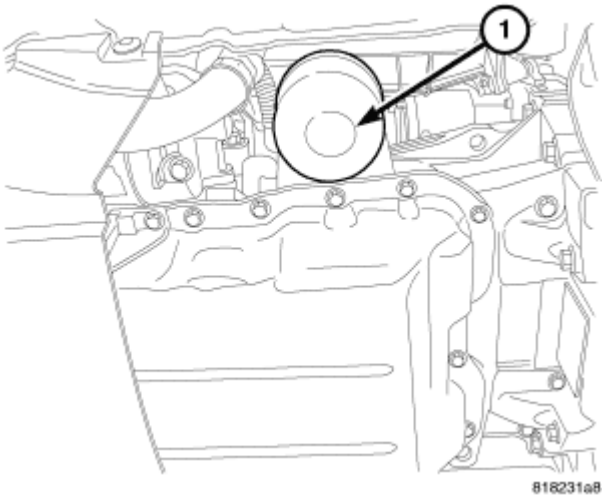


**Fig. 214: Oil Filter**
**Courtesy of CHRYSLER LLC**

7. Remove oil filter (1).
8. Remove balance shaft assembly.
9. Remove ladder frame.

**NOTE: Remove any carbon build up and clean debris from cylinder prior to piston removal to avoid scratching piston skirts.**

10. 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** .

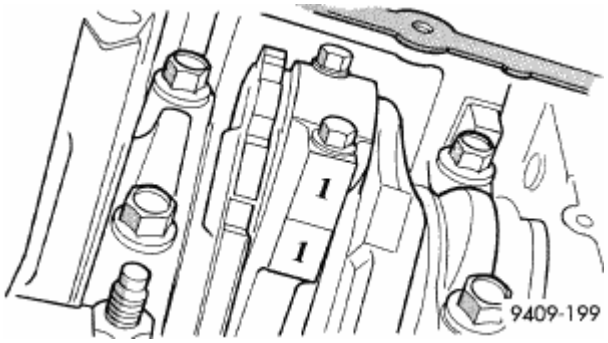


**Fig. 215: Identify Connecting Rod to Cylinder - Typical**
**Courtesy of CHRYSLER LLC**

11. Rotate crankshaft so that each connecting rod is centered in cylinder bore.

 

12. Using a permanent ink or paint marker, identify cylinder number on each connecting rod cap.

**CAUTION: DO NOT use a number stamp or a punch to mark connecting rods, as damage to connecting rod could occur.**

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

13. Remove connecting rod bolts and cap.

**NOTE: Do not reuse connecting rod bolts.**

14. Carefully push each piston and rod assembly out of cylinder bore. Re-install bearing cap on the mating rod.
15. Repeat procedure for each piston and connecting rod assembly.

**INSTALLATION**

**PISTON AND CONNECTING ROD**

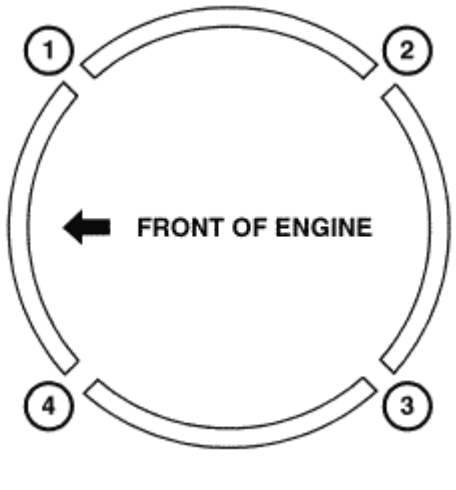


**Fig. 216: Piston Ring End Gap Position**
**Courtesy of CHRYSLER LLC**

1. Install piston rings on piston. Refer to **INSTALLATION**.
2. Before installing pistons and connecting rod assemblies into the bore, be sure that top compression ring gap (1) and the second compression ring gap (3) 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 (1) and the rail gaps (2,4) located as shown above. As viewed from the top of the piston.
4. Immerse the piston head and rings in clean engine oil, slide the ring compressor, over the piston. **Be sure**

 

**position of rings does not change during this operation** .

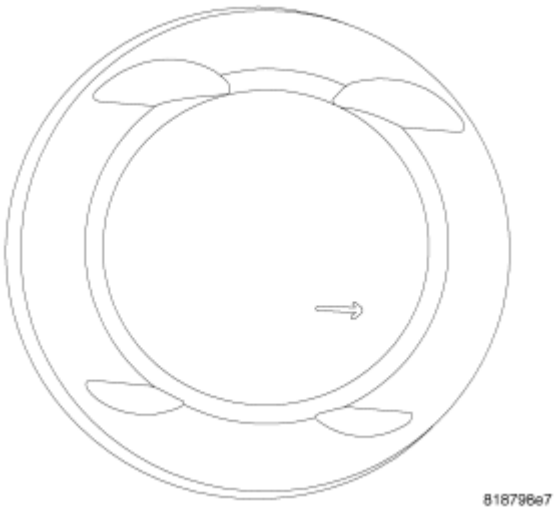


**Fig. 217: PISTON INSTALLATION**
**Courtesy of CHRYSLER LLC**

5. The directional arrow stamped on the piston should face toward the front of the engine.
6. Rotate crankshaft so that the connecting rod journal is on the center of the cylinder bore. Lubricate connecting rod journal with clean engine oil.

**NOTE: There are three different size rod bearings, perform rod bearing selection procedure.**

**NOTE: The rod bearing sizes are indicated on the nose of the crankshaft.**

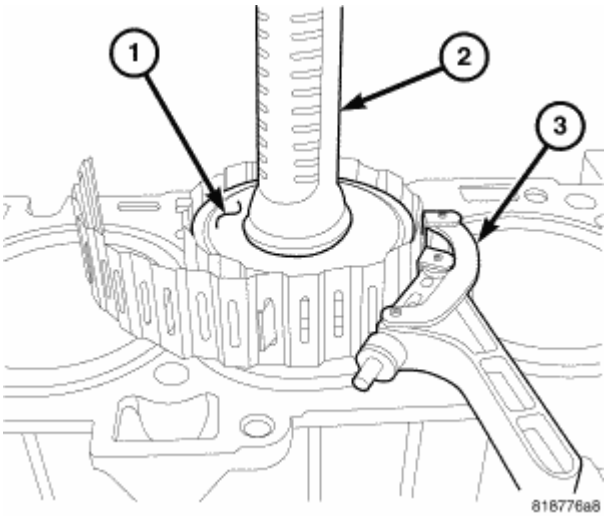


**Fig. 218: RING COMPRESSOR**
**Courtesy of CHRYSLER LLC**

7. Install connecting rod upper bearing half into connecting rod.

 

8. Install ring compressor (3).
9. Tap the piston (1) down in cylinder bore, using a hammer handle (2). At the same time, guide connecting rod into position on connecting rod journal.

**NOTE: The connecting rod cap bolts should NOT be reused.**

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

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

Tighten the bolts to 20 N.m (15 ft. lbs.).

Tighten the connecting rod bolts an additional 90°.

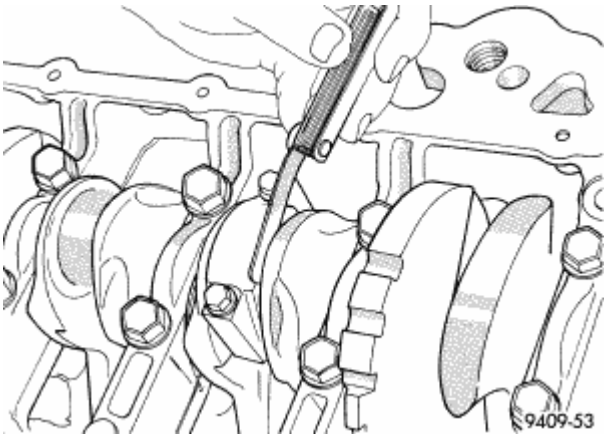


**Fig. 219: Connecting Rod Side Clearance**
**Courtesy of CHRYSLER LLC**

14. Using a feeler gauge, check connecting rod side clearance. Refer to **SPECIFICATIONS** for connecting rod side clearance.
15. Install the ladder frame. Refer to **INSTALLATION**.
16. Install oil pump/Balance Shaft Carrier Assembly. Refer to **INSTALLATION**.
17. Install oil pan. Refer to **PAN-OIL**.
18. Install cylinder head. Refer to **INSTALLATION**.

 

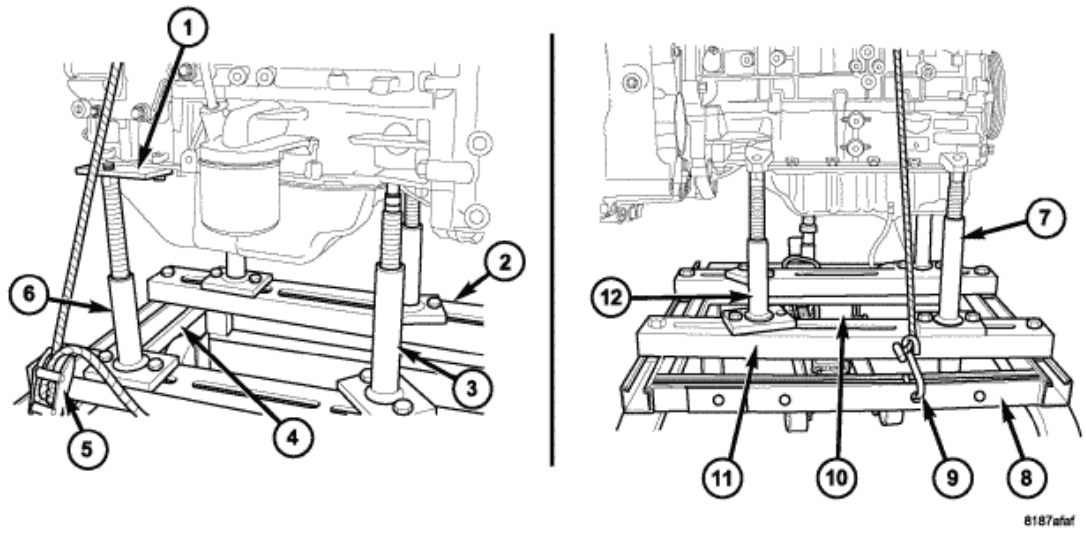


**Fig. 220: ENGINE DOLLY**
**Courtesy of CHRYSLER LLC**

19. Install engine on dolly.
20. Connect transaxle assembly to engine.
21. Install engine. Refer to **INSTALLATION**.

## BEARINGS-MAIN

### STANDARD PROCEDURE

**NOTE: There are three different possibilities for the upper main bearings and five different lower main bearings. The upper and lower bearing shells are not interchangeable.**

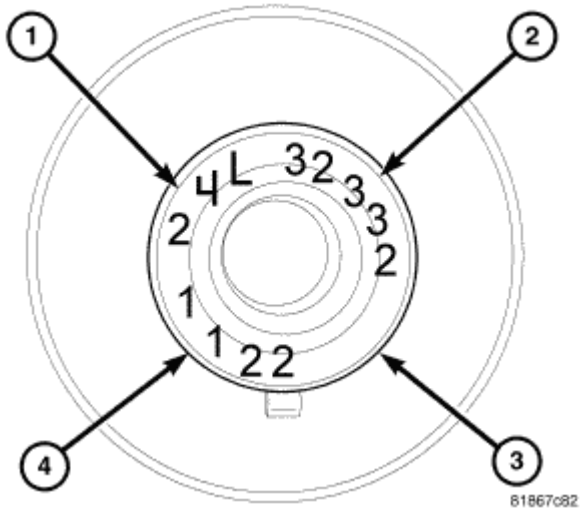


 

**Fig. 221: BEARING SELECTION**
**Courtesy of CHRYSLER LLC**

The lower main bearing identification (2) is stamped in the nose of the crankshaft (3). There are 5 different bearing sizes available 0 through 4.

| CRANKSHAFT IDENTIFICATION | | LOWER CRANKSHAFT BEARING SELECTION | |
|---|---|---|---|
| JOURNAL DIAMETER GRADE | DIMENSION | LOWER MAIN BEARING SIZE CLASSIFICATION | LOWER MAIN BEARING DIMENSION |
| 0 | 52 mm, -0.012 to -0.015 mm | 0 (Pink or Red) | 2 mm, 0 to -0.003 mm |
| 1 | 52 mm, -0.015 to -0.018 mm | 1 (Black) | 2 mm, +0.003 to 0 mm |
| 2 | 52 mm, -0.018 to -0.021 mm | 2 (No Color) | 2 mm, +0.006 to +0.003 mm |
| 3 | 52 mm, -0.021 to -0.024 mm | 3 (Green) | 2 mm, +0.009 to +0.006 mm |
| 4 | 52 mm, -0.024 to -0.027 mm | 4 (Blue) | 2 mm, +0.012 to +0.009 mm |

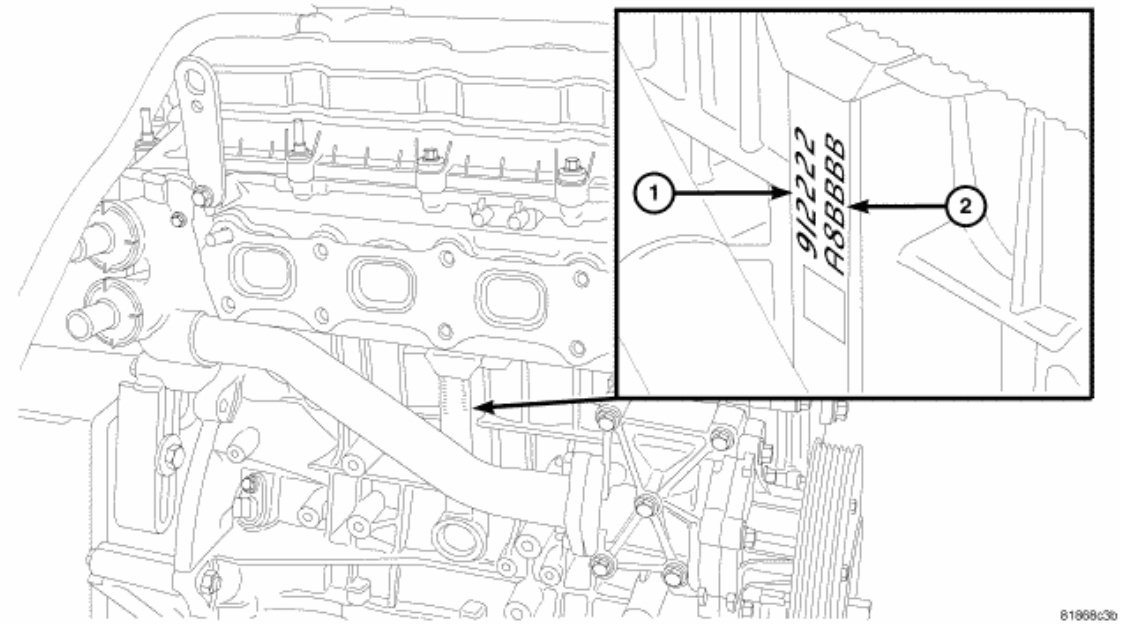


**Fig. 222: Main Bearing Selection Chart**
**Courtesy of CHRYSLER LLC**

The upper main bearing shell identification (1) is located in the middle of cylinder block on the right side of the engine. There are three different size bearings available. The bearing class is read downward from top and corresponds to the front journal to the rear journal on the bottom.

**UPPER MAIN BEARING SELECTION**

| | |
|---|---|

 

| CYLINDER BLOCK IDENTIFICATION | | UPPER CRANKSHAFT BEARING SELECTION | |
|---|---|---|---|
| MAIN BEARING GRADE | DIMENSION | UPPER MAIN BEARING SIZE CLASSIFICATION | UPPER MAIN BEARING DIMENSION |
| 1 | 56.000<56.006 mm | 1 (Black) | 2 mm, 0 to -0.006 mm |
| 2 | 56.006<56.012 mm | 2 (No Color) | 2 mm, +0.006 to 0 mm |
| 3 | 56.012<56.018 mm | 3 (Green) | 2 mm, +0.012 to +0.006 mm |

## BEARINGS-CONNECTING ROD

### STANDARD PROCEDURE

#### CONNECTING ROD - FITTING

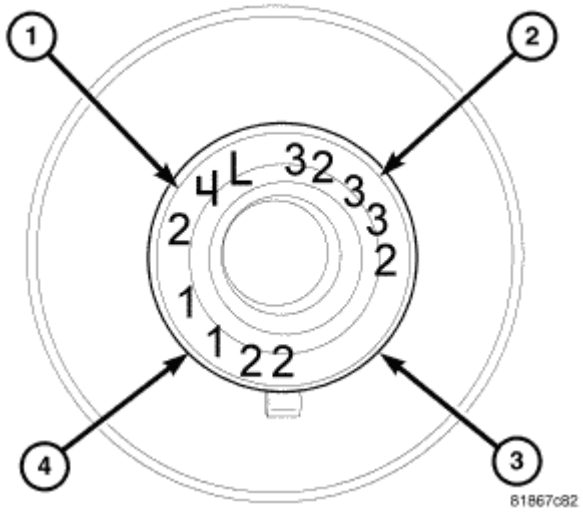


**Fig. 223: BEARING SELECTION**
**Courtesy of CHRYSLER LLC**

There are three different sizes of rod bearings available. Connecting rod bearing identification (4) can be found on the nose of the crankshaft (3). Use the table below for proper bearing selection.

**CONNECTING ROD BEARING SELECTION**

| CRANKSHAFT PIN DIAMETER GRADE | DIMENSION | CONNECTING ROD BEARING CLASSIFICATION | CONNECTING ROD BEARING DIMENSION |
|---|---|---|---|
| 1 | 48 mm | 1 (Black) | 1.5 mm |
| 2 | 48 mm | 2 (No Color) | 1.5 mm |
| 3 | 48 mm | 3 (Green) | 1.5 mm |

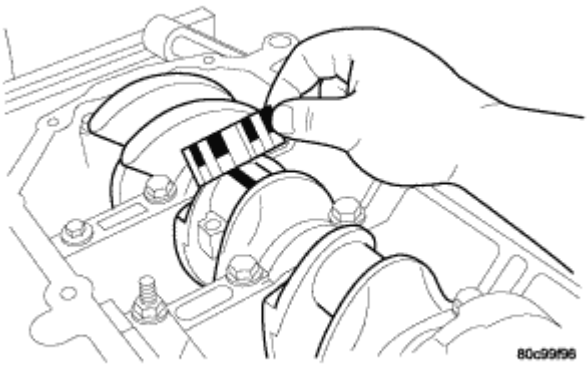


**Fig. 224: Connecting Rod Bearing Clearance - Typical**
**Courtesy of CHRYSLER LLC**

1. For measuring connecting rod bearing clearance procedure, use Plastigage. For bearing clearance, refer to **SPECIFICATIONS**.

**NOTE: The rod bolts should not be reused.**

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

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

Tighten the bolts to 27 N.m (20 ft. lbs.).
Tighten the connecting rod bolts an additional 90°.

 

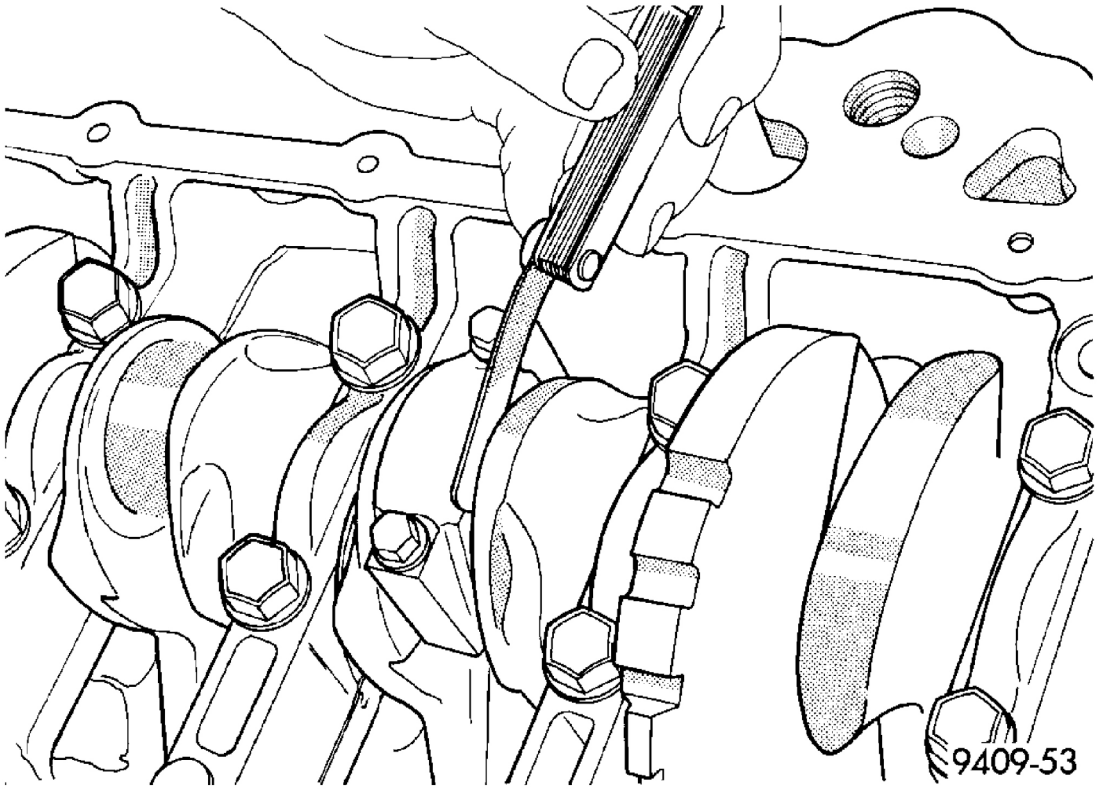


**Fig. 225: Checking Connecting Rod Side Clearance - Typical**
**Courtesy of CHRYSLER LLC**

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

## RINGS-PISTON

### STANDARD PROCEDURE

#### PISTON RING - FITTING

 

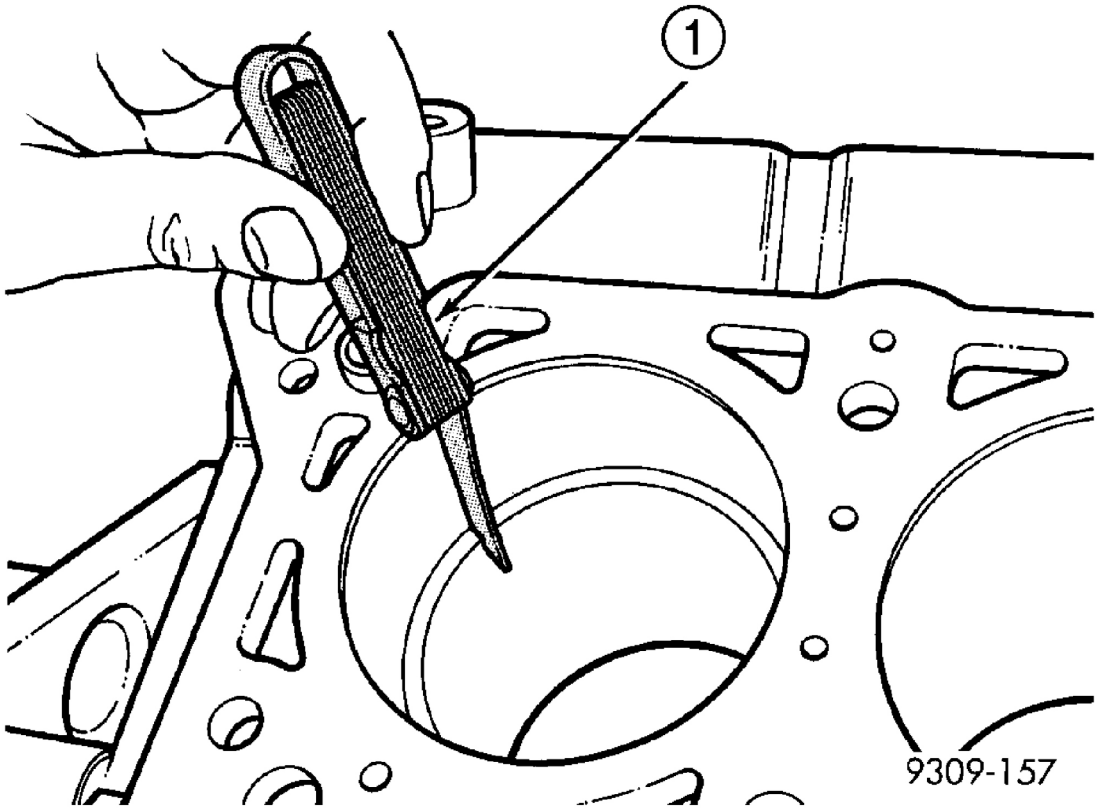


**Fig. 226: Measuring Piston Ring Gap**
**Courtesy of CHRYSLER LLC**

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 13 mm (0.50 inch) from bottom of cylinder bore and below the bottom of the oil ring travel where cylinder bore has minimal wear. Check gap with feeler gauge. Refer to Engine Specifications.

**NOTE: Ring end gap measurements are sensitive to the ring being square in the bore. Care must be used to avoid tilting the rings in cylinder bores when taking measurements.**

 

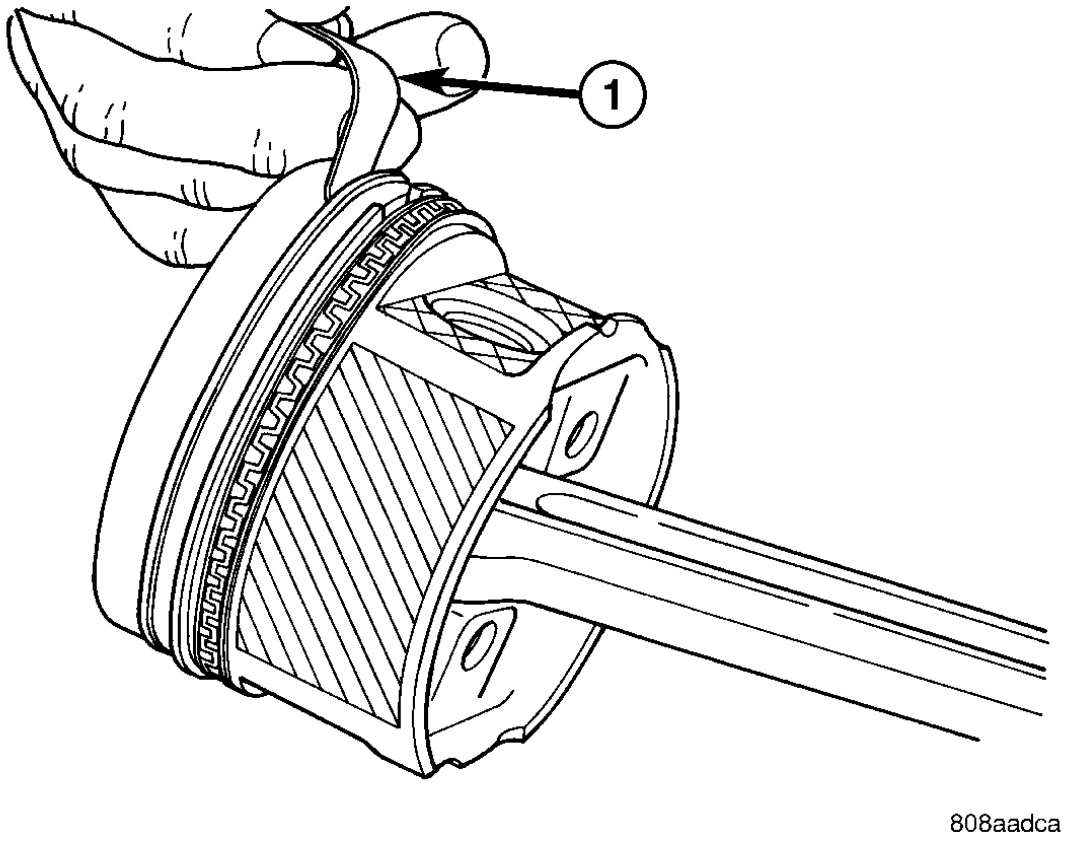


**Fig. 227: Measuring Piston Ring Side Clearance**
**Courtesy of CHRYSLER LLC**

2. Check piston ring to groove side clearance. Refer to Engine Specifications.

**CAUTION: Exercise care when using tools on piston. Do not scratch or gouge piston surface or ring grooves as this may cause engine damage.**

**REMOVAL**

**PISTON RINGS**

 

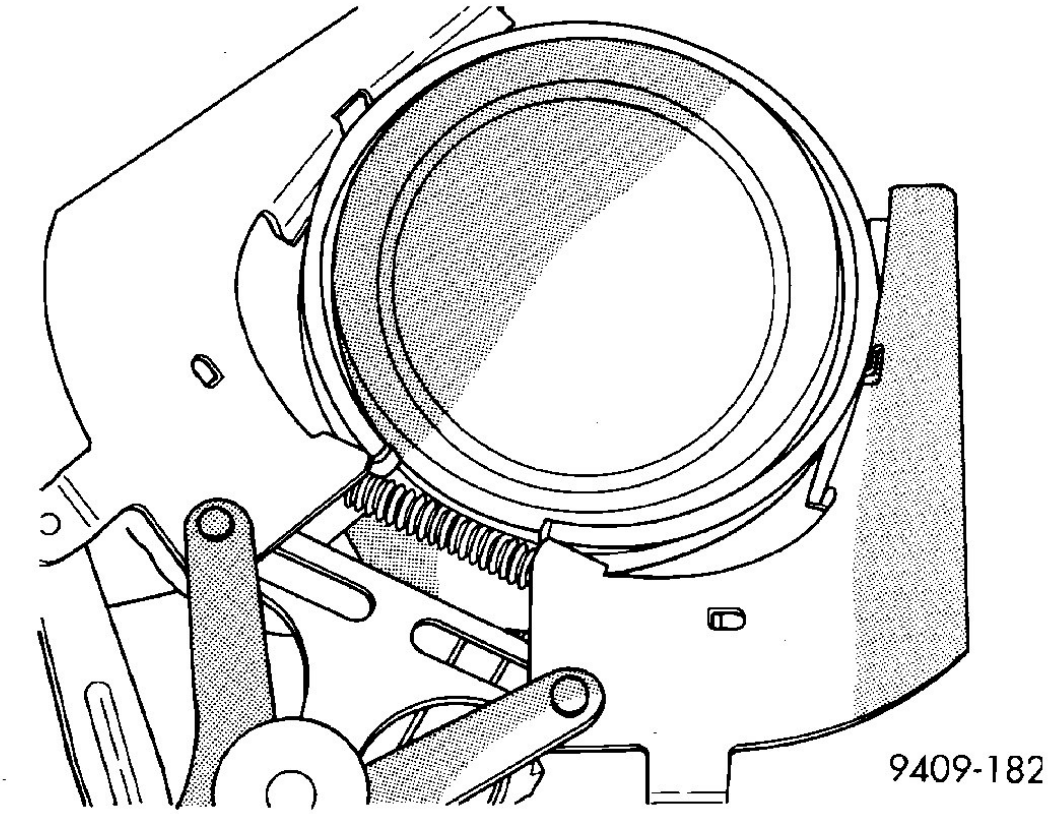


**Fig. 228: Removing/Installing Piston Rings**
**Courtesy of CHRYSLER LLC**

1. Using a suitable ring expander, remove upper and intermediate piston rings.
2. Remove the upper oil ring side rail, lower oil ring side rail and then oil ring expander from piston.
3. Clean ring grooves of any carbon deposits.

**INSTALLATION**

**PISTON RINGS**

 

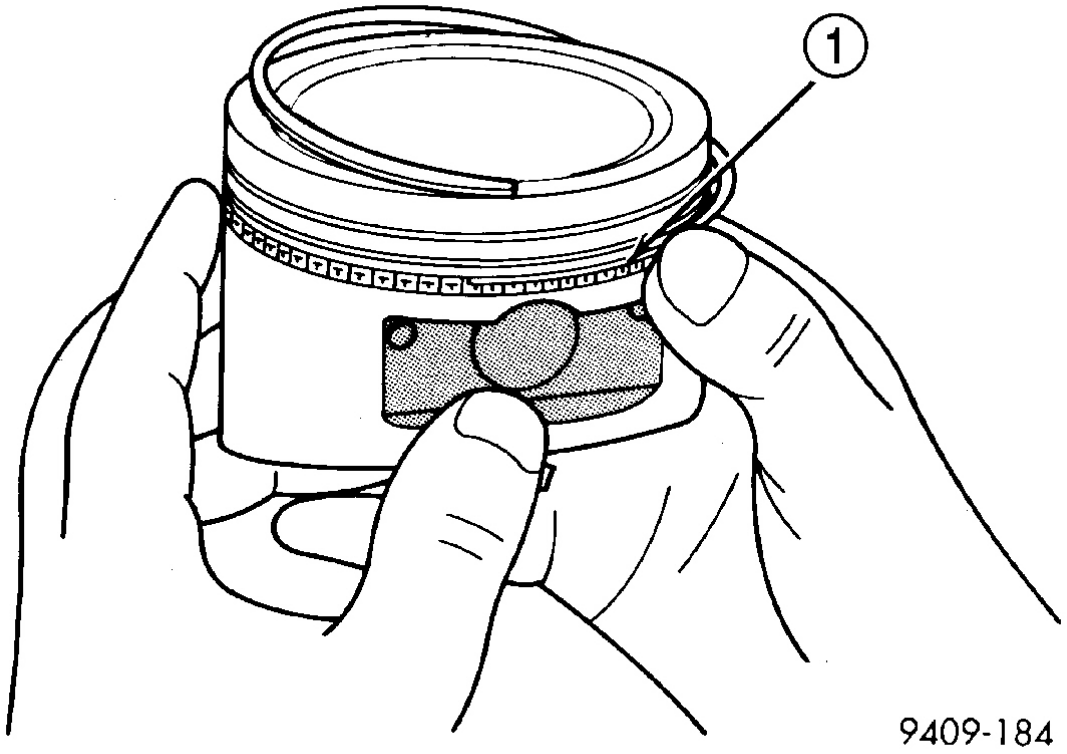


**Fig. 229: Installing Side Rail**
**Courtesy of CHRYSLER LLC**

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

**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.

1. Install oil ring expander.
2. Install upper side rail first and then the lower side rail. Install the side rails by placing one end between the piston ring groove and the oil ring expander. Hold end firmly and press down the portion to be installed until side rail is in position. **Do not use a piston ring expander.**

 

**NOTE: On normally aspirated engines, the compression rings are marked Y1 for the upper compression ring and Y2 for the second compression ring. These markings must face upward.**

**NOTE: On turbocharged engines, the compression rings are marked "TOP". "TOP" must face upward.**

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

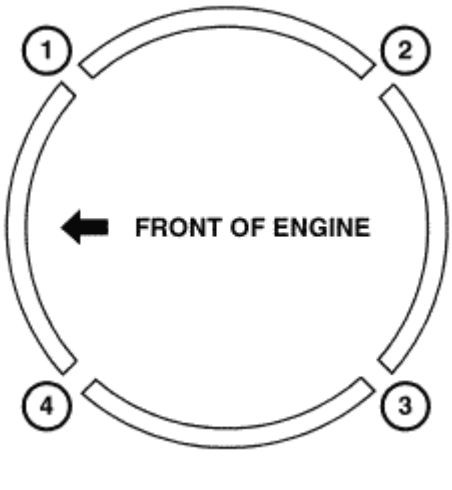


**Fig. 230: PISTON RING END GAP POSITION**
**Courtesy of CHRYSLER LLC**

**NOTE: Install the piston rings so the gaps positioned as indicated with the piston viewed from the top.**

**NOTE: Staggering ring gap is important for oil control.**

4. Install the oil expander so the ring gap is located in the (1) position.
5. Install the oil ring rails so the ring gap is located in the (2,4) position.
6. Install the second compression ring so the ring gap is located in the (3) position.
7. Install the top compression so the ring gap is located in the (1) position.

## DAMPER-VIBRATION

### REMOVAL

#### CRANKSHAFT DAMPER

 

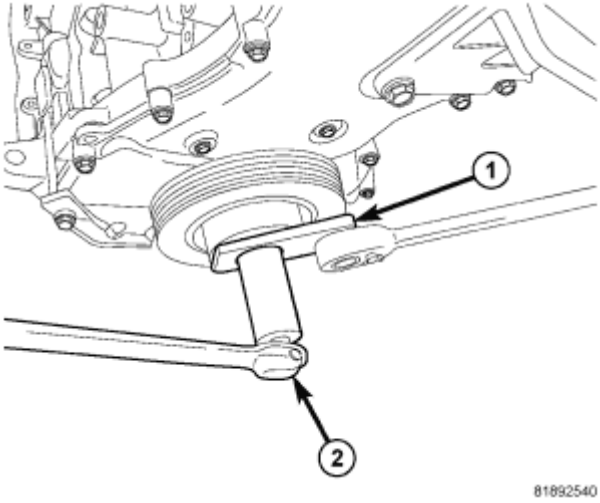


**Fig. 231: DAMPER REMOVAL**
**Courtesy of CHRYSLER LLC**

1. Remove accessory drive belts. Refer to **REMOVAL** .
2. Install Damper holder 9707 (1).
3. Remove crankshaft damper bolt.
4. Pull damper off crankshaft.

**INSTALLATION**

**CRANKSHAFT DAMPER**

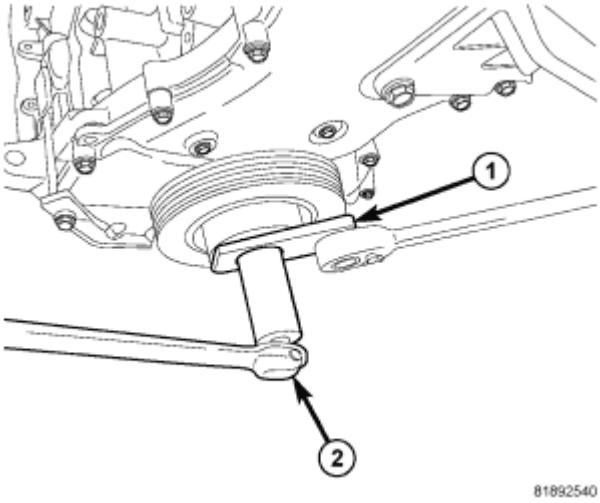


**Fig. 232: DAMPER REMOVAL**
**Courtesy of CHRYSLER LLC**

1. Install crankshaft damper.
2. Apply clean engine oil crankshaft damper bolt threads and between bolt head and washer. Tighten bolt to 210 N.m (155 ft. lbs.).

 

3. Install accessory drive belts. Refer to **INSTALLATION** .

## FRAME-LADDER

### REMOVAL

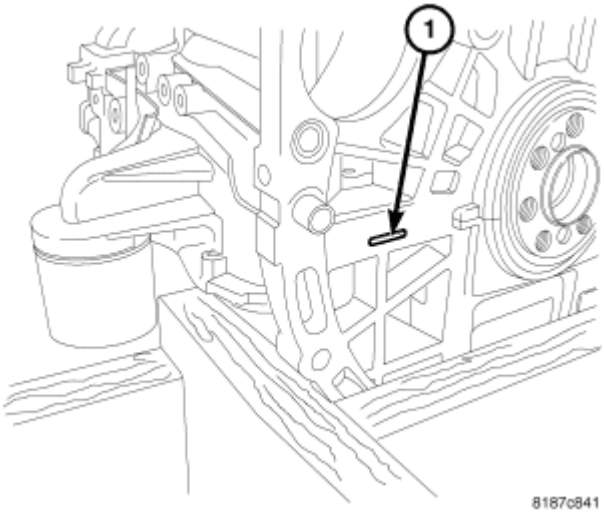


**Fig. 233: Pry Point 1**
**Courtesy of CHRYSLER LLC**

1. Remove oil pan. Refer to **PAN-OIL**.
2. Remove balance shaft assembly. Refer to **REMOVAL**.
3. Remove ladder frame retaining bolts.
4. Remove ladder frame using pry point cast in the rear of the block (1).

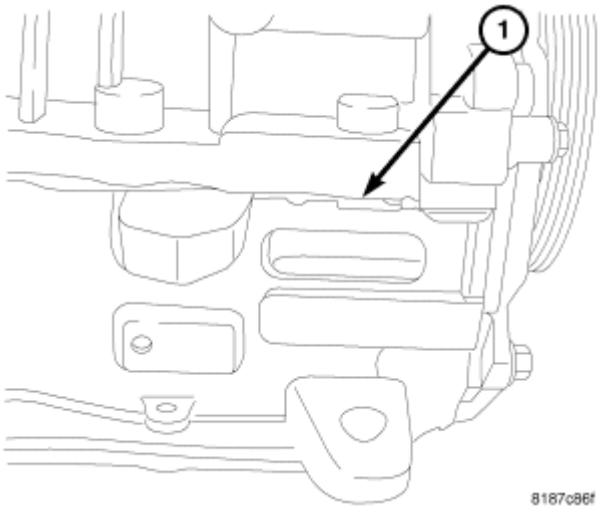


**Fig. 234: Pry Point 2**
**Courtesy of CHRYSLER LLC**

5. To assist in removing the ladder frame another (1) pry point cast in the right side of the block.

 

**CLEANING**

Clean ladder frame with a plastic or wooden scraper and a suitable solvent.

**INSTALLATION**

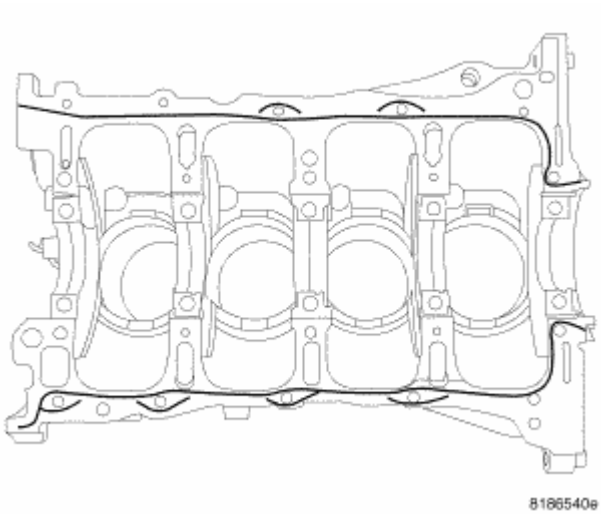


**Fig. 235: SEALING LADDER FRAME**
**Courtesy of CHRYSLER LLC**

**NOTE: When using RTV, the sealing surfaces must be clean and free from grease and oil.**

**NOTE: When using RTV, parts should be assembled in 10 minutes and tighten to final torque within 45 minutes.**

1. Apply a 2 mm bead of Mopar® engine sealant RTV or equivalent as shown.

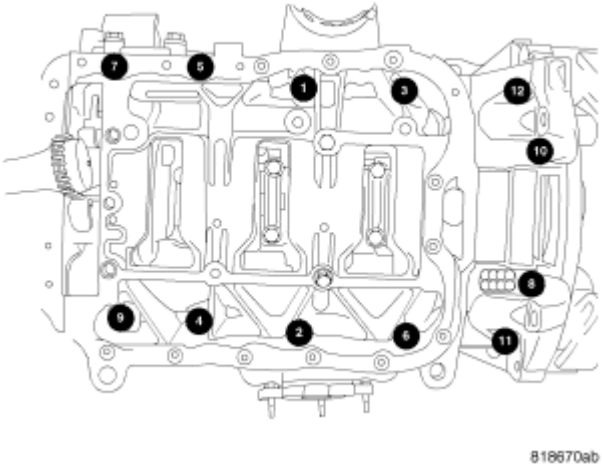


**Fig. 236: LADDER FRAME TORQUE**

 

**Courtesy of CHRYSLER LLC**

2. Install bolts and tighten as shown following a two step method.
   First: All to 10 N.m (89 in. lbs.).
   Second: All to 22 N.m (195 in. lbs.).
3. Install balance shaft module. Refer to **INSTALLATION**.
4. Install oil pan. Refer to **PAN-OIL**.

# ENGINE MOUNTING

## DESCRIPTION

The engine mounting system consists of a four-point system utilizing two load-carrying mounts and two torque controlling mounts. The load-carrying mounts are located on each frame rail. The right and left mounts are hydro-elastic mounts. The two torque controlling mounts are attached to a fore/aft member and the front and rear of the engine.

## OPERATION

The four-point engine mounting system minimizes the transmission of structure-borne engine noise to the passenger compartment. The load-carrying right and left mounts dampen and isolate vertical motion and vibration. The front and rear mount absorb torque reaction forces and torsional vibrations.

## MOUNT-LEFT

### REMOVAL

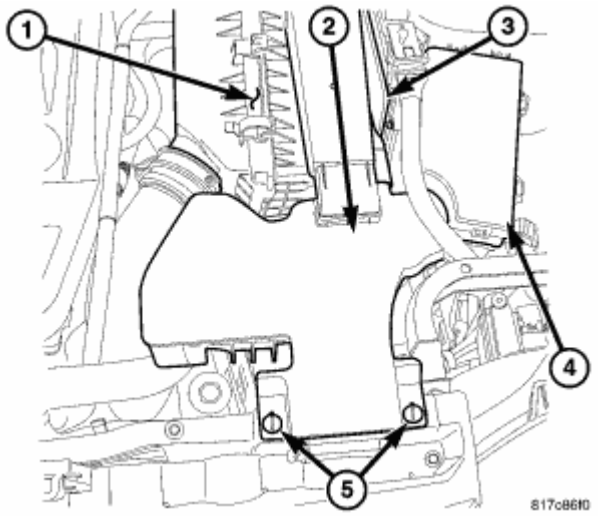


**Fig. 237: Air Cleaner Inlet And Air Cleaner Housing**
**Courtesy of CHRYSLER LLC**

1. Remove air cleaner inlet (2) and air cleaner housing (1).

 

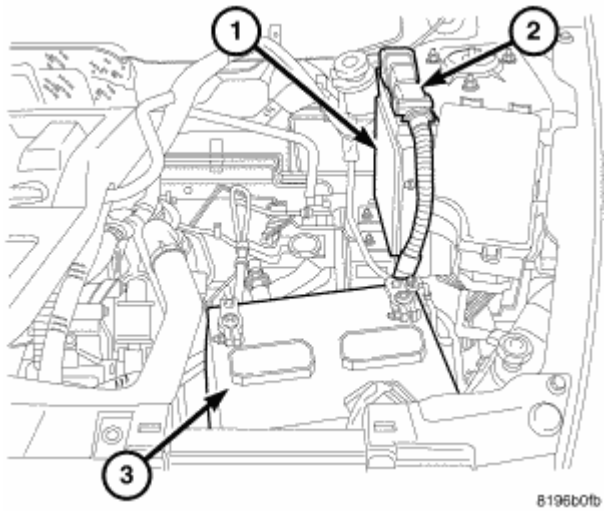


**Fig. 238: Locating PCM**
**Courtesy of CHRYSLER LLC**

2. Remove PCM (1).
3. Remove PCM mounting bracket.
4. Disconnect negative cable from battery (3).
5. Support transaxle with a suitable jack.

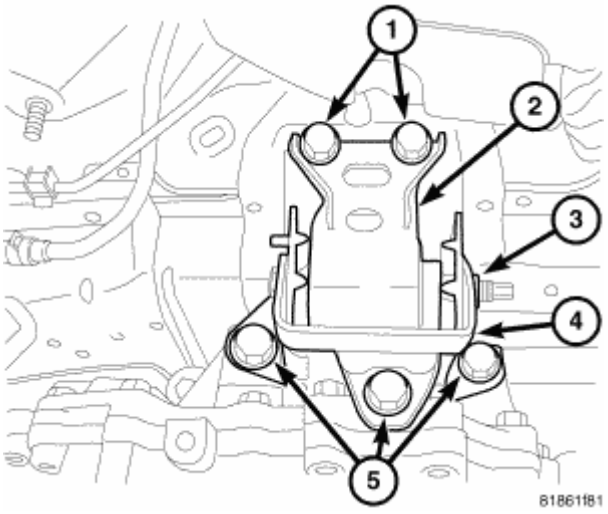


**Fig. 239: Left Mount & Bracket**
**Courtesy of CHRYSLER LLC**

6. Remove left mount through bolt (3).
7. Remove left mount bracket to body frame rail fasteners (1).
8. Remove mount.

**INSTALLATION**

 

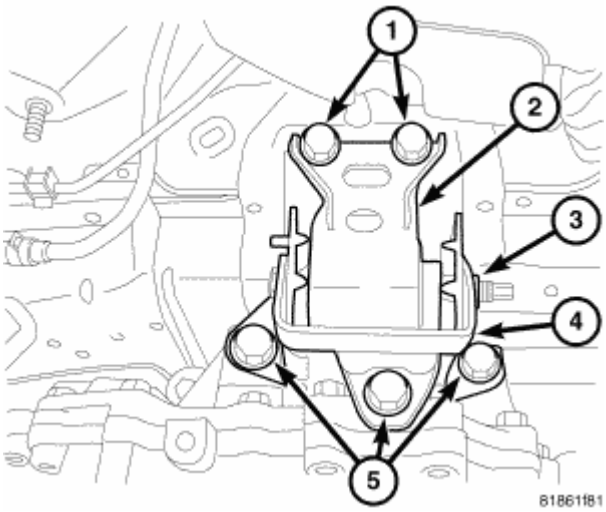


**Fig. 240: Left Mount & Bracket**
**Courtesy of CHRYSLER LLC**

1. Position mount (2) in place.
2. Install left mount to frame rail bolts (1) and torque to 75 N.m (55 ft. lbs.).
3. Install mount through bolt (3) and torque to 100 N.m (74 ft.lbs.).
4. Remove jack.

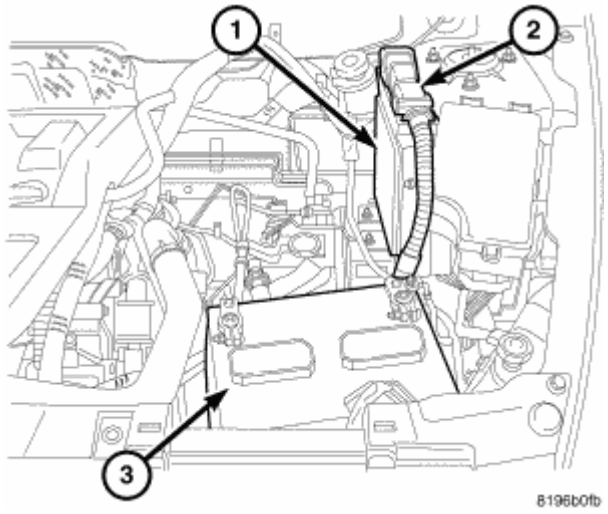


**Fig. 241: Locating PCM**
**Courtesy of CHRYSLER LLC**

5. Install PCM mounting bracket.
6. Install PCM (1).
7. Connect negative cable to battery (3).

 

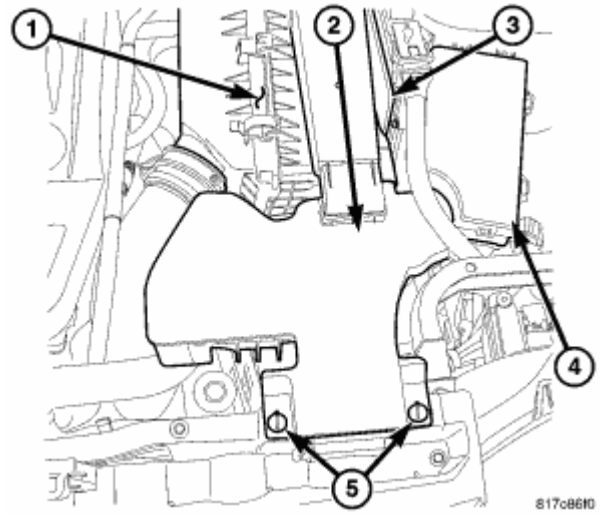


**Fig. 242: Air Cleaner Housing And Air Cleaner Inlet**
**Courtesy of CHRYSLER LLC**

8. Install air cleaner housing (1) and air cleaner inlet (2).

**MOUNT-RIGHT**

**REMOVAL**

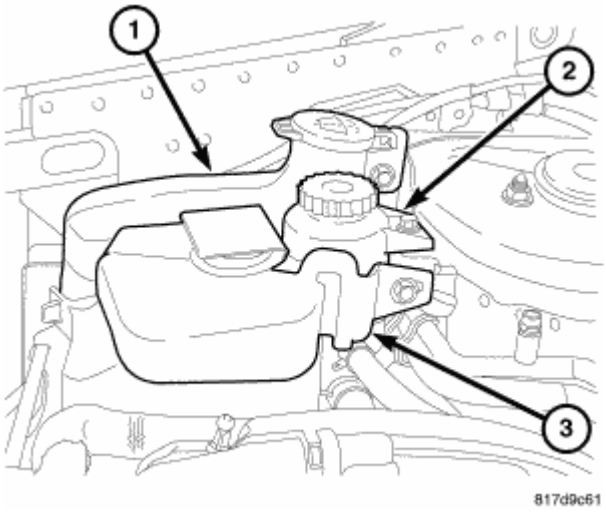


**Fig. 243: COOLANT RESERVOIR**
**Courtesy of CHRYSLER LLC**

1. Remove coolant reservoir (3) and set aside.
2. Remove power steering reservoir (2) and set aside.
3. Remove windshield washer bottle (1).

 

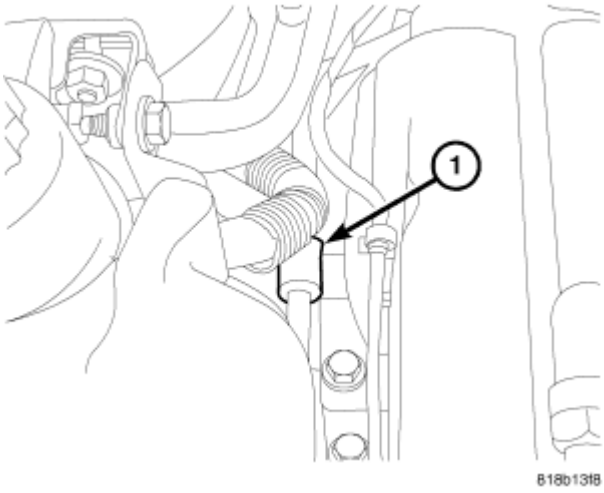


**Fig. 244: POWER STEERING LINE SUPPORT**
**Courtesy of CHRYSLER LLC**

4. Remove power steering line support bracket (1) from engine mount.

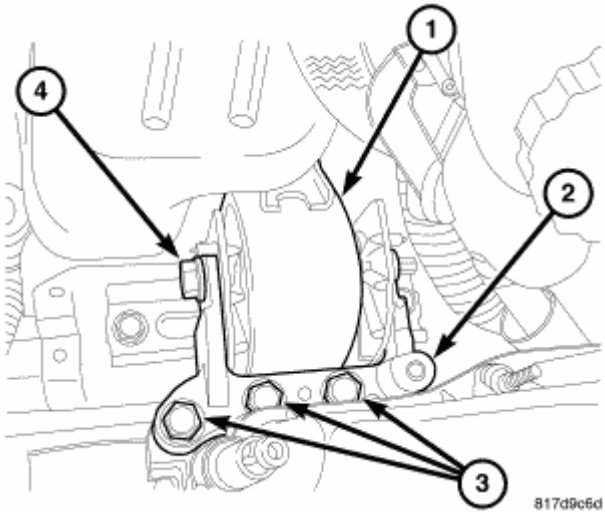


**Fig. 245: RIGHT ENGINE MOUNT**
**Courtesy of CHRYSLER LLC**

5. Support transaxle with a block of wood and a suitable jack.
6. Remove engine mount through bolt (4).
7. Remove engine mount bracket bolts (3).
8. Remove engine mount retaining bolts.
9. Remove engine mount.

**INSTALLATION**

 

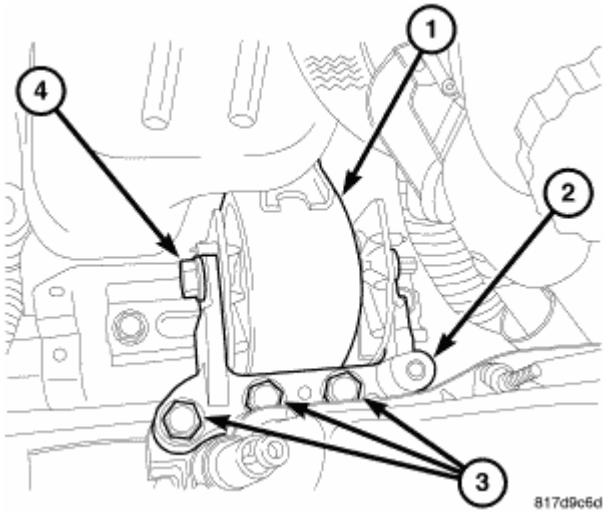


**Fig. 246: RIGHT ENGINE MOUNT**
**Courtesy of CHRYSLER LLC**

1. Position right engine mount (1).
2. Install engine mount retaining bolts and tighten to 75 N.m (55 ft. lbs.).
3. Install engine mount adapter (2) and tighten bolts (3) to 68 N.m (50 ft. lbs.).
4. Install engine mount through bolt (4) and tighten to 88 N.m (65 ft. lbs.).

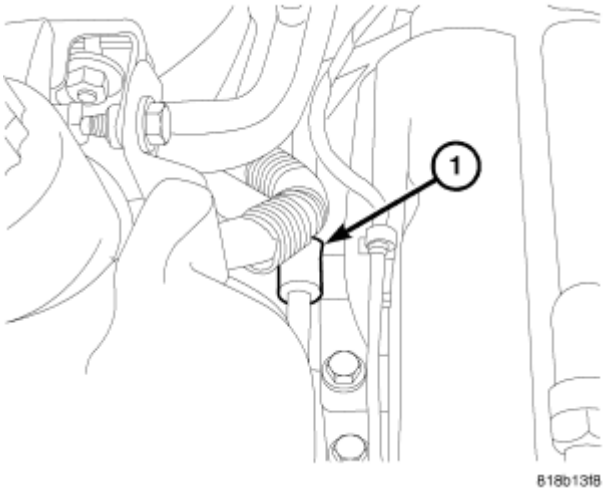


**Fig. 247: POWER STEERING LINE SUPPORT**
**Courtesy of CHRYSLER LLC**

5. Remove jack.
6. Install power steering line support bracket (1) at engine mount.

 

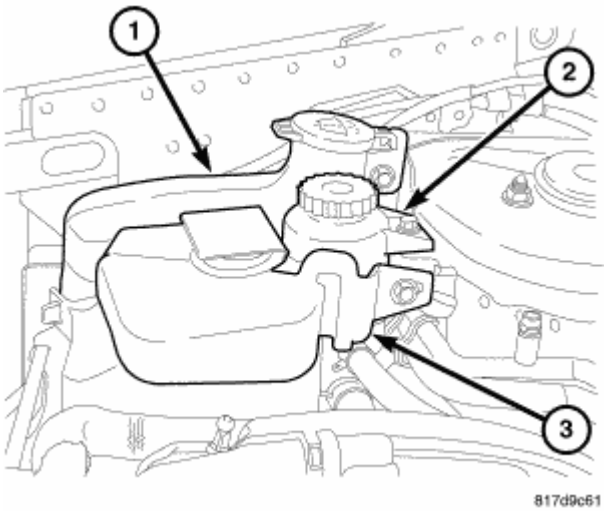


**Fig. 248: COOLANT RESERVOIR**
**Courtesy of CHRYSLER LLC**

7. Install windshield washer bottle (1).
8. Install power steering reservoir (2).
9. Install coolant reservoir (3).
10. Install engine cover.

## MOUNT-FRONT

### REMOVAL

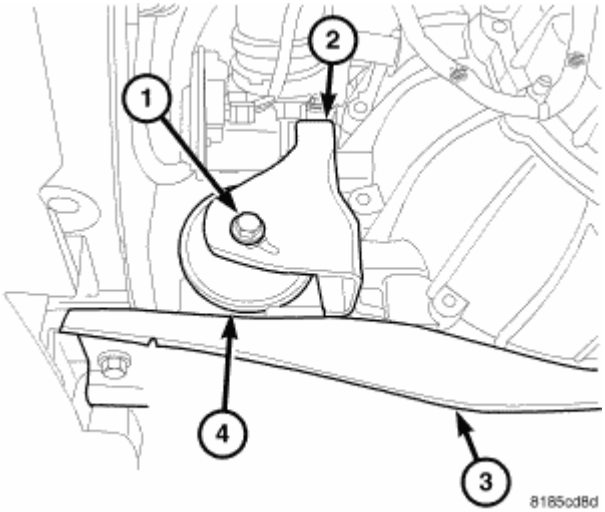


**Fig. 249: FRONT MOUNT THROUGH BOLT**
**Courtesy of CHRYSLER LLC**

1. Raise vehicle.
2. Remove fore aft member (3) to mount (4) bolts.
3. Remove mount through bolt (1).

 

4. Remove fore aft member (3) mounting bolts and remove.
5. Remove front mount (4).

**INSTALLATION**

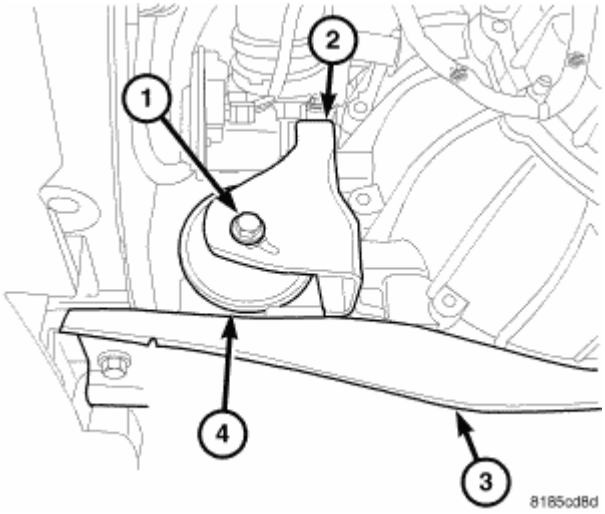


**Fig. 250: FRONT MOUNT THROUGH BOLT**
**Courtesy of CHRYSLER LLC**

1. Position mount (4) and torque bolts to 47 N.m (35 ft. lbs.).
2. Install fore aft member (3) and torque bolts to 100N.m (74 ft. lbs.).
3. Install mount through bolt (1) and torque to 47 N.m (35 ft. lbs.).
4. Lower vehicle.

**MOUNT-REAR**

**REMOVAL**

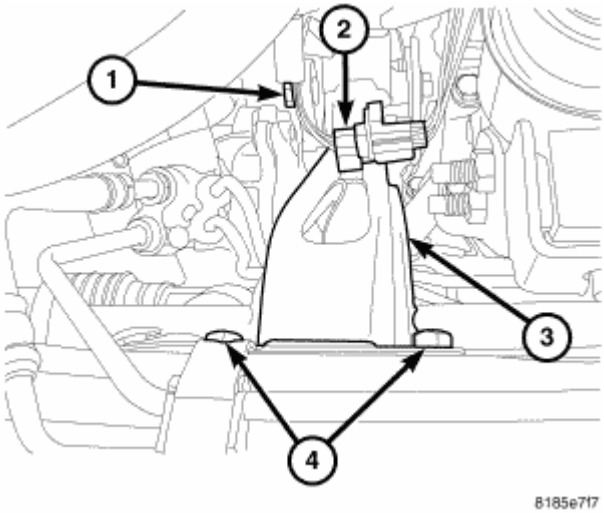


**Fig. 251: REAR MOUNT-ATX**

 

**Courtesy of CHRYSLER LLC**

1. Remove rear mount retaining bolts (4).
2. Remove rear mount through bolt (1).
3. Remove oxygen sensor connector (2) from mount.
4. Remove rear mount (3).

**INSTALLATION**

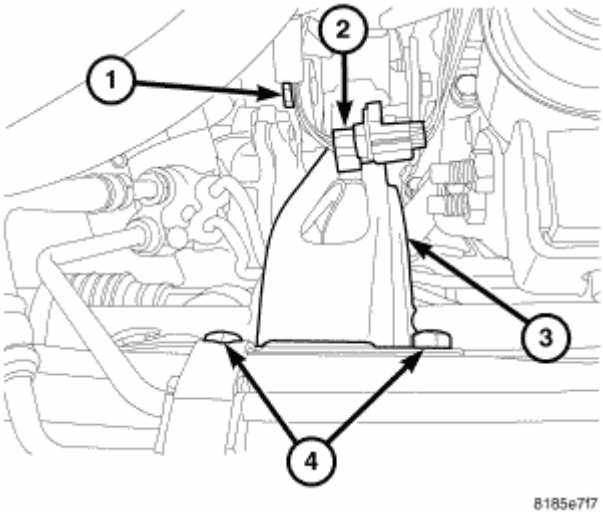


**Fig. 252: REAR MOUNT-ATX**
**Courtesy of CHRYSLER LLC**

1. Position rear mount (3).
2. Install rear mount retaining bolts (4) and torque to 50 N.m (37 ft. lbs.).
3. Install rear mount through bolt (1) and torque to 47 N.m (35 ft. lbs.).
4. Install oxygen sensor connector (2) retainer to mount (3).

# LUBRICATION

## DESCRIPTION

### ENGINE LUBRICATION SYSTEM

 

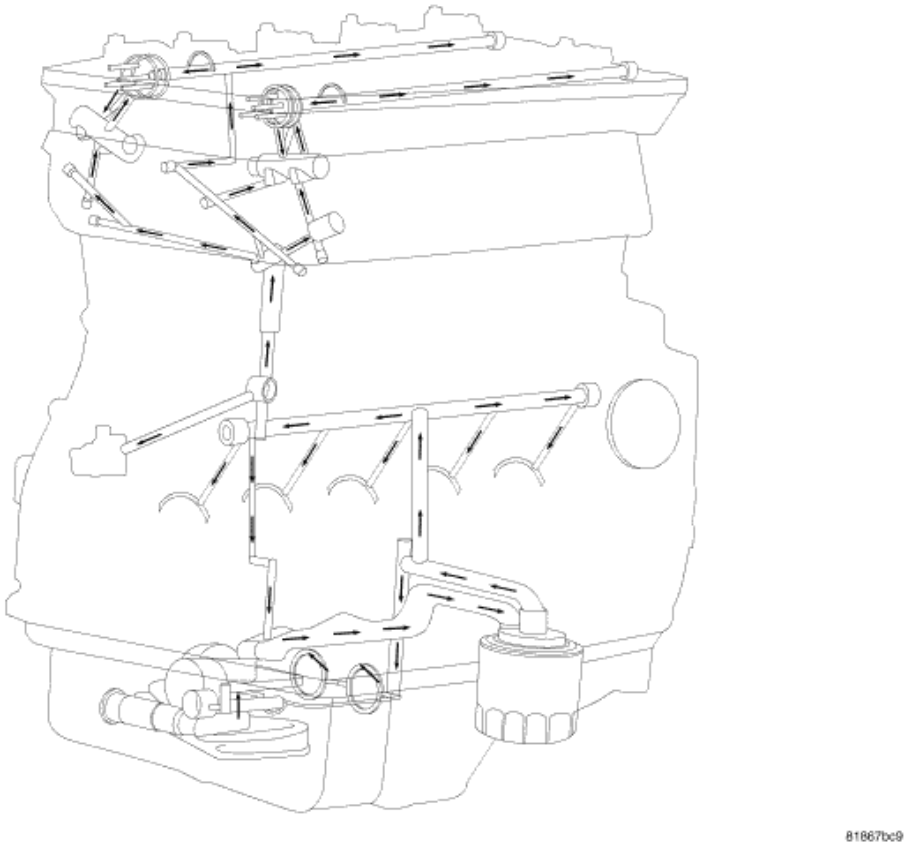


**Fig. 253: OIL FLOW DIAGRAM**
**Courtesy of CHRYSLER LLC**

The lubrication system is a full-flow filtration, pressure feed type. The balance shaft module (BSM) is mounted below the ladder frame and chain driven by the crankshaft. The BSM consists of a non-serviceable pump, oil pressure relief valve, and a non-serviceable balance assembly.

**NOTE: Not all engine blocks will be machined with the bolt on timing chain oil squirter. Some engines will be machined with an oil hole (1).**

#### ENGINE LUBRICATION SYSTEM

The lubrication system is a full-flow filtration, pressure feed type. The balance shaft module (BSM) is mounted below the ladder frame and chain driven by the crankshaft. The BSM consists of a non-serviceable pump, oil pressure relief valve, and a non-serviceable balance assembly.

## OPERATION

#### ENGINE LUBRICATION SYSTEM

Engine oil is drawn up through the pickup tube and is pressurized by the oil pump and routed through the full-flow filter to the main oil gallery running the length of the cylinder block on the intake side. A diagonal hole in each bulkhead feeds oil to each main bearing. Drilled passages within the crankshaft route oil from main

 

bearing journals to connecting rod journals. Balance shaft lubrication is provided through an internal oil passage at the #3 bearing location around the BSM mounting bolt. A vertical hole at the number one bulkhead routes pressurized oil through a filter screen and head gasket up to the cylinder head. The oil then divides into three passages; one to the intake cam phaser, one to the exhaust cam phaser and one to the camshafts. The passage to the camshafts divides to feed both of the hollow camshafts at the second cam journal. The rest of cam journals are feed oil through the hollow camshafts. The #1 cam journals are fed oil through the VVT oil passages. Oil passages to the phasers are directed through the OCV (oil control valves) to the #1 journals. The oil then flows through the camshafts to the cam phasers. Oil returning to the pan from pressurized components supplies lubrication to the valve stems, cam lobes, and tappets. Cylinder bores and wrist pins are splash lubricated from directed slots on the connecting rod thrust collars.

## DIAGNOSIS AND TESTING

### DIAGNOSIS AND TESTING-VVT OIL PRESSURE

This test can be used to help diagnose VVT faults.

1. Disconnect and remove oil pressure sensor (1).

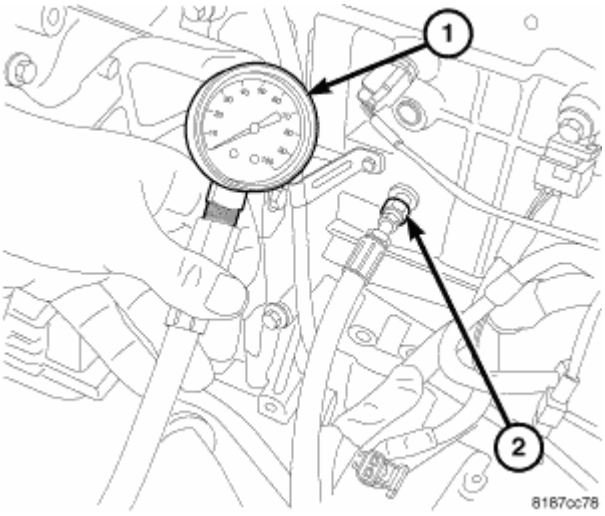


**Fig. 254: Oil Pressure Sensor**
**Courtesy of CHRYSLER LLC**

**CAUTION: Threads in block are 1/8"-28 British Standard Pipe (BSP). Do not install a National Pipe Thread (NPT) threaded adapter, this could crack the cylinder block.**

2. Install an 1/8-28 BSP male to 1/8-27 female threaded adapter (2).
3. Install oil pressure gauge (1).
4. Start engine and record oil pressure.

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

 

5. If oil pressure is 0 at idle, shut off engine. check for pressure relief valve stuck open, a clogged oil pick-up screen.
6. Remove oil pan and inspect for debris. Refer to **PAN-OIL**.
7. Remove oil pressure relief valve. Refer to **REMOVAL** and inspect, if damaged replace pressure relief valve.
8. If pressure relief valve is ok, replace balance shaft module assembly. Refer to **REMOVAL**.

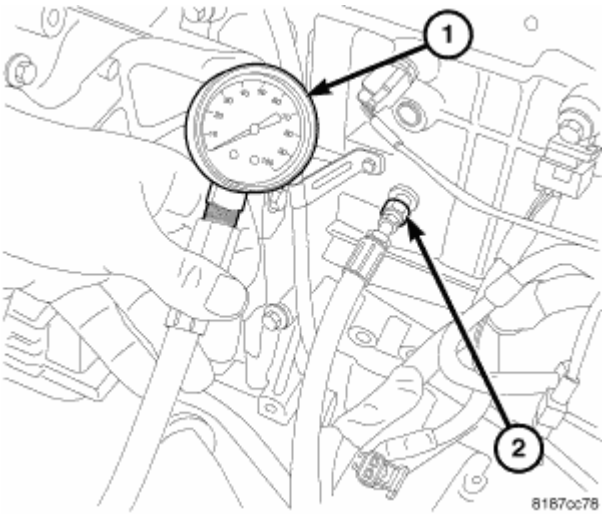


**Fig. 255: Test Gauge**
**Courtesy of CHRYSLER LLC**

9. After test is complete, remove test gauge (1) and fitting (2).
10. Install oil pressure sensor and electrical connector.

**CHECKING ENGINE OIL PRESSURE**

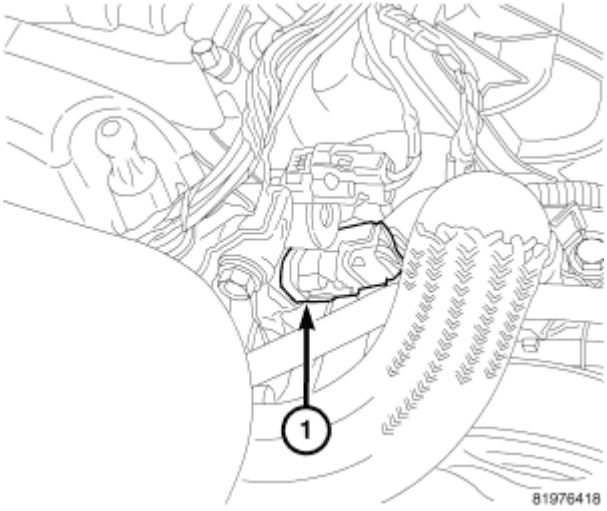


**Fig. 256: OIL TEMPERATURE SENSOR**
**Courtesy of CHRYSLER LLC**

 

**NOTE: Anytime the oil temperature sensor is removed, it should be replaced with a new sensor.**

1. Disconnect and remove oil temperature sensor (1).

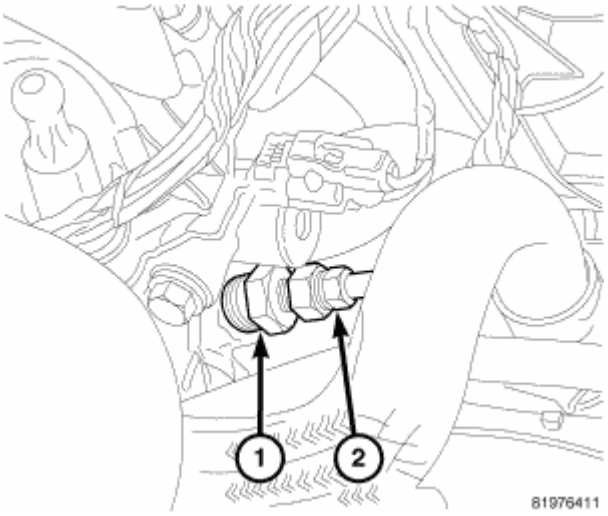


**Fig. 257: OIL PRESSURE ADAPTER 9879**
**Courtesy of CHRYSLER LLC**

**CAUTION: Threads in cylinder head are British Standard Pipe (BSP). Do not install a NPT threaded adapter, this could crack the cylinder block.**

2. Install threaded adapter 9879 (1).
3. Install oil pressure gauge (2).

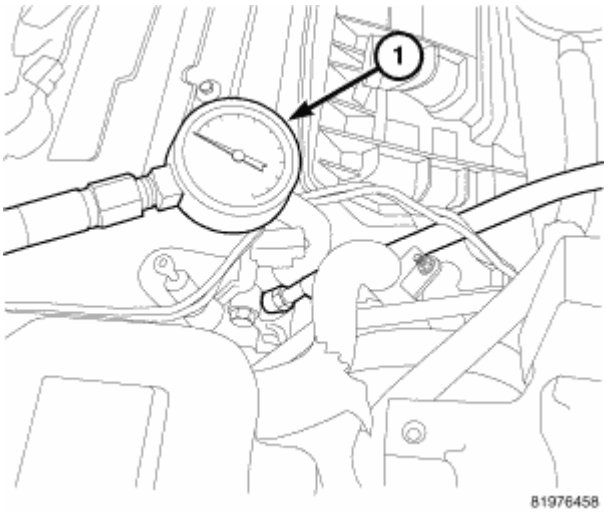


**Fig. 258: OIL PSI GAUGE**
**Courtesy of CHRYSLER LLC**

 

4. Start engine and record reading on oil pressure gauge (1).

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

5. If oil pressure is 0 at idle, shut off engine. Check for pressure relief valve stuck open, a clogged oil pick-up screen.
6. Remove oil pan and inspect for debris. Refer to **PAN-OIL**.
7. Remove oil pressure relief valve. Refer to **REMOVAL**.
8. Inspect oil pressure relief valve. See **INSPECTION**. If damaged, replace valve.
9. If pressure relief valve is ok, replace balance shaft module assembly. Refer to **REMOVAL**.

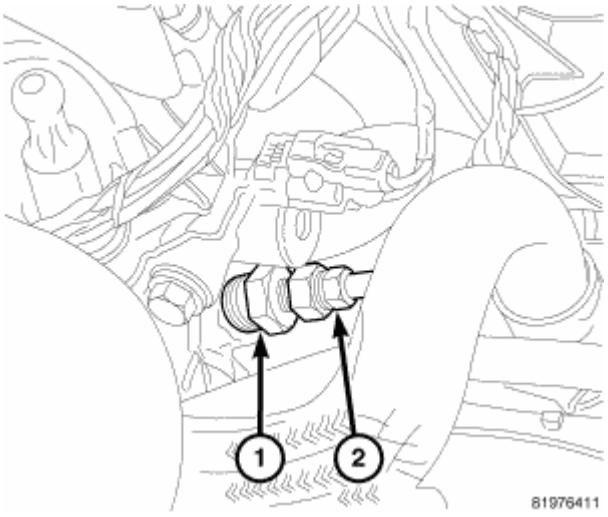


**Fig. 259: OIL PRESSURE ADAPTER 9879**
**Courtesy of CHRYSLER LLC**

10. After test is complete, remove oil pressure gauge (2) and adapter 9879 (1).

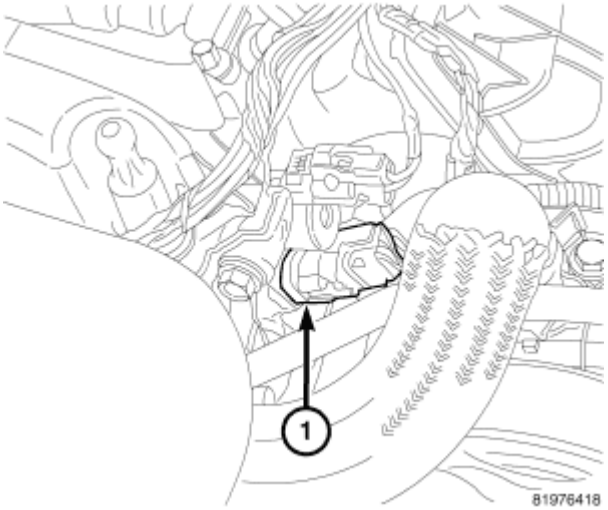


 

**Fig. 260: OIL TEMPERATURE SENSOR**
**Courtesy of CHRYSLER LLC**

11. Install a new oil pressure temperature sensor (1) and connect electrical connector.

## OIL

### 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 at mileage and time intervals described in the Maintenance Schedule. Refer to **DESCRIPTION** .

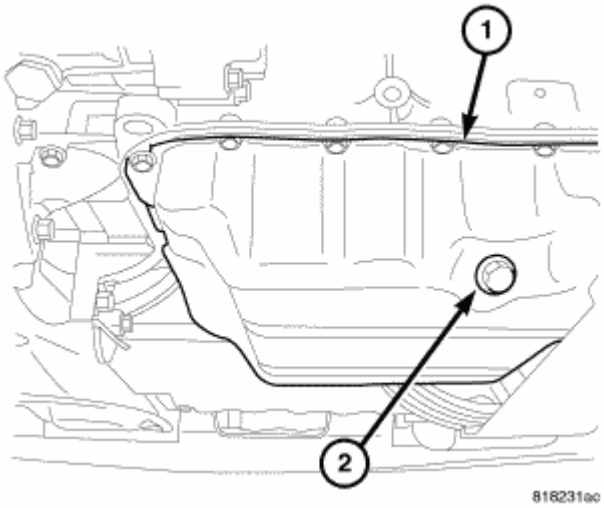


**Fig. 261: OIL DRAIN PLUG**
**Courtesy of CHRYSLER LLC**

1. Run engine until achieving normal operating temperature.
2. Position the vehicle on a level surface and turn engine off.
3. Remove oil fill cap.
4. Raise vehicle on hoist.
5. Place a suitable oil collecting container under oil pan drain plug (2).
6. Remove oil pan drain plug (2) or and allow oil to drain into collecting container. Inspect drain plug threads for stretching or other damage. Replace drain plug and gasket if damaged.

 

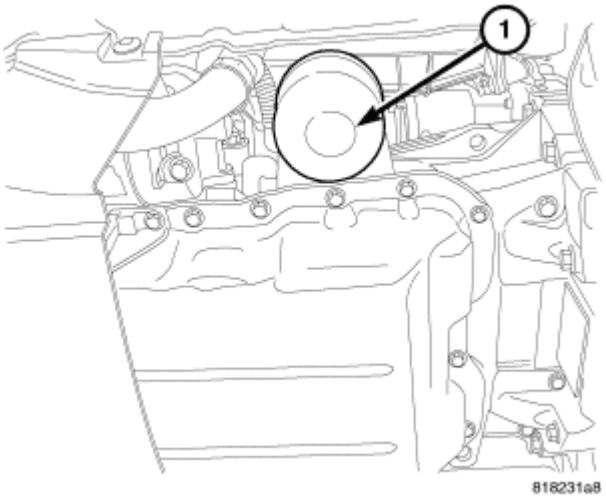


**Fig. 262: OIL FILTER**
**Courtesy of CHRYSLER LLC**

7. Remove oil filter (1). Refer to **REMOVAL**.

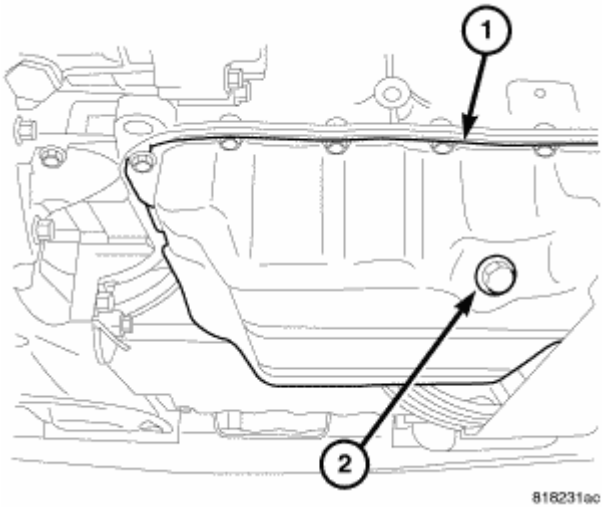


**Fig. 263: OIL DRAIN PLUG**
**Courtesy of CHRYSLER LLC**

8. Install oil pan drain plug (2) and tighten drain plug to 28 N.m (20 ft. lbs.).

 

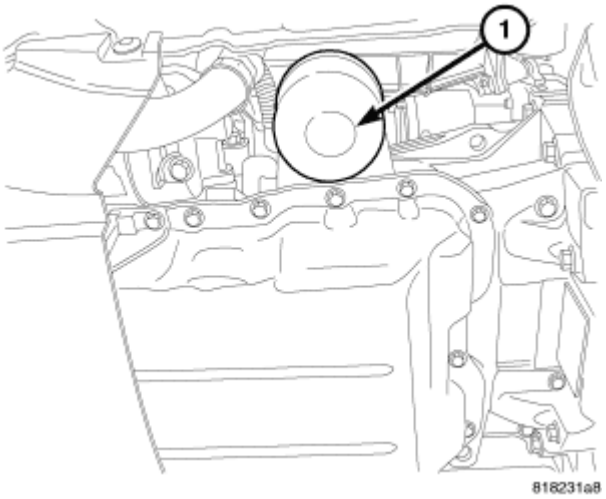


**Fig. 264: OIL FILTER**
**Courtesy of CHRYSLER LLC**

9. Install new oil filter (1). Refer to **INSTALLATION**.
10. Lower vehicle and fill crankcase with specified type and amount of engine oil. Refer to **SPECIFICATIONS** ..
11. Install oil fill cap.
12. Start engine and inspect for leaks.
13. Stop engine and inspect oil level.

#### OIL FILTER SPECIFICATION

All engines are equipped with a high quality full-flow, disposable type oil filter. Replace oil filter with a Mopar® or the 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

 

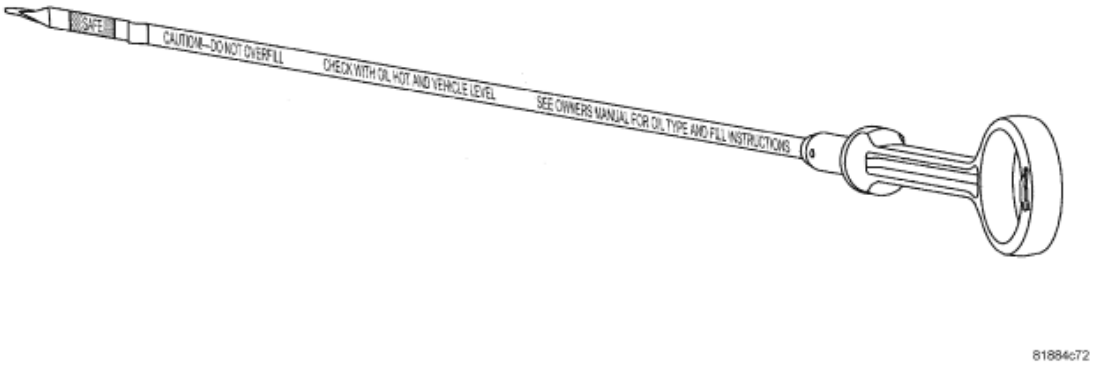


**Fig. 265: OIL LEVEL INDICATOR**
**Courtesy of CHRYSLER LLC**

**NOTE: The engine must be HOT when checking oil level.**

The best time to check engine oil level is after the engine is at operating temperature. Allow the engine to be shut off for at least 5 minutes before checking oil level.

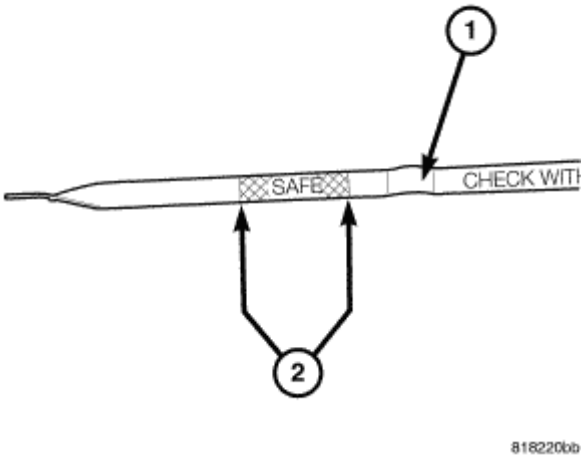


**Fig. 266: DIP STICK**
**Courtesy of CHRYSLER LLC**

Checking the oil while the vehicle is on level ground will improve the accuracy of the oil level reading. Remove dipstick (1), and observe oil level. Add oil only when the level is at or below the SAFE mark. If the oil level is in the safe (2) range, do not add oil.

**CAUTION: Do not operate engine if the oil level is above the MAX mark on the dipstick. Excessive oil volume can cause oil aeration which can lead to engine failure due to loss of oil pressure or increase in oil temperature.**

 

## FILTER-OIL

### REMOVAL

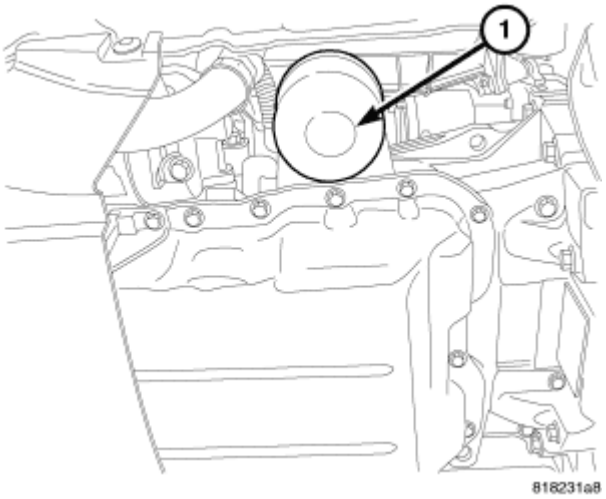


**Fig. 267: Oil Filter**
**Courtesy of CHRYSLER LLC**

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

1. Using a suitable filter wrench, turn oil filter (1) counterclockwise to remove.

### INSTALLATION

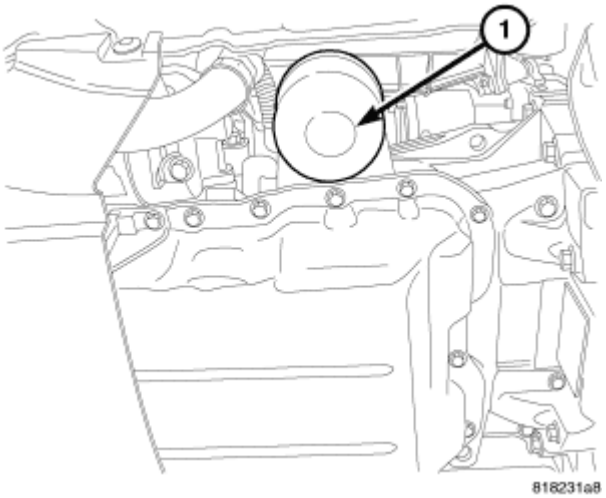


**Fig. 268: OIL FILTER**
**Courtesy of CHRYSLER LLC**

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

 

gasket.
2. Lubricate new oil filter gasket.
3. Screw oil filter (1) on until the gasket contacts base. Tighten to 14 N.m (11 ft. lbs.).

## PAN-OIL

### REMOVAL

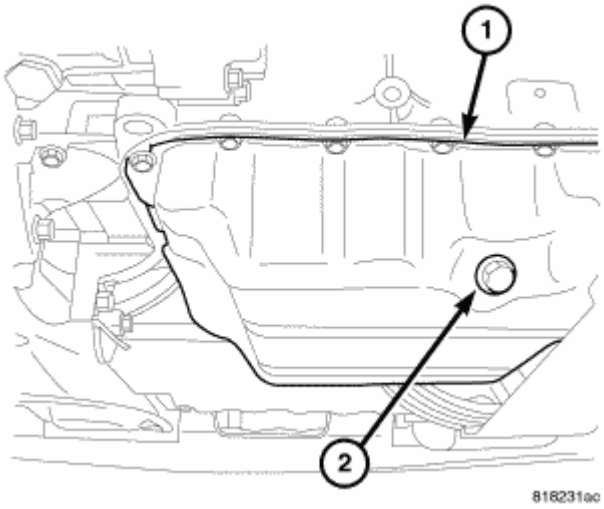


**Fig. 269: OIL DRAIN PLUG**
**Courtesy of CHRYSLER LLC**

1. Raise vehicle on hoist.
2. Remove oil drain plug (2) and drain the engine oil.
3. Remove accessory drive belt splash shield.

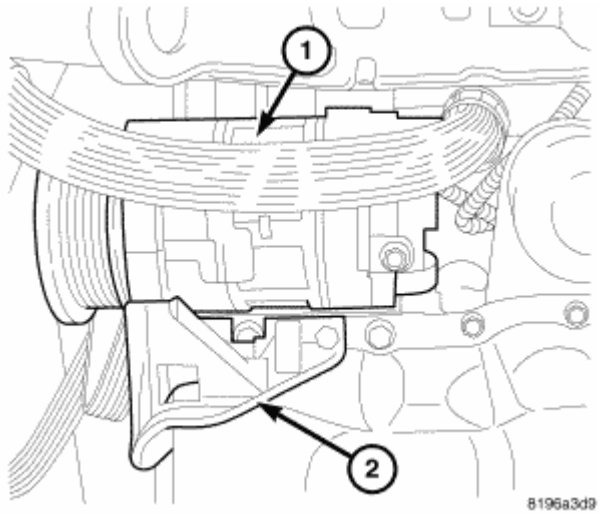


**Fig. 270: A/C COMPRESSOR**
**Courtesy of CHRYSLER LLC**

 

4. Remove lower A/C compressor mounting bolt (if equipped).
5. Remove A/C mounting bracket (2).

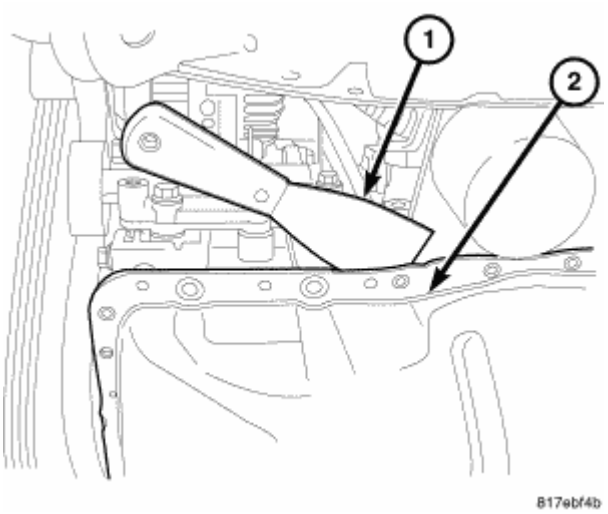


**Fig. 271: OIL PAN REMOVAL**
**Courtesy of CHRYSLER LLC**

**NOTE: Do not use pry points in block to remove oil pan.**

6. Remove oil pan retaining bolts.
7. Using a putty knife (1), loosen seal around oil pan (2).
8. Remove oil pan (2).

**INSTALLATION**

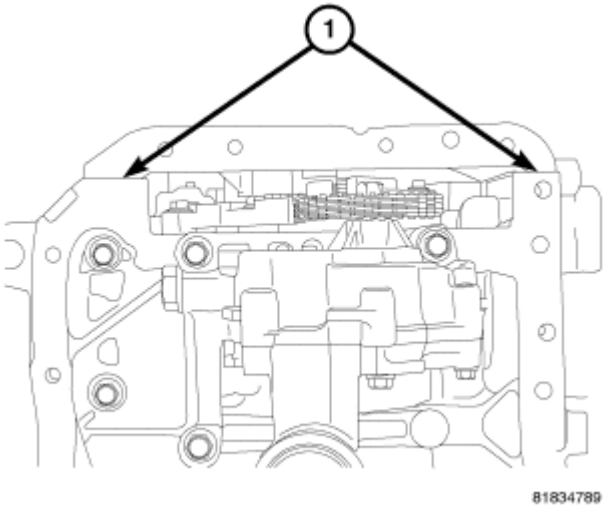


**Fig. 272: SEALER LOCATION**
**Courtesy of CHRYSLER LLC**

 

**NOTE: Oil pan sealing surfaces must be free of grease or oil.**

**NOTE: Parts must be assembled within 10 minutes of applying RTV.**

1. Apply Mopar® Engine RTV GEN II at the front cover to engine block parting lines (1).

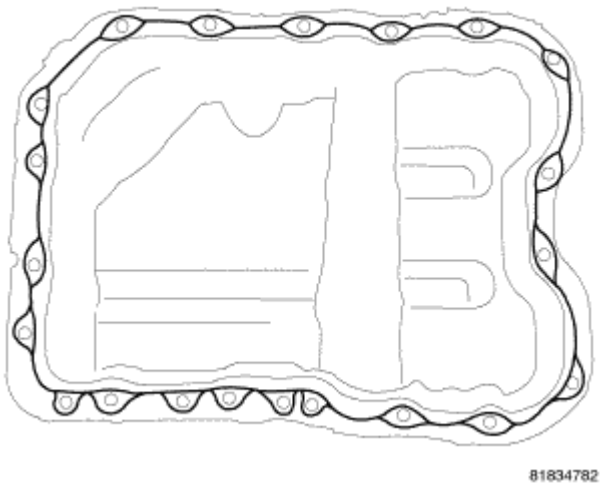


**Fig. 273: SEALING OIL PAN**
**Courtesy of CHRYSLER LLC**

2. Apply a 2 mm bead of Mopar® Engine RTV GEN II around the oil pan as shown.
3. Position oil pan and install bolts. Tighten bolts to 12 N.m (105 in. lbs.).

**NOTE: The 2 long bolts must be tightened to 22 N.m (195 in.lbs.).**

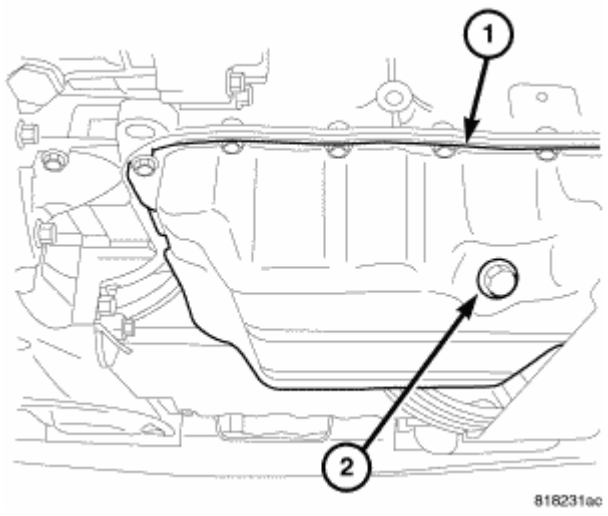


**Fig. 274: OIL DRAIN PLUG**
**Courtesy of CHRYSLER LLC**

 

4. Install oil drain plug (2).
5. Lower vehicle and fill engine crankcase with proper oil to correct level.
6. Start engine and check for leaks.

## VALVE-OIL PRESSURE RELIEF

### REMOVAL

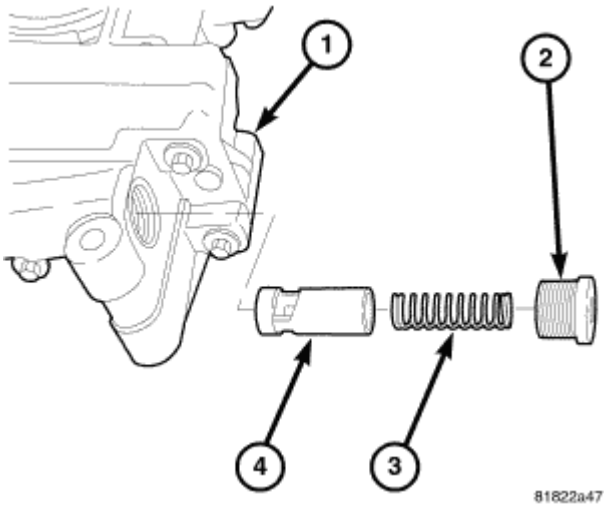


**Fig. 275: OIL PRESSURE RELIEF VALVE**
**Courtesy of CHRYSLER LLC**

1. Remove oil pan. Refer to **PAN-OIL**.
2. Remove pressure regulating valve cap (2).
3. Remove pressure regulating valve spring (3) and valve (4).

### INSPECTION

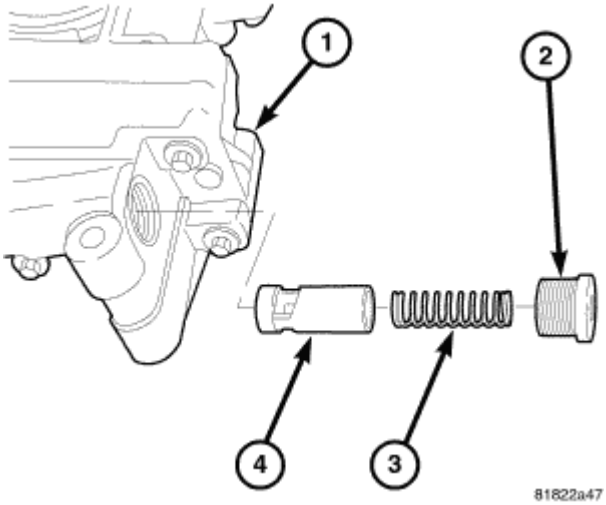


**Fig. 276: OIL PRESSURE RELIEF VALVE**

 

**Courtesy of CHRYSLER LLC**

**NOTE: Pressure regulating valve (4) can be service separately from the oil pump assembly.**

1. Inspect pressure relief valve (4) scoring, gouging, or debris. Replace as needed.
2. Inspect the pressure relief valve bore in the pump for scoring, gouging, or debris.
3. If pump bore is damaged, replace balance shaft module.

**INSTALLATION**

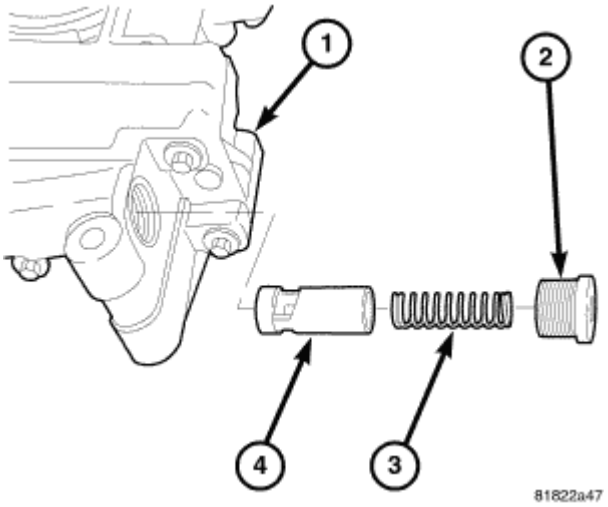


**Fig. 277: Oil Pressure Relief Valve**
**Courtesy of CHRYSLER LLC**

1. Lightly coat pressure regulating valve with clean engine oil and install valve (4).
2. Install spring (3) and cap (2).
3. Tighten cap to 44 N.m (32 lbs.ft.).

**PUMP-OIL**

**DESCRIPTION**

 

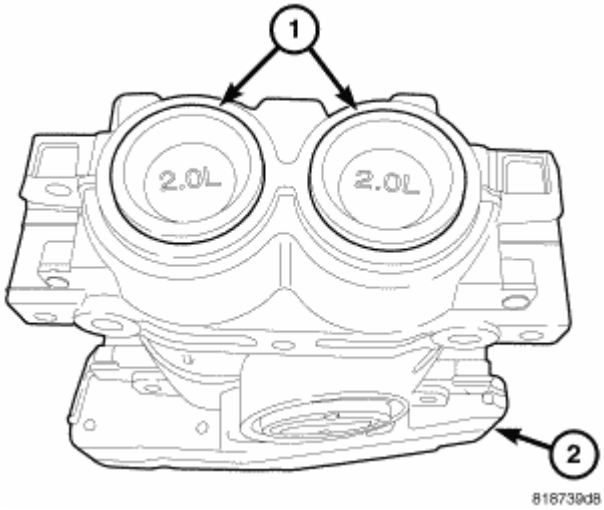


**Fig. 278: BSM IDENTIFICATION**
**Courtesy of CHRYSLER LLC**

The oil pump is integral to the balance shaft module (BSM) (2). The oil pump cannot be disassembled for inspection. The pressure relief valve is serviceable and can be removed and inspected. The BSM can be identified by the plastic end caps (1).

**REMOVAL**

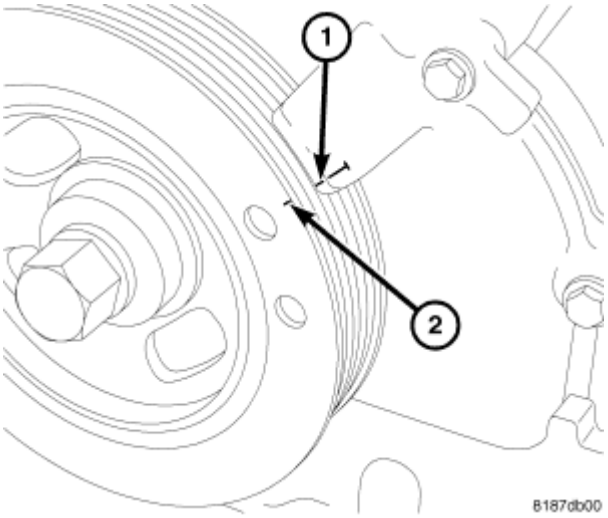


**Fig. 279: TDC**
**Courtesy of CHRYSLER LLC**

1. Rotate engine to TDC (1,2) on #1 compression stroke.

 

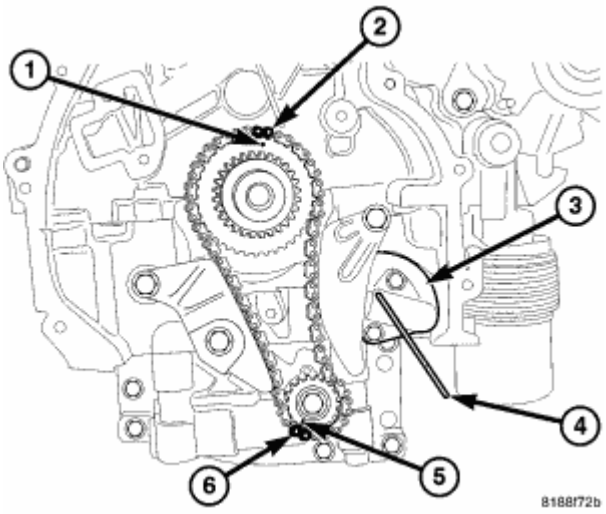


**Fig. 280: BSM Tensioner**
**Courtesy of CHRYSLER LLC**

2. Remove oil pan. Refer to **PAN-OIL**.
3. Mark the chain (6) and the sprocket (5) for reassembly.

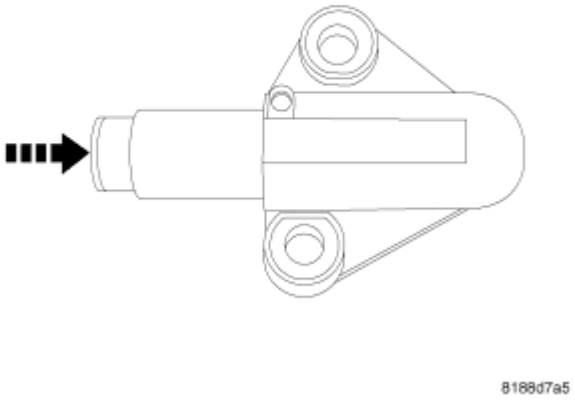


**Fig. 281: Oil Pump Tensioner Reset**
**Courtesy of CHRYSLER LLC**

4. Push tensioner piston back into the tensioner body.

 

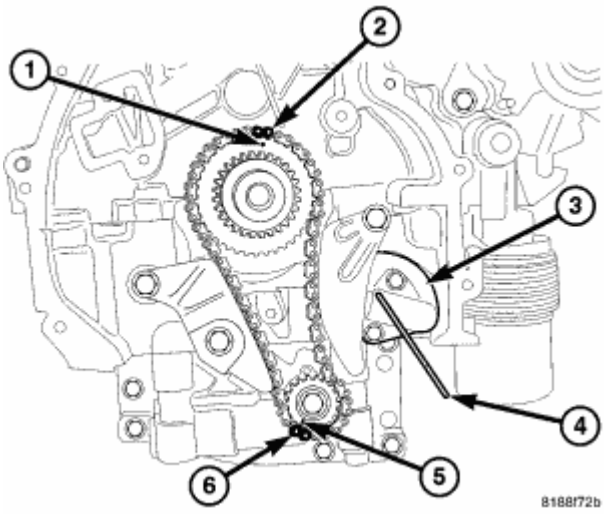


**Fig. 282: BSM Tensioner**
**Courtesy of CHRYSLER LLC**

5. With piston held back insert tensioner pin 9703 (4) into the tensioner body to hold the piston in the retracted position.

**NOTE: Do not remove sprocket from BSM.**

**CAUTION: There are two different length bolts used to attach the Balance Shaft Module (BSM) to engine block. The short bolt is 180 mm (7.086 in.) and the long bolt is 185 mm (7.283). The bolts must be replaced with the same length as removed or engine damage could result.**

**CAUTION: Do not reuse the short bolt Balance Shaft Module (BSM) to engine block bolts. Always discard the short bolts is 180 mm (7.086 in.) bolts after removing. Failure to replace bolts can result in engine damage.**

6. Remove BSM mounting bolts and discard.
7. Lower the back of the BSM and remove the chain (6) from the sprocket (5).
8. Remove BSM from the engine.

**INSTALLATION**

 

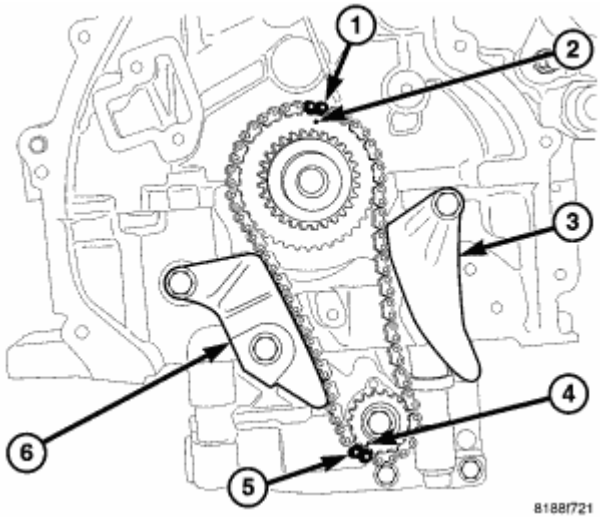


**Fig. 283: BSM TIMING**
**Courtesy of CHRYSLER LLC**

**CAUTION: There are two different length bolts used to attach the Balance Shaft Module (BSM) to engine block. The short bolt is 180 mm (7.086 in.) and the long bolt is 185 mm (7.283). The bolts must be replaced with the same length as removed or engine damage could result.**

**CAUTION: Do not reuse Balance Shaft Module (BSM) to engine block bolts. Always discard bolts after removing. Failure to replace bolts can result in engine damage.**

1. Clean BSM mounting holes with Mopar® brake parts cleaner and compressed air.
2. Align marks on crankshaft sprocket (2) and chain (1).
3. Align marks on oil pump sprocket (5) and chain (4) with the mark on the balance shaft module.
4. Install chain on sprocket.
5. Pivot BSM assembly upwards and position on ladder frame.

 

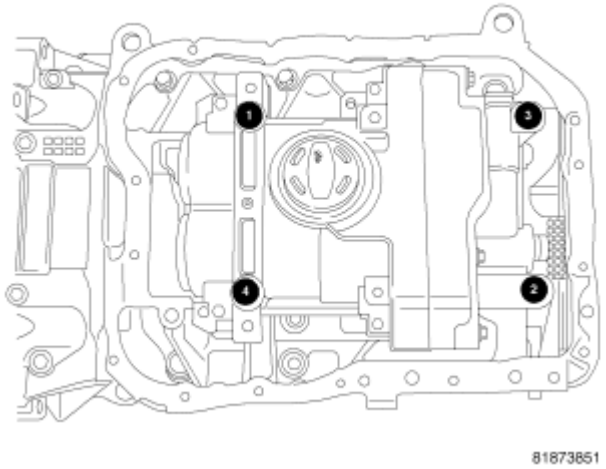


**Fig. 284: BSM Torque Sequence**
**Courtesy of CHRYSLER LLC**

6. Start **new** BSM mounting bolts by hand.

**NOTE: Use a three step procedure when torquing BSM mounting bolts.**

7. Tighten BSM mounting bolts to 15 N.m (11 ft. lbs.) as shown.
8. Tighten BSM mounting bolts to 29 N.m (22 ft. lbs.) as shown.
9. Rotate bolts an additional 90° as shown.

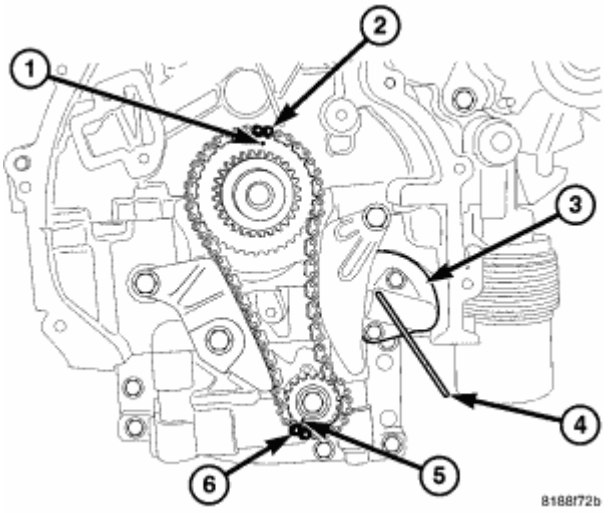


**Fig. 285: BSM Tensioner**
**Courtesy of CHRYSLER LLC**

10. Remove tensioner pin 9703 (4).
11. Install oil pan. Refer to **PAN-OIL**.
12. Fill with oil.

 

13. Start engine and check for leaks.

## SENSOR/SWITCH-ENGINE OIL PSI

### DESCRIPTION

#### OIL PRESSURE SWITCH

The oil pressure switch is located on the left front side of the engine block. The oil pressure switch is a pressure sensitive switch that is activated by the engine's oil pressure (in the main oil gallery). The switch is a two terminal device (one terminal is provided to the wiring harness and the other terminal is the switch's metal housing that screws into the engine block).

### OPERATION

#### OIL PRESSURE SWITCH

The oil pressure switch is normally "Closed." The switch changes from a "Closed" circuit to an "Open" circuit, on increasing pressure of 7 psig. The oil pressure switch changes from an "Open" circuit to a "Closed" circuit, on decreasing pressure, between 2 psig and 4 psig.

### REMOVAL

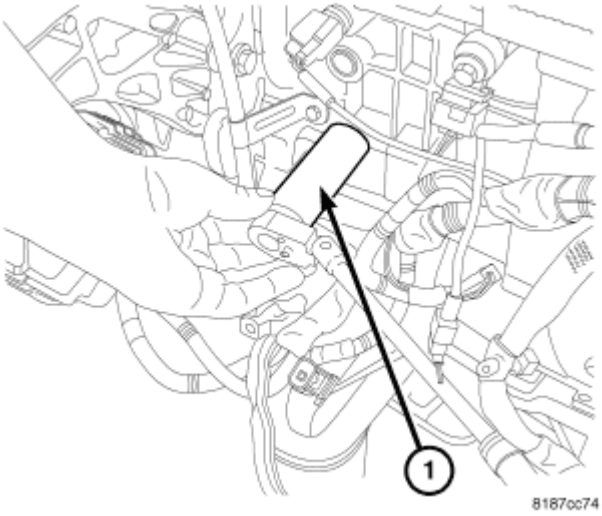


**Fig. 286: OIL SENDER**
**Courtesy of CHRYSLER LLC**

1. Raise vehicle.
2. Disconnect electrical connector.
3. Remove oil pressure sensor using oil pressure socket C-4597 (1) and discard sensor.

### INSTALLATION

 

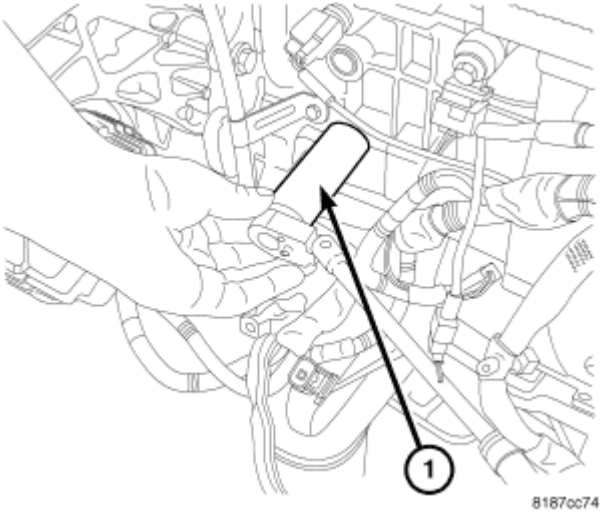


**Fig. 287: OIL SENDER**
**Courtesy of CHRYSLER LLC**

**NOTE: If the oil pressure sensor is removed, it must be replaced with a new sensor.**

**CAUTION: The oil pressure sensor has tapered threads, over tightening could crack the engine block.**

1. Install oil pressure sensor using oil pressure socket C-4597 (1) and tighten to 8 N.m (71 in. lbs.).
2. Connect electrical connector.

## SENSOR-OIL TEMPERATURE

### REMOVAL

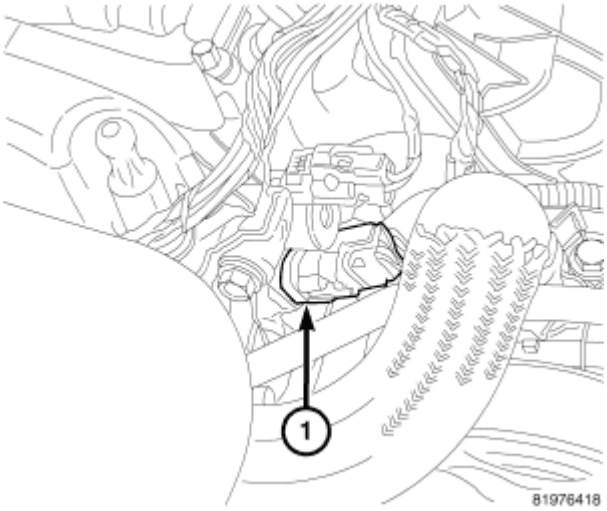


**Fig. 288: OIL TEMPERATURE SENSOR**
**Courtesy of CHRYSLER LLC**

 

1. Disconnect oil temperature sensor (1) electrical connector.
2. Remove sensor (1).

**INSTALLATION**

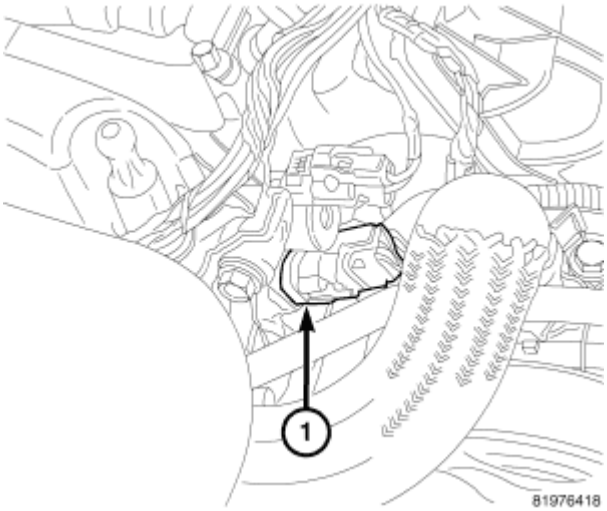


**Fig. 289: OIL TEMPERATURE SENSOR**
**Courtesy of CHRYSLER LLC**

1. If re-using the oil temperature sensor, coat the threads with Mopar® thread sealant.
2. Install oil temperature sensor (1). Tighten to 8 N.m (71 in. lbs.).
3. Connect electrical connector.

## COOLER-OIL

**DESCRIPTION**

An engine oil cooler is used on some engine packages. The cooler is a coolant-to-oil type and mounted between the oil filter and oil filter adapter.

**REMOVAL**

**NOTE: The oil cooler can not be cleaned out. In the event that the engine requires rebuilding or replacement, the oil cooler should be replaced.**

 

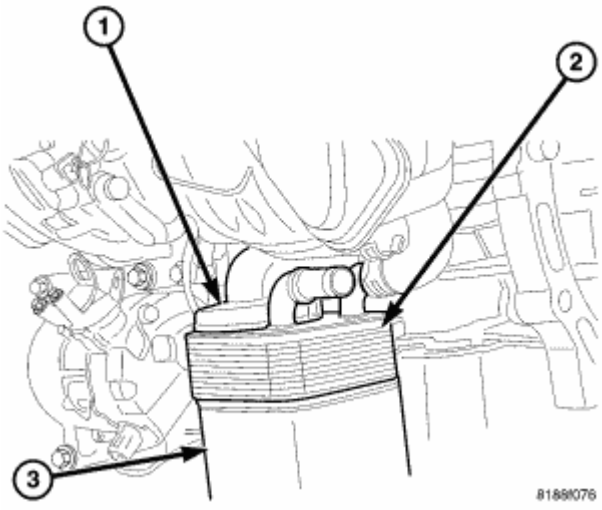


**Fig. 290: OIL COOLER**
**Courtesy of CHRYSLER LLC**

1. Raise vehicle on hoist.
2. Drain cooling system. Refer to **STANDARD PROCEDURE** .
3. Disconnect oil cooler coolant hoses.
4. Remove oil filter (3).

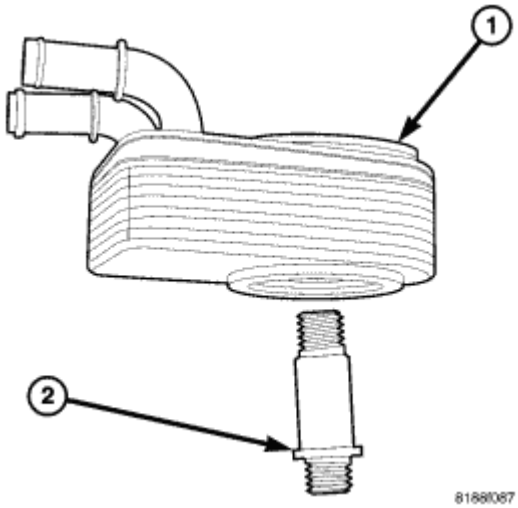


**Fig. 291: OIL COOLER MOUNTING**
**Courtesy of CHRYSLER LLC**

5. Remove oil cooler connector bolt (2).
6. Remove oil cooler (1).

**INSTALLATION**

 

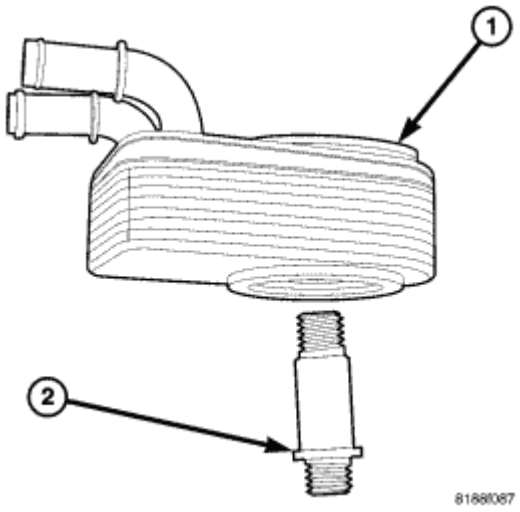


**Fig. 292: OIL COOLER MOUNTING**
**Courtesy of CHRYSLER LLC**

1. Replace oil cooler seal (1).
2. Lubricate seal and position oil cooler to oil filter adapter, aligning notch to tab.
3. Install oil cooler connector bolt (2). Tighten connector bolt to 55 N.m (41 ft. lbs.).

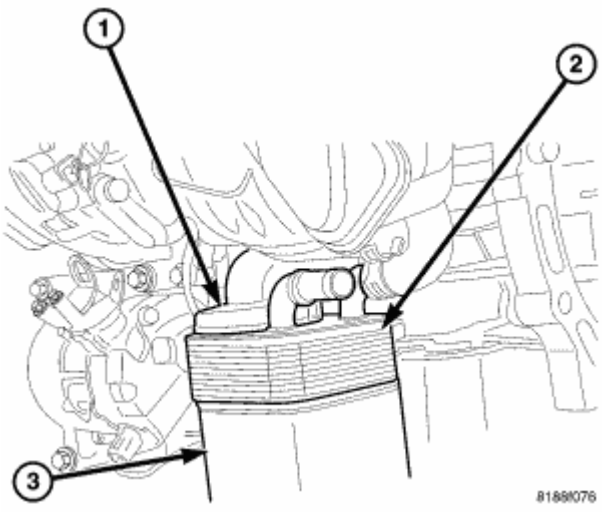


**Fig. 293: OIL COOLER**
**Courtesy of CHRYSLER LLC**

4. Install oil filter (3).
5. Connect oil cooler coolant hose.
6. Lower vehicle.
7. Fill cooling system. Refer to **STANDARD PROCEDURE** .

## MANIFOLDS

 

## MANIFOLD-EXHAUST

### REMOVAL

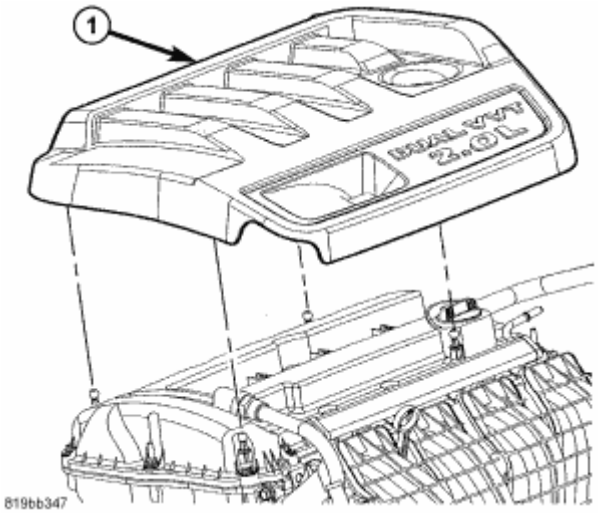


**Fig. 294: ENGINE COVER - 2.0L**
**Courtesy of CHRYSLER LLC**

1. Remove engine cover (1).
2. Disconnect negative cable from battery.
3. Remove bolts attaching upper heat shield.
4. Remove upper heat shield.
5. Disconnect exhaust pipe from manifold.

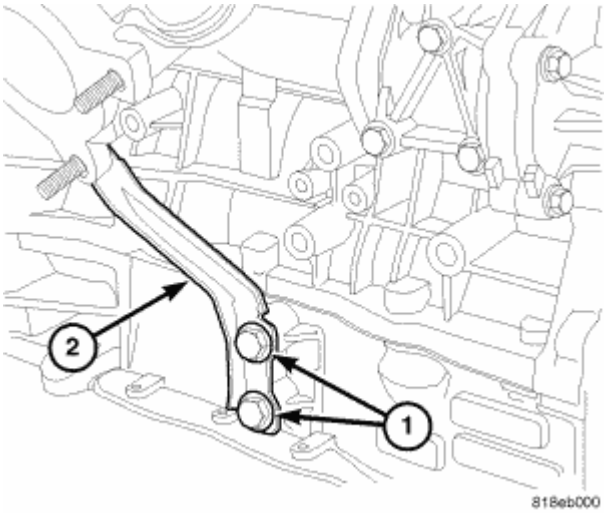


**Fig. 295: EXHAUST MANIFOLD SUPPORT BRACKET**
**Courtesy of CHRYSLER LLC**

6. Remove manifold support bracket (2).

 

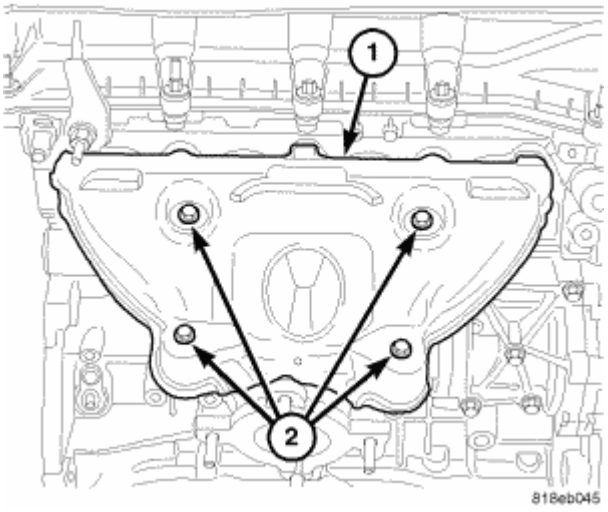


**Fig. 296: EXHAUST MANIFOLD HEAT SHIELD**
**Courtesy of CHRYSLER LLC**

7. Remove exhaust manifold heat shield (1).

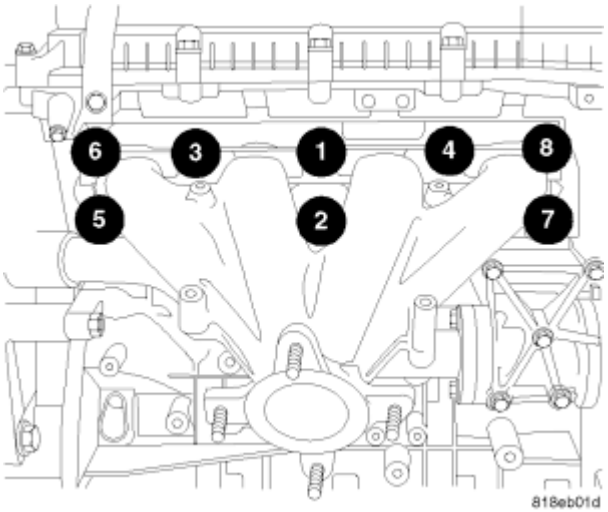


**Fig. 297: TORQUE SEQUENCE**
**Courtesy of CHRYSLER LLC**

8. Disconnect oxygen sensor electrical connector.
9. Remove exhaust manifold retaining fasteners.
10. Remove and discard manifold gasket.

**CLEANING**

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

**INSPECTION**

 

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

**INSTALLATION**

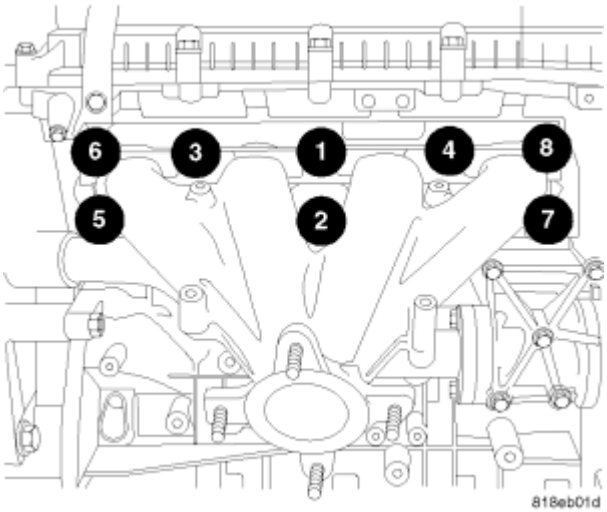


**Fig. 298: TORQUE SEQUENCE**
**Courtesy of CHRYSLER LLC**

1. Install a new exhaust manifold gasket. **DO NOT APPLY SEALER** .
2. Tighten the exhaust manifold bolts to 34 N.m (25 ft. lbs.).

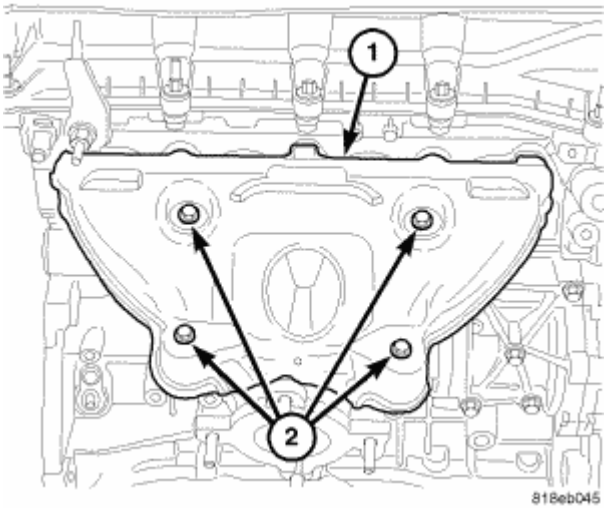


**Fig. 299: EXHAUST MANIFOLD HEAT SHIELD**
**Courtesy of CHRYSLER LLC**

3. Install exhaust manifold heat shields. Tighten bolts to 12 N.m (105 in. lbs.).

 

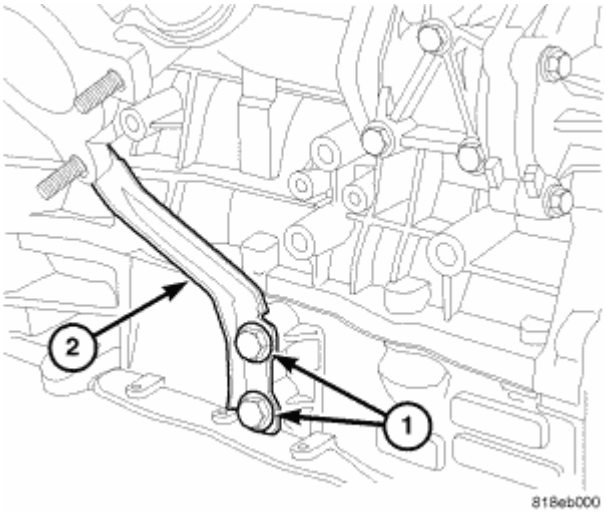


**Fig. 300: EXHAUST MANIFOLD SUPPORT BRACKET**
**Courtesy of CHRYSLER LLC**

4. Install exhaust manifold support bracket (2).

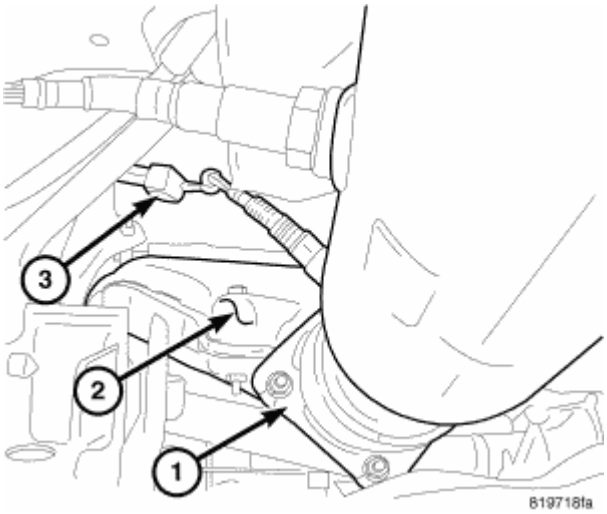


**Fig. 301: CAT AT EXHAUST MANIFOLD**
**Courtesy of CHRYSLER LLC**

5. Install new catalytic converter gasket.
6. Install exhaust pipe to manifold (1). Tighten fasteners to 28 N.m (250 in. lbs.).
7. Connect oxygen sensor electrical connector (3).

 

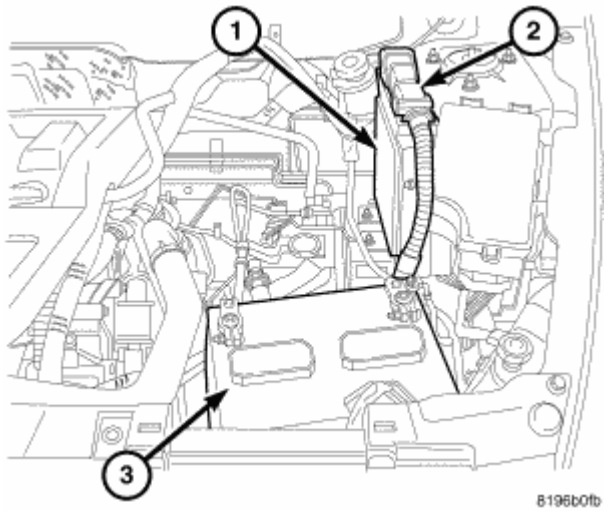


**Fig. 302: BATTERY**
**Courtesy of CHRYSLER LLC**

8. Connect negative cable to battery (3).

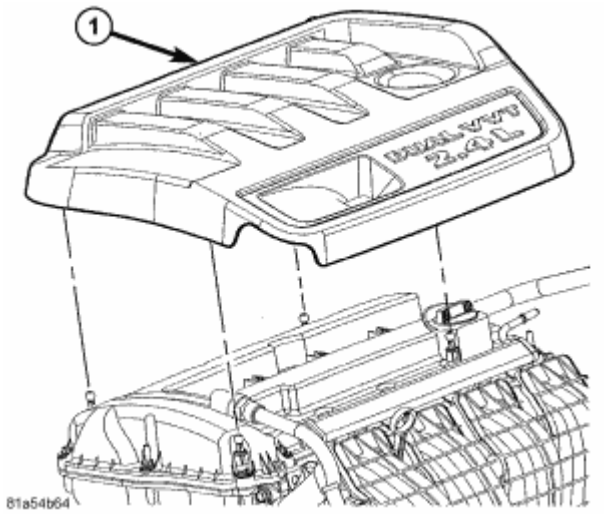


**Fig. 303: ENGINE COVER**
**Courtesy of CHRYSLER LLC**

9. Install engine cover (1).

## MANIFOLD-INTAKE

### REMOVAL

**WARNING: Release fuel system pressure before servicing system components. Service vehicles in well ventilated areas and avoid ignition sources. Never smoke while servicing the vehicle.**

 

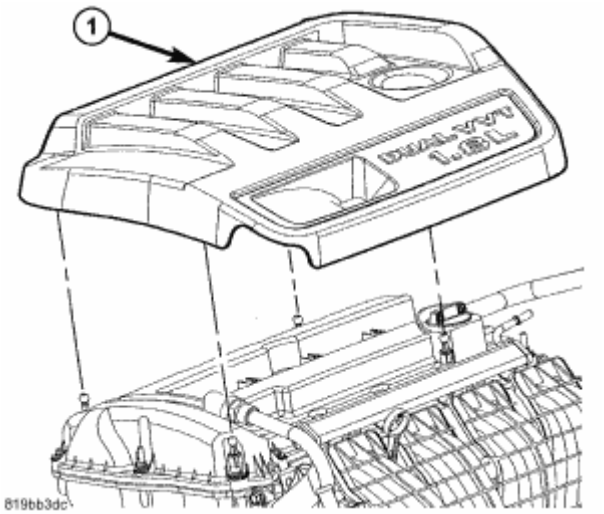


**Fig. 304: ENGINE COVER**
**Courtesy of CHRYSLER LLC**

1. Remove engine cover (1).
2. Perform fuel system pressure release procedure **before attempting any repairs. Refer to STANDARD PROCEDURE .**

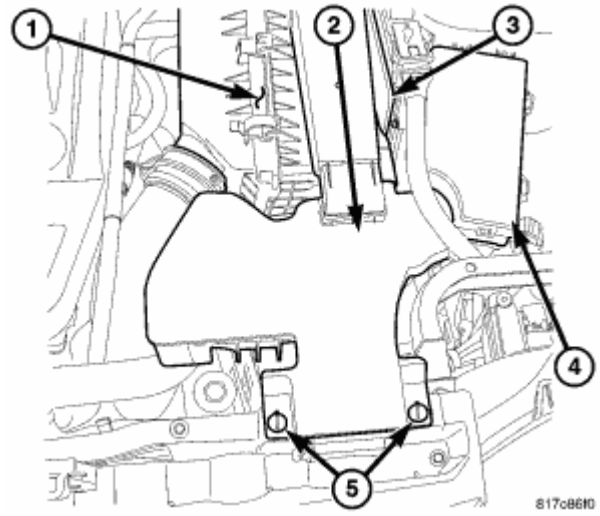


**Fig. 305: AIR CLEANER INLET**
**Courtesy of CHRYSLER LLC**

3. Remove air cleaner inlet (2).

 

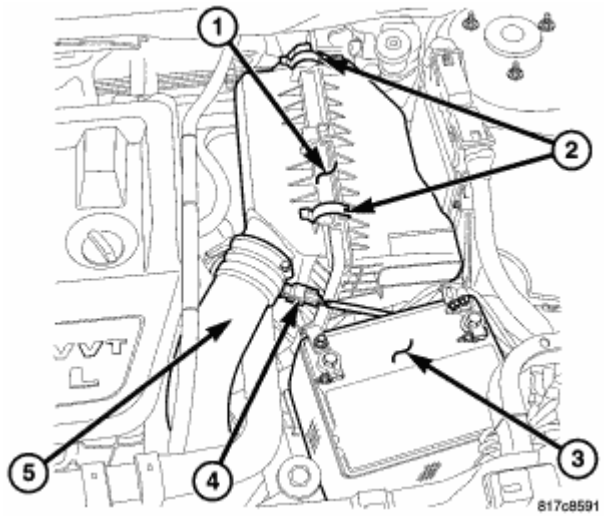


**Fig. 306: Air Cleaner Housing**
**Courtesy of CHRYSLER LLC**

4. Remove air cleaner housing (1).
5. Disconnect negative cable at battery (3).

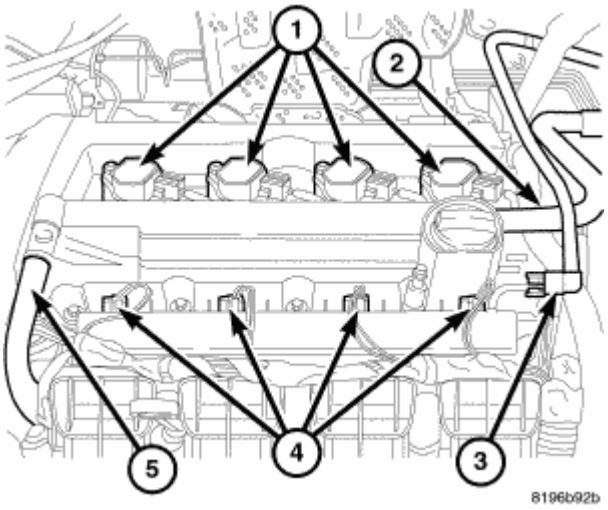


**Fig. 307: COIL CONNECTOR**
**Courtesy of CHRYSLER LLC**

6. Disconnect fuel line at rail (3).
7. Remove fuel injector electrical connectors (4).
8. Remove fuel rail retaining bolts and remove fuel rail.

 

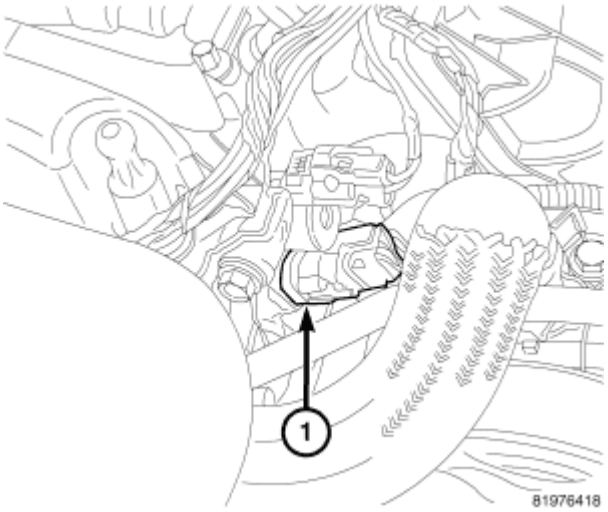


**Fig. 308: OIL TEMPERATURE SENSOR**
**Courtesy of CHRYSLER LLC**

9. Disconnect oil temperature sensor (1).
10. Disconnect variable valve timing solenoid electrical connector.
11. Disconnect intake camshaft position sensor electrical connector.
12. Position harness out of the way.

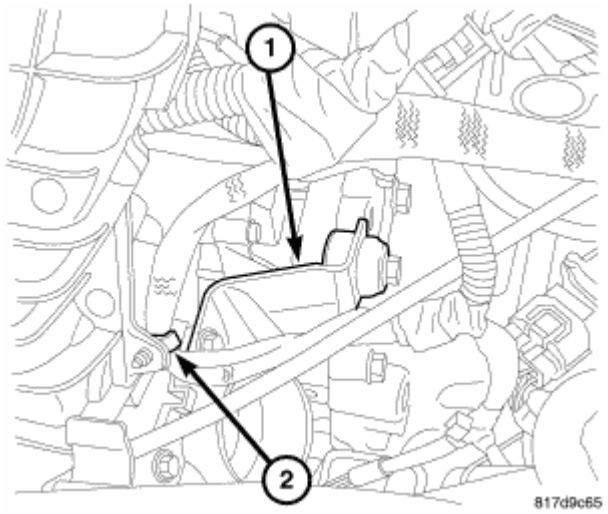


**Fig. 309: Throttle Body Support**
**Courtesy of CHRYSLER LLC**

13. Remove throttle body support bracket (1).
14. Disconnect electronic throttle control electrical connector.
15. Remove wiring harness retainer from the intake manifold (2).
16. Disconnect MAP sensor electrical connector.
17. Disconnect vacuum lines at intake.

 

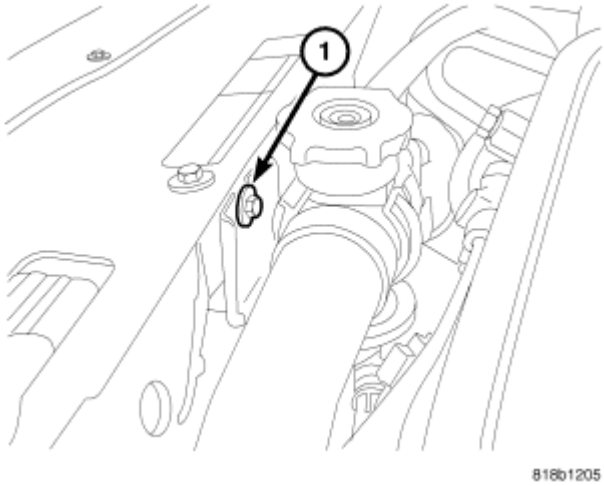


**Fig. 310: Radiator Hose Support**
**Courtesy of CHRYSLER LLC**

18. Remove upper radiator hose retaining bracket (1).

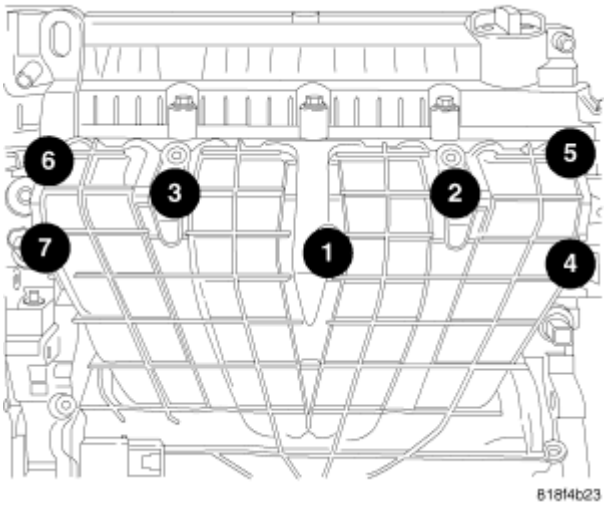


**Fig. 311: Torque Sequence**
**Courtesy of CHRYSLER LLC**

19. Remove intake manifold retaining bolts.
20. Remove intake manifold.

**CLEANING**

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

**INSPECTION**

 

1. Inspect manifold for cracks, distortion, or mounting surface warpage. Replace manifold if necessary.
2. Inspect manifold gasket for surface damage or excessive swelling. Replace gaskets as necessary.

**INSTALLATION**

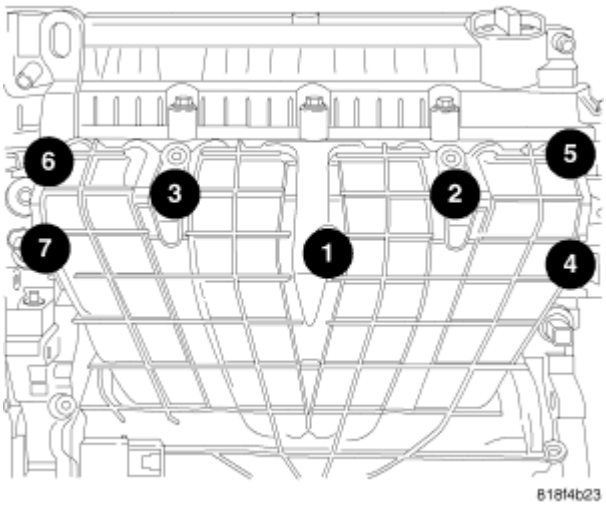


**Fig. 312: TORQUE SEQUENCE**
**Courtesy of CHRYSLER LLC**

1. Clean all gasket surfaces.
2. Replace intake manifold gasket.
3. Install intake manifold, tighten bolts to 25 N.m (220 in. lbs.).
4. Install the fuel rail assembly to intake manifold. Tighten bolts to 23 N.m (200 in. lbs.).
5. Connect fuel injector electrical connectors.

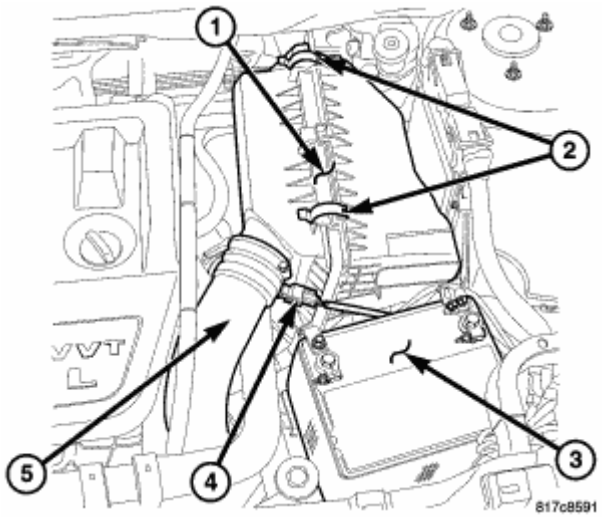


**Fig. 313: AIR CLEANER HOUSING**
**Courtesy of CHRYSLER LLC**

 

6. Inspect quick connect fittings for damage, replace if necessary. Refer to **STANDARD PROCEDURE** . Connect fuel supply hose to fuel rail assembly. Check connection by pulling on connector to insure it locked into position.
7. Connect negative cable to battery (3).
8. Fill the cooling system. Refer to **STANDARD PROCEDURE** .

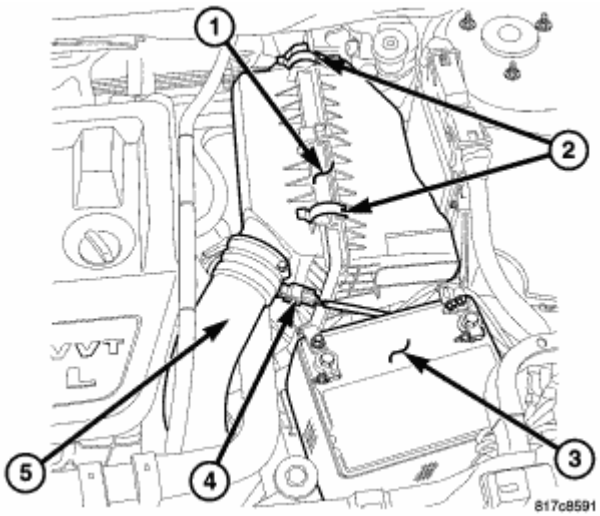


**Fig. 314: AIR CLEANER HOUSING**
**Courtesy of CHRYSLER LLC**

9. Install air cleaner housing (1).
10. Install engine cover.

# VALVE TIMING

## DESCRIPTION

### TIMING DRIVE SYSTEM

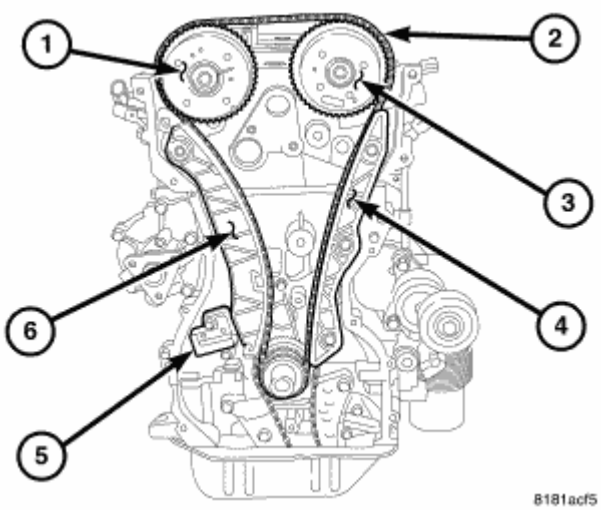


 

**Fig. 315: Timing Drive System**
**Courtesy of CHRYSLER LLC**

The timing drive system consists of the following:

Timing Chain (2)
Camshaft Sprockets (1,3)
Crankshaft Sprocket
Right Timing Chain Guide (Moveable) (6)
Left Timing Chain Guide (Fixed) (4)
Timing Chain Tensioner (5)

The camshaft sprockets are attached to the cam phasers which are attached to the front of the camshafts and is used with the timing chain and crankshaft sprocket to turn the camshafts. The camshaft position sensors target is part of the camshafts and is used with the camshaft position sensors to provide the PCM with valvetrain position information.

The timing chain tensioner is installed in the right side of the engine block. Using engine oil pressure, the tensioner applies constant pressure to the right side (movable) timing chain guide, which in turn applies pressure to the timing chain. Also as the tensioner extends, it rachet locks in position to provide constant timing chain tension.

## STANDARD PROCEDURE

### VALVE TIMING VERIFICATION

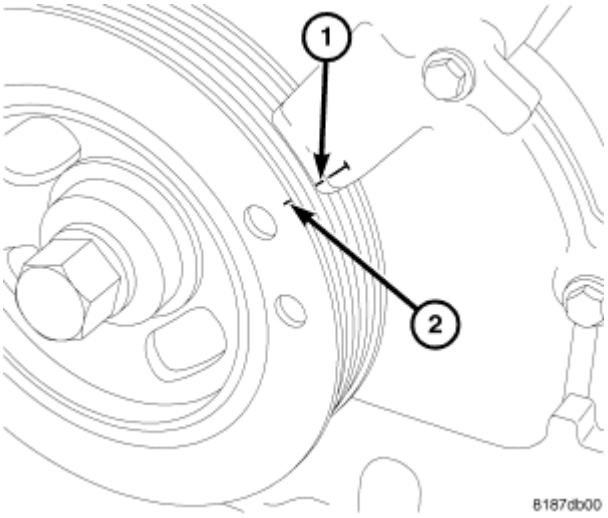


**Fig. 316: TDC**
**Courtesy of CHRYSLER LLC**

1. Remove engine cover.
2. Remove cylinder head cover. Refer to **REMOVAL**.

 

3. Set engine to TDC (1,2).

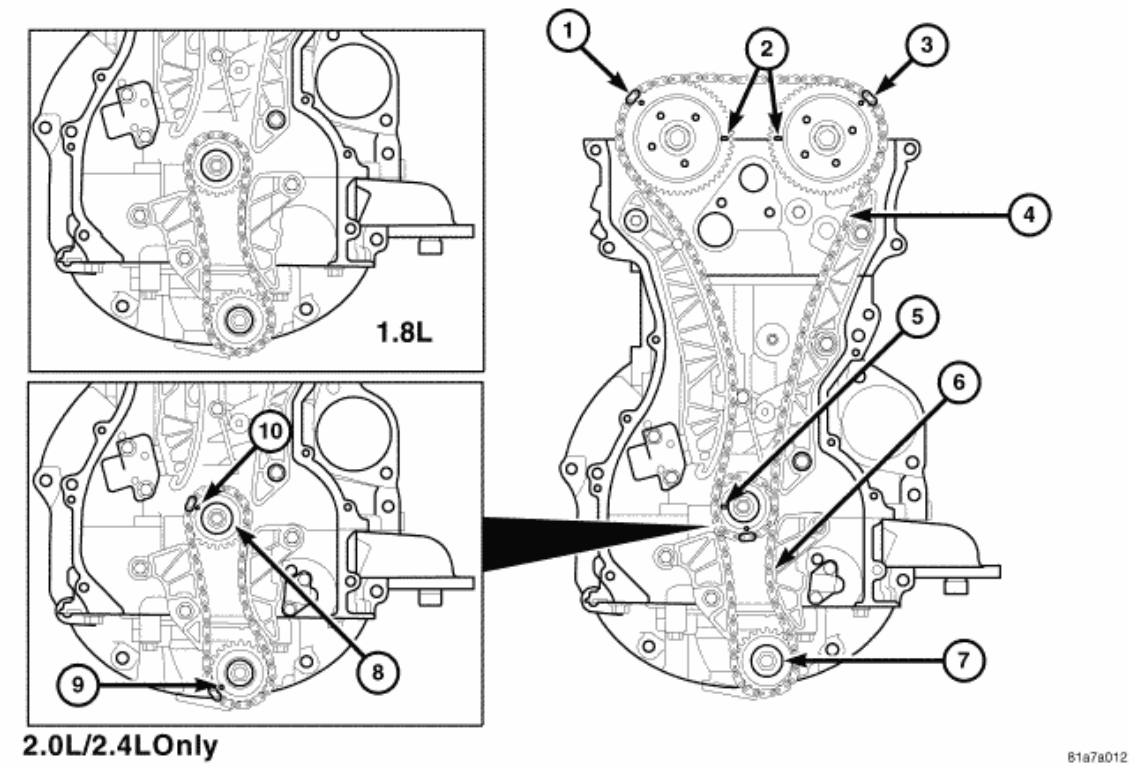


**Fig. 317: TIMING MARKS**
**Courtesy of CHRYSLER LLC**

4. The mark on the camshaft sprocket should be in line with the cylinder head cover sealing surface (2).
5. Verify that the painted or colored chain links (1,3) aligns with marks on camshaft sprockets.
6. Verify that the painted or colored chain link aligns with mark on crankshaft sprocket.
7. Install cylinder head cover. Refer to **INSTALLATION**.

## COVER-TIMING CHAIN

### REMOVAL

 

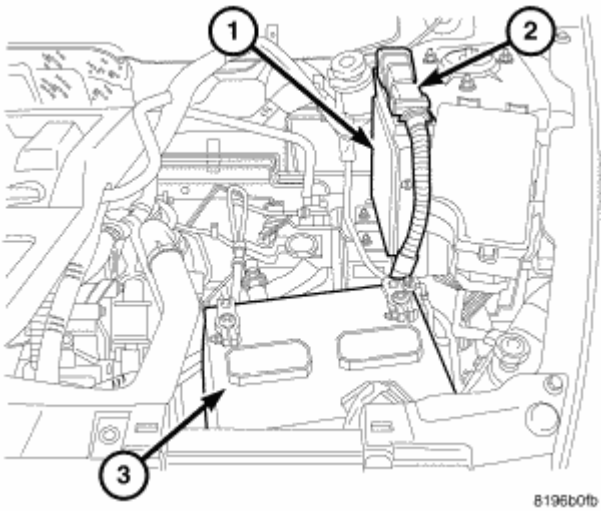


**Fig. 318: BATTERY**
**Courtesy of CHRYSLER LLC**

1. Remove engine cover by pulling upward.
2. Perform fuel pressure bleed procedure. Refer to **STANDARD PROCEDURE** .
3. Disconnect negative cable at battery (3).

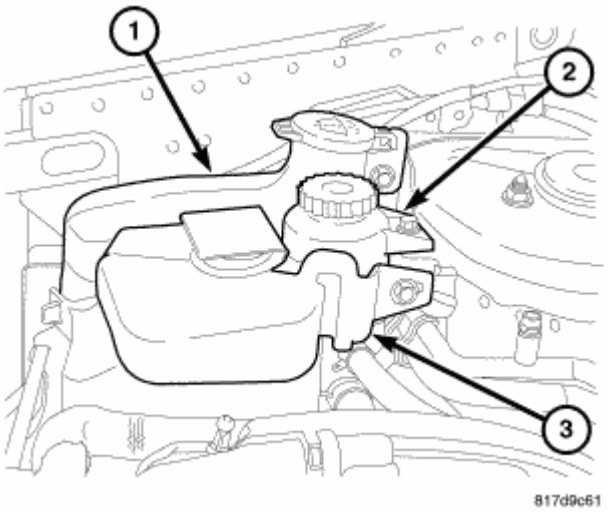


**Fig. 319: Coolant Reservoir**
**Courtesy of CHRYSLER LLC**

4. Remove coolant recovery bottle (3).
5. Remove windshield washer bottle (1).
6. Remove power steering reservoir (2) and set aside.

 

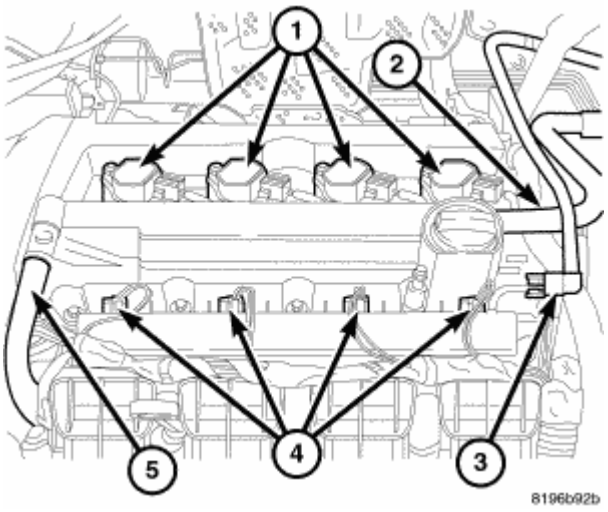


**Fig. 320: COIL CONNECTOR**
**Courtesy of CHRYSLER LLC**

7. Remove make up air hose (2).
8. Remove PCV hose (5).
9. Disconnect ignition coil electrical connectors (1).
10. Remove cylinder head cover. Refer to **REMOVAL**.

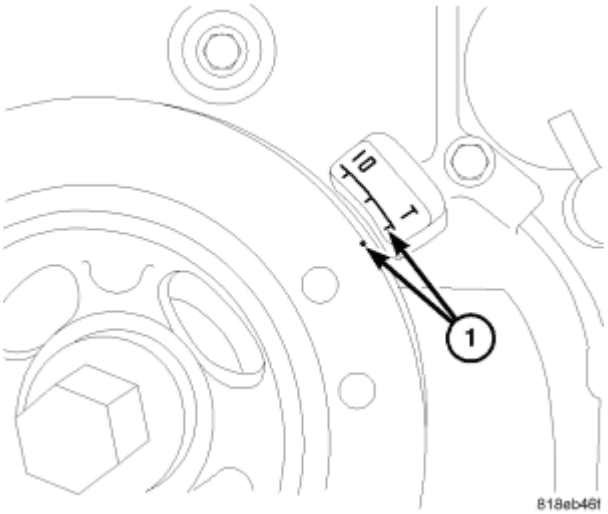


**Fig. 321: TDC**
**Courtesy of CHRYSLER LLC**

11. Raise vehicle.
12. Remove right lower splash shield.
13. Set engine to TDC (1).
14. Remove accessory drive belt. Refer to **REMOVAL** .

 

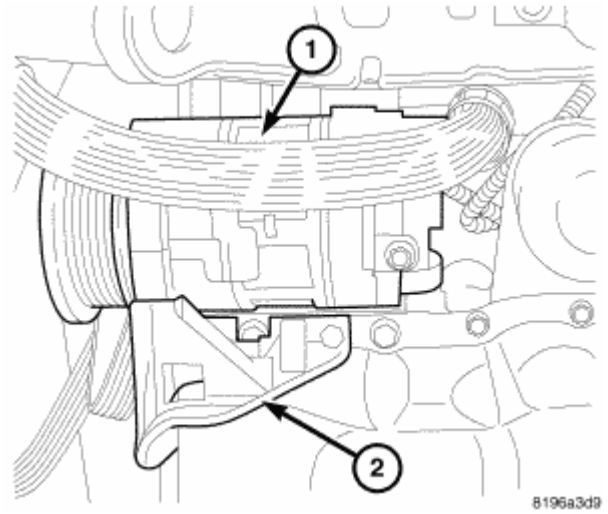


**Fig. 322: A/C COMPRESSOR**
**Courtesy of CHRYSLER LLC**

15. Remove lower A/C compressor (1) retaining bolts.
16. Remove A/C compressor lower bracket (2).

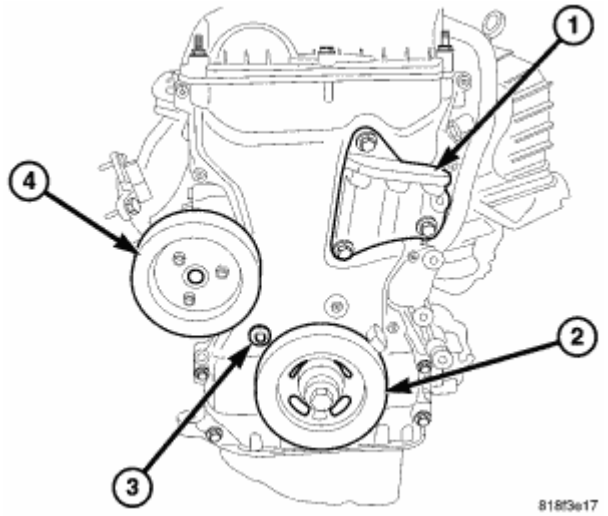


**Fig. 323: Engine Front**
**Courtesy of CHRYSLER LLC**

17. Remove accessory drive belt lower idler pulley.
18. Remove crankshaft damper (2).
19. Remove front crankshaft oil seal. Refer to **REMOVAL**.
20. Remove water pump pulley (4).
21. Remove engine mount bracket (1) lower bolt.

 

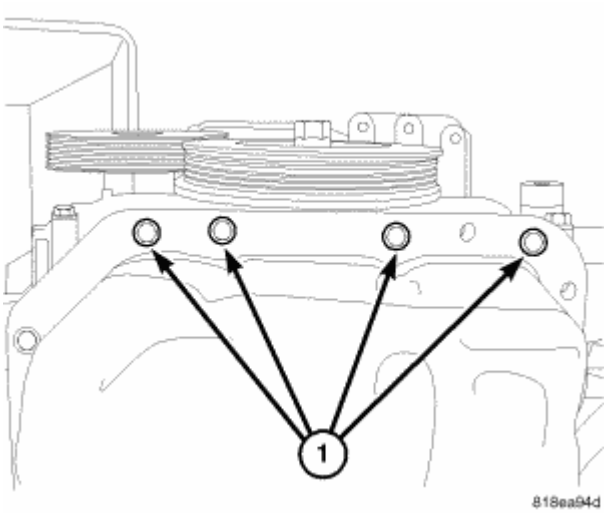


**Fig. 324: Timing Chain Cover Lower Bolts**
**Courtesy of CHRYSLER LLC**

22. Remove timing chain cover lower bolts (1).
23. Lower vehicle.

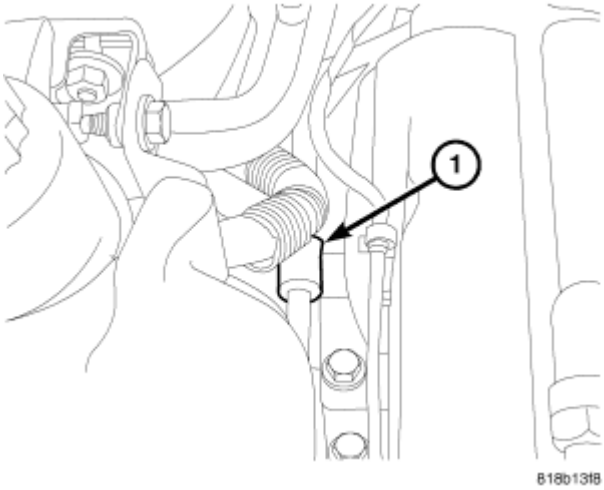


**Fig. 325: Power Steering Line Support**
**Courtesy of CHRYSLER LLC**

24. Remove power steering line support (1).
25. Remove power steering pump and set aside.
26. Support engine with a suitable jack and a block of wood under the oil pan.

 

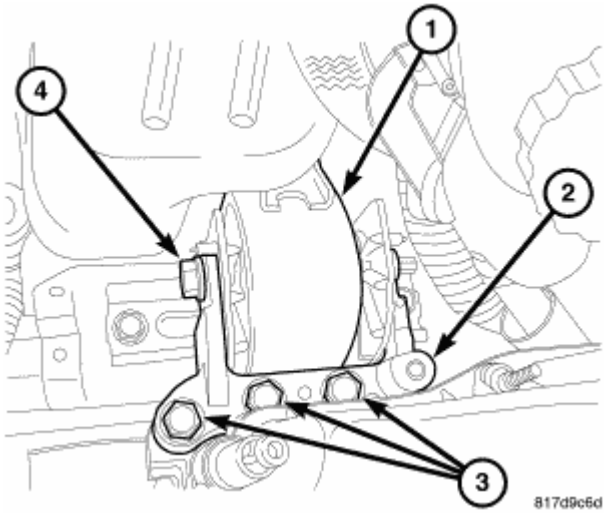


**Fig. 326: Right Engine Mount**
**Courtesy of CHRYSLER LLC**

27. Remove right engine mount to mount bracket bolts (3).
28. Remove accessory drive belt upper idler pulley.

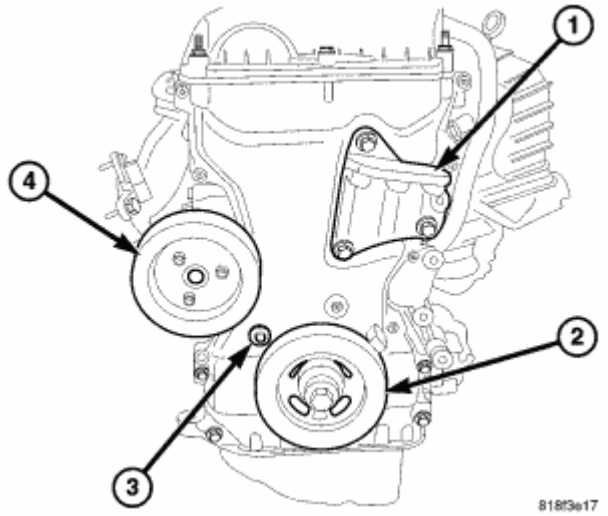


**Fig. 327: Engine Front**
**Courtesy of CHRYSLER LLC**

29. Remove right engine mount bracket (1).
30. Remove accessory drive belt tensioner.
31. Remove timing chain cover retaining bolts.

 

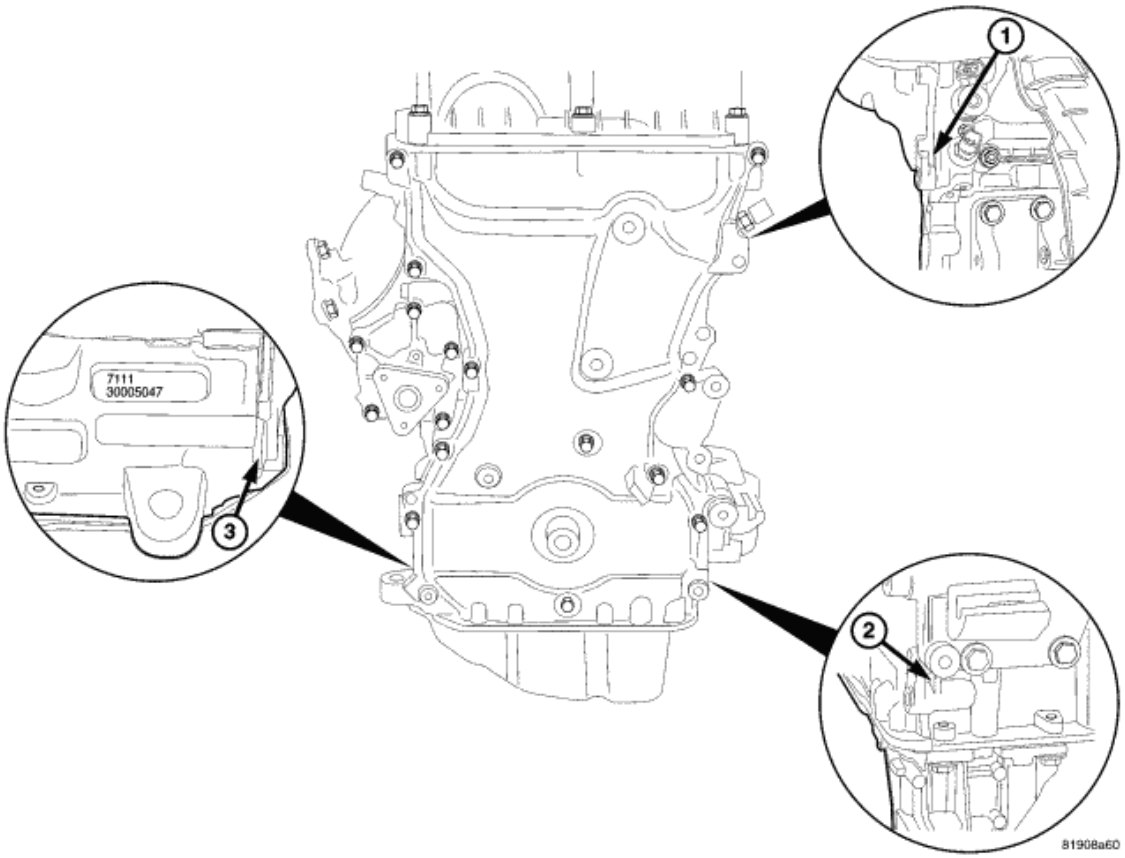


**Fig. 328: TIMING CHAIN COVER PRY POINTS**
**Courtesy of CHRYSLER LLC**

32. Remove timing chain cover using pry points (1,2,3).

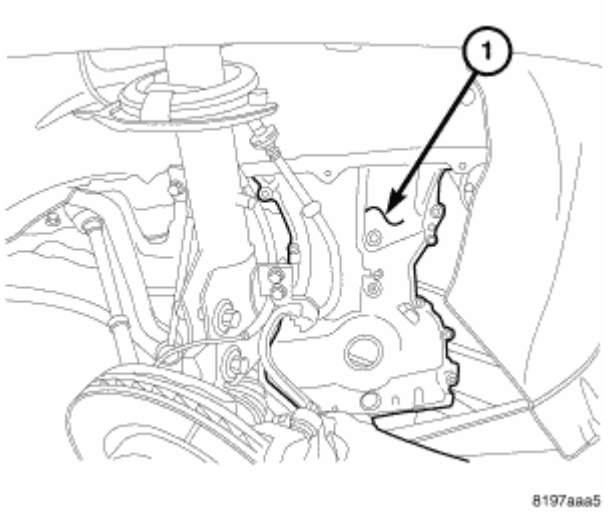


**Fig. 329: TIMING CHAIN COVER REMOVAL**
**Courtesy of CHRYSLER LLC**

33. Remove timing chain cover (1) out through the bottom of the vehicle.

 

**INSTALLATION**

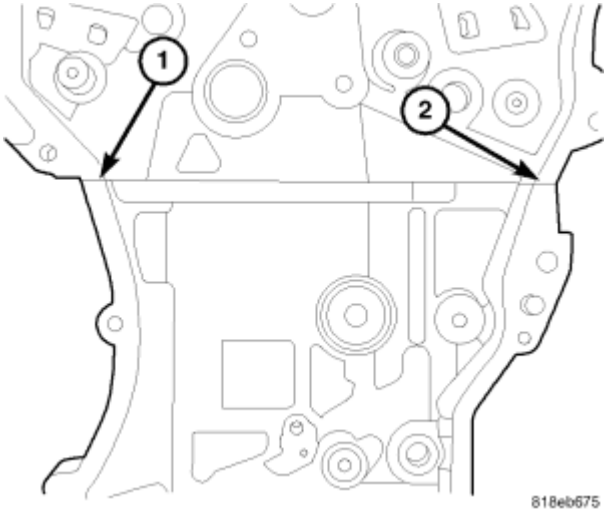


**Fig. 330: FRONT COVER UPPER T-JOINTS**
**Courtesy of CHRYSLER LLC**

**NOTE: When using RTV, the sealing surfaces must be clean and free from grease and oil.**

**NOTE: When using RTV, parts should be assembled in 10 minutes and tighten to final torque within 45 minutes.**

1. Clean all sealing surfaces.
2. Apply Mopar® engine sealant RTV (or equivalent) as shown at the cylinder head to block parting line (1,2).

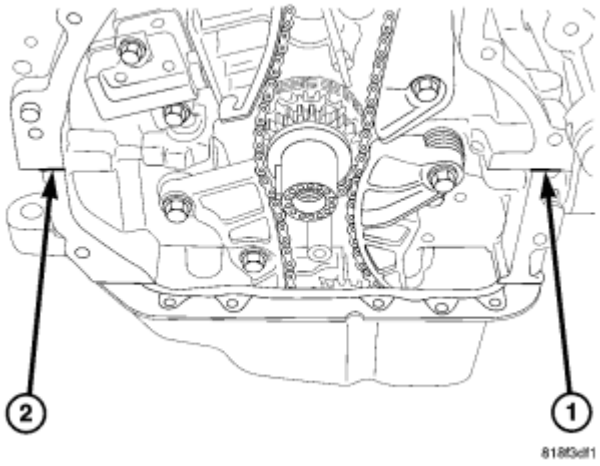


**Fig. 331: LOWER T-JOINTS**
**Courtesy of CHRYSLER LLC**

 

3. Apply Mopar® engine sealant RTV (or equivalent) as shown at the ladder frame to block parting line (1,2).

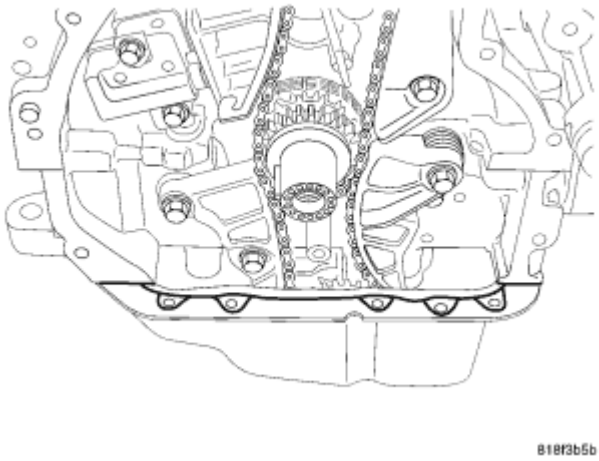


**Fig. 332: SEALING OIL PAN**
**Courtesy of CHRYSLER LLC**

4. Apply Mopar® engine sealant RTV (or equivalent) as shown in the corner of the oil pan and block.
5. Apply 2 mm bead of Mopar® engine sealant RTV (or equivalent) to the oil pan.

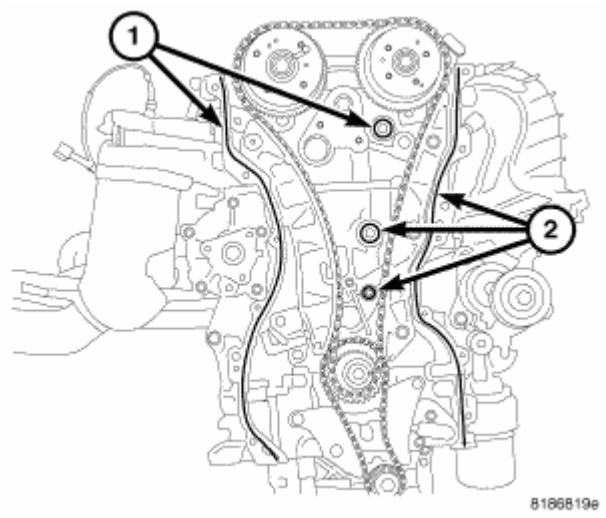


**Fig. 333: TIMING CHAIN COVER SEALING**
**Courtesy of CHRYSLER LLC**

6. Apply 2 mm bead of Mopar® engine sealant RTV (or equivalent) to the engine block (1,2) as shown.

 

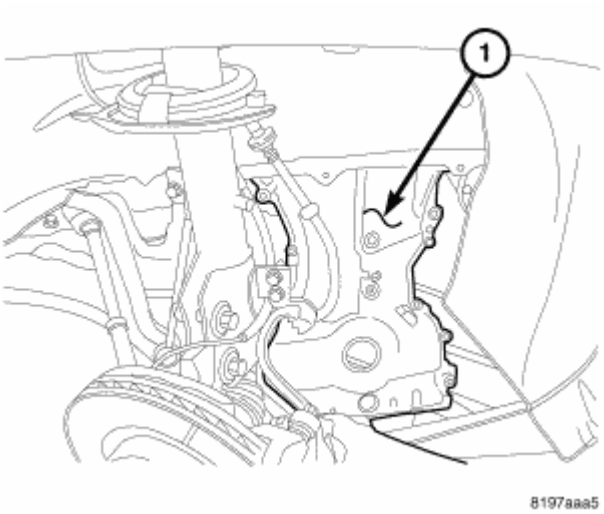


**Fig. 334: TIMING CHAIN COVER REMOVAL**
**Courtesy of CHRYSLER LLC**

7. Install timing chain cover (1) upwards from under the vehicle.
8. Install timing chain cover upper retaining bolts and tighten M6 bolts to 9 N.m (80 in lbs) and M8 bolts to 26 N.m (230 in lbs).
9. Install accessory drive belt tensioner.

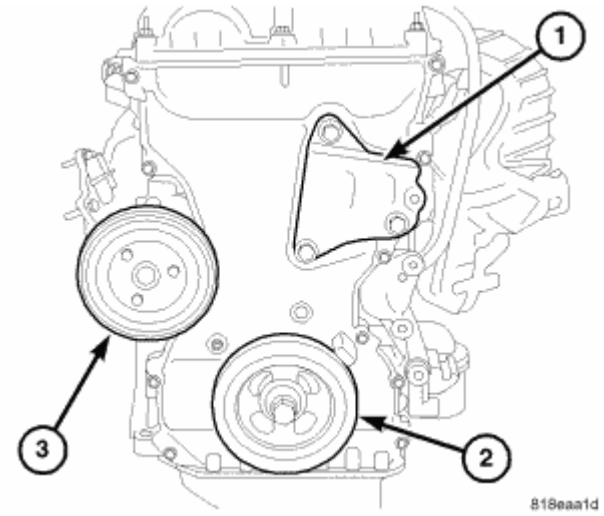


**Fig. 335: RIGHT ENGINE MOUNT BRACKET**
**Courtesy of CHRYSLER LLC**

10. Install right engine mount bracket (1).
11. Install accessory drive belt upper idler pulley.

 

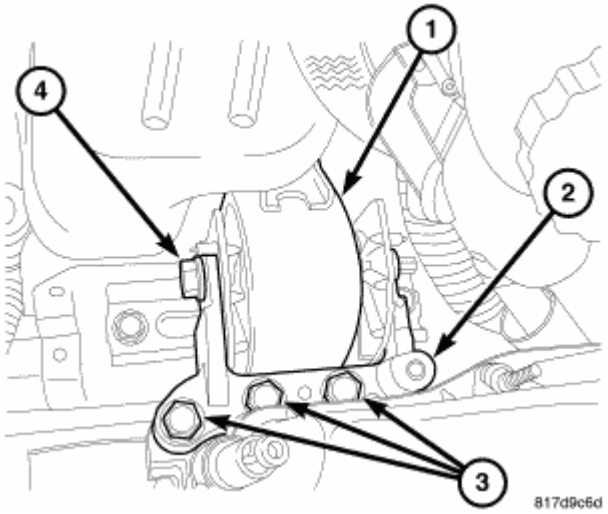


**Fig. 336: RIGHT ENGINE MOUNT**
**Courtesy of CHRYSLER LLC**

12. Install right engine mount (1).
13. Remove jack from under engine.
14. Install power steering pump.
15. Raise vehicle.

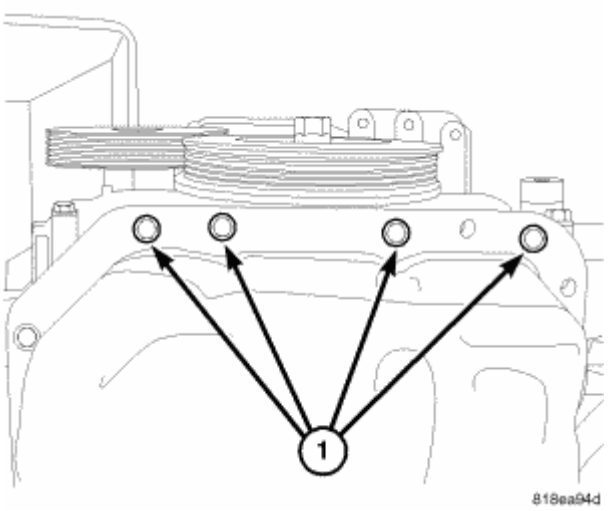


**Fig. 337: TIMING CHAIN COVER LOWER BOLTS**
**Courtesy of CHRYSLER LLC**

16. Install oil pan to timing chain cover lower retaining bolts (1) and tighten bolts.
17. Install timing chain cover retaining bolts and tighten bolts to 9 N.m (80 in lbs).

 

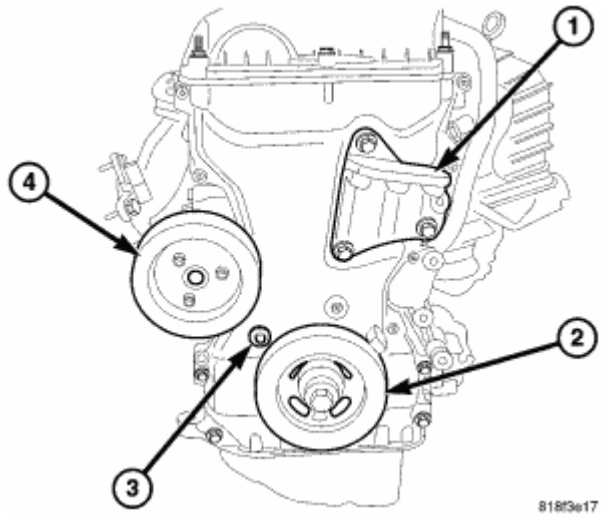


**Fig. 338: ENGINE FRONT**
**Courtesy of CHRYSLER LLC**

18. Install water pump pulley (4).
19. Install crankshaft pulley (2) and tighten bolt.
20. Install accessory drive belt lower idler pulley.

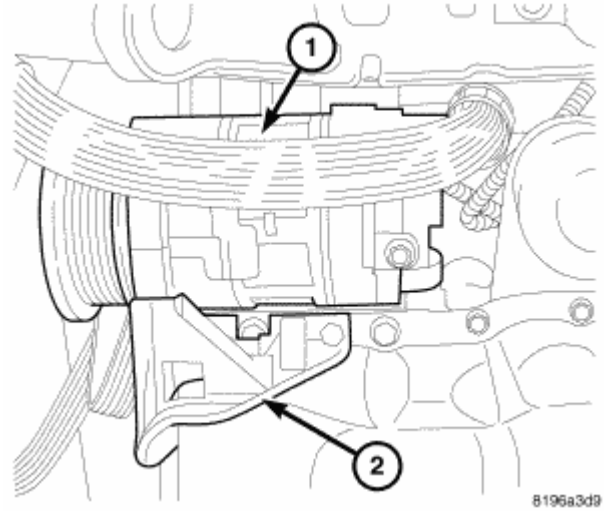


**Fig. 339: A/C COMPRESSOR**
**Courtesy of CHRYSLER LLC**

21. Install lower A/C compressor mounting bracket (2).
22. Install A/C compressor (1).
23. Install accessory drive belt. Refer to **INSTALLATION** .
24. Install right lower splash shield.
25. Lower vehicle.

 

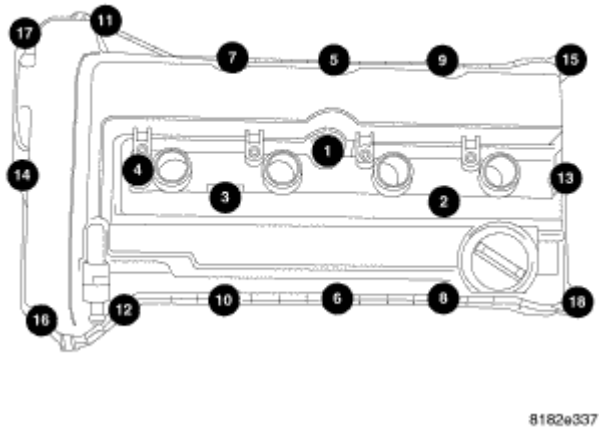


**Fig. 340: TORQUE SEQUENCE**
**Courtesy of CHRYSLER LLC**

26. Install cylinder head cover. Refer to **INSTALLATION**.

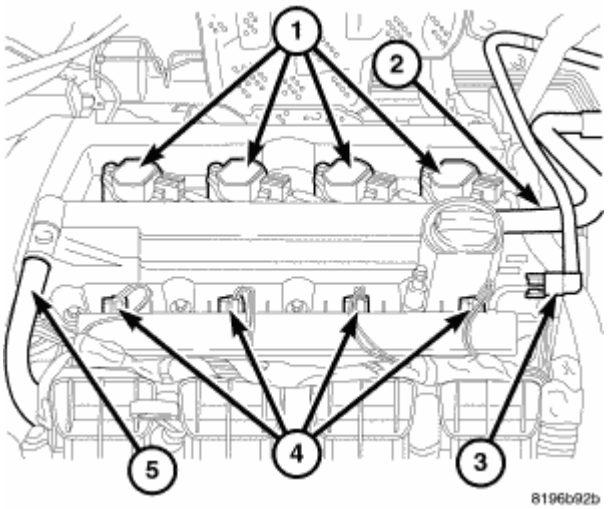


**Fig. 341: COIL CONNECTOR**
**Courtesy of CHRYSLER LLC**

27. Connect coil electrical connectors (1).
28. Connect PCV hose (5) to PCV valve.
29. Connect make up air hose (2).

 

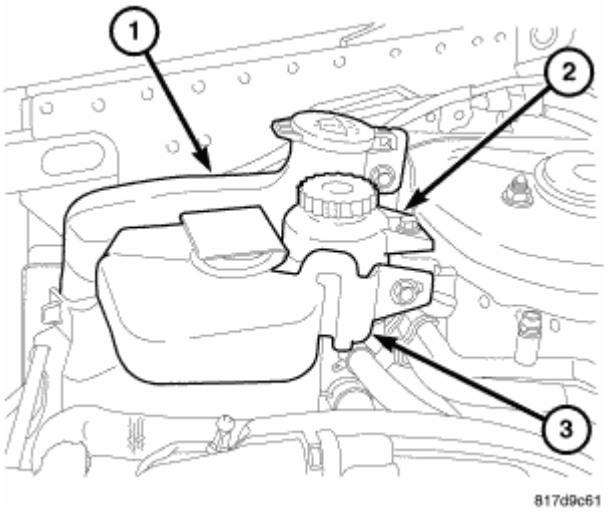


**Fig. 342: COOLANT RESERVOIR**
**Courtesy of CHRYSLER LLC**

30. Install power steering reservoir (2).
31. Install windshield washer bottle (1).
32. Install coolant recovery bottle (3).
33. Fill cooling system. Refer to **STANDARD PROCEDURE** .

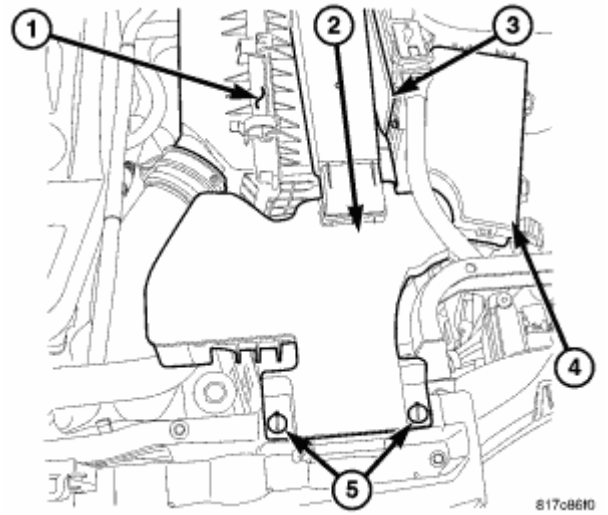


**Fig. 343: AIR CLEANER INLET**
**Courtesy of CHRYSLER LLC**

34. Install air cleaner housing inlet (2).

 

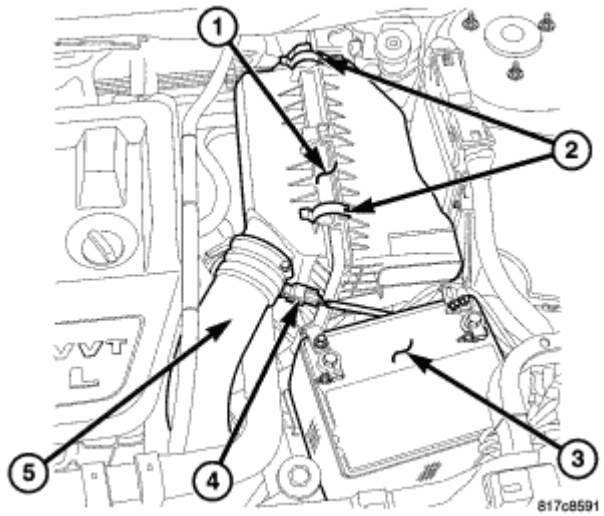


**Fig. 344: AIR CLEANER HOUSING**
**Courtesy of CHRYSLER LLC**

35. Connect negative cable to battery (3).
36. Install engine cover.

## CHAIN AND SPROCKETS-TIMING

### REMOVAL

#### REMOVAL - TIMING CHAIN

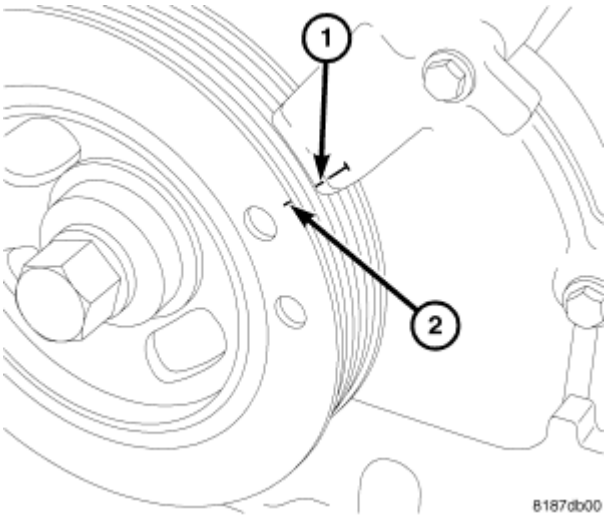


**Fig. 345: TDC**
**Courtesy of CHRYSLER LLC**

1. Set engine to TDC.
2. Remove timing chain cover. Refer to **REMOVAL**.

 

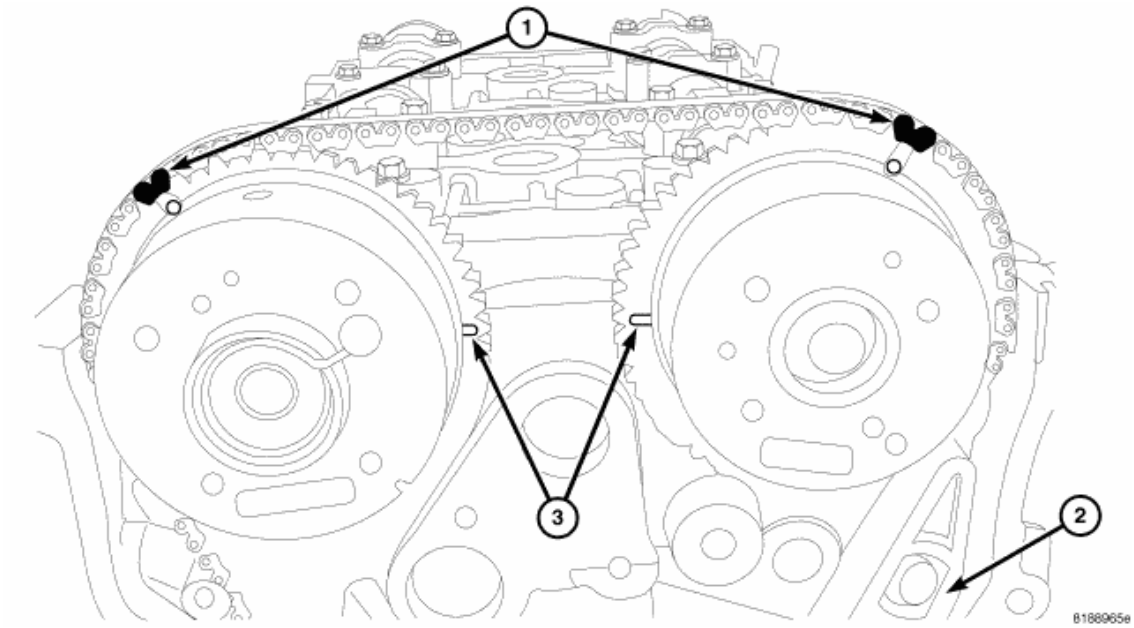


**Fig. 346: Timing Chain Timing Marks**
**Courtesy of CHRYSLER LLC**

**NOTE: If the timing chain plated links can no longer be seen, the timing chain links corresponding to the timing marks must be marked prior to removal if the chain is to be reused.**

3. Mark chain link (1) corresponding to camshaft timing mark.

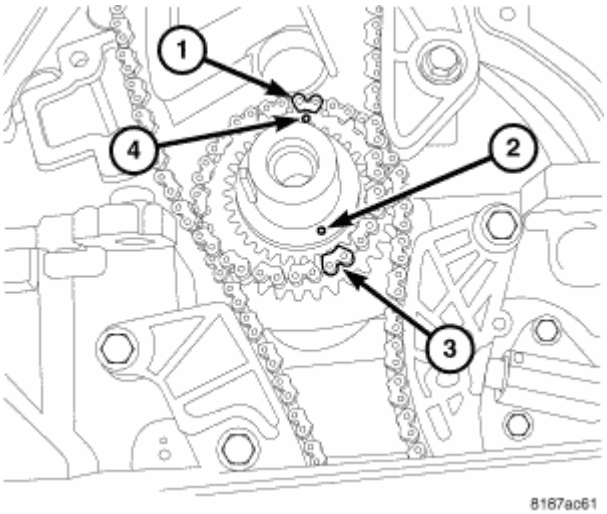


**Fig. 347: Crankshaft Timing Marks**
**Courtesy of CHRYSLER LLC**

4. Mark chain link (3) corresponding to crankshaft timing mark (2).

 

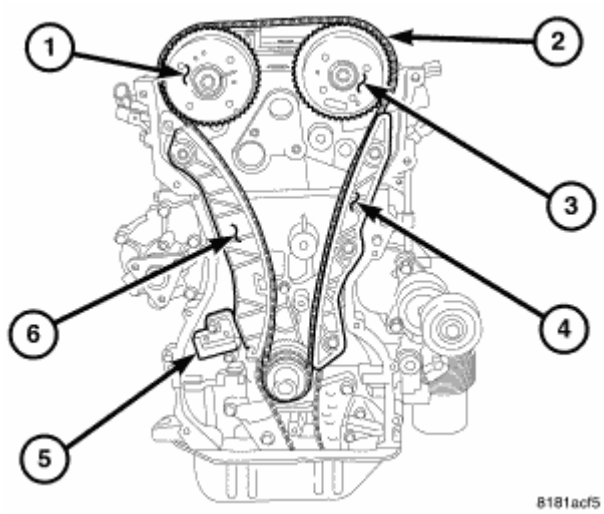


**Fig. 348: TIMING DRIVE**
**Courtesy of CHRYSLER LLC**

5. Remove timing chain tensioner (5). Refer to **REMOVAL**.
6. Remove timing chain (2).

**CRANKSHAFT SPROCKET**

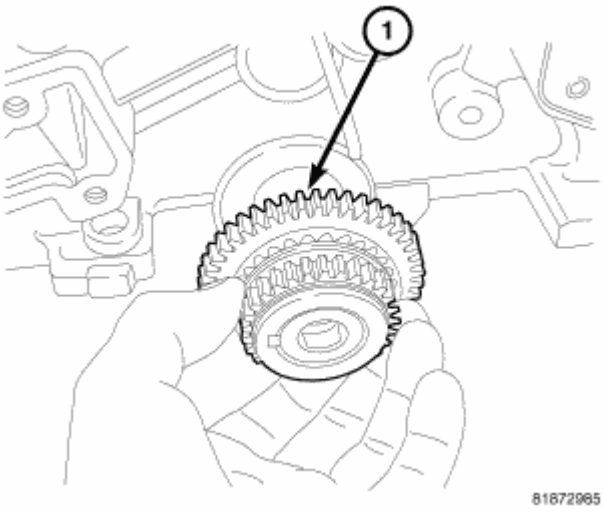


**Fig. 349: Crankshaft Sprocket**
**Courtesy of CHRYSLER LLC**

1. Remove timing chain. Refer to **REMOVAL**.
2. Remove oil pan. Refer to **PAN-OIL**.
3. Remove oil pump drive chain tensioner.
4. Remove oil pump drive chain.
5. Remove crankshaft sprocket (1).

**CAMSHAFT SPROCKET(S)**

 

**NOTE: Camshaft phasers and camshaft sprockets are supplied as an assembly, do not attempt to disassemble.**

Refer to camshaft phaser removal. Refer to **REMOVAL**.

**INSPECTION**

**INSPECTION-TIMING CHAIN**

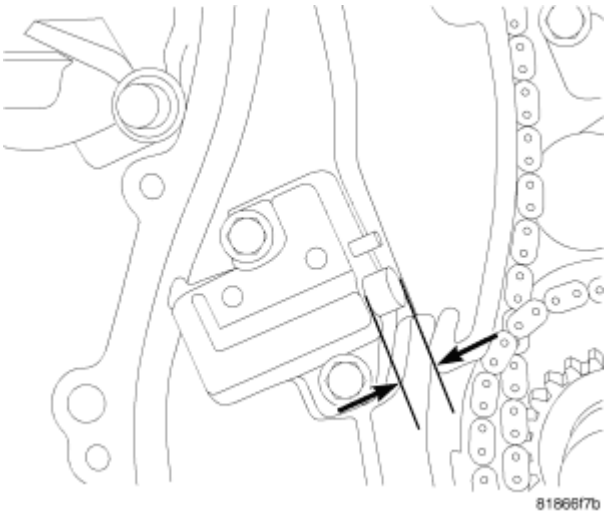


**Fig. 350: Checking Timing Chain Stretch**
**Courtesy of CHRYSLER LLC**

Inspect timing chain for stretching prior to removal.

1. Rotate engine while watching timing chain tensioner plunger. When the plunger reaches its maximum travel stop rotating engine.
2. Measure the distance from the tensioner body and the edge of the chain guide as shown.
3. If the distance is greater than 20.5 mm (0.81 in.) inspect guide shoes for excessive wear.
4. If guides are okay, replace timing chain.

**INSTALLATION**

**CRANKSHAFT SPROCKET**

 

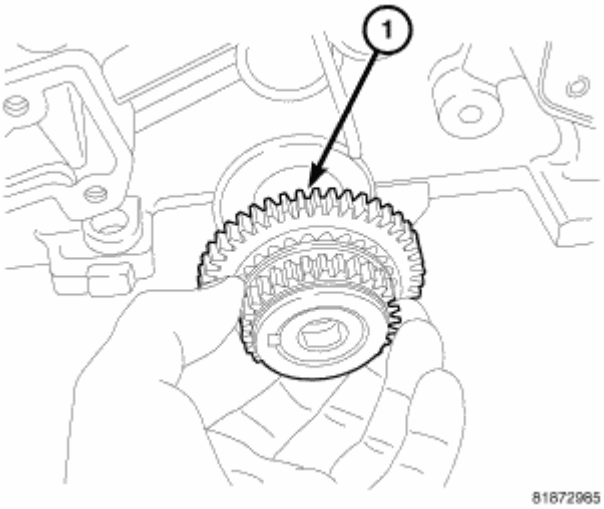


**Fig. 351: CRANKSHAFT SPROCKET**
**Courtesy of CHRYSLER LLC**

1. Install crankshaft sprocket (1) onto crankshaft.

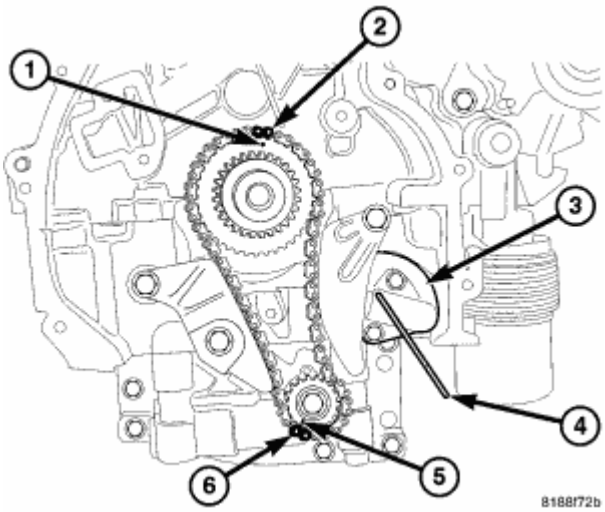


**Fig. 352: BSM TENSIONER**
**Courtesy of CHRYSLER LLC**

2. Install oil pump drive chain. Verify that Oil pump is correctly timed (1,2,5,6).

 

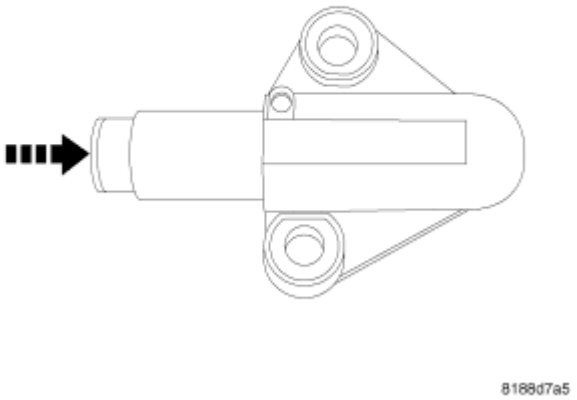


**Fig. 353: OIL PUMP TENSIONER RESET**
**Courtesy of CHRYSLER LLC**

3. Reset oil pump drive chain tensioner by pushing plunger inward and install tensioner pin 8514.

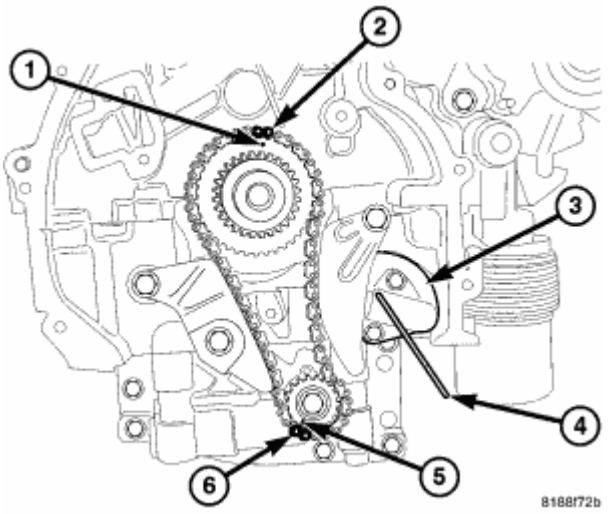


**Fig. 354: BSM TENSIONER**
**Courtesy of CHRYSLER LLC**

4. Install oil pump drive chain tensioner (3) and remove Tensioner Pin 8514 (4).
5. Install timing chain. Refer to **TIMING CHAIN**.
6. Install oil pan. Refer to **PAN-OIL**.
7. Fill engine with oil. Refer to **STANDARD PROCEDURE** .
8. Start engine and check for leaks.

**TIMING CHAIN**

 

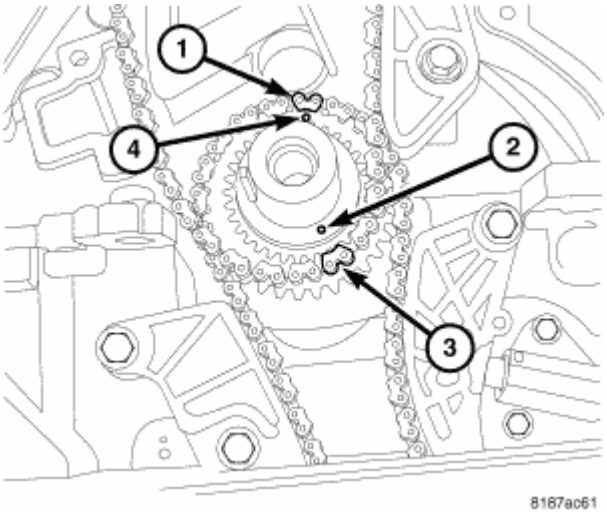


**Fig. 355: Crankshaft Timing Marks**
**Courtesy of CHRYSLER LLC**

1. Verify that the crankshaft sprocket keyway is at the 9 o'clock position.

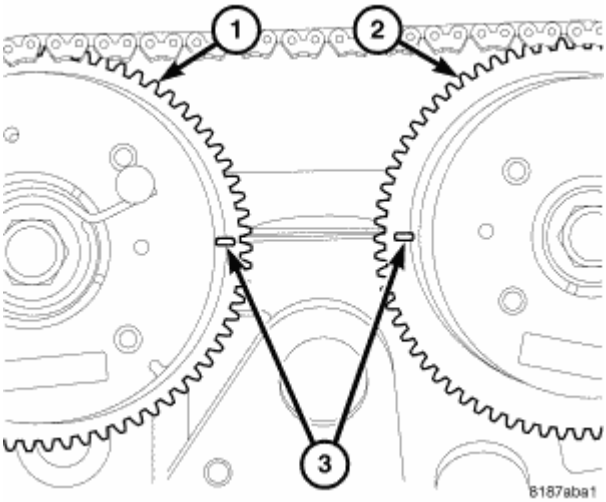


**Fig. 356: CAMSHAFT TIMING**
**Courtesy of CHRYSLER LLC**

2. Align camshaft timing marks (3) so they are parallel to the cylinder head and aligned each other as shown.

 

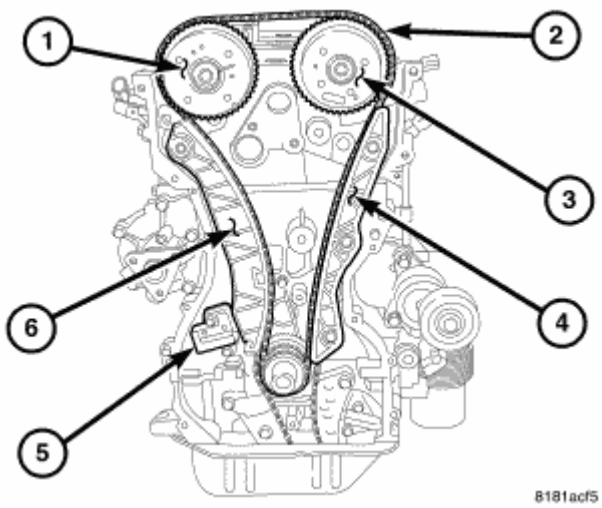


**Fig. 357: TIMING DRIVE**
**Courtesy of CHRYSLER LLC**

3. Install timing chain guide (4) and tighten bolts to 12 N.m (105 in. lbs.).

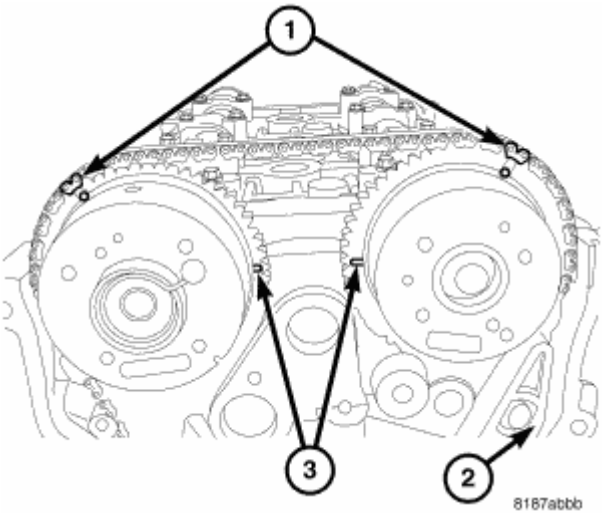


**Fig. 358: Timing Chain Timing Marks**
**Courtesy of CHRYSLER LLC**

4. Install timing chain so plated links on chain align with timing marks on camshaft sprockets (1).

 

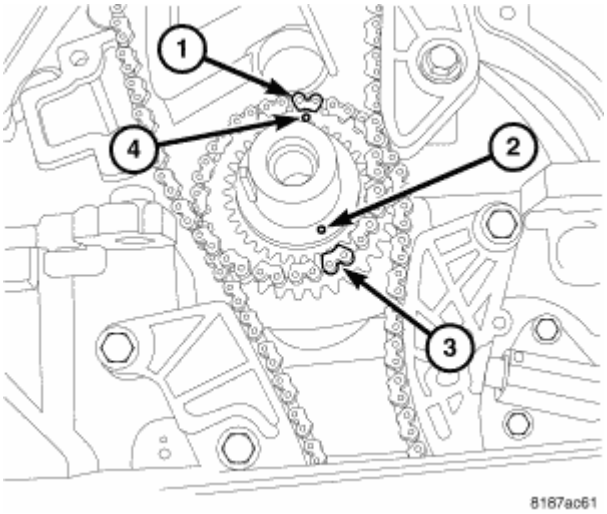


**Fig. 359: Crankshaft Timing Marks**
**Courtesy of CHRYSLER LLC**

5. Align timing mark on the crankshaft sprocket (2) with the plated link (3) on the timing chain. Position chain so slack will be on the tensioner side.

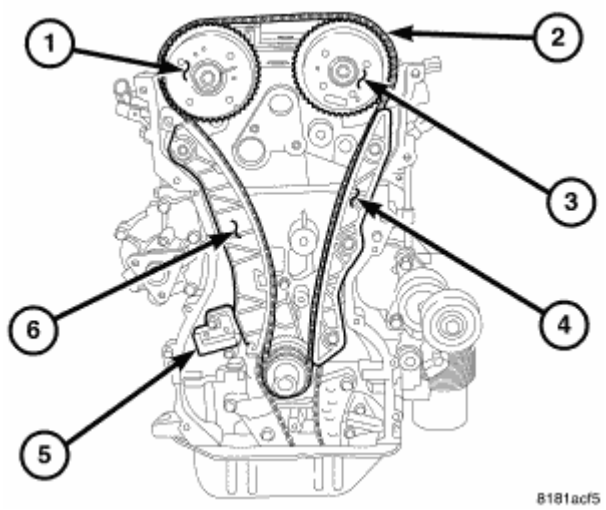


**Fig. 360: TIMING DRIVE**
**Courtesy of CHRYSLER LLC**

**NOTE: Keep the slack in the timing chain on the tensioner side.**

6. Install the moveable timing chain pivot guide (6) and tighten bolt to 12 N.m (105 in. lbs.).

 

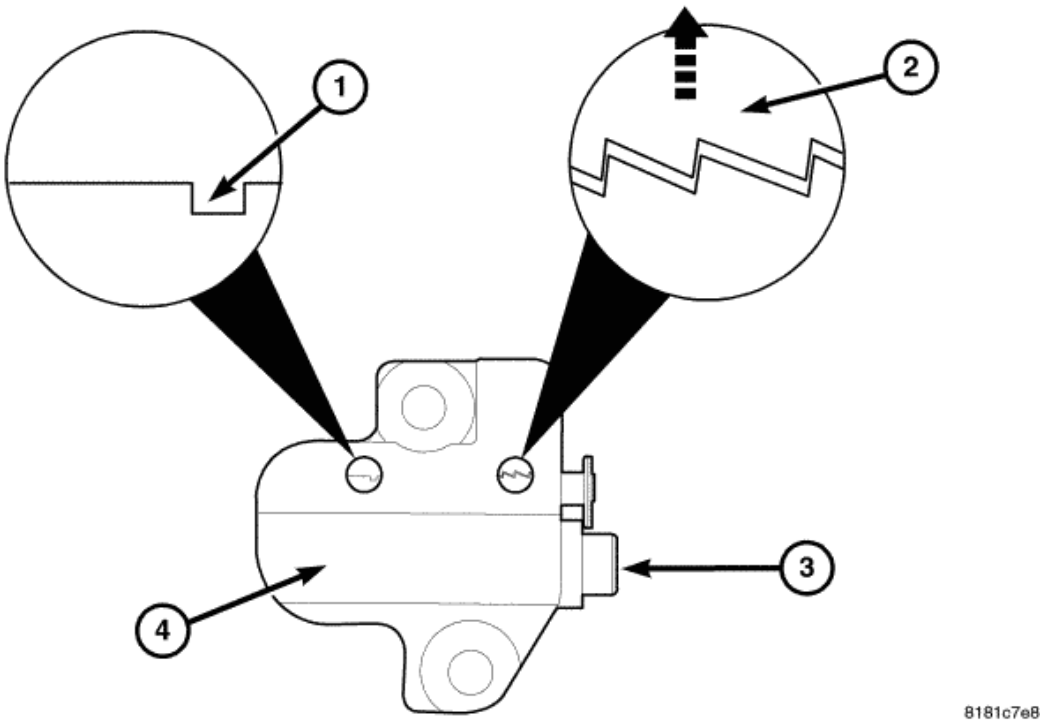


**Fig. 361: TENSIONER RESET**
**Courtesy of CHRYSLER LLC**

7. Reset timing chain tensioner (4) by lifting up on ratchet (2) and pushing plunger (3) inward towards the tensioner body (4). Insert Tensioner Pin 8514 into slot (1) to hold tensioner plunger in the retracted position.

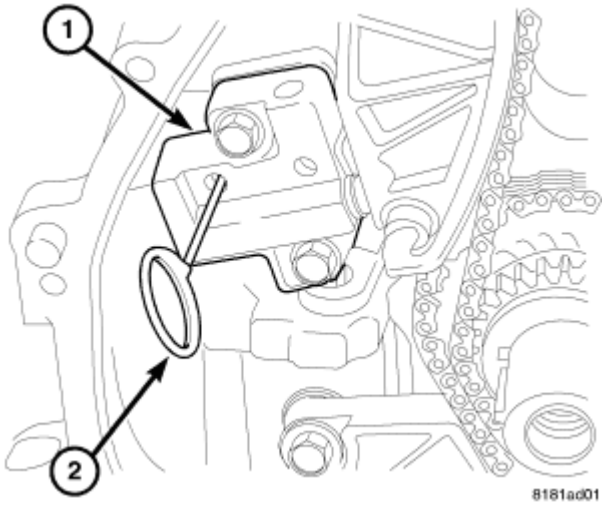


**Fig. 362: Timing Chain Tensioner**
**Courtesy of CHRYSLER LLC**

8. Install timing chain tensioner (1) and tighten bolts to 12 N.m (105 in. lbs.).
9. Remove timing Tensioner Pin 8514 (2).

 

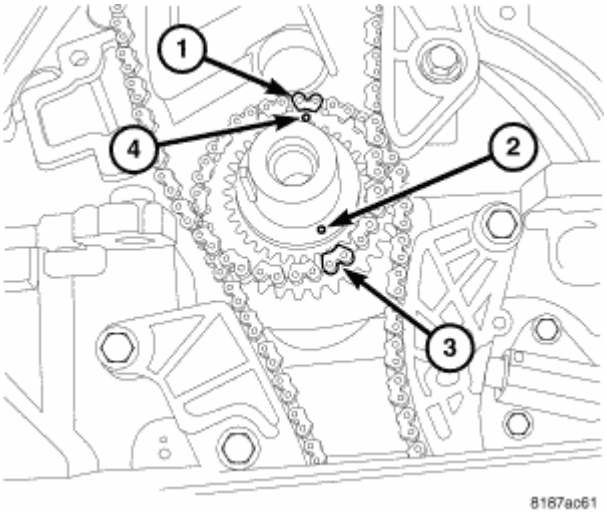


**Fig. 363: Crankshaft Timing Marks**
**Courtesy of CHRYSLER LLC**

10. Rotate the crankshaft CLOCKWISE two complete revolutions until the crankshaft is repositioned at the TDC position with the key way at the 9 o'clock position.

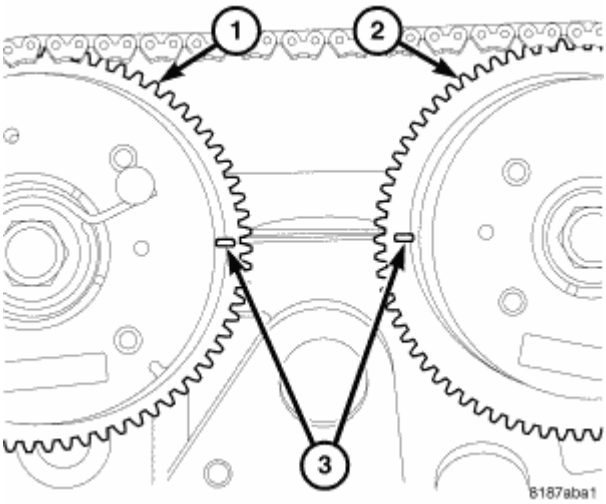


**Fig. 364: CAMSHAFT TIMING**
**Courtesy of CHRYSLER LLC**

11. Verify that the camshafts timing marks (3) are in the proper position.
12. Install front timing chain cover. Refer to **INSTALLATION**.

 

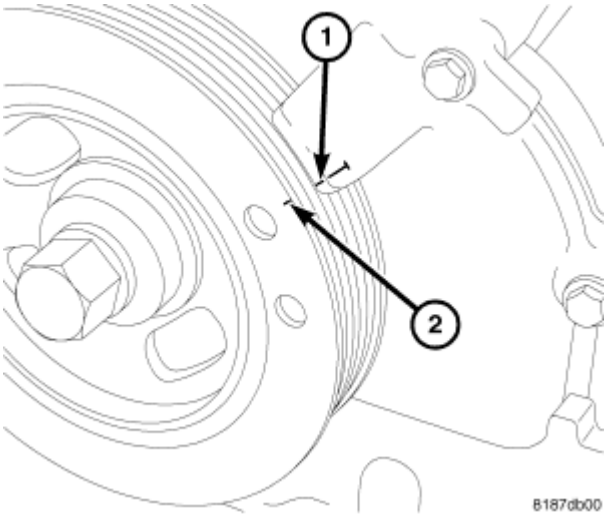


**Fig. 365: TDC**
**Courtesy of CHRYSLER LLC**

13. Install the balancer and verify that balancer mark (2) and cover mark (1) are aligned.
14. Connect negative battery cable.
15. Fill with oil, start engine and check for leaks.

**CAMSHAFT SPROCKET(S)**

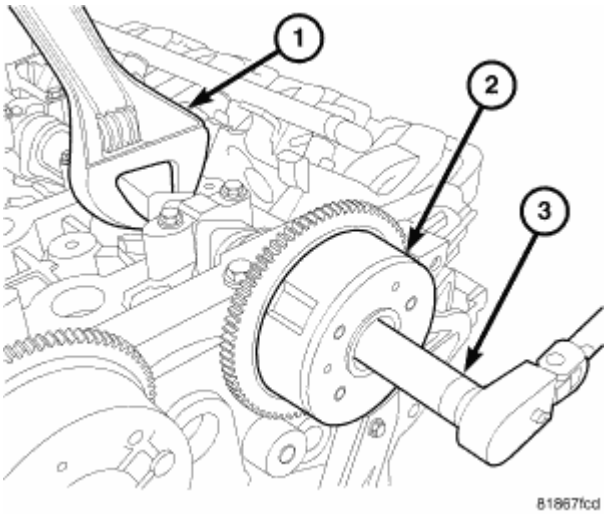


**Fig. 366: Cam Phaser Installation**
**Courtesy of CHRYSLER LLC**

**NOTE: The camshaft sprockets and the camshaft phasers are an assembly and cannot be serviced separately.**

**CAUTION: Do not use an impact wrench to tighten camshaft sprocket bolts. Damage to the camshaft-to-sprocket locating dowel pin and camshaft phaser may occur.**

 

1. Refer to Camshaft phaser (2) installation. Refer to **INSTALLATION**.

## TENSIONER-TIMING CHAIN

### REMOVAL

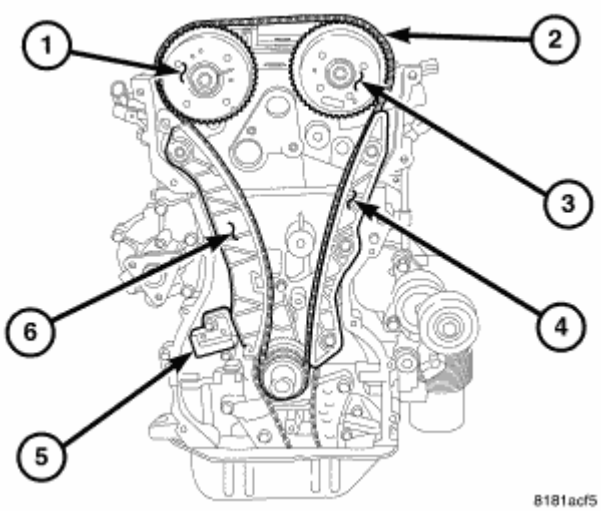


**Fig. 367: TIMING DRIVE**
**Courtesy of CHRYSLER LLC**

1. Remove timing chain. Refer to **REMOVAL - TIMING CHAIN**.

**NOTE: Tensioner will not come apart during removal.**

2. Remove timing chain tensioner retaining bolts and remove tensioner.

### INSTALLATION

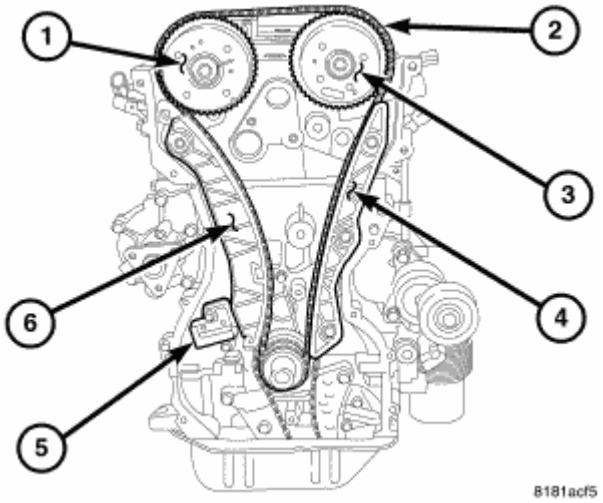


**Fig. 368: Timing Drive**

 

**Courtesy of CHRYSLER LLC**

1. Reset tensioner.
2. Install timing chain. Refer to **TIMING CHAIN**.

 